AGENDA

IDAHO WATER RESOURCE BOARD
Work Session for MEETING NO. 2-16
March 17, 2016 at 8:30 a.m.

Idaho Water Center
Conference Rooms 602 B,C,D
322 East Front Street, Boise, Idaho 83720

1. Roll Call
2. A&B Irrigation District Pipeline Status Report
3. Mountain Home AFB Water Supply Project
4. Treasure Valley Future Water Demand Study
5. ESPA Recharge
6. Wood River Valley Ground Water Model Status
7. Treasure Valley Ground Water Model Status
8. Priest Lake
9. Weiser River Basin
10. Idaho Power Integrated Resource Plan
11. Water Supply Bank Annual Report

Americans with Disabilities

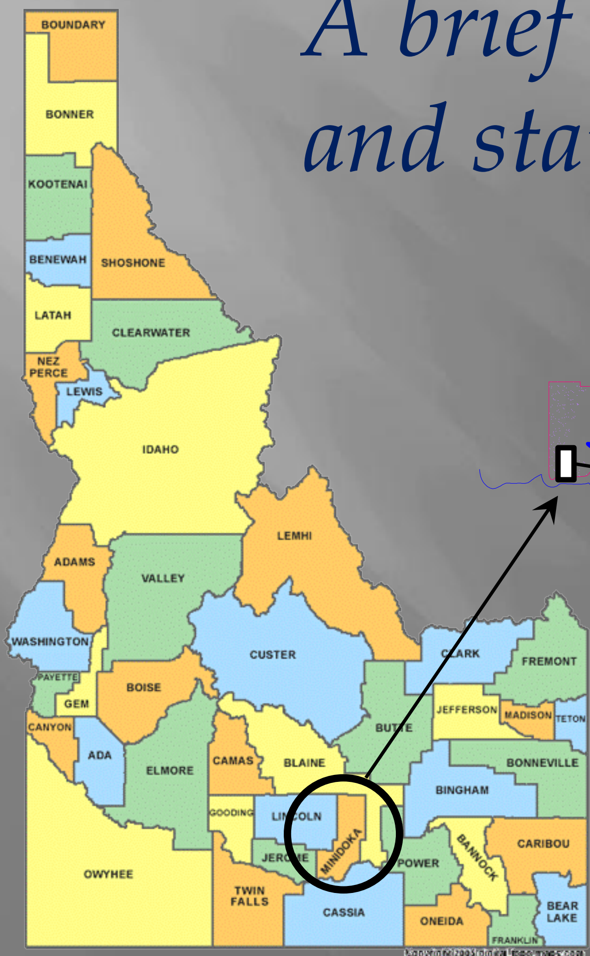
The meeting will be held in facilities that meet the accessibility requirements of the Americans with Disabilities Act. If you require special accommodations to attend, participate in, or understand the meeting, please make advance arrangements by contacting Department staff by email jennifer.strange@idwr.idaho.gov or by phone at (208) 287-4800.

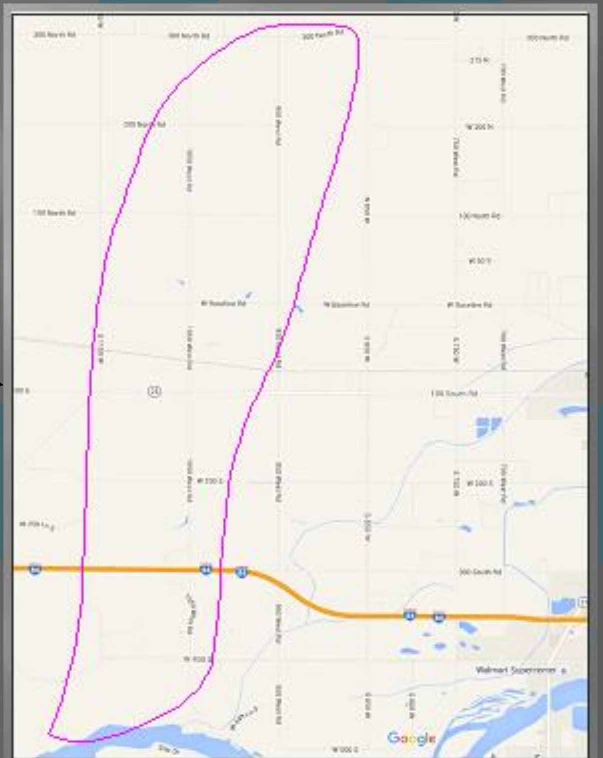
322 East Front Street, Boise, Idaho 83720 Tel: (208) 287-4800 Fax: (208) 287-6700

USDA United States Department of Agriculture

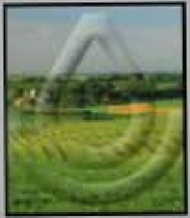
A&B PUMPING PLANT #2 AND PIPELINE PROJECT

A brief project review and status update





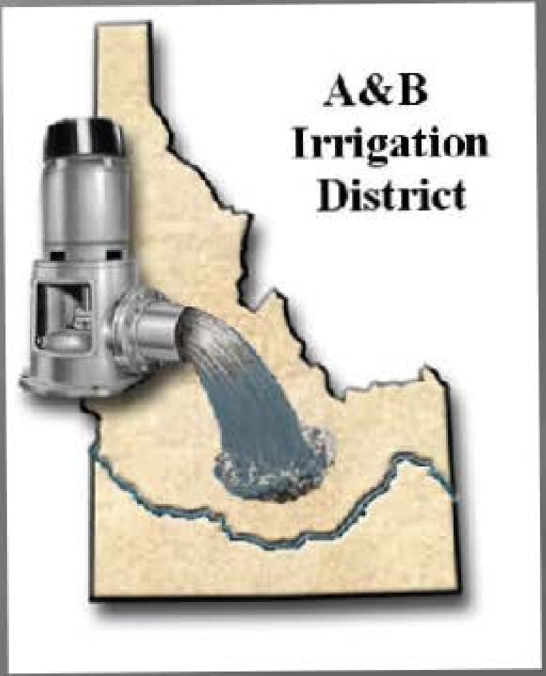
USDA United States Department of Agriculture



Minidoka Project – Idaho

A & B Irrigation District Pumping Plant No. 2
Minidoka County

Contributing Partners



USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service

IDAHO POWER.
An IDACORP Company

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CH2MHILL ch2m

IDAHO WATER RESOURCE BOARD

IDWR

BONNEVILLE POWER ADMINISTRATION

Funding Conservation Success

USDA United States Department of Agriculture

A&B Pumping Plant #2 and Pipeline Project

A short chronology

- Prior to 2013 - various planning and strategizing efforts
- Spring 2013 – 29 A&B shareholder's applications for the IWRB Agricultural Water Enhancement Program (AWEP) were selected for funding
- Spring and Summer 2013 – NRCS planning & AWEP contracting
- Spring 2013 into January 2015 – NEPA process; Reclamation & NRCS ultimately issue separate but consistent FONSIs
- 2013 through Fall 2015 – Engineering and Construction Contracting
- Fall 2015 through Spring 2016 – Construction
- Summer 2016 – Operation

Funding Conservation Success

USDA United States Department of Agriculture

Project Purpose & Goals

- From A&B's perspective, address declining aquifer levels and reduced well yields
  1. *"soft conversion" of about 1,500 acres of susceptible cropland currently supplied with ground water*
  2. *New delivery system to about 4,500 acres currently supplied with surface water*
  3. *The second goal accommodates a third goal – firming up surface water deliveries to areas currently served by Pumping Plant #1*
- From the State's perspective – ESPA benefits from:
  - *Reduced aquifer pumping*
  - *Potential infrastructure for recharge efforts*
- From NRCS's resource of concern perspective – water quantity and energy

Water Rights

- No new water rights were necessary
- Existing natural flow and storage rights will be utilized
  - *the existing natural flow right will now be split between Pumping Plant #1 and the new Pumping Plant #2*
  - *the natural flow right was amended to include soft conversion acres as an allowable place-of-use*
  - *stored water from rights in Palisades and American Falls Reservoirs will be used*
- Other surface waters could be leased or purchased
- Wells will continue to be used as necessary, when surface water is unavailable

USDA United States Department of Agriculture

Project Financing

- NRCS
  - Financial assistance came through the 2008 Farm Bill's AWEP program, specifically via the IWRB East Snake Plain Aquifer proposal
    - $3.8M under 29 contracts with A&B shareholders
    - No-cost technical assistance

NOTE: AWEP no longer exists. The 2014 Farm Bill's Regional Conservation Partnership Program (RCPP) is the most similar to AWEP.

- *RCPP emphasizes leveraging of NRCS funds with non-federal funds*
- *There are 3 competitive fund pools: national, state, & critical conservation areas*
- *Idaho's pool has averaged about $800,000*
- *2017 pre-proposals are due May 10, 2016*

- Bonneville Power Administration monies based on energy savings that will be shown over time
- A&B "out of pocket"
  - Shareholders voted to allow the District to issue bonds
  - IWRB loan
  - Significant "owner-supplied" materials

Funding Conservation Success

USDA United States Department of Agriculture

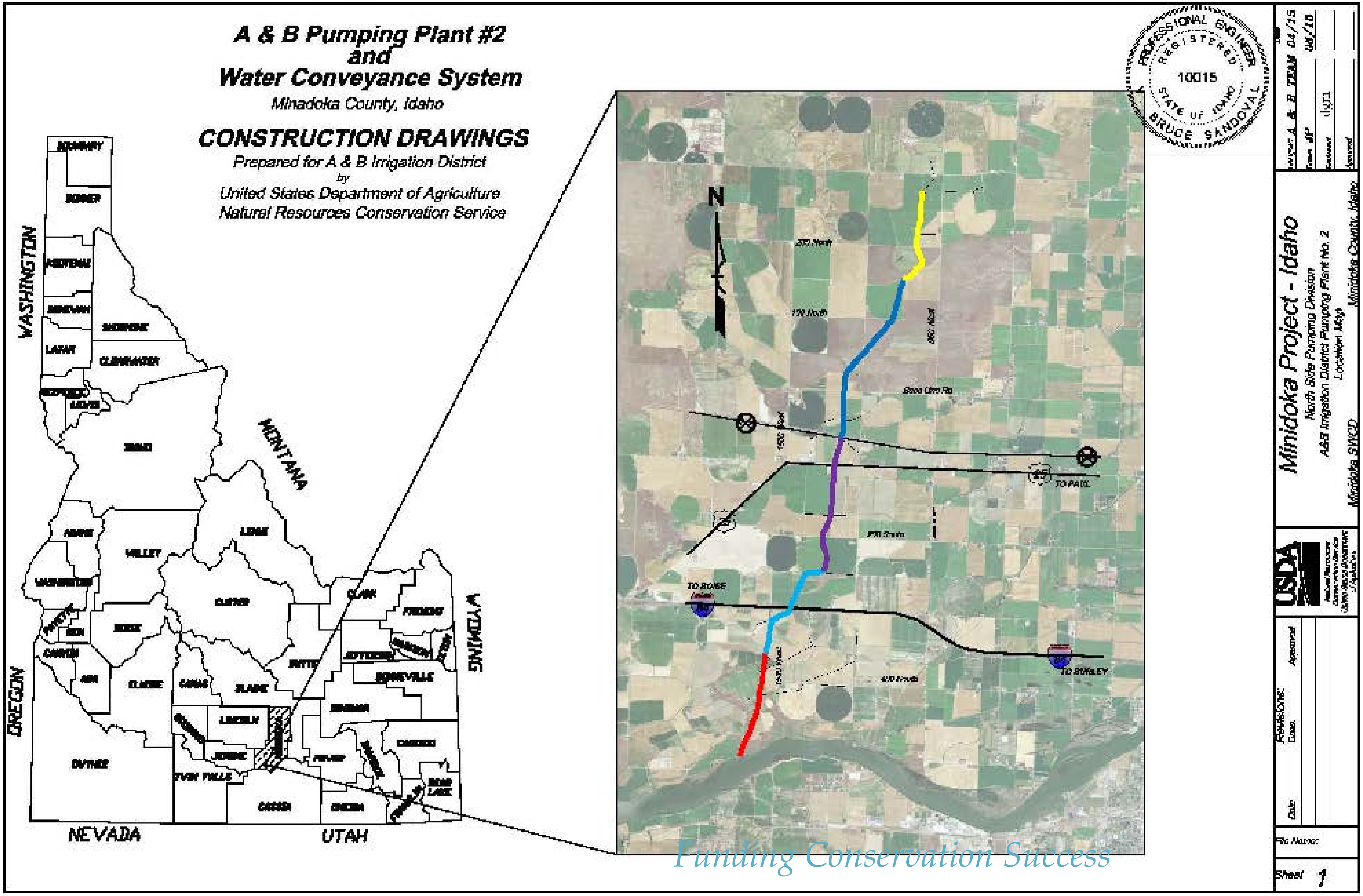
Project Design & Construction

- Reclamation
  - A&B operates the "North Side Pumping Division" component of Reclamation's *Minidoka Project*.
  - The Pumping Plant #2 & Pipeline project's pumping plant is destined to have title transferred to Reclamation - their design and construction criteria had to be met
    - Reclamation staff in Denver at their Technical Service Center
    - Reclamation staff in Boise: Project Manager and regional Construction Group
- CH2MHill Electrical Engineering & Control System by staff in Boise
- NRCS
  - Everything but the electrical
  - "Size" of project required independent review to meet internal policy
  - Staff
    - More than a dozen Professional Engineers and technicians based in Idaho
    - More than ten Professional Engineers and Professional Geologists from other states (Headquarters, National Technical Centers, peers from MT, WY, OR, and CO)
- A&B numerous staff doing inspection, fabrication, installation, and administration

Funding Conservation Success

United States Department of Agriculture

Project Design & Construction



Funding Conservation Success

United States
Department of
Agriculture

Project Design & Construction

Funding Conservation Success

USDA United States Department of Agriculture

Project Design & Construction

Filling the Pipeline!

Flushing the lines during initial fill on 3/15/16

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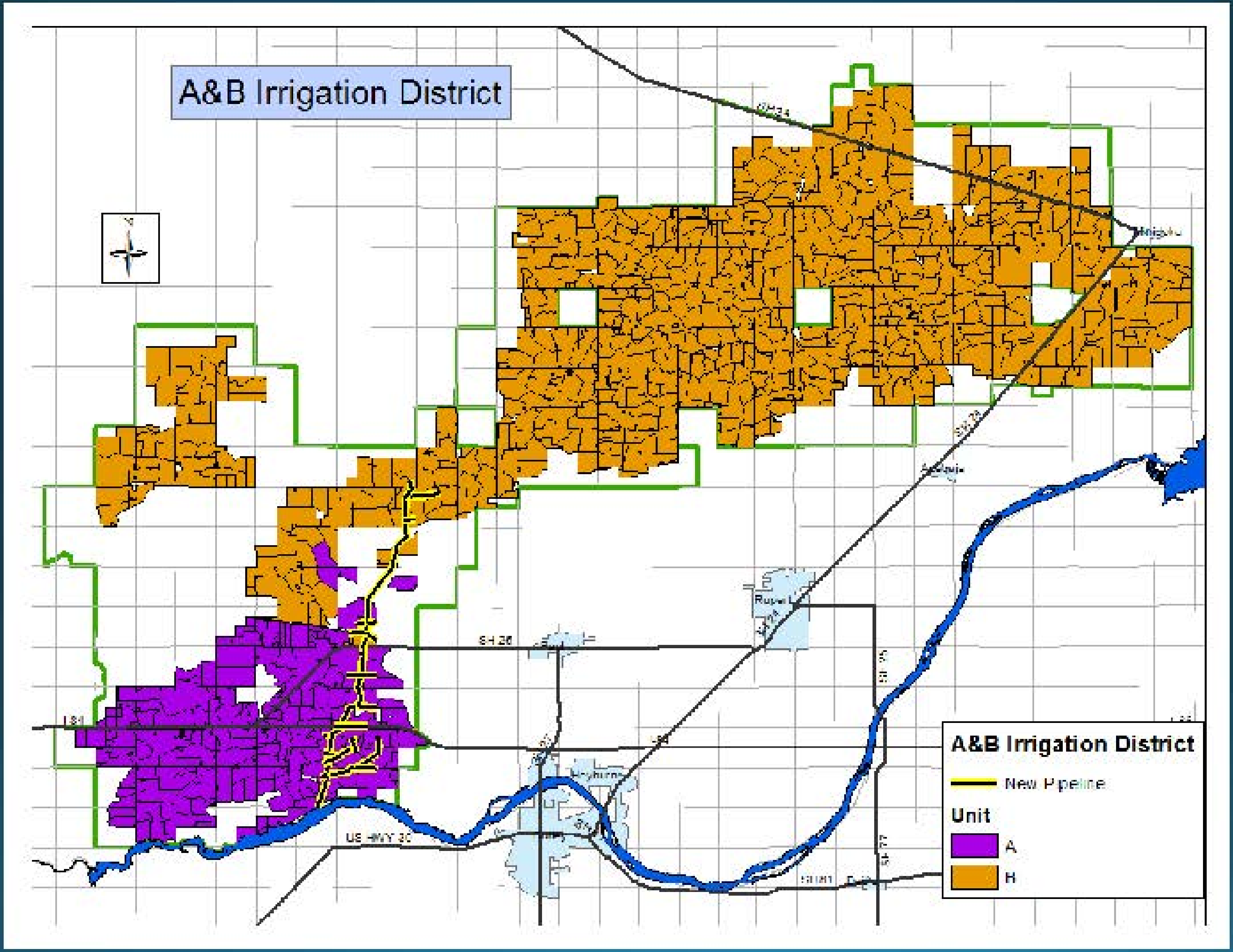
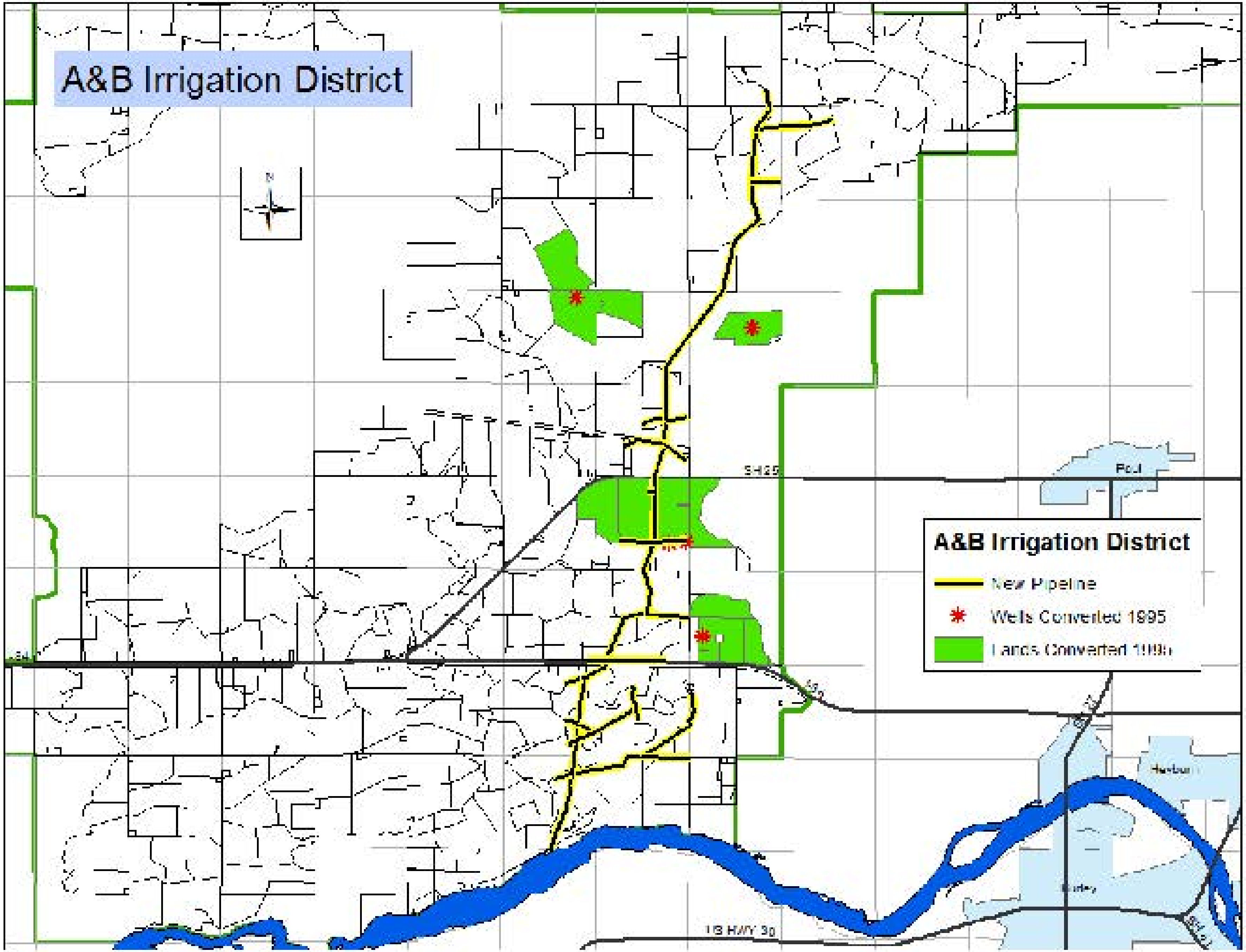
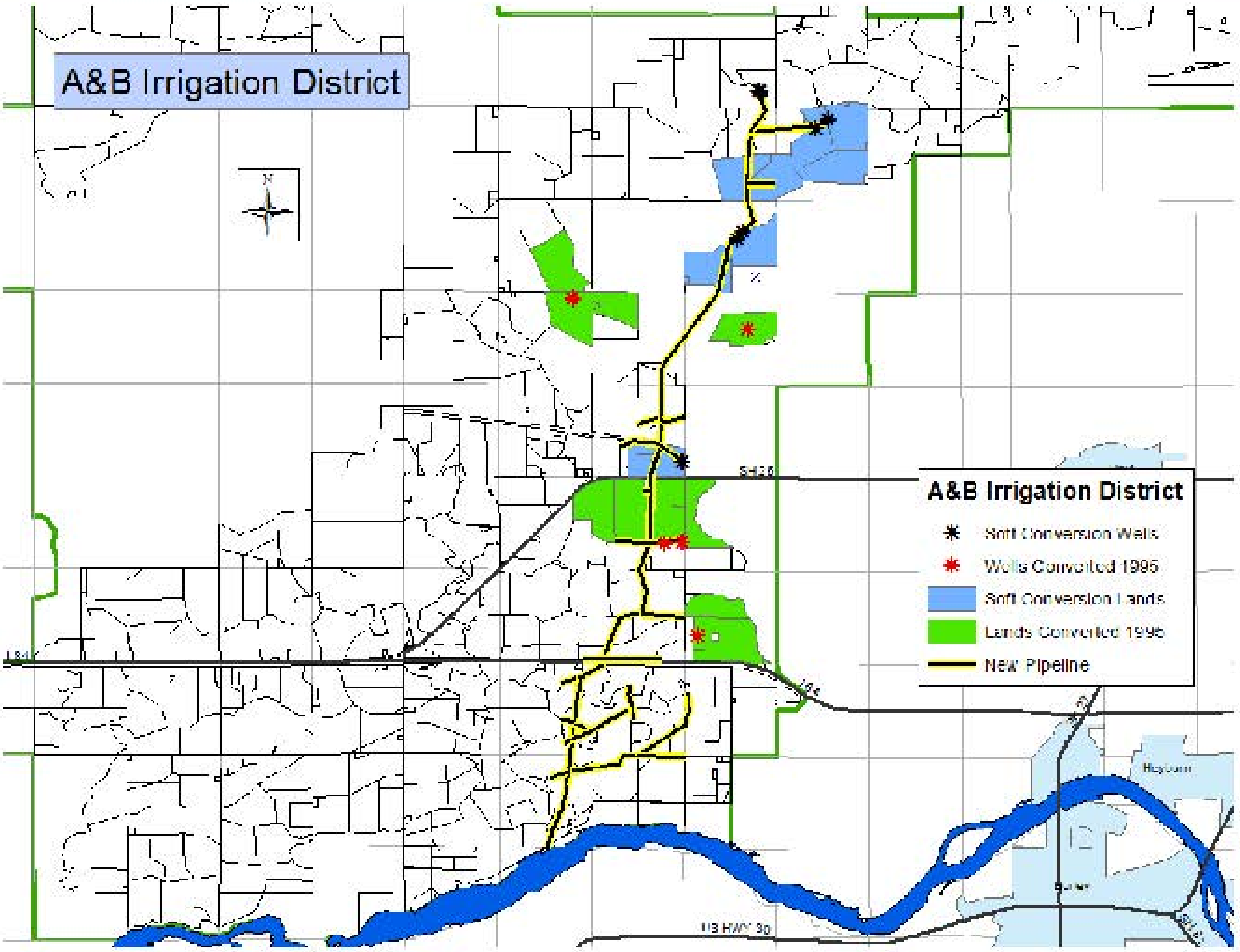
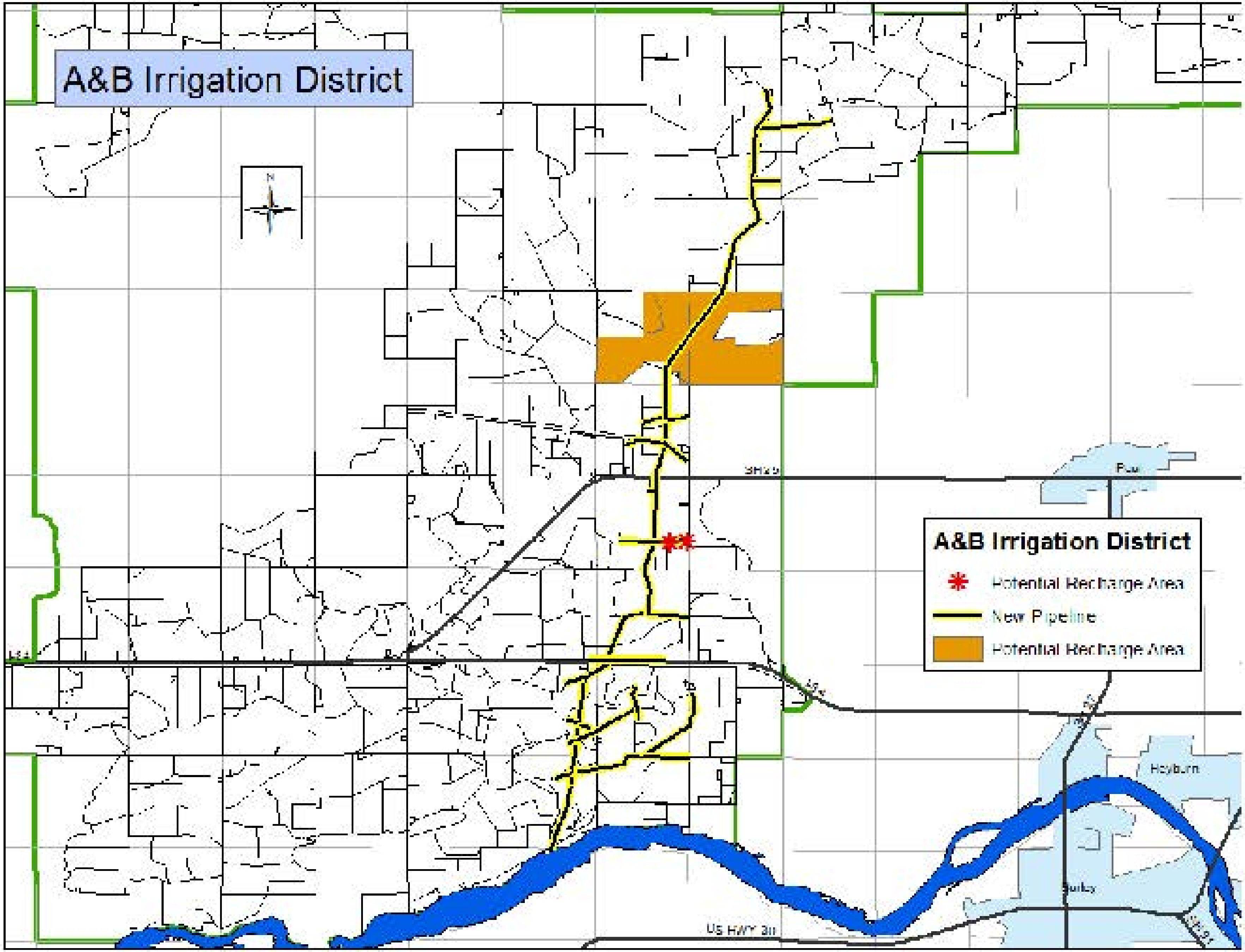
Unit A Pumping Plant #2 & Pipeline Project



A&B Irrigation District
SH 25
US HWY 30
A&B Irrigation District
New Pipeline
Unit
A
B


A&B Irrigation District
N
SH25
Paul
A&B Irrigation District
New Pipeline
Wells Converted 1995
Lands Converted
US HWY 30


A&B Irrigation District
A&B Irrigation District
Soft Conversion Wells
Wells Converted 1995
Soft Conversion Lands
Lands Converted 1995
New Pipeline
SH25
US HWY 30


A&B Irrigation District
A&B Irrigation District
Potential Recharge Area
New Pipeline
Potential Recharge Area
Heyburn
US HWY 30

Bidding & Contracting Process

- Selected engineering firm
- Pre qualification process
- Bidding process
- Contract award
- A&B handled contract administration
- A&B and NRCS handled quality assurance

Technical Data

- 110 CFS pumping capacity
- 6-500 HP motors & 2-250 HP motors for a total of 3500 horsepower
- Acres served:
  - 4500 existing surface water acres
  - 1500 existing ground water acres

Pipe Purchased for Project

Size	Ft. Delivered	Cost
6"	1,140	$1,368.00
8"	1,780	$3,684.60
10"	6,440	$20,155.57
12"	15,440	$63,372.80
15"	10,500	$69,720.00
18"	2,178	$22,298.09
21"	7,480	$107,148.66
24"	4,422	$76,364.01
27"	6,600	$148,475.73
30"	12,760	$376,419.67
36"	9,760	$433,004.33
42"	374	$59,638.54
48"	8,096	$783,421.99
54" (80 psi)	1,254	$183,325.68
54" (100 psi)	2,398	$434,314.82
54" (125 psi)	3,960	$897,924.97
	94,582	$3,680,637.46


New Road & Power Line to Pumping Plant
Pipe Backfill Material
25-acre staging area


54-inch Pipe Staged Along the Route

backfill material being placed and compacted

Cutting a 54-inch pipe for a fitting

Installing a Fitting

Isolation Valve, Turnouts, & Appurtenances

The Pumping Plant on the Milner Pool

Excavation Below Milner Pool Water Surface

Working on the floor of the north half

The Pumping Plant on the Milner Pool

Electrical Controls
with shelter

Screens

the south half

The Pumping Plant on the Milner Pool

42"x42"x54" wye fitting at the pumping plant

Milner Pool

Trash Rack Structure

(1) Control system w display & telemetry
(6) 500-Hp motors/pumps
(2) 250-Hp motors/pumps with VFDs
(8) Flow meters
(12) Rotating screens with backflush

The Pumping Plant on the Milner Pool

Memorandum

To: Idaho Water Resource Board

From: Cynthia Bridge Clark, Randy Broesch

Date: March 7, 2016

Re: Mountain Home Air Force Base Water Supply /Pipeline Project

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The following is a status report on the Mountain Home Air Force Base (MHAFB) Water Supply/Pipeline Project (Project). The Project involves efforts by the State of Idaho to assist the Military in developing a sustainable water supply to the MHAFB.

Project Concept

The MHAFB currently relies on groundwater from a critical declining aquifer for is water supply. To provide an alternate source of water, the Idaho Water Resource Board (IWRB) intends to develop a pipeline and water treatment facility to deliver surface water from the Snake River to the MHAFB. In 2014, with support from the Governor and Idaho State Legislature, the IWRB purchased senior Snake River water rights from the Simplot Corporation. The surface water will be diverted out of the C.J. Strike Reservoir and delivered to the MHAFB where it will be treated and used for Domestic Commercial Municipal Industrial (DCMI) purposes. The IWRB is expected to retain the senior water rights and enter into a water utility service agreement with the MHAFB for the delivery of the DCMI water. The IWRB will undertake the financing, design, construction, and maintenance methods to bring the project to fruition. The Governor's office, Legislature, and the IWRB recognize and are committed to supporting the MHAFB as a $1 Billion annual economic generator in the Idaho economy.

Project Status

Technical Planning Report – The IWRB issued a contract with SPF Engineering LLC (SPF) to develop a conceptual project design to assist the IWRB and MHAFB with necessary project planning efforts. The report includes:

- An evaluation of the current and future DCMI demand at the base
- Conceptual designs for the pump station at the C.J. Strike Reservoir, pipe conveyance alternatives, and treatment plant sizing criteria
- Identification of design standards and permitting requirements
- Preparation of detailed total project costs and preliminary operation and maintenance rates
- Development of a project schedule covering phases of the project from permitting and design to construction and commissioning
- Optional task – planning level design and cost estimates for a possible expansion of the pipeline to deliver water to other utility users if additional water rights from the Snake River were obtained by those entities

The study was initiated on August 5, 2015 and the findings are currently being reviewed by IDWR and MHAFB staff. Analysis associated with the "Optional Task" is ongoing; however, SPF's Terry Scanlan P.E., P.G. and Eric Landsberg P.E. will present the conclusions of the evaluation of a pipeline to the MHAFB to the IWRB at the work session on March 17th. A final report is scheduled to be released at the end of March once the Consultant has considered comments from the IWRB/IDWR and MHAFB staff.

To evaluate options for a possible expansion of the pipeline to other water users (Optional Task), SPF and IWRB Staff met on February 29th with officials from Elmore County, the City of Mountain Home, and Mountain Home Irrigation District. The purpose of the meeting was to initiate development of conceptual layouts and associated costs based on the stakeholder objectives. A follow-up meeting is scheduled for March 28th with the stakeholders to gather additional information regarding their potential involvement. This work will be completed by early June 2016 and is independent of the MHAFB report.

Regular Communication with MHAFB - In April of 2015, a significant outcome of a meeting with the MHAFB and Idaho Department of Water Resources (IDWR)/IWRB staff was the formation of a Core Action Group (CAG). The CAG is comprised of IDWR/IWRB staff and representatives from the MHAFB. It meets often to discuss the status of ongoing work, resolve planning decisions to complete the *Technical Planning Report,* and to exchange information required for their respective planning processes.

Upon Completion of the Technical Planning Report - IDWR/IWRB staff will initiate development of financing options, project delivery types, and stakeholder involvement. Meanwhile, MHAFB will advance internal contracting obligations in parallel with the required environmental compliance actions. The CAG expects to negotiate a water utility service agreement based upon the findings in the *Technical Planning Report*.

Schedule - The following are important milestones and estimated completion dates:

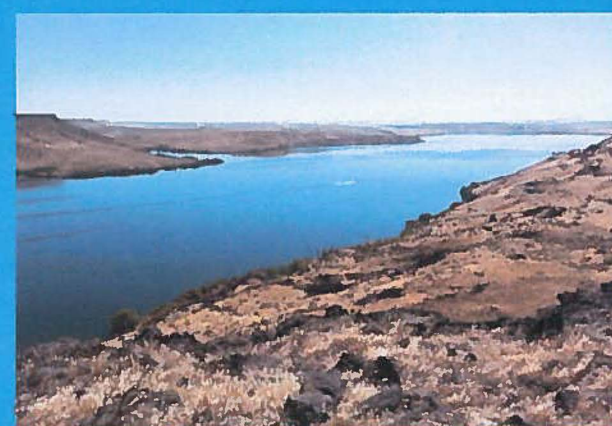
Primary Milestone	**Date**
Complete Planning Report	March 2016
Approval of Water Utility Service Agreement	October 2017
IWRB Resolution to Finance, Design, & Construct	October 2017
IWRB/Simplot Agreement Deadline to Deliver Water	February 2021

REQUIRED ACTIONS: Action is not required by the IWRB at this time.

MHAFB Water Supply Planning Study

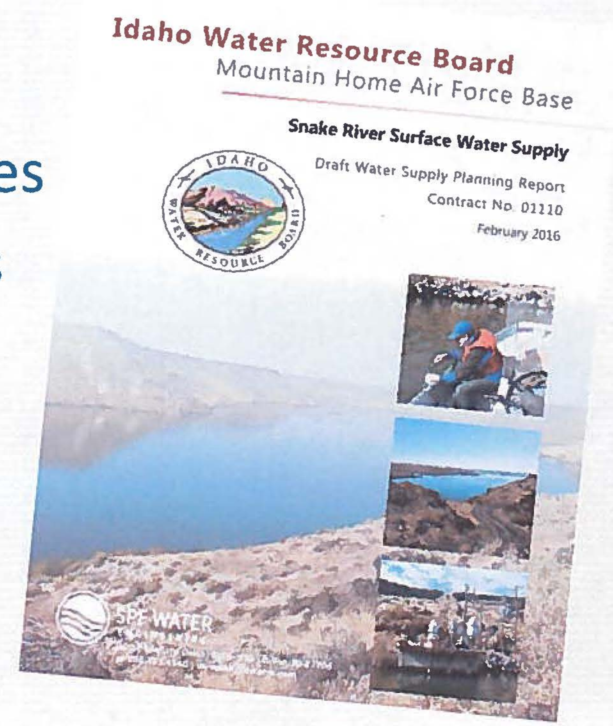
Idaho Water Resource Board

March 17, 2016

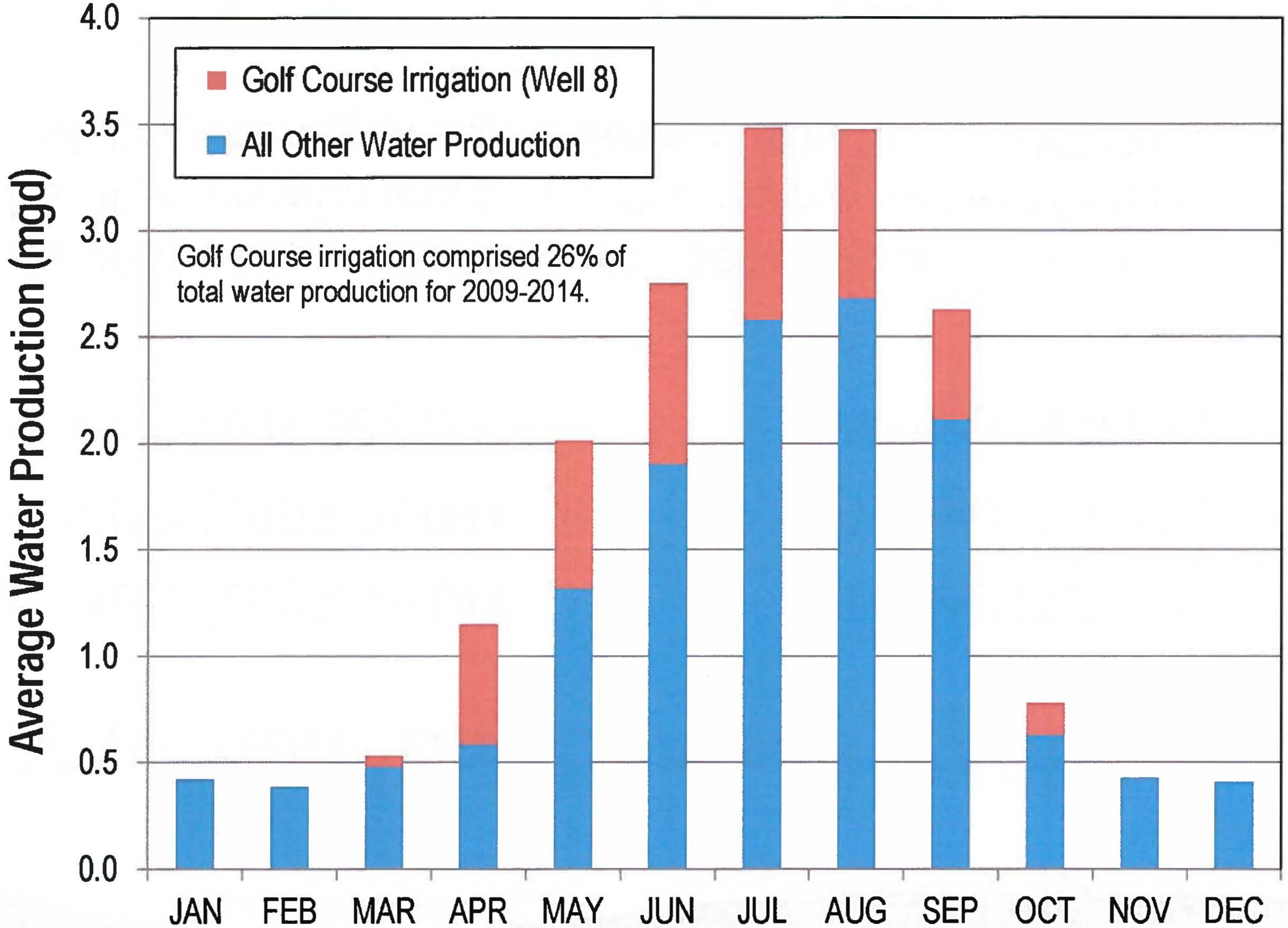


Overview of Water Supply Study

- Reviewed technical and regulatory requirements
- Identified Two Alternatives for Environmental Permitting
- Prepared Conceptual Designs for Facilities
- Prepared Cost Estimates for Alternatives
- Developed Project Implementation Schedule and Phasing



MHAFB Water Demand (2009-2014)



Maximum Day Demand (MDD)

MDD (2009-2014)	3.8 mgd (5.9 cfs)
MDD (1999-2004)	5.7 mgd (8.8 cfs)
Military Guidelines[1]	5.7 mgd (8.8 cfs)

(1) Design Capacities to be 50% above existing demands for installations with less than 5,000 personnel Per Military Civil Engineering Design Guidance, MIL-HNBK-1005/7A.

Facility Capacities Were Established

FACILITY	DESIGN CAPACITY	ULTIMATE CAPACITY
INTAKE PUMP STATION	6 mgd	8 mgd
RAW WATER PIPELINE	8 mgd	8 mgd
WATER TREATMENT PLANT	6 mgd	8 mgd

Note:
6 mgd = 9.3 cfs = 4,200 gpm
8 mgd = 12.4 cfs = 5,600 gpm
Capacities were established in October 2015 meeting with MHAFB

C.J. Strike Water Quality Review

- Collected and Analyzed Four Sets of Monthly Samples
- Evaluated 5 Years of Data from Glenns Ferry
- Overall C.J. Strike Reservoir is a high quality surface water source
- Organics low, so Disinfection By-Products anticipated to be low
- Turbidity low, could consider Direct Filtration
- Hardness is higher than typical MHAFB ground water
- Analyzed for 145 parameters and meets

all Federal Drinking Water Standards

INTAKE ALTERNATIVES

	Alternative 1 "Simplot Intake"	Alternative 2 New East Site
Total Pipeline Length	12.8 mi	7.6 mi
Water Depth at Intake	15-20 ft	20-25 ft
Distance to Existing Power	0 mi	0.3 mi
Distance to Existing Roadway	0 mi	0 mi
Land Ownership at Intake	BLM	Idaho Power

EXISTING SIMPLOT IRRIGATION PUMP STATION

GARDEN CITY 46th STREET PUMP STATION

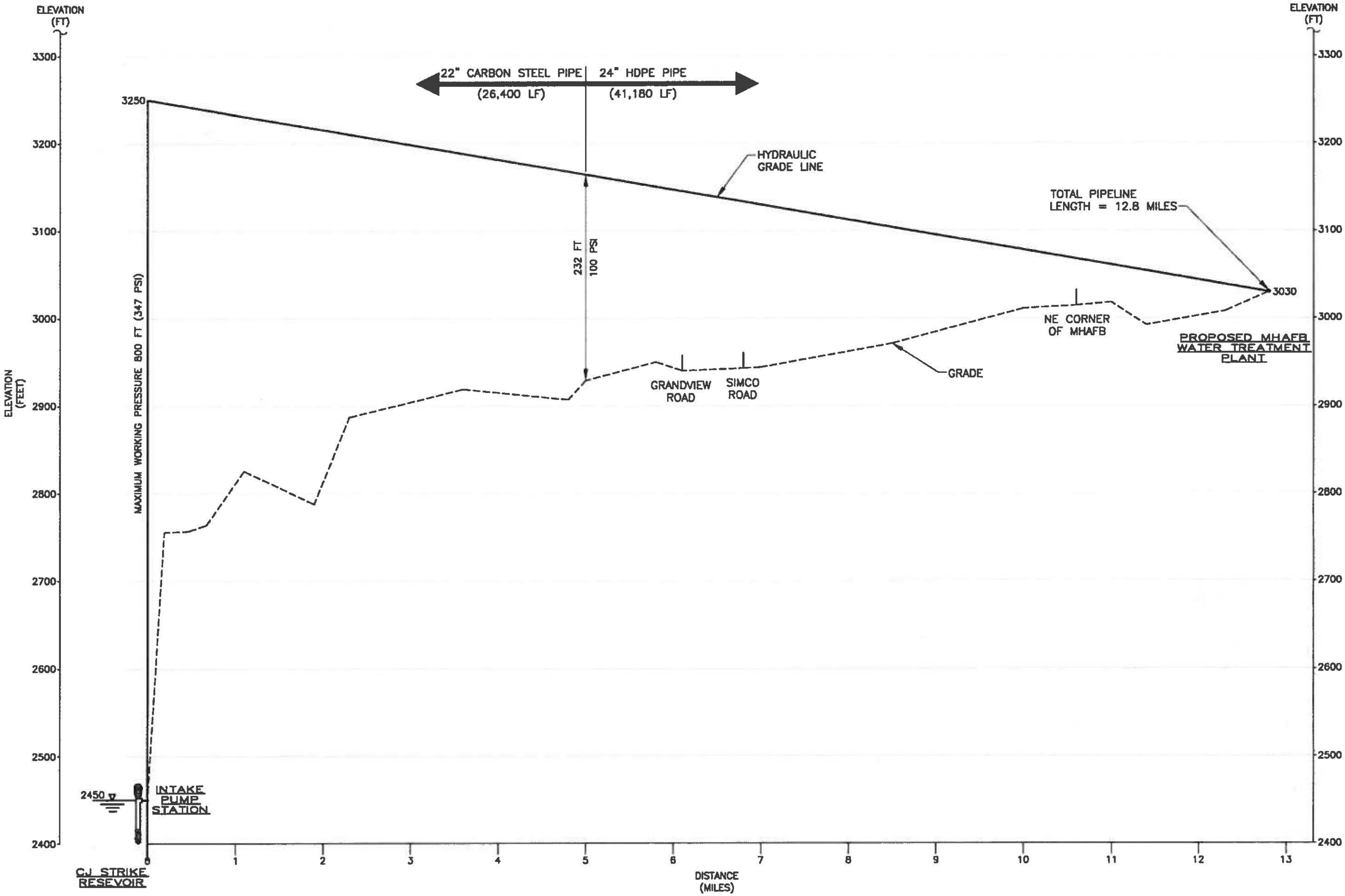
PUMP STATION EXTERIOR

VERTICAL TURBINE PUMPS
(3 EA) - 75 HP

INTAKE PUMP STATION – CONCEPTUAL DESIGN

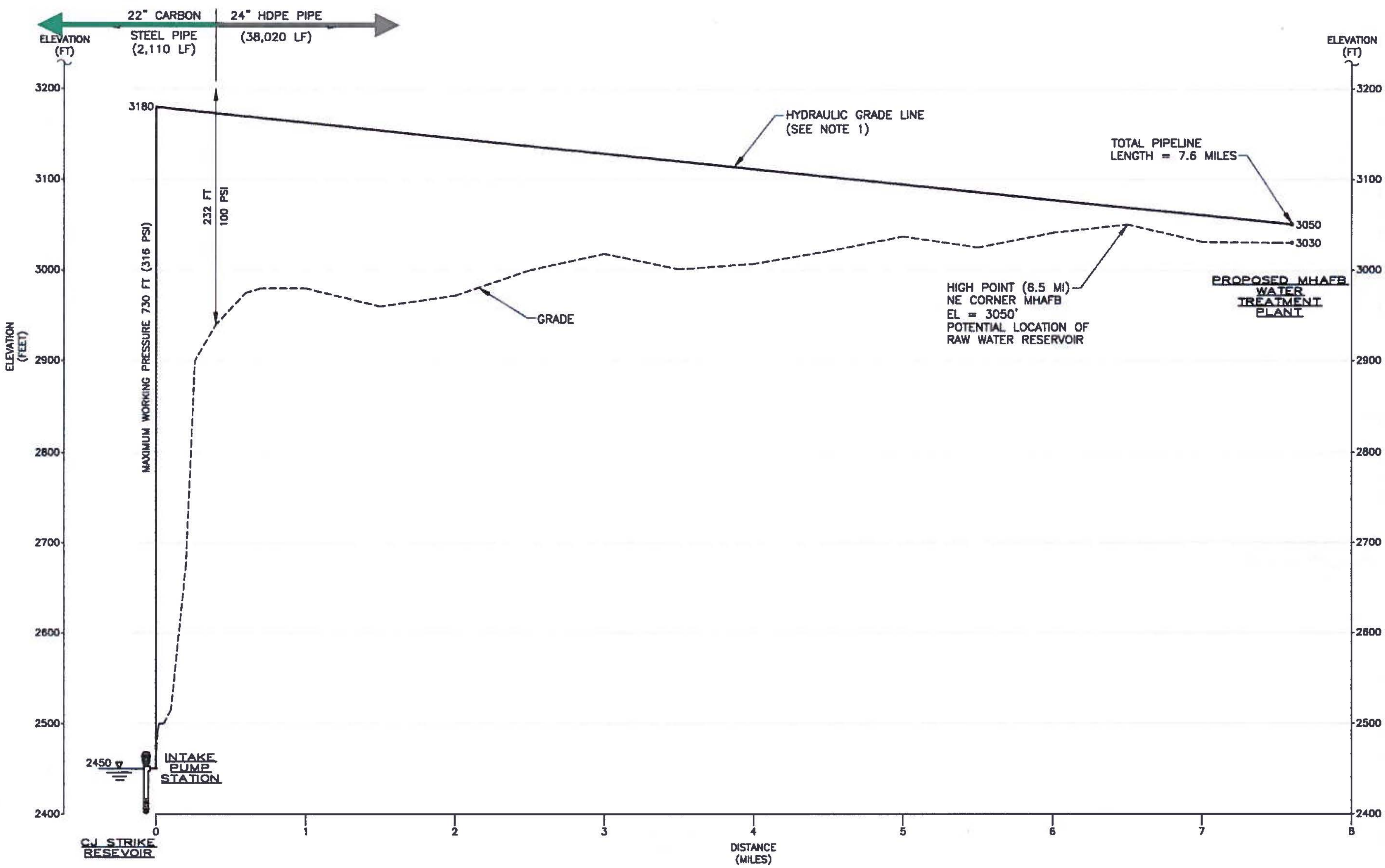
DESIGN CAPACITY	6 mgd / 4,200 gpm / 9 cfs
ULTIMATE CAPACITY	8 mgd / 5,600 gpm / 12 cfs
DISCHARGE PRESSURE	350 psi (Alt 1)/ 320 psi (Alt 2)
2 LARGE PUMPS	300 hp
FLOWRATE	1,400 gpm (3 cfs)
2 SMALL PUMPS	150 hp
FLOWRATE	700 gpm
FUTURE PUMPS	(2)-300 hp

PIPELINE ALTERNATIVE 1



HYDRAULIC PROFILE AT 8 MILLION GALLONS/DAY (5,600 GPM)

PIPELINE ALTERNATIVE 2



NOTE:
THE HYDRAULIC GRADE LINE REPRESENTS THE PRESSURE IN A PIPELINE ALONG IT'S ALIGNMENT.

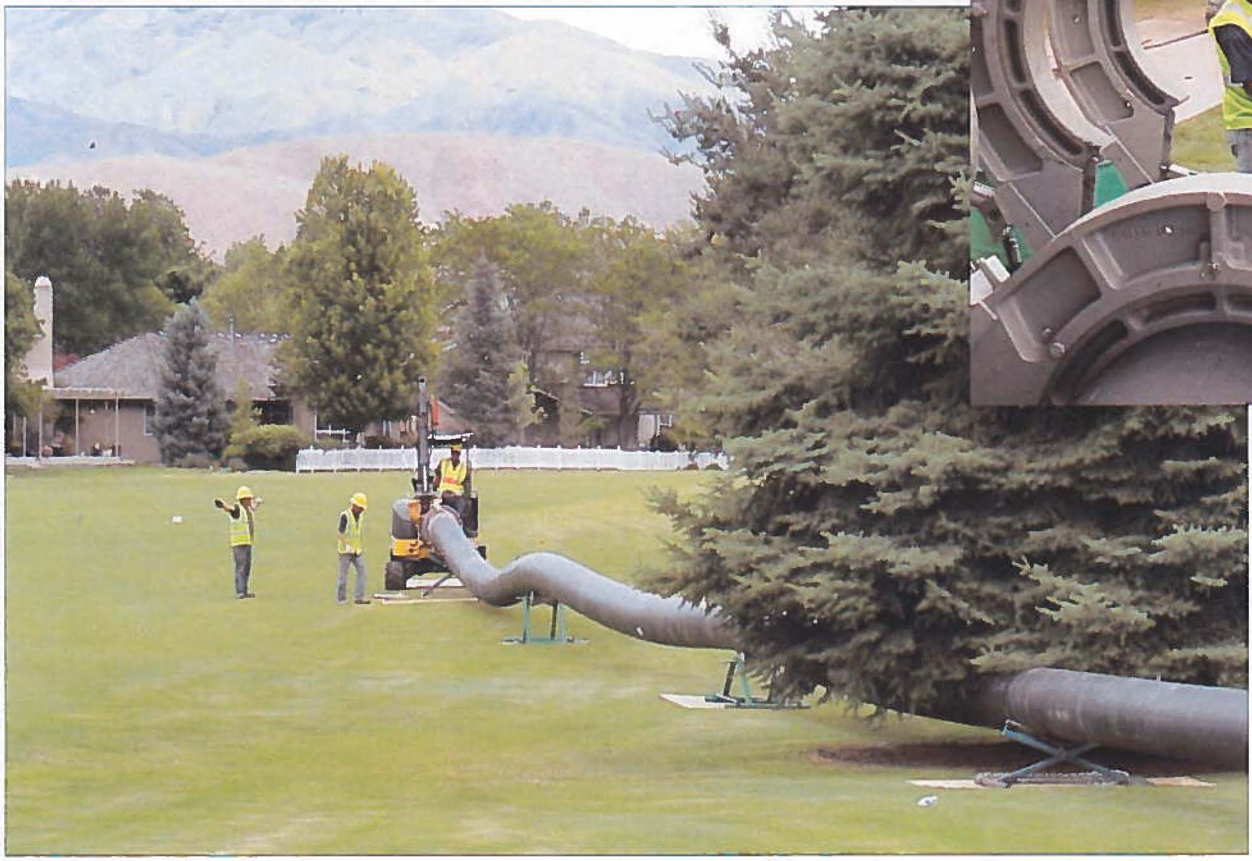
HYDRAULIC PROFILE AT 8 MILLION GALLONS/DAY (5,600 GPM)

STEEL PIPING

FOR HIGH PRESSURES (>100 PSI)

HDPE PIPING

FOR LOWER PRESSURES (<100 PSI)

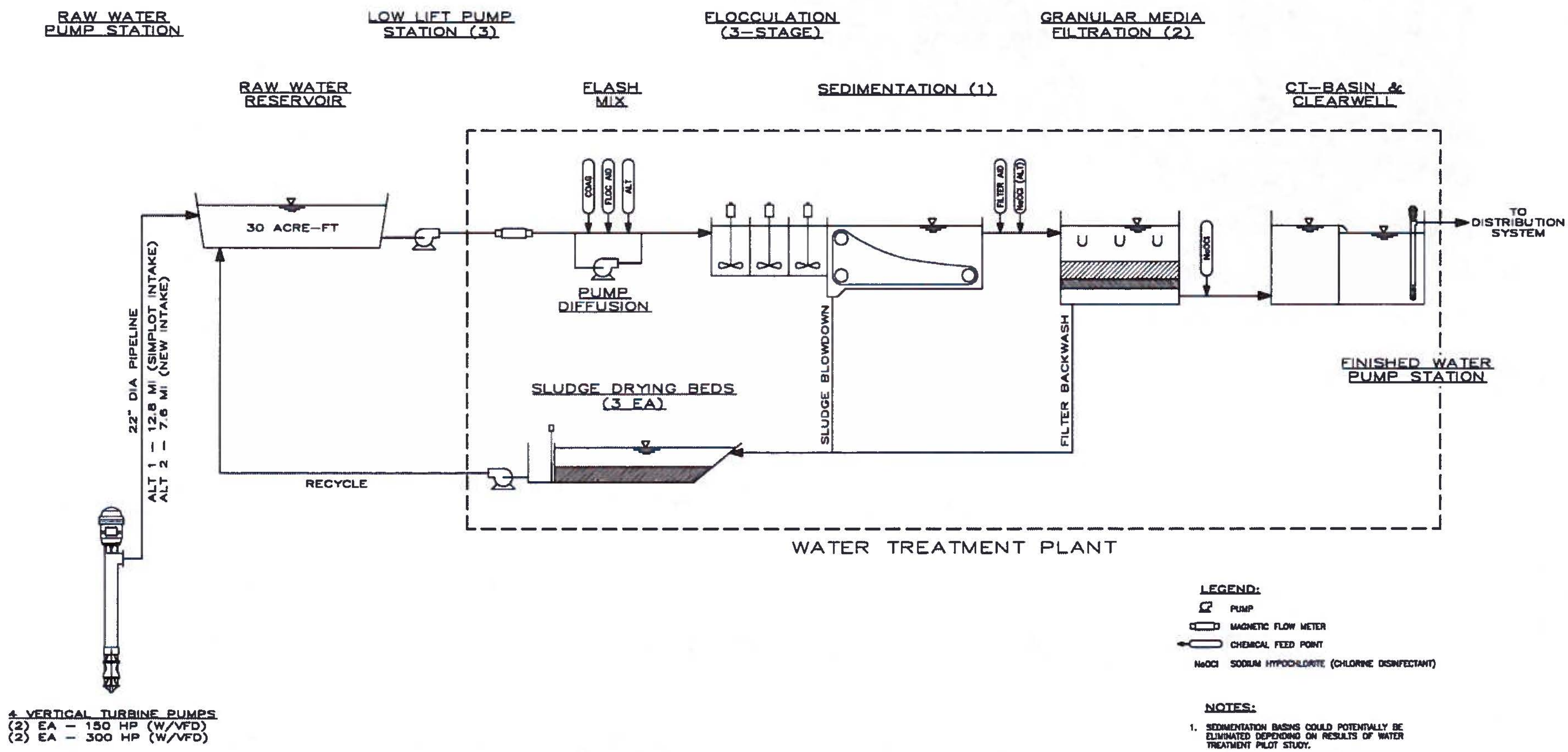


WATER TREATMENT PLANT

- Surface Water must be treated to Drinking Water Standards
- Filtration and Disinfection Required
- Conceptual Design of Treatment Process Includes
  - Coagulation
  - Flocculation
  - Sedimentation
  - Filtration
  - Disinfection

Marden WTP Boise, ID

WATER TREATMENT PLANT
PROCESS FLOW DIAGRAM

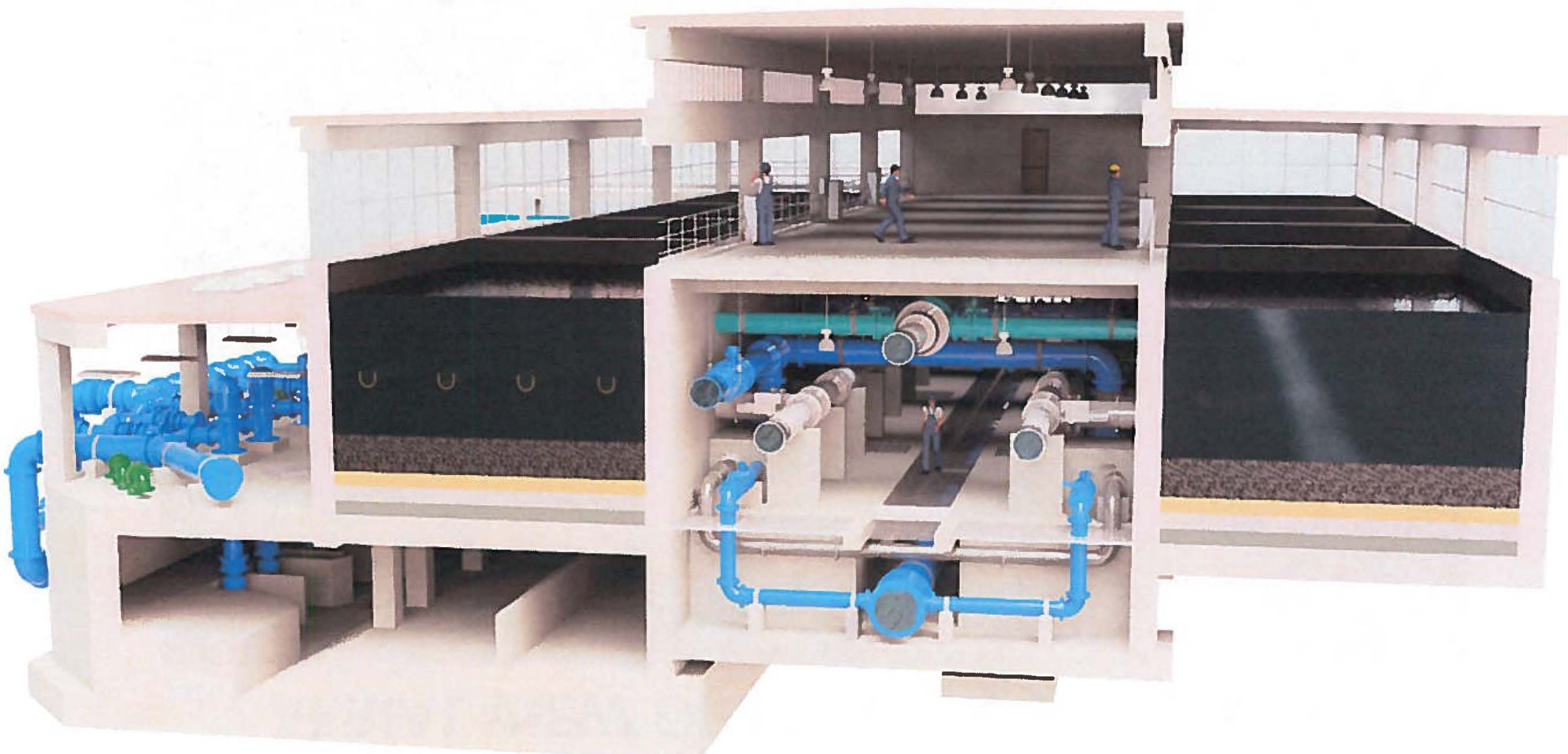


NOTES:

1. SEDIMENTATION BASINS COULD POTENTIALLY BE ELIMINATED DEPENDING ON RESULTS OF WATER TREATMENT PILOT STUDY.
2. MEMBRANE FILTRATION COULD BE SELECTED IN LIEU OF GRANULAR MEDIA FILTRATION AT SOMEWHAT HIGHER COST.
3. FOR INTAKE AND PIPELINE ALTERNATIVE 2, THE LOW LIFT PUMP STATION COULD POTENTIALLY BE ELIMINATED IF THE RAW WATER RESERVOIRS LOCATED AT THE PIPELINE HIGH POINT (NE CORNER OF MHAFB)

PROCESS FLOW DIAGRAM

CROSS SECTION OF WATER TREATMENT PLANT



AERIAL VIEW OF MARDEN WTP (BOISE)

IWRB Water Rights for Project

Water Right No.	Priority Date	Water Use	Authorized Diversion Rate (cfs)	Authorized Annual Vol. (AF)	Combined Volume (AF)
2-10300A	2/25/1963	Irrigation	8.0	1,339.0	1,600
2-10300B	5/10/1965	Irrigation	8.0	not specified	
2-10506	2/25/1963	Irrigation	4.5	900.0	900
TOTAL			12.5 (8.1 mgd)		2,500

Note: Current annual water demand is approximately 1,300 AF (2009-2014).

BUDGETARY COST ESTIMATES (AACEI CLASS 3)

	Alternative 1 West Intake	Alternative 2 East Intake
1. ENVIRONMENTAL PERMITTING	$160,000	$160,000
2. WATER TREATMENT PILOT STUDY	$640,000	$640,000
3. INTAKE PUMP STATION	$4,050,000	$4,050,000
4. RAW WATER PIPELINE	$13,250,000	$6,040,000
5. WATER TREATMENT PLANT	$11,500,000	$11,500,000
TOTAL CAPITAL COST	**$29,600,000**	**$22,390,000**
ANNUAL O&M COST	$882,000	$868,000

Capital costs include permitting, design, and construction.
Annual O&M costs include labor, power, supplies, services, and equipment maintenance.
Anticipated accuracy of AACEI Class 3 Cost Estimates is -15%/+20%.

WATER PLANNING STUDY CONCLUSIONS

- The Project is Feasible – Technical and Regulatory
- Two Alternatives Have Been Developed
- Conceptual Design Has Been Prepared for Major Facilities
- Budgetary Cost Estimates Prepared for Two Alternatives

Memorandum

To: Idaho Water Resource Board

From: Cynthia Bridge Clark

Date: March 7, 2016

Re: Treasure Valley Future Water Demand Study

The Idaho Water Resource Board (IWRB) is partnering with the US Army Corps of Engineers (USACE) in a feasibility study of alternatives to reduce flood risk and meet current and future water supply needs in the lower Boise River watershed. Measures being considered include evaluation of a raise of the Arrowrock Dam, managed recharge, upgraded irrigation headgates, replacement of push-up dams, bridge upgrades, controlled flooding of pits/ponds, temporary conveyance in the floodplain, flow split structures, and other non-structural measures.

To document future water supply needs in the study area, the IWRB contracted with SPF Water Engineering LLC to develop an updated 50-year future water supply needs estimate and water budget for the Treasure Valley. The analysis will be used to support the water supply component of the feasibility study analysis and evaluation of the proposed measures. Specifically, the report characterizes and identifies the following:

1) Water Supply Characteristics of the Treasure Valley
2) Historical and Future Population Projections for the Treasure Valley
3) Current DCMI Water Use
4) Precipitation Deficits and Climate Change
5) Assessments of Potential Water Conservation Measures
6) Water-Demand Projections
7) Mountain Home DCMI Water-Demand Projections

The IWRB has received direction and support from Governor Otter and the Idaho Legislature to address aquifer stabilization and sustainability projects statewide, including the Treasure Valley. This study will provide data and information for use in the development of other projects and strategies to support long-term water management in the Treasure Valley.

A presentation of the report will be given by Christian Petrich, PhD., P.E., P.G. to the IWRB at the March 17th work session. A copy of the executive summary is attached for reference.

REQUIRED ACTIONS: Action is not required by the IWRB at this time.

Treasure Valley DCMI Water-Demand Projections

Idaho Water Resource Board

January 17, 2016

Christian Petrich, Ph.D, P.E., P.G.
SPF Water Engineering, LLC

Outline

- Approach
- Water demand projections
- Sources of supply
- Summary

Overview of Water Demand Projections

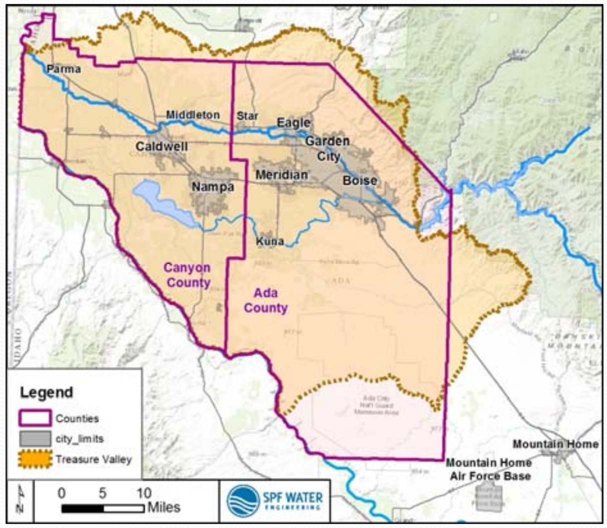
DCMI Water Demand Forecast (AF/yr)					
	2015	2065		% Increase	
		Low	High	Low	High
DCMI Use (AF/yr)	110,000	270,000	393,000	245%	357%
Increase in Net DCMI Demand		160,000	283,000		
Population	624,000	1,573,000		252%	

Approach

- **Estimate current DCMI water use (calculate per capita water use)**
- **Project population, household, and employment growth**
- **Project *indoor* water use based on current per capita use and projected population growth**
- **Project *outdoor* water use based on household growth and irrigated-area assumptions**
- **Adjust for:**
  - **Increasing evapotranspiration as a result of climate change**
  - **Reduce per capita demand through conservation**
  - **Water availability (surface water and groundwater)**

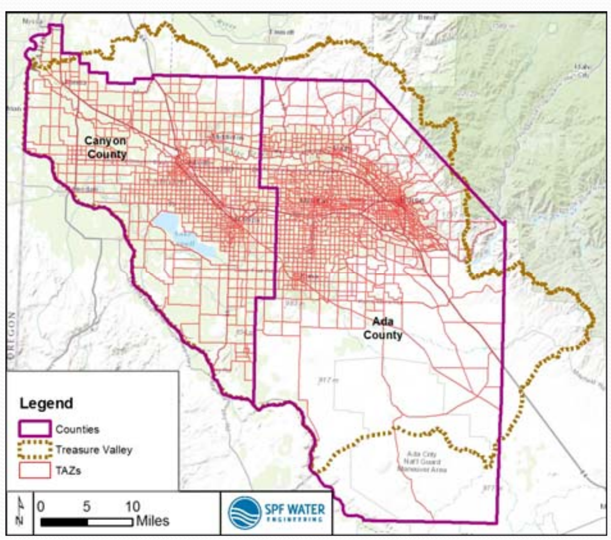
Primary Study Area

- Ada County
- Canyon County



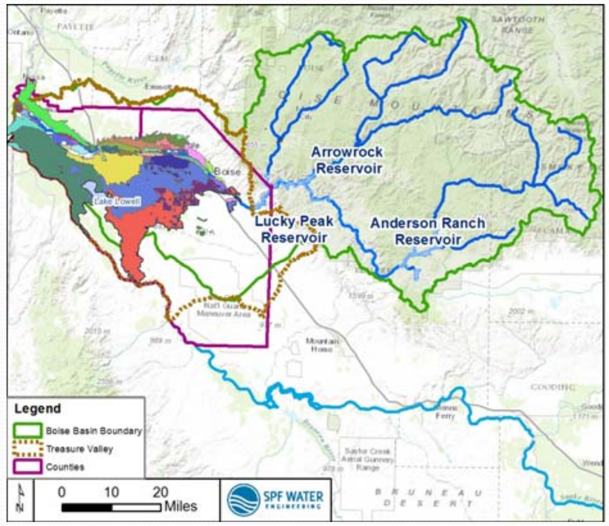
Transportation Analysis Zones (TAZs)

- Used for
  - Existing population estimates (e.g., COMPASS)
  - Population growth projections
  - Water demand projections



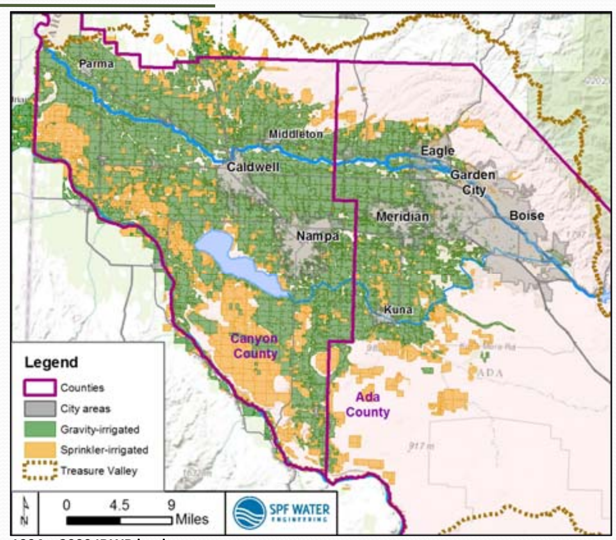
Water Availability

- Water availability influences current and future water use



Water Supply (continued)

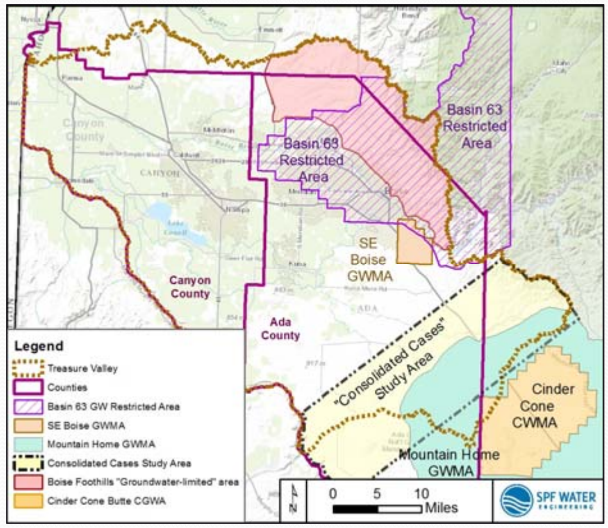
- Assume that
  - Surface water will be used for DCMI irrigation on previously irrigated agricultural land
  - Existing groundwater supplies will meet indoor and outdoor DCMI demand on land where groundwater is currently used for agricultural irrigation



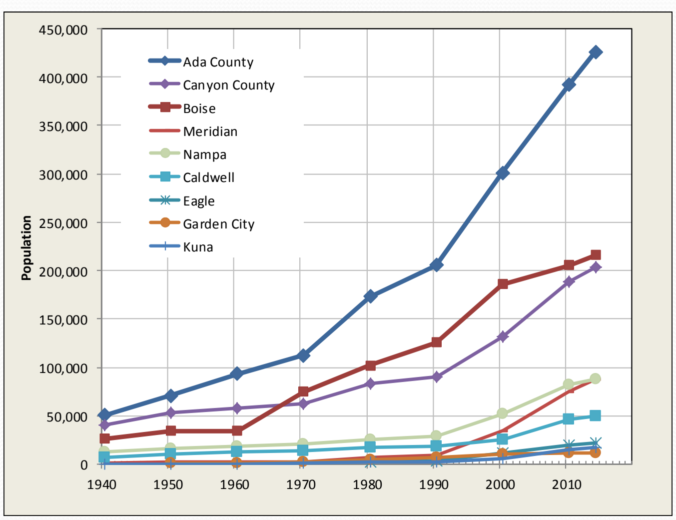
1994 – 2000 IDWR land-use coverage

"Water-Limited" Areas

- Assume per-unit DCMI irrigation will be less in areas of limited supply



Historical Population Growth



Average annual growth:

Ada: 2.9%

Canyon: 2.2%

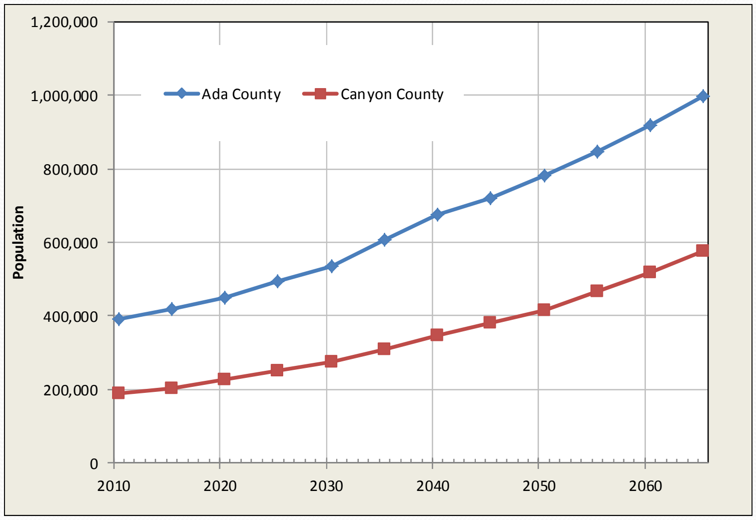
10-yr ranges:

1.4% in 1960-1970

4% in 1970-1980

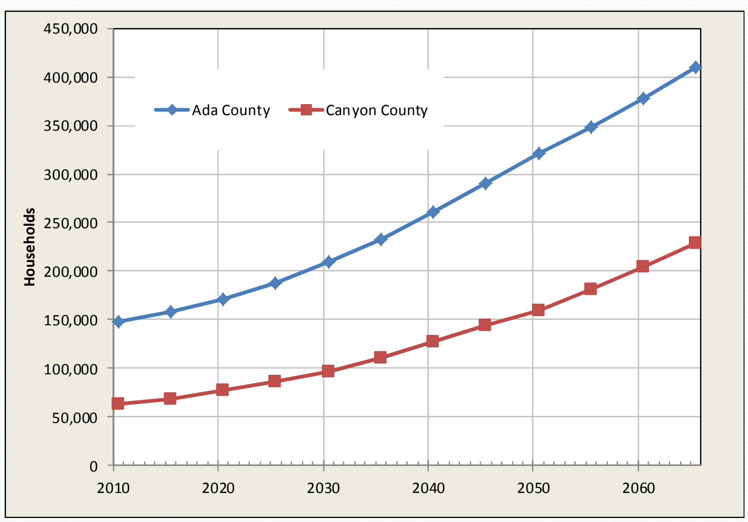
Projected Population Growth

- **2015: 624,000**
- **2065: 1.6 million**
- **Average increase: ~1.9%/yr**

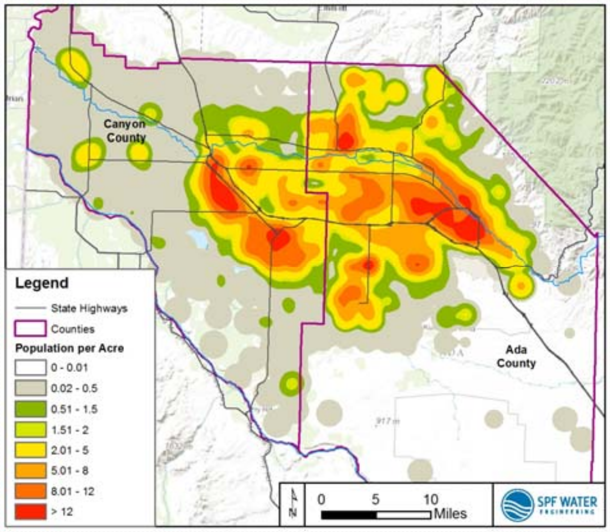


Household Growth

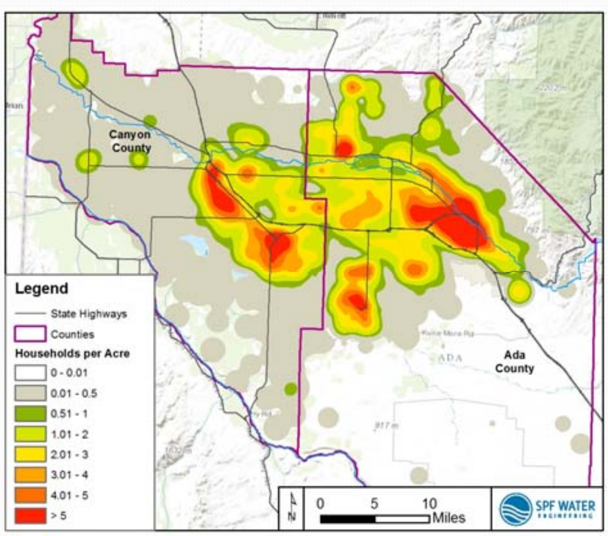
- **2015: 212,000**
- **2065: 639,000**
- **Average increase: ~2.1%/yr**



Population Distribution, 2015-2065

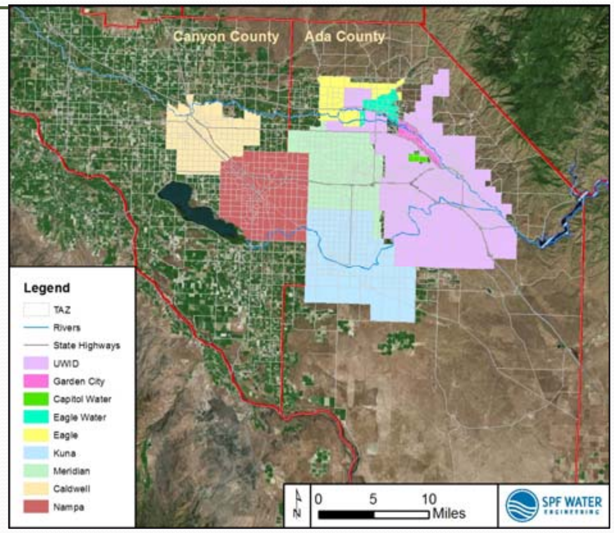


Household Distribution, 2015-2065



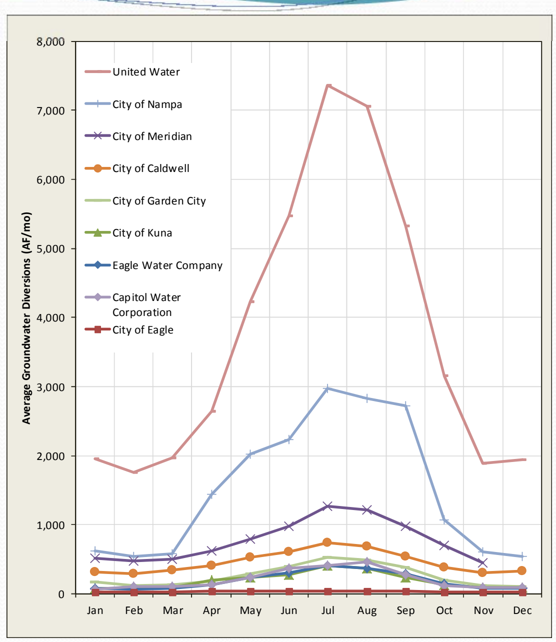
Primary Providers

- Primary DCMI providers supply approximately 90% of DCMI water use



Current Municipal Use

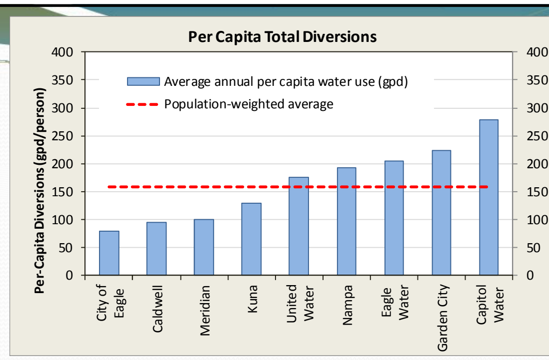
- Variability in summer demand reflects surface-water availability

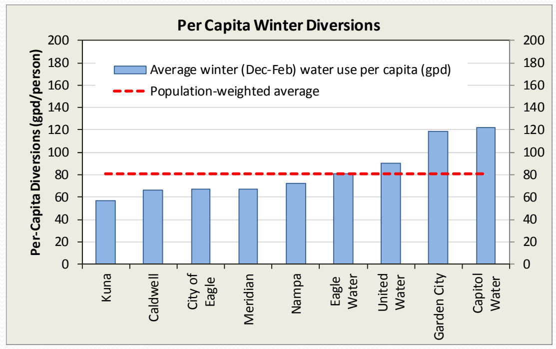


Per Capita Use

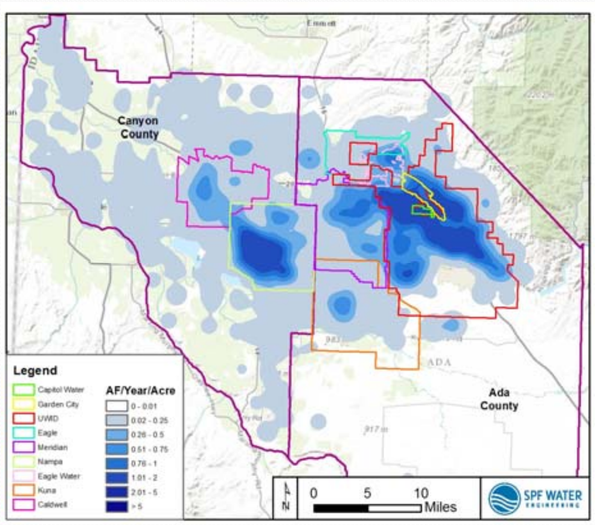
Population-weighted, per capita averages:

- **Annual: 158 gpd (80-278 gpd)**
- **Indoor: 80 gpd (57-122 gpd)**
- **Irrigation: 79 gpd (15-158 gpd)**





Distribution of Estimated 2015 DCMI Use



Project Future DCMI Water Demand

- 4 Scenarios
  - Indoor use based on population
  - Outdoor use based on irrigated area
  - Different levels of conservation and irrigation

Scenario Descriptions				
Scenario →	1	2	3	4
Primary Assumptions	Partial Irrigation (assume that either 75% of irrigable area is fully irrigated or 100% of irrigable land is irrigated with 75% of the water needed for fully-irrigated turf)			Full Irrigation (assume 100% of DCMI land is irrigated with 100% of the water needed for turf)
	No Conservation (Baseline)	Moderate Conservation	More Aggressive Conservation	Moderate Conservation
	No conservation	20% reduction in indoor use in new construction 10% reduction in outdoor use in existing and new construction	30% reduction in indoor use in existing and new construction 30% reduction in outdoor use in existing and new construction	Full water use 20% reduction in indoor use in new construction 10% reduction in outdoor use in existing and new construction

Density – Irrigation Assumptions

Assumed DCMI Irrigated Area (Non-Water-Limited Areas)			
Density (units per acre)	Assumed Irrigated Area per Household (ac/unit)	Assumed Irrigated Area per Household (ft^2/unit)	Total Irrigated Area per Acre (ac)
0	—	—	—
0 - 1.99	0.15	6,530	0.30
2 - 3.99	0.15	6,530	0.45
4-5.99	0.07	3,050	0.35
6+	0.02	870	0.16

Assumed DCMI Irrigated Area (Water-Limited Areas)			
Density (units per acre)	Assumed Irrigated Area per Household (ac/unit)	Assumed Irrigated Area per Household (ft^2/unit)	Total Irrigated Area per Acre (ac)
0	—	—	—
0 - 1.99	0.075	3,270	0.15
2 - 3.99	0.05	2,180	0.15
4-5.99	0.03	1,310	0.15
6+	0.015	650	0.12

- **Assume that 75% of irrigable urban land is irrigated, *or* that 100% is irrigated with 75% of necessary water for turf**

Climate Change

- **Assume 10% increase in precipitation deficit by 2065 (reflecting increased ET)**

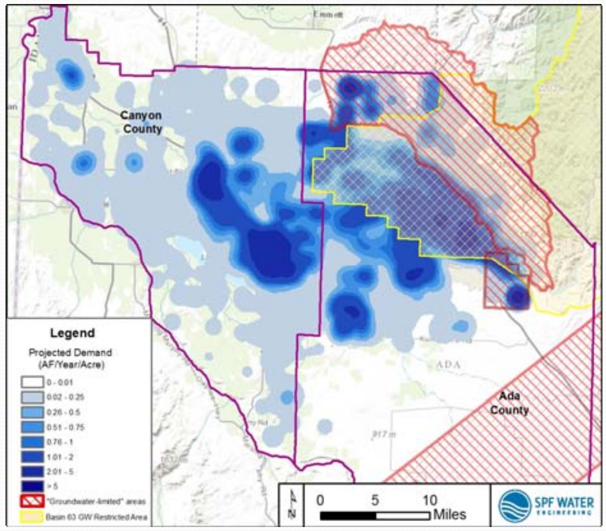
Projected Average Temperature and Precipitation Changes in the Pacific Northwest		
Period	Temperature Change (F°)	Precipitation Change (%)
2021-2050	+2.5 (+1.1 to +3.6)	+1.5 (-5 to +8)
2041-2070	+4.0 (+1.9 to +6.1)	+3.0 (-5 to +11)
2070-2099	+6.5 (+2.9 to +10.9)	+5.0 (-7 to +20)
Source: Interpreted from maps presented in Kunkel et al., 2013.		

Projected Increase in Water Demand

Projected Water Demand Increases, 2015-2065 (AF/yr)					
	Scenario →	1	2	3	4
Component	2015	Partial Irrigation, No Conservation	Partial Irrigation, Moderate Conservation	Partial Irrigation, More Aggressive Conservation	Full Irrigation, Moderate Conservation
Net DCMI indoor	55,700	76,600	61,300	37,500	61,300
Net DCMI irrig.	54,500	189,200	166,800	122,100	221,700
Net DCMI Total	110,200	265,800	228,100	159,600	283,000

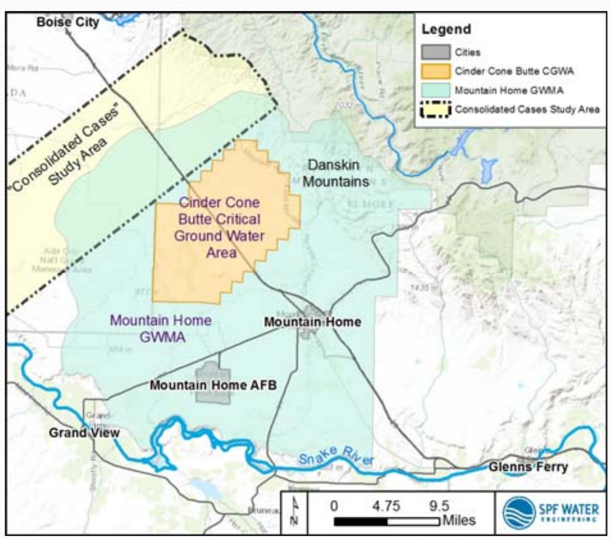
Water Demand Distribution

- **2015 (with current water-provider areas)**
- **2065**
- **2065 (with "groundwater-limited" areas)**



Mountain Home

- **Water supply is constrained**
- **Absent changes, Elmore County population may decrease, with associated water-demand decrease**
- **Expansion of MHAFB or other economic activity could lead to increases in water demand**



Factors Influencing Demand Projections

- Population and households different than those projected
- Average irrigated area per new household different than projected
- Surface-water availability constraints (e.g., consecutive drought years could lead to increased DCMI irrigation)
- Surface-water delivery-system constraints
- Higher than projected summer temperatures
- Conservation assumptions not realized
- Substantial increases in the cost of water

Future Sources of Supply

- Groundwater
  - 20% increase simulated with TVHP model
  - Impact to groundwater levels of less than 10 feet in many places
  - Primary impact: reduce discharge to drains, Boise River, Snake River
- Diversions from Boise River
  - Use of increased surface-water storage
  - Use of flood flows for aquifer storage and recovery
  - Direct diversions below Star Bridge
  - Use of existing surface water supply
- New diversions from Snake River
- Re-use of treated municipal effluent
- Conservation

Summary

- **Water demand could increase by 160,000 to 283,000 AF per year by 2065, depending on**
  - **Actual population increase (currently projected to increase from 624,002 approximately 1.6 million)**
  - **Location of population growth**
  - **Density**
  - **Water availability**
  - **Cost of water and other conservation incentives**
  - **Future climate conditions**

TREASURE VALLEY
DCMI WATER-DEMAND PROJECTIONS
(2015-2065)

Prepared for:

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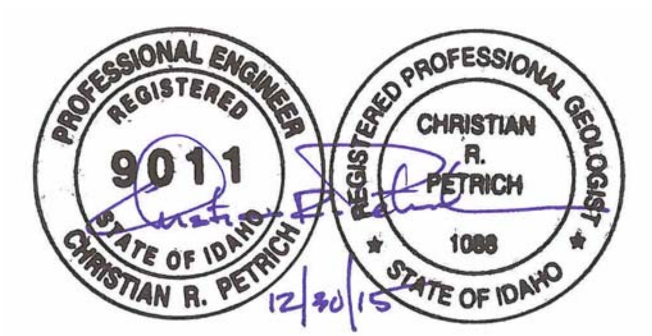

Final Draft
December 2015

SPF WATER ENGINEERING

Executive Summary

The purpose of this Treasure Valley water-demand forecast was to (1) estimate current DCMI water use and (2) project the amount of additional water needed to supply domestic, commercial, municipal, and industrial (DCMI) water demand by the year 2065.

The primary conclusion from this analysis is that the net DCMI water demand[1] could increase from 110,000 AF/year in 2015 to between 270,000 and 394,000 AF/year by the year 2065. This represents a DCMI water-demand increase of 160,000 to 283,000 AF/year.

Specific conclusions include the following:

1. The Treasure Valley population is expected to increase from approximately 624,500 people in 2015 to approximately 1.57 million people by the year 2065; the number of households is expected to increase from approximately 226,600 in 2015 to 638,700 in the year 2065.
2. Average temperatures by the year 2065 could increase by approximately 1.9°F to 6.1°F. Summary evapotranspiration could increase by approximately 5 to 20 percent as a result of temperature increases.
3. Substantial water-demand reductions are possible through conservation. These Treasure Valley DCMI water-demand projections included reductions in water use (compared to 2015 rates) of 10 to 30 percent.
4. While all of the projections have inherent uncertainty, Scenario 2 (a DCMI water-demand increase of approximately 228,000 AF by the year 2065, excluding demand met by currently-developed surface water and groundwater supplies) was deemed more probable than the other scenarios.
5. Options for supplying the increased net DCMI demand could include (1) diversions from the Boise River (through increased surface-water storage, use of flood flows for aquifer storage and recovery strategy, or direct diversions from the Boise River below Star, Idaho), (2) additional development of Treasure Valley groundwater, (3) new diversions from the Snake River, or (4) reuse of treated municipal effluent.
6. Surface water from existing agricultural irrigation could become more available for DCMI uses in the future. However, this would likely require (1)

[1] The "net DCMI water demand" is the demand that will not be met by surface water and groundwater supplies already in use for agricultural irrigation.

market incentives to cover the costs of delivery-system improvements and operations and (2) changes in existing Boise River basin storage contracts.

7. The Elmore County population is projected to decrease from approximately 27,000 people in 2010 to 22,400 people in 2065. Absent increased economic activity at the MHAFB or in the City of Mountain Home, the DCMI water demand is projected to decrease over the next 50 years. However, expansion of the MHAFB or development of other economic activity in the Mountain Home area could lead to population increases with associated increases in future DCMI water demand.

Acknowledgements

The following entities and individuals contributed to this report:

1. SPF Water Engineering, LLC (SPF) prepared estimates of existing water use, developed the water-demand forecasting tool, and projected future water use. Individuals contributing to this effort included Christian Petrich (project manager, primary author), Breanna Paulson (data compilation, GIS), Lori Graves (GIS), Roxanne Brown (GIS analysis), and Terry Scanlan (review).
2. John Church (Idaho Economics) provided historical population data and forecasts of future population, households, and employment growth.
3. Bob Taunton (Taunton Group) reviewed various regional planning documents and interviewed city and county planning officials to help project future urban growth patterns and household density.
4. The Idaho Department of Water Resources (Randy Broesch, Cynthia Bridge-Clark, and Neeley Miller) provided general project guidance, study oversight, or report review.

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APPENDICES

1 INTRODUCTION

1.1 Background

The Treasure Valley of southwestern Idaho (Figure 1) is home to about 630,000[2] people, or approximately 38 percent of Idaho's 1.64 million[3] residents. Most of the valley's residents live in or near the cities of Boise, Meridian, Nampa, Caldwell, Garden City, Eagle, and Kuna. The Treasure Valley is one of Idaho's fastest growing areas: the two primary counties – Ada County and Canyon County – grew approximately 46 percent between the years 2000 and 2014; the population more than doubled between 1990 and 2014.

Concerns about projected population growth – and the ability of existing resources to meet future water demand – has led to a renewed interest in expanding Boise River basin storage. In response, the U.S. Army Corps of Engineers (USACE) and Idaho Water Resource Board (IWRB) are partnering on an assessment of Boise River basin storage requirements. Part of this assessment includes projecting future Treasure Valley water demand for domestic, commercial, municipal, and industrial (DCMI) purposes. Thus, the IWRB, through the Idaho Department of Water Resources (IDWR), retained SPF Water Engineering, LLC (SPF) to update forecasts of future Treasure Valley DCMI water demand.

1.2 Purpose and Objectives

The purpose of the Treasure Valley water-demand forecast was to estimate current DCMI water use and project the amount of additional water needed to supply DCMI water demand from 2015 to 2065. Specific objectives included the following:

1. Review the most recent Treasure Valley water-demand projections (i.e., Cook et al., 2001; WRIME, 2010).
2. Compile existing DCMI water-diversion data, focusing on the largest Treasure Valley DCMI providers (United Water Idaho, Capitol Water Corporation, Eagle Water Company, City of Eagle, Garden City, City of Kuna, City of Meridian, City of Caldwell, and the City of Nampa.
3. Prepare estimates of per capita water use during the winter (i.e., the December through February non-irrigation season) and annual per capita water use based on the data collected from DCMI purveyors.

---

[2] See Section 5.

[3] 2014 US Census Bureau data.

4. Project Treasure Valley population, number of households, and employment over the next 50 years.
5. Define Treasure Valley subregions based on water availability, i.e., (1) areas in which surface water is currently used for irrigation purposes, (2) areas in which surface water is not available but additional groundwater is likely available for development, and (3) areas in which neither surface water nor groundwater is available in sufficient amounts to supply anticipated population growth.
6. Project the spatial distribution of population, household, and employment growth.
7. Review recent climate-trend projections; prepare an estimate of increased evapotranspiration over the next 50 years as a result of increasing average summer temperature for use in projecting future DCMI irrigation requirements.
8. Evaluate potential DCMI water-demand reductions as a result of water conservation.
9. Project future DCMI water demand based on existing water-use patterns, population and household projections, water availability, projections of climate-variability impacts, and conservation potential.
10. Compile existing DCMI water use data, project population growth for the City of Mountain Home and the Mountain Home Air Force Base, and prepare preliminary projections of future DCMI water demand for those areas.
11. Prepare a report (this document) presenting (1) existing DCMI water-use data, (2) estimates of per capita water use, (3) Treasure Valley population projections, (4) maps showing the general Treasure Valley subregions defined based on water availability, (5) the spatial distribution of population and growth in the number of households, (6) a review of climate projections, (7) a review of potential future DCMI water conservation effects, and (8) future water-demand projections. The summary report also includes a discussion of possible sources of water to meet the projected DCMI water demand (e.g., surface water, groundwater, new basin storage, etc.).

1.3 Study Area

For the purposes of this study, the Treasure Valley is defined as the area between the Boise foothills and the Snake River (Figure 1).[4] The Treasure Valley encompasses the lower Boise River basin, although some surface water and groundwater in the southern portion of the valley drains or discharges directly toward the Snake River.

This study also included compiling existing water-use data for the City of Mountain Home and the Mountain Home Air Force Base, both of which are in the Mountain

[4] The study area does not include the Payette River basin.

Home Plateau and outside the Treasure Valley. The USACE is not currently evaluating the possible use of storage water from the Boise River basin in the Mountain Home Plateau. However, limited water supply and groundwater-level declines in the Mountain Home Plateau prompted IWRB interest in projecting future DCMI water use in the Mountain Home Plateau area as part of this effort.

1.4 Report Organization

This report presents DCMI water-demand projections (and supporting information) for the Treasure Valley. The report is organized into the following sections:

Section 1: Introduction.

Section 2: Review of previous water-demand projections.

Section 3: Overview of approach and methodology.

Section 4: Summary of Treasure Valley water-supply characteristics.

Section 5: Review of historical population-growth trends.

Section 6: Projections of population, households, and employment.

Section 7: Estimate of current Treasure Valley DCMI water use.

Section 8: Discussion of precipitation deficit and potential climate-change impacts.

Section 9: Review of water conservation and reuse potential.

Section 10: Treasure Valley DCMI water-demand projections.

Section 11: Conclusions.

Supporting materials are provided in appendix and electronic form.

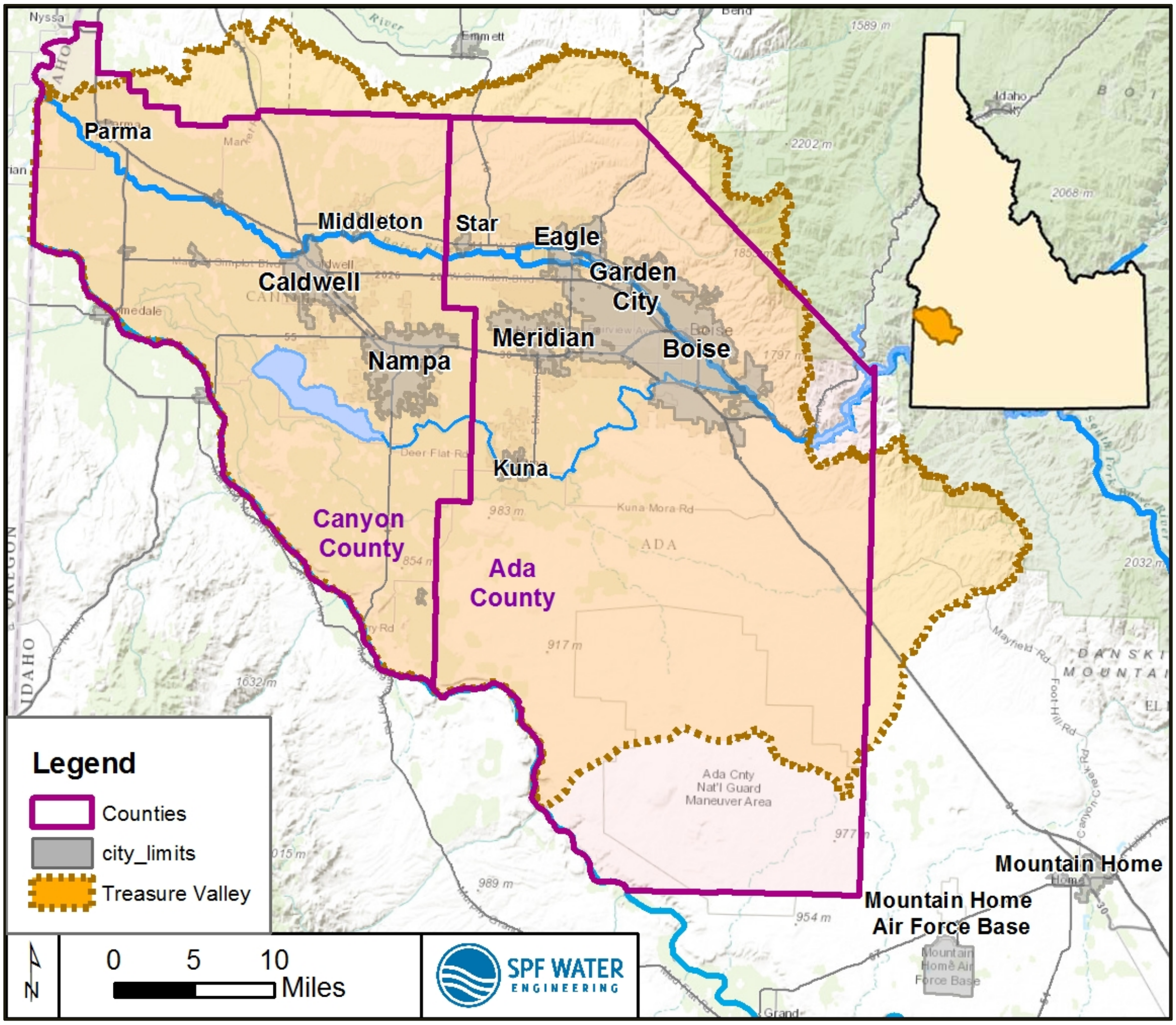

Figure 1. Study area.

2 PREVIOUS WATER-DEMAND PROJECTIONS

Future Treasure Valley DCMI water demand has been projected in two previous studies. The first (Cook et al., 2001) projected DCMI demand in Ada and Canyon counties to the year 2025. Subsequently, WRIME (2010) projected future water demand through the year 2060 as part of the IWRB's Treasure Valley Comprehensive Aquifer Management Plan (CAMP) process. Results from these previous water-demand projections are summarized below.

2.1 Cook et al. (2001)

Cook et al. (2001) estimated that the total DCMI water use between 1997 and 1998 was approximately 33.6 billion gallons of water per year (approximately 103,000 AF/year). The authors projected a 74 percent increase in water demand – to approximately 58.5 billion gallons per year (approximately 179,000 AF/year) – by the year 2025. The authors also noted that between 76,000 to 96,000 additional acre-feet of water will be needed to accommodate water demand by the year 2025.

Baseline water use was estimated based on a sampling of water use by United Water Idaho customers. The study differentiated between single-family dwellings, apartments, and mobile homes for residential use. Municipal, commercial, and industrial uses were based on the number of employees by Standard Industrial Code (SIC) and coefficients representing the amount of water used per employee within a SIC group.

Baseline per capita water use (based on the United Water Idaho data) was extrapolated to the rest of the Treasure Valley. Based on average annual data, Cook et al. (2001) estimated that a single-family household used 194 gallons per person per day, apartment dwellers used 82 gallons per person per day, and mobile home residents used 150 gallons per person per day. Over 50 percent of this average use was attributed to irrigation.

The authors noted a lack of data regarding groundwater and surface water use by commercial users. Thus, commercial and industrial water demand was estimated based on business type. The number of employees – classified by Standard Industrialization Classification (SIC) codes – and water-demand coefficients per employee per SIC code were used to estimate commercial and industrial demand. Projections of future employment were used to project future commercial and industrial water demand.

2.2 WRIME

More recently, WRIME (2010) projected that the total Treasure Valley water demand will increase from 1,715,948 acre-feet (AF)[5] per year in 2010 to 1,798,837 AF/year by the year 2060,[6] a net increase of 82,889 AF/year (Table 1). WRIME projected that DCMI demand will increase from approximately 228,000 AF/year in 2010 to 962,000 AF/year by the year 2060,[7] an increase of 734,000 AF, or 321 percent. WRIME also projected that agricultural water demand will decrease from 1,487,412 AF/year to 836,760 AF/year under average-year conditions by the year 2060, a decrease of 650,652 AF/year, or 44 percent. Implicit in WRIME's projections was that water previously used for agricultural irrigation would become available for DCMI uses, resulting in a projected 82,889-AF/year net Treasure Valley water-demand increase by the year 2060.

WRIME's projections were made based on (1) a survey (or estimate) of existing water production by United Water Idaho, Capitol Water Corporation, Eagle Water Company, Garden City, Kuna, Meridian, Star, Caldwell, Greenleaf, Melba, Middleton, Nampa, Notus, Parma, and Wilder and (2) population projections prepared by the Community Planning Association of Southwest Idaho (COMPASS) through the year 2035 (COMPASS, 2010) that were then extrapolated to the year 2060. WRIME projected population growth beyond the year 2035 by extrapolation based on a uniform rate (2 percent for the Boise area and 2.1 percent for the rest of the Treasure Valley).

WRIME estimated current average annual water use rates on a per capita basis for Treasure Valley cities (WRIME, 2010, page 3-13). WRIME estimated that the annual DCMI production in 2010 was 0.18 AF per capita (or approximately 160 gallons per person per day), and that the annual "DCMI delivered" was 0.13 AF per capita (or approximately 116 gallons per person per day).[8]

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[5] One acre foot is the volume of water required to cover one acre with one foot of water. One acre foot is equivalent to 325,850 gallons or 43,560 cubic feet (ft^3).

[6] 2010 report, page 6-2.

[7] 2010 report, page 6-1.

[8] WRIME defines the difference between "water production" and "water delivered" (WRIME, 2010, pg. 2-9) as "unaccounted water," which consists of fire protection, system flushing, water lost to the system, etc.

Summary of 2010 Water Demand Projections[1] (AF/Year)			
Year	**DCMI**	**Agricultural[2]**	**Total**
2010	228,535	1,487,412	1,715,947
2020	307,210	1,413,773	1,720,983
2030	416,050	1,375,116	1,791,166
2040	564,491	1,171,831	1,736,322
2050	759,797	977,256	1,737,053
2060	962,077	836,760	1,798,837
Net projected change, 2010-2060	733,542	-650,652	82,890
Percentage change, 2010-2060	321%	-44%	5%

Notes:
(1) Taken from WRIME (2010), Tables 6-1, 6-2, and 6-3.
(2) "Average" moisture conditions.

Table 1: Summary of WRIME's 2010 projections.

3 OVERVIEW OF APPROACH AND METHODOLOGY

This section outlines the approach and methodology used to project future DCMI water use in the Treasure Valley area.

3.1 Scope

This effort focused on projecting future water demand driven by anticipated urban population growth. The rationale for focusing on DCMI demand, much of which will be delivered via municipal water systems, was as follows:

1. Much of the projected future Treasure Valley population will live and work in areas served by municipal suppliers. Projecting future DCMI demand is the first step in determining whether or not existing water supplies will be sufficient to support the anticipated population growth.
2. The USACE is currently considering alternatives for increased Boise River basin storage. Projecting future DCMI demand provides the basis for assessing the need for increased storage.
3. Surface water from the Boise River will require treatment if used for municipal purposes. Municipal entities that supply DCMI water (as opposed to individual domestic or commercial users) are more likely to have the resources to construct surface-water treatment facilities (thereby taking advantage of increased Boise basin storage) and spread the cost of water treatment over multiple users.
4. New Boise River storage would operate under junior-priority water rights that may not be filled every year. Most Treasure Valley municipal water delivery entities have existing wells from which to draw water when surface water is not available. Surface water could be used in years in which it is available to allow groundwater levels stressed by pumping to recover. Thus, DCMI users may be able to take advantage of increased storage in ways that other user groups cannot.
5. Use of new storage water for DCMI purposes may be more cost-effective than providing new storage for other uses (e.g. agricultural use) because the cost can be shared by more users.
6. Future rural domestic water users, while contributing to the overall Treasure Valley DCMI demand, may not benefit directly from increased Boise River storage, because the infrastructure required for delivering upper Boise River basin storage water to rural domestic users likely is not cost-effective.

7. New, large, self-supplied industrial users[9] may seek to take advantage of new Boise River storage, and availability of new storage may influence siting decisions. Siting criteria for new enterprises could include water availability, supply certainty, and other factors. However, while new large industrial users may seek to locate in areas where upper Boise River storage water would be available, they may also seek to locate in areas where groundwater is available, or where existing surface water may be available, such as near the Boise River below Star (Figure 1), where irrigation return flows represent a water supply, or near the Snake River. Current policy decisions may influence future industrial siting decisions, but general projections of water demand for large, self-supplied industrial users are uncertain, and therefore not considered in this analysis.

For these reasons, the projections made as part of this Treasure Valley study were limited to future DCMI water demand, most of which likely will be met by established municipal water purveyors.

3.2 Overview of Approach and Methodology

Our approach for projecting Treasure Valley water demand consisted of (1) reviewing water-supply characteristics, (2) reviewing historical population growth rates, (3) projecting future population, household, and employment growth, (4) estimating current DCMI water use and developing estimates of current per capita DCMI water use, (5) projecting changes in evapotranspiration as a result of climate change, (6) examining the potential water-demand reductions as a result of water conservation, (7) projecting future indoor[10] and outdoor DCMI water demand, and (8) briefly consider possible sources of supply for the increased DCMI demand. The following subsections provide an overview of this approach; additional detail is provided in subsequent report sections.

3.2.1 Review Treasure Valley Water Supply Characteristics

The first step in this analysis was to review Treasure Valley water-supply characteristics. This step is important because future water use in areas of limited water supply (e.g., portions of the Boise Foothills) will likely be less than in areas of abundant supply. Also, it is important to acknowledge existing, developed surface

[9] "Self-supplied" industrial users are those that do not receive water from the municipal system but instead pump water from private wells (or divert surface water from private points of diversion).

[10] For the purposes of this report, “indoor water use" describes water used for indoor, potable uses (e.g., culinary, etc.) by residential, commercial, and industrial users.

water and groundwater supplies that can be used to meet future DCMI demand (reducing the need for water from new sources).

3.2.2 Review Historical Population Growth Rates

This review was conducted using US Census Bureau data. These data were used to compare 10-year Treasure Valley growth rates since 1940.

3.2.3 Project Future Population, Number of Households, and Employment

The Treasure Valley future DCMI water-demand projections were based, in part, on projections of future population and households.[11] Projections of population, households, and employment prepared for the COMPASS (2014) Communities in Motion 2040 transportation plan were extrapolated to the year 2065, and refined based on local knowledge.

COMPASS projects future population, households, and employment as a basis for regional transportation planning. The Communities in Motion transportation plan is used to set priorities for federal and state transportation funding for infrastructure projects in Ada and Canyon counties. Development of the COMPASS projections was overseen by a Demographic Advisory Committee.[12] The committee[13] used several methods and data sets in developing the Communities in Motion 2040 projections, including (1) economic forecasts for the Boise Metropolitan Statistical Area prepared by Woods & Poole,[14] (2) historical trends, (3) ratios (projections based on relationships of population growth in the Treasure Valley with that of the state or country), and (4) comparisons with peer or analogous areas (i.e., comparisons with other urban areas having similar demographic and growth characteristics). Committee members then examined building permit and employment information, subdivision platting activity, population forecasts, and other data providing insight about the location, type, and pace of regional growth in preparing population, households, and employment projections. In contrast to previous transportation plans, the Communities in Motion 2040 projections took into account local comprehensive plans and projected densities.

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[11] The term "household" refers to an occupied dwelling unit. The number of households excludes unoccupied homes.

[12] http://www.compassidaho.org/people/dac.htm.

[13] Committee members include representatives from Ada County, Canyon County, Ada County Highway District, Boise State University, the Idaho Transportation Department, and the cities of Boise, Caldwell, Eagle, Garden City, Kuna, Meridian, Middleton, Nampa, Parma, and Star.

[14] Woods & Poole Economics, Inc., Washington DC.

The Communities in Motion 2040 regional transportation plan culminated in the prioritization of 33 transportation corridors and project improvements. In addition to roadway improvements, the corridor improvements include high-capacity transit for State Street (Highway 44) and a route parallel to Interstate 84, as well as multi-modal infrastructure and services throughout the region.

COMPASS developed population, households, and employment projections for each of the 2,062 individual Transportation Analysis Zones (TAZs) in Ada and Canyon counties. Individual TAZs (Figure 2) range in size from 1.2 acres to approximately 125,500 acres. The TAZs provide a convenient basis for projecting the future water demand in the Treasure Valley on a spatial basis. The number and size of TAZs, which are smaller in areas of high population density, provide a basis for approximate delineations of future water demand in areas with varying water-supply characteristics. The TAZs provide greater resolution of demographic distributions (and therefore water-demand distributions) than ZIP Codes (of which there are many fewer, and some of which extend beyond county boundaries), municipal boundaries (which change over time), and municipal water-provider boundaries (for which current populations have not been well defined and which change over time).

The COMPASS projections extend only through the year 2040. John Church (Idaho Economics) extended the projections from 2040 through 2065 by semi-logarithmic extrapolation on a TAZ by TAZ basis. Mr. Church then checked the extrapolated projections using the Idaho Economics Forecasting Model, which was previously used for projecting population, household, and employment for the Rathdrum Prairie water-demand projections (SPF et al., 2010).

Finally, the projections were refined based a review of comprehensive plans and on information from key land-use professionals and developers regarding regional infrastructure planning, land ownership, possible environmental constraints, and anticipated growth and market trends.

3.2.4 Estimate current DCMI Water Use

Estimates of current water use (Section 7) formed the foundation for future water-use projections. Current DCMI water use was estimated with monthly production data collected from primary municipal providers (United Water Idaho, City of Nampa, City of Meridian, City of Caldwell, City of Kuna, City of Garden City, Eagle Water Company, Capitol Water Corporation, and the City of Eagle).

Municipal groundwater pumping (or surface-water diversions) includes water for indoor and outdoor uses, the latter being primarily for irrigation. Indoor use was estimated based on the average use during the months of December, January, and February. It was assumed that indoor use during all 12 months of the year was the same as the December through February average indoor use. Outdoor (mostly irrigation) use was estimated as the difference between total reported production and estimated indoor use.

The indoor per capita use estimates include water used by domestic (including residential, apartment, mobile home, etc.), commercial, industrial, and institutional users. Some DCMI providers track customer type (e.g., residential, commercial, etc.), which is information that theoretically could be used to disaggregate the indoor per capita water-use estimates by user type. However, such customer-class data were unavailable for all but the largest municipal suppliers, and then only in inconsistent forms.

Per capita water-use estimates were made using purveyor-reported production data and purveyor-supplied population estimates. Purveyor-supplied population estimates may not be as accurate as the census data, but the census data are difficult to disaggregate to purveyor boundaries (in part because some of the purveyor boundaries do not follow urban boundaries, overlap in some places, and do not consistently follow TAZ boundaries). Average per capita water use estimates based on data from the larger Treasure Valley providers were then used to estimate water use by small municipal water systems and rural domestic users.

3.2.5 Precipitation Deficit and Climate Change

Precipitation deficit (e.g., net irrigation demand) was estimated for fully-irrigated turf based on weather data in Boise, Nampa, and Caldwell. A review of regional climate-change projections were used to forecast an average increase in precipitation deficit over the next 50 years (see Section 8).

3.2.6 Water Conservation

Substantial reductions in water demand can be achieved through water conservation. Some level of water conservation will occur as a result of recent building code requirements and plumbing-fixture availability. Several of the municipal water purveyors in the Treasure Valley have water conservation programs that encourage reduced water use.

Greater levels of water conservation may be achievable, but would be based on policies or pricing structures that have not yet been enacted. Nonetheless, this report presents a scenario that incorporates potential water conservation measures to illustrate potential future savings. Conservation assumptions and results are presented in Section 9.

3.2.7 DCMI Water-demand Projections

Projecting future DCMI water demand (Section 10) consisted of projecting indoor DCMI water demand and DCMI irrigation.[15] Future indoor water demand was

[15] As used in this report, the term "DCMI irrigation" refers to (1) the urban irrigation demand supplied by municipal potable water systems rather than from non-potable surface-water and groundwater

projected by TAZ based on (1) estimated current per capita water demand for indoor uses (Section 7) and (2) projected population growth (Section 6). The per capita estimates represent an aggregate of domestic, commercial, industrial, and institutional users. It was assumed that this current ratio of residential, commercial, industrial, and institutional use would remain the same over the next 50 years.

Policies or pricing structures encouraging water conservation could serve to reduce existing per capita water-demand rates over the next 50 years. Possible reductions in per capita water demand as a result of water conservation were incorporated in the indoor water-demand projections (Section 9).

In contrast, future DCMI outdoor water use (primarily irrigation) cannot be projected based on current per capita water-demand rates because irrigated area (and therefore the amount of water needed for irrigation) decreases as population density increases. Furthermore, the future DCMI irrigation demand is influenced, in part, by water availability. For example, water use in areas with available existing surface water will likely be greater than in areas of short supply (e.g., Boise foothills).

Thus, future outdoor water demand was projected based on (1) assumed irrigated area per household, (2) household density, (3) employment density, (4) water availability, (5) estimated irrigation requirements (i.e., precipitation deficit[16]), and assumed irrigation efficiency. Assumptions regarding the irrigated area per household[17] were based, in part, on a survey of irrigated areas of selected subdivisions in the Twin Falls area (SPF, 2007) and professional judgment. Areas with low to moderate household density but high employment density were assumed to have minimal irrigation. New households in areas of low water supply (e.g., Boise foothills or east Ada County) were assumed to have less irrigation than new households in areas with an abundant water supply (e.g., areas with available surface water).

Evapotranspiration will increase over the next 50 years if average growing-season temperatures increase as projected. Thus, the precipitation deficit (net irrigation

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systems and (2) self-supplied domestic irrigation (defined as an exempt use under Idaho code section 42-111).

[16] *Precipitation deficit* is the difference between potential evapotranspiration and the combined amount of precipitation infiltration and water residing in the zone. In essence, precipitation deficit is the net irrigation water requirement. Monthly precipitation deficit data are compiled by the University of Idaho (http://www.kimberly.uidaho.edu/ETIdaho/) for various crop types and based on data collected at various Idaho weather stations.

[17] The assumed irrigated area per household includes areas for residential or commercial irrigation and irrigation of common areas (e.g., small parks, schools, etc.) irrigated with potable municipal deliveries.

requirement) used for projecting future outdoor DCMI water demand was increased at a uniform basis over the next 50 years based on projections of temperature increase in regional climatic models (Section 7).

3.2.8 Identify Possible Sources of Supply

A portion of future DCMI water demand will be met by existing sources. The final step in this approach (Section 10.4.7) was to briefly consider possible sources of water that could be used to meet future DCMI water demand.

3.3 Tables and Figures

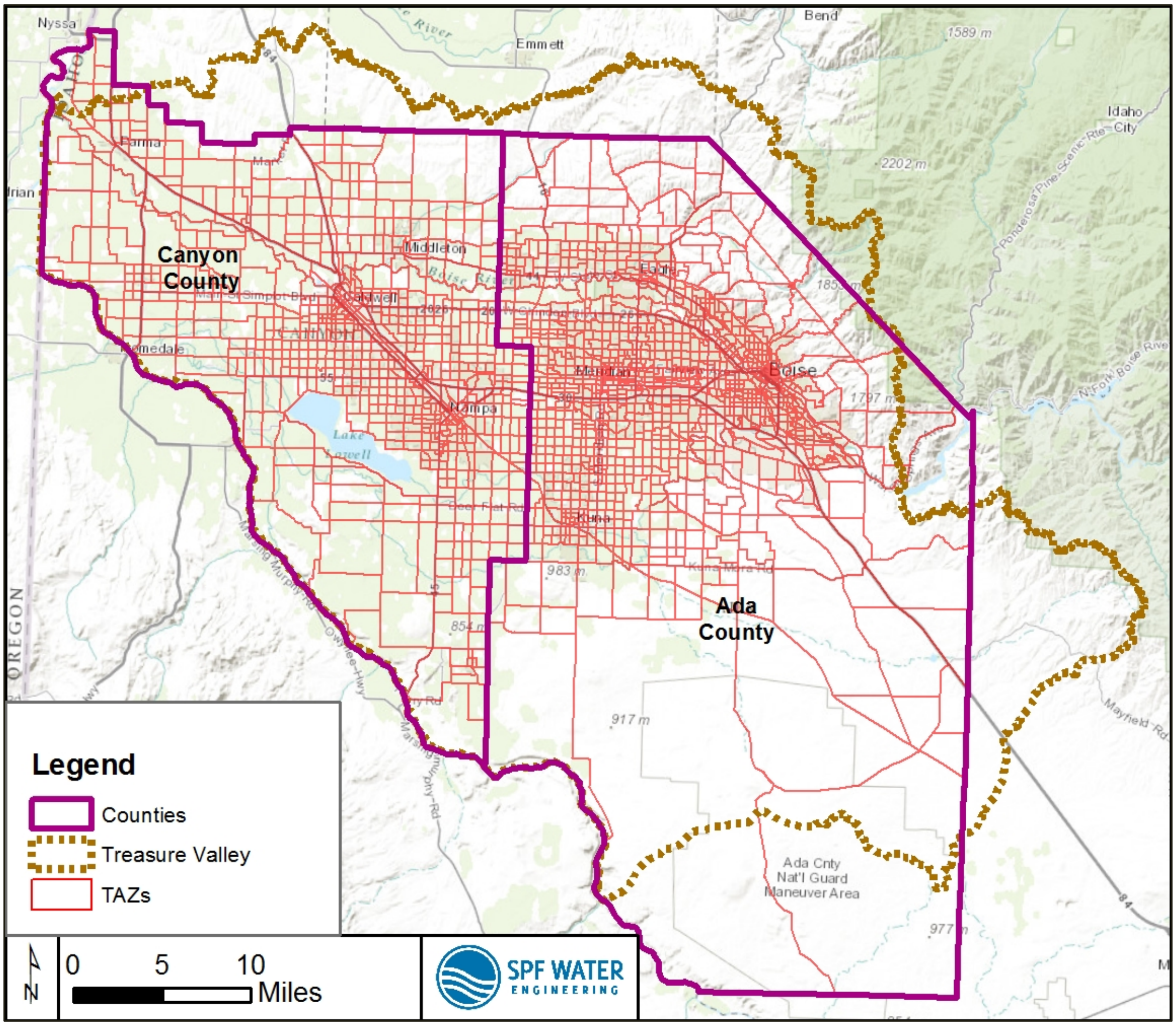

Figure 2. TAZs in Ada and Canyon counties.

4 WATER SUPPLY CHARACTERISTICS

4.1 Introduction

The Treasure Valley relies on both surface water and groundwater for irrigation and DCMI uses. The Treasure Valley development history has shown that surface water or groundwater availability can influence local future water demand (i.e., population growth has been less in areas with limited water supply than in those areas with abundant water supply).

Although a detailed discussion of Treasure Valley water supply is beyond the scope of this analysis, this section provides a (1) general summary of Treasure Valley water availability and (2) discussion of ways in which local water availability may influence future water demand. Tables and Figures are presented in Section 4.6 beginning on page 22.

4.2 Climate and Precipitation

The Treasure Valley has a temperate and arid to semi-arid climate. Average monthly temperatures range from about 83°F in the summer to 20°F in the winter (Figure 3). Annual precipitation since 1990 has ranged from approximately 7 inches in 2002 to 16.7 inches in 1998 (Figure 4). Most of the precipitation falls during the fall, winter, and spring months (Figure 5).

4.3 Surface Water

Most of the surface water in the Treasure Valley originates in the upper Boise River basin (Figure 6). Runoff from high-elevation areas is stored in three reservoirs – Anderson Ranch Reservoir, Arrowrock Reservoir, and Lucky Peak Reservoir. Water stored in these reservoirs is the primary source of Treasure Valley irrigation water.

Large-scale irrigation using surface water from the Boise River began in the late 1800s, and by the 1930s a large portion of the valley was irrigated with surface water (Figure 7). Water for irrigation is delivered mostly by gravity flow through canals operated by a variety of large and small irrigation companies or districts (Figure 8).

Development of surface-water irrigation continued in the following decades with water from the Payette River. The Black Canyon Irrigation District, developed between the 1920s through 1950s, pumps water from the Payette River to lands in the Boise River drainage west of Star, Idaho. A large portion of the dark-green area north of the Boise River in Figure 7 is land irrigated with surface water from the Payette River. Some surface water is also pumped from the Snake River in southern portions of the Treasure Valley for irrigation.

Average Boise River flows at Lucky Peak Dam, Glenwood Bridge, near Middleton, and Parma (Figure 9) are plotted in Figure 10. Discharges at Lucky Peak Dam reflect winter storage (i.e., low flows), flood releases (high flows in May and early June), and irrigation releases through September. Lower flows at Glenwood Bridge are the result of upstream Boise River diversions. Average flows are lowest in the vicinity of Star, Idaho (Figure 1). Boise River flows typically increase downstream of Star as a result of (1) groundwater discharge to surface channels, (2) irrigation return flows during the irrigation season, and (3) inflows from tributary streams. Thus, while typical Boise River flows above Star are thought to be fully appropriated, flows below Star Bridge are open for appropriation for DCMI uses.

4.4 Groundwater

Treasure Valley aquifers supply groundwater for irrigation, domestic, municipal, commercial, industrial, institutional, and other purposes. These aquifers are present in a complex series of interbedded, tilted, faulted, and eroded sediments underlying the valley (Petrich and Urban, 2004). Although these sediments extend to depths of over 6,000 feet (Wood and Clemens, 2004), most groundwater in the Treasure Valley is pumped from depths of less than 1,000 feet.

Aquifers are present in both Snake River Group and Idaho Group sediments. Shallow, local flow systems have groundwater residence times ranging from days to tens of years; deep, regional flow systems have groundwater residence times ranging from hundreds to tens of thousands of years (Hutchings and Petrich, 2002; Petrich and Urban, 2004).

Recharge to shallow aquifers occurs as seepage from surface channels (e.g., rivers, canals, and laterals), lakes (e.g., Lake Lowell), and infiltration from precipitation and irrigation water. Discharge occurs primarily to the Boise River, Snake River, drainage ditches, and wells. Discharge from deeper aquifer zones in portions of the valley is limited by interbedded confining layers.

Most of the Treasure Valley groundwater development has occurred since the 1950s. A large portion of the lands south of the Boise River shown with the dark-green color in Figure 7 (i.e., irrigation developed since the late 1930s) represent land irrigated with groundwater.

In combination, by the year 2000 (Figure 11) surface water and groundwater supplies enabled irrigation of approximately half of the Treasure Valley land area (Urban, 2004). Residential and commercial (i.e., urban) uses accounted for approximately 10 percent of the land area in the year 2000. Most of the rust-colored area in Figure 7 that was irrigated in the late 1930s but not in the year 2000 represents urban area. The remaining Treasure Valley land area is primarily non-irrigated rangeland and foothills.

4.5 Implications of Water Availability on Future DCMI Water Demand

Some Treasure Valley agricultural areas are currently irrigated with surface water, and likely will continue to be irrigated with surface water as land is urbanized. Some agricultural areas are currently irrigated with groundwater (groundwater which could be used for DCMI purposes if urbanized). Other areas have groundwater available for appropriation. In other areas, groundwater may be physically available but processing of new water-right applications is constrained. Finally, some areas have a physically-limited supply. These characteristics, outlined in greater detail below), will likely influence (1) future DCMI water demand and (2) strategies for supplying future DCMI water needs.

4.5.1 Surface Water Availability for Projected Future DCMI Use

Idaho requires the use of surface water for irrigation when available: "all applicants proposing to make land-use changes shall be required to use surface water, where reasonably available, as the primary water source for irrigation" (Idaho Code § 67-6537). Furthermore, surface water, where available to urban residents, is generally less expensive than potable water served via a municipal provider. Thus, it was assumed that surface water would be used for all DCMI irrigation in areas with available surface water.

We are not aware of current valley-wide land-use data identifying all land irrigated with surface water. However, in 1994 (and updated in 2000) IDWR digitized and categorized agricultural land by irrigation method; irrigated agricultural land was classified as either gravity-irrigated or groundwater-irrigated (Figure 12). Almost all of the gravity-irrigated land is irrigated with surface water. The presence of gravity-irrigated land largely coincides with the surface-water delivery entity areas illustrated in Figure 8.

This gravity-irrigated land use classification does not cover all surface-water-irrigated land. The irrigation-type classification did not extend into urban areas where surface water is used for irrigation.

IDWR identified approximately 273,700 acres in Ada and Canyon counties in 1994/2000 land-use review that were identified as gravity-irrigated (assumed to be irrigated with surface water)[18] and 97,000 agricultural acres identified as sprinkler-irrigated (assumed to be primarily irrigated with groundwater). For comparison, Ada and Canyon counties cover approximately 1,067,700 acres.

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[18] This amount is less than the 332,528 acres listed as being surface-water irrigated in the 2000 Boise River Watermaster report. The difference likely reflects (at least in part) urban areas irrigated with surface water, which are authorized as places of use under irrigation rights but were not described as gravity-irrigated agricultural lands in IDWR's 1994/2000 land-use review.

Despite having been completed 15 years ago, it was assumed for this analysis that the IDWR classifications of irrigation type probably represent the best current delineation of land irrigated with surface water. The number of gravity-irrigated acres within each TAZ were identified based on the IDWR land-use classifications and expressed as a percentage of land area within each TAZ, which in turn was used to identify an assumed irrigation water source for future DCMI demand (see Section 10).

However, it was assumed that future demand for indoor, potable DCMI uses will not be supplied by surface water, even if future population growth occurs on or near agricultural areas currently irrigated with surface water, for several reasons. First, although it was assumed that surface water, if available, would be used for DCMI irrigation (see above) as required by Idaho statute, it was also assumed that irrigation-delivery entities will transfer any surface water not needed for agricultural or residential irrigation to non-irrigated lands within their currently authorized permissible places of use.

Second, irrigation-delivery entities in the Treasure Valley have generally not accounted for impermeable land within urban areas to which they deliver surface water for irrigation. Instead, they have continued to deliver water based on pre-development irrigated acreage (i.e., "gross acres") rather than post-development net irrigated acreage. The rationale for doing so has been that (1) urban turf requires more water than some lower water-use crops (e.g., grains), (2) irrigation seasons may be longer in urban areas (i.e., irrigation may start earlier, and will not cease during previous "harvest" times), and (3) the greater delivery rates for "gross acres" are necessary to meet a more variable urban irrigation demand.

Third, surface-water storage contracts in the upper Boise River Basin reservoirs typically specify irrigation uses. While storage can be re-contracted for a different use, the process for doing so is not trivial.[19] Currently, very little water is stored for municipal purposes in the upper Boise River reservoirs.[20] While this may change in the future, it was assumed, for the purposes of this study, that a substantial amount of surface water currently used for agricultural irrigation would not become available to municipal providers for general DCMI uses.

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[19] Jerry Gregg, U.S. Bureau of Reclamation, personal communication, November 6, 2015. Re-contracting federal surface storage may involve NEPA and ESA analyses.

[20] Combined, UNITED WATER IDAHO, Trinity Springs, the J.R. Simplot Company, and Micron Technology, Inc. hold storage contracts for approximately 5,000 AF for municipal and industrial uses.

4.5.2 Groundwater Availability for Projected Future DCMI Use

Groundwater is available for a portion of future DCMI uses in parts of the Treasure Valley. (Figure 12).[21] Furthermore, there is clearly some amount of additional groundwater available for development in areas not currently irrigated with groundwater. A simulated 20 percent across-the-board increase in the Treasure Valley groundwater pumping predicted steady-state water-level declines of less than 10 feet in many areas, suggesting that Treasure Valley aquifers will support additional withdrawals (Petrich, 2004a; Petrich, 2004b).

However, while additional groundwater may be available for appropriation in some areas, some of the groundwater may require treatment for elevated, naturally-occurring arsenic or uranium levels if used for DCMI purposes. Also, even if additional groundwater may be available, protests to new water-right applications or other administrative constraints could limit new groundwater development.

In contrast, groundwater availability is clearly limited in some portions of the Treasure Valley. For example, portions of the Boise Foothills east of"Consolidated Cases" Study Area (Figure 13) are limited to no more than 7,440 acre feet (AF) by administrative order.[22] Authorization for new groundwater diversions in the Southeast Boise Ground Water Management Area (GWMA) is unlikely without full mitigation. Similarly, full mitigation is currently required for all new groundwater diversions in the "Basin 63 Restricted Area" above Lucky Peak Dam, and for all new groundwater diversions from aquifers shallower than 200 feet below ground surface in "Basin 63 Restricted Area" below Lucky Peak Dam.

4.5.3 Water-Demand Assumptions Based on Water Availability

The following assumptions were made based on the above-described water-availability observations:

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[21] A subdivision with 4 units per acre might generously require 250 gallons per day (gpd) per unit for indoor uses, or approximately 1.1 AF/year for 4 homes. Assuming 50 percent hardscape per acre in the 4-unit per acre subdivision example following urbanization, the irrigation of an aggregate ½ acre with an annual volume of 3.5 AF/acre would require approximately 1.75 AF/year. The combined urban use (1.1 AF/year for indoor uses and 1.75 AF/year for irrigation, or approximately 2.9 AF/year) is less than the typical diversion of 3.5 AF/per year per acre for agricultural irrigation. Thus, existing, developed groundwater is likely sufficient for new DCMI uses in agricultural areas currently irrigated with groundwater.

[22] Final Order Regarding Water Sufficiency in the Matter of Application for Transfer No. 78356 (Shekinah Industries); Application for Transfer 78355 (Orchard Ranch; Application for Permit 63-32499 (Mayfield Townsite); Application for Permit 61-12095 (Nevid-Corder); Application for Permit 61-12096 (Nevid) Application for Permit 63-32703 (Orchard Ranch); Application for Permit 61-12256 (Intermountain Sewer and Water); Application for Permit 63-33344 (Ark Properties-Mayfield Townsite), November 4, 2013.

1. Future DCMI water demand for indoor and irrigation uses in areas currently irrigated with groundwater will be met by groundwater.
2. Water for DCMI uses in the Boise Foothills will be supplied by valley aquifers or other sources, and that DCMI irrigation in the Boise Foothills (Figure 13) will be constrained.
3. Water demand up to 7,440 AF per year in the “Consolidated Cases” Study Area will be met by groundwater; additional water demand will require water from other sources.
4. Irrigation in the Boise Foothills “ground water-limited” area and the “Consolidated Cases” Study Area will likely be less than in other parts of the valley because of water-supply limitations.
5. Absent mitigation, additional development of groundwater within the Southeast Boise GWMA is unlikely.

4.6 Tables and Figures

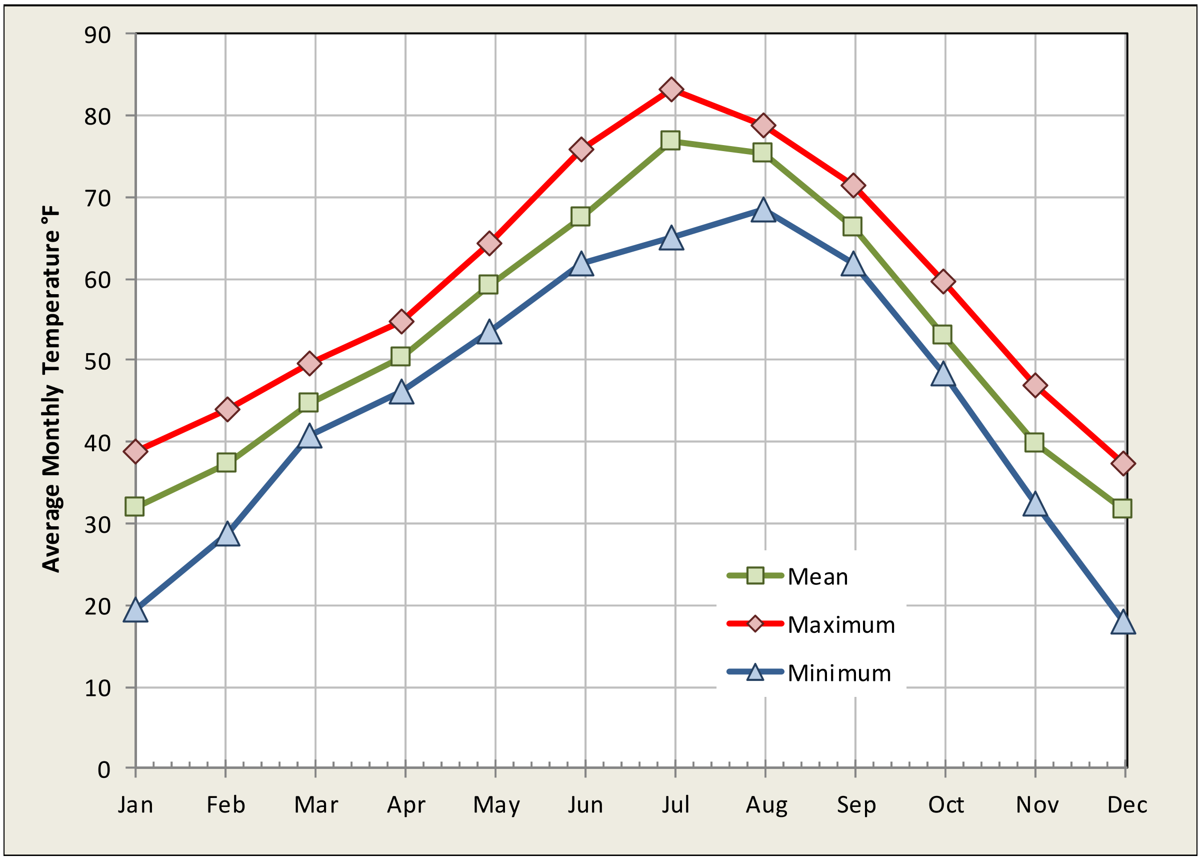


Figure 3. Average monthly temperatures, Boise Airport, 1990-2015.

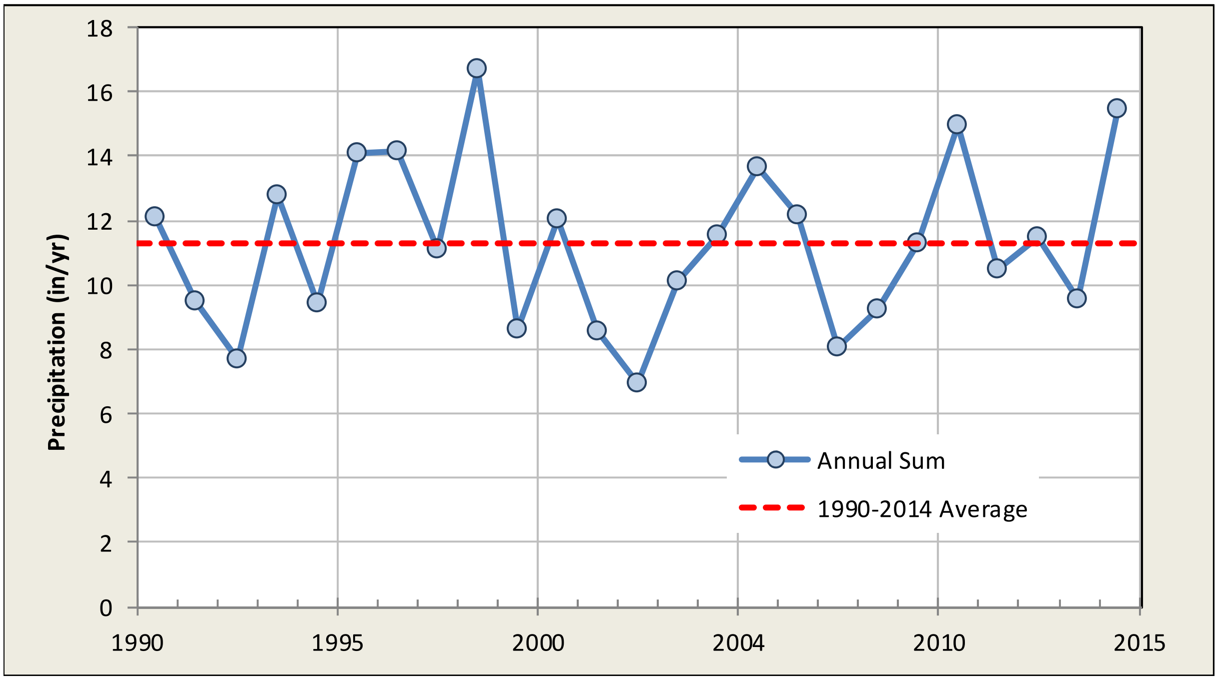


Figure 4. Annual precipitation, Boise Airport, 1990-2014.

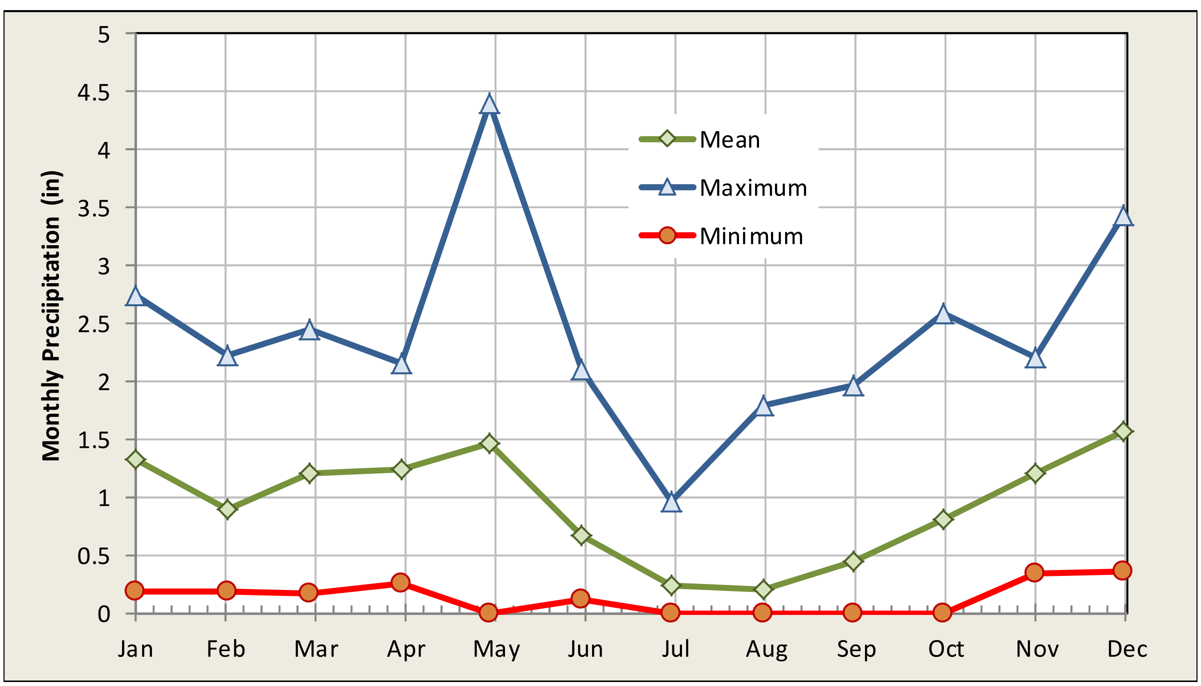


Figure 5. Monthly precipitation, Boise Airport, 1990-2014.

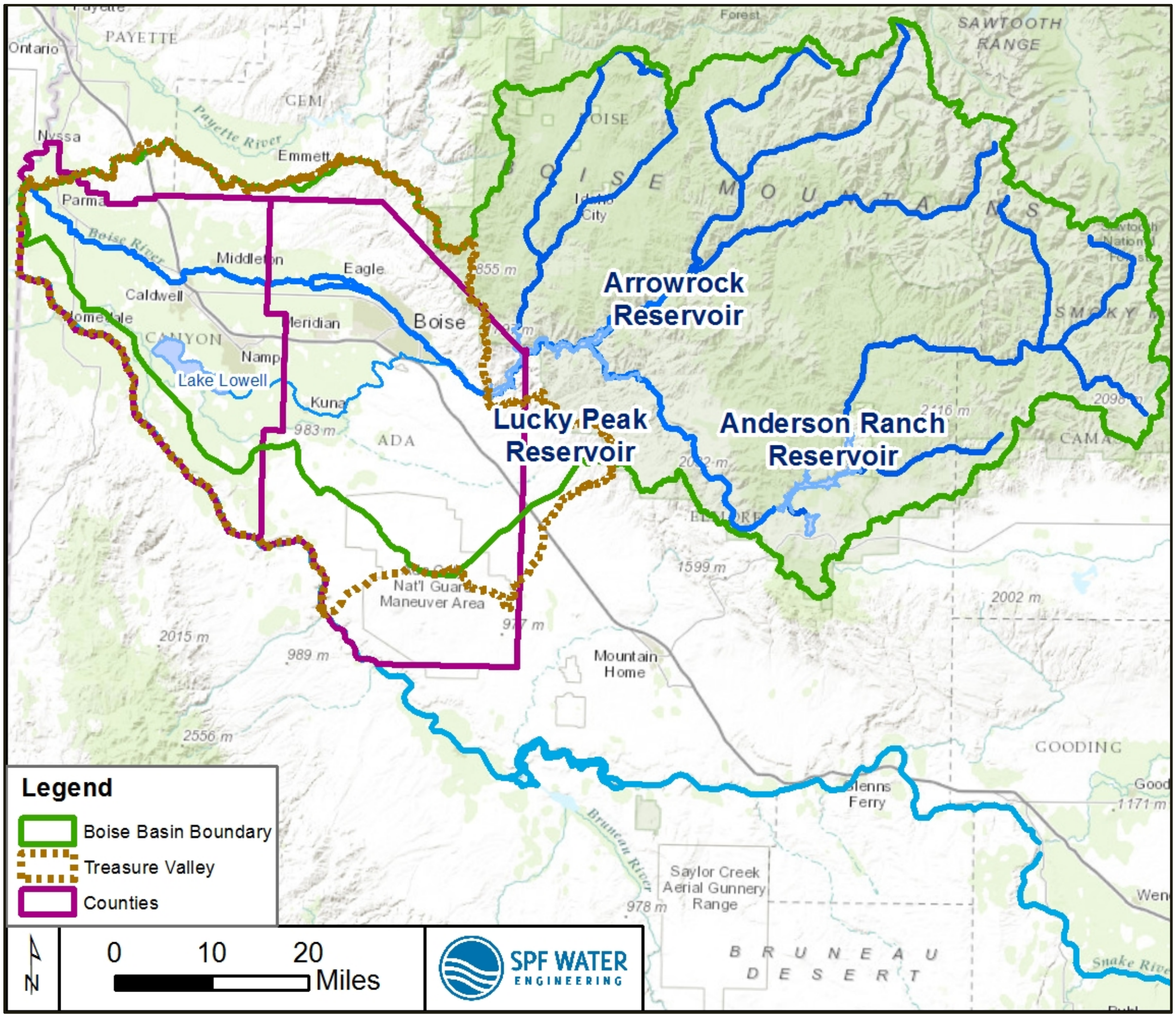
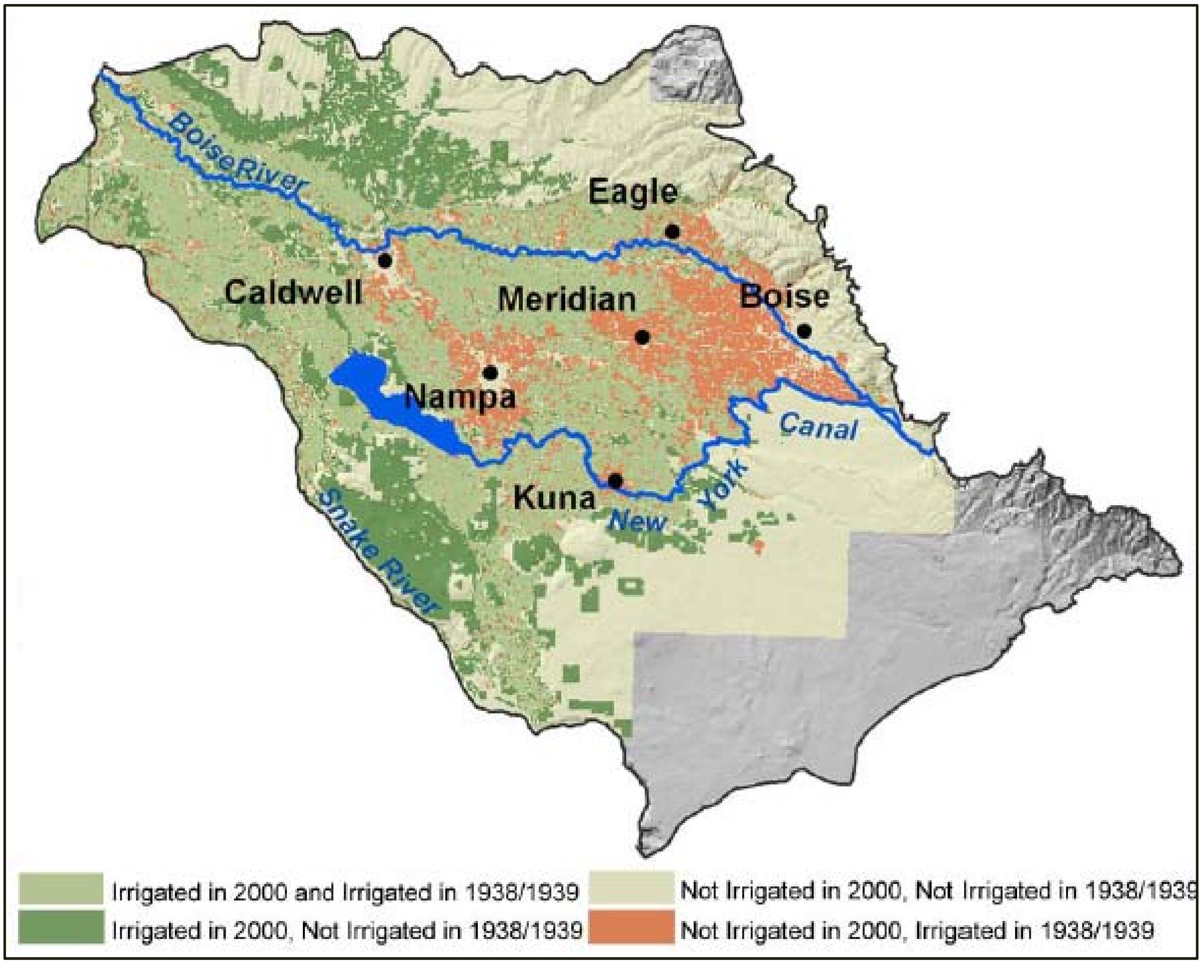


Figure 6. Boise River Watershed.



From Petrich and Urban (2004), based on IDWR data.

Figure 7. Changes in Treasure Valley irrigated lands between 1938-1939 and 2000.

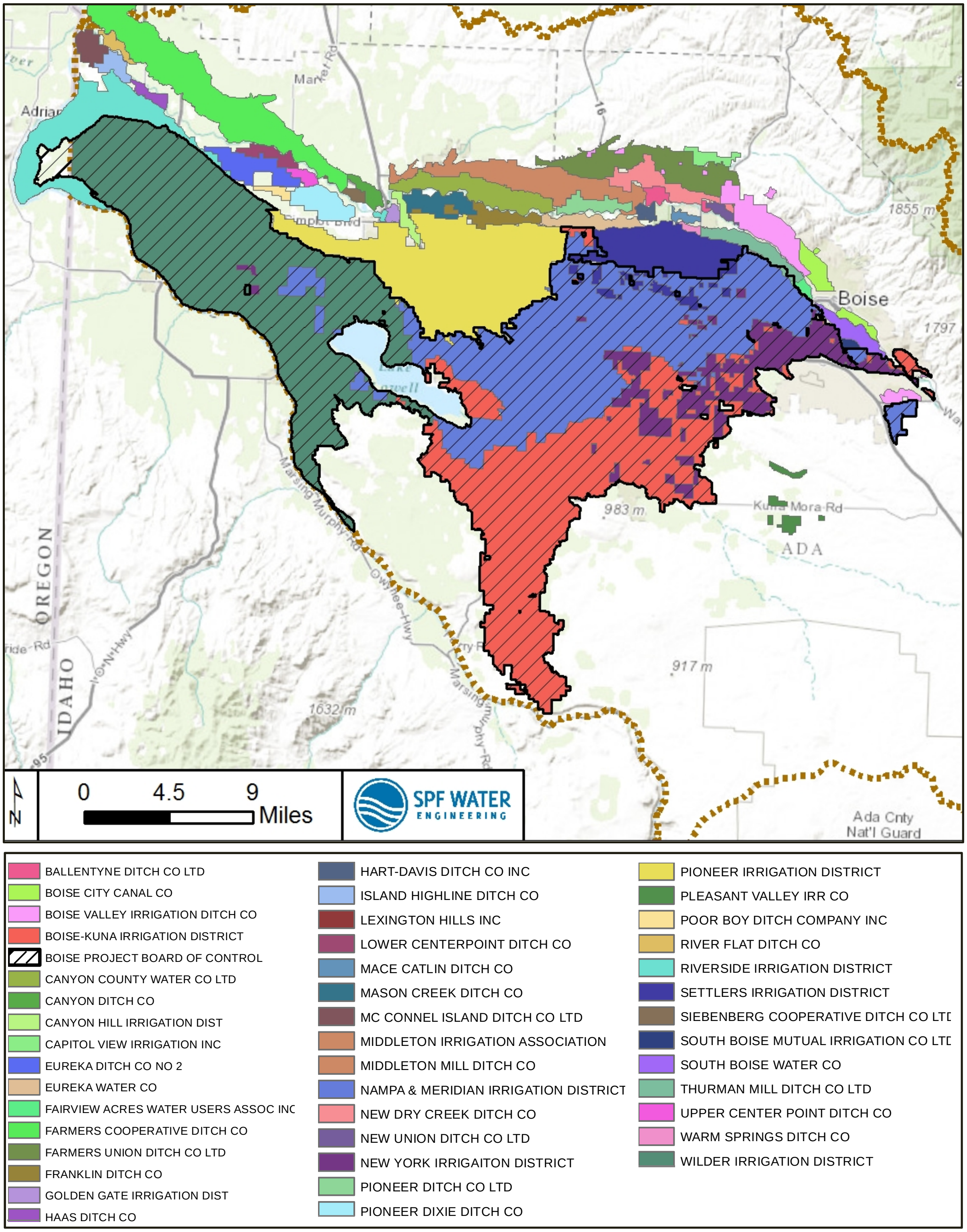


Figure 8. Treasure Valley irrigation entities.

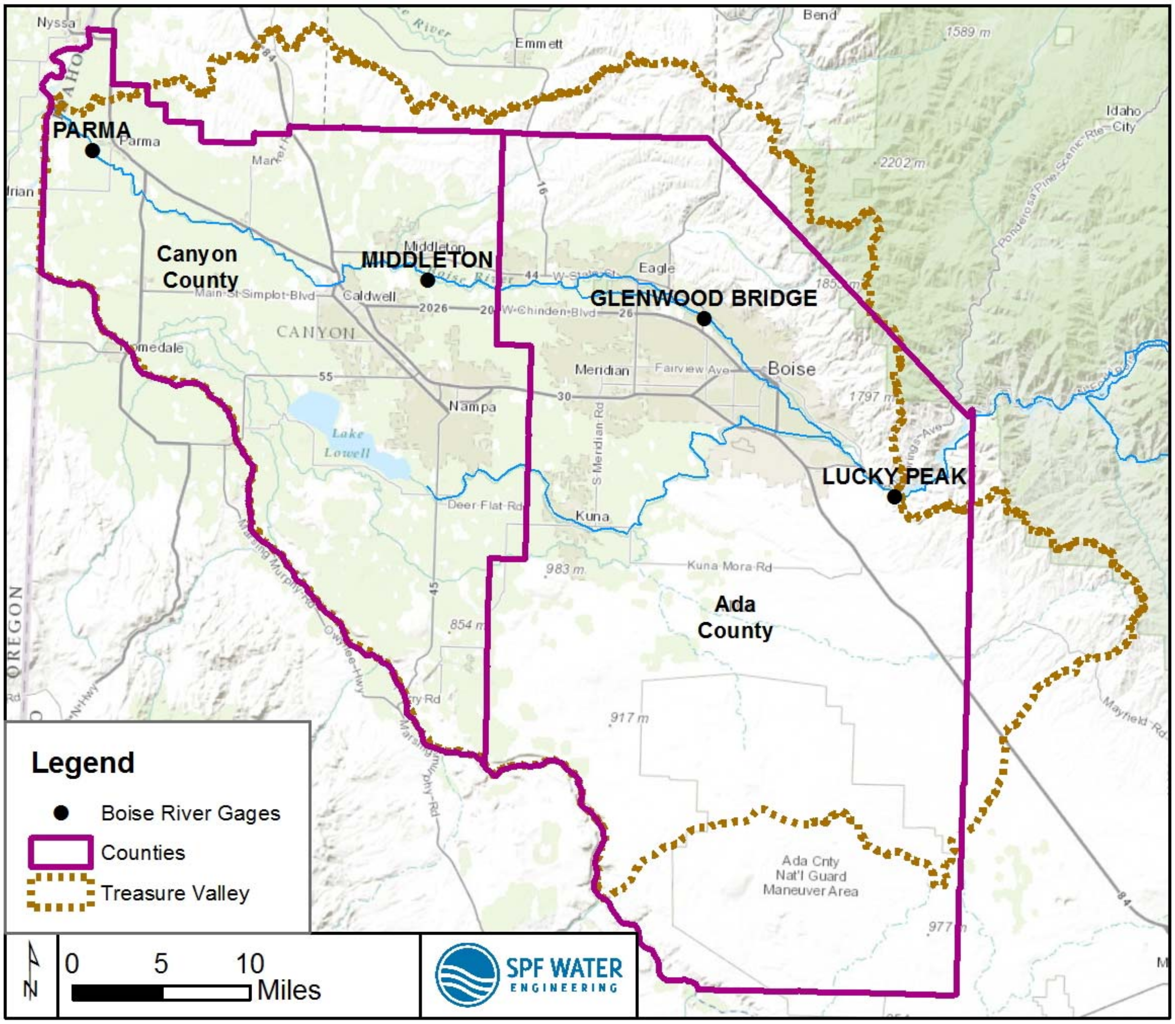


Figure 9. Boise River gaging locations.

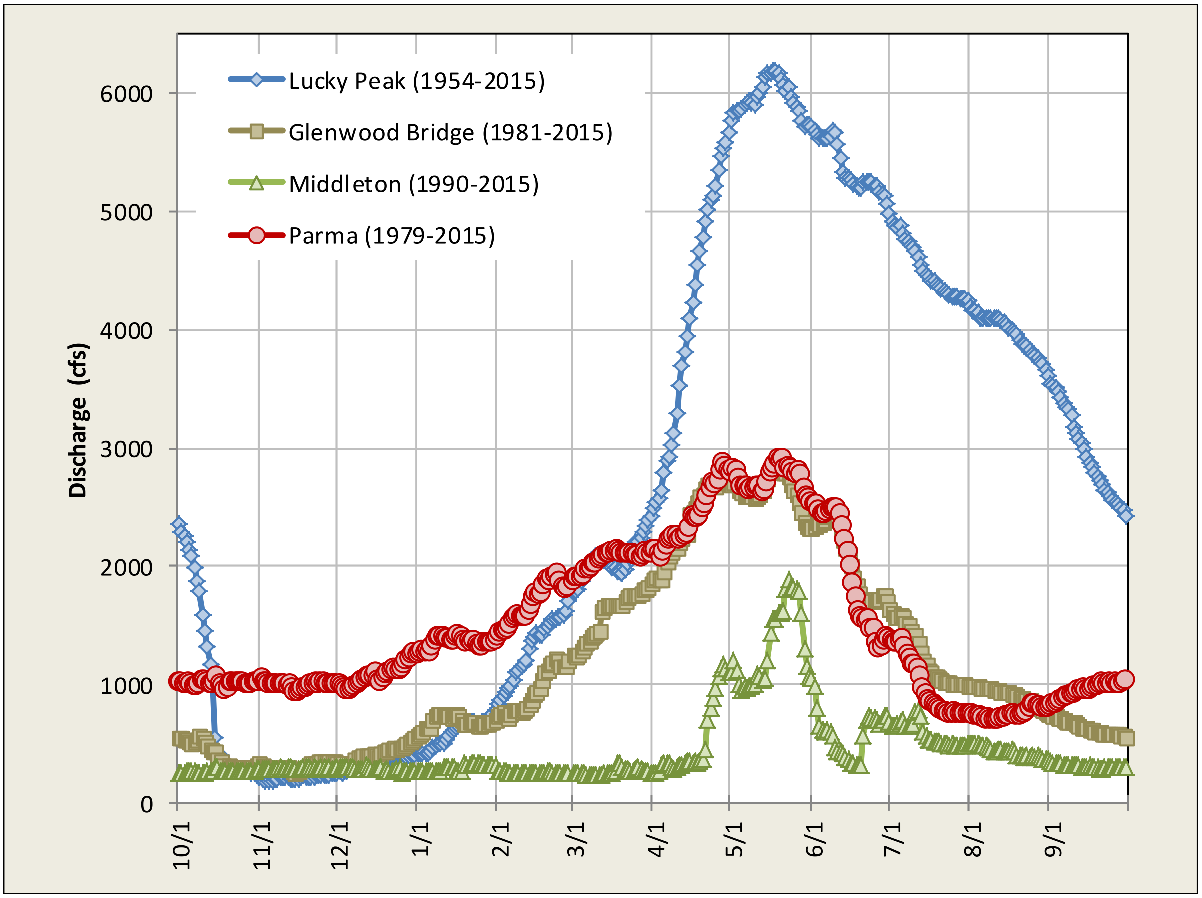
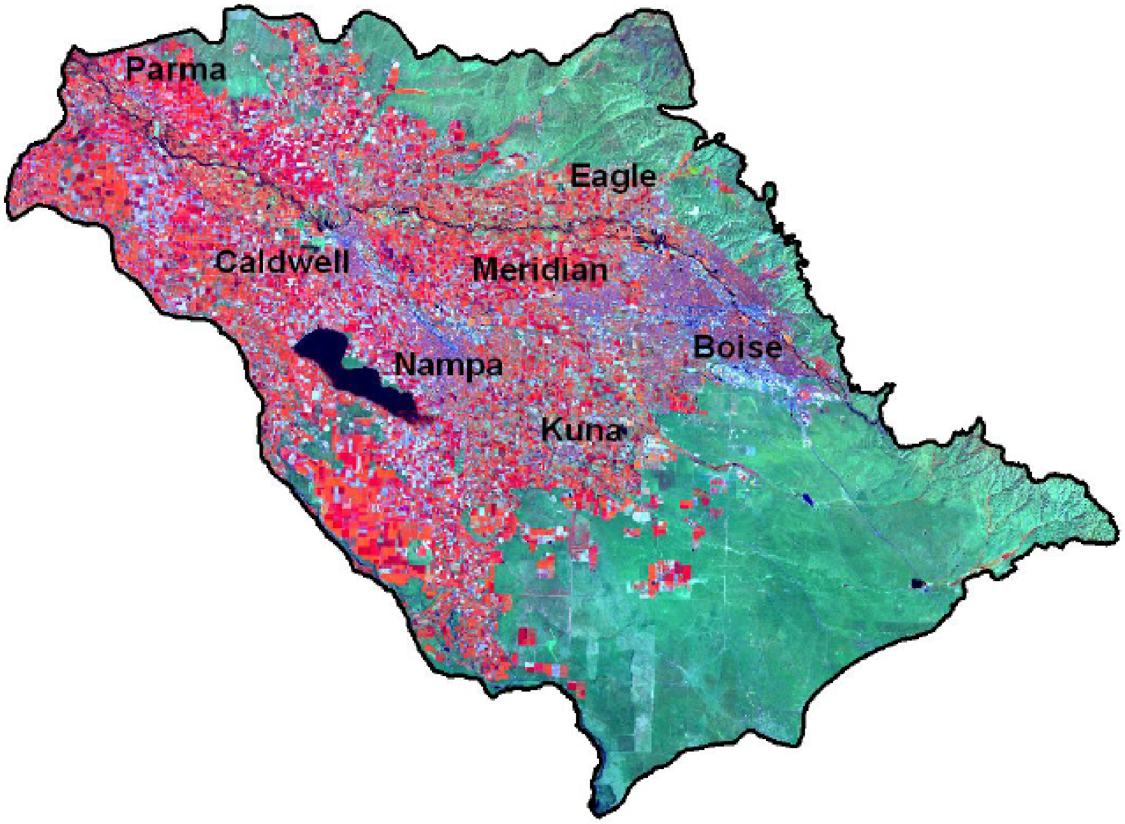


Figure 10. Boise River flows at selected gaging locations, 1980-2015.



Red areas indicate irrigated land; green areas indicate rangeland (IDWR infrared image)

From Petrich and Urban (2004).

Figure 11. Treasure Valley irrigated areas.

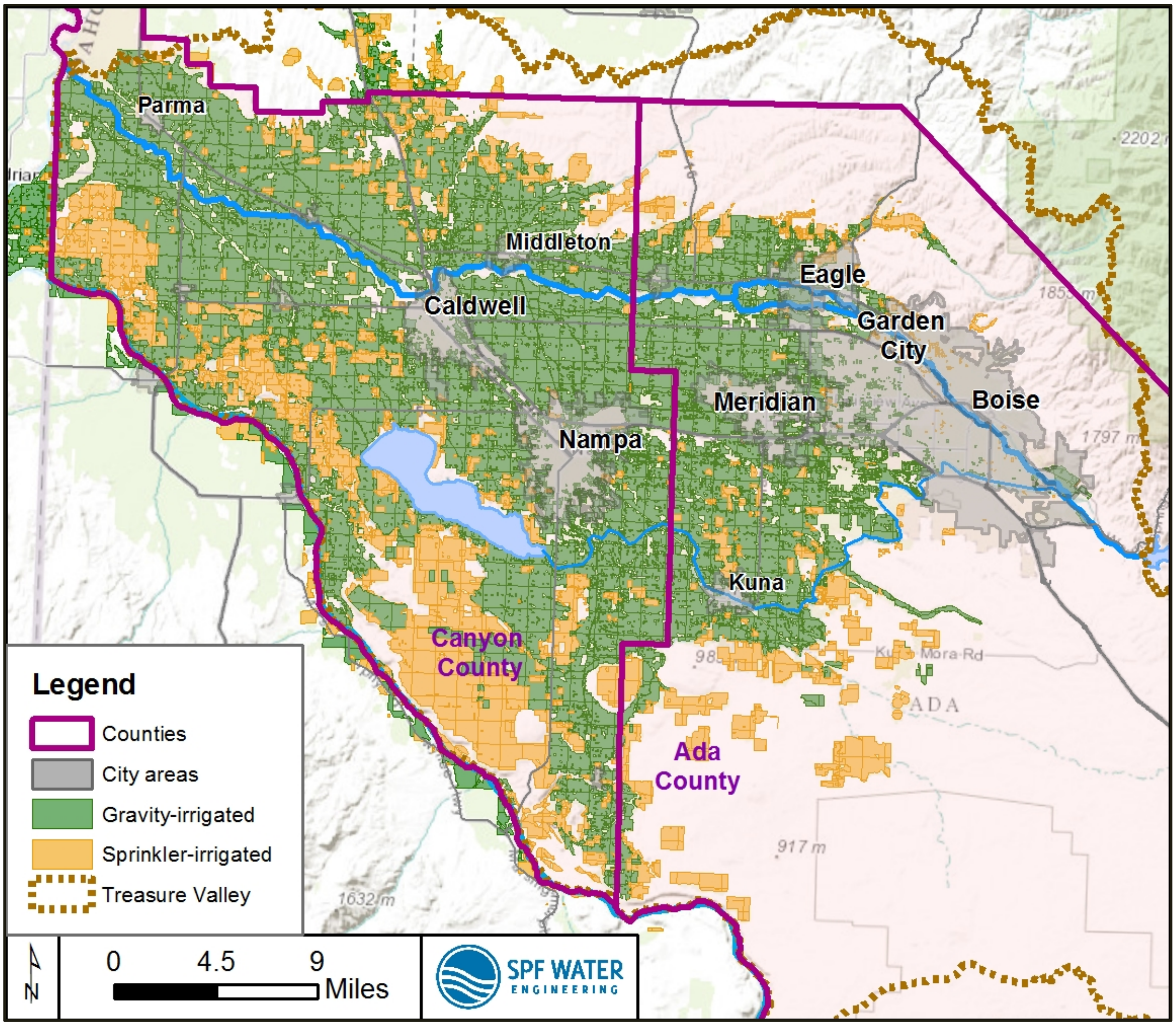


Figure 12. Agricultural irrigation type.

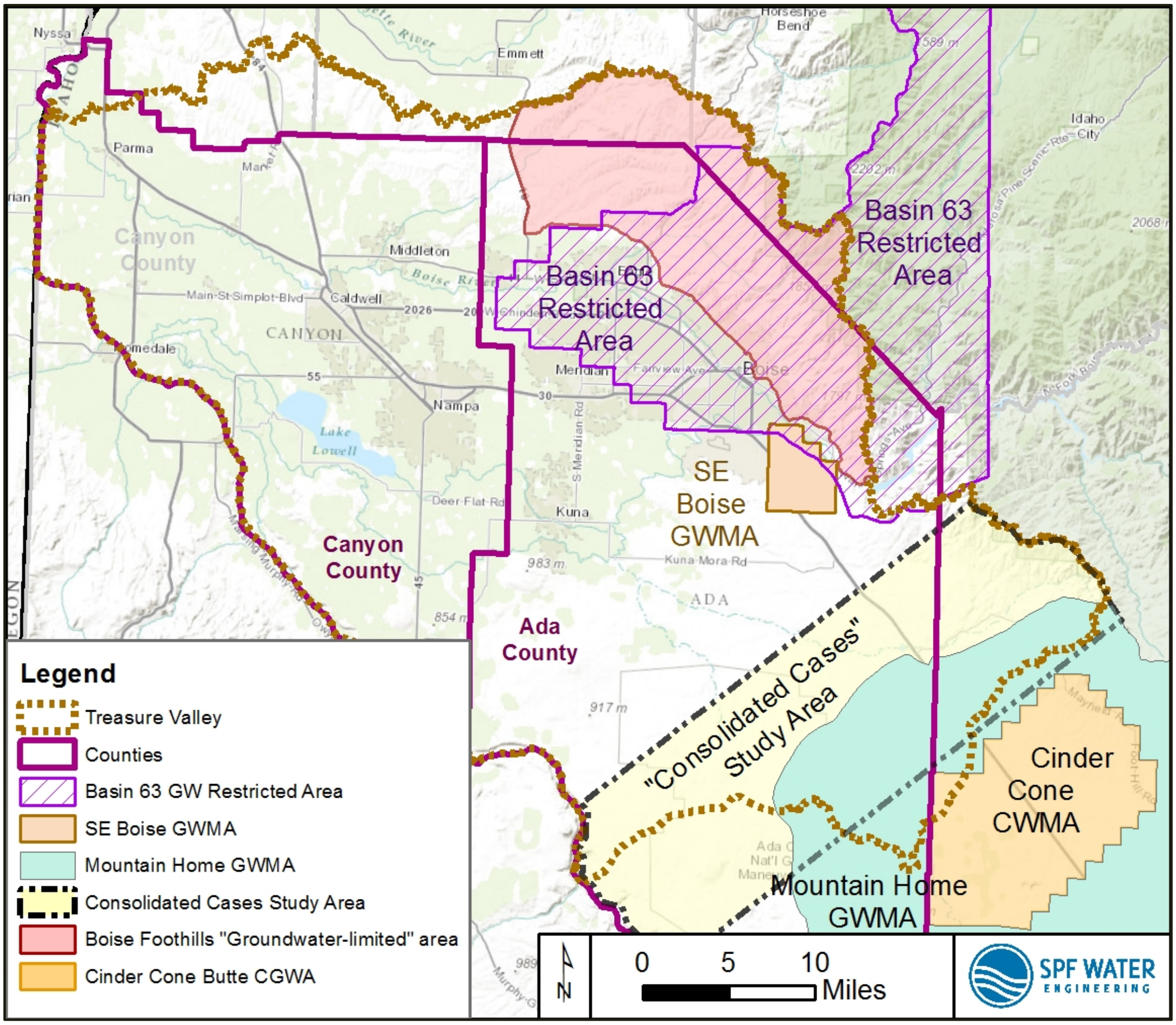


Figure 13. Water-limited areas.

5 HISTORICAL POPULATION GROWTH

5.1 Introduction

Historical population growth patterns provide insight into future population growth. This section provides a summary of Treasure Valley population growth and growth rates. Tables and Figures are presented beginning on the following page.

5.2 Historical Population – An Overview

Population in the Treasure Valley has grown from approximately 91,000 people in 1940 to approximately 630,000 in 2014 (Table 2 and Figure 14). In 2014, approximately 426,200 people (68 percent of the Treasure Valley population) lived in Ada County; 203,000 (28 percent of the Treasure Valley population) lived in Canyon County.

Overall, Ada County grew almost 750 percent since 1940; Canyon County grew almost 400 percent. Ada County experienced its lowest-growth decade (at a growth rate of about 15 percent over 10 years) between 1960 and 1970 (Table 3). However, Ada County experienced a 46 percent growth rate between 1990 and 2000 and a 54 percent growth rate between 1970 and 1980.

Population growth is not consistent from decade to decade. Canyon County experienced relatively low 10-year growth rates between 1950 and 1970 and between 1980 and 1990 (8 percent growth over 10 years – see Table 3). However, Canyon County has recently experienced higher growth rates (46 percent from 1992 to 2000, and 44 percent between 2000 and 2010).

Since 1940, Ada County has grown an average of approximately 2.9 percent per year, while Canyon County has grown an average of 2.2 percent per year. Based on these 10-year data from 1940 through 2010, the average annual population growth rate for both counties (Table 4) ranged from a low of approximately 1.4 percent (1960-1970) to a high of 4.0 percent (1970-1980).

5.3 Tables and Figures

Population Summary, 1940-2014									
County/ City	**1940**	**1950**	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2014**
Ada County	50,401	70,649	93,460	112,230	173,125	205,775	300,904	392,365	426,236
Boise	26,130	34,393	34,481	74,990	102,249	125,738	185,787	205,671	216,282
Eagle					2,620	3,327	11,085	19,908	22,502
Garden City		764	1,681	2,368	4,571	6,369	10,624	10,972	11,420
Kuna	443	534	516	593	1,767	1,955	5,382	15,210	16,999
Meridian	1,465	1,810	2,081	2,616	6,658	9,596	34,919	75,092	87,743
Star						648	1,795	5,793	7,295
Canyon County	40,987	53,597	57,662	62,123	83,756	90,076	131,441	188,923	203,143
Caldwell	7,272	10,487	12,230	14,219	17,699	18,400	25,967	46,237	50,224
Greenleaf	0	0	0	0	663	648	862	846	878
Melba	213	203	197	197	276	252	439	513	529
Middleton	477	496	541	739	1,901	1,851	2,978	5,524	6,420
Nampa	12,149	16,185	18,013	20,768	25,112	28,365	51,867	81,557	88,211
Notus	277	313	324	304	437	380	458	531	545
Parma	1,085	1,369	1,295	1,228	1,820	1,597	1,771	1,988	2,066
Wilder	507	555	603	564	1,260	1,232	1,462	1,533	1,597
Ada and Canyon Co (combined)	91,388	124,246	151,122	174,353	256,881	295,851	432,345	581,288	629,379
Source: U.S. Census Bureau (www.census.gov). Data from 2011-2014 were based on mid year estimates.									

Table 2: Population summary, 1940-2014.

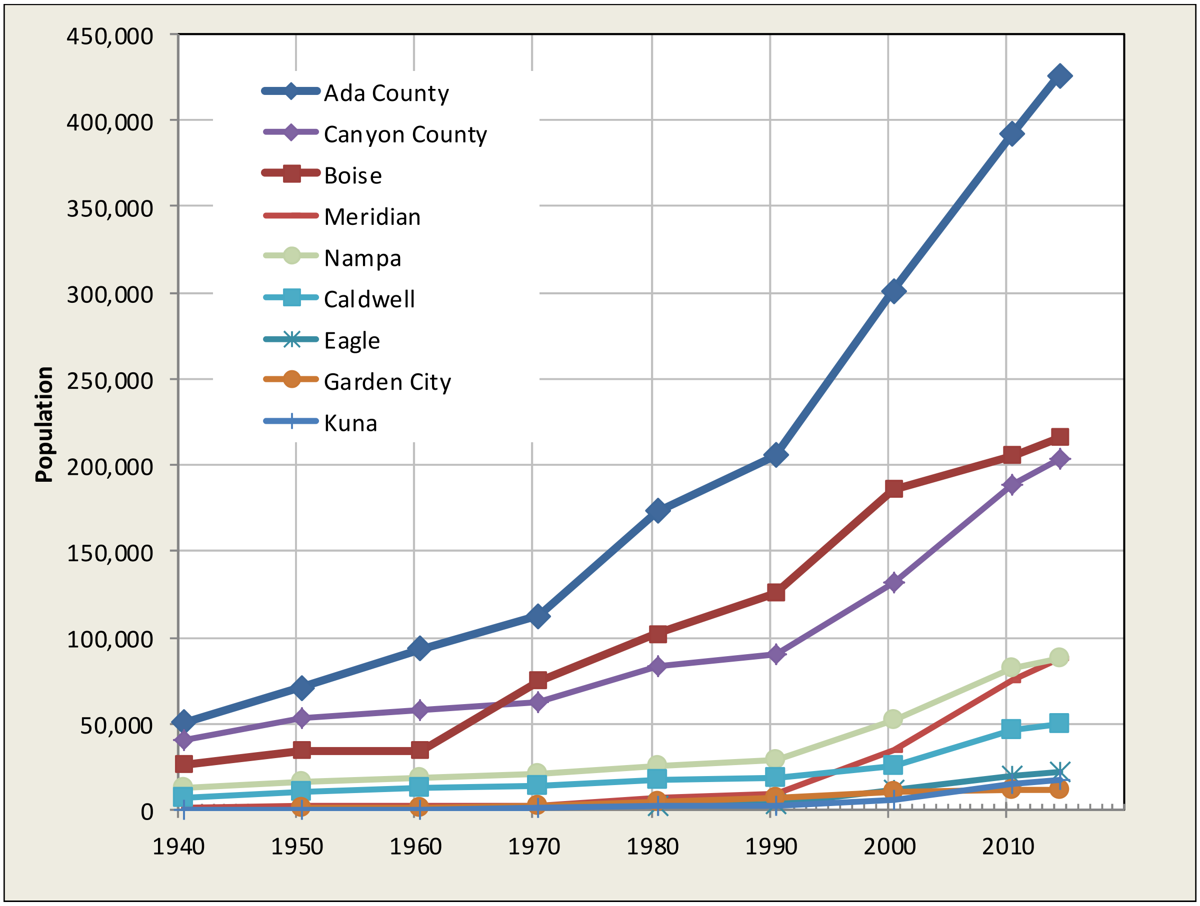


Figure 14. Ada and Canyon counties population, 1940-2014.

Percent Change in Population by Decade*								
County/City	**1940-1950**	**1950-1960**	**1960-1970**	**1970-1980**	**1980-1990**	**1990-2000**	**2000-2010**	**2010-2014***
Ada County	40%	32%	20%	54%	19%	46%	30%	9%
Boise	32%	0%	117%	36%	23%	48%	11%	5%
Eagle					27%	233%	80%	13%
Garden City		120%	41%	93%	39%	67%	3%	4%
Kuna	21%	-3%	15%	198%	11%	175%	183%	12%
Meridian	24%	15%	26%	155%	44%	264%	115%	17%
Star						177%	223%	26%
Canyon County	31%	8%	8%	35%	8%	46%	44%	8%
Caldwell	44%	17%	16%	24%	4%	41%	78%	9%
Greenleaf					-2%	33%	-2%	4%
Melba	-5%	-3%	0%	40%	-9%	74%	17%	3%
Middleton	4%	9%	37%	157%	-3%	61%	85%	16%
Nampa	33%	11%	15%	21%	13%	83%	57%	8%
Notus	13%	4%	-6%	44%	-13%	21%	16%	3%
Parma	26%	-5%	-5%	48%	-12%	11%	12%	4%
Wilder	9%	9%	-6%	123%	-2%	19%	5%	4%
Ada and Canyon Co (combined)	36%	22%	15%	47%	15%	46%	34%	8%
Source: U.S. Census Bureau (www.census.gov). Data from 2011-2014 were based on mid year estimates. * All intervals are 10 years, except for 2010-2014, which is a 5-year interval.								

Table 3: Percent population change by decade, 1940-2014.

Average Annual Population Change								
County/City	**1940-1950**	**1950-1960**	**1960-1970**	**1970-1980**	**1980-1990**	**1990-2000**	**2000-2010**	**2010-2014**
Ada County	3.4%	2.8%	1.8%	4.4%	1.7%	3.9%	2.7%	2.1%
Boise	2.8%	0.0%	8.1%	3.1%	2.1%	4.0%	1.0%	1.3%
Eagle					2.4%	12.8%	6.0%	3.1%
Garden City		8.2%	3.5%	6.8%	3.4%	5.2%	0.3%	1.0%
Kuna	1.9%	-0.3%	1.4%	11.5%	1.0%	10.7%	10.9%	2.8%
Meridian	2.1%	1.4%	2.3%	9.8%	3.7%	13.8%	8.0%	4.0%
Star						10.7%	12.4%	5.9%
Canyon County	2.7%	0.7%	0.7%	3.0%	0.7%	3.9%	3.7%	1.8%
Caldwell	3.7%	1.5%	1.5%	2.2%	0.4%	3.5%	5.9%	2.1%
Greenleaf					-0.2%	2.9%	-0.2%	0.9%
Melba	-0.5%	-0.3%	0.0%	3.4%	-0.9%	5.7%	1.6%	0.8%
Middleton	0.4%	0.9%	3.2%	9.9%	-0.3%	4.9%	6.4%	3.8%
Nampa	2.9%	1.1%	1.4%	1.9%	1.2%	6.2%	4.6%	2.0%
Notus	1.2%	0.3%	-0.6%	3.7%	-1.4%	1.9%	1.5%	0.7%
Parma	2.4%	-0.6%	-0.5%	4.0%	-1.3%	1.0%	1.2%	1.0%
Wilder	0.9%	0.8%	-0.7%	8.4%	-0.2%	1.7%	0.5%	1.0%
Ada and Canyon Co (combined)	3.1%	2.0%	1.4%	4.0%	1.4%	3.9%	3.0%	2.0%
Source: U.S. Census Bureau (www.census.gov). Data from 2011-2014 were based on mid year estimates.								

Table 4: Average annual population change, 1940-2014.

6 POPULATION, HOUSEHOLDS, AND EMPLOYMENT GROWTH PROJECTIONS

6.1 Introduction

Future Treasure Valley water-demand projections are based, in part, on projected increases in population, households, and employment. The projections were prepared by John Church (Idaho Economics) based on COMPASS projections and with semi-logarithmic extrapolation to the year 2065 (Section 3.2.3). The spatial distribution of population, households, and employment projections was refined based on a review of various comprehensive plans and interviews with local planning officials, conducted by Bob Taunton (Taunton Group).

6.2 Projections of Population, Households, and Employment

Treasure Valley population is expected to increase from approximately 580,200 people in 2010 to over 1.57 million people by the year 2065 (Table 5 and Figure 15). Approximately 63 percent of the 1.57 million people in 2065 will reside in Ada County; the balance (approximately 37 percent) will reside in Canyon County.

The number of households is projected to increase from 211,600 in 2010 to 638,700 in 2065 (Table 6 and Figure 16). Employment is projected to increase from approximately 240,500 employees in 2010 to 940,800 employees by the year 2065 (Table 7 and Figure 17).

The average number of people per household in Ada County is projected to decrease from 2.65 in 2010 to 2.43 (Table 8). The average number of people per household in Canyon County is projected to decrease from 2.96 and 2010 to 2.51 in 2065.

The average number of employees per household in Ada County is projected to decrease from 0.78 in 2010 to 0.61 in 2065 (Table 8). The average number of employees per household in Canyon County is projected to decrease from 1.27 in 2010 to 0.86 in 2065.

6.3 Density and Spatial Distribution

The population density, described as the number of people per acre and based on population per TAZ, ranges from zero to approximately 30 people per acre in 2015 to almost 100 people per acre by 2025 in a few TAZs (Figure 18). The maximum household density is projected to increase from approximately 14.6 households per acre in 2015 to approximately 34 households per acre in 2065. The maximum employment density is anticipated to increase from approximately 360 per acre in 2015 to 500 per acre in 2065.

Approximately 51% of the Ada-Canyon county area currently has a household density (Table 9 and Figure 19) of less than 0.01 units per acre (essentially zero). Areas with low household density include rangeland (public and private) and industrial/commercial areas. Approximately 3% of the bi-county area has a residential density greater than 2 households per acre. In 50 years, approximately 10% of the Ada-Canyon County area is projected to have a household density of greater than 2 units per acre. Approximately 29% of the Ada-Canyon county area (Table 9) was deemed as "water-limited" for the purposes of this study (see Figure 13).

The spatial distribution of per-acre population, households, and employment in 2015 and 2065 is illustrated in Figure 20 through Figure 25. Most of the population and household growth is projected to occur in the central portion of the valley (Boise, Meridian, Kuna, Nampa, Caldwell, Eagle, etc.). Most of the employment growth is projected to occur along the I-84 corridor between Boise and Caldwell.

6.4 Factors Influencing Population and Households Distribution

The COMPASS projections of population, households, and employment were based, in part, on economic models, historical growth rates, local comprehensive plans, and growth rates in other comparable areas. Projections of population, households, and employment were then extended to the year 2065 by semi-logarithmic extrapolation (see Section 3.2.3). However, there are also a number of other factors that have and will continue to influence these projections – and the future spatial distribution of population, households, and employment.[23]

6.4.1 Physical Characteristics

Physical characteristics such as topography (e.g., Boise foothills) already influence the spatial distribution of projected households and household density. However, changes in floodplain designations along the Boise River or other tributaries could influence future household density in certain TAZs.

6.4.2 Infrastructure Availability

The availability of water and wastewater infrastructure (e.g., sewer lines, treatment facilities, etc.), availability of transportation access and roadway capacities, and the presence of railroads (i.e., the need for overpass crossings)[24] influence the location

[23] Much of the text in this section was developed by Bob Taunton, Taunton Consulting.

[24] For example, additional railroad crossings or bridges will be required in Kuna for development south of downtown and in Caldwell. Negotiations involving such crossings and subsequent design and construction can take two decades or more.

and density of future development. Changes in current infrastructure plans will likely change household number and density assumptions used in this report.

The availability of water and wastewater infrastructure depends, in part, on funding. The proposed Spring Valley, Dry Creek Ranch, Mayfield Springs, and Mayfield Townsite developments are planned communities that will likely require privately funded wastewater treatment plants and water infrastructure (although Dry Creek may rely on United Water Idaho). The ability to secure private or public funding for infrastructure improvements by different private or public entities will influence the timing and location of new developments.

6.4.3 Statutory Framework

Statutes (e.g., Local Land Use Planning Act, or "LLUPA", Idaho Code § 67-6502) and local codes guide municipal planning and development. Revisions to statute or codes may impact future development through the creation of additional requirements or restrictions, and consequently influence locations and density of future developments.

6.4.4 Planned Communities

Large-scale planned communities are permitted outside of cities in Ada County[25] on a minimum of 640 acres. Without planned-community zoning, land in Ada County outside of a city Area of Impact (AOI) is designated for agricultural uses, allowing rural residential uses at 1 unit per 40 acres or 1 unit per 10 acres (depending on location).

During the recent 2006 housing-market peak, Ada County was in discussion with 14 proposed planned community sponsors. However, only three entitled or active planned communities remain: Avimor (840 acres), Dry Creek Ranch (1,414 acres), and Cartwright Ranch (730 acres).[26] Additionally, the City of Eagle has approved the 6,000-acre Spring Valley planned community in the Boise foothills and the City of Boise has recognized a 600-acre parcel southwest of the Boise Airport (Syringa Valley) as a possible planned community.

Amendments to the planned community ordinance since 2006 may have reduced interest in future planned communities. Additional changes or amendments in planned community ordinances could influence assumptions regarding the locations of population growth and population density.

[25] Canyon County does not have a planned community ordinance.

[26] Hidden Springs, another Ada County planned community, began prior to 2006.

6.4.5 Public Land Ownership

Public land, such as that owned and managed by the Bureau of Land Management (BLM) or State of Idaho, likely will continue to see very little (if any) population growth.

6.4.6 Existing Land Ownership

Existing land uses and ownership, such as large-lot rural subdivisions that block annexation pathways and the extension of utility services, or land with fragmented ownership which is difficult to annex or facilitate utility extensions, will continue to influence higher-density developments that require new municipal infrastructure.

6.4.7 Demographics and Market Preferences

Demographics and market preferences will influence future growth and development preferences. For example, COMPASS predicts that children and youth under the age of 20 will comprise 20.6 percent of the Treasure Valley population in the year 2040, down from 30.7 percent in 2010. An increasing number of these "Baby Boomers" and "Millennials" currently favor mixed-use, walkable communities rather than auto-oriented single-use suburbs. These preferences, if they continue, will influence future growth and development patterns.

Market preferences may also influence residential construction in the vicinity of the airport or established industries. Recently the City of Boise has conducted noise-impact forecasts for the F-35 that would expand noise impact in southwest Boise and the planned East Columbia Village area. Increased military flights could impact these areas through future development restrictions or buyer resistance. Similarly, established or new industries may create odors and require buffer zones. Examples of such industries might include sugar beet, cheese, or meat processing facilities.

6.4.8 Comprehensive Plans

COMPASS projections are based, in part, on comprehensive plans prepared for individual cities and counties. These plans typically encompass a 20-year time horizon, although many of the Treasure Valley comprehensive plans far exceed that timeframe. Comprehensive plans do not need to be updated on a regular basis. For example, the City of Boise comprehensive plan was not updated between 1997 and 2011, although it was amended many times during that time. Comprehensive plans are subject to revision and cities can make findings to approve land-use applications that are not consistent with their comprehensive plans. Furthermore, some of the comprehensive plans are not tied directly to the availability of urban services, needed transportation improvements, community facilities, and other constraints. In other words, current projections of development location and densities are subject to change as cities and counties approve developments that are not consistent with the comprehensive plans, or as comprehensive plans evolve over time.

6.4.9 Area-of-Impact Jurisdiction and Planning

Idaho statute allows cities to establish AOIs surrounding their incorporated boundaries with the agreement of the local county based on a set of criteria. AOIs represent the locations where the cities expect urban growth to occur over a 20-year period through the extension of urban services and annexation (a key intent of this requirement is to minimize sprawl by encouraging cities to grow in a cost-effective manner). Future development and population density will be influenced, in part, by the evolving plans and jurisdictions within AOIs.

Until annexation, a county continues to be the land-use approving jurisdiction. For land use applications within the AOI beyond the municipal boundary, the city's comprehensive plan applies and the county processes those applications based on the city plan.

Many of the cities have established planning areas for their comprehensive plans that far exceed their AOI boundaries, while others have prepared plans for their current AOI or reasonable additions. For example, Kuna uses an expanded planning area approach while Boise follows a more constrained policy. However, comprehensive plans that extend beyond the approved AOI have no force and effect because the county's comprehensive plan and zoning ordinances apply.

6.4.10 Population and Housing Density

Interviews with city and county planning personnel and a review of comprehensive plans (and implementing ordinances) reveal that most expect future residential densities to average 3 to 4 units per acre (typically 6,000-8,000 square-foot lots) consistent with current development patterns. However, changes in demographic and market preferences plus higher commuting costs as a result of congestion could lead to density shifts to 4 to 6 units per acre (5,000-6,000 square foot lots) to accommodate additional housing demand in key corridors. Harris Ranch in East Boise illustrates this trend. Much of the Harris Ranch community has been built at a density of 6 to 8 units per acre on lot sizes of 5,000 square feet or less and has appealed to empty-nesters and young families. By inference, such a trend would lead to greater water demand in a certain areas for indoor domestic uses and less water demand for residential irrigation.

Future transportation costs will have a strong influence on the location of urban development. Single-family developments on the "urban fringe" may be affordable with current energy prices but could be far less affordable if a rising transportation cost is added.

In existing urban areas close to public transportation, services, and employment – where infill is generally the only development option – household densities could be 8-12 units per acre or higher depending on location. In 2014, COMPASS reports that 42 percent of the total residential permits were multi-family, a spike that is more than double the average from 2001-2007.

New development in the foothills is generally expected to average 1 unit per gross acre or less depending on development constraints, such as slope. Community-level water and wastewater infrastructure will likely lead to clustering of development with smaller lots and higher net densities to reduce infrastructure-development costs. Significant portions of the site would remain as undeveloped, non-irrigated open space. A recent example of foothills development densities is the approval of the planned residential project by Boise Hunter Homes in Harris Ranch. This development includes 173 residential units (8,000-9,000 square-foot lots typical) at 0.84 units per gross acre.

Two variables could influence the spatial distribution of urban development and residential density. First, the presence (or lack thereof) of transportation infrastructure (both roadways and public transportation) could influence the above-described growth patterns. Second, changes in current land-use policies (such as a greater priority placed on the preservation of agricultural land) could similarly influence development patterns and resulting residential housing densities.

6.5 Tables and Figures

(Tables and figures begin on next page)

Population				
Year	**Ada County**	**Canyon County**	**Total**	**% Increase**
2010	391,800	188,400	580,200	
2015	419,900	204,600	624,500	1.5%
2020	448,300	226,200	674,500	1.6%
2025	493,200	251,600	744,800	2.1%
2030	535,500	273,600	809,100	1.7%
2035	606,100	309,900	916,000	2.6%
2040	674,100	347,000	1,021,200	2.3%
2045	719,500	381,500	1,101,000	1.6%
2050	780,900	415,100	1,196,000	1.7%
2055	847,400	467,800	1,315,300	2.0%
2060	919,700	518,800	1,438,500	1.9%
2065	998,100	574,600	1,572,700	1.9%

Table 5. Treasure Valley population projections, 2015-2065.

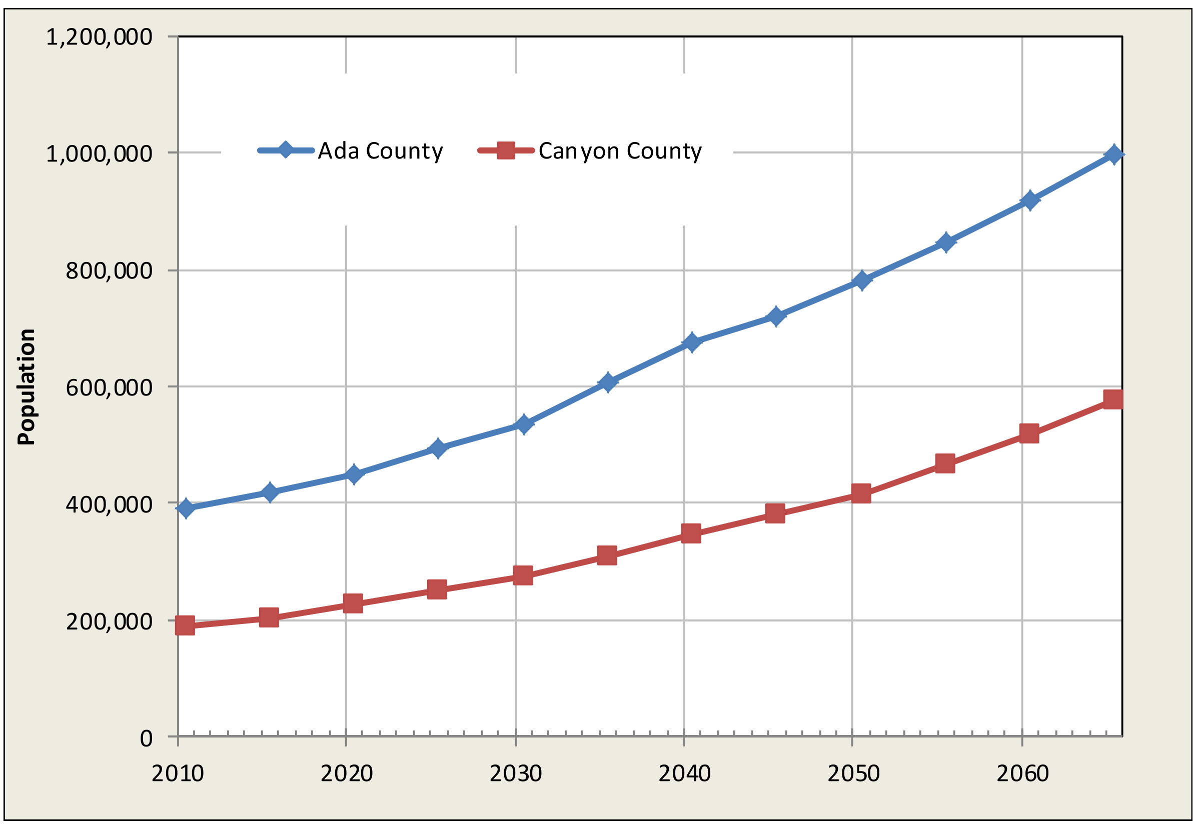


Figure 15. Treasure Valley population projections, 2015-2065.

Households				
Year	**Ada County**	**Canyon County**	**Total**	**% Increase**
2010	148,100	63,600	211,600	
2015	157,700	69,000	226,600	1.4%
2020	171,000	78,100	249,100	2.0%
2025	188,100	86,900	275,100	2.1%
2030	209,800	97,200	307,000	2.3%
2035	232,200	110,500	342,700	2.3%
2040	260,500	127,400	387,800	2.6%
2045	290,900	144,500	435,300	2.4%
2050	320,800	159,200	480,000	2.1%
2055	347,500	181,700	529,200	2.1%
2060	377,400	203,900	581,300	2.0%
2065	409,900	228,700	638,700	2.0%

Table 6. Treasure Valley household projections, 2015-2065.

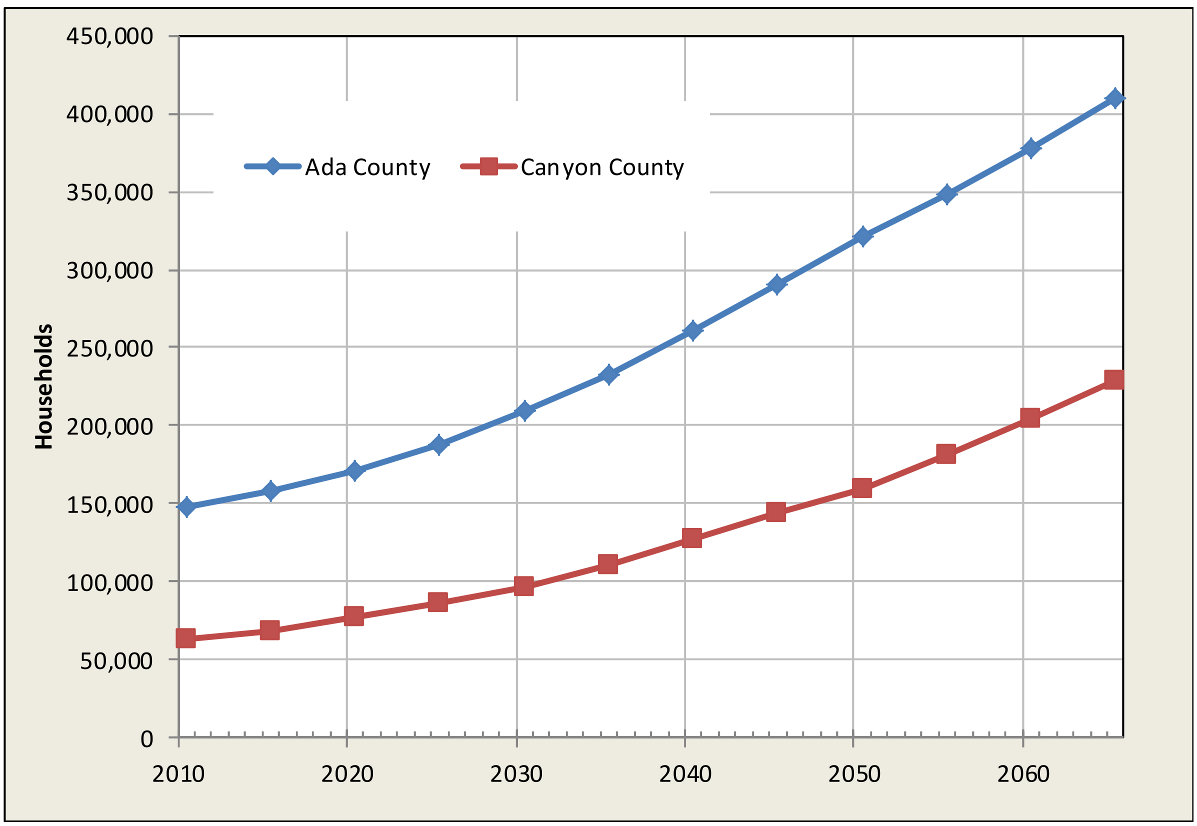


Figure 16. Treasure Valley household projections, 2015-2065.

Employment				
Year	Ada County	Canyon County	Total	% Increase
2010	190,300	50,200	240,500	
2015	208,600	57,200	265,800	2.1%
2020	228,600	65,300	293,900	2.1%
2025	255,200	75,200	330,400	2.5%
2030	284,800	86,200	371,000	2.5%
2035	316,700	98,100	414,800	2.4%
2040	352,100	111,300	463,400	2.3%
2045	394,600	129,400	524,000	2.6%
2050	446,000	152,100	598,100	2.8%
2055	508,200	181,000	689,200	3.0%
2060	583,900	217,700	801,500	3.3%
2065	676,300	264,500	940,800	3.5%

Table 7. Treasure Valley employment projections, 2015-2065.

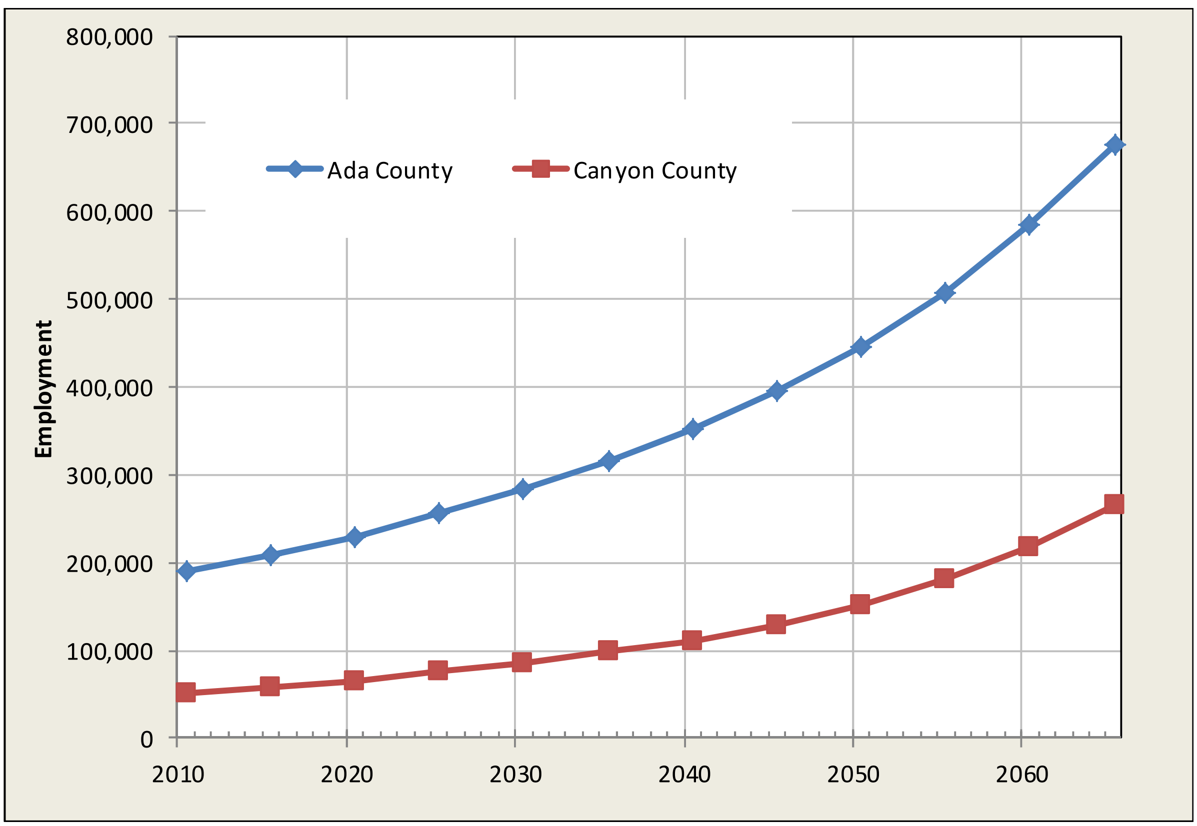


Figure 17. Treasure Valley employment projections, 2015-2065.

	People per Household		Employees per Household	
Year	Ada County	Canyon County	Ada County	Canyon County
2010	2.65	2.96	0.78	1.27
2015	2.66	2.97	0.76	1.21
2020	2.62	2.90	0.75	1.20
2025	2.62	2.89	0.74	1.16
2030	2.55	2.81	0.74	1.13
2035	2.61	2.80	0.73	1.13
2040	2.59	2.72	0.74	1.14
2045	2.47	2.64	0.74	1.12
2050	2.43	2.61	0.72	1.05
2055	2.44	2.58	0.68	1.00
2060	2.44	2.54	0.65	0.94
2065	2.43	2.51	0.61	0.86

Table 8. Projections of people and employees per household, 2015-2065.

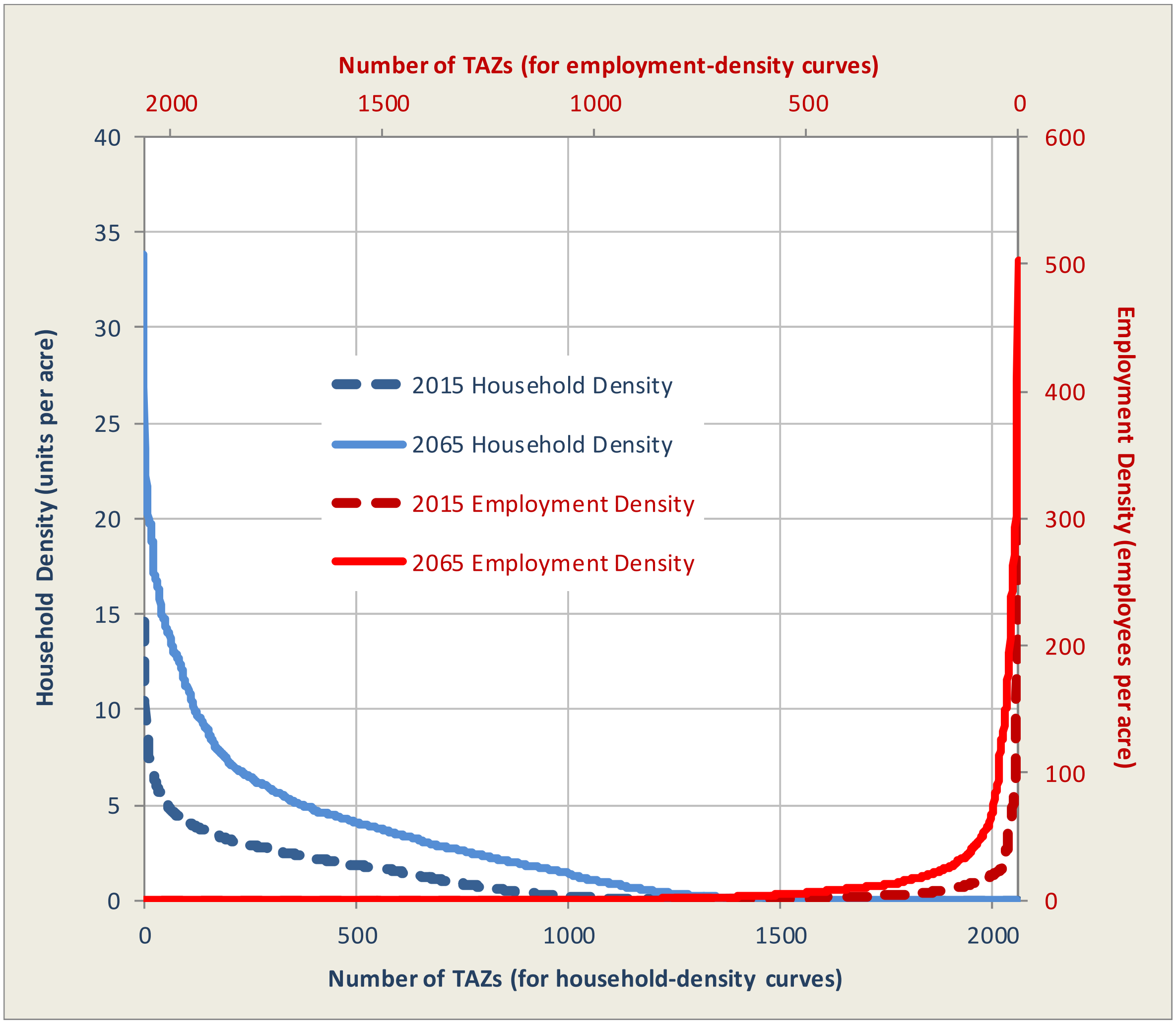
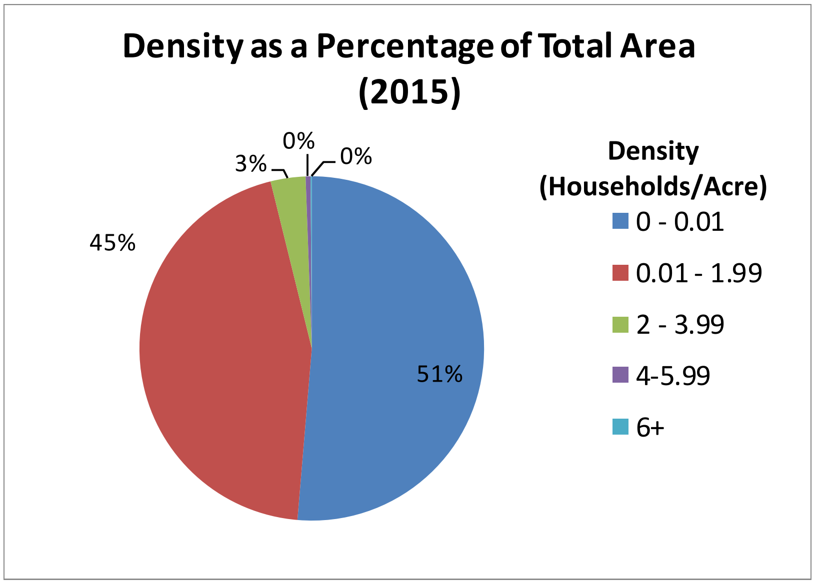


Figure 18. Ranked household and employment density by TAZ, 2015-2065 estimates.

Area by Household Density (Non-Water-Limited)				
Density (units per acre)	2015		2065	
	Area by Density Category (ac)	Percent of Total Area	Area by Density Category (ac)	Percent of Total Area
0 - 0.01	270,000	25%	232,000	22%
0.01 - 1.99	443,000	41%	420,000	39%
2 - 3.99	35,000	3%	52,000	5%
4-5.99	5,000	0%	27,000	3%
6+	1,000	0%	22,000	2%
Total, *non*-water-limited area	754,000	71%	753,000	71%
Area by Household Density (Water-Limited)				
Density (units per acre)	2015		2065	
	Area by Density Category (ac)	Percent of Total Area	Area by Density Category (ac)	Percent of Total Area
0 - 0.01	278,000	26%	246,000	23%
0.01 - 1.99	36,000	3%	67,000	6%
2 - 3.99	150	0%	1,000	0%
4-5.99	37	0%	140	0%
6+	7	0%	40	0%
Total, water-limited area	314,000	29%	314,000	29%
Total, all areas	1,068,000	100%	1,068,000	100%

Table 9. Area by household density.



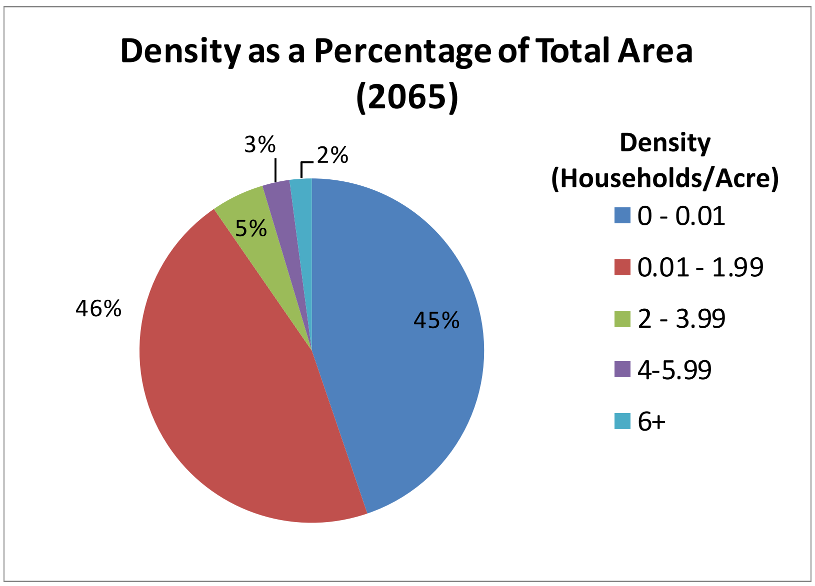


Figure 19. Density as a percentage of total area.

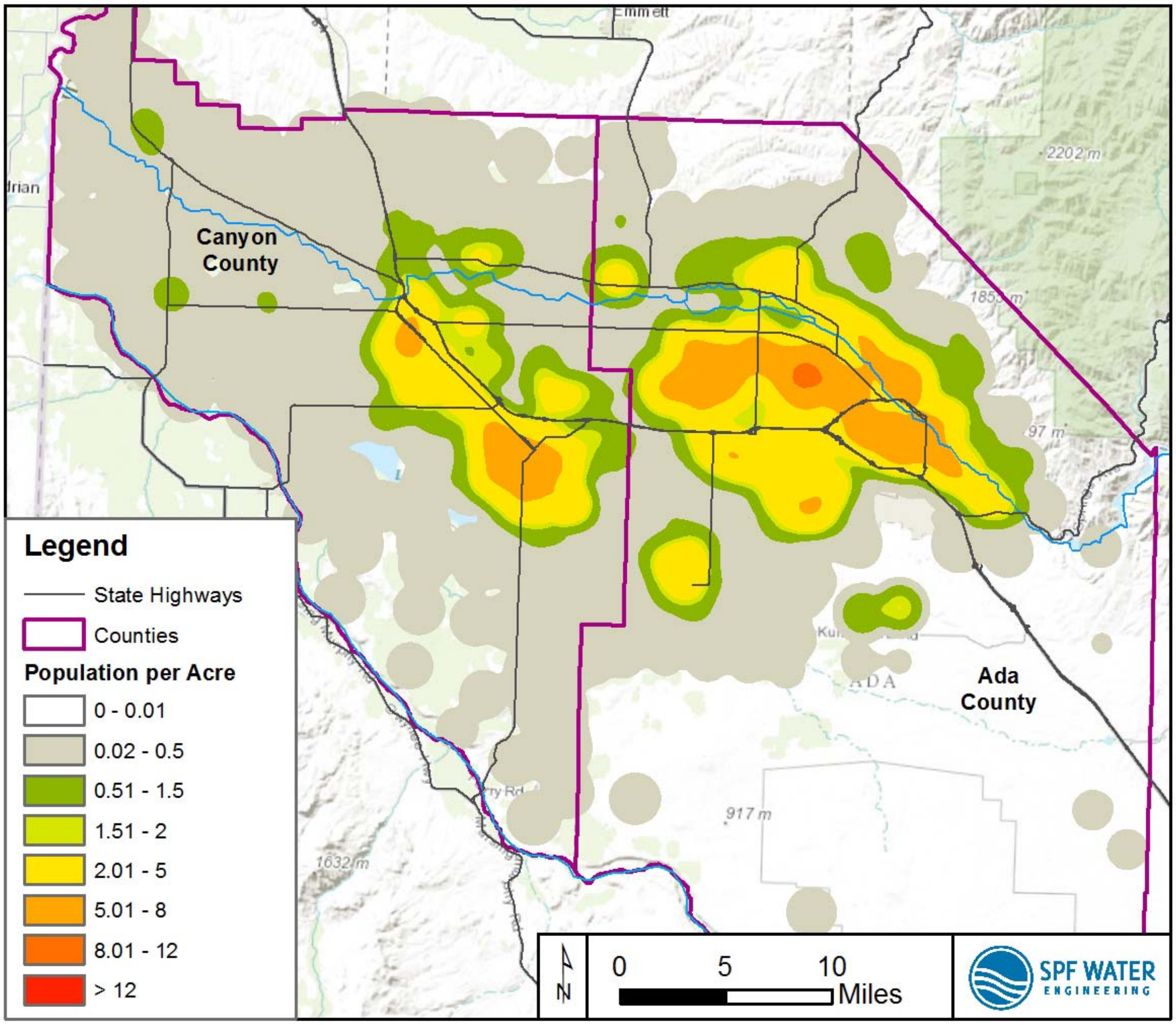


Figure 20. Population distribution, 2015.

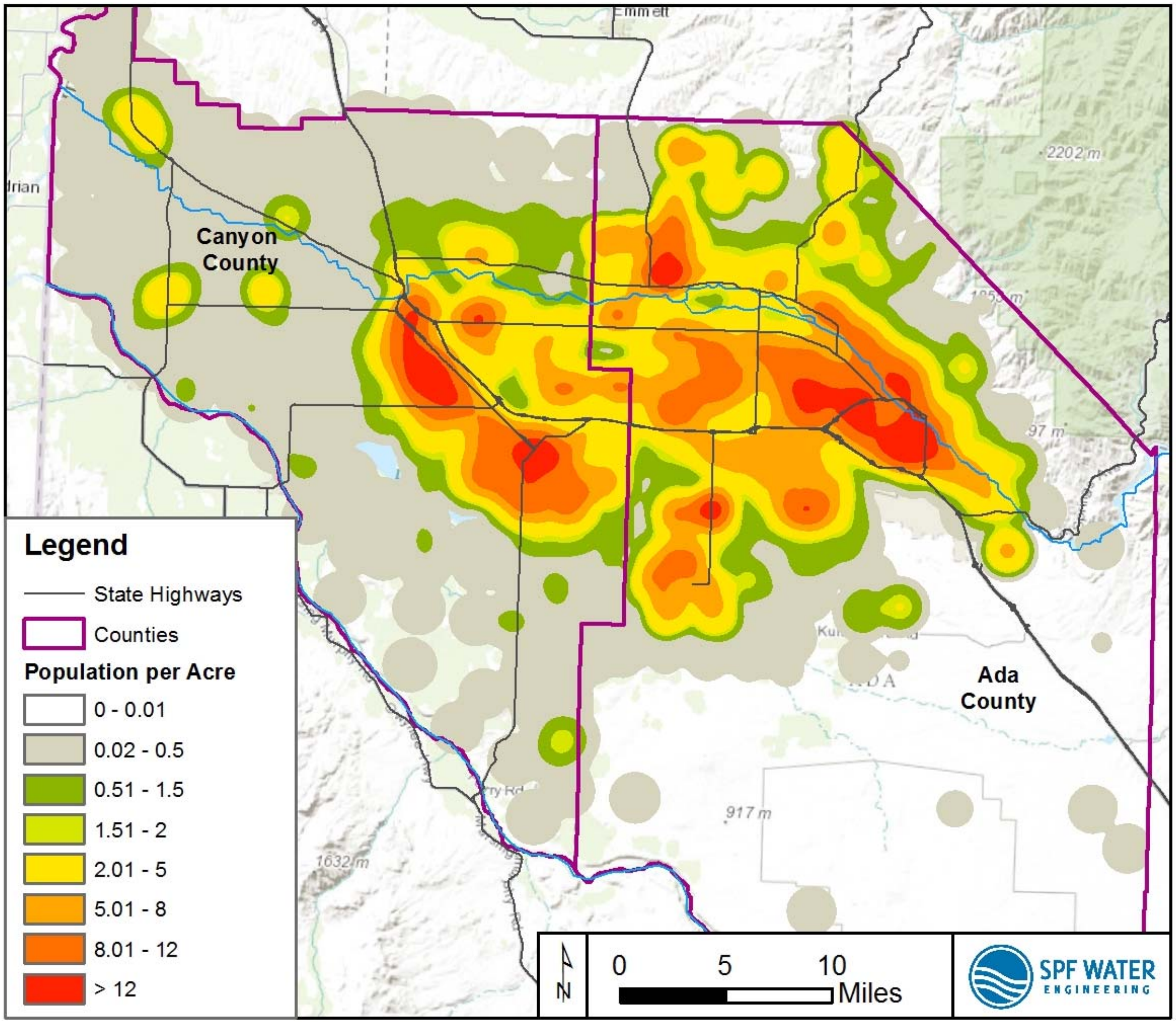


Figure 21. Population distribution, 2065

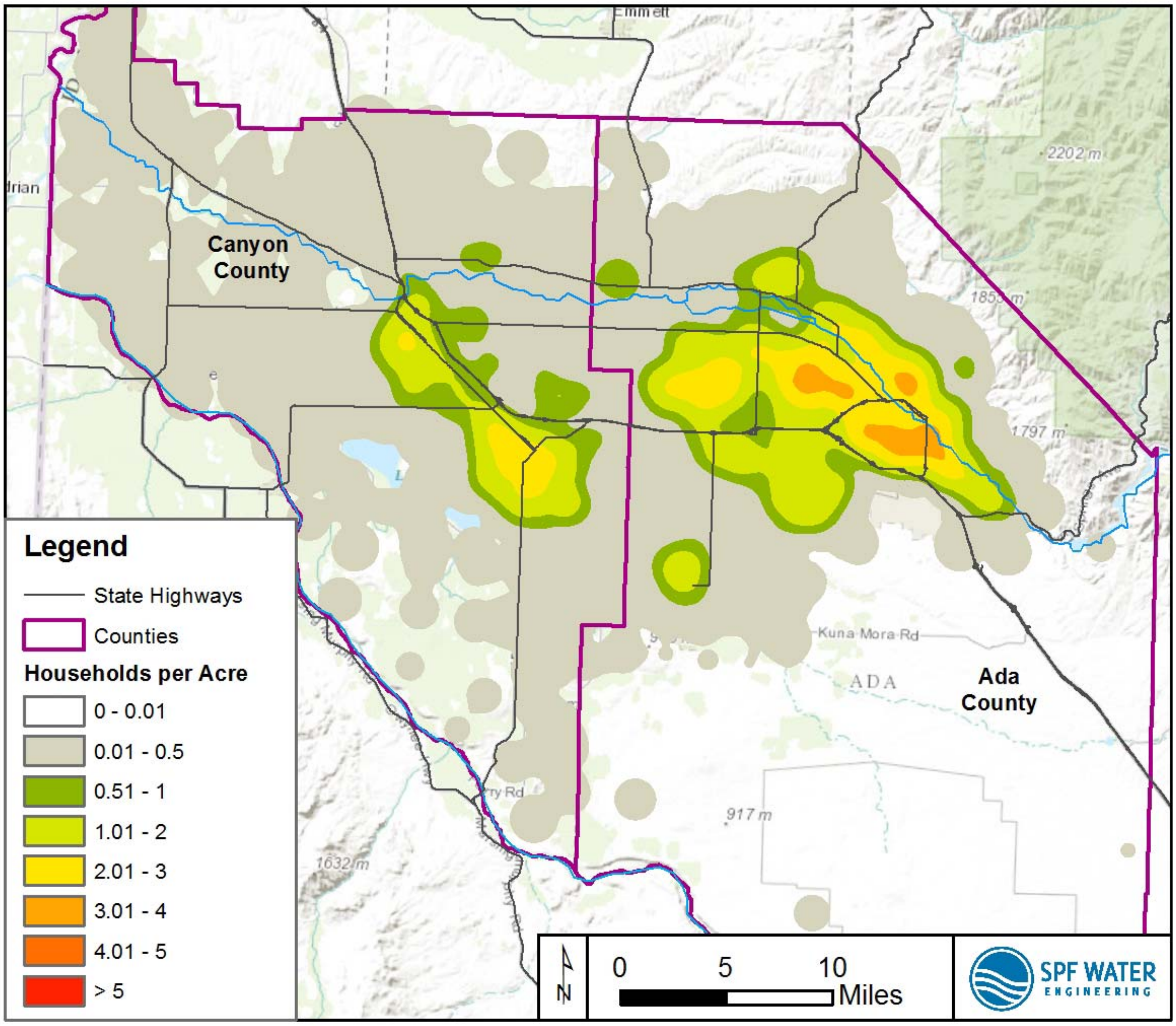


Figure 22. Household distribution, 2015.

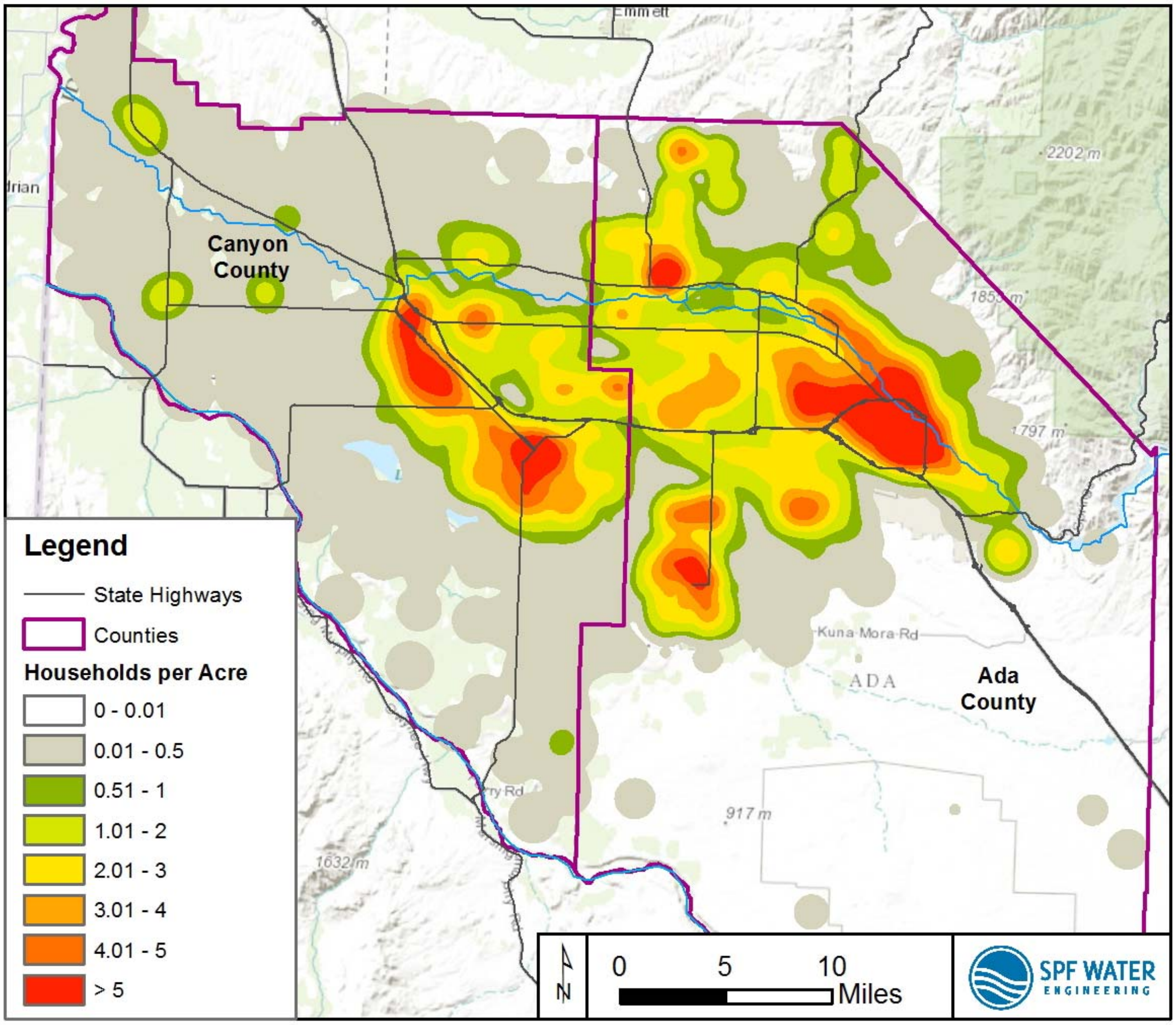


Figure 23. Household distribution, 2065.

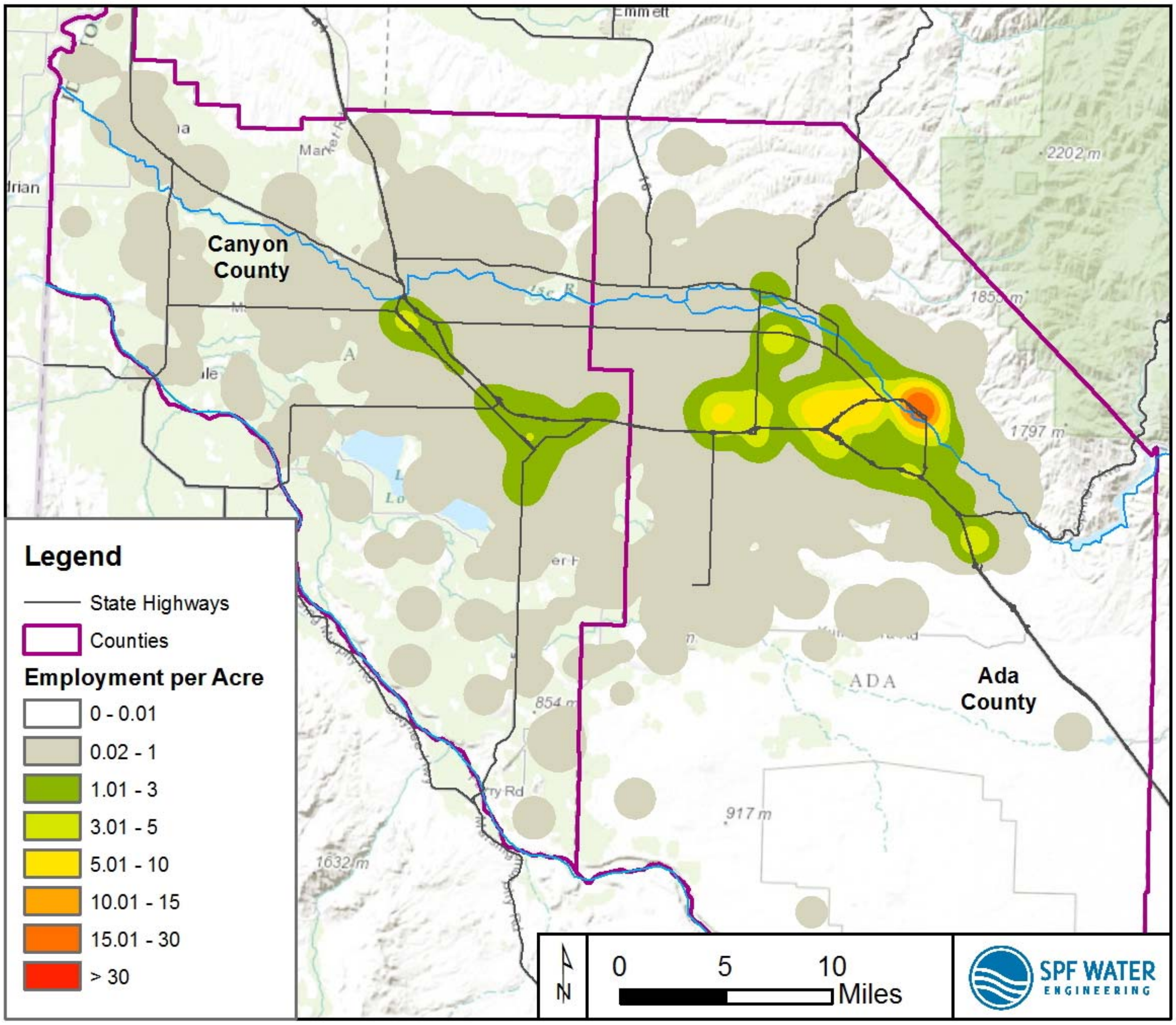


Figure 24. Employment distribution, 2015.

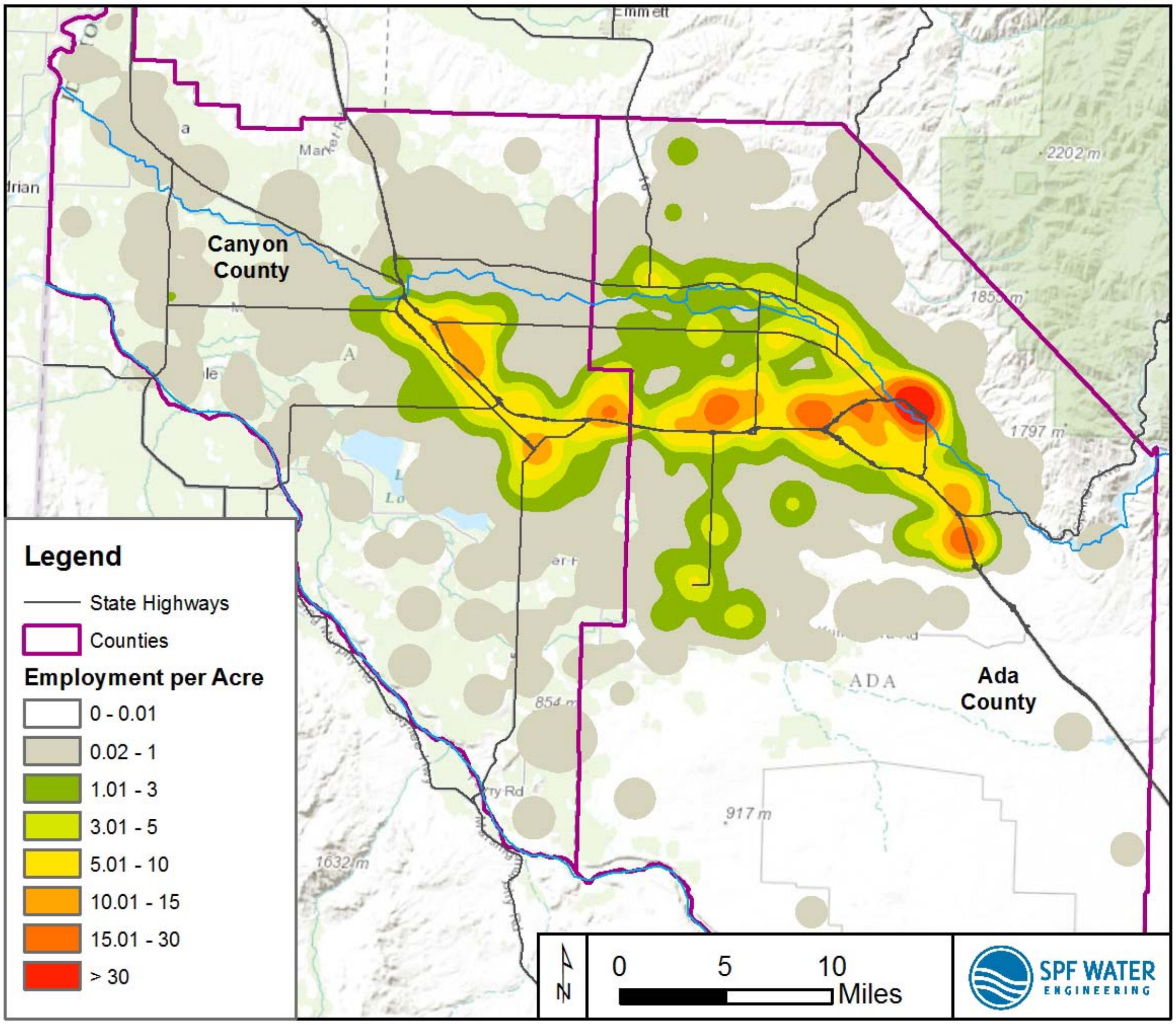


Figure 25. Employment distribution, 2065.

7 ESTIMATE OF CURRENT TREASURE VALLEY DCMI WATER USE

7.1 Introduction

Future water-demand projections are based, in part, on existing water use rates and patterns. DCMI water-production data from 2010-2014 were used to estimate per capita use. The per capita estimates were then used to estimate water production in non-reporting areas. The 2010-2014 reported production data and estimated production in non-reporting areas were then used to estimate 2015 valley-wide DCMI water use.

7.2 Existing Water Production by Primary Providers

Monthly water-use data for the period between 2010 and 2014 were supplied by United Water Idaho,[27] Capitol Water Corporation,[27] Eagle Water Company,[28] City of Eagle, Garden City, City of Kuna, City of Meridian, City of Caldwell, and the City of Nampa (Figure 26). With some exceptions, these municipal purveyors (referred to hereafter as “reporting entities”) also provided estimates of population served, numbers of connections served (by residential, commercial, and industrial categories), a brief description of current water-conservation efforts, a brief description of alternate irrigation supplies (water provided by non-municipal irrigation entities, ownership of surface water shares, use of reclaimed wastewater), and estimates of “unaccounted” water.

The following sections summarize 2010-2014 production data by the reporting entities. Compiled water-use data for each purveyor are provided in Appendix A.

7.3 Recent Water Production

Average aggregate monthly water production by the reporting entities was approximately 85,700 AF/year between 2010 and 2014 (Table 11). United Water Idaho, which produced an average annual volume of 44,800 AF during this time, accounts for approximately half of the production. Production by most of the reporting entities exhibited a slight upward trend between 2010 and 2014 (Figure 27 and Figure 28).

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[27] United Water Idaho and capital Water Corporation or public utilities providing municipal water service within the City of Boise under franchise agreements.

[28] Eagle Water Company provides municipal supply within portions of the City of Eagle.

Production data from all of the reporting entities except the City of Eagle[29] reflects substantially higher demand during the irrigation season (Figure 29 and Figure 30). Aggregate monthly production by the reporting entities ranged from approximately 4,000 AF in February to over 16,300 AF in July.

7.4 Summary of Other Reporting-Entity Information

Primary Treasure Valley DCMI water purveyors generally classify users into two categories: residential and commercial. Residential customers make up approximately 90 percent of the total reporting entities' total accounts. Commercial accounts can include multi-family residences, businesses, city properties, schools, and irrigation accounts. Nampa's 2014 Water Master Plan notes that residential water consumption accounts for 83.5 percent of winter consumption and 71.3 percent of summer consumption.

Surface water is used for irrigation purposes within the service boundaries of most Treasure Valley DCMI providers. Surface water may be provided to individuals or homeowner associations through separate pressurized- or gravity-delivery systems. By example, surface water is used by 60 to 80 percent of the DCMI customers in Meridian, Kuna, and Caldwell.

Reclaimed wastewater is (or will be) used by Meridian and Kuna to provide irrigation for crops, parks, and landscaping through separate, non-potable, irrigation delivery systems. Reclaimed wastewater is not a substantial source (by volume) of irrigation supply at this time, although greater use of reclaimed wastewater is likely in the future.

"Unaccounted" water is municipal water that is produced (i.e., pumped from aquifers or diverted from the Boise River) but not delivered to customers. Unaccounted water includes water that was lost by flushing, line breaks, distribution-system leaks, and fire-hydrant use. Municipal providers reported unaccounted water ranging from 0 to 13 percent of production. The average reported unaccounted water was approximately 8 percent. The City of Meridian reported a very low percentage of unaccounted water (0 percent) for 2014, which it attributes to the newer construction and maintenance of their system. The City of Nampa reported the largest percentage of unaccounted water with a range of 10 to 13 percent.

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[29] The City of Eagle's service area has a separate non-potable pressurized irrigation system supplied by surface water.

7.5 Per Capita Water Use

The key municipal providers (i.e., reporting entities) for which data are presented in Table 11, Figure 29, and Figure 30 served an estimated 495,800 people[30] in 2014 (Table 12). The 2015 rural population (and population residing in areas served by non-reporting municipal providers) is approximately 63,900 people.[31] The reporting entities served approximately 89 percent of the estimated 559,700 Treasure Valley residents (based on provider population estimates) between 2010 and 2014 (Table 12).

Annual per capita water use estimates (Table 13 and Figure 31, based on the reported data) ranged from 80 gallons per day (gpd) per person (City of Eagle) to 278 gpd per person (Capital Water Corporation).[32] Per capita indoor use ranged from approximately 57 gpd per person (City of Kuna) to 122 gpd per person (Capitol Water Corporation).

The average population-weighted per capita water use[33] among residents and businesses served by the reporting entities was 158 gpd per person. The average population-weighted per capita water use for indoor purposes (based on an average of December, January, and February use) is approximately 80 gpd (Table 13 and Figure 32). These per capita water-use rates are roughly equivalent to annual use of approximately 435 gpd per household[34] or 220 gpd per household[35] for indoor uses,

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[30] The reported population served by key municipal providers may be low. The estimated 2015 population is approximately 624,500 people (see Section 7), of which 63,900 live in TAZs not supplied by the reporting entities. While not all people living within areas supplied by the reporting entities receive water from the reporting entities, the current population estimates suggest that the population served by the reporting entities might range from approximately 496,000 people to approximately 561,000 people.

[31] Based on estimated 2015 population by TAZ (Section 6).

[32] Capitol Water Corporation does not meter use; customers pay a flat rate for water. Lack of meters likely contributes to high Capitol Water per capita use that is higher than that of the other reporting entities.

[33] The population-weighted per capita water use is the aggregate production by all DCMI providers divided by the aggregate population served by the DCMI providers.

[34] Calculation for total use per household: (624,500 people / 226,600 households) x 158 gpd/person = 435 gpd/household

[35] Calculation for indoor use per household: (624,500 people / 226,600 households) x 80 gpd/person = 220 gpd/household

based on an estimated 2015 population of 624,500 people (Table 5) residing in 226,600 households (Table 6).

The per capita use estimates described above are based on (1) total system production and (2) reporting-entity estimates of population served. Low production numbers (such as would be the case if production from all wells were not reported) would yield low per capita estimates. Furthermore, incorrect estimates of population served would yield incorrect per capita estimates.

Per capita use estimates do not reflect irrigation water provided by surface-water delivery entities. Surface water is delivered for irrigation in most of the reporting entities' service areas.

The above-described estimates of per capita use are based on aggregate production for domestic, commercial, municipal, and industrial (if served by a municipal provider) uses. There are insufficient provider data for estimating per capita use by sector on a valley-wide basis.

7.6 Estimate of DCMI Water Use Outside of Areas Served by Primary Providers

The per capita water-use estimates developed in the previous section were used to estimate current water use in areas not served by the reporting entities. This was done by multiplying the average, population-weighted, per capita water use estimates by the estimated 2015 population estimates for all TAZs not served by the reporting entities.[36] Based on this approach, DCMI water use outside of areas served by primary municipal providers was approximately 11,400 AF in 2015 (Table 13). This additional DCMI use includes (1) homes and businesses with individual domestic wells, (2) smaller municipal providers, and (3) rural subdivisions with central water systems.

7.7 Estimate of 2015 Treasure Valley Water Use

The population, household numbers, employment, and water-demand projections begin with the base year of 2015 to maintain even 5-year intervals through the year 2065. The 2010-2014 Treasure Valley water use was estimated to be approximately 99,000 AF in 2015 (Table 13), based on (1) 2010-2014 average water-use data provided by primary DCMI providers, (2) per capita water-use estimates derived from

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[36] This method may result in lower-than-actual estimates of irrigation use by self-supplied domestic users (i.e., domestic users pumping water from private private, domestic wells) because the self-supplied domestic users do not have the same cost incentive that may constrain water use by municipal residents. However, self-supplied domestic use is a small portion of the overall Treasure Valley use.

the data provided by primary DCMI providers, and (3) provider-supplied population estimates (Table 12). However, if the same per capita water-use estimates are applied to the entire 2015 estimated Treasure Valley population (Table 5) by TAZ (as opposed to using supplier-provided population estimates), the total 2015 DCMI water use (excluding irrigation water provided by non-DCMI entities) was estimated to be approximately 110,200 AF. This volume (110,200 AF) that was used as the 2015 baseline DCMI demand for subsequent water-demand projections (see Section 10).

The spatial distribution of estimated 2015 total DCMI water use (Figure 33) is, not surprisingly, concentrated within the service areas of the largest DCMI suppliers. The DCMI indoor and outdoor use is concentrated in the urban areas of Boise, Nampa, and Caldwell (Figure 34 and Figure 35).

7.8 Tables and Figures

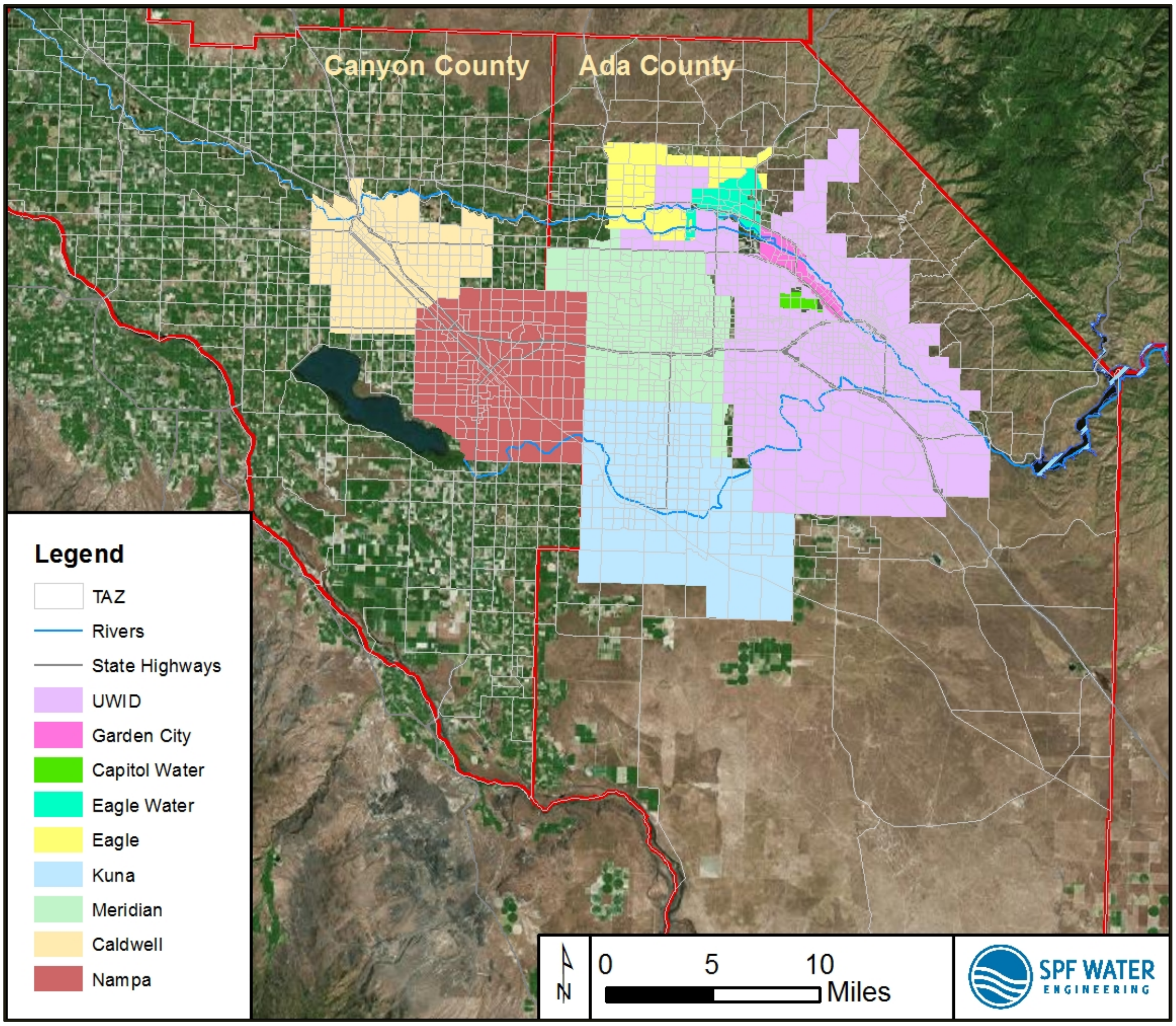


Figure 26. Primary Treasure Valley water providers.

Annual Production Water Production, 2010-2014 (AF)						
City	**2010**	**2011**	**2012**	**2013**	**2014**	**Annual Average**
United Water	42,900	41,500	45,500	47,200	46,700	44,800
City of Nampa	16,100	18,700	18,900	16,700	20,600	18,200
City of Garden City	7,300	7,300	9,800	10,200	10,200	9,000
City of Meridian	5,300	5,100	5,600	5,800	-	5,400
City of Caldwell	3,300	2,700	3,000	3,300	3,400	3,100
Capitol Water Corporation	-	-	2,000	2,600	2,400	2,300
Eagle Water Company	2,200	2,200	2,300	2,400	2,300	2,300
City of Kuna	2,000	2,000	2,100	2,200	2,500	2,100
City of Eagle	400	400	400	400	-	400
Total	79,500	79,900	89,600	90,800	88,100	87,600
Note: blank cells indicate years for which data were incomplete or not provided.						

Table 10: Annual production by primary DCMI water providers, 2010-2014.

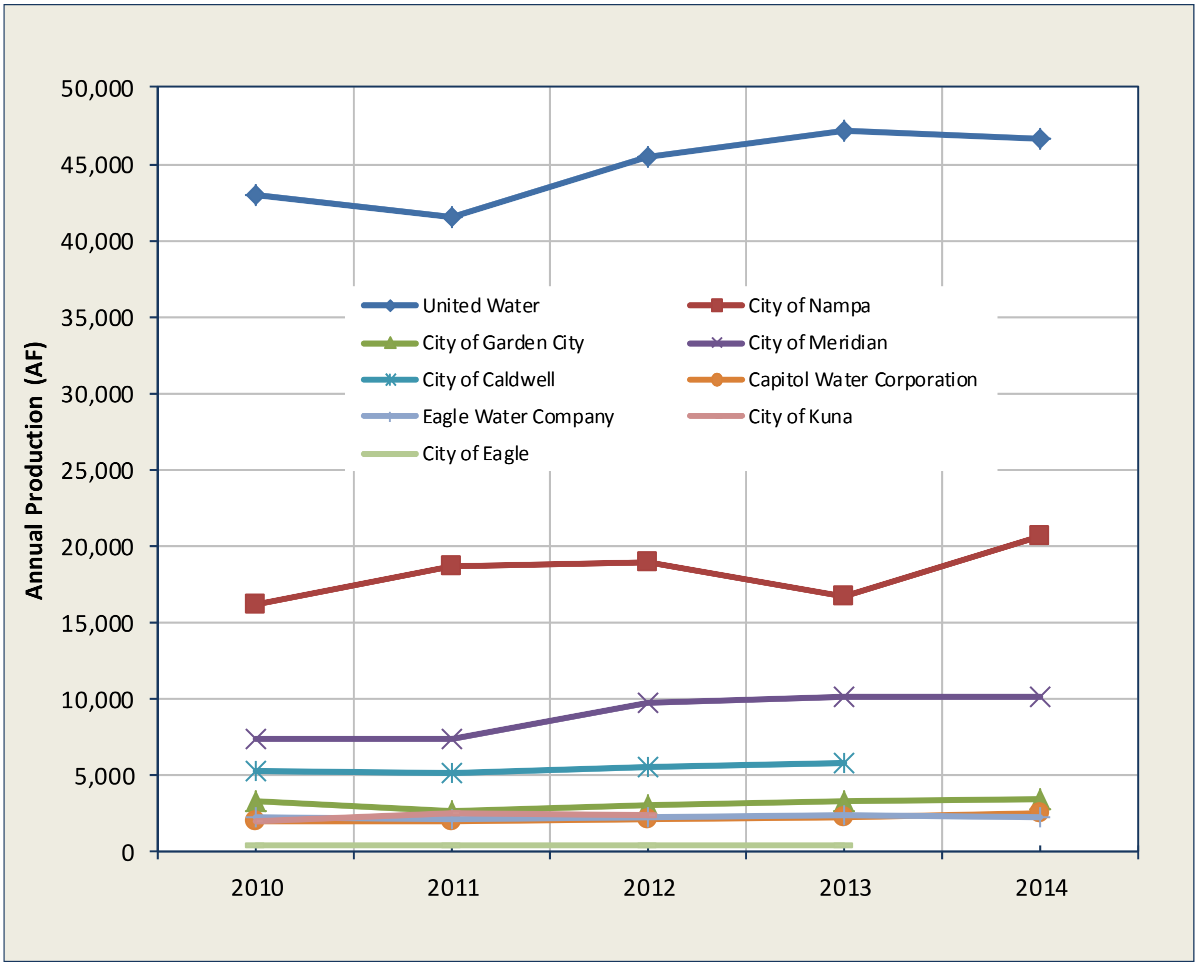


Figure 27. Annual production by primary DCMI water providers, 2010-2014.

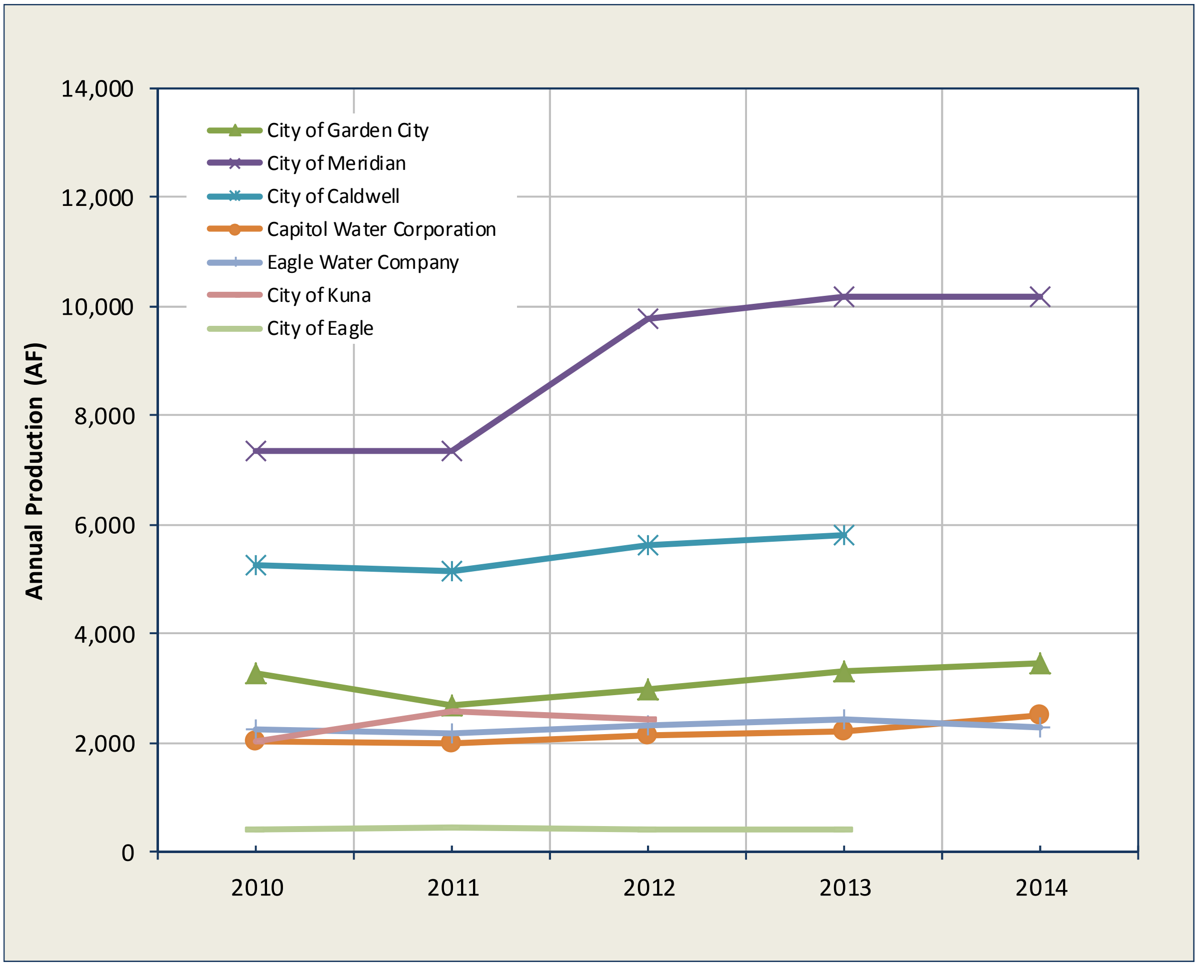


Figure 28. Annual production by smaller DCMI water providers, 2010-2014.

Average Monthly Water Production, 2010-2014 (AF/yr)										
Month	United Water	City of Nampa	City of Garden City	City of Meridian	City of Caldwell	Capitol Water Corporation	Eagle Water Company	City of Kuna	City of Eagle	Total
Jan	1,960	620	180	520	320	60	80	80	30	3,800
Feb	1,760	540	120	480	300	110	70	80	30	3,500
Mar	1,970	580	130	500	350	110	80	100	30	3,800
Apr	2,640	1,450	180	620	410	130	140	200	40	5,800
May	4,220	2,020	300	800	530	240	240	250	40	8,600
Jun	5,460	2,240	390	980	610	370	310	280	40	10,700
Jul	7,360	2,970	530	1,270	750	420	410	410	40	14,100
Aug	7,060	2,820	490	1,210	680	460	380	370	40	13,500
Sep	5,330	2,720	380	970	540	280	290	240	40	10,800
Oct	3,150	1,070	200	700	390	130	150	130	30	5,900
Nov	1,890	600	120	450	310	90	90	100	30	3,700
Dec	1,950	550	110	470	330	100	80	100	30	3,700
Total	44,800	18,200	3,100	9,000	5,500	2,500	2,300	2,300	400	88,000

Notes:
1. Values may not sum as a result of rounding.
2. Annual total based on monthly average may differ from reported annual production because of differences in reporting timeframe.

Table 11: Average monthly water production by primary DCMI water providers.

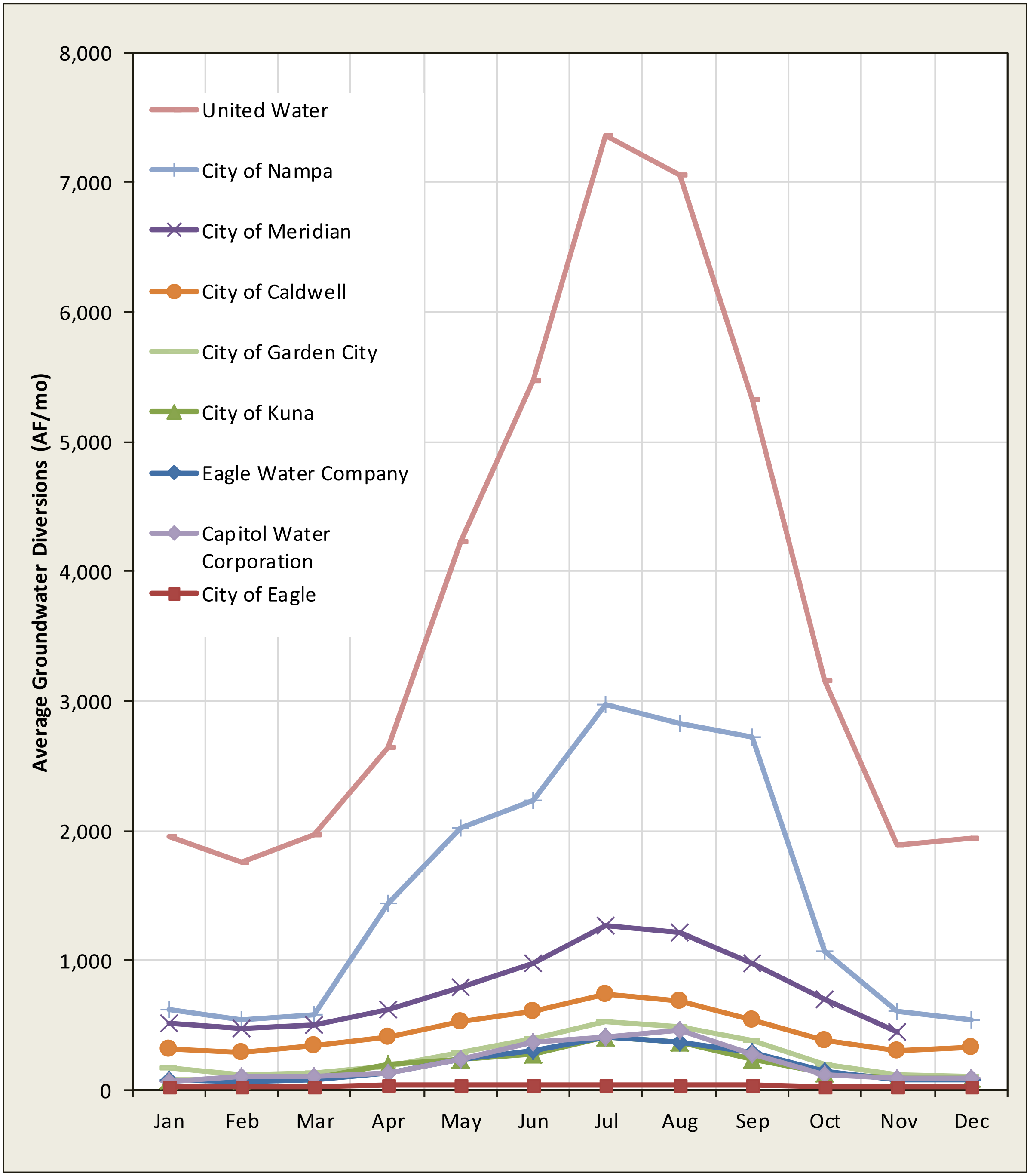


Figure 29. Average monthly water production, 2010-2014.

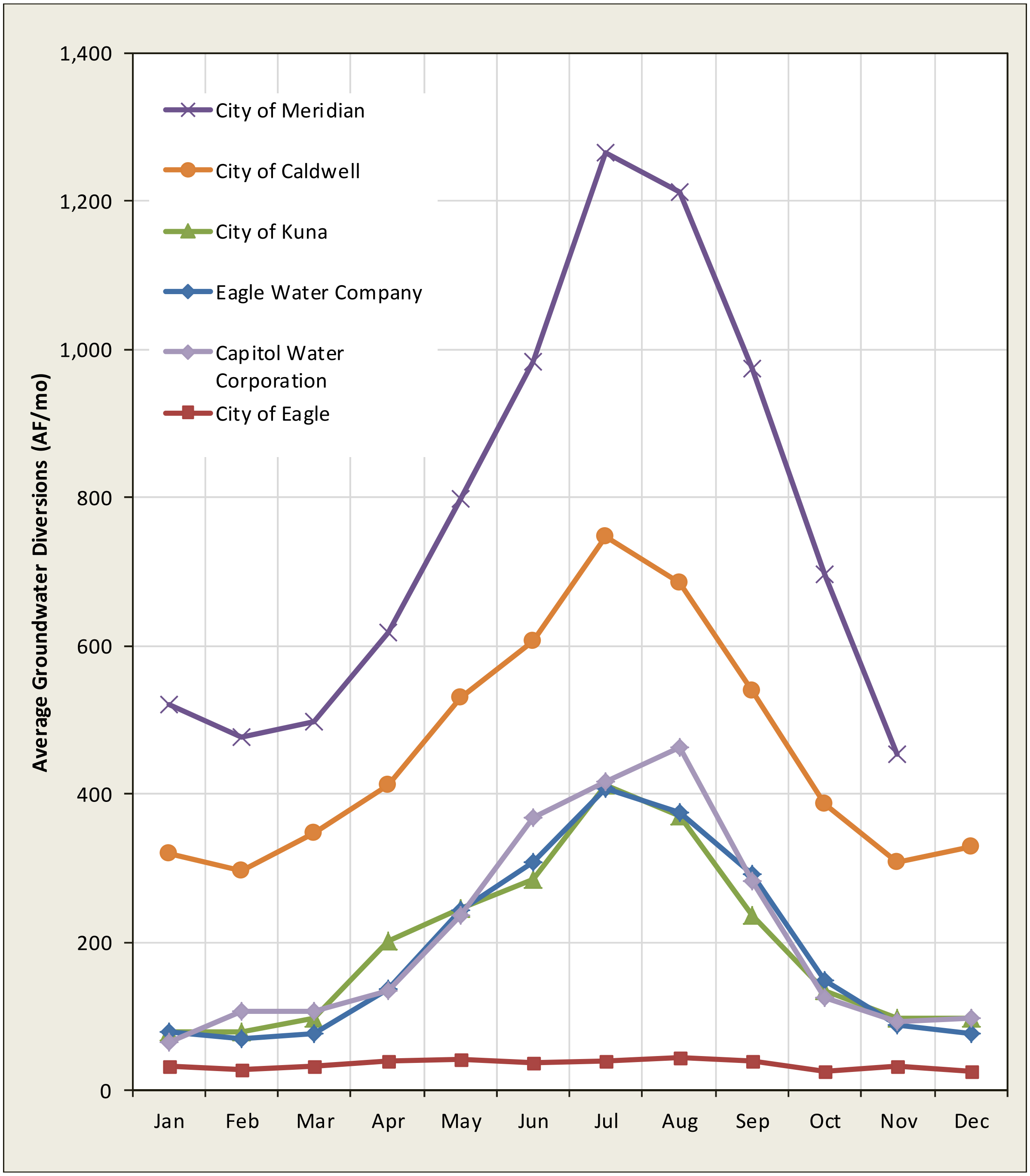


Figure 30. Average monthly production, smaller DCMI providers, 2010-2014.

Population Served by Key Municipal Providers	
Ada and/or Canyon County Water System	**Estimated 2014 population(1)**
United Water Idaho	227,000
City of Nampa(2)	86,000
City of Meridian	80,000
City of Caldwell	51,691
City of Kuna	16,000
City of Garden City	12,500
Eagle Water Company	10,000
Capitol Water Corporation(3)	8,000
City of Eagle	4,615
Total population reported by primary municipal providers (i.e., reporting entities)	495,800
Other municipals(4)	20,600
Rural(4)	43,300
Estimated 2015 total Ada and Canyon County population(5)	559,700
Approximate percentage of 2015 population served by above-listed municipal providers	89%

(1) Unless otherwise noted, data were supplied by provider.
(2) Estimate from City of Nampa 2014 Water System Master Plan
(3) Reported population: 7,500 - 8,500
(4) Based on J. Church data
(5) This number is lower than the 2015 estimated 2015 "baseline" population because the primary providers appear to be underreporting "populations served."

Table 12. Population served by key municipal providers.

Summary of Average Annual Production and Per-Capita Water Use[1]							
City	Average Annual Diversion (AF)	Population Served	Estimated Average Indoor Use[2] (AF)	Estimated Average Irrigation Use (AF)	Per-Capita Water Use		
					Annual (gpd)[3]	Indoor (gpd)[2]	Irrigation (gpd)
United Water	44,800	227,000	22,700	22,100	176	90	87
City of Nampa	18,200	86,000	6,900	11,300	193	72	118
City of Meridian	9,000	80,000	5,900	3,100	100	66	35
City of Caldwell[4]	5,400	51,700	3,800	1,700	95	66	30
City of Garden City	3,100	12,500	1,600	1,600	224	119	112
City of Kuna[5]	2,300	16,000	1,000	1,300	130	57	74
Eagle Water Co.	2,300	10,000	900	1,400	205	81	125
Capitol Wtr Corp.[6]	2,100	8,000	1,100	1,400	278	122	158
City of Eagle[7]	400	4,600	300	100	80	67	15
Other Municipals[8]	3,700	20,600	1,900	1,800	182	81	
Rural [8]	7,700	43,300	3,900	3,800	182	81	
Total	99,000	559,700	50,000	49,600			
Maximum[9]					278	122	158
Minimum[9]					80	57	15
Population-weighted average[9]					158	80	79

Notes:
(1) Unless otherwise noted, averaging period is 2010 to 2014
(2) Based on average diversions December- February
(3) Based on average annual diversions
(4) City of Caldwell averages are based on water production from 2012 to 2013
(5) City of Kuna averages are based on water production from 2012 to 2014
(6) Capitol Water averages are based on water production from 2014
(7) City of Eagle averages are based on water production from 2010 to 2013
(8) Based on population pata from John Church and per papita averages
(9) Excludes "other municipals" and "rural"

Table 13. Summary of average annual production and per-capita water use.

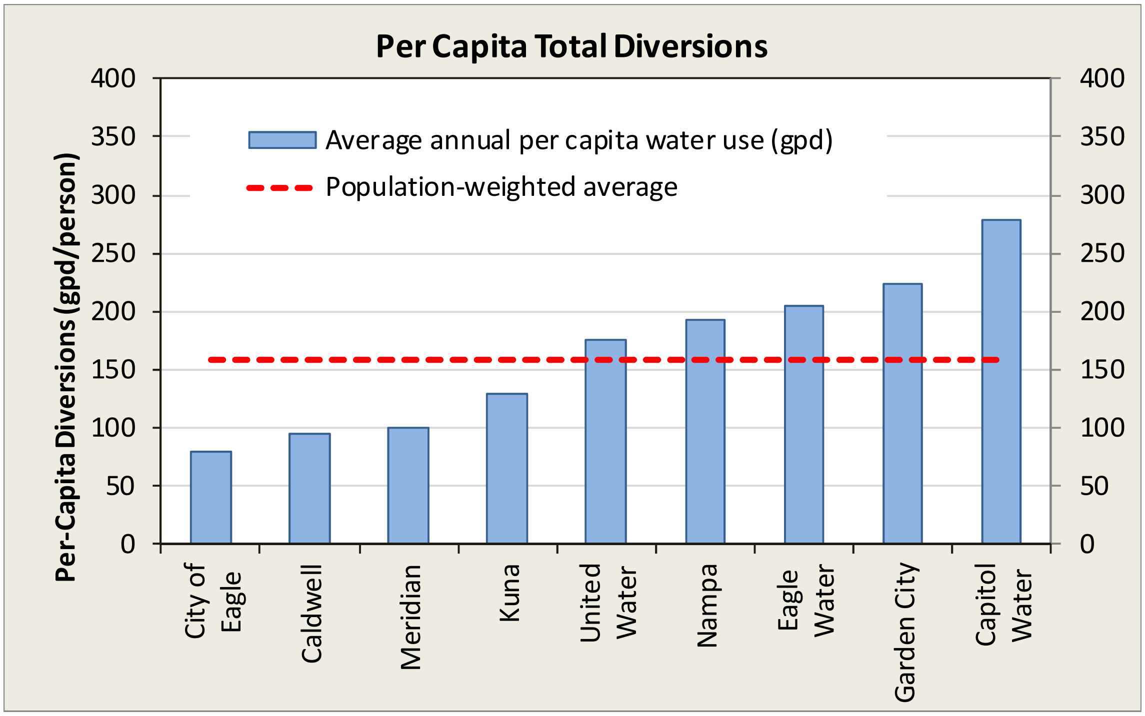


Figure 31. Average per capita diversions (total), 2010-2014.

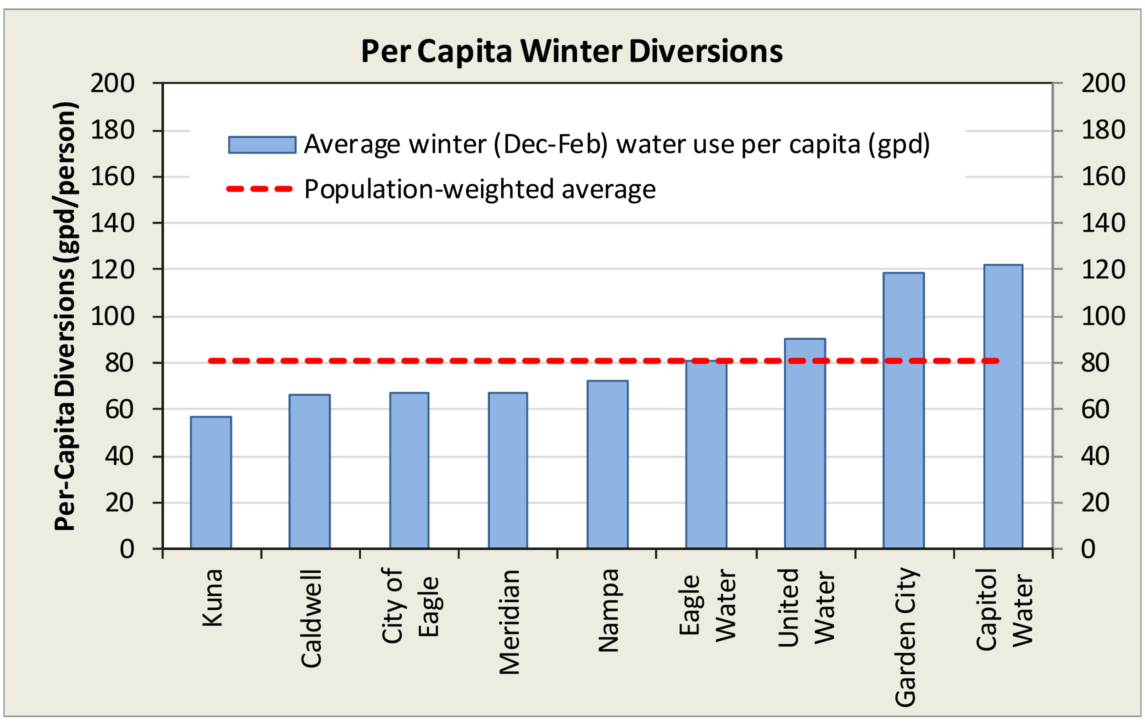


Figure 32. Average per capita diversions (winter only), 2010-2014.

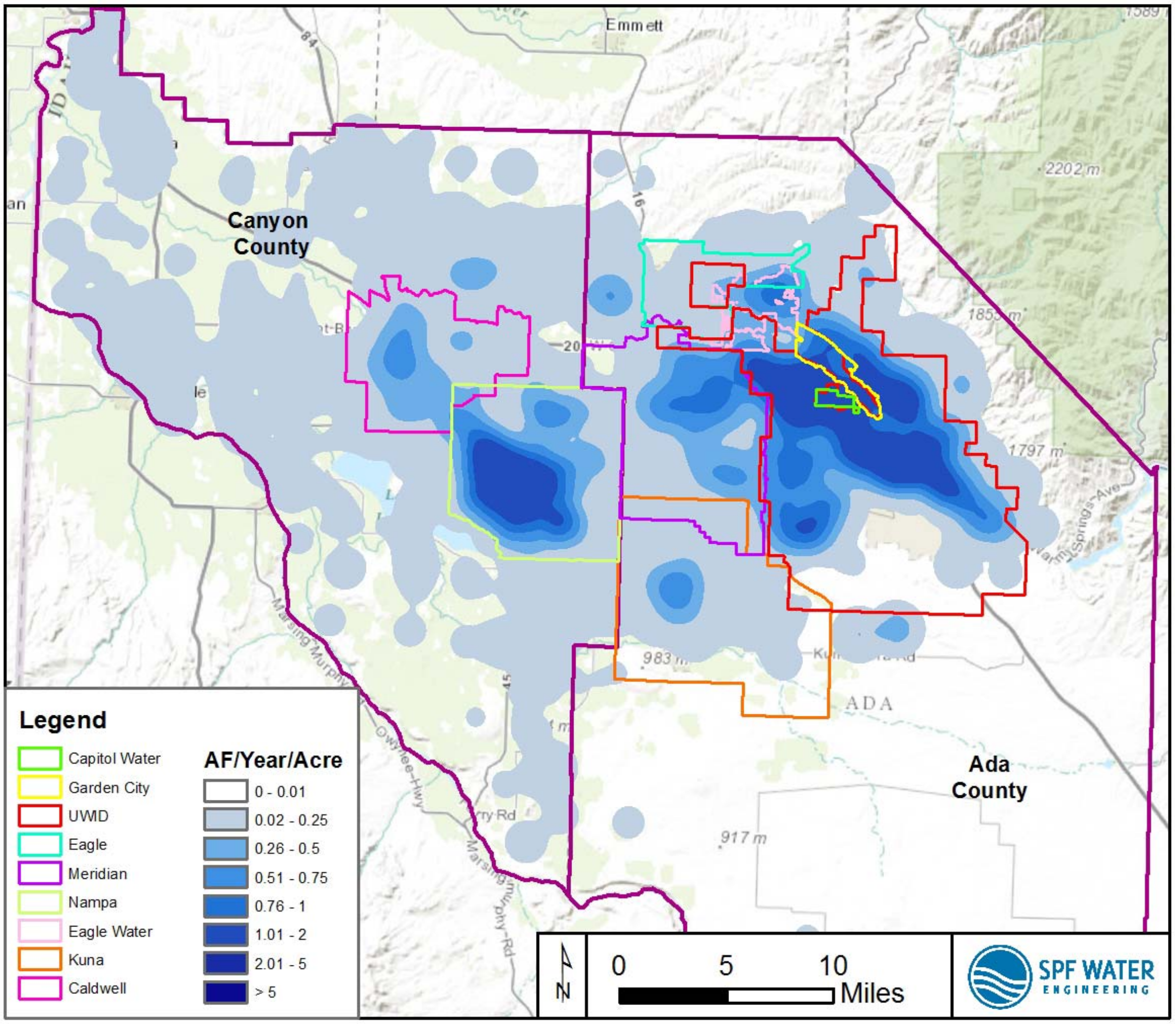


Figure 33. Distribution of 2015 total DCMI water use and provider areas.

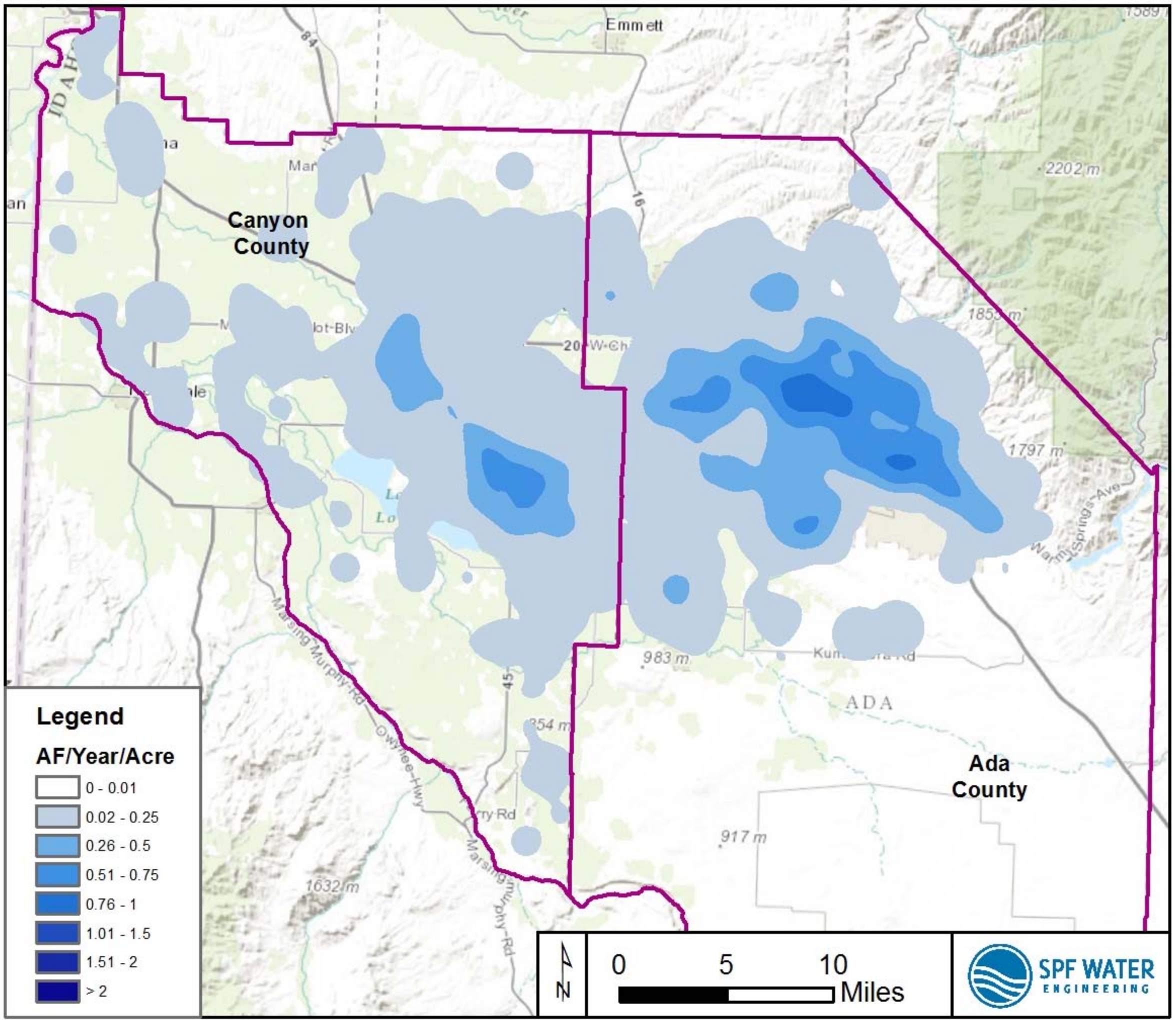


Figure 34. Distribution of 2015 indoor water use.

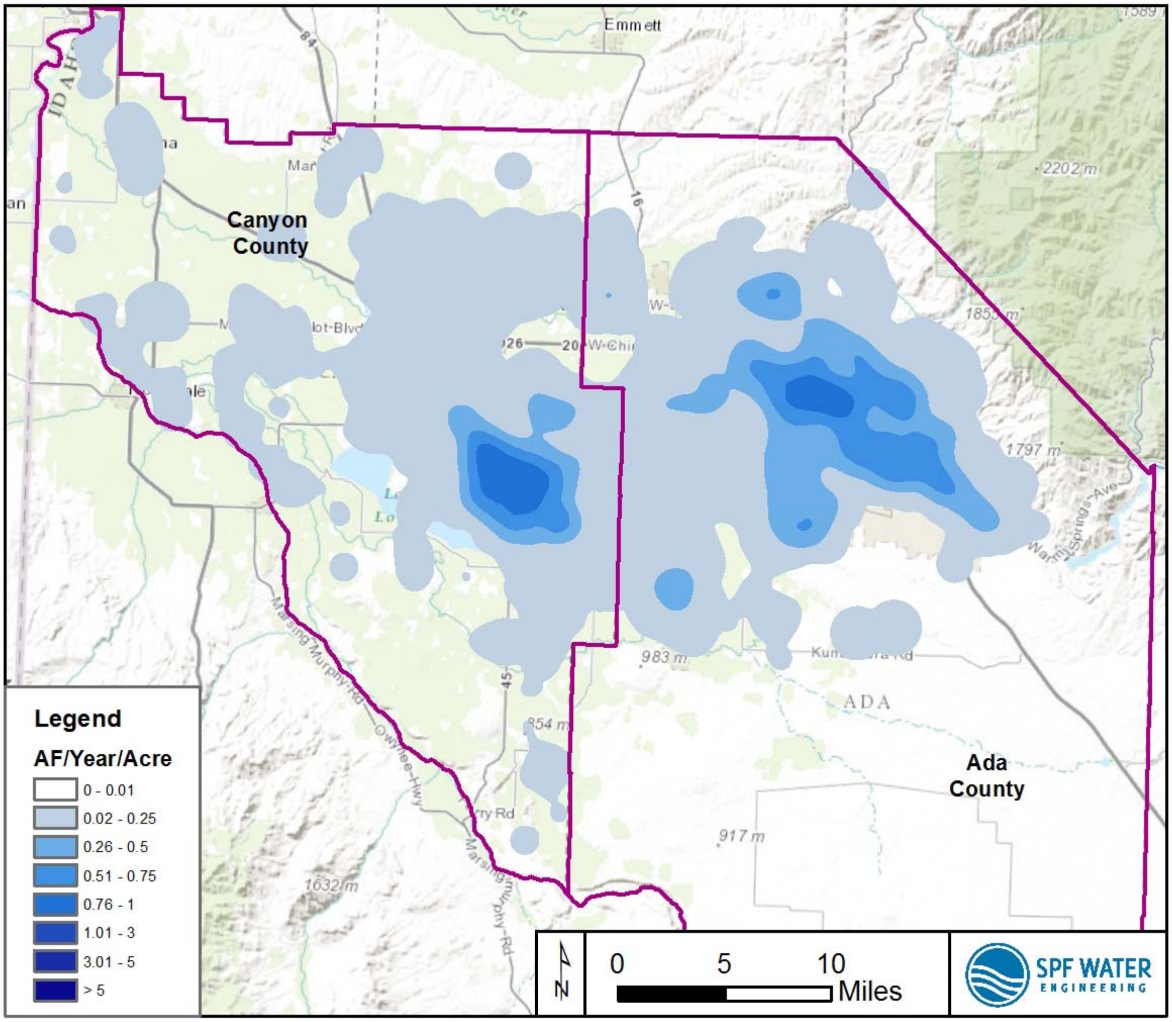


Figure 35. Distribution of 2015 DCMI irrigation water use.

8 PRECIPITATION DEFICIT AND CLIMATE CHANGE

8.1 Introduction

Projected increases in irrigation-season temperatures will likely lead to increases in evapotranspiration, which would lead to increases in irrigation demand. This section presents precipitation-deficit estimates based on historical data and describes an assumption regarding future precipitation deficit based on climate-warming trends.

8.2 Precipitation Deficit Based on Historical Data

The mean growing-season precipitation deficit for fully-irrigated turf, based on historical weather data in Boise, Caldwell, and Nampa, is 3.2, 3.7, and 3.3 feet per year, respectively (Table 14), or an average of 3.4 feet per year. These values are similar to the precipitation deficit for alfalfa (Table 14).

8.3 Climate Change Projections

The Northwest region is characterized by a highly diverse climate with large spatial variations caused by the interactions of large-scale atmospheric circulation with mountains (Kunkel et al., 2013). The north-south mountain range orientations contribute to more precipitation in the west and block precipitation in the interior. This results in a large precipitation and climate difference between the western and eastern portions of the northwest region.

In the recent U.S. National Climate Assessment (Kunkel et al., 2013), climate model simulations were used to analyze two different greenhouse gas emission scenarios (high “A2” and low “B1” emissions). Fifteen models were used in the analysis of these two scenarios and the results were summarized into a down-scaled data set. The scenarios reportedly incorporate much of the range of potential future human impacts on the climate system. The A2 scenario describes a continuously growing global population resulting in the continuous rise in emissions from approximately 40 gigatons (Gt) per year in 2000 to approximately 140 Gt per year by 2100. The B1 scenario describes emissions that peak in mid-century and decline thereafter with the introduction of clean and resource-efficient technologies. This causes emissions to rise from 40 Gt in 2000 to a maximum of approximately 50 Gt per year by midcentury and then falling to less than 30 Gt per year by 2100.

Temperatures in the Northwest have generally been above the 1901-1960 average for the last 25 years (Kunkel et al., 2013). Temperature-increase trends have ranged from +0.10°F to +0.20°F per decade. Annual precipitation has shown high variability since 1976; there has been a significantly greater amount of precipitation in the past 35 years on a regional basis.

Fluctuations in regional climate are influenced by the El Niño/Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) phenomena. In their warm phases, ENSO and PDO increase the chances for a warmer-than-average Pacific Northwest winter and spring and decrease the odds for a wetter-than-average winter. The opposite tendencies are true for cool phase ENSO (La Niña) and PDO (Dalton et al., 2013).

The National Climate Assessment provides projections for the periods of 2021-2050, 2041-2070, and 2070-2099, with changes calculated with respect to a historical climate reference period from 1971-1999, 1971-2000, or 1980-2000. "Multi-model mean" maps were used to summarize results from various model simulations. The multi-model mean maps are based on the average of all models at a grid point; separate models are weighted equally. This approach is thought to be superior to any single model in reproducing present day climate.

The multi-model mean projections (Figure 36) indicate an increase in average temperature in all three time periods (i.e., 2021-2050, 2041-2070, and 2070-2099). The 15-model averages consistently show the greatest of temperature increases in southern Idaho. Color with hatching in Figure 36 indicates that more than 50 percent of the models show a statistically significant increase in temperature.

An average annual temperature increase of 2.9°F to 10.9°F is projected by 2070 to 2099 compared to the period between 1970 and 1999 (Table 15), with the largest increases projected to occur in the summer. The temperature-increase ranges (Table 15) were based on the maximum and minimums from scenarios A2 and B1 in the model simulations. The average temperature between scenarios was determined for use in water-demand calculations by averaging the multi-model mean temperatures for southwest Idaho.

The same multi-model mean method was used by Kunkel et al. to summarize precipitation projections. The annual mean precipitation simulations project an annual increase in precipitation for all periods and scenarios in the Northwest. However, summer precipitation is projected to decrease throughout the Northwest (Figure 37) by as much as 30 percent by the end of the century.

A lower increase in precipitation is projected for southern Idaho than in northern portions of the Northwest. However, there is a large statistical variability in precipitation among the 15 climate models over most of the region. Almost all models project increases at high latitudes and decreases in low latitudes, but vary about the projections in middle latitudes. The models are consistent in projecting a decrease in summer precipitation. In Figure 37, the areas with hatching represent areas where over 50 percent of the models agree with the significant change in precipitation; widespread model consistency does not occur until 2070-2099.

In summary, climate projections indicate that the Northwest will experience temperature increases in both cool and warm seasons (P.W. Mote and E. P. Salathé

Jr, 2010). Regional climate models project decreases in summer precipitation and increases in fall and winter precipitation.

8.4 Climate Variability and Potential Impacts on Water Demand

Changes in precipitation and air temperature have already affected hydrology and water resources in the Northwest. In many watersheds (except those with little snow), as snow accumulation diminishes, spring peak flows shift earlier, winter flow increases, and late-summer flow decreases (Dalton et al., 2013). Streamflow magnitude and timing, temperatures, and water quality changes are anticipated with climate change. Snow-dominant watersheds are projected to shift towards mixed rain-snow conditions and rain-snow watersheds are projected to trend towards a mix of rain-snow and rain-dominant (Dalton et al., 2013). These hydrologic changes will impact reservoir systems, irrigated agriculture, municipal drinking water infrastructure, aquatic systems, and water dependent recreation.

Reservoirs in the Northwest rely heavily on the ability of snowpack to act as additional water storage. The amount of snow that collects in the mountains is sensitive to both precipitation and temperature. Earlier snow melt and peak flow means that more water will run off when it is not needed for human and agriculture uses (Dalton et al., 2013).

Flood risk may increase in some basins as the early snow melt results in the greater runoff, or different runoff timing. Reservoir operation systems are designed based on historical seasonal timing of snowmelt runoff. The continuing challenge for reservoir operators will be to balance competing goals (storing as much water as possible for irrigation and maintaining sufficient space to capture flood waters during early runoff) in the context of greater precipitation and runoff- timing variability. A shift in the timing of peak flows by several weeks to a month earlier in the year could result in an earlier release of water from reservoirs to create space for flood control and this could cause lower reservoir levels when the reservoir is unable to refill during late spring and summer.

Agricultural water demands could increase as climate warming leads to a longer growing season. Higher temperatures and altered precipitation patterns throughout the 21st century may benefit some cropping systems, but challenge others (Dalton et al., 2013). Vulnerabilities differ among agricultural sectors, cropping systems, and location. Projected future precipitation decreases and higher temperatures during the summer months are likely to increase irrigation demand in the Northwest. Insufficient reservoir fill could exacerbate problems associated with increased water demand as a result of higher summer temperatures.

8.5 Increased Precipitation Deficit

Projected temperature increases will lead to greater evapotranspiration rates, and combined with projected decreases in summer precipitation, result in greater precipitation deficits (i.e., irrigation requirements). There is uncertainty in the magnitude of projected increases in summer temperatures and precipitation. However, the range of projected temperature increases suggests that an evapotranspiration increase ranging from approximately 5 to 20 percent per year in 50 years is possible (Appendix B). For the purposes of this analysis, it was assumed that the precipitation deficit would increase 10 percent by the year 2065. Specifically, it was assumed that the average valley-wide precipitation deficit for turf (based on the estimates listed in Table 14) would increase from an average of 3.4 feet per year in 2010 to 3.7 feet per year by the year 2065 (Table 16).

Increasing precipitation deficit may lead to an irrigation demand in excess of current irrigation volumes. The current standard Treasure Valley field headgate diversion volume is 4.5 feet per acre for irrigation between March 1 and November 15 (Young, 1999). These values are based, in part, on consumptive irrigation requirements estimated by Allen and Brockway (1983). This maximum diversion volume of 4.5 feet per acre may be reflected in water right licenses or decrees, and has been used for evaluating future resource impacts.

However, the projected 3.7 feet per year precipitation deficit by the year 2065, combined with an irrigation efficiency of 70 percent, would require a field headgate diversion of 5.3 feet per acre, which exceeds the current field headgate volume of 4.5 feet per acre. Thus, increased precipitation deficit could require less consumptive turf or improved irrigation efficiency to stay within authorized diversion volumes. Alternatively, IDWR may at some point reassess (and increase) standard diversion volumes, allowing water users to apply for additional water rights to meet increased irrigation requirements.

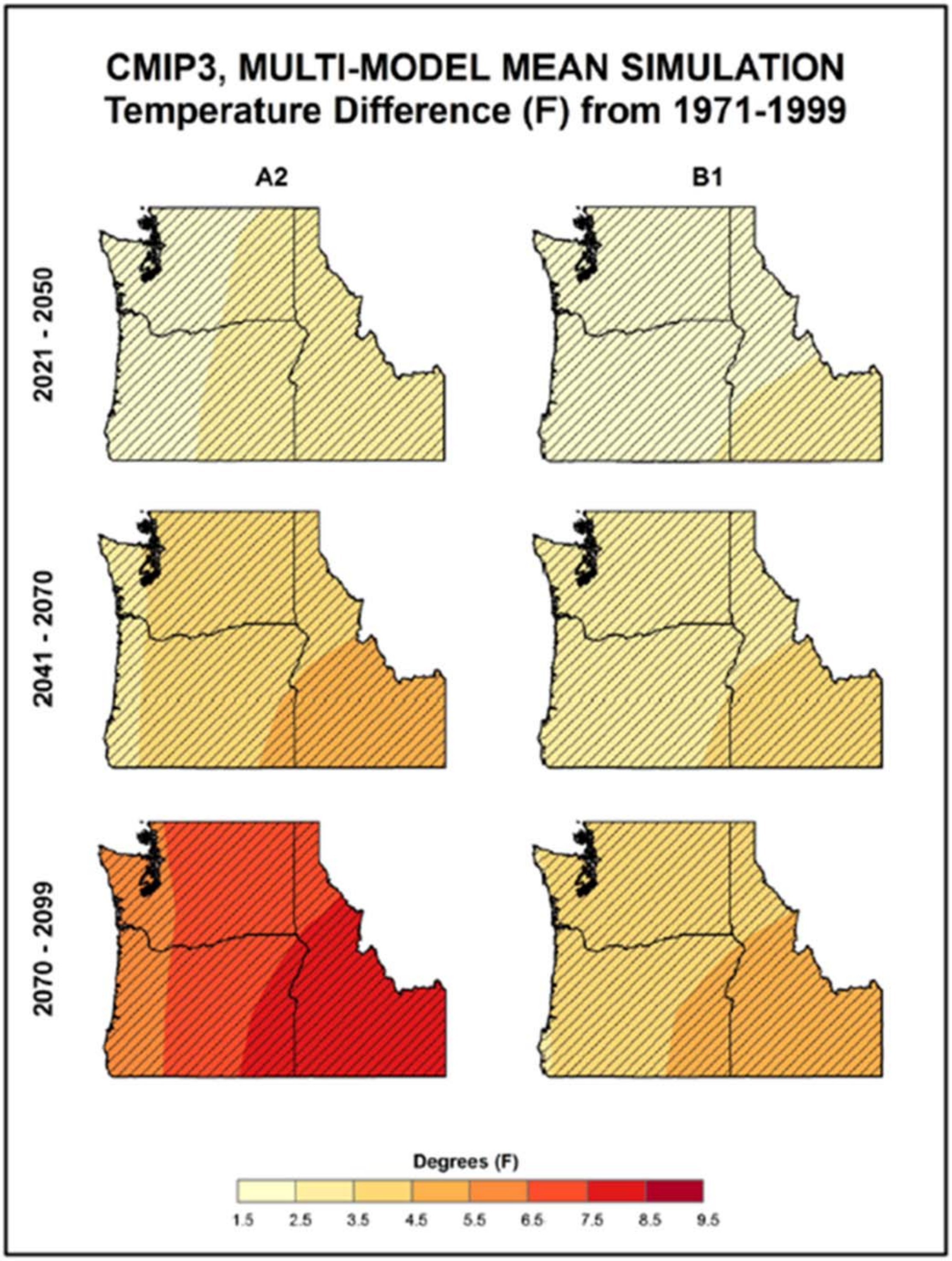
In practice, not all urban ground is irrigated with the amount of water needed for fully-irrigated turf. Some forms of landscaping may require less water than fully-irrigated turf. Drought-tolerant fescues may require less water than other forms of turf grass, and some irrigated urban turf is under-watered, because of inefficient irrigation applications, cost of potable water for irrigation, or other reasons. Thus, average water requirements for DCMI irrigation may be less than 4.5 to 5.3 feet per acre contemplated above.

8.6 Tables and Figures

Station & Crop		Growing Season Precipitation Deficit		
		Mean (ft/yr)	Standard Deviation (ft/yr)	20% Exceedance (ft/yr)
Boise WSFO Airport (NWS--101022)(1)				
	Alfalfa (frequent cuttings)	3.14	0.3	3.4
	Turf lawns (irrigated)	3.23	0.3	3.4
Caldwell(3)				
	Alfalfa (frequent cuttings)	3.6	0.3	3.8
	Turf lawns (irrigated)	3.7	0.3	3.9
Nampa (AgriMet -- NMPI)(4)				
	Alfalfa (frequent cuttings)	3.3	0.3	3.5
	Turf lawns (irrigated)	3.3	0.4	3.7

(1) http://data.kimberly.uidaho.edu/ETIdaho/stninfo.py?station=101022; statistics based on 30 years between 1979 and 2010.
(2) USDA National Agricultural Statistics Service, see report
(3) From http://data.kimberly.uidaho.edu/ETIdaho/stninfo.py?station=101380; statistics based on 30 years between 1961 and 1996.
(4) From http://data.kimberly.uidaho.edu/ETIdaho/stninfo.py?station=8, statistics based on 30 years between 1997 and 2011.

Table 14. Growing season precipitation deficit.

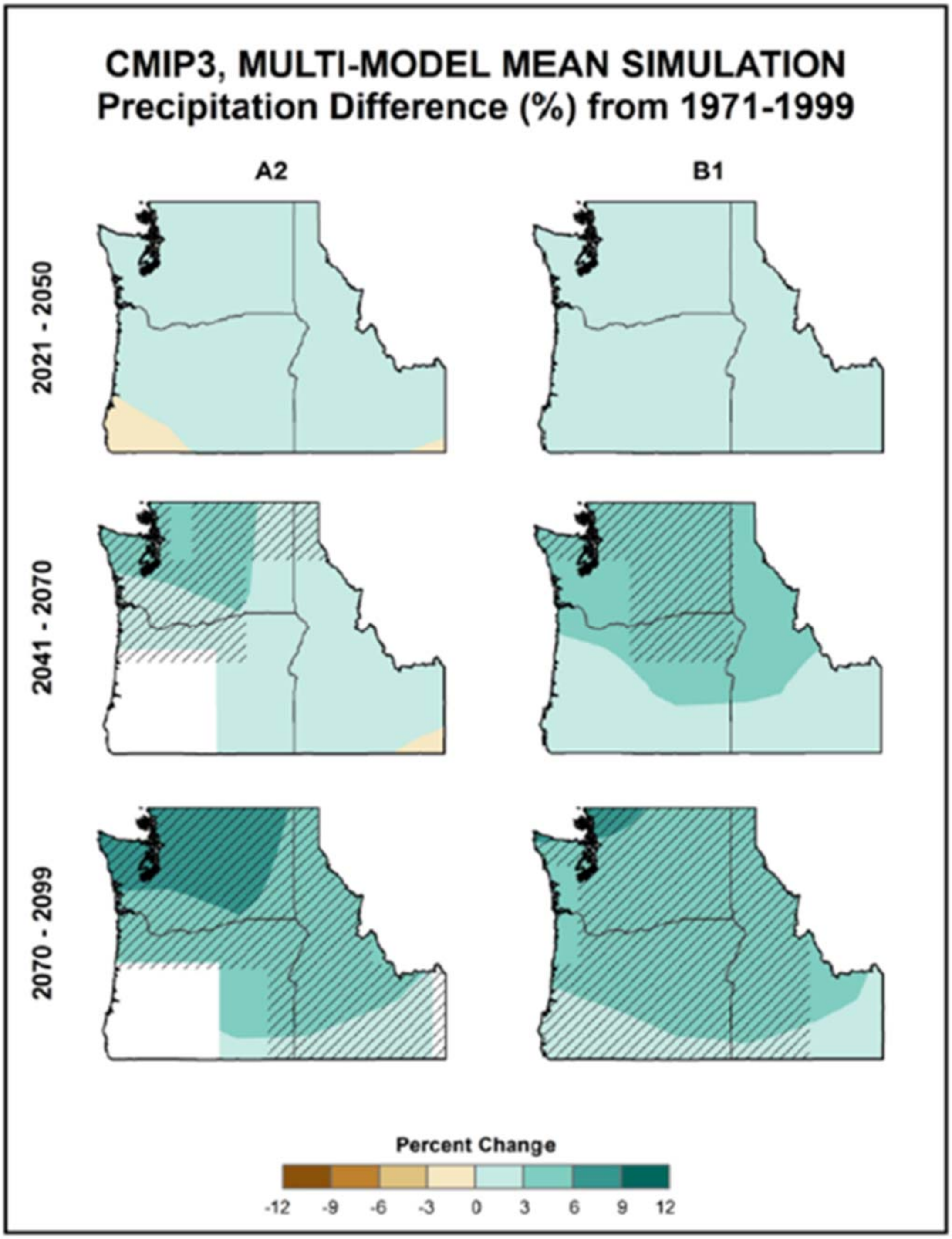


From Kunkel et al. (2013).

Figure 36: Multi-Model Mean Temperature Simulations.

Projected Average Temperature and Precipitation Changes in the Pacific Northwest		
Period	Temperature Change (F°)	Precipitation Change (%)
2021-2050	+2.5 (+1.1 to +3.6)	+1.5 (-5 to +8)
2041-2070	+4.0 (+1.9 to +6.1)	+3.0 (-5 to +11)
2070-2099	+6.5 (+2.9 to +10.9)	+5.0 (-7 to +20)
Source: Interpreted from maps presented in Kunkel et al., 2013.		

Table 15: Average and range of projected temperature and precipitation changes.



From Kunkel et al. (2013).

Figure 37:Multi-Model Mean Precipitation Simulations

Projected Precipitation Deficit		
Year	Precipitation Deficit for Irrigated Turf based on Historic Data (ft/yr)	Precipitation Deficit for Turf with Increasing ET(1) (ft/yr)
2010	3.40	3.40
2015	3.40	3.43
2020		3.46
2025		3.50
2030		3.53
2035		3.56
2040		3.59
2045		3.62
2050		3.65
2055		3.68
2060		3.71
2065		3.74
(1) Based on a possible evapotranspiration increase over the next 50 years - see text.		

Table 16. Projected precipitation deficit, 2015-2065.

9 ASSESSMENT OF WATER CONSERVATION AND RE-USE POTENTIAL

9.1 Introduction

Several of the future DCMI water-demand projections (Section 10) illustrate potential reduced water demand as a result of water conservation. This section provides the basis for water conservation assumptions used in the water-demand projections.

9.2 Water Conservation

Water conservation measures take many forms, such as public education; installation of low-water-use fixtures, appliances, and landscaping; and pricing structures that discourage excessive water use. A list of conservation measures is provided in Appendix C and IDWR's Draft Water Conservation Measures and Guidelines for Preparing Water Conservation Plans document (IDWR, 2006).

The Federal Energy Policy Act (FEPA) of 1992 established national maximum allowable water-flow rates for toilets, urinals, showerheads, and faucets. Although there are no current applicable federal water-flow rates for washing machines and dishwashers, these appliances have also become more water efficient.

Table 17 illustrates water-use reductions with various water-efficient in-home plumbing fixtures (based in part on Vickers, 2001). Highly aggressive water conservation measures could result in a 50 percent reduction in water use compared to baseline conditions with non-water-conserving fixtures.

The baseline conditions described in Table 17 yielded an average in-home use of 190 gallons per day. The per-household baseline Treasure Valley indoor use was estimated to be 220 gpd.[37] The Treasure Valley baseline estimate is higher than that listed in Table 17 likely because the Treasure Valley estimate includes not only residential in-home use but also commercial, institutional, and industrial uses (see Section 7). This value also includes "unaccounted" water that is diverted from groundwater or surface water sources but is not delivered to municipal users.

[37] This value is based on a population-weighted average current water use of 80 gpd per person winter use (Table 13) multiplied by 2.76 people per household. The average current number of people per household was calculated by dividing an estimated 2015 population of 624,500 people (Table 5) by the estimated number of 2015 households (Table 6).

9.3 Current Conservation Efforts

Some of the reporting DCMI delivery entities have active water-conservation programs. United Water Idaho has the most aggressive water-conservation program, which includes the following:

- Water-efficient demonstration gardens at the Idaho Botanical Garden, the Idaho Statehouse, and United Water Idaho's main office.
- Free conservation devices (hose timers, hose nozzles, and rain sensors) for customers.
- Free water-efficient landscaping classes.
- Water conservation education through television commercials and in newspaper spots during the irrigation season.
- Customer education through United Water's Water Conservation Guide[38], partnerships with US EPA Water Sense program and Idaho Rivers United, and outreach through Boise State University's STEM program and presentations for local schools.

Conservation efforts by reporting entities are mainly focused on metering customers and educating patrons via brochures and newsletters. Several reporting entities have not enacted conservation measures but are planning to expand their conservation efforts as operating budgets allow.

Finally, many Treasure Valley residents and businesses have implemented water-conservation measures. Some of these conservation measures likely reflect personal commitments to efficient water use, responses to pricing structures, or both.

9.4 Water Conservation Assumptions for Indoor Water-Demand Projections

Present water-use rates are not likely representative of future water-use rates. Increasing use of fixtures and appliances and higher water costs will prompt voluntary conservation measures, thereby reducing future per capita water use. It will take some time for these influences to work their way through existing housing stock, but the reductions will almost certainly be reflected in regional water demand over the 50-year planning horizon.

Future indoor water demand was projected for a baseline (no conservation) condition, a moderate water-conservation level, and a more aggressive water-conservation level.

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[38] https://www.unitedwater.com/eBooks/Idaho%202014%20%20Conservation%20Guide%20Final/finaluwidconservationguide2014.html#p=8

The baseline scenario was calculated by multiplying the projected population per TAZ by the per capita water-use rates calculated in Section 7.4 (see also Section 10.2). For the moderate conservation scenario, it was assumed that new construction between 2015 and 2065 would become increasingly efficient, so that indoor water use in new construction by the year 2065 would require 20 percent less water use per unit than in 2015. This equates to a 0.4 percent efficiency increase in new construction per year. The more aggressive indoor water conservation assumption was that water use in both new and existing housing stock would be 30 percent more efficient in the year 2065 compared to 2015. This is equivalent to a 0.6 percent efficiency increase in existing building stock and new construction per year.

The existing indoor per capita water-use estimates (Section 7) include water used for residential, commercial, general municipal, and industrial uses. It was assumed for the purposes of these water-conservation projections that the percentage reductions in water use described above apply to all DCMI water-user groups.

Water conservation levels are difficult to predict because they are based, in part, on policy decisions that have not yet been, or may not be, made. Thus, the above-described scenarios are presented for illustrative purposes only. Water conservation by the year 2065 could be greater or less than these scenarios suggest.

9.5 Water Conservation Assumptions for DCMI Irrigation

Future DCMI irrigation efficiency will depend on water availability, price, local irrigation restrictions,[39] and other factors. The source of irrigation water will likely continue to influence efficiency: DCMI users of surface water or unmetered groundwater generally have less of a price incentive to irrigate efficiently than users of metered municipal drinking water. Outdoor water conservation in response to price or other incentives could take the form of drought-tolerant landscaping (i.e., xeriscape), improved irrigation efficiency, or reductions in irrigated area (Appendix C).

[39] For example, some communities or subdivisions may have restrictions on the extent of landscaping, landscape types, irrigation efficiencies, and irrigation time periods.

9.5.1 Tables and Figures

Conservation Rate, Indoor Domestic Use						
Level of Conservation →	None		Intermediate		Aggressive	
Component	Flow rate	Water use (gpd/unit)	Flow rate	Water use (gpd/unit)	Flow rate	Water use (gpd/unit)
Toilets	4.00 gpf[1]	47.3	1.60 gpf[1]	18.9	1.28 gpf[2]	15.1
Showerheads	3.25 gpm[1]	26.6	2.50 gpm[1]	20.9	2.00 gpm[3]	16.4
Faucets	2.88 gpm[1]	35.7	2.00 gpm[1]	31.9	1.50 gpm[1]	18.8
Washing Machines	51 gpl[1]	43.7	27 gpl[1]	23.1	13 gpl[4]	19.3
Dishwashers	12 gpl[1]	2.7	7.0 gpl[1]	1.6	4.25 gpl[5]	1
Baths	N/A	3.3	N/A	3.3	N/A	3.3
Leaks	N/A	26.3	N/A	9.3	N/A	3.3
Other Domestic	N/A	4.4	N/A	4.4	N/A	4.4
Total (Daily Average)		**190**		**113**		**82**

gpf = gallons per flush
gpm = gallons per minute
gpl = gallons per load

References:
[1] Vickers (2001)
[2] EPA WaterSense tank-type high efficiency toilet specification (June 2, 2014)
[3] EPA WaterSense Specification for showerheads (March 4, 2010).
[4] Energy Star Specification as of March 7, 2015
[5] Energy Star Specification as of January 20, 2012

Assumptions:
1. Data corresponding to the number of toilet flushes/person/day, minutes/person/day, faucet use, etc., used in calculating water use (gpd/household) are based on Vickers, 2001.
2. The number of baths, showers, and other domestic uses remain the same for each scenario.
3. Leaks will always be present in potable water systems, although technology will assist to decrease leakage (decreased leakage is assumed for the moderate and more aggressive conservation scenarios).

Table 17. Potential per-unit residential domestic (indoor) water conservation.

10 TREASURE VALLEY WATER-DEMAND PROJECTIONS

10.1 Introduction

The following sections summarize 2015-2065 DCMI indoor and irrigation water-demand projections. Results are presented for indoor water-use projections, DCMI irrigation projections, and combined indoor and outdoor projections. Supporting tables and figures are presented in Section 10.5 beginning on page 95.

10.2 Scenarios

The future water-demand projections are presented in the form of 4 scenarios (Table 18). The scenarios are based on (1) common assumptions regarding the irrigated area per household and (2) different assumed levels of conservation or consumptive use.

A primary common assumption is that irrigated area for new households is influenced by density and water availability (see Section 3.2.7). It was assumed that, on average, the total irrigated area in non-water-limited portions of the valley (Figure 13) would be 0.3 acres for household densities from 0 to 2 units per acre, 0.45 acres for household densities from 2 to 4 units per acre, 0.35 acres for 4 to 6 units per acre, and 0.16 acres in areas with a density greater than 6 units per acre (Table 19).[40] In contrast, the assumed irrigated area per household in water-limited areas[41] would be no more than 0.15 irrigated acres per acre (Table 19). In each of these cases, residential irrigation was assumed to be zero if a TAZ had more than 25 employees per acre (the number of TAZs with more than 25 employees are shown in Figure 18).

The first scenario (i.e., baseline scenario – and Table 18) is built on the assumption of no future conservation over 2015 rates. A moderate level of water conservation was assumed in Scenario 2, consisting of (1) a 20 percent reduction in indoor use in new construction over the next 50 years (i.e., per-unit water demand would be 20 percent less than 50 years than in 2015) and (2) a 10 percent reduction over 2015 rates in outdoor use in existing and new construction. Scenario 3 illustrates an assumed 30 percent across-the-board reduction in indoor and outdoor use over 2015 rates.

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[40] It may at first appear counterintuitive that the total irrigated area in low-density neighborhoods (e.g., 0 to 2 units per acre) is less than that in neighborhoods with higher densities (e.g., 2 to 4 units per acre or 4 to 6 units per acre). The reason is this: although *irrigable* area in low-density neighborhoods (e.g., 0 to 2 units per acre) is greater than in denser neighborhoods, it was assumed that most residents living in these low-density neighborhoods would not irrigate the entire irrigable area with potable, municipal-supplied drinking water.

[41] A TAZ was defined as being water-limited if 50 percent or more of the area is in a water-limited zone as indicated in Figure 13.

The assumed irrigated areas described above include not only the irrigated area for each new household but also the irrigated (and non-irrigated) areas for non-residential users (e.g., schools, businesses, etc.), as long as the water for irrigation is supplied by a DCMI provider.

Inherent to these first three scenarios was the assumption that either (1) 75 percent of the assumed irrigable area is fully irrigated or (2) 100 percent of the assumed irrigable area is fully irrigated but with 75 percent of the water needed for fully-irrigated turf. These assumptions reflect the fact that some of the landscaping currently used in the Treasure Valley (and that likely will continue to be used) requires less water than fully-irrigated turf. Furthermore, not all landscaping consists of turf: landscaping rocks, areas with certain shrubs, trees, etc. may not be irrigated, or may be irrigated with volumes less than required for fully-irrigated turf. Scenario 4 differed from the previous 3 scenarios in that it was assumed that 100 percent of the irrigable DCMI area described in Table 19 would be fully irrigated with 100 percent of the water needed for irrigated turf.

It is anticipated that a portion of new DCMI indoor and irrigation demand will be met by existing surface-water or groundwater supply. The percentage of new demand met by existing supply (calculated based on the percentage of surface-water-irrigated or groundwater-irrigated land within a TAZ) remains the same in each scenario.

10.3 Treasure Valley Water-Demand Projections

The 2065 Treasure Valley DCMI water demand projected in the four scenarios described above ranged from approximately 340,000 AF to 598,000 AF (Table 20). These amounts do not include surface water that is currently (as of 2015) being used to irrigate areas served by DCMI water providers.

A primary objective for the Treasure Valley water-demand forecast was to project the amount of *additional* water (i.e., water that is not available from currently-developed surface-water or groundwater supplies) needed to meet DCMI water demand over the next 50 years. (This “additional” water demand is referred to hereinafter as “net DCMI” demand.) The net DCMI demand was calculated by subtracting estimates of currently-developed surface water or groundwater (i.e., surface water or groundwater that is currently used for agricultural irrigation) from the projected DCMI total water demand.

The projected 2065 net DCMI demand ranges from approximately 270,000 AF to 394,000 AF (Table 20 and Figure 38). The increase from 2015 demand ranges from approximately 160,000 AF to 283,000 AF, depending on consumptive-use and conservation assumptions. The spatial distribution of 2065 net indoor, net irrigation, and net total DCMI water demand is illustrated in Figure 40 through Figure 42.

The largest component of future demand in each of the four scenarios is irrigation (Figure 39). The difference between irrigating 75 percent and 100 percent of irrigable urban land (or supplying 75 percent of the irrigation requirement for fully irrigated turf on all irrigated urban land) can be seen in Scenarios 2 and 4 (Table 20 and Figure 39). The difference between a 10 percent and 30 percent reduction in per-acre irrigation through drought-tolerant landscaping, improved efficiency, etc. can be seen in the differences between Scenario 1, 2, and 3 (Table 20 and Figure 39).

10.4 Discussion

10.4.1 Assumptions

The preceding projections are based on numerous assumptions regarding (1) growth rates in employment, population, and households; (2) demographics and market preferences regarding home size, location, etc.; (3) future landscaping norms and irrigation patterns; (4) the future availability of surface-water and groundwater; (5) the effect of climate change on irrigation requirements; (6) the future availability and market penetration of efficient plumbing fixtures; and (7) policies and incentives regarding water conservation, which will be driven, in part by the availability and cost of delivered water. Despite the numerous assumptions, the projections are instructive in that they frame the magnitude of additional water volumes that will be needed to supply the projected increases in population growth. Based on the scenario results, we can anticipate that future DCMI water demand will likely be at least twice the current 110,000-AF DCMI diversion but likely less than four times the current DCMI diversions.

10.4.2 Projected Per Capita Use

The projected per capita demand for indoor use (Table 25) in the year 2065 ranges from 53 gpd per per person (Scenario 3) to 75 gpd per person (Scenario 1). The 75 gpd per person for Scenario 1 is similar to the current population-weighted rate of 80 gpd per person (Section 7.5 Table 13).[42] The lower per capita demand for indoor use in Scenarios 2 through 4 reflects reduced consumption as a result of conservation.

The projected 2065 per capita water demand for irrigation in excess of that which can be provided by existing developed surface-water or groundwater supplies ranges from 100 to 157 gpd per person (Table 25). Current per capita irrigation use (Table 13, page 69) ranges from approximately 15 gpd per person (City of Eagle) to 158 gpd per person (Capitol Water Corporation), with a valley-wide population-weighted average of 78 gpd per person. Residents served by municipal providers with lower per capita

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[42] The 75 gpd/person 2065 rate is lower than that 80 gpd/person 2015 rate because a portion of the projected indoor use will be met by existing, developed groundwater supply, which reduces the effective future per capita rate in the future net DCMI demand projections.

irrigation use (e.g., City of Eagle, City of Meridian, etc.) have access to surface water, which reduces the DCMI irrigation deliveries in these cities. In contrast, several of the providers show higher per capita irrigation use: City of Nampa (118 gpd per person), City of Garden City (112 gpd per person), Eagle Water Company (125 gpd per person), and Capitol Water Corporation (158[43] gpd per person). Less or no surface-water availability in these communities almost certainly contributes to a higher per capita irrigation rates. Regardless, the projected 2065 per capita irrigation rates (Table 25) fall within the range of current estimates based on Treasure Valley DCMI provider data.

10.4.3 Spatial Distribution of Projected Water Demand

Not surprisingly, the net indoor demand (Figure 40) is concentrated in population centers (see projected population and household distribution in Figure 21 and Figure 23, respectively). The net DCMI irrigation (Figure 41) also appears to be concentrated in relatively dense population centers. At first glance, this could be misinterpreted because the greatest increase in DCMI irrigation occurs in medium-density areas (Table 19), as opposed to the densest urban areas. However, there are substantial increases in DCMI irrigation demand in areas surrounding population centers that are not captured in Figure 41 because the plot shows only the net DCMI irrigation (i.e., it excludes DCMI irrigation with currently developed surface water or groundwater supplies). Similarly, the net DCMI water demand shown in Figure 42 also excludes DCMI irrigation demand met by currently developed surface water or groundwater resources.

A modest portion of the projected water demand falls within areas of limited water supply (Figure 43). A greater portion of the projected water demand falls within the Basin 63 ground water restricted area in which ground water from aquifers less than 200 feet deep are considered fully appropriated.

10.4.4 Most Likely Scenario

Of the 4 scenarios described above, Scenario 2 is arguably more probable than the others, for three reasons:

1. Some level of future conservation (as opposed the no-conservation assumption in Scenario 1) is probable as building codes require more efficient fixtures and retail stores offer more efficient fixtures than in years past. Similarly, the cost of water for DCMI uses will likely rise in the future to develop increased supplies, which could result in at least some per capita decreases in DCMI irrigation use. While greater levels of conservation are possible (such as those

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[43] Lack of individual meters in the Capitol Water Corporation service area likely also contributes to elevated per capita use estimates.

assumed in Scenario 3), greater levels of conservation likely will coincide with substantial cost increases or will require policy changes, neither of which are apparent at this time.

2. In contrast to Scenario 4, Scenario 2 reflects partial irrigation of irrigable urban ground (inherent to Scenario 2 is the assumption that 75 percent of irrigable ground is irrigated with an amount of water appropriate for irrigated turf, or that 100 percent of irrigable ground is fully irrigated at 75 percent of the amount needed to satisfy the irrigation demand for fully irrigated turf). Anecdotally, current DCMI irrigation patterns in the Treasure Valley are consistent with this assumption.

3. Another semi-quantitative test of reasonableness is that of future per capita use. Some increase in valley-wide per capita irrigation rates would be expected if an increasing amount of future development occurs in areas that do not have access to surface water, or if surface-water supplies become constrained. Nonetheless, a valley-wide DCMI irrigation rate of 157 gpd per person (Scenario 4, Table 25) seems unreasonably high compared to current rates. In contrast, the projected per capita DCMI irrigation amounts (100 gpd per person to 139 gpd per person in Scenarios 1, 2, and 3) are more consistent with current per capita irrigation rates in communities having less or no surface-water availability (e.g., City of Nampa, City of Garden City, Eagle Water Company, and Capitol Water Corporation – see Table 13).

10.4.5 Factors Contributing to Greater or Less DCMI Water Demand

Numerous factors could cause the net Treasure Valley DCMI water demand in the year 2065 to be greater or less than that which is projected in Scenario 2 (or Scenarios 1, 3, and 4, for that matter):

1. Population and numbers of households are greater or less than those which are projected in Section 6;
2. The average irrigated area per new household is greater or less than that which is projected in Table 19 (one reason that the irrigated area per new household would be greater or less than that which is projected is if the housing densities described in Section 6 are greater or less than those projected);
3. The availability of surface water becomes constrained (e.g., insufficient surface-water supply following consecutive drought years could result in early shut-offs, at which time some DCMI surface-water users might switch to potable DCMI water for irrigation);
4. Surface water is not as available as assumed because of delivery-system constraints;

5. Higher than projected summer temperatures could result in greater demand (because of higher irrigation demand) than the average-year projections presented here;
6. Conservation assumptions are not realized;
7. Substantial increases in the cost of water (possibly as a result of limited supply) could reduce future water demand;
8. The 2015 per capita indoor and irrigation rates are different than those estimated as a result of errors in reported production or estimates of population served by individual providers;

10.4.6 Comparison With Previous Estimates

Cook et al. (2001) estimated that the total DCMI demand would increase from approximately 103,000 AF/year in 1997-1998 to approximately 179,000 AF/year by the year 2025 (Section 2.1). Excluding surface water used for DCMI irrigation in 2015, we project (Table 21 through Table 24) that the 2025 water demand will range from 153,000 AF to 175,000 AF (depending on scenario; the Scenario 2 projection is 161,000 AF in 2025). The Cook et al. projections included self-supplied commercial and industrial use, which our projections did not, and which may account for the difference in projected 2025 DCMI water demand.

WRIME (2010) projected a DCMI demand of 962,000 AF/year by the year 2060 (Table 1). This amount includes all surface water use for DCMI irrigation and self-supplied DCMI use.[44] By comparison, we projected (Table 21 through Table 24) a total DCMI demand (excluding surface water use as of 2015 but including the new use of surface water for DCMI irrigation between 2015 and 2060) ranging from 415,000 AF to 630,000 AF, depending on scenario. The Scenario 2 projection is 516,000 AF by the year 2065.

If WRIME's projections were realized, the total per capita water use (indoor and irrigation) would be approximately 597 gpd/person.[45] This is substantially higher than the current per capita use estimates for areas with less or no current surface-water use (Table 13). It is also substantially higher than WRIME's estimate of current per capita use (Section 2.2). Thus, even with WRIME's inclusion of self-supplied commercial and industrial demand, WRIME's 962,000-AF/year DCMI demand projection and associated per capita rate appears unreasonably high.

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[44] These SPF projections do not include self-supplied commercial and industrial demand.

[45] 962,000 AF/year multiplied by 325850 gal/AF divided by a 2060 projected population of 1,438,500 people (Table 5) divided by 365 days/year.

10.4.7 Future Sources of Supply

Options for supplying the net DCMI demand could include (1) diversions from the Boise River (through increased surface-water storage, use of flood flows for aquifer storage and recovery strategy, or direct diversions from the Boise River below Star, Idaho), (2) additional development of Treasure Valley groundwater, (3) new diversions from the Snake River, or (4) reuse of treated municipal effluent.

The DCMI water-demand increase projected in Scenario 2 (228,000 AF – see Table 20) is roughly equivalent to the estimated 198,000 AF[46] of groundwater that were withdrawn from Treasure Valley aquifers in 1996 (Urban, 2004; Urban and Petrich, 1998). It is not clear, however, that Treasure Valley aquifers will be able to support the increased diversions needed to meet DCMI demand by the year 2065.

Treasure Valley aquifers will almost certainly support some additional groundwater development. TVHP model (Petrich, 2004a) simulations of withdrawing an additional 39,000 acre-feet (Petrich, 2004b) requested in over 450 then-unprocessed applications for new water rights suggested that Treasure Valley groundwater levels would reach new equilibriums, with local declines mostly ranging from 0 to less than 20 feet, depending on valley location, actual amount of withdrawals, and depth of extraction. The least declines were predicted for the uppermost model layer (i.e., the uppermost 200 feet of aquifer). These results suggest that Treasure Valley aquifers can support at least some of the projected demand increase.

However, groundwater availability is not uniform throughout the Treasure Valley. Furthermore, water quality constraints (elevated concentrations of naturally occurring arsenic or uranium) may limit additional groundwater development in some areas. Also, regulatory constraints (e.g., inability to obtain water rights, or prolonged protests to new water-right applications) may limit groundwater development in some areas.

Surface water may be available for new appropriations from the Boise River during spring runoff. However, new diversions of “flood flows” would only be available for a short period of time during the year, and would be unavailable during low-water years. Use of flood flows for dependable DCMI use would require storage in upstream Boise River reservoirs (such as is currently being contemplated by the USACE) or an effective Treasure Valley aquifer storage and recovery strategy.

Surface water from existing agricultural irrigation may become more available for DCMI uses in the future. More efficient surface-water delivery systems, irrigation ponds to meet urban peak irrigation demands, and system controls could free up water for DCMI or other uses. In such a scenario, surface-water deliveries in urban areas might be made on a net irrigated-area basis, not gross-acre basis (see Section

[46] The estimate of water withdrawals in 1996 obviously does not include groundwater development in the approximately 20 years since 1996.

4.5.1). However, such a scenario would require (1) market incentives to cover the costs of delivery-system improvements and operations and (2) changes in existing Boise River basin storage contracts (again, see Section 4.5.1). Thus, while it was assumed for this analysis that there would be minimal availability of surface water for future DCMI indoor uses, this could change in the future as the demand for DCMI water increases.

Additional water supplies may be developed from the Snake River or lower Boise River (i.e., below Star, Idaho– see Figure 1). Boise River hydrographs suggest availability of surface water as the Boise River gains from groundwater discharge and surface-water return flows (Figure 10). Permits for new diversions from the Snake River are likely available for DCMI uses during most times of the year. The primary constraint for Snake River diversions (and lower Boise River diversions) is that of the 4,750-cfs minimum streamflow established under water right No. 3-6 by the Idaho Water Resource Board in 1976. Water from the Snake River or lower Boise River may not be available for diversion during times that the minimum Snake River flow at the Weiser gage is less than the established minimum.

Reuse of treated effluent can reduce the need to develop new supplies to meet future demand. Treated wastewater can be (and is currently) used for irrigation of parks and other public common areas. Future treatment methods may enable the use of treated effluent for residential irrigation. Discharge of treated effluent directly or indirectly to the Boise River increases Boise River flows that may be diverted (especially below Star, Idaho) for future DCMI (or other irrigation) needs.

10.5 Tables and Figures

Scenario Descriptions				
Scenario →	**1**	**2**	**3**	**4**
Primary Assumptions	**Partial Irrigation** (assume that either 75% of irrigable area is fully irrigated or 100% of irrigable land is irrigated with 75% of the water needed for fully-irrigated turf)			**Full Irrigation** (assume 100% of DCMI land is irrigated with 100% of the water needed for turf)
	No Conservation (Baseline)	**Moderate Conservation**	**More Aggressive Conservation**	**Moderate Conservation**
	No conservation	20% reduction in indoor use in new construction 10% reduction in outdoor use in existing and new construction	30% reduction in indoor use in existing and new construction 30% reduction in outdoor use in existing and new construction	Full water use (see text) 20% reduction in indoor use in new construction 10% reduction in outdoor use in existing and new construction

Table 18. Scenario matrix.

Assumed DCMI Irrigated Area (Non-Water-Limited Areas)			
Density (units per acre)	Assumed Irrigated Area per Household (ac/unit)	Assumed Irrigated Area per Household (ft^2/unit)	Total Irrigated Area per Acre (ac)
0	—	—	—
0 - 1.99	0.15	6,530	0.30
2 - 3.99	0.15	6,530	0.45
4-5.99	0.07	3,050	0.35
6+	0.02	870	0.16

Assumed DCMI Irrigated Area (Water-Limited Areas)			
Density (units per acre)	Assumed Irrigated Area per Household (ac/unit)	Assumed Irrigated Area per Household (ft^2/unit)	Total Irrigated Area per Acre (ac)
0	—	—	—
0 - 1.99	0.075	3,270	0.15
2 - 3.99	0.05	2,180	0.15
4-5.99	0.03	1,310	0.15
6+	0.015	650	0.12

Table 19. Assumed per-unit DCMI irrigated area for new households constructed between 2015 and 2065.

Water Demand Projections, 2015-2065 (AF/yr)									
Scenario →		1		2		3		4	
		Partial Irrigation,[1] No Conservation		Partial Irrigation,[1] Moderate Conservation		Partial Irrigation,[1] More Aggressive Conservation		Full Irrigation,[2] Moderate Conservation	
	2015[3]	2065	Increase, 2015-2065	2065	Increase, 2015-2065	2065	Increase, 2015-2065	2065	Increase, 2015-2065
Total indoor	55,700	136,500	**80,800**	120,400	**64,600**	95,600	**39,800**	120,400	**64,600**
Total irrig.[3]	54,500	507,300	**452,700**	456,500	**402,000**	355,100	**300,600**	587,900	**533,300**
Total	110,200	643,800	**533,500**	576,900	**466,600**	450,600	**340,400**	708,200	**598,000**
Net DCMI indoor [4]	55,700	132,300	**76,600**	117,000	**61,300**	93,200	**37,500**	117,000	**61,300**
Net DCMI irrig.[4]	54,500	244,100	**189,600**	221,700	**167,200**	176,900	**122,400**	276,700	**222,200**
Net DCMI Total[4]	110,200	376,400	**266,100**	338,700	**228,400**	270,100	**159,900**	393,700	**283,400**

Notes:
1. "Partial irrigation" refers to urban areas in which a portion of the irrigable land is not irrigated or is irrigated with a water volume that is less than that which is required for fully-irrigated turf (see text).
2. "Full irrigation" refers to urban land that is irrigated with an amount needed for fully irrigated turf.
3. The irrigation volume in 2015 does not include surface water delivered by non-DCMI water-delivery entities (e.g., irrigation districts or canal companies). In contrast, the 2065 "total" irrigation volumes *does* include urban land that will be irrigated with surface water provided by non-DCMI entities.
4. The "Net DCMI" volumes do not include future demand that will be supplied by currently-developed supplies (surface water or groundwater). These indoor, irrigation, and total demand volumes therefore represent a better comparison with the total estimated 2015 DCMI demand.

Table 20. Water-demand projections, 2015-2065.

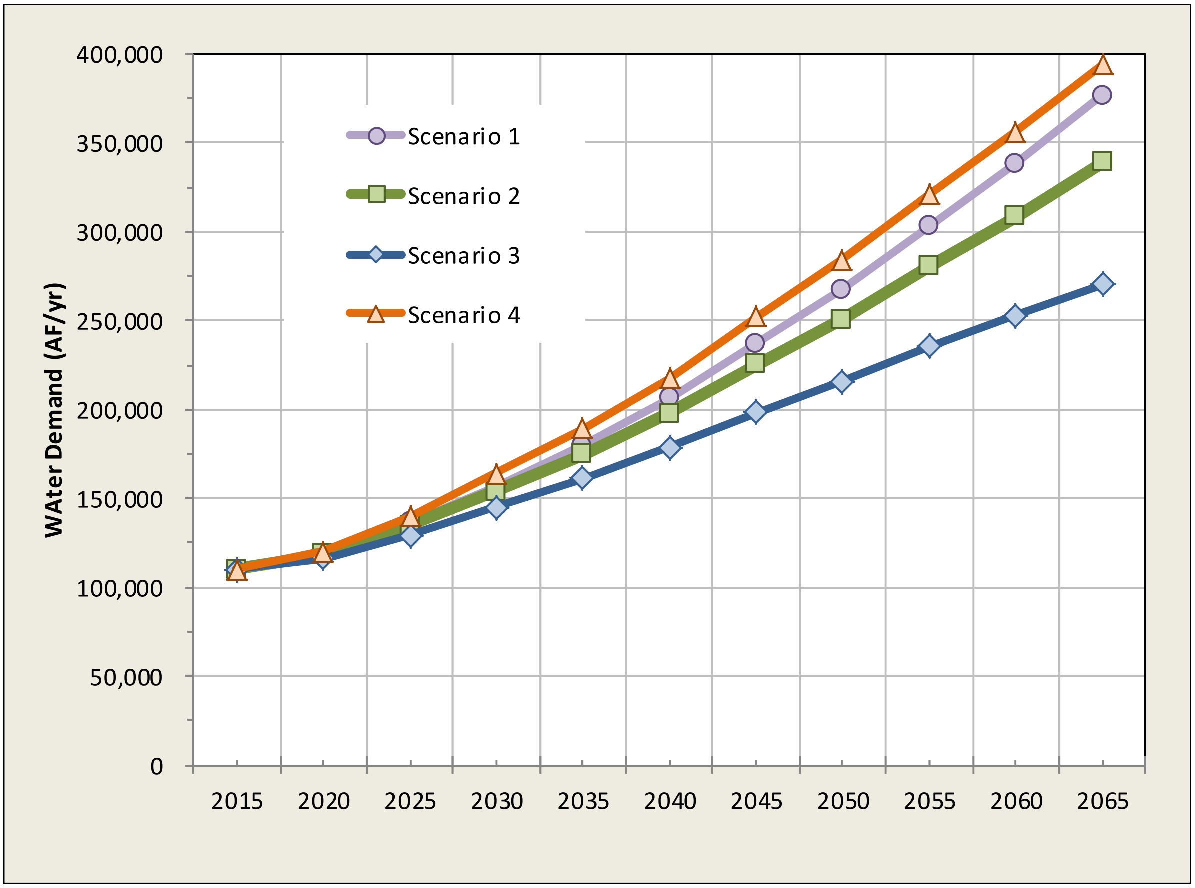

Figure 38. DCMI water-demand projections.

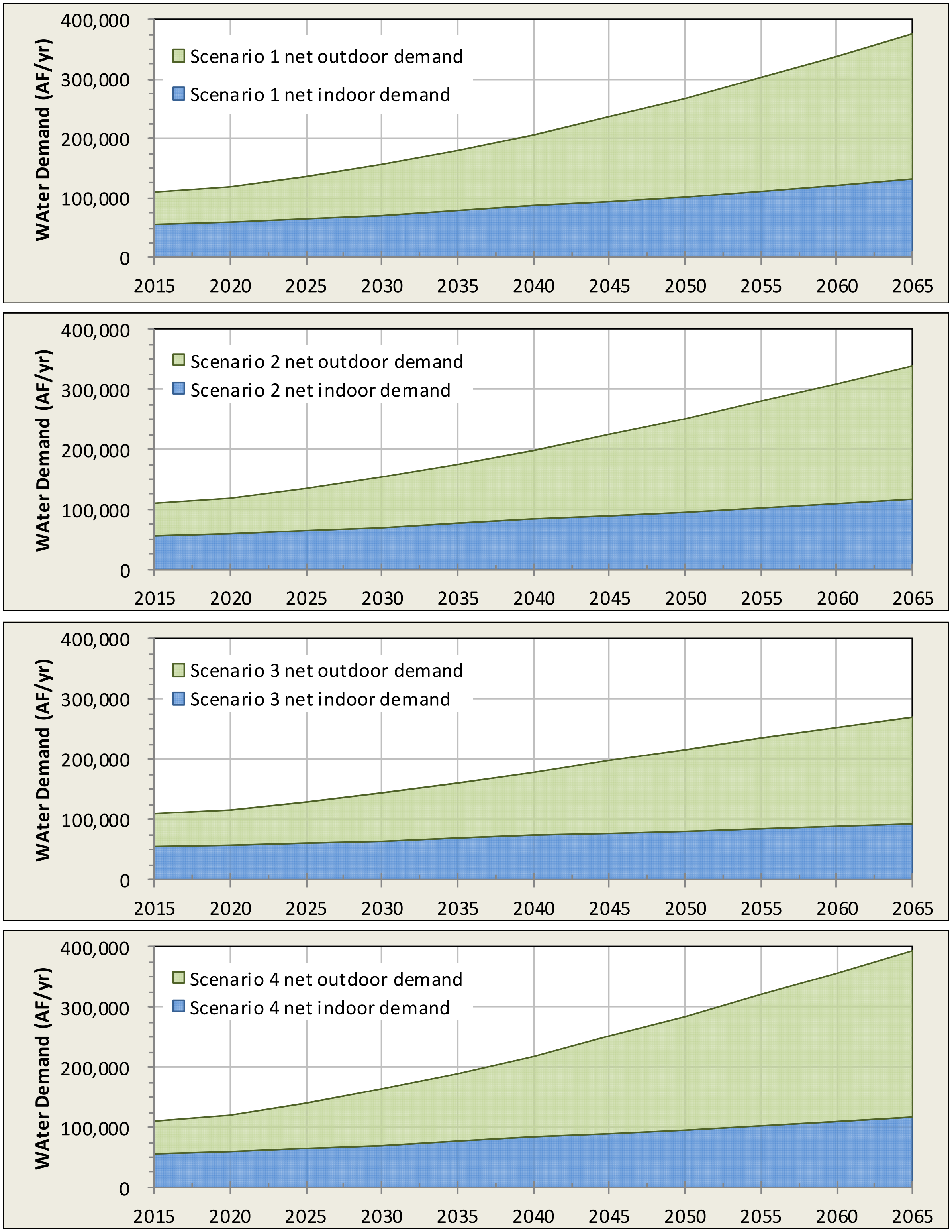

Figure 39. DCMI water-demand projections, Scenarios 1-4.

Scenario 1							
Year	Indoor Demand	New Indoor Demand Met by Existing Supply	Net Indoor Demand	Irrigation Demand	New Irrigation Demand Met by Existing Supply	Net Irrigation Demand	Combined Net Indoor and Irrigation Demand
2015	55,700	0	55,700	54,500	0	54,500	110,200
2020	59,800	300	59,500	75,500	16,000	59,500	119,000
2025	65,800	600	65,200	97,700	26,600	71,100	136,300
2030	71,300	900	70,400	129,300	42,900	86,400	156,800
2035	80,400	1,400	79,100	168,300	67,500	100,800	179,900
2040	89,500	2,000	87,500	219,200	100,600	118,600	206,200
2045	96,200	2,300	93,900	271,700	128,500	143,300	237,200
2050	104,400	2,700	101,600	331,400	165,600	165,800	267,400
2055	114,500	3,200	111,300	389,700	198,000	191,700	303,100
2060	125,100	3,700	121,400	443,000	226,200	216,800	338,200
2065	136,500	4,200	132,300	507,300	263,200	244,100	376,400

Table 21. Scenario 1 water-demand projections, 2015-2065.

Scenario 2							
Year	Indoor Demand	New Indoor Demand Met by Existing Supply	Net Indoor Demand	Irrigation Demand	New Irrigation Demand Met by Existing Supply	Net Irrigation Demand	Combined Net Indoor and Irrigation Demand
2015	55,700	0	55,700	54,500	0	54,500	110,200
2020	59,700	300	59,400	74,800	15,700	59,100	118,500
2025	65,400	600	64,800	95,700	25,700	70,100	134,900
2030	70,400	900	69,500	125,400	41,000	84,500	154,000
2035	78,500	1,300	77,200	161,600	64,000	97,600	174,800
2040	86,100	1,800	84,300	208,300	94,500	113,700	198,000
2045	91,400	2,100	89,300	255,400	119,500	135,900	225,200
2050	97,600	2,400	95,200	308,200	152,600	155,600	250,800
2055	105,100	2,700	102,400	358,500	180,500	178,000	280,400
2060	112,600	3,000	109,600	403,100	204,000	199,100	308,700
2065	120,400	3,400	117,000	456,500	234,800	221,700	338,700

Table 22. Scenario 2 water-demand projections, 2015-2065.

Scenario 3							
Year	Indoor Demand	New Indoor Demand Met by Existing Supply	Net Indoor Demand	Irrigation Demand	New Irrigation Demand Met by Existing Supply	Net Irrigation Demand	Combined Net Indoor and Irrigation Demand
2015	55,700	0	55,700	54,500	0	54,500	110,200
2020	58,000	200	57,800	73,200	14,900	58,300	116,100
2025	61,800	400	61,400	91,800	23,800	68,000	129,400
2030	64,900	600	64,200	117,700	37,200	80,500	144,700
2035	70,800	1,000	69,800	148,100	57,000	91,100	161,000
2040	76,100	1,400	74,700	186,300	82,500	103,900	178,600
2045	78,900	1,500	77,400	222,800	101,700	121,100	198,500
2050	82,500	1,700	80,700	261,800	126,600	135,200	215,900
2055	87,100	2,000	85,100	296,200	145,600	150,600	235,700
2060	91,300	2,200	89,100	323,400	159,700	163,700	252,900
2065	95,600	2,300	93,200	355,100	178,200	176,900	270,100

Table 23. Scenario 3 water-demand projections, 2015-2065.

Scenario 4							
Year	Indoor Demand	New Indoor Demand Met by Existing Supply	Net Indoor Demand	Irrigation Demand	New Irrigation Demand Met by Existing Supply	Net Irrigation Demand	Combined Net Indoor and Irrigation Demand
2015	55,700	0	55,700	54,500	0	54,500	110,200
2020	59,700	300	59,500	81,400	20,800	60,700	120,100
2025	65,400	600	64,800	109,300	34,000	75,300	140,100
2030	70,400	900	69,500	148,800	54,400	94,400	163,900
2035	78,500	1,300	77,200	196,700	84,800	111,900	189,100
2040	86,100	1,800	84,400	258,600	125,300	133,300	217,700
2045	91,400	2,100	89,300	321,200	158,400	162,800	252,100
2050	97,600	2,400	95,200	391,100	202,200	189,000	284,200
2055	105,100	2,700	102,400	457,900	239,200	218,700	321,100
2060	112,600	3,000	109,500	517,000	270,300	246,700	356,200
2065	120,400	3,400	117,000	587,900	311,200	276,700	393,700

Table 24. Scenario 4 water-demand projections, 2015-2065.

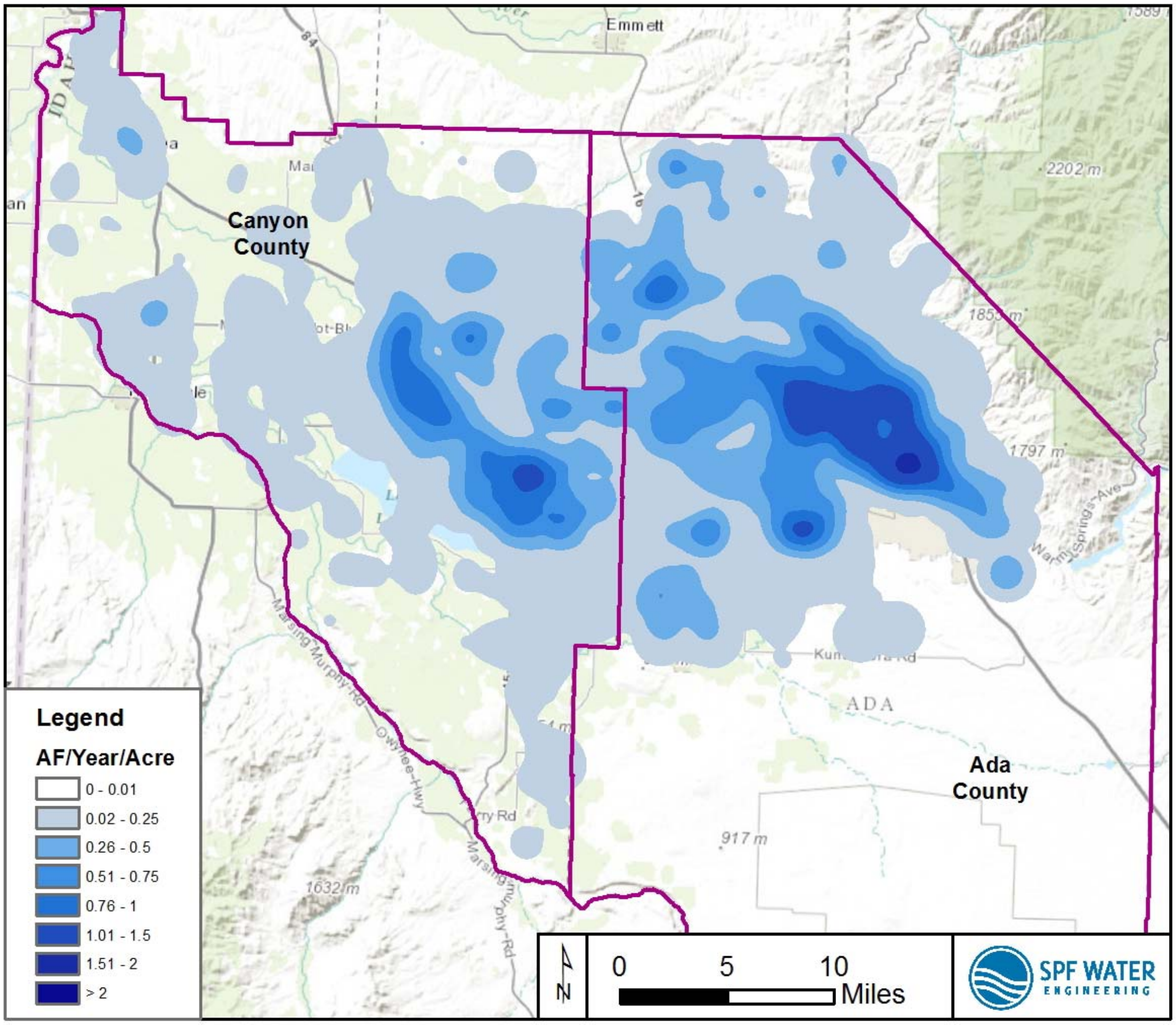

Figure 40. Spatial distribution of 2065 DCMI net indoor water demand, Scenario 2.

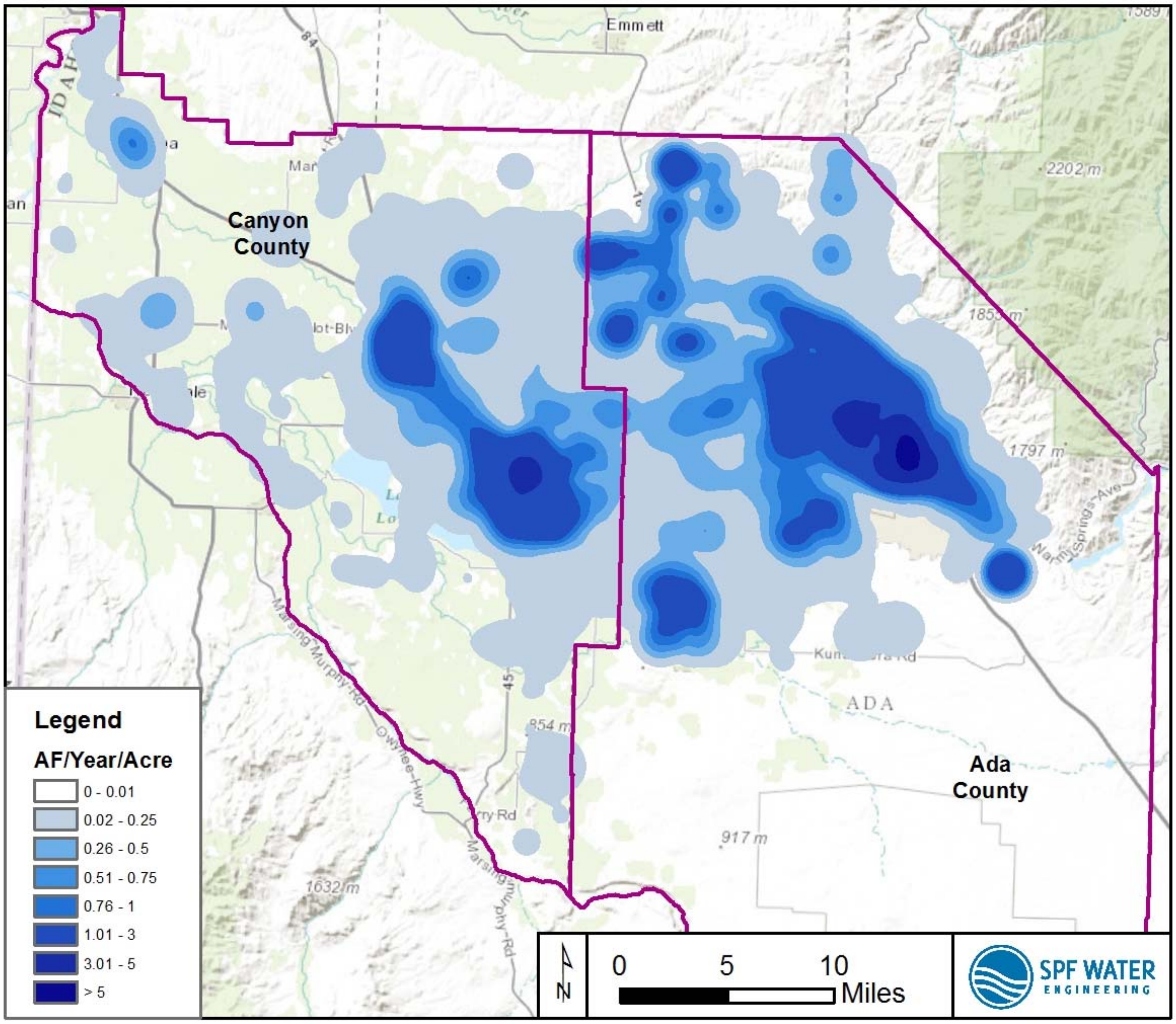

Figure 41. Spatial distribution of 2065 DCMI net outdoor water demand, Scenario 2.

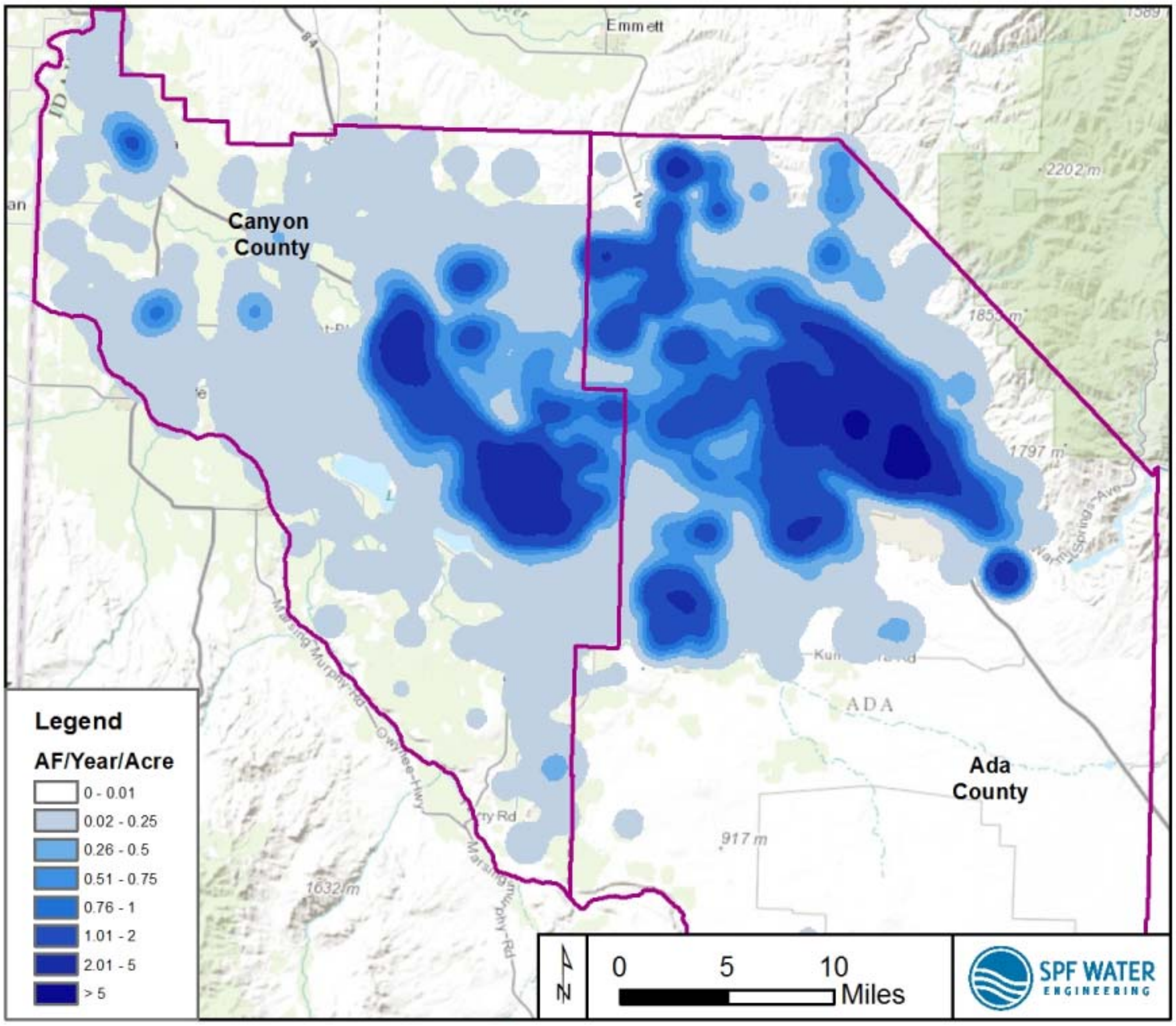

Figure 42. Spatial distribution of 2065 DCMI net total water demand, Scenario 2.

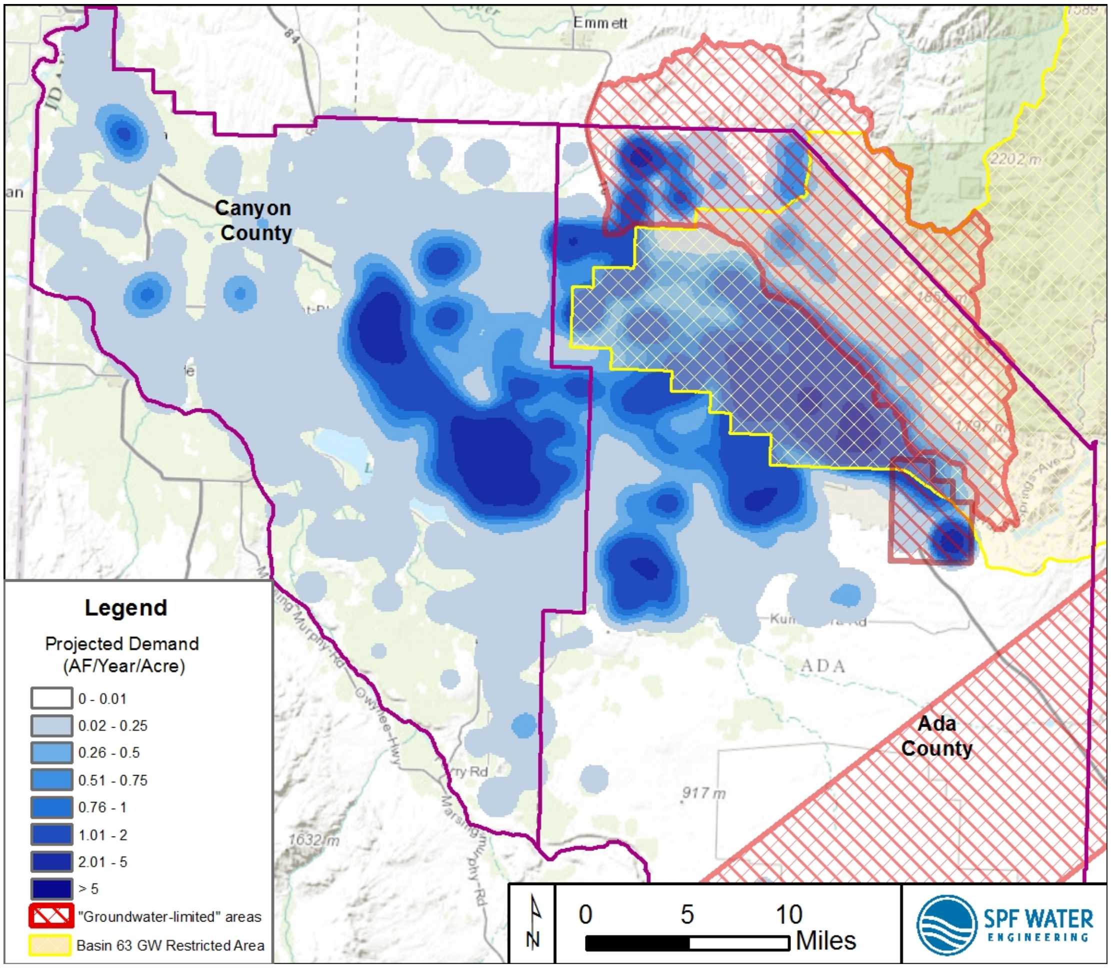

Figure 43. Spatial distribution of 2065 DCMI net total water demand and "water-limited" areas.

Comparison of Per Capita Demand Rates										
Scenario →			**1**		**2**		**3**		**4**	
			Partial Irrigation, No Conservation		**Partial Irrigation, Moderate Conservation**		**Partial Irrigation, More Aggressive Conservation**		**Full Irrigation, Moderate Conservation**	
	2015 (AF/yr)	**Per Cap**(1) (gpd)	**2065** (AF/yr)	**Per Cap**(2) (gpd)	**2065** (AF/yr)	**Per Cap**(2) (gpd)	**2065** (AF/yr)	**Per Cap**(2) (gpd)	**2065** (AF/yr)	**Per Cap**(2) (gpd)
Net DCMI indoor (3)	55,700	**80**	132,300	**75**	117,000	**66**	93,200	**53**	117,000	**66**
Net DCMI irrig.(3)	54,500	**78**	244,100	**139**	221,700	**126**	176,900	**100**	276,700	**157**
Net DCMI Total(3)	110,200	**158**	376,400	**214**	338,700	**192**	270,100	**153**	393,700	**223**

Notes
1. Estimated 2015 population: 625,000.
2. Estimated 2065 population: 1,573,000.
3. "Net DCMI" volumes do not include future demand that will be supplied by currently-developed supplies (surface water or groundwater).

Table 25. Comparison per capita demand rates, 2015-2065.

12 MOUNTAIN HOME PLATEAU DCMI WATER-DEMAND PROJECTIONS

12.1 Introduction

This section (1) summarizes of DCMI water use by the City of Mountain Home and Mountain Home Air Force Base (MHAFB) and (2) provides initial projections of future DCMI water demand. An analysis of MHAFB future system capacity requirements was recently provided in a separate analysis (Landsberg and Scanlan, 2015). Tables and figures are provided in Section 12.4.

The City of Mountain Home and the MHAFB are part of the Mountain Home Plateau, which is the eastern portion of the western Snake River Plain between the Danskin Mountains and the Snake River (Figure 45). The Mountain Home Plateau also includes the City of Glenns Ferry (at the eastern edge of the plateau). However, water-demand projections were not made for the City of Glenns Ferry (nor were current water-use data collected) because (1) the City of Glenns Ferry diverts water for municipal uses from the Snake River and (2) population is expected to decrease over the next 50 years (obviating the need for reducing water supply).

12.2 Historical Population Growth

The Elmore County population grew from approximately 5,500 people in 1940 to 26,100 in 2014 (Table 26 and Figure 45). The City of Mountain Home grew from approximately 1,200 people in 1940 to 13,800 people in 2014. The City of Glenns Ferry had approximately the same population in 2014 (1,240 people) as it did in 1940 (1,290 people).

In the 1940s and 1950s Elmore County (and in particular, the City of Mountain Home) experienced substantial population gains (Table 27), and did so again between 1990 and 2010. However, since 2010 the county and the cities of Mountain Home and Glenns Ferry have seen small decreases in population.

12.3 Existing Water Production

12.3.1 City of Mountain Home

The City of Mountain Home's water system consists of 8 active wells and a distribution system that serves approximately 14,500 residents. The water system has 5,455 total connections. Of these, 4,501 are single-family residential connections, 400 are multi-family connections, 529 are commercial connections (337 businesses, 31 churches, 50 city-property connections, 7 daycare centers, 26 schools, 19 trailer courts, 55 sprinkler systems, 4 services outside city), and 25 are industrial connections (construction). Almost all of the connections are metered (except a few remaining city park connections and mobile home parks).

From 2010 to 2014, Mountain Home's annual groundwater diversions (Table 28) averaged 4,723 acre-feet (AF), ranging from a low of 4,396 AF (2011) to a high of 4,915 AF (2012). Monthly diversions ranged from a low of approximately 98 AF per month during winter to approximately 1,008 AF per month during the summer (Table 29 and Figure 46). According to the 2011 Water Master Plan, completed by Keller & Associates, the percentage of unaccounted water is trending downward from about 17 percent in 2009. As the city continues to meter more connections, fix leaks, and replace old lines, the unaccounted water percentage is expected to decline further.

The city holds 55 shares of Mountain Home Irrigation District's water which is diverted for irrigation of the Desert Canyon Golf Course. The effluent from the city's lagoon system is used (along with water from a deep well) to irrigate 350 acres of a nearby farm.

For the past 4 years, the City of Mountain Home has distributed voluntary water conservation notices asking for alternate-day watering during peak summer months.

12.3.2 Mountain Home Air Force Base

The MHAFB's water system consists of seven active wells and a distribution system that serves approximately 6,500 residents. There are an additional 2,500 off-site employees that utilize the water system. The water system has 1,187 total connections. Metering is used to track water delivery to "billable facilities," such as Burger King, the school, bank, housing, etc. Housing currently has historically been metered as a whole, but meters are currently being installed on individual housing units.

From 2010 to 2014, MHAFB's annual groundwater diversions (Table 30) averaged 1,630 acre-feet (AF), ranging from a low of 1,440 AF (2011) to a high of 1,850 AF (2013). Monthly diversions (Table 31 and Figure 46) ranged from a low of approximately 33 AF per month during the winter to almost 300 AF per month during the summer. Unaccounted water ranges from 10 to 15 percent and is attributed primarily to flushing and fire protection.

All wastewater goes to a federally owned treatment facility on the base. The effluent is treated and used to irrigate the wastewater treatment plant grounds (1.34 acres, turf grass) and the base golf course (100.8 acres). The wastewater permit only allows the base to apply approximately 76 MG of treated effluent per year. As a back-up, the base maintains a wastewater NPDES permit, under which wastewater is discharged to a permitted outfall (Outfall 001, AKA McCalley Dam).

MHAFB's energy program has proposed several xeriscape projects to reduce irrigation demands. One project has been funded so far, which will lead to 40 acres being converted to xeriscape; additional water-conservation projects are being pursued.

12.3.3 Per Capita Water Use

The City of Mountain Home and MHAFB per capita winter, indoor water use was estimated to be 85 and 62 gpd per person, respectively (Table 35). The total (i.e., indoor and irrigation) annual per capita water use was estimated to be 291 and 224 gpd per person, respectively. These values are based on an assumed 2014 population of 14,500 in the City of Mountain Home and 6,500 served by the MHAFB.[47]

12.3.4 Projected Population

Population projections Elmore County, the City of Mountain Home, MHAFB, and the City of Glenns Ferry were prepared by John Church (Idaho Economics) using an econometric model originally developed for the Idaho Power Company. The model forecasts population, households (occupied housing units, rather than total dwelling units), and employment. The model has been used to forecast population, households, and employment in each of Idaho's counties.

It was projected that the MHAFB would experience modest increases in population and households over the next 50 years (Table 32 and Table 33), but that the population in Elmore County, City of Mountain Home, and Glenns Ferry would see modest declines. However, any substantial expansions in MHAFB activities would likely lead to increases in City of Mountain Home population, households, and employment.

12.3.5 Water Demand Projections

Absent increased economic activity at the MHAFB or in the City of Mountain Home, the DCMI water demand is projected to decrease over the next 50 years (Table 36 through Table 38). Expansion of the MHAFB would lead to increased DCMI water demand. Similarly, additional water availability in the Cinder Cone Butte Critical Ground Water Area or Mountain Home Ground Water Management Area could lead to increased agricultural or industrial activity that could result in increased DCMI demand.

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[47] These estimates of population served were provided by the City of Mountain Home and the MHAFB.

12.4 Tables and Figures

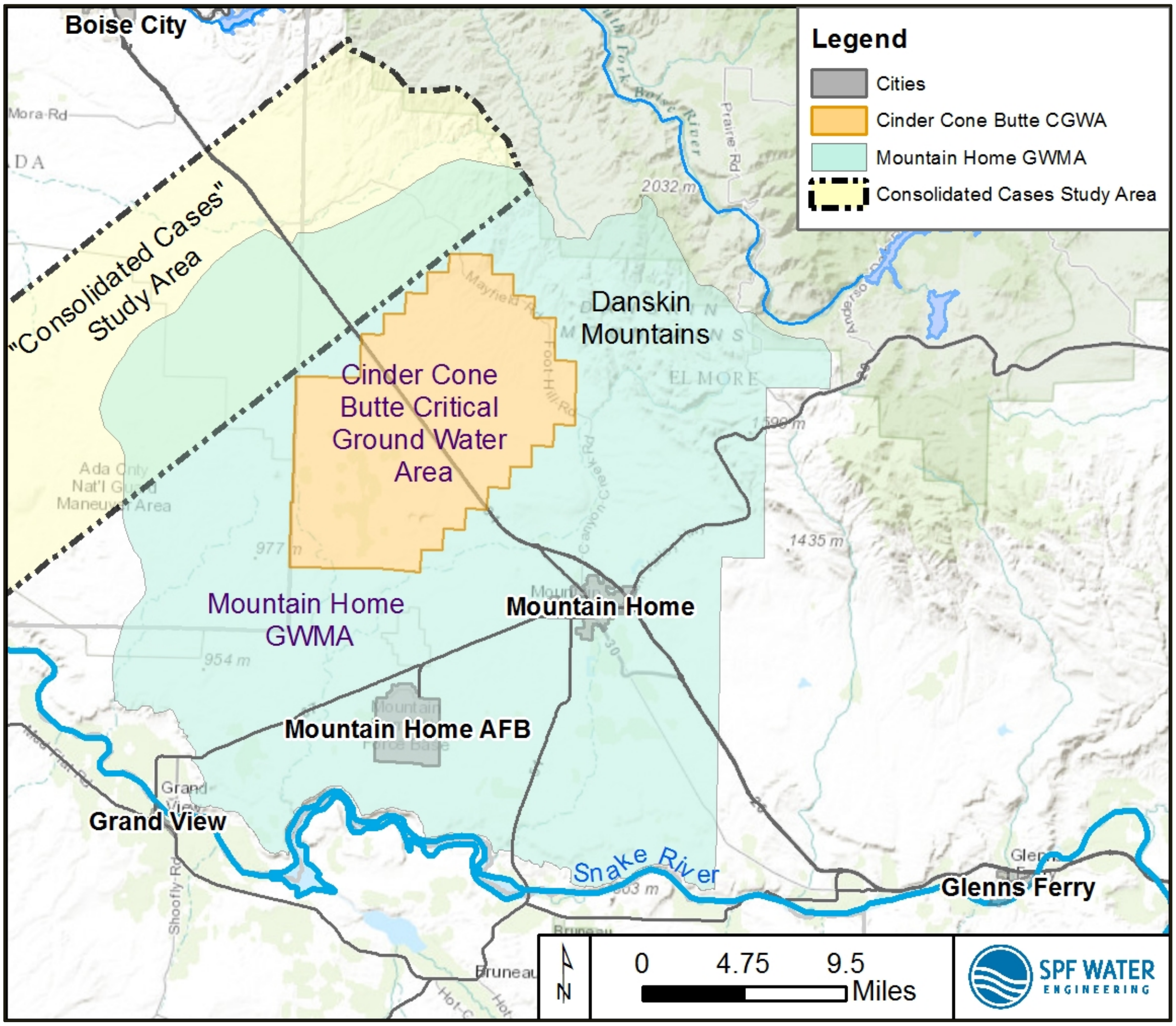

Figure 44. Mountain Home Plateau area.

Population Summary, 1940-2014									
County/ City	1940	1950	1960	1970	1980	1990	2000	2010	2014
Elmore County	5,520	6,690	16,700	17,500	21,600	21,300	29,100	27,100	26,100
Glenns Ferry	1,290	1,520	1,370	1,390	1,370	1,300	1,610	1,320	1,240
Mountain Home	1,190	1,890	5,980	6,450	7,540	7,910	11,100	14,200	13,800
Source: U.S. Census Bureau (w w w .census.gov). Data from 2011-2014 w ere based on mid year estimates.									

Table 26. Elmore County population summary, 1940-2014.

Percent Change in Population by Decade*								
County/City	1940-1950	1950-1960	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	2010-2014*
Elmore County	21%	150%	5%	23%	-1%	37%	-7%	-4%
Glenns Ferry	17%	-9%	1%	-1%	-5%	24%	-18%	-6%
Mountain Home	58%	217%	8%	17%	5%	41%	27%	-3%
Source: U.S. Census Bureau (www.census.gov). 2011-2014 data based on mid-year estimates. * All intervals are 10 years, except for 2010-2014, which is a 5-year interval.								

Table 27. Elmore County percentage change in population.

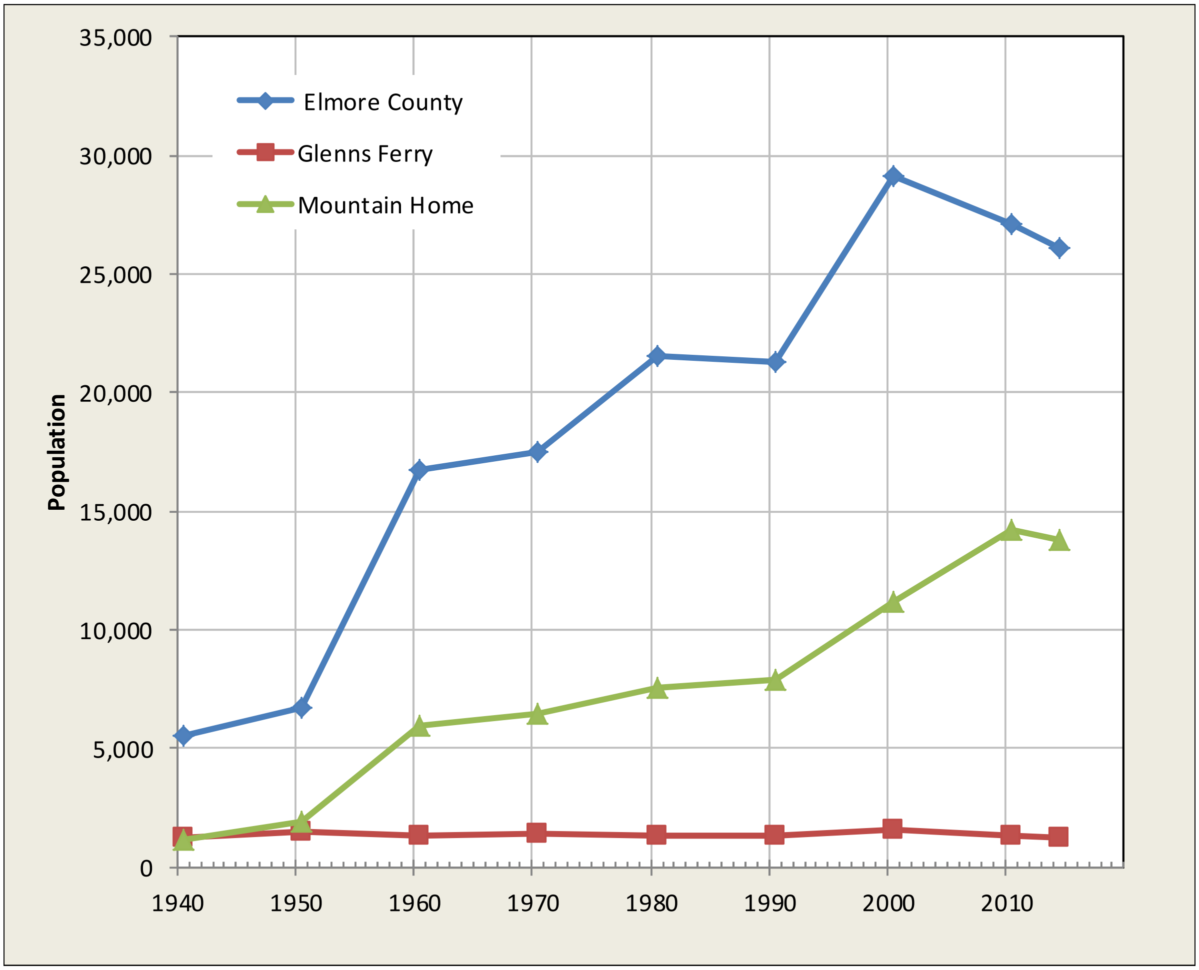

Figure 45. Historical population growth, Elmore County, 1940-2014.

City of Mountain Home Annual Diversions, 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	1,470,420	4,513
2011	1,432,282	4,396
2012	1,601,438	4,915
2013	1,591,580	4,884
2014	1,599,460	4,909
Average	1,539,036	4,723
Maximum	1,601,438	4,915
Minimum	1,432,282	4,396

Table 28. City of Mountain Home annual groundwater production, 2010-2014.

Average Monthly City of Mountain Home Water Production 2010-2014						
2010-2014	**Average (gals x1000)**	**Average (AF)**	**Maximum (AF)**	**Minimum (AF)**	**Average Estimated Irrigation Use (AF)**	**Average Estimated Domestic Use (AF)**
Jan	39,344	121	137	114	3	117
Feb	34,753	107	118	98	0	107
Mar	40,948	126	142	109	8	117
Apr	72,701	223	312	142	106	117
May	163,298	501	626	355	384	117
Jun	214,811	659	780	512	542	117
Jul	293,208	900	974	821	782	117
Aug	293,595	901	1,008	809	784	117
Sep	215,530	661	721	627	544	117
Oct	92,710	285	334	239	167	117
Nov	40,914	126	162	111	8	117
Dec	37,225	114	124	105	0	114
Total	1,539,036	4,723			3,327	1,396
* Domestic use is represented by average w ater use in December through February.						

Table 29. City of Mountain Home monthly groundwater production, 2010-2014.

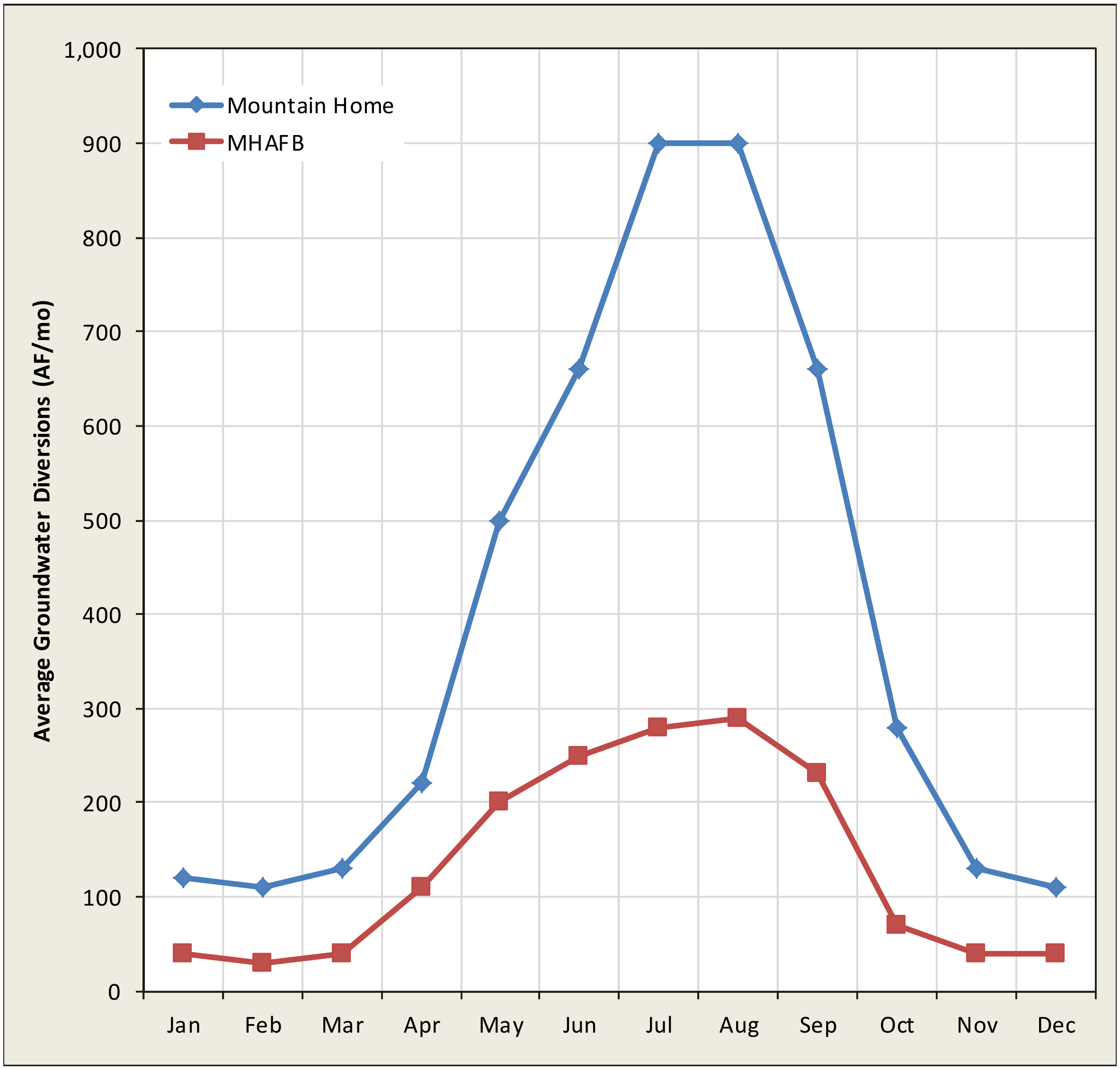

Figure 46. Average monthly DCMI water diversions.

MHAFB Annual Diversions, 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	543,418	1,668
2011	518,200	1,590
2012	527,232	1,618
2013	469,918	1,442
2014	603,552	1,852
Average	532,464	1,634
Maximum	603,552	1,852
Minimum	469,918	1,442

Table 30. MHAFB annual groundwater production, 2010-2014.

Average Monthly MHAFB Water Production, 2010-2014						
2010-2014	**Average (gals x1000)**	**Average (AF)**	**Maximum (AF)**	**Minimum (AF)**	**Average Estimated Irrigation Use (AF)**	**Average Estimated Domestic Use (AF)**
Jan	13,441	41	47	35	4	37
Feb	10,774	33	42	26	0	33
Mar	12,692	39	49	35	2	37
Apr	36,412	112	144	69	75	37
May	64,134	197	259	139	160	37
Jun	82,846	254	319	210	217	37
Jul	92,474	284	341	105	247	37
Aug	94,949	291	386	191	254	37
Sep	75,957	233	264	181	196	37
Oct	23,621	72	104	44	35	37
Nov	13,005	40	46	28	3	37
Dec	12,159	37	44	28	0	37
Total	532,464	1,634			1,192	442
* Domestic use is represented by average w ater use in December through February.						

Table 31. MHAFB monthly groundwater production, 2010-2014.

Population						
Year	Glenn's Ferry	Mountain Home	MHAFB	Rural	Total Elmore County	% Increase
2010	1,320	14,210	3,240	8,300	27,060	
2015	1,260	14,340	3,140	7,100	25,840	-1.1%
2020	1,240	14,480	2,990	6,700	25,410	-0.4%
2025	1,200	14,390	3,120	5,890	24,590	-0.8%
2030	1,150	13,810	3,230	5,420	23,600	-1.0%
2035	1,130	13,630	3,380	5,150	23,300	-0.3%
2040	1,110	13,380	3,380	5,000	22,870	-0.5%
2045	1,110	13,350	3,450	4,910	22,820	-0.1%
2050	1,110	13,320	3,470	4,870	22,770	-0.1%
2055	1,110	13,290	3,490	4,840	22,720	-0.1%
2060	1,100	13,260	3,500	4,800	22,670	-0.1%
2065	1,090	13,100	3,530	4,680	22,400	-0.3%

Table 32. Elmore County population projections, 2010-2014.

Households						
Year	Glenn's Ferry	Mountain Home	MHAFB	Rural	Total Elmore County	% Increase
2010	570	5,720	870	2,990	10,140	
2015	540	5,760	840	2,520	9,660	-1.2%
2020	540	5,920	800	2,420	9,680	0.1%
2025	530	5,950	840	2,160	9,470	-0.5%
2030	520	5,830	880	2,060	9,280	-0.5%
2035	520	5,880	930	2,040	9,370	0.2%
2040	530	5,950	930	2,070	9,480	0.3%
2045	520	5,900	950	2,020	9,400	-0.2%
2050	520	5,850	960	1,990	9,320	-0.2%
2055	520	5,810	960	1,960	9,250	-0.2%
2060	510	5,770	970	1,930	9,180	-0.2%
2065	510	5,720	980	1,900	9,110	-0.2%

Table 33. Elmore County household projections, 2010-2014.

Employment		
Year	**Elmore County**	**% Increase**
2010	6,390	
2015	6,290	-0.4%
2020	6,270	-0.1%
2025	5,970	-1.2%
2030	5,600	-1.5%
2035	5,390	-0.9%
2040	5,220	-0.8%
2045	5,170	-0.2%
2050	5,120	-0.2%
2055	5,070	-0.2%
2060	5,020	-0.2%
2065	4,970	-0.2%

Table 34. Elmore County employment projections, 2010-2014.

Per Capita Water Use		
Entity	**Average annual per capita water use (gpd)**	**Average winter water use (Dec-Feb) per capita (gpd)**
MHAFB	224	62
Mountain Home	291	85
Average	258	74

Table 35. Elmore County per capita DCMI water use.

Indoor Demand Projection (AF)			
Year	Mountain Home	MHAFB	Total
2010	1,360	230	1,590
2015	1,370	220	1,590
2020	1,380	210	1,590
2025	1,370	220	1,590
2030	1,320	220	1,540
2035	1,300	240	1,540
2040	1,280	240	1,520
2045	1,280	240	1,520
2050	1,270	240	1,510
2055	1,270	240	1,510
2060	1,270	240	1,510
2065	1,250	250	1,500

Table 36. Initial Elmore County DCMI indoor water-demand projection, 2010-2065.

DCMI Projection (AF)			
Year	Mountain Home	MHAFB	Total
2010	4,630	810	5,440
2015	4,170	700	4,870
2020	4,210	670	4,880
2025	4,180	700	4,880
2030	4,010	720	4,730
2035	3,960	760	4,720
2040	3,890	760	4,650
2045	3,880	770	4,650
2050	3,870	780	4,650
2055	3,870	780	4,650
2060	3,860	790	4,650
2065	3,810	790	4,600

Table 37. Initial Elmore County DCMI total water-demand projection, 2010-2065.

DCMI Irrigation Demand Projection (AF)			
Year	Mountain Home	MHAFB	Total
2010	3,270	590	3,860
2015	2,800	490	3,290
2020	2,830	460	3,290
2025	2,810	480	3,290
2030	2,700	500	3,200
2035	2,660	520	3,180
2040	2,610	520	3,130
2045	2,610	530	3,140
2050	2,600	540	3,140
2055	2,600	540	3,140
2060	2,590	540	3,130
2065	2,560	550	3,110

Table 38. Initial Elmore County DCMI irrigation water-demand projection, 2010-2065.

13 SUMMARY AND CONCLUSIONS

The primary conclusion from this analysis is that the net DCMI water demand[48] could increase from 110,000 AF/year in 2015 to between 270,000 and 394,000 AF/year by the year 2065. This represents an increase in DCMI demand of between 160,000 and 283,000 AF/year. Specific conclusions include the following:

Population and Employment

1. The Treasure Valley population grew from approximately 91,000 people in 1940 to approximately 630,000 people in 2014.
2. Average annual Treasure Valley population growth (based on 10-year data increments) averaged approximately 2.9 percent per year, ranging from 1.4 percent (1960-1970) to a high of 4.0 percent (1970-1980).
3. The Treasure Valley population is expected to increase to approximately 1.57 million people by the year 2065, of which about 63 percent will reside in Ada County and 37 percent in Canyon County.
4. The number of households is expected to increase from approximately 211,600 in 2010 to 638,700 in the year 2065.
5. Interviews with city and county planning personnel suggest that most future residential densities will average 3-4 households per acre, although changes in demographic and market preferences, higher commuting costs, and traffic congestion could lead average densities in new residential developments of 4-6 households per acre.
6. Population “capture” by adjacent counties (i.e., people that work in Ada and Canyon counties but choose to live in Gem County, Elmore County, Owyhee County, etc.) could reduce future DCMI water demand in Ada County and Canyon County.

Existing Water Use

7. 2010 to 2014 DCMI water-production data were supplied by United Water Idaho, Capitol Water Corporation, Eagle Water Company, City of Eagle, Garden City, City of Kuna, City of Meridian, City of Caldwell, and the City of Nampa.
8. Current per capita water use by residents served by these reporting entities ranges from approximately 80 to 278 gallons per day (gpd) per person. The

[48] The "net DCMI water demand" is the demand that will not be met by surface water and groundwater supplies already in use for agricultural irrigation.

valley-wide, population-weighted average indoor and outdoor DCMI use is approximately 80 gpd per person and 79 gpd per person, respectively. The relatively low per capita irrigation rate reflects the fact that some DCMI irrigation occurs with surface water (which is not included in these per capita estimates).

Precipitation Deficit and Climate Change

9. The average growing-season precipitation deficit for fully-irrigated turf, based on historical weather data in Boise, Caldwell, and Nampa, is about 3.4 feet per year.

10. Average temperatures by the year 2065 could increase by approximately 1.9°F to 6.1°F. Summary evapotranspiration could increase by approximately 5 to 20 percent as a result of such temperature increases. A 10 percent increase in evapotranspiration rates was assumed for these Treasure Valley future water-demand projections.

Water Conservation Potential

11. Substantial water-demand reductions are possible through conservation. These Treasure Valley DCMI water-demand projections included reduction in water use (compared to 2015 rates) of 10 to 30 percent, depending on the scenario. These levels of conservation would result from the use of water-efficient fixtures and plumbing, drought-tolerant landscaping, responses to possible future water-cost increases, etc.

Most Likely Scenario

12. While all of the projections have inherent uncertainty, Scenario 2 (a DCMI water-demand increase of approximately 228,000 AF by the year 2065, excluding demand met by currently-developed surface water and groundwater supplies) was deemed more probable than the other scenarios.

Sources of Supply

13. Options for supplying the net DCMI demand could include (1) diversions from the Boise River (through increased surface-water storage, use of flood flows for aquifer storage and recovery strategy, or direct diversions from the Boise River below Star, Idaho), (2) additional development of Treasure Valley groundwater, (3) new diversions from the Snake River, or (4) reuse of treated municipal effluent.

14. Treasure Valley aquifers can likely supply a portion of the increased future demand. However, it is also likely that the additional use of surface water (from the Boise River or Snake River) will be needed to meet the future DCMI demand.

15. Surface water from existing agricultural irrigation could become more available for DCMI uses in the future. However, this would likely require (1) market incentives to cover the costs of delivery-system improvements and operations and (2) changes in existing Boise River basin storage contracts.

Mountain Home Plateau DCMI Projections

16. The Elmore County population is projected to decrease from approximately 27,000 people in 2010 to 22,400 people in 2065.
17. Absent increased economic activity at the MHAFB or in the City of Mountain Home, the DCMI water demand is projected to decrease over the next 50 years.
18. Expansion of the MHAFB or development of other economic activity in the Mountain Home area could lead to population increases with associated increases in future DCMI water demand.

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APPENDIX A:

TREASURE VALLEY DCMI WATER-PRODUCTION DATA

This appendix summarizes 2010-2014 DCMI water production data from the following service providers: United Water Idaho, City of Nampa, City of Garden City, City of Meridian, City of Caldwell, Capitol Water Corporation, Eagle Water Company, City of Kuna, City of Eagle, City of Mountain Home, and Mountain Home Air Force Base. Well by well production data are provided in electronic form.

List of Tables

1. UNITED WATER IDAHO (UWID)

1.1. Water Use[1]

UWID's water system consists of 82 active wells, 2 surface-water treatment facilities, and a distribution system that serves approximately 227,000 residents. The water system had 86,719 total connections (at the time that data were provided for this project). Of these, 78,026 are residential connections and 8,644 are commercial connections.[2]

The UWID delivery system has multiple service levels. Interties between service levels allow water from one service level to support demand in one or more adjacent surface levels.

From 2010 to 2014, UWID's annual system production (Table 1) averaged 44,760 acre-feet (AF), ranging from a low of 41,539 AF (2011) to a high of 47,187 AF (2013). Monthly diversions have ranged from a low of approximately 1,660 AF per month during the winter to approximately 7,559 AF per month during the summer (Table 2).

UWID treats water from the Boise River at its Marden Lane and Columbia Water Treatment Plant facilities. The Marden Lane Plant produced an average of approximately 9,300 AF/year between 2010 and 2014. The Columbia Water Treatment Plant, which was constructed more recently, produced an average of approximately 3,700 AF/year from 2012 through 2014. Combined, surface water (approximately 13,000 AF/year) represents approximately 31 percent of UWID's annual production.

"Unaccounted" water is the difference between total production and aggregate delivery to end-users. Unaccounted water can include system leaks, fire hydrant flushing, etc. The 12 month rolling average (as of February 2015) for unaccounted water was reported to be 3.28 percent, or approximately 1,496 AF/year (487 MGY).

UWID supports ongoing water conservation programs. UWID contributed to water–efficient demonstration gardens at the Idaho Botanical Garden and the Idaho Statehouse. The company also has a demonstration garden at their main office. UWID offers free conservation devices (hose timer, hose nozzle and rain sensor) for customers and free water-efficient landscaping classes. During the irrigation season, the company promotes conservation through television commercials and in

[1] United Water Idaho water and population data provided by Roger Dittus, March 31, 2015.

[2] Commercial connections include multi-family housing such as apartments (John Church, personal communication, 10/2/2015)

newspaper spots. Water conservation is also promoted through customer education efforts including: UWID's Water Conservation Guide, partnerships with US EPA Water Sense program and Idaho Rivers United, and outreach through Boise State University's STEM program and presentations for local schools.

United Water Idaho Annual Diversions, 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	13,993,957	42,946
2011	13,535,552	41,539
2012	14,816,914	45,472
2013	15,375,820	47,187
2014	15,203,339	46,657
Average	14,585,117	44,760
Maximum	15,375,820	47,187
Minimum	13,535,552	41,539

Table 1. UWID annual groundwater production, 2010-2014.

Average Monthly United Water Idaho Water Production, 2010-2014						
2010-2014	**Average (gals x1000)**	**Average (AF)**	**Maximum (AF)**	**Minimum (AF)**	**Average Estimated Irrigation Use (AF)**	**Average Estimated Domestic Use (AF)**
Jan	637,431	1,956	2,063	1,843	66	1,890
Feb	575,120	1,765	1,862	1,660	0	1,765
Mar	643,363	1,974	2,114	1,824	84	1,890
Apr	859,857	2,639	3,124	2,062	749	1,890
May	1,376,011	4,223	5,409	3,145	2,333	1,890
Jun	1,780,721	5,465	6,221	4,579	3,575	1,890
Jul	2,397,016	7,356	7,559	7,040	5,466	1,890
Aug	2,299,301	7,056	7,350	6,838	5,166	1,890
Sep	1,736,725	5,330	5,703	5,024	3,440	1,890
Oct	1,027,605	3,154	3,327	2,897	1,263	1,890
Nov	616,813	1,893	2,020	1,690	3	1,890
Dec	635,155	1,949	2,086	1,839	59	1,890
Total	14,585,117	44,760	48,837	40,440	22,204	22,557
* Domestic use is represented by average w ater use in December through February.						

Table 2. UWID monthly groundwater production, 2010-2014.

2. City of Nampa

2.1. Water Use[3]

The City of Nampa's water system consists of 13 active municipal wells, 45 irrigation wells, and a distribution system that serves approximately 86,000 residents. Residential demands account for 71.3 percent of summer demand and 83.5 percent of winter demand. Commercial use accounts for 20.9 percent and 16.1 percent of summer and winter demand, respectively.

All potable water uses are metered by the city. However, there are several unmetered irrigation services within the city. According to the city, "three of the larger unmetered users include the Ridgecrest Golf Course, Harmony Heights, and Happy Valley Estates. The Ridgecrest Golf Course uses up to 200 gpm of water during the shoulder seasons before and after surface water irrigation is available."

From 2010 to 2014, Nampa's annual groundwater diversions for its potable water system (Table 3) averaged 7,954 acre-feet (AF), ranging from a low of 7,658 AF (2011) to a high of 8,278 AF (2013). Monthly diversions ranged from a low of approximately 520 AF per month during the winter to approximately 901 AF per month during the summer (Table 4).

From 2010 to 2014, Nampa's annual irrigation diversions (Table 5) averaged 10,242 acre-feet (AF), ranging from a low of 8,386 AF (2010) to a high of 12,456 AF (2014). These wells are operated from April through October each year. Monthly diversions ranged from 179 AF per month in October to approximately 3,304 AF per month in September (Table 6).

Combined potable- and irrigation-system withdrawals averaged approximately 18,200 AF/year, ranging from 16,044 to 20,734 AF (Table 7). Aggregate monthly diversions (Table 8) ranged from 543 AF (February) to 2973 AF (July).

Between 2009 and 2012, unaccounted water reportedly varied between 10 and 13 percent of the total volume produced.

[3] City of Nampa water and population data provided by Daniel Badger, March 12, 2015.

City of Nampa Municipal Annual Diversions (Potable System) 2010-2014		
Year	Annual Volume (gal x 1,000)	Annual Volume (AF)
2010	2,520,341	7,735
2011	2,495,473	7,658
2012	2,599,567	7,978
2013	2,697,233	8,278
2014	2,646,597	8,122
Average	2,591,842	7,954
Maximum	2,697,233	8,278
Minimum	2,495,473	7,658

Table 3. City of Nampa (Municipal) annual groundwater production, 2010-2014.

Average Monthly City of Nampa Water Production (Potable System) 2010-2014						
2010-2014	Average (gals x1000)	Average (AF)	Maximum (AF)	Minimum (AF)	Average Estimated Irrigation Use (AF)	Average Estimated Domestic Use (AF)
Jan	203,269	624	745	588	52	572
Feb	177,085	543	582	520	0	543
Mar	188,998	580	602	548	8	572
Apr	198,831	610	666	539	38	572
May	237,900	730	744	690	158	572
Jun	240,071	737	828	686	165	572
Jul	253,956	779	901	528	207	572
Aug	261,005	801	880	763	229	572
Sep	235,520	723	789	677	151	572
Oct	219,557	674	724	631	102	572
Nov	196,730	604	645	573	32	572
Dec	178,922	549	591	525	0	549
Total	2,591,842	7,954			1,140	6,814
* Domestic use is represented by average water use in December through February.						

Table 4. City of Nampa (Municipal) monthly groundwater production, 2010-2014.

City of Nampa Irrigation Annual Diversions (Non-Potable Irrigation System) 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	2,732,506	8,386
2011	3,586,174	11,006
2012	3,563,599	10,936
2013	3,387,338	8,428
2014	4,058,786	12,456
Average	3,465,680	10,242
Maximum	4,058,786	12,456
Minimum	2,732,506	8,386

Table 5. City of Nampa (Municipal) monthly groundwater production, 2010-2014.

Average Monthly City of Nampa Water Production (Non-Potable Irrigation System), 2010-2014				
2010-2014	**Average (gals x1000)**	**Average (AF)**	**Maximum (AF)**	**Minimum (AF)**
Jan	0	0	0	0
Feb	0	0	0	0
Mar	0	0	0	0
Apr	274,434	837	884	746
May	471,334	1,293	1,954	772
Jun	511,347	1,501	2,108	1,171
Jul	753,997	2,194	2,667	1,798
Aug	667,091	2,021	2,457	1,820
Sep	682,533	1,995	3,304	1,374
Oct	104,945	401	489	179
Nov	0	0	0	0
Dec	0	0	0	0
Total	3,465,680	10,242		
* Domestic use is represented by average w ater use in December through February.				

Table 6. City of Nampa (Municipal) monthly groundwater production, 2010-2014.

City of Nampa Municipal Annual Diversions (Combined Potable and Irrigation System) 2010-2014			
Year	Annual Potable Volume (AF)	Annual Non-Potable Volume (AF)	Total (AF)
2010	7,735	8,386	16,120
2011	7,658	11,006	18,664
2012	7,978	10,936	18,914
2013	8,278	8,428	16,706
2014	8,122	12,456	20,578
Average	7,954	10,242	18,197
Maximum	8,278	12,456	20,734
Minimum	7,658	8,386	16,044

Table 7. City of Nampa (Municipal) monthly groundwater production, 2010-2014.

Average Monthly City of Nampa Water Production (Combined Potable and Irrigation System) 2010-2014					
2010-2014	Average (AF)	Maximum (AF)	Minimum (AF)	Average Estimated Irrigation Use (AF)	Average Estimated Domestic Use (AF)
Jan	624	745	592	0	572
Feb	543	582	533	0	572
Mar	580	602	548	0	572
Apr	1,447	1,550	1,364	875	572
May	2,023	2,697	1,461	1,451	572
Jun	2,238	2,936	1,870	1,666	572
Jul	2,973	3,568	2,642	2,401	572
Aug	2,822	3,263	2,583	2,250	572
Sep	2,718	4,093	2,078	2,146	572
Oct	1,075	1,161	849	503	572
Nov	604	612	586	32	572
Dec	549	591	525	0	572
Total	18,197			11,323	6,865

* Domestic use is represented by average water use in December through February.

Table 8. City of Nampa (Municipal) monthly groundwater production, 2010-2014.

3. CITY OF GARDEN CITY

3.1. Water Use[4]

Garden City's water system consists of eight active wells and a distribution system that serves approximately 12,500 residents. The water system has 4,600 total metered connections.

From 2010 to 2014, Garden City's annual groundwater diversions (Table 9) averaged 3,135 acre-feet (AF), ranging from a low of 2,674 AF (2011) to a high of 3,450 AF (2014). Monthly diversions have ranged from a low of approximately 68 AF per month during the winter to a high of approximately 579 AF per month during the summer (Table 10). There are multiple irrigation ditches that supply non-potable water in Garden City.

City of Garden City Annual Diversions, 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	1,062,310	3,260
2011	871,338	2,674
2012	973,550	2,988
2013	1,076,791	3,305
2014	1,124,027	3,450
Average	1,021,603	3,135
Maximum	1,124,027	3,450
Minimum	871,338	2,674

Table 9. City of Garden City (Municipal) annual groundwater production, 2010-2014.

[4] City of Garden City water and population data provided by Chas Heaton, April 7, 2015.

Average Monthly City of Garden City Water Production, 2010-2014						
2010-2014	**Average (gals x1000)**	**Average (AF)**	**Maximum (AF)**	**Minimum (AF)**	**Average Estimated Irrigation Use (AF)**	**Average Estimated Domestic Use (AF)**
Jan	57,951	178	273	107	41	136
Feb	39,561	121	154	102	0	121
Mar	43,488	133	168	109	0	133
Apr	59,017	181	223	133	45	136
May	96,713	297	353	224	160	136
Jun	128,178	393	460	308	257	136
Jul	172,612	530	579	484	393	136
Aug	159,360	489	543	384	353	136
Sep	125,176	384	397	354	248	136
Oct	65,943	202	232	172	66	136
Nov	37,758	116	127	106	0	116
Dec	35,846	110	131	68	0	110
Total	1,021,603	3,135	3,640	2,550	1,563	1,572
* Domestic use is represented by average water use in December through February.						

Table 10. City of Garden City monthly groundwater production, 2010-2014.

4. CITY OF MERIDIAN

4.1. Water Use[5]

The City of Meridian's water system consists of 20 active wells and a distribution system that serves approximately 80,000 residents. The water system has 28,855 total connections. Of these, 26,798 are single-family residential connections and 1,535 are commercial or multi-family connections. There are also 522 sprinkler connections.

From 2010 to 2014, Meridian's annual groundwater diversions (Table 5) averaged 8,961 acre-feet (AF), ranging from a low of 7,333 AF (2010) to a high of 10,180 AF (2014). Monthly diversions ranged from a low of approximately 284 AF per month during the winter to approximately 1,457 AF per month during the summer (Table 12). Unaccounted water was reported as 0 percent in 2014 and 3.5 percent in 2013.

Over 80 percent of Meridian water customers use surface water supply for irrigation. Most surface water for irrigation is provided by Nampa & Meridian Irrigation District and Settlers Irrigation District. Other irrigation entities provide surface water to south Meridian as well.

Meridian's wastewater treatment plant discharges treated water into Fivemile Creek, about 50 feet downstream of the confluence with Ninemile Creek. The wastewater treatment plant has the capability to provide Class A reclaimed water to landscape areas during part of the year.

The city adopted a 2011 Water Conservation Plan which includes current and future actions. Water conservation actions include water leak monitoring, irrigation audits, metering all customers, encouraging surface-water irrigation, and support of building codes for water-efficient fixture regulation.

[5] City of Meridian water and population data provided by Jacy Jones, March 12, 2015.

City of Meridian Annual Diversions, 2010-2014		
Year	Annual Volume (gal x 1,000)	Annual Volume (AF)
2010	2,389,313	7,333
2011	2,392,298	7,342
2012	3,185,881	9,777
2013	3,315,576	10,175
2014	3,317,204	10,180
Average	2,920,054	8,961
Maximum	3,317,204	10,180
Minimum	2,389,313	7,333

Table 11. City of Meridian annual groundwater production, 2010-2014.

Average Monthly City of Meridian Water Production, 2010-2014						
2010-2014	Average (gals x1000)	Average (AF)	Maximum (AF)	Minimum (AF)	Average Estimated Irrigation Use (AF)	Average Estimated Domestic Use (AF)
Jan	169,322.92	520	611	374	31	489
Feb	155,332.06	477	630	366	0	477
Mar	162,037.08	497	573	435	9	489
Apr	200,930.12	617	819	444	128	489
May	259,761.82	797	1,035	543	308	489
Jun	320,620.53	984	1,226	762	495	489
Jul	412,382.93	1,266	1,457	989	777	489
Aug	394,746.34	1,211	1,341	1,115	723	489
Sep	317,223.22	974	1,173	771	485	489
Oct	226,660.94	696	832	529	207	489
Nov	147,918.77	454	558	329	0	454
Dec	153,117.49	470	642	284	0	470
Total	2,920,054	8,961			3,162	5,799
* Domestic use is represented by average water use in December through February.						

Table 12. City of Meridian monthly groundwater production, 2010-2014.

5. CITY OF CALDWELL

5.1. Water Use[6]

The City of Caldwell's water system consists of 12 active wells and a distribution system that serves approximately 51,691 residents. The system has 15,222 connections. Of these, 1,100 are commercial connections and 14,122 are residential connections. Municipal water deliveries to these connections are metered.

From 2010 to September 2014, Caldwell's annual groundwater diversions[7] (Table 13) averaged 5,449 acre-feet (AF), ranging from a low of 5,137 AF in 2011 to a high of 5,791 AF in 2013. Monthly diversions range from a low of approximately 284 AF per month during the winter to a high of approximately 785 AF per month during the summer (Table 14). Caldwell reported that approximately 8 percent of total pumping was considered unaccounted water in 2014.

The City of Caldwell provides surface water to 8,733 customers for pressure irrigation. There are six other irrigation entities that provide water to other service areas: Pioneer Irrigation District, Golden Gate Irrigation District, Canyon Hill Irrigation District, Nampa- Meridian Irrigation District, Boise Board of Control, and Caldwell Irrigation Lateral District.

[6] City of Caldwell water and population data provided by Gary Shoemaker, March 10, 2015.
[7] 2014 data is excluded from annual totals as data was only provided through September 2014.

City of Caldwell Annual Diversions, 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	1,715,421	5,264
2011	1,673,847	5,137
2012	1,826,376	5,605
2013	1,886,884	5,791
2014	-	-
Average	1,775,632	5,449
Maximum	1,886,884	5,791
Minimum	1,673,847	5,137

Table 13. City of Caldwell annual groundwater production 2010-2013.

Average Monthly City of Caldwell Water Production, 2010-2014						
2010-2014	**Average (gals x1000)**	**Average (AF)**	**Maximum (AF)**	**Minimum (AF)**	**Average Estimated Irrigation Use (AF)**	**Average Estimated Domestic Use (AF)**
Jan	103,975	319	342	295	4	315
Feb	96,717	297	311	284	0	297
Mar	112,975	347	360	325	32	315
Apr	134,484	413	449	370	98	315
May	172,502	529	610	460	215	315
Jun	197,252	605	672	520	291	315
Jul	243,344	747	785	694	432	315
Aug	223,170	685	725	652	370	315
Sep	175,573	539	560	519	224	315
Oct	125,687	386	399	368	71	315
Nov	100,534	309	333	299	0	309
Dec	106,938	328	380	307	13	315
Total	1,793,148	5,503			1,751	3,752
* Domestic use is represented by average w ater use in December through February.						

Table 14. City of Caldwell monthly groundwater production 2010- 2013.

6. CAPITOL WATER CORPORATION

6.1. Water Use[8]

Capitol Water Corporation's delivery system consists of five municipal wells and a distribution system that serves approximately 8,000 residents. The system has 2,890 connections of which 2,608 are residential connections and 282 are commercial connections (which include 21 commercial fire protection connections). Commercial connections are metered; residential connections are not metered.

From 2010 to 2014, Capitol Water Corporation's annual groundwater diversions (Table 7) averaged 2,201 acre-feet (AF), ranging from a low of 1,968 AF in 2011 to a high of 2,493 AF in 2014 (Table 15). Monthly diversion data[9] ranged from a low of approximately 65 AF per month during the winter to a high of approximately 462 AF per month during the summer (Table 16).

Capitol Water uses an alternate day irrigation schedule and has no intentions of future growth because UWID surrounds the entire water system.

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[8] Capitol Water Corporation's water and population data provided by Bob Price, April 15, 2015.
[9] Monthly data per well provided for 2014 only.

Capitol Water Corporation Annual Diversions, 2010-2014		
Year	Annual Volume (gal x 1,000)	Annual Volume (AF)
2010	663,614	2,037
2011	641,316	1,968
2012	695,768	2,135
2013	719,456	2,208
2014	812,219	2,493
Average	680,039	2,087
Maximum	719,456	2,208
Minimum	641,316	1,968

Table 15. Capitol Water Corporation annual groundwater diversions, 2010 - 2014.

Average Monthly Capitol Water Corporation Water Production, 2014						
2014	Average (gals x1000)	Average (AF)	Maximum (AF)	Minimum (AF)	Average Estimated Irrigation Use (AF)	Average Estimated Domestic Use (AF)
Jan	21,044	65	-	-	0	65
Feb	34,942	107	-	-	17	90
Mar	34,418	106	-	-	16	90
Apr	43,983	135	-	-	45	90
May	76,858	236	-	-	146	90
Jun	119,577	367	-	-	277	90
Jul	135,660	416	-	-	326	90
Aug	150,578	462	-	-	372	90
Sep	92,019	282	-	-	192	90
Oct	40,806	125	-	-	35	90
Nov	30,333	93	-	-	3	90
Dec	32,001	98	-	-	8	90
Total	812,219	2,493	-	-	1,438	1,055
* Domestic use is represented by average water use in December through February.						

Table 16. Capitol Water Corporation monthly groundwater diversions, 2014.

7. EAGLE WATER COMPANY

7.1. Water Use[10]

The Eagle Water Company's water system consists of six active wells and a distribution system that serves approximately 10,000 residents. The water system has 3,550 total connections. Of these, 3,075 are residential connections and 475 are commercial or multi-family connections. There are an additional 112 landscape irrigation accounts.

From 2010 to 2014, Eagle Water Company's annual groundwater diversions (Table 17) averaged 2,295 acre-feet (AF), ranging from a low of 2,186 AF (2011) to a high of 2,441 AF (2013). Monthly diversions ranged from a low of approximately 66 AF per month during the winter to approximately 381 AF per month during the summer (Table 18). Unaccounted water is reported to be from 10 to 15 percent and is mainly attributed to flushing and fire protection.

Eagle Water Company Annual Diversions, 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	731,159	2,244
2011	712,336	2,186
2012	753,619	2,313
2013	795,401	2,441
2014	746,024	2,289
Average	747,708	2,295
Maximum	795,401	2,441
Minimum	712,336	2,186

Table 17. Eagle Water Company annual groundwater production, 2010-2014.

[10] Eagle Water Company water and population data provided by Robert DeShazo, March 11, 2015.

Average Monthly Eagle Water Company Production, 2014						
2010-2014	**Average (gals x1000)**	**Average (AF)**	**Maximum (AF)**	**Minimum (AF)**	**Average Estimated Irrigation Use (AF)**	**Average Estimated Domestic Use (AF)**
Jan	25,505	78	83	73	4	74
Feb	22,487	69	73	66	0	69
Mar	25,263	78	86	71	3	74
Apr	44,775	137	220	96	63	74
May	78,048	240	324	190	165	74
Jun	100,397	308	348	262	234	74
Jul	132,620	407	444	381	333	74
Aug	122,206	375	407	335	301	74
Sep	95,015	292	331	256	217	74
Oct	48,219	148	175	123	73	74
Nov	28,345	87	133	71	12	74
Dec	24,829	76	81	72	2	74
Total	747,708	2,295	—	—	1,406	888
* Domestic use is represented by average w ater use in December through February.						

Table 18. Eagle Water Company monthly groundwater production, 2010-2014.

8. CITY OF KUNA

8.1. Water Use[11]

The City of Kuna's water system consists of eight wells and a distribution system that serves approximately 16,000 residents. The water system has 5,706 total metered connections.

From 2012 to 2014, Kuna's annual groundwater diversions (Table 19) averaged 2,331 acre-feet (AF), ranging from a low of 2,003 AF (2012) to a high of 2,555 AF (2013). The city's monthly diversions between 2012 and 2014 ranged from a low of approximately 27 AF per month in the winter to a high of approximately 495 AF in the summer (Table 20). Kuna reported approximately 9 percent unaccounted water in 2014.

Surface water from the Boise-Kuna Irrigation District, New York Irrigation District, and Nampa-Meridian Irrigation District is used for irrigation within the city's municipal distribution area. Kuna uses reclaimed wastewater to irrigate a 406 acre farm.

City of Kuna Annual Diversions, 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	-	-
2011	-	-
2012	652,659	2,003
2013	832,643	2,555
2014	793,124	2,434
Average	759,475	2,331
Maximum	832,643	2,555
Minimum	652,659	2,003

Table 19. City of Kuna annual groundwater production, 2012- 2014.

[11] City of Kuna water and population data provided by Debbie Crosley, March 10, 2015.

Average Monthly City of Kuna Water Production, 2010-2014						
2010-2014	Average (gals x1000)	Average (AF)	Maximum (AF)	Minimum (AF)	Average Estimated Irrigation Use (AF)	Average Estimated Domestic Use (AF)
Jan	25,509	78	108	27	0	78
Feb	25,387	78	95	46	0	78
Mar	31,454	97	102	89	12	84
Apr	65,377	201	225	172	116	84
May	79,837	245	297	173	161	84
Jun	92,774	285	324	229	200	84
Jul	134,188	412	495	344	327	84
Aug	120,872	371	429	336	287	84
Sep	77,117	237	280	188	152	84
Oct	43,455	133	148	116	49	84
Nov	31,971	98	102	96	14	84
Dec	31,535	97	123	67	12	84
Total	759,475	2,331			1,331	999
* Domestic use is represented by average w ater use in December through February.						

Table 20. City of Kuna monthly groundwater production, 2012- 2014.

9. The City of Eagle

9.1. Water Use[12]

The City of Eagle's water system consists of four wells and a distribution system that serves approximately 12,500 residents. The water system has 1,709 total metered connections. Of these, 1,688 are residential connections and 21 are commercial (schools and irrigation) connections.

From 2010 to 2013, Eagle's annual groundwater diversions (Table 21) averaged 415 acre-feet (AF), ranging from a low of 391 AF (2012) to a high of 434 AF (2011). The city's monthly diversions from 2010 and 2013 ranged from approximately 11 AF in winter months to 64 AF in summer (Table 22). The data provided noted many issues with SCADA data collection; these issues could result in inaccuracies in annual and monthly data.

[12] City of Eagle water and population data provided by Kellie Rekow, March 12, 2015.

There are several irrigation companies which provide irrigation to subdivisions through homeowners associations. In the past several years the City of Eagle has done high amounts of flushing and they believe the majority of the unaccounted water is directly linked to it. They reported an estimate of 12 percent unaccounted water, but believe it is declining as flushing is not needed as often.

City of Eagle Annual Diversions, 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	134,099	412
2011	141,517	434
2012	127,561	391
2013	137,986	423
2014		-
Average	135,291	415
Maximum	141,517	434
Minimum	127,561	391

Table 21. City of Eagle annual groundwater production, 2012- 2013.

Average Monthly City of Eagle Water Production, 2010-2014						
2010-2013	Average (gals x1000)	Average (AF)	Maximum (AF)	Minimum (AF)	Average Estimated Irrigation Use (AF)	Average Estimated Domestic Use (AF)
Jan	10,406	32	41	25	3	29
Feb	9,041	28	41	12	0	28
Mar	10,380	32	36	29	3	29
Apr	12,739	39	51	23	11	29
May	13,688	42	63	31	13	29
Jun	11,848	36	39	33	8	29
Jul	12,698	39	44	32	10	29
Aug	14,512	45	48	41	16	29
Sep	12,913	40	64	30	11	29
Oct	8,335	26	32	11	0	26
Nov	10,282	32	38	26	3	29
Dec	8,451	26	33	21	0	26
Total	135,291	415			79	336
* Domestic use is represented by average water use in December through February.						

Table 22. City of Eagle monthly groundwater production, 2012- 2013.

APPENDIX B:

INCREASED EVAPOTRANSPIRATION AS A RESULT OF CLIMATE CHANGE[1]

The increasing temperatures in the Northwest may result in an increase in evapotranspiration, although there is uncertainty in how much the increase in temperature will affect crop evapotranspiration and future estimates of irrigation demands.

Monthly potential evapotranspiration (PET) for Idaho Climate Division 1 was estimated from mean monthly temperature for this climate division using the Hamon equation (Hamon, 1961). Monthly Hamon PET (PETHamon) was estimated using the equation:

$$PET_{Hamon} = 0.1651 dLW_t \quad (1)$$

Where PET_{Hamon} is the PET in millimeters (mm) per month; *d* is the number of days in a month, *L* is the mean monthly hours of daylight in multiples of 12 hours, and W_t is the saturated water vapor density (g/m^3) calculated by:

$$W_t = 4.95 \exp(0.062T) \quad (2)$$

Where *T* is the monthly mean temperature in degrees Celsius.
(McCabe and Wolock, 2002)

The monthly variation of PET (Hamon, 1961) is given in Figure 1. Mean monthly temperatures were then increased by 1°C and the Hamon PET was recalculated. The results from this analysis are summarized in Table 1.

Based on this analysis, the percentage PET change was estimated to be 6.4 percent for every 1°C increase in mean temperature.

[1] This section, reprinted from SPF et al. (2010), was used as the basis for assumptions regarding increased evapotranspiration for these Treasure Valley future DCMI water-demand projections.

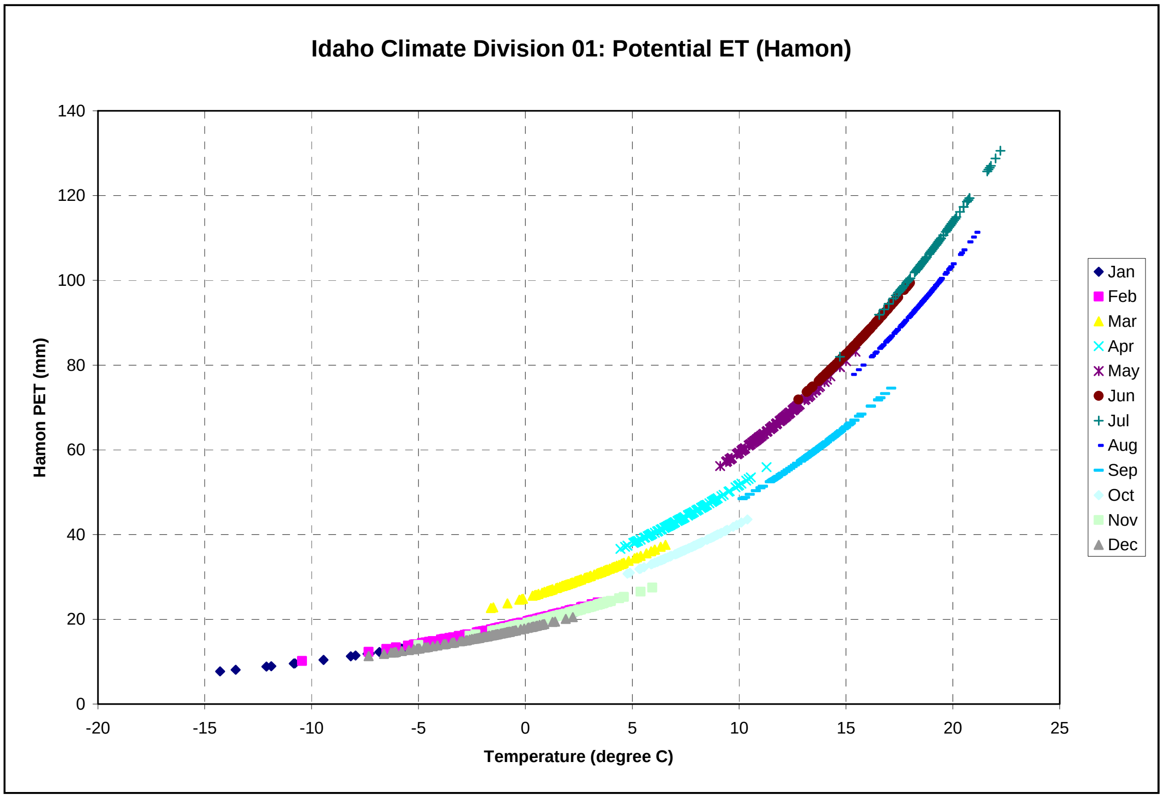

Figure 1. Monthly variation of potential evapotranspiration (Hamon, 1961) with mean monthly temperature.

Month	Hammon PET (mm)	
	Historical	*With +1 degree C*
Jan	15.57	16.56
Feb	18.58	19.77
Mar	29.93	31.85
Apr	44.14	46.96
May	66.76	71.03
Jun	85.10	90.55
Jul	107.09	113.94
Aug	93.47	99.45
Sep	59.88	63.71
Oct	36.67	39.02
Nov	21.08	22.43
Dec	16.00	17.02

Table 1. Monthly PET (Hamon) – historical and with 1°C increase in temperature.

REFERENCES

Hamon, W.R., 1961. Estimating potential evapotranspiration. J. Hydraul. Div. Proc. Am. Soc. Civil Eng. 87: 107 120.

McCabe, G.J., Wolock, D.M., 2002. Trends and temperature sensitivity of moisture conditions in the conterminous United States. Climate Research, 20: 19-29.

APPENDIX C:

WATER CONSERVATION MEASURES

1.1. Potential Water Conservation Measures and Programs

The following list of potential water conservation measures and programs was completed by evaluating existing measures and programs in the area, reviewing the Idaho Department of Water Resources (IDWR) Draft Water Conservation Measures and Guidelines for Preparing Water Conservation Plans document (IDWR, 2006), and familiarity with water-conservation measures in other areas:

1. Water Efficient Fixtures/Appliances and Incentives
    a. Retrofit kits
    b. Indoor retrofitting at water provider facilities
    c. Rebates and incentives -- residential and non-residential
    d. Promotion of new technologies
2. Landscape Efficiency
    a. Promotion of landscape efficiency
    b. Landscape planning and renovation
    c. Selective irrigation sub-metering
    d. Irrigation management
    e. Turf/high water use landscaping buy-back/incentive program
    f. Xeric or drought-tolerant landscaping and demonstration gardens at provider facilities
    g. Certification program/classes for landscape/irrigation professionals
    h. Outdoor water conservation kits
    i. Rain sensor incentive
    j. Evaluation of landscape and irrigation plans for new/re-development
3. Water-Use Audits
    a. Audits of large-volume users
    b. Landscape and irrigation audits
    c. Indoor water audits for residential customers
4. Industrial and Commercial Efficiency
    a. Commercial and industrial water conservation education and support
    b. Low-flow commercial pre-rinse spray washers
5. Education/Information Distribution

    a. Public education
    b. Youth and teacher education
    c. Workshops
    d. Water conservation webpage
    e. Conservation information available for customers
6. Encouraging Water Conservation through Water Rate Structures and Billing
    a. Inverted, tiered water rate schedule
    b. Cost-of-service accounting
    c. User charges
    d. Metered rates
    e. Cost analysis
    f. No promotional rates
    g. Understandable and informational water bill
    h. Peer-user information (e.g., average use by neighbors) printed on water bill
    i. Water bill inserts
7. Regulations/Ordinances
    a. Water use standards and regulations
    b. Requirements for new developments
8. Other Water Management Activities
    a. Water conservation officer staff position
    b. Customer service
    c. Advisory committee
9. Water Reuse/Recycling
    a. Industrial and commercial applications; large-volume water users
    b. Treatment facility water conservation/efficiency opportunities
10. Universal Metering
    a. Source-water metering
    b. Surface-connection metering
    c. Meter public use water
    d. Fixed-interval meter reading
    e. Meter-extra seat analysis
    f. Test, calibrate, repair, and replace meters
11. Water Accounting and Loss Control
    a. System maintenance, leak detection, and repair program
    b. Analysis of "unaccounted" water
    c. Water system audit

d. Automated sensors/telemetry

12. Pressure Management
    a. System-wide pressure regulation
    b. Selective use of pressure-reducing valves
13. On-Farm Water Use and Irrigation Districts
    a. On-farm water efficiency improvements
    b. Irrigation district operations (e.g., improved metering, peer water use reporting, etc.).

This list of potential conservation measures may not be appropriate for all water providers in the Treasure Valley Aquifer area, as each of the providers operate under unique conditions. However, this list of water conservation measures and programs can be used as a guide for discussion among the water providers in determining which programs might be most appropriate. Also, the above outline does not represent an exhaustive list of water conservation options available. Additional user measures[1], such as replacing turf with xeric or drought-tolerant landscaping, or running washing machines only with a full load, could offer substantial water savings.

2. REFERENCES

IDWR, 2006. Water Conservation Measures and Guidelines for Preparing Water Conservation Plans, Prepared by the Idaho Department of Water Resources, available in draft form (February 2006) from https://www.idwr.idaho.gov/files/ground_water_mgmt/200602-Draft-Conservation-Plan.pdf.

[1] User measures are sometimes referred to as non-structural measures (e.g., using the washing machine only with a full load) as opposed to structural measures (a low water-use washing machine).

MEMORANDUM

To: Idaho Water Resource Board
From: Wesley Hipke
Date: March 16th, 2016
Subject: Draft Resolution Backgrounds for North Side Canal and Dietrich Drop

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This memo is being provided to the Idaho Water Resource Board (IWRB) members to provide background information for the two resolutions related to expanding the managed recharge capacity in the Eastern Snake Plain Aquifer (ESPA). The proposed resolutions are:

- North Side Main Canal infrastructure improvements required to deliver winter recharge to Wilson Lake and potentially other sites
- Dietrich Drop Hydro Facility infrastructure improvements on the Milner-Gooding Canal to deliver winter recharge to the Shoshone Recharge Site and potentially other sites.

North Side Canal Infrastructure Improvements

The North Side Canal (NSCC) system diverts water from the Milner Pool and carries water to the northwest across the Eastern Snake River Plain. This canal system has significant potential for conducting winter-time managed recharge. NSCC has used their Main Canal to deliver water to Wilson Lake, approximately 9 miles from the Milner Pool. IWRB recharge has been limited to the fall and spring when freezing temperatures have not been a concern. Numerous structures exist on the Main Canal that would require infrastructure improvements to conduct managed recharge during the winter. When these infrastructure issues are addressed there is potential for developing managed recharge sites further down the canal.

The key structures requiring improvement are:

- Milner Pool Diversion Structure
- By-Pass Hydro Facility
- Hazelton A Hydro Facility
- Hazelton B Hydro Facility
- Wilson Lake Hydro Facility and gates

Feasibility Study

NSCC and the IWRB initiated a feasibility study in February 2015 to determine potential options for infrastructure improvements that would allow for winter recharge deliveries and to determine the infiltration rate at Wilson Lake. NSCC contracted with CH2M to conduct the study for $122,000. The study was completed under budget in February 2016 and resulted in the following key points:

Wilson Lake Recharge Capacity: 130 cfs

Infrastructure Options:

- **Option 1 – est. cost $1.1 million**
  - Overflow weir improvements
  - De-icing systems at all locations
  - High O&M cost
- **Option 2 – est. cost $2.8 million**
  - Isolate Hazelton A & B using weirs
  - De-icing systems at other locations
  - Medium O&M cost
- **Option 3 – est. cost $5.0 million**
  - New By-pass Canal using the C Canal
  - De-icing systems at other locations
  - Lowest O&M cost

Design Phase

Utilizing the results from the Feasibility Study, NSCC is moving forward with Option 2. NSCC plans to contract with CH2M to design the infrastructure improvements outlined in Option 2 of the Feasibility Report. CH2M has estimated the design cost to be $274,581. CH2M will provide 30%, 60%, 90% and final design plans. Included in the design cost CH2M will assist NSCC to obtain contractor bids, analyze the bids and make recommendations for the awarding of the contract. Bid solicitation is scheduled for August of 2016.

The resolution for the IWRB to consider is for the design phase of this project. Once construction costs can be estimated with a higher degree of certainty (90 percent design), a resolution will be presented to the IWRB for the construction cost of this project. Construction is scheduled for the fall 2016/winter 2017.

Dietrich Drop Hydro Facility Infrastructure Improvements

The Dietrich Drop Hydro Facility is located on the Milner-Gooding Canal between the MP 31 Recharge Site and the Shoshone Recharge Site. The Shoshone Recharge Site is able to recharge over 250 cfs, however, it has been limited to American Falls Reservoir District 2's (AFRD2) ability to deliver recharge water during the winter months. One limitation was a concrete flume that required rehabilitation, this project was completed in March 2016. The second limitation is the Dietrich Drop Hydro Facility. Once winter deliveries of water can be made to the Shoshone Recharge Site other opportunities exist to develop sites further down the Milner-Gooding Canal.

Feasibility Study

AFRD2 and the IWRB initiated a feasibility study in October 2015 to determine potential options for infrastructure improvements that would allow for winter managed recharge past the Dietrich Drop Hydro Facility. AFRD2 contracted with CH2M to conduct the study for $30,065.

The study evaluated potential impact to the hydro facility as a result of the canal delivering water during the winter and provided potential infrastructure improvements. AFRD2 determined that the most expedient path forward was to bypass the hydro facility. Numerous factors complicate bypassing the facility including the need to isolate both the upper and lower ends of the facility, limited BLM easements, and the volume of water to be bypassed. The feasibility study provides a high-level cost estimate of under $1.5 million for bypassing the facility.

Design/Construction Phase

AFRD2 is moving forward with the design and construction of the bypass for this facility. The schedule is to have the design complete by August of 2016 and for construction to begin in the fall of 2016.

The resolution for the IWRB to consider is for the design and construction of this project.

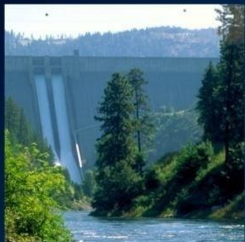
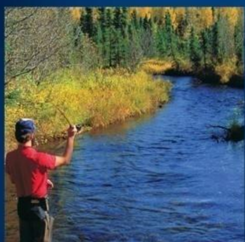
IDAHO
Water Resource Board

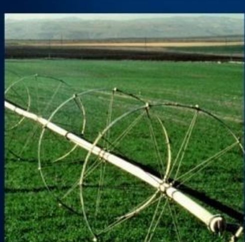
ESPA Managed Recharge Update

Idaho Water Resource Board Work Session

Wesley Hipke
March 17, 2016

IDAHO Water Resource Board



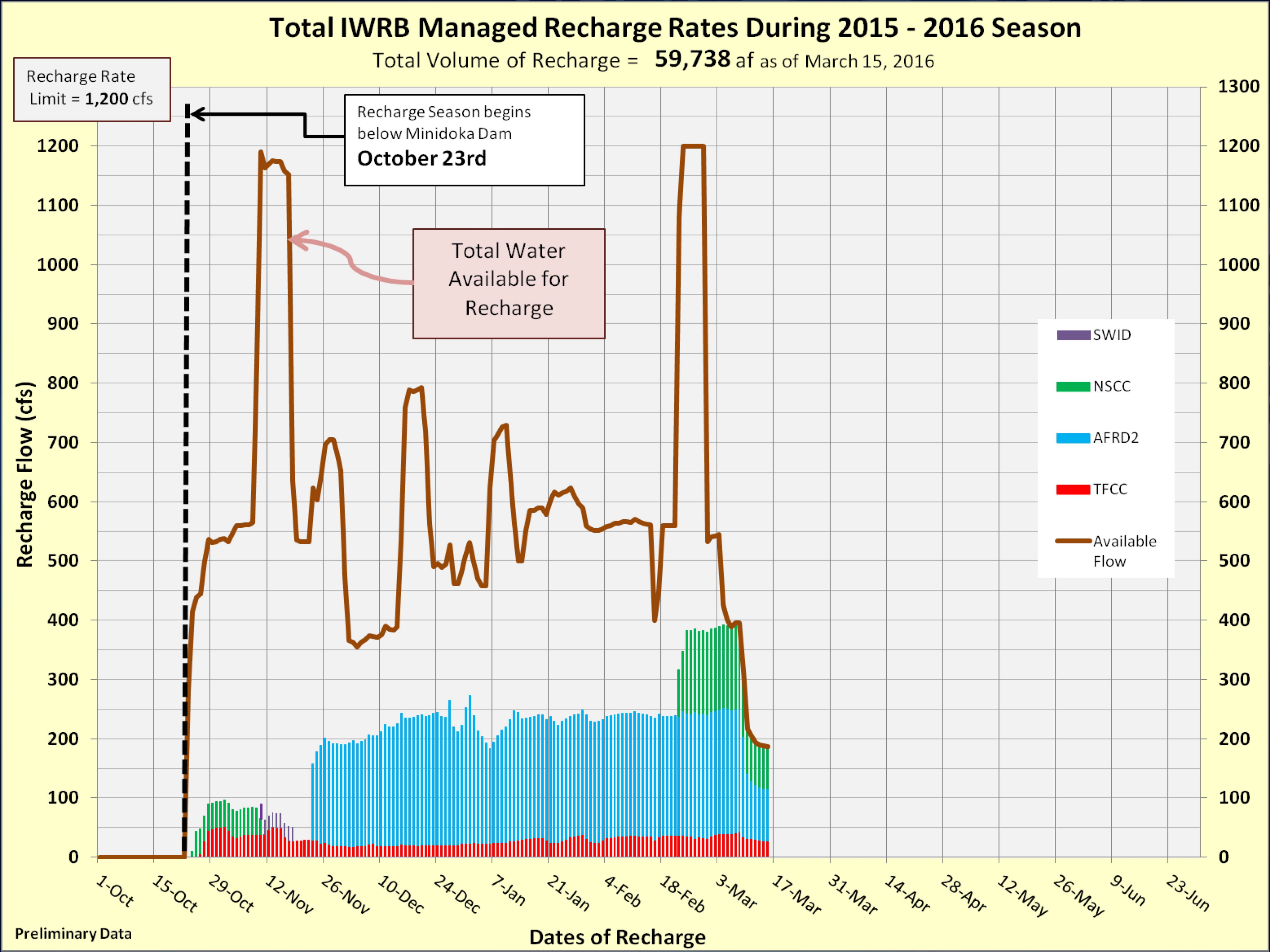
IWRB ESPA Managed Recharge – Lower Valley

- **Recharge Summary**
  - Recharge Right in Priority: Oct 23rd – present
  - IWRB Recharge Rate (Mar 15th) = 188 cfs
  - Total Recharged (as of Mar 15th) = 59,738 af *

*Preliminary Data


North Side Canal


MP 31 Recharge Site



Total IWRB Managed Recharge Rates During 2015 - 2016 Season
Total Volume of Recharge = 59,738 af as of March 15, 2016
Recharge Rate Limit = 1,200 cfs
Recharge Season begins below Minidoka Dam
October 23rd
Total Water Available for Recharge
SWID
NSCC
AFRD2
TFCC
Available Flow
Recharge Flow (cfs)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1-Oct
15-Oct
29-Oct
12-Nov
26-Nov
10-Dec
24-Dec
7-Jan
21-Jan
4-Feb
18-Feb
3-Mar
17-Mar
31-Mar
14-Apr
28-Apr
12-May
26-May
9-Jun
23-Jun
Dates of Recharge
Preliminary Data

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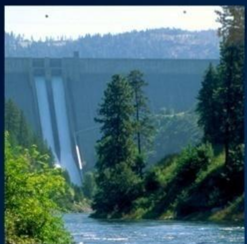
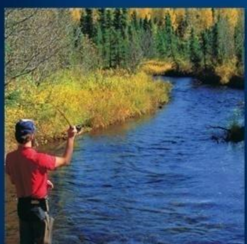
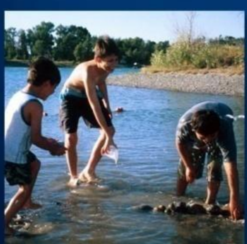
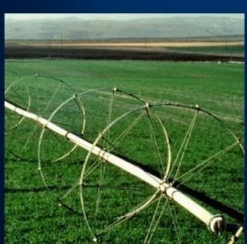
Water Resource Board







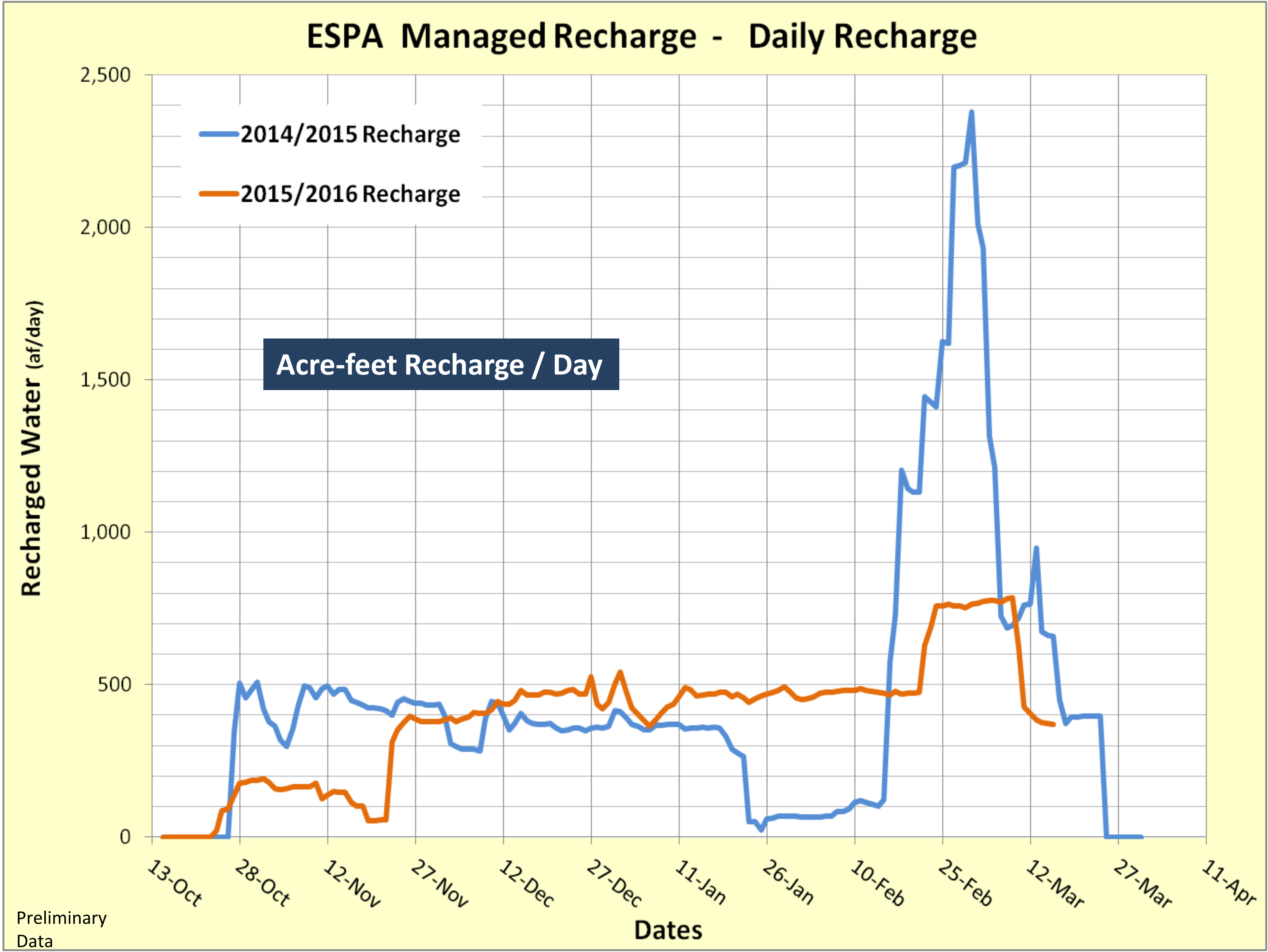


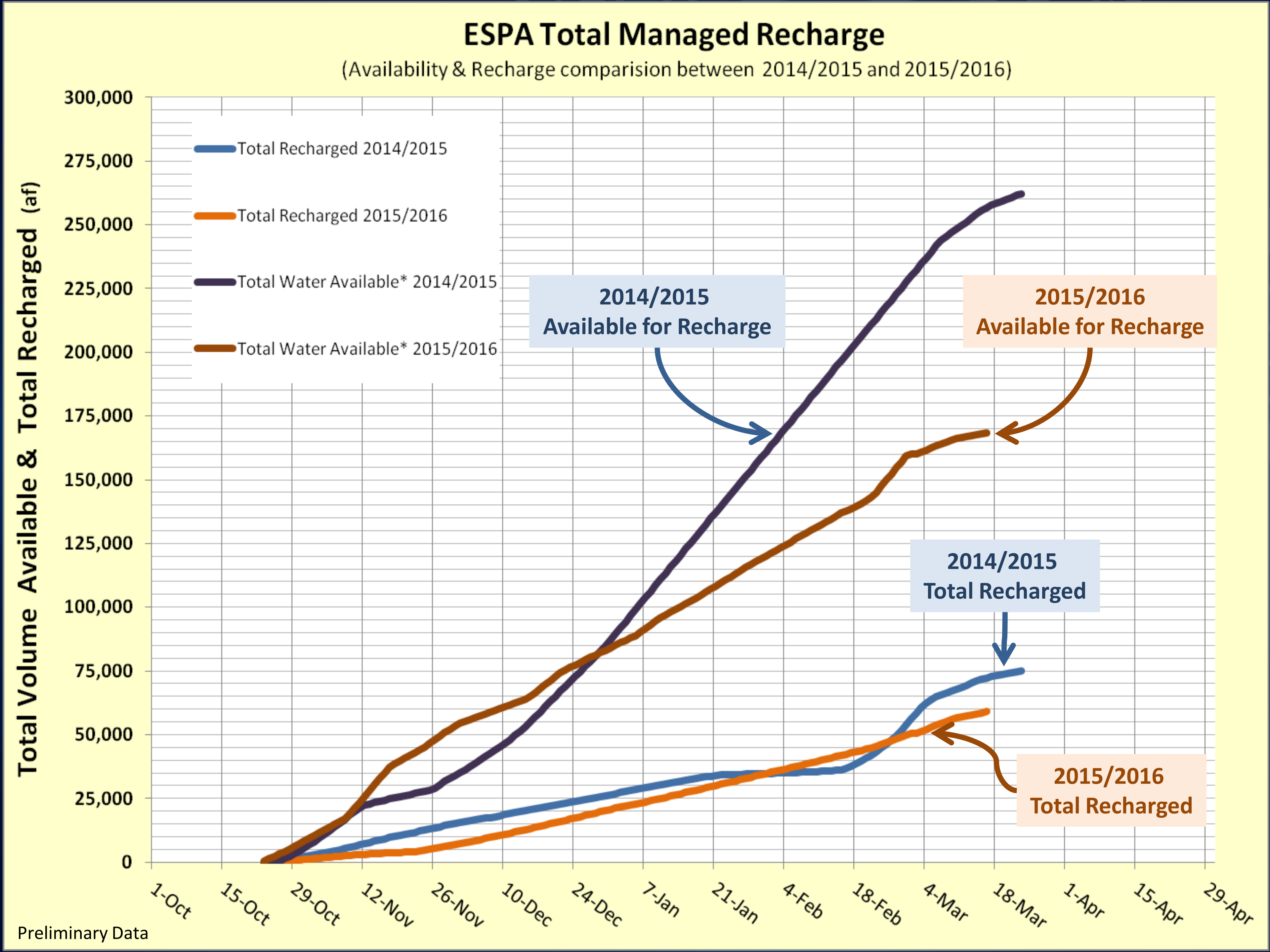
ESPA Managed Recharge Summary

Oct. 23rd, 2015 – Mar. 15th, 2016

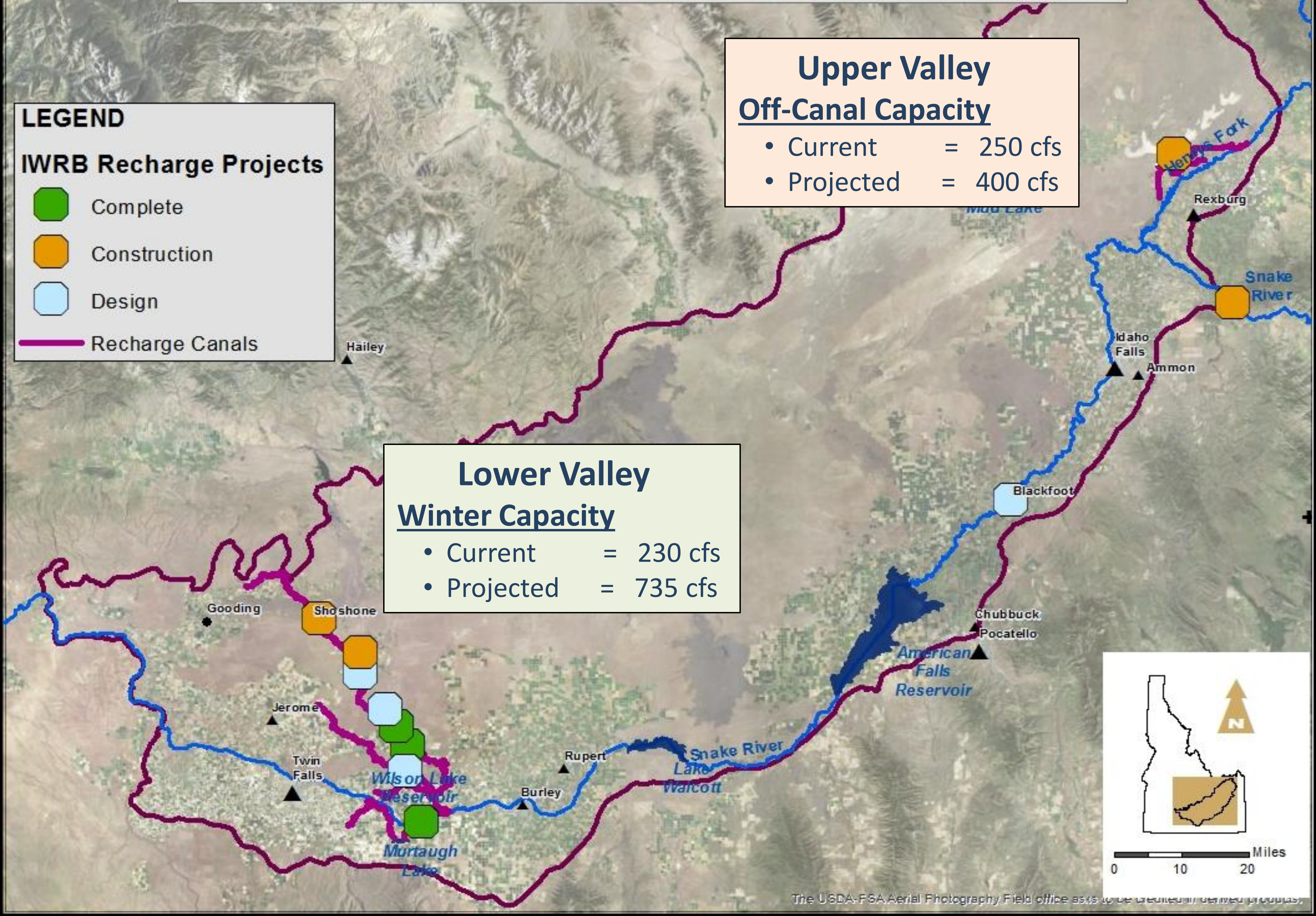
ESPA Area	Canal System	5-Year Retention Time (%)	Mean Recharge Rate (cfs)	Days Recharged	Volume Recharged (Acre-feet)
Lower Valley	American Falls Reservoir District No. 2 (Milner-Gooding Canal)	~36	195	114	44,081
	North Side Canal Company	~37	84	41	6,830
	Southwest Irrigation District	~54	25	9	446
	Twin Falls Canal Company	~45	30	142	8,381
				TOTAL	**59,738**

*Preliminary Data


ESPA Managed Recharge - Daily Recharge
2014/2015 Recharge
2015/2016 Recharge
Acre-feet Recharge / Day
Recharged Water (af/day)
2,500
2,000
1,500
1,000
500
0
13-Oct
28-Oct
12-Nov
27-Nov
12-Dec
27-Dec
11-Jan
26-Jan
10-Feb
25-Feb
12-Mar
27-Mar
11-Apr
Dates
Preliminary Data


ESPA Total Managed Recharge
(Availability & Recharge comparision between 2014/2015 and 2015/2016)
Total Volume Available & Total Recharged (af)
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
1-Oct
15-Oct
29-Oct
12-Nov
26-Nov
10-Dec
24-Dec
7-Jan
21-Jan
4-Feb
18-Feb
4-Mar
18-Mar
1-Apr
15-Apr
29-Apr
Total Recharged 2014/2015
Total Recharged 2015/2016
Total Water Available* 2014/2015
Total Water Available* 2015/2016
2014/2015 Available for Recharge
2015/2016 Available for Recharge
2014/2015 Total Recharged
2015/2016 Total Recharged
Preliminary Data

Current IWRB Recharge Project 2015/2016



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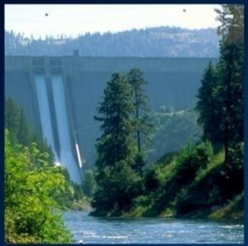
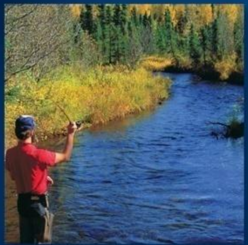
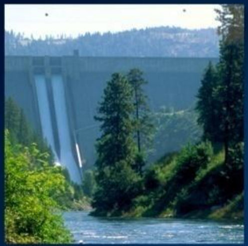
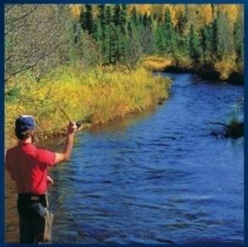



ESPA Managed Recharge Expansion Projects

Lower Valley – Winter Time Recharge

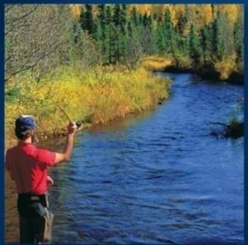
AFRD2 – Milner Gooding Canal	**+550 cfs**
• Milner-MP31 Road Improvement	Complete
• MP28 Hydro Bypass Structure	Complete
• Concrete Flume	Construction
• MP31-Shoshone Road Improvement	Construction
• MP31 Expansion	Design
• Dietrich Drop Hydro Bypass	Design

ESPA Managed Recharge Expansion Projects

Lower Valley – Winter Time Recharge

TFCC – Twin Falls Canal	**+30 cfs**
• Various Canal Improvements	Complete
NSCC – North Side Canal	**+130 cfs**
• Hazelton A Hydro Bypass	Design
• Hazelton B Hydro Bypass	Design
• De-icing Systems	Design

ESPA Managed Recharge Expansion Projects

Upper Valley – Infrastructure Improvements

Egin Bench Canal — **+150 cfs**

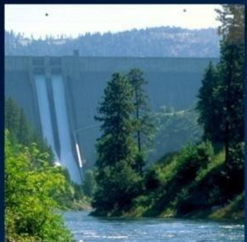
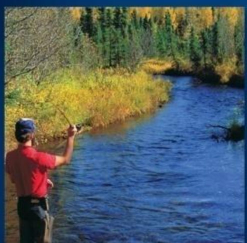
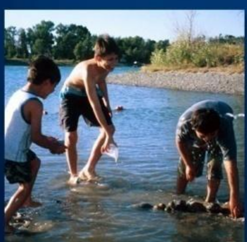
- New Recharge Canal — Construction

Great Feeder Canal — **Facilitate Recharge**

- Replacement of Headgates — Construction

City of Blackfoot — **Facilitate Recharge**

- Jensen Grove Improvements — Design

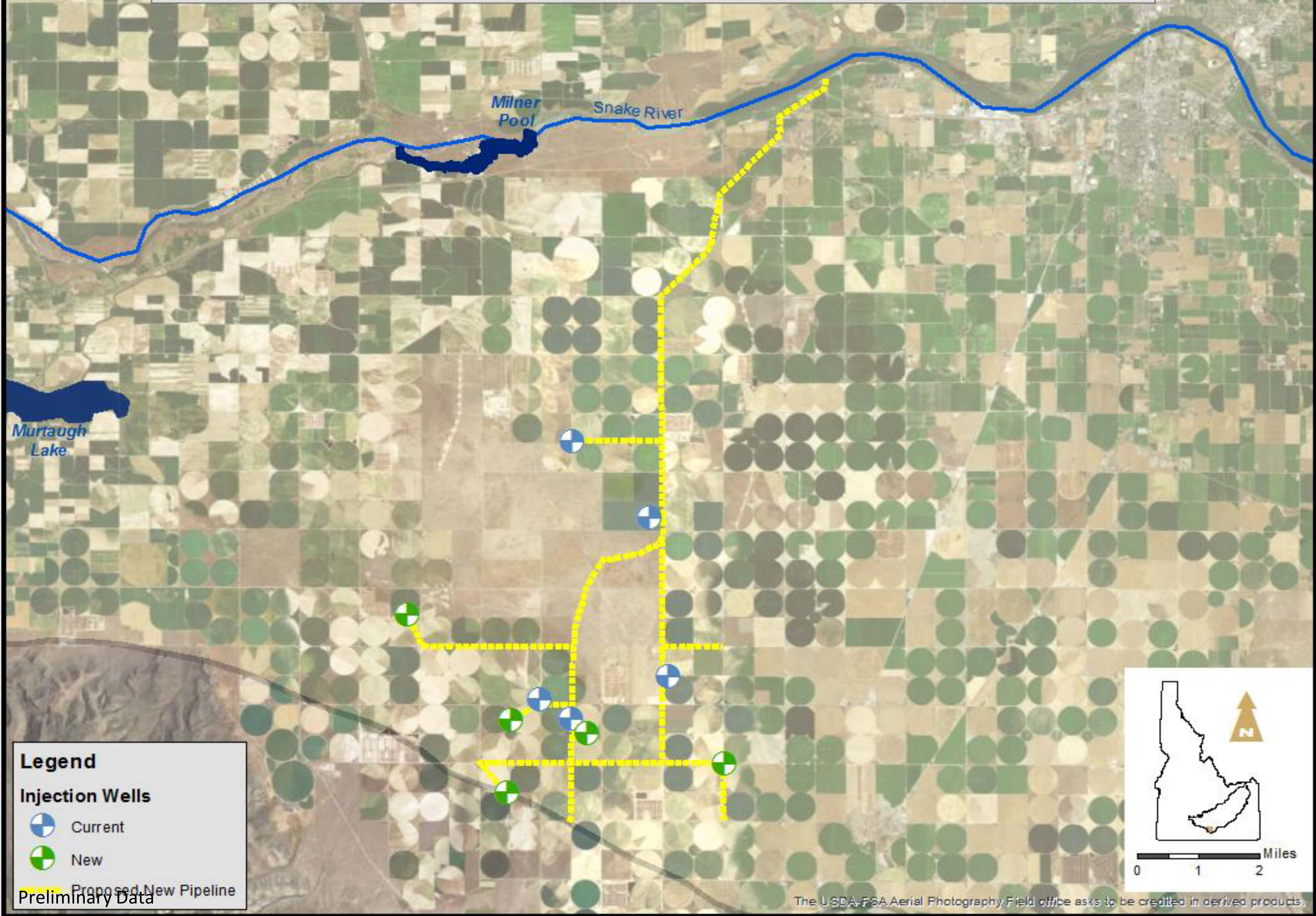

IWRB's - ESPA Managed Recharge Goal

ESPA Manage Recharge Goal:

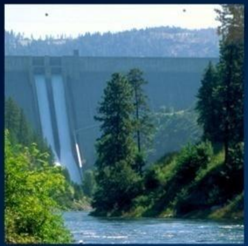
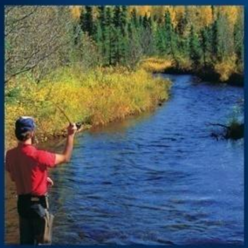
250,000 af - avg. annually

- Phase I projects completing 2016/2017
- Developing Phase II projects with Canal Partners
- Need more Projects to reach our Goal.


Southwest Irrigation District Pipeline Project



Preliminary Data

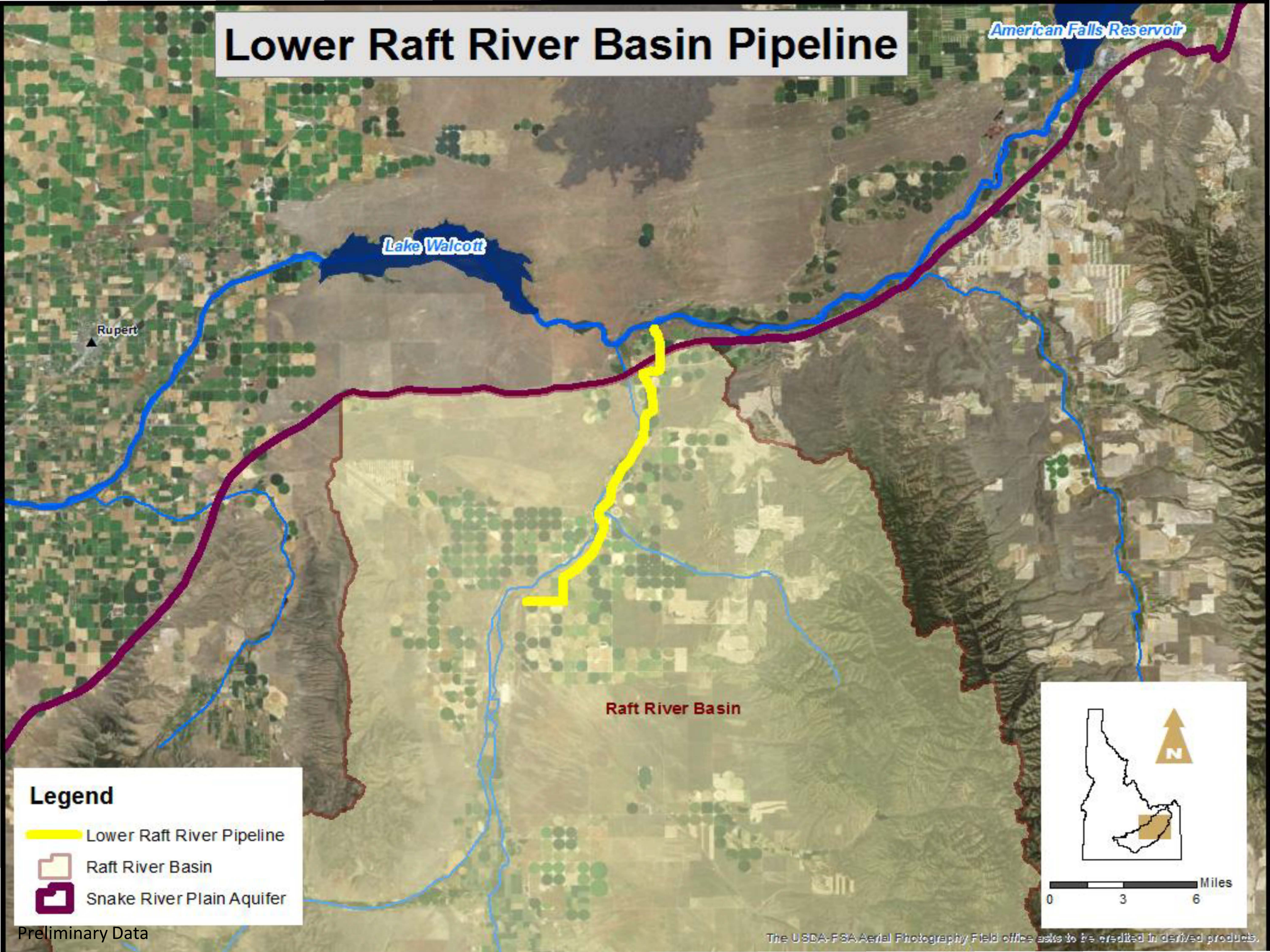



ESPA Managed Recharge Potential Project

Southwest Irrigation Pipeline Project:

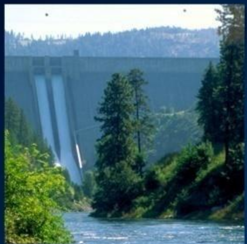
- **Background:**
  - 130,000 acres of agricultural land
  - Groundwater levels declining
- **Goals**
  - Convey Snake River water to replace groundwater supply
  - Conduct managed recharge in the non-irrigation season
- **Feasibility Study**
  - Capacity of system = 30,000 af/year
  - Recharge capacity = 84.7 cfs
  - Estimated Total cost = $13 million
    - Estimated Recharge cost = $525,000
  - Potential Construction = Fall 2016

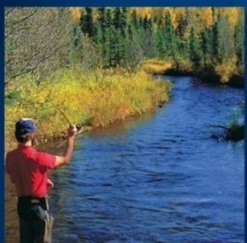
Lower Raft River Basin Pipeline

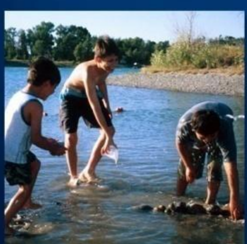


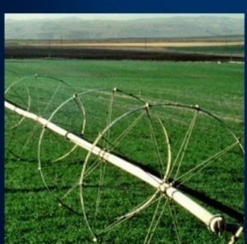
Preliminary Data

IDAHO
Water Resource Board







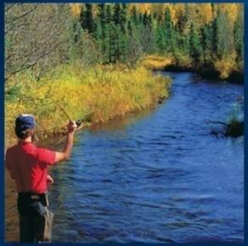


ESPA Managed Recharge Potential Project

Lower Raft River Pipeline Project:

- **Background:**
  - 70,000 acres of agricultural land
  - Groundwater levels declining
- **Goals**
  - Convey Snake River water to replace groundwater supply
  - Conduct managed recharge in the non-irrigation season
- **Feasibility Study**
  - Capacity of system = 25,300 af/year
  - Recharge capacity = 60 to 70 cfs (~19,700 af/yr)
  - Estimated cost = $18.78 million
  - Potential Construction = Fall 2017

IDAHO
Water Resource Board

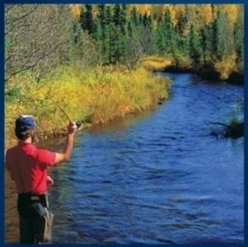



Draft Resolution - ESPA Project

<u>NSCC Main Canal Infrastructure Improvements:</u>

Winter Recharge to Wilson Lake

- **Feasibility Study – CH2M** **COMPLETE**
  - Completed Feb. 2016 - **$110,000** est.
  - 3 options for Winter Recharge to Wilson Lake
  - Alternative #2 chosen - estimated cost - **$2.8 million** (Bypass hydro plants and de-icing systems)
- **Design of Alternative #2 – CH2M**
  - Estimated cost for design - **$274,581**
  - Scheduled completion of design - **August 2016**
- **Construction**
  - Cost - **TBD** after Final Design (July/August)
  - Construction Scheduled - **Fall 2016/Winter 2017**

Draft Resolution - ESPA Project

<u>AFRD2 Milner-Gooding Canal Improvements:</u>

Dietrich Drop Hydro Plant Bypass

- **Feasibility Study – CH2M** **COMPLETE**
  - Completed Feb. 2016 - **$30,065**
  - Several options with cost est.
- **Design / Construction – est. $1,500,00**
  - Design - Completion - **August 2016**
  - Construction Scheduled – **Fall / Winter 2016**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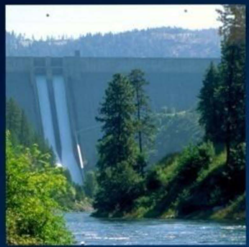
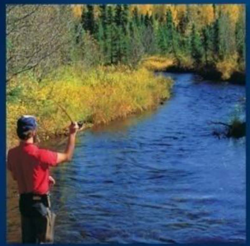




Questions

Mile Post 31 Recharge Site on January 15th, 2016.

MEMO

State of Idaho
Department of Water Resources
322 E Front Street, P.O. Box 83720, Boise, Idaho 83720-0098
Phone: (208) 287-4800 Fax: (208) 287-6700

Date: March 8, 2016

To: Idaho Water Resource Board

From: Sean Vincent SV

Subject: Update on Wood River Valley aquifer model

Action: None at this time

With funding from the Idaho Water Resource Board, IDWR and the U.S. Geological Survey (USGS) are nearing completion of a public domain model of the Wood River Valley aquifer system. The model has been designed with input from stakeholders to facilitate conjunctive administration and water resource planning efforts in the Wood River Valley. The final report is currently in review by the USGS. The anticipated timeframe for report publication and model release is April 2016.

The transient model was calibrated by IDWR staff using PEST, a state-of-the-art tool for model calibration and uncertainty analysis. The calibration period spans an 11-year period from January 2000 through December 2010. The model builds upon water budget and hydrogeologic characterization work that was performed by the USGS and funded, in part, by communities and other cooperator groups in the Wood River Valley. The nine cooperators (Blaine County, City of Hailey, City of Ketchum, The Nature Conservancy, City of Sun Valley, Sun Valley Water and Sewer District, Blaine Soil Conservation District, City of Bellevue, and Citizens for Smart Growth) contributed a total of $313K to the pre-modeling work effort. The USGS matched the local cooperators on a dollar-for-dollar basis.

Using the ESPA modeling effort as a template, staff recommends that data collection efforts in the Wood River Valley be continued and expanded in order to facilitate future model enhancements. Working with the Modeling Technical Advisory Committee, the USGS/IDWR modeling team identified several data deficiencies and developed recommendations for additional work. The recommended work includes processing METRIC data for 2012 to facilitate extending the model calibration period through the end of 2013; developing ancillary modeling tools to facilitate water rights administration; and miscellaneous tasks for the USGS including installing a new telemetered stream gage on Trail Creek, conducting a seepage survey during spring runoff, installing six wire weight gages along the Big Wood River, ongoing participation on the Modeling Technical Advisory Committee, conducting a model training session at the USGS Water Science Center, and leading a field trip for the Water Resource Board. The preliminary cost estimate for the non-IDWR work elements is $200K, which includes two years of O&M for the stream gages.

Groundwater Model Development for the Wood River Valley

Presented to the Idaho Water Resource Board by Sean Vincent
March 17, 2016

IDWR

Talking Points

- Project timeline
- Modeling objectives
- Model description
- Example scenario
- Future work

Project timeline

- Kickoff meeting – March 2013
- First bimonthly MTAC meeting – April 2013
- Initial model construction – April 2014
- Final calibration – January 2016
- Model rollout/USGS Scientific Investigation Report – early May 2016

Objectives (1-31-2014)

- Facilitate conjunctive management and conjunctive administration
- Quantify aquifer recharge and discharge
- Guide future investigations
- Tool for planning (50-year horizon)

Objectives (cont'd)

- Defensible in litigation
  - Widely accepted, public domain code
  - Collaborative, open model development process → MTAC
  - State-of-the-art calibration tool
- Accessible and well-documented
  - Public domain model
  - Documentation
    - Design documents
    - USGS Scientific Investigations Report
  - Project webpage

Wood River Valley Groundwater Flow Model Project

General Information | MTAC | Design Documents | References

Modeling Technical Advisory Committee (MTAC)

Meetings, Materials, and Presentations

Thursday, December 3, 2015
10 a.m. – 2:00 p.m.

IDWR/USGS – Modeling Technical Advisory Committee (MTAC) Meeting
Community Campus (former High School)
Bullion Room
1050 Fox Acres Road
Hailey, Idaho 83333
Map of Community Campus

- Agenda
- Example scenario, Wood River Valley Groundwater Flow Model
- Preliminary water budget from December calibration run
- December Calibration Run
- Example Predictive Uncertainty Analysis
- Current monitoring plan going forward

Thursday, October 1, 2015
10 a.m. – 2:00 p.m.

IDWR/USGS – Modeling Technical Advisory Committee (MTAC) Meeting
Wood River Inn
603 N. Main Street
Hailey, Idaho 83333

- Agenda
- Water Budget from October Calibration Run

Related Links:

- » USGS Idaho Water Science Center
- Groundwater Resources of the Wood River Valley, Idaho: A Groundwater-Flow Model for Resource Management

Contact Information

Sean Vincent
Idaho Department of Water Resources
322 East Front Street
P.O. Box 83720
Boise, Idaho 83720-0098

Phone: (208) 287-4853

sean.vincent@idwr.idaho.gov

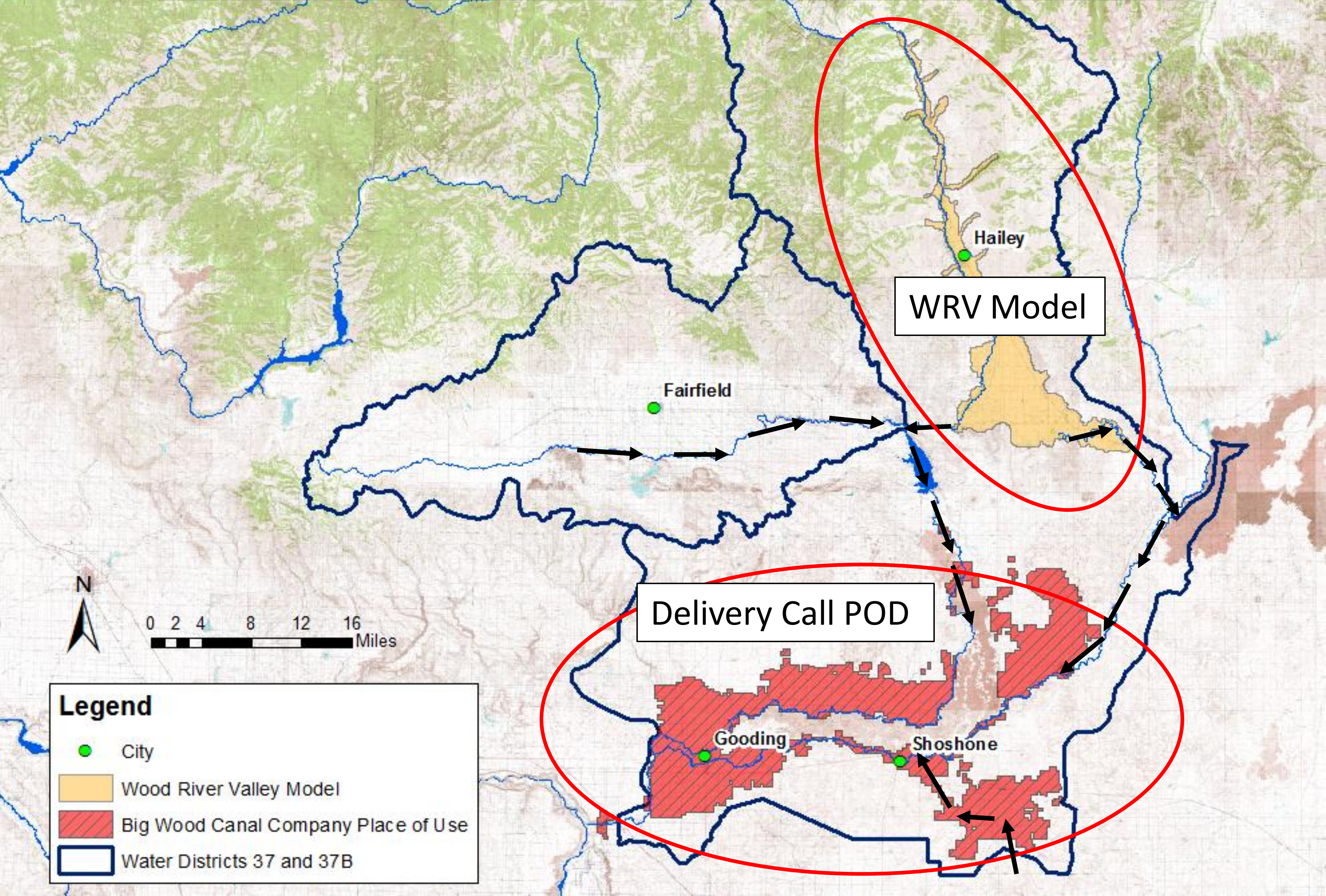
Presentation from March 19th 2013 Project kick-off meeting

Public Meeting:

Wood River Valley Aquifer
Model Project Update
By Jim Bartolino, USGS; Sean Vincent, IDWR
Wednesday, January 29, 7:00 - 8:00 p.m.

Wood River High School
Distance Learning Lab
1250 Fox Acres Road
Hailey, ID 83333

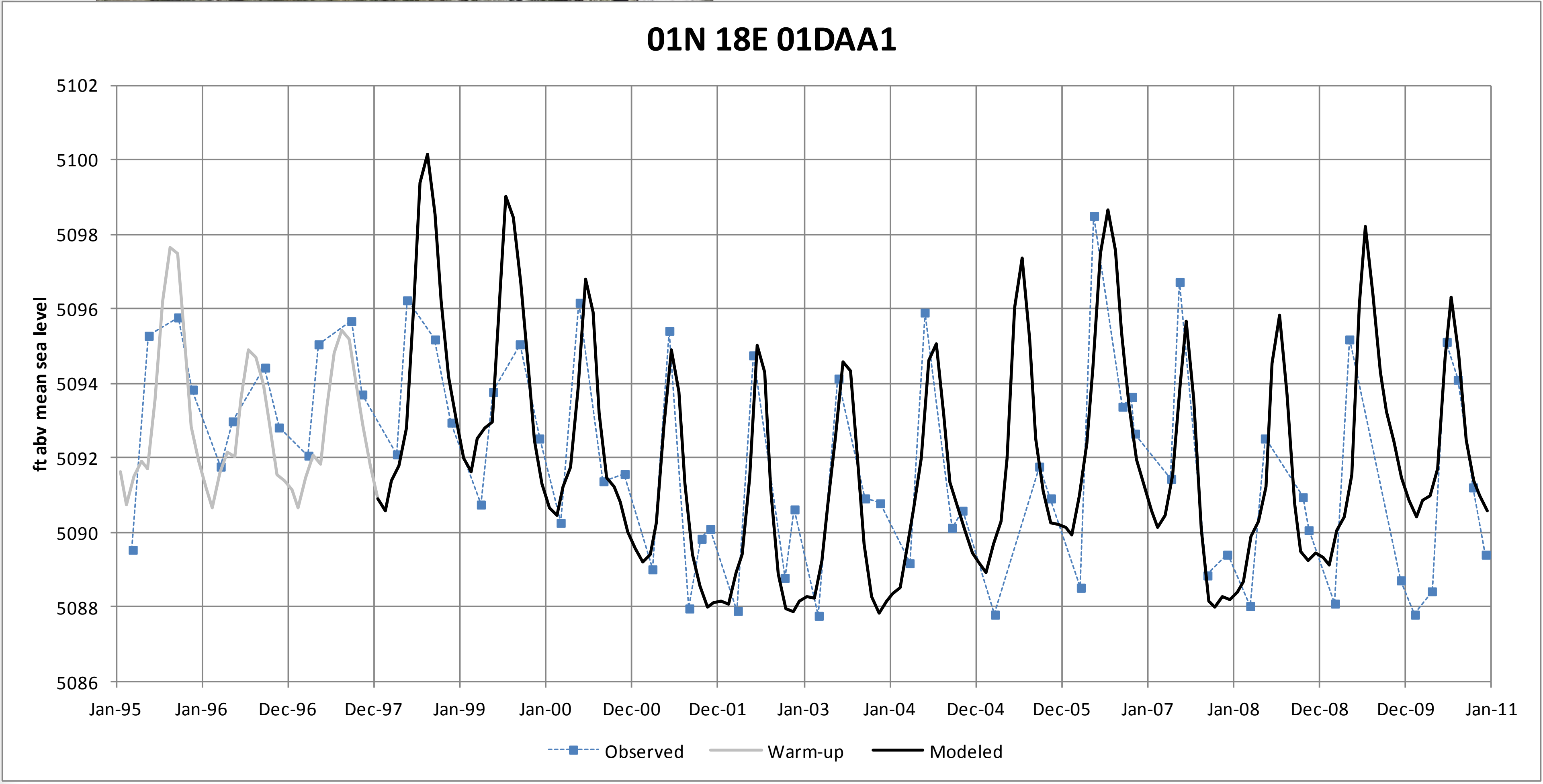
Location of WRV Model in Relation to Delivery Call POD



Model Description

- MODFLOW USG w/ preprocessor written in R
  - Model domain
    - 3 layers
    - Uniform rectangular grid - 100m x 100m cells
    - 542 rows x 299 columns
    - 54,922 active cells
  - Boundaries
    - Drains for groundwater outflows beneath Silver Creek and Stanton Crossing
    - River package for Big Wood River, Willow Cr, and Silver Cr
    - Specified flow boundaries for underflow from 22 tributary basins
  - Calibration
    - 13-yr calibration period (Jan 1998 – Dec 2010) + 3 yr warm-up
    - 1-month stress periods
    - Weekly time steps
    - Many wells w/ only a few water levels

Surveyed Observation Wells



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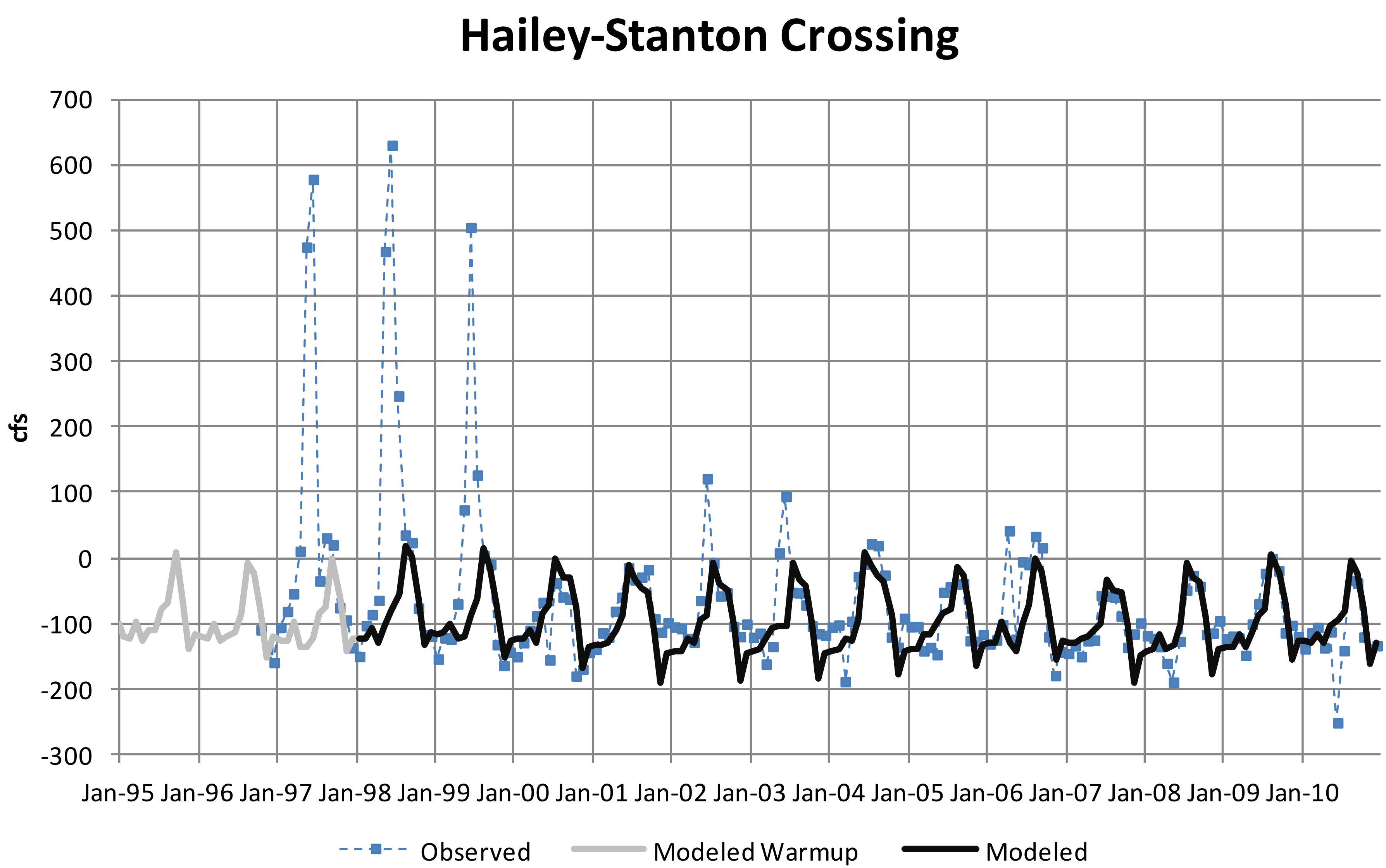


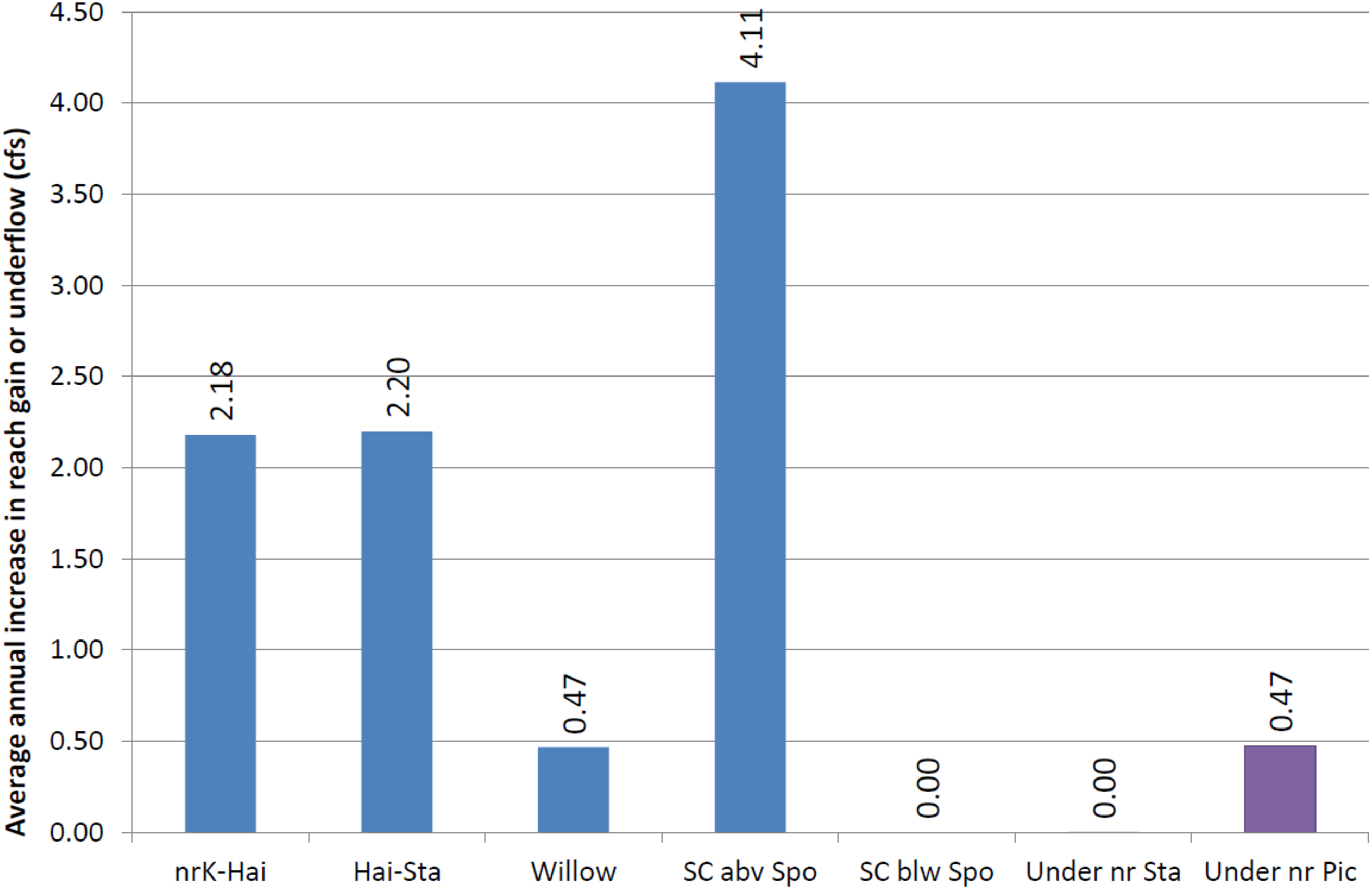
Example Scenario

- 20% reduction in groundwater consumptive use (GWCU) for irrigation
  - Preliminary version of the model
  - Not an anticipated administrative action
  - Scenario chosen by the MTAC
  - Steady state analysis using average GWCU from 1995-2010
  - Simple example of how model can be used to predict the magnitude and location of hydrologic impacts

Example Scenario (cont'd)

- Baseline condition
  - Avg. GWCU is 34,036 AF/yr or 47.0 cfs
  - On avg., 65% of GWCU occurs in agricultural areas and 54% of GWCU occurs in July and August
- Results
  - GWCU reduction = 0.2 *47.0 cfs = 9.4 cfs (magnitude)
  - ~ equal flow increase to both drainages (location)

Magnitude of and location of impacts



Future work

- Already committed to:
  - Development of ancillary tools
  - Semi-annual meetings of MTAC
  - Uncertainty analysis
  - More scenarios

- Optional 1-time activities:
  - WRV model training for consultants
  - Field trip to WRV for IWRB

- Potential additional work for model enhancement
  - Data collection
    - Seepage survey during runoff
    - Trail Creek gage
    - Chemical hydrograph separation
    - Wire-weight gages
    - 2012 METRIC ET data processing
  - Extend model calibration through 2013 (version 2.0)

Summary

- Final Report for initial model of WRV aquifer system in review
- Model will be used to support conjunctive management/administration and planning
- Anticipated model rollout in early May
- Inclusion of post-2010 time-series data would significantly improve transient calibration

Wood River Valley Groundwater Model Project Webpage

http://www.idwr.idaho.gov/WaterInformation/Projects/woodriver/

MEMO

State of Idaho
Department of Water Resources
322 E Front Street, P.O. Box 83720, Boise, Idaho 83720-0098
Phone: (208) 287-4800 Fax: (208) 287-6700

Date: March 8, 2016

To: Idaho Water Resource Board

From: Sean Vincent SV

Subject: Update on model development for the Treasure Valley

Action: None at this time

In 2010, the Department commissioned Dr. Donna Cosgrove to conduct a review of groundwater flow models that could be used to support the Comprehensive Aquifer Management Plan for the Treasure Valley. Dr. Cosgrove's primary recommendation was to update the steady state Treasure Valley Hydrologic Project (TVHP) model by expanding the model domain and performing a transient calibration. At approximately the same time, the U.S. Bureau of Reclamation (USBR) and the University of Idaho (UI) began working on a transient calibration of the TVHP model for a study of the economic impacts of water allocation. To conserve resources, Department staff were directed to work with the USBR's lead modeler to expand the model domain, which was completed in 2011, and to use the research-level, transient version of the TVHP model as a starting point for model enhancement. However, work on the Treasure Valley CAMP was put on hold in 2012, approximately a year before completion of the USBR/UI transient model. While waiting for the USBR/UI model update, Department modeling staff were reassigned to work on other priorities including providing support to the Managed Recharge Program and developing a model of the Wood River Valley aquifer system.

Very recently there has been renewed interest in model development to support water resource management in the Treasure Valley. In response, I've directed staff to conduct a detailed review of the USBR/UI transient model. The review is underway and it will include an assessment of the calibration and an identification of data gaps. A proposed plan of action will be developed upon completion of the review. To provide for stakeholder input, the plan will be developed in consultation with a Modeling Technical Advisory Committee. I will provide an update on the model review and progress toward plan development at the May Board meeting.

Groundwater Model Development for the Treasure Valley

Presented to the Idaho Water Resource Board by Sean Vincent
March 17, 2016

Talking Points

- Background
- Recent development
- Expectations
- Next steps

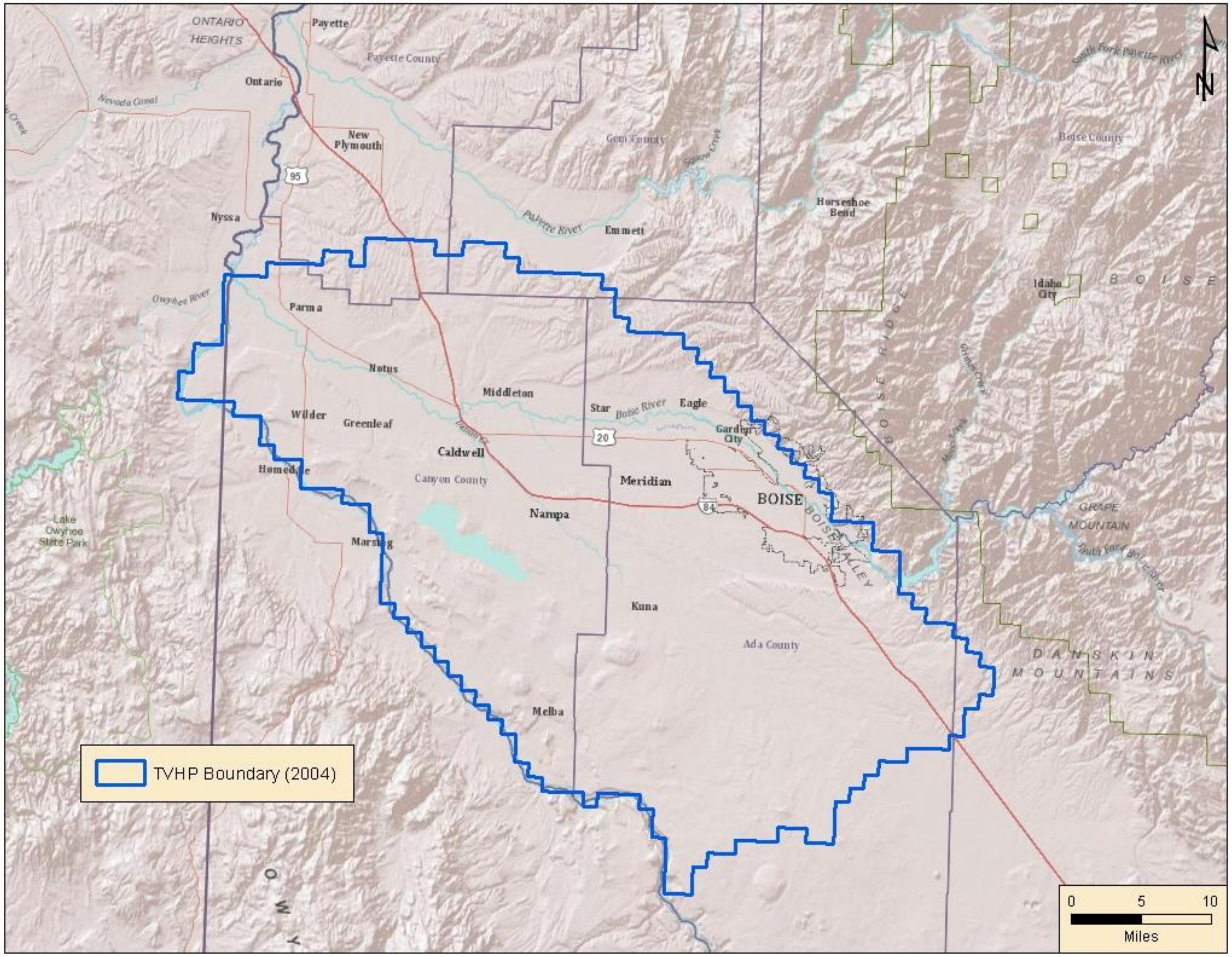
Background

- Treasure Valley Hydrologic Project (TVHP) 1996-2004
  - Hydrogeologic characterization work (geologic mapping, geophysics, monitor well installation, water level monitoring, water chemistry and age dating)
  - Water budgets for 1996 and 2000 (Urban, 2004)
  - Steady-state TVHP aquifer model (Petrich, 2004)
- North and East Ada County Hydrogeologic Investigations 2008-2012
  - Hydrogeologic characterization work in areas of proposed development
  - Water budgets
- Cosgrove review of seven models in 2010 for the TV CAMP
  - Recommended using TVHP model and making modifications
    - Extend model boundaries to include areas of proposed development
    - Attempt transient calibration
- At same time, USBR & U of I working on pseudo-transient version of TVHP model for research project
  - Monthly water budget for average single year (avg. for period 1967-1997)

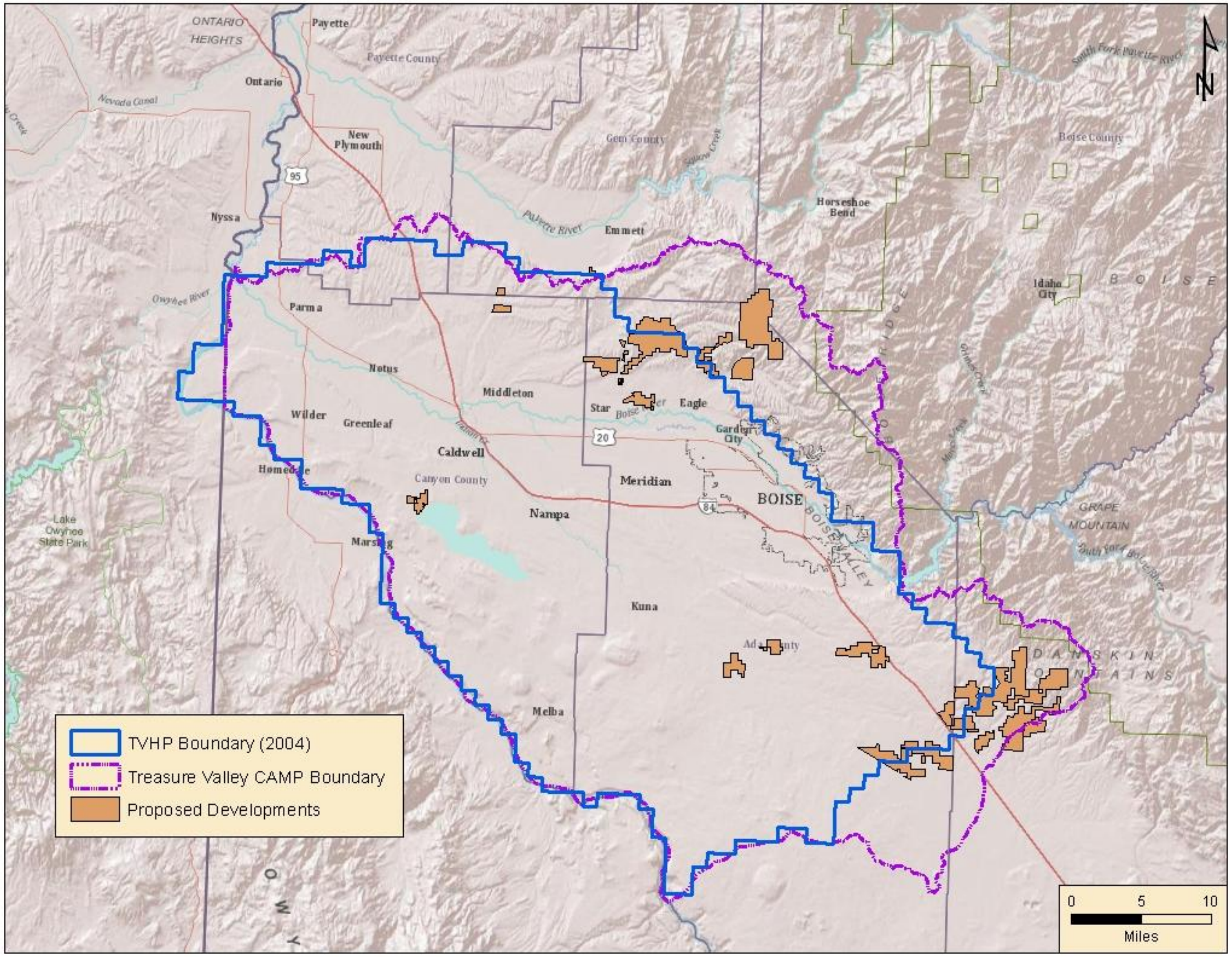
Background (cont'd)

- In 2011, modeling staff worked with USBR to expand model domain and develop water budget for expansion areas. Staff then directed to wait for completion of USBR version of TVHP model.
- Established Modeling TAC in 2012
- Proposed TV CAMP report also published in 2012
- Modeling staff assigned to work on other priorities
  - ESPAM 2.1 Final Report - January , 2013
  - WRV aquifer model kickoff meeting on March 19, 2013
  - Managed Recharge Program for ESPA
- USBR published report for pseudo-transient version of TVHP model - July, 2013

Extend TVHP Model Boundary



Extend TVHP Model Boundary



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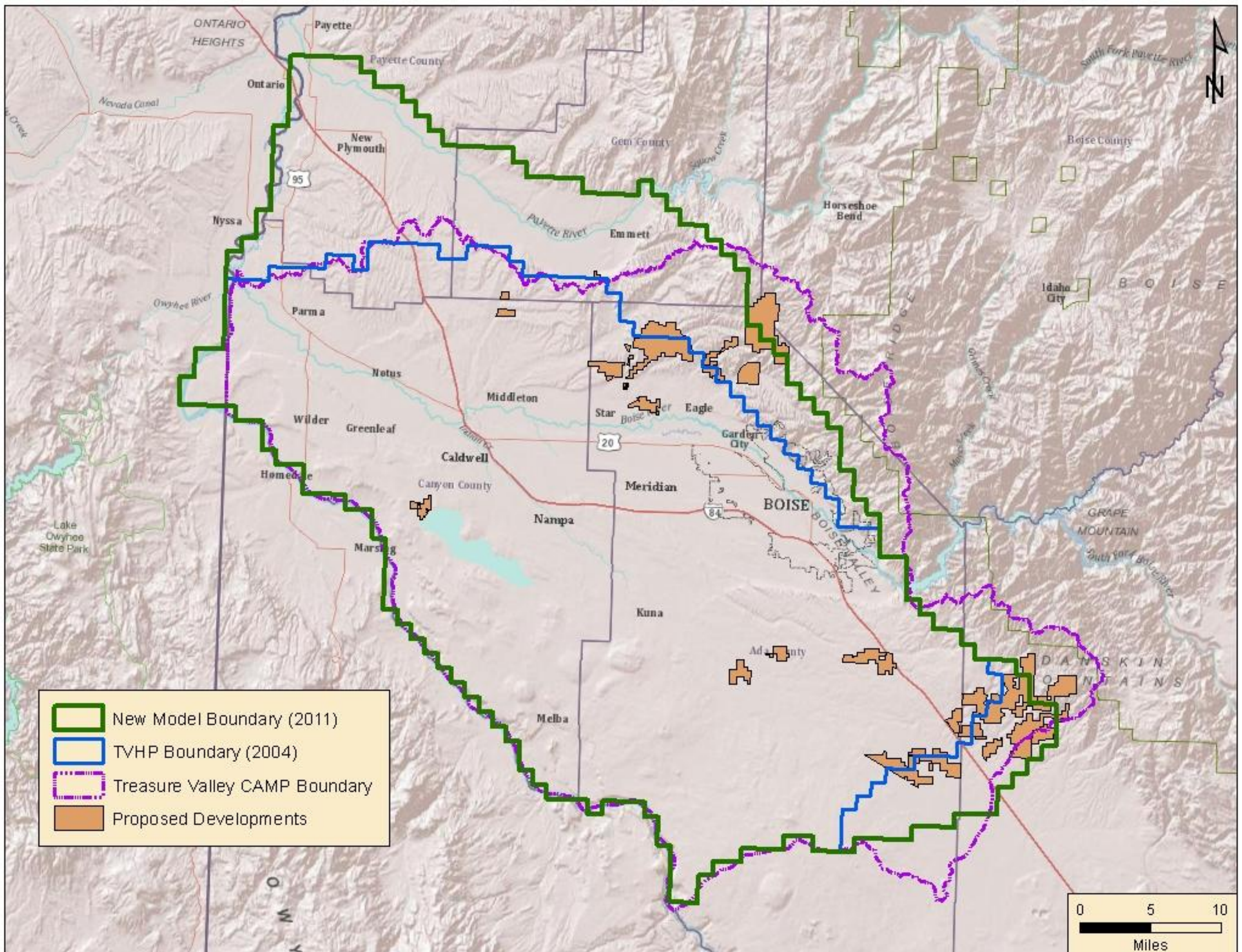
Water Resource Board

Extend TVHP Model Boundary



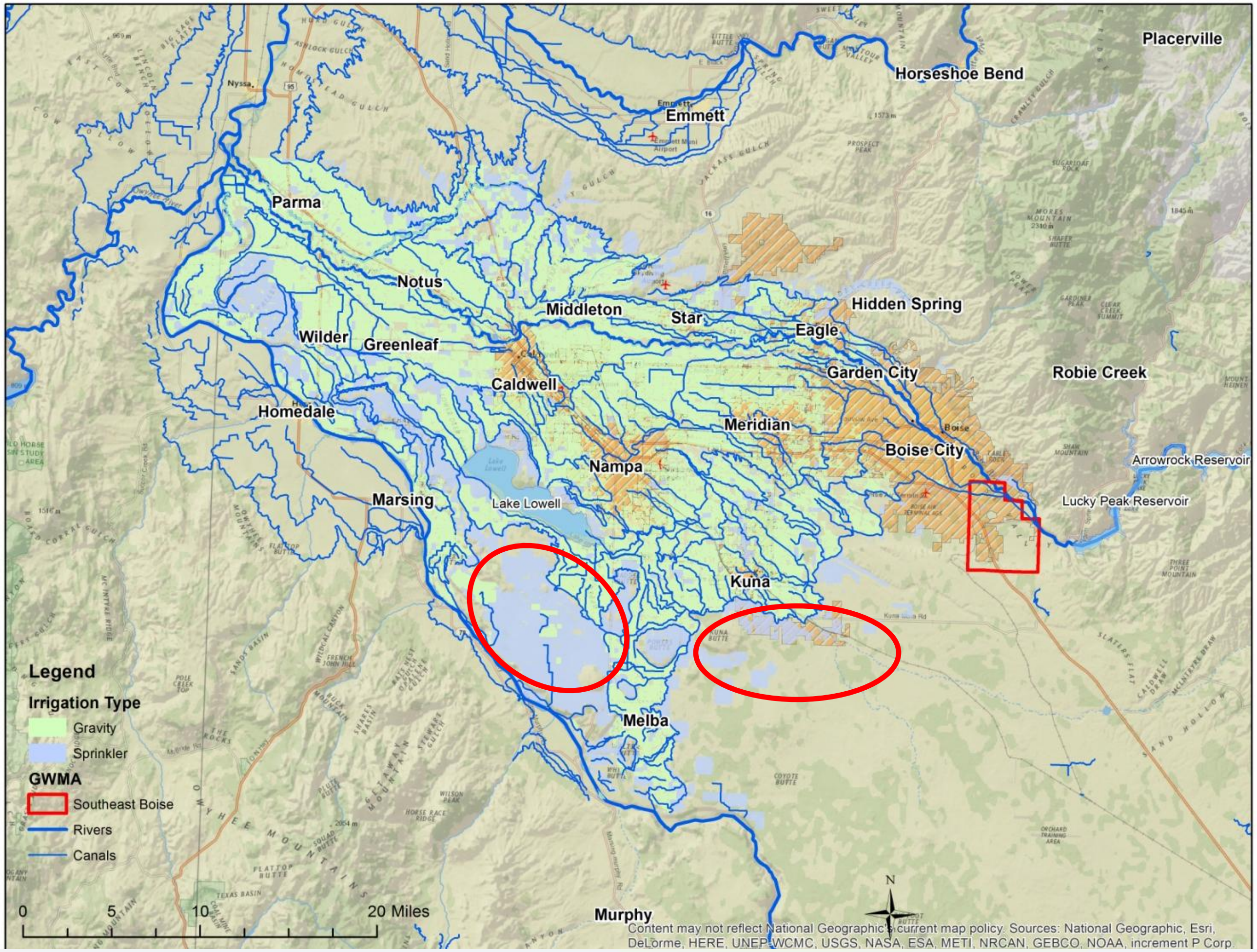
Recent development – SCR #137

"A CONCURRENT RESOLUTION STATING FINDINGS OF THE LEGISLATURE AND REQUESTING THAT THE IDAHO WATER RESOURCE BOARD ADDRESS STATEWIDE AQUIFER STALILIZATION AND SUSTAINABILITY STUDIES…"

"BE IT FURTHER RESOLVED that the Idaho Water Resource Board conduct aquifer recharge studies and develop a ground water model, with all necessary measurement networks, for the Treasure Valley Aquifer." (emphasis added)

Point of Clarification

- We have an effective incidental recharge system

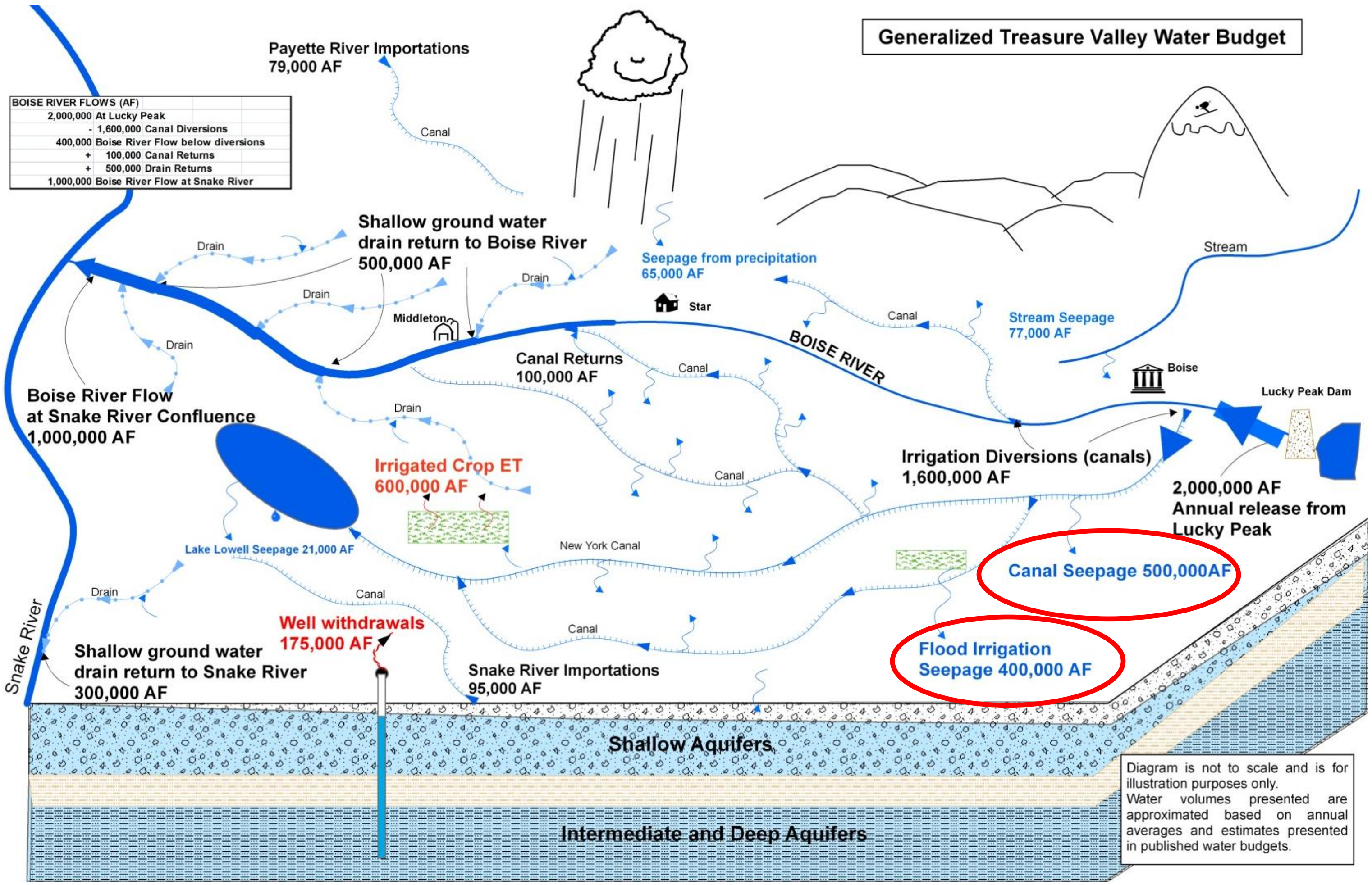


Aquifer Recharge

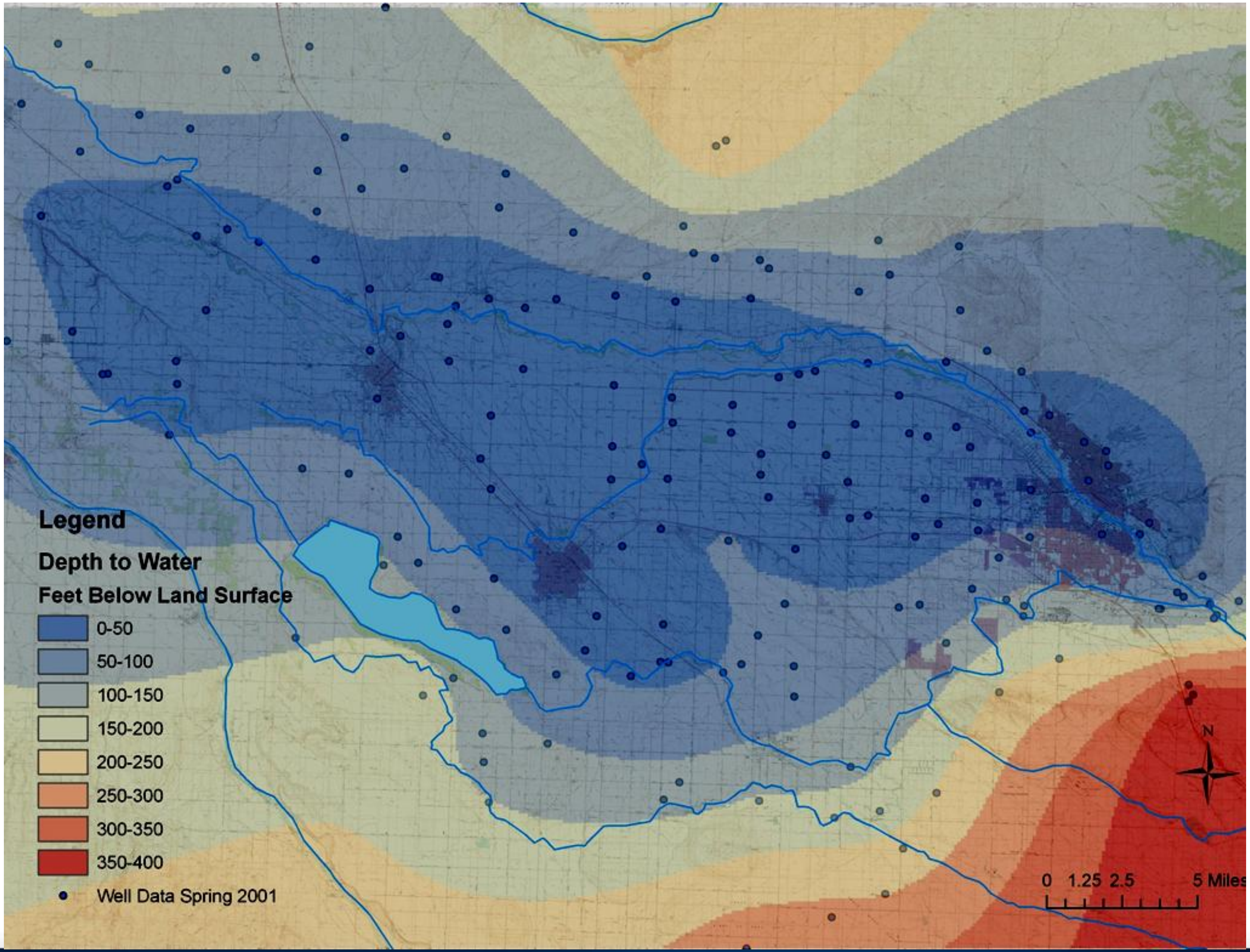
- From TVHP Executive Summary (Petrich, 2004):
  - *"The largest component of recharge to shallow aquifers is seepage from the canal system and infiltration associated with irrigated agriculture"*

    "Shallow aquifer levels increased by as much as 100 feet in some areas in response to the initiation of large-scale flood irrigation in the late 1800s and early 1900s. Shallow ground water levels rose to and have remained at (or near) ground surface in many areas (at least seasonally), discharging to drains and other surface channels."
- Flood irrigation seepage + canal seepage ~ 900 KAF in 2000 (Urban, 2004)

Water Budget



Depth to Water



Point of Clarification

- We also have a model of the Treasure Valley Aquifer system

SIMULATION OF GROUND WATER FLOW IN THE LOWER BOISE RIVER BASIN

Prepared by

Christian R. Petrich

Idaho Water Resources Research Institute
University of Idaho – Boise

Prepared for and in cooperation with

Idaho Department of Water Resources
1301 North Orchard Street
Boise, ID

FEBRUARY 2004

IDAHO WATER RESOURCES RESEARCH INSTITUTE
RESEARCH REPORT

IWRRI-2004-02

University of Idaho

RECLAMATION
Managing Water in the West

Development of a Transient Groundwater Model of the Treasure Valley Aquifer, Idaho

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Regional Office
Boise, Idaho

July 2013

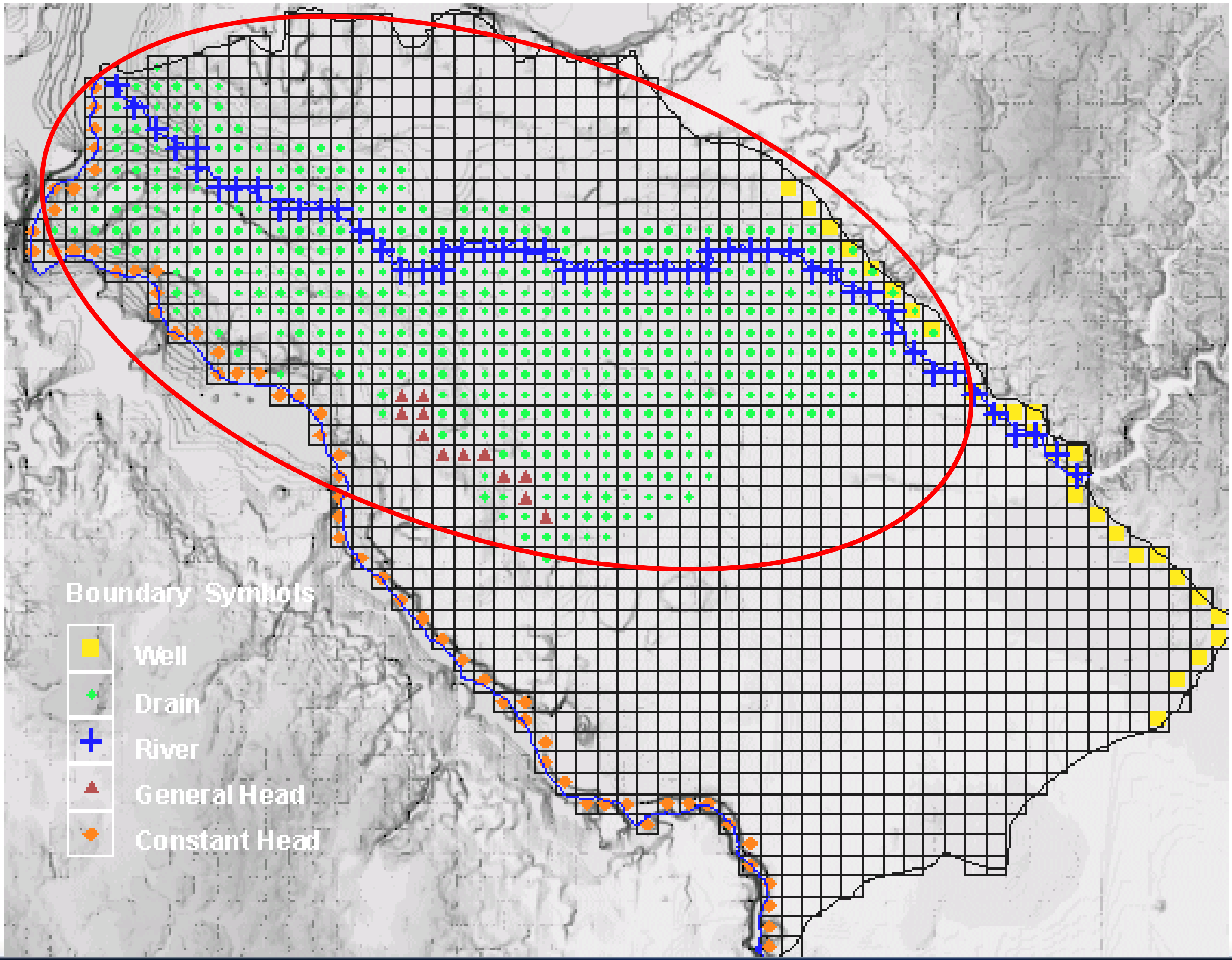
Expectations

- In response to mandate, we will deliver a new model

- Technical factors may hinder progress
  - Data gaps (reasons current models aren't fully transient)
    - Drain measurements (USBR estimated drains = 51% of aquifer discharge w/in expanded model domain)
    - Few water levels in deep aquifers (layers 3 and 4 in existing models)
    - METRIC ET data processed for one year only (2000)
    - Need year-specific water budgets

Drain Measurements

TVHP Model Boundaries



Expectations

- If mandate approved, we will deliver new model
- Technical factors may hinder progress
  - Data gaps
    - Drain measurements (~50% of estimated aquifer discharge for Lower Boise + Lower Payette valleys)
    - Few water levels in deep aquifers (layers 3 and 4 in existing models)
    - METRIC ET processed for one year only (2000)
    - Need year-specific water budgets
  - TV aquifer system is complex
    - Lateral extent and continuity of aquifers uncertain
    - Recharge mechanisms to deep aquifers poorly understood
    - Faulting along basin margin w/ isolated/bounded aquifers
    - Wells allow commingling of water levels

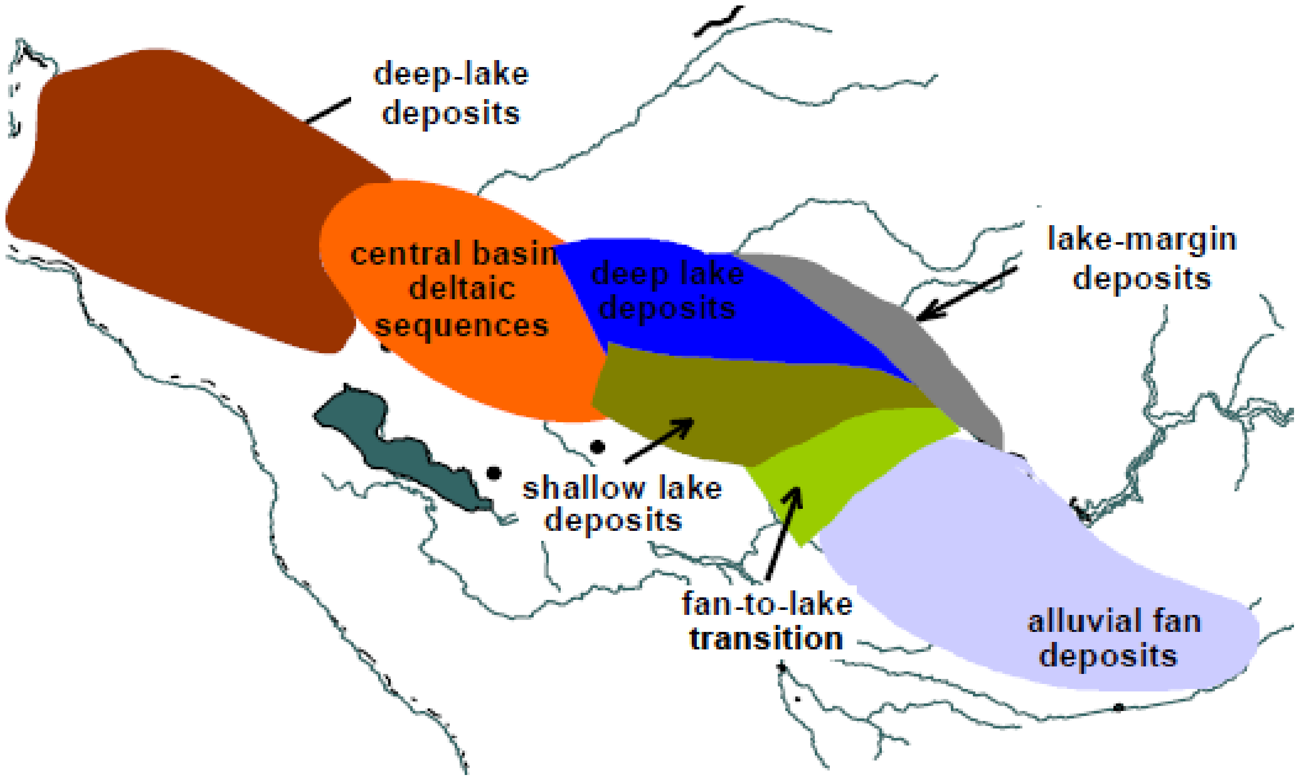
IDAHO Department of Water Resources

Complexity

"The Treasure Valley region of southwestern Idaho has a complex history of lacustrine and alluvial deposition that influences regional ground water movement. In general, basin sedimentary deposits grade from coarser, more permeable sediments near the Boise Front to finer, less permeable sediments at the distal end of the basin…These regional trends are interrupted by a complex arrangement of highly permeable deposits associated with paleo-river channels, river deltas, alluvial fans, and other features characteristic of a dynamic lacustrine history. Productive units are often surrounded by lower permeability deep-lake deposits, which, in some cases, limit interaction between productive units. The complexity of the ground water environment is well documented…

…Basin downwarping and an associated downslope trend in sediment deposition contribute to steeply dipping sedimentary deposits along the northern basin margin, which may cause deeper aquifer units to pinch out at depth (Wood, 1997). An erosional unconformity associated with changing lake levels in Pliocene Lake Idaho truncates down-dipping units along the basin margin near Boise (Wood, 1997; Squires et al., 1992). The relationship between ground water above the unconformity and ground water in the underlying delta deposits, while unclear, is thought to be significant … In addition to complexity inherent in deposition and erosion, a series of major faults bisect the stratigraphic section along the northern basin margin. The hydrologic impact of these faults is poorly understood, but they are likely to be an important influence on ground water flow in Boise-area aquifers." (emphasis added, Hutchings and Petrich, 2002)

Depositional Environments



From Hutchings and Petrich, 2002 (after Squires et al., 1992 and Wood, 1994)

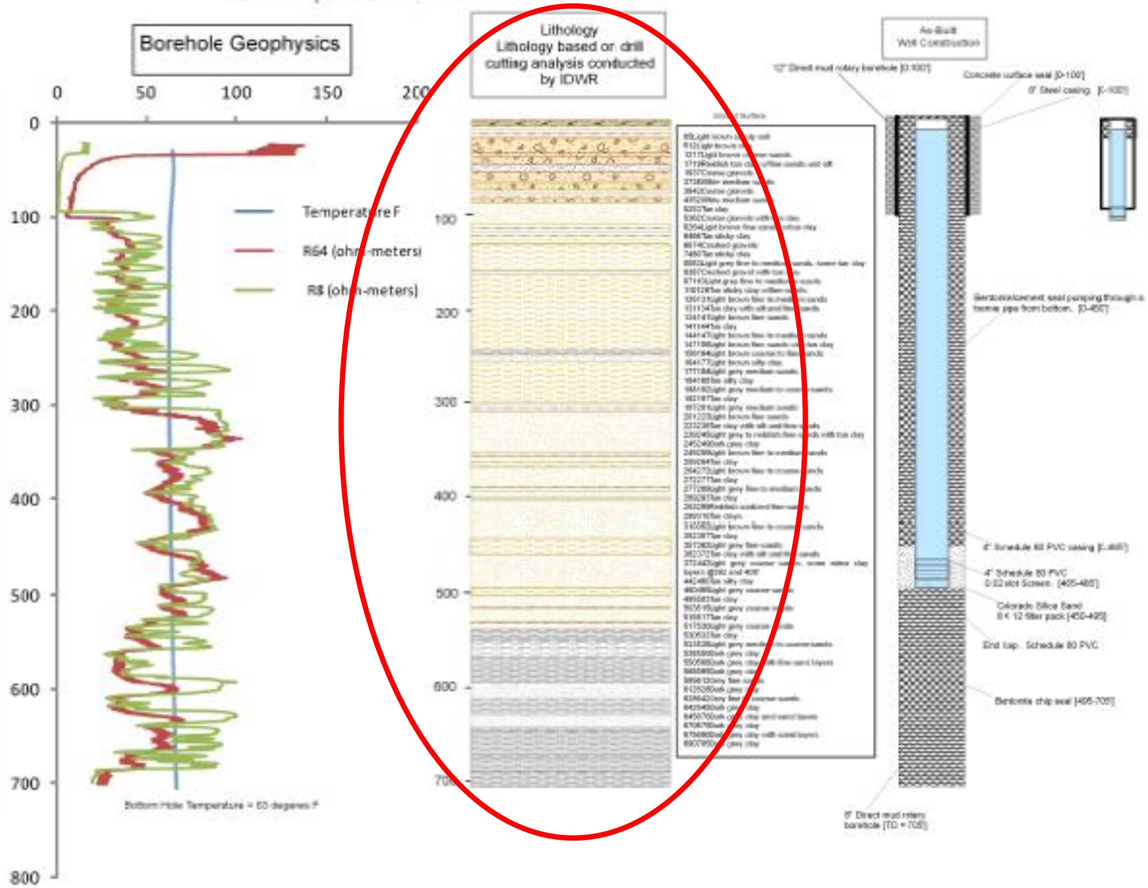
Lithologic Log

North Ada County Monitoring Well #6
T. 1 N., R. 1W., Section 1

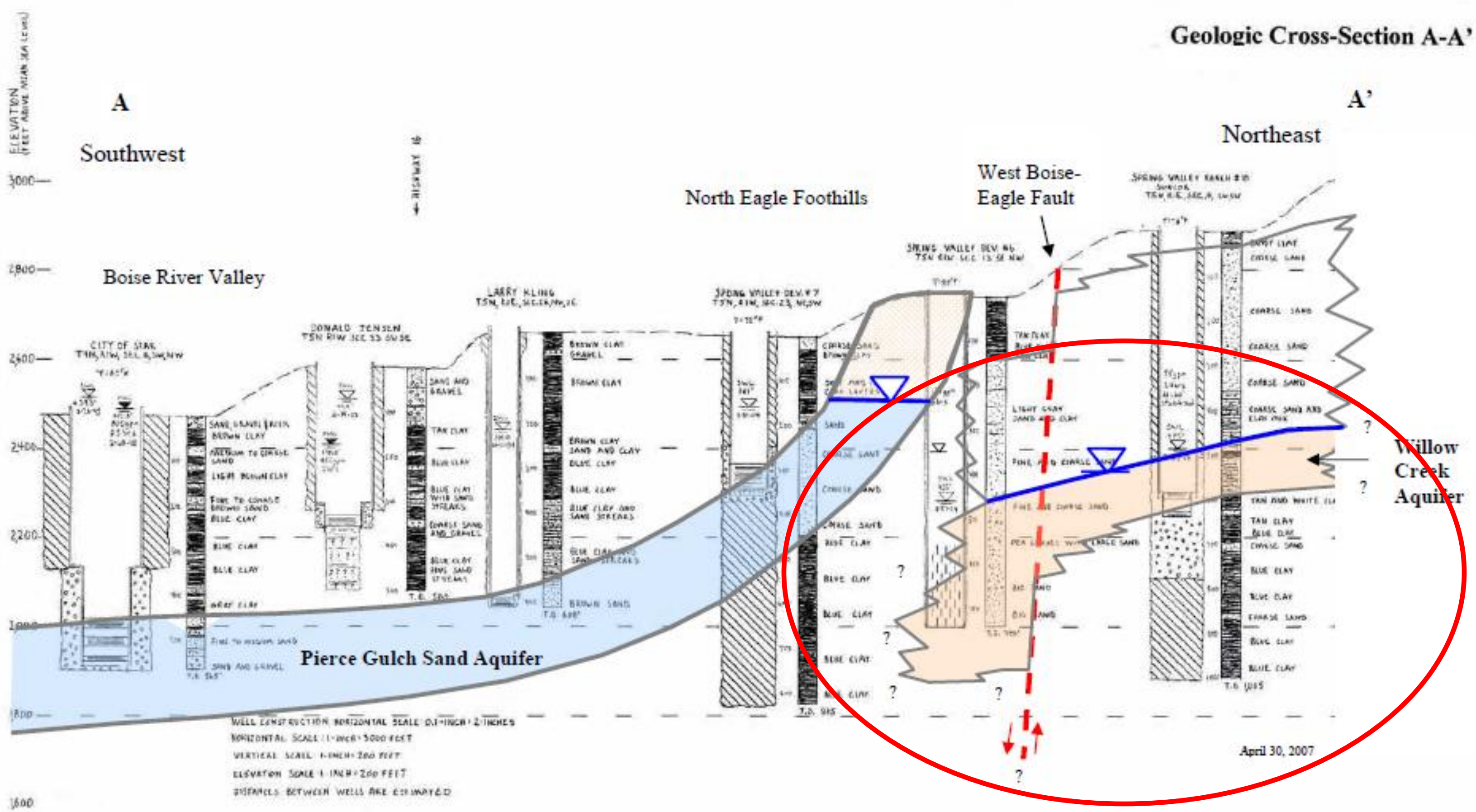
April 2011

Water Chemistry

Analyte (mg/L unless otherwise noted)	Shallow	Deep
Alkalinity as CaCO3	260	137
Ammonia	<0.010	<0.010
Arsenic	0.011	0.006
Calcium as CaCO3	61	38
Chloride	4.07	4.85
Conductivity (uS/cm)	418	282
Fluoride	0.487	0.49
Hardness	200	120
Iron	<0.01	0.018
Iron (dissolved/filtered)	<0.010	<0.010
Magnesium	12	6.9
Manganese (dissolved)	<0.002	0.01
Nitrate as N	2.19	0.702
Nitrite as N	<0.18	<0.18
Orthophosphate as P	0.153	0.22
pH (SU)	7.31	7.18
Potassium	2.9	2
Silica	45	35
Sodium	38	20
Sulfate	9.02	22.1
Sulfide	<0.10	<0.10
Total Dissolved Solids	320	200
Total Kjeldahl Nitrogen	0.18	0.2
Total Organic Carbon	0.69	0.19
Field Temperature (C)	14.6	17.1
Field Conductivity (uS/cm)	482	312
Field pH (SU)	7.45	7.27



Geologic Cross-Section



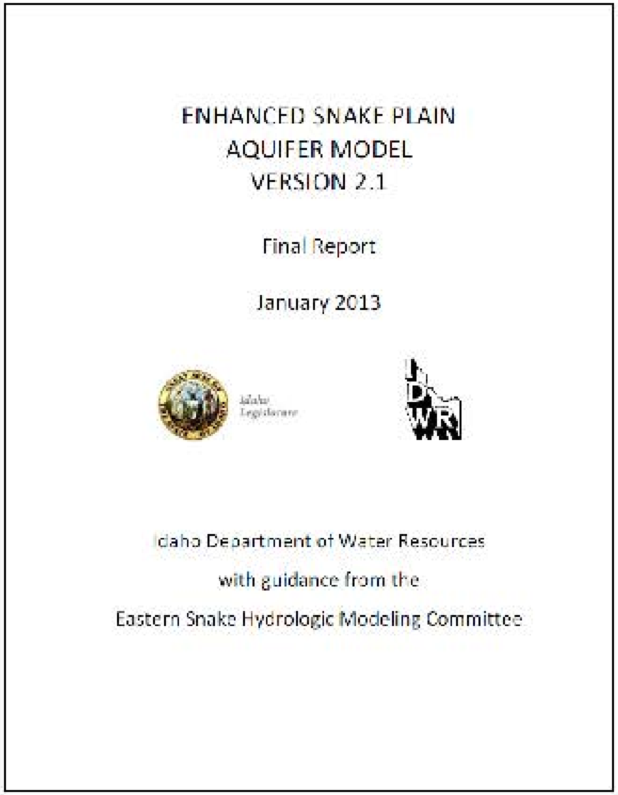
From Squires et al., 2007

Expectations (cont'd)

- Non-technical factors also may hinder progress
  - Uncertain modeling objectives
    - Inferred goal is a fully transient model to support planning and conjunctive administration
    - Other objectives?
  - Need to involve stakeholders in model development (MTAC)
    - Forum for stakeholder input
    - Transparency
    - Acceptance
  - TV will be IDWR's 4^{th} actively maintained aquifer model

Other IDWR aquifer models

ESPA (1 layer) | SVRP (mostly 1 layer) | WRV (1 & 3 layers)

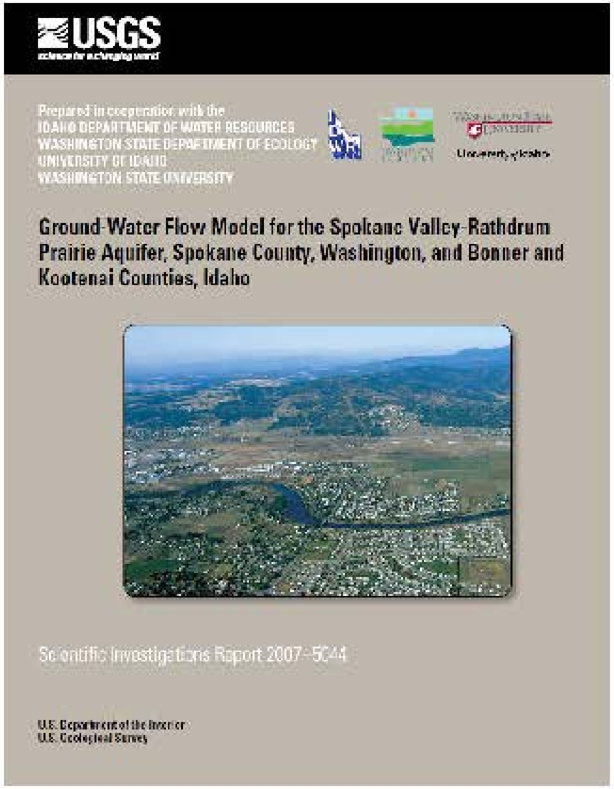


ENHANCED SNAKE PLAIN
AQUIFER MODEL
VERSION 2.1

Final Report

January 2013

Idaho Department of Water Resources
with guidance from the
Eastern Snake Hydrologic Modeling Committee



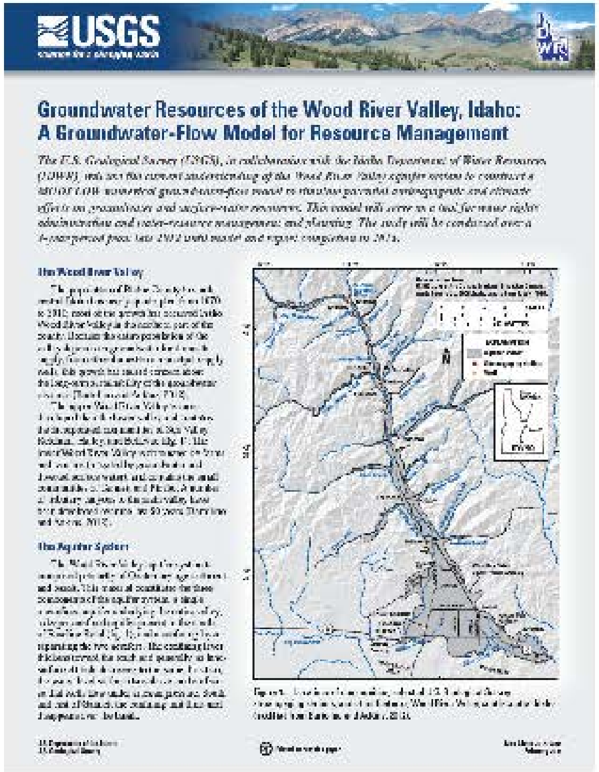
USGS

Prepared in cooperation with the
IDAHO DEPARTMENT OF WATER RESOURCES
WASHINGTON STATE DEPARTMENT OF ECOLOGY
UNIVERSITY OF IDAHO
WASHINGTON STATE UNIVERSITY

Ground-Water Flow Model for the Spokane Valley-Rathdrum Prairie Aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho

Scientific Investigations Report 2007–5044

U.S. Department of the Interior
U.S. Geological Survey



USGS

Groundwater Resources of the Wood River Valley, Idaho: A Groundwater-Flow Model for Resource Management

Recommended Next Steps

- Finish evaluation of USBR model
  - Identify data gaps
  - Assessment of calibration
- Reconvene MTAC
  - Establish modeling objectives
  - Develop preliminary SOW for data collection and modeling
- Develop work plan for data collection to support modeling (Phase I)
- Partially execute Phase I before developing work plan for modeling (Phase II)

Summary

- Legislative mandate for recharge studies, model development, and necessary data collection
- Challenging system to model and technical and nontechnical factors may hinder progress
- Next step is to complete evaluation of USBR model
- Stay tuned


END

Memorandum

To: Idaho Water Resource Board

From: Cynthia Bridge Clark

Date: March 6, 2016

Re: Priest Lake Improvements and Water Sustainability Projects

---

Background:

Priest Lake is located on the Priest River in the Idaho Panhandle north of Coeur d' Alene. It is a significant draw for tourism and recreation in the area and is known for the pristine variety of wildlife. Priest Lake is approximately 18 miles long with a maximum depth greater than 300 feet and active storage space of approximately 76,000 acre-feet. It is connected to Upper Priest Lake by a 2.5-mile-long channel, known as the "Thorofare", which is actively used by the public for recreation and access to the upper lake.

A 1,400-foot-long Breakwater structure at the north end of Priest Lake is intended to manage sediment transported from Upper Priest Lake and to provide protection to landowners at the north end of the lower lake. The Breakwater is in serious need of replacement, a project that has been considered for some time by Bonner County, the State of Idaho, and lake users.

At the mouth of the lower lake, Priest Lake Dam was constructed (1951) as an outlet control structure to maintain lake levels and downstream flows in the Priest River. The dam is owned by the Idaho Department of Water Resources (IDWR). In accordance with Idaho Code § 70-507, it is operated to maintain lake levels at 3 feet on the USGS outlet gage after spring run-off for recreation purposes. Efforts are also made to maintain a minimum of 60 cubic feet per second (cfs) in the Priest River downstream of the dam. The dam is approximately 12-feet-high with eleven radial gates to regulate discharge and does not have an emergency spillway. The dam is operated by a contractor on behalf of IDWR, does not have automation, and has some maintenance needs. In 2015, limited water supply and drought conditions in Northern Idaho resulted in difficulty maintaining required summer lake levels and downstream flow in the river.

Coordinated Project:

In accordance with the direction from Governor Otter and the Idaho Legislature, the Idaho Water Resource Board is supporting efforts to improve sustainability of water supplies statewide. The IDWR is interested in evaluating potential improvements to the Priest Lake Dam to address general maintenance needs, to improve operation through automation and measurement at and below the dam, and to evaluate alternatives to meet lake level and downstream river flow needs into the future. These alternatives may range from operational changes to a raise of the dam and lake elevations. Other water use projects on the Priest Lake system include the Breakwater replacement and Thorofare project being pursued by Bonner County.

Given the complexity and importance of the lake and river system to the community, state, environment and a wide range of stakeholders, these projects should be coordinated to leverage information and resources and to ensure that potential impacts and benefits are considered. The IWRB may consider committing funds to complete an assessment of improvements to the Priest Lake Dam and to coordinate with Bonner County, the Idaho Lakes Commission, and other agencies and entities as appropriate.

REQUIRED ACTIONS: A draft resolution will be provided for the IWRB's consideration to authorize funds to complete an assessment of potential Priest Lake Dam improvements and to partner with other entities regarding the Breakwater replacement and other associated projects to enhance sustainable water management practices of the Priest Lake and river.

Memorandum

To: Idaho Water Resource Board

From: Cynthia Bridge Clark

Date: March 6, 2016

Re: Weiser River Basin Water Sustainability Projects

Water users and legislators from the Weiser River Basin have expressed interest in pursuing funding from the Idaho Water Resource Board (IWRB) to complete projects that support long-term water sustainability within the basin. Projects such as automation and measurement improvements to the Lost Valley Reservoir (9,500 acre-foot reservoir west of Tamarack, Idaho) are expected to provide for more accurate and timely delivery of water, thereby improving the management of limited water supplies within the basin.

Staff proposes to coordinate with water users, the Water District 67 watermaster, and Idaho Department of Water Resources staff to encourage development of a funding proposal for consideration by the IWRB. This topic will be discussed at the IWRB work session to bring attention to opportunities and interest within the Weiser River basin.

REQUIRED ACTIONS: Action is not required at this time.

2015
Integrated Resource Plan

Rick Haener
March 2016

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Integrated Resource Plan

- Idaho Power first began filing integrated resource plans in the early 1990s.
- The IRP is the long-term plan for how Idaho Power expects to provide service to customers for the next 20 years.
- Idaho Power updates the IRP every two years.
- Idaho Power considers **supply-side resources**, **demand-side measures**, and **transmission options** in the IRP.
- Idaho Power **balances cost, risk, and environmental concerns**.
- **Public involvement** is a key component of the Idaho Power planning process.

Idaho Power Generation

Thermal Facilities And Capacities

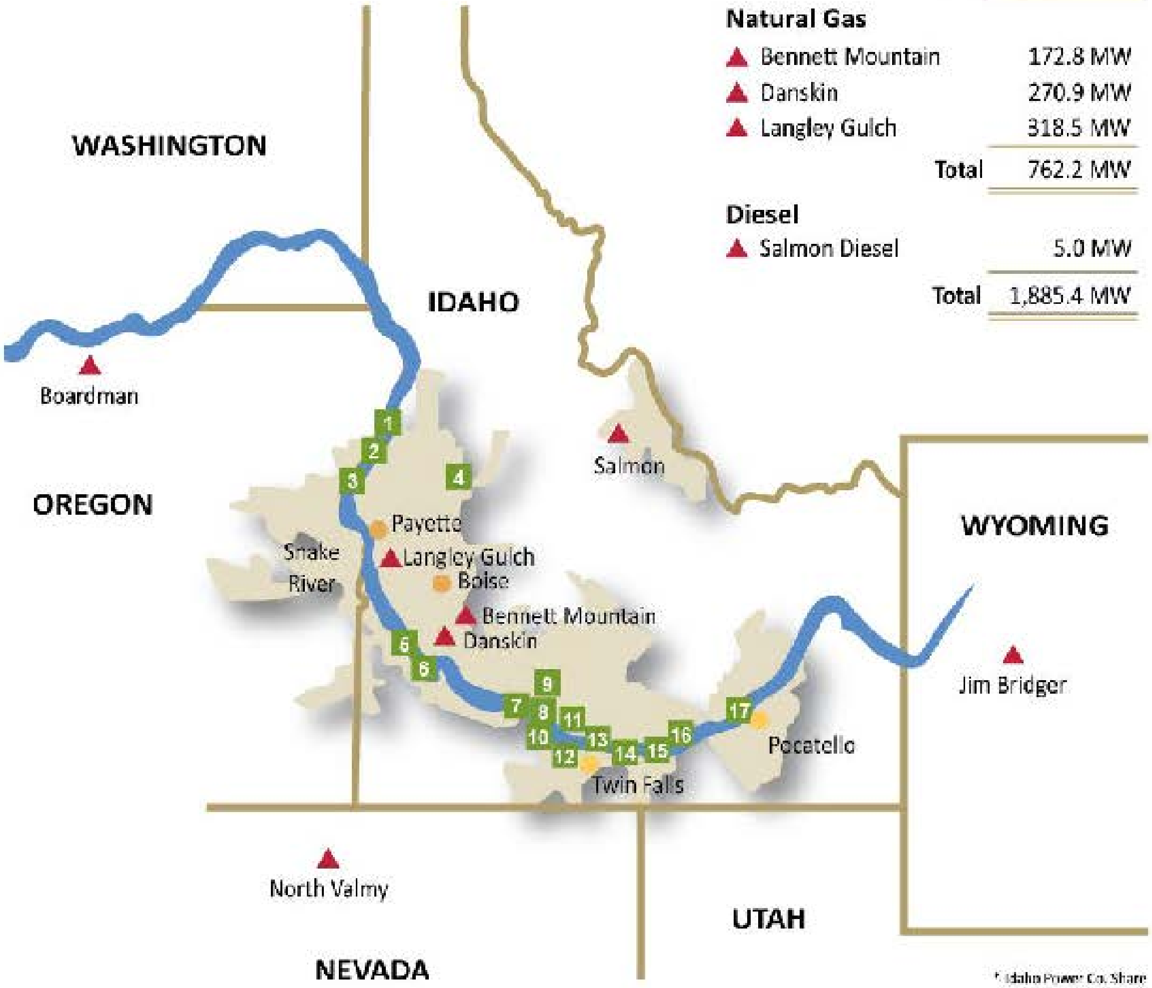
Coal	
Jim Bridger	770.5 MW*
North Valmy	283.5 MW*
Boardman	64.2 MW*
Total	1,118.2 MW

Natural Gas	
Bennett Mountain	172.8 MW
Danskin	270.9 MW
Langley Gulch	318.5 MW
Total	762.2 MW

Diesel	
Salmon Diesel	5.0 MW
Total	1,885.4 MW

Hydroelectric Facilities and Nameplate Capacities

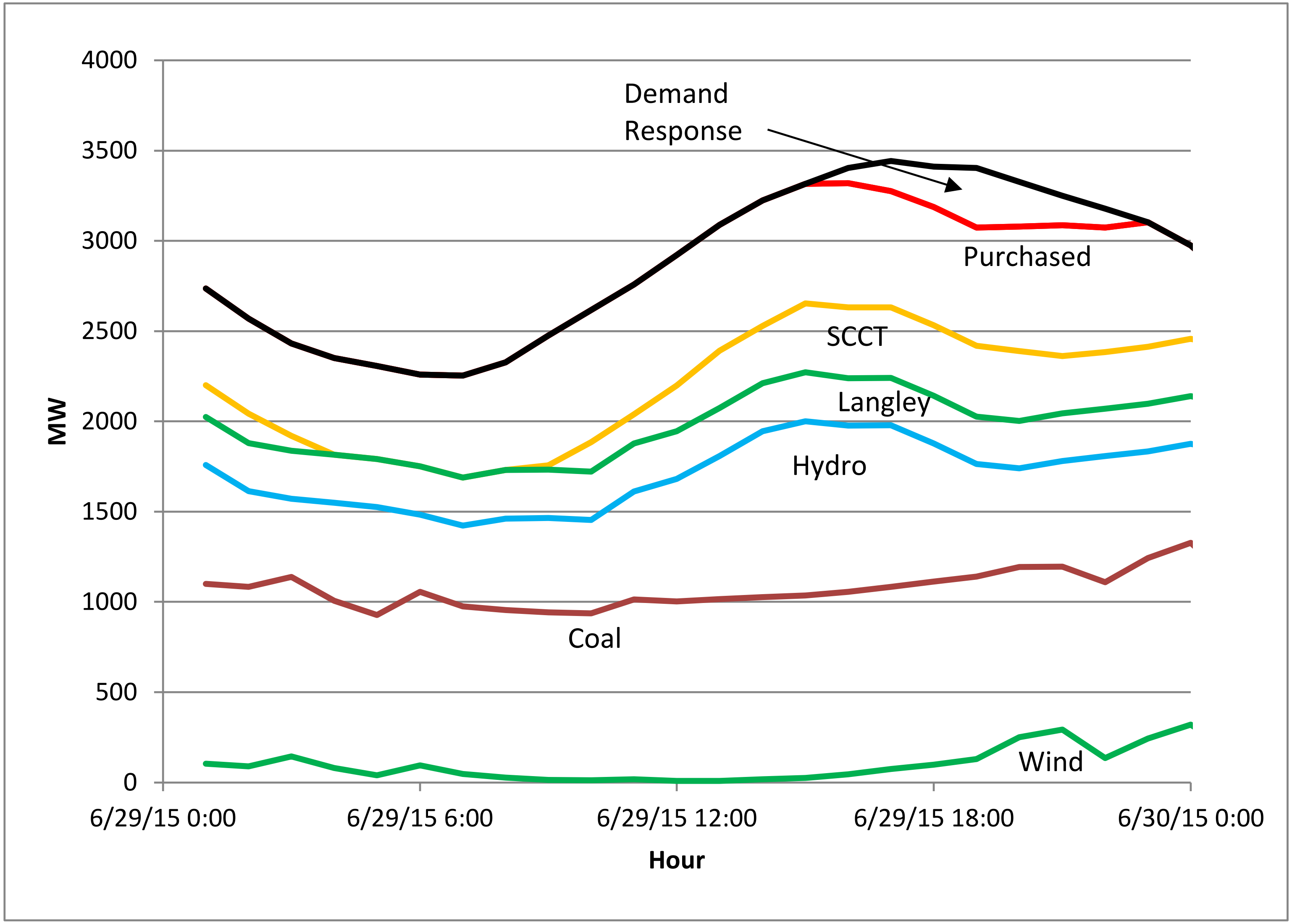
1	Hells Canyon	391.5 MW
2	Oxbow	190.0 MW
3	Brownlee	585.4 MW
4	Cascade	12.4 MW
5	Swan Falls	27.2 MW
6	C. J. Strike	82.8 MW
7	Bliss	75.0 MW
8	Lower Malad	13.5 MW
9	Upper Malad	8.3 MW
10	Lower Salmon	60.0 MW
11	Upper Salmon	34.5 MW
12	Thousand Springs	8.8 MW
13	Clear Lake	2.5 MW
14	Shoshone Falls	12.5 MW
15	Twin Falls	52.9 MW
16	Milner	59.4 MW
17	American Falls	92.3 MW
	Total	1,709.0 MW



* Idaho Power Co. Share

Generation Mix June 29, 2015

Boise High Temperature 110°



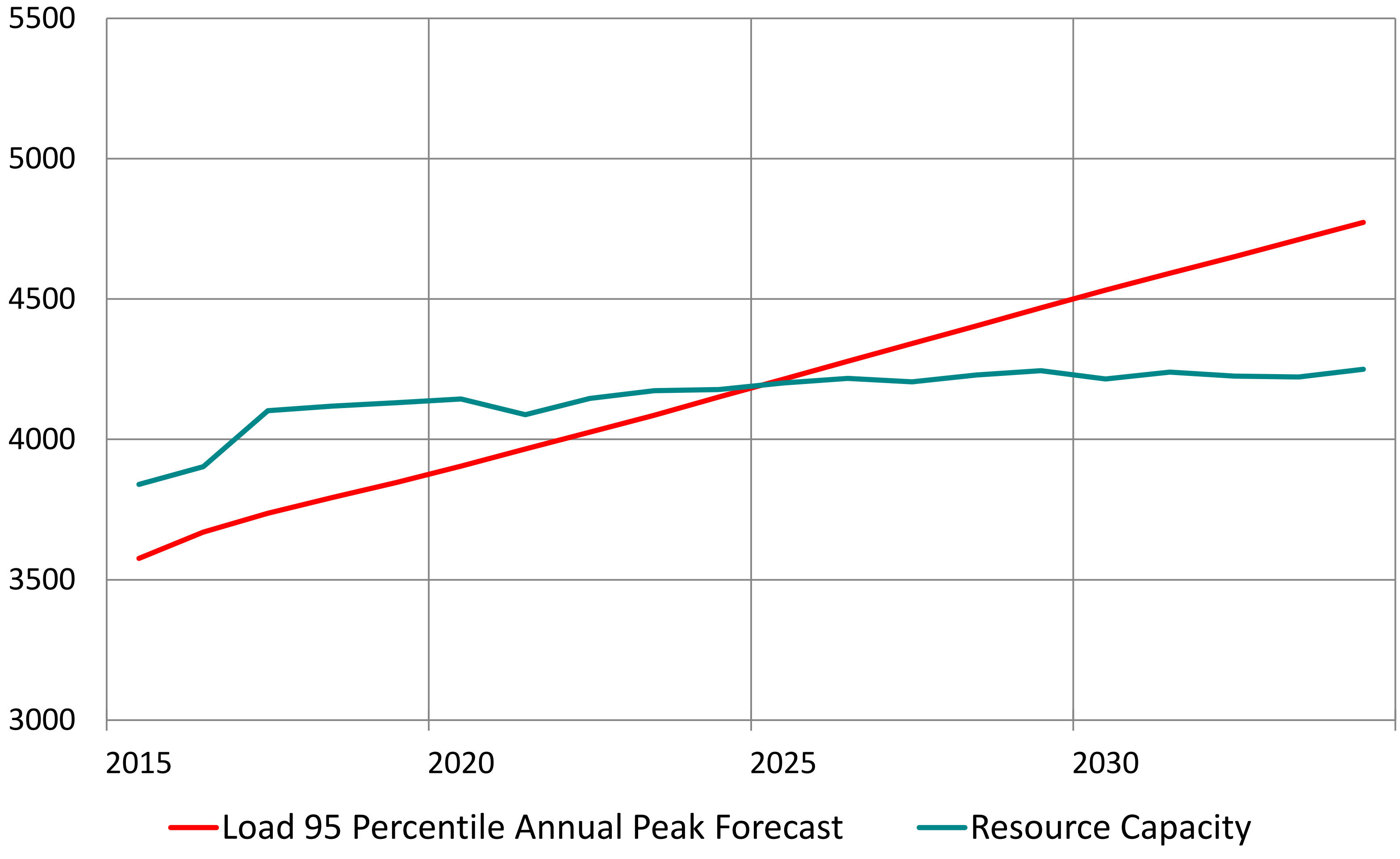
Existing Demand Response Programs

Irrigation Peak Rewards
295 MW of peak reduction

A/C Cool Credits
44 MW of peak reduction

Flex Peak
40 MW of peak reduction

Peak and Resource - Status Quo 2015-2034 in megawatts



2015 IRP Key Issues

Load Forecast

- 1.2% growth in average energy
- 1.5% growth in peak-hour capacity

Transmission Projects

- Boardman to Hemingway (B2H)
- Gateway West

PURPA Contracts

- 461 MW Solar PV contracts (contracted but not yet built)

EPA's Clean Air Act Section 111(d) Rule (the Clean Power Plan)

- No carbon adder in the 2015 IRP
- Twenty-three different portfolios analyzed around various 111(d) compliance and coal retirement scenarios
- First deficit year ranges from 2020 to 2025 depending on 111(d) compliance and coal retirement assumptions

North Valmy Generating Station

- Owner alignment on depreciation schedule and potential shutdown date

Preferred Portfolio

Portfolio P6(b)

- 301 aMW of energy efficiency over 20 years and 473 MW of reduction on peak by 2034.
- Valmy Retirement in 2025 (minus 262 MW).

  Actual Valmy retirement date will depend on B2H completion date, the ability to agree on a depreciation date and eventual closure date with NV Energy, and PUC approval of an accelerated depreciation schedule.
- Boardman to Hemingway in 2025 (+500 MW in Summer, +200 MW in Winter).

Date	Resource	Installed Capacity	Peak-Hour Capacity
2025	Boardman to Hemingway	500 MW transfer capacity Apr-Sep	500 MW
		200 MW transfer capacity Oct-Mar	
2025	Retire North Valmy (both units)	(262 MW)	(262 MW)
2030	Demand response	60 MW	60 MW
2030	Ice-based thermal energy storage	20 MW	20 MW
2031	Combined-cycle combustion turbine	300 MW	300 MW
		Total retired capacity	(262 MW)
		Total added capacity	880 MW
		Net peak-hour capacity	618 MW

Other Projects

Solar PV on Distribution Feeder Lines

Install solar PV panels near the end of long distribution feeders to boost/regulate voltage. The pilot project would confirm whether this concept is the lowest cost option in certain cases. Three locations have been identified for the pilot project.

Thermal Ice Storage Pilot Project

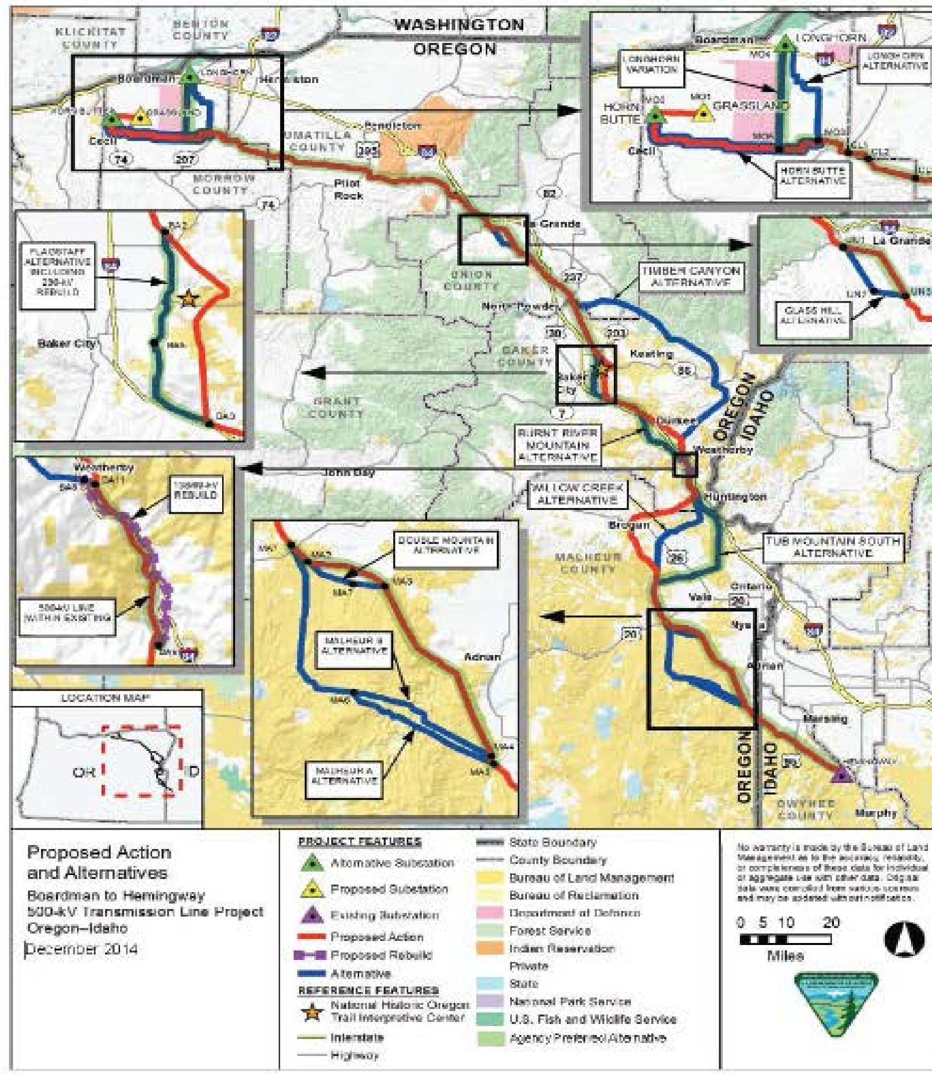
Identify and work with a commercial customer to install thermal ice storage. The initial phase would involve identifying a customer, designing the system, and putting together a detailed cost estimate. The second phase would be to purchase and install the equipment followed by data collection for a period of time to determine the effectiveness of the concept.

Community Solar

Work with the IRP Advisory Council to explore risks and opportunities of a community-based solar project.

Boardman To Hemingway (B2H)

- 500 kV transmission line
- ~300 miles long
- 33% of line is on federal land
- Permitting started in 2008

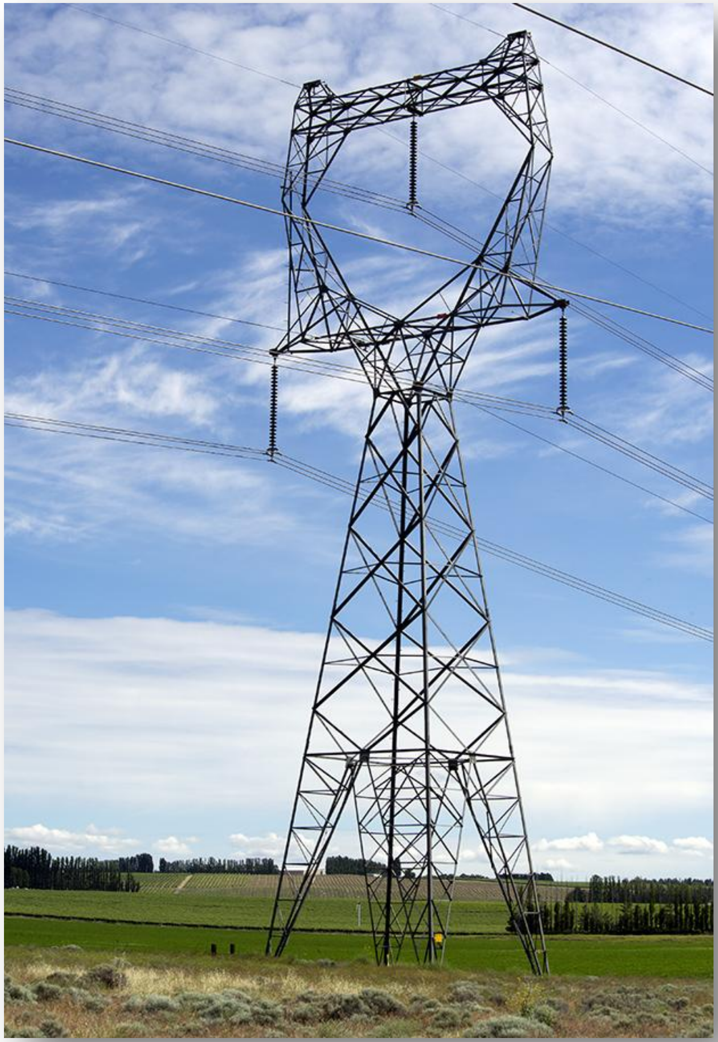


Project Details

- Total cost ~ $1.0-$1.2 billion
- Total permitting costs to-date ~ $68 million
- IPC estimated permitting cost ~ $37 million
- Permitting Interest:
    - IPC - 21%
    - PAC - 55%,
    - BPA - 24%

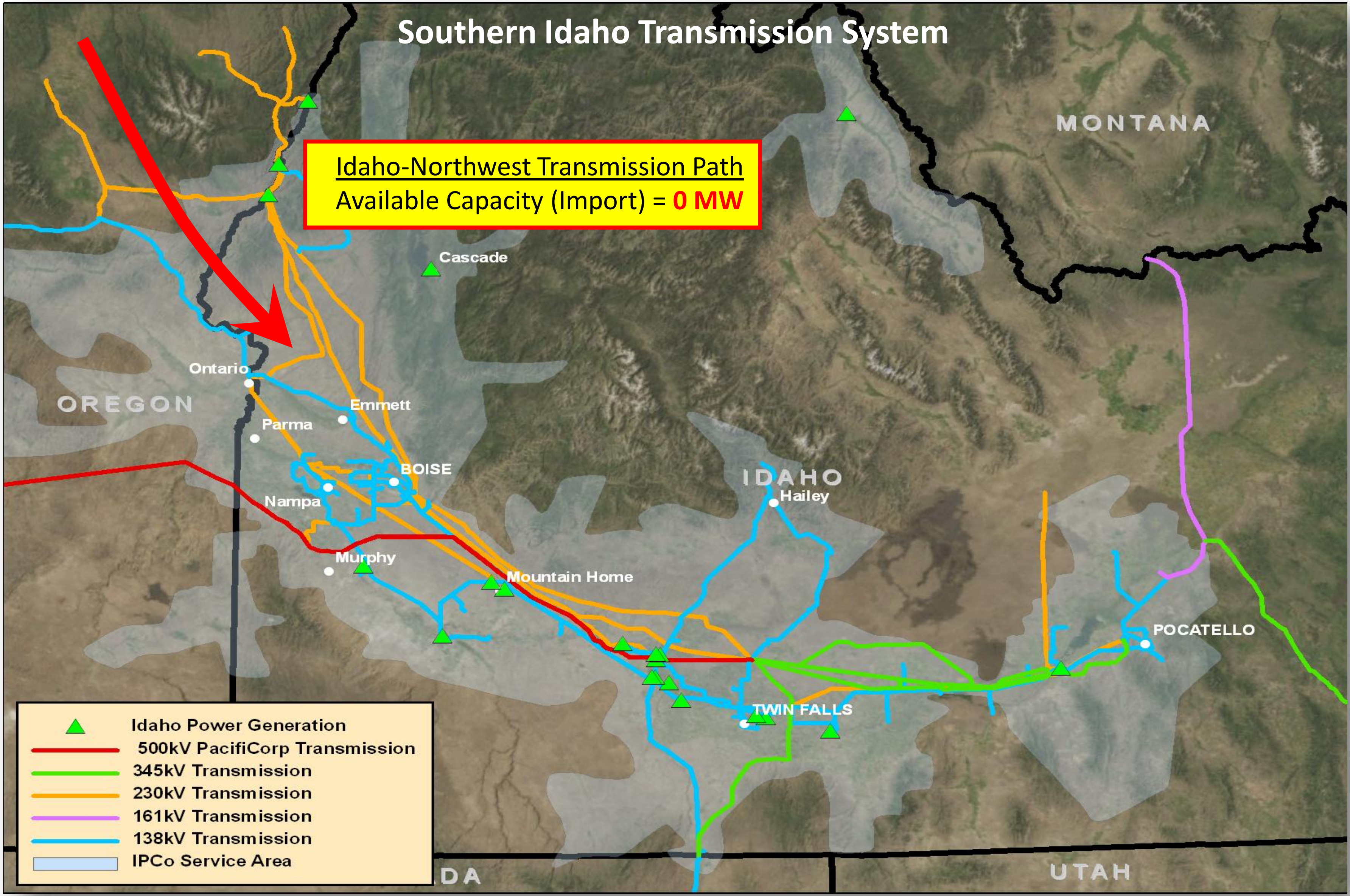
Capacity Interest

	Total (MW)	IPC (MW)	BPA (MW)	PAC (MW)
West to East (import)	1050	200-500*	400*	300
East to West (export)	1000	85	97	818



*Seasonally shaped capacity

Existing Transmission Constraints

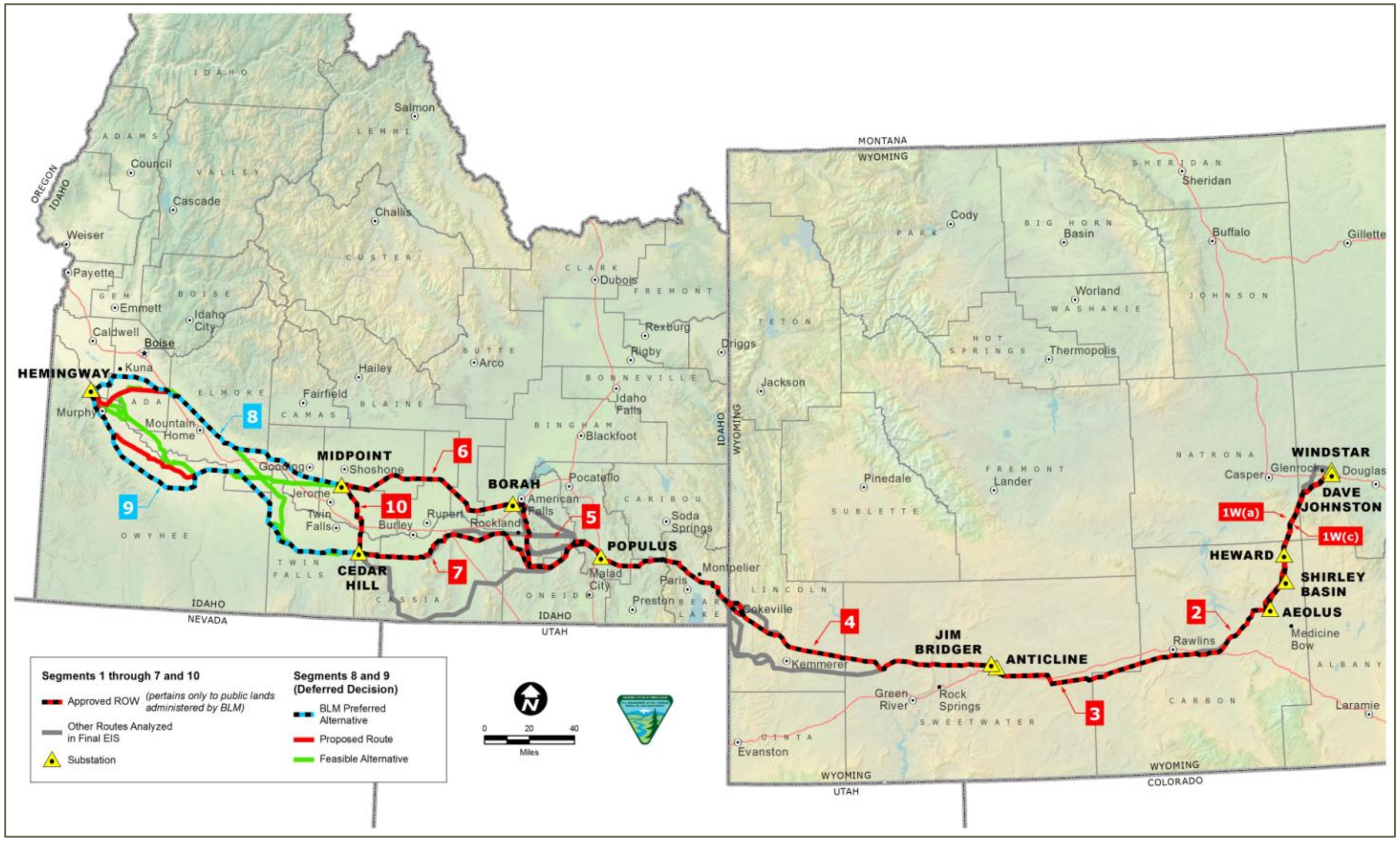


Project Benefits

- Serve Idaho Power customers
- Increased ability to import and export power to economically serve the energy needs of the region
- Increased reliability
- No carbon resource
- Presidential Priority Project

Gateway West

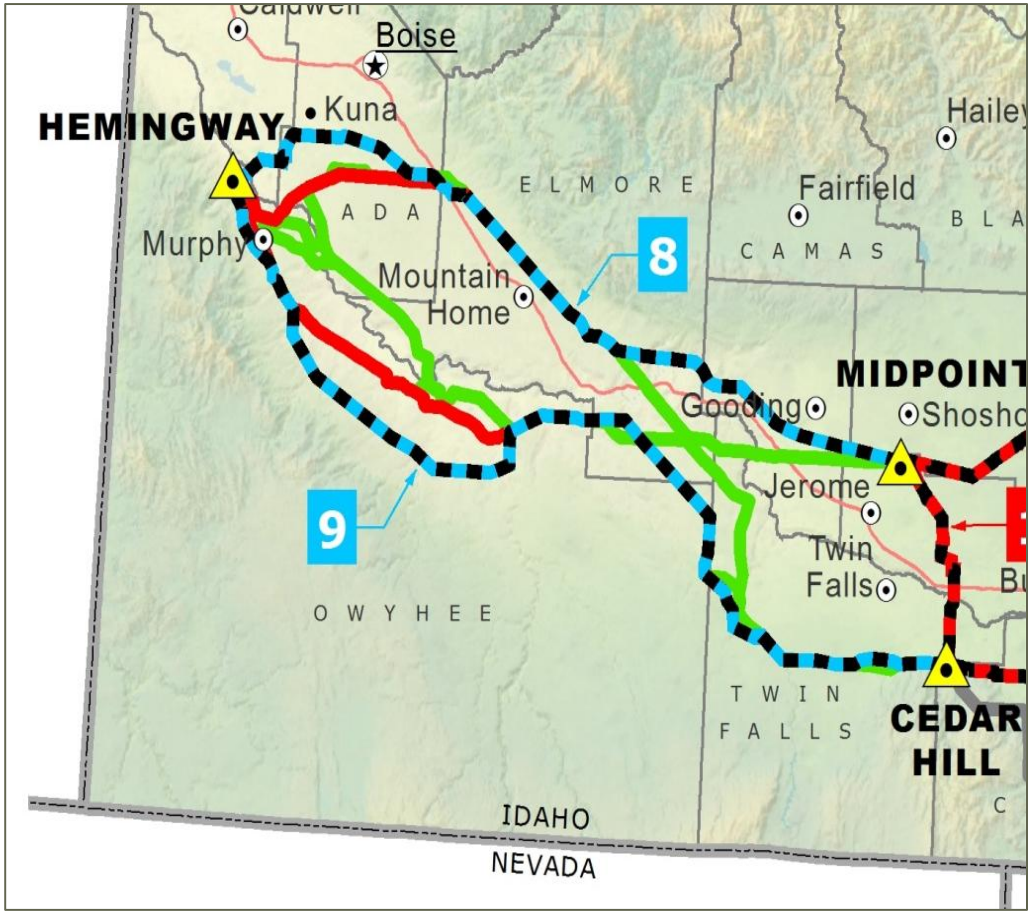
- 1,000 miles of new transmission lines
- Glenrock, Wyoming to Hemingway Substation near Melba, Idaho
- Project Lead - Rocky Mountain Power (PacifiCorp)



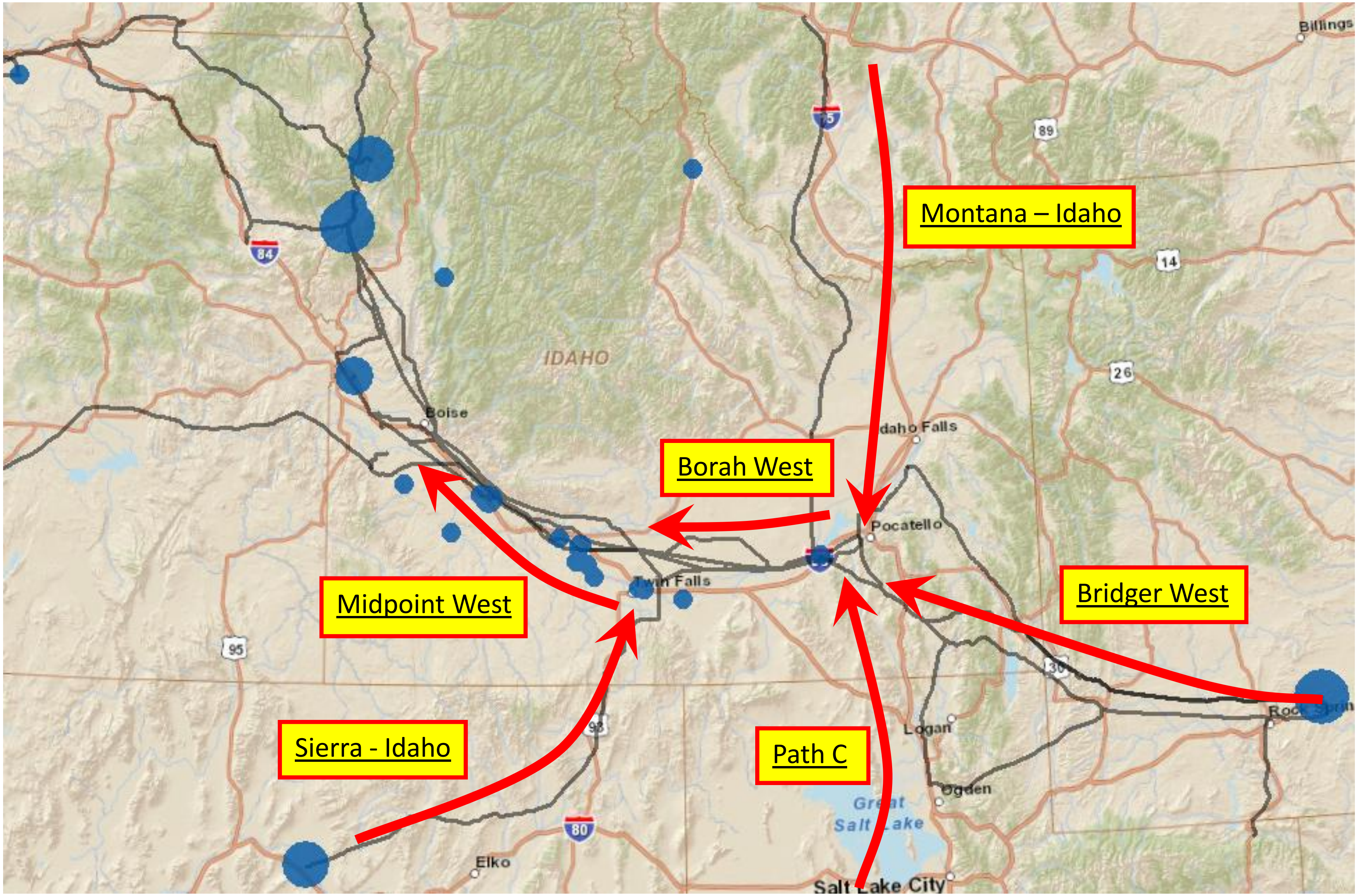
Gateway West

- New Capacity:
  - Phase 1: 1,500 MW
  - Build out: 3,000 MW

- Idaho Power's interest:
  - 33% of segments west of Midpoint/Cedar Hill
  - 11% of the total project



Existing Transmission Constraints



Schedule/Questions

2015 IRP
Water Supply Forecast

2015 IRP
Kresta Davis-Butts
Operations Hydrology

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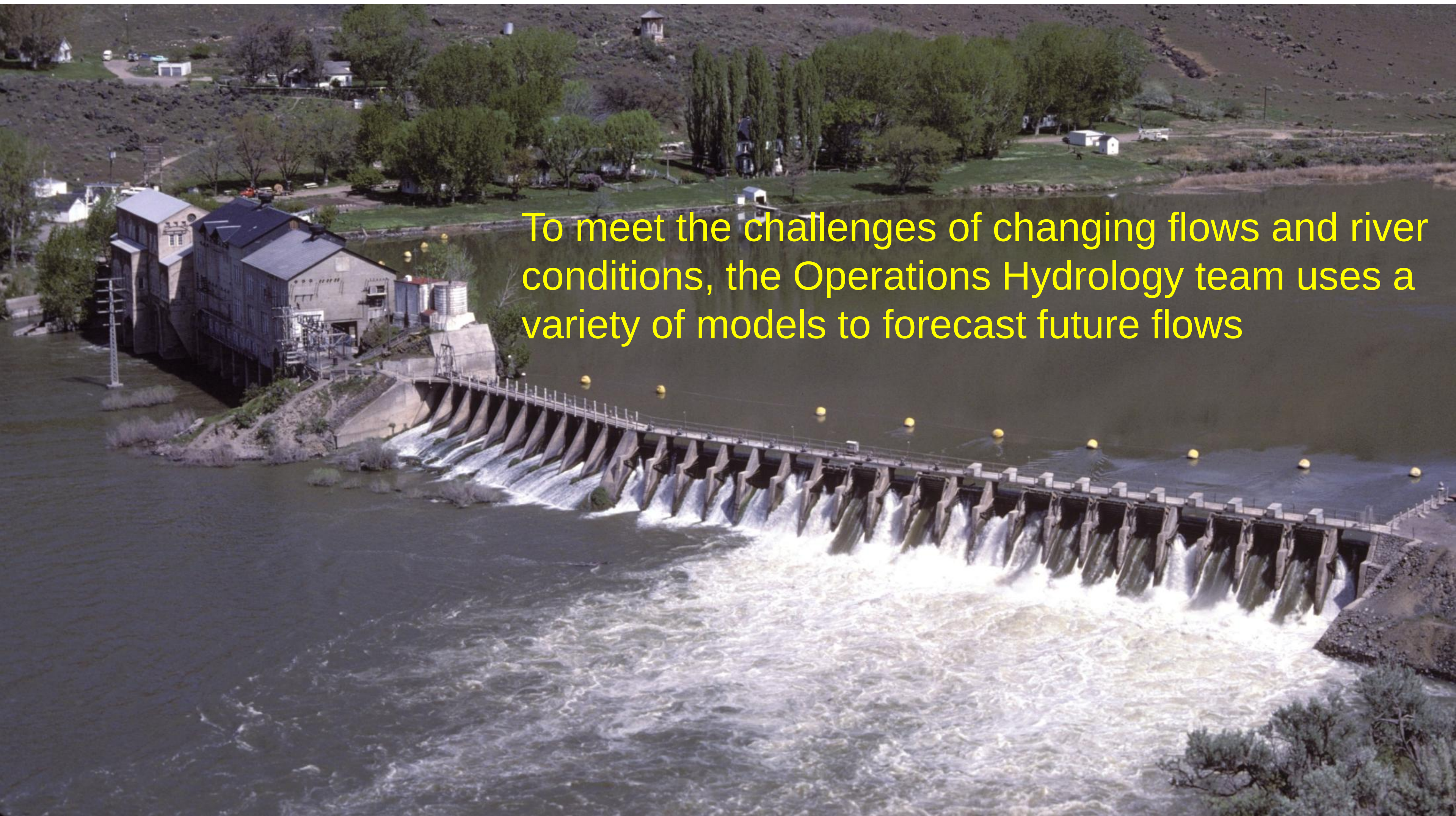
Historic Swan Falls



To meet the challenges of changing flows and river conditions, the Operations Hydrology team uses a variety of models to forecast future flows

Idaho Power's Facilities

Hydroelectric Facilities and Nameplate Capacities

1	Hells Canyon	391.5 MW
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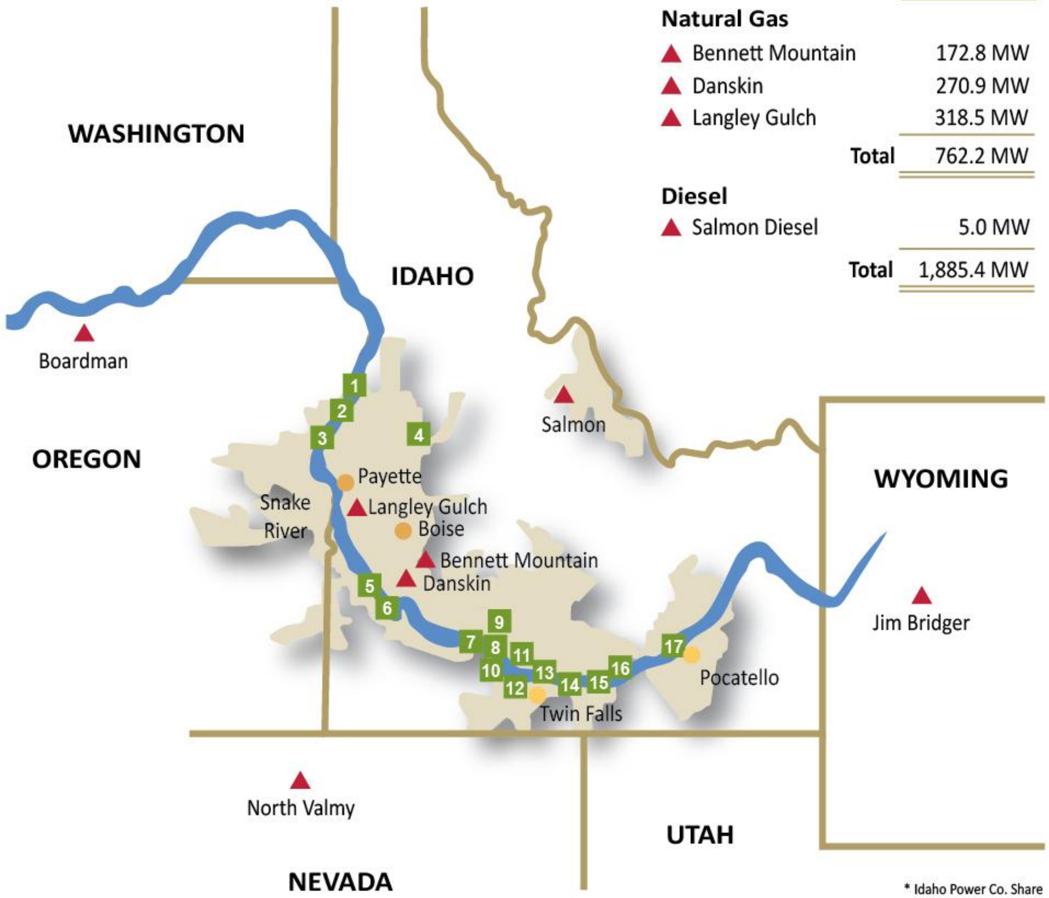
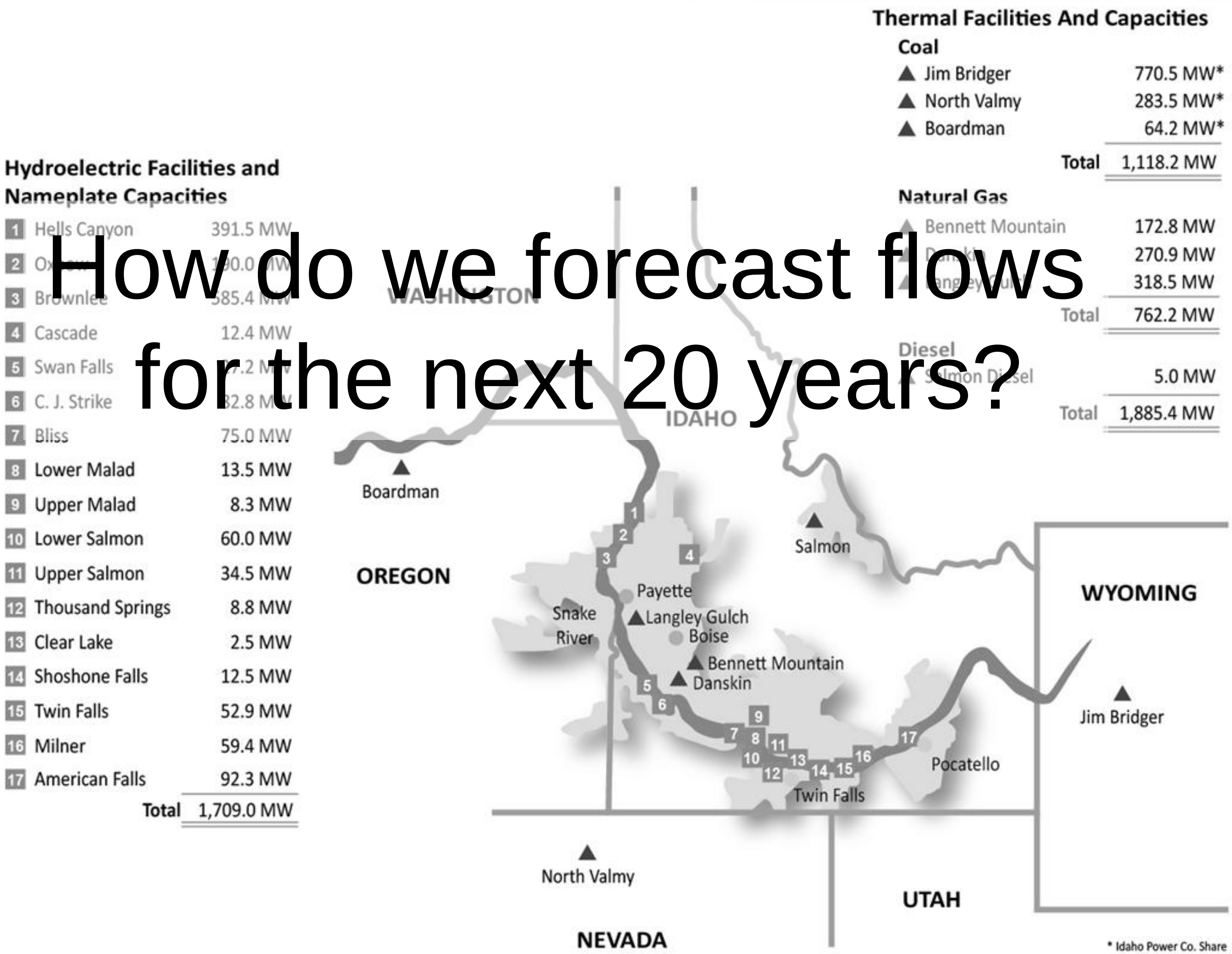


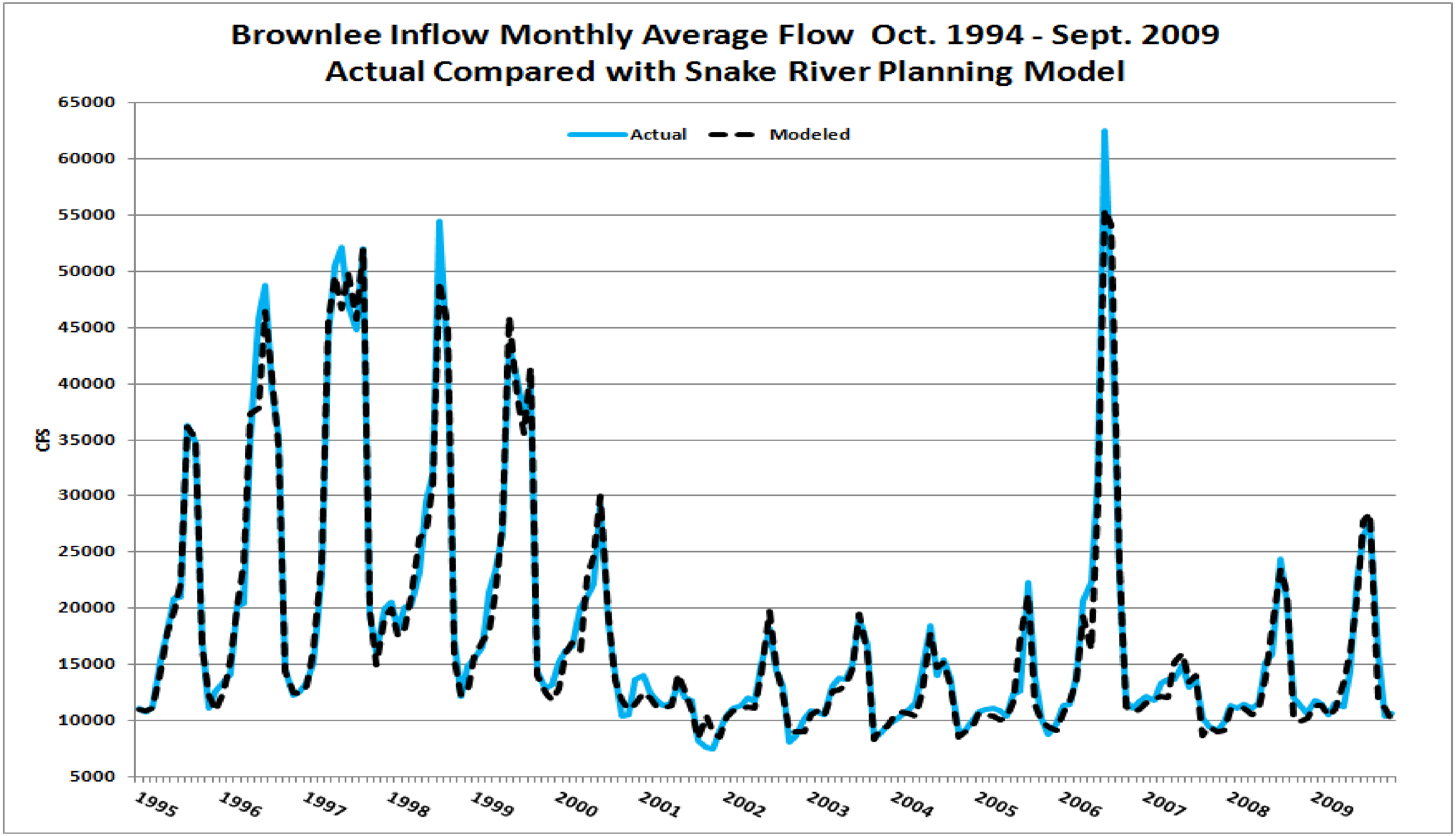
* Idaho Power Co. Share

Forecasting Future Flows

How do we forecast flows for the next 20 years?



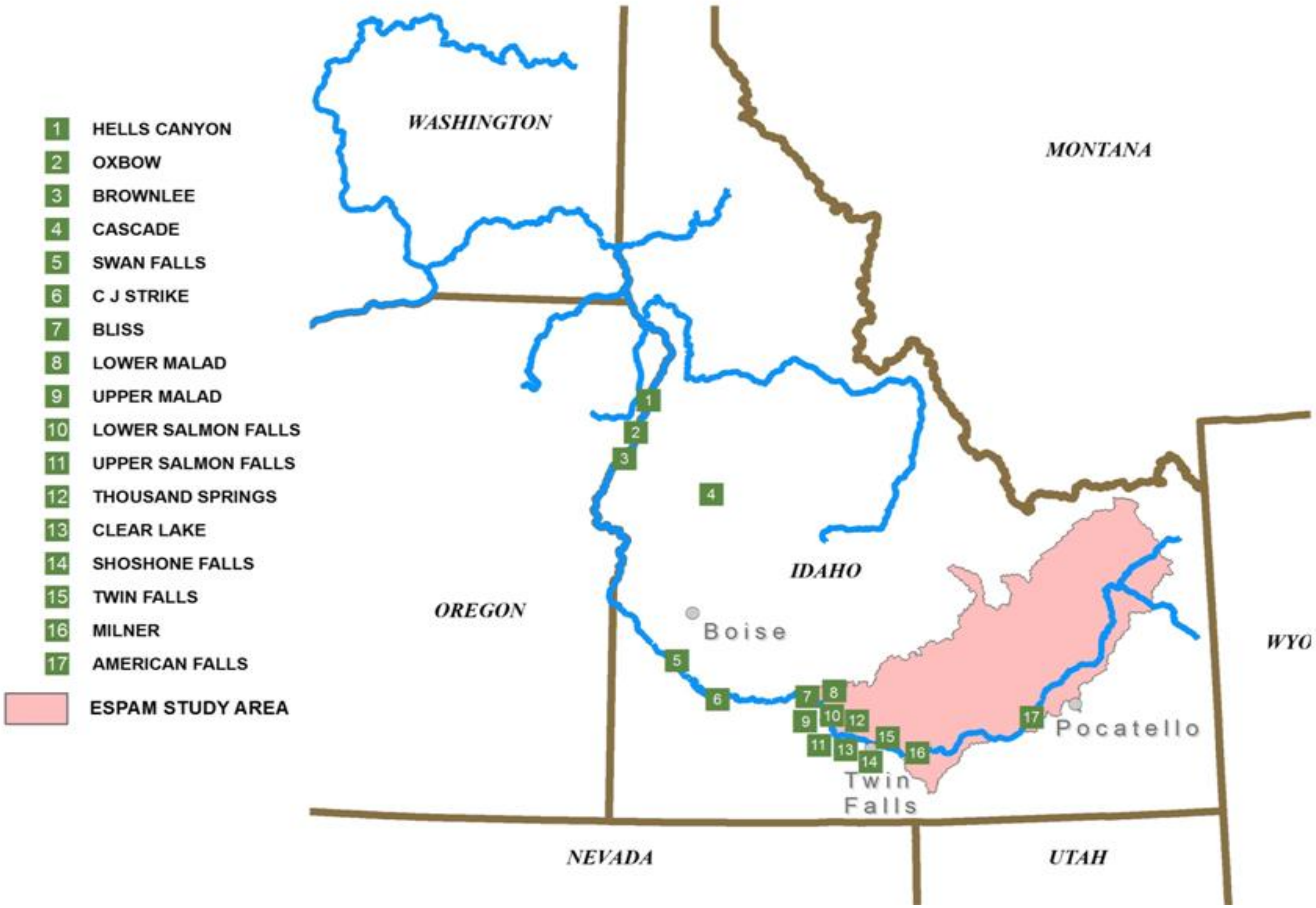
1. Snake River Planning Model (SRPM)



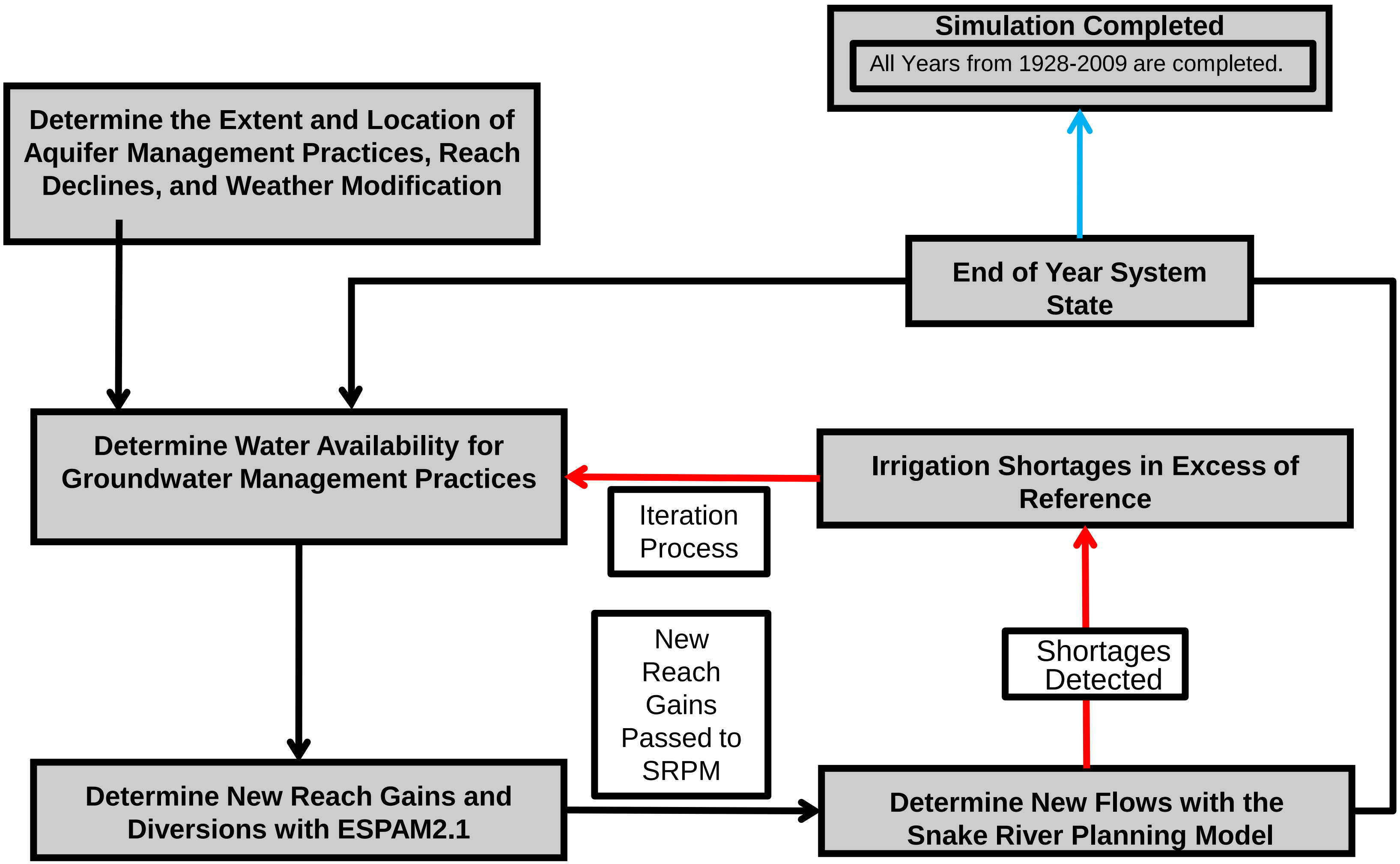
2. Define Future Assumptions

- Conservation Reserve Enhancement Program (CREP)
- System irrigation conversion projects
- Management aquifer recharge projects
- Weather modification expansion
- Reach declines

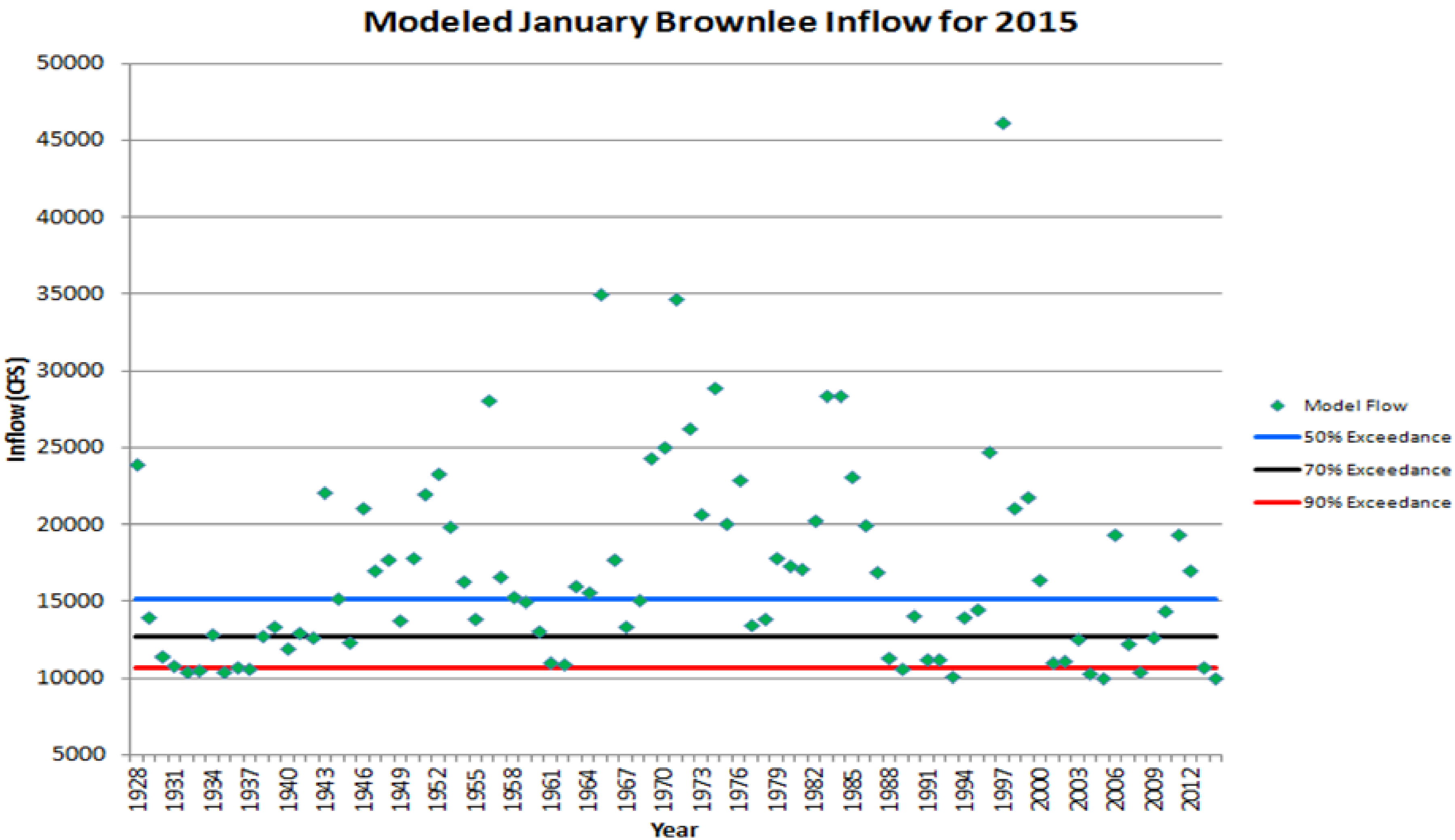
3. Enhanced Snake Plain Aquifer Model (ESPAM)



4. Combined Model (SRPM and ESPAM)



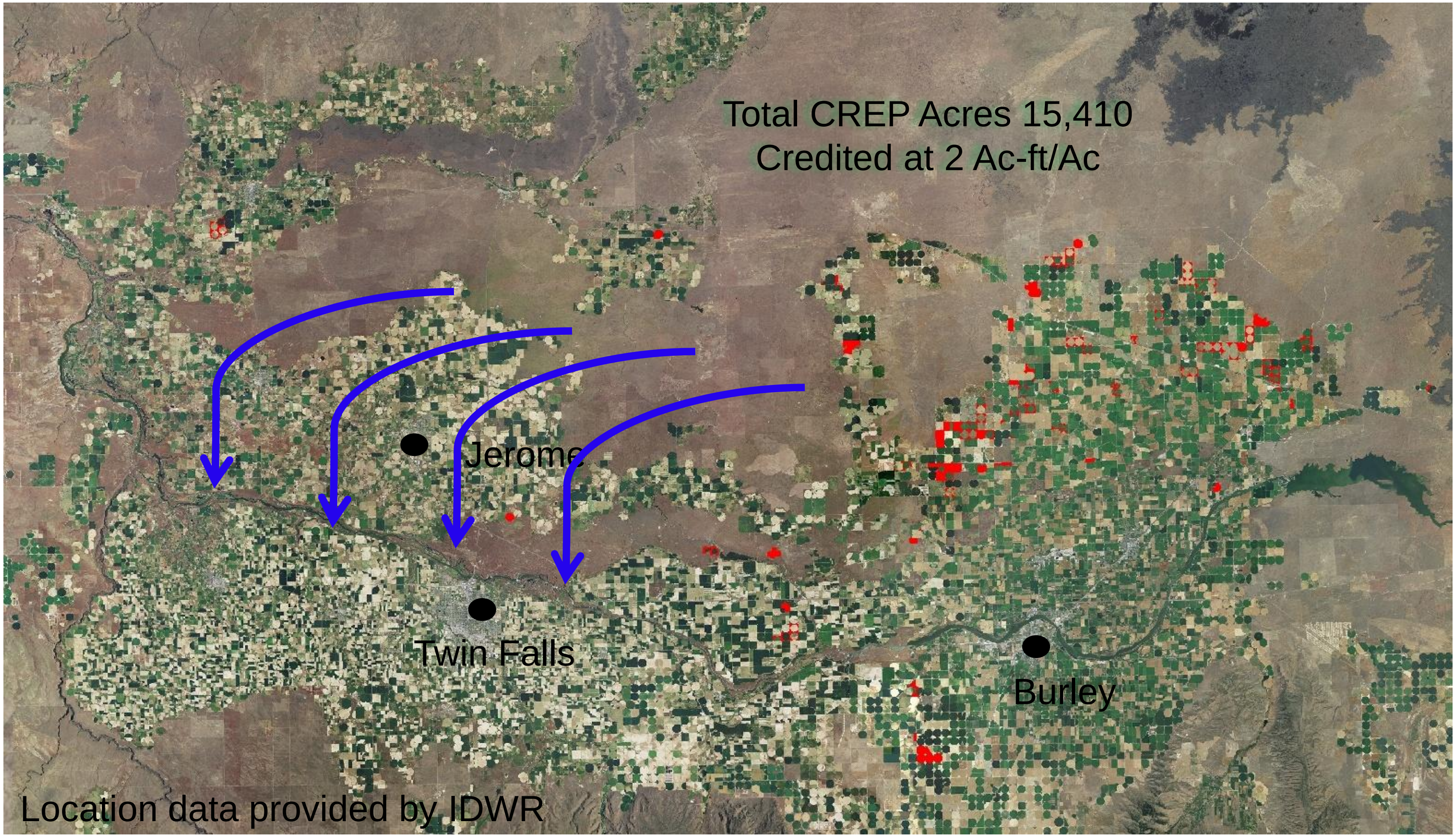
5. Calculate Monthly Exceedance Flows



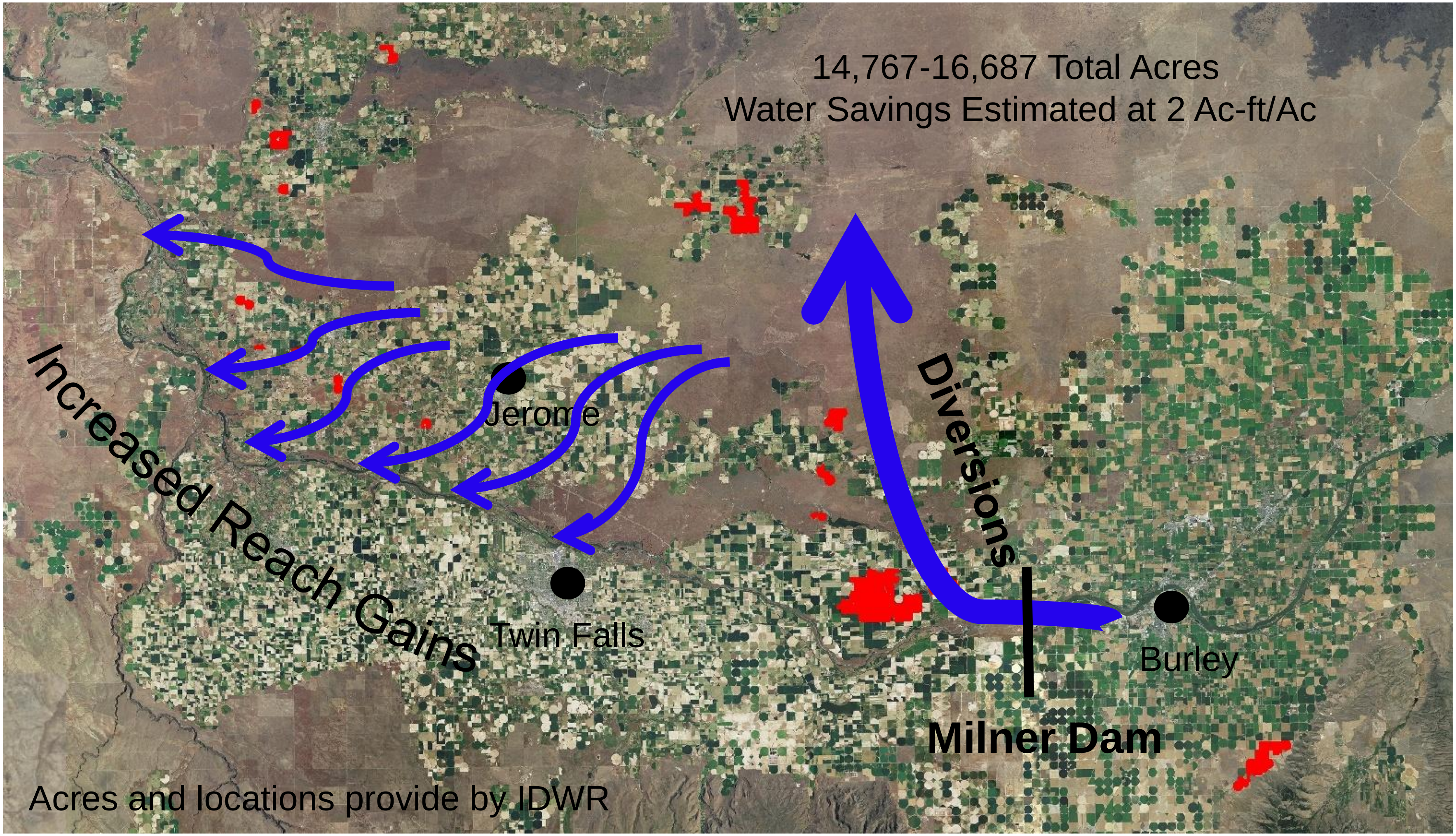
Water Management Activities

- Three Major Activities
  1. Conservation Reserve Enhancement Program (CREP)
  2. System Conversions (Ground Water to Surface Water)
  3. Managed Recharge
- Extent and timing of activities based on information provided by Idaho Department of Water Resources

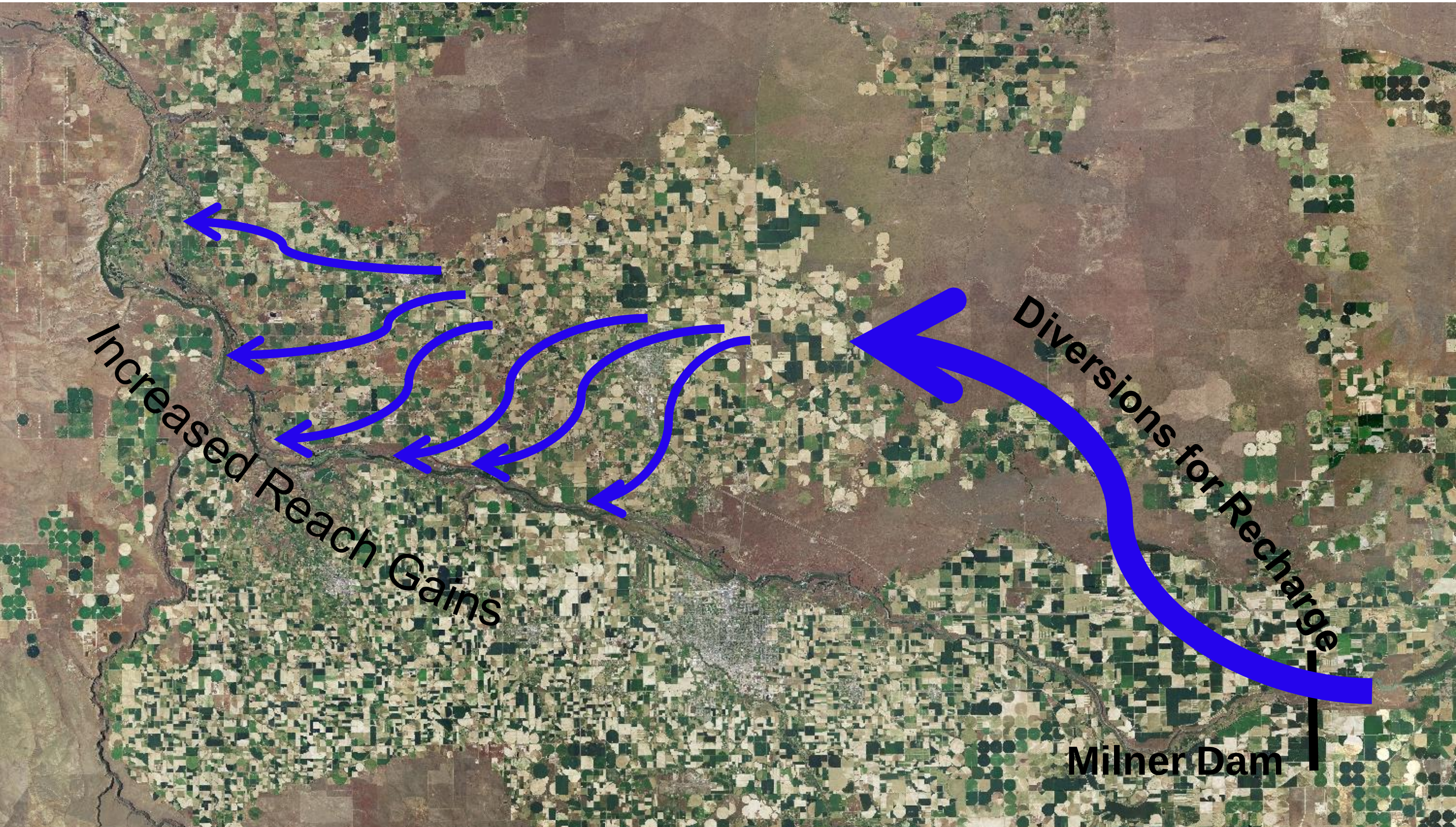
Conservation Reserve Enhancement Program (CREP)



System Conversions



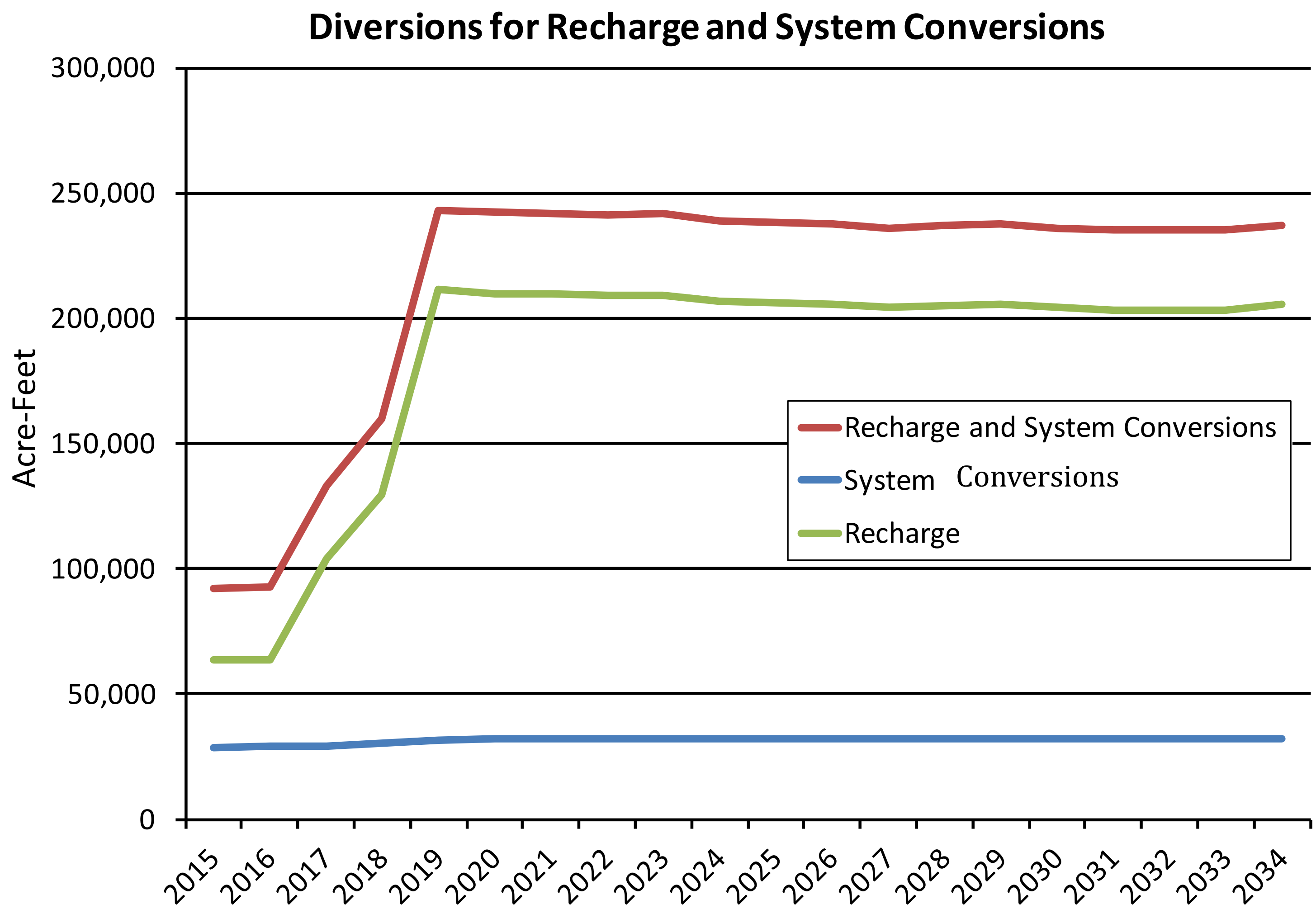
Managed Aquifer Recharge on the Eastern Snake River Plain



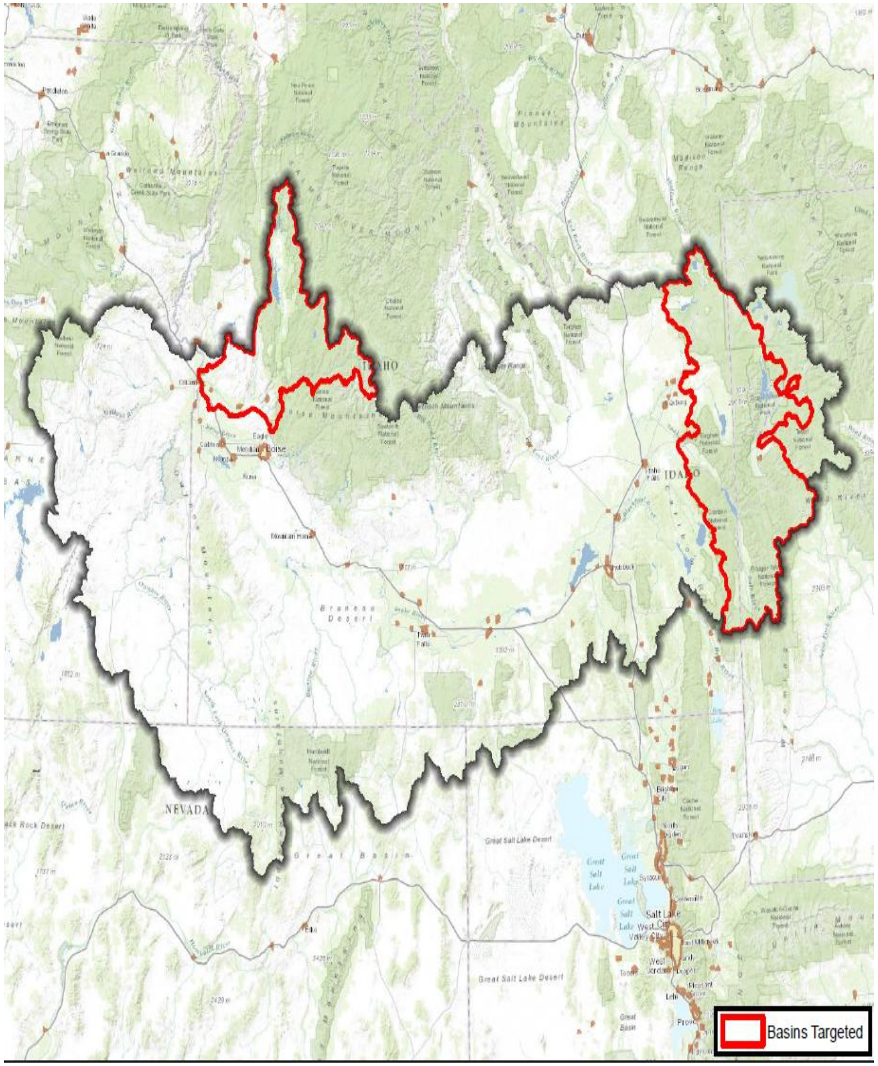
Aquifer Recharge
2015 Assumptions

- In the 2015 IRP, recharge assumptions adhere to
  - Idaho Water Resource Board preliminary plan
  - Levels established in the Swan Falls Reaffirmation Agreement
- Twelve diversions were modeled across the ESPA
- Includes some recharge through the winter
- Recharge peaks in 2019 at 211,966 ac-ft and slowly declines

System Conversions and Recharge

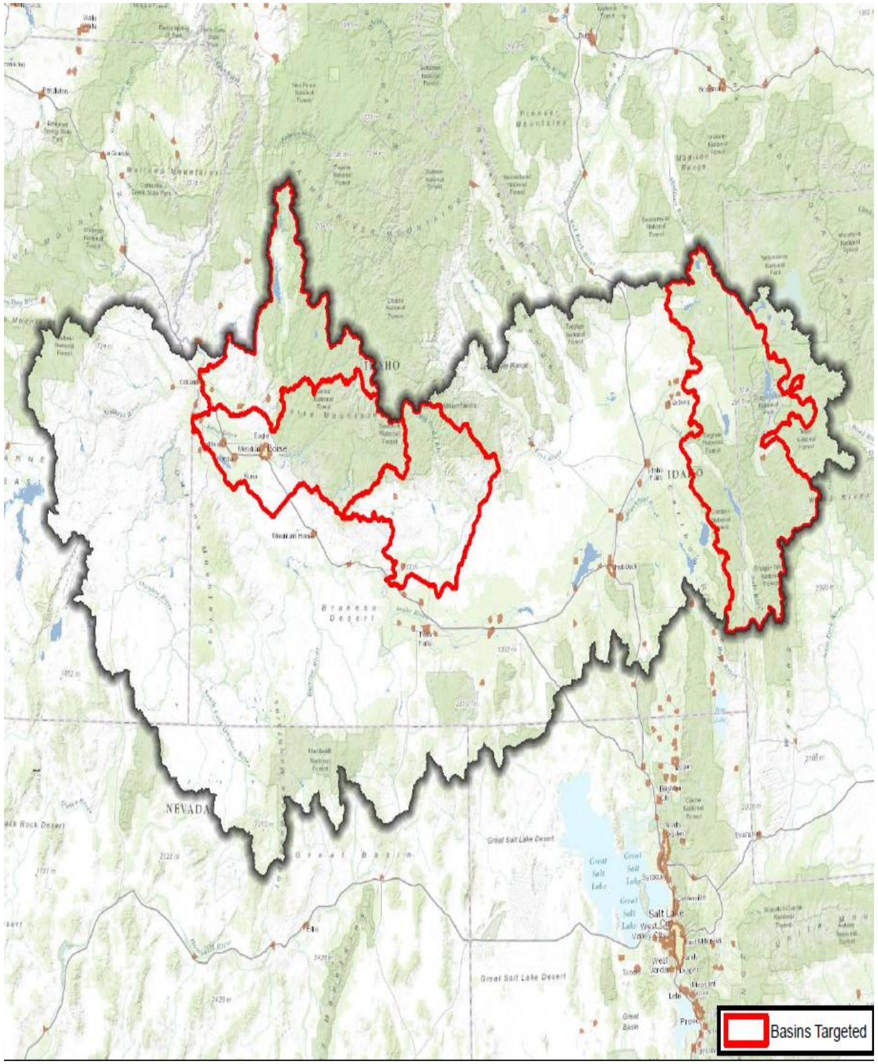


Weather Modification



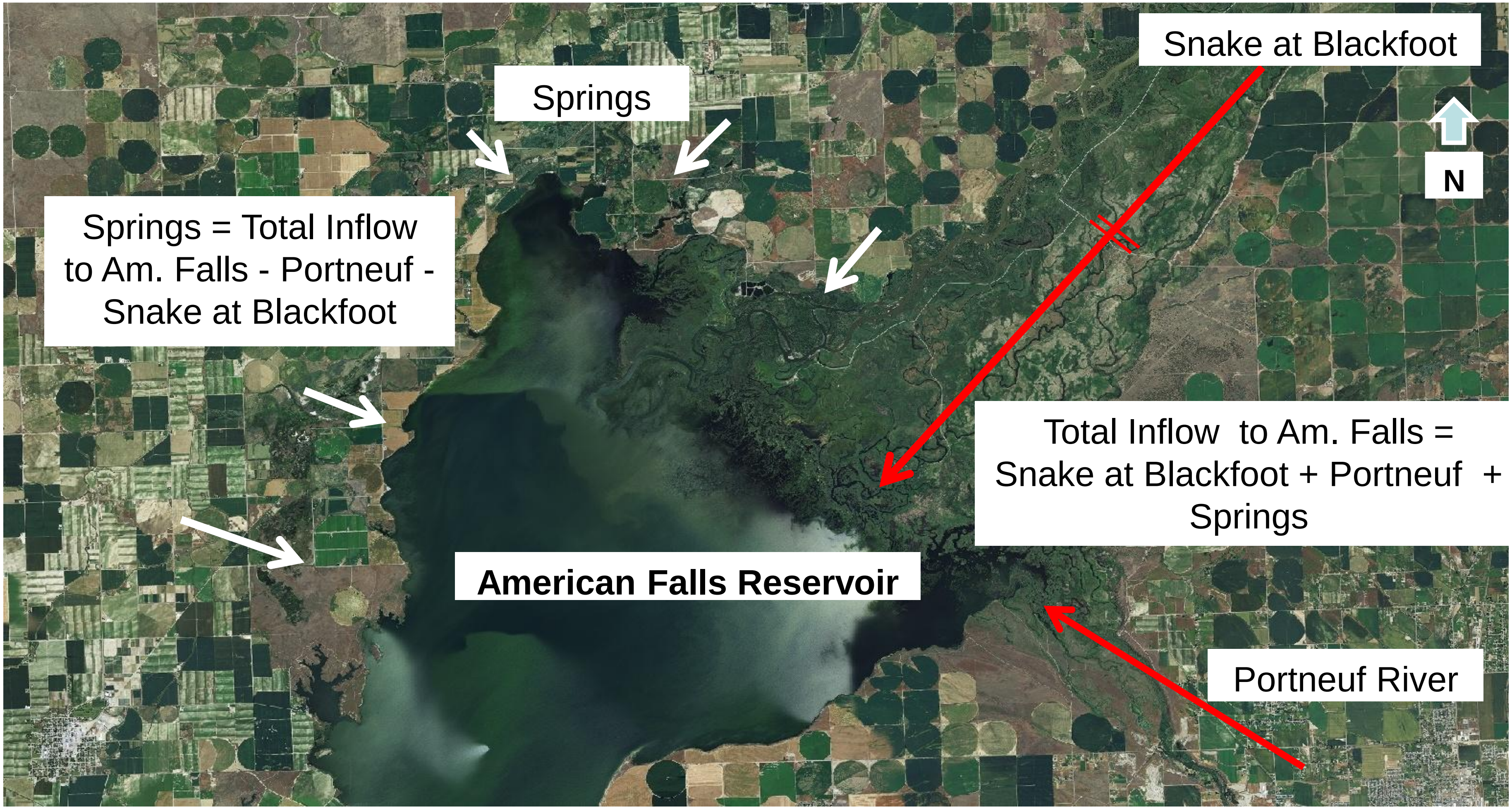
- 2013 IRP assumptions:
  - Current level of weather modification in Payette
  - Expansion in the Upper Snake and Wyoming

Weather Modification

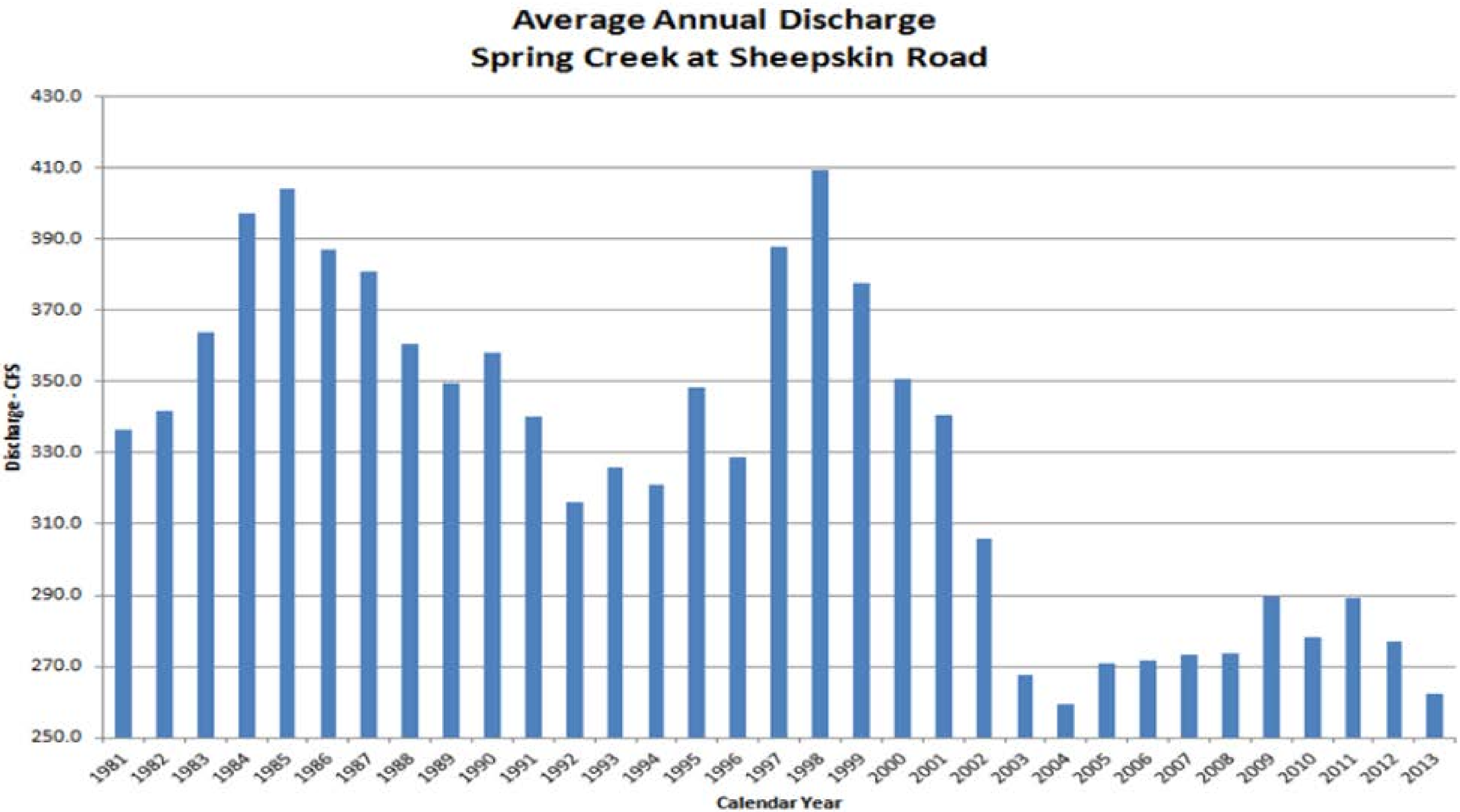


- 2015 IRP assumptions:
  - Current level of weather modification in Payette
  - Expansion in the Upper Snake and Wyoming
  - Development and expansion in Boise and Wood River Basins
- The expanded activities contribute approximately 286,000 ac-ft/yr at full build-out.

Reach Declines
Inflow to American Falls

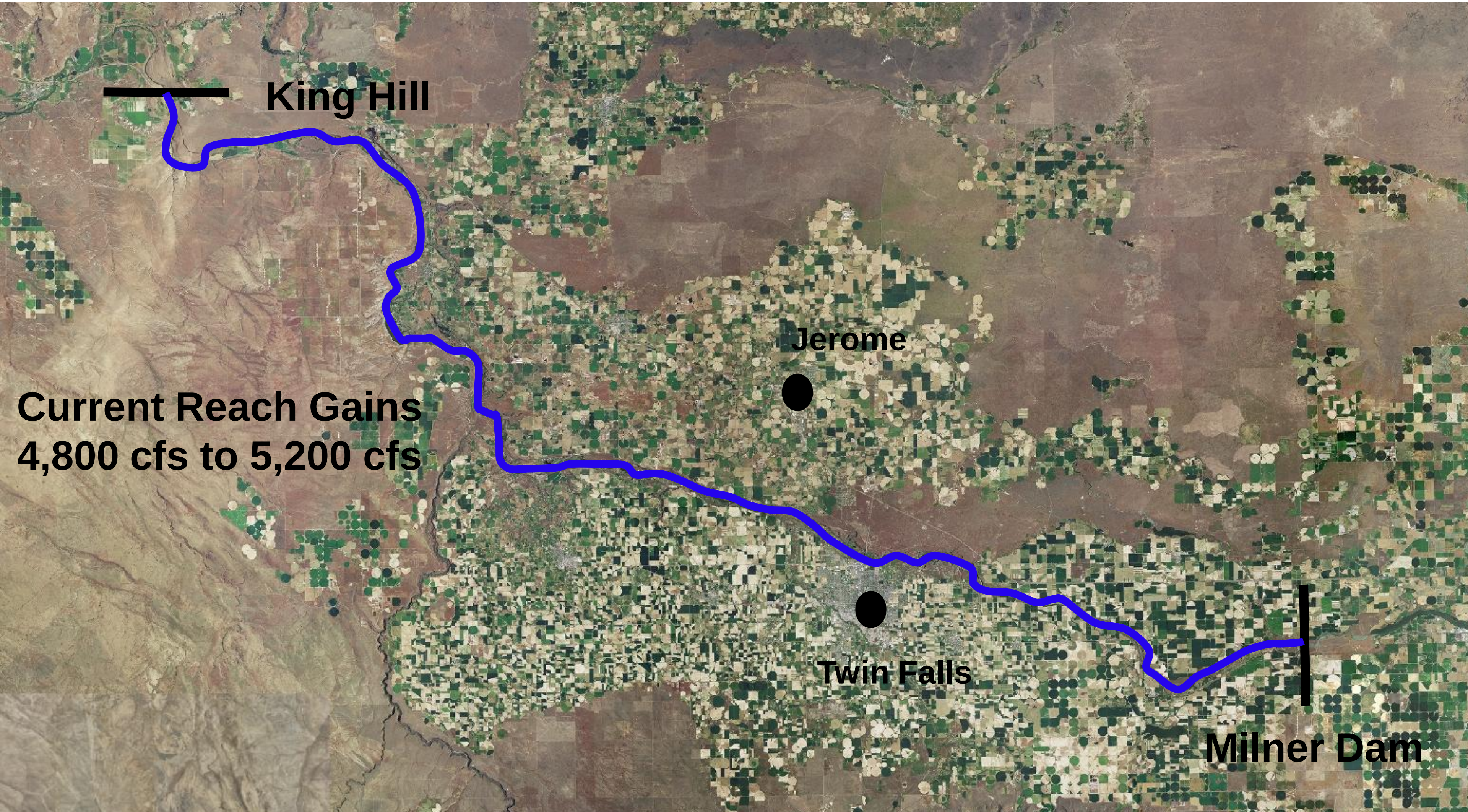


Reach Declines
Inflow to American Falls

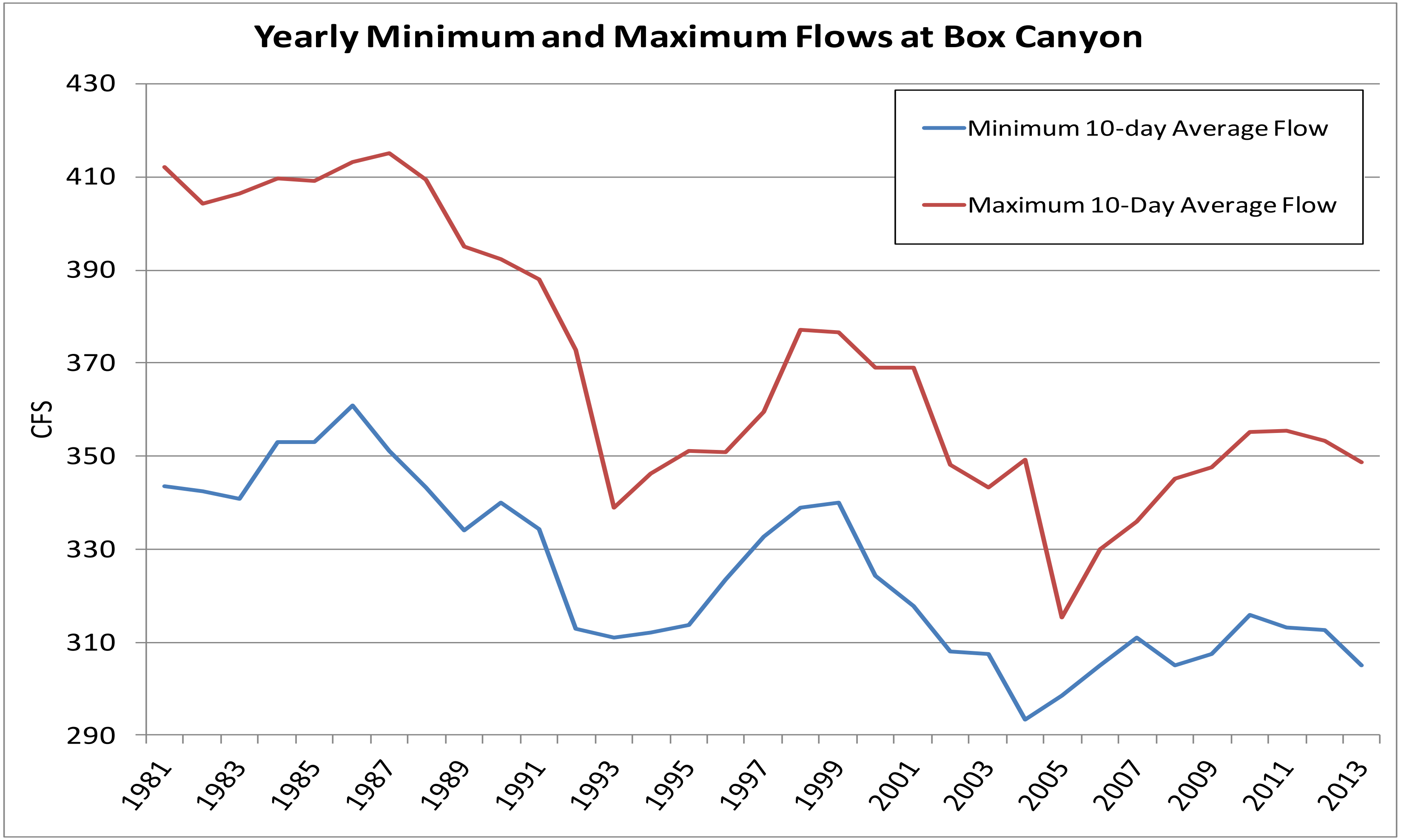


Reach Declines

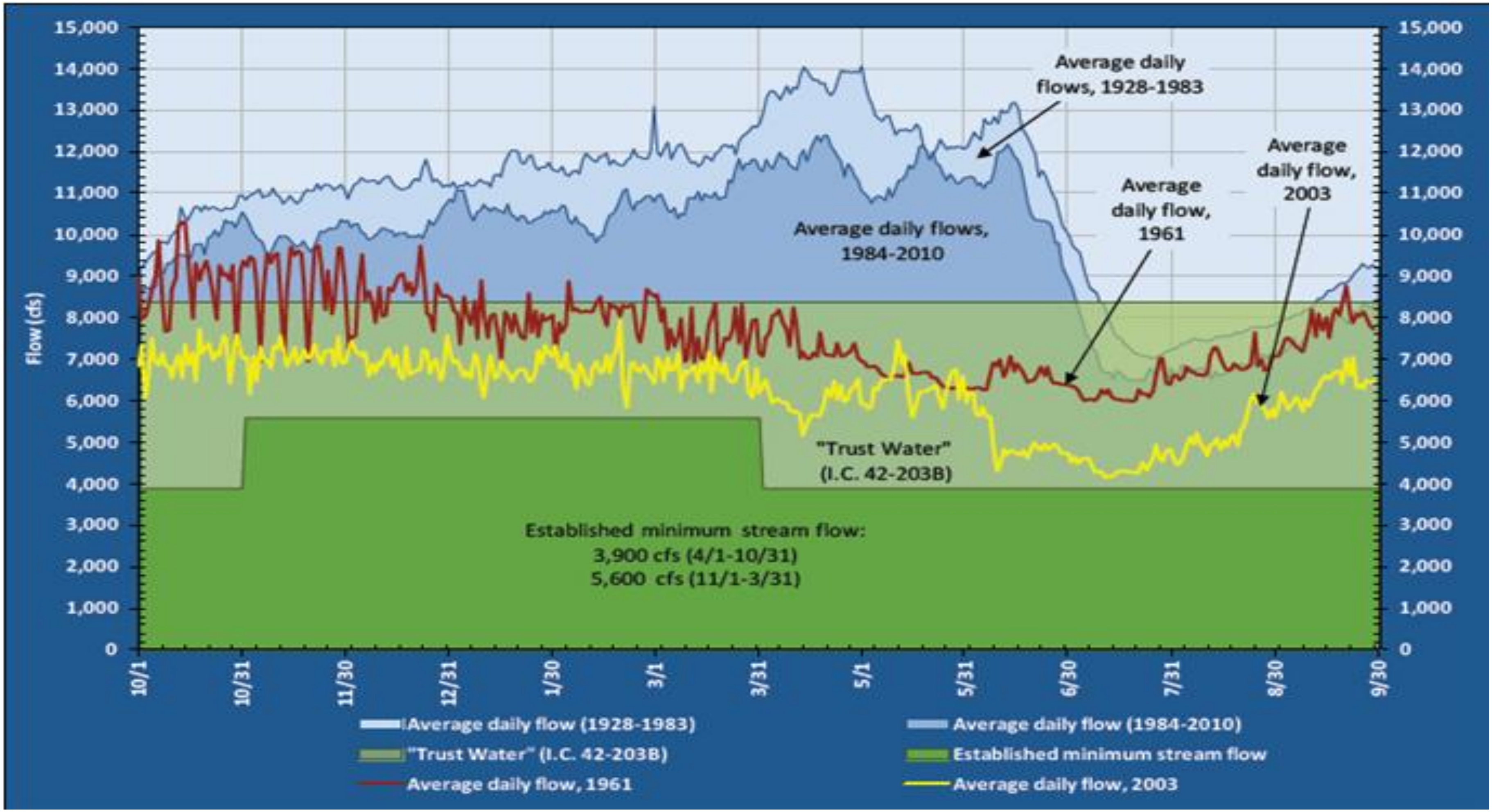
Milner to King Hill



Reach Declines
Milner to King Hill



Impacts of Reach Declines at Swan Falls



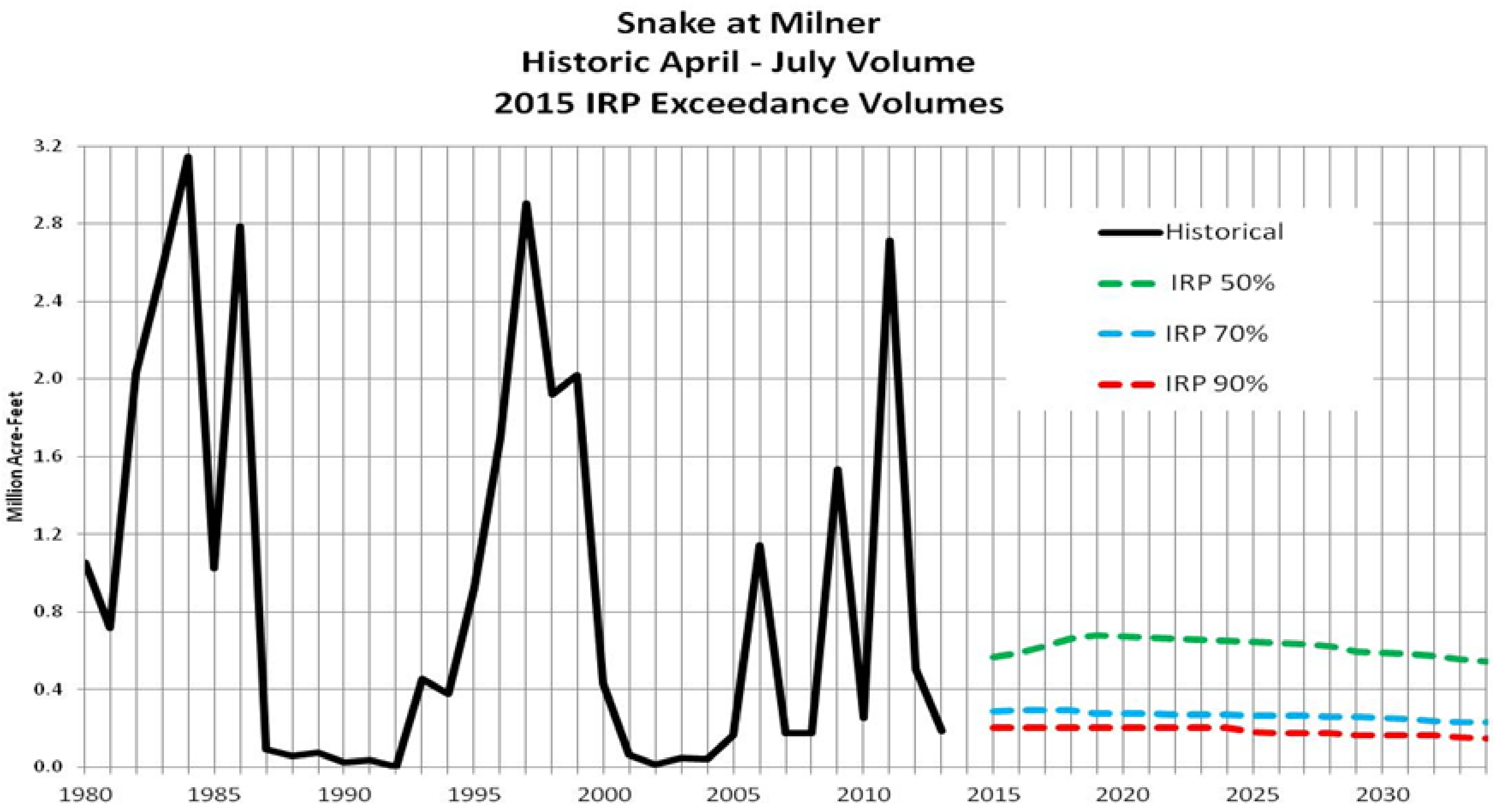
From Idaho Water Resource Board State Water Plan (Nov. 2012)

Reach Declines

- Used a similar approach to 2013 to determine reaches with a statistically significant decline
- Used 1980-2013 data for all reaches
- Maintain a rigid statistically based criteria for which declines would be included in the model
- American Falls Inflow Average -24 cfs/year (-480 cfs 2015-2034)
- Milner to Lower Salmon Average -35 cfs/year (-700 cfs 2015-2034)

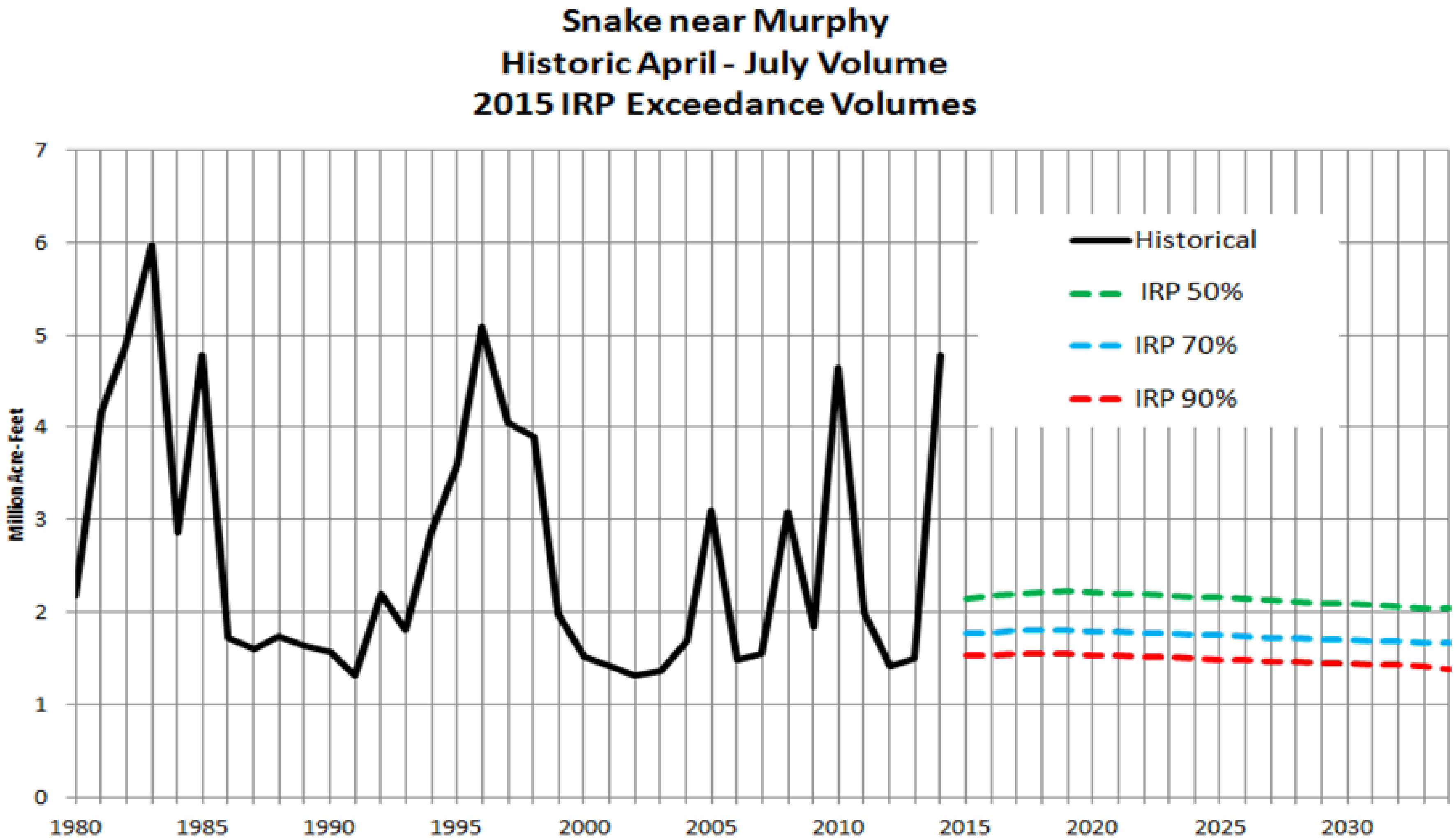
2015 IRP
Forecasted Flows at Milner

2015 IRP
Forecasted Flows at Milner

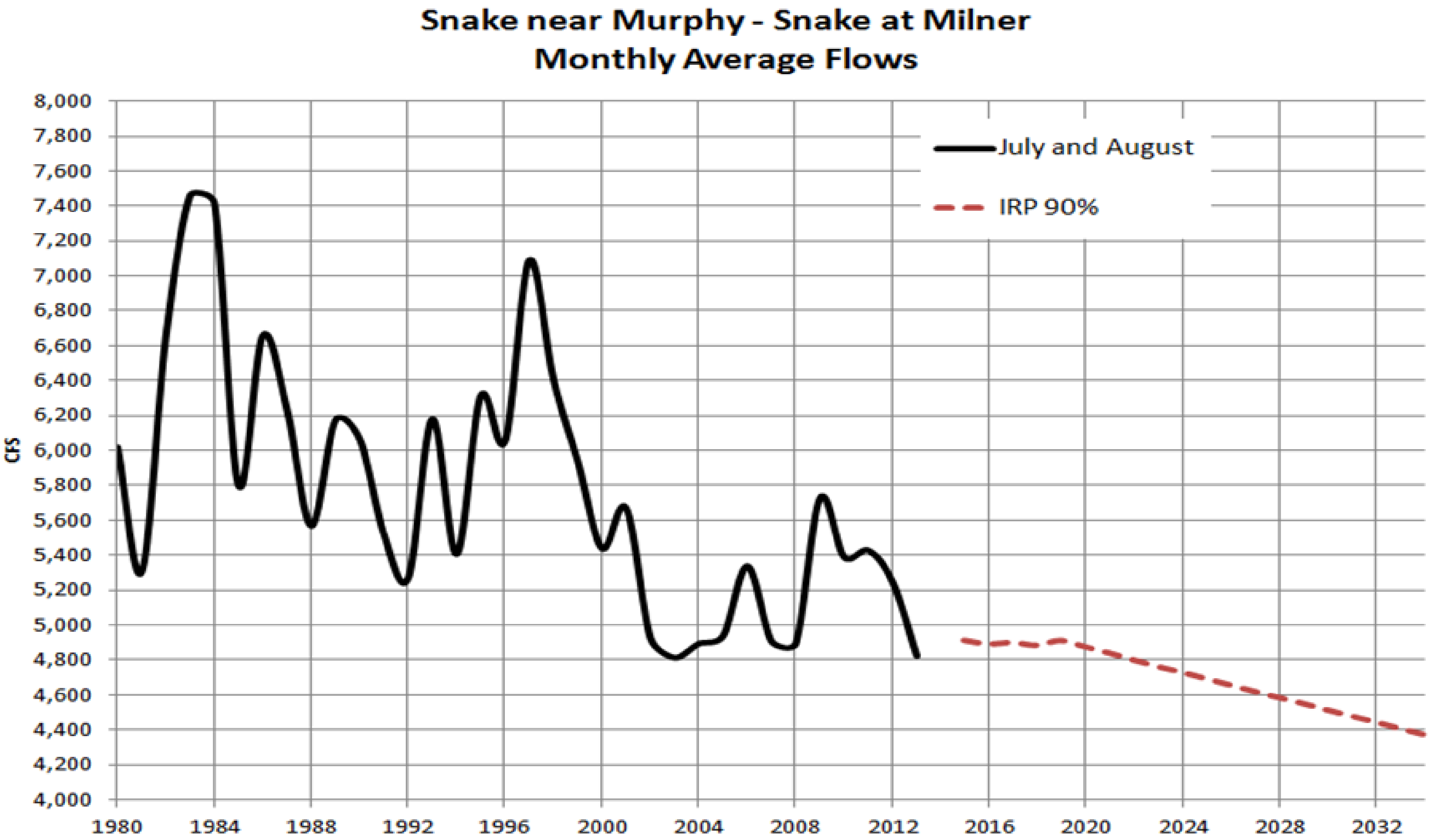


2015 IRP
Forecasted Flows at Swan Falls

2015 IRP
Forecasted Flows at Swan Falls

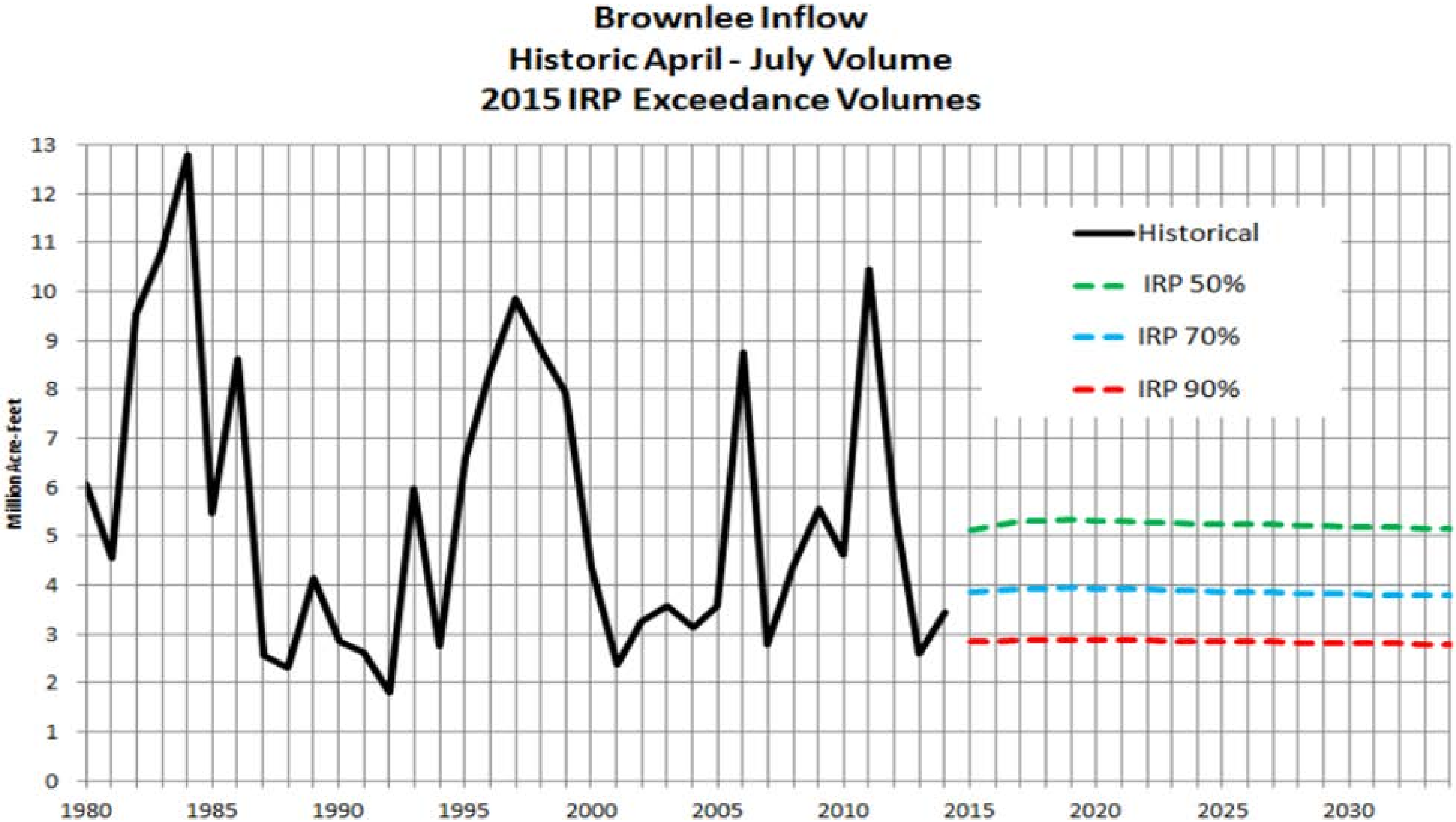


2015 IRP
Forecasted Flows at Swan Falls

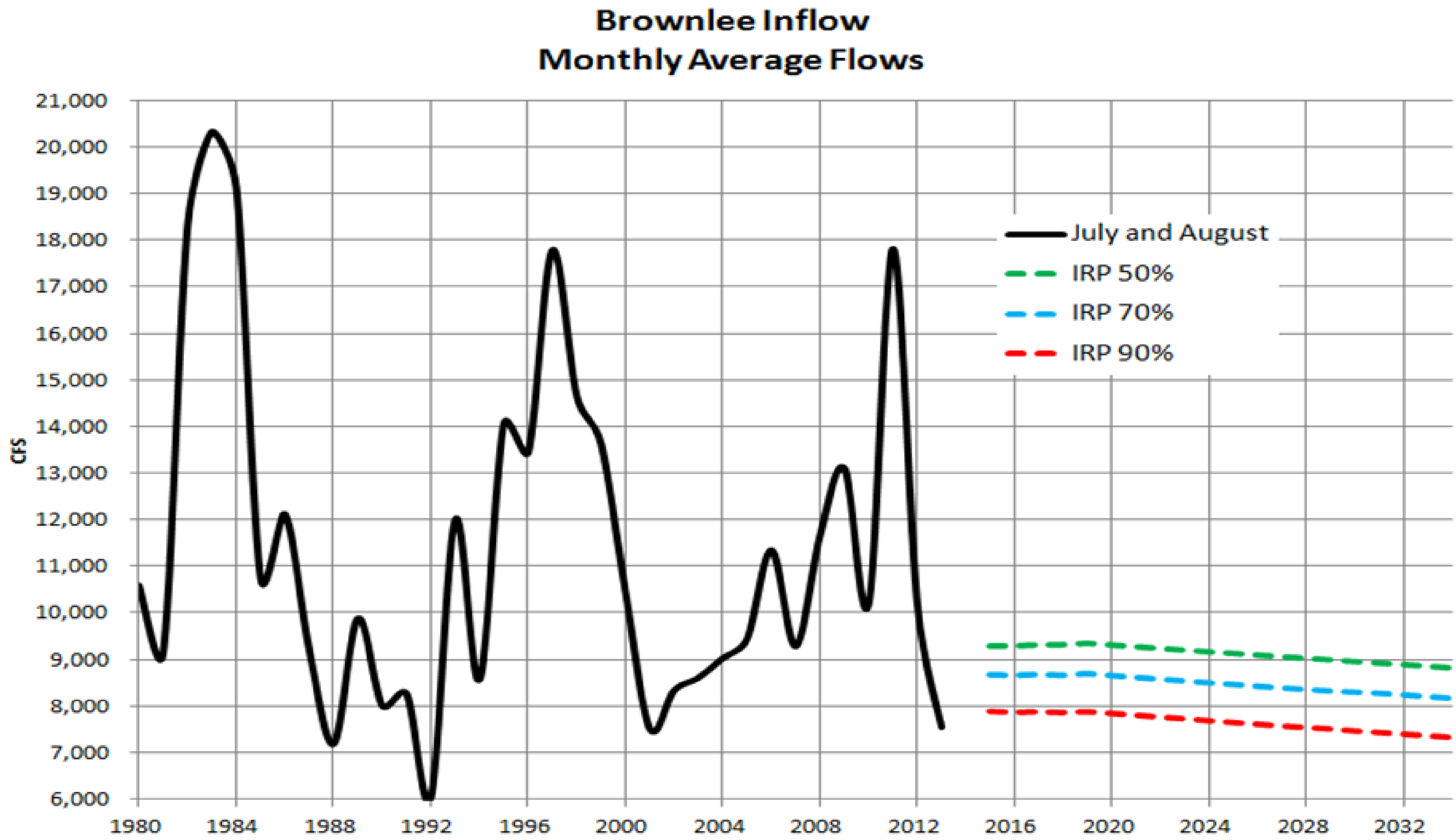


2015 IRP
Forecasted Flows at Brownlee

2015 IRP
Forecasted Flows at Brownlee



2015 IRP
Forecasted Flows at Brownlee



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Questions?

Memorandum

To: Idaho Water Resource Board

From: Remington Buyer

Date: March 7, 2016

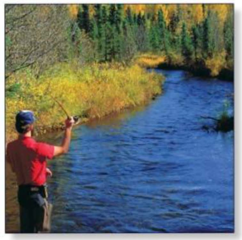
Re: Water Supply Bank 2015 Annual Report

Action Item: None.

Enclosed with this memo are two reports, summarizing administrative and financial data for the The Board's Bank and regional Rental Pools. The Board will receive a presentation on annual reports during the work session March 17th, 2015.

Water Supply Bank 2015 Annual Report

Remington Buyer
Water Supply Bank Coordinator
March 17, 2016



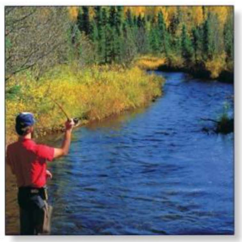
Water Supply Bank
2015 Annual Report

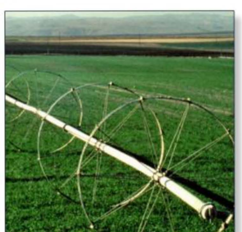
The Board's Water Supply Bank & Regional Rentals Pools

- Water Supply Bank Administration:
  - applications processed & processing times,
  - applications by type

- Rental Volumes:
  - aggregate & basin specific rental volumes,
  - warrant payments owed to lessors for WSB rentals,

- Financial Analysis:
  - Revenue received, overall & by application type,
  - Total revenue received as a percentage of applications processed,
  - Revenue received and costs expensed, per application processed





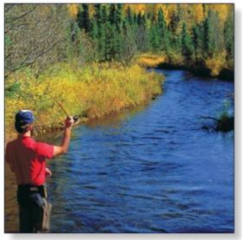
Annual Report for
The Board's Water Supply Bank

Macro level trends

- Explosive growth is continuing:
    - More applications processed in 2015 than ever before,
    - More water rented in 2015 than ever before,
    - More revenue generated in 2015 than ever before,
    - More warrants payouts in 2015 than ever before

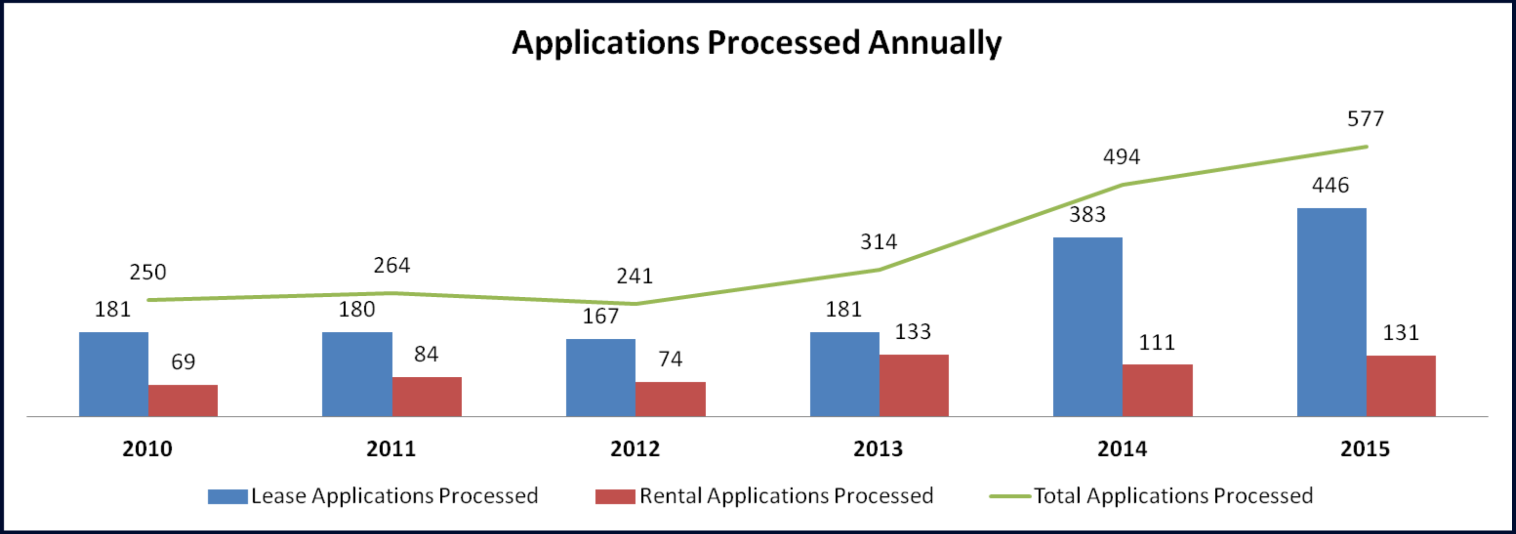
Data details and trends

- Applications being processed earlier = improved program administration,
- Marginal but stable increases in revenue generated in 2015,
- Companion applications being processed decreased slightly,
- Application processing becoming more efficient, however,
- Revenue per application remains smaller than cost per application,
- Adjusting price structures necessary to address financial imbalances.



Annual Report for
The Board's Water Supply Bank

Increased productivity: more applications processed in 2015 than ever before



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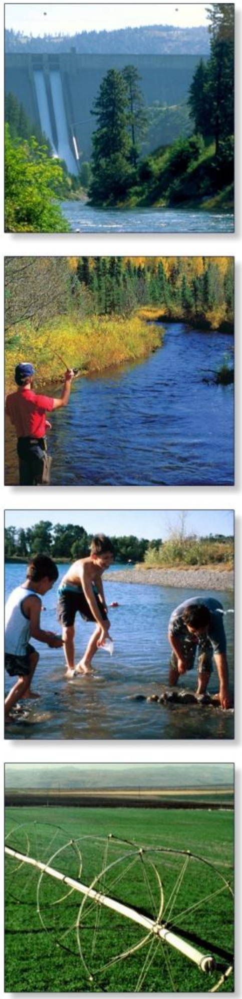
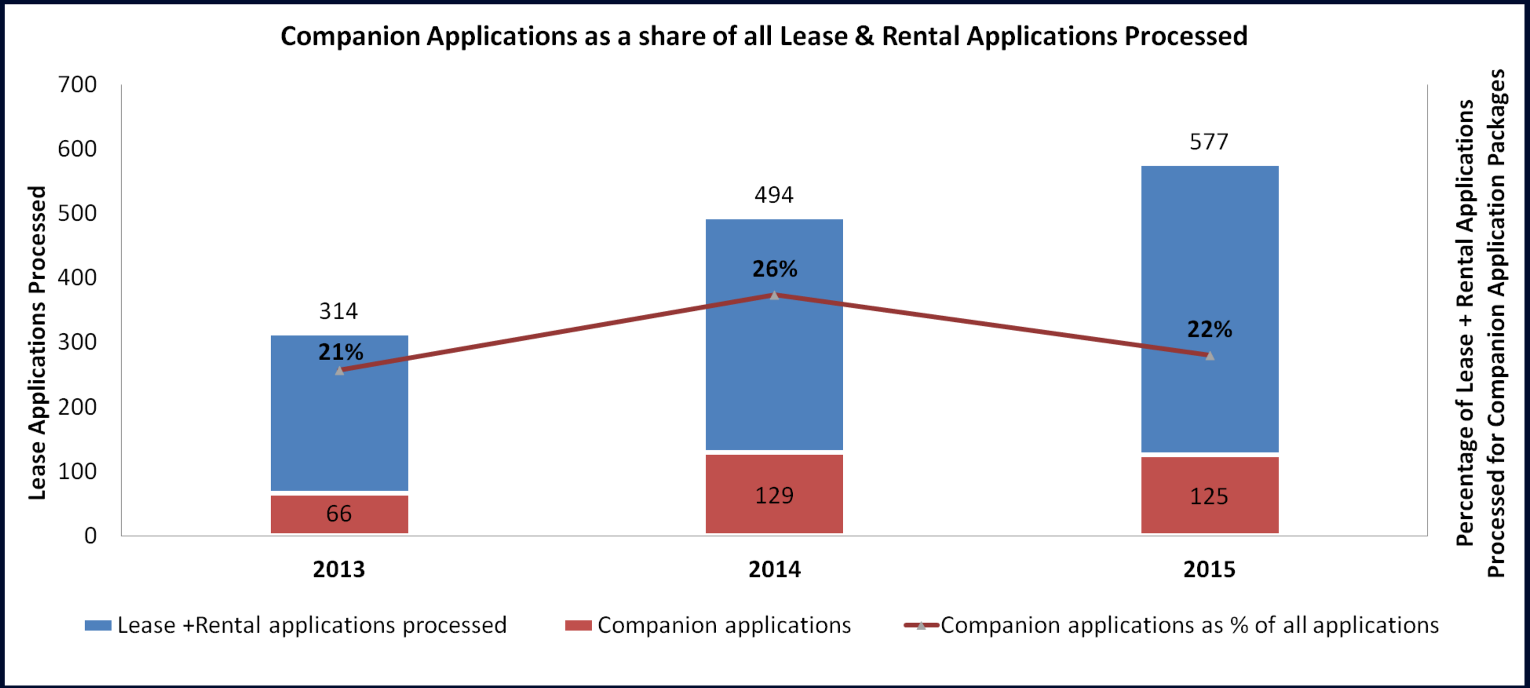


Annual Report for
The Board's Water Supply Bank

The proportion of companion applications remains stable



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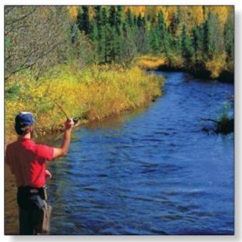
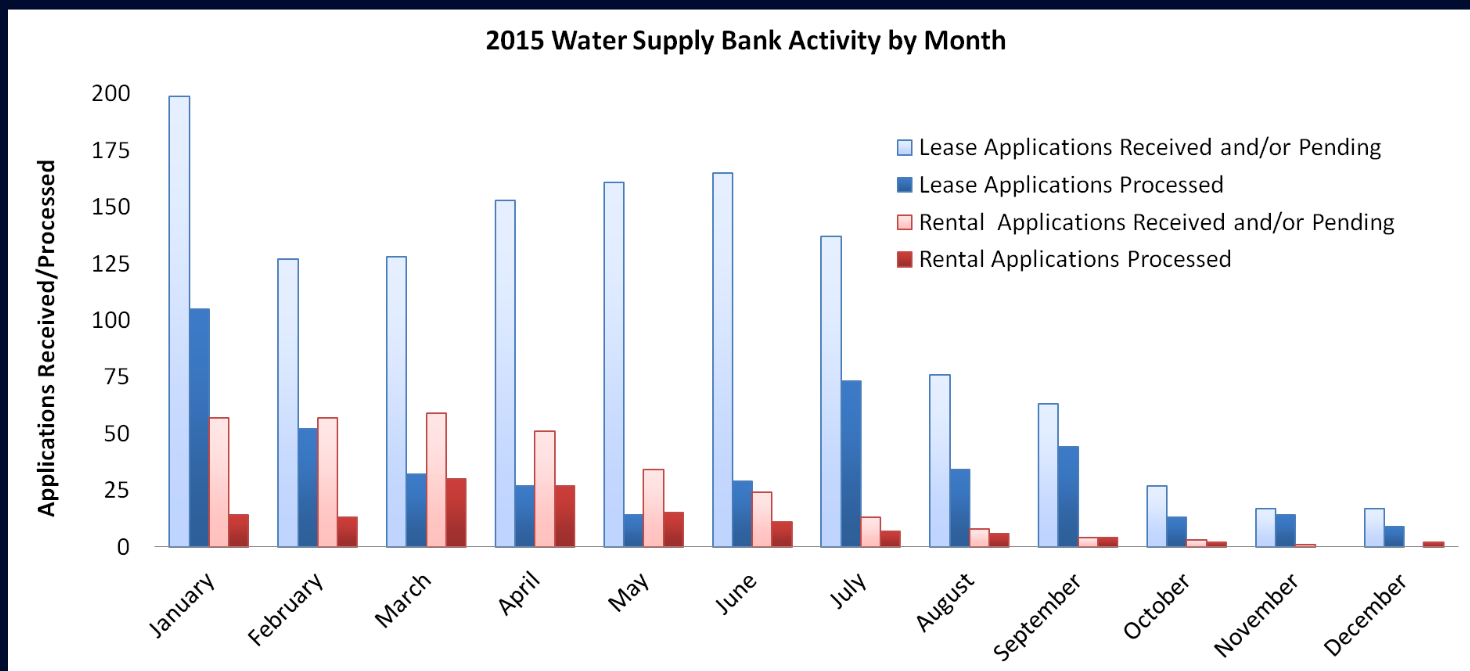


Annual Report for

The Board's Water Supply Bank

Administrative Objective: Process rentals January through May



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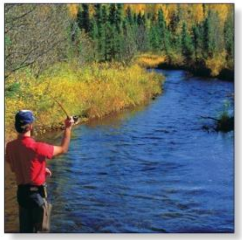
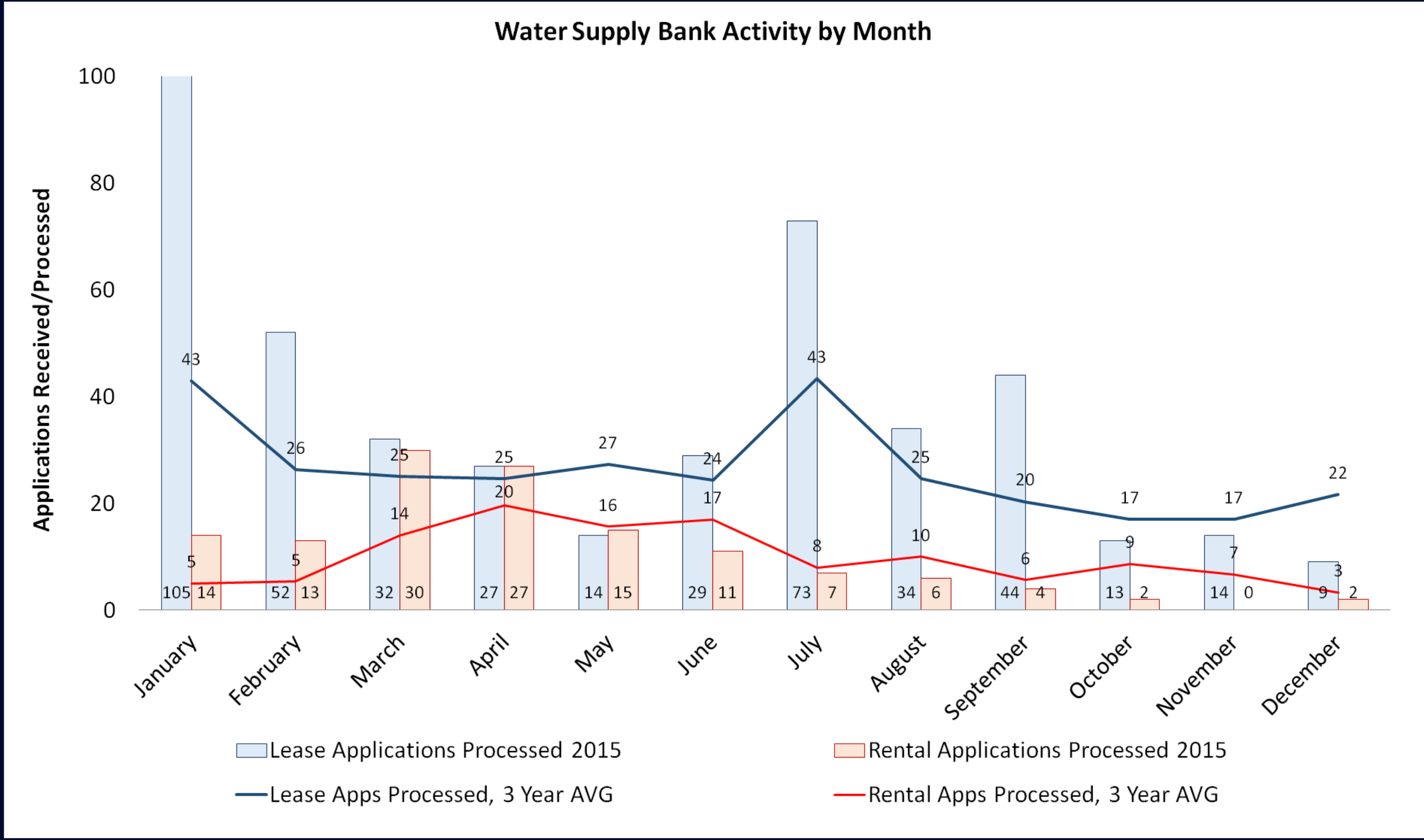


Annual Report for

The Board's Water Supply Bank

Improved processing: applications are being executed earlier in the year



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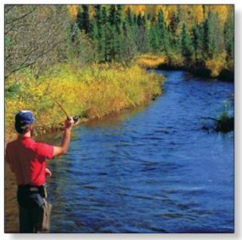
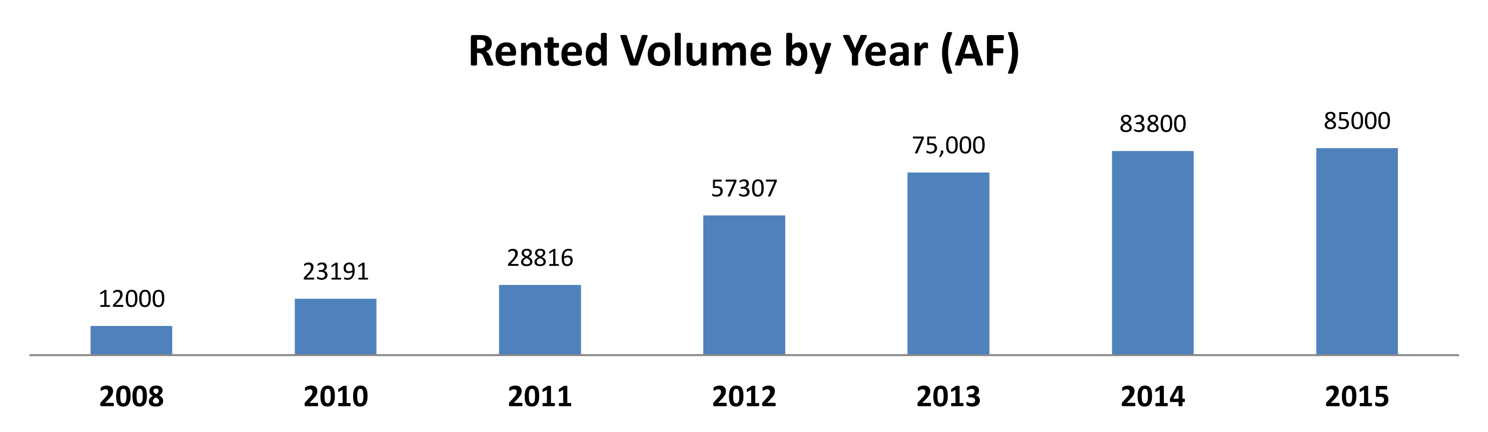
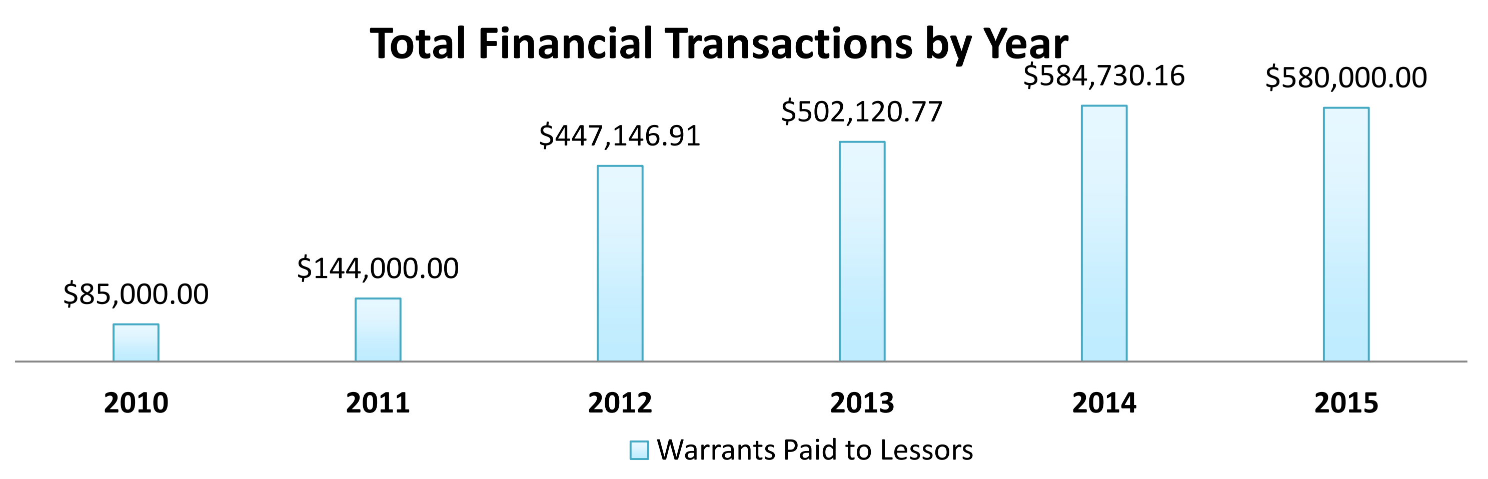


Annual Report for

The Board's Water Supply Bank

Stabilizing rental volumes indicate the Bank is satisfying demand for rentals





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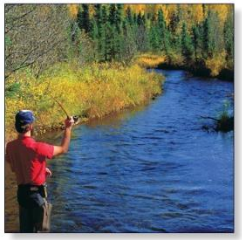
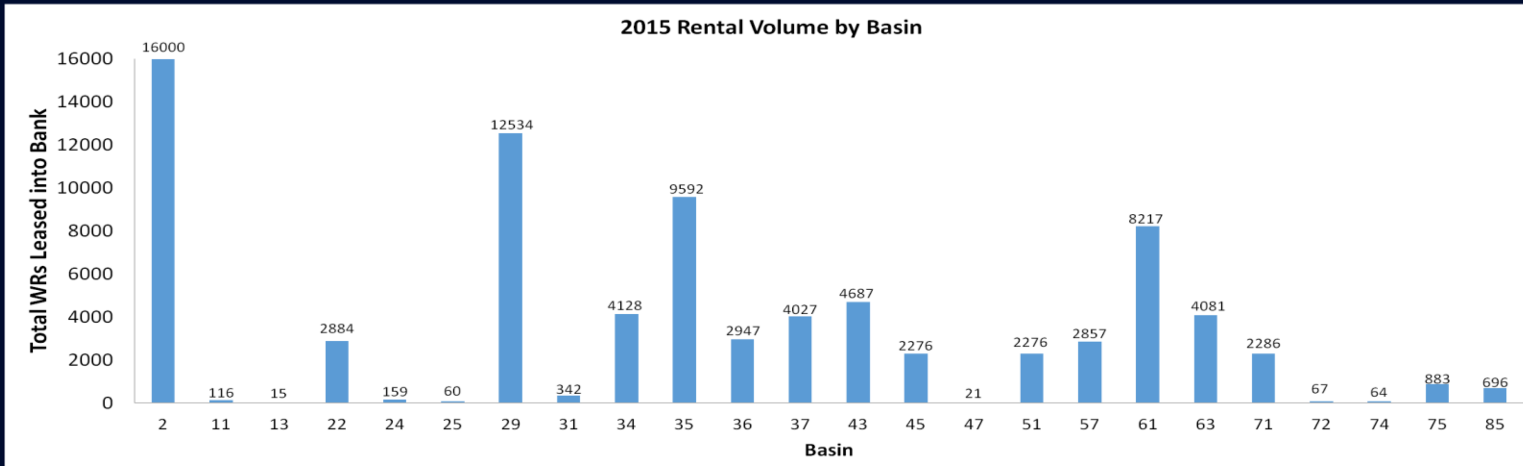


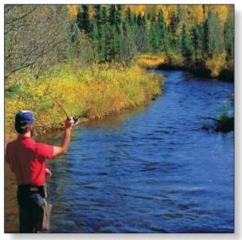
Annual Report for

The Board's Water Supply Bank

Southern Idaho Water Rights are in High Demand



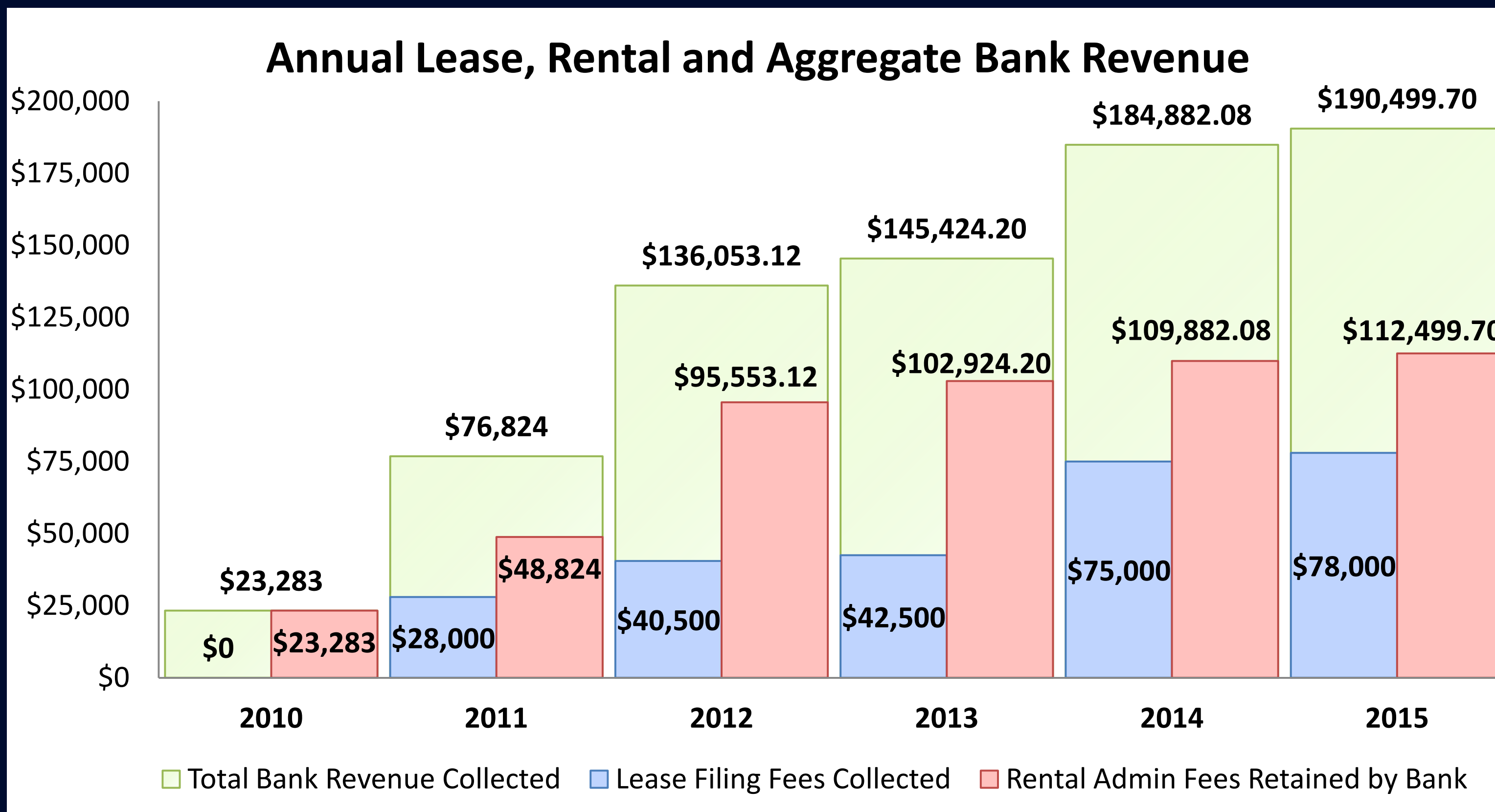
	2013				2014				2015			
#	Basin	Water Source	Volume	% of Total	Basin	Water Source	Volume	% of Total	Basin	Water Source	Volume	% of Total
1	43	Raft River	11355	15%	43	Raft River	11335	14%	2	Snake River	16000	19%
2	2	Snake River	11000	15%	29	Blackfoot Basin	9088	11%	29	Blackfoot Basin	12534	15%
3	29	Blackfoot Basin	9088	12%	37	Wood River Basin	8804	11%	35	ESPA - American Falls	9592	11%
4	37	Wood River Basin	8804	12%	34	Big Lost Basin	8635	10%	61	Mountain Home	8217	10%
5	34	Big Lost Basin	8635	12%	36	ESPA - Magic Valley	8472	10%	43	Raft River	4687	6%
			48882	65%			46334	55%			51030	60%

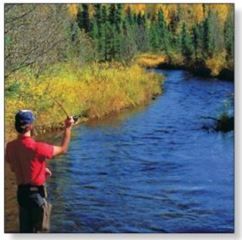


Annual Report for

The Board's Water Supply Bank

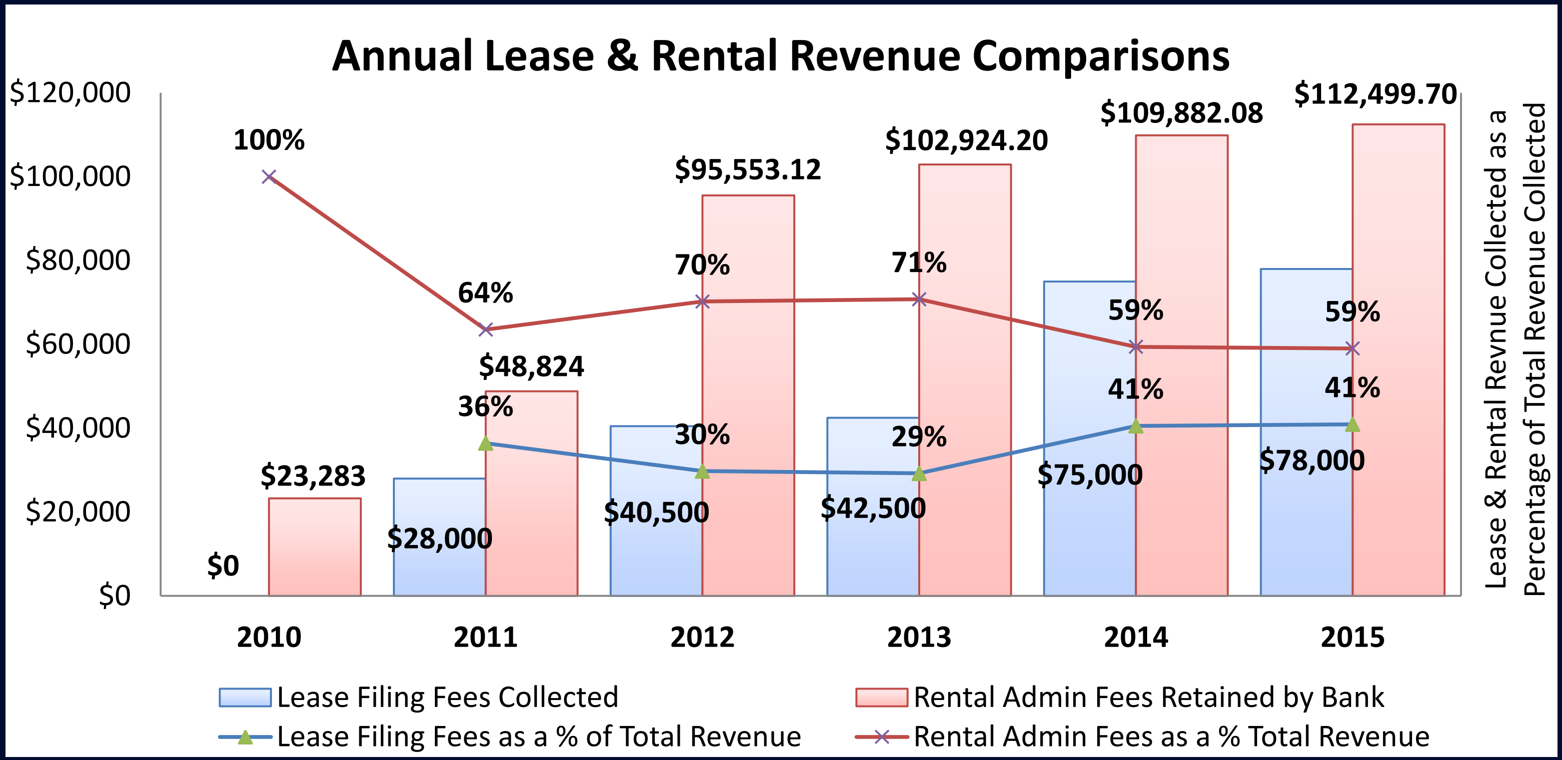
Increased revenue: lease and rental revenue generated, marginally higher





Annual Report for
The Board's Water Supply Bank

Revenue sources remain stable and consistent



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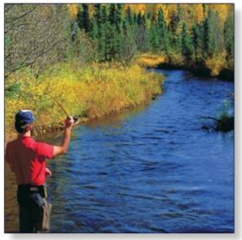
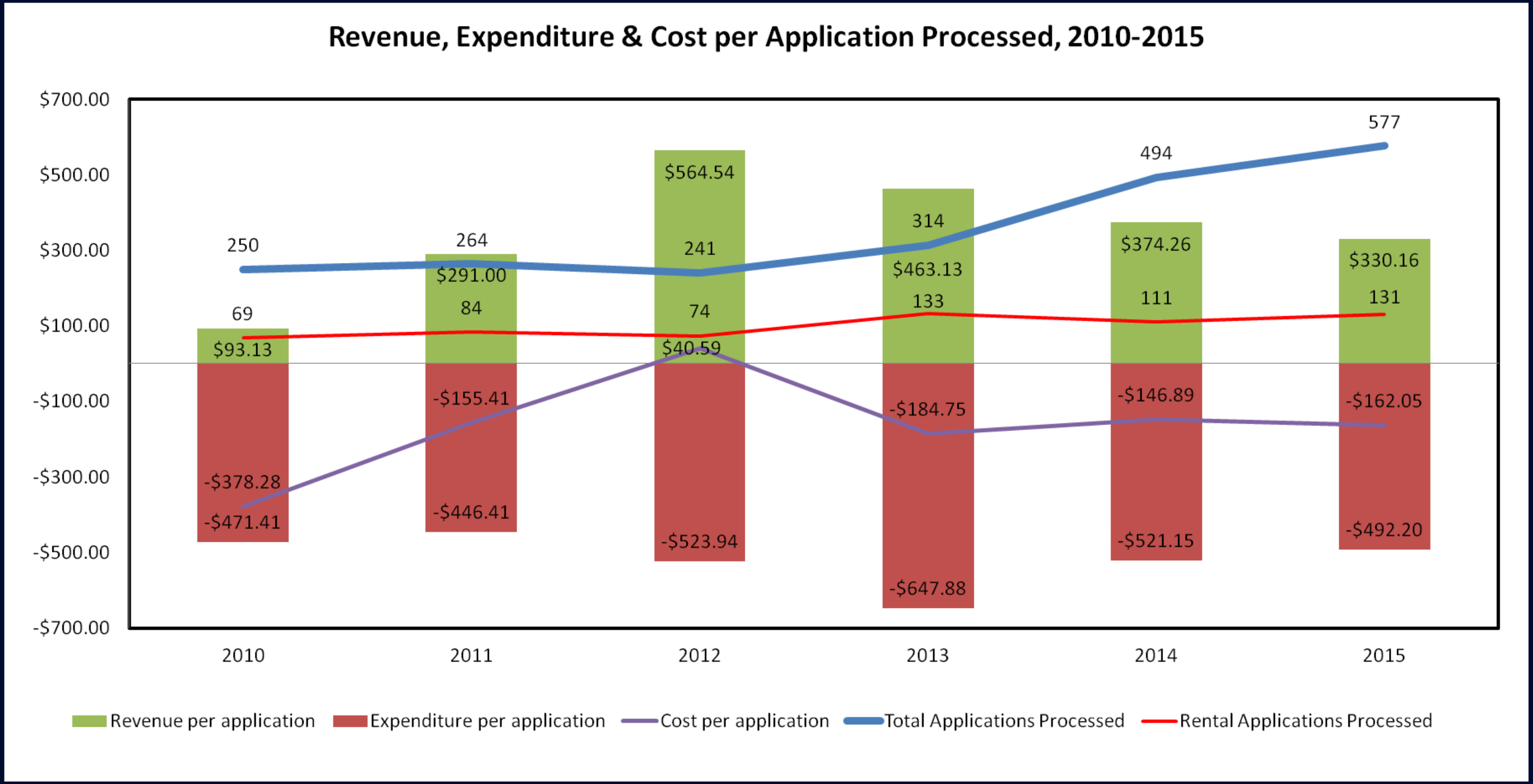


Annual Report for
The Board's Water Supply Bank

Revenue per application and cost per application are both declining



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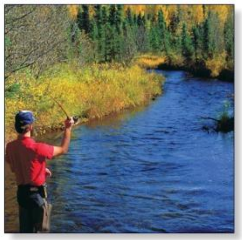
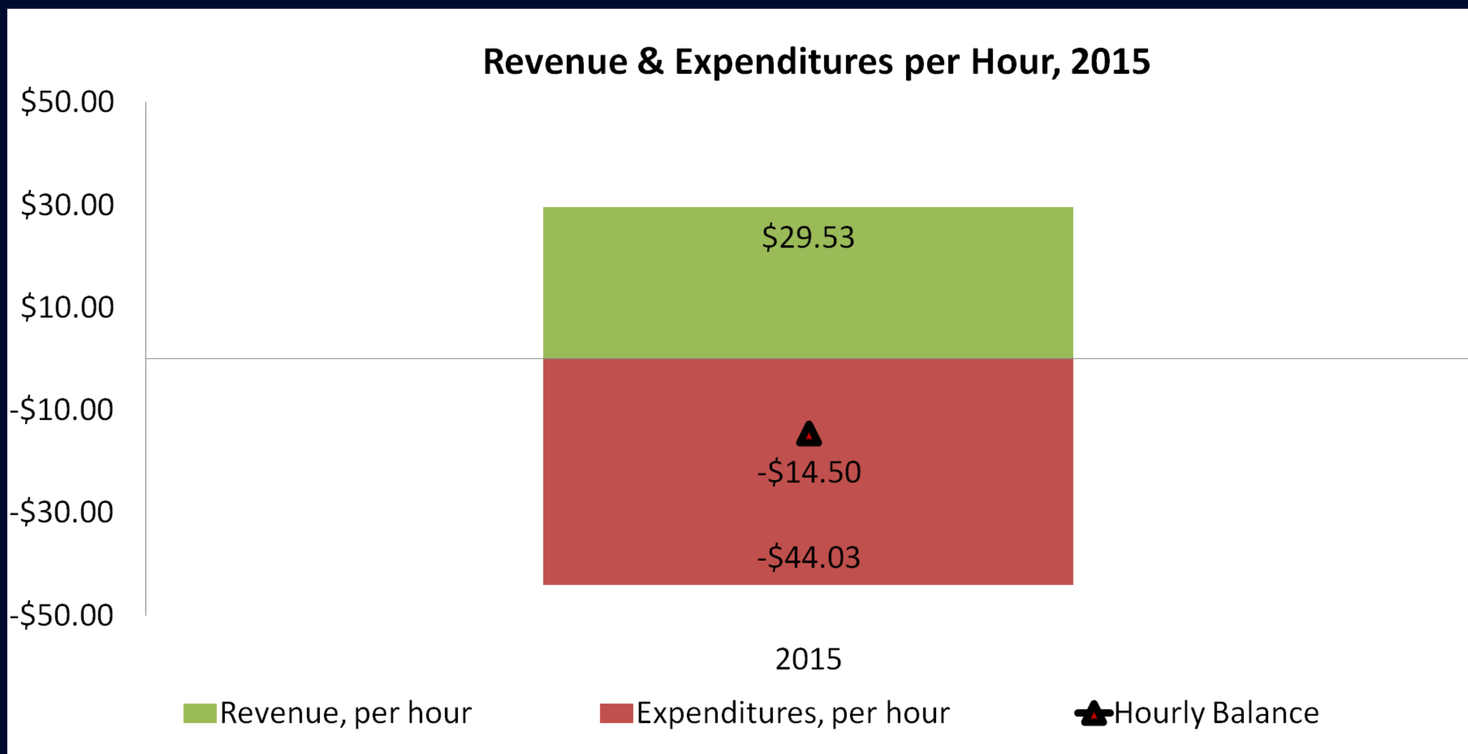


Annual Report for

The Board's Water Supply Bank

The Bank is currently operating with a negative hourly billing rate



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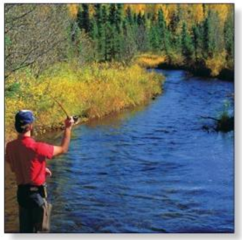
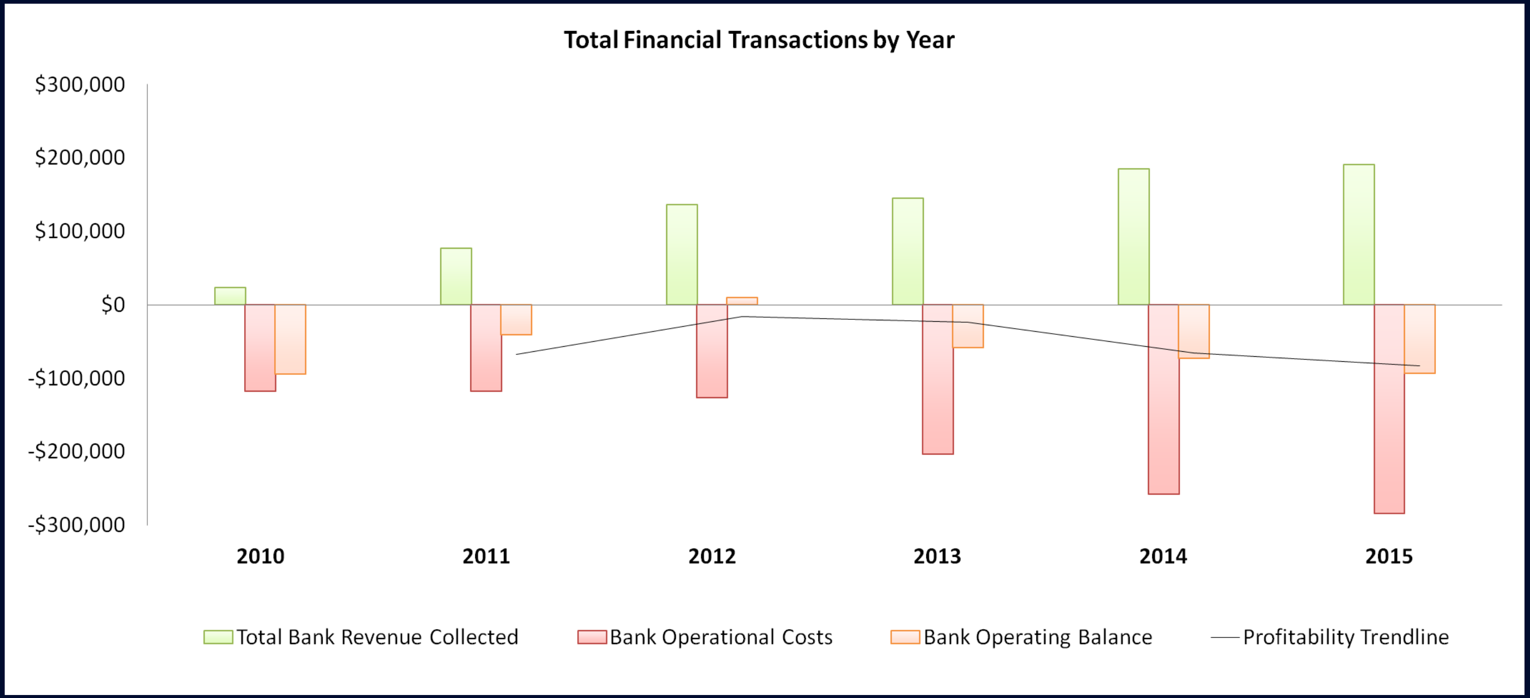
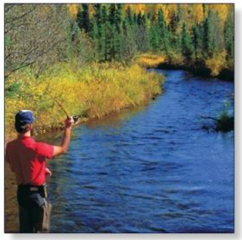


Annual Report for

The Board's Water Supply Bank

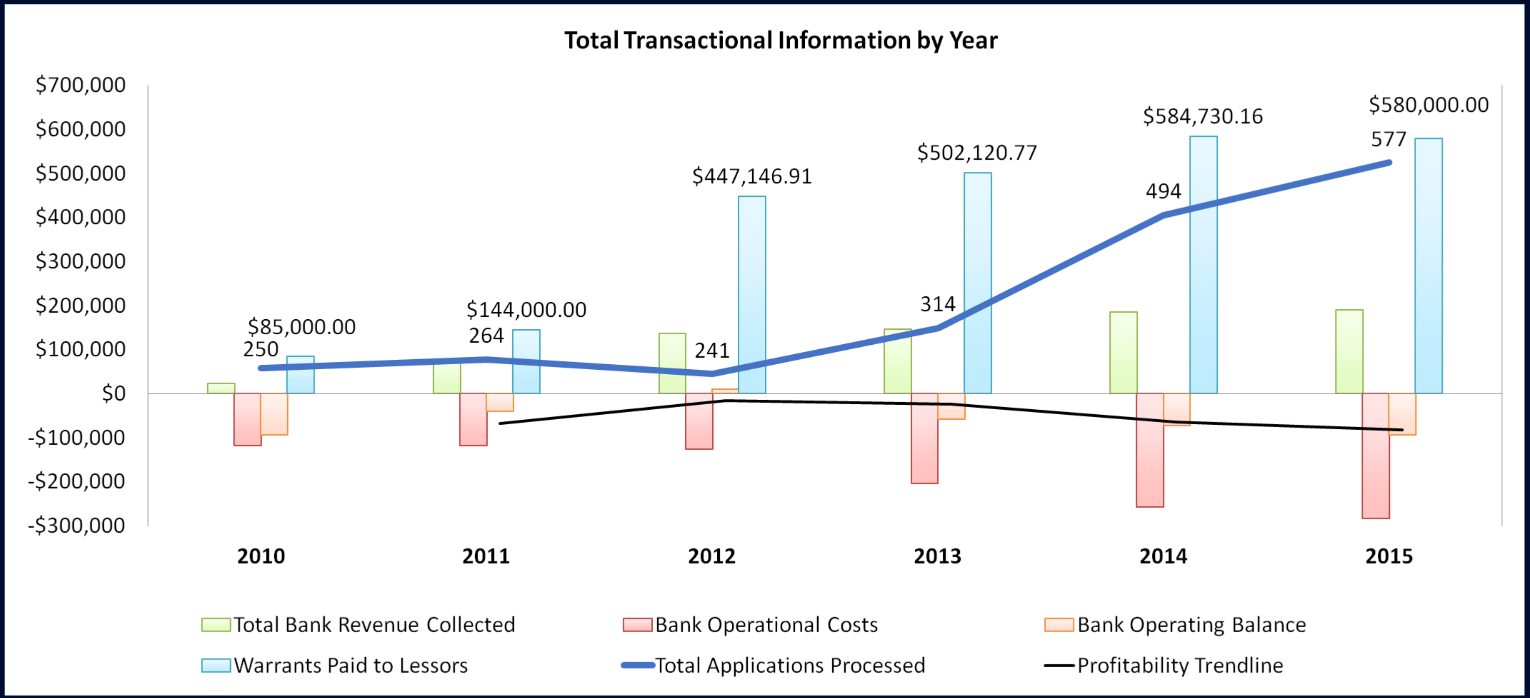
Attention is required to address declining operational balances





Annual Report for
The Board's Water Supply Bank

The utility of the program is greater than the current operational deficit



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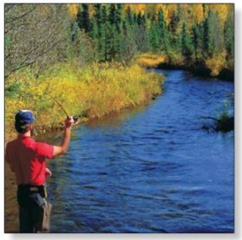
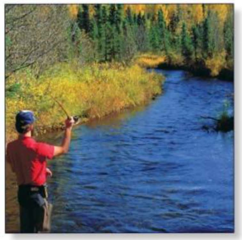


Annual Report for
The Board's Water Supply Bank

Annual Report for
Regional Rental Pools

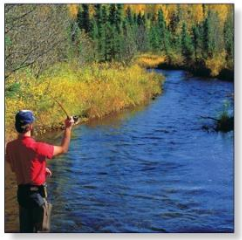
Volume leased to and rented from the rental pools,

Bureau of Reclamation transfers and rentals

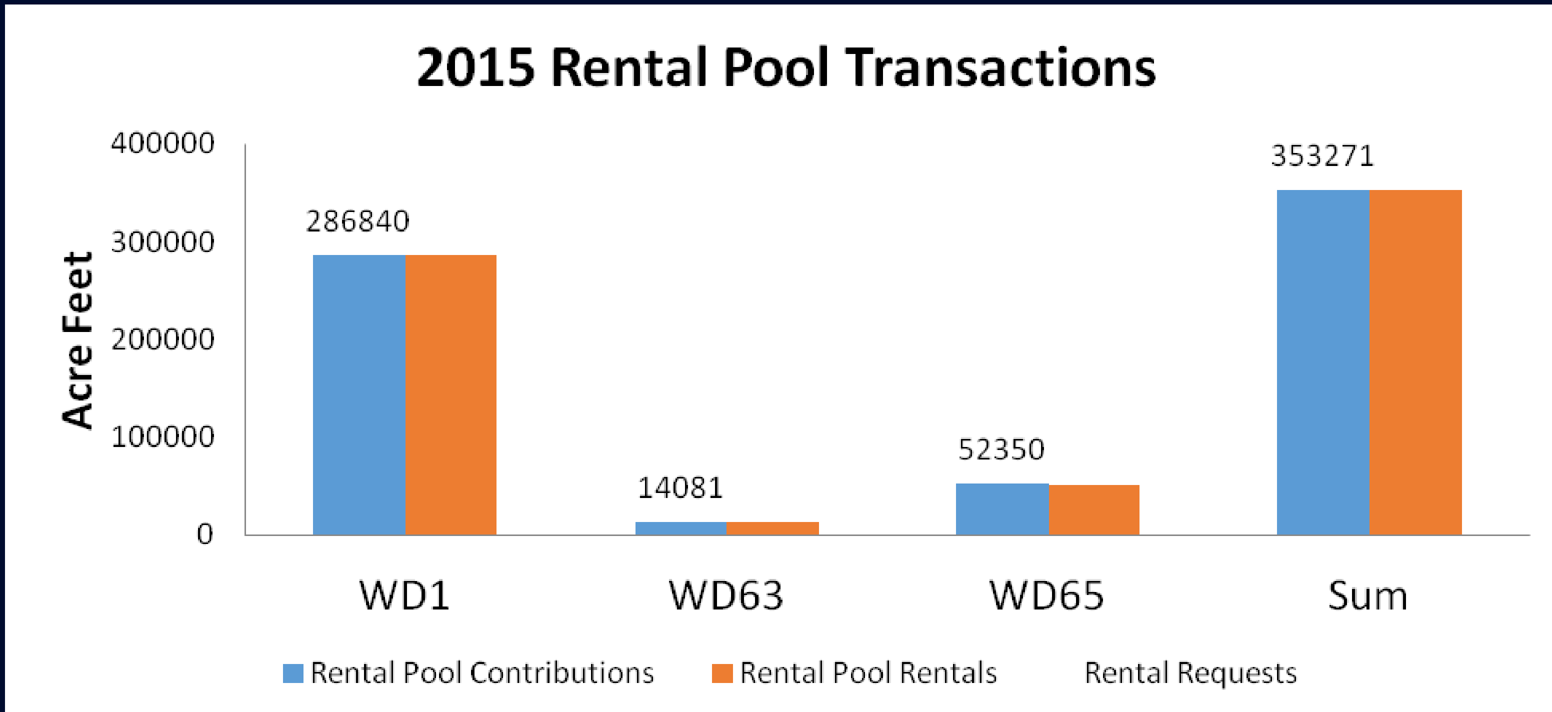
IWRB revenue generated from rental pools

IDAHO Water Resource Board

IDWR



Annual Report for Regional Rental Pools



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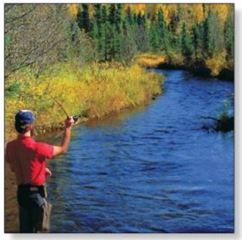
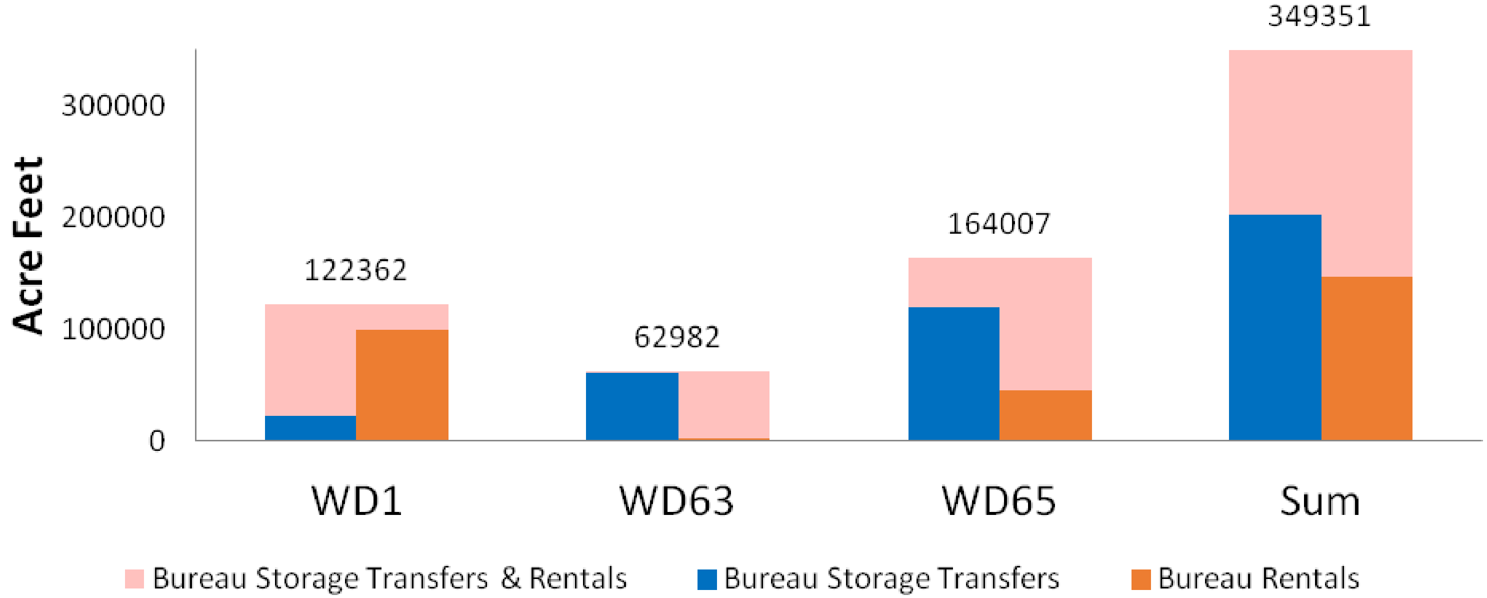
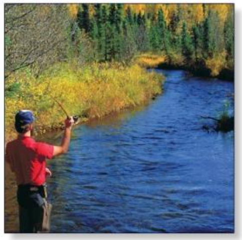


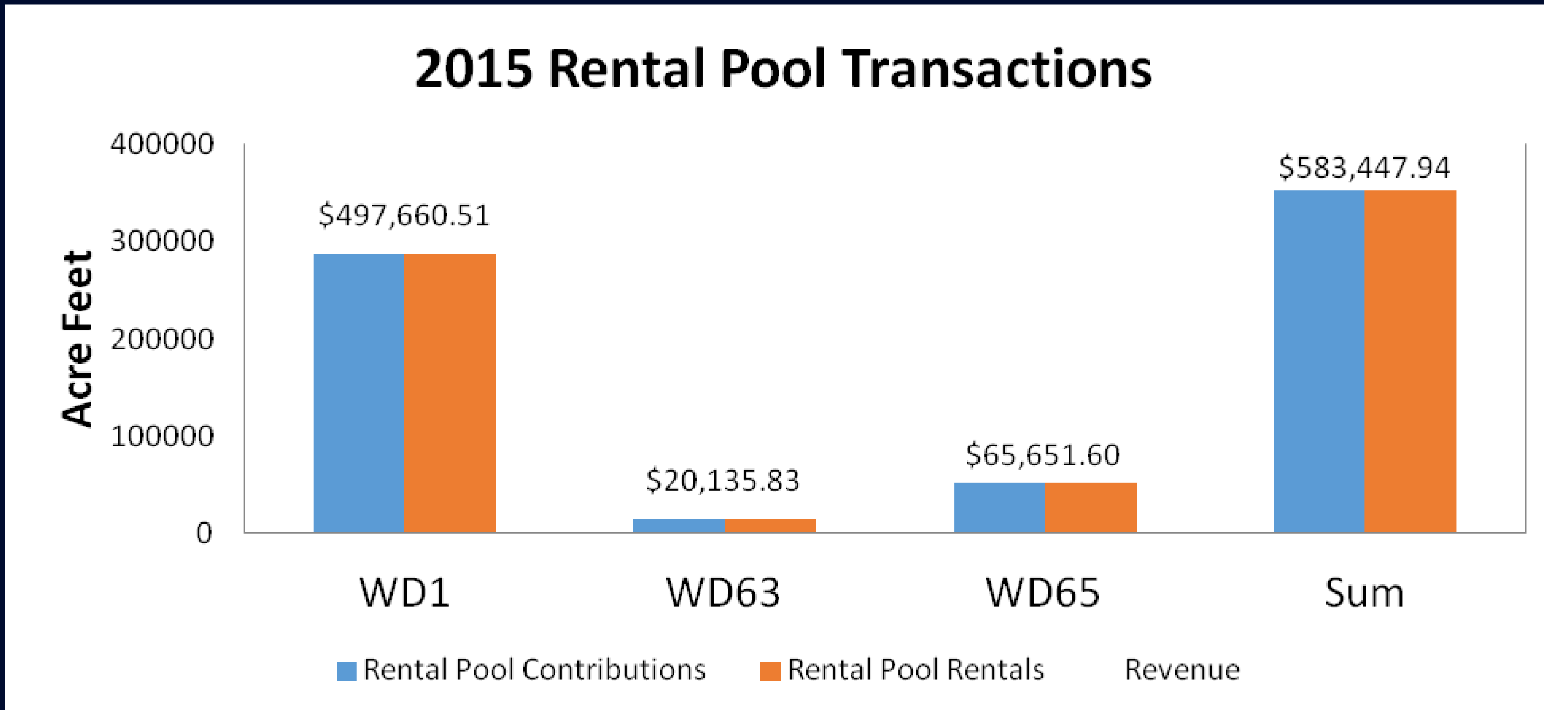
Annual Report for
Regional Rental Pools

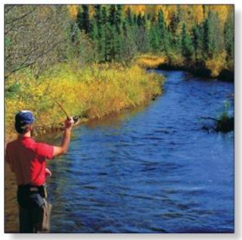
2015 Bureau of Reclamation Transfers





Annual Report for Regional Rental Pools



Annual Report for
Regional Rental Pools

Water Supply Bank

2015 Report for the Board's Water Supply Bank

Executive Summary

The Idaho Water Supply Bank (Bank) is a water exchange market operated by the Idaho Water Resource Board (Board) that allows natural flow water rights and storage water to be temporarily leased and rented for new and supplemental beneficial uses. The Water Supply Bank is comprised of two components: regional rental pools that broker exchanges of storage water, and The Board's Bank, which accommodates the temporary lease and rental of natural flow water rights. This report summarizes the 2015 lease and rental transactions of The Board's Bank.

At the end of 2015, approximately 800 water rights are leased into the Board's Bank, representing approximately 250,000 acre feet of water on approximately 75,000 irrigable acres. Actual volume and acre amounts are difficult to accurately determine because many natural flow water rights leased to the Bank do not feature decreed or licensed volume limits, and many water rights are stacked together, meaning multiple rights may jointly authorize the irrigation of a combined, limited, common number of acres with a combined, limited, common diversion volume.

Demand to lease and rent water rights through The Board's Water Supply Bank increase in 2015. More applications were processed in 2015 than ever before and more than half a million dollars was generated for pay out to water right holders who had water rights rented from the Bank in 2015.

Improved administrative processing enabled the Board's Bank to process more lease and rental applications earlier in the year, which resulted in more timely approval of applications. The Bank was also able to begin processing 2016 leases and rentals prior to the end of 2015, which sets The Board's Bank up to have an even more successful year during 2016.

2015 Accomplishments

Key accomplishments of the Water Supply Bank include:

- prioritizing the processing of lease and rental applications at key times during the year, which has enabled the Bank to better prioritize staff and process lease and rental applications more timely throughout the year;

- development and application of an effective temporary ground water rental policy in the Wood River Valley, which has enabled the Bank to continue renting ground water rights to Upper Wood River water users while the

Department concludes work on a ground water model for the Valley, and contemplates how the model may be utilized to address water curtailment calls received in the basin;

- updating more than 150 water rights that were originally leased to the Bank indefinitely, and the conversion of indefinite leases to fixed duration contracts;

- architecting and engineering of a comprehensive, proprietary software solution for the Bank, which will enable the acceptance and processing of all applications, and the management of all lease contracts and rental agreements through a single, geospatially enabled networked, database system.

2015 Activity Summary

As evidenced by the graph below, demand to lease water rights to the Bank continued to increase in 2015, though total rental requests remained relatively steady. 83 more applications were processed in 2014 than in 2013, an increase of 17%. The number of lease applications processed in 2015 increased by 63 (up 16% over 2014), while 20 more rental applications were processed in 2015 (an increase of 18%).

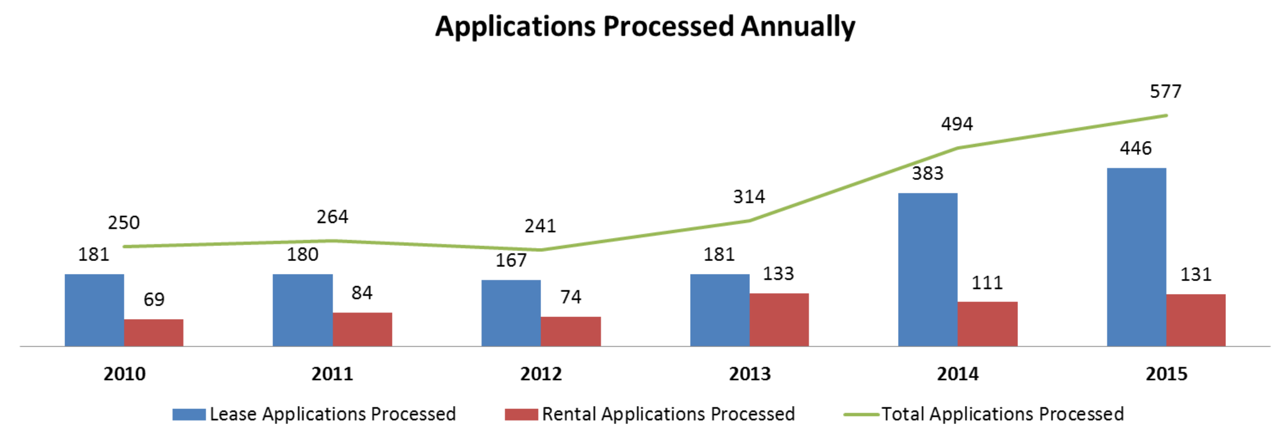


Chart 1. Total applications processed, 2010 - 2015

The Water Supply Bank requires one lease application per water right and one rental application per requested beneficial use. The cost to submit a lease application is $250. Where multiple water rights are stacked together, the Bank caps the lease application filing fee at a maximum of $500. There is no cost to submit a rental application.

One factor accounting for the rise in the number of lease applications processed in 2015 is that the Bank is continuing to encounter an increasing number of proposals to lease complex, stacked portfolios of water rights, wherein multiple water rights jointly accomplish a common beneficial use in a common area. This is evidenced by the fact that, though the total number of lease applications processed in 2015 was up 16%, revenue from lease application filing fees was up by only 4%. Furthermore, in spite of the 16% increase in the total number of leases processed in 2015, the volume of water leased to the Bank increased from 83,800 acre feet (AF) to 85,000 AF in 2015, an increase of less than 2%.

Companion Applications

Though the total number of applications processed last year was up, the proportion of lease and rental applications processed to accommodate pre-negotiated transactions, what the Bank calls companion applications, declined slightly. As a proportion of all lease applications processed in 2015, the number of leases submitted to the bank to accomplish companion rentals declined from 100 in 2014, to 80 in 2015, representing a decline from 26% of all leases in 2014, to 18% of all leases in 2015.

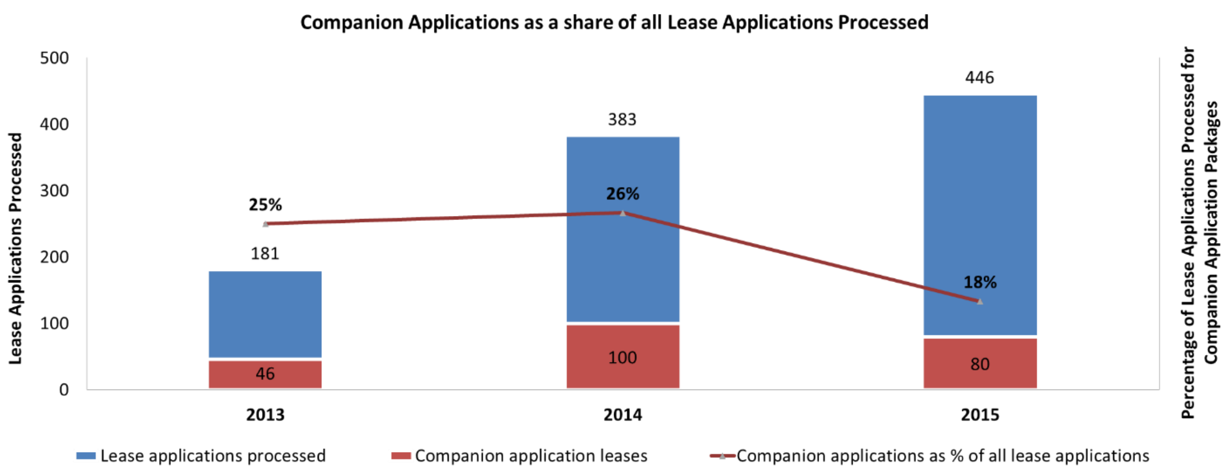


Chart 2. Companion applications as a percentage of lease applications, 2013-2015

Following the decline in the proportion number of leases submitted to accommodate rentals, the total number of pre-established lease and rental packages processed in 2015 was down from 129 in 2014, to 125 in 2015.

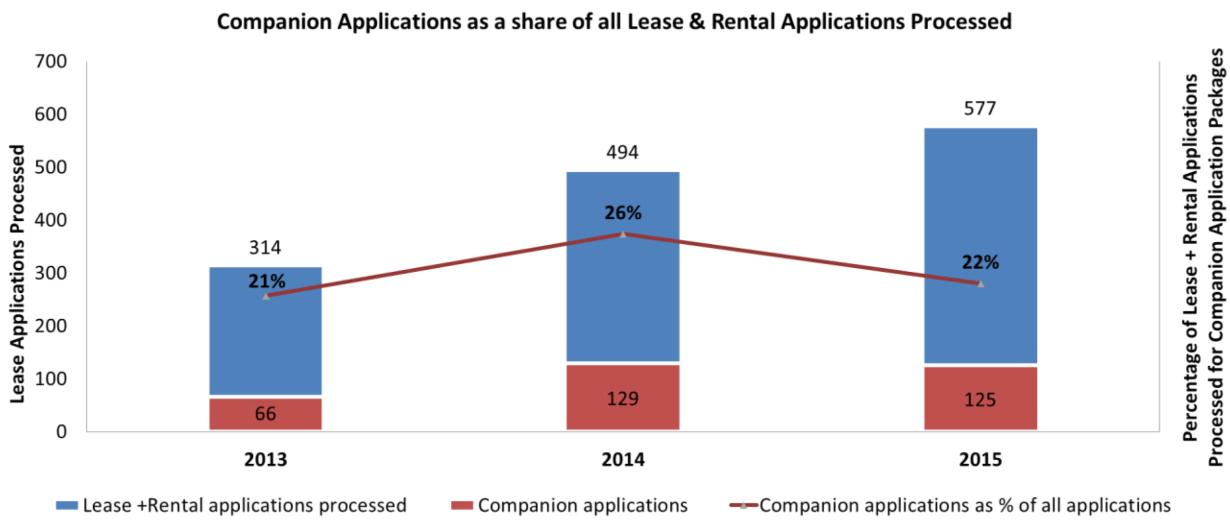


Chart 3. Companion applications as a percentage of all Bank applications, 2013- 2015

Despite the decline in 2015, the proportion of companion applications processed by the Bank remains stable, with the data demonstrating that approximately one in five applications proposed to the Bank, either as a lease or rental, is an already established transaction agreed to by the lessor and/or renter, prior to it being submitted to the Bank for review and approval.

Applications Processing Times

Building off momentum begun in 2014, the Board's Bank continued in its endeavor to process as many rentals as possible earlier in the year. Whereas in 2014, the Bank processed a majority of rental requests in April, May, June and July, the most active months for the processing of rental requests during 2015 was March, April and May.

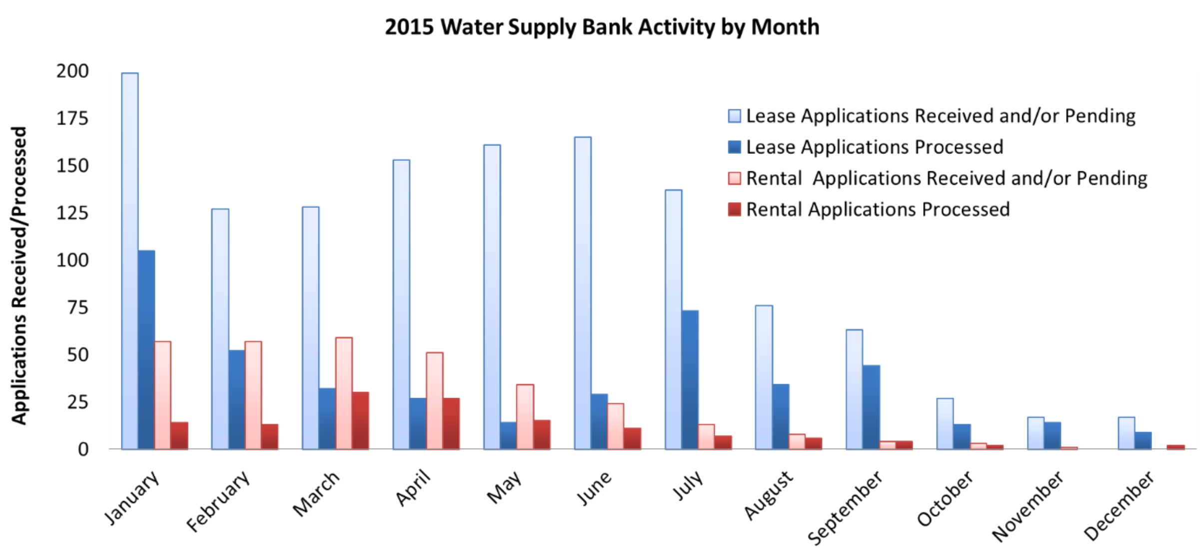


Chart 4. Lease and Rental Application Processing, by month, during 2015

It is the Bank's goal to continue processing rental requests even earlier in the year 2016 and future years, with the objective that rental requests should be processed most actively in January through March, to provide approvals to water users prior to the commencement of the irrigation season.

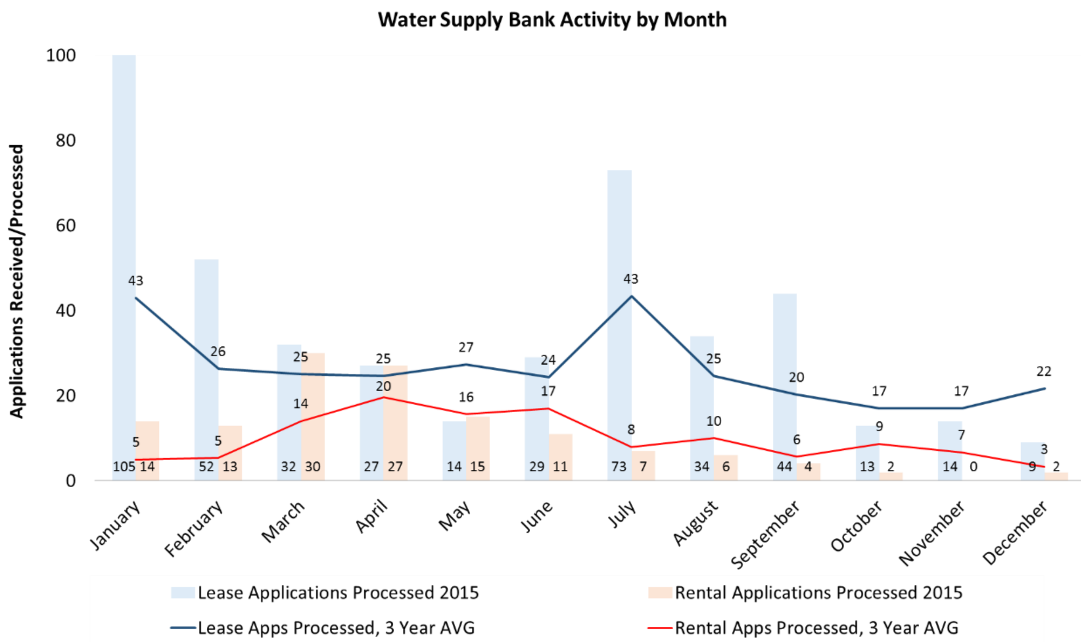


Chart 5. 2015 Application Processing & Processing Averages, 2013-2015

As evidenced in Chart 5, a significantly greater number of rental requests were processed in the months of January through April during 2015. The payoff from this effort was that water users who rented water in 2015 had greater certainty, earlier in the year, that they were authorized to divert water. Simultaneously, by clearing out the rental request backlog earlier in the year, staff could address the lease application backlog earlier in the summer, which resulted in fewer lease applications requiring processing in the autumn. The total number of lease and rental applications received and processed in 2015 is summarized in Table 1 below.

Month	Lease Applications Received	Lease Applications Pending	Lease Applications Processed	Rental Applications Received	Rental Applications Pending	Rental Applications Processed	Total Applications Received	Total Application Pending	Total Applications Processed	Lease App Percentage Processed	Rental App Percentage Processed
January	199	199	105	57	57	14	256	256	119	88%	12%
February	33	127	52	14	57	13	47	184	65	80%	20%
March	53	128	32	15	59	30	68	187	62	52%	48%
April	57	153	27	22	51	27	79	204	54	50%	50%
May	35	161	14	10	34	15	45	195	29	48%	52%
June	18	165	29	5	24	11	23	189	40	73%	28%
July	1	137	73	0	13	7	1	150	80	91%	9%
August	12	76	34	2	8	6	14	84	40	85%	15%
September	21	63	44	2	4	4	23	67	48	92%	8%
October	8	27	13	3	3	2	11	30	15	87%	13%
November	3	17	14	0	1	0	3	18	14	100%	0%
December	23	17	9	1	0	2	24	17	11	82%	18%
Sum	463	17	446	131	0	131	594	17	577	77%	23%

Table 1. Application Processing Data from 2015

Annual Rental Volumes

There was a slight increase in both the total number of rental requests processed during 2015, as well as the total volume of water rented from the Bank. Chart 6 shows the total volume rented during 2015, while Chart 7 plots the total volume rented by water basin.

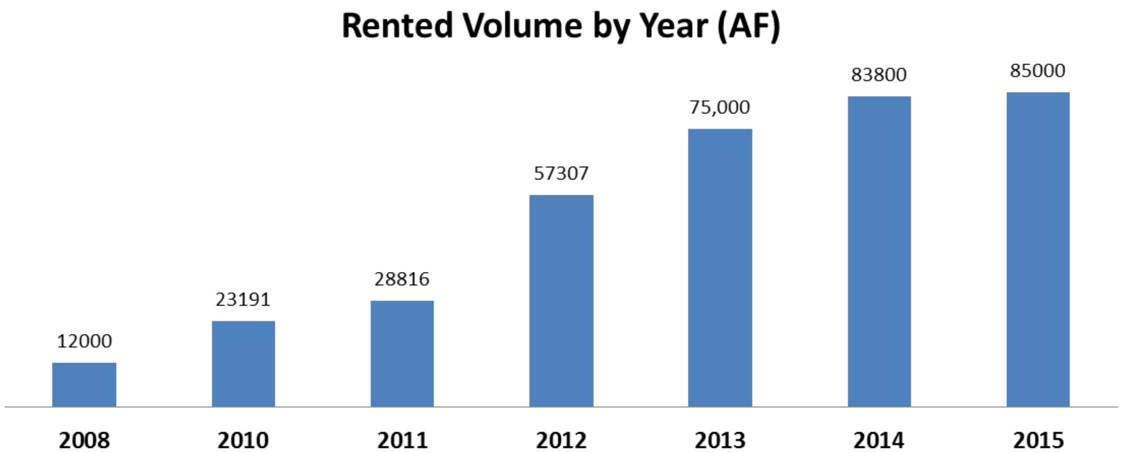


Chart 6. Annual rental volumes

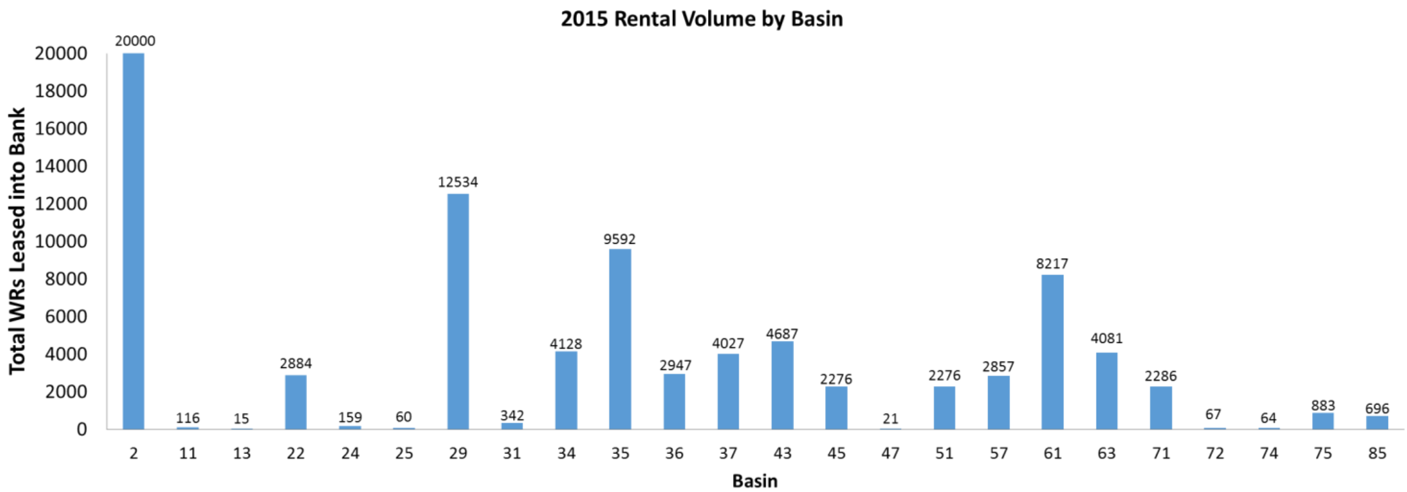


Chart 7. Annual acre-foot rental volumes, by water basin

The majority of water rented in 2015 was from basins 2 (the Snake River below Milner Dam), 29 (Blackfoot River), 35 (ESPA Ground Water), 43 (Raft River) and 61 (Mountain Home).

2014 Financial Summary

The Board's Bank made marginally more revenue in 2015, though the program again fell short of generating profit for water users. One hundred and ninety-one thousand dollars were generated last year, primarily through rental administrative fees, but as evidenced by charts seven and eight below, lease application filing fees continue to comprise a stable source of revenue for the Board's Bank.

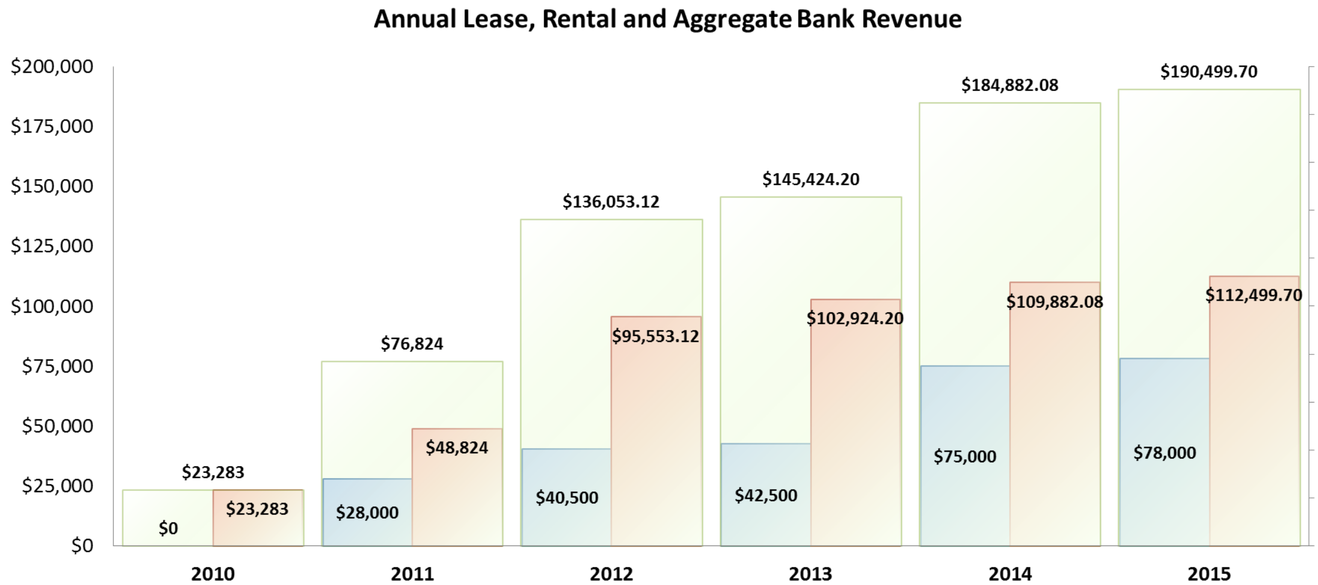


Chart 8. Annual revenue from lease application filing fees and rental admin fees

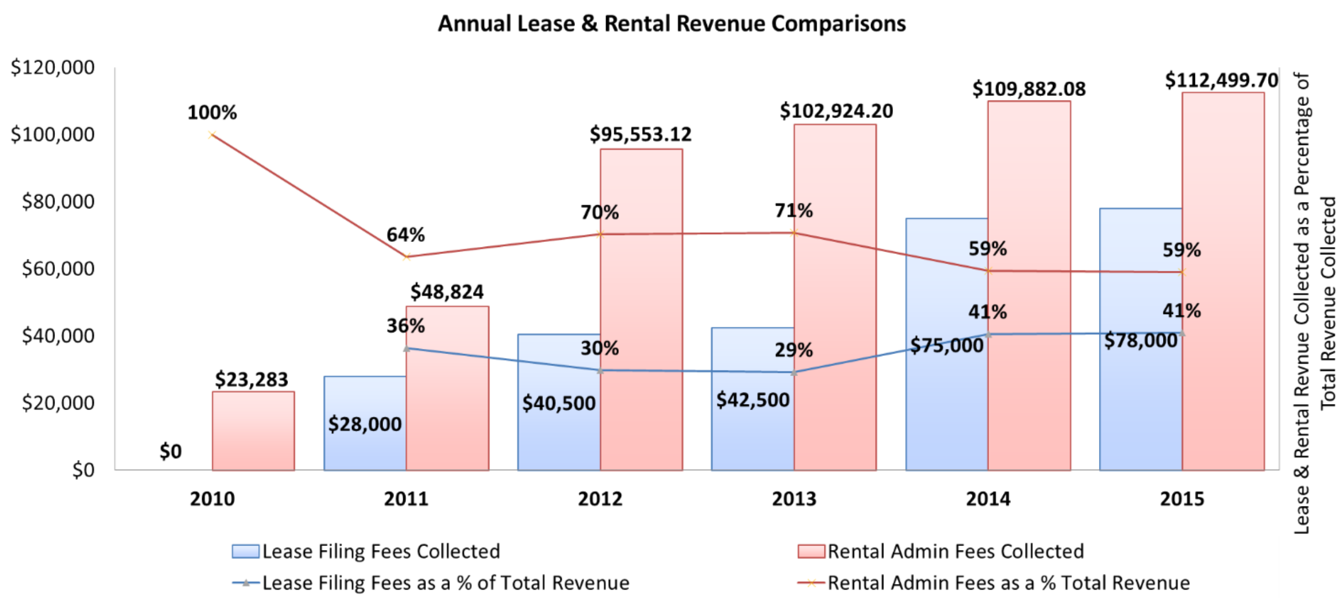


Chart 9. Annual revenue from leases and rentals as a percentage of total revenue

Even as Bank revenue increased marginally in 2015, the increase in the total number of applications processed resulted in a decline in profitability of the program as a whole. Chart 10 below displays the revenue per-application processed, as well as the expenditure incurred per application processed, for the years 2010 through 2015.

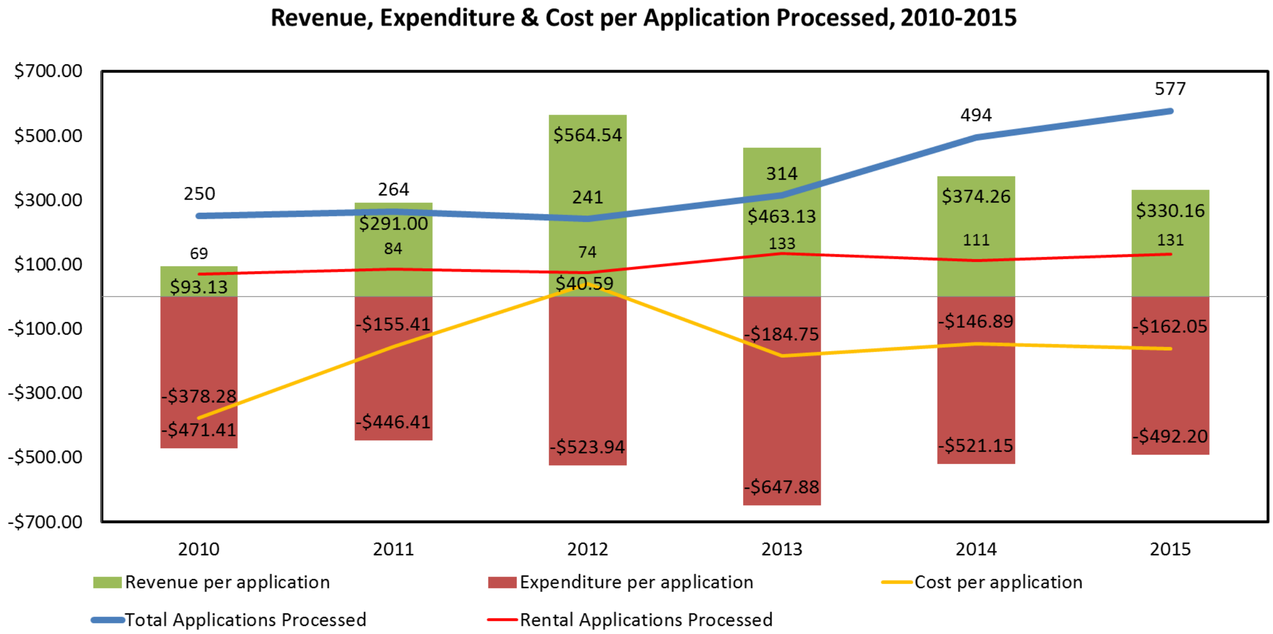


Chart 10. Revenue and Expenditure per application processed, 2010-2015

The red bar in Chart 10 is a representation of the total cost billed by Bank staff to process lease and rental applications in a given year, divided by the total number of applications processed. Similarly, the green bar represents the total revenue generated in a given year from the processing of all applications (and approved rental agreements), divided by the total number of applications processed that year. The net difference between the red and green bars is represented by the yellow line, which is the net cost or profit realized from processing of lease and rental applications in a given year.

Chart 10 shows that the average cost of processing a lease or rental application in 2010 was -$378.28 per application. Starting in 2011, the cost to process an application decreased significantly and actually went positive in 2012, which coincided with the implementation of the lease application filing fee in 2011. Interestingly, even as the cost to process an application increased in 2012 (growing to -$523.94 per application), this expenditure increase was more than offset by the increase in revenue generated through the processing of the application, in large part, due to the implementation of the lease application filing fee.

Additionally, Of further interest, with the exception of an increase in per-application expenditures during 2013, the cost to process an application has continued to decline every year since 2012, due to various improvements realized in administration of the Bank. However, though expenditure per application is declining, revenue generated per application is also declining from the high achieved in 2012, and revenue per application is diminishing more quickly than expenditure per application.

Of note, there appears to be a correlation between the number of rental applications processed and the revenue per application realized. Notice in Chart 10 that as the red bar (representing total number of rental applications processed in a given year) jumped from 74 to 133 in 2013 (an increase of 80%), the revenue generated per application declined from $564.54 to $463.13, a drop of $101.41 (and decline in profitability of approximately 20%). It was during this transition period from 2012 to 2013 that the processing cost per application declined back into negative territory. Intriguingly, as the total number of annual rental requests stabilized during 2014 and 2015, so too has the processing cost per application also remained stable.

Though the processing cost per application can be expected to decline further in 2016 and 2017, as greater administrative efficiencies are realized through improved staff training, further procedural guidance from the IWRB, and the roll out of proprietary water right administration software for the Bank, it is unlikely that expenditures per application will decrease more slowly than the decline in revenue per application. Absent direct action taken by the Idaho Water Resource Board and the Department, the Bank can be expected to continue operating at a loss moving forward into the future. The Water Supply Bank Sub-Committee should consider changes to Water Supply Bank pricing mechanisms during 2016 to enable the Bank to begin moving into revenue neutral or revenue positive territory beginning in 2017.

A summary of annual revenue, expenditures and warrant payouts is summarized in Chart 11 and Table 2, on the final page of this report.

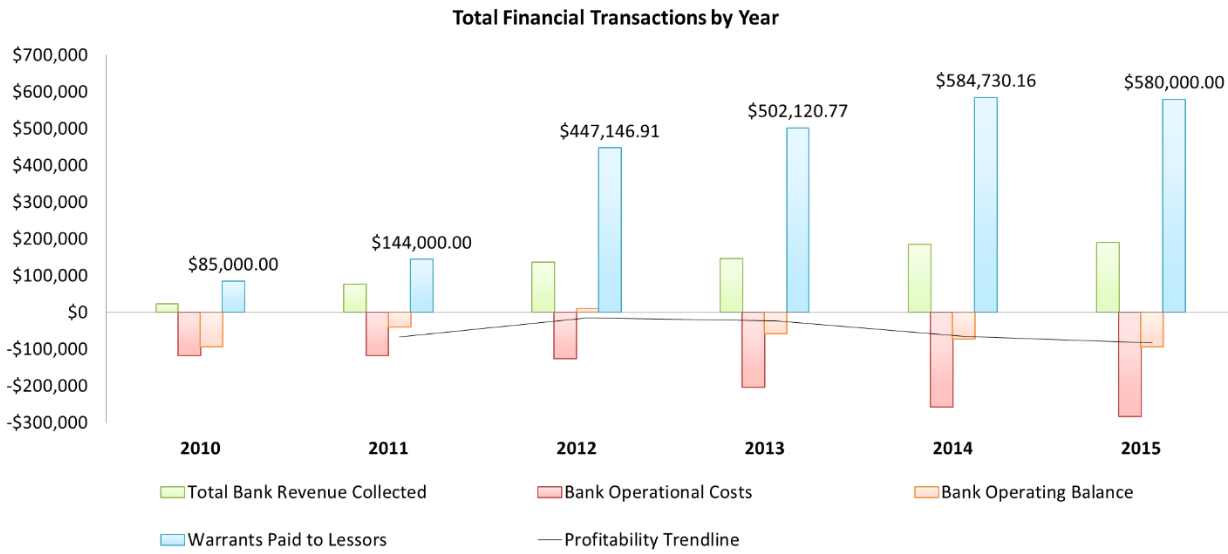


Chart 11. Bank revenue, operational costs and warrant payouts to water right holders

Year	Rental Fees Collected	Warrants Paid to Lessors	Rental Admin Fees Retained by Bank	Lease Filing Fees Collected	Total Bank Revenue Collected	Bank Operational Costs	Bank Operating Balance
2010	$108,283.00	$85,000.00	$23,283	$0	$23,283	-$117,852.00	-$94,569.00
2011	$192,824.00	$144,000.00	$48,824	$28,000	$76,824	-$117,852.00	-$41,028.00
2012	$542,700.03	$447,146.91	$95,553.12	$40,500	$136,053.12	-$126,270.00	$9,783.12
2013	$605,044.97	$502,120.77	$102,924.20	$42,500	$145,424.20	-$203,435.00	-$58,010.80
2014	$694,612.24	$584,730.16	$109,882.08	$75,000	$184,882.08	-$257,445.65	-$72,563.57
2015	$692,499.70	$580,000.00	$112,499.70	$78,000	$190,499.70	-$284,000.00	-$93,500.30

Table 2. Bank revenue, expenditures, operating balance and warrant payouts

Idaho Water Supply Bank

2015 Rental Pools Report

Introduction & Background

The Idaho Water Supply Bank (Bank) is a water exchange market operated by the Idaho Water Resource Board (Board) that allows natural flow water rights and storage water to be temporarily leased and rented for new and supplemental beneficial uses. The Water Supply Bank is comprised of two components: regional rental pools that broker exchanges of storage water, and The Board's Bank, which accommodates the temporary rental of natural flow water rights. This report summarizes 2015 lease and rental transactions through regional rental pools.

Regional rental pool administration is coordinated by local committees, which are appointed by the Board to approve temporary leases and rentals of storage water for a period of up to five years. Committee appointments are for a duration of five years. The Board has authorized local committees to operate five rental pools in Idaho: rental pools in Water Districts 1, 63, 65 and 65-K lease and rent allocations of storage water from regional reservoirs, while the Water District 74 rental pool accommodates the partial season lease and rental of natural flow water rights in order to satisfy the Board's minimum stream flow water rights in the Lemhi River and its tributaries. The Shoshone-Bannock Tribe also operates a rental pool as part of their Water Supply Bank. This report summarizes the 2015 lease and rental of water through the Water Districts No. 1, 63, 65 and 65-K rental pools.

2015 Activity Summary

Collectively between the rental pools of Water District No 1, 63 and 65, 555,608 acre-feet (AF) of water was made available for rental and transfer through the rental pools. Of the 555,608 AF, 202,337 AF (36%) was uncontracted storage water that was transferred through the rental pools by the Bureau of Reclamation to accomplish annual flow-augmentation obligations. The other storage water volume (353,271 AF) transferred through the rental pools consisted of 217,059.50 AF dedicated to "common pools" (for general rental by rental pool participants) and 136,211.50 AF of volume dedicated as pre-established private leases between lessors and renters. The Board levies a 10% administrative surcharge on all common pool and private pool rentals, which in 2015 resulted in revenue of $583,447.94. The following briefly summarizes regional rental pool transactions.

Upper Snake Rental Pool, Water District No. 1

The Upper Snake Rental Pool is the most active of the Board's rental pools. The Upper Snake Rental Pool consists of a 5,000 AF small pool (for rental requests of less than 100 AF), a 50,000 AF large pool (for larger rentals by rental pool participants), a pool specific to the Bureau of Reclamation (Bureau) (allowing for rentals to meet flow augmentation obligations, based on a pre-determined volume chart) and a supplemental pool (to allow for the rental of storage to satisfy hydropower uses below Milner Dam). Private rental opportunities between rental pool participants are also possible outside of the common pool. The annual rental rate for large, small and Bureau pools of storage water (common pool storage water) is based on annual volume of water allocated to the Upper Snake Reservoir System and may be as low as \$6/AF, or as high as \$22/AF. Variable private rental rates are allowed for private leases. The IWRB collects 10% of the rental price for all common pool and private rentals.

The Bureau of Reclamation transferred 122,362 AF of water through the rental pool, of which 100,000 was through the common pool (the remaining 22,362 AF was a transfer of uncontracted storage water). There were also rentals of 50,628.5 AF of water from the common pool, as well as 34 private leases of 136,211.5 AF of water, including the private leasing of 190 AF of the Board's storage water for delivery to Swan Falls. In total, 286,840 AF of water was rented from the Water District 1 rental pool and subject to the IWRB 10% administrative fee. Water District 1 rental pool activity resulted in revenue of \$497,660.51 in 2015.

Boise River Rental Pool, Water District No. 63

The Boise River Rental Pool rents storage allocations from Anderson Ranch, Arrow Rock, Lucky Peak and Lake Lowell Reservoirs. The Water District has established that the rental rate for storage water is \$14.27/AF, with the Board receiving \$1.43 per AF. 75,013 AF of water was leased into and through the Water District 63 rental pool in 2015, inclusive of 60,932 AF of uncontracted storage water that was transferred through the rental pool by the Bureau of Reclamation to accomplish flow augmentation obligations. Of the 14,081 AF of common pool contributions, 12,031 AF was rented for in basin uses, while 2,050 AF was rented by the Bureau of Reclamation for flow augmentation purposes. The IWRB levied an administrative fee on the 14,081 AF of water rented from the Water District 63 common pool, resulting in revenue of \$20,135.83 during 2015.

Payette River Rental Pool, Water District No. 65

The Payette River Rental Pool authorizes the lease and rental of storage water from lakes and reservoirs on the Payette River system. Water District 65 has established that the rental rate for in-basin uses is $2/AF while out of basin uses rent for $14.27/AF. The Board receives either $0.20/AF or $1.43/AF depending on rental uses.

A total of 53,350 AF of water was leased to the common pool during 2015; 7,386 AF of common pool water was dedicated for in-basin uses and 44,964 AF of water was leased for out of basin rentals. Of the 53,350 AF, 51,729.4 AF was rented, with 620.6 AF left unrented in 2015. The Bureau of Reclamation accessed 164,007 AF of rental pool water for flow augmentation purposes; the Bureau rented 44,964 AF of water from the common pool and they transferred 119,043 AF of uncontracted storage through the rental pool. The rental of the 51,729.4 AF of water from the Water District 65 rental pool provided the Board with $65,651.60 in administrative fees levied during 2015.

Lake Fork Rental Pool, Water District No. 65-K

The Lake Fork of the Payette River is a separate rental pool, administered by the Watermaster of Water District 65-K. This rental pool rents storage water along the Lake Fork drainage. The water rental rate is $13.28/AF. As of March 4, 2016, no report has been yet filed by the Watermaster of Water District 65-K and the amount of water rented through the Water District 65-K rental pool during 2015 is unknown.

Lemhi River Rental Pool, Water District No. 74

The Lemhi River rental pool is administered by the Watermaster of Water District 74. As of March 4, 2016, no report has been yet filed by the Watermaster of Water District 74 and the amount of water rented through the Water District 74 rental pool during 2015 is unknown.

Summary of 2015 Rental Pool Activity:

Rental Pool	2015 Rental Rates & Administrative Fees	Volume Leased into the Rental Pool	Volume Rented from the Rental Pool	IWRB Revenue from Rental Pool Rentals
Water District 1	$14.50/AF (reservoirs didn't fill but enough water was available for flow augmentation rentals)	286, 840 AF	286, 840 AF	$497,660.51
Water District 63	$14.27/AF (IWRB 10% admin fee = $1.43/AF)	14,081 AF	14,081 AF	$20,135.83
Water District 65	$2/AF for in-basin uses, $14.27/AF for out of basin uses, (IWRB 10% admin fee = $0.20/AF for in basin rentals and 1.43/AF for out of basin rentals)	183,121 AF	175,612 AF	$65,651.60
Water District 65-K	$13.28/AF rental rate IWRB 10% admin fee = $1.33/AF)	0 AF	0 AF	$0.00
	Total Volume Leased and Rented in 2015:	**484,042 AF**	**476,533 AF**	
	Administrative Fees Levied by the IWRB:			$**583,447.94**