

Columbia River Mainstem Off-Channel Storage Appraisal Evaluation

PNWS – AWWA 2008 Pre-Conference Workshop

Water Supply Opportunities and Challenges
in the Pacific Northwest

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Columbia River Mainstem Off-Channel Storage Study

1. Why was the Study Conducted?

2. How was the Study Done?

3. What has the Study Told Us?

4. What are the Next Steps?

The Columbia River Water Management Act

- The CRWMA directed the Washington State Department of Ecology to *“aggressively pursue the development of water supplies to benefit both instream and out-of-stream uses.”*
- Two-thirds of active storage is required to be available for appropriation for out-of-stream uses and one-third to augment instream flows.

Columbia Basin Water Needs

- Water requirements for:
 - *Agriculture*
 - *Flow augmentation for fishery resources*
 - *Domestic, commercial, municipal, and industrial (DCM&I) use*
 - *Flexibility to respond to potential impacts of climate change and resulting water needs*
- Address regional and interstate water supply and resource challenges

Columbia River Mainstem Off-Channel Storage Study

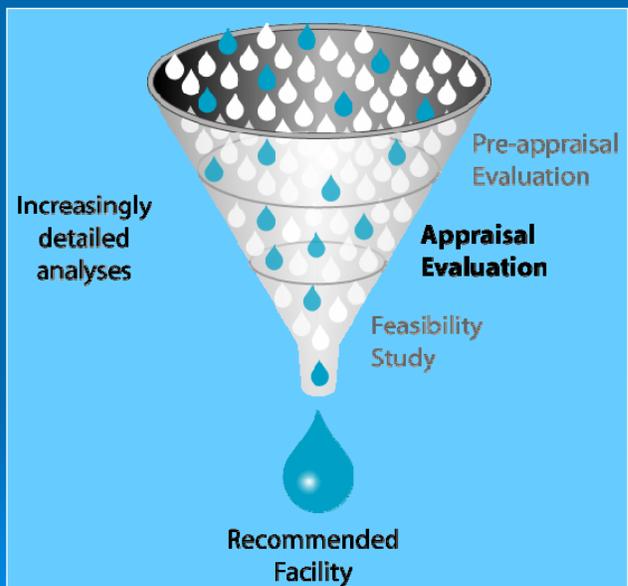
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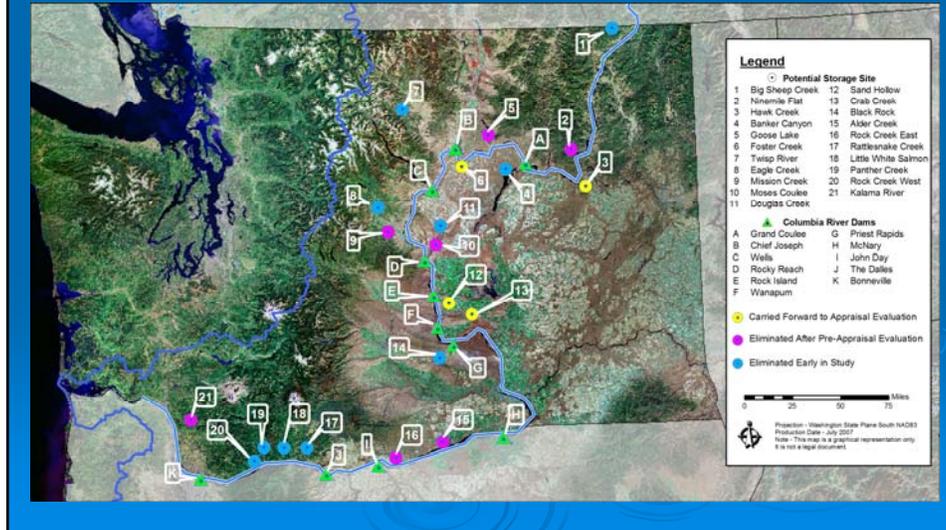
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Study History and Process



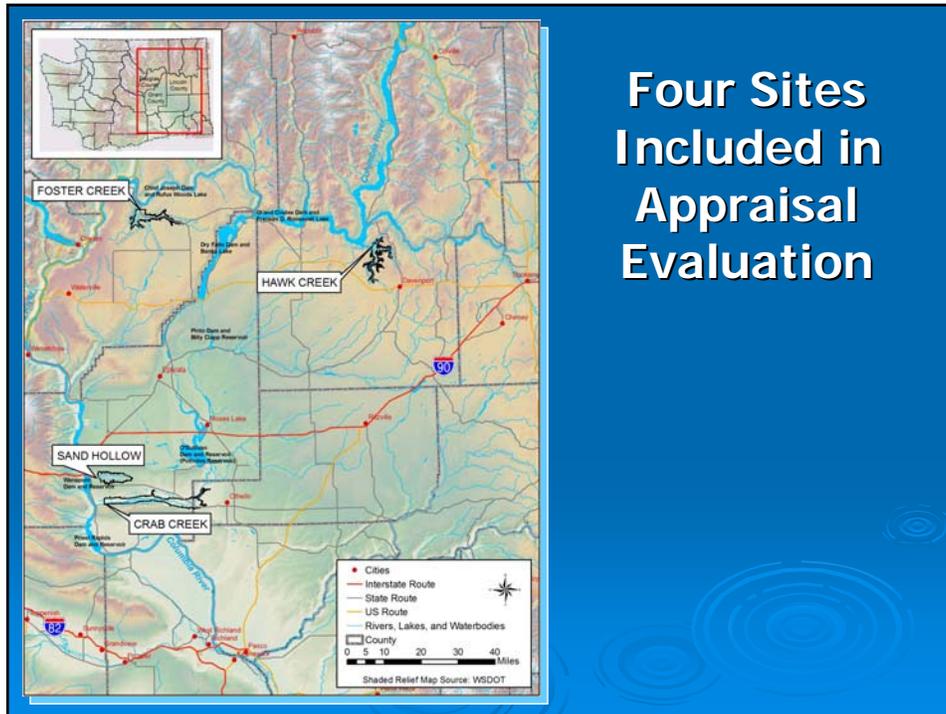
21 Options Considered



Preliminary Site Screening Criteria

- Some sites located too far downstream in the Columbia River to be integrated into the operation of Reclamation's Columbia Basin Project
- Some sites did not meet the minimum of 1 million-acre feet of active storage
- Some sites represented a high risk of failure or excessive leakage
- Early analysis identified fatal flaws for some sites

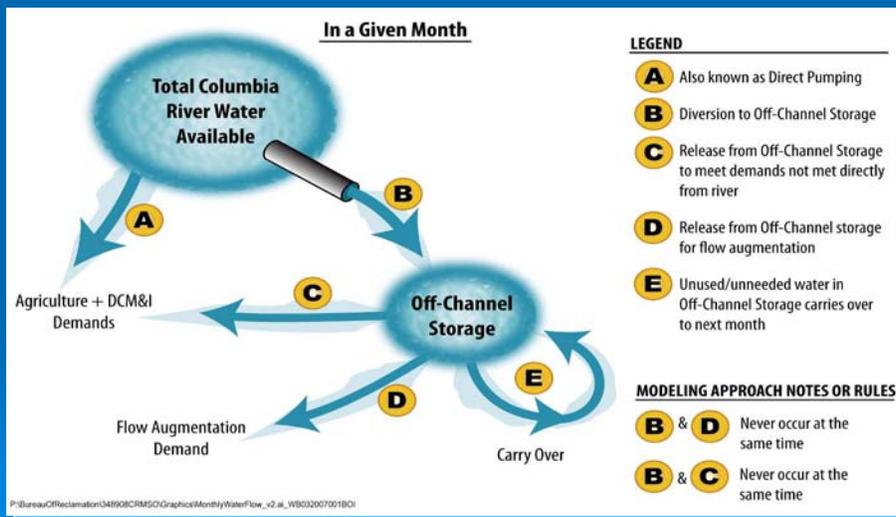
Four Sites Included in Appraisal Evaluation



Appraisal Evaluation Process

- Water availability analysis
- Field reconnaissance
- Preliminary siting and sizing proposals
- Cost estimate
- Impact/benefit assessment
 - *socioeconomic, cultural, environmental*
- Decision support model

Water Availability



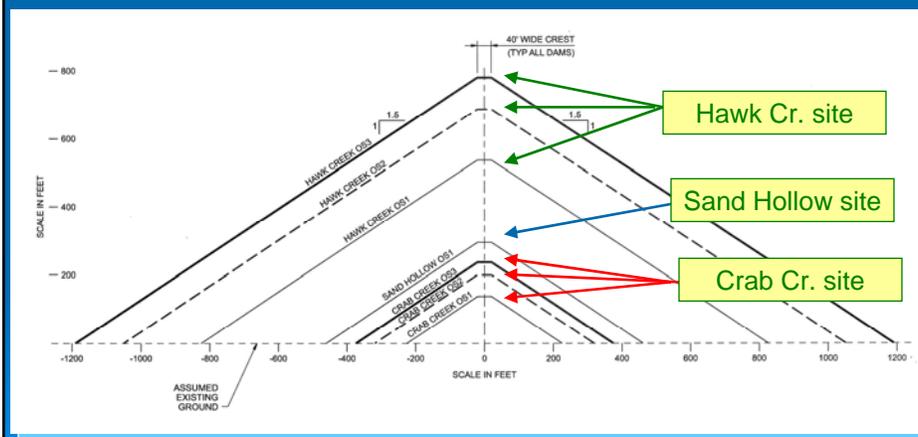
Alternative Sites



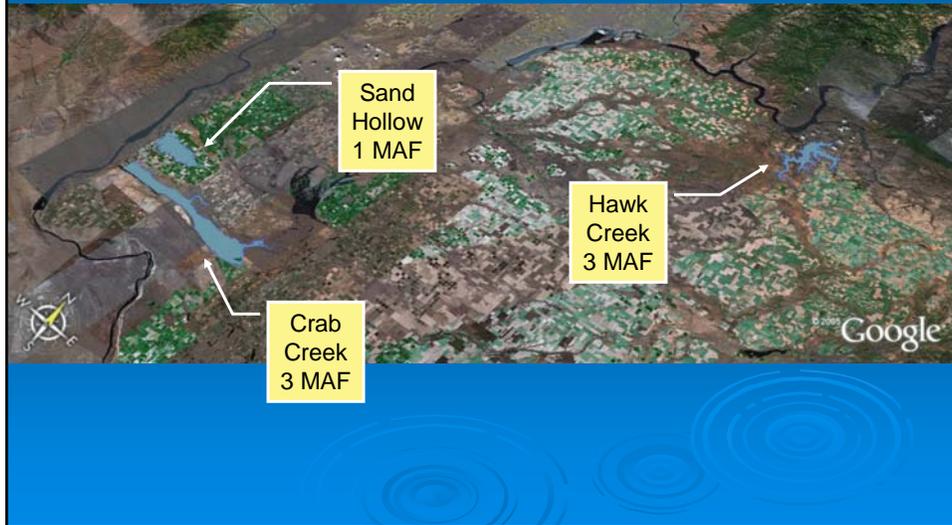
Scale of Facilities

- Storage ranging from 1 Million Acre Feet (MAF) to 3 MAF
- Dam heights range from ~130 feet to 780 feet
- Reservoir surface areas range from ~5,000 acres to 30,000 acres
- Total peak pumping power ranges from 56k hP to 1.4M hP
- Pipelines, canals, and tunnels carrying from 2,500 to 18,500 cfs

Comparative Sizes of Dams



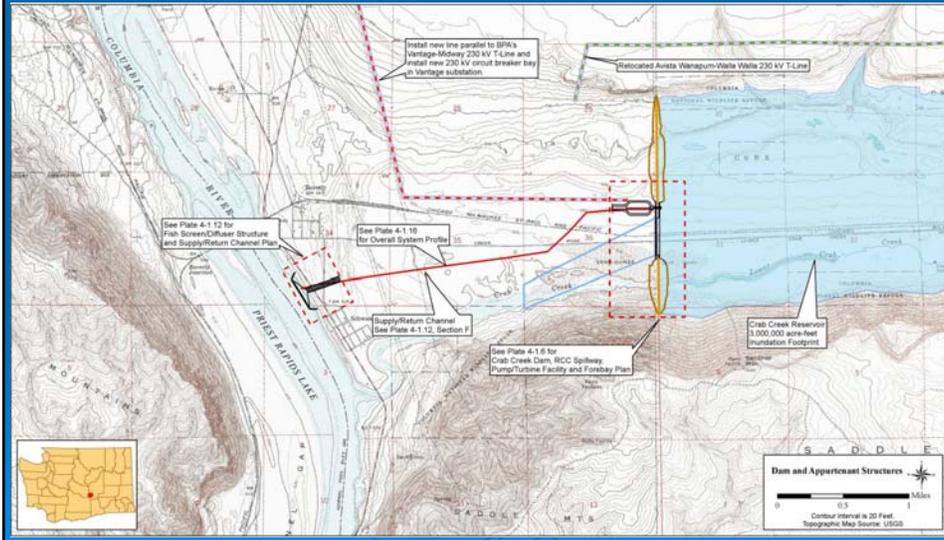
Comparative Reservoir Footprints



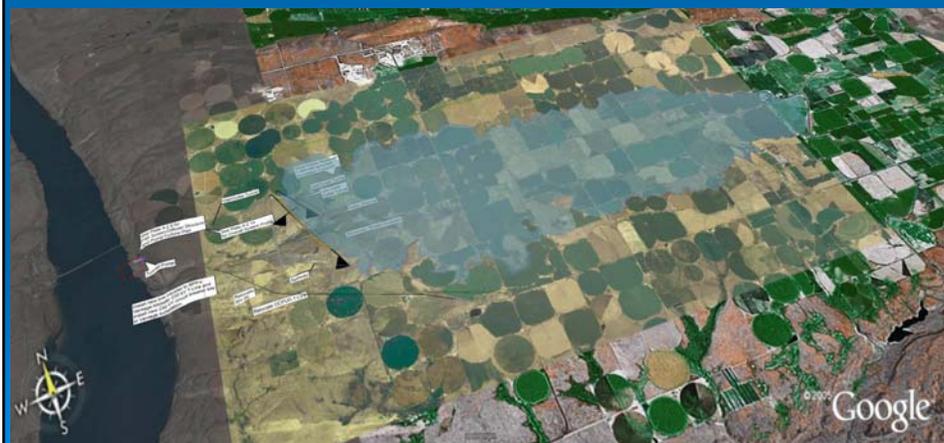
Crab Creek Site at 3 Million Acre Feet



Crab Creek Site Dam and Structures



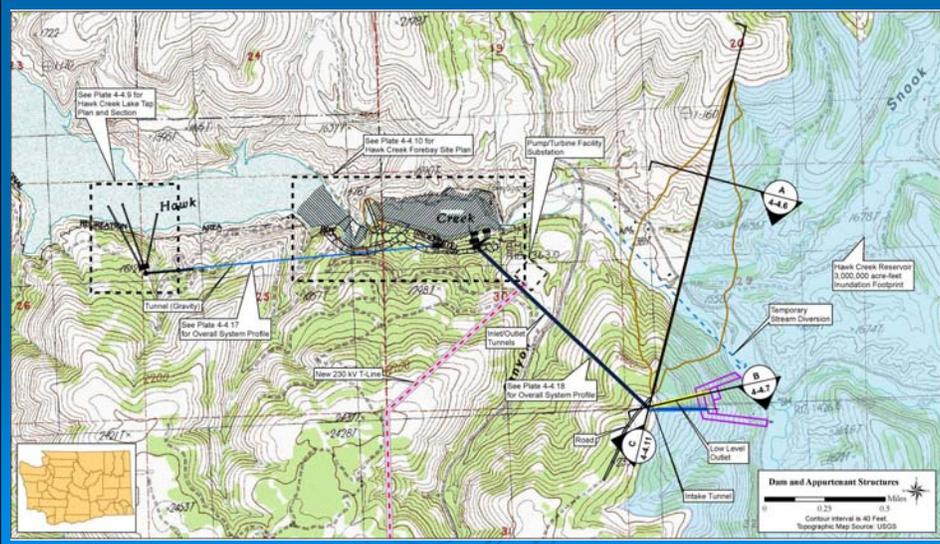
Sand Hollow Site at 1 Million Acre Feet



Hawk Creek Site at 3 Million Acre Feet



Hawk Creek Site Dam and Structures

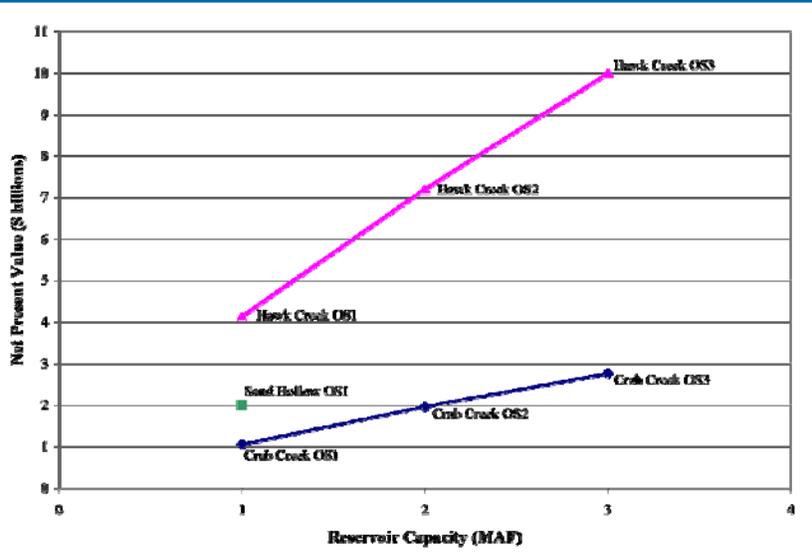


Projected Costs

Summary of Costs for All Sites and Operational Scenarios

Facility or Cost Component	Crab Creek			Sand Hollow	Hawk Creek		
	OS1	OS2	OS3	OS1	OS1	OS2	OS3
Annual Power Consumption Costs	\$3.1 M	\$9.3 M	\$16.4 M	\$16.8 M	\$16.7 M	\$42.5 M	\$67.5 M
Annual Power Generation Revenues	\$1.5 M	\$5.2 M	\$9.0 M	\$8.3 M	\$6.3 M	\$15.4 M	\$25.2 M
Annual Operation & Maintenance Labor and Expense	\$3.6 M	\$6.3 M	\$8.8 M	\$7.0 M	\$12.1 M	\$21.2 M	\$29.6 M
Total Annual Power and O&M Costs	\$5.2 M	\$10.5 M	\$16.2 M	\$15.5 M	\$22.6 M	\$48.3 M	\$71.9 M
Total Capital Costs	\$900 M	\$1.7 B	\$2.4 B	\$1.6 B	\$3.6 B	\$6.0 B	\$8.2 B
Net Present Value (over 100 years)	\$(1.0 B)	\$(2.0 B)	\$(2.8 B)	\$(2.0 B)	\$(4.1 B)	\$(7.2 B)	\$(10 B)

Relative Cost Comparison



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Alternatives Comparison

- **Alternatives compared from three perspectives:**
 - *Implementation/Technical Feasibility:*
 - *cost, safety, yield stability*
 - *Benefits/Objectives Achievement:*
 - *meeting demand/goals, power, flexibility*
 - *Impacts:*
 - *preliminary evaluation of potential socioeconomic, cultural, and biophysical impacts*

Decision Support Model

- **Key evaluation criteria:**
 - *Implementation/Technical Feasibility*
 - *Objectives/Benefits Achievement*
 - *Impacts*
- **All criteria equal: no judgments that one is more important than another**

Evaluation Example:

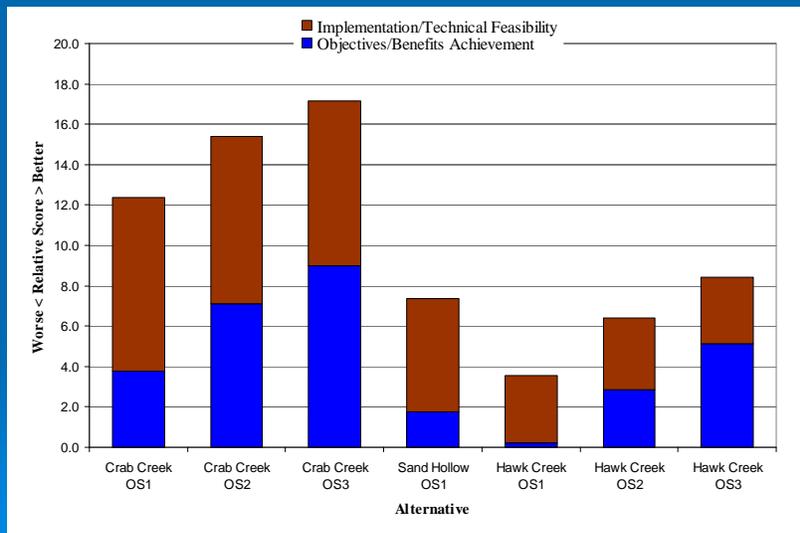
- **Implementation/Technical Feasibility**
- **Benefits/ Objectives Achievement**

Perspective				Perspective Scores				
				Category Scores		Factor Scores		
	Categories	Factors	Criteria	Criteria Scores				
A. Implementation/ Technical Feasibility								
Cost & Time to Build			Net Present Value	10.0	10.0	9.9	8.7	
			Net Present Value/50 yrs yield	9.6	9.6			
			Construction duration	10.0	10.0			
	Risk Factors	Safety & integrity	Relative risk/hazard		9.0	9.0		7.5
			Reservoir storage yield/volume	Volume reduction potential due to erosion/sedimentation		6.0		
		Totals			44.6	44.6		17.4
B. Objectives/ Benefits Achievement								
Primary Benefits	Irrigation Supply	Meeting projected demand (yield)		0.1	0.1	0.1	3.8	
	DCM&I Supply	Meeting projected demand (yield)		0.1	0.1			
	Flow augmentation	Meeting projected demand (yield)		0.1	0.1			
Secondary Benefits	Power generation	Power balance		6.8	6.8	7.4		
	Expandibility	Potential for expansion to increase storage volume in the future		8.0	8.0			
Totals			15.1	15.1	7.5	3.8		

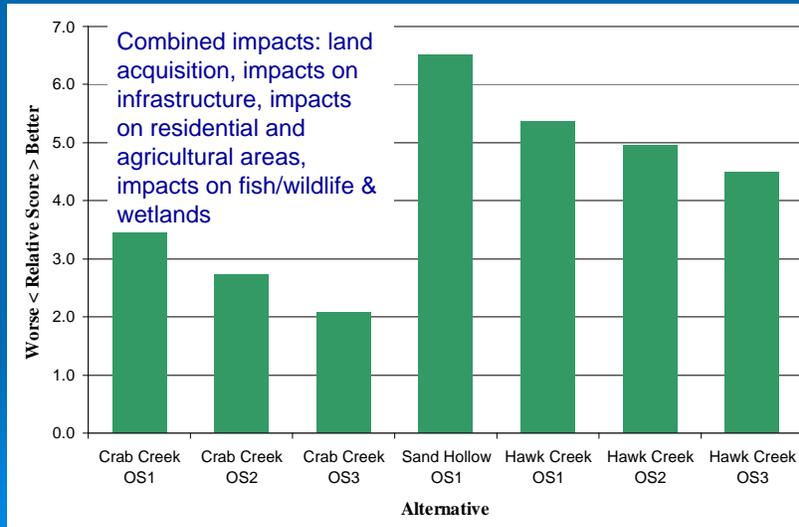
Evaluation Example: Impacts

Perspective	Categories	Factors	Criteria	Perspective Scores					
				Category Scores		Factor Scores			
				Criteria Scores		Factor Scores			
C. Impacts	Socio-economic	Land Ownership	Private land acquisition requirement	10.0	7.1	6.3	4.6		
			Federal & State land acquisition requirement	4.2					
		Land Use	Residential use	6.1	6.0				
			Irrigated Agriculture	6.0					
		Infrastructure	Highway (State, federal) impacts	6.0	5.9				
			Local road impacts	7.5					
	Railroad impacts		10.0						
	Cultural	Heritage Resources	Recorded Archaeological Prehistoric and Historic sites	0.0	3.3	3.3			
			Archaeological/National Register-eligible resources	10.0					
		Traditional Cultural Properties	Resource impacts	0.0					
	BioPhysical	Special Status Species ³	Anadromous Fish--Habitat Inundated	2.2	2.7	4.2			
			Anadromous Fish--Downstream Habitat Affected	0.0					
			Federal aquatic T & E species--Habitat Inundated	2.2					
			Federal aquatic T & E species--Downstream Habitat	0.0					
			State aquatic Sensitive species--Habitat Inundated	2.2					
			State aquatic Sensitive species--Downstream Habitat	0.0					
			State aquatic Priority Species	2.2					
			Federal terrestrial T & E species impacts	10.0					
			State terrestrial T & E and Sensitive species impacts	0.9					
			State terrestrial Priority Species	7.5					
			Special Status habitat or conservation/preservation designation	Wetland habitat impacts				1.9	5.6
				Riparian habitat impacts				8.8	
		Sand Dunes habitat impacts		0.0					
		Cliffs/Buffs habitat impacts		7.1					
		Steppe-Shrub habitat impacts		0.4					
		Candidate Wild & Scenic rivers		10.0					
		Wilderness Study Areas	10.0	1.7					
National wildlife refuges impacts		5.9							
State wildlife refuges impacts	10.0								
Totals				142.9	30.7	13.8	4.6		

Comparison Results: Combined Feasibility & Objectives Achievement



Comparison Results: Impacts



Overall rankings; no consideration of reservoir size

Comparison Results: Basic Conclusion/Observation

- Crab Creek site is clearly superior from technical and water supply benefits perspectives
- However, the Crab Creek site also has the highest potential for impacts in some important categories/ factors

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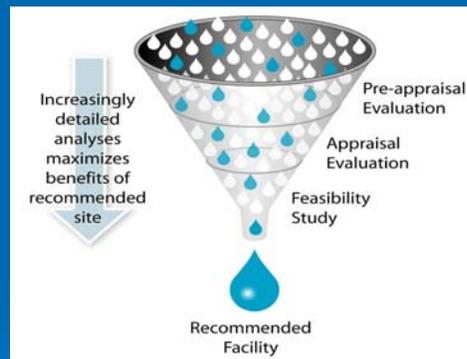
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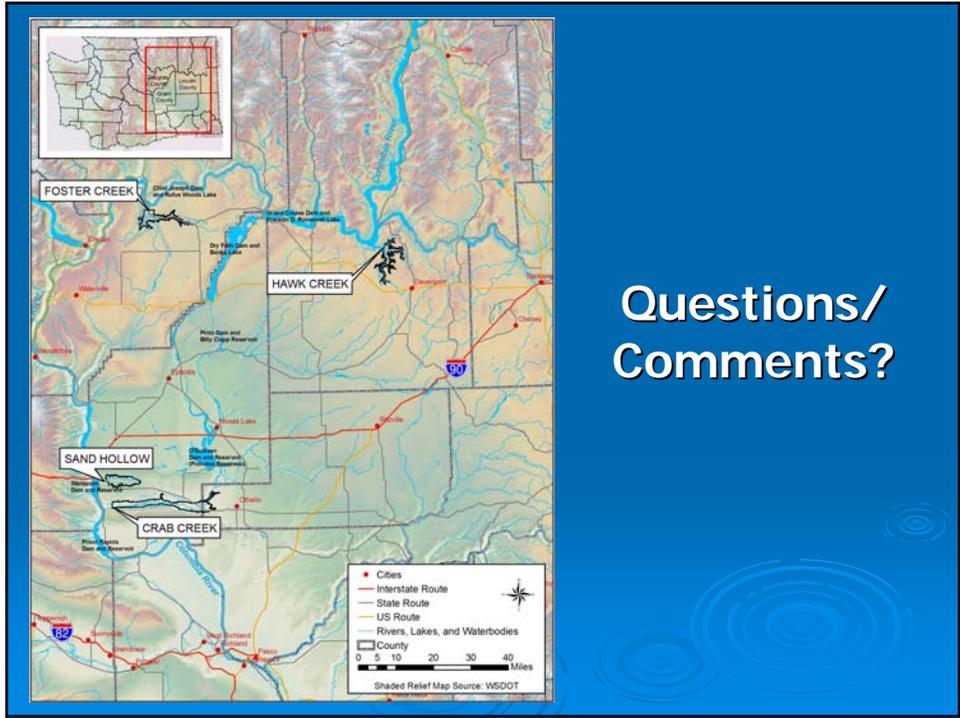
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Next Steps

- Review of the report and consultation with stakeholders on-going
- Decide whether to request Congressional authorization for a feasibility study
- If a feasibility study is conducted, then:
 - *Refine water demand*
 - *Technical investigations*
 - *Expand decision support model*
 - *Planning Report & NEPA/SEPA*





Questions/
Comments?