

**- PLAN**  
**- MAIN REPORT**

**(1 of 2 VOLUMES)**

**Property of:**  
**Pima County**  
**Flood Control District Library**  
**740-6350**

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# Ruthrauff Road Improvements

Completed 1975



Roadway improvements and storm drain system.



Catch basin leading to Ruthrauff Road Storm Drain.



Redesigned intersection of Ruthrauff Road and Highway Drive.



La Cholla Boulevard Storm Drain outlet at Rillito River.



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CRITICAL WATERSHED MANAGEMENT PLAN  
RUTHRAUFF ROAD AREA

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Property of:  
Pima County  
Flood Control District Library  
740-6350

May 13, 1983  
CBA File No. 01740-03-30-03

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## PREFACE

This document has been prepared as a result of regulatory criteria set forth in Section 1307 of the Pima County Floodplain Management Ordinance No. 1974-86 adopted by the Pima County Board of Supervisors on December 16, 1974 and amended on April 5, 1982. This section of the ordinance sets strong restrictions on development within drainage basins which have been identified by the Pima County Engineer as unsuitable for added development in a conventional sense because of the high probability of increased flooding. Official Pima County Maps identify several drainage basins as being "critical basins." These "critical basins" are defined as containing floodwater channels (natural or manmade) and/or flood control structures that cannot contain existing runoff produced by the basin and which have a documented history of severe flooding hazards. As a means of deriving goals for reasonable flood control improvements and floodplain management within these "critical basins," a commitment has been made by Pima County to prepare and adopt site specific plans referred to as Critical Watershed Management Plans for orderly development of flood control measures within the basins. Critical Watershed Management Plans for "critical basins" will serve as a basis for establishing a program for flood control improvements and establishing regulations for associated development of private properties.

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EXECUTIVE SUMMARY  
CRITICAL WATERSHED MANAGEMENT PLAN  
RUTHRAUFF ROAD AREA

INTRODUCTION

This document is an Executive Summary of the Critical Watershed Management Plan for the Ruthrauff Road Area.

The Ruthrauff Road area comprises approximately two and one-half square miles northwest of the Tucson city limits. The Ruthrauff Road area, as represented on Figure 1, is bounded by the Southern Pacific Railroad and Interstate 10 on the west, the Rillito River and Sunset Road on the north, Romero Road on the east (with a portion of the area extending further eastward to Flowing Wells Road), and Gardner Lane on the south. Drainage into and within the area is sluggish and inefficient, as it contains poor topographic relief with little or no regional provision for drainage existing at the present time. Therefore, a high incidence of sheet flooding has been experienced during storms of moderate or greater intensity. Several local depressions exist within the area and localized ponding of runoff may persist at many locations for several days subsequent to the occurrence of a flooding event. Flood conditions have progressively worsened as development has occurred by generally increasing the peak and volume of generated runoff through the introduction of a variety of impervious surfaces (such as, streets, parking areas, rooftops, and sidewalks). A map representing a generalized assessment of existing area flooding conditions is provided as Figure 2 of this Executive Summary.

The Critical Watershed Management Plan for the Ruthrauff Road has been prepared with the goal of reducing area flooding through:

1. Establishment of criteria for design and construction of public flood control improvements,

2. Establishment of floodplain management criteria (including requirements for detention/retention) as appropriate for new development, and
3. Development of a program for maintenance of drainage facilities currently existing in the area along with drainage facilities constructed in the future.

An extensive three-phase study has been performed to allow for the formulation of a Critical Watershed Management Plan for the Ruthrauff Road area. A brief description of the phase components of the study resulting in Plan derivation is provided below:

Phase 1: Delineation of study area, historical assessment of flooding, runoff determinations, identification of areas subject to flooding

Phase 2: Investigation of alternative drainage solutions, formulation of Plan, report preparation

Phase 3: Finalization of Plan

In an effort to induce public involvement and input into the preparation of the Critical Watershed Management Plan for the Ruthrauff Road Area, two public hearings were scheduled, each at key study milestones. The first public hearing was held at Flowing Wells Junior High School on December 7, 1982 after the completion of Phase 1 of the study. During this public hearing, a presentation was given by Pima County and their consultant (Cella Barr Associates) to describe the purpose of the study and the results of the Phase 1 assessment of existing flooding conditions. The audience was encouraged to identify any additional areas having flooding problems not represented in the presentation.

A second public hearing was held at Flowing Wells Junior High School on March 15, 1983, during which time the preferred Plan was presented to the public by Pima County and the Consultant. A handout was also provided to represent and clarify proposed Plan components, and input received from the audience served as a partial basis for Plan finalization.

During the process of Plan preparation by the Consultant, extensive interaction was required with appropriate members of the staff of the Pima County Department of Transportation and Flood Control District to set the guidelines and direction for Plan completion. Interim reviews of materials prepared by the Consultant were performed by a variety of staff members of Pima County on a number of occasions. Close interaction with Pima County was essential to the development of a cohesive and comprehensive Critical Watershed Management Plan for the Ruthrauff Road area.

## PLAN COMPONENTS

### General

The Critical Watershed Management Plan for the Ruthrauff Road area establishes provisions for reducing area flooding through implementation of the following:

1. Design and construction of public structural flood control improvements in the area,
2. Floodplain management relating to development of private property including setting requirements for detention/retention of storm runoff as appropriate, and
3. Public maintenance of existing and future drainage facilities.

The above Plan components are interrelated and essential to the future success of efforts to relieve flood hazards within the Plan area. The site specific proposals and regulations comprising the Plan components have been preceded by the completion of a thorough investigation of existing flooding conditions within the area, as represented in the main report "Critical Watershed Management Plan for the Ruthrauff Road Area". A more detailed description of the Plan components is provided in the following passages.

### Component 1 - Public Structural Flood Control Improvements

A number of alternative flood control improvements have been examined for the Ruthrauff Road area with importance being placed on overall feasibility of construction, effectiveness in relieving flood problems and estimated cost for construction. A key parameter used in the development of alternative flood control improvements was the identification of available outlets to the Santa Cruz River to the west and Rillito River to the north. The grade differential between the channel bed for these major watercourses and the applicable portions of the Plan area allowed for greater flexibility in design as "flatness of grade" constitutes the most

significant contribution to the flooding problem within the Plan area.)

Careful examination of alternative flood control improvements by Pima County and their Consultant resulted in the development of a preferred alternative for overall flood control improvements recommended to be implemented within the Plan area during the next several years. The estimated composite cost for the flood control measures recommended for construction in the Ruthrauff Road Area in conformance with the preferred alternative is \$8,900,000 including a 10% contingency factor. Based on the magnitude of this composite construction cost alone, it is evident that it would be prohibitive to construct all proposed improvements at one time and, thus, the composite flood control measures have been subdivided into five groups or "phases". Each phase is applicable to a particular portion of the Plan area and has been developed based on evaluations of unified effectiveness in providing flood relief, geographic considerations and funding considerations.

The five phases comprising recommended public structural flood control improvements inherent to the Plan have been identified as the Ruthrauff Road Phase, the Gardner Lane Phase, the Wetmore Road Area Phase, the Northern Area Phase and the Shannon Road/Romero Road Phase to represent their general geographical area of coverage. In general, flood control improvements are designed to collect runoff generated by a 10-year or less frequent storm event. The specific flood control improvements associated with each of these five phases are represented in the main report and are presented in more general terms in this Executive Summary as follows:

- A. Ruthrauff Road Phase: This phase of flood control improvements is focused in and around Ruthrauff Road in the central portion of the Plan area from Interstate 10 easterly to La Cholla Boulevard. Described flood control improvements are to be implemented as part of the proposed widening and reconstruction of Ruthrauff Road in this area made available through Pima County funds and bond money. Flood control improvements included in the Ruthrauff Road Phase are represented on Figure 3 and are discussed below:

1. Construction of a storm sewer along Ruthrauff Road from Kain Avenue to the Southern Pacific Railroad as part of the proposed Ruthrauff Road improvements. This storm sewer must be continued westerly from the Southern Pacific Railroad to the Santa Cruz River along the Ruthrauff Road alignment to provide an acceptable outlet.
2. Construction of an inverted crown street along Davis Avenue between Diamond Avenue and Ruthrauff Road with a storm sewer lateral extending northerly from the Ruthrauff Road storm sewer to collect flow at an existing low point in Davis Avenue approximately 300 feet north of Ruthrauff Road.
3. Construction of an inverted crown street system along Violet Avenue and along Highway Drive between Violet Avenue and Ruthrauff Road. This inverted crown street system will deliver collected runoff to the Ruthrauff Road storm sewer at Highway Drive.
4. Construction of an inverted crown street along Shannon Road from an existing high point approximately 300 feet south of Curtis Street, southerly to an existing drainage structure at the Southern Pacific Railroad just north of Ruthrauff Road.
5. Construction of a drainageway from the existing drainage structure at the Southern Pacific Railroad just north of Ruthrauff Road westerly to the Santa Cruz River. This drainageway will deliver collected runoff from the drainage structure to the Santa Cruz River.
6. Construction of a storm sewer system along Calle Harmonia and Sullinger Avenue north of Ruthrauff Road.

7. Construction of a storm sewer along La Cholla Boulevard north of Ruthrauff Road including collection systems for runoff generated by Edgebrooke Village and adjacent areas immediately southeast of the Ruthrauff Road/La Cholla Boulevard intersection.

Approximate cost of Ruthrauff Road Phase is \$2,173,000 in 1983 dollars.

- B. Gardner Lane Phase: The Gardner Lane Phase consists of flood control improvements along the southern boundary of the Ruthrauff Road Area. The purpose of construction of flood control improvements associated with the Gardner Lane Phase is to intercept, control, and eliminate substantial quantities of storm runoff entering the Ruthrauff Road area itself from offsite sources. Construction of the Gardner Lane Phase will eliminate the most significant offsite flooding source impacting the Plan area. Specific flood control improvements associated with the Gardner Lane Phase are represented on Figure 4 and are described as follows:

1. Construction of a detention basin adjacent to Gardner Lane at the southern boundary of the Ruthrauff Road Area directly to the east of the Southern Pacific Railroad.
2. Construction of an improved drainageway along the south side of Gardner Lane from Romero Road westerly to connect to the proposed detention basin. This drainageway will serve as a means of intercepting shallow flooding before it enters the Plan area.
3. Construction of an inverted crown street along La Cholla Boulevard from Wetmore Road south to connect to the improved drainageway extending westerly along Gardner Lane.
4. Construction of an improved drainageway along the east side of the Southern Pacific Railroad south of Gardner Lane to effectively intercept runoff impounded along the railroad embankment for delivery to the proposed detention basin.

5. Construction of an outfall storm sewer from the detention basin across the Southern Pacific Railroad, Interstate 10 and westerly for delivery to the Santa Cruz River along the Sweetwater Drive alignment.

Approximate cost of Gardner Lane Phase is \$2,555,500 in 1983 dollars.

C. Wetmore Road Area Phase: Flood control improvements associated with the Wetmore Road Area Phase are intended to relieve ponding and shallow flooding conditions in the predominantly light industrial area within the southwestern portion of the Ruthrauff Road Area west of La Cholla Boulevard. Generally, this phase includes the construction of drainage facilities to deliver Railroad and Interstate 10 drainage structures at the Arizona Feeds Mill south of Ruthrauff Road. Flood control improvements proposed as part of implementation of the Wetmore Road Area Phase are described below:

1. Construction of an inverted crown street along Zinnia Avenue east of Highway Drive connecting to an inverted crown street along Highway Drive north of Zinnia Avenue to the south boundary of the Arizona Feeds Mill.
2. Modification to the existing Flowing Wells Junior High School Fields to allow for detention of storm runoff.
3. Construction of a channel extending westerly along the north side of Wetmore Road to Highway Drive, a drainage crossing of Highway Drive and a channel continuing westerly to the Southern Pacific Railroad. *to meet 1985 / Spur track*
4. Construction of a drainage channel south of and parallel to Wetmore Road from Plum Avenue to the Southern Pacific Railroad.

5. Construction of an inverted crown street along Plum Avenue south of Wetmore Road to deliver runoff to the drainage channel extending westerly from Plum Avenue to the Southern Pacific Railroad.
6. Construction of an improved drainage channel within the eastern right-of-way of the Southern Pacific Railroad from the southern boundary of Cal Gas to the Arizona Feeds Mill. This improved drainage channel will connect flows collected from the Wetmore Road channel and parallel channel to the south to flows intercepted and collected by the inverted crown streets at Zinnia Avenue and Highway Drive.
7. Installation of new drainage structures across the Southern Pacific Railroad spur track, main track and Interstate 10 at the Arizona Feeds Mill to pass collected upstream runoff westerly out of the study area. Also required would be the construction of an offsite drainageway to deliver runoff collected in the new drainage structures westerly for release at the Santa Cruz River.

Approximate cost of Wetmore Road Area Phase is \$1,222,500 in 1983 dollars.

- D. Northern Area Phase: The Northern Area Phase is comprised of the construction of a number of outfall channels, inverted crown streets and storm sewers within the northern and northwestern portion of the Ruthrauff Road area. The downstream terminus point for each outfall is the Rillito River. Drainage improvements as proposed should greatly reduce long-term ponding and shallow flooding problems experienced primarily by residential areas intermixed with light industrial and commercial uses. Flood control improvements proposed as part of the construction of the Northern Area Phase are represented on Figure 6 and are described as follows:

1. Construction of an inverted crown street and storm sewer along Curtis Street from Sago Circle westerly to Highway Drive, Highway

Drive from Curtis Street to El Camino del Terra, and El Camino del Terra from Highway Drive to the Rillito River. Also included is the construction of an inverted crown street and lateral storm sewer along Sunset Road extending easterly from El Camino del Terra.

2. Construction of an inverted crown street along Shannon Road beginning just south of Curtis Street and extending northerly to the Rillito River.
3. Construction of an inverted crown street along Kain Avenue from Diamond Avenue to Curtis Street and a drainage channel along the Kain Avenue alignment from Curtis Street to the Rillito River.
4. Construction of an improved channel along the Sullinger Avenue alignment from Diamond Avenue to the Rillito River.

Approximate cost of Northern Area Phase is \$1,546,000 in 1983 dollars.

E. Shannon Road/Romero Road Phase: This phase of proposed structural flood control improvements includes further enhancements of drainage control within the northwestern portion of the Ruthrauff Road area, which currently is predominantly residential. Also included are provisions for control of runoff entering the eastern portion of the Ruthrauff Road area. Flood control improvements associated with the implementation of the Shannon Road/Romero Road Phase are represented on Figure 7 and are described below:

1. Construction of a storm sewer along Shannon Road beginning just south of Curtis Street and extending northerly to the Rillito River.
2. Construction of a storm sewer along Wetmore Road west from Romero Road for a distance of 900 feet and north along Romero Road from the Wetmore Road intersection to the terminus of the bend transition to Ruthrauff Road at an existing constructed

drainageway. Also included is the lining of the floor of the existing drainageway within the Edgebrooke Subdivision south of Ruthrauff Road.

Approximate cost of Shannon Road/Romero Road Phase is \$592,000.

The order in which the phases for flood control improvements have been presented in this section of the Plan does not necessarily represent relative timing of construction. Rather, the establishment of priorities for phase construction are the responsibility of the Pima County Engineer based on degrees of flood relief desired and available funding at future dates of action. Since a substantial percentage of the funding for the Ruthrauff Road Phase is currently available, however, it is likely that this phase of flood control improvements will be the first to commence.

The specific flood control improvements represented herein are based on preliminary designs only. Prior to implementation of any improvement phase, it will be necessary for complete design drawings and analyses to be performed to Pima County standards by a qualified registered professional engineer.

Construction of the flood control improvements represented in this component of the Critical Watershed Management Plan will result in a substantial reduction in area flooding problems. It is important to note, however, that these flood control improvements are interrelated with the other two components of the Plan and thus, their mitigative effect could be reduced substantially in time if enforcement and monitoring of the other components were not carried out.

#### Component 2 - Floodplain Management Criteria

As part of the implementation of a viable flood control program for the Ruthrauff Road area, it is essential that consideration be given to the prevention of future worsening of flood conditions. Also, without proper

floodplain management there exists a strong possibility of substantially reducing the effectiveness of constructed structural flood control improvements implemented per Component 1.

Component 2 of the Critical Watershed Management Plan for the Ruthrauff Road Area encourages private participation in further reducing the flood hazard for the area through requirements established for new development. These requirements may take the form of: 1) mandatory detention/retention of storm runoff under a given set of development conditions, and 2) dedication of rights-of-way to Pima County as required for future installation of structural flood control improvements. These requirements are site specific and will be based upon Pima County review and interpretation of flooding conditions and right-of-way requirements relevant to each proposed new site development.

Zones have been established within the Plan area for which applicable requirements for detention/retention will be administered. These zones are represented on Figure 8 of this Executive Summary. The zones have been geographically established by considering the present and future effectiveness of detention/retention as a floodplain management policy within different geographical portions of the Plan area.

Properties located within zones designated as ND zones will not require detention/retention as a condition of development due to their proximity to an existing outfall for storm runoff. Generally, the ND zones are located at downstream limits of the Plan area.

There are also portions of the Plan area which are designated as CD(X) zones for which detention/retention will be required as a condition of site development until such time as specific phases of the public structural flood control improvements are constructed as part of the implementation of Plan Component 1 of the Plan.

Flooding conditions within the remaining portions of the Plan area are of a nature that continued development will create significant increases in

area flooding problems regardless of the extent of structural flood control improvements which have been constructed in accordance with the Plan. Properties developed within these zones, represented as D zones, will require construction of accompanying detention/retention facilities unless a written waiver is obtained from the Pima County Engineer.

The second regulatory entity of Component 2 will be the establishment of a policy by Pima County to acquire necessary rights-of-way for future flood control improvements through the development process as appropriate to allow for construction of future flood control improvements within the Plan area. Affected private property owners will be required to dedicate by plat or separate instrument all necessary rights-of-way required for flood control purposes to Pima County as a condition of development based on a case-by-case review by the Pima County Flood Control District. This policy will encourage private participation in the overall flood control improvements proposed for the area and correspondingly reduce future construction costs borne by Pima County as part of the implementation of the public structural flood control improvements inherent to the Plan.

### Component 3 - Maintenance of Existing and Future Drainage Facilities

Immediate relief of several area flooding problems which have been documented within the Ruthrauff Road Area will be provided through effective public maintenance of existing drainage facilities. This public maintenance includes debris and vegetation clearing, local grading and roadway repairs as required.

Several key locations are to be placed on a regular program for annual maintenance with more frequent maintenance being provided as appropriate. The key locations which have been designated, as a minimum, to be included in a regular public maintenance program are:

- 1) The existing drainage swale and associated drainage structures along the east embankment of the Southern Pacific Railroad. Drainage structures are located at the Cal Gas plant

(approximately 570 feet south of the Wetmore Road alignment), the Arizona Feeds Mill (approximately 300 feet north of the Zinnia Avenue alignment), Ruthrauff Road and the Shannon Road dip section (approximately 350 feet north of Ruthrauff Road).

- 2) The existing roadway shoulder swale and channel extending northerly along the west right-of-way for La Cholla Boulevard from a location approximately 450 feet south of Curtis Street north to the Rillito River.
- 3) Existing roadway shoulder ditches along Highway Drive north of Curtis Road and El Camino Del Terra from Highway Drive to the Rillito River.
- 4) The existing drainage swale along the south side of Ruthrauff Road extending west from the channel outlet at Edgebrooke Village to La Cholla Boulevard.
- 5) The existing roadway shoulder swale along the south side of Wetmore Road extending approximately from Sullinger Avenue to the Southern Pacific Railroad.
- 6) Sunset Road at and east of El Camino Del Terra.
- 7) General street repairs as required to eliminate potholes and maintain drainage.
- 8) Flood control improvements constructed as part of Component 1 of the Critical Watershed Management Plan.

## CONCLUSION

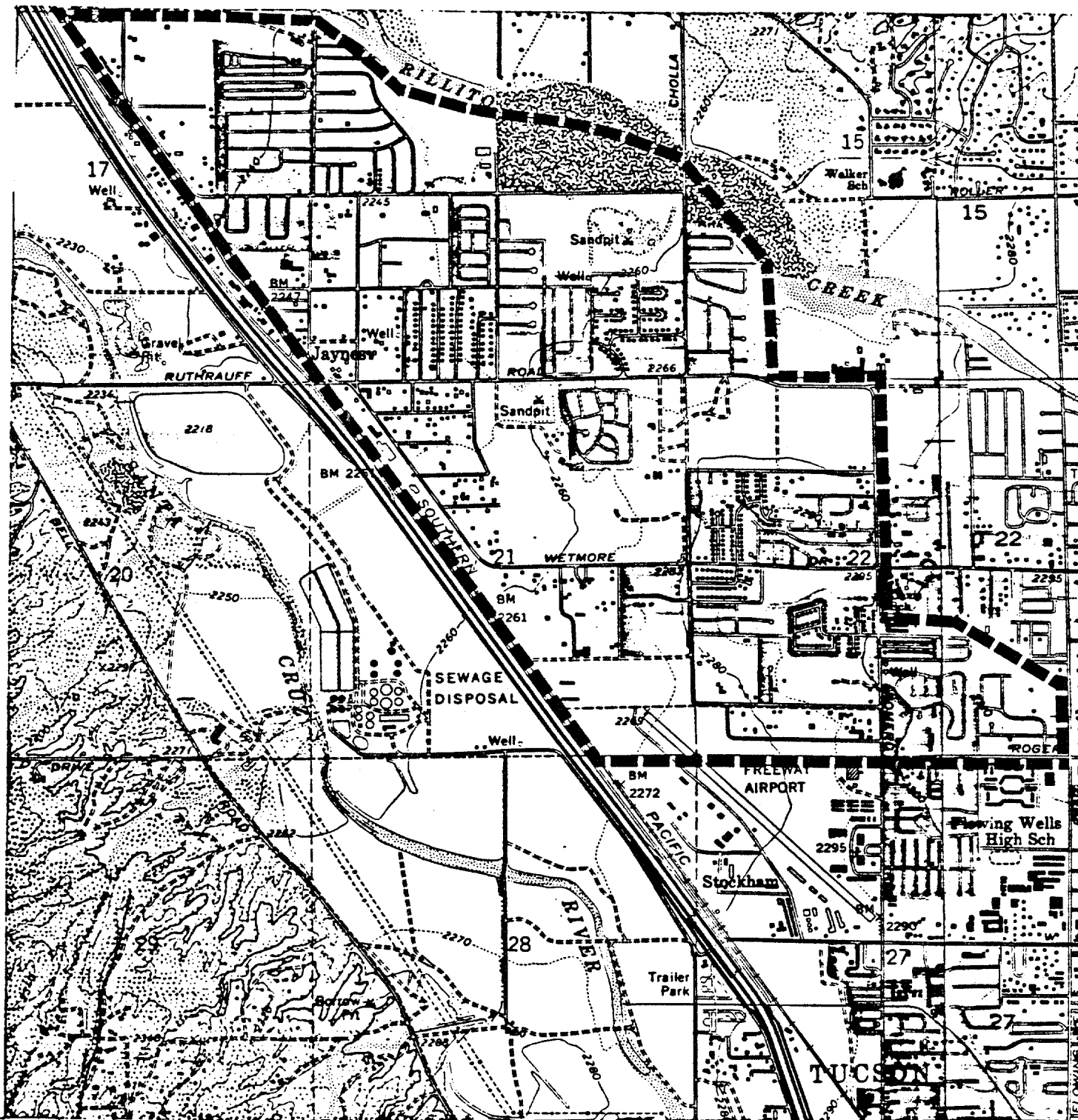
This Critical Watershed Management Plan for the Ruthrauff Road Area pertains to a two and one-half square mile area northwest of the Tucson city limits and has been prepared in recognition of area flooding problems induced by urbanization within this unusually flat portion of the Tucson basin. The preparation of this Critical Watershed Management Plan has been prompted by the adoption of Section 1307 of the Pima County Floodplain Management Ordinance No. 1974-86 by the Pima County Board of Supervisors on April 5, 1982. The Ruthrauff Road Area has been classified as a "critical basin" on official Pima County Maps, thus requiring the establishment of drainage regulations as represented in this Critical Watershed Management Plan for the area. This Critical Watershed Management Plan for the Ruthrauff Road Area has been developed based on an extensive three-phase study of area flooding and potential solutions with input being solicited from the public at two key milestone points during study preparation.

The Critical Watershed Management Plan for the Ruthrauff Road Area is comprised of three major components which are designed to reduce area flooding. These components are:

- Component 1 - Public Structural Flood Control Improvements
- Component 2 - Floodplain Management Criteria
- Component 3 - Maintenance of Existing and Future Drainage Facilities

The Plan components are interrelated and essential to the future success of efforts to relieve flood hazards within the Plan area. Adoption of the Critical Watershed Management Plan for the Ruthrauff Road Area will establish a program for flood relief provided by the efficient use of public funds utilized for structural flood control improvements, private contributions stimulated by requirements for detention/retention and right-of-way dedication for new development, and regular maintenance. This Plan will serve as an overall effective management tool for the Ruthrauff Road Area.

**CRITICAL WATERSHED MANAGEMENT PLAN  
RUTHRAUFF ROAD AREA**



**FIGURE 1.  
LOCATION MAP OF THE  
RUTHRAUFF ROAD AREA**

--- BOUNDARY OF STUDY AREA



1"=2000'  
CI-20'

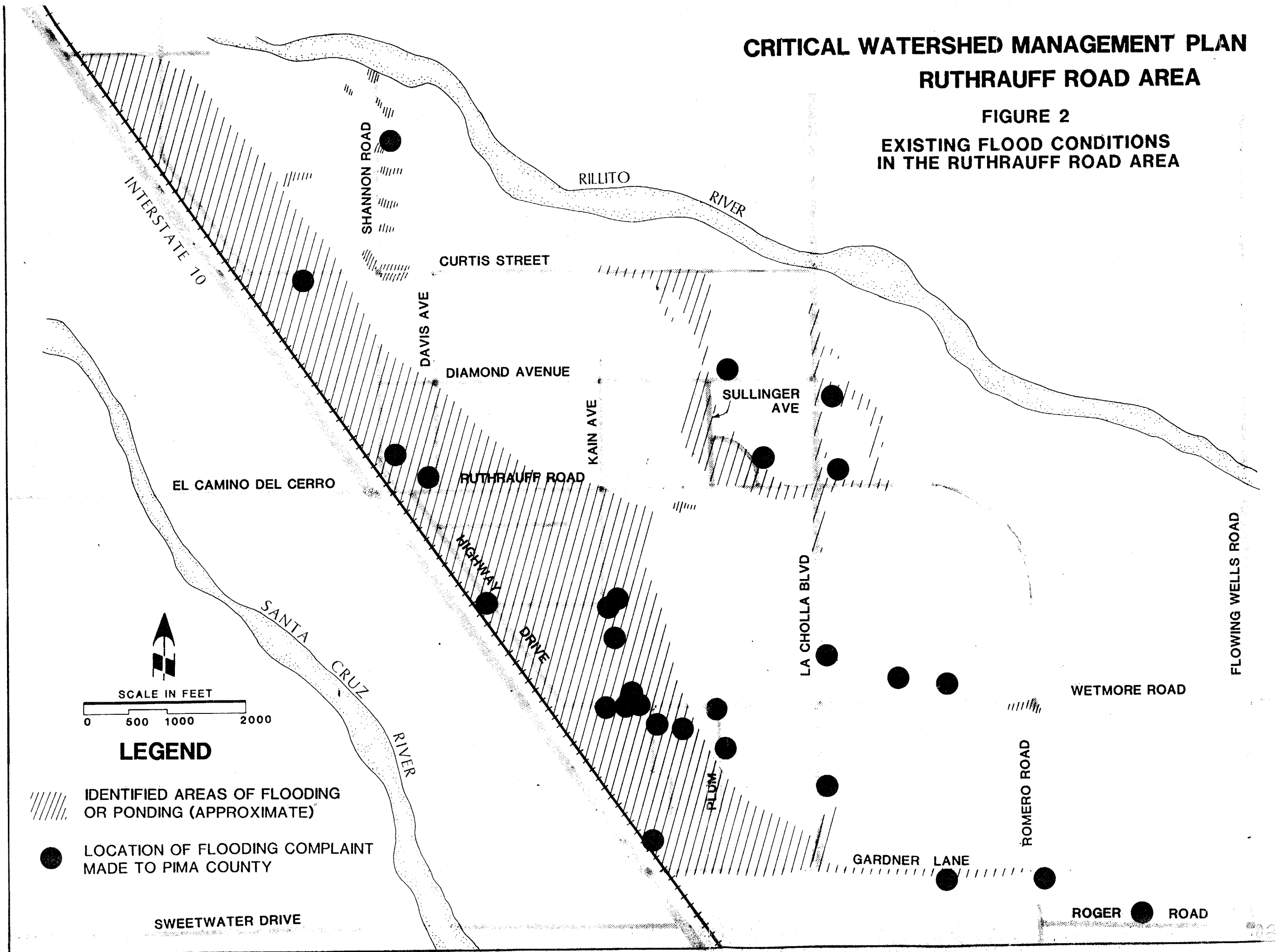
**CBA** CELLA BARR ASSOCIATES

2075 North Sixth Avenue  
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(602) 624-7401

102/

# CRITICAL WATERSHED MANAGEMENT PLAN RUTHRAUFF ROAD AREA

FIGURE 2  
EXISTING FLOOD CONDITIONS  
IN THE RUTHRAUFF ROAD AREA



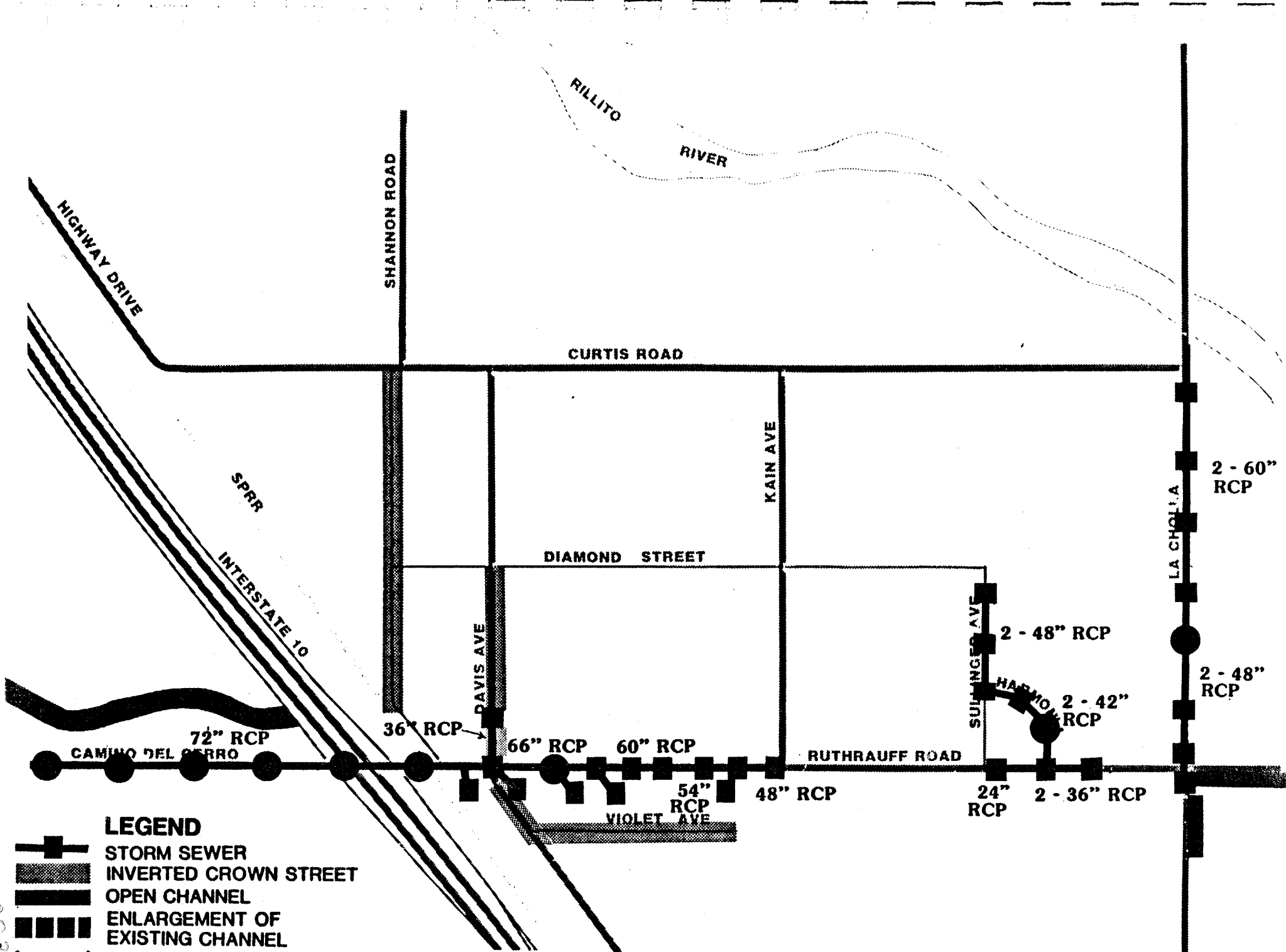
SCALE IN FEET  
0 500 1000 2000

### LEGEND






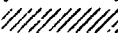
- IDENTIFIED AREAS OF FLOODING OR PONDING (APPROXIMATE)
- LOCATION OF FLOODING COMPLAINT MADE TO PIMA COUNTY

SWEETWATER DRIVE

FLOWING WELLS ROAD

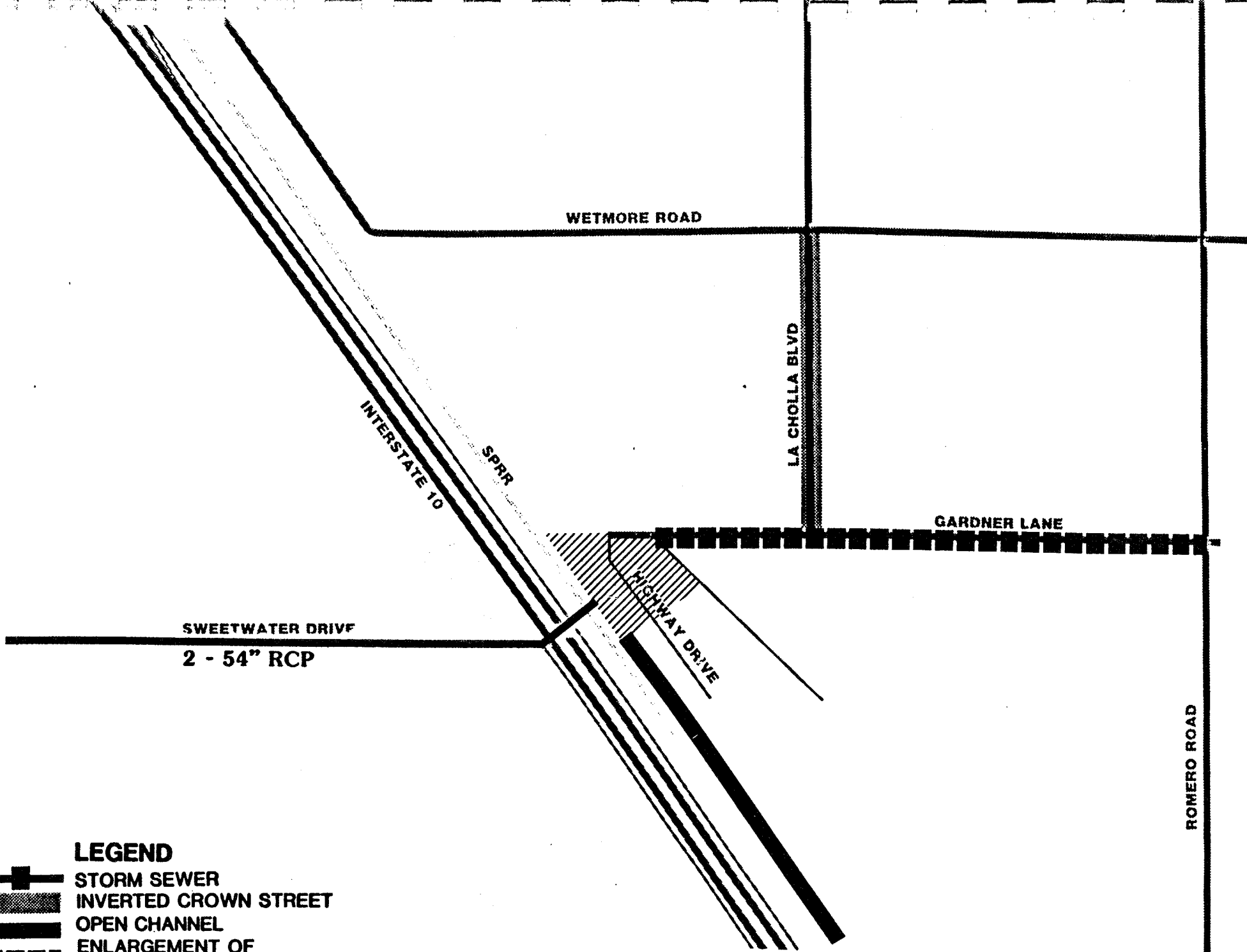


**LEGEND**






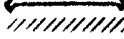
-  STORM SEWER
-  INVERTED CROWN STREET
-  OPEN CHANNEL
-  ENLARGEMENT OF EXISTING CHANNEL
-  DRAINAGE STRUCTURE
-  DETENTION BASIN

**RUTHRAUFF ROAD PHASE**

**FIGURE 3**



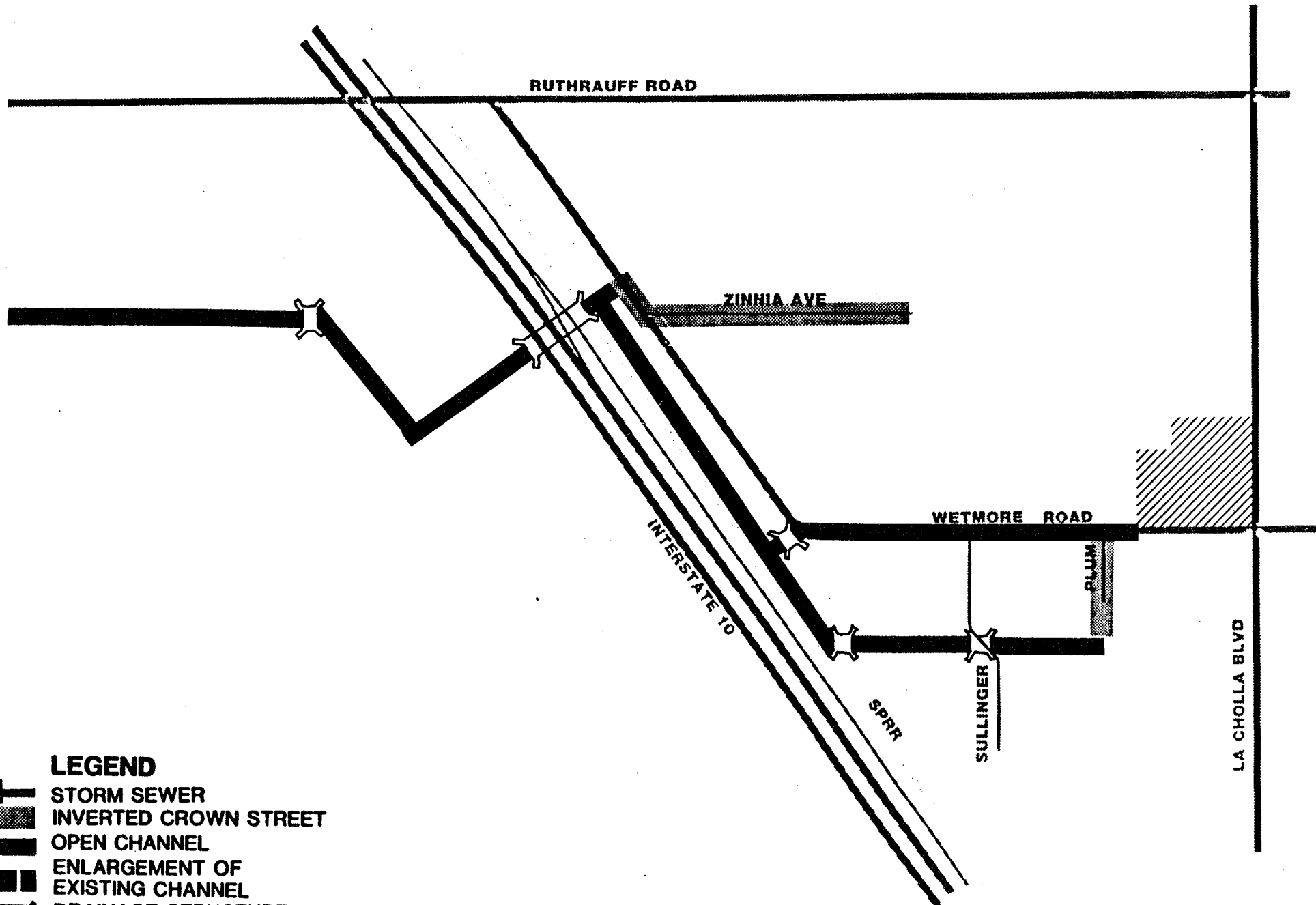
**LEGEND**

-  STORM SEWER
-  INVERTED CROWN STREET
-  OPEN CHANNEL
-  ENLARGEMENT OF EXISTING CHANNEL
-  DRAINAGE STRUCTURE
-  RETENTION BASIN






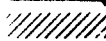
**GARDNER LANE PHASE**

**FIGURE 4**

790



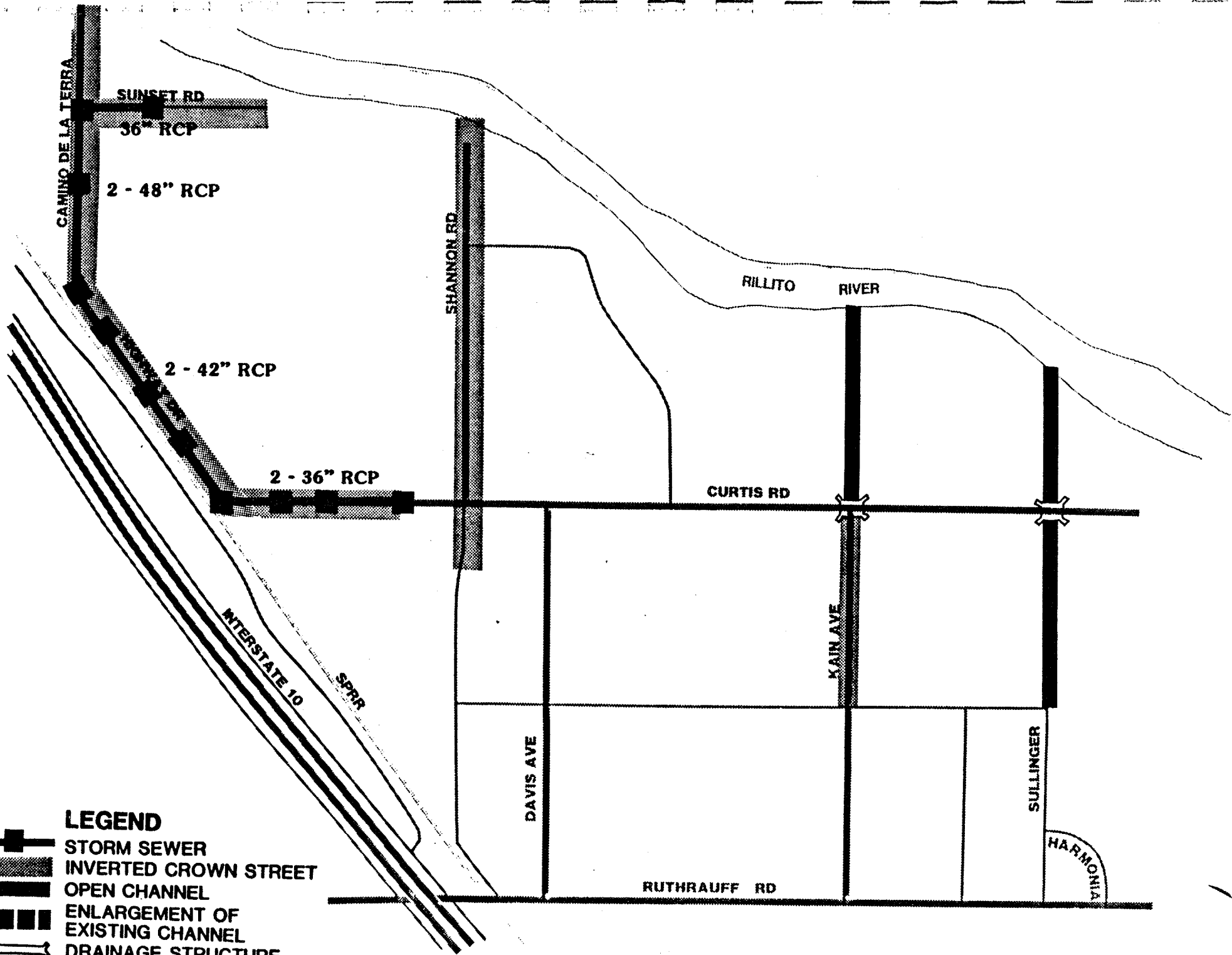
**LEGEND**

-  STORM SEWER
-  INVERTED CROWN STREET
-  OPEN CHANNEL
-  ENLARGEMENT OF EXISTING CHANNEL
-  DRAINAGE STRUCTURE
-  DETENTION BASIN

**WETMORE ROAD AREA PHASE**

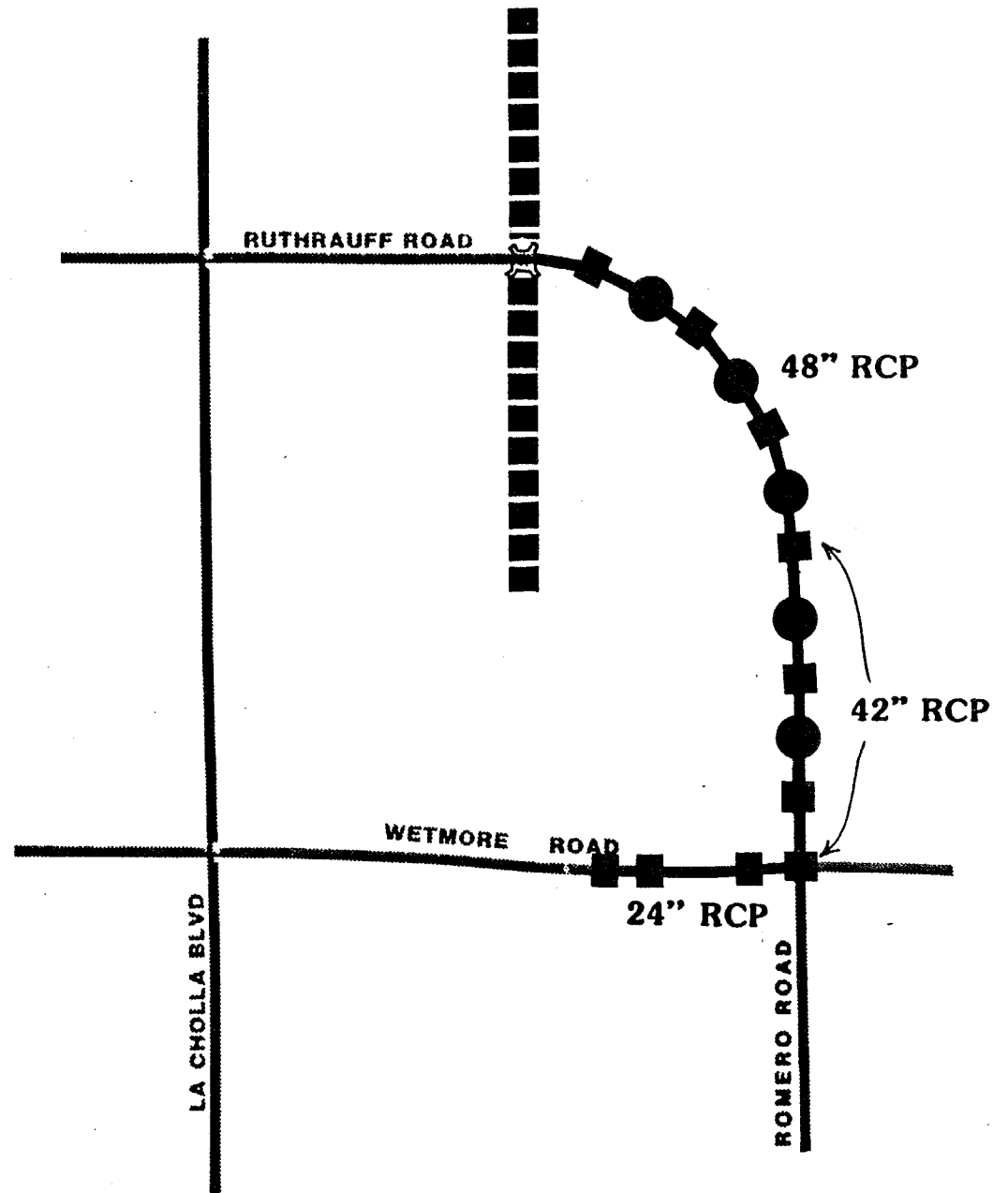
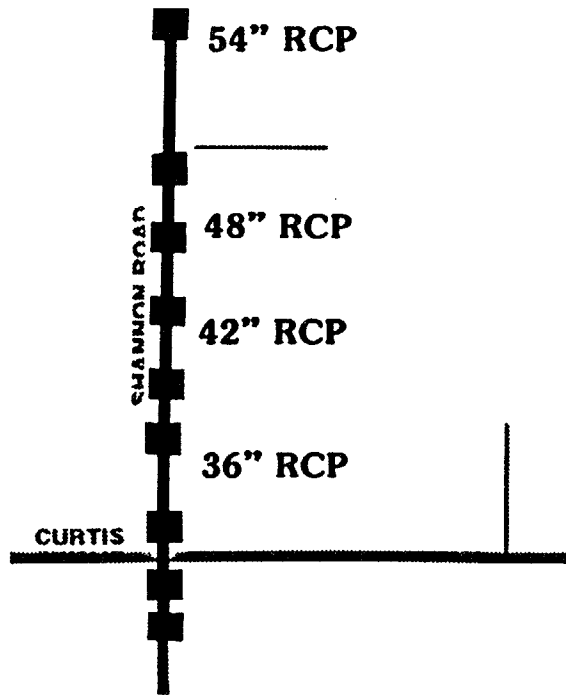
**FIGURE 5**

500



**NORTHERN AREA PHASE**

**FIGURE 6**



- LEGEND**
- STORM SEWER
  - INVERTED CROWN STREET
  - OPEN CHANNEL
  - ENLARGEMENT OF EXISTING CHANNEL
  - DRAINAGE STRUCTURE
  - DETENTION BASIN

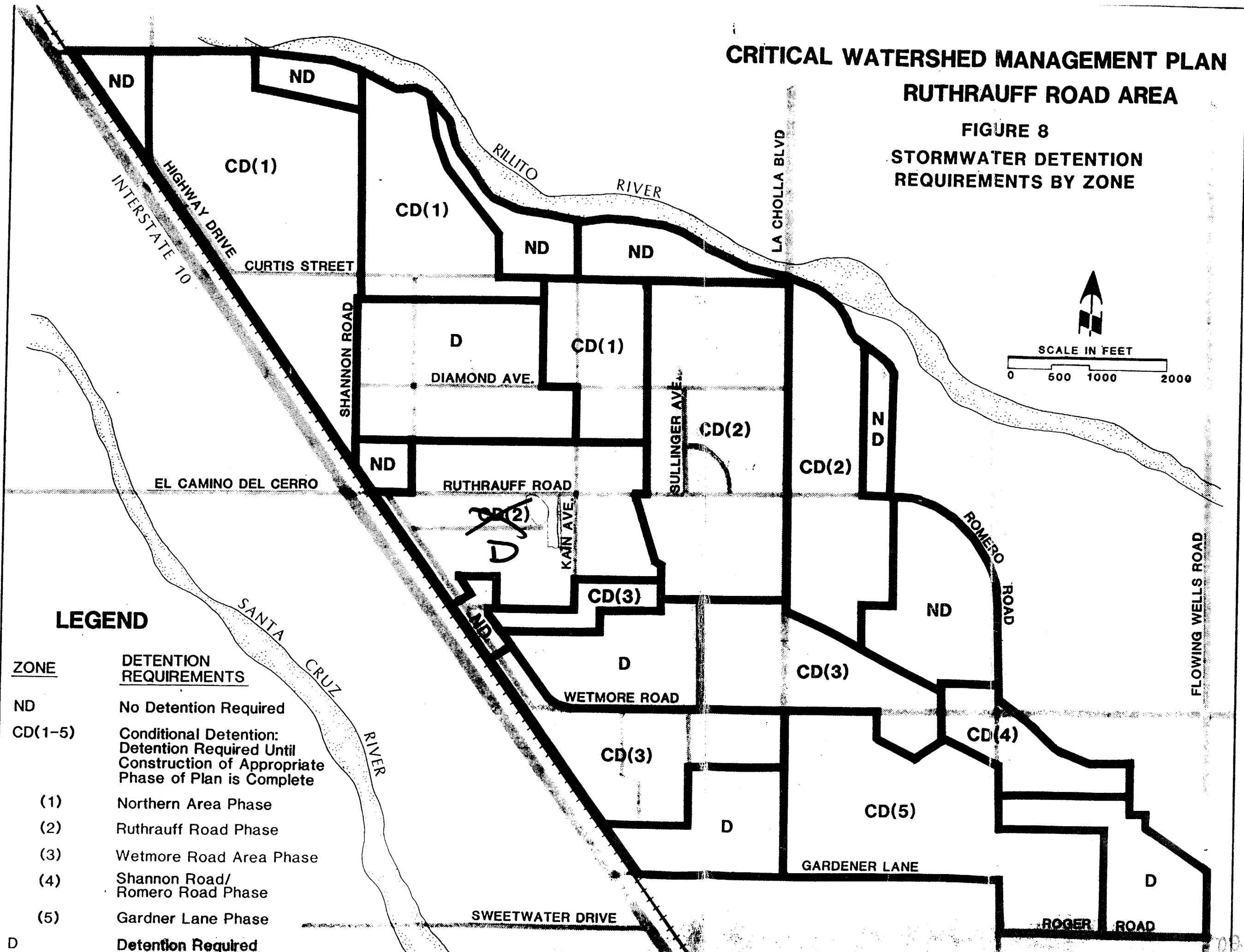
**SHANNON ROAD/ROMERO ROAD PHASE**

**FIGURE 7**

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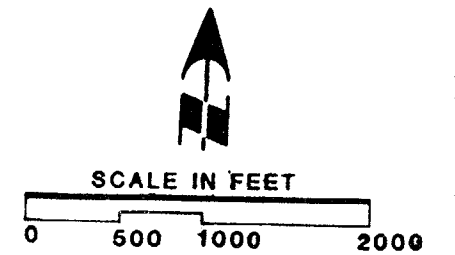
# CRITICAL WATERSHED MANAGEMENT PLAN RUTHRAUFF ROAD AREA

FIGURE 8  
STORMWATER DETENTION  
REQUIREMENTS BY ZONE



## LEGEND

ZONE	DETENTION REQUIREMENTS
ND	No Detention Required
CD(1-5)	Conditional Detention: Detention Required Until Construction of Appropriate Phase of Plan is Complete
(1)	Northern Area Phase
(2)	Ruthrauff Road Phase
(3)	Wetmore Road Area Phase
(4)	Shannon Road/ Romero Road Phase
(5)	Gardner Lane Phase
D	Detention Required



MAIN REPORT  
CRITICAL WATERSHED MANAGEMENT PLAN  
RUTHRAUFF ROAD AREA

August 15, 1983  
CBA File No. 01740-03-30-03

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## PREFACE

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MAIN REPORT  
CRITICAL WATERSHED MANAGEMENT PLAN  
RUTHRAUFF ROAD AREA

INTRODUCTION

The Ruthrauff Road area comprises approximately two and one-half square miles northwest of the Tucson city limits. The Ruthrauff Road area, as represented on Figure 1, is bounded by the Southern Pacific Railroad and Interstate 10 on the west, the Rillito River and Sunset Road on the north, Romero Road on the east (with a portion of the area extending further eastward to Flowing Wells Road), and Gardner Lane on the south. Drainage into and within the area is sluggish and inefficient, as the area contains poor topographic relief with little or no regional provision for drainage existing at the present time. Therefore, a high incidence of sheet flooding has been experienced during storms of moderate or greater intensity. Several local depressions exist within the area and localized ponding of runoff may persist at many locations for several days subsequent to the occurrence of a flooding event. Flood conditions have progressively worsened as development has occurred by generally increasing the peak and volume of generated runoff through the introduction of a variety of impervious surfaces (such as streets, parking areas, rooftops, and sidewalks). A map representing a generalized assessment of existing area flooding conditions is provided as Figure 2.

The Critical Watershed Management Plan for the Ruthrauff Road area has been prepared with the goal of reducing area flooding through:

1. Establishment of criteria for design and construction of public flood control improvements,

2. Establishment of floodplain management criteria (including requirements for detention/retention) as appropriate for new development, and
3. Development of a program for maintenance of drainage facilities currently existing in the area along with drainage facilities constructed in the future.

An extensive three-phase study has been performed to allow for the formulation of a Critical Watershed Management Plan for the Ruthrauff Road area. A brief description of the phase components of the study resulting in Plan derivation is provided below:

Phase 1: Delineation of study area, historical assessment of flooding, runoff determinations, identification of areas subject to flooding

Phase 2: Investigation of alternative drainage solutions, formulation of Plan, report preparation

Phase 3: Finalization of Plan

In an effort to induce public involvement and input into the preparation of the Critical Watershed Management Plan for the Ruthrauff Road Area, two public hearings were scheduled, each at key study milestones. The first public hearing was held at Flowing Wells Junior High School on December 7, 1982 after the completion of Phase 1 of the study. During this public hearing, a presentation was given by Pima County and Cella Barr Associates to describe the purpose of the study and the results of the Phase 1 assessment of existing flooding conditions. The audience was encouraged to identify any additional areas having flooding problems not represented in the presentation.

A second public hearing was held at Flowing Wells Junior High School on March 15, 1983, during which time the preferred Plan was presented to the public by Pima County and the Consultant. A handout was also provided to represent and clarify proposed Plan components, and input received from the audience served as a partial basis for Plan finalization.

During the process of Plan preparation by CBA, extensive interaction was required with appropriate members of the staff of the Pima County Department of Transportation and Flood Control District to set the guidelines and direction for Plan completion. Interim reviews of materials prepared by the Consultant were performed by a variety of staff members of Pima County on a number of occasions. Close interaction with Pima County was essential to the development of a cohesive and comprehensive Critical Watershed Management Plan for the Ruthrauff Road area.

#### PREVIOUS WORK

Two hydrologic investigations of Ruthrauff Road from Romero Road to I-10 have previously been performed by CBA. These studies, entitled "Hydrologic Investigation, Pima County Project No. 4-BRUTH, Ruthrauff Road, La Cholla Boulevard to Romero Road and La Cholla Boulevard, Zinnia Street to Ruthrauff Road" and "Preliminary Drainage Study Report, Ruthrauff Road, I-10 to La Cholla Boulevard," were submitted to the Pima County Department of Transportation and Flood Control District in May of 1980 and March of 1981, respectively. These studies included presentation and evaluation of drainage schemes designed to minimize projected flooding of Ruthrauff Road. Information contained in the studies was examined, modified where necessary, and expanded upon as part of the present study. A third study was previously performed for the area by CBA and was submitted to the City of Tucson in June, 1981. This third study was entitled "Hydrologic Investigation for Gardner Lane Area, City of Tucson Contract No. 0401-81," and identified additional sources of runoff south of Gardner Lane and Roger Road that impact the Ruthrauff Road area.

#### EXISTING FLOODING CONDITIONS

As previously mentioned, Phase 1 of the three-phase study undertaken to develop a Critical Watershed Management Plan for the Ruthrauff Road area consisted of a detailed examination of existing flooding conditions throughout the area. This examination was performed in the following five steps: 1) delineation of the study area and its interior drainage basins

and sub-basins; 2) assessment of historical flooding; 3) estimation of magnitudes of runoff; 4) identification of areas subject to flooding; and 5) presentation of results to the public. Each step is addressed below.

This report includes a separate Appendix that contains calculations associated with the estimation of existing flooding conditions throughout the Ruthrauff Road area. Also included in the Appendix is a summary of complaints made to Pima County regarding flooding in the Ruthrauff Road area.

#### 1. Delineation of Drainage Basins -

The Ruthrauff Road area has been divided into a number of drainage basins and sub-basins that contribute runoff to Ruthrauff Road, Highway Drive, and to a large area north of Ruthrauff Road between Shannon Road and an existing drainage channel east of La Cholla Boulevard. Delineation of these basins and sub-basins, as shown on Figure 2, is based on topographic information provided by Pima County, aerial photographs, numerous field investigations both during and immediately following rainstorms, and survey data. Basins south of Gardner Lane and Roger Road that impact Ruthrauff Road and Highway Drive by directing runoff to the Southern Pacific Railroad embankment were generally considered only in terms of sources and accompanying magnitudes of incoming runoff.

#### 2. Historical Assessment of Flooding -

Documentation of historical flooding problems throughout the Ruthrauff Road area was obtained from the Floodplain Management Section of the Pima County Department of Transportation and Flood Control District in the form of complaints filed by residents of the area. These complaints date from 1976 to the present, and have been catalogued in the Appendix with locations plotted on Figure 2. The Property Management and Operations departments of the above agency were also contacted for information concerning flooding in the area. Aerial photographs taken in December, 1978 during a prolonged winter storm were also reviewed to determine additional locations of flooding.

### 3. Runoff Estimates -

Peak runoff magnitudes were estimated for the 2-, 5-, 10-, 25-, 50- and 100-year storm events at estimated locations within the Ruthrauff Road area where runoff naturally concentrates, based on the drainage basin delineations and locations of complaints of flooding, and at points chosen for the purpose of developing structural flood control improvements (Figure 2). This range of storm events provided flexibility in the design and evaluation of structural solutions to flooding. The method used in the estimation of magnitudes of runoff is outlined in the manual entitled Hydrology Manual for Engineering Design and Flood Plain Management Within Pima County, Arizona, 1979. The resulting discharges have been tabulated by concentration point in Table 1, and the computations are contained in the Appendix.

The two drainage studies concerning Ruthrauff Road itself previously performed by CBA were also closely examined, as peak discharges were estimated therein for many points impacting the roadway. Peak discharges computed in the Gardner Lane report with the Rational Method (as requested at the time by the City of Tucson) were revised using the previously cited Pima County method. Because the area south of Gardner Lane and Roger Road falls under the jurisdiction of the City of Tucson, this area was assumed to be fully developed for purposes of estimating peak discharges in the Ruthrauff Road area.

Under existing conditions, appropriate basin factors and percentages of impervious cover in the Ruthrauff Road area were determined according to basin characteristics. Much of the Ruthrauff Road area has been intensely developed for residential and industrial purposes. Trailer homes and more permanent single-family dwellings occupy entire sub-basins and major portions of some of the larger basins. Basin factors for these areas were determined in accordance with basin factors recommended in the Pima County Manual cited above. Basin factors were also calibrated for areas in which overland sheet flow conditions exist,

TABLE 1. ESTIMATED PEAK DISCHARGES IN THE RUTHRAUFF ROAD AREA

CONCENTRATION POINT (C.P.)	DRAINAGE AREA (ACRES)	STORM RECURRENCE INTERVAL					
		2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
A1	89.44	E 64	114	139	212	264	331
		D 90	148	176	256	316	372
B1	68.25	E 81	134	159	233	288	344
		D 110	169	197	276	333	395
B2	157.69	E 124	217	259	392	500	609
		D 181	292	340	494	612	723
RR1	490.37	E 201	439	571	938	1,230	1,526
		D 586	935	1,120	1,597	1,919	2,332
C1	27.57	E 38	60	71	102	125	150
		D 39	63	75	107	131	157
C2	108.52	E 93	162	196	296	373	459
		D 148	231	270	385	464	546
D1	40.63	E 77	118	141	196	242	278
		D 77	118	141	196	242	278
D2	120.8	E 85	153	186	284	355	445
		D 144	228	274	397	496	587
RR3	805.04	E 345	640	784	1,258	1,584	1,954
		D 674	1,102	1,293	1,890	2,293	2,808
D3	19.3	E 5	16	22	41	55	71
		D 49	75	84	115	134	153
D4	171.88	E 76					
D5	95.91	E 105	180	214			489
D6	142.20	E 153	258	304			659
RR4	949.36	E 302	579	723	1,137	1,482	1,825
		D 637	1,091	1,301	1,902	2,321	2,851
E1	7.73	E 22	30	35	46	54	61
		D 22	30	35	46	54	61
E2	31.56	E 76	118	134	183	214	245
		D 76	118	134	183	214	245

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TABLE 1. CONT'D.

CONCENTRATION POINT (C.P.)	DRAINAGE AREA (ACRES)	STORM RECURRENCE INTERVAL					
		2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
E3	142.79	E 151	251	303	439	532	651
		D 249	377	442	592	738	842
E4	90.2	E 31	70	91	154	204	260
		D 164	241	290	389	469	554
RR2	633.16	E 378	687	827	1,230	1,561	1,856
		D 571	921	1,104	1,593	1,954	2,339
F1+	25.64	E 50	72	86	115	141	169
		D 70	99	114	151	183	206
F2	75.90	E 93	148*	170*	272	335	359*
		D 150	222	259	348	406	487
F3	93.7	E 97	157*	188*	303	371	405*
		D 165	249	292	402	486	573
F4	124.5	E 140	223*	256*	398	499	549*
		D 208	315	364	505	605	712
F5	174.1	E 101	175*	211*	349	451	518*
		D 264	405	468	661	769	901
G1	41.29	E 73	107	129	172	207	245
		D 73	107	129	172	207	245
G-F	219.29	E 127	232*	264	434	545	626*
		D 284	439	506	724	869	1,046
H1	40.84	E 64	102	116	166	203	246
		D 74	116	132	180	233	268
H2	23.86	E 24	43	51	76	97	118
		D 36	59	67	96	118	143
H3	19.49	E 23	37	44	62	78	92
		D 26	41	49	70	82	97
RR5	1,091.48	E 0	183	342	791	1,155	1,541
		D 246	707	989	1,659	2,146	2,621
RR5 (Local peak Q's)	142.14	E 135	223	266	387	480	569
		D 156	247	294	430	532	627
I1	59.0	E 78	121	143	201	240	281
		D 78	121	143	201	240	281

TABLE 1. CONT'D.

CONCENTRATION POINT (C.P.)	DRAINAGE AREA (ACRES)	STORM RECURRENCE INTERVAL						
		2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	
J1	6.83	E	16	23	26	35	41	47
		D	16	23	26	35	41	47
J2	1,225.97	E	0	158	309	755	1,105	1,499
		D	244	708	942	1,676	2,206	2,757
J2 (Local peak Q's)	276.63	E	127	228	278	440	567	686
		D	244	389	462	659	813	974
K1	15.89	E	40	62	70	95	110	126
		D	40	62	70	95	110	126
K2	19.71	E	30*	63*	79*	106	130	178*
		D	30*	63*	79*	106	130	178*
K3	85.52	E	119*	202*	243*	341	412	519*
		D	155	237	275	382	444	524

E: Existing Conditions  
D: Developed Conditions

+ Includes 15 cfs of runoff in the southern right-of-way of Ruthrauff Road from C.P. K1

\* Accounts for breakover of flow across Ruthrauff Road at C.P. F1 and loss of flow from C.P. K1

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that is, where slopes are generally less than 0.5 percent and runoff is essentially uncontained and passed downstream across a wide, shallow floodplain. This condition exists primarily in a northwest-trending area adjacent to the Southern Pacific Railroad, from Gardner Lane at the southern boundary of the study area to Sunset Road at its northern boundary. Details of the calibration procedure are given in the Appendix.

In the estimation of peak magnitudes of runoff generated under developed conditions in the absence of watershed management, basin factors were determined using Pima County Zoning Maps updated mainly in 1981. Where all land within a basin or sub-basin has been developed under existing zoning designations, only one set of discharges were computed. Capacities of structures within the Ruthrauff Road area were also taken into account in the discharge computations, where warranted, and are also contained in the Appendix.

#### 4. Identification of Areas Subject to Flooding -

Because the Ruthrauff Road area has been designated as a "critical basin" by Pima County, areas where flooding currently occurs as a result of nonexistent or inadequate drainage structures were identified. Magnitudes of local flooding were determined by computing runoff capacities of existing drainage structures and by estimating the conveyance capabilities of selected existing drainage channels and roadways. Floodprone areas resulting from the 100-year storm event were delineated where appropriate using standard hydrologic techniques in accordance with Pima County standards (see the Appendix).

Major floodprone areas identified are located adjacent to the Southern Pacific Railroad, where the limits of 100-year flooding area quite broad from the railroad embankment eastward, and in the northeastern portion of the study area in the vicinity of La Cholla Boulevard, Sullinger Avenue and Calle Harmonia. The western two-thirds of the Ruthrauff Road area drains to the west toward the Santa Cruz River, whereas the remaining eastern one-third drains northward to the

Rillito River (Figure 2). Drainage toward the Santa Cruz River is effectively halted by the embankment of the Southern Pacific Railroad, which was constructed in the early 1900s and forms the western boundary of the study area. Potentially high magnitudes of runoff generated by basins to the south and east concentrate along the railroad embankment from Gardner Lane to Sunset Road under existing conditions (2,332 cfs at Concentration Point RR1 to 1,594 cfs at Concentration Point RR5 from south to north during the 100-year storm event; see Table 1 and Figure 2). The limits of the 100-year floodplain along the east side of the railroad were estimated for the purpose of determining the severity of potential flooding in the area. These limits are shown on Figure 2. Although peak discharges in this area are two to ten times greater than peak discharges estimated at other concentration points throughout the Ruthrauff Road area, the depth of flooding resulting from the 100-year storm ranges only from about 1.3 to 2.7 feet at velocities of 1 to 3 feet per second.

Three drainage structures exist beneath the railroad along the study area boundary (Figure 2). Two of the structures, each consisting of two 48-inch corrugated metal pipes (CMPs) with combined capacities ranging from 108 cfs to 112 cfs, are located southwest of Cal Gas and the Arizona Feeds Mill, respectively (Figure 2). These structures lack adequate collective systems and headwalls to convey significant runoff out of the study area and are poorly maintained, thus promoting the establishment of dense vegetation on their upstream sides. Therefore, in the estimation of flooding adjacent to the Southern Pacific Railroad, it was assumed that these structures are essentially not capable of adequately functioning during storm events. As a result, peak discharges estimated for concentration points downstream of these structures were not reduced by their capacities. Runoff that ponds on the eastern side of the Southern Pacific Railroad is thus directed to the north toward Ruthrauff Road. Drainage ditches located on the eastern side of the railroad, and although this ditch is relatively well-defined in places, it completely disappears in others, particularly on the upstream side of existing railroad spurs. The

third drainage structure is a 1-cell 12'x5' wooden trestle located about 200 feet northwest of Ruthrauff Road. This drainage crossing is capable of conveying a significant amount of runoff (about 444 cfs) out of the study area; however, adequate drainage facilities for runoff to reach the Santa Cruz River from this structure are lacking. The capacity of this structure was taken into account in the estimation of downstream peak discharges.

Additional flooding in the western portion of the Ruthrauff Road area consists mainly of frequent ponding caused by inadequate street drainage, flow diversions created by the actions of local property owners (as in the berming and raising of fences), highly inadequate local drainage channels and culverts originally constructed for irrigation purposes or for access to businesses and residences, and poor roadside drainage.

Significant flooding of the Sullinger Avenue/Calle Harmonia area and La Cholla Boulevard and adjacent streets has also been documented extensively in the course of this study. Numerous complaints of flooding have been made to Pima County by residents of the Sullinger Avenue/Calle Harmonia area because of actual flooding of residences and safety hazards posed by significant ponding of stormwater, as at the intersection of Sullinger Avenue and Diamond Avenue. Hence, this area has been investigated in detail to include the estimation of where the limits of 100-year flooding (see the Appendix for computations.) Runoff impacting this area is generated primarily by a 72-acre watershed, which includes the Edgebrook Village subdivision that extends to the south of Ruthrauff Road and east of La Cholla Boulevard.

La Cholla Boulevard and adjacent streets are also impacted by runoff generated within this watershed. Based on plans of Ruthrauff Road submitted by CBA to Pima County in August 1980, recently surveyed cross-sections of the roadway and its southern right-of-way, and numerous field investigations, it has been determined that a majority of the 100-year peak discharge generated by the Edgebrooke Village

subdivision flows northward across Ruthrauff Road to La Cholla Boulevard and adjacent streets. Weir flow calculations regarding the spillover of runoff from Edgebrooke Village across both Ruthrauff Road and La Cholla Boulevard are contained in the Appendix.

A substantial dip section in La Cholla Boulevard that exists south of the recently constructed bridge across the Rillito River bridge poses a significant flood hazard (Figure 2). This dip section is intended to be drained by a channel that extends northward within the western right-of-way of the road to two 48"x78' corrugated metal pipes located beneath Curtis Road. These pipes were designed to convey 170 cfs of runoff from the channel northward for delivery into the Rillito River. Positive northward grade from the dip section is marginal, however, and extensive ponding persists for long periods of time. Using the roadway plans obtained from Pima County for the recent construction of La Cholla Boulevard, the limits of flooding at the location of the dip section resulting from the 100-year storm have been estimated (see the Appendix).

Additional, more localized existing floodprone areas will be presented and discussed as components of the Critical Watershed Management Plan.

#### 5. Presentation of Results -

The existing flooding conditions throughout the study area, including basin delineations, runoff estimations, and magnitudes of local flooding as shown on Figure 2, were presented to the public at a hearing held at the Flowing Wells Junior High School on December 7, 1982, both formally and in a question/answer period. Comments regarding validation of identified problem areas and identification of additional areas were solicited and incorporated in Phase I of the study where necessary.

## PLAN COMPONENTS

### General

The Critical Watershed Management Plan for the Ruthrauff Road area establishes provisions for reducing area flooding through implementation of the following:

1. Design and construction of public structural flood control improvements in the area,
2. Floodplain management relating to development of private property, including setting requirements for detention/retention of storm runoff as appropriate, and
3. Public maintenance of existing and future drainage facilities.

The above Plan components are interrelated and essential to the future success of efforts to relieve flood hazards within the Plan area. The site specific proposals and regulations comprising the Plan components have been preceded by completion of the Phase 1 investigation of existing flooding conditions within the area, as represented in this report and the accompanying Appendix. A more detailed description of the Plan components is provided in the following passages.

### Component 1 - Public Structural Flood Control Improvements

A number of alternative flood control improvements have been examined for the Ruthrauff Road area with importance being placed on overall feasibility of construction, effectiveness in relieving flood problems, and estimated costs of construction. A key parameter used in the development of alternative flood control improvements was the identification of available outlets to the Santa Cruz River to the west and the Rillito River to the north. The grade differential between the channel beds of these major watercourses and the applicable portions of the Plan area allowed for greater flexibility in design as "flatness of grade" constitutes the most significant contribution to the flooding problem within the Plan area.

Careful examination of alternative flood control improvements by Pima County and CBA resulted in the development of a preferred alternative for overall flood control improvements recommended to be implemented within the Plan area during the next several years. The estimated composite cost for the flood control measures recommended for construction in the Ruthrauff Road Area in conformance with the preferred alternative is \$8,900,000 in 1983 dollars, including a 10% contingency factor. Based on the magnitude of this composite construction cost alone, it is evident that construction of all proposed improvements at one time would be prohibitive; therefore, the composite flood control measures have been subdivided into five groups or "phases". Each phase is applicable to a particular portion of the Plan area and has been developed based on evaluations of unified effectiveness in providing flood relief, geographic considerations and funding considerations. Following the description of each phase is a preliminary cost estimate of the structural flood control improvements developed as part of the phase in question.

The five phases comprising recommended public structural flood control improvements inherent to the Plan have been identified as the Ruthrauff Road Phase, the Gardner Lane Phase, the Wetmore Road Area Phase, the Northern Area Phase, and the Shannon Road/Romero Road Phase, to represent their general geographical area of coverage. Drainageways proposed for construction as part of the Plan are generally of a 100-year design capacity. The storm sewer systems and drainage structures proposed herein are generally designed to collect runoff generated by a 10-year or less frequent storm event. Existing or developed watershed conditions were assumed for each structural flood control improvement design depending upon feasibility of design and associated costs for construction. Contained in the Appendix are design criteria and calculations associated with the proposed structural flood control improvements. The specific flood control improvements associated with each of the five phases are presented as follows:

- A. Ruthrauff Road Phase: This phase of flood control improvements is focused in and around Ruthrauff Road in the central portion of the Plan area from Interstate 10 easterly to La Cholla Boulevard.

Described flood control improvements are to be implemented as part of the proposed widening and reconstruction of Ruthrauff Road in this area made available through Pima County funds and bond money. Flood control improvements included in the Ruthrauff Road Phase are represented on Figure 3 and are discussed below:

1. Construction of a storm sewer along Ruthrauff Road from Kain Avenue to the Southern Pacific Railroad as part of the proposed Ruthrauff Road improvements. These improvements are designed to relieve shallow flooding of Ruthrauff Road and the surrounding area as induced primarily by flatness of grade. The storm sewer has been sized for the estimated magnitude of runoff generated by the 10-year storm event under existing conditions, resulting in a range in pipe size from a 48-inch reinforced concrete pipe (RCP) beginning at Kain Avenue to a 72-inch RCP at the Shannon Road/Ruthrauff Road intersection and westward (see the Appendix for design calculations pertaining to all the storm sewers formulated in this plan). The Ruthrauff Road storm sewer must be continued westerly from the Southern Pacific Railroad to the Santa Cruz River along the Ruthrauff Road alignment to provide an acceptable outlet. The dimensions of this storm sewer are based on a general pipeline grade of 0.5% and an alignment that results in the location of the sewer within the northern abutment of the Ruthrauff Road underpass at I-10.
2. Construction of an inverted crown street along Davis Avenue between Diamond Avenue and Ruthrauff Road with a storm sewer lateral extending northerly from the Ruthrauff Road storm sewer to collect flow at an existing low point in Davis Avenue approximately 300 feet north of Ruthrauff Road. This design is proposed to relieve existing flooding along Davis Avenue and particularly at the Davis Avenue/Ruthrauff Road intersection. The purpose of the inverted crown street is to efficiently deliver runoff to the storm sewer lateral, which has been designed in concept as a 36-inch RCP at a slope of 0.4%.

3. Construction of an inverted crown street system along Violet Avenue and along Highway Drive between Violet Avenue and Ruthrauff Road. This inverted crown street system will deliver collected runoff to the Ruthrauff Road storm sewer at Highway Drive.
4. Construction of an inverted crown street along Shannon Road from an existing high point approximately 300 feet south of Curtis Street, southerly to a series of existing drainage structures located beneath the Southern Pacific Railroad, I-10, and Frontage Roads just north of Ruthrauff Road. These existing structures consist of a 1-cell 12'x5' wooden box culvert beneath the railroad, a 1-cell 8'x6' concrete box culvert (CBC) beneath I-10 and the Frontage Roads, and a connecting drainageway in between.
5. Construction of a drainageway from the existing drainage structure at the Southern Pacific Railroad just north of Ruthrauff Road westerly to the Santa Cruz River. This drainageway will deliver collected runoff from the drainage structures to the Santa Cruz River, and has thus been sized for the lowest existing capacity of these structures (344 cfs) produced by the 1-cell 8'x6' CBC beneath I-10 and the Frontage Roads.
6. Construction of a storm sewer system along Calle Harmonia and Sullinger Avenue north of Ruthrauff Road. As discussed in the section on existing flooding conditions, the Sullinger Avenue/Calle Harmonia area is severely impacted by runoff generated within the Edgebrooke Village subdivision to the southeast and additional basins to the south (see Figure 2). This storm sewer system has been sized for the 10-year runoff estimated to occur at the Calle Harmonia/Ruthrauff Road intersection and northward, assuming the removal of a significant amount of runoff that currently impacts this area by a storm sewer system along La Cholla Boulevard to the east (as described in Item 7, following). From the Calle Harmonia/Ruthrauff Road

intersection about 270 feet eastward are proposed two 36-inch RCPs at a slope of 0.5% to collect runoff that currently flows northward across Ruthrauff Road from areas to the south. One 24-inch RCP, also with a slope of 0.5%, is proposed from Calle Harmonia westward about 350 feet to collect runoff generated by the Villa Capri subdivision located south of Ruthrauff Road opposite Calle Harmonia and Sullinger Avenue. Extending northward along Calle Harmonia and Sullinger Avenue are two 48-inch RCPs at a slope of 0.5%. An outlet for this storm sewer system is provided by an existing drainageway that extends northward from the northern end of Sullinger Avenue. This drainageway loses definition under the existing condition and allows flow to spread just upstream of Curtis Road. As part of the Ruthrauff Road Phase, the drainageway is to be extended, along straight alignment, northward to outlet at the Rillito River. The extended drainageway will be earthen and a drainage structure will be provided at Curtis Road.

7. Construction of a storm sewer along La Cholla Boulevard north of Ruthrauff Road, including collection systems for runoff generated by the Edgebrooke Village subdivision and adjacent areas immediately southeast of the Ruthrauff Road/La Cholla Boulevard intersection. The runoff collection system includes two asphaltic drainage swales, one extending approximately 500 feet southward within the eastern right-of-way of La Cholla Boulevard and the other extending about 700 feet eastward within the southern right-of-way of Ruthrauff Road. These swales have been designed to convey the 10-year peak discharges generated by portions of Edgebrooke Village to the La Cholla storm sewer. Included in this runoff collection system is raising La Cholla Boulevard south of Ruthrauff Road, in order to eliminate an existing dip section, direct runoff into the La Cholla storm sewer, and thus prevent runoff from crossing La Cholla Boulevard and impacting the Calle Harmonia/Sullinger Avenue area, as occurs under existing conditions. The storm sewer in La Cholla Boulevard has been sized to convey runoff generated by the

10-year storm event under developed conditions. Accordingly, two 48-inch RCPs at a slope of 0.5% are proposed to convey runoff generated by Edgebrooke Village and the adjacent basin to the west from the Ruthrauff Road/La Cholla Boulevard intersection northward along La Cholla Boulevard approximately to Jay Avenue.

Additional runoff contributions at Jay Avenue require enlarging the storm sewer to two 60-inch RCPs at a slope of 0.3% to convey collected runoff to the Rillito River.

Approximate cost of Ruthrauff Road Phase is \$2,279,100 in 1983 dollars.

DRAINAGE IMPROVEMENTS COST ESTIMATE  
RUTHRAUFF ROAD PHASE

ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	ESTIMATED COST
<u>Ruthrauff Road*</u> : Storm Sewer, Kain Avenue to Santa Cruz River (5,300 L.F.)					
1.	600	L.F.	24" RCP	\$ 50.00	\$ 30,000
2.	300	L.F.	36" RCP	\$ 60.00	\$ 18,000
3.	300	L.F.	48" RCP	\$ 70.00	\$ 21,000
4.	570	L.F.	54" RCP	\$ 80.00	\$ 45,600
5.	490	L.F.	60" RCP	\$ 90.00	\$ 44,100
6.	640	L.F.	66" RCP	\$ 110.00	\$ 70,400
7.	3,300	L.F.	72" RCP	\$ 125.00	\$ 412,500
8.	13	Ea.	Catch basin (misc.)	\$2,500.00	\$ 32,500
9.	9	Ea.	Manhole (misc.)	\$1,600.00	\$ 14,400
			Subtotal		\$ 688,500
<u>Davis Avenue</u> : Inverted crown street, Ruthrauff Road to Diamond Avenue (1,280 L.F.)					
1.	5,404	S.Y.	Pavement removal	\$ 0.50	\$ 2,702
2.	2,744	C.Y.	Excavation	\$ 1.50	\$ 4,116
3.	5,404	S.Y.	Subgrade preparation	\$ 0.50	\$ 2,702
4.	5,404	S.Y.	6" aggregate base course	\$ 2.00	\$ 10,808
5.	5,404	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 32,424
6.	2,560	L.F.	6" vertical curb	\$ 6.00	\$ 15,360
			Subtotal		\$ 68,110

\*Construction costs for Ruthrauff Road not included.

ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	ESTIMATED COST
<u>Violet Ave./Highway Drive:</u>			Inverted crown streets, Violet Avenue and Highway Drive from Violet Avenue to Ruthrauff Road (1,950 L.F.)		
1.	8,020	S.Y.	Pavement removal	\$ 0.50	\$ 4,010
2.	4,070	C.Y.	Excavation	\$ 1.50	\$ 6,105
3.	8,020	S.Y.	Subgrade preparation	\$ 0.50	\$ 4,010
4.	8,020	S.Y.	6" aggregate base course	\$ 2.00	\$ 16,040
5.	8,020	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 48,120
6.	3,800	L.F.	6" vertical curb	\$ 6.00	\$ 22,800
				Subtotal	\$ 101,090
<u>Shannon Road:</u>			Inverted crown street, from a location 320 feet south of Curtis Street to drainage structure 400 feet north of Ruthrauff Road (1,980 L.F.)		
1.	8,360	S.Y.	Pavement removal	\$ 0.50	\$ 4,180
2.	4,245	C.Y.	Excavation	\$ 1.50	\$ 6,368
3.	8,360	S.Y.	Subgrade preparation	\$ 0.50	\$ 4,180
4.	8,360	S.Y.	6" aggregate base course	\$ 2.00	\$ 16,720
5.	8,360	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 50,160
6.	3,960	L.F.	8" vertical curb	\$ 7.50	\$ 29,700
				Subtotal	\$ 111,310
<u>Channel:</u>			North of El Camino Del Cerro, I-10 to Santa Cruz River (3,400 L.F.)		
1.	12,136	C.Y.	Excavation	\$ 1.50	\$ 18,204
2.		L.S.	Right-of-way, including car removal		\$ 300,000
				Subtotal	\$ 318,200

ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	ESTIMATED COST
<u>Sullinger Avenue/Calle Harmonia:</u> Storm sewer, Ruthrauff Road to northern end of Sullinger Avenue (2,410 L.F.)					
1.	3,320	S.Y.	Pavement removal	\$ 0.50	\$ 1,660
2.	3,320	S.Y.	Subgrade preparation	\$ 0.50	\$ 1,660
3.	3,320	S.Y.	6" aggregate base course	\$ 2.00	\$ 6,640
4.	565	S.Y.	5" asphaltic pavement-Ruthrauff Road	\$ 8.00	\$ 4,520
5.	2,753	S.Y.	4" asphaltic pavement-Calle Harmonia/Sullinger Ave.	\$ 6.00	\$ 16,518
6.	370	L.F.	24" RCP	\$ 50.00	\$ 18,500
7.	540	L.F.	36" RCP	\$ 60.00	\$ 32,400
8.	1,540	L.F.	42" RCP	\$ 65.00	\$ 100,100
9.	2,000	L.F.	48" RCP	\$ 70.00	\$ 140,000
10.	8	Ea.	Catch basin (misc.)	\$2,500.00	\$ 20,000
11.	1	Ea.	Manhole (misc.)	\$1,600.00	\$ 1,600
				Subtotal	\$ 343,600
<u>Sullinger Avenue:</u> Drainageway from a location 200 feet north of Diamond Avenue to Rillito River (2,100 L.F.)					
1.	17,645	C.Y.	Excavation - Channel, Sullinger Avenue Alignment	\$ 1.50	\$ 26,468
2.	57	C.Y.	1-cell, 12'x 6' concrete box culvert x 40'	\$ 250.00	\$ 14,250
3.	21,700	S.F.	Right-of-way for drainageway south of Curtis Street	\$ 3.00	\$ 65,100
				Subtotal	\$ 105,820

La Cholla Blvd.: Storm sewer, Ruthrauff Road to Rillito River (2,900 L.F.)

1.	267	S.Y.	Pavement removal - cross streets	\$ <u>0.50</u>	\$ <u>134</u>
2.	267	S.Y.	Subgrade preparation - cross streets	\$ <u>0.50</u>	\$ <u>134</u>
3.	267	S.Y.	6" aggregate base course - cross streets	\$ <u>2.00</u>	\$ <u>534</u>
4.	267	S.Y.	4" asphaltic pavement - cross streets	\$ <u>6.00</u>	\$ <u>1,602</u>
5.	2,400	L.F.	48" RCP	\$ <u>70.00</u>	\$ <u>168,000</u>
6.	3,400	L.F.	60" RCP	\$ <u>90.00</u>	\$ <u>306,000</u>
7.	7	Ea.	Catch basin (misc.)	\$ <u>2,500.00</u>	\$ <u>17,500</u>
8.	3	Ea.	Manhole (misc.)	\$ <u>1,600.00</u>	\$ <u>4,800</u>
			Subtotal		\$ <u>498,700</u>

La Cholla Blvd./Ruthrauff Road: Runoff Collection System (1,450 L.F.)

1.	680	C.Y.	Excavation - asphaltic swale, Ruthrauff Road	\$ <u>1.50</u>	\$ <u>1,020</u>
2.	1,670	S.Y.	3-1/2" asphaltic pavement	\$ <u>5.00</u>	\$ <u>8,350</u>
3.	635	C.Y.	Excavation - asphaltic swale, La Cholla Blvd.	\$ <u>1.50</u>	\$ <u>953</u>
4.	1,556	S.Y.	3-1/2" asphaltic pavement	\$ <u>5.00</u>	\$ <u>7,780</u>
5.	2,333	S.Y.	Pavement removal - La Cholla Blvd. south of Ruthrauff Road	\$ <u>0.50</u>	\$ <u>1,167</u>
6.	2,333	S.Y.	Subgrade preparation	\$ <u>0.50</u>	\$ <u>1,167</u>
7.	2,333	S.Y.	6" aggregate base course	\$ <u>2.00</u>	\$ <u>4,666</u>
8.	2,333	S.Y.	5" asphaltic pavement	\$ <u>8.00</u>	\$ <u>18,664</u>
			Subtotal		\$ <u>43,770*</u>
			TOTAL		\$ <u>2,279,100</u>

\*Fill costs for reconstruction of La Cholla Blvd. south of Ruthrauff Road have not been estimated at this time.

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B. Gardner Lane Phase: The Gardner Lane Phase consists of flood control improvements along the southern boundary of the Ruthrauff Road Area just east of the Southern Pacific Railroad. The purpose of construction of flood control improvements associated with the Gardner Lane Phase is to intercept, control, and eliminate substantial quantities of storm runoff entering the Ruthrauff Road area itself from offsite sources. Construction of the Gardner Lane Phase will eliminate the most significant offsite flooding source impacting the Plan area. Specific flood control improvements associated with the Gardner Lane Phase are represented on Figure 4 and are described as follows:

1. Construction of a detention basin adjacent to Gardner Lane at the southern boundary of the Ruthrauff Road Area directly to the east of the Southern Pacific Railroad. This basin has been sized to detain approximately the 100-year runoff that enters the Ruthrauff Road area from basins south of Gardner Lane and Roger Road. The proposed basin area (approximately 7.51 acres) covers Lots 1-5 and 44-46 of the Freeway Industrial subdivision recorded in Book 15 at Page 73, Pima County Maps and Plats, and allows for storage at a depth of 10 feet.
2. Construction of an improved drainageway (concrete-lined) along the south side of Gardner Lane from Romero Road westerly to connect to the proposed detention basin. This drainageway will serve as a means of intercepting shallow flooding resulting from the 100-year storm event, assuming developed conditions, before it enters the Plan area.
3. Construction of an inverted crown street along La Cholla Boulevard from Wetmore Road south to connect to the improved drainageway extending westerly along Gardner Lane. This street will collect low flow runoff generated within adjacent residential areas to the east.

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4. Construction of an improved drainageway along the east side of the Southern Pacific Railroad south of Gardner Lane to effectively intercept runoff impounded along the railroad embankment for delivery to the proposed detention basin. This drainageway has also been sized to convey runoff resulting from the 100-year storm event, once again assuming developed conditions.
  
  5. Construction of an outfall storm sewer from the detention basin across the Southern Pacific Railroad, Interstate 10 and westerly for delivery to the Santa Cruz River along the Sweetwater Drive alignment. This storm sewer consists of two 54-inch RCPs designed to convey approximately 480 cfs, assuming inlet control conditions. This outflow will be adequate for controlling the 100-year discharge considering the attenuating effect of storage within the detention basin.

Approximate cost of Gardner Lane Phase is \$2,555,350 in 1983 dollars.

DRAINAGE IMPROVEMENTS COST ESTIMATE  
GARDNER LANE PHASE

ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	ESTIMATED COST
<u>Detention Basin: Lots 1-5, 44-46, Freeway Industrial Subdivision</u>					
1.	327,044 = 7.5 <sup>mi</sup>	S.F.	Right-of-way	\$ 3.00	\$ 981,132
2.	121,129	C.Y.	Excavation	\$ 1.50	\$ 181,694
			Subtotal		\$ 1,162,830
<u>Outfall Storm Sewer: SPRR to Santa Cruz River (3,650 L.F.)</u>					
1.	7,300	L.F.	54" RCP	\$ 80.00	\$ 584,000
2.	450	L.F.	54" RCP (tunneled)	\$ 450.00	\$ 202,500
3.	25,370	L.F.	Excavation - RCPs	\$ 1.50	\$ 38,055
4.	57,582	S.F.	25' concrete-lined trap. channel	\$ 2.00	\$ 115,164
5.	60,320	S.F.	40' concrete-lined trap. channel	\$ 2.00	\$ 120,640
6.	108,000	S.F.	20' concrete-lined rectangular channel	\$ 2.00	\$ 216,000
7.	19,345	C.Y.	Excavation - all channels	\$ 1.50	\$ 29,018
			Subtotal		\$ 1,305,380
<u>La Cholla Blvd: Inverted crown street, Wetmore Road to Gardner Lane (1,870 L.F.)</u>					
1.	3,967	C.Y.	Excavation - La Cholla Blvd.	\$ 1.50	\$ 5,951
2.	7,810	S.Y.	Pavement removal	\$ 0.50	\$ 3,905
3.	7,810	S.Y.	6" aggregate base course	\$ 2.00	\$ 15,620
4.	7,810	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 46,860
5.	3,700	L.F.	6" vertical curb	\$ 4.00	\$ 14,800
			Subtotal		\$ 87,140
			TOTAL		\$ 2,555,350

C. Wetmore Road Area Phase: Flood control improvements associated with the Wetmore Road Area Phase are intended to relieve ponding and shallow flooding conditions in the predominantly light industrial area within the southwestern portion of the Ruthrauff Road Area west of La Cholla Boulevard. Generally, this phase includes the construction of drainage facilities to deliver runoff to the Southern Pacific Railroad and Interstate 10 drainage structures at the Arizona Feeds Mill south of Ruthrauff Road. Flood control improvements proposed as part of implementation of the Wetmore Road Area Phase are described below:

1. Construction of an inverted crown street along Zinnia Avenue east of Highway Drive connecting to an inverted crown street along Highway Drive north of Zinnia Avenue to the south boundary of the Arizona Feeds Mill.
2. Modification to the existing Flowing Wells Junior High School fields to allow for detention of storm runoff. Under existing conditions, runoff that enters the fields from residential areas to the east impacts industrial and high-density residential areas to the west and northwest. A detention basin design has thus been formulated to approximately detain the volume of runoff generated at the school site by the 100-year storm event, while releasing a volume of runoff equivalent to that generated by the 2-year storm (see the Appendix). This design includes a substantial berm along the western boundary of the fields and 1 (one) 42"x27" oval concrete pipe as the basin outlet at the southwestern corner of the fields.
3. Construction of a channel extending westerly along the north side of Wetmore Road to Highway Drive and accompanying access crossings to lots (2-50"x31" corrugated metal pipe arch culverts per lot), a drainage crossing of Highway Drive consisting of a one-cell 6' x 3' concrete box culvert (only 2 feet of culvert height is hydraulically effective), and a channel continuing westerly to the Southern Pacific Railroad. This series of channels and drainage crossings have been sized for the 2-year

outflow of runoff from the detention basin described above (approximately 77 cfs) or greater (see the Appendix).

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4. Construction of a drainage channel south of and parallel to Wetmore Road from Plum Avenue to the Southern Pacific Railroad, designed to convey the 100-year runoff generated under existing conditions.
  5. Construction of an inverted crown street along Plum Avenue south of Wetmore Road to deliver runoff to the drainage channel extending westerly from Plum Avenue to the Southern Pacific Railroad. This inverted crown street will also enhance drainage of Plum Avenue and reduce maintenance of the roadway.
  6. Construction of an improved drainage channel within the eastern right-of-way of the Southern Pacific Railroad from the southern boundary of Cal Gas to the Arizona Feeds Mill. This improved drainage channel, designed to convey the 100-year runoff of approximately 625 cfs generated under existing conditions, will connect flows collected from the Wetmore Road channel and parallel channel to the south to flows intercepted and collected by the inverted crown streets at Zinnia Avenue and Highway Drive.
  7. Installation of new drainage structures, consisting of 2-cell 10'x4' concrete box culverts with capacities of approximately 700 cfs (100-year design for existing conditions), across the Southern Pacific Railroad spur track, main track and Interstate 10 at the Arizona Feeds Mill to pass collected upstream runoff westerly out of the study area. Also required would be the construction of an offsite drainageway to deliver runoff collected in the new drainage structures westerly for release at the Santa Cruz River. The offsite drainageway proposed west of I-10 has accordingly been sized for the 100-year runoff generated under existing conditions at the location of the box culverts under the Southern Pacific Railroad tracks and I-10 (625 cfs).

Approximate cost of Wetmore Road Area Phase is \$1,223,250 in 1983 dollars.

DRAINAGE IMPROVEMENTS COST ESTIMATE

WETMORE ROAD AREA PHASE

ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	ESTIMATED COST
<u>Plum Avenue:</u> Inverted crown street south of Wetmore Road (650 L.F.) and drainageway, Plum Avenue to SPRR (1,700 L.F.)					
1.	4,467	C.Y.	Excavation	\$ 1.50	\$ 6,700
2.	5,066	S.Y.	4" gunite lining	\$ 14.00	\$ 70,924
3.	106	C.Y.	2-cell, 12'x 4' concrete box culvert x 40'	\$ 250.00	\$ 26,500
4.	36	C.Y.	1-cell, 10'x 3' concrete box culvert x 40'	\$ 250.00	\$ 9,000
5.	2,744	S.Y.	Subgrade preparation	\$ 0.50	\$ 1,372
6.	2,744	S.Y.	6" aggregate base course	\$ 2.00	\$ 5,488
7.	2,744	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 16,464
8.	1,300	L.F.	6" vertical curb	\$ 4.00	\$ 5,200
9.	68,800	S.F.	Right-of-way for drainageway	\$ 3.00	\$ 206,400
Subtotal					\$ 348,050
<u>Detention Basin/Drainageway:</u> Flowing Wells, Jr. High School to SPRR (drainageway: 2,300 L.F.)					
1.	4,367	C.Y.	Fill (berm for detention basin @ Flowing Wells Jr. High School)	\$ 2.00	\$ 8,734
2.	30	L.F.	42" x 27" oval concrete pipe (basin outlet)	\$ 84.00	\$ 2,520
3.	2,187	C.Y.	Excavation - channel in north right-of-way of Wetmore Road	\$ 1.50	\$ 3,281
4.	5,510	S.Y.	4" gunite lining	\$ 14.00	\$ 77,140
5.	400	L.F.	2-50" x 31" CMPAs per access crossing	\$ 45.00	\$ 18,000
6.	35	C.Y.	1-cell, 6' x 3' concrete box culvert x 40'	\$ 250.00	\$ 8,750
Subtotal					\$ 118,430*

ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	ESTIMATED COST
<u>Eastern Right-of-Way of SPRR: Drainageway, gas spur track to Arizona Feeds Mill (2,500 L.F.)</u>					
1.	9,680	C.Y.	Excavation - channel in eastern right-of-way of SPRR	\$ 1.50	\$ 14,520
2.	13,370	S.Y.	4" gunite lining	\$ 14.00	\$ 187,180
	3,600	S.F.	2-cell, 10'x 4' concrete box culvert x 300' beneath I-10	\$ 50.00	\$ 180,000**
	1,560	S.F.	2-cell, 10'x 4' concrete box culvert x 130' beneath SPRR and spur track	\$ 50.00	\$ 78,000**
	12,400	S.F.	Right-of-way adjacent to Arizona Feeds Mill	\$ 3.00	\$ 37,200
				Subtotal	\$ 496,900
<u>Drainageway: I-10 to Santa Cruz River (3,460 L.F.)</u>					
	8,120	C.Y.	Excavation - channel from I-10 to the Santa Cruz River	\$ 1.50	\$ 12,180
	12,912	S.Y.	4" gunite lining	\$ 14.00	\$ 180,768
				Subtotal	\$ 192,950
Traffic maintenance costs not included.					
**Additional costs may be encountered if grading of detention basin requires removal and reconstruction of irrigation facilities.					
<u>Zinnia Avenue/Highway Drive: Inverted crown street, Zinnia Avenue and Highway Drive from Zinnia Avenue to Arizona Feeds Mill (1,360 L.F.)</u>					
1.	5,740	S.Y.	Pavement removal	\$ 0.50	\$ 2,870
2.	2,920	C.Y.	Excavation	\$ 1.50	\$ 4,380
3.	5,740	S.Y.	Subgrade preparation	\$ 0.50	\$ 2,870
4.	5,740	S.Y.	6" aggregate base course	\$ 2.00	\$ 11,480
5.	5,740	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 34,440
6.	2,720	L.F.	6" vertical curb	\$ 4.00	\$ 10,880
				Subtotal	\$ 66,920
				TOTAL	\$1,223,250

*Drainageway only \$ 238,900*

D. Northern Area Phase: The Northern Area Phase is comprised of the construction of a number of outfall channels, inverted crown streets and storm sewers within the northern and northwestern portion of the Ruthrauff Road area. The downstream terminus point for each outfall is the Rillito River. Drainage improvements as proposed should greatly reduce long-term ponding and shallow flooding problems experienced primarily by residential areas intermixed with light industrial and commercial uses. Flood control improvements proposed as part of the construction of the Northern Area Phase are represented on Figure 6 and are described as follows:

1. Construction of an inverted crown street and storm sewer along Curtis Street from Sago Circle westerly to Highway Drive, Highway Drive from Curtis Street to El Camino del Terra, and El Camino del Terra from Highway Drive to the Rillito River. These structural flood control improvements are designed to relieve flooding of Highway Drive produced by relatively flat grades and the impoundment of runoff by the Southern Pacific Railroad adjacent to the roadway. The storm sewer system ranges in size from two 36-inch RCPs along Curtis Road to two 48-inch RCPs along El Camino del Terra at pipeline grades of 0.3% to 0.5% (see the Appendix). This system is capable of conveying the 10-year runoff generated under existing conditions by a 179-acre area bounded by the Southern Pacific Railroad on the west, Sunset Road on the north, and Shannon Road on the east. Runoff generated by basins east of Shannon Road that impacts Highway Drive under existing conditions is assumed to be diverted to the south by the inverted crown street of Shannon Road south of Curtis Road, proposed as part of the Ruthrauff Road Phase.

Also included in this item is the construction of an inverted crown street and lateral storm sewer (1-36" RCP) along Sunset Road extending easterly from El Camino del Terra. Access to Sunset Road from Highway Drive and drainage of the former roadway will be greatly enhanced by these improvements.

2. Construction of an inverted crown street along Shannon Road beginning just south of Curtis Street and extending northerly to the Rillito River. Locally severe flood hazards created by dip sections without positive drainage along the east side of Shannon Road at intersecting streets to the east have been documented through numerous complaints made by residents to Pima County and through field investigations. Construction of an inverted crown street along Shannon Road, in conjunction with a storm sewer proposed as part of the Shannon Road/Romero Road Phase (described later) will reduce, if not eliminate, these hazards.
  
3. Construction of an inverted crown street along Kain Avenue from Diamond Avenue to Curtis Street, drainage crossing at the Kain Avenue/Curtis Road intersection (three 42-inch RCPs with a combined capacity of approximately 264 cfs), and a drainage channel along the Kain Avenue alignment from Curtis Street to the Rillito River. This drainage system is designed to mitigate existing shallow flooding of Kain Avenue produced by poorly maintained corrugated metal pipes located along the east side of the roadway, and flooding of the Kain Avenue/Curtis Road intersection created by relatively flat grades and drainage of the adjacent subdivisions. The drainage crossing and channel have both been sized for the 100-year peak discharge generated under developed conditions by a 41.3-acre basin extending to the south of Curtis Road. *per memo to [unclear] 6/1*
  
4. Lining of the improved channel constructed along the Sullinger Avenue alignment from Diamond Avenue to the Rillito River as part of the Ruthrauff Road Phase. The channel provides an outlet to the Rillito River for runoff collected by the Calle Harmonia/Sullinger Avenue storm sewer and additional surface runoff; therefore, this channel has been designed for approximately 787 cfs, which represents runoff generated by the 100-year storm event under developed conditions.

Approximate cost of Northern Area Phase is \$1,440,360 in 1983 dollars.

DRAINAGE IMPROVEMENTS COST ESTIMATE  
NORTHERN AREA PHASE

ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	ESTIMATED COST
<u>Highway Drive/Sunset Road:</u> Storm sewer and inverted crown street, Curtis Street west of Sago Circle, Highway Drive from Curtis Street to Rillito River, and Sunset Road east of Highway Drive (9,450 L.F.)					
1.	12,345	S.Y.	Pavement removal	\$ 0.50	\$ 6,173
2.	1,713	C.Y.	Excavation	\$ 1.50	\$ 2,570
3.	15,678	S.Y.	Subgrade preparation	\$ 0.50	\$ 7,839
4.	15,678	S.Y.	6" aggregate base course	\$ 2.00	\$ 31,356
5.	15,678	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 94,068
6.	1,840	L.F.	6" vertical curb - Curtis St.	\$ 6.00	\$ 11,040
7.	2,840	L.F.	36" RCP	\$ 60.00	\$ 170,400
8.	3,200	L.F.	42" RCP	\$ 65.00	\$ 208,000
9.	4,100	L.F.	48" RCP	\$ 70.00	\$ 287,000
10.	11	Ea.	Catch basin (misc.)	\$2,500.00	\$ 27,500
				Subtotal	\$ 845,950
<u>Shannon Road:</u> Inverted crown street, from a location 160 feet south of Curtis Street to Rillito River (2,650 L.F.)					
1.	8,333	S.Y.	Pavement removal	\$ 0.50	\$ 4,167
2.	10,130	C.Y.	Excavation	\$ 1.50	\$ 15,195
3.	10,555	S.Y.	Subgrade preparation	\$ 0.50	\$ 5,278
4.	10,555	S.Y.	6" aggregate base course	\$ 2.00	\$ 21,110
5.	10,555	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 63,330
6.	5,000	L.F.	8" vertical curb	\$ 7.50	\$ 37,500
				Subtotal	\$ 146,580

ESTIMATED ITEM	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	ESTIMATED COST
<u>Kain Avenue:</u>			Inverted crown street, Diamond Avenue to Curtis Street and drainageway, Curtis Street to Rillito River (2,600 L.F.)		
1.	6,122	S.Y. <i>pd</i>	Pavement removal	\$ 0.50	\$ 3,061
2.	3,109	C.Y.	Excavation	\$ 1.50	\$ 4,664
3.	6,122	S.Y.	Subgrade preparation	\$ 0.50	\$ 3,061
4.	6,122	S.Y.	6" aggregate base course	\$ 2.00	\$ 12,244
5.	6,122	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 36,732
6.	2,900	L.F.	6" vertical curb	\$ 6.00	\$ 17,400
7.	120	L.F.	3-42" RCPs	\$ 65.00	\$ 7,800
8.	10,000	C.Y.	Excavation - channel, Kain Ave. alignment	\$ 1.50	\$ 15,000
9.	2,974	S.Y.	<del>4" gunite lining</del>	\$ 14.00	\$ 41,636
10.	65,000	S.F.	Right-of-way for drainageway	\$ 3.00	\$ 195,000
				Subtotal	\$ 336,600
<u>Sullinger Avenue:</u>			Drainageway, from a location 200 feet north of Diamond Avenue to Rillito River (2,100 L.F.)		
1.	7,945	S.Y.	4" gunite lining	\$ 14.00	\$ 111,230
				Subtotal	\$ 111,230
				TOTAL	\$1,440,360

E. Shannon Road/Romero Road Phase: This phase of proposed structural flood control improvements includes further enhancements of drainage control within the northwestern portion of the Ruthrauff Road area, which currently is predominantly residential. Also included are provisions for control of runoff entering the eastern portion of the Ruthrauff Road area. Flood control improvements associated with the implementation of the Shannon Road/Romero Road Phase are represented on Figure 7 and are described below:

1. Construction of a storm sewer along Shannon Road beginning just south of Curtis Street and extending northerly to the Rillito River. The storm sewer, ranging in size from a 36-inch RCP to a 54-inch RCP at a general slope of 0.5%, has been designed to convey runoff generated under developed conditions by the 10-year storm event over an 83.5-acre area that includes Palmetto subdivision east of Shannon Road and 26.3 acres located mainly south of Curtis Road. The addition of the storm sewer to the inverted crown street proposed along the same length of Shannon Road in the Northern Area Phase essentially constitutes a 100-year structural flood control design.
2. Construction of a storm sewer along Wetmore Road west from Romero Road for a distance of 900 feet, (a 24-inch RCP at an 0.6% slope), and north along Romero Road from the Wetmore Road intersection to the terminus of the bend transition to Ruthrauff Road at an existing constructed drainageway (a 42-inch RCP at a slope of 0.6% transitioning to a 48-inch RCP with a 0.4% slope). The section of storm sewer along Wetmore Road is designed to intercept runoff generated by a series of townhomes located to the southwest of the Wetmore Road/Romero Road intersection. Also included in this phase is the lining of the floor of the existing drainageway within the Edgebrooke Subdivision south of Ruthrauff Road, and the addition of two 48-inch corrugated metal pipes to the existing culvert extension of the drainageway beneath Ruthrauff Road, in order to increase their respective capacities

to at least 546 cfs, generated by the portions of Edgebrooke Village designed to drain into this channel.

Approximate cost of Shannon Road/Romero Road Phase is \$592,050.

DRAINAGE IMPROVEMENTS COST ESTIMATE  
ROMERO ROAD/SHANNON ROAD PHASE

ITEM	ESTIMATED QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	ESTIMATED COST
<u>Romero Road:</u> Storm sewer, Wetmore Road to Ruthrauff Road (4,380 L.F.)					
1.	920	L.F.	24" RCP	\$ 50.00	\$ 46,000
2.	1,560	L.F.	42" RCP	\$ 65.00	\$ 101,400
3.	1,900	L.F.	48" RCP	\$ 70.00	\$ 133,000
4.	10	Ea.	Catch basin (misc.)	\$2,500.00	\$ 25,000
5.	5	Ea.	Manhole (misc.)	\$1,600.00	\$ 8,000
6.	2,900	S.Y.	4" gunite lining (Edgebrooke Subdivision channel)	\$ 14.00	\$ 40,600
7.	208	L.F.	2-48" CMPs	\$ 44.00	\$ 9,152
			Subtotal		\$ 363,150
<u>Shannon Road:</u> Storm sewer, from a location 160 feet south of Curtis Street to Rillito River (2,640 L.F.)					
1.	2,289	S.Y.	Pavement removal	\$ 0.50	\$ 1,145
2.	2,289	S.Y.	Subgrade preparation	\$ 0.50	\$ 1,145
3.	2,289	S.Y.	6" aggregate base course	\$ 2.00	\$ 4,578
4.	2,289	S.Y.	4" asphaltic pavement	\$ 6.00	\$ 13,734
5.	570	L.F.	36" RCP	\$ 60.00	\$ 34,200
6.	540	L.F.	42" RCP	\$ 65.00	\$ 35,100
7.	800	L.F.	48" RCP	\$ 70.00	\$ 56,000
8.	725	L.F.	54" RCP	\$ 80.00	\$ 58,000
9.	10	Ea.	Catch basin (misc.)	\$2,500.00	\$ 25,000
			Subtotal		\$ 228,900
			TOTAL		\$ 592,050

The order in which the phases for flood control improvements have been presented in this section of the Plan does not necessarily represent relative timing of construction. Rather, the establishment of priorities for phase construction are the responsibility of the Pima County Engineer based on degrees of flood relief desired and available funding at future dates of action. However, since a substantial percentage of the funding for the Ruthrauff Road Phase is currently available, it is likely that this phase of flood control improvements will be the first to commence.

The specific flood control improvements represented herein are based on preliminary designs only. Prior to implementation of any improvement phase, it will be necessary for complete design drawings and analyses to be performed to Pima County standards by a qualified registered professional engineer.

Construction of the flood control improvements represented in this component of the Critical Watershed Management Plan will result in a substantial reduction in area flooding problems. It is important to note, however, that these flood control improvements are interrelated with the other two components of the Plan and thus, their mitigative effect could be reduced substantially in time if enforcement and monitoring of the other components were not carried out.

#### Component 2 - Floodplain Management Criteria

As part of the implementation of a viable flood control program for the Ruthrauff Road area, it is essential that consideration be given to the prevention of future worsening of flood conditions. Also, without proper floodplain management there exists a strong possibility of substantially reducing the effectiveness of constructed structural flood control improvements implemented per Component 1.

Component 2 of the Critical Watershed Management Plan for the Ruthrauff Road Area encourages private participation in further reducing the flood hazard for the area through requirements established for new development. \*

where are these opportunities?

These requirements may take the form of: 1) mandatory detention/retention of storm runoff under a given set of development conditions, and 2) dedication of rights-of-way to Pima County as required for future installation of structural flood control improvements. These requirements are site specific and will be based upon Pima County review and interpretation of flooding conditions and right-of-way requirements relevant to each proposed new site development.

Zones have been established within the Plan area for which applicable requirements for detention/retention will be administered. These zones are represented on Figure 8 of this report. The zones have been geographically established by considering the present and future effectiveness of detention/retention as a floodplain management policy within different geographical portions of the Plan area.

?

Properties located within zones designated as ND zones will not require detention/retention as a condition of development due to their proximity to an existing outfall for storm runoff. Generally, the ND zones are located at downstream limits of the Plan area.

verify location

There are also portions of the Plan area which are designated as CD(X) zones for which detention/retention will be required as a condition of site development, until such time as specific phases of the public structural flood control improvements are constructed as part of the implementation of Component 1 of the Plan.

Flooding conditions within the remaining portions of the Plan area are of a nature that continued development will create significant increases in area flooding problems regardless of the extent of structural flood control improvements that have been constructed in accordance with the Plan. Properties developed within these zones, represented as D zones, will require construction of accompanying detention/retention facilities unless a written waiver is obtained from the Pima County Engineer.

In all cases, detention/retention facilities shall be designed to limit peak runoff rates exiting a development to rates experienced under a pre-development condition.

not reduced Q's since "critical"

The second regulatory entity of Component 2 will be the establishment of a policy by Pima County to acquire necessary rights-of-way for future flood control improvements through the development and zoning process as appropriate to allow for construction of future flood control improvements within the Plan area. Affected private property owners will be required to dedicate by plat or separate instrument all necessary rights-of-way required for flood control purposes to Pima County as a condition of development based on a case-by-case review by the Pima County Flood Control District. This policy will encourage private participation in the overall flood control improvements proposed for the area and correspondingly reduce future construction costs borne by Pima County as part of the implementation of the public structural flood control improvements inherent to the Plan.

*Policy should be used by COJ*

Component 3 - Maintenance of Existing and Future Drainage Facilities

Immediate relief of several area flooding problems that have been documented within the Ruthrauff Road Area will be provided through effective public maintenance of existing drainage facilities. This public maintenance includes debris and vegetation clearing, local grading and roadway repairs as required.

*Ben & Operations*

Several key locations are to be placed on a regular program for annual maintenance with more frequent maintenance provided as appropriate. The key locations that have been designated, as a minimum, to be included in a regular public maintenance program are:

- 1) The existing drainage swale and associated drainage structures along the eastern embankment of the Southern Pacific Railroad. Drainage structures are located at the Cal Gas plant (approximately 570 feet south of the Wetmore Road alignment), the Arizona Feeds Mill (approximately 300 feet north of the Zinnia Avenue alignment), Ruthrauff Road (approximately 40 feet east of the Southern Pacific Railroad), and directly west of the Shannon Road dip section (approximately 350 feet north of Ruthrauff Road).

*deformation during pipeline construction*

- 2) The existing roadway shoulder swale and channel extending northerly along the western right-of-way for La Cholla Boulevard from a location approximately 450 feet south of Curtis Street north to the Rillito River. Adequate maintenance of this swale and channel should at least partially relieve the existing flooding of the dip section in La Cholla Boulevard south of the Rillito River.
- 3) Existing roadway shoulder ditches along Highway Drive north of Curtis Road and El Camino Del Terra from Highway Drive to the Rillito River. At the present time, a series of 18-inch corrugated metal pipes located within these ditches provide access to lots adjacent to Highway Drive. Maintenance of these pipes is necessary in order to lessen ponding on their upstream sides and spillover of runoff onto Highway Drive.
- 4) The existing drainage swale along the south side of Ruthrauff Road extending west from the channel outlet at Edgebrooke Village to La Cholla Boulevard.
- 5) The existing roadway shoulder swale along the southern side of Wetmore Road extending approximately from Sullinger Avenue to the Southern Pacific Railroad. Corrugated metal pipes at this location are inoperative at the present time due to deformation and clogging by vegetation and debris.
- 6) Sunset Road at and east of El Camino Del Terra. Access to Sunset Road from El Camino Del Terra during and following rainstorms is difficult due to extremely poor drainage of Sunset Road.
- 7) General street repairs as required to eliminate potholes and maintain drainage.
- 8) Flood control improvements constructed as part of Component 1 of the Critical Watershed Management Plan.

## SUMMARY

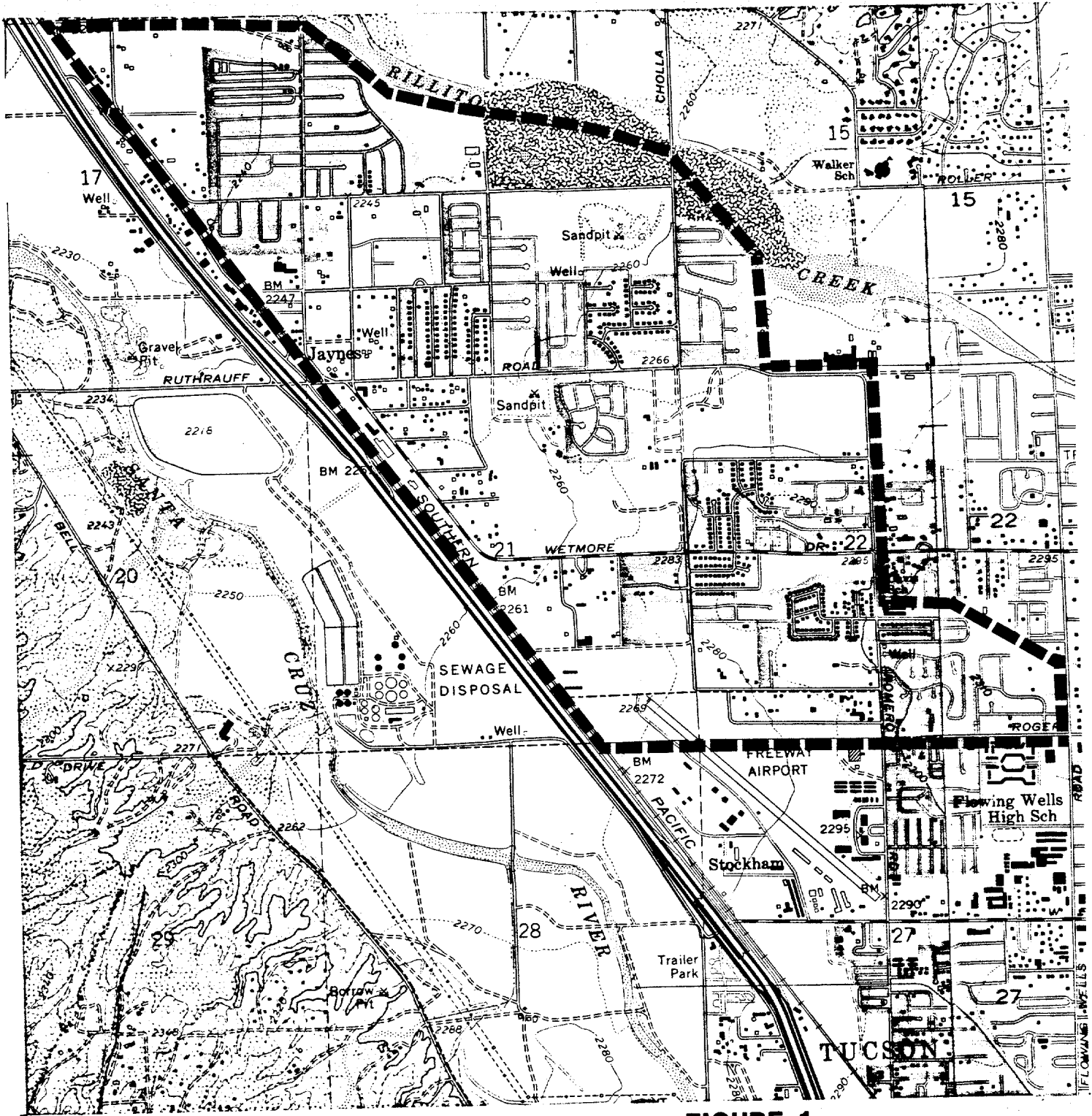
This Critical Watershed Management Plan for the Ruthrauff Road Area pertains to a two and one-half square mile area northwest of the Tucson city limits and has been prepared in recognition of area flooding problems induced by urbanization within this unusually flat portion of the Tucson basin. The preparation of this Critical Watershed Management Plan has been prompted by the adoption of Section 1307 of the Pima County Floodplain Management Ordinance No. 1974-86 by the Pima County Board of Supervisors on April 5, 1982 as rewritten and adopted as Ordinance No. 1983-FCI on July 12, 1983. The Ruthrauff Road Area has been classified as a "critical basin" on official Pima County Maps, thus requiring the establishment of drainage regulations as represented in this Critical Watershed Management Plan for the area. This Critical Watershed Management Plan for the Ruthrauff Road Area has been developed based on an extensive three-phase study of area flooding and potential solutions with input being solicited from the public at two key milestone points during study preparation.

The Critical Watershed Management Plan for the Ruthrauff Road Area is comprised of three major components designed to reduce area flooding. These components are:

- Component 1 - Public Structural Flood Control Improvements
- Component 2 - Floodplain Management Criteria
- Component 3 - Maintenance of Existing and Future Drainage Facilities

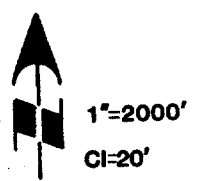
The Plan components are interrelated and essential to the future success of efforts to relieve flood hazards within the Plan area. Adoption of the Critical Watershed Management Plan for the Ruthrauff Road Area will establish a program for flood relief provided by the efficient use of public funds utilized for structural flood control improvements, private contributions stimulated by requirements for detention/retention and right-of-way dedication for new development, and regular maintenance. This Plan will serve as an overall effective management tool for the Ruthrauff Road Area.

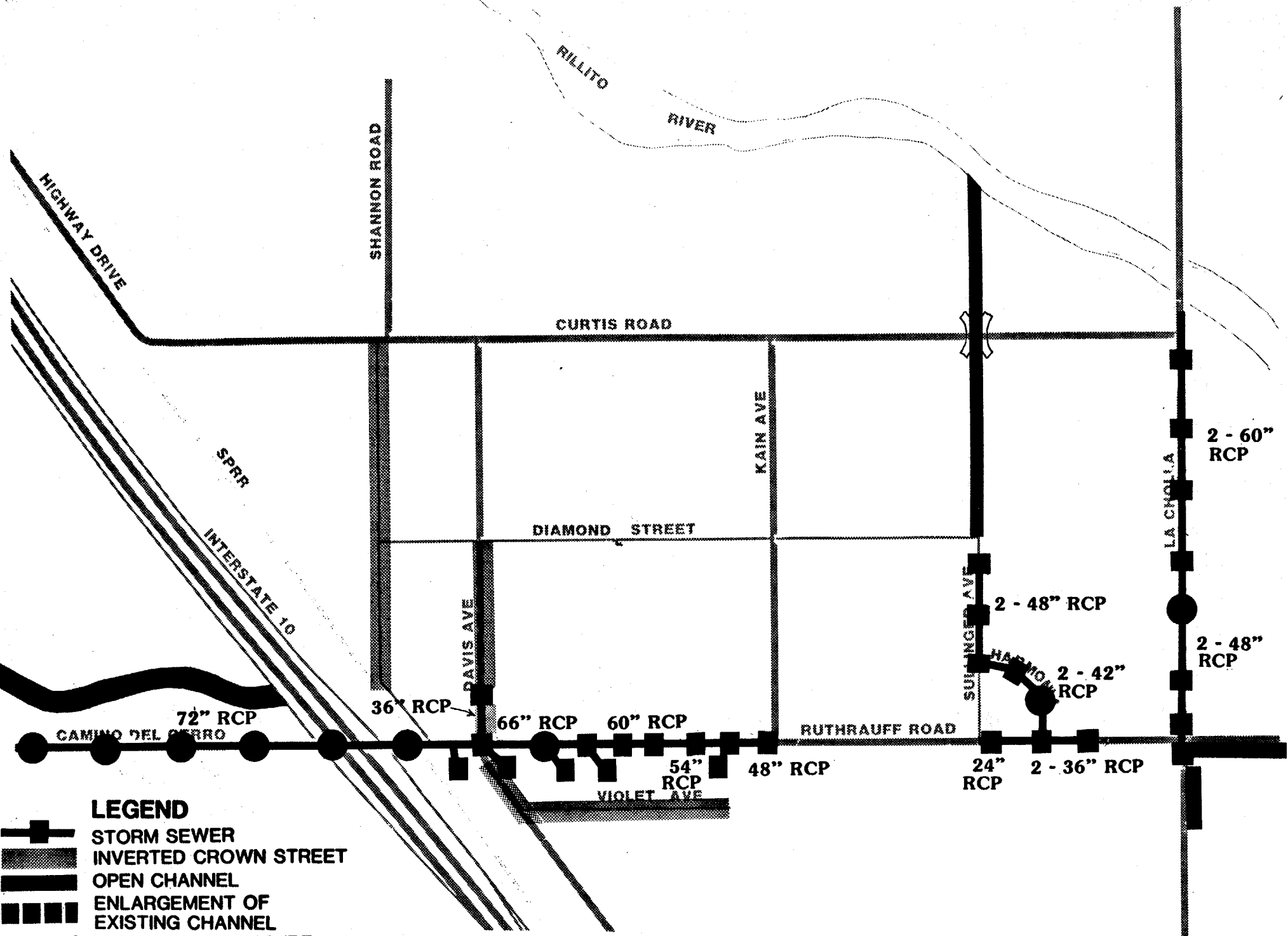
# CRITICAL WATERSHED MANAGEMENT PLAN RUTHRAUFF ROAD AREA



**FIGURE 1  
LOCATION MAP OF THE  
RUTHRAUFF ROAD AREA**

■■■■■■■■■■ BOUNDARY OF STUDY AREA



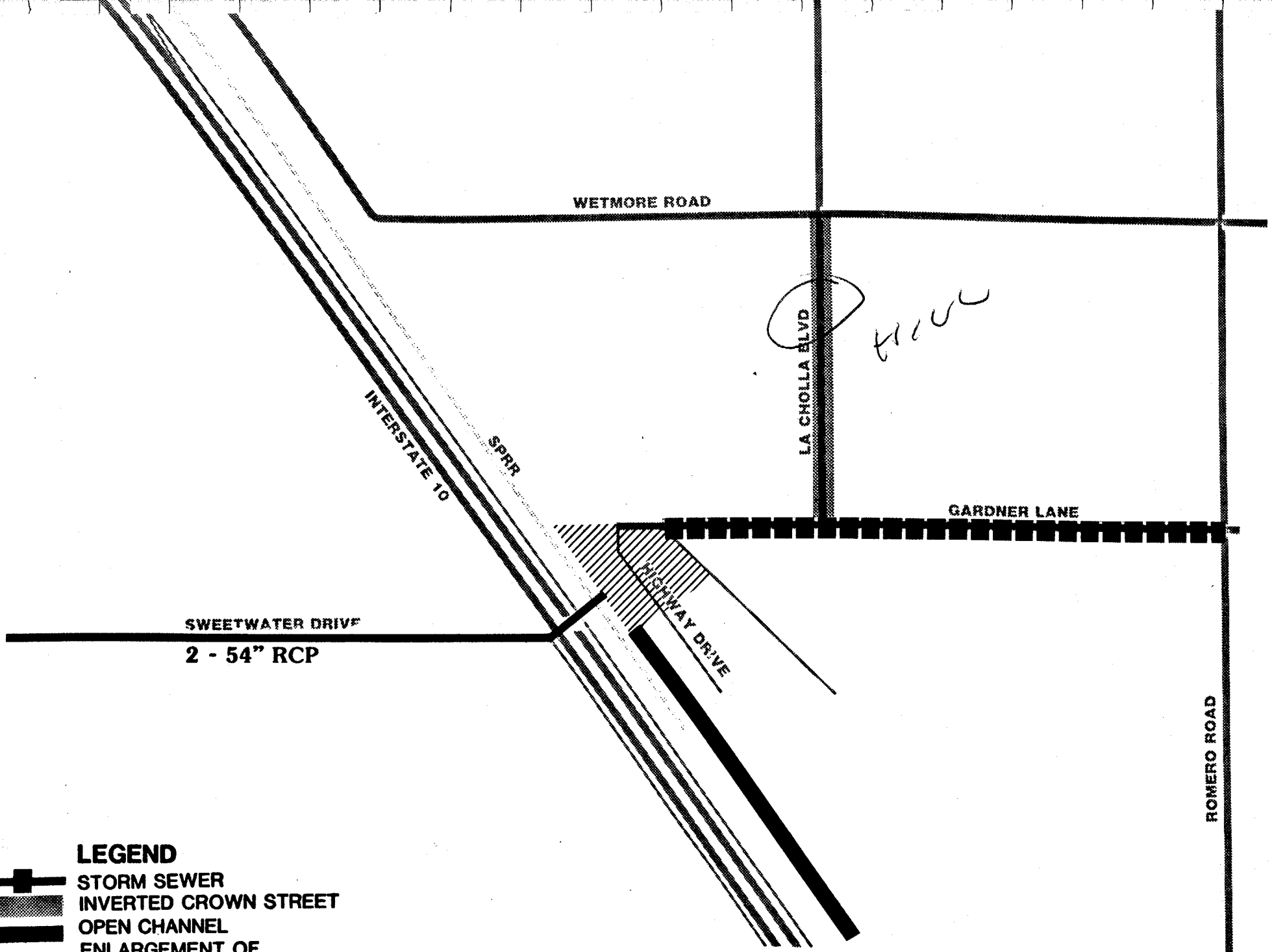


**RUTHRAUFF ROAD PHASE**

**FIGURE 3**







- LEGEND**
- STORM SEWER
  - INVERTED CROWN STREET
  - OPEN CHANNEL
  - ENLARGEMENT OF EXISTING CHANNEL
  - DRAINAGE STRUCTURE
  - DETENTION BASIN

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*trunk*

**LEGEND**

-  STORM SEWER
-  INVERTED CROWN STREET
-  OPEN CHANNEL
-  ENLARGEMENT OF EXISTING CHANNEL
-  DRAINAGE STRUCTURE
-  DETENTION BASIN

**GARDNER LANE PHASE**

**FIGURE 4**

RUTHRAUFF ROAD

ZINHIA AVE

WETMORE ROAD

INTERSTATE 10






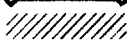
SPRR

SULLINGER

PLUM

LA CHOLLA BLVD

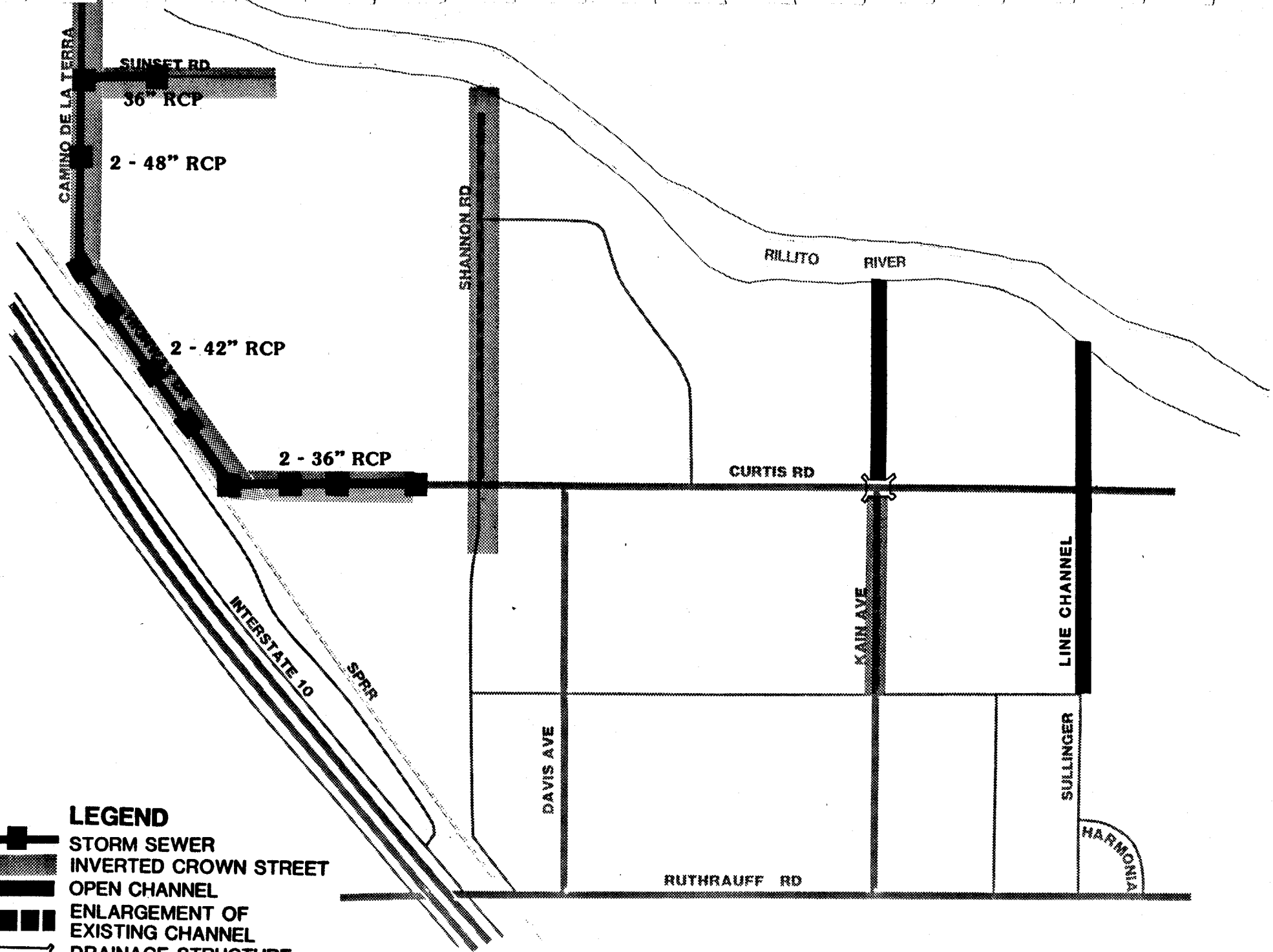
**LEGEND**





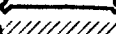

-  STORM SEWER
-  INVERTED CROWN STREET
-  OPEN CHANNEL
-  ENLARGEMENT OF EXISTING CHANNEL
-  DRAINAGE STRUCTURE
-  DETENTION BASIN

**WETMORE ROAD AREA PHASE**

**FIGURE 5**

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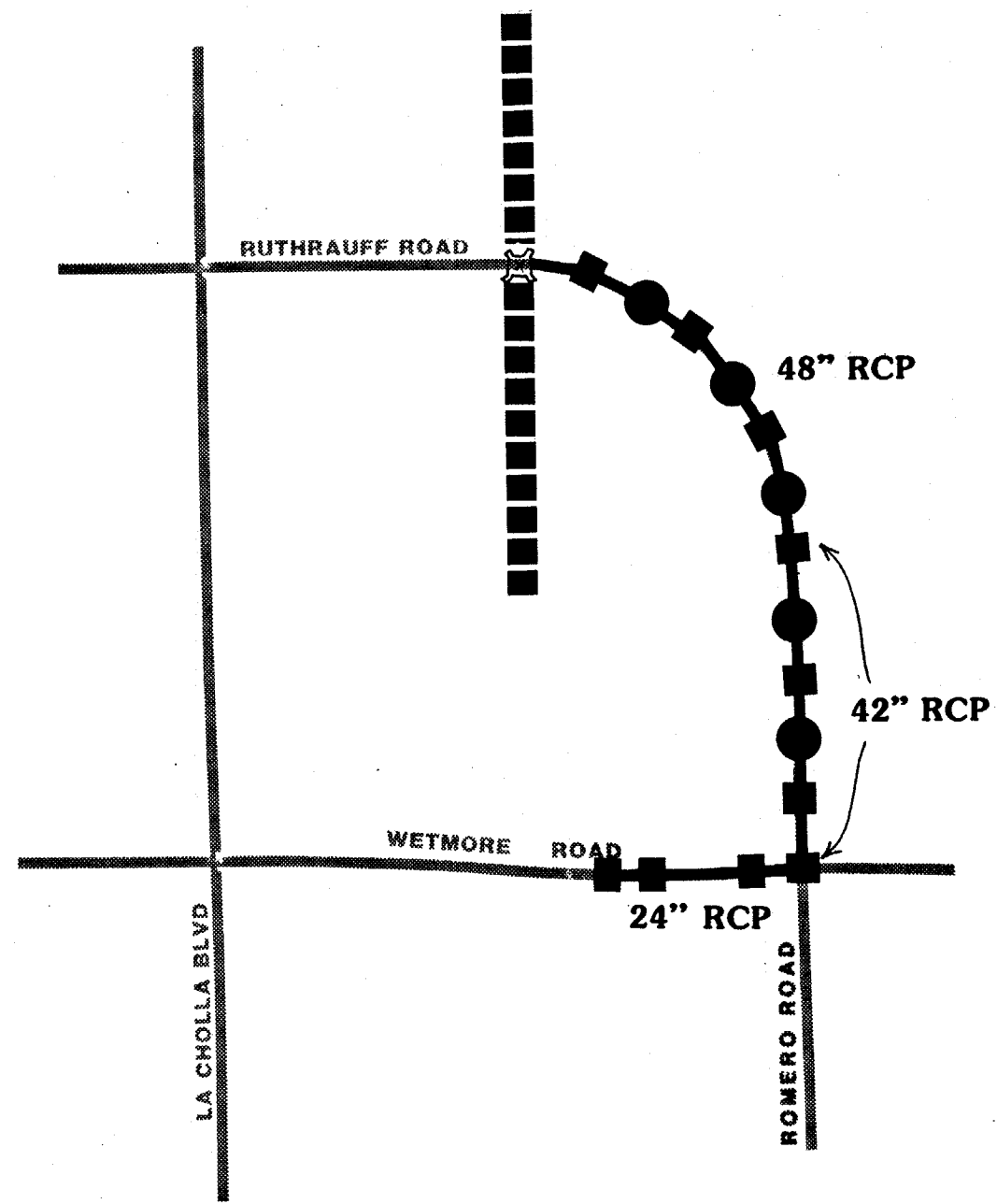
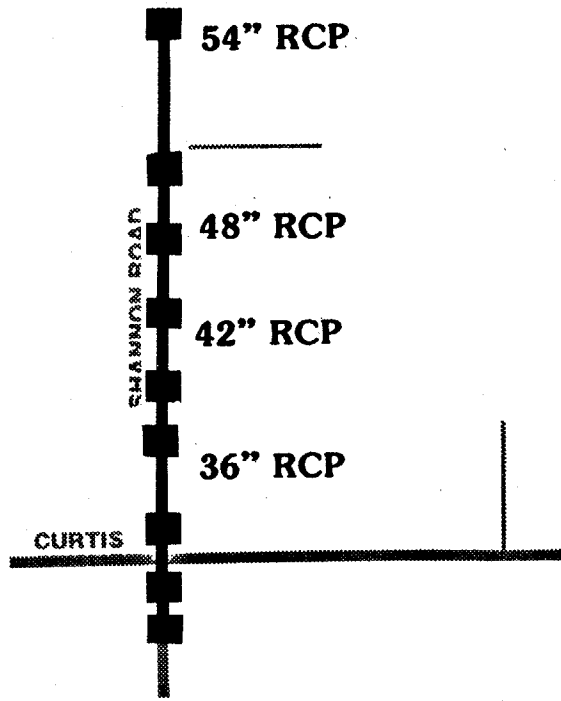


- LEGEND**
-  STORM SEWER
  -  INVERTED CROWN STREET
  -  OPEN CHANNEL
  -  ENLARGEMENT OF EXISTING CHANNEL
  -  DRAINAGE STRUCTURE
  -  DETENTION BASIN

**NORTHERN AREA PHASE**

**FIGURE 6**

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- LEGEND**
- STORM SEWER
  - INVERTED CROWN STREET
  - OPEN CHANNEL
  - ENLARGEMENT OF EXISTING CHANNEL
  - DRAINAGE STRUCTURE
  - DETENTION BASIN

078

**SHANNON ROAD/ROMERO ROAD PHASE**

**FIGURE 7**