APPENDIX E

ECONOMIC CONSIDERATIONS

U. S. Army Corps of Engineers
Albuquerque District

Rio Bosque Park, El Paso, Texas
Detailed Feasibility Study

November 2020

US Army Corps
of Engineers ®
Albuquerque District

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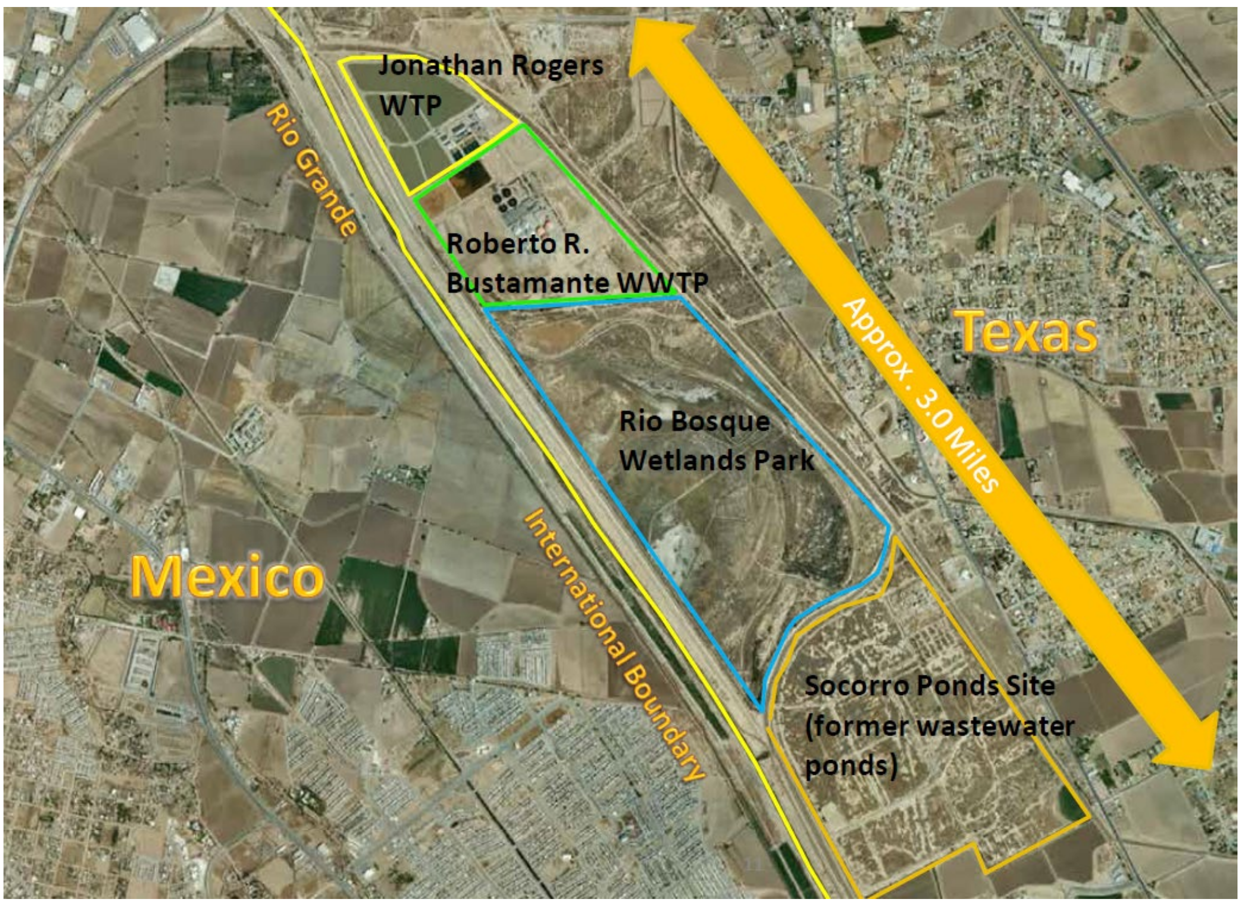
1 - Economic Considerations – Without-Project Conditions

1.1 Areas of Consideration

The 183 acre park is located in extreme southeast El Paso, near Mission Trail (Figure 1). The Park is owned by the City of El Paso, El Paso County, Texas (the City) and is managed by the El Paso Water Utility (EPWU) Public Service Board. Irrigation canals and drains on the east, south and northern sides enclose the Park. The western boundary of the park lies adjacent to the Rio Grande, which forms the international border between the United States and Mexico in this area. Water for the wetlands is reclaimed water from the Bustamante Wastewater Treatment Plant that is primarily available during the non-irrigation season of mid-October to mid-February.

Figure 1 – Study area location



2 - Economic Considerations – Ecosystem Restoration Analysis

2.1 Incremental Cost Analysis and NER Plan Selection

United States Army Corps of Engineers (USACE) policy, presented in Engineer Regulation 1105-2-100, *Planning Guidance Notebook*, requires that potential ecosystem restoration projects be analyzed for cost effectiveness and incremental benefits gained from various restoration alternatives. The plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, is selected and identified as the National Ecosystem Restoration (NER) Plan. Incremental cost and cost-effectiveness analysis (CE/ICA) is the technique used by the USACE to develop cost-effective restoration projects. Analysis of cost effectiveness, in general, compares the relative costs and benefits of alternative plans. The most efficient plans that provide the greatest increase in output for the least increase in cost are called the best buys. The least expensive best buy, which meets the restoration objective, is usually chosen as the tentatively selected plan.

Specifically, cost-effectiveness analysis compares the costs and expected environmental outputs among various alternative plans. If different alternative plans can produce the same level of output, only the least expensive (least-cost) choice makes economic sense for that level of output; economically *inefficient* alternative plans can be eliminated from further consideration. Similarly, if one alternative plan can produce a greater level of output for the same or less cost than others (cost-effective), only the greater output choice makes economic sense; economically *ineffective* alternative plans can be eliminated. After elimination of inefficient and ineffective alternative plans, there remain several least-cost, cost-effective alternative plans offering a range of output values from which to identify the means of meeting the ecosystem restoration objective. All price levels as they relate to ecosystem restoration are in 2017 price levels.

2.2 CE/ICA Analysis

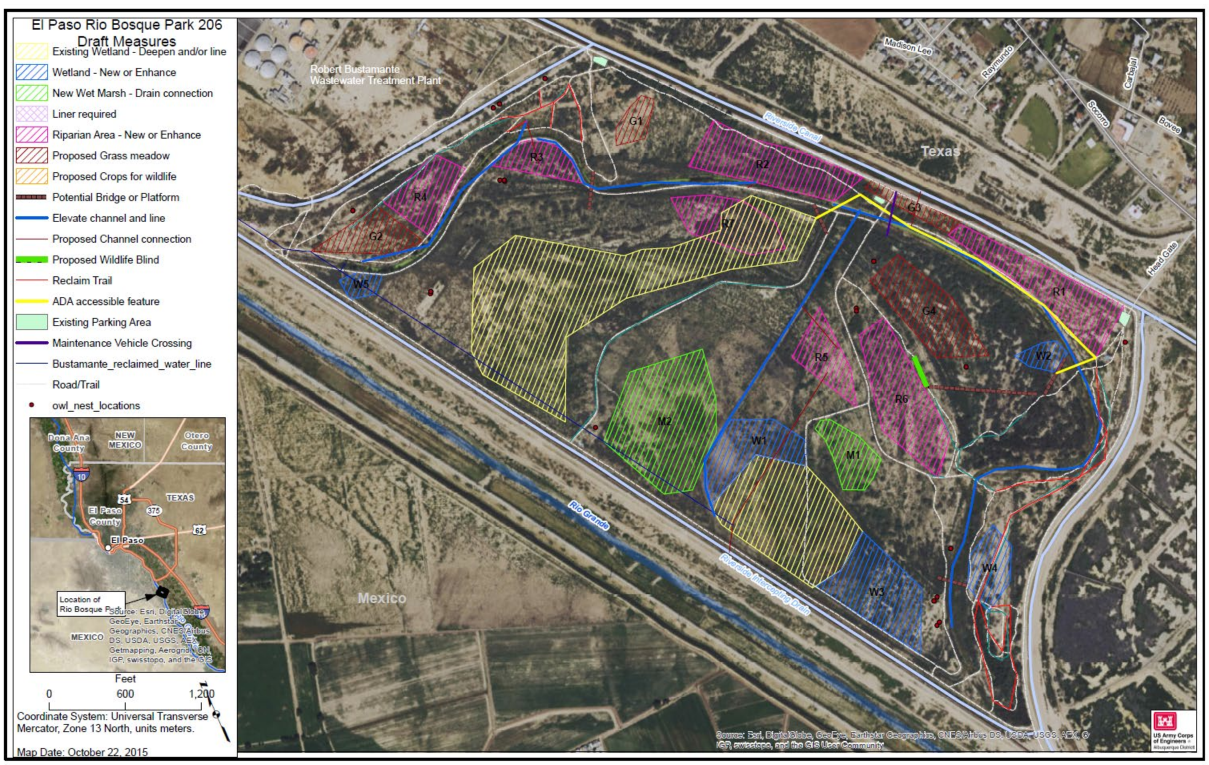
An alternative plan consists of a system of structural and/or non-structural measures, strategies, or programs formulated to meet, fully or partially, the identified study planning objectives subject to planning constraints. A management measure is a feature or an activity that can be implemented at a specific geographic site to address one or more planning objective. Management measures are the building blocks of alternative plans.

Restoration measures to enact the proposed improvements for this project include: a) new wetlands, b) existing wetlands, c) new wet marsh, d) riparian habitat, e) grass meadow habitat, and f) saltcedar removal. Alternative plans for habitat restoration could include one or more of the above measures and also include the No Action option for each restoration measure. Table 1 summarizes each of the restoration measures used in this study. Locations of those measures are displayed in Figure 2. Each of the restoration measures were entered into USACE Institute for Water Resources (IWR) Planning Suite (IWR-Plan). Each measure included the No Action option. IWR-Plan Decision Support Software assists with the formulation and comparison of alternative plans by conducting cost effectiveness and incremental cost analyses, identifying the plans which are the best financial investments, and displaying the effects of each plan on a range of decision variables.

Table 1 – Measures and their description

W1-W5	New Wetlands	Construct new wetlands or deepen existing, suboptimal areas.
E1-E2	Existing Wetlands	Areas that currently receive water during releases (November-December) are deepened and/or lined to connect to a more permanent water source.
M1-M2	New Wet Marsh	A more shallow wetland habitat type that can be constructed adjacent to deeper wetland habitat or stand alone as a wet marsh habitat.
R1-R8	Riparian Habitat	Areas that are currently riparian that can be enhanced or newly created riparian zones adjacent to existing or other newly constructed riparian habitat.
G1-G4	Grass Meadow Habitat	Constructed Grass Meadow Habitat meant to provide a different habitat type in the study area.
SC1-SC2	Salt Cedar Removal	Activities to remove exotic Salt Cedar from specific areas within the study area.

Figure 2 – Measures and their location



Most federal agencies use annualized output values as a means to display benefits and costs, and ecosystem restoration analyses should provide data that can be directly compared to the traditional benefit/cost analysis. Because habitat value is difficult to express in monetary terms, the cost effectiveness of project features is measured in habitat units (HU). HUs are the product of the amount and value of the habitat. HUs are calculated by summing HUs across all years in the period of analysis. The results of this calculation are referred to as average annual habitat units (AAHU) and can be expressed mathematically. Using AAHU as metric, plans can be compared over time based on the forecast conditions. In this way, it is possible to quantify a change in habitat by implementing the project and evaluate whether that change is cost effective.

Table 2 presents the outputs, costs, and marginal outputs necessary to conduct the cost effectiveness analysis.

Table 2 – Measures, their effects and their costs

American coot						
W1	Name	Cost	Acres	Output (AAHU)	Recomputed (w/	ost/marginal outpu
2'		$ 235,265.00	6.20	0.00	0.00	$ -
4'		$ 368,489.00	6.20	1.34	1.34	$ 274,488.31
5'		$ 409,577.00	6.20	2.68	2.68	$ 152,547.43
W2						
4'		$ 294,134.00	1.40	0.30	0.30	$ 970,304.86
5'		$ 303,411.00	1.40	0.61	0.61	$ 500,454.16
W3						
2'		$ 348,282.00	8.70	0.00	0.00	$ -
4'		$ 527,441.00	8.70	1.88	1.88	$ 279,992.01
5'		$ 585,098.00	8.70	3.77	3.77	$ 155,299.61
W4						
4'		$ 321,851.00	3.50	0.76	0.76	$ 424,695.67
5'		$ 345,046.00	3.50	1.52	1.52	$ 227,651.21
W5						
4'		$ 247,645.00	1.10	0.24	0.24	$ 1,039,747.51
5'		$ 253,766.00	1.10	0.48	0.48	$ 532,723.39
E1			38.50	4.62	0.00	$ -
4'		$ 1,580,842.00	38.50	15.17	10.56	$ 149,766.16
5'		$ 1,815,142.00	38.50	16.67	12.06	$ 150,568.19
E2						
4'		$ 1,096,621.00	16.60	6.54	4.55	$ 240,954.16
5'		$ 1,219,061.00	16.60	7.26	5.27	$ 231,319.78

Northern pintail, Gulf Coast wintering						
Marshes	Name	Cost	Acres	Output (AAHU)	Recomputed (w/	project - w/o
M1		$ 54,604.00	3.50	1.53	1.53	$ 35,605.56
M2		$ 280,478.00	15.90	6.97	6.97	$ 40,259.01
M3	W1 shallo	$ 235,265.00	6.20	2.72	2.72	$ 86,601.83
M4	W3 shallo	$ 348,282.00	8.70	3.81	3.81	$ 91,363.60
	M3 not combinable with W1					
	M4 not combinable with W3					

Yellow warbler						
Riparian	Name	Cost	Acres	Output (AAHU)	Recomputed (w/	project - w/o
R1		$ 97,301.00	8.9	7.65	5.60	$ 17,382.59
R2		$ 98,394.00	9	7.73	5.66	$ 17,382.54
R3		$ 33,891.00	3.1	2.66	1.95	$ 17,382.40
R4		$ 50,290.00	4.6	3.95	2.89	$ 17,382.45
R5		$ 42,638.00	3.9	3.35	2.45	$ 17,382.79
R6		$ 103,861.00	9.5	8.16	5.97	$ 17,382.65
R7		$ 65,596.00	6	5.15	3.77	$ 17,382.54
Salt Cedar	removal					
SC1		$ 166,199.00	21.3	19.17607433	11.38	$ 14,599.20
SC2		$ 75,044.00	9.80	8.82	5.24	$ 14,327.49

Black-tailed prairie dog						
Grass mea	Name	Cost	Acres	Output (AAHU)	Recomputed (w/	project - w/o project)
G1		$ 3,631.00	1.7	0.814145546	0.53	$ 6,905.38
G2		$ 8,544.00	4	1.81169722	1.17	$ 7,301.95
G3		$ 3,845.00	1.8	0.839626742	0.54	$ 7,090.44
G4		$ 16,661.00	7.8	3.53280958	2.28	$ 7,302.04

2.2.1 Combinability and Dependability

Combinability and dependency are two types of relationships used in the CE/ICA analysis. In a typical USACE study, management measures may or may not be mutually exclusive, and it is the property of combinability that allows planners to mix and match measures into different plans. Conversely, some measures may preclude others, and this will limit the ability to mix and match the measures. In consideration of combinability, two measures might be mutually exclusive because of:

- Location, where two different measures cannot occupy the same space at the same time.
- Function, where two different measures may work against one another.

In addition to being combinable, many measures may be dependent on other measures in order to be implemented. Dependency relationships between two measures may exist for several reasons, including:

- Necessary to function.
- Reduce risk or uncertainty.
- Improve performance.

In this analysis, all measures were relatively independent, as they are specific treatments for unique segments of land in the study area. The only non-combinable measures were M3 (a marsh habitat that represents an alternative use of wetland W1) and M4 (a second marsh habitat that represents an alternative use of Wetland W3). The existing (E1 and E2) and proposed (W1 through W5) wetlands have a couple of options (expressed as depths here) that were treated as a scalar option for the land plot.

2.2.2 Plan Generation

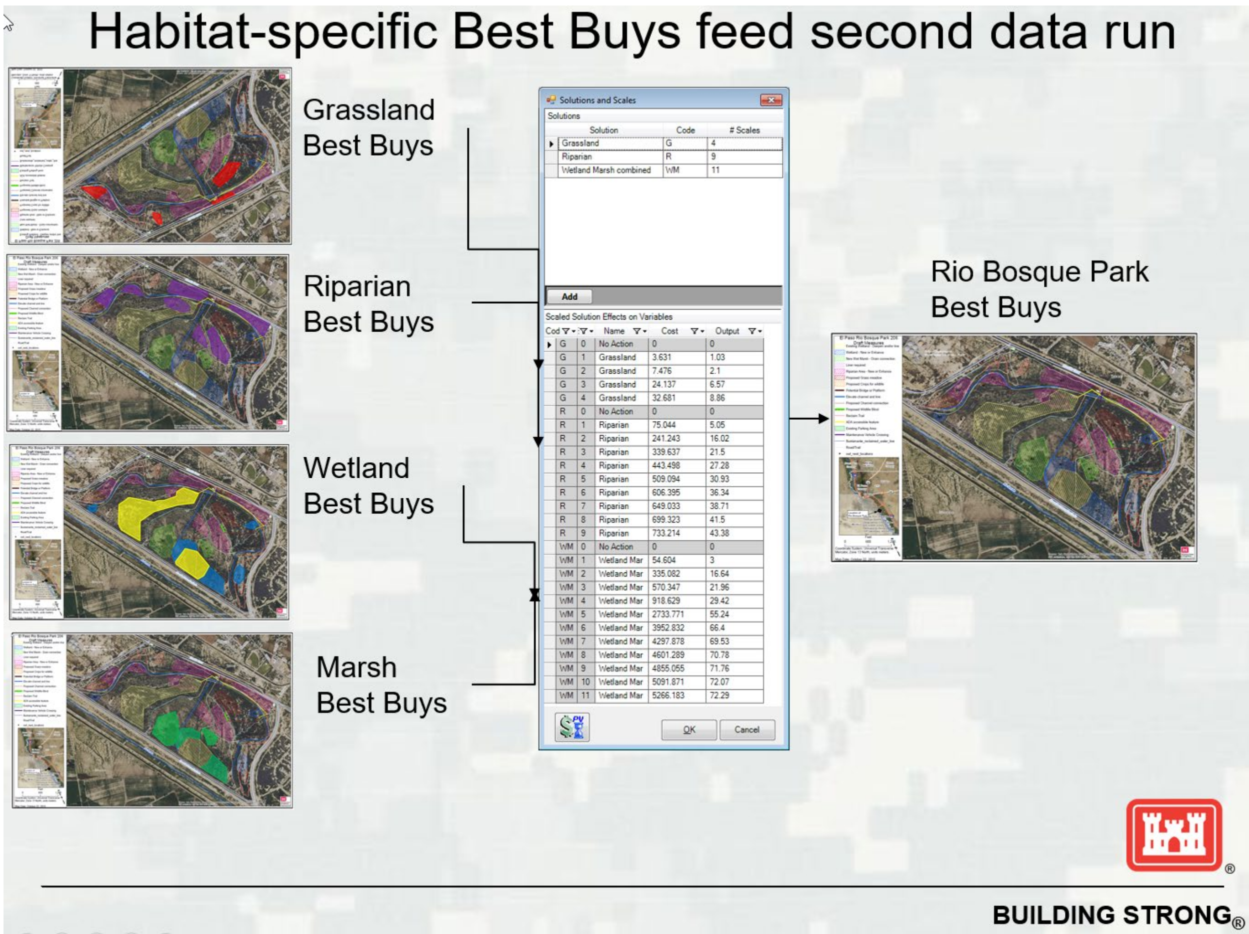
Within IWR-Plan, and once a planning study comprised of variables, outputs, and attributes has been defined with the plan editor, the plan generation module is used to populate a new planning set with plan alternatives. IWR-Plan displays generated planning sets with the information needed to assist planners to manage the plans and keep the plans in context.

The cost effectiveness analysis which follows uses the information in Table 2 and Table 3, above. There are 24 different measures available. which would generate approximately 6.2x10^23 alternatives if run in one model. The non-combinable measures (M3/W1, M4/W3 and the scalar options for the E and W measures) do substantially limit the plans generated, but the sheer number of possible alternatives would crush the modeling software so the study was broken into four components. Each run only runs measures that benefit a specific species that serves as the output measure. For instance, one model run was set up using only the American coot as an output measure, which contains the wetland measures W1 through W5 and E1 and E2. The measures columns in Table 2 are color coded, and identify which indicator species was used to calculate habitat outputs for the measures proposed.

This analysis looks over the Average Annual Habitat Unit (AAHU) output as a desirable output of the ecosystem restoration efforts. The benefit stream for all the measures was calculated over a 50 year project life and summed using the annualization calculator for NER outputs within the IWR Planning Suite. The output calculation takes into account other output computations (for the America coot, the Northern pintail, the Yellow warbler, and the Black-tailed prairie dog), weighting them all equally at 25% of the total score. This assumption served as a starting point of the analysis. Finally, where the existing condition is assigned a value for a given measure, that measure's (output score in the existing condition) x (number of acres) is removed from the (output score with project) x (number of acres) to compute only the marginal benefits of performing a specific measure in the cost effectiveness analysis.

So, to disaggregate the options to something the software can handle, four cost effectiveness models were set up. The first model contains 7 measures benefitting the American coot. The second model contains 4 measures benefitting the Northern pintail. The third model contains 9 measures benefitting the Yellow warbler, and the fourth model contains four measures benefitting the Black-tailed prairie dog. The intent of these four models is to identify only the best buys to be carried forward into a final composite run, as depicted in Figure 3.

Figure 3 – Workflow for Cost-Effectiveness Analysis



Disaggregating the array of measures into meaningful chunks was most helpful on the 9 measures benefitting the Yellow warbler, which can combine into roughly 363,000 different alternatives using 1 to 9 of these measures. The disaggregation described here doesn't preclude any of the 6.2x10^23 alternatives that could be developed in this study, but does a fairly good job of identifying efficiencies early. Prior studies and research indicate that alternatives that are not efficient/effective do not later become efficient/effective. Similarly, non-Best Buy plans will not later become Best Buy plans. Efficiency and effectiveness is a trait that, once lost, is never regained in this analysis.

Using the nomenclature, outputs and costs identified in Table 1, the Best Buys from the four runs are presented in Tables 3 to 6.

Table 3 – Wetland Best Buys

Wetland							
	Name	Cost	Output	Cost Effective			
	No Action Plan	0	0	Best Buy			
	W10W20W30W40W50E11E20	1580.842	10.56	Best Buy	E11		
	W12W20W30W40W50E11E20	1990.419	13.24	Best Buy	W12E11		
	W12W20W32W40W50E11E20	2575.517	17.01	Best Buy	W12W32E11		
	W12W20W32W40W50E12E20	2809.817	18.51	Best Buy	W12W32E12		
	W12W20W32W42W50E12E20	3154.863	20.03	Best Buy	W12W32W42E12		
	W12W20W32W42W50E12E22	4373.924	25.3	Best Buy	W12W32W42E12E22		
	W12W22W32W42W50E12E22	4677.335	25.91	Best Buy	W12W22W32W42E12E22		
	W12W22W32W42W52E12E22	4931.101	26.39	Best Buy	W12W22W32W42W52E12E22		

Table 4 – Marsh Best Buys

Marsh						
	Name	Cost	Output	Cost Effective		
	No Action Plan	0	0	Best Buy		
	M11M20M30M40	54.604	1.53	Best Buy	M1	
	M11M21M30M40	335.082	8.5	Best Buy	M1M2	
	M11M21M31M40	570.347	11.22	Best Buy	M1M2M3	
	M11M21M31M41	918.629	15.03	Best Buy	M1M2M3M4	

Table 5 – Riparian Best Buys

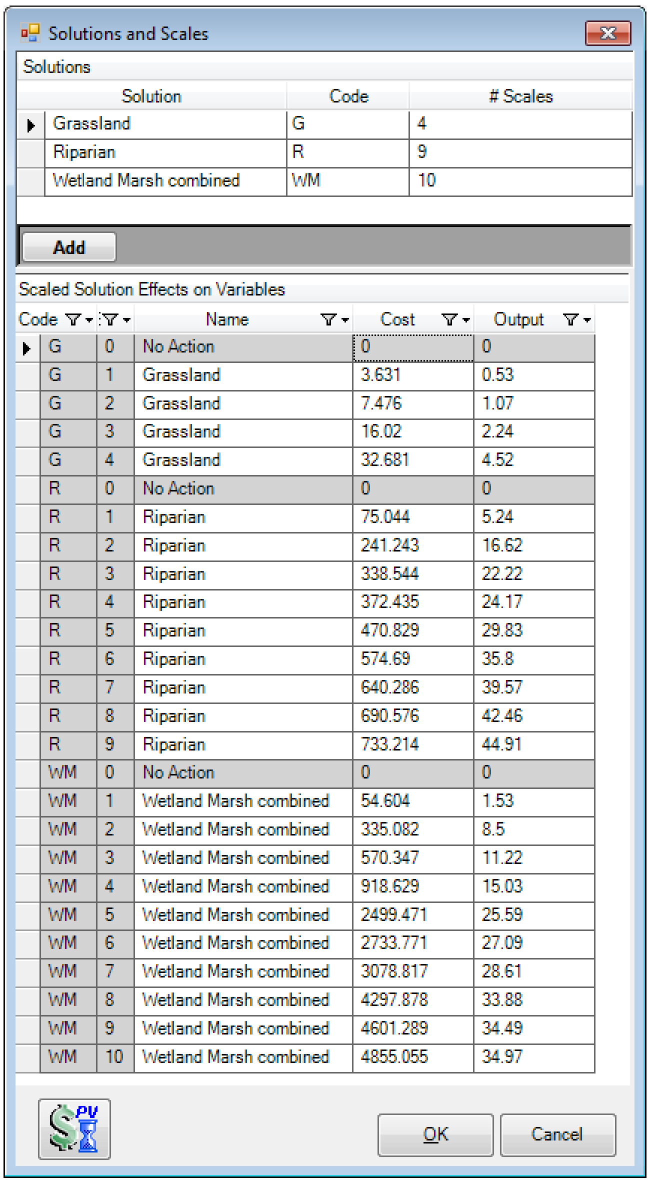
Riparian							
	Name	Cost	Output	Cost Effective			
	No Action Plan	0	0	Best Buy			
	R10R20R30R40R50R60R70SC10SC21	75.044	5.24	Best Buy	SC2		
	R10R20R30R40R50R60R70SC11SC21	241.243	16.62	Best Buy	SC1SC2		
	R11R20R30R40R50R60R70SC11SC21	338.544	22.22	Best Buy	R1SC1SC2		
	R11R20R31R40R50R60R70SC11SC21	372.435	24.17	Best Buy	R1R3SC1SC2		
	R11R21R31R40R50R60R70SC11SC21	470.829	29.83	Best Buy	R1R2R3SC1SC2		
	R11R21R31R40R50R61R70SC11SC21	574.69	35.8	Best Buy	R1R2R3R6SC1SC2		
	R11R21R31R40R50R61R71SC11SC21	640.286	39.57	Best Buy	R1R2R3R6R7SC1SC2		
	R11R21R31R41R50R61R71SC11SC21	690.576	42.46	Best Buy	R1R2R3R4R6R7SC1SC2		
	R11R21R31R41R51R61R71SC11SC21	733.214	44.91	Best Buy	R1R2R3R4R5R6R7SC1SC2		

Table 6 – Grassland Best Buys

Grassland						
	Name	Cost	Output	Cost Effective		
	No Action Plan	0	0	Best Buy		
	G11G20G30G40	3.631	0.53	Best Buy	G1	
	G11G20G31G40	7.476	1.07	Best Buy	G1G3	
	G11G21G31G40	16.02	2.24	Best Buy	G1G2G3	
	G11G21G31G41	32.681	4.52	Best Buy	G1G2G3G4	

The four Best Buy lists become measures in a second cost-effectiveness run. For example, there are 9 incrementally justified ways to perform ecosystem restoration based on performing riparian habitat work. Each measure becomes an incremental scale in the second run, presented below in Figure 4. Wetlands and marsh best buys were combined for a couple of reasons. First, where M3 and M4 were potential substitutes for W1 and W3, a quick check of unit costs indicate, where AAHU is considered equal regardless of the indicator species, marshes provide output at a lower unit cost than any of the wetlands. W1 and W3 at any depth were removed from further consideration in the second pass. Second, the radically different unit cost between marsh and wetland outputs indicated that ALL marsh measures would be implemented before the first wetland measure could be selected as a cost effective means to generate habitat output.

Figure 4 – Second pass input stack



Solutions and Scales

Solutions

Solution	Code	# Scales
Grassland	G	4
Riparian	R	9
Wetland Marsh combined	WM	10

Add

Scaled Solution Effects on Variables

Code		Name	Cost	Output
G	0	No Action	0	0
G	1	Grassland	3.631	0.53
G	2	Grassland	7.476	1.07
G	3	Grassland	16.02	2.24
G	4	Grassland	32.681	4.52
R	0	No Action	0	0
R	1	Riparian	75.044	5.24
R	2	Riparian	241.243	16.62
R	3	Riparian	338.544	22.22
R	4	Riparian	372.435	24.17
R	5	Riparian	470.829	29.83
R	6	Riparian	574.69	35.8
R	7	Riparian	640.286	39.57
R	8	Riparian	690.576	42.46
R	9	Riparian	733.214	44.91
WM	0	No Action	0	0
WM	1	Wetland Marsh combined	54.604	1.53
WM	2	Wetland Marsh combined	335.082	8.5
WM	3	Wetland Marsh combined	570.347	11.22
WM	4	Wetland Marsh combined	918.629	15.03
WM	5	Wetland Marsh combined	2499.471	25.59
WM	6	Wetland Marsh combined	2733.771	27.09
WM	7	Wetland Marsh combined	3078.817	28.61
WM	8	Wetland Marsh combined	4297.878	33.88
WM	9	Wetland Marsh combined	4601.289	34.49
WM	10	Wetland Marsh combined	4855.055	34.97

OK Cancel

For simplification, the rather elaborate measure names from the prior runs were simplified to “Habitat type” where habitat type is reduced to one letter (G for grassland, R for riparian, WM for wetland and marsh) and the number corresponds to the number of best buy from the applicable habitat run. No measures in the second pass were identified as non-combinable. Within the habitat stack of best buys, those alternatives are already mutually exclusive, existing within the same scale of habitat output.

Table 7 which follows, identifies the Best Buys of this second run. 550 plans were evaluated, and 24 were identified as Best Buys. Figure 5 is a graphical representation of the plans.

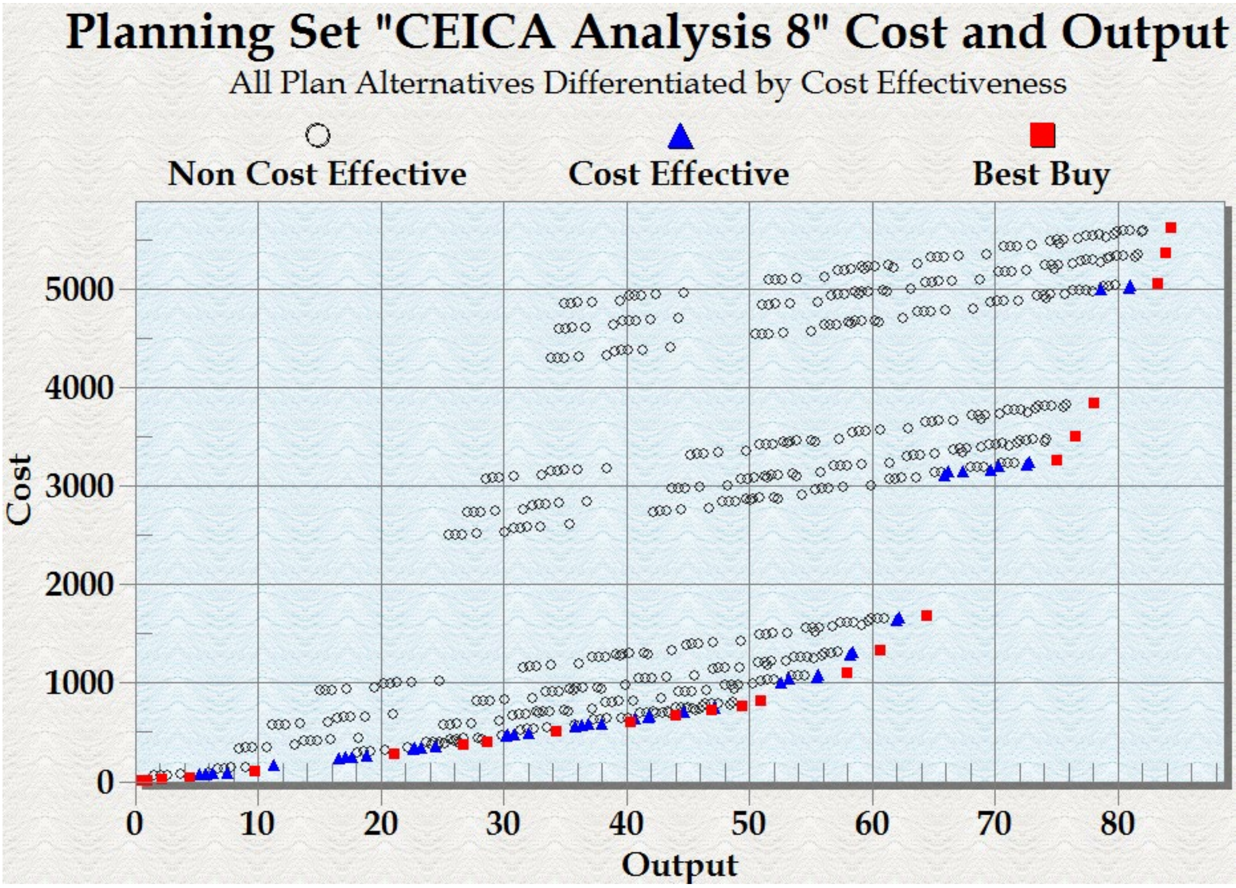
Table 7 – Best Buys identified in the second cost effectiveness run

Total and Average Cost 4/3/2017 9:36:32AM

Best Buv Plan Alternatives **Planning Set:** CEICA Analysis 8

Counter	Name	Output HU	Cost $1000	Average Cost
1	No Action Plan	0.00	0.00	
2	G1R0WM0	0.53	3.63	6.85
3	G2R0WM0	1.07	7.48	6.99
4	G3R0WM0	2.24	16.02	7.15
5	G4R0WM0	4.52	32.68	7.23
6	G4R1WM0	9.76	107.73	11.04
7	G4R2WM0	21.14	273.92	12.96
8	G4R3WM0	26.74	371.23	13.88
9	G4R4WM0	28.69	405.12	14.12
10	G4R5WM0	34.35	503.51	14.66
11	G4R6WM0	40.32	607.37	15.06
12	G4R7WM0	44.09	672.97	15.26
13	G4R8WM0	46.98	723.26	15.39
14	G4R9WM0	49.43	765.90	15.49
15	G4R9WM1	50.96	820.50	16.10
16	G4R9WM2	57.93	1,100.98	19.01
17	G4R9WM3	60.65	1,336.24	22.03
18	G4R9WM4	64.46	1,684.52	26.13
19	G4R9WM5	75.02	3,265.37	43.53
20	G4R9WM6	76.52	3,499.67	45.74
21	G4R9WM7	78.04	3,844.71	49.27
22	G4R9WM8	83.31	5,063.77	60.78
23	G4R9WM9	83.92	5,367.18	63.96
24	G4R9WM10	84.40	5,620.95	66.60

Figure 5 – Best buy plans



Put simply, it makes sense to install all the grassland measures first, followed by the riparian measures, and then the marsh measures, and finally the wetland measures. There was no real mixing of habitat types in generating output. Table 8 identifies the 24 Best Buys in terms of the naming conventions in Table 1 and Table 2.

Table 8 – Best Buys for HSI (Composite) output and their respective component measures

	Name	Cost	Output	Cost Effective			
	No Action Plan	0	0	Best Buy			
1	G1R0WM0	3.631	0.53	Best Buy		G1	G1
2	G2R0WM0	7.476	1.07	Best Buy		G2	G1G3
3	G3R0WM0	16.02	2.24	Best Buy		G3	G1G2G3
4	G4R0WM0	32.681	4.52	Best Buy		G4	G1G2G3G4
5	G4R1WM0	107.725	9.76	Best Buy		R1	SC2
6	G4R2WM0	273.924	21.14	Best Buy		R2	SC1SC2
7	G4R3WM0	371.225	26.74	Best Buy		R3	R1SC1SC2
8	G4R4WM0	405.116	28.69	Best Buy		R4	R1R3SC1SC2
9	G4R5WM0	503.51	34.35	Best Buy		R5	R1R2R3SC1SC2
10	G4R6WM0	607.371	40.32	Best Buy		R6	R1R2R3R6SC1SC2
11	G4R7WM0	672.967	44.09	Best Buy		R7	R1R2R3R6R7SC1SC2
12	G4R8WM0	723.257	46.98	Best Buy		R8	R1R2R3R4R6R7SC1SC2
13	G4R9WM0	765.895	49.43	Best Buy		R9	R1R2R3R4R5R6R7SC1SC2
14	G4R9WM1	820.499	50.96	Best Buy		WM1	M1
15	G4R9WM2	1100.977	57.93	Best Buy		WM2	M1M2
16	G4R9WM3	1336.242	60.65	Best Buy		WM3	M1M2M3
17	G4R9WM4	1684.524	64.46	Best Buy		WM4	M1M2M3M4
18	G4R9WM5	3265.366	75.02	Best Buy		WM5	E11M1M2M3M4
19	G4R9WM6	3499.666	76.52	Best Buy		WM6	E12M1M2M3M4
20	G4R9WM7	3844.712	78.04	Best Buy		WM7	W42E12M1M2M3M4
21	G4R9WM8	5063.773	83.31	Best Buy		WM8	W42E12E22M1M2M3M4
22	G4R9WM9	5367.184	83.92	Best Buy		WM9	W22W42E12E22M1M2M3M4
23	G4R9WM10	5620.95	84.4	Best Buy		WM10	W22W42W52E12E22M1M2M3M4

Each Best Buy includes the efforts in prior best buys. Each best buy represents an incremental addition to the previous best buy's slate of activities. No best buys that substituted activities from previous best buys were identified. Identifying measures in Table 8 is an attempt to clarify what's being done.

2.2.3 Sensitivity Analysis

A few sensitivity analyses were done to evaluate the impact of key variables on the final decision. The PDT was concerned there was no real mixing of habitat types along the final supply curve, which would make the "habitat heterogeneity" objective of the study impossible to meet without doing pretty much everything possible in the study area. The first sensitivity run merely looks at acreage, instead of the habitat outputs, as the desirable output of the measures, This and other sensitivity tests is designed to evaluate changing the output yardstick would impact cost effectiveness of some alternatives relative to others or would change the plan order subject to an incremental justification. The sensitivity runs quantify those notions to see their impacts on decision making. Referring to Table 2 above, the cost of the measures remain identical, but the output uses acres instead of habitat units. There is a potential weakness in this particular assumption in that the existing (without-project) acres have a non-zero value to provide habitat, which is conveniently ignored when using acres as output. This analysis merely served as the first step in exploring the nature of the cost-effectiveness data.

The first sensitivity run looks only at acres as the desirable output, but makes no weighting for, say, wetlands versus grasslands. The IWR Planning Suite is populated with new outputs and separate runs identical to what's described above are recomputed and processed through the IWR Planning Suite in two iterations (as before) to get at the final array of Best Buys, which are presented below in Table 9.

Table 9 – Best buy plans, habitat acres as output and their description

	Name	Cost	Output	Cost Effective	
1	No Action Plan	0	0	Best Buy	
2	WM0RG1	3.631	1.7	Best Buy	G1
3	WM0RG2	12.175	5.7	Best Buy	G1G2
4	WM0RG3	28.836	13.5	Best Buy	G1G2G3
5	WM0RG4	32.681	15.3	Best Buy	G1G2G3G4
6	WM0RG5	107.725	25.1	Best Buy	G1G2G3G4SC2
7	WM0RG6	273.924	46.4	Best Buy	G1G2G3G4SC1SC2
8	WM0RG7	307.815	49.5	Best Buy	R3G1G2G3G4SC1SC2
9	WM0RG8	358.105	54.1	Best Buy	R3R4G1G2G3G4SC1SC2
10	WM0RG9	456.499	63.1	Best Buy	R2R3R4G1G2G3G4SC1SC2
11	WM0RG10	522.095	69.1	Best Buy	R2R3R4R7G1G2G3G4SC1SC2
12	WM0RG11	619.396	78	Best Buy	R1R2R3R4R7G1G2G3G4SC1SC2
13	WM0RG12	723.257	87.5	Best Buy	R1R2R3R4R6R7G1G2G3G4SC1SC2
14	WM0RG13	765.895	91.4	Best Buy	R1R2R3R4R5R6R7G1G2G3G4SC1SC2
15	WM1RG13	820.499	94.9	Best Buy	M1
16	WM2RG13	1100.98	110.8	Best Buy	M1M2
17	WM3RG13	1336.24	117	Best Buy	M1M2M3
18	WM4RG13	1684.52	125.7	Best Buy	M1M2M3M4
19	WM5RG13	3265.37	164.2	Best Buy	E1M1M2M3M4
20	WM6RG13	4361.99	180.8	Best Buy	E1E2M1M2M3M4
21	WM7RG13	4683.84	184.3	Best Buy	W4E1E2M1M2M3M4
22	WM8RG13	4977.97	185.7	Best Buy	W2W4E1E2M1M2M3M4
23	WM9RG13	5225.62	186.8	Best Buy	W2W4W5E1E2M1M2M3M4

Generally, the "acres as output" run follows the same patterns as the initial habitat run. The supply curve is populated with, in order, grasslands, riparian, marsh, and wetlands. Because the output measure is acres, measures that represent intensification of a specific portion of land are excluded relative to the first increment. So, M3 and M4 are selected over W1 and W3. And constructing new wetlands to 4' depth is always preferable to 5'. Conversely, construction existing wetlands (E1, E2) to 5' depth is preferable in general relative to 4'.

A couple more sensitivity runs were developed to further explore the uniform selection of all options in a habitat type before moving on to the next habitat, only to repeat the process. The PDT believes a critical element of a successful project is a variety of habitat types in the final alternative selected. These monotypic habitat best buys along the final supply curve limit habitat heterogeneity unless plans near "do everything" are selected. The next sensitivity run evaluates all the habitat types for all the indicator species, instead of a single indicator species for each habitat type, by averaging the habitat generated for each species. This "composite" approach would mark habitat creation that benefits all species as more beneficial than habitat that only benefits one or two of the indicator species. The composite outputs were created and processed through the IWR Planning Suite as before to create the final array of best buys, presented below in Table 10:

Table 10 – Best buy plans, composite output and their description

	Name	Cost	Output	Cost Effective			
	No Action Plan	0	0	Best Buy			
1	G1R0WM0	3.845	0.14	Best Buy		G1	G1
2	G2R0WM0	7.476	0.27	Best Buy		G2	G1G3
3	G3R0WM0	24.137	0.84	Best Buy		G3	G1G2G3
4	G4R0WM0	32.681	1.13	Best Buy		G4	G1G2G3G4
5	G4R1WM0	107.725	1.73	Best Buy		R1	SC2
6	G4R2WM0	273.924	3.04	Best Buy		R2	SC1SC2
7	G4R2WM1	328.528	3.45	Best Buy		WM1	M1
8	G4R2WM2	609.006	5.32	Best Buy		WM2	M1M2
9	G4R3WM2	651.644	5.46	Best Buy		R3	R5SC1SC2
10	G4R4WM2	685.535	5.57	Best Buy		R4	R3R5SC1SC2
11	G4R5WM2	751.131	5.78	Best Buy		R5	R3R5R7SC1SC2
12	G4R6WM2	848.432	6.09	Best Buy		R6	R1R3R5R7SC1SC2
13	G4R7WM2	898.722	6.25	Best Buy		R7	R1R3R4R5R7SC1SC2
14	G4R8WM2	1002.583	6.58	Best Buy		R8	R1R3R4R5R6R7SC1SC2
15	G4R9WM2	1100.977	6.89	Best Buy		R9	R1R2R3R4R5R6R7SC1SC2
16	G4R9WM3	1336.242	7.62	Best Buy		WM3	M1M2M3
17	G4R9WM4	1684.524	8.64	Best Buy		WM4	M1M2M3M4
18	G4R9WM5	3265.366	12.39	Best Buy		WM5	E11M1M2M3M4
19	G4R9WM6	3499.666	12.76	Best Buy		WM6	E12M1M2M3M4
20	G4R9WM7	4596.287	14.38	Best Buy		WM7	E12E21M1M2M3M4
21	G4R9WM8	4718.727	14.56	Best Buy		WM8	E12E22M1M2M3M4
22	G4R9WM9	5063.773	15.05	Best Buy		WM9	W42E12E22M1M2M3M4
23	G4R9WM10	5300.589	15.25	Best Buy		WM10	W32W42E12E22M1M2M3M4
24	G4R9WM11	5474.901	15.39	Best Buy		WM11	W12W32W42E12E22M1M2M3M4
25	G4R9WM12	5778.312	15.59	Best Buy		WM12	W12W22W32W42E12E22M1M2M3M4
26	G4R9WM13	6032.078	15.74	Best Buy		WM13	W12W22W32W42W52E12E22M1M2M3M4

Relative to the initial habitat creation run, this composite output run didn't really alter the sequence or content of the best buys. The curve is still populated with grasslands, salt cedar removal, riparian, marsh and then wetland creation. There was some mixing of habitat types, as M1 and M2 showed up relatively earlier than before. Otherwise, this run didn't really alter the supply curve from the initial habitat creation model.

A final sensitivity run was developed to slightly weight the various species directly against each other in accordance with the PDT biologist's expert opinion on what is best for the study area. The final outcome of that run didn't do much to alter the final array of best buys, but it did best achieve the desired result of mixing habitat types throughout that supply curve, as depicted in Table 11. The PDT elected to use the weighted output sensitivity run as the basis for the incremental cost analysis. Figure 6 presents the output/cost graphs for the best buys. Figure 7 displays all the plans screened for cost effectiveness, per the second run in the IWR Planning Suite.

Table 11 – Best buy plans, weighted output and their description

	Name	Cost	Output	Cost Effective						
1	No Action Plan	0	0	Best Buy		First Pass				
2	G0R1WM0	42.638	1.64	Best Buy	R1	R5	R5			
3	G0R2WM0	206.628	7.94	Best Buy	R2	R2R7	R2R5R7			
4	G0R3WM0	310.489	11.93	Best Buy	R3	R6	R2R5R6R7			
5	G0R4WM0	360.779	13.86	Best Buy	R4	R4	R2R4R5R6R7			
6	G0R5WM0	394.67	15.16	Best Buy	R5	R3	R2R3R4R5R6R7			
7	G0R6WM0	491.971	18.89	Best Buy	R6	R1	R1R2R3R4R5R6R7			
8	G0R6WM1	546.575	20.3	Best Buy	WM1	M1	M1			
9	G1R6WM1	550.42	20.39	Best Buy	G1	G3	G3			
10	G1R6WM2	830.898	26.78	Best Buy	WM2	M2	M1M2			
11	G2R6WM2	834.529	26.86	Best Buy	G2	G1	G1G3			
12	G3R6WM2	851.19	27.22	Best Buy	G3	G4	G1G3G4			
13	G4R6WM2	859.734	27.4	Best Buy	G4	G2	G1G2G3G4			
14	G4R6WM3	1094.999	29.89	Best Buy	WM3	M1M3	M1M2M3			
15	G4R6WM4	1443.281	33.39	Best Buy	WM4	M4	M1M2M3M4			
16	G4R7WM4	1518.325	34.13	Best Buy	R7	SC2	R1R2R3R4R5R6R7SC2			
17	G4R8WM4	1684.524	35.75	Best Buy	R8	SC1	R1R2R3R4R5R6R7SC1SC2			
18	G4R8WM5	3265.366	46.31	Best Buy	WM5	E11	E11M1M2M3M4			
19	G4R8WM6	3499.666	47.81	Best Buy	WM6	E12	E12M1M2M3M4			
20	G4R8WM7	3844.712	49.33	Best Buy	WM7	W42	W42E12M1M2M3M4			
21	G4R8WM8	5063.773	54.6	Best Buy	WM8	E22	W42E12E22M1M2M3M4			
22	G4R8WM9	5367.184	55.21	Best Buy	WM9	W22	W22W42E12E22M1M2M3M4			
23	G4R8WM10	5620.95	55.69	Best Buy	WM10	W52	W22W42W52E12E22M1M2M3M4			
24	G4R8WM11	5857.766	55.96	Best Buy	WM11	W32	W22W32W42W52E12E22M1M2M3M4			
25	G4R8WM12	6032.078	56.15	Best Buy	WM12	W12	W12W22W32W42W52E12E22M1M2M3M4			

Figure 6 – Best Buy mapping and key plans identified, weighted output.

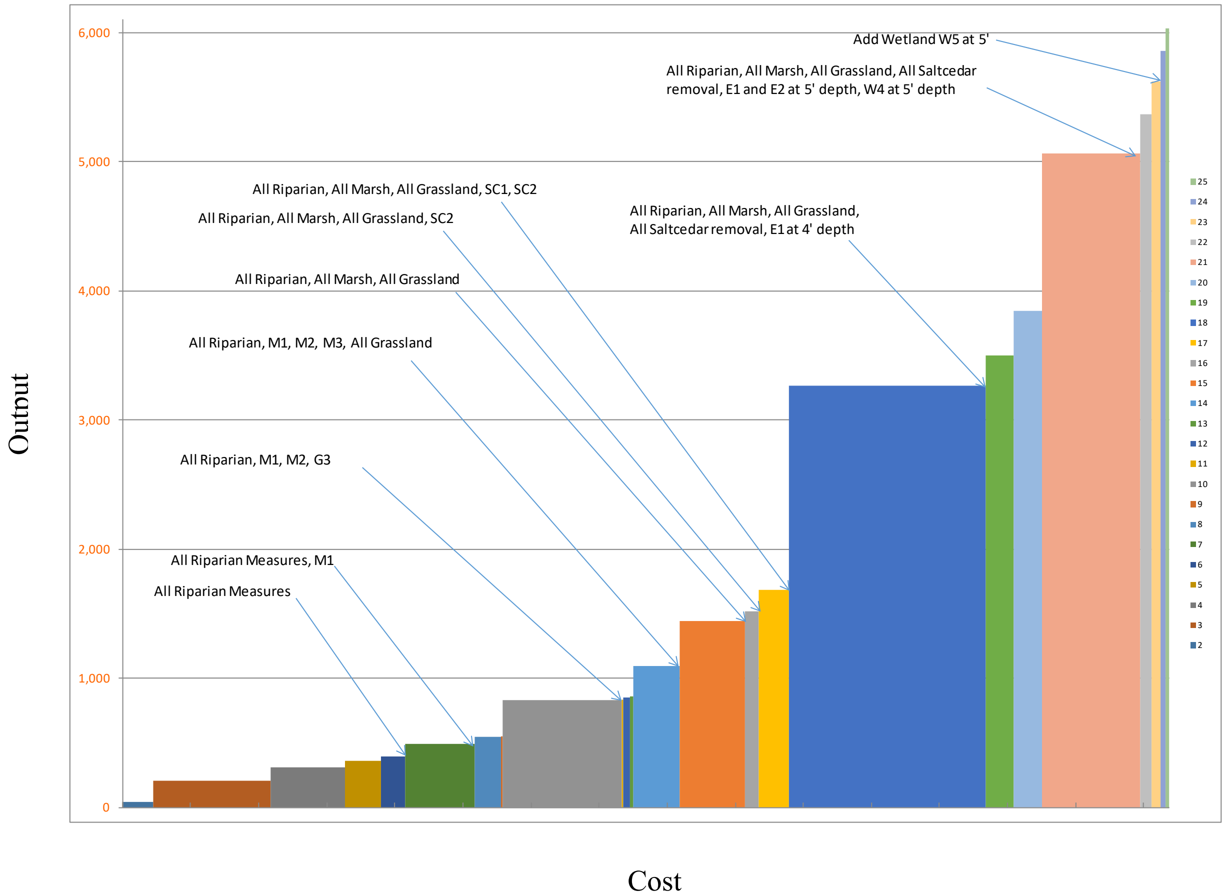
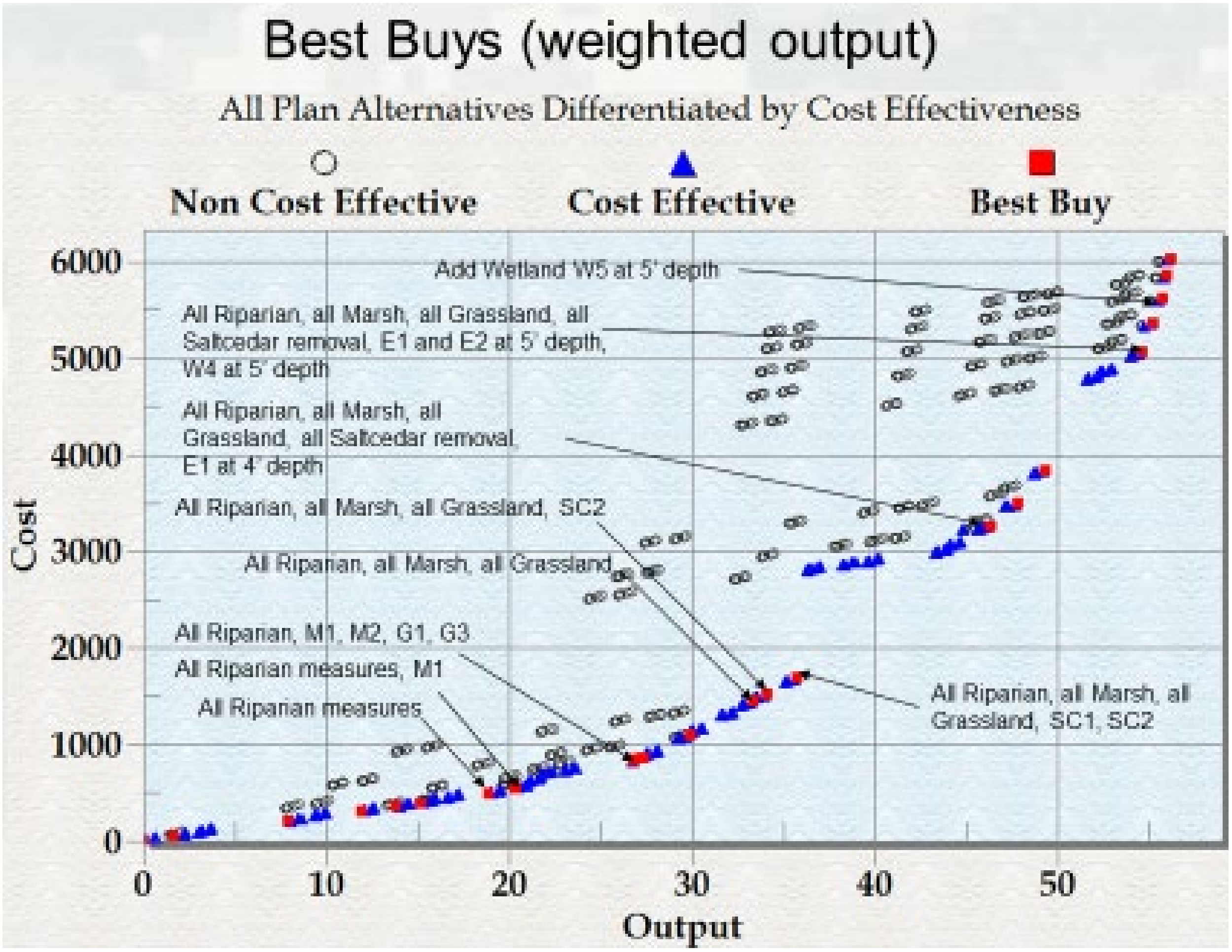


Figure 7 – Best buy mapping and key plans identified



2.2.4 Cost-effectiveness incorporating OMRR&R Costs

Technical and policy reviews on other ecosystem restoration projects highlighted the need to incorporate operations and maintenance (O&M) costs into the project costs subject to cost-effectiveness screening. To comply, the PDT developed costs for the four habitat types, presented in Table 12 to Table 15.

Table 12 – Wetland measures, their effects and their costs (composite outputs)

American coot		Relative Value Index					1				
			Annual Cost		12/16 OMRR&R	Total Annual Cost					
W1	Name	Cost					Acres	Output (AAHU)	Recomputed (w/	Weighted	ost/marginal outpu
2'		~~$ 235,265.00~~	~~$ 8,714.43~~				~~6.20~~				
4'		~~$ 368,489.00~~	~~$ 13,649.17~~				~~6.20~~	~~1.34~~	~~1.34~~	~~1.34~~	~~$ 274,488.31~~
5'		~~$ 409,577.00~~	~~$ 15,171.11~~				~~6.20~~	~~2.68~~	~~2.68~~	~~2.68~~	~~$ 152,547.43~~
W2											
4'		~~$ 294,134.00~~	~~$ 10,894.99~~				~~1.40~~	~~0.30~~	~~0.30~~	~~0.30~~	~~$ 970,304.86~~
5'		$ 345,457.36	$ 12,796.06		$ 466.56	$ 13,262.62	1.40	0.61	0.61	0.61	$ 569,806.53
W3											
2'		~~$ 348,282.00~~	~~$ 12,900.69~~				~~8.70~~				
4'		~~$ 527,441.00~~	~~$ 19,536.90~~				~~8.70~~	~~1.88~~	~~1.88~~	~~1.88~~	~~$ 279,992.01~~
5'		~~$ 585,098.00~~	~~$ 21,672.57~~				~~8.70~~	~~3.77~~	~~3.77~~	~~3.77~~	~~$ 155,299.61~~
W4											
4'		$ 686,195.77	$ 25,417.32		$ 584.96	$ 26,002.28	3.50	0.76	0.76	0.76	$ 905,463.61
5'		~~$ 345,046.00~~	~~$ 12,780.82~~				~~3.50~~	~~1.52~~	~~1.52~~	~~1.52~~	~~$ 227,651.21~~
W5											
4'		~~$ 247,645.00~~	~~$ 9,173.00~~				~~1.10~~	~~0.24~~	~~0.24~~	~~0.24~~	~~$ 1,039,747.51~~
5'		~~$ 253,766.00~~	~~$ 9,399.73~~				~~1.10~~	~~0.48~~	~~0.48~~	~~0.48~~	~~$ 532,723.39~~
E1							38.50	4.62			
4'		~~$ 1,580,842.00~~	~~$ 58,555.84~~			~~$ 58,555.84~~	~~38.50~~	~~15.17~~	~~10.56~~	~~10.56~~	~~$ 149,766.16~~
5'		$ 4,018,287.84	$ 148,841.08		$ 1,133.03	$ 149,974.11	38.50	16.67	12.06	12.06	$ 333,321.75
E2							16.60	1.99			
4'		~~$ 1,096,621.00~~	~~$ 40,619.85~~			~~$ 40,619.85~~	~~16.60~~	~~6.54~~	~~4.55~~	~~4.55~~	~~$ 240,954.16~~
5'		$ 2,099,113.27	$ 77,753.09		$ 724.91	$ 78,478.00	16.60	7.26	5.27	5.27	$ 398,311.84
	W4 not combinable with R8										

Table 13 – Marsh measures, their effects and their costs (composite outputs)

Northern pintail, Gulf (		Relative Value Index					0.917				
			Annual Cost		12/16 OMRR&	Total Annual Cost					
Marshes	Name	Cost					Acres	Output (AAHU)	Recomputed (w/	Weighted	
M1		$ 261,182.30	$ 9,674.43		$ 310.59	$ 9,985.03	3.50	1.53	1.53	1.41	$ 170,308.82
M2		$1,189,472.05	$ 44,059.14		$ 958.81	$ 45,017.94	15.90	6.97	6.97	6.39	$ 170,733.43
M3	W1 shallov	$ 717,215.34	$ 26,566.32		$ 539.34	$ 27,105.66	6.20	2.72	2.72	2.49	$ 264,009.36
M4	W3 shallov	$ 599,351.03	$ 22,200.51		$ 665.80	$ 22,866.31	8.70	3.81	3.81	3.50	$ 157,225.67

Table 14 – Riparian and salt cedar removal measures, their effects and their costs (composite outputs)

Yellow warbler							0.667	Relative Value Index			
			Annual Cost		12/16 OMRR&	Total Annual Cost	0.142	RVI - saltcedar			
Riparian	Name	Cost					Acres	Output (AAHU)	Recomputed (w/	Weighted	
R1		$ 177,439.87	$ 6,572.54		$ 1,722.20	$ 8,294.74	8.9	3.58	2.70	1.80	$ 65,614.71
R2		$ 179,433.58	$ 6,646.38		$ 1,741.55	$ 8,387.94	9	3.62	2.73	1.82	$ 65,614.71
R3		$ 61,804.91	$ 2,289.31		$ 599.87	$ 2,889.18	3.1	1.25	0.94	0.63	$ 65,614.72
R4		$ 91,710.49	$ 3,397.04		$ 890.13	$ 4,287.17	4.6	1.85	1.40	0.93	$ 65,614.71
R5		$ 93,051.73	$ 3,446.72		$ 754.67	$ 4,201.39	3.9	1.57	1.19	0.79	$ 78,523.54
R6		$ 226,664.49	$ 8,395.86		$ 1,838.31	$ 10,234.17	9.5	3.82	2.89	1.93	$ 78,523.54
R7		$ 143,156.52	$ 5,302.65		$ 1,161.04	$ 6,463.68	6	2.41	1.82	1.22	$ 78,523.54
R8		$ 75,165.16	$ 2,784.19		$ 39,657.94	$ 42,442.13	85.85452813	1.41	1.06	0.71	$ 70,872.94
Salt Cedar removal											
SC1		$ 207,793.56	$ 7,696.86		$ 13,148.77	$ 20,845.64	3.34	9.25	5.12	0.73	$ 40,554.14
SC2		$ 93,459.20	$ 3,461.81		$ 6,049.67	$ 9,511.49	20.21	4.26	2.36	0.33	$ 39,644.11

Table 15 – Grassland measures, their effects and their costs (composite outputs)

Black-tailed prairie do		Relative Value Index					0.158				
			Annual Cost		12/16 OMRR&F	Total Annual Cost					
Grass mea	Name	Cost					Acres	Output (AAHU)	Recomputed (w	Weighted	
G1		$ 7,327.68	$ 271.42		$ 148.52	$ 419.94	1.70	0.81	0.53	0.08	$ 13,935.66
G2		$ 17,241.58	$ 638.64		$ 349.45	$ 988.10	4.00	1.81	1.17	0.18	$ 14,735.15
G3		$ 7,758.72	$ 287.39		$ 157.25	$ 444.64	1.80	0.84	0.54	0.09	$ 14,307.60
G4		$ 33,621.10	$ 1,245.36		$ 681.43	$ 1,926.79	7.80	3.53	2.28	0.36	$ 14,735.16

Project installation costs were amortized over a 50 year project life using the FY 2020 discount rate of 2.75%. OMRR&R costs were calculated per year and per acre, which was multiplied by number of acres for each measure and added to the annual cost of the measure to get Total Annual Cost.

The PDT biologist made some adjustment to measure benefits consistent with review comments. Benefit streams of the measures were discounted using the FY 2020 discount rate of 2.75%.

Some measures were deleted based upon previous work, such as W1, W3, W5, as well as E1 and E2 at the 4' depth. Prior work, described in Para. 2.2.2 above, indicated these measures were not cost effective, and nothing developed since suggested that finding would change.

The process of performing cost-effectiveness analysis closely follows Para. 2.2.2, above. A cost-effectiveness run was performed against each habitat type in isolation to develop habitat-specific Best Buys. There are too many measures to feed the IWR Planning suite at once, so the measures are broken into separate cost effectiveness runs. The following tables present the results of those runs.

Table 16 – Wetland Best Buys, incorporating O&M costs

Wetland	**No change relative to composite output**		Weighted			
	Name	Cost	Output	Cost Effective		
	No Action Plan	0	0	Best Buy		
	W20W40E11E20	149.974	12.06	Best Buy	E1	
	W20W40E11E21	228.452	17.33	Best Buy	E1E2	
	W21W40E11E21	241.714	17.94	Best Buy	W2E1E2	
	W21W41E11E21	267.716	18.7	Best Buy	W2W4E1E2	

Table 17 – Marsh Best Buys, incorporating O&M costs

Marsh	**No change relative to composite output**		Weighted			
	Name	Cost	Output	Cost Effective		
	No Action Plan	0	0	Best Buy		
	M10M20M30M41	22.866	3.5	Best Buy	M4	
	M10M21M30M41	67.883	9.89	Best Buy	M2M4	
	M11M21M30M41	77.868	11.3	Best Buy	M1M2M4	
	M11M21M31M41	104.974	13.79	Best Buy	M1M2M3M4	

Table 18 – Riparian Best Buys, incorporating O&M costs

Riparian			Weighted		
	Name	Cost	Output	Cost Effective	
	No Action Plan	0	0	Best Buy	
	R10R20R31R40R50R60R70SC10SC20	2.889	0.63	Best Buy	R3
	R11R20R31R40R50R60R70SC10SC20	11.184	2.43	Best Buy	R1R3
	R11R21R31R40R50R60R70SC10SC20	19.572	4.25	Best Buy	R1R2R3
	R11R21R31R41R50R60R70SC10SC20	23.859	5.18	Best Buy	R1R2R3R4
	R11R21R31R41R50R60R71SC10SC20	30.323	6.4	Best Buy	R1R2R3R4R7
	R11R21R31R41R50R61R71SC10SC20	40.557	8.33	Best Buy	R1R2R3R4R6R7
	R11R21R31R41R51R61R71SC10SC20	44.758	9.12	Best Buy	R1R2R3R4R5R6R7
	R11R21R31R41R51R61R71SC11SC20	65.604	9.85	Best Buy	R1R2R3R4R5R6R7SC1
	R11R21R31R41R51R61R71SC11SC21	75.115	10.18	Best Buy	R1R2R3R4R5R6R7SC1SC2

Table 19 – Grassland Best Buys, incorporating O&M costs

Grassland	**No change relative to composite output**		Weighted		
	Name	Cost	Output	Cost Effective	
	No Action Plan	0	0	Best Buy	
	G10G20G31G40	0.445	0.09	Best Buy	G3
	G11G20G31G40	0.865	0.17	Best Buy	G1G3
	G11G20G31G41	2.792	0.53	Best Buy	G1G3G4
	G11G21G31G41	3.78	0.71	Best Buy	G1G2G3G4

As described in Para. 2.2.2, these best buys are fed into a “second pass” IWR Planning Suite Model, as shown in Figure 8.

Figure 8 – Second pass input stack, 2020 price levels and discount rate

Solutions and Scales

Solutions

Solution	Code	# Scales
Grassland	G	4
Riparian	R	9
Wetland Marsh combined	WM	8

Add

Scaled Solution Effects on Variables

Cod		Name	Cost	Output
G	0	No Action	0	0
G	1	Grassland	0.445	0.09
G	2	Grassland	0.865	0.17
G	3	Grassland	2.792	0.53
G	4	Grassland	3.78	0.71
R	0	No Action	0	0
R	1	Riparian	2.889	0.63
R	2	Riparian	11.184	2.43
R	3	Riparian	19.572	4.25
R	4	Riparian	23.859	5.18
R	5	Riparian	30.323	6.4
R	6	Riparian	40.557	8.33
R	7	Riparian	44.758	9.12
R	8	Riparian	65.604	9.85
R	9	Riparian	75.115	10.18
WM	0	No Action	0	0
WM	1	Wetland Mar	22.866	3.5
WM	2	Wetland Mar	67.884	9.89
WM	3	Wetland Mar	77.869	11.3
WM	4	Wetland Mar	104.975	13.79
WM	5	Wetland Mar	254.949	25.85
WM	6	Wetland Mar	333.427	31.12
WM	7	Wetland Mar	346.689	31.73
WM	8	Wetland Mar	372.691	32.49

OK Cancel

As before, measure names from the prior runs were simplified to "Habitat type" where habitat type is reduced to one letter (G for grassland, R for riparian, WM for wetland and marsh) and the number corresponds to the number of best buy from the applicable habitat run. No measures in the second pass were identified as non-combinable. Within the habitat stack of best buys, those alternatives are already mutually exclusive, existing within the same scale of habitat output.

This cost-effectiveness analysis using 2020 assumptions (price level, discount rate, O&M costs, new benefits) generated 450 plan combinations, 22 of which were identified as Best Buys. Graphically, Figure 9 shows those findings. Figure 10 provides a slightly clearer view of the best buys, with implementation cost identified explicitly.

Figure 9 – Best Buy plans, weighted outputs, 2020 assumptions

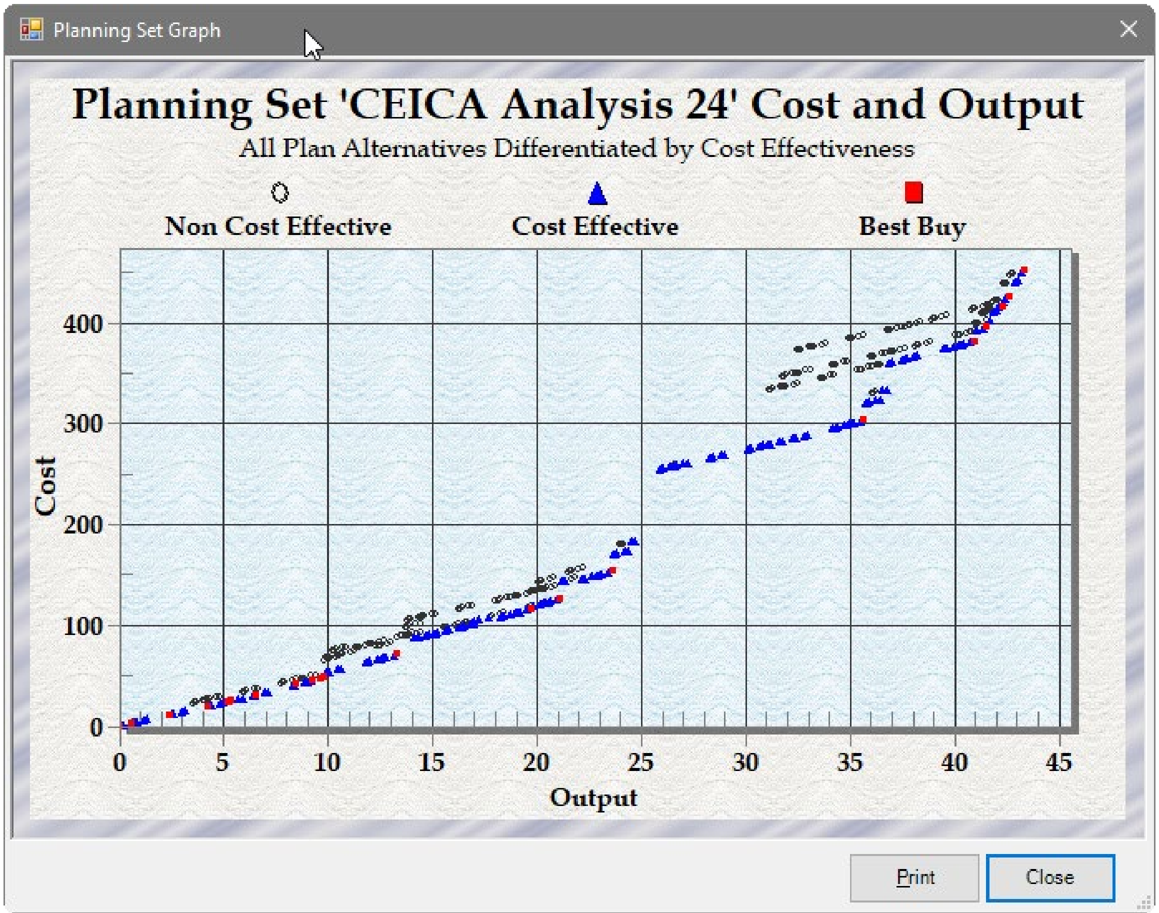


Table 20 – Incremental Cost of Best Buy Plans, weighted output

Counter	Plan Alternative	Output (HU)	Cost ($1000)	Average Cost ($1000 / HU)	Incremental Cost ($1000)	Inc. Output (HU)	Inc. Cost Per Output
Incremental Cost of Best Buy Plan Combinations (Ordered By Output)							
Planning Set:	CEICA Analysis 3						
1	No Action Plan	0.00	0.00				
2	G0R1WM0	0.63	2.89	4.5857	2.8890	0.6300	4.5857
3	G0R2WM0	2.43	11.18	4.6025	8.2950	1.8000	4.6083
4	G0R3WM0	4.25	19.57	4.6052	8.3880	1.8200	4.6088
5	G0R4WM0	5.18	23.86	4.6060	4.2870	0.9300	4.6097
6	G1R4WM0	5.27	24.30	4.6118	0.4450	0.0900	4.9444
7	G2R4WM0	5.35	24.72	4.6213	0.4200	0.0800	5.2500
8	G2R5WM0	6.57	31.19	4.7470	6.4640	1.2200	5.2984
9	G2R6WM0	8.50	41.42	4.8732	10.2340	1.9300	5.3026
10	G2R7WM0	9.29	45.62	4.9110	4.2010	0.7900	5.3177
11	G3R7WM0	9.65	47.55	4.9275	1.9270	0.3600	5.3528
12	G4R7WM0	9.83	48.54	4.9377	0.9880	0.1800	5.4889
13	G4R7WM1	13.33	71.40	5.3566	22.8660	3.5000	6.5331
14	G4R7WM2	19.72	116.42	5.9038	45.0180	6.3900	7.0451
15	G4R7WM3	21.13	126.41	5.9823	9.9850	1.4100	7.0816
16	G4R7WM4	23.62	153.51	6.4993	27.1060	2.4900	10.8859
17	G4R7WM5	35.68	303.49	8.5058	149.9740	12.0600	12.4357
18	G4R7WM6	40.95	381.97	9.3276	78.4780	5.2700	14.8915
19	G4R7WM7	41.56	395.23	9.5098	13.2620	0.6100	21.7410
20	G4R8WM7	42.29	416.07	9.8386	20.8460	0.7300	28.5562
21	G4R9WM7	42.62	425.58	9.9855	9.5110	0.3300	28.8212
22	G4R9WM8	43.38	451.59	10.4100	26.0020	0.7600	34.2132

Figure 10 –Best Buy Plans, weighted outputs, 2020 assumptions

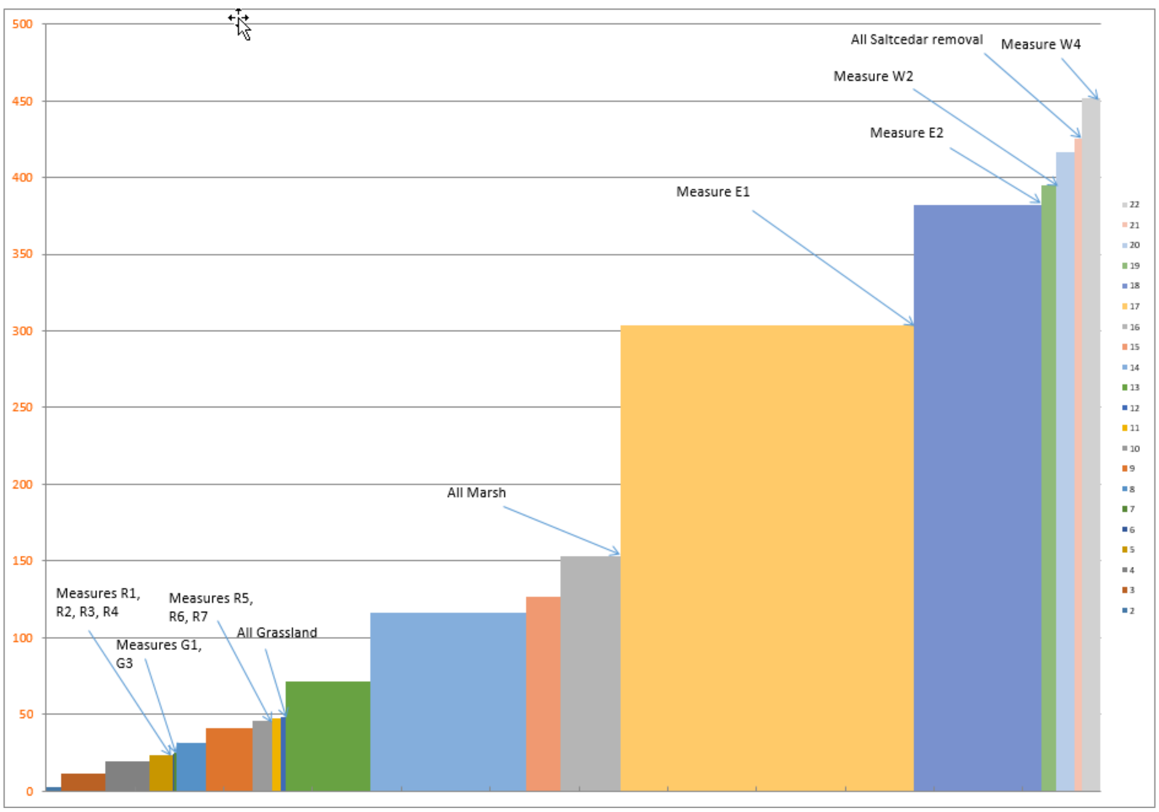


Table 20 describes those best buys in terms of their habitat specific measures. This table also shows the installation cost of each measure as well as the cumulative cost of the project as we move along the supply curve, which occurs during the incremental cost analysis.

Table 21 – Best Buys for HSI (Weighted) output, component measures, and installation costs

	Name	Annual Cost	Weighted Output	Cost Effective				Investment Cost	Cumulative Cost
	No Action Plan	0	0	Best Buy					
1	G0R1WM0	2.889	0.63	Best Buy	R1	R3	R3	$ 61,804.91	$ 61,804.91
2	G0R2WM0	11.184	2.43	Best Buy	R2	R1R3	R1	$ 177,439.87	$ 239,244.78
3	G0R3WM0	19.572	4.25	Best Buy	R3	R1R2R3	R2	$ 179,433.58	$ 418,678.35
4	G0R4WM0	23.859	5.18	Best Buy	R4	R1R2R3R4	R4	$ 91,710.49	$ 510,388.84
5	G1R4WM0	24.304	5.27	Best Buy	G1	G3	G3	$ 7,758.72	$ 518,147.56
6	G2R4WM0	24.724	5.35	Best Buy	G2	G1G3	G1	$ 7,327.68	$ 525,475.24
7	G2R5WM0	31.188	6.57	Best Buy	R5	R1R2R3R4R7	R7	$ 143,156.52	$ 668,631.75
8	G2R6WM0	41.422	8.5	Best Buy	R6	R1R2R3R4R6R7	R6	$ 226,664.49	$ 895,296.24
9	G2R7WM0	45.623	9.29	Best Buy	R7	R1R2R3R4R5R6R7	R5	$ 93,051.73	$ 988,347.98
10	G3R7WM0	47.55	9.65	Best Buy	G3	G1G3G4	G4	$ 33,621.10	$ 1,021,969.08
11	G4R7WM0	48.538	9.83	Best Buy	G4	G1G2G3G4	G2	$ 17,241.58	$ 1,039,210.66
12	G4R7WM1	71.404	13.33	Best Buy	WM1	M4	M4	$ 599,351.03	$ 1,638,561.69
13	G4R7WM2	116.422	19.72	Best Buy	WM2	M2M4	M2	$ 1,189,472.05	$ 2,828,033.74
14	G4R7WM3	126.407	21.13	Best Buy	WM3	M1M2M4	M1	$ 261,182.30	$ 3,089,216.04
15	G4R7WM4	153.513	23.62	Best Buy	WM4	M1M2M3M4	M3	$ 717,215.34	$ 3,806,431.38
16	G4R7WM5	303.487	35.68	Best Buy	WM5	E1M1M2M3M4	E1	$ 4,018,287.84	$ 7,824,719.22
17	G4R7WM6	381.965	40.95	Best Buy	WM6	E1E2M1M2M3M4	E2	$ 2,099,113.27	$ 9,923,832.49
18	G4R7WM7	395.227	41.56	Best Buy	WM7	W2E1E2M1M2M3M4	W2	$ 345,457.36	$ 10,269,289.84
19	G4R8WM7	416.073	42.29	Best Buy	R8	R1R2R3R4R5R6R7SC1	SC1	$ 207,793.56	$ 10,477,083.40
20	G4R9WM7	425.584	42.62	Best Buy	R9	R1R2R3R4R5R6R7SC1SC2	SC2	$ 93,459.20	$ 10,570,542.61
21	G4R9WM8	451.586	43.38	Best Buy	WM8	W2W4E1E2M1M2M3M4	W4	$ 686,195.77	$ 11,256,738.37

2.2.5 Incremental Analyses

As a result of the cost-effectiveness analysis, there were 22 best buy plans (including the No Action alternative) carried forward for incremental analysis. The earliest plans involve a mix of grassland habitat creation as well as riparian habitat creation. Next come all the marsh measures. Eventually, existing and proposed new wetland habitats become cost-effective means to generate output. Only after all grassland, marsh, and a new wetland option are exercised does the cost effective solutions begin to include salt cedar removal, starting with area SC1.

As stated in the main report, objectives of the study include the following:

- Within 6 years of construction re-create the mosaic of habitats characteristic of the pre-hispanic Rio Grande with an emphasis on wetlands of varying sizes, water regimes and connectivity, and designed to endure for the next 50 years.
- To increase the quantity and diversity of native wetland, riparian, and grassland habitats along with their associated native wildlife in the study area within 6 years of construction and for at least the next 50 years. Upon completion of the project the study area should be comprised of approximately 25% wetlands, 15% riparian habitat and 5% floodplain grassland.

The study team is convinced that project success is met upon the inclusion of new all habitat types. To that end, the PDT believes that including a modification of existing wetlands, starting at Plan 16, is necessary to ensure project success. Wetland E2 is also deemed a necessary increment to the PDT's recommendation. Wetland area W2 is immediately adjacent to visitor parking and provides a highly visible example of a wetland habitat to visitors, and represents an opportunity to put a glamorous face on the entire project. Wetland W2 represents an important increment and was deemed necessary for project success. Wetland W4 is immediately adjacent to a water source and the team decided that doing W4 would be a disservice to the study area (W4 is the second best buy of the wetland habitat type). Finally, not all habitat types are included until Plan 15, which includes riparian feature R5. Further wetland options (W1, W3, W5) were deemed not cost effective in analysis dating back to 2017.

The study team has an objective to perform restoration that benefits all identified indicator species. The yellow warbler is the indicator species for riparian habitat, which does not show in this incremental analysis until Plan 15. Riparian habitat R5 is a central location within the park that, left untreated, would be a source of noxious invasive species such as salt cedar to the restored marsh habitats M1 and M3, as well as wetland E1 and grassland G4. The study team believes that not all objectives of the study are met until Best Buy 18. Figure 12 depicts the measures comprising Best Buy 15, which is Best Buy 11 plus E2, W2, W4, and R5.

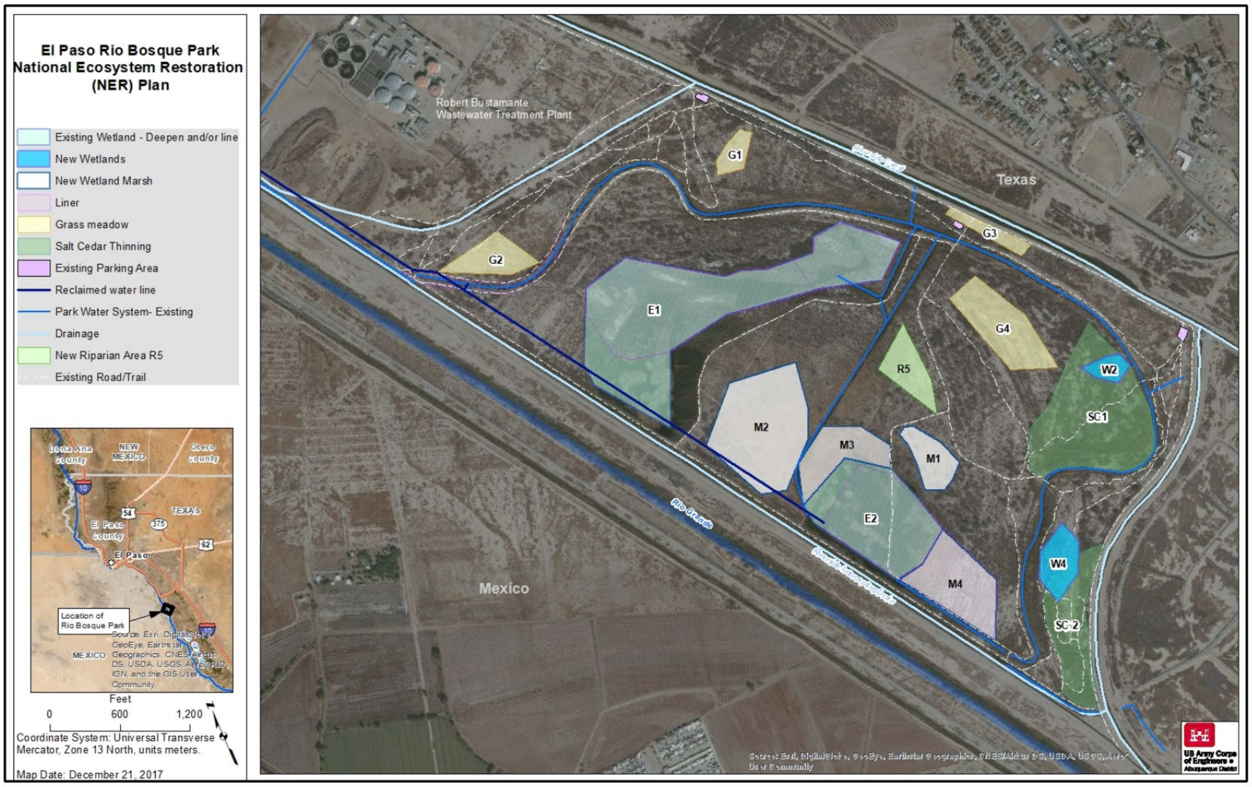


Figure 11 – Measures comprising Best Buy 18.

2.2.6 Final Findings

As a result of the CE/ICA analysis, it was determined by the PDT and Sponsor to select best buy (BB) 18. Table 20 (Plan 1 as "No action" is not identified as a plan) and Figure 11, above lists the BB18 management measures to be implemented for The Rio Bosque Park. Those measures include new wetlands development at one locations (W2, set to 5' depth). Further, the two existing wetlands (E1 and E2) will be refurbished and designed to accommodate 5' depth. All proposed Marsh habitats (M1, M2, M3, M4), Riparian habitats (R1, R2, R3, R4, R5, R6, R7), and Grassland habitats (G1, G2, G3, G4) will be modified per the recommendation to implement BB18. Finally, the recommended plan includes saltcedar removal at locations SC1 and SC2. The results show that the total cost for the project is expected to be $10.3 million. This plan was the first plan that meets the study objectives and sponsor goals for the study (detailed in the incremental cost section of this appendix).

The study team acknowledges that Section 206 authority, under which this project was developed, has a Federal spending limit of $10,000,000. In light of that, the study team believes that the Best Buy plan which would achieve most of the study objectives yet come under the spending limit, considering study costs to date, as well as upcoming design costs, would probably be Best Buy 18, at an implementation cost of $10.3 million. The study team believes that not selecting a plan as the NER plan is an unacceptable alternative to picking a plan which achieves most study objectives. Best Buy 18's final increment is the construction of new wetland W2, which represents a $345,500 investment. The incremental cost graphic, Figure 10, indicates that W2 addition has a modest effect on after implementing E2, evinced by the wide blue box within the figure. Selecting Best Buy 18 instead of Best Buy 17 would mean the provision of one new habitat type, the creation of a new wetland. Best Buy 17 does meet the criteria of providing new wetlands as part of the project outputs. Impact of Addressing Flood Risk in Four Accounts (NED, NER, OSE, RED)

The *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (March 10, 1983) establishes four accounts to facilitate the evaluation and display of effects of alternative plans. They are described in ER 1105-2-100, Planning Guidance Notebook, paragraph 2-3. The evaluation of the recommended plan against those accounts follows:

- The National Economic Development (NED) account displays changes in the economic value of the national output of goods and services. The damages and benefits described in this appendix describe NED impacts of Flood Risk Management in the study area.

- The Environmental Quality (EQ) account displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of ecosystem restoration plans. The arrays of plans described in this appendix have ecosystem restoration as their stated goals. EQ benefits or impacts are identified within the Environmental Appendix and evaluated relative to the cost of restoration alternatives in Section 4. of this appendix..

  All of the best buy plans would contribute to the EQ account by increasing the amount and quality of high value habitat in the study area by their respective quantity of outputs. All best buy plans provide an increase in habitat and therefore benefits to the EQ account as quantified by AAHU's in Table 20. Benefits to the EQ account increase with plan outputs as does the costs for the project and incremental costs for each AAHU. As described earlier only plans 7 and above will meet the improvement objective of the study. Benefits would increase in the following criteria as the amount and quality of habitat increases.

  Water Quality – Action under the proposed project would have no additive or long-term adverse impact on the existing water quality conditions. Minor, localized, long-term beneficial effects to water quality could occur as a result of the removal of nutrients by vegetation growing in the created wetlands and the enhancement of wetland and riparian areas. Therefore, there would be no cumulative adverse effects on water quality as a result of the proposed project.

  Air Quality – An increase in the number and acres of plants would contribute to absorption of carbon dioxide and release of oxygen in this urbanized area. The Bosque also acts as a heat sink during warmer months providing a corridor of shady, relatively moist environment that contrasts the urban asphalt and concrete.

  Wildlife – The increase in habitat diversity would provide for an increase diversity and density of wildlife species.

Essentially the larger the project is the more benefits to this account would be. This is quantified both in total AAHU and incremental costs per AAHU in Table 20. The cost effective analysis has provided a measure of efficiency to determine what the cost of incremental of these outputs would be.

- The Regional Economic Development (RED) account displays changes in the distribution of regional economic activity (e.g., income and employment). This account is typically used to capture the regional impacts of a large capital infusion of project implementation dollars on income and employment throughout the study area through the use of income and employment multipliers. A recent study for the Nuclear Watch of New Mexico suggests that public sector multipliers tend to be below 1.5, while the Department of Energy claimed multipliers of 2.4 to 3.5 in fiscal year 1998[1]. The important point to be made here is that a large infrastructure project in the El Paso area will have a positive impact on local income and employment.

- The Other Social Effects (OSE) account displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others. In most cases, impacts of proposed projects not covered in other accounts are described and evaluated here. Primary affects to OSE from the proposed restoration would benefit health, standard of living and education by providing a public area of improved aesthetics, air quality and providing recreational and educational opportunities. There would be significant benefits to the community from the facilities provided from the recreation component of the project, increase in quality of the recreational experience and educational opportunities within the project area.

  The proposed project would improve existing trails, create additional access, as well as provide amenities such as benches or picnic tables for an improved recreational experience. Habitat improvements would also enhance the recreational experience through those criteria listed under the EQ account and the aesthetic quality of the area. The newly constructed view over a wetland is generally more pleasing than a view obstructed by thick brush 10-20 feet high. Habitat improvements would also provide the opportunity to view wildlife considered rare in the study area.

  There is opportunity for this area to become a destination for recreational and educational activities. This plus the improved aesthetic experience increase the overall standard or living for the entire community in the El Paso southeast area.

3 - Economic Considerations – Recreation Features

3.1 Overview.

This recreation analysis follows the National Economic Development (NED) benefit evaluation procedures contained in ER 1105-2-100, Appendix E, Section VII. Because the recreation features identified in the proposed project are of a small scale and incidental to the project purpose, the unit day value (UDV) method of benefit evaluation was selected for this analysis.

[1] Dumas, L.J., *Economic Multipliers and the Economic Impact of DOE Spending in New Mexico*, March 2003.

The Rio Bosque Park was established to provide a venue for public recreation and education. The Park provides wetland and riparian habitat for animals, public open space for hiking and biking, and it offers educational opportunities for both school children and the general public. In addition, efforts to restore terrestrial and aquatic habitats provide research opportunities for students of all ages.

The UDV calculations require an estimate of 5 criteria when evaluating the without and with-project recreation experience. A discussion of each of those 5 criteria follows:

Recreation Experience – This criterion tries to explore what recreation opportunities exist at the site. In the case of Rio Bosque Park, there are some general activities common to the region such as hiking (walking, running) and wildlife viewing. The sheer size of the undeveloped area makes the recreation experience uncommon to the region. Proposed features within the recreation plan are additional improved trails, which would add to the unique experiences found within the southeast El Paso metropolitan area.

Availability of opportunity – This criterion evaluates the uniqueness of the recreation experience by identifying the number and proximity of available substitutes. The Rio Bosque Park represents a unique environmental feature within the urbanized El Paso metropolitan area, as the park represents large, unimproved and natural stretch of wildlife habitat in the El Paso area. The proposed habitat improvements would represent an even more unique recreation opportunity for residents in the region.

Carrying capacity – This criterion evaluates the ability of the recreation facilities to handle the existing and projected demand. The thinking behind this criterion is that excessively crowded facilities diminish the recreation experience for users. Similarly facilities that cannot handle the increased visitation also experience a diminished recreation experience. The proposed plan includes an information kiosk, new and improved trails through the park, and a pair of trail shelters. These features both guide users through the natural environment and provide extra facilities for recreation visitors. This increase in net carrying capacity is expected to be more than adequate for any increased visitation.

Accessibility – This criterion examines the relative ease by which users can get to and through the recreation site. The proposed plan includes additional improved trails and additional parking facilities for users.

Environmental – This criterion measures the esthetic value of the recreation experience. The habitat, as mentioned throughout this report, represents a unique and highly-prized habitat that exists within the El Paso metropolitan area. Efforts to improve the bosque habitat are naturally expected to increase that esthetic value. Table 21, which follows, describes the qualitative assessment of the without-project condition. Table 22 describes the qualitative assessment of the with-project condition. The highlighted fields are the qualitative judgment of the without-project condition and the effect of implementing the restoration and recreation plans.

Table 22 – UDV point assessment, without-project conditions

General Recreation Values		Without project conditions			
Criteria			Judgment factors		
Recreation experience[1] Total Points: 30 Point Value:	Two general activities[2] 0-4	Several general activities 5-10	Several general activities: one high quality value activity[3] 11-16	Several general activities; more than one high quality high activity 17-23	Numerous high quality value activities; some general activities 24-30
Availability of opportunity[4] Total Points: 18 Point Value:	Several within 1 hr. travel time; a few within 30 min. travel time 0-3	Several within 1 hr. travel time; none within 30 min. travel time 4-6	One or two within 1 hr. travel time; none within 45 min. travel time 7-10	None within 1 hr. travel time 11-14	None within 2 hr. travel time 15-18
Carrying capacity[5] Total Points: 14 Point Value:	Minimum facility for development for public health and safety 0-2	Basic facility to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource or activity experience 6-8	Optimum facilities to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14
Accessibility Total Points: 18 Point Value:	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to site; limited access within site 4-6	Fair access, fair road to site; fair access, good roads within site 7-10	Good access, good roads to site; fair access, good roads within site 11-14	Good access, high standard road to site; good access within site 15-18
Environmental quality Total Points: 20 Point Value:	Low aesthetic factors[6] that significantly lower quality[7] 0-2	Average aesthetic quality; factors exist that lower quality to minor degree 3-6	Above average aesthetic quality; any limiting factors can be reasonably rectified 7-10	High aesthetic quality; no factors exist that lower quality 11-15	Outstanding aesthetic quality; no factors exist that lower quality 16-20

Table 23 – UDV point assessment, with-project conditions

General Recreation Values		With project conditions			
Criteria			Judgment factors		
Recreation experience[1] Total Points: 30 Point Value:	Two general activities[2] 0-4	Several general activities 5-10	Several general activities: one high quality value activity[3] 11-16	Several general activities; more than one high quality high activity 17-23	Numerous high quality value activities; some general activities 24-30
Availability of opportunity[4] Total Points: 18 Point Value:	Several within 1 hr. travel time; a few within 30 min. travel time 0-3	Several within 1 hr. travel time; none within 30 min. travel time 4-6	One or two within 1 hr. travel time; none within 45 min. travel time 7-10	None within 1 hr. travel time 11-14	None within 2 hr. travel time 15-18
Carrying capacity[5] Total Points: 14 Point Value:	Minimum facility for development for public health and safety 0-2	Basic facility to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource or activity experience 6-8	Optimum facilities to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14
Accessibility Total Points: 18 Point Value:	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to site; limited access within site 4-6	Fair access, fair road to site; fair access, good roads within site 7-10	Good access, good roads to site; fair access, good roads within site 11-14	Good access, high standard road to site; good access within site 15-18
Environmental quality Total Points: 20 Point Value:	Low aesthetic factors[6] that significantly lower quality[7] 0-2	Average aesthetic quality; factors exist that lower quality to minor degree 3-6	Above average aesthetic quality; any limiting factors can be reasonably rectified 7-10	High aesthetic quality; no factors exist that lower quality 11-15	Outstanding aesthetic quality; no factors exist that lower quality 16-20

*There was some discussion among the PDT whether the restored Rio Bosque Park had available substitutes, thus the green highlighted box here.

3.2 UDV Evaluation of the existing and proposed project condition.

From the previous discussion of the 5 criteria used for establishing a value of the recreation experience afforded by the Albuquerque bosque, it's clear that the proposed project would touch each of these criteria in a beneficial direction. Table 23 presents an estimate of the Unit Day Valuation of the without and with-project condition.

Table 24 – Marginal UDV valuation

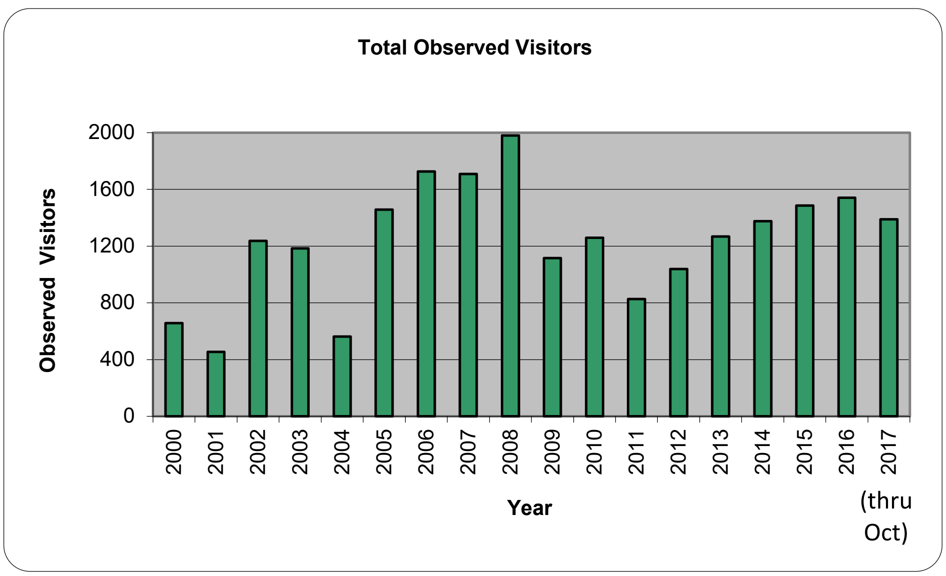
UDV calculations		WOP	WP	assumptions/reasoning
Receation experience	Several general activities; more than one high quality (kayak) activity	4	10	Bike, walk, run, picnic, wildlife watching. One parking lot.
Availability of Opportunity	Several within 1 hr. travel time; a few within 30 min. travel time	3	6	Urban resource for some activities. Increase due to extra trails and trail upgrades.
Carrying capacity	Minimum facility for development for public health and safety	2	8	Increase due to adding trail shelters and upgrade of trails
Accessability	Limited access by any means to site or within site	3	6	Increase due to improved trails.
Environmental	Low aesthetic factors that significantly lower quality	2	10	Factors to be rectified include non-native species (low visibility), occasional fire, increased diversity of wildlife
		14	40	

Converting these point values into dollars per EGM 19-3, the without project condition is worth $5.13 per visit and the with-project condition is worth $7.77 per visit. The benefits attributable to planned recreation features are therefore worth $2.64 per visit.

3.3 Recreation usage in the existing and proposed project condition.

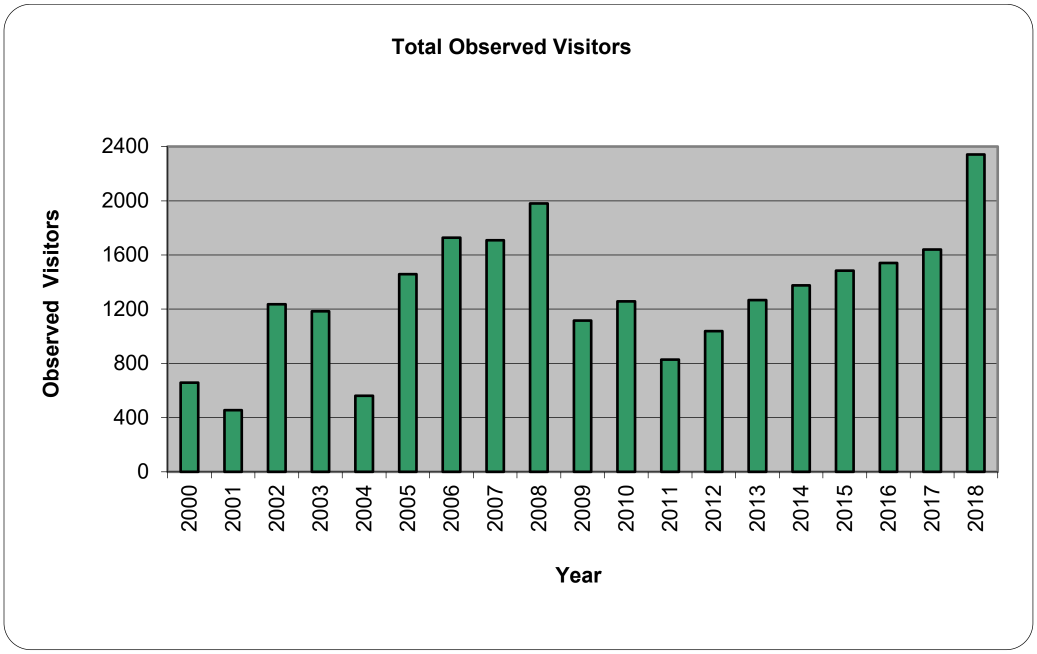
The Rio Bosque Park represents the most significant natural ecosystem feature in the study area. Park visitation data recorded since 2000 indicates visitation has been trending upward since 2000, but has stabilized around 1400 visitors annually in the last five years, as depicted in Table 24.

Table 25 – Rio Bosque Park visitation through 2017



The Sponsor has indicated that even more recent visitation data has been trending upward significantly in 2018 (Table 25). Early 2019 data suggests the trend may continue, but the data doesn't support extrapolation.

Table 26 – Rio Bosque Park visitation through 2018 (including prior year adjustments)



3.4 Benefit determination of the proposed recreation features.

This evaluation started with an evaluation of the value of the existing, without-project, recreation experience in the study area. Table 23 developed an estimate of the without and with-project UDV values Multiplying the benefits identified in Table 23, above by the estimated annual visitation established in Table 24 provides the annual benefit of the proposed recreation features.

Table 27 – Benefit calculation of proposed recreation improvements

Without-Project UDV Value (points)	Without-Project Value (dollars)	With-Project UDV Value (points)	With-Project Value (dollars)	Benefits/visit (dollars)**	Annual Benefits**
14	$5.13	40	$7.77	$2.64	$3,698.80

**Errors due to rounding.

The cost of the proposed recreation project follows:

Table 28 – Costs of proposed recreation features

Item	Unit	Quantity	Total Cost ($)
Information Kiosk (at visitor center)	Each	1	$17,391

Shade trellis	Each	0	$0
Trail Shelters	Each	2	$30,265
Bike racks	Each	0	$0
Binocular/viewing scope	Each	0	$0
Trash receptacles	Each	0	$0
Visitor center gutter installation	Each	0	$0
Picnic tables	Each	0	$0
Walking trail – crushed stone; no concrete curb border	Linear feet ($10.28 per LF)	1950	$20,046
Walking trail – crushed stone and concrete curb border	Linear feet ($21.27 per LF)	550	$11,699
Walking trail – replace deteriorating sections of concrete curb on existing ADA trail	Linear feet ($7.08 per LF)	200	$1,416
Raised boardwalk	Square feet	0	$0
Split rail fencing	Linear feet	0	$0
Footbridge deck replacement	Square feet	0	$0
Park benches	Each	0	$0
Rest areas	Each	0	$0
TOTAL	-	-	$80,816

3.5 Sensitivity Analysis of recreation benefits

From the previous discussion of the 5 criteria used for establishing a value of the recreation experience afforded by the Rio Bosque Park, it's clear that the proposed project would touch each of these criteria in a beneficial direction. What is unclear is the qualitative improvement's translation to the UDV point values. Therefore, multiple scenarios were developed to evaluate the impact of the proposed project on the existing recreation facilities. One scenario assumes the existing facilities have relatively low point values (the "minimum points" scenario), and the proposed recreation features provide a significant boost to the quality of the recreation experience. Another scenario assumes the recreation experience has a relatively high starting value (the "most likely" scenario) and the proposed recreation features are somewhat less beneficial than described in the "minimum points" scenario. This analysis will run a matrix of starting conditions and beneficial "point boosts" to establish a range of values and consider the possibility that the recreation plan isn't justified per the NED benefit evaluation procedures. This analysis will explore the impact of the "UDV point boost" expected through implementing the proposed project. The following table presents an evaluation of the without- and with-project condition for both scenarios:

Table 29 – Sensitivity valuations of the without-project condition

UDV point valuation in the without-project condition					
		Minimum points in w/o project condition		Most Likely points in w/o project condition	
Criteria	Without Project Condition	Without Project	With project	Without Project	With Project
Recreation experience	Several general activities	0	5	4	10
Availability of Opportunity	Several within 1 hr. travel time; a few within 30 min. travel time	0	4	3	6
Carrying capacity	Minimum facility for development for public health and safety	0	6	2	8
Accessability	Limited access by any means to site or within site	0	4	3	6
Environmental	Low aesthetic factors that significantly lower quality	0	7	2	10
	Total	0	26	14	40

It's expected that the restoration efforts in the bosque will improve the environmental aesthetic. The features of the recreation plan (trail shelters, informational kiosk, additional trails, improved trails) are expected to touch each of the other criteria in the UDV assessment in a positive fashion. The following table presents a minimum and most likely point assessment of the marginal benefits attributed to the proposed recreation features:

Table 30 – Sensitivity UDV valuations of with-project conditions

UDV marginal effects in the with-project condition			
Criteria	With Project Condition	Min.	Likely
Recreation experience	Bike, walk, run, picnic, wildlife watching. One parking lot.	5	6
Availability of Opportunity	Urban resource for some activities. Increase due to extra trails and trail upgrades.	4	3
Carrying capacity	Increase due to adding trail shelters and upgrade of trails	6	6
Accessability	Increase due to improved trails.	4	3
Environmental	Factors to be rectified include non-native species (low visibility), occasional fire, increased diversity of wildlife	7	8
	Total	**26**	**26**

Economic Guidance Memorandum (EGM) 19-3 outlines the general and specialized recreation valuation for UDV point values for FY 2019. The guidance outlines the value of the recreation experience per visit based upon the point values assessed. The following table is a reprint of the guidance converting points to dollar values (FY 2019 price level):

Table 31 – UDV values and economic values from EGM 19-3

Point Values	General Recreation Values (1)	General Fishing and Hunting Values (1)	Specialized Fishing and Hunting Values (2)	Specialized Recreation Values other than Fishing and Hunting (2)
0	$4.14	$5.95	$29.00	$16.83
10	$4.92	$6.73	$29.77	$17.86
20	$5.44	$7.25	$30.29	$19.16
30	$6.21	$8.03	$31.07	$20.71
40	$7.77	$8.80	$31.85	$22.01
50	$8.80	$9.58	$34.95	$24.86
60	$9.58	$10.62	$38.06	$27.44
70	$10.10	$11.13	$40.39	$33.14
80	$11.13	$11.91	$43.50	$38.58
90	$11.91	$12.17	$46.60	$44.02
100	$12.43	$12.43	$49.19	$49.19

It's unlikely that any recreation opportunities would line up perfectly with any 10-point increment, so a linear interpolation of point values is necessary to measure the value afforded by the recreation experience. The following table presents the marginal point values for the General Recreation Values identified in EGM 19-3:

Table 32 – UDV point assessments and equivalent general recreation values from EGM 19-3

Point Values	General Recreation Values (1)	Marginal $/point
0	4.14	
10	4.92	0.078
20	5.44	0.052
30	6.21	0.077
40	7.77	0.156
50	8.8	0.103
60	9.58	0.078
70	10.1	0.052
80	11.13	0.103
90	11.91	0.078
100	12.43	0.052

As the foregoing illustrates, a single point in the Unit Day Value computation can have a value of between 5 and 16 cents per visit. Applying those values to the minimum and most likely values imparted by the proposed project gives a range of values of the proposed recreation plan. A 26-point increase crosses two point value thresholds, and would be worth between $0.77 and $1. 76 per recreation visit.

The without-project condition was evaluated in the UDV framework using the five criteria and was assessed a value of 0 or 14 points having a value of $4.14 or $5.13 per visit, respectively. The proposed project is anticipated to increase that value between 26 and 40 points, which would provide a benefit of between $0.77 and 3.63 per recreation visit. Those values fall to the lower bounds of the possible values described above and will represent a reasonable estimate of the benefits of implementing the recreation plan.

Table 33 – UDV benefit calculations on a per user/day basis

Without-Project UDV Value (points)	Without-Project Value (dollars)	With-Project UDV Value (points)	With-Project Value (dollars)	Benefits/visit (dollars)**
		+26 pts.		
0	$4.14	26	$5.90	$1.76
0	$4.14	40	$7.77	$3.63
		+26 pts.		
14	$5.13	26	$5.90	$0.77
14	$5.13	40	$7.77	$2.64

3.6 Sensitivity analysis of benefits of the proposed recreation features.

This evaluation started with scenarios to evaluate the value of the existing, without-project, recreation experience in the study area. The "minimum points" scenario was a fairly conservative estimate of the relative worth of the Rio Bosque Park habitat and recreation facilities. The "most likely" scenario was a bit more generous in assessing the value of the without-project recreation experience. Table 7 developed two estimates of the with-project UDV values. Multiplying the benefits identified in Table 10, above by the estimated annual visitation established in Table 2 provides the annual benefit of the proposed recreation features. However, to acknowledge the uncertainties in assessing UDV point values in the without- and with-project condition, this analysis developed a matrix of possible without- and with-project UDV point values, and computed the benefits against the estimate of visitation developed above. The range of UDV point values in the without- and with-project condition, as well as potential minimum and maximum scores associated with 26 and 40 point UDV value boosts, is provided in the following table:

Table 34 – Recreation benefits and justifiable construction costs

Without-Project UDV Value (points)	Without-Project Value (dollars)	With-Project UDV Value (points)	With-Project Value (dollars)	Benefits/visit (dollars)**	Annual Benefits**	Justifies
		+26 pts.				
0	$4.14	26	$5.90	$1.76	$2,467	66,596.62
0	$4.14	40	$7.77	$3.63	$5,082	137,199.62
		+26 pts.				
14	$5.13	26	$5.90	$0.77	$1,084	29,254.13
14	$5.13	40	$7.77	$2.64	$3,699	99,857.13

The cost of the proposed recreation project is in Table 27, above and remains unchanged in this sensitivity analysis.

The purpose of the sensitivity analysis is to determine some boundary conditions for this recreation analysis. Table 33, above, presents a range of values of the benefits of the recreation plan presented in Table 7. The plan costs $81,000. There are some assumptions in Table 13 where the benefits do not cover this cost. It's important, therefore, to evaluate those assumptions to determine their reasonableness in the benefit calculations.

In the first row, it's assumed the without project condition has zero points per UDV calculation in Table 1 and the qualitative benefits (highlighted fields in Table 2) are the absolute minimum possible in terms of point valuation. That was deemed unreasonable by the PDT because the Rio Bosque Park exists, does provide some services (trails, restrooms, parking, and information kiosks) in a natural, though degraded environment. The Sponsor and the PDT believe the proposed improvements will improve the Rio Bosque Park's ability to attract and serve different users. Specifically, the Sponsor is targeting school groups and hopes to bring more groups in the with-project condition. That trend explains part of the visitation increase in 2018 and 2019. The proposed restoration project will bring riparian habitat to El Paso County, Texas, which is exceedingly rare in the urbanized area. The proposed improvments will improve the carrying capacity of the park and provide ADA compliant accessibility through the park.

The third row of Table 33 assumes a high value to the without project condition (using maximum points for the values ascribed in Table 1). That condition was also deemed unreasonable by the Sponsor and the PDT. The thinking here would assume the effects of the project are even less beneficial than is described in the first row of the table (explored in the previous paragraph). The Sponsor and PDT reject this notion as the purpose of the ecosystem restoration project is to restore riparian and wetland habitat that is in critically short supply in El Paso. The restored project will be unique to the area, and the proposed trails and trail improvements will provide residents opportunity to see, appreciate, and enjoy a rare habitat a short drive from their home.

How unique is the Rio Bosque Park in the with-project condition? This recreation analysis assumes the available substitutes within a 1 hour drive are the Franklin Mountains State Park and the Mesilla Valley Bosque State Park in Mesilla, New Mexico. The Franklin Mountains State Park provides trails, picnic tables and benches, and would provide the infrastructure necessary to support equivalent activities, and has the carrying capacity to support the significantly higher visitation. However, the Park has no riparian habitat and minimal wetland habitat, being within the Franklin Mountains. The Mesilla Valley Bosque State Park is 1-2 hours away (varies by where in El Paso the user begins the journey) for a recreational experience within a riparian habitat. Because of the limited substitutes available for a recreation experience within a riparian habitat, the Sponsor and PDT is more comfortable with the assumptions and benefits described in Table 6, but acknowledges those benefits could be higher. Those benefits assume maximum points in the without and with-project condition, but also keeps to the minimum and likely "point boosts" described in Table 9.

3.7 Reasonableness of results.

Based upon the project cost and the range of benefits that can be attributed to the recreation features, it's reasonable to assume, absent agreement of the value of the existing and proposed project features, that the proposed recreation plan provides benefits to the existing Rio Bosque Park users in excess of costs, and represents a feature with positive net benefits within the ecosystem restoration plan. It's important to note that this evaluation makes no effort to quantify any increased visitation due to the attractiveness of the proposed project, which would only increase claimable benefits. For instance, a mere 100 visitors per year added to Table 6 would justify an additional $7,100 in construction costs. The Sponsor is confident the visitation will increase, in large part due to active recruitment and hosting of school group outings.