COLUMBIA RIVER BASIN 2016 LONG-TERM WATER SUPPLY & DEMAND FORECAST

Presented by:

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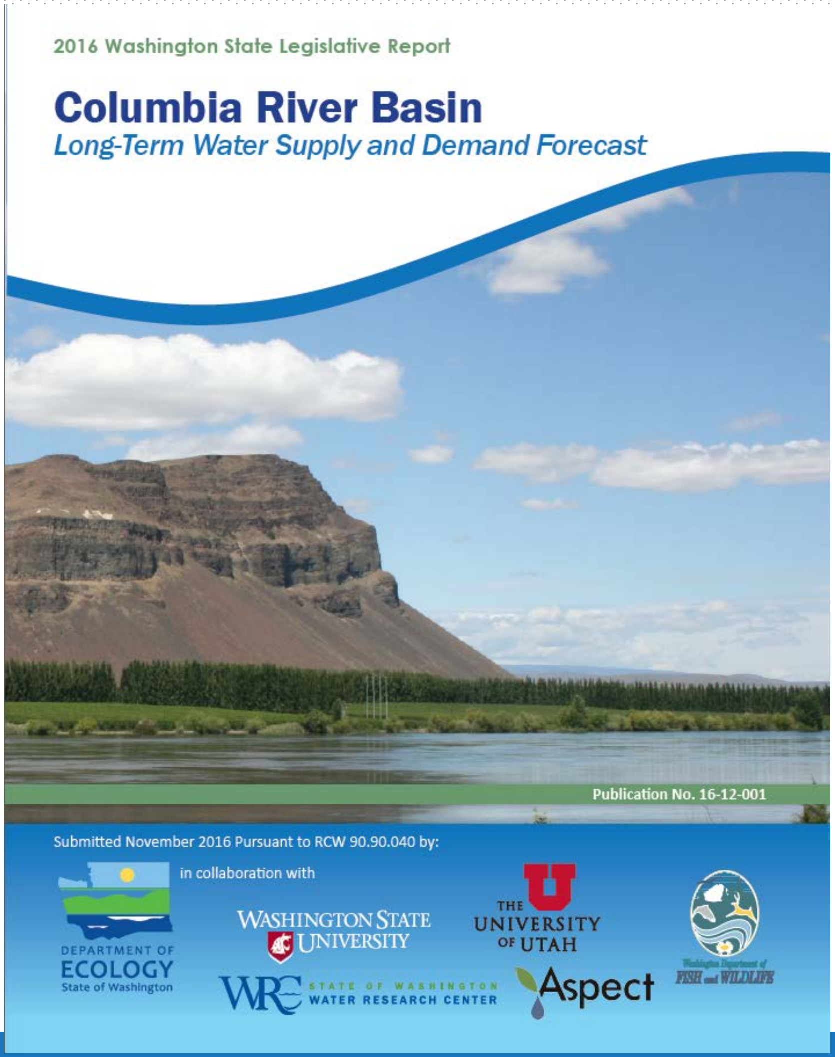
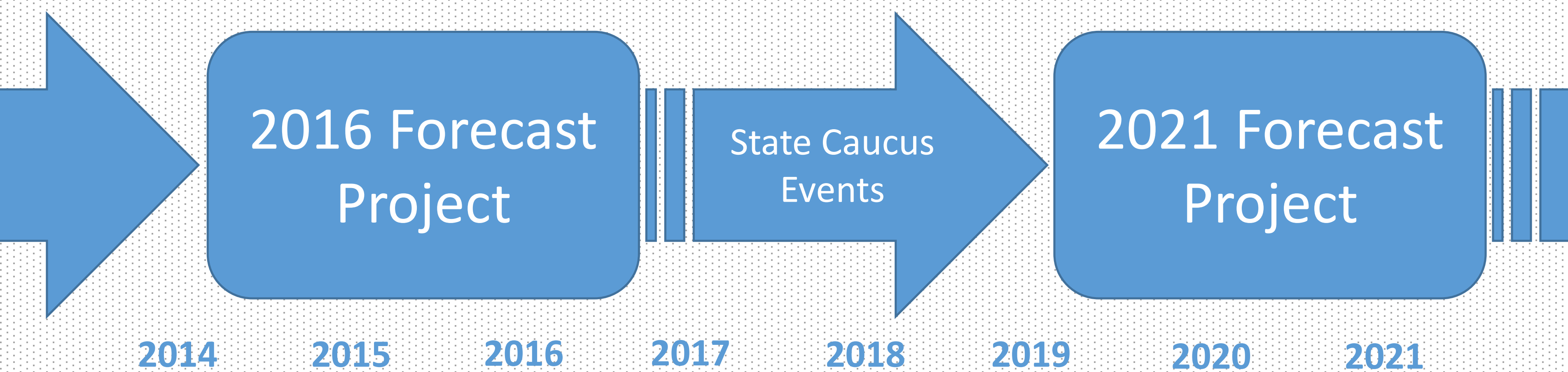
Background

- Every 5 years, the Washington State Department of Ecology's Office of the Columbia River (OCR) is required to submit a long-term (20-year) water supply and demand forecast to the State Legislature
- Washington State University (WSU) was assigned to develop the forecast for water supply and out-of-stream demand
- The forecast helps improve understanding of where additional water supply is most critically needed, now and in the future



Timeline of Water Supply/Demand Forecasts

- State Caucus: to collect data and discuss improvements for 2021 Forecast
  - July 31, 2017 (completed)
  - ~January, 2018 (target)
  - ~July, 2018 (target)
  - ~January 2019 (target)



Meeting Objectives

- Discuss Recommendations from July 31, 2017 State Caucus
  - filling data gaps
  - prioritizing model refinement
  - policy considerations

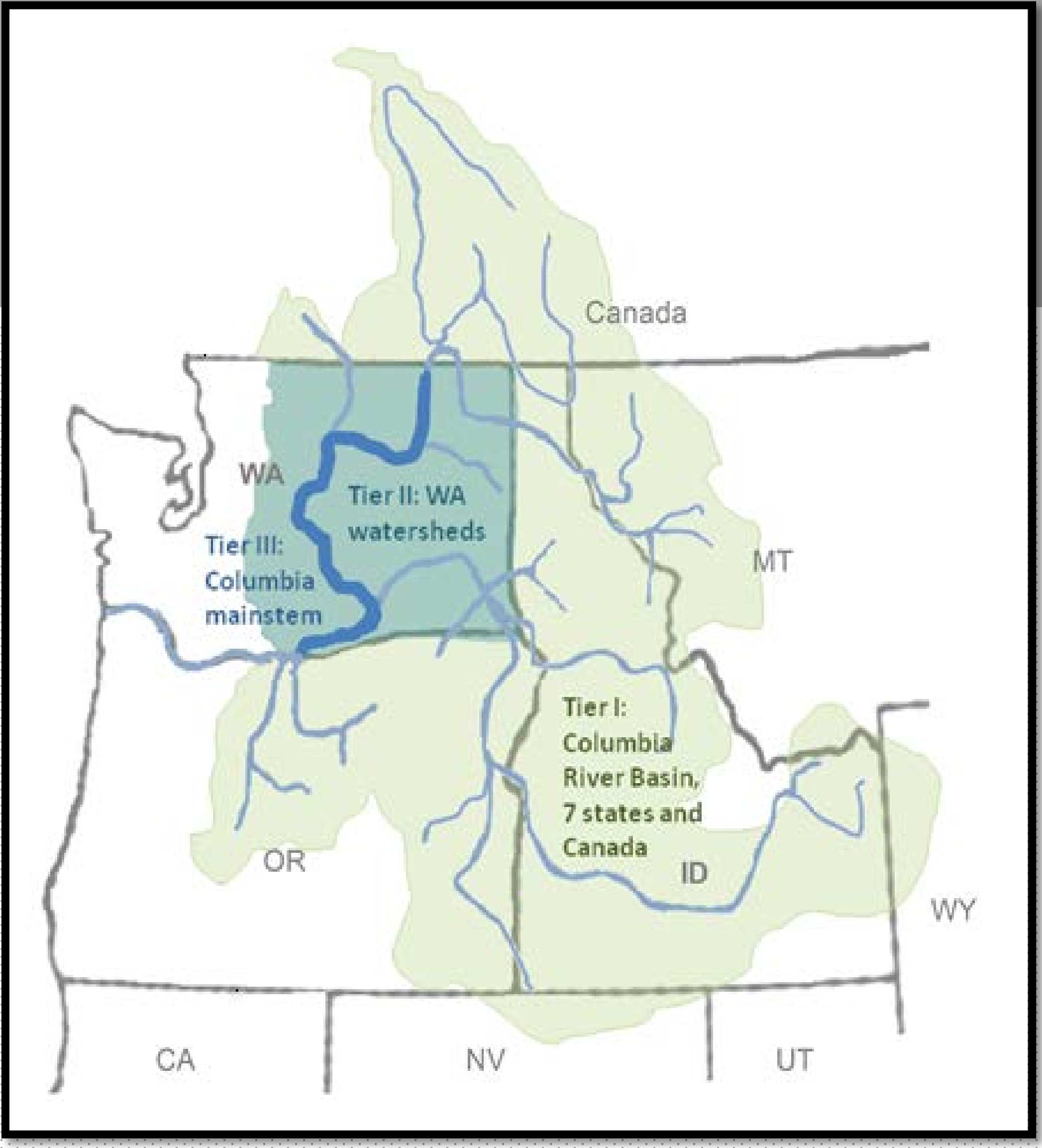
Outline

- Brief Review of Key Results from 2016 Forecast
- Improvements being Discussed for 2021 Forecast
- Summary of Material Presented and Recommendations Made at the July 31 State Caucus

2016 Forecast: Approach

1. Overview of Integrated Modeling
2. Biophysical Modeling of Water Supply and Irrigation Demand
3. Economic Modeling of Future Crop Mix
4. Municipal Demand
5. Hydropower Demand

201 Forecast: Results



2016 Forecast: Summary of Changes in Water Supply and Demand

Supply:

- **Average annual increase at Bonneville: +14.6%**
- **Average shift in seasonality:**

↓ **-10.3%** between June and October

↑ **30.8%** between November and May

Demand:

- **Average decrease in eastern WA irrigation demand:**
  - **-5.1% (historical crop mix)**
  - **-6.9% (future crop mix)**
- **Average shift in seasonality (future crop mix):**

↓ **-13.3%** between July and October

↑ **5.7%** between March and June

2016 Forecast: Summary of Water Demand Results

Water Use or Need	Estimated Volume (AF) (average of climate scenarios)
Projected changes in Eastern WA Agricultural Demand by 2035	-332,837 to -250,027
Projected changes in Agricultural Demand by 2035 with 10% Double Cropping	-272,837 to -130,027
Projected changes in Agricultural Demand by 2035 with 10% Double Cropping and Planned Water Supply Projects	27,163 to 169,973
Projected changes in Eastern WA Municipal and Domestic Demand (including municipally-supplied commercial) by 2035	80,000
Projected changes in CRB Hydropower Demand by 2035	35,000 to 75,000
Water Use or Need to be Met with Surface Supplies	
Unmet Columbia River Instream Flows in 2001 at McNary Dam	13,400,000
Unmet Tributary Instream Flows (historical droughts)	659,918
Unmet Columbia River Interruptibles (historical droughts)	40,000 to 310,000
Yakima Basin Water Supply (pro-ratables, municipal/ domestic and fish) (from 2011 Yakima Report)	450,000
Alternate Supply for Odessa (from 2010 Odessa Report)	155,000
Declining Groundwater Supplies (other than in the Odessa Subarea)	750,000

2016 Forecast: Causes of Projected Decrease in Irrigation Demand

In Response to Climate Change

- Water Supply: Springs are getting wetter
- Water Demand: shifting of irrigation requirements earlier in the season
  - Earlier planting and shorter irrigation season for most crops
  - Higher water-use efficiencies due to increases in CO_2

In Response to Economic Drivers

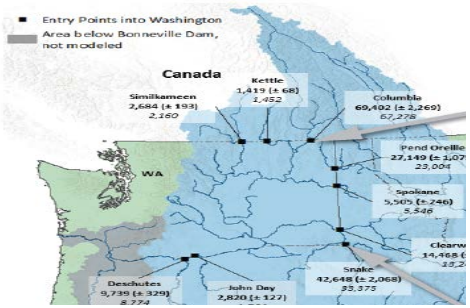
- Shift towards more water-use efficient crops

Note that many adaptive actions were not considered

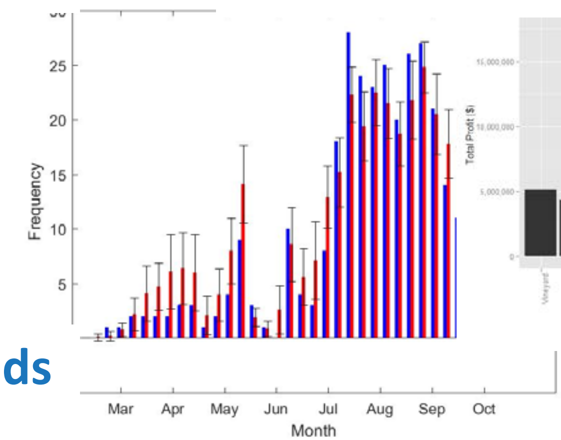
- Increases in double/cover cropping
- More slowly-maturing crop varieties (e.g., corn)
- Expanded irrigated acreage
- Changes in irrigation technology/management

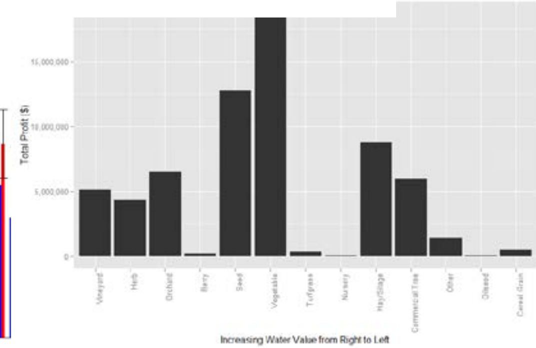
2016 Forecast: Wealth of Other Results, Tools, and Ongoing Work

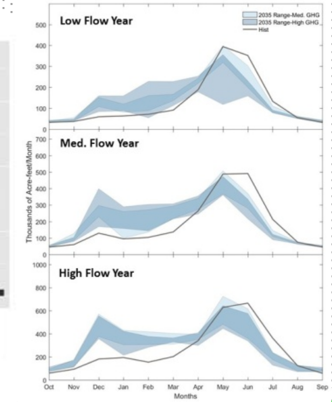
Columbia River Basin



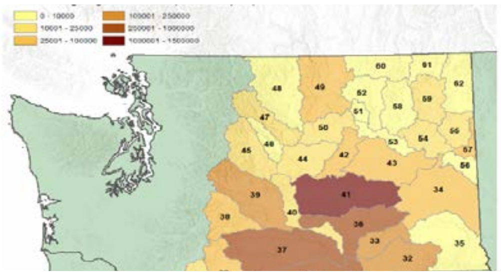
CURTAILMENT MODELING

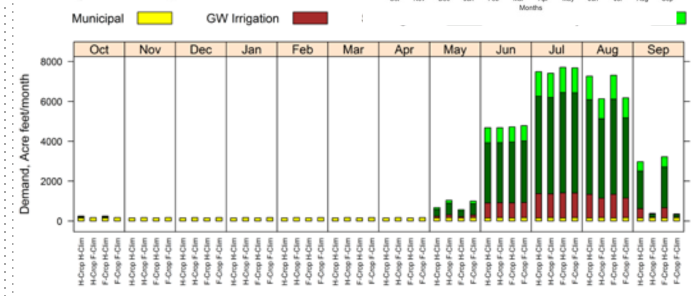




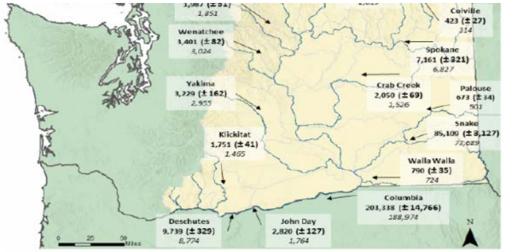


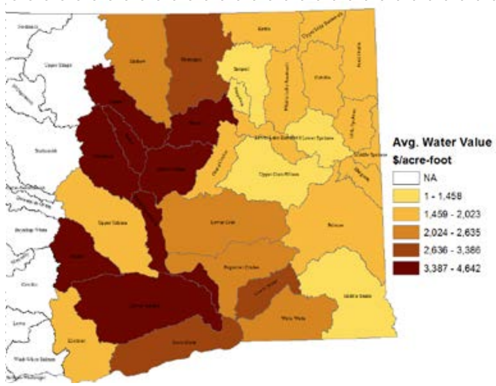
Washington's Watersheds



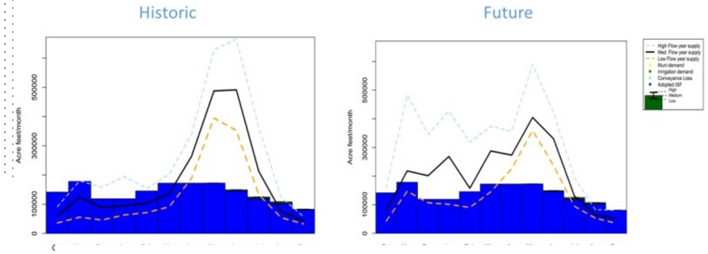


Columbia River Mainstem





WATER CAPACITY SCENARIOS



WRIA-Specific Supply and Demand

2016 Forecast: Modules

1. Columbia River Instream Flow Atlas
2. *Integrating Declining Groundwater Into The Forecast
3. Pilot Application of METRIC Crop Demand Modeling
4. Water Banking Update
5. *Effects of User-Pay Requirements on Water Right Permitting
6. West Side Forecast Scoping

(*was discussed in detail during the July 31 state caucus)

Improvements in Discussion for the 2021 Forecast

*Incorporating groundwater dynamics that impact surface water availability

*Improving municipal demand forecasting

*Columbia River system operations and instream flows

*Economic impacts (specifically cost of developing water) to future water demands and water management

*Capturing the impact of double cropping / cover cropping in the state

Refining water right curtailment data into a useable modeling format

Expanding the use of METRIC

Future Instream Atlas needs

Developing a statewide forecast

*will be discussed today

General State Caucus Questions/Recommendations

- Climate Change: Should Ecology proactively seek legislative approval to address season of use restrictions on water rights as crops emerge and require irrigation water earlier in the year?
- Irrigation Water Budget: Should Ecology coordinate survey key entities to estimate pre-and-post irrigation for integration into the 2021 Forecast?
- Double-Cropping: Can irrigation district delivery records, METRIC, or surveys be used to refine estimates of double-cropping in use today?
- Irrigated Extent Expansion: Should WSU perform a study to model the demand for irrigated acres at the extensive margin?

Incorporating groundwater dynamics that impact surface water availability into modeling efforts

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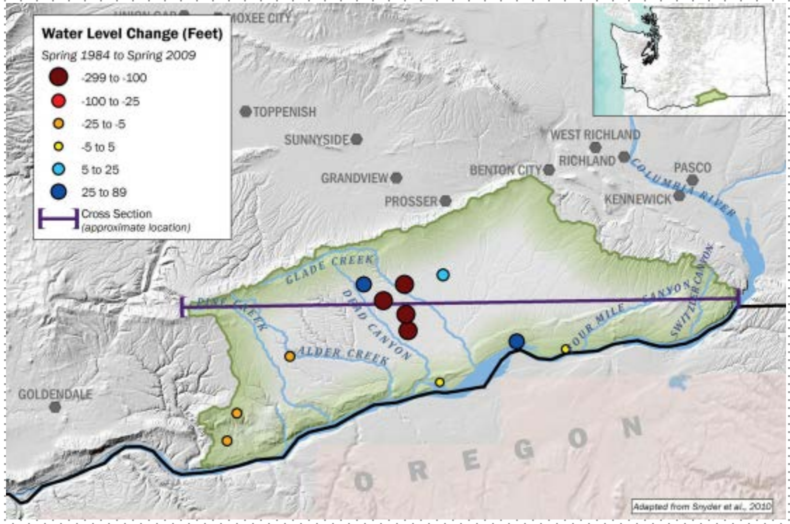
Groundwater Integration
New component for 2016 Forecast

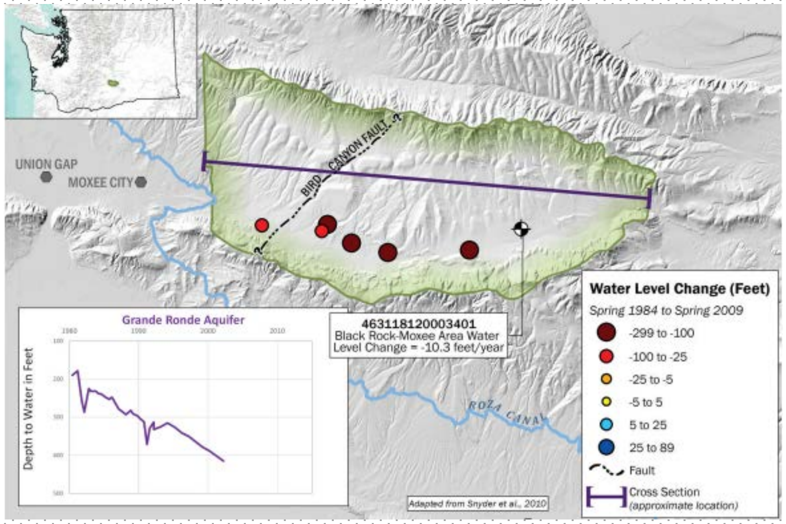
- **Why:**
  - 2011 Forecast did not evaluate effects of declining groundwater on demand
  - Users who rely on declining groundwater supplies may rely on surface water in the future
  - Groundwater can buffer drought
  - Surface and groundwater interactions can lead to water rights conflicts


Photo: Dept. of Ecology

“Hot spot” comparison

Easier to solve ⟷ Harder to solve





Horse Heaven Hills

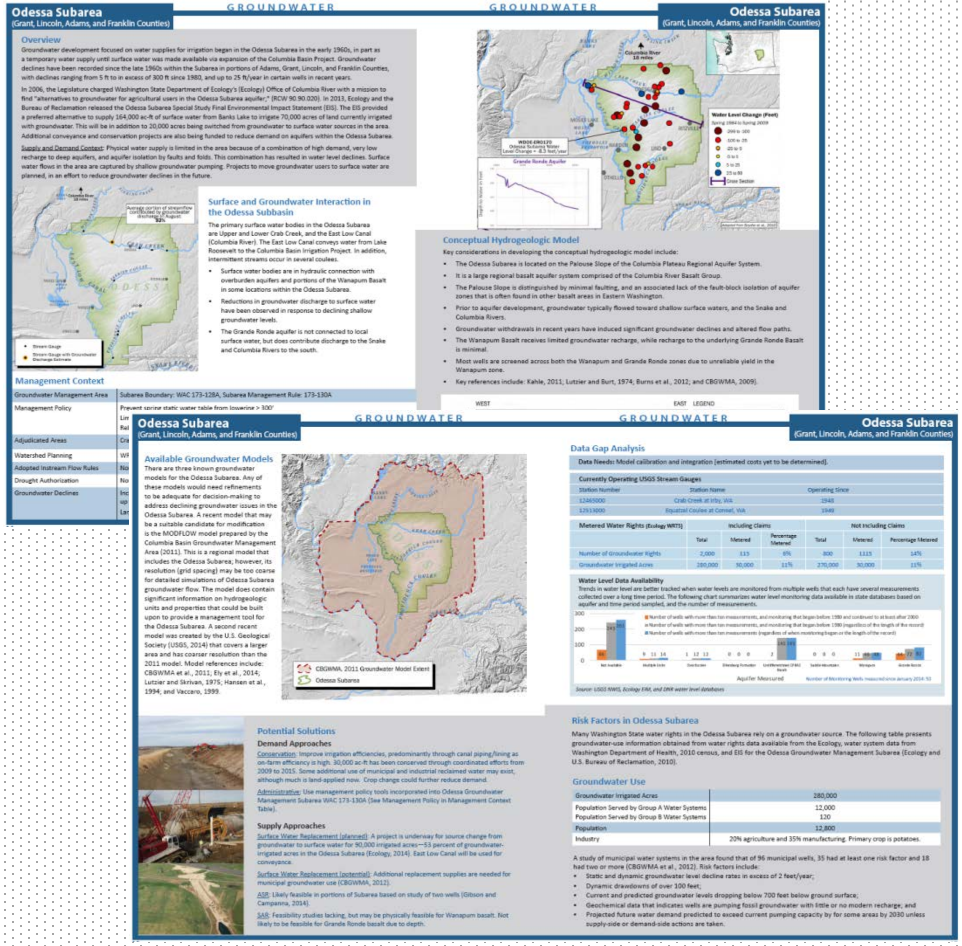
- ~50 years?? before curtailment
- Mostly vineyard
- Solutions available:
  - Direct aquifer recharge
  - Switch to surface water

Black Rock – Moxee

- ~10-20 years?? before curtailment
- Curtailment impact on small residential uses
- Limited viable solutions

Groundwater Integration - Recommendations

- Greater monitoring of extent and declines needed.
- Increased public outreach warranted to promote conservation.
- State and County government coordination needed.
- Effects of declining groundwater can be modeled through more robust curtailment modeling.



Possible approaches for 2021 Forecast

Increasing complexity →

Identify "hot spot" regions and conduct trend analysis at available wells

Expand curtailment model to include transition from surface water to groundwater

Use USGS groundwater flow model to inform groundwater irrigation demand and aquifer response as input to VIC-CropSyst

Fully couple USGS groundwater flow model and VIC-CropSyst

State Caucus Discussion Topics

- Identify key questions for 2021 groundwater analysis.
- Discuss available methodologies to address key questions.
- Discuss current data availability and new data targets to support chosen methodology.

State Caucus Questions/Recommendations

- Should Ecology proactively coordinate to improve the number of monitoring wells in declining groundwater areas through cooperative agreements with local and state government?
- Should WSU pilot multiple methods to address groundwater integration in the future?
- Should there continue to be a more detailed analysis for hot spot areas or simpler analysis for the whole region, or a combination?

Improving municipal demand forecasting

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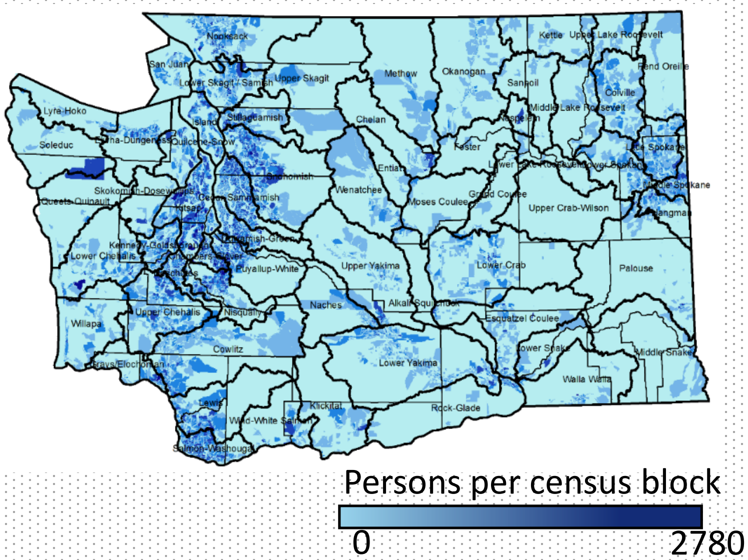
Municipal Demand: Overview of Approach

Consumptive Use = Population x Per Capita Use - Wastewater Returns



Data:

U.S. Census Bureau 2010 Block Estimates;

2010 USGS Estimate Use of Water Report

Historical population:

2015 population (OFM and DOH)

Future population:

Estimated via logistic curve model

Limitations:

- No accounting for seasonal or regional variations in water use
- Assumed no change in consumptive use per capita

Municipal Demand: Proposed Alternate Methodologies

Improving Unit Demand Analysis

- Improved population forecasting & consumptive use estimates
- Address regional differences, but not seasonality or sectoral differences

Aligning Existing Regional Forecasts

- Adopt currently existing methodology (Oregon)
- Account for seasonality & sectoral differences, data-intensive

Statistical Demand Modeling

- Statistical approach to defining relationships between physical and socioeconomic factors driving demand
- Complete overhaul of methodology, very data-intensive

State Caucus Discussion Topics

- Which methodology should be focused on for future forecasts?
- Are the data available to implement the chosen methodology?
- Are there other components that need to be incorporated?

State Caucus Questions/Recommendations

- Can we agree on the level of sophistication needed for improving municipal demand methodology?
- Numerous data sources exist to support improved municipal demand forecasting (e.g., local calibration, etc.); need for improved collaboration with other agencies to acquire and apply these data
- Determine book-end projections (high and low estimates)

Columbia River system operations and instream flows

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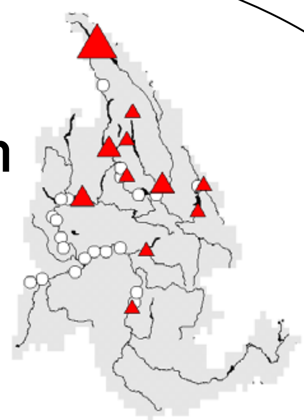
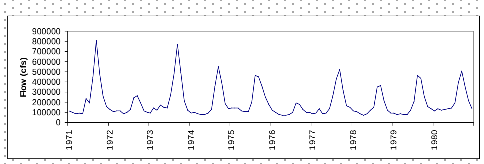
The Reservoir Model (ColSim)

Physical System
of Dams
and Reservoirs



Reservoir Operating Policies

VIC Streamflow Time Series

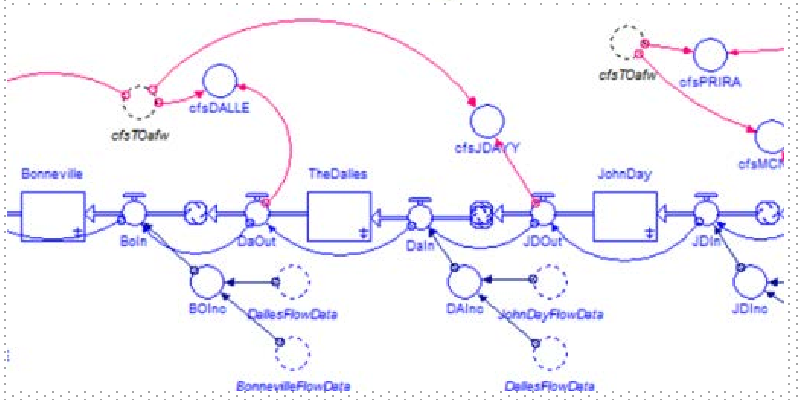


Reservoir Storage
Regulated Streamflow
Flood Control
Energy Production
Irrigation Consumption
Streamflow Augmentation

Slide courtesy of Alan Hamlet

ColSim (Columbia Simulation) Model

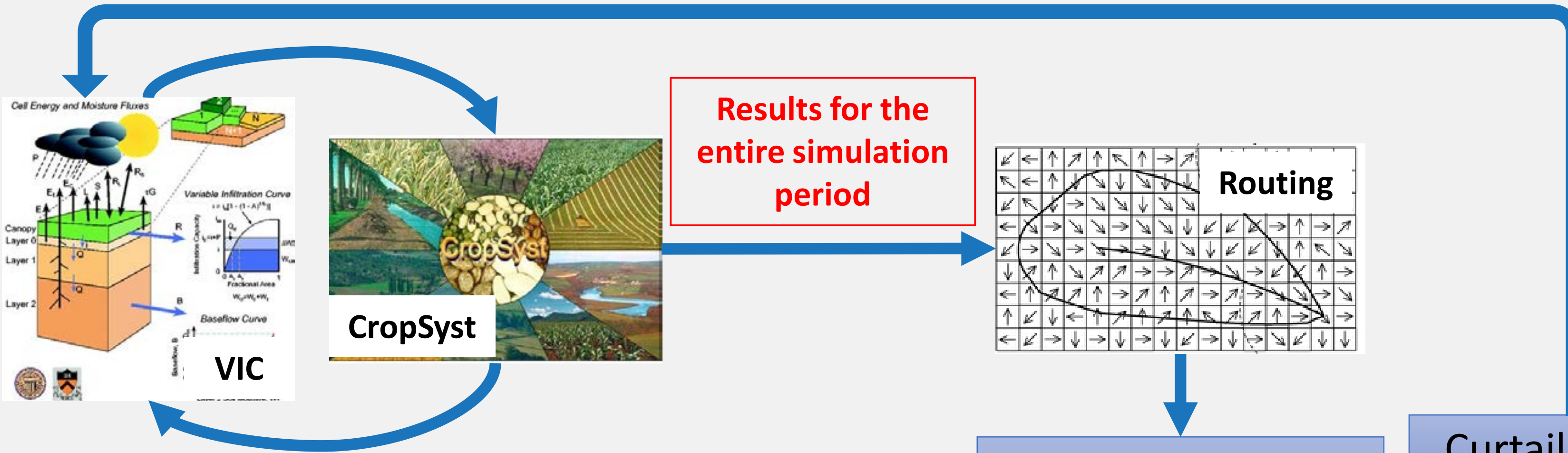
- Dam-specific operational rules:
  - 31 dams across CRB
  - 4 CRT dams
- Based on CRT's goals and details
- Two operational planning periods
  - Fixed period (Aug-Dec): rule-curves are based on historical flows and does not change
  - Variable period (Jan-Jul): based on forecast and CRT's operational goals
- Operational goals
  - Main goals: Hydropower and flood protection
  - Other goals: Irrigation, ecological flow, recreation



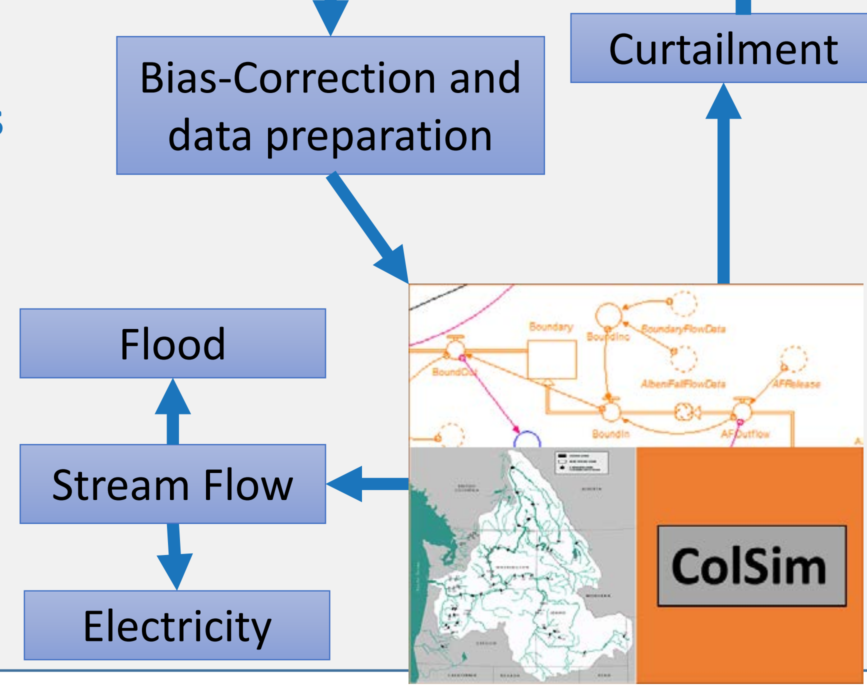
Instream Flows in ColSim

- Fish Protection Targets:
  - A minimum outflow from each dam
  - System flow targets for fish protection at
    - Columbia Falls (using Hungry Horse available storage)
    - Priest Rapids (using Grand Coulee available storage)
    - Lower Granite (limited storage at multiple reservoirs)
    - McNary (limited storage at multiple reservoirs)
- Recreational Targets:
    - Grand Coulee Dam

Integrating with Curtailment Decisions: 2016 Forecast



- **Columbia River Mainstem - interruptibles**
  - ***Forecast of April though September runoff at The Dalles dam***
  - ***Adjustments to targets***
- **Yakima River basin**
  - ***Non-proratable (senior)***
  - ***Proratable***
  - ***Junior***
- **Non Yakima tributaries - interruptibles**



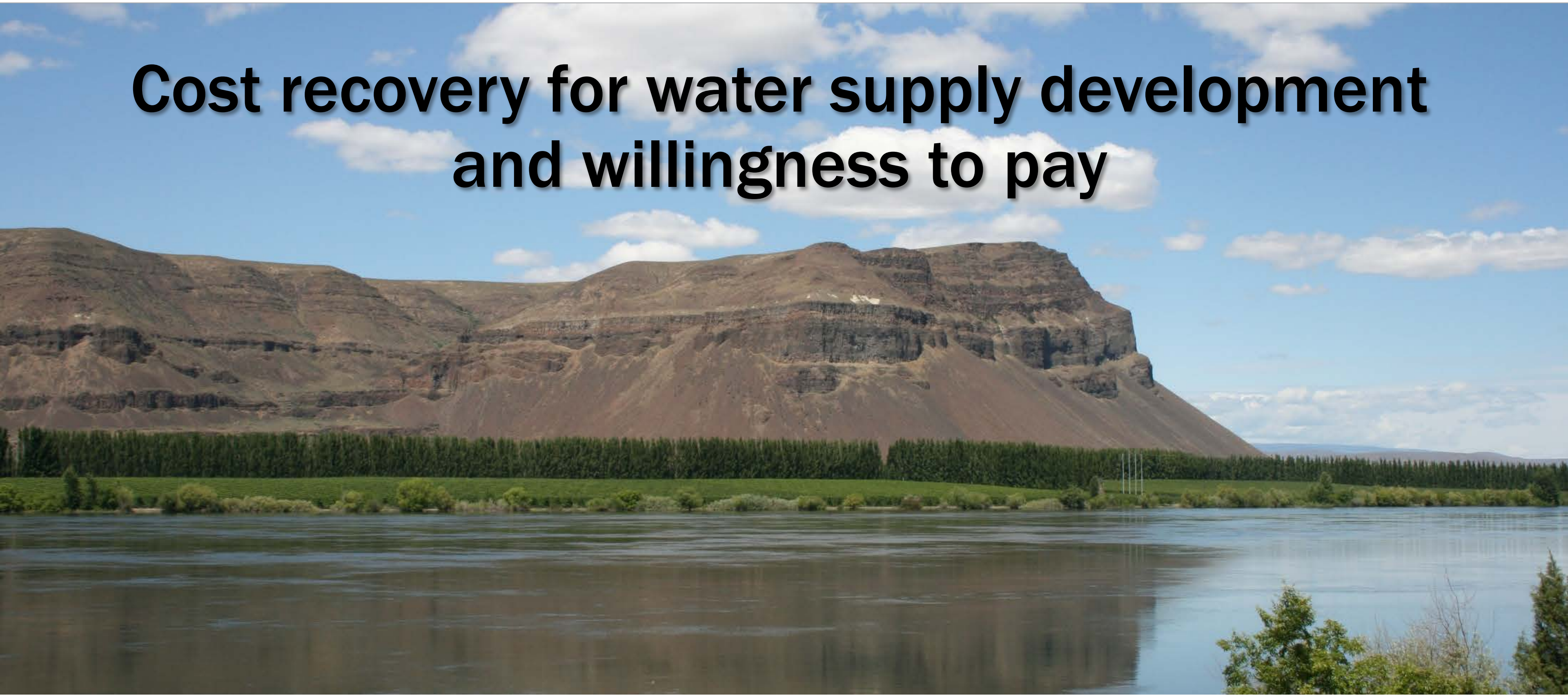
State Caucus Discussion Topics

- Feedback on approach currently taken to capture CRT and integrate instream flows into the modeling framework
- Status on CRT negotiation and possible scenarios we might include in the 2021 Forecast
- If new water becomes available as part of a CRT renegotiation, how can we shape these flows to better meet fish needs?

State Caucus Questions/Recommendations

- Should water temperature (e.g., in response to climate change and water management) be included in the Forecast modeling activities?
- Should a different metric be used to estimate instream flow demand other than current instream flow rules?
- Improved/tighter collaborations between DFW and WSU to capture ecological/fish needs and modeling capacity.

Cost recovery for water supply development and willingness to pay



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How Payment Affects Demand

Why?

- Legislature has moved towards an applicant-pays system
- Some applicants are choosing to defer or postpone rather than receive new water rights when offered

How?

- We surveyed 500 applicants from various programs (Lake Roosevelt, Wenatchee, Yakima, Cabin Owners, etc.) to understand how time and financial terms of a program are affecting processing and demand for new service.

Paying for Water – Survey Data

LOCATION	Sample size	Number completed	Response Rate
Sullivan Lake	8	0	0%
Lake Roosevelt	214	58	27%
Wenatchee Basin	37	2	5%
Yakima Basin	383	85	22%
Port of Walla Walla	6	1	17%
Yakima Cabin Owners	37	22	59%
Overall	**859**	**168**	**19.5%**

How Payment Affects Demand – Recommendations

- Paying for water makes some projects unfeasible.
- The long time period between applying for a water right and receiving a permit creates project uncertainty.
- Some participants could not participate because of unique program requirements.
- A regulatory imperative (e.g. groundwater closure, court order) is a driver to participate in cost-recovery programs even if costs are perceived to be high.

State Caucus Discussion Topics

- What pressing questions were not addressed in the previous analysis?
- What are the most pressing questions related to water supply development cost recovery?
- What are the promising opportunities for cost recovery programs to support water supply programs?
- What types of analyses would be most useful to address cost-recovery needs?
- Which of the recommendations from the 2016 Study is Ecology prioritizing for action now?

State Caucus Questions/Recommendations

- Potential rule changes to expedite resolving existing (especially old) applications. What process can be used to eliminate old applications?
- To understand willingness to pay: collect ongoing data for individuals who decline or participate any water programs. How can these data best be collected?