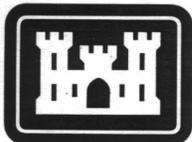

FINAL

**FLOOD DAMAGE REDUCTION
ALTERNATIVES REPORT**

TECHNICAL APPENDIX

CONTRACT NUMBER – DACW05-00-D-0017



**US Army Corps
of Engineers**

Sacramento District

Prepared by

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TECHNICAL APPENDIX

This technical appendix presents hydraulic modeling results of alternatives that were eliminated after initial consideration. Following the modeling results is a description of the process used to generate them. Information regarding cost estimates is also provided at the end of the appendix.

MODELING RESULTS OF OTHER CONSIDERED ALTERNATIVES

Table TA-1, the summary of alternatives for this appendix, explains what measures are included in each of the alternatives that were not fully discussed in the body of the report. In order to facilitate comparison with the five alternatives that were fully evaluated, all alternatives considered for this report are included in the table. In order to make finer distinctions between the various alternatives, the structure of the table differs somewhat from that of Table 2, which was presented in the body of the report. Alternatives in Table TA-1 are also identified with alphanumeric codes to aid in distinguishing them from each other.

Containment heights are presented in Table TA-2 for each of the alternatives that are not already provided in the main portion of the report.

Water surface elevation profiles can be found in Figures TA-1 and TA-2. Figure TA-1 contains Alternatives A, A4, B2, and D2, while Figure TA-2 contains Alternatives A2, B, D4, and E. Splitting them into two figures was done to ensure their readability. Some alternatives' profiles are very similar to one another, which makes them difficult to distinguish when placed together on one graph. Each figure also contains the existing conditions profile to provide a consistent standard for comparison.

In this appendix, the Preservation Alternative is not shown as a separate alternative because it is hydraulically identical to the Rehabilitation Alternative, whose results are presented in the main portion of the report.

HYDRAULIC MODELING DETAILS

In order to estimate the water surface elevations that would result from various alternatives and the corresponding floodwall heights that they would require, simulations were performed with the current version of HEC-RAS in the steady flow mode. This is a widely applied one-dimensional hydraulic model developed by the Corps' Hydrologic Engineering Center in Davis, California. "RAS" stands for "River Analysis System." Version 3.0 was used.

The model was calibrated using a flow of 23,000 cubic feet per second (cfs), which is believed to have been the peak flow at the Reno gage of the Truckee River during the 1997 flood event. Water surface elevations were compared with high water marks from the 1997 flood to perform the calibration. After completion of calibration, the 1-percent chance ("100-year") event design flow of 20,700 cfs was used to model the project alternatives and analyze their hydraulic effects.

Water surface elevation profiles for each alternative were generated from model simulations. In addition, the heights of new containment structures that would be required were estimated. The required containment height was calculated by taking the water surface elevation derived by the HEC-RAS model and subtracting the bank station elevation. This difference represents approximately how high above the bank any new containment structures would need to be. Adjustments were made as needed so that comparisons could be made to sidewalk elevation. A 4-foot margin of safety was then added to these differences to conservatively account for variation in flood events and for potential inaccuracies in data and modeling.

In addition to various project alternatives, existing conditions for the downtown Reno reach were simulated for comparison. The existing conditions model includes only those containment structures that now exist, reflecting conditions in which floodwaters overtop the banks and flow freely outside of the channel. Each project alternative was modeled with additional containment, beyond what now exists, to protect downtown

structures. These walls confine the flow of water to the channel and generate higher water surface elevations than under existing conditions. Measures that improve channel capacity or reduce restrictions serve to lower an alternative's water surface elevation and corresponding required containment heights.

COST ESTIMATES

Cost estimates for the five evaluated alternatives are presented in Table 4 in the body of the report and include:

- estimates of direct construction cost, adjusted to year 2001 dollars;
- a proportionate sum for contingency, cultural resources, design, and construction management; and
- land acquisition costs.

Land acquisition costs were initially developed in October 2000 by the Corps' Real Estate Division based upon alternatives formulated in May 2000, which relied principally upon replacement of floodwalls at the edge of the Truckee River channel. Adjustments have been made to those estimates to account for the additional land required on the north bank for terraced floodwall segments. Additional adjustments were made for those alternatives that involve the channel widening or plazas measures. However, for none of the alternatives have adjustments been made for the additional acquisition costs that would be required for setting back floodwalls from the river edge on the south bank. Consequently, the estimates understate in absolute terms the actual land acquisition costs that would be required, but the understatement applies equally to all alternatives. More comprehensive real estate estimates will be prepared at a later time in the analysis and documentation process for the regional project.

TECHNICAL APPENDIX

Tables

**Table TA-1
Alternatives Summary**

Alts.	Channelization	FWs/ Levees	Terraces @ Mapes & Midblock	Terraces @ Bundox	Plazas	Containment @ 1st St.	Replace Sierra and Lake Street Bridges	Replace Virginia Street Bridge	New Span @ Virginia St.	Mini Span @ Virginia St.	Mini Span @ Sierra St.	Culvert @ Lake St.	Mini Span @ Center St.	Widening on North Bank	Widening on South Bank	Comments
Existing Conditions																
Alt. A3 Rehabilitation	X	X	X	X												
Alt. F1 Rehabilitation - New Span	X	X		X	X	X			X		X	X	X	X		Plazas extended to 1st Street
Alt. C Matching Bridges	X	X	X	X			X	X								
Alt. C2 Landmark Bridges	X	X	X	X			X	X								Clear Span Concept
Alt. D Widening	X	X	X	X			X	X				X	X	X		
Alt. A	X	X		X	X					X	X	X	X	X	X	
Alt. A2	X	X		X	X	X			X							Plazas extended to 1st Street
Alt. A4 Reconstruction	X	X		X	X	X										Plazas extended to 1st Street
Alt. B	X	X		X	X		X			X		X	X	X		
Alt. B2	X	X		X	X		X			X		X	X	X	X	
Alt. D2	X	X		X	X		X	X				X	X	X	X	
Alt. D4	X	X		X	X	X	X	X								Plazas extended to 1st Street
Alt. E Capacity Combo	X	X		X	X		X	X					X	X	X	Clear Span Concept

**Table TA-2
Required Containment Heights for Other Alternatives Considered¹**

Left Bank (North Bank)

Left Bank Landmark	River Station	Alt A	Alt A2	Alt A4	Alt B	Alt B2	Alt D2	Alt D4	Alt E
S.W. corner Arlington & 1st St.	52.335	6.9	7.1	7.3	7.1	6.4	4.5	5.9	2.8
Arlington									
Mini-Park S.E. corner Arlington & 1st St.	52.292	5.0	5.4	5.7	5.4	4.2	1.4	3.3	0
Sierra St.									
Vacant portion of Masonic Block	52.148	5.3	3.3	3.8	6.0	5.3	0.5	0.9	0
E. end of Masonic bldg.	52.097	4.9	4.2	4.1	5.6	4.9	0.8	1.4	0
Virginia St.									
E. end of Mapes block	52.021	5.5	5.9	5.4	3.4	3.7	3.7	4.6	2.5
Center St.									
AT&T bldg.	51.990	2.8	4.1	4.2	1.4	1.4	1.4	2.6	0
Lake St.									

Right Bank (South Bank)

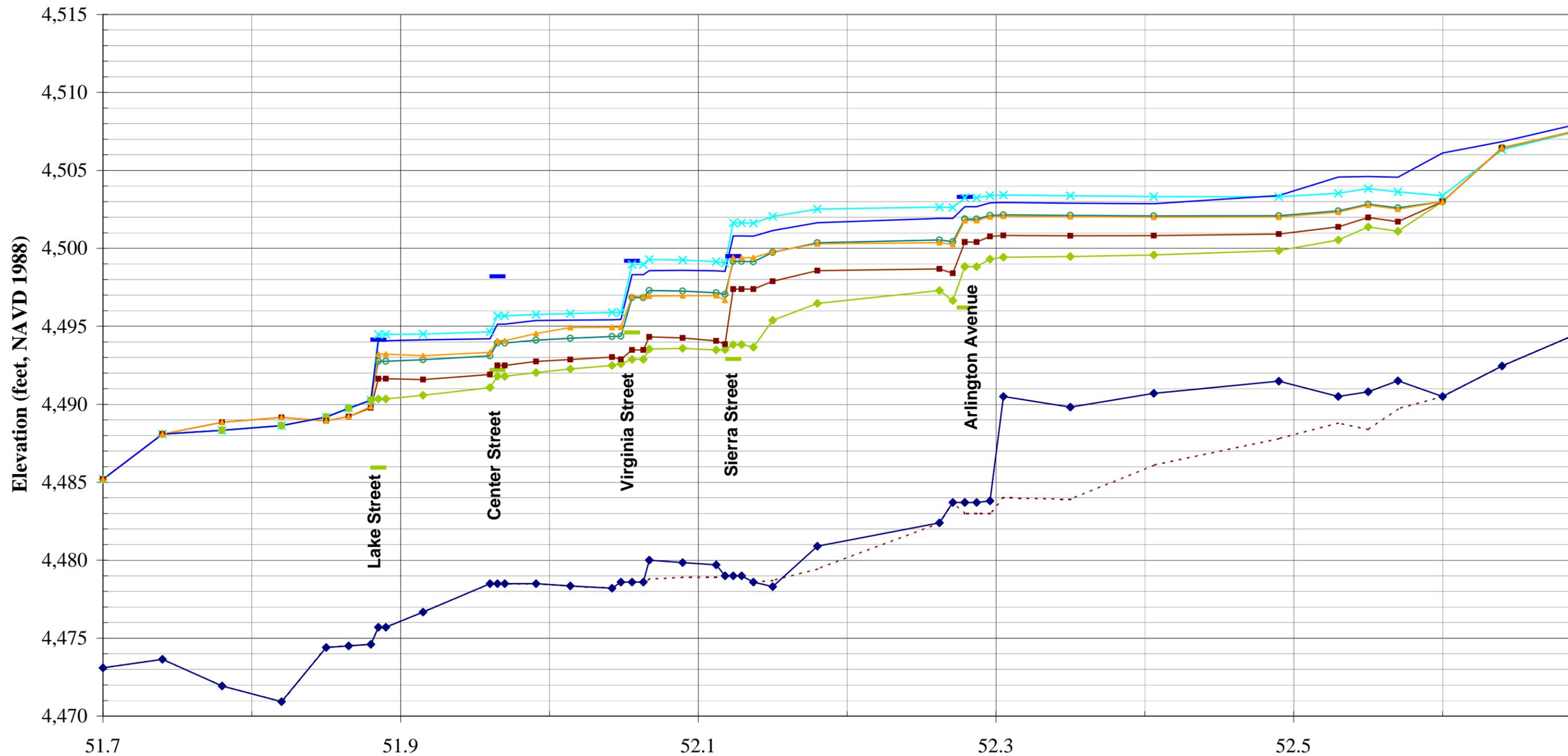
Right Bank Landmark	River Station	Alt A	Alt A2	Alt A4	Alt B	Alt B2	Alt D2	Alt D4	Alt E
Bluff	52.760	0	0	0	0	0	0	0	0
Barbara Bennett Park	52.335	8.9	9.1	9.3	9.1	8.4	6.5	7.9	4.8
Arlington									
Park Towers	52.292	6.0	6.5	6.8	6.5	5.3	2.4	4.3	0
Trinity Church	52.210	7.2	7.4	7.7	7.5	6.5	3.6	5.0	0.5
Sierra St.									
W. end Riverside Apts block	52.148	5.7	5.2	5.7	6.3	5.7	0	2.7	0
Riverside Apts.	52.097	4.6	1.4	6.4	5.3	4.6	0	0	0
Virginia St.									
E. end Post Office block	52.021	3.4	4.6	4.1	1.3	1.5	1.5	3.3	0.4
Center St.									
Siena Hotel	51.990	2.8	4.1	4.2	1.4	1.4	1.4	2.6	0
Lake St.									

1. Difference, in feet, between modeled water-surface elevation and bank elevation (sidewalk level). Includes margin of safety of 4 feet.

TECHNICAL APPENDIX

Figures

Alternative Profiles @ 20,700 cfs



Truckee River - Downtown Reno Reach

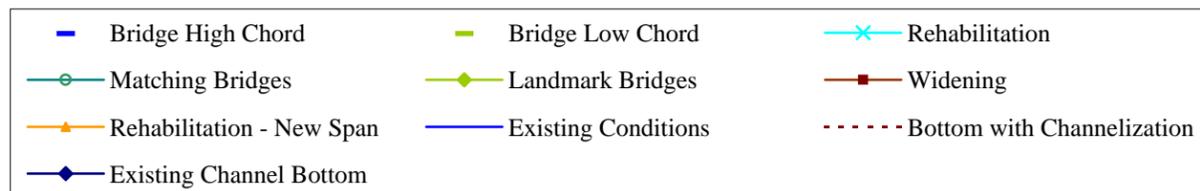
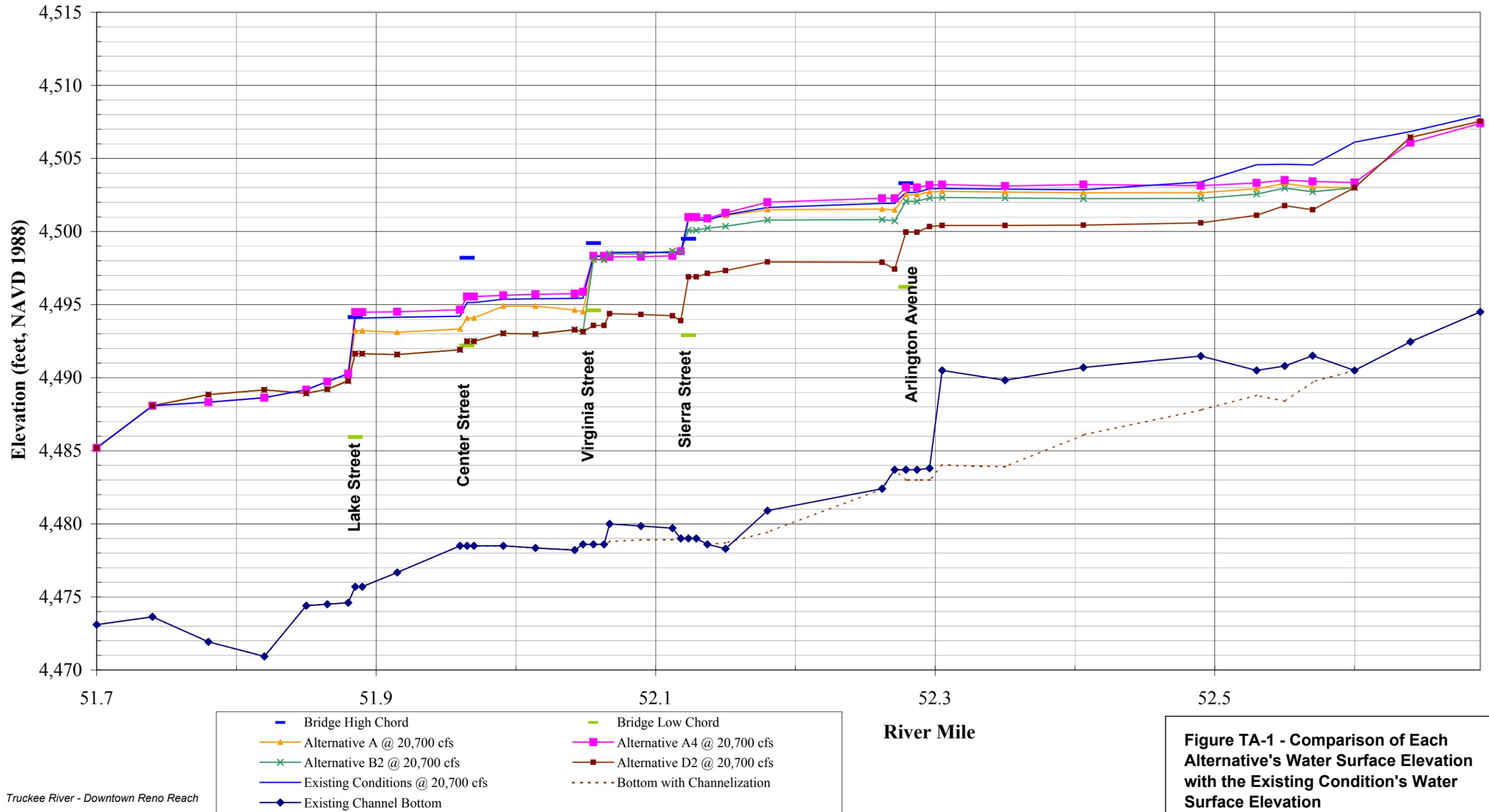


Figure 1 - Comparison of Each Alternative's Water Surface Elevation with Existing Conditions

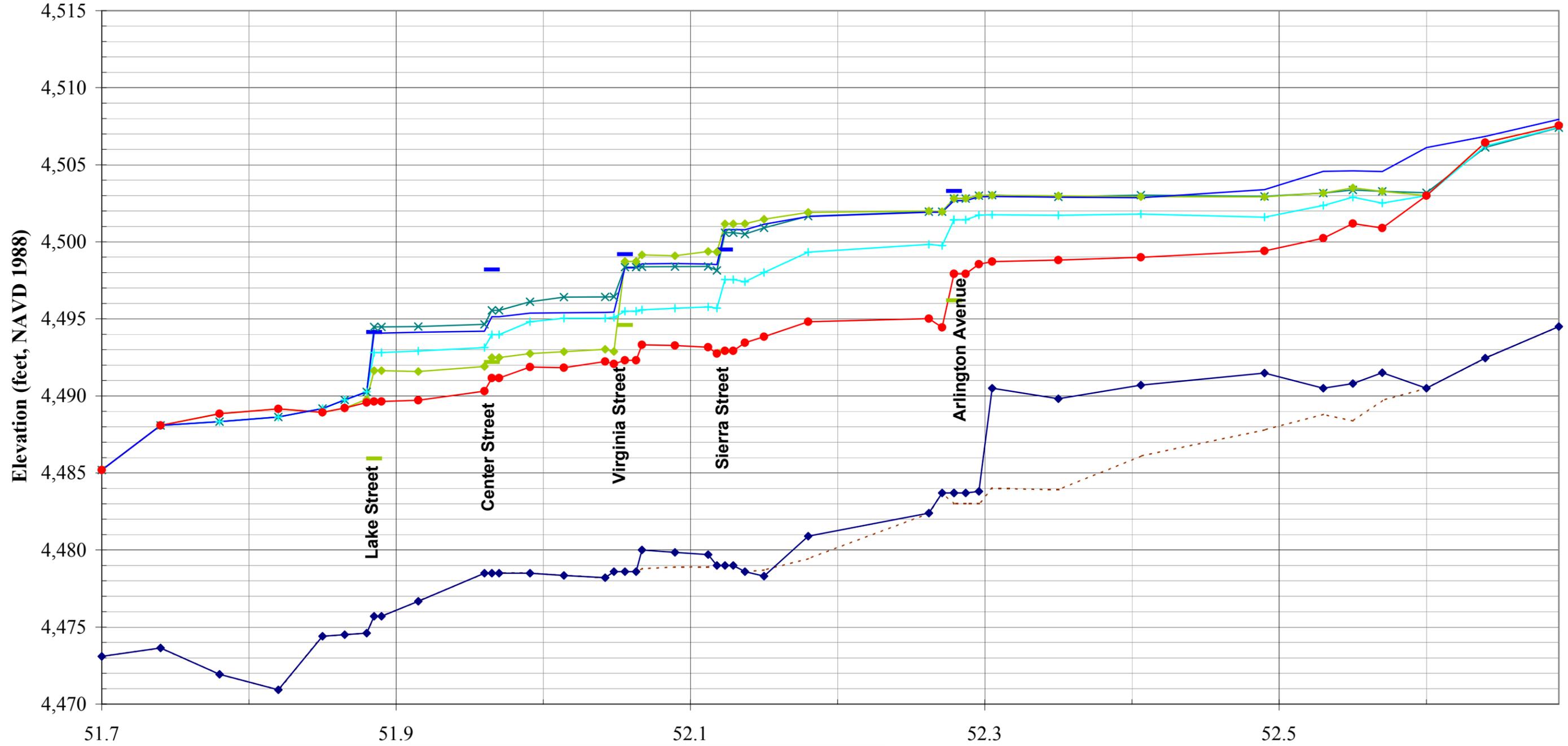
Alternative Comparisons @ 20,700 cfs (Other Alternatives Considered Set 1)



Truckee River - Downtown Reno Reach

Figure TA-1 - Comparison of Each Alternative's Water Surface Elevation with the Existing Condition's Water Surface Elevation

Alternative Comparisons @ 20,700 cfs (Other Alternatives Considered Set 2)



Truckee River - Downtown Reno Reach



Figure TA-2 - Comparison of Each Alternative's Water Surface Elevation with the Existing Condition's Water Surface Elevation