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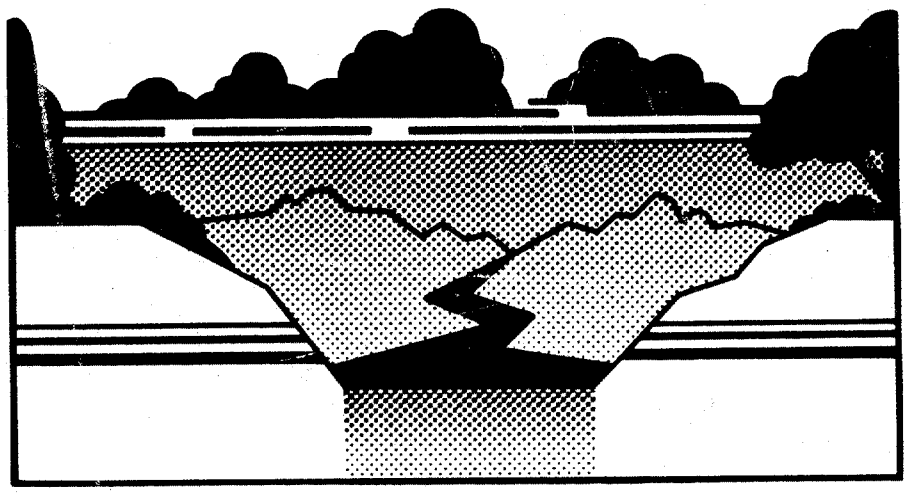
BLACK WASH DRAINAGE ANALYSIS AND POLICY ASSESSMENT REPORT



PIMA COUNTY DEPARTMENT OF TRANSPORTATION
AND FLOOD CONTROL DISTRICT

To: *FCD All Staff
From: John Wallace
Subject: Black Wash Floodway
Date: 9/09/94 Time: 5:00p

Please be advised that on this past Tuesday, September 6, 1994, the Board of Supervisor's approved a revision to a short reach of the Black Wash Floodway. The affected reach is located between Los Reales Road and Torim Road. Attached to a hard copy of this email (being distributed) you will find a copy of the memorandum to the Board of Supervisors concerning this revision which shows the revised floodway delineation along the subject reach. A copy of this email and the memorandum to the Board of Supervisors showing the revised floodway delineation will be attached to the copies of the Black Wash Drainage Analaysis and Policy Assessment reports which are kept in the Flood Control Planning and Floodplain Management libraries.

The revised floodway delineation should be used for all regulatory purposes.

001-A

APPROVED BY COUNTY ADMINISTRATOR_____
DENIED BY COUNTY ADMINISTRATOR_____

ADDITIONAL INFORMATION REQUIRED ☐ YES (SEE ATTACHED) ☐ NO

BOARD OF SUPERVISORS AGENDA ITEM SUMMARY

_____
COUNTY ADMINISTRATOR DATE

ITEM SUMMARY, JUSTIFICATION & SPECIAL CONSIDERATIONS:

THIS ITEM HAS BEEN SCHEDULED BY THE CLERK OF THE BOARD ON THE SEPTEMBER 6, 1994 MEETING ADDENDUM

Appeal by the Reverend Salcido to the Floodplain Management Board regarding a variance from the floodway requirements of the Pima County Floodplain and Erosion Hazard Management Ordinance No. 1988-FC2 (the Ordinance). Property owner desires to replace a mobile home residence within the regulatory floodway of the Black Wash where substantial improvements to residential construction are not permitted. Per the definition in the Ordinance and the owners description the mobile home replacement would be a substantial improvement.

Attached to serve as background information is the staff report on the appeal.

STAFF RECOMMENDATION:

1. That the Board of Supervisors, sitting as the Floodplain Management Board, adopt the revised Black Wash Floodway delineation as described in the staff report. If the floodway revision is adopted, then appellants parcel will be located outside of the regulatory floodway and no variance will be needed for permitting of the replacement mobile home on the property.

2. That the resolution of existing violations of the Ordinance on the property be addressed within the context of a permit for the replacement mobile home as described in the staff report.

White - Clerk of the Board

TOTAL COST TO PIMA COUNTY: $ None FUNDING SOURCE: _____

HAS FUNDING BEEN APPROVED IN THIS FISCAL YEAR'S BUDGET: ☐ Yes ☐ No

ADVERTISED PUBLIC HEARING: ☐ Yes ☐ No

REQUEST FOR: ☐ Action ☐ Discussion ☐ Discussion/Action

EFFECTIVE DATE: ___/___/___ TERMINATION DATE: ___/___/___

BOARD OF SUPERVISOR DISTRICT ☐ 1 ☐ 2 ☒ 3 ☐ 4 ☐ 5 ☐ All

IMPACT:

IF APPROVED:

Black Wash Floodway will be revised and permit can be issued for appellants replacement mobile home without the need for a variance. Existing violations of the Floodplain Ordinance on the property will also be resolved through the permitting of the mobile home.

IF DENIED:

Residence will not be built.

AGENDA ITEM INITIATED BY: the Reverend Salcido Date: 8/29/94

DEPARTMENT NAME: Department of Transportation and Flood Control Dist

DIVISION MANAGER'S SIGNATURE (When applicable): Dave Smutzer

DEPARTMENT DIRECTOR'S SIGNATURE: _____

CONTACT PERSON: John Wallace, Floodplain Mgt. PHONE # 740-6450

PROCESSING PERSON*: Debbie Grijalva PHONE # 740-6824

*** Return Items to Processing Person.**

FLOODPLAIN MANAGEMENT APPEAL

Appeal by the Reverend Jesse Salcido of Floodplain Use Permit Denial for Replacement Mobile Home at 4331 West Tetakusim Road (District 3)

BACKGROUND

On August 10, 1994, the appellant, the Reverend Jesse Salcido, applied for a Floodplain Use Permit (94-391) for a replacement mobile home at the referenced address. The subject property is located on Tetakusim Road just east of Camino de Oeste (Attachment A). The subject property is located entirely within the Administrative Floodway of the Black Wash as adopted by the Board of Supervisors on September 25, 1990. The Floodplain and Erosion Hazard Management Ordinance, 1988-FC2 (the Ordinance), Article VIII, Part A does not allow residential uses within the floodway. Article V of the Ordinance provides exemptions to the Ordinance. Under Article V, Part E:

> "Any structure which is repaired, reconstructed, or substantially improved at a cost equal to or exceeding fifty percent of the value of the structure as shown on the latest assessment roles of the Pima County Assessor either (a) before the improvement or repair is started; or (b) if the structure has been damaged and is being restored, before the damage occurred, shall conform to the provisions of this Ordinance."

The Reverend Salcido is replacing an existing mobile home with a new mobile home which, by Reverend Salcido's estimation, represents greater than a 50% increase in value. As such, the replacement does not meet the non-conforming use restriction as set forth by Article V of the Ordinance which allows for the modification or addition to a non-conforming structure up to 50% of the existing value. For this reason, the permit application was denied by letter dated August 15, 1994 from the Floodplain Management Office. The Reverend Salcido appealed the denial in writing to the County Engineer on August 16, 1994. The County Engineer, Mr. Antonio Paez, Director, Department of Transportation and Flood Control District, denied the appeal by letter dated August 29, 1994 based on the floodway location and the existence of unpermitted improvements in violation of the Ordinance which were discovered during the review of the permit application. The unpermitted fencing consists of approximately 730 lineal feet of fencing along

the west, north and east property boundaries. The unpermitted wall consists of approximately 168 lineal feel along the south property boundary. The Reverend Salcido appealed the denial by the County Engineer to the Clerk of the Board of Supervisors on August 29, 1994 and a public hearing was placed on the September 6, 1994 meeting addendum.

During the review of the floodplain use permit application the delineation was the Black Wash Floodway was reviewed to verify its accuracy. Review of the floodway delineation indicates the floodway was delineated based on a flood discharge which has since been the subject of more detailed study. The original floodway delineation was based on a regulatory peak discharge of 5035 cubic feet per second (cfs). The Southwest Basin Management Study, finished in July 1990 after the current delineation had been completed, identifies a regulatory peak discharge of 2772 cfs. The differences result from discrepancies in the earlier discharge determination which were revealed by review of newer more detailed aerial photography of the upstream watershed. The 2772 cfs discharge is based on the watershed determined from the newer more detailed aerial photography.

Based on the findings of the review of the current floodway delineation, a re-analysis of the floodway delineation in this area was performed as a part of the preparation of this report. The results of the re-analysis indicated that a considerably narrower floodway delineation should exist in the area of the subject property. The property owned by the Reverend Salcido at 4331 West Tetakusim Road is located entirely <u>outside</u> of the revised floodway. It is proposed that the revised floodway delineation from the recent re-analysis be used for regulatory purposes. The current and revised floodway delineations are shown on Attachment B of this report. The parcel would still be located within a floodplain area as mapped on the Flood Insurance Rate Map for this area.

RECOMMENDATION

The following actions are recommended to address the appeal by Mr. Salcido and other issues surrounding the re-evaluation of the Black Wash Floodway:

1. That the Board of Supervisors, sitting as the Floodplain Management Board, adopt the revised Black Wash Floodway delineation as shown on Attachment B of this report. If the floodway revision is approved, then the Salcido parcel at 4331 West Tetakusim Road will be located outside of the regulatory floodway and no variance will be needed for permitting of the replacement mobile home on the property.

2. Because of the existence of the identified unpermitted fencing and wall on the property it is recommended that the resolution of these violations of the Ordinance be addressed within the context of a permit for the replacement mobile home with the principal permit conditions to be as follows:

   A. That the lowest structural frame member of the mobile home be elevated 2.5 feet above existing natural grade.

   B. That the existing fencing and wall be elevated 1 foot above existing natural grade to allow for passage of floodwaters beneath the fencing and through the property so as not to divert flows onto adjacent properties.

   Attachment 3 shows all of the proposed special conditions for the Floodplain Use Permit (No. 94-391) for the Salcido mobile home replacement.

Prepared By:

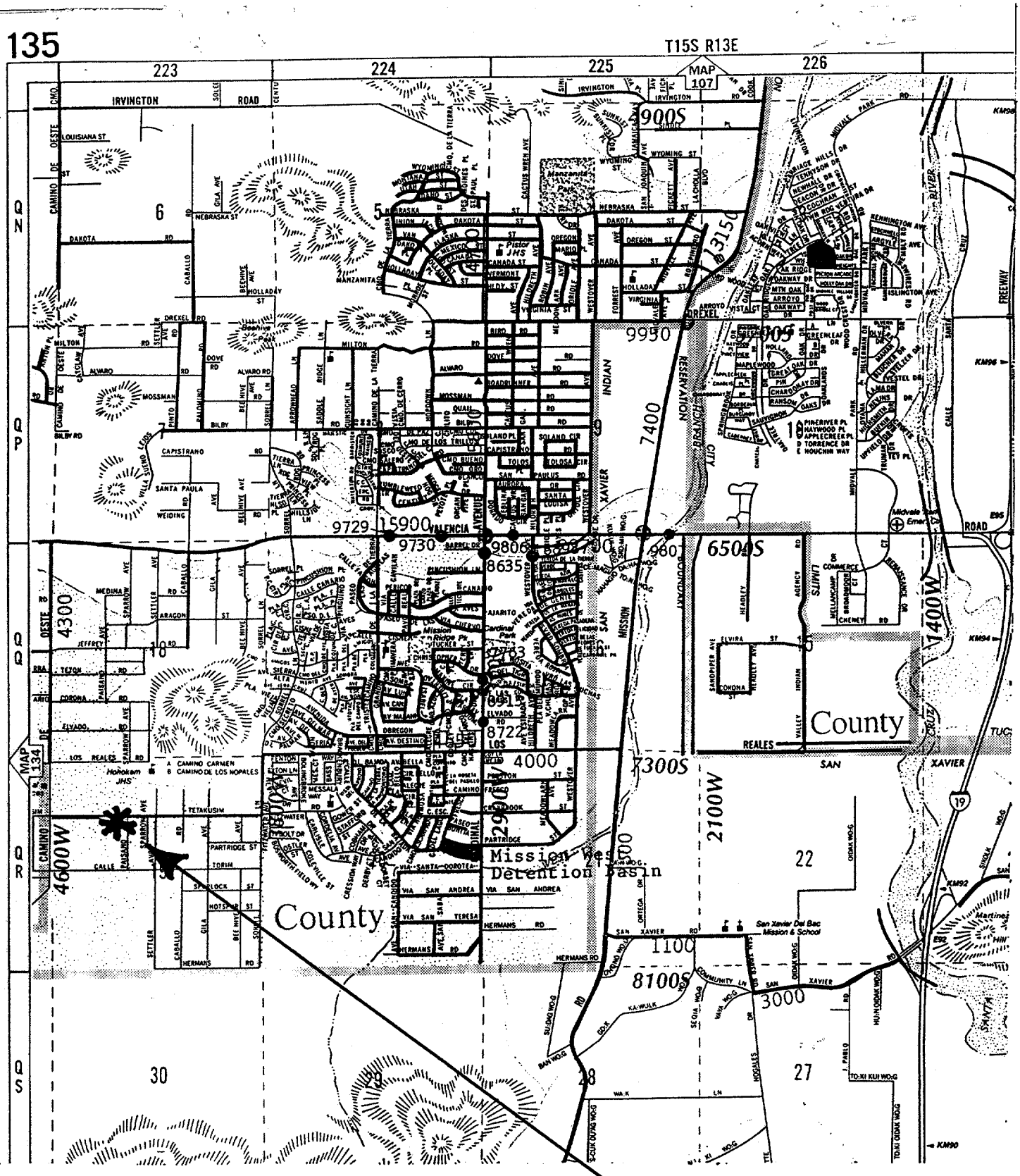
Antonio C. Paez, P.E.
County Engineer

August 31, 1994

Attachments

A: Location Map for 4331 West Tetakusim Road
B: Black Wash Floodway Map; Los Reales Road to Calle Torim
C: Proposed special conditions for Floodplain Use Permit No. 94-391

Distribution:
Clerk of the Board of Supervisors
Mr. Dave Smutzer, Manager, Flood Control Division
Mr. John Wallace, Manager, Floodplain Management Section
Ms. Christine Curtis, Deputy County Attorney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MAP 134
IRVINGTON ROAD
Mission Vista Detention Basin
County
ATTACHMENT A
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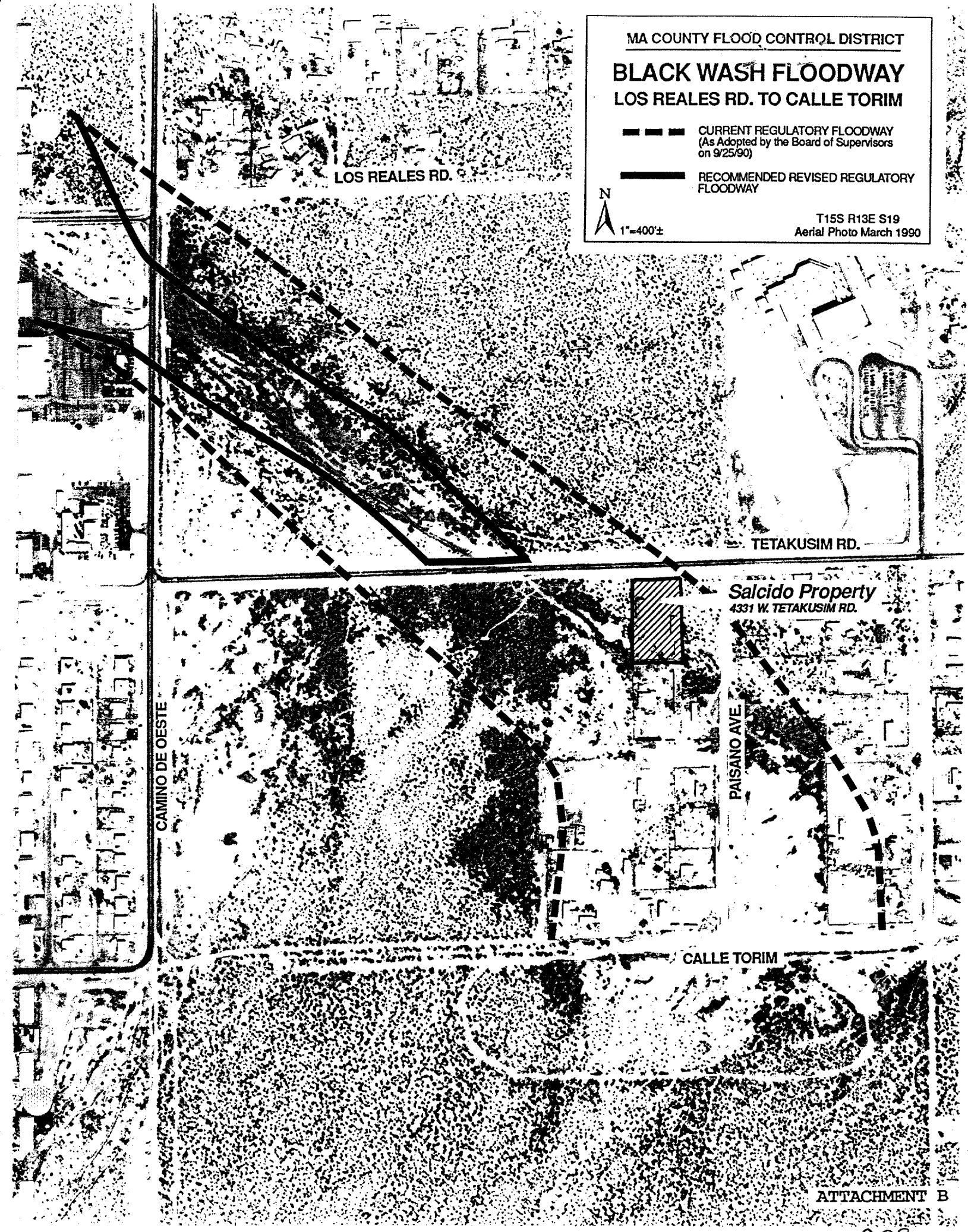

ATTACHMENT B

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The following are special conditions for Floodplain Use Permit No. 94-391 :

For purposes of this permit the following flood elevations shall be used:
Base Flood Elevation (BFE) = 1.5 feet
Regulatory Flood Elevation (RFE) = 2.5 feet
(X) above highest adjacent natural grade
( ) per the National Geodetic Vertical Datum (NGVD)

Bottom of the structural frame of the mobile home and lowest point of any attached appliances to be at or above the Regulatory Flood Elevation (RFE).

If structure to be placed on compacted fill, fill to be placed to an elevation at or above the Base Flood Elevation (BFE) and to extend at such elevation for a distance of 25 feet beyond the outside limit of the structure and protected against erosion by rip-rap, vegetation or other approved method.

If pilings are used instead of fill to elevate structure, pilings shall be placed in stable soil no more than ten feet apart.

Mobile home to be anchored to resist flotation, collapse or lateral movement by one of the methods outlined in Article X of the Ordinance.

Residence to be oriented parallel to flow.

All buildings to be setback a minimum of 50 feet to any wash (for purposes of this condition a building is any walled and roofed structure).

Completed Elevation Certificate to be returned to the Floodplain Management Section office prior to habitation of the structure.

As a condition of approval of this permit, all perimeter fencing and walls on the property are to have the bottom elevated one foot above existing natural grade. Once elevated as described above the currently unpermitted perimeter fencing and walls will be considered permitted by this office.

ATTACHMENT C

BLACK WASH DRAINAGE ANALYSIS AND POLICY ASSESSMENT REPORT

Prepared for the
Pima County Board of Supervisors
sitting as the
Flood Control District Board of Directors

Dan Eckstrom
Raul Grijalva
Greg Lunn
Ed Moore
Reg Morrison

Prepared by
The Pima County Department of Transportation
and Flood Control District
Flood Control Planning and Development Division

John M. Bernal
Director

Revised
September 12, 1990

Adopted by B.O.S.
9/25/90

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EXECUTIVE SUMMARY

During the past decade, the area immediately to the southwest of Tucson that is drained by the Black Wash has experienced stress brought about by increased developmental pressures and a lack of comprehensive flood control strategies. In an attempt to insure public safety, reduce property damages and preserve the natural attribute of Black Wash, the Black Wash Drainage Analysis and Policy Assessment Report was undertaken at the request of the County Manager's office.

A combination of structural and non-structural flood control strategies were evaluated to reduce flood hazards along the Black Wash for both existing and anticipated developments. The basis for both structural and non-structural strategies is the adoption of an administrative floodway. The administrative floodway delineated in this study is a site-specific recommendation used to identify the area subjected to frequent flooding, severe flood hazards and existing efficient flow conveyance. A floodway designation allows for stricter floodplain management regulations and land use restrictions to protect highly vulnerable areas. Implementation of flood control strategies may eliminate the need for burdensome drainage improvements on future development located outside the administrative floodway.

Increased public safety and reduced property damage at a reasonable cost, structural modifications to the administrative floodway. The areas where structural modifications have the potential of generating benefits are the Branding Iron Park Subdivision and the Avra Valley Wastewater Treatment Facility. By tying the structural modifications together with needed transportation improvements, local drainage and transportation problems could be resolved in an efficient and cost effective manner.

In all other areas along Black Wash other than those where structural modifications are proposed, the administrative floodway remain essentially unchanged to provide the multiple benefits of flood storage, groundwater recharge, open space recreation and wildlife habitat. Outside the administrative floodway, the floodplain use permitting process can be used to assure development proceeds without increasing downstream flood hazards and complies with the existing Floodplain Management Ordinance.

This study has been reviewed previously by both the Flood Control District Advisory Committee (FCDAC) and the Board of Supervisors. At their direction, an independent review of this report by a local engineer consulting firm was undertaken. Comments from both the FCDAC and the consultant have been incorporated into this document. Overall recommendations presented in this report, include four main topics: establishment of administrative floodway; area-specific administrative floodway regulations; compliance with existing Floodplain Management Ordinance; and flood prone land acquisition priorities.

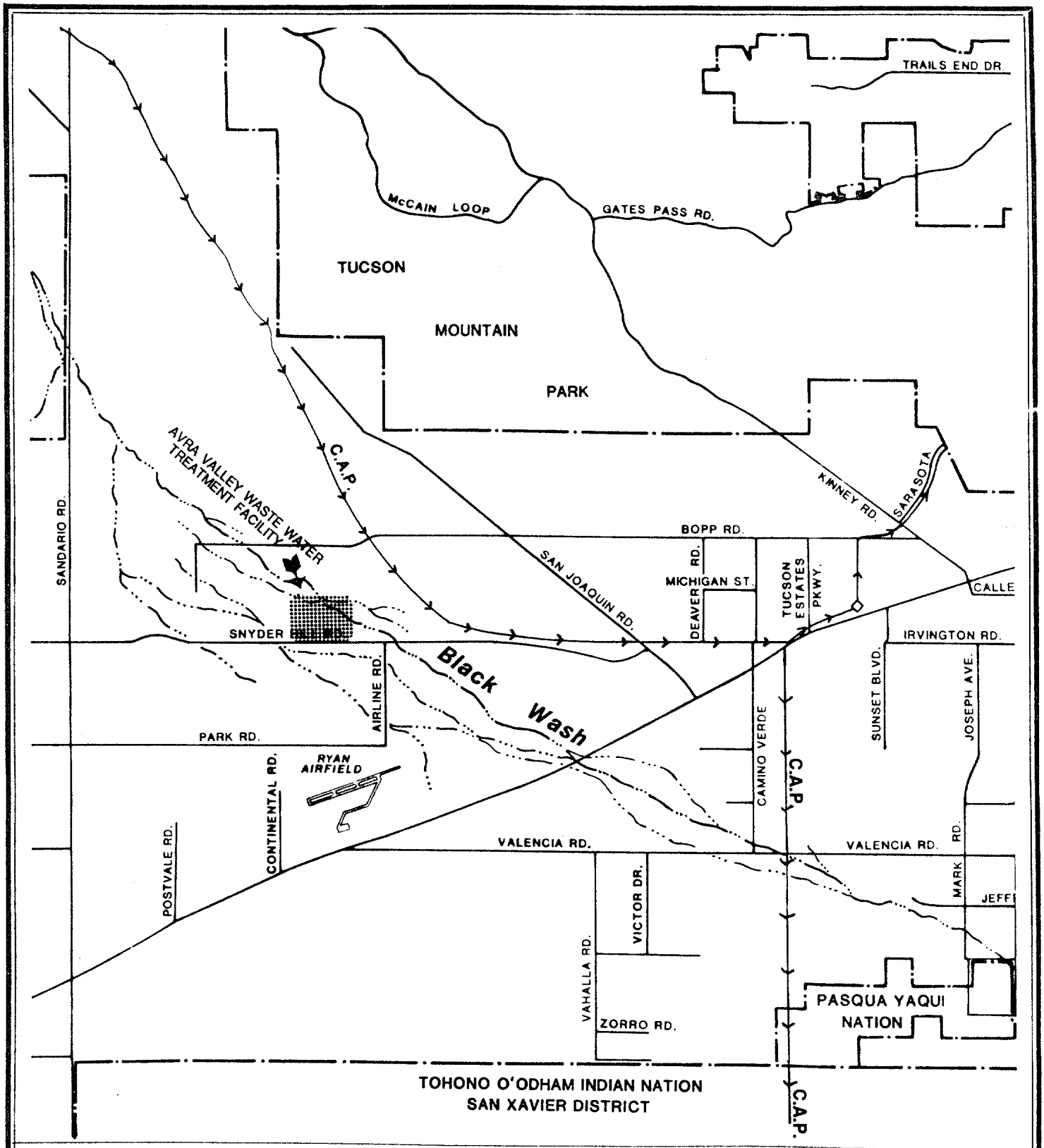
Black Wash Drainage Analysis
and
Policy Assessment Report

PURPOSE

The Black Wash area, located southwest of Tucson, is a flood prone area experiencing increased population growth and development, see Map 1. An examination of aerial photography (1974 through 1990) and applications for Floodplain Use Permits (FPUP) shows that residential development in the administrative floodway and floodplain of the Black Wash, as delineated in this report, has doubled in the past 16 years. Currently, as many as 119 residences located within the Black Wash administrative floodway and floodplain may not be in compliance with the Pima County Floodplain Management Ordinance. Without an overall flood control strategy, public safety and property will continue to be at risk from even frequent storm events in the Black Wash area.

Currently, no area-specific mitigation programs are in place to abate the existing flood hazards in this area or to provide guidance for future anticipated growth. General floodplain management policies applicable to the area are inadequate because of the lack of a regulatory floodway. Entities investing in residential and commercial development may not recognize sufficiently the type and extent of flood hazard situations occurring in the area and, as a result, may underestimate property improvement limitations due to natural flood hazards and suffer flood damage. Experience has shown that flood damage prevention through management is generally less costly than repetitive flood damage losses. Comprehensive flood control planning and floodplain management is required to achieve the most beneficial mix of remedial strategies and economic benefits.

Flood control practices are intended to protect public safety and prevent economic losses. For this study, flood damage losses are defined as loss of property and improvements on a land site in a specified time period. Until recently, prevention of losses was realized most often by structural flood control measures; however, flood control engineering



LOCATION MAP

BLACK WASH

PIMA COUNTY, ARIZONA

MAP 1

016

philosophy has changed and natural landscape preservation is viewed as a highly valued alternative. Problems specific to the Black Wash area are generated by wide-spread flooding that cannot be controlled with standard riverine approaches to flood hazard mitigation.

Pima County has adopted policies to maintain environmental attributes such as riparian zones, wildlife habitats, and natural water courses. Flood control practices that support the maintenance of environmental attributes are sanctioned by these policies. Comprehensive floodplain management policies must be designed; first to determine whether public flood controls are warranted, and then, the nature of the controls. Flood controls are influenced by several factors such as land use patterns, hydrologic characteristics and economic viability.

Recognition of the administrative floodway is the basis of all recommendations proposed within this report. Development has been allowed to continue in this highly vulnerable flood erosion hazard area under the same guidelines as imposed for less hazardous areas. Without a defined regulatory floodway, Pima County can do little more than establish finished floor elevations and not permit the impedance or diversion of flows. Because of this, FPUPs have and are still being issued through the appeals process for the area proposed for administrative floodway designation. The goal of an administrative floodway recommendation for flood damage mitigation planning is to restrict the issuance of FPUPs for reasons of safety, to decrease the need for future Flood Control District expenditures for flood hazard reduction, and to allow adequate conveyance of flood water without changing the natural characteristics of the stream.

The purpose of this report is to assist the Pima County Board of Supervisors in assessing whether the Black Wash area requires area-specific flood control policies. The report is an investigation conducted by the Pima County Flood Control Planning and Development Staff to present data and background information to the Board of Supervisors and advise them of feasible flood control options. An overall staff assessment and recommendations are included to assist in weighing the options.

A comprehensive flood control/floodplain management program for the Black Wash area has three strategies available for flood

hazard mitigation: 1) structural flood controls; 2) flood prone land acquisition to limit development in hazardous areas; and 3) strict land use controls. The goals of a comprehensive floodplain management program are the effective mitigation of public safety hazards and the prevention of flood damage.

Active flood prevention activities are encouraged by the Federal Insurance Administration (FIA) who underwrites the flood insurance program in Pima County. Presently, the FIA is studying communities that have flood management programs that exceed the minimum standards of the Federal Emergency Management Administration (FEMA). Flood insurance rate reductions may be available to communities that implement administrative actions to minimize flood and erosion damage losses. The Black Wash Drainage Analysis and Policy Assessment Report recommendations developed by the Department of Transportation and Flood Control District Planning and Development Division act to develop administrative actions that would aid in the reduction of flood insurance rates in Pima County. FIA proposes flood insurance rate reductions that may range from 10 to 45 percent of present rates.

REPORT ORGANIZATION

This section of the Black Wash Drainage Analysis and Policy Assessment Analysis briefly outlines the role of each report section to allow the reader a broad overview of the objectives and work elements.

The **Problem Statement** focuses on the occurrence of flood events and their impact on regional development. Flood control policies which are presently in force do little to mitigate the potential for flood damage. This is primarily because the Black Wash lacks a regulatory floodway and the regulations associated with an administrative floodway designation. Thus, it is argued that policies for the Black Wash area require area-specific measures related to the development of an administrative floodway and its encroachment.

As a framework to direct the study, **Objectives** and **Tasks** are presented. Central to the objectives is the requirement to develop policy prescriptions which will provide public safety, be economically efficient, and embrace the intent of the Pima County Floodplain Management Ordinance.

Current situations of **Regional Attributes** in the area are depicted to establish a basis for recommendations. Physical and environmental characteristics that affect the hydrologic system in the area are presented first. Characteristics of note in this section include descriptions of flood prone areas, groundwater recharge, wildlife, and recreation.

The Black Wash does not have a floodway delineation on the FEMA Flood Insurance Study, currently. Staff hydrologists have analyzed the hydrologic system in the main stem of the Black Wash to discern significant flow depths and velocities, the **Procedure Used to Delineate the Floodway** is explained. The administrative floodway delineation mapping and the delineation procedures are presented along with assumptions and limitations.

Land use in the Black Wash area is presented in the section **Identification of Flood Prone Property.** Emphasis is on the description of the types of flood damage losses that occur in this region for the **Economic Analysis of Flood Impacts in the Black Wash.** Land ownership, the value of existing improvements, and development potential indicate the economic value of flood control. Specific to flood prone land acquisition as a flood control alternative are considerations of land purchase costs and potential impacts to the county property tax base that are presented in summary fashion. **Structural Improvements** and flood control alternatives are presented as another flood control dimension.

Existing zoning is presented for the areas affected by the Black Wash floodway. Unique to the Black Wash situation is the fact that much of the administrative floodway is owned by governmental agencies. For the most part, current zoning designations in the area are not conducive to commercial development, and residential development near Black Wash is limited to large parcels. However, no existing or proposed zonings recognize Black Wash flooding constraints and dangers due to flooding are not properly identified in the development review process.

Lastly, **Overall Analysis** and **Recommendations** are presented as a listing of actions and area-specific land use/floodplain management policy recommendations.

PROBLEM STATEMENT

Floodplain management for large watercourses is based upon the floodway and floodway fringe concept. A floodway consists of the channel of a watercourse and the adjacent land necessary to remain unobstructed in order to convey floodwaters safely. The Federal Government has adopted standards for delineation of floodways using computer modeling.

The floodway fringe is the area between the floodway and the base floodplain boundaries. The fringe is that portion of the floodplain that could be completely obstructed without increasing the water surface elevation of the 100-year flood by more that one foot. Current ordinances allow construction to encroach in the flood fringe of a regulated floodplain under the condition that the elevation of the 100-year flood does not increase more than one foot, see Figure 1.

Until recently, the floodway of Black Wash had never been delineated, no basis exists for directing development to the less hazardous areas of the Black Wash floodplain to promote safety, to prevent property damage, and to maintain the natural conveyance of the channel. Overall, the most severe problems occurring in the Black Wash area are within the administrative floodway.

Historically, little has been done to alleviate regional flooding problems occurring in the vicinity of the Black Wash; most improvements undertaken by the Flood Control District have been isolated to resolving site specific drainage problems. With increased development in the area, the potential for flood loss correspondingly is increased.

The Southwest Area Plan (Co13-76-1), does not adequately acknowledge the hazards associated with the Black Wash flood prone lands. Existing policy mainly focuses attention on the occurrence of sheet flooding in the area. In response to flooding issues raised by Southwest Area Plan policies, a Southwest Basin Management Study was initiated. Recommendations in the Phase I Southwest Basin Management Study include the development of floodplain management tools and goals specific to this area. Prevention and abatement measures that directly address Black Wash as an administrative floodway are required for safety.

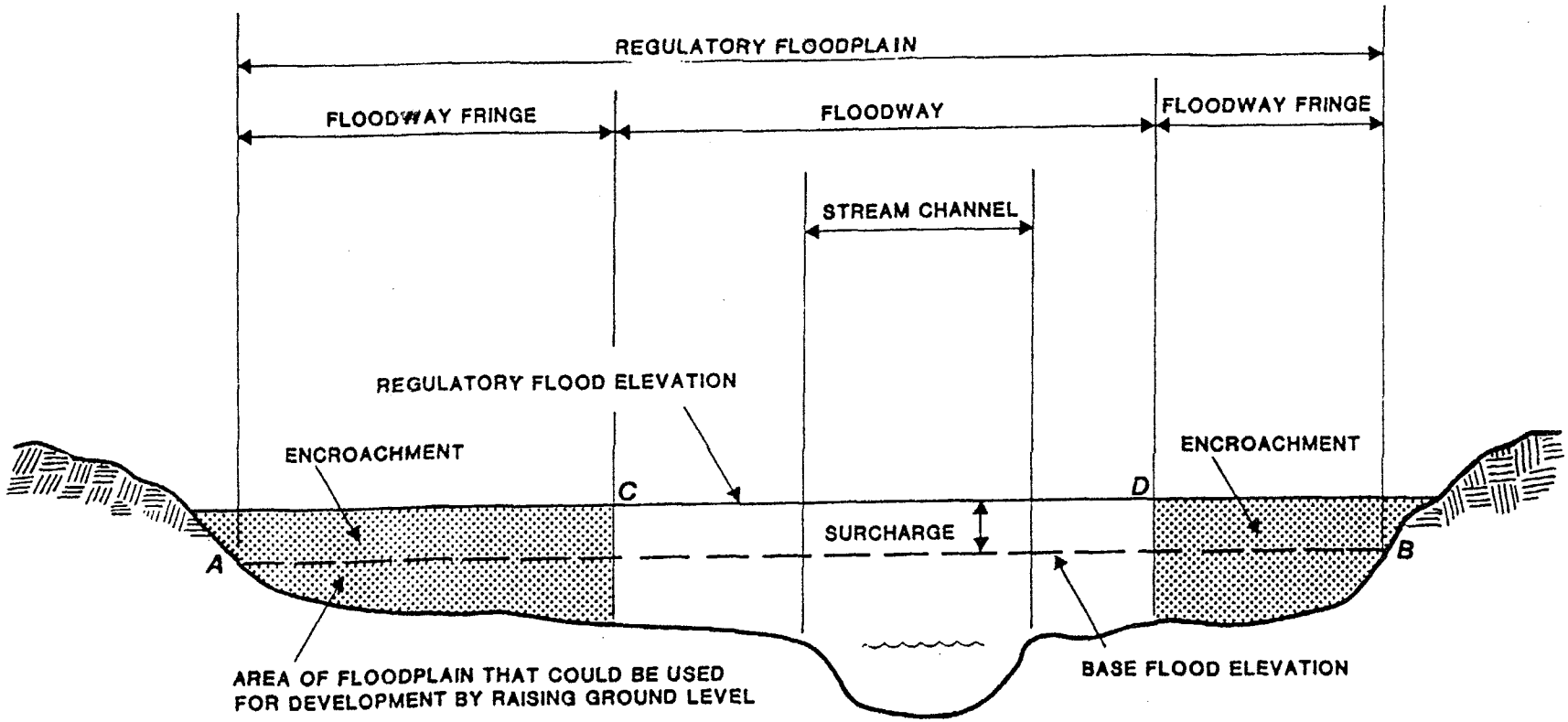
Many structures were located in the floodway previous to the establishment of the Pima County Floodplain and Erosion Hazard Management Ordinance in 1974 and did not receive a FPUP. Flood Insurance Rate Maps are in force for the area presently but are vague with respect to the floodway. Some flood zones are listed as having 1 to 3-feet of water depth with little or no detail differentiating between the zones. While certain existing structures have received "grandfathered" status with respect to the Pima County Ordinance, the grandfathered status may place people and improvements unknowingly in hazardous, ill-defined flood prone areas.

Locally maintained public facilities affected by the floodway include public roads and the Avra Valley Wastewater Treatment Facility. Ryan Airfield is located to the south of the floodway. All-weather access concerns for Valencia Road, Ajo Highway, Snyder Hill Road, and Sandario Road have been expressed by residents and by school district transportation officials.

The Central Arizona Project (CAP) has several features that are located in or along the Black Wash. North of the Black Wash administrative floodway are pumping and treatments plants. An investigation to site and construct storage facilities is currently being undertaken by the Bureau of Reclamation. The Bureau has noted to Pima County officials that the Federal Government is not under the jurisdiction of the local government and is not bound by the Pima County Floodplain and Erosion Hazard Management Ordinance. However, presently renewed discussion between Pima County and the Bureau focused on multiple-use opportunities that include flood control and recreation for the CAP storage facility.

Specific floodplain management problems associated with the Black Wash area have been identified as: 1) a high likelihood for flood damage to existing property improvements in the administrative floodway as delineated in this report; 2) limitations to private vehicular access during times of flooding; 3) the significant number of drainage complaints generated during annual storms; and 4) little recognition of flood hazards in land-use planning in the area. Examples of these problems include:

a. Existing conventional homes and manufactured homes are located within severe flood and erosion hazard zones.



LINE *AB* IS THE BASE FLOOD ELEVATION (100 YEAR FLOOD)

LINE *CD* IS THE REGULATORY FLOOD ELEVATION (1.0 FOOT ABOVE BASE FLOOD ELEVATION.)

SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT), OR LESS IF SPECIFIED BY COUNTY

FIGURE 1

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These flood hazard zones represent relatively deep depths of flow (two to four feet), hazardous velocities (three to six feet per second), and accelerated erosion potential.

b. Typically, small rezoning requests (less than 20 acres) conforming to existing or proposed land-use densities have been approved.

c. Floodplain Management variances for structures that have been rezoned have been granted with little opposition due to a lack of a comprehensive strategy for flood damage mitigation in the Black Wash area.

d. The current Southwest Area Plan indicates higher density land uses for certain properties without full consideration of existing hydrologic constraints. Thus, some individuals owning or looking to purchase property may be obtaining a false impression of land value and development potential.

e. Vehicular access within the area is severely limited during frequent flow events. Tucson Unified School District officials have expressed concern over the safety of students who rely on TUSD transportation. Additionally, TUSD officials feel that road closures due to flooding in dip crossings greatly increases the cost burden of publicly supplied school transportation.

f. Complaints about third party damages have increased mainly because individual flood controls are not concerted. Small, individual drainage diversions created by fences, roads, and trainer dikes have been employed by property owners in the Black Wash area.

g. Sheet flow areas in Black Wash are very sensitive to obstructions such as grading of roads and berms. These obstructions can cause the development of new flow paths impeding local floodplain management practices.

Overall, the most severe problems occurring along the Black Wash are within the administrative floodway. Adoption of the administrative floodway as delineated in this report would serve to protect the public from future damages.

Storm Event of July 24, 1990

A thunderstorm system developed in the Phoenix area at approximately 12 midnight on July 24, 1990. The storm was generated by minor disturbances in the upper atmosphere. Atmospheric instability in northwestern Arizona was due to wet air masses that triggered a low-pressure trough that moved in from the Pacific Northwest. The storm moved across Arizona from the northwest to the southeast and into northern Pima County.

District staff conducted reconnaissance investigations which were logged by photograph, video tape, and written reports. Damage was severe in the Black Wash area and included flooded cars and homes, mobile home support damage, downed fences, and access restrictions. Thirteen drainage complaints were filed subsequent to the storm. Most drainage complaints were for properties located within the administrative floodway.

OBJECTIVES

The overall objective for this report is to present background data for Black Wash study area and suggest safe and consistent floodplain management policies that can be established for the area. The general objectives stated within the Pima County Floodplain and Erosion Hazard Management Ordinance No. 1988-FC2 [5] provides the basis for the flood control land-use recommendations within the Black Wash area. Specific objectives for the Black Wash study area are as follows:

1. Identify reaches within the Black Wash watershed that would benefit most by the maintenance of natural hydrologic and hydraulic processes, groundwater recharge, aesthetics, natural open space, recreation areas and wildlife habitat given the present land tenure and development patterns.

2. Investigate the economic effects of alternative flood hazard abatement policies as they apply in the Black Wash to:
    a. land and property acquisition costs;
    b. property acquisition effects on the Pima County tax base;
    c. identification of nonconforming land uses within flood prone areas;
    d. estimated relocation costs;

e. structural flood hazard mitigation costs; and
f. integration of flood control with Central Arizona Project facilities.

3. Suggest area-specific administrative floodplain management policies for land-use and development in the administrative floodway that best sustain the characteristics identified in objective 1.

4. Propose a long-term, least cost flood hazard control program that guides:
   a. flood prone land acquisition priorities;
   b. limited structural flood control improvements;
   c. area-specific land use and floodplain management policies.

TASKS

In order to meet the objectives identified above, the following tasks are identified.

1. Delineate the 100-year administrative floodway for the main stem of Black Wash.

2. Calculate the administrative floodway acreage.

3. Identify sensitive natural riverine environments and wildlife habitats.

4. Classify the land ownership into private and public tenures and determine the acreage of each.

5. Determine the number of residential structures located within the administrative floodway.

6. Determine how many residential structures located within the administrative floodway can be considered grandfathered, legally permitted or non-conforming as defined by the Floodplain Management Ordinance.

7. Estimate the costs of flood prone land acquisition and relocation.

8. Estimate the impact of flood prone land acquisition on Pima County tax revenues.

9. Identify and estimate the costs of specific flood control structures.

10. Identify area specific land use and administrative floodplain policies that are consistent with Pima County Ordinances.

11. Identify potential for integration of Central Arizona Project storage facility with flood control alternatives.

REGIONAL ATTRIBUTES: PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Evaluation of advantageous environmental attributes in the Black Wash area is complicated since no market prices are associated with the value of public well-being and natural characteristics. Hydrologic and hydraulic processes affecting flood occurrence have been mapped; however in the physical system, other processes exist. In the Tucson area, concern is on groundwater depletion and water quality. Aesthetics, open space near protected areas, wildlife habitat, and recreation are land use attributes experiencing increased interest. Valuation of such attributes is a public responsibility whereby direct economic costs are balanced against public benefits. In this report, attributes are presented if potentially significant in the subject area.

Public interest in the maintenance of natural open spaces has surfaced in Pima County appearing in both ordinance guidelines and public initiative. The Pima County Floodplain And Erosion Management Ordinance No. 1988-FC2 [5] states that flood controls that embrace natural open space preservation are to be preferred in project design. Other regulatory pressures to be recognized are the mandates for natural environment maintenance placed on Pima County by the U.S. Corps of Engineers to secure Section 404 permits for flood control projects. Public concern over the preservation of open spaces adjacent to protected public lands such as Saguaro National Monument and the Tucson Mountain Park has directed renewed attention for wildlife habitat buffer zones.

Physical Characteristics of Flood Prone Areas

Generally, Black Wash is not well-defined and consists of numerous shallow, low flow channels. South of Valencia Road, Black Wash has an average 100 year floodway width ranging from approximately 500 to 1,000 feet. North of Valencia Road, the Black Wash floodway dramatically widens to a maximum of approximately 4,000 feet in width.

An approximate delineation of the flood prone regions within the Black Wash main stem was determined by the Pima County Flood Control District Planning and Development staff. The delineation is presented in Map 2 (folded map). The total area of the delineated administrative floodway in this study is approximately 2,985 acres (4.7 square miles). Further, approximately 1,334 acres (45 percent) of the administrative floodway is either County, City, State or Federally owned land.

The Flood Emergency Management Agency flood hazard designation recognizes the sheet flood problems in the area in the Federal Insurance Rate Maps (FIRM) but fails to delineate the floodway. Generally in the Black Wash area, the flood hazard potential is designated within the FIRM maps as Zone AO with water depths ranging from 1 to 3 feet. Upstream reaches are designated Zone A with no specific flood depth information.

Within the administrative floodway, velocity and depth of flow pose public hazards. The regulatory velocity in the administrative floodway is estimated to be between 3 to 6 feet per second. The regulatory discharge of the administrative floodway is approximately 5,500 cubic feet per second (cfs) in the southern reaches near Valencia road. Crossing Snyder Hill Road and flowing north-west, the regulatory floodway discharge is greater than 18,000 cfs. The flow depth within the administrative floodway ranges between 1 to 4 feet based on these discharge rates. See the Definitions Section of this report for clarification of the term regulatory when used as a flood characteristic or specification.

Groundwater Recharge

Hydrology and hydraulics as they affect groundwater recharge are subject to surface and soil processes. The flow of water into channels is the major source of groundwater recharge in the Tucson basin. Interpreting geohydrologic characteristics for groundwater recharge requires identification of the rate

water flows underground and the storativity of the local aquifer formation. Favorable hydrogeologic characteristics generate positive values for groundwater storage areas within Pima County.

Hydrogeologic features in the Black Wash are differentiated into two areas: 1) the stream bed (administrative floodway) and the floodplain; and 2) the uplands. The stream channel is recent alluvium composed of unconsolidated silt, sand, and gravel of Quaternary age. Outcrops include terrace deposits of various ages seen mostly as decomposed granite and volcanic flows. Because of mountain outcrops in the Black Wash area, aquifer depth is shallow away from the channel.

USGS data for the area lists the transmissivity as 58,000 gallons per day moving through the aquifer near Black Mountain and 80,000 gallons per day less than one mile downstream reflecting a thicker aquifer as the channel flows northwest. The yield of water in the aquifer, calculated from permeability at a 1:1 hydraulic gradient, ranges between 220 gallons and 340 gallons per day per square foot of aquifer [12].

The aquifer will not experience rapid drawdown given controlled pumpage. However, changing the channel processes through channelization and bank stabilization could decrease significantly the infiltration in the area. The results would be similar to what occurred in Avra Valley in the 1950's and 1960's when farm pumpage depleted the aquifer and changed the infiltration surface; in that area, rapid well drawdown generated increased pumpage costs through increased energy demand and accelerated pump obsolescence.

The Tucson Recharge Feasibility Assessment [12] identified the northern reaches of the Black Wash as it flows into the Brawley as being one of the five priority recharge sites in the Tucson Basin. The wide, flood prone areas where the Black Wash meets Brawley Wash are valuable natural groundwater recharge sites for Pima County.

In all, the data show that the headwaters are limited in recharge potential and that recharge significantly increases as the water course proceeds downstream.

Wildlife

The study area ranges in elevation from 2300 to 2500 feet, with the majority of the vegetation in Black Wash consisting of grasses with some creosote/bursage zones and isolated mesquite bosques. The subject reach of Black Wash is considered to be a major segment of riparian habitat.

Black Wash was identified in a recent study of Pima County as having Class I and Class II habitats [1]. This Critical and Sensitive Wildlife Habitats Study was adopted by the Board of Supervisors in November 1986. Class I habitats include Mesquite bosques at four locations, and one wetlands plant cover area within the proposed Black Wash administrative floodway. Class II is defined as a major riparian habitat not linked with a protected area, the floodway of the Black Wash is a Class II habitat.

The Black Wash administrative floodway serves as a valuable wildlife corridor for the Tucson Mountains region. Reaches along the Black Wash providing habitat are identified in Map 3. Recommendations in the Critical and Sensitive Wildlife Habitats Study include maintenance of a 1,000 foot wide wildlife corridor within Class II habitats.

Wildlife habitats in the Black Wash are both mesquite bosques and wetlands. The mesquite bosques contain songbirds, small mammals, and reptiles. The wetlands bird communities include: native songbirds, ducks, geese, and dove. No endangered animals have been found in the area.

Vegetation in the area is a diversified plant system. Plant species in the area include mesquite, palo verde, creosote, turpentine bush, bursage, cholla, and prickly pear. According to the Arizona Game and Fish Department Data Management System, the globeberry vine (Tumamoca macdougalli) may occur in the area. This species is identified in the Federally Endangered Species list and therefore is important to consider. Maintenance of vegetation such as mesquite is important for channel bank stability and flood energy dissipation.

Recreation

Natural preserve areas are important neighborhood amenities offering scenery and open space. Although established preserves are limited in the southwest area, existing bosques and wash beds provide attractive recreational environments for hiking,

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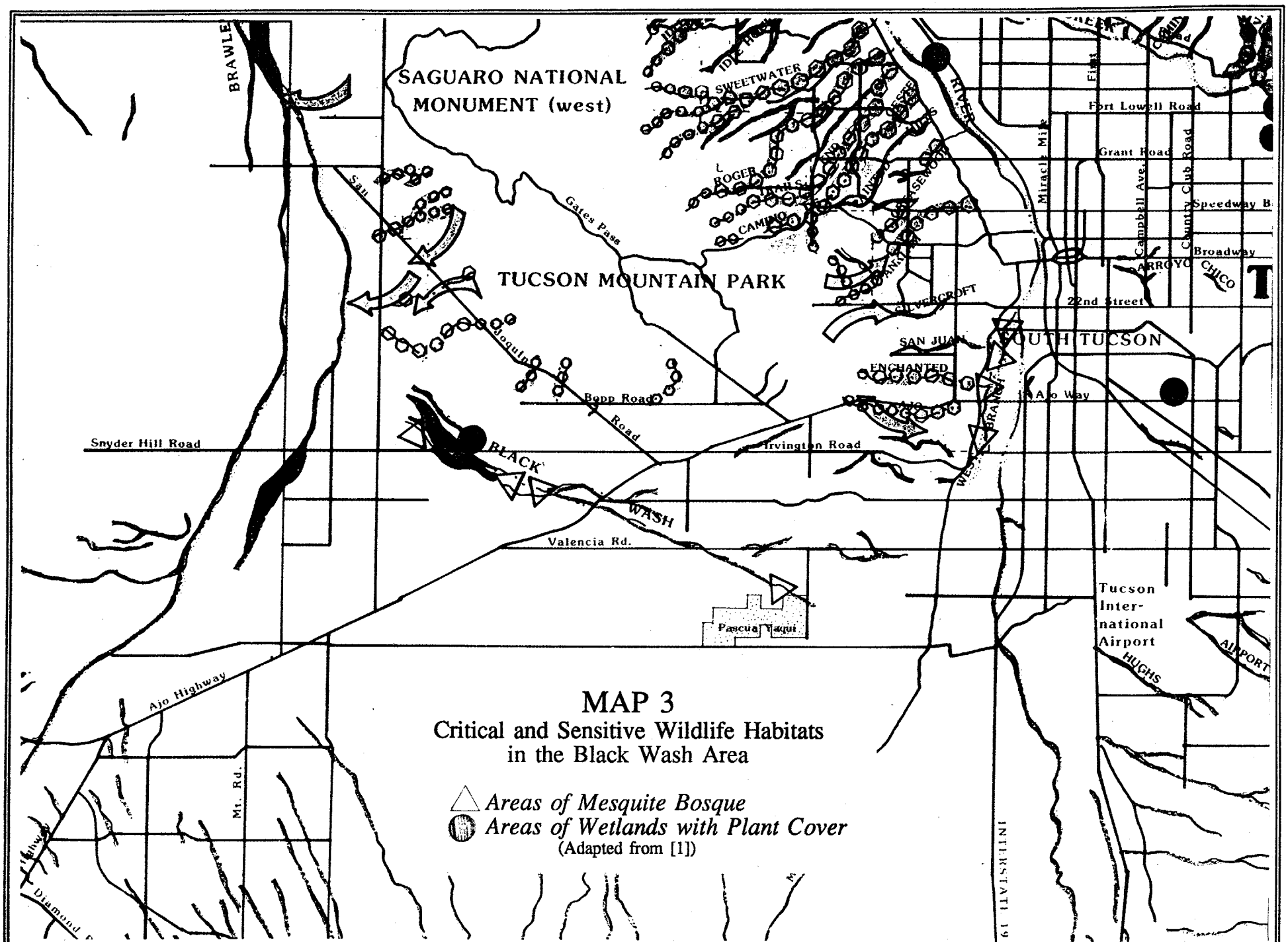
horseback riding, picnicking, and bird watching. Horseback riding in the Black wash area is of particular interest as evidenced by the number of properties with accommodations for horses and trails along the wash. While as a single activity horseback riding generates limited benefits, city growth has decreased the equestrian facilities in the Tucson area.

Black Wash is near to the proposed regional park at Saginaw Hill and to the Tucson Mountain Park. Black Wash provides a corridor for wildlife and recreation.

Summary

Not all environmental attributes in the Black Wash area are counted in this analysis, only groundwater recharge, wildlife, and recreation opportunities have been addressed. A policy that sets aside floodway/floodplain areas dedicated as open space areas would generate multi-use benefits and natural environment preservation for future generations. The level of benefits is difficult to judge since they are not market-based. On the regional basis, the benefits of groundwater recharge and recreation are large. These benefits are maximized by restraining development in the administrative floodway while encouraging it outside of the flood prone lands.



MAP 3

Critical and Sensitive Wildlife Habitats in the Black Wash Area

△ *Areas of Mesquite Bosque*

◐ *Areas of Wetlands with Plant Cover*

(Adapted from [1])

PROCEDURE USED TO DELINEATE FLOODWAY

This study combined the results of three techniques to define and delineate the administrative floodway for the main stem of Black Wash. Once the main stem area was identified generally, the U.S. Army Corps of Engineers HEC-2 backwater program was employed to model flood stage profiles in channel reaches experiencing encroachment from development. A description of the three techniques used for the final identification of the administrative floodway are as follows:

1) definition of a floodway based on significant vegetative characteristics and soil type, and, a thorough analysis of geomorphic parameters;

2) definition of a hydraulic floodway using a modified Manning's equation approach to assess the maximum encroachment which would create a one foot rise in the 100-year water surface elevation as required by FEMA or a 10 percent increase in the flow velocity as required by PCFCD channel design standards;

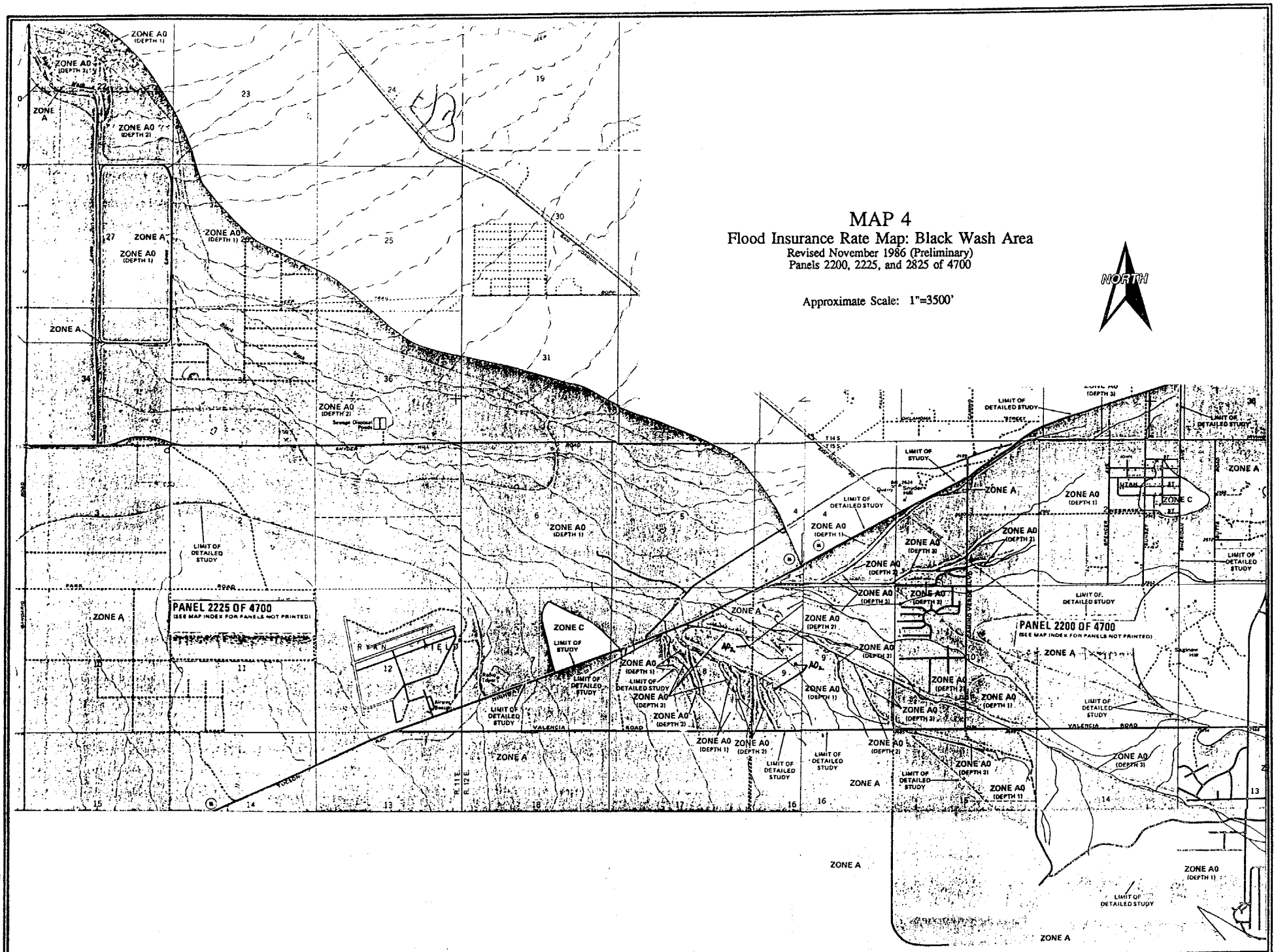
3) delineation of floodway for a reach of 3.5 miles that extends to the northwest downstream limit of the study reach using the HEC-2 model, channel cross-sections were surveyed by Cooper Aerial at a scale 1"=100' delineated in 1-foot contour intervals [15].

FIRM designations within the study area are presented in Map 4.

Geomorphic Technique

Geomorphic floodway analysis relies on aerial photographs and USDA Soil Conservation Service soil maps to account for vegetative cover, soil characteristics and upstream breakouts. These characteristics were field checked to assist in verifying the administrative floodway and floodplain.

Geomorphic parameters, other than soils and vegetation, were also used to refine the apparent floodway limits. The geologic floodplain boundaries of the Black Wash are delineated by connecting the points where the tributaries flow paths are absorbed by Black Wash as defined by the change in flow direction and topographic contour patterns.


MAP 4
Flood Insurance Rate Map: Black Wash Area
Revised November 1986 (Preliminary)
Panels 2200, 2225, and 2825 of 4700
Approximate Scale: 1"=3500'
NORTH
PANEL 2225 OF 4700
(SEE MAP INDEX FOR PANELS NOT PRINTED)
PANEL 2200 OF 4700
(SEE MAP INDEX FOR PANELS NOT PRINTED)
ZONE A
ZONE A0
(DEPTH 1)
ZONE A0
(DEPTH 2)
ZONE A0
(DEPTH 3)
ZONE C
LIMIT OF DETAILED STUDY
LIMIT OF STUDY
RANCHFIELD
VALENCIA ROAD
R.11E.
R.12E.

The administrative floodway limits are approximated by inspection, the inspection procedure employs the use of judgment to identify morphologic changes such as breakouts and divisions.

Analysis of historic aerial photographs and local maps revealed which channels have been most active over time. Prior to 1941, a portion of Black Wash south of Ajo Highway appears channelized. This reach shows up as straight lines of vegetation proceeding northwest towards the Ajo Highway bridges. Presently, this reach has become the active low-flow channel and is surrounded by the administrative floodway.

Soils maps indicate that historically, the Black Wash primary flow path looped toward Branding Iron Park, north of its current path. Although the abandoned flow path through Branding Iron Park still accumulates significant runoff, it now receives flow primarily from the Saginaw Hill area rather than from Black Wash. The origination of flow source is evident during the frequent, low-recurrence interval events.

Hydraulic Elements Technique

The standard determination of regulatory floodway limits is based on identification of the portion of the channel of a watercourse and adjacent land sufficient to discharge the 100-year peak flow rate without increasing the water surface more than one foot and without creating hazardous velocities of water. A significant increase in hazardous velocities is considered to be 10 percent or greater increment to the existing flow rate. Criteria for the encroachment approach estimation are defined by FEMA. Limits are established by incrementally modeling the effects of assumed encroachment areas until the depth and velocity criteria are met.

Equal encroachment concepts allow computation of the effects of development to the floodway and flood prone areas. Encroachment effects on one side of the channel are balanced by increased encroachment on the opposite side to account fully for the hydraulic energy generated by the flood flows.

Single cross-section profiles were used to rate 28 cross sections between the Avra Valley Wastewater Treatment Facility and Camino de Oeste. Additionally, three cross-sections east of Ajo Highway along the major tributary next to the Highway were rated. The rating employed the Manning's equation which was modified to measure divided channel areas of similar

hydraulic characteristics to balance energy over the entire cross-section.

Definition of flow velocity was complicated due to the complex channel morphology over much of the study reach. Normally, channel velocity is used to determine the statutory 10 percent maximum increase. In reaches where the Black Wash low flow channel is more than 4 feet deep and 40 feet wide, the channel velocity was used as the basis of the encroachment analysis. In divided reaches where no single channel could be distinguished or where divided flow conditions exist, the average velocity of the entire section was used.

HEC-2 Calculation of Floodwater Profile

The HEC-2 hydraulic analysis is a U.S. Army Corps of Engineers computer program that calculates step-backwater surface water profiles for channel flows at defined cross-sections. Hydraulic impediments to flow within the channel affect the velocity at adjacent cross-sections. Channel velocity is translated into discharge for specific locations in the channel. Topographic maps are employed to interpret the extent of inundation from the calculated water surface profile.

In performing the hydraulic analysis, a Manning's roughness coefficient of .055 was applied uniformly over the channel cross-sections to model the presence of dense vegetation within the floodplain area. In some areas, a roughness coefficient of 1.0 was used to simulate the presence of berms and dikes that create ineffective flow areas.

The initial results of the HEC-2 model indicate flood velocities ranging from 1.5 feet to 4 feet per second. It should be noted that, because a uniform Manning's roughness coefficient was used in most locations, velocities in specific low-flow channels may be underestimated. However, the average for the entire cross-section is accurate.

Thalweg flow depths ranged from 3.5 to 7 feet along the study reach. The floodplain width ranged from 6,000 to 8,400 feet with the widest sections occurring at the Avra Valley Wastewater Treatment Facility. Again, the floodway delineation is based on a maximum rise in water surface elevation of one foot and a maximum increase in mean flow velocity of one foot per second. Actual depth increases ranged from 0.2 to 1.0 feet and velocity ranged from 3 to 6 feet per second. The floodway width ranges

035

from approximately 2,800 to 4,100 feet with the widest section occurring where the Avra Valley Wastewater Treatment Facility is located.

Limitations

Assumptions about floodway hydraulics in most of the models depict the designated administrative floodway as smooth boundaries with no abrupt contractions or expansions. At adjacent cross-sections where the maximum allowable encroachment indicated a significant contraction in the administrative floodway, the administrative floodway limits were "smoothed" in accordance with FEMA/COE procedures. The administrative floodway encroachment at the "smoothed" cross section resulted in less than or equal to a one foot rise in the regulatory water surface elevation and less than or equal to a 10 percent increase in the velocity.

IDENTIFICATION OF FLOOD PRONE PROPERTY

Land Use in Flood Prone Areas

Directed by the administrative floodway delineation, the number of structures within the Black Wash flood prone areas were determined. The predominance of the structures appear to be residential. The determination relied on 1" = 400' aerial photographs dated 1974 and 1990 [9], see Table 1.

Permits issued by Pima County Department of Transportation and Flood Control District for those homes built since 1974 were examined. All homes counted in the 1974 photographs were considered "grandfathered" since they were in place before the Pima County Floodplain Management Ordinance No. 1974-86 was adopted and exempt from the provisions of the ordinance.

Table 1.
Summary of Estimated Number of Residential Structures in the Black Wash Floodway.

Manufactured Homes		*Conventional Homes*	
1974	1990	1974	1990
number			
45	112	1	2

Comparing the results from the 1990 aerial photographs with 1974 photographs, homes found to be constructed in the administrative floodway since 1974 were determined and examined for status of compliance with the Pima County Floodplain Ordinance.

Construction permits were checked at Pima County Central Permits for the homes having no FPUP on record. In the past, Central Permits sometimes waived requirements for FPUPs. Homes for which no permits or grandfathered rights were found were assumed to be non-conforming or in violation of the Floodplain Management Ordinance pending a further case by case investigation. Determination of the status reveals that over

26% of the manufactured homes and 50% of the conventional homes built in the flood prone lands may not be in compliance with the Pima County Floodplain Management Ordinance. The results are presented in Table 2.

Table 2.
Flood Prone Land Use Status of Residential Structures in the Black Wash Floodway and Floodplain. Listed by Grandfathered Status and Floodplain Use Permit.

	Manufactured Homes	*Conventional Homes*
Grandfathered or FPUP:	80	1
Without Grandfathered Status or Floodplain Use Permit:	33	2

Public Lands in Flood Prone Areas

State Land holdings lying within the Black Wash floodplain were determined from Arizona State Land Department Land Use Status Maps. Once these determinations were recorded, the July 8, 1988 update of the State Land Master Report [11] was referenced to verify the map data. Other public flood prone lands within the Black Wash were City of Tucson property east of Sandario Road, land east of Branding Iron Park, miscellaneous county property and less than 10 acres of Federal Reservation land in the upstream reach. A summary of the analysis of public and private lands is presented Table 3.

Table 3.
Summary of Public and Private Land Ownership within the Black Wash Floodway. Total Acreage and Percent of Total.

Public	*Private*
---- acres (percent) ----	
1334 (45%)	1651 (55%)

OTHER STUDIES

Upon reviewing past hydrologic and hydraulic studies performed on Black Wash, it is evident that hydrologic and hydraulic investigations on this watercourse lack the level of detailed analysis other major washes of similar size located within the metropolitan area have received. The following is a brief narrative on some of the more notable studies conducted on Black Wash by federal, state, and local agencies.

U.S. Geological Survey

In 1977, the Department of the Interior, United States Geological Survey (USGS) conducted a study within Avra Valley in cooperation with Pima County [2]. The USGS study defined the 100-year floodplain of Brawley Wash and its major tributaries using historical highwater marks obtained from field surveys. A small portion of the USGS study included the downstream limits of Black Wash which also falls within the study limits of this report. No floodplain management policies were developed as part of the study.

Pima County Flood Control District, 1980

The Department of Transportation and Flood Control District prepared a report in 1980 focusing on the larger area surrounding Black Wash, "Transportation and Flood Control Facilities Implementation Plan for the Southwest Area Plan" [4]. Within this report, elements of both Transportation and Flood Control needs were outlined to accommodate anticipated growth. The flood control elements in this report consisted of a brief description of the drainage problems and a detailed discussion of structural solutions to flood-proof Black Wash and its tributaries.

Briefly, this plan called for the construction of ten regional retention/detention basins, at the minimum, and numerous other diversion facilities within the Southwest Area. Three of these regional retention/detention basins were to be located on the main stem of Black Wash. The remaining seven basins were to be on tributaries of Black Wash outside of the present study area.

Due to changes in flood control philosophy and land-use in the area that have occurred over time, concerns over the implementation of this plan must be noted.

1. The basic philosophy of the plan was to remove as much Black Wash flood prone land from the floodplain by channelizing the main stem. The prevailing philosophy at that time was primarily a structural approach to flood control.

2. The plan did not address adverse impacts that may occur by implementing the proposed structural improvements. Some of these adverse impacts are as follows:

   A. short term and long term disruption of subdivisions and neighborhoods required for the construction of structural facilities;

   B. disruption of the natural hydraulic processes within Black Wash; over time, transformations from a braided shallow wash to a deeply incised channel would occur because of clean water scouring caused by sediment imbalance;

   C. deterioration of environmentally sensitive wildlife habitats;

   D. maintenance problems associated with on-line detention basins due to significant sediment deposition;

   E. flood routing calculations were never performed to size detention facilities to effectively mitigate downstream flood hazards.

3. In certain areas where structural facilities were called for, residential development has occurred.

4. No economic assessment of the structural improvements recommended within the report was provided.

The prevailing flood control strategies contained in this plan are inadequate for the mitigation of flood damage, given the current situation.

Federal Emergency Management Agency

In 1984, at the request of the Flood Control District, the Federal Emergency Management Agency initiated a Flood Insurance Study for the Black Wash area [3]. This analysis, which was conducted by Cella Barr Associates, was limited in area to Black Wash and its tributaries lying upstream of Ajo Highway.

Limitations of the study included the use of topographic maps with four-foot contour intervals and no floodway analysis. No floodplain management policies were developed as part of this study.

Bureau of Reclamation -- Central Arizona Project

Several features of the CAP are located in or along the Black Wash. Reports for construction specifications of the Reach 5 of the aqueduct and the Snyder Hill and Black Mountain Pumping Plants and Switchyards were reviewed by Flood Control District staff. Little recognition of the effects that drainage modifications generated by CAP features would have on other public facilities and private property was evident in the reports.

Presently, the Bureau of Reclamation is conducting a Tucson Aqueduct Reliability Investigation (TASRI) with the objective of providing storage in the event of a CAP system outage. In May of 1990, the District submitted comments to the Bureau on the TASRI report and proposed integrating land use, flood control and CAP water terminal storage. A concept report has been prepared by the District [16], a regional flood water detention alternative is explored in this report in the Structural Improvements section.

Arizona Department of Water Resources

The Pima County Flood Control District requested Arizona Department of Water Resources (ADWR) to evaluate the main stem of Black Wash for possible inclusion into their Alternative Assistance Program. Under the Alternative Assistance Program, flood hazard problems falling within the guidelines established by the State can be studied to determine whether the project can qualify for State funding. If the preliminary study indicates that the project may comply with the State's cost-benefit criteria, then a more detailed investigation would be conducted. The ADWR has been requested by the Pima County Flood Control District to evaluate the Branding Iron Park area to determine if it qualifies under the Alternative Assistance Program. While preliminary recommendations have been made, the ADWR seems to have a low priority for Black Wash.

Pima County Flood Control District, 1990

In response to recommendations in the Southwest Area Plan, a Southwest Basin Management Study was undertaken to determine long-range planning and land-use policies for flood control and

floodplain management. Phase I was prepared by Anderson, Passarelli and Associates for Pima County, the completion date was July 1990. The scope of the Phase I study was to catalog existing basin conditions and to discuss relative advantages of different flood control approaches used within the study area. Where applicable, the scope of the study included determination and description of areas requiring more detailed study. Among the recommendations were specific references to areas affected by the Black Wash and the need for further flood hazard mitigation activities.

Other Studies

A Sub-Basin Management study was prepared for the Star Valley Planned Community by the developer at the request of Pima County. The Star Valley development encompasses approximately 1,437 acres located within the southwest area but outside what is considered as the main stem of Black Wash. This sub-basin management study attempts to identify existing and potential drainage concerns that may be aggravated by development within the basin and to evaluate various basin management alternatives to offset the problems.

The Millstone Manor Number 6 subdivision has experienced repeated flood damages especially to lots recently developed in low lying areas of the subdivision. A study, Potential Drainage Improvements Millstone Manor Number 6, was prepared to assess structural flood control options. Because of the many splits in Ironwood Wash that crosses the subdivision, alternatives are limited. Estimated costs for structural improvements of over $300,000 would be required to decrease but not eliminate flood hazards in the subdivision.

Lastly, specific studies have been conducted for selected parcels. Objectives for this class of studies have centered on land sales, mostly. Due to limited scope of study, little information from these studies is transferable to regional studies.

ECONOMIC ANALYSIS OF FLOOD IMPACTS IN THE BLACK WASH

Economic indicators affecting land value in the Black Wash area are employed to assess flood control methods. Land use and zoning reflect existing development and the type of future development. Estimated land and improvement values reflect the

demand for development in the area. Other direct economic impacts include the tax consequences of foregone property tax base, constraints to property improvement, and the costs of flood control programs. Lastly, participation in locally initiated, area-specific flood control activities and programs such as the delineation of the administrative floodway/floodplain aids in the achievement of lower flood insurance rate for Pima County.

Land Use and Zoning in the Black Wash Area

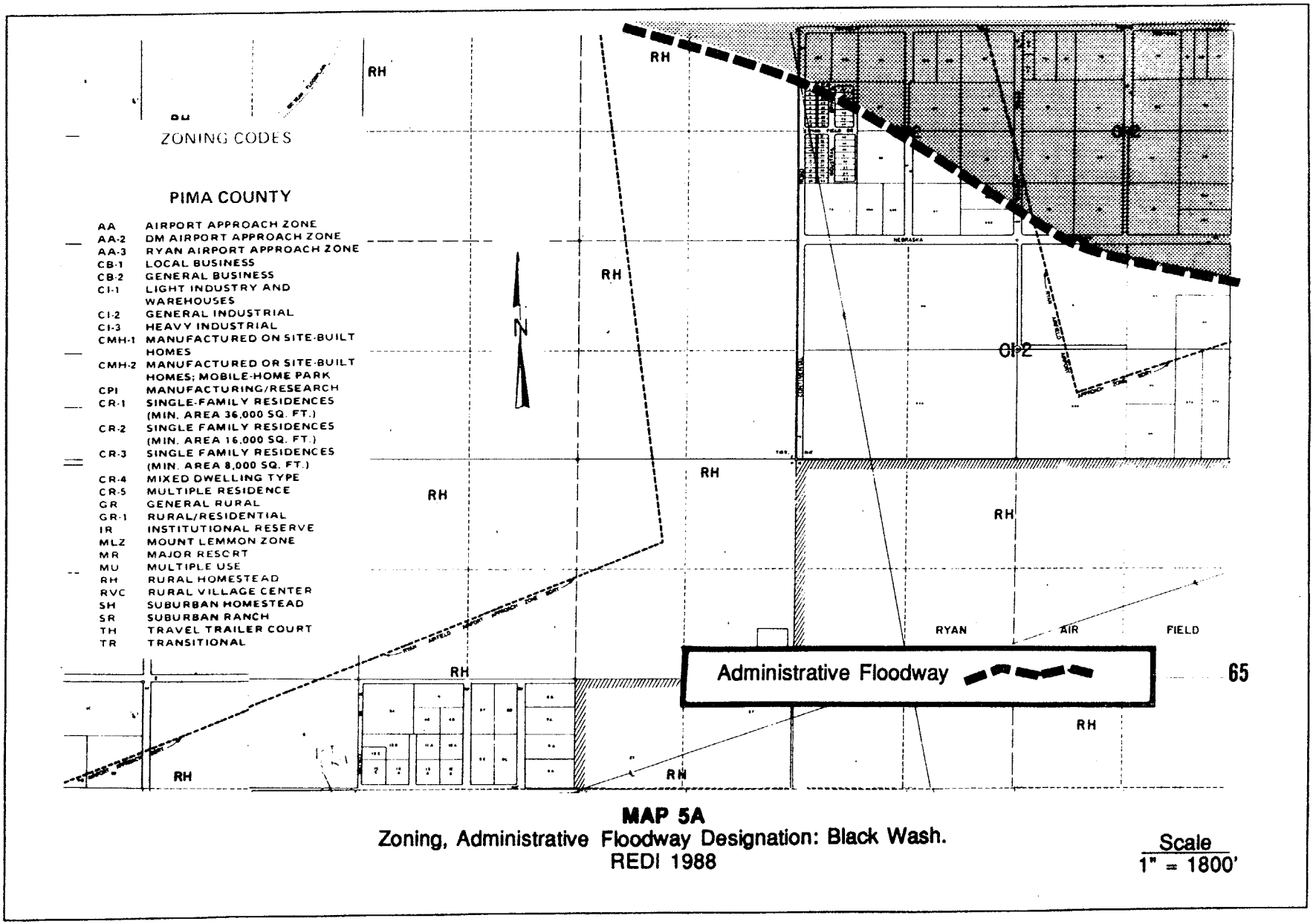
Land use is determined largely by the predominant zoning and the vicinity of flood prone areas, see Maps 5a, b, c, and d.

It can be seen readily that the zoning in the northwest sections of the flood prone areas is RH (rural homestead). Zoning in the southeast areas is mainly GR-1 (rural residential). The zoning and the flood prone status of land in this area yields indications of the value of the land as it now exists.

Rural residential zoning stipulates that development standards for minimum site area are 36,000 square feet and permitted maximum site coverage for improvements is 10 percent. Within this zoning, commercial development is limited.

The Southwest Area Plan (Co 13-76-1) contains land use recommendations in areas affected by the floodway that range from industrial to 4 residenced per acre (RAC). Industrial land uses that were planned in the northwest reaches of the Black Wash area largely have not occurred. Recommendations for residential density in the downstream reach near Sandario Road are 1RAC, 2-4RAC is recommended in the area of the reach north of Valencia Road, and higher densities for the areas upstream of Valencia Road. In all specific planning localities affected by the floodway, limited drainage recommendation are made.

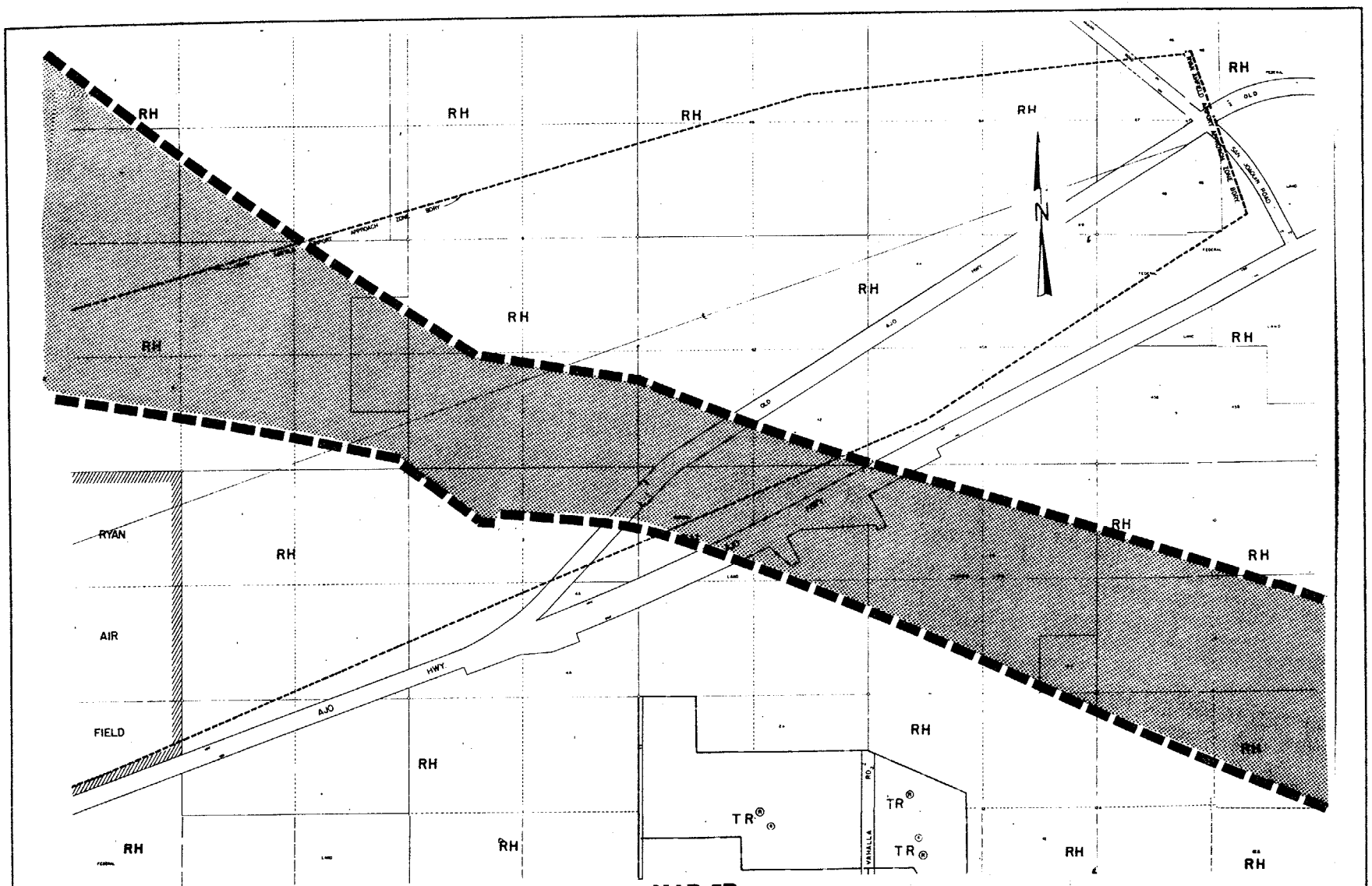
In summary, the present zoning in the subject area is restrictive for all but the most extensive land uses. Based on the zoning, residential land use is the highest and best use of land in the Black Wash area.



MAP 5A

Zoning, Administrative Floodway Designation: Black Wash.
REDI 1988

Scale
1" = 1800'

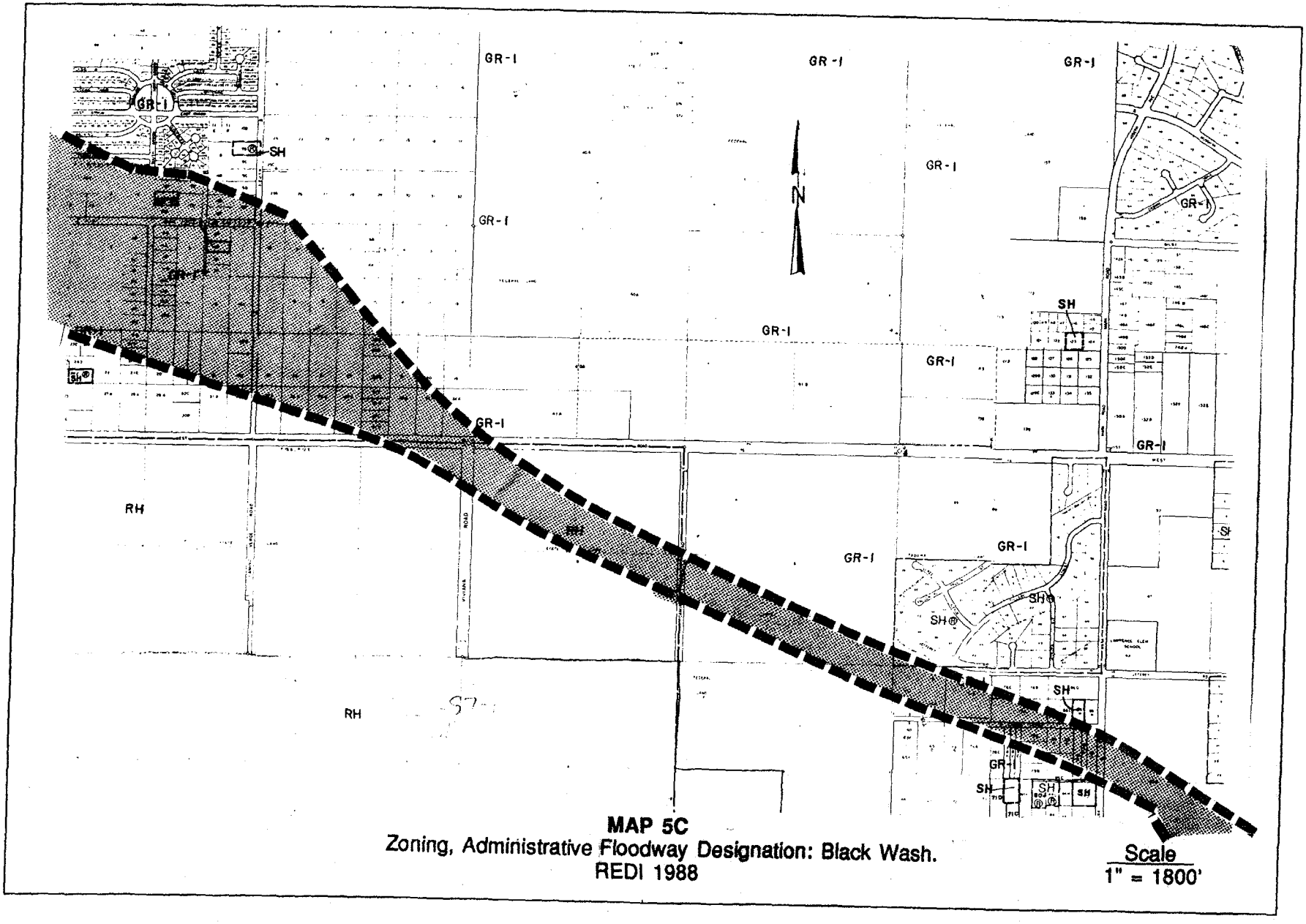


MAP 5B

Zoning, Administrative Floodway Designation: Black Wash.
REDI 1988

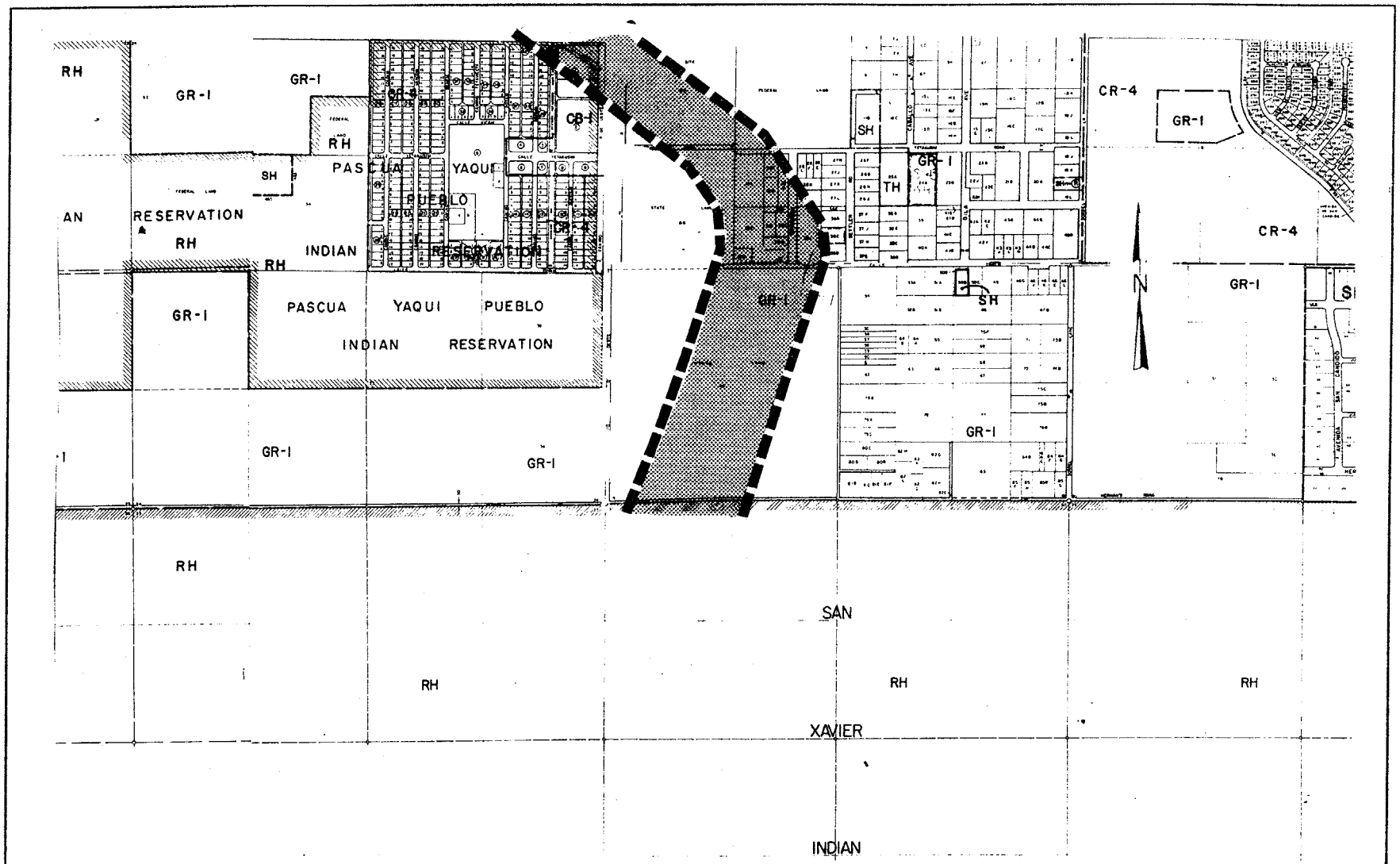
Scale
1" = 1800'

S40



MAP 5C
Zoning, Administrative Floodway Designation: Black Wash.
REDI 1988

Scale
1" = 1800'



MAP 5D
Zoning, Administrative Floodway Designation: Black Wash.
REDI 1988

Scale
1" = 1800'

Value of Land

Investigations revealed few land sales in the Black Wash area. Land sales reported by the Swango Service [13] for the first three months of 1988 revealed land values ranging from $2,000 per acre to $20,000 per acre. Lower land values were associated with flood prone status of selected parcels.

Valuations for land and improvements is based on a "comparable sales" approach. Land sales reports are adjusted to account for supply and demand criteria and for externalities. Imputed values for properties affected by the Black Wash must consider potential conforming uses and zoning conditions that are impacted by frequent floods. Land value estimations under these circumstances tend to be toward the lowest reported sales prices.

In the areas to the east of the flood prone region, land value is much higher. Residential parcels with improved access and utilities east of Camino de Oeste sold for as much as $20,000 indicating a value of about $80,000 per acre. These land values exceeded all found in the Black Wash area.

The predominant FIRM flood prone status designation for the area is Zone AO with associated flood depths of one to three feet. Because of the zoning designation and the flood prone status, land values in the Black Wash are depressed. Knowledgeable buyers would be wary of investments in this area which is reflected by land values. This fact is evident since development patterns in the Black Wash area reveal fewer property sales and lower market prices than in eastern regions outside of the flood prone area.

Conclusions which can be made are that the land use and zoning in the Black Wash area reflect low valued utilizations. Principal in the valuation is the flood prone status of the area. While some land sales and development are occurring in the area, astute investors are refraining from development in the area. Uninformed investors potentially would suffer from over-priced land with limited development possibilities.

Indicated values of the flood prone lands are presented for three areas: at the headwaters upstream of Valencia Road; for the area between Valencia Road and Ajo Way; and downstream of Ajo Way to the confluence at Brawley Wash near Sandario Road. The indicated value of the flood prone land in the upstream

area is $12,000 per acre. Indicated value for flood prone land within the area between Valencia Road and Ajo Way is $10,000 per acre. The indicated value of flood prone land in the downstream areas is $2,000 per acre. Estimated private land acquisition costs are presented in Table 4.

Table 4.
Estimated Land Acquisition Costs for Floodway Areas within the Black Wash. Listed by Channel Reach and Valuation.

Downstream of Ajo Highway:	
1,251 acres x $2,000 per acre	$2,502,000
Between Ajo Highway and Valencia Rd:	
330 acres x $10,000 per acre	$3,300,000
Upstream of Valencia Rd:	
70 acres x $12,000 per acre	$840,000
Total	$6,642,000

Value of Improvements

Residential structures were identified in the analysis as the major property improvements that lie within the flood prone areas of the Black Wash. The results of the property count list show that 80 manufactured homes and 1 conventional home are located in flood prone areas that are appropriate for acquisition.

Investigating recent sales and consulting with the Pima County Department of Transportation Property Management Division the estimated average value for manufactured homes is $25,000 and the estimated average value for conventional homes is $50,000. Estimated purchase costs are listed in Table 5.

Focus is on permitted and grandfathered structures within the floodway. The term grandfathered is in reference to the right to have a dwelling in the floodway on the grounds that the dwelling was established within the floodway prior to 1974, the year the Floodplain Management Ordinance was adopted by the Board. Of the 81 total structures, approximately 62 percent of these structures have grandfathered status and 38 percent have received permits. The floodway reach between Ajo Highway and Valencia Road has 36 grandfathered and 18 permitted structures.

The reach upstream of Valencia Road has 13 manufactured homes and one conventional home with grandfathered status and 13 manufactured homes that have been permitted. Structures with grandfathered status and with permits are viewed equally under the existing ordinance.

The large number of improvements in the administrative floodway of the Black Wash is evidence of the need for a floodway designation. Current floodplain land use policies and flood prone status has not prevented such development. The trend is to develop in the administrative floodway. The magnitude of potential flood damages losses is increasing as seen in the number of manufactured and conventional homes located in the administrative floodway. Without an area-specific administrative floodplain management program, the value of public and private damages will increase.

Table 5.
Estimated Purchase Cost of Permitted and Grandfathered Structures within Black Wash Floodway.

Downstream of Ajo Highway:		
No Homes		
Between Ajo Highway and Valencia Rd:		
54 Manufactured Homes	x $25,000	$1,350,000
Upstream of Valencia Rd.:		
26 Manufactured Homes	x $25,000	$650,000
1 Conventional Home	x $50,000	$50,000
Total		$2,050,000

Tax Consequences of Land Acquisition

The total tax base of 100 percent of all 24 sections affected by the Black Wash administrative floodplain and floodway represents 0.16 percent of the total Pima County primary and secondary assessed valuations. The flood prone lands are less than 25 percent of the total land in the tax estimate, thus the tax effects can be accomodated without major impacts to the tax base. In clarification, lands acquired or which have development restrictions will not represent a loss in revenue

to Pima County; rather, it represents the approximate amount of tax liability which would shift to the remaining tax base if the entire region were acquired by the County and removed from the roll.

Only the property in Township 15 South, Range 12 East, Section 10 which has been developed as the Branding Iron Park reflects significant economic impacts. Assessor information indicates that the total estimated 1987 taxes paid by the residents of the park was about $50,000. As a sensitivity analysis, the present value of these tax monies was calculated. The present value in 1987 dollars of the summation of the stream of annual taxes fixed at this rate, capitalized over 20 years, and discounted at 10 percent is less than $500,000. The capitalized value of the stream of taxes given the assumption of a 4 percent growth rate and all preceding assumptions is less than $600,000.

In summary, the economic impact of limiting development in the flood prone area of Black Wash would not be severe to the tax base of Pima County. However, the analysis does show that the Branding Iron Park area poses the highest return to investments in structural flood control.

Flood Insurance Rate Reduction

The FIA is developing procedures and rating criteria for the National Flood Insurance Program that will reduce insurance rate payments for program participants. Since there is a cost to implement supplementary activities beyond the present scope of the FIA, offsetting reductions in the program are being proposed.

The rating system is based on creditable activities that include, but are not limited to: public information, supplementary regulatory activities, flood damage reduction measures, maintenance of open space for flood conveyance, hazard mitigation in areas of special concern (coastal, mudslide, ice jam and alluvial plains), and comprehensive flood protection programs. The recommendations concerning the Black Wash administrative floodway is an example of a creditable program.

The reductions in rates range from 10 to 45 percent for the entire community. While no exact estimates of the total annual flood insurance premium payments are available, given an average premium of $300 per year per residence and over 1,000 residences in flood insurance areas the annual savings to the public would

range from $30,000 to $135,000 per year. The present value of such savings discounted at 8 percent over 20 years ranges from $1.4 million to $6.2 million for Pima County given no new improvements in flood insurance areas. Because the figures are conservative in number of flood insurance participants and no new improvements, the above savings are underestimated. Therefore, Black Wash flood control efforts could have far reaching beneficial impacts on the entire community.

STRUCTURAL IMPROVEMENTS

Consideration of structural improvements to the proposed Black Wash administrative floodway is necessary for the protection of Branding Iron Park and the Avra Valley Wastewater Treatment Facility. Structural flood control improvements may be warranted because of dense existing development and large public facilities. The structural alternatives identified in this report are at a conceptual level. Final determination of the scale and timing for construction requires detailed hydrologic and hydraulic analyses as well as land use and financial planning.

Each alternative should be analyzed for transportation benefits and impacts to adjacent properties, flood control benefits, environmental attribute impacts, displacement of property owners, hydrologic and hydraulic concerns and construction costs.

Because of concerns about protecting wildlife habitats, proposed encroachment into the Black Wash administrative floodway by the levee between Valencia Road and Wade Road should be limited to a minimum administrative floodway width of approximately 1,100 feet. The unconstrained floodway width at this location would be over 2,000 feet. The proposed administrative floodway width would ensure open space preservation and minimize impacts to adjacent property. Some flood storage would be retained, and groundwater recharge losses would be held to a minimum. An administrative floodway of this width would be less likely to cause channel incisement than a narrower floodway.

Branding Iron Park

Limited structural improvements to the Black Wash administrative floodway in the vicinity of Branding Iron Park are recommended

because of the number of people living in the flood hazard area and the lack of safe vehicular access during times of flooding.

Flood control improvement in this area must take into account floodwater flow paths entering the park area not only by way of the Black Wash but also from tributary flows originating at Saginaw Hill. Additionally, consideration of drainage impacts to major roads and exacerbated channel incisement in downstream reaches must be carefully analyzed.

Avra Valley Wastewater Treatment Facility

The Avra Valley Wastewater Treatment Facility is located entirely within the administrative floodway as delineated in this report. While some flood mitigation structures protect the existing facility, the Pima County Wastewater Management Department is exploring the possibility of expanding the treatment plant. The expanded facility would require an in-depth hydraulic analysis to determine drainage and environmental impacts.

A levee alignment to protect the existing and proposed expansion to the Avra Valley Wastewater Treatment Facility would require an encroachment analysis. Under the concept of equal encroachment, land on the opposite side of the floodway from an encroachment is inundated by an equal conveyance area to offset encroachment effects. The minimum floodway width at the wastewater treatment facility, under the equal encroachment concept, should be held to approximately 1,500 feet.

Development of Alternatives

The consultant for the Southwest Basin Management Study and the staff have evaluated a wide range of solutions to flooding problems in the vicinity of Branding Iron Park. These solutions range from a purely structural alternative, consisting of channelization and retention basins, to a "do-nothing" approach. Neither the pure structural approach nor the do-nothing approach appears acceptable under the goals of present flood control policies.

A do-nothing approach is not acceptable since current transportation and drainage problems will persist and such problems will only be compounded given current growth trends. Development of Star Valley, Diablo Village, and adjacent areas is expected to increase traffic volumes on Valencia Road and Camino Verde Road increasing the demand for improved vehicular

access. Further, a wait-and-see strategy is not advised since continued lot-splitting and low-density housing development in the Black Wash administrative floodway would constrain future flood control options and increase project costs.

A purely structural alternative possibly would consist of a system of regional retention/detention basins, interceptor channels, grade control structures, and outlet facilities. This approach is constrained since much of the property that would be protected is already improved. Thus, the potential for developer participation is limited and places greater reliance on public funding. Presently, public capital funds to construct such a system are not available. Given the large upfront costs of such a flood control system and the restricted supply of funds, purely structural flood controls are not likely to generate net benefits.

Structural flood controls may adversely impact the regional attributes of the area. Residents of the area are thought to enjoy their semi-rural setting and surrounding desert habitats. Further, the purely structural alternative would conflict with the county philosophy of open space maintenance for wildlife habitat, natural flood storage, groundwater recharge, and recreational benefits.

Limited structural alternatives are available. Conceptual presentations of a levee alignment for the protection of the Branding Iron Park area and a regional detention basin are discussed here. The alternatives are presented for discussion purposes only. Various permutations of the basic concepts presented here are possible.

Alternative 1: A structural channelization concept employs an earthen levee alignment along Camino Verde with extensions to the southeast along the floodway, see Figure 2. Further, it is necessary to direct tributary flow into channelized reaches to the west past Branding Iron Park. The southern portion of the levee extends upstream to a terminus at Valencia Road to prevent flow from spreading northward into Branding Iron Park. This levee extension would effectively remove Branding Iron Park and additional undeveloped land from the administrative floodway of Black Wash. Later land development could provide the Flood Control District with partial funding for the improvements.

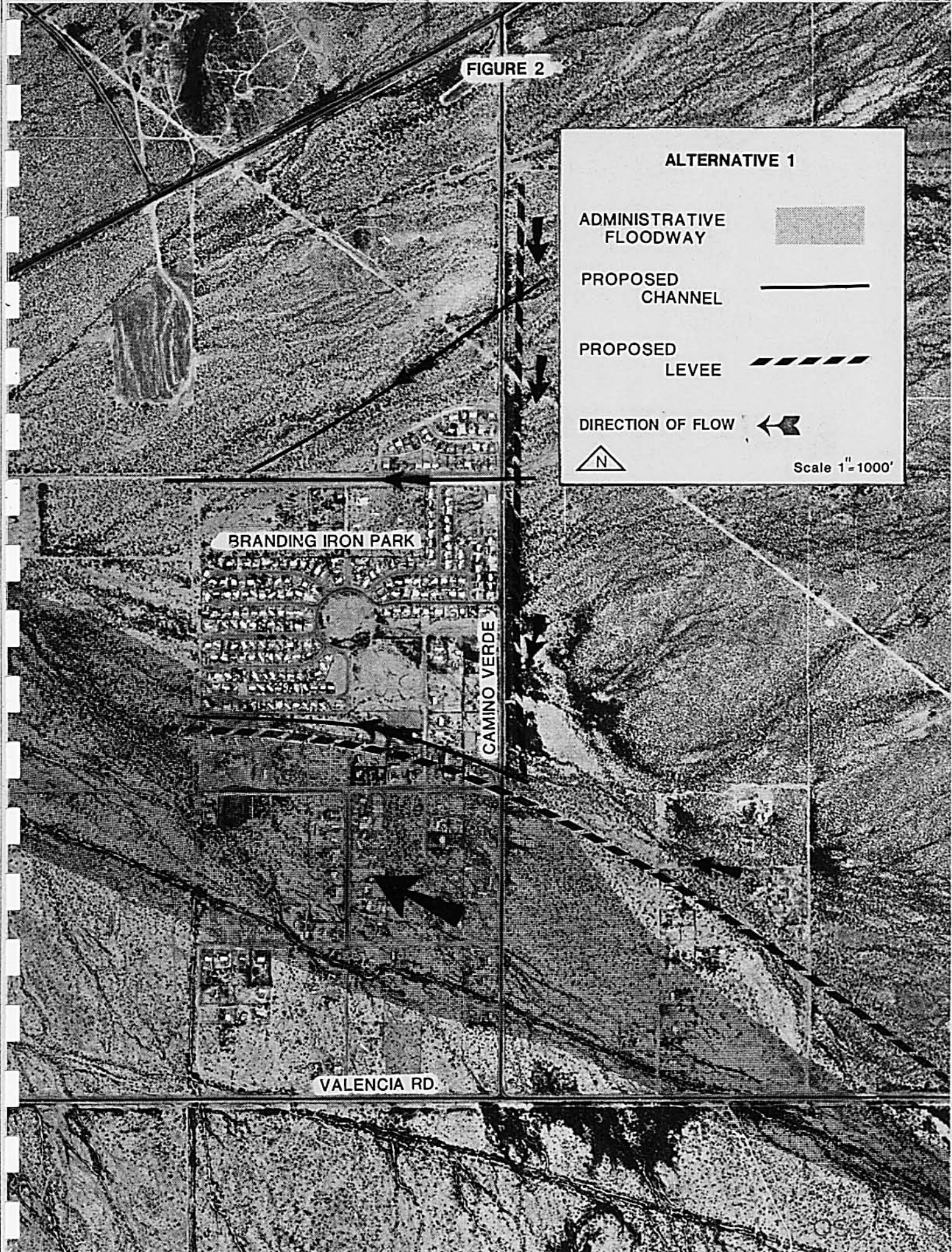


FIGURE 2
ALTERNATIVE 1
ADMINISTRATIVE FLOODWAY
PROPOSED CHANNEL
PROPOSED LEVEE
DIRECTION OF FLOW
N
Scale 1"=1000'
BRANDING IRON PARK
CAMINO VERDE
VALENCIA RD.

The levee alignments integrate with both transportation and regional drainage patterns. Since transportation improvements could greatly effect the associated flood control costs. While the Major Streets and Routes Plan shows San Joaquin Road extension of Wade Road as the major north-south street, staff favors amending the Plan to indicate Camino Verde as a major route [14]. The amendment is recommended because the Wade Road alignment has more flood control constraints, is not presently a through road, and is not County-maintained. By contrast, Camino Verde is a County-maintained paved road, and already has some drainage improvements in place. Culverts would be necessary for Camino Verde at the intersection of the 3 channels.

Alternative 2: The Bureau of Reclamation is studying alternatives that would provide reliable CAP water supplies near the Tucson Water Treatment Plant. The Tucson Aqueduct System Reliability Investigation (TASRI) includes groundwater recharge and surface storage concepts. The Pima County Department of Transportation and Flood Control District responded to inquiries from the Bureau for comments from public agencies. An outline of the opportunities to integrate goals of surface storage of CAP water and flood control needs was prepared [16].

The Southwest Basin Management Study suggests high-flow detention for attenuation of peak flood flows. The concept involves above-grade storage of floodwaters generated by the less frequent flow events while allowing the peaks associated with the more frequent events to pass through the storage facility. As envisioned, the detention storage facility would be accommodated by impounding runoff behind embankments that serve as part of the CAP storage facility. Location of the multiple purpose is envisioned as capturing flow directly or significant tributary flow of the Black Wash. This concept accomplishes a number of flood control objectives including:

- reduction in the need for downstream flood control improvements such as channel excavation and/or lining,

- provision of through passage for low-flow runoff for support of downstream riparian environments, and

- providing through passage of the dominant discharge for maintenance of the natural sediment transport characteristics of the existing channel system.

Overall, downstream flood peaks would be reduced resulting in lower depths of flooding, reduced velocities, decreased channel bank erosion and a narrower 100-year floodplain. Publicly maintained roads and drainage structures would require less maintenance of erosion and deposition of sediment which will result in cost savings.

Site selection for the storage facility is partially constrained by the availability of CAP water. Additionally, to capture flood flows the basin needs to be along the wash. A potential site for the detention basin is shown in Figure 3. The northern edge is bounded by Valencia Road and Wade Road lies to the west. The Black Wash transects the northeastern portion and the CAP will lie along the east. State lands comprise the northern portion of the basin and land owners in the southern portion have expressed to the Bureau and to District staff that arrangements for large parcel exchange or sale are possible.

OVERALL ANALYSIS

Black Wash has a definable floodway where water height and velocity are concentrated. While sheet flow flooding generally is a problem, the risk of public safety hazards and flood damage is greatest in the administrative floodway identified in this report.

Within the area, sensitive wildlife and bosque areas have been identified. The Pima County Floodplain Management Ordinance contains requirements that the maintenance of such areas be of first order priority. Earlier regional floodplain investigations ignored the consequences of destroying natural environmental attributes. Recreational uses and groundwater recharge are sensitive to the maintenance of environmental attributes. Structural flood controls usually require subsequent, incremental structures proceeding downstream to prevent further degradation. For an area that is not densely developed, structural flood controls are rarely cost-effective and run contrary to the goals of the ordinances.

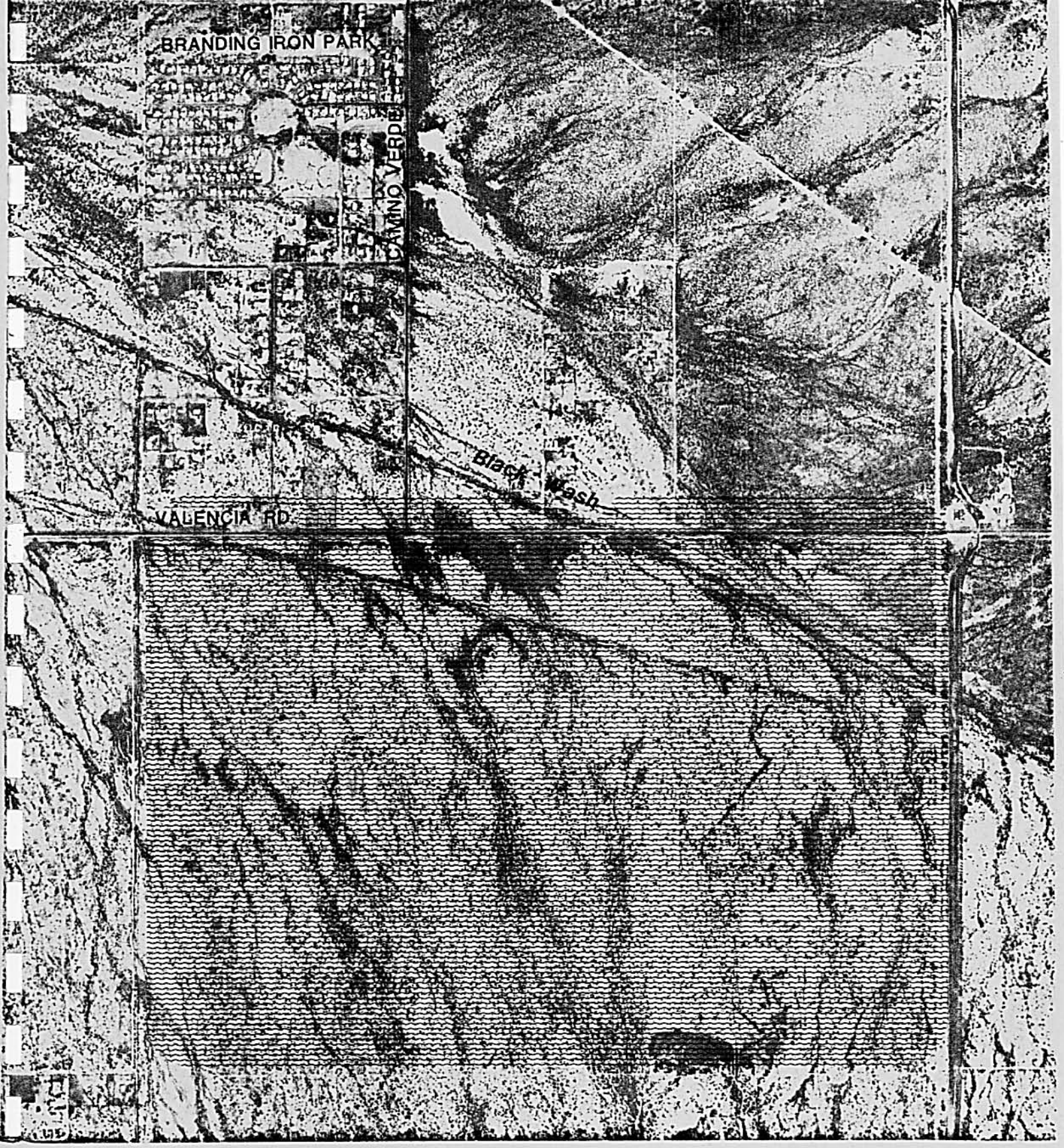


FIGURE 3

PROPOSED AREA OF REGIONAL DETENTION

N

1"=1200'

058

A review of other studies in the Black Wash area revealed that while the area is recognized as flood prone, no floodway designation has been enacted. Development investment has been made on flood prone lands that may increase public liability in the event of a flood.

Zoning and floodplain use permits presently allow development in the administrative floodway. Although the land values in the area are relatively low, few recent land sales in the area have been recorded.

The economic impact of acquiring land for dedication as a flood prone area is low due to the limited development in much of the area. As growth pressures in eastern Pima County increase, the demand for land will increase and the corresponding risk of flood damage losses will increase. The costs of land acquisition may be partially offset by new incentive programs under development by the FIA.

The areas experiencing the greatest flood damage loss risk are near Branding Iron Park located between Valencia Road and Ajo Way and the Avra Valley Wastewater Treatment Facility. Many of the improvements surrounding the Branding Iron Park are within the administrative floodway. Although the scale of investment and tax revenues is small in relation to the costs of structural improvements, the protection of public safety may override economic rationale in the requirement for structural alternatives.

The Avra Valley Wastewater Treatment Facility encroaches into the proposed administrative floodway. Structural flood control alternatives specific to this facility range from simply protecting local affected areas to a levee provides regional protection.

Land ownership in the administrative floodway and administrative floodplain of the Black Wash is 45 percent public lands and 55 percent private lands, see Table 3. Residential development conforming to floodplain ordinances or exempt due to grandfathered date of development consists of 1 conventional home and 80 manufactured homes. Development in most of the subject area is not intensive which limits the benefits generated through regional structural flood control alternatives.

Estimated total costs for land and improvement acquisition in the administrative floodway total approximately 8.7 million dollars, see Table 6. Land acquisition in the administrative floodway will be approximately 76 percent of the total acquisition costs.

Table 6.
Estimated Total Land and Improvement Acquisition Costs for Floodway Areas in the Black Wash.
Listed by Reach.

Downstream of Ajo Highway:	$2,502,000
Between Ajo Highway and Valencia Rd:	$4,650,000
Upstream of Valencia Rd.:	$1,540,000
Total	$8,692,000

An opportunity exists for land exchanges for other previously acquired land that has been protected by flood protection projects. Costs of acquisition would be offset by implementation of a land exchange program. This program has been discussed by the Pima County Flood Control District Advisory Committee.

Analysis of aerial photography in the area reveals that new development is occurring in the administrative floodway and administrative floodplain. Much of the new development has not received floodplain use permits. Compliance with floodplain ordinances is haphazard because of the unsettled disposition of floodway definition for Black Wash.

Black Wash is presently designated a Critical Basin where no discharge increases generated by development are allowed. A floodplain management solution, whether structural or non-structural, could allow portions of the basin to be down-graded and reduce costs of future development by eliminating the need for neighborhood detention facilities.

C60

RECOMMENDATIONS

Recommendations to ensure public safety and to mitigate potential flood damage losses in the Black Wash area encompass four general objectives: establish administrative floodway; establish area-specific administrative floodway policies; develop a compliance program that is consistent with the Pima County Floodplain Management And Erosion Hazard Ordinance No. 1989-FC2; and begin an active property acquisition and property management program.

Further area-specific studies are required to identify flood damage control alternatives for the Branding Iron Park Subdivision and Avra Valley Wastewater Treatment area. Because the Black Wash watercourse crosses major transportation routes, flood control alternatives must be integrated with transportation planning.

Implementation of the specific recommendations requires assurance of appropriate legal authority and direction from the Board of Supervisors sitting as the Board of Directors of the Pima County Flood Control District. All recommendations are consistent with the language and spirit embodied in Pima County Floodplain Management And Erosion Hazard Ordinance No. 1989-FC2.

ESTABLISH ADMINISTRATIVE FLOODWAY

1. Establish the administrative floodway as delineated on Map 2 as the official regulatory Black Wash administrative floodway. This action would help establish strict floodplain management regulation within areas having severe flood and erosion hazards.

2. Realignment of the administrative floodway through evaluation of possible structural improvements within the vicinity of the Branding Iron Park Subdivision in order to reduce the floodway to a minimum width of 1100 feet.

3. Realignment of the administrative floodway through evaluation of possible structural improvements within the vicinity of the Avra Valley Wastewater Treatment Facility in order to reduce the floodway to a minimum width of 1,500 feet.

ESTABLISH AREA-SPECIFIC ADMINISTRATIVE FLOODWAY POLICIES

4. Consistent with the objectives of the Pima County Floodplain Management And Erosion Hazard Ordinance No. 1988-FC2, the Black Wash administrative floodway should be preserved in its natural state and in compliance with floodway land uses permitted in the Ordinance. Exceptions would be at major transportation routes and within the Branding Iron Park and Avra Valley Wastewater Treatment areas, see Map 2. Because of existing development in these two areas, further analysis should be initiated to determine if structural flood control and transportation improvements would be cost effective.

5. Attach to the Southwest Area Plan Co13-76-1 located within the Planning and Development Services Division, for information purposes only, floodplain management information that is readily available to the general public from the Planning and Development Division of the Pima County Department of Transportation and Flood Control District. Additionally, the following amendments should be added to the Southwest Area Plan through the five year update process by Planning and Development Services:

   A. Delineate the Black Wash administrative floodway limits as established by this analysis.

   B. Specify by note that in some instances, densities specified by the Southwest Area Plan may not be consistent with the hydrologic constraints impacting a specific parcel.

   C. Specify by note that land use within the administrative floodway must be compatible with the Floodplain Management Ordinance.

DEVELOP COMPLIANCE PROGRAM

6. All building permits and floodplain use permits in the Black Wash area must be in compliance with the current Floodplain and Erosion Hazard Ordinance, No. 1988-FC2, effective upon the date of approval of these recommendations by the Board of Supervisors sitting as the Board of Directors of the Pima County Flood Control District.

7. A public notification of all individuals who own property within the area designated as administrative floodway by this report should be initiated. Information supplied by the Pima County Assessor identifies 1,538 parcels of land in the Black Wash region. An estimate of the potential cost for a certified mail notification is $2,500.

8. A public outreach program should be instituted to educate property owners of the necessity of compliance with floodplain management ordinance, Southwest Area Plan policies and building regulations. Currently, a substantial number of the property owners in the area either do not know or understand the building codes and floodplain management regulations. For example, swimming pools, walls, fences, and corrals may create ponding, diversions or other drainage problems. As part of the program, public meetings should be held to inform the residents of the hazards and solicit public input into the planning process.

9. Institute a compliance assurance program that includes routine drive-by and overflight inspections of the Black Wash administrative floodway. Observance of unpermitted improvements or other violations should be followed by appropriate enforcement actions.

10. Direct staff to verify that existing improvements are in compliance with the Floodplain Management Ordinance before the issuance of a new FPUP.

LAND ACQUISITION

11. Establish criteria to direct land acquisition priorities within the administrative floodway with primary emphasis on the two areas with proposed structural improvements. Under these criteria, develop a priority list consistent with Pima County right-of-way acquisition principles and public safety.

    The recommended priorities are, listing from highest to lowest:
    1) Property receiving flood control improvements,
    2) Developed property that has experienced recent flood damage,
    3) Developed property with a high probability of flood damage, and
    4) Undeveloped land.

12. Because of the large tracts of public lands in the Black Wash area, continue discussion with the public landholding agencies to establish open space policies and land uses compatible with the objectives of the Board of Supervisors.

13. Direct the Property Management Division to explore the potential of implementing a land exchange alternative for the acquisition of Black Wash flood prone land using the following guidelines:

    a) Land exchange shall result in the removal of non-conforming uses from the Black Wash floodplain rather than transferring the non-conforming use within the flood prone area.

    b) Black Wash flood prone land shall be appraised for its fair market value and exchange shall be undertaken in a direct value-for-value basis.

    c) Acquired flood prone properties shall be managed to maximize the public benefit. Land uses inconsistent with established floodplain management policies and practices shall not be allowed on acquired flood prone properties.

Administrative Floodway: A designation of floodway and floodplain made by the Pima County Board of Supervisors sitting as the Board of Directors of the Pima County Flood Control District.

Flood: A temporary inundation of land not normally covered by water; or a rise in flow or stage of any stream, watercourse, or lake that results in water overtopping its banks and inundating adjacent areas that are not normally covered partially or wholly by floodwater.

Floodplain: The areas adjoining the channel of a watercourse including areas where drainage is or may be restricted by man-made structures which have been or may be covered partially or wholly by floodwater.

Floodplain Use Permit: An official document which authorizes specific activity within the regulatory flood plain.

Floodway: The channel of a watercourse and the adjacent land area necessary in order to discharge the base (one-hundred year) flood without cumulatively increasing the water surface more than one (1) foot above the base flood elevation and without creating hazardous velocities of flood waters.

Grandfathered: Reference to the right to have a dwelling in the floodway on the grounds that the dwelling was established within the floodway prior to 1974, the year the Floodplain Management Ordinance was adopted by the Board.

Manufactured Home: A structure transportable in one or more sections which is built on a permanent chassis and designed to be used with or without a permanent foundation when connected to the required utilities.

Regulatory Flood Criteria: Velocity and flood water height for the 100-year return event. Also, called the base flood by the Federal Emergency Management Agency.

REFERENCES

[1] University of Arizona, School of Renewable Natural Resources, 1986. Critical and Sensitive Wildlife Habitats of Eastern Pima County.

[2] U. S. Geological Survey, March, 1978. Areas Subject To Inundation by the 100-Year Flood in Avra Valley, Pima County, Arizona. U. S. Geological Survey Water-Resources Investigations 78-33, Open-File Report, Tucson, Arizona.

[3] Cella Barr Associates, September 9, 1984. Pima County Flood Insurance Study Hydrologic Investigation Appendix.

[4] Pima County Department of Transportation and Flood Control District, April, 1980. Transportation and Flood Control Facility Implementation Plan for the Southwest Area Plan.

[5] Pima County Board of Supervisors, 1988. Floodplain Management And Erosion Hazard Ordinance No. 1988-FC2.

[6] Federal Emergency Management Agency, November, 1986. Flood Insurance Rate Map, Pima County Arizona. National Flood Insurance Program. Panels 2225, 2220, and 2825.

[7] McLain Harbers Company, 1983-84. Aerial photos, 1" = 100', 2 foot contour interval.

[8] Cooper Aerial Survey, 1990. Aerial photos, 1" = 1000'.

[9] Cooper Aerial Survey, 1974 and 1990. Aerial photos, 1" = 400'.

[10] Pima County Planning Department, March, 1985. Southwest Area Plan, Co13-76-1 Plan and Policies.

[11] Arizona State Land Department, 1988. Arizona State Land Master Report. Dated July 8, 1988.

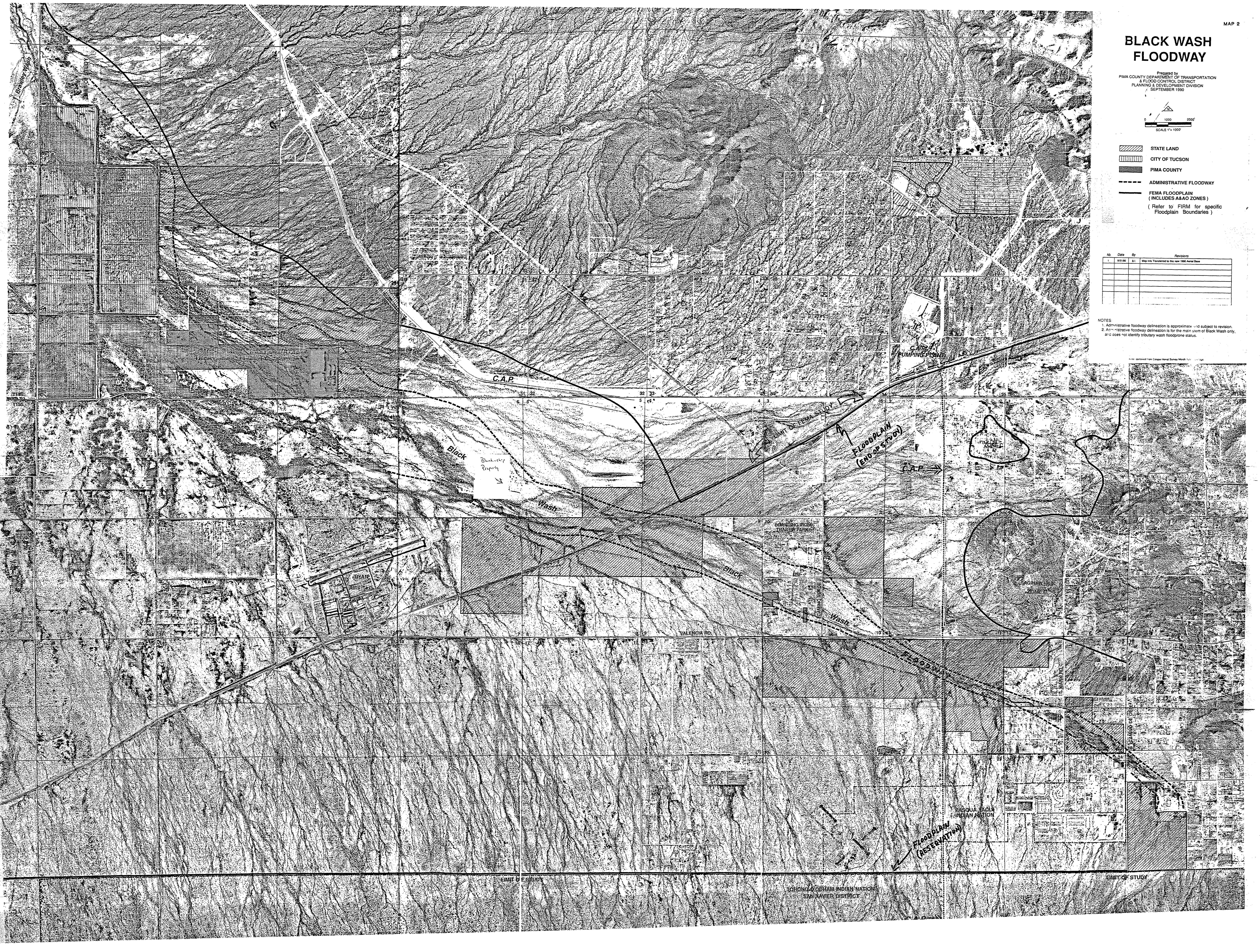
[12] CH2M Hill, June 1987. Tucson Recharge Feasibility Assessment, Phase A. Plate 9.

[13] Swango Real Estate Service, 1988

[14] Pima County Department of Transportation, 1988. Major Streets and Routes Plan (CO 14-79-2). Amended through May 3, 1988.

[15] CMG Drainage Engineering, 1990. Final Report on the Black Wash Floodplain\Floodway Analysis and Avra Valley Wastewater Treatment Facility Expansion Evaluation. Pima Co. DOT&FCD. Revised February 15, 1990.

[16] Concept Report -- Tucson Aqueduct System Reliability Investigation: Opportunities for Flood Control. Transmitted from John M. Bernal, Director Pima County DOT&FCD, to Ed Moore, Member Pima County Board of Supervisors. August 17, 1990.



MAP 2
BLACK WASH FLOODWAY
Prepared by
PIMA COUNTY DEPARTMENT OF TRANSPORTATION
& FLOOD CONTROL DISTRICT
PLANNING & DEVELOPMENT DIVISION
SEPTEMBER 1990
N
0 1000 2000'
SCALE 1"= 1000'
STATE LAND
CITY OF TUCSON
PIMA COUNTY
ADMINISTRATIVE FLOODWAY
FEMA FLOODPLAIN (INCLUDES A&AO ZONES)
(Refer to FIRM for specific Floodplain Boundaries)
No. | Date | By | Revisions
1 | 8/31/90 | B.I. | Map Info Transferred to this new 1990 Aerial Base
NOTES:
1. Administrative floodway delineation is approximate and subject to revision.
2. Administrative floodway delineation is for the main stem of Black Wash only, and does not identify tributary wash floodprone status.
compiled from Cooper Aerial Survey March
C.A.P.
C.A.P. PUMPING PLANT
LIMIT OF FEMA STUDY
FLOODPLAIN (END OF STUDY)
C.A.P. →
Black Wash
Black Wash
FLOODWAY
VALENCIA RD.
PASQUA YAQUI INDIAN NATION
FLOODPLAIN (RESERVATION)
LIMIT OF STUDY
LIMIT OF STUDY
TOHONO O'ODHAM INDIAN NATION
SAN XAVIER DISTRICT