The Lake Powell Pipeline: Affordable? Desirable?

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This is unfunded research.

Thanks to:
Gail Blattenberger
Associate Professor of Economics Emeritus
University of Utah

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):

<table>
<thead>
<tr>
<th></th>
<th>Low Cost</th>
<th>High Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Costs</td>
<td>$1,328,461,944</td>
<td>$1,750,908,555</td>
</tr>
<tr>
<td>“O&amp;M”</td>
<td>$23,493,231</td>
<td>$62,867,794</td>
</tr>
<tr>
<td>Power sale revenue</td>
<td>$9,947,747</td>
<td>$72,005,740</td>
</tr>
</tbody>
</table>

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)
Is the LPP Affordable?  Is the LPP desirable?

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

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Is the LPP Affordable?

Is the LPP desirable?

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### spreadsheet columns continued...

<table>
<thead>
<tr>
<th>Annual Service on Existing Debt:</th>
<th>per WCWCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing O&amp;M Costs:</td>
<td>per WCWCD</td>
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#### 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.

<table>
<thead>
<tr>
<th>LPP O&amp;M Costs:</th>
<th>per WCWCD</th>
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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 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:

<table>
<thead>
<tr>
<th>One option</th>
<th>Increase in Impact Fee Revenues (factor)</th>
<th>Increase in Water Sales Revenues (factor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>one option</td>
<td>0</td>
<td>4.18713</td>
</tr>
<tr>
<td>another option</td>
<td>3.45680</td>
<td>0</td>
</tr>
<tr>
<td>yet another option</td>
<td>$1 + \frac{1}{2} \times (3.45680 - 1)$</td>
<td>$1 + \frac{1}{2} \times (4.18713 - 1)$</td>
</tr>
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for $c$ between 0 and 1.
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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 $22,644,522 \times 2.594 = $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 l.2
- **7,450 ac-ft/yr**: p. ES-15 l.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.
Is the LPP Affordable? Desirable?

0 25 50

\[ Q = 36.88 \text{ (old TR's)} \]

\[ Q = 14.22 \text{ (new TR's)} \]

4,130,550 / 614,064 \approx 6.7.

\[ \times\text{'s: capacity without LPP.} \]
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:

<table>
<thead>
<tr>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005 Estimate</td>
<td></td>
<td>48,978</td>
<td>91,090</td>
<td>168,078</td>
<td>279,864</td>
<td>415,510</td>
<td>559,670</td>
<td>709,674</td>
<td>860,378</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012 Estimate</td>
<td></td>
<td>48,978</td>
<td>91,090</td>
<td>138,748</td>
<td>196,762</td>
<td>280,558</td>
<td>371,743</td>
<td>472,567</td>
<td>581,731</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Households (est. 2012)</td>
<td></td>
<td>15,481</td>
<td>30,191</td>
<td>46,545</td>
<td>70,919</td>
<td>112,378</td>
<td>151,647</td>
<td>192,884</td>
<td>237,065</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To solve for geometric growth rates: \( x_{2060} = x_{2010} \times \text{Exp}(r \times (2060-2010)) \) and solve for \( r \).

But that is for continuous compounding. For annual compounding: 190,520 change in households

\( x_{2060} = x_{2010} \times (1+r)^{(2060-2010)} \) and solve for \( r \).

\( \Rightarrow \text{Exp}(\text{Ln}(x_{2060}/x_{2010}) / (2060-2010)) - 1 \times r. \)
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 = \((1 + \text{markup}) \cdot \text{wholesale price}\), 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:
The Washington County Water Conservancy District’s Model
## WCWCD Repayment Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>% of 2014 LPP cost to be repaid</th>
<th>million $ to be repaid</th>
<th>repayment in million 2014 $</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td></td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>2032</td>
<td>1.2%</td>
<td>10.8</td>
<td>5.3</td>
</tr>
<tr>
<td>2033</td>
<td>2.3%</td>
<td>20.7</td>
<td>9.8</td>
</tr>
<tr>
<td>2034</td>
<td>2.3%</td>
<td>21.3</td>
<td>9.7</td>
</tr>
<tr>
<td>...</td>
<td>:</td>
<td>:</td>
<td>:</td>
</tr>
<tr>
<td>2050</td>
<td>3.8%</td>
<td>35.3</td>
<td>8.6</td>
</tr>
<tr>
<td>...</td>
<td>:</td>
<td>:</td>
<td>:</td>
</tr>
<tr>
<td>2060</td>
<td>5.1%</td>
<td>46.8</td>
<td>7.7</td>
</tr>
<tr>
<td>sum</td>
<td>100%</td>
<td>969</td>
<td>306</td>
</tr>
</tbody>
</table>

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

Cost per person per year (current dollars, not 2014 dollars)

- Blue line: adding interest and O&M for LPP & existing
- Red line: original WCWCD
- Gray line: adding interest and O&M for LPP
- Orange line: adding interest
An even bigger problem:
Is the LPP Affordable? Desirable?

Inconsistent: 35.15 billion gallons and $71.9 million

Note: $676,000/(bil. gal.) × 35.15 (bil. gal.) 
≈ $24 million.

WCWCD’s $71.9 million = P × Q
= $6,198,172/(bil. gal.) × 11.61 (bil. gal.).
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.
Is the LPP Affordable?

Is the LPP desirable?

The District’s impact fee calculation is wrong

The District ignored required interest payments

The District’s 75%/25% split of fee burdens was incorrectly analyzed

Citizens express no awareness that the ultimate burden of impact fees is on current landowners, not newcomers

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**

<table>
<thead>
<tr>
<th>Impact Fee-Qualifying Costs</th>
<th>Yield (acre-feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Existing Excess Capacity in Supply Facilities</td>
<td>$4,419,170</td>
</tr>
<tr>
<td>Cost of New Supply Facilities</td>
<td>$1,461,718,340</td>
</tr>
<tr>
<td><strong>Total Cost of Supply Facilities</strong></td>
<td>$1,466,137,510</td>
</tr>
<tr>
<td>Cost of Supply Facilities per Acre-Foot</td>
<td>$15,838</td>
</tr>
<tr>
<td>Acre-Foot per ERC</td>
<td>0.89</td>
</tr>
<tr>
<td><strong>Cost of Supply Facilities per ERC</strong></td>
<td>$14,096</td>
</tr>
</tbody>
</table>

**Table 15: Treatment Facilities Portion of Impact Fee**

<table>
<thead>
<tr>
<th>Impact Fee-Qualifying Costs</th>
<th>Capacity (acre-feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Existing Excess Capacity in Treatment Facilities</td>
<td>$6,616,273</td>
</tr>
<tr>
<td>Cost of New Treatment Facilities</td>
<td>$123,751,431</td>
</tr>
<tr>
<td><strong>Total Cost of Treatment Facilities</strong></td>
<td>$130,367,704</td>
</tr>
<tr>
<td>Cost of Treatment Facilities per Acre-Foot Treated</td>
<td>$3,343</td>
</tr>
<tr>
<td>Acre-Foot per ERC</td>
<td>0.89</td>
</tr>
<tr>
<td><strong>Cost of Treatment Facilities per ERC</strong></td>
<td>$2,975</td>
</tr>
</tbody>
</table>
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.”
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%
- commercial: 2%
- industrial: 1%
- institutional: 2%
- other crop: 6%
- corn: 4%
- wheat: 7%
- hay: 65%

Is the LPP Affordable?
Is the LPP desirable?

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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
http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=25364
lozada@economics.utah.edu; www.economics.utah.edu/lozada
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 19th 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

- 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 \( \frac{295}{55} \approx 5.4 \). (Assume no agricultural conservation.)
- Answer: about 5,578,000.