Draft Green River Pipeline Cost Analysis

In 2020, the Utah Legislature instructed the Utah Division of Water Resources to update the estimated project costs associated with a 2002 Draft Green River Pipeline Cost Analysis and the 2003 addendum (Utah Code 73-10-35). The study analyzed the potential cost of importing 60,000 acre-feet of water from the Green River of the Colorado River Basin and delivering the water to the Bear River and Weber basins. Since then, inflation, facilities, and material costs have increased dramatically, making this project less likely today than when it was originally considered. The list below outlines the key takeaways from the updated report.

- Updated project costs, depending on alignment, range from an estimated $732 million to $1.455 billion.
- Unit cost for delivered raw (untreated) water range from $615 per acre-foot delivered to the Bear River to $1,455 per acre-foot delivered to the Weber/Provo canal diversion.
- The routes investigated range in length from 69.4 miles to 142.0 miles.
- Points of diversion would originate at Fontenelle or Flaming Gorge reservoirs.
- Delivery destinations include the Bear River below the town of Randolph, Echo and Rockport reservoirs on the Weber River, and the Weber/Provo diversion canal.

Costs in this study compare with those of the most recent Lake Powell Pipeline study (comparable length of 140 miles), which is also an estimate with a cost range of +/- 25%. As with the Lake Powell Pipeline, the cost of environmental studies and mitigation have not been included in this report.

Although this report updates the costs contained in the original "Draft Green River Pipeline Cost Analysis," the Utah Division of Water Resources recognizes that is a coarse estimate and a more detailed analysis including field visits, updated material costs, and design details would be necessary to more accurately represent the actual cost. The division did not finalize the original draft due to a host of potential challenges and obstacles.

Some of the difficulties associated with the project include:

- Importing water into the Bear River would require a possible revision of the Bear River Compact and would require approval from Utah, Idaho and Wyoming, and Congress.
- Diverting water in Wyoming for use in Utah would require obtaining water rights from the State of Wyoming. Potential alignments are located in Wyoming and would require approval.
- While Utah's current depletions from the Colorado River are well below the state's allocation under the Colorado River Compact, all future uses are currently in place and accounted for.

These uses include:

  - Lake Powell Pipeline Development Project
  - Tribal water settlements
  - Modest increases to existing exports and in-basin uses
- Any proposed project that aims to export water beyond what has been outlined by Utah's State Engineer would come under heavy scrutiny from the Colorado River Basin States and their stakeholders (including Utah's).
- Currently, there is no water right associated with a potential Green River development project.
- Acquiring a water right to divert would be a challenge and creates significant water rights priority issues.
- Several endangered fish species inhabit the aquatic environment downstream of the project.

Cost Comparison of Proposed State Projects

One request the Division received for this update was for a cost comparison of the different state projects currently being investigated. The table below lists the total costs and annualized unit costs for the lowest and highest cost proposal for each project. These cost comparisons are somewhat cursory due to the differing levels of detail included in each of the cost studies. It should also be noted that any of the Green River Project proposals that deliver water into the Bear River (such as the lowest cost Green River option shown below) would incur the additional costs of the Bear River Project in order to deliver water to the Wasatch Front. If the same water were to be used for environmental needs in the Great Salt Lake, it would not.

Cost Comparison of Bear River, Green River and Lake Powell Proposals

Proposed Project	Low Total Project Cost	High Total Project Cost	Annualized Low Unit Cost Ac-ft	Annualized High Unit Cost Ac-ft
Bear River†`	$1.5 Billion	$2.8 Billion	$314	$582
Green River*	$732 Million	$1.499 Billion	$615	$1,455
Lake Powell*	$1.184 Billion	$1.924 Billion	$647	$1,051

† The Bear River Development used a 50-year repayment with a 4.0% rate.

* The annualized acre-feet for Lake Powell and Green River Pipeline projects were calculated with a 50 year repayment period at a 3.90% rate.

Draft

Green River Pipeline

Cost Analysis Update

Utah Division of Water Resources

February, 2021
(Subject to Revision)

Table of Contents

Executive Summary

In 2020, the Utah Legislature instructed the Utah Division of Water Resources to update the estimated project costs associated with a draft investigation study from 2002 called the Draft Green River Pipeline Cost Analysis and the 2003 addendum. The Study analyzed the potential cost of importing 60,000 acre-feet of water from the Green River of the Colorado River Basin delivering water to the Bear River or Weber River basins. Since then, inflation, facilities, and material costs have increased dramatically. The list below outlines the key takeaways from this report:

- Updated project costs, depending on alignment, range from an estimated $732 million to $1.455 billion.
- Unit cost for delivered raw (untreated) water range from $615 per acre-foot delivered to the Bear River, to $1,455 per acre-foot delivered to the Weber/Provo canal diversion. Additional costs would be incurred to deliver finished water to potential customers.
- The routes investigated range in length from 69.4 miles to 142.0 miles.
- Points of diversion would originate at Fontenelle or Flaming Gorge reservoirs, in the state of Wyoming.
- Delivery destinations in Utah include the Bear River below the town of Randolph, Echo and Rockport reservoirs on the Weber River, and the Weber/Provo diversion canal.
- Costs in this study compare with those of the most recent Lake Powell Pipeline study (comparable length of 140 miles) which is also an estimate with a cost range of +/- 25%. As with the Lake Powell Pipeline, the costs of environmental studies and mitigation have not been included in this report.

Disclaimer: Although this report updates the costs contained in the original "Draft Green River Pipeline Cost Analysis," the Utah Division of Water Resources makes no claim as to the feasibility of such a project. The division did not finalize the original draft due to a host of potential challenges and obstacles. The feasibility of such a project is even less likely today than it was then. Some of the difficulties associated with the project include:

- Utah's Colorado River allocations are already planned for. While Utah's current depletions are well below the allocation under the Colorado River Compact, all future uses from the Colorado River are currently in place and accounted for. These uses include:
    - Lake Powell Pipeline Development Project
    - Tribal water settlements
    - Modest increases to existing exports and in-basin uses.
- Any proposed project that aims to export water beyond what has been outlined by Utah's water agencies would come under heavy scrutiny from the Colorado River Basin States and their stakeholders (including Utah's).
- Importing water into the Bear River would require a possible revision of the Bear River Compact, which would need approval from the states of Utah, Idaho and Wyoming, and Congress.
- Currently, there is no water right associated with a potential Green River development project.
- Diverting water in the state of Wyoming for use in Utah would require water rights from the State of Wyoming.
- Potential alignments are located in the State of Wyoming and would require approval and permits from impacted jurisdictions.
- Acquiring a water right to divert would be a challenge and create significant water rights priority issues.
- Several endangered fish species inhabit the aquatic environment downstream of the project.

Section 1 – Introduction

In 2002, the Utah Division of Water Resources prepared a draft report that looked at the cost of various alternatives to import water from the Green River drainage, a major tributary to the Colorado River, for use along the Wasatch Front. In particular, the draft investigated the feasibility of importing water from either Fontenelle Reservoir in western Wyoming or Flaming Gorge Reservoir, near the Utah Wyoming border, into the Bear River or Weber River drainage.[1] In 2003, the division issued a draft addendum adding additional alignments to the report that would deliver water to a point on the Weber River above the Weber/Provo diversion.[2]

Due to the many challenges and obstacles a project of this nature would have to overcome and the lack of an immediate need, the division never pursued the project beyond the initial draft cost estimates.

In 2020, a new law went into effect directing the division to update the costs contained in the 2002 draft and subsequent addendum. This report satisfies the requirements of the law.

Disclaimer: Although this report updates the costs contained in the original draft "Green River Pipeline" reports as directed by law, by issuing this update, the Utah Division of Water Resources makes no claim as to the feasibility of such a project. As noted above, the division did not finalize the original cost estimates due to a host of potential challenges and obstacles. The feasibility of such a project is even less likely today than it was then.

Pursuing a Green River development project is not currently in the State of Utah's plan for the Colorado River, nor is there any intention for it to be included. The legislature could direct the Division of Water Resources to explore the concept in more depth. While Utah's current depletions are well below the allocation under the Colorado River Compact, all future uses from the river are currently planned for. These uses include the Lake Powell Pipeline Development Project, tribal water settlements, and modest increases to existing exports and in-basin uses. Any proposed project that aims to export water beyond what has been routinely outlined by the State would come under heavy scrutiny from the Colorado River Basin States and their stakeholders.

Section 5 of this document articulates a few more difficulties associated with the project.

[1] Utah Division of Water Resources, *Draft Green River Pipeline: Cost Analysis*, Larry Anderson, Robert King, Todd Stonely, October 2002.
[2] Utah Division of Water Resources, *Draft Addendum to October 2002 Green River Pipeline: Cost Analysis*, October 2003.

Section 2 – Basic Design Parameters & Assumptions

For the sake of simplicity, the original cost analysis and the update presented in this report uses similar design parameters and assumptions as those found in a detailed study performed on another Utah project with similar characteristics, namely the Lake Powell Pipeline.[3] The Lake Powell Pipeline is a project located along the Utah/Arizona border that proposes to transport water from Lake Powell 140 miles overland to the St. George area.

Although useful for comparative purposes, this report should not be construed as comparable to the study prepared for the Lake Powell Pipeline. While significant resources have been spent to investigate the proposed alignments and alternatives of the Lake Powell Pipeline, no comparable investigations have been performed for the Green River Pipeline. Subsequently, this report should be viewed as a preliminary and draft analysis only.

Table 1 lists basic design parameters and unit costs used in the original 1995 Lake Powell Pipeline study and in this report. For the most part, the unit costs used and other assumptions made are very similar. Pipe costs and pumping plant costs however, have increased considerably since the 2003 study. Notable differences between this study and the 2003 study include the interest rate of 3.9% (instead of 4.13%) and the design life of 50 years (instead of 40 years). Also, the level of detail and field reconnaissance contained in each pipeline reach for this report is much rougher than that for the Lake Powell Pipeline. Costs for the longer alignment in this report (142 miles, 2 pump plants) are comparable, although slightly higher than those of the Lake Powell Pipeline (140 miles, 4 pump stations).

[3] Boyle Engineering Corp. & Alpha Engineering, Inc., *Lake Powell Pipeline Feasibility Study*, 1995. This study was conducted with help from and in cooperation with the Washington County Water Conservancy District and the Utah Division of Water Resources.

TABLE 1
Basic Design Parameters and Other Assumptions

Parameter	DRAFT 2002 Green River Pipeline Cost Analysis*	2020 (This Report)
Design Flow	60,000 acre-feet/yr.	60,000 acre-feet/yr.
Manning's Roughness coefficient	0.011	0.011
Base Pipe Costs: 51"	$3.20/lf/in	$21.50/lf/in#
Adverse Condition Costs:		
High Pressure	Accelerating cost formula for pressures above 150 psi	Modeled fit of formula used for Lake Powell Pipeline
Rock	$0.30 to 0.80/lf/in	$3.00 to 12.00/lf/in**
Ground Water	Not Encountered	$3.00 to 9.00/lf/in
Slope	1.00 to 1.22 multiplier	1.00 to 1.22 multiplier
Appurtenances	1.05 multiplier	1.05 to 1.07 multiplier†
Right-of-Way Acquisition	100' wide corridor at $500 to $2,000 per acre	100' wide corridor at $1,250 to $5,000 per acre^
Pumping Plant (85% efficient):	$7,750,000 to $11,800,000	$31,000,000 to $62,000,000‡
Hydropower Station (82% efficient)	$4,100,000	$5,800,000 to $7,100,000
Contingencies	15% design & administration 10% additional contingency	15% design & administration 10% addition contingency
Interest Rate	4.13%	3.90%§
Design Life	40 years	50 years§
Energy Costs	$0.030/kwh off-peak $0.045/kwh on-peak $0.035/kwh average	$0.035/kwh off-peak~ $0.225/kwh on-peak~ $0.090/kwh average

* Values used in the 1995 Lake Powell Pipeline Study indexed to 2002 construction prices using the ENR cost index.
# Pipe costs in this report use the Bureau of Reclamation's 2020 Q2 cost index which are more inclusive of associated piping costs, such as compaction and backfill materials etc.
** Lower costs per foot were used in the 2002 Green River Pipeline report because pipe reaches were not broken up into small segments, thus tending to overestimate the impacts of adverse conditions. The 2002 study costs were indexed to 2020.
† Multiplier of 1.07 used along I-80 corridor where greater costs are expected during construction.
^ Right of way estimates used for each segment (in the 2003 report the $500/acre reference was omitted, the $2000/acre was also only used in roadless areas).
‡ This report assumed slightly lower costs because pump lifts were lower in nearly every instance. Lower costs of these stations were indexed to 2020. Bureau of Reclamation 2020 Q2 cost index source.
§ Economic variables used by the Division of Water Resources during the summer of 2002 are currently equal in 2020.
~ Values used for generating plants are an average of the Green River Power plant and Fremont Power plant, for power sold back into the grid. Rocky Mountain Power 2020 peak and off-peak rates were used for power consumption.

Section 3 – Pipeline Alternatives

Pipeline Alignments

Four alignments were selected for this preliminary analysis (see Figure 1). Two of these alignments originate high on the Green River at Fontenelle Reservoir (elev. 6506), located approximately 35 miles northeast of Kemmerer, Wyoming. The other two alignments originate lower on the Green River at Flaming Gorge Reservoir (elev. 6040), located approximately six miles east of Manila, Utah.

Both alignments from Fontenelle Reservoir follow U.S. Highway 189 to a point about three miles east of Kemmerer, where they diverge and take a different course to their ultimate destinations on the Bear and Weber rivers. Alignment A goes through Kemmerer and continues in a westerly direction until it terminates at the Bear River, near Randolph, Utah. Alignment B turns south, crosses about 14 miles of rangeland, and eventually joins U.S. Highway 89, south of Kemmerer. Alignment B follows U.S. Highway 89 to Interstate 80, then parallels it west through Evanston to Echo Reservoir, and to its eventual terminus at Rockport Lake, near Wanship.

Alignments C and D originate from separate locations on Flaming Gorge Reservoir. Alignment C begins in Wyoming at a point about 15 miles north of Manila, Utah. This alignment crosses about 36 miles of rangeland before it joins Alignment D, near Mountain View, Wyoming. From this point alignment C continues west, joins Interstate 80, and parallels it west through Evanston to Echo Reservoir, and to their eventual terminus at Rockport Lake, near Wanship. Alignment D begins in Utah at a point approximately four miles east of Manila. This alignment crosses some rangeland until it reaches a local road near Manila. This road eventually joins state route 46 to Manila. At Manila, the alignment continues west along route 46, crosses into Wyoming where it becomes state route 414, and eventually joins alignment C near Mountain View. From there this alignment follows the same course as alignment C all the way to Rockport Lake.

Project Alternatives

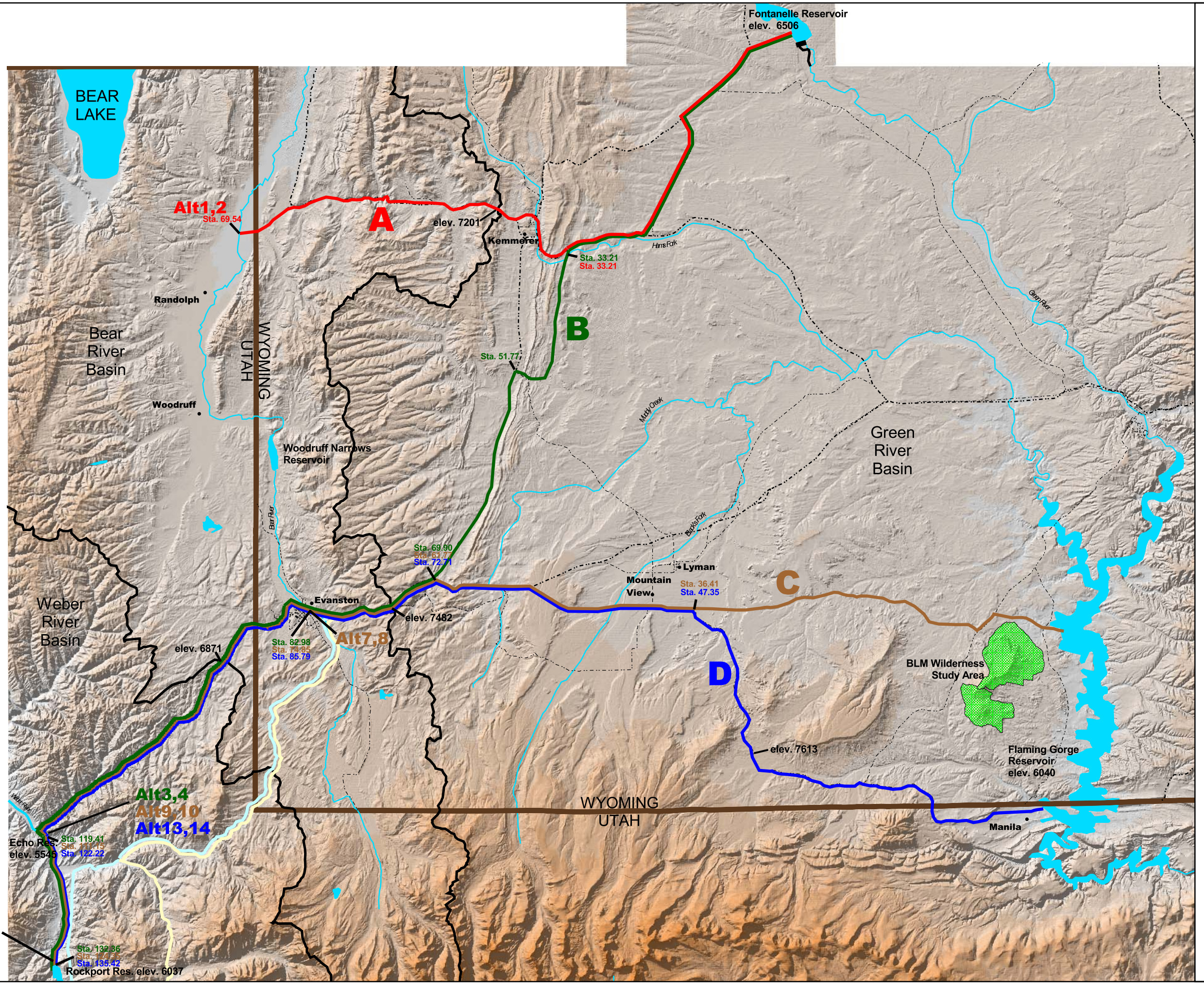
Two alternatives were analyzed for Alignment A, the only difference being that alternative 1 has one pump station while alternative 2 has two pump stations. Alignments B and D have four alternatives each: two that terminate lower on the Weber River at Echo Reservoir and two that terminate higher on the Weber River at Rockport Lake. Alignment C has six alternatives: two terminate at the Bear River near Evanston; two terminate at Echo Reservoir; and two terminate at Rockport Reservoir. Single pump station and dual pump station alternatives were analyzed for each pipe run (all odd numbered alternatives have a single pump station; even numbered alternatives have dual pump station.).

Table 2 summarizes the essential differences of the 16 alternatives.

Figure 1

Green River Pipeline

Alignments and Alternatives



Legend

- Alignment A
- Alignment B
- Alignment C
- Alignment D

5 0 5 10 Miles

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TABLE 2
Comparison of Alternatives

Alternatives	Destination				Number of Pump Stations	
	Bear River near Evanston	Weber River at Echo Reservoir	Weber River at Rockport Lake	Weber River Above Provo Div.	1	2
1,7	X				X	
2,8	X					X
3,9,13		X			X	
4,10,14		X				X
5,11,15			X		X	
6,12,16			X			X
17,18,19,20,21,22*				X		X
23*				X	X	

*Alternatives 17 – 23 follow the Chalk Creek drainage rather than Echo Canyon and are discussed at the end of chapter 4.

Alternatives 1 & 2 (Fontenelle Reservoir to the Bear River, below Woodruff Narrows Reservoir) have the shortest pipeline length, 69.4 miles. Alternatives 20 (Flaming Gorge Reservoir to the Weber River, above Provo Diversion) has the longest pipeline length, 142.0 miles. All other alternatives have pipelines that range in length from 74.9 to 132.9 miles, depending upon the point of origin and destination.

Section 4 – Cost Estimates

A detailed cost estimate was prepared for each of the 23 alternatives (see Appendix B). Table 3 summarizes the alternatives that terminate on the Bear River. Tables 4 and 5 summarize the alternatives that terminate on the Weber River at Echo Reservoir and Rockport Lake, respectively.

Bear River Alternatives

Table 3 summarizes the costs of the four Bear River alternatives analyzed.

TABLE 3
Cost Estimate Summary for Bear River Alternatives

Alternative	Total Project Cost	Total Annualized Cost	Yearly O&M Cost*	Unit Cost†
1	$737,902,000	$36,931,000	$3,168,000	$616
2	$734,141,000	$36,889,000	$3,298,000	$615
7	$779,828,000	$45,585,000	$9,903,000	$760
8	$732,291,000	$43,625,000	$10,118,000	$727

* Includes regular operation and maintenance costs and net energy purchase costs.
† Cost per acre-foot assumes full utilization of 60,000 acre-feet per year.

As shown, the unit cost of water at the point of discharge (under full use conditions) ranges from a low of $615 to a high of $760 per acre-foot. The $616 per acre-foot unit cost is for Alternative 1, which is the shortest pipeline of all the alternatives and has one pump station. The unit cost for Alternative 2, which is the same as Alternative 1 with two pump stations, is $615 per acre-foot.

While importing water into the Bear River Drainage is the cheapest of all the alternatives analyzed, it has its disadvantages. The largest disadvantage being that there is no existing infrastructure that would allow the water to be put to use along the Wasatch Front where it is most needed. The latest cost estimates for bringing Bear River water to the Wasatch Front are in the neighborhood of $315 to $582 per acre-foot (see table 8 at the end of section 4). In addition to this, importation of water into the Bear River would require a possible revision of the Bear River Compact, and would require not only Utah's approval, but that of Idaho and Wyoming and the Congress.

Weber River Alternatives

Six alternatives were studied that terminate on the Weber River at Echo Reservoir. Alternatives 3 & 4 follow Alignment B from Fontenelle Reservoir. Alternatives 9 & 10 follow Alignment C and Alternatives 13 & 14 follow Alignment D; all four of these alternatives originate from Flaming Gorge Reservoir. Table 4 summarizes the costs of these six alternatives.

TABLE 4
Cost Estimate Summary for Weber River at Echo Reservoir Alternatives

Alternative	Total Project Cost	Total Annualized Cost	Yearly O&M Cost*	Unit Cost†
3	$1,311,183,000	$62,249,000	$2,255,000	$1,037
4	$1,253,851,000	$59,785,000	$2,415,000	$996
9	$1,233,485,000	$61,262,000	$4,823,000	$1,021
10	$1,185,574,000	$59,282,000	$5,035,000	$988
13	$1,299,931,000	$65,060,000	$5,581,000	$1,084
14	$1,290,482,000	$64,868,000	$5,821,000	$1,081

* Includes regular operation and maintenance costs and net energy purchase costs.
† Cost per acre-foot assumes full utilization of 60,000 acre-feet per year.

As shown, the unit cost of water at the point of discharge (under full use conditions) ranges from a low of $988 to a high of $1,084 per acre-foot. The $988 per acre-foot unit cost is for Alternative 10. This alternative has two pump stations. The next lowest Weber River alternative is Alternative 4, with a unit cost at $996 per acre-foot. This alternative also contains two pump stations. The unit cost for Alternative 9, which is the same as Alternative 10 with only one pump station, is significantly more at $1,021 per acre-foot.

Six alternatives were also studied that terminate higher up on the Weber River at Rockport Lake. Alternatives 5 & 6 follow Alignment B from Fontenelle Reservoir. Alternatives 11 & 12 follow Alignment C from a location high up on Flaming Gorge Reservoir. Alternatives 15 & 16 follow Alignment D which originates from a location on Flaming Gorge Reservoir near Manila, Utah. Table 5 summarizes the costs of these six alternatives.

TABLE 5
Cost Estimate Summary for Weber River at Rockport Lake Alternatives

Alternative	Total Project Cost	Total Annualized Cost	Yearly O&M Cost*	Unit Cost†
5	$1,432,811,000	$71,401,000	$5,842,000	$1,190
6	$1,378,027,000	$69,052,000	$6,000,000	$1,151
11	$1,361,794,000	$70,728,000	$8,418,000	$1,179
12	$1,315,939,000	$68,855,000	$8,643,000	$1,148
15	$1,437,149,000	$74,947,000	$9,189,000	$1,249
16	$1,435,973,000	$75,133,000	$9,429,000	$1,252

* Includes regular operation and maintenance costs and net energy purchase costs.
† Cost per acre-foot assumes full utilization of 60,000 acre-feet per year.

As shown, the unit cost of water at the point of discharge (under full use conditions) ranges from a low of $1,148 to a high of $1,252 per acre-foot. These alternatives range from $160 to $168 per acre-foot more than those alternatives that terminate lower on the Weber River, at Echo Reservoir. The $1,148 per acre-foot unit cost is for Alternative 12, which follows Alignment C

and originates at Flaming Gorge. The unit cost for Alternative 11, which is the same as Alternative 12 with only one pump station, is significantly more at $1,179 per acre-foot.

The next lowest Weber River alternative is Alternative 6, with a unit cost at $1,151 per acre-foot. This alternative originates at Fontenelle Reservoir and also contains two pump stations.

Chalk Creek Drainage Alternatives

The original Green River Pipeline study investigated the delivery of Green River water to Echo Reservoir and/or Rockport reservoir via Echo Canyon. In 2003, however, the presence of the railroad alignment and Interstate 80 in Echo Canyon prompted the exploration for an alternative to this potentially problematic alignment. This section investigates the feasibility of routing the pipeline through the Chalk Creek Drainage instead of Echo Canyon.

The alignments investigated here followed the original C and D alignments to a point approximately 3 miles east of Evanston. From there the pipeline would run south into the Bear River watershed, cross the Bear River, ascend Bernard Hollow in a southwesterly direction, cross Coyote Creek and Sage Creek, then turn south and ascend the Yellow Creek drainage to a saddle point of elevation 7340. The Pipeline would then descend the Chalk Creek drainage of the Weber River watershed. See Figure 2.

Within the Chalk Creek drainage three alignments were considered. First, the pipeline could extend all the way down the Chalk Creek drainage and into Echo Reservoir. This option has been called Alignment E and includes two alternatives: Alternative 17 (following Alignment C and E) and Alternative 18 (following Alignment D and E). Secondly, it was discovered that if the pipeline were to turn south and extend up the South Fork of Chalk Creek, a three-mile tunnel could be employed to deliver water directly to the Weber River. This alignment would not only deliver water above Rockport Reservoir, but also above the Weber/Provo diversion canal. Thus, with relatively little additional cost, Green River water could be delivered to the entire Wasatch Front via the Provo River and/or the Weber River. This option has been called Alignment G and includes two alternatives: Alternative 21 (following Alignment C and G) and Alternative 22 (following Alignment D and G).

Finally, as an alternative to tunneling it may be possible to exit the Chalk Creek drainage and maintain a high elevation alignment above the Weber River and Rockport Reservoir, thus reaching the Weber/Provo diversion canal without a tunnel. This alignment was called Alignment F and includes two alternatives: Alternative 19 (following Alignments C and F) and Alternative 20 (following Alignments D and F). See Figure 2 for more detailed information on the location of Alternatives 17 through 22 and Alignments E, F, and G.

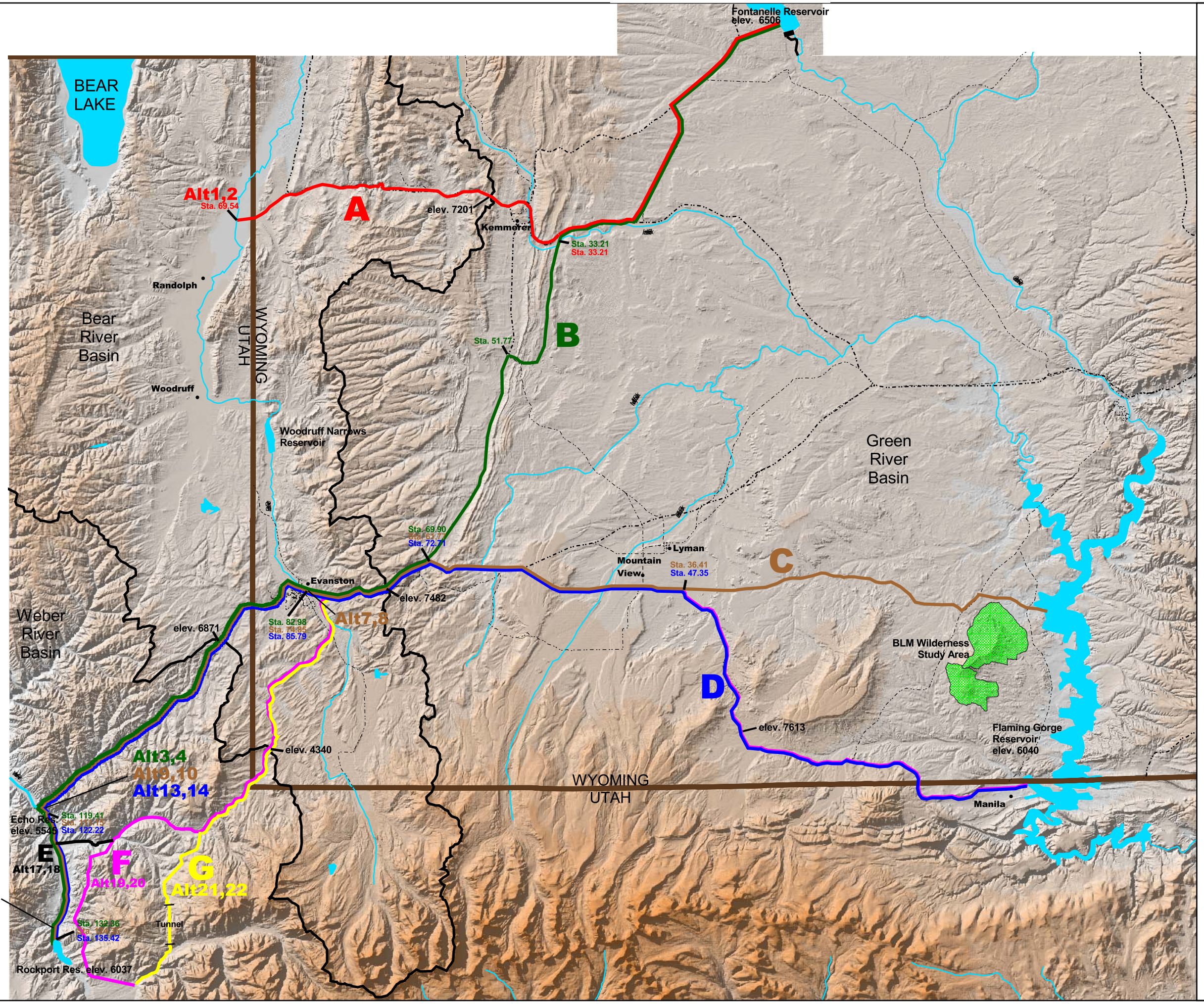
Assumptions

The initial investigation included a cost estimate alternative for one and two pump stations for each possible alignment. In every case the two-pump station approach was the most cost effective. It has been assumed here that the two-pump station alternative is the most cost

Figure 2

Green River Pipeline

Alignments and Alternatives



Legend

- Alignment A
- Alignment B
- Alignment C
- Alignment D
- Alignment E
- Alignment F
- Alignment G

5 0 5 10 Miles

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effective approach. Single pump station alternatives have not been investigated. For tunneling costs, a dialog with Bureau of Reclamation CUP project managers resulted in the following suggested figures: $5 million for mobilization and $17 million per mile of tunnel. These figures could vary up or down significantly depending upon a number of factors. Consequently, an alternative to tunneling has also been included here.

Discussion of Cost Estimates

A summary of the costs associated with each of the alternatives is given in the tables that follow. Table 6 compares the cost of delivering water to Echo Reservoir: Alternatives 17 and 18 are compared with previously investigated Alternatives 10 and 14. The total project cost for Alternative 17, at just over $1.158 billion, was about 2.3% lower than the $1.186 billion for Alternative 10, while the total project costs of $1.297 billion for Alternative 18, represented about a 0.5% increase compared to $1.290 billion for Alternative 14.

Table 6
Cost Estimate Summary for Delivery to Echo Reservoir

Alternative	Alignment	Total Project Cost	Annualized Cost	Yearly O&M Cost	Unit Cost
10	C	$1,185,574,000	$59,282,000	$5,035,000	$988
17	C-E	$1,157,866,000	$58,516,000	$5,537,000	$975
14	D	$1,290,482,000	$64,868,000	$5,821,000	$1,081
18	D-E	$1,296,662,000	$65,815,000	$6,485,000	$1,097

Table 7 compares the cost of delivering water to Rockport Reservoir. Alternatives 19 and 21 were compared to Alternative 12. Alternatives 20 and 22 were compared to Alternative 16. Actually, while Alternatives 12 and 16 were computed to estimate the cost of delivering the water directly to Rockport Reservoir; Alternatives 19 through 22 would actually deliver water to a point above Rockport at the Weber/Provo canal diversion.

The total project cost for Alternative 19 of just under $1.377 billion is about a 4.6% increase in cost compared to Alternative 12, while the total project costs for Alternative 21, at $1.282 billion, represented a 2.5% decrease in total project costs. The unit cost for these two alternatives (19 & 21), however, showed an increase of 8.4% and 11% respectively. The increases in unit cost are a function of hydropower benefits. For Alternatives 12 and 16, a significant portion of the head required to lift water from Flaming Gorge Reservoir could be used for hydropower generation. For alternatives 19 through 22, however, the Weber/Provo diversion canal is 453 feet above Rockport Reservoir. This reduction in available head greatly reduces the hydropower benefit that can be expected with these alternatives.

The total project cost for Alternative 20 was just over $1.499 billion, an increase of 4.4% compared with alternative 16. The total project costs for Alternative 22 was $1.399 billion, a reduction of 2.6% compared to Alternative 16. For both of these alternatives though the reduced hydropower benefit resulted in an increase of the Unit Cost. The Unit Cost for Alternative 20, at $1,455 dollars per acre-foot, was a 16% increase, while the Unit Cost for Alternative 22, at $1,387 per acre-foot was a 10.8% increase over the $1,252 per acre-foot for Alternative 16.

Table 7
Cost Estimate Summary for Delivery to Rockport Reservoir

Alternative	Alignment	Total Project Cost	Annualized Cost	Yearly O&M Cost	Unit Cost
12	C	$1,315,939,000	$68,855,000	$8,643,000	$1,148
19	C-F	$1,376,819,000	$74,678,000	$11,680,000	$1,245
21	C-G	$1,282,445,000	$76,507,000	$17,828,000	$1,275
16	D	$1,435,973,000	$75,133,000	$9,429,000	$1,252
20	D-F	$1,499,129,000	$87,323,000	$18,729,000	$1,455
22	D-G	$1,398,789,000	$83,191,000	$19,188,000	$1,387

Conclusions for Chalk Creek Alternatives

- The pump lift used in the initial Green River Pipeline D-alignment is adequate to move water over the saddle point of 7340 and into the Chalk Creek drainage. The C-Alignment however, required an additional 30-feet of lift. Consequently, it is feasible to deliver water to the Weber via Chalk Creek rather than Echo Canyon.
- The Chalk Creek drainage alignment to Echo Reservoir would be about 8 miles longer than the more direct route down Echo Canyon. However, by avoiding Interstate 80 and the railroad alignment there appears to be a slight reduction in total project costs.
- By means of a three-mile long tunnel Green River water could be moved from the Chalk Creek drainage directly to the Weber River above the Weber/Provo diversion canal making Green River water available throughout the entire Wasatch Front. Should tunneling cost prove to be prohibitively high, it may be possible to maintain a high line alignment above the Weber River and Rockport Reservoir and deliver water to the Weber/Provo Diversion Canal without a tunnel.

Delivery of water to a point on the Weber River above the Weber/Provo Diversion Canal rather than Rockport Reservoir or Echo Reservoir will greatly reduce the potential hydropower benefits associated with the earlier investigated alignments.

Cost Comparison of Proposed State Projects

One request the Division received for this 2020 update was for a cost comparison of the different state projects currently being investigated. Table 8 shown below, lists the total costs and annualized unit costs for the lowest and highest cost proposal for each project. These cost comparisons are somewhat cursory due to the differing levels of detail included in each of the cost studies. It should also be noted any of the Green River Project proposals that deliver water into the Bear River (such as the lowest cost Green River option shown in Table 8) would incur the additional costs of the Bear River Project in order to deliver water to the Wasatch Front. If the same water were to be used for environmental needs in the Great Salt Lake, it would not.

Total Bear River Project costs are generally higher partially due to the additional costs of developing storage and rights-of-way acquisition that other projects and options do not incur. Due to the high volume of water that the Bear River Project is to deliver however, unit costs are the lowest of the three projects by a considerable margin.

TABLE 8
Cost Comparison of Bear River, Green River and Lake Powell Proposals

Proposed Project	Low Total Project Cost	High Total Project Cost	Annualized Low Unit Cost Ac-ft	Annualized High Unit Cost Ac-ft
Bear River†`	$1.5 Billion	$2.8 Billion	$314	$582
Green River*	$732 Million	$1.499 Billion	$615	$1,455
Lake Powell*	$1.184 Billion	$1.924 Billion	$647	$1,051

† The Bear River Development used a 50 year repayment with a 4.0% rate.
* The annualized acre-feet for Lake Powell and Green River Pipeline projects were calculated with a 50 year repayment period at a 3.90% rate.

Section 5 – Areas for Further Study and Other Significant Obstacles

The report to this point could easily be considered a "quick and dirty" analysis. Generally speaking, assumptions that have been made are conservative, so as to not underestimate actual costs. Certainly, refinements can and should be made if a better idea of actual costs is desired. Areas of weakness in this report include the following:

- Design parameters remained constant and were not optimized (i.e. 60,000 acre-feet and 51 in. pipe diameter).[4]
- No field reconnaissance was performed to observe and pinpoint potential problem areas and refine individual reach costs.
- Acquisition of rights-of-way was assumed to cost $1,250 per acre along the entire path of the pipeline ($5,000/acre in locations where alignment did not follow a major highway).
- Pipe costs were assumed to be the same as those shown in the Lake Powell Pipeline study (1995) indexed to 2020 prices using the Bureau of Reclamation's 2020 Q2 cost index. Actual pipe construction costs may vary and could have a large impact on project costs.
- Energy costs were assumed to be the same as averaged from the Green River and Fremont power plants for power sold back into the grid and Rocky Mountain Power peak and off-peak rates for consumption. Actual costs of energy may vary and could have an impact on actual project costs.
- Reservoir pump station costs were assumed to be similar to the Bureau of Reclamation's estimates for the Lake Powell Pump Station and indexed to 2020.[5]
- None of the alternatives investigate the potential for a peaking reservoir that would maximize the economic benefits of a hydropower station. (For instance, the Lake Powell Pipeline study found that a peaking reservoir and enlarged hydropower station would significantly reduce the unit cost of the project.)
- Additional costs associated with storing, treating and delivering the project water to the end consumer was not investigated.

In addition to the weaknesses of the report listed above, pursuit of a project to import water from the Green River drainage to the Wasatch Front would encounter a host of other significant challenges and obstacles. Some of these are articulated below:

- Utah's Colorado River allocations are already planned for. While Utah's current depletions are well below the allocation under the Colorado River Compact, all future uses from the Colorado River are currently in place and accounted for. These uses include: Lake Powell Pipeline Development Project, Tribal water settlements, and modest increases to existing exports and in-basin uses.

[4] Although not included in this report, a few test runs were made at a flow rate of 80,000 acre-feet per year, instead of 60,000 acre-feet. These test runs indicated that a unit cost of approximately $110 per acre-foot could be obtained for Alternative 1 using the same 51 in. pipe diameter. This represents more than a 13 percent reduction in unit costs (Alternative 1 at 60,000 acre-feet has a unit cost of $127).

[5] See Bureau of Reclamation, *Preliminary Design and Cost Estimate for Lone Rock Pump Station*, (Provo: 2002).

- Any proposed project that aims to export water beyond what has been outlined by Utah's water agencies would come under heavy scrutiny from the Colorado River Basin States and their stakeholders (including Utah's).
- Importing water into the Bear River would require a possible revision of the Bear River Compact, which would need approval from the states of Utah, Idaho and Wyoming, and Congress.
- Currently, there is no water right associated with a potential Green River development project.
- Diverting water in the state of Wyoming for use in Utah would require water rights from the State of Wyoming.
- Potential alignments are located in the State of Wyoming and would require approval and permits from impacted jurisdictions.
- Acquiring a water right to divert would be a challenge and create significant water rights priority issues.
- Several endangered fish species inhabit the aquatic environment downstream of the project.

Appendix A – Pipeline Alignment Profiles

This appendix contains pipeline profiles for each of the four alignments analyzed in this report. The general description of each alignment from the report is repeated below:

Alignments A, B, and C all originate at Fontenelle Reservoir and follow U.S. Highway 189 to the vicinity of Kemmerer, where they diverge. Alignment A goes through Kemmerer and continues in a westerly direction until it crosses the Bear River in Utah. The alignment then turns south along state route 16 until it reaches Interstate 80, where it continues to its Weber River destination, Echo Reservoir.

Alignments B and C are essentially the same, with only a slight difference in their path near Kemmerer. Both alignments eventually join again on U.S. Highway 89, south of Kemmerer, and continue until they join Interstate 80. They then follow Interstate 80 west through Evanston to Echo Reservoir.

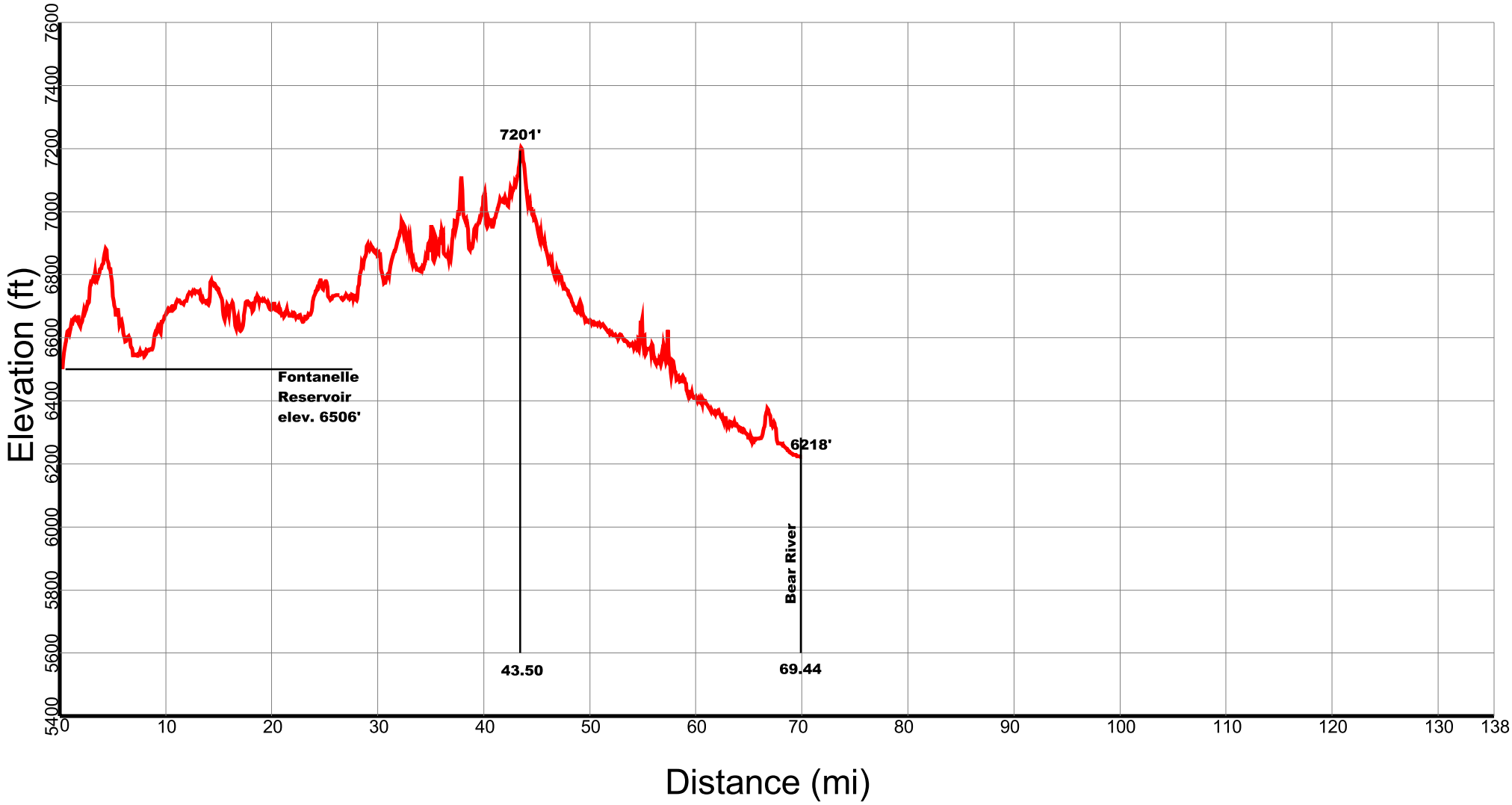
Alignment D originates from Flaming Gorge Reservoir. This alignment goes west until it reaches a local road near Manila. This road eventually joins state route 46 to Manila. At Manila, the alignment continues west along route 46, crosses into Wyoming where it becomes state route 414, and eventually joins Interstate 80 near Mountain View. From there it follows Interstate 80 through Evanston to its Weber River destination, Echo Reservoir.

The Chalk Creek alignments follow the original C and D alignments to a point approximately 3 miles east of Evanston. From there the pipeline would run south into the Bear River watershed, cross the Bear River, ascend Bernard Hollow in a southwesterly direction, cross Coyote Creek and Sage Creek, then turn south and ascends the Yellow Creek drainage to a saddle point of elevation 7340. The Pipeline would then descend the Chalk Creek drainage of the Weber River watershed.

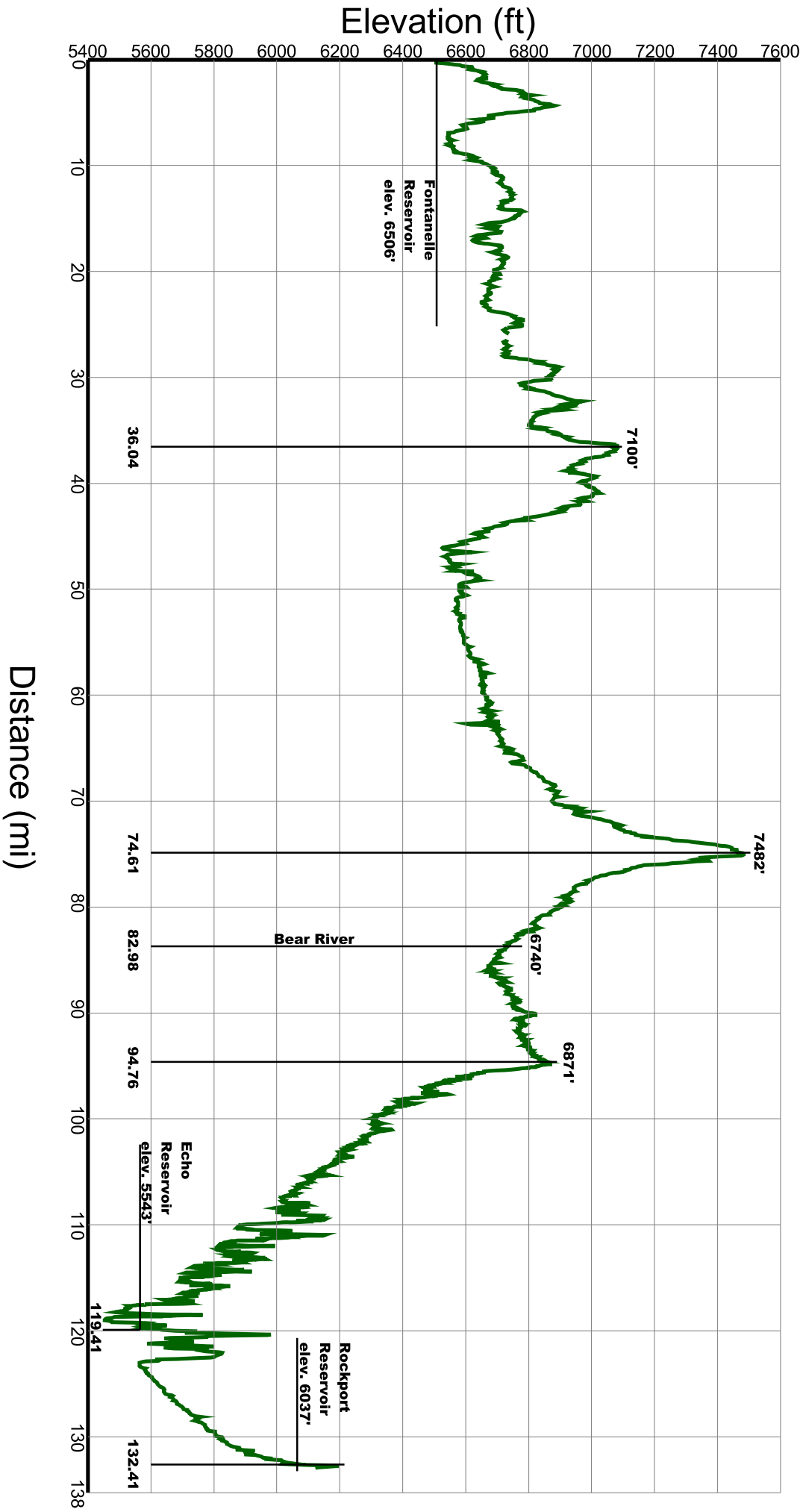
Within the Chalk Creek drainage three alignments were considered. First, the pipeline could extend all the way down the Chalk Creek drainage and into Echo Reservoir. This option has been called Alignment E and includes two alternatives: Alternative 17 (following Alignment C and E) and Alternative 18 (following Alignment D and E). Secondly, it was discovered that if the pipeline were to turn south and extend up the South Fork of Chalk Creek, a three-mile tunnel could be employed to deliver water directly to the Weber River. This option has been called Alignment G and includes two alternatives: Alternative 21 (following Alignment C and G) and Alternative 22 (following Alignment D and G).

Finally, as an alternative to tunneling it may be possible to exit the Chalk Creek drainage and maintain a high elevation alignment above the Weber River and Rockport Reservoir, thus reaching the Weber/Provo diversion canal without a tunnel. This alignment was called Alignment F and includes two alternatives: Alternative 19 (following Alignments C and F) and Alternative 20 (following Alignments D and F).

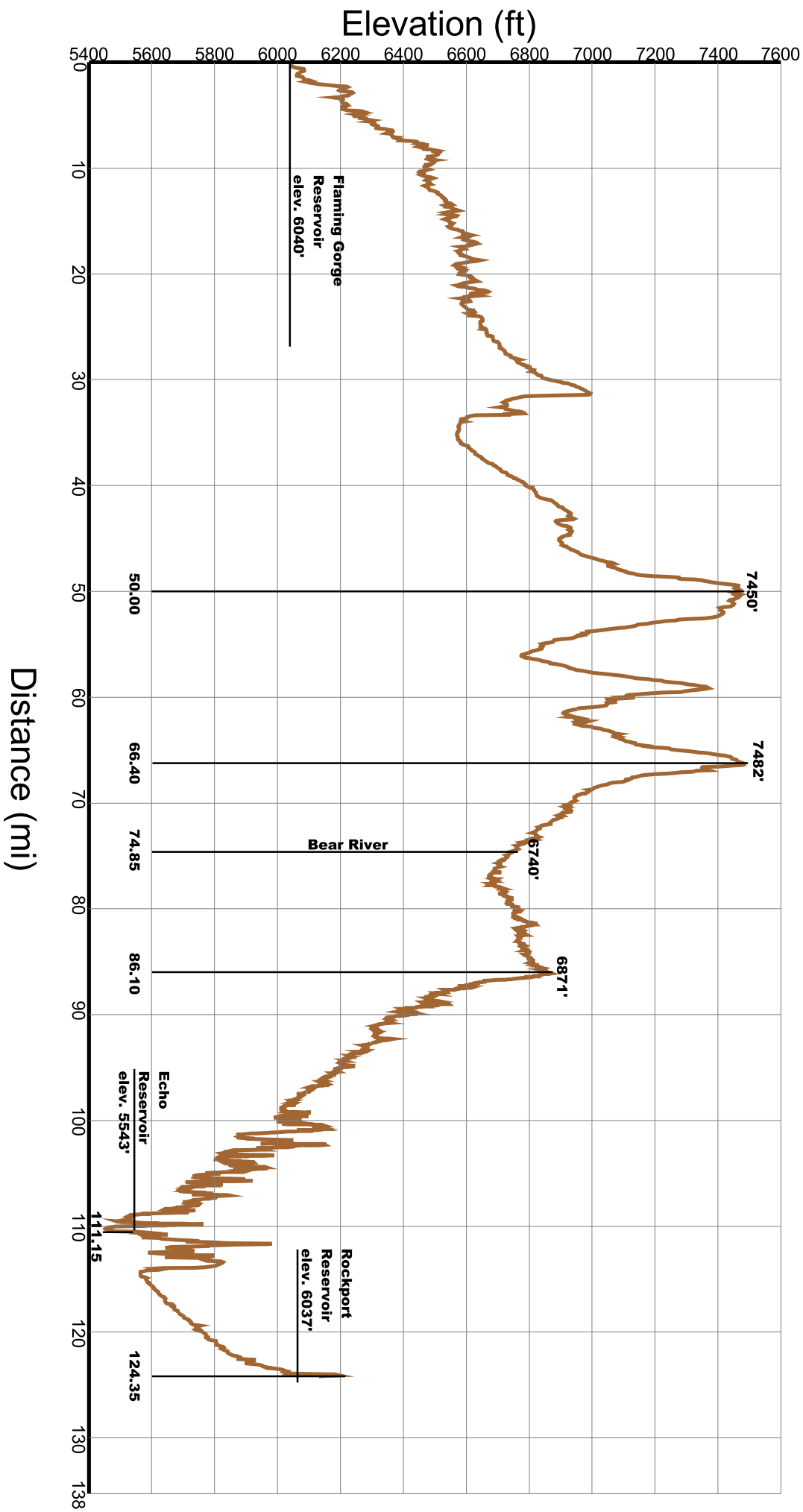
Alignment A


Elevation (ft)
7600
7400
7200
7000
6800
6600
6400
6200
6000
5800
5600
5400
0
10
20
30
40
50
60
70
80
90
100
110
120
130
138
Distance (mi)
7201'
Fontanelle
Reservoir
elev. 6506'
6218'
Bear River
43.50
69.44

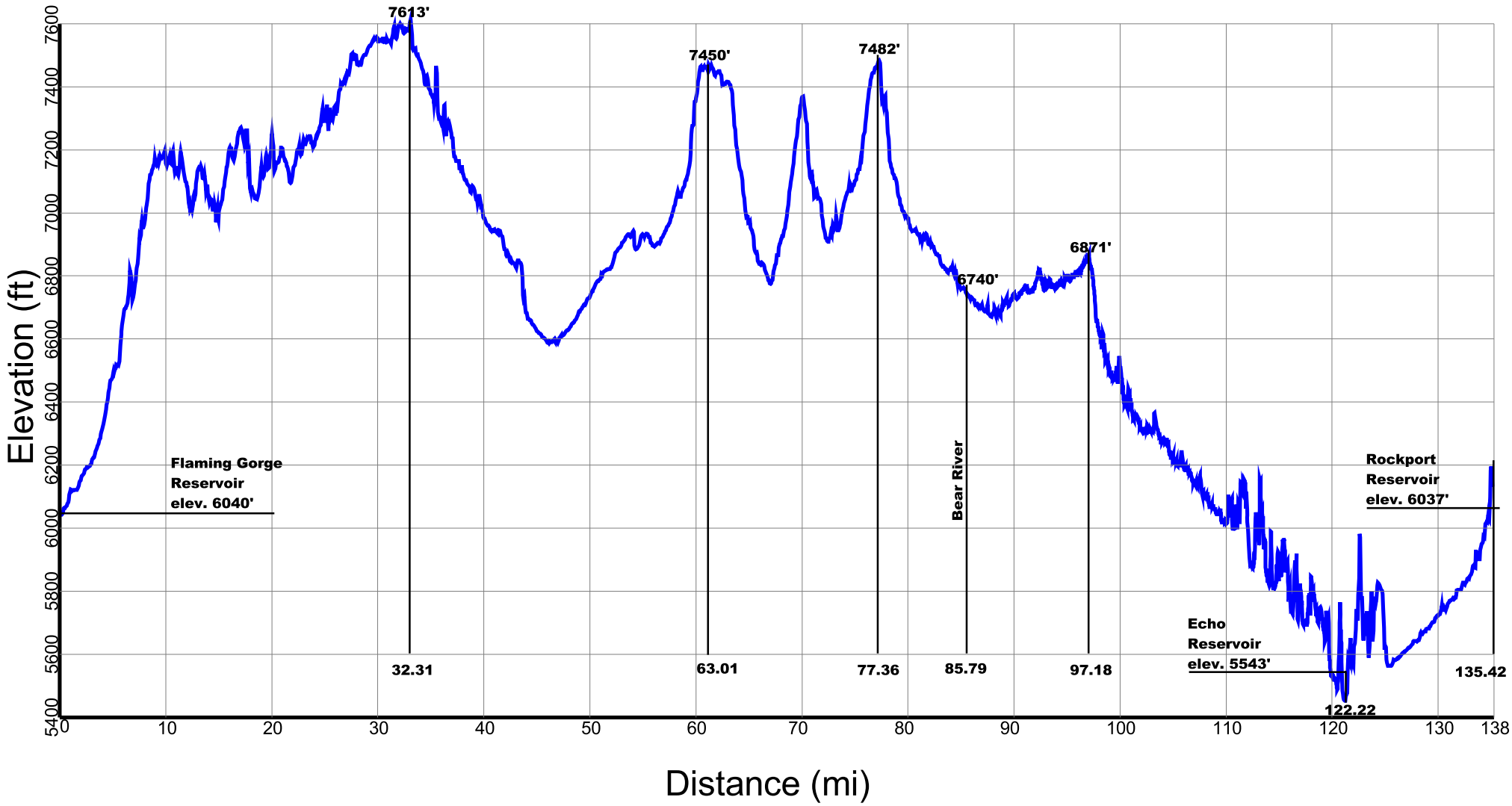
Alignment B


Elevation (ft)
5400
5600
5800
6000
6200
6400
6600
6800
7000
7200
7400
7600
Distance (mi)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
138
Fontanelle Reservoir elev. 6506'
36.04
7100'
74.61
7482'
Bear River
82.98
6740'
94.76
6871'
Echo Reservoir elev. 5543'
119.41
Rockport Reservoir elev. 6037'
132.41

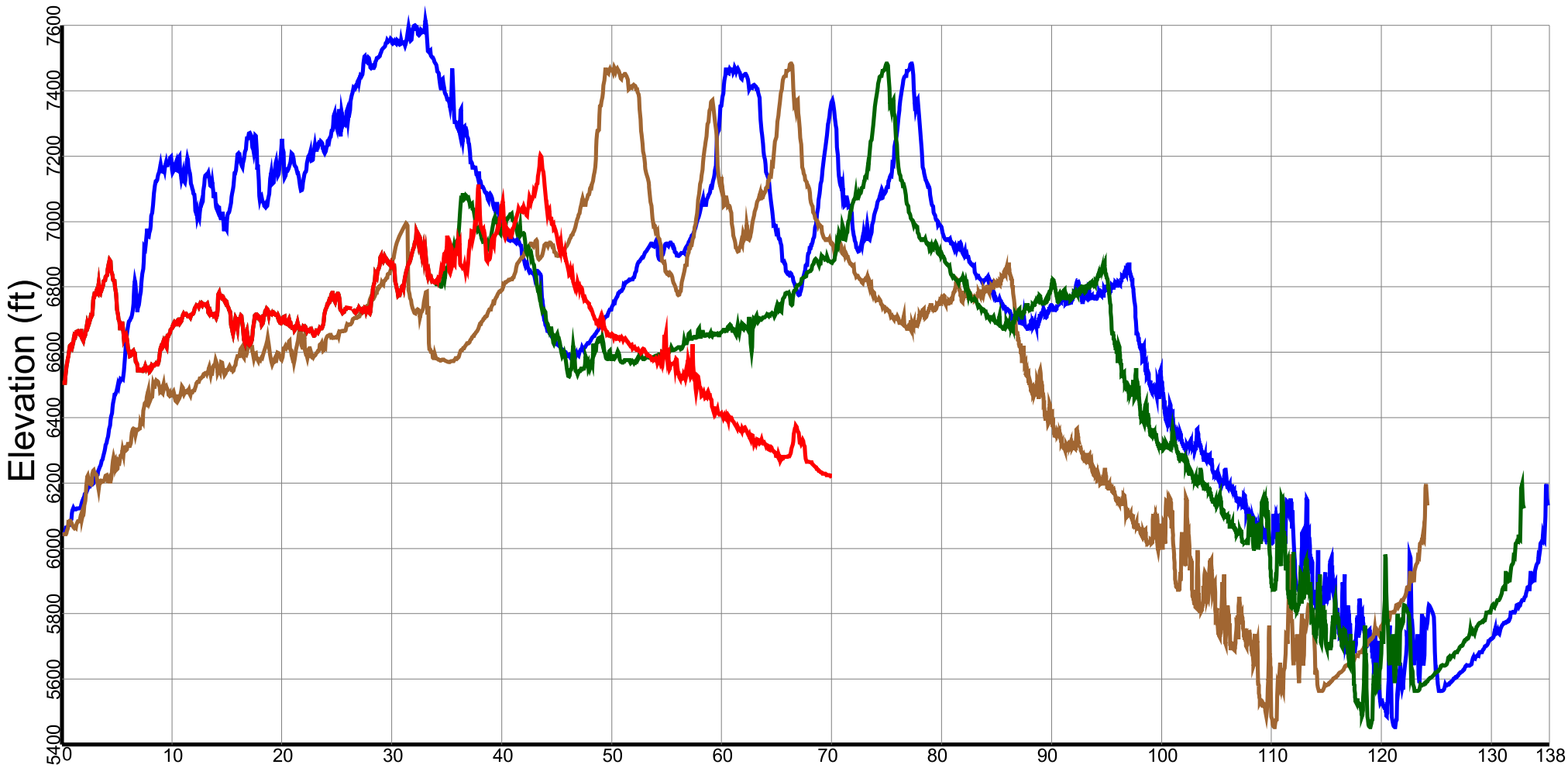
Alignment C


Elevation (ft)
5400
5600
5800
6000
6200
6400
6600
6800
7000
7200
7400
7600
Distance (mi)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
138
Flaming Gorge Reservoir elev. 6040'
50.00
7450'
66.40
7482'
Bear River
74.85
6740'
86.10
6871'
Echo Reservoir elev. 5543'
111.15
Rockport Reservoir elev. 6037'
124.35

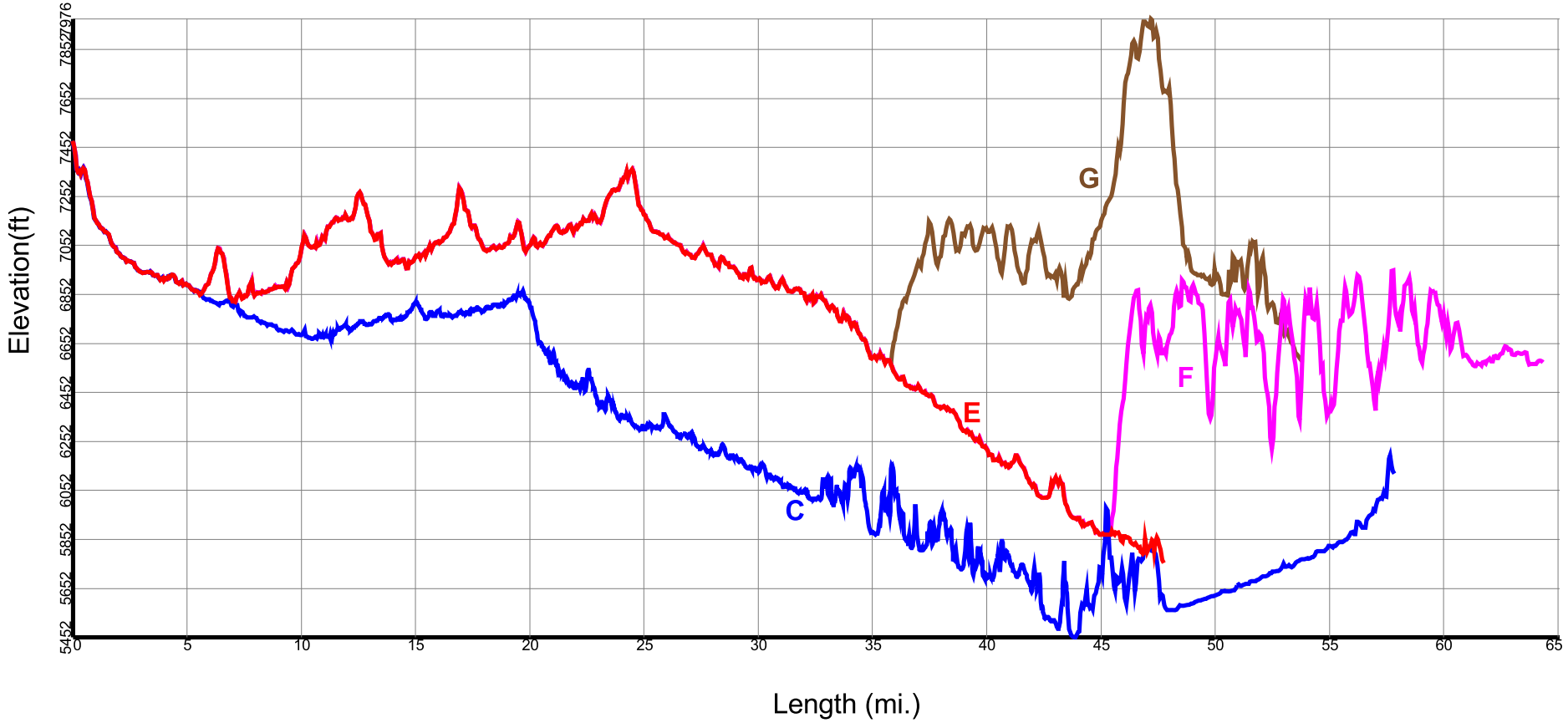
Alignment D


Elevation (ft)
7600
7400
7200
7000
6800
6600
6400
6200
6000
5800
5600
5400
7613'
7450'
7482'
6871'
6740'
Flaming Gorge
Reservoir
elev. 6040'
Bear River
Rockport
Reservoir
elev. 6037'
Echo
Reservoir
elev. 5543'
32.31
63.01
77.36
85.79
97.18
122.22
135.42
0
10
20
30
40
50
60
70
80
90
100
110
120
130
138
Distance (mi)

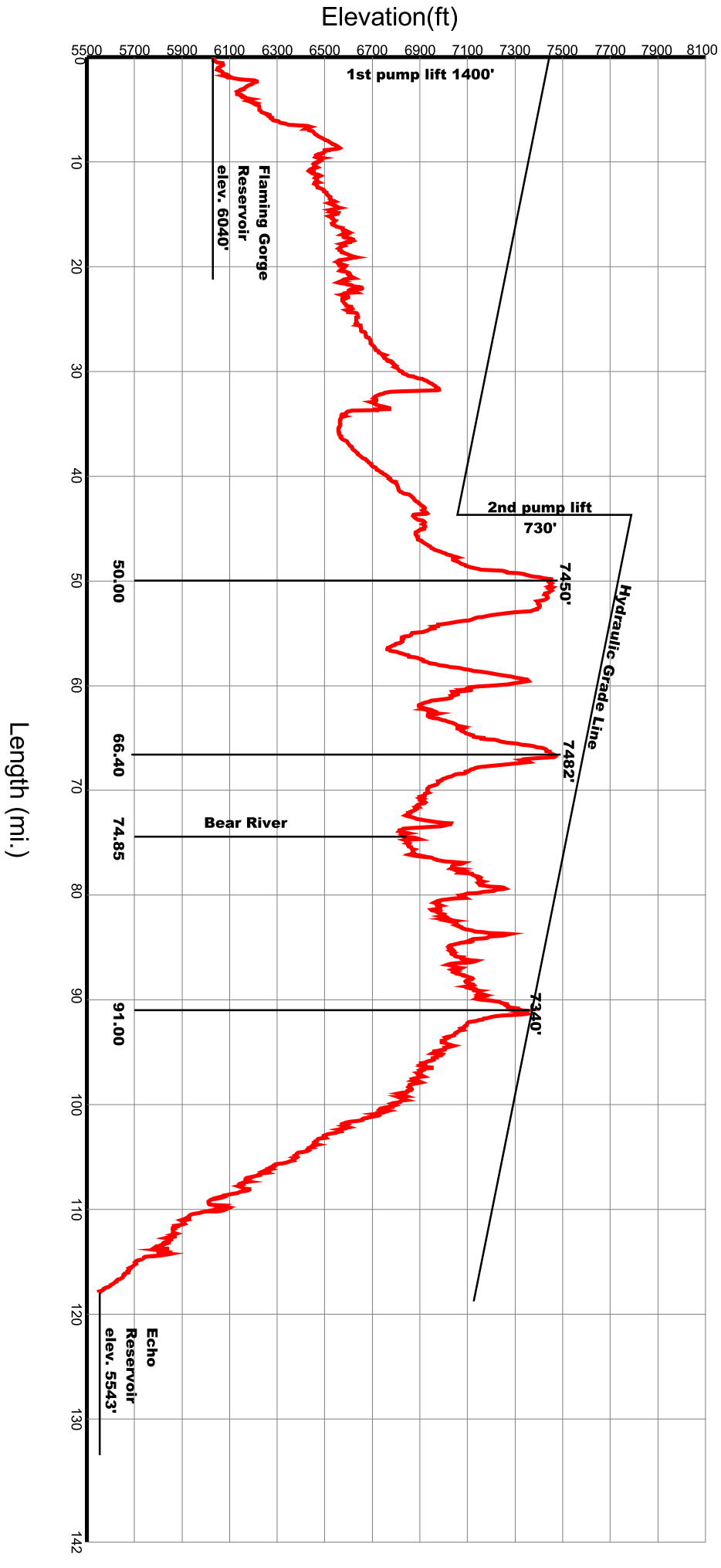
All Alignments



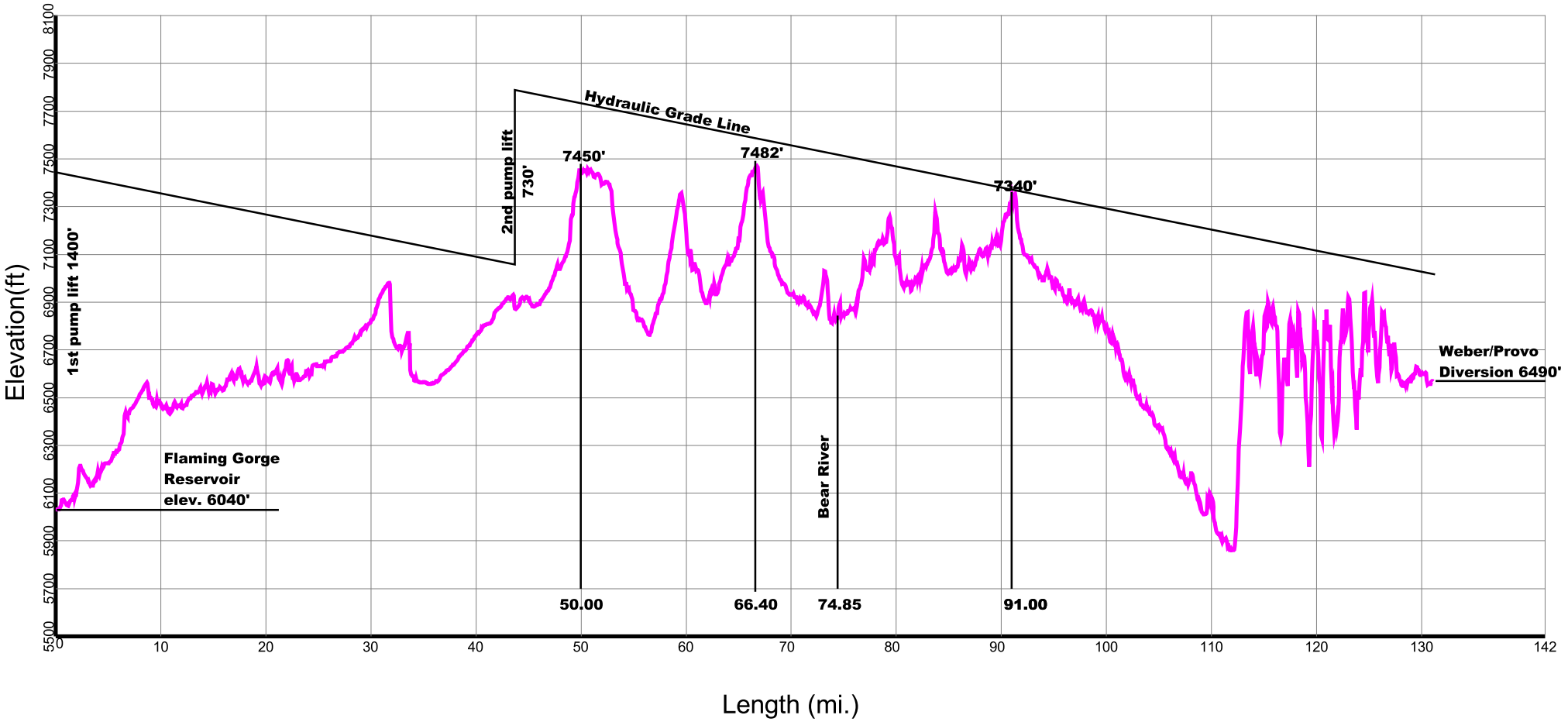
Alignments C, E, F, and G



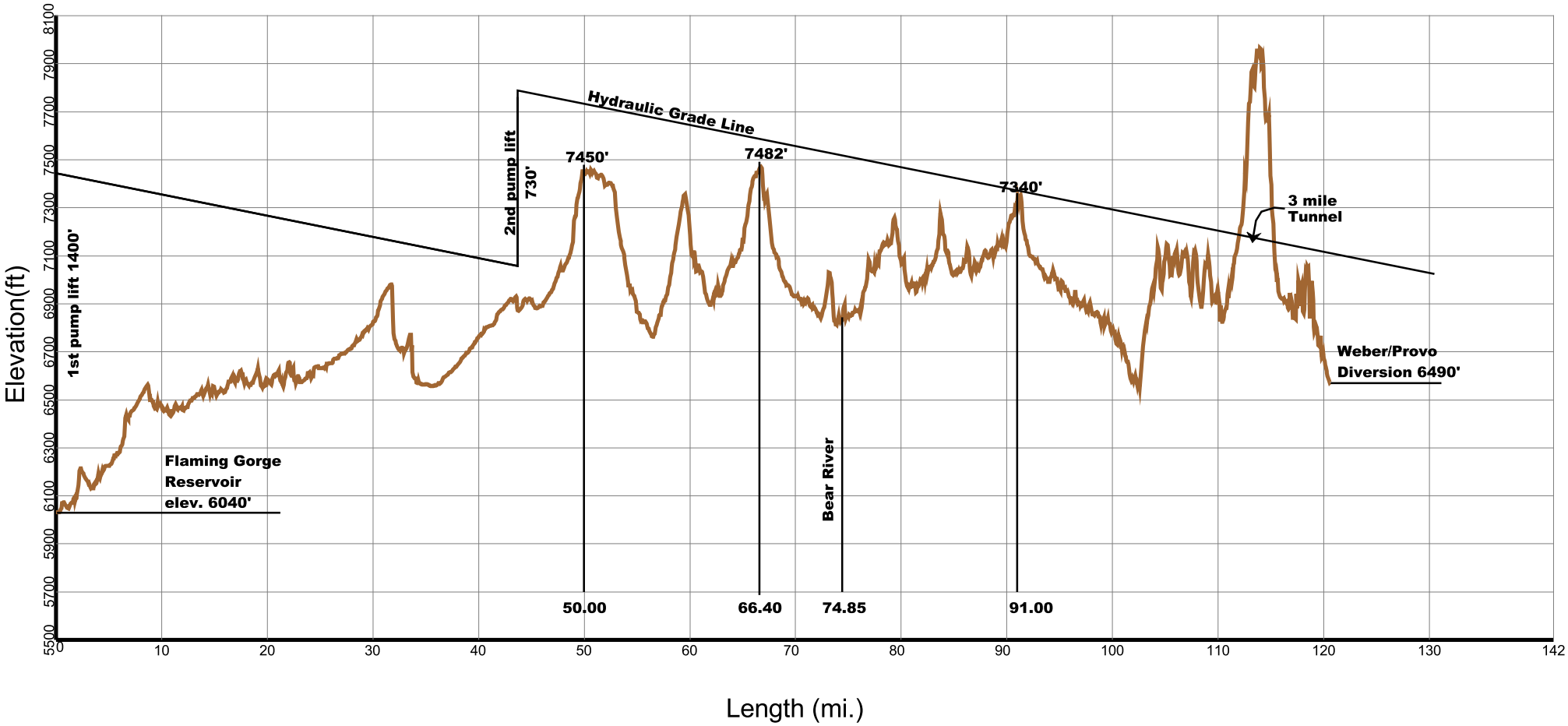
Alignments C - E



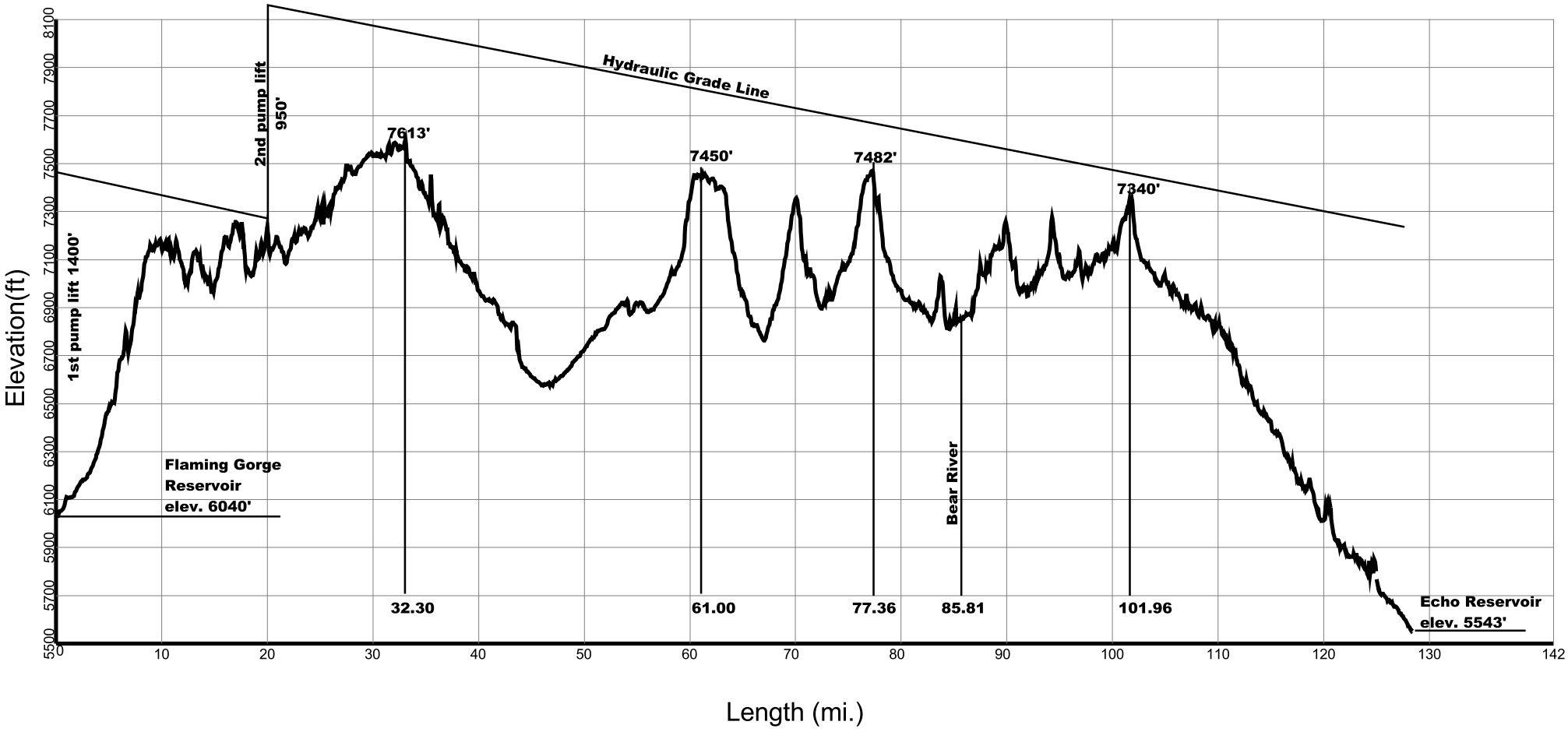
Alignments C - F



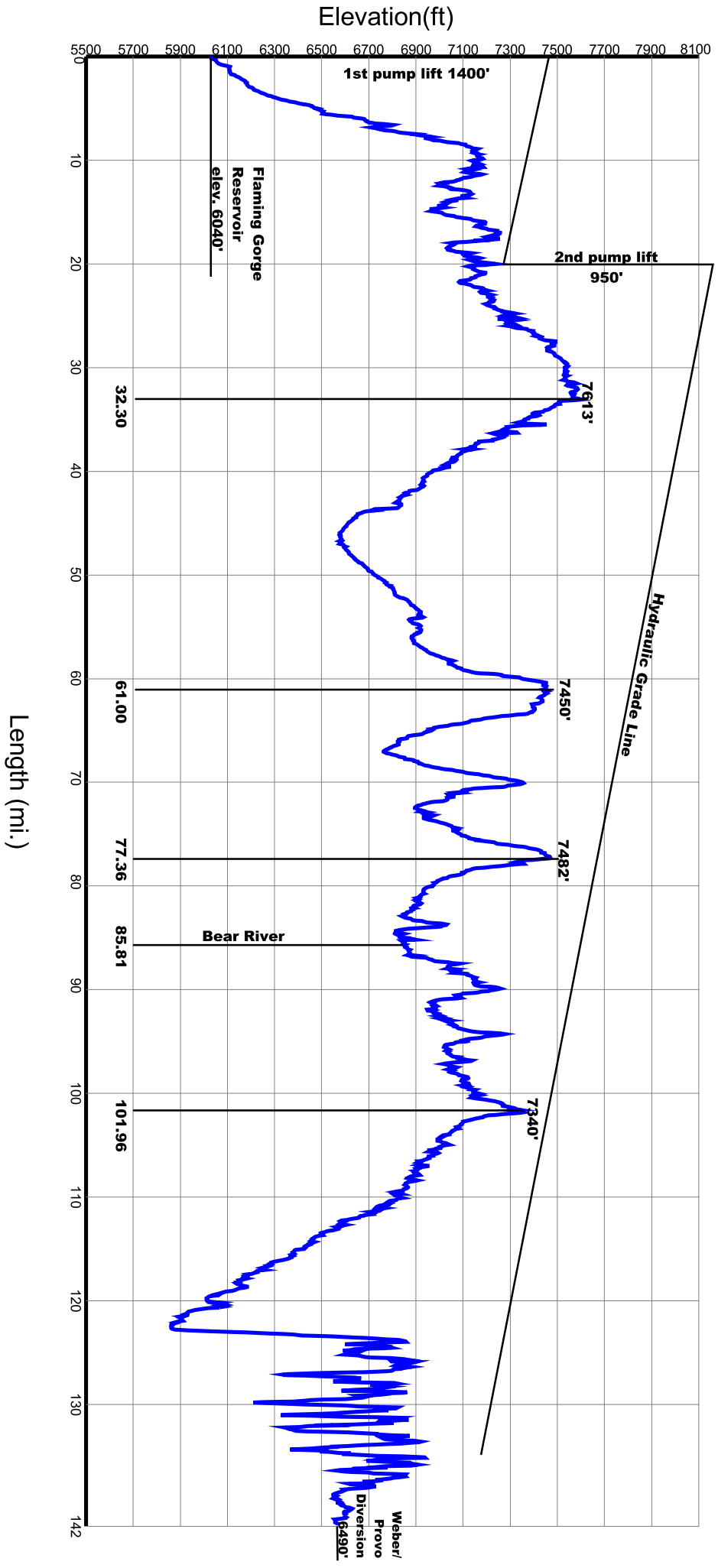
Alignments C - G



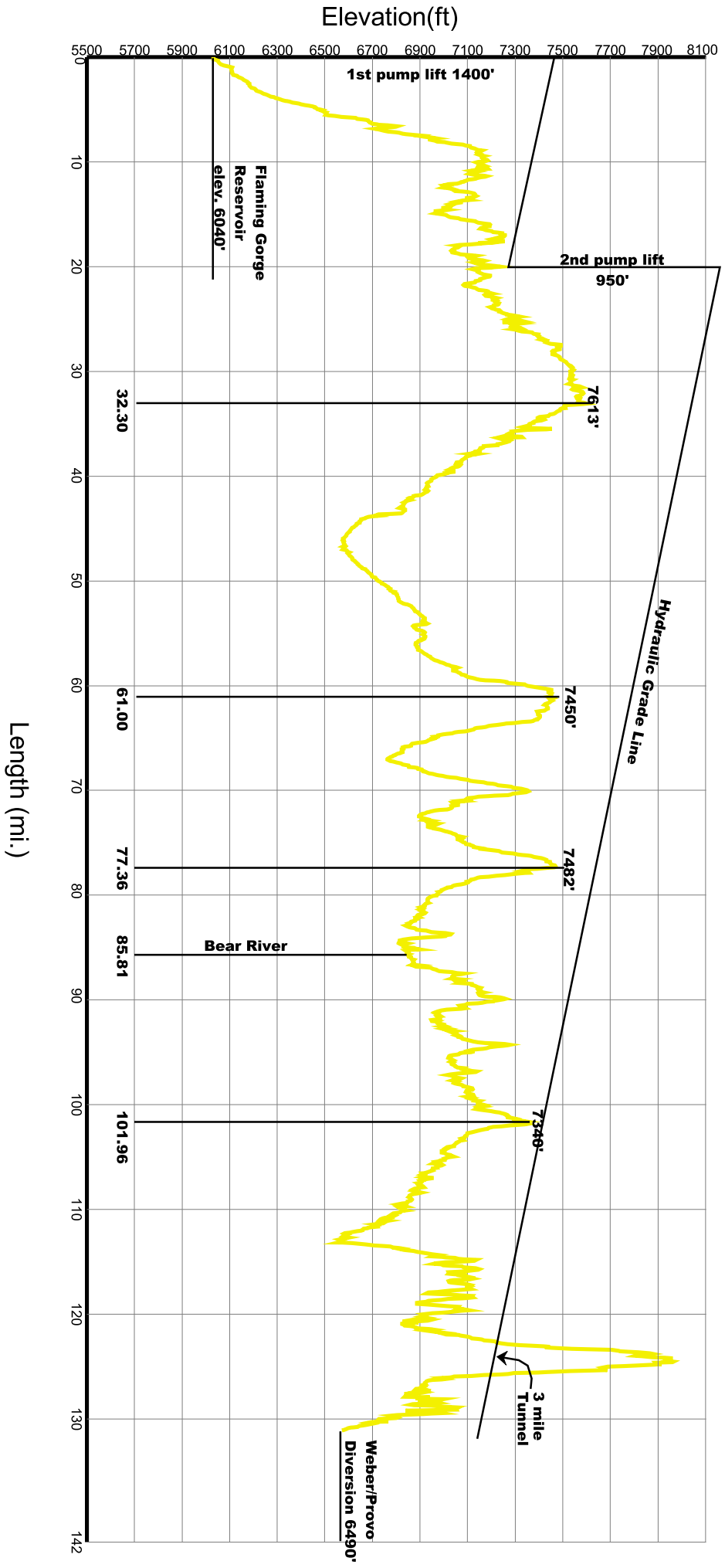
Alignments D - E



Alignments D - F



Alignments D - G



Appendix B – Cost Estimate Sheets

This appendix contains detailed cost estimate sheets for each of the 23 alternatives. A description of various items on each sheet is provided below:[6]

Station (miles)	The pipeline station in miles from its point of origin.
Pipe Diam. (in.)	The inside diameter of the pipeline.
Velocity (ft/sec)	The flow velocity in the pipeline.
HGL Slope	The slope of the hydraulic grade line (head loss per unit length of pipe).
Base Pipe Cost ($/lf/in)	The basic cost of fabricating and installing the pipe in dollars per linear foot of pipe divided by pipe diameter in inches. This includes a 10% contingency.[7]
Ground Elev.	The ground elevation at the station indicated.
HGL Elev.	The elevation (in feet) of the hydraulic grade line at the station indicated. It generally includes the HGL elevation at control points, including high points, pump stations, etc.
Avg. Press. (psi)	The average pipe pressure between the current station and the previous station.
Add for High Press. ($/lf/in)	The unit cost (in dollars per linear foot per inch diameter) added for high pressure.
Add for Rock ($/lf/in)	The unit cost (in dollars per linear foot per inch diameter) added for rock or marginally rippable soils.
Add for Grndwter ($/lf/in)	The unit cost (in dollars per linear foot per inch diameter) added for anticipated high groundwater conditions (at major stream crossings and along Alignment A in the Bear River Valley).
Slope Factor	A multiplier that increases estimated construction costs for steep slopes.
Appurt. Factor	A multiplier that increases estimated construction costs to account for valving, traffic control, mobilization, paving, dust control, reseeding, etc.
Unit Pipeline Cost ($/lf/in)	The unit cost (in dollars per linear foot per inch diameter) for the pipeline which includes all construction costs.
R/W Cost ($/lf)	The unit cost per linear foot of right-of-way purchased. This assumes a 100' wide easement and acquisition costs of $1,250 to $5,000 per acre.
Reach Cost ($)	The total construction and right-of-way cost between the current station and the previous station.
Annualized Cost ($)	The amortized payment amount at the interest rate and period indicated in the project data section. Annualized costs are included for the pipeline, pump station and hydropower station construction cost totals, and for energy and O&M costs.

[6] Boyle Engineering Corp. & Alpha Engineering, Inc., *Lake Powell Pipeline Feasibility Study*, 1995, 49.
[7] Ibid, 14.

Alternative 1 - Alignment A, Fontenelle Reservoir to Bear River, below Woodruff Narrows (one pump station)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
			Fontenelle Reservoir Elevation =			6506										
			Fontenelle Pump Station, lift (ft) =			1150							Right-of-Way Width (ft) =		100	
0.00	51	5.84	0.001724	21.50	6506	7656	498	5.23			1.00	1.05	28.06	2.87	0	
10.00	51	5.84	0.001724	21.50	6703	7565	373	2.96			1.00	1.05	25.69	2.87	69,319,688	
20.00	51	5.84	0.001724	21.50	6715	7474	329	2.25			1.00	1.05	24.94	2.87	67,296,608	
30.00	51	5.84	0.001724	21.50	6868	7383	223	0.75			1.00	1.05	23.36	2.87	63,066,732	
33.21	51	5.84	0.001724	21.50	6848	7354	219	0.70			1.00	1.05	23.31	2.87	20,198,093	
36.79	51	5.84	0.001724	21.50	6860	7321	200	0.46	12.00		1.00	1.05	35.66	2.87	34,428,737	
37.90	51	5.84	0.001724	21.50	7018	7311	127	0.00		6.00	1.22	1.05	35.23	2.87	10,546,346	
39.43	51	5.84	0.001724	21.50	7058	7297	104	0.00		6.00	1.10	1.05	31.76	2.87	13,109,281	
43.50	51	5.84	0.001724	21.50	7201	7260	26	0.00	3.00		1.22	1.05	31.38	2.87	34,458,125	
50.00	51	5.84	0.001724	21.50	6658	7201	235	0.91	12.00		1.00	1.05	36.13	2.87	63,336,210	
60.00	51	5.84	0.001724	21.50	6368	7110	321	2.13	12.00		1.00	1.05	37.42	2.87	100,903,522	
67.79	51	5.84	0.001724	21.50	6235	7039	348	2.55	3.00		1.00	1.05	28.41	2.87	59,706,299	
69.44	51	5.84	0.001724	21.50	6218	7024	349	2.57	3.00	6.00	1.00	1.05	34.72	2.87	15,451,950	
			Hydropower Station, head (ft) =			806							1 River Crossing		1,500,000	
															Total Cost of Pipeline =	**553,321,591**	**25,317,591**

PUMP STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	1150	0.85	9,484			7,532,401
Capital Costs									31,000,000	1,418,425
O&M Costs										310,000
								Total Cost of Pump Station(s) =	**31,000,000**	**9,260,826**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	806	0.82	4,632			-4,734,237
Capital Costs									6,000,000	274,534
O&M Costs										60,000
								Total Cost of Hydrostation =	**6,000,000**	**-4,399,703**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	590,321,591	
15% Design & Administration	88,548,239	4,051,583
10% Contingency	59,032,159	2,701,055
TOTAL PROJECT COST	**737,901,988**	**36,931,352**
UNIT WATER COST, FULL USE ($/af)		**616**
YEARLY OPERATING COST (Energy+O&M)		**3,168,164**

Alternative 2 - Alignment A, Fontenelle Reservoir to Bear River, below Woodruff Narrows (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
			Fontenelle Reservoir Elevation =			6506										
			Fontenelle Pump Station, lift (ft) =			550						Right-of-Way Width (ft) =		100		
0.00	51	5.84	0.001724	21.50	6506	7056	238	0.95			1.00	1.05	23.57	2.87	0	
10.00	51	5.84	0.001724	21.50	6703	6965	114	0.00			1.00	1.05	22.58	2.87	60,941,475	
20.00	51	5.84	0.001724	21.50	6715	6874	69	0.00			1.00	1.05	22.58	2.87	60,941,475	
26.00	51	5.84	0.001724	21.50	6770	6819	21	0.00			1.00	1.05	22.58	2.87	36,564,885	
			Second Pump Station, lift (ft) =			600										
26.00	51	5.84	0.001724	21.50	6770	7419	281	1.54			1.00	1.05	24.19	2.87	0	
30.00	51	5.84	0.001724	21.50	6868	7383	223	0.75			1.00	1.05	23.36	2.87	25,226,693	
33.21	51	5.84	0.001724	21.50	6848	7354	219	0.70			1.00	1.05	23.31	2.87	20,198,093	
36.79	51	5.84	0.001724	21.50	6860	7321	200	0.46	12.00		1.00	1.05	35.66	2.87	34,428,737	
37.90	51	5.84	0.001724	21.50	7018	7311	127	0.00		6.00	1.22	1.05	35.23	2.87	10,546,346	
39.43	51	5.84	0.001724	21.50	7058	7297	104	0.00		6.00	1.10	1.05	31.76	2.87	13,109,281	
43.50	51	5.84	0.001724	21.50	7201	7260	26	0.00	3.00		1.22	1.05	31.38	2.87	34,458,125	
50.00	51	5.84	0.001724	21.50	6658	7201	235	0.91	12.00		1.00	1.05	36.13	2.87	63,336,210	
60.00	51	5.84	0.001724	21.50	6368	7110	321	2.13	12.00		1.00	1.05	37.42	2.87	100,903,522	
67.79	51	5.84	0.001724	21.50	6235	7039	348	2.55	3.00		1.00	1.05	28.41	2.87	59,706,299	
69.44	51	5.84	0.001724	21.50	6218	7024	349	2.57	3.00	6.00	1.00	1.05	34.72	2.87	15,451,950	
			Hydropower Station, head (ft) =			806							1 River Crossing		1,500,000	
														Total Cost of Pipeline =	**537,313,091**	**24,585,112**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	1150	0.85	9,484			7,532,401
Capital Costs									44,000,000	2,013,249
O&M Costs										440,000
								Total Cost of Pump Station(s) =	**44,000,000**	**9,985,650**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	806	0.82	4,632			-4,734,237
Capital Costs									6,000,000	274,534
O&M Costs										60,000
								Total Cost of Hydrostation =	**6,000,000**	**-4,399,703**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	587,313,091	
15% Design & Administration	88,096,964	4,030,934
10% Contingency	58,731,309	2,687,289
TOTAL PROJECT COST	**734,141,364**	**36,889,282**
UNIT WATER COST, FULL USE ($/af)		**615**
YEARLY OPERATING COST (Energy+O&M)		**3,298,164**

Alternative 3 - Alignment B, Fontenelle Reservoir to Weber River, Echo Reservoir (one pump station)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
			Fontenelle Reservoir Elevation =			6506										
			Fontenelle Pump Station, lift (ft) =			1700							Right-of-Way Width (ft) =	100		
0.00	51	5.84	0.001724	21.50	6506	8206	737	10.63			1.00	1.05	33.74	2.87	0	
10.00	51	5.84	0.001724	21.50	6688	8115	618	7.77			1.00	1.05	30.74	2.87	82,918,400	
20.00	51	5.84	0.001724	21.50	6650	8024	595	7.26			1.00	1.05	30.20	2.87	81,461,969	
30.00	51	5.84	0.001724	21.50	6868	7933	461	4.52			1.00	1.05	27.32	2.87	73,716,745	
33.21	51	5.84	0.001724	21.50	6848	7904	457	4.44			1.00	1.05	27.24	2.87	23,595,147	
34.08	51	5.84	0.001724	21.50	6796	7896	477	4.80		9.00	1.00	1.05	37.07	11.48	8,737,292	
36.04	51	5.84	0.001724	21.50	7100	7878	337	2.38			1.00	1.05	25.07	11.48	13,350,259	
40.00	51	5.84	0.001724	21.50	7000	7842	365	2.82	3.00		1.00	1.05	28.69	11.48	30,829,082	
48.38	51	5.84	0.001724	21.50	6630	7766	492	5.11	3.00		1.00	1.05	31.09	11.48	70,654,834	
50.00	51	5.84	0.001724	21.50	6596	7751	500	5.27			1.00	1.05	28.11	2.87	12,286,127	
60.00	51	5.84	0.001724	21.50	6655	7660	435	4.04			1.00	1.05	26.81	2.87	72,358,003	
69.90	51	5.84	0.001724	21.50	6870	7570	303	1.86			1.00	1.05	24.53	2.87	65,535,361	
74.61	51	5.84	0.001724	21.50	7482	7527	19	0.00			1.20	1.07	27.61	2.87	35,084,296	
77.18	51	5.84	0.001724	21.50	6950	7503	240	0.97	9.00		1.10	1.07	37.04	2.87	25,672,005	
80.00	51	5.84	0.001724	21.50	6875	7478	261	1.26			1.00	1.07	24.35	2.87	18,534,251	
82.98	51	5.84	0.001724	21.50	6740	7451	308	1.93		6.00	1.00	1.07	31.49	2.87	25,314,022	
85.14	51	5.84	0.001724	21.50	6670	7431	330	2.26		9.00	1.00	1.07	35.05	2.87	20,422,096	
90.00	51	5.84	0.001724	21.50	6800	7387	254	1.16			1.00	1.07	24.25	2.87	31,808,856	
94.76	51	5.84	0.001724	21.50	6871	7343	205	0.52			1.00	1.07	23.56	2.87	30,272,075	
95.49	51	5.84	0.001724	21.50	6630	7337	306	1.90	9.00		1.00	1.07	34.67	2.87	6,826,817	
100.00	51	5.84	0.001724	21.50	6280	7296	440	4.12	9.00		1.00	1.07	37.05	2.87	45,060,462	
110.00	51	5.84	0.001724	21.50	6000	7205	522	5.70	9.00		1.10	1.07	42.61	2.87	114,890,502	
119.41	51	5.84	0.001724	21.50	5543	7119	683	9.29	9.00		1.10	1.07	46.83	2.87	118,817,645	
			Hydropower Station, head (ft) =			1576							2 River Crossings		3,000,000	
														Total Cost of Pipeline =	**1,011,146,246**	**46,265,658**

PUMP STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	1700	0.85	14,020			11,134,854
Capital Costs									31,000,000	1,418,425
O&M Costs										310,000
								Total Cost of Pump Station(s) =	**31,000,000**	**12,863,279**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1576	0.82	9,059			-9,258,352
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-8,879,214**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,048,946,246	
15% Design & Administration	157,341,937	7,199,283
10% Contingency	104,894,625	4,799,522
TOTAL PROJECT COST	**1,311,182,807**	**62,248,528**
UNIT WATER COST, FULL USE ($/af)		**1,037**
YEARLY OPERATING COST (Energy+O&M)		**2,254,501**

Alternative 4 - Alignment B, Fontenelle Reservoir to Weber River, Echo Reservoir (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
			Fontenelle Reservoir Elevation =			6506										
			Fontenelle Pump Station, lift (ft) =			700							Right-of-Way Width (ft) =		100	
0.00	51	5.84	0.001724	21.50	6506	7206	303	1.86			1.00	1.05	24.53	2.87	0	
10.00	51	5.84	0.001724	21.50	6688	7115	185	0.28			1.00	1.05	22.87	2.87	61,736,048	
20.00	51	5.84	0.001724	21.50	6650	7024	162	0.01			1.00	1.05	22.59	2.87	60,983,283	
30.00	51	5.84	0.001724	21.50	6868	6933	28	0.00			1.00	1.05	22.58	2.87	60,941,475	
33.21	51	5.84	0.001724	21.50	6848	6904	24	0.00			1.00	1.05	22.58	2.87	19,562,214	
34.08	51	5.84	0.001724	21.50	6796	6896	43	0.00			1.00	1.05	22.58	11.48	5,341,461	
			Second Pump Station, lift (ft) =			1000										
34.08	51	5.84	0.001724	21.50	6796	7896	477	4.80		9.00	1.00	1.05	37.07	11.48	0	
36.04	51	5.84	0.001724	21.50	7100	7878	337	2.38			1.00	1.05	25.07	11.48	13,350,259	
40.00	51	5.84	0.001724	21.50	7000	7842	365	2.82	3.00		1.00	1.05	28.69	11.48	30,829,082	
48.38	51	5.84	0.001724	21.50	6630	7766	492	5.11	3.00		1.00	1.05	31.09	11.48	70,654,834	
50.00	51	5.84	0.001724	21.50	6596	7751	500	5.27			1.00	1.05	28.11	2.87	12,286,127	
60.00	51	5.84	0.001724	21.50	6655	7660	435	4.04			1.00	1.05	26.81	2.87	72,358,003	
69.90	51	5.84	0.001724	21.50	6870	7570	303	1.86			1.00	1.05	24.53	2.87	65,535,361	
74.61	51	5.84	0.001724	21.50	7482	7527	19	0.00			1.20	1.07	27.61	2.87	35,084,296	
77.18	51	5.84	0.001724	21.50	6950	7503	240	0.97	9.00		1.10	1.07	37.04	2.87	25,672,005	
80.00	51	5.84	0.001724	21.50	6875	7478	261	1.26			1.00	1.07	24.35	2.87	18,534,251	
82.98	51	5.84	0.001724	21.50	6740	7451	308	1.93		6.00	1.00	1.07	31.49	2.87	25,314,022	
85.14	51	5.84	0.001724	21.50	6670	7431	330	2.26		9.00	1.00	1.07	35.05	2.87	20,422,096	
90.00	51	5.84	0.001724	21.50	6800	7387	254	1.16			1.00	1.07	24.25	2.87	31,808,856	
94.76	51	5.84	0.001724	21.50	6871	7343	205	0.52			1.00	1.07	23.56	2.87	30,272,075	
95.49	51	5.84	0.001724	21.50	6630	7337	306	1.90	9.00		1.00	1.07	34.67	2.87	6,826,817	
100.00	51	5.84	0.001724	21.50	6280	7296	440	4.12	9.00		1.00	1.07	37.05	2.87	45,060,462	
110.00	51	5.84	0.001724	21.50	6000	7205	522	5.70	9.00		1.10	1.07	42.61	2.87	114,890,502	
119.41	51	5.84	0.001724	21.50	5543	7119	683	9.29	9.00		1.10	1.07	46.83	2.87	118,817,645	
			Hydropower Station, head (ft) =			1576							2 River Crossings		3,000,000	
														Total Cost of Pipeline =	**949,281,174**	**43,434,981**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	1700	0.85	14,020			11,134,854
Capital Costs									47,000,000	2,150,516
O&M Costs										470,000
								Total Cost of Pump Station(s) =	**47,000,000**	**13,755,369**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1576	0.82	9,059			-9,258,352
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-8,879,214**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,003,081,174	
15% Design & Administration	150,462,176	6,884,495
10% Contingency	100,308,117	4,589,663
TOTAL PROJECT COST	**1,253,851,468**	**59,785,295**
UNIT WATER COST, FULL USE ($/af)		**996**
YEARLY OPERATING COST (Energy+O&M)		**2,414,501**

Alternative 5 - Alignment B, Fontenelle Reservoir to Weber River, Rockport Lake (one pump station)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
			Fontenelle Reservoir Elevation =			6506										
			Fontenelle Pump Station, lift (ft) =			1700							Right-of-Way Width (ft) =	100		
0.00	51	5.84	0.001724	21.50	6506	8206	737	10.63			1.00	1.05	33.74	2.87	0	
10.00	51	5.84	0.001724	21.50	6688	8115	618	7.77			1.00	1.05	30.74	2.87	82,918,400	
20.00	51	5.84	0.001724	21.50	6650	8024	595	7.26			1.00	1.05	30.20	2.87	81,461,969	
30.00	51	5.84	0.001724	21.50	6868	7933	461	4.52			1.00	1.05	27.32	2.87	73,716,745	
33.21	51	5.84	0.001724	21.50	6848	7904	457	4.44			1.00	1.05	27.24	2.87	23,595,147	
34.08	51	5.84	0.001724	21.50	6796	7896	477	4.80		6.00	1.00	1.05	33.92	11.48	7,999,330	
36.04	51	5.84	0.001724	21.50	7100	7878	337	2.38			1.00	1.05	25.07	11.48	13,350,259	
40.00	51	5.84	0.001724	21.50	7000	7842	365	2.82	3.00		1.00	1.05	28.69	11.48	30,829,082	
48.38	51	5.84	0.001724	21.50	6630	7766	492	5.11	3.00		1.00	1.05	31.09	11.48	70,654,834	
50.00	51	5.84	0.001724	21.50	6596	7751	500	5.27			1.00	1.05	28.11	2.87	12,286,127	
60.00	51	5.84	0.001724	21.50	6655	7660	435	4.04			1.00	1.05	26.81	2.87	72,358,003	
69.90	51	5.84	0.001724	21.50	6870	7570	303	1.86			1.00	1.05	24.53	2.87	65,535,361	
74.61	51	5.84	0.001724	21.50	7482	7527	19	0.00			1.20	1.07	27.61	2.87	35,084,296	
77.18	51	5.84	0.001724	21.50	6950	7503	240	0.97	9.00		1.10	1.07	37.04	2.87	25,672,005	
80.00	51	5.84	0.001724	21.50	6875	7478	261	1.26			1.00	1.07	24.35	2.87	18,534,251	
82.98	51	5.84	0.001724	21.50	6740	7451	308	1.93		6.00	1.00	1.07	31.49	2.87	25,314,022	
85.14	51	5.84	0.001724	21.50	6670	7431	330	2.26		9.00	1.00	1.07	35.05	2.87	20,422,096	
90.00	51	5.84	0.001724	21.50	6800	7387	254	1.16			1.00	1.07	24.25	2.87	31,808,856	
94.76	51	5.84	0.001724	21.50	6871	7343	205	0.52			1.00	1.07	23.56	2.87	30,272,075	
95.49	51	5.84	0.001724	21.50	6630	7337	306	1.90	9.00		1.00	1.07	34.67	2.87	6,826,817	
100.00	51	5.84	0.001724	21.50	6280	7296	440	4.12	9.00		1.00	1.07	37.05	2.87	45,060,462	
110.00	51	5.84	0.001724	21.50	6000	7205	522	5.70	9.00		1.10	1.07	42.61	2.87	114,890,502	
119.41	51	5.84	0.001724	21.50	5543	7119	683	9.29	9.00		1.10	1.07	46.83	2.87	118,817,645	
130.00	51	5.84	0.001724	21.50	5810	7023	525	5.77			1.00	1.05	28.64	2.87	81,819,414	
132.41	51	5.84	0.001724	21.50	6037	7001	418	3.72			1.00	1.05	26.48	2.87	17,220,761	
			Hydropower Station, head (ft) =			964							2 River Crossings		3,000,000	
														Total Cost of Pipeline =	**1,109,448,459**	**50,763,540**

PUMP STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	1700	0.85	14,020			11,134,854
Capital Costs									31,000,000	1,418,425
O&M Costs										310,000
								Total Cost of Pump Station(s) =	**31,000,000**	**12,863,279**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	964	0.82	5,539			-5,661,211
Capital Costs									5,800,000	265,383
O&M Costs										58,000
								Total Cost of Hydrostation =	**5,800,000**	**-5,337,828**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,146,248,459	
15% Design & Administration	171,937,269	7,867,102
10% Contingency	114,624,846	5,244,735
TOTAL PROJECT COST	**1,432,810,574**	**71,400,827**
UNIT WATER COST, FULL USE ($/af)		**1,190**
YEARLY OPERATING COST (Energy+O&M)		**5,841,642**

Alternative 6 - Alignment B, Fontenelle Reservoir to Weber River, Rockport Lake (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
			Fontenelle Reservoir Elevation =			6506										
			Fontenelle Pump Station, lift (ft) =			700						Right-of-Way Width (ft) =		100		
0.00	51	5.84	0.001724	21.50	6506	7206	303	1.86			1.00	1.05	24.53	2.87	0	
10.00	51	5.84	0.001724	21.50	6688	7115	185	0.28			1.00	1.05	22.87	2.87	61,736,048	
20.00	51	5.84	0.001724	21.50	6650	7024	162	0.01			1.00	1.05	22.59	2.87	60,983,283	
30.00	51	5.84	0.001724	21.50	6868	6933	28	0.00			1.00	1.05	22.58	2.87	60,941,475	
33.21	51	5.84	0.001724	21.50	6848	6904	24	0.00			1.00	1.05	22.58	2.87	19,562,214	
34.08	51	5.84	0.001724	21.50	6796	6896	43	0.00			1.00	1.05	22.58	11.48	5,341,461	
			Second Pump Station, lift (ft) =			1000										
34.08	51	5.84	0.001724	21.50	6796	7896	477	4.80		9.00	1.00	1.05	37.07	11.48	0	
36.04	51	5.84	0.001724	21.50	7100	7878	337	2.38			1.00	1.05	25.07	11.48	13,350,259	
40.00	51	5.84	0.001724	21.50	7000	7842	365	2.82	3.00		1.00	1.05	28.69	11.48	30,829,082	
48.38	51	5.84	0.001724	21.50	6630	7766	492	5.11	3.00		1.00	1.05	31.09	11.48	70,654,834	
50.00	51	5.84	0.001724	21.50	6596	7751	500	5.27			1.00	1.05	28.11	2.87	12,286,127	
60.00	51	5.84	0.001724	21.50	6655	7660	435	4.04			1.00	1.05	26.81	2.87	72,358,003	
69.90	51	5.84	0.001724	21.50	6870	7570	303	1.86			1.00	1.05	24.53	2.87	65,535,361	
74.61	51	5.84	0.001724	21.50	7482	7527	19	0.00			1.20	1.07	27.61	2.87	35,084,296	
77.18	51	5.84	0.001724	21.50	6950	7503	240	0.97	9.00		1.10	1.07	37.04	2.87	25,672,005	
80.00	51	5.84	0.001724	21.50	6875	7478	261	1.26			1.00	1.07	24.35	2.87	18,534,251	
82.98	51	5.84	0.001724	21.50	6740	7451	308	1.93		6.00	1.00	1.07	31.49	2.87	25,314,022	
85.14	51	5.84	0.001724	21.50	6670	7431	330	2.26		9.00	1.00	1.07	35.05	2.87	20,422,096	
90.00	51	5.84	0.001724	21.50	6800	7387	254	1.16			1.00	1.07	24.25	2.87	31,808,856	
94.76	51	5.84	0.001724	21.50	6871	7343	205	0.52			1.00	1.07	23.56	2.87	30,272,075	
95.49	51	5.84	0.001724	21.50	6630	7337	306	1.90	9.00		1.00	1.07	34.67	2.87	6,826,817	
100.00	51	5.84	0.001724	21.50	6280	7296	440	4.12	9.00		1.00	1.07	37.05	2.87	45,060,462	
110.00	51	5.84	0.001724	21.50	6000	7205	522	5.70	9.00		1.10	1.07	42.61	2.87	114,890,502	
119.41	51	5.84	0.001724	21.50	5543	7119	683	9.29	9.00		1.10	1.07	46.83	2.87	118,817,645	
130.00	51	5.84	0.001724	21.50	5810	7023	525	5.77			1.00	1.05	28.64	2.87	81,819,414	
132.41	51	5.84	0.001724	21.50	6037	7001	418	3.72			1.00	1.05	26.48	2.87	17,220,761	
			Hydropower Station, head (ft) =			964							3 River Crossings		4,500,000	
														Total Cost of Pipeline =	**1,049,821,349**	**48,035,262**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	1700	0.85	14,020			11,134,854
Capital Costs									46,600,000	2,132,213
O&M Costs										466,000
								Total Cost of Pump Station(s) =	**46,600,000**	**13,733,067**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	964	0.82	5,539			-5,661,211
Capital Costs									6,000,000	274,534
O&M Costs										60,000
								Total Cost of Hydrostation =	**6,000,000**	**-5,326,677**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,102,421,349	
15% Design & Administration	165,363,202	7,566,301
10% Contingency	110,242,135	5,044,201
TOTAL PROJECT COST	**1,378,026,686**	**69,052,154**
UNIT WATER COST, FULL USE ($/af)		**1,151**
YEARLY OPERATING COST (Energy+O&M)		**5,999,642**

Alternative 7 - Alignment C, Flaming Gorge Reservoir to Bear River, near Evanston (one pump station)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				2100							Right-of-Way Width (ft) =		100		
0.00	51	5.84	0.001724	21.50	6040	8140	910	15.46			1.00	1.05	38.80	11.48	0	
10.00	51	5.84	0.001724	21.50	6460	8049	688	9.43			1.00	1.05	32.47	11.48	88,053,542	
20.00	51	5.84	0.001724	21.50	6595	7958	591	7.15			1.00	1.05	30.09	11.48	81,619,152	
30.00	51	5.84	0.001724	21.50	6860	7867	436	4.05			1.00	1.05	26.83	11.48	72,858,949	
36.41	51	5.84	0.001724	21.50	6590	7809	528	5.82			1.00	1.05	28.69	11.48	49,910,800	
43.99	51	5.84	0.001724	21.50	6930	7740	351	2.59		3.00	1.00	1.05	28.45	2.87	58,180,589	
50.00	51	5.84	0.001724	21.50	7450	7685	102	0.00			1.00	1.05	22.58	2.87	36,625,827	
55.43	51	5.84	0.001724	21.50	6840	7635	345	2.50	3.00		1.00	1.07	28.89	2.87	42,317,713	
60.00	51	5.84	0.001724	21.50	7100	7594	214	0.64			1.00	1.07	23.69	2.87	29,216,235	
61.77	51	5.84	0.001724	21.50	6946	7578	274	1.43			1.22	1.07	29.94	2.87	14,295,341	
69.05	51	5.84	0.001724	21.50	7482	7511	13	0.00	9.00		1.10	1.07	35.90	2.87	70,484,229	
70.00	51	5.84	0.001724	21.50	6940	7503	244	1.02			1.20	1.07	28.92	2.87	7,412,536	
74.85	51	5.84	0.001724	21.50	6740	7459	311	1.98			1.00	1.07	25.13	2.87	32,887,088	
			Hydropower Station, head (ft) =			719							2 River Crossings		3,000,000	
															Total Cost of Pipeline =	**586,862,001**	**26,852,255**

PUMP STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2100	0.85	17,318			13,754,819
Capital Costs									31,000,000	1,418,425
O&M Costs										310,000
								Total Cost of Pump Station(s) =	**31,000,000**	**15,483,244**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	719	0.82	4,131			-4,221,714
Capital Costs									6,000,000	274,534
O&M Costs										60,000
								Total Cost of Hydrostation =	**6,000,000**	**-3,887,180**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	623,862,001	
15% Design & Administration	93,579,300	4,281,782
10% Contingency	62,386,200	2,854,521
TOTAL PROJECT COST	**779,827,501**	**45,584,622**
UNIT WATER COST, FULL USE ($/af)		**760**
YEARLY OPERATING COST (Energy+O&M)		**9,903,105**

Alternative 8 - Alignment C, Flaming Gorge Reservoir to Bear River, near Evanston (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400							Right-of-Way Width (ft) =		100		
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	11.48	0	
10.00	51	5.84	0.001724	21.50	6460	7349	385	3.16			1.00	1.05	25.89	11.48	70,327,789	
20.00	51	5.84	0.001724	21.50	6595	7258	287	1.63			1.00	1.05	24.28	11.48	65,992,927	
30.00	51	5.84	0.001724	21.50	6860	7167	133	0.00			1.00	1.05	22.58	11.48	61,396,104	
36.41	51	5.84	0.001724	21.50	6590	7109	225	0.77			1.00	1.05	23.39	11.48	40,754,027	
43.99	51	5.84	0.001724	21.50	6930	7040	47	0.00		3.00	1.00	1.05	25.73	2.87	52,623,237	
		Second Pump Station, lift (ft) =				700										
43.99	51	5.84	0.001724	21.50	6930	7740	351	2.59		3.00	1.00	1.05	28.45	2.87	0	
50.00	51	5.84	0.001724	21.50	7450	7685	102	0.00			1.00	1.05	22.58	2.87	36,625,827	
55.43	51	5.84	0.001724	21.50	6840	7635	345	2.50	3.00		1.00	1.07	28.89	2.87	42,317,713	
60.00	51	5.84	0.001724	21.50	7100	7594	214	0.64			1.00	1.07	23.69	2.87	29,216,235	
61.77	51	5.84	0.001724	21.50	6946	7578	274	1.43			1.22	1.07	29.94	2.87	14,295,341	
69.05	51	5.84	0.001724	21.50	7482	7511	13	0.00	9.00		1.10	1.07	35.90	2.87	70,484,229	
70.00	51	5.84	0.001724	21.50	6940	7503	244	1.02			1.20	1.07	28.92	2.87	7,412,536	
74.85	51	5.84	0.001724	21.50	6740	7459	311	1.98			1.00	1.07	25.13	2.87	32,887,088	
		Hydropower Station, head (ft) =				719							2 River Crossings		3,000,000	
														Total Cost of Pipeline =	**527,333,054**	**24,128,469**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2100	0.85	17,318			13,754,819
Capital Costs									52,500,000	2,402,172
O&M Costs										525,000
								Total Cost of Pump Station(s) =	**52,500,000**	**16,681,991**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	719	0.82	4,131			-4,221,714
Capital Costs									6,000,000	274,534
O&M Costs										60,000
								Total Cost of Hydrostation =	**6,000,000**	**-3,887,180**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	585,833,054	
15% Design & Administration	87,874,958	4,020,776
10% Contingency	58,583,305	2,680,517
TOTAL PROJECT COST	**732,291,317**	**43,624,573**
UNIT WATER COST, FULL USE ($/af)		**727**
YEARLY OPERATING COST (Energy+O&M)		**10,118,105**

Alternative 9 - Alignment C, Flaming Gorge Reservoir to Weber River, Echo Reservoir (one pump station)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				2100							Right-of-Way Width (ft) =		100	
0.00	51	5.84	0.001724	21.50	6040	8140	910	15.46			1.00	1.05	38.80	11.48	0	
10.00	51	5.84	0.001724	21.50	6460	8049	688	9.43			1.00	1.05	32.47	11.48	88,053,542	
20.00	51	5.84	0.001724	21.50	6595	7958	591	7.15			1.00	1.05	30.09	11.48	81,619,152	
30.00	51	5.84	0.001724	21.50	6860	7867	436	4.05			1.00	1.05	26.83	11.48	72,858,949	
36.41	51	5.84	0.001724	21.50	6590	7809	528	5.82			1.00	1.05	28.69	11.48	49,910,800	
43.99	51	5.84	0.001724	21.50	6930	7740	351	2.59		3.00	1.00	1.05	28.45	2.87	58,180,589	
50.00	51	5.84	0.001724	21.50	7450	7685	102	0.00			1.00	1.05	22.58	2.87	36,625,827	
55.43	51	5.84	0.001724	21.50	6840	7635	345	2.50	3.00		1.00	1.07	28.89	2.87	42,317,713	
60.00	51	5.84	0.001724	21.50	7100	7594	214	0.64			1.00	1.07	23.69	2.87	29,216,235	
61.77	51	5.84	0.001724	21.50	6946	7578	274	1.43			1.22	1.07	29.94	2.87	14,295,341	
69.05	51	5.84	0.001724	21.50	7482	7511	13	0.00	9.00		1.10	1.07	35.90	2.87	70,484,229	
70.00	51	5.84	0.001724	21.50	6940	7503	244	1.02			1.20	1.07	28.92	2.87	7,412,536	
74.85	51	5.84	0.001724	21.50	6740	7459	311	1.98			1.00	1.07	25.13	2.87	32,887,088	
77.01	51	5.84	0.001724	21.50	6672	7439	332	2.30		9.00	1.00	1.07	35.10	2.87	20,447,239	
80.00	51	5.84	0.001724	21.50	6775	7412	276	1.46			1.00	1.07	24.57	2.87	19,828,775	
87.36	51	5.84	0.001724	21.50	6871	7345	205	0.53			1.00	1.07	23.57	2.87	46,822,713	
90.00	51	5.84	0.001724	21.50	6400	7321	399	3.39	9.00		1.00	1.07	36.27	2.87	25,821,652	
100.00	51	5.84	0.001724	21.50	6025	7230	522	5.70	9.00		1.00	1.07	38.74	2.87	104,460,392	
110.00	51	5.84	0.001724	21.50	5500	7139	710	9.96	9.00		1.10	1.07	47.62	2.87	128,389,313	
111.15	51	5.84	0.001724	21.50	5543	7128	687	9.39	9.00		1.10	1.07	46.95	2.87	14,556,120	
			Hydropower Station, head (ft) =			1585							3 River Crossings		4,500,000	
														Total Cost of Pipeline =	**948,688,205**	**43,407,849**

PUMP STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2100	0.85	17,318			13,754,819
Capital Costs									31,000,000	1,418,425
O&M Costs										310,000
								Total Cost of Pump Station(s) =	**31,000,000**	**15,483,244**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1585	0.82	9,112			-9,312,333
Capital Costs									7,100,000	324,865
O&M Costs										71,000
								Total Cost of Hydrostation =	**7,100,000**	**-8,916,468**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	986,788,205	
15% Design & Administration	148,018,231	6,772,671
10% Contingency	98,678,820	4,515,114
TOTAL PROJECT COST	**1,233,485,256**	**61,262,411**
UNIT WATER COST, FULL USE ($/af)		**1,021**
YEARLY OPERATING COST (Energy+O&M)		**4,823,486**

Alternative 10 - Alignment C, Flaming Gorge Reservoir to Weber River, Echo Reservoir (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

$2000/acre in roadless areas

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400						Right-of-Way Width (ft) =		100		
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	11.48	0	
10.00	51	5.84	0.001724	21.50	6460	7349	385	3.16			1.00	1.05	25.89	11.48	70,327,789	
20.00	51	5.84	0.001724	21.50	6595	7258	287	1.63			1.00	1.05	24.28	11.48	65,992,927	
30.00	51	5.84	0.001724	21.50	6860	7167	133	0.00			1.00	1.05	22.58	11.48	61,396,104	
36.41	51	5.84	0.001724	21.50	6590	7109	225	0.77			1.00	1.05	23.39	11.48	40,754,027	
43.99	51	5.84	0.001724	21.50	6930	7040	47	0.00		3.00	1.00	1.05	25.73	2.87	52,623,237	
		Second Pump Station, lift (ft) =				700										
43.99	51	5.84	0.001724	21.50	6930	7740	351	2.59		3.00	1.00	1.05	28.45	2.87	0	
50.00	51	5.84	0.001724	21.50	7450	7685	102	0.00			1.00	1.05	22.58	2.87	36,625,827	
55.43	51	5.84	0.001724	21.50	6840	7635	345	2.50	3.00		1.00	1.07	28.89	2.87	42,317,713	
60.00	51	5.84	0.001724	21.50	7100	7594	214	0.64			1.00	1.07	23.69	2.87	29,216,235	
61.77	51	5.84	0.001724	21.50	6946	7578	274	1.43			1.22	1.07	29.94	2.87	14,295,341	
69.05	51	5.84	0.001724	21.50	7482	7511	13	0.00	9.00		1.10	1.07	35.90	2.87	70,484,229	
70.00	51	5.84	0.001724	21.50	6940	7503	244	1.02			1.20	1.07	28.92	2.87	7,412,536	
74.85	51	5.84	0.001724	21.50	6740	7459	311	1.98			1.00	1.07	25.13	2.87	32,887,088	
77.01	51	5.84	0.001724	21.50	6672	7439	332	2.30		9.00	1.00	1.07	35.10	2.87	20,447,239	
80.00	51	5.84	0.001724	21.50	6775	7412	276	1.46			1.00	1.07	24.57	2.87	19,828,775	
87.36	51	5.84	0.001724	21.50	6871	7345	205	0.53			1.00	1.07	23.57	2.87	46,822,713	
90.00	51	5.84	0.001724	21.50	6400	7321	399	3.39	9.00		1.00	1.07	36.27	2.87	25,821,652	
100.00	51	5.84	0.001724	21.50	6025	7230	522	5.70	9.00		1.00	1.07	38.74	2.87	104,460,392	
110.00	51	5.84	0.001724	21.50	5500	7139	710	9.96	9.00		1.10	1.07	47.62	2.87	128,389,313	
111.15	51	5.84	0.001724	21.50	5543	7128	687	9.39	9.00		1.10	1.07	46.95	2.87	14,556,120	
		Hydropower Station, head (ft) =				1585							3 River Crossings		4,500,000	
														Total Cost of Pipeline =	**889,159,257**	**40,684,063**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2100	0.85	17,318			13,754,819
Capital Costs									52,500,000	2,402,172
O&M Costs										525,000
								Total Cost of Pump Station(s) =	**52,500,000**	**16,681,991**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1585	0.82	9,112			-9,312,333
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-8,933,194**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	948,459,257	
15% Design & Administration	142,268,889	6,509,606
10% Contingency	94,845,926	4,339,737
TOTAL PROJECT COST	**1,185,574,072**	**59,282,203**
UNIT WATER COST, FULL USE ($/af)		**988**
YEARLY OPERATING COST (Energy+O&M)		**5,035,486**

Alternative 11 - Alignment C, Flaming Gorge Reservoir to Weber River, Rockport Lake (one pump station)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				2100							Right-of-Way Width (ft) =		100		
0.00	51	5.84	0.001724	21.50	6040	8140	910	15.46			1.00	1.05	38.80	11.48	0	
10.00	51	5.84	0.001724	21.50	6460	8049	688	9.43			1.00	1.05	32.47	11.48	88,053,542	
20.00	51	5.84	0.001724	21.50	6595	7958	591	7.15			1.00	1.05	30.09	11.48	81,619,152	
30.00	51	5.84	0.001724	21.50	6860	7867	436	4.05			1.00	1.05	26.83	11.48	72,858,949	
36.41	51	5.84	0.001724	21.50	6590	7809	528	5.82			1.00	1.05	28.69	11.48	49,910,800	
43.99	51	5.84	0.001724	21.50	6930	7740	351	2.59		3.00	1.00	1.05	28.45	2.87	58,180,589	
50.00	51	5.84	0.001724	21.50	7450	7685	102	0.00			1.00	1.05	22.58	2.87	36,625,827	
55.43	51	5.84	0.001724	21.50	6840	7635	345	2.50	3.00		1.00	1.07	28.89	2.87	42,317,713	
60.00	51	5.84	0.001724	21.50	7100	7594	214	0.64			1.00	1.07	23.69	2.87	29,216,235	
61.77	51	5.84	0.001724	21.50	6946	7578	274	1.43			1.22	1.07	29.94	2.87	14,295,341	
69.05	51	5.84	0.001724	21.50	7482	7511	13	0.00	9.00		1.10	1.07	35.90	2.87	70,484,229	
70.00	51	5.84	0.001724	21.50	6940	7503	244	1.02			1.20	1.07	28.92	2.87	7,412,536	
74.85	51	5.84	0.001724	21.50	6740	7459	311	1.98			1.00	1.07	25.13	2.87	32,887,088	
77.01	51	5.84	0.001724	21.50	6672	7439	332	2.30		9.00	1.00	1.07	35.10	2.87	20,447,239	
80.00	51	5.84	0.001724	21.50	6775	7412	276	1.46			1.00	1.07	24.57	2.87	19,828,775	
87.36	51	5.84	0.001724	21.50	6871	7345	205	0.53			1.00	1.07	23.57	2.87	46,822,713	
90.00	51	5.84	0.001724	21.50	6400	7321	399	3.39	9.00		1.00	1.07	36.27	2.87	25,821,652	
100.00	51	5.84	0.001724	21.50	6025	7230	522	5.70	9.00		1.00	1.07	38.74	2.87	104,460,392	
110.00	51	5.84	0.001724	21.50	5500	7139	710	9.96	9.00		1.10	1.07	47.62	2.87	128,389,313	
111.15	51	5.84	0.001724	21.50	5543	7128	687	9.39	9.00		1.10	1.07	46.95	2.87	14,556,120	
120.00	51	5.84	0.001724	21.50	5790	7048	545	6.17			1.00	1.07	29.61	2.87	70,702,098	
124.35	51	5.84	0.001724	21.50	6037	7008	421	3.78			1.00	1.07	27.04	2.87	31,744,861	
		Hydropower Station, head (ft) =				971							4 River Crossings		6,000,000	
														Total Cost of Pipeline =	**1,052,635,164**	**48,164,010**

PUMP STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2100	0.85	17,318			13,754,819
Capital Costs									31,000,000	1,418,425
O&M Costs										310,000
								Total Cost of Pump Station(s) =	**31,000,000**	**15,483,244**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	971	0.82	5,582			-5,704,497
Capital Costs									5,800,000	265,383
O&M Costs										58,000
								Total Cost of Hydrostation =	**5,800,000**	**-5,381,114**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,089,435,164	
15% Design & Administration	163,415,275	7,477,173
10% Contingency	108,943,516	4,984,782
TOTAL PROJECT COST	**1,361,793,955**	**70,728,095**
UNIT WATER COST, FULL USE ($/af)		**1,179**
YEARLY OPERATING COST (Energy+O&M)		**8,418,322**

Alternative 12 - Alignment C, Flaming Gorge Reservoir to Weber River, Rockport Lake (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

$2000/acre in roadless areas

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Groundwater ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400					Right-of-Way Width (ft) =			100		
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	11.48	0	
10.00	51	5.84	0.001724	21.50	6460	7349	385	3.16			1.00	1.05	25.89	11.48	70,327,789	
20.00	51	5.84	0.001724	21.50	6595	7258	287	1.63			1.00	1.05	24.28	11.48	65,992,927	
30.00	51	5.84	0.001724	21.50	6860	7167	133	0.00			1.00	1.05	22.58	11.48	61,396,104	
36.41	51	5.84	0.001724	21.50	6590	7109	225	0.77			1.00	1.05	23.39	11.48	40,754,027	
43.99	51	5.84	0.001724	21.50	6930	7040	47	0.00		3.00	1.00	1.05	25.73	11.48	52,967,845	
		Second Pump Station, lift (ft) =				700										
43.99	51	5.84	0.001724	21.50	6930	7740	351	2.59		3.00	1.00	1.05	28.45	2.87	0	
50.00	51	5.84	0.001724	21.50	7450	7685	102	0.00			1.00	1.05	22.58	2.87	36,625,827	
55.43	51	5.84	0.001724	21.50	6840	7635	345	2.50	3.00		1.00	1.07	28.89	2.87	42,317,713	
60.00	51	5.84	0.001724	21.50	7100	7594	214	0.64			1.00	1.07	23.69	2.87	29,216,235	
61.77	51	5.84	0.001724	21.50	6946	7578	274	1.43			1.22	1.07	29.94	2.87	14,295,341	
69.05	51	5.84	0.001724	21.50	7482	7511	13	0.00	9.00		1.10	1.07	35.90	2.87	70,484,229	
70.00	51	5.84	0.001724	21.50	6940	7503	244	1.02			1.20	1.07	28.92	2.87	7,412,536	
74.85	51	5.84	0.001724	21.50	6740	7459	311	1.98			1.00	1.07	25.13	2.87	32,887,088	
77.01	51	5.84	0.001724	21.50	6672	7439	332	2.30		9.00	1.00	1.07	35.10	2.87	20,447,239	
80.00	51	5.84	0.001724	21.50	6775	7412	276	1.46			1.00	1.07	24.57	2.87	19,828,775	
87.36	51	5.84	0.001724	21.50	6871	7345	205	0.53			1.00	1.07	23.57	2.87	46,822,713	
90.00	51	5.84	0.001724	21.50	6400	7321	399	3.39	9.00		1.00	1.07	36.27	2.87	25,821,652	
100.00	51	5.84	0.001724	21.50	6025	7230	522	5.70	9.00		1.00	1.07	38.74	2.87	104,460,392	
110.00	51	5.84	0.001724	21.50	5500	7139	710	9.96	9.00		1.10	1.07	47.62	2.87	128,389,313	
111.15	51	5.84	0.001724	21.50	5543	7128	687	9.39	9.00		1.10	1.07	46.95	2.87	14,556,120	
120.00	51	5.84	0.001724	21.50	5790	7048	545	6.17			1.00	1.07	29.61	2.87	70,702,098	
124.35	51	5.84	0.001724	21.50	6037	7008	421	3.78			1.00	1.07	27.04	2.87	31,744,861	
		Hydropower Station, head (ft) =				971							4 River Crossings		6,000,000	
														Total Cost of Pipeline =	**993,450,825**	**45,455,992**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2100	0.85	17,318			13,754,819
Capital Costs									52,500,000	2,402,172
O&M Costs										525,000
								Total Cost of Pump Station(s) =	**52,500,000**	**16,681,991**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	971	0.82	5,582			-5,704,497
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-5,325,359**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,052,750,825	
15% Design & Administration	157,912,624	7,225,395
10% Contingency	105,275,083	4,816,930
TOTAL PROJECT COST	**1,315,938,532**	**68,854,950**
UNIT WATER COST, FULL USE ($/af)		**1,148**
YEARLY OPERATING COST (Energy+O&M)		**8,643,322**

Alternative 13 - Alignment D, Flaming Gorge Reservoir to Weber River, Echo Reservoir (one pump station)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				2350						Right-of-Way Width (ft) =		100		
0.00	51	5.84	0.001724	21.50	6040	8390	1018	18.85			1.00	1.05	42.37	2.87	0	
9.94	51	5.84	0.001724	21.50	7200	8300	476	4.80			1.00	1.05	27.62	11.48	74,525,752	
20.00	51	5.84	0.001724	21.50	7205	8208	435	4.02			1.00	1.05	26.80	2.87	72,749,968	
30.00	51	5.84	0.001724	21.50	7588	8117	229	0.83			1.00	1.05	23.45	2.87	63,288,035	
32.31	51	5.84	0.001724	21.50	7613	8096	209	0.58			1.00	1.05	23.18	2.87	14,453,726	
40.00	51	5.84	0.001724	21.50	7960	8026	29	0.00	3.00		1.00	1.05	25.73	2.87	53,386,898	
50.00	51	5.84	0.001724	21.50	6745	7935	516	5.57			1.00	1.05	28.43	2.87	76,695,643	
54.93	51	5.84	0.001724	21.50	6930	7890	416	3.69		3.00	1.00	1.05	29.60	2.87	39,369,662	
60.00	51	5.84	0.001724	21.50	7365	7844	207	0.55			1.00	1.05	23.16	2.87	31,691,726	
63.01	51	5.84	0.001724	21.50	7458	7816	155	0.00			1.00	1.05	22.58	2.87	18,343,384	
66.37	51	5.84	0.001724	21.50	6840	7786	410	3.58	3.00		1.00	1.07	30.05	2.87	27,237,987	
70.00	51	5.84	0.001724	21.50	7326	7753	185	0.28			1.22	1.07	28.43	2.87	27,846,720	
72.71	51	5.84	0.001724	21.50	6946	7728	339	2.40			1.10	1.07	28.14	2.87	20,572,879	
77.36	51	5.84	0.001724	21.50	7482	7686	88	0.00			1.20	1.07	27.61	2.87	34,637,363	
80.00	51	5.84	0.001724	21.50	6946	7662	310	1.96	9.00		1.00	1.07	34.74	2.87	24,733,132	
85.79	51	5.84	0.001724	21.50	6740	7609	377	3.01			1.00	1.07	26.23	2.87	40,984,244	
87.95	51	5.84	0.001724	21.50	6672	7589	397	3.37		9.00	1.00	1.07	36.24	2.87	21,111,314	
90.00	51	5.84	0.001724	21.50	6750	7571	356	2.67			1.00	1.07	25.86	2.87	14,307,989	
97.18	51	5.84	0.001724	21.50	6871	7505	275	1.45			1.00	1.07	24.56	2.87	47,585,360	
98.30	51	5.84	0.001724	21.50	6600	7495	388	3.20			1.00	1.07	26.43	2.87	7,989,252	
100.00	51	5.84	0.001724	21.50	6496	7480	426	3.87	9.00		1.00	1.07	36.78	2.87	16,862,318	
110.00	51	5.84	0.001724	21.50	6090	7389	563	6.55	9.00		1.00	1.07	39.64	2.87	106,901,510	
120.00	51	5.84	0.001724	21.50	5525	7298	768	11.45	9.00		1.10	1.07	49.38	2.87	133,122,209	
122.22	51	5.84	0.001724	21.50	5543	7277	751	11.02	9.00		1.10	1.07	48.87	2.87	29,247,434	
		Hydropower Station, head (ft) =				1734							3 River Crossings		4,500,000	
														Total Cost of Pipeline =	**1,002,144,507**	**45,853,777**

PUMP STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2350	0.85	19,380			15,392,298
Capital Costs									31,000,000	1,418,425
O&M Costs										310,000
								Total Cost of Pump Station(s) =	**31,000,000**	**17,120,723**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1734	0.82	9,970			-10,188,990
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-9,809,852**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,039,944,507	
15% Design & Administration	155,991,676	7,137,501
10% Contingency	103,994,451	4,758,334
TOTAL PROJECT COST	**1,299,930,633**	**65,060,484**
UNIT WATER COST, FULL USE ($/af)		**1,084**
YEARLY OPERATING COST (Energy+O&M)		**5,581,307**

Alternative 14 - Alignment D, Flaming Gorge Reservoir to Weber River, Echo Reservoir (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

$2000/acre in roadless areas

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400					Right-of-Way Width (ft) =			100		
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	2.87	0	
9.94	51	5.84	0.001724	21.50	7200	7350	65	0.00			1.00	1.05	22.58	11.48	61,027,727	
20.00	51	5.84	0.001724	21.50	7205	7258	23	0.00			1.00	1.05	22.58	2.87	61,307,124	
		Second Pump Station, lift (ft) =				950										
20.00	51	5.84	0.001724	21.50	7205	8208	435	4.02			1.00	1.05	26.80	2.87	0	
30.00	51	5.84	0.001724	21.50	7588	8117	229	0.83			1.00	1.05	23.45	2.87	63,288,035	
32.31	51	5.84	0.001724	21.50	7613	8096	209	0.58			1.00	1.05	23.18	2.87	14,453,726	
40.00	51	5.84	0.001724	21.50	7960	8026	29	0.00	3.00		1.00	1.05	25.73	2.87	53,386,898	
50.00	51	5.84	0.001724	21.50	6745	7935	516	5.57			1.00	1.05	28.43	2.87	76,695,643	
54.93	51	5.84	0.001724	21.50	6930	7890	416	3.69		3.00	1.00	1.05	29.60	2.87	39,369,662	
60.00	51	5.84	0.001724	21.50	7365	7844	207	0.55			1.00	1.05	23.16	2.87	31,691,726	
63.01	51	5.84	0.001724	21.50	7458	7816	155	0.00			1.00	1.05	22.58	2.87	18,343,384	
66.37	51	5.84	0.001724	21.50	6840	7786	410	3.58	3.00		1.00	1.07	30.05	2.87	27,237,987	
70.00	51	5.84	0.001724	21.50	7326	7753	185	0.28			1.22	1.07	28.43	2.87	27,846,720	
72.71	51	5.84	0.001724	21.50	6946	7728	339	2.40			1.10	1.07	28.14	2.87	20,572,879	
77.36	51	5.84	0.001724	21.50	7482	7686	88	0.00			1.20	1.07	27.61	2.87	34,637,363	
80.00	51	5.84	0.001724	21.50	6946	7662	310	1.96	0.30		1.00	1.07	25.43	2.87	18,115,372	
85.79	51	5.84	0.001724	21.50	6740	7609	377	3.01			1.00	1.07	26.23	2.87	40,984,244	
87.95	51	5.84	0.001724	21.50	6672	7589	397	3.37		9.00	1.00	1.07	36.24	2.87	21,111,314	
90.00	51	5.84	0.001724	21.50	6750	7571	356	2.67			1.00	1.07	25.86	2.87	14,307,989	
97.18	51	5.84	0.001724	21.50	6871	7505	275	1.45			1.00	1.07	24.56	2.87	47,585,360	
98.30	51	5.84	0.001724	21.50	6600	7495	388	3.20			1.00	1.07	26.43	2.87	7,989,252	
100.00	51	5.84	0.001724	21.50	6496	7480	426	3.87	9.00		1.00	1.07	36.78	2.87	16,862,318	
110.00	51	5.84	0.001724	21.50	6090	7389	563	6.55	9.00		1.00	1.07	39.64	2.87	106,901,510	
120.00	51	5.84	0.001724	21.50	5525	7298	768	11.45	9.00		1.10	1.07	49.38	2.87	133,122,209	
122.22	51	5.84	0.001724	21.50	5543	7277	751	11.02	9.00		1.10	1.07	48.87	2.87	29,247,434	
		Hydropower Station, head (ft) =				1734							3 River Crossings		4,500,000	
														Total Cost of Pipeline =	**970,585,878**	**44,409,791**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2350	0.85	19,380			15,392,298
Capital Costs									55,000,000	2,516,561
O&M Costs										550,000
								Total Cost of Pump Station(s) =	**55,000,000**	**18,458,859**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1734	0.82	9,970			-10,188,990
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-9,809,852**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,032,385,878	
15% Design & Administration	154,857,882	7,085,624
10% Contingency	103,238,588	4,723,749
TOTAL PROJECT COST	**1,290,482,347**	**64,868,171**
UNIT WATER COST, FULL USE ($/af)		**1,081**
YEARLY OPERATING COST (Energy+O&M)		**5,821,307**

Alternative 15 - Alignment D, Flaming Gorge Reservoir to Weber River, Rockport Lake (one pump station)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				2350							Right-of-Way Width (ft) =		100		
0.00	51	5.84	0.001724	21.50	6040	8390	1018	18.85			1.00	1.05	42.37	2.87	0	
9.94	51	5.84	0.001724	21.50	7200	8300	476	4.80			1.00	1.05	27.62	11.48	74,525,752	
20.00	51	5.84	0.001724	21.50	7205	8208	435	4.02			1.00	1.05	26.80	2.87	72,749,968	
30.00	51	5.84	0.001724	21.50	7588	8117	229	0.83			1.00	1.05	23.45	2.87	63,288,035	
32.31	51	5.84	0.001724	21.50	7613	8096	209	0.58			1.00	1.05	23.18	2.87	14,453,726	
40.00	51	5.84	0.001724	21.50	7960	8026	29	0.00	3.00		1.00	1.05	25.73	2.87	53,386,898	
50.00	51	5.84	0.001724	21.50	6745	7935	516	5.57			1.00	1.05	28.43	2.87	76,695,643	
54.93	51	5.84	0.001724	21.50	6930	7890	416	3.69		3.00	1.00	1.05	29.60	2.87	39,369,662	
60.00	51	5.84	0.001724	21.50	7365	7844	207	0.55			1.00	1.05	23.16	2.87	31,691,726	
63.01	51	5.84	0.001724	21.50	7458	7816	155	0.00			1.00	1.05	22.58	2.87	18,343,384	
66.37	51	5.84	0.001724	21.50	6840	7786	410	3.58	3.00		1.00	1.07	30.05	2.87	27,237,987	
70.00	51	5.84	0.001724	21.50	7326	7753	185	0.28			1.22	1.07	28.43	2.87	27,846,720	
72.71	51	5.84	0.001724	21.50	6946	7728	339	2.40			1.10	1.07	28.14	2.87	20,572,879	
77.36	51	5.84	0.001724	21.50	7482	7686	88	0.00			1.20	1.07	27.61	2.87	34,637,363	
80.00	51	5.84	0.001724	21.50	6946	7662	310	1.96	9.00		1.00	1.07	34.74	2.87	24,733,132	
85.79	51	5.84	0.001724	21.50	6740	7609	377	3.01			1.00	1.07	26.23	2.87	40,984,244	
87.95	51	5.84	0.001724	21.50	6672	7589	397	3.37		9.00	1.00	1.07	36.24	2.87	21,111,314	
90.00	51	5.84	0.001724	21.50	6750	7571	356	2.67			1.00	1.07	25.86	2.87	14,307,989	
97.18	51	5.84	0.001724	21.50	6871	7505	275	1.45			1.00	1.07	24.56	2.87	47,585,360	
98.30	51	5.84	0.001724	21.50	6600	7495	388	3.20			1.00	1.07	26.43	2.87	7,989,252	
100.00	51	5.84	0.001724	21.50	6496	7480	426	3.87	9.00		1.00	1.07	36.78	2.87	16,862,318	
110.00	51	5.84	0.001724	21.50	6090	7389	563	6.55	9.00		1.00	1.07	39.64	2.87	106,901,510	
120.00	51	5.84	0.001724	21.50	5525	7298	768	11.45	9.00		1.10	1.07	49.38	2.87	133,122,209	
122.22	51	5.84	0.001724	21.50	5543	7277	751	11.02	9.00		1.10	1.07	48.87	2.87	29,247,434	
130.00	51	5.84	0.001724	21.50	5730	7207	640	8.27			1.00	1.07	31.85	2.87	66,845,342	
135.42	51	5.84	0.001724	21.50	6037	7157	485	4.98			1.00	1.07	28.33	2.87	41,429,153	
		Hydropower Station, head (ft) =				1120							4 River Crossings		6,000,000	
														Total Cost of Pipeline =	**1,111,919,001**	**50,876,581**

PUMP STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2350	0.85	19,380			15,392,298
Capital Costs									31,000,000	1,418,425
O&M Costs										310,000
								Total Cost of Pump Station(s) =	**31,000,000**	**17,120,723**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1120	0.82	6,439			-6,581,154
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-6,202,016**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,149,719,001	
15% Design & Administration	172,457,850	7,890,922
10% Contingency	114,971,900	5,260,614
TOTAL PROJECT COST	**1,437,148,752**	**74,946,824**
UNIT WATER COST, FULL USE ($/af)		**1,249**
YEARLY OPERATING COST (Energy+O&M)		**9,189,143**

Alternative 16 - Alignment D, Flaming Gorge Reservoir to Weber River, Rockport Lake (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

$2000/acre in roadless areas

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400					Right-of-Way Width (ft) =			100		
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	2.87	0	
9.94	51	5.84	0.001724	21.50	7200	7350	65	0.00			1.00	1.05	22.58	11.48	61,027,727	
20.00	51	5.84	0.001724	21.50	7205	7258	23	0.00			1.00	1.05	22.58	2.87	61,307,124	
		Second Pump Station, lift (ft) =				950										
20.00	51	5.84	0.001724	21.50	7205	8208	435	4.02			1.00	1.05	26.80	2.87	0	
30.00	51	5.84	0.001724	21.50	7588	8117	229	0.83			1.00	1.05	23.45	2.87	63,288,035	
32.31	51	5.84	0.001724	21.50	7613	8096	209	0.58			1.00	1.05	23.18	2.87	14,453,726	
40.00	51	5.84	0.001724	21.50	7960	8026	29	0.00	3.00		1.00	1.05	25.73	2.87	53,386,898	
50.00	51	5.84	0.001724	21.50	6745	7935	516	5.57			1.00	1.05	28.43	2.87	76,695,643	
54.93	51	5.84	0.001724	21.50	6930	7890	416	3.69		3.00	1.00	1.05	29.60	2.87	39,369,662	
60.00	51	5.84	0.001724	21.50	7365	7844	207	0.55			1.00	1.05	23.16	2.87	31,691,726	
63.01	51	5.84	0.001724	21.50	7458	7816	155	0.00			1.00	1.05	22.58	2.87	18,343,384	
66.37	51	5.84	0.001724	21.50	6840	7786	410	3.58	3.00		1.00	1.07	30.05	2.87	27,237,987	
70.00	51	5.84	0.001724	21.50	7326	7753	185	0.28			1.22	1.07	28.43	2.87	27,846,720	
72.71	51	5.84	0.001724	21.50	6946	7728	339	2.40			1.10	1.07	28.14	2.87	20,572,879	
77.36	51	5.84	0.001724	21.50	7482	7686	88	0.00			1.20	1.07	27.61	2.87	34,637,363	
80.00	51	5.84	0.001724	21.50	6946	7662	310	1.96	9.00		1.00	1.07	34.74	2.87	24,733,132	
85.79	51	5.84	0.001724	21.50	6740	7609	377	3.01			1.00	1.07	26.23	2.87	40,984,244	
87.95	51	5.84	0.001724	21.50	6672	7589	397	3.37		9.00	1.00	1.07	36.24	2.87	21,111,314	
90.00	51	5.84	0.001724	21.50	6750	7571	356	2.67			1.00	1.07	25.86	2.87	14,307,989	
97.18	51	5.84	0.001724	21.50	6871	7505	275	1.45			1.00	1.07	24.56	2.87	47,585,360	
98.30	51	5.84	0.001724	21.50	6600	7495	388	3.20			1.00	1.07	26.43	2.87	7,989,252	
100.00	51	5.84	0.001724	21.50	6496	7480	426	3.87	9.00		1.00	1.07	36.78	2.87	16,862,318	
110.00	51	5.84	0.001724	21.50	6090	7389	563	6.55	9.00		1.00	1.07	39.64	2.87	106,901,510	
120.00	51	5.84	0.001724	21.50	5525	7298	768	11.45	9.00		1.10	1.07	49.38	2.87	133,122,209	
122.22	51	5.84	0.001724	21.50	5543	7277	751	11.02	9.00		1.10	1.07	48.87	2.87	29,247,434	
130.00	51	5.84	0.001724	21.50	5730	7207	640	8.27			1.00	1.07	31.85	2.87	66,845,342	
135.42	51	5.84	0.001724	21.50	6037	7157	485	4.98			1.00	1.07	28.33	2.87	41,429,153	
		Hydropower Station, head (ft) =				1120							4 River Crossings		6,000,000	
															1,086,978,133	**49,735,395**

Total Cost of Pipeline =

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2350	0.85	19,380			15,392,298
Capital Costs									55,000,000	2,516,561
O&M Costs										550,000
								Total Cost of Pump Station(s) =	**55,000,000**	**18,458,859**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1120	0.82	6,439			-6,581,154
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-6,202,016**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,148,778,133	
15% Design & Administration	172,316,720	7,884,464
10% Contingency	114,877,813	5,256,309
TOTAL PROJECT COST	**1,435,972,666**	**75,133,012**
UNIT WATER COST, FULL USE ($/af)		**1,252**
YEARLY OPERATING COST (Energy+O&M)		**9,429,143**

Alternative 17 - Alignment C-E, Flaming Gorge Reservoir to Weber River, above the Provo Diversion (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

$2000/acre in roadless areas

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400							Right-of-Way Width (ft) =		100	
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	11.48	0	
10.00	51	5.84	0.001724	21.50	6460	7349	385	3.16			1.00	1.05	25.89	11.48	70,327,789	
20.00	51	5.84	0.001724	21.50	6595	7258	287	1.63			1.00	1.05	24.28	11.48	65,992,927	
30.00	51	5.84	0.001724	21.50	6860	7167	133	0.00			1.00	1.05	22.58	11.48	61,396,104	
36.41	51	5.84	0.001724	21.50	6590	7109	225	0.77			1.00	1.05	23.39	11.48	40,754,027	
43.99	51	5.84	0.001724	21.50	6930	7040	47	0.00		3.00	1.00	1.05	25.73	11.48	52,967,845	
		Second Pump Station, lift (ft) =				730										
43.99	51	5.84	0.001724	21.50	6930	7770	364	2.80		3.00	1.00	1.05	28.67	2.87	0	
50.00	51	5.84	0.001724	21.50	7450	7715	115	0.00			1.00	1.05	22.58	2.87	36,625,827	
55.43	51	5.84	0.001724	21.50	6840	7665	358	2.70	3.00		1.00	1.07	29.11	2.87	42,643,675	
60.00	51	5.84	0.001724	21.50	7100	7624	227	0.80			1.00	1.07	23.86	2.87	29,434,657	
61.77	51	5.84	0.001724	21.50	6946	7608	287	1.62			1.22	1.07	30.18	2.87	14,410,628	
66.40	51	5.84	0.001724	21.50	7482	7566	36	0.00	9.00		1.10	1.07	35.90	2.87	44,827,195	
69.00	51	5.84	0.001724	21.50	6946	7542	258	1.22			1.00	1.07	24.31	2.87	17,057,676	
71.00	51	5.84	0.001724	21.50	6740	7524	340	2.42			1.00	1.07	25.59	2.87	13,811,574	
75.40	51	5.84	0.001724	21.50	6845	7484	277	1.48			1.20	1.07	29.50	2.87	35,019,507	
76.60	51	5.84	0.001724	21.50	6870	7473	261	1.26		9.00	1.00	1.07	33.98	11.48	11,053,166	
79.80	51	5.84	0.001724	21.50	6900	7444	236	0.91			1.00	1.07	23.98	2.87	20,713,592	
80.80	51	5.84	0.001724	21.50	7075	7434	156	0.00	9.00		1.20	1.07	39.16	2.87	10,560,695	
83.00	51	5.84	0.001724	21.50	6975	7414	190	0.35	9.00		1.20	1.07	39.61	11.48	23,596,496	
86.20	51	5.84	0.001724	21.50	7100	7385	124	0.00	9.00		1.20	1.07	39.16	2.87	33,794,224	
91.00	51	5.84	0.001724	21.50	7330	7342	5	0.00			1.00	1.07	23.01	2.87	29,807,702	
92.50	51	5.84	0.001724	21.50	7145	7328	79	0.00	9.00		1.20	1.07	39.16	2.87	15,841,042	
102.00	51	5.84	0.001724	21.50	6960	7242	122	0.00		9.00	1.00	1.07	32.64	2.87	83,629,491	
104.00	51	5.84	0.001724	21.50	6345	7223	381	3.08			1.00	1.07	26.30	2.87	14,195,458	
106.00	51	5.84	0.001724	21.50	6145	7205	459	4.48			1.00	1.07	27.80	2.87	15,001,060	
107.70	51	5.84	0.001724	21.50	6000	7190	515	5.57			1.00	1.07	28.96	2.87	13,285,130	
111.70	51	5.84	0.001724	21.50	5800	7153	586	7.06			1.00	1.07	30.56	2.87	32,976,399	
118.00	51	5.84	0.001724	21.50	5600	7096	648	8.46			1.00	1.07	32.06	11.48	54,768,874	
		Hydropower Station, head (ft) =				1496							3 River Crossings		4,500,000	
														Total Cost of Pipeline =	**888,992,761**	**40,676,445**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2130	0.85	17,566			13,951,317
Capital Costs									30,500,000	1,395,547
O&M Costs										305,000
								Total Cost of Pump Station(s) =	**30,500,000**	**15,651,864**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1496	0.82	8,598			-8,787,426
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-8,408,288**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	926,292,761	
15% Design & Administration	138,943,914	6,357,470
10% Contingency	92,629,276	4,238,313
TOTAL PROJECT COST	**1,157,865,951**	**58,515,804**
UNIT WATER COST, FULL USE ($/af)		**975**
YEARLY OPERATING COST (Energy+O&M)		**5,536,890**

Alternative 18 - Alignment D-E, Flaming Gorge Reservoir to Weber River, above Provo Diversion (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

$2000/acre in roadless areas

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400							Right-of-Way Width (ft) =		100	
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	2.87	0	
9.94	51	5.84	0.001724	21.50	7200	7350	65	0.00			1.00	1.05	22.58	11.48	61,027,727	
20.00	51	5.84	0.001724	21.50	7205	7258	23	0.00			1.00	1.05	22.58	2.87	61,307,124	
		Second Pump Station, lift (ft) =				900										
20.00	51	5.84	0.001724	21.50	7205	8158	413	3.64			1.00	1.05	26.39	2.87	0	
30.00	51	5.84	0.001724	21.50	7588	8067	208	0.55			1.00	1.05	23.16	2.87	62,509,609	
32.31	51	5.84	0.001724	21.50	7613	8046	188	0.31			1.00	1.05	22.90	2.87	14,280,964	
40.00	51	5.84	0.001724	21.50	7960	7976	7	0.00	3.00		1.00	1.05	25.73	2.87	53,386,898	
50.00	51	5.84	0.001724	21.50	6745	7885	494	5.14			1.00	1.05	27.97	2.87	75,478,690	
54.93	51	5.84	0.001724	21.50	6930	7840	394	3.31		3.00	1.00	1.05	29.20	2.87	38,844,896	
60.00	51	5.84	0.001724	21.50	7365	7794	186	0.29			1.00	1.05	22.88	2.87	31,313,911	
63.01	51	5.84	0.001724	21.50	7458	7766	134	0.00			1.00	1.05	22.58	2.87	18,343,384	
66.37	51	5.84	0.001724	21.50	6840	7736	388	3.21	3.00		1.00	1.07	29.65	2.87	26,876,737	
70.00	51	5.84	0.001724	21.50	7326	7703	163	0.03			1.22	1.07	28.10	2.87	27,525,995	
72.71	51	5.84	0.001724	21.50	6946	7678	317	2.07			1.10	1.07	27.74	2.87	20,285,373	
77.40	51	5.84	0.001724	21.50	7482	7635	66	0.00	9.00		1.20	1.07	39.16	2.87	49,529,659	
80.00	51	5.84	0.001724	21.50	6946	7612	288	1.64			1.00	1.07	24.76	2.87	17,377,061	
82.00	51	5.84	0.001724	21.50	6740	7594	370	2.90			1.00	1.07	26.11	2.87	14,092,741	
86.40	51	5.84	0.001724	21.50	6845	7554	307	1.92			1.20	1.07	30.07	2.87	35,689,425	
87.60	51	5.84	0.001724	21.50	6870	7543	291	1.69		9.00	1.00	1.07	34.44	11.48	11,201,347	
90.80	51	5.84	0.001724	21.50	6900	7513	266	1.32			1.00	1.07	24.42	2.87	21,090,865	
91.80	51	5.84	0.001724	21.50	7075	7504	186	0.29	9.00		1.20	1.07	39.54	2.87	10,662,120	
94.00	51	5.84	0.001724	21.50	6975	7484	221	0.72	9.00		1.20	1.07	40.09	11.48	23,881,774	
97.20	51	5.84	0.001724	21.50	7100	7455	154	0.00	9.00		1.20	1.07	39.16	2.87	33,794,224	
102.00	51	5.84	0.001724	21.50	7330	7412	35	0.00			1.00	1.07	23.01	2.87	29,807,702	
103.50	51	5.84	0.001724	21.50	7145	7398	110	0.00	9.00		1.20	1.07	39.16	2.87	15,841,042	
113.00	51	5.84	0.001724	21.50	6960	7311	152	0.00		9.00	1.00	1.07	32.64	2.87	83,629,491	
115.00	51	5.84	0.001724	21.50	6345	7293	411	3.60			1.00	1.07	26.86	2.87	14,494,502	
117.00	51	5.84	0.001724	21.50	6145	7275	490	5.06			1.00	1.07	28.42	2.87	15,334,456	
118.70	51	5.84	0.001724	21.50	6000	7259	546	6.19			1.00	1.07	29.63	2.87	13,589,320	
122.70	51	5.84	0.001724	21.50	5800	7223	617	7.73			1.00	1.07	31.28	2.87	33,753,964	
129.00	51	5.84	0.001724	21.50	5600	7166	678	9.18			1.00	1.07	32.83	11.48	56,078,451	
		Hydropower Station, head (ft) =				1566							3 River Crossings		4,500,000	
														Total Cost of Pipeline =	**975,529,455**	**44,635,988**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2300	0.85	18,968			15,064,802
Capital Costs									55,000,000	2,516,561
O&M Costs										550,000
								Total Cost of Pump Station(s) =	**55,000,000**	**18,131,363**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1566	0.82	9,000			-9,197,871
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-8,818,732**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,037,329,455	
15% Design & Administration	155,599,418	7,119,553
10% Contingency	103,732,946	4,746,369
TOTAL PROJECT COST	**1,296,661,819**	**65,814,541**
UNIT WATER COST, FULL USE ($/af)		**1,097**
YEARLY OPERATING COST (Energy+O&M)		**6,484,931**

Alternative 19 - Alignment C-F, Flaming Gorge Reservoir to Weber River, above the Provo Diversion (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

$2000/acre in roadless areas

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400							Right-of-Way Width (ft) =		100	
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	11.48	0	
10.00	51	5.84	0.001724	21.50	6460	7349	385	3.16			1.00	1.05	25.89	11.48	70,327,789	
20.00	51	5.84	0.001724	21.50	6595	7258	287	1.63			1.00	1.05	24.28	11.48	65,992,927	
30.00	51	5.84	0.001724	21.50	6860	7167	133	0.00			1.00	1.05	22.58	11.48	61,396,104	
36.41	51	5.84	0.001724	21.50	6590	7109	225	0.77			1.00	1.05	23.39	11.48	40,754,027	
43.99	51	5.84	0.001724	21.50	6930	7040	47	0.00		3.00	1.00	1.05	25.73	11.48	52,967,845	
		Second Pump Station, lift (ft) =				730										
43.99	51	5.84	0.001724	21.50	6930	7770	364	2.80		3.00	1.00	1.05	28.67	2.87	0	
50.00	51	5.84	0.001724	21.50	7450	7715	115	0.00			1.00	1.05	22.58	2.87	36,625,827	
55.43	51	5.84	0.001724	21.50	6840	7665	358	2.70	3.00		1.00	1.07	29.11	2.87	42,643,675	
60.00	51	5.84	0.001724	21.50	7100	7624	227	0.80			1.00	1.07	23.86	2.87	29,434,657	
61.77	51	5.84	0.001724	21.50	6946	7608	287	1.62			1.22	1.07	30.18	2.87	14,410,628	
66.40	51	5.84	0.001724	21.50	7482	7566	36	0.00	9.00		1.10	1.07	35.90	2.87	44,827,195	
69.00	51	5.84	0.001724	21.50	6946	7542	258	1.22			1.00	1.07	24.31	2.87	17,057,676	
71.00	51	5.84	0.001724	21.50	6740	7524	340	2.42			1.00	1.07	25.59	2.87	13,811,574	
75.40	51	5.84	0.001724	21.50	6845	7484	277	1.48			1.20	1.07	29.50	2.87	35,019,507	
76.60	51	5.84	0.001724	21.50	6870	7473	261	1.26		9.00	1.00	1.07	33.98	11.48	11,053,166	
79.80	51	5.84	0.001724	21.50	6900	7444	236	0.91			1.00	1.07	23.98	2.87	20,713,592	
80.80	51	5.84	0.001724	21.50	7075	7434	156	0.00	9.00		1.20	1.07	39.16	2.87	10,560,695	
83.00	51	5.84	0.001724	21.50	6975	7414	190	0.35	9.00		1.20	1.07	39.61	11.48	23,596,496	
86.20	51	5.84	0.001724	21.50	7100	7385	124	0.00	9.00		1.20	1.07	39.16	2.87	33,794,224	
91.00	51	5.84	0.001724	21.50	7330	7342	5	0.00			1.00	1.07	23.01	2.87	29,807,702	
92.50	51	5.84	0.001724	21.50	7145	7328	79	0.00	9.00		1.20	1.07	39.16	2.87	15,841,042	
102.00	51	5.84	0.001724	21.50	6960	7242	122	0.00		9.00	1.00	1.07	32.64	2.87	83,629,491	
104.00	51	5.84	0.001724	21.50	6345	7223	381	3.08			1.00	1.07	26.30	2.87	14,195,458	
106.00	51	5.84	0.001724	21.50	6145	7205	459	4.48			1.00	1.07	27.80	2.87	15,001,060	
107.70	51	5.84	0.001724	21.50	6000	7190	515	5.57			1.00	1.07	28.96	2.87	13,285,130	
111.70	51	5.84	0.001724	21.50	5800	7153	586	7.06			1.00	1.07	30.56	2.87	32,976,399	
112.00	51	5.84	0.001724	21.50	6500	7150	282	1.55	9.00		1.20	1.07	41.15	2.87	3,328,805	
131.00	51	5.84	0.001724	21.50	6490	6978	211	0.60	9.00		1.20	1.07	39.93	2.87	204,602,904	
		Hydropower Station, head (ft) =				488							3 River Crossings		4,500,000	
														Total Cost of Pipeline =	**1,042,155,595**	**47,684,511**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.012	0.035	0.225	82.85	2130	0.85	17,566			13,951,317
Capital Costs									52,500,000	2,402,172
O&M Costs										525,000
								Total Cost of Pump Station(s) =	**52,500,000**	**16,878,488**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	488	0.82	2,802			-2,864,001
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-2,484,863**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,101,455,595	
15% Design & Administration	165,218,339	7,559,673
10% Contingency	110,145,560	5,039,782
TOTAL PROJECT COST	**1,376,819,494**	**74,677,591**
UNIT WATER COST, FULL USE ($/af)		**1,245**
YEARLY OPERATING COST (Energy+O&M)		**11,680,315**

Alternative 20 - Alignment D-F, Flaming Gorge Reservoir to Weber River, above Provo Diversion (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

$2000/acre in roadless areas

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400							Right-of-Way Width (ft) =		100	
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	2.87	0	
9.94	51	5.84	0.001724	21.50	7200	7350	65	0.00			1.00	1.05	22.58	11.48	61,027,727	
20.00	51	5.84	0.001724	21.50	7205	7258	23	0.00			1.00	1.05	22.58	2.87	61,307,124	
		Second Pump Station, lift (ft) =				900										
20.00	51	5.84	0.001724	21.50	7205	8158	413	3.64			1.00	1.05	26.39	2.87	0	
30.00	51	5.84	0.001724	21.50	7588	8067	208	0.55			1.00	1.05	23.16	2.87	62,509,609	
32.31	51	5.84	0.001724	21.50	7613	8046	188	0.31			1.00	1.05	22.90	2.87	14,280,964	
40.00	51	5.84	0.001724	21.50	7960	7976	7	0.00	3.00		1.00	1.05	25.73	2.87	53,386,898	
47.35	51	5.84	0.001724	21.50	6745	7909	504	5.35			1.00	1.05	28.19	2.87	55,905,324	
54.93	51	5.84	0.001724	21.50	6930	7840	394	3.31		3.00	1.00	1.05	29.20	2.87	59,725,013	
60.00	51	5.84	0.001724	21.50	7365	7794	186	0.29			1.00	1.05	22.88	2.87	31,313,911	
63.01	51	5.84	0.001724	21.50	7458	7766	134	0.00			1.00	1.05	22.58	2.87	18,343,384	
66.37	51	5.84	0.001724	21.50	6840	7736	388	3.21	3.00		1.00	1.07	29.65	2.87	26,876,737	
70.00	51	5.84	0.001724	21.50	7326	7703	163	0.03			1.22	1.07	28.10	2.87	27,525,995	
72.71	51	5.84	0.001724	21.50	6946	7678	317	2.07			1.10	1.07	27.74	2.87	20,285,373	
77.40	51	5.84	0.001724	21.50	7482	7635	66	0.00	9.00		1.20	1.07	39.16	2.87	49,529,659	
80.00	51	5.84	0.001724	21.50	6946	7612	288	1.64			1.00	1.07	24.76	2.87	17,377,061	
82.00	51	5.84	0.001724	21.50	6740	7594	370	2.90			1.00	1.07	26.11	2.87	14,092,741	
86.40	51	5.84	0.001724	21.50	6845	7554	307	1.92			1.20	1.07	30.07	2.87	35,689,425	
87.60	51	5.84	0.001724	21.50	6870	7543	291	1.69		9.00	1.00	1.07	34.44	11.48	11,201,347	
90.80	51	5.84	0.001724	21.50	6900	7513	266	1.32			1.00	1.07	24.42	2.87	21,090,865	
91.80	51	5.84	0.001724	21.50	7075	7504	186	0.29	9.00		1.20	1.07	39.54	2.87	10,662,120	
94.00	51	5.84	0.001724	21.50	6975	7484	221	0.72	9.00		1.20	1.07	40.09	11.48	23,881,774	
97.20	51	5.84	0.001724	21.50	7100	7455	154	0.00	9.00		1.20	1.07	39.16	2.87	33,794,224	
102.00	51	5.84	0.001724	21.50	7330	7412	35	0.00			1.00	1.07	23.01	2.87	29,807,702	
103.50	51	5.84	0.001724	21.50	7145	7398	110	0.00	9.00		1.20	1.07	39.16	2.87	15,841,042	
113.00	51	5.84	0.001724	21.50	6960	7311	152	0.00		9.00	1.00	1.07	32.64	2.87	83,629,491	
115.00	51	5.84	0.001724	21.50	6345	7293	411	3.60			1.00	1.07	26.86	2.87	14,494,502	
117.00	51	5.84	0.001724	21.50	6145	7275	490	5.06			1.00	1.07	28.42	2.87	15,334,456	
118.70	51	5.84	0.001724	21.50	6000	7259	546	6.19			1.00	1.07	29.63	2.87	13,589,320	
122.70	51	5.84	0.001724	21.50	5800	7223	617	7.73			1.00	1.07	31.28	2.87	33,753,964	
123.00	51	5.84	0.001724	21.50	6500	7220	312	1.99	9.00		1.20	1.07	41.72	2.87	3,374,884	
142.00	51	5.84	0.001724	21.50	6490	7047	242	0.99	9.00		1.20	1.07	40.44	2.87	207,170,208	
		Hydropower Station, head (ft) =				557							3 River Crossings		4,500,000	
															Total Cost of Pipeline =	**1,131,302,846**	**51,763,501**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.125	0.035	0.225	82.85	2300	0.85	18,968			21,323,341
Capital Costs									62,000,000	2,836,851
O&M Costs										620,000
								Total Cost of Pump Station(s) =	**62,000,000**	**24,780,192**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	557	0.82	3,204			-3,274,446
Capital Costs									6,000,000	274,534
O&M Costs										60,000
								Total Cost of Hydrostation =	**6,000,000**	**-2,939,912**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,199,302,846	
15% Design & Administration	179,895,427	8,231,233
10% Contingency	119,930,285	5,487,489
TOTAL PROJECT COST	**1,499,128,558**	**87,322,503**
UNIT WATER COST, FULL USE ($/af)		**1,455**
YEARLY OPERATING COST (Energy+O&M)		**18,728,895**

Alternative 21 - Alignment C-G, Flaming Gorge Reservoir to Weber River, above the Provo Diversion (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre
				$2000/acre in roadless areas	

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)	
		Flaming Gorge Reservoir Elevation =				6040											
		Flaming Gorge Pump Station, lift (ft) =				1400							Right-of-Way Width (ft) =		100		
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	11.48	0		
10.00	51	5.84	0.001724	21.50	6460	7349	385	3.16			1.00	1.05	25.89	11.48	70,327,789		
20.00	51	5.84	0.001724	21.50	6595	7258	287	1.63			1.00	1.05	24.28	11.48	65,992,927		
30.00	51	5.84	0.001724	21.50	6860	7167	133	0.00			1.00	1.05	22.58	11.48	61,396,104		
36.41	51	5.84	0.001724	21.50	6590	7109	225	0.77			1.00	1.05	23.39	11.48	40,754,027		
43.99	51	5.84	0.001724	21.50	6930	7040	47	0.00		3.00	1.00	1.05	25.73	11.48	52,967,845		
		Second Pump Station, lift (ft) =				730											
43.99	51	5.84	0.001724	21.50	6930	7770	364	2.80		3.00	1.00	1.05	28.67	2.87	0		
50.00	51	5.84	0.001724	21.50	7450	7715	115	0.00			1.00	1.05	22.58	2.87	36,625,827		
55.43	51	5.84	0.001724	21.50	6840	7665	358	2.70	3.00		1.00	1.07	29.11	2.87	42,643,675		
60.00	51	5.84	0.001724	21.50	7100	7624	227	0.80			1.00	1.07	23.86	2.87	29,434,657		
61.77	51	5.84	0.001724	21.50	6946	7608	287	1.62			1.22	1.07	30.18	2.87	14,410,628		
66.40	51	5.84	0.001724	21.50	7482	7566	36	0.00	9.00		1.10	1.07	35.90	2.87	44,827,195		
69.00	51	5.84	0.001724	21.50	6946	7542	258	1.22			1.00	1.07	24.31	2.87	17,057,676		
71.00	51	5.84	0.001724	21.50	6740	7524	340	2.42			1.00	1.07	25.59	2.87	13,811,574		
75.40	51	5.84	0.001724	21.50	6845	7484	277	1.48			1.20	1.07	29.50	2.87	35,019,507		
76.60	51	5.84	0.001724	21.50	6870	7473	261	1.26		9.00	1.00	1.07	33.98	11.48	11,053,166		
79.80	51	5.84	0.001724	21.50	6900	7444	236	0.91			1.00	1.07	23.98	2.87	20,713,592		
80.80	51	5.84	0.001724	21.50	7075	7434	156	0.00	9.00		1.20	1.07	39.16	2.87	10,560,695		
83.00	51	5.84	0.001724	21.50	6975	7414	190	0.35	9.00		1.20	1.07	39.61	11.48	23,596,496		
86.20	51	5.84	0.001724	21.50	7100	7385	124	0.00	9.00		1.20	1.07	39.16	2.87	33,794,224		
91.00	51	5.84	0.001724	21.50	7330	7342	5	0.00			1.00	1.07	23.01	2.87	29,807,702		
92.50	51	5.84	0.001724	21.50	7145	7328	79	0.00	9.00		1.20	1.07	39.16	2.87	15,841,042		
102.00	51	5.84	0.001724	21.50	6960	7242	122	0.00		9.00	1.00	1.07	32.64	2.87	83,629,491		
112.00	51	5.84	0.001724	21.50	7120	7150	13	0.00	9.00		1.20	1.07	39.16	2.87	105,606,949		
115.00	51	5.84	0.001724	21.50	7120	7123	1	0.00					17,000,000		56,000,000	Tunnel	
116.00	51	5.84	0.001724	21.50	6850	7114	114	0.00	9.00		1.20	1.07	39.16	2.87	10,560,695		
120.00	51	5.84	0.001724	21.50	6650	7078	185	0.28		9.00	1.00	1.07	32.94	11.48	35,722,265		
		Hydropower Station, head (ft) =				428							3 River Crossings		4,500,000		
														Total Cost of Pipeline =	**966,655,748**	**44,229,966**	

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.125	0.035	0.225	82.85	2130	0.85	17,566			19,747,268
Capital Costs									52,500,000	2,402,172
O&M Costs										525,000
								Total Cost of Pump Station(s) =	**52,500,000**	**22,674,440**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	428	0.82	2,458			-2,512,302
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-2,133,163**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,025,955,748	
15% Design & Administration	153,893,362	7,041,491
10% Contingency	102,595,575	4,694,328
TOTAL PROJECT COST	**1,282,444,685**	**76,507,061**
UNIT WATER COST, FULL USE ($/af)		**1,275**
YEARLY OPERATING COST (Energy+O&M)		**17,827,966**

Alternative 22 - Alignment D-G, Flaming Gorge Reservoir to Weber River, above Provo Diversion (two pump stations)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	=	82.85	cfs
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

$2000/acre in roadless areas

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				1400							Right-of-Way Width (ft) =		100	
0.00	51	5.84	0.001724	21.50	6040	7440	607	7.51			1.00	1.05	30.46	2.87	0	
9.94	51	5.84	0.001724	21.50	7200	7350	65	0.00			1.00	1.05	22.58	11.48	61,027,727	
20.00	51	5.84	0.001724	21.50	7205	7258	23	0.00			1.00	1.05	22.58	2.87	61,307,124	
		Second Pump Station, lift (ft) =				950										
20.00	51	5.84	0.001724	21.50	7205	8208	435	4.02			1.00	1.05	26.80	2.87	0	
30.00	51	5.84	0.001724	21.50	7588	8117	229	0.83			1.00	1.05	23.45	2.87	63,288,035	
32.31	51	5.84	0.001724	21.50	7613	8096	209	0.58			1.00	1.05	23.18	2.87	14,453,726	
40.00	51	5.84	0.001724	21.50	7960	8026	29	0.00	3.00		1.00	1.05	25.73	2.87	53,386,898	
50.00	51	5.84	0.001724	21.50	6745	7935	516	5.57			1.00	1.05	28.43	2.87	76,695,643	
54.93	51	5.84	0.001724	21.50	6930	7890	416	3.69		3.00	1.00	1.05	29.60	2.87	39,369,662	
60.00	51	5.84	0.001724	21.50	7365	7844	207	0.55			1.00	1.05	23.16	2.87	31,691,726	
63.01	51	5.84	0.001724	21.50	7458	7816	155	0.00			1.00	1.05	22.58	2.87	18,343,384	
66.37	51	5.84	0.001724	21.50	6840	7786	410	3.58	3.00		1.00	1.07	30.05	2.87	27,237,987	
70.00	51	5.84	0.001724	21.50	7326	7753	185	0.28			1.22	1.07	28.43	2.87	27,846,720	
72.71	51	5.84	0.001724	21.50	6946	7728	339	2.40			1.10	1.07	28.14	2.87	20,572,879	
77.40	51	5.84	0.001724	21.50	7482	7685	88	0.00	9.00		1.20	1.07	39.16	2.87	49,529,659	
80.00	51	5.84	0.001724	21.50	6946	7662	310	1.96			1.00	1.07	25.11	2.87	17,616,155	
82.00	51	5.84	0.001724	21.50	6740	7644	391	3.27			1.00	1.07	26.50	2.87	14,302,054	
86.40	51	5.84	0.001724	21.50	6845	7604	329	2.24			1.20	1.07	30.49	2.87	36,190,229	
87.60	51	5.84	0.001724	21.50	6870	7593	313	2.01		9.00	1.00	1.07	34.78	11.48	11,312,252	
90.80	51	5.84	0.001724	21.50	6900	7563	287	1.63			1.00	1.07	24.75	2.87	21,373,817	
91.80	51	5.84	0.001724	21.50	7075	7554	208	0.56	9.00		1.20	1.07	39.88	2.87	10,753,290	
94.00	51	5.84	0.001724	21.50	6975	7534	242	1.00	9.00		1.20	1.07	40.45	11.48	24,096,623	
97.20	51	5.84	0.001724	21.50	7100	7505	176	0.17	9.00		1.20	1.07	39.38	2.87	33,982,492	
102.00	51	5.84	0.001724	21.50	7330	7462	57	0.00			1.00	1.07	23.01	2.87	29,807,702	
103.50	51	5.84	0.001724	21.50	7145	7448	131	0.00	9.00		1.20	1.07	39.16	2.87	15,841,042	
113.00	51	5.84	0.001724	21.50	6960	7361	174	0.15		9.00	1.00	1.07	32.80	2.87	84,042,567	
123.00	51	5.84	0.001724	21.50	7120	7270	65	0.00	9.00		1.20	1.07	39.16	2.87	105,606,949	
126.00	51	5.84	0.001724	21.50	7200	7243	19	0.00					17,000,000		56,000,000	Tunnel
127.00	51	5.84	0.001724	21.50	6850	7234	166	0.06	9.00		1.20	1.07	39.24	2.87	10,582,821	
131.00	51	5.84	0.001724	21.50	6650	7198	237	0.94		9.00	1.00	1.07	33.64	11.48	36,472,380	
		Hydropower Station, head (ft) =				548							3 River Crossings		4,500,000	
														Total Cost of Pipeline =	**1,057,231,545**	**48,374,321**

PUMP STATION(S)

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.125	0.035	0.225	82.85	2350	0.85	19,380			21,786,892
Capital Costs									55,000,000	2,516,561
O&M Costs										550,000
								Total Cost of Pump Station(s) =	**55,000,000**	**24,853,453**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	548	0.82	3,147			-3,216,469
Capital Costs									6,800,000	311,138
O&M Costs										68,000
								Total Cost of Hydrostation =	**6,800,000**	**-2,837,330**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	1,119,031,545	
15% Design & Administration	167,854,732	7,680,303
10% Contingency	111,903,155	5,120,202
TOTAL PROJECT COST	**1,398,789,432**	**83,190,948**
UNIT WATER COST, FULL USE ($/af)		**1,387**
YEARLY OPERATING COST (Energy+O&M)		**19,188,423**

Alternative 23 - Alignment C-E, Flaming Gorge Reservoir to Weber River, above Provo Diversion (one pump station)

PROJECT DATA

Design Flow (Q) =	60,000	af/yr	= 82.85	cfs	
Manning's Roughness Coefficient (n) =	0.011				
Pipe Diameter (D) =	51	inches	Interest Rate =	3.90%	
Area (A) =	14.1863	ft^2	Period =	50	yrs.
Wetted Perimeter (Wp)	13.3518	ft			
Velocity (V) =	5.84049	ft/sec	Base Pipe Cost =	$21.50	/lf/in
Energy Gradient (S) =	0.00172		Right-of-Way Cost =	$1,250	/acre

PIPELINE

Station (miles)	Pipe Diam. (in.)	Velocity (ft/sec)	HGL Slope	Base Pipe Cost ($/ft/in)	Ground Elev.	HGL Elev.	Avg. Press. (psi)	Add for High Press. ($/ft/in)	Add for Rock ($/ft/in)	Add for Ground water ($/ft/in)	Slope Factor	Appurt. Factor	Unit Pipeline Cost ($/ft/in)	R/W Cost ($/lf)	Reach Cost ($)	Annualized Costs ($)
		Flaming Gorge Reservoir Elevation =				6040										
		Flaming Gorge Pump Station, lift (ft) =				2120							Right-of-Way Width (ft) =	100		
0.00	51	5.84	0.001724	21.50	6040	8160	919	15.72			1.00	1.05	39.08	11.48	0	
10.00	51	5.84	0.001724	21.50	6460	8069	697	9.64			1.00	1.05	32.70	11.48	88,655,534	
20.00	51	5.84	0.001724	21.50	6595	7978	599	7.34			1.00	1.05	30.29	11.48	82,161,157	
30.00	51	5.84	0.001724	21.50	6860	7887	445	4.21			1.00	1.05	27.00	11.48	73,306,467	
36.41	51	5.84	0.001724	21.50	6590	7829	537	6.00			1.00	1.05	28.88	11.48	50,233,664	
43.99	51	5.84	0.001724	21.50	6930	7760	359	2.73		3.00	1.00	1.05	28.59	2.87	58,480,107	
50.00	51	5.84	0.001724	21.50	7450	7705	110	0.00			1.00	1.05	22.58	2.87	36,625,827	
55.43	51	5.84	0.001724	21.50	6840	7655	353	2.63	3.00		1.00	1.07	29.03	2.87	42,534,287	
60.00	51	5.84	0.001724	21.50	7100	7614	223	0.75			1.00	1.07	23.80	2.87	29,361,232	
61.77	51	5.84	0.001724	21.50	6946	7598	282	1.56			1.22	1.07	30.10	2.87	14,371,907	
66.40	51	5.84	0.001724	21.50	7482	7556	32	0.00	3.00		1.10	1.07	28.84	2.87	36,022,531	
69.00	51	5.84	0.001724	21.50	6946	7532	254	1.16			1.00	1.07	24.24	2.87	17,013,369	
71.00	51	5.84	0.001724	21.50	6740	7514	335	2.35			1.00	1.07	25.52	2.87	13,772,413	
75.40	51	5.84	0.001724	21.50	6845	7474	272	1.41			1.20	1.07	29.42	2.87	34,926,476	
76.60	51	5.84	0.001724	21.50	6870	7463	257	1.20		9.00	1.00	1.07	33.92	11.48	11,032,606	
79.80	51	5.84	0.001724	21.50	6900	7434	231	0.86			1.00	1.07	23.92	2.87	20,661,323	
80.80	51	5.84	0.001724	21.50	7075	7424	151	0.00	3.00		1.20	1.07	31.46	2.87	8,486,162	
83.00	51	5.84	0.001724	21.50	6975	7404	186	0.29	3.00		1.20	1.07	31.84	11.48	18,993,119	
86.20	51	5.84	0.001724	21.50	7100	7375	119	0.00	3.00		1.20	1.07	31.46	2.87	27,155,718	
91.00	51	5.84	0.001724	21.50	7330	7332	1	0.00			1.00	1.07	23.01	2.87	29,807,702	
92.50	51	5.84	0.001724	21.50	7145	7318	75	0.00	3.00		1.20	1.07	31.46	2.87	12,729,243	
102.00	51	5.84	0.001724	21.50	6960	7232	118	0.00		9.00	1.00	1.07	32.64	2.87	83,629,491	
104.00	51	5.84	0.001724	21.50	6345	7213	376	3.01			1.00	1.07	26.22	2.87	14,153,738	
106.00	51	5.84	0.001724	21.50	6145	7195	455	4.40			1.00	1.07	27.71	2.87	14,954,423	
107.70	51	5.84	0.001724	21.50	6000	7180	511	5.48			1.00	1.07	28.87	2.87	13,242,511	
111.70	51	5.84	0.001724	21.50	5800	7143	582	6.97			1.00	1.07	30.46	2.87	32,867,270	
118.00	51	5.84	0.001724	21.50	5600	7086	644	8.36			1.00	1.07	31.95	11.48	54,584,844	
		Hydropower Station, head (ft) =				1486							4 River Crossings		6,000,000	
														Total Cost of Pipeline =	**925,763,119**	**42,358,897**

PUMP STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Total Lift (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.125	0.035	0.225	82.85	2120	0.85	17,483			19,654,558
Capital Costs									31,000,000	1,418,425
O&M Costs										310,000
								Total Cost of Pump Station(s) =	**31,000,000**	**21,382,983**

HYDROPOWER STATION

Item	Avg. ($/kwh)	Off Peak ($/kwh)	On Peak ($/kwh)	Flow (cfs)	Head (ft)	Effic.	Power (kW)		Cost ($)	Annualized Costs ($)
Energy Cost	0.090	0.035	0.225	82.85	1486	0.82	8,541			-8,728,682
Capital Costs									5,800,000	265,383
O&M Costs										58,000
								Total Cost of Hydrostation =	**5,800,000**	**-8,405,299**

PROJECT SUMMARY

Item	Cost ($)	Annualized Costs ($)
Total Construction Cost	962,563,119	
15% Design & Administration	144,384,468	6,606,406
10% Contingency	96,256,312	4,404,270
TOTAL PROJECT COST	**1,203,203,899**	**66,347,257**
UNIT WATER COST, FULL USE ($/af)		**1,106**
YEARLY OPERATING COST (Energy+O&M)		**11,293,876**