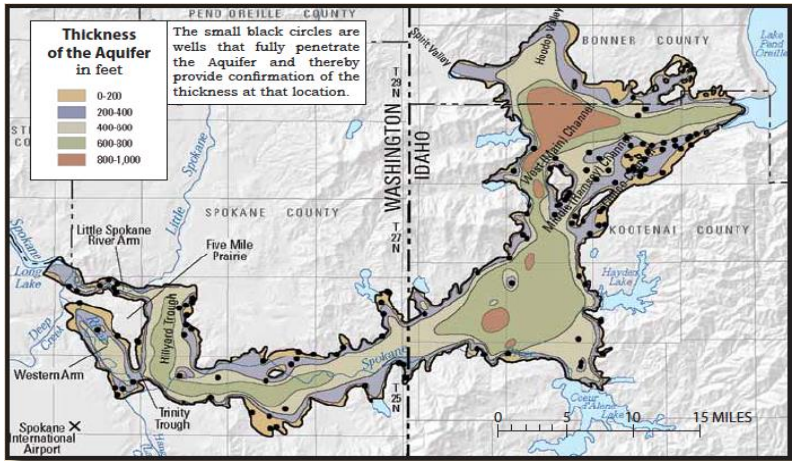
WISDM

Watershed Integrated **System Dynamics** Modeling

Allyson Beall King and Melanie Thornton



Spokane River Watershed and Spokane Valley Rathdrum Prairie Aquifer

WASHINGTON STATE UNIVERSITY

CERE

USDA

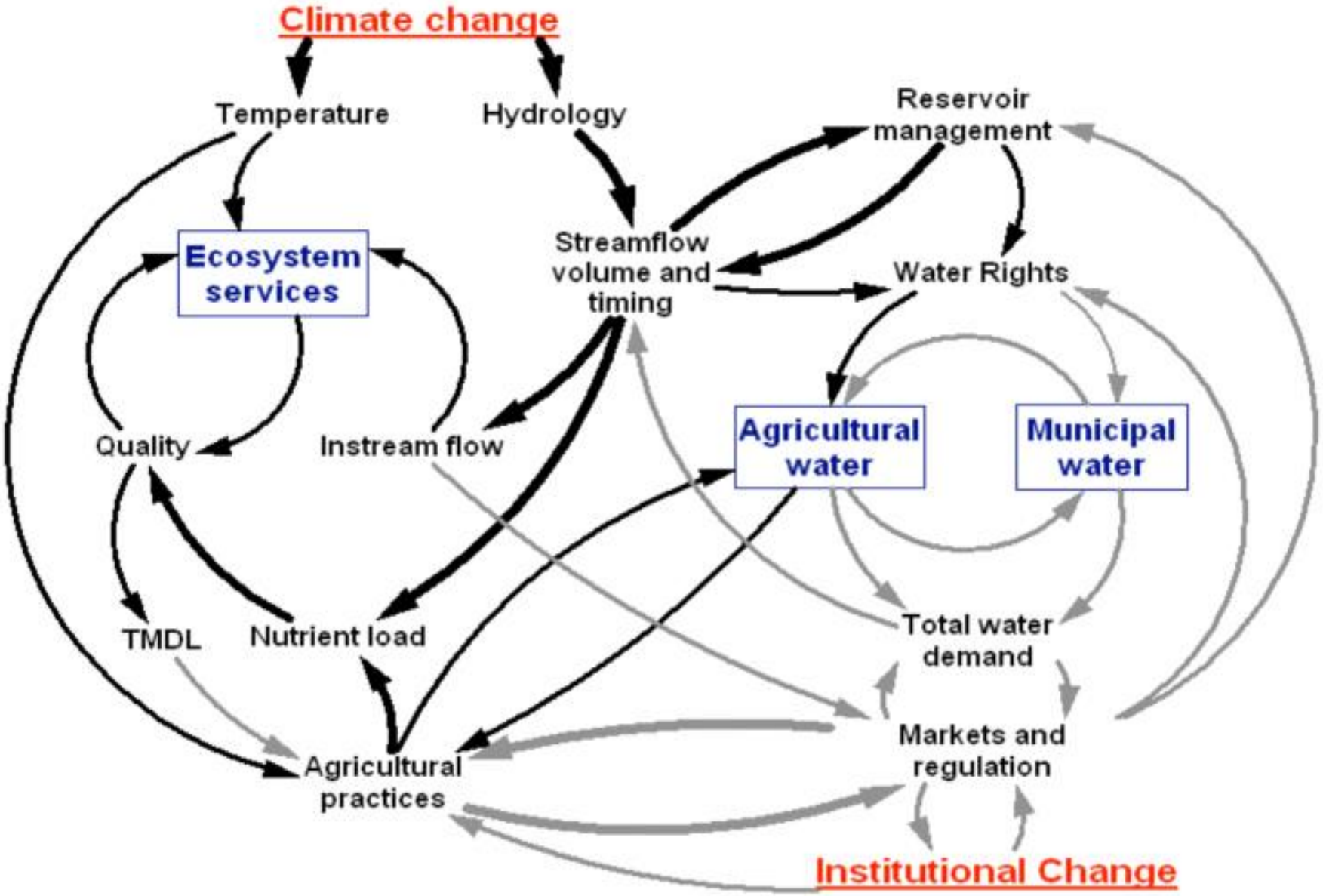
NSF

State of Washington Water Research Center

BioEarth

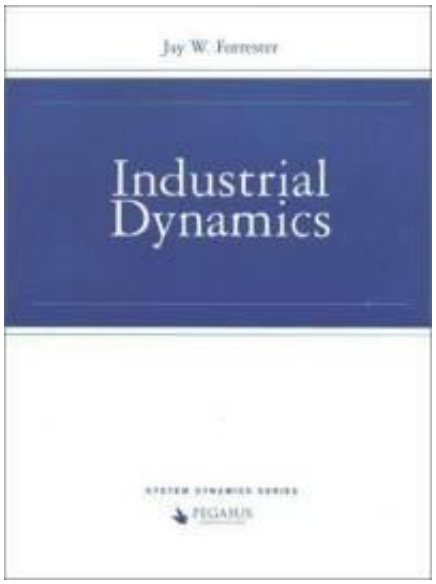
Biosphere-relevant earth system model

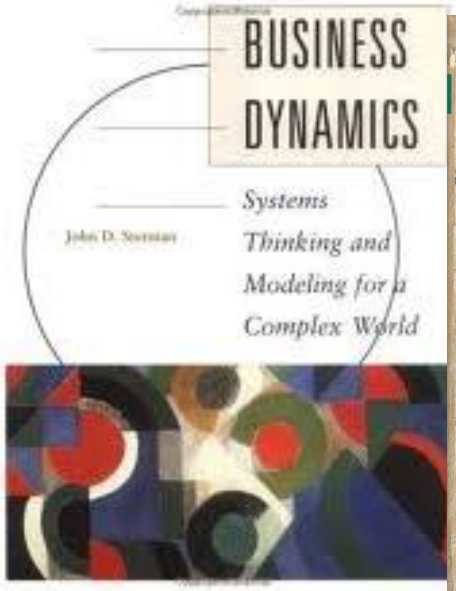
Model Linkages and Feedbacks

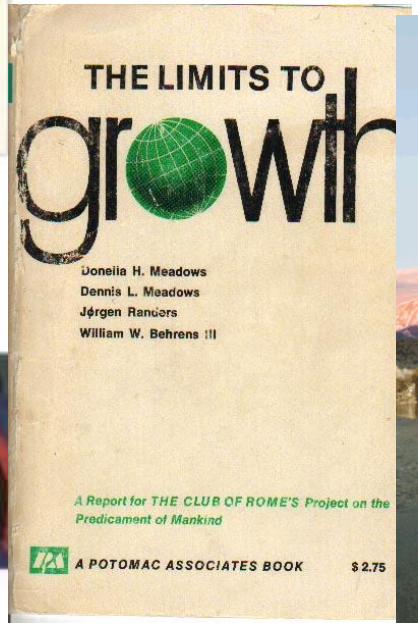


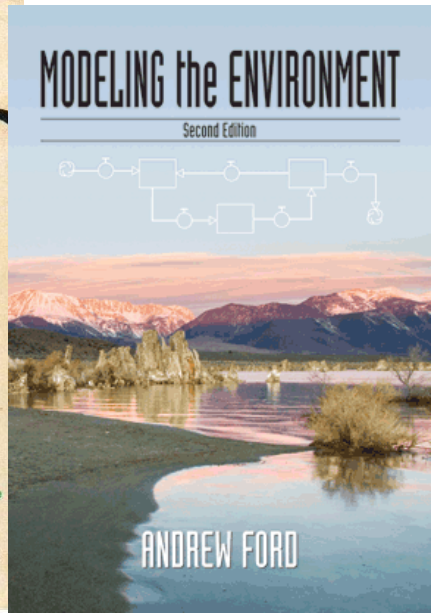
What is System Dynamics?

- Approach to studying and managing complex systems that change over time
- Addresses internal feedback loops and time delays that affect the behavior of the entire system

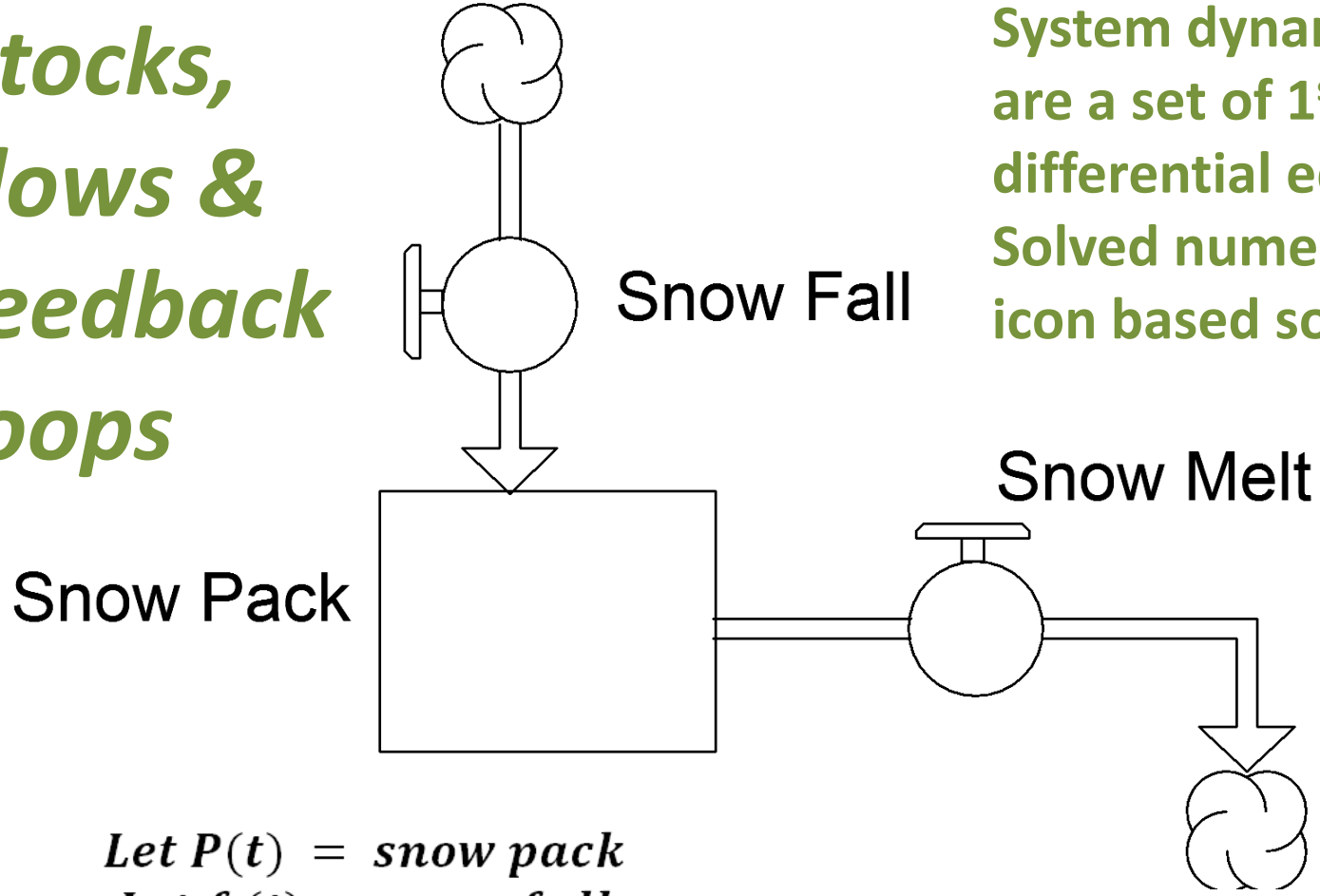








Stocks, flows & feedback loops



System dynamics models are a set of 1st order differential equations. Solved numerically with icon based software.

$$Let\ P(t) = snow\ pack$$
$$Let\ f\ (t) = snow\ fall$$
$$Let\ m(t) = snow\ melt$$

$$\frac{Dp}{Dt} = f(t) - m(t),$$

$$solved\ numerically\ via:$$

$$P(t) = P(t - dt) + (f(t) - m(t)) * dt$$

Easier for non-specialists to interpret and use than a purely process-based modeling approach

Collaborative Modeling Purpose

- Can address resource management challenges
- Stakeholders integrate differing perspectives and interests
- Participants build a shared language and to identify areas of agreement and disagreement
- Can clarify assumptions and facts, while building trust in the process.

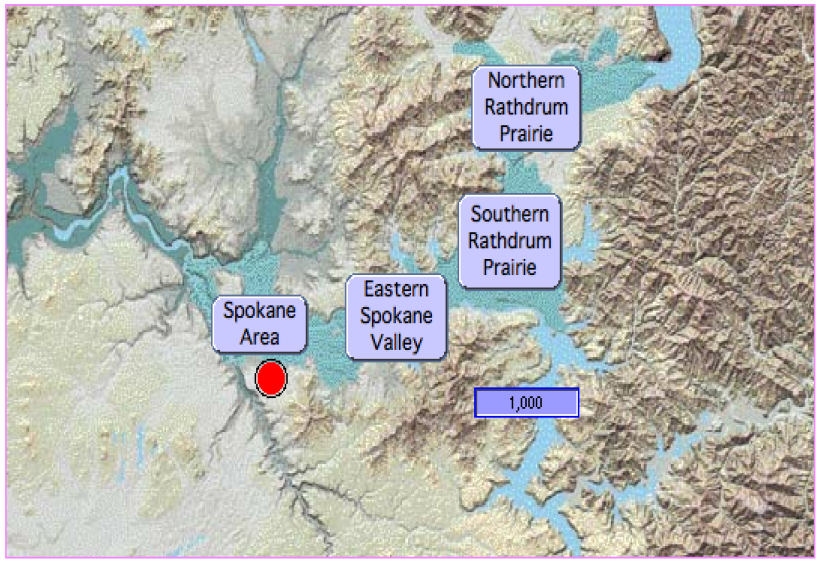
Collaborative Modeling Examples in Water Planning and Management

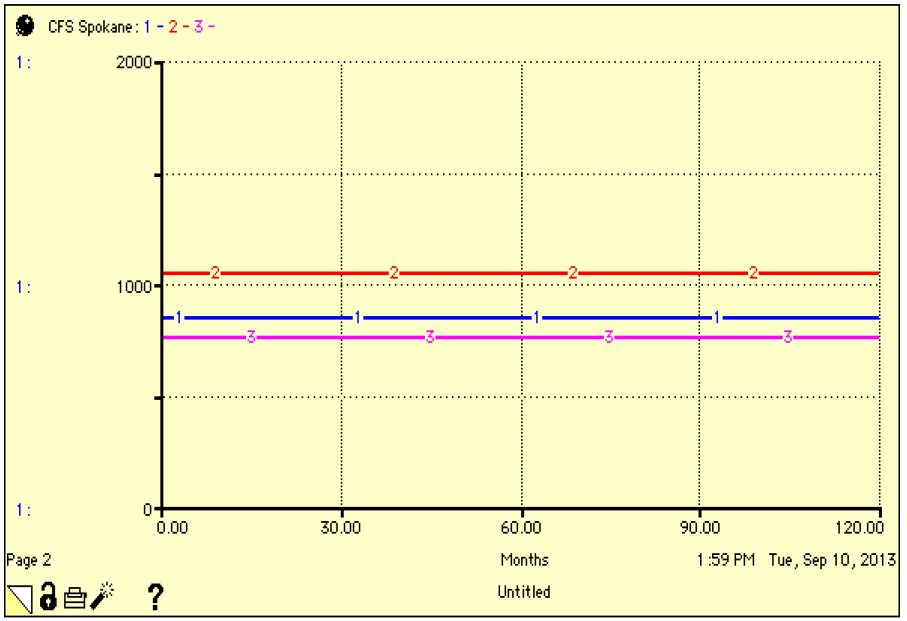
- Potomac River Basin
- Lake Ontario – St. Lawrence River Study
- Roanoke River Basin Hydropower Re-License
- Portugal - Nuno Videira
- Solomon's Harbor Watershed
- St. Albans Bay Watershed
- Upper Mississippi River
- ACT-ACF Basin
- Cedar and Green Rivers
- Gila River
- James River
- Kanawha River
- Rappahannock River
- Snake Plan Aquifer
- Pacific Northwest Climate Change
- Lake Powell/Lake Mead
- Los Angeles
- Marais des Cygnes – Osage
- Middle Rio Grande
- Mississippi Headwaters
- Susquehanna River
- Upper Rio Grande River
- Willamette River

Your Input

- WRIA interests
- Potential policy questions
- Management strategies
- Contact
  - Allyson Beall King, WSU
  - abeall@wsu.edu
  - Melanie Thornton, WSU
  - melanie.thornton@email.wsu.edu

Spokane Valley Rathdrum Prairie Aquifer and Spokane River System Dynamics Model





Run

Restore All Devices

CFS River Flow 1
CDA
0 30000
1000

Augmentation Scenario

Public Supply

Public Supply ESV
0 4000
2700

Public Supply NRP
0 4000
0

Public Supply SRP
0 4000
600

Public Supply S
0 4000
700

Areal Recharge

Change in Recharge Percent
1.0
1.0
0.0 2.0

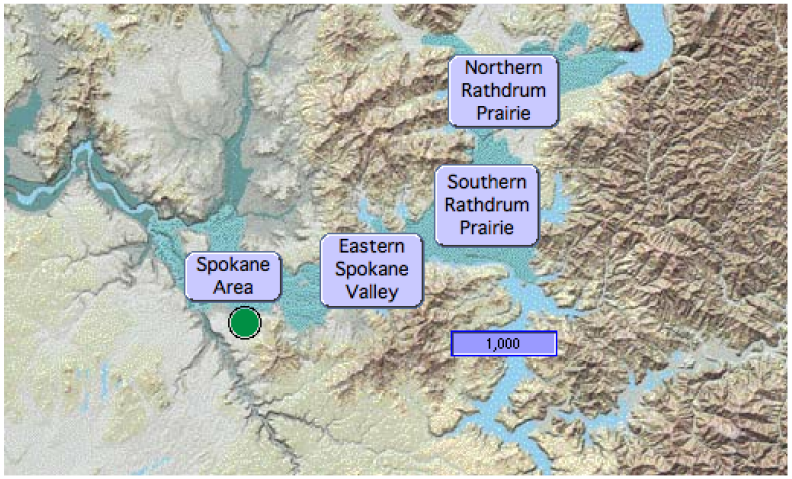
Areal recharge NRP
0 4500
0

Areal recharge SRP
0.00 4500.00
0.00

Areal Recharge S
0.00 4500.00
0.00

Areal recharge ESV
0.00 4500.00
0.00

Spokane Valley Rathdrum Prairie Aquifer and Spokane River System Dynamics Model



Run

Restore All Devices

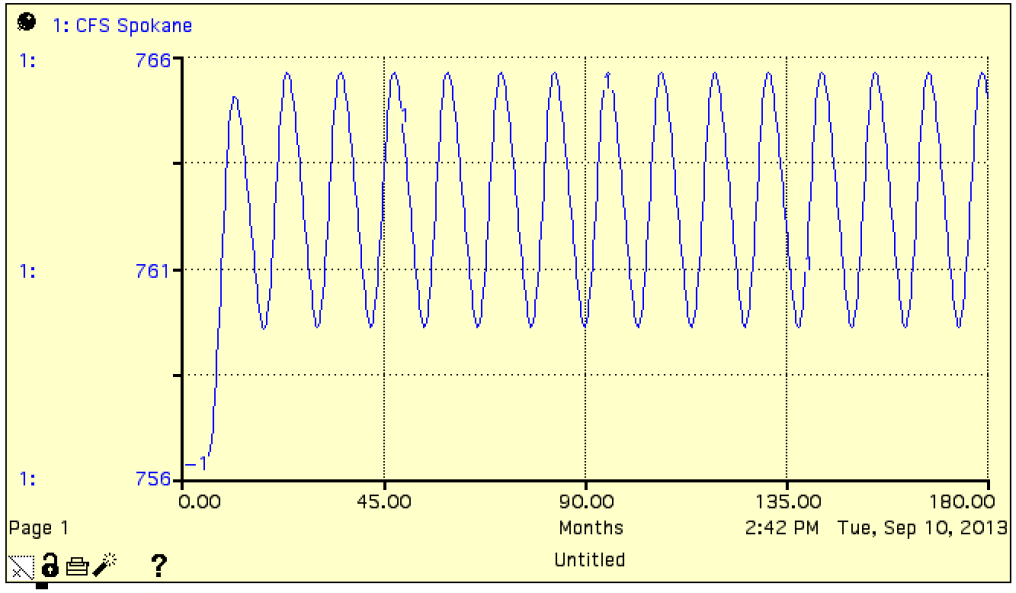
Back

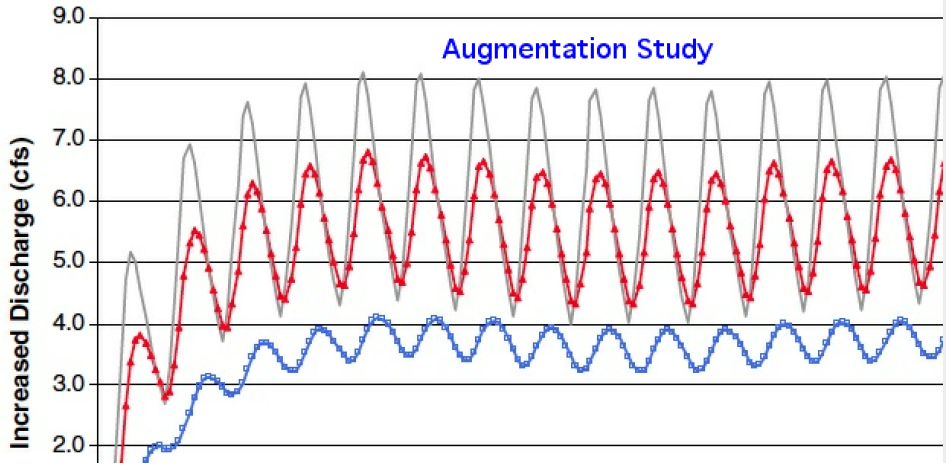
turn on SRP augmentation

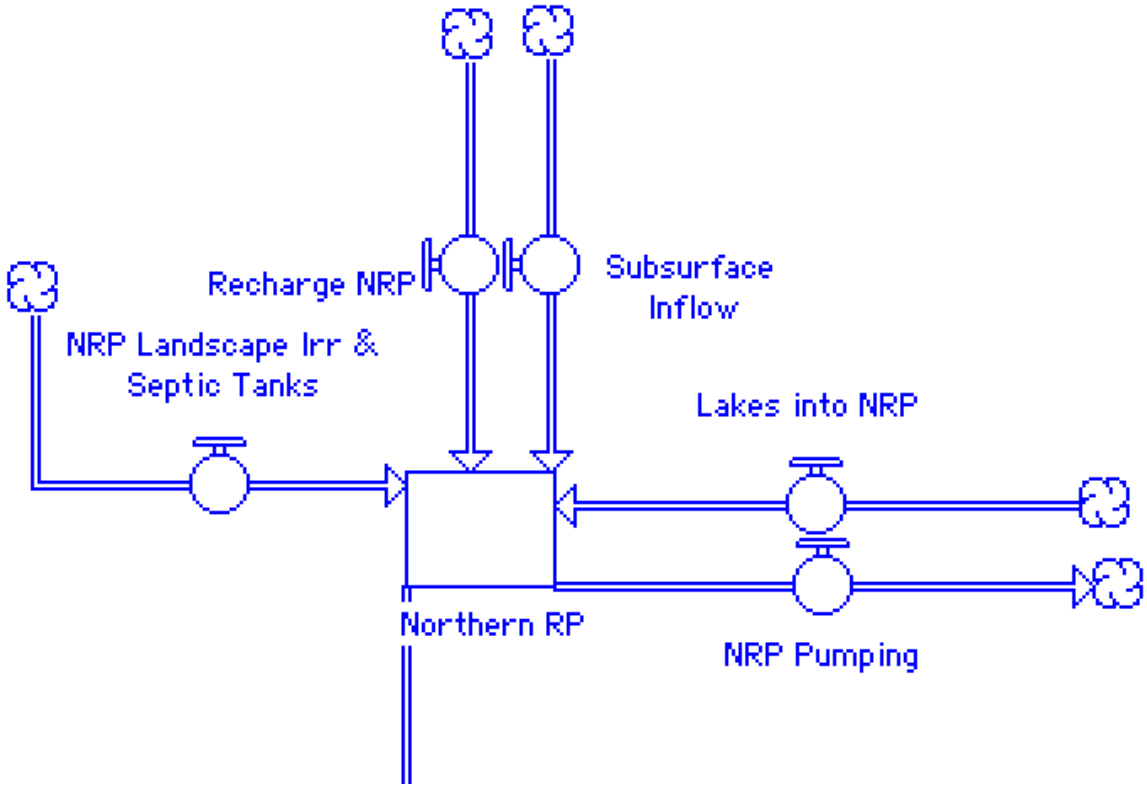
Aug Volume CFS SRP

0 2000

U 30







Stock and Flow diagram of the northern section of the SVRP 'Northern Rathdrum Prairie'

Palouse Basin Web Simulation

- http://forio.com/simulation/ns/allysonbeall/palouse_basin_model/

- This is system dynamics model developed by Dr. Allyson Beall King through a collaborative modeling process in the Palouse Basin.
- This is an example of a web simulation that is used by the general public.