US Army Corps of Engineers®
Albuquerque District

SOUTHWEST VALLEY FLOOD DAMAGE REDUCTION PROJECT
Albuquerque, Bernalillo County, New Mexico

Final Feasibility Report and Environmental Assessment

Prepared by:
U.S. Army Corps of Engineers
Albuquerque District
South Pacific Division

In Coordination With:
Albuquerque Metropolitan Arroyo Flood Control Authority
And Bernalillo County

April 2004

Table of Contents

FIGURES

APPENDICES

LIST OF ACRONYMS

ACRONYM	REFERENCE
AHYMO	Arid-Lands Hydrologic Model
AMAFCA	Albuquerque Metropolitan Arroyo Flood Control Authority
AMC	Antecedent Moisture Condition
ASACW	Assistant Secretary to the Army for Civil Works
ASCI	Albuquerque Surveying Company, Incorporated
BERNCO	Bernalillo County
BMP	Best Management Practice
C	Centigrade
COA	City of Albuquerque
DPM	Development Process Manual
EC	Engineering Circular
EPA	Environmental Protection Agency
F	Fahrenheit
HEC	Hydrologic Engineering Center
HYMO	Hydrologic Model
IWR	Institute for Water Resources
LPP	Locally Preferred Plan
MRGCD	Middle Rio Grande Conservancy District
NED	National Economic Development
NMAC	New Mexico Annotated Code
NMED	New Mexico Environment Department
NMISC	New Mexico Interstate Stream Commission
NMSHTD	New Mexico State Highway and Transportation Department
NMWQCC	New Mexico Water Quality Control Commission
NPDES	National Pollution Discharge Elimination System
OCA	Office of Contract Archeology
PL	Public Law
PREFRE	Computation of Precipitation Frequency-Duration Values in the Western United States
RTI	Resource Technology, Incorporated
SCS	Soil Conservation Service—presently the National Resources Conservation Service
TMDL	Total Maximum Daily Load
USACE	Unites States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WWTF	Waste Water Treatment Facility

Unified Soil Classification System

CL	Lean Clay
ML	Lean Silt
GM	Gravel Silty
GP	Gravel Poorly Graded
SC	Sand Clayey
SM	Sand Silty
SP	Sand Poorly Graded

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, Albuquerque District, has conducted a feasibility study and environmental assessment for flood control, environmental quality, and water related problems and opportunities for the Southwest Valley of Albuquerque and Bernalillo County, New Mexico. The purpose of the study was to identify the best plan that meets the Southwest Valley's current and future needs, identify the plan that is economically feasible and is in the Federal interest of flood control. These efforts are proceeding in partnership with Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) and Bernalillo County, the non-Federal sponsors. The Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) was created in 1963 by the New Mexico Legislature with specific responsibility for flooding problems in greater Albuquerque. AMAFCA's purpose is to prevent injury or loss of life, and to eliminate or minimize property damage. The mission of Bernalillo County Government is to administer laws enacted by the State of New Mexico and carry out all policies and ordinances enacted by the Board of County Commissioners. County government is responsible for providing those services and facilities necessary to promote the welfare and safety of the public.

The Federal Project Area is that portion roughly bounded by Bridge Boulevard on the north; the Rio Grande on the east; Rio Bravo Boulevard on the south; and Coors Boulevard on the west, see Figure 5.3C in Appendix A. The contributing drainage basin into the Federal Project Area is shown on Figure 2.2B, also located in Appendix A.

All together, twenty-two alternatives that would reduce flood damages in the Southwest Valley were evaluated. The initial alternative selected was presented in an Alternative Formulation Briefing (AFB) in February of 2002. The baseline assumptions on meeting the Federal Criteria were questioned by the U.S. Army Corps of Engineers Headquarters (Headquarters). Both Headquarters and South Pacific Division (SPD) met with the Albuquerque District to review the Southwest Valley (SWV) Feasibility Report. Policy concerns regarding the flow criteria for flood project authorization were discussed. There was no single point in mesa-flow runoff where the flow requirements were being met. Based on ensuing discussion, the representatives from headquarters agreed to present the project to the Secretary of the Army for Civil Works (ASACW) for either a waiver to the flow criteria or buy-off on the flow criteria being met using a weir concept across Coors Boulevard.

Headquarters met with the ASACW regarding this concern. Because of the complexities of the project, Headquarters was not able to relay the flood concern adequately. As a result of the Washington D.C. meeting with ASACW on 28 February 2002, in addition to coordination meetings with the sponsors, Resource Technology, Inc. (RTI) and core team members, the following direction was given for this project:

1. Meeting the flow criteria by adding flows across Coors Boulevard (weir concept) was not accepted.

2. The District was tasked with modeling the mesa and intervening valley flows for existing and future conditions in a non-attenuated hydrograph with the irrigation base flows being added to the flow amount in Isleta Drain. A more detailed description of model assumptions is given below. This would hypothetically allow flows to enter into the

Isleta Drain without any obstructions and collect flows as it continues downstream creating, in effect, a more natural stream condition. The additional flows from the Armijo Drain could also be added to the total in the Isleta Drain at their confluence just above Rio Bravo Boulevard.

3. The location where concentrated flows reach the Q_{10} of 800 cubic feet per second (cfs) or the Q_{100} of 1,800 cfs within the system may eliminate the need for a waiver from the Secretary of the Army.

The District prepared a position paper explaining and supporting how, where, and why the urban discharge criteria is met. The District recommend that the future conditions Q_{10} flow point be used for formulation. This position paper was sent to Division and upon review and support was forwarded to Headquarters. Based on the analytical approach taken, Headquarters supported the position paper that the flow criteria was met.

Due to concerns raised by the Sponsors, Headquarters and ASACW about possible benefits not being considered, especially for future conditions, the District requested South Pacific Division come to Albuquerque to meet with core team members and sponsors about the economic analysis. SPD met with the District on 28 March 2002 to give project guidance.

The flow criteria technical information was completed by April 1, 2002 with the position paper forwarded for Division review by April 5, 2002. Upon review of the position paper, SPD concurs with the technical findings and Headquarters finalized the AFB Planning Guidance Memorandum.

The flow criteria analysis provided a point of concentration along the lowest point of the valley, the Isleta Drain. There is an existing infrastructure of drains and canals along the valley operated and maintained by the Middle Rio Grande Conservancy District (MRGCD). The drains were built in the 1930's in cooperation with MRGCD and the U.S. Bureau of Reclamation (BOR) to provide field drainage and return flow conveyance. The Corps and Sponsors approached MRGCD and BOR to see if the existing drains could be improved to carry flood flows of the Mesa. After much coordination and an Operations & Maintenance agreement established, MRGCD approved the use of the drains as part of the project. The Corps is continuing to work with BOR on licensing prior to construction. The BOR and MRGCD are in disagreement as to what provisions, if any, remain enforceable under Contract 178r-423 as well as the issue of ownership of the subject real property. Notwithstanding this current dispute, the parties to this Agreement are committed to completion of the important work contained herein. Therefore, the parties expressly agree that no provisions of the agreement in who or in part may be used in any way, or in any proceeding, in connection with the dispute over Contract 178r-423 or ownership of the subject real property. The specific objectives for flood reduction within the study area has been identified as follows:

1. Reduces the flood hazard that exists within the Southwest Valley floodplains within Albuquerque and Bernalillo County in order to preserve human life and reduce damages to existing property;

2. Contributes to the preservation and enhancement of natural and beneficial values of fish and wildlife resources, wetlands, and aesthetic qualities;

3. To the extent possible, avoids or minimizes, adverse impacts to the environment and cultural resources of the study area, and compensates for any unavoidable adverse effects caused by project implementation;

4. Maintains water quality conditions within the study area; and

5. Maintains existing open spaces to maximize public recreational opportunities.

A number of measures were developed based on those originally identified in the original feasibility study, with additional measures added based upon the results of the flow criteria. As the study continued, the set of measures was screened and refined. A final array of 4 alternatives and a "No Action" alternative were produced. Additional refinement of those alternatives and subsequent analysis of costs and flood reduction benefits relative to their effectiveness, acceptability, completeness, and efficiency let to the selection of the preliminary recommended plan. The proposed plan is illustrated in Figure 5.3C. It is characterized by:

Alternative 3, the NED Plan, would capture West Mesa flood flow utilizing existing surface drain facilities. This alternative is sized to safely convey the ten (10) year frequency storm. The main features of the proposed work would involve utilizing existing easements, widening existing drains (see Figure 4.2 and 5.3C in Appendix A), constructing a large storm water detention ponding area, and constructing two new channels. Generally, the work entails:

1. Utilizing existing easements and enlarging existing 30 to 40-foot wide drains (top width) to 68 feet to store and convey flood flows on:

   a. 22,700-feet of the Isleta Drain beginning near Bridge Boulevard and continuing 4,200-feet south of Rio Bravo Boulevard;

   b. 8,100 feet of the Armijo Drain from Robertson Road to its intersection with the Isleta Drain just north of Rio Bravo Boulevard;

   c. 4,600 feet of the Los Padillas Drain from the southern boundary of Anderson Farms to its intersection with a newly constructed flood-flow channel;

New access roads and trails up to 20 feet wide would be installed on each side of these drains.

2. Rehabilitating and/or enlarging existing road-crossings to facilitate the proposed improvements and additions to the drainage system. This alternative includes overflow spill collection from the Arenal Canal with conveyance to the Isleta Drain.

3. Construction of a 25-acre detention pond (Pond 187) in an existing agricultural field situated east of the Isleta Drain to detain a portion of flood-flow during large storm events. Proposed volume capacity of this pond for alternative 3 is 325 Acre Feet.

4. Construction of a 4,300-foot long by 120-foot wide earthen lined flood flow channel, for storage and conveyance, along the southern property boundary of Anderson Farms below Rio Bravo Boulevard to connect flood flow from the existing Isleta Drain to the existing Los Padillas Drain. New access roads 15 feet wide would be placed on each side of this drain.

5. Construction of a new 3,800-foot long by 45-foot wide (top width) concrete-lined flood flow channel (near Metzgar Road) from the Los Padillas Drain to the Rio Grande levee. Flood Gates would be built at the Rio Grande Levee. An engineered outfall would continue from the levee for approximately 700 feet through the floodplain to the Rio Grande. This work would occur entirely within an existing power line easement. New 15-foot wide access roads would run along each side of this channel.

Implementation of this alternative will result in over 96% of the 10-year floodplain removed from the valley floor and 85% of the 100-year floodplain removed from the valley floor.

Environmental analyses conducted in accordance with the provisions of the National Environmental Protection Act (NEPA) indicate the likelihood of no lasting negative impacts from implementation of the recommended plan. The analyses identified, based on the analyses and information described above, the Corps has determined that the conduct of the proposed flood reduction project would not likely adversely affect the Southwestern Willow Flycatcher, Bald Eagle, and Rio Grande silvery minnow; nor would it destroy or adversely modify designated critical habitat of the Rio Grande silvery minnow.

The non-Federal sponsors, AMAFCA and Bernalillo County, has also expressed a desire to reduce flooding in the project area and have committed to continue capturing flood flows beyond the federal project.

The total first cost for construction of the NED plan is $17,493,600. Cost sharing for the flood control features would be 65 percent Federal and 35 percent non-Federal. Thus, the Non-Federal share of the project would be $ 6,122,760. Annual Cost for Operation, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R) include dredging, vegetation control, inspection, cleaning of floatables after storm events, culvert cleaning, fence, barricade, gates and lock repair. Annual cost is expected to be $ 85,000 split between the Sponsors (AMAFCA and Bernalillo County).

1. PURPOSE AND NEED

1.1 PURPOSE OF THE STUDY

The purpose of this report is to present the results of a feasibility study undertaken to evaluate technical and economic aspects of a comprehensive flood reduction program for the Southwest Valley in Bernalillo County and portions of Albuquerque, New Mexico. This report provides planning, engineering, and construction details of the recommended flood damage reduction measures plan to allow final design and construction to proceed subsequent to the approval of the plan. The Sponsors for this study are Albuquerque Metropolitan Flood Control Authority (AMAFCA) and Bernalillo County. The Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) was created in 1963 by the New Mexico Legislature with specific responsibility for flooding problems in greater Albuquerque. AMAFCA's purpose is to prevent injury or loss of life, and to eliminate or minimize property damage. AMAFCA does this by building and maintaining flood control structures that help alleviate the problem. AMAFCA is a political subdivision of the State of New Mexico, and is governed by a publicly-elected five-member Board of Directors. Directors are elected from their districts during the general election, and they serve six-year staggered terms. The Board elects a Chairman from among the Directors. AMAFCA oversees a variety of flood control structures. Traditional flood control measures focus on protection of existing developments through construction of dams (to hold water back) and channels (to divert or confine flows).

The first mission of AMAFCA was to be the local sponsor for construction of two very large federally-funded project, the North and South Diversion Channels (NDC and SDC), which were built by the Army Corps of Engineers. The NDC drains Northeast Albuquerque and can carry 44,000 cubic feet per second at its outlet. The smaller SDC protects the Southeast Valley by intercepting flows from Southeast Albuquerque and the Tijeras Arroyo. AMAFCA today is still responsible for those two main flood control structures. AMAFCA is also concerned with protecting the quality of water for Albuquerque and its surrounding areas. Structures which catch debris and protect the Rio Grande from pollution are often modeled in the UNM Hydraulics Lab before they are built by AMAFCA.

The mission of Bernalillo County Government is to administer laws enacted by the State of New Mexico and carry out all policies and ordinances enacted by the Board of County Commissioners. County government is responsible for providing those services and facilities necessary to promote the welfare and safety of the public. The County of Bernalillo is a constitutionally mandated entity, deriving powers from the Federal and State governments. In recognition of their responsibilities to the citizens of Bernalillo County, the elected officials and employees pledge the following:

To courteously and equitablity administer all programs, ordinances
and laws; to provide efficient and effective services; to foster open communication between County Government and the Citizens of Bernalillo County; to maintain a professional administration through the application of sound personnel and management practices. The County Manager's goals are to address any recommendations from the annual independent financial audits of the County and maintain the County's strong financial position; to assure a

balanced budget and adequate financial reserves, as mandated by the Board of Commissioners; and to deliver professional and timely services to the Citizens of Bernalillo County. The Technical Services Department is mandated to develop, maintain and improve county roads and utilities through acquisition and management of right of way, design, and construction of roadway, drainage and utility systems. Programming of future improvements and engineering studies as needed to provide quality customer service and maximize the effects of funds available.

The Development Review (DR) group is part of the Technical Services Department and is responsible for the review and enforcement of a wide variety of private development actions that affect the County Public Works Division (PWD) or the general public. Actions consist of reviewing Building, Planning, and Zoning Department permits and platting actions. These permits generally consist of building permits, zoning permits, fence permits, zone changes, special use permits, and or platting actions. The DR group reviews these permits for compliance with PWD ordinances such as the drainage, flood plain, street standards and excavation ordinances.

1.2 STUDY AUTHORITY

The Southwest Valley feasibility study was authorized by the Flood Control Act of 1941 (Public Law 228) as contained in House Document No. 4911, 77th Congress, 1st Session, dated 18 August 1941.

> *"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That hereafter Federal investigations and improvements of rivers and other waterways for flood control and allied purposes shall be under the jurisdiction of and shall be prosecuted by the War Department under the direction of the Secretary of War and supervision of the Chief of Engineers, and Federal investigations of watersheds and measures for run-off and waterflow retardation and soil-erosion prevention on watersheds shall be under the jurisdiction of and shall be prosecuted by the Department of Agriculture under the direction of the Secretary of Agriculture, except as otherwise provided by Act of Congress . . .*
>
> *Sec. 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following named localities . . . Rio Grande and tributaries, New Mexico."*

As supplemented by S. 507 Water Resource Development Act of 1999.

> *Sec. 433 SOUTHWEST VALLEY, ALBUQUERQUE, NEW MEXICO. The Secretary shall conduct a study to determine the feasibility of undertaking a project for flood damage reduction in the Southwest Valley, Albuquerque, New Mexico.*

1.3 REGULATORY COMPLIANCE

One objective of this integrated Feasibility Report/Environmental Assessment is to determine the environmental effects of proposed flood damage reduction measures. This document, prepared by the U.S. Army Corps of Engineers, Albuquerque District, is in compliance with all applicable Federal statutes, regulations, and Executive Orders, including:

- National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq*.);
- Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 *et seq*.);
- U.S. Army Corps of Engineers' Procedures for Implementing NEPA (33 CFR 230);
- Clean Air Act, as amended (42 U.S.C. 7401 *et seq*.);
- Clean Water Act of 1977, as amended (33 U.S.C. 1251 *et seq*.);
- Endangered Species Act, as amended (16 U.S.C. 1531 *et seq*.);
- Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.);
- Flood Plain Management (Executive Order 11988);
- Protection and Enhancement of Environmental Quality (Executive Order 11514)
- Protection of Wetlands (Executive Order 11990);
- National Historic Preservation Act, as amended (16 U.S.C. 470 et seq.);
- Protection of Historic and Cultural Properties (36 CFR 800 et seq.);
- Protection and Enhancement of the Cultural Environment (Executive Order 11593);
- American Indian Religious Freedom Act (42 U.S.C. 1996); and
- Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 et seq.);
- Noise Control Act of 1972 (42 U.S.C. 4901 et seq.);
- Resource Conservation and Recovery Act of 1976 and Amendments of 1984
- (42 U.S.C. 6901 et seq.);
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980
- (42 U.S.C. 9601 et seq.);
- Intergovernmental Review of Federal Programs (Executive Order 12372)
- Federal Actions to Address Environmental Justice in Minority Populations and Low-
- Income Populations (Executive Order 12898)

This document also reflects compliance with applicable State of New Mexico regulations and standards for water and air quality, as well as regulations conserving endangered plants and animals.

1.4 GENERAL PROJECT PLANNING

Development of the Southwest Valley Flood Damage Reduction Feasibility Study followed the Corps of Engineers' six-step planning process specified in Engineering Regulation (ER) 1105-2-100.

The process identifies and responds to problems and opportunities associated with the Federal objective and specified state and local concerns. The process provides a flexible, systematic, and rational framework to make determinations and decisions at each step. This allows the interested public and decision-makers to be fully aware of the basic assumptions employed; the data and

information analyzed; the areas of risk and uncertainty; and the significant implications of each alternative plan.

The steps used in the plan formulation process are outlined below. In addition, a schematic of the plan formulation process is included below.

1. Identify Problems and Opportunities: The specific problems and opportunities are identified, and the causes of the problems discussed and documented.

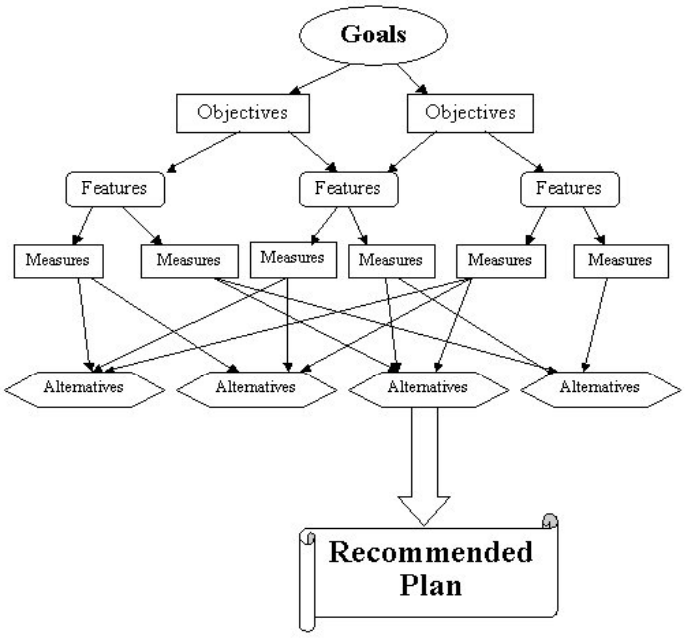
2. Inventory and Forecast Resource Conditions: This step characterizes and assesses existing conditions in the Southwest Valley project area and forecasts the most probable without-project condition (or "no action alternative") over the period of analysis. The without-project condition is what the area and its uses are anticipated to be like over the 50-year planning period without any restoration implemented as a result of this study. The with-project condition is what the area and its uses are anticipated to be if restoration measures are implemented. This assessment gives the basis by which to compare various alternative plans and their impacts.

3. Formulate Alternative Plans: Potential features are proposed to meet the identified objectives. Specific design measures are developed for these features. These measures are combined into alternative plans in a systematic manner to ensure that reasonable alternatives are evaluated. Refer to Figure 1.1 for a schematic diagram of this process.

4. Evaluate Alternative Plans: The evaluation of each alternative consists of measuring or estimating the environmental benefits, costs, technical considerations, and social and economic effects of each plan, and determining the difference between the without- and with-project conditions. A key measure for evaluation of alternative plans is a cost-effectiveness incremental cost analysis and evaluation of significance.

5. Compare Alternative Plans: Alternative plans are compared, focusing on the differences among the plans identified in the evaluation phase and public comment. As part of the evaluations, the "Best Buy" plans are identified—those plans that provide the greatest increase in benefits for the least increase in cost.

6. Select Recommended Plan: A Recommended Plan or National Economic Development (NED) Plan is selected. If a viable plan is not identified, the recommended plan will be the "no action alternative." In most cases, the NED Plan will be selected from among the Best Buy plans. The NED Plan should be evaluated on acceptability, completeness, effectiveness, efficiency and reasonableness of costs.



Schematic diagram of formulation process.

The report is organized to follow the planning process and therefore does not follow exactly the planning steps as they occurred. The planning process is iterative. As such, as additional information was learned in subsequent steps, it was necessary to revisit and repeat portions of the previous step(s).

1.5 REFORMULATION PROCEDURE

As a result of the AFB in February 2002, the flow criteria analysis was re-evaluated per ER-1165-2-21. The District requested that the Hydrology and Hydraulics (H&H) contractor complete a sensitivity analysis for future condition hydrology that would include routed flows in addition to the ponded storm water for the floodplain delineations to determine if any change in damages would result.

The position paper was prepared and submitted as follows:

Flooding Problems

Portions of the Southwest Valley are subject to flooding from a variety of sources. The runoff from the West Mesa is largely controlled by a series of dams, detention basins, and diversion channels constructed by AMAFCA, Bernalillo County, and the City of Albuquerque. Most of the AMAFCA facilities release controlled flood discharges directly or indirectly into features of the Middle Rio Grande Project. Flood damages occur when floods overwhelm the capacity of the AMAFCA facilities, or the capacity of the Middle Rio Grande Project drains or canals is exceeded. A large portion of the Mesa runoff is uncontrolled and flows directly into the valley. The runoff consists of high peak and low volume discharges that, due to the steep slopes, typically transport large quantities of sediment.

USACE Guidance and Policies Under ER 1165-2-21 Flood Damage Reduction Measures in an Urban Area

Corps guidance under Decision Criteria for Participation (para. 7a) requires that urban water damage problems associated with a natural stream or modified natural waterway be addressed under the flood control authorities downstream from the point where the flood discharge of such a stream or waterway within an urban area is greater than 800 cubic feet per second for the 10-percent flood under conditions expected to prevail during the period of analysis.

Division engineers are authorized to grant exceptions to the 800 cfs, 10-percent flood discharge criterion whenever both of the following criteria are met:

a. The discharge for the one-percent flood exceeds 1,800 cfs; and
b. The reason that the 10-percent flood discharge is less than 800 cfs is attributable to a hydrologic disparity.

Meeting the Criteria Set by ER 1165-2-21: Due to the nature of the floodplain in the southwest valley, much of the damaging flood flows are in the form of sheet flow being intercepted by the existing irrigation facilities and overflowing and breaching drains and canals. The flow under existing conditions does not allow for the collected water to concentrate at any one point in exceedance of the criteria listed above. Once the flood flows reach the valley, the slope becomes very flat. The flows are intercepted by a series of irrigation canals, laterals, acequias, and drains that traverse the valley; most of which have embankments from one to three feet high. These embankments and raised roadways divide the valley into many small sub-areas. Some sub-areas discharge into the agricultural drains where confining embankments are low or do not exist. Other floodwater discharges into these sub-areas and ponds on-site, inundating residential, commercial, or agricultural land.

The Alternative Formulation Briefing (AFB) was held for this project on 6 February 2002. Several critical questions arose from HQUSACE as a result of this review. The key question relates to where the project meets federal interest to participate, and will determine whether or not the project receives a favorable AFB Planning Guidance Memorandum from HQUSACE. This key issue is as follows:

> **Does the project meet the 800 cubic feet per second (cfs) requirement for the 10-percent and/or 1800 cfs for the 1-percent flood discharge criterion to warrant federal interest to participate per the ER 1165-2-21 regulation?**

This issue was discussed at length in a follow-up meeting on February 27, 2002 with HQUSACE staff members and the ASACW in Washington D.C. Due to the existing landscape of the project, ASACW questioned achieving the urban drainage criteria. Guidance was given to conduct additional analysis to settle this policy question.

Assumptions Made for Flow Criteria Based on Guidance from HQUSACE:

a. Modify the hydrologic models for the Southwest Valley Flood Damage Reduction Study. This work was accomplished using existing condition hydrology for the 10-percent and 1- percent flood discharge and future condition hydrology for the 10- and 1 percent flood discharge. From the results of this analysis, determine the points at which the 10- percent flood discharge produces 800 cfs and the 1- percent flood discharge produces 1800 cfs in the Isleta Drain for both existing and future conditions. The following assumptions were applied to the models:

1) Remove all flow restrictions in the Isleta Drain to provide for unlimited capacity of future flows into and through the Drain.

2) For future condition hydrology, consider developed conditions as allowing for free discharge over the drainage basin.

3) Allow for breeching failure at points along the Arenal Canal where overtopping occurs. Assume irrigation flows (150 cfs) from the Arenal Canal will escape and be added to the storm water flows contributing to the Isleta Drain.

4) Perform the analysis without the proposed AMAFCA I-40 Interceptor channel as identified in the Drainage Master Plan in place due to no current or future plans for funding.

5) Apply a risk and uncertainty analysis to the Amole Del Norte Channel for freeboard encroachment in consultation with the government.

6) Perform the analysis with the valved outlets of the AMAFCA Dams in the open position due to the New Mexico State Engineers Rio Grande Compact requirements on holding flood waters in the valley no longer than 96-hours after the rain event (see more detail in the Planning Constraints section).

7) Perform the analysis without the proposed AMAFCA Guac Dam in place as identified in the Drainage Master Plan in place due to no current or future plans for funding.

8) Perform the analysis without the proposed AMAFCA McCoy Dam Diversion Channels in place as identified in the Drainage Master Plan in place due to no current or future plans for funding.

Results and Conclusions:

Four distinct flow conditions were analyzed to determine the point at which each condition met the flow criterion, 800 cfs for a 10- percent flood discharge or 1800 cfs for a 1- percent flood discharge. The four flow conditions analyzed were the 10- & 1- percent flood discharge storm events for both existing and future developed conditions.

Based on a field investigation, all flow paths and contributing drainage areas between Unser Boulevard and Arenal Canal were identified; and all locations where runoff reaches the canal were identified. Mesa runoff hydrographs were added to local runoff hydrographs with due regard to time distribution of runoff.

After computing and adding of valley sub-basin runoff on the west side of Isleta Drain, the hydrographs were accumulated along the Isleta Drain, with Arenal Canal overflows added in where they would eventually reach the Isleta Drain irrigation base flows.

The points at which flow criterion is met are as follows (see Figure 1.5A in Appendix A):

Isleta Drain

1. 10-percent flood discharge (800 cfs minimum) with existing watershed development conditions is met on the Isleta Drain within Isleta reach IS-10, at Arenal Road – 815 cfs

2. 1-percent flood discharge (1800 cfs minimum) with existing watershed development conditions is met on the Isleta Drain within Isleta reach IS-11, at Pajarito Lateral – 1825 cfs.

3. 10- percent flood discharge (800 cfs minimum) with future watershed development conditions is met on the Isleta Drain within Isleta reach IS-7, at Rosendo Garcia Road – 1376 cfs.

4. 1-percent flood discharge (1800 cfs minimum) with the future watershed development conditions is met on the Isleta Drain within Isleta reach IS-7, at Rosendo Garcia Road – 3750 cfs.

Away from the Isleta Drain

5. The 10- percent flood discharge (800 cfs minimum), with future watershed development conditions is met below the North-South Coors Pond spillway near the intersection of N/S Coors and Bridge Boulevard - 801 cfs.

6. The 1- percent flood discharge (1800 cfs minimum), with future watershed development conditions is met below the North-South Coors Pond spillway near the intersection of N/S Coors and Bridge Boulevard - 2554 cfs.

When the assumption was made to remove all flow restrictions from the Isleta Drain to evaluate the point at which flow criterion is met, it was also assumed that the flow restriction was removed from Rio Bravo Boulevard. Based on this assumption, and since the Isleta Drain provides a hydraulic connection throughout the valley, it was determined there would be no need to re-evaluate the flows downstream (south) of Rio Bravo Boulevard. The flows would continue to increase as they move downstream and additional tributary flows are added (just south on Figure 1.5).

Since the $Q_{10} \geq 800$ cfs criterion for both existing and future conditions is met either at or upstream from the point at which $Q_{100} \geq 1800$ cfs is met, it will not be necessary to request an exception to this policy. This point where the minimum flow criteria is met fell within Federal interest, areas outside Federal interest are shaded in hatch pattern. (see Figure 1.5B in Appendix A).

Therefore, based on the aforementioned assumptions used in the Isleta Drain analysis for the Southwest Valley Flood Damage Reduction Study, USACE Policy per 1165-2-21 is met regarding flow criteria and SPD concurs with the technical findings.

This position paper was officially approved by USACE Headquarters in August of 2002.

Additionally, the sensitivity analysis demonstrated that it was likely that additional benefits could be realized. The detailed analysis that followed resulted in an adjustment to without project damages. The 1 percent chance flood event (100-year) would cause approximately $11 million in damages to the Southwest Valley within the damage area. The damage area is bounded by Bridge Boulevard to the north, Rio Bravo Boulevard to the south, the Arenal Ditch to the east, and the Arenal Main Canal to the west. The alternative formulation work that followed resulted in the preferred alternative outlined below:

Southwest Valley Plan Formulation

The PDT pursued alternatives that would capture West Mesa flood flow utilizing the existing Middle Rio Grande Project Feature's surface drain facilities. The main features of the proposed work would involve utilizing existing easements, widening existing drains, constructing a large ponding detention area, and constructing two new channels.

2. EXISTING CONDITIONS WITHOUT PROJECT-PROBLEM IDENTIFICATION

This section describes the flooding problems and flood control needs in the Albuquerque Southwest Valley study area.

2.1 FLOODING PROBLEMS

Portions of the Southwest Valley are subject to flooding from a variety of sources. The runoff from the West Mesa is largely controlled by a series of dams, detention basins, and diversion channels constructed by AMAFCA, Bernalillo County, and the City of Albuquerque. Most of these facilities release controlled discharges directly or indirectly into existing drain facilities. Flood damages occur when large floods overwhelm the capacity of these facilities, or the capacity of the drains or canals is exceeded.

Some portions of the West Mesa are directly tributary to the valley. The runoff consists of high peak discharges that, due to the steep slopes, typically transport large quantities of sediment. The runoff overtops the Arenal Main Canal, Gun Club Lateral, or Butte Lateral embankments, and combines with the agricultural supply water to exceed the capacity of these facilities during floods.

Runoff from the valley floor also causes flooding. The valley is traversed by a series of irrigation canals, laterals, acequias, and drains; most of which have embankments from one to three feet high. These embankments and raised roadways have divided the valley into many small subareas. Some of the subareas discharge into the agricultural drains where the drain embankments are low or do not exist. Others either discharge into adjacent subareas or pond on-site, inundating residential, commercial, or agricultural land. The flows from subareas that discharge into irrigation drains combine with the runoff from the mesa, groundwater, and agricultural return water to exceed the capacity of the drains, inundating adjacent lands.

The valley is also subject to flooding from the Rio Grande. The Albuquerque west levee, a major flood control structure, constructed by the Corps of Engineers in 1958, protects the northern portion of the Southwest Valley and is designed for a discharge of 42,000 cfs in the Rio Grande. This levee extends south of Rio Bravo Boulevard and exists throughout the Federal Project Area as described in Section 2.2.

2.2 WATERSHED DESCRIPTION

The study area proper is located west of the Rio Grande and comprises three physiographic regions: the relatively flat West Mesa, the steeply sloping “ceja” or mesa edge, and the very flat valley proper. The West Mesa drains into Westgate Dam or Cedar Wash; the ceja drains into other AMAFCA dams or directly onto the valley. Elevations range from 6,000 feet on the West Mesa to 4,870 feet at the Rio Grande. The study area encompasses 177.7 square miles, including 23.5 square miles of valley area and 154.2 square miles of West Mesa and ceja area. Detention dams constructed by AMAFCA, control 41.4 square miles of the West Mesa drainage area. Another 17.4 square miles of mesa area that contributes to valley flooding is uncontrolled.

The valley area drainage system is defined and delimited by irrigation canals, groundwater/irrigation wastewater drains, and numerous roadways. Because many of the larger irrigation canals and major roadways are constructed several feet above the surrounding ground level, they function as drainage divides and ponding area boundaries.

2.3 FEDERAL OBJECTIVES

The Federal objective of water and related land resources planning is to contribute to national economic development (NED) while protecting the Nation's environment through compliance with national environmental statutes, applicable executive orders, and other Federal planning requirements. The intent of the Federal objective is to alleviate problems and realize opportunities related to the output of goods and services or related to increased economic efficiency. Contributions to NED are measured in terms of increases in the net value of the national output of goods and services, expressed in monetary units; direct net benefits that accrue in the study area and the rest of the nation; and increases in the net value of those goods and services that are both marketed and unmarketed.

3. PLANNING CONSTRAINTS

The planning parameters used to define the flooding problems and develop and evaluate solutions to those problems are as follows:

1. The study was limited to the watershed area in the immediate vicinity of the Southwest Valley of Albuquerque and Bernalillo County, New Mexico;

2. Existing data and information were utilized to describe the project area and to develop hydrologic and hydraulic models;

3. Flood damage reduction plans that induce damages in other areas were avoided;

4. To be implementable, the total benefits derived from a flood damage reduction plan must equal or exceed the total costs;

5. To be implementable, flood damage reduction plans must be in full compliance with environmental laws and regulations, including the National Environmental Policy Act of 1969 (NEPA); and

6. To be implementable, a project must have the support of a non-Federal sponsor willing to cost share at the rate defined by the Water Resources Development Act of 1996 (Public Law 104-303).

7. Alternatives requiring storage of floodwaters without release into the Rio Grande are constrained by requirements of both New Mexico State Law and Interstate Compact. Given that all surface flows are already allocated, the State Engineer requires that flood flows be released from a detention structure within a 96-hour period. This also makes sense from an engineering perspective, as it prepares the detention facility for a potential

subsequent storm event. To avoid this 96-hour requirement, it is possible the local project sponsor could purchase a water right for waters generated by and stored after a flood event. However, there are two factors which would make this problematic; 1.) Water rights are just that. They allow the owner a usage right to the water, not a real property ownership. Water rights are seniority ranked by the date the right was established. During times of limited supply the senior users can call a junior users water rights, forcing evacuation of any detained floodwaters. 2.) Water right owners must put the water to beneficial use in order to maintain ownership. Beneficial usage might include agricultural irrigation, ground water recharge, or other use. This would require that the project sponsor develop a method of utilizing the stored water after a flooding/storage event. In either case, the Local Project Sponsor would not be able to guarantee the Government with any surety that a non-pumped detention project could be operated and maintained as a fully operational facility.

4. FORMULATION OF ALTERNATIVES

Plan Formulation Criteria and Rationale

The following paragraphs discuss the technical, economic, environmental, and social criteria used to develop the alternatives formulated to meet the stated objectives of the study.

Technical Criteria

The following technical criteria were adopted for use in developing, evaluating, and comparing alternative flood damage reduction plans.

1. The plan should effectively and efficiently alleviate the problems identified.

2. The plan must be technically feasible, employing established engineering methods and procedures applicable and appropriate to the solution.

3. The plan should be designed to provide a project life of at least 50 years.

4. Existing facilities should be used to the maximum extent possible.

5. The plan is to be complete within itself and not require additional future improvements other than normal replacements and operation and maintenance.

6. The plan must adhere to Corps of Engineers engineering and design criteria for flood control.

Economic Criteria

The economic feasibility of a plan is displayed as a relationship of benefits-to-costs, the benefit/cost ratio. Identified as benefits, are the monetary savings due to damages prevented and reductions in the costs of emergency services. These project benefits are annualized to represent a yearly benefit applicable for the life of the project. The project implementation cost, which includes the construction or first cost, the interest on the first cost during construction, and the operation and maintenance costs, are also annualized to represent an annual project cost

applicable for the analysis period of the project. The annual benefits and the annual costs are then related in a ratio of benefits-to-costs. To be economically feasible, a plan must have benefits which equal or exceed costs, *i.e.*, a benefit/cost ratio equal to or greater than 1.0.

Plans formulated to provide for flood protection and other water resource needs should be designed to make the maximum possible contribution to NED and be consistent with protecting the nation's environment as established in the Water Resources Council, *Economic and Environmental Principles and Guidelines, for Water and Related Land Resources Implementation Studies, Chapter II—National Economic Development Benefit Evaluation Procedures* (WRC 1983c). The NED goal is to enhance the value of the nation's output of goods and services and thereby improve national economic efficiency. To be consistent with protecting the nation's environment, the project will be designed to avoid and minimize adverse effects on environmental and cultural resources of the study area.

Further, the NED objective is to maximize the economic worth of alternative plans as set forth in the Principles and Guidelines. Moreover, the NED objective is to increase the nation's output of goods and services and improve national economic efficiency. These objectives relate to a plan's capability to prevent inundation from flood flows by comparing the plan's economic benefits with the project cost. The amount that a project's economic benefits exceed the project cost is defined as "net" benefits. In the plan formulation process, the plans that yield the greatest net benefits are the plans that make the greatest contribution to the NED objective.

To meet the Federal guidelines for planning water resource projects, the following economic criteria were followed.

1. All plans must be economically feasible, such that the flood reduction benefits must exceed the cost of the plan.

2. The recommended plan should be the plan that reasonably maximizes benefits over costs consistent with protecting the nation's environment (the NED plan) and has the greatest net benefits, unless the Assistant Secretary of the Army (Civil Works) grants an exception. Such an exception may be granted for a locally preferred plan when economically justified and at the additional expense of the non-Federal sponsor.

3. Each separable unit or purpose of a given alternative plan must provide benefits at least equal to its costs.

4. Alternative plans should be evaluated using current price levels, a 50-year period of analysis, and the current Federal discount rate for water resource projects as determined by the Department of Treasury. Annual costs and benefits for this study have been calculated at the current interest rate of 6.375 and November 2000 price levels. A 50-year amortization period was used for the period of analysis.

5. Annualized costs include the cost of operation, maintenance, repair, rehabilitation, and replacement.

National Economic Development Criteria

The NED procedures are for Federal administrative purposes and do not create any substantive or procedural rights in private parties. Criteria for evaluating NED effects of alternative plans include the following:

1. When an alternative procedure provides a more accurate estimate of a benefit, the alternative estimate may also be shown if the procedure is documented.

2. Steps in a procedure may be abbreviated by reducing the extent of the analysis and amount of data collected where greater accuracy or detail is clearly not justified by the costs of the plan components being analyzed. The steps abbreviated and the reason for abbreviation should be documented.

3. The following must be presented in support of the NED analysis:

    a. Installation Period - the number of years required for installation (design and construction) of the plan. If staged installation is proposed over an extended period of time, the installation period is the time needed to install the first phase.

    b. Installation Expenditures - the monetary expenses expected to be incurred during each year of the installation period.

    c. Period of Analysis - the time horizon for project benefits, deferred installation costs, and operation, maintenance, rehabilitation, repair, and replacement (OMRR&R) costs must be the same for all alternative plans. The period of analysis is the time required for implementation, plus the lesser of the period of time over which any alternative plan would have significant beneficial or adverse effects or a period not to exceed 50 years. Appropriate consideration should be given to environmental factors that may extend beyond the period of analysis.

    d. Benefit Stream - the pattern of expected benefits over the period of analysis.

    e. OMRR&R Costs - the expected costs over the period of analysis for operation, maintenance, repair, rehabilitation, and replacement necessary to maintain the benefit stream and agreed upon levels of mitigating losses to fish and wildlife habitats.

    f. Discount Rate - the rate established annually for use in evaluating Federal water resource projects.

Net NED benefits of a plan are calculated in average annual equivalent terms. In performing this calculation, the benefit stream, deferred installation costs, and OMRR&R costs are discounted to the beginning of the period of analysis using the applicable project discount rate. Installation expenditures are brought forward to the end of the period of installation by charging compound interest at the project discount rate from the date the costs are incurred. The project discount rate is used to convert the present worth values to average annual equivalent terms.

Environmental Criteria

Plans formulated under Federal directives must consider the opportunities for enhancement of the human environment through the management, conservation, preservation, creation, restoration, or improvement of natural and cultural resources in the proposed project area. Structural and non-structural measures must be evaluated according to guidelines established by NEPA, as amended, (P.L. 91-190), and the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, Chapter III—Environmental quality Evaluation Procedures* (WRC 1983d).

The following environmental criteria were considered:

1. Compliance with all pertinent Federal and state environmental, biological, and cultural resource laws and regulations, including, but not limited to, NEPA, the Endangered Species Act (P.L. 93-205), the Fish and Wildlife Coordination Act (P.L. 86-624), the National Historic Preservation Act (P.L. 89-665), and the Archeological Resources Protection Act (P.L. 96-95).

2. Coordination with Federal and non-Federal agencies, special interest groups, and the general public through cooperative efforts and public meetings.

3. Maintenance or enhancement of the quality of air, water, and terrestrial resources.

4. Preservation or enhancement of archeological or historical resources within the project area.

Social Criteria

Social well-being factors considered during the formulation of alternatives for the Southwest Valley study area include:

1. Potential for loss of life and hazards to public health and safety.

2. Effect on local community patterns and impacts to local development.

3. Preservation and enhancement of social, cultural, educational, and historic values of the area.

4. Preservation of aesthetic values of the area.

5. Provision of adequate water and related land-based recreational opportunities.

5. DESCRIPTION OF ALTERNATIVES AND RECOMMENDED PLAN

5.1 INTRODUCTION

The primary focus of this Feasibility Report/Environmental Assessment is to identify a flood damage reduction plan for the Southwest Valley that meets the criteria defined in Section 2. Other allied purposes, such as the preservation of open space, enhancement of the environment including fish and wildlife resources, improvement of water quality, implementing a non-structural solution such as an early warning emergency evacuation system and other related planning objective purposes were also investigated.

Participants in the plan formulation process have included Bernalillo County and the Albuquerque Metropolitan Arroyo Flood Control Authority, as project sponsors; Middle Rio Grande Conservancy District; Pueblo of Isleta; Bureau of Indian Affairs, Southern Pueblo Agency; City of Albuquerque; and the public.

5.2 PROJECT ALTERNATIVES EVALUATED AND ELIMINATED FROM FURTHER CONSIDERATION

Potential drainage management projects were investigated to develop recommended solutions to widespread flooding in the study area. Favorable features from reconnaissance level alternatives were grouped to create these alternatives. Early in the feasibility study, over 20 valley-wide solutions were studied but due to cost and a limited benefit base they were eliminated from further consideration. The team considered the following:

- No Action
- Non-Structural (Floodproofing)
- Small detention ponds (storage)
- Pumps
- Cross basin channels
- Combination Detentions and Storage

Options that were further explored as potential solutions are:

Option 1 -- Detention Storage and Use of Existing Drains for Storm Water Conveyance

In Option 1, the Isleta, Armijo, Los Padillas, Isleta Indian, Atrisco Riverside and the Isleta Riverside Drains are used to convey runoff during storm events in addition to agricultural water flows. A system of detention ponds is used to collect, attenuate and store peak runoff flows at locations where agricultural drain capacity is exceeded or to provide centralized storage for runoff from multiple sub-basins

Proposed detention ponds will store runoff until approximately 30 hours have passed since the beginning of the storm. The pond outflow rates were established to drain the ponds within 96 hours of the beginning of the design storm, or 66 hours after the end of the 30-hour duration design storm. If the pond volume requirements were excessive (insufficient undeveloped surface area available) for the 66-hour pumping period, pumping would begin with initial inflow into the pond to provide 96 hours of pumping. During future design phases it will be necessary to

balance pond volume requirements versus pumping capacity and duration. Mesa area ponds (MPonds) and valley ponds (DPonds) will outfall to the system of agricultural drains.

Option 2 -- Detention Storage and Pumping out of Existing Drains at Cross-Valley Pipe Drains for Existing Large Mesa Area Dams

Option 2 uses the system of drains with detention ponds in a manner similar to Option 1 but also adds pumping of storm water to the Rio Grande at two of the proposed cross-valley pipe drains – the Amole Dam cross-valley drain and the Don Felipe Dam cross-valley drain. These pipe drains have the additional benefit of providing a gravity outfall directly to the Rio Grande for the AMAFCA west mesa dams. Consequently their locations are limited by the dam locations and available alignments.

Mesa area ponds and valley ponds would outfall to the system of agricultural drains for conveyance to a pumping location.

Option 3 -- Existing Drains Widened and Used for Detention Storage and Storm Water Conveyance

Option 3 increases the runoff storage capacity available in the system of agricultural drains but still uses off-channel detention ponds where drain capacity will be exceeded. In Option 3 the Isleta Drain cross section upstream of Rio Bravo would be widened to a 70-foot bottom width section with 2H:1V side slopes. The Isleta Drain would be excavated to a 10-foot bottom width from Rio Bravo to the I-25 crossing. The Armijo Drain cross-section would be widened along its entire length to a 10-foot bottom width with 2H:1V side slopes. The Los Padillas Drain cross section would be increased to a 10-foot bottom width section with 2H:1V side slopes from south of Durand Road to Pajarito Road where the drain would be further widened to a 20-foot bottom width section to Raymac Road. Below Raymac Road the remainder of the Los Padillas Drain would continue within a 10-foot bottom width, 2H:1V section. In addition to excavation of the existing drains, several culvert crossings are proposed for modification to maximize the storage in the upstream drain segment

Option 4 -- Detention Storage and Below Ground Conveyances in MRGCD Rights-of-Way

Option 4 uses a system of pipe and concrete box culvert storm drains to convey runoff without mixing storm water and agricultural water in the drains. The proposed system of conveyances would be constructed in rights-of-way parallel to the existing Isleta, Armijo, and Los Padillas drains. The Atrisco Riverside, Isleta Indian and Isleta Riverside drains would be used to convey storm water. Cross-valley drains at Amole Dam and Don Felipe Dam would be used to drain the dams and to provide an outfall for segments of the pipe and box culvert conveyance system. Equalizing ponds would be required adjacent to the cross-valley drains to provide reservoirs for pumping to the drainpipes

After preliminary evaluation, it was quickly determined that most of these options were either cost prohibitive due to the benefit base.

5.4 HYDROLOGIC ANALYSIS METHODOLOGY

Due to the complexity of the hydrology for this watershed, a detailed analysis is contained in the main report. For additional information, please refer to Appendix D.

The Southwest Valley study area was divided into 237 sub-basins ranging in size from 5 to 290 acres. Of these, 91 are non-contributing (up to 500-year volumes) and 99 are partially contributing. The non-contributing sub-basins have sufficient capacity to retain all excess precipitation, and thus, do not contribute flows to downstream or adjacent sub-basins. Ridges (e.g., roads, berms, laterals, canals, and other raised structures or natural features), high ground, and agricultural drains define the sub-basin boundaries. The Cedar Wash watershed was divided into 52 sub-basins ranging in size from 200 to 3,000 acres. The overall Southwest Valley watershed is shown on Figure 2.2A in Appendix A.

The Federal Project Area resulting from the re-evaluation is that portion of the study area roughly bounded by Bridge Boulevard on the north; the Rio Grande on the east; Rio Bravo Boulevard on the south; and Coors Boulevard on the west. The contributing drainage basin into the Federal Project Area is shown on Figure 2.2B, also located in Appendix A.

WITHOUT-PROJECT FLOODPLAINS (EXISTING CONDITION)

Floodplain Analysis

The results of K-ROUTE modeling for the 10-, 25-, 100-, and 500-yr. floods for the area north of Rio Bravo (Isleta Drain Segments 2-15), were presented previously in Table 5.3-12A for existing conditions hydrology. No project improvements were considered in this analysis.

The resulting existing condition floodplain elevations were mapped as shown on Figure 2.6A (overall damage area) and Figure 2.6B (enlarged view of IS6, IS7 and IS8).

The floodplain extent for Arenal Main Canal overflows were determined by taking one or more representative cross sections across the potential flow paths and outside the limits of the Isleta Drain floodplain. A flow depth was estimated using the selected cross section and Manning's Equation and that flow depth was then used to map the floodplain extent. This procedure was used for the Arenal overflows only; the Isleta and Armijo Drain floodplains were based on elevations from the K-ROUTE modeling.

These "without project" floodplains can be compared to the "with project" floodplains, described in later sections of this report, to determine the extent of improvements and damage reduction that may be expected from the proposed project.

FUTURE WITHOUT-PROJECT CONDITION

Corps of Engineers' Engineering Regulation 1105-2-100 describes the criteria that must be met to satisfy the without project condition. They are as follows:

- Assume floodplain communities belong to the National Flood Insurance Program (NFIP) administered by the Federal Emergency Management Agency. The City of Albuquerque and Bernalillo County participate in the NFIP and have adopted ordinances, which require new development within the 1 percent chance floodplain to be built at or above the median discharge 1 percent chance flood level.
- Uncertainties in without project conditions must be explicitly considered. For example, for any particular damage reduction study there may be other Federal or non-Federal flood control or drainage plans, which are authorized or in various stages of planning but, which are not yet constructed. The City of Albuquerque (COA), AMAFCA and Bernalillo County (BERNCO) have identified several projects, which have been or would likely be constructed during the feasibility phase. If economically justified, the sponsors would apply for Section 104 credit. Section 104 of Public Law 99-662 identifies criteria for determining whether work carried out by local interests is compatible with a flood control project and that the local improvement directly relates to a flood control purpose. Compatible work may be considered part of the project and credited against the non-Federal share of the cost of the project. Local work must receive Army approval prior to construction to be eligible for credit, taking into account the economic and environmental feasibility of the project. Benefits and costs of the compatible work will be considered in the economic evaluation of the Federal project. The potential Section 104 projects are described below. All are designed to reduce flood damages resulting from the 1 percent chance future condition storm.

    (1) Borrega Dam (AMAFCA). Borrega Dam will control runoff that presently enters the valley because the existing inlet to Hubbell Reservoir from Borrega Arroyo has limited capacity. Under existing conditions, this inflow causes flooding in the Gun Club Road and Coors Boulevard areas. The damage reaches are primarily mobile homes, where the depth of flow is significantly below the finished floor elevation. Construction of Borrega Dam would remove the 1 percent chance and the 0.2 percent chance floods from sub-basin 252 and riverine areas 3B and 3C. Construction was completed in December 2000. The project is included in the without project condition.

    (2) Five Points Project (AMAFCA). The Five Points Road drainage project, which would consist of a storm drain, detention basin, and pumping station, would reduce localized street flooding in sub-basins 21 and 25. This project is currently in the design phase and may become part of the Isleta Phase IA project described below. However, in either case, since the costs exceed the damages prevented, the project does not qualify as a candidate Section 104 project, and is therefore included in the without project condition.

    (3) Isleta Phase IA (BERNCO). Phase 1A includes a detention pond, pumping plant outfall to the Rio Grande, and a short length of gravity drain. Phase 1B consists of gravity drains in Isleta Boulevard that would drain nearby ponding areas and transmit the water to the detention basin. Phases IA and 1B are scheduled for completion in 2003. The Isleta Boulevard Phase IA project would eliminate the 1 percent chance flood

damages in sub-basins 10, 13, 16 (ponds 16.1, 16.2, and 16.3), 25, 31, and 34. Average annual benefits for Isleta Phase IA are $129,000. The project cost is $17.2 million. The benefit to cost ratio is 0.11; therefore the Isleta Phase IA project does not qualify for Section 104 credit and is included in the without project condition.

(4) Osage-La Media (COA). The Osage-La Media project, consisting of a detention basin, pumping station, and storm drain collector system, is complete. This project along with the Gonzales detention basin project mentioned below will reduce flooding in the areas along Isleta Drain north and south of Bridge Boulevard and in sub-basins 20, 23, 225, 226, 700, 702, 706, 708, 710, 712, and 714. The estimated first cost is $3,530,000, which equates to an average annual cost of $237,000. Estimated average annual benefits are $75,000. The benefit to cost ratio is 0.32. Therefore, this project does not qualify for Section 104 credit and is included in the without project condition. The detention basin was completed in April 2001. The storm drain collector system and pumping station were completed in September 2001. Its contributing drainage area is now non-contributing to the valley area.

(5) Gonzales Detention Basin (COA). This project, which consists of a detention basin, outfall, and storm drain system, was completed in 1997. Since the Gonzales project was constructed prior to the start of the feasibility phase, it is not eligible for Section 104 credit, and has been included in the without project condition. Its contributing drainage area is now non-contributing to the valley area.

(6) Adobe Acres (BERNCO). This project consists of four phases. The Phase I improvements (*i.e.*, detention basin, pumping station, and outfall) and Phase II features (*i.e.*, storm drain system in the eastern half of the subdivision) were completed in 1993 and 1996, respectively, and are therefore not eligible for Section 104 credit. Phase III improvements (*i.e.*, install storm drain system in the southwestern portion of the subdivision) are to be completed by August 2001. When completed, the project would reduce flood damages in sub-basins 195 and 201. Average annual benefits for this Phase are $138,000. The first cost is estimated at $2,918,000. Assuming a 50-year project life and amortization at 6.375 percent results in an average annual cost of $195,000. The benefit to cost ratio is 0.71. Therefore, the Phase III improvements do not qualify for Section 104 credit and have been included in the without project condition. Phase IV is the installation of a storm drain system in the Santa Anita Street area on the east side of Isleta Boulevard. Phase IV improvements would reduce flood damages in sub-basins 48 and 49. Average annual benefits for these areas are estimated to be $4,700. Since the construction costs would exceed the benefits, there is no Federal interest to participate in this phase.

(7) Valley Gardens (COA). The Valley Gardens project uses on-site retention for flood damage reduction within sub-basin 138. The project provides protection from the 1 percent chance future condition storm, but some residual damage will occur during the 0.2 percent chance flood. The

project was completed in December 2001. Under existing conditions, the costs are $1.1 million. Amortized at 6.375 percent with a project life of 50 years, this has an average annual cost of $73,000. Average annual benefits are $32,000; the benefit to cost ratio is 0.44. Therefore, the project does not meet the Section 104 criteria and is included in the without project condition.

- Executive Order 11988 (Flood Plain Management) remains in effect. The intent is to avoid floodplain development, reduce hazards and risk associated with floods, and restore and preserve natural floodplain values. In the event there is no alternative to construction in the floodplain, as is the case with flood control projects, the Corps is required to minimize the adverse impacts induced by construction of the projects. In considering adverse impacts, the following should be addressed:
  (1) Induced new development in the floodplain or induced improvements to existing development in the floodplain that would increase potential flood damages; and
  (2) The detrimental effect of induced activities on natural floodplain values.
- Flood damage reduction studies are conducted using a risk-based analytical framework. Projects are analyzed and described in terms of their expected performance, not in terms of levels of protection. Models, data, and measurement and many physical, social, economic, and environmental conditions are subject to variation and uncertainty. The risk framework captures and quantifies the extent of the risk and uncertainty, and enables quantified tradeoffs between risk and cost.
- Minimum flows, minimum drainage area, and urban drainage. In urban and urbanizing areas provision of a basic drainage system to collect and convey local runoff is a non-Federal responsibility. Water damage problems may be addressed under flood control authorities downstream from the point where the flood discharge is greater than 800 cfs for the median discharge 10 percent chance flood. Drainage areas of less than 1.5 square miles are assumed to lack sufficient discharge to meet the above criterion. Exceptions may be granted in areas of hydrologic disparity, that is areas producing limited discharge for the median discharge 10 percent chance event but in excess of 1,800 cfs for the one percent event.

  The upstream most point where the 800 cfs discharge for the 10 percent chance event is met is at Rosendo Garcia Road within the Isleta Drain. At this point a flow rate was calculated of 1376 cfs with future watershed development conditions. Thus, all areas downstream of this point meet the minimum flow criteria.

FUTURE WITHOUT PROJECT ZONING

The DPM design criteria for flood control projects assume a fully developed watershed. The non-Federal sponsors support adopting the DPM criteria. For this reason, the sponsors may consider a "buy-up" of the National Economic Development (NED) plan. Consequently, the DPM criteria were applied to future without-project hydrology and hydraulic analyses for comparison with the NED plan.

Ordinarily, the plan that reasonably maximizes net benefits (*i.e.*, the NED plan) is recommended. However, projects may deviate from the NED plan if requested by the non-Federal sponsor and

approved by the ASACW. Plans requested by the non-Federal sponsor that deviate from these plans shall be identified as the Locally Preferred Plan (LPP). When the LPP is of less scope and cost and meets the Administration's policies for high-priority outputs, an exception for deviation is usually granted by ASACW. The LPP must have greater net benefits than smaller scale plans, and enough alternatives must be analyzed during the formulation and evaluation process to insure that net benefits do not maximize at a smaller scale than the sponsor's preferred plan.

Conversely, if the sponsor prefers a plan more costly than the NED plan, and the increased scope of the plan is not sufficient to warrant full Federal participation, ASACW may grant an exception as long as the sponsor pays the difference in cost between those plans and the locally preferred plan. The LPP must have outputs similar in-kind, and equal to or greater than the outputs of the Federal plan.

The most likely future without-project development scenario was developed in consultation with the Bernalillo County Planning Department. The County's Southwest Area Plan 2000 was used to project future development, except in those few instances where land parcels have been zoned for higher density use. In those cases, the actual zoning published in the *Bernalillo County Zone Atlas*, dated 1999 was used.

Mesa Area

The West Mesa area west of Coors Boulevard and south of Central Avenue is largely undeveloped. Areas to the north of Rio Bravo Boulevard and east of 118th Street are zoned for medium-high density (*i.e.*, up to nine dwelling units per acre). The area bounded by Rio Bravo Boulevard to the north, 118th Street to the west, and Pajarito Road to the south and Coors Boulevard to the east is zoned medium density (*i.e.*, up to six dwelling units per acre). The remainder of the West Mesa area is zoned low density (*i.e.*, one dwelling unit per acre). However, recent trends and developer inquiries have led to the opinion by Bernalillo County planners that these areas are likely to develop at a density of eight (8) dwelling units per acre. This is an overall increase from past predictions and was used in the analysis for developing the Federal plan. See the attached letter from Bernalillo County Public Works Department which addresses this issue at the end of this section.

Cedar Wash

Only the portion of the Cedar Wash watershed north of the Isleta Reservation line will likely be developed in the future. The portion of the watershed within the Isleta Reservation is not expected to develop.

Isleta Pueblo

The only development anticipated on the Isleta Reservation is along State Road 45 above the valley and east of Interstate 25. The area would be zoned low density, allowing one dwelling unit per acre.

Valley Area

Under existing conditions, the northern portion of the valley is largely developed, whereas, the southern half is largely undeveloped. Areas to the north of Rio Bravo Boulevard and east of the Arenal Canal are zoned up to three dwelling units per acre. Under existing conditions, areas to the south of Rio Bravo Boulevard allow two or three houses per acre; however, under future without project conditions, this area is zoned low density (*i.e.*, up to 1 dwelling unit per acre).

County of Bernalillo

State of New Mexico

PUBLIC WORKS
2400 BROADWAY, S.E.
ALBUQUERQUE, NEW MEXICO 87102
(505) 848-1500

March 26, 2002

Ms. April Fitzner
Albuquerque District, COE
4101 Jefferson Plaza, NE
Albuquerque, NM 87109

RE: Projected Development Densities in the Southwest Valley Flood Damage Reduction Feasibility Study (SWVFDRFS) Area

Dear Ms. Fitzner:

The Bernalillo County Public Works Division (BCPWD) and the Albuquerque Metropolitan Arroyo Flood Control Authority have had recent discussions with Bernalillo County planners centered on future development densities in the watershed for the Southwest Valley Flood Damage Reduction Feasibility Study (SWVFDRFS). From that discussion, it was learned that future densities for some of the areas in the study are likely to develop in a greater density than those predicted in planning documents used to develop hydrographs for the current SWVFDRFS.

The areas of concern are the west mesa areas bounded by Coors Boulevard on the east, the Ceja on the west, Interstate 40 on the north, and Pajarito Road. Recent trends and developer inquiries have lead to the opinion that these areas are likely to develop at a density of eight (8) dwelling units per acre. This is an increase from past predictions. The valley areas of the study area are still predicted to build out to densities used in current planning documents.

The increased densities on the west mesa area will likely result in greater runoff volume and peak flows and we feel that it is important to consider the future build out of these areas. With this letter we are requesting that the study consultant be directed to consider the greater densities predicted for the future and to develop hydrographs based on that information. The below information shows future development in the Southwest Valley from Middle Rio Grande Council of Government data.

Forecast Socioeconomics, South Valley Area Plan
Source: Middle Rio Grande Council of Governments (MRGCOG)

Year	Dwelling Units	Single Fam	Multi Fam	Pop	Basic Emp.	Retail Emp.	Service Emp
2000	24841	23278	1563	71276	2296	2319	4767
2005	28420	26451	1969	78991	2636	2601	5261
2010	30457	27776	2681	82862	2696	3120	6356
2020	35377	31207	4170	90937	3029	4250	8664
2025	35376	33611	4169	92935	3719	10520	4126
2050	47108	41731	5377	110143	13951	11572	28127

The BCPWD will be glad to provide information to assist you and your study contractor in this activity. We look forward to continued work on this project. If you have any additional questions please contact Brad Catanach at 848-1518.

Sincerely,

Mathew O'Grady, P.E.
Technical Services Director
Bernalillo County Public Works Division

Cc: Jerry Lovato, AMAFCA

WITHOUT-PROJECT FLOODPLAINS (FUTURE CONDITION)

Floodplain Analysis

The results of K-ROUTE modeling for the 10-, 25-, 100-, and 500-yr. floods for the area north of Rio Bravo (Isleta Drain Segments 2-15), were previously presented in Table 2-12B for future condition hydrology. No project improvements were considered in this analysis.

The resulting future condition floodplain elevations were mapped as shown on Figure 3.3A (overall damage area) and Figure 3.3B in (enlarged view of IS6, IS7 and IS8) in Appendix A.

The floodplain extent for Arenal Main Canal overflows were determined by taking one or more representative cross sections across the potential flow paths and outside the limits of the Isleta Drain floodplain. A flow depth was estimated using the selected cross section and Manning's Equation and that flow depth was then used to map the floodplain extent. This procedure was used for the Arenal overflows only; the Isleta and Armijo Drain floodplains were based on elevations from the K-ROUTE modeling.

These "without project" floodplains can be compared to the "with project" floodplains, described in later sections of this report, to determine the extent of improvements and damage reduction that may be expected from the proposed project.

FUTURE WITHOUT PROJECT ECONOMIC ANALYSIS

Area Of Consideration

Appendix B presents the economic analysis conducted for the Southwest Valley feasibility study. The hydrologic analysis identified 237 ponding areas, which were treated as separate floodplains in both the hydrologic and economic investigations.

It is currently estimated that the mean 1-percent chance exceedance flood would cause damages of about $9.9 million in the study area ("Year 1" conditions) up to $14.2 million in the future ("Year 27" conditions). Interpolating damages between the present and future conditions (using methods described in paragraph B-06 of this appendix), discounting damages to present value, and summing those damages over the project lifetime, the mean 1-percent chance event would cause an average of $11.0 million in damages. Additionally, other damages, estimated at approximately 13 percent, have not been included in these figures. These include costs for emergency services, pumping, vehicle damages, road damages, utility damages, annual flood insurance, and future fill.

Economic Risk and Uncertainty Analysis

The purpose of the land use analysis is to estimate the damages that will occur as a result of different flood events, both now and in the future. Flood damage is generally treated as a

function of the depth (stage) of water. The components of the damage estimate analysis include the following:

1. An inventory of the number, type, value, and susceptibility to flooding of structures in the floodplain;
2. An estimate of property values;
3. An estimate of content values;
4. A determination of the flood stage at which damage begins;
5. A determination of first floor elevations of structures;
6. Reponses to flood forecasts and warnings
7. Flood fighting efforts;
8. An estimate of cleanup costs; and
9. An estimate of damages at each level of inundation.

General Computational Procedures

The assumptions and procedures used to analyze and quantify the economic variables are presented in this section. The hydro-economic model used to develop expected annual damages is based on discharge-frequency, stage-frequency, and stage-damage curves used to develop a damage-frequency curve. Stage-percent damage curves express dollar damages resulting from varying depths of water based on a percentage of the value of structure and contents.

Each surveyed property was assigned to a category (*e.g.*, commercial, residential, public, outbuilding, transportation facilities, utilities, and vehicles) with as many subcategories (*e.g.*, contents) as necessary. Details of ground and first floor elevations were also noted. The depth-damage relationship for each category was expressed as a cumulative percentage of value for each foot of inundation. The depth-damage relationships were derived from historical data obtained from insurance companies, a commercial content survey, the Flood Insurance Administration, and Corps of Engineers data and experience. Note that the 2001 residential curves developed by the Institute of Water Resources (IWR) were used; thus, the residential content damages are a direct relationship to structure value.

Value of Property: A survey of structures within the floodplain was conducted in 2000 and re-evaluated in 2002, to evaluate the flood threat to the Southwest Valley. Property categories surveyed include residential, commercial, public buildings, vehicles, transportation facilities, utilities, and outbuildings (*e.g.*, sheds and detached garages).

Depreciated, replacement residential structure values were computed using Bernalillo County assessor records, which display the assessed value for land in the study area and improvements to that land. The properties were then compared to actual sales data in the area and field inspected for consistency and first floor elevations.

Content values were estimated from several sources. Residential content values were fixed at 50 percent of the structure value. Generally, property insurers estimate content values at greater

than 55 percent of structure value. Commercial and public content values were estimated primarily from surveys of similar establishments and interviews.

Vehicle estimates were determined using in-house data and published surveys. It is assumed that all business-related vehicles would have been evacuated from the floodplain. Therefore, the vehicles that would remain in the floodplain would be associated with residential structures and apartments. The typical household in Bernalillo County owns two vehicles. It was assumed that 1 of these vehicles was driven out of the floodplain. The remaining vehicles will be distributed among the residential structures located within the 0.2 percent chance exceedance floodplain.

Street and utility damage estimates were calculated from data provided by the Galveston District and applied to the measured linear feet of streets and utilities within the floodplain.

Table 5.3-13: Value of Damageable Property Without Project Conditions (Year 1)

VALUE OF DAMAGEABLE PROPERTY
WITHOUT PROJECT CONDITIONS (YEAR 1)
SOUTHWEST VALLEY FLOODPLAIN
(x $1,000 February, 2004 price level)

Land Use Category	EVENT							
	10%		4%		1%		0.20%	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Residential	30,324	301	31,723	310	34,865	312	36,078	312
Res. Content	16,678	165	17,448	170	19,176	169	19,843	174
Commercial	0	0	26	16	26	16	28	16
Comm. Content	0	0	28	18	28	18	28	16
Public	0	0	0	0	0	0	0	0
Pub. Content	0	0	0	0	0	0	0	0
Apartments	402	29	402	29	402	28	402	29
Apt. Contents	221	16	221	16	221	16	241	14
Total	**47,625**		**49,847**		**54,717**		**56,620**	

Table 5.3-14: Number of Structures Without-Project Conditions

NUMBER OF STRUCTURES WITHOUT PROJECT CONDITIONS (YEAR 1) SOUTHWEST VALLEY FLOODPLAIN

Land Use Category	EVENT							
	10%		4%		1%		0.20%	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Residential	432.26	2.04	449.98	2.07	492.58	2.25	510.04	2.15
Commercial	0.00	0.00	0.47	0.27	0.47	0.27	0.51	0.27
Public	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apartments	5	0	5	0	5	0	5	0
TOTAL STR.	437.26	2.0366719	455.45	2.0966489	498.05	2.2706388	515.55	2.1598643

Average Annual Damages

Risk and uncertainty analysis was used to derive average annual damages. Hydrologic and hydraulic uncertainty was combined through Monte Carlo simulations. A total of 100,000 simulations were run by reach and damageable property category. Separate analyses were performed for each reach to account for increasing flood volumes that would occur in the future, without-project conditions (identified in this appendix as "Year 27"), and then discounted to compute equivalent average annual damages. When flooding from all sources is considered, the Southwest Valley faces the risk of approximately $1.7 million in average annual damages to structures and contents. Tables 5A and 5B of Appendix B present the average annual damages that could occur from flooding in the study area without any flood protection, by land use category and floodplain, for present and future conditions. Table 8 of Appendix B presents damages and benefits for locations where structural flood control measures are feasible. Those damages are presented for the future condition, but are expected to be lower for the present, with-project condition.

Table 5.3-15: Single Occurrence Damages Pre-Project Conditions

SINGLE OCCURRENCE DAMAGES
WITHOUT PROJECT CONDITIONS (YEAR 1)
SOUTHWEST VALLEY FLOODPLAIN
(x $1,000 February, 2004 price level)

Land Use Category	EVENT 10% Mean	10% SD	4% Mean	4% SD	1% Mean	1% SD	0.20% Mean	0.20% SD
Residential	4,230	59	4,648	62	5,457	67	6,248	70
Res. Content	2,537	39	2,772	40	3,229	42	3,656	44
Commercial	0	0	2	2	2	2	3	2
Comm. Content	0	0	2	2	2	2	2	2
Public	0	0	0	0	0	0	0	0
Pub. Content	0	0	0	0	0	0	0	0
Apartment	54	8	54	8	62	8	72	8
Apt. Content	33	5	33	5	37	5	42	5
Subtotal - Structures	4,284	59	4,705	63	5,521	68	6,323	70
Subtotal - Contents	2,570	39	2,807	40	3,268	43	3,701	44
Subtotal - Structures and Contents	6,854		7,513		8,790		10,024	
Streets	68		106		199		550	
Utilities	0		495		769		1,248	
Vehicles	41		79		155		379	
Total	**6,963**		**8,192**		**9,912**		**12,201**	

Table 5.3-16: Average Annual Damages By Land Use Category

AVERAGE ANNUAL DAMAGES (YEAR 1) BY LAND USE CATEGORY						
(x $1,000 February, 2004 price level)						
LAND USE CATEGORY	Average Annual Damages (x $1,000 February, 2004 price level)					
		Probability Avg. Ann. Damages Exceed Indicated Amount				
		0.95	0.75	0.5	0.25	0.05
Residential	733.91	697.58	719.43	734.16	749.08	769.24
Res. Contents	456.52	434.63	447.23	456.61	465.74	478.93
Commercial	0.27	0.20	0.24	0.27	0.30	0.35
Comm. Contents	0.39	0.25	0.33	0.38	0.43	0.54
Public	0.00	0.00	0.00	0.00	0.00	0.00
Pub. Contents	0.00	0.00	0.00	0.00	0.00	0.00
Apartment	11.64	10.72	11.23	11.68	12.05	12.41
Apt. Contents	7.36	6.82	7.12	7.40	7.61	7.83
Subtotal - Structures	745.82	709.61	731.48	746.29	761.14	781.21
Subtotal - Contents	464.27	442.35	455.00	464.40	473.49	486.74
Subtotal - Structures and Contents	1,210.09	1,168.25	1,193.59	1,209.92	1,227.34	1,251.80
Streets, roads	10.63					
Utilities	59.99					
Vehicles	6.90					
Emergency Costs	19.31					
TOTAL	**1,306.92**					

HYDRAULIC PLAN FORMULATION

This section discusses the plan formulation process used to investigate the flooding problems and flood control needs for the Southwest Valley as defined in the previous section.

PLANNING OBJECTIVES

Planning studies conducted by the U.S. Army Corps of Engineers are guided by the principles and guidelines developed by the Water Resource Council entitled *Economic and Environmental Principles for Water and Related Land Resources*, dated 3 February 1983 (WRC 1983a) and *Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies, Chapter I – Standards*, dated 10 March 1983 (WRC 1983b). The guidelines establish the principles and standards to be used in formulating and evaluating alternative plans for water and related land resource studies. The planning process consists of a series of steps that identifies or responds to problems and opportunities associated with the Federal objective and specific State and local concerns, and culminates in the selection of a recommended plan. The process involves a systematic approach to making determinations and decisions at each step so that the interested public and decision makers can be fully aware of the basic assumptions employed, the data and information analyzed, the areas of risk and uncertainty, the reasons and rationales used, and the significant implications of each alternative plan.

The planning objectives considered for this feasibility report reflect professional and public concerns about potential flood hazards in the Southwest Valley study area, and are based upon the specific problems and needs identified in Section 3 of this report. The objective is to develop a flood damage reduction plan acceptable to the non-Federal sponsor, which:

1. Reduces the flood hazard that exists within the Southwest Valley floodplains within Albuquerque and Bernalillo County in order to preserve human life and reduce damages to existing property;

2. Contributes to the preservation and enhancement of natural and beneficial values of fish and wildlife resources, wetlands, and aesthetic qualities;

3. To the extent possible, avoids or minimizes, adverse impacts to the environment and cultural resources of the study area, and compensates for any unavoidable adverse effects caused by project implementation;

4. Maintains water quality conditions within the study area; and

5. Maintains existing open spaces to maximize public recreational opportunities.

HYDRAULIC ANALYSIS OF OPTIONS

In determining the final version of the Federal project, a number of iterations were performed to investigate various project configurations in order to determine the NED Plan. After the completion of each iteration, the Technical Advisory Committee (TAC) evaluated the results and proposed changes for the next iteration. The TAC was composed of representatives from Resource Technology, Incorporated (RTI) the AE firm performing the hydrology/hydraulics

funtion, AMAFCA, BERNCO and Albuquerque District USACE. Table 4-1 is a comprehensive comparison of the differences between iterations.

Within the iterations, refinements were made based upon interim results and stated design criteria and assumptions. Design criteria included limiting the depth of flow over proposed roadway dip sections to 0.5 feet, limiting the top-of-road elevation increase to the proposed service roads (additional fill required) to approximately 1 foot, and minimizing the floodplain extent.

The design criterion requiring the most extensive and expensive changes was limiting the flow over the roadway dip sections in widened drains (see Figure 4.2 in Appendix A). Changes to the models based on this criterion were therefore limited to the adopted designs. The two adopted iterations were Iteration 2 and Iteration 4. Iteration 2 defined Alternative 1. Iteration 4 defined Alternative 2 and Alternative 3.

Iteration 1

Iteration 1 included widening of the drains (see Figure 4.2) within the Federal project limits (Armijo Segments 1-8, Isleta Segments 2-17, and Los Padillas Segments 1-4), improvements to the culverts under Rio Bravo, the construction of the Los Padillas Extension Drain and outfall channel to the Rio Grande, diversions to Pond 187 from Isleta and Armijo drains, and two structures limiting flow downstream. The two flow limiting structures that were proposed are, an 18" orifice plate at the downstream end of Los Padillas Segment 4 with an overflow weir redirecting high flow to the outfall channel; and a reduced sized culvert in Isleta Segment 17 with an overflow weir redirecting high flow to the Los Padillas Extension Drain. The flow limiting structures, in both cases, are used to raise the water surface elevation and force a spill into the next downstream segment of the proposed system as well as to regulate flows continuing downstream in these two drains. In addition, five storm drains were incorporated into Iteration 1; these are identified as follow systems P11F, M11A, N11G, N11A, and P12H. A description of the storm drain orientation is as follows:

- P11F: Line in Barboa Road and Joe Sanchez Road from Blake Road to the Armijo Drain (crosses Barcelona Road)
- M11A: Line in Foothill Road, Telsfor Drive, and Procopio Place from Granada Road to the Isleta Drain
- N11G: Line in Foothill Road and Blake Road from Vegita Road to the Isleta Drain
- N11A: Line in Barcelona Road from Silvia Road to the Isleta Drain
- P12H: Adobe Acres Pump Line from Pond 48 to Adobe Acres Pond to Rio Grande

Although originally envisioned as a shallow conveyance channel, the Los Padillas Drain Extension was enlarged and modeled as a detention pond (just as all the drain segments were modeled) to evaluate the benefits of additional storage. The invert elevation and storage elevation data were based upon the Los Padillas Segment 1 data; however, the storage values were multiplied by a factor of nine to account for the longer length of the extension. Although upstream flow reaching this location had increased because of the enlarged Rio Bravo culverts, storage in the extension reduced the required size of the Los Padillas Outfall to the river.

Financial assumptions of potential Federal interest benefits were compared to a preliminary projected cost to determine the amount of improvements that could be included and still maintain a B/C ratio of greater than 1.0. These projected costs balanced with potential floodplains indicated that several refinements were necessary. These changes are modeled in Iteration 2. In addition, another consideration not included in Iteration 1 was evaluated in Iteration 2: the potential failure of the Arenal Canal.

The Iteration 1 floodplain map is presented on Figure 4.2A which is located in Appendix A.

Iteration 2

Iteration 2 included all the same improvements as Iteration 1, with the following exceptions: storm drain L11B was added, storm drain M11A was excluded and storm drain N11A was extended to capture additional flooding; the invert elevations of Armijo Segment 8, and Isleta Segments 10, and 15 were lowered two feet and the invert of Los Padillas Segment 4 was lowered 4 feet; also, a number of culverts were increased in size to either increase flow downstream or to limit the flow over the proposed roadway dip sections to 0.5 feet. A complete comparison of proposed structures can be found in Table 4-1.

The orientation of the additional storm drains and the extension is as follows:

- L11B: Trunk line in Sage Road and drainage easement (between Rosendo Garcia Road and San Ygnacio Road) to the Isleta Drain
- N11A: Line in Silvia Road and in Barcelona Road from Silvia Road to the Isleta Drain.

Overland flow that is not intercepted by AMAFCA drainage structures on the Mesa enters the Valley and some of this flow reaches the Arenal Main Canal. This increase flow in the canal will lead to overflows, erosion of the banks, and eventual failures. The most likely locations have been identified, and Iteration 2 contains plans for improvements at most of these locations. Several failures will allow runoff into fields and since those damages are minimal, these failures will not be prevented. All other locations will have a failure section to control the exact locations of the overflows. The proposed storm drains L11B and the N11A extension intercept flow from two of these locations. Another location, north of Arenal Road, will utilize a channel to convey flows to the Isleta Drain.

The Iteration 2 floodplains are presented on Figure 4.2B (Alternative #1), which is located in Appendix A.

Iteration 3

Iteration 3 was similar to Iteration 2 with the exceptions that there were no drain improvements to Armijo Segments 1 through 5 and Isleta Segments 2 through 5; and no diversion to Pond 187 from Armijo Drain (the diversion from Isleta Drain was still included). In addition, the 10-year and 25-year storms required the same level of detailed analysis that was performed for the 100-year storm for these first three iterations.

The Iteration 3 floodplain map is presented on Figure 4.2C in Appendix A.

Iteration 4

Iteration 4 was performed to determine the benefits and costs for two other designs. Iteration 2, the Alternative #1 design, was the base model for Iteration 4.

For Iteration 4, the Alternative #3 design, the following changes were made: storm drains P11F and N11G were removed; improvements were not made to Armijo Segments 1 through 5 and Isleta Segments 2 through 3; and the diversion to Pond 187 from Armijo Drain was excluded. For Iteration 4, the Alternative #2 design, the same changes as the Alternative #3 design were made, but improvements to Isleta Segment 3 were included.

The final version of Iteration 4 for the two designs included increased culverts to increase flows downstream or reduce flows over the roadway dip sections to 0.5 feet. The listing of proposed structures is included on Table 5.3-17 for all iterations.

The Iteration 4 floodplain maps are located on 4.2D (Alternative #3) and 4.2E (Alternative #2).

Table 5.3-17

	Iteration 1	Iteration 2 Alternative #1	Iteration 3	Iteration 4	
				Alternative #3	Alternative #2
Storm Drains Included					
P11F	X	X	X		
M11A	X				
N11G	X	X	X		
N11A	X	X (Extended)	X (Extended)	X (Extended)	X (Extended)
P12H	X	X	X	X	X
L11B		X	X	X	X
M11D		X	X	X	X
Lowered Invert Elevation					
ARM8 (4924' to 4922')		X	X	X	X
IS10 (4925' to 4923')		X	X	X	X
IS15-ARM9 (4925' to 4923')		X	X	X	X
LP4 (4916' to 4912')		X	X	X	X
Channel Improvements					
ARM1	X	X			
ARM2	X	X			
ARM3	X	X			
ARM4	X	X			
ARM5	X	X			
ARM6	X	X	X	X	X

	Iteration 1	Iteration 2 Alternative #1	Iteration 3	Iteration 4	
				Alternative #3	Alternative #2
ARM7	X	X	X	X	X
ARM8	X	X	X	X	X
IS2	X	X			
IS3	X	X			X
IS4	X	X		X	X
IS5	X	X		X	X
IS6	X	X	X	X	X
IS7	X	X	X	X	X
IS8	X	X	X	X	X
IS9	X	X	X	X	X
IS10	X	X	X	X	X
IS11	X	X	X	X	X
IS12	X	X	X	X	X
IS13	X	X	X	X	X
IS14	X	X	X	X	X
IS15-ARM9	X	X	X	X	X
IS16	X	X	X	X	X
IS17A	X	X	X	X	X
IS17B	X	X	X	X	X
LPEXT	X	X	X	X	X
LP1	X	X	X	X	X
LP2	X	X	X	X	X
LP3	X	X	X	X	X
LP4	X	X	X	X	X
Increase Low Bank Elevation					
ARM1					
ARM2					
ARM3					
ARM4					
ARM5	X	X			
ARM6	X	X	X	X	X
ARM7	X		X	X	X
ARM8	X	X	X		
IS2					
IS3	X	X			X
IS4	X	X		X	
IS5	X				
IS6					
IS7	X	X	X	X	X
IS8	X	X	X	X	X

	Iteration 1	Iteration 2 Alternative #1	Iteration 3	Iteration 4	
				Alternative #3	Alternative #2
IS9	X	X	X	X	X
IS10	X	X	X	X	X
IS11	X	X	X	X	X
IS12	X	X	X	X	X
IS13					
IS14	X	X	X	X	X
IS15-ARM9	X	X	X		
IS16	X	X	X	X	X
IS17A					
IS17B					
LP1	X	X	X	X	X
LP2	X	X	X	X	X
LP3	X				
LP4	X	X	X	X	X
Total Fill Required	26,146 cu. yd.	11,913 cu.yd.	12,069 cu. yd.	6,691 cu. yd.	6,450 cu. yd.
Raise Weir Spill: Roadway Elevation					
ARM 5: Weir Spill @ 4932.5'		Raise to 4933.5'			
IS 8: Weir Spill @ 4936.5'		Raise to 4938'			
IS 9: Weir Spill @ 4936.5		Raise to 4938'			
IS 10 : Weir Spill @ 4933.5'		Raise to 4935.5'			
IS 16: Weir Spill @ 4927.5'		Raise to 4928'			
LP2: Weir Spill @ 4922.5'		Raise to 4923'			
Other Changes					
IS 11: Weir Spill @ 4933'	No Change	Lowered to 4932', b = 80.	Lowered to 4932', b = 80.	Lowered to 4932', b = 80.	Lowered to 4932', b = 80.
Arenal Crossing Improvement		X	X	X	X
No Diversion to Pond 187 from Armijo Drain			X	X	X
Construct Failure Section Upstream of Arenal Rd:					
New Channel (Arenal to Isleta Drain) and appurtenances (Arenal Canal spill section)		X	X	X	X
At L11B - at Sage Rd.		X	X	X	X

	Iteration 1	Iteration 2 Alternative #1	Iteration 3	Iteration 4	
				Alternative #3	Alternative #2
and appurtenances (Arenal culverts & spill section)					
Structure Comparison - Drain Segment (Existing Culvert)					
ARM1 (3' CMP)					
ARM 2 (4' CMP)					
ARM 3 (3' CMP)					
ARM 4 (5' CMP)					
ARM 5 (3' CMP)		6' RCP			
ARM 6 (3'x3' wood box)		(2) 5' RCPs			2x 5' RCP
ARM 7 (3'x3' box)		(2) 5' RCPs			
ARM 8 (4' CMP)		(2) 5'x5' Concrete Boxes	(2) 5'x5' Concrete Boxes	(2) 5'x5' Concrete Boxes	(2) 5'x5' Concrete Boxes
IS 2 (4' CMP)					
IS 3 (4' CMP)					
IS 4 (4' CMP)					
IS 5 (5' RCP)					
IS6 (5' CMP)					
IS 7 (3' CMP)		(2) 5.5' RCPs		2x 5.5' RCP	2x 5.5' RCP
IS 8 (6' CMP)		(2) 6' RCPs			
IS 9 (5' CMP)		(2) 6'x10' Concrete Boxes			
IS 10 (4' CMP)		(2) 5.5' RCPs	(2) 5.5' RCPs	(2) 5.5' RCPs	(2) 5.5' RCPs
IS 11 (5' CMP)					
IS 12 (2' CMP)					
IS 13 (6' RCP)					
IS 14 (4' CMP)		(2) 5' RCPs			5' RCP
IS 15 - ARM 9 (4' RCP)	(2) 7'x7' Concrete Boxes	(2) 6'x'10' Concrete Boxes	(2) 6'x10' Concrete Boxes	(2) 6'x10' Concrete Boxes	(2) 6'x10' Concrete Boxes
IS 16 (4' CMP)		(2) 7' RCPs			5' RCP
IS 17A (3' CMP)					
IS 17B (4' CMP)					
LPEXT (6' CMP)					
LP01 (3' CMP)		(2) 5' RCPs		5' RCP	2x 5' RCP
LP02 (5' CMP)		(2) 5' RCPs		5' RCP	2x 5' RCP
LP3 (4' CMP)		(2) 5' RCPs	5' RCP	5' RCP	2x 5' RCP
LP04 (4' CMP)	18" Orifice	18" Orifice	18" Orifice	18" Orifice	18" Orifice

	Iteration 1	Iteration 2 Alternative #1	Iteration 3	Iteration 4	
				Alternative #3	Alternative #2
	Plate	Plate	Plate	Plate	Plate

5.4 GEOTECHNICAL ANALYSIS METHODOLOGY

Preliminary geotechnical investigations were accomplished through Bernalillo County, one of the local sponsors. Terracon, a geotechnical engineering firm, prepared a letter report dated 23 October 2001. The geotechnical report, with boring logs attached, is included in Appendix D.

The conceptual design accomplished for the feasibility report phase is at approximately a 10% level of design. The preliminary geotechnical issues that have been addressed at this level of design relate to the depth to groundwater and insuring that the intended design concept is not inconsistent with the findings of the geotechnical investigations.

A more extensive geotechnical investigation will be performed during the PED phase with specific project recommendations as the various design elements are developed to a greater level of detail.

5.5 PROJECT ALTERNATIVES DEVELOPED TO DETERMINE NATIONAL ECONOMIC DEVELOPMENT PLAN

In the reformulation study, an overall plan to address the Southwest Valley flooding was developed entitled, "HYDROLOGY AND HYDRAULICS REPORT FUTURE CONDITIONS WITH PROJECT, SOUTHWEST VALLEY FLOOD DAMAGE REDUCTION STUDY VOLUME III" prepared for USACE by RTI and dated March 2003. This report was developed utilizing a combination of features from previously analyzed Options 1 through 5 (predominately Option 3) to develop a plan that could be implemented by the sponsors and the local community in the future as funding becomes available to the community.
Within this overall plan, there appeared to be a project that could be developed which would result in a Benefit/Cost ratio greater than 1. Although a flood warning emergency evacuation system was not fully developed as an alternative, the Sponsors have agreed to pursue this on their own as funding becomes available. Four iterations were performed as previously described in Section 5.3 to make that determination. From that work, four alternatives were developed to determine the Federal Project (NED Plan). Alternative 1 resulted from Iteration 2 and Alternatives 2 and 3 resulted from Iteration 4. They are described as follows:

Alternative 1

Alternative 1 would capture West Mesa flood flow utilizing existing surface drain facilities. This alternative is sized to safely convey the one hundred (1%) year frequency storm. The main features of the proposed work would involve utilizing existing easements, widening existing drains (see Figure 4.2 in Appendix A), constructing a large storm water detention ponding area, and constructing two new channels. Generally, the work entails:

1. Utilizing existing easements and enlarging existing 30 to 40-foot wide drains (top width) to 68 feet to store and convey flood flows on:

a. 25,200-feet of the Isleta Drain beginning south of Central Avenue and continuing 4,200-feet south of Rio Bravo Boulevard;

b. 17, 200 feet of the Armijo Drain from Robertson Road to its intersection with the Isleta Drain just north of Rio Bravo Boulevard;

c. 4,600 feet of the Los Padillas Drain from the southern boundary of Anderson Farms to its intersection with a newly constructed flood-flow channel;

New access roads and trails up to 20 feet wide would be installed on each side of these drains.

2. Rehabilitating and/or enlarging existing road-crossings to facilitate the proposed improvements and additions to the drainage system that would meet County Code requirements. This alternative includes overflow spill collection from the Arenal Canal with conveyance to the Isleta Drain.

3. Construction of a 25-acre detention pond (Pond 187) in an existing agricultural field situated east of the Isleta Drain to detain a portion of flood-flow during large storm events. Proposed volume capacity of this pond for alternative 1 is 456 Acre Feet.

4. Construction of a 4,300-foot long by 120-foot wide earthen lined flood flow channel, for storage and conveyance, along the southern property boundary of Anderson Farms below Rio Bravo Boulevard to connect flood flow from the existing Isleta Drain to the existing Los Padillas Drain. New access roads 15 feet wide would be placed on each side of this drain.

5. Construction of a new 3,800-foot long by 45-foot wide (top width) concrete-lined flood flow channel (near Metzger Road) from the Los Padillas Drain to the Rio Grande levee. Flood Gates would be built at the Rio Grande Levee. An engineered outfall would continue from the levee for approximately 700 feet through the floodplain to the Rio Grande. This work would occur entirely within an existing power line easement. New 15-foot wide access roads would run along each side of this channel.

Alternative 1, more specifically described, includes widening of the drains within the Federal project limits (Armijo Segments 1-8, Isleta Segments 2-17, and Los Padillas Segments 1-4), improvements to the culverts under Rio Bravo (2 – 6' X 10' CBC's), the construction of the Los Padillas Extension Drain, outfall channel to the Rio Grande, Detention Pond 187 (456 Ac-ft volume), diversions to Pond 187 from Isleta drain (N11E) and Armijo drain (M11M), and two structures limiting flow downstream. The two flow limiting structures that were proposed are, an 18" orifice plate at the downstream end of Los Padillas Segment 4 with an overflow weir redirecting high flow to the outfall channel; and a reduced sized culvert in Isleta Segment 17 with an overflow weir redirecting high flow to the Los Padillas Extension Drain. The flow limiting structures, in both cases, are used to raise the water surface elevation and force a spill into the next downstream segment of the proposed system as well as to regulate flows continuing downstream in these two drains. In addition, four storm drains are incorporated into Alternative

1; these are identified as systems P11F, N11G, N11A, and L11B. A description of the storm drain orientation is as follows:

- P11F: Line in Barboa Road and Joe Sanchez Road from Blake Road to the Armijo Drain (crosses Barcelona Road)
- N11G: Line in Foothill Road and Blake Road from Vegita Road to the Isleta Drain
- N11A: Line in Silvia Road and in Barcelona Road from Silvia Road to the Isleta Drain.
- L11B: Trunk line in Sage Road and drainage easement (between Rosendo Garcia Road and San Ygnacio Road) to the Isleta Drain

The Los Padillas Drain Extension was enlarged and modeled as a detention pond to evaluate the benefits of additional storage. Although upstream flow reaching this location had increased because of the enlarged Rio Bravo culverts (2 – 6' X 10' CBC's), storage in the extension reduced the required size of the Los Padillas Outfall. This concrete lined outfall channel will discharge a flow rate of 205 cfs to the Rio Grande. A gated structure will be required at the Rio Grande Levee to prevent flooding of the Southwest Valley from the Rio Grande during flood stage.

Overland flow that is not intercepted by AMAFCA drainage structures on the Mesa enters the Valley and some of this flow reaches the Arenal Main Canal. This increase flow in the canal will lead to overflows, erosion of the banks, and eventual failures. The most likely locations have been identified, and Alternative 1 contains plans for improvements at most of these locations. Several failures will allow runoff into fields and since those damages are minimal, these failures will not be prevented. All other locations will have a spill section to control the exact location of the overflows. The proposed storm drains L11B and the N11A extension intercept flow from two of these locations. Another location, north of Arenal Road, will utilize a channel to convey flows to the Isleta Drain.

Alternative 1 is highlighted in green in Figure 5.3A found in Appendix A.

Alternative 2

Alternative 2 would capture West Mesa flood flow utilizing existing surface drain facilities. This alternative is sized to safely convey the twenty-five (4%) year frequency storm. The main features of the proposed work would involve utilizing existing easements, widening existing drains (see Figure 4.2 in Appendix A), constructing a large storm water detention ponding area, and constructing two new channels. Generally, the work entails:

1. Utilizing existing easements and enlarging existing 30 to 40-foot wide drains (top width) to 68 feet to store and convey flood flows on:

   a. 24,200-feet of the Isleta Drain beginning between Central Avenue and Bridge Boulevard and continuing 4,200-feet south of Rio Bravo Boulevard;

   b. 8,100 feet of the Armijo Drain from Robertson Road to its intersection with the Isleta Drain just north of Rio Bravo Boulevard;

c. 4,600 feet of the Los Padillas Drain from the southern boundary of Anderson Farms to its intersection with a newly constructed flood-flow channel;

New access roads and trails up to 20 feet wide would be installed on each side of these drains.

2. Rehabilitating and/or enlarging existing road-crossings to facilitate the proposed improvements and additions to the drainage system that would meet County Code requirements. This alternative includes overflow spill collection from the Arenal Canal with conveyance to the Isleta Drain.

3. Construction of a 25-acre detention pond (Pond 187) in an existing agricultural field situated east of the Isleta Drain to detain a portion of flood-flow during large storm events. Proposed volume capacity of this pond for alternative 2 is 350 Acre Feet.

4. Construction of a 4,300-foot long by 120-foot wide earthen lined flood flow channel, for storage and conveyance, along the southern property boundary of Anderson Farms below Rio Bravo Boulevard to connect flood flow from the existing Isleta Drain to the existing Los Padillas Drain. New access roads 15 feet wide would be placed on each side of this drain.

5. Construction of a new 3,800-foot long by 45-foot wide (top width) concrete-lined flood flow channel (near Metzger Road) from the Los Padillas Drain to the Rio Grande levee. Flood Gates would be built at the Rio Grande Levee. An engineered outfall would continue from the levee for approximately 700 feet through the floodplain to the Rio Grande. This work would occur entirely within an existing power line easement. New 15-foot wide access roads would run along each side of this channel.

Alternative 2, more specifically described, includes widening of the drains within the Federal project limits (Armijo Segments 6-8, Isleta Segments 3-17, and Los Padillas Segments 1-4), improvements to the culverts under Rio Bravo, the construction of the Los Padillas Extension Drain and outfall channel to the Rio Grande, Detention Pond 187 (350 Ac-ft volume), a diversion to Pond 187 from Isleta drain (N11E), and two structures limiting flow downstream. The two flow limiting structures that were proposed are, an 18" orifice plate at the downstream end of Los Padillas Segment 4 with an overflow weir redirecting high flow to the outfall channel; and a reduced sized culvert in Isleta Segment 17 with an overflow weir redirecting high flow to the Los Padillas Extension Drain. The flow limiting structures, in both cases, are used to raise the water surface elevation and force a spill into the next downstream segment of the proposed system as well as to regulate flows continuing downstream in these two drains. In addition, two storm drains are incorporated into Alternative 2; these are identified as N11A, and L11B. A description of the storm drain orientation is as follows:

- N11A: Line in Silvia Road and in Barcelona Road from Silvia Road to the Isleta Drain.
- L11B: Trunk line in Sage Road and drainage easement (between Rosendo Garcia Road and San Ygnacio Road) to the Isleta Drain

The Los Padillas Drain Extension was enlarged and modeled as a detention pond to evaluate the benefits of additional storage. Although upstream flow reaching this location had increased because of the enlarged Rio Bravo culverts (2 – 6' X 10' CBC's), storage in the extension reduced the required size of the Los Padillas Outfall to the river. This concrete lined outfall channel will discharge a flow rate of 191 cfs to the Rio Grande. A gated structure will be required at the Rio Grande Levee to prevent flooding of the Southwest Valley from the Rio Grande during flood stage.

Overland flow that is not intercepted by AMAFCA drainage structures on the Mesa enters the Valley and some of this flow reaches the Arenal Main Canal. This increase flow in the canal will lead to overflows, erosion of the banks, and eventual failures. The most likely locations have been identified, and Alternative 2 contains plans for improvements at most of these locations. Several failures will allow runoff into fields and since those damages are minimal, these failures will not be prevented. All other locations will have a spill section to control the exact location of the overflows. The proposed storm drains L11B and the N11A extension intercept flow from two of these locations. Another location, north of Arenal Road, will utilize a channel to convey flows to the Isleta Drain.

Alternative 2 is highlighted in green in Figure 5.3B located in Appendix A.

Alternative 3 (Preferred Plan)

Alternative 3 would capture West Mesa flood flow utilizing existing surface drain facilities. This alternative is sized to safely convey the ten (10%) year frequency storm. The main features of the proposed work would involve utilizing existing easements, widening existing drains (see Figure 4.2 in Appendix A), constructing a large storm water detention ponding area, and constructing two new channels. Generally, the work entails:

1. Utilizing existing easements and enlarging existing 30 to 40-foot wide drains (top width) to 68 feet to store and convey flood flows on:

    a. 22,700-feet of the Isleta Drain beginning near Bridge Boulevard and continuing 4,200-feet south of Rio Bravo Boulevard;

    b. 8,100 feet of the Armijo Drain from Robertson Road to its intersection with the Isleta Drain just north of Rio Bravo Boulevard;

    c. 4,600 feet of the Los Padillas Drain from the southern boundary of Anderson Farms to its intersection with a newly constructed flood-flow channel;

    New access roads and trails up to 20 feet wide would be installed on each side of these drains.

2. Rehabilitating and/or enlarging existing road-crossings to facilitate the proposed improvements and additions to the drainage system that would meet County Code

requirements. This alternative includes overflow spill collection from the Arenal Canal with conveyance to the Isleta Drain.

3. Construction of a 25-acre detention pond (Pond 187) in an existing agricultural field situated east of the Isleta Drain to detain a portion of flood-flow during large storm events. Proposed volume capacity of this pond for alternative 3 is 325 Acre Feet.

4. Construction of a 4,300-foot long by 120-foot wide earthen lined flood flow channel, for storage and conveyance, along the southern property boundary of Anderson Farms below Rio Bravo Boulevard to connect flood flow from the existing Isleta Drain to the existing Los Padillas Drain. New access roads 15 feet wide would be placed on each side of this drain.

5. Construction of a new 3,800-foot long by 45-foot wide (top width) concrete-lined flood flow channel (near Metzgar Road) from the Los Padillas Drain to the Rio Grande levee. Flood Gates would be built at the Rio Grande Levee. An engineered outfall would continue from the levee for approximately 700 feet through the floodplain to the Rio Grande. This work would occur entirely within an existing power line easement. New 15-foot wide access roads would run along each side of this channel.

Alternative 3, more specifically described, includes widening of the drains within the Federal project limits (Armijo Segments 6-8, Isleta Segments 4-17, and Los Padillas Segments 1-4), improvements to the culverts under Rio Bravo, the construction of the Los Padillas Extension Drain and outfall channel to the Rio Grande, Detention Pond 187 (325 Ac-ft volume), a diversion to Pond 187 from Isleta drain (N11E), and two structures limiting flow downstream. The two flow limiting structures that were proposed are, an 18" orifice plate at the downstream end of Los Padillas Segment 4 with an overflow weir redirecting high flow to the outfall channel; and a reduced sized culvert in Isleta Segment 17 with an overflow weir redirecting high flow to the Los Padillas Extension Drain. The flow limiting structures, in both cases, are used to raise the water surface elevation and force a spill into the next downstream segment of the proposed system as well as to regulate flows continuing downstream in these two drains. In addition, two storm drains are incorporated into Alternative 3; these are identified as N11A, and L11B. A description of the storm drain orientation is as follows:

- N11A: Line in Silvia Road and in Barcelona Road from Silvia Road to the Isleta Drain.
- L11B: Trunk line in Sage Road and drainage easement (between Rosendo Garcia Road and San Ygnacio Road) to the Isleta Drain

The Los Padillas Drain Extension was enlarged and modeled as a detention pond to evaluate the benefits of additional storage. Although upstream flow reaching this location had increased because of the enlarged Rio Bravo culverts (2 – 6' X 10' CBC's), storage in the extension reduced the required size of the Los Padillas Outfall to the river. This concrete lined outfall channel will discharge a flow rate of 182 cfs to the Rio Grande. A gated structure will be required at the Rio Grande Levee to prevent flooding of the Southwest Valley from the Rio Grande during flood stage.

Overland flow that is not intercepted by AMAFCA drainage structures on the Mesa enters the Valley and some of this flow reaches the Arenal Main Canal. This increased flow in the canal will lead to overflows, erosion of the banks, and eventual failures. The most likely locations have been identified, and Alternative 3 contains plans for improvements at most of these locations. Several failures will allow runoff into fields and since those damages are minimal, these failures will not be prevented. All other locations will have a spill section to control the exact location of the overflows. The proposed storm drains L11B and the N11A extension intercept flow from two of these locations. Another location, north of Arenal Road, will utilize a channel to convey flows to the Isleta Drain.

Alternative 3 is highlighted in green in Figure 5.3C in Appendix A.

Alternative 4

Alternative 4 would capture West Mesa flood flow utilizing existing surface drain facilities. This alternative is sized to convey the five-year (20%) frequency storm through the Isleta, Armijo and Los Padillas Drains. Considerations were also made to generally match the post-project flood plains of Alternative 3. The main features of the proposed work would involve utilizing existing easements, improving conveyance of existing drains by increasing culvert capacity at crossings and drain widening in specified locations (see Figure 4.2 in Appendix A), constructing a large storm water detention ponding area, and constructing two new channels. Generally, the work entails:

1. Utilizing existing easements, improving conveyance of existing drains by increasing culvert capacity at crossings and enlarging selected portions of existing 30 to 40-foot wide drains (top width) to 68 feet to store and convey flood flows as follows:

   a. Increased conveyance capacity through the 18,500-foot reach of the Isleta Drain beginning near Bridge Boulevard and continuing to Rio Bravo Boulevard by upsizing culverts at crossings and adding embankment height;

   b. Widening of 4,200-feet of the Isleta Drain beginning at Rio Bravo Boulevard and continuing 4,200-feet south of Rio Bravo Boulevard;

   c. Increased conveyance capacity through the 8,100-foot reach of the Armijo Drain from Robertson Road to its intersection with the Isleta Drain just north of Rio Bravo Boulevard by upsizing culverts at crossings and adding embankment height;

   d. Widening of 4,600 feet of the Los Padillas Drain from the southern boundary of Anderson Farms to its intersection with a newly constructed flood-flow channel;

   New access roads and trails up to 20 feet wide would be installed on each side of these drains.

2. Rehabilitating and/or enlarging existing road-crossings to facilitate the proposed improvements and additions to the drainage system that would meet County Code

requirements. This alternative includes overflow spill collection from the Arenal Canal with conveyance to the Isleta Drain.

3. Construction of a 25-acre detention pond (Pond 187) in an existing agricultural field situated east of the Isleta Drain to detain a portion of flood-flow during large storm events. Proposed volume capacity of this pond for alternative 4 is 325 Acre Feet.

4. Construction of a 4,300-foot long by 120-foot wide earthen lined flood flow channel, for storage and conveyance, along the southern property boundary of Anderson Farms below Rio Bravo Boulevard to connect flood flow from the existing Isleta Drain to the existing Los Padillas Drain. New access roads 15 feet wide would be placed on each side of this drain.

5. Construction of a new 3,800-foot long by 45-foot wide (top width) concrete-lined flood flow channel (near Metzgar Road) from the Los Padillas Drain to the Rio Grande levee. Flood Gates would be built at the Rio Grande Levee. An engineered outfall would continue from the levee for approximately 700 feet through the floodplain to the Rio Grande. This work would occur entirely within an existing power line easement. New 15-foot wide access roads would run along each side of this channel.

Alternative 4, more specifically described, includes widening of the drains within the project limits south of Rio Bravo Blvd. (Isleta Segments 16-17, and Los Padillas Segments 1-4), includes upsized crossings for increased conveyance of flow for the five (5) year frequency storm flow in the drains north of Rio Bravo Blvd. (Armijo Segments 6-9, Isleta Segments 4-15), improvements to the culverts under Rio Bravo, the construction of the Los Padillas Extension Drain and outfall channel to the Rio Grande, Detention Pond 187 (325 Ac-ft volume), a diversion to Pond 187 from Isleta drain (N11E), and two structures limiting flow downstream. The two flow limiting structures that were proposed are, an 18" orifice plate at the downstream end of Los Padillas Segment 4 with an overflow weir redirecting high flow to the outfall channel; and a reduced sized culvert in Isleta Segment 17 with an overflow weir redirecting high flow to the Los Padillas Extension Drain. The flow limiting structures, in both cases, are used to raise the water surface elevation and force a spill into the next downstream segment of the proposed system as well as to regulate flows continuing downstream in these two drains. In addition, two storm drains are incorporated into Alternative 4; these are identified as N11A, and L11B. A description of the storm drain orientation is as follows:

- N11A: Line in Silvia Road and in Barcelona Road from Silvia Road to the Isleta Drain.
- L11B: Trunk line in Sage Road and drainage easement (between Rosendo Garcia Road and San Ygnacio Road) to the Isleta Drain

The Los Padillas Drain Extension was enlarged and modeled as a detention pond to evaluate the benefits of additional storage. Although upstream flow reaching this location had increased because of the enlarged Rio Bravo culverts (2 – 6' X 10' CBC's), storage in the extension reduced the required size of the Los Padillas Outfall to the river. This concrete lined outfall channel will discharge a flow rate of 197 cfs to the Rio Grande. A gated structure will be

required at the Rio Grande Levee to prevent flooding of the Southwest Valley from the Rio Grande during flood stage.

Overland flow that is not intercepted by AMAFCA drainage structures on the Mesa enters the Valley and some of this flow reaches the Arenal Main Canal. This increased flow in the canal will lead to overflows, erosion of the banks, and eventual failures. The most likely locations have been identified, and Alternative 4 contains plans for improvements at most of these locations. Several failures will allow runoff into fields and since those damages are minimal, these failures will not be prevented. All other locations will have a spill section to control the exact location of the overflows. The proposed storm drains L11B and the N11A extension intercept flow from two of these locations. Another location, north of Arenal Road, will utilize a channel to convey flows to the Isleta Drain.

Alternative 4 is highlighted in green (with upsized culverts at crossings north of Rio Bravo Blvd. highlighted in orange) as shown in Figure 5.3D in Appendix A.

Three major design constraints controlled design of the final array of alternatives. Two of the constraints are institutional; 1.) All flood flows must be evacuated from the system to the Rio Grande within 96 hours. This is a requirement of the New Mexico State Engineer. 2.) This project cannot increase flows entering Isleta Pueblo via the drainage system. The Isleta Pueblo lies downstream of the proposed gravity flow diversion to the Rio Grande. 3.) The third constraint is a design constraint with significant economic consequences. As stated within the Report, a number of alternatives were screened prior to the final array. Several of the early alternatives included pump stations to deliver flows into the Rio Grande. First costs of the pumps and the annual operating expenses made alternatives requiring pumps non-feasible. To avoid these pumping expenses, it was necessary that the outfall to the Rio Grande consist of a gravity flow conduit. Given the very slight grade change through the Southwest Valley, the water surface profile at the entrance to the gravity flow conveyance channel is critical. All of the final alternatives were carefully balanced between storage and conveyance to meet the abovementioned constraints.

The drainage solutions proposed (Alternatives 1 through 4) all incorporate a balanced design (storage vs. conveyance) to deliver a stormwater discharge of approximately 200 cfs to the Rio Grande via the gravity outfall conduit. This flow is delivered into the Rio Grande by raising the water surface elevation at specific locations downstream of Rio Bravo Boulevard with a configuration that includes orifice control and side channel weir overflow. The basis of the outfall design (south of Rio Bravo Boulevard) maximizes the use of existing irrigation facilities (Isleta & Los Padillas Drains) while preserving the irrigation function of the system. The outfall design does not change between alternatives. Therefore, the design (for all alternatives) balances the needs of valley residents for irrigation supply (orifice control) while still providing protection against flooding (side channel weir overflow).

In order for the system to operate efficiently and within the design parameters for the outfall (+/- 200 cfs outfall discharge) at the 5-year design storm event while holding flood damages constant (as compared with alt 3), the conveyance within the Isleta Drain and the Armijo Drain upstream

of Rio Bravo Boulevard must be increased. The flows being generated at the 5-year design event are so low that we must rely substantially on conveyance to obtain the 200 cfs outfall design discharge. It is true that "storage is cheaper" in that basic excavation is less expensive than rebuilding road crossings to increase flow rates. However, in order to meet the design constraints previously discussed, it was necessary to develop a system that gave a balanced design in terms of storage vs. conveyance to meet the system discharge operability of +/- 200 cfs.

If we were not attempting to optimize storage vs. conveyance to deliver the 200 cfs to the gravity outfall, but instead were to rely solely on storage upstream of Rio Bravo it would still be necessary to evacuate the storm water to the Rio Grande within 96 hours to comply with New Mexico water rights law. In order to meet this requirement, a very expensive storm water pumping station would be needed to pump the stormwater from the valley into the Rio Grande. This option was investigated thoroughly but was abandoned early in formulation.

To recap, the design constraints under which this alternative was developed are as follows:

1) Deliver +/- 200 cfs to the outfall at the "design storm event".
2) Hold damages constant between alternatives 3 & 4.
3) Provide for irrigation needs.
4) Evacuate floodwaters within 96 hours.
5) Do not increase water flow to Isleta Pueblo.

Discussion of Alternatives

The alternatives were originally conceived as developing projects to address specific storm frequency events. However, as project performance shows, all three alternatives have a profound effect on all floodplains.

The widened drains are used in mitigating flooding in the Southwest Valley by utilizing both their storage and conveyance attributes (see Figure 4.2 in Appendix A). Under existing conditions they act, in essence, as long linear detention ponds separated by roadway crossings that intersect the drains at various locations. Therefore, by widening the drain for the same segment length, the storage volume is maximized; and by maintaining the existing road crossing structures, the costs are reduced. For this reason, the maximum widened cross section was utilized in every alternative for the drain segments that were improved. The changes that occurred between alternatives only affected which drain segments that were widened rather than a change in width within the widened sections. However, this approach did have the effect of reducing the overall storage capacity in the system for the alternatives with fewer segments of drain widening (Alternative 2 & Alternative 3).

The reason for taking this approach rather than reducing the width of the widened cross sections is two fold. First, the reduced width in that drain segment results in increased floodplains within that drain segment due to the volume of flood waters produced for higher rain events (exceeding the 0.05 flood event). The corresponding reduced storage capacity within that drain segment translates directly into flooded properties. Secondly, the reduced drain storage would have to be replaced by increased conveyance, for which the costs rise dramatically. The cost increase is a result of the need to upsize the flow capacity at the crossings and the resulting increase in flow

rates and volumes downstream within the system. If the conveyance throughout the system is not increased to carry the additional flows that result, there is a danger that floodplains could be displaced from one area of the valley to another resulting in induced damages.

Based on the preceding discussion, other possible alternatives that were eliminated from consideration would not have utilized the full drain widening benefit. **Alternative 3 was considered to be the smallest effective project for implementation**. However, a smaller project, Alternative 4, was developed to show the full consideration of alternatives and proves both through performance and economics that Alternative 3 is the best buy for the Sponsors and the Federal government.

As stated earlier, many of the project features common in all alternatives provide storm water detention capacity within the system. The widened drains function as linear detention ponds, pond 187 is a large storm water detention storage area, and the Los Padillas diversion channel functions as a detention pond. All the referenced project features would be designed as excavated ponding facilities rather than perched dams or levees. The drains and the Los Padillas Diversion would be excavated channels with storage potential. Pond 187 would be an excavated basin to provide storm water detention. In some locations it would be necessary to raise the bank height of the various facilities, but this will generally be only 1 to 2 feet and would be designed and built to US Army Corps of Engineer's Standards. Therefore, the consequences of failure are minimized. If the system is overwhelmed at one location or another, it may "overflow" but it won't catastrophically fail in the sense that a dam or levee might "breach".

Table 5.5-a Summary Comparison of Detailed Plans

Plan Description	No Action	Alternative 1 (100-year frequency)	Alternative 2 (25-year frequency)	**Alternative 3 (10-year frequency)**	Alternative 4 (5-year frequency)
Volume of flood water stored/conveyed	0 ac-ft	932 Ac-ft	774 Ac-ft	**708 Ac-ft**	418 Ac-ft
Linear Feet of Conveyance Channel		59,300 ft.	45,000 ft.	**43,500**	16,900
Net Benefits (x1000)		2.6	475.0	**482.6**	493.4
Total Investment Cost	$0	27,382,720	19,582,040	**18,760,240**	19,233,180
Annual Project Performance	0	97.5%	95.2%	**95.2%**	---
B/C ratio	N/A	1.0	1.39	**1.40**	1.40

5.5 ECONOMIC ANALYSIS OF PROJECT ALTERNATIVES AND NED PLAN SELECTION

Equivalent average annual benefit computations for the flood control alternatives considered are depicted in Tables 8a-8c of Appendix B. Average annual residual damages calculations for those alternatives considered are also presented in Appendix B, Tables 8a-8c. Tables 9 and 10 of Appendix B include probability that the value measured (residual damages or net benefits) will exceed a specific value. These tables measure the uncertainty distribution about the measurements. Table 11 of Appendix B shows the expected B/C ratio and the error distribution

of the B/C ratio in the baseline year. The recommended alternative consists of an enlarged Isleta drain with a collection of feeder drains scattered throughout the study area. Specifically, the plan that maximizes net benefits is **Alternative 3**. Benefits for the post project condition were computed by changing the flood frequency event volume from the 20% (5-year), 10% (10-year), 4% (25-year), 1% (100-year) and 0.2% (500-year) chance exceedance event to determine how much damageable property remained. Benefit calculations for this alternative are displayed on Tables 8a through 8b of Appendix B.

Administrative costs of flood insurance policies represent an NED loss. Those administrative costs are approximately $133 per flood insurance policy (fiscal year 2003). FEMA has reported that 12.1% of New Mexico properties in the 1% chance floodplain have flood insurance. FEMA officials contacted indicated that Doña Ana and Bernalillo counties had higher participation rates, but no quantities were available, and the state average participation rate was applied to the structures within the study area's 1% chance exceedance floodplain. A benefit of the structural alternatives considered is the savings of those administrative costs. If the recommended plan captures the 1% chance exceedance event more than 95% of the time, administrative costs associated with flood insurance policies no longer required could be claimed as benefits. The recommended plans do not contain more than 95% of those events, and no flood insurance benefits are claimed for alternatives providing protection for less than 95% of the 1% (100-year) chance events. Table 9 notes the flood insurance benefits based on most recent administrative costs and the available statewide participation rate applied to the area under consideration.

Table 5.5-a Economic Cost Summary for the Recommended Plan

Cost Type	Amount
Construction Cost	$13,705,900
Real Estate	$ 2,800,000
PED	$ 987,700
Total First Cost	**$17,493,600**

5.6 REAL ESTATE

The Albuquerque District, Corps of Engineers (Corps), has furnished the non-Federal sponsors, Bernalillo County and AMAFCA, preliminary project routing information from which the a real estate gross appraisal was prepared. Although the project has evolved into a slightly smaller route, unit value information provided by the appraisal is considered valid and appropriate. Information related to types of property, numbers of owners and estimated values was used by the Corps to prepare a Real Estate Plan (REP) as shown in Appendix C and forms the basis of more detailed real estate oriented cost estimates.

5.7 PLAN IMPLEMENTATION

This chapter summarizes the cost-sharing requirements and procedures necessary to implement the restoration features of the tentatively selected plan.

A. Study Recommendation

The Tentatively Selected Plan is an flood reduction project that provides incidental flood control and recreation benefits. Because of its positive environmental contribution selected plan is tentatively recommended.

B. Division of Plan Responsibilities

The Water Resources Development Act (WRDA) of 1986 (P.L. 99-662) and various other administrative policies have established the basis for the division of Federal and non-Federal responsibilities in the construction, maintenance and operation of Federal water resource projects accomplished under the direction of the Corps of Engineers. This is discussed in detail below.

C. Cost Allocation

Cost sharing for construction of this project would be in keeping within current Corps of Engineers policy whereby for flood reduction projects, the non-Federal sponsor shall provide all lands, easements and rights-of-way and dredged material disposal areas, provide relocations of bridges and roadways; provide alteration of utilities which do not pass under or through the project's structure; and maintain and operate the project after construction. Also, during the construction phase, the non-Federal sponsor shall contribute in cash a minimum of 5% of total costs and any additional funds as are necessary so that the non-Federal contribution would be at least *35%* of total flood reduction costs. Additional studies and analysis of the tentatively selected plan will be accomplished during Preconstruction Engineering and Design (PED). As a result of these studies, additional necessary project features may be identified that could be part of the Federal cost sharing for this project. In this event, Federal project cost sharing would be adjusted in accordance with the terms that will be included in the Project Cooperation Agreement. Corps guidance (PGL No. 36 and *59)* specifies that the level of financial participation in recreation development by the Corps at an otherwise justifiable project may not increase the Federal cost of the project by more than ten percent. This cost would be cost shared between the Corps and the non- Federal sponsor. Recreation costs are normally cost shared on a 50%/50% basis between the Corps and the non-Federal sponsor. However, all of the recreation improvements included in the tentatively selected plan are designed to minimize human interference with restored areas. As such the improvements are an integral part of the restoration project because they minimize the interference of already established park use by helping to direct and facilitate traffic. Because these improvements are part of the flood reduction project they are also cost shared on a 65%/35% basis between the Corps and the local sponsor.

The Economic Appendix provides detailed information on project first costs and cost sharing between the Federal and non-Federal sponsors. The total project first cost is currently estimated to be $17,493,600, at February 2004 price levels. Hence, the Corps' share of the project cost totals $11,370,840.

Table 5.7-a Cost Apportionment Table
Southwest Valley, New Mexico
Flood Reduction Project

Item	ALLOCATION		
	Federal	**Non-Federal**	**Total**
Construction, S&A, PED, Contingency	**11,370,840**	**3,322,760**	**14,693,600**
LEERDs		**2,800,000**	**2,800,000**
Total First Cost	**11,370,840**	**6,122,760**	**17,493,600**
(Percentage of total Cost)	**65**	**35**	

D. Current and Future Work Eligible for Credit
There is no current or future work planned or in construction which is part of the Corp' Selected Plans, or which would be eligible for Section 104 credit.

E. Policy Requirements
Upon implementation of the cost-shared project, the non-Federal sponsor will prepare the following preliminary financial analysis:
(1) Assess project-related yearly cash flows (both expenditures and receipts where cost recovery is proposed), including provisions for major rehabilitation and operational contingencies and anticipated but uncertain repair costs resulting from damages from natural events;
(2) Demonstrate ability to finance their current and projected-future share of the project cost and to carry out project implementation operation, maintenance, and repair/rehabilitation responsibilities;
(3) Investigate the means for raising additional non-Federal financial resources including but not limited to special assessment districts; and
(4) Complete any other necessary steps to ensure that they are prepared to execute their project-related responsibilities at the time of project implementation. In addition, as part of any Project Cooperation Agreement, the non-Federal sponsor would be required to undertake to hold and save the Federal Government free from damages due to construction, operation, and maintenance of the project, excluding damages due to the fault or negligence of the Federal Government or its contractors.

F. Non-Federal Requirements
The presently estimated non-Federal share of the total first cost of the project is $17,493,600 which includes $2,800,000 in LERRDs credits and $3,322,760 in non-Federal contributions. In addition, maintenance and operation of the flood reduction project is estimated to cost the non-Federal sponsor $85,000 annually. Requirements of non-Federal cooperation are specified below:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total project costs as further specified below:

(1) Enter into an agreement which provides, prior to execution of the project

cooperation agreement, 25 percent of design costs;

(2) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(3) Provide, during construction, a cash contribution equal to 5 percent of total project costs;

(4) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(5) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(6) Provide, during construction, any additional costs as necessary to make its total contribution equal to at least 35 percent of total project costs.

b. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

c. Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project, including mitigation features without cost to the Government, in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

d. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

e. Hold and save the Government free from all damages arising for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

f. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

g. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

h. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

i. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and, to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

j. Prescribe and enforce regulations to prevent obstruction of or encroachment on the Project that would reduce the level of protection it affords or that would hinder operation or maintenance of the Project.

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

l. Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army", and all applicable federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

m. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a Non-Federal interest to have prepared a flood plain management plan within one year after the date of signing a Project Cooperation Agreement. The plan shall be designed to reduce the impacts of future flood events in the project area, including but not limited to, addressing those measures to be undertaken by Non-Federal interests to preserve the level of flood protection provided by the project. As required by Section 402, implement the plan not later than one year after completion of the construction of the project. Provide an information copy of the plan to the Government upon its preparation;

n. Provide the non-federal share of that portion of the costs of archeological data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

o. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

p. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

q. Inform affected interests, at least annually, regarding the limitations of the protection afforded by the project.

G. Sponsorship Agreements

AMAFCA and Bernalillo County has provided a Letter of Intent acknowledging sponsorship requirements for the Southwest Valley Flood Reduction Project (included in Appendix I, Letters of Support and Financial Capability). Prior to the start of construction, the non-Federal sponsor will be required to enter into an agreement with the Federal Government that it will comply with Section 221 of the Flood Control Act of 1970 (P.L. 9 1-61 1), and the Water Resources Development Act of 1986 (P.L. 99-662) as amended.

AMAFCA and Bernalillo County have agreed to share the OMRR&R requirements by implementing the following:

Total Maintenance budget of $85,000 is allocated as follows:
1) Annual Maintenance Costs Associated with the Widened MRGCD Drains: $50,000

Isleta Drain	22,700 LF
Armijo Drain	8,100 LF
Los Padillas Drain	4,600 LF
Los Padillas Diversion	4,300 LF
TOTAL	39,700 LF

39,700 LF @ $1.25/LF = $49,625 Rounded to $50,000

Maintenance for these features would include:
Annual Inspection.
Dredging of live growth in drains to maintain system capacity for storage & conveyance.
Sediment and debris removal from drains to maintain system capacity.
Sediment, debris & tumbleweed removal from culverts and storm drains.
Regrading to repair erosion.
Repair of asphalt paving and concrete slope paving at crossings.
Removal of floatables after storm events.
O & M of BMP water quality features.

2) Annual Maintenance Costs Associated with the Concrete Lined Outfall Channel and appurtances including floodgates: $10,000

3,800 LF Concrete Lined Channel @ $2.60/LF = $9,880 rounded to $10,000

Maintenance for these features would include:

Annual Inspection.
Sediment and debris removal from channel to maintain system capacity.
Sediment, debris & tumbleweed removal from culverts and storm drains.
Joint Repair
Repair of asphalt paving and concrete slope paving at crossings.
Removal of floatables after storm events.
O & M of BMP water quality features.

3) Annual Maintenance Costs Associated with the Detention Pond (Pond 187) and appurtances: $25,000

25 Acre Storm Water Detention Pond @ $1000/Acre = $25,000

Maintenance for these features would include:

Annual Inspection.
Sediment and debris removal from pond to maintain system capacity.
Sediment, debris & tumbleweed removal from culverts and outfall pipes.
Regrading to repair erosion and maintain storage capacity and grade to drain.
Vegetation removal from embankment.
Rodent control.
Repair of asphalt paving and concrete slope paving at crossings on inflow channel.
Sediment and debris removal from inflow channel to maintain system capacity.
Removal of floatables after storm events.
O & M of BMP water quality features.

H. Procedures for Implementation

Future actions necessary for authorization and construction of the selected plans are summarized as follows:

(1) This report will be reviewed by the Headquarters of the U.S. Army Corps of Engineers, Washington, D.C.

(2) The Chief of Engineers will seek formal review and comment by the Governor of the State of New Mexico and interested Federal agencies.

(3) Following State and Agency review, the report will be sent to the Assistant Secretary of the Army for Civil Works.

(4) Upon approval of the Assistant Secretary, the report will be forwarded to the Office of Management and Budget (0MB) to obtain the relationship of the project to programs of the President.

(5) The final report of the Chief of Engineers will then be forwarded by the Assistant Secretary of the Army for Civil Works to Congress.

(6) Congressional review of the feasibility report and possible authorization of the project would follow.

(7) Pending project authorization for construction, the Chief of Engineers could include funds where appropriate, in his budget requests for preconstruction engineering and design of the project. The objective is to ready each project for a construction start established with the feasibility study.

(8) Following receipt of funds, preconstruction engineering and design would be initiated and surveys and detailed engineering designs would be accomplished.

(9) Following Congressional authorization of the project, plans and specifications would be accomplished by the District Engineer.

(10) Subsequent to appropriation of construction funds by Congress, but prior to construction, formal assurances of local cooperation would be required from non- Federal interests.

(11) Bids for construction would be initiated and contracts awarded.

6. ENVIRONMENTAL ASSESSMENT - EXISTING ENVIRONMENTAL CONDITIONS

This section describes the socioeconomic characteristics, physiography, climate, and ecology of the study area.

6.1 PHYSIOGRAPHY AND GEOLOGY

Physiography

Although the study area lies in the southwestern portion of the Albuquerque metropolitan area, this section will describe the more general physiographic and geologic setting.

Albuquerque, New Mexico lies along the Rio Grande, which rises in high and remote parts of Colorado, flowing southward 1,640 miles to the Gulf of Mexico. In the vicinity of Albuquerque, the river flows along the valley floodplain that slopes southward about four feet per mile and ranges in width from 2.5 to four miles. The elevation of the riverbed just west of downtown Albuquerque is 4,900 feet above sea level. West of the river floodplain, approximately 8 to 12 miles from downtown Albuquerque, the land rises through low bluffs and gradual slopes to a high mesa 5,600 to 6,000 feet in elevation. On the east side of the Rio Grande, the land between the Albuquerque International Airport and Interstate 40 rises to the East Mesa, 5,100 to 5,300 feet in altitude. North of Interstate 40, the high, flat mesa disappears and, instead, the ground gradually slopes upward from the river bottom for nearly eight miles to the foot of the Sandia Mountains, elevation 6,000 feet. The highest point on the Sandia Mountains is Sandia Crest, elevation 10,678 feet.

Three physiographic features characterize the Albuquerque area: the Sandia-Manzano mountain backdrop on the east; the naturally wooded lowlands of the river floodplain, and the western mesa and volcano skyline.

Geology

Rio Grande Valley: The Rio Grande flows along a series of linked troughs, or long segments of the crust of the earth that has subsided between mountain uplifts. The study area lies within the Santo Domingo-Albuquerque-Belen Basin, the largest in the series of complex structural basins, which collectively form the Rio Grande trough, which extends from the northern end of the San Luis Valley in Colorado to near El Paso, Texas. The Albuquerque basin measures 30 miles wide and 90 miles long, with Albuquerque near the center. The basin was probably formed during the upper Tertiary (Miocene and Pliocene) period, coincidental with the uplifting of the Sandia-Manzano-Los Pinos easterly tilted fault block mountain range. Total basin subsidence and the resultant infilling are estimated to be as much as 15,000 feet. Little is known of the sedimentary rocks underlying much of the basin, but they are likely of Cretaceous age and older; some early Tertiary deposits may also be present.

In very late geologic time, the Rio Grande eroded the trough-filling deposits into an inner valley, approximately 10 miles wide, which comprises that part of the trough between the flanking mesa rims. Before cutting its inner valley, the Rio Grande probably meandered on a wide plain that

extended from the level of the high mesa or the lava flows on the west, to the East Mesa east of the Rio Grande. The subsequent period of valley cutting may have occurred several hundred thousand to perhaps only twenty thousand years ago, after which the river began filling again.

Approximately 2,000 years ago, the Rio Grande took up its present course, having shifted from an earlier one that flowed down the east side between Albuquerque's Second and Twelfth Streets. Once the river changed to its more westerly course, it began to build up its channel and form flanking banks or natural levees until the channel bottom was several feet higher than the old course. Because the level of the river bottom more or less determines the level of the water table in the surrounding floodplain, a river level at or above the adjacent plain creates a poorly drained condition in the low areas adjacent to the river. This is the case in the Southwest Valley, where it is slightly uphill to the river and so low in slope that drainage is extremely slow. Recognizing that the threat of flooding is ever present, the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) has constructed a series of channels and detention basins west of the river to reduce flood damages in the valley areas.

In the early 1930s the Middle Rio Grande Conservancy District completed a series of drainage ditches that began lowering the water table, and this, coinciding with dry periods in the 1930s and 1940s, made it possible to occupy much reclaimed swampland. Prior to this time, runoff from the arroyos into the lowland area just stood until it evaporated because it could not be absorbed into soil already saturated with water.

Sandia Mountains: In the Albuquerque area, the Sandia mountain range forms the eastern boundary of the basin. The Sandia block tilts only 15 degrees to the east, but because of the simultaneous subsidence of the Rio Grande trough, the block exposes a western escarpment 13 miles long that averages 4,000 feet high. Pennsylvanian and Mississippian limestone layers that form the caprock of the mountains are underlain by Precambrian and metamorphic rocks. Throughout most of the basin, the western boundary is formed by a series of north to south trending, high-angle and parallel normal faults that step down eastward into the basin.

Volcanoes: Volcanoes and fissure flows that erupted during the Tertiary period mark the western boundary of the study area. Adjacent to the study area are the five Albuquerque volcano cones and the 17 Isleta or Wind Mesa cones. During the upper Tertiary time, as the uplifting occurred, detritus from the highlands was washed into the basin to comprise what is now a complex sequence of gravel, sand, silt, clay, caliche, and volcanic deposits known as the Santa Fe formation. A mantle of unconsolidated Quaternary alluvium and thick piedmont deposits overlies much of the Santa Fe formation. The Tertiary deposits in the deeper parts of the basin are approximately 15,000 feet thick.

6.2 SOILS

The soils in the project area are assigned to the Madurez-Wink association (West Mesa and Cedar Wash drainage areas), Bluepoint-Kokan association (mesa areas), and Gila-Vinton-Brazito association (valley areas). The Madurez-Wink association consists of deep, well-drained soils that are forming on piedmonts in old unconsolidated alluvium modified by wind. Slopes are 1 to 5 percent. These fine sandy loam soils occur on gently sloping slightly convex piedmont fans and low ridges (Hacker 1977).

Within the Cedar Wash drainage area on the Pueblo of Isleta Reservation is a large pocket of Pajarito series soils. Pajarito soils are associated with Kokan, Wink, Madurez, Latene, and Bluepoint soils. They consist of deep, well-drained loamy fine sand soil forming in old alluvium and aeolian deposits on the mesas along the Rio Grande. Slopes are 1 to 9 percent (Hacker 1977).

The Bluepoint-Kokan association is a somewhat excessively or excessively drained sandy and gravelly soil that occurs on dissected terraces and alluvial fans. Bluepoint soils make up approximately 50 percent of the mapping unit. Typically, they are loamy sands forming in sandy alluvium partly modified by wind. These nearly level to rolling soils are mainly on broad, convex alluvial fans. Kokan soils are typically gravelly and very gravelly sands, forming in old alluvial sand and gravel of mixed sources. These rolling to steep soils occur on dissected terraces. The soils in this association are a major source of sand and gravel (Hacker 1977).

The Gila-Vinton-Brazito association consists of deep, well-drained soils forming in recent alluvium on the floodplain along the Rio Grande. This association occurs in the irrigated Rio Grande Valley. The Gila-Vinton-Brazito association comprises about 33 percent Gila loam and sandy loam, 25 percent Vinton sandy loam, 13 percent Brazito silty clay loam, and 29 percent Agua, Glendale, Anapra, and Armijo soils and the frequently flooded Torrifluvents (Hacker 1977).

Table 6-1 lists important structural, physical and chemical characteristics of soils in the Southwest Valley project area. Structurally, soil types grade from fine sandy loams at the higher elevations of the West Mesa to gravelly sand on the river terrace, and loam to sandy loams on the valley floor. Permeability (ability to transmit water through the soil) is moderate to moderately rapid on the West Mesa; rapid to very rapid on the river terrace; and slow to moderate on the valley floor. Fine-grained soils found in the project area exhibit a moderate to high potential for wind erosion. Depending upon the material types and flow velocities, the potential for water erosion is low to moderate on the West Mesa; moderate to high along the river terrace; and low to moderate on the valley floor.

The subsurface materials primarily comprise sands, silts, and lean clays interbedded with sands and gravels. The upland Madurez, Wink, and Pajarito soils are classified in the Unified Soil Classification for use as construction material as sandy silt, lean silt, sandy clay, lean clay, or gradations between (*i.e.*, SM, ML, SC, CL, SC-SM, and SM-MC). The river terrace soils are classified as poorly graded gravel, silty gravel, poorly graded sand, sandy silt, and gradations between (i.e., GP, GM, GP-GM, SP, SM, SP-SM). The soils on the valley floor comprise sandy silt, lean silt, lean clay, and gradations between (i.e., SM, ML, SC, CL, SM-SC, AND CL-ML).

Table 6-1: Soil Types and Characteristics

Soil series/complexes are listed in order from highest to lowest elevational positions (Source: Hacker 1977)

Soil Series or complex	Structure	Chemical Characteristics	Permeability	Potential for erosion by...		Risk of corrosion to...		Shrink-swell potential
				Water	Wind	Steel	Concrete	
Madurez	Fine sandy loam/ sandy clay loam	Moderately calcareous. Moderately alkaline.	Moderate	Moderate	Moderate to High	High	Low	Moderate
Wink	Sandy loam	Slightly calcareous. Moderately alkaline.	Moderately rapid	Low to moderate	Moderate	High	Low	Low
Pajarito	Fine sandy loam/ sandy loam	Slightly to Moderately Calcareous. Moderately alkaline.	Moderately rapid	Moderate	Moderate	High	Low	Low
Bluepoint	Loamy fine sand/ loamy sand	Slightly calcareous. Mildly/moderately alkaline.	Rapid	Moderate to high	High	Low	Low	Low
Kokan	Gravelly sand/ very gravelly sand	Slightly calcareous. Mildly alkaline.	Very rapid	Moderate	Low	High	Low	Low
Gila	Stratified loam to sandy loam	Moderately calcareous. Moderately alkaline.	Slow	Low to moderate	Moderate	Moderate to High	Low	Low
Vinton	Sandy loam/ loamy sand	Slightly calcareous. Moderately alkaline	Slow	Moderate	High	High	Low	Low
Brazito	Fine sandy loam to silty clay loam	Non-saline to moderately saline. Slightly calcareous. Moderately alkaline.	Moderate	Low	Moderate to High	Moderate	Low	Low to Moderate

6.3 CLIMATE

The climate in the vicinity of Albuquerque is classified as semi-arid continental, characterized by fairly hot summers, mild winters, and short temperate spring and fall seasons. The average daily maximum temperature in July is 92 degrees Fahrenheit. The average daily minimum in December and January is 22 degrees Fahrenheit. The recorded temperature extremes are –17 degrees Fahrenheit and 105 degrees Fahrenheit. The average frost-free period is 197 days and usually begins in mid-April and lasts until late October.

The average annual precipitation for the area ranges from 8 inches in the valley to 10 to 14 inches in the foothills and 30 inches on the mountain peaks bounding the eastern side of the city. About 72 percent of the average precipitation in the valley occurs from May to October with almost one-half of the annual amount falling during July and August. Most of the rainfall during this period is the result of brief but intense thundershowers. During the winter months, most precipitation occurs as snowfall. The average annual snowfall is 11 inches.

The Rio Grande Basin lies in a transitional zone between the Gulf and Pacific rainfall provinces, with attendant complex meteorological conditions further complicated by the presence of extensive mountainous areas. The major portion of the precipitation in the watershed is derived from the tropical Gulf source region. During the summer months, tropical Pacific air seldom invades the watershed. Precipitation usually occurs as the result of thunderstorm activity caused by convective or orographic lifting, although frontal activity may produce light-to-moderate storms of several days duration. The relative weakness of polar air intrusions limits the occurrence of general storms of major importance during the summer.

6.4 HYDROLOGY AND WATER QUALITY

Surface Water - Rio Grande Basin

The Rio Grande defines the eastern boundary of the project area. The Rio originates in the Rocky Mountains of southern Colorado along the Continental Divide, and flows southward through New Mexico and Texas, terminating in the Gulf of Mexico. The Rio Grande forms the physical border between Texas and Mexico. The drainage basin encompasses 181,468 square miles, of which 88,800 square miles are within the United States; the remainder is within Mexico. The Colorado River and the Rio Grande are the main sources of permanent water in the desert Southwest. The study area lies within the reach referred to as the Middle Rio Grande, which extends from Cochiti Dam, downstream 160 miles to San Marcial. The Middle Rio Grande represents seven percent of the total Rio Grande drainage and half of New Mexico's direct tributary drainage. Principal tributaries between Cochiti Dam and the Southwest Valley are Galisteo Creek and the Jemez River. The Corps of Engineers constructed flood control dams on these tributaries in 1970 and 1953, respectively.

Through the Middle Rio Grande Valley, the river gradient is approximately four feet per mile. The average channel width is approximately 200 to 300 feet. The geomorphological characteristics include a substrate of shifting sands and gravels; low, poorly defined banks; and slight sinuosity with occasional straight, meandering, and braided reaches. Within the Middle Rio Grande Valley, the active floodplain is largely confined between earthen levees, which have contributed to the aggradation of the river channel. During low flows and, in particular, when flood flows recede, sediment bars form in the channel, generally defining the configuration. In

some places where the channel has virtually no banks and sediment has deposited between the levees, the bed of the river is at or above the surface of lands outside the levees. This is not the case throughout all areas of the Southwest Valley.

Surface Flows: The majority of the discharge in the Rio Grande comes from its headwaters in Colorado and from the Rio Chama, which joins the Rio Grande 35 miles north of Cochiti Lake. The Rio Chama usually maintains a perennial discharge because of the San Juan-Chama trans-mountain diversion, a large watershed area, and dams along the Rio Chama and its tributaries.

The surface flows of the Middle Rio Grande are of two general types: peak discharges which result from late spring snow melt and rain storms; and summer convective storms that produce runoff in isolated parts of the basin and increase the discharge for brief periods. Consequently, water flow amounts in the river vary seasonally and may fluctuate among years. Flows are generally low during the fall and winter. Moderate discharge rates and large runoff volumes characterize the spring flows. The spring runoff period lasts approximately two months, during which shorter duration peak flows may also occur. The summer runoff period occurs between May and October. The summer flows produce discharges that peak sharply and recede quickly; the runoff volumes are generally smaller than during the spring flows.

Section 404 of the Clean Water Act (CWA) provides for the protection of waters of the United States from impacts associated with irresponsible or unregulated discharges of dredged or fill material into waters of the United States, including wetlands. The Rio Grande is the only perennial surface water body, as defined under Section 404(b)(1), within the project area. It is not anticipated that any of the proposed work would involve Section 404 regulated discharges. The project plans would be reviewed by the Regulatory Branch of the Albuquerque Corps for a final 404 permit determination. In the event that a permit is needed, state water quality certification is required under Section 401 of the CWA and would be obtained from the New Mexico Environmental Department (NMED). The Corps would also coordinate with NMED regarding work activities and schedules to allow the opportunity for monitoring water quality conditions during project construction.

Section 402(p) if the CWA regulates point source discharges of pollutants into waters of the United States and specifies that storm water discharges associated with construction activities be conducted under National Pollutant Discharge Elimination System (NPDES) permit guidance. Storm water discharges associated with Federal projects that require a Storm Water Pollution Prevention Plan (SWPP) include discharges from construction activities (clearing, grading, and excavation) that result in disturbance to 1 acre or more of land (Federal Register 1999). Project construction would comply with the general conditions of NPDES, that is, a Notice of Intent would be filed, and a SWPP would be developed and kept on file at the construction site and become part of the permanent record. The Corps or its contractor would obtain the NPDES permit prior to construction

To protect surface waters and other environmentally sensitive areas, construction activities would be accomplished applying standard Corps Best Management Practices (BMP). Construction access would be from existing surface streets, ditch maintenance roads, power line maintenance roads, and agricultural roads. All staging, including the stockpiling of construction

materials, and equipment parking for vehicle and equipment not in operation, would be above the 100-year floodplain. Fuel, oil, hydraulic fluids and other similar substances would be appropriately stored above floodplains and would have a secondary containment system to prevent spills if the primary storage container leaks. Appropriate erosion control measure would be utilized to prevent surface water drainage and erosion material from leaving the construction areas. Water dispersal equipment would be used to minimize dust during construction activities. Compliance would be required for all appropriate laws regarding the treatment and disposal of waste material. All waste material would be disposed properly at pre-approved or commercial disposal areas or landfills. Activities would be limited to the designated or otherwise approved areas and would be shown on the construction drawings for construction areas, staging, access, and borrow use. Corps approval of these areas would be required regardless of their ownership or distance to the construction sites to ensure protection of vegetation, water quality, threatened and endangered species, cultural resources and other significant resources. The Corps' Contracting Officer would coordinate with the Crops Environmental Resources Section to approve any changes in access routes, non-commercial borrow sites, staging areas, and other high-use areas.

Prior to the onset of construction activities, all environmental protection measures as expressed by contract clauses, contract drawings or other means would be reviewed with the contractor at the pre-construction conference. The construction contractor would be required to submit an Environmental Protection Plan acknowledging and incorporating these protection measures during construction of the project.

Water Quality: The New Mexico Water Quality Control Commission (NMWQCC 2000) has established water quality standards for surface waters within the state. The Rio Grande within the Southwest Valley flood damage reduction project area are subject to the general standards (20 NMAC 6.4 Section 105) and applicable use-specific numeric standards (20 NMAC 6.4 Section 900). The uses defined as applicable in the project area are:

- Irrigation – a water of the State used as a supply of water for crops;
- Limited warm water fishery – a stream reach where intermittent flow may severely limit the ability of the reach to sustain a natural fish population on a continuous annual basis; or a stream where historical data indicate that water temperature may routinely exceed 32.2° Centigrade (C) (90° Fahrenheit (F);
- Livestock watering – a water of the State used as a supply of water for consumption by livestock and other animals;
- Wildlife habitat – a water of the State used by plants and animals, not considered pathogenic to humans or domesticated livestock and plants.
- Secondary contact – any recreational or other water use in which contact with the water may occur and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, wading, commercial and recreational boating and any limited seasonal contact.

The referenced statutes provide general standards for water quality parameters such as turbidity, temperature, salinity, radioactivity, nutrients, and pathogens. In any single sample, pH shall be within the range of 6.6 to 9.0; temperature shall not exceed 32.2° C (90° F). The monthly

geometric mean of fecal coliform bacteria shall not exceed 1,000/100 milliliter (ml); no single sample shall exceed 2,000/100 ml. At mean monthly flows above 100 cfs, the monthly average concentration for Total Dissolved Solids shall not exceed 1,500 milligram per liter (mg/l), sulfate shall not exceed 500 mg/l, and chloride shall not exceed 250 mg/l. Dissolved oxygen shall not be less than 5 mg/l. Table 6-2 summarizes applicable standards for metal concentrations in the project area (NMWQCC 2000).

Table 6-2: Numeric Water Quality Standards for Metals in Watercourses within the Proposed Project Area

(New Mexico Water Quality Control Commission 2000).

Substance	Concentration not to be exceeded (mg/l)
Dissolved aluminum	5.00
Dissolved arsenic	0.10
Dissolved boron	0.75
Dissolved cadmium	0.01
Dissolved chromium	0.10
Dissolved cobalt	0.05
Dissolved copper	0.20
Dissolved lead	5.00
Dissolved molybdenum	1.00
Dissolved selenium	0.13
Dissolved selenium in presence of >500 mg/l SO_4	0.25
Dissolved vanadium	0.10
Dissolved zinc	2.00

Pueblo of Isleta Water Quality Standards: Pursuant to Section 518 of the Clean Water Act, the Tribal Council of the Pueblo of Isleta enacted the Pueblo of Isleta Water Quality Standards in February 1992. The standards set forth in the Pueblo of Isleta Water Quality Standards, Sections V.A and C, are applicable to the project at the reservation boundary.

The uses and standards for the segment of the Rio Grande that passes through the Pueblo of Isleta Reservation, including all tributaries, except for drains, which are separately designated, are as follows:

- Warm water fishery – a stream reach, lake, or impoundment where water temperature and other characteristics are suitable for support and propagation of warm water fish such as large-mouth black bass, small-mouth black bass, crappie, white bass, bluegill, flathead catfish, or channel catfish.
- Primary contact ceremonial – a stream, reach, lake, or impoundment used for religious or traditional purposes by members of the Pueblo of Isleta. Such use involves immersion, and intentional or incidental ingestion of water, and it requires protection of sensitive and valuable aquatic life and riparian habitat.

- Primary contact recreation – recreational use of a stream, reach, lake, or impoundment involving prolonged contact and the risk of ingesting water in quantities sufficient to pose a health hazard; examples are swimming and water skiing.
- Secondary contact recreation – recreational use of a stream, reach, lake, or impoundment in which contact with the water may, but need not, occur and in which the probability of ingesting water is minimal; examples are fishing and boating.
- Agricultural water supply – the use of water for irrigation and livestock watering.
- Industrial water supply – the use of water for the production of goods or services for profit.

The standards for this reach of the Rio Grande are as follows:

- Dissolved oxygen minimum: 5 mg/l
- Fecal coliform geometric mean maximum: 100 colonies per 100 ml (The geometric mean calculation is based on a minimum of five samples taken over a maximum of 30 days. The single sample maximum is 200 colonies per 100 ml).
- Temperature maximum: 32.2° C (90° F).
- pH range: 6.0 – 9.0
- Un-ionized ammonia (as N) maximum: 0.03 mg/l
- Total residual chlorine maximum: 0.011 mg/l
- Maximum Contaminant Levels (MCLs): not to exceed levels set forth in Table 5-3 below.
- Turbidity: not to exceed 25 Nephelometric Turbidity Units (NTUs).

Table 6-3: Maximum Contaminant Levels (MCLs)

Substance	MCL (mg/l)
Methoxychlor	0.1
2, 4- Dichlorophenoxy acetic acid	0.1
2- (2, 4, 5- Trichlorophenoxy) propionic acid (Silvex)	0.01
Total Trihalomethanes	0.10
Trichloroethylene	0.005
Carbon tetrachloride	0.005
1,2-dichloroethane	0.005
Vinyl chloride	0.002
Benzene	0.005
1, 1, 1-trichloroethane	0.20
1, 4-dichlorobenzene	0.075
Barium	1.0
Fluoride	4.0
Nitrate	10.0
Selenium	0.01

The following standards are applicable to the segments of the Albuquerque Riverside Drain, Atrisco Riverside Drain, Isleta Interior Drain, Indian Interior Drain, and Isleta Riverside Drain within the Reservation. The designated uses are the same as the Rio Grande segment above.

- Dissolved oxygen minimum: 6 mg/l
- Fecal coliform geometric mean maximum: 100 colonies per 100 ml (The geometric mean calculation is based on a minimum of five samples taken over a maximum of 30 days. The single sample maximum is 200 colonies per 100 ml).
- Temperature maximum: 20° C (68° F)
- pH range: 6.5 – 8.5
- Un-ionized ammonia (as N) maximum: 0.03 mg/l
- Total residual chlorine maximum: 0.011 mg/l
- Maximum Contaminant Levels (MCLs): not to exceed levels set forth in Table 5-3 above.
- Turbidity: not to exceed 25 NTUs.

Water quality data collected by the City of Albuquerque and Bernalillo County will be used to assess the potential impacts of storm water runoff in the Southwest Valley. In addition, data obtained from the City of Albuquerque's storm water monitoring program will assist in estimating storm water runoff concentrations for toxic substances from residential streets.

Proposed Total Maximum Daily Load Management (TMDL) Plans: Section 202(d) of the Federal Clean Water Act requires states to develop TMDL management plans for water bodies determined to be water quality limited. A TMDL documents the amount of a pollutant a water body can assimilate without violating a state's water quality standards. It also allocates that load capacity to known point sources and nonpoint sources. TMDLs are defined in 40 CFR Part 130

as the sum of the individual Waste Load Allocations (WLA) for point sources and Load Allocations (LA) for nonpoint sources, including a margin of safety and natural background conditions. The Middle Rio Grande segment is listed as being water quality limited for fecal coliform, specifically in storm water. Proposed TMDL targets are based on the water quality standards to support the designated uses within the segment (NMWQCC 2000). Load analyses show that the estimated load capacities are currently exceeded and, therefore, require reductions.

There are three significant sources of fecal coliform bacteria in the middle Rio Grande. National Pollutant Discharge Elimination System (NPDES) permit violations have occurred. These include periodic spills and end of pipe violations. Second, there are nonpoint sources of fecal coliform bacteria from livestock rearing, livestock operations, and other domestic animals, and limited seasonal inputs from migratory birds that use the Rio Grande as a flyway. The bacteria from these sources get to the river either directly or via side canals. The main contributor of fecal coliform is storm water.

Fecal coliform loading from storm water runoff is the principal cause of fecal coliform counts ranging between 10,000 and 100,000 colonies/100 ml routinely observed in the river during the summer rainy season (June to September). Fecal coliform/fecal streptococci ratios indicate feces of domestic animals are an important source of fecal bacteria contained in storm water runoff. High levels of fecal coliform are collected from neighborhoods, including parks and vacant lots, then transported to the river unfiltered. These pulse events directly lead to elevated levels of fecal coliform in the surface water. The storm water impacts on surface water quality associated with future growth in the middle Rio Grande valley is also a concern. The fecal coliform standard for the Albuquerque reach that specifies a logarithmic mean of less than 1,000 fecal coliforms per 100 ml on a monthly basis was adopted prior to an understanding of the effect of urban runoff. At the present time, there are no sampling sites in the Southwest Valley.

River Loading Capacity: Two proposed loading capacities have been calculated for the Albuquerque reach. The first, waters below Alameda Bridge down to the Albuquerque wastewater treatment facility (WWTF) (363 cfs) will be calculated as follows:

1,000 fcu/100 ml x 1,000 ml/1 L x 1 L/ 0.264 gallons x 234,613,071 flow in gallons / day

The load may be expressed as:

The assimilative loading limit in the river is **8.88×10^{12} fcu/day** at the 4Q3 low flow.

The second, waters below the Albuquerque WWTF (474 cfs) and a protective standard of 100 fcu per 100 ml will be calculated as follows:

100 fcu/100 ml x 1,000 ml/l L x 1L/ 0.264 gallons **x 306,354,258 flow in gallons / day**

The load may be expressed as:

The assimilative loading limit in the river is **1.16×10^{12} fcu/day** at the 4Q3 low flow.

Applying the Isleta tribal standard and using the previously determined river critical low flow (363 cfs) 234.6 million gallons per day, the load may be expressed as:

100 fcu/100 ml x 1,000 ml.l L x 1L/ 0.264 gallons x 234,613,071 flow in gallons / day

The assimilative loading limit in the river is **1.16×10^{11} fcu/day** at the 4Q3 low flow.

Proposed Implementation Plan

The proposed NED plan calls for storm water to be detained in the widened drainage system and within 96 hours be conveyed to the Rio Grande at no more than 182 cfs. Pertinent reports prepared for the City of Albuquerque (Parsons 2000 and Metric 1993) regarding storm water conveyances in the Rio Grande indicate that there are no direct affects from suspended sediment as levels in storm water runoff are not significantly above those occurring naturally in the Rio Grande. Additionally, the reports state that storm water discharges evaluated under previous biological assessments did not exceed any applicable surface water quality standards, and are therefore protective of aquatic-dependent species such as the Rio Grande silvery minnow. It should also be noted that all storm water conveyed to the river as a result of this project is water that would have eventually returned to the river downstream, after flood damages occurred.

The Sponsors will be going through the NPDES permit process at the point of discharge for this project. However, regarding clarification on water quality of the flood waters reaching the Rio Grande, Best Management Practices (BMP) have been integrated into the project that will prevent toxicity levels from exceeding, Clean Water Act, New Mexico state or Pueblo water quality standards. Project BMP's include:

- Maintenance activities and maintenance schedules for structural controls for storm water system. This would include investigating improved floatable control using retrofit designs for a storm water trapped inlet on the street collectors.

- Detention ponding would slow velocities allowing the water to drop the sediment and any toxins attached to the sediment particles to drop out of the water column. Because the outfall begins in Isleta drain via a weir or spillway, only the top of the water column will enter into the outfall and into the Rio Grande. Additionally, the outfall will be further developed in the Plans and Specifications phase of the project to provide water dispersion into the Bosque further improving the water quality.

Offsite BMP's will be implemented by the Sponsors such as:

- Public education and outreach
- Public participation and involvement
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management in new development and redevelopment
- Pollution prevention/good housekeeping

(Bernalillo County Stormwater Quality Whitepaper Draft BCPWD May 2002)

The Sponsors (AMAFCA and Bernalillo County) will be pursuing a NPDES permit at the point of discharge.

In addition, several water quality studies in the area have concluded that storm water entering into the Rio Grande is such a small percent of the total loading, based upon the best scientific and commercial data for the area (Parsons, June 2000).

6.5 BIOLOGICAL RESOURCES

Surveys

In July 2003, a Corps of Engineers biologist conducted a survey to identify plants and animals, including special status species, within the proposed project area and surroundings. Intensive pedestrian surveys were conducted along the agricultural drains. Specific emphasis was placed on identifying locations and habitat for special status species and identifying important wildlife. In accordance with the Fish and Wildlife Coordination Act of 1958, as amended, the U.S. Fish and Wildlife Service, Albuquerque Ecological Service Office was funded and requested to prepare a Coordination Act Report (CAR) for the proposed project. The final CAR and the Corps' responses to their recommendations are included in Appendix H.

Plant Communities

The Southwest Valley study area lies within the Plains and Great Basin grassland biotic community (Brown 1982). On the valley floor, much of the grassland has been converted to cultivated cropland through irrigation. Fallow fields and irrigation ditches are major features. Riparian communities occur along the Rio Grande and valley floor.

The dominant plant community on the West Mesa is Great Basin grassland. This plant community is mainly grasses mixed with some shrubs and annual plants. The dominant grass is black grama. Less abundant are sand dropseed, mesa dropseed, galleta, three-awn, blue grama, alkali sacaton, bush muhly, Indian ricegrass, and fluffgrass. Apache plume is the most common shrub. Broom snakeweed, broom dalea, prickly pear cactus, small soapweed, cholla cactus, winterfat, catclaw mimosa, and range ratany also occur. Annual plants, which increase in years of above-average precipitation, are tansy mustard, Indian paintbrush, wooly Indian-wheat, lambsquarters, Russian thistle, and bladderpod. If this plant community is disturbed, annual plants increase. Sand dropseed becomes prominent and cactus, and broom snakeweed increase significantly. Disturbance is also evident by dense stands of Russian thistle and summer cypress. Over time, urban development and encroachment have disturbed and degraded the native vegetation in and around Albuquerque.

In general, the project area is characterized as semi-urban consisting of commercial development along the major traffic arteries and private residences on large lots along the secondary and residential roadways. Most of the open land has been cleared around the residences for use as yards or for housing horses and other livestock.

Due to the presence of maintenance roads on both sides of existing ditches, project disturbance to vegetation would primarily be limited to plants growing on ditch banks. Observed

plants included purple aster, coyote willow, kochia, dock, horsetail (*Equisetum* spp.), Bermuda grass, Siberian elm, and cattail. During normal ditch maintenance, ditch bank vegetation is mowed or uprooted. Therefore, removal of these plants during construction would not be considered a significant or adverse environmental impact.

Construction of the new flood flow channel along the southern boundary of Anderson Farms would be accomplished at the edge of an existing agricultural field and primarily within the perimeter farm road. The new flood flow channel near Metzger Road would be constructed entirely within an existing power-line right-of-way (ROW). The ROW is periodically maintained by mowing the vegetation to prevent its interference with the electric lines and allow vehicular access for repair work. For these reasons, construction disturbance to vegetation in this area would not be considered significant or adverse.

In 1981 and 1982, Hink and Ohmart (1984) conducted a study of 163 miles of riparian habitat in the Upper and Middle Rio Grande between Española and San Acacia, New Mexico, describing in detail, plant communities and associated fauna. The Middle Rio Grande riparian woodland (bosque) represents the largest cottonwood riparian forest in the southwestern United States. This reach of the Middle Rio Grande extends from Cochiti Dam downstream 160 miles to San Marcial, New Mexico. Albuquerque is located near the center of this reach. The Rio Grande is regulated for water supply (primarily irrigation) and flood control, and that regulation has contributed to the present character of the riparian ecosystem.

The riparian vegetation in the study area is characterized as woodland with an overstory of cottonwood (*Populus* sp.) and a variety of midstory and understory trees and shrubs, chiefly Russian olive (*Elaeagnus angustifolia*), coyote willow (*Salix exigua*), salt cedar (*Tamarix chinensis*), seep willow (*Baccharis salicina*), indigo bush (*Amorpha fruticosa*), and New Mexico olive (*Forestiera neomexicana*). In areas where cottonwood overstory is lacking, exotic species such as Russian olive dominate.

Construction activities within the riparian area of the west bank of the Rio Grande would be confined to the maintained power line ROW (near Metzger Road). Vegetation in this area consists primarily of coyote willow and New Mexico olive plants 4 to 5-foot high. Due to regular mowing within the limits of the ROW, disturbance to this vegetation from the proposed construction would not be considered significant or adverse. There would be no disturbance from construction to the cottonwood gallery vegetative community on either side of the utility ROW.

Wildlife Communities

Wildlife use in the residential portions of the project area is limited by the disturbed condition of the ground cover and proximity of suburban residences and activity. Much of the area within the city and county limits has been converted to urban or residential land uses. Portions of the West Mesa are still largely undeveloped and support animal species typical of grassland plant communities.

While structure and diversity of native plant communities appear to significantly influence the diversity and abundance of wildlife species in the riparian ecosystem, some introduced plants

that have become naturalized, providing nesting sites, shelter, and food for some animal species. Fruits of Russian olive appear to be a significant part of the diet for some resident, migrant, and breeding bird species. Salt cedar provides cover for birds and mammals, and habitat for many insect species as well as pollen for domestic honeybees. The following describes the most common species expected to occur within the study area.

In the riparian zone, the fauna likely to occur is as follows:

Birds: Birds represent the largest and most diverse group. Bird species composition, diversity, and abundance in the Middle Rio Grande Valley have changed as a result of habitat changes and human activity. Surveys conducted in the Middle Rio Grande bosque in 1981 and 1982 documented 277 species of birds (Hink and Ohmart 1984), and Thompson *et al*. (1994) observed 259 avian species in 1992 and 1993. In the Middle Rio Grande, 12 avian species are declining and 14 species are increasing. The declining species are associated with riparian areas and the increasing species are associated with agricultural areas (Thompson *et al*. 1994).

The most common species recorded by Hink and Ohmart (1984) were the Mourning Dove and Black-Chinned Hummingbird. Other common species include Gambel's Quail, Northern Flicker, Ash-throated Flycatcher, European Starling, American Robin, Black-headed Grosbeak, Dark-eyed Junco, White-crowned Sparrow, Coopers Hawk, and American Kestrel.

The most common species recorded by Thompson *et al.* (1994) were the Black-Chinned Hummingbird, Blue Grosbeak, and Mourning Dove. Other common species include Western Kingbird, Bullock's Oriole, Red-winged Blackbird, House Finch, Barn Swallow, Cliff Swallow Northern Mockingbird, Great-tailed Grackle, and Western Meadowlark.

Of the 325 avian species known to occur in New Mexico, 241 (74 percent) have been detected within the riparian habitat and adjacent agricultural areas of the Middle Rio Grande (Hubbard 1987). About one-third of these species occupy the Middle Rio Grande only during annual migrations between their breeding and wintering grounds (Finch *et al*. 1995). Yong and Finch (1996) captured 157 species at the Bosque del Apache National Wildlife Refuge (60 miles south of Albuquerque) and the Rio Grande Nature Center in Albuquerque during the spring and fall migration in 1994. Of the total, 74 species were Neotropical long-distance migrants; 78 species were short-distance migrants; and 5 species were resident or border migrants (Yong and Finch 1996, Shaw and Finch 1996).

Fish. Along the length of the Rio Grande within New Mexico, 27 native fish species and 33 non-native species are documented (Sublette *et al*. 1990). Coldwater species are prevalent in the upper reach (upstream of Cochiti Lake) and warm water species occur near Elephant Butte Reservoir. The fish that occur in the project area are a mixture of warm and coldwater species. Common species in the Albuquerque reach are the red shiner, white sucker, flathead chub, western mosquito fish, river carpsucker, and channel catfish. Critical habitat for the endangered Rio Grande silvery minnow is present in the river adjacent the project area and at the proposed stormwater discharge point at the utility line right-of-way.

Reptiles: Fifty-seven reptile species may occur in the Middle Rio Grande Valley (Degenhardt *et al*. 1996). Common species expected to occur are the painted turtle, ornate box turtle, spiny softshell turtle, plateau lizard, New Mexico whiptail, eastern fence lizard, Great Plains skink, common king snake, and common garter snake.

Amphibians: Thirteen amphibian species are likely to occur in the Middle Rio Grande Valley. Amphibians captured in association with temporary or permanent water during a study by Hink and Ohmart (1984) included the tiger salamander, bullfrog, and western chorus frog. The plains spadefoot toad and Great Plains toad were found in open, drier habitat. The most often captured, and perhaps most abundant, were the bullfrog and Woodhouse toad. Other species include Couch's spadefoot toad, New Mexico spadefoot toad, and northern leopard frog.

Small Mammals: Hink and Ohmart (1984) captured 16 small mammal species along the Rio Grande: the white-footed mouse, western harvest mouse, house mouse, desert shrew, rock squirrel, Ord kangaroo rat, Merriam kangaroo rat, western harvest mouse, deer mouse, pinyon mouse, hispid cotton rat, Norway rat, plains pocket mouse, silky pocket mouse, northern grasshopper mouse, and the New Mexican jumping mouse. Stuart and Bogan (1996) captured five small mammal species along the Rio Grande: the white-footed mouse, house mouse, tawny-bellied cotton rat, white-throated woodrat, and rock squirrel. Their survey area included fragmented patches of Rio Grande bosque at six locations between the town of Bernalillo and Caballo Reservoir.

Eleven species of bats are found along the Rio Grande (Findley *et* a*l*. 1975). Species that may occur in the valley are the little brown myotis, Yuma myotis, pallid bat, Brazilian free-tailed bat, big free-tailed bat, Townsend's big-eared bat, long-legged myotis, silver-haired bat, big brown bat, hoary bat, and spotted bat.

Large Mammals: Hink and Ohmart (1984) documented 19 large mammal species along the Rio Grande. Beaver, muskrat, and raccoon are highly dependent upon aquatic and riparian habitat. Other species identified were porcupine, long-tailed weasel, striped skunk, Botta pocket gopher, yellow-faced pocket gopher, desert cottontail, black-tailed jackrabbit, spotted ground squirrel, and coyote.

Due to the semi-urban character of the land within the project area, the limited amount of wildlife habitat, and the disturbed condition of the construction areas impacts to wildlife would not be adverse or significant from the proposed construction activities.

6.6 SPECIAL STATUS SPECIES

Three agencies who have primary responsibility for the protection of animal and plant species in New Mexico are the U.S. Fish and Wildlife Service (USFWS), under authority of the Endangered Species Act of 1973 (as amended); the New Mexico Department of Game and Fish (NMDGF), under the authority of the Wildlife Conservation Act of 1974; and the New Mexico Energy, Mineral and Natural Resource Department, under authority of the New Mexico Endangered Plant Species Act and Rule NO NMFRCD 91-1. Each agency maintains a list of animal species that have been classified or are candidates for classification as endangered or threatened based on present status and potential threat to future survival and recruitment. Of

these species, those with potential to occur in or nearer the project are given in Table 6.4. Because the State of New Mexico has no jurisdiction on tribal lands, only those state listed species of concern capable of migrating to or from the project area are including in this listing and discussion

Table 6.4: Federal and State of New Mexico species of concern that may occur in the project area.

Species	Federal Status*	State Status*
Bald Eagle (*Haliaeetus leucocephalus)*	T	T
Southwestern Willow Flycatcher (*Empidonax traillii extimus*)	E	E
Rio Grande silvery minnow (*Hybognathus amarus*)	E	E

*E – Endangered
*T – Threatened

Bald Eagle

The Bald Eagle (*Haliaeetus leucocephalus*) is a winter resident along rivers and at reservoirs in the southwestern United States. This species was listed as Federally endangered in 1967 (32 Federal Register 4001) and again in 1978 (43 Federal Register 6233), but recently was reclassified as threatened due to breeding population increases throughout the country (USFWS 1995b). The USFWS proposed removing the Bald Eagle from the list of endangered and threatened wildlife in July 1999 (USFWS 1999b); however, final delisting of the species has not yet occurred.

In New Mexico the Bald Eagle is a winter migrant from the northern border, and southward to the Gila, lower Rio Grande, middle Pecos, and Canadian valleys. The bird prefers to roost and perch in large trees near water. A few hundred migratory Bald Eagles winter in New Mexico along major river systems, reservoir, and lakes, but there are only two known nesting sites in the State. The typical diet of bald eagles is fish, with many other types of prey such as waterfowl and small mammals, depending on location, time of year, and population cycles of the prey species (Federal Register 1995b). In New Mexico, these birds typically roost in groups in trees at night, usually in protected areas such as canyons (NMDGF 1988).

The general daily routine for a wintering Bald Eagle is to leave its roost at dawn for its foraging ground, feed until midmorning, perch for most of the midday, and possibly feed again in late afternoon before returning to its roost site (Hawkwatch International, Inc. 1993). Adults of this species are easily recognized by their white heads and tails and dark bodies. The main threats to New Mexico's wintering population are habitat loss and degradation, including declines in prey and availability of roost-sties. Human disturbance near foraging areas probably poses the greatest threat to wintering eagles since birds will choose to move to more secluded areas, possibly with less prey.

No Bald Eagles are known to nest in or around the project area; however, migrant eagles occur regularly throughout the Middle Rio Grande corridor each winter (November to March). They are attracted to Cochiti and Elephant Butte Reservoirs and the Bosque del Apache National

Wildlife Refuge because of the abundant waterfowl that over-winter there. Bald Eagles migrate up and down the Middle Rio Grande corridor, using the mature cottonwoods for perch and roost sites. Bald Eagles have been observed perching and flying within the proposed project area. There is a major winter roost in the bosque adjacent to the project area, where more than twenty birds have been observed (Stahlecker and Cox 1997).

Southwestern Willow Flycatcher

In 1993, the Southwestern Willow Flycatcher was proposed for listing as federally endangered, with critical habitat. In 1995, the flycatcher was listed as endangered and, in 1997 critical habitat was designated. On May 11, 2001 the 10th Circuit Court set aside the designation. The USFWS is currently in the process of re-proposing critical habitat. The State of New Mexico lists the flycatcher as Endangered, Group 2 (New Mexico Department of Game and Fish 1987 and 1988). The flycatcher is a Neotropical migrant that nests and forages in riparian thickets associated with rivers, streams, and other wetlands where dense growth of willow, Russian olive, salt cedar, or other plants is present, often with a scattered overstory of cottonwood. Surface water or saturated soil is usually present beneath or adjacent to occupied thickets (Phillips *et al*. 1964, Muiznieks *et al*. 1994). The flycatcher also forages in backwaters and sandbars adjacent to nesting areas.

Rio Grande Silvery Minnow

The Rio Grande silvery minnow (*Hybognathus amarus*) was formerly one of the most widespread and abundant species in the Rio Grande basin of New Mexico, Texas, and Mexico (Bestgen and Platania 1991). At the time of it's listing as endangered, the silvery minnow was restricted to the Middle Rio Grande in New Mexico, occurring only from Cochiti Dam downstream to the headwaters of Elephant Butte Reservoir, only 5 percent of its historic range (Platania 1991). The Rio Grande silvery minnow was listed as federally endangered under the Endangered Species Act in July 1994 (USFWS 1994). The species is listed by the State of New Mexico as an endangered species, Group II. The U.S. Fish and Wildlife Service (USFWS) documented that de-watering of portions of the Rio Grande below Cochiti Dam through water regulation activities, the construction of main stream dams, the introduction of non-native competitor/predator species, and the degradation of water quality as possible causes for declines in Rio Grande silvery minnow abundance (USFWS 1993).

Critical habitat for this species was designated in July 1999 (USFWS 1999a) and included the Rio Grande corridor from the New Mexico Highway 22 Bridge (immediately downstream from Cochiti Dam) to the railroad bridge near San Marcial, New Mexico, approximately 160 miles downstream. The stormwater discharge point for the proposed project is within the designated critical habitat of the fish. Constituent elements of critical habitat required to sustain the Rio Grande silvery minnow include stream morphology that supplies sufficient flowing water to provide food and cover needs for all life stages of the species; water quality to prevent water stagnation (elevated temperatures, decreased oxygen, etc.); and water quantity to prevent formation of isolated pools that restrict fish movement, foster increased predation by birds and aquatic predators, and congregate disease-causing pathogens (USFWS 1999).

In November 2000, the U.S. District Court for the District of New Mexico issued an opinion that the designation of critical habitat for the Rio Grande silvery minnow was invalid and suspended

the designation pending preparation of an Environmental Impact Statement by the USFWS and the formulation of a new rule. On February 19, 2003, the final rule designated critical habitat from the Highway 22 Bridge downstream to the utility line crossing the Rio Grande, a permanent identified landmark in Socorro County, New Mexico, a distance of approximately 170 miles. This designation became effective March 31, 2003. (Although the actual wording in the Federal Register stated the critical habitat extended from "Cochiti Dam" to the utility line, by the time this document is issued in draft this wording will have been corrected.)

The Rio Grande silvery minnow is a moderately sized, stout minnow, reaching 3.5 inches in total length, which spawns in the late spring and early summer, coinciding with high spring snowmelt flows (Sublette *et al.* 1990). Spawning also may be triggered by other high flow events such as spring and summer thunderstorms. This species is a pelagic spawner, producing neutrally buoyant eggs that drift downstream with the current (Platania 1995). As development occurs during the drift, which may last as long as a week depending on temperature and flow conditions, the larvae seek quiet waters off-channel. Platania (1995) found that eggs developed in 24 to 48 hours in a laboratory experiment. Considerable distance could be traveled by the drifting, developing eggs when taking into account the possible length of the drift (Sublette *et al.* 1990, Bestgen and Platania 1991, USFWS 1993, Platania 1995, Platania and Altenbach 1998). Maturity for this species is reached toward the end of the first year. Most individuals of this species live one year, with only a very small percentage reaching age two. It appears that the adults die after spawning (Sublette *et al.* 1990, Bestgen and Platania 1991, USFWS 1993).

This reproductive strategy, where the progeny are moved downstream, may partially explain the greater abundance of the species in the San Acacia reach (San Acacia Diversion Dam to Elephant Butte Reservoir), as revealed by numerous fish collections (Bestgen and Platania 1991; Platania 1993). During recent surveys in 1999, over 95 percent of the Rio Grande silvery minnows captured occurred downstream of San Acacia Dam (Platania and Dudley 1999; Smith and Jackson 2000). In the past, the young drifted downstream, developed to maturity, and proceeded back upstream to occupy available habitat. Mainstem dams now block upstream migration, thus restricting the species' redistribution. Concurrently, a portion of the reproductive effort upstream of each dam is distributed downstream by the drift. It is believed that Rio Grande silvery minnows that move into the San Acacia reach (the majority of the population) are transported by high velocities in the narrow and deep channel into Elephant Butte Reservoir, where none survive (USBR 1999).

Natural habitat for the Rio Grande silvery minnow includes stream margins, side channels, and off-channel pools where water velocities are lower than in the main channel. Areas with detritus and algal-covered substrates are preferred. The lee sides of islands and debris piles often serve as good habitat. Stream reaches dominated by straight, narrow, incised channels with rapid flows would not typically be occupied by the Rio Grande silvery minnow (Sublette *et al.* 1990; Bestgen and Platania 1991).

In the proposed project area, past actions have reduced the total habitat from historic conditions and altered the habitat for the Rio Grande silvery minnow. Levee construction, jetty-jack placements, channel armoring (riprap), lack of side channels and off-channel pools, and changes in natural flow regimes have all adversely affected the Rio Grande silvery minnow and its

habitat. These environmental changes have degraded spawning, nursery, feeding, resting, and refugia areas required for species survival and recovery (USFWS 1993). Upstream dams (Angostura and Cochiti Dams) act as fish migration barriers.

6.7 CULTURAL RESOURCES

An archaeological survey of the project area was conducted in November and December 2003. Prior to initiating the survey, the New Mexico Archaeological Records Management files were reviewed, and the locations of all known archaeological sites were plotted on maps. No known sites were within the specific construction locations. The survey included the existing drains to be widened and the locations for the new drains and pond construction. Two archaeological sites, one historic-period barn, and 16 isolated artifacts were recorded.

Human occupation of the Rio Grande valley occurred throughout the last 12,000 years. As populations increased in numbers the resources were used more intensively and the remains left behind become more common. Prior to the construction of levees in 1957 and subsequently Cochiti Dam, the course of the Rio Grande changed between the east and west bluffs. Some archaeological sites were destroyed or deeply buried. Modern agricultural practices and urbanization have also destroyed sites. Most of the earliest sites from the Paleo-Indian and Archaic Periods are found on the mesas on either side of the river. The remains of the hunter-gatherers of these periods consist of stone tools many of which are diagnostically shaped spear points. As agriculture became increasingly important, the populations became more sedentary. Shallow pit houses with quantities of corn stored within have been excavated on the West Mesa; some date to several hundred years before Christ. During the next 1,500 years the settlements changed from a few scattered pit houses to multi-room adobe houses (pueblos) and agricultural fields.

After AD 1300 the settlements expanded from the mesas to the valley floor. While the Spanish entered New Mexico and passed through the Southwest Valley in AD 1540, it was not until the mid to late 1600s that there were substantial numbers of Spanish settlers in the valley. The locations of early Spanish settlements were tied to fields, ditches, and entrances to major side valleys where livestock were grazed. Their agriculture relied on irrigation from the Rio Grande through an acequia (ditch) system. Frequently a large ditch (acequia madre) was constructed from the river and feeder ditches from it led to individual fields. The acequia madre for Albuquerque was constructed in 1706, the same year as the founding of the villa (town).

Manufactured goods and new settlers entered the area with greater frequency via the Santa Fe Trail, following the annexation of New Mexico by the United States in 1848 and became a flood after the arrival of the railroad in 1881. After 300 years of farming, combined with flooding and a rising water table, there was a marked decline in agricultural productivity such that by 1917 the area of arable land was decreased by one half. In 1925 the Middle Rio Grande conservancy District was formed to organize and improve flood control, drainage, and the patchwork acequia system. Old ditches were abandoned or remodeled and new ones were added with the result of opening thousands of formerly non-irrigable land to cultivation.

An intensive or Class III archaeological survey of the proposed project area was conducted in November and December 2003 by representatives from the Office of Contract Archaeology at

the University of New Mexico. The results are included in Appendix F - *Southwest Valley Flood Damage Feasibility Study cultural Resources Inventory* by David Vaughan and Richard C. Chapman. The survey included the existing drains that will be widened and the locations for the new drains and ponds. Each side of the existing drains was surveyed by one person walking zig-zag transects. In all of the locations of new construction, two surveyors separated by 15 to 20 meters walked parallel transects. The survey included all of the locations of proposed project. A total of 526 acres were surveyed. Prior to initiating the survey, the New Mexico Archaeological Records Management files were reviewed, and the locations of all known archaeological sites were plotted on maps. No known sites were within the Corps' project locations. Two archaeological sites, one historic-period barn, and 16 isolated occurrences were located.

Two archaeological sites were found. The first, LA 142019, a low-density scatter of Pueblo II and Pueblo III (AD 1500 to 1300) pottery and stone is located within the western termination of the proposed New Channel in area L-11B. It is probably less than 25 percent intact; disturbance includes water erosion, and road, canal, and housing construction. Three shovel test pits were excavated. Two contained no material, and one had two stone flakes however, an oil can lid was found below them indicating extreme disturbance in the upper 50 cm of the fill.

The second site, LA 142020, is located in the southern pond area in a plowed field. It is also a scatter of pottery and chipped stone. As much as 25 percent of the site could be intact. It is also a low-density artifact scatter from the Pueblo II or Pueblo III periods. No shovel tests were conducted at this site because the site is on private land, and the right-of-entry only provided for archaeological, pedestrian, survey. The site will be tested later.

An historic-period barn and stable are located in the right-of-way of the New Channel in area IS10. The barn is a two-story structure with a corrugated metal gable roof and random-width horizontal wooden siding. Small corrals extend to the east and west from the barn. A State of New Mexico structural form was completed.

The data recorded in the field for the 16 isolated occurrences (IOs) exhausted their relevant information potential, and they will require no further investigation.

Consultation with the New Mexico State Historic Preservation Office concerning the eligibility of the two archaeological sites, the historic-period barn, and the 16 isolated occurrences to the National Register of Historic Places (NRHP) will take place. The eligibility of the two sites will be based on their potential to contribute scientific knowledge concerning the Pueblo Indians' occupation of these locations. It is the opinion of the Corps that (1) LA 142019 is not eligible to the NRHP due to extensive disturbance; (2) LA 142020 is eligible; (3) the historic-period barn is not eligible as it is a vernacular structure lacking in architectural merit; and (4) the 16 IOs are not eligible based on the data recorded about each one during the survey.

Consultation with the New Mexico State Historic Preservation Office concerning the eligibility of the two archaeological sites and concerning the adequacy of the recording of the barn will take place. Prior to initiation of construction it is anticipated that both archaeological sites will be tested to determine if any intact sub-surface remains are present. Any further mitigation will

depend on the outcome of that testing. Neither archaeological site nor the barn is of sufficient magnitude or complexity that they will be an impediment to the construction.

6.8 AIR QUALITY AND NOISE LEVELS

Bernalillo County is within the State of New Mexico's Air Quality Control Region 6 (Environmental Protection Agency (EPA) Region 153) (NMED 1997). The County is in attainment status for National Air Quality Standards for priority pollutants (particulate matter, sulfur oxides, nitrogen dioxide, carbon monoxide, ozone, and lead), meaning that ambient air quality meets or exceeds State and Federal standards. Generally, the only air pollutant of any concern in the area is carbon monoxide. In 1978, Albuquerque/ Bernalillo County was designated as a non-attainment area for carbon monoxide. However, in 1996, after four consecutive years without any exceedances (1992-1995), EPA re-designated Albuquerque/Bernalillo County to attainment/maintenance status. This designation refers to former non-attainment areas that have successfully reduced pollutant concentrations to meet the ambient standards, and now have maintenance plans to keep air pollutants in check.

Existing noise levels in the project area are typical of urban and semi-rural environments. Ambient noise levels are primarily defined by local and commercial road traffic. Some increase in ambient noise levels are expected from construction-related activities; however noise levels would remain far below State and Federal standards for public safety and would not persist beyond completion of the planned construction work.

6.9 SOCIOECONOMIC CHARACTERISTICS

The city of Albuquerque is located in Bernalillo County in central New Mexico, approximately 60 miles south of Santa Fe, the State capital. Albuquerque is accessible via two principal highways: Interstate 25, the primary north-south route linking New Mexico to southeastern Colorado and west Texas; and Interstate 40, the major east-west route connecting New Mexico to eastern Arizona and the Texas panhandle. AMTRAK and the Burlington Northern and Santa Fe railway lines pass through Albuquerque. The Albuquerque International Airport provides domestic and international airline service.

The population of Bernalillo County is 558,589. The current population of Albuquerque is 446,871, which represents 80 percent of the county's population. Table 6-5 presents the growth projections from 2000 to 2030. The principal employment sectors in Bernalillo County are services, wholesale and retail trade, and government.

Table 6-5: Population Growth Projects for Bernalillo County and Albuquerque

	2000	2005	2010	2015	2020	2025	2030
Bernalillo County	558,589	594,317	621,940	650,784	679,538	709,487	740,646
City of Albuquerque	446,871	475,454	520,627	543,630	567,590	567,590	592,517

6.10 LAND USE AND RECREATION CONSIDERATIONS

Bernalillo County encompasses approximately 1,108 square miles, which includes 357 square miles of Indian reservation land and 164 square miles of Federal lands (USDA Forest Service, Department of Interior, and Kirtland Air Force Base). The remainder is private land interspersed with some state-owned land. Primary land uses in the project area consist of commercial, residential, and semi rural agricultural and livestock lots within both city and county jurisdiction. Commercial development is scattered throughout the city and county.

6.11 WETLANDS AND FLOODPLAINS

Executive Order 11990 (Protection of Wetlands) requires the avoidance, to the maximum extent possible, of long- and short-term impacts associated with the destruction, modification of wetland habitats.

Executive Order 11988 (Floodplain Management) provides Federal guidance for activities within the floodplains of inland and coastal waters. Preservation of the natural values of floodplains is of critical importance to the nation and the State of New Mexico. Federal agencies are required "to ensure that its planning programs and budget requests would not contribute to or result in any additional development of the Rio Grande floodplain. Work within the floodplain would involve the construction of a short pipe or swale on the riverside of the flood control levee to carry discharge water for surface release into the bosque. The property is owned by the Middle Rio Grande Conservancy District and is kept in its natural state in perpetuity. The proposed work in the floodplain would not contribute or result in any residential or commercial development in the floodplain.

6.12 INDIAN TRUST ASSETS

Indian Trust Assets are legal interests in property held in trust by the United States for Indian tribes or individuals. Examples of trust assets include land, minerals, hunting and fishing rights, and water rights. The United States has and Indian Trust responsibility to protect and maintain rights reserved by or granted to Indian tribes or individuals by treaties, statutes, executive orders, and rights further interpreted by the courts. This trust responsibility requires that all federal agencies take all actions reasonably necessary to protect such assets. The northern boundary of the Isleta Pueblo lies just to the south of the project limits.

7. FORESEEABLE EFFECTS OF THE PROPOSED PLAN AND ALTERNATIVES

The following sections discuss environmental effects that would be associated with the Proposed Plan (Alternative #3), the No Action/Future Without the Project, and Alternatives 1, 2 and 4:

7.1 FORESEEABLE EFFECTS OF THE PROPOSED PLAN (ALTERNATIVE #3)

Physiography and Geology, Land Use and Recreation, Wetlands and Floodplains, and Indian Trust Assets

Due to the limited scope of the proposed work and the man-altered condition of the construction areas, impacts to physiography and geology and soils would be negligible. There are no parks or other public recreation facilities within or adjacent the project limits. The project would not

result in changes in land use in the affected area. There are no wetlands within the project area. Work involved with the ditch outfall in the Rio Grande floodplain would not result in increasing the surface elevation under the power line ROW or result in impeding floodflows. Consequently, flood stages within the floodplain would not be increased as a result of the work. There are no Indian trust assets in the project area nor would the planned work have any affect downstream of the project area on natural, religious, or man-made resources within Isleta Pueblo. For these reasons, the planned action would have no significant effect on these resources.

Hydrology and Water Quality

The proposed plan conveys flood-waters to the river within 96-hours of the flood event. The hydrology will be changed to collect the water at the low points in the valley via the drain and gravity canals to the river. The storm water has been determined, based on other studies, to have no effect on the current water quality in the Rio Grande.

The Sponsors will be going through the NPDES permit process at the point of discharge for this project. However, regarding clarification on water quality of the flood waters reaching the Rio Grande, Best Management Practices (BMP) have been integrated into the project that will prevent toxicity levels from exceeding, Clean Water Act, New Mexico state or Pueblo water quality standards. Project BMP's include:

- Maintenance activities and maintenance schedules for structural controls for storm water system. This would include investigating improved floatable control using retrofit designs for a storm water trapped inlet on the street collectors.

- Detention ponding would slow velocities allowing the water to drop the sediment and any toxins attached to the sediment particles to drop out of the water column. Because the outfall begins in Isleta drain via a weir or spillway, only the top of the water column will enter into the outfall and into the Rio Grande. Additionally, the outfall will be further developed in the Plans and Specifications phase of the project to provide water dispersion into the Bosque further improving the water quality.

Offsite BMP's will be implemented by the Sponsors such as:

- Public education and outreach
- Public participation and involvement
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management in new development and redevelopment
- Pollution prevention/good housekeeping

Please refer to Bernalillo County Stormwater Quality Whitepaper Draft BCPWD May 2, 2002

The Sponsors (AMAFCA and Bernalillo County) will be pursuing a NPDES permit at the point of discharge.

In addition, several water quality studies in the area have concluded that storm water entering into the Rio Grande is such a small percent of the total loading, based upon the best scientific and commercial data for the area (Parsons, June 2000).

Biological Resources

Plant Communities: Vegetation within the proposed project construction lies within previously altered areas in and along existing ditches, in uplands and riparian portions of a periodically mowed electrical power line right-of-way, agricultural land that is in alfalfa production, and fallow agricultural lands. No rare plants would be found in the project area (NMRP 2003). For these reasons, construction activities would have no significant effect on vegetation within the project limits.

Wildlife Communities: Wildlife that may be impacted by the proposed project inhabits areas characterized as low quality disturbed urban and semi-rural environments. No high quality wildlife communities would be impacted by the proposed project. Construction work within the riparian area under the power line right-of-way would minimally only disturb periodically mowed vegetation of low habitat value; therefore, impacts to riparian wildlife would be minimal. Species common to urban and rural areas would be temporarily displaced during construction. For these reasons, the construction work would have no significant impact on wildlife communities within the project limits.

Special Status Species

Bald Eagle: Work in the bosque within the power line right-of-way contains no overstory vegetation that might be utilized by the Bald Eagle. To minimize the potential for disturbing Bald Eagles that may be present in adjacent habitat during construction, efforts would be made to schedule all work outside of the Bald Eagle riparian high use months of December, January, and February. If a Bald Eagle is present within 0.5 mile upstream or downstream of the riparian construction work underneath the power line right-of-way in the morning before project activity starts, or following breaks in project activity, the contractor would be required to suspend all activity until the bird leaves of its own volition, or a Corps biologist, in consultation with the USFWS, determines that the potential for harassment is minimal. However, if an eagle arrives during construction activities, or if an eagle is beyond 0.5 mile of the site, construction would not be interrupted. If Bald Eagles were found consistently in the immediate riparian project area during the construction period, the Corps would contact the USFWS to determine whether formal consultation under the Endangered Species Act is necessary. Implementation of these measures would preserve undisturbed Bald Eagle use of winter roosts in the bosque adjacent the project area. For these reasons, the proposed work may affect, but is not likely to adversely affect the Bald Eagle.

Southwestern Willow Flycatcher: There is no suitable or potential habitat for the Southwestern Willow Flycatcher within the limits of construction in the Rio Grande riparian zone or the adjacent cottonwood gallery north or south of the project area. As noted in Section 5.4, all construction work would occur outside of the irrigation season (March through October) when the Flycatcher is not present in New Mexico. Therefore, the proposed project would have no effect on the Southwestern Willow Flycatcher.

Rio Grande Silvery Minnow: Annual sampling efforts from 1993 through 2003 by the U.S. Bureau of Reclamation (USBR 2003) at the Rio Bravo Bridge (just upstream of the project discharge point) produced catches ranging from 0 (2000 and 2002) to 48 (1997). Of the ten-year capture total of 136 silvery minnows, 13 were caught between 1999 and 2003. During the same

time periods and sampling efforts, capture totals were not adversely affected (i.e. did not decline) for the fathead minnow (*Pimephales promelas*) and red shiner (*Cyprinella lutrensis*), species having similar water quality needs as the Rio Grande silvery minnow.

The Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) and other local flood control authorities have compiled a final draft biological evaluation (SWCA 2003) for review and concurrence by the USFWS for the maintenance of storm water conveyances in the Middle Rio Grande. The evaluation states that there are no direct affects from suspended sediments as levels in storm water runoff are not significantly above those occurring naturally in the Rio Grande. Additionally, the report states that storm water discharges evaluated under previous biological assessments did not exceed any applicable surface water quality standards, and are therefore protective of aquatic-dependant species such as the silvery minnow.

Direct Effects: Adverse direct effects are not expected as a result of the proposed action for either the Rio Grande silvery minnow or its designated critical habitat. The project does not involve or authorize any in-river construction activities, which may disturb either the Rio Grande silvery minnow or its designated critical habitat. In the case of suspended sediment levels in storm water runoff are not significantly above those occurring naturally in the Rio Grande once the BMP's are in place. Removal of significant quantities of suspended sediments before storm water reaches the Rio Grande would moderate potential direct effects of suspended sediments on the Rio Grande silvery minnow.

Indirect Effects: Indirect effects might include reduction of food availability or modification of habitat structure elements such as depth and substrate type. However, based on inspection of normal river hydrographs and significant storm water runoff event, (primarily June-September) the contribution of sediment from storm water runoff is relatively minor compared to average river flows in that same period. Because the Rio Grande in the Albuquerque reach has a fluid and changing bed and bottom morphometry, it is unlikely permanent changes to food distribution or habitat structure elements important to the Rio Grande silvery minnow would be permanently occur. EPA has ruled on other similar storm water discharges that the storm water, after undergoing similar BMPS's do not exceed any applicable surface water quality standards (Parsons, June 200 and Metric Corp. 1993), and are therefore protective of aquatic dependent species such as the minnow.

Cumulative Effects: Future actions with non-federal activities may result in contributions of chemical constituents to the Rio Grande in Rio Grande silvery minnow critical habitat. Because no direct effects are anticipated, cumulative effects are considered minimal and not likely to adversely affect the Rio Grande silvery minnow or its critical habitat.

Parsons Engineering (Parsons 2000) conducted toxicity tests for AMAFCA and other applicants using water fleas (*Ceriodaphnia dubia*) and fathead minnows on storm water runoff collected at the North Diversion Channel in Albuquerque to determine if the storm water constituents working in concert would produce toxic effects on aquatic life. There was no mortality among fathead minnows (again, similar in life history requirements as the Rio Grande silvery minnow) and only a single water flea died. The study concluded that the constituents of the City's storm water did not combine to produce substantially toxic effects to Rio Grande aquatic life. In

consideration of this information, the proposed storm water discharge constituents associated with this project would have no direct effect on the Rio Grande silvery minnow. Additionally, the Corps would implement Best Management Practices during construction and obtain the requisite NPDES permit. However, because the storm water would be discharged into designated critical habitat, the proposed project may affect, but is not likely to adversely affect the Rio Grande silvery minnow. The US Fish and Wildlife Service concurred with these determinations in their letter dated April 20, 2004 (see Appendix G.) This completed coordination under Section 7 of the Endangered Species Act.

Air Quality and Noise Levels

Project construction would result in a temporary increase in airborne dust, hydrocarbon emissions, and noise generated by construction activities and equipment during the daytime work period. These effects would be temporary, relatively minor in nature, and would not have significant cumulative effects or air quality or sound levels. Airborne dust would be reduced by frequent watering of disturbed soil surfaces in construction areas and along actively used unsurfaced roads, staging areas, and waste disposal areas. Guidelines for the protection of air quality would be included in contract specifications. The hydrocarbon emissions would not adversely affect public health or biological systems or lead to a significant deterioration of the existing air quality. The project would not affect Bernalillo County's attainment status with the State of New Mexico. After project completion, disturbed areas would be re-vegetated to reduce wind and water erosion and blowing dust. The proposed project would have no significant effect on air quality and noise levels.

Cultural Resources

Two archaeological sites were found. The first, LA 142019, a low-density scatter of Pueblo II and Pueblo III (AD 1500 to 1300) pottery and stone is located within the western termination of the proposed New Channel in area L-11B. It is probably less than 25 percent intact; disturbance includes water erosion, and road, canal, and housing construction. Three shovel test pits were excavated. Two contained no material, and one had two stone flakes however, an oil can lid was found below them indicating extreme disturbance in the upper 50 cm of the fill.

The second site, LA 142020, is located in the southern pond area in a plowed field. It is also a scatter of pottery and chipped stone. As much as 25 percent of the site could be intact. It is also a low-density artifact scatter from the Pueblo II or Pueblo III periods. No shovel tests were conducted.

A historic-period barn and stable are located in the right-of-way of the New Channel in area IS10. The barn is a two-story structure with a corrugated metal gable roof and random-width horizontal wooden siding. Small corrals extend to the east and west from the barn. A State of New Mexico structural form was completed.

The data recorded in the field for the 16 isolated occurrences (IOs) exhausted their relevant information potential, and they will require no further investigation. Consultation with the New Mexico State Historic Preservation Officer (SHPO) concerning the eligibility of the two archaeological sites, the historic-period barn, and the 16 IOs to the National

Register of Historic Places (NRHP) will take place. Completion of the proposed project will result in the destruction of portions of two archaeological sites, the historic-period barn, and the 16 IOs. Prior to construction, the sites and barn will be documented through excavation and photography and a report detailing the excavation and subsequent analyses of recovered material will be prepared. The report will preserve the information for the future.

Socioeconomic Characteristics

The people living and working in the project area would experience a large reduction in flood damages to their property, provide for save conveyance of flood-waters and move closer to eliminating the need for flood insurance. Environmental Justice was considered due to a large percentage of the population within the project boundary being of a minority. This project will increase their livelihood by reducing flood damage repair cost, improve the infrastructure, and have environmentally safer neighborhoods that are without standing water and mosquitoes.

7.2 NO ACTION/FUTURE WITHOUT THE PROJECT

With No Action/Future Without the Project there would be no significant impacts to these resources.

Hydrology and Water Quality

The hydrology of the flood-waters will continue to collect within personal property causing damage to the owner. Water quality will deteriorate due to long-standing water either eventually reaching an agricultural drain with a potential for high toxicity levels, compromising the current NPDES exemptions held by the irrigation district or seeping into the shallow groundwater. High groundwater tables will continue to be an issue for farmers in the area.

Cultural Resources

The two sites identified in the survey will continue to be susceptible to flooding.

Socioeconomic Characteristics

The people living and working in the project area would continue to experience a large flood damages to their property, experience unsafe conveyance of flood-waters and continue to need flood insurance. Environmental Justice was considered due to a large percentage of the population within the project boundary being of a minority. Without flood reduction they will continue having to rebuild and fix their property due to flood damage infrastructure will continue to deteriorate, and the people will continue to be exposed to environmentally hazardous conditions within their neighborhoods that are with standing water and mosquitoes.

7.3 ALTERNATIVE #1

The primary difference between the action alternatives is widening culverts and the linear extent of existing drains that would be widened and otherwise improved for purposes of flood damage reduction. Features common to all action alternatives include the specific drains that would be improved and the two new ditch sections at Anderson Farms and the PNM power line right-of-way. As previously noted, most of the proposed construction work would occur in an urban/semi-rural altered environment on previous built structures. For these reasons, there would be no significant impacts to the subject resources under this alternative.

Physiography and Geology, Land Use and Recreation, Wetlands and Floodplains, and Indian Trust Assets Biological Resources, Special Status Species, Air Quality and Noise Levels

The outfall area from the Rio Grande flood control levee to the channel is a construction site common to all action alternatives. Since the volume of the storm water discharge at this location would not differ between alternatives, the design features and construction work would also be similar. Therefore, impacts to the subject resources would be identical to those discussed for the Proposed Plan. The feasibility study has laid out a conceptual plan that incorporates only 10% of the final level of design. This plan indicates that the storm water will discharge via pipe at the riverside of the levee. This outfall will be further designed in detail in the Plans and Specifications phase. However, the opportunity exists to explore ways to enhance riparian wetland habitat by discharging and dispersing the stormwater overland to the river. This would be in lieu of discharging the stormwater directly into the river by a pipe or a constructed channel. The overland stormwater flow would be accomplished in a manner that would also prevent the formation of a shallow surface channel that would discharge the intermittent storm water directly into the river. The Corps and Sponsors will search out ways for this wetland enhancement to be sustainable utilizing the intermittent flood flows and work with PNM on required maintenance activities.

Hydrology and Water Quality

Alternative Option One conveys flood-waters to the river within 96-hours of the flood event. The hydrology will be changed to collect the water at the low points in the valley via the drain and canals to the river. The storm water has been determined, based on other studies, to have no effect on the current water quality in the Rio Grande.

The proposed plan conveys flood-waters to the river within 96-hours of the flood event. The hydrology will be changed to collect the water at the low points in the valley via the drain and gravity canals to the river. The storm water has been determined, based on other studies, to have no effect on the current water quality in the Rio Grande.

Regarding clarification on water quality of the flood waters reaching the Rio Grande, Best Management Practices (BMP) have been integrated into the project that will prevent toxicity levels from exceeding, Clean Water Act, New Mexico state or Pueblo water quality standards. Project BMP's include:

- Maintenance activities and maintenance schedules for structural controls for storm water system. This would include investigating improved floatable control using retrofit designs for a storm water trapped inlet on the street collectors.

- Detention ponding would slow velocities allowing the water to drop the sediment and any toxins attached to the sediment particles to drop out of the water column. Because the outfall begins in Isleta drain via a weir or spillway, only the top of the water column will enter into the outfall and into the Rio Grande. Additionally, the outfall will be further developed in the Plans and Specifications phase of the project to provide water dispersion into the Bosque further improving the water quality.

Offsite BMP's would be implemented by the Sponsors such as:

- Public education and outreach
- Public participation and involvement
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management in new development and redevelopment
- Pollution prevention/good housekeeping

Please refer to Bernalillo County Stormwater Quality Whitepaper Draft BCPWD May 2, 2002

The Sponsors (AMAFCA and Bernalillo County) wouldl be pursuing a NPDES permit at the point of discharge.

In addition, several water quality studies in the area have concluded that storm water entering into the Rio Grande is such a small percent of the total loading, based upon the best scientific and commercial data for the area (Parsons, June 2000).

Cultural Resources

Impacts to the subject resources would be identical to those discussed for the Proposed Plan, see Alternative 3 (NED Plan).

Socioeconomic Characteristics

The people living and working in the project area would experience a large reduction in flood damages to their property, provide for save conveyance of flood-waters and move closer to eliminating the need for flood insurance. Environmental Justice was considered due to a large percentage of the population within the project boundary being of a minority. This project will increase their livelihood by reducing flood damage repair cost, improve the infrastructure, and have environmentally safer neighborhoods that are without standing water and mosquitoes.

7.4 ALTERNATIVE #2

There would be no significant impacts to these resources under this alternative

Physiography and Geology, Land Use and Recreation, Wetlands and Floodplains, and Indian Trust Assets Biological Resources, Special Status Species, Air Quality and Noise Levels

Affects to these resources would be the same as those for the Proposed Plan and Option 1.

Hydrology and Water Quality

Alternative Option 2 conveys flood-waters to the river within 96-hours of the flood event. The hydrology will be changed to collect the water at the low points in the valley via the drain and canals to the river. The storm water has been determined, based on other studies, to have no effect on the current water quality in the Rio Grande.

The proposed plan conveys flood-waters to the river within 96-hours of the flood event. The hydrology will be changed to collect the water at the low points in the valley via the drain and gravity canals to the river. The storm water has been determined, based on other studies, to have no effect on the current water quality in the Rio Grande.

Regarding clarification on water quality of the flood waters reaching the Rio Grande, Best Management Practices (BMP) have been integrated into the project that will prevent toxicity levels from exceeding, Clean Water Act, New Mexico state or Pueblo water quality standards. Project BMP's include:

- Maintenance activities and maintenance schedules for structural controls for storm water system. This would include investigating improved floatable control using retrofit designs for a storm water trapped inlet on the street collectors.

- Detention ponding would slow velocities allowing the water to drop the sediment and any toxins attached to the sediment particles to drop out of the water column. Because the outfall begins in Isleta drain via a weir or spillway, only the top of the water column will enter into the outfall and into the Rio Grande. Additionally, the outfall will be further developed in the Plans and Specifications phase of the project to provide water dispersion into the Bosque further improving the water quality.

Offsite BMP's would be implemented by the Sponsors such as:

- Public education and outreach
- Public participation and involvement
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management in new development and redevelopment
- Pollution prevention/good housekeeping

Please refer to Bernalillo County Stormwater Quality Whitepaper Draft BCPWD May 2, 2002

The Sponsors (AMAFCA and Bernalillo County) wouldl be pursuing a NPDES permit at the point of discharge.

In addition, several water quality studies in the area have concluded that storm water entering into the Rio Grande is such a small percent of the total loading, based upon the best scientific and commercial data for the area (Parsons, June 2000).

Cultural Resources

Impacts to the subject resources would be identical to those discussed for the Proposed Plan, see Alternative 3 (NED Plan).

7.5 ALTERNATIVE #4

There would be no significant impacts to these resources under this alternative

Physiography and Geology, Land Use and Recreation, Wetlands and Floodplains, and Indian Trust Assets Biological Resources, Special Status Species, Air Quality and Noise Levels

Affects to these resources would be the same as those for the Proposed Plan and Option 1.

Hydrology and Water Quality

Alternative Option 4 conveys flood-waters to the river within 96-hours of the flood event. The hydrology will be changed to collect the water at the low points in the valley via the drain and canals to the river. The storm water has been determined, based on other studies, to have no effect on the current water quality in the Rio Grande.

The proposed plan conveys flood-waters to the river within 96-hours of the flood event. The hydrology will be changed to collect the water at the low points in the valley via the drain and gravity canals to the river. The storm water has been determined, based on other studies, to have no effect on the current water quality in the Rio Grande.

Regarding clarification on water quality of the flood waters reaching the Rio Grande, Best Management Practices (BMP) have been integrated into the project that will prevent toxicity levels from exceeding, Clean Water Act, New Mexico state or Pueblo water quality standards. Project BMP's include:

- Maintenance activities and maintenance schedules for structural controls for storm water system. This would include investigating improved floatable control using retrofit designs for a storm water trapped inlet on the street collectors.

- Detention ponding would slow velocities allowing the water to drop the sediment and any toxins attached to the sediment particles to drop out of the water column. Because the outfall begins in Isleta drain via a weir or spillway, only the top of the water column will enter into the outfall and into the Rio Grande. Additionally, the outfall will be further developed in the Plans and Specifications phase of the project to provide water dispersion into the Bosque further improving the water quality.

Offsite BMP's would be implemented by the Sponsors such as:

- Public education and outreach
- Public participation and involvement
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management in new development and redevelopment
- Pollution prevention/good housekeeping

Please refer to Bernalillo County Stormwater Quality Whitepaper Draft BCPWD May 2, 2002

The Sponsors (AMAFCA and Bernalillo County) wouldl be pursuing a NPDES permit at the point of discharge.

In addition, several water quality studies in the area have concluded that storm water entering into the Rio Grande is such a small percent of the total loading, based upon the best scientific and commercial data for the area (Parsons, June 2000).

Cultural Resources

Impacts to the subject resources would be identical to those discussed for the Proposed Plan, see Alternative 3 (NED Plan).

Socioeconomic Characteristics

The people living and working in the project area would experience a large reduction in flood damages to their property, provide for save conveyance of flood-waters and move closer to eliminating the need for flood insurance. Environmental Justice was considered due to a large percentage of the population within the project boundary being of a minority. This project will increase their livelihood by reducing flood damage repair cost, improve the infrastructure, and have environmentally safer neighborhoods that are without standing water and mosquitoes.

8. CUMULATIVE IMPACTS

NEPA defines cumulative effects as "…the impact on the environment which results from the incremental impact of the action when added to other, past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." The AMAFCA et al studies (SWCA 2003, Parsons 2000) concluded that the constituents of their storm water systems were not combining individually or cumulatively to produce substantially toxic effects to aquatic life on the Middle Rio Grande or the surrounding area.

The footprint of the project lies within an urban/semi-urban residential area that has little, if any, resemblance to what was present prior to urbanization. Since the construction work primarily involves expansion of existing storm drain facilities, most environmental impacts associated with the proposed project would have been incurred during the original construction of the ditches. These impacts have stabilized and have been considered the baselines against which impacts of the proposed project have been compared. The two areas of new ditch construction involve disturbance to the perimeter of an existing agricultural field and a maintained utility line right-of-way. This would not significantly impact the current conditions of the local environment. The current state of the drainage system adequately, but not completely, prevents flood damages to residences and structures in the project area. Positive flood prevention benefits are anticipated to occur from the proposed project that would enhance the quality of life for residents and business owners in the area. For these reasons, the proposed project when combined past, present, or future activities in the Middle Rio Grande would not significantly add to or raise local cumulative environmental impacts to a level of significance.

9. PLAN IMPLEMENTATION AND RECOMMENDATIONS

This chapter summarizes the cost-sharing requirements and procedures necessary to implement the flood reduction features of the tentatively selected plan.

Study Recommendation

The Tentatively Selected Plan, Alternative 3, is a single purpose flood control project. Because of its positive flood reduction contribution, the selected plan is tentatively recommended.

Division of Plan Responsibilities

The Water Resources Development Act (WRDA) of 1986 (P.L. 99-662) and various other administrative policies have established the basis for the division of Federal and non-Federal responsibilities in the construction, maintenance and operation of Federal water resource projects accomplished under the direction of the Corps of Engineers. This is discussed in detail below.

Cost Allocation

Cost sharing for construction of this project would be in keeping within current Corps of Engineers policy whereby for flood reduction projects, the non-Federal sponsor shall provide all lands, easements and rights-of-way and dredged material disposal areas, provide relocations of bridges and roadways; provide alteration of utilities which do not pass under or through the project's structure; and maintain and operate the project after construction. During the construction phase, the non-Federal sponsor shall contribute in cash a minimum of 5% of total costs and any additional funds as are necessary so that the non-Federal contribution would be at least *35%* of total project costs. Additional studies and analysis of the tentatively selected plan will be accomplished during Preconstruction Engineering and Design (PED). As a result of these studies, additional necessary project features may be identified that could be part of the Federal cost sharing for this project. In this event, Federal project cost sharing would be adjusted in accordance with the terms that will be included in the Project Cooperation Agreement. Corps guidance (PGL No. 36 and *59)* specifies that the level of financial participation in recreation development by the Corps at an otherwise justifiable project may not increase the Federal cost of the project by more than ten percent. This cost would be cost shared between the Corps and the non- Federal sponsor. Recreation costs are normally cost shared on a 50%/50% basis between the Corps and the non-Federal sponsor.

The Economic Appendix provides detailed information on project first costs and cost sharing between the Federal and non-Federal sponsors. The total project first cost is currently estimated to be $17,493,600, at February 2004 price levels. Hence, the Corps' share of the project cost totals $11,370,840.

D. Current and Future Work Eligible for Credit

There is no current or future work planned or in construction which is part of the Corp' Selected Plans.

E. Institutional Requirements

Upon implementation of the cost-shared project, the non-Federal sponsor will prepare the following preliminary financial analysis:
(1) Assess project-related yearly cash flows (both expenditures and receipts where cost recovery is proposed), including provisions for major rehabilitation and operational contingencies and anticipated but uncertain repair costs resulting from damages from natural events;
(2) Demonstrate ability to finance their current and projected-future share of the project cost and to carry out project implementation operation, maintenance, and repair/rehabilitation responsibilities;
(3) Investigate the means for raising additional non-Federal financial resources including but not limited to special assessment districts; and
(4) Complete any other necessary steps to ensure that they are prepared to execute their project-related responsibilities at the time of project implementation. In addition, as part of any Project Cooperation Agreement, the non-Federal sponsor would be required to undertake to hold and save the Federal Government free from damages due to construction, operation, and maintenance of the project, excluding damages due to the fault or negligence of the Federal Government or its contractors.

F. Environmental Requirements

The Tentatively Selected Plan could result in discharge of fill material into waters of the United States during the period of construction. It also may result in discharges associated with operation and maintenance activities. A Section 404(b)(l) evaluation will be prepared to address practicable alternatives. An NPDES permit will also be required for any water discharged to the river. The EA includes a discussion on the 404(b)(1) requirement as part of the feasibility study. It is anticipated that the Corps would receive a 404(r) exemption for the project, when Congress approves the project report and authorizes the project. The 404(r) exemption would cover both the construction period and the operation and maintenance activities, for as long as the project remains authorized. The report will include a description of the required O&M activities for as long as the project remains authorized. These activities will be incorporated into an O&M manual that will be provided to the non-Federal sponsor at the end of construction. The non-Federal sponsor will not need to obtain a Section 404 permit for future O&M activities if the non-Federal sponsor carries out the O&M activities as specified in the O&M manual, without deviation. Anytime during the life of the project should O&M requirements need to be modified or should there be a change in conditions not anticipated during this feasibility study, then an appropriate NEPA document will need to be prepared to modify the O&M manual and determine the need for any mitigation or 404 permit for O&M activities.

Under direction of the Corps and the Sponsors, qualified archaeologists from the Office of Contract Archeology at the University of New Mexico performed an intensive archaeological survey of 526 acres within the areas to be affected by the Proposed Plan. The two archaeological sites, the historic-period barn, and the 16 isolated occurrences will be evaluated for eligibility to the National Register of Historic Places by the Corps and concurrence will be requested from the New Mexico State Historic Preservation Officer (SHPO). Prior to initiation of construction, any required mitigation (excavation) at the archaeological sites will be coordinated with the SHPO, the Advisory Council on Historic Preservation, the Pueblo of Isleta, and other interested Native American Indian Tribes. Any required documentation such as photography and measurements of the barn will be completed. The documentation of the 16 isolated artifacts is sufficient to exhaust their potential to the National Register of Historic Places.

All cultural resource activities are in compliance with the National Historic Preservation Act of 1966 (36 CFR 800): In accordance with 36 CFR 800, regulations implementing Section 106 of the National Historic Preservation Act, a records search has been performed. Corps identification and evaluation studies will be coordinated with the Sponsors and interested Native American Indian tribes. The Corps' determinations of eligibility and effect will be coordinated with the New Mexico State Historic Preservation Officer (SHPO).

G. Non-Federal Requirements

The presently estimated non-Federal share of the total first cost of the project is $6,122,760 that includes $2,800,000 in LERRDs credits and $3,322,760 in non-Federal contributions. In addition, maintenance and operation of the flood reduction project is estimated to cost the non-Federal sponsor $85,000 annually.

Requirements of non-Federal cooperation are specified below:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total project costs as further specified below:

(1) Enter into an agreement which provides, prior to execution of the project cooperation agreement, 25 percent of design costs;

(2) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(3) Provide, during construction, a cash contribution equal to 5 percent of total project costs;

(4) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(5) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(6) Provide, during construction, any additional costs as necessary to make its total contribution equal to at least 35 percent of total project costs.

b. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

c. Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project, including mitigation features without cost to the Government, in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

d. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

e. Hold and save the Government free from all damages arising for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

f. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

g. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

h. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

i. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and, to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

j. Prescribe and enforce regulations to prevent obstruction of or encroachment on the Project that would reduce the level of protection it affords or that would hinder operation or maintenance of the Project.

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

l. Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army", and all applicable federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without

substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

m. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a Non-Federal interest to have prepared a flood plain management plan within one year after the date of signing a Project Cooperation Agreement. The plan shall be designed to reduce the impacts of future flood events in the project area, including but not limited to, addressing those measures to be undertaken by Non-Federal interests to preserve the level of flood protection provided by the project. As required by Section 402, implement the plan not later than one year after completion of the construction of the project. Provide an information copy of the plan to the Government upon its preparation;

n. Provide the non-federal share of that portion of the costs of archeological data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

o. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

p. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

q. Inform affected interests, at least annually, regarding the limitations of the protection afforded by the project.

H. Sponsorship Agreements

Bernalillo County and AMAFCA has provided a Letter of Intent acknowledging sponsorship requirements for the Southwest Valley Flood Reduction Project (included in Appendix K, Letters of Support and Financial Capability). Prior to the start of construction, the non-Federal sponsor will be required to enter into an agreement with the Federal Government that it will comply with Section 221 of the Flood Control Act of 1970 (P.L. 9 1-61 1), and the Water Resources Development Act of 1986 (P.L. 99-662) as amended.

I. Procedures for Implementation

Future actions necessary for authorization and construction of the selected plans are summarized as follows:

(1) This report will be reviewed by the Headquarters of the U.S. Army Corps of Engineers, Washington, D.C.

(2) The Chief of Engineers will seek formal review and comment by the Governor of the State of New Mexico and interested Federal agencies.

(3) Following State and Agency review, the report will be sent to the Assistant Secretary of the Army for Civil Works.

(4) Upon approval of the Assistant Secretary, the report will be forwarded to the

Office of Management and Budget (0MB) to obtain the relationship of the project to programs of the President.
(5) The final report of the Chief of Engineers will then be forwarded by the Assistant Secretary of the Army for Civil Works to Congress.
(6) Congressional review of the feasibility report and possible authorization of the project would follow.
(7) Pending project authorization for construction, the Chief of Engineers could include funds where appropriate, in his budget requests for preconstruction engineering and design of the project. The objective is to ready each project for a construction start established with the feasibility study.
(8) Following receipt of funds, preconstruction engineering and design would be initiated and surveys and detailed engineering designs would be accomplished.
(9) Following Congressional authorization of the project, plans and specifications would be accomplished by the District Engineer.
(10) Subsequent to appropriation of construction funds by Congress, but prior to construction, formal assurances of local cooperation would be required from non- Federal interests.
(11) Bids for construction would be initiated and contracts awarded.

9.2 RECOMMENDATION FROM THE DISTRICT ENGINEER

The Southwest Valley within the city limits of Albuquerque, New Mexico and portions of Bernalillo Coutny have a long history of flooding and flood damages. These problems have been acknowledged and studied for many years. More recently, heightened environmental awareness and the listing of area aquatic species as threatened and endangered have resulted in a need for increased focus on the development of flood control alternatives that minimize environmental impacts and that incorporate environmental features to enhance fish and wildlife habitats.

The recommended project is the NED Plan as described in this report. It would provide 10-year flood protection for the Southwest Valley. The project would provide estimated annual benefits of $1.8 million including avoiding damages such as vehicles, streets, utilities, and emergency costs. Annual net benefits are estimated at $482,600 and a positive benefit-to-cost ratio of 1.40 to 1. The recommended project is supported by the local sponsors, AMAFCA and Bernalillo County, who will assume all costs for any betterments and the annual OMRR&R.

I recommend that the selected plan described herein for flood damage reduction purposes be authorized for implementation as a Federal project. The implementation cost of the project is currently estimated at $17,493,600. The Federal share is currently estimated at $11,370,840 and the non-Federal share is $6,122,760. I further recommend that funds in the amount of $350,000 be allocated in fiscal year 2005 to complete plans and specifications.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of flood reduction projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted as proposals for implementation funding. However, prior to transmittal, the sponsor, the States, interested federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Dana R. Hurst
Lieutenant Colonel, U.S. Army
District Engineer

10. PREPARATION, COORDINATION AND CONSULTATION

10.1 PREPARATION

This Detailed Project Report/Environmental Assessment was prepared by the U.S. Army Corps of Engineers, Albuquerque District. The Product Delivery Team and Principal preparers included:

April Sanders P.E. – Project Manager/Planner
Steve Boberg P.E. – Hydraulic Engineer
Ernest Jahnke – Biologist
John Schelberg Ph.D. – Archaeologist
Michael Martinez P.E. – Civil Engineer
Jim McAdoo – Geotechnical and HTRW
W. Michael Howell – Real Estate
Alan CdeBaca – Cost Estimator
Theresa A. Armijo – Contracting Division
Rob Browning – Economist

The Albuquerque District Independent Technical Review Team consisted of:

Anthony Apodaca, P.E. – Plan Formulation
Gary Rutherford – CAP Manager/Economist
Mike Guerin, P.E. – Chief, General Engineering
Bruce Beach P.E. – Chief, Hydrology and Hydraulics
Carolyn Brumfield, P.E. – Hydraulic Engineer
Mike Velasquez – Hydraulic Engineer
Glenn Roybal, P.E. – Chief, Cost Engineering
W. Michael Howell – Review Appraiser
Champe Green – Biologist/Ecologist
Darrell Rieckenburg- District Councel

Resource Technology, Inc. (Albuquerque, NM) conducted geomorphic, hydrologic and hydraulic analyses which formed the basis of all findings and performed the hydraulic design. Bernalillo County conducted the real estate gross appraisal.

10.2 COORDINATION AND CONSULTATION

Agencies and other entities contacted formally or informally in preparation of this EA include:

City of Albuquerque
Albuquerque Metropolitan Arroyo Flood Control Authority
City of Albuquerque Transportation Division
Bernalillo County
Isleta Pueblo

Middle Rio Grande Conservancy District
New Mexico State Historic Preservation Bureau
New Mexico State Engineer
New Mexico Interstate Stream Commission
New Mexico Department of Game and Fish
New Mexico Environment Department
U.S. Bureau of Reclamation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

10.3 PUBLIC REVIEW AND COMMENT

Please refer to Appendix G for all public comments during two public meetings as well as responses from government agencies.

LITERATURE CITED

Anderson, C.E.
1997 *AHYMO Computer Program*. Anderson-Hydro, Albuquerque, New Mexico.

Bernalillo County
1999 *Bernalillo County Zone Atlas, Vol. 1*. Bernalillo County Planning Department, Albuquerque, New Mexico.

Bestgen, K.R., and S.P. Platania.
1991. *Status and Conservation of the Rio Grande Silvery Minnow, Hybognathus amarus.* Southwestern Naturalist 36 (2):225-232.

Biological Interagency Team
1993 *Middle Rio Grande Ecosystem: Bosque Biological Management Plan*. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Brinker, Russell C., and Paul R. Wolf
1984 *Elementary Surveying*. Seventh Edition. Harper and Row, Publishers, New York.

Brown, David, editor
1982 "Biotic communities of the American Southwest – United States and Mexico." *Desert Plants*. Vol. 4:1-132.

Bullard, T. and S. Wells
1992 *Hydrology of the Middle Rio Grande from Velarde to Elephant Butte Reservoir, New Mexico*. U. S. Fish and Wildlife Service, Resource Publication 179.

City of Albuquerque Public Works Department
1992 *Categorical Exclusion for the Menaul/Mildred Storm Drainage Improvements.* U.S. Bureau of Reclamation.

Degenhardt, W., C. Painter, and A. Price
1996 *Amphibians and Reptiles of New Mexico*. University of New Mexico Press, Albuquerque, New Mexico. 431 pp.

Federal Register.
1978 Endangered and threatened wildlife and plants: Final rule to list the bald eagle as and endangered species.
1995 Bald eagle reclassification
1999 National Pollutant Discharge Elimination System – Regulations for Revision of the Water Pollution Control Program Addressing Storm Water Discharges; Final Rule. 40 CFR Parts 9, 122, 123, and 124. December 8, 1999.

Finch, D.
1991 "Population Ecology, Habitat Requirements, and Conservation of Neotropical Migratory Birds." *General Technical Report RM-205*. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Finch, D., and J. Tainter, editors
1995 "Ecology, Diversity, and Sustainability of the Middle Rio Grande Basin." *General Technical Report RM-GTR-268*. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. 186 pp.

Finch, D., G. Wolters, and W. Yong
1995 "Plants, Arthropods, and Birds of the Rio Grande". In Ecology, Diversity, and Sustainability of the Middle Rio Grande Basin, edited by D. Finch and J. Tainter. USDA, Forest Service. *General Technical Report, RM-GTR-268*. 186 pp.

Findley, J., A. Harris, D. Wilson, and C. Jones
1975 *Mammals of New Mexico*. University of New Mexico Press, Albuquerque, New Mexico. 360 pp.

Forrest, S., and D. Biggins
1988 *Black-footed Ferret Recovery Plan*. U. S. Fish and Wildlife Service, Denver, Colorado. 154 pp.

Hacker, Leroy W.
1977 *Soil Survey of Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico*. U.S. Department of Agriculture, Soil Conservation Service, and the U.S. Department of the Interior, Bureau of Indian Affairs and Bureau of Land Management, in cooperation with the New Mexico Agricultural Experiment Station.

Hawkwatch International, Inc
1993 Bald Eagle behavior.

Hawley, J., compiler
1978. "Guidebook to Rio Grande Rift in New Mexico and Colorado." *New Mexico Bureau of Mines and Mineral Resources, Circular 163*. 241 pp.

Hink, V., and R. Ohmart
1984 *Middle Rio Grande Biological Survey*. U. S. Army Engineer District, Albuquerque, New Mexico. Contract No. DACW47-81-C-0015, Arizona State University, 193 pp.

Hubbard, J.P.
1987. *The Status of the Willow Flycatcher in New Mexico*. Endangered Species Program, New Mexico Department of Game and Fish, Santa Fe, NM. 29 pp.

Leachman, B., and B. Osmundson
1990 *Status of the Mountain Plover: A literature review*. U. S. Fish and Wildlife Service, Fish and Wildlife Enhancement. Golden, Colorado. 83 pp.

Metric Corporation
1993 *Environmental Assessment for Alameda and Riverside Drains Engineering Analysis*. Leedshill-Herkenhoff, Inc. 70pp.

Miller, J.F., R.H. Frederick, and R.J. Tracy
1973 *NOAA Atlas, No. 2*. "Precipitation-Frequency Atlas of the Western United States." U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, Maryland.

Mitsch, William J.
1986. *Wetlands*. Van Nostrand Reinhold, Publishers. New York.

Muiznieks, B. S. Sferra, T. Corman, M. Sogge, and T. Tibbits
1994. *Arizona Partners in Flight Southwestern Willow Flycatcher Survey, 1993.* Draft technical report: nongame and endangered wildlife program, Arizona Game and Fish Department, phoenix, Arizona. April 1994. 28 pp.

New Mexico Department of Game and Fish
1987 *Status of the Willow Flycatcher in New Mexico.* Endangered Species Program, New Mexico Department of Game and Fish, Santa Fe, New Mexico. 29 pp.

1988 *Handbook of Species Endangered in New Mexico.* Santa Fe, New Mexico. 124 pp.

New Mexico Environment Department (NMED)
1997 *State of New Mexico Air Quality Bureau Annual Report 1994-1996*.

2000 *Draft Middle Rio Grande Total Maximum Daily Load (TMDL) for Fecal Coliform in Storm Water.* New Mexico Environment Department Surface Water Quality Bureau, Santa Fe, New Mexico. 74 pp.

New Mexico Rare Plants (NMRP).
2003. www.nmrareplants.unm.edu/nmrptc/county.

New Mexico Water Quality Control Commission (NMWQCC)
2000 *State of New Mexico Standards for Interstate and Intrastate Streams (20 NMAC 6.4)*.

Muiznieks, B., S. Sferra, T. Corman, M. Sogge, and T. Tibbitts
1994 *Arizona Partners in Flight: Southwestern Willow Flycatcher Survey, 1993.* Draft technical report: Non-game and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona. 28 pp.

Parsons Engineering Science, Inc.
2000 *National Pollutant Discharge Elimination System (NPDES) Permit for the Albuquerque Municipal Separate Storm Water System (MS4)*. Final biological evaluation. June 2000.

Platania, S.P.
1991. *Fishes of the Rio Chama and Upper Rio Grande, New Mexico, with Preliminary Comments on Their Longitudinal Distribution*. Southwestern Naturalist 36:186-193.

1993. *The Fishes of the Rio Grande Between Velarde and Elephant Butte Reservoir and Their Habitat Associations*. U.S. Bureau of Reclamation, Albuquerque, New Mexico. 188 pp.

1995. *Reproductive Biology and early life-history of the Rio Grande Silvery Minnow, Hybognathus amarus*. U.S. Army Corps of Engineers, Albuquerque, New Mexico. 23 pp.

Platania, S.P., and C.S. Altenbach
1998. *Reproductive Strategies and Egg Types of Seven Rio Grande Basin Cyprinids*. Copeia 1998:559-569.

Platania, S.P., and R.K. Dudley
1999. *Draft Summary of Aquatic Conditions in the Middle Rio Grande Between San Acacia Dam and San Marcial Railroad Bridge Crossing for the Period 14 through 26 April 1999*. Prepared for New Mexico Ecological Services Field Office, U.S. Fish and Wildlife Service. Division of Southwestern Biology, University of New Mexico. 15 pp.

Phillips, A., J. Marshall, and G. Monson
1964 *The Birds of Arizona*. University of Arizona Press, Tucson, Arizona. 212 pp.

Shaw, D., and D. Finch (Technical Coordinators)
1996 "Desired Future Conditions for Southwestern Riparian Ecosystems: bringing interests and concerns together." *General Technical Report RM-GTR-272*. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. 359 pp.

Stahlecker, Dale W., and Nancy S. Cox
1997 *Bosque Biological Monitoring Program: Bird Populations in Rio Grande Valley State Park, Winter 1996-97 and Spring 1997*. Eagle Environmental, Inc., Santa Fe, New Mexico. 28 pp.

Stuart, J., and M. Bogan

1996 *Fragmented riparian habitats and small mammal assemblages in the Middle Rio Grande Valley, New Mexico*. Interim Report. National Biological Service, Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico. 39 pp.

Sublette, J., M. Hatch, and M. Sublette

1990 *The Fishes of New Mexico*. New Mexico Department of Game and Fish. University of New Mexico Press, Albuquerque, New Mexico. 393 pp.

SWCA Environmental Consultants

2003 *Maintenance of Existing and Future Storm Water Conveyances in the Middle Rio Grand, New Mexico*. Final draft biological evaluation. Prepared for the City of Albuquerque, Albuquerque Metropolitan Arroyo Flood Control, University of New Mexico, and New Mexico State Highway and Transportation Department. July, 2003. 53 pp.

Thompson, B., D. Leal, and R. Meyer

1994 *Bird Community Composition and Habitat Importance in the Rio Grande System of New Mexico with Emphasis on Neotropical Migrant Birds*. New Mexico Cooperative Fish and wildlife Research Unit and Fishery and Wildlife Sciences Department, New Mexico State University, Las Cruces, New Mexico. 151 pp.

U.S. Army Corps of Engineers

1949 *Plan of Improvement Proposed in House Document 243*. U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1953 *Rio Grande and Tributaries, Albuquerque, New Mexico and Vicinity, Review Report on Survey for Flood Control.* U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1958 *Rio Grande and Tributaries, New Mexico, Review Survey for Flood Control, Interim Report on Main Stem of the Rio Grande above Elephant Butte Dam.* U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1979 *Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico, Interim Feasibility Report.* U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1981 *Report of the Chief of Engineers.* U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1986 *Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico, General Design Memorandum, No. 1.* U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1994 *Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico Limited Reevaluation Report.* U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1991 *Albuquerque Arroyos, Albuquerque, New Mexico, Rio Grande and Tributaries, New Mexico Reconnaissance Study*. U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1995 *Albuquerque Arroyos, Albuquerque, New Mexico, Rio Grande and Tributaries, New Mexico Modifications to Existing Projects (Section 216).* U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1992 *Rancho, New Mexico Reconnaissance Report.* U.S. Army Corps of Engineers, Albuquerque District, New Mexico.

1995 "Risk Based Analysis for Evaluation of Hydrology, Hydraulics, and Economics in Flood Damage Reduction Studies." *Engineering Circular 1110-2-205*.

U.S. Bureau of Reclamation (USBR)

1999 *Biological Assessment, Rio Grande Restoration at Santa Ana Pueblo, Terrestrial Habitat Enhancement Plan*. U.S. Department of Interior, Bureau of Reclamation, Albuquerque Area Office, Albuquerque, New Mexico. 27 pp.

2003. Rio Grande Silvery Minnow Population Monitoring. http://www.usbr.gov/uc/albuq/envprog/rg/rgsm2003/index.html.

U.S. Fish and Wildlife Service (USFWS)

1993 Endangered and threatened wildlife and plants; proposed rule to list the Rio Grande silvery minnow as endangered, with critical habitat. Federal Register. 58:11821-11828.

1994. Endangered and threatened wildlife and plans; proposed rule to list the Rio Grande silvery minnow as an endangered species. Federal Register. 59:36988-37001.t Water Resources Council

1999a. Endangered and threatened wildlife and plants; final designation of critical habitat for the Rio Grande silvery minnow. Federal Register. 64 (128): 36274-36288.

1999b Endangered and threatened wildlife and plants; proposed rule to remove the Bald Eagle in the lower 48 states from the list of endangered and threatened wildlife; proposed rule. Federal Register. 64 (128): 36454-36464.

Water Resources Council

1983a *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*. Water Resource Council, Washington, D.C.

1983b *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, Chapter I--Standards*. Water Resource Council, Washington, D.C.

1983c *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, Chapter II--National Economic Development Benefit Evaluation Procedures*. Water Resource Council, Washington, D.C.

1983d Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, Chapter III--Environmental Quality Evaluation Procedures. Water Resource Council, Washington, D.C