Groundwater Storage Assessments for the Yakima Basin

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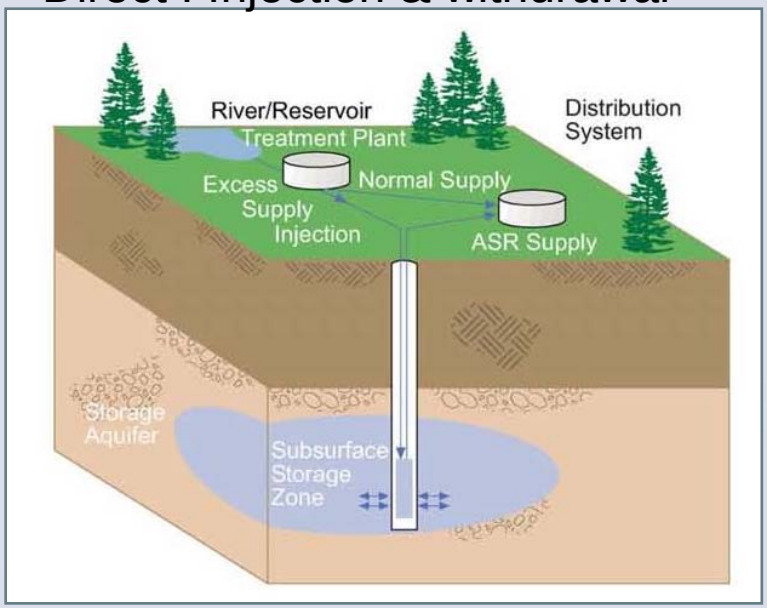
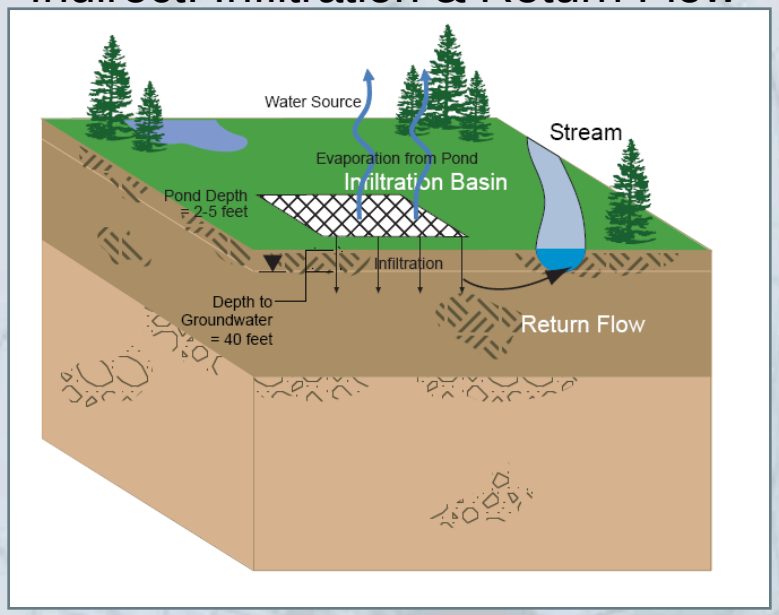
Aquifer Recharge Concept

- Divert and store water underground <u>when it is available</u> (i.e. pre-storage control)
- Recover water (directly or indirectly) during storage control to benefit streamflows

Direct : Injection & withdrawal



Indirect: Infiltration & Return Flow



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Aquifer Recharge Project Options

- Surface Infiltration and Return Flow
  - Method : spreading basin
  - Issue : return flow timing & magnitude
  - Primarily flow augmentation
- Municipal ASR
  - Method : wells (injection/withdrawal)
  - Issues : timing/operation/treatment
  - Primarily source replacement
- Agricultural ASR
  - Method : wells (injection/withdrawal)
  - Issues: volume/conveyance/treatment
  - Primarily source replacement

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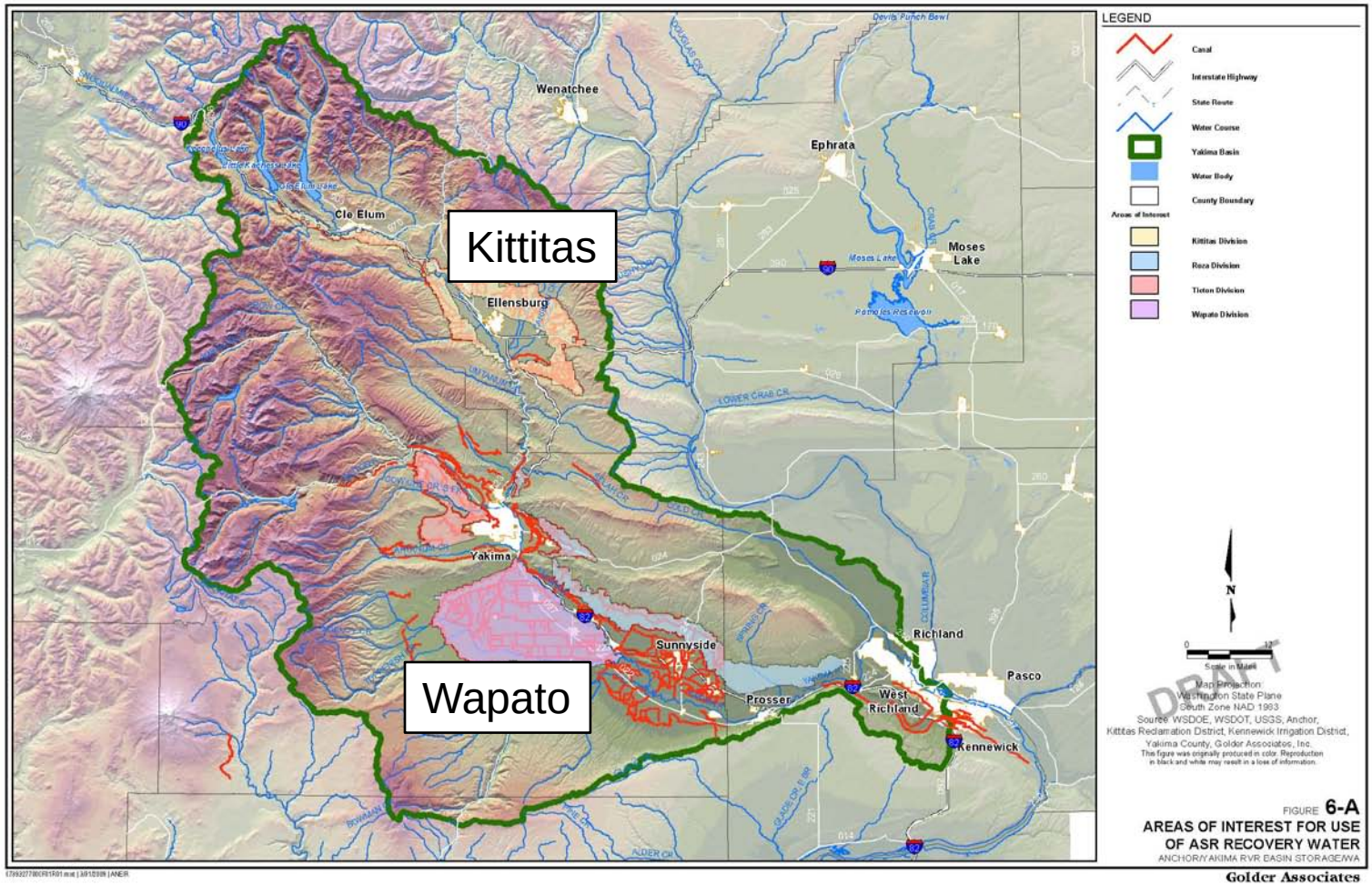
Infiltration and Return Flow Target Areas

Objective : Passive return flow to streams



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Spreading Basin - Arizona

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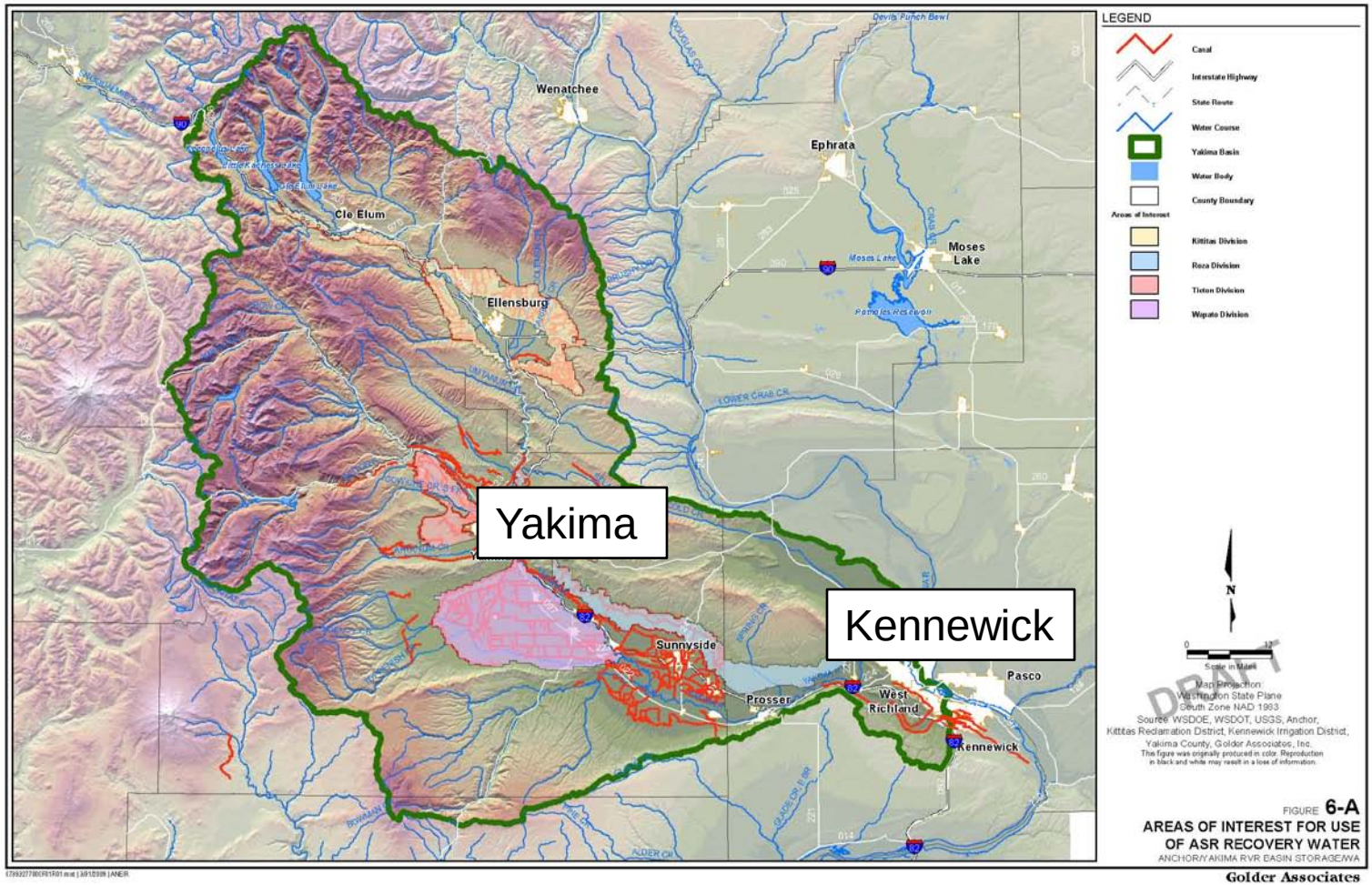
Municipal ASR Target Areas

Objective : Direct municipal supply



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ASR - Wellhouse

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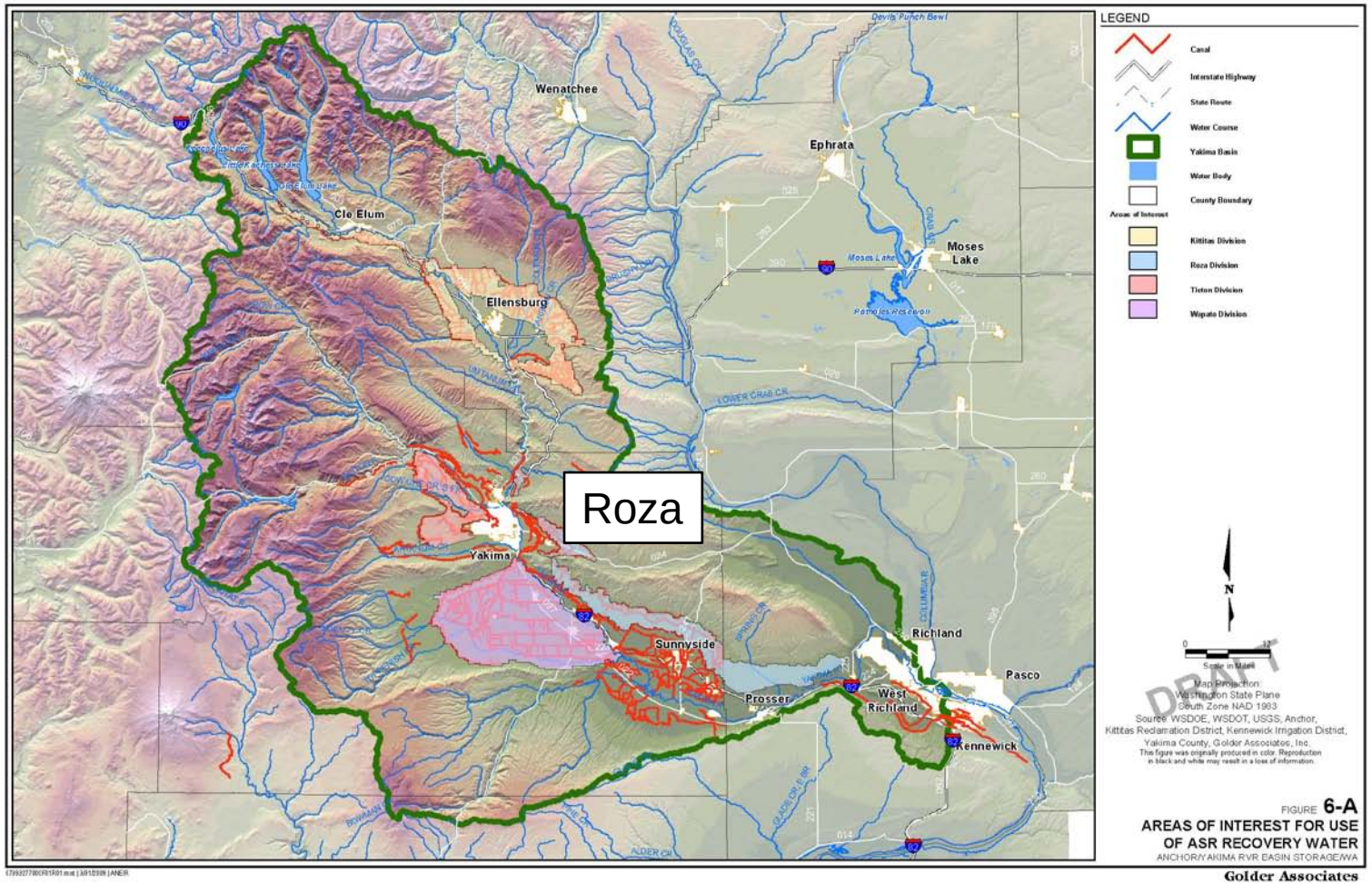
Regional ASR Target Areas

Objective : Direct agricultural supply



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Relative Comparisons

Option	Study Scope	Ultimate Cost	Net Benefit (Habitat + People)	Nexus
Surface Infiltration & Return Flow	High	Moderate	Moderate	Moderate
Municipal ASR	Low	Low	Low	Low
Agricultural ASR	Moderate	High	High	High

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Key study objectives

Infiltration/Return Flow

- Land availability/area
- Shallow aquifer characteristics and variability
- Shallow aquifer water quality
- Timing of return flow
- Conceptual Design:
  - Distance, Conveyance, Basin Facilities
  - Sediment Loading Rates, Pre-Treatment.

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Key study objectives

Municipal ASR

- Utility WTP capacity
- Operational strategy (annual vs. banking)
- Water quality compliance strategy

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Key study objectives

Regional/Agricultural ASR

- Storage Capacity
- Water Quality
  - Conventional Treatment (not feasible)
  - Pre-treatment options (RBF, Sedimentation, Land Application)
  - Water Quality Compliance Strategy
- Operational strategy

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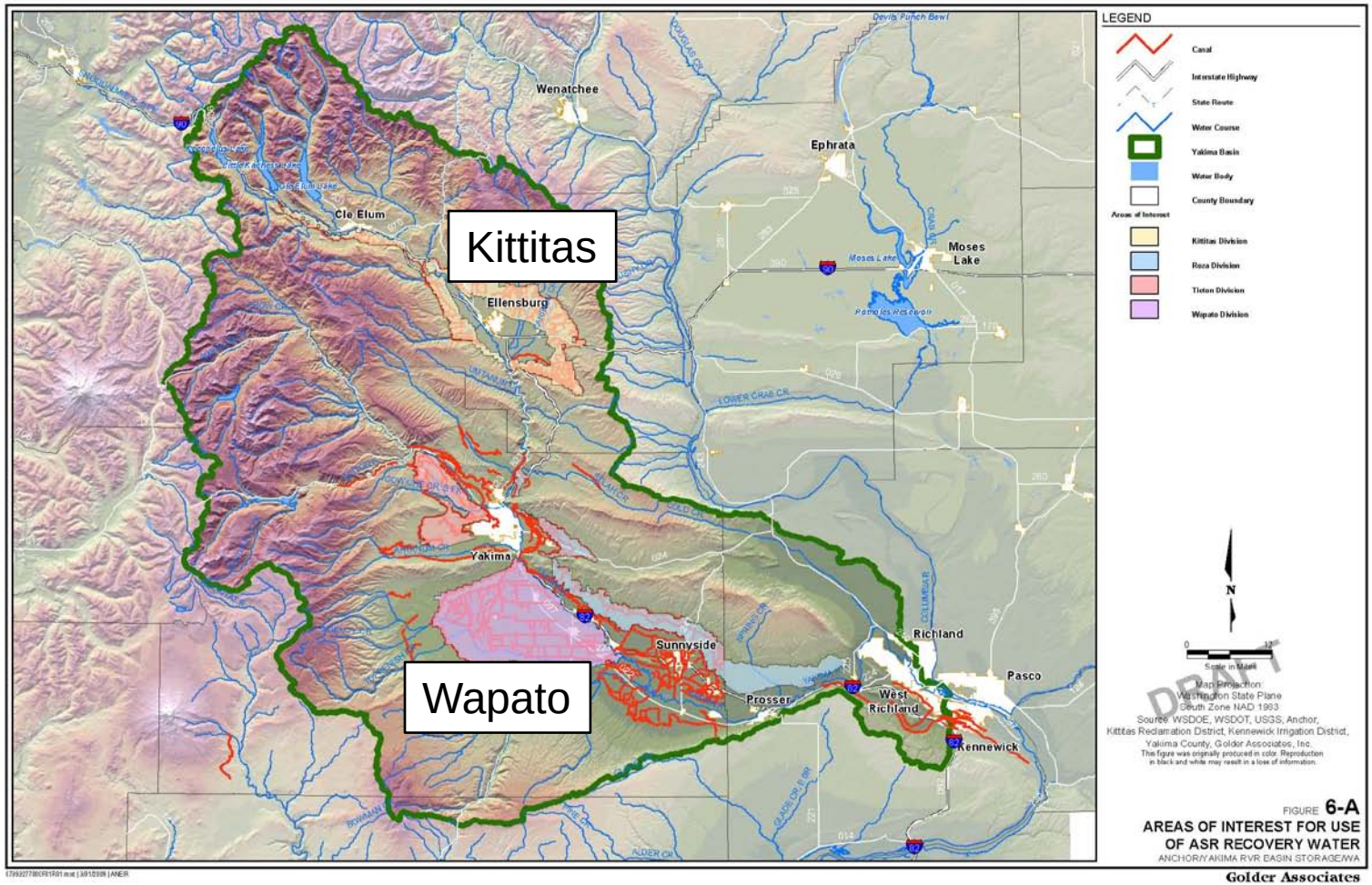
Infiltration and Return Flow Target Areas

Objective : Passive return flow to streams



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- Hydrogeologic component
- Planning component
- Engineering component

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Surface Infiltration Project

- Hydrogeologic work:
  - 10-15 soil borings (15-20 acres)
  - 5-7 wells + slug tests
  - Test pits + infiltration testing
  - Water level monitoring – for diffusivity evaluation
  - Model (analytic or numerical)
  - Predicted return flow profile
  - Pilot test (1-acre)
  - Water quality evaluation

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Surface Infiltration Project

- Planning work
  - Operational profile (inflow)
  - Site constraints:
    - Ownership
    - Land cover
    - Land use
  - Design constraints:
    - Topography
    - Geology
  - Construction/permitting issues

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Surface Infiltration Project

- Engineering work:
  - Source water (river vs. canal)
  - Conveyance (grade, pipe vs. canal)
  - Pond design (berms, excavation depth, etc.)
  - Treatment

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Surface Infiltration Project

- Hydrogeologic Work:
  - Cost range : $800 - $1M
- Planning Work:
  - Cost range : $100 - $200K
- Engineering Work:
  - Cost range : $200 - $300K

- Total Pilot & FS : $1.1M – 1.5M

Does not include final design/construction

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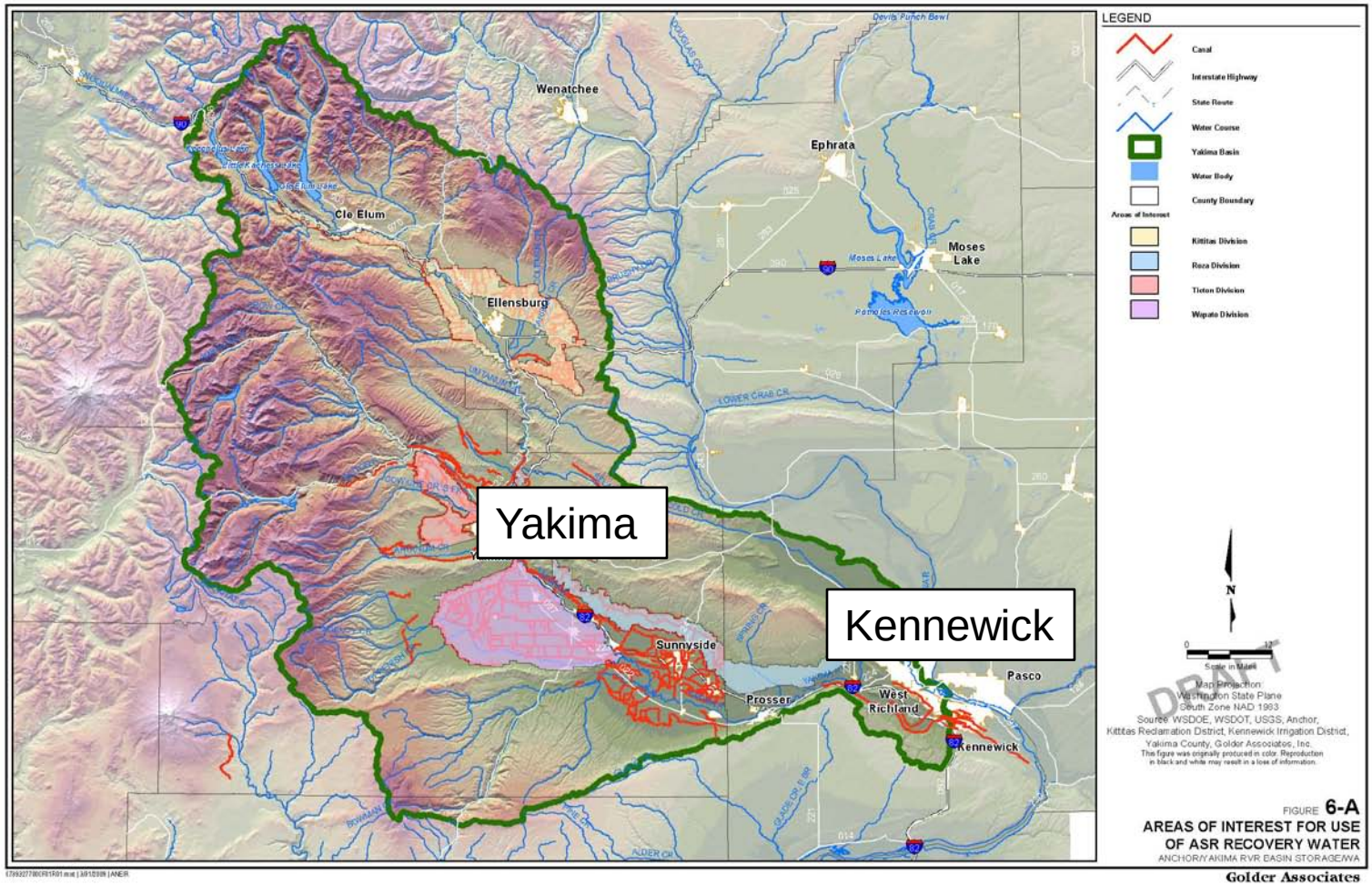
Municipal ASR Target Areas

Objective : Direct municipal supply



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Muni ASR Project

- Construct ASR Wellhead Facilities
- Finalize Conditional Reservoir Permit
- ASR Pilot Testing
- Reporting

- Total : $300K – $800K

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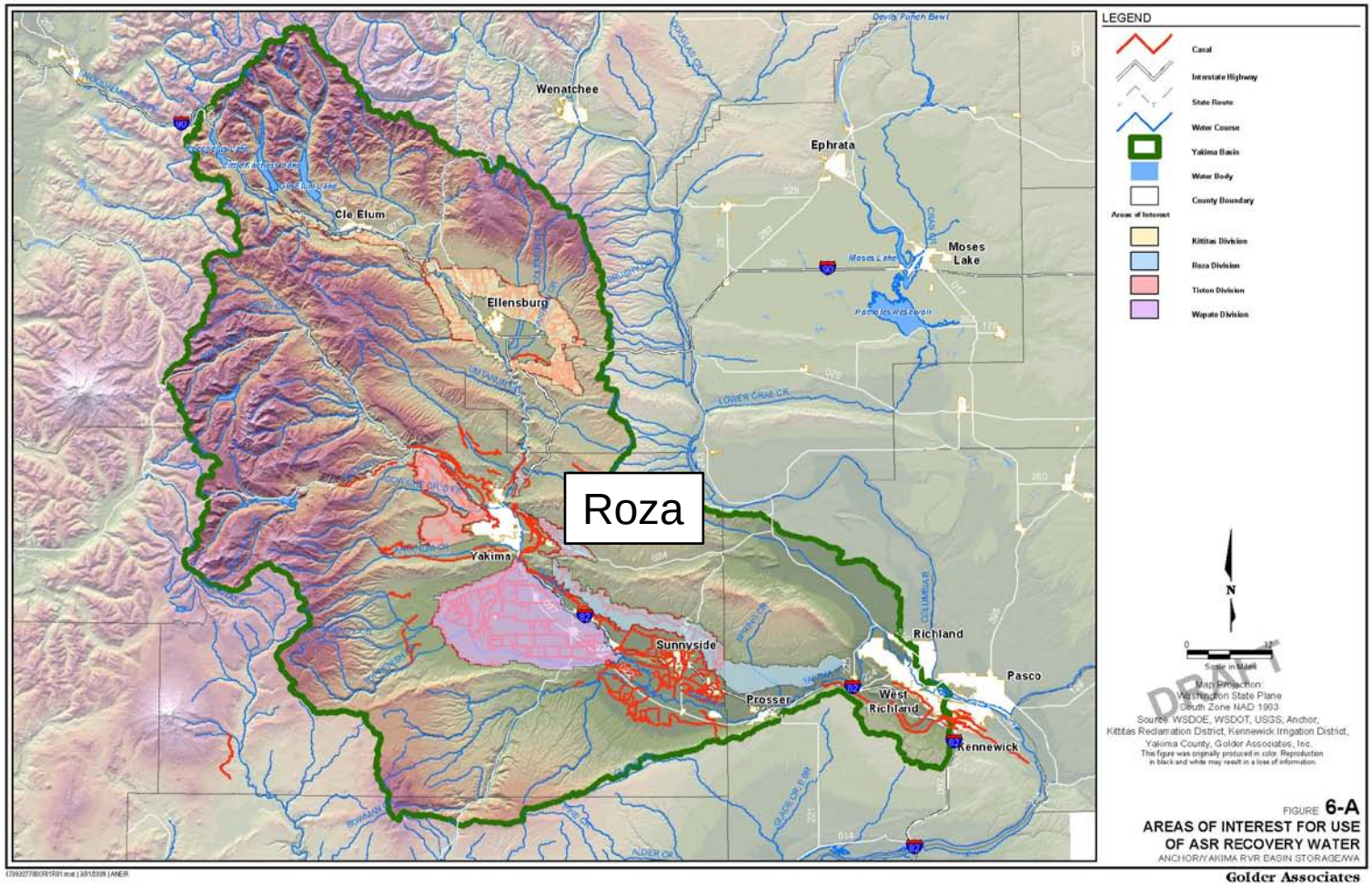
Regional ASR Target Areas

Objective : Direct agricultural supply



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Regional (Agricultural) ASR Project

- Hydrogeologic component
- Planning component
- Engineering component

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Agricultural ASR Project

- Hydrogeologic Work
  - 2 to 3 Aquifer Tests – Grande Ronde
  - Model (numerical – possibly fracture flow)
  - Water quality baseline

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Agricultural ASR Project

- Engineering Work
  - Water quality feasibility design (River Bank Filtration)
  - Conveyance feasibility design

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Regional ASR Project

- Planning work
  - Operational profile (inflow)
  - Site constraints (conveyance/RBF)
  - Design constraints (conveyance/RBF)
    - Topography
    - Geology
  - Site-scale construction/permitting issues
  - Some overlap with infiltration study

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Agricultural ASR Project

- Hydrogeologic Work:
  - Cost range : $300 - $500K
- Planning Work:
  - Cost range : $100 - $200K
- Engineering Work:
  - Cost range : $200 - $300K

- Total FS : $500K – $1.0M

Does not include injection pilot or final design/construction

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Surface Infiltration Project

- Surface Infiltration:
  - Total : $1.1M – 1.5M
  - Volume : 10,000 – 20,000 AF
- Muni ASR:
  - Total : $300K – $800K
  - Volume : 5,000 – 10,000 AF
- Agricultural ASR:
  - Cost range : $500K – 1.0M
  - Volume : 50,000 – 100,000 AF

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Relative Comparisons

Option	Study Scope	Ultimate Cost	Benefit (Habitat + People)	Nexus
Surface Infiltration & Return Flow	High ($1.1 – $1.5M)	Moderate	Moderate (10-20 KAF)	Moderate
Municipal ASR	Low ($0.3 - $.05M)	Low	Low (5-10 KAF)	Low
Agricultural ASR	Moderate ($0.5 - $1.0M)	High	High (50-100 KAF)	High

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Thank You

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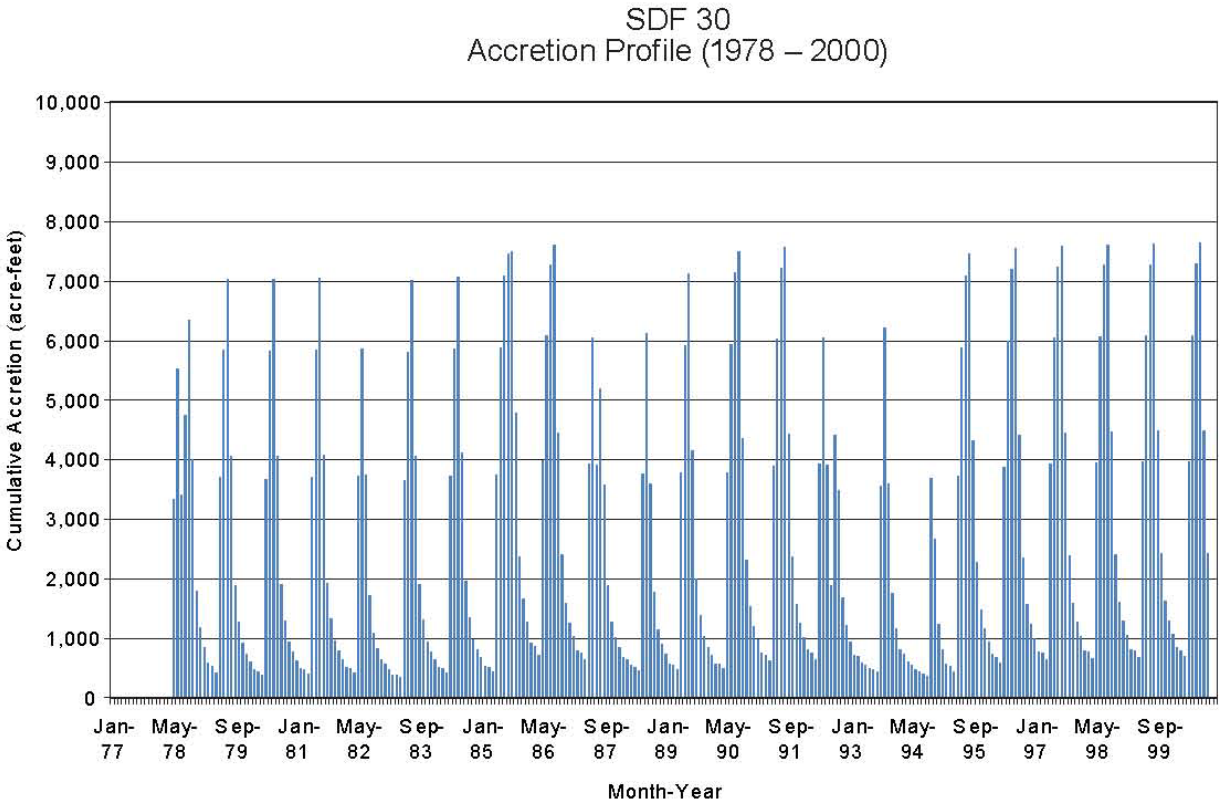

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