Executive Summary

1. Introduction

The Bureau of Reclamation (Reclamation) and the New Mexico Interstate Stream Commission (NMISC) prepared this Carlsbad Project Water Operations and Water Supply Conservation Environmental Impact Statement (EIS) to assess the potential consequences of proposed changes in Carlsbad Project operations and the implementation of a water acquisition program in the Pecos River basin, New Mexico.

This analysis was carried out to meet requirements of the National Environmental Policy Act (NEPA) and the Endangered Species Act of 1973, as amended (ESA). This EIS includes a description of alternative means of implementing the proposed Federal action (alternatives) and presents an evaluation of the potential environmental, economic, and social consequences that could result from implementing these alternatives. These proposed changes in water operations are designed to conserve the federally threatened Pecos bluntnose shiner (*Notropis simus pecosensis*) (shiner) and its designated critical habitat, while conserving the Carlsbad Project water supply.

2. Proposed Federal Actions

The proposed Federal actions that require NEPA compliance are changes in Carlsbad Project operations and the implementation of a water acquisition program. As required by NEPA, a No Action Alternative is also analyzed that would continue current Carlsbad Project operations and water acquisition actions.

Carlsbad Project operations include diverting water to storage and releasing water for authorized uses. Sumner Lake is the storage reservoir located immediately upstream of the reach of the river where the shiner is still present. Reclamation has limited opportunities to store and release water in Sumner Lake under its State water rights permit and the Sumner Dam authorization.

Proposed changes in Carlsbad Project operations include bypassing available inflows through Santa Rosa and Sumner Dams to meet target flows or minimum flows as measured at either the Taiban gage (i.e., the Below Taiban Creek Near Fort Sumner gage) or the Near Acme gage. These gages are used to monitor flows in river reaches that have dried in the past. Depending on the alternative, these target flows can be constant or variable by time of year or by to hydrologic

conditions. Actions contemplated also include guidance for block releases, continued use of a fish conservation pool, and implementation of an adaptive management plan (AMP).

Because changes in Carlsbad Project operations to benefit the shiner could result in reduction to the available Carlsbad Project water supply, a variety of options for acquiring water to keep the project whole are under consideration. Additional options have been developed to acquire water to directly augment flows and meet target flows at gage locations in reaches of the river where the shiner is present. The Carlsbad Project water acquisition (CPWA) options and additional water acquisition (AWA) options are not necessarily mutually exclusive. Both types of water acquisition options include a range of actions that are not fully developed as site-specific proposals. As part of the record of decision (ROD) for this EIS, options that provide Reclamation the tools needed to meet the project purpose and need will be retained and specific proposals developed. Implementation of water acquisition options may require additional permitting, consultations, Congressional authorization, and NEPA analysis. Additional NEPA analysis is expected to include the preparation of documents tiered from this EIS, such as environmental assessments and categorical exclusions. For some actions, resource-specific field studies, such as cultural and biological resource studies, may be conducted. Entities other than Reclamation may need to implement some of these options. Reclamation actions must be in accordance with its existing Federal and State legal and statutory authorities and obligations, the Pecos River Compact, water rights, and contractual obligations.

3. Purpose of and Need for Action

The purpose of Reclamation's proposed Federal action is to conserve the Pecos bluntnose shiner, a federally threatened fish species,[1] and to conserve the Carlsbad Project water supply.[2] The underlying need for Reclamation action is compliance with ESA and Reclamation's responsibility to conserve the Carlsbad Project water supply.

Reclamation needs to comply with ESA for operation of its Pecos River facilities. Reclamation is proposing changes in operations that benefit the shiner under its existing authorities and are consistent with its ESA section 7(a) (1) obligation to

[1] Conserving the shiner means that Reclamation would ensure that any discretionary action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. Reclamation would continue to participate in interagency actions to protect federally-listed species and designated critical habitats, within its legal and discretionary authority.

[2] Conserving the Carlsbad Project water supply means delivering the amount of water to the project that would otherwise be available but for changes to operations.

conserve and protect listed species. Within the exercise of its discretionary authority, Reclamation must also continue to avoid jeopardizing the continued existence of the shiner or destroying or adversely modifying designated critical habitat [ESA section 7(a)(2)].[3]

Reclamation has also elected to keep the Carlsbad Project water supply whole. Without an accompanying program to acquire and provide water, changes to historical operations would cause reductions to the Carlsbad Project water supply.

4. Alternatives

NEPA requires consideration of a reasonable range of management alternatives that meet the purpose of and need for the proposed action. The joint lead agencies also need to be responsive to issues identified during scoping; need to provide flexibility in order to address issues of uncertainty; and need to meet Federal, State, and local laws, regulations, and agreements.

Reclamation and NMISC developed a No Action Alternative and five action alternatives: (1) Taiban Constant, (2) Taiban Variable, (3) Acme Constant, (4) Acme Variable, and (5) Critical Habitat. Reclamation has selected Taiban Constant as the preferred alternative for the EIS and for initiation of section 7 consultation under ESA with the Fish and Wildlife Service (Service). This alternative proposes to operate the Carlsbad Project to (1) divert to storage when flows at the Taiban gage are greater than 35 cfs and (2) deliver from storage Carlsbad Project water as contracted for irrigation and consistent with applicable Federal and State laws. This alternative best meets the purpose of and need for the proposed action.

Under the No Action Alternative, Reclamation would continue to manage Pecos River dam operations in accordance with the Final Biological Opinion for the Bureau of Reclamation's Proposed Pecos River Dam Operations, March 1, 2003 through February 28, 2006, dated June 18, 2003 (BO), Reclamation authorizations, water rights, and contractual obligations. Each action alternative includes common guidance for block releases. The action alternatives include an AMP that is intended to monitor target flows and net depletions; to establish procedures when compliance with target flows are threatened; and to respond to new information and changing conditions. Under the action alternatives, Reclamation would cooperate with other agencies in ongoing and future conservation measures, including developing wells and pumping infrastructure for supplementing short-term flows, removing non-native riparian vegetation, using a

[3] Under section 7(a)(2), a discretionary agency action jeopardizes the continued existence of a species if it "reasonably would be expected, directly or indirectly, to reduce appreciably the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species."

refugia, participating in channel restoration projects, and other direct and indirect actions to enhance shiner conservation. Reclamation participation would be limited by its authority, and most of these measures would require additional permitting, Congressional authorization, and project-specific NEPA analysis.

Table ES.1 provides a summary of the alternatives, specifies target flows and minimums, and indicates gage locations for monitoring flows. Target flows for the alternatives are either constant or variable by time of year or whether hydrologic conditions are dry, average, or wet. The defined target flows do not preclude enhancing base flows beyond target flows, if additional water is available and the Carlsbad Project water supply is conserved. The Near Acme gage on the Pecos River northeast of Roswell, New Mexico, is currently used to monitor flows in critical habitat for the shiner. Some alternatives include proposals to monitor flows at the Taiban gage. Use of this gage for monitoring may provide more timely and accurate information on river conditions in critical habitat for the shiner and improve the success of maintaining flows.

Table ES.1 Carlsbad Project Water Operations and Water Supply Conservation EIS alternatives

	Range of flows [1,2]						Block release protocols	Other elements
	Dry		Average		Wet			
Alternative	**Non-irrigation season target flows**	**Irrigation season target flows**	**Non-irrigation season target flows**	**Irrigation season target flows**	**Non-irrigation season target flows**	**Irrigation season target flows**	**Time of year, magnitude, frequency, duration, ramp down**	**Water acquisition, shiner conservation and management measures, adaptive management**
Taiban Constant	35 cfs Taiban	35 cfs Taiban	35 cfs Taiban	35 cfs Taiban	35 cfs Taiban	35 cfs Taiban	**Time of Year**: On CID[3] request. Avoid releases during 6 weeks around August 1. **Magnitude**: On CID request and to maximize efficiency. **Frequency**: On CID request, but a minimum of 14 days between block releases. **Duration**: 15-day maximum per release. Maximum of 65 days per year. **Ramp down**: No ramp down required.	Within Reclamation's authorities, acquire water for the Carlsbad Project and for the shiner using respective "A" list options. Maintain fish conservation pool. Implement AMP. Continue existing shiner management measures and cooperate with others in shiner conservation measures.
Taiban Variable [4]	35 cfs Taiban	45 cfs, -5, +10 Taiban	35 cfs Taiban	45 cfs, -5, +10 Taiban	35 cfs Taiban	45 cfs, -5, +10 Taiban		
Acme Constant	35 cfs Acme	35 cfs Acme	35 cfs Acme	35 cfs Acme	35 cfs Acme	35 cfs Acme		
Acme Variable	35 cfs Acme	12 cfs Acme	35 cfs Acme	24 cfs Acme	35 cfs Acme	48 cfs Acme		
Critical Habitat	35 cfs Taiban minimum	Critical habitat kept wet; avoid intermittency Acme	35 cfs Taiban minimum	5 cfs Acme	35 cfs Taiban minimum	10 cfs Acme		

Table ES.1 Carlsbad Project Water Operations and Water Supply Conservation EIS alternatives

	Range of flows [1,2]						Block release protocols	Other elements
	Dry		Average		Wet			
No Action (current operations, based on 2003-2006 BO)	35 cfs Acme	Upper critical habitat kept wet; avoid intermit-tency Acme	35 cfs Acme	20 cfs Acme	35 cfs Acme	35 cfs Acme	**Same as other alternatives except**: Time of year: No stipulation to avoid releases during 6 weeks around August 1.	**Same as other alternatives except**: AMP is not specifically included. Water would continue to be acquired from current sources, and new sources would be developed.

[1] Target flows are based on the Final Biological Opinion for the Bureau of Reclamation's Proposed Pecos River Dam Operations, March 1, 2003, through February 28, 2006, dated June 18, 2003 (U.S. Fish and Wildlife Service [Service], 2003).

[2] Dry hydrologic condition: Effective Brantley storage is less than 75,000 acre-feet.
Average hydrologic condition: Effective Brantley storage is greater than 75,000 acre-feet and less than 110,000 acre-feet.
Wet hydrologic condition: Effective Brantley storage is greater than 110,000 acre-feet.

[3] CID = Carlsbad Irrigation District

[4] During the nonirrigation season, Reclamation would target flows of 35 cfs at the Taiban gage. During the irrigation season, target flows would be 40 cfs to 55 cfs, depending on water availability and other operational constraints.

Under all action alternatives, additional water would be acquired to ensure that the Carlsbad Project water supply would be conserved. Options for acquiring water for both the Carlsbad Project water supply (CPWA options) and for augmenting flows for the shiner were screened (AWA options) and developed for analysis in this EIS. The CPWA and AWA options are not necessarily mutually exclusive. These water acquisition options include five general categories: water right purchase and retirement, water right lease and retirement, change in cropping patterns, development of well fields, and Fort Sumner Irrigation District (FSID) gravel pit pumping. The options are not linked to specific alternatives, but instead represent a suite of potential sources for water acquisition. Some water acquisition options may need to be implemented by entities other than Reclamation.

Table ES.2 presents the "A" list of 16 CPWA options. The "A" list is further refined by recognition that the amount of water generated by the option would not be fully effective in replacing depletions to the Carlsbad Project water supply. For example, the purchase and retirement of FSID water rights make water available far upstream of the Carlsbad Project, and less than the full amount of water generated at FSID would be available farther downstream because of conveyance losses. Table ES.3 presents the "A" list of AWA options. The table includes the final combined total score, the amount of potentially available water, and the projected cost. The table describes the AWA options that could be implemented to provide water within 3 years. Additional NEPA analysis may be required for some options and may include the preparation of documents tiered from this EIS, such as environmental assessments and categorical exclusions. For some options, resource specific field studies (cultural and biological resource studies) may be conducted.

Table ES.2 "A" list: equally weighted ranking of CPWA options

Rank	Designation[1]	Option name/ description	Reclamation authority	Amount available (consumptive acre-feet/year)[2]	Average CPWA efficiency to CID[3]	Average effective CPWA (acre-feet/year)	Combined total score – workgroup ranking (no units)	Adjusted EUAC[4] ($/acre-feet/year)
1	Q1-SR	Develop well field: Seven Rivers	No authority to construct facilities, but authority to acquire water for the Carlsbad Project	10,000	67%	6,700	77.0	433
2	Q1-BV	Develop well field: Buffalo Valley	No authority to construct facilities, but authority to acquire water for the Carlsbad Project	10,000	58%	5,800	76.0	455
3	D-1B	Surface water right purchase: Roswell area	Yes – for Carlsbad Project uses	1,600	55%	1,300	74.0	180
4	E-1B	Surface water right lease: Roswell area	Yes – for Carlsbad Project uses	1,600	55%	1,300	73.0	165
5	D-1A	Surface water right purchase: FSID	Yes – for Carlsbad Project uses	1,000	23%	300	72.0	431
6	D-1BX	Surface water right purchase: Roswell area	Yes – for Carlsbad Project uses	1,600	55%	1,300	72.0	252
7	L-3	Changes to cropping patterns: CID[5] (very low water use crop)	Yes – for Carlsbad Project uses	10,500	100%	10,500	71.5	182
8	E-1A	Surface water right lease: FSID	Yes – for Carlsbad Project uses	1,000	23%	300	71.0	396
9	D-1C	Surface water right purchase: CID	Yes – for Carlsbad Project uses	3,150	100%	3,150	71.0	99
10	E-1C	Surface water right lease: CID	Yes – for Carlsbad Project uses	3,150	100%	3,150	70.0	91
11	D-1AX	Surface water right purchase: FSID	Yes – for Carlsbad Project uses	1,000	23%	300	70.0	603

Table ES.2 "A" list: equally weighted ranking of CPWA options

Rank	Designation[1]	Option name/ description	Reclamation authority	Amount available (consumptive acre-feet/year)[2]	Average CPWA efficiency to CID[3]	Average effective CPWA (acre-feet/year)	Combined total score – workgroup ranking (no units)	Adjusted EUAC[4] ($/acre-feet/year)
12	D-1CX	Surface water right purchase: CID	Yes – for Carlsbad Project uses	3,150	100%	3,150	69.0	139
13	L-2	Changes to cropping patterns: CID[5] (low water use crop)	Yes – for Carlsbad Project uses	8,800	100%	8,800	66.5	249
14	L-1	Changes to cropping patterns: CID[5] (average of all water use amounts)	Yes – for Carlsbad Project uses	8,900	100%	8,900	65.5	206
15	L-4	Changes to cropping patterns: CID[5] (medium water use crop)	Yes – for Carlsbad Project uses	6,000	100%	6,000	64.5	209
16	U	FSID gravel pit pumping	Unknown – construction may be considered operations and maintenance, but do have the authority to acquire water for the Carlsbad Project	300	74%	222	62.0	13

[1] Options designated with an "X" represent the option with the same designation but with an escalated cost of 40% to account for market pressures.

[2] Amount presented for all water rights acquisition options is the consumptive irrigation requirement (CIR). The CIR is the amount of irrigation water, exclusive of precipitation, stored soil moisture or ground water needed consumptively for crop production.

[3] Note that “amount available” column multiplied by efficiency in this column does not yield effective offset. Only diverted amounts (convert from CIR amount by multiplying by 3 acre-feet/acre and dividing by 2.1 acre-feet/acre) can be multiplied by efficiencies in this column to determine effective offset.

[4] EUAC was “adjusted” to account for CPWA option efficiencies.

[5] The changes to cropping patterns were based on conversion of 5,000 acres of alfalfa to the crops with the indicated level of water.

Table ES.3 "A" list AWA options

Designation[1]	Option name	Reclamation authority	Combined total score workgroup ranking	Amount available (consumptive acre-feet/year)	EUAC ($/acre-feet/year)
A-1	Surface water right purchase: CID	Yes – for Carlsbad Project uses	75.5	3,150	99
A-2	Surface water right purchase: FSID	Yes – for Carlsbad Project uses	73.5	1,000	99
A-1X	Surface water right purchase: CID (additional 40-percent inflation)	Yes – for Carlsbad Project uses	73.5	3,150	139
B-1	Surface water right lease: CID	Yes – for Carlsbad Project uses	72.5	3,150	91
A-2X	Surface water right purchase: FSID (additional 40-percent inflation)	Yes – for Carlsbad Project uses	71.5	1,000	139
B-2	Surface water right lease: FSID	Yes – for Carlsbad Project uses	70.5	1,000	91
I	FSID gravel pit pumping	Unknown – construction may be considered operations and maintenance, but do have the authority to acquire water for the Carlsbad Project	63.5	300	10
J-2	Fort Sumner area large-capacity well field	No authority to construct facilities, but authority to acquire water for the Carlsbad Project	62.0	1,384	150
J-1	Fort Sumner area small-capacity well field	No authority to construct facilities, but authority to acquire water for the Carlsbad Project	61.0	500	164
D-1C	Changes to cropping patterns: CID (very low water use crop)	Yes – for Carlsbad Project uses	60.0	10,500	128
D-1A	Changes to cropping patterns: CID (average of all water use amounts crop)	Yes – for Carlsbad Project uses.	60.0	8,900	144
D-1D	Changes to cropping patterns: CID (medium water use crop)	Yes – for Carlsbad Project uses	60.0	6,000	147
D-1B	Changes to cropping patterns: CID (low water use crop)	Yes – for Carlsbad Project uses	60.0	8,800	175
D-2	Changes to cropping patterns: FSID (small grain)	Yes – for Carlsbad Project uses	59.0	3,375	158
A-4	Surface water right purchase: Puerto de Luna area	Yes – for Carlsbad Project uses	57.5	110	99
A-4X	Surface water right purchase: Puerto de Luna area (additional 40-percent inflation)	Yes – for Carlsbad Project uses	55.5	110	139
B-4	Surface water right lease: Puerto de Luna area	Yes – for Carlsbad Project uses	54.5	110	91
D-4	Changes to cropping patterns: Puerto de Luna area (very low water use crop)	Yes – for Carlsbad Project uses	47.5	360	168

[1] Options designated with an "X" represent the option with the same designation but with an escalated cost of 40 percent to account for market pressures.

5. Environmental Consequences

The proposed Federal action could potentially affect water resources; water quality; agricultural soil and land resources; biological resources, including special status species; regional economy; recreation, cultural resources; Indian trust and treaty assets (ITA); and environmental justice. The analysis of the effects of the alternatives on these resources focused on selected *indicators*. A resource indicator is a particular measure of a resource used to assess impacts on the overall resource. Table ES.4 (at the end of this summary) summarizes the impacts of the alternatives on the resource indicators analyzed in this EIS.

5.1 Water Resources

The following indicators were selected to evaluate water resources: (1) flow frequency at the Near Acme gage, (2) additional water needed (AWN) to meet target flows, (3) Carlsbad Project water supply, (4) Pecos River flows at the New Mexico-Texas State line, (5) Pecos River Compact delivery obligation (6) base inflows in the Acme to Artesia reach of the Pecos River (7) CPWA option efficiencies.

The analysis indicates higher flows would occur more frequently under the alternatives with higher target flows, but the associated target flows cannot be met as frequently. Model results show that intermittency (flows of 0 cfs) occurs less frequently under every alternative than under the pre-1991 (historical operations) baseline. Differences in the frequency of intermittency among the alternatives are quite small and may be considered negligible. The analysis indicates that the highest average annual net depletions to both the Carlsbad Project water supply and to State-line flows would occur under the Acme Constant and Acme Variable Alternatives, and the lowest net depletions would occur under the Taiban Constant and Critical Habitat Alternatives. There is a strong correlation between an alternative's net depletions to the Carlsbad Project water supply and the magnitude of its target flows. There is a similar correlation between an alternative's net depletions to State-line flows and the magnitude of its target flows.

5.2 Water Quality

The following indicators were selected to evaluate water quality: (1) total dissolved solids (TDS) and (2) specific electrical conductance (EC). The analysis indicates that EC, the selected indicator of water quality, would be lower under the Acme Constant and Acme Variable Alternatives and higher under the Critical Habitat Alternative and the Taiban Variable Alternative than the under No Action Alternative. However, model results indicate that any effects on EC resulting from bypass flows would be eliminated once the CPWA options are in place. As a result, changes in Carlsbad Project operations would have no net effect on water quality.

Changes in Carlsbad Project operations would not affect the five reaches of the Pecos River in the study area that are listed as impaired for sedimentation/siltation under the Clean Water Act or the reasons for their listing. Likewise, the four Carlsbad Project reservoirs are listed as impaired for excessive mercury concentrations in fish tissue would not be affected by changes in Carlsbad Project operations.

The Pecos River from Sumner Dam to Brantley Reservoir is classified as supporting a warmwater fishery. This reach of the Pecos River is listed under the Clean Water Act as fully supporting of all classified uses. In addition to a warmwater fishery, the river is classified for irrigation, livestock watering, wildlife habitat, and secondary contact recreation, i.e., contact that does not involve full body immersion in the water. None of these uses should be adversely affected by changes in Carlsbad Project operations.

5.3 Agricultural Soil and Land Resources

The following indicators were selected to evaluate agricultural soil and land resources: (1) soil erosion potential (mainly wind erosion), (2) soil quality (mainly soil salinity), (3) land quality, as measured by the acres of lands meeting criteria for national prime farmland (PF) and the acres of lands meeting criteria for farmlands of Statewide importance (FSI), and (4) acres of land infested with noxious weeds and plants (mainly salt cedar).

Greater evaporative transmission losses associated with the No Action Alternative and all the action alternatives would tend to lead to a smaller water supply and a higher salinity of the irrigation water at the Carlsbad Irrigation District (CID) diversion structure at Avalon Dam into the CID main canal compared to conditions since the construction of Brantley Reservoir.

In the absence of water acquisition options, the result would be substantial adverse impacts (e.g., greater soil salinity, reduced crop yields) to CID soil and land resources. Many CID lands barely meet the criteria for national PF, and any decrease in the quantity or increase in the salinity of the irrigation water would raise soil salinity above the threshold of 4 deciSiemens per meter (dS/m) EC of the saturation extract (ECe) for PF in many areas. Higher soil salinity also would lead to smaller crop yields and encourage abandonment of some marginal lands. In dry and average hydrologic conditions, water quality (salinity) also would deteriorate during the critical early spring crop establishment period, a major adverse impact on CID.

This analysis of the alternatives is based on full water acquisition options to make up for any depletions to CID and provide for an early spring block release to reduce the salinity in Brantley Reservoir for crop establishment. These water acquisition options have the effect of “spreading” the impacts on the land and resources over the entire Pecos River Valley downstream from the Guadalupe County northern boundary line. The principal adverse impact would be the

potential loss of PF if water acquisition options are chosen that require water right purchase and retirement of lands from irrigation. Impacts to soil quality should be minimal as long as the retired lands are reseeded to perennial grasses. The impacts also could be minimized by targeting marginal and unproductive lands for retirement rather than prime farmlands.

5.4 Biological Resources

The following broad indicators were selected to evaluate biological resources: (1) terrestrial and flood plain ecosystem components (including wetlands, riparian vegetation, and wildlife), (2) riverine aquatic ecosystem components, (3) reservoir aquatic ecosystem components, (4) special status species that occur within the study area, especially the Pecos bluntnose shiner and the interior least tern, and (5) critical habitat within the study area.

No additional impacts on terrestrial, flood plain, and wetland ecosystem components, including special status species inhabiting terrestrial ecosystems, are expected under any alternative because no changes are expected in overbank flooding or bank erosion. Carlsbad Project water acquisition options may occur on upland habitats and would have direct impacts to terrestrial vegetation.

For riverine aquatic ecosystem components, analysis shows that in the reach from Santa Rosa Reservoir to Sumner Lake, no change is expected under any alternative because of stable base inflow conditions. In the reach from Sumner Lake to Brantley Reservoir, model results show that intermittency occurs under all alternatives with bypass flows, with little difference among the alternatives. With AWA options and adaptive management guidance, impacts could be eliminated or mitigated to levels that would be better than under the No Action Alternative. These flexibilities would be extremely important for protecting Pecos bluntnose shiner populations during the irrigation season in dry and average hydrologic conditions.

The analysis of reservoir aquatic ecosystem components shows that the minimum, average, and maximum pool elevations of Santa Rosa Reservoir, Sumner Lake, Brantley Reservoir, and Avalon Reservoirs each are very similar under all the alternatives. Additionally, measures of variation in pool elevations were very similar and indicate that little difference would be expected in elevations over time. Because of the similarities, effects to the habitats of reservoir fishes or their spawning areas would be comparable under all alternatives.

For the interior least tern, impacts of all action alternatives would be expected to be very similar to those of the No Action Alternative. Generally, impacts to other special status species would be minimal.

5.5 Regional Economy

Several indicators were selected to evaluate impacts on the regional economy: (1) change in value of regional output produced in the study area, (2) change in regional income, and (3) change in regional employment.

Impacts to the regional economy associated with changes in Carlsbad Project operations could occur as a result of water acquisition options that require water right purchases/leases (and associated land retirement or fallowing) and changes in cropping patterns. Assuming the use of these water acquisition options, impacts would result from changes in net farm revenues and input expenditures associated with changes in agricultural production. Most of these changes in agricultural production would lead to negative regional economic impacts. Some positive impacts also could occur as a result of land or lease payments made to farmers adversely affected by land use changes.

Regional economic impacts are estimated to be less under the Taiban Constant Alternative, the Taiban Variable Alternative (45 cfs), and the Critical Habitat Alternative than under the No Action Alternative. The estimated upper range of regional economic impacts under these three alternatives are $1.6 million in total value of output lost and losses of about 21 jobs per year compared to the pre-1991 baseline. The high range of impacts is $0.5 million in additional value of output and creation of 7 jobs each year compared to the No Action Alternative.

Some positive impacts are associated with each action alternative as a result of lump-sum land retirement or lease payments and compensation for lost farm revenues as a result of changes to cropping patterns. These are **one-time impacts,** not recurring negative annual impacts. The greatest one-time positive impacts would occur under the Acme Constant Alternative, followed by the Acme Variable Alternative, the Taiban Variable Alternative, and the Taiban Constant and Critical Habitat Alternatives.

5.6 Recreation

The following indicators were selected to evaluate recreation: (1) recreation visitation and associated expenditures at Santa Rosa Reservoir, Sumner Lake, Brantley Reservoir, and Avalon Reservoir and (2) recreation along the Pecos River.

The action alternatives are expected to have negligible to minor impacts on recreation. That is, recreation use of the reservoirs and the Pecos River is expected to vary from year, perhaps drastically, but the different operating regimes for the system would not, in and of themselves, be the cause of major changes in use from year to year.

5.7 Cultural Resources

The following indicators were selected to evaluate changes to cultural resources: (1) the presence or potential for cultural resources that may be eligible for listing on the *National Register of Historic Places* (NRHP) or locations that are important to Native American or other traditional communities in areas affected by the action, (2) changes in riverflow and reservoir storage levels and fluctuations where there is a potential for directly disturbing resources, increasing access to resources, or exposing submerged resources and (3) ground-disturbing

activities such as drilling, trenching, grading, or construction where resources may be present; modifications to historic water retention or conveyance infrastructure; or loss or abandonment of historic structures associated with water acquisition options.

The changes in Carlsbad Project operations proposed under all of the alternatives would result in negligible impacts to cultural resources. Sites in the immediate vicinity of the river or in flood zones have been subject to past disturbances, reducing the likelihood of their intact preservation. Proposed flow levels, flow fluctuations, and changes in reservoir storage would be within the range of normal river and reservoir operations and would not be expected to exacerbate erosion of archaeological resources or exposure of submerged resources. The potential for these kinds of impacts is greater from natural drought cycles and flood events.

Water acquisition options could be associated with negligible to major impacts on cultural resources due to ground-disturbing activities, modification of historic infrastructure, loss or abandonment of historic structures. In all cases, the implementation of these options would require further consideration of cultural resource impacts and completion of the National Historic Preservation Act, section 106 process for actions that are Federal undertakings. Depending on the option, the identification, evaluation, effects determination, and resolution of adverse effects through the section 106 process could require extensive additional fieldwork and the possibility of project redesign to avoid resources. Impacts would be expected to be reduced to negligible or minor in most cases.

5.8 Indian Trust and Treaty Assets

The following resource indicator was selected to evaluate Indian trust and treaty assets (ITAs): (1) the potential for the action to affect Indian real property, physical assets, or intangible property rights.

No ITAs have been identified in consultation with tribes and the Bureau of Indian Affairs. There are no reservations or ceded lands in the region of influence. Because resources are not believed to be present, no impacts are anticipated to result from the alternatives or from water acquisition options. Contacts with tribal groups to identify ITA or other issues would continue through the EIS process and as water acquisition options are proposed and implemented.

5.9 Environmental Justice

The location of any negative regional economic or social impacts associated with each alternative is difficult to determine because the location of retired/fallowed land or land with changes to cropping patterns cannot be predicted with any certainty. However, environmental justice concerns would be raised if any alternative results in impacts that are primarily imposed on irrigated land or recreation in Guadalupe County. Likewise, there could be an environmental justice impact if acequias are retired since many of these systems support lands owned by Hispanic farmers. Acquiring acequia water would require consensus of

the acequia community, which is unlikely; therefore, such an impact would have a low chance of occurring.

The analysis of agricultural economic impacts indicates the greatest potential negative regional impacts are associated with the Acme Constant and Acme Variable Alternatives. The recreation analysis indicates minimal impacts under each alternative, although "somewhat less" recreation is expected to occur under the Taiban Constant and Taiban Variable Alternatives. Therefore, the possibility of potential environmental justice concerns is greatest under the Acme Constant and Acme Variable Alternatives.

5.10 Environmental Commitments

This section provides the environmental commitments that may be implemented with the selection of any of the alternatives. These commitments generally are intended to avoid, mitigate, or compensate for adverse environmental effects that would otherwise occur.

Water acquisition programs: The Carlsbad project water acquisition options and the additional water acquisition options are incorporated as common actions to all alternatives. These options would be implemented as needed to help meet target flows and to conserve the Carlsbad Project water supply. All options that involve water or land leasing or purchasing would be conducted on a willing-seller basis. Further environmental compliance actions and permitting would be completed as required.

Adaptive management plan: Implementation of an AMP is incorporated as common to all alternatives. Uncertainty is an unavoidable component of restoring and managing natural systems. To help address uncertainty, the AMP would be implemented to guide how management actions should be adjusted over time based on results of monitoring. The core components of the Adaptive Management Plan are criteria, triggers, monitoring, and responses. The AMP provides guidance for addressing changing conditions in the future management of river operations by modifying operations within established parameters. It also provides a framework to ensure that the selected alternative satisfies the requirements of the EIS and the purpose of and need for the proposed action. Attachment 2 is an AMP based on the Taiban Constant Alternative.

Section 7 consultation measures: Reclamation will implement measures from the BO (see appendix 1) to offset take and to avoid or reduce any adverse effects. The specific Reasonable and Prudent Measures and other actions outlined in the BO that Reclamation will implement will be included in the ROD.

Agricultural lands: To minimize soil erosion, any retired farmlands should be reseeded to perennial grasses. This could require short-term maintenance in order to obtain adequate cover. In retiring lands, marginal or unproductive lands should be targeted rather than prime farmland.

Land disturbance: Any activities that disturb the land would follow best management practices including soil stabilization (e.g., mulching and watering), revegetation, and noxious weed control. Appropriate environmental studies would be conducted to comply with laws and regulations. These could include archeological surveys, biological surveys, Native American consultation, and hazardous waste assessments.

6. Cumulative Impacts

Cumulative impacts are "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of which agency (Federal or non-Federal) or person undertakes such actions"(40 Code of Federal Regulations section 1508.7). There are numerous past, present, and reasonably foreseeable actions in the study area; however, the analysis focused on actions that may have a continuing, additive, and significant relationship to the effects of the proposed action.

6.1 Water Resources

The most apparent significant cumulative impact to water resources in the study area results from the Settlement Agreement. Because this project also uses agricultural land retirement as a solution to water resource supply problems, it would additionally impact farmers in the basin. If measures to conserve the Carlsbad Project water supply are insufficient and depletions occur, the burden of meeting those thresholds would shift to NMISC under the terms of the Settlement Agreement. Water conservation projects may augment the Carlsbad Project water supplies and help increase State-line flows, but the level of this conservation may reach a point of diminishing returns and, in fact, may introduce new net depletions if taken too far (losses from rising ground water tables). Other projects, such as restoration and water salvage activities along the river, are small, and will not have a significant cumulative impact on water resources in the basin because of their limited size

6.2 Water Quality

Overall, many of the cumulative actions strive to increase or maintain water flows in the river, which would have a beneficial net effect on water quality. Likewise, less agricultural use of water could reduce salinity as less drain and tailwater would enter the Pecos River system. Conversely, any future development in the basin likely would degrade water quality as a result of increased waste loadings to the river. Only activities directly related to agricultural development would likely be considered cumulative to the Carlsbad Project operations addressed in this EIS.

6.3 Agricultural Soil and Land Resources

The only major cumulative adverse impact of the actions considered in this EIS and the other related actions on agricultural soils and lands would be a reduction in the acreages of PF and FSI in New Mexico.

6.4 Biological Resources

The net cumulative effect to biological resources generally would be positive as most of the listed projects are focused on increasing flows for Pecos River Compact delivery purposes and the Carlsbad Project water supply. Higher and more reliable base inflows would benefit aquatic ecosystems throughout the study area. Current riparian ecosystems and the species dependent upon the habitats provided likely would not benefit from the listed projects. However, long-term benefits might be realized through the removal of non-native phreatophytes that would allow for possible reestablishment of native vegetated communities and associated wildlife species. Channel restoration projects could also improve fish habitat.

6.5 Regional Economy

The continuing trend in the region for land fallowing, retirement, and changes to cropping patterns could have a cumulative negative impact to local economies in the long term. In the short term, the Settlement Agreement and other regional activities would be expected to add value to the economy in the CID area. Without specific data on which CPWA options would be implemented and the location of options, a cumulative assessment of long-term losses in economic output and employment as crop value loss and job loss is uncertain. Other actions would serve to mitigate this impact, such as increased oil and gas production, expansion of the dairy industry, and new developments, such as the cheese factory. Other actions, such as the closure of Cannon Air Force Base, could increase the net adverse impact to the broader economy.

6.6 Recreation and ITAs

There are no cumulative impacts of the proposed action on recreation or Indian trust and treaty assets in relation to other projects or programs (ongoing or reasonably foreseeable future actions) in the Pecos River basin.

6.7 Cultural Resources

Although few surveys have been conducted to confirm their presence, it is likely that there are many unrecorded cultural resources that could be impacted by this project or ongoing or reasonably foreseeable future actions. The changes in Carlsbad Project operations (block releases, target flows, reservoir levels) proposed under all of the alternatives would result in negligible effects to cultural resources. The effects of water acquisition options are unknown, but could be similar to those resulting from ongoing or reasonably foreseeable future regional actions in type, intensity, timeframe, and general location. Implementation of the water acquisition options and many of the regional actions would be subject to

further consideration under Federal and/or State cultural resource statutes and regulatory protections. Some regional actions would not be subject to further cultural resource consideration. The intensity of cumulative impacts is unknown because of uncertainty about water acquisition options and the cultural resource impact, but it is anticipated that cumulative impacts are possible because of the additive effect and the location and timing of other regional actions.

6.8 Environmental Justice

A continuing trend of ongoing and proposed programs to fallow, retire, or change farming practices exists within the Pecos River basin. The exact location of where retirement or fallowing would occur cannot be predicted with certainty; however, the majority is expected to occur within CID and Fort Sumner Irrigation District, where a large percentage of the irrigated acreage is located. To the extent that some land retirement could also occur in Guadalupe County, there could be some cumulative impacts that would affect low-income or minority populations.

7. Summary of Impacts Table

Table ES.4 summarizes the impacts of the alternatives on the resource indicators analyzed in this EIS.

Table ES.4 Summary of impacts of alternatives on resources

Indicator	No Action Alternative	Taiban Constant Alternative	Taiban Variable Alternative	Acme Constant Alternative	Acme Variable Alternative	Critical Habitat Alternative
Water Resources						
Difference in percent of time modeled flows of 10 cfs at the Near Acme gage are exceeded	10 percent more frequently than under pre-1991 baseline	3 percent less frequently than under No Action	3 percent less to 4 percent more frequently than under No Action	7 percent more frequently than under No Action	5 percent more frequently than under No Action	2 percent less frequently than under No Action
Difference in percent of time modeled flows of 20 cfs at the Near Acme gage are exceeded	19 percent more frequently than under pre-1991 baseline	10 percent less frequently than under No Action	8 to 9 percent less frequently than under No Action.	10 percent more frequently than under No Action	3 percent more frequently than under No Action	6 percent less frequently than under No Action
Difference in percent of time modeled flows of 30 cfs at the Near Acme gage are exceeded	24 percent more frequently than under pre-1991 baseline	23 percent less frequently than under No Action	23 percent less frequently than under No Action.	8 percent more frequently than under No Action	0.6 percent more frequently than under No Action	23 percent less frequently than under No Action

Table ES.4 Summary of impacts of alternatives on resources

Indicator	No Action Alternative	Taiban Constant Alternative	Taiban Variable Alternative	Acme Constant Alternative	Acme Variable Alternative	Critical Habitat Alternative
Difference in frequency of modeled intermittency at the Near Acme gage	0.3 percent less frequently than under pre-1991 baseline	0.04 percent less frequently than under No Action	0.08 to 0.3 percent less frequently than under No Action	0.3 percent less frequently than under No Action	0.3 percent less frequently than under No Action	0.1 percent more frequently than under No Action
Additional water needed (AWN) to meet target flows	Average of 2,900 acre-feet per year more than under pre-1991 baseline	Average of 720 acre-feet per year more than under pre-1991 baseline	Average of 1,400 to 4,200 acre-feet per year more than under pre-1991 baseline	Average of 9,500 acre-feet per year more than under pre-1991 baseline	Average of 5,300 acre-feet per year more than under pre-1991 baseline	Average of 620 acre-feet per year more than under pre-1991 baseline
Modeled average annual depletions (net depletions) to Carlsbad Project water supply	Average of 1,600 acre-feet per year greater than under pre-1991 baseline	Average of 1,200 acre-feet per year greater than under pre-1991 baseline	Average of 1,200 to 1,700 acre-feet per year greater than under pre-1991 baseline	Average of 3,900 acre-feet per year greater than under pre-1991 baseline	Average of 3,000 acre-feet per year greater than under pre-1991 baseline	Average of 1,200 acre-feet per year greater than under pre-1991 baseline
Modeled average annual flows at the New-Mexico State line	1,200 acre-feet per year lower than under pre-1991 baseline	440 acre-feet per year lower than under pre-1991 baseline	690 to 1,600 acre-feet per year lower than under pre-1991 baseline	2,100 acre-feet per year lower than under pre-1991 baseline	1,600 acre-feet per year lower than under pre-1991 baseline	530 acre-feet per year lower than under pre-1991 baseline
Water Quality						
EC	EC as much as 900 µS/cm higher in Brantley Reservoir and more than 300 µS/cm higher in CID; higher EC in all year types, but highest in dry year, lowest in wet year. Impacts would be moderate, localized, and long-term.	Slightly higher EC in wet year, but higher than under No Action in other year types. Impacts would be minor, localized, and long-term.	Higher EC in dry years and lower EC in normal and wet years at high and intermediate target flows; lower EC in wet years and higher EC in normal and dry years at lowest target flows. Impacts would vary with target flows, but overall would be minor, localized, and long-term.	Lower EC in normal and dry years, but higher in wet years when EC is generally lower. Impacts would be moderate, localized, and long-term.	No change in EC in wet year, but lower EC in normal and dry years, highest EC in dry years. Impacts would be moderate, localized, and long-term.	Higher EC in all year types, Impacts would be minor, localized, and long-term.
Agricultural Soil and Land Resources						
Overall resource	Minor localized adverse impacts to agricultural soil and land resources compared to pre-1991 baseline	Minor adverse impacts compared to No Action	Minor adverse impacts compared to No Action	Minor adverse impacts compared to No Action, mainly because of greater land retirement	Minor adverse impacts compared to No Action	Minor, mitigatable impacts compared to No Action

Table ES.4 Summary of impacts of alternatives on resources

Indicator	No Action Alternative	Taiban Constant Alternative	Taiban Variable Alternative	Acme Constant Alternative	Acme Variable Alternative	Critical Habitat Alternative
Biological Resources						
Terrestrial and flood plain ecosystem components	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Riverine aquatic ecosystem components: Santa Rosa Reservoir to Sumner Lake	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	No change The lack of AWA options and adaptive management guidelines would not provide the management flexibility necessary to offset these potential impacts.	With bypass flows only: Total amount of intermittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action. With AWA options and adaptive management guidance, impacts could be offset or mitigated to levels that would be better than under No Action. These flexibilities would provide managers with the ability to augment base inflows and limit intermittency for the benefit of the shiner.	With bypass flows only: Total amount of intermittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action. With AWA options and adaptive management guidance, impacts could be offset or mitigated to levels that would be better than under No Action. These flexibilities would provide managers with the ability to augment base inflows and limit intermittency for the benefit of the shiner.	With bypass flows only: Total amount of intermittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action. With AWA options and adaptive management guidance, impacts could be offset or mitigated to levels that would be better than under No Action. These flexibilities would provide managers with the ability to augment base inflows and limit intermittency for the benefit of the shiner.	With bypass flows only: Total amount of intermittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action. With AWA options and adaptive management guidance, impacts could be offset or mitigated to levels that would be better than under No Action. These flexibilities would provide managers with the ability to augment base inflows and limit intermittency for the benefit of the shiner.	With bypass flows only: Total amount of intermittency likely would not be significantly different from No Action. Flows greater than 3 to 5 cfs likely would not be significantly different from No Action. Same as No Action. AWA options would not reduce or eliminate intermittency as under other action alternatives.
Riverine aquatic ecosystem components: Brantley Dam to New Mexico-Texas State line	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Reservoir aquatic ecosystem components	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action

Table ES.4 Summary of impacts of alternatives on resources

Indicator	No Action Alternative	Taiban Constant Alternative	Taiban Variable Alternative	Acme Constant Alternative	Acme Variable Alternative	Critical Habitat Alternative
Pecos bluntnose shiner	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir	Same as for riverine aquatic ecosystem components: Sumner Lake to Brantley Reservoir
Interior least tern	No change	No significant change from No Action	No significant change from No Action	No significant change from No Action	No significant change from No Action	No significant change from No Action
Regional Economy						
Change in annual value of regional output ($)	- 350,000 to - 2,165,000	+ 88,000 to + 525,000	+ 88,000 to + 525,000 to - 22,000 to - 131,000	- 504,000 to - 3,149,000	- 307,000 to - 1,902,000	+ 88,000 to + 525,000
Change in annual regional income ($)	- 27,000 to - 871,000	+ 7,000 to + 211,000	+ 7,000 to + 211,000 **to** -2,000 to + 53,000	- 39,000 to - 1,267,000	- 24,000 to - 766,000	+ 7,000 to - 211,000
Change in regional employment (jobs)	-0.3 to -28.1	+0.1 to +6.8	+0.1 to +6.8 **to** 0.0 to -1.7	-0.5 to -40.8	-0.3 to -24.7	+0.1 to +6.8
Recreation						
Reservoir recreation and impacts	No change	Approximately the same as No Action	Approximately the same as No Action	Approximately the same as No Action	Approximately the same as No Action	Approximately the same as No Action
River recreation and impacts	No change	Less recreation use implies less recreation related spending and lower net benefits than No Action	Less recreation use implies less recreation related spending and lower net benefits than No Action	More recreation use implies more recreation related spending and higher net benefits than No Action	More recreation use implies more recreation related spending and higher net benefits than No Action	Approximately the same recreation use implies approximately the same recreation related spending and approximately the same net benefits as No Action
Cultural Resources						
Presence or potential for significant cultural resources	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Riverflow and reservoir storage levels and fluctuation where resources could be disturbed	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action

Table ES.4 Summary of impacts of alternatives on resources

Indicator	No Action Alternative	Taiban Constant Alternative	Taiban Variable Alternative	Acme Constant Alternative	Acme Variable Alternative	Critical Habitat Alternative
Ground-disturbing activities, modification, loss, or abandonment of historic structures	No change	Unknown. Low AWN. Lower potential to exercise water acquisition options which could affect cultural resources.	Unknown. Low AWN. Lower potential to exercise water acquisition options which could affect cultural resources.	Unknown. Most AWN. Highest potential to exercise water acquisition options which could affect cultural resources.	Unknown. High AWN. Higher potential to exercise water acquisition options which could affect cultural resources	Unknown. Least amount of AWN. Lower potential to exercise water acquisition options which could affect cultural resources.
Indian Trust and Treaty Assets						
Potential to affect Indian real property, physical assets, or intangible property rights	No change	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Environmental Justice						
The proportion of physical or economic impacts compared to the distribution of specific population characteristics	No change	Negligibly higher potential than No Action	Negligibly higher potential than No Action	Higher potential than No Action	Higher potential than No Action	Similar potential as No Action

EC = specific electrical conductance, AWN = additional water needed, µS/cm = microSiemens per centimeter