

Lake Powell Pipeline Project

Final Study Report 10 Socioeconomics and Water Resource Economics

April 2016

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Chapter 5

Water Resource Economic Benefits and Costs

NED Analyses

The key economic analysis assumptions and analysis variable have been reviewed in Chapter 4 and are displayed schematically in Appendix A. The base construction cost estimates are derived from multiple technical reports and spreadsheets included in Appendix B (MWH, Opinion of Construction Costs, 2016). Some cost estimates are provided from a review of other large-scale water development projects, and LPP Project data and information related to other MWH projects. Power cost data are based on recent USBR technical reviews (USBR, 2010, 2015, TSC Denver), a review of market forecast information developed by the Northwest Conservation and Power Planning Council (2015, 2016) and the market data identified in Chapter 6, and communications with industry analysts and MWH technical staff. The fundamental analysis findings are described in this chapter.

Depending on variable economic perspectives and assumptions, the LPP Water Supply Project direct net benefits range from about \$3.9 to 7.5 billion, and the LPP Project costs range from about \$1.3 to \$1.6 billion (2015\$, present value, rounded) (see Tables 5-1 and 5-2). Overall, the Project is displaying greater benefits than costs given the complex set of economic variables under consideration.

From an NED or state direct net value perspective, the LPP Project development benefits are greater than the costs of LPP Project construction and operation, given the life-cycle cost review conducted here (B/C ratio of about 2.89). This perspective assumes some relative escalation (2.0 percent) in monetary values between the costs of water resources development today versus other “product” costs tomorrow, and a more short-term cost-of-capital factor of 4.9 percent. It also reflects relatively high marginal costs for alternative, long-term water supply resources.

From a sensitivity analysis perspective (Table 5-2), where the inter-generational benefits and costs of the LPP Project are taken more fully into consideration (social time preference discount rate of 3.0 percent) and the real monetary value of water, power, and construction costs are assumed to increase over the life of the LPP Project, the LPP Project benefits exceed the costs. The B/C ratio is about 4.71. Stated differently, the value of future benefits to future residents is given more emphasis, than just consideration of the “up-front” costs of LPP Project construction, and the value of water and power is assumed to escalate in real terms. This latter value may be viewed as providing greater social equity between generations during the economic life of the LPP Project.

Initial analyses also have been made for a LPP Project configuration that includes a pump storage component (Tables 5-3 and 5-4). This is a more costly LPP Project configuration, raising overall LPP Project costs to about \$2.1 to 2.6 billion, and with benefits in the \$4.2 to \$8.2 billion range. These estimates are based on current information. The B/C ratio is about 2.01 to 3.06 depending on analysis assumptions. In the case of the pump storage configuration, more (higher) capital costs are incorporated in the near-term years of life-cycle cost analysis, as compared to the project power value benefits that are gained at a greater rate in the future.

In effect, the (baseline) Water Supply Project benefits are expected to significantly exceed costs, and the pump storage hydro system configuration will bring the overall B/C ratio down, but still provide benefits exceeding costs.

**Table 5-1
LPP NED Analyses
Baseline NED Assumptions-Water Supply Project
And Inline Power Production with Hurricane Cliffs Peaking Power Generation**

Real Discount Rate and Escalation Rate					
Benefits:	PV (2015\$)	Annual PV	Discount Rate	Escalation Rate	Water \$/Acre-ft.
M&I Water	\$3,851,762,000	\$207,735,600	4.9%	2.0%	\$3,675
Power-Inline	\$21,282,000	\$1,148,000	4.9%	2.0%	
Power-PK	\$44,925,000	\$2,531,000	4.9%	2.0%	
Total Benefits	\$3,919,969,000	\$211,414,000			
Costs:	PV	Annual PV			
Capital Constr.	\$1,177,469,000	\$63,504,200	4.9%	2.0%	
OM&R	\$86,240,000	\$4,651,000	4.9%	2.0%	
Power Oper.	\$79,612,000	\$4,293,700	4.9%	2.0%	
Foregone Power	\$13,254,000	\$714,800	4.9%	2.0%	
Total Costs:	\$1,356,576,000	\$73,164,000			
NED B/C:	2.89	2.89			

NOTE:

All Values Rounded Above.

Annualized PV for 50-year Period.

Estimated Cost Per Delivered M&I Water in \$/Acre-Ft.: \$1,161

Expressed in Constant Annualized \$/Acre-Ft.*

Expressed in \$/1,000 gal.: \$3.56

* For Average Annual Acre-Ft. Delivery 2024-2070: 62,996

The detailed description of the benefit/cost components are provided in Chapter 2, and Appendices A and B. In summary:

M&I Water:	LPP Project delivered water based on LPP Project alternative costs.
Power-Inline:	Hydropower system power from water delivery line generators.
Power PK:	Hurricane Cliffs peaking power generation.
Capital Construction Costs:	pumping plants, pipelines, and power generation and transmission facilities.
OM&R:	Operation, maintenance and replacement costs for the LPP Project.
Power Oper.:	Water power pumping/lift costs for the pipeline.
Foregone Power:	Reduced power generation from the USBR hydro system, from LPP Project water diversion.

Table 5-2
LPP NED Analyses
Baseline NED Assumptions-Water Supply Project
And Inline Power Production with Hurricane Cliffs Peaking Power Generation
(Social Time Preference Discount Rate)

Real Discount Rate and Escalation Rate					
Benefits:	PV (2015\$)	Annual PV	Discount Rate	Escalation Rate	Water \$/Acre-ft.
M&I Water	\$7,451,372,000	\$289,601,300	3.0%	2.0%	\$3,675
Power-Inline	\$41,081,000	\$1,597,000	3.0%	2.0%	
Power-PK	\$92,470,000	\$3,594,000	3.0%	2.0%	
Total Benefits	\$7,584,923,000	\$294,792,000			
Costs:	PV	Annual PV			
Capital Constr.	\$1,327,676,000	\$51,601,000	3.0%	2.0%	
OM&R	\$86,240,000	\$3,352,000	3.0%	2.0%	
Power Operers.	\$170,647,000	\$6,632,000	3.0%	2.0%	
Foregone Power	\$26,287,000	\$1,022,000	3.0%	2.0%	
Total Costs:	\$1,610,850,000	\$62,607,000			
NED B/C:	4.71	4.71			

NOTE:	
All Values Rounded Above.	
Annualized PV for 50-year period.	
Estimated Cost Per Delivered M&I Water in \$/Acre-Ft.:	\$994
Expressed in Constant Annualized \$/Acre-Ft.*	
Expressed in \$/1,000 gal.:	\$3.05
* For Average Annual Acre-Ft. Delivery 2024-2070:	62,996

The detailed description of the benefit/cost components are provided in Chapter 2, and Appendices A and B. In summary:

- M&I Water: LPP Project delivered water based on LPP Project alternative costs.
- Power-Inline: Hydropower system power from water delivery line generators.
- Power PK: Hurricane Cliffs peaking power generation.
- Capital Construction Costs: pumping plants, pipelines, and power generation and transmission facilities.
- OM&R: Operation, maintenance and replacement costs for the LPP Project.
- Power Operers.: Water power pumping/lift costs for the pipeline.
- Foregone Power: Reduced power generation from the USBR hydro system, from LPP Project water diversion.

**Table 5-3
Baseline NED Assumptions—Water Supply Project
And Inline Power Production/Hurricane Cliffs Peaking
And Pump Storage Configuration**

Real Discount Rate and Escalation Rate					
Benefits:	PV (2015\$)	Annual PV	Discount Rate	Escalation Rate	Water \$/Acre-ft.
M&I Water	\$3,851,762,000	\$207,735,600	4.9%	2.0%	\$3,675
Power-Inline	\$21,282,000	\$1,148,000	4.9%	2.0%	
Power-PS-SH	\$421,766,000	\$22,745,000	4.9%	2.0%	
Total Benefits	\$4,294,811,000	\$231,630,000			
Costs:	PV	Annual PV			
Capital Contr.	\$1,588,991,000	\$85,698,000	4.9%	2.0%	
OM&R	\$116,186,000	\$6,266,000	4.9%	2.0%	
Power Oper.	\$79,612,000	\$4,293,700	4.9%	2.0%	
Power PS Oper.	\$337,155,000	\$18,185,000	4.9%	2.0%	
Foregone Power	\$13,254,000	\$714,800	4.9%	2.0%	
Total Costs:	\$2,135,199,000	\$115,156,000			
NED B/C:	2.01	2.01			

NOTE:

All Values Rounded Above.

Annualized PV for 50-year period.

Estimated Cost Per Delivered M&I Water in \$/Acre-Ft.: NA

Expressed in Constant Annualized \$/Acre-Ft.*

Expressed in \$/1,000 gal.: NA

* For Average Annual Acre-Ft. Delivery 2024-2070: 62,996

NOTE: NA, not applicable to the pump storage configuration.

The detailed description of the benefit/cost components are provided in Chapter 2, and Appendices A and B. In summary:

M&I Water:	LPP Project delivered water based on LPP Project alternative costs.
Power-Inline:	Hydropower system power from water delivery line generators.
Power PS-SH:	Pump Storage and Hurricane Cliffs peaking power generation.
Capital Construction Costs:	pumping plants, pipelines, and power generation and transmission facilities.
OM&R:	Operation, maintenance and replacement costs for the LPP Project.
Power Oper.:	Water power pumping/lift costs for the pipeline.
Power PS Oper.:	Water power pumping/lift costs for pumped storage operation.
Foregone Power:	Reduced power generation from the USBR hydro system, from LPP Project water diversion.

**Table 5-4
Baseline NED Assumptions—Water Supply Project
And Inline Power Production/Hurricane Cliffs Peaking
And Pump Storage Configuration
(Social Time Preference Discount Rate)**

Real Discount Rate and Escalation Rate					
Benefits:	PV (2015\$)	Annual PV	Discount Rate	Escalation Rate	Water \$/Acre-ft.
M&I Water	\$7,451,372,000	\$289,601,300	3.0%	2.0%	\$3,675
Power-Inline	\$41,081,000	\$1,597,000	3.0%	2.0%	
Power-PS-SH	\$748,446,000	\$29,089,000	3.0%	2.0%	
Total Benefits	\$8,240,898,000	\$320,267,000			
Costs:	PV	Annual PV			
Capital Contr.	\$1,791,548,000	\$69,629,400	3.0%	2.0%	
OM&R	\$116,186,000	\$4,516,000	3.0%	2.0%	
Power Oper.	\$170,647,000	\$6,632,300	3.0%	2.0%	
Power PS Oper.	\$590,024,000	\$22,932,000	3.0%	2.0%	
Foregone Power	\$26,287,000	\$1,021,700	3.0%	2.0%	
Total Costs:	\$2,694,692,000	\$104,731,000			
NED B/C:	3.06	3.063			

NOTE:

All Values Rounded Above.

Annualized PV for 50-year period.

Estimated Cost Per Delivered M&I Water in \$/Acre-Ft.: NA

Expressed in Constant Annualized \$/Acre-Ft.*

Expressed in \$/1,000 gal.: NA

* For Average Annual Acre-Ft. Delivery 2024-2070: 62,996

NOTE: NA, not applicable to the pump storage configuration.

The detailed description of the benefit/cost components are provided in Chapter 2, and Appendices A and B. In summary:

M&I Water:	LPP Project delivered water based on LPP Project alternative costs.
Power-Inline:	Hydropower system power from water delivery line generators.
Power-PS-SH:	Pump Storage and Hurricane Cliffs peaking power generation.
Capital Construction Costs:	pumping plants, pipelines, and power generation and transmission facilities.
OM&R:	Operation, maintenance and replacement costs for the LPP Project.
Power Oper.:	Water power pumping/lift costs for the pipeline.
Power PS Oper.:	Water power pumping/lift costs for pumped storage operation.
Foregone Power:	Reduced power generation from the USBR hydro system, from LPP Project water diversion.

The hydro system power projects' benefits and costs are reviewed in greater detail in Chapter 6, focusing exclusively on regional power factors.