The Lake Powell Pipeline: Affordable? Desirable?

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June 13, 2018

This is unfunded research.

Thanks to:
Gail Blattenberger
Associate Professor of Economics Emeritus
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Following in the footsteps of BYU Emeritus Professor of Economics B. Delworth Gardner, editor of *Aquanomics* (2012) and researcher on Utah water since 1964.

The "Lake Powell Pipeline Development Act" requires the water districts which receive the water to fully compensate the State for building the pipeline.

Is the LPP Affordable?

LPP Costs & Revenues

For Washington County only (approx. 94% of total):

	Low Cost	High Cost
Construction Costs	$1,328,461,944	$1,750,908,555
"O&M"	$23,493,231	$62,867,794
Power sale revenue	$9,947,747	$72,005,740

source: Draft Socioeconomics and Water Resource Economics Study Report, Utah Board of Water Resources, 2012

Other WCWCD costs & revenues

- Property Taxes ($9,938,660 in 2013, rising with population)
- sale of Real Estate
- Debt Service on existing debt
- Impact Fees ($6102/ERU in 2013, rising with population)
- Water Sales ($7,013,377 in 2013—i.e., less than property taxes—rising with population)

Base Case: No Price or Fee Changes, Low-Cost Scenario

Structure of Spreadsheet, First/Second Scenarios

Property Taxes: escalated from 2013 figure by rate of population growth

Water Sales Revenue: escalated from 2013 figure by rate of population growth

Power Sale Revenue and Surcharges: escalated from 2013 figure by rate of population growth

Impact Fees: escalated from 2013 figure by rate of population growth

Real Estate sale revenue: per WCWCD

LPP Power sale revenue: per WCWCD

Total Revenues

. . . spreadsheet columns continued. . .

Annual Service on Existing Debt: per WCWCD

Existing O&M Costs: per WCWCD

Annual LPP Debt Service:

- Utah Code Title 73 Chapter 28 Part 4 Section 402 (4) (a portion of the Lake Powell Pipeline Development Act): *"The board shall establish and charge a reasonable interest rate for the unpaid balance of reimbursable preconstruction and construction costs."*
- Assume the LPP is paid for with a 50-year "mortgage" at 4%.
- Annual debt payment: $61,840,170 for full amortization.

LPP O&M Costs: per WCWCD

Total Annual Debt Service

Total Expenses

Result of Base Case:

- Result: Net Annual Surplus or Deficit for each year, 2015–2064
- WCWCD capital account balance in the year 2064: −$6,732,647,870.
- So price and/or fee changes are needed.

Price Changes: The Isoelastic Demand Curve

$$Q_t = \text{constant} \cdot P_t^{-1/2} \quad \text{so}$$
$$\text{total revenue}_t = Q_t\, P_t = \text{constant} \cdot P_t^{+1/2}\,.$$

- Increasing total revenue is possible; it requires P to rise to $P_t = (\text{total revenue desired}/\text{constant})^2$.
- Raising P will cause Q to fall.

Impact Fee Increases

Impact Fee Increases will result in the price of the average home site falling by the same amount, so the losers are current Washington County landowners, not newcomers.

Price and/or Fee Changes that pay off the LPP by 2064:

	Increase in Impact Fee Revenues (factor)	Increase in Water Sales Revenues (factor)
one option	0	4.18713
another option	3.45680	0
yet another option	$1+\frac{1}{2}\times(3.45680-1)$ $=2.228$	$1+\frac{1}{2}\times(4.18713-1)$ $=2.594$
in general	$1+(1-c)\times(3.45680-1)$	$1+c\times(4.18713-1)$

for c between 0 and 1.

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in general	$1 + (1-c) \times (3.45680 - 1)$	$1 + c \times (4.18713 - 1)$

for c between 0 and 1.

Obtaining Increased Impact Fee Revenue

- The impact fee with no fee changes was \$6,102.
- It has to increase to $2.228 \times \$6{,}102 = \$13{,}598$.
- As explained above, the losers are current Washington County landowners, not newcomers.

Obtaining Increased Water Sales Revenue: year 2050

Taking the year 2050 as an example, the water sales revenue with no price changes was \$22,644,522.

We need to increase it to $2.594 \times \$22{,}644{,}522 = \$58,730,040$.

How?

Capacity in 2050 without LPP

Lake Powell Pipeline Study, Water Needs Assessment (Draft), March 2011, MWH for the Utah Division of Water Resources:

74,560 ac-ft/yr: p. ES-15 I.2

7,450 ac-ft/yr: p. ES-15 I.2 (secondary)

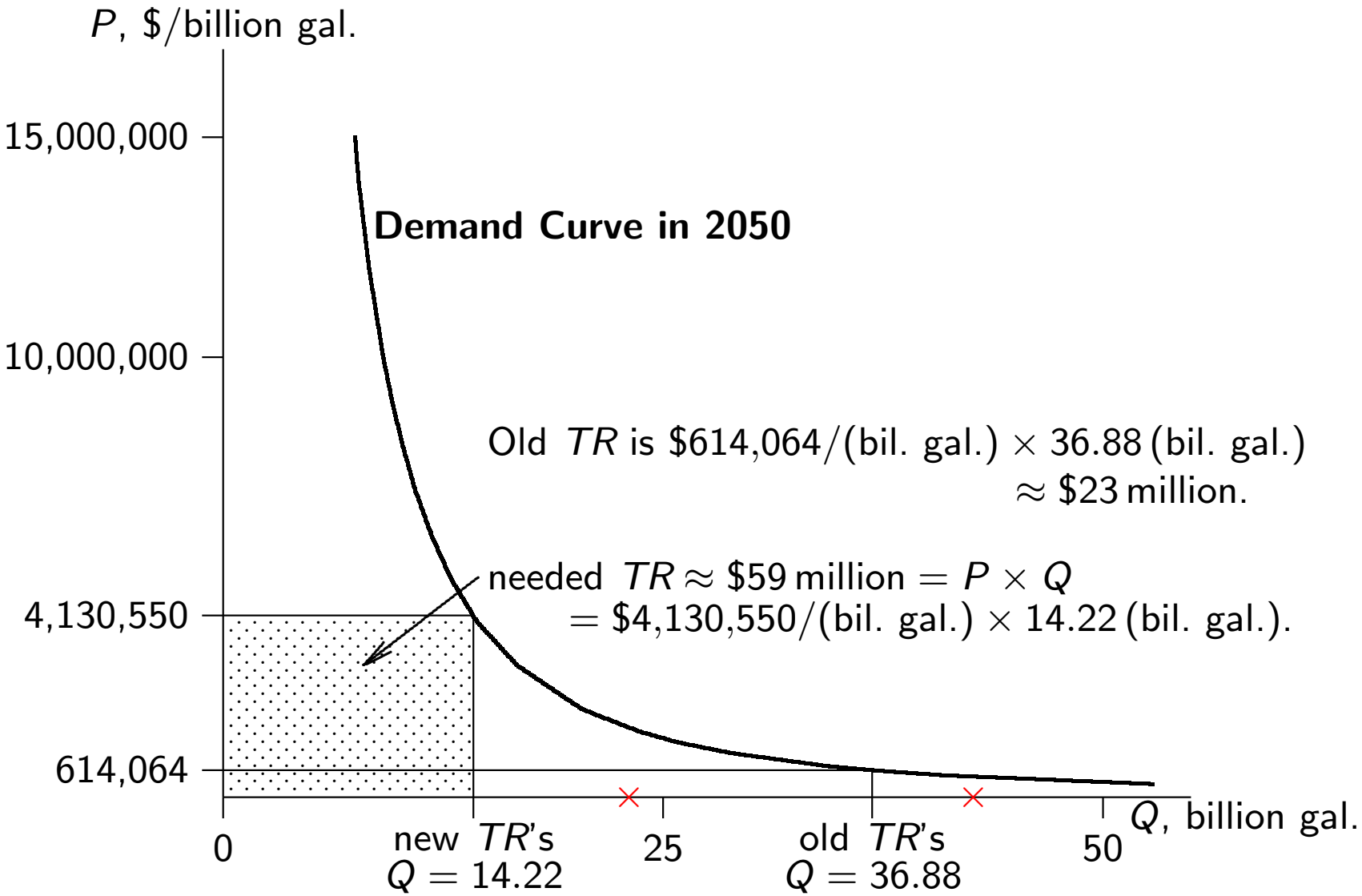
3,830 ac-ft/yr: p. ES-16 Table ES-11, Ash Creek

7,300 ac-ft/yr: p. ES-16 Table ES-11, maximize existing wastewater reuse

10,080 ac-ft/yr: p. ES-16 Table ES-11, agricultural conversion

27,620 ac-ft/yr: p. ES-16 Table ES-11, future wastewater reuse

Sum:130,840 ac-ft/yr. This equals **42.63** billion gallons, used in the graph.
The water district's model, sheet `'Dynamic Population'S56`, "anticipated supply after evaporation": 70,773 ac-ft/yr. That is **23.06** billion gallons.



4,130,550/614,064 ≈ **6.7**.

×'s: capacity without LPP.

Criticisms by Barbara Hjelle, WCWCD Associate General Manager and Counsel, on KUER's "Radio West," 6/4/18

- "...as far as the economists' study goes, there were a number of issues with the numbers that they used; and we have identified those, these reports are available on our web site."
- Our refutations are available on my web site: `www.economics.utah.edu/lozada`, "Miscellaneous Research Materials," third bullet point under *The Lake Powell Pipeline.*

Point: "They didn't take into account the same population growth numbers that are the commonly used population projections."

Counterpoint: From our spreadsheet:

B	C	D	E	F	G	H	I	J	K	L	M	N
GOPB Estimates	1990	2000	2010	2020	2030	2040	2050	2060				
2005 Estimate	48,978	91,090	168,078	279,864	415,510	559,670	709,674	860,378				
2012 Estimate	48,978	91,090	138,748	196,762	280,558	371,743	472,567	581,731				
# Households (est. 2012)	15,481	30,191	46,545	70,919	112,378	151,647	192,884	237,065				
To solve for geometric growth rates: x_2060 = x_2010 * Exp(r * (2060-2010)) and solve for r.												
But that is for continuous compounding. For annual compounding:							190,520	change in households				
x_2060 = x_2010 * (1+r)^(2060-2010) and solve for r.							0.0330941	Annually Compounded Household Growth Rate, 2010--2060				
=> Exp[Ln(x_2060/x_2010) / (2060-2010)] - 1 = r.							0.0290818	Annually Compounded Population Growth Rate, 2010--2060				

Hjelle, criticism #2

Point: "They didn't take into account the actual cost of water in our customer service areas, so that they estimated a massive increase but then that's because they started at a very low number that's massively underestimated."

Counterpoint: If retail price $= (1 + \text{markup}) \cdot$ wholesale price, then

$$\frac{d \text{ retail price}}{d \text{ wholesale price}} = 1 + \text{markup} > 1 \,.$$

Example: If the water price has to increase by a factor of 6.7 (570%), and the markup is 100%, then the retail price would have to increase by a factor of 13.4 (1240%).

Hjelle, criticism #3

Point: "They didn't understand that Washington County Water Conservancy District doesn't serve all the water that is sold to our municipal residents."

Counterpoint: So projected water shortages will not be as bad as if one only looked at the WCWCD's supplies. Also: we only considered the WCWCD revenue stream because the revenue streams of the other water suppliers don't belong to the WCWCD & so can't be used to pay back the pipeline.

Hjelle, criticism #4

Point: "And there were a number of other factors that weren't taken into account. They didn't apply the Lake Powell Pipeline Development [Act] payback scheme, which allows for the water to be taken down in blocks and then paid for over 50-year periods. That's allowing the future generations who need that water who will be using that water to pay for it over time."

Counterpoint: No act of the Utah Legislature can shield State taxpayers from incurring the financing costs over only 20 or 30 years—that's dictated by the bond market. All the State can do is agree to lend long-term to the WCWCD, which is what we assume: 10 <- enter number of initial payment-free years

Year	Property Taxes	water sales revenue	Power sale revenue and Surcharges	Impact Fees	Real Estate sale revenue	LPP Power sale revenue	TOTAL REVENUES	Annual Debt Service on Existing Debt	Existing O&M Costs	Annual LPP Debt Service	LPP O&M Costs	Total Annual Debt Service	TOTAL EXPENSES	Net Annual Surplus (Deficit)	Cumulative Surplus (Defic
2060	$44,438,837	$32,396,786	$10,307,735	$40,680,941	$0	$37,744,899	$165,569,198	$0	$57,267,538	$61,840,170	$89,140,749	$61,840,170	$208,248,456	($42,679,258)	($5,542,852,6
2061	$45,909,501	$33,468,929	$10,648,860	$42,027,241	$0	$39,254,695	$171,309,226	$0	$59,162,756	$61,840,170	$92,706,379	$61,840,170	$213,709,305	($42,400,079)	($5,806,966,8
2062	$47,428,836	$34,576,554	$11,001,275	$43,418,095	$0	$40,824,883	$177,249,642	$0	$61,120,695	$61,840,170	$96,414,634	$61,840,170	$219,375,499	($42,125,857)	($6,081,371,3
2063	$48,998,451	$35,720,834	$11,365,352	$44,854,979	$0	$42,457,878	$183,397,494	$0	$63,143,431	$61,840,170	$100,271,219	$61,840,170	$225,254,820	($41,857,326)	($6,366,483,5
2064	$50,620,011	$36,902,983	$11,741,479	$46,339,415	$0	$44,156,193	$189,760,081	$0	$65,233,107	$61,840,170	$104,282,068	$61,840,170	$231,355,345	($41,595,263)	($6,662,738,1

The Washington County Water Conservancy District's Model

WCWCD Repayment Schedule

Date	% of 2014 LPP cost to be repaid	million $ to be repaid	repayment in million 2014 $
2014		50	50
2032	1.2%	10.8	5.3
2033	2.3%	20.7	9.8
2034	2.3%	21.3	9.7
⋮	⋮	⋮	⋮
2050	3.8%	35.3	8.6
⋮	⋮	⋮	⋮
2060	5.1%	46.8	7.7
sum	100%	969	306

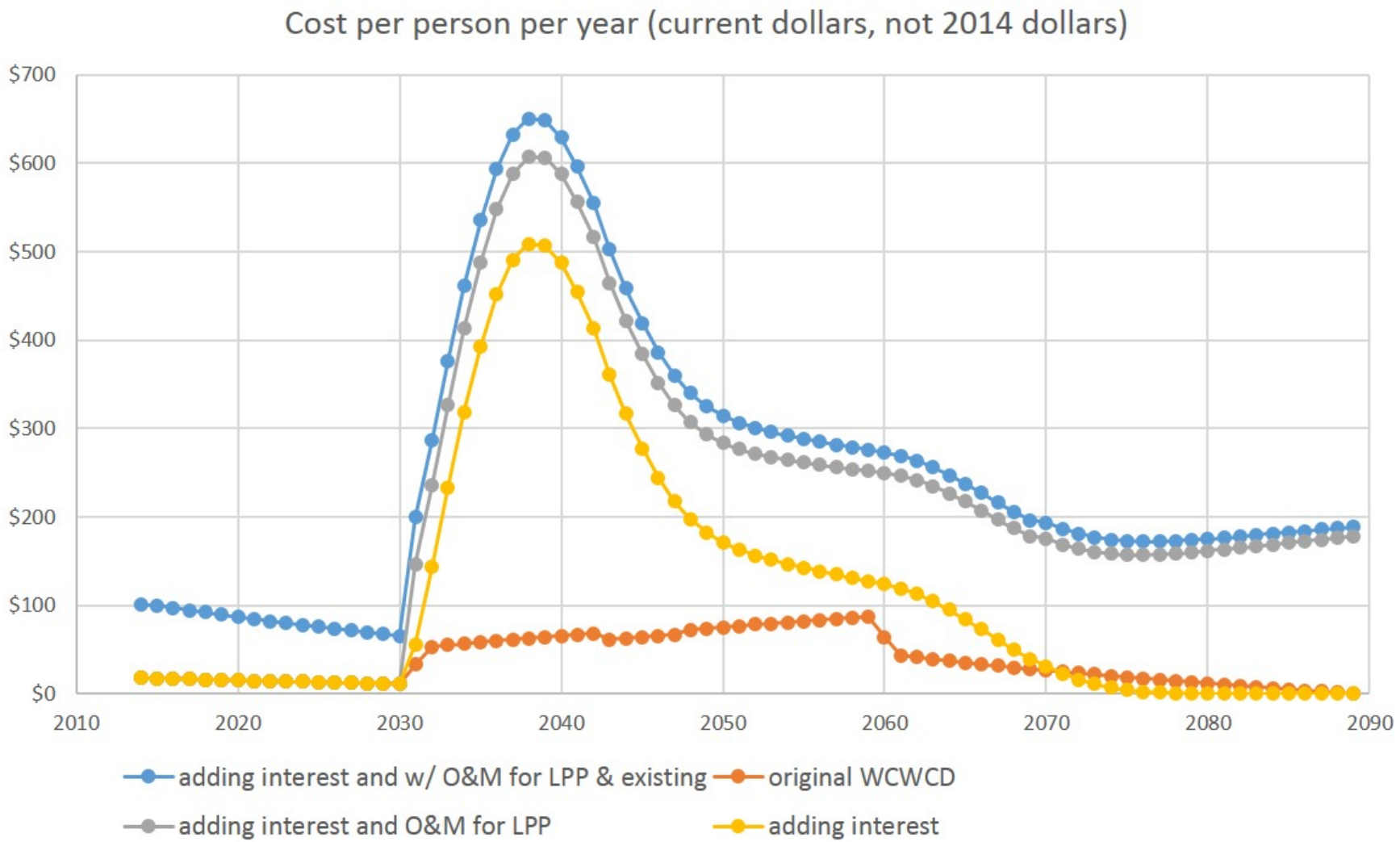
Note: Year 2061 is actually the last year of payments; fixed in our version of the WCWCD spreadsheet.

Minor Errors in the WCWCD Model

For example, counting 30 years bond repayments:

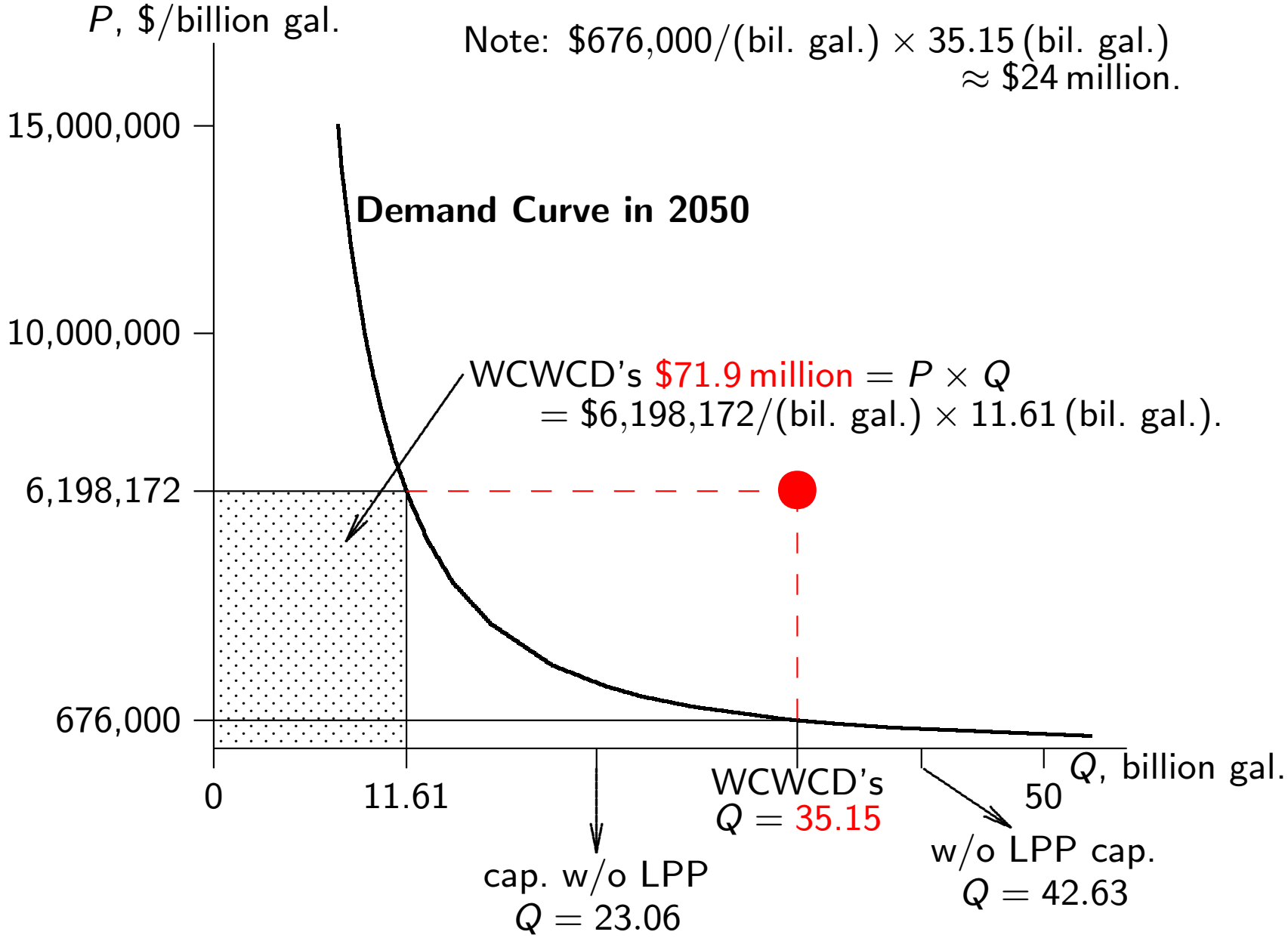
```
=IF('Incremental Repayments'!$R$22="Debt",
    IF(AND(W$4>=$D54,W$4<=$D54+'Incremental
                                Repayments'!$I$31),
        -PMT('Interest Rate'!$J$16,
        'Incremental Repayments'!$I$31,
        (HLOOKUP($D54,$E$4:$CZ$32,28,FALSE)*
        'Incremental Repayments'!$I$22))
    ,0)
,0)
```

Major Problems with the WCWCD model so far



An even bigger problem:

Inconsistent: 35.15 billion gallons and $71.9 million



Summary of the WCWCD Model

- Uses low values for the LPP cost and for the non-LPP water system capacity.
- Omits operations and maintenance costs.
- Omits reimbursement for interest payments made by taxpayers of the State of Utah.
- Does not account for demand curves, invalidating its conclusions about prices.

WCWCD 2017 Regional Water Impact Fee Facilities Plan & Analysis: a critique

1. The District's impact fee calculation is wrong
2. The District ignored required interest payments
3. The District's 75%/25% split of fee burdens was incorrectly analyzed
4. Citizens express no awareness that the ultimate burden of impact fees is on current landowners, not newcomers
5. The District's analysis of water needs is dubious

Let's just consider Point 2.

WCWCD 2017 impact fee calculation

The costs per ERC of supply facilities and treatment facilities are added together to determine the total impact fee for one ERC.

Table 14: Supply and Transmission Facilities Portion of Impact Fee

	Impact Fee-Qualifying Costs	Yield *(acre-feet)*
Cost of Existing Excess Capacity in Supply Facilities	$4,419,170	2,131
Cost of New Supply Facilities	$1,461,718,340	90,439
Total Cost of Supply Facilities	$1,466,137,510	92,570
Cost of Supply Facilities per Acre-Foot		$15,838
Acre-Foot per ERC		0.89
Cost of Supply Facilities per ERC		**$14,096**

Table 15: Treatment Facilities Portion of Impact Fee

	Impact Fee-Qualifying Costs	Capacity *(acre-feet)*
Cost of Existing Excess Capacity in Treatment Facilities	$6,616,273	6,721
Cost of New Treatment Facilities	$123,751,431	32,273
Total Cost of Treatment Facilities	$130,367,704	38,994
Cost of Treatment Facilities per Acre-Foot Treated		$3,343
Acre-Foot per ERC		0.89
Cost of Treatment Facilities per ERC		**$2,975**

WCWCD 2017 impact fee calculation, continued

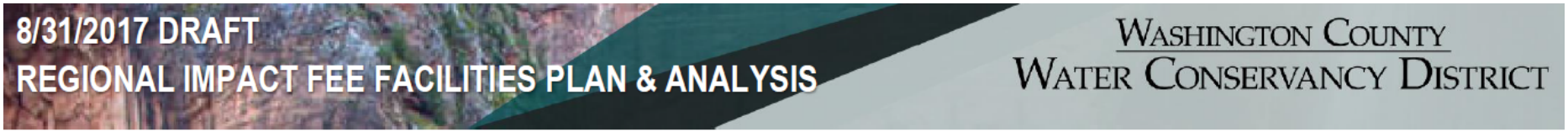


Table 16: Total Impact Fee

	Cost per ERC
Cost of Supply Facilities per ERC	$14,096
Cost of Treatment Facilities per ERC	$2,975
Total Cost per ERC	**$ 17,071**

Page 2 of the Economists' letter of September 2016 says that the no-interest feature of the loan from the State to the District "amounts to the State paying 72% of the true financial cost of the project (its 'net present value') and the WCWCD paying only 28% of it."

Is the low-cost variant of the LPP Affordable? Conclusion.

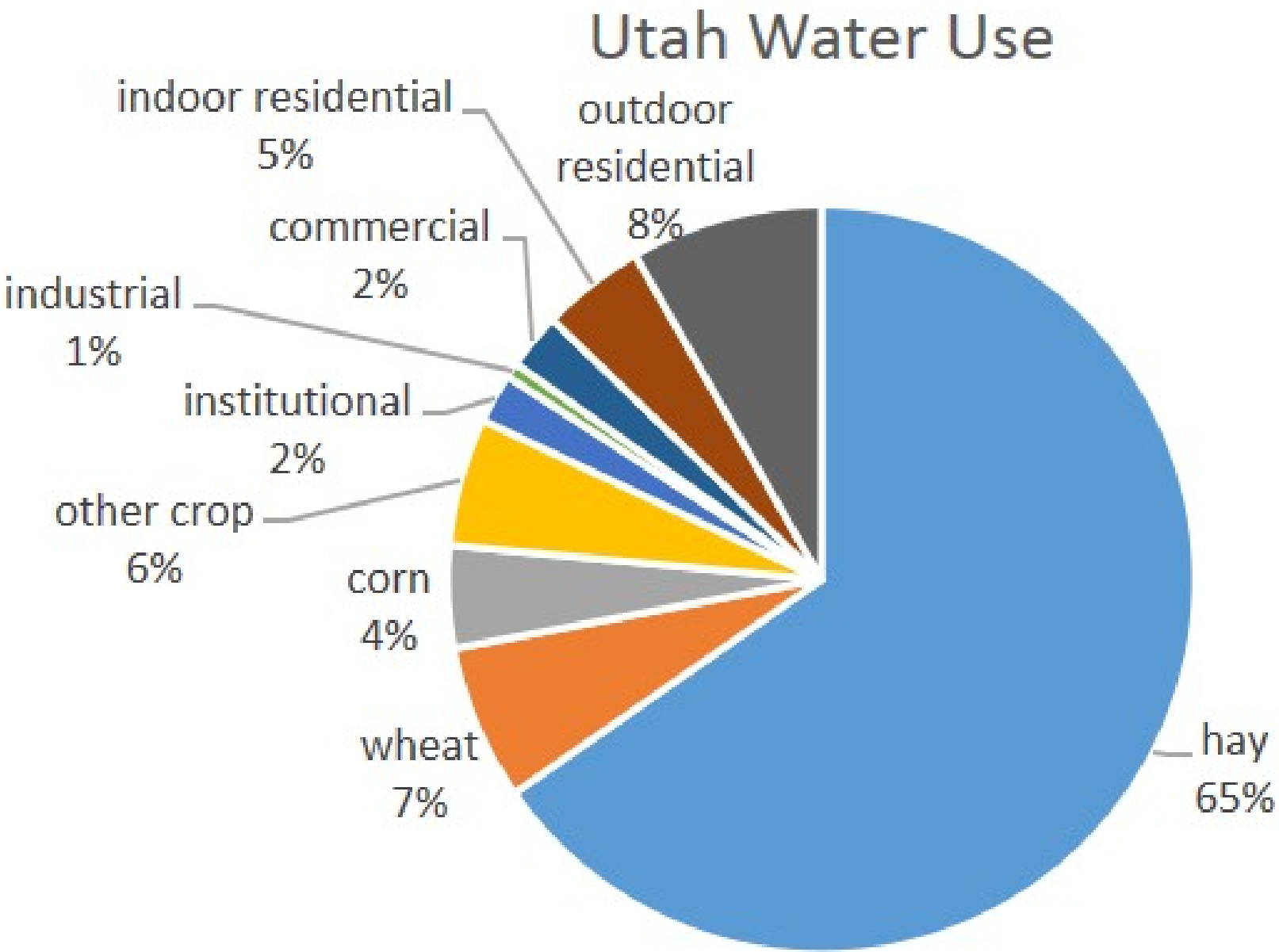
Yes, for example, by combining:

- A more-than-doubling of impact fees (factor 2.228, about 123%), from 2013's $6102 to an average of $13,630 in 2015 dollars, which would cause a fall in the value of land in Washington & Kane Counties now; together with
- Raising water prices 6.7 times (576%), which would cause water use to fall so much that the pipeline would be totally unused (but affordable).

Probably because a $1.3 billion LPP sitting unused and unneeded would be too much of a political embarrassment, the District is planning to keep water prices very low and put most of the burden on impact fees, whose true effect is easier to hide. If all the burden were on impact fees, those fees would need to have risen to $22,900 in 2015, in 2015 dollars.

Is the LPP Desirable?

(Newer, sole-authored work; limited peer review)


Utah Water Use
indoor residential
5%
outdoor
residential
8%
commercial
2%
industrial
1%
institutional
2%
other crop
6%
corn
4%
wheat
7%
hay
65%

Economical Sources of more water for Utah urban areas

- Hay contributes approximately \$258 million per year to Utah's economy, which represents approximately 1/2 of 1% of Utah's GDP.
- Utah can more than sextuple $(65\%/(5\% + 2\% + 1\% + 2\%) = 6.5)$ the amount of water available to its commercial, industrial, institutional, and indoor (not outdoor) residential uses by paying 1/2 of 1% of its income (plus distribution expenses).
- Option 1 is to pay \$258 million for 1.5 billion acre-feet of water per year: a price of \$172 million per billion acre-feet.
- Option 2 is the LPP: pay \$62 million per year over 50 years—or let's use \$53 million per year over 500 years—for less than 90,000 acre-feet (0.000 09 billion acre-feet) of water per year: a price of \$589,000 million per billion acre-feet. Note: $589{,}000/172 \approx 3400$.

Chicken Little

- Common scare tactic: "We could run out of water! What would happen if one day you tried to turn on your faucet to get a drink of water and nothing came out? Think about the grandchildren!"
- The reality: Directing water shortages to indoor use, threatening almost all of Utah's GDP, instead of to agricultural use, threatening a tiny percentage of Utah's GDP, would be irrational.
- Water shortages are going to affect mostly cattle (including foreign dairy cows), not Utah families. And "affect" means not thirsty cattle, but merely an increase the price of products derived from cattle due to having to use hay from higher-priced non-Utah sources.
- Agricultural water use should be the focus of Utah water planning, and "Chicken Little" scare tactics about shortages of indoor water are unserious.

https://www.ksl.com/?sid=27056998
https://news.nationalgeographic.com/news/2014/01/140123-colorado-river-water-alfalfa-hay-farming-export-asia/
http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=25364
http://www.mcclatchydc.com/news/nation-world/world/article24769813.html
https://hayandforage.com/article-1791-hay-exports-hit-record-high.html

The Marginal Cost of Water to Farmers:

0

Consequence:

Extremely high water use in agriculture.

Let the market work

- Utah farmers cannot sell "wet" water, shackled by 19^{th} century water law.
- In Australia, a farmer can, for example, sell a week's unneeded water online, and it's delivered the next day.

The water infrastructure we really do need:

1. the legal infrastructure to allow farmers to sell & buy "wet" water; and
2. the physical infrastructure to allow farmers to sell & buy "wet" water.

Downside of Markets in previously-agricultural Water

Non-farmers in rural areas lose income.

A Future Water Surplus?

Studying agricultural water is a better way to address future water deficits. **But is Utah even going to have future water deficits?**
Even if Utah's population grows as projected, new people will live:

- largely on previously-agricultural land; or
- in high-rise buildings; or
- in some combination of these.

The first causes water use to go *down.* The second causes very small increases.
Even just conservation, not high-density living, achieves 55 GPCD or less in Australia and in San Francisco *now.*

Washington Cnty. population without LPP, hay, new lawns

- Current Population: about 160,000.
- Eliminate Hay & new residential outdoor watering: more than sextuple (factor of 6.5) to 1,040,000.
- Urban Conservation: reduce GPCD from 295 (2011 DWRe Water Needs Assessment, p. ES-7) to 55: increase by a factor of $295/55 \approx 5.4$. (Assume no agricultural conservation.)
- Answer: about 5,578,000.