

Conservation of surface and ground water in a Western watershed experiencing rapid loss of irrigated agricultural land to development

Dr. Rob Van Kirk, Humboldt State University, Project Director

Brian Apple, Humboldt State University

Jason Barnes, Humboldt State University

Dr. J. Mark Baker, Humboldt State University

Dr. Yvonne Everett, Humboldt State University

Dr. Brad Finney, Humboldt State University

Lora Liegel, Humboldt State University

Veronica Orosz, Humboldt State University

Kimberly Peterson, Humboldt State University

Kim Ragotzkie, Henry's Fork Foundation

Dr. Steve Steinberg, Humboldt State University

Dale Swenson, Fremont-Madison Irrigation District

Steve Trafton, Henry's Fork Foundation

Amy Verbeten, Friends of the Teton River



Outline

- Project history
- Objectives
- Project administration
- Primary results
- Information transfer
- Booklet
- WIRE endorsement request



Project History

- Hydrologic and ecological effects of I.P. Dam management
 - Benjamin and Van Kirk 1999, JAWRA
 - *Intermountain Journal of Sciences* Special Issue 2000
 - H.F. Drought Management Plan 2003
- Hydrologic alteration analyses
 - Upstream of St. Anthony 2004
 - Teton Valley 2005
 - Watershed-scale geomorphic analysis, Bayrd thesis 2006
- HFWC Meetings 2005-2006
 - Economic growth and sustainability
 - Effects of residential development on canal system operation
 - How does change in land use affect water use?
- USDA Coop. State Research, Education, Extension Grant 2008
 - Eligibility: academic institutions
 - Grant proposal endorsed by HFWC, April 2008
 - \$620,000 grant from USDA, 2009-2011



Goals of CSREES Grant Program

- contribute to the improvement of the quality of our Nation's **surface water** and **groundwater** resources
- explore the linkage between surface water and groundwater availability
- demonstrate conservation of water resources at the watershed scale
- prepare the next generation of water professionals to address multi-disciplinary water resource issues and challenges

Project Objectives

1. Model ground and surface water flow under historic, current and future land and water use scenarios.
2. Identify socioeconomic factors that determine water use on formerly irrigated land that has been developed and on irrigated land in proximity to development.
3. Provide information on hydrology and water use to decision-makers and stakeholders.
4. Develop strategies to increase water availability for agriculture while enhancing ecological benefits in key stream reaches.
5. Train an interdisciplinary team of graduate students.



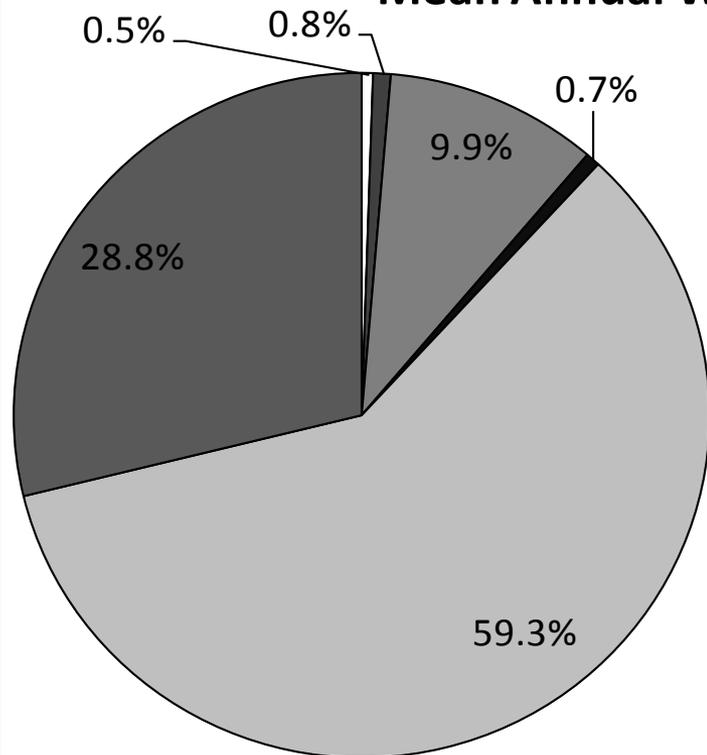
Project Administration

- Fiscal administration: HSU Sponsored Programs Foundation
- Partner organizations
 - Fremont-Madison Irrigation District
 - Friends of the Teton River
 - Henry's Fork Foundation
- Budget (\$620,000 total; about \$140,000 spent in watershed)
 - Graduate student stipends, tuition, fees, etc. \$154,500
 - Student summer wages \$40,320
 - Faculty salaries \$152,571
 - Benefits \$43,826
 - FMID, FTR, HFF (incl. HFWC expenses) \$72,050
 - Supplies and services \$24,800
 - Travel \$28,600
 - Indirect costs (@ 20%) \$103,333
- Technical Review
 - Bryce Contor (via USBR)



Results: Water budget

Mean Annual Water Budget for Surface and Shallow GW System

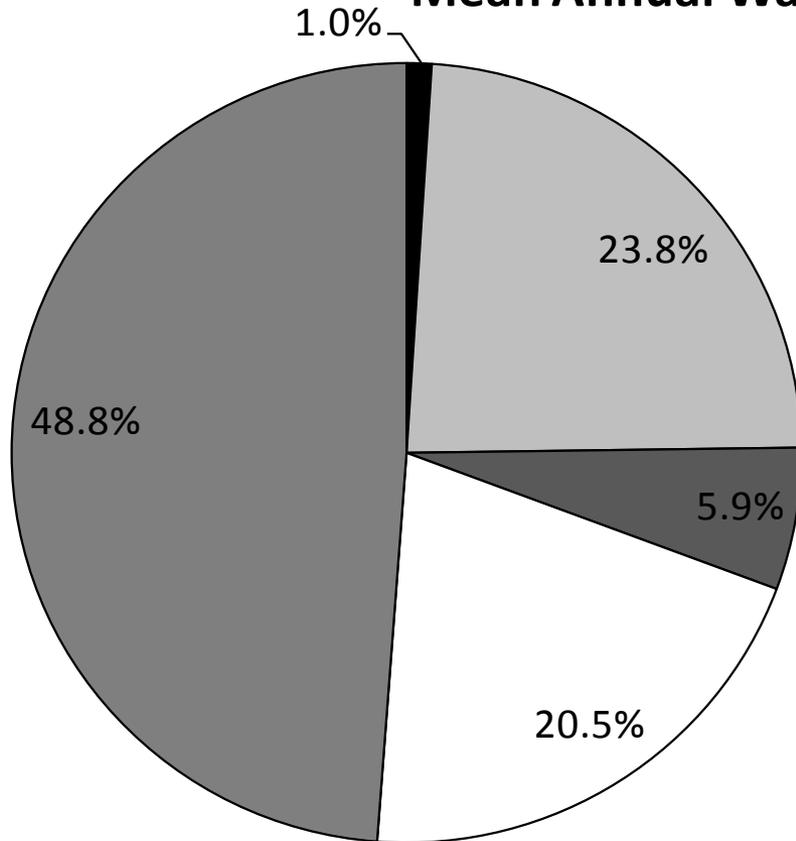


- Domestic, commercial, industrial use: 14,766 a-f
- Reservoir, canal, sprinkler evaporation: 22,929 a-f
- Crop ET supplied by surface irrigation: 278,076 a-f
- Crop ET supplied by shallow GW irrig.: 18,680 a-f
- Surface outflow from basin: 1,666,326 a-f
- GW outflow from basin: 809,135 a-f

Total Surface/Shallow GW Supply: 2,809,912 a-f/year

Results: Surface irrigation budget

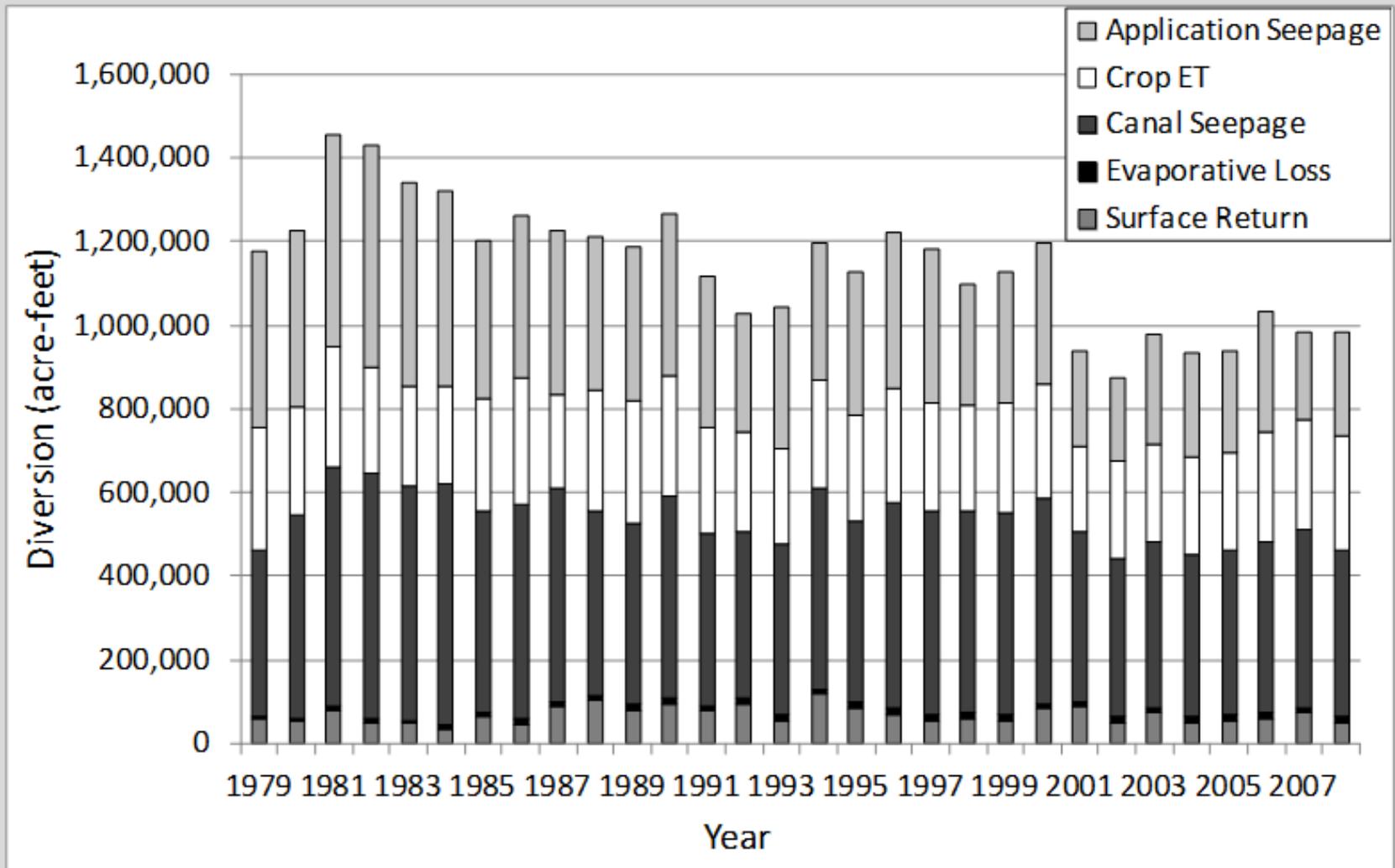
Mean Annual Water Budget for Surface Irrigation System



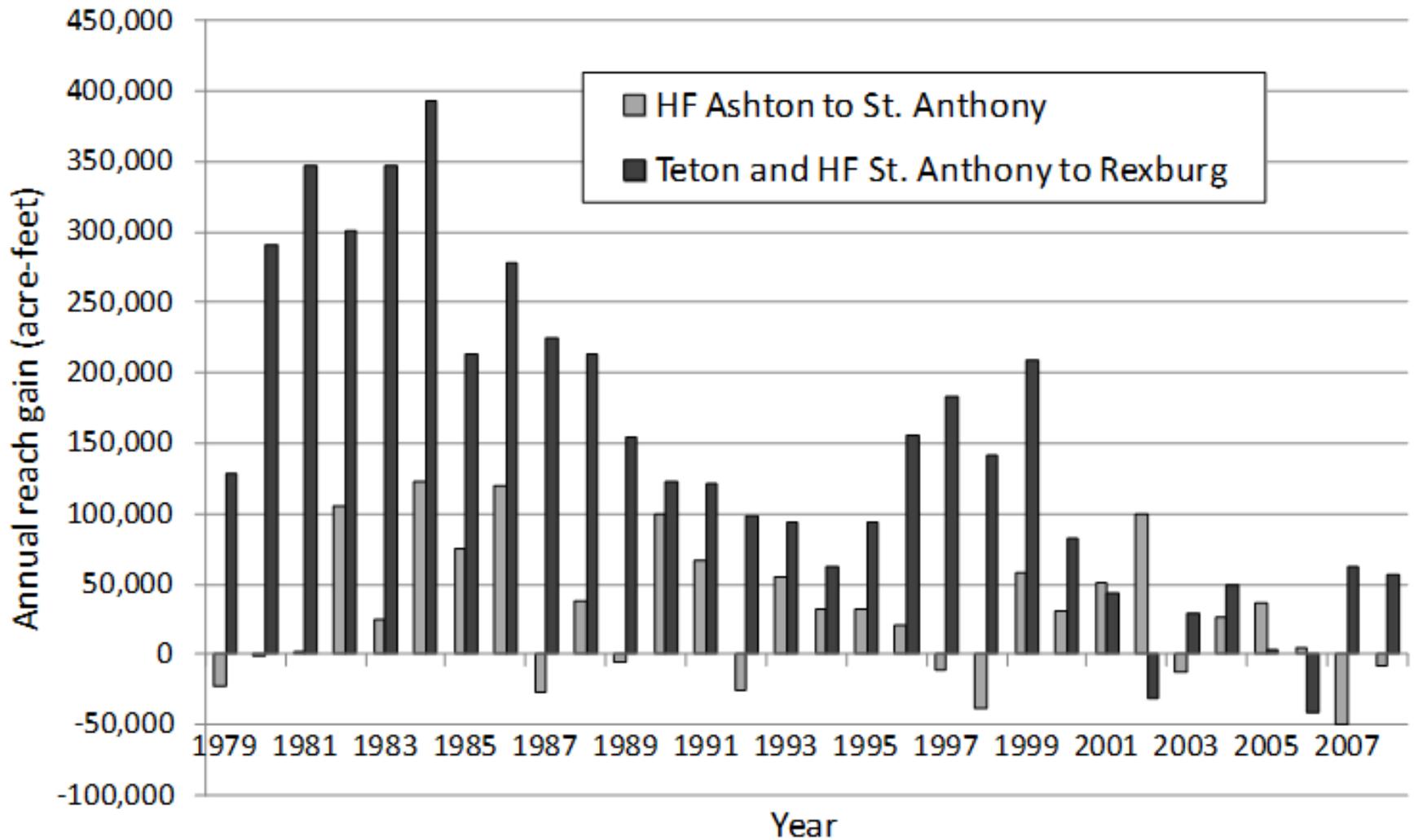
- Canal & sprinkler evaporation: 11,936 a-f
- Crop ET: 278,076 a-f
- Surface return flow: 68,940 a-f
- Return to streams via GW: 239,994 a-f
- Outflow from basin as GW: 571,099 a-f

Total diversion: 1,170,045 a-f/year

Results: Total Diversion 1979-2008

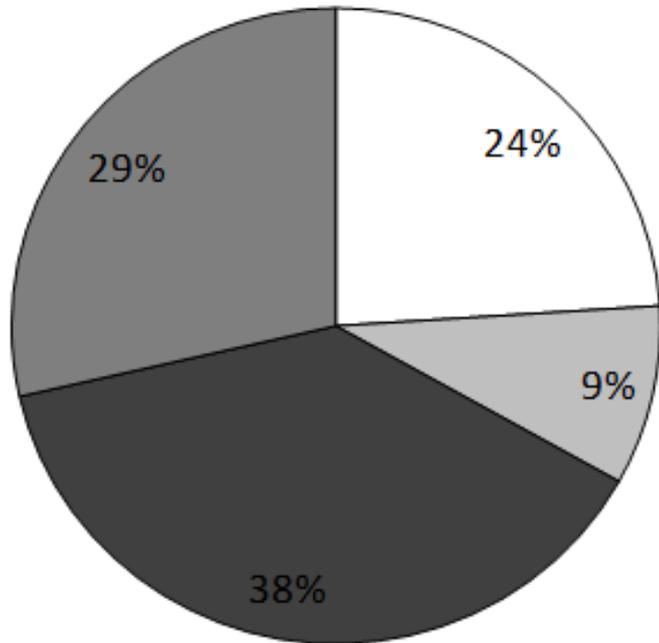


Results: River Reach Gains 1979-2008



Results: Recharge to shallow aquifers

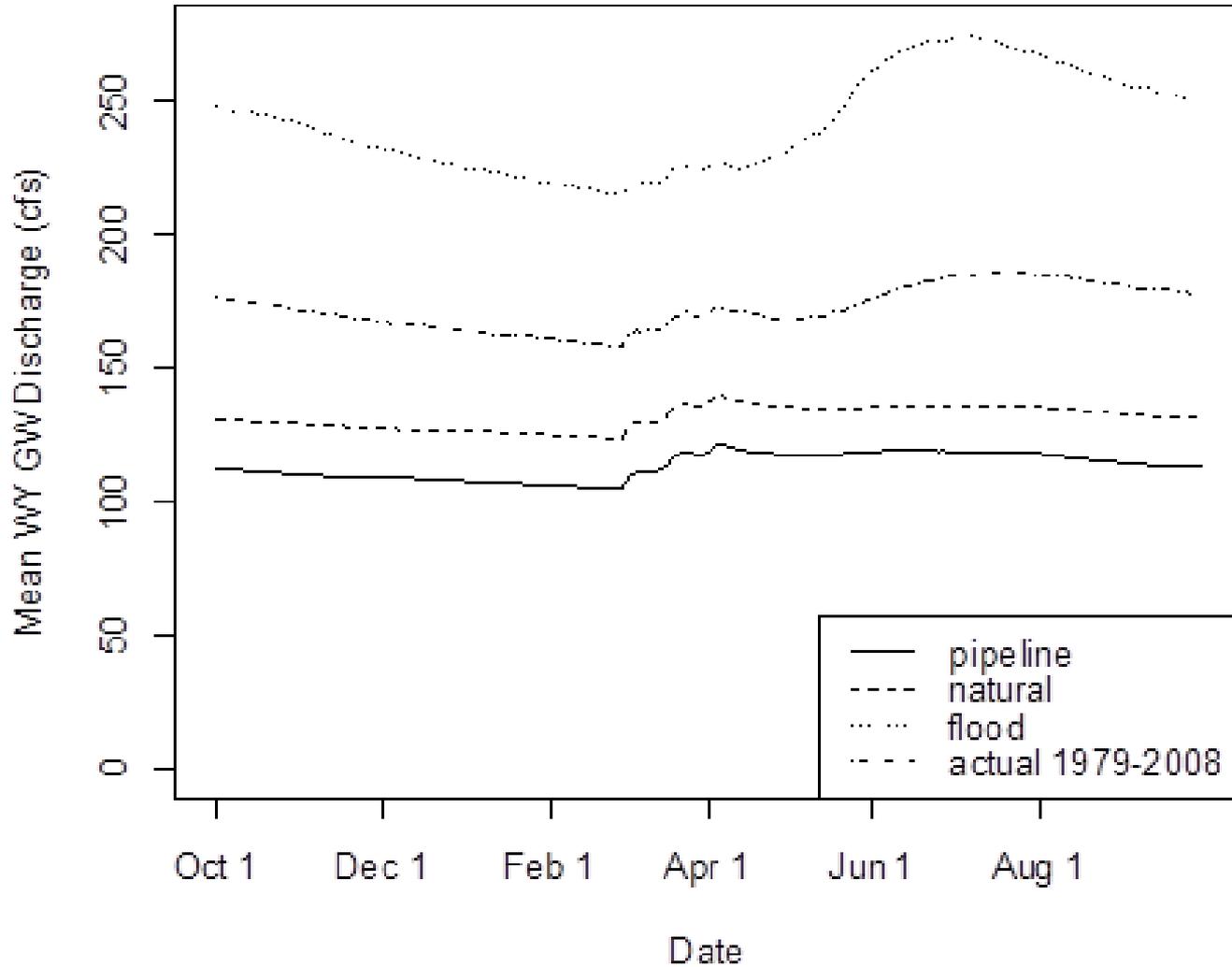
Mean Annual Shallow Groundwater Recharge in Valley Areas



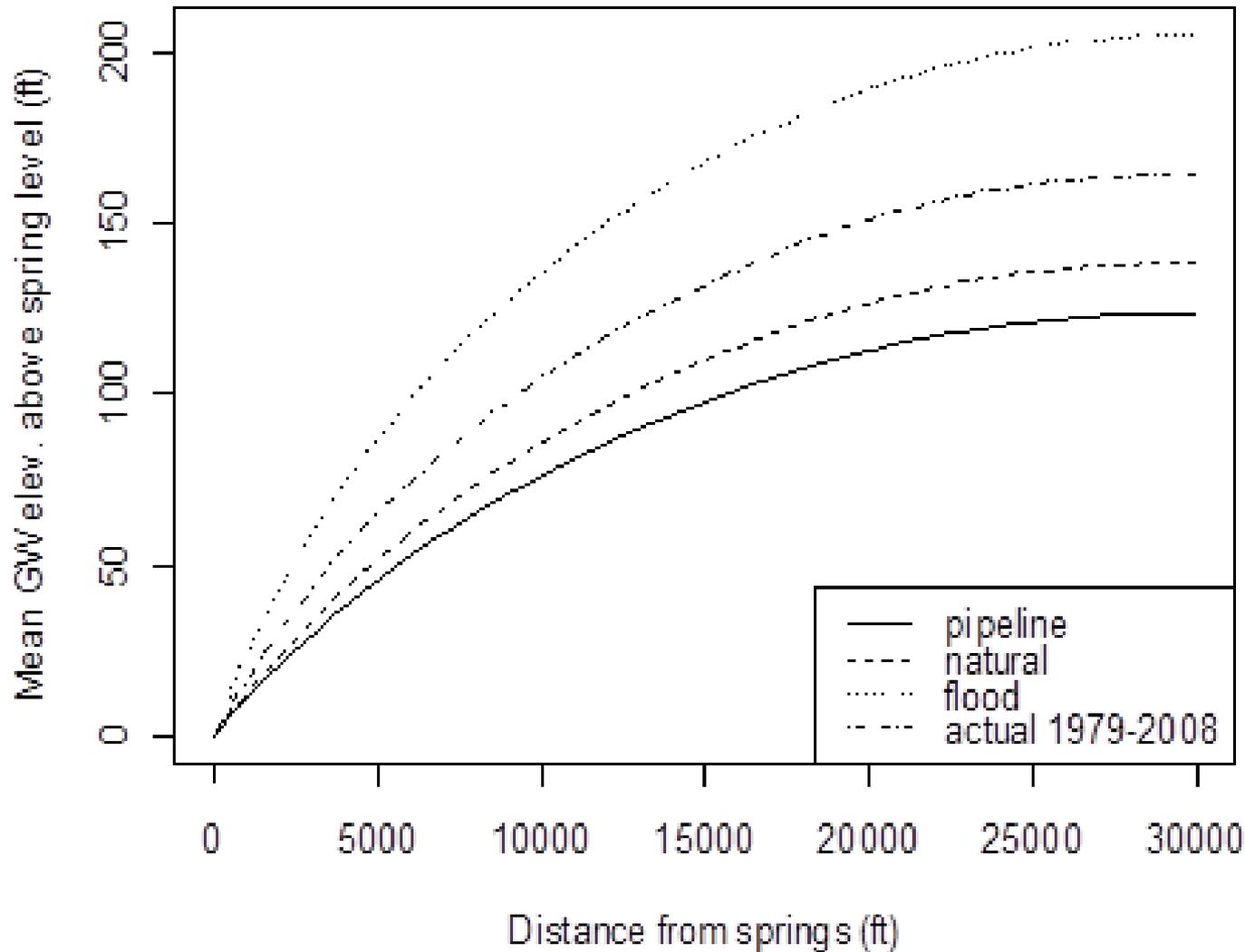
- Direct Precipitation: 291,032 a-f
- ▒ Stream Channel Seepage: 110,984 a-f
- Canal Seepage: 464,508 a-f
- ▓ Irrigation Application Seepage: 346,587 a-f

Total Recharge: 1,213,112 a-f/year

Teton Valley Groundwater Model: GW Outflow

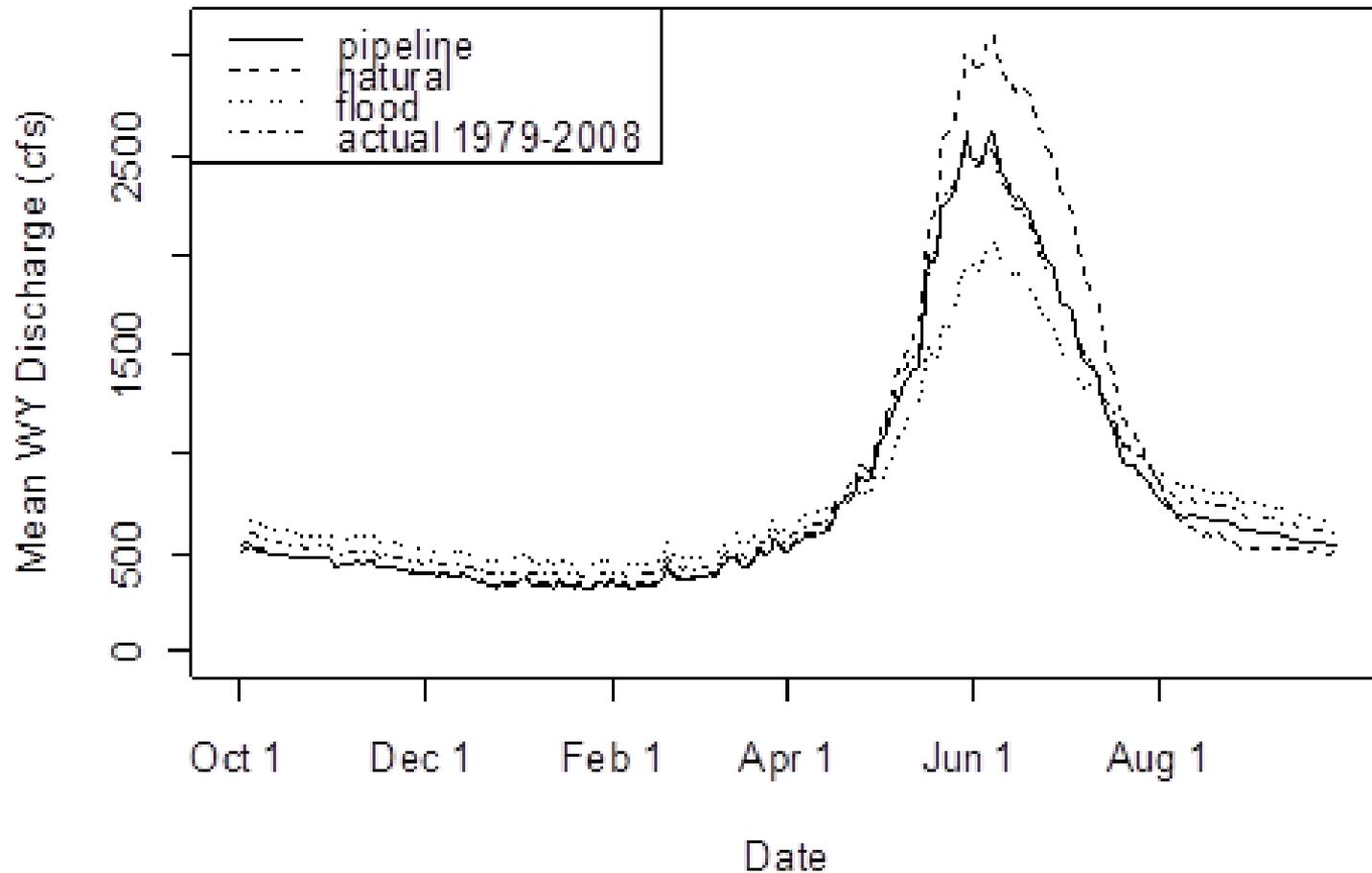


Teton Valley Groundwater Model: GW Level



Teton Valley GW-SW Model: Teton R. Flow

Teton R. at St. Anthony



Main Results

- Consumptive use of water in watershed is about 12% of supply.
- Largest effect of irrigation is to change **timing** and **location** of water.
- Irrigation is largest source of shallow-aquifer recharge; canal seepage is largest component.
- Reduction in diversion has decreased GW levels and GW return flow.
- Changes are good for some resources and users, bad for others.
- Generally, more GW recharge yields more late-season surface flow.
- Development has replaced 5% of irrigated lands watershed-wide.
- Water use rates (depth/season) in new subdivisions are no different than on agricultural lands (and no different than demand).
- But, development can challenge ability of canal companies to continue to maintain and operate canals.
- MAJOR POINT: Changes in amount of water delivered through canals and changes in application methods will affect local and regional hydrology and dependent resources.



Information Transfer

- 2 master's theses complete; 1 in preparation
- Numerous “working documents” (e.g., water budget)
- Data and models to USBR
- Peer-reviewed publications in preparation
- Basis for future publications, projects and grants
- 7 conference presentations
 - USDA/NOAA National Water Conference 2010, 2011
 - ASCE World Environmental and Water Resources Congress 2011 (4 talks)
 - AWRA Specialty Conference on Integrated Water Res. Management 2011
- Academic seminar talks: Utah State, Humboldt State, Boise State
- Other regional non-academic talks
- 7 Watershed Council meetings plus field trip
- Presentations to county planning and zoning commissions (2012)
- Booklet



Booklet: Goals, Audience and Purpose

The major goals...were to ***identify changes to the hydrology of the Watershed that could result from changes in land use, and to communicate these results to stakeholders and decision-makers ...*** we focus primarily on the ***regions of the watershed that support irrigated agriculture...*** We anticipate that this booklet will serve as a resource for ***city and county planners*** (working with canal companies, agencies and developers), ***canal company representatives, Homeowners Associations, and individual residents.***

It is not the intent of this project to prescribe a particular course of action or set of steps to take in regard to water management and land use planning. Rather, it is our intent to encourage our watershed's communities to work together to understand and plan for the impacts of land use on water management as our landscape continues to change.



Request to Henry's Fork Watershed Council

1. Formal endorsement of booklet contents using WIRE criteria
Replace “project” with “booklet” in WIRE checklist
2. Any other comments or critiques of overall project value, information, interaction with Watershed Council, etc.—can be informal, provided later, anonymous, etc.

3. THANK YOU!

