



ECONOMIC ANALYSIS OF  
CRITICAL HABITAT  
DESIGNATION FOR THE PECK'S  
CAVE AMPHIPOD, COMAL  
SPRINGS DRYOPID BEETLE, AND  
COMAL SPRINGS RIFFLE BEETLE

Final Report | June 20, 2007

prepared for:

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## EXECUTIVE SUMMARY

1. The purpose of this report is to identify and analyze the potential economic impacts associated with the proposed critical habitat designation for the federally listed *Stygobromus pecki* (Pecks' cave amphipod), *Stygoparnus comalensis* (Comal Springs dryopid beetle), and *Heterelmis comalensis* (Comal Springs riffle beetle), collectively known as the three Comal Springs invertebrates (hereafter, referred to as CSI). This report was prepared by Industrial Economics, Incorporated (IEc), under contract to the U.S. Fish and Wildlife Service's (Service) Division of Economics.
2. The Service has proposed 50 acres in Comal and Hays counties, Texas, as critical habitat for the CSI. Potential critical habitat is divided into four units. Exhibits ES-1 through ES-4 provide maps of the areas. The units are comprised of a mix of state, private, and municipal lands, which account for 60 percent, 25 percent and 15 percent of the total area, respectively. Although this critical habitat designation (CHD) is relatively small, its location within the Edwards Aquifer, an area experiencing ongoing litigation pertaining to several threatened and endangered species, creates a complex regulatory context for this analysis.
3. Because the Service describes "the potential failure of spring flow due to drought or excessive groundwater pumping" as a primary threat to CSI, the economic analysis focuses on identifying and quantifying impacts to groundwater users that rely on water pumped from proposed CHD areas. San Marcos Springs and Comal Springs, which represent 96 percent of the area proposed as critical habitat for CSI, fall within the Edwards Aquifer along the Balcones fault zone. These two springs represent the two largest remaining non-saline springs in Texas. The two smaller units, Hueco Springs and Fern Bank Springs, also fall within the aquifer. The Edwards Aquifer currently provides the primary source of water to more than 1.7 million people in south-central Texas, including the growing metropolitan area of San Antonio.
4. A 1993 court decision addressed impacts of groundwater withdrawals from the Edwards Aquifer on five listed species: Texas wild-rice, fountain darter, San Marcos gambusia, Texas blind salamander, and San Marcos salamander.<sup>1</sup> The decision specifically addressed streamflow issues at two CHD units in the aquifer: Comal Springs and San Marcos Springs. The CSI were not listed at the time of the court decision. Following this decision, the State of Texas formed the Edwards Aquifer Authority (EAA) to manage, enhance, and protect the aquifer. Under the terms of the Edwards Aquifer Authority Act, groundwater withdrawals must be permitted and strictly controlled. The Service was also

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<sup>1</sup> Sierra Club v. Lujan, No. MO-91-CA-069, 1993 WL 151353 (W.D. Tex. Feb. 1, 1993). Four of these species also have critical habitat, though it is downstream of proposed CHD for CSI (Texas wild-rice, fountain darter, San Marcos gambusia, Texas blind, and San Marcos salamander).

directed by the court to develop minimum flow guidelines for the five listed species. These guidelines have been incorporated into the EAA's Demand Management/Critical Period Management Trigger Levels, which determine aquifer-wide pumping reductions necessary during periods of reduced springflow. Thus, a number of regulatory initiatives are ongoing in the Edwards aquifer that aim to protect endangered species in the aquifer, though most of these stem from a lawsuit that does not include the CSI.

5. The Key Findings of the analysis are highlighted below, and Exhibit ES-5 summarizes the quantitative results of this analysis. Future impacts associated with conservation efforts for the CSI in areas proposed for designation are forecast to be \$24.5 million over the next 20 years under Scenario 1, or \$154 million under Scenario 2 (undiscounted). The present value of Scenario 1 impacts is \$18.0 million, using a discount rate of three percent; or \$12.5 million, using a discount rate of seven percent. The present value of Scenario 2 impacts is \$113 million, using a discount rate of three percent; or \$78.5 million, using a discount rate of seven percent. The relative magnitude of impacts to each type of affected activity are shown in Exhibits ES-6 through ES-8.
6. These findings should be viewed in light of the following considerations:
  - The legislative and management history of the Edwards Aquifer presents a complex and dynamic context for assessing critical habitat impacts. The results presented in this report need to be viewed in the context of ongoing changes in Edwards Aquifer groundwater use and management.
  - The majority of the economic impacts quantified in this analysis are jointly the result of the presence of eight endangered species, including the three CSI. Because all of these species reside in the same habitat and require substantially the same protections, the best available data do not allow for separation of future impacts of CSI from impacts associated with the other listed species.
  - Since all of the units proposed for designation are within the Edwards aquifer, and all are impacted by groundwater use, this analysis makes the simplifying assumption that these costs can be allocated to the various units based on the acreage of the units. However, by not designating one or more of these units, the hydrologic requirements associated with the other units may not change, and thus the costs associated with their protection may not be avoided.

EXHIBIT ES-1 PROPOSED CRITICAL HABITAT DESIGNATION FOR THE COMAL SPRINGS INVERTEBRATES





EXHIBIT ES-2 PROPOSED CRITICAL HABITAT DESIGNATION FOR THE COMAL SPRINGS INVERTEBRATES

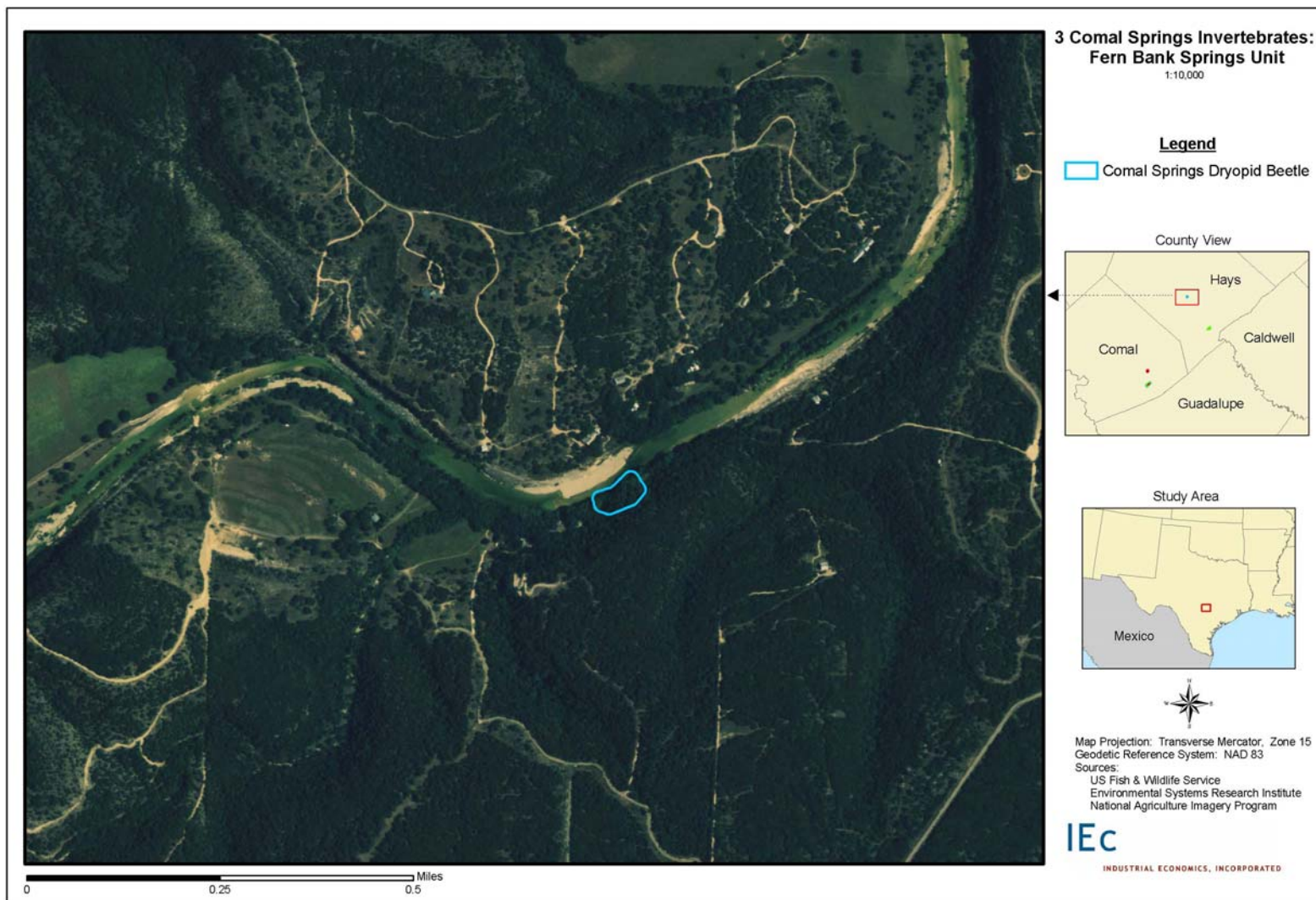
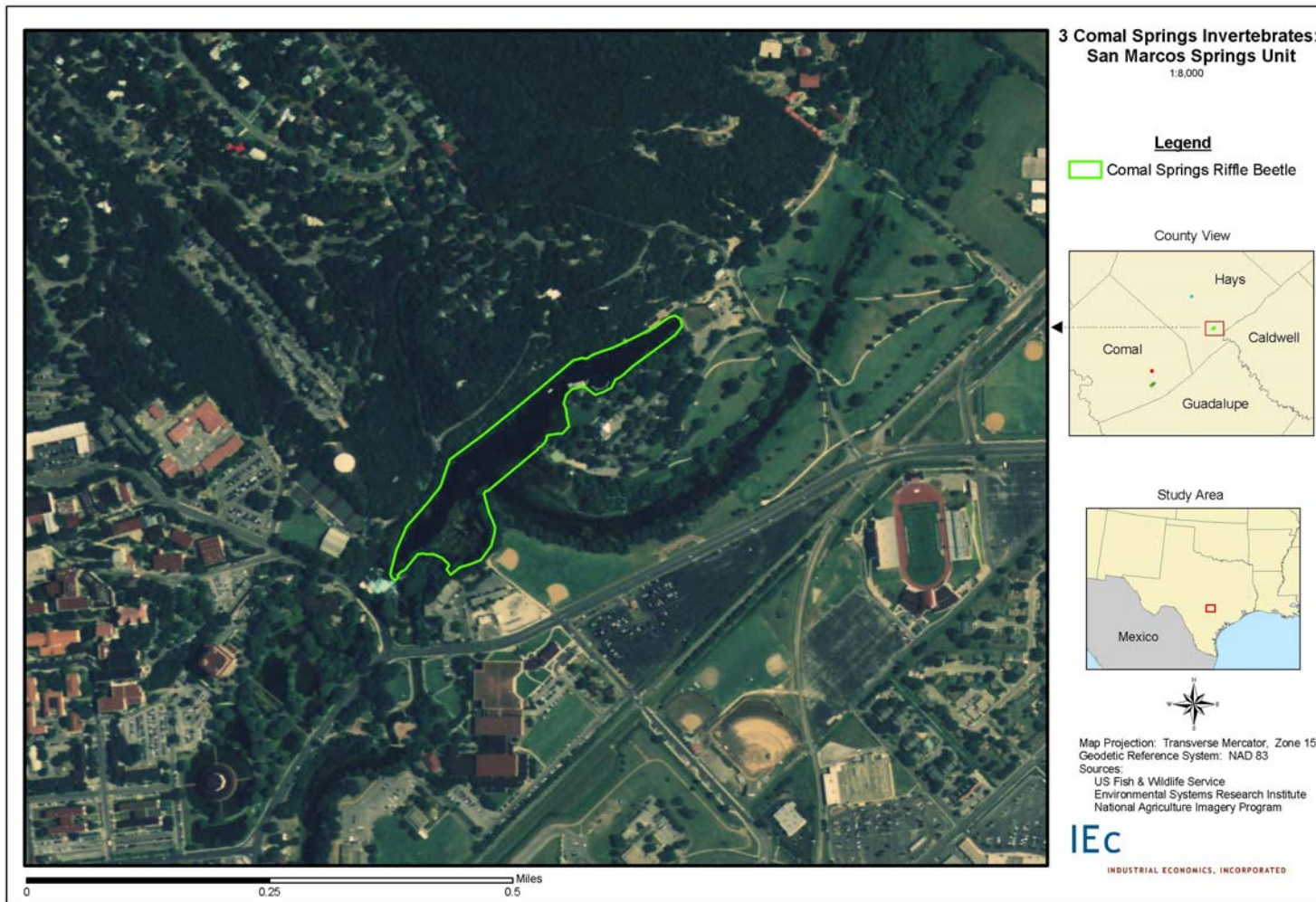


EXHIBIT ES-3 PROPOSED CRITICAL HABITAT DESIGNATION FOR THE COMAL SPRINGS INVERTEBRATES





EXHIBIT ES-4 PROPOSED CRITICAL HABITAT DESIGNATION FOR THE COMAL SPRINGS INVERTEBRATES





## KEY FINDINGS

**Total Future Impacts:** The draft economic analysis forecasts future impacts associated with conservation efforts for the CSI in areas proposed for designation to be \$24.5 million over the next 20 years under Scenario 1, or \$154 million under Scenario 2 (undiscounted). The present value of Scenario 1 impacts is \$18.0 million, using a discount rate of three percent; or \$12.5 million, using a discount rate of seven percent. The present value of Scenario 2 impacts is \$113 million, using a discount rate of three percent; or \$78.5 million, using a discount rate of seven percent. **It should be noted that the majority of economic impacts quantified in this analysis are jointly caused by eight endangered species, including the three CSI. Because all of these species reside in the same habitat, separating future impacts of CSI from the other listed species in the aquifer is not possible.**

**Quantified Impacts:** Impacts associated with water use changes comprise the vast majority, or between 91 and 99 percent of the total quantified impacts in the areas proposed for designation under Scenarios 1 and 2. In summary:

- **Water Use:** As soon as 2008, total permitted water withdrawals in the Edwards aquifer may be reduced from 549,000 acre-feet per year to 400,000 acre-feet per year. These restrictions stem from a lawsuit concerning five endangered species in the Edwards aquifer that share habitat with the CSI (Scenario 1). In dry years, additional restrictions may be imposed that will further limit aquifer withdrawals to 340,000 acre-feet (Scenario 2). This analysis presents social welfare and regional economic impacts that could result from these limits to water use in the aquifer.

The 20-year welfare impacts of reductions in permitted withdrawals from 549,000 to 400,000 or 340,000 acre-feet per year (i.e., the welfare losses resulting from increases in water prices) are anticipated to range from \$15.8 million under Scenario 1 to \$111 million under Scenario 2 (discounted at three percent). In addition, direct costs are estimated at \$631,000 (discounted at three percent) for several future water-related projects. Therefore, total impacts related to water use are estimated at \$16.5 million to \$111 million (discounted at three percent).

- **Administrative Costs:** Total administrative costs associated with section 7 consultation are forecast to be \$1.2 million (discounted at three percent) over 20 years.
- **Other economic activities:** Total future costs of project modifications for economic activities other than water use are estimated to be \$318,000 (discounted at three percent). These impacts are expected to be incurred in the San Marcos and Comal Springs units for conservation actions undertaken for the CSI during development activities as well as for an aquatic restoration project. No future impacts are anticipated for the two remaining privately owned units, Fern Bank Springs and Hueco Springs.

**Critical Habitat Unit with Highest Impacts:** The unit with the largest projected impacts (undiscounted dollars) is the Comal Springs unit, which is the largest unit by area. Impacts in this unit constitute between 70 and 75 percent of the total estimated impacts in the four subunits proposed for designation. **It should be noted that because the CSI are assumed to live in a shared aquifer, it is unclear that removing a particular area from proposed CHD would reduce expected economic impacts.**

EXHIBIT ES-5 SUMMARY OF FUTURE IMPACTS, (2007-2026)

CATEGORY	UNDISCOUNTED		3% DISCOUNT RATE		7% DISCOUNT RATE	
	SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2
Total Economic Impacts	\$24,518,000	\$154,326,000	\$17,966,000	\$112,976,000	\$12,508,000	\$78,501,000
Annualized Impacts	\$1,226,000	\$7,716,000	\$1,235,000	\$7,621,000	\$1,252,000	\$7,447,000

EXHIBIT ES-6 FUTURE ECONOMIC IMPACTS BY ACTIVITY (UNDISCOUNTED)

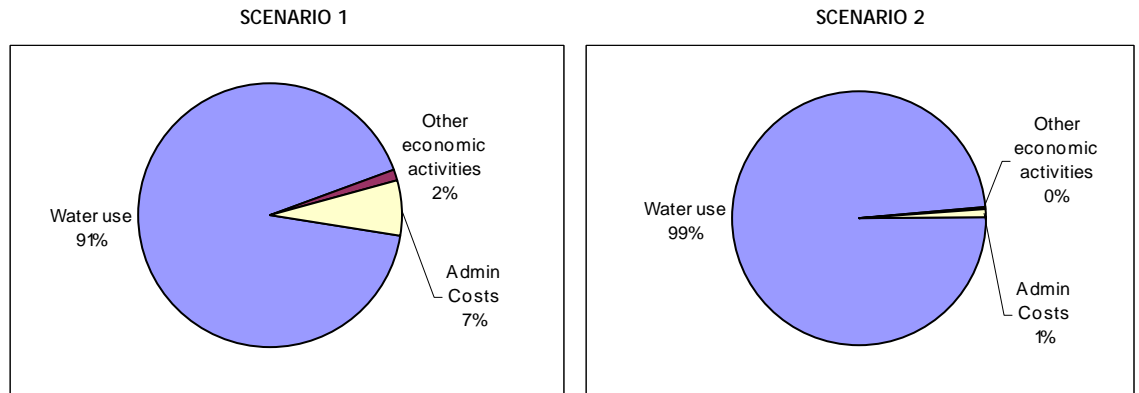


EXHIBIT ES-7 FUTURE ECONOMIC IMPACTS BY ACTIVITY (DISCOUNTED AT 3 PERCENT)

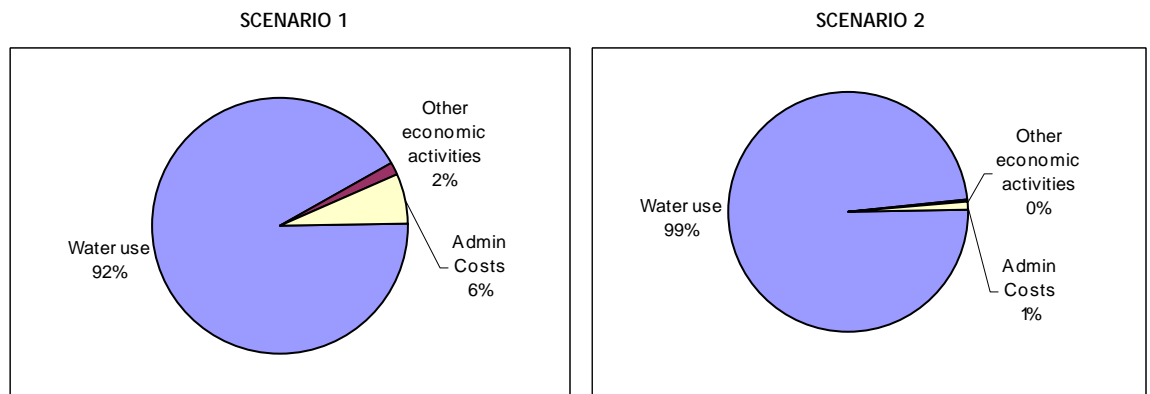
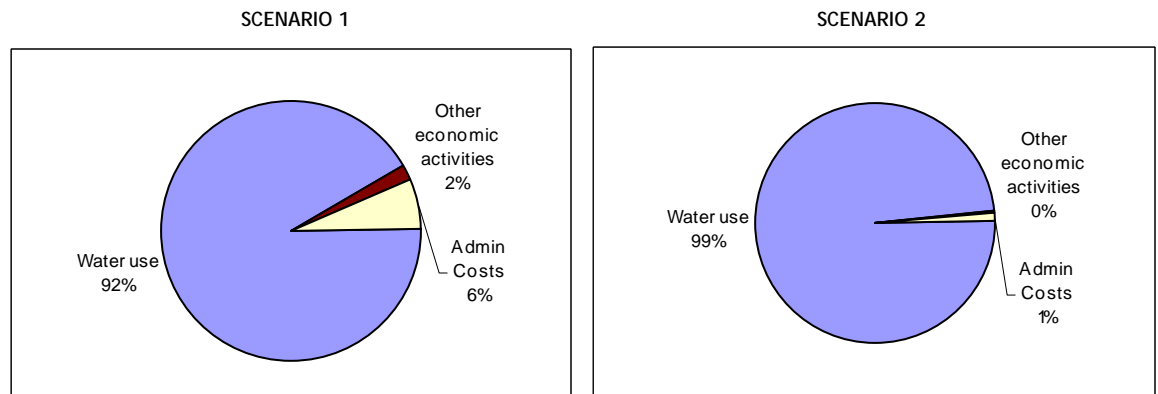


EXHIBIT ES-8 FUTURE ECONOMIC IMPACTS BY ACTIVITY (DISCOUNTED AT 7 PERCENT)



- Exhibit ES-9 ranks the units proposed for critical habitat designation in order of the magnitude of expected impact. **It should be noted that because the species are assumed to live in a shared aquifer, it is unclear that removing a particular area from proposed CHD would reduce expected conservation efforts and associated impacts.** Exhibit ES-10 presents more detailed information regarding present value and annualized impacts in each unit.



EXHIBIT ES-9 SUMMARY OF FUTURE IMPACTS BY UNIT, RANKED BY IMPACTS (2007-2026)

UNIT	UNDISCOUNTED				DISCOUNTED AT 3 PERCENT				DISCOUNTED AT 7 PERCENT			
	SCENARIO 1		SCENARIO 2		SCENARIO 1		SCENARIO 2		SCENARIO 1		SCENARIO 2	
	IMPACTS	% OF TOTAL	IMPACTS	% OF TOTAL	IMPACTS	% OF TOTAL	IMPACTS	% OF TOTAL	IMPACTS	% OF TOTAL	IMPACTS	% OF TOTAL
Comal Springs	\$17,132,000	70%	\$115,260,000	75%	\$12,548,000	70%	\$84,731,000	75%	\$8,727,000	70%	\$58,614,000	75%
San Marcos Springs	\$4,912,000	20%	\$31,955,000	21%	\$3,626,000	20%	\$23,420,000	21%	\$2,549,000	20%	\$16,298,000	21%
Fern Bank Springs	\$601,000	2%	\$4,206,000	3%	\$440,000	2%	\$3,079,000	3%	\$305,000	2%	\$2,138,000	3%
Hueco Springs	\$172,000	1%	\$1,202,000	1%	\$126,000	1%	\$880,000	1%	\$87,000	1%	\$611,000	1%
<b>Total</b>	<b>\$24,518,000</b>	<b>100%</b>	<b>\$154,326,000</b>	<b>100%</b>	<b>\$17,966,000</b>	<b>100%</b>	<b>\$112,976,000</b>	<b>100%</b>	<b>\$12,508,000</b>	<b>100%</b>	<b>\$78,501,000</b>	<b>100%</b>

Note: Totals may not add due to rounding and costs associated with multiple units.

EXHIBIT ES-10 DETAILED FUTURE IMPACTS BY UNIT (2007 - 2026)

SUBUNIT	UNDISCOUNTED		PRESENT VALUE, 3%		PRESENT VALUE, 7%		ANNUALIZED, 3%		ANNUALIZED, 7%	
	SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2
San Marcos Springs	\$4,912,000	\$31,955,000	\$3,626,000	\$23,420,000	\$2,549,000	\$16,298,000	\$248,000	\$1,578,000	\$252,000	\$1,516,000
Comal Springs	\$17,132,000	\$115,260,000	\$12,548,000	\$84,371,000	\$8,727,000	\$58,614,000	\$853,000	\$5,680,000	\$847,000	\$5,556,000
Hueco Springs	\$172,000	\$1,202,000	\$126,000	\$880,000	\$87,000	\$611,000	\$8,000	\$59,000	\$8,000	\$58,000
Fern Bank Springs	\$601,000	\$4,206,000	\$440,000	\$3,079,000	\$305,000	\$2,138,000	\$30,000	\$207,000	\$29,000	\$202,000
Multiple Units	\$1,702,000	\$1,702,000	\$1,228,000	\$1,228,000	\$839,000	\$839,000	\$96,000	\$96,000	\$115,000	\$115,000
<b>Total</b>	<b>\$24,518,000</b>	<b>\$154,326,000</b>	<b>\$17,966,000</b>	<b>\$112,976,000</b>	<b>\$12,508,000</b>	<b>\$78,501,000</b>	<b>\$1,235,000</b>	<b>\$7,621,000</b>	<b>\$1,252,000</b>	<b>\$7,447,000</b>

Note: Totals may not add due to rounding.

## CHAPTER 1 | FRAMEWORK FOR ANALYSIS

8. The purpose of this report is to estimate the economic impact of actions taken to protect the federally listed *Stygobromus pecki* (Peck's cave amphipod), *Stygoparnus comalensis* (Comal Springs dryopid beetle), and *Heterelmis comalensis* (Comal Springs riffle beetle), collectively known as the three Comal Springs invertebrates (hereafter, referred to as CSI). It attempts to quantify the economic effects associated with the proposed designation of critical habitat. It does so by taking into account the cost of conservation-related measures that are likely to be associated with future economic activities that may adversely affect the habitat within the proposed boundaries. The analysis looks retrospectively at costs incurred since the CSI were listed, and it attempts to predict future costs likely to occur after the proposed critical habitat designation (CHD) is finalized.
9. This information is intended to assist the Secretary in determining whether the benefits of excluding particular areas from the designation outweigh the benefits of including those areas in the designation.<sup>2</sup> In addition, this information allows the U.S. Fish and Wildlife Service (the Service) to address the requirements of Executive Orders 12866 and 13211, and the Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA).<sup>3</sup> This report also complies with direction from the U.S. Court of Appeals for the 10th Circuit that “co-extensive” effects should be included in the economic analysis to inform decision-makers regarding which areas to designate as critical habitat.<sup>4</sup>
10. This chapter provides background information on the species and the proposed designation. Next, it describes the regulatory alternatives considered by the Service. Then, it describes the approach to estimating impacts and lays out the scope of the analysis. Information sources relied upon are summarized in the next section. The chapter concludes with a description of the organization of the remainder of this report.

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<sup>2</sup> 16 U.S.C. §1533(b)(2)

<sup>3</sup> Executive Order 12866, Regulatory Planning and Review, September 30, 1993; Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use, May 18, 2001; 5.U.S.C. §601 et seq; and Pub Law No. 104-121.

<sup>4</sup> In 2001, the U.S. Court of Appeals for the 10th Circuit instructed the Service to conduct a full analysis of all of the economic impacts of proposed CHD, regardless of whether those impacts are attributable co-extensively to other causes (New Mexico Cattle Growers Ass'n v. U.S.F.W.S., 248 F.3d 1277 (10th Cir. 2001)).

### 1.1 BACKGROUND

11. On December 18, 1997, the Service published the final rule listing the CSI as endangered.<sup>5</sup> In the final rule, the Service determined that designation of critical habitat for the species was not prudent. On July 17, 2006, the Service proposed critical habitat for the CSI. For a description of the three species and the primary constituent elements that are essential to the conservation of the species, refer to the proposed listing rule, dated July 17, 2006.
12. The Service has identified 50 acres in Comal and Hays counties as proposed critical habitat for the CSI. Proposed critical habitat is divided into four units. Two units are composed completely of private lands, while a third is comprised entirely of State land. The final unit is a mix of State, municipal, and private lands. Exhibits 1-1 and 1-2 summarize landownership and primary threats by unit. For maps showing the location of each unit, see Exhibits ES-1 through and ES-4 in the Executive Summary.

#### EXHIBIT 1-1. PROPOSED CRITICAL HABITAT LANDOWNERS (ACRES)

UNIT	STATE	MUNICIPAL	PRIVATE	TOTAL
Comal Springs	19.8	7.3	11	38.1
Fern Bank Springs	-	-	1.4	1.4
Hueco Springs	-	-	0.4	0.4
San Marcos Springs	10.5	-	-	10.5
Total	30.3	7.3	12.8	50.4
% of Total	60.1%	14.5%	25.4%	100%

#### EXHIBIT 1-2. PRIMARY THREATS BY UNIT

UNITS	COUNTY	LANDOWNERS/ LAND MANAGER(S)	PRIMARY THREATS
Comal Springs	Comal	State, Municipal, Private	Water withdrawals, hazardous materials spills, pesticide use, excavation, construction, stormwater pollutants, invasive species, well entrapment
Fern Bank Springs	Hays	Private	Water withdrawals, excavation, construction, pesticide use
Hueco Springs	Comal	Private	Water withdrawals, hazardous materials spills, pesticide use, excavation, construction, stormwater pollutants, and well entrapment
San Marcos Springs	Hays	State	Water withdrawals, hazardous materials spills, pesticide use, excavation, construction, stormwater pollutants, invasive species

<sup>5</sup> 63 FR 54956



## 1.2 REGULATORY ALTERNATIVES

13. Executive Order 12866 directs Federal Agencies to evaluate regulatory alternatives. The Service identifies four units or areas of proposed CHD. The potential impacts of designating all four units are estimated in this report. An alternative to the proposed rule is to only designate some of the units. In addition, section 4(b)(2) of the Act allows the Service to exclude additional areas proposed for designation based on economic impact and other relevant impact. Consideration of impacts at a unit level may result in alternate combinations of proposed habitat that may or may not ultimately be designated as critical habitat. As a result, the impacts of multiple combinations of proposed habitat are also available to the Service.

## 1.3 APPROACH TO ESTIMATING ECONOMIC IMPACTS

14. This economic analysis considers economic efficiency effects that may result from activities to protect the CSI and their habitat (hereinafter referred to collectively as “CSI conservation activities”). Economic efficiency effects generally reflect “opportunity costs” associated with the commitment of resources required to accomplish species and habitat conservation. For example, if activities that can take place on a parcel of land are limited as a result of the designation or the presence of the species, and thus the market value of the land is reduced, this reduction in value represents one measure of opportunity cost or change in economic efficiency. Similarly, the costs incurred by a Federal action agency to consult with the Service under section 7 represent opportunity costs of required conservation activities.

### EFFICIENCY EFFECTS

15. At the guidance of the Office of Management and Budget (OMB) and in compliance with Executive Order 12866 "Regulatory Planning and Review," Federal agencies measure changes in economic efficiency in order to understand how society, as a whole, will be affected by a regulatory action. In the context of regulations that protect CSI habitat, these efficiency effects represent the opportunity cost of resources used or benefits foregone by society as a result of the regulations. Economists generally characterize opportunity costs in terms of changes in producer and consumer surpluses in affected markets.<sup>6</sup>
16. In some instances, compliance costs may provide a reasonable approximation for the efficiency effects associated with a regulatory action. For example, a Federal land manager, such as the US Forest Service, may enter into a consultation with the Service to ensure that a particular activity will not adversely modify critical habitat. The effort required for the consultation is an economic opportunity cost, because the landowner or manager's time and effort would have been spent in an alternative activity had the parcel not been included in the designation. When compliance activity is not expected to

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<sup>6</sup> For additional information on the definition of "surplus" and an explanation of consumer and producer surplus in the context of regulatory analysis, see: Gramlich, Edward M., *A Guide to Benefit-Cost Analysis (2nd Ed.)*, Prospect Heights, Illinois: Waveland Press, Inc., 1990; and U.S. Environmental Protection Agency, *Guidelines for Preparing Economic Analyses*, EPA 240-R-00-003, September 2000, available at <http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html>.

significantly affect markets -- that is, not result in a shift in the quantity of a good or service provided at a given price, or in the quantity of a good or service demanded, given a change in price -- the measurement of compliance costs can provide a reasonable estimate of the change in economic efficiency.

17. Where habitat protection measures are expected to significantly impact a market, it may be necessary to estimate changes in producer and consumer surpluses. For example, a designation that precludes the development of large areas of land may shift the price and quantity of housing supplied in a region. In this case, changes in economic efficiency (i.e., social welfare) can be measured by considering changes in producer and consumer surplus in the market. In this case, changes in economic efficiency (i.e., social welfare) can be measured by considering changes in producer and consumer surplus in the market.
18. This analysis begins by measuring costs associated with measures taken to protect CSI and their habitat. As noted above, in some cases, compliance costs can provide a reasonable estimate of changes in economic efficiency. However, where the cost of conservation activities is expected to significantly impact markets, the analysis considers potential changes in consumer and/or producer surplus in affected markets.

#### DISTRIBUTIONAL AND REGIONAL ECONOMIC EFFECTS

19. Measurements of changes in economic efficiency focus on the net impact of conservation activities, without consideration of how certain economic sectors or groups of people are affected. Thus, a discussion of efficiency effects alone may miss important distributional considerations. OMB encourages Federal agencies to consider distributional effects separately from efficiency effects.<sup>7</sup> This analysis considers several types of distributional effects, including impacts on small entities; impacts on energy supply, distribution, and use; and regional economic impacts. It is important to note that these are fundamentally different measures of economic impact than efficiency effects, and thus cannot be added to or compared with estimates of changes in economic efficiency.

#### Impacts on Small Entities and Energy Supply, Distribution, and Use

20. This analysis also considers how small entities, including small businesses, organizations, and governments, as defined by the Regulatory Flexibility Act, might be affected by future conservation activities for the CSI.<sup>8</sup> In addition, in response to Executive Order 13211 "Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use," this analysis considers the future impacts of conservation activities on the energy industry and its customers.<sup>9</sup>

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<sup>7</sup> U.S. Office of Management and Budget, "Circular A-4," September 17, 2003, available at <http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf>.

<sup>8</sup> 5 U.S.C. § 601 *et seq.*

<sup>9</sup> Executive Order 13211, *Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use*, May 18, 2001.

#### Regional Economic Effects

21. Regional economic impact analysis can provide an assessment of the potential localized effects of conservation activities. Specifically, regional economic impact analysis produces a quantitative estimate of the potential magnitude of the initial change in the regional economy resulting from a regulatory action. Regional economic impacts are commonly measured using regional input/output models. These models rely on multipliers that represent the relationship between a change in one sector of the economy (e.g., expenditures by recreationists) and the effect of that change on economic output, income, or employment in other local industries (e.g., suppliers of goods and services to recreationists). These economic data provide a quantitative estimate of the magnitude of shifts of jobs and revenues in the local economy.
22. The use of regional input/output models in an analysis of the impacts of species and habitat conservation activities can overstate the long-term impacts of a regulatory change. Most importantly, these models provide a static view of the economy of a region. That is, they measure the initial impact of a regulatory change on an economy but do not consider long-term adjustments that the economy will make in response to this change. For example, these models provide estimates of the number of jobs lost as a result of a regulatory change, but do not consider re-employment of these individuals over time or other adaptive responses by impacted businesses. In addition, the flow of goods and services across the regional boundaries defined in the model may change as a result of the regulation, compensating for a potential decrease in economic activity within the region.
23. Despite these and other limitations, in certain circumstances regional economic impact analysis may provide useful information about the scale and scope of localized impacts. It is important to remember that measures of regional economic effects generally reflect shifts in resource use rather than efficiency losses. Thus, these types of distributional effects are reported separately from efficiency effects (i.e., not summed). In addition, measures of regional economic impact cannot be compared with estimates of efficiency effects, but should be considered as distinct measures of impact.



#### CALCULATING PRESENT VALUE AND ANNUALIZED IMPACTS

For each land use activity, this analysis compares economic impacts incurred in different time periods in present value terms. The present value represents the value of a payment or stream of payments in common dollar terms. That is, it is the sum of a series of past or future cash flows expressed in today's dollars. Translation of economic impacts of past or future costs to present value terms requires the following: a) past or projected future costs of plant conservation activities; and b) the specific years in which these impacts have been or are expected to be incurred. With these data, the present value of the past or future stream of impacts ( $PV_c$ ) of plant conservation efforts from year  $t$  to  $T$  is measured in 2007 dollars according to the following standard formula:<sup>a</sup>

$$PV_c = \sum_t^T \frac{C_t}{(1+r)^{t-2007}}$$

$C_t$  = cost of plant conservation efforts in year  $t$

$r$  = discount rate<sup>b</sup>

Impacts of conservation efforts for each activity in each unit are also expressed as annualized values. Annualized values are calculated to provide comparison of impacts across activities with varying forecast periods ( $T$ ). For this analysis, however, all activities employ a forecast period of 20 years, 2006 through 2025. Annualized impacts of future plant conservation activities ( $APV_c$ ) are calculated by the following standard formula:

$$APV_c = PV_c \left[ \frac{r}{1 - (1+r)^{-N}} \right]$$

$N$  = number of years in the forecast period (in this analysis, 20 years)

<sup>a</sup> To derive the present value of past conservation activities for this analysis,  $t$  is 1998 and  $T$  is 2006; to derive the present value of future conservation efforts,  $t$  is 2007 and  $T$  is 2026.

#### 1.4 SCOPE OF THE ANALYSIS

24. This analysis identifies those economic activities believed to most likely threaten the listed species and its habitat and, where possible, quantifies the economic impact to avoid, mitigate, or compensate for such threats within the boundaries, or adjacent to, proposed critical habitat. In instances where critical habitat is being proposed after a species is listed, some future impacts may be unavoidable, regardless of the final

designation and exclusions under 4(b)(2). However, due to the difficulty in making a credible distinction between listing and critical habitat effects within critical habitat boundaries, this analysis considers all future conservation-related impacts to be co-extensive with the designation.<sup>10,11</sup>

25. Co-extensive effects may also include impacts associated with overlapping protective measures of other Federal, State, and local laws that aid habitat conservation in the areas proposed for designation. In past instances, some of these measures have been precipitated by the listing of the species and impending designation of critical habitat. Because habitat conservation efforts affording protection to a listed species likely contribute to the efficacy of the CHD efforts, the impacts of these actions are considered relevant for understanding the full effect of the proposed CHD. Enforcement actions taken in response to violations of the Act, however, are not included.

#### SECTIONS OF THE ACT RELEVANT TO THE ANALYSIS

26. This analysis focuses on activities that are influenced by the Service through sections 4, 7, 9, and 10 of the Act.
- Section 4 of the Act focuses on the listing and recovery of endangered and threatened species, as well as CHD. In this section, the Secretary is required to list species as endangered or threatened "solely on the basis of the best available scientific and commercial data."<sup>12</sup> Section 4 also requires the Secretary to designate critical habitat "on the basis of the best scientific data available and after taking into consideration the economic impact, and any other relevant impact, of specifying any particular area as critical habitat."<sup>13</sup>
  - Section 7 of the Act requires Federal agencies to consult with the Service to ensure that any action authorized, funded, or carried out will not likely jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat.<sup>14</sup>

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<sup>10</sup> In 2001, the U.S. Court of Appeals for the 10th Circuit instructed the Service to conduct a full analysis of all of the economic impacts of proposed CHD, regardless of whether those impacts are attributable co-extensively to other causes (*New Mexico Cattle Growers Assn v. U.S.F.W.S.*, 248 F.3d 1277 (10th Cir. 2001)).

<sup>11</sup> In 2004, the U.S. Ninth Circuit invalidated the Service's regulation defining destruction or adverse modification of critical habitat (*Gifford Pinchot Task Force v. United States Fish and Wildlife Service*). The Service is currently reviewing the decision to determine what effect it (and to a limited extent *Center for Biological Diversity v. Bureau of Land Management* (Case No. C-03-2509-SI, N.D. Cal.)) may have on the outcome of consultations pursuant to section 7 of the Act.

<sup>12</sup> 16 U.S.C. 1533.

<sup>13</sup> 16 U.S.C. 1533.

<sup>14</sup> The Service notes that the Ninth Circuit judicial opinion, *Gifford Pinchot Task Force v. United States Fish and Wildlife Service*, invalidated the Service's regulation defining destruction or adverse modification of critical habitat. The Service is currently reviewing the decision to determine what effect it (and to a limited extent *Center for Biological Diversity v. Bureau of Land Management* (Case No. C-03-2509-SI, N.D. Cal.)) may have on the outcome of consultations pursuant to section 7 of the Act.

- Section 9 defines the actions that are prohibited by the Act. In particular, it prohibits the "take" of endangered wildlife, where "take" means to "harass, harm, pursue, or collect, or to attempt to engage in any such conduct."<sup>15</sup>
- Under section 10(a)(1)(B) of the Act, an entity (e.g., a landowner or local government) may develop a Habitat Conservation Plan (HCP) for an endangered animal species in order to meet the conditions for issuance of an incidental take permit in connection with the development and management of a property.<sup>16</sup>

#### OTHER RELEVANT PROTECTION EFFORTS

27. The protection of listed species and habitat is not limited to the Act. Other Federal agencies, as well as State and local governments, may also seek to protect the natural resources under their jurisdiction.<sup>17</sup> For the purpose of this analysis, such protective efforts are considered to be co-extensive with the protection offered by critical habitat, and costs associated with these efforts are included in this report. In addition, under certain circumstances, the CHD may provide new information to a community about the sensitive ecological nature of a geographic region, potentially triggering additional economic impacts under other State or local laws. In cases where these costs would not have been triggered absent the designation of critical habitat, they are included in this economic analysis.

#### ADDITIONAL ANALYTIC CONSIDERATIONS

28. This analysis also considers the potential for other types of economic impacts that can be related to section 7 consultations in general and CHD in particular, including time delay, regulatory uncertainty, and stigma impacts.

##### Time Delay and Regulatory Uncertainty Impacts

29. Time delay impacts are costs resulting from project delays associated with the consultation process or compliance with other regulations. Regulatory uncertainty costs occur in anticipation of having to modify project parameters (e.g., retaining outside experts or legal counsel to better understand responsibilities with regard to critical habitat). Time delays and regulatory uncertainty impacts are not anticipated in this case, because the Federal agencies involved in consultations are familiar with the process.

##### Stigma Impacts

30. Stigma refers to the change in economic value of a particular project or activity due to negative (or positive) perceptions of the role critical habitat will play in developing, implementing, or conducting that policy. For example, changes to private property

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<sup>15</sup> 16 U.S.C. 1532.

<sup>16</sup> U.S. Fish and Wildlife Service, "Endangered Species and Habitat Conservation Planning," August 6, 2002, accessed at <http://endangered.fws.gov/hcp/>.

<sup>17</sup> For example, the Sikes Act Improvement Act (Sikes Act) of 1997 requires Department of Defense (DoD) military installations to develop Integrated Natural Resources Management Plans (INRMPs) that provide for the conservation, protection, and management of wildlife resources (16 U.S.C. §§ 670a - 670o). These plans must integrate natural resource management with the other activities, such as training exercises, taking place at the facility.

values associated with public attitudes about the limits and costs of implementing a project in critical habitat are known as "stigma" impacts. Because the proposed designation includes little private property (approximately 13 acres proposed for designation), stigma effects are not quantified in this analysis.

#### BENEFITS

31. Under Executive Order 12866, OMB directs Federal agencies to provide an assessment of both the social costs and benefits of proposed regulatory actions.<sup>18</sup> OMB's Circular A-4 distinguishes two types of economic benefits: *direct benefits and ancillary benefits*. Ancillary benefits are defined as favorable impacts of a rulemaking that are typically unrelated, or secondary, to the statutory purpose of the rulemaking.<sup>19</sup>
32. In the context of CHD, the primary purpose of the rulemaking (i.e., the direct benefit) is the potential to enhance conservation of the species. The published economics literature has documented that social welfare benefits can result from the conservation and recovery of endangered and threatened species. In its guidance for implementing Executive Order 12866, OMB acknowledges that it may not be feasible to monetize, or even quantify, the benefits of environmental regulations due to either an absence of defensible, relevant studies or a lack of resources on the implementing agency's part to conduct new research.<sup>20</sup> *Rather than rely on economic measures, the Service believes that the direct benefits of the proposed rule are best expressed in biological terms that can be weighed against the expected cost impacts of the rulemaking.*
33. Critical habitat designation may also generate ancillary benefits. Critical habitat aids in the conservation of species specifically by protecting the primary constituent elements on which the species depends. To this end, critical habitat designation can result in maintenance of particular environmental conditions that may generate other social benefits aside from the preservation of the species. That is, management actions undertaken to conserve a species or habitat may have coincident, positive social welfare implications, such as increased recreational opportunities in a region. While they are not the primary purpose of critical habitat, these ancillary benefits may result in gains in employment, output, or income that may offset the direct, negative impacts to a region's economy resulting from actions to conserve a species or its habitat.
34. It is often difficult to evaluate the ancillary benefits of critical habitat designation. To the extent that the ancillary benefits of the rulemaking may be captured by the market through an identifiable shift in resource allocation, they are factored into the overall economic impact assessment. For example, if habitat preserves are created to protect a species, the value of existing residential property adjacent to those preserves may increase, resulting in a measurable positive impact. Ancillary benefits that affect markets are not anticipated in this case, and therefore are not quantified.

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<sup>18</sup> Executive Order 12866, *Regulatory Planning and Review*, September 30, 1993.

<sup>19</sup> U.S. Office of Management and Budget, "Circular A-4," September 17, 2003, available at <http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf>.

<sup>20</sup> *Ibid.*

#### GEOGRAPHIC SCOPE OF THE ANALYSIS

35. The geographic scope of the analysis includes areas proposed for CHD and areas proposed for exclusion under section 4(b)(2) of the Act. The economic impacts of proposed designation are estimated for each of these two categories of land identified in the proposed rule.<sup>21</sup> The analysis focuses on activities within or affecting these areas.
36. Impacts are presented at the finest level of resolution feasible, given available data. For this proposed critical habitat designation, impacts are reported for each unit identified in the proposed rule. The Executive Summary presents maps of proposed CHD units.

#### ANALYTIC TIME FRAME

37. The analysis estimates impacts based on activities that are "reasonably foreseeable," including, but not limited to, activities that are currently authorized, permitted, or funded, or for which proposed plans are currently available to the public. This analysis estimates economic impacts to activities from 1997 (year of the species' final listing) to 2026 (20 years from the final year anticipated in 2007). Forecasts of economic conditions and other factors beyond the next 20 years would be speculative.

#### 1.5 INFORMATION SOURCES

38. The primary sources of information for this report were communications with and data provided by personnel from the Service, Federal action agencies, affected private parties, State, and Municipal agencies. Specifically, the analysis relies on data collected in communication with personnel from the following entities:
  - The Edwards Aquifer Authority;
  - The San Antonio Water System;
  - U.S. Army Corps of Engineers
  - U.S. Department of Defense;
  - Randolph Air Force Base;
  - City planning departments; and
  - Private landowners.
39. In addition, this analysis relies upon the Service's section 7 consultation records, public comments, and published journal sources. The reference section at the end of this document provides a full list of information sources.

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<sup>21</sup> However, in this rule, no areas are proposed for exclusion.



**1.6 STRUCTURE OF THE REPORT**

40. The remainder of this report is organized as follows:

- Section 2: Impacts to Water Use Activities;
- Section 3: Impacts to Other Economic Activities;
- Appendix A: Administrative Costs;
- Appendix B: Impacts on Small Entities and Energy Use;
- Appendix C: Historic Springflow Levels; and
- References.

## CHAPTER 2 | POTENTIAL IMPACTS ON WATER USE ACTIVITIES

41. Because the Service describes "the potential failure of spring flow due to drought or excessive groundwater pumping"<sup>22</sup> as a primary threat to CSI, this chapter focuses on identifying and quantifying impacts to groundwater users that rely on water pumped from proposed CHD areas. This section first presents an overview of the methodology used to evaluate water use activities. It then presents background information on endangered species protection within the Edwards Aquifer and on current groundwater pumping. It then estimates past economic impacts related to CSI conservation activities. Finally, it forecasts potential future economic impacts associated with three categories of impacts:
- (1) Direct costs associated with obtaining alternative municipal and industrial water supplies;
  - (2) Welfare impacts resulting from pumping restrictions on municipal and industrial water users; and
  - (3) The regional economic impacts of pumping restrictions on agricultural water users.

It should be noted that these three categories of impacts are not additive; therefore, to be consistent in totality with other costs, the summary section highlights the resulting welfare impacts. Regional economic impacts also are presented in the summary section.

### 2.1 SUMMARY OF IMPACTS

42. While a number of past actions related to water management have been affected by endangered species concerns in the Edwards Aquifer, relatively few of these have been associated with the CSI, which were listed in 1997. Past costs of project modifications (e.g., implementation of water conservation efforts and preparation of a biological assessment by DOD) associated with actions to prevent jeopardy of endangered species in the Edwards aquifer that may be associated with the CSI are estimated at \$501,000 (undiscounted dollars). Past administrative costs associated with water use projects and CSI are estimated to have been \$185,000 from 1997 to 2006. These administrative costs are detailed in Appendix A.
43. Total permitted withdrawals from the Edwards Aquifer are to be reduced from approximately 549,000 acre-feet to 450,000 acre-feet, following a 1993 lawsuit

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<sup>22</sup> U.S. Fish and Wildlife Service, "Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Peck's Cave Amphipod, Comal Springs Dryopid Beetle, and Comal Springs Riffle Beetle; Proposed Rule," July 17, 2006.

concerning five endangered species in the Edwards aquifer that share habitat with the CSI. As soon as 2008, total permitted water withdrawals in the Edwards aquifer may be further limited from 549,000 acre-feet per year to 400,000 acre-feet per year, (Scenario 1). It is also possible that, in dry years, additional restrictions may be imposed that will further limit aquifer withdrawals to 340,000 acre-feet (Scenario 2). This analysis examines social welfare and regional economic impacts that could result from these limits to water withdrawals in the aquifer. Again it should be noted that these estimated impacts are subject to the caveats highlighted in the Executive Summary.

44. Exhibit 2-1 presents the welfare impacts of reductions in permitted withdrawals from 549,000 to 400,000 or 340,000 acre-feet per year (i.e., surplus losses to municipal and industrial users associated with higher resultant water prices). As shown, future undiscounted costs are anticipated to range from \$21.6 million under Scenario 1 to \$151 million under Scenario 2. The costs of obtaining replacement water supplies are presented in Section 2.5. Regional economic impacts resulting from changes in the amount of irrigated agricultural land and subsequent changes in labor employment and regional labor income are estimated at \$12.5 million under Scenario 1 or \$13.7 million under Scenario 2 (see Exhibit 2-8).
45. Finally, the analysis estimates future administrative costs associated with water use projects to be \$534,000 over the next 20 years. Administrative costs are detailed in Appendix A. Direct costs of projects associated with these consultations are estimated to be \$900,000 (undiscounted). Thus, total costs, including both the direct costs of water-related projects requiring consultation and the welfare impacts of reductions in permitted groundwater withdrawals, are forecast to be \$22.5 million to \$152 million over the next twenty years.

**EXHIBIT 2-1. WELFARE IMPACTS OF REDUCTIONS IN PERMITTED GROUNDWATER WITHDRAWALS IN THE EDWARDS AQUIFER (\$2006) (2007-2026)**

UNIT	FUTURE (UNDISCOUNTED DOLLARS)		FUTURE PRESENT VALUE 3%		FUTURE PRESENT VALUE 7%	
	SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2
San Marcos Springs	\$4,505,000	\$31,548,000	\$3,297,000	\$23,091,000	\$2,290,000	\$16,039,000
Comal Springs	\$16,345,00	\$114,474,000	\$11,963,000	\$83,786,000	\$8,310,000	\$58,198,000
Hueco Springs	\$172,000	\$1,202,000	\$126,000	\$880,000	\$87,000	\$611,000
Fern Bank Springs	\$601,000	\$4,206,000	\$440,000	\$3,079,000	\$305,000	\$2,138,000
<b>Total</b>	<b>\$21,622,000</b>	<b>\$151,430,000</b>	<b>\$15,826,000</b>	<b>\$110,836,000</b>	<b>\$10,992,000</b>	<b>\$76,986,000</b>

Note: Because all units fall within the Edwards Aquifer, costs are distributed by unit according to relative acreage in proposed CHD. It should be noted that these economic impacts are jointly caused by eight endangered species, including the three CSI.

## 2.2 OVERVIEW OF APPROACH TO ESTIMATING IMPACTS

46. This analysis constructs estimates of the opportunity costs of providing water necessary to provide flow for threatened and endangered species in proposed CHD areas. These costs include: (1) replacement of water previously supplied by Edwards aquifer withdrawals; (2) reduced net economic benefits, or social welfare, associated with higher water prices; (3) changes in agricultural activity and associated regional economic impacts.
47. Under State law in Texas, users of Edwards aquifer groundwater may be regulated through the permitting of water withdrawals or other groundwater management measures. As such, the Edwards Aquifer Authority (EAA) permits and manages groundwater withdrawals from the aquifer. To calculate the costs associated with replacing currently permitted water withdrawals that may no longer be obtained from the aquifer, this analysis uses replacement costs developed by the South Central Texas Regional Water Planning Group.
48. This analysis also estimates the secondary economic effects of retiring water from current uses on the regional economy, including effects on employment, wages, and income. Regional economic impacts are expressed in terms of jobs losses and regional sector revenue changes. Unlike the social welfare benefits, which reflect the well-being of *all* citizens under different resource allocations (i.e., species status and extent of habitat), regional economic benefits reflect changes in *local* output, employment and taxes. These types of impacts are generally assumed to be distributive; that is, changes in economic activity in the local economy are offset by changes elsewhere. Social welfare and regional economic benefits reflect distinct measures of economic impacts and thus should not be added.
49. To address the above two categories of impacts, this analysis relies upon information from a previous study of the economic implications of establishing pumping limits on Edwards aquifer habitat (Jones et al., 2001).<sup>23</sup> The authors utilize an integrated hydrologic-economic model to estimate the impacts of groundwater withdrawal limits based on alternatives being considered in the formation of the now draft HCP for the EAA groundwater permit program. This research was subsequently published in the peer-reviewed journal, *Water Resources Research*.<sup>24</sup>
50. The scenarios discussed in this chapter are designed to frame the potential economic impacts of water limits that may occur in the Edwards Aquifer due to endangered species concerns. While the lawsuit that resulted in the Edwards Aquifer Authority Act and subsequent restrictions on water use (as described below) did not address CSI specifically, these species reside in the same habitat as species that were included in that

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<sup>23</sup> Jones, Lonnie L., Dhazn Gillig and Bruce McCarl, "Economic Impacts of Edwards Aquifer Pumping Restriction Alternatives," Submitted to Hicks and Company for the Edwards Aquifer Authority Habitat Conservation Plan, March 15, 2001.

<sup>24</sup> Gillig, D., B. McCarl, L. Jones and F. Boadu, "Economic Efficiency and Cost Implications of Habitat Conservation: An Example in the Context of the Edwards Aquifer Region," *Water Resources Research*, 40, 2004.

lawsuit. Protection methods, in terms of water use restrictions, jointly improve habitat for all species. Thus, separating future costs of protecting CSI from the costs of protecting other listed species in the aquifer is not possible. For example, should the other species be delisted in the future (for example, the San Marcos gambusia is already believed to be extinct), the CSI could become primarily responsible for water restrictions and other conservation efforts in the Edwards Aquifer.

## 2.3 BACKGROUND

### ENDANGERED SPECIES AND THE EDWARDS AQUIFER

51. The Edwards Aquifer is a geologically complex groundwater system, currently serving more than 1.7 million people and 90,000 acres of agricultural lands in south-central Texas.<sup>25</sup> San Marcos Springs and Comal Springs are artesian springs fed by waters in the Aquifer, and collectively make up 96 percent of the area proposed as critical habitat for CSI. Both fall on the eastern edge of the Edwards Aquifer. These two springs represent the two largest remaining non-saline springs in Texas.<sup>26</sup> The two smaller units, Hueco Springs and Fern Bank Springs, also fall within the aquifer.<sup>27</sup> The proposed CHD areas are also home to five other endangered species: fountain darter, San Marcos gambusia, Texas wild-rice, San Marcos salamander, and Texas blind salamander. The San Marcos springs system is designated as critical habitat for the fountain darter, San Marcos gambusia, Texas wild-rice, and San Marcos salamander.
52. In 1991, the Sierra Club and the Guadalupe-Blanco River Authority filed a lawsuit against the Department of the Interior alleging that reduced springflows associated with water withdrawals from the aquifer represented a threat to listed species and that the Service had failed to implement adequate measures to protect the species. At the time of the lawsuit, the CSI were not listed as threatened or endangered; instead the lawsuit addressed the fountain darter, San Marcos gambusia, Texas wild-rice, San Marcos salamander and Texas blind salamander.
53. As part of a 1993 ruling, Judge Lucius Bunton ruled in favor of the plaintiffs and required the Service to recommend minimum springflows for San Marcos and Comal Springs that would be adequate to prevent jeopardy of the listed species and adverse modification of critical habitat. The judge also ordered the Texas State Legislature to develop and implement a regulatory system to limit water withdrawals from the aquifer. This ruling led to the 1993 Senate Bill 1477 (the Texas Edwards Aquifer Authority Act), and the creation of the EAA in 1996.
54. Under S.B. 1477, the EAA is charged with managing, enhancing, and protecting the Edwards Aquifer. As part of its duties, the EAA serves as the groundwater permitting

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<sup>25</sup> Edwards Aquifer Authority, "Comprehensive Water Management Plan," Adopted December 14, 2004.

<sup>26</sup> Edwards Aquifer Authority, Draft Edwards Aquifer Habitat Conservation Plan and Draft Environmental Impact Statement, July 2004, as amended September 21, 2004, p. 3-118.

<sup>27</sup> Ibid.



authority for the aquifer. Until the creation of this entity, no agency had authority to restrict groundwater pumping from the aquifer.<sup>28</sup> EAA has issued permits for withdrawal of approximately 549,000 acre-feet annually, following rules set out in the Edwards Aquifer Authority Act.<sup>29</sup> Actual usage is somewhat less than this, amounting to about 513,000 acre feet as maximum annual usage.<sup>30</sup> Furthermore, under the terms of S.B. 1477, permitted groundwater withdrawals must not exceed 450,000 acre-feet from time of the act enactment until the end of 2007, and must not exceed 400,000 acre-feet commencing in 2008.<sup>31</sup> If permitted withdrawals are reduced from 549,000 acre-feet to 400,000 acre-feet in 2008, this would represent a reduction in permitted withdrawals by approximately 150,000 acre-feet, or 27 percent. While the EAA has issued temporary rules to resolve this overallocation of water rights, the long term solution remains uncertain. The EAA has currently handled the pumping cap through the issuance of 450,000 acre-feet in senior rights and 99,000 acre-feet in junior rights, a combination of which are typically issued to diverters. A current proposal being considered by EAA and the Texas state legislature would be to raise the pumping cap to allow all junior water rights to be converted to senior water rights (resulting in senior rights of approximately 549,000 acre-feet), then to implement drought management measures such that the pumping cap that would be no less than 340,000 acre-feet per year, even under the most severe drought conditions.<sup>32</sup>

55. The Service's recommended minimum flow guidelines for the five species, generated in response to Judge Bunton's order, have been incorporated into the EAA's drought management measures, called Demand Management/Critical Period Management Trigger Levels (DM/CPM). These DM/CPM identify minimum spring discharge rates at which mandatory aquifer-wide reductions in withdrawals will be imposed. Exhibit 2-2 presents a summary of the DM/CPM. The DM/CPM are now a key component of a draft HCP for the EAA.
56. Under the DM/CPM, Stage One restrictions begin in the San Antonio Pool (Bexar, Medina, parts of Atasca, Comal, Guadalupe, Hays, and Caldwell counties) when the aquifer level drops to 650 feet above sea level at the J-17 index well in Bexar County or if the rate of springflow drops below a certain level at either the San Marcos Springs (110 cfs) or Comal Springs (220 cfs). At Stage One, all municipal and industrial water users holding groundwater withdrawal permits and pumping more than three acre-feet annually are required to curtail their pumping and water use by five percent.<sup>33</sup> The San Antonio

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<sup>28</sup> Although the Edwards Underground Water District was created in 1959 with a charge to conserve and protect the Edwards Aquifer, it had no regulatory authority to restrict groundwater pumping from the aquifer. Accessed at <http://www.edwardsaquifer.net/rules.html> on August 21, 2006.

<sup>29</sup> Edwards Aquifer Authority, Board of Directors, Legislative Proposal memo, September 12, 2006; Personal communication with R. Ilgner, Edwards Aquifer Authority, October 11, 2006.

<sup>30</sup> The EAA permitting process allowed permits for historic water uses during the period 1972 to 1993, some of which did not reflect current use. Peer review comments of Dr. Bruce McCarl, Texas A&M University, November 6, 2006.

<sup>31</sup> Edwards Aquifer Authority Act of 1993, as amended. Appendix A, Section 1.21.

<sup>32</sup> Edwards Aquifer Authority, Board of Directors, Legislative Proposal memo, September 12, 2006.

<sup>33</sup> Edwards Aquifer Authority, Demand Management/Critical Period Management Trigger Levels, June 2006.

Water System imposes restrictions on landscape watering, car washing, use of fountains, etc, under Stage One restrictions. Additional restrictions on these activities are imposed under the three other Stages.<sup>34</sup>

**EXHIBIT 2-2. DEMAND MANAGEMENT/CRITICAL PERIOD MANAGEMENT TRIGGER LEVELS, 2006**

INDEX	MEASURE	STAGE 1	STAGE II	STAGE III	STAGE IV
J-17 Index Well	Trigger Level	650 ft	640 ft	630 ft	627 ft
	Groundwater Use Reduction	5%	10%	15%	23%
	Affected Permit Holders	M&I	M&I	M&I, Irr	M&I, Irr
San Marcos Springs	Trigger Level	110 cfs	96 cfs	80 cfs	contingent on J-17
	Groundwater Use Reduction	5%	10%	15%	
	Affected Permit Holders	M&I	M&I	M&I, Irr	M&I, Irr
Comal Springs	Trigger Level	220 cfs	154 cfs	86 cfs	contingent on J-17
	Groundwater Use Reduction	5%	10%	15%	
	Affected Permit Holders	M&I	M&I	M&I, Irr	M&I, Irr

Source: Edwards Aquifer Authority, Demand Management/Critical Period Management Trigger Levels, June 2006.  
M&I=Municipal and Industrial Water users, Irr=Irrigation users.

**CURRENT GROUNDWATER PUMPING WITHIN THE EDWARDS AQUIFER**

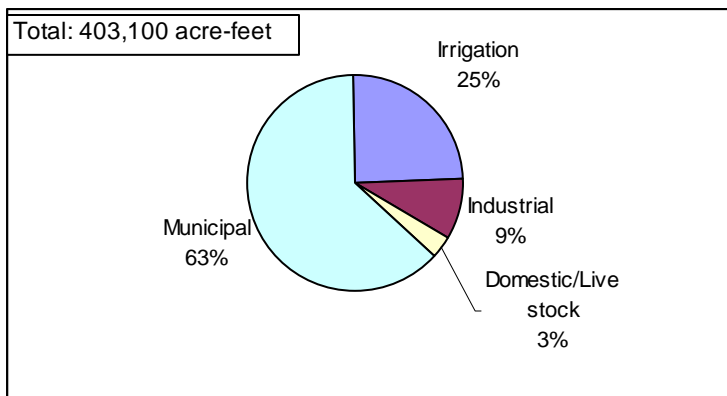
57. The South Central Texas Region, also known as Region L, is one of 16 planning regions in the State of Texas, as defined by the Texas Water Development Board. This region includes 20 counties as well as a portion of Hays County in the Guadalupe Basin. The EAA's jurisdictional area includes a portion of Region L, including Uvalde, Medina, and Bexar Counties, as well as portions of Atascosa, Comal, Hays, Caldwell, and Guadalupe Counties.
58. Although EAA has granted approximately 549,000 acre-feet in groundwater permits as of 2006, the ten-year median annual discharge to water users in the EAA's jurisdictional area (1993 to 2003) was less than this: 403,000 acre-feet,<sup>35</sup> and total water use during 2000 for the area was approximately 461,885 acre-feet.<sup>36</sup> As shown in Exhibit 2-3, median annual use by municipal water users dominated withdrawals between 1993 and 2003, comprising 63 percent of total withdrawals. Over this time period, irrigation use comprised 25 percent of total water use, while industrial use and domestic/livestock use made up 12 percent.

<sup>34</sup> Personal communication with S. Kosub, P. Shriver, and J. Cole, San Antonio Water System, August 17, 2006.

<sup>35</sup> This estimate does not include 423,2000 acre-feet in springflow discharge. Edwards Aquifer Authority, Comprehensive Water Management Plan, Adopted by the Board of Directors on December 14, 2004.

<sup>36</sup> Ibid.

**EXHIBIT 2-3. TEN YEAR MEDIAN ANNUAL EDWARDS AQUIFER GROUNDWATER DISCHARGE DISTRIBUTION WITHIN THE EDWARDS AQUIFER AUTHORITY JURISDICTIONAL AREA (1993-2003)**



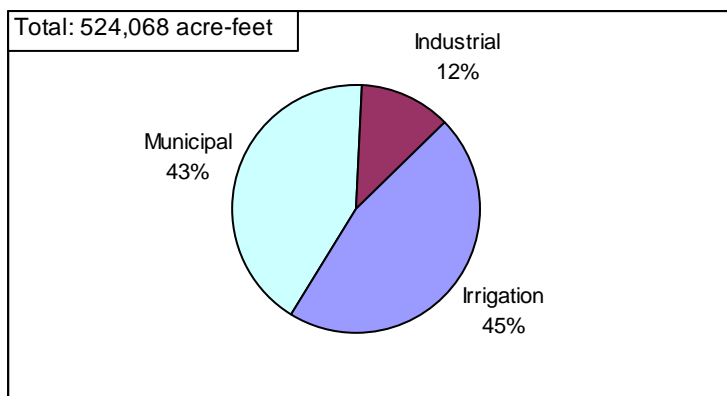
Source: Edwards Aquifer Authority, Comprehensive Water Management Plan, Adopted by the Board of Directors on December 14, 2004. Excludes unconsumed springflow discharge.

59. The distribution of groundwater permits for Edwards aquifer water is somewhat different than that of typical groundwater usage of the aquifer. As of 2004, municipal groundwater permits comprised 43 percent of groundwater permits, or approximately 233,000 acre-feet, which is actually less than the average municipal usage from 1993 to 2003 (approximately 252,000).<sup>37</sup> San Antonio Water System (SAWS), the dominant municipal water user in the Aquifer, reports that to meet current demand, SAWS supplements their permitted water rights by leasing water rights that are currently permitted for other uses.<sup>38</sup> Correspondingly, irrigation permits comprised 45 percent of total permits issued as of 2004, but irrigation water usage comprised only 25 percent of typical use.

<sup>37</sup> Presentation of Gregory Ellis, Edwards Aquifer Authority, "Edwards Aquifer: A Texas Treasure," February 15-16, 2005. [http://www.nipc.org/environment/slmrwc/conferences/5A\\_Ellis.pdf](http://www.nipc.org/environment/slmrwc/conferences/5A_Ellis.pdf)

<sup>38</sup> Personal communication with S. Kosub, P Shriver, and J. Cole, San Antonio Water System, August 17, 2006.

EXHIBIT 2-4. DISTRIBUTION OF PERMITS ISSUED BY PURPOSE OF USE THROUGH AUGUST 31, 2004 (ACRE-FEET)



Source: Presentation of Gregory Ellis, Edwards Aquifer Authority, "Edwards Aquifer: A Texas Treasure," February 15-16, 2005.

60. Since the creation of the EAA in 1996, over one thousand water rights transfers (including partial sales, leases, sub-leases, and re-sales) involving nearly 200,000 acre-feet have been recorded.<sup>39</sup> Most of these transfers (138,600 acre-feet in volume) have resulted in transfers into or within Bexar County, which includes the City of San Antonio.<sup>40</sup> Thus, it appears that many transfers are likely to have involved the transfer of agricultural water use to M&I water use. Because of the high demand of M&I use and the relatively small number of existing municipal groundwater permits, this result is not surprising.
61. If groundwater withdrawal permits are reduced to 400,000 acre-feet, some water users will lose some of their water rights (though they are likely to be compensated, as discussed in Section 2.5). It is worth noting that although permitted rights may be reduced by 27 percent, average annual usage, as gauged by the average pumped from 1993 to 2003 of 403,000 acre-feet, would be reduced significantly less than 27 percent.<sup>41</sup>
62. In addition to permitted withdrawal reductions, the DM/CPM may trigger reductions in groundwater use that would cause users to be unable to utilize other water rights during some periods of time. Appendix C presents a depiction of historic daily streamflows at Comal and San Marcos Springs, as well as Index Well J-17. Approximately 14 percent of days in the record between 1976 and 2006 at Index Well J-17 would have resulted in Stage 1 limits, or reductions of five percent of water use in the aquifer. Other Stages of DM/CPM would have resulted in limits on far less than 14 percent of days. Nonetheless, the DM/CPM would have resulted in a need for some users to seek replacement water rights or forego the use of water in some years between 1976 and 2006.

<sup>39</sup> Presentation of Gregory Ellis, Edwards Aquifer Authority, "Edwards Aquifer: A Texas Treasure," February 15-16, 2005.

<sup>40</sup> Ibid.

<sup>41</sup> Peak use, however, could be reduced by as much as 27 percent.

## 2.4 PAST ECONOMIC IMPACTS

63. While a number of past actions related to water management have been affected by endangered species concerns in the Edwards Aquifer, relatively few of these have been associated with the CSI, which were listed in 1997. In fact, only three past consultations addressed water management issues and the CSI. These past consultations are discussed in this section.
64. A November 1999 biological opinion addressed impacts of the ongoing activities and projected mission increases at four Department of Defense military installations (Fort Sam Houston, Lackland Air Force Base (AFB), Kelly AFB, and Randolph AFB) on fountain darter, Texas wild-rice, San Marcos salamander, Texas blind salamander, San Marcos gambusia, the CSI, as well as critical habitat for the fountain darter, Texas wild-rice, San Marcos salamander, and San Marcos gambusia.<sup>42</sup> A prior consultation in 1997 addressed only impacts on Kelly AFB, and was reconsidered and revised in the context of the 1999 consultation. None of the four installations are in close proximity to proposed CHD for the CSI (all are downstream). Nonetheless, the consultation addressed progressively reducing the dependence of the four installations on Edwards Aquifer groundwater between 1999 and 2003, with a goal of increasing springflow from Comal and San Marcos springs. All four installations directly withdraw water from the Edwards Aquifer. The historic average water use by the bases was estimated at 12,264 acre-feet per year between 1973 and 1993. DOD proposed implementing water conservation measures that would reduce groundwater withdrawals by reusing a portion of their waste water and through other conservation practices. Proposed measures included water conservation and reuse, analyzing the feasibility of expanding reuse lines to other areas of the bases, and reducing reliance on groundwater. Reasonable and Prudent Measures/Terms and Conditions (RPMs/TCs) the Service in their biological opinion consisted of the following:
- Implement water conservation measures that would reduce water withdrawals on the four installations to 11,830 acre-feet in 2000 and 2001 and 10,515 acre-feet in 2002 and 2003 from approximately 12,264 acre-feet;
  - Implement Drought Management Plans on each installation;
  - Partner with the appropriate parties and contribute \$262,877 to the development and/or refinement of the Edwards aquifer computer model;
  - Design a voluntary program (or partner with EAA, San Antonio Water Systems, etc.) to assist employees with achieving on and off-base water conservation;
  - Work with other water users to develop a comprehensive approach to aquifer management;

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<sup>42</sup> Service, Biological Opinion on the effects of Edwards aquifer withdrawals incidental to the combined ongoing activities and projected mission increases anticipated at four Department of Defense (DOD) military installations, November 5, 1999. Consultation #2-15-98-F-759.



- Work with other water users to find alternative sources of water that will yield longer-term, additional reductions of water withdrawals from the Edwards aquifer; and
  - Submit annual reports to the Service on progress.
65. As part of an attempt to maintain DOD water use from the Edwards aquifer within its established cap, the installations have undertaken a number of water conservation efforts, as well as studies to assess the impacts of their water use on the aquifer. Specifically, the installations report spending \$276,000 on an aquifer modeling effort to model impacts of DOD water use on Edwards aquifer water levels.<sup>43</sup> In addition, they report reinitiating the 1999 consultation three times, and preparing a new biological assessment recently for \$225,000.<sup>44</sup> The set of conservation efforts for the four military installations were undertaken for the combination of eight listed species, including the CSI.<sup>45</sup> It is therefore not possible to separate costs that were borne as a result of the CSI alone.
66. The third consultation that addressed CSI was an internal Service consultation in 1999 that addressed impacts of the Comal River Bypass Project, a project where the City of New Braunfels planned to install a gated culvert leading from Landa Lake to a bypass channel providing flow to the original Comal River channel.<sup>46</sup> Although this project occurred within the boundaries of proposed CHD for the CSI, the Service determined that it would not affect the CSI due to its location away from spring areas. Thus, the consultation focused on the endangered fountain darter and did not include RPMs or TCs for the CSI. Nonetheless, this analysis includes administrative costs of this consultation as part of past costs related to the CSI.

## 2.5 FUTURE ECONOMIC IMPACTS

67. The legislative history of endangered species management and the Edwards Aquifer creates a complex context for assessment of critical habitat impacts for the CSI. This section first discusses potential future changes to groundwater pumping from the aquifer that may occur as part of meeting requirements of the 1993 legal decision regarding the five (non-CSI) listed species, Edwards Aquifer Authority Act, and associated rules. While the 1993 lawsuit did not address CSI specifically, the CSI reside in habitat that overlaps that of species named in the lawsuit. Thus, as stated above, because habitat protections regarding water withdrawals are likely to be protective of all aquifer species, separating future costs associated with protecting CSI from costs associated with protecting the other listed species is not possible. However, should the other five species be delisted in the future, the CSI species could become primarily responsible for any restrictions.

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<sup>43</sup> Personal communication with A. Richmond, Biological Scientist, Randolph Air Force Base, October 19, 2006.

<sup>44</sup> Personal communication with A. Richmond, Biological Scientist, Randolph Air Force Base, October 19, 2006.

<sup>45</sup> Personal communication with A. Richmond, Biological Scientist, Randolph Air Force Base, October 19, 2006.

<sup>46</sup> Service, "Formal Intra-Service Biological Opinion for Comal River Bypass Project in New Braunfels, Texas," Austin Ecological Services Office, November 23, 1999. Consultation #2-15-99-F-897.

#### EXPECTED FUTURE GROUNDWATER PUMPING WITHIN THE EDWARDS AQUIFER

68. As stated above, under S.B. 1477, the EAA must reduce permitted groundwater pumping from the currently permitted levels (approximately 549,000 acre-feet per year) to 400,000 acre-feet per year by 2008. In addition, the DM/CPM levels that EAA established for the aquifer may lead to additional reductions in groundwater pumping in dry years. A current proposal being considered by EAA and the Texas state legislature would be to raise the pumping cap to allow all junior water rights to be converted to senior water rights (resulting in senior rights of approximately 549,000 acre-feet), then to implement drought management measures such that the pumping cap that would be no less than 340,000 acre-feet per year, even under the most severe drought conditions.<sup>47</sup> The South Central Texas Regional Water Planning Group (SCTRWPG) identified 340,000 acre-feet per year as a placeholder for a sustainable level of withdrawals from the Edwards Aquifer.<sup>48</sup> Thus, these two scenarios (400,000 acre-feet, Scenario 1; and 340,000 acre-feet, Scenario 2) provide useful reference points for framing the potential economic impacts of CSI-related protection efforts.
69. As noted, Jones et al. (2001) estimate the economic impacts of groundwater withdrawal limits in the Edwards Aquifer under several alternatives being considered in the formation of the now draft HCP for the EAA groundwater permit program. Two of their scenarios are of substantial relevance to this analysis, namely reductions in maximum pumping from a baseline of 513,000 acre-feet per year in 2012 to 400,000 and 340,000 acre-feet per year.<sup>49</sup> Considering its direct relevance and quality, this analysis relies on information transferred from the Jones et al. (2001) study to estimate future economic impacts.

#### EFFECT OF PUMPING LIMITS

70. Under either scenario, a number of currently permitted water rights would need to be retired, and some users may need to obtain replacement water supplies by buying permits from others. Following Jones et al. (2001) who, in turn, tried to reflect the water market provisions of the EAA Act, this analysis assumes that, "water users may buy, sell, or lease water rights, implement water conserving management practices, or acquire water from other sources to fill the deficit between their demand and their maximum withdrawal limit."<sup>50</sup>
71. The costs of reduced water availability in the Edwards aquifer will include: (1) replacement of water previously supplied by Edwards aquifer withdrawals; (2) reduced net economic benefits, or social welfare, associated with the higher water prices resulting from the increased cost of replacement water supplies; (3) changes in agricultural activity

<sup>47</sup> Personal communication with R. Ilgner, Edwards Aquifer Authority, October 11, 2006.

<sup>48</sup> South Central Texas Regional Water Planning Group, "South Central Texas Regional Water Planning Area Regional Water Plan," January 2001.

<sup>49</sup> Jones, Lonnie L., Dhazn Gillig and Bruce McCarl, "Economic Impacts of Edwards Aquifer Pumping Restriction Alternatives," Submitted to Hicks and Company for the Edwards Aquifer Authority Habitat Conservation Plan, March 15, 2001. The baseline pumping scenario was developed using the EDSIMR model.

<sup>50</sup> Ibid.

and associated regional economic impacts. These categories are addressed in turn in the following sections.

72. The Jones et al. (2001) model predicts that water users, when faced with lowered water permit availability, will sell or lease their water rights to higher-valued uses, as has occurred in water markets throughout Texas and the western United States.<sup>51</sup> In the agricultural context, this means producers would change their land uses to less water intensive enterprises such as dryland crops or livestock. The value of water in the planning area is likely to rise faster than the profitability of irrigated crops, and thus agricultural water will be traded from agriculture to municipal and industrial (M&I) use, again as been common in the western United States.<sup>52</sup>
73. In contrast to agricultural water users, municipal and industrial (M&I) users are assumed to be more likely to meet their needs by purchasing water rights, developing alternative sources of supply, and implementing water conservation strategies. Hence, reductions in Edwards aquifer withdrawals would be partially made up by new water supply options and strategies.
74. Jones et al. (2001) utilize the Edwards Aquifer Simulation Model River basin version (EDSIMR)<sup>53</sup> to simulate the effects of the alternative pumping scenarios. The authors anticipate that if water use is restricted to 400,000 acre-feet per year (Scenario 1), average municipal consumption from the aquifer would fall from 469,000 acre-feet to 324,300 acre-feet (i.e., by 144,700 acre-feet). This 324,300 acre-feet of municipal pumping from the aquifer would include 119,420 acre-feet of rights transferred from agriculture to M&I interests. M&I interests would also develop an outside supply of 72,260 acre-feet. Overall agricultural pumping is anticipated to fall by 7,700 acre-feet. The remaining rights are assumed to be retired by irrigation users who will find it profitable to sell or lease their water rights and change their land uses to less water intensive enterprises such as dryland crops or livestock.
75. Jones et al. (2001) develop the estimate of new supplies that will be sought to replace lost Edwards aquifer supply using alternatives discussed in SCTRWP's South Central Texas Regional Water Plan (2001). They anticipate that four strategies will be utilized to meet projected water replacement needs. These are: water conservation measures by municipal users (L10 Mun), water conservation measures by agricultural users (L10 Irr), transfer of

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<sup>51</sup> Ronald C. Griffin. "The Application of Water Market Doctrines in Texas." In *Markets for Water: Potential and Performance*, pp. 51-63, edited by W. Easter, M. Rosegrant, and A. Dinar. Boston: Kluwer Academic Publishers, 1998.

<sup>52</sup> The Edwards Aquifer Authority Act contains a restriction on the sale and lease of irrigation rights as follows: "A permit holder may lease permitted water rights, but a holder of a permit for irrigation use may not lease more than 50 percent of the irrigation rights initially permitted. The user's remaining irrigation water rights must be used in accordance with the original permit and must pass with transfer of the irrigated land." Jones et al. assumes that the Authority will be able to purchase and retire remaining agricultural water rights for the purposes of maintaining aquifer levels.

<sup>53</sup> The EDSIMR model was developed as an expansion of an Edwards Aquifer only model. Jones, Lonnie L., Dhazn Gillig and Bruce McCarl, "Economic Impacts of Edwards Aquifer Pumping Restriction Alternatives," Submitted to Hicks and Company for the Edwards Aquifer Authority Habitat Conservation Plan, March 15, 2001. The model is explained in Gillig, D., B.A. McCarl, and F.O. Boadu, "An Economic, Hydrologic, and Environmental Assessment of Water Management Alternative Plans for the South-Central Texas Region," *Journal of Agricultural and Applied Economics*, 33, 1 (April), 59-78, 2001.

Edwards irrigation rights to M&I use (L15), and Guadalupe diversions at Lake Dunlap (SCTN-6a). Using annual per acre-foot costs estimated by SCTRWPG or each supply alternative, this analysis develops an estimate of the cost of replacing these water rights. Costs of replacing water rights for M&I use are estimated annually at \$6.9 million under Scenario 1, or \$23.8 million under Scenario 2. These costs are summarized in Exhibit 2-5.

**EXHIBIT 2-5. COSTS ASSOCIATED WITH ALTERNATIVE MUNICIPAL AND INDUSTRIAL WATER SUPPLIES (ANNUAL)**

ALTERNATIVE WATER STRATEGY	UNIT COST OF WATER/ACRE-FOOT/YEAR	SCENARIO 1		SCENARIO 2	
		VOLUME (ACRE-FEET)	COSTS	VOLUME (ACRE-FEET)	COSTS
Water Conservation measures by municipal users (L10 Mun)	\$465	3,350	\$1,558,000	36,700	\$17,070,000
Water Conservation measures by ag users (L10 Irr)	\$64	39,720	\$2,547,000	38,980	\$2,499,000
Transfer of Edwards Irr Rights to M&I use (L15)	\$94	29,190	\$2,756,000	40,490	\$3,823,000
Guadalupe Diversions at Lake Dunlap (SCTN-6a)	\$622	-	\$0	590	\$367,000
<b>TOTAL</b>		<b>72,260</b>	<b>\$6,861,000</b>	<b>116,760</b>	<b>\$23,760,000</b>

Note: Table may not sum due to rounding.

Sources: Agricultural rights value estimate is adapted from Edwards Aquifer Authority, Draft Edwards Aquifer Habitat Conservation Plan and Draft Environmental Impact Statement, July 2004, as amended September 21, 2004. Jones, Lonnie L., Dhazn Gillig and Bruce McCarl, "Economic Impacts of Edwards Aquifer Pumping Restriction Alternatives," Submitted to Hicks and Company for the Edwards Aquifer Authority Habitat Conservation Plan, March 15, 2001. The baseline pumping scenario was developed using the EDSIMR model.

**WELFARE IMPACTS OF PUMPING REDUCTIONS ON MUNICIPAL AND INDUSTRIAL WATER USERS**

76. This section addresses impacts to M&I users of pumping restrictions under Scenarios 1 and 2. Jones et al. (2001) found that because of higher prices that are necessary to pay for alternative water supply management strategies, M&I consumers are likely to experience a loss of net economic benefits.
77. Under Scenario 1, where future pumping is restricted to 400,000 acre-feet per year, new supplies of 72,260 acre-feet per year are likely to be needed for M&I use. As described in Exhibit 2-5, L10 MUN, L10 IRR and L15 pumping strategies are likely to be implemented to fill these supply needs. Using EDSIMR, Jones et al. (2001) estimate that these strategies would result in water prices rising \$0.26 to \$0.29 per 1000 gallons (2006 dollars). Net economic benefits from M&I water use are estimated to decline from \$1.105 billion to \$1.103 billion in 2006 dollars (a reduction of \$1.1 million).
78. Under Scenario 2, where future pumping is restricted to 340,000 acre-feet per year, new supplies of 116,760 acre-feet per year are likely to be needed for M&I use. As described in Exhibit 2-5, pumping strategies L10 MUN, L10 IRR, L15, and SCTN-6a are likely to

be implemented to fill these supply needs. Using EDSIMR, Jones et al. estimate that these strategies would result in water prices rising \$0.89 to \$0.91 per 1,000 gallons (2006 dollars). Net economic benefits from M&I water use are estimated to decline from \$1.1015 billion to \$1.097 billion million in 2006 dollars (reduction of \$8 million).

**EXHIBIT 2-6. CHANGE IN REGIONAL WATER PRICE RESULTING FROM PUMPING RESTRICTIONS ON M&I WATER USERS (2006 DOLLARS)**

	BASELINE	SCENARIO 1		SCENARIO 2	
	PRICE / 1000 GAL	PRICE / 1000 GAL	CHANGE	PRICE / 1000 GAL	CHANGE
Western Region	\$2.05	\$2.32	\$0.26	\$2.95	\$0.89
Central Region	\$2.06	\$2.32	\$0.27	\$2.96	\$0.90
Eastern Region	\$2.45	\$2.74	\$0.29	\$3.36	\$0.91

Note: The baseline pumping scenario was developed using the EDSIMR model. There are 325,851 gallons per acre-foot of water. Cost estimates are inflated to 2006 dollars using the GDP deflator. Source: IEC analysis and Jones, Lonnie L., Dhazn Gillig and Bruce McCarl, "Economic Impacts of Edwards Aquifer Pumping Restriction Alternatives," Submitted to Hicks and Company for the Edwards Aquifer Authority Habitat Conservation Plan, March 15, 2001.

**EXHIBIT 2-7. LOSS IN REGIONAL NET ECONOMIC BENEFITS RESULTING FROM PUMPING RESTRICTIONS ON M&I WATER USERS (2006 DOLLARS)**

	BASELINE	SCENARIO 1		SCENARIO 2	
	NET ECONOMIC BENEFITS	NET ECONOMIC BENEFITS	CHANGE	NET ECONOMIC BENEFITS	CHANGE
Municipal users	\$1,014,580,000	\$1,013,442,000	-\$1,138,000	\$1,008,887,000	-\$5,693,000
Industrial users	\$89,957,000	\$89,957,000	\$0	\$87,680,000	-\$2,277,000
<b>Total</b>	<b>\$1,104,537,000</b>	<b>\$1,103,399,000</b>	<b>-\$1,138,000</b>	<b>\$1,096,567,000</b>	<b>-\$7,970,000</b>

Note: The baseline pumping scenario was developed using the EDSIMR model. There are 325,851 gallons per acre-foot of water. Cost estimates are inflated to 2006 dollars using the GDP deflator. Source: IEC analysis and Jones, Lonnie L., Dhazn Gillig and Bruce McCarl, "Economic Impacts of Edwards Aquifer Pumping Restriction Alternatives," Submitted to Hicks and Company for the Edwards Aquifer Authority Habitat Conservation Plan, March 15, 2001.

**REGIONAL ECONOMIC IMPACTS OF PUMPING REDUCTIONS ON IRRIGATION USERS**

79. The previous sections discussed the replacement cost of Edwards Aquifer water, as well as the reduction in net economic benefits associated with increased M&I water prices. In contrast, this section addresses the regional economic impacts (e.g., employment, wages and output) associated with reduced irrigated agricultural output following transfer of water to higher-valued uses.
80. As stated above, Jones et al. (2001) predict that, if pumping is restricted, irrigated crop acreage will shift to dryland production.<sup>54</sup> Specifically, the study found that:

<sup>54</sup> The Edwards Aquifer Authority Act contains a restriction on the sale and lease of irrigation rights as follows: "A permit holder may lease permitted water rights, but a holder of a permit for irrigation use may not lease more than 50 percent of the irrigation rights initially permitted. The user's remaining irrigation water rights must be used in accordance with the



- Regional irrigated crop acreage (in 2012) would have been 93,254 acres if no pumping limits were imposed, dominated by feed grains (primarily corn and grain sorghum) and vegetables;
- The reduction in irrigated acres would result in a loss in farmer income, as dryland and livestock alternatives are less profitable on a per acre basis. Further, if water rights are sold or leased, other production resources (land, capital, labor, and management) would need to be put to alternate uses or idled;
- Hired seasonal and part-time farm workers would likely be first and most directly impacted by cessation of irrigated crop production;
- Farm operators who lease land for irrigated crop production would likely be displaced, with limited opportunities for alternative employment of their capital, management, and labor;
- Leasing or selling of water rights would generate income to landowners, but "would not provide the same level of economic support as irrigated farming to the region." These payments would be comparable to transfer payments from other sources;
- If absentee landowners hold a significant portion of rights, these payments may exit the area and have no local impact;
- Businesses that are dependent on the irrigated crops sector would suffer a reduction in demand for their goods. Most directly affected would be irrigation equipment suppliers, machinery and equipment dealers, suppliers of seed, fertilizer, and chemicals, banks and financial institutions, as well as cotton ginneries, grain elevators, and other first stage processing businesses;
- Many of the job losses may be relatively low-paying and occupied by persons with limited skills and alternative employment opportunities. Without a substitute for irrigated crops, and out-migration of laborers and their families could occur; and

81. Higher springflow levels are anticipated to contribute to river flows downstream of the aquifer. Municipalities, industries, and farmers who use river water are anticipated to have more available water supply. However, Jones et al. (2001) state that whether the users will use the water to an economic benefit depends on a "myriad of economic variables that are beyond the scope of this report." It is important to note that increased springflows are likely to generate potentially significant ecological or recreational *benefits*. This point is also recognized explicitly in the Gillig et al. (2004) *Water Resources Research* article. While qualitatively noteworthy, it is beyond the scope of this analysis, and available information, to attempt to estimate the physical, behavioral and economic implications of such increased flows.
82. Under Scenario 1, irrigated acreage is estimated to be 60,228 acres (a reduction of 33,026 from without pumping limits). Virtually all of the irrigation water rights in the Central

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original permit and must pass with transfer of the irrigated land." Jones et al. assumes that the Authority will be able to purchase and retire remaining agricultural water rights for the purposes of maintaining aquifer levels.

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and Eastern regions are predicted to transfer to other uses, or be retired by 2012.<sup>55</sup> Little impact on the Western Region would occur. Labor employment is predicted to fall by 578 jobs (9 percent of irrigation related employment with no pumping restrictions). Regional labor income related to irrigated agriculture would decline by \$6.8 million (11 percent). Gross regional product of irrigated agriculture would decline by \$12.5 million (10 percent).

83. Under Scenario 2, irrigated acreage is estimated to be 58,386 acres (a reduction of 34,868 from without pumping limits).<sup>56</sup> Similar to Scenario 1, virtually all of the irrigation water rights in the Central and Eastern regions are predicted to transfer to other uses, or be retired.<sup>57</sup> Little impact on the Western Region would occur. Labor employment is predicted to fall by 623 jobs (10 percent of irrigation related employment with no pumping restrictions). Regional labor income related to irrigated agriculture would decline by \$8.0 million (13 percent). Gross regional product of irrigated agriculture would decline by \$13.7 million (10 percent). These findings are summarized in Exhibit 2-8.

**EXHIBIT 2-8. REGIONAL ECONOMIC IMPACTS OF PUMPING RESTRICTIONS ON AGRICULTURAL WATER USERS (2006 DOLLARS)**

	BASELINE	SCENARIO 1		SCENARIO 2	
		TOTAL	CHANGE	TOTAL	CHANGE
Irrigated agricultural lands (acres)	93,254	60,228	-33,026	58,386	-34,868
Labor employment in ag sector (2012)	6,156	5,578	-578	5,533	-623
Regional labor income in ag sector (2012)	\$62,628,000	\$55,796,000	-\$6,832,000	\$54,658,000	-\$7,970,000
Gross regional product (2012)	\$130,950,000	\$118,425,000	-\$12,525,000	\$117,286,000	-\$13,664,000

Source: Jones, Lonnie L., Dhazn Gillig and Bruce McCarl, "Economic Impacts of Edwards Aquifer Pumping Restriction Alternatives," Submitted to Hicks and Company for the Edwards Aquifer Authority Habitat Conservation Plan, March 15, 2001. The baseline pumping scenario was developed using the EDSIMR model. Costs estimates are inflated to 2006 dollars using the GDP deflator.

<sup>55</sup> See footnote above.

<sup>56</sup> See footnote above.

<sup>57</sup>The HCP Planning area, and study area for the analysis, includes 17 counties in south-central Texas. These are grouped into four regions: Western (Edwards, Kinney, Real, and Uvalde), Central (Atascosa, Medina), Eastern (Bexar, Caldwell, Comal, Guadalupe, Hays, Kendall), Downstream (Calhoun, Dewitt, Gonzales, Refugio, Victoria).

## CHAPTER 3 | POTENTIAL IMPACTS ON OTHER ECONOMIC ACTIVITIES

84. This section discusses impacts of CSI conservation activities on construction, development, water quality, and other activities taking place within and adjacent to proposed critical habitat. The first section provides a summary of the impacts of all of the above mentioned activities. The following sections discuss affected activities in each unit and the costs associated with those activities.

### 3.1 SUMMARY OF IMPACTS

85. Total past costs (1997-2006) of project modifications for projects related to the CSI are estimated at \$328,000 (2006 dollars, discounted at seven percent), as presented in Exhibit 3-1. These costs are associated with a dam repair project in the Comal Springs unit. Total future costs of project modifications for other activities are estimated to be \$252,000 (2006 dollars discounted at seven percent). These costs are expected to be incurred in the San Marcos and Comal Springs units for conservation actions undertaken for the CSI during development activities as well as for an aquatic restoration project. No future costs are anticipated for the two remaining privately owned units, Fern Bank Springs and Hueco Springs.
86. This analysis also includes estimates of administrative costs of conducting section 7 consultations on the CSI for activities other than water management. Total future administrative costs are estimated at \$795,000 (2006 dollars, discounted at three percent) for these activities. Administrative costs are detailed in Appendix A.

EXHIBIT 3-1. SUMMARY OF PAST AND FUTURE IMPACTS BY UNIT

UNIT	PAST COSTS (1997-2006)			FUTURE COSTS (2007-2026)		
	UNDISCOUNTED	3% DISCOUNT RATE	7% DISCOUNT RATE	UNDISCOUNTED	3% DISCOUNT RATE	7% DISCOUNT RATE
San Marcos Springs	\$0	\$0	\$0	\$140,000	\$130,000	\$118,000
Comal Springs	\$250,000	\$281,000	\$328,000	\$253,000	\$188,000	\$134,000
Hueco Springs	\$0	\$0	\$0	\$0	\$0	\$0
Fern Bank Springs	\$0	\$0	\$0	\$0	\$0	\$0
<b>Total</b>	<b>\$250,000</b>	<b>\$281,000</b>	<b>\$328,000</b>	<b>\$393,000</b>	<b>\$318,000</b>	<b>\$252,000</b>

Note: Totals may not sum due to rounding.

### 3.2 SAN MARCOS SPRINGS

87. The San Marcos Springs unit includes the surface area of Spring Lake in Hays County. The unit is entirely state-owned as part of the Texas Rivers Center Aquarena Center, owned and operated by Texas State University as a non-profit nature center. Spring Lake provides habitat for five other federally listed species: the fountain darter, the San Marcos gambusia, the San Marcos salamander, the Texas blind salamander, and the Texas wild-rice. As discussed in Section 2, this unit has been included in litigation regarding spring flow requirements for these species. Because Spring Lake is a protected area that serves a public function to educate the public about spring systems and endangered species, few active land uses of the area current appear to threaten the 3 CSI (other than water withdrawals, which are discussed in Section 2).
88. In 2001, following a flood event in 1998, Texas State University repaired the impoundment dam on the San Marcos River downstream from Spring Lake with assistance from USACE and FEMA. The dam was originally built in 1849 to form Spring Lake. It is approximately 440 feet long and between eight and 15 feet high. This project was not located within proposed critical habitat for the 3 CSI, and surveys done at the time indicated the CSI were not present within the action area of the project. Therefore, no costs from this project have been attributed to the species.
89. A second project with USACE to restore the aquatic ecosystem at Spring Lake is expected to go forward in 2008 or 2009.<sup>58</sup> This project will involve the demolition of several existing buildings at the nature center, the removal of the submarine theater and underwater structures, and the removal of exotic, terrestrial plant species. The Service consulted on the project in 2005, but the project currently is on hold for funding reasons.<sup>59</sup> USACE estimates total costs of restoration efforts at \$1.8 million (undiscounted, see Exhibit 3-2). Of that \$1.8 million, USACE estimates that approximately \$140,000 (undiscounted) will be used for species protection measures such as reducing sedimentation, monitoring, appropriate equipment staging, and minimizing disturbance to the water.<sup>60</sup> These costs are included as potential costs associated with the CSI. This analysis estimates that as many as three extensions or reinitiations of this consultation may occur in the next 20 years. Thus, administrative cost estimates for this unit include costs associated with these potential future consultations.

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<sup>58</sup> Personal communication with Jeff Tripe, USACE Fort Worth District, October 3, 2006.

<sup>59</sup> See Consultation # 02-15-F-2005-0087, "Aquatic Ecosystem Restoration at Spring Lake."

<sup>60</sup> See Appendix K (Project Costs) of the Spring Lake Integrated Detailed Project Report and Environmental Assessment, available at <http://www.swf.usace.army.mil/pubdata/notices/SpringLake/index.asp>.

## EXHIBIT 3-2. COSTS OF THE AQUATIC ECOSYSTEM RESTORATION PROJECT

PROJECT DESCRIPTION	PROJECT COSTS (UNDISCOUNTED)
Building Demolition	\$823,576
<b>Species Protection Measures</b>	<b>\$140,000</b>
Installation of Restrooms, Creation of Trails, Exotic Plant Removal, etc.	\$307,877
Spec Costs	\$91,850
33% Contingencies	\$450,073
<b>Total</b>	<b>\$1,813,930</b>

SOURCE: Appendix K (Project Costs) of the Spring Lake Integrated Detailed Project Report and Environmental Assessment, available at <http://www.swf.usace.army.mil/pubdata/notices/SpringLake/index.asp>.

### 3.3 COMAL SPRINGS

90. The Comal Springs Unit is composed primarily of Landa Lake and the aquatic habitat surrounding the lake, including its confluence with Spring Run Number One. The southern portion of the lake, including the areas that contain the primary springs where 3 CSI are found, is managed by the City of New Braunfels as a public park and golf course. Land ownership for the unit is a mix of private, municipal, and State holdings.
91. In 2001, FEMA, USACE, and the City of New Braunfels consulted with the Service regarding repairs to Landa Lake Dam (located at the southern end of the Lake) and to the retaining walls surrounding Landa Lake. In the consultation, the Service required FEMA and USACE to adhere to various measures deemed "reasonable and prudent" such as minimizing disturbance to the water body, monitoring the area for endangered species, proper equipment staging, and best management practices to reduce sedimentation. Because these measures are similar to those required for the Spring Lake Dam project, this analysis uses the project costs for the Spring Lake dam repair of \$250,000 (undiscounted)<sup>61</sup> to estimate the cost of the Landa Lake dam repair. This represents the cost of the entire dam repair and may therefore overstate the costs of measures taken specifically to protect the CSI.
92. Based on past consultation history, this analysis anticipates that a future consultation with the Service regarding Landa Lake Dam and further repairs to the dam is likely to occur in the next 20 years. A future project modification cost of \$250,000 (undiscounted) is therefore applied to this unit associated with potential future dam repairs. The costs associated with consultation are detailed in Appendix A.
93. In addition, this analysis anticipates that some single family home development will take place on the private lands at the northern end of Landa Lake. The area is zoned for single-family residential (R-1), single or two-family residential (R-2), or resort commercial (C-4) use.<sup>62</sup> Private development of lands on the northwest side of the lake

<sup>61</sup> "SWT begins Spring Lake Dam repairs," Texas State University. Accessed at: <http://www.mrp.txstate.edu/mrp/relations/NewsReleases/2001/05/4n1.html> on October 3, 2006.

<sup>62</sup> "Black and White Zoning Map," City of New Braunfels Planning Department. Accessed at: <http://www.nbtexas.org/planning/Zoning%20Maps/zoningbw.pdf> on October 3, 2006.



occurs on top of a steep cliff above the lake and, therefore, falls outside of proposed critical habitat. Approximately 26 parcels on the northeast side of the Lake abut the proposed CHD (see Exhibit 3-2). Of these parcels, two parcels are currently undeveloped.<sup>63</sup>

### EXHIBIT 3-3. PARCELS SURROUNDING LANDA LAKE



Note: Red highlighting indicates vacant parcels

94. This analysis assumes that these two parcels will be developed within the next twenty years and that developers will have to undertake conservation activities similar to those for the Spring Lake aquatic ecosystem restoration project. Based on those costs, species protection measures are anticipated to cost \$3,500 per acre.<sup>64</sup> The total area of the two undeveloped parcels is approximately three-quarters of an acre, resulting in a total cost to potential landowners or developers of approximately \$2,590 (undiscounted, or \$1,370 discounted at seven percent).

<sup>63</sup> "Comal County GIS," Comal County Engineers Office. Accessed at: <http://www.co.comal.tx.us/gis/website/comal14/Run.htm> on October 3, 2006.

<sup>64</sup> Total species protection measures for the Spring Lake Aquatic Restoration Project are estimated at \$140,000. The project covers a total acreage of 40 acres, resulting in a cost of \$3,500 per acre.



### 3.4 HUECO SPRINGS

95. The main outlet of Hueco Springs occurs on undeveloped private land. A second set of springs occurs within an undeveloped area of a campground that is owned by the same private landowner. The landowner is contemplating several potential projects for the main outlet area over the long term, including constructing a riverwalk type development and damming Elm Creek, which terminates in the headwaters of the springs. For the springs located in the campground area, the landowner is thinking about possibly increasing the number of RV hookups available at the campground.<sup>65</sup> It is not known which (if any) of these projects are likely to go forward in the future. Because of the uncertainty associated with future projects, both in terms of planning and in terms of potential Service involvement, this analysis does not attribute any costs to possible future actions in this unit.

### 3.5 FERN BANK SPRINGS

96. The Fern Bank Springs unit also occurs entirely on private land. This unit consists of a main outlet and a number of seep springs that occur at the base of a bluff overlooking the Blanco River. Currently, the main outlet serves as a water source for a single family residence on the property. It appears that no plans exist to further utilize the spring water, or to further develop the private parcel. Therefore, no costs have been estimated for this unit.

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<sup>65</sup> Personal communication with Robert Pfueller, August 9, 2006.

## APPENDIX A | ADMINISTRATIVE COSTS

97. This appendix presents administrative costs of actions taken under section 7 of the Act associated with the geographic area proposed as critical habitat for the CSI. First, this Appendix defines the types of administrative costs likely to be associated with the proposed habitat. Next, the Appendix presents estimates of the number of technical assistance efforts and consultations likely to result from the designation of critical habitat and/or the listing of the CSI, as well as the per-unit costs of each of these activities. Based on this analysis, estimates of past and future administrative costs are derived.

### A.1 CATEGORIES OF ADMINISTRATIVE COSTS

98. The following section provides an overview of the categories of administrative cost impacts that arise due to the implementation of section 7 in the geographic area proposed as critical habitat for the CSI.

#### TECHNICAL ASSISTANCE

99. Frequently, the Service responds to requests for technical assistance from State agencies, local municipalities, and private landowners and developers who may have questions regarding whether specific activities may affect critical habitat. Technical assistance costs represent the estimated economic costs of informational conversations between these entities and the Service regarding the designation of critical habitat for the CSI. Most likely, such conversations will occur between municipal or private property owners and the Service regarding lands designated as critical habitat or lands adjacent to critical habitat. The Service's technical assistance activities are voluntary and generally occur in instances where a Federal nexus does not exist.

#### SECTION 7 CONSULTATIONS

100. Section 7(a)(2) of the Act requires Federal agencies (Action agencies) to consult with the Service whenever activities that they undertake, authorize, permit, or fund may affect a listed species or designated critical habitat. There are two scenarios under which the designation of critical habitat can result in section 7 consultations with the Service beyond those required by the listing. These include:
- New consultations, which can occur when activities involving a Federal nexus are proposed in critical habitat not thought to be currently occupied by the species; and
  - Re-initiations of consultations, which result when consultations that previously occurred under the listing are re-initiated due to new information or circumstances generated by the designation.

In some cases, consultations will involve the Service and another Federal agency only, such as the U.S. Forest Service. More often, they will also include a third party involved in projects on non-Federal lands with a Federal nexus, such as state agencies and private landowners.

101. During a consultation, the Service, the Action agency, and the landowner manager applying for Federal funding or permitting (if applicable) communicate in an effort to minimize potential adverse effects to the species and/or to the proposed critical habitat. Communication between these parties may occur via written letters, phone calls, in-person meetings, or any combination of these. The duration and complexity of these interactions depends on a number of variables, including the type of consultation, the species, the activity of concern, and the potential effects to the species and designated critical habitat associated with the activity that has been proposed, the Federal agency, and whether there is a private applicant involved.
102. Section 7 consultations with the Service may be either informal or formal. *Informal consultations* consist of discussion between the Service, the Action agency, and the applicant concerning an action that may affect a listed species or its designated critical habitat. The process is designed to identify and resolve potential concerns at an early stage in the planning process. By contrast, a *formal consultation* is required if the Action agency determines that its proposed action may or will adversely affect the listed species or designated critical habitat in ways that cannot be resolved through informal consultation. The formal consultation process results in the Service's determination in its Biological Opinion of whether the action is likely to jeopardize a species or adversely modify critical habitat, and recommendations to minimize those impacts. Regardless of the type of consultation or proposed project, section 7 consultations can require substantial administrative effort on the part of all participants.

#### A.2 ESTIMATED COSTS OF CONSULTATIONS AND TECHNICAL ASSISTANCE

103. Estimates of the cost of an individual consultation and technical assistance request were developed from a review and analysis of historical section 7 files from a number of Service field offices around the country conducted in 2002. These files addressed consultations conducted for both listings and critical habitat designations. Cost figures were based on an average level of effort of low, medium, or high complexity, multiplied by the appropriate labor rates for staff from the Service and other Federal agencies.
104. The administrative costs estimates presented in this section take into consideration the level of effect of the Service, the Action agency, and the applicant, as well as the varying complexity of the consultation or the technical assistance request. Costs associated with these consultations include the administrative costs associated with conducting the consultations, such as the costs of time spent in meetings, preparing letters, and the development of a biological opinion. Exhibit A-1 provides a summary of the estimated administrative costs of consultations and technical assistance requests.

**EXHIBIT A-1. ESTIMATED ADMINISTRATIVE COSTS OF CONSULTATION AND TECHNICAL ASSISTANCE EFFORTS (PER EFFORT) (\$2006)**

CONSULTATION TYPE	SERVICE	ACTION AGENCY	THIRD PARTY	BIOLOGICAL ASSESSMENT
Technical Assistance	\$520	N/A	\$1,050	N/A
Informal Consultation	\$2,250	\$2,900	\$2,050	\$2,000
Formal Consultation	\$5,050	\$5,750	\$3,500	\$4,800

Source: IEC analysis based on data from the Federal Government Schedule Rates, Office of Personnel Management, 2006, a review of consultation records from several Service field offices across the country. Confirmed by local Action agencies.

**A.3 SUMMARY OF PAST ADMINISTRATIVE COSTS**

105. Since the listing of the CSI in 1997, there have been six formal section 7 consultations in the geographic area proposed as critical habitat for the CSI.
106. As shown in Exhibit A-2, past administrative costs are estimated at \$555,000. Administrative costs resulting from past formal consultations are estimated to have been between \$87,000 while informal consultations and technical assistance requests are estimated to have cost between \$468,000 since the listing of the species.<sup>66</sup>

**A.4 SUMMARY OF FUTURE ADMINISTRATIVE COSTS**

107. This analysis assumes that the rate of consultation will increase slightly after the designation of critical habitat. As shown in Exhibit A-4, future administrative costs are estimated at \$1.2 million, assuming a three percent discount rate over twenty years, or an annualized value of \$108,000 (discounted at three percent).

**A.5 CAVEATS**

108. The number of consultations and technical assistance efforts to be undertaken in the future for activities within a given complex is highly uncertain. The frequency of such efforts will be related to the level of economic activity, the presence of HCPs or other regional plans that obviate the need for consultation, and the extent to which economic activity overlaps with critical habitat. To the extent that this analysis over or underestimates the number of these efforts in the future, estimated costs will be over or understated.

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<sup>66</sup> To estimate the number of informal consultations, a ratio of informal consultations to formal consultations of 2.4 to 1 was used. This ratio was based on comparing the average number of informal consultations per year to the average number of formal consultations per year. To estimate the number of technical assistance requests, a ratio of technical assistance requests to formal consultations of 3 to 1 was used. This ratio was based on information provided by the Service for the Southwestern willow flycatcher EA.

## EXHIBIT A-2. PAST ADMINISTRATIVE COSTS BY RIVER SEGMENT AND BY ACTIVITY, 1997-2006, \$2006

UNIT	TYPE OF CONSULT	WATER USE	WATER QUALITY	EXCAVATION / CONSTRUCTION	TOTAL	TOTAL COSTS
San Marcos Springs	Formals	0	0	1	1	\$14,500
	Informals	0	0	8	8	\$60,000
	Technical Assistance	0	0	12	12	\$18,000
	<b>Subtotal</b>				<b>21</b>	<b>\$92,500</b>
Comal Springs	Formals	1	0	1	2	\$29,000
	Informals	8	0	8	16	\$120,000
	Technical Assistance	12	0	12	24	\$36,000
	<b>Subtotal</b>				<b>42</b>	<b>\$185,000</b>
Hueco Springs	Formals	0	0	0	0	\$0
	Informals	0	0	0	0	\$0
	Technical Assistance	0	0	0	0	\$0
	<b>Subtotal</b>				<b>0</b>	<b>\$0</b>
Fern Bank Springs	Formals	0	0	0	0	\$0
	Informals	0	0	0	0	\$0
	Technical Assistance	0	0	0	0	\$0
	<b>Subtotal</b>				<b>0</b>	<b>\$0</b>
Multiple	Formals	1	2	0	3	\$43,500
	Informals	8	16	0	24	\$180,000
	Technical Assistance	12	24	0	36	\$54,000
	<b>Subtotal</b>				<b>63</b>	<b>\$277,500</b>
<b>Total</b>	Formals	2	2	2	6	\$87,000
	Informals	16	16	16	48	\$360,000
	Technical Assistance	24	24	24	72	\$108,000
<b>Total Costs</b>		<b>\$185,000</b>	<b>\$185,000</b>	<b>\$185,000</b>	<b>\$555,000</b>	<b>\$555,000</b>

Note: Based on discussions with the Service, for technical assistance, a ratio of technical assistance requests to formal consultations of 12 to 1 is assumed. For informal consultations, a ratio of informal consultations to formal consultations of 8 to 1 is assumed.

## A-3. FUTURE ADMINISTRATIVE COSTS BY REACH AND BY ACTIVITY (2007-2026), \$2006

UNIT	TYPE OF CONSULT	WATER WITHDRAWALS	WATER QUALITY	EXCAVATION / CONSTRUCTION	TOTAL	TOTAL COSTS
San Marcos Springs	Formals	0	0	3	3	\$41,889
	Informals	0	0	23	23	\$173,333
	Technical Assistance	0	0	35	35	\$52,000
				<b>Subtotal</b>	<b>61</b>	<b>\$267,222</b>
Comal Springs	Formals	3	0	3	6	\$83,778
	Informals	23	0	23	46	\$346,667
	Technical Assistance	35	0	35	69	\$104,000
				<b>Subtotal</b>	<b>121</b>	<b>\$534,444</b>
Hueco Springs	Formals	0	0	0	0	\$0
	Informals	0	0	0	0	\$0
	Technical Assistance	0	0	0	0	\$0
				<b>Subtotal</b>	<b>0</b>	<b>\$0</b>
Fern Bank Springs	Formals	0	0	0	0	\$0
	Informals	0	0	0	0	\$0
	Technical Assistance	0	0	0	0	\$0
				<b>Subtotal</b>	<b>0</b>	<b>\$0</b>
Multiple	Formals	3	6	0	9	\$125,667
	Informals	23	46	0	69	\$520,000
	Technical Assistance	35	69	0	104	\$156,000
				<b>Subtotal</b>	<b>182</b>	<b>\$801,667</b>
Total	Formals	6	6	6	17	\$251,333
	Informals	46	46	46	139	\$1,040,000
	Technical Assistance	69	69	69	208	\$312,000
	<b>Total Costs</b>	<b>\$534,444</b>	<b>\$534,444</b>	<b>\$534,444</b>	<b>\$1,603,333</b>	<b>\$1,603,333</b>

Note: Totals may not sum due to rounding



## EXHIBIT A-4. TOTAL FUTURE ADMINISTRATIVE COSTS, 2007-2026

UNIT	UNDISCOUNTED DOLLARS	PRESENT VALUE 3%	PRESENT VALUE 7%	ANNUALIZED 3%	ANNUALIZED 7%
San Marcos Springs	\$267,000	\$199,000	\$141,000	\$18,000	\$25,000
Comal Springs	\$534,000	\$397,000	\$283,000	\$36,000	\$50,000
Hueco Springs	\$0	\$0	\$0	\$0	\$0
Fern Bank Springs	\$0	\$0	\$0	\$0	\$0
Multiple	\$802,000	\$597,000	\$425,000	\$54,000	\$76,000
<b>Total</b>	<b>\$1,603,000</b>	<b>\$1,192,000</b>	<b>\$849,000</b>	<b>\$108,000</b>	<b>\$151,000</b>

Note: Totals may not sum due to rounding.

## APPENDIX B | SMALL BUSINESS ANALYSIS AND ENERGY IMPACT ANALYSIS

109. This appendix considers the extent to which the impacts discussed in the previous Sections could be borne by small businesses and the energy industry. The analysis presented in Section B.1 is conducted pursuant to the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996. Information for this analysis was gathered from the Small Business Administration (SBA), U.S. Census Bureau, and the Risk Management Association (RMA). The energy analysis in Section B.2 is conducted pursuant to Executive Order No. 13211.

### B.1 IMPACTS TO SMALL ENTITIES

110. When a Federal agency proposes regulations, the RFA requires the agency to prepare and make available for public comment an analysis that describes the effect of the rule on small entities (i.e., small businesses, small organizations, and small government jurisdictions).<sup>67</sup> No initial regulatory flexibility analysis (IRFA) is required if the head of an agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. SBREFA amended the RFA to require Federal agencies to provide a statement of the factual basis for certifying that a rule will not have significant economic impact on a substantial number of small entities. To assist in this process, this appendix provides a screening level analysis of the potential for CSI conservation efforts to affect small entities.

#### B.1.1 SUMMARY OF IMPACTS ON SMALL ENTITIES

111. This screening analysis is based on the estimated impacts associated with the proposed rulemaking as described in Chapters 2 and 3 of this analysis. The analysis evaluates the potential for economic impacts related to several land use categories, including:

- Aquatic restoration
- Water use
- Construction/development

112. Aquatic restoration activities are not anticipated to affect small entities as these activities will be carried out by a Federal Agency (USACE).

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<sup>67</sup> 5 U.S.C. 601 et seq.

113. As detailed in Chapter 2, two types of economic impacts associated with changes in water use (i.e., pumping restrictions) are quantified: 1) welfare impacts to municipal and industrial water consumers associated with higher water prices; and 2) changes in agricultural activity and associated regional impacts.
114. The first of these categories of impact are expected to be borne indirectly by municipal and industrial water consumers. Impacts of restrictions on pumping may manifest in higher regional water prices. The welfare impacts of these restrictions would therefore be distributed among both municipal consumers (not considered small businesses) and industry in the region. While this analysis describes that an estimated nine percent of the Edwards Aquifer groundwater discharge is consumed by industrial users, the total number of industrial users, by industry type and size is uncertain.<sup>68</sup>
115. The second category of impacts associated with changes in water use are borne indirectly by the regional industries associated with irrigated agriculture. This analysis assumes that, as a result of increased pumping restrictions, increased water prices will make it more profitable for farmers to choose to sell their water rights, switching to less water-intensive farming, rather than continuing to rely on water as an input to their production. In this scenario, no impacts are forecast to be borne by farmers as they are compensated for their water rights. Indirect impacts, however, may be experienced by regional industries associated with irrigated agriculture. That is, decreased agricultural output in the regional economy may affect businesses that provides goods and services to the irrigated agriculture industry. This impact is not a direct result of increased pumping restrictions, however, and is distributed among multiple industries and businesses in the region. How those impacts may be distributed among businesses of specific types and sizes, and whether impacts at this indirect level would be observable or diluted by the number of industries and businesses affected, is uncertain.
116. This screening analysis therefore focuses on economic impacts resulting from modifications to construction and development activities. Exhibit B-1 summarizes the estimated impacts to small entities described in detail in the remainder of this appendix.

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<sup>68</sup> Edwards Aquifer Authority, Comprehensive Water Management Plan, Adopted by the Board of Directors on December 14, 2004.

## EXHIBIT B-1. SUMMARY OF IMPACTS TO SMALL ENTITIES

ACTIVITY	TOTAL NUMBER OF AFFECTED SMALL ENTITIES	PERCENTAGE OF TOTAL SMALL ENTITIES THAT ARE EXPECTED TO BE AFFECTED	ESTIMATED IMPACT PER SMALL ENTITY	PERCENTAGE IMPACT PER SMALL ENTITY
Construction and Development	1 developer	0.3 percent of all small developers	\$44 - \$85	<0.001 percent of total sales

## B.1.2 DETAILED ANALYSIS OF IMPACTS TO SMALL ENTITIES

117. This analysis is intended to improve the Service's understanding of the effects of the proposed rule on small entities and to identify opportunities to minimize these impacts in the final rulemaking.
118. The Endangered Species Act (Act) requires the Service to designate critical habitat for threatened and endangered species to the maximum extent prudent and determinable. Section 4(b)(2) of the Act requires that the Service designate critical habitat "on the basis of the best scientific data available and after taking into consideration the economic impact, the impact on national security, and any other relevant impacts, of specifying any particular area as critical habitat." This section grants the Secretary [of Interior] to exclude any area from critical habitat if (s)he determines "the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat". The Secretary's discretion is limited, as (s)he may not exclude areas if so doing "will result in the extinction of the species."
119. Three types of small entities are defined in the RFA:
- Small Business - Section 601(3) of the RFA defines a small business as having the same meaning as small business concern under section 3 of the Small Business Act. This includes any firm that is independently owned and operated and is not dominant in its field of operation. The U.S. Small Business Administration (SBA) has developed size standards to carry out the purposes of the Small Business Act, and those size standards can be found in 13 CFR 121.201. The size standards are matched to North American Industry Classification System (NAICS) industries. The SBA definition of a small business applies to a firm's parent company and all affiliates as a single entity.
  - Small Governmental Jurisdiction - Section 601(5) defines small governmental jurisdictions as governments of cities, counties, towns, townships, villages, school districts, or special districts with a population of less than 50,000. Special districts may include those servicing irrigation, ports, parks and recreation, sanitation, drainage, soil and water conservation, road assessment, etc. When counties have populations greater than 50,000, those municipalities

of fewer than 50,000 can be identified using population reports. Other types of small government entities are not as easily identified under this standard, as they are not typically classified by population.

- **Small Organization** - Section 601(4) defines a small organization as any not-for-profit enterprise that is independently owned and operated and not dominant in its field. Small organizations may include private hospitals, educational institutions, irrigation districts, public utilities, agricultural co-ops, etc. Depending upon state laws, it may be difficult to distinguish whether a small entity is a government or non-profit entity. For example, a water supply entity may be a cooperative owned by its members in one case and in another a publicly chartered small government with the assets owned publicly and officers elected at the same elections as other public officials.

120. The courts have held that the RFA/SBREFA requires federal agencies to perform a regulatory flexibility analysis of forecast impacts to small entities that are directly regulated. In the case of *Mid-Tex Electric Cooperative, Inc., v. Federal Energy Regulatory Commission (FERC)*, FERC proposed regulations affecting the manner in which generating utilities incorporated construction work in progress in their rates. The generating utilities expected to be regulated were large businesses; however, their customers -- transmitting utilities such as electric cooperatives -- included numerous small entities. In this case, the court agreed that FERC simply authorized large electric generators to pass these costs through to their transmitting and retail utility customers, and FERC could therefore certify that small entities were not directly affected within the definition of the RFA.<sup>69</sup>
121. Similarly, *American Trucking Associations, Inc. v. Environmental Protection Agency (EPA)* addressed a rulemaking in which EPA established a primary national ambient air quality standard for ozone and particulate matter.<sup>70</sup> The basis of EPA's RFA/SBREFA certification was that this standard did not directly regulate small entities; instead, small entities were indirectly regulated through the implementation of state plans that incorporated the standards. The court found that, while EPA imposed regulation on states, it did not have authority under this rule to impose regulations directly on small entities and therefore small entities were not directly affected within the definition of the RFA.
122. The Small Business Administration (SBA) in its guidance on how to comply with the RFA recognizes that consideration of indirectly affected small entities is not required by the RFA, but encourages agencies to perform a regulatory flexibility analysis even when the impacts of its regulation are indirect.<sup>71</sup> "If an agency can accomplish its statutory mission in a more cost-effective manner, the Office of Advocacy [of the

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<sup>69</sup> 773 F. 2d 327 (D.C. Cir. 1985).

<sup>70</sup> 175 F. 3d 1027, 1044 (D.C. Cir. 1999).

<sup>71</sup> Small Business Administration, Office of Advocacy. May 2003. A Guide for Government Agencies: How to Comply with the Regulatory Flexibility Act. pg. 20.

SBA] believes that it is good public policy to do so. The only way an agency can determine this is if it does not certify regulations that it knows will have a significant impact on small entities even if the small entities are regulated by a delegation of authority from the federal agency to some other governing body."<sup>72</sup>

123. The regulatory mechanism through which critical habitat protections are enforced is Section 7 of the Act, which directly regulates only those activities carried out, funded, or permitted by a Federal agency. By definition, Federal agencies are not considered small entities, although the activities they fund or permit may be proposed or carried out by small entities. Given the SBA guidance described above, this screening analysis considers the extent to which this designation could potentially affect small entities, regardless of whether these entities would be directly regulated by the Service through the proposed rule or by a delegation of impact from the directly regulated entity. The small entities described in this appendix are not considered to be directly regulated by the Service through Section 7.
124. This screening analysis focuses on small entities that may bear the regulatory costs quantified in Chapters 2 and 3 of this economic analysis. Although indirectly affected businesses are considered, this analysis considers only those entities whose impact would not be measurably diluted. Of the three affected activities discussed in the economic analysis, 1) aquatic restoration, 2) changes in water use, and 3) construction and development activities, this analysis describes that only impacts to construction and development activities are forecast to be borne in part by small entities.
125. As described in Chapter 3, aquatic restoration activities are expected to be carried out by Federal agencies and are therefore not anticipated to impact small entities.
126. Chapter 2 of this analysis describes three categories of impacts that may result from CSI conservation efforts as relate to regional water use:
- Direct costs associated with obtaining alternative municipal and industrial water supplies;
  - Welfare impacts resulting from pumping restrictions on municipal and industrial water users; and
  - Regional economic impacts of pumping restrictions on agricultural water users.
127. The first two categories of impact are expected to be borne by both municipal and industrial water users. Impacts to these individual water consumers are discussed in Chapter 2. Data are not available to determine the relative fractions of the total impact borne by specific consumer types. That is, the fraction of total impacts that may be borne by municipal users (individual households not considered businesses), versus industrial users (which may or may not be small businesses) is unknown. While this analysis describes that an estimated nine percent of the Edwards Aquifer

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<sup>72</sup> *Ibid.*, pg. 21.



groundwater discharge is consumed by, broadly, "industrial users," the total number of industrial users, by industry type and size, is unknown.<sup>73</sup>

128. The final category of impacts associated with changes in water use is forecast to be borne indirectly by the regional industries associated with irrigated agriculture. No net losses are expected to be incurred by farmers as they will be compensated for revenue losses associated with decreased production through the selling of their water rights, which will be more profitable for them than continuing to rely on water as an input to farm production. While the primary welfare losses to the farmer in this scenario, decreased farm production, are assumed to be compensated through the sales of water rights, small businesses may be indirectly impacted as changes in land use from irrigated agriculture may lead to a decrease in regional agricultural production as described in Chapter 2. A smaller regional agriculture industry affects upstream related industries that provide goods and services to the agriculture industry. While regional economic modeling can identify particular sectors that provide inputs to the agriculture industry, data are not available to describe how impacts may be distributed across the specific industries and businesses. That is, how regional economic impacts would be distributed among related industries of specific types and sizes, and whether these per-business impacts would be observable or diluted, is uncertain.
129. As impacts to aquatic restoration activities and changes and water use are not expected to result in a quantifiable impact to small businesses, the remainder of this appendix focuses on impacts to construction and development activities.

#### Number of Small Entities to which the Proposed Rule will Apply

130. This analysis estimates that one small developer (0.3 percent of small developers) in the region may be affected by conservation efforts for the CSI.
131. Chapter 3 of this analysis details potential impacts of CSI conservation efforts on private development expected on two parcels in the Comal Springs unit. To understand to what extent these potential impacts may be experienced by small entities, this analysis assumes that the developable private lands in proposed critical habitat are currently owned by developers. This analysis further assumes that impacts of CSI conservation efforts (e.g., reducing sedimentation, monitoring, appropriate equipment staging, and minimizing disturbance to the water body) will be borne by these developers.<sup>74</sup> This assumption may overestimate the number of affected small entities as the affected landowners may not be developers, but

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<sup>73</sup> Edwards Aquifer Authority, Comprehensive Water Management Plan, Adopted by the Board of Directors on December 14, 2004.

<sup>74</sup> As described in Chapter 3, before purchasing a parcel the developer will consider the regulatory restrictions associated with that parcel. Therefore, any costs associated with conservation efforts for the CSI will be reflected in the price paid for the parcel. Thus, the costs of CSI conservation efforts are ultimately borne by the current landowner in the form of reduced land values.

individuals or families that are not registered businesses (e.g., individuals holding the land as an investment).<sup>75</sup>

132. To determine how many small developers may be affected, this analysis employs the following method:

- *Estimate the number of residential housing units constructed within proposed critical habitat.* Approximately two residential housing units are likely to be constructed within proposed critical habitat given current zoning.
- *Estimate the number of developers required to construct the potential residential housing units.* On average, a developer in this region constructs 29 residential housing units annually, therefore, one developer would be required to construct the two forecast housing units.
- *Estimate number of small developers potentially affected.* Approximately 98 percent of developers in the region are considered small (see Exhibit B-2). Thus, the one affected developer is likely to be small and is considered as such in this analysis.<sup>76</sup>

133. Exhibit B-2 describes the characteristics of developers in the potentially affected region, Comal County.

**EXHIBIT B-2. CHARACTERISTICS OF DEVELOPERS IN COMAL COUNTY**

NAICS CODE	NUMBER OF DEVELOPERS	NUMBER OF SMALL DEVELOPERS	PERCENT SMALL DEVELOPERS
236115 - New Single-Family Housing Construction	278	273	98%
236116 - New Multifamily Housing Construction (except Operative Builders)	25	24	96%
236117 - New Housing Operative Builders	9	8	89%
237210 - Land Subdivision	33	33	100%
<b>Total</b>	<b>345</b>	<b>338</b>	<b>98%</b>

Source: Dialog search of File 516, Dun and Bradstreet, "Duns Market Identifiers," on October 18, 2006.

<sup>75</sup> North American Industry Classification System (NAICS) code exists for landowners, and SBA does not provide a definition of small landowner.

<sup>76</sup> The average developer in this region is small. The Small Business Administration defines developers in the New Single-Family Housing Construction (except operative builders), New Multi-Family Housing Construction (except operative builders), and New Housing Operative Builders as small entities as those who earn less than \$31 million in annual revenues. Developers in the Land Subdivision sector are defined as small if revenues are less than \$6.5 million.

134. The one small developer estimated to be affected by conservation efforts for the CSI represents 0.3 percent of the total small developers in the region.

*Economic Impact of Compliance Requirements on Small Entities*

135. The one small developer expected to be affected is forecast to experience an impact equivalent to less than 0.001 percent of estimated annual sales.
136. As described in Chapter 3, for those development projects forecast to be undertaken by a small entity, CSI conservation efforts are estimated to be approximately \$659 and \$1,270 per project (present value, discounted at three percent), or an annualized value of \$44 to \$85 per project over twenty years. Assuming the annual revenues of an average small developer are \$18.9 million,<sup>77</sup> the average annualized impact per project is less than 0.001 percent of typical annual sales.

**B.2 POTENTIAL IMPACTS TO THE ENERGY INDUSTRY**

137. Pursuant to Executive Order No. 13211, “Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use,” issued May 18, 2001, Federal agencies must prepare and submit a “Statement of Energy Effects” for all “significant energy actions.” The purpose of this requirement is to ensure that all Federal agencies “appropriately weigh and consider the effects of the Federal Government’s regulations on the supply, distribution, and use of energy.”<sup>78</sup>
138. The Office of Management and Budget provides guidance for implementing this Executive Order, outlining nine outcomes that may constitute “a significant adverse effect” when compared with the regulatory action under consideration:
- Reductions in crude oil supply in excess of 10,000 barrels per day (bbls);
  - Reductions in fuel production in excess of 4,000 barrels per day;
  - Reductions in coal production in excess of 5 million tons per year;
  - Reductions in natural gas production in excess of 25 million Mcf per year;
  - Reductions in electricity production in excess of 1 billion kilowatts-hours per year or in excess of 500 megawatts of installed capacity;
  - Increases in energy use required by the regulatory action that exceed the thresholds above;

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<sup>77</sup> The weighted average revenue for a developer in this region is \$18.9 million. The average revenues for New Single-Family Housing Construction (except Operative Builders) is \$16.2 million; New Housing Operative Builders is \$24.0 million; Land Subdivision is \$15.6 million; and New Multifamily Housing Construction (except Operative Builders) is \$28.6 million. Source: Robert Morris Associates. 2005. Annual Statement Studies, Financial Ratio Benchmarks, 2005-2006.

<sup>78</sup> Memorandum For Heads of Executive Department Agencies, and Independent Regulatory Agencies, Guidance For Implementing E.O. 13211, M-01-27, Office of Management and Budget, July 13, 2001, <http://www.whitehouse.gov/omb/memoranda/m01-27.html>.

- Increases in the cost of energy production in excess of one percent;
- Increases in the cost of energy distribution in excess of one percent; or
- Other similarly adverse outcomes.<sup>79</sup>

As none of these criteria is relevant to this analysis, energy-related impacts associated with conservation efforts within the potential critical habitat are not expected.

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<sup>79</sup> Ibid.

APPENDIX C | HISTORIC SPRINGFLOW LEVELS

EXHIBIT C-1 DAILY AQUIFER LEVEL READINGS (FT.) AT THE J-17 INDEX WELL (1976-2005)

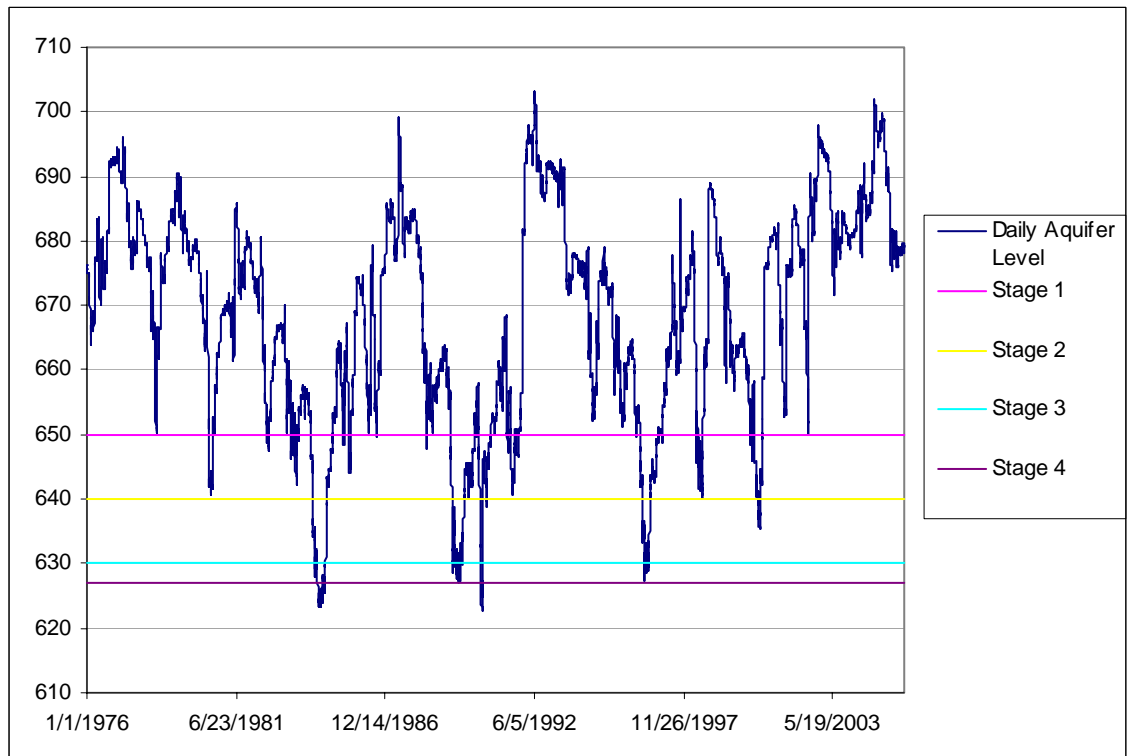


EXHIBIT C-2 DAILY SPRINGFLOW LEVELS (CFS) AT COMAL SPRINGS (1976-2005)

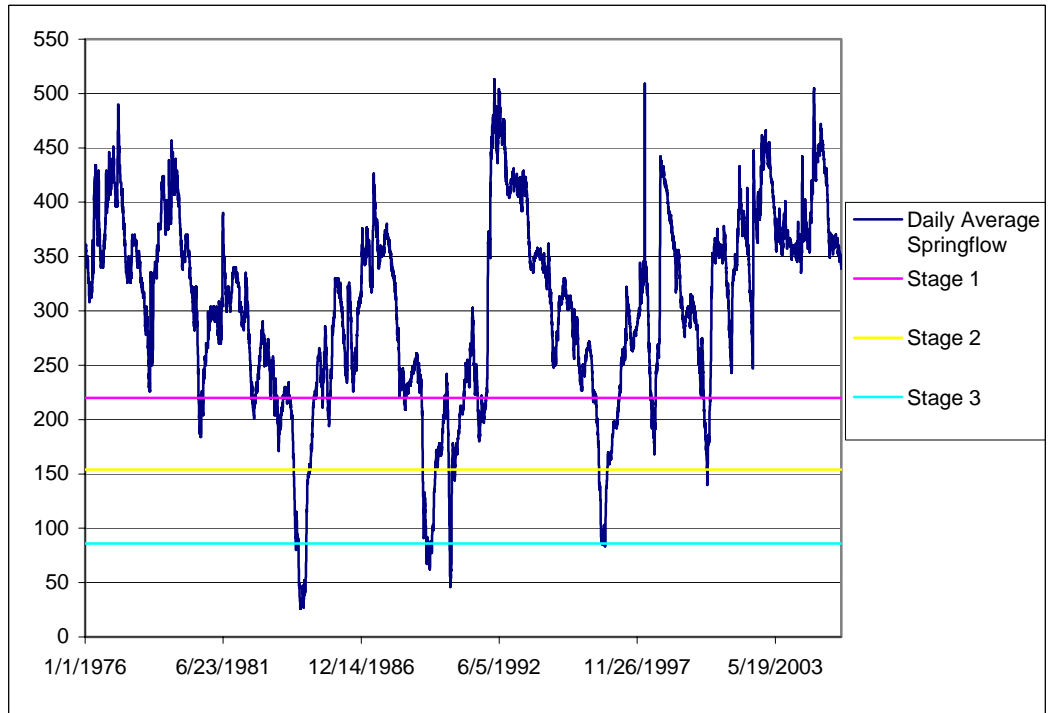
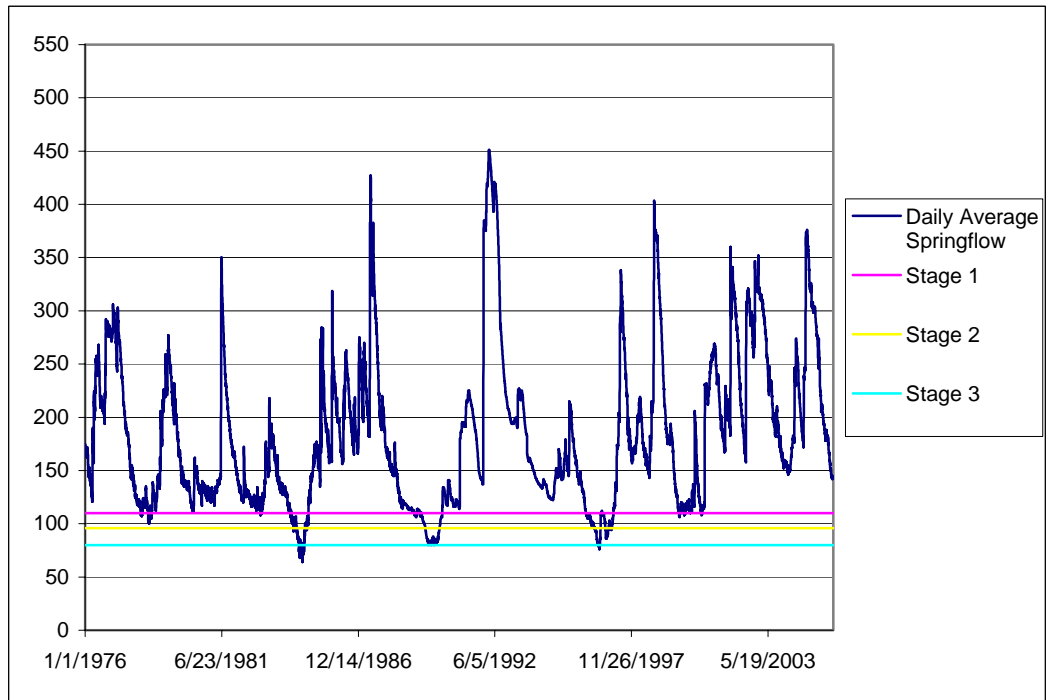


EXHIBIT C-3 DAILY SPRINGFLOW LEVELS AT SAN MARCOS SPRINGS (1976-2005)





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