
LAGUNA ATASCOSA NATIONAL WILDLIFE REFUGE

SOUTH TEXAS REFUGES COMPLEX

PROPOSED RESTORATION OF BAHIA GRANDE

FINAL

ENVIRONMENTAL ASSESSMENT

**United States Fish and Wildlife Service
Southwest Region
500 Gold Avenue, SW
Albuquerque, New Mexico 87102
March 2005**

SUMMARY

The U.S. Fish and Wildlife Service (Service) proposes to restore tidal flow to the Bahia Grande wetland system, which includes three main basins: (1) Bahia Grande, 6,500 acres; (2) Laguna Larga, 1,670 acres; and (3) Little Laguna Madre, 1,300 acres. This wetland system is located within the Bahia Grande Unit of the Laguna Atascosa National Wildlife Refuge. The Bahia Grande Unit covers 21,762.451 acres of land and water, including bays, basins, lomas, low-lying flats, resacas, and native brush. The Bahia Grande basin, historically a shallow bay, is the major wetland feature on the unit. This bay is ephemeral in nature and is covered with water only following extreme rainfall events or tropical storm surges. The majority of time, the wetland system remains dry.

The project area is located in Cameron County west of Port Isabel, Texas (Figure 1). Part of the Tamaulipan Biotic Province, the Bahia Grande Unit is close to the Gulf of Mexico and consists of wind tidal flats and high ground that includes brush-covered clay dunes (lomas) that attain heights of up to 30 feet. This matrix of stabilized clay dunes is interspersed with grass and brush-covered uplands, saline flats, marshes, and shallow bays. Historically, the Bahia Grande area was rich in biological resources and contained important waterfowl habitat, especially for wintering waterfowl. Bahia Grande was also an important estuarine nursery area, contributing to a productive sport and commercial fishery. A small island within the bay provided nesting habitat for more than 10,000 terns, gulls and black skimmers.

With the construction of the Brownsville Ship Channel in the mid 1930's, and the placement of dredge spoil on the north side of the channel, the shallow bay and wind tidal flats were isolated from the Laguna Madre. Open exchange of water was effectively blocked. An additional blockage was caused by the construction of State Highway 48 in the early 1950s, when this roadway paralleled the ship channel on its northern side. These barriers to the natural hydrological connection between Bahia Grande and the Lower Laguna Madre caused a decline in biological productivity on the tidal flats and a loss of wildlife that was dependent on this productivity, including a decline in waterfowl numbers. In its historical condition prior to the 1930's, Bahia Grande reportedly supported wintering flocks of redheads (15,000 were reported in one survey) and other ducks, much as the adjacent Lower Laguna Madre does today. Once converted from a dry basin to one inundated by tidal variations, it is probable that flocks of redheads and other waterfowl will once again use the area on a regular basis in the winter months. In addition, floral assemblages, both upland and wetland, were altered. At present, Bahia Grande is barren and dry most of the year with only portions having ephemeral, moist sediment or standing water conditions. Primary inflows are limited to water captured during precipitation events and occasional storm surges and other high tidal conditions.

Reasons for restoring flow to this system are:

- (1) to provide nursery areas and habitat for aquatic organisms such as shrimp, crabs and finfish,
- (2) to provide habitat for resident and migratory wildlife such as water birds,
- (3) to reduce Bahia Grande as a source of windblown dust, and
- (4) to provide increased public recreational areas.

The U.S. Fish and Wildlife Service (Service) proposes to re-flood and restore the Bahia Grande wetland system through construction of one or more channels designed to take advantage of the normal tidal regime in the area. Thereby, providing adequate tidal exchange of salt water to maximize water circulation as well as allow migration of marine organisms into and out of the basin (Figure 2). These actions will significantly increase productivity of this wetland system. Engineering and hydrological studies indicate that under favorable conditions water may inundate approximately 6,500 acres in the wetland system. A recent topographic survey showed that most of the Bahia Grande basin lies below mean sea level (MSL) and would be inundated with seawater during low tides (Figure 3). Additional acreage (up to 10,000 acres) would be inundated by high tides, storm surges, or periods of high rainfall.

There is much local interest between both private individuals and agencies in the prospect of restoring flow and productivity to Bahia Grande. Support comes from local landowners, officials and residents of nearby communities, and a number of conservation organizations (Ocean Trust, The Conservation Fund, Natural Resources Conservation Service, Ducks Unlimited, Coastal Conservation Association, National Marine Fisheries Service, National Fisheries Institute, and Texas Parks and Wildlife Department). Several organizations have offered financial and technical assistance for the Bahia Grande restoration project.

A hydrological modeling and channel design study has been funded by the National Marine Fisheries Service, and is available on request from the South Texas Refuge Complex. It was produced as a thesis headed by Dr. Billy Edge of the Ocean Engineering Program, Department of Civil Engineering, Texas A&M University. This study details the water circulation and mixing needed in the Bahia Grande to accomplish biological productivity goals and gave recommendations on the technical aspects of channel design needed to accomplish these goals. It was from this thesis, by Dianna L. Van Valkenburg, that channel locations and designs for this project were taken.

The proposed re-flooding and restoration project of Bahia Grande has four different alternatives:

- Alternative A: (No Action Alternative) No Flooding,
- Alternative B: Flooding from San Martín Lake only (Channel A),
- Alternative C: Flooding from Brownsville Ship Channel only (Channel E), and
- Alternative D: (Proposed Action) Flooding from both directions (Alternatives B and C).

Alternatives B, C, and D all include additional interior channels B1, B2, C1, C2, and D, which will flood approximately 3,000 acres in Laguna Larga and Little Laguna Madre.

Preparation of this document is in accordance with the National Environmental Policy Act (NEPA) of 1969. NEPA requires public input into all major federal actions that may have a significant affect on the human environment. NEPA ensures that ample public input is considered, through written and verbal comments, including the use of public scoping meetings. The final draft environmental assessment (EA) for this project was released in late July 2003. A

30-day comment period ending September 5, 2003 was established and a public meeting was held in Port Isabel, Texas on August 14, 2003. In addition, numerous newspaper articles, radio show appearances, and other public outreach efforts were conducted to provide public notification and to provide sufficient opportunities for public comment and review of the final draft EA.

Along with verbal comments recorded at the public meeting in Port Isabel, a total of 559 letters of support was received from the public. No letters or comments objecting to the project were received. One letter expressing neither support nor objection was received, which merely offered ideas for implementation of the project. In summary, there were no negative comments received regarding this proposed project. All the comments received were supportive. Two letters from State regulatory agencies were of a questioning nature, and were answered to their satisfaction. The total supporting letters, signatures, and other forms of expression, all written, numbered 566.

As required by NEPA, the Regional Director, U.S. Fish and Wildlife Service, Region 2, has used this final EA to make two decisions: (1) to select a "proposed action" and (2) to determine if the proposed action will or will not have a significant affect on the quality of the human environment, within the meaning of Section 102(2)(c) of NEPA. The decision was made to select Alternative D as the proposed action, and it was decided that the proposed action was not a major Federal action that would significantly affect the quality of the human environment or natural environment.

Alternative D was determined to be the most feasible and effective action necessary to restore the Bahia Grande wetland system. This action calls for the construction of two main channels, the 2,200-foot long by 150-foot wide Channel E through Brownsville Navigation District property, and the 7,850-foot long by 50-foot wide Channel A through refuge property. These two primary channels, along with proposed secondary channels connecting the Bahia Grande basin with the Laguna Larga and Little Laguna Madre basins, should restore the hydrology to the wetland system.

However, because of possible funding limitations and other factors, such as the Service not having control over the design, construction, or funding of Channel E, it has been decided that the proposed action should take place in three main phases. Phase 1 includes the construction of Channel E (Brownsville Navigation District channel), which connects the Bahia Grande basin to the Brownsville Ship Channel, and the construction of Channels B2, C1, and C2 (Service channels), which connect the Bahia Grande basin to the Laguna Larga and Little Laguna Madre basins (Figure 4). The completion of this phase is essential for minimally fulfilling the basic "purpose and need" of the proposed project. Phase 2 is the construction of Channel A, which connects San Martín Lake to the Bahia Grande basin. In her 2002 Master of Engineering thesis, Dianna L. Van Valkenburg did not recommend the construction of Channel A, as described in the following excerpt: *"Clearly a channel connecting the Brownsville Ship Channel and Bahia Grande basin, Channel "E", will produce the maximum exchange rate ... up to 16% of the total volume of Bahia Grande ... If Channel "E" is constructed, building Channel "A" will not significantly impact the water exchange in Bahia Grande. Thus, Channel "A" should not be built if Channel "E" is constructed ..."* (Appendix F, Page 18). However, this phase will be

implemented by the Service if any of the following three scenarios should occur: (1) Channel E is not constructed; (2) Channel E is constructed, but not at the proper dimensions (e.g., 150-foot bottom width minimum or as recommended in hydrological studies); or (3) Channel E is constructed to recommended dimensions and follow-up hydrological studies indicate that Channel A is essential for providing improved volume, circulation, and mixing of tidal waters within Bahia Grande. Phase 3 is the construction of Channels B1 and D, which are additional channels connecting the Bahia Grande to the Laguna Larga and Little Laguna Madre basins, respectively. This phase should be implemented if follow-up hydrological studies (i.e., after the completion of Phase 1 or Phase 2) indicate that it is essential for improving volume, circulation, and mixing of tidal waters within or among the three main basins.

The successful restoration of the Bahia Grande will ultimately depend on multiple existing and new partnerships between the Service and local and national organizations, businesses, and government agencies. Sufficient funding for channel construction and ancillary projects (e.g., water control structures, bridges, biological monitoring) is also needed to complete this project. It is anticipated that successful restoration may be completed within five years after initial channel construction is started.

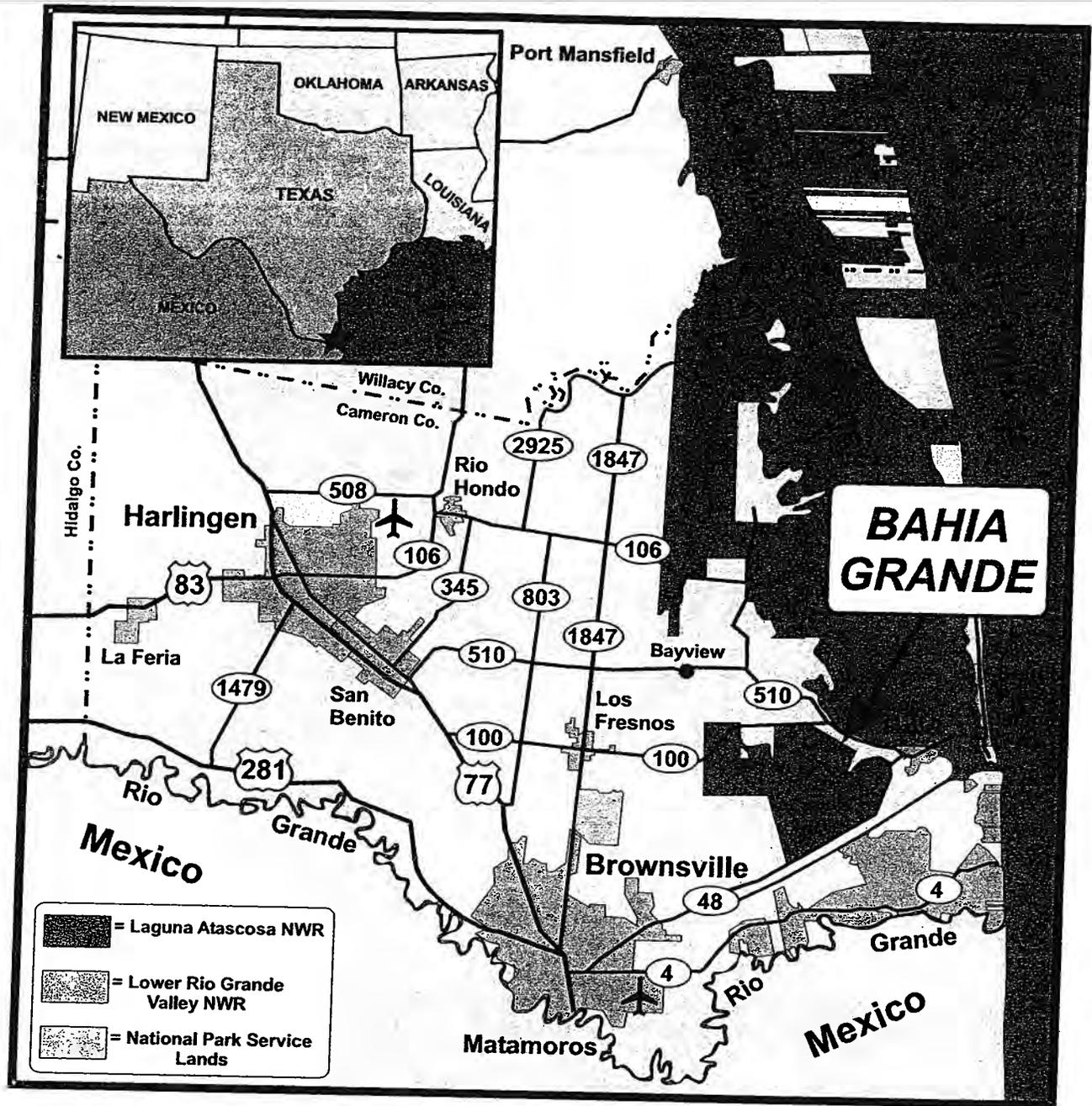


Figure 1. Location of the Bahia Grande Unit, Laguna Atascosa National Wildlife Refuge, Cameron County, Texas.

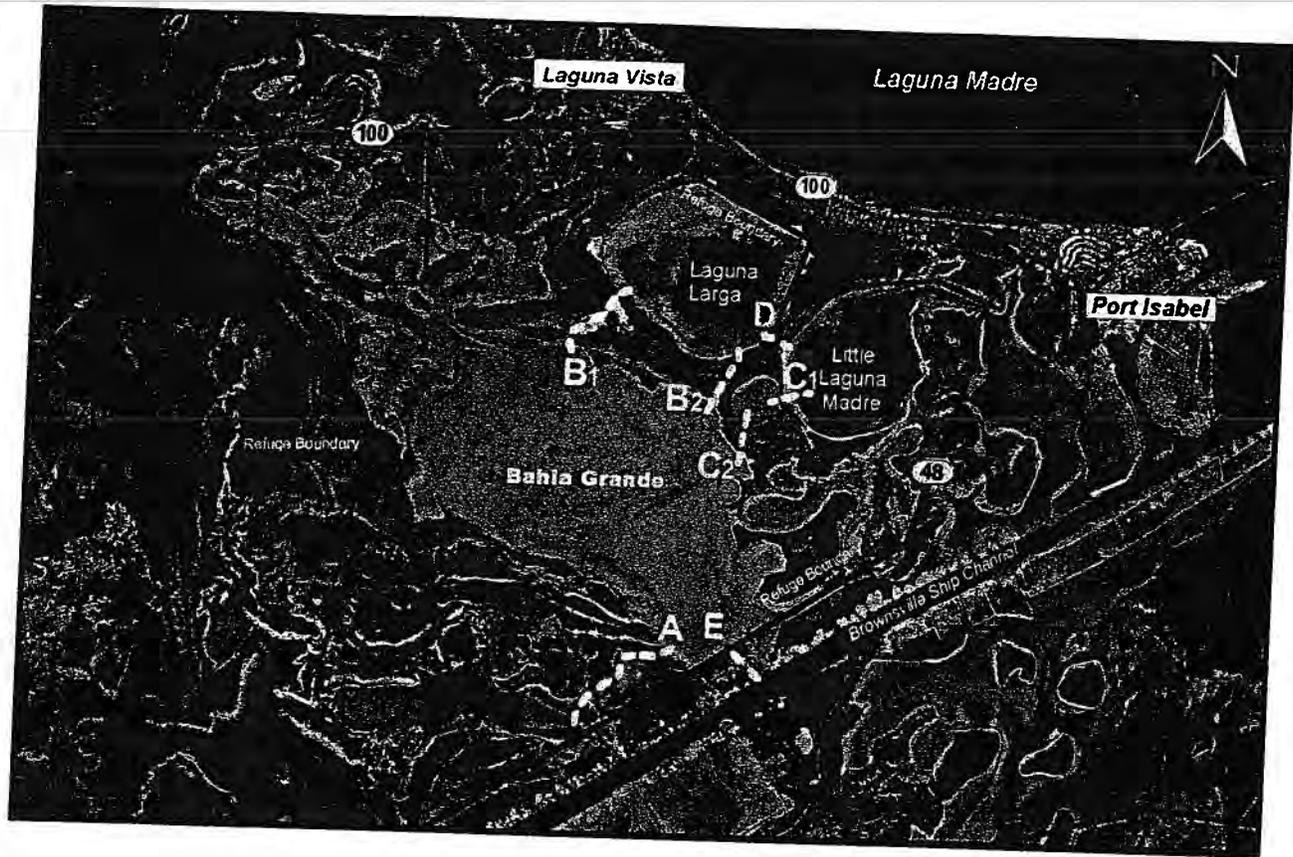


Figure 2. Overview of the Project Area: Bahia Grande, Laguna Larga, and Little Laguna Madre. Red lines represent refuge boundaries. Yellow, dashed lines represent approximate locations of proposed channels, as discussed in this document. (Photo courtesy of USGS, Digital Orthophoto Quarter Quadrangles (DOQQ)).

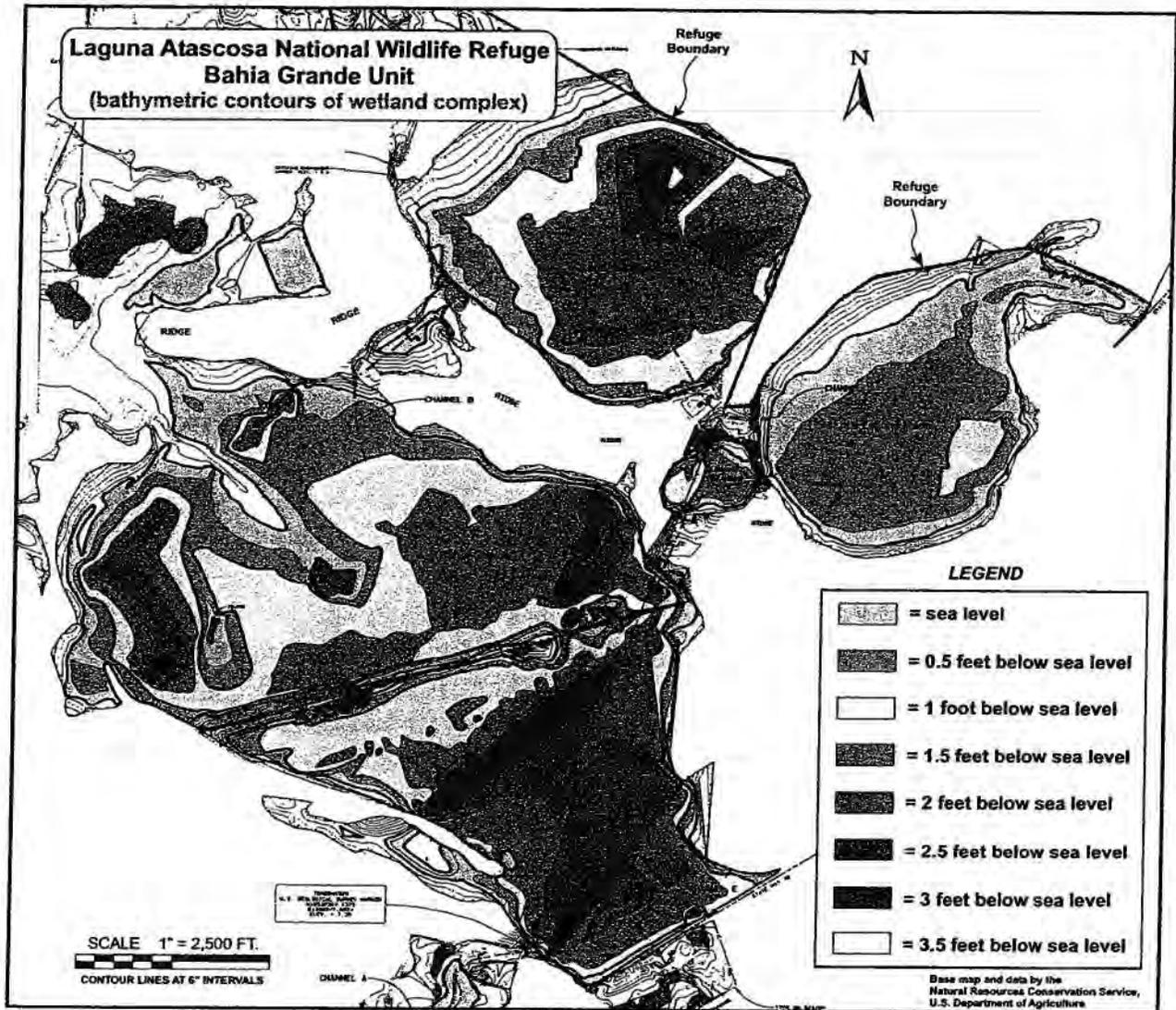


Figure 3. Approximate elevations contours of Bahia Grande, Laguna Larga, and Little Laguna Madre basins.

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1.0 PURPOSE AND NEED FOR ACTION**1.1 Purpose and Need****1.1.1 Purpose**

The purpose of the proposed action is to reestablish, as much as possible, the natural character and biological functions of the Bahia Grande. Ultimately, implementing the proposed action would allow the Laguna Atascosa National Wildlife Refuge (the Refuge) to further accomplish its migratory bird objectives, while being able to develop, manage, conserve and protect fish and wildlife resources (under the Fish and Wildlife Act of 1956). The original enabling legislation for the Refuge and its current purposes make it clear that refuge objectives include conservation and maintenance of wintering habitat for migratory waterfowl.

1.1.2 Need

Restoration of flow to the Bahia Grande will greatly enhance biological productivity, restore habitat for wintering waterfowl and migratory shorebirds, create additional nursery habitat for finfish and shellfish populations and restore and enhance other native wildlife and plant communities, including seagrass beds and fringing black mangrove stands. This effort represents an opportunity to restore a natural tidal hydrological pattern in the Bahia Grande, with the goal of achieving a biodiversity level currently present at nearby San Martín Lake. As well as providing needed habitat for waterfowl, shorebirds, wading birds and other wildlife, this restoration could open up new recreational fishing opportunities and contribute to the commercial shellfish and finfish industries. In addition, a blowing sediment problem, which is affecting air quality in nearby communities, will be greatly reduced (Photo A, Figure 2). It should be understood that Bahia Grande is not the sole source of blowing dust in the area. Spoil deposition sites, like Long Island, also contribute to the windblown dust problem.

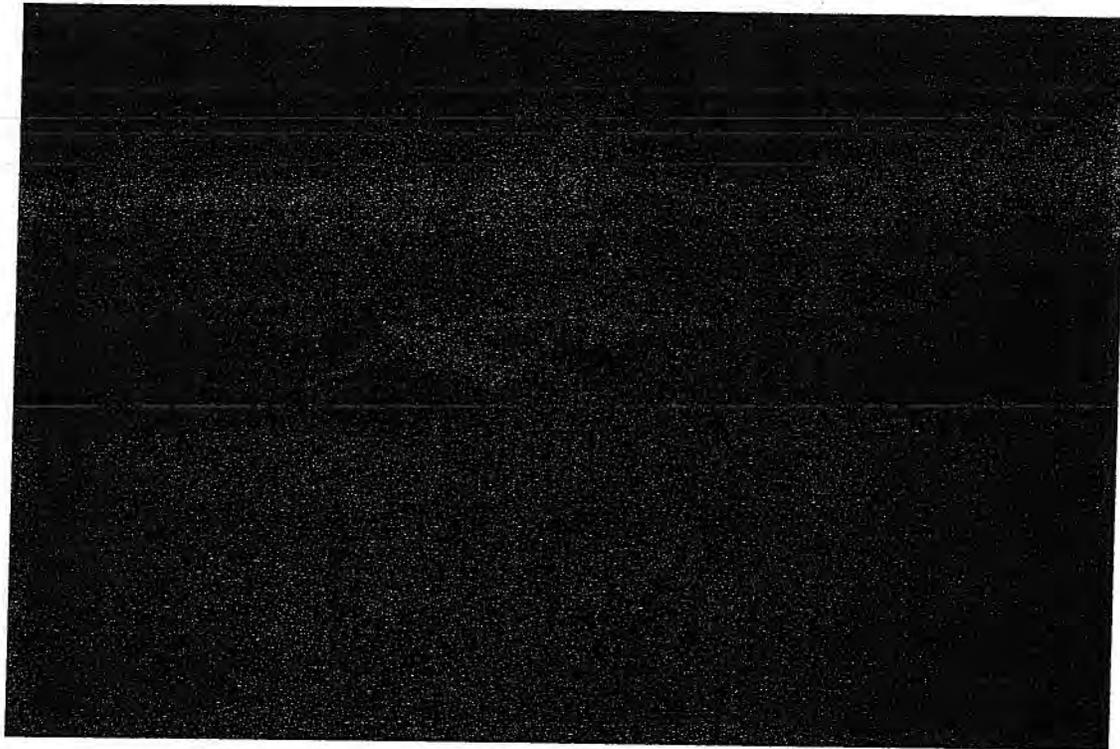


Figure 5. Windblown dust from Bahia Grande threatens power line transformers, various mechanical devices, and human health. (Photo by Larry Ditto, USFWS)

San Martín Lake is presently an active estuary, connected to the Brownsville Ship Channel. The lower third of this estuary is on the Bahia Grande Unit. Lined with black mangroves, and wind tidal flats, San Martín Lake is habitat for cormorants, pelicans, night-herons, herons, egrets, spoonbills, ducks, gulls, terns, and various passerine species. It receives copious freshwater flows from its upper end where several major drainage ditches from Brownsville converge. Because of these drainage ditches' effects, San Martín is often much less saline than the Lower Laguna Madre and Brownsville Ship Channel.

Two documents in Appendix C cite the substantial need for flooding Bahia Grande, Laguna Larga, and Little Laguna Madre, all on refuge lands, to curtail some of the blowing dust problem. One is a newspaper article from 1945, illustrating the longevity of this dust problem. The other is a letter from the Superintendent of Schools in Port Isabel, listing the problems associated with the blowing dust, including mechanical failure, landscape destruction, and human health threats. While this is not a mandated responsibility of the U.S. Fish and Wildlife Service (Service), this is an exceptional case, and the alleviation of some blowing dust for communities and schools around the refuge is paramount in importance, along with re-creation of wetland habitats for invertebrates, fish, migratory birds, and other wildlife.

There are many positive, beneficial effects that will occur as a result of introducing the historical tidal flow to Bahia Grande, as opposed to the occasional rainwater pool that now occurs therein. The estuarine nature of the restored Bahia Grande will allow shrimp, crabs, finfish, mangroves, and other animals and plants to reenter the basin for purposes of growth and reproduction. Even intermittent dust storms, originating in Bahia Grande, Laguna Larga, or the Little Laguna Madre, will be a past memory and nothing more. Finally, with cessation of the blowing, salty dust, vegetation on the surrounding lomas should be healthier with higher rates of reproduction, resulting ultimately in denser covers of native brush and grasses to benefit, endangered cats, peripheral birds, and other species.



Figure 6. "From Clouds of Dust to Schools of Fish" (David R. Blankinship, USFWS) – the change being sought by U.S. Fish and Wildlife Service at the Bahia Grande site in Cameron County. (Photo by Steve Labuda, USFWS)

1.2 Proposed Action

The Service proposes to restore tidal flow to the Bahia Grande, a portion of the Bahia Grande Unit of the Laguna Atascosa National Wildlife Refuge.

This proposed action has resulted from interest and partnerships between the Service and The Conservation Fund, Natural Resources Conservation Service, Ocean Trust, Ducks Unlimited, Coastal Conservation Association, National Marine Fisheries Service, National Fisheries Institute, Texas Parks and Wildlife Department, and representatives of the shrimping industry and local communities.

Letters of support for this project have been received and references are included in Appendix B. This includes such letters, not only from the entities listed above, but from the adjacent private landowners as well.

1.3 Decisions Needed

The Regional Director, Fish and Wildlife Service, Region 2, will use the final environmental assessment (EA) to make two decisions. The first decision is selecting the alternative (proposed action) to implement. The second decision, required by the National Environmental Policy Act (NEPA), is to determine if the selected alternative will or will not have significant impact on the quality of people's lives or the natural environment. If it is determined that the selected alternative will have significant negative impacts on the human and natural environment, the Service must prepare an environmental impact statement of the proposed action. If not, the Regional Director will sign a Finding of No Significant Impact (FONSI), after which the Service can begin the selected alternative (proposed action) as funding is available and all applicable permits have been acquired.

2.0 DESCRIPTION OF ALTERNATIVES

The proposed re-flooding and restoration project of Bahia Grande has four different alternatives:

- Alternative A: (No Action Alternative) No Flooding;
- Alternative B: Flooding from San Martín Lake only (Channel A);
- Alternative C: Flooding from Brownsville Ship Channel only (Channel E); and
- Alternative D: (Proposed Action) Flooding from both directions (Alternatives B and C).

2.1 Alternative A: (No Action Alternative) No Flooding

This alternative continues the status quo. No extraordinary effort to flood Bahia Grande will take place and the area will remain an ephemeral wetland, only partially filling with water during extreme rainfall events or tropical storm surges, and allowing restricted water access via the

current small, deteriorated culverts in place under State Highway 48. Currently, storm surges and extraordinarily high tides deposit numerous fish species within Bahia Grande. As the tide recedes, and the area dries up, large fish kills have occurred. At present, according to Dr. Dolores Munoz, Superintendent of Port Isabel Independent School District (Port Isabel ISD), damages to mechanical equipment, amortized over time, amount to an estimated \$100,000.00 per year; to landscape and maintain grounds, an estimated \$35,000.00 per year; and to human health costs, an estimated \$1,500,000.00 per year. This does not include estimates for lost income through fines or lowered air quality in the local area. Land use issues will remain essentially unchanged, except for closer oversight by the Refuge.

Wildlife and fisheries would remain unaffected under this alternative. The basins would remain dry, except for occasional flooding from rainfall and high tides. Fishery resources would be as they are now, minimal to non-existent. Wildlife resources would continue to suffer loss of habitat, from the blowing, salty dust, which kills vegetation on upland sites, and basin rims. In 2004, spring and summer rains filled Bahia Grande, Laguna Larga, and Little Laguna Madre. When the waters in these basins dried up in late August and early September, wading birds, shorebirds, and as many as five ospreys were seen in the area, feeding on the marine resources that had flourished and were trapped in receding pools of water. In Little Laguna Madre, in particular, a fish-kill estimated in the hundreds of thousands of fish, redfish, spotted seatrout, and mullet, occurred in early August of 2004, when that wetland dried up. In late August and early September 2004, another fish-kill occurred in the Bahia Grande. Texas Parks and Wildlife Department fishery biologists investigated this fish kill and estimated that 18,904 fish (74% was redfish) died with an estimated value of \$812,000.00. Rains in late September filled these basins again partially. By the end of October drying basins were found to have high salinity levels: Bahia Grande, 67 ‰; Little Laguna Madre, 55 ‰; and the 108-acre wetland (known as "The Bowl") in Channel C between Little Laguna Madre and Bahia Grande, 75 ‰.

2.2 Alternative B: Flooding from San Martín Lake only (Channel A)

Under this alternative, water will be diverted from San Martín Lake and pass through a constructed channel (Channel A) to inundate Bahia Grande. The size and orientation of the channel will determine the volume and rate of water exchange between the two sites. Estimates from the Van Valkenburg thesis configure the channel at 8,255 feet long, by 50 feet wide (bottom width), by 4 feet deep (minus 4 feet below mean sea level (MSL)). The typical cross-section and profile drawings shown in Appendix E were plotted from topographic surveys performed by the Natural Resources Conservation Service. All channel dimensions, grades, elevations, and side slopes were engineered by the U.S. Fish and Wildlife Service. Land use issues will remain essentially unchanged, except for closer oversight by the refuge.

The proposed flooding of Bahia Grande with tidal water will have a positive, beneficial socioeconomic impact on surrounding communities of people. Channels B1, B2, C1, C2, and D (Figure 2) will have an even greater beneficial effect, allowing approximately 3,000 acres of additional flooding in Laguna Larga, Little Laguna Madre, and Vadia Ancha. Land developers may build houses on the northern bluffs, along State Highway 100, overlooking the basins. Already (because of recent heavy rainfall that flooded the basin), people are catching crabs along State Highway 48 where the single, open culvert allows storm water to flow in and out of Bahia

Grande at the present time. Fishing activity, bird watching, and other compatible public uses will have significant beneficial effects in the socioeconomic arena of the local populace.

Wildlife and fisheries would be beneficially affected under this alternative. The basins would be permanently flooded with tidal waters, although mixing and aeration of the water would be minimal. Fishery resources would increase, with many saltwater species, both vertebrate and invertebrate, moving into the Bahia Grande system. Wildlife resources would no longer suffer loss of habitat, from the blowing, salty dust, which kills vegetation on upland sites, and basin rims. The resultant flush of vegetation would encourage colonization and survival of more and different wildlife species, both on the lomas and on the basins' rims.

2.3 Alternative C: Flooding from Brownsville Ship Channel only (Channel E)

Under this alternative, water will be diverted from the Brownsville Ship Channel, pass through a relatively straight constructed channel and enter under a proposed 200-foot bridge over State Highway 48 to inundate Bahia Grande. Cooperation must be obtained from the Port of Brownsville as the landowners of the channel site. Close coordination is also needed with the Texas Department of Transportation (TXDOT). The size and orientation of the channel will determine the volume and rate of water exchange between the two sites. Estimates from the Van Valkenburg thesis configure the channel at 2,400 feet long, by 200 feet wide, by 9 feet deep (minus 9 feet MSL). The typical cross-section and profile drawings shown in Appendix E were plotted from topographic surveys performed by the Natural Resources Conservation Service. All channel dimensions, grades, elevations, and side slopes were engineered by U.S. Fish and Wildlife Service. Land use issues will remain essentially unchanged, except for closer oversight by the refuge.

The proposed flooding of Bahia Grande, Laguna Larga, and Little Laguna Madre with tidal water will have a positive, beneficial socioeconomic impact on surrounding communities of people. Land developers may build houses on the northern bluffs, along State Highway 100, overlooking the basins. Already (because of recent heavy rainfall that flooded the basin), people are catching crabs along State Highway 48 where the single, open culvert allows water to flow in and out of Bahia Grande at the present time. Fishing activity, bird watching, and other compatible public uses will have significant beneficial effects in the local socioeconomic arena.

Wildlife and fisheries would be beneficially affected under this alternative. The basins would be permanently flooded with tidal waters. Fishery resources would increase and new marine species would colonize the Bahia Grande. Mixing of waters would be even greater than in Alternative B, and this should result in increased survival of seagrasses, mangroves, crustaceans, fish, and other marine species. Wildlife resources would no longer suffer loss of habitat, from the blowing, salty dust, which kills vegetation on upland sites and the basins' rims. Instead, vegetation would flourish, and dependent wildlife species would increase.

2.4 Alternative D: (Proposed Action) Flooding from both directions (Alternatives B and C)

Under this alternative, two channels (Channels A and E) will be constructed. The level of circulation desired in the Bahia Grande may necessitate implementation of both channels. These

will be used simultaneously or individually to provide adequate tidal circulation. Hydrological, topographic and engineering studies provide recommendations on channel dimensions necessary for adequate tidal circulation in Bahia Grande and assist restoration planning. The final draft results of this study, in thesis format, are included in Appendix E, and are summarized in the following section, Study Results. Land use issues will remain essentially unchanged, except for closer oversight by the refuge.

The proposed flooding of Bahia Grande, Laguna Larga, and Little Laguna Madre with tidal water will have a positive, beneficial socioeconomic impact on surrounding communities of people. Land developers may build houses on the northern bluffs, along State Highway 100, overlooking the basins. Already (because of recent heavy rainfall that flooded the basin), people are catching crabs along State Highway 48 where the single, open culvert allows water to flow in and out of Bahia Grande at the present time. Fishing activity, bird watching, and other compatible public uses will have significant beneficial effects in the socioeconomic arena of the local populace.

Wildlife and fisheries would be beneficially affected under this alternative. The basins would be permanently flooded with tidal waters. Fishery resources would increase and new marine species would colonize the Bahia Grande. Mixing of waters would be even greater than in Alternatives B or C, individually, and this should result in increased survival of seagrasses, mangroves, crustaceans, fish, and other marine species. Wildlife resources would no longer suffer loss of habitat, from the blowing, salty dust, which kills vegetation on upland sites and the basins' rims. Instead, vegetation would flourish, and dependent wildlife species would increase.

2.5.1 Study Results

A series of channel depths and widths were modeled for each of the channel sites proposed. In summary, a combination of Channel A, between San Martín Lake and Bahia Grande, 8,255 feet long, 50-feet wide and 4 feet below MSL (Alternative B), coupled with Channel E, between the Brownsville Ship Channel and Bahia Grande, 2,400 feet long, 200-feet wide and 9 feet below MSL (Alternative C), is the recommended size of inlet channels (Figure 7). Working together, these two channels should provide maximum mixing and exchange of waters in the basins (Van Valkenburg, Dianna L., 2002, ME Thesis, Ocean Engineering Program, Texas A&M University, See Appendix F.).

Channel	Channel Length (ft)	Channel Width (ft) at bottom	Channel Depth (ft, depth below mean sea level)	Channel Cross Sectional Area (ft ²)	Volumetric Flow (ft ³ /12.5 hours)
A	8,255	50	- 4	200	2,946,489
E	2,400	200	- 9	1800	80,892,032
Total				2000	83,839,032

Figure 7. Proposed Action of Channels A and E, used to flood Bahia Grande, Laguna Larga, and Little Laguna Madre, with maximum effects (Van Valkenburg, D. L., 2002, TAMU)

A series of models was used to test the efficacy of different channel configurations. The results were that Channel E, running from the Brownsville Ship Channel to Bahia Grande is about twice as effective as Channel A, running from San Martín Lake to Bahia Grande when both had the same channel depth and bottom width dimensions (Figure 8).

Channel	Channel Length (ft)	Channel Width (ft) at bottom	Channel Depth (ft, depth below mean sea level)	Channel Cross Section (ft ²)	Volumetric Flow (ft ³ /12.5 hours)
A	8,400	200	- 4	800	16,953,344
E	4,000	200	- 4	800	38,397,248

Figure 8. Relative efficiency of an 8,400-ft. Channel A and a 4,000-ft. Channel E, based on lunar tides only. (Van Valkenburg, D. L., 2002, TAMU)

This difference in efficiency is directly related to the length of the channels in question. Channel A is estimated to be 8,400 feet, and Channel E is estimated to be 4,000 feet. The table above (Figure 8) and these length estimates are illustrating the efficiency of channels based on length alone. Additional work on the modeling project includes consideration of wind effects. The strong southeast trade winds and equally strong winter storm fronts (“blue norther”) have effects equal to or greater than that of the lunar tides used to model the data presented in this EA and in the thesis in Appendix F.

The winter and early spring of 2002/2003 allowed a unique opportunity to study the effects of wind tides on the Bahia Grande. Two tropical depressions in early November dumped 22+ inches of rainfall in a one week period on eastern Cameron County. This rainfall rapidly flooded the dry Bahia Grande basin. From January through March 2003, records were made of the rise and fall of the water column along State Highway 48, using two standard water measurement gauges inserted in Bahia Grande and visible from State Highway 48. The results of this study are summarized in Figure 9 below.

Water Gauge Site	Calm Wind Conditions	Strong SE Winds	Strong NW winds
#1, Port Isabel	0.5125	0.18	1.106
#2, Yellow Gate	0.4612	0.18	1.029
Average	0.4868	0.18	1.068

Figure 9. Wind tide measurements in Bahia Grande during the early spring, January through March 2003. Figures represent difference in water column height in feet.

As can be seen in the above table (Figure 9), the average difference between calm conditions and gusty southeast winds was 3.7 inches. The difference between calm conditions and the gusty northwest winds was 6.97 inches. This results in maximum difference of 10.66 inches between “low tide” with a strong southeast wind and “high tide” with a “blue norther” blowing. These figures represent water column depth difference based on wind effects only. This will have an effect in addition to the lunar tidal data compiled in the Van Valkenburg thesis.

A third channel, Channel F, into Laguna Larga, will bring rain waters from the north side of State Highway 100, under the highway, and down a diked channel, through an old resaca bed, to Laguna Larga (Figure 4). Channel F is being constructed by the Natural Resources Conservation Service, U.S. Department of Agriculture (USDA), in partial fulfillment of requirements for their assistance in helping the Service acquire the lands on which Bahia Grande is located under the Wetland Reserve Program. The objective of this third channel will be to bring fresh rainwater from the areas around State Highway 100 and Laguna Vista into Laguna Larga, making it a basin with more fresh water than will be present in Bahia Grande and Little Laguna Madre. A topographic map of the project area and sectional views for all channels, (Alternatives B and C), are found in Appendix E. The typical cross-section and profile drawings shown in Appendix E were plotted from topographic surveys performed by the Natural Resources Conservation Service. All channel dimensions, grades, elevations, and side slopes were engineered by U.S. Fish and Wildlife Service.

The rainwater that is now occasionally trapped in Bahia Grande, Laguna Larga and Little Laguna Madre, is not really freshwater. Salinity readings taken in mid-November 2002, after the basins were filled with rainwater runoff associated with two early November tropical depressions, were in the range of 21 ppt to 28 ppt, only about 5 ppt lower than ocean water. This is too salty for cattails and other freshwater plants to survive, but is appropriate for black mangroves and other marine/estuarine plants. Consequently, the provision of permanent tidal waters will not negatively impact any species that may depend on pools of fresh rainwater, since the fresh water that enters the basins now dissolves the salt in the bottom soils, and produces a saltwater mix that is only slightly fresher than seawater.

A monitoring study has already been funded to the University of Texas-Pan American, through the Marine Research Laboratory. Primary researchers for this study, which is intended to track colonization of the Bahia Grande, Laguna Larga, and Little Laguna Madre basins by marine

species, plant and animal, are Hudson Deyoe and Don Hockaday (pers.comm.) Additional funds for evaluation are now available through the Environmental Protection Agency (EPA). Agreements are in place between EPA and the three universities that are going to be researching the permanently flooded basins: University of Texas-Brownsville, University of Texas-Pan Am, and Corpus Christi A&M University.

3.0 AFFECTED ENVIRONMENT

3.1 Climate

The Bahia Grande area, located along the Gulf Coast of Texas in the Lower Rio Grande Valley, lies approximately 27 degrees north of the equator and receives an average annual rainfall of 26 inches (50-year average). The climate is both semi-arid and subtropical. Diurnal onshore and nocturnal offshore breezes moderate the thermal highs and lows along the coast. Prevailing winds, from the southeast off the Gulf of Mexico bring high humidity most of the year. Seasonal temperature variations range from a mean of 62^o F in the winter to 84^o F in the summer. Freezing temperatures occur once every four years on the average. Tropical storms and hurricanes periodically strike the area during the summer and fall months. Drought conditions, some of which extend over several years, also occur periodically.

3.2 Air Quality

The Bahia Grande area is within Region 15 of the Texas Commission on Environmental Quality (TCEQ). According to information released by the TCEQ, the area is in attainment of unclassifiable for all National Ambient Air Quality Standards (NAAQS). Blowing dust is the cause for most of the particulate matter in the region's air. This information was obtained from personal communication with the TCEQ office in Harlingen, Texas, (956) 425-6010.

3.3 Geology and Soils

The Gulf Coast Plain is geologically of recent origin. The area is typified by sediments deposited during Pleistocene interglacial periods. Most of the sediments were derived from deltaic or fluvial deposits of the ancestral Nueces and Rio Grande Rivers. Large portions were subsequently covered by wind-deposited silts and sands. These sediments continue to undergo wind transport and form extensive dune fields on the barrier islands and clay lomas (brushy dunes) in the Rio Grande delta. Wetland soils in the area are scattered and highly variable, usually with little peat and high sand content. This information was obtained from a document entitled "Soil Survey of Cameron County, Texas. United States Department of Agriculture. Soil Conservation Service. Texas Agricultural Experiment Station. 1977."

3.4 Water Resources

Several types of wetland habitat are found in the Bahia Grande area including natural inland ponds, small constructed impoundments (for livestock watering), resacas (old oxbow river channels), estuaries and tidal flats. San Martín Lake contains permanent water even in drought years. Other surface waters are seasonal in nature. The Bahia Grande, once a tidal bay, was

disconnected from the Gulf of Mexico by the construction of the Brownsville Ship Channel in the mid 1930's.

According to the Texas Parks and Wildlife Department in Brownsville, the Lower Laguna Madre area has tremendous importance as a finfish and shellfish nursery area on which a major commercial fishery and a lucrative recreational fishery are dependent. The Lower Laguna Madre supports a significant shrimping fleet for the state of Texas.

3.5 Biological Resources

3.5.1 Wildlife

The Bahia Grande Unit of the Laguna Atascosa National Wildlife Refuge is located within the Tamaulipan Biotic Province and, in conjunction with surrounding natural lands, is regarded as an important reservoir of natural biological diversity. Limited wildlife surveys on the Unit have recorded several of the Valley's "million dollar" birds, the plain chachalaca, groove-billed ani, great kiskadee, and green jay. Other wildlife of interest encountered on the Unit are the Texas horned lizard, Rio Grande lesser siren, bobcat, ocelot, javelina, and nilgai. Just since November of 2002, anglers have been catching blue crabs (*Callinectes sapidus*) at the single, open culvert that allows water to flow into and out of Bahia Grande, under State Highway 48, during storm events. It is certain that with permanent tidal flooding of the basin, marine life including crabs, shellfish, various other invertebrates, and finfish will colonize the restored bay. The uplands likewise should support more species than are presently there, and denser populations of native wildlife are an expected result. The Laguna Atascosa National Wildlife Refuge has documented more than 400 species of birds, one of the highest diversities on National Wildlife Refuges in the nation. The Rio Grande lesser siren, black-spotted newt, green jay, brown jay, tropical parula, Texas ayenia, Coues rice rat, ocelot, and jaguarundi occur only in the Tamaulipan Biotic province (Refuge Checklists). This biotic province extends from the Nueces River of Texas south to the Rio Corona in Tamaulipas. The species listed are limited to this region, and are found nowhere else.

The piping plover, a federally listed threatened species, is particularly dependent on both sides of the Lower Laguna Madre for its winter habitat, spending more than nine months a year in the area. Depending on wind direction and tidal influence, this species may need algal flats on the north end of South Padre Island and wind tidal flats on the mainland, including the Bahia Grande area. It has been estimated that 10 to 20 percent of the world's population of piping plovers use the Lower Laguna Madre area. In addition, the snowy plover, a species of concern, is both a summer nesting and winter species. This species' habitat will be enhanced by the proposed flooding of Bahia Grande and the ancillary wetlands.

Sand/mud/algal flat environments are important feeding sites for a variety of wildlife species, including the piping plover, which is listed as a threatened species by the federal government. These flats provide a rich source of aquatic and surface invertebrates such as worms, flies, small crustaceans (including crabs and shrimp) and molluscs (including clams and snails), which are essential foods for shorebirds and wading birds as well as other wildlife. These species will also

benefit from enhanced habitat conditions as a result of flooding Bahia Grande and the ancillary wetlands.

The Lower Laguna Madre area contains important habitat for migratory and resident waterfowl and shorebirds and as well as wading birds. It is an important migration corridor for other birds such as peregrine falcons, ospreys and swallow-tailed kites and is an important resting and feeding area for trans-Gulf neotropical migrant bird species. (The Peregrine Fund, Annual Report, 1998.)

The Bahia Grande area supports the federally endangered northern Aplomado falcon. Through a reintroduction program headed by The Peregrine Fund, several releases of falcons have occurred in the area. Aplomado falcons have successfully nested on the Bahia Grande Unit. This popular falcon attracts bird watchers from all over the world, and its numbers will assuredly increase as a result of the permanent tidal flooding of Bahia Grande. More shorebirds on the flooded flats, and more passerines on the restored lomas will represent more prey available for these avian predators.

3.5.2. Vegetation

The general area in which the Bahia Grande is located is classified by Blair (1950) as the Tamaulipan Biotic Province of Texas. The boundaries of the Tamaulipan Biotic Province approximate those of South Texas Plain vegetation, also known as the Rio Grande Plain, which lies south of San Antonio between the Rio Grande and the Gulf Coast.

By examining San Martín Lake, immediately west of Bahia Grande, one can envision the changes that will probably occur in the dry basin when it is flooded with tidal waters. San Martín Lake is ringed with black mangroves and open shorelines, providing habitat for myriad cormorants (both neotropic and double-crested), white and brown pelicans, terns, gulls, night-herons (black-crowned and yellow-crowned), herons, egrets, ducks, American pipits, eastern and western meadowlarks, horned larks, and others.

The topographically diverse nature of Bahia Grande, with basins and lomas, prairies and brushlands, will contribute to a diverse assemblage of wildlife species. Different species inhabit different habitats and there will be a variety of different habitats available when the permanent tidal flooding is realized. By putting permanent water on the basins, even the highest lomas will benefit. Windblown, salty dust will be a thing of the past, and as future rains leach the existing salt out of the topsoil layers, plant life will flourish, and the dependent wildlife species will not be far behind.

3.6 Cultural Resources

An important cultural resource is an abandoned railroad bed that bisects the Bahia Grande. The railroad bed consists of local fill and windblown sand/clay drifts around approximately 2 miles of degraded cypress pilings on which a narrow-gauge railroad trestle was historically supported. From information provided by the Port Isabel Museum, it has been determined that this railroad may have been originally constructed in 1865 under command of General Phil Sheridan to move

Union troops between Brownsville and Port Isabel. Later, in 1872, Simón Celaya converted the army railroad to a “42-inch gauge” railroad, and named it the Rio Grande Railroad. This railroad ran a total of 26 miles between Brownsville and Port Isabel. Some of the railroad bed is deteriorated and some pilings are missing; therefore, this resource is no longer fully intact. A review of this resource was conducted by Service archaeologist David Siegel. No problems were anticipated, as restoring flow to the Bahia Grande would not produce areas of inundation of water depths greater than what occurred historically under natural high tide conditions more than 70 years ago. It was determined that breaching the railroad bed would not diminish the overall integrity of the property’s location, design, setting, materials, or workmanship. The restoration project would replicate historic flooding conditions, would not exceed historical flood levels, and was determined to represent the type of activity that has no potential to cause deleterious effects on historical properties present. The freshwater channel (Channel F, Figure 4) that will bring rainwater into Laguna Larga will cut through an old railroad right of way, but only where local fill materials were used to elevate it. No pilings or other structures will be impacted by this freshwater channel’s crossing of the right-of-way.

To comply with Section 106 of the National Historic Preservation Act (NHPA), Mr. Bill Martin of the Texas Historical Commission (THC), Archeology Division, was contacted and advised of the proposed restoration of Bahia Grande. THC recommended that an archeologist conduct a cultural resources survey of the project area, including the proposed new channels and around the edges of the proposed inundation areas. The Service contacted Thor Lassen, Ocean Trust, who in turn, contracted Dr. Robert A. Ricklis of Coastal Environments, Inc., of Corpus Christi, Texas to conduct the cultural resources.

The field portion of the archeological survey within the Bahia Grande refuge unit was conducted during the period of May 19-28, 2004. As a result of this survey, a draft report was provided to Ocean Trust and the Service that gave a “green light” to all the proposed channels, except Channel C3 (Figure 4). Two significant archeological sites were found, one in the vicinity of Channel A and one in the vicinity of Channels B2, C2, and C3. The site at Channel A was previously described by avocational archeologist A. E. Anderson, and artifacts found included small burned clay nodules and scattered *Rabdotus* land snails. It was concluded by Dr. Ricklis that the proposed channel construction would not impact this site. The second site, which extended about 500-600 meters along the eroded clay dune forming the northeast banks of Bahia Grande, was in the vicinity of Channels B2, C2, and C3. It was found that this site was more extensive and contained more artifacts than when it was previously described by A. E. Anderson; therefore, it was more susceptible to impact from the proposed channels. Artifacts found at this site included two Tortugas dart points (arrowheads), four shell artifacts, and 31 fish otoliths, which indicated that this site had been used as an archaic fishing camp. The proposed alignment of Channel C3 passed directly through the middle of this site, with the alignments of Channel B2 and Channel C2 located at the northern and southern fringes, respectively, of the site. A follow-up survey of this site by Dr. Ricklis was conducted on December 9-10, 2004 to better define the boundaries of this site. Dr. Ricklis concluded from the findings of this survey that construction of Channels C2 and B2 would not impact the site; however, construction of Channel C3, would significantly impact the site.

When the Service was selecting possible locations for Channel C (i.e., the channel alignment that connects Bahia Grande to Little Laguna Madre through the 108-acre wetland known as "The Bowl", Figure 4), it was aware that an A. E. Anderson site was located somewhere in the vicinity of the western third of this channel. The western third of the proposed channel would pass through a high, clay loma that bordered the Bahia Grande shoreline, a location that was also a good location for either an archaic or modern campsite. Therefore, the Service proposed two optional channel alignments: Channel C2 and Channel C3, at this location on the assumption that only one of the channels would be excluded by the cultural resources survey, but hopefully not both. Channel C3 was excluded by the archeological survey and therefore was abandoned by the Service. Channels C2 and C1 were cleared by the archeological survey, and they will be constructed to connect the Bahia Grande to Little Laguna Larga.

On February 7, 2005, the Service's Regional Director, Region 2, sent a letter and a copy of Dr. Robert A. Ricklis' cultural resources survey to the THC with a "no effect" determination for the Bahia Grande Restoration project. By letter dated February 22, 2005, the THC concurred with our "no effect" determination. This concluded the historic preservation review for NHPA, Section 106, and the Service's historic preservation review requirements as set forth under 614-2.2 of the Service Manual. No further review will be necessary, unless archeological remains are encountered during construction, especially human remains, then all construction will cease until additional clearances to proceed can be obtained.

3.7 Land Use

Grazing is the primary land use on private lands outside of refuge boundaries in the vicinity of the Bahia Grande. Also, nearby are the communities of Port Isabel, Laguna Heights, and Laguna Vista. Urbanization is steadily enlarging the boundaries of these communities and many rural properties are being developed as commercial and residential areas. Figure 2 is a map of Bahia Grande and the surrounding area. It shows these various towns, highways, and other landscape features on and around the Bahia Grande Unit.

The Brownsville Port Authority (Brownsville Navigation District, BND) owns the Brownsville Ship Channel that parallels the southern boundary of the Bahia Grande Unit. The Brownsville Ship Channel would be a major source of water inflow into the system should Channel E be constructed between the Brownsville Ship Channel and Bahia Grande. Presently, the Service leases land south of the ship channel from the BND as the Lomas Ecological Preserve, a unit of the Lower Rio Grande Valley National Wildlife Refuge. This lease was originally negotiated for a period of forty years. The BND has easements for spoil placement on private lands adjacent to the Brownsville Ship Channel.

There is a limited amount of oil and gas drilling in and near the Bahia Grande Unit. In addition to a lease agreement from the Texas General Land Office, and permit(s) from the U.S. Army Corps of Engineers, potential oil and gas exploration companies are required by policy to obtain a Special Use Permit from the Refuge, the surface owner and land manager, before drilling for oil and gas on the Unit. A Special Use Permit was issued in 2003 authorizing the drilling of an exploratory gas well about three-quarters of a mile north of the proposed location for Channel A.

Land use issues, such as oil and gas exploration and development, will remain essentially unchanged. The Service's Comprehensive Conservation Planning (CCP), which provides for significant public input on land and public use issues, was initiated in January 2004 for the Laguna Atascosa National Wildlife Refuge. When completed, it will include the Bahia Grande Unit.

3.8 Socioeconomic Considerations

This issue includes concerns about individual and local economic endeavors and quality of life resulting from the restoration project.

The Lower Laguna Madre supports a significant shrimping fleet for the state of Texas. The local shrimp fishing industry's harvested shrimp value reaches \$50,000,000 a year (Lower Laguna Madre Foundation).

The Lower Laguna Madre Foundation estimates the Lower Laguna Madre is worth more than \$400 million to Texas businesses yearly from sport fishing and recreational use.

Tourism and related economic sectors, such as retail trade and lodging, are very important to the local economy. Nature tourism is increasing in popularity and many people are coming to the Lower Rio Grande Valley to see its rich and diverse natural resources, including its wildlife species, many of which are found nowhere else in the country.

The proposed flooding of Bahia Grande, Laguna Larga, and Little Laguna Madre with tidal water will have a positive, beneficial socioeconomic impact on surrounding communities of people. With elimination of the blowing dust from these particular basins, land developers may build houses on the northern bluffs, along State Highway 100, overlooking the basins. Already, people are catching crabs along State Highway 48 where the single, open culvert allows water to flow in and out of Bahia Grande at the present time. Fishing activity, bird watching, and other compatible public uses will have significant beneficial effects in the socioeconomic arena of the local populace.

3.8.1 Tax Revenues

For fiscal years, 2001, 2002, and 2003, the Service paid Refuge Revenue Sharing amounts of \$166,210.00, \$137,691.00, and \$141,870.00, respectively, to Cameron County to help compensate the county for lost property taxes attributable to the Laguna Atascosa National Wildlife Refuge, including the Bahia Grande Unit. The Refuge Revenue Sharing Act makes these payments available, based on revenues received from grazing leases, timber sales, and offshore oil leases managed by the U.S. Department of Interior. Each year Congress may allocate additional funding to counties for revenue sharing purposes.

This proposed action would have no effect on these Refuge Revenue Sharing payments to Cameron County.

3.9 Public Use and Recreation

Many Texans believe preserving environmental quality for recreation and nature tourism is an important concern. *Eye on Nature*, a booklet published by Texas Parks and Wildlife Department (Austin, Texas, 1998) reported that by the year 2000, an estimated 18 million Texans will participate in nature tourism, especially birdwatching. Economists generally recognize that income that comes from people from outside of a given area, but spent within that area realizes more positive economic benefits to that area than income generated and spent within that area.

The current direction of public use, recreation, and management of the Bahia Grande Unit of the Laguna Atascosa National Wildlife Refuge is guided by the Final Conceptual Management Plan (FCMP), which is included in Appendix D of the Laguna Atascosa National Wildlife Refuge - Proposed Refuge Expansion Plan (Environmental Assessment and Conceptual Management Plan), approved in September 1999. Future direction of public use, recreation, and management of the Unit will be determined during the development and completion of a Comprehensive Conservation Plan (CCP), which was initiated in January 2004, for the Laguna Atascosa National Wildlife Refuge. The CCP process will include extensive public involvement through public outreach and multiple public meetings at various stages of the process. Another planning initiative similar to the CCP is Habitat Management Planning (HMP). The HMP is a step-down plan from the CCP and includes annual plans for managing the refuge habitats in compliance with the purposes of a given refuge.

The FCMP found six public recreational activities compatible with the purposes of the Bahia Grande Unit: recreational fishing, recreational hunting, wildlife observation, wildlife photography, environmental education, and interpretation. However, the only legal, and compatible, public recreational use that occurred on the Unit prior to acquisition by the Service was bank fishing (for crabs and finfish) along the right-of-way boundary of State Highway 48 at San Martín Lake and the Bahia Grande lake basin (when seasonally flooded). This traditional use will continue to be allowed. Private (not public) hunting leases for deer, waterfowl, dove, and quail occurred on the Unit prior to acquisition by the Service. Public recreational hunting (e.g., white-tailed deer, waterfowl, bobwhite quail, mourning dove, and feral pig) is not currently allowed; however, it will, along with wildlife observation (e.g., wildlife tour loop, observation platforms), wildlife photography, expanded recreational fishing (e.g., wade fishing), boating access (e.g., canoe, kayak), environmental education, and interpretation (e.g., guided environmental and cultural resource tours) will be evaluated through the CCP process. The final, approved CCP will identify the scope and intensity of each of these wildlife-dependent public recreational uses on the Bahia Grande Unit.

The only refuge-sanctioned public use now occurring on the Bahia Grande Unit includes walk-in bank fishing on San Martín Lake, with access from State Highway 48. As mentioned above, some crabbing by locals also occurs in the vicinity of the single, open culvert under State Highway 48 that allows limited tidal waters to flow in and out of Bahia Grande.

Fishing and boating occurs adjacent to the Bahia Grande in the Lower Laguna Madre, Brownsville Ship Channel and at an access point along State Highway 48. If permanent tidal waters are introduced to Bahia Grande, it may be compatible, as mentioned above, to allow non-

motorized watercraft such as kayaks and canoes to use the area. Certainly, wading anglers would want to try their luck in the shallow bay. Flounder, redfish, and spotted seatrout are the most avidly sought species in such locations.

Hunting for waterfowl, bobwhite quail, mourning and white-winged doves, nilgai (an exotic antelope native to India), white-tailed deer and wild hogs occur in areas adjacent to the Bahia Grande. While public hunting is not currently allowed on Bahia Grande, it may be possible to provide some high quality hunting for waterfowl, doves and quail. White-tailed deer are not numerous enough at the present time to support such a refuge hunt; however, public hunts may be allowed to help control exotic wild hogs and nilgai, both of which compete directly with native wildlife and destroy habitat.

Some unauthorized public use also occurs. The most common infractions are trespass vehicles, littering, and fishing without a license, particularly in the area along San Martín Lake where walk-in bank fishing is permitted. Some limited poaching of javelina, nilgai, and white-tailed deer occurs along the western section of the Unit where a county road parallels the refuge boundary. Also, cattle trespass occurs at varying degrees; however, Refuge law enforcement actions have greatly reduced, though not eliminated this persistent problem.

3.10 Contaminants and Hazardous Wastes

In 2000, a transport tanker truck on State Highway 48 overturned near San Martín Lake. Its cargo, a chemical called *Furfural*, spilled into the borrow ditches on the sides of State Highway 48, which at the time were filled with water, connected to San Martín Lake. Texas Parks and Wildlife Department, the U.S. Coast Guard, National Oceanic and Atmospheric Administration, and the Texas Commission on Environmental Quality assisted the Service in cleaning up the spill and mitigating the associated impacts of the breaching of an emergency ditch dam which resulted in a kill of several million fish. The Service knows that such accidents may happen which gives cause for concern. For this reason, a Spill Contingency Plan is maintained by Laguna Atascosa National Wildlife Refuge, and supplies (oil spill booms, rubber gloves, detergent, etc.) are maintained in refuge storage areas. The Refuge also works closely with the Texas General Land Office's Oil Spill Response Team, to conduct oil spill training scenarios on refuge lands in order to improve coordination of resources.

4.0 ALTERNATIVES AND ENVIRONMENTAL CONSEQUENCES

4.1 Alternative A - (No Action Alternative) No Tidal Flooding

This alternative continues the status quo. No effort to flood would take place and the Bahia Grande would remain an ephemeral wetland, only partially filling with water during extreme rainfall events or tropical storm surges and by very restricted water access via the current small, deteriorated culverts in place under State Highway 48. Salty dust would continue to blow out of the basin, and into surrounding communities, increasing the incidence and severity of respiratory symptoms, degradation of mechanical devices (e.g., HVAC units), and causing wildfires through short circuits on power line transformers (two wildfires were attributed to this in the past five years).

The possibility of eventual litigation against the Service as a result of wildfires, property loss, and human health problems remains a distinct possibility.

Existing constructed wetlands (e.g., livestock watering tanks), and various wildlife watering devices, including “guzzlers” and water wells from oil and gas exploration wells, are used to provide potable water for various wildlife species present. The continued blowing dust will also impact plants growing on upland loma sites around the basins. With reduced cover, low wildlife diversity and numbers will be the norm.

Continued fish kills, such as that described in Section 2.1 above, in which the loss of a half million or more game fish was documented, may be expected annually.

4.1.1 Climate

This alternative would not have an effect on the climate.

4.1.2 Air Quality

Under this alternative, air quality would remain unchanged. Blowing dust is the cause for most of the particulate matter in the region’s air. A traffic hazard will be occasionally present in the form of blowing dust, which reduces visibility, across State Highway 48 and State Highway 100. As urbanization progresses around the Bahia Grande, it can be expected that more and more people will suffer respiratory problems as a result of the continuing dusty conditions.

4.1.3 Geology and Soils

There would be the continuing effect on soils in the area, because silt and sand would still be wind transported and dust will continue to be a problem. These “blowouts” are created by the wind’s scouring action on the bay bottom, digging ever deeper, and deeper. Salty dust blown out covers upland vegetation, killing it and preventing other vegetation from getting established. This results in erosion, possibly affecting even geological formations. The effect on soils and geology of the continual dry basins is negative, and potentially significant.

4.1.4 Water Resources

The tidal flat area of the Bahia Grande would remain an ephemeral wetland. Only a small portion of this acreage will be covered with water during extreme rainfall events or tropical storm surges.

4.1.5 Biological Resources

Little habitat for wading birds, shorebirds, and threatened species like the piping plover would continue under this alternative. Fishery resources would continue to blossom with tropical rainfall events, and then literally “dry up” as drier months ensue, resulting in fish kills of significant size. The loss of up to half a million fish can be expected. Furthermore, increased urbanization in the surrounding areas, which will occur whether or not Bahia Grande is flooded,

would introduce feral dogs and cats that would have far-reaching effects on native wildlife species. In addition, new drains from urbanized areas might affect the area in ways unknown at this point in time.

4.1.6 Cultural Resources

The refuge would continue protection of cultural resources under this alternative. Following the recommendations of Dr. Robert A. Ricklis and Coastal Environments, Inc., of Corpus Christi, Texas, the Texas Historical Commission, and Service archeologists, continued protection of specific sites will be implemented.

4.1.7 Land Use

Land use would continue as at present.

4.1.8 Socioeconomic Resources

The area surrounding the Bahia Grande would continue to follow a trend of increased urbanization. Under this alternative, land values would change only as the local markets are affected by future trends. Market values might increase due to anticipated increased development in areas such as along State Highway 100 and close to towns. There would be no effect on the commercial shellfish and finfish industry. The continued blowing dust may affect some real estate values in certain areas.

4.1.9 Effects on Tax Revenues

There should be no effect.

4.1.10 Public Use and Recreation

Presently there is a good deal of tourism and economic benefit associated with South Padre Island. A good parallel would be to look at the City of Harlingen, Texas. Harlingen was the very first city in the Lower Rio Grande Valley (Valley) to sponsor a Birding Festival. In their first year, 1995, the Festival brought in \$3.5 million in a five-day period. This was all nature-based tourism, and about 50% of it was directly related to the Valley refuges, particularly Laguna Atascosa National Wildlife Refuge. Tours, talks, and help with building and setting up props for a lunch area at the Festival, all helped generate more economic benefit because of the refuge. Unfortunately, the landscape of the Bahia Grande Unit is very xeric and relatively unattractive, and it will stay that way with no admittance of permanent tidal waters into the basins thereon.

Very little to no benefit is associated with Bahia Grande under this alternative. This status quo would not change if the basins are not flooded with permanent tidal waters.

4.1.11 Contaminants and Hazardous Waste

No change in levels of contaminants or hazardous waste is expected.

4.2 Alternative B: Flooding from San Martín Lake only (Channel A)

Under this alternative, water will be diverted from San Martín Lake and pass through an approximate 8,255-foot, constructed channel to inundate Bahia Grande. The final size and orientation of the channel will determine the volume and rate of water exchange between the two sites. Hydrological, topographic and engineering studies have been completed and recommendations provided by Texas A&M University's Department of Civil Engineering, School of Ocean Engineering. Channel dimensions necessary for adequate tidal circulation in Bahia Grande also assist restoration planning.

In addition to Channel A itself, a series of five other channels will be dug in phases (Figure 4). These have been designated as Channels B1, B2, C1, C2, and D as follows:

Channel B1, 60 feet wide, by -2 feet below MSL, and approximately 7,800 feet long, a Phase 3 channel that will connect Bahia Grande to Laguna Larga, enhancing circulation of water between these two basins;

Channel B₂, 60 feet wide by -2 feet below MSL, and approximately 3,719 feet long, a Phase 1 channel that will connect Bahia Grande to Laguna Larga, allowing approximately 1,700 acres of additional flooding in Laguna Larga;

Channel C1, the western segment of Channel C, 60 feet wide, by -2 feet below MSL, and approximately 2,175 feet long, a Phase 1 channel that will connect Bahia Grande to Little Laguna Madre; allowing approximately 1,400 acres of additional flooding in Little Laguna Madre;

Channel C2, the eastern segment of Channel C, 60 feet wide, by -2 feet below MSL, and approximately 625 feet long, a Phase 1 channel that will connect Bahia Grande to Little Laguna Madre; allowing approximately 1,400 acres of additional flooding in Little Laguna Madre; and

Channel D, 60 feet wide, by -2 feet below MSL, and approximately 2,178 feet long, a Phase 3 channel that will connect Laguna Larga to Little Laguna Madre, enhancing circulation of water between these two basins.

A total of about 6,500 acres will be flooded in Bahia Grande under this alternative, 4,000 permanently, and 2,500 tidally. In addition, about 1,700 acres in Laguna Larga would be flooded, either by freshwater from the NRCS diversions under State Highway 100, or by saltwater from Bahia Grande. Another 1,400 acres will be inundated in Little Laguna Madre under this alternative. Therefore a total of approximately 9,600 acres will be flooded, either permanently (6,800-plus acres) or periodically by lunar and wind tidal effects (2,800-plus acres). Appendix D shows revisions to proposed channel design dimensions and additional

structures that are needed to manage the wetland system. Appendix E provides typical drawings of the original proposed channels, both cross-sectional and longitudinal. There is also a topographic view of the entire project.

Overall water depths will be very shallow (Figure 3). Average depth will probably be less than 6 inches due to the vast areas that will be covered by the sheet water flows of wind tides. Some areas will be as deep as three to four feet below mean sea level. The amount of water introduced by lunar and wind tides under this alternative will be significantly greater than that introduced by Alternative B or C. That is because of the direct alignment of Channel E with the prevailing southeast winds. Channel A, in Alternative B, is not aligned so beneficially, and its greater length, 8,255 linear feet compared to 2,400 linear feet with Channel E, work against effective flooding, as well.

4.2.1 Climate

This alternative would not have a singular effect on the climate.

4.2.2 Air Quality

Under this alternative, air quality would improve. Blowing dust would still account for most of the particulate matter in the region's air, but would be reduced in the Bahia Grande area by restoring a tidal hydrological pattern to flood the dry basin. A traffic hazard may still be occasionally present in the form of blowing dust across State Highway 48 and State Highway 100, but it would be much reduced. The major source of blowing dust would be eliminated, representing perhaps 60% of the total problem. Additional dust may still come from Long Island, from the sides of the Brownsville Ship Channel, and from U.S. Army Corps of Engineers spoil areas in the vicinity.

4.2.3 Geology and Soils

There would be an effect to geology and soils in the area. Silt and sand would continue to be wind transported but these effects would be reduced in the Bahia Grande area by restoring a tidal hydrological pattern to flood the dry basin. Dust storms that adversely affect Laguna Vista, Laguna Heights, and Port Isabel would be reduced in severity. Positive beneficial effect on loma vegetation has already been addressed. In addition, some of the soils removed in digging channels, when appropriate, will be used to "patch" eroded gullies and other damage to the existing lomas. This should stabilize the erosion problem, conserve the topsoil, and encourage colonization by various plant species, which will further stabilize the areas.

4.2.4 Water Resources

Restoring tidal hydrological patterns in these waters would greatly increase wildlife and fishery values and provide additional recreational opportunities. The exchange of salt water would contribute to improving water circulation in the Bahia Grande. This alternative alone may not provide enough circulation and water mixing to maintain the system at maximum biological productivity. The channel planned for the connection from San Martín Lake to Bahia Grande

will be located close to the mouth of San Martín Lake, and in the vicinity of the Brownsville Ship Channel. This placement will minimize the expected turbidity levels that would result from tidal waters flowing back and forth between the two bodies of water. Turbidity effects should be isolated near the mouth of San Martín Lake, and should not affect the entire lake.

A total of about 6,500 acres will be flooded in Bahia Grande under this alternative, 4,000 permanently, and 2,500 tidally. In addition, about 1,700 acres in Laguna Larga would be flooded, either by freshwater from the NRCS diversions under State Highway 100, or by saltwater from Bahia Grande. Another 1,400 acres will be inundated in Little Laguna Madre under this alternative. Therefore a total of approximately 9,600 acres will be flooded, either permanently (6,800-plus acres) or periodically by lunar and wind tidal effects (2,800-plus acres). Appendix D shows revisions to proposed channel design dimensions and additional structures that are needed to manage the wetland system. Appendix E provides typical drawings of the original proposed channels, both cross-sectional and longitudinal. There is also a topographic view of the entire project.

All of this additional water is habitat for shrimp, crabs, other shellfish and invertebrates, and finfish, which in turn provide a rich feeding source for shorebirds, wading birds, and waterfowl.

4.2.5 Biological Resources

Habitat for wading birds, shorebirds, and threatened species like the piping plover would be favorably impacted under this alternative. Migration of marine organisms into and out of the Bahia Grande would be increased. Biological productivity will be significantly increased. In addition to the obvious habitat improvement for shrimp, crabs, shellfish and other invertebrates, and finfish, these species will provide a rich feeding source for shorebirds, wading birds, and waterfowl.

Evaluation of the effects of flooding on marine plant and animal species will be provided by one or more of the regional universities. The University of Texas-Pan American, which has a recognized coastal marine science department, has proposed and had approved a request for funding to the Department of Housing and Urban Development to implement a study of seagrass colonization. Texas A&M-Corpus Christi University has shown interest in conducting a more thorough study of marine organisms colonization in the restored Bahia Grande estuarine system. These studies have been funded by a grant from the EPA's Gulf of Mexico Program.

The alleviation of the dust problem and restoration efforts creating an attractive wetland may also increase development and market values for properties near the Bahia Grande. This could have a detrimental effect on biological resources on private lands near the Bahia Grande as rural properties are developed and native habitat for wildlife is destroyed. Species impacted with such an urbanization scenario might include Texas tortoise, Texas horned lizard, plain chachalaca, white-tipped dove, Harris' hawk, ladder-backed woodpecker, green jay, great kiskadee, altamira oriole, olive sparrow, bobcat, ocelot, jaguarundi, javelina, and white-tailed deer.

4.2.6 Cultural Resources

The refuge would continue protection of cultural resources under this alternative. Following the recommendations of Dr. Robert A. Ricklis and Coastal Environments, Inc., of Corpus Christi, Texas, the Texas Historical Commission, and Service archeologists, continued protection of specific sites will be implemented.

4.2.7 Land Use

The Bahia Grande would be partially restored to a historical natural condition. Recreational use of the Bahia Grande area may be enhanced under this alternative.

The flooding of Bahia Grande will provide an invaluable study site for universities. Already the University of Texas Pan-American has submitted a proposal to the National Oceanic and Atmospheric Administration (NOAA) to fund a study of seagrasses colonizing the flooded basins, as well as the potential for introducing black mangroves and seagrasses to the site, (Don Hockaday, pers. comm.) Texas A&M University Kingsville has contacted the Service about doing studies of changes in the upland habitats as a result of flooding Bahia Grande, looking at the plant and animal communities, to assess the changes that occur therein (Bill Kuvlesky, pers. comm.). Texas A&M University-Corpus Christi is preparing a funding proposal to assess the complex issue of marine organism colonization, including both plant and animal species (Wes Tunnel and Liz Smith, pers.comm.).

The Environmental Protection Agency, through its Gulf of Mexico Program, has provided a grant of \$225,000.

The Service has an interest in encouraging more northern Aplomado falcons on the site, through improvement of the habitat, and would also support the natural proliferation of plant life, re-vegetation of denuded loma sites, and stabilization of all wildlife populations native to the site.

4.2.8 Socioeconomic Resources

The area surrounding the Bahia Grande would continue to follow a trend of increased urbanization. Under this alternative, land values would change only as the local markets are affected by future trends. Market values might increase due to anticipated increased development in areas such as along State Highway 100 and close to towns. Alleviation of the dust problem may also increase development and market value for properties near the Bahia Grande.

Nature tourism and other recreational activities will increase under this alternative due to the increase in wildlife resources. This is likely to have a positive impact on the local economy (Pete Moore, South Padre Island Development Council, pers. comm., and Patrick Marchan, Port Isabel Mayor, pers. comm.).

In addition, commercial and recreational fisheries will be enhanced by restoration of estuarine nursery habitat for shellfish and finfish.

4.2.9 Effects on Tax Revenues

There should be no effect.

4.2.10 Public Use and Recreation

Opportunities for wildlife-oriented recreation, including the “Big Six” priority public uses on national wildlife refuges: hunting, fishing, wildlife observation, photography, environmental education, and interpretation, under this alternative will be explored as part of the Comprehensive Conservation Planning initiative.

4.2.11 Contaminants and Hazardous Waste

No change in levels of contaminants or hazardous waste is expected under this alternative. However, because of the connection to San Martín Lake, there would be potential for the introduction of toxic chemicals into the Bahia Grande due to a spill.

4.3 Alternative C: Flooding from Brownsville Ship Channel Only

Under this alternative, water will be diverted from the Brownsville Ship Channel, and pass through a relatively straight 2,400 feet long by 200 feet wide by 9 feet below MSL, constructed channel and enter under a bridge at State Highway 48 to inundate Bahia Grande. Cooperation must be obtained from the Port of Brownsville as the owners of the channel site. Close coordination is also needed with the Texas Department of Transportation (TXDOT). The final size and orientation of the channel will determine the volume and rate of water exchange between the two sites. Hydrological, topographic and engineering studies have been used to provide recommendations on channel dimensions necessary for adequate tidal circulation in Bahia Grande and to assist restoration planning. This work, a thesis from Texas A&M University, was done in 2003. An advantage of Channel E is that prevailing winds from the southeast can facilitate maximum inundation of the basin by pushing tidal waters.

In addition to Channel E itself, a series of five other channels will be dug in phases (Figure 4). These have been designated as Channels B1, B2, C1, C2, and D as follows:

Channel B1, 60 feet wide, by -2 feet below MSL, and approximately 7,800 feet long, a Phase 3 channel that will connect Bahia Grande to Laguna Larga, enhancing circulation of water between these two basins;

Channel B₂, 60 feet wide by -2 feet below MSL, and approximately 3,719 feet long, a Phase 1 channel that will connect Bahia Grande to Laguna Larga, allowing approximately 1,700 acres of additional flooding in Laguna Larga;

Channel C1, the western segment of Channel C, 60 feet wide, by -2 feet below MSL, and approximately 2,175 feet long, a Phase 1 channel that will connect Bahia Grande to Little Laguna Madre; allowing approximately 1,400 acres of additional flooding in Little Laguna Madre;

Channel C2, the eastern segment of Channel C, 60 feet wide, by -2 feet below MSL, and approximately 625 feet long, a Phase 1 channel that will connect Bahia Grande to Little Laguna Madre; allowing approximately 1,400 acres of additional flooding in Little Laguna Madre; and

Channel D, 60 feet wide, by -2 feet below MSL, and approximately 2,178 feet long, a Phase 3 channel that will connect Laguna Larga to Little Laguna Madre, enhancing circulation of water between these two basins.

A total of about 6,500 acres will be flooded in Bahia Grande under this alternative, 4,000 permanently, and 2,500 tidally. In addition, about 1,700 acres in Laguna Larga would be flooded, either by freshwater from the NRCS diversions under State Highway 100, or by saltwater from Bahia Grande. Another 1,400 acres will be inundated in Little Laguna Madre under this alternative. Therefore a total of approximately 9,600 acres will be flooded, either permanently (6,800-plus acres) or periodically by lunar and wind tidal effects (2,800-plus acres). Appendix D shows revisions to proposed channel design dimensions and additional structures that are needed to manage the wetland system. Appendix E provides typical drawings of the original proposed channels, both cross-sectional and longitudinal. There is also a topographic view of the entire project.

Overall water depths will be very shallow (Figure 3). Average depth will probably be less than 6 inches due to the vast areas that will be covered by the sheet water flows of wind tides. Some areas will be as deep as three to four feet below mean sea level. The amount of water introduced by lunar and wind tides under this alternative will be significantly greater than that introduced by Alternative B or C. That is because of the direct alignment of Channel E with the prevailing southeast winds. Channel A, in Alternative B, is not aligned so beneficially, and its greater length, 8,255 linear feet compared to 2,400 linear feet with Channel E, work against effective flooding, as well.

TXDOT is presently reviewing the need to widen State Highway 48 to a four-lane expressway, and has separated out the bridge required for Channel E, to "put it on the fast track". Estimates given in meetings with the Cameron County Judge have bid review packages for this bridge being let by December 2004, contractor selection by April 2005, and completion of the project by December 2006.

4.3.1 Climate

This alternative would not have a singular effect on the climate.

4.3.2 Air Quality

Under this alternative, air quality would improve. Blowing dust would still account for most of the particulate matter in the region's air, but it would be reduced in the Bahia Grande area by restoring a tidal hydrological pattern to flood the dry basin. A traffic hazard may still be occasionally present in the form of blowing dust across State Highway 48 and State Highway 100, but it would be much reduced. The major source of blowing dust would be eliminated,

representing perhaps 60% of the total problem. Additional dust will still come from Long Island, from the sides of the Brownsville Ship Channel, and from U. S. Army Corps of Engineers spoil areas in the vicinity.

4.3.3 Geology and Soils

There would be an effect to geology and soils in the area. Silt and sand would continue to be wind transported, but these effects would be reduced in the Bahia Grande area by restoring a tidal hydrological pattern to flood the dry basin. Dust storms that adversely affect Laguna Vista, Laguna Heights, and Port Isabel would be reduced in severity. Positive beneficial effect on loma vegetation has already been addressed. In addition, some of the soils removed in digging channels, when appropriate, will be used to "patch" eroded gullies and other damage to the existing lomas. This should stabilize the erosion problem, conserve the topsoil, and encourage colonization by various plant species, which will further stabilize the areas.

4.3.4 Water Resources

Restoring tidal hydrological patterns in these waters would greatly increase wildlife and fishery resources, and may provide additional recreational opportunities. The exchange of salt water would contribute to improving water circulation in the Bahia Grande. This alternative alone may not provide enough circulation and water mixing to maintain the system at maximum biological productivity, but it will be more efficient than Channel A alone, Alternative B.

A total of about 6,500 acres will be flooded in Bahia Grande under this alternative, 4,000 permanently, and 2,500 tidally. In addition, about 1,700 acres in Laguna Larga would be flooded, either by freshwater from the NRCS diversions under State Highway 100, or by saltwater from Bahia Grande. Another 1,400 acres will be inundated in Little Laguna Madre under this alternative. Therefore a total of approximately 9,600 acres will be flooded, either permanently (6,800-plus acres) or periodically by lunar and wind tidal effects (2,800-plus acres). Appendix D shows revisions to proposed channel design dimensions and additional structures that are needed to manage the wetland system. Appendix E provides typical drawings of the original proposed channels, both cross-sectional and longitudinal. There is also a topographic view of the entire project.

The effects of Channel E, while similar to those for Channel A, will, by virtue of its wider and deeper dimensions, and shorter distance overland, provide for faster inflows and outflows of water inside the basin. This may be of special importance during times of heavy rainfall events. Also, because Channel E is more directly aligned with the prevailing southeast winds, wind tidal flooding will be magnified in this alternative.

4.3.5 Biological Resources

Greatly improved habitat for wading birds, shorebirds, and threatened species like the piping plover would be beneficial under this alternative. Migration of marine organisms into and out of the Bahia Grande would be facilitated. Biological productivity will be significantly increased.

In addition to the obvious habitat provision for shrimp, crabs, shellfish and other invertebrates, and finfish, these will provide a rich feeding source for shorebirds, wading birds, and waterfowl.

The alleviation of the dust problem and restoration efforts creating an attractive wetland may also increase development and market value for properties near the Bahia Grande. This could have a detrimental effect on biological resources on private lands near the Bahia Grande, as rural properties are developed and native wildlife habitat is destroyed.

Monitoring of marine organisms entering Bahia Grande will be needed to evaluate the survival, reproduction, and use of habitat by marine organisms in the basin. A wetland management plan may be developed through use of a graduate study from one of the regional universities, such as the University of Texas-Pan American, which has a recognized coastal marine science department.

As mentioned under the previous section for Alternative B, alleviation of the dust problem and restoration efforts creating an attractive wetland may also increase development and market value for properties near the Bahia Grande. This could have a detrimental effect on biological resources on private lands near the Bahia Grande as rural properties are developed and native habitat for wildlife is destroyed. Species impacted with such an urbanization scenario might include Texas tortoise, Texas horned lizard, plain chachalaca, white-tipped dove, Harris' hawk, ladder-backed woodpecker, green jay, great kiskadee, altamira oriole, olive sparrow, bobcat, ocelot, jaguarundi, javelina, and white-tailed deer.

On the refuge, marine organisms, fish, crabs, shellfish and other invertebrates, finfish, shorebirds, herons and egrets, ospreys, raccoons, coyotes, and other species, which all benefit from shallow flooding in coastal wetlands, will benefit. Other, upland species, which may not have as direct a relationship with the flooded basins, such as plain chachalaca, great kiskadee, green jay, Harris' hawk, and others, will benefit as their upland habitats are improved by the reduction of blowing salty dust, and the leaching out of salts by future rainfall events.

The flooding of Bahia Grande will provide an invaluable study site for universities. Already the University of Texas Pan-American has submitted a proposal to the National Oceanic and Atmospheric Administration (NOAA) to fund a study of seagrasses colonizing the flooded basins, as well as the potential for introducing black mangroves and seagrasses to the site, (Don Hockaday, pers. comm.). Texas A&M University Kingsville has contacted the Service about doing studies of changes in the upland habitats as a result of flooding Bahia Grande, looking at the plant and animal communities, to assess the changes that occur therein (Bill Kuvlesky, pers. comm.). Texas A&M University-Corpus Christi is preparing a funding proposal to assess the complex issue of marine organism colonization, including both plant and animal species (Wes Tunnel and Liz Smith, pers. comm.). These various studies are being funded by the \$225,000 grant from the EPA Gulf of Mexico Program.

In summary, flooding basins may have a negative impact on wildlife off the refuge, due to urbanization and land clearing. In contrast, flooding the basins will have a beneficial impact on wildlife on the refuge, through habitat improvement associated with the reduction of blowing dust.

4.3.6 Cultural Resources

The refuge would continue protection of cultural resources under this alternative. Following the recommendations of Dr. Robert A. Ricklis and Coastal Environments, Inc., of Corpus Christi, Texas, the Texas Historical Commission, and Service archeologists, continued protection of specific sites will be implemented.

4.3.7 Land Use

The Bahia Grande would be partially restored to a historical natural condition. Recreational use of the Bahia Grande area may be enhanced under this alternative.

The flooding of Bahia Grande will provide an invaluable study site for universities. A variety of universities and colleges have offered projects to study the recovery of the Bahia Grande habitats.

The Service has an interest in encouraging more northern Aplomado falcons on the site, through improvement of the habitat, and would also support the natural proliferation of plant life, re-vegetation of denuded loma sites, and stabilization of all wildlife populations native to the site.

4.3.8 Socioeconomic Resources

The area surrounding the Bahia Grande would continue to follow a trend of increased urbanization. Under this alternative, land values would change only as the local markets are affected by future trends. Market values might increase due to anticipated increased development in areas such as along State Highway 100 and close to towns. Alleviation of the dust problem may also increase development and market value for properties near the Bahia Grande. Also, and related to the urbanization problem, but in a positive sense, nature tourism and other recreational activities may increase under this alternative due to the increase in wildlife resources, commensurate with the increased human population. This is likely to have a positive impact the local economy (Pete Moore, South Padre Island Development Council, pers. comm., and Patrick Marchan, Port Isabel Mayor, pers. comm.).

In addition, commercial and recreational fisheries will be enhanced by restoration of estuarine nursery habitat for shellfish and finfish.

4.3.8.1 Effects on Tax Revenues

There should be no effect.

4.3.9 Public Use and Recreation

Opportunities for wildlife-oriented recreation under this alternative will be positive for the general public. The restoration of the Bahia Grande will increase wildlife viewing opportunities, such as birdwatching. Additional public uses, including the "Big Six" priority public uses on national wildlife refuges: hunting, fishing, wildlife observation, photography, environmental

education, and interpretation, will be explored. The development of the CCP and HMP will include several public meetings to allow the public to propose and comment on potential public recreational uses for the Bahia Grande Unit.

4.3.10 Contaminants and Hazardous Waste

No change in levels of contaminants or hazardous waste is expected under this alternative. However, because of the connection to the Brownsville Ship Channel, there would be potential for the introduction of toxic chemicals into the Bahia Grande due to a spill. The refuge maintains a supply of booms, suits, and other gear to be used by the U.S. Coast Guard (lead agency) and other cooperators, in case of a spill. The Refuge also works closely the Texas General Land Office, Oil Spill Response Team, to conduct oil spill training scenarios on refuge lands in order to improve coordination of resources. The refuge Spill Contingency Plan will be updated prior to flooding the basins.

4.4 Alternative D: (Proposed Action) Flooding from both directions (Alternatives B and C)

The level of water circulation desired in the Bahia Grande may necessitate the construction of both channels (Channel A and Channel E). These will be used individually, or simultaneously, to provide adequate tidal circulation. Hydrological, topographic and engineering studies have been completed by Texas A&M University's Department of Civil Engineering, Ocean Engineering Branch, to provide recommendations on channel dimensions necessary for adequate tidal circulation in Bahia Grande and to assist restoration planning with Channels A, B, C, D, and E.

This alternative is the "Preferred Alternative" because it should provide the greatest level of natural circulation of waters in Bahia Grande, Laguna Larga, and Little Laguna Madre. With both "feeder channels" in place, an optimum environment for fish, shrimp, and other marine organisms will be in place.

In addition to the main "feeder channels", A and E, a series of five other channels will be dug in phases (Figure 4). These have been designated as Channels B1, B2, C1, C2, and D as follows:

Channel B1, 60 feet wide, by -2 feet below MSL, and approximately 7,800 feet long, a Phase 3 channel that will connect Bahia Grande to Laguna Larga, enhancing circulation of water between these two basins;

Channel B2, 60 feet wide by -2 feet below MSL, and approximately 3,719 feet long, a Phase 1 channel that will connect Bahia Grande to Laguna Larga, allowing approximately 1,700 acres of additional flooding in Laguna Larga;

Channel C1, the western segment of Channel C, 60 feet wide, by -2 feet below MSL, and approximately 2,175 feet long, a Phase 1 channel that will connect Bahia Grande to Little Laguna Madre; allowing approximately 1,400 acres of additional flooding in Little Laguna Madre;

Channel C2, the eastern segment of Channel C, 60 feet wide, by -2 feet below MSL, and approximately 625 feet long, a Phase 1 channel that will connect Bahia Grande to Little Laguna Madre; allowing approximately 1,400 acres of additional flooding in Little Laguna Madre; and

Channel D, 60 feet wide, by -2 feet below MSL, and approximately 2,178 feet long, a Phase 3 channel that will connect Laguna Larga to Little Laguna Madre, enhancing circulation of water between these two basins.

A total of about 6,500 acres will be flooded in Bahia Grande under this alternative, 4,000 permanently, and 2,500 tidally. In addition, about 1,700 acres in Laguna Larga would be flooded, either by freshwater from the NRCS diversions under State Highway 100, or by saltwater from Bahia Grande. Another 1,400 acres will be inundated in Little Laguna Madre under this alternative. Therefore a total of approximately 9,600 acres will be flooded, either permanently (6,800-plus acres) or periodically by lunar and wind tidal effects (2,800-plus acres). Appendix D shows revisions to proposed channel design dimensions and additional structures that are needed to manage the wetland system. Appendix E provides typical drawings of the original proposed channels, both cross-sectional and longitudinal. There is also a topographic view of the entire project.

All of this additional water is habitat for shrimp, crabs, shellfish and other invertebrates, and finfish, which in turn provide a rich feeding source for shorebirds, wading birds, and waterfowl. Additional water would be better aerated, and seagrasses and other plants would experience much greater success. As a result, under Alternative D, there should occur higher survivability, reproduction, and density of marine organisms than in either of the prior alternatives, B or C, which, in turn, would provide a richer feeding site for greater numbers of shorebirds, wading birds, waterfowl, osprey, and other species.

Channel construction will generate spoil material. If transport of the spoil by heavy truck across the dry basin is feasible, spoil islands may be created. These spoil islands will be shaped to retain as much material as possible in high wind situations, and are expected to prove valuable as nesting areas for colonial water birds. Historically, two small islands within Bahia Grande provided nesting habitat for more than 10,000 terns, gulls, and black skimmers. Restoring this type of habitat, if feasible, would be a secondary goal of the project.

Additional possibilities for the disposal of spoil from the channel construction process are use by the Brownsville Landfill for "capping debris" with soil, and by TXDOT for use in the roadbed of an expanded State Highway 48.

4.5.1 Climate

This alternative will not have an effect on the climate.

4.5.2 Air Quality

Under this alternative, air quality would improve. Blowing dust would still account for most of the particulate matter in the region's air, but it would be reduced in the Bahia Grande area by restoring a tidal hydrological pattern to flood the dry basin. A traffic hazard may still be occasionally present in the form of blowing dust across State Highway 100 and State Highway 48, but it would be much reduced. The major source of blowing dust would be eliminated, representing perhaps 60% of the total problem. Additional dust will still come from Long Island, from the sides of the Brownsville Ship Channel, and from U.S. Army Corps of Engineers spoil areas in the vicinity.

4.5.3 Geology and Soils

There would be an effect to geology and soils in the area. Silt and sand would continue to be wind transported, but these effects would be reduced in the Bahia Grande area by restoring a tidal hydrological pattern to flood the dry basin. Dust storms that adversely affect Laguna Vista, Laguna Heights, and Port Isabel would be reduced in severity.

Positive beneficial effects on loma vegetation have already been addressed. In addition, some of the soils removed in digging this channel, if appropriate, will be used to "patch" eroded gullies and other damage to the existing lomas. This should stabilize the erosion problem, conserve the topsoil, and encourage colonization by various plant species, which will further stabilize the areas.

4.5.4 Water Resources

Restoring tidal hydrological patterns in these waters would greatly increase wildlife and fishery resources and may provide additional recreational opportunities. The exchange of salt water would contribute to improving water circulation in the Bahia Grande. This alternative alone will provide circulation and water mixing to maintain the system at maximum biological productivity. It should be more efficient than either Channels A or E alone.

A total of about 6,500 acres will be flooded in Bahia Grande under this alternative, 4,000 permanently, and 2,500 tidally. In addition, about 1,700 acres in Laguna Larga would be flooded, either by freshwater from the NRCS diversions under State Highway 100, or by saltwater from Bahia Grande. Another 1,400 acres will be inundated in Little Laguna Madre under this alternative. Therefore a total of approximately 9,600 acres will be flooded, either permanently (6,800-plus acres) or periodically by lunar and wind tidal effects (2,800-plus acres). Appendix D shows revisions to proposed channel design dimensions and additional structures that are needed to manage the wetland system. Appendix E provides typical drawings of the original proposed channels, both cross-sectional and longitudinal. There is also a topographic view of the entire project.

The effects of the proposed action (Preferred Alternative), while similar to those for Channels A and E, will, by virtue of its combination of both, provide for faster inflows and outflows of water inside the basin. This may be of special importance during times of heavy rainfall events.

4.5.5 Biological Resources

Habitat for wading birds, shorebirds, and threatened species like the piping plover would be enhanced under this alternative. Migration of marine organisms into and out of the Bahia Grande would be possible. Biological productivity will be significantly increased. In addition to the obvious habitat provision for shrimp, crabs, shellfish and other invertebrates, and finfish, these will provide a rich feeding source for shorebirds, wading birds, and waterfowl.

A grant from the EPA is available for "monitoring and evaluation of the effects of flooding on marine plant and animal resources". This grant, of \$225,000, is being awarded to four Texas Universities: The University of Texas – Brownsville, the University of Texas – Pan American, Corpus Christi A&M University, and Texas A&M University, College Station.

The alleviation of the dust problem and restoration efforts creating an attractive wetland may also increase development and market value for properties near the Bahia Grande. This could have a detrimental effect on biological resources on private lands near the Bahia Grande as rural properties are developed and native habitat for wildlife is destroyed. Species impacted with such an urbanization scenario might include Texas tortoise, Texas horned lizard, plain chachalaca, white-tipped dove, Harris' hawk, ladder-backed woodpecker, green jay, great kiskadee, altamira oriole, olive sparrow, bobcat, ocelot, jaguarundi, javelina, and white-tailed deer.

4.5.6 Cultural Resources

The refuge would continue protection of cultural resources under this alternative. Following the recommendations of Dr. Robert A. Ricklis and Coastal Environments, Inc., of Corpus Christi, Texas, the Texas Historical Commission, and Service archeologists, continued protection of specific sites will be implemented.

4.5.7 Land Use

The Bahia Grande would be partially restored to a historical natural condition. Recreational use of the Bahia Grande area may be greatly enhanced under this alternative. Specific recreational activities permitted will be determined through the CCP and HMP planning initiatives.

The Service has an interest in encouraging more northern Aplomado falcons on the site, through improvement of the habitat, and would also support the natural proliferation of plant life, re-vegetation of denuded loma sites, and stabilization of all wildlife populations native to the site.

The proposed action (Preferred Alternative) differs from Alternatives B and C in that it will provide a much greater circulation and aeration of waters in Bahia Grande, Laguna Larga, and Little Laguna Madre. This will result in a proliferation of plant and animal life in the aquatic habitat, and the permanent flooding with tidal waters will benefit upland plants and wildlife on lomas and other sites by suppressing the windblown, salty dust that heretofore has impacted negatively the plants and wildlife thereon.

4.5.8 Socioeconomic Resources

The area surrounding the Bahia Grande would continue to follow a trend of increased urbanization. Under this alternative, land values would change only as the local markets are affected by future trends. Market values might increase due to anticipated increased development in areas such as along State Highway 100 and close to towns. The alleviation of the dust problem may also increase development and market value for properties near the Bahia Grande. Also, and related to the urbanization problem, but in a positive sense, nature tourism and other recreational activities will increase under this alternative due to the increase in wildlife resources, commensurate with the increased human population. This is likely to positively impact the local economy (Pete Moore, South Padre Island Development Council, pers. comm., and Patrick Marchan, Port Isabel Mayor, pers. comm.).

In addition, commercial and recreational fisheries will be enhanced by restoration of estuarine nursery habitat for shellfish and finfish.

4.5.8.1 Effects on Tax Revenues

There should be no effect.

4.5.9 Public Use and Recreation

Opportunities for wildlife-oriented recreation under this alternative will be positive for the general public. The restoration of the Bahia Grande will increase wildlife viewing opportunities, such as birdwatching. Additional public uses, including the "Big Six" priority public uses on national wildlife refuges: hunting, fishing, wildlife observation, photography, environmental education, and interpretation, will be explored. The development of the CCP and HMP will include public meetings to allow the public to propose and comment on potential public recreational uses for the Bahia Grande Unit.

4.5.10 Contaminants and Hazardous Waste

No change in levels of contaminants or hazardous waste is expected. However, because of the connection to the Brownsville Ship Channel, there would be potential for the introduction of toxic chemicals into the Bahia Grande due to a spill. The refuge maintains a supply of booms, suits, and other gear to be used by the U.S. Coast Guard (lead agency) and other cooperators, in case of a spill. The Refuge also works closely the Texas General Land Office, Oil Spill Response Team, to conduct oil spill training scenarios on refuge lands in order to improve coordination of resources. The refuge Spill Contingency Plan will be updated prior to flooding the basins.

5.0 UNEXPECTED IMPACTS - CONTROLLED/MINIMIZED

Unexpected impacts are likely to come from a more rapid urbanization around the communities of Port Isabel, Laguna Heights, and Laguna Vista. To reduce negative impacts from this source,

the Service will maintain frequent communications with the county judge, mayors, and town councils of these three communities.

6.0 REFUGE OVERSIGHT

The Bahia Grande Unit is a part of the National Wildlife Refuge System, and is managed by the Refuge Manager of the Laguna Atascosa National Wildlife Refuge, which is part of the South Texas Refuge Complex.

7.0 ENVIRONMENTAL JUSTICE ISSUES

No negative impacts are anticipated under Environmental Justice Issues. The significant reduction of blowing dust, negatively impacting local communities, will be a beneficial impact of this project on Environmental Justice Issues. The towns of South Padre Island, Port Isabel, Laguna Heights, Laguna Vista, Bayview, and Los Fresnos, will all experience an increase in quality of life, due to the effect of this project in reducing blowing dust.

8.0 PERMITS REQUIRED

The following required permits, oversight, and approval are listed as they stand as of March 1, 2004.

8.0.1 U.S. Army Corps of Engineers: Section 404 Permit

The U.S. Army Corps of Engineers (USACE) verified the issuance of a National Wide 27 permit, No. SWG-03-27-006, in a letter, dated February 4, 2004, to Kenneth Merritt, Project Leader, South Texas Refuge Complex. The letter stated that the project could commence upon compliance with Section 106 of the National Historic Preservation Act of 1966 (NHPA) and USACE's implementing regulations found in Appendix C of 33 CFR Part 325 (Appendix C).

8.0.2 Texas Historic Preservation Office: Concurrence with the Proposed Project

On February 7, 2005, the Service's Regional Director, Region 2, sent a letter and a copy of Dr. Robert A. Ricklis' cultural resources survey to the State Historic Preservation Officer (SHPO), Texas Historical Commission, with a "no effect" determination for the Bahia Grande Restoration project. By letter dated February 22, 2005, the Texas SHPO concurred with our "no effect" determination. This concluded the historic preservation review for NHPA, Section 106, and the Service's historic preservation review requirements as set forth under 614- 2.2 of the Service Manual. No further review will be necessary, unless archeological remains are encountered during construction, especially human remains, then all construction will cease until additional clearances to proceed can be obtained.

8.0.3 Texas Commission on Environmental Quality: Concurrence

The Texas Commission on Environmental Quality has given its concurrence that the proposed action (preferred alternative) is acceptable to them.

8.0.4 National Environmental Policy Act: Compliance

Public scoping and review compliance with the National Environmental Policy Act has included numerous newspaper articles, radio show appearances, and one public meetings in Port Isabel, Texas.

9.0 PUBLIC COMMENTS

The Service provided several opportunities for the public to comment on the final "draft" EA for the proposed action. A 30-day comment period (August 4, 2003 through September 5, 2003) was provided during which the Service accepted written comments and featured a public meeting on August 14, 2003 in Port Isabel, Texas. The purpose of the 30-day comment period and public meeting was to solicit public opinion about the project, as described in the final "draft" EA. Comments received have been carefully considered, and incorporated in the body of the final EA, as their contents merit.

10.0 CUMULATIVE IMPACTS

The only other federal action in the foreseeable future is the proposed improvements of State Highway 48, which runs parallel to the Brownsville Ship Channel between Brownsville and Port Isabel. The Texas Department of Transportation proposes to widen this road, from its present two-lane status to a four-lane highway with shoulders. This road improvement will include construction of an approximately 200-foot long bridge to span the proposed channel connecting Bahia Grande directly to the Brownsville Ship Channel. Initially, the Brownsville Navigation District, in cooperation with the Texas Department of Transportation, may construct a "pilot channel" (approximately 20 feet wide by 2,300 feet long and -4 feet below MSL) smaller than the proposed main channel (Channel E). If constructed, this planned "pilot channel" will cross under State Highway 48 via a series of existing culverts to be cleaned out by the Texas Department of Transportation. The main purpose of the pilot channel is to improve tidal inflow into the Bahia Grande, primarily a dust abatement measure, until the main channel can be engineered, funded, and constructed.

11.0 MITIGATION

Placement of fill will be mitigated for by the extent of wetlands to be restored by the project. Approximately 4,130,680 cubic feet of fill material may be excavated in digging the proposed channels A, B1, B2, C1, C2, and D. In return, approximately 19,160 acre/feet of tidal water will cover approximately 9,600 acres of bay bottoms as follows: 6,500 acres in Bahia Grande, 1,700 acres in Laguna Larga, and 1,400 acres in Little Laguna Madre. This trade off of fill material to acres flooded is believed to be beneficial to wildlife and wetland resources when the overall project is considered. In addition, the restored wetlands will be covered with permanent, tidal water, while the areas covered by fill (approximately 50 to 75 acres) are ephemeral wetlands covered intermittently with rain water. Fill material dug from the channels may be stored on site for future disposal.

12.0 DOCUMENT PREPARATION

This document was prepared by personnel of the South Texas Refuge Complex, Region 2, U.S. Fish and Wildlife Service, U.S. Department of Interior. Primary responsibility for writing this document was given to Stephen E. Labuda, Jr. The initial draft of the document was prepared by Marie Fernandez. Others who offered significant help in fine-tuning the Environmental Assessment were Kenneth Merritt, David Blankinship, John D. Wallace, Ernesto Reyes (Santa Ana Ecological Services Sub-Office), and Tim Cooper (Mackay Island National Wildlife Refuge). Additional significant assistance came from Pat Clements at the Corpus Christi Ecological Services Field Office.

13.0 OTHER FEDERAL AGENCIES CONSULTED

The following list entails the other Federal Agencies consulted during the course of writing this draft Environmental Assessment:

Natural Resource Conservation Service, U.S. Department of Agriculture
U.S. Army Corps of Engineers, Department of the Army
Office of Congressman Solomon Ortiz, Congress of the United States of America
National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Additional State of Texas consultations were made with the following:

Texas Parks and Wildlife Department
Texas Commission on Environmental Quality

APPENDIX A: REFERENCES

Blair, W.F. 1950. The biotic provinces of Texas. *Texas Journal of Science* 2(1):93-117

Eye on Nature, a publication of the Nongame and Urban Program, Texas Parks and Wildlife Department, 1995.

Morton, R.A. 1991. Physical evaluation of proposed flooding of Bahia Grande, Cameron County, Texas. Bureau of Economic Geology, University of Texas, Austin, Texas. 13pp.

Natural Resource Conservation Service. 2002. Topographic map and channel sectionals for Bahia Grande WRP. USDA. 6 pp., one over-size.

U.S. Fish and Wildlife Service. 1999. Laguna Atascosa National Wildlife Refuge - Proposed Refuge Expansion Plan (Environmental Assessment and Conceptual Management Plan). 63 pp.

Van Valkenburg, Dianna L., and Billy L. Edge. February 2003. Analysis of Proposed Flooding of Bahia Grande, Cameron County, Texas. A Thesis. Ocean Engineering Program, Civil Engineering Department, Texas A&M University, College Station, Texas 77843-3136.

APPENDIX B: LETTERS OF SUPPORT

A total of 559 letters of support were received from the public. No letters objecting to the project were received. One letter expressing neither support nor objection was received, which merely offered ideas for implementation of the project.

Three substantive letters of support with significant questions were received as follows:

- Three substantive letters of support with significant questions were received from the government agencies:
 - Texas Commission on Environmental Quality (TCEQ)
 - Texas Parks and Wildlife Department (TPWD)
 - National Resources Conservation Service (NRCS), U.S. Department of Agriculture

Questions concerning the project were answered and provided to these agencies.

- An additional eight letters of support came from other public agencies and groups:
 - The Conservation Fund
 - Point Isabel Independent School District (2 letters)
 - South Padre Island Chamber of Commerce
 - Laguna Madre Water District
 - David Garza, Cameron County Commissioner, Precinct 3
 - City of Port Isabel
 - South Padre Island Fly Fishing Association

- Valley Sportsmen's Club
- Publicity in favor of the project included more than 25 newspaper articles and two emails from supporters who made contacts to promote public support. In addition, one supporter sent letters of information to Congressman Sonny Callahan of the House Energy and Water Appropriations Subcommittee, with cc copies to the following:
 - Congressman Solomon Ortiz, 27th District of Texas
 - Congressman Peter J. Visclosky, Ranking Member
 - Congressman Chet Edwards, 11th District of Texas
 - Gilberto Hinojosa, Cameron County Judge
 - Cameron County Commissioners Court
 - Javier Mendez, Cameron County Parks and Recreation Director
 - Raul Besteiro, Director Brownsville Navigation District
 - Bob Corneilson, Director Padre Island / San Benito Navigation District
 - Dr. Dolores Munoz, Superintendent Point Isabel Independent School District
 - Pat Marchan, Mayor City of Port Isabel
 - David Privett, Mayor Town of Laguna Vista
 - Bob Pinkerton, Mayor of South Padre Island
 - Port Isabel Chamber of Commerce
 - South Padre Island Chamber of Commerce
- Letters of support from personal sources were 10 in number.
- Form letter 1, which was dated 11 or 13 August 2003, had a total of 356 senders with no personal comments included.
- Form letter 2, which was dated 14 August 2003, had:
 - 7 letters without any personal comments, and
 - 22 letters with personal commentary.
- Cameron County Commissioner David A. Garza, Precinct 3, circulated a petition in favor of the project, which went chiefly to individuals working in the shrimp industry in Cameron County. On these petitions, he secured the signatures of 163 supporters.
- In further compliance with the National Environmental Policy Act, a public meeting was held on August 14, 2003, from 7:00 p.m. to 9:00 p.m. at the Port Isabel High School. While this meeting was lightly attended by the public (fewer than 100) all citizens were supportive of the proposed action (preferred alternative), to flood Bahia Grande, Laguna Larga, and Little Laguna Madre.

In summary, there were no negative comments received regarding this proposed project. All the comments received were supportive. Two letters from TCEQ and TPWD were of a questioning nature, and were answered to their satisfaction. The total supporting letters, signatures, and other forms of expression, all written, numbered 566.

APPENDIX C: HISTORIC DOCUMENTS

1. Reprint of a 1945 newspaper article, in 2002:

Dust has always been a problem for Port Isabel, and in 1945 some action was taken to control the dust. In the Wednesday, November 14, 1945 edition of *The Port Isabel Pilot*, an article describing this nuisance ran, as follows:

"Definite Action Taken to Control Dust Nuisance

Definite action was taken by the Directors of the Port Isabel Chamber of Commerce to abate the dust that at intervals in recent years has been not only a scourge to the people but a health menace as well.

Earl Long was employed to put the present pump in working order and execute plans for, if not completely eliminating the dust nuisance, to at least control it. The present levees about the spoil banks between the South channel and ship channel are to be strengthened and made higher. A flood gate is to be installed and so arranged that when these flats are covered during high tide, the gate can be closed, retaining this water within the confines of the dykes.

To finance this project, estimated to cost not less than \$300, business institutions and individuals will be called upon to donate. A "Dust Bowl Committee" composed of E. W. "Fritz" Edwards, chairman, Flem L. Marlin, and James J. Jaudon was appointed to contact business institutions and others to raise the necessary amount to complete this project.

"These funds are to be kept separate and apart from those of the Chamber of Commerce and are to be used exclusively in the matter of dust control", so stated Secretary Stuart Adkins."

2. Unfortunately, this attempt in 1945 was not successful in controlling the dust problem, as attested to by the following letter from the Point Isabel Independent School District, dated June 25, 2001.

"RE: Environmental Restoration and Enhancement Project

Mr. Labuda,

Allow me to express my gratitude for meeting with me and having other staff meet with our administrators, Mr. Raul Villareal and Dr. Estella Guetzow and for addressing a serious and hazardous situation that we currently have in our school district. I would certainly like to see the sandy area behind our Port Isabel Junior High flooded; I understand that a channel will efficiently flood that zone. Frankly, it is critical that some type of action take effect. The current condition of the blowing sand on a daily basis creates a hazardous situation for our students and the air quality in the school. The results are highly detrimental: sick buildings and ill student and staff members. Our schools staff are already feeling the effects of this hazardous situation. The Junior High playground is profoundly affected as well; there is no recreational area for the students due to the sand dunes that accumulate in this area. In addition, the past three years and to date, we have working on improving the air

quality of our schools by fixing and redoing our whole HVAC (Heating, Ventilating, and Air Conditioning) systems. We have spent approximately five million dollars in this improvement effort. However, our engineers have advised us that the sandy conditions of this area will cause severe harm to the improvements that we are making; thus, possibly throwing away tax dollars that are important to our community.

Furthermore, some of our students are frail and have special needs. Some of these children can get very ill if our air quality diminishes and if the sand conditions of our playgrounds and surrounding areas continues to deteriorate. I have witnessed these situations in these past two years. We are extremely concerned about the health of our students and employees and in protecting the investment of our taxpayers. I believe that this situation needs immediate attention in order to avoid future litigation and significant health problems.

It is, therefore, urgent that the County, State, and all entities affected, find a remedy to our duster-sand control for Port Isabel, particularly the areas surrounding our schools. Please keep us informed as a partnership in this worthwhile health related issue.

Sincerely,

s/

*Dr. Dolores Munoz
Superintendent*

*Xc: Robert Cornelison
Raul Villareal*

*Raul Besteiro
Daniel L. Rentfro, Jr. "*

The carbon copy addressees in this letter are: (1) Robert Cornelison, Director of the Port Isabel/San Benito Navigation District, (2) Raul Villareal, Maintenance Supervisor for the Point Isabel School District, (3) Raul Besteiro, Director of the Brownsville Navigation District, and (4) Daniel L. Rentfro, Jr., Attorney for the Brownsville Navigation District.

APPENDIX D: PROPOSED CHANNEL DESIGN REVISION AND ADDITIONAL STRUCTURES

Bahia Grande Channel Construction

The U.S. Fish and Wildlife Service (Service) proposes to construct up to five channels (A, B1, B2, C, and D) on the Bahia Grande Unit of Laguna Atascosa National Wildlife Refuge. Two additional channels, Channel E and Channel F, are proposed for construction by other agencies. Channel E is proposed for construction by the Brownsville Navigation District (BND) on BND property, which borders the southern boundary of the refuge unit. Channel F is proposed for construction by the Natural Resources Conservation Service (NRCS), U.S. Department of the Agriculture (USDA), as part of the Wetlands Reserve Program (WRP). NRCS has a 30-year WRP easement on 17,061 acres of the Bahia Grande Unit (Exhibit 2). All seven channels are located within the "Laguna Vista" USGS Topographic Quadrangle.

Channel Design

Channel A will have a bottom width of 50 feet and bottom depth of minus 4 feet below mean sea level (MSL), while the other four channels will have a bottom width of 60 feet and a bottom depth of minus 2 feet below MSL. All channels will be trapezoidal-shaped with 4:1 (H:V) side slopes; however, steeper side slopes (e.g., 3:1) may be used to reduce the top width in certain locations, as needed, to facilitate the installation of water control structures, bridges, or culverts. The top widths of the channels will vary depending on average elevations above MSL along the proposed channel alignments. The end points of each channel will be at about minus 1-foot MSL, and the ends of the channels will be "flared" into the basin at about a 4:1 slope. Therefore, the channels will extend anywhere from 10 to 50 feet beyond the end points of the channels. The north end of Channel E will "flare" onto refuge property about 200 feet at a 20:1 slope.

Additional Structures and Roads

The Service proposes to construct a vehicle bridge (e.g., concrete spans, box culverts) at the road crossing of Channel C1 to provide access to the northern half of the Refuge unit. The Service proposes to construct a major water control structure (WCS) (Exhibit 6) and vehicle bridge at the road crossing of Channel B2 adjacent to the Laguna Larga basin. Also, the Service proposes to construct a 150-foot wide emergency spillway (e.g., using articulating concrete block) at the road crossing of Channel B1 adjacent to the Laguna Larga basin. The WCS at Channel B2 and the emergency spillway at Channel B1 are ancillary components of the NRCS "Channel F" WRP Project. A temporary road (10 feet wide) may be constructed adjacent to the alignment of Channel D using dredge spoil material as a road base and crushed limestone as a surface base. Sections of existing roads will be upgraded, as needed, with a crushed limestone surface base to provide all-weather access to channel locations. All new roads or road improvements are necessary for the transport of heavy equipment, fuel, materials, supplies, and personnel needed to construct and/or maintain and revegetate the channels and spoil berms.

Channel Specifications

Except for the "Middle" and "South - Extension" segments of Channel B1, all channels have been surveyed and staked at 100-foot intervals along their proposed alignments. Channel alignments and station coordinates (NAD 83 datum) are provided in Exhibits 7, 8, 9, and 10.

Specific channel and spoil dimensions, by segment, are provided as follows:

Channel A:

(7,880 feet - bottom at minus 4 feet MSL)

Segment	Stations	Avg. Elevation Above/Below Mean Sea Level (MSL)	Approx. Length (ft.)	Bottom Width (ft.)	Top Width (ft.)	Cubic Yards Spoil	Acres of Spoil Area (five ft. high maximum)	End Flare Length (ft.)
1.	0+00 to 67+00	+1.0 feet	6,700	50	90	86,852	13.84	20
2.	67+00 to 72+50	+6.0 feet	550	50	130	18,333	2.53	N/A
3.	72+50 to 78+50	0.0 to -0.5 feet	600	50	82	5,867	1.01	20
Totals:	---	---	7,850	---	---	111,052	17.38	---

Note: spoil in **bold** will be moved to another location away from the channel.

Channel B1:

(6,495 feet - bottom at minus 2 feet MSL)

Segment	Stations	Avg. Elevation Above/Below Mean Sea Level (MSL)	Approx. Length (ft.)	Bottom Width (ft.)	Top Width (ft.)	Cubic Yards Spoil	Acres of Spoil Area (five ft. high maximum)	End Flare Length (ft.)
North	0+00 to 5+00	+5.0 feet	500	60	116	11,408	1.65	30
Middle*	N/A	0.0 feet (MSL)	2,670	60	76	13,449	2.94	N/A
South 1	0.00 to 8+50	+1.0 feet	850	60	84	6,800	1.25	N/A
South 2	8+50 to 12+50	+2.0 feet	400	60	92	4,504	0.74	N/A
South* Extension	N/A	0.0 to -0.5 feet	2,000	60	76	10,074	2.21	10
Totals:	---	---	6,420	---	---	46,235	8.79	---

* bold segments have not been surveyed and staked

Note: spoil in **bold** will be moved to another location away from the channel.

Channel B2:

(3,710 feet - bottom at minus 2 feet MSL)

Segment	Stations	Avg. Elevation Above/Below Mean Sea Level (MSL)	Approx. Length (ft.)	Bottom Width (ft.)	Top Width (ft.)	Cubic Yards Spoil	Acres of Spoil Area (five ft. high maximum)	End Flare Length (ft.)
1.	0+00 to 5+50	0.0 to -0.5 feet	550	60	76	2,771	0.61	10
2.	5+50 to 34+00	+2.0 feet	2,850	60	92	32,089	5.30	N/A
3.	34+00 to 37+00	+5.0 feet	300	60	116	6,845	0.91	30
Totals:	---	---	3,700	---	---	41,705	6.82	---

Note: spoil in **bold** will be moved to another location away from the channel.

Channel C (Segment 1):

(625 feet - bottom at minus 2 feet MSL)

Segment	Stations	Avg. Elevation Above/Below Mean Sea Level (MSL)	Approx. Length (ft.)	Bottom Width (ft.)	Top Width (ft.)	Cubic Yards Spoil	Acres of Spoil Area (five ft. high maximum)	End Flare Length (ft.)
1.	0+00 to 1+50	0.0 to -0.5 feet	150	60	76	756	0.17	10
2.	1+50 to 4+00	+6.0 feet	250	60	124	6,815	0.96	N/A
3.	4+00 to 6+00	0.0 to -0.5 feet	200	60	76	1,008	0.22	10
Totals:	---	---	600	---	---	8,579	1.35	---

Note: spoil in **bold** will be moved to another location away from the channel.

Channel C (Segment 2):

(2,175 feet - bottom at minus 2 feet MSL)

Segment	Stations	Avg. Elevation Above/Below Mean Sea Level (MSL)	Approx. Length (ft.)	Bottom Width (ft.)	Top Width (ft.)	Cubic Yards Spoil	Acres of Spoil Area (five ft. high maximum)	End Flare Length (ft.)
1.	0+00 to 6+00	0.0 to -0.5 feet	600	60	76	3,023	0.66	30
2.	6+00 to 10+00	+6.0 feet	400	60	124	10,904	1.53	N/A
3.	10+00 to 12+50	+1.0 feet	250	60	84	2,000	0.37	N/A
4.	12+50 to 19+00	+6.0 feet	650	60	124	17,719	2.49	N/A
5.	19+00 to 21+50	+1.0 feet	250	60	84	2,000	0.37	10
Totals:	---	---	2,150	---	---	35,646	5.42	---

Note: spoil in **bold** will be moved to another location away from the channel.

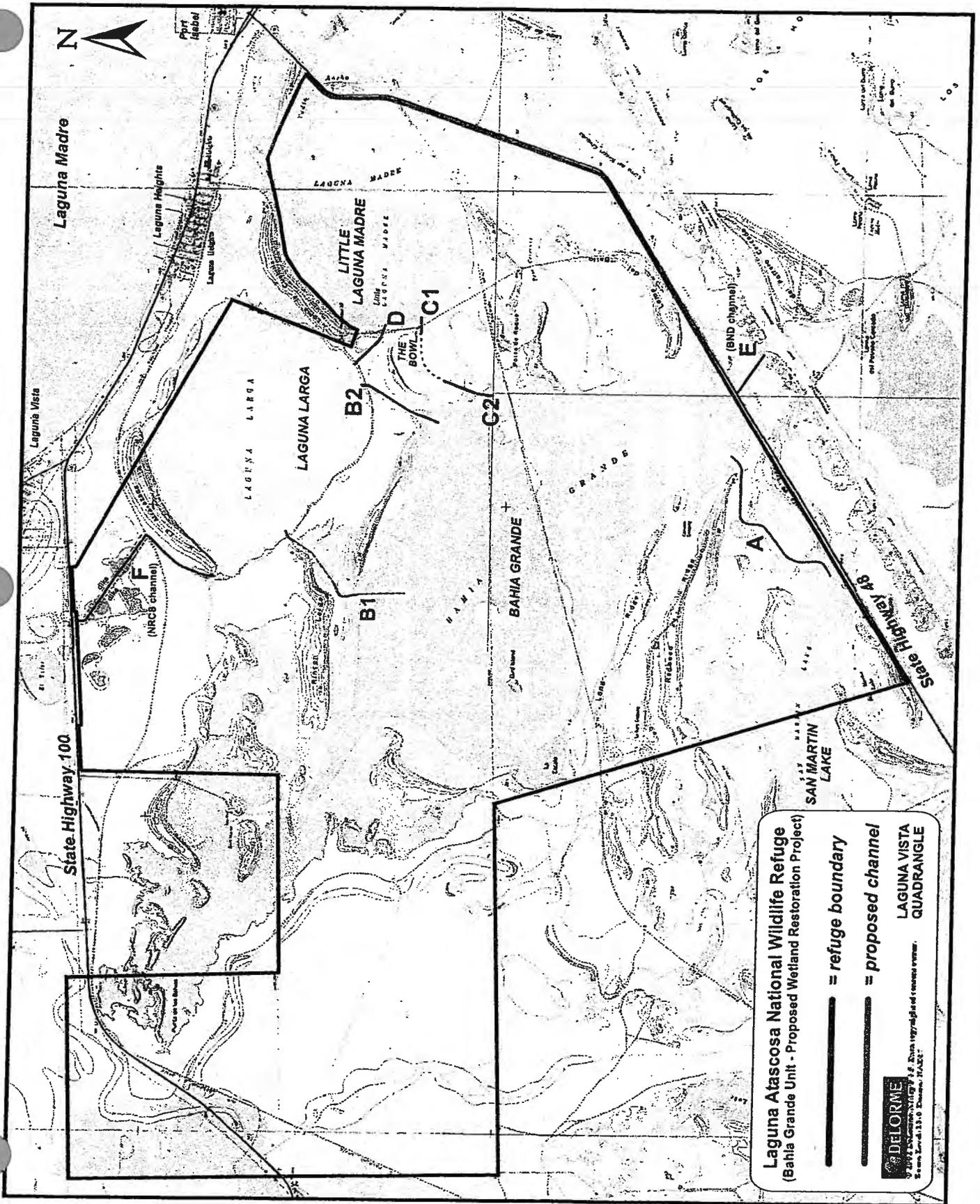
Channel D:

(2,178 feet - bottom at minus 2 feet MSL)

Segment	Stations	Avg. Elevation Above/Below Mean Sea Level (MSL)	Approx. Length (ft.)	Bottom Width (ft.)	Top Width (ft.)	Cubic Yards Spoil	Acres of Spoil Area (five ft. high maximum)	End Flare Length (ft.)
1.	0+00 to 4+00	+10.0 feet	400	60	156	19,200	2.75	10
2.	4+00 to 7+50	+1.0 feet	350	60	84	2,800	0.51	N/A
3.	7+50 to 21+50	+6.0 feet	1,400	60	124	38,163	5.37	10
Totals:	---	---	2,150	---	---	60,163	8.63	---

APPENDIX E: TOPOGRAPHICAL MAP AND SECTIONAL VIEWS OF CHANNELS

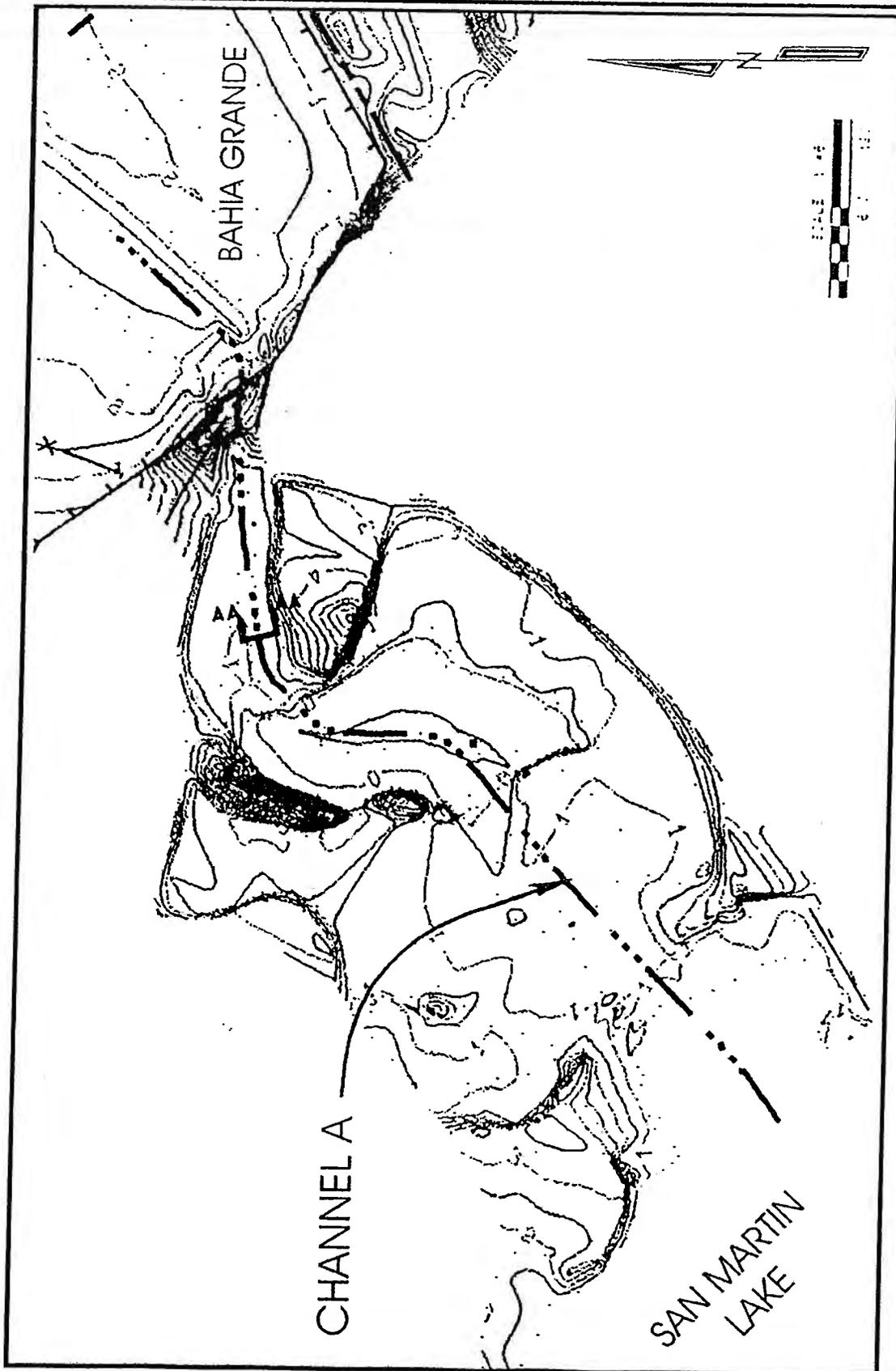
APPENDIX E



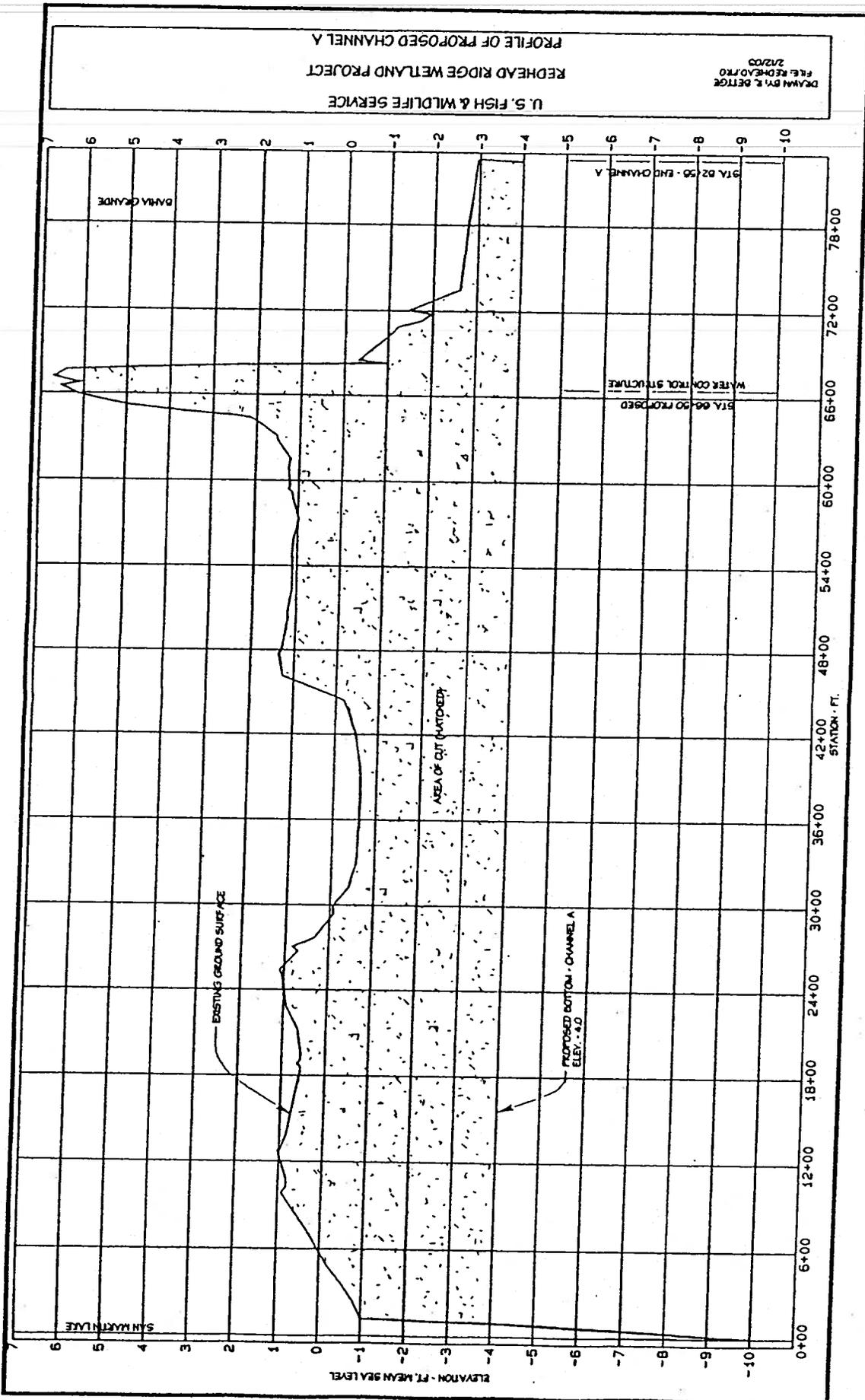
APPENDIX E

DRAWN BY: R. BETTIG
FILE: REDHEADPRO
2/13/05

U. S. FISH & WILDLIFE SERVICE
REDHEAD RIDGE WETLAND PROJECT
PLAN VIEW - CHANNEL A

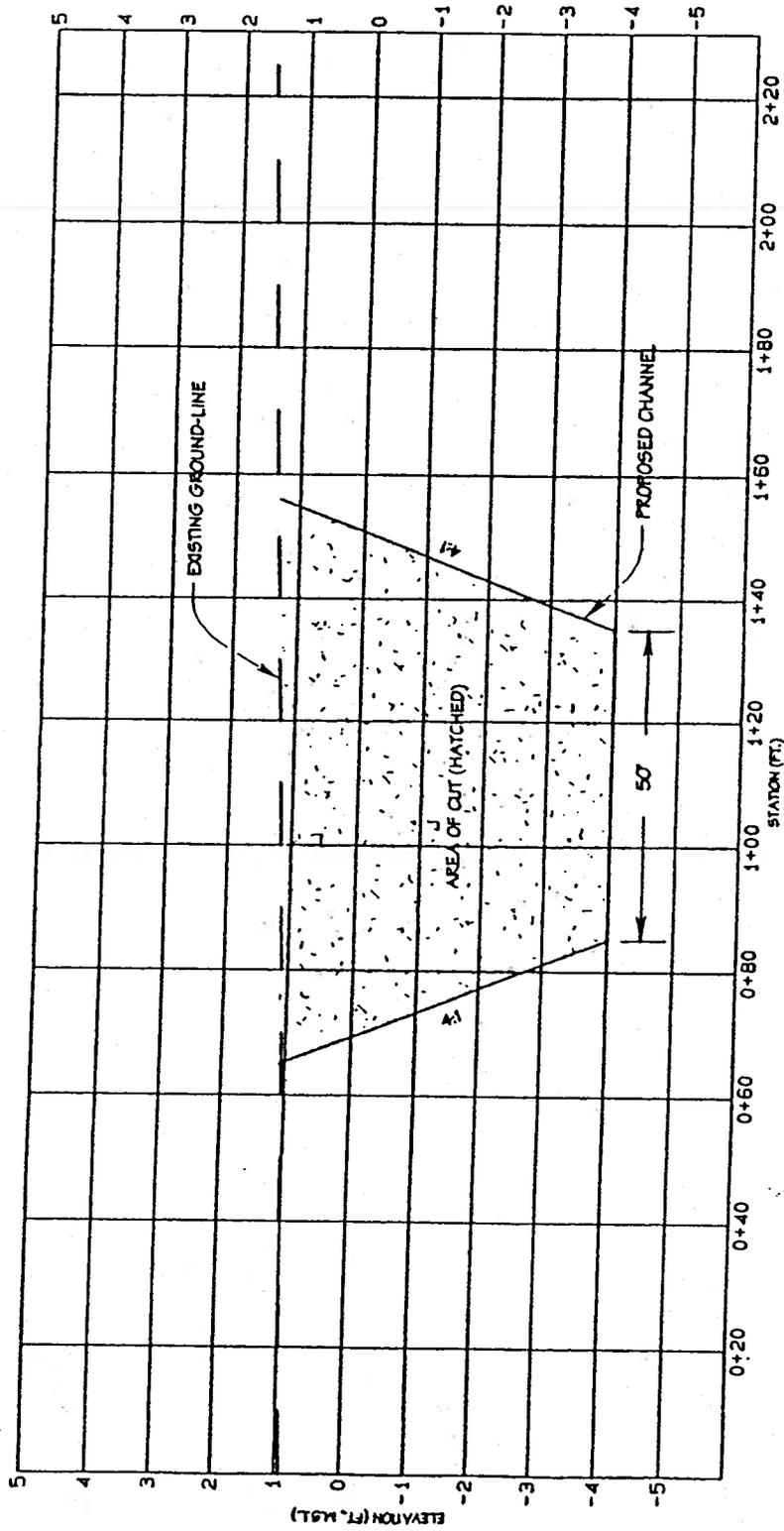


APPENDIX E

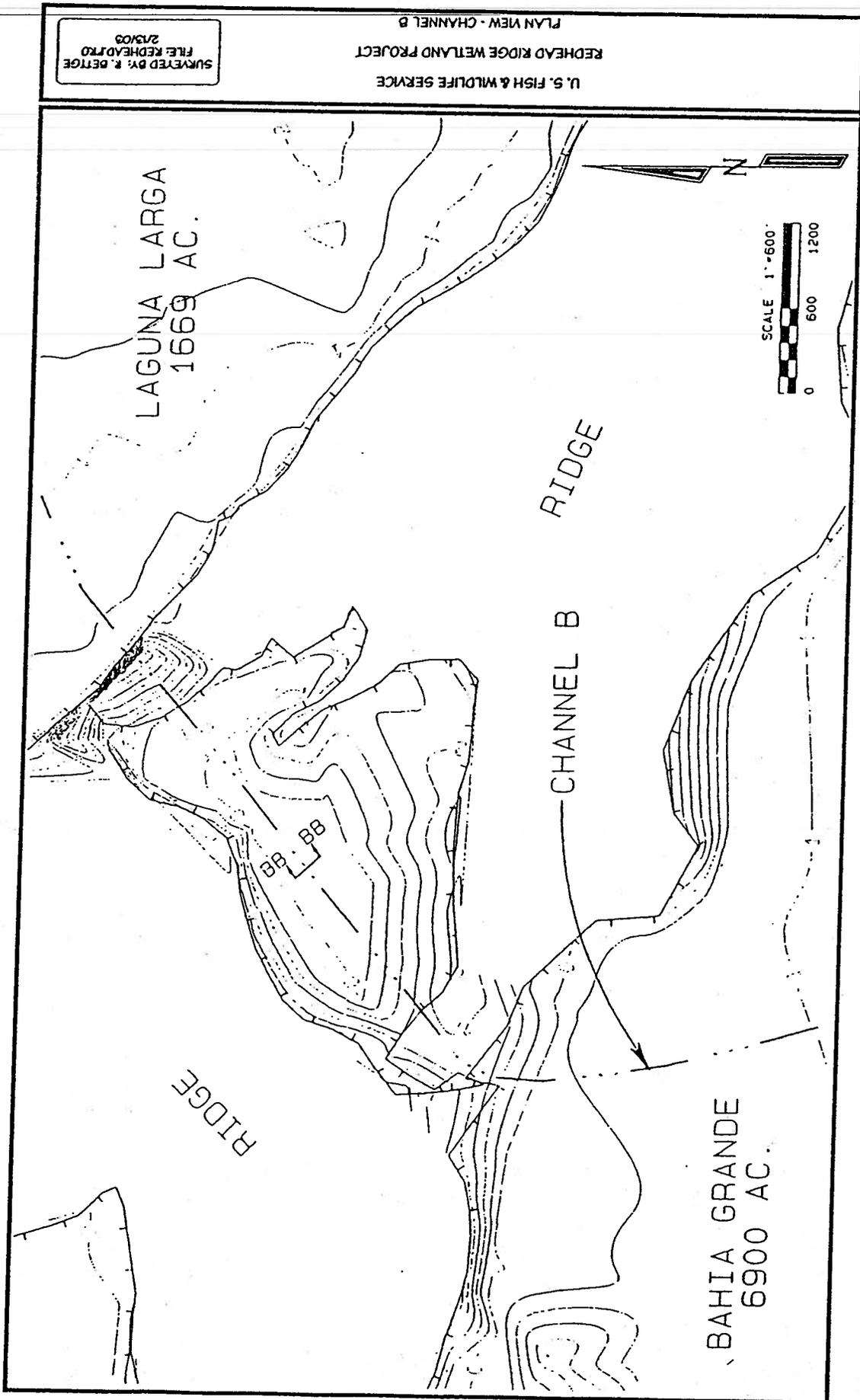


APPENDIX E

U. S. FISH & WILDLIFE SERVICE
 REDHEAD RIDGE WETLAND PROJECT
 SECTION AA - AA' CHANNEL A
 DRAWN BY: R. BEITGE
 FILE: REDHEAD.RXD
 2/2/03



APPENDIX E

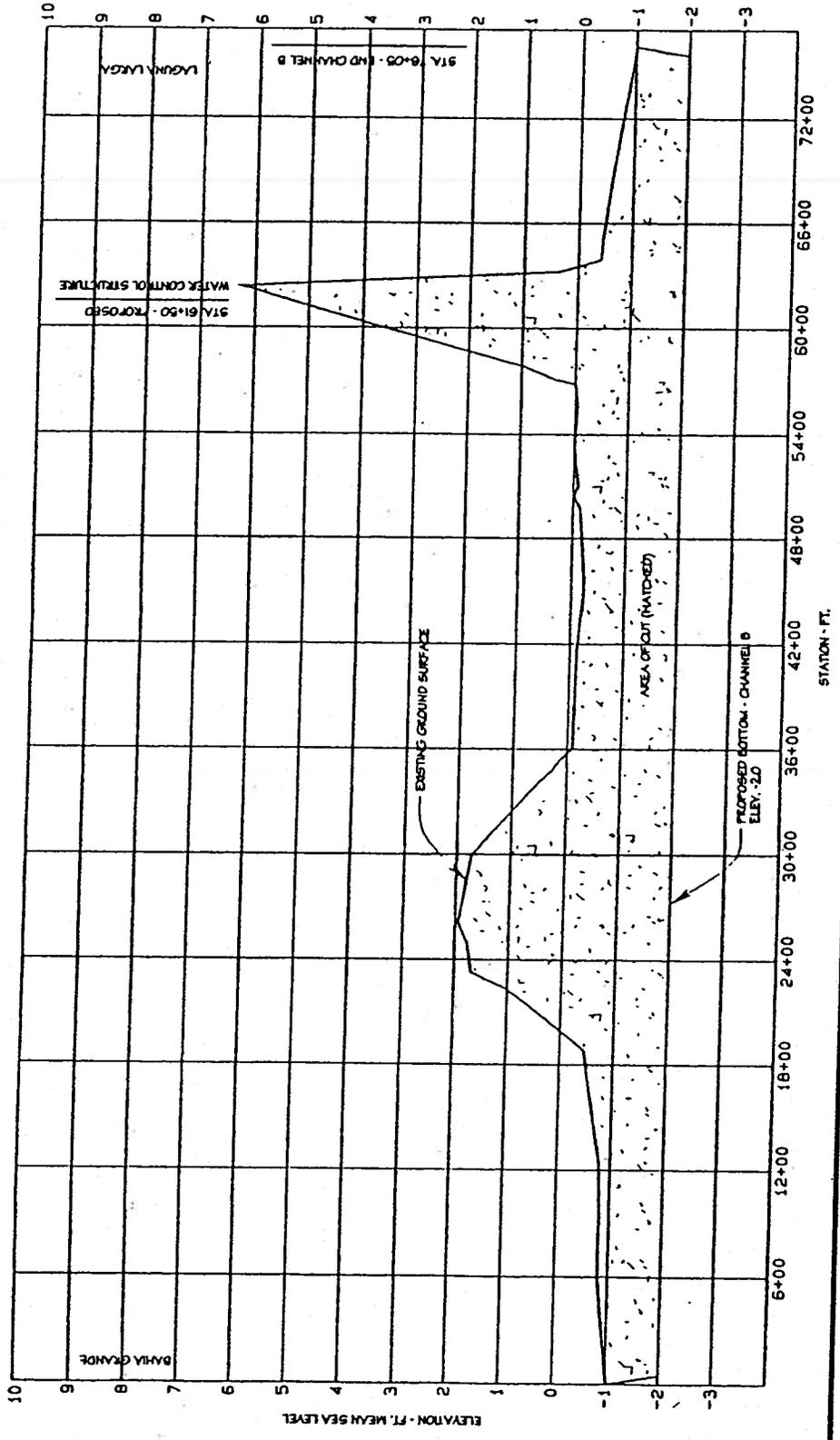


SURVEYED BY: R. GETTIG
FILE REDHEADRTO
2/23/09

U. S. FISH & WILDLIFE SERVICE
REDHEAD RIDGE WETLAND PROJECT
PLAN VIEW - CHANNEL B

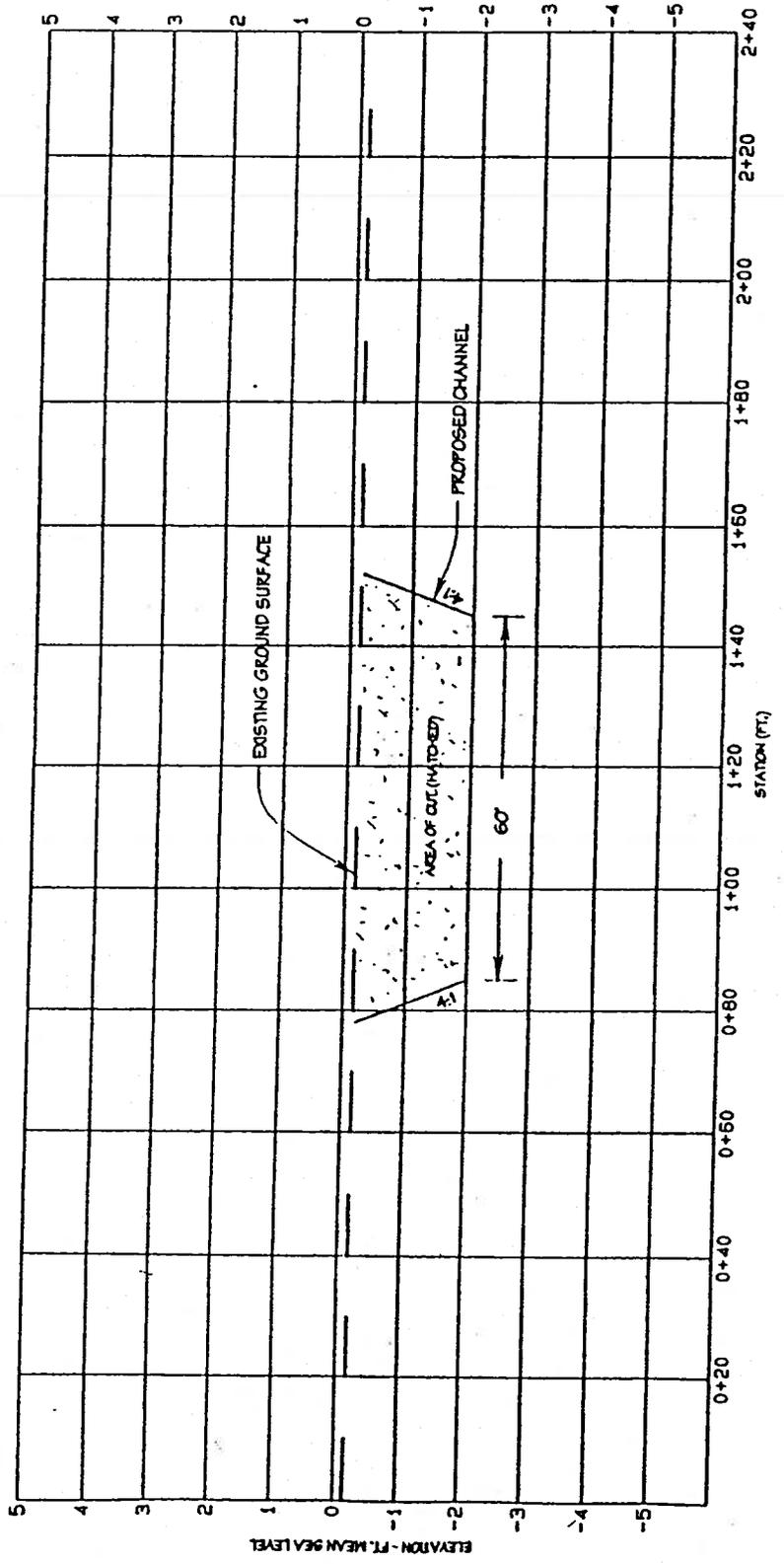
APPENDIX E

U. S. FISH & WILDLIFE SERVICE
 REDHEAD RIDGE WETLAND PROJECT
 PROFILE OF PROPOSED CHANNEL B
 DRAWN BY: RICHARD BETTGE
 FILE: REDHEAD.PRO
 2/13/03

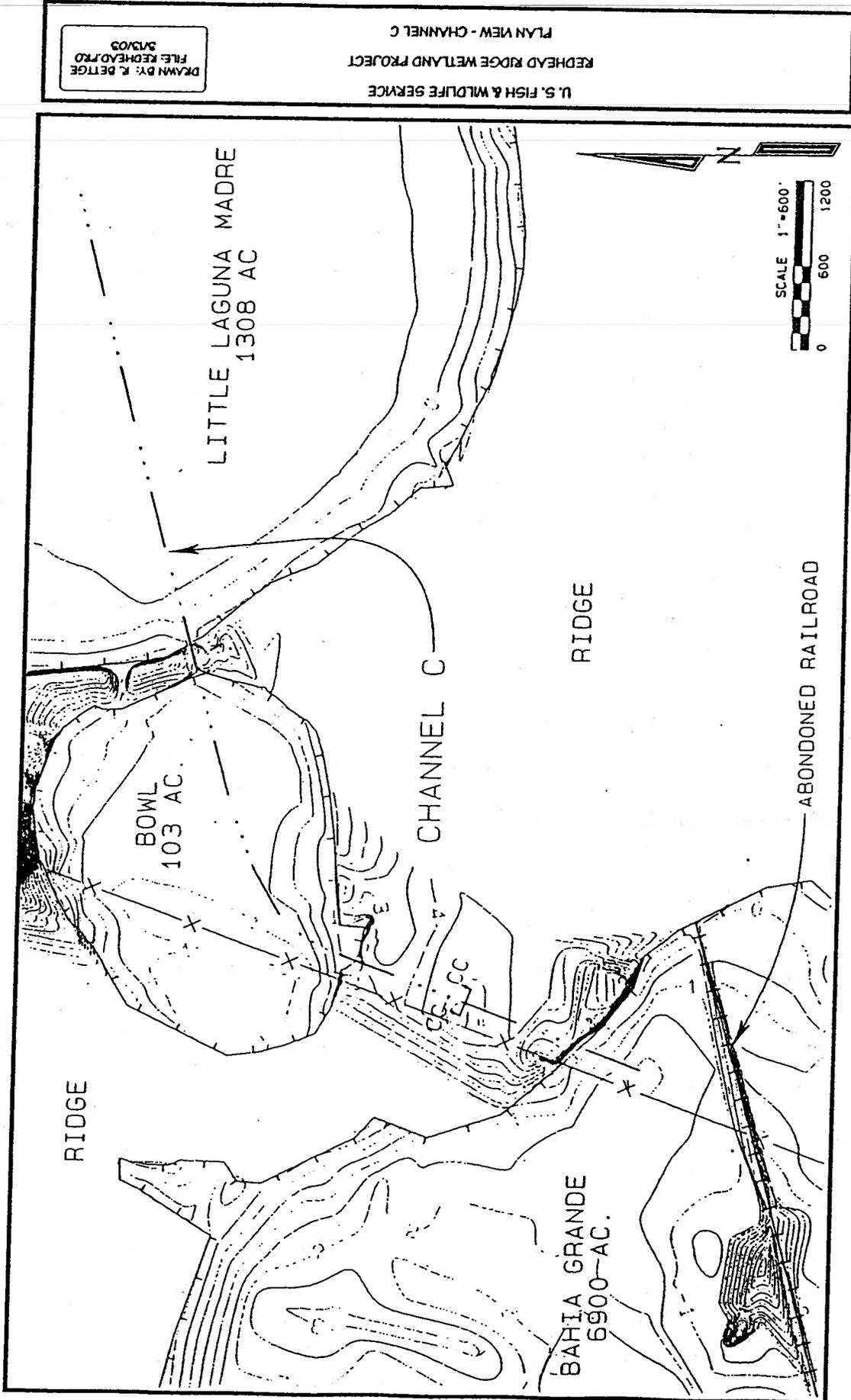


APPENDIX E

U. S. FISH & WILDLIFE SERVICE
 REDHEAD RIDGE WETLAND PROJECT
 SECTION BB-BB: CHANNEL B
 DRAWN: E. DEITGE
 FILE: REDHEAD/NO
 2/20/03



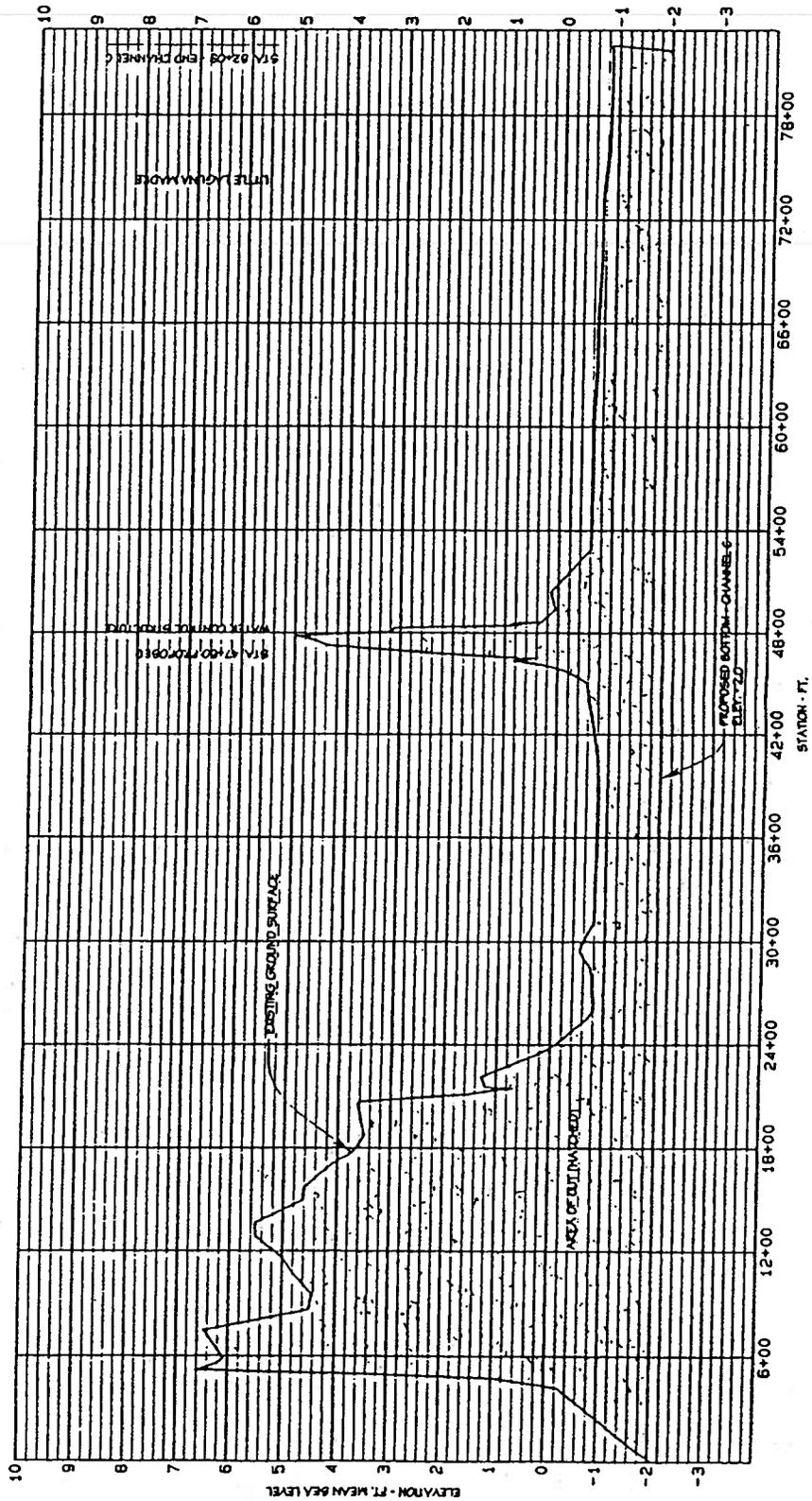
APPENDIX E



U.S. FISH & WILDLIFE SERVICE
REDHEAD RIDGE WETLAND PROJECT
PLAN VIEW - CHANNEL C
DRAWN BY: R. BETTGE
FILE: REDHEAD/RO
5/23/03

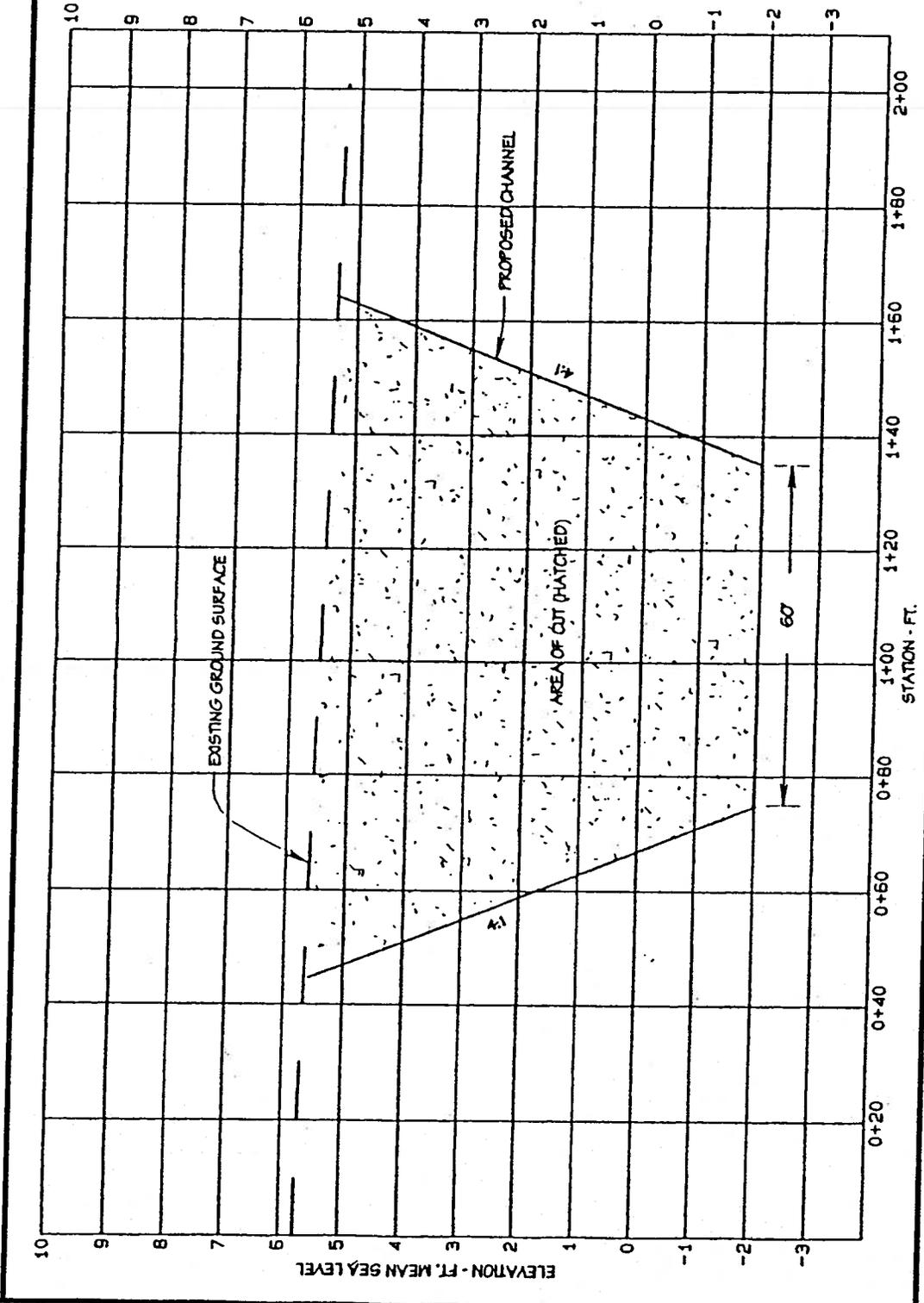
APPENDIX E

U. S. FISH & WILDLIFE SERVICE
 REDHEAD RIDGE WETLAND PROJECT
 PROFILE OF PROPOSED CHANNEL C
 DRAWN BY: R. BEITGE
 FILE: REDHEAD.PFD
 2/23/03

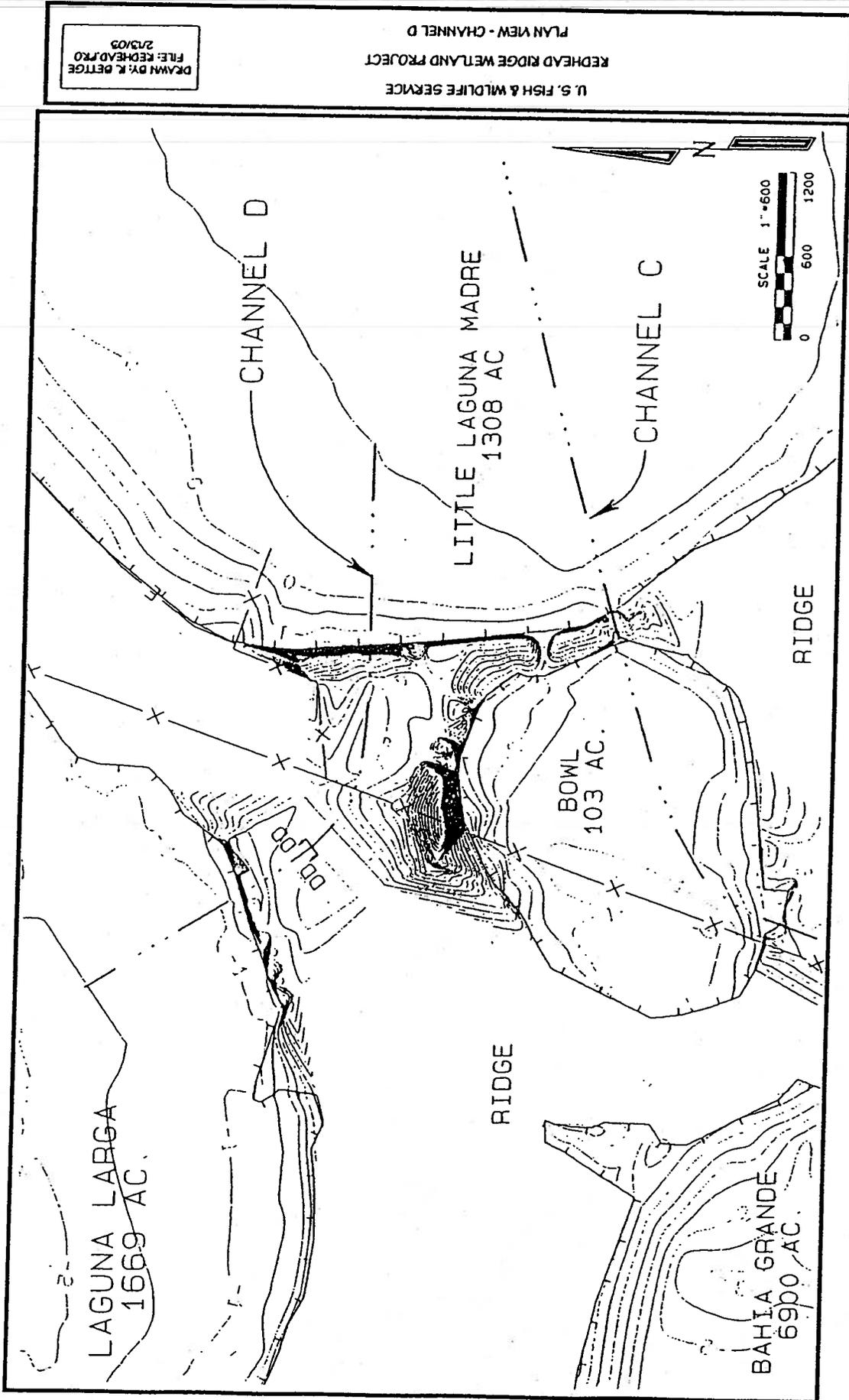


APPENDIX E

U. S. FISH & WILDLIFE SERVICE
REDHEAD RIDGE WETLAND PROJECT
SECTION CC - CC; CHANNEL C
DRAWN BY: R. DETTGE
FILE: REDHEAD.RXD
2/13/03

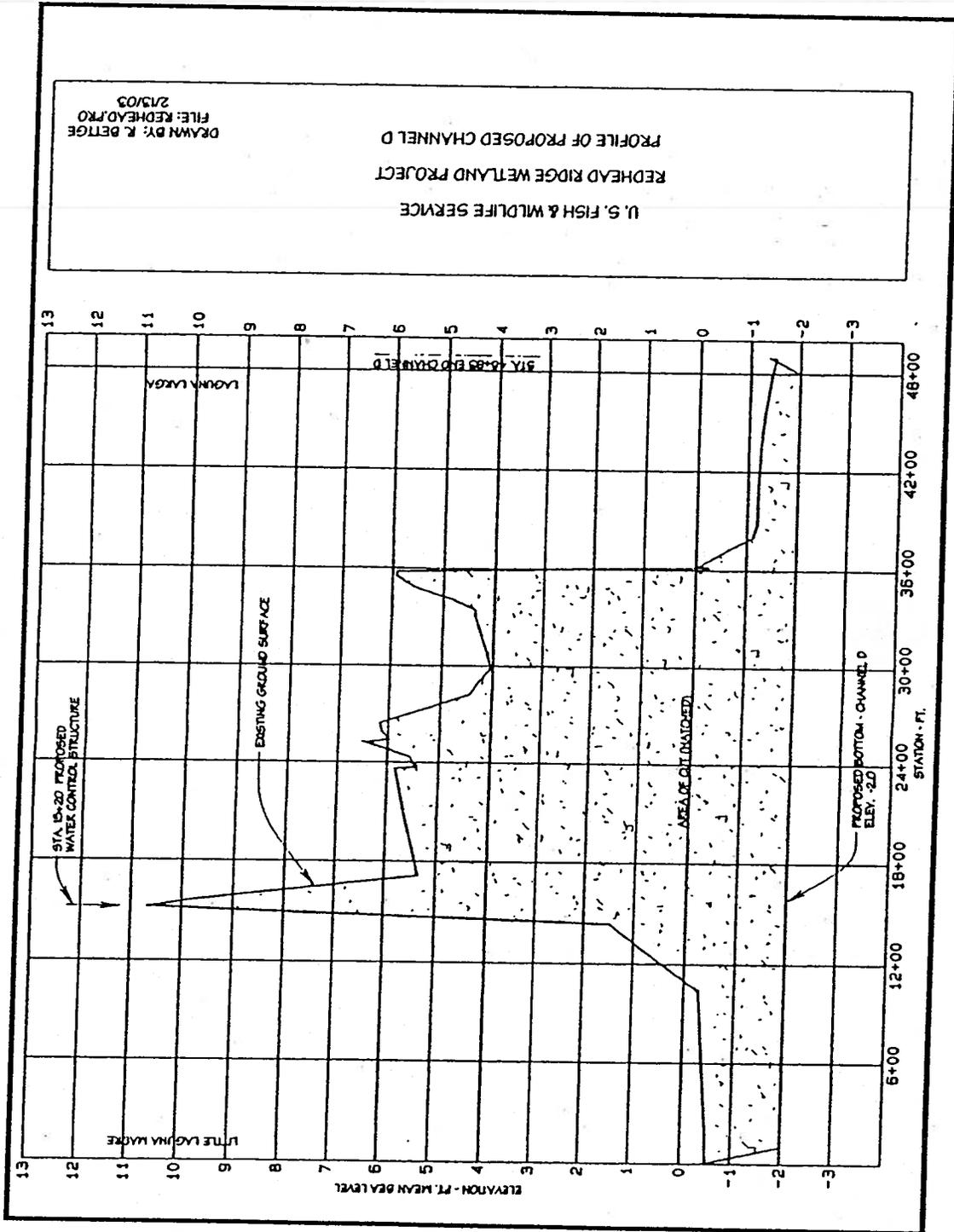


APPENDIX E



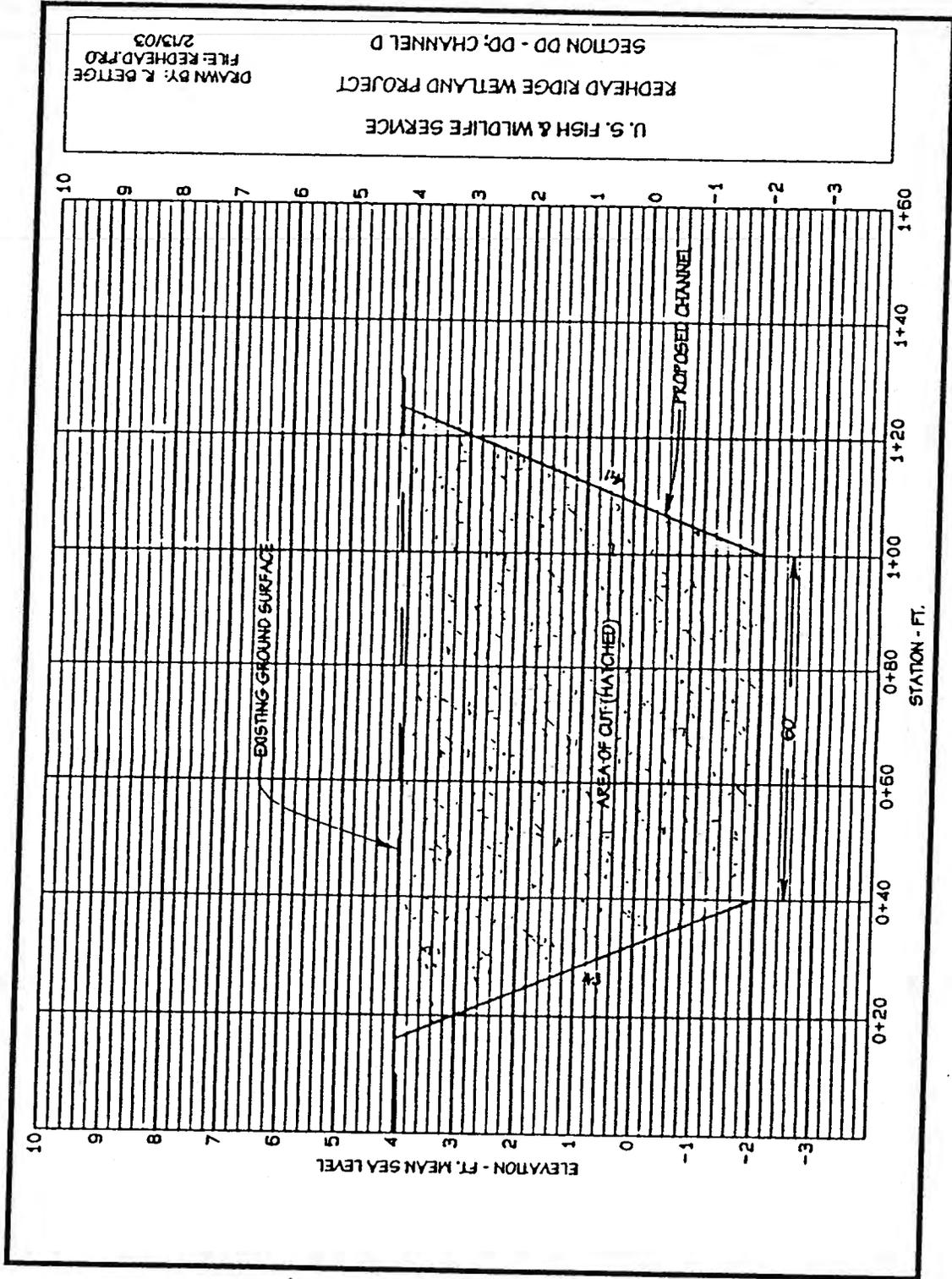
U. S. FISH & WILDLIFE SERVICE
REDHEAD RIDGE WETLAND PROJECT
PLAN VIEW - CHANNEL D
DRAWN BY: R. BETTGE
FILE: REDHEAD.PKO
2/23/03

APPENDIX E



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 REDHEAD RIDGE WETLAND PROJECT
 PROFILE OF PROPOSED CHANNEL D
 DRAWN BY: R. BETTGE
 FILE: REDHEAD.PKO
 2/13/03

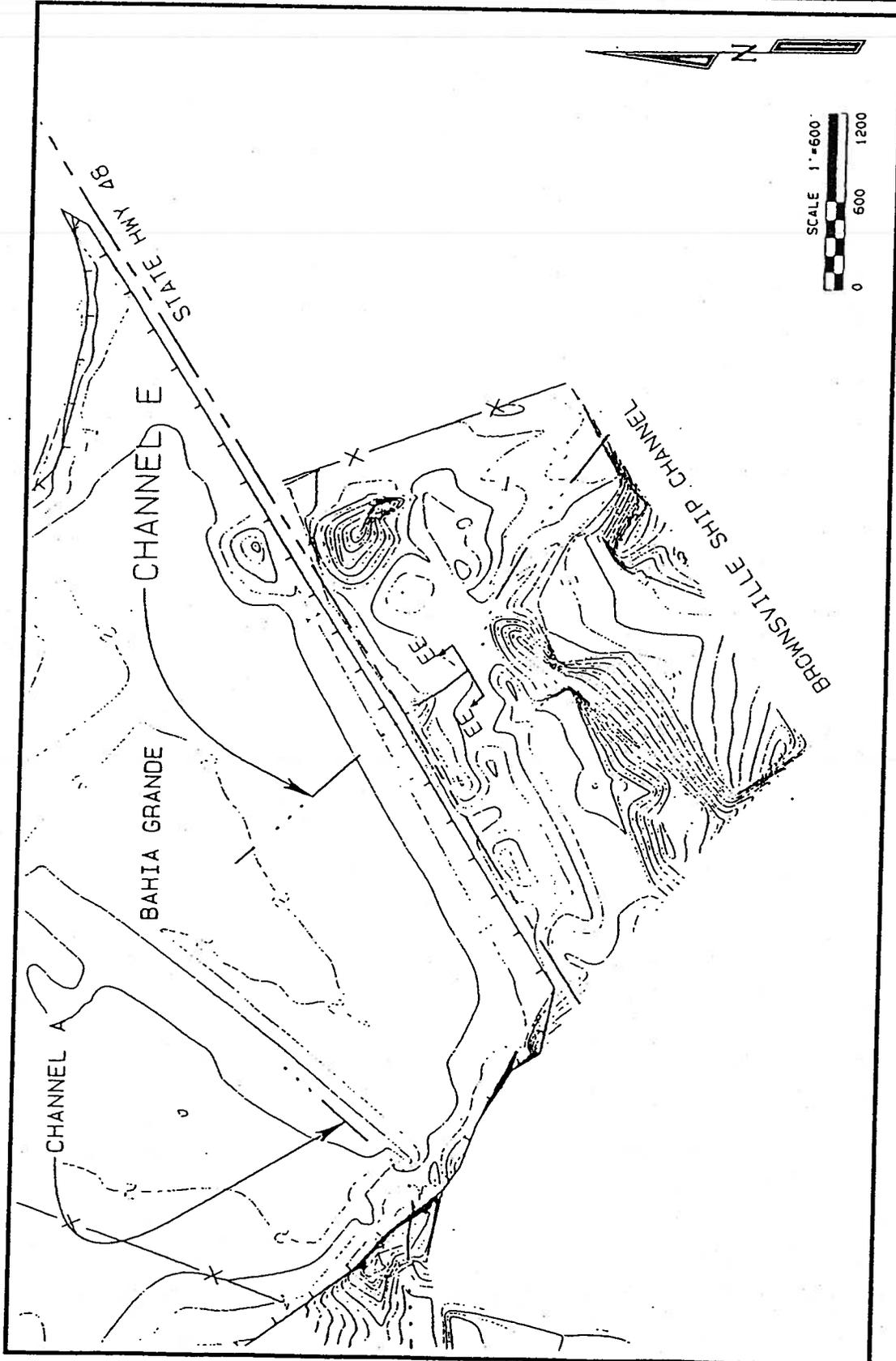
APPENDIX E



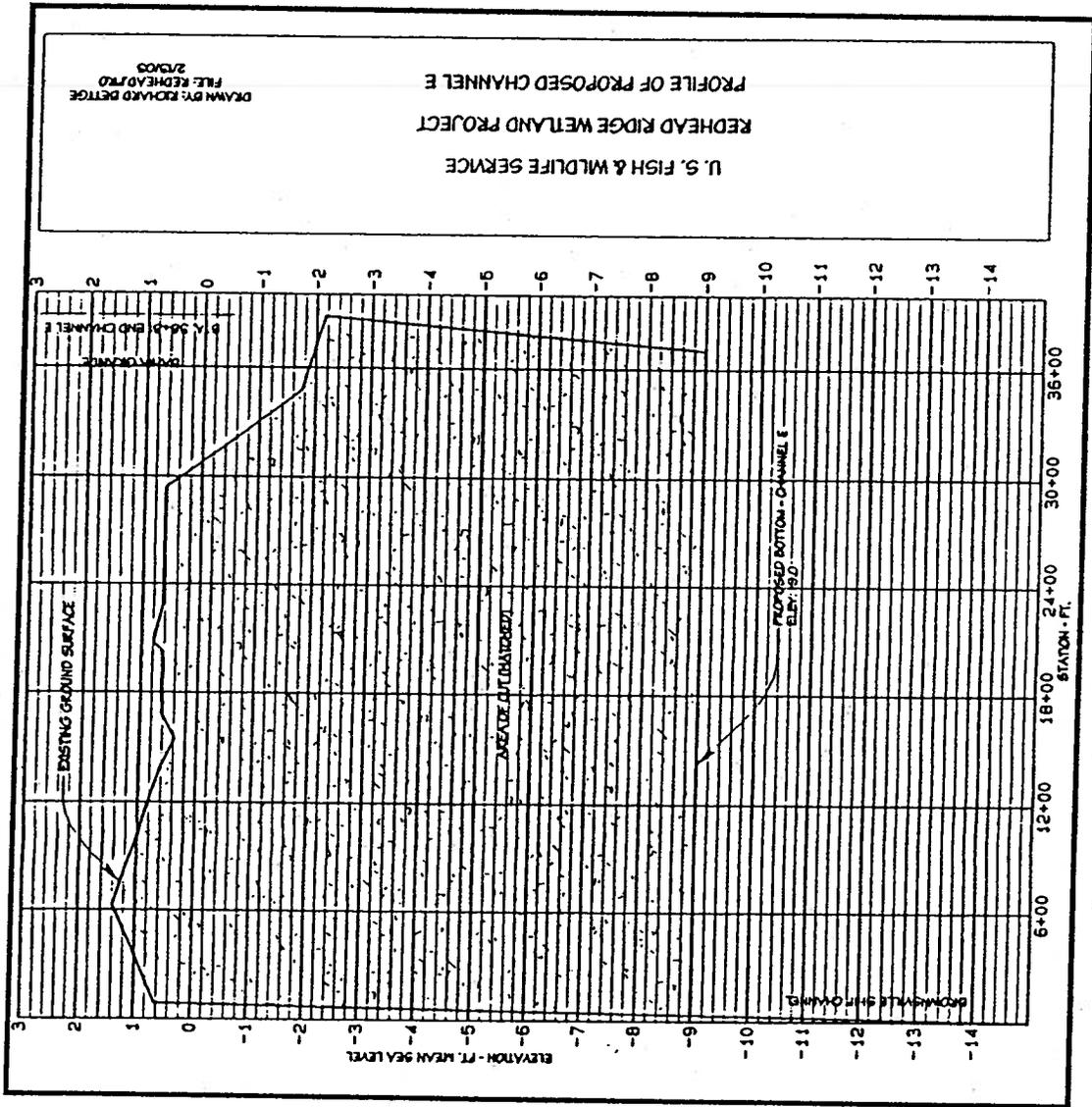
APPENDIX E

DRAWN BY: R. DETTGE
FILE: REDHEAD.PKO
3/23/03

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REDHEAD RIDGE WETLAND PROJECT
PLAN VIEW - CHANNEL E



APPENDIX E



APPENDIX E

