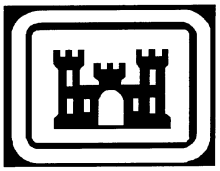


US Army Corps
of Engineers
Los Angeles District

FINAL

ENVIRONMENTAL ASSESSMENT

TANQUE VERDE CREEK, PIMA COUNTY, ARIZONA
CRAYCROFT ROAD TO SABINO CANYON ROAD BANK PROTECTION

AUGUST 2002

LOS ANGELES DISTRICT, CORPS OF ENGINEERS
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

FINDING OF NO SIGNIFICANT IMPACT

TANQUE VERDE CREEK
CRAYCROFT ROAD TO SABINO CANYON ROAD
BANK PROTECTION AND RIPARIAN PRESERVE PROJECT
PIMA COUNTY, ARIZONA

I have reviewed the attached Environmental Assessment (EA) prepared for the Tanque Verde Creek, Craycroft Road to Sabino Canyon Road, Bank Protection Project, Pima County, Arizona. This EA addresses impacts related to bank stabilization along Tanque Verde Creek, Arizona.

The proposed project consists of stabilizing unprotected creek banks between Craycroft Road Bridge and Sabino Canyon Road Bridge with soil cement, and acquiring an area supporting desert riparian vegetation as a preserve along the north bank. The project reach is approximately two miles long. Currently, approximately 8,800 linear feet of existing bank within the project reach have been stabilized. Bank stabilization has occurred in four segments (See Figure 2 of the EA). Bank stabilization for the preferred alternative includes: 1,550-feet of soil cement bank stabilization along the north bank upstream of Craycroft Road, approximately 5,000 feet of modified bank stabilization along the preserve area, and a total of about 7,050-feet along the south bank, in two segments.

The primary purpose of the proposed project is reduction of lateral erosion and flood damages along Tanque Verde Creek and provision of protection to private property, public infrastructure, and existing riparian areas between Craycroft Road and Sabino Canyon Road.

The U.S. Army Corps of Engineers environmental staff conducted environmental resource surveys for biological, cultural, water resources, air quality, land use, esthetics, noise, and traffic along the project reach.

The proposed construction of the bank stabilization would not result in significant impacts to the resources identified above. Due to implementation of the preferred Alternative, a total of approximately 9.0 acres of habitat would be directly removed, including approximately 1.0 acre of high quality mesquite Bosque habitat and 8.0 acres of disturbed desert wash habitat. Based upon the Modified HEP Analysis, acquisition and protection of the 48-acre riparian area along the north bank would provide the appropriate level of mitigation needed for project impacts. The Incremental Analysis included the preserve area to determine habitat quality and habitat units to compare with the habitat affected due to project implementation. A total of 2.38 Average Annual Habitat Units (AAHUs) will be lost due to implementation of the Recommended Plan. Based upon the HEP Analysis, acquisition, maintenance, and protection of the 48-acre mesquite bosque area along north bank would provide a net increase of 4.43 AAHUs over without-project conditions, more than offsetting the impacts to the construction area. Since the mitigation plan provides a slight increase in AAHUs (about 10%) over without-project conditions, acquisition and protection of the 48-acre preserve is recommended as adequate and appropriate mitigation.

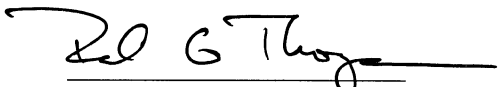
The Corps conducted a lateral migration analysis to investigate erosion along the Tanque Verde Creek banks. This analysis indicated that lateral shifts on the order of 650 feet in the banks of the main channel are not unusual over a 50-year time period. Over the 50-year period of analysis, an average annual erosion rate of approximately 13 feet per year appears to be a reasonable estimation of the erosion potential within the area (see details in Appendix A of the EA). The majority of this lateral erosion of would occur as the result of one or a few catastrophic flood events rather than at a constant rate.

Short-term construction related impacts would be minimized by implementation of the environmental commitments identified in this EA. No construction would occur during the summer monsoon season, or during heavy rain, to avoid impacts to water quality. Watering of the construction site would be conducted to minimize fugitive dust.

A prehistoric archeological site is located within the project's area of potential effects. The site is potentially eligible for listing in the National Register of Historic Places. The Corps will perform evaluation studies on the site. If the site is eligible for listing and cannot be avoided by construction of the project, a memorandum of agreement (MOA) stipulating mitigation measures will be executed in consultation with the Arizona State Historic Preservation Officer, Pima County and interested Native American tribes. Site avoidance is the preferred alternative. Otherwise, data recovery excavations are typically implemented for the purpose of documenting the important information contained within the archeological sites. A burial agreement will be negotiated with interested tribes and artifacts will be curated in an approved facility. Proper implementation of all mitigation measures stipulated in the MOA prior to construction will reduce adverse effects to levels of insignificance.

I have considered the available information contained in the EA. It is my determination that impacts resulting from the proposed modifications to Tanque Verde Creek will not have a significant adverse effect upon the existing environment or the quality of the human environment. Therefore, preparation of an Environmental Impact Statement is not required.

12 SEP 2002
DATE



Richard G. Thompson
Colonel, Corps of Engineers
District Engineer

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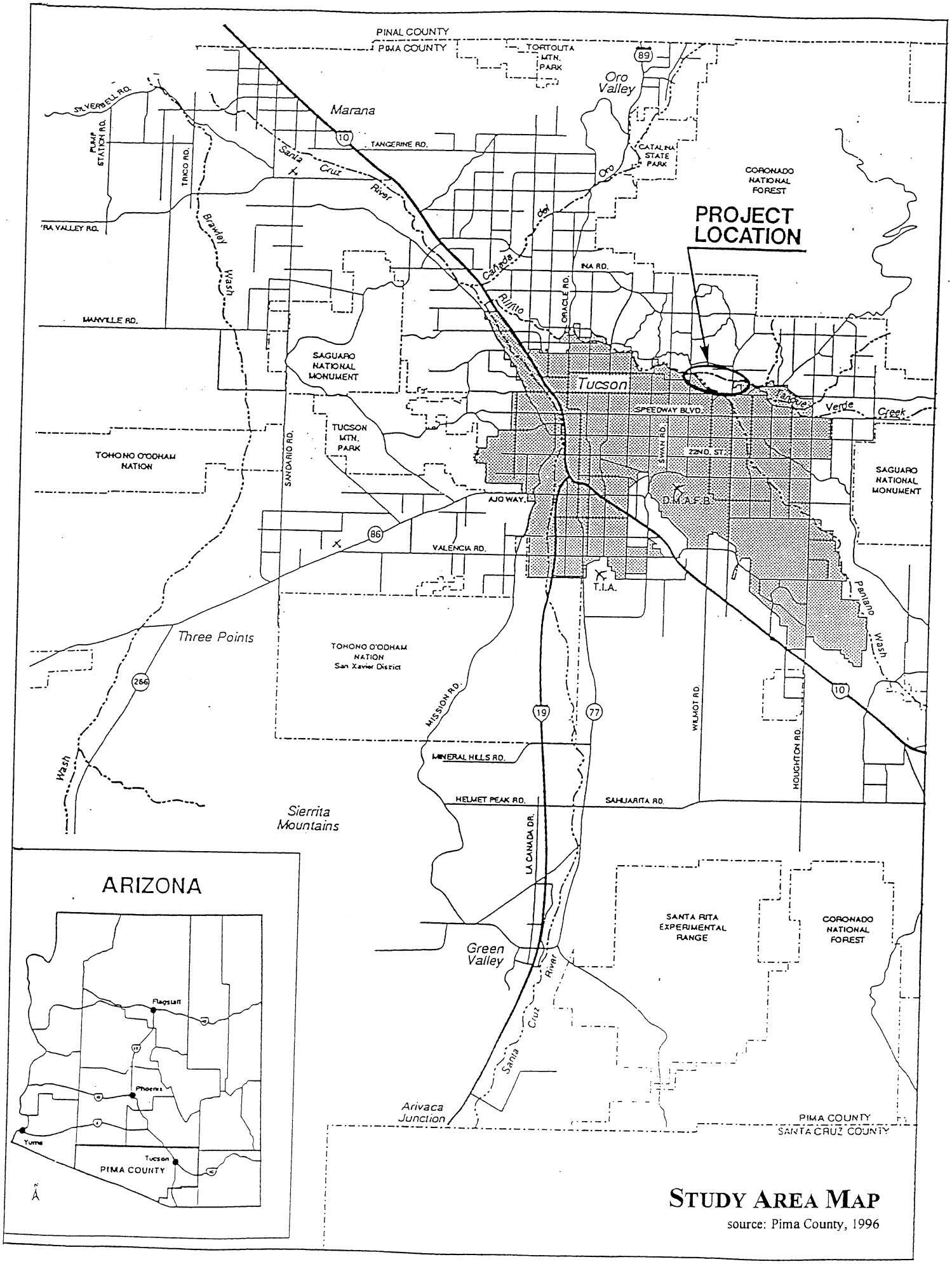
1.0 INTRODUCTION

1.1 Location

Tanque Verde Creek is an ephemeral stream, draining a 219 square mile watershed that extends into the Catalina and Tanque Verde mountains, north and east of the City of Tucson, Arizona. Tanque Verde Creek merges with the Pantano Wash and flows into the Rillito River, which continues west along the northern edge of Tucson. Craycroft Road, a major north-south city/county roadway, crosses directly over the confluence via an 850-foot long multispan bridge. The project area is located between Craycroft Road and Sabino Canyon Road (See Figure.1).

1.2 Project Background

The Corps of Engineers (Corps), initiated general design studies for the Rillito River bank protection project in June 1987 after receiving a letter of assurance, dated 6 May 1987, from the Pima County Department of Transportation and Flood Control District (PCDOT & FCD), the non-Federal sponsor of the project. In the letter, the County expressed their intent to cooperate with the Federal Government in constructing the authorized Rillito River project.



STUDY AREA MAP

source: Pima County, 1996

The authorized project consisted of soil cement, bank stabilization and a comprehensive recreation plan as identified in the May 1986 Rillito River & Associated Streams Survey Report and in the October 1992 General Design Memorandum. Construction of the Rillito River bank protection project has been divided into three increments - Increments I and II for the flood control portion and Increment III for recreation and aesthetic treatment of the entire river reach.

As part of the currently authorized Rillito River and Associated Streams Study (RRAS), the Corps of Engineers completed a Survey Report and Environmental Assessment for the Rillito River and Associated Streams in 1987. This report examined flood related problems on the Rillito River and its major tributaries, including Tanque Verde Creek. At the time of the final report, there were no economically justified flood control measures for Tanque Verde Creek, with the exception of the reach adjacent to the Forty-Niners Country Club Estates (which was later studied by the Corps under Section 205 of the Continuing Authorities Program). Since publication of the final report, however, severe flooding demonstrated that substantial damages could occur to private property, public infrastructure, and existing riparian areas along Tanque Verde Creek, especially along the reach between Craycroft Road and Sabino Canyon Road. The PCDOT & FCD, the proposed non-Federal sponsor, therefore, asked the Corps to prepare a Limited Reevaluation Report (LRR) to investigate the feasibility and justification of adding bank protection, by increments, on Tanque Verde Creek between Craycroft Road and Sabino Canyon Road.

The proposed project is to stabilize unprotected creek banks between Craycroft Road Bridge and Sabino Canyon Road Bridge with soil cement. The non-federal sponsor, PCDOT & FCD, proposes to acquire and set aside as a preserve a 48-acre site along the north bank of the project area that supports mesquite bosque/desert riparian habitat. The mesquite bosque preserve will be used as mitigation for short-term and long-term project impacts. The project reach is approximately two miles long. Currently, approximately 8,800 linear feet of existing bank within the project reach are stabilized with soil cement in four segments (See Figure 2). Bank stabilization for the Recommended Plan (Alternative 4), includes 1,550 feet along the north bank and a total of about 7,050 feet along the south bank, in two segments. In addition, approximately 5,000 feet of modified bank stabilization would be provided along the preserve area on the north bank. All of the proposed bank protection would be follow the alignment of the existing channel banks. The project-related direct loss of habitat is about 9.0 acres for the Recommended Plan, of which 4.88 acres will be temporary losses. The Corps has performed modified Habitat Evaluation Procedures (HEP) and an Incremental Cost Analysis (Appendix B-5) for the Recommended Alternative and other viable Alternatives to identify project-related impacts to biological resources, to determine the number of habitat units lost under each Alternative scenario, and to determine the amount of mitigation required for each Alternative. The Modified HEP calculates habitat units for the construction area as well as for the 48-acre preserve area for existing conditions and for the life of the project for the viable alternatives. Recommended mitigation areas to provide habitat units equal to those that would be lost have been identified. The Corps has performed a Geomorphic/Lateral Migration Analysis for the proposed project including the riparian preserve area (May 1999). The study result shows that banks in the vicinity of the riparian preserve could be eroded on an average of 13 feet per year, or a total of approximately 650 feet over the 50-year period of analysis, which would include almost the entire preserve. The actual rate of erosion may be lower because the existing vegetation provides

limited natural bank stabilization. The majority of lateral erosion is likely to occur in one or a few major storm events, rather than at a steady rate of 13 feet per year. The detailed Lateral Migration Analysis study is located in Appendix A of this Environmental Assessment (EA). Section 3.3 of this EA summarizes the study results.

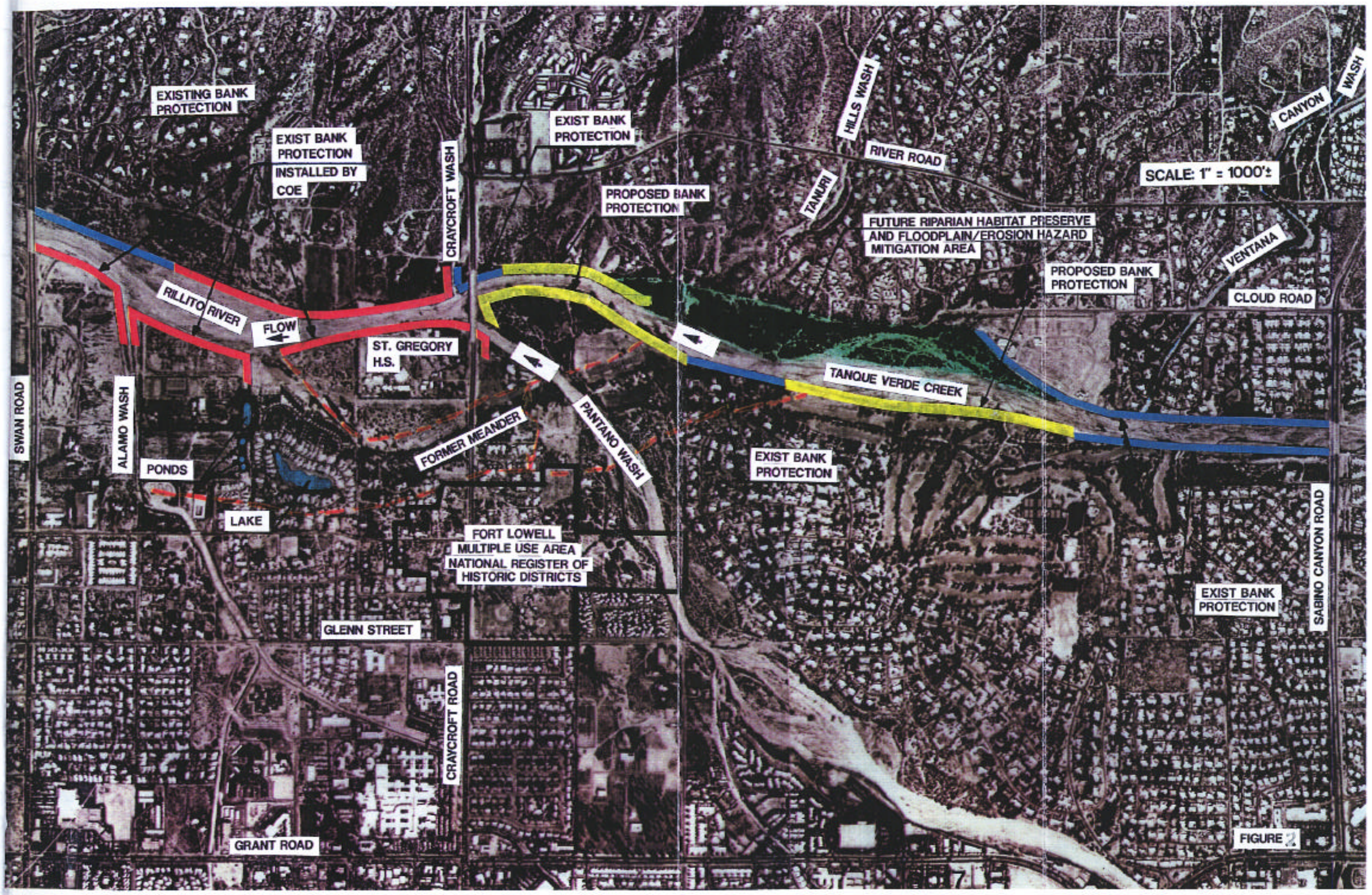

EXISTING BANK PROTECTION
EXIST BANK PROTECTION INSTALLED BY COE
EXIST BANK PROTECTION
PROPOSED BANK PROTECTION
CRAYCROFT WASH
HILLS WASH
TANURI
RIVER ROAD
CANYON WASH
SCALE: 1" = 1000'±
FUTURE RIPARIAN HABITAT PRESERVE AND FLOODPLAIN/EROSION HAZARD MITIGATION AREA
VENTANA
PROPOSED BANK PROTECTION
CLOUD ROAD
RILLITO RIVER
FLOW
ST. GREGORY H.S.
TANQUE VERDE CREEK
SWAN ROAD
ALAMO WASH
FORMER MEANDER
PANTANO WASH
PONDS
LAKE
FORT LOWELL MULTIPLE USE AREA NATIONAL REGISTER OF HISTORIC DISTRICTS
EXIST BANK PROTECTION
SABINO CANYON ROAD
GLENN STREET
CRAYCROFT ROAD
EXIST BANK PROTECTION
GRANT ROAD

FIGURE 2

1.3 Authority

Flood related investigations of Tanque Verde Creek, as part of the currently authorized Rillito River and Associated Streams Study (RRAS) were authorized in Public Law 761, Seventy-fifth Congress, known as Section 6 of the Flood Control Act of 1938, which states:

> *"The Secretary of War (now Secretary of the Army) is hereby authorized and directed to cause preliminary examinations and surveys...at the following localities...Gila River and tributaries, Arizona..."*

Additional authority was given by Section 601(b) of the Water Resources Development Act of 1986 (PL 99-662), which authorized a project for the Rillito River in Tucson, Arizona as follows:

> *"A Rillito River, Tucson, Arizona. Report of the Division Engineer, for the purpose of providing bank protection against the level of flooding that occurred in October 1983, at a total cost of $26,000,000. Section 104 of this act shall apply to the project authorized by this paragraph."*

Specific appropriations further detailing the project area of this EA were included in the *Energy and Water Development Appropriations Bill, 1998*, Report 105-190, which states:

> *"Rillito River, Arizona. --The Corps of Engineers is directed, as part of the Rillito River project, to accomplish a limited reevaluation report of Tanque Creek immediately upstream and including Craycroft Road Bridge to determine the advisability of extending the bank protection and related measures. The analysis will be consistent with that of the Chief of Engineers report for the Rillito Creek project to include full use of location benefits for economic justification purposes. The Committee has provided $5,000,000 for this work and the construction of pedestrian bridges required for safety purposes."*

1.4 Past Studies and Documents:

The summary of previously prepared documents is provided in the following paragraphs. These reports are on file at Corps of Engineers (Corps), Los Angeles District (LAD).

1945-1946 Studies: In November 1945 a report entitled "Interim Report on Survey of Gila River and Tributaries in the Vicinity of Tucson, Arizona" was prepared. In a follow-up report, the Chief of Engineers' Report dated October 31, 1946, construction of a diversion channel and levee system to protect portions of Tucson was recommended.

Late 1960's Studies: In the late 1960's, the Corps studied flood-related problems along the Santa Cruz River and its principal tributaries, extending north from the boundary of the United States and Mexico, to its confluence with the Gila River. This was an interim study conducted under the Gila River and Tributaries, Arizona, and New Mexico study authority. It addressed flood-related problems on the Rillito River and tributaries and Airport Wash (see details in LRR).

Mid-1970's Studies and Reports: In the mid 1970's, two Floodplain Information Reports were prepared by the Los Angeles District at the request of Pima County, under the continuing authority provided by Section 206 of the Land Acquisition Policy Act of 1960 (Public Law 86-645), as amended. The first report addressed the Rillito River and Pantano Wash and was published in June 1973. The second report addressed Tanque Verde Creek and Tributaries and was published in August 1975. The purpose of these reports was to identify those areas subject to possible future flooding. Although these reports did not provide solutions to flood problems, they did furnish a suitable basis for the adoption of land use controls to guide floodplain development, and thereby prevent intensification of future flood-related damages. These reports were utilized by Pima County to regulate floodplain development.

1980-86 Studies and Reports: In October 1983, major flooding occurred along the Rillito River and caused substantial damage. At the request of Pima County, the Los Angeles District initiated a Section 14 (Emergency Streambank Protection) Initial Appraisal, in the vicinity of the Flowing Wells Road Bridge, to examine the feasibility of protecting public property (utilities, bridge, fire station) from imminent damage due to future channel bank erosion. The report, which recommended construction of 700 linear feet of soil cement revetment bank protection, was approved in July 1984. Construction was completed in early 1986.

In May 1985, the Final Tucson Urban Study (TUS) Report was submitted to the South Pacific Division for approval. It recommended no further studies under the TUS authority. Detailed studies were to be continued under the Rillito River and Associated Streams authority. The South Pacific Division and Board of Engineers for Rivers and Harbors concurred with this recommendation in July 1985 and November 1985, respectively (refer to Chapter III of LLR for details).

The authorized plan for stabilization of the Rillito River was developed by the U.S. Army Corps of Engineers in the 1986 Survey Report (revised in February 1987). The project included approximately 10.8 miles of soil cement bank protection and 15 invert stabilizers, similar to that already constructed by local interests along several reaches. At the time of the final report there were no economically justified flood control solutions to the problems on Tanque Verde Creek, with the exception of a reach adjacent to the Forty-Niners Country Club Estates (which was later studied by the Corps under Section 205 of the Continuing Authorities Program).

Final Environmental Assessment (EA) for the Rillito River and Associated Streams Project in Pima County - May 1986: A Final EA was completed and a Finding of No Significant Impact (FONSI) was signed in May 1986, and later revised in February 1987. This Final EA addressed impacts related to stabilization of 13.2 linear miles of banks along the Rillito River with soil cement revetment, and re-establishment of the pre-October 1983 channel alignment and configuration.

1990-1996 Studies and Report: In 1992, the Federal Emergency Management Agency (FEMA) completed a Flood Insurance Study, which designated flood hazard zones within unincorporated areas of Pima County, Arizona. In October 1992, the Corps of Engineers prepared a General Design Memorandum (GDM) for bank protection along the Rillito River.

Construction of the Rillito River bank protection project was divided into three increments. Increments I and II were for flood control, and Increment III was for recreation and aesthetic treatment of the entire river reach. This project included construction of approximately 10.8 miles of soil cement bank protection and 15 invert stabilizers.

The Pima County Flood Control District has prepared a report in 1996 detailing a proposed plan for bank stabilization, and a potential riparian area preserve, along Tanque Verde Creek. The purpose of this report was to develop a plan to provide protection to private property, public infrastructure, and existing riparian areas along Tanque Verde Creek, especially within the reach between Craycroft Road and Sabino Canyon Road.

Final Supplemental Environmental Assessment to April 1986, Final Environmental Assessment Rillito River and Associated streams Project - October 1992: This supplemental EA was prepared to address impacts related to modifications made to the Final EA of 1986. The modifications were: relocation of recreation rest areas and staging areas. The Supplemental EA also included compliance with new Federal and State environmental requirements and policies.

Final Supplemental Environmental Assessment - June 1995: This supplemental EA was prepared to address impacts related to modifications to be made during construction of the second phase of the Corps Rillito River project. During design of the second phase of the project, additional changes were recommended due to changing conditions in the project area and refinement of the project design. These changes included stabilization of about six miles along both banks of the river and construction of nine invert stabilizers between Craycroft Road and the Santa Cruz River.

Supplemental Environmental Assessment - January 1998: This Supplemental EA was prepared to evaluate impacts related to installation of pedestrian bridges (Phase III) in alignment with the recreational trail at intersections of the trail and river channels. Construction of these pedestrian bridges would help preserve the existing bank stabilization measures. They would also eliminate the public safety risk incurred by crossing the tributary and main channels of the Rillito River system in the absence of pedestrian bridges.

1.5 Summary of Impacts

Potential impacts associated with construction of the proposed bank stabilization measures along Tanque Verde Creek are summarized below:

Short Term Impacts: Short-term impacts from stabilization of the banks would result from the excavation of material, use of construction equipment, and transportation of required construction materials.

- Fugitive dust particles and emissions generated by vehicles and equipment would be increased within the project areas during construction. Watering of the excavated site and unpaved road would be employed to control the fugitive dust. Normal conditions would be reestablished after completion of the project.

- Noise levels from the construction equipment would be increased in the vicinity of the project area. This impact would be short term and insignificant.

- Approximately 4.88 acres of desert wash habitat will be excavated for toe-down and access. This habitat is expected to recover within approximately 3-5 years. These temporary impacts have been considered in the mitigation plan.

Long Term Impacts:

- Secondary impacts to the mesquite bosque habitat at the confluence of Tanque Verde Creek with Pantano Wash and the Rillito River may also occur over a long period of time. Mature trees will continue to obtain ground water, but germination and establishment of new seedlings may be inhibited, as the bank protection prevents overflow of floodwaters onto this stand. The proposed mitigation plan takes into consideration these impacts.

- For the Recommended Plan, a total of approximately 4.12 acres of habitat would be permanently removed, including approximately 1.0 acre of high quality mesquite Bosque habitat and 4.22 acres of disturbed desert wash habitat. Bank stabilization utilizing soil cement will not support regrowth of vegetation along the creek banks. Based on the modified HEP, an estimated 2.38 average annual habitat units (AAHUs) would be lost in the construction area over the 50-year period of analysis. Acquisition and maintenance of the preserve area located along north bank of the creek would adequately mitigate for the loss of these AAHUS. Habitat units lost, mitigation requirements, and mitigation costs have also been calculated for the other viable alternatives Appendix B-5.

2.0 PURPOSE AND NEED

The primary purpose of the proposed project is to provide bank protection along Tanque Verde Creek between Craycroft Road and Sabino Canyon Road in order to reduce flood damages to private property, public infrastructure, and existing riparian areas. The Tanque Verde Creek area is subject to periodic inundation from large magnitude floods. Associated flood damages impact residential, commercial, and recreational developments as well as roads, bridges, and utilities. The upper reaches of the creek remain undeveloped and unencroached upon by man. The lower reaches from Wentworth Road to the confluence with the Rillito River are substantially developed.

Historically, flooding has occurred along the Rillito River and its tributaries. The floods of December 1965 (Rillito River, peak discharge of 12,400 cubic feet per second [cfs]) and of December 1967 (peak discharge of 16,000 cfs) caused significant damage in Tucson and in the vicinity. Estimated damage caused by past flooding, per event has ranged from $2,000,000 to $10,000,000. Historically, the highest recorded peak discharge was 28,500 cfs in Pima County. Along Tanque Verde Creek, significant damage occurred due to flooding of 1993. This prompted the renewed investigation into a project to reduce flood damages to private property, public infrastructure, and existing riparian areas. The following problems and opportunities have been identified in the reach of Tanque Verde Creek between Craycroft Road and Sabino Canyon Road. During the flood of 1993, this reach experienced significant lateral erosion. Major damages occurred to an existing 8" sanitary sewer line located along the south bank of Tanque Verde Creek, near the Tucson Country Club Estates, which was exposed due to lateral bank erosion. Lateral bank migration of about 100' also occurred during this flood.

If more flooding occurs in this vicinity, it will damage the sewer line located on the north side of Tanque Verde Creek. This is a 30" sewer line, known as the North Rillito Interceptor, which runs along the base of the river bluff. If a line break occurred, it would be impossible to close down flow without inducing sewer back-flow into residential properties, due to the interceptor's gravity flow design. According to the Pima County Wastewater Management Department, it is likely that a line break during a storm event could produce a 20 million gallon release of wastewater prior to its containment.

On the south side of Tanque Verde Creek, Pima County has already awarded an engineering and design contract for construction of a new 36" Tanque Verde Interceptor Extension sewer line. This interceptor will parallel Tanque Verde Creek from Craycroft Road east to the Tucson Country Club. This project was approved with the 1997 sewer system revenue bond ballot initiative.

Lateral Migration Analysis: The Corps conducted an analysis to investigate erosion along the Tanque Verde Creek banks. This indicated that lateral shifts on the order of 650 feet within the banks of the main channel, of are not unusual over a 50-year time period. This distance correlates very closely to the long-term migration distance (652 feet) computed using building setback formulas in the City of Tucson's drainage standards (City of Tucson, 1989), in conjunction with a bankful discharge of 17,000 cfs. Likewise, over the 50-year period of

analysis, an average annual erosion rate of approximately 13 feet per year appears to be a reasonable estimation of the erosion potential within the area. On a per-event basis, flow events even smaller than a 5-year event could cause bank migration of unprotected banks. The maximum historic migration that has been observed in the study area is 195 feet, although the frequency associated with such an event is unknown.

Under without-project conditions, it is also expected that scour, degradation and erosion along the creek banks will occur. The erosion zone in question includes residential properties, an existing sewer line, a proposed sewer line, and the Tucson Country Club. There are 56 residential structures located within the erosion zone. Equivalent Annual Damages by category are shown in Table 4.2 of Chapter IV of the LRR.

Upstream of the Craycroft Road Bridge, an old meander bend extends south of the existing channel. This meander intersects Craycroft Road approximately 1,000 feet south of the bridge. Flood flows and subsurface flows tend to follow this meander and have already resulted in undermining of the roadway embankment. Periodic repairs to the road surface and to an interceptor sewer line have been required due to these flows. In the event of a severe flood, flows could undermine and break through the roadway embankment, washing out the roadway and the sewer interceptor. Such an event could also cause inundation and erosion damages to houses and other development west of Craycroft Road, the North Rillito Interceptor, and the Tanque Verde Interceptor Extension.

An evaluation of 60 years of photographic records was performed to determine erosion potential along the study area. Photographs used in this analysis were taken in 1936, 1953, 1960, 1967, 1971, 1983, 1993, and 1996. For details see Chapter IV, Problems and Opportunities, of the Limited Reevaluation Report.

The unprotected banks of Tanque Verde Creek would experience rapid erosion during significant flood events. There are two large gaps along the south as well as the north banks. It is necessary to provide bank protection between Craycroft Road and Sabino Canyon Road to halt further channel migration, and to protect existing structures, property, and riparian areas.

Flood flows from Pantano Wash, moreover, have the potential for causing added damage in the confluence area, where floodflows could commingle with flows from Tanque Verde Creek. Such combined flows would potentially cause damage to property within the area between the two conveyances, as well as to the Craycroft Road bridge and embankment.

3.0 ALTERNATIVES DEVELOPMENT PROCEDURE

The Tanque Verde Creek Limited Reevaluation Study was conducted to develop feasible alternatives to provide required bank stabilization to protect properties and infrastructure within the project area and to reduce the flood threat to the residences and businesses located in the vicinity of Tanque Verde Creek. Planning objectives, economic, social and environmental criteria described below have been taken into consideration in the development of the feasible alternatives. Viable alternatives including the No Action Alternative are described in section 3.3.

3.1 Planning Objectives.

The following Planning Objectives have been developed as guidelines for plan evaluation for the Tanque Verde Creek Project:

- Reduce damages resulting from streambed degradation and bank erosion and failure along Tanque Verde Creek.
- Prevent or minimize flood hazards along Tanque Verde Creek.
- Maintain existing open space and natural resources located within the proposed project area to the extent possible.
- Minimize impacts to existing riparian habitat and wildlife resources located within the proposed project area.
- Avoid or minimize impacts to existing historical archaeological resources located within the proposed project boundary.

3.2 Criteria for Plan Evaluation

Bank Protection:

- An alternative should be consistent with Pima County and City of Tucson General Plans, particularly the County's Rillito Corridor study and the authorized Rillito River and Associated Streams Study.
- The Recommended Plan should not cause flood hazards for downstream developments without measures to compensate for the effects resulting from implementation of the selected Alternative.

Economic Criteria:

- The total benefits associated with the implementation of the selected plan must be equal to or exceed the total costs associated with the proposed project.
- Project benefits should be based on analyses of conditions without and with a project, using methodologies described in "Principles and Guidelines" and Corps of Engineers regulations.

- The benefits and costs should be expressed in comparable terms as fully as possible. Plan evaluation should be based on the same price level and the same interest rate for both benefits and costs, and a project life of at least 50 years.

Environmental Criteria:

- An environmental document must be in compliance with the National Environmental Policy Act (NEPA), and applicable Federal, State and Local environmental laws and regulations.
- If possible, avoid impacts to the significant resources located within the project area. Provide mitigation to offset project related impacts fully.
- To the extent practicable, enhance significant resources including wildlife, vegetation, land, air, water, open space, scenic and aesthetics located within the project area.
- Maintain riparian habitat benefits (including mesquite bosque.
- Avoid/preserve historical/archeological resources and perform site testing to identify eligibility of the cultural resources located within the project area.

Socio-economic Criteria:

- Minimize relocation of structures or people from the project area.

- Consideration should be given to safety, health, and social well-being of the people.

3.3 Alternatives

3.3.1 Alternative 1, No Action Alternative

Under the No Action Alternative, no bank stabilization would take place at the reach of Tanque Verde Creek between Craycroft Road and Sabino Canyon Road. The eroded south bank would not receive any stabilizing reinforcement and would be subject to continued erosion by low flows and flood flows on Tanque Verde Creek. About 56 structures, including a sewer line (North Rillito Interceptor), as well as desert riparian vegetation located within and adjacent to the project area are likely to be damaged by future flooding and erosion. If the sewer line is damaged, it could release about 20 million gallons of wastewater in the project area, which would cause significant degradation in water quality of the creek.

Based on the analysis, the south bank of Tanque Verde Creek could be eroded an average of 13 feet per year. A summary of the lateral migration analysis is provided below, details can be found in the LRR and Appendix A of the EA.

Lateral Migration Analysis summary: On July 20-21, 1998, the Corps of Engineers and Pima County staff conducted a site visit with the U.S. Fish & Wildlife Service (USFWS), and the Arizona Game and Fish Department (ADGF). At this meeting the USFWS and ADGF expressed their concerns that the project may result in eroding unprotected riparian vegetation located within the project area. The Corps contracted out the Lateral Migration Analysis Studies to Tetra Tech Inc., Infrastructure Southwest Group (TTISG), to investigate bank erosion, lateral

migration, and channel migration and in particular to assess bank stabilization impacts along the unprotected northern banks of the riparian preserve. The study was performed for the project reach located between Craycroft Road and Sabino Canyon Road along Tanque Verde Creek.

Historical Geomorphic Analysis: Simons Li & Associates (now part of TTISG) performed evaluation of aerial photographs of the study reach of the years 1936, 1953, 1960, 1967, 1971, 1979, 1983, and 1996 in connection with USGS flow records. In addition, changes in land uses and vegetation locations were documented and correlated to movement of the creek banks. This study indicated that in the past, bank erosion has occurred due to shifts in the river course or lateral erosion. About 650 feet of lateral shift occurred during a period of 60 years. Most of the bank erosion occurred due to the major flood event of December 1965 (see details in Appendix A of this EA and in LRR, Lateral Migration Analysis).

Erosion/Meander Potential: The results of the 1998 fluvial geomorphologic analysis revealed that under without-project conditions, lateral shifts or erosion would occur along the creek bank within the project area. It is estimated that under without-project conditions, an average of about 13 feet of bank per year could be eroded. Based on historical data, a flooding event even smaller than a 5-year event could cause lateral migration of unprotected banks, but the majority of lateral migration occurs as the result of one or a few major flood events. Although the maximum historic migration observed in the study area is 195 feet, the frequency associated with this erosion episode is not known.

3.3.2 Alternative 2

Stabilization of unprotected banks between Craycroft Bridge and Sabino Canyon Road (7,050 linear feet along south bank and 1,550-linear feet upstream of Craycroft Road North Bank), acquisition of Mesquite Bosque Preserve along north bank as mitigation

Alternative 2 would stabilize unprotected creek banks between the Craycroft Road Bridge and the Sabino Canyon Road Bridge and would acquire and protect a mesquite bosque/desert riparian preserve from future development as mitigation. This alternative was previously recommended by the U.S. Fish and Wildlife Service as well as the local sponsor; however, due to considerable public and agency concern that the preserve would not endure without erosion protection, Alternative 2 is no longer the recommended plan. The project reach is approximately two miles long and already includes partial bank protection. Approximately 8,800 linear feet of existing bank within this reach have been stabilized with soil cement in four segments (See Figure 2), consisting of about 4,500 feet along the north bank (two segments) and about 4,300 feet along the south bank (two segments).

The actual study reach extends a short distance downstream of Craycroft Road and a short distance upstream of Sabino Canyon Road. On the north bank, existing bank protection begins at Sabino Canyon Road bridge and extends approximately 4,000 feet west (downstream) to Cloud Road. For the remaining distance to Craycroft Road Bridge, the north bank is unprotected, except for about 500 feet of protection immediately upstream of the bridge, and the overbank is heavily vegetated with native mesquite bosque/desert riparian vegetation. On the south bank, existing soil cement bank protection begins at Sabino Canyon Road and extends approximately 2,700 feet west. An additional section of bank protection, constructed after the

1993 flood, begins approximately 4,200 feet further downstream, and continues 1,600 feet west. The Craycroft Road Bridge is roughly 2,400 feet downstream of that point. At the bridge, the banks are protected by soil cement installed either as part of the 1993 flood riprap (north abutment) or as part of the Corps Rillito River Bank Protection Project (south abutment). See the aerial photo at Figure 2 for existing bank protection and proposed bank stabilization features within the project reach.

The project limits for this alternative were established-using an analysis of the 100-year floodplain. A 1993 topographic base map was used for this in conjunction with HEC-2 water-surface profile model. The analysis included a backwater analysis for the confluence region that considered the combined flows from Pantano Wash and Tanque Verde Creek. The entire floodplain model was based on a single discharge, 34,000 cfs, which is the current regulatory 100-year discharge for Tanque Verde Creek. For details, see the LRR, Section IV-B. Acquisition of 48 acres of land along the north bank as a preserve is proposed as mitigation. This privately owned land consists of moderate and high quality mesquite bosque habitat that would otherwise be subject to future degradation. This 48-acre site, when acquired and managed as a preserve, will replace the project-related habitat units lost.

Bank Stabilization: The structural measures for this alternative include stabilization of the unprotected streambed using soil cement along the north and south banks of the creek. In addition, protection features would be constructed along the confluence of Tanque Verde Creek and Pantano Wash to protect property within the area between the confluence of Tanque Verde Creek, Pantano Wash and the Craycroft Road Bridge. Bank stabilization would be constructed to make smooth curves along the existing bank. Where feasible, the ends of the soil-cement banks would match the existing soil cement. On the south bank, at the downstream end, the proposed soil cement would key into the bank just upstream of the confluence with Pantano Wash. On the north bank, at the upstream end, the soil cement would key into the existing bank and be tied back to high ground as shown in Exhibit 11 "Typical Cross Section of Bank Protection" of the LRR.

The soil cement used would match the top of the existing bank, and the toe-down in the streambed would extend about 10 feet below the channel invert. The average height of the soil cement banks would be about 8'. Soil would be obtained from the creek bed and would include soil excavated for the tow-down and slope preparation. Soil cement would be mixed on-site. The soil cement layer would be an 8-foot thick layer of soil and cement that is mixed and placed in 6-inch to 1-foot-thick lifts. The lifts are successively placed until the desired bank protection height is reached. The soil cement banks would have a 2:1 slope.

Construction Materials: About 115,000 cubic yards (C.Y.) total of material would be excavated along the creek banks and toe along the banks to be stabilized. The excavated soil would be mixed with stabilizer material such as Portland cement and pozzolon. About 6,300 tons (3,500 C.Y.) of Portland cement and about 650 tons (360 C.Y.) of pozzolon would be required to mix with the soil. Compacted soil cement of about 43,000 C.Y. would be required to stabilize unprotected banks. Prior to placement of the soil cement, compacted fill material would be placed between the excavated bank and the layer of soil cement, and another 29,000 C.Y. of compacted fill material would be used to smooth the surface of the excavated banks. About

8,250 linear feet of safety hand railing would be installed in selected areas of the project. The stabilization of banks with soil cement, also the non-federal sponsor's preference, would be consistent with the existing stabilized banks along Tanque Verde Creek and along the Rillito River. The materials available on site are close to the ideal materials that can be used for soil cement. They are in the right size range and are relatively well blended and uniformly distributed across that size range. Furthermore, there are no significant amounts of clays present. Soil cement banks would provide the required strength and durability to withstand high velocity flows during larger flooding events and would provide the desired level of flood protection along Tanque Verde Creek.

Construction Schedule: The proposed bank stabilization along partially unprotected banks along Tanque Verde and at the confluence of Tanque Verde Creek and Pantano Wash would take about six months. About 195 truck trips would be required to transport construction related materials. Transportation of construction related material could be expected to total about 60 days with about 4-truck trips expected daily over this period.

Construction Crew: A selected contractor will construct the project with a construction crew of about 30 members. Most of the construction crew would come from the Tucson, Arizona vicinity, with a maximum travel distance of about 10 miles from the project area.

Construction Equipment: Equipment used for bank stabilization would include: three scrapers, two bulldozers, one compactor, four belly dump trucks for soil cement movement, a cement mixer, and one water truck.

Staging Area: There would be two equipment staging areas and a material-processing site. One staging area would be located in the vicinity of the north bank of Tanque Verde Creek about 50 yards upstream of Craycroft Road. The second staging area could be located along the south bank of the creek in the vicinity of the banks being stabilized. These staging areas will be about 2 acres in size.

Haul/Access Roads: Craycroft Road, Sabino Canyon Road, and Grant Road would be the major haul routes. Material would be excavated using a scraper, and deposited in the area within the creek banks. This activity may require transportation of material for as much as 1/4 mile. Needed cement would be obtained from a local supplier located in Tucson, within about 5 miles of the project site.

Mesquite Bosque Preserve: The study area includes a 48-acre high-value mesquite bosque/desert riparian zone along the north bank, approximately 5,000 feet upstream of Craycroft Road. Currently, this land is privately owned, and could be subject to future development or other disturbance. To restrict future development and disturbance in this area and to preserve this natural riparian vegetation, the Corps and the local sponsor propose to acquire the land and establish a permanent 500-foot-wide riparian vegetation buffer as a preserve along the north bank. Restricting future development within this area would reduce potential degradation or loss of the riparian community and would mitigate for short-term and long-term impacts of the proposed project. The proposed riparian preserve area would continue to experience a similar level of inundation and scour from larger floods as is currently experienced.

With the surrounding banks stabilized, a slight increase in the erosion of the banks along the proposed preserve could be expected as compared to existing conditions. This would allow for some channel movement and occasional inundation of the riparian area. Mesquite bosque ecosystems require occasional inundation by flood flows to stimulate seed germination and provide flushing and cleansing benefits.

3.3.3 Alternative 3

Stabilization of unprotected banks between Craycroft Bridge and Sabino Canyon Road (4,220 linear feet along south bank adjacent to golf course and 1,550-linear feet along north bank upstream of Craycroft Road), acquisition of Mesquite Bosque Preserve along north bank as mitigation

This Alternative is similar to Alternative 2 except that approximately 2,830 feet on the south bank, just upstream of the Craycroft Road Bridge, will not be stabilized with soil cement. The protection on the south bank would tie, instead, into the existing protection upstream of the golf course. It would continue to a point just downstream of the golf course, and beyond the site of the historic meander. The unprotected portion of the south bank would be allowed to erode naturally. The construction schedule could be reduced to about 4.5 to 5 months. Estimated quantities of materials include excavation of about 80,500 C.Y. of excavated material, 2,500 C.Y. Portland cement, 252 C.Y. pozzolon, 20,300 C.Y. compacted fill, and 30,100 C.Y. soil cement. Approximately 140 truck trips would be required to deliver construction materials. Construction methods, equipment, and access would be as described for Alternative 2. Based on the Modified HEP analysis (Appendix B-5) approximately 10 acres of the mesquite bosque preserve would be required to mitigate the impacts of Alternative 3. Alternative 3 is not the Recommended Plan because it would not provide the required level of erosion protection benefits.

3.3.4 Alternative 4 (Recommended Plan)

Stabilization of unprotected banks between Craycroft Bridge and Sabino Canyon Road (7,050 linear feet along south bank and 1,550 linear feet upstream of Craycroft Road north bank), acquisition of Mesquite Bosque preserve along north bank, and modified bank stabilization along preserve.

This Alternative would be similar to Alternative 2 except that modified bank stabilization would be provided for the preserve area to reduce the rate of erosion. Recommended bank stabilization measures include a low soil cement berm adjacent to the bank of the habitat area (approximately 5,000 feet long), with "weep holes" installed through the berm to maintain the hydrologic connection between the creek and the preserve area. The size and spacing of the weep holes will be determined during the Pre-construction, Engineering and Design (PED) phase of this project. The berm would stabilize the slope with a height that would continue to allow overtopping from floods of near the same frequency as under existing conditions, estimated as a 10-15-year frequency flood. The berm will be constructed to the lowest elevation that will effectively control bank erosion. It is estimated that the berm would average approximately 2 feet above ground level and have toe-down depths the same as the upstream and downstream slope protection (approximately 10 feet). Refer to Alternative 2 for details on the construction

schedule, construction equipment, construction crew, construction material, and haul routes. Due to the additional 5,000 feet of soil cement with weep holes, the construction schedule would lengthen and quantities of materials would increase by about 45% assuming a berm 2' above ground surface level and a 10' toe-down. Construction time is estimated at 8-9 months. About 280 truck trips would be required to transport construction materials. Construction material quantities are estimated at 161,000 C.Y. materials excavated, 5,075 C.Y. Portland cement, 522 C.Y. pozzolon, 63,000 C.Y compacted soil cement, 42,000 C.Y. compacted fill material.

3.4 Alternatives Eliminated from further Consideration (Sideslope Stabilization)

In preparation of the "Survey Report & Environmental Assessment, Rillito River & Associated Streams" report, the Corps conducted extensive analyses of the economic and engineering viability of various structural techniques on the Rillito River to which Tanque Verde Creek is a tributary. The Corps determined that gabions and stone revetment were not cost effective in comparison to grouted stone and soil cement revetments and dropped them from further consideration. Current cost data suggest that the cost efficiencies of grouted stone and soil cement revetment still exist. Gabions and stone revetment, therefore, are not considered viable candidates for this report. Although grouted stone is economically viable, current costs and the requirement for additional land sustain its cost ineffectiveness relative to soil cement as in the Survey Report. Web cellular confinement systems were investigated as potential alternatives, but these systems would require the addition of concrete into the cells, as flow velocities exceed 15 cfs. This would defeat their intended environmental functions. Soil cement revetment, in sum remains a viable solution from both engineering and economic perspectives.

3.4.1 Gabion-reinforced Banks

Rather than using soil cement, the south bank of the creek could be reinforced using gabions (rock-filled wire baskets or cages). The gabion toes would be placed at either the elevation of the existing streambed or 2 to 3 feet below the current streambed elevation. Gabion-reinforced banks could provide the needed protection, but would not be consistent with the soil cement banks already established within the project reach. The Corps determined that gabions were cost inefficient in comparison to grouted stone and soil cement revetment and were dropped from further consideration. This option, therefore, has been eliminated from further consideration.

3.4.2 Stabilization of Banks by Riprap

This option consists of stabilizing the creek banks with ungrouted riprap from the toe to the top of the stream bank. Implementation of this option would require transportation of rocks from an existing quarry to the project site. Riprap is also not consistent with the appearance of these stabilized creek banks and rivers in the Tucson area. The Corps also examined this option for the economical analysis. This option is not economically feasible and would not provide the needed level of bank protection and, therefore, not evaluated further in this document.

3.4.3 Grouted Stone Banks

This option would be similar to the riprap bank stabilization, but the riprap placed on the creek banks would be grouted with concrete to fill the spaces between the rocks and to provide

additional armoring for the slope. This option would provide the needed protection to the project area, but would be expensive compared to the preferred alternative. Grouted stone is economically viable; however, current costs and its requirement for additional land maintain its cost ineffectiveness relative to soil cement revetment as analyzed in the Survey Report.

3.4.4 Web Cellular Confinement Systems

The Environmental Resources Branch coordinated the proposed project implementation with the Corps Regulatory Branch, Tucson office. The Regulatory Branch suggested that we examine using Geo-web type of slope protection rather than soil cement. Web-cellular confinement systems were investigated as potential alternatives. These systems would require the addition of concrete into the cells, as flow velocities exceed 15 cfs; thus defeating their intended environmental functions. Based on the creek's hydrology, this alternative is not feasible. In addition, if the cells are filled with concrete, the bank will not support any vegetation.

3.4.5 Concrete-lined Channel Banks

This option would require lining unprotected sections of the Tanque Verde Creek with concrete, although the channel bottom would not need to be lined. Implementation of this alternative would be expensive. The appearance would be that of an obviously man-made structure and would be out of character with the other tributaries and main rivers. It would result in potentially significant effects on native plants and wildlife and the visual character of the creek. For these reasons, this alternative has been eliminated from consideration.

3.4.6 Compacted Fill Banks

This option involves stabilizing the creek bank with compacted fill material. Compacted fill offers very little erosion protection. This option would provide substantially less erosion protection and would be eroded relatively quickly during severe flooding events. Severe flooding and high velocity stream flows are very common along Tanque Verde Creek. The results of a Lateral Migration Analysis (Appendix A) revealed that severe flooding and the high velocity of stream flows caused severe lateral bank erosion in the past. This option would not be consistent with the planning objectives of the project and would require continuous maintenance. It would not provide adequate stream bank protection or flood protection to the property located along the creek banks; therefore, this alternative has been eliminated from consideration.

4.0 EXISTING ENVIRONMENT

4.1 Physical Setting

The City of Tucson is located in a desert valley bounded by the Santa Catalina Mountains on the north, the Rincon Mountains to the east, the Tucson Mountains to the west, and the Santa Rita and Sierrita Mountains to the south. These mountains range in elevation from 4,600 to over 9,000 feet above mean sea level. The city limits extend to an area of 156.04 square miles, and the entire metropolitan area covers nearly 500 square miles.

The study area lies in the southwest physiographic area known as the Basin and Range Province. It is marked by relatively flat alluvial plans located between mountain ranges extending north and south.

4.2 Climate

The climate within the Tucson basin is typified by abundant sunshine, a long hot season, mild winter temperatures, low average annual precipitation, relatively low humidity, and generally light surface winds. Tucson's hot season extends from May through September, when average daily maximum temperatures approach or exceed 90 degrees, and often exceed 100 degrees in the months of June and July. During the remainder of the year, temperatures remain relatively mild. In comparison to most of the United States, Tucson's relative humidity is low. As a result, higher temperatures in the region are more-easily tolerated. Precipitation in the Tucson basin averages 12 inches per year. About 60 percent of the precipitation occurs during the monsoon season, between July and September, when brief torrential downpours cause flash floods.

4.3 Water Quality

The Tucson basin is drained by the north-flowing Santa Cruz River and its three main tributaries: Pantano Wash, Rillito River/Tanque Verde Creek, and Canada del Oro Wash. The Santa Cruz River flowed perennially in the 1800's, but increased pumping and the subsequent lowering of the groundwater table have created an ephemeral river, which flows only during and immediately after significant periods of rainfall.

The quality of surface water in the Tucson area is generally acceptable except for large amounts of suspended sediments. The dissolved solids content is generally less than 400 mg/l. Sources of pollutants originate from treated sewage effluent and urban runoff discharged into the watercourses. Most of the storm water runoff is channeled down the city streets to the major watercourses. The Santa Cruz River and Rillito River, downstream of Tanque Verde Creek, are the primary pollutant sinks of the Tucson area. Based on sampling of wells along the Rillito River and water quality information from the City of Tucson, there is no indication of groundwater contamination from urban runoff. This appears to be the result of dilution from mountain streams and short duration of flows.

Tucson is one of the largest cities in the United States that is totally dependent upon groundwater. The Tucson basin is a 1,000 square mile area in the upper Santa Cruz drainage basin of southeastern Arizona. The major influx of groundwater enters the basin from the south along the Santa Cruz River. The general direction of groundwater movement is north to northwest except for the portion of the basin drained by the Canada del Oro Wash where the water table gradient is to the southwest.

The water supply in Tucson comes from 180 groundwater wells located in and around the Tucson metropolitan area. In urban Tucson, most of the wells, also known as Points of Entry, serve the neighborhood in which they are located with excess supply routed to reservoirs for use elsewhere in the system. Wells located outside the urban core often deliver water to a single "collector" main prior to delivery to customers. The collector main is termed as "combined Point of Entry (POE)" to the drinking water system. The Tucson Water system has four combined POEs: the Southern Avra Valley well field, the Santa Cruz well field, the South Side well field, and the Tucson Airport Area Remediation Project (TARP) well field. In general, the groundwater quality of the Tucson basin remains high. Specific portions of the basin have had wells with high levels of fluoride, sulfate, or nitrate such that the EPA drinking water standards were exceeded. However, water from these wells was mixed with water from wells of higher quality so that standards could be met and the water distributed to the public. In early 1981, trichloroethylene (TCE) in amounts in excess of the EPA recommended reaction level (5 parts per billion) was found in a Santa Cruz well. Subsequent to this finding, additional sampling was conducted. A total of 16 wells, including six operated by the City of Tucson, were found to exceed the EPA standard for TCE.

Potential sources of groundwater contamination include urban runoff, landfill leachate, septic systems, agriculture, and mineral extraction. The Rillito and Santa Cruz Rivers have been identified as pollution sinks from urban runoff. Preliminary analysis has not revealed groundwater contamination from urban runoff. Nine landfills were identified as areas of good possibility for groundwater contamination. Septic systems may be responsible for nitrate contamination of groundwater. Potential groundwater pollutants from agricultural activity consist of pesticides, plant nutrients (nitrogen, phosphorus), dissolved salts, and sediment. There is limited but inconclusive data to support allegations that agricultural areas irrigated with well water are causing groundwater pollution. Sand and gravel mining operations pose a problem when located near watercourses, especially when the abandoned pits are used as dumps.

Several mountain streams feed Tanque Verde Creek, and they probably provide a significant amount of flow to the Creek as opposed to storm water runoff from the urban area. In general, the water quality of the surface flows is acceptable.

The Interior Well Field provides the groundwater for the areas surrounding Tanque Verde Creek. In general, the groundwater for these areas is of good quality.

4.4 Air Quality

Air quality in the Tucson area is under the jurisdiction of the Arizona Department of Environmental Quality (ADEQ), Air Quality Division. The ADEQ maintains a network of air

quality monitoring stations throughout the state of Arizona. These stations monitor the surrounding area for the presence of criteria pollutants for which the state and federal governments have established air quality standards. These pollutants include carbon monoxide (CO), lead, nitrogen dioxide, ozone, particulates of PM_{10} (10 micros or smaller in diameter), and sulfur dioxide.

The study area is within the boundaries of the Tucson Air Planning Area which is a "non-attainment" area (exceeds Federal standards) for carbon monoxide. According to the Environmental Protection Agency, areas are described as "not classified" if they were designated "non-attainment" prior to the enactment of the 1990 Clean Air Act Amendments and if they did not violate the NAAQS for the two-year period 1988 through 1989. A Limited Maintenance Plan for the Tucson Carbon Monoxide (CO) "non-attainment" Area was submitted to the Environmental Protection Agency (EPA), April 1996. The Plan has been deemed complete and is currently undergoing EPA review. Once approved, the area will be redesignated to attainment. From 1987 to 1990, CO concentrations in Tucson gradually declined, and From 1991 to 1996 CO concentrations substantially decreased. These variations were most likely due to changes in meteorological conditions.

According to PDEQ data, ozone concentrations have fluctuated from 1987 to 1996, but remain below the Federal standards of the 1-hour standard, 0.12 ppm. Lead concentrations during the past ten years were well below the quarterly standard, 1.5 ug/m^3, in urban Tucson. This is the result of major reductions in lead emissions from cars from the mid-1970's through the early 1980's. Concentrations of nitrogen dioxide have remained far below the annual standard, 100 ug/m^3 in Tucson. There have been no exceedances of the 1-hour ozone concentration standard monitored in Tucson.

In the Tucson area, according to ADEQ data, PM_{10} concentrations have been lower than in other areas of Arizona. Thus, no exceedances of the annual standard have been monitored in Tucson. For the most part, annual averages have not changed significantly. Further, no exceedances of the 24-hour standard have been monitored in Tucson since 1988.

Overall, the major source of Tucson's air pollution is motor vehicle emissions. Carbon monoxide levels have dropped considerably since the County began monitoring this pollutant in 1973, due mainly to improved Federal tailpipe emission standard for new cars, and the introduction of oxygenated fuels in September of 1995. Air quality in Tucson is also affected by development patterns and industrial activities. As the population continues to grow in the region, CO emissions remain the primary air quality problem.

4.5 Biological Resources

Vegetation: Tanque Verde Creek is located within the Arizona Upland subdivision of the Sonoran Desert Scrub formation. Major plant communities in the region include creosote-bursage on the bajadas, palo verde-saguaro on well-drained upper slopes, saltbush scrub in the bottomlands where flooding and alkali soils occur, and desert riparian along watercourses. The creosote-bursage community is the dominant native association of vegetation in the Tucson region. In addition to the dominant creosote bush (*Larrea tridentata*) and common bursage

(*Ambrosia dumosa*), chain fruit cholla (*Opuntia fulgida*) and cane cholla (*O. spinosior*) are frequently associated with this plant community in the Tucson vicinity. In the immediate project area, the creosote-bursage vegetation has been largely replaced with urban and recreational development.

Desert riparian habitat occurs along watercourses in the region, including portions of Tanque Verde Creek, and is dependent on surface and ground water. In the project area, desert riparian habitat is best represented by the mesquite bosques at the upstream confluence of Pantano Wash and Tanque Verde Creek (approximately 22 acres) and in the proposed preserve area on the north bank of Tanque Verde Creek (approximately 48 acres). Velvet mesquite (*Prosopis velutina*) is the dominant plant species in this community. Other associated species include Fremont cottonwood (*Populus fremontii*), desert willow (*Chilopsis linearis*), burro brush (*Hymenoclea monogyra*), seep willow (*Baccharis salicifolia*), desert broom (*B. sarothroides*), Mexican palo verde (*Parkinsonia aculeata*), and Mexican elderberry (*Sambucus mexicana*). A portion of the proposed mesquite bosque preserve was burned in a fire within the past few years. The area includes some standing dead trees. Some trees that were damaged in the fire have begun to resprout, especially the Mexican elderberry.

In the more disturbed portions of the project area, the desert wash plant community is represented by occasional Fremont cottonwood in the streambed. Scattered mesquite, blue palo verde (*Cercidium floridum*), Mexican elderberry, broom baccharis, and burrobush *are* found on the stream banks. Saltbush (*Atriplex* spp.) scrub is uncommon in the project area. Additional plant species identified on site include:

Cat-claw acacia (*Acacia greggii*)
White acacia (*Acacia constricta*)
Fiddleneck (*Amsinckia intermedia*)
Four-wing saltbush (*Atriplex canescens*)
Desert broom (*Baccharis sarothroides)*
Desert marigold (*Baileya* sp.)
Needle grama (*Bouteloua aristidoides*)
Netleaf hackberry (*Celtis reticulata*)
Jimson weed (*Datura* sp.)
Skeleton weed (*Eriogonum deflexum*)
Eucalyptus (*Eucalyptus* sp.)
Burro-weed (*Isocoma tenuisecta*)
Boxthorn (*Lycium* sp.)
Stick-leaf (*Mentzelia* sp.)
Cholla (*Opuntia whippleei*)
Prickly pear (*Opuntia* sp.)
Tobacco (*Nicotiana* sp.)
Mexican palo verde (*Parkinsonia aculeata*)
Devil's claw (*Proboscidia parviflora*)
Russian thistle (*Salsola iberica*)
Globe mallow (*Sphaeralcia* sp.)
Fluff grass (*Tridens pulchellus*)
Yucca (*Yucca elata*)
Ziziphus (*Ziziphus obtusifolius*)

Fish and Wildlife: A diversity of wildlife occurs in the project area, especially in the mesquite bosques. These desert riparian areas also function as important corridors for wildlife movement and migration.

Mammals characteristic of the project area include kangaroo rats (*Dipodomys* spp.), pocket mice (*Perognathus* spp.), wood rats (*Neotoma* spp.), cottontail rabbits (*Sylvilagus* spp.), blacktailed jackrabbits (*Lepus californicus*), raccoon (*Procyon lotor*), skunks (*Mephitis mephitis, M. macroura,* and *Spilogale putorius*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), and javelina

(*Tayassu tajacu*). Mountain lions (*Felis concolor*) have been reported on site, probably using the area primarily as a migratory corridor.

Numerous bird species are found in the project area, especially in the mesquite bosque areas either as residents or migrants. The following is a list of birds that have been identified in the project area:

Mallard (*Anas platyrhynchos)*
Turkey vulture (*Cathartes aura)*
Cooper's hawk *(Accipiter cooperi)*
Red-tailed hawk *(Buteo jamaicensis)*
Swanson's hawk (*Buteo swainsoni)*
Harris hawk *(Parabuteo unicinctus)*
Gamble's quail *(Calipepla gambelii)*
Great blue heron *(Ardea heradias)*
Rock dove *(Columba livia)*
White-winged dove *(Zenaida asiatica)*
Mourning dove *(Zenaidura macroura)*
Roadrunner *(Ceococcyx californianus)*
Great horned owl *(Bubo virginianus)*
Elf owl (*Micrathene whitneyi)*
Poor-Will *(Phalaenoptilus nuttallii)*
Lesser nighthawk *(Chordeiles minor)*
Anna's hummingbird *(Calypte anna)*
Costa's hummingbird *(Calypte costae)*
Black-chinned hummingbird *(Archilochus alexandri)*
Northern flicker (*Colaptes chrysoides)*
Gila woodpecker *(Centurus uropygialis)*
Vermilion flycatcher (*Pyrocephalis rubinus*)
Ash-throated flycatcher *(Myiarchus cinerascens)*
Says phoebe *(Sayornis saya)*
Cliff swallow *(Petrochelidon pyrrhonota)*
Common raven *(Corvus corax)*
Verdin *(Auriparus flaviceps)*
Cactus wren *(Campylorhynchus brunneicapillus)*
Northern mockingbird *(Mimus polyglottos)*
Curve-billed thrasher *(Toxostoma curvirostre)*
Black-tailed gnatcatcher *(Polioptila melanura)*
Phainopepla *(Phainopepla nitens)*
Starling *(Sturnus vulgaris)*
Lucy's warbler *(Vermivora luciae)*
Wilson's warbler *(Wilsonia pusilla)*
Great-tailed grackle *(Cassidix mexicanus)*
Brown-headed cowbird *(Molothrus ater)*
Cardinal *(Richmondena cardinalis)*
House finch *(Carpodacus mexicanus)*
Lawrence's goldfinch *(Spinus lawrencii)*
Albert's towhee *(Pipilo aberti)*
Lark sparrow *(Chondestes grammacus)*
Black-throated sparrow *(Amphispiza bilineata)*
Chipping sparrow *(Spizella passerina)*
White-crowned sparrow *(Zonotrichia leucophrys)*

Reptiles expected in the project area include Tucson banded gecko (*Coleonyx variegatus bogerti*), western collared lizard (*Crotaphytus collaris baileyi*), horned lizards (*Phrynosoma* spp.), Gila monster (*Heloderma suspectum*), Sonoran gopher snake (*Pituophis melanoleucus affinis*), and western diamondback rattlesnake (*Crotalus atrox*). Few amphibians are expected in the project area due to prolonged periods of drought, but some species adapted to dry conditions, such as Couch's spadefoot toad (*Scaphiopus couchii*) and Great Plains toad (*Bufo cognatus*) may be present. No fish are expected in the project area due to a lack of permanent water (Corps 1986, 1992; USFWS, 1993).

Threatened and Endangered Species: Endangered and Threatened species are protected under the Endangered Species Act of 1973 (as Amended). If the Federal project sponsor determines that an action may affect a listed species, the agency is required to initiate formal consultation

with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Act. The Los Angeles District, U.S. Army Corps of Engineers requested in a letter dated July 16, 1998 that the USFWS provide updated Endangered and Threatened species information pursuant to Section 7 of the Endangered Species Act. The USFWS provided the requested information in a letter dated August 5, 1998. The response includes a total of eighteen (18) listed species one proposed species and five (5) candidate species. The request and response are included in Appendix B-3 of this EA. Subsequent to the preparation of the response, the American Peregrine Falcon (*Falco peregrinus anatum*) was removed from the Federal list of Endangered and Threatened species. The information provided with the response applies to all of Pima County, and is not project specific. The habitat in the project area is unsuitable for the majority of the species. Table 4-5 summarizes the information on the special status species. The following listed Endangered and Threatened species potentially occur in the project area:

Bald Eagle (*Haliaeetus leucocephalus*), Threatened. An estimated 200 to 300 bald eagles winter in Arizona along rivers and reservoirs. A smaller number of resident birds nest in the state. The habitat in the project area is not suitable for nesting, and is probably unsuitable for foraging, as well. Bald eagles would be expected in the project area only as occasional migrants or transients.

Cactus Ferruginous Pygmy Owl (*Glaucidium brasilianum cactorum*), Endangered. The Cactus Ferruginous Pygmy Owl historically occurred throughout much of the Tucson area. Only a few documented sites where this species persists are known. Habitat consists of mature cottonwood/willow riparian woodland, mesquite bosques, and Sonoran desert scrub. The mesquite bosque habitats at the western end of the project area and the proposed preserve area on the north side of the project area appear to be marginally suitable habitat for this owl. Other areas along the project alignment may be marginally suitable, as well. Biologists with Westland Resources, Inc. (1999) surveyed the project area according to proposed USFWS protocol. Westland Resources biologists hold a permit from USFWS to conduct Cactus Ferruginous Pygmy Owl surveys. The surveys were conducted on March 17-19, 1999; April 21, 1999, and May 12-14, 1999, and no Cactus Ferruginous Pygmy Owls were detected. A March 11, 1999 search of the Arizona Game and Fish Department Heritage Data Management System revealed no recent observations within the Township and Ranges that include the project area. In addition, informal coordination with Westland Resources biologists indicated that it would be unlikely that the owl would be found on site in future surveys. The report documenting the findings of the surveys is included in Appendix B-1 of this EA. A previous report on biological resources of the area (Ruffner, et al 1983) does not include the Cactus Ferruginous Pygmy Owl as likely to occur in the project area.

Candidate Species. Candidate species are those species under review for listing as Endangered or Threatened, but for which no formal listing proposal has been published. Federal law does not protect candidate species, but the USFWS recommends that they be considered in the planning process in the event that they become listed or proposed for listing prior to project completion. The proposed project area appears unsuitable for all of the candidate species known from Pima County, Arizona.

Table 4-5 Special Status Species

Known or Potentially Occurring at the Tanque Verde Project Site

SPECIES	STATUS	HABITAT	OCCURRENCE POTENTIAL
Plants			
Huachuca Water Umbel *Lilaeopsis schaffneriana* ssp. *recurva*	Federal Endangered	Cienegas, perennial low gradient streams, wetlands 3,500-6,500'	None - No potential habitat
Kearney's blue star *Amsonia kearneyana*	Federal Endangered	West facing drainages, Baboquiveri Mountains, 3,600-3800'	None - No potential habitat & Outside Range
Nichol's Turk's head cactus *Echinocactus horizonthalonius* var. *nicholii*	Federal Endangered	Sonoran desert scrub on limestone alluvial fans and terraces 2,400-4,100'	None - No potential habitat
Pima pineapple cactus *Coryphantha scheeri robustispina*	Federal Endangered	Sonoran Desert scrub and semi-desert grasslands in alluvial valleys and hillsides 2,300-5,000'	None - No potential habitat
Acuna cactus *Echinomastus erectocentrus acunensis*	Federal Candidate	Well-drained knolls and gravel ridges in Sonoran desert scrub 1,300-2,000'	None - No potential habitat

Table 4-5 Special Status Species

Known or Potentially Occurring at the Tanque Verde Project Site

SPECIES	STATUS	HABITAT	OCCURRENCE POTENTIAL
Invertebrates			
San Xavier talus snail *Sonorella eremita*	Proposed Endangered	Limestone talus, 3,850' to 3820'	None - No potential habitat
Fish			
Desert pupfish *Cyprinodon macularis*	Federal Endangered	Shallow springs, small streams, marshes <5,000'	None - No perennial water
Gila chub *Gila intermedia*	Federal Candidate	Pools, springs, cienegas, and streams 2,000-3,500'	None - No perennial water
Amphibians			
Chiricahua leopard frog *Rana chiricahuensis*	Federal Candidate	Streams, rivers, backwaters, ponds, and stock tanks free from introduced fish and bullfrogs with permanent or nearly permanent water source 3,000-8,300'	None - No perennial water
Reptiles			
Sonoyta mud turtle *Kinosternon sonoriense longifemorale*	Federal Candidate	Ponds and streams, Quitobaquito Springs 1,000'	None - Outside range, No perennial water

Table 4-5 Special Status Species

Known or Potentially Occurring at the Tanque Verde Project Site

SPECIES	STATUS	HABITAT	OCCURRENCE POTENTIAL
Birds			
Cactus ferruginous pygmy owl *Glaucidium brasilianum cactorum*	Federal Endangered	Mature cottonwood/willow, mesquite bosques, Sonoran desert scrub <4,000'	Low to Moderate - potentially suitable habitat (mesquite bosque) on site, but not detected in spring 1999 protocol surveys.
Masked bobwhite *Colinus virginianus ridgewayi*	Federal Endangered	Desert grasslands with diversity of dense native grasses, forbs, and brush, Buenos Aires wildlife Reserve, 1,000-4,000'	None - No suitable habitat, outside present range of species.
Southwestern willow flycatcher *Empidonax trailii extimus*	Federal Endangered	Cottonwood/willow and tamarisk vegetation along rivers and streams	Low - Habitat does not appear suitable, not within critical habitat.
Mexican spotted owl *Strix occidentalis lucida*	Federal Threatened	Canyons, dense forest, sites with cool microclimates, 4,100-9,00'	None - No suitable habitat, elevation too low.
Bald eagle *Haliaeetus leucocephalus*	Federal Threatened	Large trees or cliffs near water, with abundant prey	Low to moderate - Habitat unsuitable for nesting, but may be occasional migrant or visitor

Table 4-5 Special Status Species

Known or Potentially Occurring at the Tanque Verde Project Site

SPECIES	STATUS	HABITAT	OCCURRENCE POTENTIAL
Birds (Continued)			
Mountain plover *Charadrius montanus*	Federal Candidate	Open arid plains, short-grass prairies, and scattered cactus.	None - No suitable habitat.
American Peregrine Falcon *Falco peregrinus anatum*	Delisted 1999 (formerly Federal Endangered)	Cliffs and steep terrain, usually near water or woodlands with abundant prey	Low to moderate - Habitat unsuitable for nesting, but may be occasional migrant or visitor
Mammals			
Lesser long-nosed bat *Leptonycteris curasoae yerbabuenae*	Federal Endangered	Roosts in caves and abandoned tunnels, forages at night on nectar, pollen, and fruit of paniculate agaves and columnar cacti, >6000'	Low - No suitable roosting or foraging habitat, but may fly over area
Mexican gray wolf *Canis lupus baileyi*	Federal Endangered	Chaparral, woodland, and forested areas, may cross desert areas. 4,000-12,000'	Low - Habitat appears unsuitable and elevation too low, extirpated from most of historic range
Ocelot *Felis paradilis*	Federal Endangered	Humid, tropical and sub-tropical forests, savannahs, and semi-arid thorn-scrub, >8000'	Low - Habitat appears unsuitable, no recent confirmed reports in state.

Table 4-5 Special Status Species

Known or Potentially Occurring at the Tanque Verde Project Site

SPECIES	STATUS	HABITAT	OCCURRENCE POTENTIAL
Mammals (continued)			
Jaguarundi *Felis yagouaroundi tolteca*	Federal Endangered	Variety of habitats, 3,500-6,000'	Low - Habitat may be suitable, but no confirmed records from state
Jaguar (U.S. population) *Panthera onca*	Federal Endangered	Formerly ranged from Sonoran desert to conifer forests <8,000'	Low - Population nearly extirpated from Arizona
Sonoran pronghorn *Antilocapra americana sonoriensis*	Federal Endangered	Broad, intermountain alluvial valleys with creosote/bursage & palo verde/mixed cacti associations, 2,000-4,000'	None - No suitable habitat

4.6 Land Use

The City of Tucson is comprised of a variety of land uses that range from residential to industrial, municipal, and commercial development. According to the most recent data, residential acreage in the urbanized Tucson area amounted to 30.70 percent of the total land area. Residential acreage consisted of suburban ranch, single family, multiple family, and mobile homes. Commercial acreage amounted to 5.83 percent of the land area. Commercial structures consisted of general/strip commercial malls, major office buildings and shopping centers. Industrial acreage totaled 4.11 percent of the land area, consisting of industrial structures and non-structures, transportation, communication, utilities, resource extraction and airports. Agriculture acreage is minimal, representing about two percent of the land area. Open space acreage totaled about four percent of the land area, consisting of natural areas and preserves, parks and cemeteries. Overall, a very rural, low-density land use is typical of most of the urban area.

The Tanque Verde Creek study area is predominantly composed of open space and rural residential properties. Residential structures are concentrated on the north side of Tanque Verde Creek along Cloud Road and south of the bank between Sabino Canyon Road and Craycroft Road. To the north of the bank is an existing riparian area consisting of high quality desert habitat. Located alongside the south bank is the Tucson Country Club. The club encompasses approximately 200 acres and includes a clubhouse, tennis courts, swimming pool and golf course.

4.7 Aesthetics

Aesthetics vary considerably throughout Tucson, ranging from the open space and vegetation associated with natural surroundings to the cultural or regional characteristics in the architectural design of homes and commercial buildings. Green trees such as palo verde, mesquite and cottonwood grow in abundance. There are also many varieties of cacti in colorful bloom from April until late May. In the surrounding residential areas of Tanque Verde Creek native desert landscaping and many other types of shrubs and flowers are common.

The aesthetic value of Tanque Verde Creek is associated with the natural surroundings and open spaces. Except for channelization around Sabino Canyon Road, the watercourse remains relatively undisturbed. The confluence of Tanque Verde Creek and Pantano Wash supports an abundance of Cottonwoods.

4.8 Noise

A noise environment consists of a base of steady "background" noise that is the sum of many distant and indistinguishable noise sources. Superimposed on this background noise is the sound from individually recognizable local sources. These sources can vary from an occasional aircraft overflight to virtually continuous noise from traffic on adjacent streets or highways. Within the study area, noise sources include traffic from vehicles, motorcycles, construction vehicles and related equipment, and flight paths associated with Tucson International Airport. However, the predominant noise source in the study area is traffic along Craycroft Road, a major north-south arterial city/county roadway. Noise levels in this area average 70-80 decibels.

4.9 Socioeconomics

As of July 1, 1998, the estimated population for the State of Arizona was 4,764,025, which ranks 24th in the nation. Pima County accounts for 17.2 percent of the State total with an estimated population of 823,900 and is the second most populated county in Arizona. The City of Tucson is the largest city in Pima County with an estimated population of 475,450 as of July 1999, accounting for 56.8 percent of the County total.

According to the U.S. Census figures for Pima County, the median age in 1990 was 32.8, slightly below the national average. The median age is rising primarily because of the aging of the Baby Boom generation, and not because of net migration of senior citizens. A percentage distribution of population by age in 1990 revealed that the greatest percentage of residents in Pima County is within the age category of 20-29 (17 percent). The second largest percentage is in the 30-39 years age group (16.5 percent). Pima County's racial composition is diverse, as reported by the U.S. Census in 1995 as shown in the following table:

White, Nonhispanic	63.7%
Hispanic	26.5%
Black	3.8%
Native American	3.5%
Asian or Pacific Islander	2.47%
Other	0.1%

Source: Future West Greater Economic Council

In the Tucson metropolitan area, residential units authorized by building permits in 1999 totaled about 10,646. Approximately 68 percent were single family, detached homes. Only 4.9 percent were townhouses, while about 10.9 percent were multifamily units and 16.2 percent were mobile homes. Permits in 1999 were up 7.9 percent from 1998.

As of March 1997, the civilian labor force in Pima County totaled approximately 379,300 people, or nearly 50 percent of the projected total population. A much higher percentage of the work force in Pima County is employed in services (31.15 percent), government (22.63 percent), trade (22.05 percent) and a much lower percentage is employed in manufacturing (9 percent), construction (6.54 percent), transportation, communications, public utilities (4.16 percent), finance/insurance/real estate (3.92 percent), and mining (.69 percent). This reflects the influence of tourism, education, and retirement on the local economy. Tourism is an important sector of the Tucson economy generating a total of 36,500 wage and salary jobs, which is more than 12 percent of the wage and salary jobs in Pima County.

Tucson has the second largest university and college enrollment for the State of Arizona. The University of Arizona had an enrollment of 34,000 and Pima County Community College had 65,000, together making up a student population of approximately 100,000.

Arizona's principal crop is cotton. A crop area of 14,570 acres cultivated in Pima County in 1997 was devoted to cotton. Other principal crops grown in Arizona include: lettuce, cantaloupe, broccoli, watermelon, cauliflower, citrus and honeydew. There has been a substantial decrease in agricultural land as a result of the Groundwater Management Act of 1980.

4.10 Transportation

The demographic, economic, and geographic travel trends forecast for the Tucson metropolitan area indicate a substantial increase in travel demand over the next twenty years. In 1990, 72

percent of Pima County residents commuted to work by driving alone, 15 percent carpooled, 10 percent used other means of transportation, and 3 percent worked at home.

The proposed bank stabilization would occur between Craycroft Road and Sabino Canyon Road. Data derived from 48-hour counts that were collected in the spring of 1998 indicate traffic peak times along Craycroft Road are from 7:00am - 8:00am and 5:00pm - 6:00pm. As listed in Table 4-10 below, the subject streets have 4 and 2 lanes. The estimated average daily traffic (ADT), volumes along these streets range from 2,000 ADT along Cloud Road to 36,000 ADT along Sabino Canyon Road.

Table 4-10 Average Daily Traffic

Construction Access Streets	Number of Lanes	Average Daily Traffic (ADT)
Cloud Road	2	2,000
River Road	4	15,300
Craycroft Road	4	26,200
Sabino Canyon Road	4	36,000

Source: Pima Association of Governments, 1999.

4.11 Recreation

The City of Tucson, with its abundant sunshine, allows for a wide range of public recreation. Existing recreation facilities in the Tucson area include city parks, state parks, pools, tennis courts and golf courses. The City of Tucson maintains and operates 119 parks and 24 municipal pools, with facilities include: court games (tennis, basketball), field sports (soccer, baseball, and football), playgrounds, swimming pools, and picnic facilities. Pima County Department of Parks and Recreation service 30 parks in an area covering 2,811.5 acres. Pima County's Recreation Division provides a wide variety of activities for all age groups for all county residents. These activities include: toddler, youth and teen recreation, after school, holiday, and summer day camps, arts and crafts, sports, aquatics, music and cultural events.

Tucson residents also have access to 13 trailheads leading into Coronado National Park, Saguaro National Park, Tucson Mountain Park and the Cienega Creek Natural Preserve.

4.12 Cultural Resources

Cultural Setting. The presence of humankind over the course of time has generally reflected a response to changing environmental conditions. Still in all people find their own methods of maintaining a successful existence in a given environment. The success of a group's methods of

exploiting their environment is found in their ability to reproduce viable offspring, thereby perpetuating group longevity. As environmental conditions varied, the types of resources that are available or that are no longer existent are prime factors that drive change in a culture and its toolkit. As cultures evolve, either in a given area or a specific culture, changes are recorded in the culture's history and chronological sequence.

While studying the culture history of a group of people other elements come into play. Since the early 1960s there has been a movement to study culture change through the processes that precipitated evolution from one stage to another. Another fruitful approach to analyzing cultural changes is the study of the behavioral aspects of culture. In other words, what were these people doing and why were they doing it. Obviously not every decision is based on an environmental situation but also on mental templates that help to characterize a cultural groups identity. These various issues are at the core of developing a culture history of a geographic area and when coupled with modern dating methods we are able to place that history in an accurate temporal framework.

Culture History and Chronology. Culture evolution in the Tucson Basin is primarily grouped into stages of development that are further broken down periods and phases. The oldest Stage is the Archaic, followed by the Formative, then by the unnamed Stage that incorporates the Protohistoric and Historical periods.

PaleoIndian Period. There is an old Paleo-Indian period that is only known in the Tucson Basin from a few isolated Clovis projectile points. Although the older known Paleo-Indian sites are in southeastern Arizona in Cochise County, assuredly there will be Paleo-Indian sites discovered in the alluvial sediments of the Tucson area watercourses. The Clovis Culture dates to around 11,500 years before Present (B.P.).

Archaic Period. The Archaic in the Tucson Basin is divided into three time periods; Early, Middle, and Late. Modifications to the material culture and subsistence patterns are reflected in the transition from one stage to another. The Early Archaic period dates from 8500 to 6000 B.C., the Middle Archaic dates range from 6000 to 1500 B.C., and the Late Archaic begins at 1500 B.C. and extends to A.D. 100. The temporal division between the end of the Late Archaic and the following Formative stage is still poorly defined (Neily, et al. 1999). Little is known of the Early Archaic period in the Tucson Basin. In the absence of reliable dates, a local researcher, Bruce Huckell, has assigned the Pinto Basin projectile point as the diagnostic tool for this period. Otherwise little is known of the Early Archaic beyond speculation.

Exploitation of a very diverse array of microenvironments became emblematic of the Middle Archaic. The diversity included forays into stabilized dune fields, bajadas, and mountain pediment locations. A high degree of mobility is suggested during this period in the Tucson Basin. Sites are small and lack the elements that typify larger, sedentary sites, such as architecture, trash mounds, and storage facilities.

There is general acceptance that the Late Archaic was more of a transitional step to the formative period than a separate cultural stage. As early as 3,000 years ago evidence for maize agriculture was apparent in the floodplains of the Tucson Basin. There was a more pronounced tendency

towards residential stability, corn agriculture, and an advanced material culture. Diagnostic projectile points included points associated with the San Pedro stage, Cochise Culture, and Cienega, and Cortaro styles. The Milagro Site along the Tanque Verde Wash is probably the earliest known agricultural site. Cultural constituents of the Milagro site included bell-shaped pits outside of the main site area, fired ceramic figurines, and small pit structures.

Even with the inroads of agriculture, changing climactic patterns probably required a sustained reliance on seasonal foraging and collecting. In order to address shifting economic patterns, the Late Archaic people were probably organized around a dynamic, composite band that was able to expand and contract as needed.

Hohokam Sequence

Pioneer/Formative Period. The Pioneer/Early Formative period marked the earliest manifestation of the Hohokam culture. The Pioneer was distinguished by increased sedentism and greater reliance on agriculture. In addition to more permanent pitstructures, manufacture of plain ware ceramics was getting underway. These two main features really define the Pioneer period more so than dramatic population or cultural changes. The plainware ceramic horizon was supplanted by a redware ceramic industry. Overall, the early Formative in the Tucson Basin was identified with the aforementioned ceramics, small, well developed pit houses that were loosely arranged, inhumation burials, and large communal houses. Toward the late Pioneer period the Hohokam house became more functionally distinct seen in a combination of both small, informal structures and larger, more formalized structures that were appearing at different sites in the Tucson Basin. The Late Pioneer period is poorly represented in the Tucson Basin; however, it is known that there was a much greater reliance on agriculture by this time.

Colonial Period. Cultural changes of much greater magnitude transpired during the succeeding Colonial period. Substantial increases in population and Hohokam culture area led to increased number of settlements, refinements with ceremonial architecture, new classes of material culture, more advanced mortuary rituals, and redefined settlements patterns and social organization. Following a continuum of minimal data the early Colonial period, the Cañada del Oro phase, is about as poorly defined in the Tucson Basin as the Late Pioneer period's Snaketown phase.

Geomorphic changes in the Santa Cruz River after A.D. 800 led to an increase in the potential for floodwater farming in the Tucson Basin. It is not clear however, if this advanced agricultural conditions were instrumental in the overall cultural changes during the Rillito phase, or if they were restricted to the San Xavier area. Another major cultural feature that arrived full-blown into the Hohokam culture area during the Rillito phase was the Mesoamerican ball court. The interesting feature of the ball courts was that they were public architecture and the ritual activities and exchange practiced in them probably required community participation. The large Rillito phase sites are usually found along the Santa Cruz River testifying to the Hohokam's preference for adapting to a riverine environment.

Hohokam culture reached its climax in the Tucson Basin in the Sedentary period. During this time frame there was unification of the regional system and interregional contacts were at their peak. Perhaps during this period the interregional system was starting to be dismantled leaving

the Tucson Basin as a discrete cultural center. This period is the most prolific for number of well documented sites in the Tucson Basin. As stated in the previous sentence, the Sedentary period sites have been the most intensively investigated. Major Sedentary period sites in the Tucson area include: the Hodges Ruin, Punta de Agua sites, the West Branch site, Valencia, and the Tanque Verde Wash site.

Sedentary Period. Later in the Sedentary period, Rincon phase dry-farming was being practiced outside the floodplain at the West Branch and Valencia sites. The Valencia site, AZ:BB:9:54, bisected by Craycroft Road, is directly northwest of the Tanque Verde Wash project. Possibly due to over utilization of the riverine environments specialized changes in subsistence practices and settlement function were replacing older economic systems. Earlier sites were being abandoned or diminished in size and the ball courts were phased out as well. By the end of the Sedentary period the Hohokam regional system was gone. In the waning days of the Sedentary period, buff wares had been replaced with small numbers of Mimbres Classic Black-on-white ceramics. This indicates a transition in the Tucson Basin Hohokam's external contacts.

Classic Period. Ceramics played a greater role in defining the two phases of the Classic period. The earlier Tanque Verde phase is identified with Tanque Verde Red-on-Brown which perseveres through to the Tucson phase. During the Tucson phase other ceramics coincide with the Tanque Verde phase, Tanque Verde Red-on-Brown. Tucson Polychrome, Roosevelt Red Ware, and a non-local type, White Mountain Redware are associated with the Tucson phase.

Another change in settlement patterns was first identified in the Marana Community in the northern Tucson Basin. Platform mounds were the central focal point for multiple-function settlements that were arranged around it in a specific pattern. In the eastern Tucson Basin settlements were comprised of large multi-compound villages and were constructed in areas that had previously been low population density. New domestic architectural forms appeared in the transitional period between the Sedentary and Classic periods. Styles such as contiguous, rectangular surface rooms, puddled adobe, and enclosed compounds became prevalent. Toward the end of the Classic period there was a regressive tendency to reintroduce pithouse architecture. Platform mounds replaced ball courts as the central feature of the ceremonial system. In spite of structural similarities, there were considerable functional differences between the platform mounds. The number of villages with public facilities such as platform mounds declined from the Sedentary to the Classic period. At one time these changes were considered to part of the expansion of the Salado culture in the Tucson Basin but research has shown that they started during the late Rincon subphase of the Sedentary period.

The Classic period was short lived in the Tucson Basin. There had been a dramatic population decrease by the Tucson phase. The Tucson phase is synonymous with depopulation, reorganization of existing populations, and movement to other areas. Whereas earlier researchers thought these changes were directly attributable to the Salado incursion, they are seen as a cultural response to environmental conditions.

Post Classic Period. The terminal Classic period is synonymous with the collapse of the Hohokam culture. Various scenarios have been advanced to explain the collapse and identify

their predecessors. Currently the four Southern Tribes maintain that they are the descendants of the Hohokam. The Tohono O'odham, formerly known as the Papago, lay claim to a direct link with the Tucson Basin Hohokam. However this has not been archaeologically demonstrated.

Records and Literature Search. A records and literature search was conducted at the Arizona State Museum Archives, and at the office of the Pima County archaeologist before commencing with the fieldwork. Approximately one-half of the APE (Craycroft Road to the project mid-point) had been negatively surveyed. Unfortunately the survey report was missing from the Museum's archives. The survey location on their maps showed it as being negative however. That survey also covered the portion of the APE that included the north bank of the Pantano Wash. A Late Rincon phase Hohokam site, AZ:BB:9:54 (ASM) bisected by Craycroft Road was excavated approximately 200 meters north of the Rillito River/Tanque Verde Wash confluence in 1982. The closest survey to the eastern end of the Tanque Verde Wash was surveyed in 1984 by Allan Dart for Cella Barr Associates. Dart's survey found one site, AZ:BB:9:141 (ASM) that only consisted of two lithic scatters. That site is outside of the APE.

U.S. Army Corps of Engineers Survey. Corps staff archaeologist, Richard Perry, surveyed the area of potential effects (APE) on March 7, 1999, and was accompanied by a cultural resources contractor, Dr. Jeffrey Altschul. Dr. Altschul walked the creek bank during the survey and noted a dark stain associated with some lithics, pot sherds, and faunal material. Heading further east, the stain picked up intensity and thickness. At the time, it appeared that the deposit was a pithouse profile with a midden. More sherds were found as well as lithics, including flakes and a few scrapers. A sample of the sherds were collected and typed at the Statistical Research lab. They were identified as non-diagnostic gray wares. Dr. Altschul; speculated that based on the temper, they were probably indicative of a dual component site--early Formative/Pre-classic occupation and the second component may be early Classic period. Another weaker hypothesis was that it was much older, or dated from the Pioneer period. The site is near the point where a cross channel from the Pantano Wash was hitting the Tanque Verde Banks and eroding away the site. This probably explains the earlier negative survey. The deposit was covered with unconsolidated alluvium that was deposited from high-energy flows on the Tanque Verde. The upper layers of the alluvium contained historic debris. There was no surface evidence of the site. We have no knowledge of how far back into the creek bank the deposit extends.

Mr. Perry returned to the site in June 1999 with Dr. Edgar Huber, of the Statistical Research staff. Dr. Huber had recommended the return visit because the rain water swollen Tanque Verde may have impacted the site. It appeared that as much as two-feet of the creek bank had been sheared off from water flows in the channel. What had originally been identified as a pithouse profile was no longer visible, but the extensive midden stain with artifacts and faunal materials was still intact. The site has been temporarily named COE_TV_99_1. A site record is being prepared to be submitted to the Arizona State Museum for a site number assignment. The rest of the survey was negative.

5.0 ENVIRONMENTAL EFFECTS

This EA addresses impacts related to stabilization of the unprotected banks of Tanque Verde Creek between Craycroft Road Bridge and Sabino Canyon Bridge. The creek banks would be stabilized using soil cement, consistent with existing stabilized creek banks in the vicinity and along the Rillito River. Impacts related to all environmental resources have been analyzed for the viable alternatives, including the No Action Plan and the recommended plan.

5.1 No Action Alternative

If the creek banks are not stabilized, they will continue to erode. A Lateral Migration Analysis (Appendix A) revealed that, on an average, about 13 feet of the creek banks would be eroded annually. However, erosion varies from year to year, and depends on the velocity of the water and duration of the flooding event. The majority of the lateral erosion would most likely occur as the result of one or a few major flood events. The Lateral Migration Analysis to determine the erosion potential within the study area was based on an evaluation of 60 years of photographic records taken between 1936 and 1996. During this time frame, about 650 feet of lateral erosion occurred within the project area. An additional 650 feet of erosion are predicted over the next 50 years. Without implementation of the bank stabilization, there is a flooding potential along the study reach during any 100-year event. In severe flooding events, significant damage could occur to the property located along the creek banks and to development west of Craycroft Road. Flooding could cause damage to the roadway embankment and damage the roadway and the sewer interceptor. Damage to the sewer line would result in adding contaminated sewer water to the creek. The No Action Alternative would not achieve the purpose of the project, to reduce bank erosion and flood damages. For most resources, the No Action Alternative would have no adverse impacts; therefore, no detailed impact analysis is provided in this section. For those resources where No Action would have an adverse impact, the impacts are discussed.

5.2 Physical Setting (Alternatives 2, 3 and 4)

Any project-related impacts on the physical environment are anticipated to be minor. Riparian vegetation located along the north banks would be eroded with or without a project. The average height of the banks is about 10 to 12 feet, but in some areas the height has been lowered to about 4 to 5 feet.

5.3 Climate (Alternatives 2, 3 and 4)

This project will have little to no impact on the climate of the area. Some relatively small amount of dust will be released to the atmosphere during the movement of dirt and sand.

5.4 Water Quality (Alternatives 2, 3 and 4)

Currently, portions of the creek banks have been severely eroded due to past flooding. Bank erosion is prominent within the project area. The proposed action is not expected to increase soil erosion or adversely impact surface water quality. Sewer lines located in the vicinity of the project area would be protected; therefore, accidental discharge of contaminated sewer water into the creek would be prevented. During the field surveys (June 1998 and January 1999) both Tanque Verde Creek and Pantano Wash were dry, and severe erosion was noticed along the gully located along the north bank of the creek. Material required for the project construction will be obtained from the creek bed, primarily from excavation for the toe of the bank protection. No excavation would occur within flowing water to minimize impacts to the water quality. Excavated soil would be mixed with cement in equipment located along the banks or at a staging area. After stabilization of the creek banks, erosion along Tanque Verde Creek and the confluence with Pantano Wash would be reduced. Procedures to minimize erosion during construction would be followed, including: checking weather conditions daily; using clean water and material to stabilize creek banks; ensuring that no polluted silt or other material is placed in the creek or wash; removing debris from the washes; and postponing construction during rainstorms or flood events. Impacts to water quality would be minor. Bank stabilization would reduce future releases of eroded material into Tanque Verde Creek. Thus increased turbidity caused by the flooding events would be minimized with the implementation of the project.

The proposed project would be constructed by the Corps of Engineers; therefore, to comply with Section 404 of the Clean Water Act a Section 404 (b)(1) Evaluation has been prepared The Section 404(b)(1) Evaluation is located in Appendix C-1 of this document. During preparation of the EA, the Environmental Resources Branch staff coordinated the proposed project with the Corps Regulatory Branch, Tucson Office. Regulatory Branch expressed their concerns regarding bank stabilization with soil cement and compliance with the Section 404 (b)(1) guidelines. The agency needs to identify the least environmentally damaging alternative to comply with the Section 404(b)(1) guidelines. They recommended use of riprap or geotech mat for the bank stabilization rather than soil cement. Regulatory Branch will review the Section 404(b)(1) Evaluation for this project. The Environmental Resources Branch (ERB) provided a working copy of a Draft EA and a Section 404 (b)(1) Evaluation to the Regulatory Branch. ERB will continue to coordinate the proposed project with the Regulatory Branch.

On May 11, 2000, informal coordination was conducted with the Arizona Department of Environmental Quality (ADEQ) regarding requirements for Section 401 Water Quality Certification. To meet requirements of the State of Arizona Environmental Quality regulations, a State of Arizona AEQ/WQD Form 404-003 was prepared and is located in Appendix C-2 of this document. A request for the Section 401, State Water Quality Certification will be submitted, including an application form 404-015 to the ADEQ prior to project construction.

A Storm Water Permit will be required for the proposed project if project-related grading exceeds 5 acres. The total area to be graded will be determined during preparation of Plans and Specifications for the project.

5.5 Air Quality (Alternatives 2, 3 and 4)

Bank stabilization activities would have a short-term adverse impact on air quality. Minor adverse impacts would be associated with equipment emissions and fugitive dust particles due to the transportation of materials during construction. Some dust will be released during excavation of the banks and creek bed. Watering trucks will be used as needed to minimize impacts, which are considered short term and minor.

Project-related activities that contribute to emissions include: excavation of the creek banks, stabilizing the creek banks with soil cement, and transportation of the required construction material from the vicinity of the project area. Air quality analysis performed for the construction activities, is located in Appendix D of this EA. The Corps used AP-42 (EPA guideline) and California Environmental Quality Act, Air Quality Handbook, prepared by the South Coat Air Quality Management District, 1993.

About 115,000 C.Y. of material would be excavated from the creek bed and side slopes. About 3,500 C.Y. of the Portland cement and about 360 C.Y. of pozzolon (stabilizer) would be obtained from the vicinity of the project area. About 4 trucks per day would be utilized to transport construction related material from a distance of about 10 miles. Project construction would not result in significant impacts to air quality. Quantities of particulate matter (PM_{10}) generated due to excavation activities and trucks traveling on unpaved roads were calculated (see Appendix D). Per day, about 7 pounds of fugitive dust would be generated by the construction activities after implementation of the mitigation measures.

The construction of the project may take about four months. Project-related emissions would be well below the significance levels of Carbon Monoxide (CO), Reactive Organic Compounds (ROC) and Oxides of Nitrogen (NOX), fugitive dust, and other air pollution.

Mitigation measures to reduce fugitive dust include watering the excavation site and unpaved roads and limiting truck speeds to 15 miles an hour on unpaved roads. Construction related emissions are short term, minimum, and conditions will stabilize after completion of the project.

5.6 Biological Resources

Some loss of habitat and associated wildlife will occur with each of the action alternatives 2,3, and 4. Even with No action, some future decline in habitat values is anticipated due to increased disturbance from the expanding population and development in the surrounding areas and erosion of the unprotected mesquite bosque habitat on the north bank of Tanque Verde Creek. Impacts of any of the action alternatives would be greater than with No Action.

The Watercourse and Riparian Habitat Protection and Mitigation Requirement of the Pima County Floodplain Management Ordinance require a mitigation plan for projects that adversely impact riparian habitat. The Ordinance specifically includes mesquite bosque habitat. Appropriate mitigation measures have been identified for each of the action alternatives.

Modified Habitat Evaluation Procedures (HEP) and an Incremental Cost Analysis were performed to obtain mitigation requirements for the loss of habitat due to implementation of each

of the alternatives, including the No Action Alternative. When mitigation is necessary, Corps regulations (ER1105-2-100:7-35) require an Incremental Cost Analysis of mitigation options for the recommended alternative, other viable alternatives and the No Action Alternative. By performing an Incremental Cost Analysis, comparison and cost for various mitigation options can be identified and the most cost-effective mitigation option or combination of options that best meet the mitigation goals can be implemented for the project. Appropriate/required mitigation measures for each alternative have been developed based on these calculations. The Modified HEP Analysis and Incremental Analysis are provided in Appendix B-5 of this EA. The modified HEP was performed for the recommended alternative, other viable alternatives, and the No Action Alternative.

ALTERNATIVE 1. No Action. Under the No Action Alternative, no construction-related impacts to biological resources would occur, but the overall habitat quality is expected to decline even with no project. The burned area would eventually recover, but other factors such as trespassing, wood-cutting, domestic animals, etc are expected to adversely impact the project area and the preserve area.

Moderate to major erosion to the mesquite bosque is predicted to occur during severe storms, potentially eliminating much of the preserve vegetation. The Lateral Migration Analysis (Appendix A of this EA) predicts a potential for erosion on the north bank of up 650 feet over the period of analysis for this project. Since all but the widest point of the proposed preserve area is 650 feet or less in width, the entire preserve is subject to lateral erosion with the No Action Alternative, as well as Alternatives 2 and 3. Following severe episodes of erosion, desert riparian habitat will be replaced with desert wash habitat, followed by reestablishment of riparian habitat during periods of low to moderate flows. This successional riparian habitat would be considerably different from the existing mesquite bosque habitat, and would most likely consist of faster-growing trees, such as cottonwoods and willows. Invasion by non-native species, especially salt cedar, is also to be expected. As the channel widens, the rate of erosion, channel migration, and habitat loss is expected to decrease. Since the number and intensity of storms over the period of analysis is unpredictable, it will be assumed, for the purposes of this study, that after the first 5 years of the period of analysis, the average condition of the preserve area with no project or with Alternative 2 or 3 will consist of 50% desert riparian habitat and 50% desert wash habitat. Desert riparian habitat is considered a significant resource by federal, state, and county authorities.

ALTERNATIVE 2. The proposed action would affect desert riparian habitat, including mesquite bosque habitat, along Tanque Verde Creek. A total of approximately 9.0 acres of habitat would be directly lost due to project construction, including approximately 1.0 acre of high quality mesquite bosque habitat and 8.0 acres of disturbed desert wash habitat. Impacts to approximately 4.88 acres of the desert wash habitat would be temporary. Impacts to wildlife in the disturbed desert wash area will be minor because relatively few species inhabit these areas, and most are relatively common. Impacts to wildlife found in the mesquite bosque habitats would include temporary and permanent displacement and mortality of some wildlife that is unable to escape. The Lateral Migration Analysis (Appendix A of this EA) indicates that stabilization of the south bank would not significantly accelerate erosion of the mesquite bosque habitat on the north bank, but that the cumulative effects of channelization on Tanque Verde

Creek has a major effect on the erosion of the unprotected areas. The nature of impacts to the preserve area would, therefore, be similar to those described for the No Action alternative.

North Bank Protection, Upstream of Craycroft Road. The addition of approximately 1,550 linear feet of soil cement bank protection on the north bank of Tanque Verde Creek would disturb or eliminate approximately 0.7 acre of desert riparian habitat and associated wildlife. This estimate assumes a width of eight feet for the bank protection, and an additional ten feet of excavation for the toe-down and to provide a smooth slope. Along the downstream and central portions of the reach, approximately 0.8 acres of low to moderate quality desert wash habitat, consisting of scattered mesquite, small shrubs and ground cover, and possibly an occasional cottonwood and palo verde, would be removed. Along the upstream portion of the reach, approximately 0.3 acre of high quality desert riparian (mesquite bosque) habitat and associated wildlife would be eliminated.

South Bank Protection, Pantano Wash to Existing Bank Protection. The addition of approximately 2,830 linear feet of soil cement bank protection on the south bank of Tanque Verde Creek from Pantano Wash to the existing bank protection (including about 300 feet of Pantano Wash at the confluence) would disturb or eliminate approximately 2.4 acres of habitat. Approximately 0.7 acre of mesquite bosque habitat and associated wildlife would be replaced with soil cement along the downstream 1,700 feet of this reach. About 1.0 acre of low to moderate quality desert wash habitat would be replaced with soil cement along the upstream 1,100 feet of this reach. The soil cement revetment on the south bank may indirectly accelerate erosion of the portion of the north bank that would be left in its natural condition under this alternative. At the confluence with Pantano Wash, the soil cement would reduce surface flow to the riparian/mesquite bosque habitat, but ground water and occasional surface flows from Pantano Wash would continue to be available. Some indirect impacts are expected to occur over the long term, due to the altered hydrology, potentially limiting germination and recruitment of new trees. Existing trees would probably not be affected.

South Bank Protection from Existing Bank Protection West of Sabino Canyon Road to Existing Bank Protection Downstream. The addition of approximately 4,220 linear feet of soil cement bank protection on the south bank of Tanque Verde Creek from the existing bank protection west of Sabino Canyon Road to the existing bank protection downstream would disturb or eliminate approximately 3.2 acres of habitat, primarily low to moderate quality desert wash habitat. No mesquite bosque habitat will be lost in this reach.

Mitigation. Based on the HEP Analysis (Appendix B-5), a total of 2.14 Average Annual Habitat Units (AAHUs) will be lost due to implementation of Alternative 2. Project-related impacts include both the direct loss of 9.0 acres (4.22 acres long term and 4.88 acres short term) and indirect effects such as modified hydrology and water availability that lower the quality of habitat that remains. As with the No Action Alternative, all but the widest point of the proposed preserve area is subject to lateral erosion. Following severe episodes of erosion, desert riparian habitat will be replaced with desert wash habitat, followed by reestablishment of riparian habitat during periods of low to moderate flows. This successional riparian habitat would be considerably different from the existing mesquite bosque habitat, and would most likely consist of faster-growing trees, such as cottonwoods and willows. Invasion by non-native species,

especially salt cedar, is also to be expected. As the channel widens, the rate of erosion, channel migration, and habitat loss is expected to decrease. Since the number and intensity of storms over the period of analysis is unpredictable, it will be assumed, for the purposes of this study, that after the first 5 years of the period of analysis, the average condition of the preserve area with no project or with Alternative 2 or 3 will consist of 50% desert riparian habitat and 50% desert wash habitat. Desert riparian habitat is considered a significant resource by federal, state, and county authorities. Based upon the HEP Analysis, acquisition and maintenance of the 48-acre mesquite bosque area along north bank would provide a net increase of only 0.53 AAHUs in mitigation, still 1.61 AAHUs under the requirement Habitat units (HUs) are obtained by multiplying the number of acres by a number between 0.0 and 1.0 called a Habitat Suitability Index (HSI), which rates the habitat relative to optimal habitat for a species or group of species. See Appendix B-5 for more detail.

ALTERNATIVE 3. Impacts of Alternative 3 would be similar to the impacts of Alternative 2, except that less habitat would be disturbed on the South Bank upstream of the confluence with Pantano Wash. Indirect effects on the mesquite bosque habitat at the confluence with Pantano Wash are not anticipated with this alternative. About 1.0 acre of low to moderate quality desert wash habitat would be replaced with soil cement immediately upstream of the golf course to just downstream of the golf course. A total of approximately 2.8 acres of habitat would be lost with this alternative, consisting of approximately 0.3 acre of mesquite bosque habitat and 1.5 acres of disturbed desert wash habitat.

Mitigation. Based on the modified HEP Analysis, approximately 0.61Average Annual Habitat Units would be lost due to implementation of this alternative (Appendix B-5). Based on the modified HEP Analysis, these Habitat units could be replaced with the proposed preserve and minimal restoration following major flood damage. Acquisition of the preserve with no bank protection provides a net increase of only 0.53 AAHUs, still leaving a deficiency of 0.99 AAHUS.

ALTERNATIVE 4. Impacts of Alternative 4 would include the impacts discussed for Alternative 2, as well as impacts of the erosion protection which would be provided on the north bank along the proposed preserve area. Total habitat losses for this alternative are estimated at approximately 9.9 acres, consisting of approximately 1.9 acre of moderate to high quality mesquite bosque habitat and 8.0 acres of disturbed desert wash habitat.

Mesquite Bosque Habitat Erosion Protection. Modified bank protection would be provided along the exposed edge of the mesquite bosque preserve area. Protection would potentially consist of a low soil-cement berm along the existing bank of the mesquite bosque habitat area on the north bank. The berm would be approximately 5,000 feet long and the minimum height that would protect the toe of the preserve area from erosion, probably about 2 feet. "Weep holes" would be embedded through the width of the berm to maintain the hydrologic connection between the creek and the mesquite bosque. The berm would reduce erosion of the mesquite bosque habitat but would be low enough to allow overtopping by flood events of approximately the same frequency that provide overbank flow under existing conditions, approximately a 10-15-year event. Approximately 0.9 acre of moderate to high quality mesquite bosque habitat would be removed or disturbed on the slopes of the preserve area for construction of the erosion

control berm. Approximately 1.1 acre disturbed desert wash habitat would be removed at the base of the slope for the toe-down. This estimate assumes a width of eight feet for the bank protection, for the smooth transition from the erosion protection to the natural bank, and an additional ten feet of excavation for the toe-down. The toe-down of 10 feet would not cut off the ground water to the root zone of the mature mesquite trees but could have detrimental effects on seedlings and saplings that have not yet developed a deep root system especially near the edge of the preserve. The berm would not be of sufficient height to allow development of the parcel. While the soil cement berm may slightly reduce overbank flows from some moderate storms; the majority of overbank flow is from local drainage; therefore, the germination and recruitment of new mesquite seedlings will probably not be inhibited significantly. Slopes of the berm will be graded to minimize the barrier effect on wildlife migration. Although the bank protection for this alternative has been modified to minimize adverse hydrologic effect on the vegetation and barriers to wildlife, the Corps and Pima County will continue to analyze additional options for bank protection of the preserve area during the PED phase of this project.

Mitigation. Based on the modified HEP and Incremental Cost Analysis, the proposed preserve with modified bank protection will provide the appropriate level of mitigation for this project (see Appendix B-5).

Threatened and Endangered Species (Alternatives 2, 3, and 4)

Bald Eagle (Threatened). Although the bald eagle may be an occasional visitor to the area, no impact to this species is anticipated because no nesting or breeding habitat would be affected, and the habitat would be used only occasionally, if ever, for foraging.

Cactus Ferruginous Pygmy Owl (Endangered). The Corps performed a site visit with the resource agencies (USFWS and Arizona Fish and Game) to obtain their view for implementation of the project. The USFWS and Arizona Game and Fish expressed concerns regarding the potential for Federally listed Endangered or threatened species, particularly the cactus ferruginous pygmy owl. WestLand Resources, Inc. Engineering and Environmental Consultants, conducted surveys for the cactus ferruginous pygmy owl under contract to the Corps. WestLand Resources biologists have the required permits to conduct the surveys. Three complete protocol surveys, as proposed (and subsequently adopted) under USFWS protocol were conducted in March, April, and May 1999. Fifteen calling stations provided complete coverage of the project area during each survey session. The area surveyed for this project included all potential habitats from the confluence of Pantano Wash and Tanque Verde Creek to the upstream end of the project area. No evidence of Pygmy Owls or nesting sites was detected during the surveys. The project area includes a preponderance of developed lands, and vegetation in the area appears to lack the structural diversity normally associated with occupied habitats. Based on this assessment, habitat quality along the portion of Tanque Verde Creek surveyed for this report appears low to moderate for the Pygmy Owl. Habitat quality on the nearby lands also appeared low to moderate for Pygmy Owl. Based on protocol surveys conducted in 1999, the Corps has concluded that the proposed action will not affect the Cactus Ferruginous Pygmy Owl because it does not occur in the project area (see report in Appendix B-1). The determination of no effect obviates the requirement to prepare a Biological Assessment and to conduct Section 7 Consultation under the Endangered Species Act. The project has been coordinated with the

USFWS. On June 15, 2000, the USFWS provided a Final Coordination Act Report, in which they indicated that no threatened or endangered species are known to occur in the proposed project area.

5.7 Land Use

No Action Alternative: If the creek banks are not stabilized, adverse impacts to land use are likely to occur, including the possible loss of rural residential structures and land on the north bank and erosion of the Tucson Country Club on the south bank. Loss or damage to the sewer interceptor and roadways could also occur.

Alternative 2. The proposed project would protect existing land uses, including rural residential uses on the north bank and the Tucson Country Club on the south bank. No direct impacts to the desert riparian (mesquite bosque) habitat on the north bank would occur, and this land would be acquired as a preserve. Acquisition of this parcel would prevent urban development and would secure the site as permanent open space. The preserve would continue to be subject to erosional forces: however, the dense vegetation may help to stabilize the slope.

Alternative 3. Effects of Alternative 3 would be similar to Alternative 2, except that an undeveloped reach on the south bank, just upstream of the confluence with Pantano wash would not be protected. Since the area is undeveloped, the effect of leaving it unprotected is minimal.

Alternative 4. Effects of Alternative 4 would be similar to Alternative 2, except that a low soil cement berm with "weep holes" would be constructed along the toe of the slope adjacent to the riparian preserve. The berm would be too low to provide adequate flood protection to the site to allow urban or commercial development.

5.8 Aesthetics (Alternatives 2, 3 and 4)

Short-term adverse aesthetic impacts will occur during the construction period, when construction equipment and the soil-cement processing plant are operating. Long-term aesthetic impacts will not be significant. Nearly all soil cement will be placed over eroded slopes with little or no existing vegetation. The soil cement will be similar in color and texture to existing unvegetated banks.

5.9 Noise: (Alternatives 2, 3 and 4)

Construction activities will increase the noise level in the immediate area of the work. Few people reside in the area to be impacted. Noise will have some adverse impact to users of the Tucson Country Club during construction of the south bank protection. Typical noise levels at 50 feet from most types of construction equipment (i.e. bulldozers, graders, scrapers, loaders) range from about 85 to 89 dBA. Assuming an average construction noise level of 87 dBA, and a 6.0 dBA decrease per doubling of the distance, the noise level will decrease to approximately 70 dBA. This noise level is considered generally acceptable for golf courses and similar recreational facilities within about 400 feet of construction activities.

5.10 Socioeconomics: (Alternatives 2, 3 and 4)

Short-term benefits to local businesses will occur during the construction period, when construction personnel may patronize restaurants and retail shops in the local area. Bank protection will provide long-term economic benefits to local residents and to the Tucson Country Club. Loss of property due to bank erosion would be reduced, and property values may increase due to erosion protection. Designation of the mesquite bosque on the north bank as a preserve would prevent most types of economic development in this area, but the preserve would provide important social benefits associated with shaded open space in a desert urban environment.

5.11 Transportation: (Alternatives 2, 3 and 4)

Any of the construction alternatives would have only temporary and minor impacts to traffic. Public roads would be used to transport workers, equipment, and materials to the project site. Since the project does not involve road work, no road closures or lane closures are anticipated. Slow-moving equipment could cause minor traffic delays. No long-term adverse impacts to traffic will occur.

5.12 Recreation: (Alternatives 2, 3 and 4)

Construction would have short-term impacts on recreational use in the project area, especially equestrian use of the creek bed. During the construction period, equestrians will likely be required to temporarily use alternate routes to avoid ongoing construction. Recreational use of the Tucson Country Club will not be precluded during construction; however, the area near the bank of the creek may be temporarily off limits, and some members and guests may choose to avoid areas within about 400 feet of construction due to noise.

5.13 Cultural Resources: (Alternatives 2, 3, and 4)

Applying soil cement or riprap to the exposed cultural surface will impact prehistoric archeology site COE_TV_99_1. At this time, Section 106 consultation has not been coordinated with the State Historic Preservation Officer (SHPO). If, after testing, the site is determined to be eligible for listing in the National Register of Historic Places, the effects will be considered adverse. There is a historic element to the site, but it appears to be only associated with transport from extended high velocity stream flows, not an integral part of the site's composition. Subsurface testing will also indicate if the site is part of AZ:BB:9:54 (ASM). BB:9:54 was a Sedentary period, Late Rincon phase site located approximately 200 meters north.

5.14 Cumulative Impacts: (Alternatives 2, 3 and 4)

Cumulative effects refer to environmental impacts of the project in combination with past, ongoing, and reasonably foreseeable future actions in the project vicinity. The proposed action would fill in gaps in bank protection between existing soil cement bank protection on Tanque Verde Creek downstream of Sabino Canyon Road to the confluence with the Rillito River. The extent of proposed bank protection is relatively minor, as compared with existing bank

protection. No additional bank protection on the Rillito River or tributaries is anticipated in the near future. Although there have been cumulative impacts, due to several federal and non-federal projects on the Rillito River and Tanque Verde Creek, the impacts of the current project will be mitigated. The Rillito River Bank Protection Project did not involve formal mitigation for loss of habitat, but that project included extensive plantings of native vegetation for aesthetic treatment associated with recreational features. In addition, the Corps is currently conducting a feasibility study under authority of Section 1135 of the Water Resources Development Act of 1986, as amended, to restore degraded habitat along the south bank of the Rillito River between Craycroft Road and Alvernon Way. This restoration project, if implemented, would develop approximately 100 acres of wetland, riparian, and native upland habitats. The Corps could potentially become involved in future Section 1135 restoration projects in the Rillito River system as new opportunities are identified.

6.0 COORDINATION

Coordination Summary: Informal coordination has been conducted with the following agencies:

U.S. Fish and Wildlife Service; Corps of Engineers (Regulatory Section, Tucson); Arizona Department of Game and Fish; Arizona Department of Environmental Quality; and Arizona State Historic Preservation Officer.

U.S. Fish and Wildlife Service. The Corps of Engineers requested an updated list of endangered, threatened, and candidate species from the U.S. Fish and Wildlife Service on July 16, 1998. A reply was forwarded to the COE in a letter dated August 5, 1998 (Appendix B-3). Mr. Mike Martinez, with the USFWS, Phoenix office, was contacted in July 1998 by telephone for a site visit. On July 21, 1998, a site visit was conducted with the resource agencies and PCDOT & FCD staff. The USFWS and Arizona Game and Fish participated in this site visit. The USFWS and Arizona Game and Fish expressed their concerns that the cactus Ferruginous Pygmy Owl may be located within the project area. In March, April, and May 1999, WestLand Biological Services, under contract to the Corps, conducted a survey for Cactus Ferruginous Pygmy Owl as per USFWS protocol. No Pygmy Owl was detected during the surveys. Since July 1998, the Corps biologist has continued coordination of the project's progress with the USFWS. The USFWS indicated in their Coordination Act Report a preference for implementation of Alternative No. 2, no structural protection along the riparian vegetation preserve. This view was confirmed in a telephone conversation between the Corps and USFWS on May 3, 2000. The USFWS submitted the Draft Coordination Act Report in January 2000, and the Final Coordination Act Report was provided in June 2000 (Appendix B-2).

Corps of Engineers (Regulatory Branch). During preparation of the Draft EA, project construction was coordinated with Regulatory Branch (Tucson Office) regarding compliance with the Section 404 of the Clean Water Act and preparation of a Section 404 (b)(1) Evaluation. Regulatory Branch expressed their concerns for use of soil cement for the bank stabilization. They prefer use of riprap or geotech mat, which will allow growth of vegetation. To comply with Section 404(b) (1) guidelines, the selected alternative should be the least environmentally damaging. The ERB staff will work with the Regulatory Branch staff for the proposed project.

Arizona Department of Environmental Quality. On May 11, 2000, the Corps coordinated the proposed project with Mr. Andy Travers, ADEQ staff. The Corps provided project related information via telephone. According to Mr. Travers, the project would require State Water Quality Certification. The Corps needed to submit the ADEQ/WQD form 404-003 and form 404-015 application with the Draft EA. He also requested that the Corps provide a map, project description, and design drawing with the Draft EA. The Corps submitted form 404-003 with the Draft LRR and EA as requested (Appendix C-2). The document included the project description and available design drawings. The Corps will submit a request for the State 401 Water Quality Certification with application-404-015 prior to construction.

Arizona Department of Game and Fish. The Corps of Engineers invited the Arizona Game and Fish Department (AGDFG), to participate in the July 21, 1998 field a site visit. At this site visit, Ms. Sherry Ruther of AGDFG expressed concerns that stabilizing the south banks may cause erosion along the riparian vegetation located along north bank of the Tanque Verde Creek. As per AGDFG's recommendation, the Corps performed a lateral migration analysis for the project area (May 1999). This study is located in Appendix A of the EA and details are provided in the LRR. Arizona Game and Fish was also concerned that the cactus Ferruginous Pygmy Owl may be located within the project area. Cactus Ferruginous Pygmy Owl surveys were conducted in the spring of 1999 per USFWS protocol. No Pygmy Owl was detected during the surveys.

Arizona State Historic Preservation Officer. Coordination with the SHPO has been informally initiated. All further consultation towards compliance with Section 106 will be coordinated with SHPO.

7.0 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

7.1 National Environmental Policy Act (NEPA), as amended. National Environmental Policy Act of 1969 (Public Law 91-190) as amended

This EA has been prepared in accordance with the requirements of NEPA of 1969 (42 USC 43221, as amended) for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508) dated 1 July 1988. NEPA requires that agencies of the Federal Government shall implement an environmental impact analysis program in order to evaluate "major federal actions affecting the quality of the human environment." This Environmental Assessment has been prepared in accordance with the requirements of the Act and with the Council of Environmental Quality Regulations for implementing NEPA.

7.2 200-2-2, 33 CFR 230, March 1988

This regulation provides guidance for implementation of the procedural provisions of the National Environmental Policy Act (NEPA) for the Civil Works Program of the USACOE. It supplements Council on Environmental Quality (CEQ) regulations 4-0 CFR 1500-1508, November 29, 1978, in accordance with the CEQ regulations. Wherever the guidance in this regulation is unclear or not specific, the reader is referred to the CEQ regulations. This regulation is applicable to all USACOE responsibility for preparing and processing environmental documents in support of civil works functions.

7.3 ER-1105-2-100 Regulation December 1990

ER-1105-2-100 provides guidance for the conduct of Civil Works planning studies and related programs by the U.S. Army Corps of Engineers. Guidance provided in these regulations has been followed in the preparation of this document.

7.4 Clean Water Act, as amended

The Clean Water Act governs discharge or dredge of materials in the waters of the United States and it governs pollution control and water quality of waterways throughout the U.S. Its intent, in part, is to restore and maintain the biological integrity of the nation's waters. The goals and standards of the Clean Water Act are enforced through permit provisions. Sections 404, 401 and 402 of the Clean Water Act pertain directly to the proposed project. Section 404 outlines the permit program required for dredging or filling the nation's waterways. The COE does not issue itself a permit for civil works projects, therefore, to comply with Section 404 of the act, a 404(b)(1) analysis has been performed (Appendix C-1). Section 230.10(a)(2) of the 404(b)(1) guidelines states that an alternative is practicable if it is available and capable of being done after taking into consideration costs, existing technology and logistics in light of overall project purposes.

The proposed bank stabilization would occur along Tanque Verde Creek and at the confluence of Pantano Wash. State of Arizona water quality form WQMS - 404 003 has been prepared and will be submitted to ADQA in compliance with Arizona Department of Environmental Quality requirements (Appendix C-2). The proposed project has been coordinated with the ADEQ. To meet the requirements of the ADEQ, the Corps will submit required forms. A request for a Section 401 Water Quality Certification with form 404-015 application would be submitted to ADEQ. Prior to the project construction, Section 401 Water Quality Certification would be obtained. Provisions of the Clean Water Act are complied with.

7.5 Clean Air Act, as amended

Section 118 specifies that any Federal activity which may result in discharge of air pollutants must comply with Federal, State, interstate, and local requirements respecting control and abatement of air pollution. Section 176 requires that all Federal projects conform to Environmental Protection Agency-approved or promulgated State Implementation Plans. The proposed construction will not significantly impact the air quality in this area. During construction a watering program will be employed to reduce fugitive dust. The project-related impacts are short term and minor.

7.6 National Historic Preservation Act, as amended

The project is not in compliance with Section 106 of the National Historic Preservation Act (36 CFR 800). Informal consultation has been initiated with the Arizona Office of Historic Preservation by telephone. Currently survey information is insufficient to determine the National Register eligibility of archeology site, COE_TV_99_1. To conform to the requirements of Section 106, a site number needs to be acquired from the Arizona State Museum, a survey report needs to be filed at the Museum and then transmitted to the SHPO, and a subsurface test of the site needs to be completed. If the test indicates the site has the ability to answer significant questions in the prehistory of the Tucson Basin, it will be determined to be eligible for listing in the National Register of Historic Places. Before mitigating adverse effects to the site, a MOA will need to be developed between the Corps of Engineers, the SHPO, interested Native Americans, Pima County, and possibly the Advisory Council on Historic Preservation. The MOA will contain stipulations that will guide mitigation. When the MOA is executed, the project as planned will be in compliance with Section 106 and may proceed. Upon completion of field work for mitigation construction may proceed.

7.7 Endangered Species Act of 1973, as amended (Public Law 93-205)

The Corps requested Endangered Species information from USFWS in a letter dated July 16, 1998. USFWS provided the information as requested in a letter dated August 5, 1998 (see Appendix B-1). Protocol surveys were conducted for the Endangered Cactus Ferruginous Pygmy Owl, as recommended by the USFWS and the Arizona Game and Fish Department. No evidence of Cactus Ferruginous Pygmy Owl was found on site. None of the alternatives would affect listed threatened or endangered species; therefore, the project is in compliance with the Act. WestLand Biological Services, under contract to the Corps, conducted a survey for Cactus

Ferruginous Pygmy Owl as per USFWS protocol in March, April, and May 1999. No Pygmy Owl was detected during the surveys. Based on these surveys, the Corps biologist determined that the project would have no effect on the Pygmy Owl. The Corps also determined that the proposed action would not affect other Threatened or Endangered species potentially occurring in the project area as shown in Table 4-5 of this EA. This determination has been coordinated with the USFWS. USFWS indicated that the determination of no effect needs no further documentation other than that included in the EA; therefore, a Biological Assessment was not prepared and Section 7 Consultation is not required. On October 17, 2001, Mr. Frank Baucom of the USFWS Phoenix office reaffirmed that it was the policy of his office not to comment on another agency's "no effect" determination; therefore, the project is in compliance with the Act. In order to comply with ER 1105-2-100, the Corps will request written concurrence from USFWS that the EA also satisfies ESA Section 7 Consultation/Coordination requirements. This will be accomplished during the Preconstruction, Engineering, and Design (PED) phase of the project. When the Corps receives this concurrence, the project will also be in compliance with ER 1105-2-100.

7.8 Fish and Wildlife Coordination Act (Public Law 85-624)

This project has been coordinated with the USFWS and the Arizona Game and Fish Department. The USFWS, Phoenix Ecological Services Field Office, has prepared a Final Coordination Act Report (CAR) in compliance with the Act. The Final CAR is located in Appendix B-2 of this document. A site visit was conducted with the USFWS staff (Mr. Mike Martinez), Phoenix office, and Arizona Department of Game and Fish (Ms. Sherry Ruther). The USFWS and Arizona Game and Fish expressed their concerns that the cactus Ferruginous Pygmy Owl, a Federally listed Endangered species, may be located within the project area. Their concerns regarding Ferruginous Pygmy Owl and bank erosion along the riparian preserve located along the north bank have been taken into consideration. The Corps conducted a bank erosion study and Westland Biological Services conducted protocol surveys for Pygmy Owl under contract to the Corps. The USFWS indicated in CAR a preference for implementation of Alternative No. 2, no structural protection along the riparian vegetation preserve. This view was confirmed in a telephone conversation between the Corps and USFWS on May 3, 2000.

7.9 Migratory Bird Treaty Act

The proposed project would not involve the taking, killing, harming, or possession of birds protected under the Act. The project is, therefore, in compliance.

7.10 Executive Order 11990, Protection of Wetlands

Wetlands protection includes avoidance to the maximum extent possible of long and short-term adverse impacts associated with the destruction or modification of wetlands and avoidance of support of new construction in wetlands. The proposed project involves no new construction or maintenance in wetlands and is in compliance with the Executive Order.

7.11 Arizona Native Plant Law

This Law provides various levels of protection to many plants native to Arizona. The Law also requires that the Arizona Department of Agriculture be notified prior to removal of protected native plants. The proposed action would not affect any plants designated as a Highly

Safeguarded under the Native Plant Law, but some plants provided a lesser degree of protection, including mesquite, would be removed. The Arizona Department of Agriculture will be notified as required. The law requires contacting the Arizona Department of Agriculture sixty days prior to commencement of a project which may result in the removal of protected species. The project is not required to comply with this State regulation since it is located on Federal land. However, sensitive plants will be avoided or relocated where possible.

7.12 Executive Order 11988, Floodplain Management, May 24, 1977

Under this Order, the USACOE shall take action to avoid development in the base (100-year) floodplain unless it is the only practicable alternative; to reduce hazards and risks associated with floods; to minimize the impact of floods on human safety, health and welfare; and to restore and preserve the natural and beneficial value of the base floodplain.

7.13 Executive Order 12898, Environmental Justice

The alternatives developed for the EA were based on a set of criteria that did not discriminate on the basis of race, color, or national origin. This Executive Order requires that the Federal agency analyze the impacts of federal actions on minority and low-income populations.

7.14 Executive Order 13045, Environmental Health and Safety Risks to Children (62 Fed. Reg. 1988s (1997)

On April 21, 1997, this Executive Order was signed by President Clinton. It is designed to focus Federal attention on actions that affect human health and safety conditions that may disproportionately affect children. Executive Order 13045 requires that federal agencies, to the extent permitted by law, and appropriate and consistent with the agency's mission:

- Shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children.
- Ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Consistent with Executive Order 13045, the project would not disproportionately impact children in the region of influence.

7.15 Pima County Floodplain and Erosion Hazard Management Ordinance.

Chapter 6.54 Watercourse and Riparian Habitat Protection and Mitigation Requirements

This section of the ordinance describes mitigation requirements for development that adversely affects riparian habitat.

8.0 ENVIRONMENTAL COMMITMENTS

- A watering truck will be utilized during construction to minimize fugitive dust; the water will be obtained from a local water supply and will be free of contaminants.
- Clean material will be used to construct structures; no polluted silts or other material will be placed in the creek water; construction debris and rock will be removed upon completion of the project; and surfaces will be periodically cleaned after storm events.
- No construction would occur during heavy storm events.
- Construction debris as a result of bank stabilization will be removed and will be disposed of properly. Oil and grease potentially generated in the course of construction will be disposed of properly.
- A qualified biologist familiar with the Environmental Assessment, and environmental commitments will be present at critical times during mobilization, construction, and demobilization to monitor the project.
- Biological Mitigation for the Recommended Plan will involve the acquisition and maintenance as a preserve of the 48-acre mesquite bosque habitat area located along the north bank of the creek.
- The mesquite bosque preserve will be provided with modified bank stabilization measures to minimize habitat losses due to bank erosion.
- If bank stabilization for the mesquite bosque preserve consists of a soil cement berm, the berm will be embedded with sufficient "weep holes" to maintain the hydrologic connection between Tanque Verde Creek and the preserve.
- If bank stabilization for the mesquite bosque preserve consists of a soil cement berm, the height of the berm will be the minimum that would protect the bank from lateral erosion, and the slope gradient will be designed to sustain wildlife movement between the preserve and the creek bed.
- During the PED phase of the project, the Corps and Pima County will analyze additional options for bank stabilization along the preserve.
- Mitigation measures will need to be developed if test results from archeology site COE-TV-99-1 (temporary designation) show that it demonstrates the research potential to be determined National Register eligible. Testing will confirm the extent of the site and provide information towards developing a suitable set of research questions. Mitigation will require excavating enough material in the APE to enable answering the research questions. Mitigation measures will be defined in a memorandum of agreement (MOA), in consultation with the State, County, and interested tribes.

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9.0 PUBLIC INVOLVEMENT AND PUBLIC REVIEW

9.1 Public Review. The Draft Environmental Assessment (EA) for this project was sent for 30-day Public Review starting May 24, 2002. Due to problems encountered in distributing and notifying the public of the availability of the document as originally scheduled, the comment period was extended to July 31, 2002. Written comments on the Draft EA and LRR and responses are included in Appendix E of this Final EA.

9.2 Public Meetings. The Corps and the Pima County Department of Transportation and Flood Control District held two public meetings to present the draft LRR and EA to the public and to solicit public comments and concerns on the proposed project. The first of these meetings took place at the Dusenberry/River Public Library on May 28, 2002. Due to problems encountered in notifying interested parties of the first meeting, a second meeting was held on July 9, 2002 at St. Alban's Episcopal Church. Written comments on the EA and LRR, responses, and summaries of the Public Meeting are included in Appendix E of this document.

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10.0 LIST OF PREPARERS AND REVIEWERS

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Mr. Robert Ngo, Engineer Intern, Technical Assistance
Dr. John Moeur, Senior Terrestrial Ecologist (Reviewer)

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