Economic and Financial Impacts of the Proposed Flaming Gorge Pipeline

Final Report

For

WESTERN RESOURCE
ADVOCATES
PROTECTING THE WEST'S LAND, AIR, AND WATER

By

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Introduction

Background

The Flaming Gorge Pipeline Project (FGP or the Project) is a large pipeline project intended to convey Colorado's remaining unallocated portion of Colorado River Upper Basin supplies from the Green River system to the Colorado Front Range. Under its current concept, it would divert water from Flaming Gorge Reservoir in Wyoming and generally follow the I-80 corridor eastward. Prior to reaching Laramie, the pipeline would diagonal towards the southeast towards Fort Collins and run parallel to the Front Range, possibly as far south as Pueblo. Maps and more detailed descriptions of the Project are available from other sources. A description of one of the Project proposals is contained on a Corps of Engineers website as part of its draft Environmental Impact Statement (DEIS) process.[1]

The Project, if constructed, would likely evolve from one of two projects currently being considered. One is the Regional Watershed Supply Project (RWSP), also known as the Million Project, named after its primary supporter Aaron Million, of Fort Collins, Colorado. It is intended to withdraw 250,000 acre-feet of water per year from a combination of Flaming Gorge Reservoir (165,000 acre-feet) and the Green River above the reservoir (85,000 acre-feet). This project is the furthest along planning-wise, but due to a wide range of issues has gotten slowed in the permitting process. The Corps has targeted a 2016 release date for its DEIS. In addition to its enormity, the Million Project is most notable for being developed and potentially owned and operated by the private sector.

A second proposal for a FGP is being considered by a group of public water providers, primarily members of the South Metro Water Supply Authority (South Metro), headed by Parker Water and Sanitation District. Their organizational structure is the Colorado-Wyoming Coalition, comprising the South Metro organizations and others along the Front Range, including Wyoming members. Their proposal is currently in the middle of a two year study. As a result, there is no technical information about their project. However, they have been influential in the creation of a State-funded Flaming Gorge Task Force to further its study.

The Project is very controversial due to a wide range of issues, including its environmental impacts, its potential impacts to existing water institutions and providers, and its economic impacts to its area-of-origin. Although this effort briefly discusses these issues as they apply to the economic and financial analysis, a simple on-line search is recommended to appreciate the level of interest surrounding the Project. Unfortunately, the search will also reveal that it has few certainties, ranging from how much water is available, how much it will cost, and whether anyone can afford it.

[1] http://www.nwo.usace.army.mil/html/od-tl/eis/RWSP-EIS.html

The Project's ultimate fate is debatable. However, the term "water runs uphill towards money" possibly never had as good of application. Its construction cost will be measured in billions of dollars, with a transmission length of nearly 500 miles uphill (and downhill) before reaching its first major demand. It is no surprise that how much the water it will cost Front Range providers is a critical issue influencing the Project's potential support and construction.

A somewhat less publicized issue is the Project's potential impacts to the recreation industry at Flaming Gorge Reservoir, in the Flaming Gorge National Recreation Area below the dam, and in the nearby communities depending on tourists' spending. This will be driven by a diminished recreation experience, fewer visitors, and reduced expenditures. Although the resulting dollar impacts have fewer zeros attached to them compared to Front Range issues, and the economy is smaller, the relative impact may be substantial.

Objectives

Two analyses are conducted in this effort:

1. The impact of the Project to recreation at Flaming Gorge Reservoir and facilities on the Green River immediately below the dam. Variables considered include recreation visitation, its economic value, and the impact of visitation changes on local expenditures.

2. In order to assess the appeal of Project water to potential Front Range users, a finance plan is developed to estimate its probable delivered cost, on a dollar per acre-foot basis. The finance plan estimates the user charge necessary to maintain a positive cash flow with carryover reserves during Project start-up and over the long-term. In addition, the cash flow analysis is conducted under two ownership-operation scenarios:
    - A privately-developed, privately-operated project
    - A project owned and operated by a public agency or a coalition of public entities

Analysis Methods

Recreation Impacts

The analysis of impacts to recreation uses methods consistent with traditional National Economic Development (NED) and Regional Economic Development (RED) analysis, as described in the Principles and Guidelines.[2] Two data sources will contribute to the economic analysis:

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[2] Water Resources Council, *"Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies"*. 1983.

- The Flaming Gorge EIS contained comprehensive recreation economic[3] and socio-economic[4] appendices containing estimated impacts due to changes in reservoir operations. The economic relationships and values described in these appendices are directly applicable to this analysis.
- Analysis of Colorado River flows under various future development scenarios conducted by CADSWES, for the Bureau of Reclamation.[5] However, it is noted that the results are preliminary, have had limited distribution, and have not yet been thoroughly reviewed by Reclamation. Therefore, economic estimates dependent upon these results will also remain preliminary until review is complete.

Finance Plan

The Project's finance plan consists of a cash flow model that considers major sources and uses of funds. Its structure is shown in Table 1. Primary sources of funds include:

- Investor contributions, from the private sector perspective, or other up-front financing in the case of a public project. For the RMSP, this line item would be what has been spent to date, along with what is anticipated in the near future. For a private project, it is assumed that a high rate of return is paid to these investors, payable when the project begins construction. For a public project, these expenditures are reimbursed by the public at a municipal bond rate.

- Debt issuance proceeds depend on whether the debt is private or public-issued. The type and timing of debt is exogenous to the model, meaning that it is specified by the user in order to match the timing of major expenditures. Assumptions associated with each type of debt are discussed in a subsequent section.

- Water sales are the product of annual demand, in acre-feet, times the assumed price of water, in dollars per acre-foot. Annual demand is discussed in a subsequent section. The price per acre-foot is specified by the model user. The specified prices, along with the timing of debt issuance, are the exogenous decision variables in the model. Water sales are further categorized as being for "first use" water or reuse water.[6]

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[3] *"Operation of Flaming Gorge Dam Draft Environmental Impact Statement, Recreation Visitation and Valuation Technical Appendix"*, 2003.

[4] *"Operation of Flaming Gorge Dam Draft Environmental Impact Statement Socioeconomics Technical Appendix",* 2003.

[5] Environmental Flows Research Project: *"Modeling Assumptions, Baseline Scenario and Baseline Results"; "Increased Upper Basin Demands Scenario Results."* 2011

[6] The water from the FGP will be fully consumable due to its out-of-basin origin. As a result, there will be a reuse volume that will equal about 60 percent of the initial use volume as the water is consumed to extinction. Both components are potentially marketable.

- Pipeline leases account for the possibility that the Front Range portion of the pipeline may have additional value for transmission of others' raw water supply as well as Colorado River water.

- Interest income on carryover reserves recognizes the relatively small return to be gained on hold cash reserves. For public agencies, the rate of return on reserves is capped at a rate lower than their financing rate. For private investors, it is assumed to be a competitive Treasury rate to reflect opportunity cost of capital.

Major uses of funds include:

- Up-front development cost consisting of engineering, legal, and administration and permitting.

- Construction costs, depending on whether the Project is constructed by private or public entities.

- Debt service costs also differ depending on whether the project is developed by the private or public sectors.

- Annual operating cost, commonly identified as O&M for operations and maintenance, primarily account for the energy cost to pumping water along a 578 mile route over the Continental Divide and, from the Front Range, over the Palmer Divide. Also included in O&M is a possible hydropower offset, expressed here as a percentage estimating how much of the pumping energy cost can be recovered through the sales of hydropower produced on the pipeline's downhill portions. Finally, other costs account for annual maintenance on the diversion, transmission, and storage facilities.

- USBR and CRSP-related cost refer to potential charges for O&M for Flaming Gorge Reservoir storage and potential charges for CRSP forgone power.

Assumptions underlying these cost estimates are discussed below.

In its operation, the model user specifies: (1) whether the Project will be developed by the private sector or by the public; (2) the cost per acre-foot charged; (3) annual usage, in acre-feet; and a schedule for either issuing debt or collecting contributions. With this information, annual net income is calculated and reserve balances change over time. The objective is for the modeler to manage user charges and debt issuance in a manner that maintains positive year-end reserves. Equivalently, the model can work backwards to determine what user charges would have to be to maintain a certain level of reserves given a specified level of debt.

Given a level of user charges that allow the project to "cash flow", comparisons can then be made to determine whether this price is competitive with alternative sources of water supply facing potential Project subscribers. However, it should be appreciated that simply being competitively price-wise, or being a good investment, does not necessarily translate to financial feasibility. For example, the public project may have financing requirements beyond the abilities of those entities backing it.

Table 1. Structure of the Cash Flow Model

	Sources of funds
	Investor contributions
+	Debt issue proceeds
	Private debt
	Public debt
+	Water sales
	First use municipal
	Reuse
+	Pipeline leases
+	Interest income on reserve balances
=	Total source of funds
	Uses of funds
	Up-front costs
	Engineering
	Legal
	Permitting
+	Construction, private project
+	Construction, public project
+	Debt service
	Private debt
	Public debt
+	Annual operating costs
	Energy
	Hydropower offset
	Other
+	USBR and CRSP-related
+	Return to initial investors
=	Total uses of funds
	Net income = total sources - total uses
	Reserves
	Initial balance
+	Net income
=	Ending balance

Dealing with Uncertainty

Despite a great deal of interest and publicity surrounding the FGP, very little specific data is available about its cost, the volume of water supply available, and the level of future demand. Although not surprising because the Project is under development and technical studies are ongoing, there is little basis for making decisions since nothing is known with any degree of certainty.   While reading through this analysis, it will become apparent that anecdotes and comparisons to other projects form the basis for many estimates.

A result of these numerous uncertainties is that any single point estimate derived from this information would be highly questionable, or "precisely wrong". In response, this analysis proposes two measures to deal with the inevitable uncertainties.

1. Bracketing estimates of costs, water supply, and water demand with low and high values, with a most likely value in between.
2. Using these ranges to define triangular statistical distributions for uncertain variables and use Monte Carlo simulation to examine the range of probability-weighted possible outcomes.

The use of Monte Carlo simulation allows a large number of different combinations of the variables to be examined simultaneously. Its benefit is that results can be expressed in terms of probabilities rather than single point estimates. For example, a traditional analysis may indicate the municipal price of water needs to be, say, $2,500 per acre-foot to make the FGP cash flow. This figure would be based on estimates of Project costs, O&M, water supply, and a range of other uncertain variables. The probability that the actual price would be $2,500 is nearly zero due to the high level of uncertainties. In contrast, Monte Carlo simulation results in a frequency analysis of the break-even water price, such as might be summarized in a percentile table. This approach aids the decision maker by recognizing the uncertainties and using all the available information to generate these frequencies and probability distributions.

A desirable characteristic of Monte Carlo analysis is its ability of examine variables with a wide range of statistical distributions. The user can specify the characteristics of the uncertain variable's distribution, such as mean, variance, and skew. For this analysis, most variables were assumed to have triangular distributions, bounded by the low and high estimates of the variables, with its mode value as the most likely estimate. These triangular distributions can approximate any shape and reflect a significant degree of skew in many instances.

For its ability to generate joint probability distributions of combinations of many uncertain variables, Monte Carlo simulation has become increasingly used in the water resources field for water supply planning and flood damage analysis, and by the Corps of Engineers for developing probability-based cost estimates. It appears applicable here due to the high number of uncertainties.

Report Organization

In order, the following sections of this report focus upon:

- The economic impacts to Flaming Gorge recreation and Green River recreation below the dam, including economic impacts and local expenditure impacts

- Project water availability and Front Range water demand

- The FGP finance plan and its underlying assumptions
- Results of the cash flow analysis for a private project and a public project, with comparisons and a sensitivity analysis
- Summary and Conclusions

Economic Impacts to Recreation at Flaming Gorge Reservoir and on the Green River

The Flaming Gorge EIS (2003) contained a thorough analysis of the potential impacts to reservoir recreation and to recreation along the Green River below the dam. With some updating of unit-day economic values, the data and analysis methods are directly transferable to this analysis. Additional needed data was supplied by the Colorado River Simulation System (CRSS) hydrologic and operations model of the Colorado River supported by the Bureau of Reclamation. For purposes of this analysis, Western Resource Advocates (WRA) modified Reclamation's 2011 version of the model to accommodate withdrawals from a Flaming Gorge pipeline.

- Estimated elevation at Flaming Gorge Reservoir under baseline conditions and under a scenario that included 250,000 acre-feet of combined diversions the reservoir and the Green River above the reservoir. Years considered were 2012-2060. Statistical variability around these estimated elevations were based on 100 runs of the model assuming different starting elevations and different timing of historical hydrologic events.
- Estimated Green River flow at Greendale, representing flows below the dam and within the Flaming Gorge National Recreation Area, upstream of Dinosaur National Monument. Flow estimates were made for current baseline conditions (2012), future baseline conditions (2060), and with the FGP diversions (2060). Statistical variability was established in the form of 10^{th} and 90^{th} percentiles around the estimate.

Appendix A contains additional data supporting the Upper Colorado River analyses.

Flaming Gorge Recreation

Estimates of visitation and value per visitor day were indexed to reservoir elevations. Using survey-based data, various elevation levels were ranked as "low", "preferred", and "high" by the respondents. These rankings are shown in Table 2 by type of recreation.

"Current" and "high kink" rankings were developed by the USBR as a method of extending their data; "current" conditions reflect conditions when the survey was taken and "high kink" reflects an adjustment considered necessary to form a "well-behaved" benefit curve.[7] As Table 2 indicates, 6,029 feet appears to be preferred for all types of recreation and there is no variation across these types.

Table 2. Ranking of elevations by recreation type, Flaming Gorge Reservoir

	Low	Current	Preferred	High kink	High
Power boating; water skiing	6,017	6,021	6,029	6,034	6,037
Boat fishing	6,017	6,021	6,029	6,034	6,037
Boat camping	6,017	6,021	6,029	6,034	6,037
Swimming; water play	6,017	6,021	6,029	6,034	6,037

Appendix A, Table A-1 shows the economic values estimated to correspond to various reservoir elevations, expressed in dollars per visitor day, or unit-day. Table 3 shows how these unit day values correspond to ranked elevations. These values reflect true "consumer surplus" in the economic theory sense and are in addition to the actual expenditures the visitors make locally.

Table 3. Economic values corresponding to reservoir elevation, $/unit day, 2003 dollars

	Low	Current	Preferred	High kink	High
Power boating; water skiing	$ -	$ 26.00	$ 46.00	$ 26.00	-
Boat fishing	$ -	$ 25.00	$ 38.00	$ 25.00	-
Boat camping	$ -	$ 13.00	$ 22.00	$ 13.00	-
Swimming; water play	$ -	$ 1.50	$ 10.50	$ 1.50	-

Appendix A, Table A-2, shows estimated annual visitation at each major recreation site along the reservoir, by type of recreation, and also shows the minimum reservoir elevation needed to use the facilities' boat ramps. If estimated elevation is above this minimum, the recreation site is used to its full usage level; if elevation is below the boat ramps, visitation drops to zero.[8]

The analysis compares annual end-of-July reservoir elevations for a baseline scenario, 2010-50 and a scenario assuming a FGP is in place. Economic benefits are calculated for each year of the scenarios and compared. Their difference is the net economic impact to Flaming Gorge Recreation, expressed in 2011 dollars.

Using the NED approach, over the 50-year period 2010-60, and assuming that the Project begins delivery in 2020, the present value of adverse economic impact resulting from the FGP is estimated to be $196.5 million dollars (Table 4). This assumes a 3 percent "real"

[7] In this case, well-behaved refers to an inverted U shape, in which benefits increase with water elevation (or flow, for river recreation) to a point in which additional elevation (or flow) becomes detrimental.
[8] This is a reasonable assumption in the short term but somewhat tenuous in the long-term. At a cost, it may be possible to extend the boat ramps and maintain recreation. This was not considered in the USBR analysis.

inflation-free discount rate. The annual equivalent value is approximately $7.6 million per year. Increasing the real discount rate from 3 to 6 percent results reduces the present value to $86.1 million and the annual equivalent value to $5.5 million.

Table 4. Summary of the economic impact of the FGP to recreation using NED evaluation procedures (million, 2011 dollars)

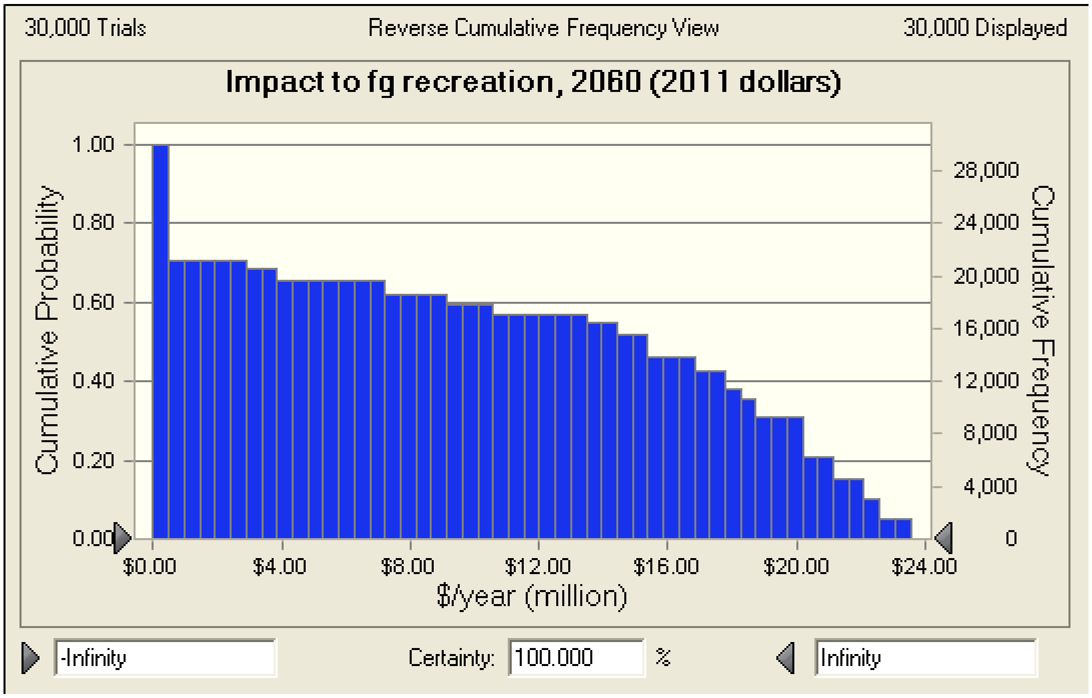
Discount rate	3%	6%
Present value of impact, 2020-60	$196.5	$86.1
Annual equivalent value	$7.6	$5.5

An interesting aspect of Project's impacts on impacts to Flaming Gorge Reservoir is the affect on variability around the estimated reservoir levels with the FGP in place. In addition to the FGP reducing the expected reservoir elevation about 10 feet, it increases the downside variability substantially. Alternative stated, its more probable that elevation will be below its estimated value that above it. This is graphically shown in Figure 31 from the recent Environmental Flows Research Project, *Increased Upper Basin Demands Scenario Results.* The significance of this increase in downside variability can be illustrated using Monte Carlo simulation and a snapshot of year 2060.

Under the baseline scenario, year 2060 reservoir elevation is estimated to be about 6,030 feet with a standard deviation of about 10 feet appearing normally distributed around 6,030. With FGP, the expected elevation drops to 6,020 feet with a high end deviation of about 12 feet and a low end deviation about 30 feet.[9] Defining a triangular distribution around these values (low 5,990, most likely 6,020, and high 6,032) and using Monte Carlo simulation to examine a wide range of possible elevations results in the frequency chart shown in Figure 1 and the percentiles shown in Figure 2.

[9] These deviations represent 90^{th} and 10^{th} percentile values.

Figure 1. Reverse cumulative frequency of the adverse economic impact to recreation at Flaming Gorge Reservoir, year 2060.



Figures 1 and 2 indicates there is about a 20 percent probability that impacts are 0, a 50 percent probability that impacts are $15.05 million per year or greater (or less) and a 80 percent probability that impacts are $21.14 million or less (or a 20 percent probability that impacts are $21.14 or greater).

The NED analysis appears to understate the potential economic impacts to Flaming Gorge recreation, especially from current perspective, because the latter years of the analysis are heavily discounted and, due to the slow change in expected reservoir levels, the majority of the impacts occur in those distant years.

Figure 2. Frequency percentiles of the FGP's adverse economic impact to recreation at Flaming Gorge Reservoir, year 2060 (million).

Percentile	Forecast values
0%	$0.00
10%	$0.00
20%	$0.00
30%	$2.75
40%	$8.98
50%	$15.05
60%	$17.55
70%	$19.72
80%	$21.14
90%	$22.34
100%	$23.54

Green River Recreation

Similar to Flaming Gorge recreation, recreation depends upon water levels, here measured in cfs of flow. Table 5 shows the ranking of flow levels by type of recreation along the reach below the dam by type of recreation. Compared to reservoir recreation, there appears to be some variation in preferred river levels across activities.

Table 5. Ranking of river levels by recreation type, Green River below Flaming Gorge Reservoir (cfs)

	Low end	Current	Preferred flow	High end kink	High
Scenic floating	953	1,097	2,170	3,700	3,905
Guide boat fishing	854	1,359	1,837	2,758	3,731
Private boat fishing	879	1,373	1,808	2,673	3,656
Shoreline fishing; trail use	825	1,299	1,624	2,473	3,709
Camping	836	1,115	2,000	3,169	3,538

Table 6 shows the estimated level of visitation for the combined sites below the dam under different flow preferences, by type of recreation. No recreation is assumed at the low end and the high ends of the flow preferences.

Table 6. Estimated combined visitation at the Green River sites below Flaming Gorge Reservoir (annual)

	Low end	Current	Preferred flow	High end kink	High
Scenic floating	-	24,768	30,770	24,768	-
Guide boat fishing	-	11,400	13,598	11,400	-
Private boat fishing	-	18,531	21,610	18,531	-
Shoreline fishing; trail use	-	35,482	50,819	35,482	-
Camping	-	2,281	2,504	2,281	-
	-	92,462	119,301	92,462	-

Table 7 summarizes the economic values associated with these preferences, by type of recreation. Similar to visitation, no economic value is assumed at the low and high ends of the flow preferences.

Table 7. Economic value of recreation activities under ranked flows, $/unit-day, 2003 dollars

	Low end	Current	Preferred flow	High end kink	High
Scenic floating	$ -	$ 47	$ 94	$ 47	$ -
Guide boat fishing	$ -	$ 183	$ 240	$ 183	$ -
Private boat fishing	$ -	$ 37	$ 70	$ 37	$ -
Shoreline fishing; trail use	$ -	$ 23	$ 34	$ 23	$ -
Camping	$ -	$ 11	$ 14	$ 11	$ -

Appendix Table A-5 uses the visitation and unit day values associated with each increment of flow to estimate the economic benefits of each increment.

The annual recreation visitation estimates were allocated to a monthly basis using historical visitation proportions. The analysis was then conducted considering monthly flow estimates in order to better account for the variability in flows across the recreation seasons.

With the above data and flow data developed in WRA's CRSS analysis, the present value of the net impact over the period 2010-60, assuming a discount rate of 3 percent and an initial delivery of 2020, is estimated to be $79.2 million, in 2011 dollars. On an annual equivalent basis the impact is $3.1 million (Table 8).

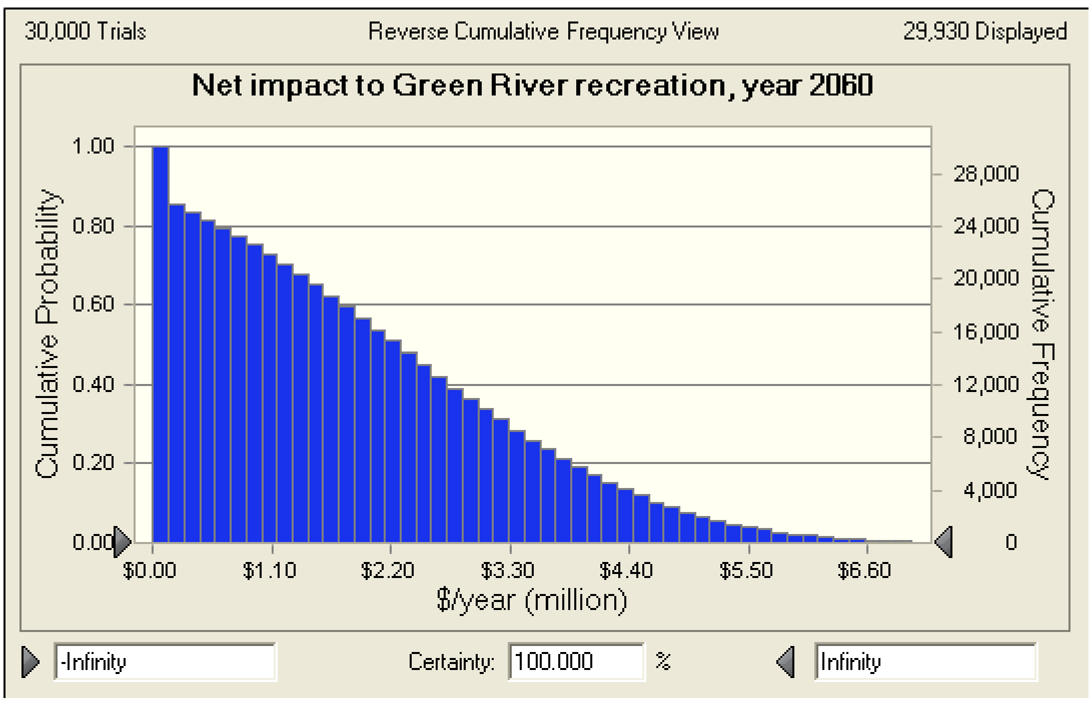
Table 8. Summary of the economic impact of the FGP to Green River recreation using NED evaluation procedures (million)

Discount rate	**3%**	**6%**
Present value of impact, 2010-60	$79.2	$39.5
Annual equivalent value	$3.1	$2.6

Similar to the Flaming Gorge recreation analysis, it is interesting to note the Project's impact on variability of flow. The FGP will reduce average flows but actually reduce their down-side variability. That is because minimum flow levels will be maintained for threatened and endangered (T&E) species, effectively placing a floor on flow changes. This is graphically shown in Figure 31 from the recent Environmental Flows Research Project, *Increased Upper Basin Demands Scenario Results."*

Monte Carlo simulations were conducted on baseline and with-FGP benefit estimates for the snapshot year of 2060. It was assumed the uncertainty was based on the 10th and 90th percentiles of the flow estimates. The difference in these estimates is shown in Figures 3 and 4.

Figure 3. Reverse cumulative frequency of the adverse economic impact to recreation on the Green River below Flaming Gorge Dam, year 2060.



Figures 3 and 4 indicates there is about a 80 percent probability that impacts are greater than $0.54 million per year, a 50 percent probability that impacts are $2.19 million or greater (or less) and a 80 percent probability that impacts are $3.79 million or less (or a 20 percent probability that impacts are $3.79 million or greater).

This snapshot of year 2060 indicates that the annual equivalent value estimated with NED assumptions is slightly lower than the 50th percentile of the Monte Carlo simulation. This would suggest that the NED value has a slightly lower than 50 percent probability of occurring.

Figure 4. Frequency percentiles of the FGP's adverse economic impact to recreation on the Green River, below Flaming Gorge Reservoir, year 2060 (million)

Percentile	Forecast values
0%	$0.00
10%	$0.00
20%	$0.54
30%	$1.16
40%	$1.69
50%	$2.19
60%	$2.67
70%	$3.21
80%	$3.79
90%	$4.60
100%	$8.35

Impacts to Local Expenditures and Regional Economic Impacts

In addition to the FGP's impact to Upper Colorado Basin economic benefits is the impact to recreation visitor spending on the regional economy surrounding the sites. Fewer visitors translate to lower spending. From an NED perspective, this reduction would not be considered in a benefit-cost analysis because individuals may decide to go somewhere else to boat or fish and otherwise spend similar amounts in another location or for another activity. Reductions in Upper Colorado spending would be offset by increases in spending elsewhere. However, viewed in terms of regional economic development (RED), these reductions could have substantial impact.

As described in the Socio-economics Appendix of the Flaming Gorge EIS, estimates of the expenditure impacts are based on estimates of visitation changes at the two recreation sites, by type of activity, multiplied by estimates of expenditures at each site, also by type of activity. These estimates are shown in Table 9 for the range of water conditions considered in the EIS analysis. The expenditures are further categorized by type, such as for lodging, camping fees, restaurants, guide services, etc. The breakdown by type of expenditure is not shown here but can be observed in the EIS.

Table 9. Expenditure levels corresponding to recreation type and water conditions

Flaming Gorge visitor expenditures, $/day

	Low	Current water elevation	Preferred water elevation	High end kink	High
Power boating; water skiing	$ -	$ 158	$ 282	$ 158	$ -
Boat fishing	$ -	$ 104	$ 150	$ 104	$ -
Boat camping	$ -	$ 138	$ 164	$ 138	$ -
Swimming; water play	$ -	$ 55	$ 65	$ 55	$ -

Green River visitor expenditures, $/day

	Low	Current	Preferred flow	High end kink	High
Scenic floating	$ -	$ 343	$ 444	$ 343	$ -
Guide boat fishing	$ -	$ 724	$ 1,050	$ 724	$ -
Private boat fishing	$ -	$ 245	$ 361	$ 245	$ -
Shoreline fishing; trail use	$ -	$ 144	$ 214	$ 144	$ -
Camping	$ -	$ 81	$ 92	$ 81	$ -

Table 10 shows the result of multiplying visitation changes 2020-60 times expenditures per visitors. The present value of the total impact is approximately $1.0 billion and $460 million, for 3 percent and 6 percent discount rates, respectively. On an annual basis, these translate to annual equivalent estimates of $39 million and $29 million.

Table 10. Estimates of forgone recreation-related expenditures resulting from the FGP, accruing to Daggett and Uintah Counties in Utah and Sweetwater County, Wyoming (million)

Discount rate	**3%**	**6%**
Present value of impact due to reduction in Flaming Gorge visitation, 2020-60	$571.5	$246.9
Present value of impact due to reduction in Green River visitation, 2020-60	$425.4	$212.5
Present value of total impact, 2020-60	$997.0	$459.4
Annual equivalent value	$38.7	$29.1

Figures 5 and 6 use a snapshot of year 2060 conditions to illustrate the uncertainty surrounding annual expenditure impacts. It is interesting to note that the median expenditure impact estimate about $23 million, indicating that it is more likely that the 2060 impact will be less than the calculated annual equivalent value of $39 million.

Figure 5. Reverse cumulative frequency of the reductions in recreation expenditures stemming from reductions in visitors at Flaming Gorge Reservoir and the Green River, year 2060 (million)

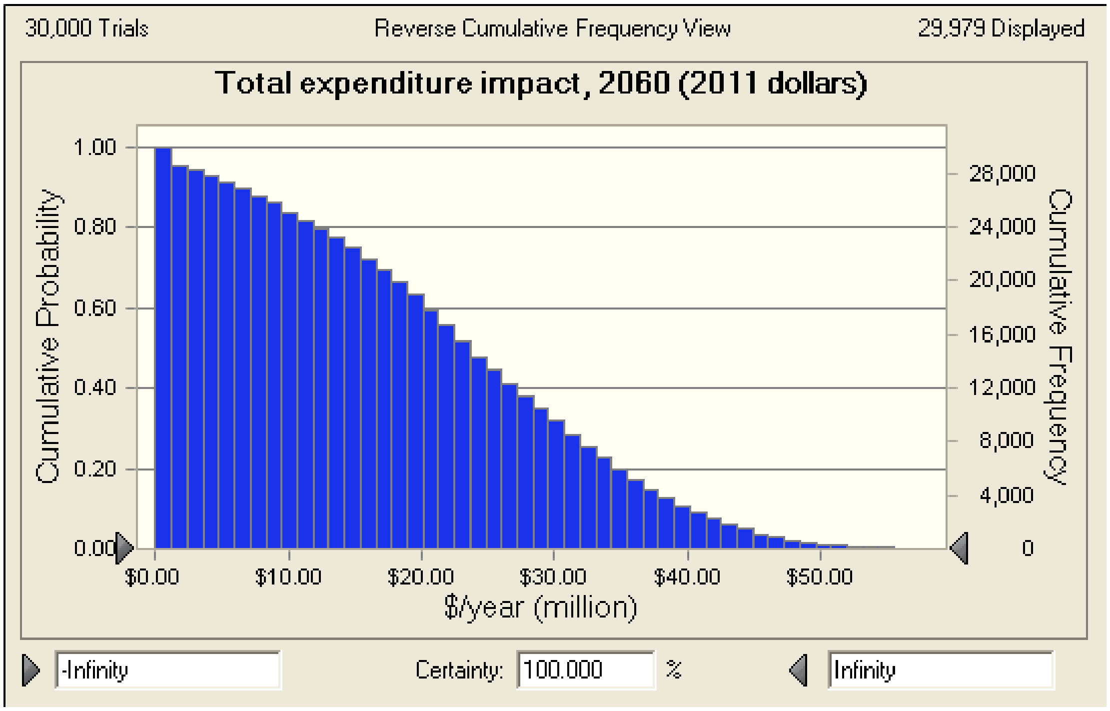


Figure 4. Frequency percentiles of the FGP's adverse economic impact to recreation expenditures, year 2060 (million)

Percentile	Forecast values
0%	$0.00
10%	$5.60
20%	$11.61
30%	$16.36
40%	$19.94
50%	$23.01
60%	$26.43
70%	$30.22
80%	$34.22
90%	$39.49
100%	$65.32

In order to determine whether $39 million per year, or $23 million, is a significant portion of the regional economy, the USBR analysis defined the regional economy as the sum of Daggett and Uintah Counties in Utah, plus Sweetwater County in Wyoming.

Geographically, this would include Vernal, Utah, on the south and Green River/Rock Springs, Wyoming on the north, with Daggett County in the middle. It should be noted that there is considerable mining in this region and, *a priori*, one would expect the value of regional output to be dominated by the value of the mined product.

The USBR analysis was intended to focus on multiplier-based impacts, such as the value regional output, regional earning, and employment. To accomplish this, they adapted a version of the IMPLAN economic input-output model to the 3-county region. Due to very minor estimated changes in direct economic output, their impacts were quite small and, as a result, the multipliers used in their analysis were not explicitly presented or focused upon. As a consequence, this analysis uses more general information to gain perspective on the magnitude of expenditure impact.

- According to the baseline version of 3-county IMPLAN model, the total value of output for the region was approximately $4 billion per year (in 1999 dollars), with mining accounting for about 1/3 of this total. Therefore, an annual expenditure impact in the range of $30 to $36 million, with multiplier effects and indexing output to 2011 dollars, would have a relatively small impact on the total regional economy, in the range of 1 percent.

- Realizing this, the USBR defined a subgroup of industries termed "most affected sectors" that included a range of retail and service categories that would be most affected by recreation spending. The value of annual regional output of these sectors was estimated to be approximately $227 million in 1999 dollars or about $306 million in 2011 dollars. The project's direct impact of $23 to $36 million would be about 7-12 percent of this total, possibly as high as 10-18 percent if an output multiplier of 1.5 is assumed.[10]

- With respect to employment, a conservative employment multiplier would be approximately 30.0, meaning that every million dollars of direct output translates to 30 jobs in the region. An impact of $23 to $39 million would therefore have an adverse employment impact of approximately 700 to 1,100 jobs. This would be about 2 to 3 percent of the total regional workforce, but about 15 percent of employment for the most affected sectors.

Project Water Availability and Front Range Water Demand

Water Availability

The volume of water involved in the FGP has tended to center around 250,000 acre-feet per year, which is the volume specified by the RWSP and also the volume being

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[10] An output multiplier of 1.5 is a somewhat arbitrary, conservative value based on studies in other regions. However, given the range of uncertainties of the critical variables, this multiplier appears reasonable for comparison purposes.

considered in the Project's stalled EIS process. Of this volume, 165,000 acre-feet are assumed to be diverted at Flaming Gorge Reservoir itself and 85,000 are assumed to be diverted from the Green River upstream of the reservoir. The 85,000 acre-feet has been identified as the dry year yield of Green River diversion, with potentially higher volumes occurring in average and wet years.

The volume of water available through the Project is currently unknown and not likely to be resolved in the near-term. The Bureau of Reclamation, who is in charge of ensuring that T&E releases are met, informally indicated that approximately 165,000 acre-feet could be diverted from Flaming Gorge Reservoir on a long-term basis while still meeting target T&E releases.[11] Their analysis was conducted in response to the RWSP but remains preliminary and is somewhat dated (2007). Regardless, this appears to be the smallest volume identified as available Project water.

Representatives from the Colorado River Water Conservancy District (the River District) have expressed serious doubt whether there is actually 250,000 acre-feet left in Colorado's unallocated portion of Upper Basin supplies. The River District's concern, shared to differing degrees with other users of trans-basin diversions, is that if there is not, the Project would jeopardize Colorado's further development of West Slope supplies and increase the probability that a Colorado River Compact call could occur. As a result, the availability of water will be seriously studied and probably litigated prior to development of the FGP Project.

If 165,000 acre-feet and 250,000 acre-feet are assumed to be the low and high ends of the water availability, what would be a most likely value for analysis purposes? This analysis concludes that the location of the most likely value within this range is speculative. In response, the most likely value is assumed be to approximately the mid-point between these two extremes, or 210,000 acre-feet (Table 11).

Implicitly, these assumptions state that this annual volume of water, whether it 165,000 acre-feet, 250,000 acre-feet, or somewhere in between, would be available from year to year with a very high degree of certainty. That is, the optimal combination of Project storage and available yield is accurately implemented despite a range of uncertainties, including climate change and questions about Colorado water rights priorities in times of priority calls on the River. These factors would contribute to reducing average Project yield and increasing its variability.

Although these implicit assumptions are acceptable under a baseline financial analysis, they beg the question of the possible impact of climate change and institutional uncertainties on Project yields, resulting unit costs, and reliability of supply. In response, this analysis proceeds with development of a baseline analysis assuming water availability is fixed and certain throughout the period of analysis. However, after discussing these results, additional scenarios consider the incremental impacts of climate change and the possibility the Project may have a relatively lower priority in times of shortage than anticipated by its sponsors. These impacts should be heavily weighted in

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[11] Obtained from http://www.westernresourceadvocates.org/water/pipeline/USBRReporttoUCRC.pdf.

the ultimate assessment of whether the Project is financially feasible, but separating them yields an opportunity to observe their individual, incremental impact.

Table 11. Assumed values for FGP water availability			
	Low end estimate	**Most likely value**	**High end estimate**
Water availability, acre-feet per year	165,000	210,000	250,000

Front Range Water Demand for Flaming Gorge Supplies

Opportunities to construct pipeline projects in phases are limited because the greatest economies of scale are achieved when a pipeline project is constructed once in its entirety. It is therefore likely that the majority of the FGP project will be constructed at one time.[12] However, it raises the question of whether the Front Range can financially absorb the project until the demands are fully developed and the pipeline is operating at near full capacity.

The 2050 municipal supply "gap" has been estimated to vary from 365,000 acre-feet[13] to 390,000[14] depending on a variety of factors. The issue is whether the FGP will become the preferred water supply alternative for the entities comprising the gap. Along with additional factors, this will depend on the municipalities' location with respect to the regional plumbing system and Project water's cost compared to other alternatives. Currently, neither the RWSP nor the public sector project proposed by the Colorado-Wyoming Coalition is identified as a preferred water supply alternative for Front Range municipalities. In addition, the Project has not been identified by the State as an IPP (Identified Projects and Processes) for purposes of filling the gap. As a result, demand for Project water is speculative.

In response to this speculation, and as part of the Draft EIS process, the Corps of Engineers has asked Project proponents to provide evidence that demand for Project water supplies exists. Potential users submitted letters to the RWSP proponents identifying their future water needs, summarized in Table 12. This analysis has categorized them as being primarily for municipal usage or primarily for irrigation usage.

[12] A phase-in of the Project's north diversion on the Green River may be possible and was considered by the CWCB. However, the bulk of the pipeline will likely be constructed at full capacity.

[13] Western Resource Advocates, "*Filling the Gap, Commonsense Solutions for Meeting Front Range Water Need*", February, 2011. Active conservation, acceptable planned projects, reuse, and agricultural leasing through agreements such as the Super Ditch will reduce this total gap.

[14] Colorado Water Conservation Board, *"SWSI 2010 Mission Statement, Key Findings, and Recommendations"*, 2011. http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/SWSI2010FactSheet.pdf

As of July, 2011, the Corps terminated its evaluation of the Project, though notably, the Corps was not evaluating potential participants' ability to pay.[15]

Table 12. Volumes Requested from the Regional Watershed Supply Project (Million Project), acre-feet per year

	Stated volume	Apparent municipal use	Apparent irrigation use
Central Colorado Water Conservancy District (CCWCD), Groundwater Management Subdistrict	50,000	-	50,000
CCWCD, Well Augmentation Subdistrict	50,000	-	50,000
CCWCD	50,000	-	50,000
City of Brighton	12,000	12,000	
Douglas County (South Metro)	40,000	40,000	
Fort Collins-Loveland Water District	5,000	5,000	
Lower South Platte Water Conservancy District	35,000		35,000
North Sterling Reservoir Company	25,000		35,000
Prewitt Operating Company	10,000		10,000
Larimer-Weld Irrigation Districts	20,000		20,000
City of Windsor	10,000	10,000	
Woodmoor Water and Sanitation District	3,000	3,000	
T-Cross Ranches	20,000	20,000	
East Larimer County Water District	5,000	5,000	
City of Cheyenne	4,500	4,500	
Penley Water Company	10,000	10,000	
Lake Hattie Irrigation Company	8,000	-	8,000
El Paso County Water Authority	22,600	22,600	
	380,100	132,100	258,000

It is interesting to note that letters requesting Project water are not binding and no firm obligations are involved. In addition, the potential price of the water was not considered in the requests. Since there was little resulting risk in requesting the water, it is likely that many are either inflated or not realistic considering the water's probable cost.

Of the total identified demand of 380,100 acre-feet, approximately 258,000 acre-feet is identified for irrigation. It is unlikely that irrigators can afford the water since its probable cost will far exceed its value for growing crops, even with the current high commodity prices. Temporarily taking irrigation "off the table" results in a municipal demand of about 132,100 acre-feet. Of this, about ½ is accounted for by Douglas County (40,000) and El Paso County Water Authority (22,600 acre-feet). The volume requested by Douglas County represents the year 2050 build-out water needs for the members of the South Metro Water Supply Authority[16]. The El Paso County Water Supply Authority request represents the total 2050 water supply gap for northern El Paso County, excluding Colorado Springs. There are other measures already in progress to fill this gap, including the Super Ditch and water purchases by individual local agencies. As a result, ultimate

[15] Personal communication with Rena Brand, Corps of Engineers, May 18, 2011. The Corps emphasized that the water's potential price is not part of this evaluation.
[16] http://www.southmetrowater.org/downloads/SMWSA_MasterPlan.pdf

demand for Project water in El Paso County may be considerably lower than 22,600 acre-feet.

Based on uncertain nature of the demands shown in Table 12, the likely long-term nature of developing these demands (if they indeed exist to the degree stated), and the probable cost of water to irrigators, there is little reason to assume the Project will be fully utilized at start-up. This does not imply that the Project would never operate at full capacity, but it recognizes that there are few either willing to "pony up" at this time or who have a sincere belief that the Project is their current preferred alternative.

With respect to this analysis, the critical questions are what the start-up demands will be and at what rate will this demand increase over time. Similar to water availability, these variables are quite speculative, but the following assumptions are made to move the analysis forward. Start-up demand is assumed to be 100,000, or about ½ of the assumed available water. This demand is assumed to increase at a rate of 10% per year until available water is fully utilized. Low and high bounds around these assumptions are shown in Table 13. It should be emphasized that these assumptions are critical to the analysis because they establish the denominator of the equation of how much the water will cost. It should also be noted that 100,000 acre-feet is quite a distance from the intermediate term unmet demand identified for South Metro and northern El Paso County. Alternatively stated, 100,000 acre-feet may be a "stretch".

Table 13. Assumed values for start-up demand and its rate of increase

	Low end estimate	Most likely value	**High end estimate**
Water demand at start-up	60,000	100,000	160,000
Rate of increase in demand until Project is fully utilized	5%	10%	20%

With the most likely demand estimates, it would take approximately 9 years to reach the Project's full capacity. Under the low and high scenarios, it is estimated to take approximately 25 years and 3 years, respectively.

Finance Plan Assumptions

A number of assumptions about how the Project will be developed and its cost are necessary to make the cash flow model operational.

Timeframe

At this point, the Project's timeframe is anticipated to be the same whether it is developed by private interests or the public sector:

- The Project is assumed to be developed during the 2011-20 timeframe. This is consistent with the schedule anticipated by Project proponents. Up-front development expenditures associated with engineering, legal issues, administration, and permitting are assumed to be made at this time.

- Project construction is assumed to be during the 2020-22 time period

- Project deliveries are assumed to begin in 2023.

It should be noted that the Corps of Engineers anticipated release date for the Draft EIS is 2016. This may be somewhat optimistic given the anticipated challenges to the Project and whether the Corps will continue to be the lead federal permitting agency.

Further development of the cash flow model could accommodate uncertain development timeframes. Considering the opportunity cost of capital, alternative timeframes may have significant financial impacts. However, for the baseline analyses, the timeframe is assumed fixed.

Inflation

For comparison purposes, the rate of cost escalation, or inflation, is assumed to be zero. Although inflation is near certain to occur, focusing on current price level facilitates comparison of alternatives. Therefore, all dollar figures are expressed at 2010-11 price levels. This assumption is consistent with NED evaluation procedures but somewhat inconsistent with typical cash flow analysis. However, this cash flow analysis covers a much longer time span than a typical cash flow analysis; 1 to 5 years is typical and 50 years are considered here. In light of this longer timeframe, a zero inflation assumption appeared reasonable.

It is recognized that assumptions about rate of return to investors and interest rates for project debt are expressed in nominal terms, meaning that an inflation expectation is embodied within them. As a result, the effect of these variables may be slightly overstated.

First Use of Water and Reuse

Since FGP will be a trans-basin transfer, the supply will be fully consumable on the Front Range. As a result, there may be marketable reuse of Project water as it is used until extinction, as much as 60 percent of the diverted volume.

Reuse has become increasingly valuable to municipalities in the form of direct reuse of treated effluent, such irrigating golf courses, and the marketing of indirect reuse to downstream users. It is likely that municipalities will want to retain the reuse for either of these purposes. During the course of this analysis, there was some speculation that the RWSP would sell municipalities “first use water” and sell the reuse portion to irrigation entities at a reduced cost. This may be an avenue to make the Project affordable to irrigation, if possible.

For the baseline analysis, it is assumed that whoever purchases Project water receives both first use and reuse components. However, if this issue arises in the future, the cash flow model can accommodate the assumption that reuse is also marketed.[17]

Private Project Development

Under a private ownership-operation scenario, the following project development assumptions are made:

- The initial investors contribute funds necessary to carry the Project through design and permitting. At the time of construction, these investors are repaid assuming a 20 percent rate of return to risk and capital.
- Private bonds are issued in each of the three years of construction at levels high enough to fund construction, repay initial investors, and maintain positive cash flow.
- Investors in these bonds will receive terms described under the Financing Cost section below.

Public Project Development

- With public ownership-operation, the initial investors are the participating agencies who get reimbursed for their contributions at their own cost of capital.
- Municipal grade bonds are issued in each of the three years of construction at levels high enough to fund construction, repay initial investors, and maintain positive cash flow.
- Investors in these bonds will receive terms described under the Financing Cost section below.

Capital Costs

Discussion

Despite the high level of publicity surrounding the FGP, there is very public information about its cost. Project proponents initially estimated the cost in the range of $2 billion to $3 billion[18]; a later article in the Caspar Star-Tribune, summarizing a local EIS Scoping Meeting, mentions a $4 billion estimated cost but does not provide documentation.[19] Detailed cost estimates prepared by the project's backers have not yet been shared with

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[17] A reviewer observed the possibility that Front Range entities receiving Project water could potentially sell their own reuse water, undercutting the RWMP's reuse market potential. It is implicitly assumed that water delivery contracts would deal with this possibility and restrict this activity.
[18] Powerpoint presentation developed by Jeff Fassett, HDR Engineering, and Aaron Million. 2007.
[19] http://trib.com/news/state-and-regional/article_2233a65d-dc06-5104-ade6-77fd6250f5c1.html

the public and may not be available until the Draft EIS is released in 2016, according the Corps of Engineers, the lead federal agency.

The only reviewable cost estimate appears to be that made by the engineering firm CDM in a recent study for the CWCB, which compares the estimated cost of a FGP pipeline with that of several other proposed trans-basin pipeline projects.[20] Specifically, the FGP version considered by the CWCB would withdraw 250,000 acre-feet per year in a manner similar to that of the Million Project but terminates near Barr Lake and I-76, northeast of the Denver metropolitan area, rather than in Pueblo County. The estimated cost for facilities relevant to this analysis is approximately $6.1 billion. The terminal location was considered logical due to its proximity to East Cherry Valley Water and Sanitation District's Northern Project and Aurora's Prairie Waters Project, both having the capabilities to deliver water to entities in Douglas and Arapahoe counties.

It should be noted that CWCB estimates were for purposes of comparing alternatives, so the relative cost differences rather than the absolute costs were the focus of the study. Large contingencies were added to the construction estimates and no attempts were made to optimize projects, such as adding hydropower facilities at elevation drops. As a result, the CWCB estimates are useful for their intended purpose but are quite high, more than double those estimated by the Project's proponents when compared on as equal basis as possible considering the lack of data.

Table 14 summarizes the CWCB estimates of the Project's capital cost. It shows that a 30 percent contingency is added to construction cost estimates. The third column of costs, containing engineering, legal, and administration cost estimates (ELA), assumes that ELA costs are 20 percent of the transmission facilities construction cost. These percentages are commonly used when developing unit-cost based estimates using the rationale that resulting total cost will have a low probability of being exceeded. It is assumed that Draft and Final EIS cost is included in this cost category. The final column summarizes the costs that are considered in this analysis of the FGP.

Costs associated with treatment and re-use are not considered in this analysis because these costs would be borne by water purchasers and not the project developers. It is interesting to note that ELA costs are estimated to be nearly $1 billion ($889 million). Since there are few projects of this scale and potential controversy, there is little basis to question this estimate. However, it appears to be an order of magnitude higher than those experienced by previous projects.

[20]Memorandum from Nicole Rowan and Susan Morea to Eric Hecox, CWCB, "Reconnaissance Level Cost Estimates for Agriculture and New Supply Strategy Concepts." June 4, 2010. http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=143892&searchid=bbbbf69b-ff6e-4950-9110-1846bbbaa99e&dbid=0

Table 14. Estimated Cost of the Flaming Gorge Pipeline, as Summarized in CWCB's Reconnaissance Study (millions)

	Estimated construction cost	Contingency, 30% of estimated construction cost	Engineering, legal, and administration (ELA), 20% of est. construction cost	Total	Costs considered in this analysis
Water rights	$ 4	$ -	$ -	$ 4	$ 4
Storage	$ 269	$ 81	$ -	$ 350	$ 350
Transmission	$ 4,447	$ 1,334	$ 889	$ 6,670	$ 5,781
Treatment	$ 323	$ 97	$ -	$ 420	
Reuse	$ 1,615	$ 485	$ -	$ 2,100	
	$ 6,658	$ 1,996	$ 889	$ 9,544	$ 6,135

There is little to compare the CWCB cost estimate to given the magnitude of the project, however, an admittedly crude comparison can be made involving capital cost estimates for other large pipeline projects in similarly rugged terrain, on a cost per mile basis. Two projects are considered here, the Lake Powell Pipeline and the Gallup-Navajo Pipeline:

- The Lake Powell Pipeline, proposed by the State of Utah, Division of Water Resources, would consist of three pipeline segments to serve Washington, Kane, and Iron counties. The pipeline length is estimated by the UDWR to be 139 miles; total annual deliveries are estimated to be approximately 86,250 acre-feet per year. Also known as the St. George Pipeline, the total capital cost estimate for the "baseline" project, with hydropower facilities, but not hydropower pump-back facilities, is approximately $1.1 billion in 2010 dollars and includes pipeline, pump stations, hydropower facilities, program (ELA) costs, and a 15 percent contingency on construction costs.[21] On a per mile basis, the estimated cost is $7.9 million. Applying this cost to the FGP (578 miles) results in a total capital cost of approximately $4.6 billion, rounded.

- The Gallup-Navajo Pipeline is being developed to convey approximately 38,000 acre-feet per year of San Juan River water 234 miles to Gallup, New Mexico and points in the Navajo Nation. The primary sponsor of the project is the federal government on behalf of the Tribe. Its estimated cost was $716 million in 2005 and about $864 million in 2007. Backing-out treatment facilities for comparison to the other pipeline alternatives results in a total cost of $812 million, or $0.812 billion. The simple cost per mile of the 2007 estimate is $3.47 million. When applied to the FGP, the latter's total cost would be $2.0 billion.

[21] *Lake Powell Pipeline, Draft Study Report 10, Socio-economics and Water Resource Economics*. Prepared for the Utah Board of Water Resources. March, 2011. p. 1-1.

Whether these projects are truly comparable to the FGP is arguable. Both are smaller projects in pipe diameter and length but traverse similarly sparsely inhabited and rough desert terrain. However, they illustrate a wide range in possible project costs.

In addition to the estimated capital cost, an issue raised during the analysis was whether a private-sector version of the FGP would be less expensive than a public-sector version. That is, can the private sector build the same project for less cost? Anecdotally, one may say yes because, *a priori*, the private sector is not burdened by some of the procurement and regulatory issues associated with government-financed projects, Davis-Bacon provisions being an example. Project proponent Aaron Million was quoted as estimating that 30 to 50 percent reduction in construction cost was possible.[22] Although empirical evidence would be more convincing, this analysis agrees that some construction cost savings may be achieved through the private sector and, in response, have adjusted assumed construction costs slightly downward when considering a privately-developed project.

Engineering, legal, and administrative and permitting cost estimates have a wide range.

- The most likely engineering cost is estimated to be about $75 million dollars and range from $50 on the low end to $150 on the high end. These estimates are considerably less expensive than a typical unit cost estimate of 10 to 15 percent of construction cost. This is because of the magnitude of this project in relation to the ability to achieve design economies of scale. Though no doubt presenting its own engineering challenges, this project does not appear to require unprecedented pipeline technology or construction methods.

- Implicit in the legal cost assumptions (Table 15) is that the legal issues can be resolved within the Upper Basin states and the Colorado River "Law of the River" as it applies between the Lower Basin and the Upper Basin will not come under challenge. The most likely legal cost is estimated to be $25 million, bounded by $15 million and $50 million on the low and high range, respectively.

- With respect to administrative and permitting costs, the Corps of Engineers initially estimated the Project's EIS would cost a maximum of $20 million. Possibly this estimate was to calm concerns among the Project's sponsors of a long, protracted process costing considerably more. Since this estimate, the sponsors and Corps have parted company, with the sponsors indicating that they are refining the Project for hydropower purposes, hoping that the Federal Energy Regulatory Commission's (FERC) permitting process will be less time consuming and less expensive. However, the Corps would still be involved in Section 404 wetland issues. It is interesting to note the approximate costs of EIS's involving controversial water projects. Over $50 million (in 1988 dollars) was spent on the Two Forks Dam issue, only to be eventually halted by EPA at the national level. The City of Newport News, Virginia also spent roughly $50 million in studies and

[22] Pueblo Chieftain, "Flaming Gorge: a roundup, not a showdown". By Chris Woodka. May 8, 2011.

permitting to develop what would eventually become the proposed King William Reservoir project. After initial denial of a Section 404 permit at the regional level, the Corps Mid-Atlantic Division approved it on appeal. However, federal courts later reversed the appeals decision and denied the permit. Overall, for this analysis administrative and permitting costs are assumed to be bounded by $20 million, the Corps' estimate, on the low end and $100 million on the high end. The most likely value is assumed to be $75 million.

Capital Costs Assumed for the Analysis

Capital costs include construction costs and the supporting up-front costs for engineering, legal, and administration. Assumed values used in the Monte Carlo analysis are shown below in Table 15.

Table 15. Capital Cost Assumptions Used in the Analysis (million)

	Low end estimate	Most likely value	High end estimate
Construction cost, public project	$3,000	$4,500	$6,100
Potential cost savings due to private development	0%	15%	30%
Engineering cost	$50	$75	$150
Legal costs	$15	$25	$50
Administration and permitting	$20	$75	$100

Construction costs are assumed to be distributed equally over the period 2020-22. Up-front costs associated with engineering, legal, and permitting are spent in the annual proportions shown in Table 16.

Table 16. Assumed annual proportions of expenditures for engineering, legal, and permitting.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Engineering	5%	5%	5%	5%	5%	5%	20%	20%	20%	10%
Legal	5%	5%	10%	20%	20%	20%	20%			
Permitting	5%	10%	20%	20%	20%	20%	5%			

Project Operation and Maintenance Costs

Operation and maintenance (O&M) costs account for annually occurring costs, primarily the power and energy for pumping water the height and distance from the Project diversion points to the Colorado Front Range. A smaller portion of O&M accounts for the maintenance of the project facilities themselves. In addition, two additional annually occurring components to O&M are considered here: (1) a potential hydropower component that would offset a portion of pumping costs with revenues from power sales during peak and non-peak periods; and (2), costs at the water source, primarily lost Colorado River Storage Project (CRSP) revenues from hydropower production at Flaming Gorge Reservoir.

There has been little discussion by the project proponents about O&M costs and their estimates have not been made public. The CWCB estimated O&M costs to be approximately $146 million per year for the transmission facilities and ongoing legal assistance considered in this analysis. Based on deliveries of 250,000 acre-feet per year, this amounts to approximately $584 per acre-foot. This estimate assumes that power and energy accounts for high percentage of this cost and energy is valued at a retail rate of $0.11 per kwh[23]. As indicated above, no attempt was made to optimize the costs with respect to non-peak operations or through hydropower development. As a result, this may represent the high-end estimate of actual O&M costs. As a point of interest, at $0.11 per kwh, transmission costs are approximately $1.01 per acre-foot per mile. The estimate of $584 per acre-foot is assumed to be the high end estimate.

Although crude, it is interesting to compare this O&M estimate with that made for the Lake Powell Pipeline. Prior to any credit for hydropower production, the transmission component was estimated to cost $198 per acre-foot, or approximately $1.42 per acre-foot per mile. In addition, it was estimated that hydropower sales could offset 48 percent of the transmission pumping cost. Another comparison is the estimated annual transmission cost for the Gallup-Navajo Pipeline. Excluding treatment costs, O&M was estimated to range from $216 to $270 per acre-foot, depending on whether the energy was provided by the CRSP or the Navajo Tribe's utility enterprise, amounting to approximately $0.92 to $1.16 per acre-foot per mile. Despite their tenuous nature, these comparisons tend to create an expectation of transmission O&M costs of about $1.00 to $1.50 per acre-foot per mile. Although these examples demonstrate that FGP O&M costs will likely be lower than the CWCB's estimate, there is little to indicate how much lower. As a result, the assumed values for the low end estimate and the most likely estimate are lower but not substantially lower than the CWCB estimate (Table 17).

Table 17. Operation and Maintenance Cost Assumptions Used in the Analysis (million)

	Low end estimate	Most likely value	High end estimate
Power and energy costs, inc. O&M on pumping facilities, $/acre-foot	$450	$500	$584
Potential hydropower offset of power and energy costs, % reduction in pumping costs	0%	20%	50%
USBR and CRSP costs, $ per acre-foot	$25	$50	$100

[23] Personal communication with Nicole Rowan, CDM, June 16, 2011. Note: a reasonable plug number but Nicole is checking with their cost estimator to get the precise figure.

The hydropower potential of the FGP is currently under study by the Project's proponents and little information about this effort is available.[24] As a result, estimates of how much sales of Project-produced hydropower could offset its power and energy costs would be speculative. As indicated above, the revenues from Lake Powell Pipeline hydropower sales are estimated to offset energy costs by nearly 50 percent (48 percent). Table 17 indicates that a 20 percent hydropower offset is estimated as its most likely level, with no hydropower and a 50 percent offset establishing its low and high bounds.

A cost receiving relatively little attention to date has been the federal government's potential charge for use of their facilities, primarily Flaming Gorge Reservoir, and whether there will be any loss-of-power charges resulting from potentially less water going though its power plant and power plants downstream. Flaming Gorge is part of the Colorado River Storage Project (CRSP) administered by the Bureau of Reclamation. They carefully coordinate Upper Basin reservoir operations and associated hydropower production. For this analysis, this coordination is beneficial because policies and prices already exist for obtaining water service through CRSP facilities.

Figure 6 is a Reclamation-supplied graph of CRSP charges for municipal water service. As can be seen, the rates depend on the date contracted, with more recent years having the highest rates. The rates are calculated to recover CRSP capital costs and O&M. Conceptually, this is equivalent to recovering the lost hydropower production with the energy valued at the cost of service.[25]

Estimating the value of foregone hydropower production is a relatively complex process involving capacity, energy production, season, and how the CRSP coordinates power distribution with the Western Area Power Administration. This process has been modeled by Argonne National Laboratories and Reclamation would likely use their model to develop precise estimates of the value of foregone hydropower. In a previous study of severe and sustained drought in the Colorado River Basin, Booker (1992) estimated the marginal value of hydropower production at major facilities in the Colorado River Basin.[26] He estimated a baseline value of approximately $21 per acre-foot at Flaming Gorge Reservoir and a combined sum of approximately $60 per acre-foot for main stem facilities between Flaming Gorge and Davis Dam. These two figures may not be completely additive because intervening facilities, primarily Glen Canyon Dam, have their own operating criteria. Regardless, if Booker's $21 per acre-foot estimate is

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[24] However, the proponents appear to be in the process of re-defining the Project to have a primarily hydropower purpose with a secondary purpose of M&I water supply. Their rationale is to change the lead federal permitting agency (Corps of Engineers to FERC) and hopefully accelerate the permitting process. If this indeed occurs, hydropower will become a focus of the Project. The Lake Powell Pipeline is being developed as a hydropower project with FERC as the lead federal permitting agency.

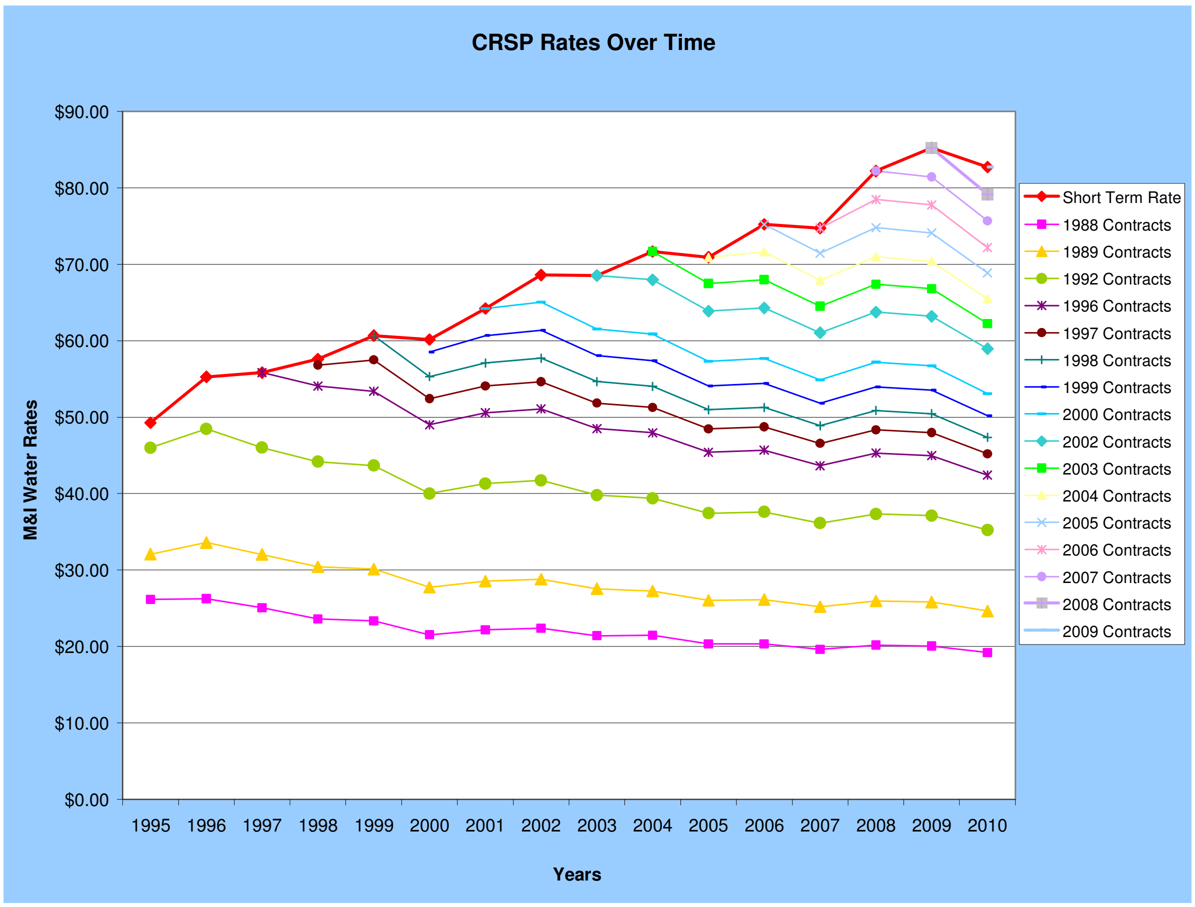
[25] Personal communication with Michael Loring, Bureau of Reclamation, Upper Colorado Region, Salt Lake City. July 26, 2011.

[26] Booker, James F. *Economic and Hydrologic Impacts of Drought Under Alternative Policy Responses*. Water Resources Bulletin. Vol. 31. No. 5. October, 1995.

indexed to 2011 using a general CPI, the marginal value is approximately $34 per acre-foot. If one sums similar impact at downstream facilities, the total impact would be approximately $81 in 1992 dollars or $130 per acre-foot in 2011 dollars.

It should also be noted that Reclamation would likely address rates for potential large volume users on an individual, case-by-case basis. For this analysis, the most likely CRSP-related charge is assumed to be $50 per acre-foot, which is the approximately visual mid-point of the rates shown in Figure 6. The low and high bounds are assumed to be $25 and $100 per acre-foot, respectively (Table 17).

Figure 6. Colorado River Storage Project (CRSP) municipal water service rates



Financing Costs

The cost of private financing for the Project will depend on its credit worthiness, or risk, which in turn will depend on the strength of its financial balance sheet and income statement. It is also assumed there are two components of the private funding: the Project development component and the Project construction component. The development component is associated with a high degree of risk. One needs to look no further than Aaron Million to appreciate this. He has spent nearly $5 million on the RWSP, by his own estimate, with no assurance of success in obtaining permits or attracting buyers. There is a probability that much of this investment will be lost, so it is balanced by a high rate of return. For this analysis, it was assumed that the initial investors will receive a 20 percent rate of return on their capital, compounded annually, until the project receives a Record of Decision and is "shovel ready".[27]

The second component of private financing would be for its actual construction after the necessary permits were either obtained or were assured to be obtainable. Though there would still be financial risks to investors, the risks would be lower and likely comparable to those facing investors in private utilities. In addition, investors would likely hedge by requiring long-term service contracts from water users, backed by the user charge revenue streams or their taxing authority. In light of this, Table 18 summarizes assumed long-term financing terms for the private Project. The most likely private bond scenario assumes a 10 percent rate of return over 20 years, which is a rate consistent but possibly slightly higher than that allowed regulated private utilities. In this case, the slightly higher rate is considered appropriate to recognize marginally greater risk. The low end recognizes the potential for better terms in the event a large capital fund may have incentives to either diversify their investments or manage their tax liability in manner that results in lower-cost funds for the Project. The high end assumes that demand is slow developing and investors are wary of its viability.

Table 18. Financing costs assumed for privately-held debt and public issued debt

	Low end estimate	Most likely value	High end estimate
Private bonds, interest rate and term (years)	7% over 20 years	10% over 20 years	15% over 20 years
Public bonds, interest rate and term (years)	4% over 40 years	6% over 40 years	6% over 20 years

From a public perspective, Colorado Springs Utilities, recently issued $180 million in Build America Bonds for funding a portion of Southern Delivery System construction, paying a 5.51 percent rate interest over 40 years. The federal government will reimburse 35 percent of the interest cost, resulting in an effective interest rate of 3.62 percent. Build America Bonds were targeted towards a soft municipal bond market as a method of stimulating investment in public infrastructure. Colorado Springs may still have to finance $500 million or more in additional construction costs before completion of SDS. The total estimated cost of SDS is approximately $800 million to $1.0 billion, although recent bids indicate it may be constructed for less than $800 million.

The Prairie Waters Project, estimated to cost nearly $700 million when completed, was financed with cash (approx. $43 million), a subsidized CWCB loan of approximately $75

[27] This rate of return is admittedly speculative. However, it is sufficiently high to allow initial investors to "double their money" if the Project is permitted.

million, with the balance being financed through revenue bonds backed by water enterprise revenues.

Due to loss of severance tax revenues and other budget cuts, the CWCB is effectively out of the business of financing large water projects. In the near-term future, they do not anticipating making any additional loans of the magnitude made to Aurora.[28]

Despite the heavily financed efforts by two of the State's largest water providers, Colorado Springs and Aurora, financing construction costs of approximately $1.0 to $2.0 billion per year for 3 years is not typical for most Front Range water providers. Other than the State of Colorado, there is not a single entity that blankets the range of Front Range water agencies with the authority to issue bonds, let alone as much as $3 to $6 billion in bonds. South Metro Water Authority, for instance, cannot issue bonds, although its individual members can. Therefore, each public entity considering participating in the FGP would likely have to bring their own financing to the table. This is possible, but inefficient and relatively expensive with respect to issuance costs and market bargaining power. This analysis will move forward assuming that public funds could be raised, but appreciates that this level of public financing is highly uncertain and possibly not achievable without State of Colorado involvement.

It is also worth noting that revenue bonds issued by the Front Range municipalities would be backed by their water enterprise revenues, including water service revenues and impact fees. If desiring FGP supplies and after completing Master Plans identifying the FGP pipeline as a major source of new supply, the municipalities themselves would likely continue their "growth pays for growth" policies and adjust impact fees to finance their share of the Project. However, bond buyers would likely stipulate that customer rates be high enough to cover all debt service before impact fee revenues are considered. In a real sense, the current customer base would be responsible for bond repayment even if growth doesn't materialize as anticipated. This assertion is based on what actually occurred during the late 1980's and early 90's in several small water and sanitation districts in Denver's south suburban area. These small districts, including the defunct Arapahoe Water and Sanitation District, issued bonds based on impact fee revenues that did not materialize due to slow growth.[29] If not for fortuitous rapid growth during the mid and latter 90's, and early 2000's, ratepayers in these areas would have experienced large increases in monthly bills.

For analysis purposes, it is assumed that a public Project could obtain necessary financing at the terms shown in Table 18. Similar to the private scenario, the most likely interest rate may be slightly higher than expected for public debt, but appears reasonable considering the increased risk associated with such a large public works project, the many entities involved, and questionable start-up demand. The low end scenario implies that the Project may find subsidized financing, either through the federal or State government.

[28] Personal communication with Ana Mauss, CWCB, May 18, 2011.
[29] Arapahoe Water and Sanitation District was eventually taken over by the Arapahoe County Water and Wastewater Authority (ACWWA).

The high end scenario maintains the same interest rate as the most likely scenario, but shortens the repayment period in response to an assumption of increased risk.

Results of the Cash Flow Analysis

Results of the cash flow analysis are expressed in the cost per acre-foot users would have to pay to:

- Allow the Project to cash flow over the initial 10-years of operation, when there is the highest level of financial risk;

- Allow the Project to cash flow over its long-term operation.

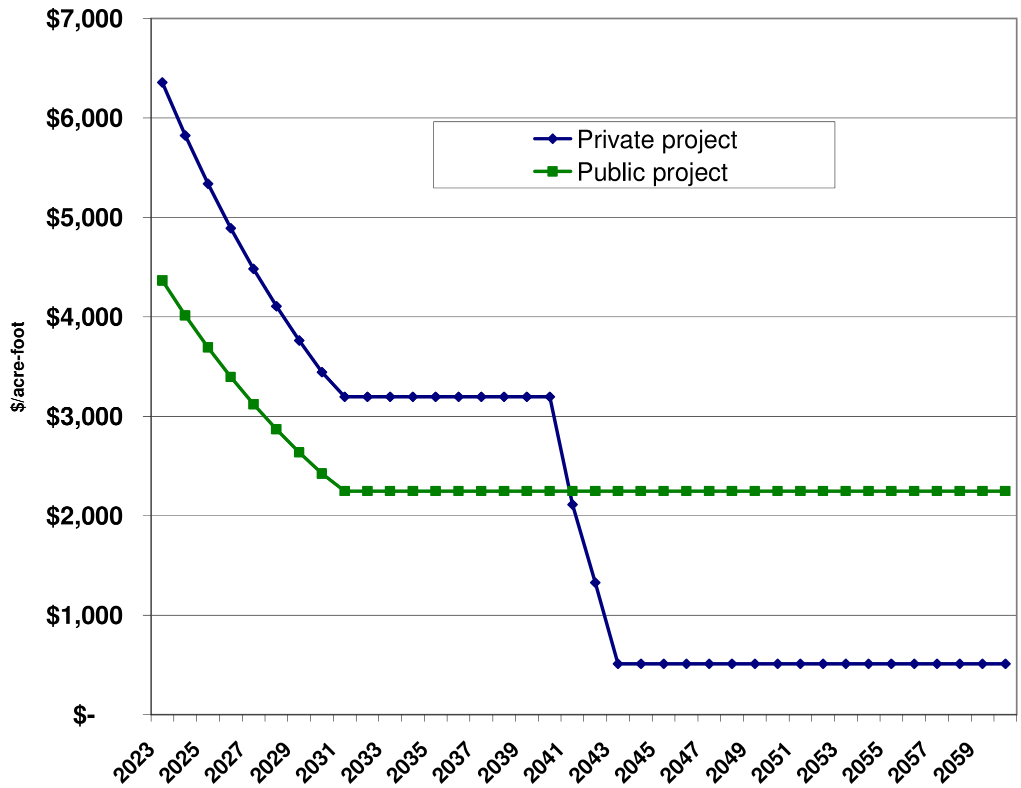
It is unlikely that a single cost per acre-foot would apply equally to all Project water users. Their cost would likely depend on the type of contract they have, firm supply versus interruptible supply for example, and their physical location in the system. However, these differences are unknown, resulting in the cost per acre-foot metric providing an adequate benchmark for the absolute and relative costs to potential users.

Figure 7 compares the cost per acre-foot necessary to achieve a positive Project cash flow, assuming the most likely values for uncertain variables. It shows that the private project is relatively more expensive in the near-term but less expensive in the long-term, with the opposite results for the public project. This difference in primarily due to assumed financing terms – private financing is expected to have higher interest rates and shorter term lengths than public financing, plus the initial investors need to be reimbursed. As a result of the shorter term lengths, the private project retires its debt earlier, resulting in the precipitous drop in costs for the private project.

However, with the private project, there is little reason to believe that actual user costs will drop proportionately. The price charged by the private project would not be regulated by cost-of-service principles and would likely be fixed (with escalators) through long-term contracts, limited only by the willingness-to-pay of potential users.

On absolute terms and by either ownership scenario, the Project's cost per acre-foot appears high compared to supply options being considered by most Front Range municipalities (Table 25 in the Conclusions section). This difference decreases over time, but it still appears to be an order of magnitude higher than what providers are currently considering.

Figure 7. Cost per acre-foot necessary to achieve a positive cash flow, based on the most likely values of uncertain variables (2011 dollars).



Private Project (Million Project)

Over its initial 10 years of operation, the average cost of Project water under a private ownership scenario is shown in Table 19. At the 50th percentile, meaning that ½ of the observations are below this level and ½ are above this level, the average cost is about $4,700 per acre-foot. There is a less than 10 percent probability that the cost will be less then $3,500 per acre-foot, and a 20 percent probability it will be greater than $5,700 per acre-foot.

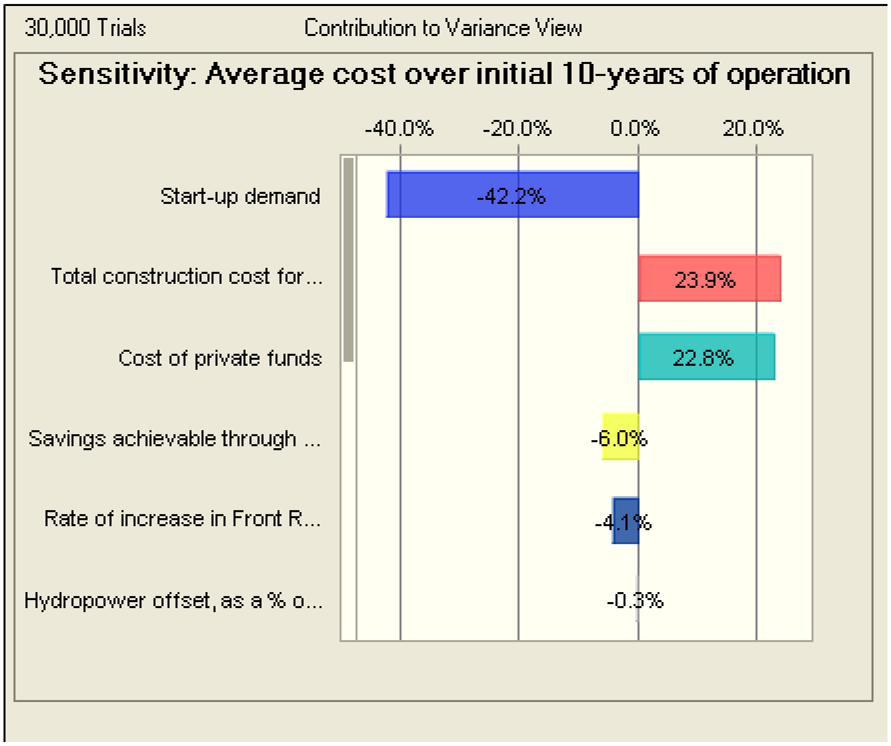
Table 19. Percentiles of average project cost over its initial 10 years of operation, private project $/acre-foot (2011 dollars).

Percentile	Forecast values
0%	$2,260
10%	$3,524
20%	$3,862
30%	$4,144
40%	$4,406
50%	$4,672
60%	$4,968
70%	$5,307
80%	$5,739
90%	$6,439
100%	$11,379

Driving the variability around this 50th percentile value is the uncertainty of start-up demand, which accounts for about 42 percent of the variability (Figure 8), and the variability around estimated construction cost and the cost of financing, combining to account for most of the remaining variability. The variability assumed for the rate of increase in Front Range demand for FGP water is also significant, accounting for about 4 percent of the variability.

It is interesting to note that the variability surrounding the remaining uncertain variables, including the hydropower offset, Colorado River water availability, and ELA costs, account for less than 1 percent of the total variability surrounding the cost estimate. This does not imply they are not important variables in determining the total cost, but it does imply that spending a lot of time defining their variability does not improve the certainty of the overall cost estimate.

Figure 8. Contribution to variance for average project cost over its initial 10 years of operation, private project

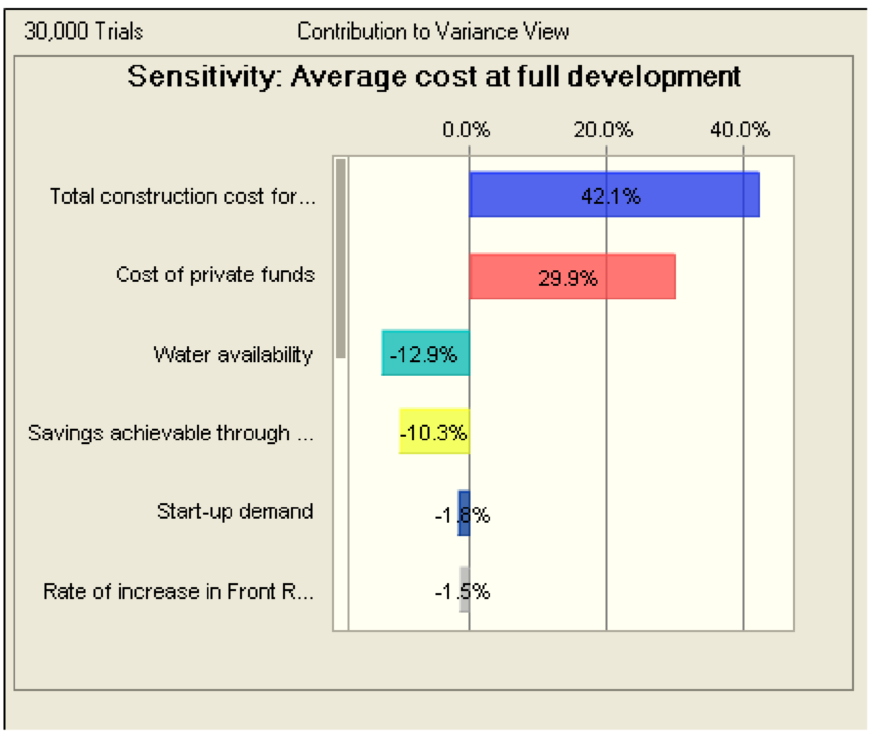


Considering longer-term operations, the private Project's 50th percentile cost drops approximately 25 percent, to about $3,400 per acre-foot (Table 20). There appears to be a 10 percent probability of the actual value being less than $2,700 per acre-foot, and a 20 percent probability that it may be greater than $3,900 per acre-foot. With respect to variability, start-up demand is less of a factor, with variability of construction cost, financing costs, and water availability accounting for the majority of the variability around the cost estimate.

Table 20. Percentiles of average project cost over its long-term operation, private project, $/acre-foot (2011 dollars).

Percentile	Forecast values
0%	$1,862
10%	$2,682
20%	$2,893
30%	$3,058
40%	$3,212
50%	$3,360
60%	$3,513
70%	$3,693
80%	$3,909
90%	$4,220
100%	$6,773

Figure 9. Contribution to variance for average project cost over its long-term operation, private project.



Public Project

Over its initial 10 years of operation, the average cost of Project water under a public ownership scenario is shown in Table 21. At the 50th percentile, the average cost is about $2,800. There is a less than 10 percent probability that the cost will be less then $2,200 per acre-foot, and a 20 percent probability it will be greater than $3,420 per acre-foot.

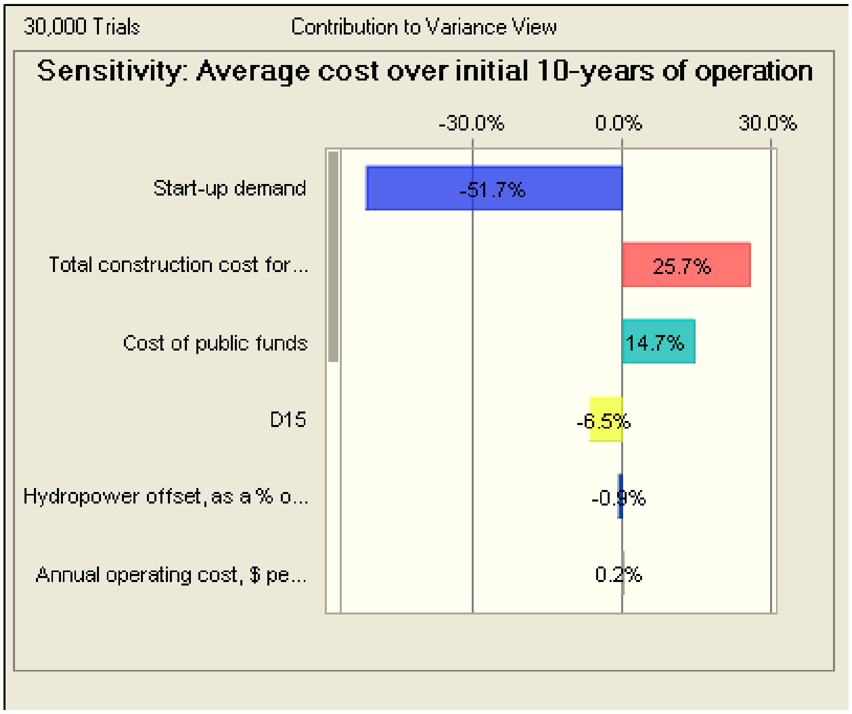
Table 21. Percentiles of average project cost over its initial 10 years of operation, public project $/acre-foot (2011 dollars).

Percentile	Forecast values
0%	$1,478
10%	$2,217
20%	$2,403
30%	$2,553
40%	$2,696
50%	$2,837
60%	$2,994
70%	$3,184
80%	$3,418
90%	$3,799
100%	$7,322

Driving the variability around this 50^{th} percentile value is the uncertainty of start-up demand, which accounts for about 52 percent of the variability (Figure 10), and the variability around estimated construction cost and the cost of financing, combining to account for most of the remaining variability. The variability assumed for the rate of increase in Front Range demand for FGP water is also significant, accounting for about 7 percent of the variability.

Similar to the private project scenario, it is interesting to note that the variability surrounding the remaining uncertain variables, including the hydropower offset, Colorado River water availability, and ELA costs, account for less than 1 percent of the total variability surrounding the cost estimate.

Figure 10. Analysis of variance for average project cost over its initial 10 years of operation, public project.



Considering longer-term operations, the public Project's 50th percentile cost drops to about $2,200 per acre-foot (Table 22). There appears to be a 10 percent probability or less of the actual value being less than $1,820 per acre-foot, and a 20 percent probability that it may be greater than $2,485 per acre-foot. With respect to variability, the public Project shares the same characteristics as its private version: start-up demand is less of a factor, with variability of construction cost, financing costs, and water availability accounting for the majority of the variability around the cost estimate.

Table 22. Percentiles of average project cost over its long-term operation, public project, $/acre-foot (2011 dollars).

Percentile	Forecast values
0%	$1,266
10%	$1,823
20%	$1,938
30%	$2,030
40%	$2,112
50%	$2,194
60%	$2,275
70%	$2,369
80%	$2,485
90%	$2,645
100%	$4,473

Impacts of Additional Water Supply Uncertainties

The previous results assume a constant volume of water is available from year-to-year over the period of analysis. The volume itself is uncertain – it may be as low as 165,000 acre-feet or as high as 250,000 acre-feet, but it does not vary over time from its initial level. In a sense, it means that water planners "guessed right" about the Project's firm yield at the beginning of the process and correctly incorporated outside factors such as long-term climate change impacts and the Project's priority in times of regional water shortage.

The following scenarios stretch this assumption by explicitly considering a lowering of the Project's priority in times of shortages and the potential incremental impacts of climate change, both of which would reduce expected Project yield and increase its variability.

Priority Calls

An area of concern among Colorado River water users in Colorado is whether the FGP water supply will come under the umbrella of Colorado water law and have an associated priority date. If so, what would that date be and how frequent would priority-based curtailments be for FGP pipeline users? These are truly million dollar questions beyond the scope of this analysis. However, by imposing periodic water shortages to the cash flow analysis, one can observe the simple financial impact of reduced supplies and the associated frequency of shortages.

- For analysis purposes, two water shortage scenarios were assumed: randomly placed shortages with a frequency of 1 year in every 10 and with a frequency of 1 year in every 5.
- The level of shortage was assumed to have a triangular statistical distribution with a most likely value of 50 percent. That is, 1 year in ten, the FGP water supply would be reduced 50 percent. This value was bounded on the low end by 20 percent and on the high end by 100 percent.

The impacts of these two scenarios are shown in Table 23 and discussed below.

Climate Change

Although the level of impact is debatable, it appears that global warming will have some measurable impact on future water supplies in the Colorado River basin. Based on anecdotal discussions, many water resource planners acknowledge this risk but do not yet explicitly incorporate it into future plans. This may be due to a number of factors, including relatively short planning horizons and wide variability, and perceived low reliability, of estimates of potential impacts. This analysis proceeds under the assumption that global warming, or climate change, will reduce available yield of the Upper Colorado system, but its impact will likely be relatively small over the next 50 to 60 years. However, there needs to be some allowance for the small possibility that its impact may be greater than anticipated.

In response to the likelihood that climate change impacts will be relatively small with very remote possibility the impacts will be high, a highly-skewed probability distribution is assumed. From a technical standpoint, a beta distribution is assumed that resembles Figure 11. As shown, the level of water supply reduction due to climate change is assumed to be 0.0 percent per year, with an assumed maximum level of reduction of 3 percent per year. However, the 3 percent level occurs so infrequently that it is not perceptible in the figure. Overall, most possible values are clustered at levels far less than ½ of one percent per year. The alpha and beta parameters in Figure 11 mathematically help describe the distribution's compactness around the minimum of 0.0 percent.

Figure 11. Assumed shape of beta distribution used to represent the impact of climate change.

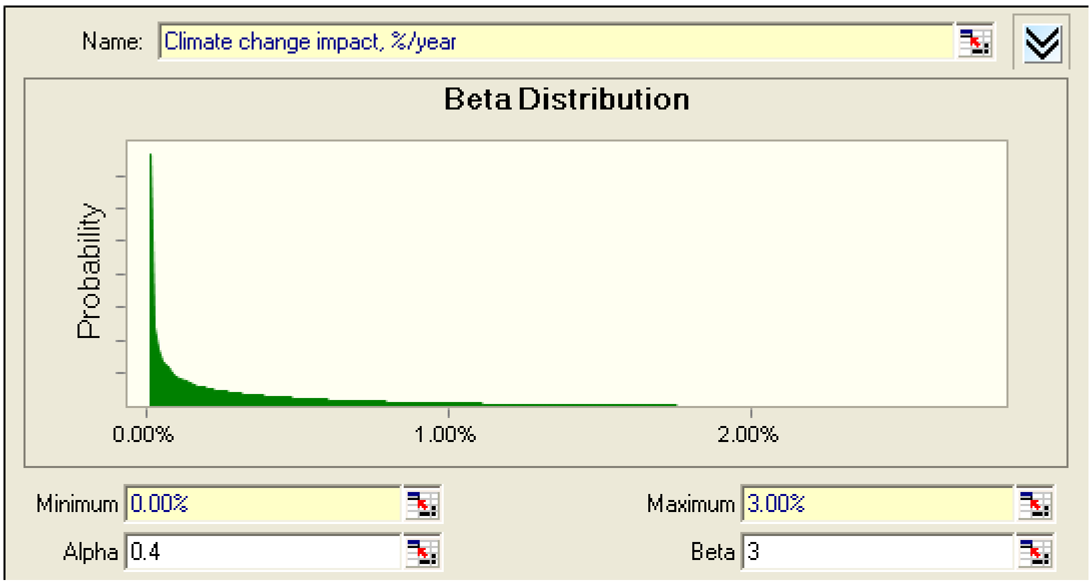
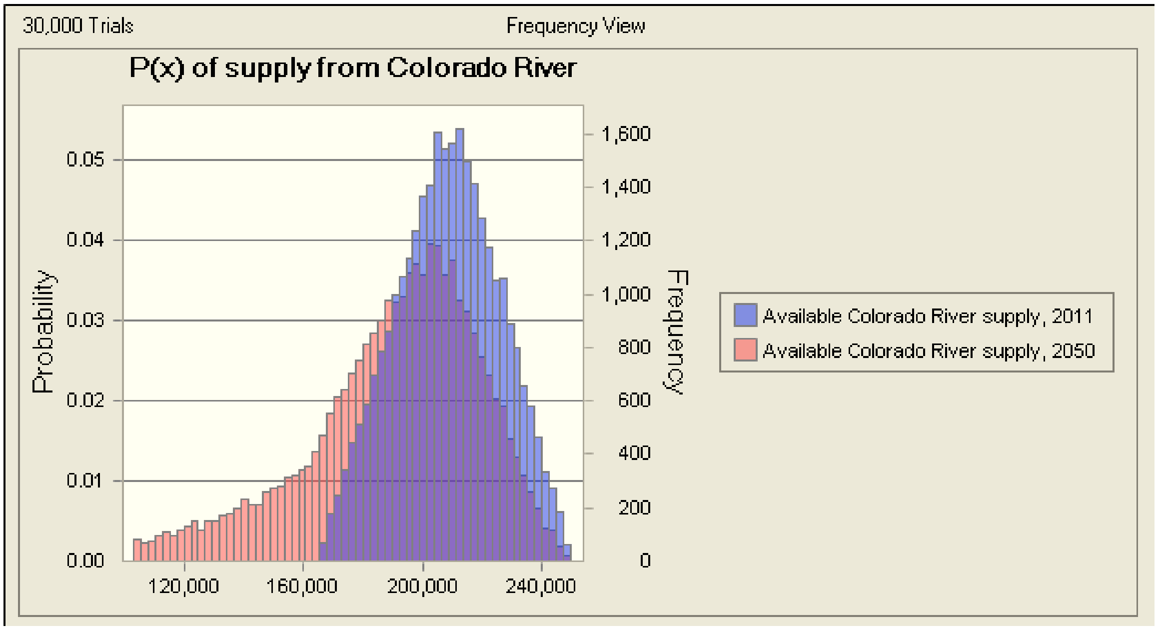


Figure 12 is a frequency diagram comparing the available water supply in 2011 with available supply in 2050, assuming the above climate change assumptions were in effect during the period 2011-50. As can be seen, the average year supply is reduced incrementally, but there is an increased probability that actual available yield will be considerably less than the average.

It should be noted that climate change's estimated impact is highly dependent on these plausible, yet arbitrary assumptions. As a result, these estimates are not included in the financial baseline analysis.

Figure 12. Frequency distributions of available Colorado River water supply, years 2011 and 2050, assuming climate change (acre-feet on the horizontal axis)



Impact of Priority Calls and Climate Change

Table 23 summarizes the cash flow analysis under alternative water supply assumptions. For purposes of illustration, only a public version of the FGP at full development was considered.

- If priority calls occur in 1 of every 10 years, average cost per acre-foot increases approximately 10 percent to $2,450. Consistent with the 1-in-10 assumption, there were about 4 priority calls over the 40-year analysis period, with the average shortage estimated to be 104,000 acre-feet.

- Increasing the frequency of shortages to 1-in-5 increases the per acre-foot cost to $2,700 with 7 to 8 periods of shortages averaging 104,000 acre-feet.

Although the potential impact of priority calls to individual Pipeline users could likely be partially mitigated with storage and other measures, they would likely come at cost.

Table 23 also shows the impact of the climate change assumptions and its combined impact with potential priority calls.

Climate change results in shortages in about 80 percent of the years considered in the analysis period, but the shortages are relatively minor, averaging 10,500 acre-feet but increasing over time. The resulting cost per acre-foot increases by about 7 percent, from $2,200 to $2,350.

Imposition of priority calls with climate change – both plausible occurrences with respect to this analysis, result in about the same frequency of shortages as with climate change in isolation, but with increases in volume. These examples illustrate that their combined impact could increase break-even Project cost by nearly 1/3 (32 percent), from $2,200 per acre-foot to $2,900 per acre-foot.

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Table 23. Comparative impacts of baseline financial scenario with alternative water supply assumptions, for a public project at full development

	Cost per acre-foot at full development	Number of years with shortage, 2020-2060	Average shortage volume (acre-feet)
Baseline financial scenario	$2,200	0	0
Priority calls occur in 1 of every 10 years	$2,450	4	104,000
Priority calls occur in 1 of every 5 years	$2,700	7	104,000
Climate change reduces available yield, no priority calls	$2,350	32	10,500
Climate change reduces available yield, priority calls 1 in every 10 years	$2,620	32	24,800
Climate change reduces available yield, priority calls 1 in every 5 years	$2,900	33	37,500

Conclusions

Flaming Gorge Recreation and Regional Economy

Summary of Impacts

The following economic impacts were estimated using: (1) evaluation procedures and background data developed by the Bureau of Reclamation for the Flaming Gorge EIS; (2) a with-and-without Project hydrological analysis that estimated the impact to Reservoir elevations and downstream river flows over the period 2010-2060.

- Based on NED evaluation procedures, the FGP reduces the value of recreation at Flaming Gorge Reservoir by an estimated annual equivalent value of $7.6 million. This assumes a "real" inflation-free discount rate of 3 percent, a reasonable rate considering inflation was assumed to be zero in the analysis (for comparison purposes). The long-term reservoir level is estimated to be reduced by approximately 10 feet, with increasing probabilities that, in any given year, the drop will probably be greater than this. As a result of this increasing down-side uncertainty, in the more distant years of the analysis annual impacts will likely be greater than $7.6 million. The Monte Carlo analysis estimated a 50 percent probability that year 2060 impacts could approach $15 million for that single year.

- Also using NED procedures and a 3 percent discount rate, impacts to recreation along the Green River below the reservoir are estimated to have an annual equivalent value of approximately $3.1 million. This estimate was somewhat higher than the 50th percentile estimate generated for year 2060 in the Monte Carlo analysis ($2.2 million).

- These reductions in recreation visitation have corresponding impacts to regional spending by those visiting Flaming Gorge Reservoir or the Green River. On an annual equivalent basis, regional expenditures are reduced by approximately $39 million. Although this figure comprises a small proportion of the regional economy, less than one percent, it makes-up approximately 10 percent to 18 percent of the retail and service industries in the region, depending on the economic multiplier one assumes.

Conclusions

Based on the analysis summarized above, the FGP would have a significant adverse impact to the value of recreation at Flaming Gorge Reservoir and along the Green River, in the FGNRA. These impacts would have corresponding adverse impacts to regional businesses depending on these visitors' expenditures.

A mitigating measure, at least with respect to Flaming Gorge Reservoir, would be to modify the recreation facilities to accommodate lower water levels, such as extending boat ramps. This would preserve visitation and regional expenditures, but still result in a diminished recreation experience and lower overall recreation values.

Front Range Water Supply

Summary

Table 24 summarizes the estimated cost of FGP supply under private and public ownership-operation scenarios for the initial 10 years of operation and for the long-term.

Table 24. Comparison of Estimated Project Costs, 50th percentile values, $/acre-foot (2011 dollars)

	Initial 10 years of operation, 2023-32	Long-term operation, 2033-2060
Private project	$4,670	$3,360
Public project	$2,840	$2,200

- Of the long-term estimates, slightly less than $500 per acre-foot accounts for annual operating and maintenance costs, with the remainder accounting for capital costs and associated financing.

- During the initial 10 years of operation, the Project's start-up demands have the most influence on the variability of the cost per acre-foot cost estimates. The variability around the construction costs and the financing terms are also highly significant but much less than initial demand.

- As demand develops over the long-term, average cost per acre-foot is reduced. Variability around construction cost, financing costs, and water availability (rather than demand) become the driving influences on the overall variability of the cost estimates.

- The possible influences of climate change and potential priority calls on water supplies could increase long-term cost by about one-third, on a dollars per acre-foot basis.

Conclusions

Under the most probable assumptions, the FGP appears to be a relatively expensive water supply alternative compared to other sources either recently developed or in the development process. With a probable cost ranging from $2,200 per acre-foot to $4,700 per acre-foot, depending on ownership and time frame considered, it is significantly more expensive than the cost of new supplies currently considered by Front Range water suppliers and users (Table 25).

As expected, the cost of Project water is strongly influenced by the capital cost of the project, its O&M cost, and the degree hydropower can offset O&M costs. However, in terms of driving the variability of the cost to potential users, start-up demand has by far the most influence.

The FGP would need to be nearly fully subscribed at start-up to approach competitiveness with the other sources of supply considered. This occurring by a start-up year in the late 2010's or early 2020's, as anticipated by it proponents, appears unlikely. Even at their 2050 build-out, the entities most supporting a FGP pipeline could not use its full planned capacity. As a result, a greater number of entities would have to be included and the Project would need postponing for some period of time.

Table 25
Range of new water supply costs for Front Range providers

Provider/project	Est. capital cost[30]	Est. annual operation and maintenance cost	Annual cost, capital plus O&M[31]	Firm yield (AF/year)	Average yield (AF/year)	Cost, $/AF/year	Discussion
Colorado Springs Utilities, Southern Delivery System	$880 mil.	$19 mil.	$77.5 mil.	42,400	52,000	$1,800 for firm yield; $1,490 for avg. yield	Cost at full development, includes treatment
Pikes Peak Regional Water Authority; various water supply alternatives						$1,600 to $5,400	Includes treatment[32]
Aurora Water, Prairie Waters Project	$650 mil.	$1,120/AF	$54.4 mil.	10,000 at start-up	10,000 AF at start-up, increasing to approx. 50,000 AF at full development	$5,440 at start-up, declining to approx. $2,000 at full development	Includes treatment
South Metro Water Supply Authority						$460 to $1,200 for intermediate term alternatives; $1,200 to $1,900 for long-term alternatives	Includes treatment; updated from South Metro's 2007 Water Supply Plan
Denver Water, Moffat System Expansion	$140 mil.	$0.30 mil.	$9.3 mil.	18,000	18,000	$530	High quality raw water, O&M not included in cost
Northern Colorado Water Conservancy District, Windy Gap Firming Project	$273 mil.	$0.80 mil.	$18.9 mil.	30,000	30,000	$630	High quality raw water, O&M not included in cost
Northern Colorado Water Conservancy District, Northern Integrated Supply Project	$490 mil.	$2.45 mil. + $40 per AF for pumping	$36.6 mil.	40,000	40,000	$915	High quality raw water
Northern Colorado Water Conservancy District, purchase of Colorado-Big Thompson units	$8,500 per unit	$25 per AF unit municipal fee	$560 per unit	.60 AF per unit	.70 AF per unit	$840 to $980 depending on firm or average yield	High quality raw water

[30] Each project may incur additional, unforeseen costs such as treatment plant upgrades and other mitigation, some of which may be substantial. These costs are not included in the calculations.
[31] For comparison purposes, capital costs for all entities are amortized over 40 years at 6% interest. However, it is recognized that several of the projects have already obtained public financing, or partial financing, at better terms.
[32] Avoided Water Supply Costs for PPRWA (draft) memorandum from George Oamek of Honey Creek Resources to Peter Nichols, dated November 3, 2009.

Table 25
Range of new water supply costs for Front Range providers

Proposed Flaming Gorge Pipeline	Est. to range between 3.0 billion and 6.1 billion	Assumed to range between $450 mil. and $600 mil. per year, partially offset by hydropower		Scenarios examined a range varying between 165,000 and 250,000 AF per year	$4,700 start-up, $3,300 long term for a private project; $2,800 start-up, $2,200 long-term for a public project	High quality raw water; Estimates shown at their 50th percentiles;

Appendix A
Supporting Data for the Flaming Gorge Recreation Analysis

Table A-1. Unit day values corresponding to Flaming Gorge Reservoir Water Elevations (updated from Flaming Gorge Operations EIS)

Elevations	Unit day values			
	Power boating; water skiing	Boat fishing	Boat camping	Swimming; water play
5990	$ -	$ -	$ -	$ -
5991	$ -	$ -	$ -	$ -
5992	$ -	$ -	$ -	$ -
5993	$ -	$ -	$ -	$ -
5994	$ -	$ -	$ -	$ -
5995	$ -	$ -	$ -	$ -
5996	$ -	$ -	$ -	$ -
5997	$ -	$ -	$ -	$ -
5998	$ -	$ -	$ -	$ -
5999	$ -	$ -	$ -	$ -
6000	$ -	$ -	$ -	$ -
6001	$ -	$ -	$ -	$ -
6002	$ -	$ -	$ -	$ -
6003	$ -	$ -	$ -	$ -
6004	$ -	$ -	$ -	$ -
6005	$ -	$ -	$ -	$ -
6006	$ -	$ -	$ -	$ -
6007	$ -	$ -	$ -	$ -
6008	$ -	$ -	$ -	$ -
6009	$ -	$ -	$ -	$ -
6010	$ -	$ -	$ -	$ -
6011	$ -	$ -	$ -	$ -
6012	$ -	$ -	$ -	$ -
6013	$ -	$ -	$ -	$ -
6014	$ -	$ -	$ -	$ -
6015	$ -	$ -	$ -	$ -
6016	$ -	$ -	$ -	$ -
6017	$ -	$ -	$ -	$ -
6018	$ 6.50	$ 6.25	$ 3.25	$ 0.38
6019	$ 13.00	$ 12.50	$ 6.50	$ 0.75
6020	$ 19.50	$ 18.75	$ 9.75	$ 1.13
6021	$ 26.00	$ 25.00	$ 13.00	$ 1.50
6022	$ 28.50	$ 26.63	$ 14.13	$ 2.38
6023	$ 31.00	$ 28.25	$ 15.25	$ 3.25
6024	$ 33.50	$ 29.88	$ 16.38	$ 4.13
6025	$ 36.00	$ 31.50	$ 17.50	$ 5.00
6026	$ 38.50	$ 33.13	$ 18.63	$ 6.38
6027	$ 41.00	$ 34.75	$ 19.75	$ 7.75
6028	$ 43.50	$ 36.38	$ 20.88	$ 9.13
6029	$ 46.00	$ 38.00	$ 22.00	$ 10.50
6030	$ 42.00	$ 35.40	$ 20.20	$ 8.70
6031	$ 38.00	$ 32.80	$ 18.40	$ 6.90
6032	$ 34.00	$ 30.20	$ 16.60	$ 5.10
6033	$ 30.00	$ 27.60	$ 14.80	$ 3.30
6034	$ 26.00	$ 25.00	$ 13.00	$ 1.50
6035	$ 17.42	$ 16.75	$ 8.71	$ 1.01
6036	$ 8.58	$ 8.25	$ 4.29	$ 0.50
6037	$ -	$ -	$ -	$ -
6038	$ -	$ -	$ -	$ -
6039	$ -	$ -	$ -	$ -
6040	$ -	$ -	$ -	$ -

Table A-2. Flaming Gorge Recreation Facilities, Minimum Boat Ramp Elevations, and Annual Visitation

	Minimum boat ramp elevation (feet)	Annual visitation estimate
Antelope Flat		
Power boating; water skiing	6,015	5,001
Boat fishing	6,015	3,999
Boat camping	6,015	-
Swimming; water play	6,015	6,469
Anvil Draw		
Power boating; water skiing	6,015	1,200
Boat fishing	6,015	1,600
Boat camping	6,015	-
Swimming; water play	6,015	-
Buckboard Crossing		
Power boating; water skiing	6,010	60,000
Boat fishing	6,010	30,000
Boat camping	6,010	-
Swimming; water play	6,010	-
Cedar Springs		
Power boating; water skiing	6,018	60,000
Boat fishing	6,018	30,000
Boat camping	6,018	-
Swimming; water play	6,018	-
Firehole		
Power boating; water skiing	6,019	2,608
Boat fishing	6,019	2,000
Boat camping	6,019	-
Swimming; water play	6,019	3,429
Hideout		
Power boating; water skiing	6,014	8,800
Boat fishing	6,014	5,000
Boat camping	6,014	9,300
Swimming; water play	6,014	1,000
Jarvies Canyon		
Power boating; water skiing	6,012	450
Boat fishing	6,012	300
Boat camping	6,012	525
Swimming; water play	6,012	50
Kingfisher Island		
Power boating; water skiing	6,010	270
Boat fishing	6,010	200
Boat camping	6,010	350
Swimming; water play	6,010	-
Lucerne Valley		
Power boating; water skiing	6,005	101,600
Boat fishing	6,005	95,000
Boat camping	6,005	-
Swimming; water play	6,005	5,337
Mustang Ridge		
Power boating; water skiing	6,000	7,000
Boat fishing	6,000	4,000
Boat camping	6,000	-
Swimming; water play	6,000	-
Sheep Creek		
Power boating; water skiing	6,015	12,000
Boat fishing	6,015	9,000
Boat camping	6,015	-
Swimming; water play	6,015	-
Squaw Hollow		
Power boating; water skiing	6,015	100
Boat fishing	6,015	100
Boat camping	6,015	-
Swimming; water play	6,015	-
Sunny Cove		
Power boating; water skiing	6,016	-
Boat fishing	6,016	-
Boat camping	6,016	-
Swimming; water play	6,016	5,000
Upper Marsh Creek		
Power boating; water skiing	6,000	50
Boat fishing	6,000	50
Boat camping	6,000	
Swimming; water play	6,000	

Table A-3. Flaming Gorge Reservoir, visitation and elevation look-up table.

Elevations	Expenditures per day				Total visitation				Economic value			
	Power boating; water skiing	Boat fishing	Boat camping	Swimming; water play	Power boating; water skiing	Boat fishing	Boat camping	Swimming ; water play	Power boating; water skiing	Boat fishing	Boat camping	Swimming; water play
5990	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
5991	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
5992	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
5993	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
5994	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
5995	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
5996	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
5997	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
5998	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
5999	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
6000	$ -	$ -	$ -	$ -	-	-	-	-	-	-	-	-
6001	$ -	$ -	$ -	$ -	7,050	4,050	-	-	-	-	-	-
6002	$ -	$ -	$ -	$ -	7,050	4,050	-	-	-	-	-	-
6003	$ -	$ -	$ -	$ -	7,050	4,050	-	-	-	-	-	-
6004	$ -	$ -	$ -	$ -	7,050	4,050	-	-	-	-	-	-
6005	$ -	$ -	$ -	$ -	7,050	4,050	-	-	-	-	-	-
6006	$ -	$ -	$ -	$ -	108,650	99,050	-	5,337	-	-	-	-
6007	$ -	$ -	$ -	$ -	108,650	99,050	-	5,337	-	-	-	-
6008	$ -	$ -	$ -	$ -	108,650	99,050	-	5,337	-	-	-	-
6009	$ -	$ -	$ -	$ -	108,650	99,050	-	5,337	-	-	-	-
6010	$ -	$ -	$ -	$ -	108,650	99,050	-	5,337	-	-	-	-
6011	$ -	$ -	$ -	$ -	168,920	129,250	350	5,337	-	-	-	-
6012	$ -	$ -	$ -	$ -	168,920	129,250	350	5,337	-	-	-	-
6013	$ -	$ -	$ -	$ -	169,370	129,550	875	5,387	-	-	-	-
6014	$ -	$ -	$ -	$ -	169,370	129,550	875	5,387	-	-	-	-
6015	$ -	$ -	$ -	$ -	178,170	134,550	10,175	6,387	-	-	-	-
6016	$ -	$ -	$ -	$ -	196,471	149,249	10,175	12,856	-	-	-	-
6017	$ -	$ -	$ -	$ -	196,471	149,249	10,175	17,856	-	-	-	-
6018	$ 39.50	$ 26.00	$ 34.50	$ 13.75	196,471	149,249	10,175	17,856	7,760,605	3,880,474	351,038	245,520
6019	$ 79.00	$ 52.00	$ 69.00	$ 27.50	256,471	179,249	10,175	17,856	20,261,209	9,320,948	702,075	491,040
6020	$ 118.50	$ 78.00	$ 103.50	$ 41.25	259,079	181,249	10,175	21,285	30,700,862	14,137,422	1,053,113	878,006
6021	$ 158.00	$ 104.00	$ 138.00	$ 55.00	259,079	181,249	10,175	21,285	40,934,482	18,849,896	1,404,150	1,170,675
6022	$ 173.50	$ 109.75	$ 141.25	$ 56.25	259,079	181,249	10,175	21,285	44,950,207	19,892,078	1,437,219	1,197,281
6023	$ 189.00	$ 115.50	$ 144.50	$ 57.50	259,079	181,249	10,175	21,285	48,965,931	20,934,260	1,470,288	1,223,888
6024	$ 204.50	$ 121.25	$ 147.75	$ 58.75	259,079	181,249	10,175	21,285	52,981,656	21,976,441	1,503,356	1,250,494
6025	$ 220.00	$ 127.00	$ 151.00	$ 60.00	259,079	181,249	10,175	21,285	56,997,380	23,018,623	1,536,425	1,277,100
6026	$ 235.50	$ 132.75	$ 154.25	$ 61.25	259,079	181,249	10,175	21,285	61,013,105	24,060,805	1,569,494	1,303,706
6027	$ 251.00	$ 138.50	$ 157.50	$ 62.50	259,079	181,249	10,175	21,285	65,028,829	25,102,987	1,602,563	1,330,313
6028	$ 266.50	$ 144.25	$ 160.75	$ 63.75	259,079	181,249	10,175	21,285	69,044,554	26,145,168	1,635,631	1,356,919
6029	$ 282.00	$ 150.00	$ 164.00	$ 65.00	259,079	181,249	10,175	21,285	73,060,278	27,187,350	1,668,700	1,383,525
6030	$ 257.20	$ 140.80	$ 158.80	$ 63.00	259,079	181,249	10,175	21,285	66,635,119	25,519,859	1,615,790	1,340,955
6031	$ 232.40	$ 131.60	$ 153.60	$ 61.00	259,079	181,249	10,175	21,285	60,209,960	23,852,368	1,562,880	1,298,385
6032	$ 207.60	$ 122.40	$ 148.40	$ 59.00	259,079	181,249	10,175	21,285	53,784,800	22,184,878	1,509,970	1,255,815
6033	$ 182.80	$ 113.20	$ 143.20	$ 57.00	259,079	181,249	10,175	21,285	47,359,641	20,517,387	1,457,060	1,213,245
6034	$ 158.00	$ 104.00	$ 138.00	$ 55.00	259,079	181,249	10,175	21,285	40,934,482	18,849,896	1,404,150	1,170,675
6035	$ 105.86	$ 69.68	$ 92.46	$ 36.85	259,079	181,249	10,175	21,285	27,426,103	12,629,430	940,781	784,352
6036	$ 52.14	$ 34.32	$ 45.54	$ 18.15	259,079	181,249	10,175	21,285	13,508,379	6,220,466	463,370	386,323
6037	$ -	$ -	$ -	$ -	259,079	181,249	10,175	21,285	-	-	-	-
6038	$ -	$ -	$ -	$ -	259,079	181,249	10,175	21,285	-	-	-	-
6039	$ -	$ -	$ -	$ -	259,079	181,249	10,175	21,285	-	-	-	-
6040	$ -	$ -	$ -	$ -	259,079	181,249	10,175	21,285	-	-	-	-

Table A-4. Flaming Gorge Reservoir End-of-July elevations and variability, No Action and with a FGP

End of July Flaming Gorge Pool Elevation					
	No Action Alternative	Assumed standard deviation	With Flaming Gorge Pipeline	Low range	High range
2010	6,029	10	6,029	*6,020*	*6,037*
2011	6,029	10	6,029	*6,019*	*6,037*
2012	6,029	10	6,028	*6,019*	*6,037*
2013	6,029	10	6,028	*6,018*	*6,037*
2014	6,029	10	6,028	*6,018*	*6,037*
2015	6,029	10	6,028	*6,017*	*6,037*
2016	6,029	10	6,028	*6,016*	*6,036*
2017	6,029	10	6,027	*6,016*	*6,036*
2018	6,029	10	6,027	*6,015*	*6,036*
2019	6,029	10	6,027	*6,015*	*6,036*
2020	6,029	10	6,027	*6,014*	*6,036*
2021	6,029	10	6,027	*6,013*	*6,036*
2022	6,029	10	6,027	*6,013*	*6,036*
2023	6,029	10	6,026	*6,012*	*6,036*
2024	6,029	10	6,026	*6,012*	*6,036*
2025	6,029	10	6,026	*6,011*	*6,035*
2026	6,029	10	6,026	*6,010*	*6,035*
2027	6,029	10	6,026	*6,010*	*6,035*
2028	6,029	10	6,025	*6,009*	*6,035*
2029	6,029	10	6,025	*6,009*	*6,035*
2030	6,029	10	6,025	*6,008*	*6,035*
2031	6,029	10	6,025	*6,007*	*6,035*
2032	6,029	10	6,025	*6,007*	*6,035*
2033	6,029	10	6,025	*6,006*	*6,035*
2034	6,029	10	6,024	*6,006*	*6,035*
2035	6,029	10	6,024	*6,005*	*6,034*
2036	6,029	10	6,024	*6,004*	*6,034*
2037	6,029	10	6,024	*6,004*	*6,034*
2038	6,029	10	6,024	*6,003*	*6,034*
2039	6,029	10	6,023	*6,003*	*6,034*
2040	6,029	10	6,023	*6,002*	*6,034*
2041	6,029	10	6,023	*6,001*	*6,034*
2042	6,029	10	6,023	*6,001*	*6,034*
2043	6,029	10	6,023	*6,000*	*6,034*
2044	6,029	10	6,023	*6,000*	*6,034*
2045	6,029	10	6,022	*5,999*	*6,033*
2046	6,029	10	6,022	*5,998*	*6,033*
2047	6,029	10	6,022	*5,998*	*6,033*
2048	6,029	10	6,022	*5,997*	*6,033*
2049	6,029	10	6,022	*5,997*	*6,033*
2050	6,029	10	6,021	*5,996*	*6,033*
2051	6,029	10	6,021	*5,995*	*6,033*
2052	6,029	10	6,021	*5,995*	*6,033*
2053	6,029	10	6,021	*5,994*	*6,033*
2054	6,029	10	6,021	*5,994*	*6,033*
2055	6,029	10	6,021	*5,993*	*6,032*
2056	6,029	10	6,020	*5,992*	*6,032*
2057	6,029	10	6,020	*5,992*	*6,032*
2058	6,029	10	6,020	*5,991*	*6,032*
2059	6,029	10	6,020	*5,991*	*6,032*
2060	6,030	10	6,020	*5,990*	*6,032*

Table A-5. Economic benefits associated with various flow levels by recreation type

	Unit day values					Visitation											
flow in 100 cfs	Scenic floating	Guide boat fishing	Private boat fishing	Shoreline fishing; trail use	Camping	Scenic floating	Guide boat fishing	Private boat fishing	Shoreline fishing; trail use	Camping	Scenic floating	Guide boat fishing	Private boat fishing	Shoreline fishing; trail use	Camping	Flow in cfs	Total economic benefit
7	$ -	$ -	$ -	$ -	$ -	-	-	-	-	-	$ -	$ -	$ -	$ -	$ -	700	$ -
8	$ -	$ -	$ -	$ -	$ -	-	-	-	-	-	$ -	$ -	$ -	$ -	$ -	800	$ -
9	$ -	$ -	$ -	$ 5	$ 4	-	-	-	7,096	760	$ -	$ -	$ -	$ 32,643	$ 2,788	900	$ 35,431
10	$ -	$ 37	$ 7	$ 9	$ 7	-	2,280	3,706	14,193	1,521	$ -	$ 83,448	$ 27,426	$ 130,574	$ 11,152	1,000	$ 252,599
11	$ 47	$ 73	$ 15	$ 14	$ 11	24,768	4,560	7,412	21,289	2,281	$ 1,164,096	$ 333,792	$ 109,704	$ 293,791	$ 25,091	1,100	$ 1,926,473
12	$ 51	$ 110	$ 22	$ 18	$ 11	25,314	6,840	11,119	28,386	2,306	$ 1,297,899	$ 751,032	$ 246,833	$ 522,295	$ 26,132	1,200	$ 2,844,191
13	$ 56	$ 146	$ 30	$ 23	$ 12	25,859	9,120	14,825	35,482	2,331	$ 1,436,365	$ 1,335,168	$ 438,814	$ 816,086	$ 27,190	1,300	$ 4,053,623
14	$ 60	$ 183	$ 37	$ 27	$ 12	26,405	11,400	18,531	40,594	2,355	$ 1,579,494	$ 2,086,200	$ 685,647	$ 1,082,516	$ 28,264	1,400	$ 5,462,120
15	$ 64	$ 197	$ 45	$ 30	$ 12	26,951	13,680	22,237	45,707	2,380	$ 1,727,285	$ 2,698,380	$ 1,006,233	$ 1,386,436	$ 29,355	1,500	$ 6,847,689
16	$ 68	$ 212	$ 54	$ 34	$ 13	27,496	14,230	23,007	50,819	2,405	$ 1,879,739	$ 3,009,539	$ 1,230,872	$ 1,727,846	$ 30,462	1,600	$ 7,878,458
17	$ 73	$ 226	$ 62	$ 33	$ 13	28,042	14,779	23,777	49,115	2,430	$ 2,036,856	$ 3,336,359	$ 1,468,211	$ 1,609,877	$ 31,586	1,700	$ 8,482,889
18	$ 77	$ 240	$ 70	$ 32	$ 13	28,587	13,598	21,610	47,411	2,454	$ 2,198,635	$ 3,263,520	$ 1,512,700	$ 1,496,073	$ 32,726	1,800	$ 8,503,654
19	$ 81	$ 234	$ 66	$ 30	$ 14	29,133	13,378	21,268	45,707	2,479	$ 2,365,077	$ 3,134,512	$ 1,410,770	$ 1,386,436	$ 33,883	1,900	$ 8,330,678
20	$ 85	$ 229	$ 63	$ 29	$ 14	29,679	13,158	20,926	44,003	2,504	$ 2,536,182	$ 3,008,010	$ 1,311,349	$ 1,280,963	$ 35,056	2,000	$ 8,171,560
21	$ 90	$ 223	$ 59	$ 28	$ 14	30,224	12,939	20,584	42,298	2,485	$ 2,711,950	$ 2,884,014	$ 1,214,436	$ 1,179,657	$ 34,174	2,100	$ 8,024,231
22	$ 94	$ 217	$ 55	$ 27	$ 14	30,770	12,719	20,242	40,594	2,467	$ 2,892,380	$ 2,762,523	$ 1,120,033	$ 1,082,516	$ 33,302	2,200	$ 7,890,754
23	$ 91	$ 212	$ 52	$ 25	$ 13	30,370	12,499	19,899	38,890	2,448	$ 2,759,609	$ 2,643,539	$ 1,028,138	$ 989,540	$ 32,439	2,300	$ 7,453,264
24	$ 88	$ 206	$ 48	$ 24	$ 13	29,970	12,279	19,557	37,186	2,430	$ 2,629,345	$ 2,527,059	$ 938,752	$ 900,730	$ 31,586	2,400	$ 7,027,472
25	$ 85	$ 200	$ 44	$ 23	$ 13	29,570	12,059	19,215	35,482	2,411	$ 2,501,588	$ 2,413,086	$ 851,875	$ 816,086	$ 30,741	2,500	$ 6,613,376
26	$ 81	$ 194	$ 41	$ 21	$ 13	29,169	11,840	18,873	32,525	2,393	$ 2,376,339	$ 2,301,618	$ 767,507	$ 685,739	$ 29,906	2,600	$ 6,161,109
27	$ 78	$ 189	$ 37	$ 19	$ 12	28,769	11,400	18,531	29,568	2,374	$ 2,253,598	$ 2,151,180	$ 685,647	$ 566,726	$ 29,080	2,700	$ 5,686,232
28	$ 75	$ 183	$ 33	$ 17	$ 12	28,369	11,400	16,678	26,612	2,355	$ 2,133,364	$ 2,086,200	$ 555,374	$ 459,048	$ 28,264	2,800	$ 5,262,250
29	$ 72	$ 163	$ 30	$ 15	$ 12	27,969	10,133	14,825	23,655	2,337	$ 2,015,637	$ 1,648,356	$ 438,814	$ 362,705	$ 27,457	2,900	$ 4,492,969
30	$ 69	$ 142	$ 26	$ 13	$ 12	27,569	8,867	12,972	20,698	2,318	$ 1,900,418	$ 1,262,022	$ 335,967	$ 277,696	$ 26,659	3,000	$ 3,802,763
31	$ 66	$ 122	$ 22	$ 12	$ 11	27,169	7,600	11,119	17,741	2,300	$ 1,787,707	$ 927,200	$ 246,833	$ 204,022	$ 25,870	3,100	$ 3,191,632
32	$ 63	$ 102	$ 19	$ 10	$ 11	26,769	6,333	9,266	14,784	2,281	$ 1,677,503	$ 643,889	$ 171,412	$ 141,682	$ 25,091	3,200	$ 2,659,576
33	$ 60	$ 81	$ 15	$ 8	$ 7	26,369	5,067	7,412	11,827	1,521	$ 1,569,807	$ 412,089	$ 109,704	$ 90,676	$ 11,152	3,300	$ 2,193,427
34	$ 56	$ 61	$ 11	$ 6	$ 4	25,968	3,800	5,559	8,871	760	$ 1,464,618	$ 231,800	$ 61,708	$ 51,005	$ 2,788	3,400	$ 1,811,919
35	$ 53	$ 41	$ 7	$ 4	$ -	25,568	2,533	3,706	5,914	-	$ 1,361,936	$ 103,022	$ 27,426	$ 22,669	$ -	3,500	$ 1,515,053
36	$ 50	$ 20	$ 4	$ 2		25,168	1,267	1,853	2,957		$ 1,261,762	$ 25,756	$ 6,856	$ 5,667	$ -	3,600	$ 1,300,042
37	$ 47	$ -	$ -	$ -		24,768	-	-	-		$ 1,164,096	$ -	$ -	$ -	$ -	3,700	$ 1,164,096
38	$ -	$ -	$ -			-	-	-	-		$ -	$ -	$ -	$ -	$ -	3,800	$ -
39	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	3,900	$ -
40	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,000	$ -
41	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,100	$ -
42	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,200	$ -
43	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,300	$ -
44	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,400	$ -
45	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,500	$ -
46	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,600	$ -
47	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,700	$ -
48	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,800	$ -
49	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	4,900	$ -
50	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,000	$ -
51	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,100	$ -
52	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,200	$ -
53	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,300	$ -
54	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,400	$ -
55	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,500	$ -
56	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,600	$ -
57	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,700	$ -
58	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,800	$ -
59	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	5,900	$ -
60	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,000	$ -
61	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,100	$ -
62	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,200	$ -
63	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,300	$ -
64	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,400	$ -
65	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,500	$ -
66	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,600	$ -
67	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,700	$ -
68	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,800	$ -
69	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	6,900	$ -
70	$ -	$ -	$ -	$ -	-	-	-	-	-		$ -	$ -	$ -	$ -	$ -	7,000	$ -

Table A-6. Calculation of economic impacts of flow reductions.

	March				April				May				June			
Proportion of visits	0.037				0.12				0.115				0.174			
		Low	Most likely	High		Low	Most likely	High		Low	Most likely	High		Low	Most likely	High
Baseline 2059 flow	808	800	808	2,077	808	800	808	2,077	1,619	1,612	1,619	2,644	3,218	1,055	3,218	7,398
Flow with Flaming Gorge Pipeline 2059	801	800	801	1,424	801	800	801	1,424	1,613	1,612	1,613	2,076	2,833	1,055	2,833	7,398
Baseline 2059 economic benefit	$ -				$ -				$ 906,023				$ 462,766			
Benefit with FGP	$ -				$ -				$ 906,023				$ 915,632			

	July				August				September				October				
Proportion of visits	0.249				0.184				0.102				0.022				
		Low	Most likely	High		Low	Most likely	High		Low	Most likely	High		Low	Most likely	High	
Baseline 2059 flow	1,607	800	1,607	3,104	1,500	800	1,500	2,602	1,510	800	1,510	2,603	1,512	800	1,512	2,602	
Flow with Flaming Gorge Pipeline 2059	929	800	929	2,453	801	800	801	2,120	810	800	810	2,134	811	800	811	2,132	
Baseline 2059 economic benefit	$ 1,961,736				$ 1,259,975				$ 698,464				$ 150,649				$ 5,439,613
Benefit with FGP	$ 8,822				$ -				$ -				$ -				$ 1,830,477
														Net impact to Green River recreation, year 20(			$ 3,609,136 2003 dollars
																	$ 4.41 million 2011 dollars