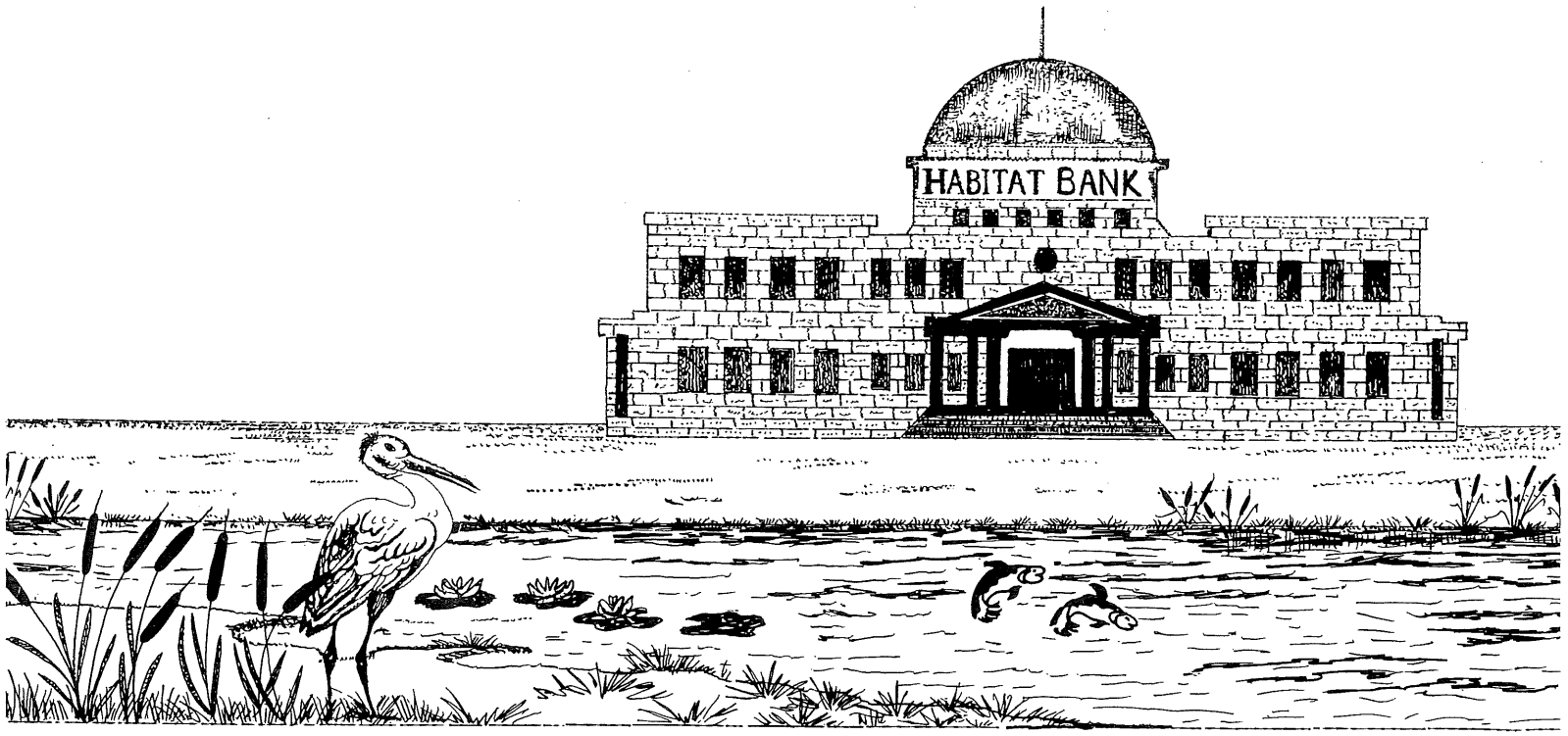
FINAL REPORT ON THE TENNECO LATERRE CORPORATION MITIGATION BANKING PROPOSAL, TERREBONNE PARISH, LOUISIANA



PREPARED BY
DAVID M. SOILEAU, SENIOR FIELD BIOLOGIST

UNDER THE SUPERVISION OF

DAVID W. FRUGE, FIELD SUPERVISOR
U.S. FISH AND WILDLIFE SERVICE
DIVISION OF ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

JUNE 1984

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EXECUTIVE SUMMARY

The Tenneco LaTerre (TLT) Corporation has proposed the establishment of a management program on approximately 5,000 acres of its coastal marsh in Terrebonne Parish, Louisiana. If successful, this program would produce fish and wildlife habitat benefits (credits) which could be used by TLT as mitigation for unavoidable fish and wildlife impacts associated with future activities requiring Corps of Engineers Section 10/404 and Louisiana Coastal Use Permits. The management program, which was jointly developed by TLT and the Soil Conservation Service, was designed to increase freshwater and sediment inflow, to improve water circulation, and to reduce saltwater intrusion into the management area.

A Fish and Wildlife Service (FWS) Habitat Evaluation Procedures (HEP) analysis of management-program impacts to fish and wildlife resources was conducted by FWS, with assistance from the National Marine Fisheries Service, Louisiana Department of Wildlife and Fisheries, Louisiana Department of Natural Resources (Coastal Management Section), Soil Conservation Service, and TLT. The HEP analysis indicated a net gain of 108,733 average annual habitat units (AAHU's) of Resource Category 2 wildlife benefits, 83,416 AAHU's of Resource Category 2 estuarine fishery benefits, 124,552 AAHU's of Resource Category 2 freshwater fishery benefits, and 25,992 AAHU's of Resource Category 3 wildlife benefits over the 77-year life of the project. TLT was unwilling to initially provide greater than a 25-year active management program and was unable to guarantee that, at a minimum, residual credits would continue to be produced beyond that period. Therefore, the interagency team reduced the number of credits available over the first 25 years to 25/77 th's of the total produced within the 5,000-acre area over the 77-year life of the project. This resulted in the following Category 2 usable credits by TLT during the first 25 years: 27,100 estuarine fishery AAHU's, 40,400 freshwater fishery AAHU's, and 35,300 wildlife AAHU's. Usable Category 3 credits during the first 25 years would include 8,400 wildlife AAHU's. When compared to losses of 304 Resource Category 2 wildlife AAHU's, 453 Resource Category 2 estuarine fishery AAHU's, and 453 Resource Category 2 freshwater fishery AAHU's, which were estimated to result from a "typical" oil and gas exploration canal, it would appear that the mitigation bank could be capable of offsetting the damages from 60 to 120 such canals.

It was concluded that, although mitigation banking is a relatively new concept for which little prior FWS experience exists, potential does appear to exist for this concept to ultimately become a workable approach for achieving offsite mitigation of unavoidable habitat losses. Within the framework of policy guidance afforded by the FWS's overall Mitigation Policy and the FWS's Interim Guidance on Mitigation Banking, the following recommendations and implementational and operational procedures for administering the TLT mitigation bank were developed:

1. The FWS's Habitat Evaluation Procedures should be used to assess credits and debits to be applied to the mitigation bank.

2. Every effort should be made to reduce adverse project impacts via project modification or onsite mitigation; mitigating via debiting credits from the mitigation bank is only appropriate to offset unavoidable fish and wildlife impacts.

3. Consistent with the FWS's Mitigation Policy, Resource Category 2 habitat losses should only be mitigated with Resource Category 2 habitat credits; however, Resource Category 3 habitat losses may be mitigated with Resource Category 2 habitat credits.

4. Credits generated within a given hydrologic unit, as defined by Wicker (1980), should be applied predominantly to activities requiring mitigation within that same hydrologic unit, but may be applied to a limited degree outside of that hydrologic unit with the approval of the interagency review team. In no case should credits be applied to projects implemented outside the State of Louisiana.

5. Buying, selling, or trading mitigation credits is appropriate, provided that all such transactions are concurred in by the interagency review team.

6. If future permitted development activities are proposed within the mitigation bank site, debits from the bank should include those associated with the proposed activity plus those associated with the loss of resource that, in the former mitigation analysis, may have been assumed to be producing mitigation credits.

7. FWS should provide data sheets of each transaction (either debit or credit) to all participating agencies and corporations (or individuals, as appropriate) for signature concurrence. Copies of signed transaction data sheets should be held as a permanent record by the FWS and the mitigation bank owner (in this case, TLT).

8. As the TLT proposal is a pilot program being implemented and administered under interim policy guidance, it is imperative that the program be closely reviewed on a periodic basis. It is proposed that this review include a complete HEP reanalysis at 5 years and again at 25 years following implementation, to assess the success of the management program in producing banking credits, with more frequent monitoring of the management program to ensure maximum fish and wildlife resource benefits.

9. A formal Memorandum of Agreement among participating Federal, State, and industry representatives should be developed to serve as a binding instrument of mitigation bank implementation.

INTRODUCTION

General

This report describes the analysis of and implementational procedures for a mitigation banking project to be implemented by Tenneco LaTerre corporation on its properties in Terrebonne Parish, Louisiana. This report and the December 14, 1983, Memorandum of Agreement (MOA) between the U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service (NMFS), U.S. Soil Conservation Service (SCS), Louisiana Department of Natural Resources (LDNR), Louisiana Department of Wildlife and Fisheries (LDWF), and the Tenneco Oil Company, direct the manner in which the mitigation bank will be administered.

Under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Fish and Wildlife Service (FWS) provides comments to the U.S. Army Corps of Engineers (USCE) on applications for permits under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Federal Water Pollution Control Act (Clean Water Act), as amended in 1977. FWS comments to the USCE on specific permit applications typically contain recommendations to mitigate adverse impacts of the proposed work on fish and wildlife resources. Mitigation, as defined by the President's Council on Environmental Quality in the Regulations For Implementing the Procedural Provisions of the National Environmental Policy Act, can include:

> (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments.

The FWS's Mitigation Policy, published in the Federal Register (Vol. 46, No. 15) on January 25, 1981, embraces the above definition of mitigation.

The USCE may include measures to prevent, reduce, or minimize anticipated impacts to fish and wildlife as a condition of a permit. Traditionally, however, those measures (when required as permit conditions) are implemented at the actual work site. Unfortunately, significant losses of productive wetlands are occurring in coastal Louisiana as a result of extensive water-dependent oil and gas exploration and production activities for which onsite mitigation measures are technically infeasible, economically prohibitive, and/or unacceptable to the landowner. In those cases, offsite mitigation

remains the only alternative available for compensating for unavoidable losses of valuable fish and wildlife habitat. Under the present USCE regulations, however, it is very difficult to have a permit conditioned to require offsite mitigation of unavoidable impacts. Instead, USCE has taken the position that offsite mitigation is a matter to be resolved by agreements negotiated between the permit applicant and the commenting agency or agencies, such as the FWS. This, in essence, makes offsite mitigation a voluntary action by the applicant; it also places the FWS in the position of a mitigation negotiator with no regulatory authority. When mitigation must be negotiated after the comments by FWS and other agencies are provided by the Corps to the permit applicant, the blame for delays in permit issuance is often placed on FWS and other advisory agencies. Another consideration is that, because of inadequate staffing at the field level, FWS does not recommend offsite mitigation on many permit applications involving works that individually do not cause major habitat losses but cumulatively lead to substantial reductions in fish and wildlife habitat. Given the above-cited limitations on achieving offsite mitigation for adverse impacts to fish and wildlife resources for activities regulated by the USCE, FWS managers must utilize innovative approaches to achieving full mitigation for unavoidable habitat losses caused by USCE-permitted actions in coastal Louisiana. One such approach is mitigation banking.

Mitigation Banking Concept

Within the FWS's January 15, 1981, Mitigation Policy and, again, in the FWS's June 23, 1983, Interim Guidance on Mitigation Banking (ES Instructional Memorandum No. 80), mitigation banking is defined as habitat protection or improvement actions taken expressly for the purpose of compensating for unavoidable, necessary losses from specific future development actions. In concept, mitigation banking is similar to maintaining a bank account (Brown 1983). Measures to create, protect or improve fish and wildlife habitat are implemented in advance of anticipated project actions which might adversely impact similar fish and wildlife habitat. The benefits of these measures are quantified via a suitable habitat-based methodology (e.g., the FWS's Habitat Evaluation Procedures) and serve as "credits" from which future withdrawals can be made. Withdrawals of credits from this "bank account" can be made to the degree necessary to mitigate for unavoidable fish and wildlife impacts for one or more projects, until the bank account is depleted.

For credits to be applicable to a development proposal, in-kind habitat of the same or superior value within the same geographical area must be included in the mitigation bank area. Utilization of a mitigation bank should only occur after all attempts to avoid adverse impacts or to provide onsite mitigation have been exhausted. The credits being "banked" must have a period of effectiveness at least equal to the life of the proposed development, as well as that time required for project impacts to cease in the case of an abandoned project.

The concept is most applicable to small projects where unavoidable habitat losses, individually, are relatively minor and cannot be fully mitigated on or immediately adjacent to the project site.

Tenneco LaTerre Corporation Proposal to Initiate Mitigation Banking Project

On October 29, 1982, an organizational meeting was held in Kenner, Louisiana, to discuss a proposal by the Tenneco LaTerre (TLT) Corporation to establish a mitigation bank on a portion of its properties in Terrebonne Parish, Louisiana. The meeting was attended by members of the USCE's New Orleans District (NOD), NMFS, FWS, SCS, LDWF, the Coastal Management Section (CMS) of the LDNR, TLT, and Tenneco, Inc. (i.e., the parent company of TLT). Mr. Jack Cutshall, SCS representative, reviewed the general design for the pilot mitigation banking project being proposed by TLT. Dr. Mike Zagata, Manager of the Ecological Sciences Division of Tenneco, Inc., emphasized that mitigation banking was not being proposed as a means to secure "carte blanche" approval of all of that industry's activities in the wetlands of coastal Louisiana; he also indicated that any mitigation for project impacts should be provided in the "general vicinity" of the project(s) being mitigated. Dr. Zagata stressed that mitigation banking served as a means for TLT to:

1. reduce the uncertainty involved in obtaining permits;

2. obtain credit for (marsh) management actions by that company; and

3. integrate the concept of mitigation into future land management options to be considered by upper-management decision-makers.

David Fruge, FWS representative, indicated that mitigation banking is a good concept, but reminded the group that credits should be applied only to mitigate unavoidable project impacts. He noted that FWS would continue to support, first, implementation of the least environmentally damaging alternative and, second, onsite mitigation of unavoidable impacts, where feasible and appropriate. The consensus of the interagency group was that the mitigation banking concept had merit and that FWS (as lead agency) and other interested agencies would perform a Habitat Evaluation Procedures (HEP) analysis to measure the credits to be banked by TLT. All attendants at the meeting agreed that an interagency approach to analyzing the benefits of the mitigation banking proposal was preferred.

On November 8-9, 1982, the FWS's Lafayette, Louisiana, Ecological Services Field Office hosted a meeting to initiate the HEP analysis. Meeting attendants included representatives from TLT, NMFS, SCS, LDWF, and CMS. During this two-day meeting, the group defined the area of impact of the mitigation plan, identified habitat types and quantities

(acreages) to be impacted by the mitigation plan, and selected evaluation elements (i.e., species and species groups) and sample sites to be used in completing the field-segment of the HEP analysis (reference Appendix A for details).

Individuals representing the FWS, CMS, LDWF, SCS, NMFS, and TLT met on November 15-17, 1982, at the site of the proposed mitigation area; baseline habitat quality of various habitats occurring within the mitigation area was assessed. Completion of the HEP analysis by FWS was initiated in January 1983.

PROPOSED MITIGATION BANK PROJECT

Field personnel from TLT and SCS jointly developed a structural program for intensively managing approximately 5,000 acres of TLT property and an additional 2,014 acres of adjacent property, owned by some 15 other individuals, located in Terrebonne Parish, Louisiana (Figure 1). The management program would retard the rate of loss of and enhance presently deteriorating marshland in this area. The benefits (to be measured via HEP analysis) generated from preservation and enhancement of at least the 5,000 acres of TLT property would be available for future use by TLT in mitigating the unavoidable impacts of Section 10/404 permit actions and Louisiana Coastal Use Permit actions. An intensive management program would be implemented within the first 25 years of project life; the project life (77 years) was defined as the period after which area marshes were expected to be totally lost in the without-management condition (reference Appendix B for computation of project life). At the end of the 25-year period of intensive management, TLT would consult with appropriate agencies to determine the best course of action to maintain its interest in subsurface minerals and to continue to protect the ecological integrity of the wetlands of the mitigation bank area.

As indicated in Figure 1, two fixed-crest weirs will be installed along the southern edge of the Marmande Canal to allow freshwater from the Gulf Intracoastal Waterway (GIWW) to enter the marsh on the northern end of the mitigation area, via Minors Canal and the Marmande Canal. Breaks in the spoil banks of the pipeline canal which extends east-west across the mitigation area will be provided to allow the freshwater to flow into the intermediate and brackish marshes to the south. A fixed-crest weir in Minors Canal, about midway along the western boundary of the mitigation area, will permit additional freshwater flow to enter that segment of the mitigation area which is experiencing rapid marsh loss from saltwater intrusion. To further minimize saltwater intrusion, an existing, debilitated weir will be replaced in the southeastern corner of the mitigation area. That weir will be a variable-crest weir which will allow draw-down or ponding of freshwater, depending on prevailing hydrological conditions and desired management results. The weir will be sized to ensure ingress and egress of marine organisms. In the event that, during the intensive management period, a majority of the cooperating agencies

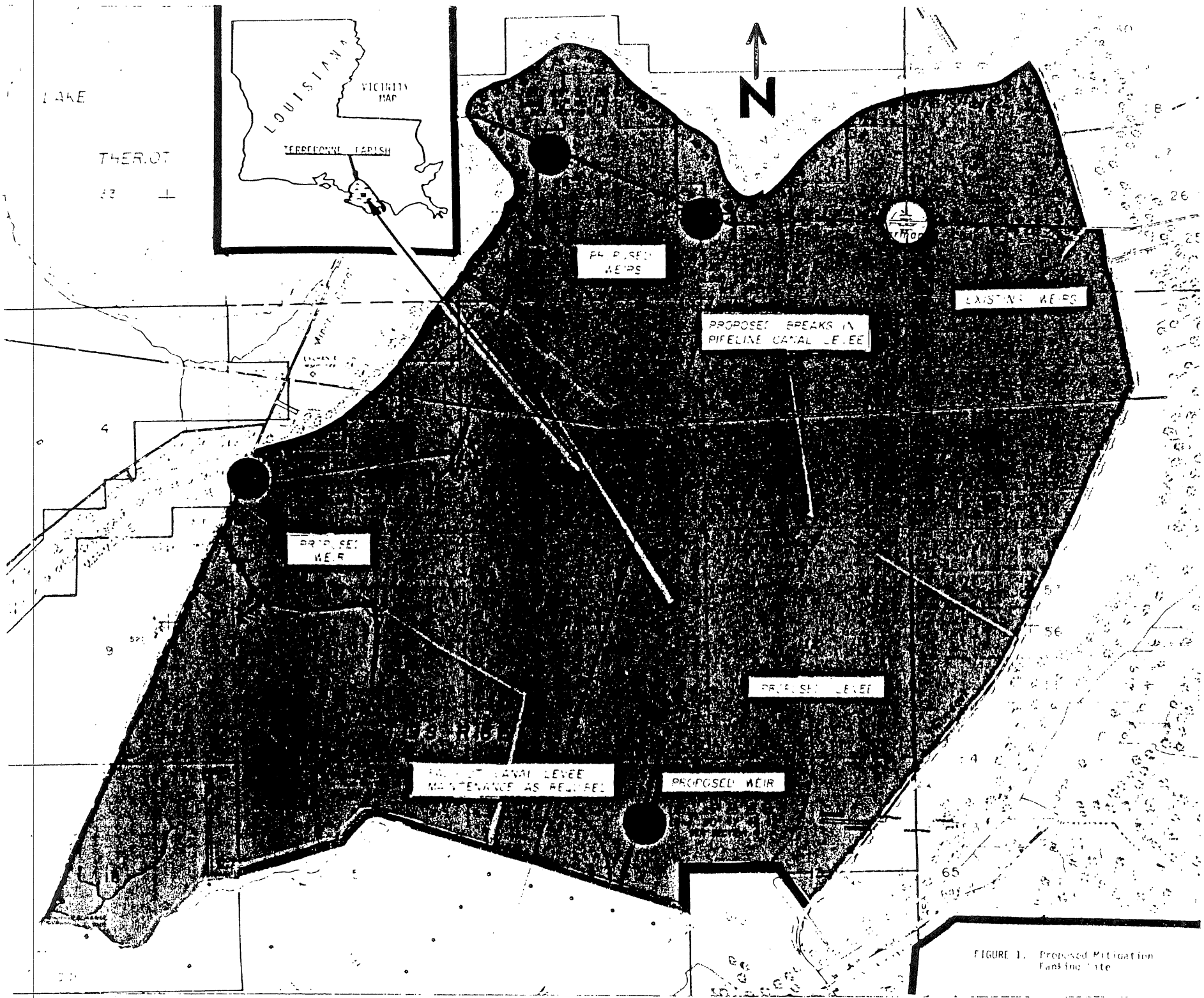


FIGURE 1. Proposed Mitigation Eanking Site

determine the need for an additional weir along the southern end of the mitigation area, TLT has agreed to construct that additional weir.

Spoil banks along the northern edge of the Falgout Canal and oil field canals adjacent to the southern end of the mitigation area will be constructed and maintained to prohibit the entry of saltwater. A controlled burn of about one-third of each marsh type each year will be employed to eliminate the buildup of thatch which could lead to a future uncontrolled burn; this program is designed to promote the invasion of annual grasses and sedges and to increase plant diversity.

MITIGATION AREA SETTING

General

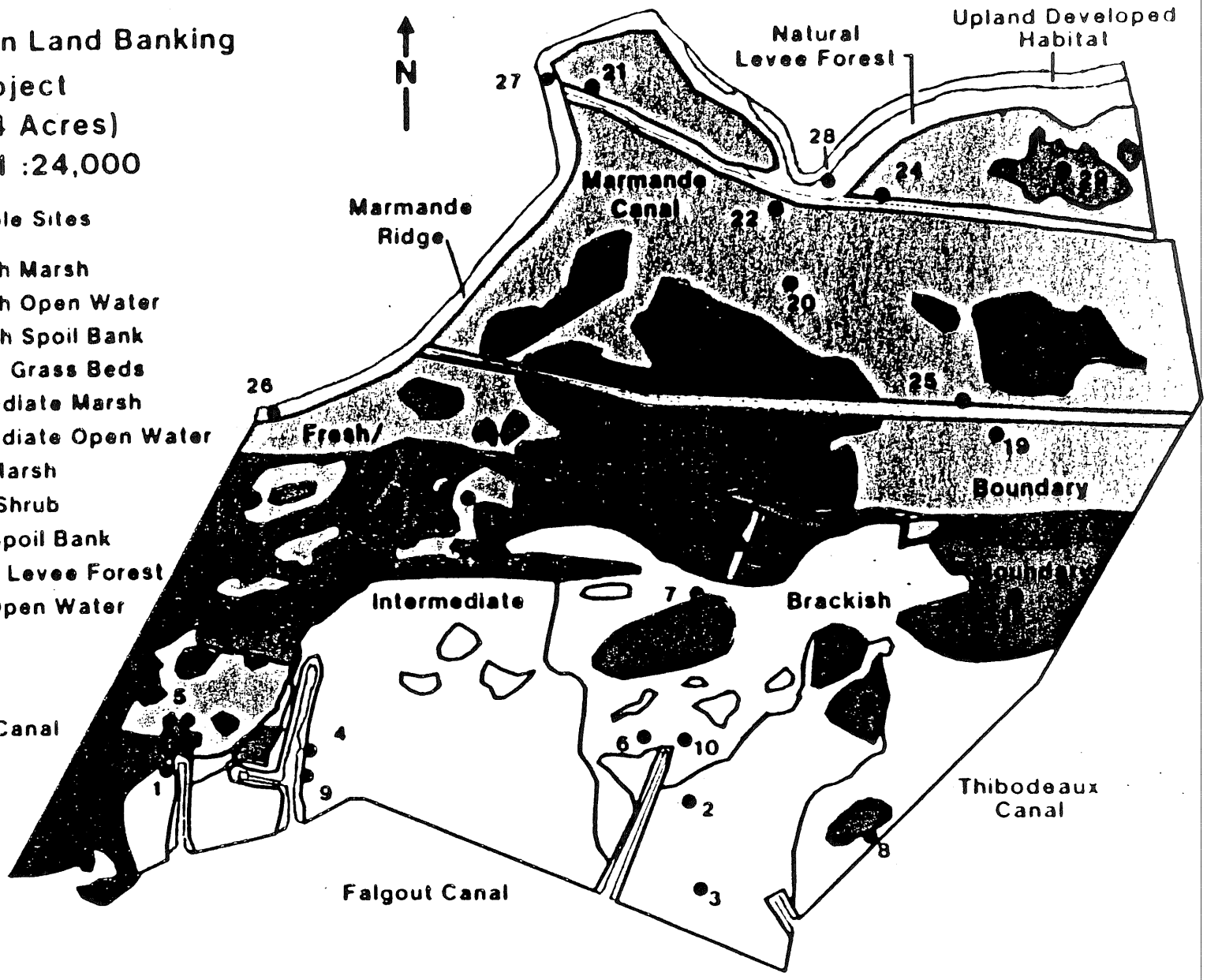
The mitigation bank site includes an area of some 5,000 acres owned by TLT and approximately 2,014 acres lying adjacent to the northern and eastern boundaries of the TLT property which would be benefited by the management program being proposed. The mitigation area is located in Terrebonne Parish, Louisiana (Figure 1) and is within Hydrologic Unit 5 as delineated by Wicker (1980). The area consists primarily of marsh, adjacent shallow open water areas, and natural levees formed as a result of the deposition of Mississippi River sediments during the past 6,000 years (Gagliano and van Beek 1970). These sediments formerly entered the area via Bayou Lafourche, a distributary of the Mississippi River. However, in 1904 this avenue of freshwater and sediment was permanently separated from the Mississippi River by a closure constructed by the U.S. Army Corps of Engineers at Donaldsonville, Louisiana. Levee construction along the Lower Mississippi River and, in particular, elimination of Bayou Lafourche as a distributary of the Mississippi River has virtually eliminated freshwater and sediment transport to area wetlands. Natural subsidence occurring at about one foot per century in this area (U.S. Army Corps of Engineers 1973), and other factors such as excavation of major navigation canals, canalization for oil and gas exploration and production, and saltwater intrusion via these man-made waterways have led to the conversion of fresh marsh to open water and more saline vegetation types.

One of the greatest causes of marsh deterioration in the mitigation area is saltwater intrusion via the Falgout Canal which forms the southern boundary of the area. That canal allows salt water to enter the area from the Houma Navigation Canal which lies to the east; that canal extends to the Gulf of Mexico. Deteriorated spoil banks along the Falgout Canal have allowed salt water to gradually invade the southern half of the mitigation area since about the mid-1960's. The area has converted from the essentially homogeneous maidencane fresh marsh which existed in the mid-1950's, to the fresh/intermediate brackish marsh, which occurs now (Figure 2).

Pilot Mitigation Land Banking Project (7,014 Acres) Scale: 1 :24,000

Sample Sites

- 1-4 Brackish Marsh
- 6-8 Brackish Open Water
- 9-10 Brackish Spoil Bank
- 11-12 Aquatic Grass Beds
- 13-15 Intermediate Marsh
- 5, 16-17 Intermediate Open Water
- 19-22 Fresh Marsh
- 18, 23 Scrub/Shrub
- 24-25 Fresh Spoil Bank
- 26-28 Natural Levee Forest
- 29 Fresh Open Water



Although several potential sites for freshwater diversion from the Mississippi River to alleviate the rapid rate of coastal marsh loss are being strongly considered by NOD and other Federal and State agencies, it is unlikely that any of these diversions would influence this area. Accordingly, all future without-management (FWOM) habitat projections were made under the assumption that the present rate of marsh loss would continue into the future. Based on various assumptions regarding "natural" habitat trends and on published rates of loss of certain habitat types within the mitigation area, specific acreages of habitats in the mitigation site were estimated for the FWOM condition at various target years (TY) through project life (Table A-1). Based on data from Wicker (1980), the project life (assumed to be the period of time elapsed before all vegetated wetlands would be eliminated in the FWOM condition) was computed to be 77 years. Therefore, Year 2059 is considered the end of the project life and Year 1982 is considered baseline or TY 0. Appendix A contains a detailed discussion of the methodologies used in calculating project life and FWOM habitat acreages.

Fish and Wildlife Resources

Fish and wildlife habitat types identified in the project area include fresh, intermediate, and brackish marshes, open water, aquatic bed, scrub/shrub, canal, and spoil bank. As previously indicated, the FWOM scenario within the mitigation area includes a trend toward increased saltwater intrusion and increased loss of preferred fish and wildlife habitats such as marsh and aquatic bed.

Predominant vegetation of the fresh marsh area includes maidencane (Panicum hemitomon) and cattail (Typha latifolia). In intermediate marsh, wiregrass (Spartina patens) becomes more dominant; however, cattail is still common. Brackish marsh is dominated by wiregrass and the more salt-tolerant species, saltgrass (Distichlis spicata). Fresh, shallow aquatic bed areas with low turbidity support Eurasian watermilfoil (Myriophyllum spicatum), while more saline, shallow aquatic bed areas support widgeongrass (Ruppia maritima). The predominant woody vegetation of the scrub/shrub habitat is waxmyrtle (Myrica cerifera); ground cover in this habitat type includes bulltongue (Sagittaria falcata), pennywort (Hydrocotyle sp.), and water hyssop (Bacopa monnieri). Spoil banks of the area support primarily the woody species, eastern baccharis (Baccharis halimifolia) and marsh elder (Iva frutescens); ground cover includes wiregrass and blackberry (Rubus sp.).

The marshes and shallow open water of the mitigation area provide excellent habitat for numerous juvenile and adult fishes and shellfishes. Due to the diverse salinity regimes, both freshwater species (e.g., largemouth bass, bluegill, warmouth, blue catfish, and channel catfish) and estuarine species (e.g., Gulf menhaden, sand seatrout, Atlantic croaker, blue crab, and white and brown shrimp) inhabit the area. The wildlife value of the area is considered high.

The mitigation area is located within the Terrebonne Unit of the Central Gulf Coast Wetlands Study Area (U.S. Fish and Wildlife Service 1982). That unit ranks first, based on wintering waterfowl use, out of 14 key privately-owned wetland units located along the coasts of Louisiana, Mississippi, and Alabama. The area consistently winters a tremendous number of waterfowl, and as a result, there is keen competition to lease the marshes in this area for waterfowl hunting. Non-game wetland birds which occur in the area include egrets, herons, ibises, and the white pelican. The mitigation area also supports an abundant population of furbearers. Trapping records furnished by TLT indicate that, annually, large numbers of nutria, muskrat, and American alligators are harvested on the project site, and smaller numbers of raccoon and mink are taken.

MITIGATION PROJECT IMPACT ASSESSMENT METHODOLOGY

At the request of TLT and with the concurrence of the cooperating Federal and State agencies listed in the "INTRODUCTION" section of this report, the FWS's HEP analysis was used to assess the impacts of the proposed mitigation project on fish and wildlife resources. This analysis allowed a quantification and qualification of non-monetary (habitat-based) impacts of the proposed management program.

Via the HEP analysis, habitat quality and quantity were established for baseline conditions (i.e., existing or TY 0 conditions) and predicted for future with-management (FWM) and FWOM conditions. This standardized methodology allowed a numeric comparison of FWM and FWOM conditions at various times (target years) during the life (77 years) of the mitigation program and, hence, provided a unit of measure of management-induced impacts on fish and wildlife resources (reference Appendix A for thorough discussion of HEP procedures and analyses). To establish baseline habitat quality, a representative list of fish and wildlife species and species groups (including species of primary economic concern and/or high public interest) was selected for the mitigation area. Various sample sites within each habitat type occurring in the mitigation area were rated according to their ability to support the selected fish and wildlife species and species groups. The average rating (scored from a low of zero to a high of ten) for all species over all sample sites within one habitat type yielded a relative measure of the baseline habitat quality, termed habitat unit value (HUV), of that habitat type for fish or wildlife elements. Baseline HUV's for freshwater fishery, estuarine fishery, and wildlife elements (Tables A-2, A-3, and A-4) were tracked separately to allow completion of individual freshwater fishery, estuarine fishery and wildlife HEP analyses. Based on a number of assumptions detailed in Appendix A, FWOM and FWM HUV's (Tables A-2, A-3 and A-4) were projected for various target years. Generally, it was assumed that habitat quality in the FWOM condition would remain constant; whereas, habitat quality in the FWM scenario would improve.

The methodology employed in estimating habitat quantity (Table A-1) in the baseline, FWOM, and FWM conditions is discussed thoroughly in Appendix A. It was assumed that in the FWOM condition the present trend of vegetated wetland loss would continue until all such habitat would be eliminated in TY 77 (end of project life). It was further assumed that during the 25-year intensive management program of the FWM condition the rate of habitat loss would be reduced. However, during the period following (TY 26 - TY 77), habitat quantity would decline at the FWOM rate. The assumption that habitat quality and quantity would deteriorate at the FWOM rate after TY 25 is subject to change (i.e., the management-induced increase in habitat quality and reduction in marsh acreage decline to be realized during the first 25 years of project life might be sustained) if TLT agrees at the 25-year interagency/TLT program review to extend intensive management beyond TY 25.

The fish and wildlife HUV's (from Tables A-2, A-3 and A-4) multiplied by the habitat acreages (from Table A-1), for each respective habitat type and future condition (i.e., FWM versus FWOM), yielded a unit of measure of both habitat quality and quantity, expressed as habitat units (HU). Comparison of the HU's in the FWM and FWOM conditions (Tables A-5, A-6 and A-7) afforded a measure of the anticipated impacts of the management program on freshwater fishery estuarine fishery, and wildlife species.

MITIGATION PROJECT IMPACTS

Habitat Quantity

Fresh marsh conversion to other habitat types (i.e., intermediate and brackish marshes and open water) is occurring in the proposed mitigation area at the rate of 6.6 percent per year (reference Appendix A for methodology used to establish this rate). Significant benefit in reducing this rate of conversion is expected from features in the management program that would provide additional freshwater and sediment input from the GIWW and features that would limit saltwater intrusion via the Falgout Canal. These features, alone, are expected to affect the conversion of all baseline intermediate marsh acreage (564 acres) to fresh marsh during the period TY 0 to TY 25. The "freshening" effect of the management program is expected to result in the conversion of all brackish marsh to intermediate marsh by TY 5. The latter is based on the expected establishment of oligohaline vegetation (e.g., bulltongue, cattail, and dwarf spikerush) in the wiregrass-dominated marsh. Due to stabilized water levels and reduced turbidity expected within one year of the installation of the proposed weirs, it has been projected that the area of shallow open water that would be occupied by aquatic bed would increase by 150 percent. It was assumed that scrub/shrub habitat would maintain baseline (TY 0) acreage throughout the 25-year period, except for

minor reductions to account for increases in canals and spoil banks. The acreages of canal and spoil bank were projected to follow the same trend as in the FWOM condition, since the management program should have no appreciable impact on these habitat types.

After TY 25 (i.e., the year in which the intensive management program may be terminated) it was assumed that FWOM habitat acreage trends would resume (as previously stated, this assumption is subject to change based on further agreements at the 25-year interagency/TLT program review). Hence, significant declines in marsh, aquatic bed, and scrub/shrub acreages are expected from TY 25 to TY 77. Conversely, a significant increase in open water, resulting from the loss of vegetated wetlands, is expected during that same period.

Nevertheless, a net annualized increase of 3,036 acres of fresh and intermediate marsh, aquatic bed, and scrub/shrub is expected over the 77-year project life under the FWM condition; this net increase represents a reduction in the average annual decline of fresh and intermediate marsh acreage, compared to the FWOM condition.

Reference Table A-1 for a listing of projected habitat acreage changes under the FWM condition.

Habitat Quality

Although it was predicted that vegetated wetland habitats would be eliminated within 77 years in the FWOM condition, it was assumed that the HUV's for fish and wildlife evaluation elements would remain constant for each habitat type. Conversely, during the 25-year intensive management segment of the mitigation plan, the habitat quality of all marsh types, open water, and aquatic bed are expected to increase significantly. Based on the fact that the proposed management program would bring rapid relief from increasing saltwater intrusion problems and would, concurrently, provide new sources of freshwater and sediment inflow into the mitigation area, it was assumed that the projected increases in habitat quality would occur by TY 5 and would be sustained throughout the remainder of the intensive management period (through TY 25).

All marsh habitats would respond favorably to improvements in water-level control resulting from weir installation, reductions in saltwater intrusion resulting primarily from maintaining a continuous levee adjacent to the Falgout Canal, freshwater and sediment introduction from the GIWW, and controlled burning. The ability to reduce water levels to the extent of periodically exposing mud flats would encourage the establishment of annual grasses and sedges; this would be of particular benefit to migratory puddle ducks. Reflooding with freshwater, in lieu of saltwater, would help ensure maintenance of the newly emerged grasses and sedges. Increased production of Olney's threesquare, of particular benefit to geese and muskrats, is expected in intermediate marsh areas.

Increased productivity of the marsh would increase detrital input into open water and aquatic bed habitats. Accordingly, productivity of those habitats would increase significantly. The stabilizing effect that the proposed weirs would have on water levels would also enhance the productivity of those aquatic habitats.

The increased productivity of mitigation area marsh, open water, and aquatic bed habitats would be of significant benefit to immature white and brown shrimp, Gulf menhaden, Atlantic croaker, sand seatrout, and blue crab. This is particularly important in view of the dramatic decline in wetland habitats being experienced in coastal Louisiana. Evidence indicates that under a basically artificial condition (i.e., water level control as proposed for the mitigation area), larval brown shrimp acclimate better to lower salinities than in an open system subjected to normal tidal ranges (White and Boudreaux 1977). As most of the canals and spoil banks within the mitigation area have already peaked in habitat quality and because the management program would not be expected to have any impact on these habitats, the HUV's for those habitats were not assumed to vary from baseline HUV's. Similarly, it was concluded that the management program would not impact the quality of the scrub/shrub habitat.

As it is possible that the intensive management program may be terminated after TY 25, it has been assumed that all HUV's would return to baseline (TY 0) values by TY 77 (end of project life).

Reference Tables A-2, A-3 and A-4 for listings of projected HUV changes under FWM conditions.

Overall Impacts to Fish and Wildlife

As indicated previously, the product of habitat quality (i.e., HUV's from Tables A-2, A-3 and A-4) and habitat quantity (i.e., acres from Table A-1) yields a unit measure of both quality and quantity, expressed as habitat units (HU's). The computation of HU's was performed separately for wildlife elements, estuarine fishery elements, and freshwater fishery elements (Tables A-5, A-6 and A-7). Any net annualized difference in HU's, expressed as average annual habitat units (AAHU's), between the FWOM and FWM conditions is attributable to the management program. A positive (+) net change in AAHU's within a habitat type indicates that the management plan would improve the value of that habitat for fish or wildlife. Conversely, a negative (-) net change in AAHU's within a habitat type indicates that the management plan would decrease the value of that habitat for fish or wildlife.

As is evident from Tables A-5, A-6 and A-7, the proposed management plan would produce net benefits to wildlife in all habitats except brackish marsh, canal, and spoil bank and to fishery species in all habitats except brackish marsh, open water, canal, and spoil bank. The apparent decrease in benefits within brackish marsh is attributable solely to an assumed total conversion of brackish marsh

to intermediate marsh by TY 5. In reality, the habitat quality (HUV) of the brackish marsh remaining at TY 1 was assumed to increase significantly due to the management program. Since the trends in both acreage and HUV of canal and spoil bank were assumed to be identical in the FWOM and FWM conditions, no net benefits or losses in AAHU's are expected in those habitats. In summary, a net increase of 192,465 AAHU's, 79,946 AAHU's, and 142,505 AAHU'S for wildlife elements, estuarine fishery elements, and freshwater fishery elements, respectively, would be attributable to the mitigation plan when implemented over the entire 7,014-acre tract.

PROPOSED MITIGATION BANKING IMPLEMENTATION AND OPERATIONAL PROCEDURES

Period of Analysis

According to the FWS's Mitigation Policy, appropriate mitigation would provide for a duration of effectiveness for the life of a project plus such additional time required for the adverse effects of the abandoned project to cease to occur. Such a requirement is particularly appropriate where the habitat base to be impacted could be expected to have an inperpetuity natural life expectancy, notwithstanding the possibility of future destruction by man-induced activities. In circumstances where the habitat resource base to be impacted is judged to have a life expectancy of less than perpetuity, providing mitigation for that "lesser period" would appear to be equitable and appropriate. In the case of the TLT proposal, the life of the habitat of primary concern (i.e., marsh) within the mitigation area was estimated to be 77 years from Year 1982 (i.e., baseline year or TY 0). Accordingly, the period of analysis of the mitigation area was 77 years, even though the period of intensive management is presently guaranteed only during the first 25 years of the mitigation project life. An interagency/TLT program review which is to occur at the end of TY 25 may result in a TLT decision to extend the intensive management program beyond 25 years. Nevertheless, in the event that a decision is made to terminate intensive management at TY 26, it has been assumed that the presently scheduled 25-year intensive management segment of the mitigation program will produce residual beneficial impacts to fish and wildlife resources throughout the remainder of the 77-year analysis period by prolonging the life of the remaining wetlands.

It is proposed that mitigation bank credits be used to offset the damages from projects causing impacts of a duration equal to or less than the duration of the mitigation bank (i.e., not of a duration exceeding Year 2059). In the example (reference Appendix B) selected to demonstrate a methodology for estimating losses to be debited from the mitigation bank, the same period of analysis (77 years) was used,

since the permitted action was assumed to be occurring in an area (i.e., the same hydrologic unit) within which the habitat base had a life expectancy identical to that of the mitigation area and was assumed to be implemented concurrently with the mitigation program. In cases where reliable data indicate that the life expectancy of habitat to be impacted by a permitted action is less than the mitigation bank area, the future without-project life expectancy of the permit impact area should be the period of analysis for permit impacts. In the case of a project implemented in TY 20 (i.e., on a habitat base having a remaining life expectancy of 57 years) the period of analysis of project impacts would be 57 years. The number of AAHU's of damage estimated over that project life would be debited directly from the AAHU credits in the mitigation bank.

Mitigation Credits to be Banked by TLT

As indicated previously, the proposed management program would generate a total net increase of 192,465 AAHU's, 79,946 AAHU's, and 142,505 AAHU'S in wildlife, estuarine fishery, and freshwater fishery benefits, respectively, when implemented over the entire 7,014-acre tract. Those benefits would accrue to preferred fish and wildlife habitats (e.g., marsh and aquatic bed), as well as to habitats, such as open water and scrub/shrub, presently considered by the FWS to be of lesser concern or importance to fish and wildlife. Marsh and aquatic bed have been designated Resource Category 2 habitats, according to the FWS's Mitigation Policy; this is based on the fact they are of high value to the evaluation species and are becoming scarce on a regional, state, and national basis. Open water and scrub/shrub have been designated Resource Category 3 habitats, based on the fact that they are of high to medium value to the evaluation species and are relatively abundant on a national basis.

Since the FWS's Mitigation Policy established the goal of no net loss of in-kind habitat value for Resource Category 2 habitats, it is appropriate that future permit-related losses in Category 2 habitat value be offset exclusively with Category 2 habitat value benefits generated by the mitigation bank. The mitigation goal for Resource Category 3 habitats is somewhat more flexible in that it encourages minimization of the loss of in-kind habitat value but ultimately requires simply the avoidance of a net loss of habitat value, without specifying the absolute need for in-kind replacement. It is appropriate, then, that future losses in Category 3 habitat value be allowed to be mitigated with both Category 2 or 3 habitat value benefits generated by the mitigation bank.

Given these mitigation constraints, the net AAHU benefits (previously referenced) to be generated over all habitat types by the management program have little bearing on the credits to be banked by TLT. Those credits (AAHU's) generated within the 7,014-acre tract include Category 2 net benefits of 119,166 estuarine fishery AAHU's, 177,931 freshwater fishery AAHU's and 155,333 wildlife AAHU's, and Category 3 net benefits of 37,132 wildlife AAHU's (reference Tables A-5, A-6 and

A-7). There are no Category 3 net benefits to fishery elements resulting from the management program; accordingly, all future fishery losses must be deducted from Category 2 credits.

At this writing, TLT is only able to provide management guarantees over the 5,000 acres which it owns; the remaining 2,014 acres of the management area are owned by a host of other individuals from whom no assurances guaranteeing at least 25 years of marsh management have yet been acquired. Therefore, usable Category 2 and 3 credits have been reduced by 30 percent; these include: 83,416 estuarine fishery AAHU's; 124,552 freshwater fishery AAHU's; and 108,733 wildlife AAHU's. Usable Category 3 credits include 25,992 wildlife AAHU's.

TLT was unable to guarantee that, at a minimum, residual credits will continue to be produced beyond TY 25. Therefore, the interagency team agreed to reduce the credits available over the first 25 years to 25/77 th's of the total produced within the 5,000-acre area over the entire 77-year period of analysis. This resulted in the following Category 2 usable credits by TLT during the first 25 years: 27,100 estuarine fishery AAHU's; 40,400 freshwater fishery AAHU's; and 35,300 wildlife AAHU's. Usable Category 3 credits during the first 25 years would include 8,400 wildlife AAHU's. However, since the complete analysis separating estuarine and freshwater fishery credits from general fishery credits had not been completed when the MOA was signed, the MOA contains only a reference to the number of wildlife credits and overall fishery credits (i.e., 30,400 AAHU's) available for use by TLT during the first 25 years. In recording actual credits and debits for the mitigation bank, estuarine and freshwater fishery elements will be treated separately.

Area of Applicability of Mitigation Benefits

During a June 13, 1983, Federal, State, and local agency/industry conference (titled Current Concepts in Marsh Management) held in Baton Rouge, Louisiana, the concept of mitigation banking was discussed at length. An issue of genuine concern to local governmental agencies and landowner representatives was the question of whether credits generated in a mitigation bank in one parish (county) should be permitted to be applied to damages generated by a permit action in another parish. Many believed that it would be inappropriate to allow damages to be incurred within one parish or to one landowner or corporation, while developing a mitigation program to offset those damages within another parish or on lands held by another individual or corporation. The consensus appeared to be that mitigation programs within many parishes by many landowners, to offset damages as near to the site of occurrence as possible, would be more equitable. This approach would also seem to most nearly satisfy a priority of the FWS's Mitigation Policy that, if possible, the mitigation site be within the project planning area.

All participating agency and TLT representatives have agreed that mitigation bank credits generated in one State would not be allowed to

be used to mitigate fish and wildlife damages in another State. In lieu of further limiting the applicability of mitigation bank credits to set political boundaries, however, the interagency group agreed to allow the application of credits generated within a discrete hydrologic unit (e.g., a hydrologic unit as defined by Wicker 1980) to future mitigation needs generated within that same unit. Critical areas (e.g., Resource Category 2 wetlands) receiving adverse impacts within a specific hydrologic unit are more likely to be equitably mitigated by a management program within that same unit, as factors such as baseline habitat quality and the prevailing rates of habitat loss or gain are likely to be more similar within one unit than among several units.

At an interagency/TLT meeting held in Lafayette, Louisiana, on July 19, 1983, it was agreed that any request by TLT to apply credits outside the hydrologic unit within which they were generated would be considered by interagency participants on a case-by-case basis. The minimum criteria which must be satisfied before the application of credits outside a hydrologic unit would be considered acceptable include the following:

1. The habitat type to be impacted by a proposed project is included within the mitigation area (i.e., in-kind habitat mitigation would be possible).

2. The HUV of the habitat to be impacted by a proposed project is equal to or less than the HUV of the same habitat type in the mitigation area.

3. The "natural" life expectancy of the habitat to be impacted by a proposed project is equal to or less than the life expectancy of mitigation area habitat (i.e., in this case Year 2059).

4. All agency participants must concur in the application of credits outside the hydrologic unit in which they were generated.

Future parish legislation may further limit the applicability of credits generated via mitigation banking, however, that issue is beyond the scope of this document.

Selling/Trading Mitigation Credits

The interagency group concluded that the selling or trading of credits by a mitigation banker (e.g., TLT) would be a reasonable extension of the mitigation banking concept. Such exchange or sale of credits, however, would be limited in applicability to proposed activities that are normally located within the same hydrologic unit in which the credits have been generated, that have been determined to be

water-dependent, and for which associated habitat losses have been found to be unavoidable. As indicated previously, however, the flexibility to apply credits for in-kind habitat losses within a reasonable geographic area outside of the hydrologic unit in which the credits have been generated is available.

The availability of such a buy/sell/trade mechanism would provide a viable offsite mitigation option to permit applicants, and regulatory and advisory agencies, thus representing an additional means of achieving full mitigation of permit-related losses of fish and wildlife habitat. However, transactions involving selling or trading credits would be subject to approval by the interagency group overseeing the administration of the mitigation bank involved.

By selling some of the mitigation credits available in a bank, the holder of those credits could recoup some of the costs associated with generating those credits (i.e., the costs of implementing the management program designed to enhance habitat value). The buy/sell approach would appear to be most applicable where smaller developers without large land holdings or mitigation banks were in need of providing offsite mitigation for a proposed permit action. Major land holding companies having mitigation credits in one region or State could trade with other companies having credits in other regions or States to facilitate permit issuance for activities of a company within an area where that company may not have an available supply of its "own" credits. However, in no case would credits in one State be applied to offset damages in another State. Based on the comments aired at the previously referenced June 13, 1983, conference in Baton Rouge, Louisiana, political constraints to doing business in this fashion may also become a future issue.

Computing Debits from Mitigation Bank for Permitted Actions

Since benefits or credits derived from the mitigation bank were assessed via the FWS's HEP analysis, all analyses of fish and wildlife impacts of future permitted actions to which mitigation credits will be applied must also be done via HEP or another similar and credible methodology. The detailed assumptions and methodologies that could be used to assess the adverse impacts of a typical oil and gas exploration permit request are contained in Appendix B.

Just as with the mitigation area, the HEP impact analysis of a proposed project would include formulating estimates of the duration of adverse impacts to be caused by the project, of baseline (TY 0) habitat quality and quantity, and of future with- and without-project habitat quality and quantity. All of those data are required to compute the net AAHU loss, by Resource Category, that must be deducted from the mitigation bank credits. Projections in Tables B-5, B-6 and B-7 indicate that to fully mitigate damages resulting from the hypothetical canal referenced above, 304 AAHU's, 274 AHHU's, and 330 AAHU's of wildlife, estuarine fishery, and freshwater fishery

Category 2 losses, respectively, must be deducted from the wildlife and fishery Category 2 credits in the mitigation bank. Similarly, 131 AAHU's of wildlife Category 3 losses must be deducted from wildlife Category 3 credits. As there are no fishery Category 3 net credits in the bank, the 179 AAHU's of estuarine fishery and the 123 AAHU's of freshwater fishery Category 3 losses must be deducted from fishery Category 2 credits.

The account ledger for such transactions might be as follows:

	Resource Category2			Resource Category3		
Transaction	wildlife AAHU's	estuarine fishery AAHU's	freshwater fishery AAHU's	wildlife AAHU's	estuarine fishery AAHU's	freshwater fishery AAHU's
Establish mitigation bank	+35,300	+27,100	40,400	+8,400	0	0
Debit AAHU losses due to example project	-304	-453[1]	-453[1]	-131[1]	-	-
Balance	+34,996	+26,647	-39,947	+8,269	-	-

1. The sum of Category 2 and 3 estuarine fishery losses (i.e., 274 and 179) and the sum of Category 2 and 3 freshwater fishery losses (i.e., 330 and 123) must be debited from Category 2 estuarine and freshwater credits respectively, as there are no Category 3 fishery credits generated via the mitigation program.

Future Permit Actions Within Mitigation Area

If it is assumed in the FWM condition that no permit-related development action would be implemented within the mitigation area, then particular attention must be paid to computing debits if such future action is proposed. Not only must the adverse impacts (measured in AAHU's) of the specific action be debited from the bank, but also any benefits (credits) that were previously assumed to be derived from that part of the mitigation area to be impacted must now be deducted from the mitigation credits. To eliminate the need to reanalyze the benefits of the "reduced" mitigation area each time a development action is proposed, it is recommended that twice the number of AAHU

losses to be caused by each action proposed within the mitigation area be debited from the mitigation credits.

In the analysis of the TLT mitigation proposal, approximately 1 percent per year increase in the acreage of canal and spoil bank habitat was assumed for both the FWOM and FWM conditions. Accordingly, FWM habitat projections include an assumed increase of approximately 515 acres of direct and indirect impact from future oil and gas exploration activities. It is proposed that TLT be permitted to expand petroleum activities within the mitigation area (via the least damaging alternative approach), with only the requirement to debit specific AAHU losses caused by those activities until estimated direct and indirect impacts from those activities consume the entire 515 acres. After that point is reached, the impacts from additional development activities within the mitigation bank area would be debited from remaining mitigation credits via the method described in the paragraph above (i.e., double the specific number of AAHU losses caused by an action).

Accounting Responsibilities

At an interagency/TLT meeting held in Lafayette, Louisiana, on July 19, 1983, it was agreed that the FWS, with appropriate input from cooperating agencies and TLT, would complete the HEP analysis required to compute AAHU losses to be deducted from the mitigation bank for each proposed permit action. FWS would furnish copies of a "transaction data sheet" to TLT and each cooperating agency indicating the pre-project credits available in the bank, the debits to be applied to those credits as a result of the proposed action, and the credit balance remaining in the bank subsequent to each transaction. Concurrence via signature on the transaction data sheet by a designated representative of TLT and each agency would be requested by FWS. Copies of the signed transaction data sheets would be furnished by cooperating members to TLT and FWS for permanent keeping. Those records would be available for review by others on an as-needed basis. The Memorandum of Agreement which accompanies this document also provides that FWS shall furnish each member of the interagency group an annual summary of debits and credits to the mitigation bank.

Monitoring the Mitigation Bank

As the TLT proposal is a pilot program being implemented and administered under interim policy guidance, it is imperative that the program be subjected to close scrutiny and review on a periodic basis. Such review will permit verification and revision of many of the assumptions regarding the projected life of the mitigation bank, changes in habitat quality and quantity within the mitigation area, and anticipated residual habitat benefits following the possible cessation of intensive management. Recognizing this need, TLT and agency representatives have agreed that 5 years after implementation

of the mitigation bank a complete HEP reanalysis of mitigation credits would be undertaken. Based on that reanalysis, an upward or downward adjustment of banking credits could be made if agreed to by TLT and participating agencies. A preliminary assessment will be made 1 year after implementation of the management program to evaluate the effectiveness of the management program. If significant operational and/or structural changes are made at any time to improve the success of the management program, a complete HEP evaluation would be made in 3 to 5 years following those changes. Periodic monitoring would continue throughout the remainder of the 25-year intensive management period to ensure that water control structures were functioning as anticipated and that the general management program was affording the desired results.

A complete HEP reanalysis of the mitigation area would again be undertaken at TY 25. An upward or downward adjustment of remaining credits, based on the results of that reanalysis, would be required at this time. The reanalysis would also provide TLT with the data necessary to decide the best course of action to maintain its interest in subsurface minerals and to continue to protect the ecological integrity of the wetlands of the mitigation bank area.

Establishing a Formal Memorandum of Agreement (MOA)

A formal MOA among participating Federal, State, and industry representatives was executed on December 14, 1983, to serve as the implementing instrument establishing the mitigation bank. The MOA serves as a summary document identifying the mitigation bank holding company, describing the location, size, and type of mitigation area, identifying primary management measures and objectives, summarizing credits to be entered into the account, and related details. The document was formalized by signatures of agency and industry representatives agreeing to be bound by its provisions. This final report with appendices serves as an integral part of that MOA, to provide more specific guidance relative to the methodology by which the bank should be operated.

CONCLUSIONS

Louisiana's coastal marshes are being lost at a rate exceeding 25,000 acres per year, and indications are that this rate is increasing. This alarming decline is an item of serious concern to the FWS because of the national importance of Louisiana's coastal wetlands to waterfowl and other migratory birds, fur animal and alligator harvest, and sport and commercial fisheries.

Data contained in a report by Scaife et al. (In Press), indicate that as much as 90 percent of the land loss rate being experienced in coastal Louisiana is due directly or indirectly to canalization and channelization. According to Gagliano (1973), 65 percent of the land loss in coastal Louisiana caused by these man-made waterways is attributable to oil-and gas-related canals. It is quite possible, then, that nearly 60 percent (.90 x .65) of Louisiana's coastal wetland loss is caused by an activity which is regulated under the USCE's Section 10/404 permit program and the State's Coastal Use Permit program.

Onsite restoration of wetlands affected by oil- and gas-related canals is often infeasible, and prevention of wetland losses via directional drilling is frequently engineeringly, geologically, and/or economically prohibitive. Therefore, offsite mitigation often represents the only means of offsetting habitat losses associated with such energy-related activities. Under the present USCE regulations, however, it is very difficult to have a permit conditioned to require offsite mitigation of unavoidable impacts. Although limited success has been achieved in the form of voluntary agreements whereby some permit applicants have agreed to at least partially mitigate unavoidable project-related losses, the unmet mitigation deficit from activities permitted by NOD in coastal Louisiana gets progressively larger over time. Based on the past failure to acquire full mitigation and on the questionable potential for improving this situation via the USCE's regulatory program, it appears that a voluntary mitigation banking program should be viewed as a viable option for making a significant contribution toward compensating for the unavoidable losses associated with future oil- and gas-related and other small industrial developments in coastal Louisiana.

In addition to providing a measurable benefit to fish and wildlife resources, mitigation banking will afford private landholders and industry with a multitude of tangible benefits which should serve as an incentive to further manage productive but deteriorating coastal wetlands. The results of recent FWS studies have alerted private landowners along coastal Louisiana to the fact that emergent wetlands are being lost at a rate exceeding 40 square miles a year. Management efforts intended to reduce the land loss rate can very often be modified to include features which will enhance the fish and wildlife habitat value of the area. That enhanced value can be used to fulfill future mitigation needs of the individual or company managing the property or be sold to other individuals or companies needing the mitigation credit. The ability to sell credits allows the manager of lands to recoup expenditures associated with habitat improvement on those lands and, accordingly, may serve as extra incentive to initiate or intensify wetlands management programs. Additional monetary benefits from enhanced hunting and trapping leases would also accrue to the landowner via improved habitat management.

Other types of benefits, which are more difficult to quantify, would also result via marsh management for mitigation banking purposes.

Having a readily available supply of mitigation credits would expedite permit processing, assuming that the proposed action fits the criteria of being in the public interest and being the least environmentally damaging, feasible alternative for which on-site mitigation measures are not feasible. It is important to reiterate, however, that mitigation credits should be applied only to offset unavoidable project impacts. This requires that every feasible means of minimizing and rectifying project damages be employed prior to drawing upon mitigation bank credits. Implementation of a sound land-management program which would benefit fish and wildlife is also likely to improve a company's public image.

RECOMMENDATIONS

Mitigation banking is a relatively new concept to the FWS, a concept for which little prior experience exists. However, potential does appear to exist for this concept to ultimately become a workable approach for achieving offsite mitigation of unavoidable habitat losses. Until further mitigation banking policy guidance is formulated, it is imperative that pilot proposals such as this one be developed and administered within the constraints and provisions of the FWS's overall Mitigation Policy and the FWS's Interim Guidance on Mitigation Banking (ES Instructional Memorandum No. 80, June 23, 1983); this proposal adheres to that guidance. A list of TLT mitigation bank implementation and operational recommendations follows:

1. The FWS's HEP should be used to assess credits and debits to be applied to the mitigation bank.

2. Every effort should be made to reduce project impacts via project modification or onsite mitigation; mitigating via debiting credits from the mitigation bank is only appropriate to offset unavoidable fish and wildlife impacts, respectively.

3. Consistent with the FWS's Mitigation Policy, Resource Category 2 habitat losses should only be mitigated with Resource Category 2 habitat credits; however, Resource Category 3 habitat losses may be mitigated with Resource Category 2 habitat credits.

4. Credits generated within a given hydrologic unit, as defined by Wicker (1980), should be applied predominantly to activities requiring mitigation within that same hydrologic unit, but may be applied to a limited degree outside of that hydrologic unit with the approval of the interagency review team. In no case should credits be applied to projects implemented outside the State of Louisiana.

5. Buying, selling, or trading mitigation credits is appropriate, provided that all such transactions are concurred in by the interagency review team;

6. If future permitted development activities are proposed within the mitigation bank site, debits from the bank should include those associated with the proposed activity plus those associated with the loss of resource that, in the former mitigation analysis, may have been assumed to be producing mitigation credits.

7. FWS should provide data sheets of each transaction (either debit or credit) to all participating agencies and corporations (or individuals, as appropriate) for signature concurrence. Copies of signed transaction data sheets should be held as a permanent record by the FWS and the mitigation bank owner (in this case, TLT).

8. As the TLT proposal is a pilot program being implemented and administered under interim policy guidance, it is imperative that the program be closely reviewed on a periodic basis. It is proposed that this review include a complete HEP reanalysis at 5 years and again at 25 years following implementation, to assess the success of the management program in producing banking credits, with more frequent monitoring of the management program to ensure maximum fish and wildlife resource benefits.

9. A formal Memorandum of Agreement among participating Federal, State, and industry representatives should be developed to serve as a binding instrument of mitigation bank implementation.

Appendix A

HABITAT EVALUATION PROCEDURES ANALYSIS OF TENNECO/LATERRE MITIGATION BANK AREA

I. Establishing Habitat Acreages

A. Baseline and future without-management scenarios

1. The interagency group identified the mitigation bank area on 1956 and 1978, 1:24,000 scale, Lake Theriot, Louisiana, quadrangle habitat map overlays which had been prepared by Coastal Environments, Inc., for the Fish and Wildlife Service's Office of Biological Services. Habitat maps for the two years were prepared from the overlays.

2. All discrete habitat types within the mitigation area, that were considered by the interagency team to be of sufficient size and significance to be assessed in the future without-management (FWOM) and future with-management(FWM) conditions, were delineated on both the 1956 and 1978 habitat maps.

   a. The 1956 habitat map indicated that the entire mitigation area consisted of fresh marsh, with the exception of the natural levee forest along the Marmande Ridge.

   b. From the 1978 habitat map, the interagency group selected the following habitat types within the mitigation area for planimetering:

      (1) Fresh marsh
      (2) Intermediate marsh
      (3) Brackish marsh
      (4) Open water
      (5) Aquatic bed
      (6) Scrub/shrub
      (7) Spoil bank
      (8) Natural Levee Forest (later deleted)
      (9) Canal (later added)

   c. The natural levee forest habitat type was eliminated from the analysis when it became apparent that little if any change would be expected in that habitat type in either the FWOM or FWM conditions.

   d. An additional habitat category, canals, was later added when it was determined that much of the original (1956) fresh marsh had been lost to canals, via erosion (e.g., along the Falgout Canal) and oil and gas activities.

3. Using 1978 color-infrared and 1981 black and white aerial photographs in combination with field truthing, the habitat boundaries delineated on the 1978 habitat maps were refined, and a 1982 habitat map (reference Figure 2 of main report) was constructed; this allowed a more precise measurement of the area of each habitat type existing in 1982. In this analysis, 1982 is considered the baseline year.

4. From members of the Soil Conservation Service and field representatives of the Tenneco LaTerre Corporation who were reasonably familiar with recent vegetative changes in the mitigation area, other members of the interagency team learned that habitat conditions which existed in 1956 continued, without significant change, through about 1965. The mid-1960's is apparently the period when two major events (i.e., construction of the Houma Navigation Canal and the passage of Hurricane Betsy through the area) occurred; these events are believed to be the primary causes for habitat changes which have occurred within the mitigation area sincethat period. It was agreed, then, that the acreage of fresh marsh lost (determined by planimetering previously referenced 1956 and 1982 habitat maps) should be uniformly istributed over the period 1965 to 1982 (17 years) to estimate an annual fresh marsh loss rate. To have distributed the fresh marsh acreage lost over the period 1956 to 1982 (26 years) would have been inappropriate, since no significant loss of fresh marsh was believed to have occurred between 1956 and 1965.

5. Using the following formula, it was determined that fresh marsh was being lost at a rate of 6.6 percent per year:

$$\text{percent change per year} = \sqrt[n]{\frac{\text{beginning value}}{\text{ending value}}} - 1, \quad \text{where } n = \text{number of years}$$

$$\text{Therefore, percent annual change in fresh marsh acreage} = \sqrt[17]{\frac{\text{fresh marsh acreage in 1982}}{\text{fresh marsh acreage in 1965}}} - 1$$

$$= \sqrt[17]{\frac{2143}{6844}} - 1$$

$$= \sqrt[17]{.3131209} - 1$$

$$= .9339766 - 1$$

$$= -6.6 \text{ percent}$$

6. The interagency group agreed to apply that annual rate (-6.6 percent) of loss of fresh marsh consistently over the first 25 years (that period during which the intensive management segment of the mitigation program would be carried out) of FWOM condition, although most believed that the rate of loss would accelerate in the future, as is the case within most wetland habitats throughout the Louisiana Coastal Zone.

7. Once an estimate of the remaining fresh marsh acreage had been computed for each year (from 1982-2007), it became necessary to distribute to other habitat types the acres of fresh marsh lost. The following methodology was used:

a. The known acreage of other habitat types in 1982 was divided by the total fresh marsh lost between 1965 and 1982. The resulting percentage, for each habitat type, was applied to the acreage of fresh marsh lost in each year from 1982 to 2007 to assign a portion of the fresh marsh loss to each habitat type.

The following formula was applied to compute the acreage of fresh marsh lost each year that would be converted to intermediate marsh:

$$\text{Intermediate Marsh Acreage Year n} = \left[\frac{\text{intermediate marsh acres in 1982}}{\text{fresh marsh acres lost from 1965 to 1982}} \times \left(\text{fresh marsh acres in n-1} - \text{fresh marsh acres in n}\right)\right] + \text{intermediate-marsh acres in n-1}$$

b. That same methodology was applied to each habitat type with the following exceptions:

(1) It was assumed that none of the fresh marsh acreage lost would be converted to scrub/shrub habitat after 1982, target year 0 (TY 0). This assumption was based on an April 8, 1983, personal communication from Dr. Robert Chabreck of Louisiana State University (LSU) in Baton Rouge. Dr. Chabreck is a respected marsh ecologist who believes that the phenomenon causing the present occurrence of the scrub/shrub community is probably geological in nature. He does not believe that this habitat type will expand via conversion from other habitat types in the FWOM condition, or that the prescribed burning as proposed in the management program would beneficially or deleteriously impact the scrub/shrub habitat type. The latter opinion is based on his belief that there would probably not be enough "fuel" to allow a crown burn of the existing wax myrtle canopy.

(2) Dr. Chabreck pointed out, however, that wax myrtle is very susceptible to saltwater intrusion. It was assumed, therefore, that as saltwater intrusion proceeded northward into the scrub/shrub community, 60 percent of that habitat type would convert to open water and 40 percent would convert to brackish marsh. The following scenario was established for the changes in scrub/shrub habitat (FWOM) by target year:

(a) No change in scrub/shrub acreage would occur from TY 0 to TY 1.

(b) By TY 5, all scrub/shrub acreage south of the baseline fresh/intermediate marsh boundary would be converted to open water and brackish marsh.

(c) By TY 10, all scrub/shrub acreage between the pipeline canal and the existing (TY 0) fresh/intermediate marsh boundary would be converted to open water and brackish marsh.

(d) By TY 25, 50 acres of scrub/shrub habitat north of the pipeline canal would be converted to open water and brackish marsh.

(3) Although the open water acreage will be increasing, the area occupied by aquatic beds is not expected to increase. However, the location of aquatic beds may vary. It was assumed (based on conversations with Dr. Chabreck of LSU and Mike Windham of the Louisiana Department of Wildlife and Fisheries) that deterioration of scattered marsh areas presently occurring within open water areas will permit greater wave action, increase turbidity, and thereby eliminate the potential for expansion of the aquatic beds.

(4) Based on data presented by Johnson and Gosselink (1982), it was determined that the average width of spoil banks declines at a rate of approximately 2.3 feet per year (i.e., a typical oil and gas canal has a 130-foot-wide spoil bank which is lost via subsidence, erosion, etc. within 56 years). That rate of loss is approximately 1.8 percent per year (i.e., 2.3 - 130). When this loss rate was applied to the smaller rate of in crease in spoil bank acreage (i.e., from conversion of fresh marsh), the net effect was a gradual decline in the acreage of spoil bank. Spoil bank losses were assumed to convert to open water.

8. With data available in Wicker (1980), it was determined (reference Appendix II) that the wetlands (i.e., marsh and scrub/shrub habitat) within Hydrologic Unit V, the unit which contains the mitigation banking area wetlands, would be eliminated in the FWOM condition in 77 years (Year 2059).

a. Accordingly, that point was considered the end of project life for both the FWOM and FWM conditions.

b. By TY 77 all fresh, intermediate, and brackish marsh and scrub/ shrub acreage in the FWOM scenario was assumed to be converted to open water. Because of anticipated increases in turbidity and wave action, due to the loss of these wetlands, aquatic bed was also assumed to be converted to open water.

c. Between TY 25 and TY 77, canal and spoil bank acreages were assumed to follow the same trends they did between TY 0 and TY 25.

9. Reference Table A-1 for a listing of FWOM habitat acreages.

B. Future with-management scenario

1. It was assumed that all baseline (TY 0) intermediate marsh acreage would be converted to fresh marsh over the 25-year intensive anagement segment of the project. For analysis purposes, it was assumed that the conversion would occur in equal increments of 113 acres every 5 years (i.e., 564 - 5 = 113; see Table A-1). The remaining acreage of intermediate marsh at various target years was again reduced by varying amounts (usually 1 to 3 acres) to account for assumed increases in canals and spoil banks.

2. It was assumed that baseline (TY 0) brackish marsh would be reduced by 2 acres in TY 1 to account for increases in canals and spoil banks. It was further assumed that in TY 5, 6 acres of brackish marsh would go to canals and spoil banks and the remainder would be converted to intermediate marsh. This is based on the expected establishment of oligohaline plant species (e.g., bulltongue, cattail, and spikerush) in the wiregrass-dominated marsh by TY 5.

3. Based on a paper entitled "Weirs, Plugs and Artificial Potholes for the Management of Wildlife in Coastal Marshes" by Robert H. Chabreck (1968) and on a telephone conversation between Mr. David Soileau (FWS) and Dr. Thomas Michot (FWS), and Dr. Robert Chabreck (LSU) on April 7, 1983, it was assumed that the baseline (TY 0) percentage (i.e., 333-1622 = 20%) of aquatic bed to combined open water/aquatic bed would increase to 50 percent at the end of TY 1 and maintain that ratio over the first 25 years of project life.

4. It was assumed that scrub/shrub habitat would maintain baseline (TY 0) acreage throughout project life except for minor reductions to account for increases in canals and spoil banks.

5. The acreages of canals and spoil banks were assumed to follow the same trend as in the FWOM condition.

6. After TY 25, the year in which the intensive management program may be terminated, it was assumed that FWOM habitat trends would resume. Hence, significant reductions in marsh, aquatic bed, and scrub/shrub habitats are expected through TY 77. Conversely, a significant increase in open water, resulting from the loss of vegetated wetlands, is expected during that same period. Canal and spoil bank trends from TY 25 to TY 77 are expected to be the same as the FWOM condition.

7. Reference Table A-1 for a listing of FWM habitat acreages.

II. Assigning Habitat Unit Values

A. Baseline condition

1. At a meeting held on November 8 - 9, 1982, the interagency group selected 10 species or species groups; i.e., white and brown shrimp (primarily white shrimp in fresh habitat), Gulf menhaden, Atlantic croaker, largemouth bass, American alligator, nutria, muskrat, migratory puddle ducks, lesser snow geese, and herons, egrets and ibises, for use in evaluating the baseline quality of the non-wooded habitat within the mitigation area. For wooded areas (i.e., natural levee forest and spoil banks), the group initially elected to evaluate habitat quality for three different species (i.e., white-tailed deer, swamp rabbit, and raccoon). Using the revised (1982) habitat map, the interagency group selected 29 sample sites within the mitigation area; two to four sites were selected for each habitat type within each of the three salinity zones (fresh, intermediate, and brackish). Site locations were somewhat controlled by accessibility and by a conscious effort to evenly distribute the sites over the entire area. The interagency group nominated the following represensentatives as HEP fields participants, who agreed to perform the baseline field sampling on November 16-17, 1982:

Mike Windham - LA Dept. of Wildlife and Fisheries
Billy Craft - Soil Conservation Service
Peggy Keney - National Marine Fisheries Service
Darryl Clark - LA Dept. of Natural Resources, Coastal Management Section
Thomas Michot - U.S. Fish and Wildlife Service

2. On November 15, 1982, the interagency participants met with John Woodard at the Tenneco LaTerre office in Houma, LA, and reviewed species accounts (i.e., summaries of life requisites and habitat requirements) of the 13 species to be used to evaluate baseline habitat quality at the designated sample sites.

3. On November 16-17, 1982, with the use of two airboats and a helicopter furnished by Tenneco LaTerre, the interagency group completed the field HEP assignment of habitat suitability indices (habitat unit values). A permanent stake bearing the sample site number was placed at each sample site to allow re-sampling of the sites in the future.

4. At a subsequent meeting on December 22, 1982, the interagency group elected to eliminate the natural levee forest habitat type from the HEP analysis, as very little change in the quantity or quality of this habitat would be expected in either the FWOM or FWM condition. Further, in order to simplify the HEP analysis, the group eliminated the three species (i.e., white-tailed deer, swamp rabbit, and raccoon) used to rate wooded habitats; they then rated (from mental recall) spoil bank habitat for the same 10 species and species groups used to rate non-wooded habitat.

5. Although it was originally anticipated that a 1980 HEP analysis would be performed, subsequent discussions with Bruce Bell, U.S. Fish and Wildlife Service Region 4 HEP Coordinator, led the Lafayette Field Office (FWS) to select the 1976 HEP version of the analysis for this effort. It was concluded that the 1980 HEP analysis, which uses an independent "tracking system" for each evaluation species or species group throughout the analysis, would be too cumbersome for use on a regular basis to compute mitigation requirements on small-scale oil and gas-related activities which require expeditious permit processing. To maintain consistency, then, it was concluded that the 1976 HEP analysis should be used both to assess the mitigation credits to be generated from the management program and, later, to measure the mitigation requirements for specific Section 10/404 permit actions.

6. In order to allow the baseline habitat suitability indices (HSI's) previously assigned during the field portion of the HEP to be used in the 1976 HEP format, the HSI assigned to each species or species group at each sample site was multiplied by 10; the resultant value is known as the Habitat Unit Value (HUV). For example:

FRESH MARSH

SAMPLE SITE	Muskrat	Nutria	American alligator	largemouth bass	Gulf menhaden	Atlantic croaker	white & brown shrimp	lesser snow goose	migratory puddle ducks	herons, egrets, and ibises
19 (HSI)	.4	.8	.8	.7	.7	.6	.6	.4	.7	.5
(x 10)										
19 (HUV)	4	8	8	7	7	6	6	4	7	5

7. HUV's for freshwater fishery evaluation elements, estuarine fishery evaluation elements, and wildlife evaluation elements were maintained separately so that separate HEP analyses could be conducted for each of those groups. This eliminated the high probability that low fishery element HUV's in certain habitat types might be negated by high wildlife element HUV's in those same habitat types, or vice-versa.

   a. To determine an HUV for estuarine fishery evaluation elements at a specific sample site within a certain habitat type, the individual HUV's for each element (i.e. Gulf menhaden, Atlantic croaker, and white and brown shrimp) were summed within that sample site; that sum was multiplied by 10/3 to permit completion of the analysis as if there were 10 evaluation species (this complies with 1976 HEP procedures). Using the data from sample site 19 (above):

$$\text{HUV for estuarine fishery evaluation elements at Site 19} = \frac{(7 + 6 + 6)(10)}{3} = 63.33$$

b. The HUV for all wildlife evaluation elements (i.e., muskrat; nutria; American alligator; lesser snow goose; migratory puddle ducks; and herons, egrets, and ibises) at a specific sample site within a certain habitat type was computed using the same technique used for fishery elements. However, since there were six wildlife evaluation elements, the sum of the HUV's for those was multiplied by 10/6. Using the data from sample site 19 (above):

$$\text{HUV for wildlife evaluation elements at site 19} = \frac{(4 + 8 + 8 + 4 + 7 + 5)\ (10)}{6} = 60$$

c. Since only one freshwater fishery evaluation element (largemouth bass) was used in the analysis, the HSI for that element was simply multiplied by 10. Using the data from sample site 19 (above), the HUV for the freshwater fisherey evaluation element would be 70.

8. Finally, the HUV's for each group (separately) for all sample sites within one habitat type were averaged to yield overall HUV's for that habitat type. These figures then became the measure of baseline quality of that habitat type for estuarine fishery elements, freshwater fishery elements, and for wildlife elements throughout the mitigation area.

9. Reference Tables A-2, A-3, and A-4 for listings of baseline (TY 0) HUV's for wildlife evaluation elements, estuarine fishery evaluation elements, and freshwater fishery evaluation elements, respectively.

B. Future Without-Management Condition

1. Throughout the 77-year FWOM condition, it has been assumed that the HUV's for wildlife evaluation elements and fishery evaluation elements in all habitat types, except open water, would not vary from the baseline (TY 0) HUV's. In TY 77, HUV's were assigned only to habitat types still in existence.

2. It has been assumed that within the first 25 years of the FWOM condition most of the small marsh areas now interspersed throughout open water habitat would be lost. This would result in the loss of the existing benefit of edge effect, would increase the impact of wind-driven waves and hence increase turbidity, and would decrease available detrital material. For these reasons, the baseline HUV for fishery elements in open water was reduced by 1.0 each year through TY 10; at TY 25 the HUV for fishery elements in open water was assumed to be equal to that of canals and to remain at that level through TY 77. Similarly, the baseline HUV for wildlife elements in open water was reduced by 1.0 each year and by TY 77 was assumed to be equal to the HUV of canals.

3. Reference Tables A-2, A-3, and A-4 for listings of FWOM condition HUV's for wildlife evaluation elements, estuarine fishery evaluation elements, and freshwater fishery evaluation elements, respectively.

C. Future With-Management Condition

1. Fish and Wildlife Service biologists, in considering the proposed management program, assigned what they perceived to be reasonable, achievable HUV's for the FWM condition to each of the evaluation species or species groups within each habitat type. The same mathematical procedures, described in the previous paragraph (II.A.) entitled "Baseline condition," were applied to those numbers to yield overall HUV's for wildlife evaluation elements, estuarine fishery evaluation elements, and freshwater fishery evaluation elements within each habitat type. Based on the type of management program being proposed, those HUV's were assumed to be achievable by TY 5 and to be sustainable throughout the remainder of the 25-year period of intensive management; by TY 77, however, all HUV's were assumed to return to baseline values.

2. In each case, the HUV for TY 1 was then derived by adding 20 percent of the increase in HUV, between TY 0 and TY 5, to TY 0. This was based on the assumption that the increase in HUV at the end of TY 1 was proportionate to the period of management required to reach the maximum anticipated HUV (i.e., 5 years).

   Example for Wildlife Evaluation Elements in Fresh Marsh:

$$\frac{\text{HUV for TY 5} - \text{Baseline HUV}}{5} + \text{Baseline HUV} = \text{HUV for TY 1}$$

$$\text{i.e., } \frac{75.00 - 62.08}{5} + 62.08 = 64.66 \text{ (HUV for TY 1)}$$

3. The fish and wildlife HUV's for fresh marsh would increase initially due to increased productivity resulting from intensive management; specifically, water level control, freshwater introduction, and marsh burning. The expected reappearance of annual grasses and sedges would be of particular benefit to migratory puddle ducks.

4. The fish and wildlife HUV's for intermediate marsh would increase for the same reasons that the HUV's of fresh marsh would increase. In addition, increased production of Olney's threesquare (Scirpus olneyi) is expected to greatly benefit habitat for geese and muskrats.

5. The fish and wildlife HUV's for both open water and aquatic bed habitats would increase due to associated increases in productivity of surrounding fresh and intermediate marsh. Increased productivity of the marsh would increase detrital input into these aquatic habitats. The stabilizing effect that the weirs would have on water levels would also enhance productivity of aquatic habitats.

6. As most of the canals and spoil banks sampled in the field had already peaked in habitat quality and because the management program would not be expected to have any impact on these habitats, the fish and wildlife HUV's for those habitat types were not assumed to vary from the baseline HUV's.

7. Based on a telephone conversation with Dr. Robert Chabreck (previously referenced), it was concluded that the management program would not impact the quality of the scrub/shrub habitat.

8. Because of the effect that the management program (particularly burning and increased freshwater inflow) would have on brackish marsh within 1 year of implementation, the fish and wildlife HUV's of that habitat are expected to rise. An HUV for brackish marsh beyond TY 1 was not determined since all brackish marsh was assumed to convert to intermediate marsh by TY 5.

9. Reference Tables A-2, A-3, and A-4 for listings of FWM condition HUV's for wildlife evaluation elements, estuarine fishery evaluation elements, and freshwater fishery evaluation elements, respectively.

III. Measuring Benefits of the Management Program

1. The product of the HUV's (Tables A-2, A-3, and A-4) and the habitat acreages (Table A-1) in the FWOM and FWM conditions, respectively, yielded a measure of estuarine fish, freshwater fish, and wildlife habitat quality and quantity (expressed as habitat units, i.e., HU's) under either condition (reference Tables A-5, A-6, and A-7).

2. Assuming that the FWM condition produces HU's in excess of that available in the FWOM condition, the net annualized difference in HU's between these two conditions is attributable to the management program.

3. The net difference, in this case a gain of 192,465 wildlife AAHU's, 79,946 estuarine AAUH's, and 142,505 freshwater AAHU's, can be attributed to the proposed management program.

Table A-1. Comparison of future without-management (FWOM) and future with-management (FWM) habitat acreages of mitigation area

Target year/Condition		Fresh Marsh	Intermediate Marsh	Brackish Marsh	Open Water	Aquatic Bed	Scrub/ Shrub	Canal	Spoil Bank	TOTAL
0	FWOM	2144	564	1335	1289	333	893	260	196	7014
	FWM	2144	564	1335	1289	333	893	260	196	7014
1	FWOM	2029	581	1375	1342	333	893	263	198	7014
	FWM	2163	541	1333	813	812	891	263	198	7014
5	FWOM	1642	638	1576[1]	1619	333	730	275	201	7014
	FWM	2245	1775	Neg[1]	816	815	887	275	201	7014
10	FWOM	1285	691	1822[1]	1970	333	429	285	199	7014
	FWM	2349	1655	Neg[1]	821	821	884	285	199	7014
25	FWOM	722	775	2039[1]	2290	333	379	302	174	7014
	FWM	2672	1306	Neg[1]	841	841	878	302	174	7014
77	FWOM	0	0	0	6628	0	0	311	75	7014
	FWM	1578	423	926	2779	231	655	311	75	7014
Annual-ized	FWOM	657	487	1269	3637	221	298	300	146	7014
	FWM	2216	1051	377	1493	627	805	300	146	7014
Net Change		+1559	+564	-892	-2144	+406	+507	0	0	-

1. A small amount of brackish marsh may be present in the immediate vicinity of any water control structure on the southern end of the project area.

Table A-2. Habitat unit values of mitigation area for wildlife evaluation elements in the baseline (existing), future without-management (FWOM), and future with-management (FWM) conditions.

Target year	Condition	Fresh Marsh	Intermediate Marsh	Brackish Marsh	Open Water	Aquatic Bed	Scrub/ Shrub	Canal	Spoil Bank
0	Baseline	62.08	63.33	38.89	48.06	44.17	45.00	9.17	14.17
1	FWOM	62.08	63.33	38.89	47.06	44.17	45.00	9.17	14.17
	FWM	64.66	65.96	51.50	48.95	46.64	45.00	9.17	14.17
5	FWOM	62.08	63.33	38.89	43.06	44.17	45.00	9.17	14.17
	FWM	75.00	76.50	-	52.50	56.50	45.00	9.17	14.17
10	FWOM	62.08	63.33	38.89	38.06	44.17	45.00	9.17	14.17
	FWM	75.00	76.50	-	52.50	56.50	45.00	9.17	14.17
25	FWOM	62.08	63.33	38.89	23.06	44.17	45.00	9.17	14.17
	FWM	75.00	76.50	-	52.50	56.50	45.00	9.17	14.17
77	FWOM	-	-	-	9.17	-	-	9.17	14.17
	FWM	62.08	63.33	38.89	48.06	44.17	45.00	9.17	14.17

Table A-3. Habitat unit values of mitigation area for estuarine fishery evaluation elements in the baseline (existing), future without-management (FWOM), and future with-management (FWM) conditions.

Target year	Condition	Fresh Marsh	Intermediate Marsh	Brackish Marsh	Open Water	Aquatic Bed	Scrub/ Shrub	Canal	Spoil Bank
0	Baseline	55.83	61.11	64.44	65.55	75.00	35.00	41.66	0.00
1	FWOM	55.83	61.11	64.44	64.55	75.00	35.00	41.66	0.00
	FWM	57.66	62.89	70.00	66.77	75.66	35.00	41.66	0.00
5	FWOM	55.83	61.11	64.44	60.55	75.00	35.00	41.66	0.00
	FWM	65.00	70.00	-	71.66	78.33	35.00	41.66	0.00
10	FWOM	55.83	61.11	64.44	55.55	75.00	35.00	41.66	0.00
	FWM	65.00	70.00	-	71.66	78.33	35.00	41.66	0.00
25	FWOM	55.83	61.11	64.44	41.66	75.00	35.00	41.66	0.00
	FWM	65.00	70.00	-	71.66	78.33	35.00	41.66	0.00
77	FWOM	-	-	-	41.66	-	-	41.66	0.00
	FWM	55.83	61.11	64.44	65.55	75.00	35.00	41.66	0.00

Table A-4. Habitat unit values of mitigation area for freshwater fishery evaluation elements in the baseline (existing), future without-management (FWOM), and future with-management (FWM) conditions.

Target year	Condition	Fresh Marsh	Intermediate Marsh	Brackish Marsh	Open Water	Aquatic Bed	Scrub/ Shrub	Canal	Spoil Bank
0	Baseline	67.50	53.33	13.33	45.00	35.00	35.00	35.00	0.00
1	FWOM	67.50	53.33	13.33	44.00	35.00	35.00	35.00	0.00
	FWM	69.00	54.66	20.00	48.00	43.00	35.00	35.00	0.00
5	FWOM	67.50	53.33	13.33	40.00	35.00	35.00	35.00	0.00
	FWM	75.00	60.00	-	60.00	75.00	35.00	35.00	0.00
10	FWOM	67.50	53.33	13.33	35.00	35.00	35.00	35.00	0.00
	FWM	75.00	60.00	-	60.00	75.00	35.00	35.00	0.00
25	FWOM	67.50	53.33	13.33	35.00	35.00	35.00	35.00	0.00
	FWM	75.00	60.00	-	60.00	75.00	35.00	35.00	0.00
77	FWOM	-	-	-	35.00	-	-	35.00	0.00
	FWM	67.50	60.00	13.33	45.00	35.00	35.00	35.00	0.00

Table A-5. Comparison of future without-management (FWOM) and future with-management (FWM) Average Annual Habitat Units for wildlife elements.

Target year/Condition		Fresh Marsh	Intermediate Marsh	Brackish Marsh	Open Water	Aquatic Bed	Scrub/ Shrub	Canal	Spoil Bank
0	FWOM	133,100	35,718	51,918	61,949	14,709	40,185	2,384	2,777
	FWM	133,100	35,718	51,918	61,949	14,709	40,185	2,384	2,777
1	FWOM	125,960	36,795	53,474	63,155	14,709	40,185	2,412	2,806
	FWM	139,860	35,684	68,650	39,796	37,872	40,095	2,412	2,806
5	FWOM	101,935	40,405	61,291	69,714	14,709	32,850	2,522	2,848
	FWM	168,375	135,788	0	42,840	46,048	39,915	2,522	2,848
10	FWOM	79,773	43,761	70,858	74,978	14,709	19,305	2,613	2,820
	FWM	176,175	126,608	0	43,103	46,387	39,780	2,613	2,820
25	FWOM	44,822	49,081	79,297	52,807	14,709	17,055	2,769	2,466
	FWM	200,400	99,909	0	44,153	47,517	39,510	2,769	2,466
77	FWOM	0	0	0	60,779	0	0	2,852	1,063
	FWM	97,962	26,789	37,412	133,559	10,203	29,475	2,852	1,063
Annual-ized	FWOM	40,772	30,825	49,357	59,762	9,742	13,413	2,748	2,074
	FWM	158,390	78,281	15,199	74,103	34,159	36,204	2,748	2,074
Net Change		+117,618	+47,456	-34,158	+14,341	+24,417	+22,791	0	0

*Total management benefits to wildlife elements = 192,465 HU's.

Table A-6. Comparison of future without-management (FWOM) and future with-management (FWM) Average Annual Habitat Units for estuarine fishery elements.

Target year/Condition		Fresh Marsh	Intermediate Marsh	Brackish Marsh	Open Water	Aquatic Bed	Scrub/ Shrub	Canal	Spoil Bank
0	FWOM	119,700	34,466	86,027	84,494	24,975	31,255	10,832	0
	FWM	119,700	34,466	86,027	84,494	24,975	31,255	10,832	0
1	FWOM	113,279	35,505	88,605	86,626	24,975	31,255	10,957	0
	FWM	124,719	34,023	93,310	54,284	61,436	31,185	10,957	0
5	FWOM	91,673	38,988	101,557	98,030	24,975	25,550	11,457	0
	FWM	145,929	124,250	0	58,475	63,839	31,045	11,457	0
10	FWOM	71,742	42,227	117,410	109,434	24,975	15,015	11,873	0
	FWM	152,685	115,850	0	58,833	64,309	30,940	11,873	0
25	FWOM	40,309	47,360	131,393	95,401	24,975	13,265	12,581	0
	FWM	173,680	91,420	0	60,266	65,876	30,730	12,581	0
77	FWOM	0	0	0	276,122	0	0	12,956	0
	FWM	88,100	25,850	61,991	182,163	17,325	22,925	12,956	0
Annual-ized	FWOM	36,667	29,744	81,783	158,044	16,542	10,432	12,486	0
	FWM	138,494	72,138	24,520	101,098	48,750	28,158	12,486	0
Net Change		+101,827	+42,394	-57,263	-56,946	+32,208	+17,726	0	0

*Total management benefits to fishery elements = 79,946 HU's.

Table A-7. Comparison of future without-management (FWOM) and future with-management (FWM) Average Annual Habitat Units for freshwater fishery elements.

Target year/Condition		Fresh Marsh	Intermediate Marsh	Brackish Marsh	Open Water	Aquatic Bed	Scrub/ Shrub	Canal	Spoil Bank
0	FWOM	144,720	30,078	17,796	58,005	11,655	31,255	9,100	0
	FWM	144,720	30,078	17,796	58,005	11,655	31,255	9,100	0
1	FWOM	136,958	30,985	18,329	59,048	11,655	31,255	9,205	0
	FWM	149,247	29,571	26,660	39,024	34,916	31,185	9,205	0
5	FWOM	110,835	34,025	21,008	64,760	11,655	25,550	9,625	0
	FWM	168,375	106,500	0	48,960	61,125	31,045	9,625	0
10	FWOM	86,738	36,851	24,287	68,950	11,655	15,015	9,975	0
	FWM	176,175	99,300	0	49,260	61,575	30,940	9,975	0
25	FWOM	48,735	41,331	27,180	80,150	11,655	13,265	10,570	0
	FWM	200,400	78,360	0	50,460	63,075	30,730	10,570	0
77	FWOM	0	0	0	231,980	0	0	10,885	0
	FWM	106,515	25,380	12,823	125,055	8,085	22,925	10,885	0
Annual-ized	FWOM	44,331	25,957	16,918	128,234	7,720	10,432	10,490	0
	FWM	161,659	62,937	5,311	75,082	42,950	28,158	10,490	0
Net Change		+117,328	+36,980	-11,607	53,152	+35,230	+17,726	0	0

*Total management benefits to fishery elements = 142,505 HU's.

APPENDIX B

SCENARIO FOR HABITAT EVALUATION PROCEDURES ANALYSIS OF PERMITTED ACTION

I. Establishing Duration (i.e., Project Life) of Project Impacts

A. It has been assumed that the duration of adverse impacts to fish and wildlife resources from a permitted action (e.g., an oil and gas exploration canal) in the wetlands of coastal Louisiana will be equivalent to the life (duration) of the wetlands in the area of the permitted action. In other words, the adverse impacts caused by an access canal are expected to continue as long asthere are wetlands available to be impacted.

B. The life expectancy of wetlands within various regions of coastal Louisiana can be estimated by using data from Wicker (1980) and Gosselink et al. (1979).

C. To compute wetland life expectancy for the example which will follow, an area of marsh within Hydrologic Unit V, as delineated by Wicker (1980), was selected. That unit contains the mitigation banking area wetlands. From Appendix 9 in Wicker (1980), total marsh (including fresh and nonfresh) and scrub/shrub acreages were summed within years 1956 and 1978:

Hydrologic Unit V

Year	Acres of Marsh and Scrub/Shrub Habitat
1956	696,500
1978	547,500
22 (years elapsed)	149,000 (acreage lost)

$\frac{149,000}{22}$ = 6,773 acres of marsh and scrub/shrub habitat lost per year

Therefore, $\frac{547,500}{6,773}$ = 81 years of life remaining in this unit from year 1978

Therefore, end of project life for any project implemented in this unit:

Year 1978 + 81 years = Year 2059; this is 77 years from TY 0 (1982).

II. Establishing "Natural" Rate of Wetlands Loss

A. To allow assessment of the impacts of a proposed action, future without-project (FWOP) and future with-project (FWP) habitat conditions must be estimated. The complete assessment involves, in addition to determining direct and indirect habitat impacts of the FWP scenario, adjusting habitat acreage of intermediate target years (TY) between TY 0 and TY 77 (end of project life) by the rate of "natural" marsh loss being experienced in the area.

B. To compute a "natural" marsh loss rate for the example which will follow, we used the same data from Wicker (1980) that was used to compute wetland life expectancy:

$$\text{i.e., } \frac{\text{acres per year lost}}{\text{acres in 1978}} = \frac{6,773}{547,500} = 1.24 \text{ percent lost annually due to "natural" causes}$$

III. Performing HEP Analysis of Project Impacts

NOTE: THE FOLLOWING EXAMPLE USES SPECIFICATIONS OF A TYPICAL OIL AND GAS EXPLORATION PERMIT REQUEST

A. Assume that a public notice is received requesting an oil exploration canal 1,200 feet long and 70 feet wide and a drill slip 345 feet by 160 feet, with a continuous spoil bank around the canal and slip (reference Figure B-1).

1. Field measurements (personal communication, Dr. Jim Gosselink, Louisiana State University Center For Wetland Resources, April 25, 1983) indicate that spoil banks adjacent to such canals average approximately 130 feet in width.

2. Using those dimensions, an area of direct impact can be computed:

a. Area of Canal:

$$= \frac{(70 \text{ ft.})\ (1,200 \text{ ft.})}{43,560} = 1.9 \text{ acres}$$

b. Area of Slip:

$$= \frac{(345 \text{ ft.} + 90 \text{ ft.})\ (160 \text{ ft.})}{43,560} = 1.6 \text{ acres}$$

c. Area of Spoil:

$$= \frac{(2)(1200 + 90 + 345)(130) + (130)(160 + 130 + 130)}{43,560}$$

$$= \frac{425,100 + 54,600}{43,560}$$

$$= 11.0 \text{ Acres}$$

Therefore, direct impacts:

Canal/slip	= 3.5 acres
Spoil	= 11.0 acres
Total	= 14.5 acres

3. Using up-to-date color infrared photography, field evaluation, or a combination of these, the type of habitat to be directly impacted could be determined. For this example, assume that the following habitat types and quantities would be directly impacted:

Project Feature	Habitat Type	
	Fresh Marsh (acres)	Open Water (acres)
Canal/Slip	2.5	1.0
Spoil	7.5	3.5
Total	10.0	4.5

B. Compute area of indirect impact of oil exploration canal/slip through project life:

1. Based on data contained in a report by Scaife et al. (In Press), we have calculated that:

   a. 11 percent of the total land loss from 1956 to 1978 was not canal-related.

   b. 10 percent of the total land loss from 1956 to 1978 was directly due to canal excavation.

   c. 79 percent of the total land loss from 1956 to 1978 was indirectly (via saltwater intrusion, increased wave action and erosion, etc.) due to canal excavation.

2. A report by Gagliano (1973) indicated that 65 percent of canal induced losses are due to oil and gas-related canals.

3. Therefore,

   a. (79%)(65%) = 50% of total land loss from 1956 to 1978 is attributable to indirect effects of oil and gas canals

   b. (10%)(65%) = 6.5% of total land loss from 1956 to 1978 is attributable to direct effects of oil and gas canals.

   c. $\frac{50 \text{ percent}}{6.5 \text{ percent}} = 7.69/1$ = ratio of indirect to direct oil and gas canal impacts from 1956 to 1978

   d. $\frac{7.69}{22 \text{ years}} = 0.35/1$ = average annual ratio of indirect to direct oil and gas canal impacts from 1956 to 1978

   e. Indirect impact of canal/slip in this example:

3.5 acres of direct impact due to canal/slip	X	0.35 annual ratio of indirect to direct impact due to canal/slip	X	77 year project life	=	94 acres of indirect impact

4. Using up-to-date color infrared photography, field evaluation, or a combination of these, the type(s) of habitat to be indirectly impacted could be determined. For this example, assume that indirectly impacted habitat occurred in the same ratio as directly impacted habitat types.

a. $\frac{10 \text{ acres}}{14.5 \text{ acres}} = \frac{X \text{ acres}}{94.0 \text{ acres}}$

ratio of fresh marsh directly impacted to total habitat directly impacted (reference III. A.3.) = ratio of fresh marsh indirectly impacted to total habitat indirectly impacted

Therefore, $X = \frac{(10)(94)}{14.5}$

$X = \underline{65 \text{ acres}}$ of fresh marsh indirectly impacted

b. $\frac{4.5 \text{ acres}}{14.5 \text{ acres}} = \frac{X \text{ acres}}{94 \text{ acres}}$

ratio of open water directly impacted to total habitat directly impacted (reference III.A.3.) = ratio of open water indirectly impacted to total habitat indirectly impacted

Therefore, $X = \frac{(4.5)(94)}{14.5}$

$X = \underline{29 \text{ acres}}$ of open water indirectly impacted

C. Estimate habitat changes in FWOP and FWP conditions at various periods (TY's) over project life. Reference Table B-1 for summary of acreage figures.

1. TY 0 (baseline)

a. Total acreage (108.5 acres) was derived by summing the direct project impact acreage (14.5 acres determined in III.A.1. and 2.) and the indirect project impact acreage (94.0 acres determined in III.B.3.e.)

b. The acreage by habitat type (i.e., 75.0 acres of fresh marsh and 33.5 acres of open water) would be determined as described in III.A.3. and III.B.4.

2. TY 1

a. FWP

(1) For analysis purposes, it was assumed that project completion would occur by the end of the first year; at that point all direct impacts would be experienced. Hence, 11 acres would be converted to spoil bank and 3.5 acres would be converted to canal/slip (reference III.A.2.).

(2) To the remaining 65 acres (i.e., 75 total minus 10 acres directly impacted) of fresh marsh, the "natural" marsh loss rate (i.e., 1.24 percent, reference II.) was applied:

(65)(0.0124)(1 year) = approximately 0.8 acres of the fresh marsh remaining in TY 0 would be lost in TY 1 FWP condition

Therefore, fresh marsh in TY 1 FWP condition:

= 65.0 - 0.8 = 64.2 acres

(3) It has been assumed that all natural or indirect losses in fresh marsh convert to open water; therefore,

33.5 -	4.5 +	0.8	=	29.8 acres of open water in TY 1
TY 0 acreage of open water	open water lost to direct impacts in TY 1	fresh marsh converted to open water in TY 1		

b. FWOP

(1) The "natural" marsh loss rate (1.24 percent, reference II.) was applied to the 75.0 acres of fresh marsh available at TY 0:

(75.0)(0.0124) = approximately 1.0 acre per year of fresh marsh lost in FWOP condition

Therefore, fresh marsh in TY 1:

75.0 - (1.0)(1 year) = 74.0 acres

(2) It has been assumed that all losses in fresh marsh convert to open water; therefore,

33.5 + 1.0 = 34.5 acres of open water in TY 1

TY 0 acreage of open water	TY 1 acreage of fresh marsh lost

3. TY 77

a. FWP

(1) It was assumed that the original 3.5 acres of canal/slip remained static.

(2) It was assumed that the remainder of the fresh marsh (i.e., 64.2 acres) and all of the spoil bank (i.e., 11.0 acres) in TY 1 would erode to open water.

(3) Therefore,

Total open water = 64.2 (acres of fresh marsh converted to open water after TY 1) + 11.0 (acres of spoil bank converted to open water after TY 1) + 29.8 (acres of open water available in TY 1) = 105 acres

b. FWOP

(1) Based on a previous determination (reference I.) that all marsh would be lost to "natural" causes within 77 years, all fresh marsh in TY 1 was assumed to convert to open water.

(2) Therefore,

Total open water = 74.0 (fresh marsh converted to open water after TY 1) + 34.5 (open water available in TY 1) = 108.5 acres

D. Assign habitat unit values (HUV)

1. Ideally, the assignment of TY 0 (baseline) HUV's to various habitat types to be affected by a proposed action would be performed in the field by an interagency team of biologists, as was done for the mitigation area.

a. If this technique is used, it is recommended that the same species or species groups used to evaluate the mitigation area be used to evaluate the project area. This would allow a more equitable comparison of habitat quality between the mitigation area and the proposed-project area.

b. An alternative to completing a field evaluation of each proposed project site would involve the use of HUV's previously assigned to habitats which are known, or believed, to be of similar quality to habitats within the project impact area.

2. To allow completion of the HEP analysis on the example project, FWOP and FWP HUV's were assigned, based on a series of assumptions:

   a. FWOP - Reference Tables B-2, B-3, and B-4 for listing of HUV's.

      (1) Fresh Marsh. It was assumed that, for both estuarine and freshwater fish elements and wildlife evaluation elements, the average HUV for TY 0 would be identical to the TY 0 HUV's (55.83, 67.50, and 62.08, respectively) for those elements in the mitigation area. It was further assumed that habitat quality would not vary over the life of marsh (i.e., project life).

      (2) Open Water. Just as with fresh marsh, it was assumed that average HUV's for estuarine and freshwater fish elements and wildlife evaluation elements in TY 0 were identical to the TY 0 HUV's (65.55, 45.00, and 48.06, respectively) for those elements in the mitigation area. For reasons identified in discussion of the mitigation area, it was assumed that the habitat quality of open water would decline over project life. For this example, it was assumed that the TY 0 HUV would decline by 1 percent each year of project life.

   b. FWP - Reference Tables B-2, B-3, and B-4 for listing of HUV's.

      (1) Fresh Marsh. It was assumed that HUV's for both fish and wildlife elements followed the same trends over project life as the HUV's in the FWOP condition.

      (2) Open Water. Just as with fresh marsh, it was assumed that HUV's for both fish and wildlife elements followed the same trends over project life as the HUV's in the FWOP condition.

      (3) Canal. It was assumed that TY 1 HUV's for both estuarine and freshwater fish elements and wildlife elements in the project area were identical to TY 1 HUV's in the mitigation area. It was assumed that the TY 77 HUV for fish elements would be equal to one-half of the TY 77 HUV's for fish elements in open water habitat. It was assumed that the TY 77 HUV for wildlife elements would be zero.

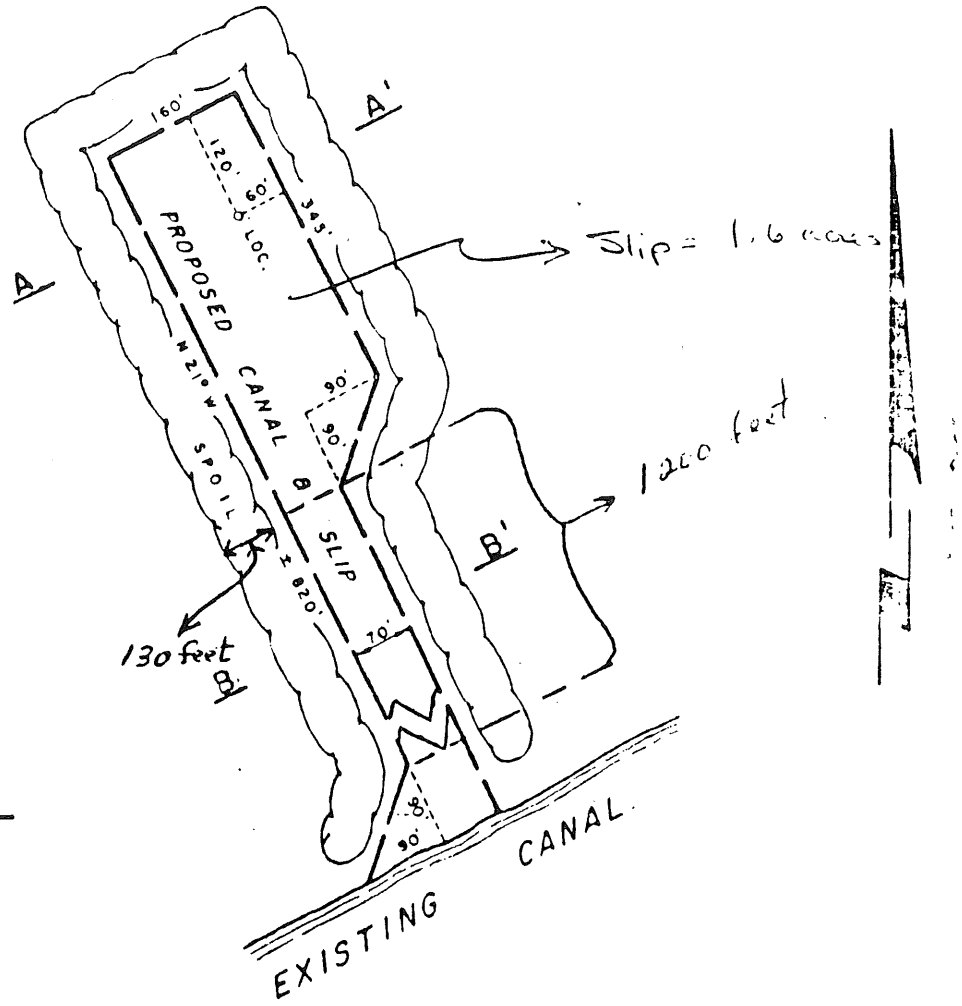
      (4) Spoil Bank. It was assumed that spoil bank has no habitat value for fishery elements, as was assumed in the mitigation area. It was assumed that the TY 1 HUV for wildlife elements in the project area was identical to the TY 1 HUV in the mitigation area; however, by TY 77 the HUV was assumed to decline to zero. The decline results from the total erosion of the spoil bank during project life.

E. Compute average annual habitat unit (AAHU) losses (debits) caused by the project which would be deducted from AAHU benefits (credits) in the mitigation bank.

1. The product of the HUV's (Tables B-2, B-3, and B-4) and the habitat acreages (Table B-1) in the future without- and future with-project conditions, respectively, yielded a measure of both fish and wildlife habitat quality and quantity (expressed as habitat units, i.e., HU's) under either condition (reference Tables B-5, B-6, and B-7).

2. If project implementation creates a reduction in AAHU's over the FWOP condition, that deficit must be mitigated. In this example, there is a net loss of 367 estuarine fishery AAHU's, 383 freshwater fishery AAHU's, and 338 wildlife AAHU's.

3. Once these AAHU losses are deducted from the mitigation bank credit ledgers for fish and wildlife, respectively, project damages would be formally mitigated. Any credits remaining on the ledgers could be used to mitigate fish and wildlife damages caused by future projects.



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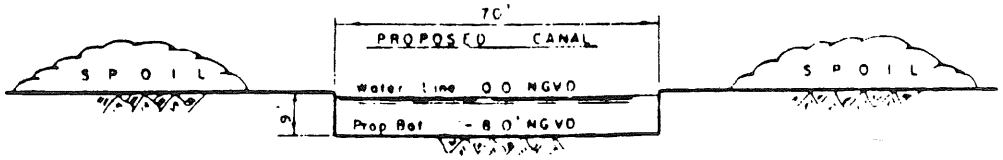
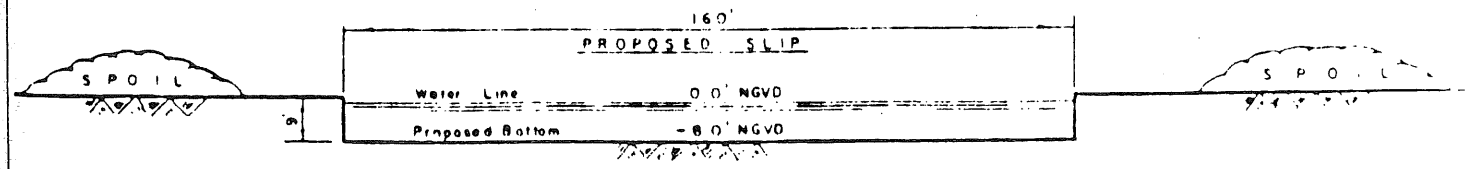


SECTION B-B'



SECTION A-A'

HORZ. & VERT SCALE 0 10 20 30 40 FT

NOTES:

1.) ALL INTERMITTENT STREAMS, BAYOUS, SLOUGHS, LAKES, AND CANALS PREVIOUSLY DUG THAT THIS NEW CANAL CROSSES WILL BE LEFT OPEN.

2.) APPROX. 32,183 CU YDS. OF DREDGING FOR LOC

SHEET 2 OF 2

PROPOSED DREDGING FOR CANAL & SLIP

APPLICATION BY :
JAN. 31, 1983

LAFAYETTE, LOUISIANA

Table B.1. Comparison of future without-project (FWOP) and future with-project (FWP) habitat acreages in area affected by typical oil and gas canal[a].

Target Year/	Condition	Fresh Marsh	Open Water	Canal/ Slip	Spoil Bank	Total
0	baseline	75.0	33.5	0	0	108.5
1	FWOP	74.0	34.5	0	0	108.5
	FWP	64.2	29.8	3.5	11.0	108.5
77	FWOP	0	108.5	0	0	108.5
	FWP	0	105.0	3.5	0	108.5

a. Canal, spoil, and slip dimensions given in Section III.

Table B-2. Habitat unit values of project area (affected by typical oil and gas canal)[a] for wildlife evaluation elements in the baseline (existing), future without-project (FWOP), and future with-project (FWP) conditions.

Target Year/	Condition	Fresh Marsh	Open Water	Canal	Spoil Bank
0	Baseline	62.08	48.06	-	-
1	FWOP	62.08	47.58	-	-
	FWP	62.08	47.58	9.17	14.7
77	FWOP	62.08	11.05	-	-
	FWP	62.08	11.05	0	0

a. Canal, spoil, and slip dimensions given in Section III.

Table B-3. Habitat unit values of project area (affected by typical oil and gas canal)[a] for estuarine fishery evaluation elements in the baseline (existing), future without-project (FWOP), and future with-project (FWP) conditions.

Target Year/	Condition	Fresh Marsh	Open Water	Canal	Spoil Bank
0	Baseline	55.83	65.55	-	-
1	FWOP	55.83	64.89	-	-
	FWP	55.83	64.89	41.66	0
77	FWOP	55.83	15.08	-	-
	FWP	55.83	15.08	7.54	0

a. Canal, spoil, and slip dimensions given in Section III.

Table B-4. Habitat unit values of project area (affected by typical oil and gas canal)[a] for freshwater fishery evaluation elements in the baseline (existing), future without-project (FWOP), and future with-project (FWP) conditions.

Target Year/	Condition	Fresh Marsh	Open Water	Canal	Spoil Bank
0	Baseline	67.50	45.00	-	-
1	FWOP	67.50	44.55	-	-
	FWP	67.50	44.55	35.00	0
77	FWOP	67.50	10.35	-	-
	FWP	67.50	10.35	5.18	0

a. Canal, spoil, and slip dimensions given in Section III.

Table B-5. Comparison of future without-project (FWOP) and future with-project (FWP) average annual habitat units (AAHU's) for wildlife elements in area affected by typical oil and gas canal.[a]

Target Year/	Condition	Fresh Marsh	Open Water	Canal/ Slip	Spoil Bank
0	FWOP	4,656	1,610	0	0
	FWP	4,656	1,610	0	0
1	FWOP	4,594	1,642	0	0
	FWP	3,986	1,418	32	162
77	FWOP	0	1,199	0	0
	FWP	0	1,160	0	0
Annual-ized	FWOP	2,327	1,423	0	0
	FWP	2,023	1,292	16	81
Net Change[b]		- 304	- 131	+16	+81

a. Canal, spoil, and slip dimensions given in Section III.

b. Total wildlife AAHU's lost due to project: 338.

Table B-6. Comparison of future without-project (FWOP) and future with-project (FWP) average annual habitat units (AAHU's) for estuarine fishery elements in area affected by typical oil and gas canal[a]

Target Year/	Condition	Fresh Marsh	Open Water	Canal/ Slip	Spoil Bank
0	FWOP	4,187	2,196	0	0
	FWP	4,187	2,196	0	0
1	FWOP	4,131	2,239	0	0
	FWP	3,584	1,934	146	0
77	FWOP	0	1,636	0	0
	FWP	0	1,583	26	0
Annual-ized	FWOP	2,093	1,941	0	0
	FWP	1,819	1,762	86	0
Net Change[b]		- 274	- 179	+86	-

a. Canal, spoil, and slip dimensions given in Section III.

b. Total fishery AAHU's lost due to project: 367.

Table B-7. Comparison of future without-project (FWOP) and future with-project (FWP) average annual habitat units (AAHU's) for freshwater fishery elements in area affected by typical oil and gas canal[a]

Target Year/	Condition	Fresh Marsh	Open Water	Canal/ Slip	Spoil Bank
0	FWOP	5,063	1,508	0	0
	FWP	5,063	1,508	0	0
1	FWOP	4,995	1,537	0	0
	FWP	4,334	1,328	123	0
77	FWOP	0	1,123	0	0
	FWP	0	1,087	18	0
Annual-ized	FWOP	2,530	1,333	0	0
	FWP	2,200	1,210	70	0
Net Change[b]		- 330	- 123	+70	-

a. Canal, spoil, and slip dimensions given in Section III.

b. Total fishery AAHU's lost due to project: 383.

APPENDIX C

MEMORANDUM OF AGREEMENT

BETWEEN THE

U.S. FISH AND WILDLIFE SERVICE

U.S. NATIONAL MARINE FISHERIES SERVICE

U.S. SOIL CONSERVATION SERVICE

LOUISIANA DEPARTMENT OF NATURAL RESOURCES

LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES

AND

THE TENNECO OIL COMPANY

EXECUTION COPY

DATE 12/14/83

MEMORANDUM OF AGREEMENT

BETWEEN THE

U.S. FISH AND WILDLIFE SERVICE

U.S. NATIONAL MARINE FISHERIES SERVICE

U.S. SOIL CONSERVATION SERVICE

LOUISIANA DEPARTMENT OF NATURAL RESOURCES

LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES

AND

THE TENNECO OIL COMPANY

PURPOSE

This Memorandum of Agreement ("Agreement") is to implement a management program to establish a mitigation bank of fish and wildlife habitat units for Tenneco Oil Company ("Tenneco") under the guidance and the approval of the above-named Federal and State agencies. This Agreement contains general recommendations and implementation and operational procedures for administering the mitigation bank. A more comprehensive and detailed discussion of the implementation and operational procedures is contained in the attached "Final Report on the Tenneco LaTerre Corporation Mitigation Banking Proposal, Terrebonne Parish, Louisiana," ("Final Report") prepared by the Fish and Wildlife Service ("FWS") and reviewed by the National Marine Fisheries Service, the Soil Conservation Service, the Louisiana Department of Natural Resources, the Louisiana Department of Wildlife and

Fisheries and the Tenneco LaTerre Corporation (TLT), (Tenneco is the corporate parent of Tenneco LaTerre Corporation). In the event there is a conflict between this Agreement and Final Report, this Agreement shall take precedence.

Mitigation Bank Proposal

Since it is in the nation's interest to maintain and enhance wetland habitats throughout the United States and in Louisiana's coastal marshes in particular, Tenneco has proposed a management program to preserve and improve fish and wildlife habitat on approximately 5,000 acres of its property located within Sections 35 and 36 of Township 18 South/Range 16 East and within Sections 1, 2, 3, 9, 10, 11, 12, 13, 14 and 15 of Township 19 South/Range 16 East in Terrebonne Parish, Louisiana (mitigation bank area). This area will be intensively managed for twenty-five (25) years by installing, operating and maintaining the series of water control structures and levees referred to in provision 16 for the purpose of increasing freshwater and sediment inflow, improving water circulation, and reducing saltwater intrusion. An additional 2,200 acres in other ownership but to be enclosed within the levees will be enhanced. Habitat units obtained from this 2200 acres may be added to the mitigation bank at a later date pursuant to Tenneco's reaching an agreement with the affected land owners. Credits will not be included in the bank for these acres until the legality of such is clarified. The management program will generate habitat unit credits created by the Tenneco management program which will be placed in the mitigation bank and which can be used to offset mitigation requirements associated with future activities requiring Corps of Engineers Section 10/404 permits and/or Louisiana Coastal Use Permits.

An analysis under the FWS Habitat Evaluation Procedures (HEP) and Mitigation Policy has initially indicated that the management program on the 5000 acres TLT owns will produce, over the seventy-seven (77) year life of the mitigation bank, 108,733 average annual habitat units (AAHU's) of Wildlife Habitat Resource Category 2 credits; 25,992 AAHU's of Wildlife Habitat Resource Category 3 credits; and 93,529 AAHU's of Fishery Habitat Resource Category 2 credits. Of those totals, 35,300 AAHU's of Wildlife Habitat Resource Category 2 credits; 8,400 AAHU's of Wildlife Habitat Resource Category 3 credits; and 30,400 AAHU's of Fishery Habitat Resource Category 2 credits will be available for withdrawal from the bank during the first twenty-five (25) years of mitigation bank life. Tenneco shall not be required to perform additional mitigation as result of any failure of the fully implemented management program to produce such credits during the first twenty-five (25) years. However, avoidance of any impending failure of the management program to produce anticipated AAHU's will be sought through voluntary revision of the management program by Tenneco. Approximately 73,433 AAHU's of Wildlife Habitat Resource Category 2 credits; 17,592 AAHU's of Wildlife Habitat Resource Category 3 credits; and 63,129 AAHU's of Fishery Habitat Resource Category 2 credits would be available for the last fifty-two (52) years of mitigation bank life, subject to a re-evaluation after twenty-five (25) years. However, the re-evaluation may result in an increase or decrease in those remaining credits.

General Provisions

It is mutually agreed that:

1. The life of the bank shall be seventy-seven (77) years. Crediting and debiting provisions of this agreement are to be in effect for the life of the bank.

2. Tenneco, TLT and their successor and assignes, agree to implement, operate and maintain the fish and wildlife habitat management program, as more fully described in the Final Report, for a period of at least twenty-five (25) years.

3. The interagency review team, here and after referenced, consisting of U.S. Fish & Wildlife Service (serving as chairman), U.S. National Marine Fisheries Service, the U.S. Soil Conservation Service, the Louisiana Department of Natural Resources and the Louisiana Department of Wildlife and Fisheries shall determine habitat units and the AAHU's to be initially credited to the mitigation bank and shall determine future debits and credits to the mitigation bank.

4. The appropriate parties to this Agreement shall use HEP, or a mutually agreeable and credible methodology, to determine credits and debits to be applied to the mitigation bank.

5. Mitigation by debiting available AAHU's from the mitigation bank is appropriate and will be used to offset only unavoidable impacts on fish or wildlife when the applicant can demonstrate to the satisfaction of all parties to this Agreement that there are no onsite alternatives which are available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

6. Consistent with Fish and Wildlife Service's Mitigation Policy, Resource Category 2 habitat losses shall be mitigated only with Resource Category 2 habitat unit credits. However, Resource Category 3 habitat losses may be

mitigated with either Resource Category 2 or 3 habitat unit credits. In addition, wildlife losses shall be offset only by wildlife AAHU's, freshwater fisheries losses shall be offset only by freshwater fisheries AAHU's and estuarine fishery losses shall be offset only by estuarine fishery AAHU's.

7. This Agreement does not eliminate the applicant's or agency's responsibilities under applicable laws and/or regulations.

8. Credits generated within Hydrologic Unit 5 shall be applied to activities requiring mitigation within that same Hydrologic Unit, and may be applied outside of Hydrologic Unit 5 only with the approval of the interagency review team. In no case shall credits be applied to projects outside the State of Louisiana.

9. Tenneco may buy, sell, trade or otherwise dispose of mitigation credits in the form of AAHU's to be debited from the mitigation bank. The buyer or assignee of such AAUH's may use such credits to satisfy its mitigation obligations subject to applicable laws, regulations and provisions of this Agreement. The interagency review team shall be informed prior to such AAHU's transfer.

10. If future projects requiring mitigation occur within the mitigation bank area and the bank is to be debited for such projects, then such debits shall be equal to twice the AAHU's caused to be lost by the proposed activity. If future projects requiring mitigation occur outside the mitigation bank area, and the bank is to be debited, then such debits shall be equal to only the AAHU's caused to be lost by the proposed activity.

11. The FWS shall provide data sheets, of the type described in the Final Report, for each transaction (either debit or credit) to all parties to this Agreement for signature concurrence. No debits or credits can be applied until all parties to this Agreement concur with the FWS data sheet analysis. Such concurrence, substantiations of the reasons for nonconcurrence or request for additional time to consider such data sheets must be forwarded to the Lafayette office of the U.S.F.W.S. within 15 federal and state working days after receipt of the data sheets. The non-timely response by any party shall be deemed to indicate concurrence. Copies of signed transaction data sheets shall be held as a permanent record by the FWS and Tenneco. FWS shall prepare and provide on a calendar year basis an annual summary of debits and credits to the mitigation bank to all parties .

12. As the Tenneco proposal is a pilot program, five (5) years after implementation of the management plan a complete evaluation of the management program shall be made by the interagency review team using HEP, or a mutually agreeable and credible methodology. A preliminary assessment is to be made one year after implementation of the management program to evaluate the effectiveness of the management program. Whenever significant operational and/or structural changes are then made to improve success, another complete evaluation should be made in three (3) to five (5) years following those changes.

13. At the end of the twenty-five (25) year management program, referenced in provision 2, the interagency review team shall conduct a complete evaluation of the management program and shall negotiate with Tenneco in good faith to

determine a mutually agreeable course of action which takes into consideration Tenneco's interest in maintaining its subsurface mineral rights as well as all parties interests in protecting the ecological integrity of wetlands.

14. Any party's obligation under this Agreement shall be suspended and deferred during such time as that party is prevented or hindered from complying in whole or part because of Force Majeure.

15. In the event that any structures built pursuant to this Agreement are damaged or destroyed during the first twenty-five (25) years of the management program for any reason beyond the control of Tenneco, Tenneco shall have the option to repair, replace or abandon any damaged or destroyed structures. In the event of abandonment of any damaged or destroyed structures parties to this Agreement shall use shall use HEP or a mutually agreeable and credible methodology to revaluate the remaining AAHU's and make appropriate adjustments. These adjustment shall include alternative mitigation, to be implemented by Tenneco, in lieu of mitigation not accomplished as result of such damage or destruction.

16. The designs, locations and numbers of water control (exchange) structures and new levees and the general operational plan in the mitigation bank area shall be provided to all parties to this Agreement for signature concurrence. All parties shall respond to this proposal within 15 federal and state working days of its receipt. The non-timely response of any party will be deemed to indicate concurrence. The AAHU's shall not be available for debiting until all of the initial structural components of the management program have been

installed by Tenneco and the interagency review team is notified.

17. Any modification to this Agreement can be proposed at any time, but shall not be adopted unless agreed to by all parties to this Agreement. The parties recognize that revisions may become necessary. In such event, the parties shall consult to attempt to resolve the issues and amend this Agreement accordingly. If, however, such revisions are not agreed to within one (1) year after proposed, then the party proposing the revision may elect to terminate its particiation in this Agreement at the end of such one year period.

18. This Agreement is not intended to be a blanket endorsement of the mitigation banking concept for other future uses for which mitigation may be needed.

12/19/83

Regional Director, Southeast Region — Date
U.S. Fish and Wildlife Service

Regional Director, Southeast Region — Date
U.S. National Marine Fisheries Service

12/15/83

Louisiana State Conservationist — Date
U.S. Soil Conservation Service

12/20/83

Secretary, Department of Natural — Date
Resources, State of Louisiana

12/15/83

Secretary, Department of Wildlife — Date
and Fisheries, State of Louisiana

Tenneco Oil Company — Date

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AMENDMENT TO
MEMORANDUM OF AGREEMENT
BETWEEN THE
U.S. FISH AND WILDLIFE SERVICE
U.S. NATIONAL MARINE FISHERIES SERVICE
U.S. SOIL CONSERVATION SERVICE
LOUISIANA DEPARTMENT OF NATURAL RESOURCES
LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES
AND
TENNECO OIL COMPANY

WHEREAS, the above-named parties entered into a Memorandum of Agreement dated December 14, 1983; and

WHEREAS, said parties now desire to amend said Memorandum of Agreement in certain respects.

NOW, THEREFORE, in view of the mutual covenants expressed herein and other good and valuable consideration, the parties hereto hereby amend said Memorandum of Agreement as follows:

1. Mitigation Bank Proposal (Pages 2 and 3) shall be amended to read as follows:

Since it is in the nation's interest to maintain and enhance wetland habitats throughout the United States and in Louisiana's coastal marshes in particular, Tenneco has proposed a management program to preserve and improve fish and wildlife habitat on approximately 5,000 acres of its property located within Sections 35 and 36 of Township 18 South/Range 16 East and within Sections 1, 2, 3, 9, 10, 11, 12, 13, 14 and 15 of Township 19 South/Range 16 East in Terrebonne Parish, Louisiana (mitigation bank area). This area will be intensively managed for twenty-five (25) years by installing, operating and maintaining the series of water control structures and levees referred to in provision 16 for the purpose of increasing freshwater and sediment inflow, improving water circulation, and reducing saltwater intrusion. An additional 2,014 acres in other ownership but to be enclosed within the levees will also be enhanced. The management program will generate habitat unit credits created by the Tenneco management program which will be placed in the mitigation bank and which can be used to offset mitigation requirements associated with future activities requiring Corps of Engineers Section 10/404 permits and/or Louisiana Coastal Use Permits. Habitat units obtained from the total 7,014 acres enhanced by the management program will be available for use by Tenneco.

An analysis under the FWS Habitat Evaluation Procedures

(HEP) and Mitigation Policy has initially indicated that the management program on the 7,014-acre management area will produce, over the seventy-seven (77) year life of the mitigation bank, 155,333 average annual habitat units (AAHU's) of Wildlife Habitat Resource Category 2 credits; 37,132 AAHU's of Wildlife Habitat Resource Category 3 credits; 177,931 AAHU's of Freshwater Fishery Habitat Resource Category 2 credits; and 119,166 AAHU's of Estuarine Fishery Habitat Resource Category 2 credits. Of those totals, 50,433 AAHU's of Wildlife Habitat Resource Category 2 credits; 12,056 AAHU's of Wildlife Habitat Resource Category 3 credits; and 57,700 AAHU's of Freshwater Fishery Habitat Resource Category 2 credits; and 38,690 AAHU's of Estuarine Fishery Resource Category 2 credits will be available for withdrawal from the bank during the first twenty-five (25) years of mitigation bank life. Tenneco shall not be required to perform additional mitigation as a result of any failure of the fully implemented management program to produce such credits during the first twenty-five (25) years. However, avoidance of any impending failure of the management program to produce anticipated AAHU's will be sought through voluntary revision of the management program by Tenneco. Approximately 104,900 AAHU's of Wildlife Habitat Resource Category 2 credits; 25,076 AAHU's of Wildlife Habitat Resource Category 3 credits; 120,161 AAHU's of Freshwater Fishery Habitat Resource Category 2 credits; and 80,476 AAHU's of Estuarine Fishery Habitat Resource Category 2 credits would be available for the last fifty-two (52) years of mitigation bank life, subject to a re-evaluation after twenty-five (25) years. However, the re-evaluation may result in an increase or decrease in those remaining credits.

2. Paragraph 10 (Page 5) shall be amended to read as follows: 10.a. Unavoidable impacts of future project(s), having up to a cumulative total of 88 acres of direct impact (i.e., 17 percent of the 515 acres of allowable development referenced on page 19 of Final Report), within that portion of the mitigation bank area owned by Tenneco shall require debiting equal to only the AAHU loss caused by the project(s). After the 88-acre threshold is reached, mitigation for project(s) within that portion of the mitigation bank area owned by Tenneco shall require debiting at twice the AAHU loss caused by the project(s). If future projects requiring mitigation occur within that portion of the mitigation bank area not owned by Tenneco, credits shall be debited from the mitigation bank at a level equal to the AAHU loss caused by the project(s). In addition, it is anticipated that the developer of the project(s) on that portion of the mitigation bank area not owned by Tenneco will be requested to provide, as a condition of the State and Federal permits

required for such projects, additional mitigation at a level equal to the AAHU loss caused by that project, either at an offsite location or by negotiating with Tenneco to allow additional debiting from the mitigation bank.

b. In the event that the interagency review team requires that a canal (the fish and wildlife resource damages of which are to be debited from the mitigation bank) be plugged, the debits initially assigned to the indirect impacts of that canal will be reduced by 2 percent each year, after the first year, that the plug is determined to be in place and functional. This reduction in debits is limited to a maximum of 50 percent of the initial debit requirement assessed to the indirect impacts of the unplugged canal. To receive each incremental (i.e., 2 percent) debit reduction, Tenneco must provide to the interagency review team, on an annual basis, written assurances that the plug is in place and functioning as intended.

This Amendment shall be effective the day after the date of signing by the last signator, below:

Regional Director, Southeast Region — March 14, 1988
U.S. Fish and Wildlife Service — Date

Regional Director, Southeast Region — March 21, 1988
U.S. National Marine Fisheries Service — Date

Louisiana State Conservationist — March 24, 1988
U.S. Soil Conservation Service — Date

Secretary, Department of Natural — April 7, 1988
Resources, State of Louisiana — Date

Secretary, Department of Wildlife — April 15, 1988
and Fisheries, State of Louisiana — Date

C. W. Nance — May 25, 1988
Tenneco Oil Company — Date