

Arizona Hydrological Society
18th Annual Symposium
Sept. 21-24, 2005

Summary and Highlights
 By Kenneth Janecek
 For: C.W.A.G. - Oct. 8, 2005 Meeting

This presentation was prepared using materials distributed and notes taken by the author at the AHS's 18th Annual Meetings. Although every effort has been made to summarize accurately the presentations discussed below, readers are cautioned to remember that to err is human and the author is most definitely human.

AHS Symposium Schedule

- Wednesday Sept 21 Workshops
- Geographic Information Systems
- Well Design
- Project W.E.T. Conservation Curriculum
- Spring Classification
- Xeriscaping
- Drought Planning

AHS Symposium Schedule

Thursday, Sept. 22

Conservation & Innovation Forum

- Plenary Session
 - Herb Guenther – ADWR
 - Jane Harkins –Bureau of Reclamation
- Conservation & Innovation Forum
 - 8 Panelist Presentations
 - Panelists Q&A Session

AHS Symposium Schedule

Friday, Sept. 23 Technical Sessions

Water Regs & Policy	Surface Water/ Groundwater	Numerical Models Groundwater Flow
Dev. & Mgmt. for Hydrological Assets & A.M.A.'s	Surface Water	Water Education
Drought Mgmt. & Conservation	Watershed Impacts	Water Quality

AHS Symposium Schedule

Saturday Sept. 24

- Field Trip – Fossil Creek Dam Decommissioning & Stream Restoration

Drought Planning Workshop

- Overview of Arizona Climate
- Two Perspectives on Drought: Paleoclimate and Climate Change
- Climate Forecasts & F'cast Uncertainty
- Climate & Drought Info. on the Web
- Drought Planning for Small Water Providers and Communities

7

Overview of Az Climate

Mike Crimmins - U. of A.

- Solar energy distribution over the earth
 - 0-32° latitude = net increase [warming]
 - 32-90° latitude = net decrease [cooling]
 - Ocean and air currents re-distribute energy to maintain temperatures in balance
- Hadley Cells: 0-30° latitude
 - Warm air rises near the equator
 - Upper atmosphere winds from equatorial regions move north and create high pressure clear skies near 30° latitude when they descend
- Earth's deserts focused around 30° latitude
 - Seasonal shifts north and south for Hadley Cells change weather patterns at 30-35° where AZ is located

8

Overview of Az Climate

Mike Crimmins - U. of A.

Upper atmosphere jet streams:

- Move south in winter bringing Pacific storms [occasionally] into AZ
- Move north in summer bringing the Bermuda High as far west as AZ
 - Clockwise winds around Bermuda High bring Gulf humidity into AZ creating Monsoon storms
 - Southern AZ gets more Monsoon than north
 - About 60% of Tucson precip. = Monsoon

9

Overview of Az Climate

Mike Crimmins - U. of A.

- Sea surface temperature variations affect jet stream strength and shifts
- Computer modeling of climate and sea temperature historical data shows correlations useful for predicting future climate
- New satellite and ground based data collection greatly improve model accuracy
- Massive high speed computers are now available to process the huge volume of data

10

Overview of Az Climate

Mike Crimmins - U. of A.

E.N.S.O. El Nino Southern Oscillation

- Jan.- March Pacific 3°C warmer from Mexico to Peru = stronger jet stream + further south in AZ

L.N.S.O. La Nina Southern Oscillation

- Jan.- March Pacific 3°C cooler from Mexico to Peru creates a huge high in the N. Pacific
- This splits jet stream, with more energy shifted north to Alaska, then down into the Midwest as the "Polar Express"
- Az + intermountain west is left dry under high pressure
- La Nina occurs half as often as El Nino

11

Overview of Az Climate

Mike Crimmins - U. of A.

- Pineapple Express 4-7 day winter storm
 - Warm Pacific from Hawaii to Calif.
- P.D.O. Pacific Decadal Oscillation
 - Warm N.Pacific means stronger El Ninos
 - Cooler N.Pacific means stronger La Ninas
 - 20-30 year cycle turned cooler in 1998
- A.M.O. Atlantic Modular Oscillation
 - Warm N. Atlantic long cycle may amplify P.D.O. or be the consequence of P.D.O.
 - Need another 10-20 years of data at the current comprehensive collection rate to quantify impact²

Two Perspectives on Drought Gregg Garfin –U.A. CLIMAS

Tree ring borings - a climate record proxy:

- Need ~ 20 tree corings for each area studied
- Local 100 year climate records compared to tree ring spacing + density, input to computer modeling program, shows good correlation.
- Strong correlation allows 1000 years of tree rings to reveal climate and stream flow history [especially drought]
- Trees on slopes most sensitive to drought
- Rings don't record wet year excesses

13

Two Perspectives on Drought Gregg Garfin–U.A. CLIMAS

Measured climate changes since 1976:

- AZ+2°F. which is the largest and fastest change in 400yrs.
- 16% increase in annual melt area in Greenland
- Glaciers receding rapidly globally
- Arctic sea ice shrinking fast - oceans 1°C warmer
- Peak stream flows in Western US 5-15 days earlier
- Upper Colorado basin snowpack measured on March 1 has been dropping [since 1950]

14

Two Perspectives on Drought Gregg Garfin–U.A. CLIMAS

Climate forecast for next 50 years:

- Depends on CO₂ change from 380 ppm
- AZ est. is +1°F summer, +1.5°F Winter
- N. plains states +2.5°F winter
- Precipitation variations not predictable
- Full CAP delivery to AZ only 25% of years
- Full delivery to Mexico 50% of years
- Powell + Mead @ 50% of power capacity

15

Climate F'casts and F'cast Uncertainty Gregg Garfin–U.of A. CLIMAS

- Explained U.S. Climate Prediction Center methods of statistical analysis used to develop short and long term forecasts
- Southwest US f'casts better than rest of US
- AZ winter f'casts better than summer
- La Nina f'casts accurate for AZ
- Multi-year f'cast better than short term
- Climate variation > 2 sigma units from mean [like 2002] is very rare 2 years in a row

16

Climate & Drought Info on the Web Mike Crimmins – U.of A.

Western Regional Climate Center

- www.wrcc.dri.edu/summary/climasmaz.html
 - All AZ reporting sites historical data
 - AZ climate maps + departure from mean
- National Drought Mitigation Center
- www.drought.unl.edu/monitor/monitor/html
 - Drought monitor+impacts data and maps
- Drought monitor animation
- www.drought.unl.edu/dm/html

17

Climate & Drought Info on the Web Mike Crimmins – U.of A.

National Oceanic Atmospheric Administration

National Climate Data Center

- www.lwf.ncdc.noaa.gov
 - Original NOAA data center
- Climate Diagnostics Center
- www.cdc.noaa.gov
 - Good E.N.S.O. data + visualization tools & maps
- Climate Prediction Center
- www.cpc.noaa.gov
 - E.N.S.O.+ climate f'cast – 8 day to 1 year

18

Climate & Drought Info on the Web


Mike Crimmins – U.of A.

National Weather Service

- www.wrh.noaa.gov/climate/index.php?wfo=fgz
- Daily & monthly forecasts for N. AZ
- Links to most other weather sites
- N. AZ climate extremes

19

Background: Arizona Drought and Conservation Planning Activities



Courtesy USGS

20

Drought Planning for Small Water Providers and Communities

Katharine Jacobs-U.of A. Assoc Prof.& Specialist for SAHRA, WRRC, SWES, HWR

Governor's Drought Task Force 3/03-10/04:

- Dev.+ implement short term ['03-'04] plan
- Dev.+ implement AZ statewide water conservation education strategy
- Dev. + implement long term drought mitigation plan with thresholds and triggers for all levels, including disaster declaration & request for Federal \$

21

Drought Planning

Katharine Jacobs

G.D.T.F. 10/04 Recommendations:

- Centralized science based "early warning" system
- Focus on preparedness, monitoring, & warning
- Fund a drought coordinator & staff
- Develop a drought info. web site
- Form local drought assessment groups
- All potable water providers must develop a drought contingency plan

22

Drought Planning

Katharine Jacobs

AZ Drought Triggers [~ 12 month lag to raise or lower] [independent judgment for each watershed]

Description	Level	% Rank	Response
Normal	0	40-100	Cut vulnerability
Abnormally dry	1	25-40	Raise consciousness
Mod. Drought	2	15-25	Voluntary reduction
Severe Drought	3	5-15	Curtailment
Extreme Drought	4	0-5	Elim. non-essent. use Emergency declaration

23

Drought Planning

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HB 2277 for water providers:

All systems submit plans

- Systems > 1850 people by 1/1/07
- Systems < 1850 people by 1/1/08

All plans must include:

- Water supply
- Drought preparedness
- Water conservation
- Annual report on withdrawals, diversions, deliveries

Private wells and providers inside A.M.A.'s are exempt from plan [already make annual reports]

24

Drought Planning

Katharine Jacobs

Phoenix position on drought:

[per Grady Gammage]

- We don't analyze growth impact on prolonged drought
- We can't even define what "prolonged" means
- We must ask: Can we sustain these new demands in a drought?

25

Drought Planning

Katharine Jacobs

Az Republic editorial July 25, '04:

- Unlike Denver and Las Vegas, valley cities don't see need for mandatory conservation
- They fear this negative message would slow the fast paced "Growth Machine"
- Overall the valley is in relatively good shape because of 2 decades of good water policies

Note: Kathy Jacobs was not allowed to address "growth" in AZ Drought Plan. Only politicians can address growth

26

Drought Planning

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New York Times Jan. 27, '03

- Article by Joe Sigg of the AZ Farm Bureau
 - AZ high country hit hardest by drought
 - Depend on surface water and groundwater
 - No CAP access or reservoirs as backup

27

Drought Planning

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Santa Fe New Mexican Sept. 17, 2005:

- Drought prompted city + county to change how they consider development, utility service, and conservation
- In the city, developers must provide water to get new developments approved
- In the county, no new water allocations will be approved until water portfolio is in order

28

Drought Planning

Katharine Jacobs

Drought & Water Supply Planning Process

[1] Transparent Planning Process

- State plan is the model to follow
- Set up task force w/ all stakeholders
- Public must participate at every step
- Invite media to all meetings
- Set up a web site for public monitoring
- Track public perception

29

Drought Planning

Katharine Jacobs

Drought & Water Supply Planning Process

[2] Define Goals and Objectives

- Who should plan affect?
- Define watershed geographic boundaries & jurisdictions
- Set timeline and milestones for completion
- Develop long term conservation plans, not just short term drought response
- How to avoid impacts vs. responding to shortage

30

Drought Planning

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Drought & Water Supply Planning Process

[3] Assess Drought Vulnerability

- Risk = Hazard x Vulnerability
- Hazard = natural events
 - hurricanes, fires, dry rivers, dry wells
- Vulnerability = social factors
 - budgets, laws, public perceptions, policies
 - capacities, interconnects
 - consider multiple things going wrong at once like pump failures, main breaks, fires

31

Drought Planning

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Drought & Water Supply Planning Process

[3] Assess Drought Vulnerability

- Assess water supply & demand
 - Define baseline normal supply, distribution, peak hour, day, month
 - Describe drought impacts on supply + demand in 2002
 - Project future supply + demand through 2025

32

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Drought & Water Supply Planning Process

[3] Assess Drought Vulnerability

- Assess supply during 2002 drought
 - Stream flow
 - Reservoir levels
 - Groundwater levels, well locations, pumping patterns
 - Storage availability
 - Alternate sources
 - Water quality changes/issues

33

Drought Planning

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Drought & Water Supply Planning Process

[3] Assess Drought Vulnerability

- Assess current ability to respond to drought [conservation, ordinances, alternate supplies, rates, funding]
- What new creative outdoor demand conservation can be implemented?
- Is usage by large industrial, commercial, gov't facilities efficient and interruptible?
- Do laws, policies, water rights limit ability to respond to drought?

34

Drought Planning

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Drought & Water Supply Planning Process

[4] Define Drought Indicators & Triggers

- Indicators may be: precipitation, stream flows, groundwater levels, reservoir levels, soil moisture, Palmer Drought Index
- Triggers are local, not state choice
- Triggers are values of each indicator that start or stop each level of local drought management response

35

Drought Planning

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Drought & Water Supply Planning Process

[5] Mitigation & Responses to Drought Stages

- Increased data collection & metering
- Public info and education
- Cooperative planning-utilities & jurisdictions, watershed stakeholders
- Restrictions, bans on non-essential uses
- Drought & excess use surcharges
- Local ordinances on use & penalties for non-compliance

36

Drought Planning

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Drought & Water Supply Planning Process

[5] Mitigation & Response to Drought Stages

- Large user water audits, re-use, phased reduction programs
- Partnerships with other providers and agencies for interconnects, hauling
- System optimization, loss reduction, metering, repairs, communication
- Emergency declarations + req. for fed help 37

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Drought & Water Supply Planning Process

[5] Mitigation & Response to Drought Stages

- Clarify Conservation Goals & Objectives
 - Short term - stay in effect only during drought, and often focused on behavior changes
 - Long term - drought preparedness
 - Permanently reduce total water demand
 - Include indoor and outdoor conservation
 - May "harden" demand since discretionary uses are cut
 - May allow for more growth 38

Drought Planning

Katharine Jacobs

Drought & Water Supply Planning Process

[5] Mitigation & Response to Drought Stages

- Evaluate alt. strategies against a matrix of:
 - Consumer acceptance
 - Cost and equity among users
 - Effectiveness [demand cut or supply increase]
 - Sustainability
 - Legal or contractual issues
 - History of previous actions
 - Ease and timing of implementation 39

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Drought & Water Supply Planning Process

[6] Develop staged drought response plan

- Propose programs to address water shortfall at each drought stage
- Identify responsible agencies and individuals
- Identify funding options and revenue impacts
- Publicly discuss options, criteria, costs
- Adjust as needed for agreement
- Formally adopt plan with all stakeholders signatory 40

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Drought & Water Supply Planning Process

[7] Assign tasks and implement plan

- Create effective public information and communication strategy
- Provide outreach and tech. assist for users
- Pass ordinances for plan as needed
- Draft public notices and letters requesting future assistance
- Establish perform. goal metrics / milestones.

Drought Planning

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Drought & Water Supply Planning Process

[8] Implement enforcement mechanisms

- Monitoring & early warning system database
- Web site and public info. activities
- Train responsible individuals and agencies
- Technical assistance
- Draft citations, compliance orders, emergency response / water supply contingency plans 42

Drought Planning

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Drought & Water Supply Planning Process

[9] Ongoing data collection and plan review

- Define process and responsibility for review and amendment to assure a “living process” that endures during wet periods
- Ensure funding for plan updates, database maintenance, and dialog with ADWR, LAIAG
- Measure performance against milestones on a regular basis

43

THE EL NINNY EFFECT



Normally the government drifts along at about 8,000 m

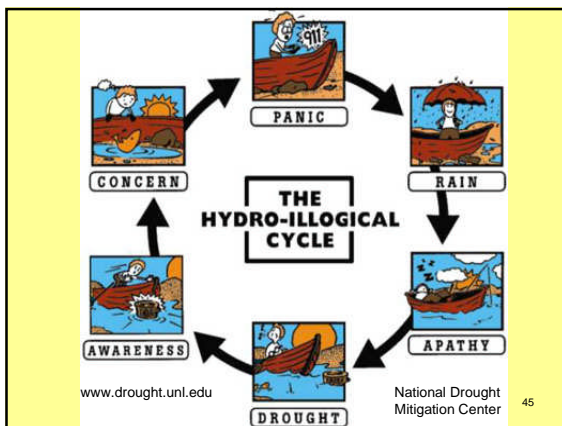
Every few years there's a drought. When it gets really bad, it suddenly rains politicians, experts and media.



They form pools of expertise and funding to cope with the drought cycle

As soon as the good years return, they evaporate back to 8,000 m

44



(For more information, see ADWR Web site
http://www.azwater.gov/dwr/Content/Find_by_Program/Drought_and_Conservation/HB_2277/default.htm)

46

AHS Conservation & Innovation Forum Plenary Session - Herb Guenther, ADWR

AZ Water Portfolio	MAFA	[2005]
Groundwater	2.9	
Colo. R. Alloc.	2.8	1.5m CAP part is Junior rights
Gila River	0.4	
SRP	1.0	Salt + Verde
Reclaim	0.77	
Total supply	7.87	

47

AHS Conservation & Innovation Forum Plenary Session - Herb Guenther, ADWR

AZ 2005 water demand:

- Agriculture 74% [100% conversion to municipal = 40m > population in AZ]
- Municipal + Commercial 20% [5.85m pop. Today will double in 12 years]
- Industrial 6%

48

AHS Conservation & Innovation Forum
Plenary Session - Herb Guenther, ADWR

AZ Water Issues:

- Gila adjudication took 20 years
- Little Colorado may take even longer
- AMA's won't be in safe yield by 2025
- Valley is a desert with 4" rain and 8' evap.
 - Need more conservation, xeriscape, less turf
 - New Vegas golf course uses 45 AFA for 18 holes
 - Wringing out wasted water hardens demand and increases vulnerability in drought

49

AHS Conservation & Innovation Forum
Plenary Session - Herb Guenther, ADWR

AZ Water Issues [continued]

- Drought preparedness
 - State drought plan done 10/04
 - HB2277 – 20 year local water supply and drought plan
- Virtual Water University
 - Research and community assistance
 - Arsenic and water quality issues
 - Web based hydrological data base
 - Upper Verde River hydrology study
 - Develop new commercial products to license

50

AHS Conservation & Innovation Forum
Plenary Session - Herb Guenther, ADWR

Colorado River Under Stress

- 7 states compact gives upper states 7.5m AFA, but they must deliver 7.5m AFA to the lower states + 1.5m AFA to Mexico
- Long term river capacity is about 12-14m AFA, and as low as 7m AFA in 2002
- Upper states only need 4.6m AFA today but will need 6.5m AFA by 2030
- Lower states need full 7.5m AFA now and will need much more in 2030

51

AHS Conservation & Innovation Forum
Plenary Session - Herb Guenther, ADWR

Colorado River Under Stress

- Time is coming when upper basin unlikely to meet 75m AF /10 years contract terms
- If doctrine of prior appropriation had been used during 7 states negotiation of compact, lower basin would have more than the 7.5m AFA
- If lower basin initiates a "call" for full allotment, upper states will have to shut off pumps
- AZ will suffer shortage first, but Nevada will likely initiate the "call", because of their big budget
- AZ has legal defense fund \$1.5m for "call" suit + \$2m for supreme court adjudication of suit

52

AHS Conservation & Innovation Forum
Plenary Session - Herb Guenther, ADWR

Colorado River Under Stress

- 7 states working on flow augmentation plan
 - Weather modification [cloud seeding]
 - Salt cedar [tamarisk] eradication
 - Yuma Desalter upgrade and re-start
- Upper basin wants lower basin's agreement not to call the contract
- Lower basin wants right to control level in Lake Powell

53

AHS Conservation & Innovation Forum
Plenary Session - Herb Guenther, ADWR

Audience Q&A Session:

- Q: Why won't legislature pass a bill to allow cities to decide water allocation issues?
- A: Property rights lobby controls legislature. The general public doesn't get upset until we are on the brink of disaster. Herb doesn't know how to raise public consciousness other than to keep educating the public to vote in new legislators and lobbying the legislature

54

AHS Conservation & Innovation Forum Plenary Session – Jane Harkins USBOR

Colorado River Management

- Powell at 49% of capacity, Mead at 59%
- Total storage capacity = 60m AF
- Salt cedar sucking up ~5% of total river flow
- Nevada paying AZ to store unused share underground in AZ until needed in 10 years
- Historical river supply [% of normal]

1999 - 109%	2000 - 62%	2001- 59%
2002 - 25%	2003 - 52%	2004 - 51%
2005 - 109% [est.]		

55

AHS Conservation & Innovation Forum Panel Questions

- [1] What conservation programs have you done?
- What worked and what didn't? Why?
 - How much water did you save?
- [2] What new ideas are you implementing today?
- What are your expectations for these?
- [3] What makes demand mgmt. unique and challenging in your community?
- What is your history of conservation?

56

AHS Conservation & Innovation Forum Panel Questions [page 2]

- What is the conservation limit before a behavioral change in lifestyle is required?
- When do users, the water utility, and government see adverse impacts?
- What are the adverse impacts?
- How difficult is it to get past these limits?
- Is water price a cure-all?
- When do users, utilities, and government see an adverse impact?

57

AHS Conservation & Innovation Forum Panel Speakers

MDC-S.Cal.	Lynn Lipinski	Landscape Mgr.
Tucson	Fernando Molena	Conserv. Mgr.
Flagstaff	Adam Miller	Conserv. Mgr.
Hopi Tribe	Nat Nutongla	Water Resource
S. Nevada	Doug Bennett	Conserv. Mgr
Navaho N.	John Leeper	Water Mgmt. Mgr.
Payson	Karen Probert	Water Qual. Spec.
Phoenix	Tom Babcock	Conserv. Coord.

58

AHS Conservation & Innovation Forum MDC - Lynn Lipinski

Background:

- MDC supplies 26 utilities serving 18m people
- What works? Financial incentives
- 2m toilets @ \$60 since '88. [saves 23b gal/yr.]
 - 50% complete today, and doing 3300/yr.
 - Goal is 80% by 2025
 - Lo-flow toilet is a passive reqm't all for new homes
 - Washing machine rebates
 - Waterless urinals
 - 26 utilities all have gray water incentive programs

AHS Conservation & Innovation Forum MDC - Lynn Lipinski

What didn't work?

- Low flow showerheads
- Term "xeriscape" [citizens don't like to think they live in a harsh desert]
- Weak passive support for "green" industry
- "Moderate" rate increases

Innovations that appear successful

- Grants to entrepreneurs for water saving devices
 - X-ray film developer recycle for hospitals and clinics [98% water saved] \$400/ unit rebate
 - Pressurized water broom for pavement [80% water saved] \$200/ unit rebate

60

AHS Conservation & Innovation Forum MDC - Lynn Lipinski

New focus: Behavior modification

- Outdoor conservation way of life [cultural]
- Public outreach and education
 - Use Hollywood stars in ad program = \$3.2m/yr
- Partner with landscape & const. industry
 - “Calif. Friendly Home” certificate + sign
 - Up to \$2500/ home rebate for conservation
 - \$100 per toilet, \$400 per washing machine
 - \$0.80 / ft² to use non-turf landscaping

61

AHS Conservation & Innovation Forum Tucson – Fernando Molina

Background:

- Water mgmt. focus has evolved over 40 years
 - 1970’s Peak agricultural demand mgmt.
 - 1980’s Meeting new groundwater code
 - 1990’s Securing and using CAP water
 - 2000’s Conservation and drought planning
 - Demand over 40 years dropped from 240gpcd to 165 [Note: Ag decrease may be helping this?]

62

AHS Conservation & Innovation Forum Tucson – Fernando Molina

Conservation Programs:

- Information bulletins
- Education and training programs
- Progressive block rates
- Toilet rebates
- Commercial assistance & water audits
 - Schools, hotels, restaurants, and homes
- Ordinances for xeriscaping, water wasting, and emergency cutbacks

63

AHS Conservation & Innovation Forum Tucson – Fernando Molina

What worked?

- Beat the Peak ads [Pete the Beak duck]
- Progressive rates with sub metering in multi family housing
- “Zanjero” residential water audit program
 - Sprinklers, toilets, showers, leak detection
- Landscaper training [40 people 3x /yr]
 - Separate tree and plant systems + xeriscape
- Water waste ordinance enforcement

64

AHS Conservation & Innovation Forum Tucson – Fernando Molina

Conservation planning focus

- Develop long range supply/demand curve
- Conservation task force including reps from schools, hotels, landscapers, builders, restaurants
- Hiring consultants on housing trends, retrofit water fixtures to inventory
- Drought plans
- Finding more effluent to collect

65

AHS Symposium Technical Session Forecasting Muni Demand – Gary Woodward

Water use models 20 years ago have turned out to be wrong for Tucson. Here are some of the surprises:

- Single family home ownership is at an all-time high
- Population growth rate is dramatically higher
- # of people per home has dropped sharply
- # of homes with pools has dropped sharply
- AC has taken almost 100% of market share from evaporative coolers
- Homes have twice as many toilets as they did 20 years ago

66

AHS Conservation & Innovation Forum Flagstaff - Adam miller

Background:

- Cut water use [gpcd] 1% / year for 15 years

What worked?

- Progressive rates
 - 1st 5k gal @ \$2.83/k; 5k-15k gal @ \$4.71/k
- Mandatory use restrictions
 - Odd-even days + non-compliance surcharge
- Rebates for toilets [\$100], washers [\$100], hot water recirc. [\$100], turf removal [\$0.33/ft²], waterless urinals [230 done]

67

AHS Conservation & Innovation Forum Flagstaff - Adam Miller

What worked? [continued]

- Education programs
 - W.E.T. Festival [for 3rd and 5th graders]
 - Make a Splash [for 4th graders]
 - 50 gal rain barrels [\$30 rebate]
 - 900 sold in 2005
 - Good conservation PR, especially for kids
 - Flagstaff Xeriscape Council
 - \$40k grant from City and USBOR

68

AHS Conservation & Innovation Forum Flagstaff - Adam Miller

What worked? [continued]

- Reclaim programs [rates are 35-75% of potable water]
 - NAU 141mg/yr
 - SCA Tissue 105mg/yr
 - Receives effluent and returns it
 - Golf courses use reclaimed water
 - AZ Snowbowl ski center - snow-making
 - Will use reclaim when golf courses don't need it

69

AHS Conservation & Innovation Forum Hopi Tribe – Nat Nutongla

Background:

- First recognition of conservation was in Vietnam where he had 4 canteens/day
- 12 Hopi villages are centered around springs that have served sustainably for these villages for centuries
- Supplies are in the sandstone Navajo aquifer [N-aquifer]
- Supplies in Entrada, Mesa Verde, and Mancos formations are poorer quality

70

AHS Conservation & Innovation Forum Hopi Tribe – Nat Nutongla

Background [page 2]

- Tribal unemployment is 50-60%
- Hopi domestic use is 400 AFA
 - No landscaping, car wash, etc. very frugal use
- Half of the 17 water supplies on the reservation have inadequate distribution
- Population will reach 50k by 2100
- Natural recharge to the N-aquifer=13000AFA
- Peabody Coal pipeline uses 5000 AFA
 - Creates a deep cone of depression affecting Tribal wells
 - Mixed feelings in the Tribe about Peabody contract renewal

71

AHS Conservation & Innovation Forum Hopi Tribe – Nat Nutongla

1997 Hopi Tribe Water Resource Code:

- Well design and well head protection
- Regs. on how to develop water resources
 - 1 mile well spacings [had cone of depression interferences]
- Regionalization of supplies
- Water quality issues [no arsenic problems]
- Lived sustainably for 1000 years, so not focused on conservation today

72

AHS Conservation & Innovation Forum
S. Nevada Water Auth. – Doug Bennett

Background:

- Serving 2m people, and 280k tourists
- 100k/yr pop. Increase
- Receive 4"/yr. rain with 9"/yr. evaporation
- 1991 @ 312gpcd; 2005 @270gpcd
- Future goal is 240gpcd

73

AHS Conservation & Innovation Forum
S. Nevada Water Auth. – Doug Bennett

Background [page 2]

- Outside water use is 69% of total
- Inside use is 31% divided as follows:
 - Toilets 8% Laundry 6.7%
 - Showers 5.1% Faucets 4.8%
 - Leaks 4.2% Other 0.7%

74

AHS Conservation & Innovation Forum
S. Nevada Water Auth. – Doug Bennett

Background [page 3]

- Water consumption by user type
 - 43% single family
 - 16% multi-family
 - 14% commercial, hospitals
 - 8% golf courses [13m ft.² turf]
 - 7% resorts
 - 75% indoor use;
 - outdoor use is: 19%A.C.; 4% landscaping
 - 2% pools + fountains
 - 5% schools + government

75

AHS Conservation & Innovation Forum
S. Nevada Water Auth. – Doug Bennett

What worked?

- Water waste investigator trucks
 - Overspray irrigation, fountains, bad misters
 - 50,000 inspections per year
 - 10,000 violation notices
 - 150,000 assessments on monthly bills
 - Assessment schedule initiated during drought but strong public support exists to make it permanent

76

AHS Conservation & Innovation Forum
S. Nevada Water Auth. – Doug Bennett

What worked? [page 2]

- Assessment fee schedule

Violation #	1" meter	2-3" meter	4"+ meters
1	\$40	\$80	\$160
2	80	160	320
3	160	320	640
4	320	640	1280
5	640	1280	2560

77

AHS Conservation & Innovation Forum
S. Nevada Water Auth. – Doug Bennett

What worked? [page 3]

- Incentives [20% of utility's budget = \$32m/yr]
 - \$1/ ft.² turf removed up to 500,000 ft.²
 - \$0.50/ ft.² for turf over 500,000 ft.²
 - Water Smart Home label [if 11 standards met]
- Turf Ordinances
 - No front yard turf
 - < 50% of backyard in turf
 - <50% of golf course acreage in turf
 - Seasonal watering restrictions

78

AHS Conservation & Innovation Forum S. Nevada Water Auth.-Jason Ekberg

What worked? [page 4]

Water Smart Contractor License [makes buyers comfortable]

- City can provide list of these to buyers
- Listing on award winning SNWA web site [200k hits per year] with link to contractor's web site or info. page
- Wall certificate, decals, and business card listing
- Half of contractor's employees must pass an 8 hr training class on building codes, laws, xeriscape, and irrigation system design
- License must be renewed annually and any unresolved complaints from buyers result in revocation of license
- 88 contractors are on list out of 1000+ in Las Vegas
- 30 more are in process of certification

79

AHS Conservation & Innovation Forum Navajo Nation – John Leeper

Background:

- 27000 sq. miles
- 45% unemployment
- Per capita income \$5000 vs. \$22,500 AZ
- 60% of tribe lived on the res. in 2000
- 60% of total income is spent off the res.
- 1980-1990 res. pop. increased 22%
- 1980-1990 off-res. pop. increased 125%
- 30% of res. homes have no plumbing
- Fixing sanitation deficiency would cost \$380m

80

AHS Conservation & Innovation Forum Navajo Nation – John Leeper

Background [page 2]

- Urban / suburban res. pipeline delivery = \$600/AF
- Hauling water costs \$20,000 / AF
- Highest cost borne by poorest people on res.
- Haulers use non-potable stock tanks supply
- Little Colorado adjudication may bring pipeline to Cameron in 20 years
- Navajo Tribal Utility Auth. [NTUA] delivers water to 50% of residents
 - [NTUA needs 3 conn. per mile to justify extending pipe]

81

AHS Conservation & Innovation Forum Navajo Nation –John Leeper

Tribal Water Management Policy:

- Current customers served by NTUA use 80gpcd
- Charge is \$5/k gal.
- There is no landscaping, so there is little interest in conservation
- Goal is to be able to afford using more water in many of the homes

82

AHS Conservation & Innovation Forum Payson –Karen Probert

Background:

- 90 miles north of Phoenix, pop. 15000
- 37 wells averaging 100 gpm in fractured granite are drought/growth sensitive
 - Avg. well water level decline 2002 = 28'
 - Avg. decline 2004 = 7'
- SWGW Assoc. est. for safe yield = 1826AFA
 - 2002 pumping at 99% of S.Y.
 - 2003 at 92% of S.Y. ; 2004 at 88%

83

AHS Conservation & Innovation Forum Payson –Karen Probert

Background [page 2]

- 365 AFA tertiary treated sewage is recharged in 3 lakes or used for public landscape
- City is trying to secure 3000 AFA from Blue Ridge Reservoir owned by SRP and Phelps Dodge but it will require a 20 mi pipeline and a huge bonding cost
- Current use is 86 gpcd

84

AHS Conservation & Innovation Forum Payson –Karen Probert

What worked?

- Ordinances
 - No new grass, no turf sprinkling
 - No spas in hotels
 - Mandatory plant list for landscaping
 - Fire dept has foam sprayers [saves 90% of water use]
 - Development must bring its own water
 - Limit 20 lots per development [this has cut growth to 3%]

85

AHS Conservation & Innovation Forum Payson –Karen Probert

What worked? [page 2]

- Rebates for 1200 toilets and urinals retrofits, & new hot water recirc. systems
- Progressive block rates [may raise these]
 - <2k gal \$19.65 2-5k gal @\$2.65/k
 - 5-10k gal @\$3.50/k 10-20k gal @ \$4.00/k
 - >20k gal @\$5.50/k

86

AHS Conservation & Innovation Forum Payson –Karen Probert

What worked? [page 3]

- Effective leak detection program
- Education and advertising
 - Publish list of 10 biggest water users monthly
 - Xeriscape demonstration plots
 - Educate users about wise groundwater use
 - Educate Council about facts of water budget

87

AHS Conservation & Innovation Forum Payson –Karen Probert

What hasn't worked?

- Out of state businesses don't understand the water problems, and are not doing their part to conserve water
- Owners of vacation homes are not part of the community and reject behavior change
- Large private golf course outside city limits continues to use groundwater

88

AHS Conservation & Innovation Forum Phoenix – Tom Babcock

Background:

- Water users served [indust.+comm.+resid.]
 - 1987 950,000 + tourists
 - 2005 1,400,000 + tourists
- Total consumption = constant for 6 years
 - Resid. = 205k AFA Non-resid. =103k AFA
 - L'scape = 104k AFA Public turf = 6k AFA
 - Pool = 28k AFA City golf = 3k AFA
 - Indoor = 72k AFA Private golf = 5.5k AFA

89

AHS Conservation & Innovation Forum Phoenix – Tom Babcock

Background: [page 2]

- Metered consumption
 - 1980 = 260-270 gpcd
 - 1990 = 220 gpcd
 - 2005 = 209 gpcd
- GPCD is useful to measure conservation progress in a given utility, but cannot compare effectiveness between programs of various cities, because of climate, user mix, and cultural differences

90

AHS Conservation & Innovation Forum
Phoenix – Tom Babcock

What worked?

- Rebates & residential audits [on-going]
 - Toilets = \$40m in 300,000 pre-1980 homes
 - All conservation has saved 94k AFA since 1980
- Ordinances
 - Landscape and other water features
 - Water efficient indoor appliances

91

AHS Conservation & Innovation Forum
Phoenix – Tom Babcock

What worked? [page 2]

- Public education
 - “Water–Use It Wisely” [program started in 1998]
 - Azmet [U of A website] for irrigation mgmt.
 - Water system repair video
 - Xeriscape promotion programs
 - Landscaper training programs
 - Ads for retrofit water fixtures rebates
 - Mister nozzle maintenance manual
 - Turf irrig. advisory every 3 days in Az Republic₉₂

AHS Conservation & Innovation Forum
Phoenix – Tom Babcock

What hasn't worked?

- Water waste patrol [council rejected it]
- Lawn size limit [council rejected it]
- Progressive block rates [rejected-hurts poor]
- 20,000 hi-use SRP users w/ senior rights
- Drought plan [council put it on hold]
 - Too draconian; affects growth; drought is over
 - Revised plan goes to council in Dec. '05
 - Cost would be \$450k in '05; \$370k in '07

93

AHS Conservation & Innovation Forum
Phoenix – Tom Babcock

Proposed Drought Plan [Stage 1]:

- Cut city use 13%, residential+commercial 5%
- 2x /wk turf watering max.
- No over-seeding with winter rye grass
- Reduce outdoor misting
- Shut off public fountains
- Enforce fines for sprinkler discharges on the street
- Create \$1.5m/yr drought department ₉₄

AHS Conservation & Innovation Forum
Phoenix – Tom Babcock

Challenges:

- Maintain political will for conservation in wet years
- User acceptance of effluent re-use and recharge
- Deal with population increase raising demand
- Share the cost of developing new water with all agencies

95

AHS Conservation & Innovation Forum
Panel Q&A Session

What is your utility's single family GPCD?

Tucson	120	Phoenix	130?
Hopi Tribe	30-40	Navaho Nation	50
Payson	86	Flagstaff	115
So. Nevada	<100	MWD LA	140
		MWD S. Diego	150

96

AHS Conservation & Innovation Forum Panel Q&A Session

Education to improve water policy:

Politicians

- Don't have time to understand water science enough to believe they need to "rock the boat."
- Major education task after every election.
- Repeat the message over and over.

Public

- Too busy to take time to learn about water issues.
- Below the radar. Water still flows at the tap.
- Train teachers to teach kids conservation as a way of life.
- Need continuous P.R. and media campaign and public outreach.

97

AHS Conservation & Innovation Forum Panel Q&A Session

Can you consider water to manage growth?

- Payson: Developments limited to 20 lots now
 - May reduce it to 5 lots or go to moratorium if drought continues
- MWD: Utility doesn't make growth policy
 - That is province of city government
- Phoenix: 1992 shifted 100% of new water cost to new homes.
 - Require best water conservation fixtures for new homes.
 - You can't ask a landowner to pay property tax, then say he can't build on his land

98

AHS Conservation & Innovation Forum Panel Q&A Session

Why should we promote water conservation?

- It is ethically the right thing to do
- We must consider future generations
- CAP banking today will help overdraft mgmt. in the next drought
- Flagstaff has no cheap alt. to Lake Mary
- Tribes already use water efficiently and beneficially. Today, goal is to be able to afford using more water

99

AHS Conservation & Innovation Forum Panel Q&A Session

Rain capture

- Passive land terracing is most cost effective
- Tanks and pumps for roof catchments are >\$
- Phoenix: West Nile is a concern with standing water and don't need water in winter when most of the rain occurs.

100

AHS Conservation & Innovation Forum Panel Q&A Session

Gray water systems for landscape:

- Flagstaff: It's ok, but expensive. Sewage treatment plant can handle the flow for < \$
- Phoenix: Not good. Health issues. Treatment plant is prepared to take dilute effluent
- So. Nevada: OK for residential, but not cost effective for commercial users

101

AHS Conservation & Innovation Forum Panel Q&A Session

Challenges for conservation:

- Visible public wasting of water causes users to reject personal lifestyle sacrifices
- Saving water so new homes can be built is a negative incentive for conservation
- Educating the public that saving water is cheaper than finding new water
- Changing beliefs, behavior to feel good about conservation as a way of life

102

AHS Conservation & Innovation Forum Panel Q&A Session

Challenges for conservation:

- More efficient use and eliminating non-essential use, is a “demand hardening” that increases vulnerability in drought and forces more draconian sacrifices
- Eliminate automatic timers and drip systems so users must hand water. This “time sink” watering thirsty plants will quickly force use of xeriscape
- Put trees and plants on different drip lines to suit their different needs

103

AHS Conservation & Innovation Forum Lunch Speaker – Robert Glennon, U of A

- The West needs a voluntary market based system for water allocation & management
 - Alfalfa farmers’ water is subsidized. It is not a cost effective beneficial use
 - They should switch to higher value cost effective crops or give up this water for municipal use.
- The government has a role to protect landowners harmed by mandates
 - Imperial Valley farmers were forced to give up 10% of their water to MWD
 - MWD must pay these farmers to fallow their land and line their canals to reduce losses

104

AHS Conservation & Innovation Forum Lunch Speaker – Robert Glennon, U of A

- The Hopi Tribe is concerned about Peabody Coal hurting the N-aquifer with their slurry pipeline. They would like to see Peabody put in a railroad to replace the pipeline.
- Peabody feels the Hopi must make concessions to help Peabody justify this cost.
- The Supreme Court’s decision to uphold the New London, Conn. condemnation of private land for a shopping center is a classic battle of individual rights vs. the common good brought to focus in “Tragedy of the Commons.”
- Will this extend to water rights in the future?

105

AHS Symposium Technical Session Intro to AZ Water Law – Tom Sheddon Conflicting Water laws in AZ:

- Surface water - Prior appropriation
 - 1st in use; 1st in right [at the same amount]
- Groundwater - Rights of the commons
 - Beneficial use of whatever you pump
 - In AMA’s prior appropriation applies
- Colorado River – 1922 Law of the River
- Recharged effluent – ADWR rules

106

AHS Symposium Technical Session Intro to AZ Water Law – Tom Sheddon

Indian Water Rights:

- Judge Winter’s decision on Ft. Belnap
 - Every tribe on a reservation has a right to minimum water needs for domestic + farms
 - Fed. Gov’t must deliver it based on practicable irrigable acres even if fallow today
- Gila + Little Colorado River litigation
 - >30,000 parties with 100,000 claims to resolve
 - This is the largest litigation in the world

107

AHS Symposium Technical Session Intro to AZ Water Law – Tom Sheddon

Gila + Little Colorado Litigation Impact:

- Cities potentially affected by the outcome of this litigation are afraid to make water decisions because they may be voided by the future settlements with the Tribes
- Colorado River Augmentation:
- Cloud seeding may enhance river flow
 - Downwind users may be impacted by reduced atmospheric moisture
 - This may be the next big litigation

108

AHS Symposium Technical Session

Recov.of Banked CAP Water - Ken Seasholes

- To get CAP approval, AZ had to accept junior rights for the 1.5m AFA canal capacity
- AZ has taken the full 1.5m AFA each year and banked unused excess in groundwater storage
- Total banked excess is >2.6m AF to date
- This is 40% of expected CAP shortfall in a future "100 year drought"
 - Phoenix has 1.5m AF = 50% of shortfall
 - Tucson has 0.86m AF = 25% of shortfall
 - Pinal has 0.24m AF = 33% of shortfall

109

AHS Symposium Technical Session

Recov.of Banked CAP Water - Ken Seasholes

Bank options if USBOR cuts AZ CAP share:

- Pump banked storage to users
- Get banked water from another provider's wells
- Pump banked water into CAP canal for users
- Accept \$ compensation for shortfall and forego future replacement
- Reduce demand and get credit for future replacement

110

AHS Symposium Technical Session

Tucson 50 Year Water Plan – Ralph Marra

Water Use History:

- 1970 - 500k AFA [mostly ag. + mining]
 - Many mines shut down since 1970
 - City retired 20,000 acres of farm land
- 2000 - 300k AFA with muni. growing fast
 - Muni.- 125k AFA serving 650k people
 - Agriculture- 100k AFA
 - Mining- 75k AFA

111

AHS Symposium Technical Session

Tucson 50 Year Water Plan – Ralph Marra

Projected Demand Growth:

- By 2030 population will double to 1.2m and muni. water demand could be 250k AFA
- To meet this growth will require 100% of CAP water, plus maximum reclaim water and conservation
- The problem will be overcoming public objections to CAP and reclaim water

112

AHS Symposium Technical Session

Tucson 50 Year Water Plan – Ralph Marra

Public perceptions:

- Added CAP water to mix a few years ago without pH adjustment
- Lower pH CAP water rusted distribution piping and created red water problems before error was recognized
- Groundwater has 300 ppm of dissolved solids while CAP water has 650 ppm
- Current blend is 450 ppm which public says should be the maximum

113

AHS Symposium Technical Session

Tucson 50 Year Water Plan – Ralph Marra

Problems with water strategy options:

- Desalination is not an option to reduce CAP salinity, because of the high 15% loss to evaporation and enormous land requirement for evaporation ponds
- Costs and hazards of a separate distribution system for CAP water are not acceptable
- Public "yuck" perception prevents direct use of reclaimed effluent and CAP water

114

AHS Symposium Technical Session Tucson 50 Year Water Plan – Ralph Marra

Education to change perceptions:

- Technical problems with reclaim and CAP water can be resolved
- Groundwater cannot continue to be mined. Water tables have dropped 200' with 3 - 4' subsidence
- An all-out effort of PR, media and public dialog will be needed to change public and government perceptions about water, in order to solve Tucson's looming shortage

115

AHS Symposium Technical Session Water Rate Structure – Laurel Lacher

White Mountain Apache Tribe Water Rates:

- Current un-metered flat \$20 / mo. rate doesn't cover cost of distribution
- Water is sacred to the tribe and is not abused or wasted, but demand will soon exceed capacity
- Tribe goal is to cover cost but keep minimum use affordable

116

AHS Symposium Technical Session Water Rate Structure –Laurel Lacher

AZ Rate Study Results:

- Flat rate - No meters, simplest, but hurts the poor and encourages abuse
- Declining rate – Need meters, favors big users, encourages > use, hurts poor
- Uniform volume rate – Need meters, still hurts poor, but most frequently used
- Inverted block rate – Need meters, encourages conservation, helps poor, second most frequently used structure

117

AHS Symposium Technical Session Water Rate Structure –Laurel Lacher

Recommendations to tribe:

- Install meters
- Switch to inverted block rate
- Increase rates over 5 years to generate 74% higher revenue to cover cost

118

AHS Symposium Technical Session G.W. Based A.W.S. Issues – Ken Seasholes

- PAMA allowance of spatial disconnect between withdrawal and recharge is a problem and is fueling growth
- Aquifer drawdown to 1000' has structural consequences we need to address [Subsidence]
- AZ water law has never been a tool to address growth. We always go into overdraft
- There won't be a moratorium on growth if we fail to reach safe yield by 2025

119

AHS Symposium Technical Session USGS AZ Water Science Center – Nick Melcher

R&D Priorities:

- Provide data for rural watersheds outside AMA's that have inadequate hydrological info
- Evaluate effects of pharmaceuticals, pathogens, and organics in wwtp effluents
- Develop nested models for Rural Water Initiative in AMA's
- Expand use of gravity as an indicator to measure water storage
- Complete water availability study of AZ
- Develop models for aquifers such as N-aquifer
- Expand partnerships and collaboration with other government agencies

120

AHS Symposium Technical Session Endocrine Disruption in Fish – Gail Cordy

- Male fish are losing their reproductive capabilities in Southwest streams composed primarily of treated sewage effluent
- This has been traced to “endocrine disruption” chemicals that are refractory [not removed] in sewage treatment plants
- These chemicals come from antibiotics, steroids, hormones, detergents, disinfectants, fire retardants, pesticides and all kinds of non-prescription and prescription drugs, all in very low “parts per billion” ranges

121

AHS Symposium Technical Session Endocrine Disruption in Fish – Gail Cordy

- The USGS and U of A are doing a controlled research experiment to quantify the impact of Tucson sewage effluent on the bony tail chub, a common AZ fish
- It is an expensive and virtually impossible task to identify all of the thousands of these trace chemicals in effluent, and in the streams
- Researchers are looking for a simple “surrogate” chemical that behaves like these endocrine disruptors, is refractory to sewage treatment, and is easy to identify in a lab test

122

AHS Symposium Technical Session Endocrine Disruption in Fish – Gail Cordy

- Caffeine could be a candidate for this surrogate chemical.
- The next question that has far-reaching consequences is: What effect does this “dilute soup of endocrine disruptors” have on humans?
- What is the effect of recharging these chemicals into the groundwater for future withdrawal as drinking water?

123

AHS Symposium Technical Session Valuation of Riparian Corridors in Tucson Rosalind Bark-Hodgins

Project goals:

- Isolate and quantify the premiums for sales of homes located within 0.2 miles of a riparian corridor with flowing water.
- Calculate the increase in property tax revenue from higher valuations of properties near riparian habitats
- Calculate the cost for using effluent to restore flowing water in riparian corridors

124

AHS Symposium Technical Session Valuation of Riparian Corridors in Tucson Rosalind Bark - Hodgins

Procedure used in study:

- Studied data on 700 homes within 1 mile of 51 riparian corridors with and without flowing water
- Created a comprehensive computer model to analyze the impact of flowing water in riparian corridors on home prices

125

AHS Symposium Technical Session Valuation of Riparian Corridors in Tucson Rosalind Bark-Hodgins

Study conclusions:

- The increase in price for single family homes within 0.2 miles of riparian corridors with flowing water was \$14,657 over dry corridors
- Extrapolating that to 3893 homes within 0.2 miles of riparian corridors in Pima County = \$114m-\$228m increased valuation
- Annual incremental property tax collection would be \$1.15m /yr

126

AHS Symposium Technical Session
Valuation of Riparian Corridors in Tucson
Rosalind Bark - Hodgins

Study conclusions: [page 2]

- Fixed capital cost for a delivery system to bring reclaim water to these dry corridors was estimated at \$37m - \$188m
- No attempt was made to find the lowest cost corridors with highest cost homes to supply
- Variable operating costs for reclaim water, pumping, and administration were estimated at \$1.7m

127

AHS Symposium Technical Session
Valuation of Riparian Corridors in Tucson
Rosalind Bark-Hodgins

Study conclusions: [page 3]

- There is a real esthetic valuation of riparian corridors in urban area home prices
- That may be attributable to extra privacy, trees, improved viewshed, flowing water or other riparian values
- The cost of restoring stream flows using reclaim effluent may be offset by increased property tax revenue from higher home valuation

128

AHS Symposium Technical Session
CAP Shortfall – Sid Wilson G.M.

Background:

- Design is 1.5m AFA; can handle 1.8m AFA
- AZ is banking excess CAP for future drought needs
- Can bank up to 0.4m AFA in recharge ponds
- Adding more ponds in Tucson and Pinal
- CAP delivery requires a total lift of 3000'
- CAP pumping is the largest single power demand in the state
- CAP owns 24% of Navajo power plant, and all of Lake Pleasant hydro plant

129

AHS Symposium Technical Session
CAP Shortfall – Sid Wilson G.M.

Colorado flow augmentation:

- USBOR promised to work on producing 2.5m AFA additional flow in the system
- Little done to date for cloud seeding, tamarisk eradication, or running the Yuma desalter
- New technology could allow the Yuma desalter to run at \$300/AF, the lowest cost water in the system, but BOR says they have no money

130

AHS Symposium Technical Session
CAP Shortfall – Sid Wilson G.M.

Problems with running the Yuma desalter:

- High solids runoff from the Salton sea irrigation systems for 25 years created "Cienaga de Santa Clara"
- This new lake in Mexico is now a habitat for 97 species of birds
- Running the Yuma desalter will dry up this lake, threatening this habitat and all the birds
- The US gets no credit for this water now because it is higher in solids than the US-Mexico treaty allows

131