

APPENDIX A: Water Resources Modeling Methods and Definitions

Introduction

This appendix provides definitions for the resource indicators and overall methods used in the hydrological modeling and water resource impact analysis.

Resource Indicators

1. Flow Frequency at the Near Acme Gage

Evaluation of the effectiveness of the water leasing action to augment river flows in the critical habitat for the Pecos Bluntnose shiner (shiner) is best accomplished by examining impacts to the duration of flows at the Near Acme gage and the occurrence of zero flow (or intermittency) at the Near Acme gage. The duration of flows and occurrence of intermittency are presented in flow duration curves and intermittency charts. The flow duration curves denote the percentage of time that a certain flow occurs over a given time period, and intermittency charts depict the exact days that zero flow occurred during a given time period. The Near Acme gage was used as a location on the river because it is located just downstream of the critical habitat in a location that often undergoes river drying (Reclamation 2006a).

2. Additional Water Needed to Meet Target Flows

Due to seasonal distributions of inflows to Sumner and Santa Rosa reservoirs, bypassing Carlsbad Project inflows through the reservoirs to meet target demands is insufficient during much of the irrigation season. Additional water needed (AWN) refers to the amount of water, measured as Sumner Reservoir outflow, that needs to be acquired to achieve downstream flow at the target location all of the time. AWN can apply to evaluation of an alternative that only considers bypassing as an option such as the alternatives presented in the EIS or AWN can apply to the remaining water need after additional water acquisition (AWA), such as the leasing agreement considered in this document, has been implemented.

3. Carlsbad Project Water Supply

Along with the goal of augmenting Pecos River flows for the shiner, it is also desirable to not impact the water supply of the Carlsbad Project. Impacts to Carlsbad Project water supplies are measured in net depletions, or relative shortfalls to the project before ESA operations were established. These relative shortfalls are measured against the before 1991 (pre-91) baseline, which refers to Pecos River operations before ESA, when river operations were tailored to be most efficient for irrigation operations. These relative shortfalls occur due to bypassing flows through Sumner Dam that under the baseline operations would

have been stored and released in a block release. These “net depletions” are primarily caused by increases in evaporation from the river surface, seepage into the local ground water system, and losses to transpiration from riparian corridor vegetation due to bypassing (or releasing in the case of an FCP) small amounts of water as opposed to releasing large chunks of water all at once. Net depletions to the Project water supply can also occur due to changes in block release configurations (duration, magnitude, and frequency), reservoir storage configurations, or differences in conservation spills from the study area of the Pecos River system.

4. Pecos River Flows at the New Mexico-Texas State Line

The Pecos River Compact (Compact) mandates that New Mexico must share a portion of Pecos River water with the State of Texas. The delivery of water under this compact is measured at the New Mexico-Texas State Line, specifically at the USGS’s Red Bluff gage. Because flow reduction in the Pecos River at this location is undesirable, the impact of the alternatives on this resource indicator is important. Flows at the New Mexico-Texas State Line are affected by changes in three primary sources: flood inflows downstream of Avalon Dam, diversions (and subsequent return flows) by the Carlsbad Irrigation District (CID), and conservation spills from Avalon Dam. Shortages in CID allotments (net depletions to the Project water supply) may cause changes in supplemental well pumping in the CID; however, it is not anticipated that the project action will affect the pumping patterns of these irrigators as long as the Project water supply is not impacted. Although river flows at this location were not modeled specifically for this document, the relative impacts to this resource indicator can be inferred from impacts to Carlsbad Project water supply and changes to conservation spills from the Project water supply at Avalon Dam.

5. Changes to Pecos River Compact Obligation

Because the Pecos River Compact obligation is dependent on outflows from Sumner Reservoir in addition to flood inflows below Sumner Dam, changes to the Compact obligation are also in important resource indicator. The Compact obligation can vary because outflow from Sumner Dam can vary due to changes in water operations. Flood inflows below Sumner Dam are fixed and are not affected by changes in water operations; therefore, changes to the Sumner outflows can be evaluated in the context of Compact calculations and a relative change in Compact obligation can be estimated. This resource indicator is important to consider in addition to flows at the New Mexico-Texas State Line since even though flows may increase (or decrease) due to an alternative, the obligation may also increase (or decrease) due to an alternative.

6. Changes to Ground Water Withdrawals in the Study Area

Since the action contemplated in this document includes the leasing of ground water rights in the study area, it is appropriate to quantify those withdrawals and measure their relative change from historic withdrawals for the same water rights. It is anticipated that ground water withdrawals will change from the

action in Ft. Sumner area where water rights are being acquired for the long-term lease.

7. Changes to Pecos River Water Quality in the Study Area

A change to water quality in the Pecos River is also an important resource indicator since the purpose of use for the long-term ground water lease will change from its historic use (irrigation to habitat enhancement). Water quality impacts will be handled qualitatively in this document.

Modeling of Alternatives

Modeling alternatives was accomplished using the latest version of the Pecos River RiverWare Model (Boroughs and Stockton, 2006; Boroughs and Stockton, 2005). The model runs 60-years (1940-1999) of hydrology inputs with policy and reservoir configurations as they are in the present. Three alternatives and one baseline were simulated with the model. The baseline is used to represent conditions in the Pecos River before any changes were made to operations for the Endangered Species Act (ESA); this baseline was called the pre-91 baseline. The No Action alternative represents Reclamation's current operations on the Pecos River. The Action alternative was subdivided into two operational scenarios to study in detail different scenarios of the proposed action.

Pre-91 Baseline

The modeled pre-91 baseline includes an operational policy that focuses solely on providing irrigation for agriculture. The pre-91 baseline is used to compare the impacts of the Action and No Action alternatives to operating conditions before changes were made for the shiner. Comparisons with the pre-91 baseline are made to determine impacts to Carlsbad Project water supplies, State-line flows, and changes to Compact obligations. Since the pre-91 baseline represents a historical mode of operation with the current system elements (e.g. reservoirs presently operating along the Pecos River), it will not match historical Pecos River hydrology in the regulated system. To contrast with the alternatives, the pre-91 baseline: does not bypass or release water to maintain river flows; does not have any stipulations on when block releases can be made; does not have any retirement of historical diversions; and does not have any supplemental water actions for augmenting river flows such as ground water pumping or releases from an FCP.

No Action Alternative

The No Action alternative represents current actions being conducted on the Pecos River by Reclamation. These actions include: bypass of inflows when available to keep 35 cfs at the Taiban gage or prevent intermittency, administration of a 500 acre-foot per year fish conservation pool (FCP) to prevent intermittency, exchange of 375 acre-feet per year of Roswell Artesian Basin well water pumped into Brantley to pay for depletions caused by the FCP,

4,215 acre-feet per year retirement of the historical diversions by river pumpers in the study area, pumping of 900 acre-feet per year (2.5 cfs pumped for approximately 180 days) of ground water rights upstream of the USGS's Near Acme gage to the Pecos River, and constraints on block releases. The constraints put on block releases for the alternatives amount to a maximum duration of 15 days, at least 14 days in between releases, a maximum of 65 days of block release per year, and a no-release period for 6 weeks centered on August 1 of every year. The No Action RiverWare model of this alternative contains all of these elements.

Proposed Action

The Proposed Action was split into two operational scenarios for modeling with the Pecos River RiverWare model. These include operational scenarios A and B. Operational Scenario A is essentially identical to the No Action alternative, but includes leasing of approximately 1,100 acre-feet per year of ground water rights in the Ft. Sumner area and pumping those rights to the Pecos River at a rate of 10 cfs per day (or less). Operational Scenario B includes a lease of approximately 1,600 acre-feet per year of ground water rights in the Ft. Sumner area and pumping those rights to the Pecos River at a maximum rate of 15 cfs per day. Table A.1 summarizes the modeling elements included for the pre-91 baseline, No Action, and the Proposed Action operational scenarios. The table includes the target flow used for each model simulation, block releases constraints, annual maximum release volume for an FCP, annual maximum ground water lease amounts in the Ft. Sumner area, current ground water lease amounts, Carlsbad Project Water Acquisition for eliminating depletions from bypassing (retirement of river pumpers), and exchange at Brantley from FCP depletions. The target flows for the alternatives consist of a 35 cfs target at Taiban and a 2 cfs target at the Near Acme location in the model to simulate a target for keeping the Pecos River continuous. It is also important to note that the ground water lease in the Ft. Sumner area will not divert any additional amount from the local aquifer in this area than the original consumptive irrigation requirement (CIR) associated with the water right as it was used for agriculture. For Operational Scenario A, this amount is precisely 1,107.6 acre-feet per year or enough to pump 10 cfs per day to the Pecos River for 55.8 days; and for Operational Scenario B, this amount is precisely 1,580 acre-feet per year or enough to pump 15 cfs per day to the Pecos River for 53.1 days.

Table A.1 Summary of Modeled Hydrologic Operations for Alternatives and the Pre-91 Baseline

Model	Target Flow ¹	Block Release Constraints ²	FCP (acre-feet per year)	Ft. Sumner Area Ground Water Lease (acre-feet per year) ³	Near Acme Ground Water Lease (acre-feet per year)	River Pumpers CPWA (acre-feet per year)	Seven Rivers Exchange (acre-feet per year)
pre-91 baseline	N/A	N/A	N/A	N/A	N/A	4215 Diverted	N/A
No Action	35 cfs at Taiban	Typical	500	N/A	900 (2.5 cfs for 181.5 days)	No Diversion	375
Action (Operational Scenario A)	35 cfs at Taiban	Typical	500	1107.6 CIR (10 cfs for 55.8 days)	900 (2.5 cfs for 181.5 days)	No Diversion	375
Action (Operational Scenario B)	35 cfs at Taiban	Typical	500	1580 CIR (15 cfs for 53.1 days)	900 (2.5 cfs for 181.5 days)	No Diversion	375

¹ A 35 cfs target at Taiban also includes a 2 cfs target at the Near Acme gage during summer months.

² Typical block release constraints include a 15-day maximum duration, 14-day no-release period between block releases, a maximum of 65 block release days per year, and a no-release period for 6-weeks centered on August 1 of every year.

³ Consumptive Irrigation Requirement (CIR) associated with ground water lease amounts.

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