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Aquifer Storage and Recovery Implementation in Washington – City of Walla Walla Experience

ASR

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Presentation Outline

- Introduction
- ASR Regulations in Washington
- History of ASR in Walla Walla
- ASR Implementation in Walla Walla

Mill Creek Diversion

Well No. 6 (ASR)

Introduction

Why Did Walla Walla Start ASR?

- Historic declining groundwater levels in Columbia River Basalt aquifer – used by City wells
- Concerns about long-term water availability for growth
- State designated Critical Water Source Supply Area (CWSSA)
- Vulnerability of surface water source
  - Fire in watershed
  - Drought – climate change

ASR Regulations in Washington State

Primary Regulation:

- WAC 173-157: *Underground Artificial Storage and Recovery*

Other Applicable Regulations:

- WAC 173-200: *Water Quality Standards for Ground Waters of the State of Washington*
- WAC 173-162: *Minimum Standards for Construction and Maintenance of Wells*
- WAC 173-218: *Underground Injection Control Program*
- WAC 246-290: *Group A Public Water Supplies*

ASR Permits and Authorizations Required

- Ecology
  - Water Rights for recharge source water
  - Reservoir Permit to store water
  - Secondary Permit
    - Required if beneficial use(s) of stored water is for different beneficial use(s) than beneficial use(s) authorized for recharge source water
  - Underground Injection Control Program Registration for ASR Wells
    - Class V Injection Wells
  - NPDES Permit
    - Discharges to surface water such as flushing or pump-to-waste
  - Start Card and Well Logs
    - ASR Well modifications below ground (seals, new casings, etc.)
    - New ASR Wells
    - New monitoring wells

ASR Permits and Authorizations Required

- Local Jurisdiction
  - SEPA Checklist
    - Construction of ASR facilities
- Department of Health
    - Wellhead piping modifications
    - Recovered water quality

Walla Walla Well 6

WAC 173-157: *Underground Artificial Storage and Recovery*

Components of ASR Reservoir Permit Application Package

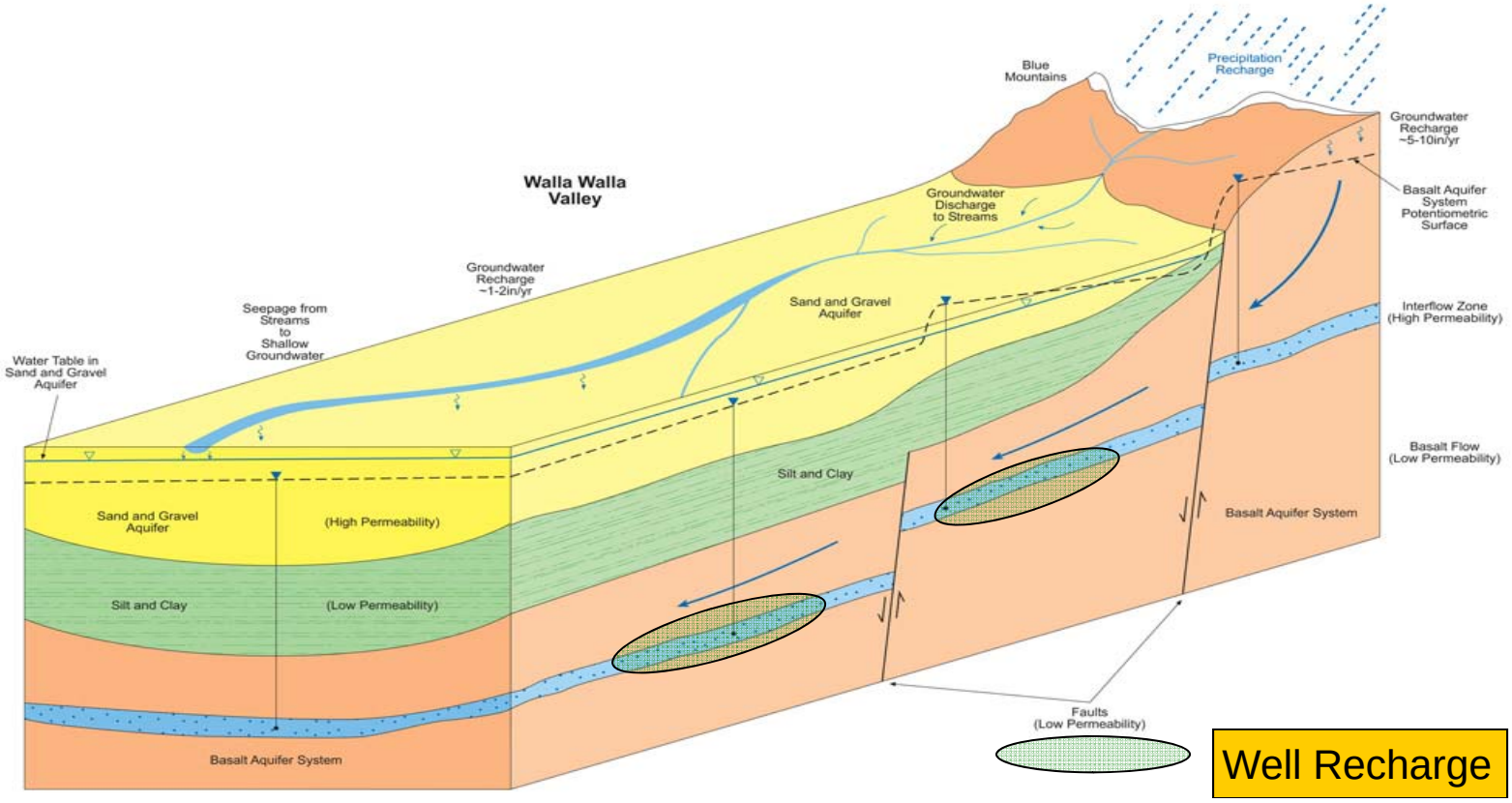
- Hydrogeologic System Description
- Legal Framework
- Operations Plan
- Environmental Assessment
- Mitigation Plan
- Monitoring Plan

Effective February 23, 2003

WAC 173-157: *Hydrogeologic System*

Describes Hydrogeologic Components of Site and Surrounding Area

- Aquifer Description and Hydraulic Properties
- Surface Water, Springs, and other Wells in Project Area
- Groundwater and Recharge Water Quality and Compatibility
- Estimated Storage Volume and Area Affected by ASR



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WAC 173-157: *Legal Framework*

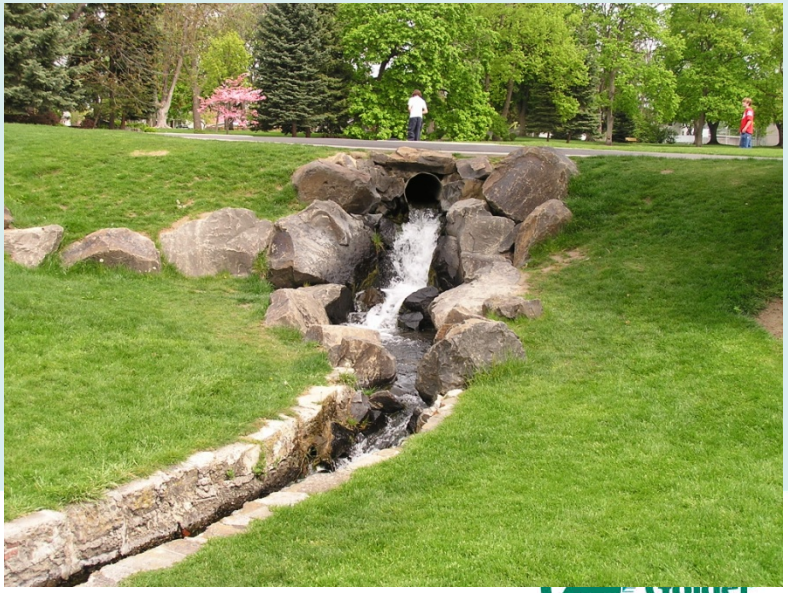
Describes Project Water Rights and Permits

- Recharge source water rights
- Other water rights in project area
- Instream flows
- Ownership and control of ASR project facilities

WAC 173-157: *Environmental Assessment*

Describes Environmental Components of Application Package

- Land Uses
- Surface Water, Springs, Wetlands, and other Wells in Project Area
- Proximity to Hazardous Sites
- Potential impacts to surface water, wetlands, and springs, slopes, and ground deformation.



WAC 173-157: *Operations Plan*

Describes Operation of ASR System

- Recharge water rates, quantities, and availability
- Recharge, storage, and recovery durations
- ASR facility details
- Water treatment details

WAC 173-157: *Project Mitigation Plan*

Describes Mitigation for Adverse Impacts

- Necessary only if Adverse Impacts Identified
- Mitigation Measures
- Means to Measure Effectiveness of Mitigation

WAC 173-157: *Project Monitoring Plan*

Describes Monitoring Plan to Verify and Update Conceptual Model

- Measurement locations, frequency, methods
  - Water Quality – Recharge Water, Recovered Water
  - Recharge and Recovered Water Rates and Quantities
  - Groundwater Levels
- Provide Data for Evaluation of Percentage of Recoverable Water with Time

Washington State ASR - Supporting Regulations

WAC 173-200:
Water quality standards for ground waters of the state of Washington

WAC 173-162:
Minimum standards for construction and maintenance of wells

WAC 246-290:
Group A Public Water Supplies

WAC 173-218:
Underground Injection Control Program

Walla Walla ASR Timeline

USGS – Well No. 3 Testing – No Further Action	Construction of Mill Creek WTP – Renewed Interest in ASR	Well No. 1 Pilot Testing	Well No. 1 in Service	Well No. 6 Pilot Testing	Well No. 6 in Service	Groundwater Flow Model	ASR Permit	Processing Timeframe Uncertain	Future Build-out
1957	1990's	1999		2002 - 2003		2004 - 2007	2006 - 2009		2010 - ??

Well No. 3

Well No. 1

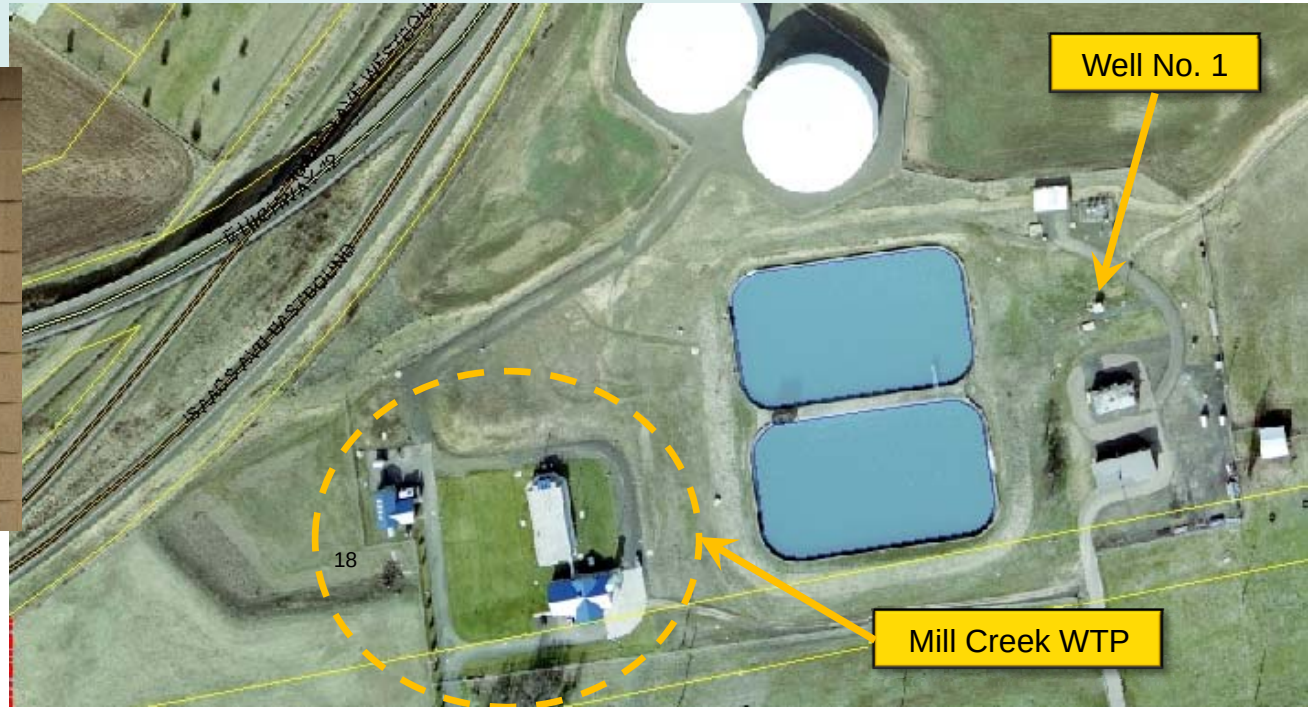
Well No. 6

Walla Walla ASR Timeline: 1950's

- USGS Well No. 3 Testing – 1957
  - Several short recharge tests
  - ASR was feasible, but some clogging issues
  - No further action until late 1990's

Walla Walla ASR Timeline: 1990's

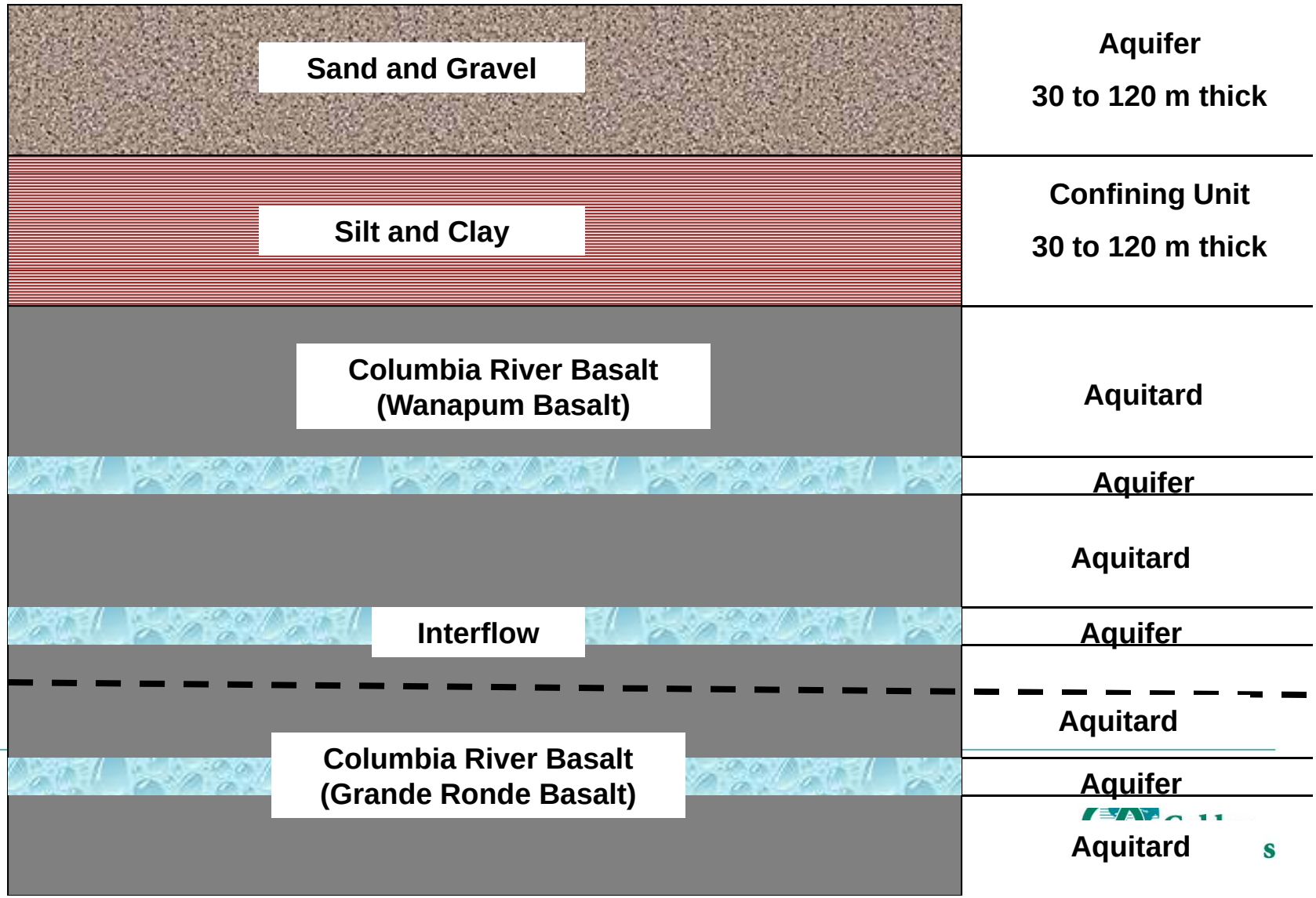
- Mill Creek WTP Constructed in late 1990's
  - Availability of High-Quality Recharge Water - Ozone
- Well No. 1 ASR Pilot Testing - 1999
  - Several test cycles demonstrated success
  - Well No. 1 placed into service as ASR well
  - 1,300 gpm recharge capacity



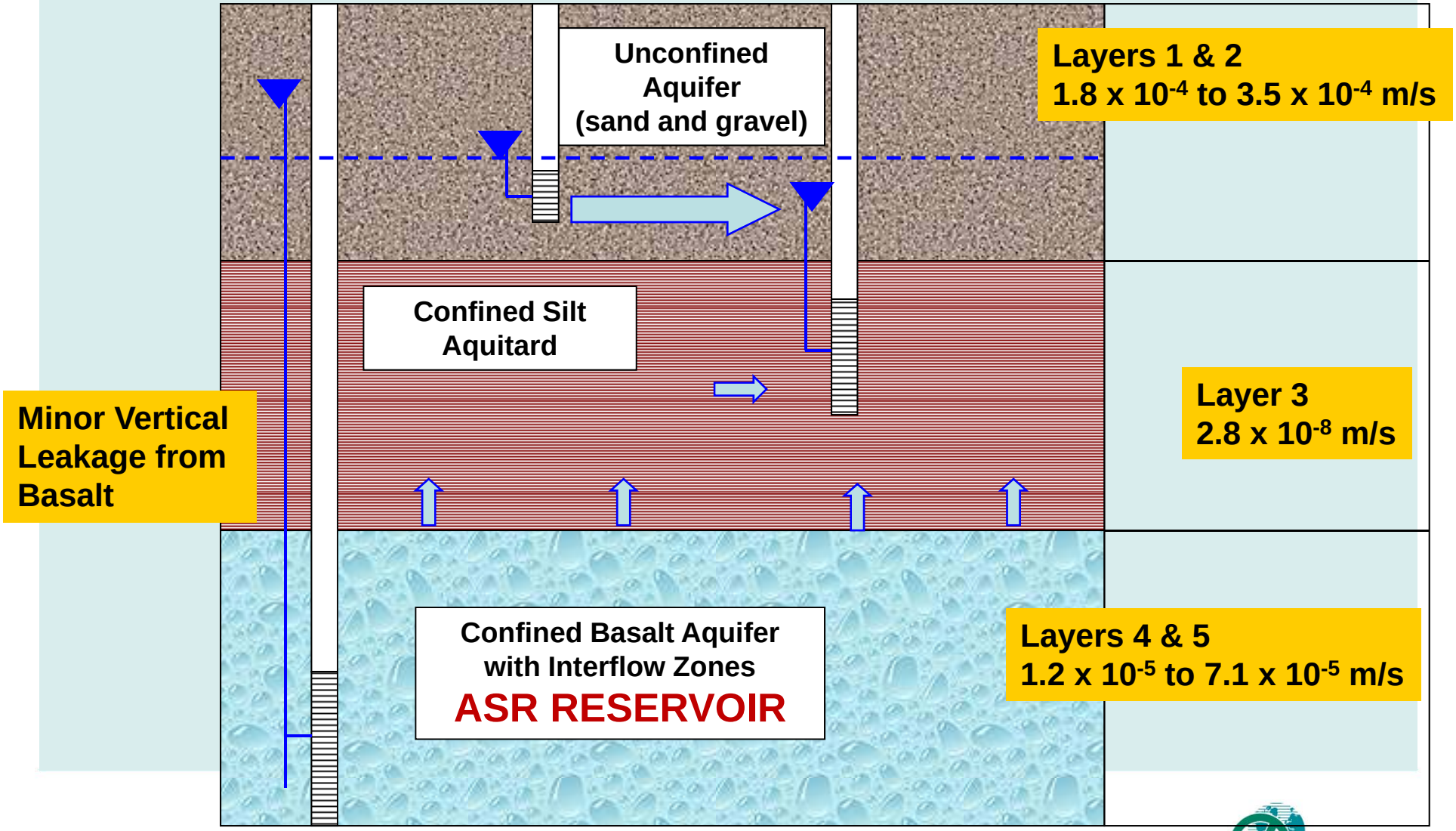
Walla Walla ASR Timeline: 2002 to 2003

- Well No. 6 Pilot Testing
  - Pilot testing successful
  - Placed intro service as ASR well
  - 1,600 gpm recharge capacity

Simplified Hydrogeology



Simplified Groundwater Model Representation



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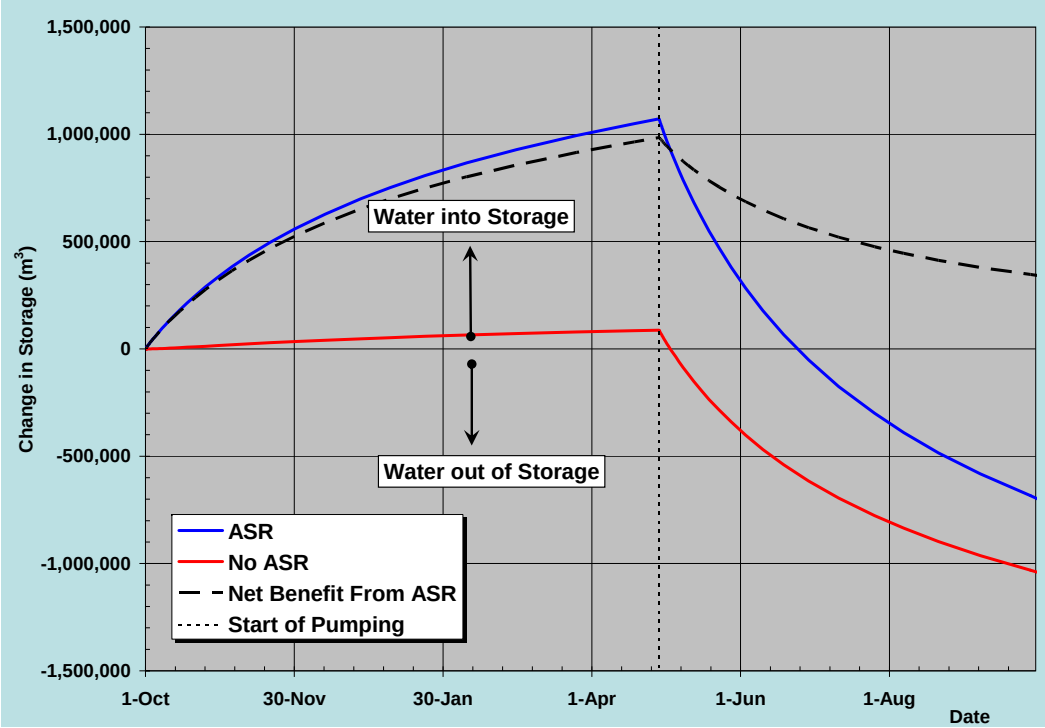
Walla Walla ASR Timeline: 2004 - 2007

- Groundwater Flow Model
  - Hydraulics of Basalt Aquifer System
  - Support ASR Permitting
    - Evaluate storage capacity of basalt aquifer
    - Evaluate ASR water balance
    - Evaluate ASR recovery quantity efficiency
    - Evaluate ASR effects on surface water



Change in Storage

Blocks I and II (ASR Blocks)

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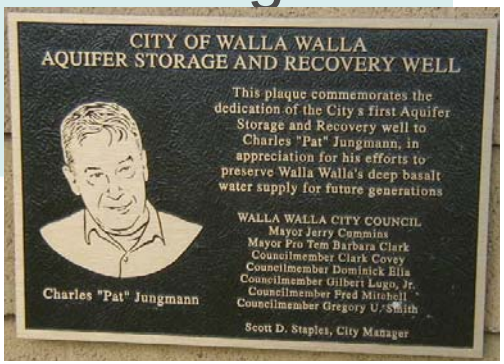
Walla Walla ASR Timeline: 2006 to Present

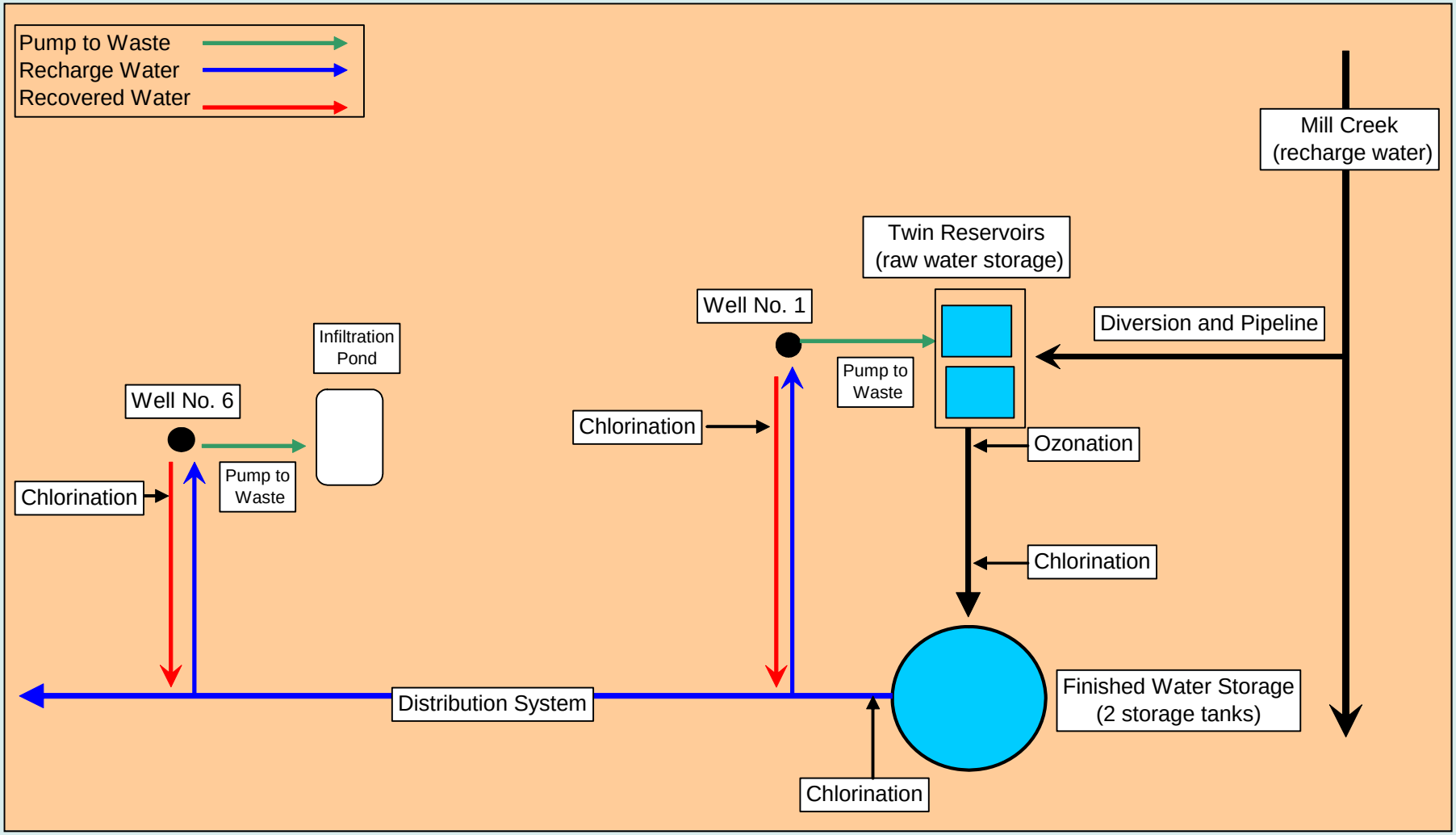
- ASR Reservoir Permit Application submitted in 2006
  - 6,200 AF (2,020 MGal)
  - First ASR reservoir permit application in Ecology Eastern Regional Office and one of first in State
- Revised application submitted in 2009 following additional modeling
  - 11,750 AF (3,830 MGal)
- Application currently being processed by Eastern Regional Office
- Processing timeframe uncertain because of staffing issues and technical factors



Walla Walla ASR System

- Water Source: Diversion on Mill Creek in Oregon
  - Oregon and Washington Water Right Permits
- Mill Creek Water Treatment Plant
  - 24 MGD capacity
  - Ozonation
  - Chlorination
  - May be upgraded to meet LT2SWTR
- Two ASR Wells
  - Well No. 1
  - Well No. 6
  - Combined recharge capacity 2,900 gpm
  - Combined pumping capacity of 5,500 gpm
  - Over 6 Billion gallons stored since 1999

Walla Walla ASR System



ASR Permitting/Implementation Issues

Disinfection Byproducts in Recharge Water (anti-degradation)

Recoverable Water under ASR Permit (Water Balance Neutral)

Water Rights

Recharge Water Quality – Anti-degradation

Issue: *Anti-Degradation Criteria for Recharge Water are Lower than Drinking Water Criteria*

- Drinking water is defined as the beneficial use generally requiring the highest quality of ground water – ***but anti-degradation criteria are more stringent for several constituents – including DBP's***

Constituent	Drinking Water Criteria (WAC 246-290)	Anti-Degradation Criteria (WAC 173-200
Total Trihalomethane	80 μg/L	No criteria
Chloroform	No Criteria	7 μg/L
Bromoform	No Criteria	5 μg/L
Bromdichloromethane	No Criteria	0.3 μg/L
Dibromochloromethane	No Criteria	0.5 μg/L

Recharge Water Quality – Anti-Degradation

Issue: *Anti-Degradation Criteria for Recharge Water are Lower than Drinking Water Criteria*

- Recharge water is high-quality drinking water
- Evaluation of treatment – AKART
  - Pre-treatment to meet anti-degradation criteria prior to recharge would add significant costs
  - Approach – technical, cost and risk based evaluation and operational monitoring
  - Uncertainty over waivers and treatment might affect ASR feasibility
  - WAC 173-200 Allows 5-Year Variance

Water Quality – Well 6 Pilot Testing

Test Phase	Sample Date	Percent of Recharge Volume Recharged or (Recovered)	Chloroform (mg/L)	Bromoform (mg/L)	Bromodichloro-methane (mg/L)	Dibromochloro-methane (mg/L)	Total Trihalomethanes (mg/L)
MCL			**nc**	**nc**	**nc**	**nc**	**80**
Anti-Degradation Standard			**7**	**5**	**5**	**nc**	**nc**
Native Groundwater	October 31, 2002	Pre-ASR	<0.20	<0.20	<0.20	<0.20	<0.20
Recharge	May 5, 2003	15	na	na	na	na	na
	June 4, 2003	76	na	na	na	na	na
	June 16, 2003	100	na	na	na	na	na
Storage	June 23, 2003	na	na	na	na	na	na
	July 16, 2003	na	na	na	na	na	na
	July 28, 2003	na	**8.9**	<0.5	<0.5	<0.5	<0.5
Recovery	August 4, 2003	(28)	6.6	<0.5	<0.5	<0.5	<0.5
	August 11, 2003	(59)	3.9	<0.5	<0.5	<0.5	<0.5
	August 19, 2003	(93)	2.6	<0.5	<0.5	<0.5	<0.5
	September 10, 2003	(181)	1.0	<0.5	<0.5	<0.5	<0.5

- Chloroform only DBP present - degraded during storage and recovery to below anti-degradation criteria
- Recovered water meets drinking water criteria

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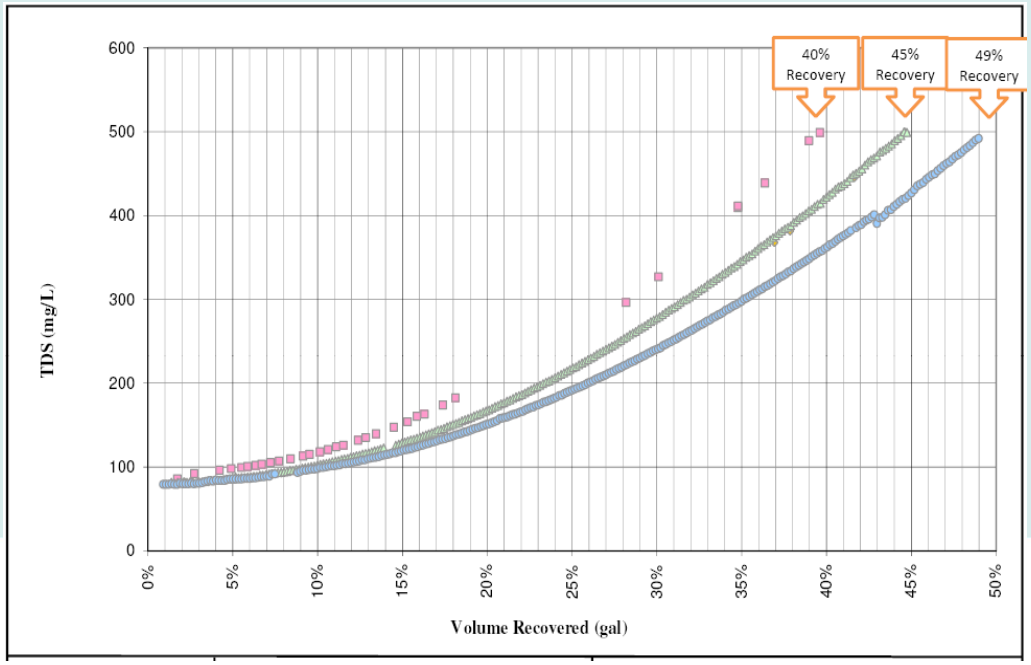
Recoverable Water

Issue: *How Much Water can be Recovered?*

- Excellent in-situ, recharge, and recovered water quality means ***water quality*** recovery efficiency not an issue in Walla Walla

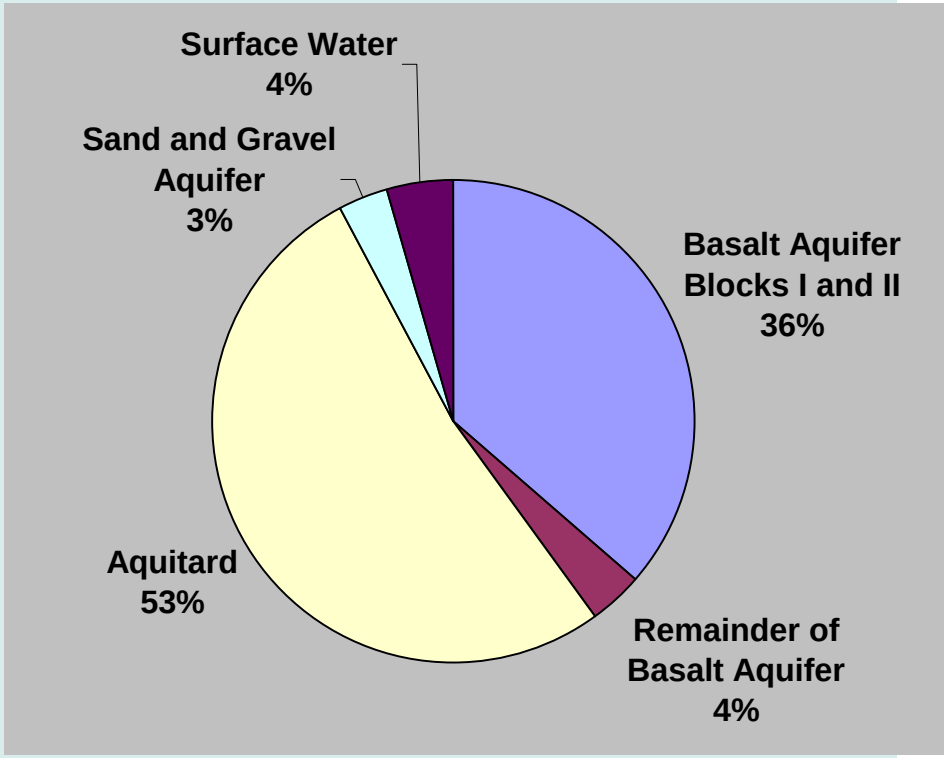
- Water quality recovery efficiency is only relevant in poor quality aquifers – such as brackish aquifers. Is operational decision, not permit quantity



Recoverable Water

Issue: *How Much Water can be Recovered?*

- Water Balance provides best tool to assess ***water quantity*** recovery. Supported by data/analysis from:
  - Monitoring Well(s), Pumping Tests, ASR Operations
  - Conceptual Hydrogeological Model
  - Numerical Groundwater Flow Model
- Recovery varies with storage duration because of losses



Change in Storage at end of Recharge

Water Rights

Issue: *What Water Rights are Required for ASR?*

- Water rights for source waters for recharge
  - Washington and Oregon Permits for Mill Creek
  - Underlying rights specify beneficial use
- Reservoir Permit
  - For underground storage
  - Processing in progress
- Secondary Permit
  - Required if beneficial use of recovered water is different than specified for source water

➢Is ASR a Good Idea for Walla Walla and Washington?

- ***Yes, because ASR provides***:
  - Safe, secure storage in the event of a watershed fire or during drought (summer) or from climate change
  - Conjunctive use of surface and groundwater
  - Use of compartmented, high-permeability confined basalt aquifer with limited effects on surface water
  - Restoration of declining groundwater levels in basalt aquifer
  - Benefits to other water users – decreased pumping lifts
  - Streamflow increase in low flow periods from losses
- Key Issues remaining:
  - Anti-degradation
  - Recoverable water

Thank You

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