This presentation premiered at WaterSmart Innovations

watersmartinnovations.com

watersmart
INNOVATIONS

Water Smart Innovations Conference

Oct. 8-10, 2014

Las Vegas, Nevada

Putting a Value on Environmental Benefits of Water Efficiency

Bill Gauley, P.Eng., Gauley Associates Ltd.

&

Tracy Patterson, Freeman Associates

for

THEWATERSTRATEGY.COM

Gauley Associates Ltd.

Alliance for Water Efficiency

Why Assign a Value to Environment?

- No $ = No value = No consideration
- But – maintaining/improving natural environment is very IMPORTANT, and IMPORTANT = VALUABLE
- If we can assign a $ value to the environmental benefits of a project, this value gets included on the evaluation ledger

Need to Include Environmental Benefits in Bottom Line

- Important because per capita demands are declining across North America
- Difficult to “justify” efficiency projects if no deferral, downsizing, or eliminating of infrastructure
- Amazing! How can a system be “too efficient”?
- So – what do we do?

Consider: Manning (Gauckler) Formula

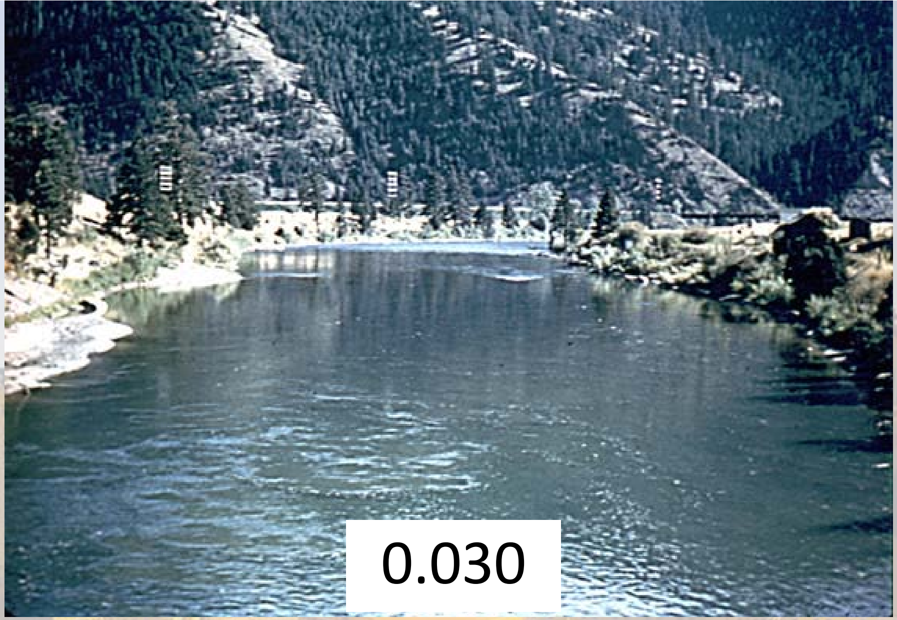
- An empirical formula estimating avg. velocity of liquid flowing in an open channel (e.g., rivers)
- **Empirical relationship** is based solely on observation rather than theory.
  - Requires only confirmatory data irrespective of theoretical basis
- Empirical relationships can be approximations!

Manning’s “n” Value

$$V = \frac{k}{n} {R_h}^{2/3} S^{1/2}$$

		Avg.
1.	Clean, straight, full stage,	
	no rifts or deep pools	0.030
2.	Same as above, but more stone	
	and weeds	0.035
3.	Clean, winding, some pools and shoals	
4.	Same as above, but some weeds and	0.040
	some stones	0.045
5.	Same as above, lower stages, more	
	ineffective slopes and sections	0.048
6.	Same as 4, but more stone	
7.	Sluggish reaches, weedy, deep pools	0.050
8.	Very weedy reaches, deep pools, or	0.070
	floodways with heavy stand of timber	0.100
	and underbrush	


0.024


0.030


0.050


0.040

Open to Slight Interpretation

- Formula derived in 1891
- Been used and useful for > 120 years
- Requires user to make judgment call re friction factor of river bank (or section of river bank)
- Two analysts may get slightly different answers
- **Doesn't matter** – just be in the ballpark
- Close counts in horseshoes, hand grenades, and Manning's 'n'

In the Ballpark

- We routinely accept many values that cannot easily be accurately defined:
  - Age and weight
  - GHG offsets
  - City populations
  - Cost of new infrastructure
  - Length of coastline
  - Manning's n value
- Just because we can't accurately define a value doesn't mean that we should ignore it.

Value of Environment

- Natural environment **IS** valuable
- But, difficult to accurately quantify environmental values - either generally or in specific instances
- Triple bottom line accounting considers financial benefits AND environmental & societal benefits
- We know taking water from ground or surface source degrades environment to SOME extent –
- But…
  – Can we assign a dollar value of the degradation?

Negligible ≠ None

- Costs of environmental degradation often ignored – hard to quantify, easy to argue against
- Consider adding a drop of oil to the ocean
  - Did you cause any damage?
  - What if you add a tanker full of oil?
- The truth: “death by a thousand cuts”
  - Every drop of oil degrades the ocean to same extent!
  - But, FAR easier to see when degradation is huge
  - Damage can be cumulative if *nature* does not have enough time to complete repairs!!

Bad Company

- Humans are not typically nature's closest ally
- Most times when we interact with nature, we end up degrading nature somewhat
- We must think holistically – the big picture!
- Unfortunately, this makes the problem even more difficult because there are even more interconnected effects

Short-Term vs. Long-Term

- Short-Term: easier and less expensive to…
  - Not change oil in your car
  - Drop litter on the street
  - Not pick up dog ‘droppings’
  - Not maintain our infrastructure, etc.
- But: ALWAYS requires more effort and expense in the long-term (and we must look long-term)
  - Don’t know how much more effort and expense, but
  - we **KNOW** the effort and expense will be there.

CUWCC / LBL

- If no $ value assigned to environmental benefits
  - Environment benefits do not show up on ledger
- CUWCC /LBL developed program to allow water agencies to input site-specific data and information into a spreadsheet program to determine the dollar value associated with taking less water from the natural environment
- Essentially – this program calculated a dollar value for every gallon of water NOT drawn

CUWCC/LBL (con't)

- Sometimes very complicated or difficult to obtain required input data
- Lots of input data required
- Obviously a wide range of outputs
- Program has not yet 'caught on'
- BUT – study determined an approximate **avg. $ value** for water not taken from environment-
- $50 per acre-foot of water left in environment
  - Equates to ~ $0.04 per m^3

$50 per Acre-Foot of Water Saved

- Value based on avg of several beta runs of model
- Input from “non-drought” time period
- If program re-run today, with California in a MEGA drought, the average value would likely be much greater than $50!
- **AWE Tracking Tool** has a set of fields where environmental benefit values can be input – BUT – fields always blank because no one knows the value to enter

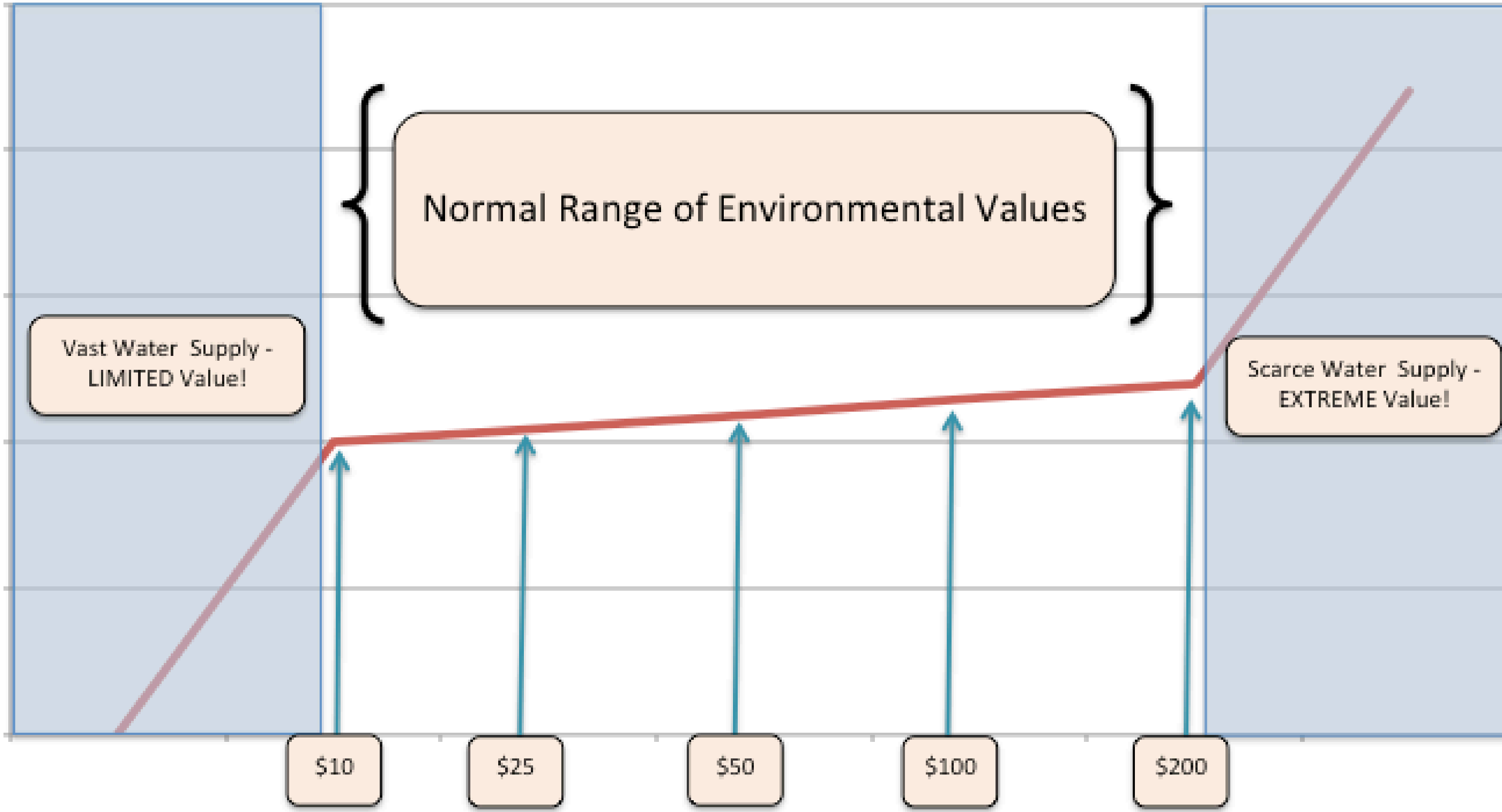
Complexity = Inactivity

- If it is TOO difficult or expensive to determine the environmental value of water efficiency …
  - Water agencies simply WILL NOT determine the environmental value of water efficiency!!
- Need to develop an EASY method to determine a realistic and acceptable APPROXIMATE environmental value of water efficiency under various scenarios…

Back to Manning

- Just like Manning managed the difficult task of determining the friction coefficients for a wide range of river flow conditions…
- We need to develop environmental value coefficients for a wide range of water supply / availability conditions.
- Method requires:
  - Easy and fast input
  - Minimum knowledge required from analyst
  - Results from different analysts in same ballpark

Coefficients of Environmental Values
$ per Acre-Foot



Coefficients of Environmental Value

- Extreme values…
- Vast Water Supply: value associated with taking small volume of water from a vast supply is minimal (not zero! But minimal)
  - camper beside large, clear mountain stream
  - city on ocean coast using desalination plants, wastewater treated and returned to ocean
  - Assume a $0 value
- Scarce Water Supply – declining or potentially declining water supply, lowering river flows/lake levels/aquifer levels, taking water is harmful to natural habitat, etc.
  - Cities taking water from Colorado river
  - Cities taking water from Ogallala aquifer
  - Value so high that it does not need to be calculated!

Coefficients of Environmental Value

- $10/ac-ft:
  - plenty of water (e.g., on huge, healthy river or Great Lake); no *apparent* negative impact on habitat; virtually all wastewater is treated and returned to same watershed
- $25/ac-ft:
  - healthy and abundant water supply (river, lake, aquifer); minimal impact on natural habitat
- $50/ac-ft:
  - typical conditions; take water from small river/lake or healthy aquifer; limited impact on natural habitat
- $100/ac-ft:
  - potential limitation to water withdrawals and/or potential negative impact on natural habitat
- $200/ac-ft:
  - limited availability of water supply; declining melt water; unstable river flows/lake levels/aquifer levels; some negative effect on natural habitat

For Instance -

- Estimated total groundwater depletion in USA during 1900–1999 ~ 187 cubic miles (mi^3)
- Furthermore, rate of depletion is increasing
  - 1900-1999 ~ 1.9 mi^3/year
  - 2000–2008 ~ 5.9 mi^3/year (18 billion gallons/day)
- Clearly not sustainable! The “well” will run dry at some time.
- Groundwater depletion is largely invisible, so it is acceptable.
- But, if we could just assign a cost…not invisible!

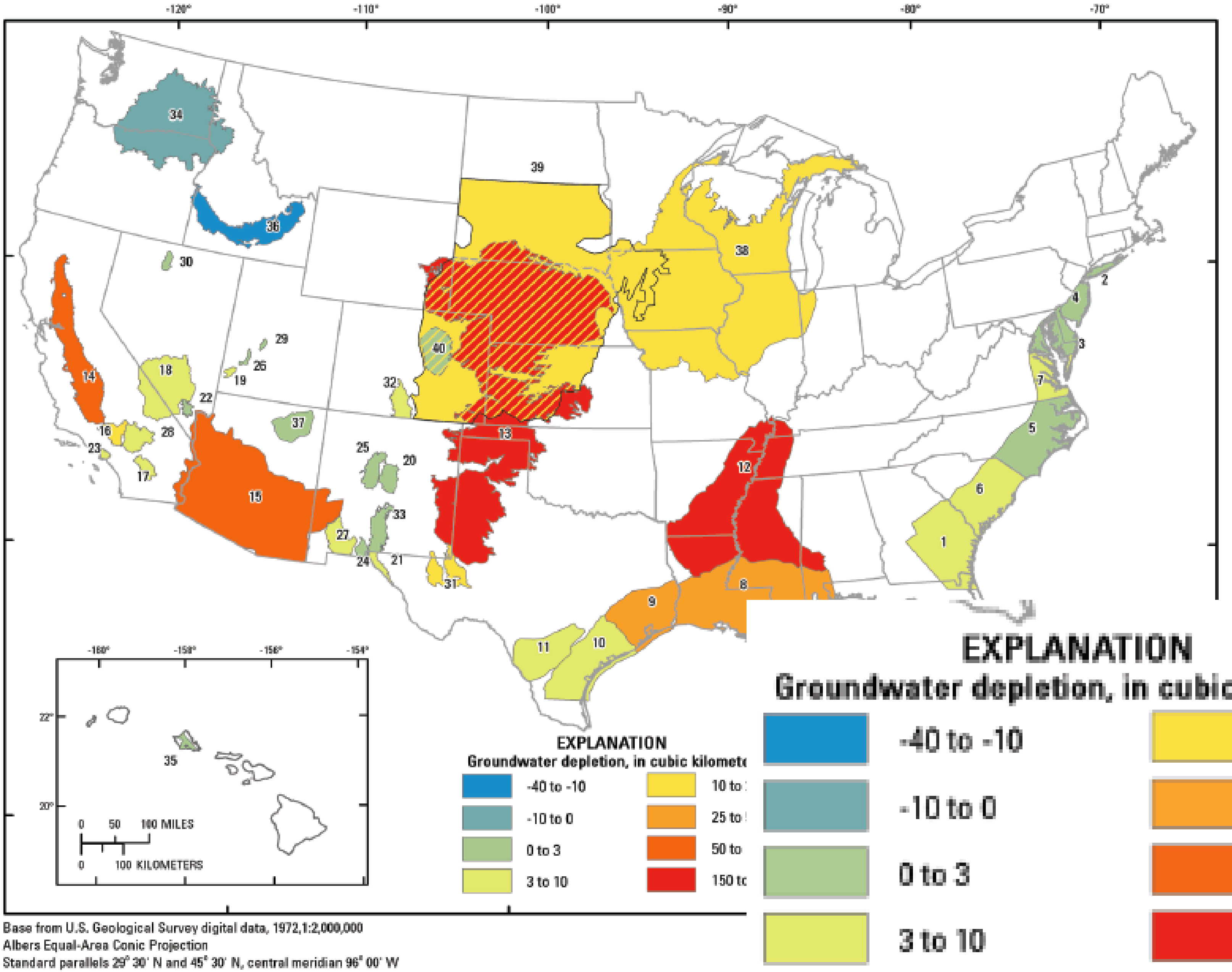


Figure 2. Map of the United States (excluding Alaska) showing cumulative groundwater depletion, 1900 through 2008, in 40 assessed aquifer systems or subareas. Index numbers are defined in table 1. Colors are hatched in the Dakota aquifer (area 39) where the aquifer overlaps with other aquifers having different values of depletion.

Obvious Environmental Benefits

- Many areas of USA experiencing groundwater depletion
- Ogallala aquifer supplies ~30% of groundwater used for irrigation in USA
- Volume reduced by 0.12% per year between 1950 and 2000
- Volume reduced by 0.38% per year between 2000 and 2008
- What is the value of water efficiency in this case?

Holistic Approach

- Need to start assigning a $ value to ‘hard to determine’ environmental benefits of water efficiency – so…
- Need to complete research to better define the range of values that will be used to determine the coefficient factors – so…
- Need interested partners – research partners, funding partners, in-kind partners, knowledge partners, etc.
- Need your help!

Thank You – Questions?

Bill Gauley, P.Eng., Gauley Associates Ltd.
Tracy Patterson, Freeman Associates
THEWATERSTRATEGY.COM
bill@gauley.ca