APPENDIX E

ECONOMIC COST BENEFIT ANALYSIS

ENGINEERING APPENDIX E
ECONOMIC COST BENEFIT ANALYSIS

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1.1 Description of Alternatives for Cost/Benefit Analysis

1.1.1 Stock Water Issue: The riparian corridor is fenced. The landowner grazes on adjacent fields to the riparian corridor and the project fence cuts off access to stock water.

1.1.1.1 Stock Water Measure A - Water Gap (alternative A1). In this alternative, a break in the fence is provided that allows access to the stream for stock watering. The fence will tie to the fence on the opposite bank to prevent access down the corridor. In the area of the water gap, the riverbed and adjacent banks will be excavated and backfilled with 1 foot (ft) of rock fill. The surface voids of the rock fill will be choked with gravel material to provide a uniform surface to walk on.

1.1.1.2 Stock Water Measure B – Stock Watering Trough (alternative B1). In this alternative, a source of water outside of the riparian corridor is developed by pumping water from the spring to a stock trough. The pipe intake is submerged below the spring water surface and is screened to meet NMFS screen requirements. The trough is heated so that the water does not freeze in winter. Power for the trough was assumed to be provided by underground cable from a source approximately 900 ft away. The trough is a commercial item that has a self-filling system that keeps the trough filled and is similar to the automatic troughs being installed at the Corps of Engineers project at East Birch Creek, near Pilot Rock, Oregon.

1.1.2 Diversion Issue

The secondary channel proposed for the site on Bureau of Land Management (BLM) property near the Highway 93 bridge could be constructed with several different types of entrances depending upon the environmental benefit desired and the associated project development needed to achieve that benefit.

1.1.2.1 Diversion Scale 1 - Culvert Entrance (alternative A13). This alternative uses a culvert at the channel inlet to regulate the flow in the channel. The culvert reduces the flow into the channel and the channel velocities are much less than for the other alternative that does not regulate the inflow. For the culvert Entrance alternative, the channel velocities will be so low that no erosion of banks and alteration of channel alignment are anticipated. Consequently, nearby permanent structures are not threatened by potential damage by channel realignment.

1.1.2.2 Diversion Scale 2 - Sill Entrance with Riprap Toe (alternative A23). In this alternative, the channel intake is unregulated, has an entrance lined with large boulders to reduce sediment deposition and blocking of the entrance. It also has riprap to protect the existing highway embankment. With the unregulated entrance used in this alternative, the channel velocities will vary with the flood stage of the main channel. For vents larger than the 10-year event, the channel may erode its banks and alter its alignment over time. This dynamic range of flows in the channel provides greater environmental benefit because of the more complex habitat features that will develop and because of the greater inundation of flood plain that will occur. The greater inundation will result in more robust and varied riparian zone. But, this potential for the channel to alter its alignment threatens the existing highway embankment adjacent to the channel. Consequently, the allowing greater freedom to the channel requires protection of the highway embankment. This alternative protects the highway embankment by placing a riprap blanket at the toe of the embankment. The riprap would extend to a depth of approximately 4 ft below the ground line.

1.1.2.3 Diversion Scale 3 - Sill Entrance with Barbs (alternative A33). In this alternative, the channel intake is unregulated, has an entrance lined with large boulders to reduce sediment deposition and blocking of the entrance. The dynamic range of discharge and freedom of channel response is similar to alternative 2. This alternative protects the highway embankment by constructing a series of barbs along the toe of the embankment rather than using riprap blanket as described in alternative 2.

1.1.3 Fence Alternatives

In most cases, there will be grazing on fields adjacent to the project's riparian corridors. Fencing will be required to prevent damage to the vegetative planting and to protect the banks of the stream from trampling. Four types of fences were considered. The fence materials have different first costs for construction and different long-term maintenance costs. The costs for maintenance were based on experience of the local range conservationists.

1.1.3.1 Fence Scale #1 – Log and Block Fence. This fence consists of log stringers that alternate with short blocks that provide the vertical support. The point at which the stringers and blocks meet is pinned together with a rebar dowel (see photo 1-1).

Photo 1-1 Fence Scale #1 – Log and Block Fence.

1.1.3.2 Fence Scale #2 – High-tensile Wire. This fence system uses wooden posts and steel wire with out barbs. The wires are installed in a way that allows the wire to be tensioned to around 300 lbs per strand. If a branch falls onto the fence, the strands will stretch, with our serious damage, and the strands re-tensioned.

1.1.3.3 Fence Scale #3 – Concrete Pillar Fence. This fence uses a concrete pillar to support log stringers. In the event that a flood knocks the fence apart, the concrete pillars can be reset and the fence reassembled (see photo 1-2).

Photo 1-2 Fence Scale #3 – Concrete Pillar Fence.

1.1.3.4 Fence Scale #4 – Jack Fence. This fence consists of logs used to form a support section and stringers that run the length of the fence (see photo 1-3).

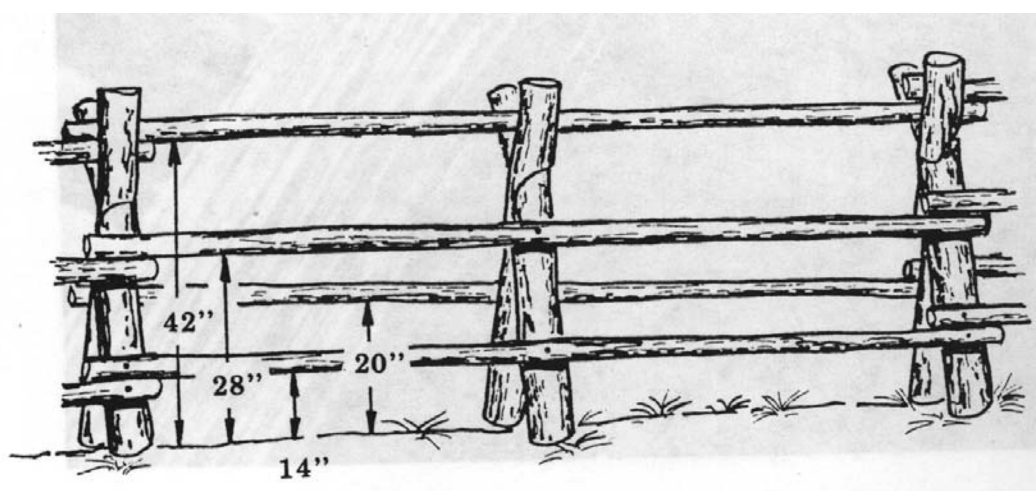


Photo 1-3 Fence Scale #4 – Jack Fence.

1.2 Benefits Calculation for Cost/Benefit Analysis

Table 1-1 below identifies the habitat categories and assigned score per acre that are used for calculating project benefits. The color codes are used to illustrate the assigned project areas that are identified for each site in the following maps on pages 1-6 to 1-10.

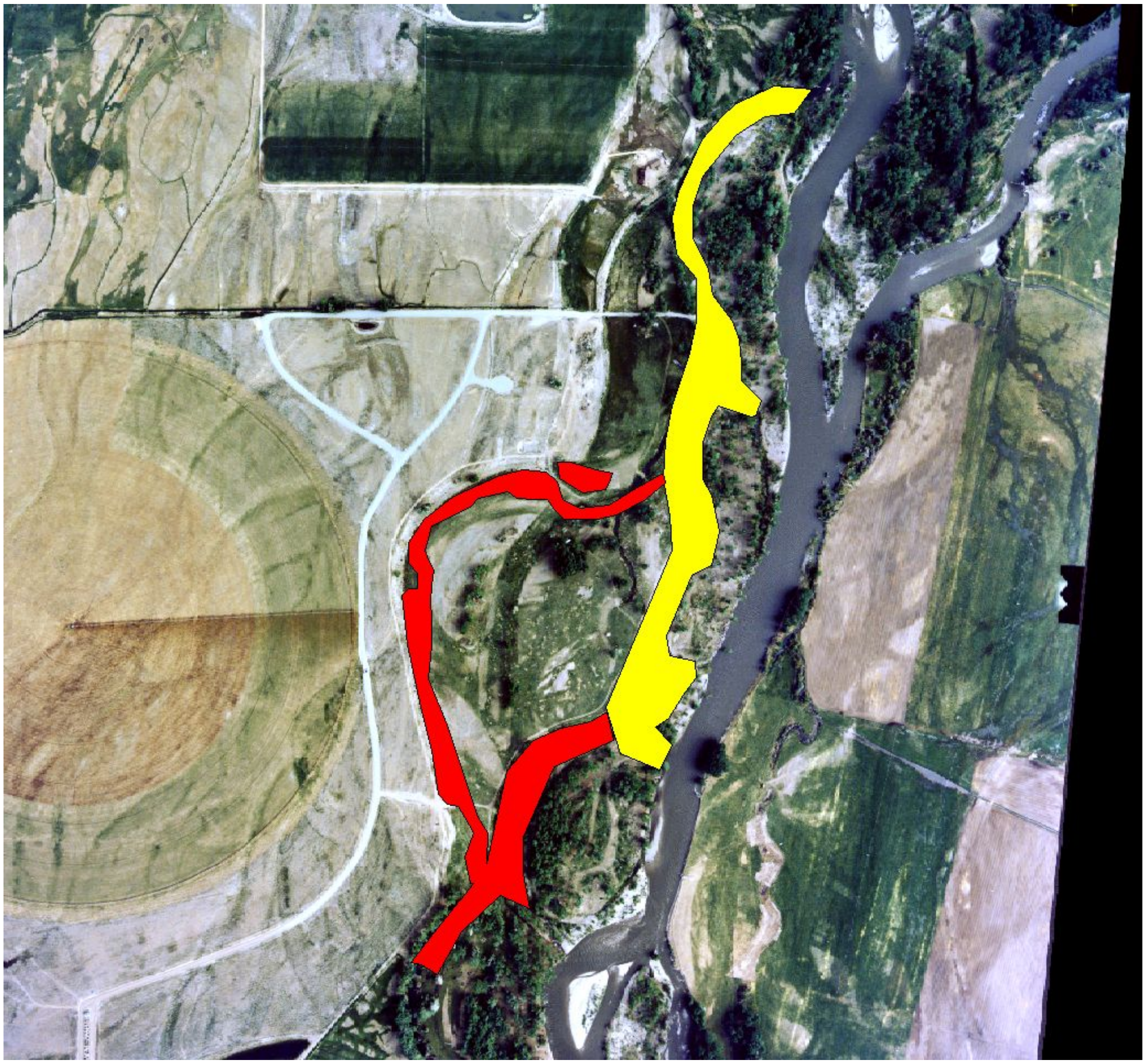
Table 1-1 Habitat Benefits Scoring and Identification Table.

Score	Color	Description	Code
9 points per acre		Riverine Category 1 - Provides water temperatures that are assured to be near optimal. Riparian condition and in-stream habitat conditions may vary over a range from moderate to good with relatively static conditions over the long-term.	Riv 1
6-10 points per acre		Riverine Category 2 - Provides a system that is dynamic and regenerative, but water temperatures are uncertain. Good quality habitat that is sustainable over the long-term is provided. At the worst, temperatures may be near those of the main channel with shade from direct sun. At best, the temperatures may be significantly lower than the main channel.	Riv 2
4-6 points per acre		Riverine Category 3 - Provides a system in which a riparian zone and full canopy can be developed, but which is relatively static, and water temperatures are uncertain. Flows are constrained in a way that avoids the full range of fluvial processes and will not provide a dynamic regenerative system. At the worst, temperatures may be near those of the main channel with shade from direct sun. At best, the temperatures may be significantly lower than the main channel.	Riv 3
2 points per acre		Riverine Category 4 - Clearly less than desirable habitat conditions.	Riv 4
0.5 points per acre		Remote Riverine and Wetlands Category - Wetlands not immediately adjacent to the stream bank (greater than approx. 75 feet) and wetlands of any kind.	RR&W

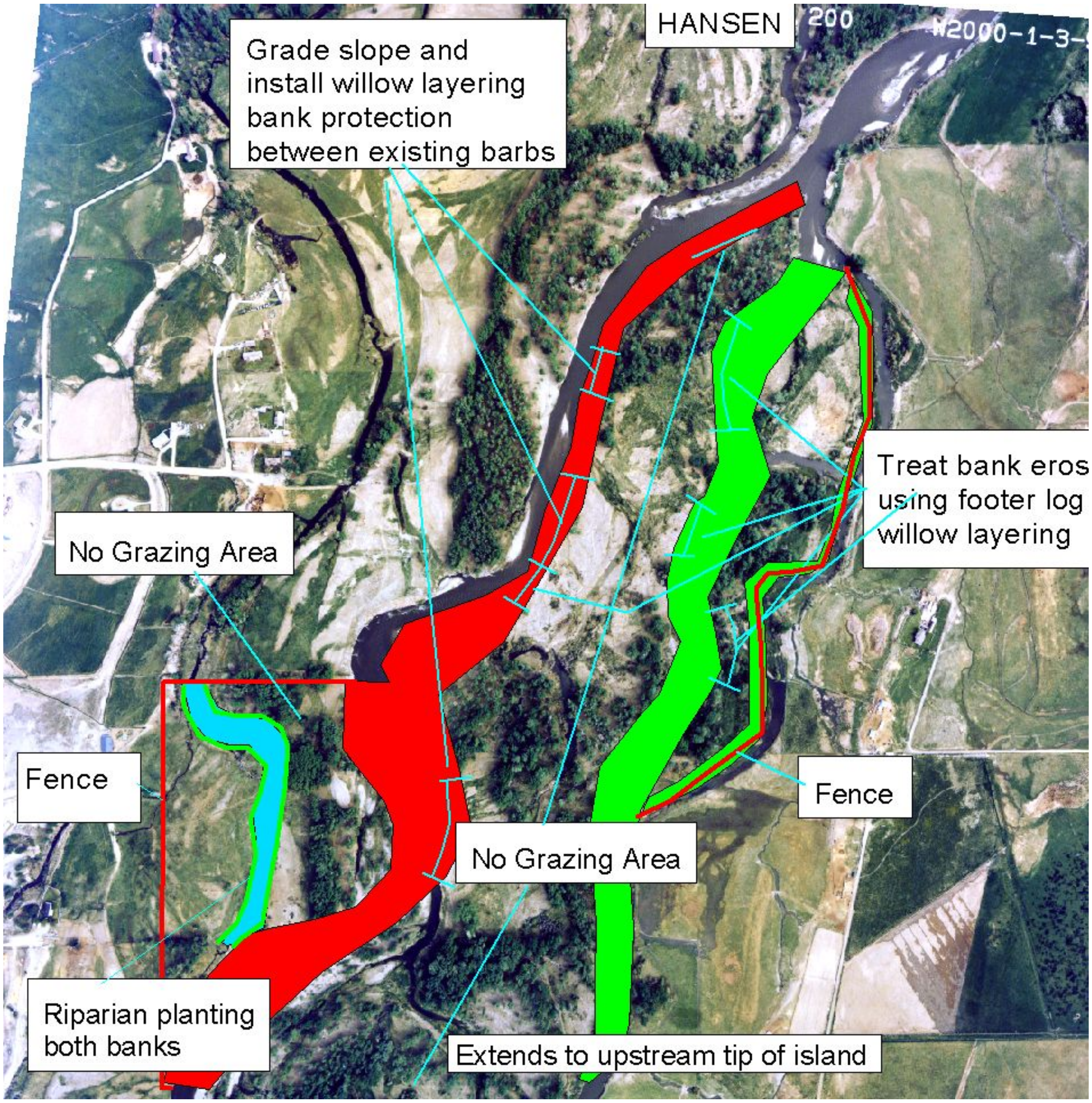
The following table 1-2 identifies the summary of the habitat categories and total score for each site. The site average benefit score is used as the benefit value in the cost/benefit analysis.

Table 1-2 Habitat Benefit Scoring Summary Table by Site and Option.

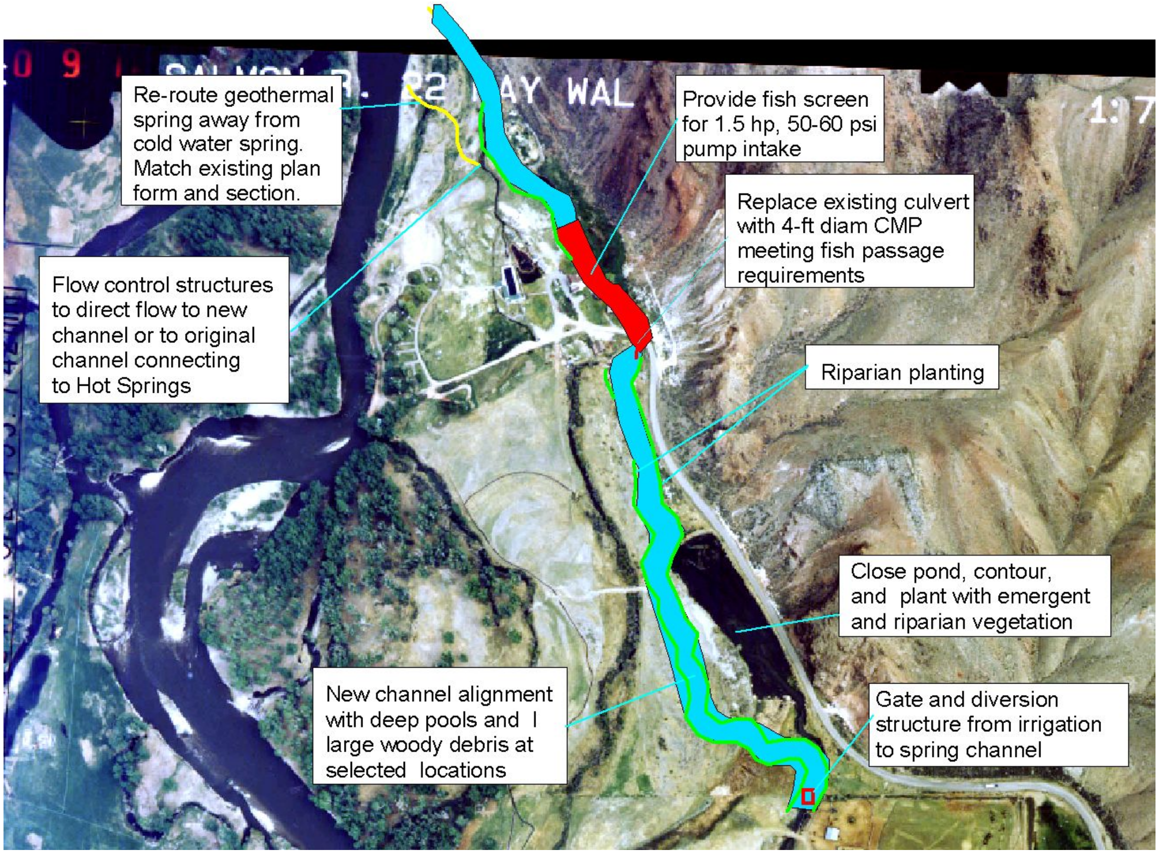
Score / acre Property/Site	Riv1 (acres)	Riv1 Score 9	Riv2 (acres)	Riv2 High Score 10	Riv2 Low Score 6	Riv3 (acres)	Riv3 High Score 6	Riv3 Low Score 4	Riv4 (acres)	Riv4 Score 2	RR&W (acres)	RR&W Score 0.5	Site Ave. Benefit score	Total Acres	Site Ave Benefit score per acre
1. Dunfee Slough	0	0	0	0	0	14	84	56	11	22	59	29.5	121.5	84	1.4
2. One Mile Island	4	36	27	270	162	0	0	0	32	64	122	61	377	217	2.0
3. Hot Springs (Hammond)	7	63	0	0	0	0	0	0	1	2	2	1	66	66	6.6
3. Hot Springs (Stark) with water gaps	36	324	0	0	0	0	0	0	12	24	152	76	424	488	2.1
3. Hot Springs (Stark) with stock trough & pump	40	360	0	0	0	0	0	0	8	16	152	76	452	520	2.3
4. Pennal Gulch	0	0	0	0	0	17	102	68	0	0	91	45.5	130.5	108	1.2
5. Hwy 93 Bridge (riprap toe or barb)	0	0	5	50	30	0	0	0	0	0	6	3	43	11	3.9
5. Hwy 93 Bridge no barbs and orifice culvert entrance	0	0	0	0	0	5	30	20	0	0	6	3	28	11	2.5



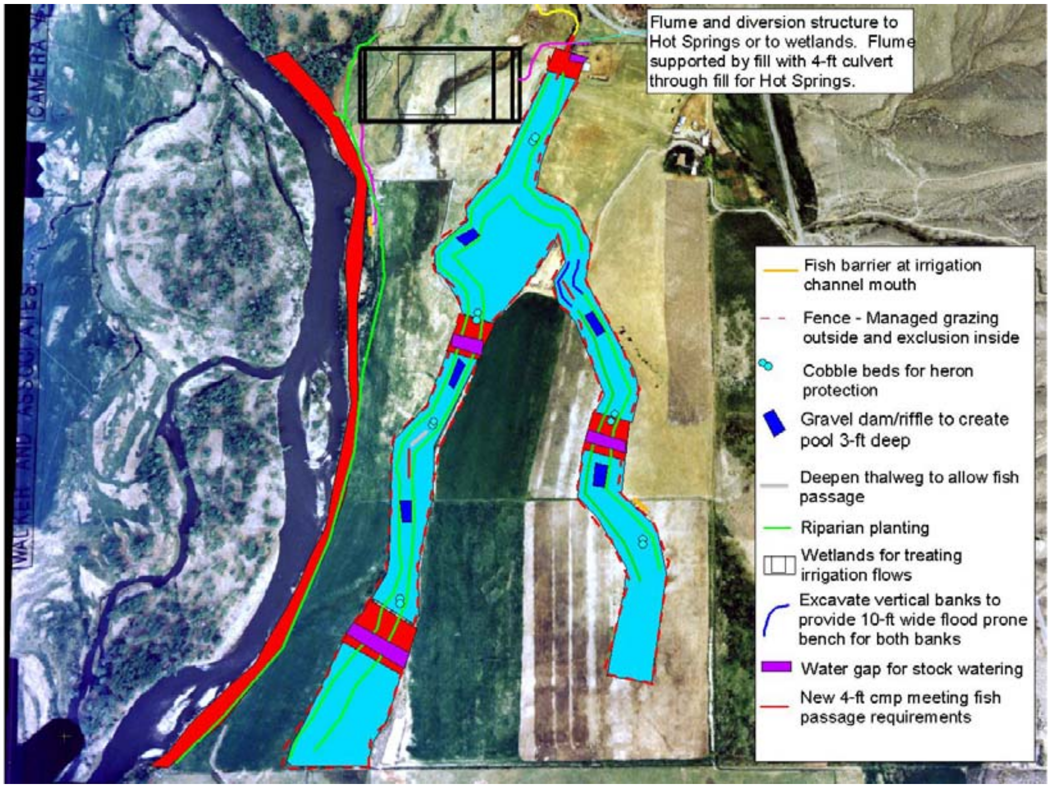
Map 1-1 Site 1 – Dunfee Slough.



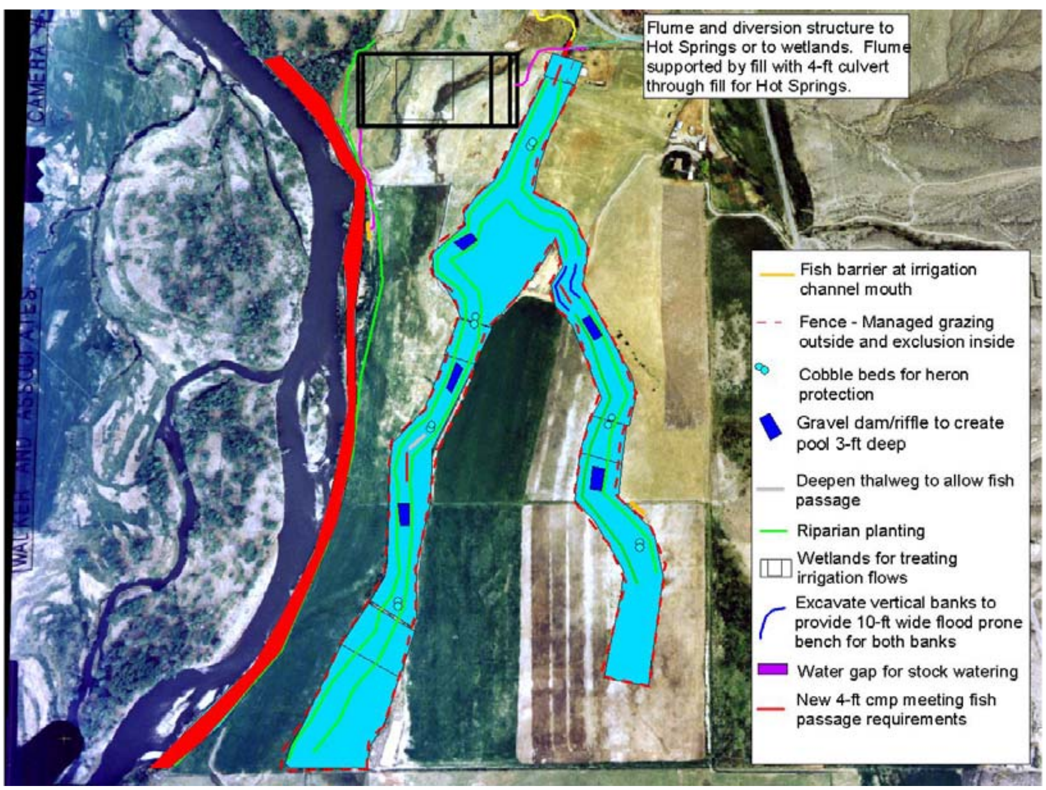
Map 1-2 Site 2 – One Mile Island.



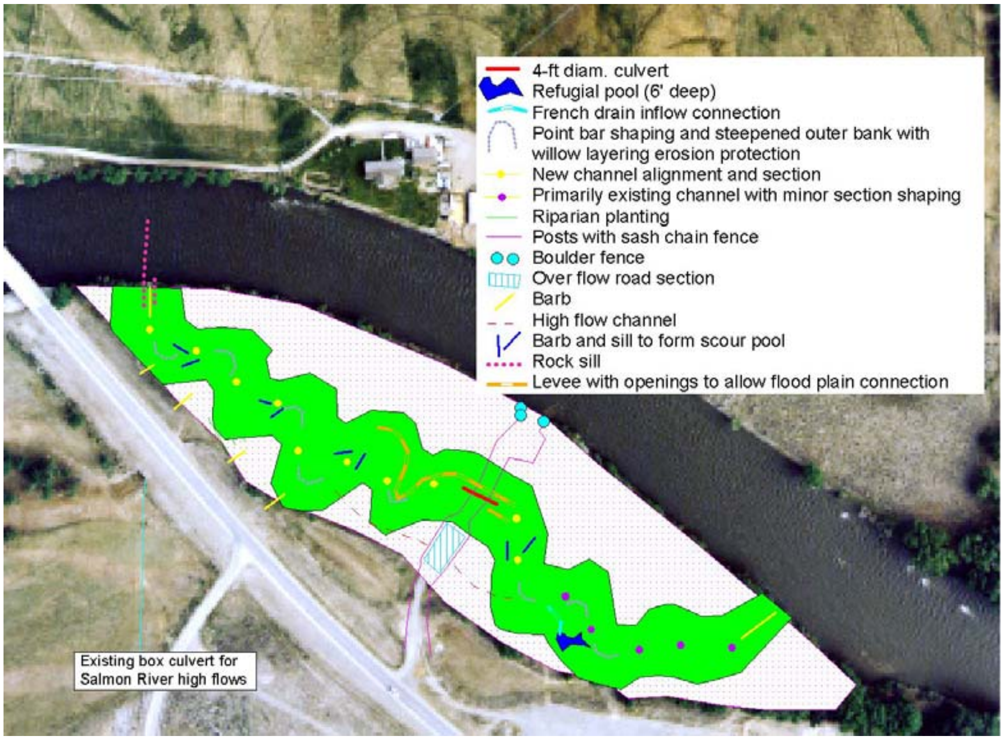
Map 1-3 Site 3 – Hot Springs (Hammond).



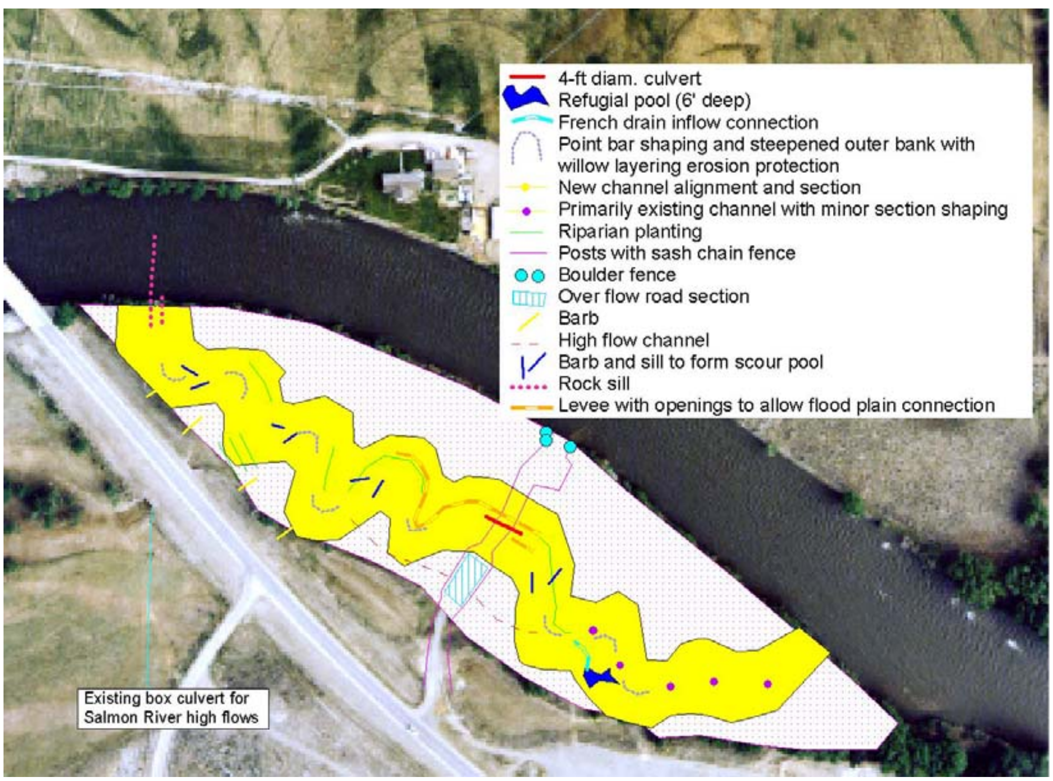
Map 1-4 Site 3 – Hot Springs (Stark) with water gaps.



Map 1-5 Site 3 – Hot Springs (Stark) w/ water trough and pump (no water gaps).



Map 1-6 Site 5 - BLM (riprap toe or barb).



Map 1-7 Site 5 - BLM orifice culvert entrance (no barbs).

2.0 INCREMENTAL COST ANALYSIS AND COST EFFECTIVENESS

2.1 Policy/Process

Environmental plan evaluation consists of a comparison of the environmental outputs and the economic costs of alternative plans. The cost effectiveness analysis and incremental cost analysis procedures provide a structured framework to assist in environmental plan evaluation.

Environmental restoration projects produce outputs that can be evaluated in a number of ways. Every possible combination of solutions is derived and a total cost and total output estimated is calculated for each combination. The cost effectiveness analysis first identifies the least cost combination for every possible level of output, and then identifies the cost effective set of combinations by screening out plans where more output could be provided by another combination at the same or less cost. Once the cost-effective set of combinations is identified, the incremental cost and incremental output of moving from each combination to the next larger combination is calculated to determine the optimum combination. From the subset of the cost effective measures, a list of alternatives is identified which are the most efficient in production, or “best-buys”.

This project consists of 5 sites along the Salmon River. Construction would take place over 3 years. At each site, different levels of investment were analyzed to determine the most cost effective measures at each site and the incremental benefit of increased investment. The best combination of measures for each site was combined in the preferred alternative.

Table 2-1 shows the different measures for each site. The sites are: Stark Hammond, Hansen, BLM at Highway Bridge, BLM near M_M, and Dunfee. For this analysis, each site is listed with a code to differentiate alternative measures that were analyzed. In Year 1, there is one site with 8 different measures examined. In Year 2, there is one site with 4 different measures examined. In Year 3, there are 3 sites with a total of 11 different measure examined.

The Preferred Alternative

The best alternative is the combination of:
Year 1, Hot Springs (Stark/Hammond) site; Trough with High Tensile Wire,
Year 2, One Mile Island (Hansen) site; High Tensile Wire,
Year 3, Highway 93 bridge site; Sill with Barb,
    Pennal Gulch (M_M) site; High Tensile Wire,
    Dunfee Slough site; High Tensile Wire.

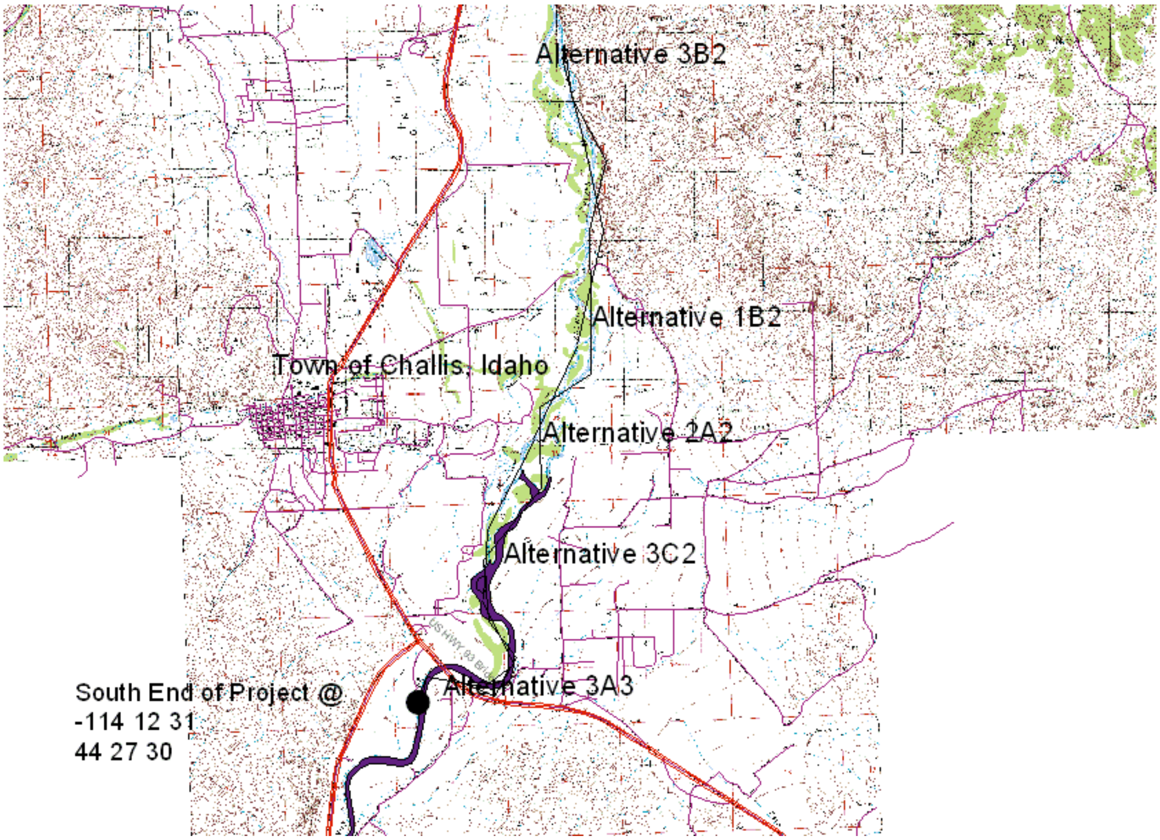
Table 2-1 Costs and Interval for Monitoring and Maintenance of Project Alternatives.

			Alternative							**Maintenance**				
My codes	Phase	Constr Start Date	Altern. #	Sites	Variable #1	Variable #2		Monitoring	**Monitoring Cost Interval**	**Fence**	**Interval for Fence Maintenance**	**Channel Opening**	**Interval for Channel Maintenance (remove sediment blockage)**	**Wetlands (remove vegetation mat buildup)**
	1st phase	Nov-03	1A1	Stark Hammond	Water Gap	Log&Block		1000	ea yr for 2 yrs	$14,296	ea yr after 20yrs			5000
	Site 3		1A2		Water Gap	High Tensile Wier		1000	ea yr for 2 yrs	$4,966	ea yr after 10yrs			5000
			1A3		Water Gap	Concrete Piller		1000	ea yr for 2 yrs	$6,511	ea yr after 30yrs			5000
			1A4		Water Gap	Jack		1000	ea yr for 2 yrs	$10,997	ea yr after 20yrs			5000
			1B1		Trough	Log&Block		1000	ea yr for 2 yrs	$14,296	ea yr after 20yrs			5000
			1B2		Trough	High Tensile Wier		1000	ea yr for 2 yrs	$4,966	ea yr after 10yrs			5000
			1B3		Trough	Concrete Piller		1000	ea yr for 2 yrs	$6,511	ea yr after 30yrs			5000
			1B4		Trough	Jack		1000	ea yr for 2 yrs	$10,997	ea yr after 20yrs			5000
2A1	2nd phase	Nov-04	2A	Hansen		Log&Block		1000	ea yr for 2 yrs	$6,202	ea yr after 20yrs			
2A2	**Site 2**		2B			High Tensile Wier		1000	ea yr for 2 yrs	$2,156	ea yr after 10yrs			
2A3			2C			Concrete Piller		1000	ea yr for 2 yrs	$2,826	ea yr after 30yrs			
2A4			2D			Jack		1000	ea yr for 2 yrs	$4,774	ea yr after 20yrs			
3A1	3rd phase	Nov-05	3A1	BLM @ Highway Bridge	Culvert Entrance			1000	ea yr for 2 yrs			20000	every 10 years	
3A2			3B1		Sill	Riprap Toe		1000	ea yr for 2 yrs			20000	every 10 years	
3A3	**Site 5**		3B2		Sill	Barb		1000	ea yr for 2 yrs			20000	every 10 years	
3B1	3rd phase	Nov-05	4A	BLM Near M_M		Log&Block		1000	ea yr for 2 yrs	$7,051	ea yr after 20yrs	20000	every 10 years	
3B2			4B			High Tensile Wier		1000	ea yr for 2 yrs	$2,449	ea yr after 10yrs	20000	every 10 years	
3B3	**Site 4**		4C			Concrete Piller		1000	ea yr for 2 yrs	$3,209	ea yr after 30yrs	20000	every 10 years	
3B4			4D			Jack		1000	ea yr for 2 yrs	$5,424	ea yr after 20yrs	20000	every 10 years	
3C1	3rd phase	Nov-05	5A	Dunfee		Log&Block		1000	ea yr for 2 yrs	$2,801	ea yr after 20yrs	20000	every 10 years	
3C2			5B			High Tensile Wier		1000	ea yr for 2 yrs	$973	ea yr after 10yrs	20000	every 10 years	
3C3	**Site 1**		5C			Concrete Piller		1000	ea yr for 2 yrs	$1,273	ea yr after 30yrs	20000	every 10 years	
3C4			5D			Jack		1000	ea yr for 2 yrs	$2,155	ea yr after 20yrs	20000	every 10 years	

2.2 Alternative Analyses-Cost Effective Alternatives Summary

The project area and cost effective alternatives are illustrated in the figure 2-1 below.

Figure 2-1 Most Cost Effective Alternative Identified at Each Site Location.



Alternatives are scheduled to stage construction and implementation over a 3-year period. The first year, one alternative will be scheduled. The second year, another alternative will be scheduled and the 3rd year, three alternatives will be scheduled.

2.3 Alternative Analyses: Master Summary of Cost Effective Alternatives

The following table 2-2 summarizes the five selected alternative costs, benefits, and uncertainty assessment. Alternative code names illustrate year of implementation, alpha measure and scale of investment (3B2 means project is scheduled for construction and implementation in the 3rd year, for measure B_Scale 2 investment). Figure 2-2 illustrates the cost for each project site and the cost per habitat unit for the most cost effective alternative. Figure 2-3 illustrates the average number of habitat units at each site and the cost per habitat unit for the most cost effective alternative. Figure 2-4 illustrates the number of habitat units compared to the cumulative habitat units for each site.

Table 2-2 Most Cost Effective Alternatives - Ranked by Cumulative Annual Benefits Units.

Salmon River Section 206
Cost Effectiveness Analysis

Site Number	Alternatives Code(Year/Measure/Scale)	Total Project Costs (2003 Price Level)	Present Value First Costs and Lifetime O&M	Avg. Annual Equivalent of Total Costs	Avg. Annual Benefit Units (Habitat Units)	Avg Cost per Habitat Unit Benefit	Avg Cost per Habitat Unit Benefit/with Uncertainty	Cumulative Annual Costs	Cumulative Annual Benefit Units (HU)	Cumulative Annual Cost/HU
3	1B2	$2,794,903	$2,854,512	$177,950	518	$344	$344	$177,950	518	$344
2	2A2	$836,435	$833,948	$51,988	377	$138	$138	$229,938	895	$257
5	3A3	$432,879	$451,354	$28,137	43	$654	$692	$258,075	938	$275
4	3B2	$386,087	$400,539	$24,970	130.5	$191	$196	$283,045	1,069	$265
1	3C2	$664,422	$643,640	$40,125	121.5	$330	$331	$323,170	1,190	$272
	Totals	$5,114,726	$5,183,993	$323,170	1190					
	Weighted Avg.					$272	$274			

The 5 preferred alternatives staged over a 3 year implementation period over 7 river miles will cost $5.2 million. The $5.2 million is the present value of all first costs and future costs (O&M) discounted to the base year 2003 using a 5.875% discount rate and project life of 50 years. The average annual equivalent cost will equate to $323,170 for an annual yield of 1190 habitat units over the life of the project. This equates to an average annual equivalent cost per habitat unit of $272. Appling the uncertainty ranges around the annual costs and yield (habitat units), the average cost per habitat units only goes up $2 per year to $274. The average cost per habitat unit, after applying uncertainty, goes up very little since those alternatives that have the largest degree of uncertainty are the smallest investment (3B2,3A3).

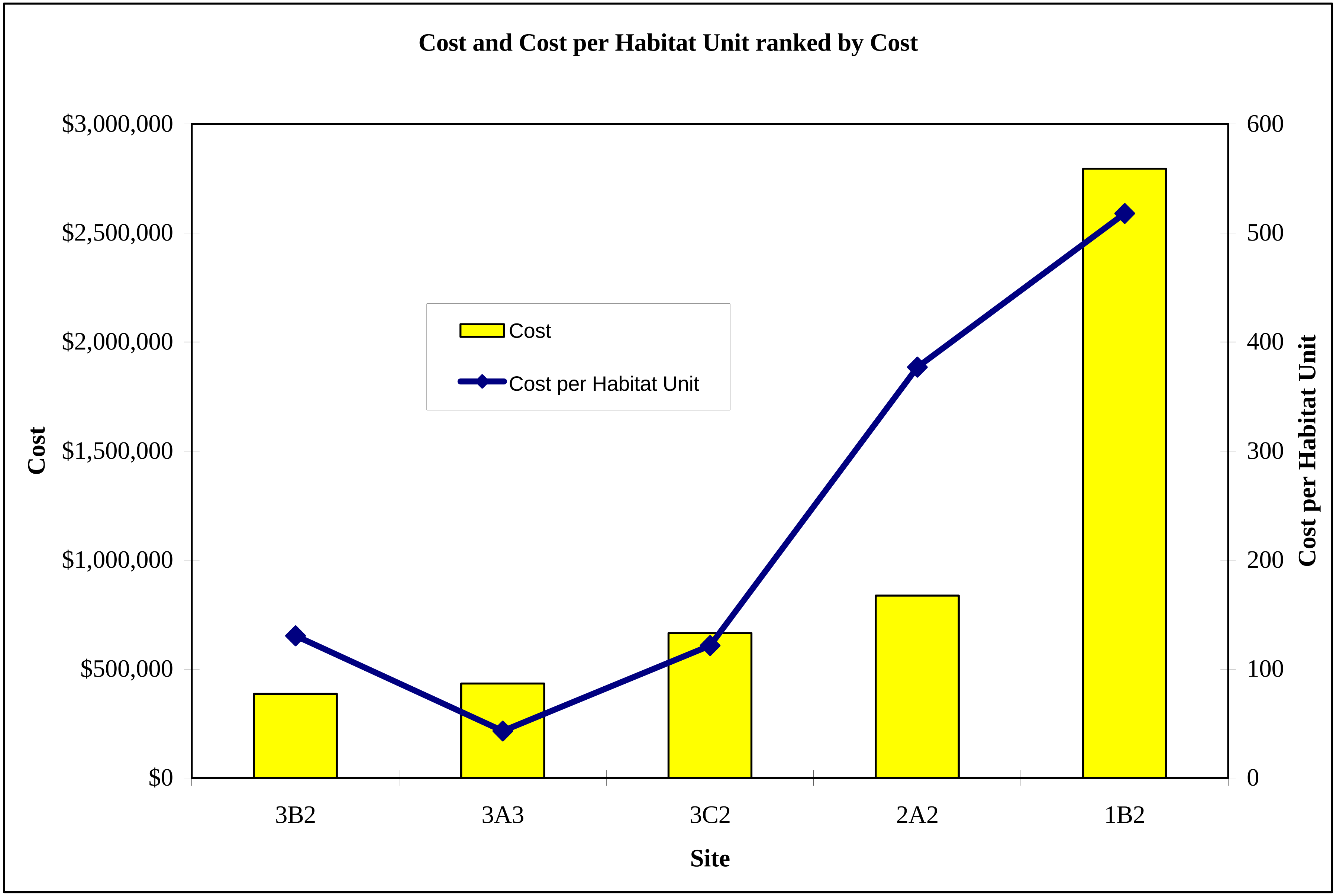


Figure 2-2 Graphical Display of Cumulative Annual Costs and Benefits.

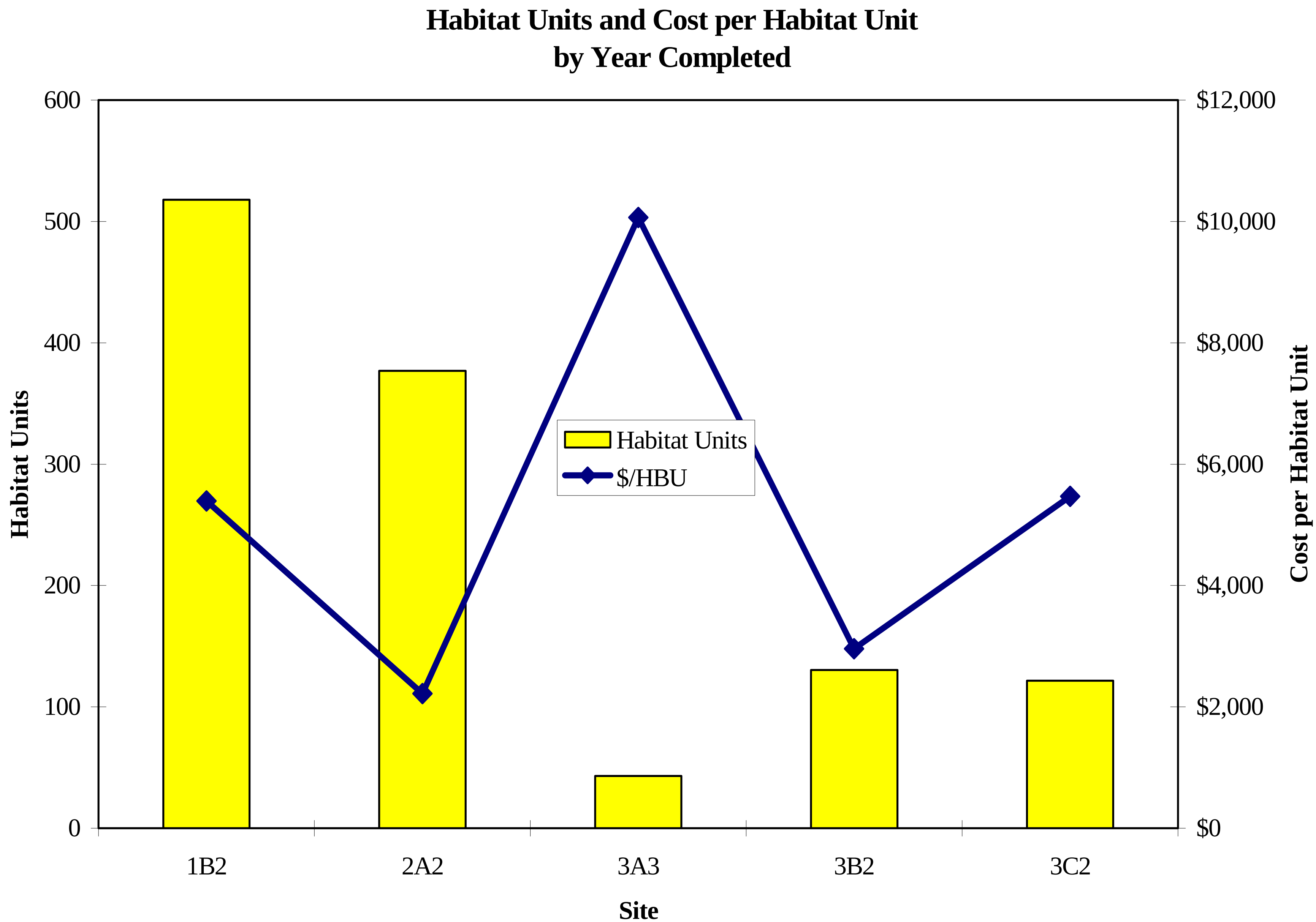


Figure 2-3 Graphical Display of Habitat Units and Cost per Habitat Unit.

Incremental and Cumulative Habitat Units

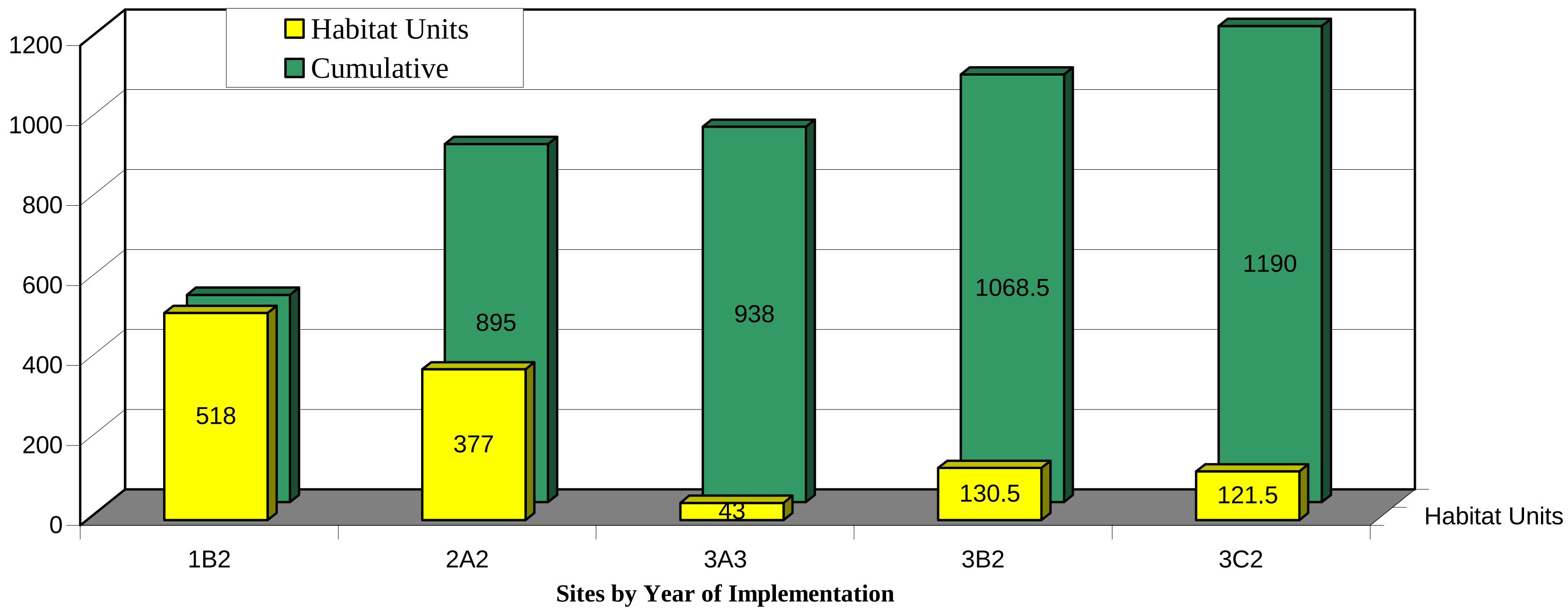


Figure 2-4 Graphical Display of Incremental and Cumulative Habitat Units.

2.4 Incremental Analysis by Site

The following information show results from incremental analysis and uncertainty analysis for each site.

2.4.1 Site 3 Incremental Cost Analysis (Period 1). Each alternative is compared to the Without Project Condition. The Benefits Units value for the Without Project Condition is zero.

Salmon River Section
Period 1_Incremental Cost

Period/Measure Scales	Average Annual Equivalent Total Project Cost/Most (incl O&M)	Benefit Unit Yield	Incremental Cost/Unit (Neg or Zero= No Benefit)	Incre-mental Cost Effect	Average Cost Habitat Unit
1A2	$175,335	490		cost effective	$358
1B2	$177,950	518	$93.39	cost effective	$344
1A4	$181,352	490	-$121.50	no benefit	
1B4	$183,967	518	#DIV/0!	no benefit	
1A3	$183,372	490	-$193.64	no benefit	
1B3	$185,986	518	#DIV/0!	no benefit	
1A1	$184,643	490	-$239.04	no benefit	
1B1	$187,258	518	#DIV/0!	no benefit	

Alternative 1B2 with an average cost per habitat unit of $344 is the most effective alternative for Period 1. All other alternatives illustrate higher cost with no increase in benefit units.

Table 2-3 Site 3 Incremental Costs per Unit.

2.4.1.1 Site 3 Uncertainty Analysis. The information contained in table 2-4 shows that alternative 1B2 (Trough and High Tensile Wire) has the minimum average annual cost per habitat unit of $333. After running the model, there is very little uncertainty in any of the alternatives, with all showing a coefficient of variation of less than 1 percent. The probability of exceeding the maximum value of $335 is less than 2 percent*.

* **The model used 1000 iterations at the 99 percent confidence level using triangular distribution.**

Salmon River Section 206
Uncertainty Analysis

	Alternative Code	Site Name	Variable #1	Variable #2	Avg Cost Habitat Unit Low Value	Avg Cost Habitat Unit High Value	Avg Cost Habitat Unit Worst Case	Avg Cost Habitat Unit Best Case	Avg Cost Habitat Unit Most Likely Value	Low_Side Uncertainty %	High_Side Uncertainty %
	1A1	Stark Hammond	Water Gap	Log&Block	$375	$380	$380	$375	377	0.50%	0.79%
	1A2		Water Gap	High Tensile Wier	$356	$361	$361	$356	358	0.52%	0.83%
	1A3		Water Gap	Concrete Piller	$372	$377	$377	$372	374	0.50%	0.80%
	1A4		Water Gap	Jack	$368	$373	$373	$368	370	0.51%	0.81%
	1B1		Trough	Log&Block	$360	$364	$364	$360	362	0.49%	0.78%
	1B2		Trough	High Tensile Wier	$342	$346	$346	$342	344	0.51%	0.82%
	1B3		Trough	Concrete Piller	$357	$362	$362	$357	359	0.49%	0.79%
	1B4		Trough	Jack	$353	$358	$358	$353	355	0.50%	0.79%
Std Dev									$11		
Average							$365	$360	$362		
Minimum	1B2							$342	$344		
Maximum	1A1						$380				
Co-ef Var									3.04%		

Table 2-4 Site 3 Uncertainty Analysis.

Minimum average annual cost per habitat unit under best condition with total project costs at the low end and the habitat benefit yield at the high end is alternative 1B2 at an average annual cost per habitat unit of $342. Alternative 1A1 would be the worst-case scenario with total projects costs at the high end and the habitat units at the low end would yield an average annual cost per habitat unit of $380.

ALTERNATIVE CODE	SITE NAME	ACTION_VARIABLE 1	ACTION_VARIABLE 2	Avg Cost Habitat Unit Most Likely	Avg Cost Habitat Unit Low Value	Avg Cost Habitat Unit High Value	Uncertainty Run Avg Cost Habitat Unit Most Likely	Low_Side Uncertainty %	High_Side Uncertainty %
1A2	Stark Hammond	Water Gap	High Tensile Wier	$346	$344	$349	$347	0.51%	0.81%
1A3		Water Gap	Concrete Piller	$359	$357	$362	$359	0.54%	0.86%
1A4		Water Gap	Jack	$360	$358	$363	$360	0.52%	0.87%
1A1		Water Gap	Log&Block	$369	$367	$372	$369	0.52%	0.83%
1B2		Trough	High Tensile Wier	$333	$331	$335	$333	0.64%	0.74%
1B3		Trough	Concrete Piller	$345	$343	$347	$345	0.50%	0.80%
1B4		Trough	Jack	$345	$343	$348	$345	0.53%	0.85%
1B1		Trough	Log&Block	$354	$352	$357	$354	0.51%	0.82%
MIN				$333			$333		
MAX				$369					

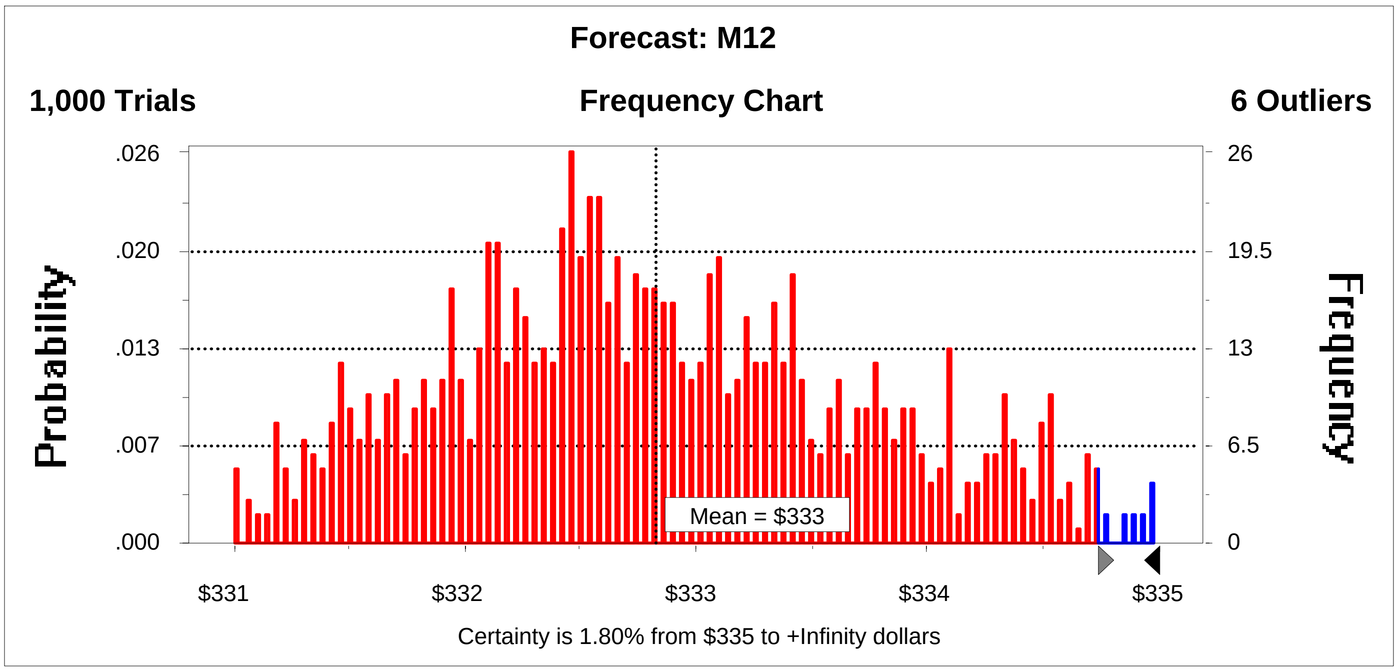


Figure 2-5 Probability vs. Cost for Site 3.

2.4.2 Site 2 Incremental Cost Analysis (Period 2). Each alternative is compared to the Without Project Condition. The Benefits Units value for the Without Project Condition is zero.) An uncertainty analysis was not performed because there are no uncertainty ranges surrounding the cost.

Salmon River Section 206					
Period 2_Incremental Cost Analysis					
	Average Annual Equivalent				
Period/Measure/Scales	Total Project Cost/Most Likely (incl O&M)	Benefit Unit Yield	Incremental Cost/Unit Gained (Neg or Zero=No Benefit)	Incremental Cost Effect	Average Cost Habitat Unit
					Avg Cost/
2A2	$51,988	377		cost effective	$138
2A3	$54,580	377	#DIV/0!	no benefit	
2A4	$54,709	377	#DIV/0!	no benefit	
2A1	$56,512	377	#DIV/0!	no benefit	

Table 2-5 Site 2 Incremental Costs per Unit.

Period 2 has only one Measure with 4 scales of investment. Measure/Scale 2A2 has the least average annual cost per habitat unit at $138 There are no uncertainty ranges surrounding the costs for the 4 scales, therefore, we will recommend the alternative with the least average annual cost per habitat unit yield. Using only the middle value of annual costs with a range of habitat unit outputs from the high side of 431 and low side of 323, we find the worst case average minimum cost for Alternative 2A2 is $161 with the best case cost at $121. These outside ranges of values would require the most likely middle value cost along with the worst and best habitat unit yields and would be highly unlikely since these values are on the outer edges of the confidence range.

2.4.3 Site 5 Incremental Cost Analysis (Period 3 Measure A). Each alternative is compared to the Without Project Condition. The Benefits Units value for the Without Project Condition is zero.

	Salmon River Section 206				
Period 3 Measure A_Incremental Cost Analysis					
	Average Annual Equivalent Total Project Cost/Most Likely (incl O&M)	Benefit Unit Yield	Incremental Cost/Unit Gained (Neg or Zero=No Benefit)	Incremental Cost Effect	Average Cost Habitat Unit
Period/Measure/Scales					
					Avg Cost/
3A1	$26,698	28			$954
3A2	$28,478	43	$118.67	Cost Effective	$662
3A3	$28,137	43	$95.93	Cost Effective	$654

Table 2-6 Site 5 Incremental Costs per Unit.

Period 3 has only one of three Measures with 3-4 scales of investment. Measure/Scale 3A3 has the least average annual cost per habitat unit at $654 at the middle level. There are uncertainty ranges surrounding the 3 scales, therefore, we will also analyze the alternative with the least average annual cost per habitat unit yield, given uncertainty surrounding the mean average annual cost per habitat unit.

2.4.3.1 Site 5 Uncertainty Analysis

	Salmon River Section 206									
	Uncertainty Analysis_Period 3_Measure A									
	Alternative Code	Site Name	Variable	Variable	Avg Habitat Worst	Avg Habitat Best	Avg Habitat Most Likely	Low_Side Uncertainty %	High_Side Uncertainty %	Min Avg 1000 runs Cost/HU_
	3A	BLM_Hwy	Culvert	n/a	$1,23	$79	95	16.58%	29.28%	$99
	3A	BLM_Hwy	na	Rip_Rap	$92	$51	66	22.05%	39.73%	$70
	3A	BLM_Hwy	na	Bar	$91	$51	65	22.02%	39.30%	$69
Std							$17			
Average							$75			
Minimum						$51	$65			
Maximum					$1,23					
Co-ef							22.525			

Table 2-7 Site 5 Uncertainty Analysis.

Minimum average annual cost per habitat unit under best condition with total project costs at the low end and the habitat benefit yield at the high end is alternative 3A3 at an average annual cost per habitat unit of $510. Alternative 3A1 would be the worst-case scenario with total projects costs at the high end and the habitat units at the low end would yield an average annual cost per habitat unit of $1,232. All alternatives vary 16 and 40 percent between the high and low average annual cost per habitat unit. We can conclude the distribution of uncertainty among all alternatives is wider (30-40 percent) on the high side, while variations on the low side are 16-22 percent among all three alternatives. The coefficient of variation (standard deviation/average value) comparing the most likely values is 23 percent among alternatives for period 3, without considering potential uncertainty ranges. It may be that uncertainty simulation will show that the expected mid level minimum average annual cost per habitat unit will probably be exceeded because of the wide variations on the high side (30-40 percent) among all 3 choices. The simulation did illustrate this. After running the simulation 1000 iterations at the 99 percent confidence level using the triangular distribution, the alternative with the minimum average annual cost per habitat unit is still 3A3. The simulation did illustrate that there is a 20 percent chance that the stated minimum average cost per habitat unit for 3A3 of $654 will be exceeded. The minimum cost per habitat unit for 3A3 will most likely be $692 instead of $654.

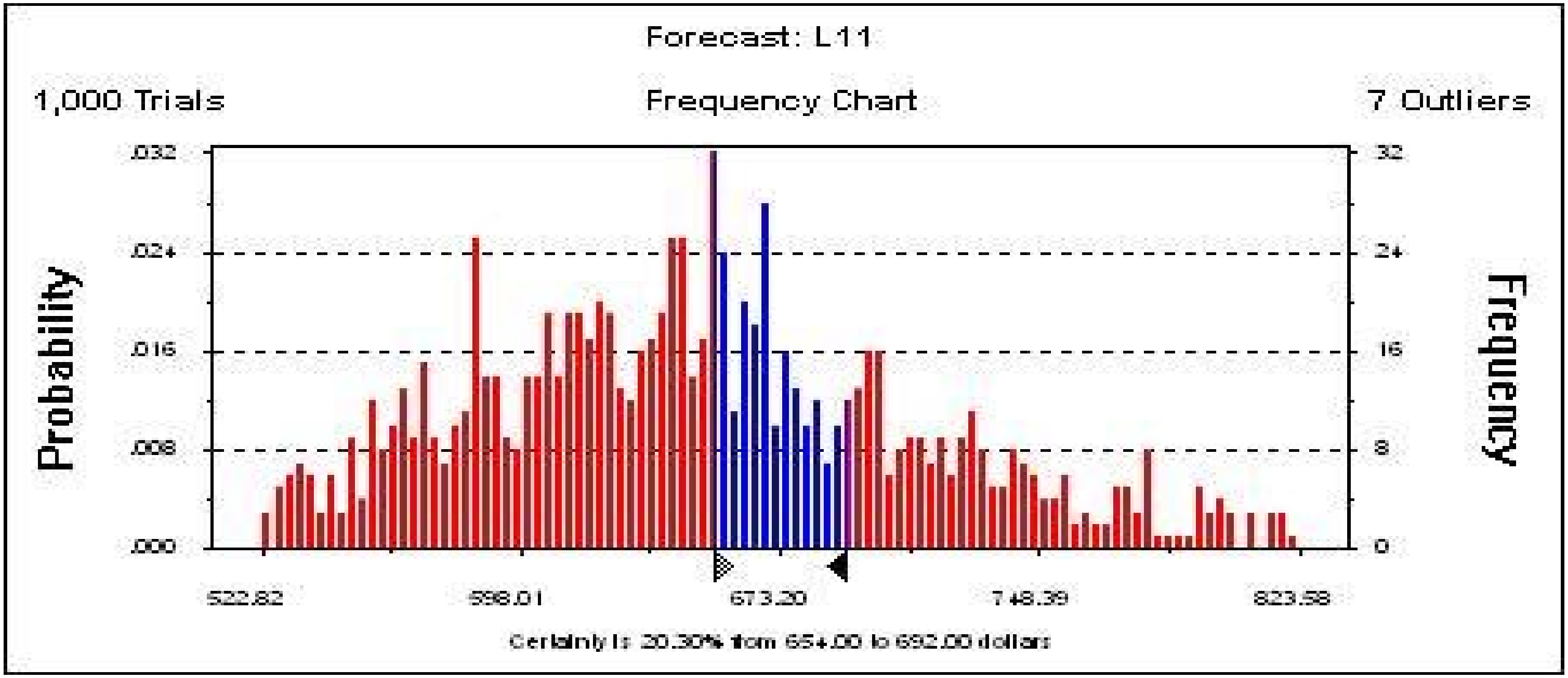


Figure 2-6 Probability vs. Cost for Site 5.

2.4.4 Site 4 Incremental Cost Analysis (Period 3 Measure B). Each alternative is compared to the Without Project Condition. The Benefits Units value for the Without Project Condition is zero.

Salmon River Section 206					
Period 3 Measure B_Incremental Cost Analysis					
	Average Annual				
	Equivalent				
	Total Project Cost/Most Likely		Incremental Cost/Unit Gained	Incremental	Average Cost
Period/Measure/Scales	(incl O&M)	Benefit Unit Yield	(Neg or Zero=No Benefit)	Cost Effect	Habitat Unit
					Avg Cost/
3B2	$24,970	130.5		Cost Effective	$191
3B4	$27,860	130.5	#DIV/0!	No Benefit	$213
3B3	$29,047	130.5	#DIV/0!	No Benefit	$223
3B1	$29,934	130.5	#DIV/0!	No Benefit	$229

Table 2-8 Site 4 Incremental Costs.

Period 3 has three Measures with 3-4 scales of investment. Measure 3B has four scales of investment. Measure/Scale 3B2 has the least average annual cost per habitat unit at $191 at the middle level. There are uncertainty ranges surrounding the 3 scales, therefore, we will also analyze the alternative with the least average habitat annual cost per unit yield given uncertainty surrounding the mean average annual cost per habitat unit.

2.4.4.1 Site 4 Uncertainty Analysis.

	Salmon River Section									
	Uncertainty Analysis_Period 3_Measure B									
					Avg Cost	Avg Cost	Avg Cost	Best	Worst	
	Alternative	Site			Habitat Unit	Habitat Unit	Habitat Unit	Low_Side	High_Side	1000 runs
	Code	Name	Variable #1	Variable	Most Likely	Worst Case	Best Case	Uncertainty %	Uncertainty %	Min Avg Cost/HU_ per Alternative
	3B1	Pennal Gulch	na	Log&Block	$229	$275	$200	13.00%	19.83%	$235
	3B2	Pennal Gulch	na	High Tensile Wire	$191	$231	$166	13.24%	20.73%	$196
	3B3	Pennal Gulch	na	Concrete Piller	$223	$256	$185	17.04%	14.80%	$221
	3B4	Pennal Gulch	na	Jack	$213	$257	$185	13.15%	20.66%	$218
Std Dev					$17					$196
Average					$214			14.11%	19.00%	
Minimum					$191		$166			
Maximum						$275				
Co-ef					8%					

Table 2-9 Site 4 Uncertainty Analysis.

Minimum average annual cost per habitat unit under best condition with total project costs at the low end and the habitat benefit yield at the high end is alternative 3B2 at an average annual cost per habitat unit of $166. Alternative 3B1 would be the worst-case scenario with total projects costs at the high end and the habitat units at the low end would yield an average annual cost per habitat unit of $275. All alternatives vary 13 and 21 percent between the high and low average annual cost per habitat unit. We can conclude the distribution of uncertainty among all alternatives is almost uniformly distributed between the high and low sides, with a slight edge on the high side (5 percent). The coefficient of variation (standard deviation/average value) comparing the most likely values without uncertainty applied low (8 percent). It may be that uncertainty simulation will show that the expected level of minimum average annual cost per habitat unit will probably slightly exceed the calculated minimum since uncertainty ranges of the apparent minimum cost alternative (3B2) is slightly weighted on the high side (21 to 13 percent). After running the simulation 1000 iterations at the 99 percent confidence level using the triangular distribution, we find the alternative with the minimum average annual cost per habitat unit is still 3B2 at $196 instead of calculated $191. The uncertainty showed that alternative 3B3 minimum cost decreased from $223 to $221, nevertheless, 3B2 is still the lowest cost at $196. The simulation did tell us that there is a 17 percent chance that the stated minimum average cost per habitat unit for 3B2 of $191 will be exceeded. The minimum cost per habitat unit for 3B2 will most likely be $196 instead of $191.

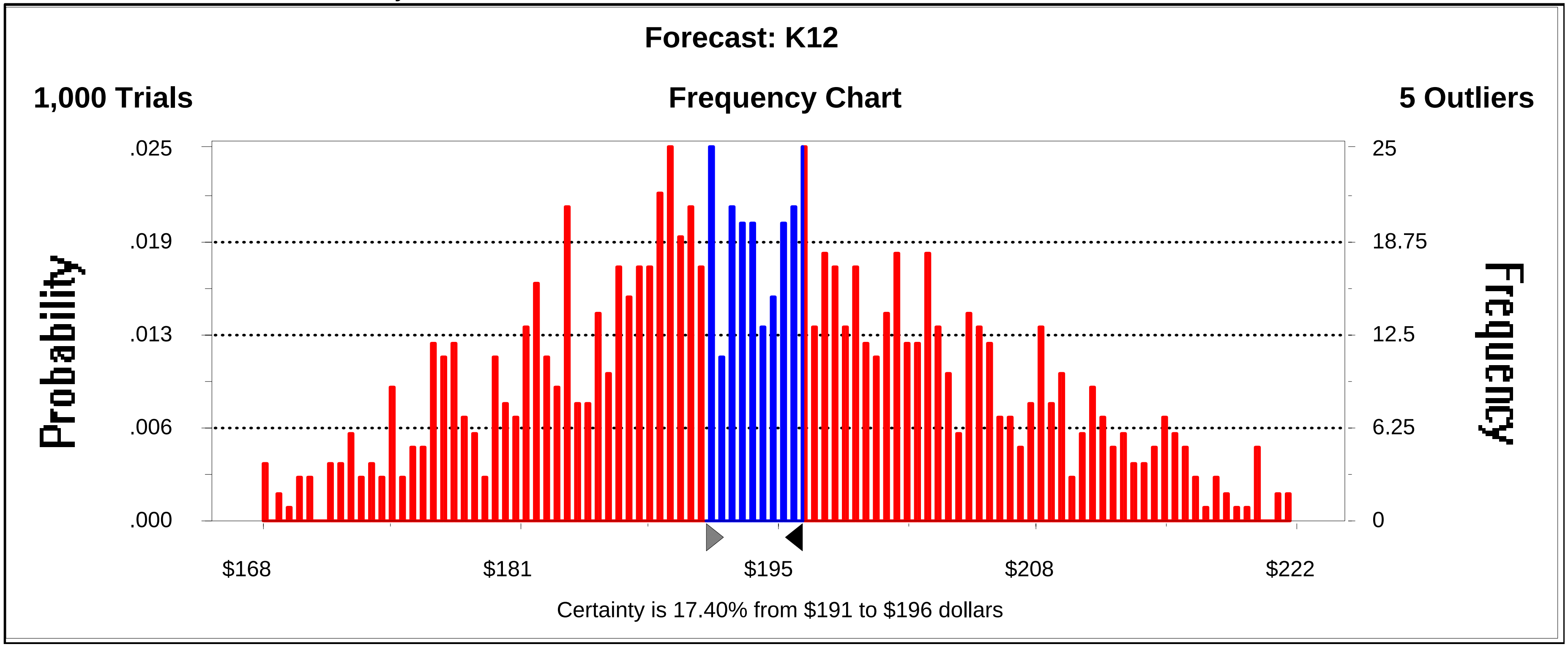


Figure 2-7 Probability vs. Cost for Site 4.

2.4.5 Site 1 Incremental Cost Analysis (Period 3 Measure C). Each alternative is compared to the Without Project Condition. The Benefits Units value for the Without Project Condition is zero.

Salmon River Section 206					
Period 3 Measure C_Incremental Cost Analysis					
	Average Annual				
	Equivalent				
	Total Project Cost/Most Likely		Incremental Cost/Unit Gained	Incremental	Average Cost
Period/Measure/ Scales	(incl O&M)	Benefit Unit Yield	(Neg or Zero=No Benefit)	Cost Effect	Habitat Unit
					Avg Cost/
3C2	$40,125	121.5		Cost Effective	$330
3C3	$41,232	121.5	#DIV/0!	No Benefit	$339
3C4	$41,285	121.5	#DIV/0!	No Benefit	$340
3C1	$42,174	121.5	#DIV/0!	No Benefit	$347

Table 2-10 Site 1 Incremental Costs per Unit.

Period 3_Measure C has 4 scales of investment having the same annual benefit. Measure/Scale 3C2 has the least average annual cost per habitat unit at $330 at the middle level. There are uncertainty ranges surrounding the 3 scales, therefore, we will also analyze the alternative with the least average annual cost per habitat unit yield given uncertainty surrounding the mean average annual cost per habitat unit.

2.4.5.1 Site 1 Uncertainty Analysis.

	Salmon River Section 206 Uncertainty Analysis_Period 3_Measure									
	Alternative Code	Site Name	Variable #1	Variable #2	Avg Cost Habitat Unit Most Likely	Avg Cost Habitat Unit Worst Case	Avg Cost Habitat Unit Best Case	Best Case Low_Side Uncertainty %	Worst Case High_Side Uncertainty %	1000 runs Min Avg Cost/HU_ p Alternative
	3C1	Dunfee	na	Log&Block	$347	$394	$310	10.66%	13.54%	$347
	3C2	Dunfee	na	High Tensile Wire	$330	$375	$295	10.60%	13.64%	$331
	3C3	Dunfee	na	Concrete Piller	$339	$386	$303	10.62%	13.86%	$340
	3C4	Dunfee	na	Jack	$340	$386	$304	10.59%	13.53%	$340
Std Dev					$7					$331
Average					$339			10.62%	13.64%	
Minimum					$330		$295			
Maximum						$394				
Co-ef Var					2%					

Table 2-11 Site 1 Uncertainty Analysis.

Minimum average annual cost per habitat unit under best condition with total project costs at the low end and the habitat benefit yield at the high end is alternative 3C2 at $295. Alternative 3C4 would be the worst-case scenario with total projects costs at the high end and the habitat units at the low end would yield an average annual cost per habitat unit of $386. All alternatives vary 10 and 141 percent between the high and low average annual cost per habitat unit. The distribution of uncertainty among all alternatives can be concluded is almost uniformly distributed between the high and low sides, with a slight edge on the high side (4 percent). The coefficient of variation (standard deviation/average value) comparing the most likely values without uncertainty applied is very low (2 percent). It may be that uncertainty simulation will show that the expected level of minimum average annual cost per habitat unit will probably slightly exceed the calculated minimum since uncertainty ranges of the apparent minimum cost alternative (3C2) is slightly weighted on the high side (14 to 10 percent). After running the simulation 1000 iterations at the 99 percent confidence level using the triangular distribution, we find the alternative with the minimum average annual cost per habitat unit is still 3C2 at $331, instead of calculated $330. The simulation did illustrate there is only a 2 percent chance that the stated minimum average cost per habitat unit for 3C2 of $330 will be exceeded. The minimum cost per habitat unit for 3C2 will most likely be $331, instead of $330.

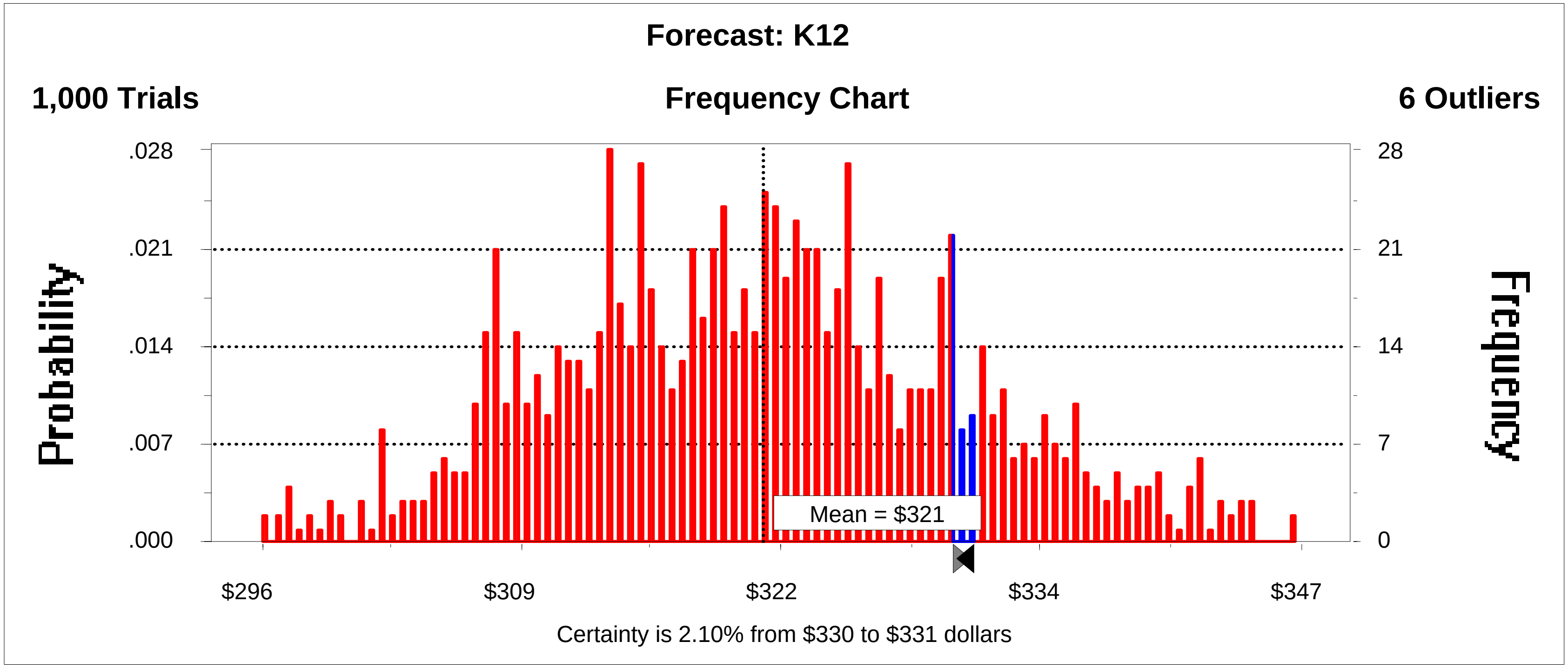


Figure 2-8 Probability vs. Cost for Site 1.

2.5 Alternative Analyses: Summary of Cost Effective Alternatives

The expected cumulative minimum average cost per habitat unit for the five alternatives is $272, without applying uncertainty, and $274 per habitat unit, taking into consideration the uncertainties surrounding the costs and benefits of each alternative.

The graphical presentation of the cumulative incremental costs and benefits (figure 2-2) shows that each investment step, starting with the smallest annual investment up to the maximum annual investment is incrementally justified.