

University of Idaho

Modeling the Palouse Basin Water Resources System

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Acknowledgements

- Ramesh Dughel, Matthew Reeves
- Jennifer Hinds
- Erin Brooks
- Steve Robischon
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University of Idaho



Why Model?

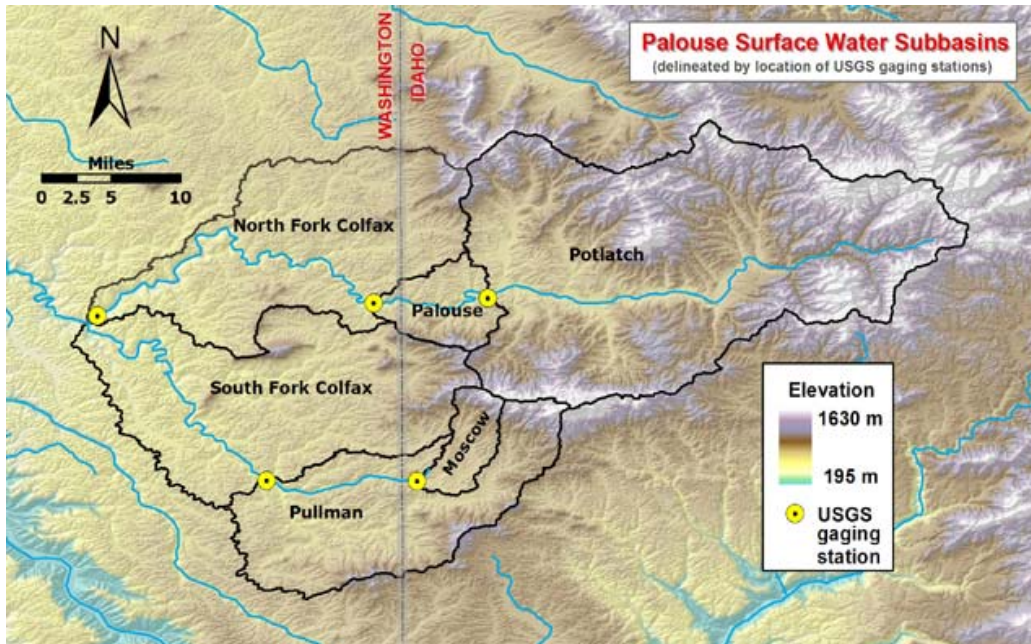
- Essentially, all models are wrong...
- But some models are useful (George Box)

- Understanding
- Scenario and trend exploration
- Relative importance of variables
- Tool for **collaboration** and **decision support**

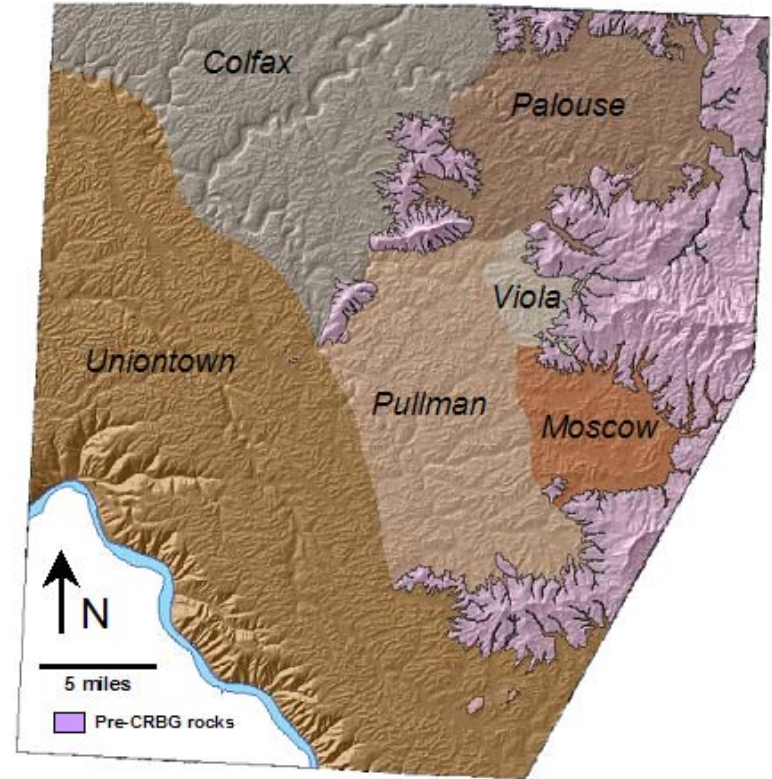
Background and Motivation

- Much research has been done in the basin!
- Build on last year's Water Summit
- A first attempt to “tie it all together”
- Essential to couple supply and demand
 - PBAC: To ensure a **long-term**, quality water supply for the Palouse Basin region...
 - Develop and Implement a **balanced** basin wide **Water Supply and Use** Program by 2020

Palouse Basin



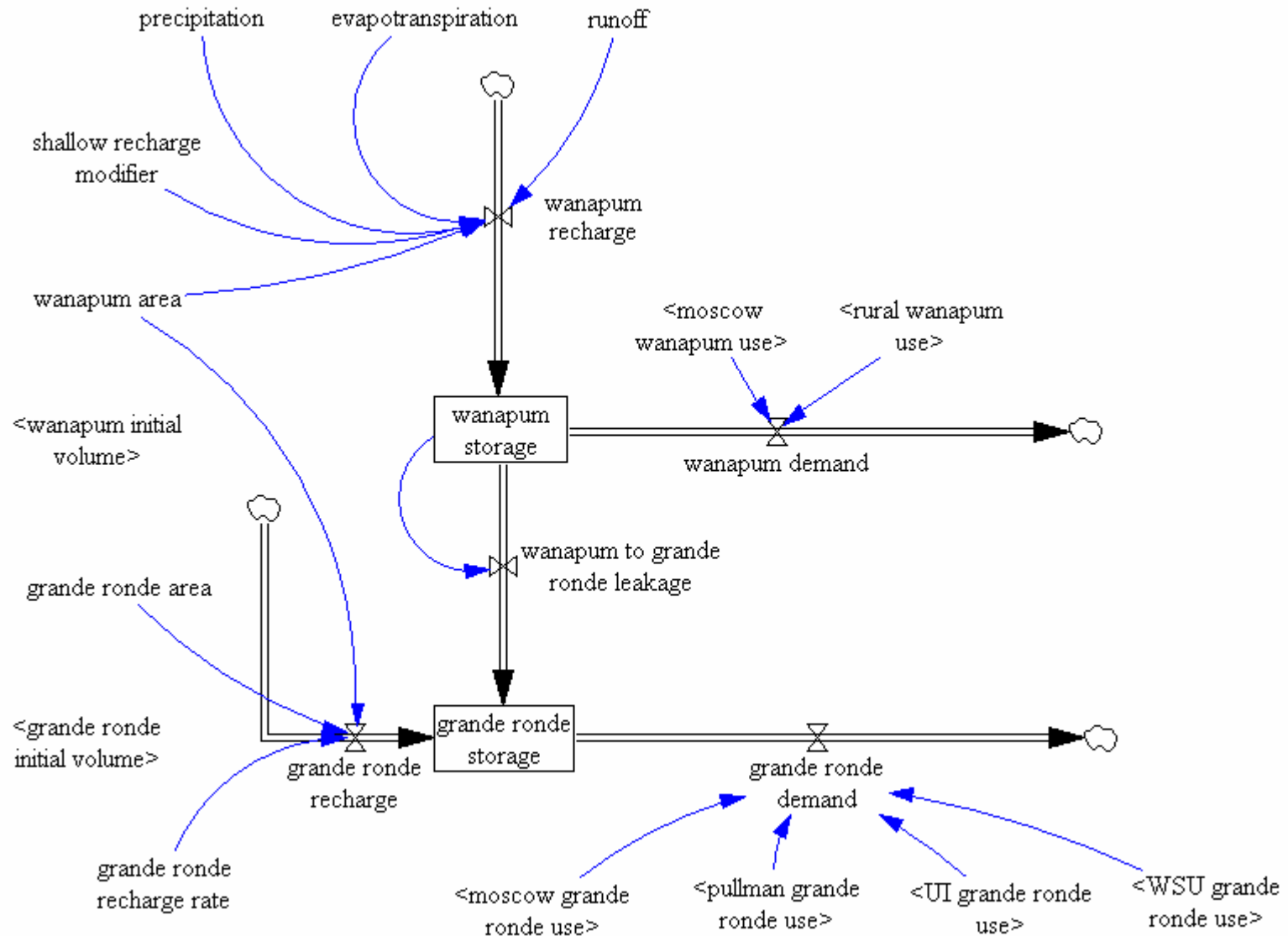
J. Hinds



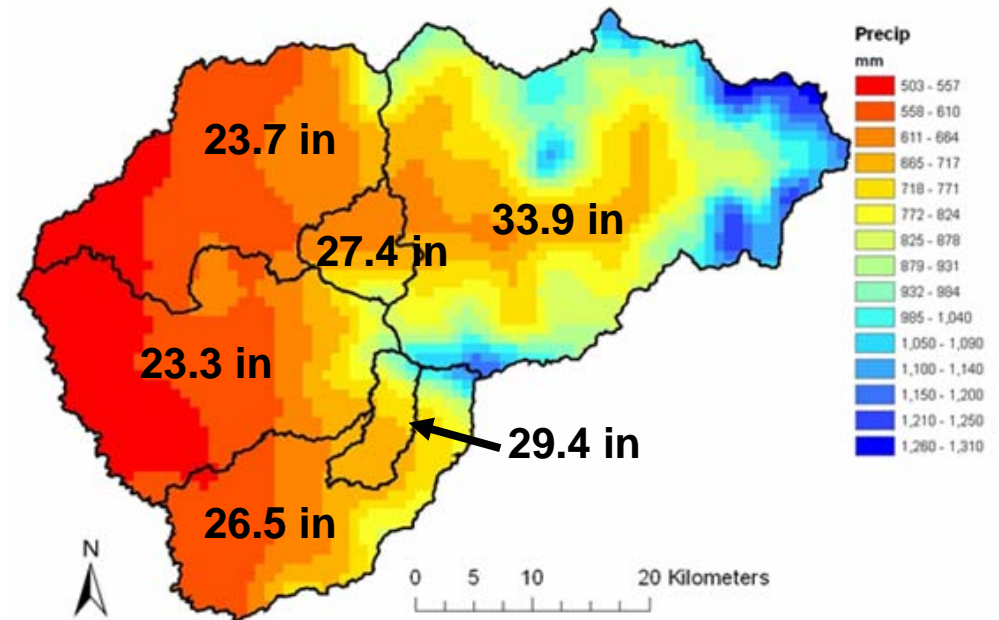
J. Bush and J. Hinds

- Focus on Pullman – Moscow area

Palouse Basin System

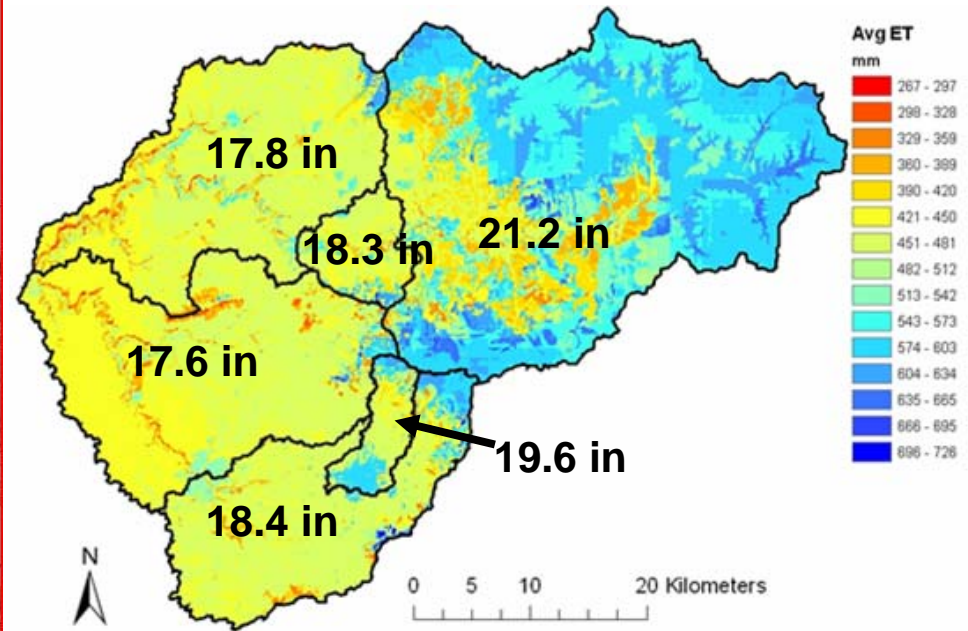


Data: Precipitation



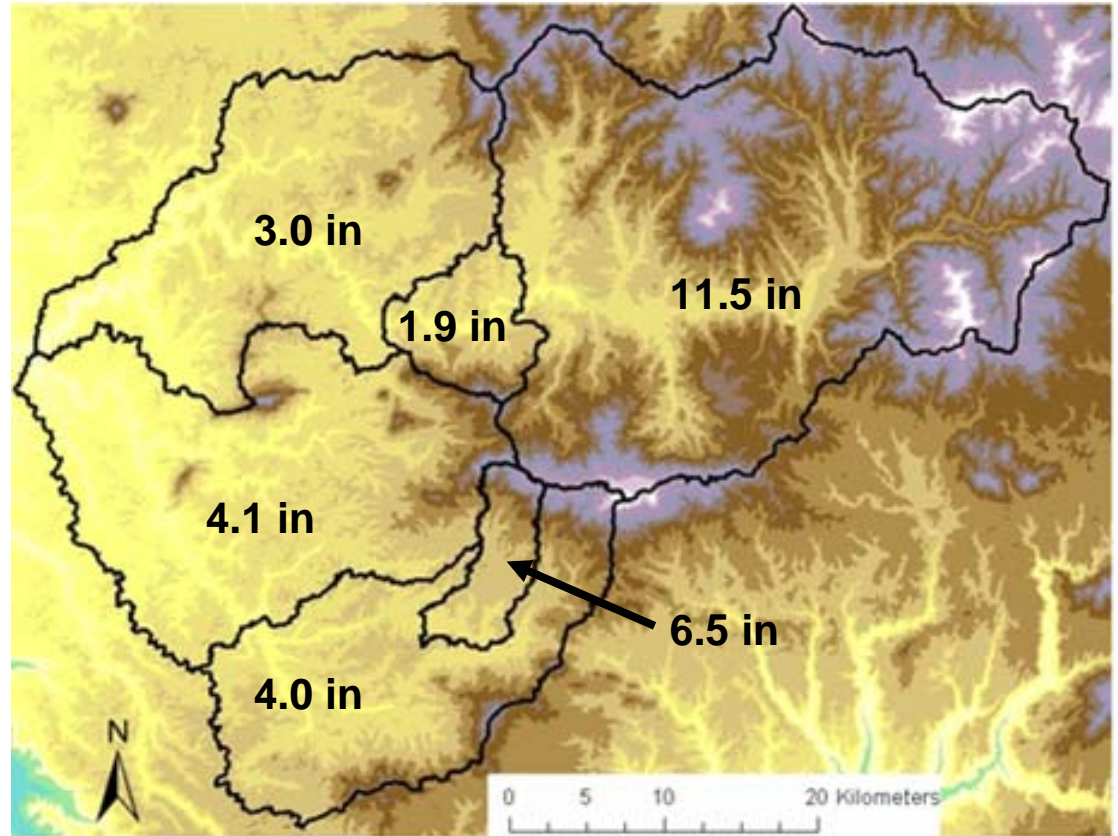
- P-M precipitation: about 28 in/yr

Data: Evapotranspiration



- P-M evapotranspiration: about 19 in/yr

Data: Runoff



- P-M runoff: about 6 in/yr

Data: Recharge

Wanapum (in/yr)	
Stevens, 1960	1.2
Foxworthy and Washburn, 1963	0.6
Barker, 1979	7.8
Smoot, 1987	3.6
Bauer and Vaccaro, 1989	2.8
Lum et al., 1990	2.8
Johnson, 1991	4.1
Muniz, 1991	1 - 4
O' Brien and Others, 1997 (Pullman)	0.1 - 0.8
Ogeen et al. (2005) (deep soils)	0.01 - 0.4
Fealko, 2005 (Paradise Creek)	3.3
Fiedler et al., 2006	1.2 – 8.1
Grande Ronde (in/yr)	
Crosby and Chatters, 1965	Negligible
Foxworthy and Washburn, 1963	0.6
Barker, 1979	0.7
Smoot, 1987	1.9
Bauer and Vaccaro, 1987	4.1
Lum et al., 1990	2

Groundwater Volumes

- Why is volume important? (planning window)



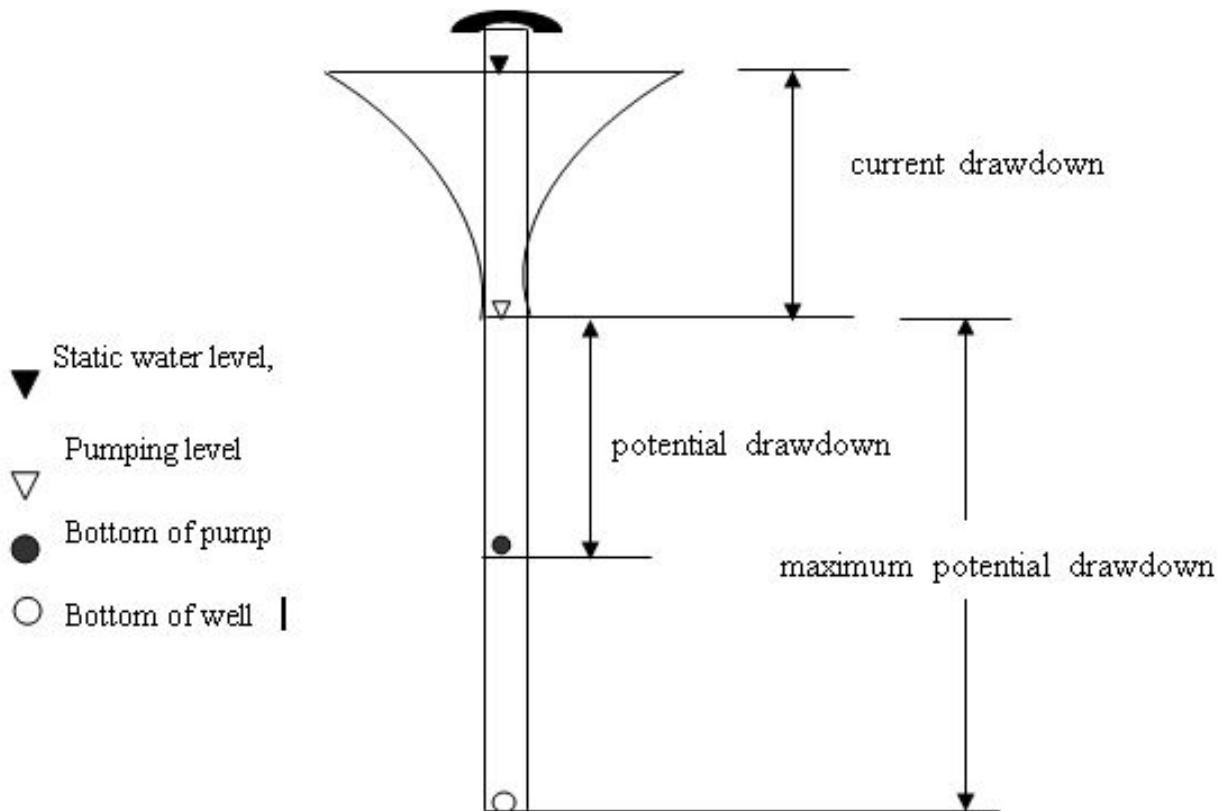
or



?

Groundwater Volumes

- $\text{Volume} = \text{Storativity} * \text{Area} * \text{Potential Drawdown}$



Palouse

Potential: ~ 100 feet

Maximum: ~ 1000 feet

Groundwater Volumes

- Currently available (100 ft drawdown)
- Storativity = 0.00001 to 0.001
 - *Osiensky, 2006*
- Area
 - Wanapum: around 20,000 acres (31 mi²)
 - Grande Ronde: around 190,000 acres (294 mi²)
 - Based on *Bush and Hinds, 2006*
- Wanapum: 6.5 to 650 million gallons
- Grande Ronde: 61 to 6100 million gallons

Previous Volume Estimates

- Jones and Ross, 1969
- Upper aquifer: 37 billion gallons
- Lower aquifers: 350 billion gallons
 - Storativity ~ 0.01

- Amount ***in storage*** may last until 2050-2100

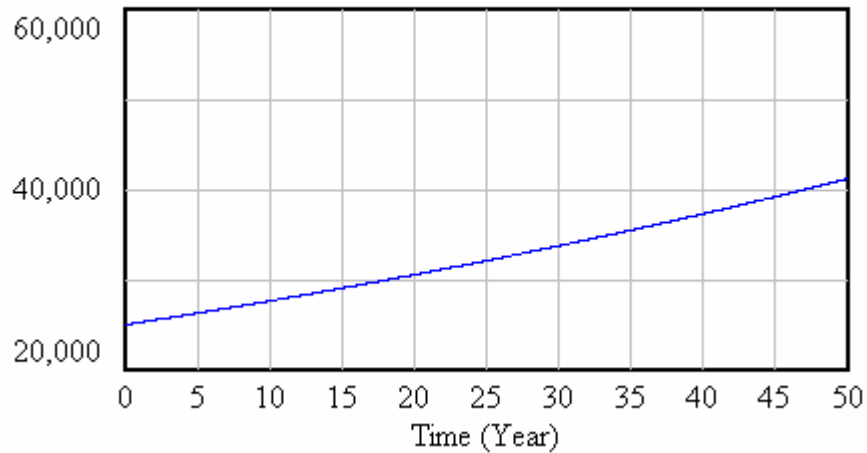
Demand

- PBAC: 2.44 billion gallons in 2005 (P-M)
- ~160 gallons per person per day
- Populations:
 - Pullman: 25,000 (95 gpcd)
 - Moscow: 21,000 (107 gpcd)
 - WSU: 17,000 (83 gpcd)
 - UI: 12,000 (54 gpcd)
- Total modeled use: 2.44 BGal/yr + rural

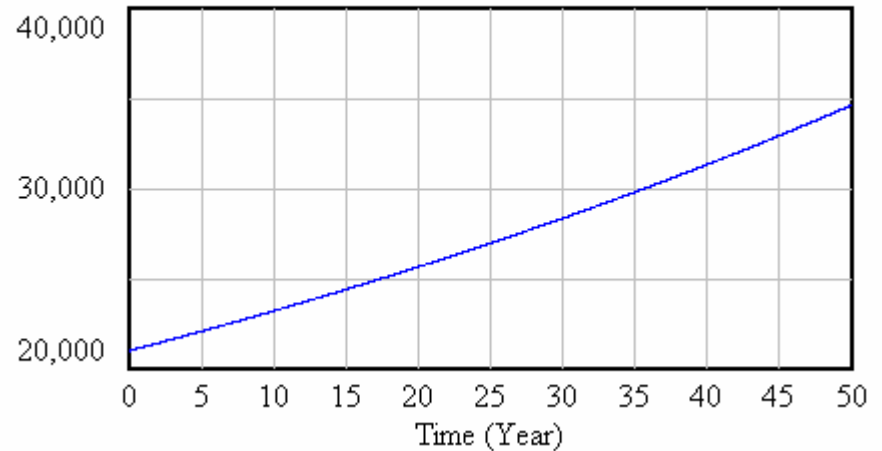
Population Growth

- 1% per year

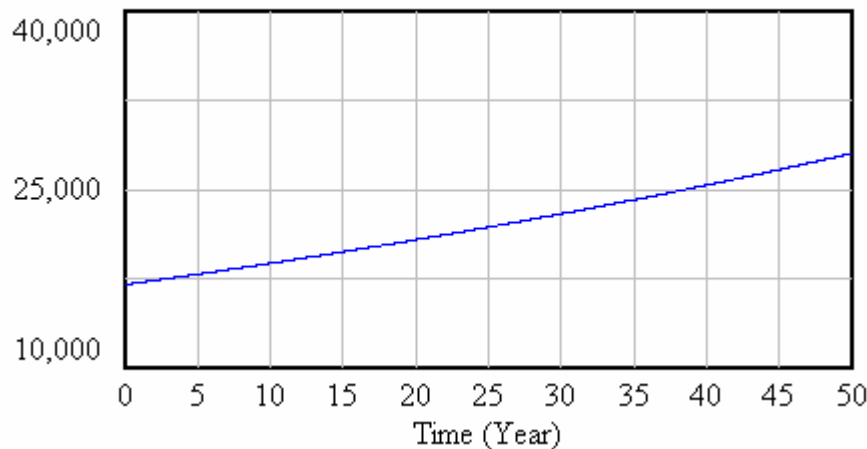
pullman population



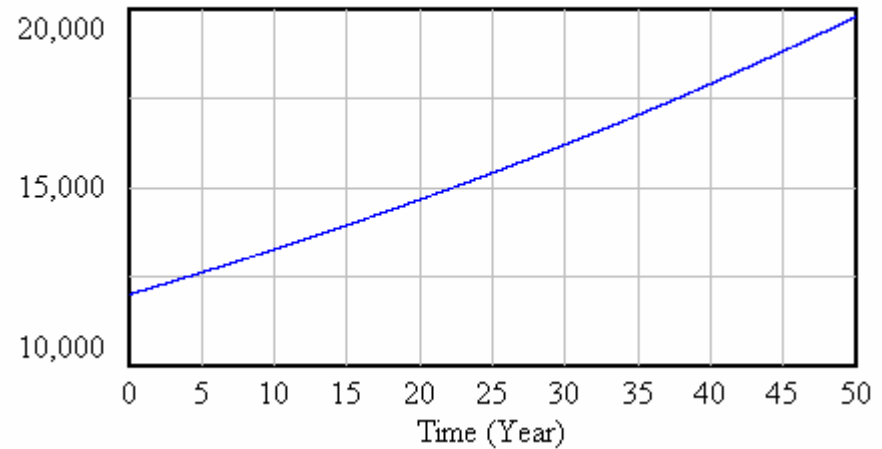
moscow population



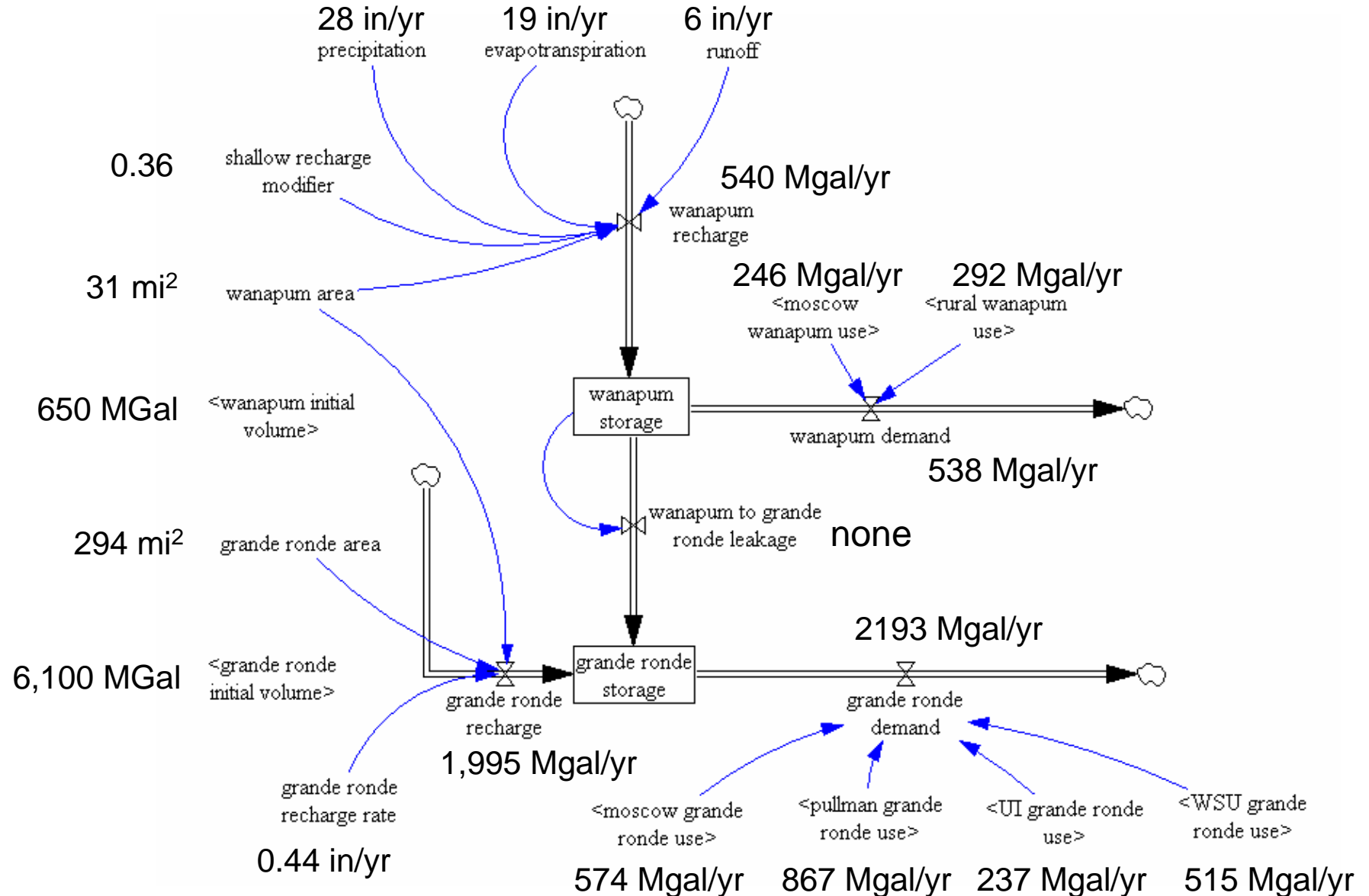
WSU student population



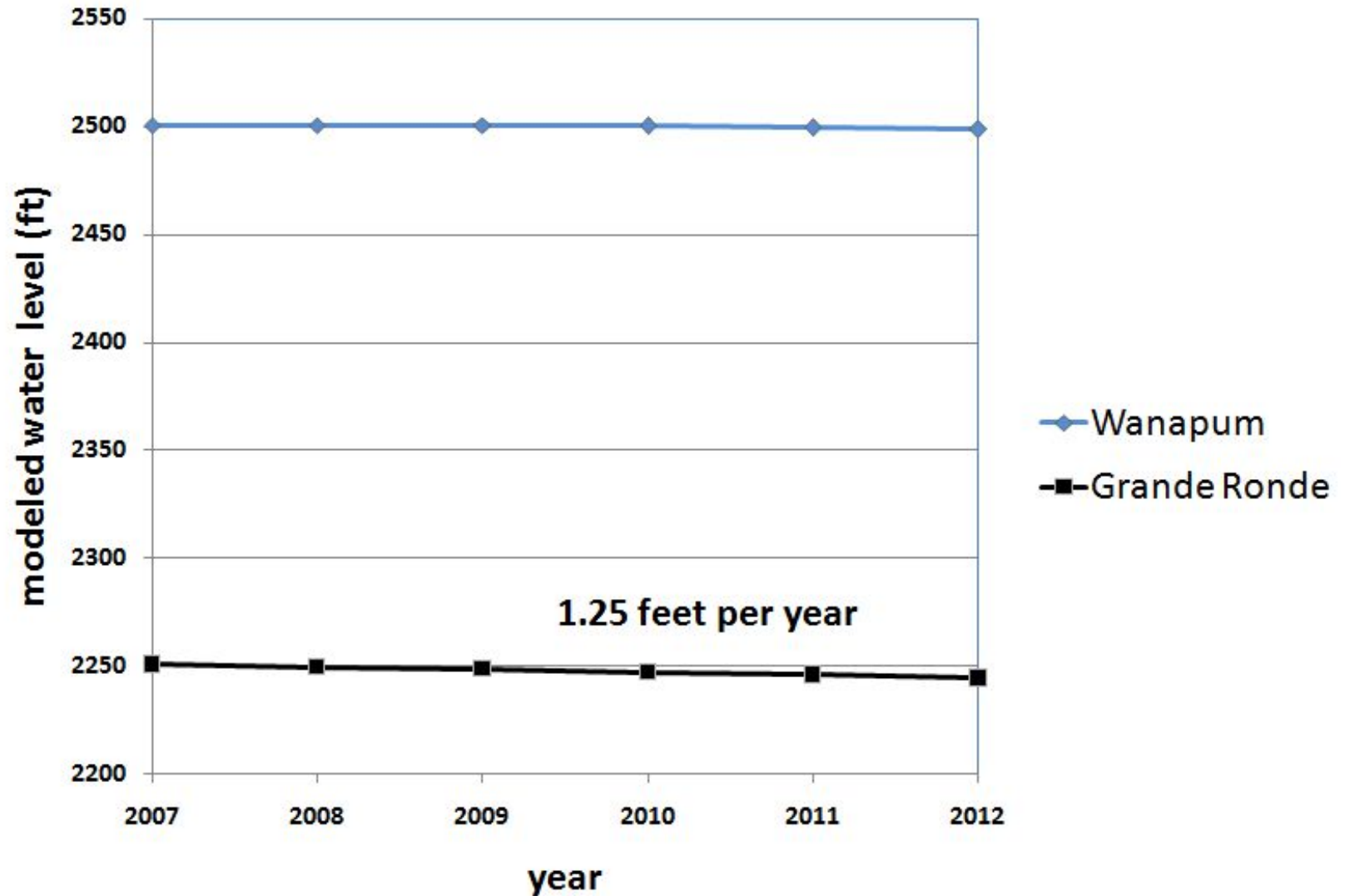
UI student population



Summary of Base Scenario



Near-Term Results

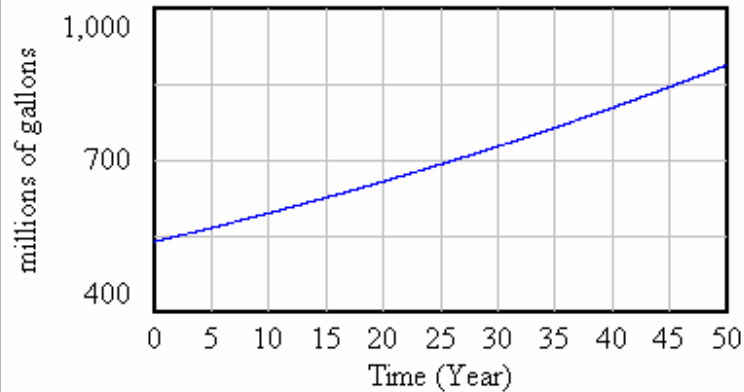


50-Year Results

2.5 BG

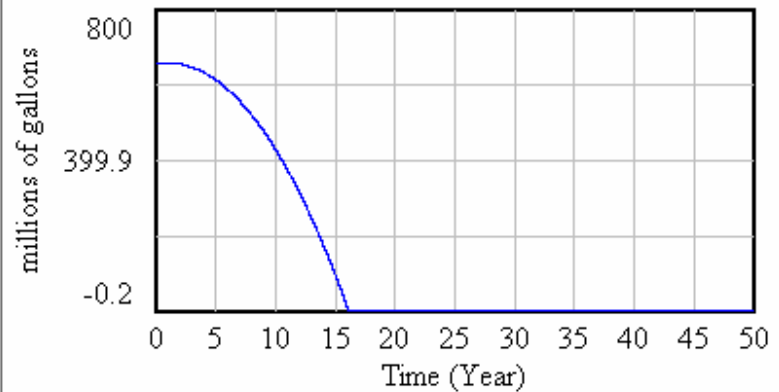
4.5 BG

wanapum demand



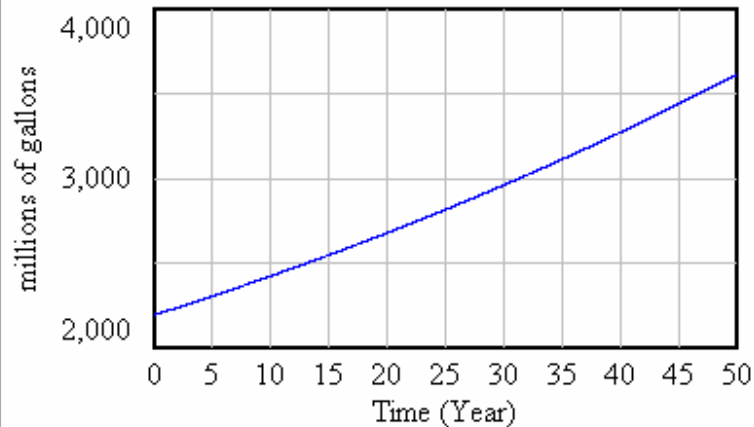
wanapum demand : base

wanapum storage



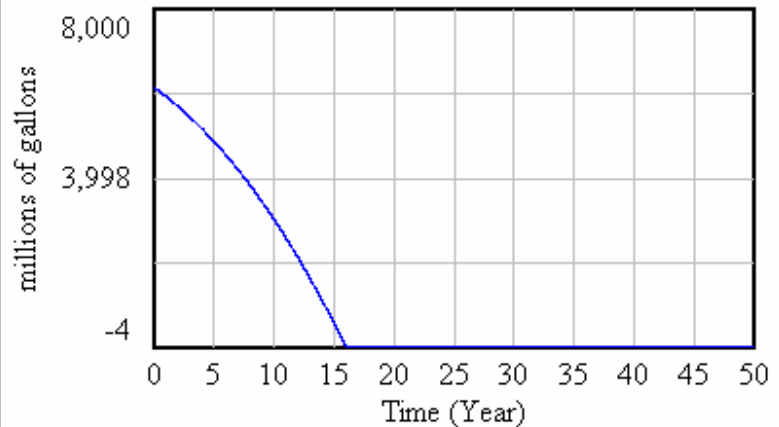
wanapum storage : base

grande ronde demand



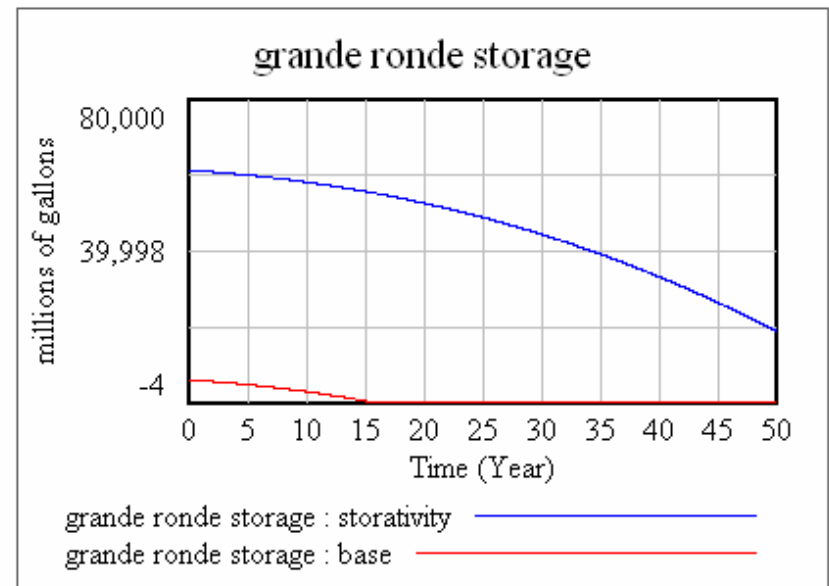
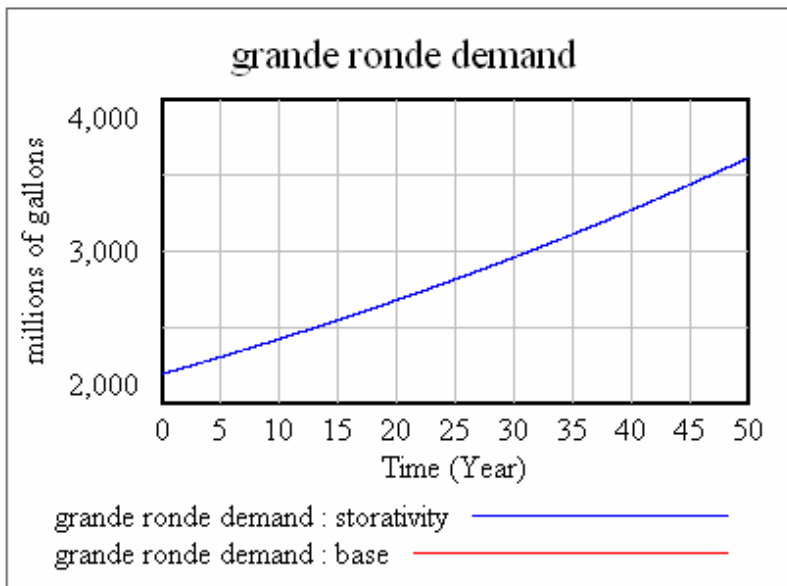
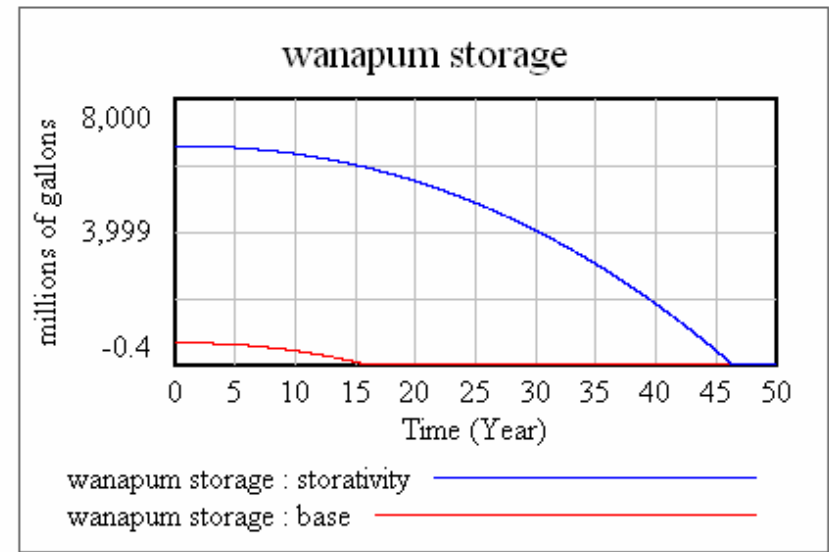
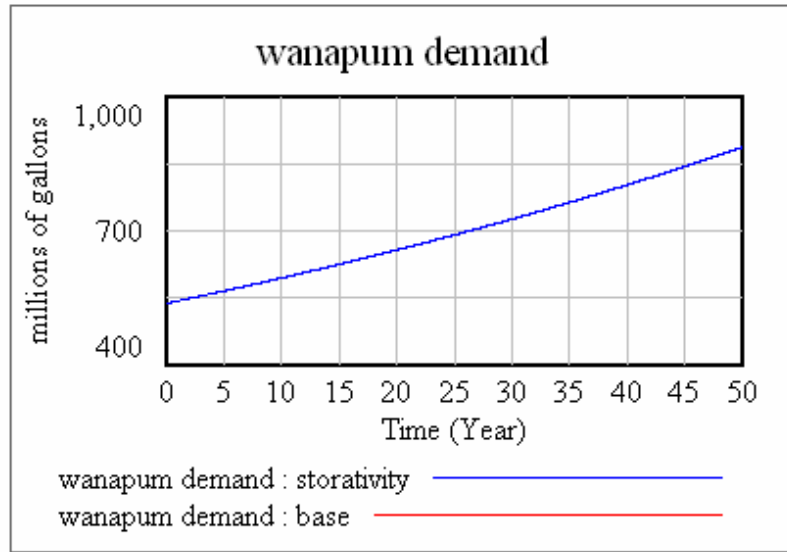
grande ronde demand : base

grande ronde storage



grande ronde storage : base

Storativity = 0.01 (Jones and Ross, 1969)

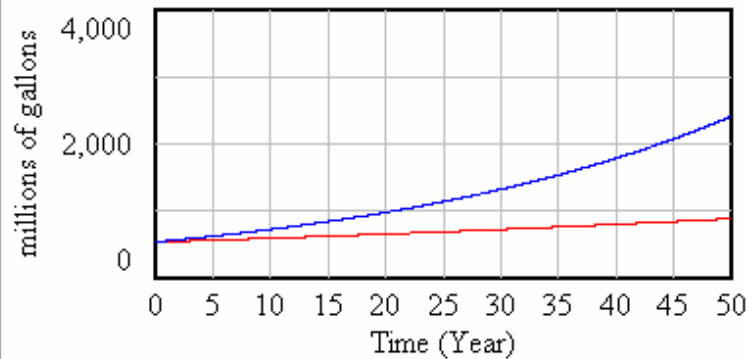


3% Population Growth

2.5 BG

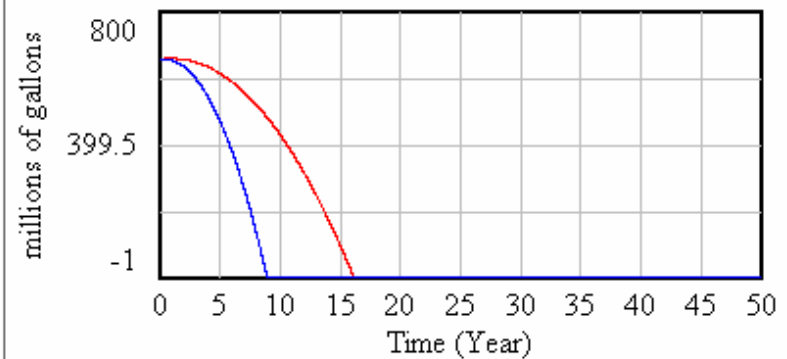
10.2 BG

wanapum demand



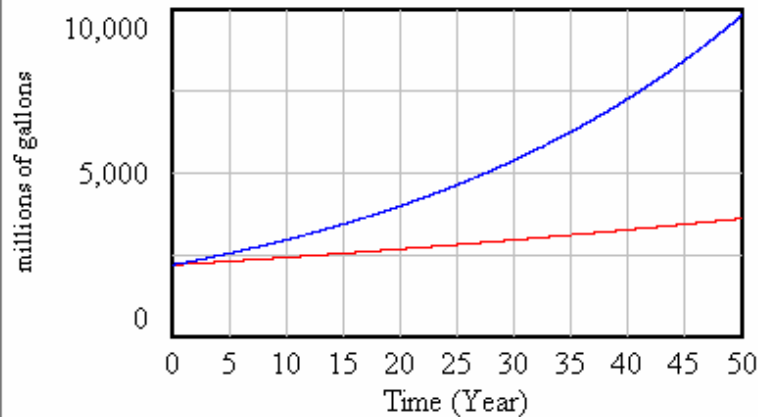
wanapum demand : population
wanapum demand : base

wanapum storage



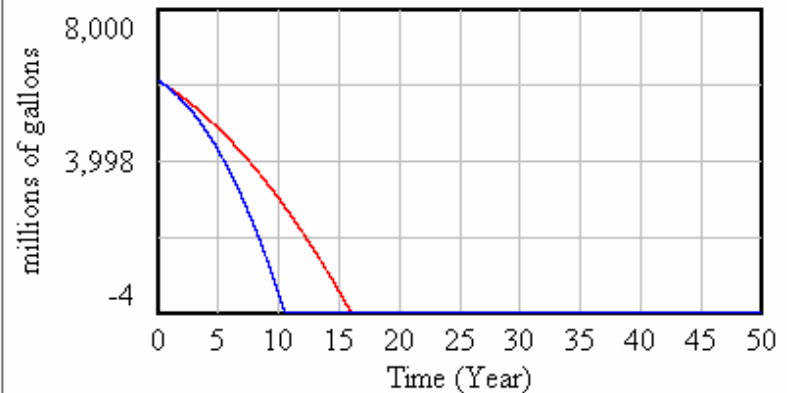
wanapum storage : population
wanapum storage : base

grande ronde demand



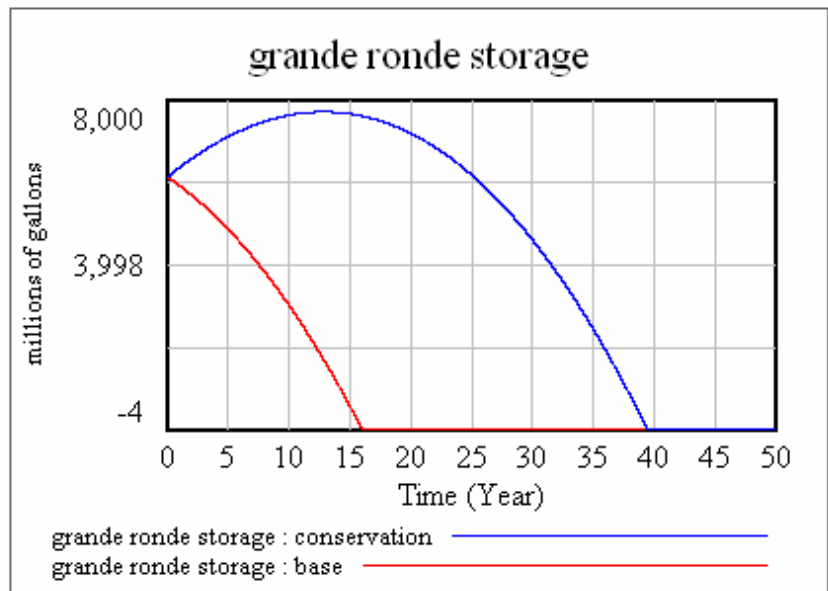
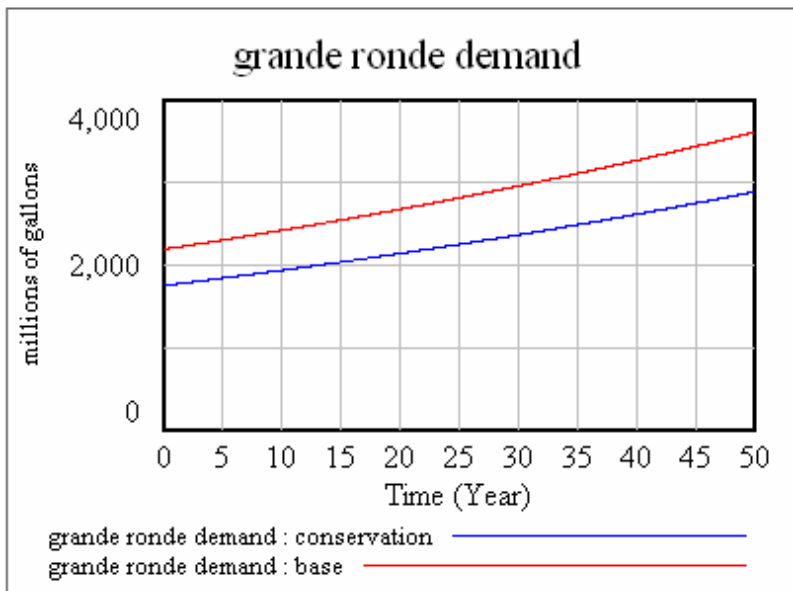
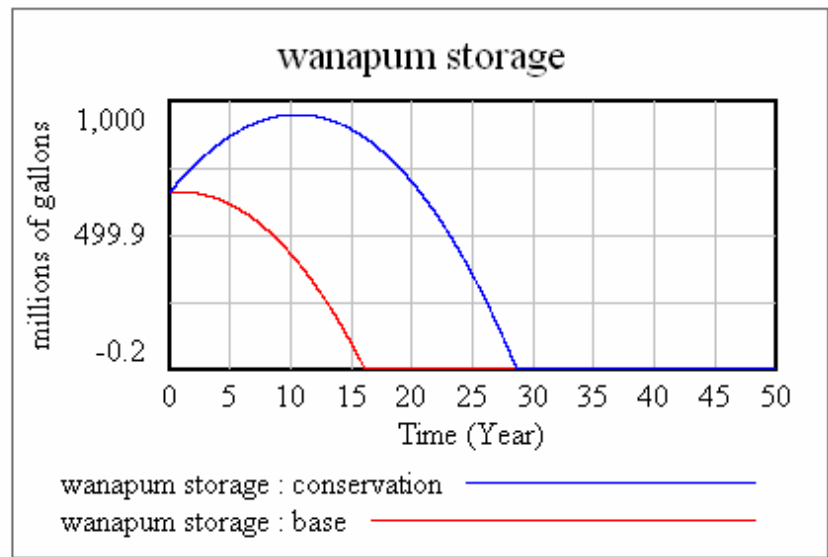
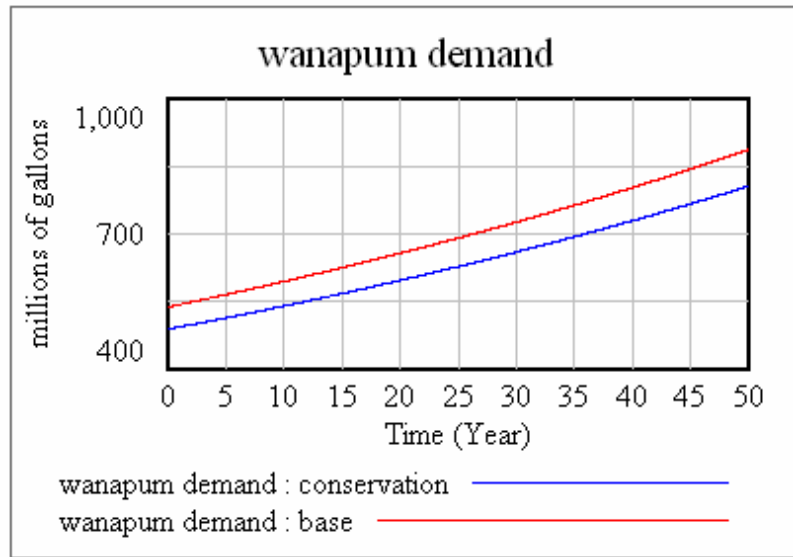
grande ronde demand : population
grande ronde demand : base

grande ronde storage

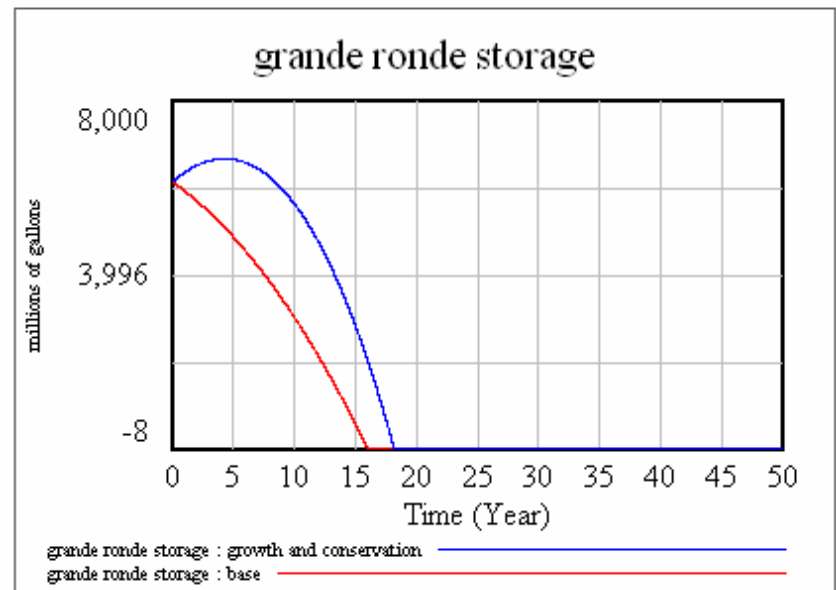
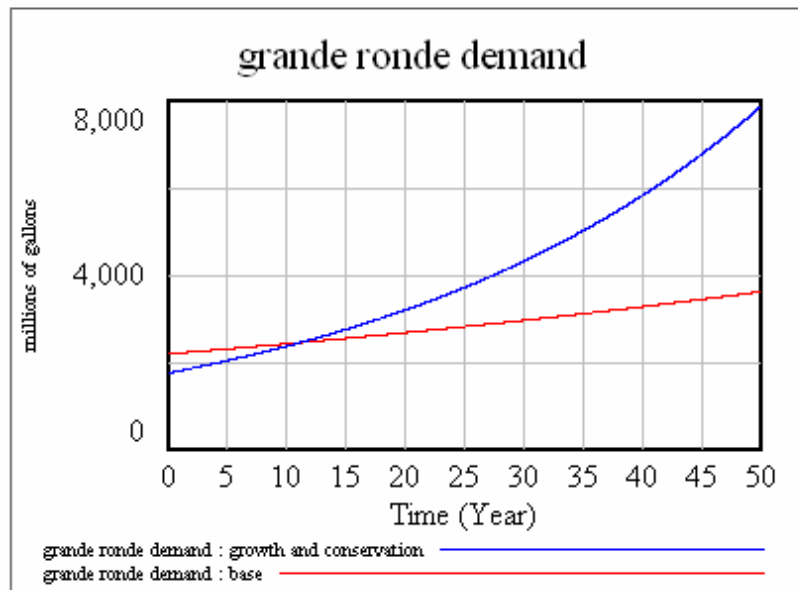
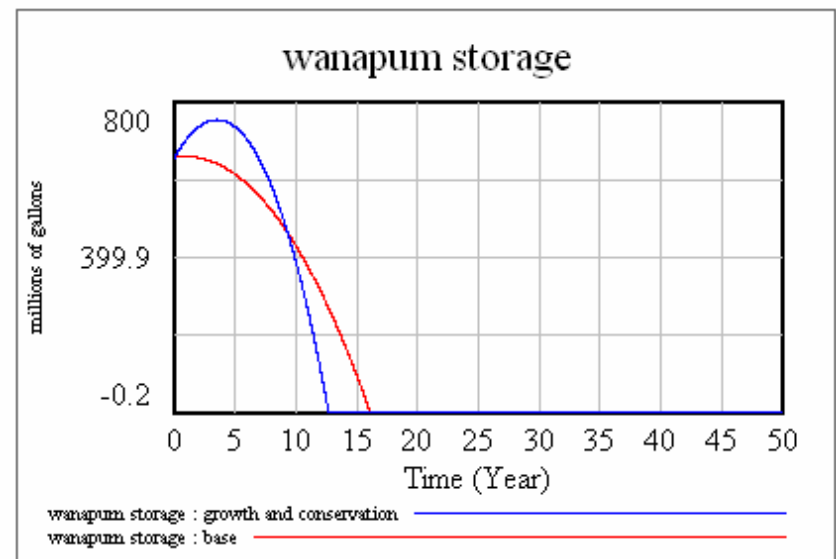
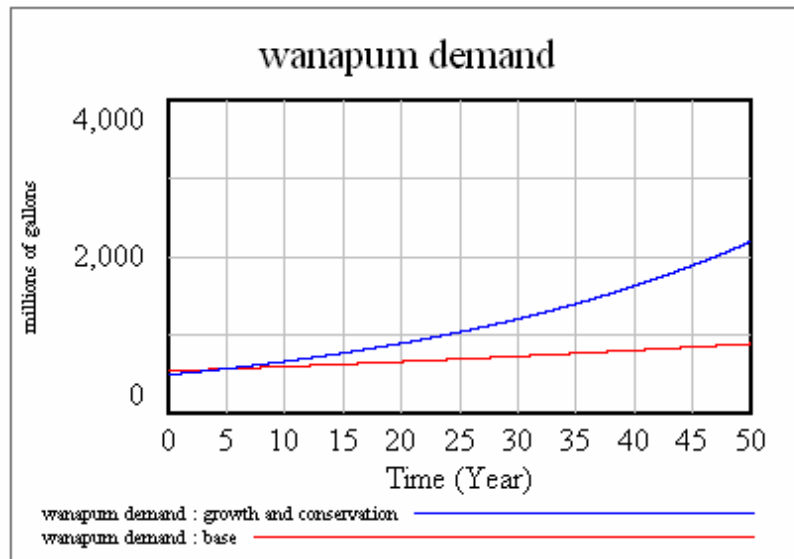


grande ronde storage : population
grande ronde storage : base

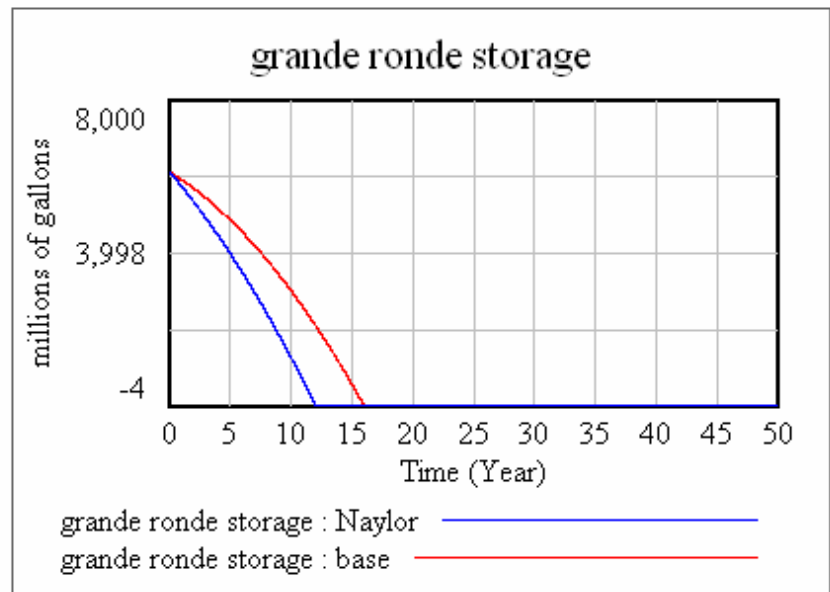
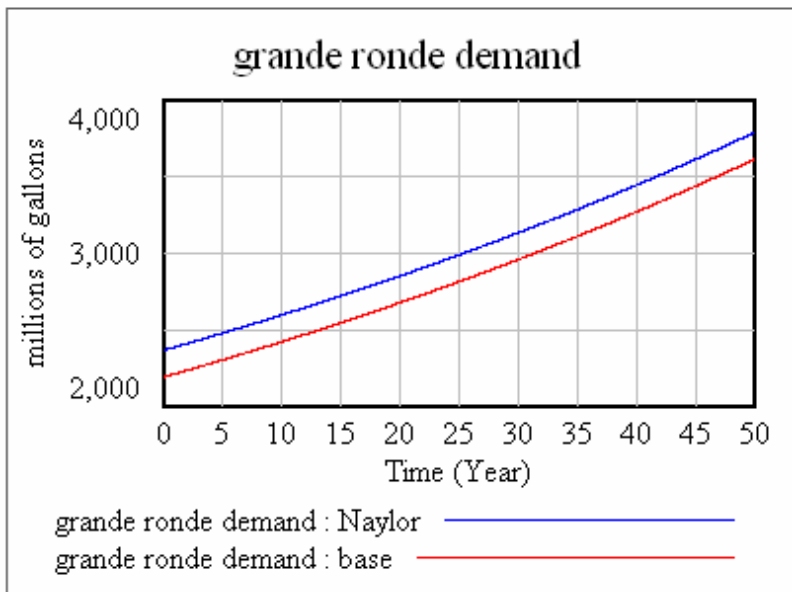
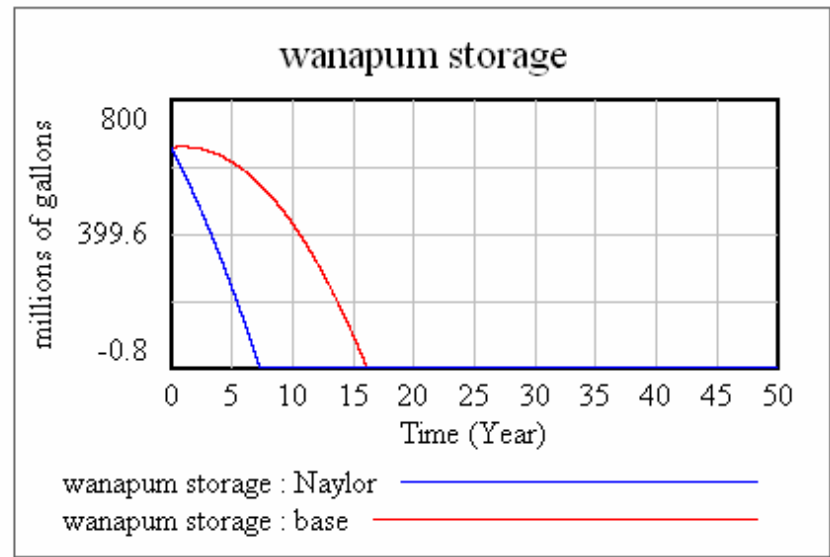
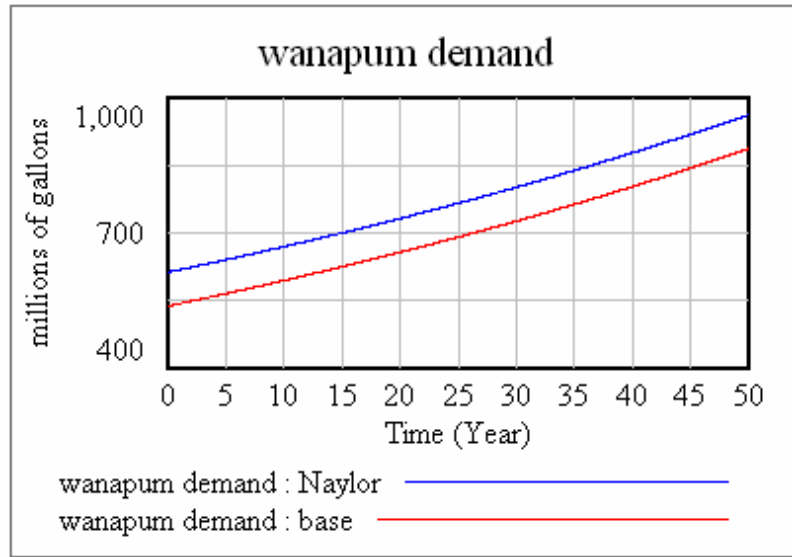
Conservation: 20% reduction



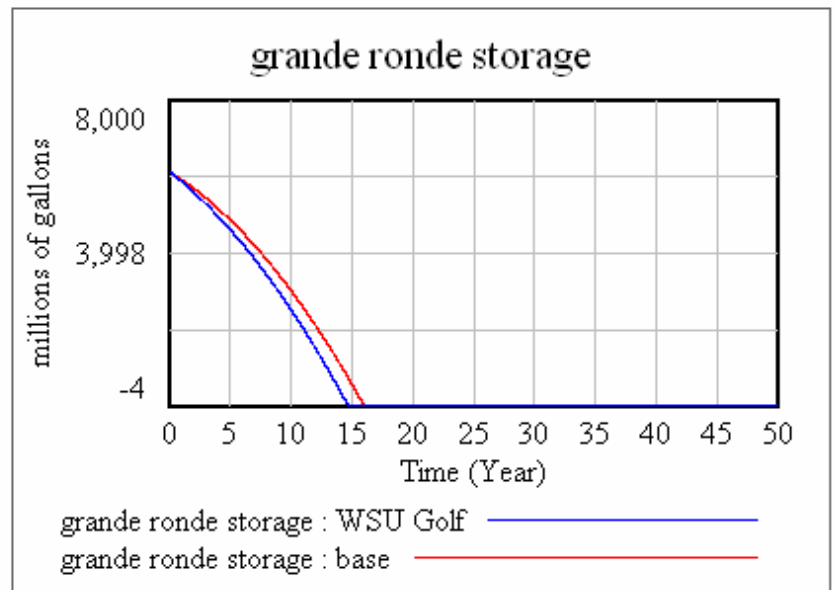
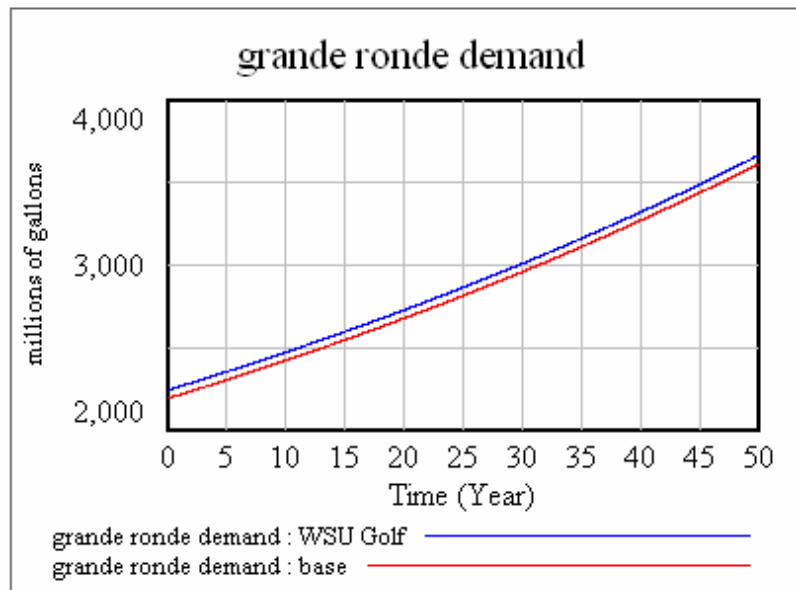
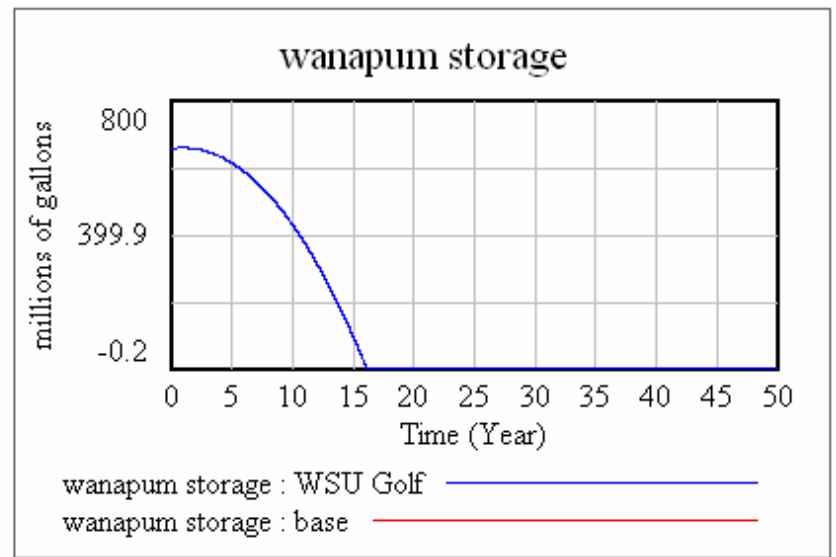
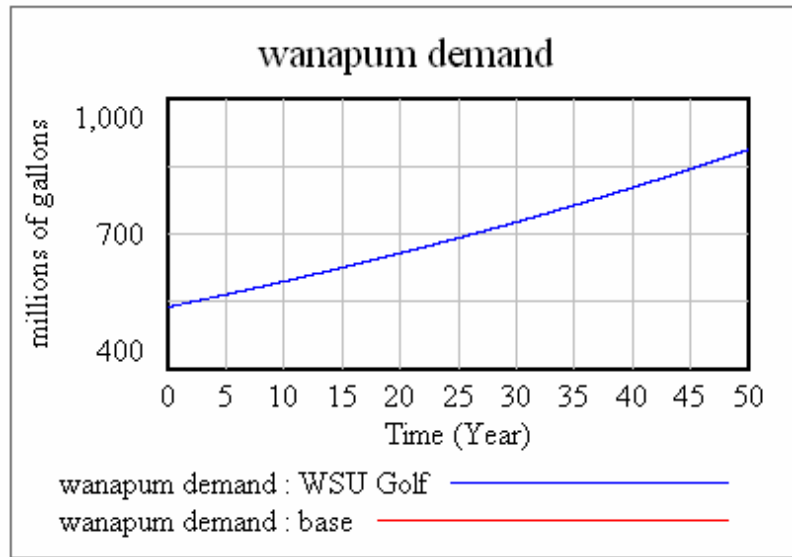
20% Conservation and 3% Growth



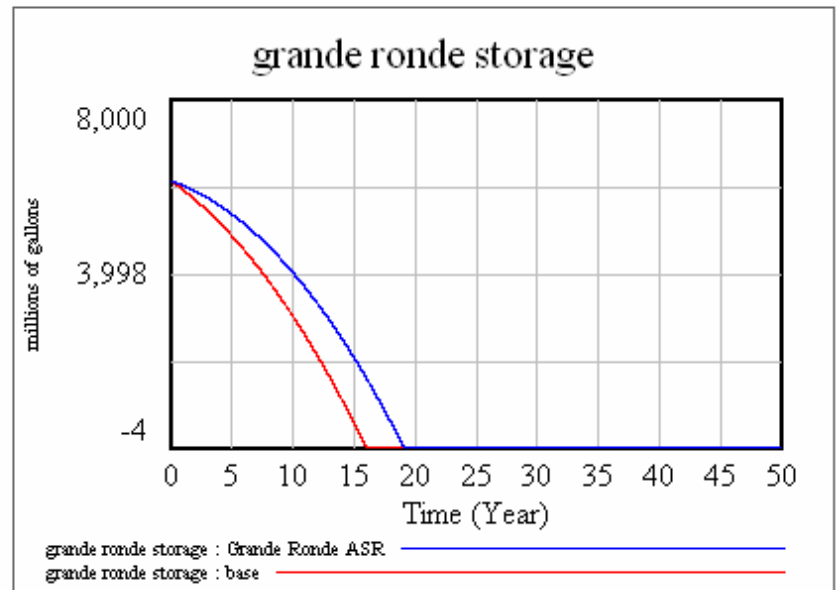
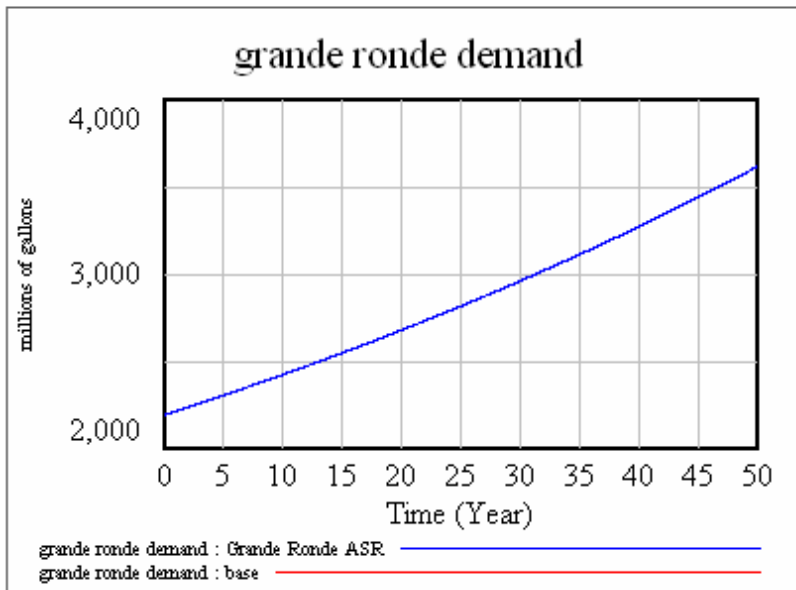
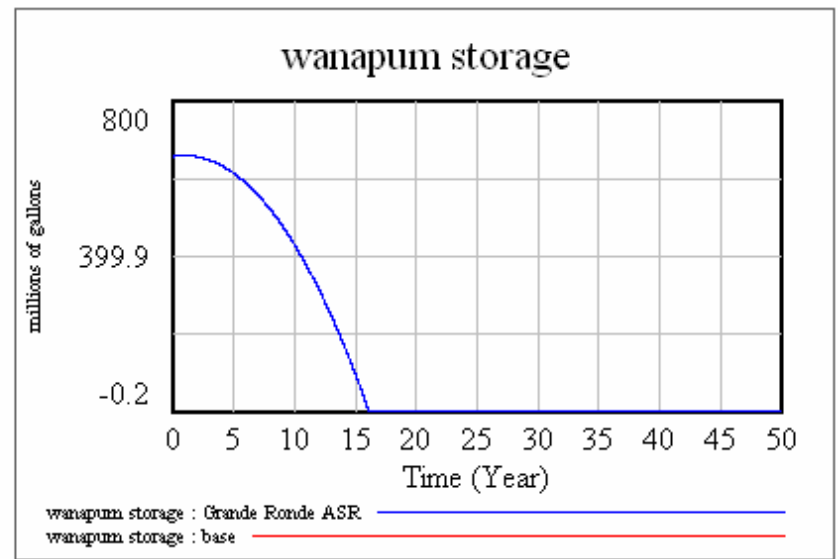
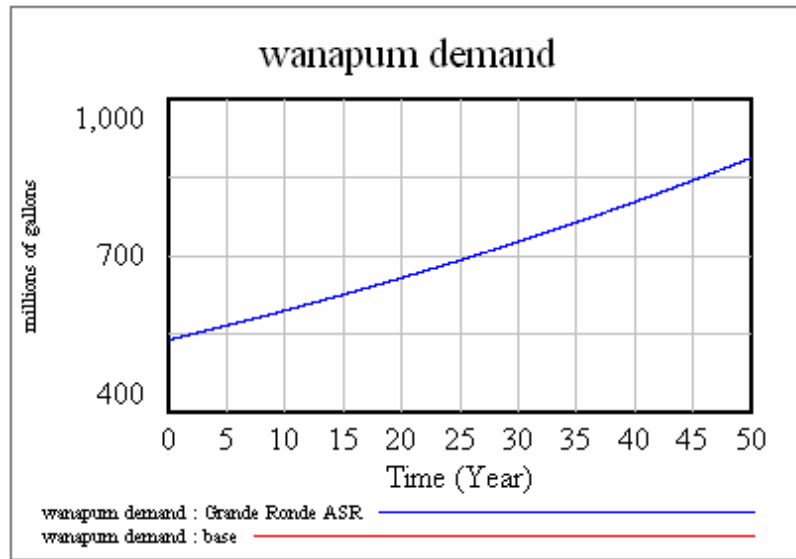
Naylor Farm: 250 MGal/yr



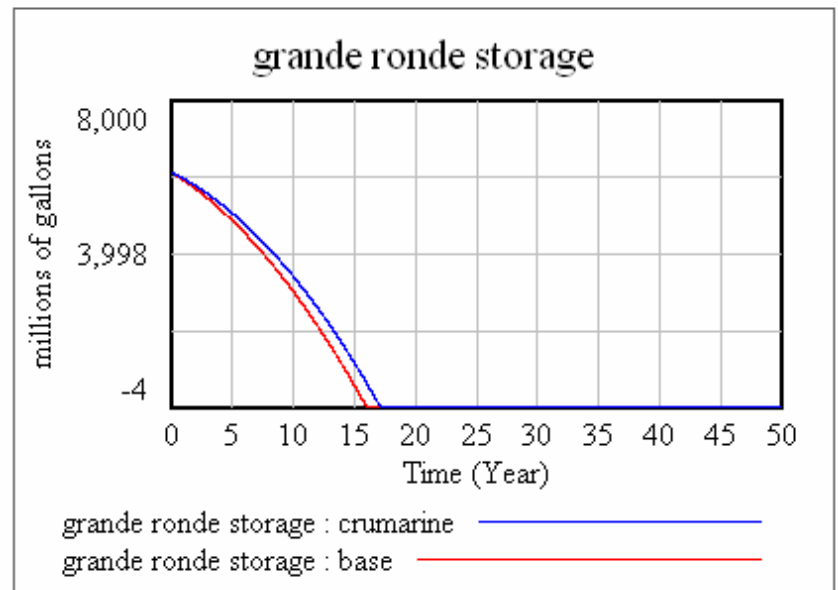
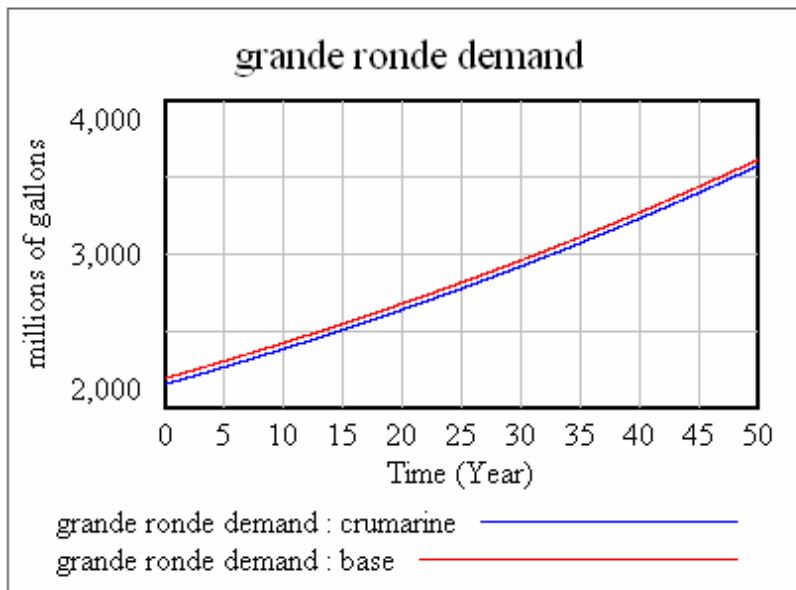
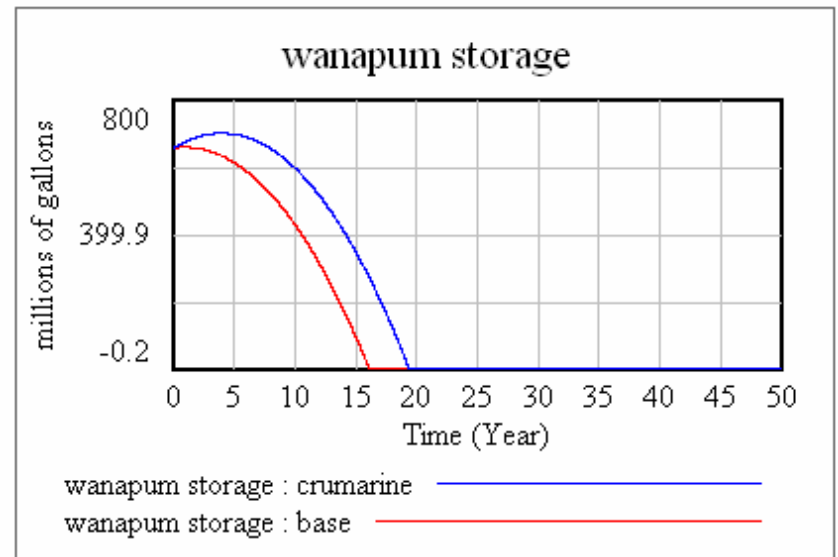
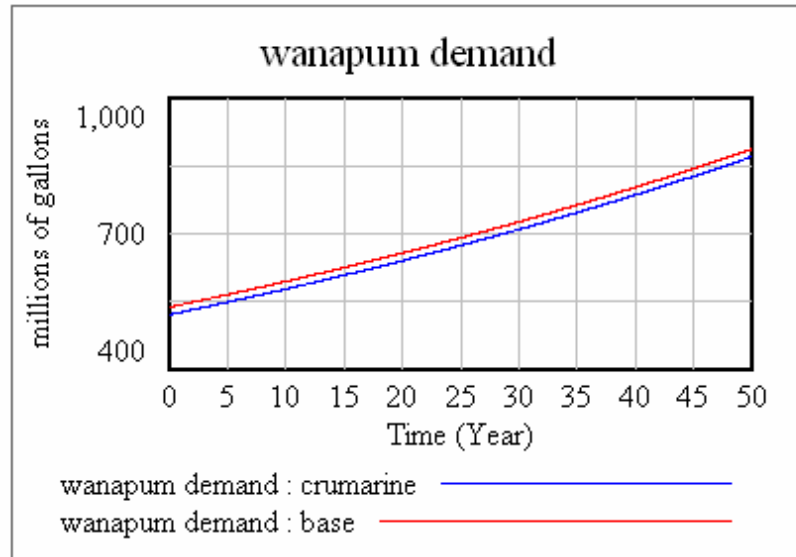
WSU Golf Course: 50 Mgal/yr



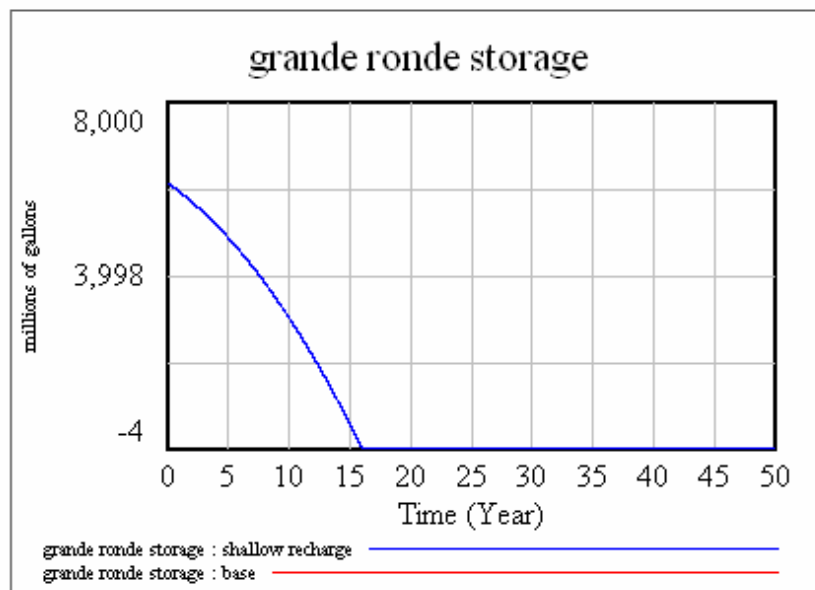
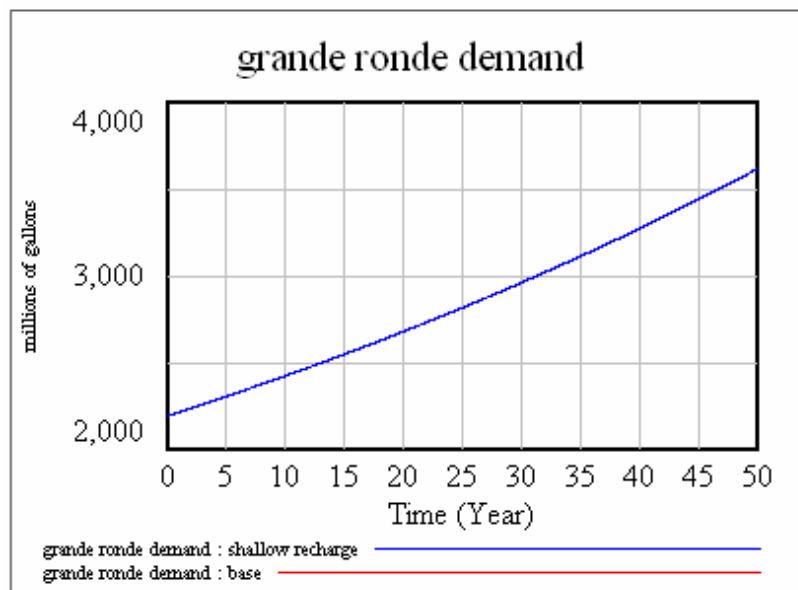
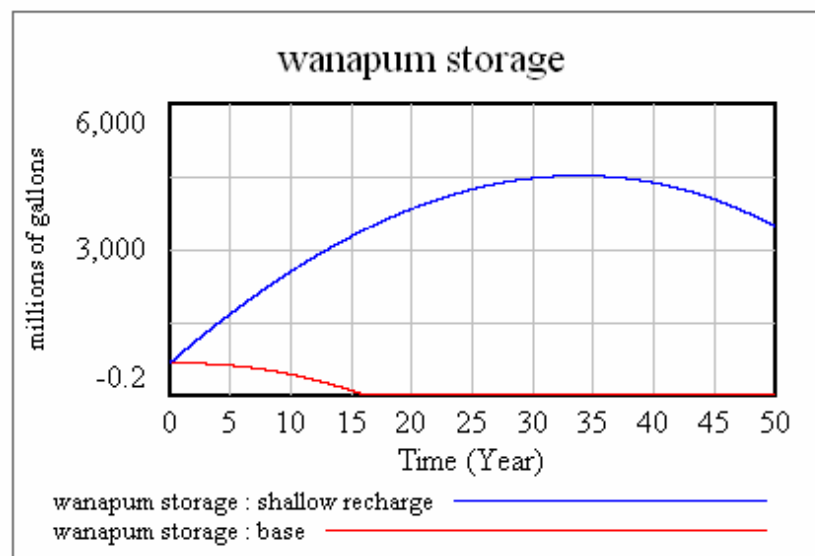
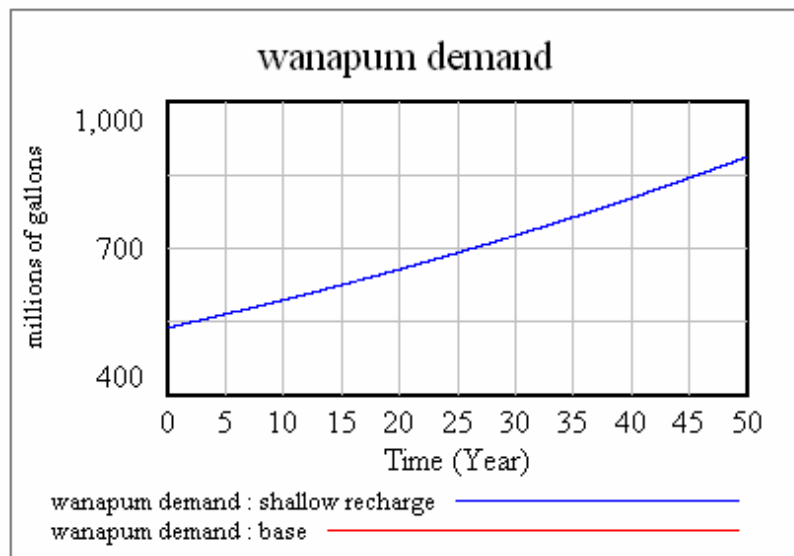
Grande Ronde ASR: 100 MGal/yr



Crumarine Reservoir: 56 Mgal/yr



Shallow Recharge: 750 Mgal/yr



Cooperative/Collaborative/Participatory Modeling

- Stakeholders build model that serves as a framework for planning and further study
- Both process and model valuable
- Tool to link natural and social systems
- Examples:
 - Middle Rio Grande, New Mexico
 - James River, Virginia
 - Lake Ontario – St. Lawrence River

Conclusions

- Recharge AND current storage important
- Conservation can balance growth (for a while)
- The model is incomplete
 - Physical refinements
 - Improve future demand estimates
 - Add economics, water rights
 - **Missing shared vision**

Palouse Water Information System

- <http://wr.civil.uidaho.edu/cwis/palouse>