III. Environmental Baseline

The Acme gage occurs below upper critical habitat and is in the reach of river that provides excellent shiner habitat when the river is flowing. It is also in the reach of river that often goes intermittent. Annual mean runoff at the Acme gage is an indicator flow through this important reach of river. The annual mean stream flow for water years 2000, 2001, 2002, and 2003 at the Acme gage has been 173 cfs, 92.4 cfs, 71.9 cfs, and 51.0, respectively (viewed at http://waterdata.usgs.gov/nm/nwis/rt on February 7, 2006). The 2003 mean is the lowest for the period of record (1938-2003), with the 2002 mean being the 4th lowest on record. The lowest annual mean recorded prior to 2003 was in 1964 (56.5 cfs). The low annual mean runoff is reflected in the number of days of intermittency that occurred at Acme; 49 and 44 days in 2002 and 2003, respectively. Conditions were less severe in 2004, with only 8 dry days. Monthly mean stream flows at the Acme gage for the first nine months of 2004 showed some increase over 2003; with very high flows from spring rains and summer storms in August having the most effect on the increase in mean monthly flows.

In 2003, Reclamation attempted to sustain flows in the Rangelands reach during the irrigation season, and provide 35 cfs at the Acme gage during the winter season. Intermittency in the Rangelands reach occurred between Taiban and Acme on 44 days. During the winter season, flows at the Acme gage averaged 35 cfs, with 12 days in the record having a daily mean flow of less than 26 cfs (the lower target of flows described in the 2003 biological opinion) and 12 days when the mean was over 41 cfs (the upper target of flows) (USGS stream gage data for Acme gage, November 1, 2002 to February 28, 2003).

In 2004, intermittency occurred 8 days. Reclamation released water from the Fish Conservation Pool in Sumner Reservoir to limit the extent of the intermittency. Flows reconnected due to flood inflows prior to the released water reaching the affected area (Reclamation 2005b). During the winter season, flows at the Acme gage averaged 27 cfs, with 48 days recorded below 26 cfs and six above 41 cfs (USGS Streamgage Data for Acme gage, November 1, 2003-February 29, 2004). The majority of days below 26 cfs were in November and early December of 2003. The days above 41 cfs were all at the end of February.

In 2005, there were no days of intermittency. During the winter season (November 1, 2004-February 28, 2005) flows at the Acme gage averaged 38 cfs. During the irrigation season (March 1-October 31, 2005) flows averaged 137 cfs, and during the 2006 winter season (November 1, 2005-February 21, 2006) flows averaged 175 cfs. This increase in average flow was due to the sale of water by CID to ISC and delivery of 34,000 af to Texas.

As of April 1, 2006, the snowpack in the Pecos River Basin is at 11 percent of average, with year to date precipitation at 37 percent. The National Resources Conservation Service indicates that the basin is on track to be drier than the very dry years of 2000 and 2002 (http://www.wcc.nrcs.usda.gov/water/snow/bor2.pl?state=nm&year=2006&month=2&format=text, viewed April 11, 2006). The current snowpack in the Upper Pecos River Basin is the worst in more than 50 years and inflow to Santa Rosa reservoir is expected to be 9 percent of normal (http://www.srh.noaa.gov/data/ABQ/ESABQ, viewed April 11, 2006).

Water storage in the Pecos River Basin reservoirs as of April 10, 2006, totaled 115,342 af (data from http://www.spa.usace.army.mil/wc/adbb/pecrt.htm.) with storage in Santa Rosa Reservoir at 65,542 af, Sumner at 18,500 af, Brantley at 30,000 af, and Avalon at 1,300 af.

Based on collections, the known range of the shiner included the mainstem Pecos River from Santa Rosa, New Mexico, to the New Mexico-Texas border (Chernoff et al. 1982), but it is likely the species occurred upstream to the Pecos River-Gallinas River confluence and downstream to, at least, Live-Oak Creek confluence (near Sheffield, Texas) because the Pecos River had similar characteristics throughout (Pope 1854, Newell 1891, Freeman and Mathers 1911, Dearen 1996). These characteristics included perennial flow, a wide-erosive river channel, and shifting sand-beds (Newell 1891, Fisher 1906, Freeman and Mathers 1911, Thomas 1959, Hufstetler and Johnson 1993, Dearen 1996). The reason the full extent of the historical shiner range is not well defined is that historical fish collections were few and collectors sampled the river at easily accessible localities such as bridge crossings and villages (Sublette et al. 1990).

Development of irrigated agriculture began in the early 1850s with acequia diversions from headwater reaches of the mainstem Pecos River and tributaries (U.S. National Resources Planning Board 1942). Large-scale diversion and impoundment of the mainstem Pecos River began in the 1880's (U.S. National Resources Planning Board 1942), while groundwater pumping became widespread after 1900 (Lingle and Linford 1961). By 1940, when systematic fish collections were initiated, Pecos River hydrology and geomorphology were already dramatically changed (Grover et al. 1922, U.S. National Resources Planning Board 1942, President's Water Resources Policy Commission 1950, Campbell 1958, Thomas 1959, Grozier et al. 1966, Ashworth 1990, Hufstetler and Johnson 1993). The response of Pecos River fishes to early human developments is unknown, but it is significant that the majority of native species were decimated in areas directly impacted by irrigation projects, such as the Pecos River between Carlsbad, New Mexico and Girvin, Texas (Campbell 1958). The same pattern has been documented in other sand bed streams (Arkansas and Cimarron rivers) (Cross et al. 1985). Native fishes have survived best in reaches with fewer direct impacts, such as the Pecos River between Taiban Creek and Salt Creek confluences (Hoagstrom 2000).

Currently, six dams (Santa Rosa, Sumner, FSID Diversion Dam, Brantley, Avalon, and Black River) largely control the flow of the Pecos River in New Mexico (Figure 1). The uppermost dam, Santa Rosa (completed in 1980), is operated by the Corps for flood control and irrigation. Sumner and Brantley dams are operated by Reclamation primarily for irrigation purposes and secondarily for flood control. Sumner Dam was built in 1937 and is 55 mi (88 km) downstream from the Santa Rosa Dam. The FSID Diversion Dam is located 14 mi (23 km) downstream of Sumner Dam and was completed in 1951. Brantley Dam was completed in 1989 and is 225 mi (360 km) downstream of Sumner Dam. Brantley Dam replaced McMillan Dam, which was completed in 1893.

The construction of the dams and human activities has had many adverse effects on the Pecos River ecosystem over the last 100 years. Santa Rosa and Sumner Dams trap sediment needed for shiner habitat development and alter the downstream flow regime (Collier et al. 1996). When these effects are combined with the depletion of groundwater, diversion of Pecos River flows, capture of sediment by tributary dams, water pollution, and salt cedar colonization, the result is large scale changes to the Pecos River hydrograph and shiner habitat. The Pecos River downstream of Roswell has become highly incised, and is poor habitat for the shiner (Tashjian 1995, Hoagstrom 2002). The reach from Sumner Dam to the FSID Diversion Dam has become incised and armored with gravel and cobble (Hoagstrom 2003). This substrate does not provide the sand/silt habitat that the shiner prefers (Tashjian 1993, 1994, 1995, 1997; Hoagstrom 2000, 2001, 2002).

Up to 100 cfs (2.8 m^3/s) is diverted by FSID at the diversion dam for delivery to agricultural fields from March 1 through October 31. Water can also be diverted for two, eight-day periods during the winter; however, recently, this diversion has been made in the two weeks prior to the irrigation season (i.e., February 15 to March 1). Fort Sumner Irrigation District has no storage rights in the upstream reservoirs, but is entitled to water rights that predate Sumner Dam construction (1937). The water entitlement is based on a calculation made by the OSE from flow data collected every two weeks throughout the irrigation season. Reclamation releases water from Sumner Dam for FSID and the water travels 14 mi (23 km) downstream to the FSID Diversion Dam. The water is diverted into a main canal which is 15 mi (24 km) long and then into smaller lateral canals. The system also includes a drain canal which collects seepage and runoff from the fields and carries these return flows back to the Pecos River near the confluence of Taiban Creek. The return flows to the Pecos River may be up to half of the amount diverted, but were less than 20 cfs (0.6 m^3/s) in 2002. A pumpback system, located at the lower end of the irrigation canal, pumps from 10 to 15 cfs (0.28 to 0.42 m^3/s) from the main return canal back into lateral canals. A new pump which can pump 2-3 cfs more than the old pump has further reduced the amount of water returning to the river (G. Dean, Reclamation, pers.comm. 2002). Operation of this pump continued through the 2003-2006 period.

The Pecos Bluntnose Shiner Recovery Plan stated that the operation of Sumner Dam had significantly altered flow regimes in the upper Pecos River (Service 1992). During the period 1913 to 1935, prior to dam operation, flows were never less than 1 cfs (0.03 m^3/s) at the Sumner Dam Gage. For the period after dam operation began, 1937 to 1990, flows less than 1 cfs (0.03 m^3/s) occurred an average of 55 days per year. After Sumner Dam was completed, it prevented all movement between the shiner population above and below the dam. Shiners were last collected above Sumner Dam in 1963 (Platania and Altenbach 1998).

The effect of upstream water storage and diversion on the downstream reaches of the Pecos River was to virtually eliminate floods (Table 1), eliminate winter inflows (Table 2), and reduce summer inflows (Table 3). These Tables and the implications for the shiner and its habitat are described in detail below.

The maximum release capacity of Sumner Dam is 1,400 cfs (40 m^3/s). Prior to the completion of Sumner Dam, flows greater than 1,400 cfs (40 m^3/s) occurred an average of 7 days per year and the lowest annual peak mean daily discharge was 2,020 cfs (57 m^3/s) (Table 1). By comparison, only two of 18 post-Sumner Dam years had mean daily discharge greater than 1,400 cfs (40 m^3/s) for an average of 1 day per year. The maximum mean daily discharge in the pre-Sumner

Dam years was 26,200 cfs (740 m^3/s) while the maximum of the 18 post-Sumner Dam years was 1,980 cfs (56 m^3/s). This maximum was less than the lowest annual peak of the pre-dam period. Reduced peak discharge has caused the channel to become narrower, less braided, and to have less complex fish habitat (Tashjian 1993, 1994, 1995, 1997; Hoagstrom 2000, 2001, 2002).

Table 1. Summary of change in frequency and magnitude of flows > 1400 ft^3/s (maximum Sumner Dam release) at the Pecos River Below Sumner Dam Gage. The Fort Sumner gage represents inflow into the Pecos bluntnose shiner range. The pre-Dam summary was completed using mean daily discharge data for the 18 calendar years with complete records. The post-Dam summary was completed using the calendar years 1962 through 1979 (18 years). This period was chosen because it represented flow conditions after the 1950s drought, pre-Santa Rosa Dam, and pre-1980s and 1990s wet years. In other words, this 18-year period was the most 'normal' for the post-Sumner Dam period.

Period	Days	Days > 1400 ft^3/s	Mean Days per Year > 1400 ft^3/s	Years With Flows > 1400 ft^3/s	Maximum Discharge (ft^3/s)
Pre-Dam	6574	128	7.1	18	26200
Post-Dam	6574	18	1.0	2	1980

Before the construction of Sumner Dam, mean daily discharge in the non-irrigation season (winter), was 97 cfs (3 m^3/s) with a minimum flow of 41 cfs (1.2 m^3/s) (Table 2). After the dam was built (1962 to 1979), mean daily discharge in the winter was 6 cfs (0.2 m^3/s), a reduction of 94 percent. The storage of winter season base flows in Sumner Reservoir reduced the amount of water and habitat available to the shiner. Since 1998/1999, the winter season operation of Sumner Dam has been modified to divert water to storage only when not required to meet downstream flow targets at the Acme gage. Reclamation bypasses flows in the winter to target approximately 35 cfs at the Acme gage. Typically, 5 to 10 cfs is bypassed in November to supplement natural flows in the river. By February or March about 25 to 30 cfs is bypassed, depending on the natural flows. Flows coming into Sumner greater than the amounts bypassed to supplement natural flows are stored (Reclamation 2002). This operation has continued in 2006.

Table 2. Summary of winter flows (i.e., flows reported for the typical FSID non-irrigation season, 1 November to 14 February) at the Pecos River Below Sumner Dam Gage. The Fort Sumner gage represents inflow into the Pecos bluntnose shiner range. The pre-Dam summary was completed using mean daily discharge data from the 18 calendar years having complete flow records. The post-Dam summary was completed using the calendar years 1962 through 1979 (18 years). This period was chosen because it represented flow conditions after the1950s drought, pre-Santa Rosa Dam, and pre-1980s and 1990s wet years. In other words, this 18-year period was the most 'normal' for the post-Sumner Dam period.

Period	Days	Mean ft^3/s	Minimum ft^3/s	Maximum ft^3/s
Pre-Dam	1908	97.3	41	265
Post-Dam	1908	6.0	0	99

During the irrigation season (March 1 to October 31), prior to Sumner Dam, the mean daily discharge flows exceeded 100 cfs (2.8 m^3/s) 147 days per year compared to 69 days per year after the completion of Sumner Dam (Table 3). Discharge adequate to overflow (greater than 100 cfs [2.8 m^3/s]) the FSID Diversion Dam during the irrigation season was recorded more than twice as often in the years prior to Sumner Dam, than in the post-Dam period. Overflow of the FSID Diversion Dam was less frequent and of greater magnitude after Sumner Dam was built because of block releases of water from Sumner Dam. Before November 1998, all water available above FSID's 100 cfs (2.8 m^3/s) requirement was stored in Sumner. Since 1999, the Sumner Dam operations have been modified to bypass water that is available above FSID's 100 cfs (2.8 m^3/s) requirement in an attempt to keep the water flowing in the reach from Sumner Dam down to the Acme gage. In 2002, water was bypassed on fewer than 5 days during the irrigation season. In 2003, releases out of Sumner Dam were over 100 cfs for 13 days in June, which was followed by a high spike release from June 18-30. Flows during the rest of the irrigation season were below 100 cfs. In 2004, there was an eight day spike in March, flows of 98-109 cfs through late April to mid-June, and a second spike flow in late September. Otherwise, releases were below 100 cfs (USGS Streamflow Data for Below Sumner Dam Gage). Data for 2005 are not available, but information from Reclamation indicates that bypass flows were available during 2005 (Reclamation 2005b).

Table 3. Summary of flows at the Pecos River Below Sumner Dam Gage during the FSID irrigation season (March through October). The pre-Dam summary was completed using mean daily discharge data for the 18 calendar years with complete records. The post-Dam summary was completed using the calendar years 1962 through 1979 (18 years). This period was chosen because it represented flow conditions post 1950's drought, pre-Santa Rosa Dam, and pre-1980's and 1990's wet years. In other words, this 18-year period was the most 'normal' for the post-Sumner Dam period. Since FSID can divert a maximum 100 ft^3/s, it was assumed that flows >100 ft^3/s overflowed downstream. Mean overflow for each period was calculated solely for the days in which overflow presumably occurred (discharge >100 ft^3/s).

Period	Days	Days > 100 ft^3/s	Mean Days per Year > 100 ft^3/s	Mean Overflow (ft^3/s)
Pre-Dam	4666	2649	147.2	355.7
Post-Dam	4666	1238	68.8	594.2

Dams have many downstream effects on the physical and biological components of a stream ecosystem (Williams and Wolman 1984). Some of these effects include a change in water temperature, a reduction in lateral channel migration, channel scouring, blockage of fish passage, channel narrowing, changes in the riparian community, diminished peak flows, changes in the timing of high and low flows, and a loss of connectivity between the river and its flood plain (e.g., Sherrard and Erskine 1991, Power et al. 1996, Kondolf 1997, Friedman et al. 1998, Polzin and Rood 2000, Collier et al. 1996, Shields et al. 2000). To our knowledge temperature studies on the Pecos River have not been conducted and it is not known how the temperature regime below Sumner dam may be different from the historical temperature regimes. However, the other downstream effects have been noted. In particular, Sumner Dam has reduced sediment inflows from the upper basin, caused channel scour from the dam to the Taiban Creek confluence, and eliminated large floods. Large floods are an important component of riverine ecosystems because they maintain channel width and complexity, limit colonization of non-native vegetation, maintain native riparian vegetation, recharge the alluvial aquifer, increase nutrient cycling, and maintain the connection between the aquatic and riparian ecosystems (Ward and Stanford 1995, Schiemer 1995, Power 1996, Shafroth 1999). Sumner Dam blocks fish passage fragmenting the Pecos River and preventing shiners from migrating upstream. Shiners have been extirpated above Sumner Dam (none collected since 1963).

Reclamation diverts water to storage at Sumner Reservoir for the Carlsbad Project and then releases the stored water for the CID. The release of water occurs in "blocks" where large amounts of water (usually a minimum of 1,000 cfs [28 m^3/s]) are released over a short period of time. Blocks of water are used because less water is lost to evaporation and groundwater seepage during transport. Sumner Dam block releases occurred between one and four times per year from 1990 to 2001 (not including the years in which block releases were modified for hydrologic studies). The average annual number of block releases per year was 2.6. The block release durations ranged from 7 to 30 days, with an average of 15.7 days. Since 1999, the Sumner Dam irrigation season operations have been modified to: 1) limit the block release duration to a maximum of 15 days; and 2) limit block release timing and frequency. There was one block release in 2003, two in 2004, three in 2005, and one so far in 2006.

Although block releases are maintaining channel width, peak flows are now much lower than they were before Sumner Dam was built (Table 1). Biological consequences of diminished peak flows can include changes in the riparian vegetation (Polzin and Rood 2000), aquatic macroinvertebrate species composition (Sheldon et al. 2002), nutrient exchange processes (Schiemer 1995), and shorter food webs (Power et al. 1996). These changes could have an indirect effect on the fish community including the shiner. However, these complex ecosystem interactions have not been investigated on the Pecos River. Given the relatively short duration of this BO, there are no anticipated impacts to channel width.

The range of the shiner was reduced by inundation of Major Johnson Springs in 1988 and declines have occurred upstream of the Taiban Creek confluence (Hoagstrom 2000, 2003) in the Tailwaters reach. Restrictions on the duration of block releases and institution of base-flow bypass have benefited the shiner population at times, but have not reduced the primary threat to the species (intermittency). Bypass flows are most commonly available during the non-irrigation season (November through February), but intermittent flows are most frequent during irrigation season (USGS historical surface flow data).

Block releases that have occurred during the spawning season from May through September have rapidly transported semi-buoyant shiner eggs and larvae into Brantley Reservoir. The eggs require water velocity to remain suspended in the water column. In the reservoir, the eggs sink to the bottom and likely perish when they are covered with sediments and suffocate or are eaten by predators. Larval fish are likely eaten by predatory fish. Eggs and larvae drift downstream for a total of 3 to 5 days; the distance they travel depends on the rate of egg and larvae development and water velocity (Platania and Altenbach 1998). Assuming a drift rate of 1.8 mi/h (3 km/h), the eggs and larvae could be transported 176 to 220 mi (284 to 354 km) in 4 to 5 days. Swifter currents and a more uniform channel would carry the eggs and larvae a greater distance. Block releases exceeding 65 days per year result in the transport of many age-0 shiners into the Farmlands reach (Hoagstrom 2002). The effect on size class distribution is not as pronounced when the total is less than 65 days per year.

The provision of low flows from bypasses and other supplemental water does not intrinsically provide for the cues (rising water levels) needed to initiate spawning in the shiner. Without these cues provided naturally (by seasonal monsoon inflows) or through management (some level of spike flow), spawning may occur at reduced levels. Similarly, very high long duration flows associated with block releases made during the spawning period are likely to, while triggering spawning responses, also remove a significant percentage of eggs and larvae out of the favorable habitat reach of the Rangelands, and into the less suitable Farmlands reach or to Brantley Reservoir. Block releases that occur during the spawning season from May through September have a direct effect on the shiner by rapidly transporting their semi-buoyant eggs and larvae into Brantley Reservoir (Dudley and Platania 1999). The eggs and larvae die in the reservoir from predation and lack of appropriate habitat. Although eggs and larvae are lost into Brantley Reservoir during natural flood events, the number is less because the peak of a flood hydrograph lasts for a very short time (several hours). In contrast, the peak flow in a block release is maintained for several days (10 to15). The narrow channel and lack of slack and backwater habitat in the lower reach of critical habitat results in fewer eggs and larvae being retained in that reach, poor survival and growth of the juveniles, and greater transport of eggs and larvae into the reservoir (Hoagstrom 1997, 1999, 2000, Dudley and Platania 1999). Block releases do help maintain channel morphology (Tetra Tech 2003).

From monitoring conducted on one day of a block release in August 1997, it was estimated that approximately 22 million eggs would be transported into Brantley Reservoir (Reclamation 2002). That equals approximately 1.2 million eggs per day of a block release (Reclamation 2002). Clearly the number of eggs and larvae transported to Brantley will be highly variable depending upon the number of females producing eggs, the number of eggs produced per female, the magnitude of the discharge, and the timing within the spawning season. Eggs and larvae would enter Brantley Reservoir by natural flood flows without block releases, but the number would be much smaller (Dudley and Platania 1999). There is little retention of eggs and larvae downstream of Roswell due to unsuitable habitat (relatively narrow and deep channel).

Groundwater pumping has reduced Pecos River base-flow. Local pumping reduced seepage inflows from Truchas Creek, near Fort Sumner (Akin et al. 1946) and along the Pecos River between Fivemile Draw and the U.S. Geological Survey surface water gaging station near Acme (Shomaker 1971). Inflows from the Roswell Artesian Basin (from the Pecos River near Acme to McMillan Dam) were severely reduced during the 1920s to 1950s (Fiedler and Nye 1933, Thomas 1959). Groundwater development of the Roswell basin aquifers reduced the amount of natural discharge into the Pecos River by 80 to 90 percent (Reynolds 1989 as cited in Reclamation 2002). The State of New Mexico has retired many of these water rights, and the result has been an increase in the water level in the Roswell artesian aquifer (Garn 1988, Balleau et al. 1999). Increases in groundwater pumping that could affect flows in the Rangelands reach could be adverse to the shiner, particularly during dry years where summer intermittency is an issue.

In 2000, Reclamation leased 3,492 af of water rights from river pumpers. Additionally, as a result of mediation in Federal District Court, Reclamation entered into an emergency forbearance program with FSID paying for crops foregone as a result of reduced water use by participating FSID members. The Service provided additional funding ($100,000) in October 2000 to increase the number of irrigators participating in the forbearance program. In 2002, Reclamation leased approximately 4,500 af of water from a variety of land owners to make up for water bypassed for the shiner.

In 2002, Reclamation bypassed approximately 5,500 af from Sumner Dam with only 228 af bypassed in the irrigation season. Reclamation leased approximately 4,300 af of water from a variety of land owners to make up for water bypassed for the shiner.

In March 2002, CID moved 27,000 af of irrigation water from Santa Rosa and Sumner Reservoirs, drawing Sumner down to its minimum pool of 2,500 af and leaving only 1,000 af in Santa Rosa. The combination of the early season block release and the drought conditions led to extensive river drying throughout the summer of 2002. With no storage left in the reservoirs, alternative water operation actions to limit intermittency were precluded. The subsequent river drying killed shiners and dewatered approximately 38 mi (61 km), including 10 to 15 mi (16 to 24 km) of upper critical habitat (D. Propst, NMDGF, pers. comm. 2002, C. Hoagstrom, Service, pers. comm. 2002, USGS 2002 stream flow records as reported at: http://waterdata.usgs.gov/nm/nwis/rt). Sumner Reservoir was drained May 30 to June 1, 2002. As the reservoir was drained, silty, muddy water was released downstream affecting water quality in the Pecos River below the dam (G. Dean, Reclamation, pers. comm. 2003).

Prior to 2002, there was always a sufficient amount of water in Sumner Reservoir to bypass to meet FSID's calculated water right for water. From May 30 to June 1, 2002, Sumner Reservoir dried, stopping the bypass of water to FSID for 3 days. When there is no release from Sumner Reservoir for approximately 8 days, the probability of drying in the reach from Sumner Dam to the Taiban Creek confluence becomes very high (G. Dean, Reclamation, pers. comm. 2002). Repeated releases of small blocks of water from Santa Rosa Reservoir kept Sumner Reservoir from drying again after June 1.

In 2002, intermittency occurred in the Pecos River from near 6-mile Draw to Bitter Lake National Wildlife Refuge (38 mi [61 km]) and led to the death of shiners (D. Propst, NMDGF, pers. comm. 2002). The lower end of the upper critical habitat designated for the shiner became intermittent from near the DeBaca County line, downstream. The 30 mi (48 km) reach of the Pecos River from Taiban Creek to Dunlap normally remains perennial even in extremely low flow conditions. During low flows, the source of water for this reach is primarily from groundwater seepage, return flows from the FSID diversion canal, and Taiban Creek. A second, 2 mi (3 km) reach of river is kept wet because of the pumping of water from the Lynch Ranch Well. When the flow at the Acme gage falls to 10 cfs (0.28 m^3/s) pumping from the Lynch Ranch Well begins (G. Dean, Reclamation, pers. comm. 2002). After intermittency, it is believed that shiners from these two refugia repopulate the river downstream.

From May through August 2002, FSID diverted virtually the entire flow of the Pecos River (http://waterdata.usgs.gov/nm/nwis/rt viewed February 26, 2003). This caused river drying from the FSID Diversion Dam to the Taiban Creek confluence (10 mi [16 km]) and increased the probability of intermittency downstream of the Taiban Creek confluence. Fort Sumner Irrigation District's pumpback operation further reduces the amount of water returning to the river and increases the amount and duration of intermittency downstream (G. Dean, Reclamation, pers. comm. 2002).

The combined effects of Sumner Dam block releases of water for CID, and water diversion and pumpback operations by FSID, have reduced the amount of water in the channel, increased the likelihood of the river drying, reduced the amount and suitability of habitat for the shiner, and decreased the survival of shiner eggs, larvae, and adults. Drought conditions in 2002 increased the difficulties of maintaining water in the river for the shiner. Diversions by FSID contributed significantly to river drying in 2002 and the early season block release by CID may have significantly reduced the opportunity to alleviate later season drying.

In 2003, Reclamation bypassed approximately 5,700 af from Sumner Dam; approximately 350 af were bypassed during the irrigation season. In addition Reclamation signed an agreement with FSID to return approximately 18 percent of their diversion right to the Pecos River. Reclamation leased approximately 3,200 af of water from a variety of land owners to make up for water bypassed for the shiner.

On August 1, 2003, Reclamation and CID received emergency authorization from the New Mexico State Engineer to create a Fish Conservation Pool to store water in Sumner or Santa Rosa Reservoir for the purpose of providing riverine habitat. The Fish Conservation Pool contained 500 af in 2003. The Fish Conservation Pool does not affect the storage entitlement in Sumner Reservoir. Water from the Fish Conservation Pool was released from August 2, 2003 to September 7, 2003. The flow rate varied from 5 to 10 cfs. The water from the Fish Conservation Pool was diverted into the FSID's main canal and returned to the river at the nearest wasteway (Sandgates). This operation simplifies the process of getting the small flows past the diversion dam. A final permit for the Fish Conservation Pool in Sumner Reservoir and Santa Rosa Reservoir was received in March 2004. The permit authorizes Reclamation to store and release 500 af from Sumner Reservoir to maintain riverine habitat in the upper critical habitat of the Pecos River. Reclamation must replace the water released out of Sumner Reservoir with 375 af of water in Brantley Reservoir.

Winter season bypasses were initiated on November 6, 2002, and discontinued on February 16, 2003. Irrigation season bypasses occurred once, from June 4 through June 15 (10 to 20 cfs). The only CID block release of the 2003 irrigation season was initiated on June 18 and terminated on June 30, a total of 21,898 af were released from Sumner Dam (Figure 4). There were 8 days at peak discharge of 1,400 cfs.

In 2004, Reclamation bypassed approximately 5,400 af during the non-irrigation season from November 1, 2003, through February 28, 2004. A total of approximately 200 af was bypassed during the 2004 irrigation season.

In 2004 the retired acreage ranged from 1,164 to 716 ac (changes on August 15), a total of 6,800 af was bypassed by the FSID into the Pecos River under this lease agreement.

Two Carlsbad Project block releases occurred during the 2004 irrigation season. The first block release was initiated on March 3 and terminated on March 10, a total of 18,345 af were released from Sumner Dam. The second block release was initiated on September 17 and terminated on September 30, a total of 33,472 af were released from Sumner Dam. Sumner Reservoir reached a maximum total storage of 23,573 af on December 31, 2004. Sumner Reservoir's lowest total storage was on July 22, at 2,050 af. Sumner Reservoir end-of-year total storage was 23,573 af.

There were three Carlsbad Project block releases in 2005. In addition, the New Mexico Interstate Stream Commission (ISC) purchased approximately 34,000 af of unused irrigation water from CID which was released to Texas (The Associated Press, November 23, 2005). Despite continuous flows in 2005, preliminary data from the first and second trimester indicate that shiner abundance did not increase and may have decreased. This may be due to higher flows in spring and not during the monsoon when shiner spawning is triggered and because of low shiner abundance.

An early Carlsbad Project block release occurred from February 20 to March 1, 2006, releasing a total of approximately 16,455 af. Santa Rosa and Sumner Reservoir's total storage as of April 10, 2006, was 84,042 af.

Status of the Species within the Action Area

Interior Least Tern

The breeding population of terns in New Mexico declined from about 60 birds in the early 1960s to 3 poorly producing nesting pairs annually from 1987 to 1990. In New Mexico, terns were first recorded as nesting at Bitter Lake National Wildlife Refuge in 1949, and terns have continuously nested on or adjacent to refuge lands annually since then. Population counts over the period have been variable, ranging as high as 60 birds in 1961, but typically 20 to 30 individuals during a breeding season. For several years during the 1980s, the breeding colony was on a vegetation-free area of the Roswell Test Facility adjacent to the refuge. The colony then shifted back to barren alkali "flats" on the refuge following the growth of vegetation at the off-refuge site. A 1997 survey of potential nesting habitat on Bureau of Land Management lands by the New Mexico Natural Heritage Program located two nests at the Grace Well flats just north of the refuge.

The following list summarizes the breeding activity of the tern colony at Bitter Lake National Wildlife Refuge from 1996 through 2005 (J. Montgomery, Fish and Wildlife Service permittee, annual survey report, December 30, 2005):

	Number of pairs	Number of chicks observed	Number of chicks fledged	Number fledged per pair
1996	7	4	5	0.71
1997	7	11	3	0.43
1998	7	10	9	1.29
1999	7	1	1	0.14
2000	10	19	15	1.50
2001	11	14	9	0.82
2002	11	18	17	1.89
2003	12	15	13	1.08
2004	11	13	7	0.64
2005	14	24	23	1.64

On June 9, 2004, 5 pairs of interior least terns were first observed in a backwater area of Brantley Reservoir on the Pecos River in Eddy County. The nearest documented nesting elsewhere in near the top of conservation storage, which in 2005 was elevation 3,256.13 ft for a total conservation storage of 42,556 af. By June 9, 2005, a large increase in water level had submerged all potential nesting habitat for the terns, with one small exception that measured approximately 100 by 75 meters to the west of the 2004 colony area, and it was becoming overgrown with sprouting kochia and cockleburr (J. Montgomery, Fish and Wildlife Service permittee, annual survey report, December 30, 2005). Regular monitoring found no evidence of tern nesting during the summer months. Because block releases depend on an assortment of variables which include, but are not limited to, the annual snowpack in the upper Pecos Basin, the current volume of water stored at each of the Pecos River reservoirs, the demand by downstream irrigators, and the amount of local rainfall, Reclamation can not predict the frequency and timing of block releases that may affect terns at Brantley Reservoir within a given year.

Terns roosting at Brantley Reservoir in 2005 were subject to disturbance, displacement, and inundation of their nesting habitat. Irrigation block releases from Sumner Dam, flood inflows from natural events, predation, and human disturbance adversely affect terns. If terns nest at elevations near or above the top of conservation storage, then the highest risk of inundation of tern nests has been from unpredictable flood inflows from upstream weather events, depending on nest locations to the existing water's edge. Such weather events may include local and regional storms that occur below Sumner Dam, causing imminent and immediate flooding or stalled weather patterns that provide large inflows of water over extended periods of time. Even if Carlsbad Irrigation District demand does not immediately require a release from Sumner, natural inflows could also inundate nests established at low elevation.

Another type of flood inflow, spring runoff, occurs upstream of Santa Rosa Dam in early spring. The Corps of Engineers may initiate emergency flood operations depending on the fullness of upstream reservoirs, such as Santa Rosa and Sumner. Emergency bypasses of high spring flows may be necessary to pass water down to lower reservoirs. This event occurred in 1999 and 2005. These events have the potential to inundate tern nesting areas, but it is unlikely that nests would be active during these events in early spring.

Human recreational disturbance at this location was a likely contributing factor to the lack of tern breeding activity in 2005. In late June, a campsite was erected adjacent to the site where terns were roosting and exhibiting courtship behavior. This site is located within Seven Rivers Waterfowl Area, a designated Wildlife Management Area, where overnight camping is not permitted. Vehicle tracks were also observed in this area at different times in July.

During the winter of 2003 to 2004, Reclamation, through its Operations and Maintenance (O&M) contract with CID, supported the removal of large expanses of salt cedar trees from the shoreline of Brantley Reservoir in the vicinity of the 2004 tern nesting location (L. Robertson, Reclamation, pers. comm., February 13, 2006). The salt cedar removal beneficially contributed to the creation of suitable unvegetated habitat for the tern colony in 2004. Unfortunately, clearing also resulted in the area producing dense, tall kochia and cockleburr in 2005 that caused the previously used area to become unsuitable for tern nesting and brooding (J. Montgomery, Fish and Wildlife Service permittee, annual survey report, December 30, 2005).

Episodic golden algae blooms that have killed fish have been reported at Brantley Reservoir since at least 2002 (J. Lusk, New Mexico Ecological Services Field Office, electronic mail message, April 11, 2006). However, it is currently unknown if these fish kills are adversely affecting terns foraging at the reservoir. It has also been reported that DDT (dichloro-diphenyl-trichloroethane) levels are elevated at Brantley Reservoir when compared to other lakes across the U.S. (J. Lusk, New Mexico Ecological Services Field Office, electronic mail message, April 11, 2006), but it is currently unknown whether these DDT residues are adversely affecting terns feeding at Brantley Reservoir.

IV. Effects of the Action

The Service must consider the direct and indirect effects, as well as the effects of interdependent and interrelated actions to the shiner and the tern. Indirect effects are those that are caused by, or result from, the proposed action, and are later in time, but are reasonably certain to occur.

Direct Effects

Pecos Bluntnose Shiner

This year, Reclamation and the Service will continue to work together with river users to monitor the water supply and work to devise management options to meet the needs of both the shiner and the river users. We anticipate this coordination will be especially important to ensure that river management provides continuous flows. A negative effect of the proposed action is the loss of semi-buoyant eggs and larvae into the Farmlands reach and Brantley Reservoir during block releases. While some loss of eggs and larvae can occur during block releases in May and June, July would be the primary month when significant loss of these life stages would occur because shiners normally spawn during elevated flows associated with monsoonal storm events. The eggs require water velocity to remain suspended in the water column. In the reservoir, the eggs sink to the bottom and will likely perish when they are covered with sediments and suffocate or are eaten by predators. Larval fish will likely be eaten by predatory fish. Eggs and larvae can drift downstream for a total of 3 to 5 days; the distance they travel depends on the rate of egg and larvae development and water velocity (Platania and Altenbach 1998). Assuming a drift rate of 1.8 mi/h (3 km/h), the eggs and larvae could be transported 176 to 220 mi (284 to 354 km) in 4 to 5 days. Swifter currents and a more uniform channel would carry the eggs and larvae a greater distance. Block releases exceeding 65 days per year have a cumulative negative effect on shiner size class distribution because many age-0 shiners are transported into the Farmlands reach (Hoagstrom 2002). The effect is not as pronounced when the total is less than 65 days per year; we do not anticipate block releases exceeding 65 days (Hoagstrom 2002).

There are numerous benefits to the shiner that will result from Reclamation's proposed action to keep the river whole. Because shiners normally spawn during monsoonal storm events in July and August, their ability to maintain or improve their condition during the pre-spawn period of March through June will increase their spawning success. Even when fish survive intermittent conditions, they are less likely to spawn successfully because of the increased energetic expenditure associated with survival. Poor water quality, predators, and competitors all become