City of Las Cruces®
PEOPLE HELPING PEOPLE

Council Action and Executive Summary

Item # 20 **Ordinance/Resolution#** 16-193

For Meeting of _____ (Ordinance First Reading Date)

For Meeting of April 4, 2016 (Adoption Date)

Please check box that applies to this item:

☐ QUASI JUDICIAL ☐ LEGISLATIVE ☒ ADMINISTRATIVE

TITLE: A RESOLUTION ADOPTING A MULTI-JURISDICTIONAL FLOOD WARNING SYSTEM MASTER PLAN WITHIN DONA ANA COUNTY AND LAS CRUCES FOR THE DEVELOPMENT OF AN ALERT 2 (AUTOMATED LOCAL EVALUATION IN REAL-TIME) FLOOD WARNING SYSTEM.

PURPOSE(S) OF ACTION:

To adopt a multi- jurisdictional Flood Warning System Master Plan.

COUNCIL DISTRICT: N/A		
Drafter/Staff Contact: Louis Grijalva, P.E.	**Department/Section:** Public Works/Project Development	**Phone:** 528-3135
City Manager Signature:		

BACKGROUND / KEY ISSUES / CONTRIBUTING FACTORS:

A Flood Warning System is intended to provide communities an early alert that flooding may soon occur. The early alert provides an advanced notice to the Office of Emergency Management to take actions that mitigate loss of life or property, which might otherwise occur. Other benefits include, but are not limited to:

- The potential to lower flood insurance rates through the National Flood Insurance Program (NFIP) Community Rating System (CRS), a program the City of Las Cruces (City) currently participates in.
- Education/research opportunities from collected rainfall data for local schools, City staff, and the public.
- Development of improved drainage design standards that fit local conditions.
- The ability to analyze sediment load in arroyos and ponding areas.
- Improved storm water management.

A Flood Warning System Master Plan was finalized in the summer of 2013 as a joint effort between the City and Dona Ana County (DAC). The master plan includes a five (5) year development process for an Alert 2 Flood Warning System. This system includes standard

(Continue on additional sheets as required)

weather stations (rain gauge, measuring devices, and stream gauge) and an advanced communication technology to transmit rainfall and other data to a central location. Additionally, the plan will provide a high-level overview for flood risk regions within the City and DAC, propose site locations for future flood warning systems, and set budgets for maintenance, operations and expansion.

The NFIP CRS is a voluntary incentive program which assigns points for flood prevention activities. It recognizes communities for implementing flood plain management practices that exceed the federal minimum requirements of the NFIP to provide protection from flooding. Annually, the City gets credit for activities in excess of 2000 points which results in a 20% discount on flood insurance premiums for City residents within the flood zone, amounting to approximately $200,000 annually.

After completion of the master plan in 2013, the City began to make the necessary budget arrangements to allocate funding to install the first flood warning/weather station at the Las Cruces Outfall Channel inlet tower. The flood warning/weather station was fully operational in the summer of 2015. The City's Public Works Department submitted documentation in the fall of 2015 to the NFIP CRS Program requesting points for this activity. Staff received notice that the City was not eligible for the points until the multi-jurisdictional Flood Warning System Master Plan is officially adopted by the City Council.

Furthermore, approval of the master plan and its implementation will add the value necessary to secure additional future long-term funding. No adverse effects to the budget is anticipated with the approval of this resolution.

SUPPORT INFORMATION:

1. Resolution.
2. Exhibit "A", Flood Warning System Master Plan.

(Continue on additional sheets as required)

SOURCE OF FUNDING:

Is this action already budgeted?			
N/A	Yes	☐	See fund summary below
	No	☐	If No, then check one below:
	Budget Adjustment Attached	☐	Expense reallocated from: _____
		☐	Proposed funding is from a new revenue source (i.e. grant; see details below)
		☐	Proposed funding is from fund balance in the _____ Fund.
Does this action create any revenue?			
	Yes	☐	Funds will be deposited into this fund: (_____) in the amount of $_____ for FY__.
	No	☒	There is no new revenue generated by this action.

BUDGET NARRATIVE

N/A

FUND EXPENDITURE SUMMARY:

Fund Name(s)	Account Number(s)	Expenditure Proposed	Available Budgeted Funds in Current FY	Remaining Funds	Purpose for Remaining Funds
N/A	N/A	N/A	N/A	N/A	N/A

OPTIONS / ALTERNATIVES:

1. Vote "Yes"; this will approve the resolution to adopt the multi-jurisdictional Flood Warning Master Plan within Dona Ana County and Las Cruces for the development of an Alert 2 Flood Warning System.
2. Vote "No"; this will reject the adoption of the multi-jurisdictional Flood Warning Master Plan within Dona Ana County and Las Cruces.
3. Vote to "Amend"; this could reject the proposed plan and provide an opportunity to modify the master plan as deemed necessary.
4. Vote to "Table"; this could allow City Council to postpone consideration of the resolution and direct staff accordingly to seek an alternative direction.

REFERENCE INFORMATION:

The resolution(s) and/or ordinance(s) listed below are only for reference and are not included as attachments or exhibits.

1. N/A

(Continue on additional sheets as required)

City of Las Cruces®

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COUNCIL ACTION AND EXECUTIVE SUMMARY PACKET ROUTING SLIP

For Meeting of _____ (Ordinance First Reading Date)

For Meeting of April 4, 2016 (Adoption Date)

TITLE: **A RESOLUTION ADOPTING A MULTI-JURISDICTIONAL FLOOD WARNING SYSTEM MASTER PLAN WITHIN DONA ANA COUNTY AND LAS CRUCES FOR THE DEVELOPMENT OF AN ALERT 2 (AUTOMATED LOCAL EVALUATION IN REAL-TIME) FLOOD WARNING SYSTEM.**

Purchasing Manager's Request to Contract (PMRC) {Required?} **Yes** ☐ **No** ☒

DEPARTMENT	SIGNATURE	PHONE NO.	DATE
Drafter/Staff Contact		528-3135	3/7/16
Department Director		528-3125	3/7/16
Other			
Assistant City Manager /CAO Management & Budget Manager		541-2078 541-2107	3-7-2016 3-7-2016
Assistant City Manager/COO			3/8/16
City Attorney		EXT 2128	8 MAR 2016
City Clerk		x2115	3-22-16

RESOLUTION NO. 16-193

A RESOLUTION ADOPTING A MULTI-JURISDICTIONAL FLOOD WARNING SYSTEM MASTER PLAN WITHIN DONA ANA COUNTY AND LAS CRUCES FOR THE DEVELOPMENT OF AN ALERT 2 (AUTOMATED LOCAL EVALUATION IN REAL-TIME) FLOOD WARNING SYSTEM.

The City Council is informed that:

WHEREAS, a Flood Warning System Master Plan was finalized in the summer of 2013 as a joint effort between the City and Dona Ana County (DAC). The master plan includes a five (5) year development process for an Alert 2 Flood Warning System; and

WHEREAS, the system includes standard weather stations (rain gauge, measuring devices, and stream gauge) and an advanced communication technology to transmit rainfall and other data to a central location. Additionally, the plan will provide a high-level overview for flood risk regions within the City and DAC, propose site locations for future flood warning systems, and set budgets for maintenance, operations and expansion; and

WHEREAS, the National Flood Insurance Program (NFIP) Community Rating System (CRS) is a voluntary incentive program which assigns points for flood prevention activities. It recognizes communities for implementing flood plain management practices that exceed the federal minimum requirements of the NFIP to provide protection from flooding. Annually the City gets credit for activities in excess of 2000 points which results in a 20% discount on flood insurance premiums for City residents within the flood zone, amounting to approximately $200,000 annually; and

WHEREAS, after completion of the plan in 2013, the City made necessary budget arrangements to allocate funding to install the first flood warning/weather station system along the Las Cruces Outfall Channel inlet tower which was completed the summer of 2015; and

WHEREAS, approval of the master plan and its implementation will add the value necessary to secure additional future long-term funding.

NOW, THEREFORE, Be it resolved by the governing body of the City of Las Cruces:

(I)

THAT the multi-jurisdictional Flood Warning System Master Plan for the development for an Alert 2 Flood Warning System within Dona Ana County and Las Cruces, as outlined in Exhibit "A", attached hereto and made part of this resolution, is hereby approved.

(II)

THAT City staff is hereby authorized to do all deeds necessary in the accomplishment of the herein above.

DONE AND APPROVED this _____ day of _____, 20___.

APPROVED:

_____
Mayor

ATTEST:

_____
City Clerk

(SEAL)

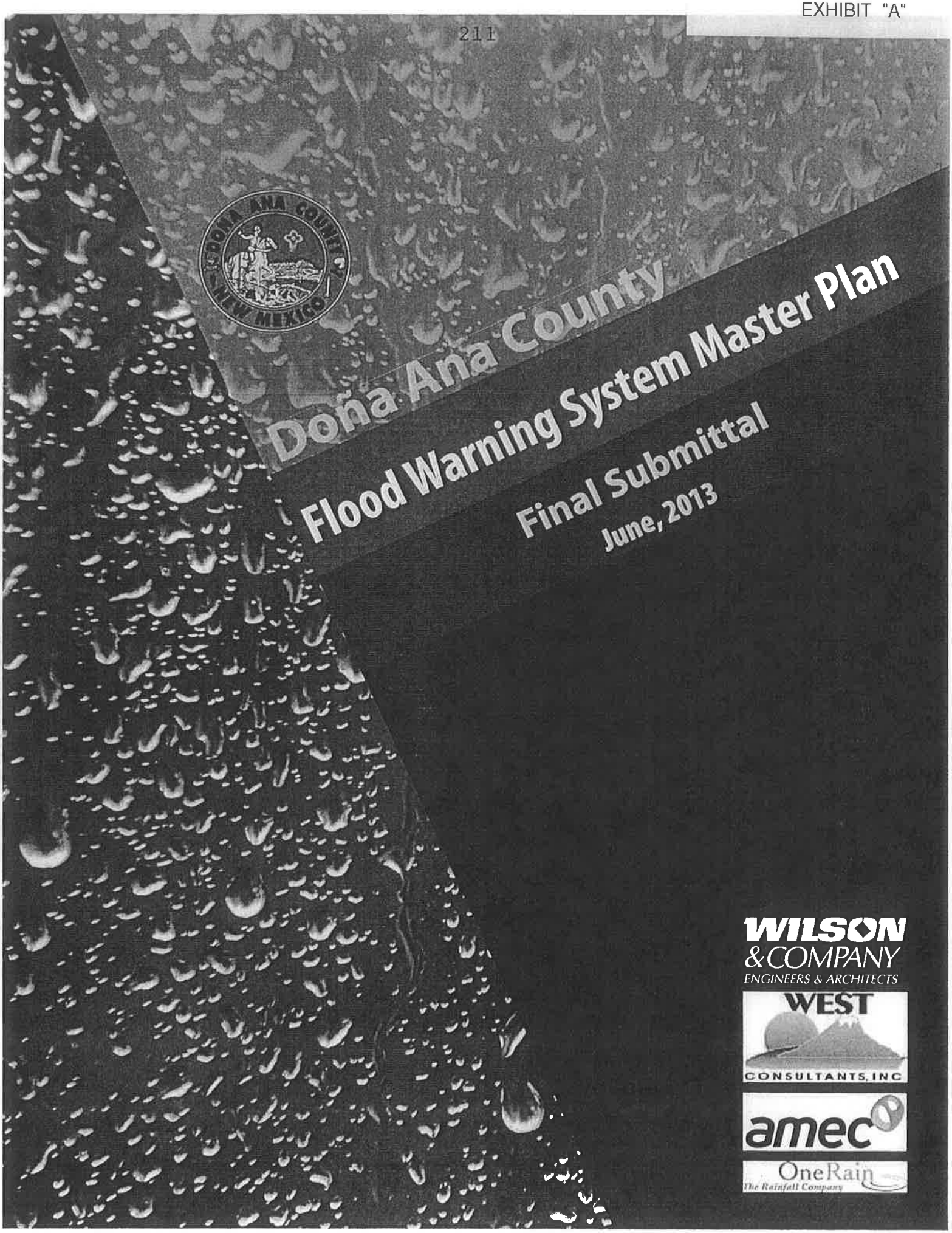
Moved by: _____

Seconded by: _____

APPROVED AS TO FORM:

_____
City Attorney

VOTE:
Mayor Miyagishima: ____
Councillor Gandara: ____
Councillor Smith: ____
Councillor Pedroza: ____
Councillor Eakman: ____
Councillor Sorg: ____
Councillor Levatino: ____



Doña Ana County

Flood Warning System Master Plan

Final Submittal

June, 2013

WILSON & COMPANY
ENGINEERS & ARCHITECTS

WEST CONSULTANTS, INC

amec

OneRain
The Rainfall Company

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A. Introduction

A.1. General Introduction

Doña Ana County is one of 33 counties in the state of New Mexico. It was created in 1852 and is the second-most populated county in the state. The 2010 Census population estimate for Doña Ana County was 209,233. A majority of the population is located in the Las Cruces metropolitan area, with another concentration in the Sunland Park/Anthony area, making their watersheds critical. Other non-incorporated communities and watershed locations throughout the County are usually situated along a major highway.

A.1.1 Geography

The County comprises 3,804 square miles in south-central New Mexico as outlined in Figure 1. The County shares a portion of the east and southeast borders with El Paso County, Texas; its remaining southern border with the State of Chihuahua, Mexico; its western border with Luna County; its northern border with Sierra County; and a portion of the eastern border with Otero County.

There are many geographically diverse areas within Doña Ana County, including mountain ranges, valleys, and deserts. The most notable is the Mesilla Valley – the Rio Grande geologic floodplain – that extends north to south through the center of the County. Rising from the valley are the San Andres and Organ Mountains along the eastern edge and the Sierra de las Uvas on the west. Other smaller mountain ranges in the County include the Robledo Mountains, Doña Ana Mountains, East and West Potrillo Mountains, and two small, isolated mountains, Tortugas (or A) Mountain on the east and Picacho Peak on the west side of the Las Cruces. The County also includes one of New Mexico's four large lava fields, the Aden Malpais, and one of the world's largest maar volcanoes, Kilbourne Hole.

Elevations across the County range between approximately 8,900 feet at Organ Peak to approximately 3,750 feet at the southern end of the Mesilla Valley.

A.1.2 Climate

Climate statistics for weather stations within Doña Ana County are produced by the Western Region Climate Center and span records dating back to the late 1890s. In general, acreage temperatures within Doña Ana County range from below freezing during the winter months to over 100 degrees Fahrenheit during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly, the altitude, within the County.

Precipitation throughout Doña Ana County is governed to a great extent by elevation and season of the year. Average annual precipitation for most of the County averages around 10 inches. Summer rains fall almost entirely during brief, but frequently intense, thunderstorms which are often accompanied by strong winds, blowing dust, and hail storms. The general southeasterly circulation from the Gulf of Mexico brings moisture for these storms into the state; strong surface heating, combined with orographic lifting as the air moves over higher terrain, causes air currents and condensations. July and August are the rainiest months, having between 30 and 40 percent of the year's total moisture falling at that time. During the warmest six months of the year – May through October – total precipitation averages between 60 and 70 percent of the annual total for the County.

A.1.3 Land Ownership/Management

According to 2012 Bureau of Land Management records, land ownership/management within Doña Ana County is comprised of approximately 13.4% private, 11.8% state, and 74.8% federal interests. Table 1 summarizes the general land ownership statistics for Doña Ana County and Figure 2 depicts the geographic distribution of the holdings.

Ownership / Management Agency or Entity	Land Area (SqMiles)	Percent of Doña Ana County
US Bureau of Land Management	1,743.25	45.71%
US Bureau of Reclamation	1.31	0.03%
US Department of Agriculture	171.03	4.48%
US Department of Defense	766.77	20.10%
US Fish and Wildlife Service	88.72	2.33%
National Park Service	81.72	2.14%
Private	509.83	13.37%
State of New Mexico	450.33	11.81%
New Mexico State Park	0.89	0.02%
Source: U.S. Bureau of Land Management, 2012		

Table 1: Doña Ana County Land Ownership/Management

The government agencies that have the largest landholdings in the County are:

U.S. Bureau of Land Management (BLM) – The BLM has over 1,743 square miles of federal-owned land (45.7% of Doña Ana County land). Most BLM lands are located in the western portion of the County. According to the Comprehensive Plan Inventory of the City of Las Cruces and Doña Ana County (CPI_CLC-DAC), the BLM is planning to dispose of some land on the eastern side of the Rio Grande. It is also planning to consolidate resources on the west side of the Rio Grande by exchanging properties with the state of New Mexico.

U.S. Department of Defense (DOD) – The DOD owns and/or manages approximately 766.8 square miles of land (20.1% of Doña Ana County). The lands comprise a portion of the White Sands Missile Range and Fort Bliss Military Reservation located on the eastern side of the County. This land is not available for private ownership.

State of New Mexico – The state of New Mexico, through the State Land Trust, New Mexico State University, and New Mexico State Park, owns and manages over 451.2 square miles of land (11.8% of Doña Ana County). State Trust lands were allocated when the state of New Mexico was formed, and proceeds from the sale or lease of State Trust land must be used for education or public services. The Chihuahuan Desert Rangeland Research Center (CDRRC), located north and a little west of the City of Las Cruces on the eastern side of the Rio Grande, is the largest consolidated area of state-owned land. The CDRRC and other NMSU properties comprise a significant portion of the state-owned land within the County.

U.S. Department of Agriculture (USDA) – The USDA owns 171 square miles of land (4.5% of Doña Ana County) north of Las Cruces and west of the White Sands Missile Range. The land is preserved and used for research by NMSU in conjunction with the CDRRC.

Other federal agencies that have minor land ownership footprints within the County include the Fish and Wildlife Service (2.3%), National Parks Service (2.1%), and the U.S. Bureau of Reclamation (0.03%). Private land ownership of Doña Ana County is estimated at 13.4%, and is mostly located along the Rio Grande, near or within metropolitan areas.

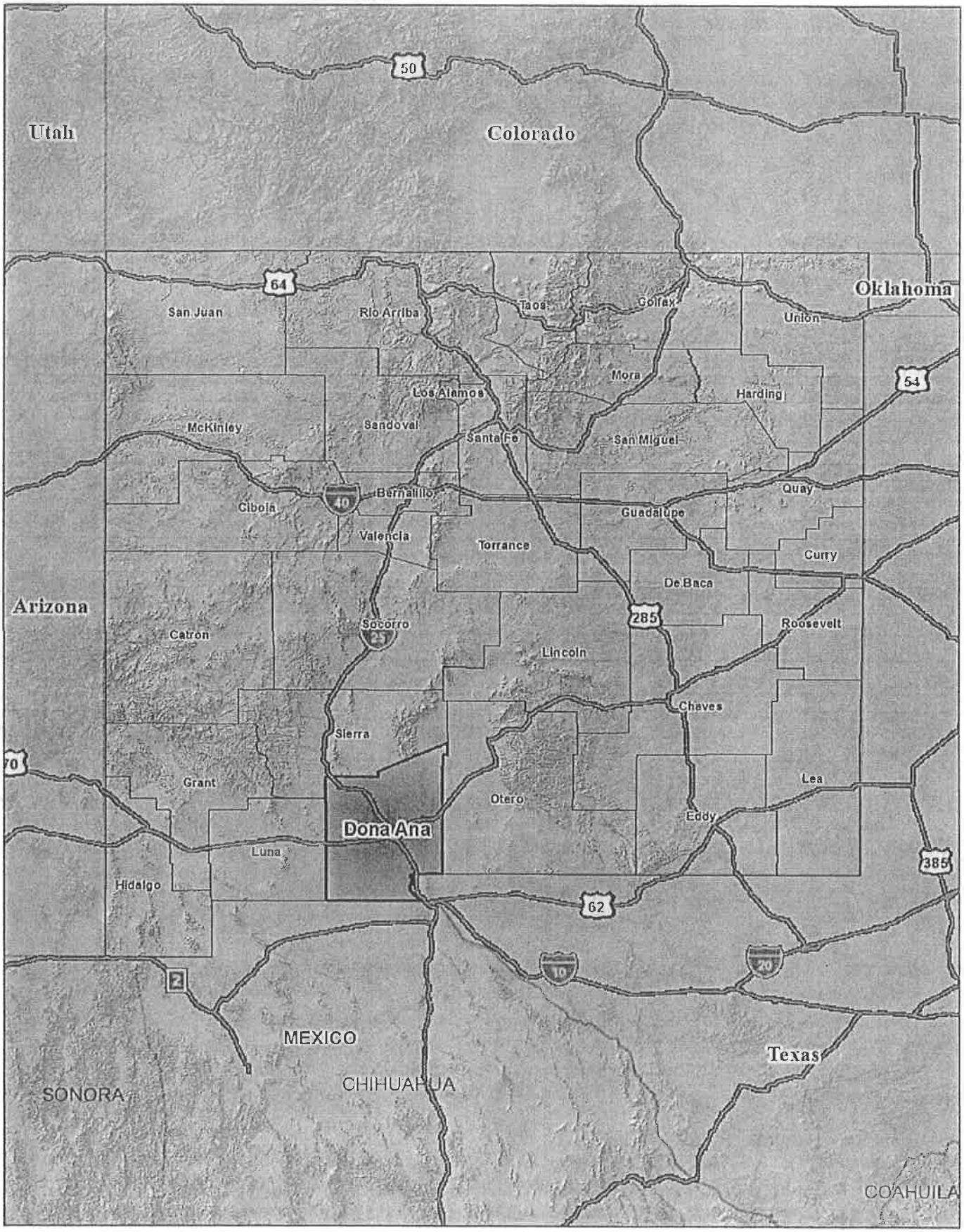
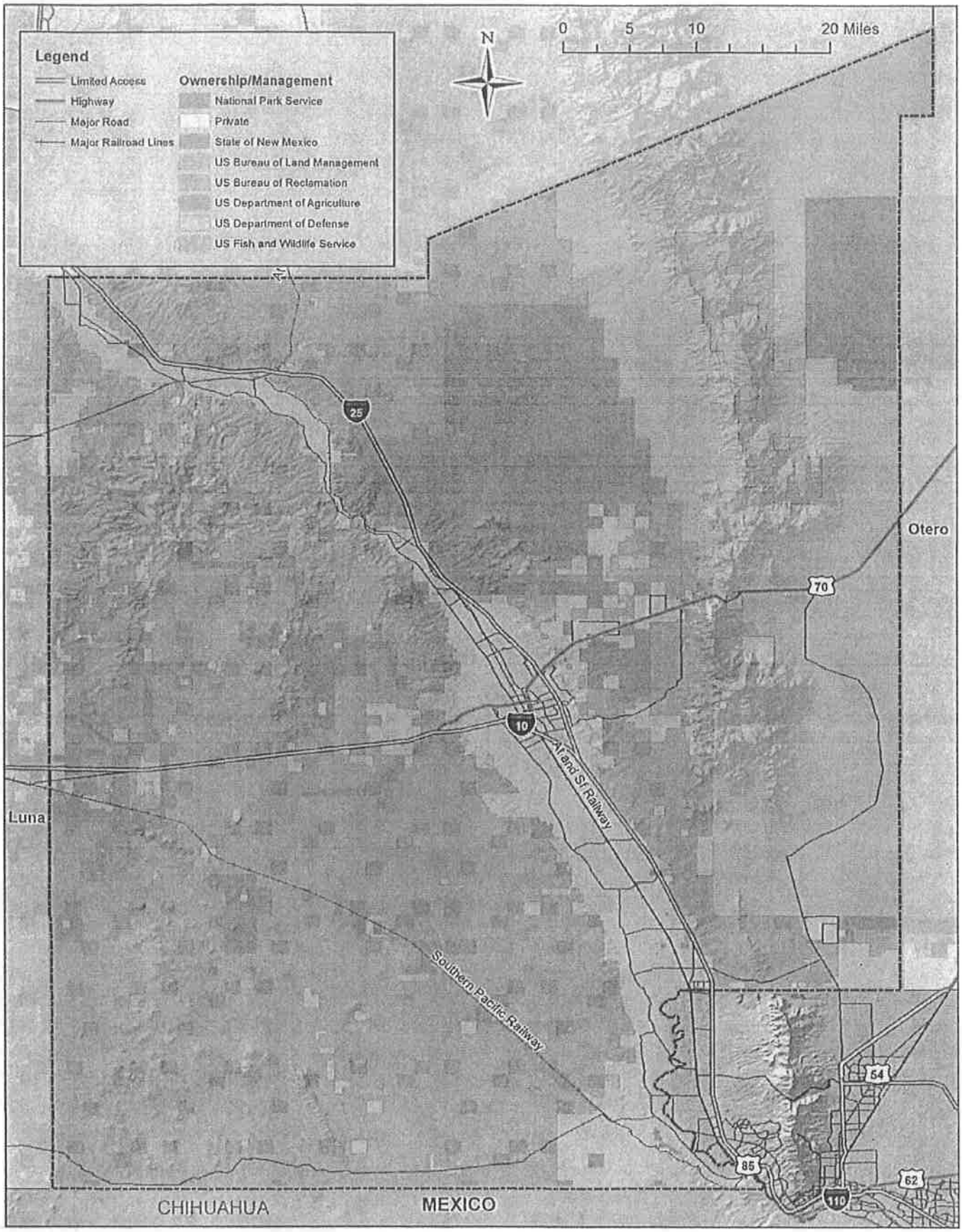


Figure 1: Doña Ana County Vicinity Map



Source: U.S. Bureau of Land Management, 2012

Figure 2: Doña Ana County Land Ownership/Management

A.2. Overview of the Project

A.2.1 Project Description

The Doña Ana County Flood Commission intends to develop an ALERT2 Flood Warning System consisting of two base stations with associated hardware, software, communications equipment, and remote sensor stations. The purpose of this project is to provide the Doña County Flood Commission with a 5-year Master Plan for the development of the flood warning system.

A.2.2 Goals and Objectives of the Master Plan

The Master Plan will provide a high-level overview of Doña Ana County flood risk regions, proposed base station and gauge site locations, and the flood warning system design; set budgets for on-going maintenance, operations, and expansion of the system; create future scopes and budgets for these activities; and to provide the basis for budget requests and staffing needs.

A.2.3 Strategies

The strategy used to successfully complete the Master Plan combines desktop analyses with physical site inspections in order to provide the DAC Flood Commission with accurate, and vetted, information on which to base both immediate and future system acquisitions.

Flood Commission GIS data will be provided to, and utilized by, the project team to identify critical watersheds and generate a list of proposed locations for gauge sites, repeater stations, and base stations. These locations will be narrowed down to a list of 30 gauge sites, as few repeater stations as possible, and two base stations. On-site inspections will provide detailed information on site suitability and will impact final recommendations for the system design.

Base station locating will be centered on utilizing existing infrastructure (such as fire stations or antennae array) in order to eliminate or reduce the need for additional real-estate, security, and power requirements. Base station recommendations will be based on balancing reduced installation costs against the ability of the infrastructure to meet the project's needs.

Utilizing these analyses and inspections, a 5-year build out, operations, and maintenance plan will be developed to give the Flood Commission all the information necessary to install the system.

B. Flood Warning Systems

B.1. General Introduction

Flood warning systems are intended to provide communities an early alert that flooding may soon occur. The early alert provides time: time to take actions that mitigate loss of life or property that might otherwise occur. Lives are protected when people move to higher ground or barricades are posted to keep people out of the danger zone. Property is protected when residents have sufficient time to move cars, furniture, and other valuables out of harm's way.

Narrowly speaking, flood warning systems include components necessary to detect developing flood conditions, and then communicate the flood threat to a command center where it is confirmed and relayed to a target audience. Recipients of the flood warning then take action to protect lives and property. In this narrow view, the flood warning system is more often described as a flood threat recognition system.

In a broader context, a flood warning system is a tool that fits into "Emergency Planning and Response" or "All Hazards Planning and Response". The key is planning and being ready to respond. An effective flood warning system is one that is integrated into a well thought-out, well-rehearsed approach to a planned flood response.

B.2. Emergency Planning and Response

Flood emergency planning is a never-ending process, as illustrated in Figure 3. The first step is the preparation of a flood response plan. The flood threat recognition component triggers an initial awareness of a developing threat. Once a flood threat is detected, some level of flood forecasting occurs, even if it is only a qualitative assessment of a small, medium, or large flood that is about to occur. Next, a forecast or warning is disseminated to the target audience who begin to take appropriate action. Once the flood peaks and begins to recede, recovery activities begin. After the event passes, a post-flood assessment occurs to determine what improvements are necessary. The flood hazard is re-evaluated, the response planned is updated, and the whole process begins anew.

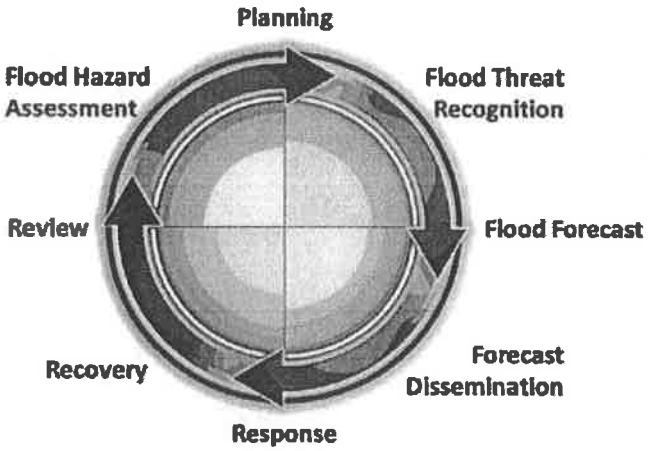


FIGURE 3: FLOOD EMERGENCY PLANNING AND RESPONSE PROCESS

A second way to look at the flood emergency planning and response process is illustrated in Figure 4, where process elements are superimposed on an example flood hydrograph. In this case, flood preparedness planning takes place well in advance of the flood event. As the flood event develops, the threat is recognized, followed by a forecast, warning dissemination, flood response, recovery, and planning again.

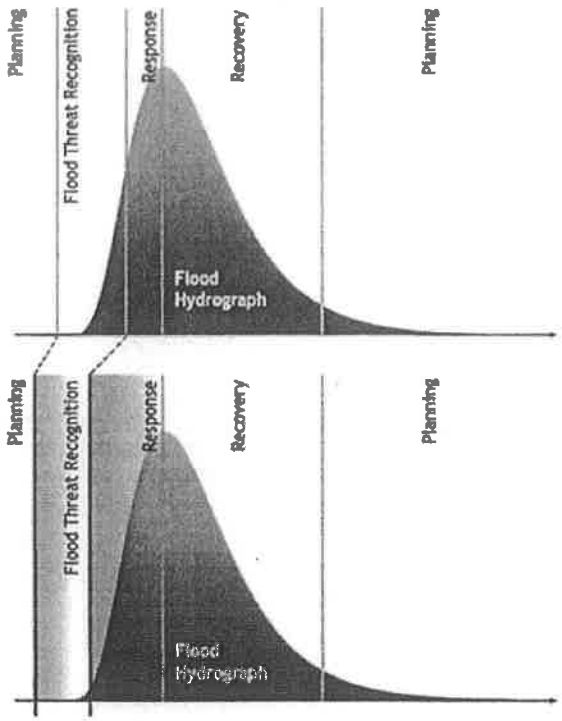


FIGURE 4: TIMELINE FOR FLOOD EMERGENCY PLANNING AND RESPONSE WITH A FLOOD HYDROGRAPH

Effective flood threat recognition must occur as far in advance of the flood event as possible. Without effective threat recognition, flood response will start late, often too late to avoid the avoidable damages.

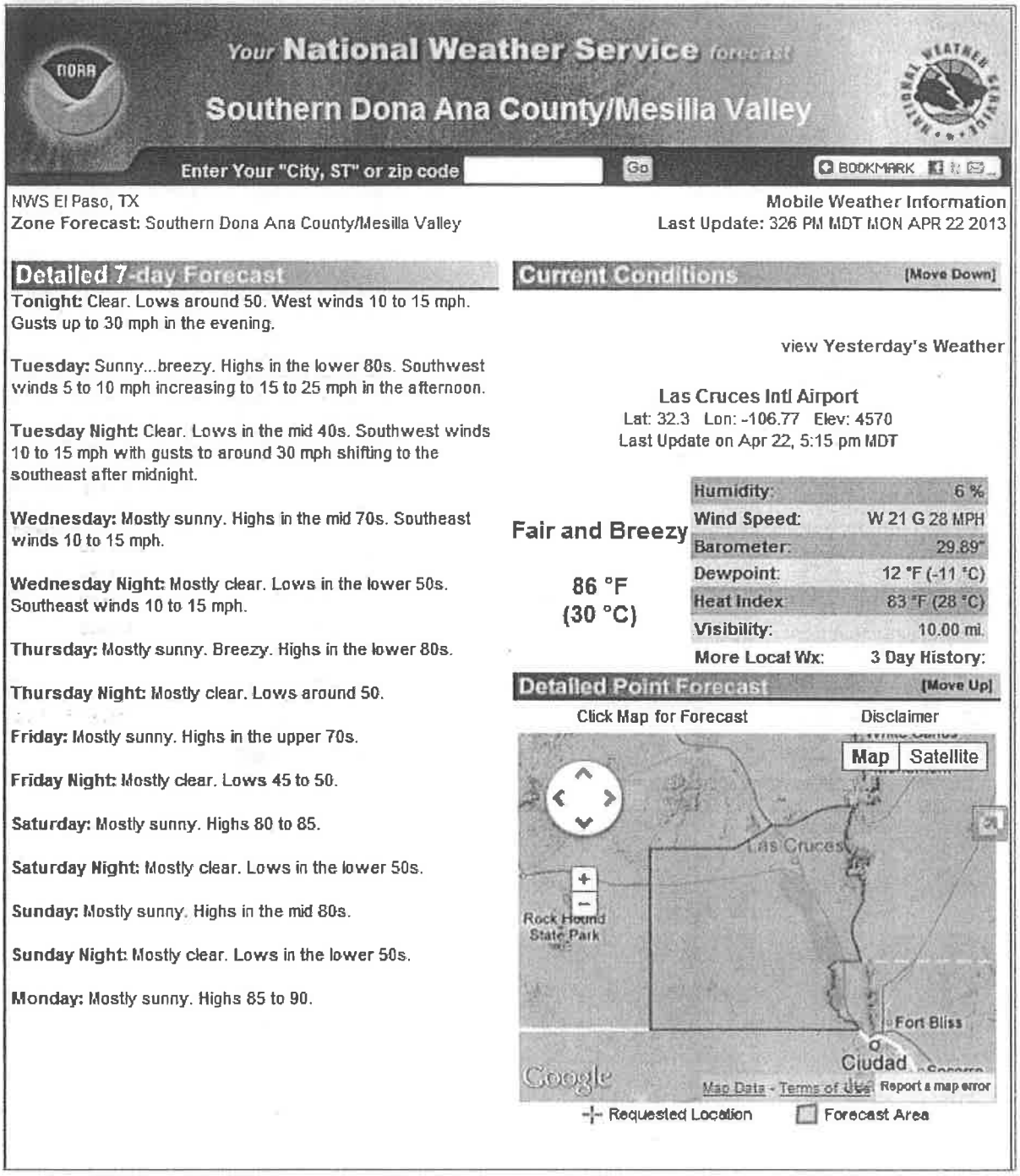
The objective of flood threat recognition is simply to detect the threat in advance and to begin flood response as early as possible. Every minute gained gives people more time to respond and avoid damages and loss of life. Flood threat recognition triggers preplanned and rehearsed responses defined in the flood emergency preparedness plan.

The hardware/software components of the flood warning system shift recognition of the flood threat and the initiation of flood response earlier in time, increasing the time available for flood response.

C. Flood Threat Recognition System Components

C.1. General Weather Awareness

The first level of flood threat recognition is on-going monitoring of the general near term weather conditions in Doña Ana County using publicly available resources. Local weather forecasts are readily available from a variety of sources including the National Weather Service (See Figure 5) and well-known private weather providers such as The Weather Channel, Accuweather, and Weather Underground. Local media, the Internet, PDAs, smart phones, and tablets all serve as distribution channels for weather information. Figure 6 illustrates an example iPad weather app called Meteogram showing an April 22, 2013 weather forecast with rainfall amounts over Nashville, TN, for the period April 23-28, 2013. Social media channels such as Facebook and Twitter are increasingly utilized for disseminating weather and disaster information. Leveraging these resources heightens awareness of developing weather conditions with the potential for flooding.



Your National Weather Service forecast

Southern Dona Ana County/Mesilla Valley

Enter Your "City, ST" or zip code Go BOOKMARK

NWS El Paso, TX
Zone Forecast: Southern Dona Ana County/Mesilla Valley

Mobile Weather Information
Last Update: 326 PM MDT MON APR 22 2013

Detailed 7-day Forecast

Tonight: Clear. Lows around 50. West winds 10 to 15 mph. Gusts up to 30 mph in the evening.

Tuesday: Sunny...breezy. Highs in the lower 80s. Southwest winds 5 to 10 mph increasing to 15 to 25 mph in the afternoon.

Tuesday Night: Clear. Lows in the mid 40s. Southwest winds 10 to 15 mph with gusts to around 30 mph shifting to the southeast after midnight.

Wednesday: Mostly sunny. Highs in the mid 70s. Southeast winds 10 to 15 mph.

Wednesday Night: Mostly clear. Lows in the lower 50s. Southeast winds 10 to 15 mph.

Thursday: Mostly sunny. Breezy. Highs in the lower 80s.

Thursday Night: Mostly clear. Lows around 50.

Friday: Mostly sunny. Highs in the upper 70s.

Friday Night: Mostly clear. Lows 45 to 50.

Saturday: Mostly sunny. Highs 80 to 85.

Saturday Night: Mostly clear. Lows in the lower 50s.

Sunday: Mostly sunny. Highs in the mid 80s.

Sunday Night: Mostly clear. Lows in the lower 50s.

Monday: Mostly sunny. Highs 85 to 90.

Current Conditions [Move Down]

view Yesterday's Weather

Las Cruces Intl Airport
Lat: 32.3 Lon: -106.77 Elev: 4570
Last Update on Apr 22, 5:15 pm MDT

Fair and Breezy

86 °F
(30 °C)

Humidity:	6 %
Wind Speed:	W 21 G 28 MPH
Barometer:	29.89"
Dewpoint:	12 °F (-11 °C)
Heat Index:	83 °F (28 °C)
Visibility:	10.00 mi.
More Local Wx:	3 Day History:

Detailed Point Forecast [Move Up]

Click Map for Forecast Disclaimer

Map Satellite

Las Cruces
Rock Hound State Park
Fort Bliss
Ciudad
Google
Map Data - Terms of Use Report a map error

Requested Location Forecast Area

FIGURE 5: EXAMPLE NWS WEATHER FORECAST FOR SOUTHERN DOÑA ANA COUNTY

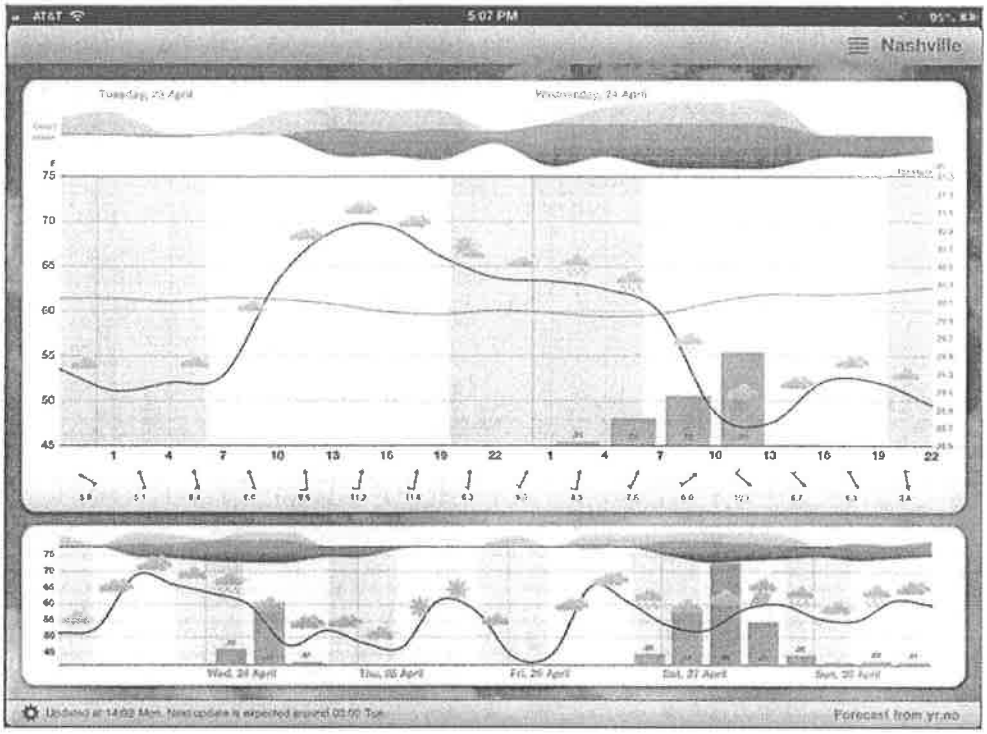


FIGURE 6: EXAMPLE IPAD WEATHER APP, METEOGRAM

FIGURE 7: NWS WEATHER WEBSITE COVERING DOÑA ANA COUNTY

C.2. Local Flood Threat Recognition

To move beyond maintaining a general awareness of developing weather conditions that may cause flooding, additional components are needed. Automatically reporting rain gauges are critically important for quantifying a local flood threat in near real-time. Several types of rain gauges are available but ALERT gauges are commonly used throughout the southwestern US, where flash flooding is a large concern. ALERT is a technology developed in the late 1970s at the National Weather Service California-Nevada River Forecast Center, specifically for flash flood threats. ALERT is an acronym representing **A**utomated **L**ocal **E**valuation in **R**eal-**T**ime.

An ALERT rain gauge (See Figure 8) consists of a 12 inch diameter, 10-ft tall aluminum cylinder housing a tipping bucket rain gauge and a battery operated radio transmitter. As rain falls through the gauge orifice, a funnel directs the rain to the tipping bucket. When the equivalent of 1 mm (0.04 in) collects in the first tipping bucket, the bucket is heavy enough to tip and empty its contents as a second bucket moves into position to collect more rainfall. Each time a bucket tips, the radio transmitter sends a brief message to a central command center announcing that 1 mm of rainfall has occurred at that site.

The data reporting rate of ALERT rain gauges is a key feature. The buckets fill, tip, and trigger a data report at rates that are directly proportional to the rainfall rate. The maximum data reporting rates occur at precisely the same time as the maximum rainfall intensities over each gauge site. High rainfall rates are immediately identified which are used to trigger alarms or alerts at any time of day or night.

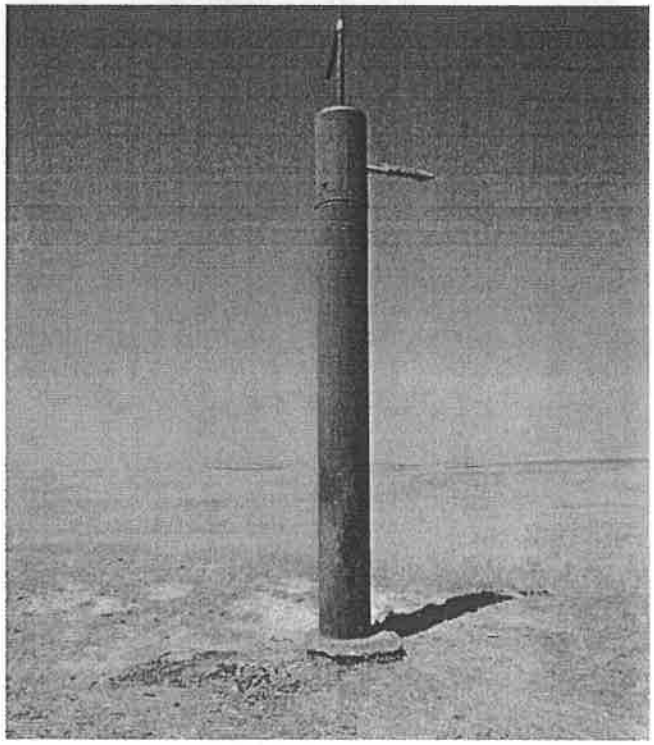


FIGURE 8: EXAMPLE ALERT RAIN GAUGE

Stream gauges are used to measure water surface elevations. Data are reported in much the same way as ALERT rain gauges. In the case of Doña Ana County, stream gauges may be problematic due to the

extreme alluvial nature of most of the streams and their undefined channels. Bridge or culvert locations might be possible at locations similar to that shown in Figure 9.

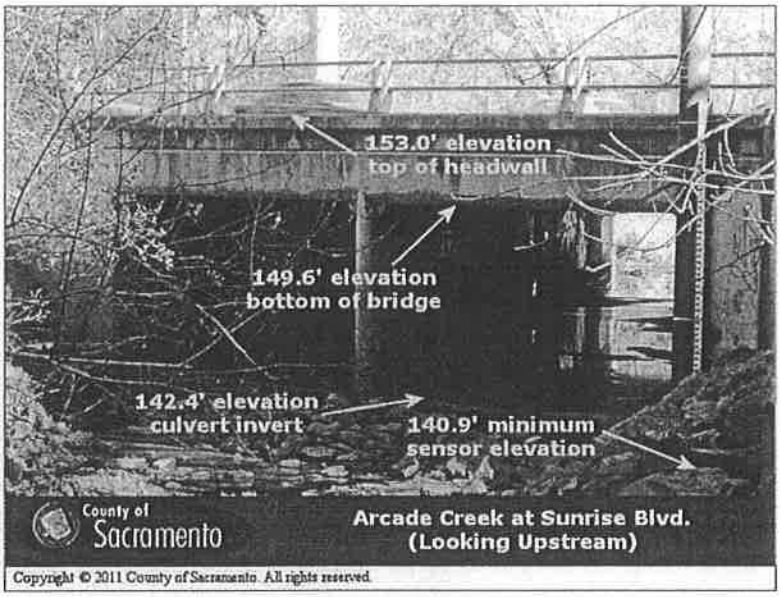


FIGURE 9: EXAMPLE STREAM GAUGE LOCATION

More than likely, stream gauges or, more fittingly, water elevation sensors in Doña Ana County may be more appropriately and valuably deployed at detention basin locations. Figure 10 illustrates an example water level measurement location at a detention basin in Clark County, NV.

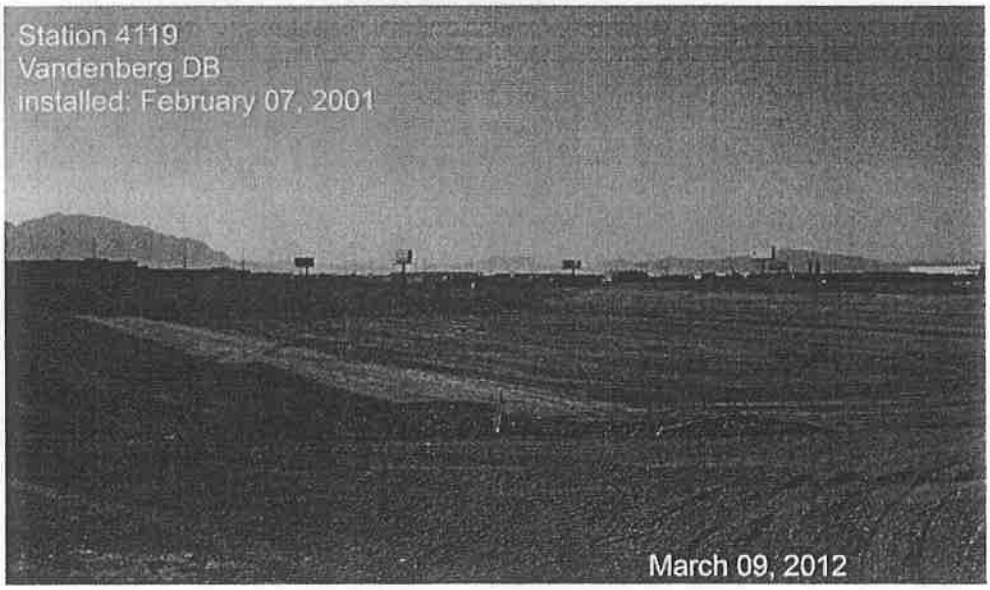


FIGURE 10: EXAMPLE DETENTION BASIN, CLARK COUNTY, NV.

A variety of other sensors such as wind speed, wind direction, humidity, barometric pressure, and solar radiation can be added to enrich the collected data sets to support other purposes such as weather forecasting, fire weather, agriculture, and recreation. The bulk of the cost of a weather station (See Figure 11) is the supporting structure, the tipping bucket rain gauge and the radio transmitter package. Adding additional sensors represents a relatively small incremental cost that can yield benefits to a broader potential user base in Doña Ana County.

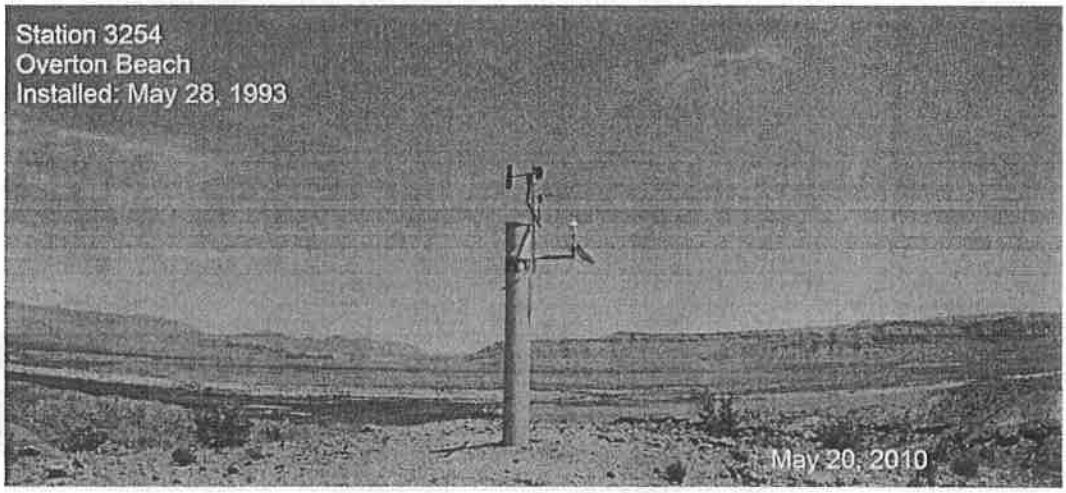


FIGURE 11: EXAMPLE ALERT WEATHER STATION IN CLARK COUNTY, NV.

Another relatively new component for field observation within flood warning systems is streaming video. Cameras established at critical locations such as detention basins or low water crossings provide real time visual imagery of the developing field conditions. Commonly used to monitor traffic conditions in urban areas, video imagery is increasingly used to monitor flood conditions. Cameras can be redirected to view adjacent waterways or water crossings when flood conditions are present.

Cameras along Houston bayous provide visual confirmation of stream conditions to Harris County Flood Control District Operations. One Houston example appears in Figure 12. In another example shown in Figure 13, images from a camera installed to monitor post-fire watershed conditions near Denver, CO, are streamed to the flood monitoring center of the Denver Urban Drainage and Flood Control District.

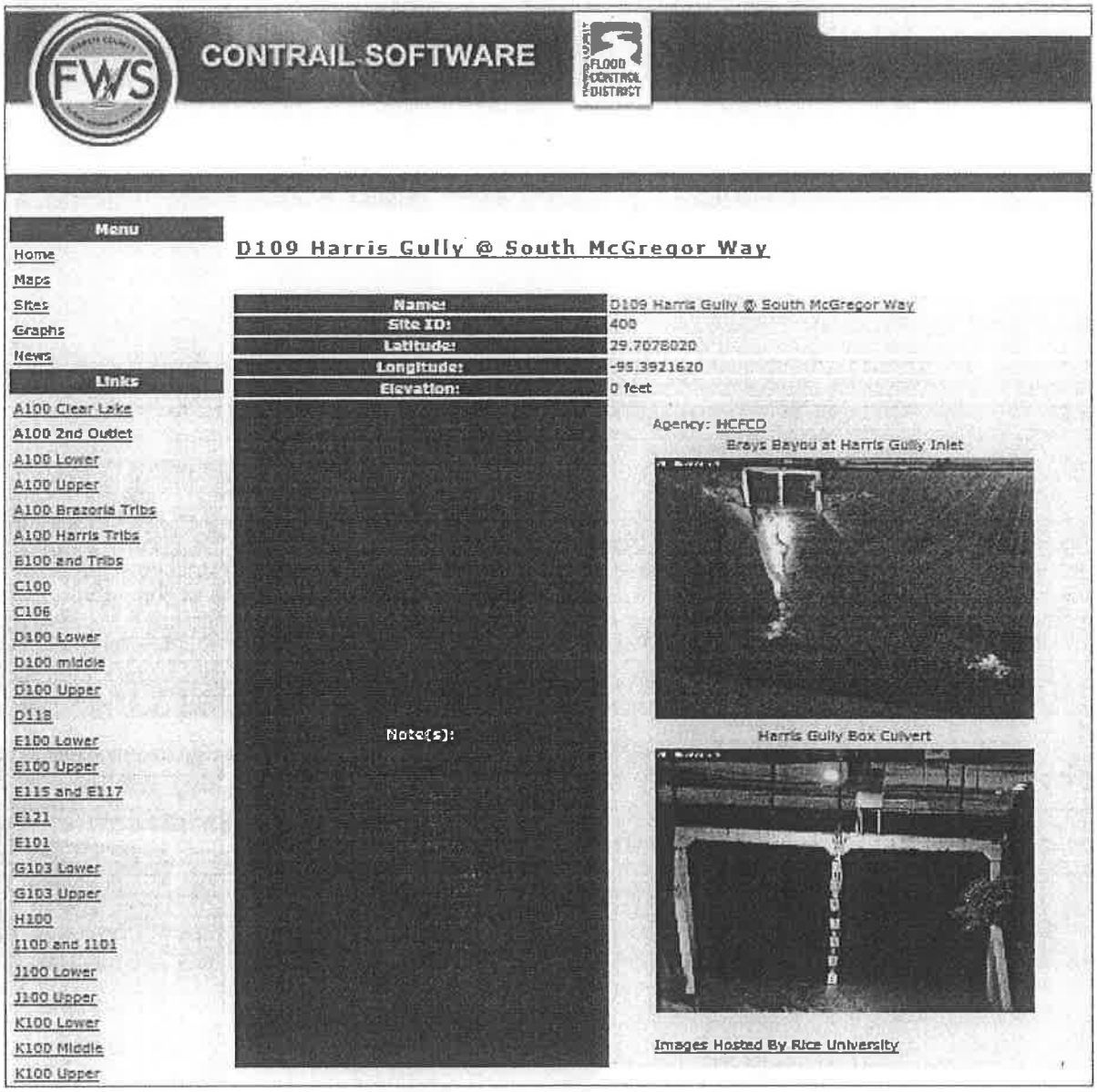


FIGURE 12: EXAMPLE VIDEO CAMERA MONITORING IN HOUSTON, TX.

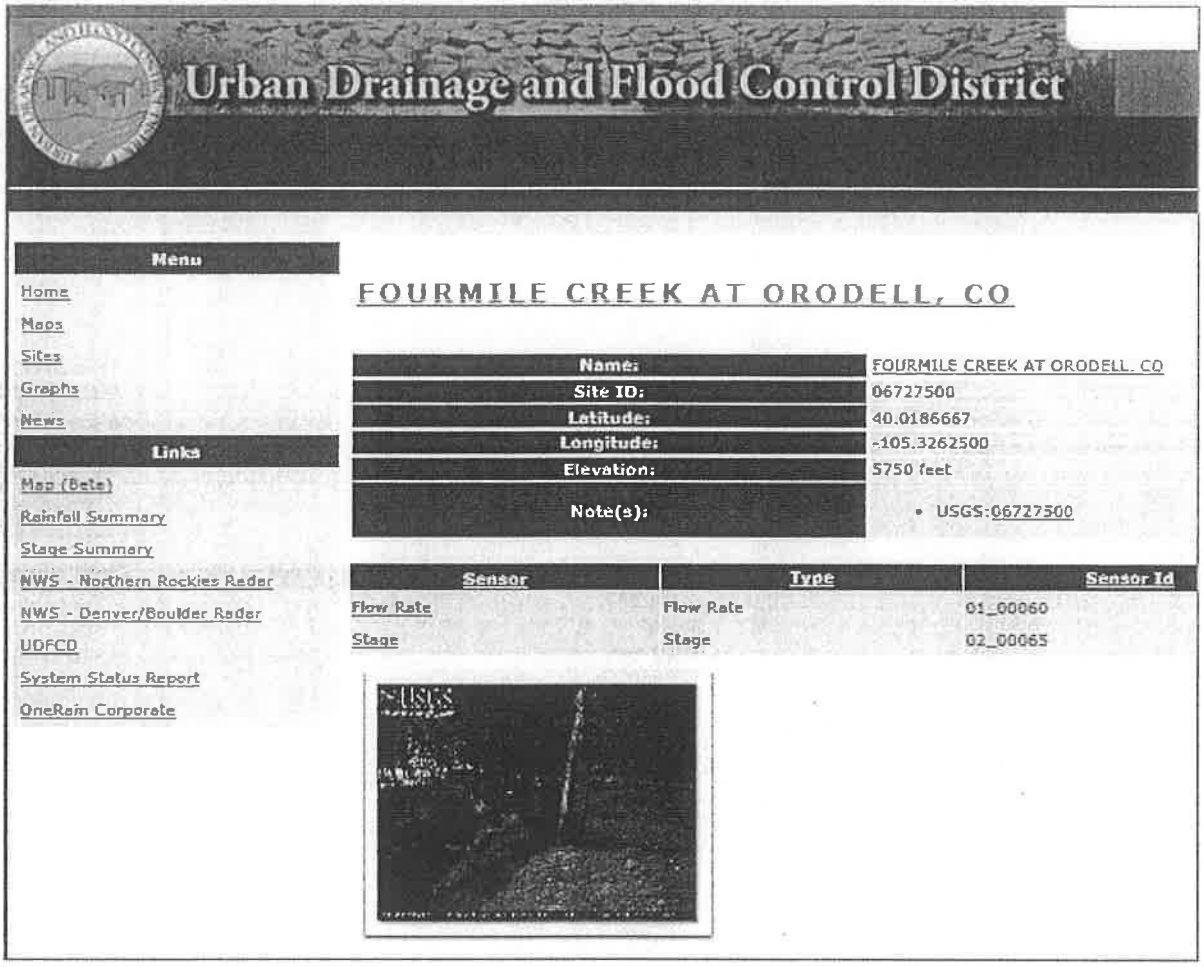


FIGURE 13: EXAMPLE NEAR REAL-TIME VIDEO MONITORING OF POST-FIRE WATERSHED CONDITIONS

D. Data Communication

D.1. Potential Methods

A flood warning system is a mission critical system. Data communications should be reliable in poor weather, independent of infrastructure that would be compromised during an emergency weather event. The nature of monitoring locations being distributed widely across the County requires a communications approach that eliminates or minimizes single points of failure. Technologies that can be used for flood warning networks include ALERT, ALERT2, Cell Phone, IP Network, Land Line Phone, L-Band Satellite, and Geostationary Operational Environmental Satellites (GOES). All of these technologies can be evaluated based on their pros and cons. Problems with cell phone and public wireless networks are that those resources become oversubscribed during events. People call or text most when the warning systems would need to use those same resources most. GOES are reliable, but have data latency on the order of an hour that is unacceptable for real-time flood warning systems that require response times within minutes. Available technologies that have proven to be reliable during extreme weather events include: ALERT, ALERT2, L-Band Satellite, and GOES. Some of these technologies can be married together to provide cost effective reliable solutions for flood warning systems.

Flood warning communication networks require a backbone to bring the data in from remote locations to one or two central locations to support decision makers. The reliability of the backbone is the most important part of the communications network, since loss of data on the backbone can completely stop the data flow and leave the decision maker blind. Redundancy of backbone components without dependence on common infrastructure is the way to ensure reliability so that the most data gets to the central decision making locations.

D.2. ALERT

ALERT (Automated Local Evaluation in Real Time) is the most commonly used communications protocol for flood warning systems in the U.S. The ALERT technology was developed in the 1970s. It is a resilient, reliable, low cost, low power solution that has served the flood warning community well over the last 30+ years. Drawbacks to ALERT today are data loss due to collisions and data errors due to RF noise, which are common; the available range of IDs and values transmitted are limited (8192 IDs and 2048 values); and use of RF bandwidth is inefficient at only 300 baud.

D.3. ALERT2

Recently the National Hydrologic Warning Council (NHWC) sponsored the development of the ALERT2 standard. ALERT2 is designed to overcome the limitations of ALERT while still being backward compatible with ALERT technology so that existing ALERT networks can upgrade in phases. ALERT2 has error detection and forward error correction, so that the data collected can be relied on to be correct. It has 7 to 10 times the bandwidth of standard ALERT. ALERT2 uses TDMA (Time Division Multiple Access) to avoid data loss through collisions. The FCC is pushing to use radio frequencies (RF) more efficiently and the result is that ALERT2 will be replacing ALERT systems across the country over the next few years.

D.4. Reliability of Backbone

Building redundant data paths through the network backbone is the most reliable way to add reliability to the communications component of a flood warning system. The network design should ensure that if any single backbone component goes down, the data will have another path to the decision makers. Having a redundant backbone moves the single point of failure out to the individual gauge sites. Examples of redundant backbone technologies that can work in tandem are RF, IP, or Satellite, in any combination of two.

E. Typical Base Station and User Interface

Data transmitted from remote locations eventually arrive at what is commonly referred to as a "Base Station". At a minimum, the base station consists of data receiving and decoding equipment, one or more computers (typically PCs), data management software, user interface, and secure power. The base station may be located at an emergency operations center, public works department, a flood operations center, or other appropriate location with the necessary communication, Internet, electrical power, and security resources.

E.1. Stand Alone

Traditional stand alone solutions are typically "PC-centric". Data from field sensors are received, decoded, and stored on a standard commonly available personal computer running specialized data management software with a user interface for data display and user interaction. A connection to local or wide area networks enables data sharing within agencies. An Internet connection enables broad public distribution and sharing of flood related information. Figure 14 illustrates one Internet-accessible data

map for the City of Roseville, CA. Public users click on icons through a web browser to view the very latest rainfall or streamflow data.

FIGURE 14: CITY OF ROSEVILLE, CA, FLOOD ALERT MAP INTERFACE.

The components of the minimum base station are building blocks for developing more complex flood monitoring operations. Figure 15 illustrates the flow of field observations from the City of Roseville flood ALERT stations, data from ALERT stations in nearby counties, as well as forecasts, warnings, imagery, and data from external sources such as the National Weather Service. Roseville Flood ALERT data flows to adjacent communities and NWS.

With Roseville's Flood ALERT Base Station, several important products are produced for use by the City and for distribution to the general public. The City's flood information delivery system includes the City Internet website and the local Cable TV Government Access Channel. Roseville is in the Sacramento, CA, media market where the region's TV, radio, and newspapers incorporate Roseville's Flood ALERT base station data and products into their information delivery systems.

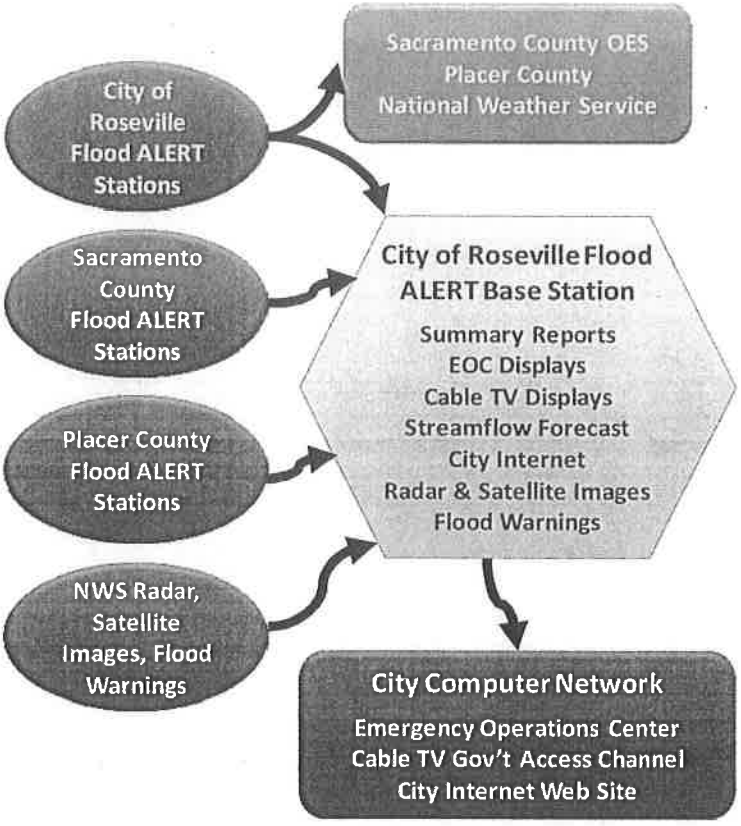


FIGURE 15: INFORMATION FLOW, CITY OF ROSEVILLE, CA, FLOOD ALERT SYSTEM

E.2. Cloud or Web-based Approach

Cloud-based solutions leverage Internet services to collect, manage, display, and distribute flood information. Figure 16 shows an example of a cloud-based flood warning solution in the Chehalis River Watershed in west central Washington.

Observed rainfall and stream elevations are transmitted via the GOES (**G**eostationary **O**perational **E**nvironmental **S**atellites) system. Data are relayed through the satellite to an earth receiving station located in Wallops Island, VA, where they are accessed by secure servers located in Boulder, CO. Users can access the data from any location with Internet access using a PC, PDA, tablet, or smart phone.

Figure 17 presents an iPad screen capture of the Chehalis River Flood Warning System user interface. Users click on large easy-to-see icons for weather forecasts, 10-day rainfall forecasts, and specific river stage forecasts from the NWS. Charts, graphs, and tables showing near real-time data from gauges throughout the region, road conditions, including closures, and flood inundation maps are all available to the public.

The Chehalis system features a critical aspect of system integrity. Since the data and key system operations are located well outside the Chehalis River Watershed, they are not susceptible to interruption by a flood disaster on the Chehalis River. As long as access to the Internet is possible via land line or cell phones during a flood emergency, local users can still access flood warning system data and information throughout the event.

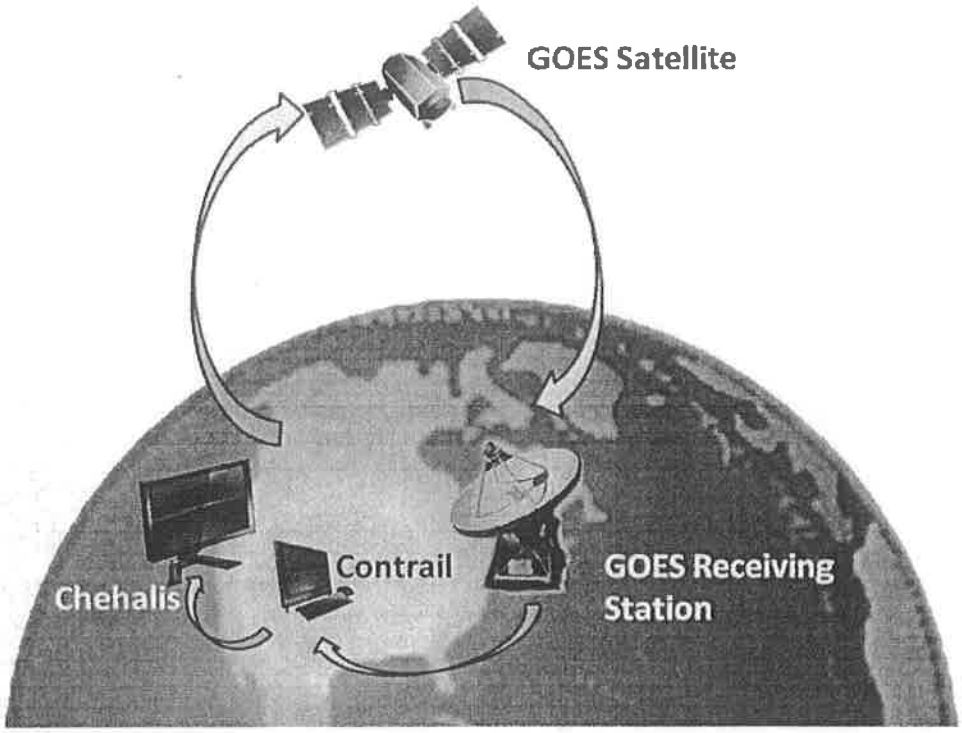


FIGURE 16: CLOUD-BASED SOLUTION FOR FWS IN THE CHEHALIS RIVER BASIN IN WEST CENTRAL WASHINGTON

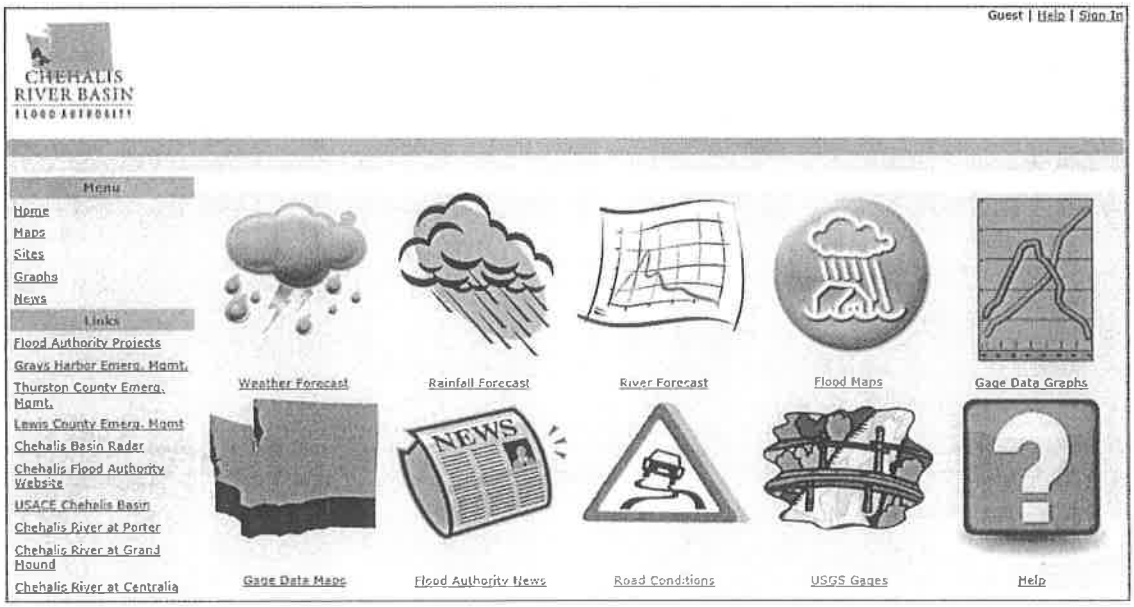


FIGURE 17: IPAD SCREEN CAPTURE OF CHEHALIS RIVER FLOOD WARNING SYSTEM USER INTERFACE.

E.3. Combination Approaches

PC-centric and cloud-based building blocks are easily combined in configurations that increase functionality, security, and reliability. For example, multiple computers and/or servers are often combined to create synchronized redundant systems to ensure continued operation should a computer fail during an event. Data communications networks can be designed with multiple pathways to avoid a "single point of failure" that brings the entire system down. Cloud solutions are used to provide automatic off-site backup of all mission critical data.

The variety of flood warning system base station configurations possible with just a few building blocks is virtually unlimited.

E.4. Mobile Access

The proliferation of Internet-enabled smart phones, tablets, etc. in recent years has dramatically increased the reach of flood warning systems. Users access nearly all of the information and products available on a PC via mobile devices, meaning access is available from any location with cell or Wi-Fi coverage. In addition, the alarm/alert functionality of most base stations allows users to receive email or text messages as threatening conditions are observed or specific warnings are issued.

E.5. Base Station Administration

Administrative access to the base station should be login and password controlled. Administrative access should be role based so that only the required access is assigned to each user. For example, Alarm Administration, User Account Administration, and Site and Sensor Administration would each be assigned independently to the appropriate users needing those capabilities.

E.6. Public Website

Public websites allow agencies to accomplish many objectives of the flood warning mission. Public websites provide read only views of the data to serve the public. It is a positive way to support Public Outreach. The public website should be hosted in a way that does not interfere with the real-time mission critical operations of the flood warning system.

E.7. Alarming

The base stations should have alarming and notification capabilities that send both email and text pager information. All alarms should be logged for reporting and auditing.

E.8. Historical Data

The long term value you gain by collecting and storing data is that the data can be used for many purposes. This data can be used for engineering, design, planning, legal and public good. The base station should store and make available all historical data. It should provide tools for exporting historical data in both event and time series forms.

E.9. Data Analysis

The base station should provide tools for data analysis. For example, Rainfall analysis, Sensor Performance Analysis, and Maintenance Analysis. In addition to built in data analysis tools, the capability to export data to other tools is important to support the data analysis process.

Inches of rainfall

Return Period	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12 hour	1-day	2-day	4-day	Color
2-year	0.7	1.1	1.5	2.0	2.4	2.7	3.2	3.8	4.5	5.3	6.2	
5-year	0.8	1.3	1.7	2.3	3.1	3.1	3.8	4.6	5.5	6.4	7.7	
10-year	0.9	1.5	2.0	2.7	3.7	3.9	4.9	5.9	7.1	8.3	10.5	
25 year	1.0	1.6	2.3	3.2	4.4	4.7	6.0	7.2	8.8	10.1	12.9	
50-year	1.1	1.8	2.6	3.6	5.0	5.5	7.2	8.8	10.7	12.2	14.8	
100-year	1.2	2.0	2.9	4.1	5.7	6.4	8.4	10.3	12.6	14.1	16.9	
500-year	1.3	2.3	3.4	4.9	7.7	8.1	11.1	13.5	16.4	17.9	22.3	

Rainfall Intensities

Inches of rainfall

Site	Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day
A100 Clear Lake 2nd Outlet @ SH 146	100	0.4	0.8	1.2	1.4	2.0	2.6	3.0	3.6	3.6	0.0	0.0
Mary's Creek @ Melodywood Drive	105	0.2	0.4	0.7	1.1	1.6	2.0	2.5	3.4	3.5	0.0	0.0
A100 Clear Creek @ I-45	110	0.4	0.7	0.8	1.2	1.6	1.8	2.1	3.8	3.8	0.0	0.0
Cowart Creek @ Baker Road	115	0.2	0.5	0.8	1.0	2.2	2.4	3.3	4.0	4.0	0.0	0.0
A100 Clear Creek @ FM 528	120	0.3	0.6	0.9	1.0	1.5	1.8	2.2	3.4	3.4	0.0	0.0
Chigger Creek @ Windsong Lane	125	0.3	0.6	1.0	1.7	2.7	3.1	3.8	4.9	4.9	0.0	0.0
A100 Clear Creek @ Bay Area Boulevard	130	0.4	0.7	1.0	1.1	1.3	1.5	1.9	3.2	3.2	0.0	0.0
A100 Clear Creek @ FM 2351	135	0.3	0.6	0.9	1.0	1.4	1.7	2.1	3.3	3.3	0.0	0.0
A119 Turkey Creek @ FM 1959	140	0.4	1.0	1.5	1.8	2.2	2.4	2.5	4.3	4.4	0.0	0.0
A100 Clear Creek @ Country Club Drive	150	0.3	0.6	0.9	1.4	2.1	3.0	3.6	4.7	4.8	0.0	0.0
A120 Beamer Ditch @ Hughes Road	160	0.2	0.6	1.1	1.2	1.7	1.9	2.5	4.3	4.3	0.0	0.0
A100 Clear Creek @ Nassau Bay	170	0.3	0.7	0.9	1.1	1.4	1.9	2.4	4.1	4.1	0.0	0.0
A100 Clear Creek @ Mykawa Road	180	0.4	0.8	1.2	1.7	3.0	3.3	4.0	5.6	5.6	0.0	0.0
A100 Clear Creek @ SH 288	190	0.2	0.5	0.7	1.1	1.5	1.7	2.0	2.2	2.2	0.0	0.0
A104 Taylor Lake @ Nasa Road 1	200	0.3	0.6	0.9	1.1	1.6	2.0	2.5	3.6	3.6	0.0	0.0
A104 Taylor's Bayou @ Shoreacres Boulevard	610	0.4	1.0	1.6	2.7	3.7	4.8	5.4	5.8	5.8	0.0	0.0

FIGURE 18: RAINFALL INTENSITY ANALYSIS SHOWING PEAK RAINFALL INTENSITY WITH ASSOCIATED RETURN PERIODS

Site	Sensor	Sparkline	% Total Availability
Elbert Wx	Air Temp	56.0 ~8.0	76.2
Castle Rock	Air Temp	78.0 ~8.0	100.0
Salisbury Park	Air Temp	62.0 ~10.0	98.4
Aurora Res Wx	Air Temp	58.0 ~4.0	81.7
Brighton	Air Temp	56.0 ~6.0	100.0
Site A	High Float Switch	Alarm Normal	100.0
Site A	Low Float Switch	Alarm Normal	91.3
Site A	Intrusion	Alarm Normal	100.0

FIGURE 19: SENSOR PERFORMANCE ANALYSIS SHOWING SPARK LINES AND AVAILABILITY

F. Flood Inundation Mapping

F.1. General

Maps of expected areas of inundation from flood events of various sizes are valuable tools used to communicate flood risk to emergency officials as well as to the public. Inundation maps are valuable not only in identifying the maximum inundated area from a flood of a given size but in delineating inundated areas as flood waters rise and recede. They provide a sense of timing as to when critical routes of ingress and egress are blocked by flood waters. They also provide information about when critical facilities such as hospitals, schools, nursing homes, fire stations, and police stations are impacted as waters rise and when they are accessible again as flood waters recede. They are key indicators identifying safe areas for evacuation and for staging response/recovery operations.

Where specific flood stage forecasts are available, inundation maps are typically prepared in advance of the flood at appropriate increments of stage (e.g. 1-ft intervals.) through the full range of possible flood elevations. Users take the forecast flood elevation for a given time and check the inundation map corresponding to the forecast stage. The map illustrates the spatial extent of flooding expected at that time.

Figure 20 presents a series of inundation maps, each associated with a specific flood stage or elevation. The maps in Figure 20 show inundation areas for the "No Flooding" condition, inundated areas at "Action" stage, or the stage when conditions warrant very close monitoring through "Minor", "Moderate", and "Major" flood conditions. (Note: Action, Minor, Moderate, and Major flood levels are terms commonly used by the National Weather Service to qualitatively categorize flood severity.)

Even if site specific flood forecasts are not available, flood inundation maps can still be used to communicate flood risk. In this case, the range of potential flow conditions is identified by hydrologic and hydraulic simulation of stream conditions. The range of flood conditions (i.e. Action, Minor, Moderate, and Major) can be identified in advance. As a potential flood producing storm approaches, rainfall observations and forecasts are used with a measure of antecedent moisture conditions (e.g. wet, normal, or dry) as predictors of the magnitude of potential categories expected.

Inundation maps communicate flood risk in a visually powerful manner; in much the same way, radar images have communicated severe storm risk on television for the past two decades.

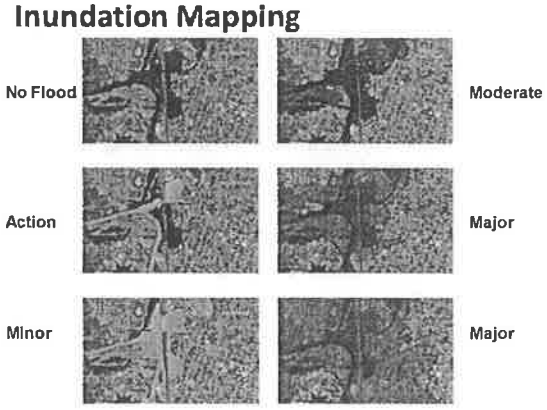


FIGURE 20: INUNDATION MAPPING

F.2. Cost Estimates for Incremental Inundation Mapping

As a supplement to the original scope-of-work, AMEC was asked to produce the following cost estimates.

Cost estimates were developed for the creation of incremental inundation mapping for the risk centers affected by the final 30 proposed remote monitoring stations. These estimates were developed using AMEC 2013 unit rates and should only be used as a guideline for determination of actual mapping costs. The following factors were considered in the development of these estimates:

- Inundation mapping will be developed for five increments corresponding to action, minor flooding, moderate flooding, major flooding, and 2x major flooding categories as determined by the National Weather Service, where available.
- Should flood categories not be available from the National Weather Service, establishment of new categories will be necessary.
- FEMA flood profiles exist for several of the flooding sources associated with the risk centers of Doña Ana County, and can be utilized to create inundation mapping without hydrologic or hydraulic analyses.
- Where FEMA flood profiles are not available, new hydrologic and hydraulic analyses will need to be performed.

Estimated Cost of Inundation Mapping Creation					
Risk Area	Risk Center	Cost	Risk Area	Risk Center	Cost
Central Las Cruces	Flowpath 6 & 7	$3,495	Salem	Salem	$8,140
East Mesa	Tierra Grande	$22,725	Chaparral	Central	$510
Las Cruces East	Las Cruces Arroyo North	$4,975	Las Cruces East	Alameda Dam	$2,250
East Mesa	Baylor Canyon	$14,938	Las Cruces North	Moreno North	$675
Soledad Canyon	Fillmore Arroyo	$18,000	Sunland Park	Sunland Park	$2,835
East Mesa	High Ridge/Las Colinas	$3,150	Las Cruces East	Little Dam Arroyo	$2,925
Hatch	Hatch	$10,400	Central Las Cruces	Las Cruces Dam	$4,500
Las Cruces East	Las Cruces Arroyo South	$2,475	Doña Ana	Doña Ana South	$18,000
Mesquite - Vado	Vado	$3,825	Doña Ana	Doña Ana Site 2	$900
Chaparral	East Lisa	$8,775	Fairacres	Nafzinger Arroyo	$1,500
East Mesa	Brahman Channel	$13,350	Rincon	Rincon Arroyo	$57,350
University Park	Tortugas Arroyo	$6,750	Anthony	Breedlove Arroyo	$2,475
Anthony	Lauson Arroyo	$6,750	Mesquite - Vado	Mossman Arroyo	$2,475
Chaparral	West Sagewood	$2,250	Doña Ana	Doña Ana Site 1	$1,250
Hatch	Placitas Arroyo	$32,600	Radium Springs	Leesburg Main	$13,600

Table 2: Estimated Cost of Inundation Mapping

G. Interagency Coordination

Information collected from flood warning systems is of interest to a wide range of potential stakeholders and agencies. The benefits derived from a flood warning system expand greatly if the information is shared for the benefit of all involved.

Figure 15, in Section E, provides an excellent example of the flow of information among a range of stakeholders in and near the City of Roseville, CA. Data from the City's Flood ALERT stations are shared with nearby counties and cities to enhance their emergency operations during flood events. In turn, data from adjacent communities is shared with the City to improve Roseville's flood response. The NWS uses the data to support weather and flood forecasts, watches, and warnings issued to the general public. The State of California Department of Water Resources receives Roseville's data to support flood monitoring at the state level.

During the flood event, Roseville produces a variety of products for dissemination through a range of channels including local news media, public access cable, and the Internet. These products are used by emergency responders, the general public, critical facility managers, transportation authorities, businesses and many others to improve flood response and mitigate damages, including loss of life.

Many stakeholders use Roseville's data in non-flood applications. Local agriculture interests use the data for crop management. Others use rain, weather, and stream information for a variety of recreational activities. Data are archived for later analysis and incorporation into the development of improved hydrologic standards at the local, state, and even national levels.

Sharing data and coordinating activities between agencies leverages everyone's resources and makes all of their activities more effective and valuable.

Doña Ana County has the opportunity to achieve a similar level of interagency coordination. Within the region, there are numerous potential stakeholders with an interest in data and products from a Doña Ana County flood warning system. Several entities in the region may have data and information to share with Doña Ana County.

Local flood agencies, first responders, the general public, agencies like the National Weather Service, the United State Geological Survey, other government agencies at all levels, irrigation and water supply districts, water managers, agriculture operations, educational institutions, recreational interests, and many others all have an interest in and could benefit from flood warning system information. The more value Doña Ana County provides to stakeholders, the more support the flood warning system will receive; this value is an essential element to securing long term funding.

H. Flood Warning System Benefits

The most obvious benefits derived from flood warning systems are fewer lives lost and lower flood damages. Further benefits from a well thought-out flood warning system can accrue from a broad range of other sources, including but not limited to:

1. Lower flood insurance rates - FEMA's Community Rating System (CRS) recently increased the number of points gained by implementing a flood warning system. The additional points help a community to qualify for lower flood insurance rates.

2. Agriculture - Local ranchers and growers may find rainfall information valuable to their water management programs. Adding sensors measuring temperature, wind speed, wind direction, barometric pressure, and humidity to the flood warning system will provide even more benefit to local agricultural interests.
3. Recreation - As with agriculture, adding a suite of weather sensors provides benefits for local recreation and a small incremental cost.
4. Education - Data from the flood warning system provide students of all levels, elementary through university, with a valuable resource supporting earth science programs.
5. Research - Archived data observations are an invaluable resource to support watershed, ecosystem, and climate science research programs, to name a few.
6. Design standards - Archived rainfall records enable engineers and scientists to develop improved hydrologic design standards that appropriately fit local conditions.
7. Water quality - Rainfall records are an important element in analyzing local stream loadings from sediment and related constituents.
8. Stormwater management - Both real-time and archived rainfall data help improve local stormwater management.

The list of derived benefits can go on and on. Leveraging the flood warning system to serve a broad spectrum of stakeholders dramatically improves the community return on investment and strengthens its foundation of support.

I. Operations and Maintenance

I.1. System Health Monitoring

Health monitoring allows proactive notifications to inform operations and maintenance staff if something breaks, right when it happens. This includes monitoring of data feeds, base station servers, and monitoring of health of individual environmental monitoring sites.

I.2. Daily, Weekly, and Monthly System Performance Reporting

Automated reports on health of the flood warning system and its components are sent to maintenance staff to notify them about how well the system is performing. They provide a means for prioritizing activities for the maintenance staff, and provide a report card to whoever oversees the maintenance to inform them that the maintenance activities are effective.

I.3. Well-Documented Maintenance Procedures

In order to have thorough and consistent maintenance performed on sites, field staff need standard procedures for performing maintenance. These standard procedures would include cleaning, calibrating, verifying operation, and checking the batteries, electronic, radio, and mechanical components of the individual sites. A checklist of maintenance steps would be needed for each type of site.

I.4. Tools for Tracking and Performing Maintenance

Maintenance activities need to be tracked and recorded. The most efficient method is for field staff to use the same tools for tracking maintenance as they use to support tracking inventory and for maintenance activities such as calibration of sensors and verifying transmitters.

I.5. Quality Control Tools

After every major event, data analysis tools should be used to compare sensors to their neighbors, identify data losses and anomalies, and evaluate overall performance and capacity.

I.6. Field Maintenance Tools

Field staff need tools to perform their day to day jobs. Standard tools required on a maintenance truck include an RF Receiver and Decoder to verify transmissions at a site. Mobile computers for programming devices, and with network access, verify end to end connectivity and calibration of a site before leaving. Sensor calibration tools are used for setting and measuring the calibration of devices.

J. Flood Risk Mapping

J.1. Data Evaluation

To identify and map centers of flood risk across Doña Ana County (DAC), AMEC performed a geospatial desktop analysis of data acquired from DAC Flood Commission. Several pieces of spatially-referenced GIS data were provided to AMEC by DAC Flood Commission GIS staff. These data were either provided in ESRI raster grid or shapefile format. This data included:

- Digital Elevation Models
- Orthoimagery
- Locations of Airports and Landing Strips
- Locations of Communications Infrastructure, such as radio and cellular phone towers
- Locations of gas lines, government buildings, and power lines
- Project boundaries and hydrologic data in support of the Chaparral, East Mesa, and Picacho Hills Drainage Master Plans
- Locations of existing gauges managed by EBID
- Locations of emergency facilities, including fire stations and border patrol checkpoints
- Locations of DAC facilities
- Locations and outlines of dams
- FEMA flood hazard areas from 1995 and 2008 map updates
- Locations of structures owned by the IBWC
- Landuse boundaries
- Locations of culverts, low-water crossings, and other known flooding locations
- Parcel boundaries, with ownership and value
- Locations of parks, schools, and other public facilities
- Transportation features

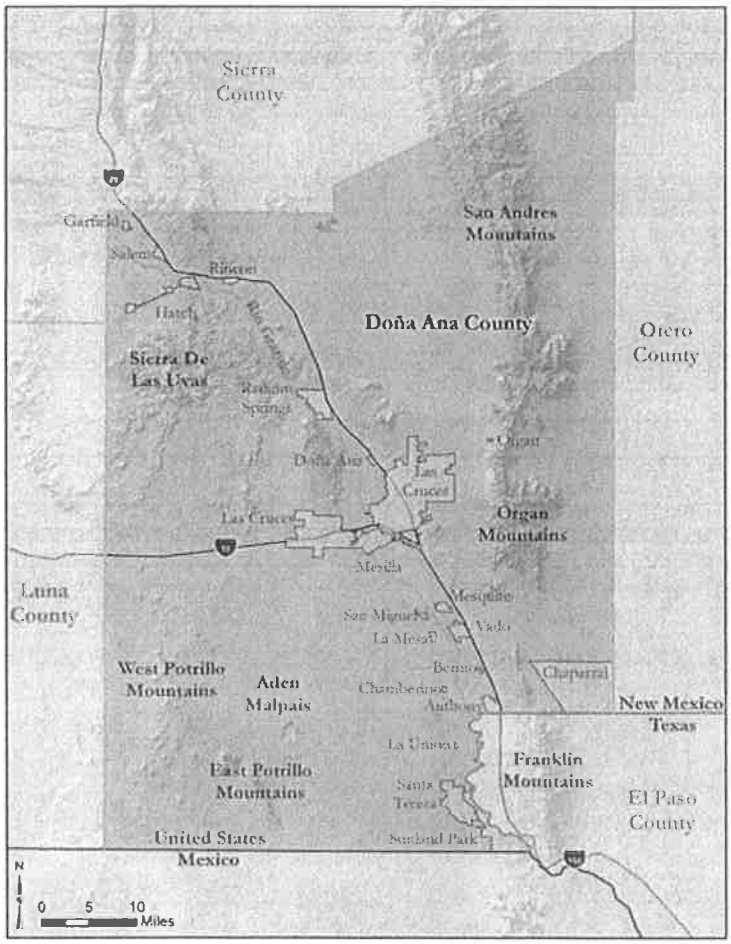
In addition, DAC Flood Commission GIS staff provided scanned copies of the East Mesa, Jornada, Old Picacho, and Picacho Hill Drainage Mater Plans. AMEC also collected:

- Monthly average rainfall amounts for June, July, and August, in ESRI raster grid format, from the PRISM Climate Group at Oregon State University
- The DAC portion of the National Hydrography Dataset from the USGS
- The FEMA Flood Insurance Study, effective September 1995, for Doña Ana County and Incorporated Areas.

J.2. Remote Monitoring Station Location and Verification

J.2.1 Flooding in Doña Ana County

Doña Ana County is situated in the basin-and-range region of south-central New Mexico and is marked by numerous, rugged, north-south oriented mountain ranges that are separated by wide desert basins. The County lies within the Chihuahuan Desert, a high desert ecoregion with an annual precipitation of less than ten inches, most of which falls during the late summer "monsoon season". The Rio Grande is a perennial stream that bisects Doña Ana County from north to south through the central part of the County known as the Mesilla Valley. Communities along the Rio Grande and its contributing arroyos include Hatch, Rincon, Radium Springs, Doña Ana, Las Cruces, Mesquite, Vado, and Anthony. Given their proximity to the Rio Grande itself, and their positions at the downstream end of the many ephemeral arroyos coming off the mountains, these communities possess significant flood risk.



Although it is not a main focus of this project, it is important to note that the Rio Grande is a large flooding source that has potential to cause a significant amount of damage to the communities of the Mesilla Valley. It is controlled upstream of the County at Elephant Butte Dam. The Rio Grande is surrounded by a system of levees, constructed by the IBWC. Several laterals branch off from the Rio Grande to provide irrigation water to the agricultural areas of the Mesilla Valley. Unused irrigation water is returned to the river through a system of return drains. Given high flow conditions, the Rio Grande, as well as each of its laterals and drains has potential to flood.

The majority of severe flooding that occurs in Doña Ana County is caused by runoff from the ephemeral arroyos coming off the mountains and water collecting in the low lying areas of the valleys. In the months of June, July, and August, also known as the monsoon season, moisture-laden

air from the Gulf of Mexico moves inland to southern New Mexico. The high temperatures during this season cause convective thunderstorms, resulting in heavy rainfall amounts in a localized area; properties that have been developed in low-lying areas have an increased risk from this type of flooding. Some developments of concern include the Village of Hatch at the downstream terminus of the Placitas Arroyo, the Town of Rincon along the Rincon Arroyo, various residential developments along the Sand Hill Arroyo east of Las Cruces, businesses and homes in central Las Cruces, and the entire Chaparral area sitting at the downstream terminus of several unnamed arroyos.

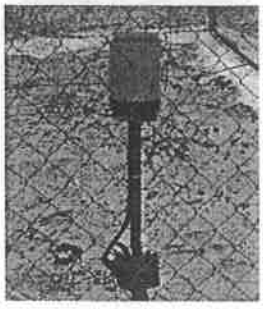
J.2.2 Methodology

The goal of this task, as defined by DAC Flood Commission staff, was to identify the locations of 30 remote monitoring stations that will provide optimum flood threat recognition lead times to identified critical communities, infrastructure, and facilitates that are susceptible to local and regional flooding. Discussions with DAC Flood Commission staff, as well as an initial, general characterization of the flood threats in Doña Ana County resulted in the determination that a system of remote monitoring stations that was optimized to cover the entire area of the county was not suitable for this project. Rather, a network of monitoring stations focused directly on those centers of population, transportation, and commerce most at-risk of flooding, mainly in the Mesilla Valley, would be more appropriate. It is for this reason that AMEC approached the placement of the 30 remote monitoring stations with a three-step approach targeting areas where flood losses, considering both human and financial losses, would be the greatest.

J.2.3 Monitoring Station Location Identification

Using engineering judgment and geospatial analysis, and assuming the use of only one remote monitoring station per risk center (to help ensure that monitoring stations were spread evenly across the county), AMEC determined the optimum location for a remote monitoring station that would provide adequate flood warning for each identified risk center. Two types of remote monitoring stations are proposed: stations that measure only rainfall or stations that are a combination of stage measurement and rainfall measurement.

Rainfall – In an ideal flood warning system, rainfall gauges are spaced evenly throughout the watershed, allowing for an accurate depiction of rainfall across the watershed and extended flood warning lead times. While this may be ideal, it is not always practical, which is the case in Doña Ana County. For the purpose of this project, AMEC selected an area in the upper reaches of the watershed contributing to each risk center where capture of rainfall data would provide flood warning lead times. These wide-area locations were further refined during the station filtering and site reconnaissance portions of the project. Of the 60 risk centers, AMEC identified that 39 would be adequately warned through the use of rainfall-only gauges.



Combination Rainfall and Stage – For watersheds where dams were present, providing some assumed level of protection for the risk center below, AMEC identified the areas adjacent to the dam spillway as the appropriate location for a remote monitoring station that measures both stage and rainfall. By measuring stage, staff of the DAC Flood Commission will be able to monitor the level of water as it rises behind the dam, warning citizens within the downstream risk

center as the water level approaches the dam spillway. Although measuring rainfall at this same location will not provide DAC Flood Commission with an indication of inflows into the dam, or even outflows from the dam, it will provide them with a depiction of potential flooding from adjacent, non-dam arroyos, thus providing more flood warning for the risk centers downstream. Twenty risk centers out of the total 60 were identified as having some level of protection from a dam, thus benefitting from the use of a combination stage and rainfall gauge for flood warning purposes. In some situations, a combination rainfall and stage monitoring station will be proposed either immediately downstream of a dam or on a manmade channel. At these types of monitoring stations, the stage information collected is converted to a flow using a rating curve. Knowing the outflow from a larger dam or in a channel is a very useful tool in flood warning.

Monitoring station locations were also assigned a qualitative ranking based on the potential effectiveness at providing early warning information for the associated downstream risk center. The qualitative rankings were broken down as follows:

Excellent – More than 90% of the watershed upstream of the risk center is covered by this monitoring station location. No augmentation in coverage needed.

Good – More than 60% of the watershed of the risk center is covered by this monitoring station location. Coverage may need to be augmented in the future by additional monitoring stations.

Fair – Less than 60% of the watershed upstream of the risk center is covered by this monitoring station. Coverage will need to be augmented in the future by more monitoring stations.

Redundant – A monitoring station at this location will duplicate coverage already provided by a different monitoring station nearby. Consider removal of this location during the filtering process.

J.2.4 Risk Center Identification and Grouping

To identify and map centers of flood risk across Doña Ana County, AMEC performed a geospatial desktop analysis of data acquired from DAC and other sources. The desktop analysis involved overlaying FEMA flood maps with other, county-supplied data noted above to identify critical infrastructure and facilities located within the floodplain. Doña Ana County currently has two sets of FEMA flood maps. The effective maps were last revised in 1995, and preliminary maps have been on hold since 2008 for administrative reasons. For risk center identification, both sets of maps, as well as maps from local studies and drainage master plans, were assessed. Locations identified as being subject to flooding were deemed to be flood "risks". AMEC identified additional flood risks by using aerial imagery to identify buildings located within the FEMA floodplain or adjacent to a FEMA or USGS identified ephemeral stream. Drainage Master Plans were also utilized to mark additional risk points that may not have been identified using the methods described above. Additional scrutiny was performed in important areas as identified by DAC Flood Commission staff, including Hatch, Rincon, Chaparral, Doña Ana, and the Sand Hill Arroyo.

It should be noted that the Rio Grande will not be included in this portion of the Master Plan. Given that it is controlled upstream by the USBR, the number of flow gauges operated by the USGS along the river that could be easily integrated into the DAC FWS once it is established, and the six to eight hour travel time from Elephant Butte Dam down the river to Santa Teresa, the DAC Flood Commission staff feels that there is already adequate flood warning available for the Rio Grande.

Individual flood risks were grouped into 'risk centers" having a common flooding source, community subdivision, or flood protection mechanism. These risk centers were further grouped into "risk regions" representing the general geographic location of the flood risk within Doña Ana County. In total, AMEC identified 60 specific risk centers, which have been separated into 19 risk regions. The risk regions are shown in Appendix B.

J.2.5 Risk Region Descriptions and Site Locations

Risk Region Description: Anthony

The Anthony risk region is near the CDP of Anthony, the southernmost Doña Ana community along I-10, and encompasses three risk centers. North of the Anthony CDP are risk centers associated with the Lauson and Breedlove Arroyos, which flow from the east off the Franklin Mountains, between the Mesilla Valley and Chaparral. Although small dams on these arroyos protect the Anthony community from flooding from smaller events, larger flood events are likely to overwhelm their storage capacity. These two arroyos have potential to flood I-25, as shown on the FEMA flood maps. After crossing the Interstate, the Lauson Arroyo splits into two flow paths, flowing northwest and southwest. Residential tracts housing approximately 800 people are at risk of flooding from these two arroyos. The third risk center is named for Anthony Arroyo, which flows from the ridge to the east down Anthony Wash to the Anthony Arroyo Site One Dam, near Hacienda Acres. After passing through the dam, the arroyo passes through the southeast corner of Anthony, before leaving New Mexico and flowing into Texas.

Proposed Site Locations

Risk Centers: Anthony Arroyo, Breedlove Arroyo, Lauson Arroyo

To warn these risk centers, AMEC proposes three combination dam level and rainfall monitoring stations at Anthony Arroyo Site 1 dam and the unnamed dams on Lauson and Breedlove Arroyos east of I-25 near New Mexico Highway 404. Given their location at dams on the only tributary above each risk center, all three of these proposed site locations provide excellent coverage for their associated downstream risk center. Each site has nearby road access and may have line-of-sight telemetry available.

Risk Region Description: Central Las Cruces

The Central Las Cruces region covers the flood threat centers generally northeast of I-10, west of I-25, and south of the Doña Ana Drain. This encompasses the majority of the City of Las Cruces and a population of approximately 60,000 residents. It is home to many businesses and all varieties of residential areas. Flooding within this region, with the exception of that in the Las Cruces Dam threat center, is caused by localized rainfall occurring over Las Cruces collecting in the lowest areas of town. Given their urban setting and potential for over $500 million in losses, these areas have been heavily studied by FEMA and its mapping partners. The Las Cruces dam, also known as U.S. Government Dam, is a large flood control structure constructed by the U.S. Army Corps of Engineers in 1975 to reduce flood flows from the Las Cruces and Alameda Arroyos. The dam has two outlets on its north and south ends, resulting in a small risk center along I-25 where potentially high flows from the dam could exceed channel capacity.

PROPOSED SITE LOCATIONS

Risk Center: Flowpath 4

The use of a rainfall monitoring station anywhere within the contributing watershed is proposed for this risk center. Given the number of channels in the widespread risk center, a single monitoring station location within the watershed may only provide good coverage, with two or more being required to product excellent coverage. This site area is very accessible and should have no issues with telemetry.

Risk Center: Flowpath 4 – Burn Lake

The use of a rainfall monitoring station anywhere within the contributing watershed is proposed for this risk center. The large watershed contributing to this risk center will only allow good coverage from a single monitoring station. A combination gauge at Burn Lake could provide some early warning, though additional monitoring stations would be necessary to account for flows in the other tributary flowpaths that enter this risk center. If combined with rainfall gauges in adjacent risk centers, this coverage may be increased to excellent. This site location is very accessible and should have no issues with telemetry.

Risk Center: Flowpath 5

The use of a rainfall monitoring station anywhere within the contributing watershed is proposed for this risk center. Given its small watershed, a single station within this site area provides excellent coverage to the risk center. The site location is very accessible and should have no issues with telemetry.

Risk Center: Flowpath 6 & 7

This is a very large risk center, and a single site location can provide good coverage. Stations installed at Flowpath 4 and Flowpath 5 locations could augment the data available for monitoring in this risk center. DAC Flood Commission staff indicated that the City of Las Cruces flood control project near the corners of Main and Chestnuts Streets would be a great location for a combination stage and rainfall monitoring station. A rainfall gauge installed at this site location could also provide additional data for the surrounding risk centers. This site location is very accessible and should have no issues with telemetry.

Risk Center: Flowpath 7 Tributary

A stage monitoring station, upstream of the risk center on the tributary of interest, would provide good coverage for the risk center. The site area will be augmented by rainfall data from any adjacent site locations. This site location is very accessible and should have no issues with telemetry.

Risk Centers: Las Cruces Arroyo and Las Cruces Dam

Monitoring the water level behind the dam or the stage of the outlets at the Las Cruces dam site location can provide excellent coverage for both the Las Cruces Arroyo and Las Cruces Dam risk centers. Additional stage gauges at the Las Cruces Arroyo site location are redundant given the proximity and broad coverage provided by the dam. This site location is very accessible and should have no issues with telemetry.

Risk Region Description: Chaparral

The Chaparral risk region covers the entire CDP of Chaparral. With a population just over 14,600 people, Chaparral is located in a flat valley in the southeast corner of Doña Ana County, just north of El Paso, Texas. Given its flat topography, flooding in Chaparral is very shallow and widespread. Chaparral received substantial damage during the floods in 2006. The risk centers of West HWY 213, West Sagewood, and West McLain are flooded by arroyos coming from the Franklin Mountains to the east. Flooding in the Central risk center of Chaparral is caused by localized runoff, as is the flooding in the centers of East Lisa and Far East.

Proposed Site Locations

Risk Center: Central

Location of a rainfall monitoring station within the contributing watershed provides excellent coverage for the Central risk center, though the proximity of this site location to the East Lisa and West McLain site areas may render this site redundant if used in conjunction with those. This site has nearby road access and may have line-of-sight telemetry available.

Risk Center: East Lisa

A single site location provides incomplete coverage for the East Lisa risk center. To provide excellent coverage, sites are necessary in both the western and eastern halves of the watershed. The proposed site locations are on BLM land with difficult, often gated, access. Line-of-sight telemetry is not necessarily available, given their remote locations.

Risk Center: Far East

A single site location in the watershed upstream of the Far East risk center would provide excellent coverage, and there is nearby road access and line-of-sight telemetry available as well. A drawback is that the best proposed site location would be outside of Doña Ana Count to the east, near El Paso, Texas.

Risk Center: West HWY 213

The West HWY 213 risk center has a single tributary such that a single site location in the upper watershed provides excellent coverage. This site area is in a remote area with difficult access; line-of-sight telemetry is not necessarily available.

Risk Center: West McLain

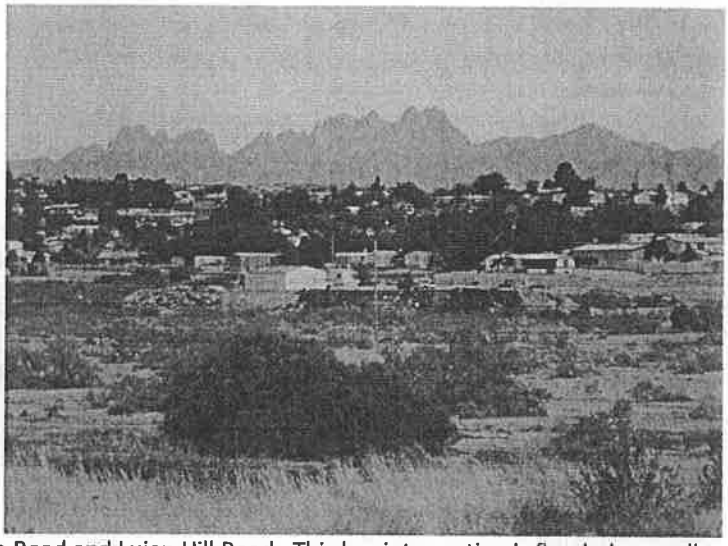
A single location provides incomplete coverage for the West McLain risk area, though it may be augmented by a site in the East Lisa area. This site area is in a remote area with difficult access; line-of-sight telemetry is not necessarily available.

Risk Center: West Sagewood

Given that the area contributing to this risk center consists of three tributaries, a single site location provides incomplete coverage for the West Sagewood risk center. The site area is in a remote area with difficult access, unless the site is placed immediately adjacent to New Mexico Highway 404. Line-of-sight telemetry is not necessarily available.

Risk Region Description: Doña Ana

The risk region immediately north of Las Cruces is Doña Ana, named for the small CDP of Doña Ana Village that is home to 1,211 residents. This region is comprised of five specific areas of flood risk along the I-25 and Doña Ana Road Corridor between Hill and Las Cruces. The flood risk for this area is primarily due to the numerous small arroyos running off of Doña Ana Mountain into the Mesilla Valley, the largest of which is the Doña Ana Arroyo. The Doña Ana North risk center is positioned at the outlet to Cleofas Canyon and floods an area of agricultural buildings. The Doña Ana Road risk center is located near the intersection of Goat Hill Road with Doña Ana Road and Lujan Hill Road. This key intersection is flooded, as well as several residences and agricultural buildings. The Doña Ana South risk center is located between I-25 and Doña Ana Road along Doña Ana Lateral. It is flooded by a number of unnamed arroyos coming off Doña Ana Mountain. Although this center is not protected by dams, it is somewhat protected by the embankment of I-25, with flow through the embankment limited to culvert, viaduct, and overpass openings. The smaller, Doña Ana Site 1 and Doña Ana Site 2 centers are named for the two dams that protect them upstream.



Proposed Site Locations

Risk Centers: Doña Ana North and Doña Ana Road

Although these two site areas are specified to cover the risk centers of their respective namesakes, a single station monitoring rainfall in the proposed area contributing to the Doña Ana North risk centercan provide excellent coverage of the entire Cleofas Valley watershed, and would provide excelled early warning coverage for both risk centers. A second station covering the Doña Ana Road site would be redundant. Line-of-sight telemetry may be available at the fire station in Doña Ana Village.

Risk Centers: Doña Ana Site 1 and 2

Combination dam level/outlfow and rainfall monitoring stations can provide excellent coverage for the Doña Ana Site 1 and 2 risk centers. The dams above these risk centers are a good measurement location for the high flows that may come down the arroyos. These site areas are very accessible and should have no issues with telemetry.

Risk Center: Doña Ana South

A rainfall monitoring station in the area contributing to the Doña Ana South risk center could serve two purposes; first off, it could provide good coverage for the large number of unnamed arroyos that feed the risk center from the western flanks of the Doña Ana Mountains. Secondly,

this monitoring station location could help augment the coverage provided by the proposed monitoring station location at for Doña Ana North. As with the Doña Ana North site location, line-of-sight telemetry may be available at the first station in Doña Ana Village.

Risk Region Description: DAC Southwest

The DAC Southwest risk region contains the Hwy 9 Overtop risk center. This single risk center is located along New Mexico Highway 9, west of Portrillo, near Mount Riley. Although there is no population in this area, it was identified as a risk center due to an unnamed arroyo overtopping Highway 9 on the FEMA flood map, resulting in the closure of a major transportation route.

Proposed Site Location

Risk Center: HWY 9 Overtop

The watershed contributing to this risk center is very large, and thus a single monitoring station would likely not provide adequate coverage for flood warning. Although rainfall monitoring in the higher elevations can capture a larger percentage of the flow, a stage gauge along the arroyo would be necessary to provide excellent coverage. This site area is in a remote area with difficult access; line-of-sight telemetry is not necessarily available.

Risk Region Description: DAC West

The DAC West risk region is another small region containing a single risk center. The I-10 West Border Patrol risk center is located along I-10 west of Las Cruces. Although there are no permanent residences at this location, it was identified as a risk center due to the potential for flooding of the border patrol checkpoint and the risk to its workers by the arroyo coming out of Kimble Draw from the north.

Proposed Site Location

Risk Center: I-10 West Border Patrol

The watershed contributing to this risk center is very large, and thus a single monitoring station would likely not provide adequate coverage for flood warning. Although rainfall monitoring in the higher elevations can capture a larger percentage of the flow, a stage gauge along the arroyo would be necessary to provide excellent coverage. This site area is in a remote area with difficult access; line-of-sight telemetry is not necessarily available.

Risk Region Description: East Mesa

The East Mesa risk region is located east of Las Cruces, mainly along US70 from Las Cruces to Organ. The area is primarily residential, and flooding risk throughout this area is posed by the many tributaries and multiple flowpaths of the Sand Hill and Baylor Canyon Arroyos. Over 25,000 residents live in this area, making it a particular concern to DAC Flood Commission staff. The region is comprised of ten centers of significant flood risk. The Sand Hill Arroyo itself has its headwaters in the Organ Mountains and flows down multiple paths to Las Cruces. It floods the High Ridge/Las Colinas, Mesa/Dos Suenos, and Tierra Grande centers, north of US70. The High Ridge/Las Colinas center is protected by Sandhill Arroyo Dam, while the remainder of the Arroyo is controlled by the detention structure at Waterfall Pond. The Homestead risk center is located on an unnamed tributary to the Sandhill Arroyo, on the south side of US70. The centers of Organ and Valley Vista are flooded by small, unnamed arroyos coming off Baylor Peak. The Brahman Channel center encompasses a residential area flooded by several unnamed arroyos controlled upstream by the Brahman Channel Dam. The remaining centers of the East Mesa region make up the Baylor Canyon Arroyo, which flows from the Organ Mountains, through a large residential area, to Isaac Lake.

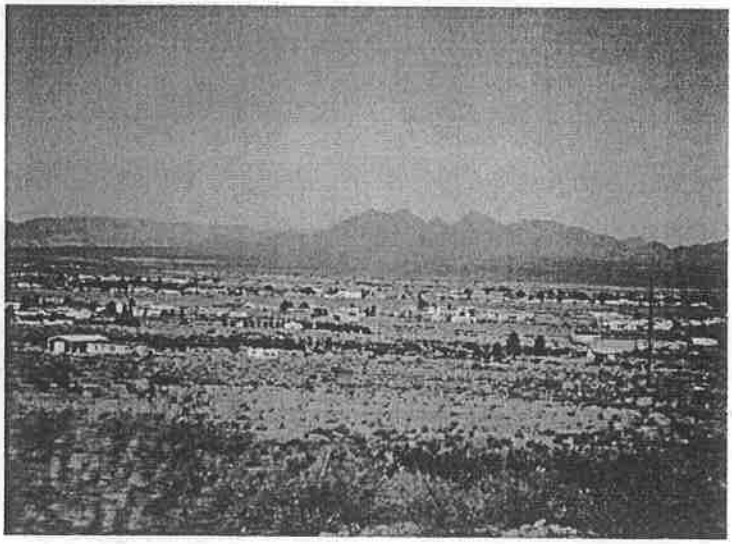
Proposed Site Location

Risk Center: Baylor Canyon

A single site location for the Baylor Canyon Arroyo may not provide adequate coverage for flood warning given the expansive contributing watershed. The best location for a monitoring station would be in the southern portion of the watershed where monitoring rainfall on two tributaries would provide good coverage. This site area is in a more upland area and may be difficult to access, though nearby infrastructure may provide line-of-sight telemetry from existing antennae.

Risk Center: Brahman Channel

A monitoring station located along Brahman Channel dam is well placed to provide excellent coverage for the Brahman Channel risk center. All the unnamed arroyos that threaten this risk centers are captured behind the dam and funneled to the north. This site area is very accessible and should have no issues with telemetry.



Risk Center: High Ridge/Las Colinas

A combination stage and rainfall monitoring station on the Sandhill Arroyo Dam would provide excellent coverage for a number of risk centers, including High Ridge/Las Colinas, Mesa/Dos Suenos, and Settler's Ridge/Vista Del Rio. This site location is very accessible and should have no telemetry issues.

Risk Center: Homestead

A rainfall monitoring station alone in this area provides redundant coverage given the number of rainfall stations proposed to serve adjacent risk centers. Ideally, a station monitoring the flow of the arroyo would provide excellent coverage, but flow gauges are not sustainable in this part of the desert. This site area is very accessible and should have no issues with telemetry.

Risk Center: Mesa/Does Suenos and Tierra Grande

The proposed site locations for these two risk centers are overlapping given the protection provided by Waterfall Pond, owned by the City of Las Cruces. Excellent coverage is provided for both by a combination rainfall and stage monitoring station at Waterfall Pond.

Risk Center: Moongate Acres

A rainfall monitoring station in the area contributing to this risk center would be redundant, given the number of adjacent proposed rainfall monitoring stations. This site location is very accessible and should have no issues with telemetry.

Risk Center: Organ

Although a single rainfall monitoring station upstream of the Organ risk center would provide excellent coverage for flood warning, it is not technically feasible given that the area has been designated an Area of Critical Environmental Concern by the BLM.

Risk Center: Space Mural

A single site location upstream of this risk center provides good coverage for flood warning. A rainfall monitoring station in this southern portion of the contributing watershed could serve the dual purpose of covering the Space Mural and Baylor Canyon risk centers. This site location is in a more upland area and may be difficult to access, though nearby infrastructure may provide line-of-sight telemetry.

Risk Center: Valley Vista

A stream gauge in the Valley Vista site area will provide excellent coverage of the downstream risk center. This site area is very accessible and should have no issues with telemetry.

Risk Region Description: Fairacres

The Fairacres region encompasses an area to the west of Las Cruces that is north of US 70 and south of Picacho Mountain. The Fairacres CDP, which extends to the south of US 70, has a population of 824 people. Compared to the East Mesa, residential development in this region is sparse. Two risk centers affect this area. The Fairaces risk center contains a small arroyo flowing parallel to US 70 on its north side, crossing the highway near Marwood Lane. The Nafzinger Arroyo risk center covers a small development on top of an alluvial fan at the outlet of the Nafzinger Arroyo, along Picacho Mountain Road.

Proposed Site Locations

Risk Center: Fairacres

The location of a rainfall monitoring station in the area upstream of the Fairacres risk center provides excellent coverage for the downstream risk center, and coverage here may be augmented by a rainfall monitoring station in the Nafzinger Arroyo. This site has nearby road access and may have line-of-sight telemetry available.

Risk Center: Nafzinger Arroyo

A rainfall monitoring station located in the upstream reaches of the Nafzinger Arroyo provides excellent coverage for the downstream risk center, and will also augment coverage for the Fairacres risk center. This site has nearby road access and may have line-of-sight telemetry available.

Risk Region Description: Garfield

The Garfield risk region centers on the Census Designated Place (CDP) of Garfield, located just south of the county line on the edge of the Mesilla Valley between I-25 and the Rio Grande at the outlet from Garfield Canyon. According to the 2010 Census, 137 people live within the Garfield CDP. FEMA flood maps show that there are several residences, a fire station, and a public school at risk of flooding, namely from Garfield Canyon Creek and the Wassen Arroyo via the Garfield Lateral. Although this area is protected by the Caballo Arroyo Site 2 and Hatch Valley Arroyo Site 6 Dams, DAC Flood Commission staff indicates that most dams are only designed for a 50-year event.

Proposed Site Locations

Risk Center: Garfield

Combination dam level/outflow and rainfall monitoring stations in this area could provide excellent coverage. Given the number of dams protecting this risk center, a single site location provides only fair coverage. All dams in this area have nearby road access and may have line-of-sight telemetry available.

Risk Region Description: Hatch

The Hatch risk region encompasses two risk centers, named Placitas Arroyo and Hatch. The Village of Hatch is known worldwide for its green chili farming, and is positioned at the terminus of several arroyos, most notably the Placitas Arroyo. The Placitas Arroyo is a large watershed that has its headwaters in the Sierra de las Uvas, southwest of Hatch. The 30 square mile watershed accumulates peak 100-year flows near 10,000 cubic feet-per-second. West of the village is Placitas, a small adjacent CDP also situated along the Placitas Arroyo. In addition to the Placitas Arroyo, Spring Canyon and Rodney Canyon Arroyos to the south flood the remaining 1,500 people living in Hatch via the Rodney Lateral and Colorado Drain. The areas of Hatch and Placitas were repeatedly flooded during the 2006 monsoon season, resulting in substantial damage to property and endangerment to human lives.

Proposed Site Locations

Risk Center: Hatch

A combination dam level/outflow and rainfall monitoring station at the Spring Canyon Flood Detention facility will provide good coverage for the Village of Hatch. A station at this location is likely to be able to operate using line-of-sight telemetry to the radio towers in Hatch. There is excellent road access to this site as well.

Risk Center: Placitas Arroyo

Given its large size, limited road access, and limited line-of-sight telemetry, the Placitas Arroyo is a difficult watershed in which to place a single remote monitoring station location. That said, flash flood events can be effectively monitored with rainfall stations in the mid/upper elevations of the Arroyo. A single rainfall monitoring station within this watershed will only provide good coverage.

Risk Region Description: Las Cruces East

The Las Cruces East region is comprised of flood risk centers upstream of the Las Cruces Dam along the Alameda and Las Cruces Arroyos and their tributaries. These arroyos flow through residential subdivisions that were built, according to the FEMA flood maps, above the 100-year flood elevation. However, high flows from these arroyos still pose a risk to those buildings adjacent to the arroyo. The Alameda Dam, Las Cruces Arroyo North Fork, and Las Cruces Arroyo South Fork risk centers are protected upstream by dams.

Proposed Site Locations

Risk Center: Alameda Dam

A dam level and rainfall monitoring station on Alameda Dam provides good coverage for the downstream risk center. There are a number of smaller tributaries that join the wash below the dam but above the risk center that would need to be monitored for the coverage to be considered excellent. This site has nearby road access and may have line-of-sight telemetry available.

Risk Center: Alameda North

A single rainfall monitoring station provides good coverage for the downstream risk center. There are a few additional tributaries that would not be covered by this location. This location has good road access and may have line-of-sight telemetry available.

Risk Center: Alameda South

Location of a rainfall monitoring station in the areas upstream of this risk center would provide good coverage for the risk center downstream. There are a few additional tributaries that would not be covered by this location. This location has good road access and may have line-of-sight telemetry available.

Risk Center: Las Cruces Arroyo North

A combination dam level and rainfall monitoring station at the North Fork Dam provides good coverage for the downstream risk center. There are a number of smaller tributaries that join the wash between the site and the risk center that need to be monitored for the coverage to be considered excellent. This site appears to have nearby road access and may have line-of-site telemetry available.

Risk Center: Las Cruces Arroyo South

Although similar to the North Fork, a combination dam level and rainfall monitoring station at the South Fork Dam provides excellent coverage for the downstream risk center since there are not many tributaries downstream of the dam. This site has nearby road access and may have line-of-site telemetry available.

Risk Center: Little Dam Arroyo

A single site location in the upstream area of the Little Dam Arroyo provides good coverage for the downstream risk center. Coverage here will be enhanced by rainfall monitoring at the South Fork Dam, in the adjacent arroyo. Given its proximity to Las Cruces, it may be necessary to work

with a private property owner for site access. This site has nearby road access and may have line-of-site telemetry.

Risk Region Description: Las Cruces North

The Las Cruces North risk region encompasses the majority of flooding from the Moreno Arroyo and its tributaries, as well as the downstream end of the Sand Hill Arroyo in an area of approximately 3,000 residents called San Ysidro. At this point, the Sand Hill Arroyo is relatively controlled from upstream, and thus the flooding in the Settler's Ridge/Vista Del Rio risk center comes mainly from localized rainfall. The Moreno Arroyo has its headwaters in the East Mesa region, flowing southwest into San Ysidro.

Proposed Site Locations

Risk Centers: Moreno Arroyo, Moreno Arroyo North and South

Three site locations for these three risk centers will be redundant, and thus can be provided excellent coverage by sites in the areas upstream of Moreno North and Moreno South. These site areas are very accessible and should have no issues with telemetry.

Risk Center: Settler's Ridge/Vista Del Rio

The proposed site location for this risk center is somewhat redundant. The Settler's Ridge/Vista Del Rio risk center is provided good coverage by the site on the Sand Hill Arroyo Dam proposed for the High Ridge/Las Colinas risk center, and additional coverage through rainfall monitoring is possible from the Moreno North and South sites. This site area is very accessible and should have no issues with telemetry.

Risk Region Description: Mesquite – Vado

The risk region encompassing the CDP's of Mesquite and Vado covers an area along I- 25 that is prone to flooding. In July 2004, just over three inches of rainfall in three hours over the Vado Arroyo resulted in over $500,000 in damage and the evacuation of 14 homes. This flooding comes from the east, around Vado Hill. In Mesquite, two flood risk centers have been identified. The Mesquite Site 4 risk center is protected by the Apache Brazito Mesquite Site Four Dam. Upstream of the dam, the contributing arroyo has a large drainage area with its headwaters on the southern and western slopes of Pyramid Peak. To the north, the Mossman Arroyo risk center is protected by the Apache Brazito Mesquite Site Three Dam. The headwaters of the Mossman Arroyo come from the northern slopes of Pyramid Peak via Finley Canyon as well as the southern end of the Organ Mountains, near Peña Blanco.

Proposed Site Locations

Risk Center: Mesquite Site 4

This site location provides excellent coverage for the downstream risk center. Dam level monitoring covers the only tributary to the risk center. This site has nearby road access and may have line-of-site telemetry available.

Risk Center: Mossman Arroyo

A monitoring station site is proposed at Apache Brazito Mesquite Site 3 dam, also known as Mossman Arroyo Dam to serve this risk center. This site location provides excellent coverage for the downstream risk center. Dam level monitoring covers the only tributary to the risk center. This site has nearby road access and may have line-of-site telemetry available.

Risk Center: Vado

A single rainfall monitoring station within the watershed upstream of the Vado risk center will provide good coverage for flood warning. There are two tributaries that must be monitored to provide excellent coverage to the risk center. The site has nearby road access and may have line-of-sight telemetry available.

Risk Region Description: Radium Springs

North of Las Cruces, on a bend in the Rio Grande, is the Radium Springs risk region. This risk region contains two risk centers, Masson Farms and Leasburg Main. Masson Farms is a large complex of greenhouses, positioned in a small natural gulch called Medler, where three unnamed canyons outlet into the Rio Grande. Though small, this area contains just under $1.9 million in building value at risk of flooding. The Leasburg Main, an area of less flooding, consists of agricultural buildings along Doña Ana Road, valued at approximately $170,000.

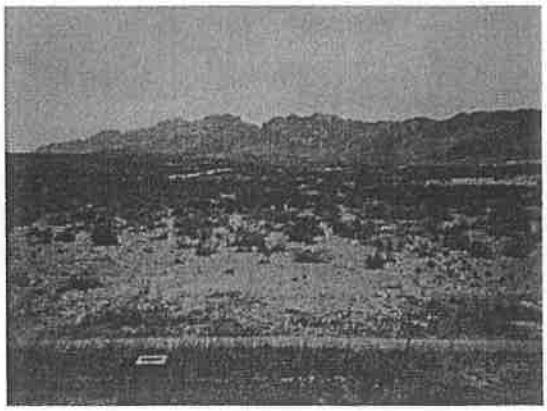
Proposed Site Locations

Risk Center: Leasburg Main

A single rainfall monitoring station in the upper elevations of the Leasburg Main area can provide good coverage for the Leasburg Main risk center. There are a number of arroyos spread over approximately 2.5 miles, so a single gauge cannot provide excellent coverage. While dam level stations could be installed at the Lucero Dam and the Rhodes Arroyo Retarding Dam, they would not offer a significant improvement in coverage. Telemetry for this site is unknown, and access looks to be good.

Risk Center: Masson Farms

A rainfall monitoring station in the area upstream of the Masson Farms risk center offers good coverage for flood warning. This site is accessible by road. Telemetry for this site is unknown.



Risk Region Description: Rincon

The Rincon risk region is home to a single risk center, known as Rincon Arroyo. Rincon itself is a small, 271-person CDP located between Hatch and Las Cruces along I-25. Its primary flooding source is the Rincon Arroyo, a massive arroyo having its headwaters in the Caballo Mountains and spanning 78 square miles in drainage area with 100-year peak flows in excess of 3,000 cubic feet-per-second.

PROPOSED SITE LOCATIONS

Risk Center: Rincon Arroyo

The watershed for the Rincon Arroyo is quite expansive, and thus a single rainfall monitoring station can only provide fair coverage. The watershed is also very remote, making access very difficult. Depending on the location of the monitoring station, there is a fire station in Rincon that could provide line-of-sight telemetry. It is proposed that a rainfall monitoring station be placed as near to a road as possible, most likely off County Road E070.

RISK REGION DESCRIPTION: SALEM

The Salem risk region centers on the small CDP of Salem and encompasses two risk centers. Similar to Garfield, the CDP of Salem is located near the county line between I-25 and the Rio Grande and has 942 residents. The majority of the population is located at the outlet of several small, unnamed arroyos flowing from the north. Salem proper, covered by the Salem risk center, is protected by the Hatch Valley Arroyos and Caballo Arroyo Site 3 Dams and contains a County Park. An additional risk center in this region, south of the Salem CDP, is primarily comprised of agricultural buildings at a value of $63,800 and is protected by the Reed-Thurmond Dam.

PROPOSED SITE LOCATIONS

Risk Center: Reed-Thurmond Dam

A combination dam level and rainfall monitoring station on Reed-Thurmond Dam will provide excellent coverage for the small risk center downstream. Access is not an issue, and line-of-site telemetry should be available.

Risk Center: Salem

Combination dam level and rainfall monitoring stations on the Hatch Valley Arroyos and Caballo Arroyos Site 3 Dams will provide excellent coverage for the Salem risk center. That said, a single station can only provide good coverage. No fire station or antenna is present near the Salem site location, so it is unclear at this time how signal will be relayed from the warning stations. The site location has good road access.

RISK REGION DESCRIPTION: SOLEDAD CANYON

The Soledad Canyon risk region covers the Fillmore and Peña Blanco Arroyos, which flow off the west side of Squaw Mountain, on the western slopes of the Organ Mountains, and down to the Fillmore Dam Site Number 1. Flooding through this area is widespread and very shallow, generally between one and two feet deep, as evidenced in the large Zone AO designation on the FEMA flood map. Approximately 650 people live in this area of Doña Ana County.

PROPOSED SITE LOCATIONS

Risk Center: Fillmore Arroyo

A rainfall monitoring station in the upstream areas of this arroyo can provide good coverage for the downstream risk center, and also improve the coverage in the Peña Blanco Arroyo risk center. This site has nearby road access and may have line-of-site telemetry available.

Risk Center: Peña Blanco Arroyo

Location of a site in the upstream areas of this arroyo will provide excellent coverage for the downstream risk center since it covers the only tributary into that risk center. Rainfall monitoring in the Fillmore Arroyo will further augment this coverage. This site has nearby road

access and may have line-of-site telemetry available.

Risk Region Description: Sunland Park

The risk region of Sunland Park encompasses the City of Sunland Park, a community on the border between the U.S. and Mexico. The Sunland Park risk center lies along the Rio Grande at the outlet of Anapra Wash, an ephemeral flooding source flowing north from Rancho Anapra, a suburb of Ciudad Juarez, Mexico.

Proposed Site Locations

Risk Center: Sunland Park

Location of a site to adequately warn the Sunland Park risk center is difficult given that the best location for a rainfall monitoring station is in Mexico. A site location along the border, near the base of Sierra de Cristo Rey will provide only fair coverage for the purpose of flood warning. Access may be an issue given its proximity to the border and restrictions by border patrol. Telemetry should not be an issue.

Risk Region Description: University Park

The University Park region covers the area just north of the split between I-25 and I-10. It is comprised of a mix of residential and commercial buildings along with school buildings on the New Mexico State University campus. Approximately 4,300 people live in University Park, a CDP in the center of this region. One major flooding source covers the entire area, and thus there is a single risk center in this area for the Tortugas Arroyo. The Tortugas Arroyo has its headwaters far off in the Organ Mountains, and flows down through relatively uninhabited desert, around the north side of Tortugas Mountain, before reaching University Park. The majority of the center is protected by the Tortugas Site Number 1 Dam.

Proposed Site Locations

Risk Center: University Park

A combination dam level and rainfall monitoring station on Tortugas Site Number 1 Dam can provide excellent coverage to the downstream risk center. The downstream risk center is highly linear and has few side tributaries that might contribute additional flow. This site has nearby road access and may have line-of-sight telemetry.

Risk Center Summary Table

The table on the following pages summarizes the population, building value, public facilities, and major transportations routes that are at-risk of flooding in each of the 60 risk centers, along with the level of coverage provided by the proposed monitoring station above the risk center.

Risk Center Summary Table					
Risk Center	Population at Risk	Building Value at Risk	Public Facilities at Risk	Major Transportation at Risk	Coverage
Anthony Risk Region					
Anthony Arroyo	585	$629,400			Excellent
Breedlove Arroyo	353	$0			Excellent
Lauson Dam	1655	$3,509,926			Excellent
Central Las Cruces Risk Region					
Flowpath 4	2530	$26,237,192		Doña Ana Road Main Street	Good
Flowpath 4 - Burn Lake	4648	$76,605,438		Valley Drive Picacho Avenue Amador Avenue	Good
Flowpath 5	411	$1,878,545		Solano Drive	Excellent
Flowpath 6 & 7	8913	$291,441,553	Alameda Elementary Alma De Arte Las Cruces High School Mesilla Park Elementary Lettuce (Nursing Home) Willoughby (Nursing Home) NMSU Police Station	Picacho Avenue Amador Avenue Main Street Avenida De Mesilla Valley Drive Interstate 10 University Avenue Union Avenue	Good
Flowpath 7 Tributary	2358	$16,797,375		Solano Drive	Good
Las Cruces Arroyo	736	$16,594,474		Solano Drive	Excellent
Las Cruces Dam	283	$17,719,816			Excellent
Chaparral Risk Region					
Central	889	$3,347,927			Excellent
East Lisa	1921	$9,822,637			Good
Far East	446	$982,311			Excellent
West HWY 213	739	$6,822,805			Excellent
West McLain	529	$1,234,448			Fair
West Sagewood	1243	$7,433,730			Fair
Doña Ana Risk Region					
Doña Ana North	5	$126,200			Excellent
Doña Ana Road	110	$1,433,788			Redundant
Doña Ana Site 1	152	$2,155,300			Excellent
Doña Ana Site 2	413	$1,652,800			Excellent
Doña Ana South	421	$5,909,207			Excellent
DAC Southwest Risk Region					
HWY 9 Overtop	0	$0			Fair
DAC West Risk Region					
I-10 West Border Patrol	0	$0			Fair
East Mesa Risk Region					
Baylor Canyon	3035	$14,604,192			Fair
Brahman Channel	1752	$12,471,206	East Mesa Fire Station		Excellent
High Ridge/Las Colinas	2753	$15,797,091			Excellent
Homestead	872	$9,634,255	Onate High School		Redundant
Mesa/Dos Suenos	3209	$40,952,242			Redundant
Moongate Acres	665	$4,124,795			Redundant
Organ	168	$2,235,196	Organ Fire Station		Excellent
Space Mural	303	$8,190,313			Good
Tierra Grande	3497	$53,865,418	Las Cruces Station #5 (Fire)	US Highway 70	Excellent
Valley Vista	48	$2,696,600			Excellent
Fairacres Risk Region					
Fairacres	364	$548,900			Excellent
Nafzinger Arroyo	281	$5,152,500			Excellent
Garfield Risk Region					
Garfield Canyon	91	$449,900	Garfield Elementary School	Highway 187	Excellent

Table 3: Risk Center Summary Table

Hatch Risk Region					
Hatch	1767	$29,755,004	Ben Archer Health Clinic DAC Hatch Police Substation Hatch Fire Station Hatch Public Health Office Hatch Valley Elementary Hatch Valley High School		Good
Placitas Arroyo	979	$12,959,845			Good
Las Cruces East Risk Region					
Alameda Dam	879	$2,515,095			Good
Alameda North	481	$5,657,107			Good
Alameda South	422	$2,683,755			Good
Las Cruces Arroyo North	3090	$24,465,327			Good
Las Cruces Arroyo South	472	$81,715,100		Roadrunner Parkway	Excellent
Little Dam Arroyo	530	$9,412,509			Good
Las Cruces North Risk Region					
Moreno Arroyo	933	$10,197,034			Redundant
Moreno North	826	$480,571			Excellent
Moreno South	1507	$10,848,252			Excellent
Settler's Ridge/Vista Del Rio	1881	$10,457,543		Interstate 25	Redundant
Mesquite - Vado Risk Region					
Mesquite Site 4	37	$2,420,300			Excellent
Mossman Arroyo	173	$3,081,200			Excellent
Vado	1997	$6,596,686			Good
Radium Springs Risk Region					
Leasburg Main	180	$178,800			Good
Masson Farms	0	$1,874,200			Good
Rincon Risk Region					
Rincon Arroyo	335	$1,585,026			Fair
Salem Risk Region					
Reed-Thurmond Dam	6	$63,800			Excellent
Salem	1045	$2,627,739			Good
Soledad Canyon Risk Region					
Fillmore Arroyo	1154	$93,010,703			Good
Pena Blanco Arroyo	301	$3,880,401			Excellent
Sunland Park Risk Region					
Sunland Park	701	$5,136,029	Primero Los Niños (clinic) Sunland Park Public Health Office Southern New Mexico Human Development	McNutt Road Anapra Road	Fair
University Park Risk Region					
Tortugas Arroyo	1433	$19,451,991			Excellent

Table 3 (cont): Risk Center Summary Table

J.2.6 Station Filtering, Reconnaissance, and Prioritization

Station Filtering

To filter the list of 60 monitoring stations down to 30, AMEC used various methods, some more technical than others. Considerations were made for aspects such as population, building value, public facilities, and major transportation routes at risk of flooding, as well as the desire of DAC Flood Commission staff to spread stations evenly across the risk regions of Doña Ana County. Ultimately, AMEC followed the following steps to filter the number of remote monitoring stations.

1. AMEC assigned a total affected population to each risk center by performing a geospatial intersection of the risk center polygons with the census block polygons from the 2010 census. The top five risk centers based on population at risk were concentrated in Las Cruces and its suburban areas on the East Mesa.

2. AMEC assigned a total value of affected buildings for each risk center by performing a geospatial intersection of the risk center polygons with the parcel polygons provided by DAC Flood Commission. As expected, the top five risk centers based on building value were also concentrated in Las Cruces and surrounding areas. The surprise being Soledad Canyon, a low density residential subdivision southeast of Las Cruces.
3. AMEC calculated a weighted priority score based on the above values. For this scoring system, population at-risk was given a 75% weighting, while building value at-risk was given a 25% weighting. Given its 75% weighting on population at risk, it is no surprise that the risk centers with the highest scores were concentrated in Las Cruces and the East Mesa.
4. AMEC qualitatively determined if placement of a remote monitoring station was feasible based on a visual assessment of the site area, and if not feasible, removed the station from the top 30 list. Three risk centers were eliminated through this process. For the Far East risk center in the Chaparral risk region, the monitoring station would have to be placed in Otero County to be effective, which is not currently a possibility. In addition, the HWY 9 Overtop and I-10 West Border Patrol risk centers were removed because of the remoteness of their contributing watersheds and the difficultly in establishing power, security, and telecommunications in those remote areas.
5. For remaining stations, AMEC qualitatively determined if placement of a remote monitoring station was sensible. This test allowed engineering and practical judgement to be incorporated into the process. Those risk centers removed from the list through this process included the Anthony Arroyo, which is mainly in Texas, Masson Farms, which consists of a single large business within its risk center, and Organ, which would have required a monitoring station placed in a BLM-designated Area of Critical Environmental Concern.
6. For remaining stations, AMEC determined if the risk center could be provided with at least fair coverage by a remote monitoring station from an adjacent risk center. Given that 55 risk centers remained on the list and DAC Flood Commission desires only 30, this filtering was applied liberally. A total of 18 stations were removed from the list through this process.
7. Finally, AMEC ranked stations in order of priority score, and removed those stations outside of the top 30. A total of seven stations were removed, leaving the following list of stations to be further analyzed through site reconnaissance.

Top 30 Priority Monitoring Stations

Priority	Number	Risk Region	Risk Center	Final Score	Proposed Station Type	Proposed Site Reconnaissance Location
1	MS-11	Central Las Cruces	Flowpath 6 & 7	0.1725	Combination	Detention Pond North of Downtown
2	MS-27	East Mesa	Tierra Grande	0.0527	Combination	Waterfall Pond
3	MS-14	Las Cruces East	Las Cruces Arroyo North	0.0408	Combination	North Fork Dam
4	MS-2	East Mesa	Baylor Canyon	0.0377	Rainfall	Private Property off Baylor Canyon Road
5	MS-10	Soledad Canyon	Fillmore Arroyo	0.0362	Rainfall	Private Property off Soledad Canyon Road
6	MS-13	East Mesa	High Ridge / Las Colinas	0.0349	Combination	Sand Hill Arroyo Dam
7	MS-12	Hatch	Hatch	0.0273	Combination	Spring Canyon Dam
8	MS-15	Las Cruces East	Las Cruces Arroyo South	0.0257	Combination	South Fork Dam
9	MS-29	Mesquite – Vado	Vado	0.0241	Rainfall	Off Santana Road
10	MS-9	Chaparral	East Lisa	0.0240	Rainfall	Directly North of Chaparral
11	MS-3	East Mesa	Brahman Channel	0.0228	Combination	Brahman Channel Dam
12	MS-28	University Park	Tortugas Arroyo	0.0210	Combination	Tortugas Site 1 Dam
13	MS-17	Anthony	Lauson Arroyo	0.0195	Combination	Lauson Dam
14	MS-30	Chaparral	West Sagewood	0.0158	Rainfall	Along Highway 404
15	MS-23	Hatch	Placitas Arroyo	0.0142	Rainfall	Along CR E-004
16	MS-25	Salem	Salem	0.0124	Combination	Hatch Valley Arroyo Site 2 Dam
17	MS-5	Chaparral	Central	0.0108	Rainfall	Chaparral Elementary or Middle Schools
18	MS-1	Las Cruces East	Alameda Arroyo	0.0105	Combination	Alameda Dam
19	MS-20	Las Cruces North	Moreno North	0.0094	Rainfall	El Paso Electric Substation
20	MS-26	Sunland Park	Sunland Park	0.0091	Rainfall	Private Property Along Border with Mexico
21	MS-19	Las Cruces East	Little Dam Arroyo	0.0083	Rainfall	City of Las Cruces Landfill

22	MS-16	Central Las Cruces	Las Cruces Dam	0.0076	Combination	Las Cruces Dam North Outlet
23	MS-8	Doña Ana	Doña Ana South	0.0062	Rainfall	Alvillar Dam Area
24	MS-7	Doña Ana	Doña Ana Site 2	0.0051	Combination	Doña Ana Site 2
25	MS-22	Fairacres	Nafzinger Arroyo	0.0044	Rainfall	Off Box Canyon Road
26	MS-24	Rincon	Rincon Arroyo	0.0042	Rainfall	Off CR E-070
27	MS-4	Anthony	Breedlove Arroyo	0.0040	Combination	Breedlove Dam
28	MS-21	Mesquite – Vado	Mossman Arroyo	0.0027	Combination	Mossman Arroyo Dam
29	MS-6	Doña Ana	Doña Ana Site 1	0.0022	Combination	Doña Ana Site 1 Dam
30	MS-18	Radium Springs	Leasburg Main	0.0021	Rainfall	In the Hills East of I-25 and North of Leasburg

Table 4: Repeater Locations to Base Station Receive Locations

J.2.7 Use of Existing Weather Monitoring Stations

At the recommendation of DAC Flood Commission staff, AMEC considered replacing monitoring stations mentioned in the section above with an existing station operated by EBID. Four locations specifically noted by DAC Flood Commission staff were sites in the Placitas and Rincon Arroyos, a site adjacent to the airport west of Las Cruces, and a site at the base of Twin Peaks Mountain, near Doña Ana Village. By utilizing these existing sites during the startup phase of their flood warning system, DAC Flood Commission would be able to shift funding to purchase any repeater stations necessary to relay the ALERT2 signal back to the base stations.

J.2.8 Site Reconnaissance

AMEC staff performed a detailed site reconnaissance in Doña Ana County over three and one-half days in early May 2013. The purpose of the visit was to verify the accessibility and suitability of each site for the proposed monitoring station. In general, collected data included GPS points of inspected location, photo and video documentation of site, notes on accessibility, proximity to electric power sources, perceived line-of-sight issues, and security concerns, as well as a three-dimensional track of the route taken to the site. Although several photos are included in this report, a number of photos, as well as the video documentation for each proposed remote monitoring station location, are included in a supplemental project folder. It should also be noted that, during this site reconnaissance, radio communications were only evaluated based on the visibility of antennae from the proposed site. A more detailed assessment for radio communications were performed by OneRain. For rainfall-only monitoring locations, it should be noted that, although AMEC did select a single point at which to target their site reconnaissance, on-the-ground site conditions at the time of construction will dictate the adjustment of that point to a different location in the vicinity of the proposed site area. The following table summarizes the results of Site Reconnaissance. Detailed descriptions of each site visit are included in Appendix B.

Site Reconnaissance Results Summary									
Number	Risk Center	Site Location	GPS Coordinates	Existing/Proposed	Ownership	Access[1]	Security[2]	Power[3]	LOS[4]
MS-1	Alameda Arroyo	Alameda Dam	32.367447, -106.701479	Proposed	Federal	Poor	Poor	S	Y
MS-2	Baylor Canyon	Baylor Canyon Road	32.409419, -106.613392	Proposed	Private	Excellent	Excellent	D	Y
MS-3	Brahman Channel	Brahman Channel Dam	32.367447, -106.701479	Proposed	Federal	Good	Poor	S	Y
MS-4	Breedlove Arroyo	Breedlove Arroyo Dam	32.044512, -106.592144	Proposed	Federal	Poor	Poor	S	N
MS-5	Central	Chaparral Middle School	32.041548, -106.41157	Proposed	Municipal	Excellent	Good	D	Y
MS-6	Doña Ana Site 1	Doña Ana Site 1 dam	32.392776, -106.799908	Proposed	Private	Good	Poor	S	Y
MS-7	Doña Ana Site 2	Doña Ana Site 2 Dam	32.394637, -106.810198	Proposed	Private	Good	Poor	S	Y
MS-8	Doña Ana South	Alvillar Dam 4-C	32.425436, -106.808644	Proposed	Private	Poor	Poor	T	Y
MS-9	East Lisa	North of Chaparral	32.065942, -106.398645	Proposed	Federal	Good	Good	S	N
MS-10	Fillmore Arroyo	Soledad Canyon Road	32.304254, -106.594604	Proposed	Federal	Excellent	Poor	D	Y
MS-11	Flowpath 6 & 7	Gallagher Pond	32.319694, -106.779193	Proposed	Municipal	Excellent	Excellent	D	Y
MS-12	Hatch	Spring Canyon Dam	32.640021, -107.157148	Proposed	Private	Good	Poor	S	U
MS-13	High Ridge / Las Colinas	Sand Hill Arroyo Dam	32.379625, -106.742048	Proposed	Municipal	Excellent	Poor	D	Y
MS-14	Las Cruces Arroyo North	North Fork Dam	32.351552, -106.699922	Proposed	State	Poor	Poor	T	Y
MS-15	Las Cruces Arroyo South	South Fork Dam	32.336169, -106.707247	Proposed	State	Good	Poor	S	Y
MS-16	Las Cruces Dam	Las Cruces Dam	32.245611, -106.763121	Proposed	Private	Excellent	Poor	D	U
MS-17	Lauson Arroyo	Lauson Dam	32.02772, -106.577649	Proposed	Federal	Good	Poor	D	N
MS-18	Leasburg Main	State Land	32.471959, -106.862034	Proposed	State	Poor	Poor	T	N
MS-19	Little Dam Arroyo	Water Facility	32.330668, -106.717258	Proposed	Private	Good	Excellent	D	U
MS-20	Moreno North	El Paso Electric	32.386668, -106.759869	Proposed	Private	Excellent	Poor	D	Y
MS-21	Mossman Arroyo	Mesquite Site 3	32.17623, -106.657901	Proposed	State	Excellent	Poor	S	N

MS-22	Nafzinger Arroyo	Box Canyon Road	32.307168, -106.90944	Existing	Municipal	Good	Excellent	S	Y
MS-23	Placitas Arroyo	Las Uvas Ranch	32.583554, -107.239327	Existing	State	Good	Excellent	S	Y
MS-24	Rincon Arroyo	Conniff Cattle Ranch	32.706044, -107.021314	Existing	Private	Poor	Excellent	S	Y
MS-25	Salem	Hatch Valley Arroyo Site 2	32.716915, -107.209136	Proposed	Federal	Good	Poor	S	N
MS-26	Sunland Park	Anapra Road	32.784249, -106.568895	Proposed	Private	Excellent	Good	D	N
MS-27	Tierra Grande	Waterfalls Pond	32.395068, -106.665472	Proposed	State	Excellent	Good	T	Y
MS-28	Tortugas Arroyo	Tortugas Site 1 Dam	32.288711, -106.724503	Proposed	Private	Good	Poor	S	Y
MS-29	Vado	Sierra Vista Trailhead	32.304254, -106.594604	Proposed	Federal	Good	Poor	T	Y
MS-30	West Sagewood	Highway 404	32.019718, -106.499466	Proposed	Federal	Excellent	Good	S	U

Table 5: Repeater Locations to Base Station Receive Locations

[1] Level of access was categorized as follows:
Excellent – Adjacent Paved Roads
Good – Gravel Roads or trails suitable for a 4WD automobile
Poor – Rough gravel, sand, or dirt, not suitable for a 4WD automobile

[2] Level of security was categorized as follows:
Excellent – Existing fence >8 feet tall with barbed wire and locked gate
Good – Existing fence <8 feet tall with locked gate
Poor – No fence or fence without locked gate

[3] Level of power was categorized as follows:
T – Transmission lines adjacent to site within 500 feet
D – Distribution lines adjacent to site within 500 feet
S – No power, solar power recommended

[4] Line-of-site (LOS) was categorized as follows:
Y – LOS to radio antenna in DAC data visible during field reconnaissance
U – LOS to antenna of unknown ownership visible during reconnaissance
N – No antenna visible from proposed site

K. Proposed Doña Ana Flood Warning System

K.1. Flood Warning System Network Configuration

K.1.1 Typical Gauging Site Configuration

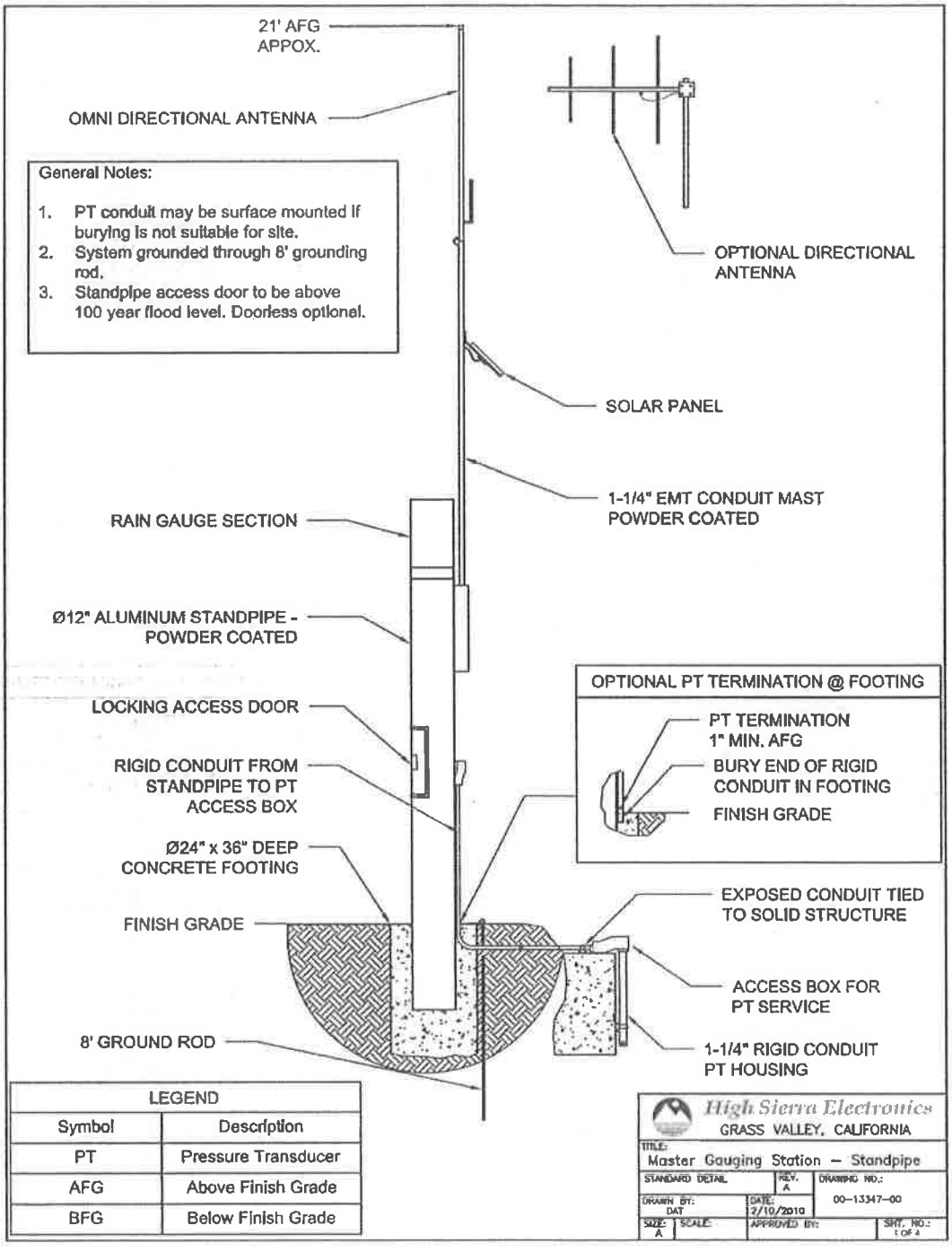


FIGURE 21: STANDARD SITE INSTALLATION – COURTESY OF HIGH SIERRA ELECTRONICS

K.1.2 TELEMETRY

ALERT2 sites use RF telemetry to transmit data to a receiving location. A simple network can be configured if the base station can be located with line of sight access to all sites. Unfortunately Doña Ana County monitoring sites do not have line of sight access to either the primary flood commission building or the backup EOC site. The network will require repeater locations to get gauge data from the individual gauging sites to the base stations. We looked at five potential repeater locations of which, all but Lookout Mountain have IP network available as a potential redundant telemetry path. Repeater locations with IP network access will be prioritized over RF only repeater locations.

K.1.3 RF PATH ANALYSIS

GENERAL APPROACH

Radio Mobile Software was used to model the theoretical signal loss from each gauging site to each potential repeater, and from each potential repeater site to each potential base station receive location. Tables of the resulting signal strength are provided in Tables 6, 7, and 8 below. The tables have color formatting of levels, with colors set to:

- ≥ 12 dB for good/green
- 0 – 12 dB for poor
- < 0 dB for unusable

The purpose of this was to review the paths that were poor to see if it was appropriate to use a directional antenna or power amp.

The purpose of an RF path analysis is to predict the reliability of receiving the gauge transmissions at the final (base) destination. As many details remain to be defined, conservative estimates are usually applied to a first-cut analysis. This usually quickly allows a triage approach of focusing on those paths that are poor performers (these thresholds are arbitrary, and ideally adjustable in the analysis), to see what would be required to make them reliable (perhaps by using a directional higher gain antenna, or a power amplifier).

At the VHF frequencies used for the hydrologic band (170 +/- MHz), reliable reception over reasonable distances can be expected if the path is clear LOS (Line Of Sight). But this significantly over-simplifies the situation, and the modeling program is able to analyze the expected performance over the specific terrain.

In the simplest implementation, gauge sites may be able to be received directly by the base station. This is often not the case, since gauges are usually physically low, have low power transmitters, and modest antennas. Additionally, the base station may not have the benefit of an extremely high tower or large antenna. In the typical case where the base station cannot be expected to reliably receive the gauges directly, a repeater on a high location that can ideally see both the gauge site, and the base station, is considered. This also gives the benefit of the repeater being able to receive using an omni-directional (receives well from all directions) antenna (since gauges are often located around the repeater site), yet get the benefit of using a directional (yagi) antenna (with gain) aimed at the base station to transmit the messages.

A redundant solution can be achieved when there is more than one repeater that can see most of the gauges, and even two base stations that can receive either repeater. This minimizes single points of failure. Additionally, repeaters usually have the ability to output their received data over serial data, and may have the ability to log the received messages. Accordingly, internet access to a repeater site can be helpful in network performance analysis and troubleshooting.

Repeater and base station sites often require filtering to minimize interference from nearby strong transmitters. This is not included in the Radio Path Analysis.

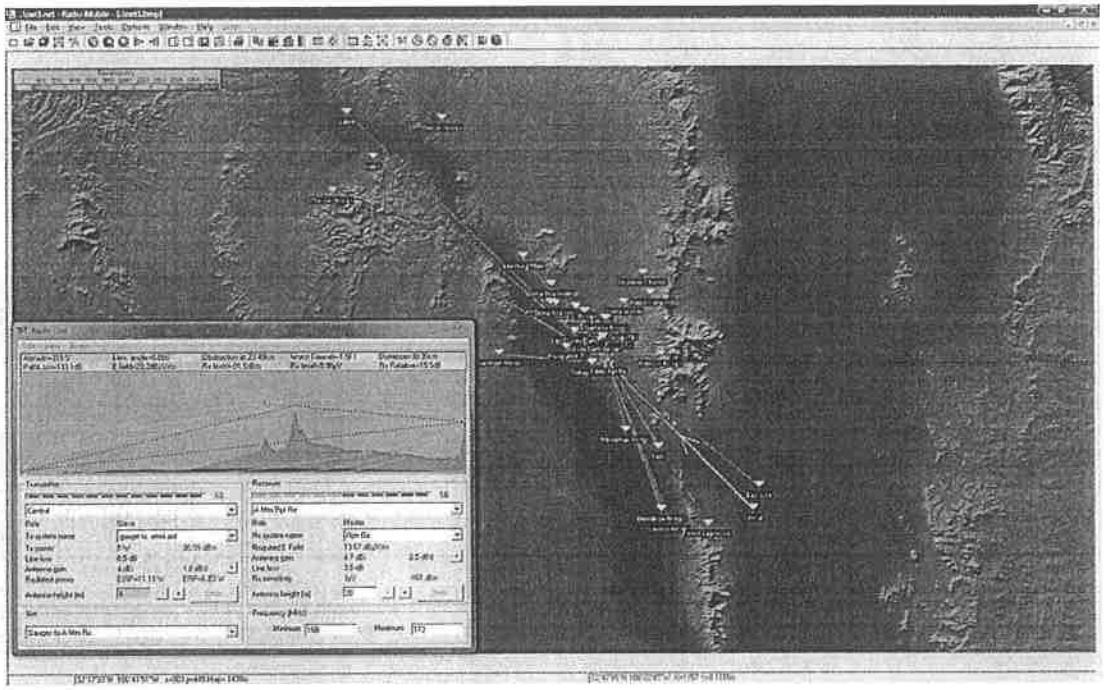


FIGURE 22: EXAMPLE PATH ANALYSIS FROM SITE (CENTRAL) TO POTENTIAL REPEATER AT A MOUNTAIN

Gauge Sites were modeled as basic sites with a 5W transmitter, and an omni antenna. An omni has the best chance of being received by multiple repeaters or receiving sites for redundancy. If a gauge is on the edge of being received, then a power amp or directional antenna could be used.

	Gauges to Rx Stns direct				
Gauge Site	Chaparral FD Rx	Sunland Pk Rx	East Mesa FD Rx	Radium Spr FD Rx	Hatch PD Rx
Flowpath 6 & 7	-28	-16	10	9	-21
Tierra Grande	-16	-20	35	8	-24
Las Cruces Arroyo No	-21	-6	21	12	-15
Baylor Canyon	-31	-26	36	2	-4
Fillmore Arroyo	-26	-46	-1	-18	-45
High Ridge / Las Col	-20	-6	22	7	-18
Hatch	-49	-59	-25	-16	38
Las Cruces Arroyo So	-22	-25	16	7	-14
Vado	-2	-2	-18	-6	-31
East Lisa	26	-15	-21	-20	-39
Brahman Channel	-28	-17	43	4	3
Tortugas Arroyo	-27	-29	3	-3	-25
Lauson Arroyo	2	-3	-21	-13	-30
West Sagewood	29	-10	-14	-19	-31
Placitas Arroyo	-61	-66	-35	-18	26
Salem	-36	-37	-28	-7	30
Central	44	-16	-19	-11	-38
Alameda Arroyo	-22	-19	28	5	-20
Moreno Arroyo	-15	-7	26	22	-11
Little Dam Arroyo	-14	-16	14	6	-18
Las Cruces Dam	-30	-23	3	18	-15
Leasburg Main	-22	-19	-6	37	-6
Doña Ana South	-13	4	8	14	-19
Doña Ana Site 2	-16	-4	1	21	-14
Nafzinger Arroyo	6	4	24	-2	-22
Rincon Arroyo	-44	-53	-28	-30	8
Breedlove Arroyo	-19	-8	-18	-27	-30
Mossman Arroyo	-14	9	-11	-11	-27
Doña Ana Site 1	-23	-16	11	16	-11
Sunland Park	-22	56	-10	-9	-39

Table 6: Gauge Sites to Fire and Police Stations

After review of the poor signal strength for radio paths from gauge sites to repeaters, we do not recommend that any of the fire stations be used as receive sites.

	Gauges to Rptrs				
Gauge Site	Anthony SO Rpt Rx	A Mtn Rpt Rx	Rincon Mtn Rpt Rx	Twin Pks Rpt Rx	Lookout Pk Rpt Rx (no IP)
Flowpath 6 & 7	-18	41	11	40	39
Tierra Grande	-18	35	8	41	34
Las Cruces Arroyo No	-5	43	13	38	35
Baylor Canyon	-16	35	28	43	38
Fillmore Arroyo	-26	49	-26	14	17
High Ridge / Las Col	-4	32	0.6	51	31
Hatch	-40	-11	38	-13	14
Las Cruces Arroyo So	-20	52	13	34	32
Vado	8	26	-13	12.1	16
East Lisa	-7	17	-24	-4	13
Brahman Channel	-8	34	27	40	22
Tortugas Arroyo	-16	51	-13	25	21
Lauson Arroyo	30	16	-6	7	13
West Sagewood	7	22	-23	7	11
Placitas Arroyo	-48	-15	30	-23	-2.2
Salem	-28	8	31	4	17
Central	-1	15	-10	-0.3	9
Alameda Arroyo	-14	37	7	45	36
Moreno Arroyo	3	37	15	62	41
Little Dam Arroyo	-8	50	2	35	26
Las Cruces Dam	-18	36	10	42	36
Leasburg Main	-19	20	21	-5	53
Doña Ana South	3	32	2	1.5	44
Doña Ana Site 2	-13	36	7	3.8	46
Nafzinger Arroyo	14	36	14	27	17
Rincon Arroyo	-57	-10	54	-20	3.8
Breedlove Arroyo	20	14	-16	-9	11
Mossman Arroyo	18	35	-9	10	16
Doña Ana Site 1	-12	31	7	13	40
Sunland Park	18	28	-11	21	10.8

TABLE 7: GAUGE SITES TO REPEATERS

Repeater Sites were initially modeled with the antenna at low height (2m), since in general we do not how high we can get up on a tower, and the sites usually are at a high elevation, often on a peak. When it was noticed that the path losses seemed excessive in a particular direction (e.g. at A Mountain to the west, or at Anthony SO), then the height was increased, and the height at which conditions significantly improved was noted. A relatively low receiver sensitivity was assumed. Transmit model did not include a power amp initially, but did assume a yagi (directional) antenna, aimed at the Flood Commission building.

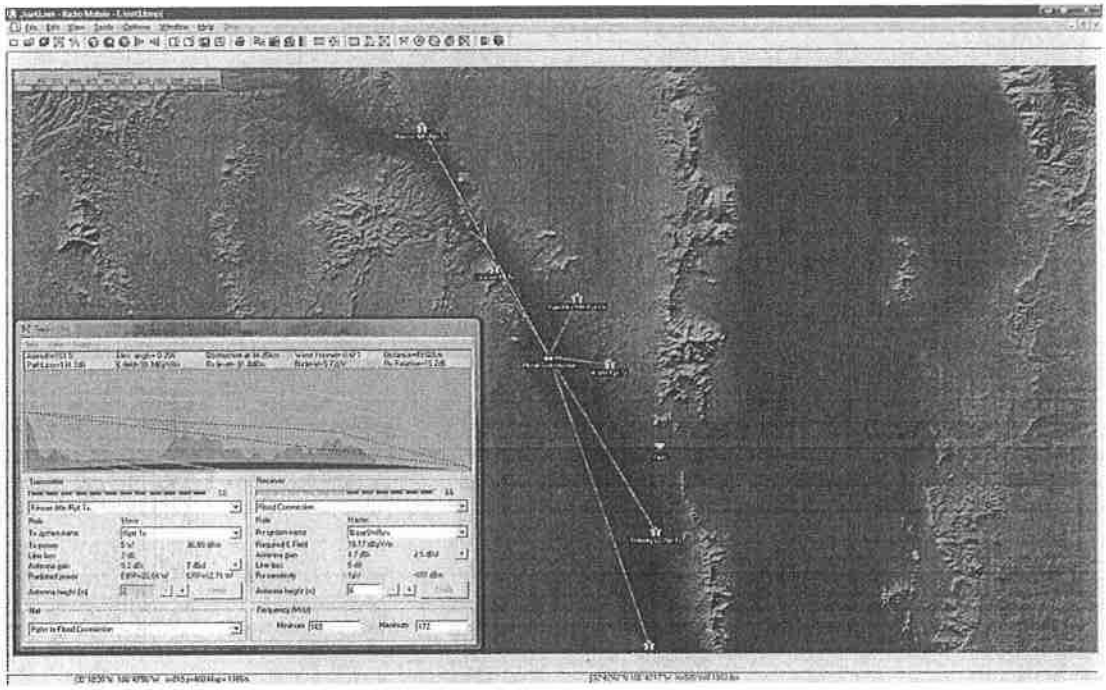


FIGURE 23: EXAMPLE PATH ANALYSIS FROM POTENTIAL REPEATER LOCATION RINCON MOUNTAIN TO FLOOD COMMISSION RECEIVE LOCATION

Repeater Locations	Flood Commission	EOC
Anthony SO Rpt Tx	-10	-10
A Mtn Rpt Tx	44	44
Rincon Mtn Rpt Tx	15	15
Twin Pks Rpt Tx	43	43
Lookout Pk Rpt Tx	35	35
Sunland Pk Rpt Tx	0.9	0.9

TABLE 8: REPEATER LOCATIONS TO BASE STATION RECEIVE LOCATIONS

OBSERVATIONS

Gauges are not received well by the Fire Department or Police Department locations, with the exception of gauges that are nearby. In the case of the Hatch PD, it has excellent reception of its 3 nearby sites, but those would also be well received by a repeater on Rincon Mountain.

Having internet connection to the repeaters would be highly desirable, to be able to do remote troubleshooting (pull logs) and possible firmware upgrades. For that reason, Lookout Peak (with no internet) is not a top pick, even though it has very good RF paths.

A Mountain does not appear to have a good ground level path to the west. But by getting the antennas 20m up (typical of they can be installed on an existing tower), the paths improve tremendously and it becomes a desirable site for receiving most of the gauges.

Rincon Mountain does a good job receiving the sites in the vicinity of Hatch (Hatch, Placitas Arroyo, and Salem), but receives many other sites well, including Rincon Arroyo, which is not received well by any other site. Therefore we believe it is more desirable to place a repeater on Rincon Mountain than a remote receiver at the Hatch PD.

In summary, it appears that if the antennas can be at least 20m above ground, a first choice for a repeater would be A Mountain. Then Rincon Mountain would fill in receiving gauges. At Rincon Mountain, it would be reasonable to consider a power amp to increase transmitted power for reception at the Flood Commission building. If a third repeater is considered for redundancy, Twin Peaks should be considered. If Lookout Peak were to get internet access, then it would be a desirable backup or even primary repeater.

K.1.4 Radio Path Network Recommendations

Primary repeater at A Mountain, with a second repeater at Rincon. Add IP redundant telemetry from each repeater to each base station location. Both the Flood Commission and EOC have good radio path to both repeater locations, so both sites are acceptable as RF base station receive locations.

K.1.5 Repeater Configuration

ALERT2 Repeaters are usually customized for the installation location. They are sometimes rack mounted, NEMA enclosure mounted. The antenna locations on towers must be planned for optimal receive and transmit. The A Mountain and Rincon repeaters would use omni receive antenna to accept data from all directions, with yagi directional transmit antenna to ensure good signal to the Flood Commission and EOC locations. The locations are within three miles of each other, so the directional antenna will work for both of them. We recommend that Doña Ana County leverage the IP connectivity at these two repeater locations to provide second redundant data feeds via IP from these repeater locations to each base station site.

K.1.6 Base Station Configuration

Base station software will collect and manage partner agency data; provide real time text and email alarming; and provide data visualization tools including map views, graphing, and dynamic display of data. The base station will monitor data in real-time, and send alarms to emergency management staff if appropriate. It will also monitor the health of your flood warning system and send alarms to your maintenance and management staff should there be any major system failures. The base station is the heart and brains of a real-time flood warning system.

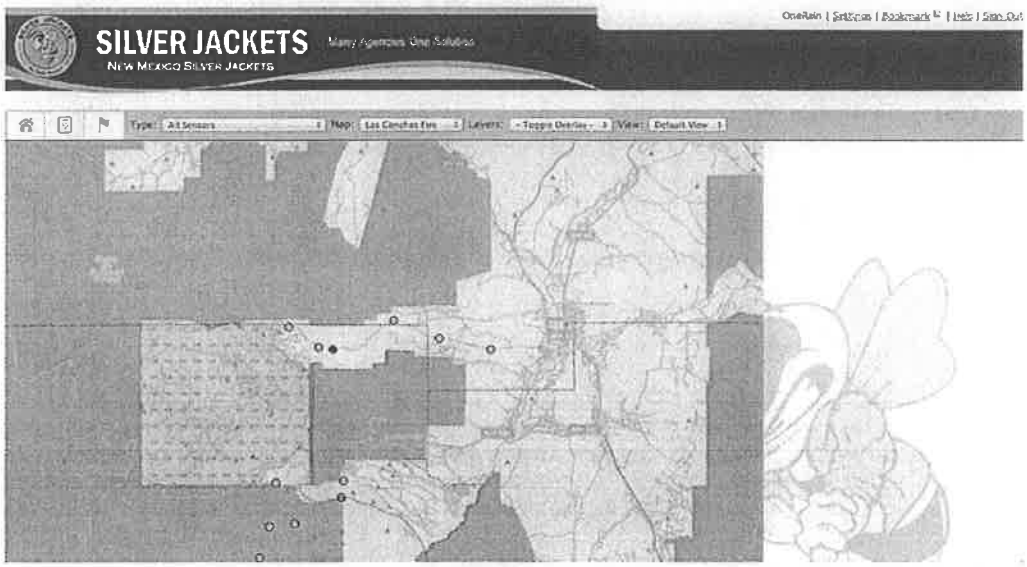


Figure 24: Base station map display showing one site in alarm (red), one site that is out of service (black), and ten sites that are operating properly

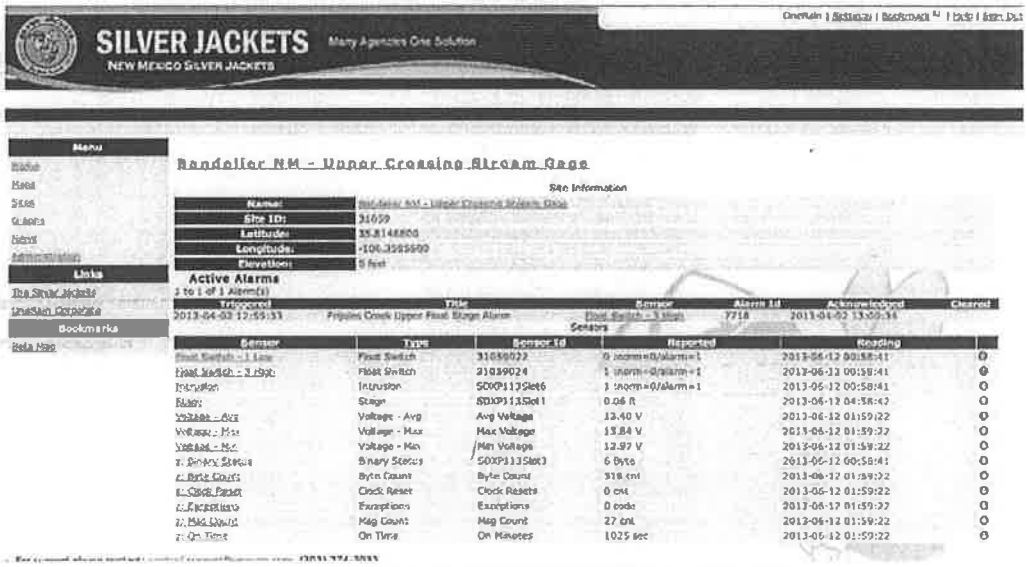


Figure 25: Base station site view of sensor readings and active alarm

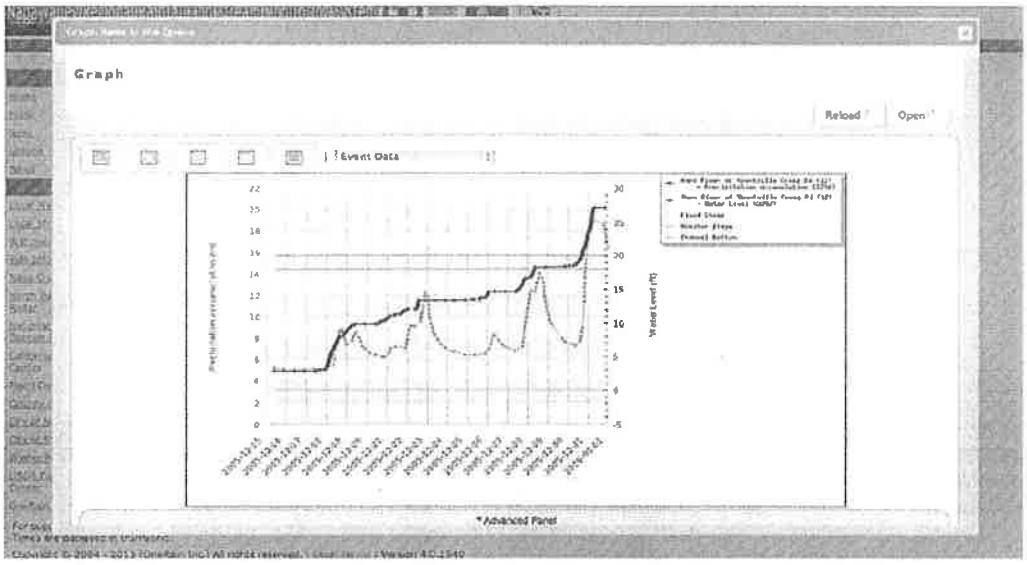


Figure 26: Graph showing accumulated rainfall and stream level, note flooding occurred on New Years Eve

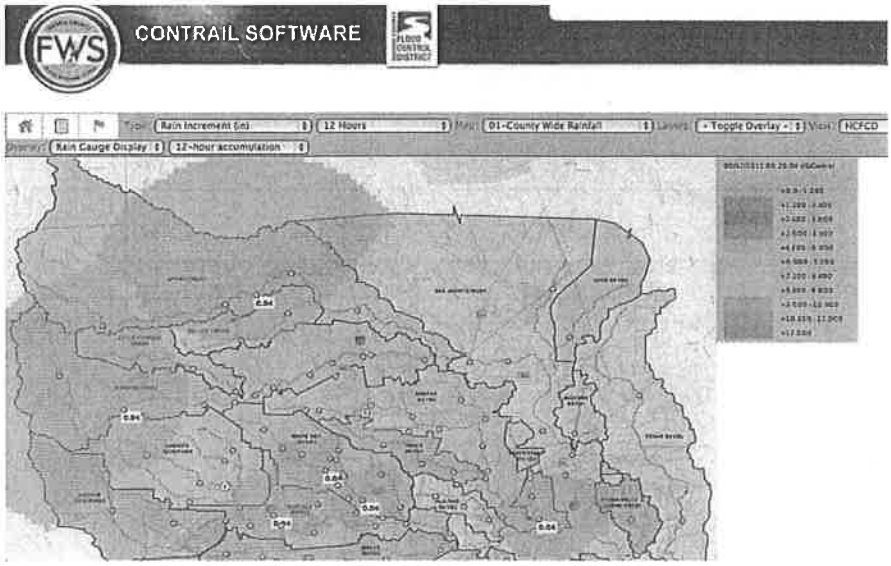


Figure 27: Map display with 12 hour rainfall accumulations

K.1.7 ALERT2™ Flood Warning System Components

Base Station

The Base Station is a software application that automatically collects, processes, archives and displays real-time hydro-meteorological and environmental data from local ALERT/ALERT2 instrumentation, as well as neighboring outside sources such as USGS, METAR, HADS, etc. The web-based platform enables the complete management and real-time dissemination of data (precipitation, stream flow, reservoir or lake levels, meteorological data, and more). Authorized users and administrators have access to all current and historical rainfall and hydrometeorological data from anywhere via the

Internet. The software provides reporting tools and automated alarms and notifications about triggered events and critical conditions.

ALERT 2 RECEIVER (ANTENNA/RECEIVER/DEMODULATOR)

ALERT2 Base Station Receiver/Demodulator: Includes rack mountable enclosure that houses radio and ALERT2 decoder. Device logs received messages to both SD card and console port. Requires: IP access for data transfer and required NTP service (GPS is optional). GPS time synchronization using NTP included. DB225 Antenna, 150 ft Cabling, Battery and AC Charger, includes mounting and installation for a rooftop side mount antenna.

ALERT2 REPEATER

ALERT2 Repeater with TCP/IP access: console port SSH, WinSCP; received ALERT2 frames logged to 2G SD card, without TCP/IP Data Server hardware/application.

ALERT2 WEATHER STATION

Fully integrated ALERT2 Weather Station: Radio, GPS Antenna, Standpipe, Transmitter Antenna, Tipping Bucket, Relative Humidity/ Air Temp, Barometric Pressure, 20W Solar Regulator, Data Logger, Solar Shield, and Battery.

ALERT2 RAIN GAUGE

Fully integrated ALERT2 Rain Gauge: Rain Tipping Bucket: Radio, GPS Antenna, Standpipe, Transmitter Antenna, 10W Solar Regulator and Battery.

ALERT2 RAIN AND STREAM GAUGE

Fully integrated ALERT2 Rain and Stream Gauge: Rain Tipping Bucket and Pressure Transducer, Radio, GPS Antenna, Standpipe, Transmitter Antenna, 10W Solar Regulator and Battery.

NOTE:

Installation pricing may vary depending on soil type, topography, travel to site, and accessibility to the site. The PT conduit and wire length may vary depending on site location.

K.1.8 IT INFRASTRUCTURE

A flood warning system requires coordination with all of the partner agencies IT groups. Real-time data collection and dissemination will require firewall changes to accommodate data feeds, database replication, and website access. For example, a two server configuration running in two different virtual server hosting locations would need to have ports opened to feed data from the radio receive locations to the servers; ports opened to support database replication between the two servers; ports opened for data exchange with partner agencies; a potential VPN or special access for support from their chosen software vendors; and finally, ports opened so that internal, external, and public can access the flood warning system websites.

K.2. INTERAGENCY COMMUNICATION

Establishing communication links with other agencies such as the National Weather Service, irrigation districts, and emergency responders, is important on several different levels. For example, the National Weather Service needs access to the data collected by the Flood Warning System. Real-time data will aid routine weather forecasting tasks and important timely information about changing weather conditions will improve National Weather Service flood watches and warnings. Also, maintaining ongoing personal

working relationships with the National Weather Service will aid communication as potential flood conditions develop during an event.

Similarly, collecting and sharing data with local irrigation districts leverages resources and creates value for everyone. Coordinating with emergency responders increases their effectiveness as well. Training them to incorporate the flood warning system data into their operational environment will increase their efficiency with faster, more targeted response. Real-time data will help them improve public safety during flood events but the data helps keep first responders safe as well. Sharing data with schools at all levels from elementary to university provides important educational opportunities.

Specifically, Doña Ana County Flood Commission should establish real-time sharing of data with two key partner agencies, Elephant Butte Irrigation District (EBID) and the National Weather Service (NWS). For the EBID, there are two potential approaches to sharing data. The first is to write a custom web data interface that scrapes data from their website. The second approach is to develop an agreed upon data exchange, sharing data in both directions with their agency. Choosing the best solution for data exchange with EBID requires discussion with their agency to get their support and to choose a solution that best benefits both agencies.

For the NWS, data sharing can be accomplished by using standard published interfaces provided by the NWS. The majority of the NWS offices in the US require data from outside agencies in the Standard Hydrometeorological Exchange Format (SHEF). Providing data to the NWS will require coordination with the local NWS office.

K.3. Public Outreach

Public education is essential to understanding risks associated with flooding and should be an on-going multi-channel affair. Flood awareness campaigns can be conducted as flood season(s) approach. Both FEMA and the National Weather Service are eager to work with communities throughout the year but, especially so, during announced "flood awareness weeks." These can include community-wide events and presentations in local schools.

Brochures and pamphlets provide educational materials to help build awareness. Many communities include them with utility and/or tax bills.

Local signage is another channel to develop public awareness. For example, Figure 28 shows a road sign that's part of the National Weather Service effort to reduce auto-related flood fatalities. Figure 29 presents a sample poster with the "Turn around. Don't drown." theme.

Figure 28: "Turn around. Don't drown." Road Sign

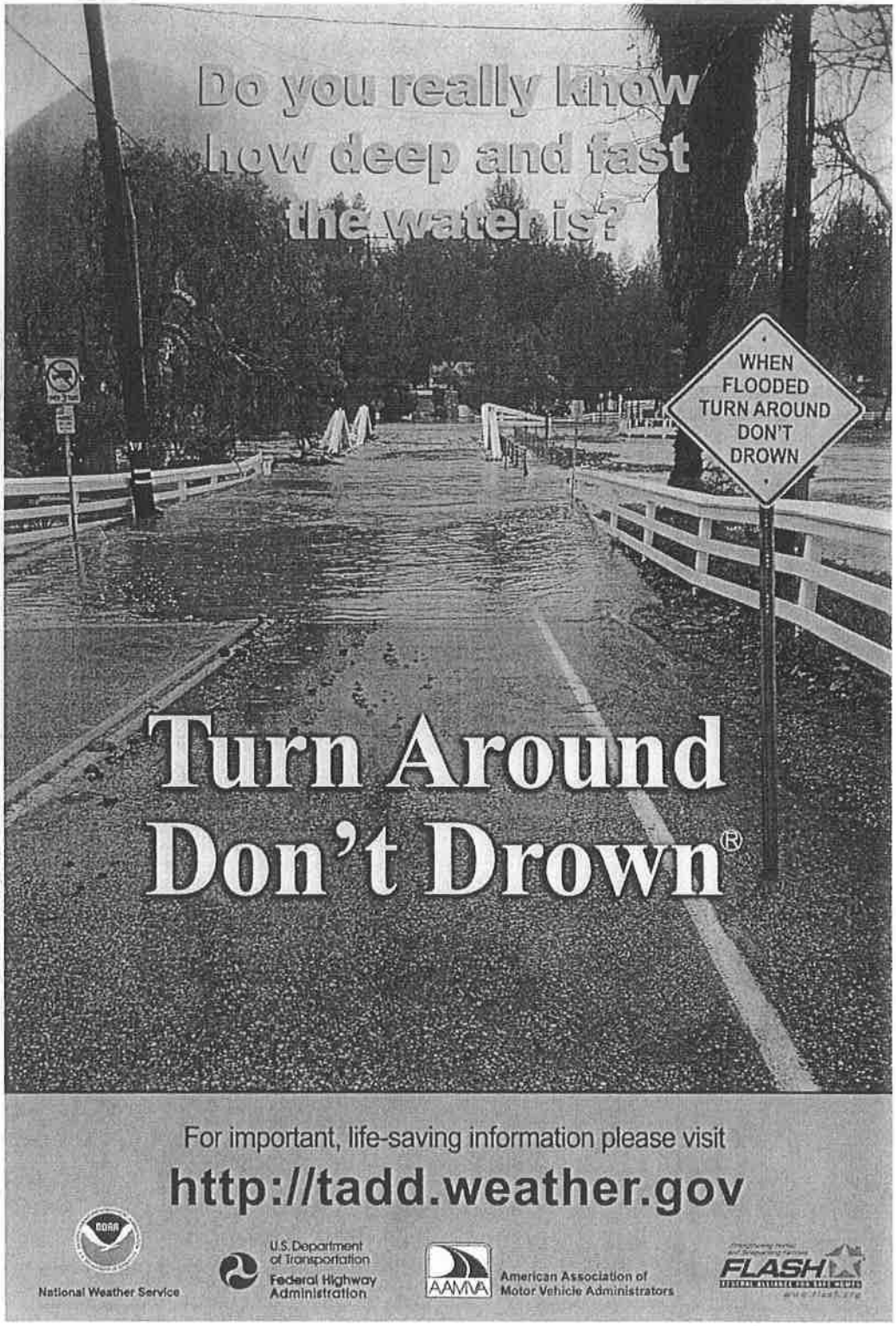


Figure 29: "Turn around. Don't drown." Poster

Note: More detailed guidance on use of warning signs can be found in Chapter 2C of the Manual on Uniform Traffic Control Devices (MUTCD).®

Several example posters, brochures, and public service announcements promoting flood awareness can found at http://www.nws.noaa.gov/om/water/tadd/tadd-resources.shtml#brochures.

Local media such as television, radio, and newspapers are traditional channels of communication before, during, and after emergencies. They are still vital components and, despite competing channels enabled by the Internet, will continue to be so for the foreseeable future. Local news outlets are willing partners for public service activities such as promoting flood safety. They can also use data and reports from the flood warning system to support news stories and on-air broadcasts.

Doña Ana County should create easy pathways for the local media outlets to incorporate flood warning system data into their daily operations. Simply sharing data via a flood warning system website may be all that's needed.

Social media is a rapidly growing channel for emergency communications. Facebook, Twitter, and Instagram are all beginning to be used by the emergency management community. To begin to understand this trend, consider that the first few hours of on-air reporting of the earthquakes in Haiti and Chile on CNN were enabled by Twitter feeds. Most of the "normal" modes of communication were interrupted by the earthquake. Twitter feeds with text, pictures, and video got through and were aired directly by CNN.

Facebook, Twitter, and basic text messaging are used to help answer questions such as "Are you ok?" or "I am ok." Twitter's real-time search engine and help response agencies such as the Red Cross to monitor Twitter traffic to identify specific response requests and direct emergency personnel to the scene.

Even the National Weather Service is using social media to both receive and disseminate time-critical weather information. In one recent high profile example, a picture of a flooded intersection in Miami was recently Tweeted by NBA basketball star, LeBron James. A National Weather Service employee in Miami, who "follows" LeBron on Twitter, spotted the photo and used it as the basis to issue an urban flood warning.

Facebook pages are increasingly used by public agencies to disseminate information to the public. Facebook is fast becoming a major component in flood preparedness, flood response, and recovery. It's a channel billions of people now use on a daily basis and a common meeting ground for information sharing.

On-site photos of emergency conditions are continuously uploaded to popular sites such as Instagram. The Susquehanna River Basin Commission's flood warning application accepts geo-coded photographs uploaded from the public to provide real-time visual snapshots of developing field conditions.

Figure 30 (inserted after this page) shows an "info-graphic" chronicling the recent experience with social media's role in emergency management.

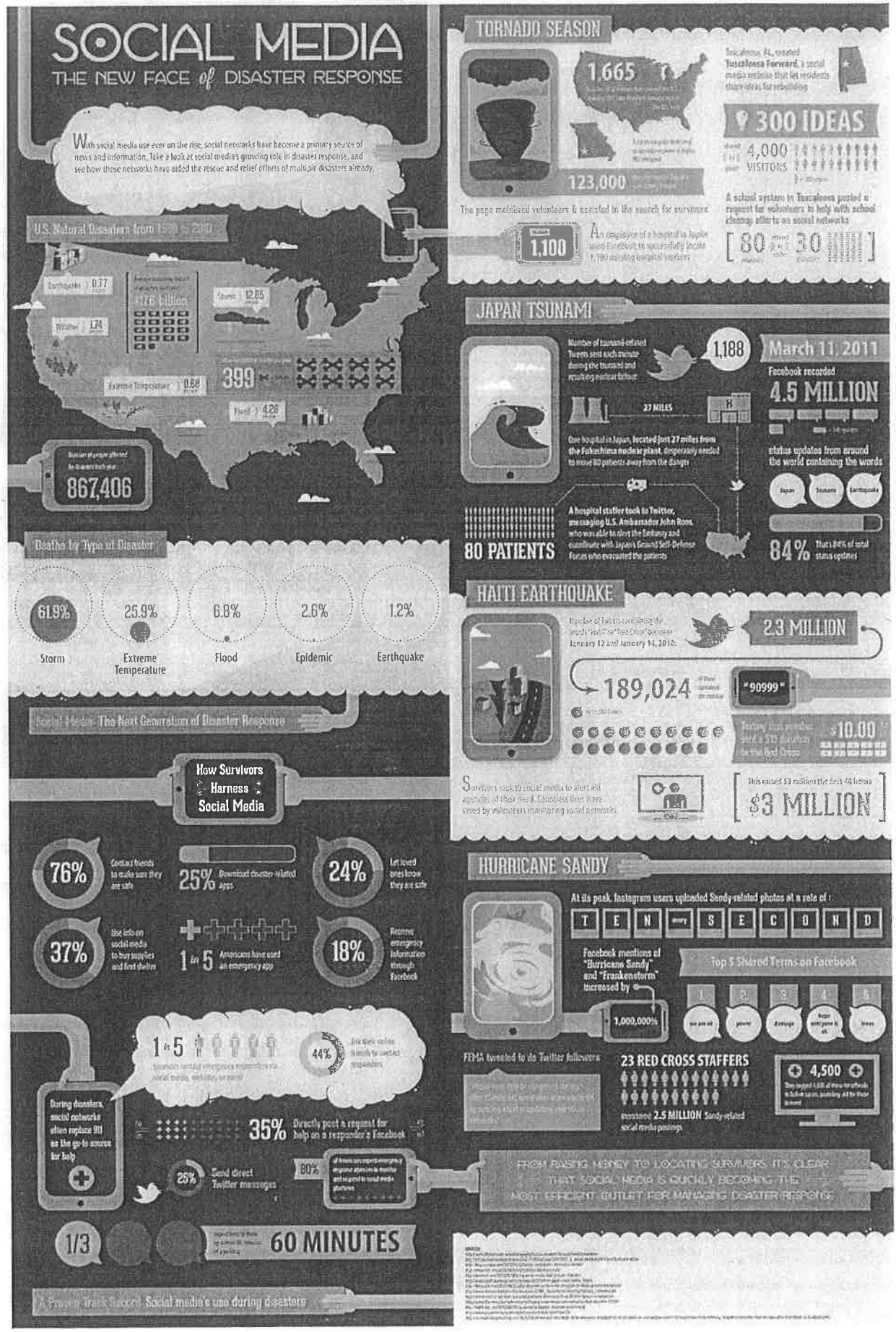

SOCIAL MEDIA
THE NEW FACE of DISASTER RESPONSE
With social media use ever on the rise, social networks have become a primary source of news and information. Take a look at social media's growing role in disaster response, and see how these networks have aided the rescue and relief efforts of multiple disasters already.
U.S. Natural Disasters from
867,406
Deaths by Type of Disaster
61.9% Storm
25.9% Extreme Temperature
6.8% Flood
2.6% Epidemic
1.2% Earthquake
Social Media: The Next Generation of Disaster Response
How Survivors Harness Social Media
76% Contact friends to make sure they are safe
25% Download disaster-related apps
24% Let loved ones know they are safe
37% Use info on social media to buy supplies and find shelter
1 in 5 Americans have used an emergency app
18% Receive emergency information through Facebook
1 in 5
44%
During disasters, social networks often replace 911 as the go-to source for help
35% Directly post a request for help on a responder's Facebook
25% Send direct Twitter messages
80%
1/3
60 MINUTES
A Proven Track Record: Social media's use during disasters
TORNADO SEASON
1,665
123,000
The page mobilized volunteers & assisted in the search for survivors
1,100
Tuscaloosa, AL, created Tuscaloosa Forward, a social media website that lets residents share ideas for rebuilding
300 IDEAS
4,000 VISITORS
A school system in Tuscaloosa posted a request for volunteers to help with school cleanup efforts on social networks
80
30
JAPAN TSUNAMI
Number of tsunami-related Tweets sent each minute during the tsunami and resulting nuclear fallout:
1,188
March 11, 2011
Facebook recorded
4.5 MILLION
status updates from around the world containing the words
Japan
Tsunami
Earthquake
84% That's 84% of total status updates
27 MILES
One hospital in Japan, located just 27 miles from the Fukushima nuclear plant, desperately needed to move 80 patients away from the danger
80 PATIENTS
A hospital staffer took to Twitter, messaging U.S. Ambassador John Roos, who was able to alert the Embassy and coordinate with Japan's Ground Self-Defense Forces who evacuated the patients
HAITI EARTHQUAKE
Number of Tweets containing the words "Haiti" or "Red Cross" between January 12 and January 14, 2010:
2.3 MILLION
189,024
"90999"
Texting this number sent a $10 donation to the Red Cross
$10.00
Survivors took to social media to alert aid agencies of their need. Countless lives were saved by volunteers monitoring social networks
This raised $3 million the first 48 hours
$3 MILLION
HURRICANE SANDY
At its peak, Instagram users uploaded Sandy-related photos at a rate of:
TEN every SECOND
Facebook mentions of "Hurricane Sandy" and "Frankenstorm" increased by
1,000,000%
Top 5 Shared Terms on Facebook
1 we are ok
2 power
3 damage
4 hope everyone is ok
5 trees
FEMA tweeted to its Twitter followers
23 RED CROSS STAFFERS
monitored 2.5 MILLION Sandy-related social media postings
4,500
FROM RAISING MONEY TO LOCATING SURVIVORS, IT'S CLEAR THAT SOCIAL MEDIA IS QUICKLY BECOMING THE MOST EFFICIENT OUTLET FOR MANAGING DISASTER RESPONSE

Figure 30 notes that 1 in 5 Americans have used an emergency app. 76% of disaster survivors have used social media to contract friends to make sure they are safe. Ten pictures per second were uploaded to Instagram during hurricane Sandy.

Certain social media are most appropriate for distributing information. Others are potential tools for near real-time data or information collection. For example, Facebook works well to post and distribute information to an audience of "friends." Critical weather and preparedness information can be posted as the event evolves. Facebook "friend" can post information about what they are experiencing during the event.

Twitter operates well in real-time. Short bursts of critical information can be pushed out to followers. Likewise, users can tweet observations in real-time. Twitter's powerful search engine can track trends in the Twitter stream which can provide useful data to emergency response teams.

Social media is relatively inexpensive to setup and operate; just a few hours of staff or consultant time are required to set up a minimal presence. However, social media does require an ongoing commitment of time and energy to be most effective.

Between storms, a social media manager would post information and activities to "drive" traffic and create followers; especially those followers who create leverage in the Twitter stream by "re-tweeting" posts by the County to their followers. During storms, continuous monitoring and engagement is required by County staff to both post and receive information via the various social media channels implemented.

Social media is no longer a fad or experiment. It is fast becoming, if it's not already, a vital cog in emergency management.

Internet communications have revolutionized how individuals communicate and share information. At a minimum, Doña Ana County's Flood Warning System should have a public website with news, data, alerts, warnings, response information etc. that's available to the public. This could be the most highly valued outcome from the flood warning system.

Internet enabled cell phones provide a rich source of information that can be used by emergency managers. A few flood warning software suites are now exploring how to monitor trending activities to identify "heat" maps which show areas of greatest activity, perhaps enabling the identification of the most troublesome spots for emergency managers to address.

K.4. Community Rating System (CRS)

The Community Rating System is a FEMA Flood Insurance System program. It enables communities to develop or implement a series of activities that can lower flood insurance premiums. New CRS regulations were recently published (2013) that significantly increased the value flood warning systems can contribute to lower premiums.

Some of the key elements and changes include.

- Recognition of a threat from flood, levee, or dam failure;
- Dissemination of warnings;
- Implementing an emergency response plan;

- Coordinating emergency preparedness, warnings, response, and other safety-related activities with owners and operators of critical facilities.

In addition, CRS credits are available for becoming a National Weather Service StormReady community, hosting emergency flood response drills and a host of other activities that collectively lead to lower premiums, reduced long term flood damages, and, most importantly, increased public safety.

L. Capital and O&M Programs

L.1. Maintenance

Maintenance is the key to ensuring that the flood warning system stays operational and useful. A proper maintenance program is comprised of real-time performance monitoring, properly trained maintenance personnel, spare parts, and tools for testing and verifying the operations of each of the systems components.

L.2. Real-Time Performance Monitoring

Real-time performance monitoring tells identifies system problems as they happen. The health of the network backbone, data collection from the real-time monitoring system, health of the data feeds to and from your partner agencies should be monitored too.

L.3. Maintenance Personnel

The most important requirement for maintaining a well run flood warning system is motivated and properly trained maintenance personnel. Maintenance personnel should be trained on the tools and procedures for doing standard maintenance and configuration of all components of the system. Additionally, they should also be trained on proper troubleshooting of each of the components of the system.

The county has several options with respect to maintenance. The maintenance for a thirty gauge network with a repeater backbone should take a full time staff person. They should perform normal maintenance during business hours, and be on call during off hours to be able to troubleshoot any system problems that interfere with emergency operations during those hours. A second option is to outsource the maintenance to a third party company with experience and resources for maintaining the network. If you choose to outsource, you will still need to have a local staff resource available to help in emergencies, since the outsourced maintenance resource may not be located in Doña Ana County.

L.4. Spare Parts

Spare parts are required for quick swap out of components when parts fail or must be sent to the manufacturer for repair. For the network backbone, you should have a spare repeater, a spare receiver/decoder, and approximately 10% spare parts for the individual gauging sites. These parts will allow quick replacement of any failed components.

You should also budget to replace parts as they are damaged by natural events or human vandalism. Gauging sites can be hit by lightning, destroyed by flash flooding or debris flow events, burnt in brush or forest fires, or can be damaged by vandals intentionally destroying the gauging sites. This budget will likely vary widely from year to year based upon events, but a starting budget may be 10% or three gauging sites.

L.5. Field Maintenance Tools

Field Staff need tools to perform their day to day job. Standard tools need on a maintenance truck include RF Receiver, Decoder to verify transmissions at a site. Mobile computers for programming devices, and with remote network access, verify end to end connectivity and calibration of a site before leaving. Sensor calibration tools for setting and measuring the calibration of devices.

L.6. Doña Ana County Flood Warning System Five Year Plan

The Five Year Equipment and Maintenance Budget is attached as Appendix A.

Year 1

Basic System with Data Integration Establish a core flood warning system. Setup a ALERT2 network backbone, with a single base station with receive capabilities, a single repeater, and three sites made up of one weather station and two combination rain/stage sites. Integrate data from Elephant Butte Irrigation District, and provide a data feed to the NWS. This will give Doña Ana County a core working system.

Year 2

Expansion of Gauging Sites Addition of 11 gauging sites, 6 rain and 5 rain/stage sites, leveraging the network set up the previous year. This will allow monitoring of a total 13 gauging sites, and one weather station. This will give Doña Ana County an expanded system real-time flood warning network without redundancy for key components.

Year 3

Improving the network by adding redundancy plus 5 more gauging sites Add a second repeater and base station receive location. This will allow a radio path for the four additional sites plus provide radio path redundancy for a majority of the sites. A second base station/receive location, completes the redundancy of the system. Also, five additional gauging sites, 3 rain, and 2 rain/stage sites. There will be a total of 18 gauging sites. This will give Doña Ana County a fully redundant mission critical flood warning system.

Year 4

Expansion of Gauging Sites Addition of 10 gauging sites, 5 rain and 5 rain/stage sites. This will bring the total number of gauging sites to 28. This will almost fully complete the Doña Ana County flood warning network, with the exception of a few gauging sites.

Year 5

Complete the Flood Warning Network Addition of the final two gauging sites. This brings the total number of sites to 30 real-time monitoring sites. This will complete the Don Ana County Flood Warning Network.

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Appendix A

Five Year Equipment and Maintenance Budget

Doña Ana ALERT2 Yearly Equipment and Maintenance Budget

06.12.13

Year 1

System Component	# Sites	Purchase/Install - Each	Ex. Total	#Sites	Annual Maint.*	Annual Maint. Ex. Total
Base Station	1	$ 20,000.00	$ 20,000.00		$ -	$ -
Base Station Set Up & Training	1	$ 17,360.00	$ 17,360.00		$ -	$ -
Custom Data Interface -Elephant Butte	1	$ 3,500.00	$ 3,500.00		$ -	$ -
Receive(ANT/REC/DEC)	1	$ 12,974.00	$ 12,974.00		$ -	$ -
Repeaters(A2) & Antenna	1	$ 9,474.00	$ 9,474.00		$ -	$ -
Rain/Stage	2	$ 11,632.00	$ 23,264.00		$ -	$ -
Weather Station	1	$ 14,093.00	$ 14,093.00		$ -	$ -
Totals			**$ 100,665.00**			**$ -**

Year 2

System Component	# Sites	Purchase/Install - Each	Ex. Total	#Sites	Annual Maint.*	Annual Maint. Ex. Total
Rain Only Site	6	$ 7,098.00	$ 42,588.00	1	$ 677.00	$ 677.00
Rain/Stage	5	$ 11,632.00	$ 58,160.00	2	$ 844.00	$ 1,688.00
Weather Station	0	$ -	$ -	1	$ 892.00	$ 892.00
Repeaters(A2) & Antenna	0	$ -	$ -	1	$ 733.00	$ 733.00
Training for Gauge Maintenance(2 Days)	0	$ -	$ -	1	$ 5,000.00	$ 5,000.00
Annual Recurring Base Station Fee	0	$ -	$ -	1	$ 5,000.00	$ 5,000.00
Totals			**$ 100,748.00**			**$ 13,990.00**

Year 3

System Component	# Sites	Purchase/Install - Each	Ex. Total	#Sites	Annual Maint.*	Annual Maint. Ex. Total
Base Station	1	$ 20,000.00	$ 20,000.00		$ -	$ -
Base Station Set up & Install	1	$ 8,360.00	$ 8,360.00		$ -	$ -
Annual Recurring Base Station Fee	1	$ -	$ -	1	$ 5,000.00	$ 5,000.00
Weather Station	0	$ -	$ -	1	$ 892.00	$ 892.00
Repeaters(A2) & Antenna	1	$ 9,474.00	$ 9,474.00	1	$ 733.00	$ 733.00
Receive(ANT/REC/DEC)	1	$ 12,974.00	$ 12,974.00		$ -	$ -
Rain Only Site	3	$ 7,098.00	$ 21,294.00	6	$ 677.00	$ 4,062.00
Rain/Stage	2	$ 11,632.00	$ 23,264.00	7	$ 844.00	$ 5,908.00
Spare Parts	1	$ 6,000.00	$ 6,000.00			$ -
Totals			**$ 101,366.00**			**$ 16,595.00**

Year 4

System Component	# Sites	Purchase/Install - Each	Ex. Total	#Sites	Annual Maint.*	Annual Maint. Ex. Total
Rain Only Site	5	$ 7,098.00	$ 35,490.00	9	$ 677.00	$ 6,093.00
Rain/Stage	5	$ 11,632.00	$ 58,160.00	9	$ 844.00	$ 7,596.00
Repeaters(A2) & Antenna	0	$ -	$ -	2	$ 733.00	$ 1,466.00
Annual Recurring Base Station Fee	0	$ -	$ -	2	$ 5,000.00	$ 10,000.00
Weather Station	0	$ -	$ -	1	$ 892.00	$ 892.00
Totals			**$ 93,650.00**			**$ 26,047.00**

Year 5

System Component	# Sites	Purchase/Install - Each	Ex. Total	#Sites	Annual Maint.*	Annual Maint. Ex. Total
Annual Recurring Base Station Fee	0	$ -	$ -	2	$ 5,000.00	$ 10,000.00
Repeaters(A2) & Antenna	0	$ -	$ -	2	$ 733.00	$ 1,466.00
Weather Station	0	$ -	$ -	1	$ 892.00	$ 892.00
Rain Only Site	0	$ 7,098.00	$ -	14	$ 677.00	$ 9,478.00
Rain/Stage	2	$ 11,632.00	$ 23,264.00	14	$ 844.00	$ 11,816.00
Spare Parts	1	$ 8,000.00	$ 8,000.00			$ -
Totals			**$ 31,264.00**			**$ 33,652.00**

Appendix B

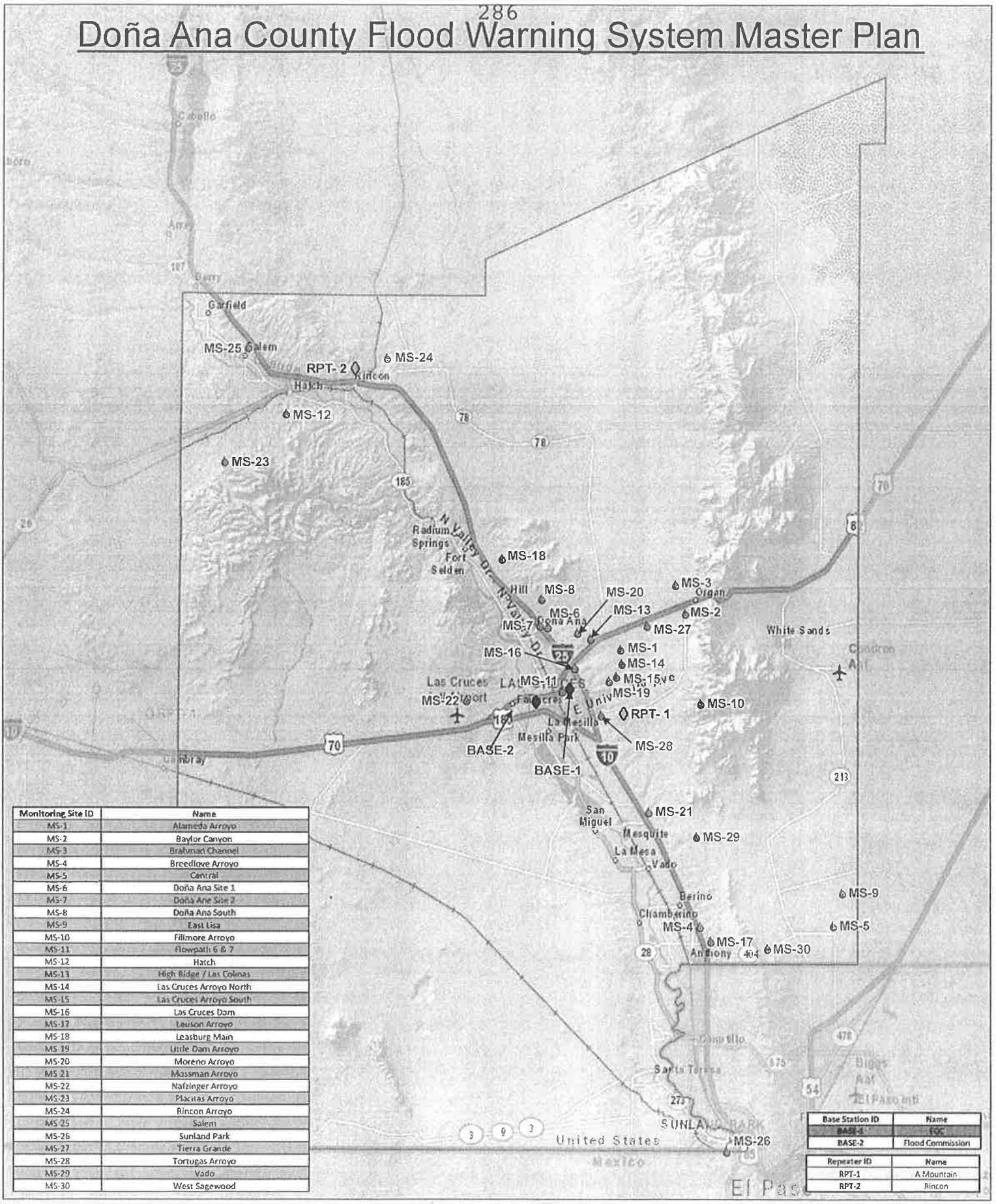
Overall Site Maps

Site Reconnaissance

Detailed Site Descriptions

Site Elevation Profiles

Doña Ana County Flood Warning System Master Plan



Monitoring Site ID	Name
MS-1	Alameda Arroyo
MS-2	Baylor Canyon
MS-3	Brahuman Channel
MS-4	Breedlove Arroyo
MS-5	Central
MS-6	Doña Ana Site 1
MS-7	Doña Ana Site 2
MS-8	Doña Ana South
MS-9	East Lisa
MS-10	Fillmore Arroyo
MS-11	Flowpath 6 & 7
MS-12	Hatch
MS-13	High Ridge / Las Colinas
MS-14	Las Cruces Arroyo North
MS-15	Las Cruces Arroyo South
MS-16	Las Cruces Dam
MS-17	Lauson Arroyo
MS-18	Leasburg Main
MS-19	Little Dam Arroyo
MS-20	Moreno Arroyo
MS-21	Mossman Arroyo
MS-22	Nafzinger Arroyo
MS-23	Placitas Arroyo
MS-24	Rincon Arroyo
MS-25	Salem
MS-26	Sunland Park
MS-27	Tierra Grande
MS-28	Tortugas Arroyo
MS-29	Vado
MS-30	West Sagewood

Base Station ID	Name
BASE-1	EOC
BASE-2	Flood Commission

Repeater ID	Name
RPT-1	A Mountain
RPT-2	Rincon

Monitoring Station (MS)
Base Station (BASE)
Repeater (RPT)
Doña Ana County

N W E S

0 5 10 Miles

amec
WEST CONSULTANTS, INC.
WILSON & COMPANY
OneRain

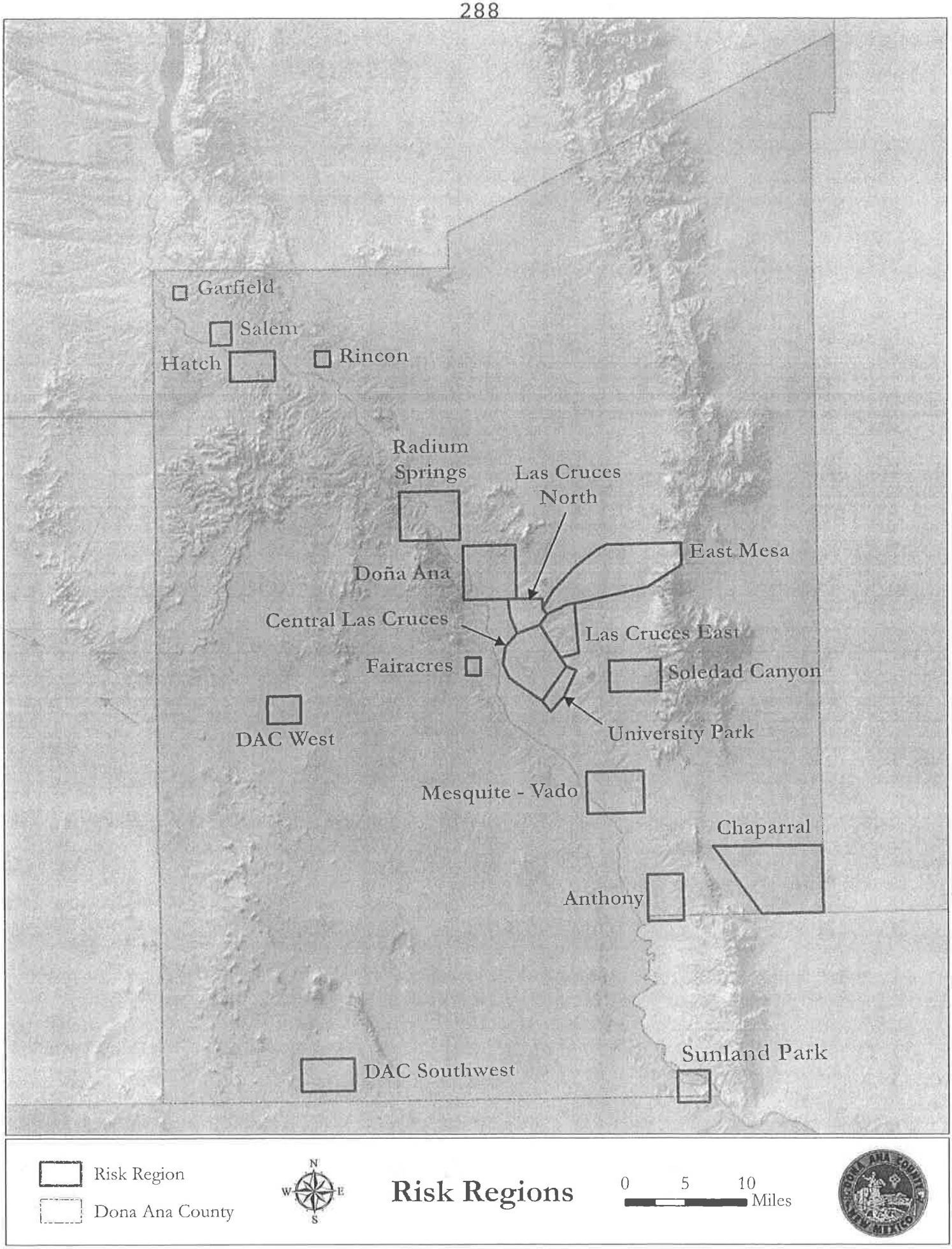
Doña Ana County Flood Warning System Master Plan

Monitoring Site ID	Name
MS-1	Alameda Arroyo
MS-2	Baylor Canyon
MS-3	Brahman Channel
MS-4	Breedlove Arroyo
MS-5	Central
MS-6	Doña Ana Site 1
MS-7	Doña Ana Site 2
MS-8	Doña Ana South
MS-9	East Lisa
MS-10	Fillmore Arroyo
MS-11	Flowpath 6 & 7
MS-12	Hatch
MS-13	High Ridge / Las Colinas
MS-14	Las Cruces Arroyo North
MS-15	Las Cruces Arroyo South
MS-16	Las Cruces Dam
MS-17	Lauson Arroyo
MS-18	Leasburg Main
MS-19	Little Dam Arroyo
MS-20	Moreno Arroyo
MS-21	Mossman Arroyo
MS-22	Nafzinger Arroyo
MS-23	Placitas Arroyo
MS-24	Rincon Arroyo
MS-25	Salem
MS-26	Sunland Park
MS-27	Tierra Grande
MS-28	Tortugas Arroyo
MS-29	Vado
MS-30	West Sagewood

Base Station ID	Name
BASE-1	FOC
BASE-2	Flood Commission

Repeater ID	Name
RPT-1	A Mountain
RPT-2	Rincon

amec
WEST CONSULTANTS, INC.
WILSON & COMPANY
OneRain


Garfield
Salem
Hatch
Rincon
Radium Springs
Las Cruces North
East Mesa
Doña Ana
Central Las Cruces
Las Cruces East
Fairacres
Soledad Canyon
DAC West
University Park
Mesquite - Vado
Chaparral
Anthony
Sunland Park
DAC Southwest
Risk Region
Dona Ana County
N
W
E
S
Risk Regions
0 5 10
Miles

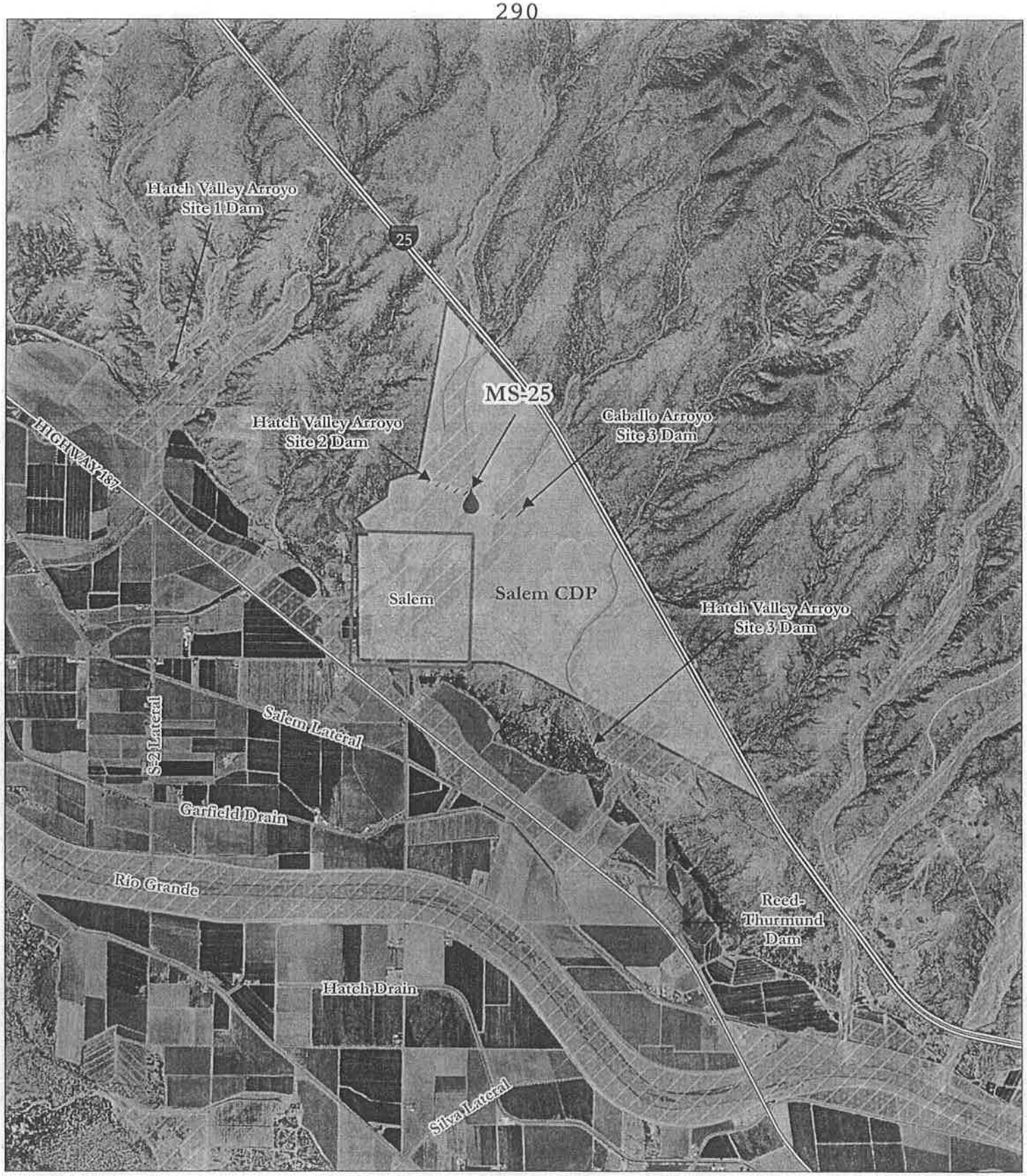
Risk Center
Dam
FEMA Floodplain
Community Boundary
School
Waterline
Major Road

Garfield Risk Region

N
W E
S

0 500 1,000
Feet

DONA ANA COUNTY NEW MEXICO



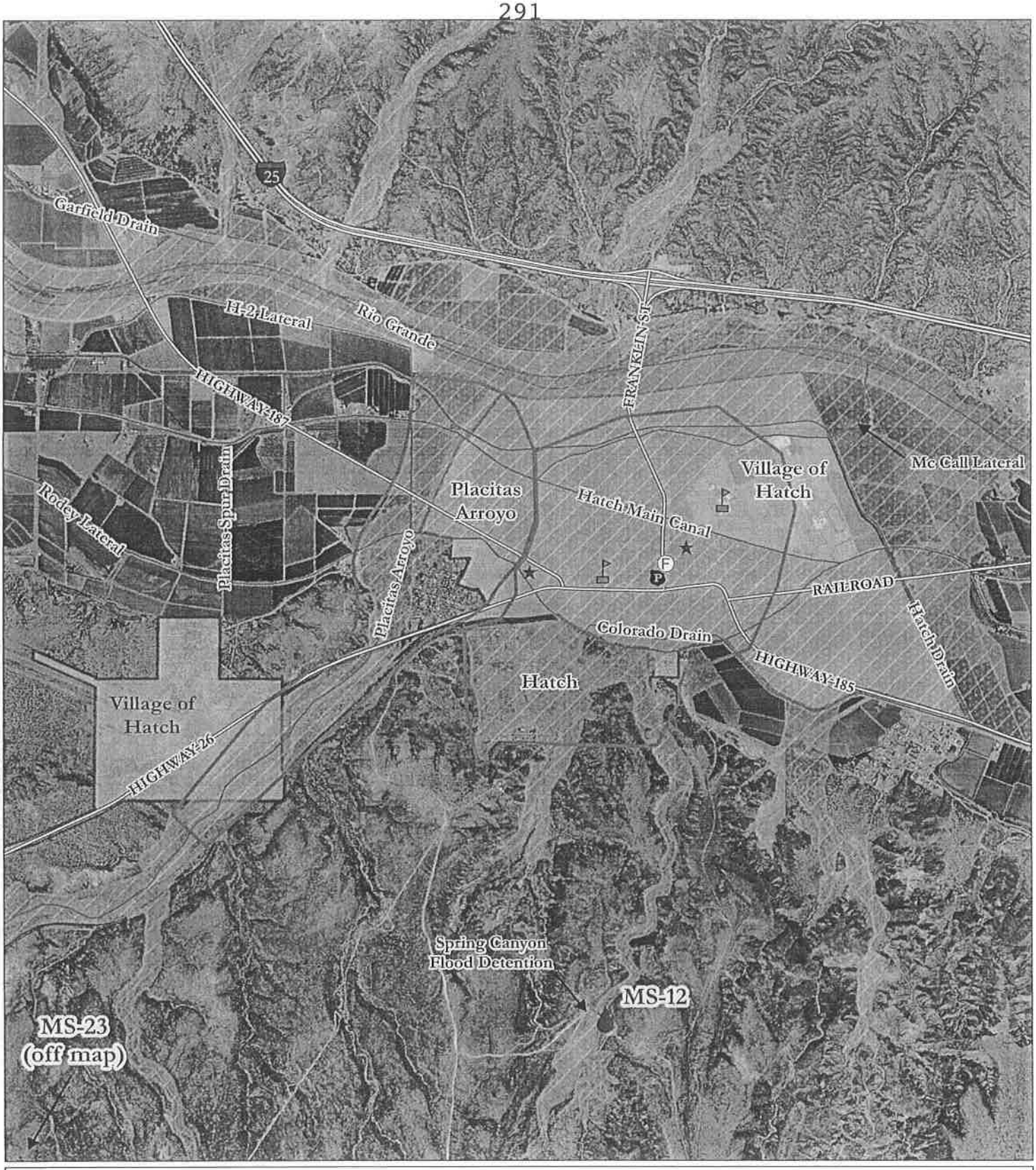
Risk Center
Dam
FEMA Floodplain
Community Boundary
Waterline
Major Road
Monitoring Station

Salem Risk Region

N
W E
S

0 0.25 0.5 Miles

DONA ANA COUNTY NEW MEXICO



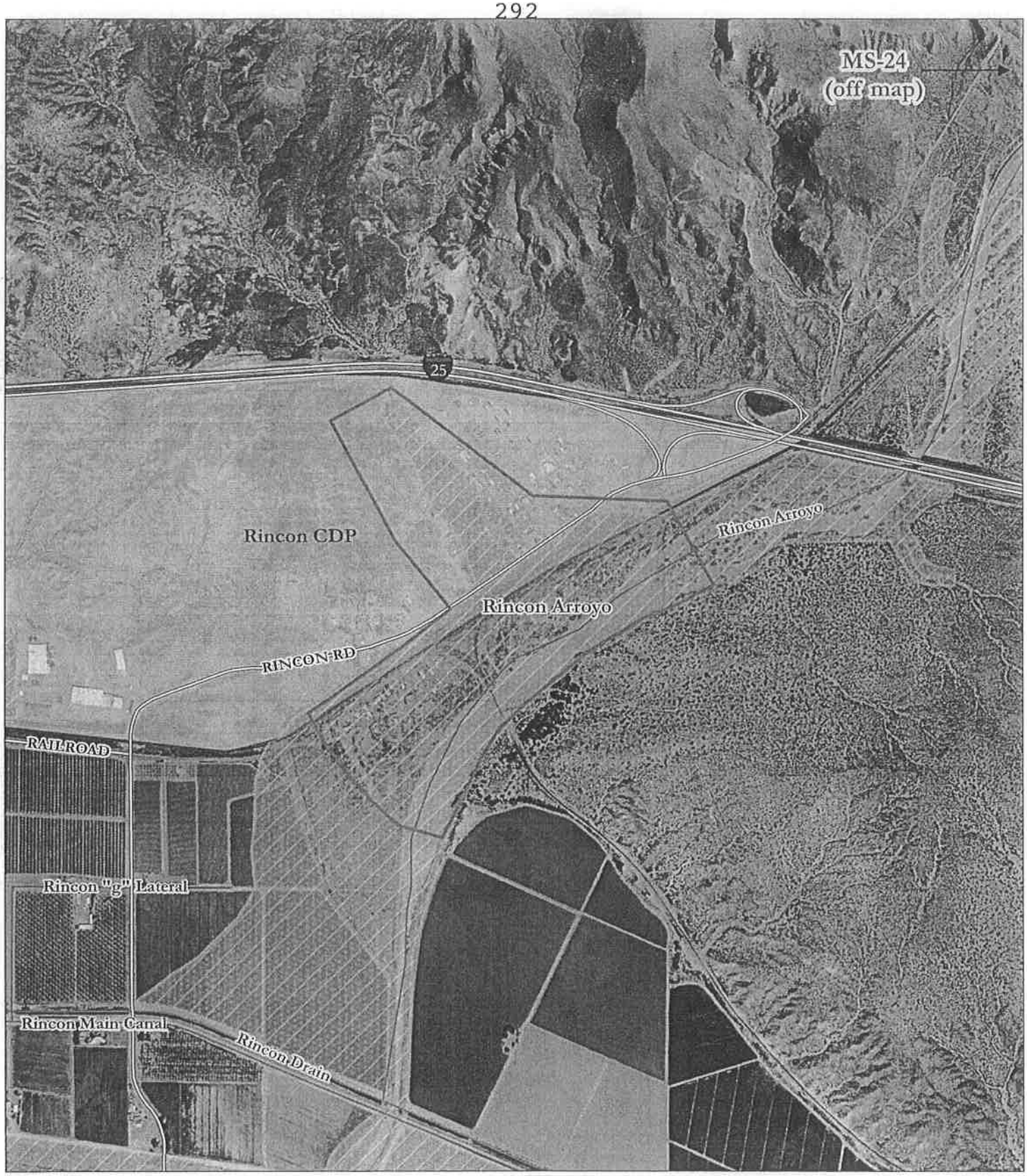
Waterline
Risk Center
Dam
FEMA Floodplain
Community Boundary
Major Road
Fire Station
School
Clinic
Police Station
Monitoring Station

Hatch Risk Region

N
W E
S

0 0.25 0.5 Miles

DONA ANA COUNTY NEW MEXICO



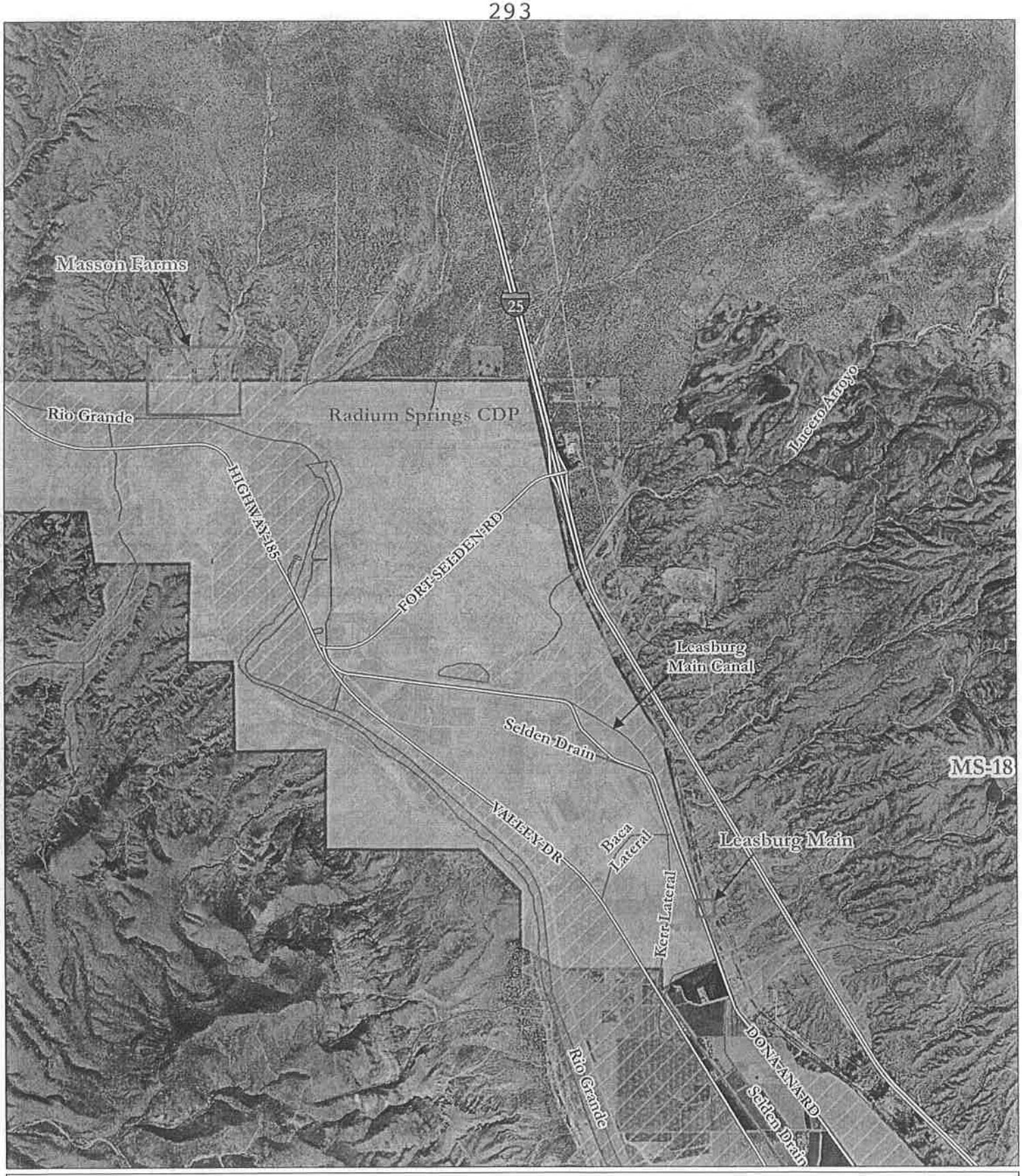
Risk Center
FEMA Floodplain
Community Boundary
Major Road
Waterline
Monitoring Station

Rincon Risk Region

N
W E
S

0 500 1,000
Feet

DONA ANA COUNTY NEW MEXICO



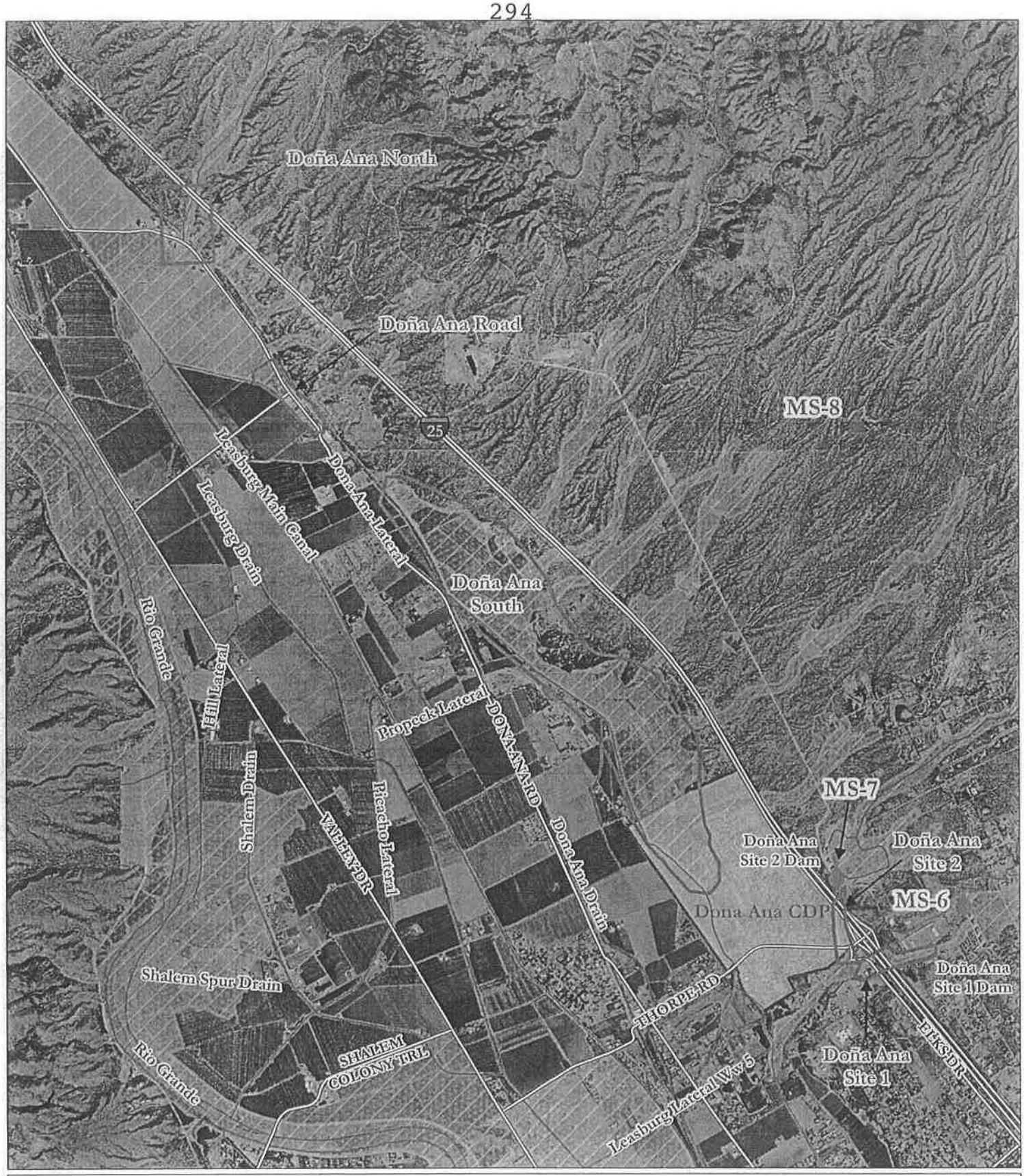
Risk Center
FEMA Floodplain
Community Boundary
Major Road
Waterline
Monitoring Station

Radium Springs Risk Region

N
W E
S

0 0.25 0.5 Miles

DONA ANA COUNTY NEW MEXICO



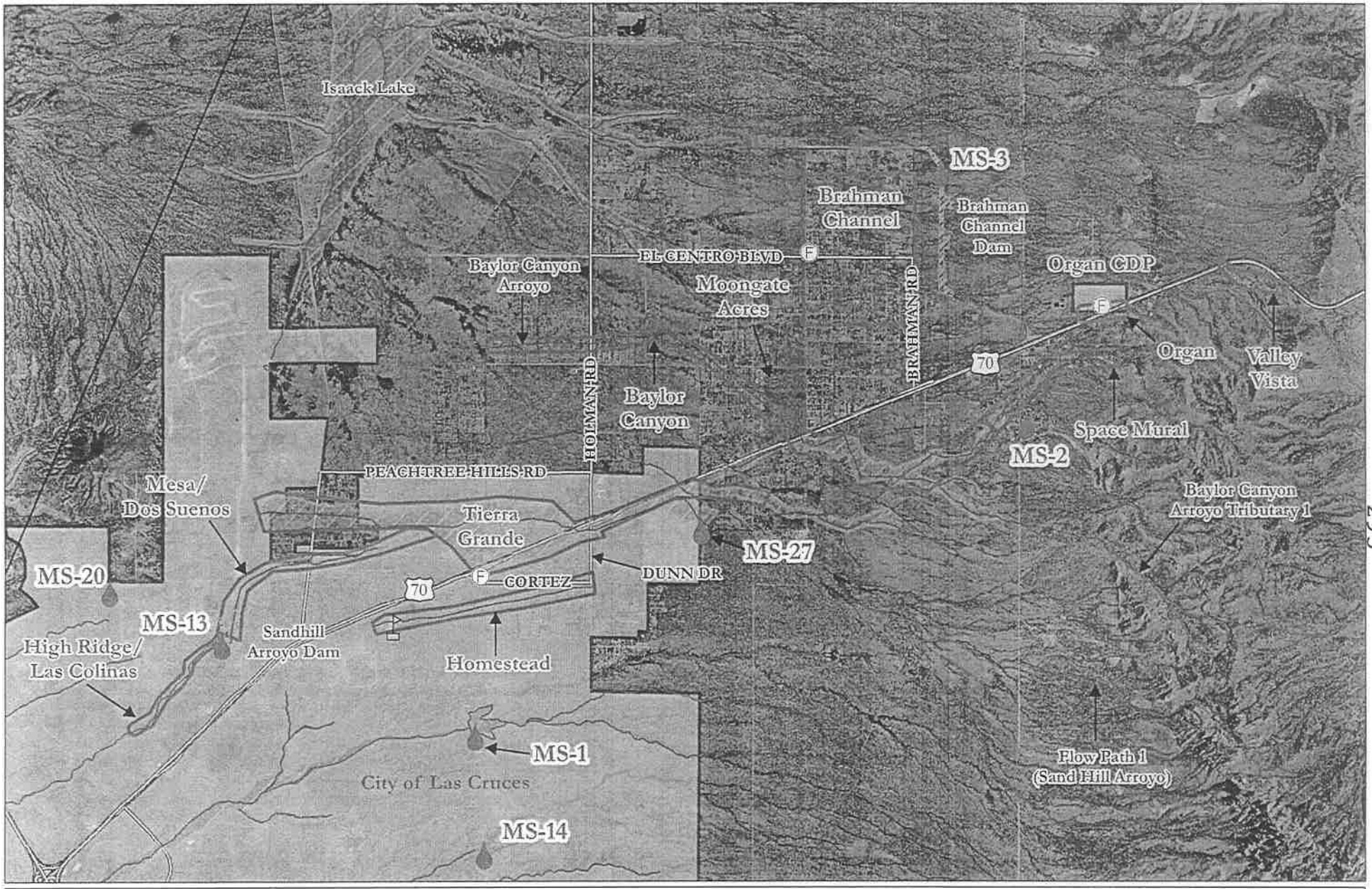
Risk Center
Dam
FEMA Floodplain
Community Boundary
Major Road
Waterline
Monitoring Station

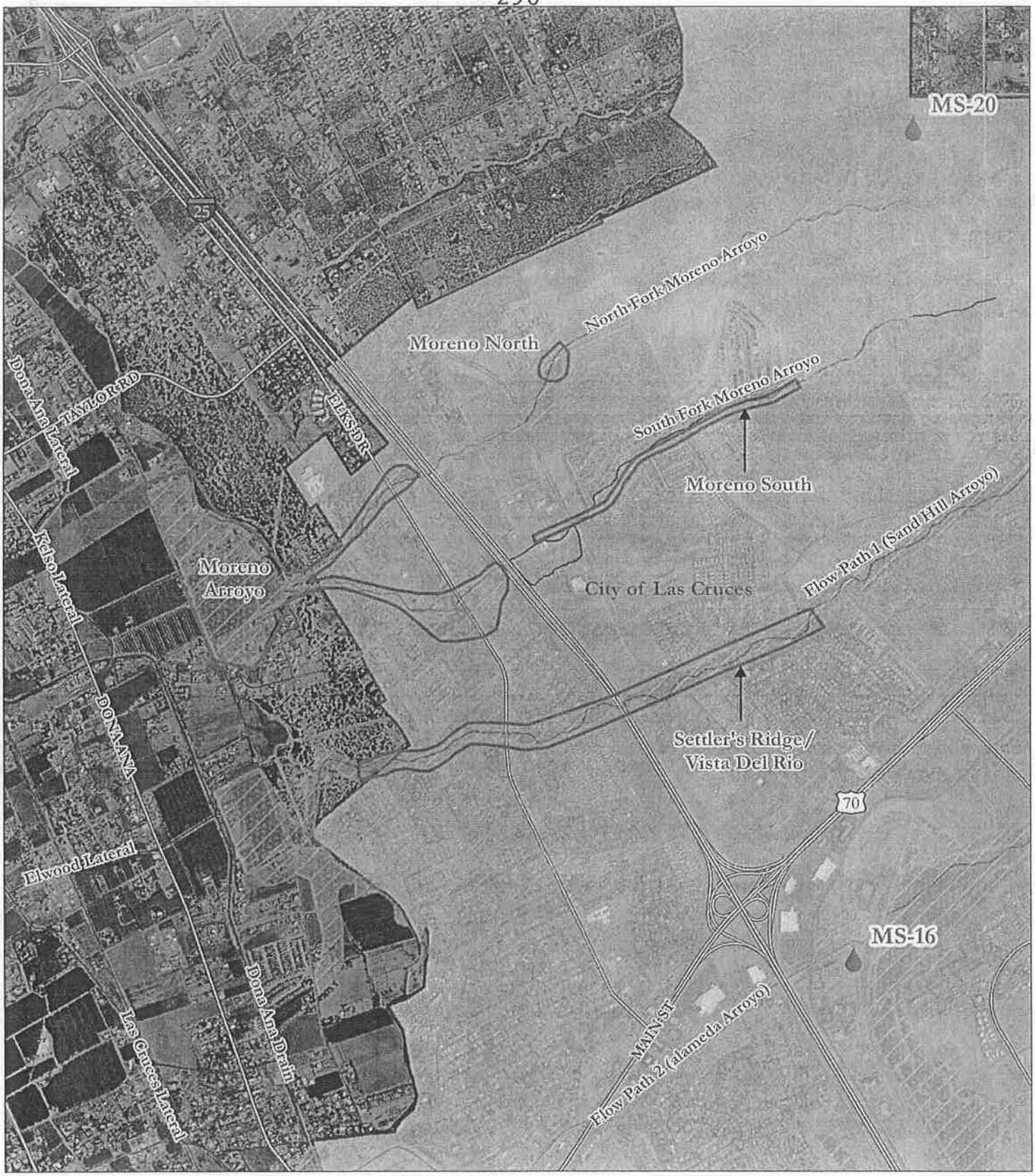
Doña Ana Risk Region

N
W E
S

0 0.25 0.5 Miles

DONA ANA COUNTY NEW MEXICO


Isaack Lake
MS-3
Brahman Channel
Brahman Channel Dam
EL CENTRO BLVD
Baylor Canyon Arroyo
Moongate Acres
BRAHMAN RD
Organ CDP
Organ
Valley Vista
70
HOLMAN RD
Baylor Canyon
Space Mural
MS-2
PEACHTREE HILLS RD
Mesa/ Dos Suenos
Tierra Grande
Baylor Canyon Arroyo Tributary 1
MS-27
MS-20
CORTEZ
DUNN DR
MS-13
Sandhill Arroyo Dam
High Ridge/ Las Colinas
Homestead
MS-1
City of Las Cruces
MS-14
Flow Path 1 (Sand Hill Arroyo)
Risk Center
Dam
FEMA Floodplain
Community Boundary
Fire Station
School
Major Road
Waterline
Monitoring Station
East Mesa Risk Region
N
W
E
S
0 0.5 1
Miles
DONA ANA COUNTY NEW MEXICO



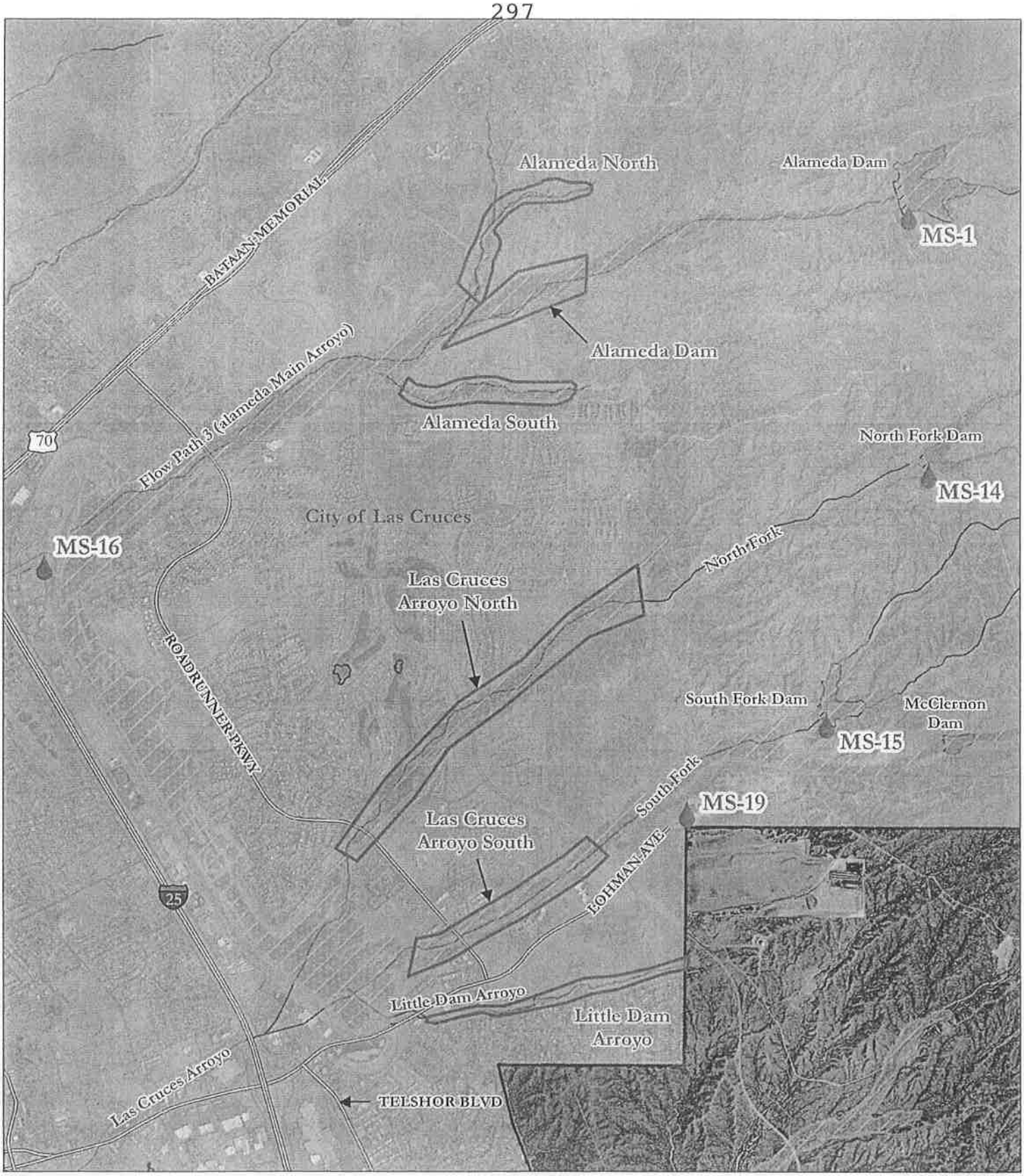
Risk Center
FEMA Floodplain
Community Boundary
Major Road
Waterline
Monitoring Station

Las Cruces North Risk Region

N
W E
S

0 0.25 0.5 Miles

DONA ANA COUNTY NEW MEXICO



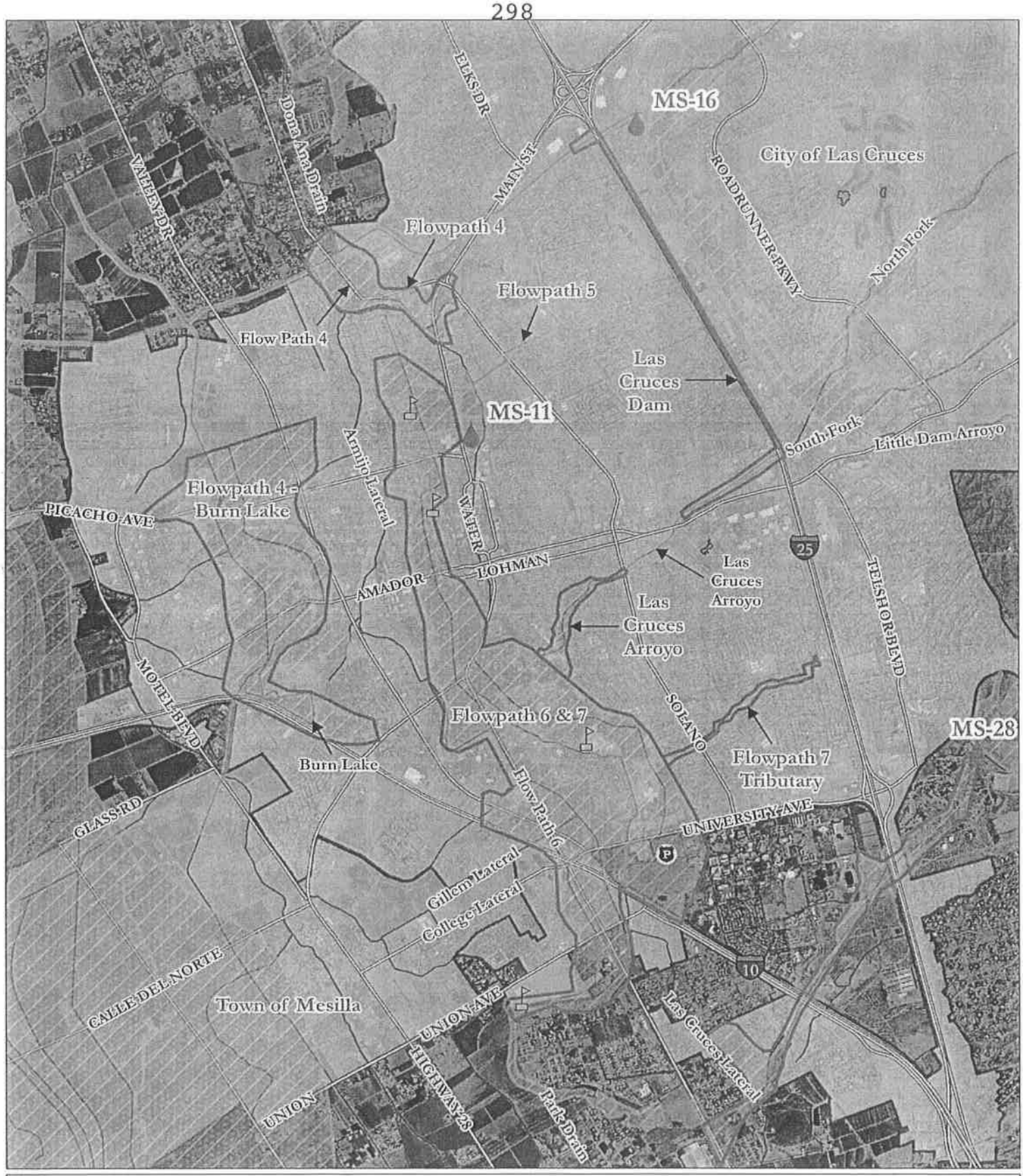
Risk Center
Dam
FEMA Floodplain
Community Boundary
Major Road
Waterline
Monitoring Station

Las Cruces East Risk Region

N
W E
S

0 0.25 0.5
Miles

DONA ANA COUNTY NEW MEXICO

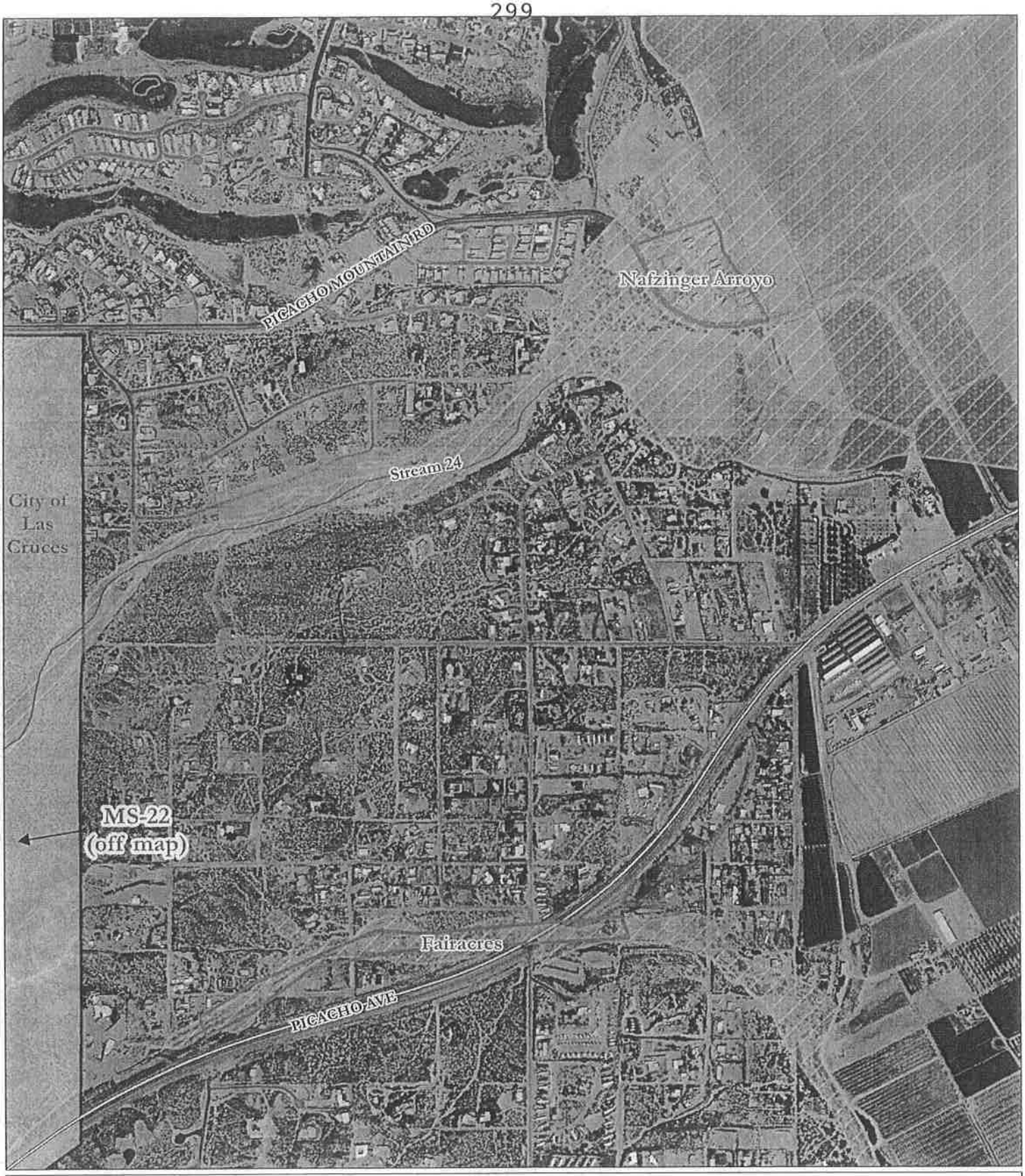


Major Road
Risk Center
FEMA Floodplain
Community Boundary
Waterline
School
Nursing Home
Police Station

Central Las Cruces Risk Region

N
W E
S

0 0.25 0.5
Miles



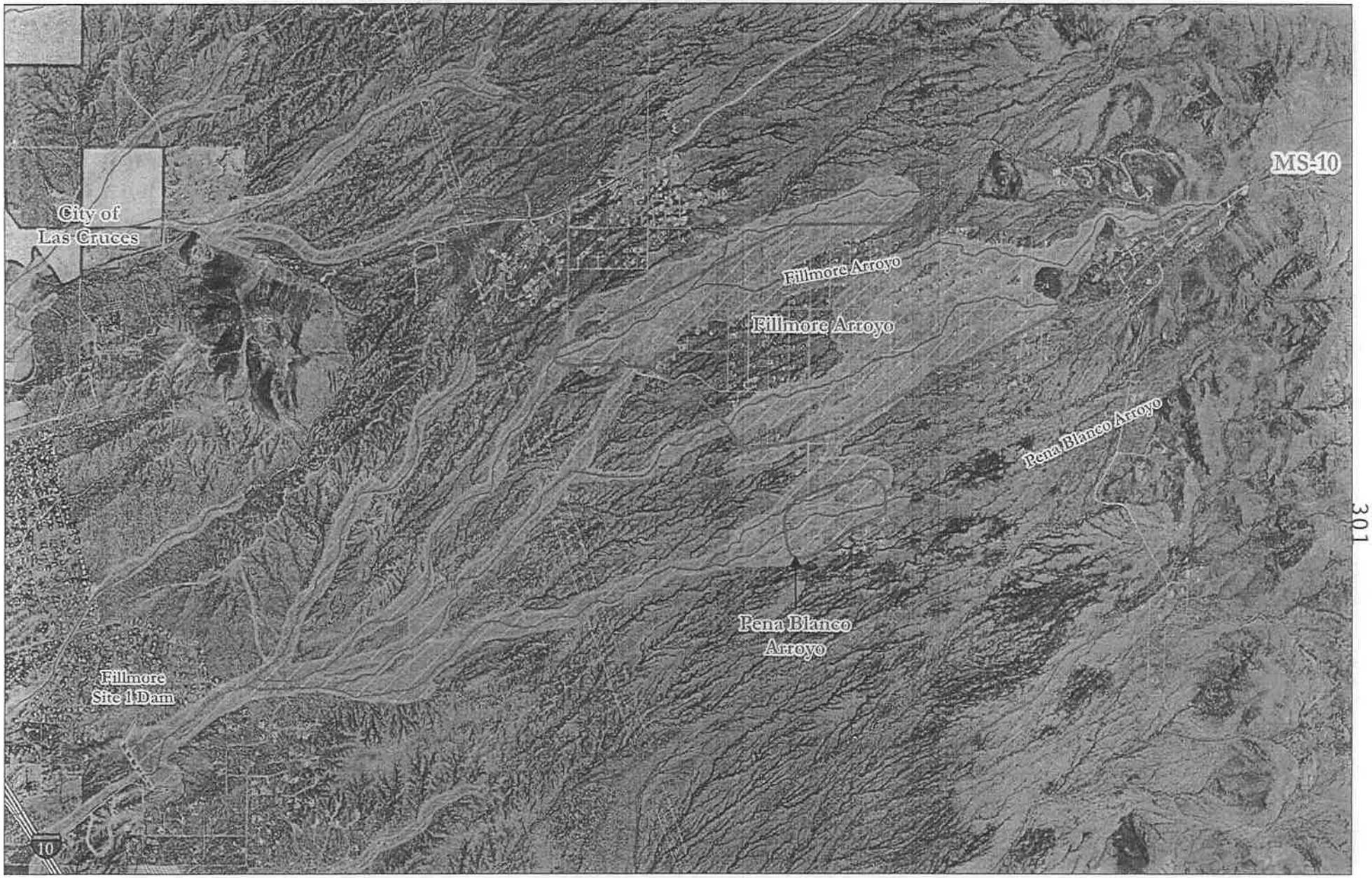
Risk Center
FEMA Floodplain
Community Boundary
Waterline
Major Road
Monitoring Station

Fairacres Risk Region

N W E S

0 500 1,000 Feet


Tortugas Arroyo
TELSHOR BLVD
SOLANO DR
MS-28
25
City of Las Cruces
Tortugas Site 1 Dam
UNIVERSITY AVE
Flow Path 10
Tortugas Arroyo
UNION
10
STERN DR
Tortuga Arroyo
Flow Path 11
MAIN ST
Boughton Lateral
10
Risk Center
Dam
FEMA Floodplain
Community Boundary
Waterline
Major Road
Monitoring Station
University Park Risk Region
N
W
E
S
0
0.25
0.5
Miles



Risk Center
Dam
FEMA Floodplain
Community Boundary
Major Road
Waterline
Monitoring Station

Soledad Canyon Risk Region

N
W E
S

0 0.45 0.9
Miles

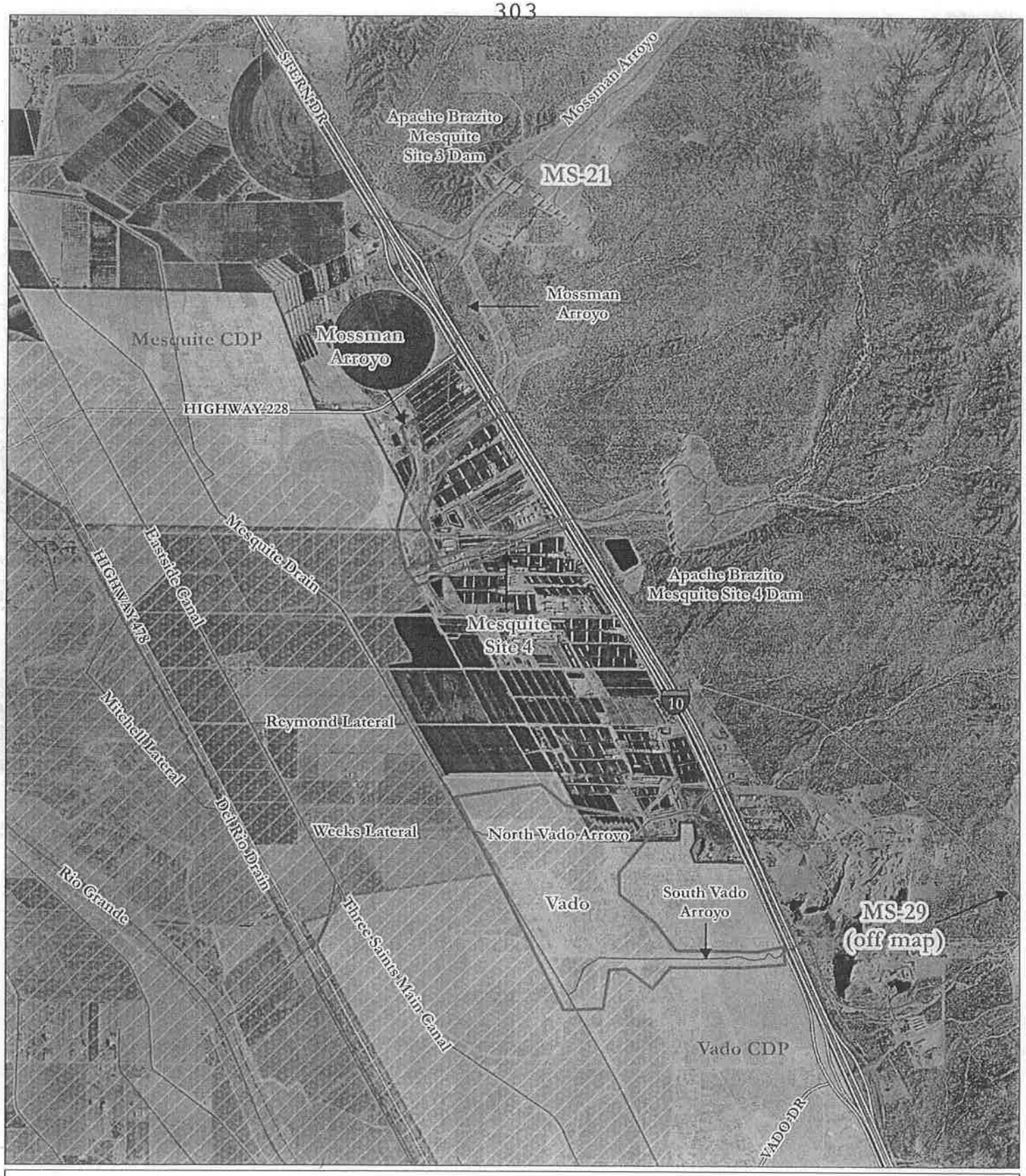
DONA ANA COUNTY NEW MEXICO

Risk Center
Major Road
FEMA Floodplain
Waterline
Community Boundary
BP Checkpoint

DAC West Risk Region

N
W
E
S

0 1,000 2,000 Feet

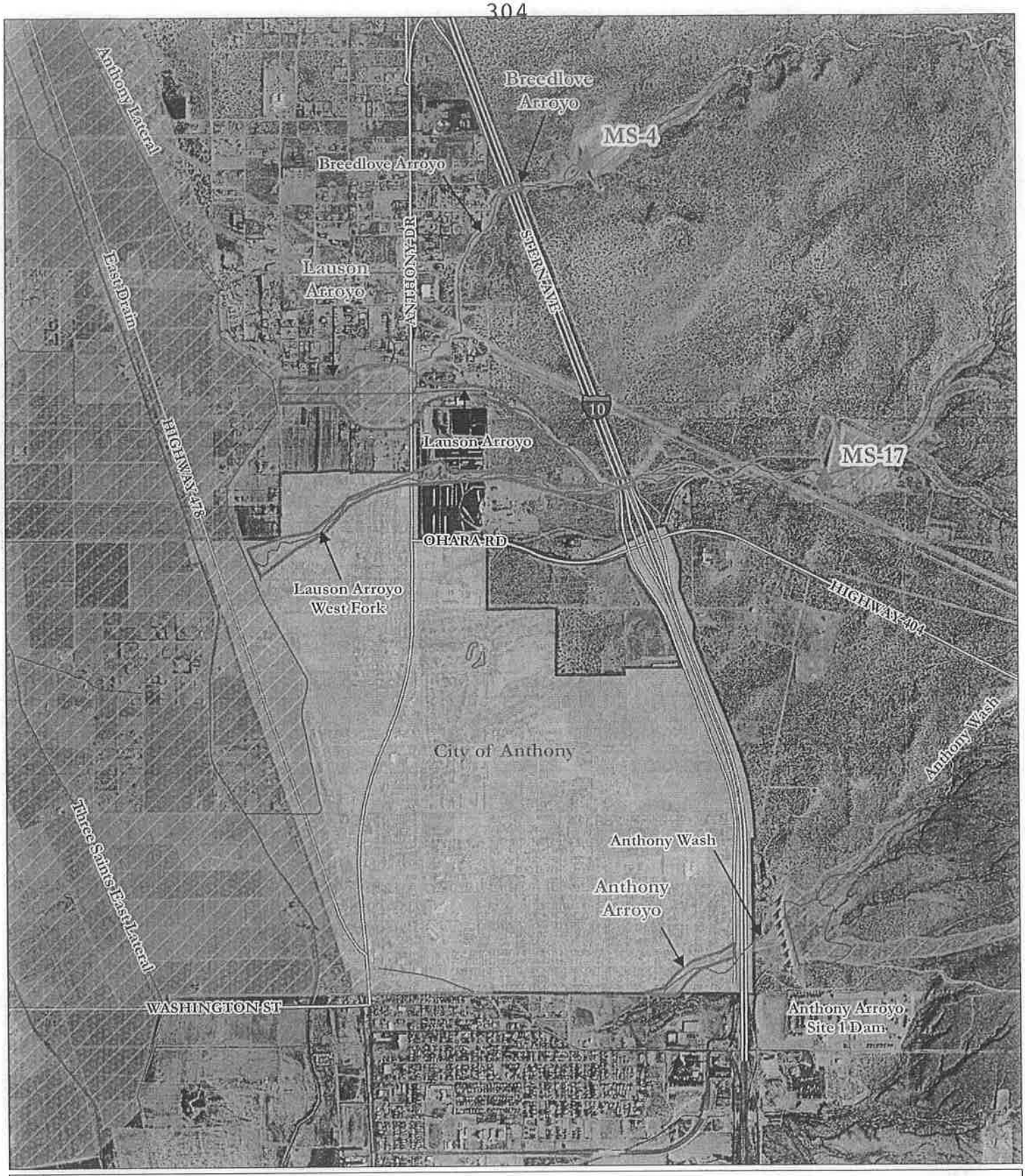


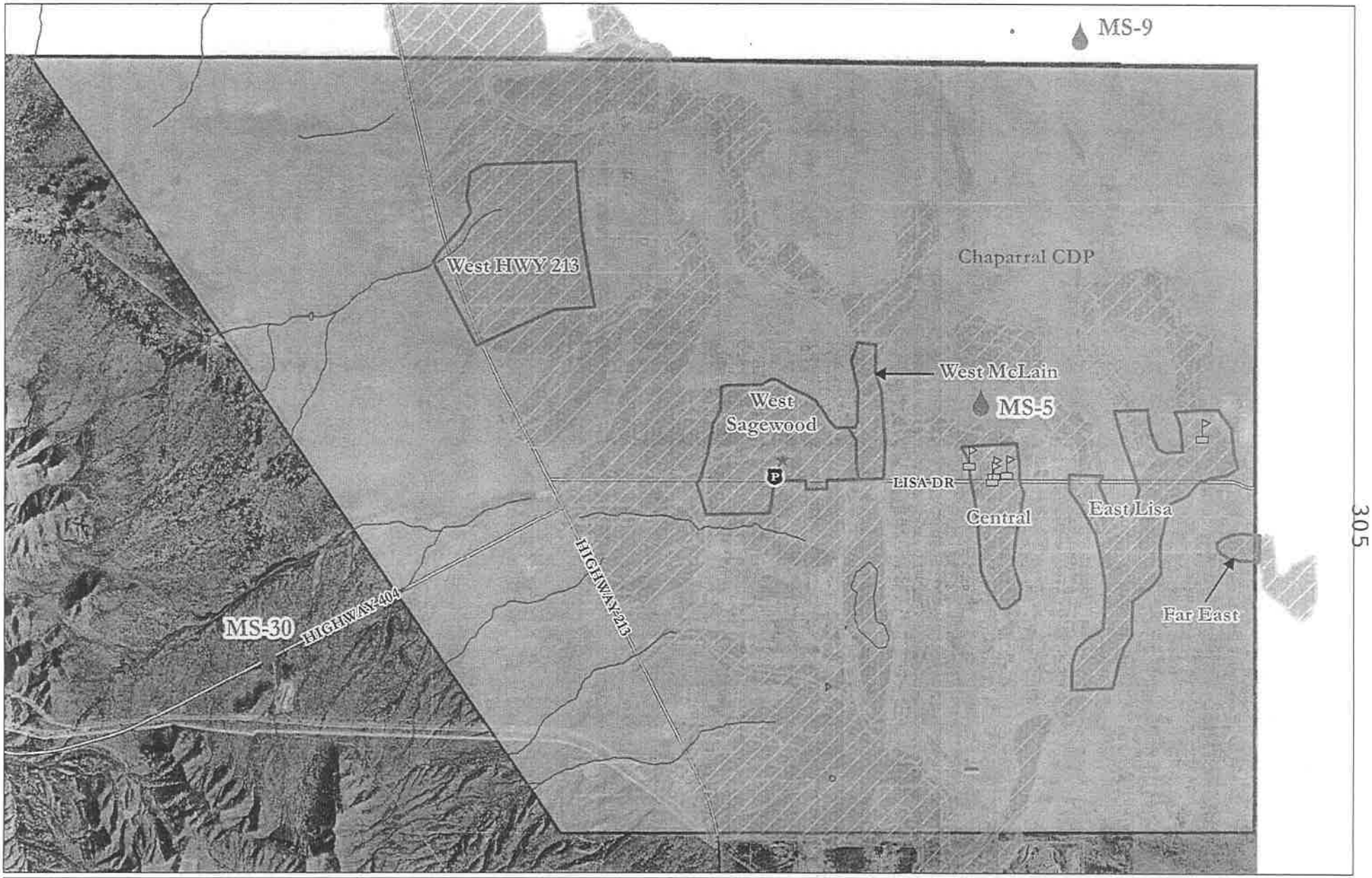
Risk Center
Dam
FEMA Floodplain
Community Boundary
Waterline
Major Road
Monitoring Station

Mesquite - Vado Risk Region

N W E S

0 0.25 0.5 Miles


Anthony Lateral
East Drain
HIGHWAY 478
Three Saints East Lateral
Breedlove Arroyo
Breedlove Arroyo
MS-4
ANTHONY DR
STERN AVE
Lauson Arroyo
Lauson Arroyo
10
MS-17
OHARA RD
Lauson Arroyo West Fork
HIGHWAY 404
Anthony Wash
City of Anthony
Anthony Wash
Anthony Arroyo
WASHINGTON ST
Anthony Arroyo Site 1 Dam
Risk Center
Dam
FEMA Floodplain
Community Boundary
Waterline
Major Road
Monitoring Station
Anthony Risk Region
N
W
E
S
0
0.25
0.5
Miles



Risk Center
Dam
DMP Floodplain
Community Boundary
Police Station
Clinic
School
Major Road
Waterline

Chaparral Risk Region

N
W E
S

0 0.55 1.1
Miles

DONA ANA COUNTY NEW MEXICO

Major Road

Waterline

Risk Center

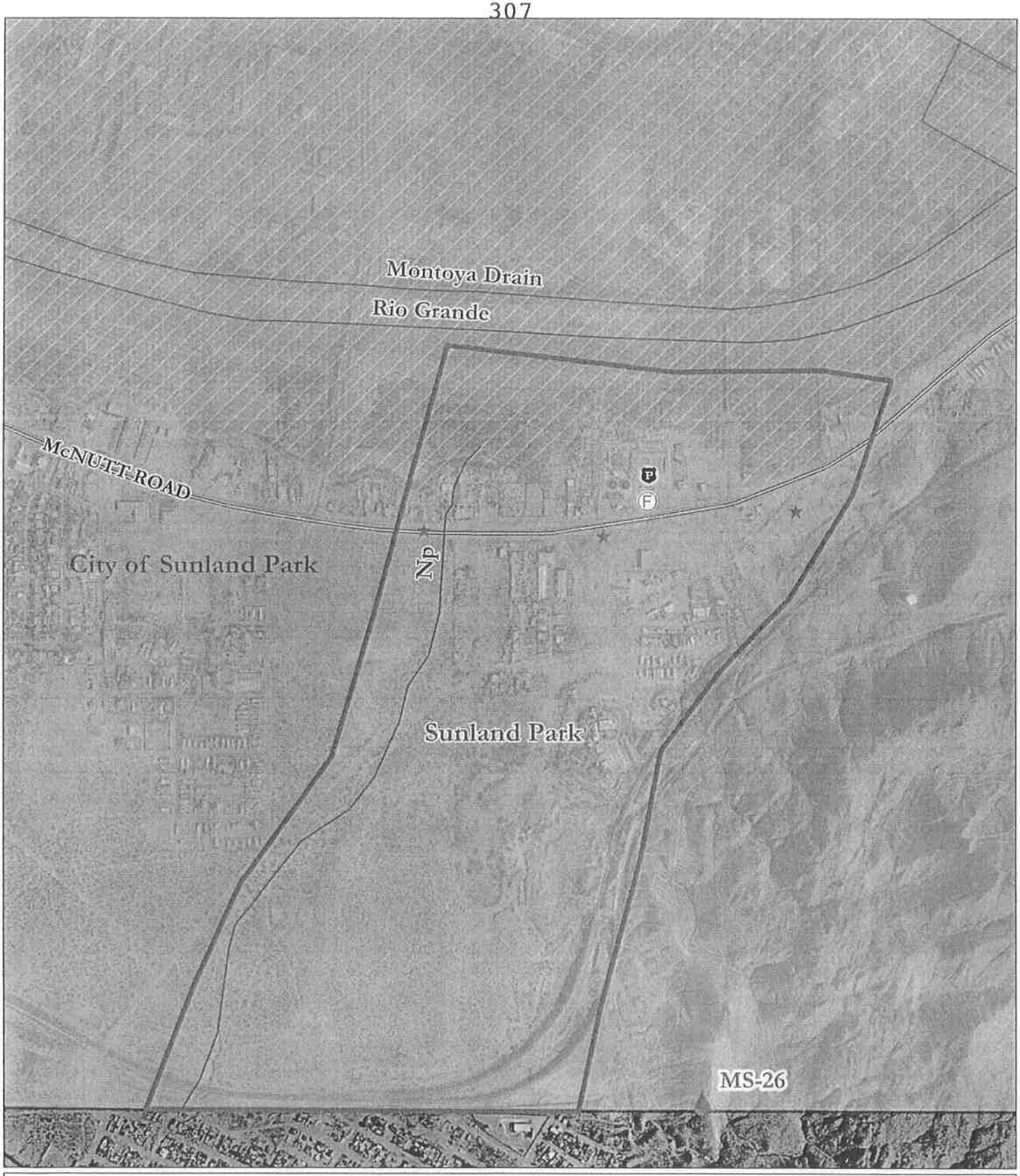
FEMA Floodplain

N
W E
S

DAC Southwest Risk Region

0 0.25 0.5 Miles

DONA ANA COUNTY NEW MEXICO



Risk Center
FEMA Floodplain
Community Boundary
Waterline
Major Road
Fire Station
Clinic
Police Station

Sunland Park Risk Region

N
W E
S

0 0.1 0.2 Miles

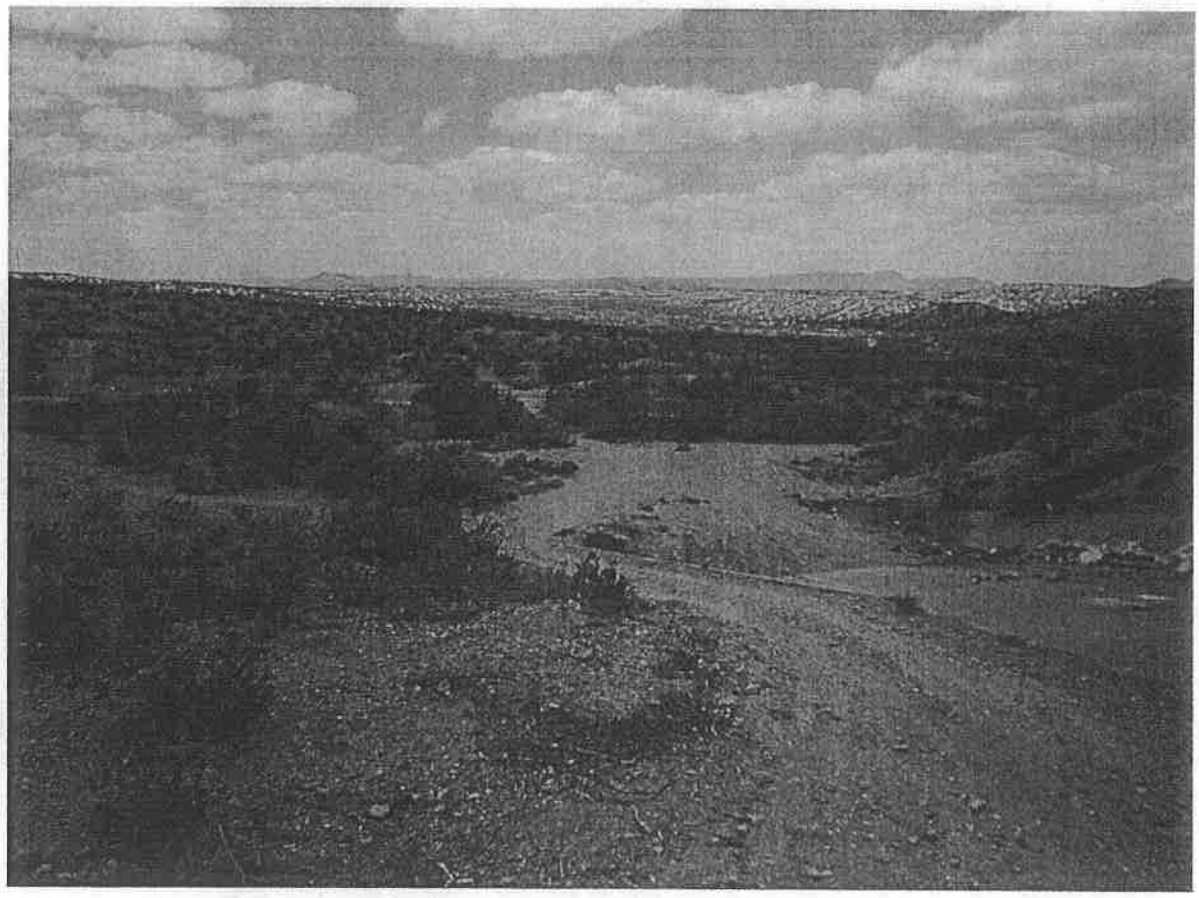
DONA ANA COUNTY NEW MEXICO

MS-1 Alameda Arroyo

Site Location:	Alameda Dam	GPS Coordinates:	32.367447, -106.701479
Site Type:	Combination	Property Ownership:	Federal
Access:	Poor	Security:	Poor
Distance to Nearest Paved Road:	1.5 miles		

Site Description:

Alameda Dam is located east of Las Cruces along the Alameda Arroyo. A combination rainfall and dam level monitoring station is proposed at this location, with the most important aspect for downstream flood warning being the dam level. The site can be accessed via a rough and narrow gravel path beginning Aldrich Road near the Davis Road intersection. The entrance to this path is over a steep berm adjacent to a ditch, which can cause problems for full size trucks and sport utility vehicles with a wide clearance. This path is rather eroded with several ups and downs as it crosses the many small arroyos, and is most suited to an all-terrain vehicle. The site is on BLM property, and would need to be secured by constructing a tall fence around the station. Line-of-site communications to Twin Peaks Mountain are available. Although power is available via the transmission lines approximate 500 yards away from the site, solar power is likely the best option.



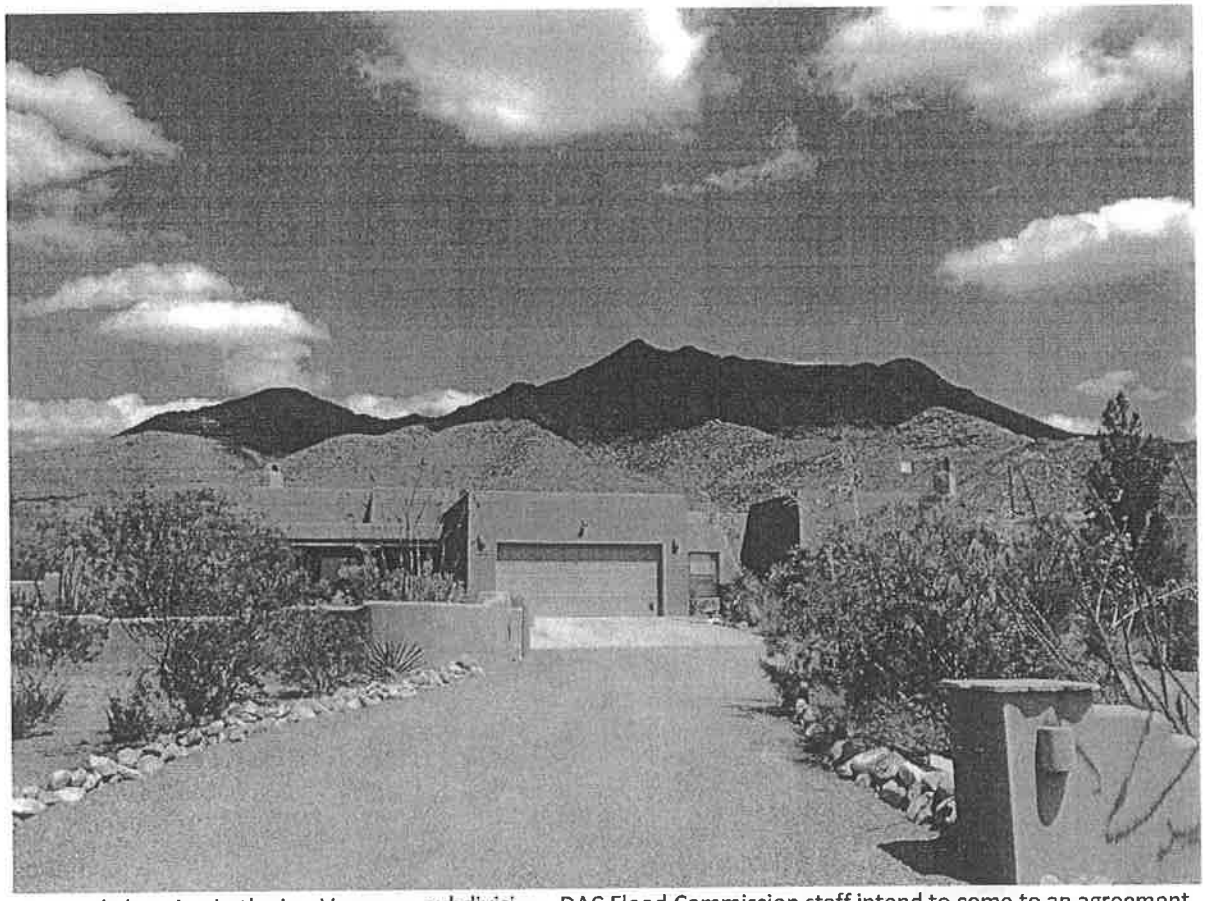
Looking east-southeast from the dam. Note transmission lines in the distance.

MS-2 Baylor Canyon

Site Location:	Baylor Canyon Road	GPS Coordinates:	32.409419, -106.613392
Site Type:	Rainfall	Property Ownership:	Private
Access:	Excellent	Security:	Excellent
Distance to Nearest Paved Road:	0 miles		

Site Description:

At the recommendation of DAC Flood Commission staff, AMEC's reconnaissance efforts for Baylor Canyon were limited. DAC Flood Commission staff intends to negotiate an agreement with a private landowner owning property adjacent to Baylor Canyon Road, most likely in the Los Vaqueros subdivision, for placement of a rainfall monitoring station for the purpose of warning this risk center. The proposed private property is easily accessible from Los Vaqueros Drive, has adequate power in the vicinity, and line-of-sight communications.



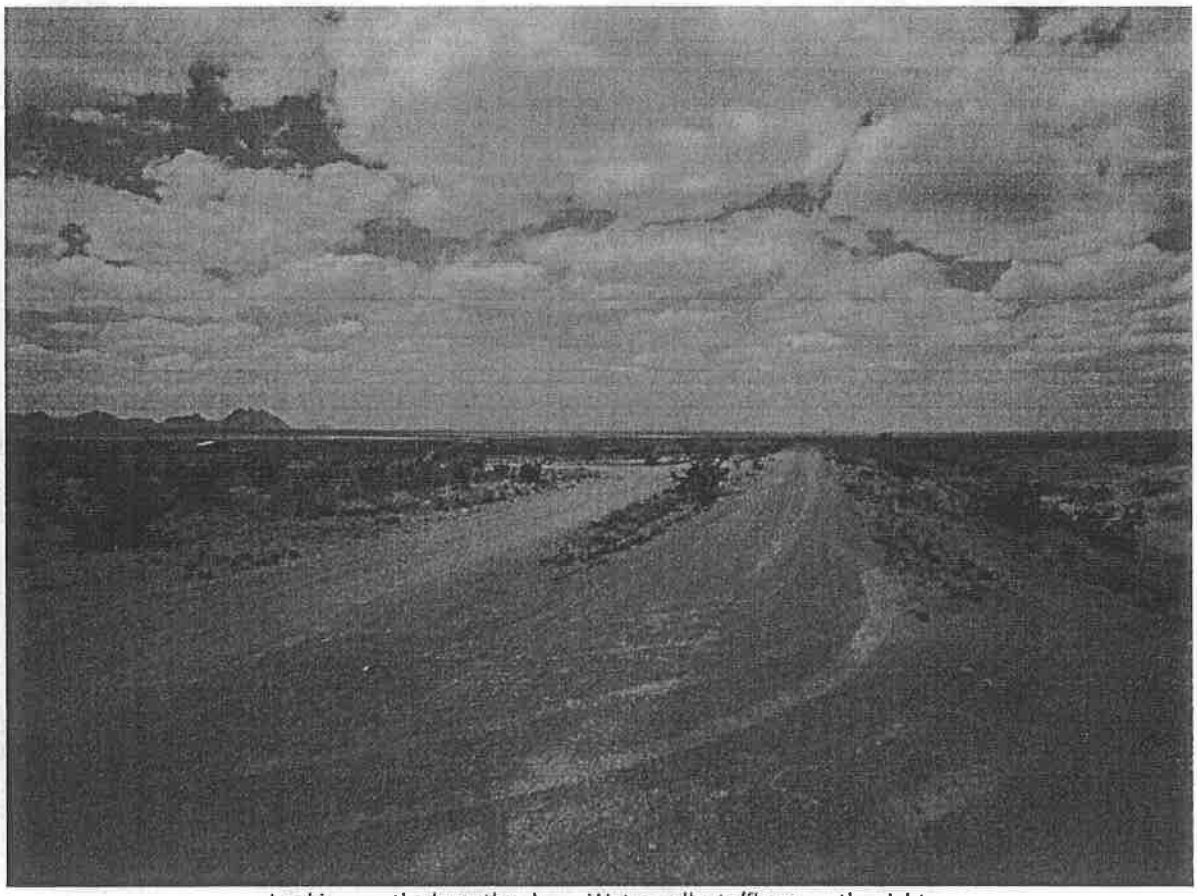
A sample location in the Los Vaqueros subdivision. DAC Flood Commission staff intend to come to an agreement with private property owners in the area for placement of a rainfall station.

MS-3 Brahman Channel

Site Location:	Brahman Channel Dam	GPS Coordinates:	32.367447, -106.701479
Site Type:	Combination	Property Ownership:	Federal
Access:	Good	Security:	Poor
Distance to Nearest Paved Road:	0.4 miles		

Site Description:

Brahman Channel Dam is located northeast of Las Cruces and dams the multiple flowpaths making up the Brahman Channel Arroyo. A combination rainfall and dam level monitoring station is proposed at this location, with the most important aspect for downstream flood warning being the dam level, which would correspond to. The site can be accessed via gravel path adjacent to the dam in the flood control right-of-way off the intersection of Brahman Road and Dragonfly Avenue. The entrance to this path is over some very large rip-rap. The site is on BLM property, and would need to be secured by constructing a tall fence around the station. Line-of-site communications to Twin Peaks Mountain are available. Although power is available via the distribution lines approximate 500 yards away from the site parallel to Brahman Road, solar power may be the best option at this location.



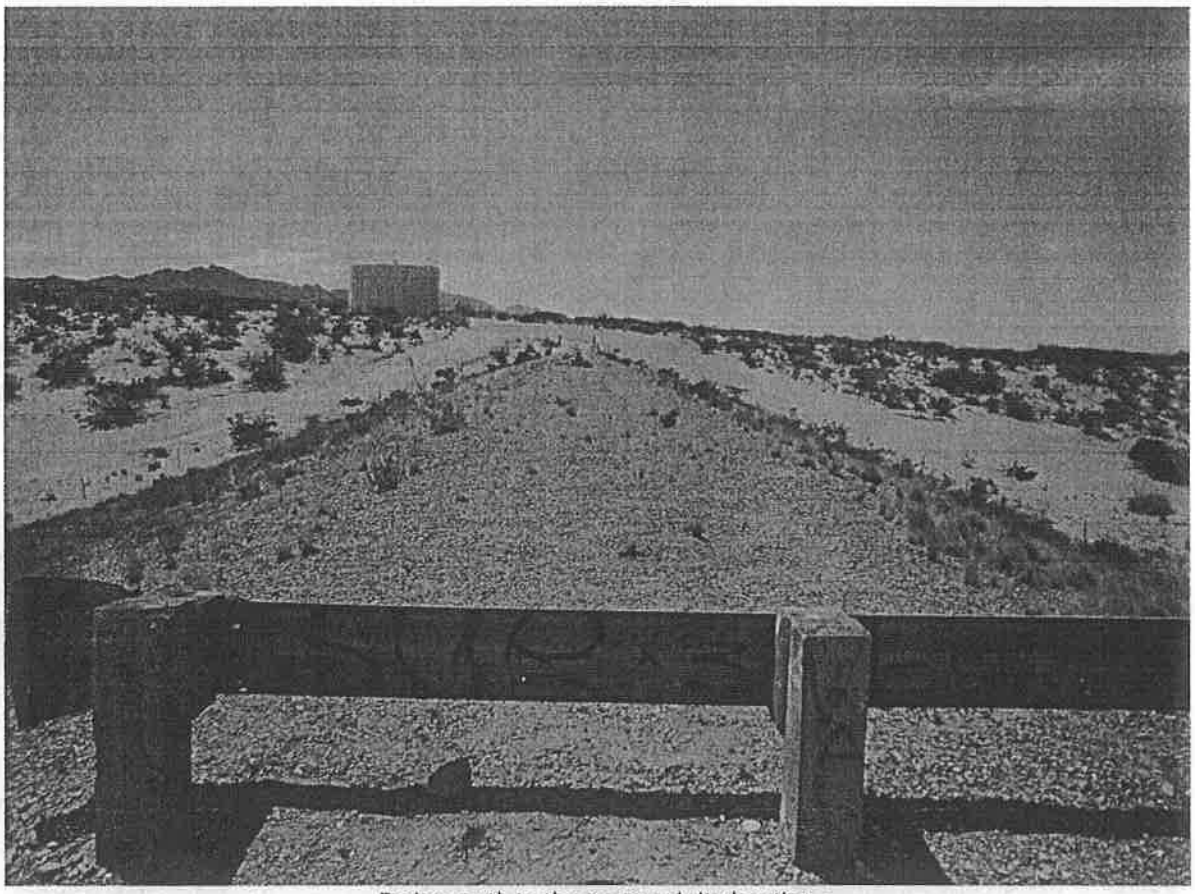
Looking north along the dam. Water collects/flows on the right.

MS-4 Breedlove Arroyo

Site Location:	Breedlove Arroyo Dam	GPS Coordinates:	32.044512, -106.592144
Site Type:	Combination	Property Ownership:	Federal
Access:	Poor	Security:	Poor
Distance to Nearest Paved Road:	2.13 miles		

Site Description:

The Breedlove Arroyo Dam is a perfect location to provide excellent coverage to the Breedlove Arroyo risk center. It is accessible from Mathis Road via a very soft, sandy road on BLM property. Line-of-sight telemetry was unable to be verified through field reconnaissance. There is no adjacent power, making solar power the best option. Security is a concern given that the property is so easily accessible.



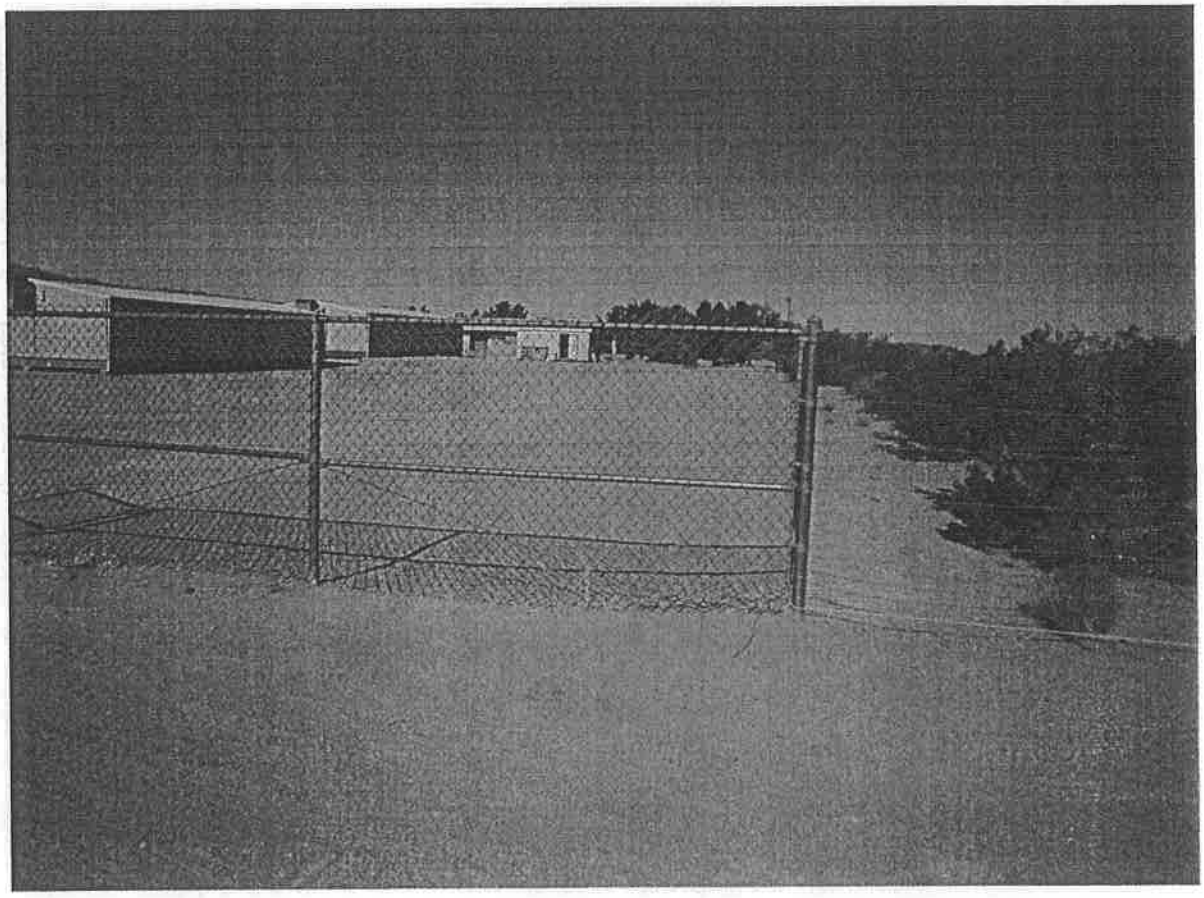
Facing south to the proposed site location.

MS-5 Central

Site Location:	Chaparral Middle School	GPS Coordinates:	32.041548, -106.41157
Site Type:	Rainfall	Property Ownership:	Municipal
Access:	Excellent	Security:	Good
Distance to Nearest Paved Road:	0 miles		

Site Description:

To provide good coverage for the Central risk center, AMEC recommends placement of a rainfall monitoring station at the Chaparral Middle School. This location, is a remote corner of the school property, is fenced and gated, providing security from vandalism. Line-of-sight telemetry is available to the Chaparral Fire Station, and likely directly to the radio antenna on St. Jude Mountain, although this was unable to be verified through field reconnaissance. Power is available at the school.



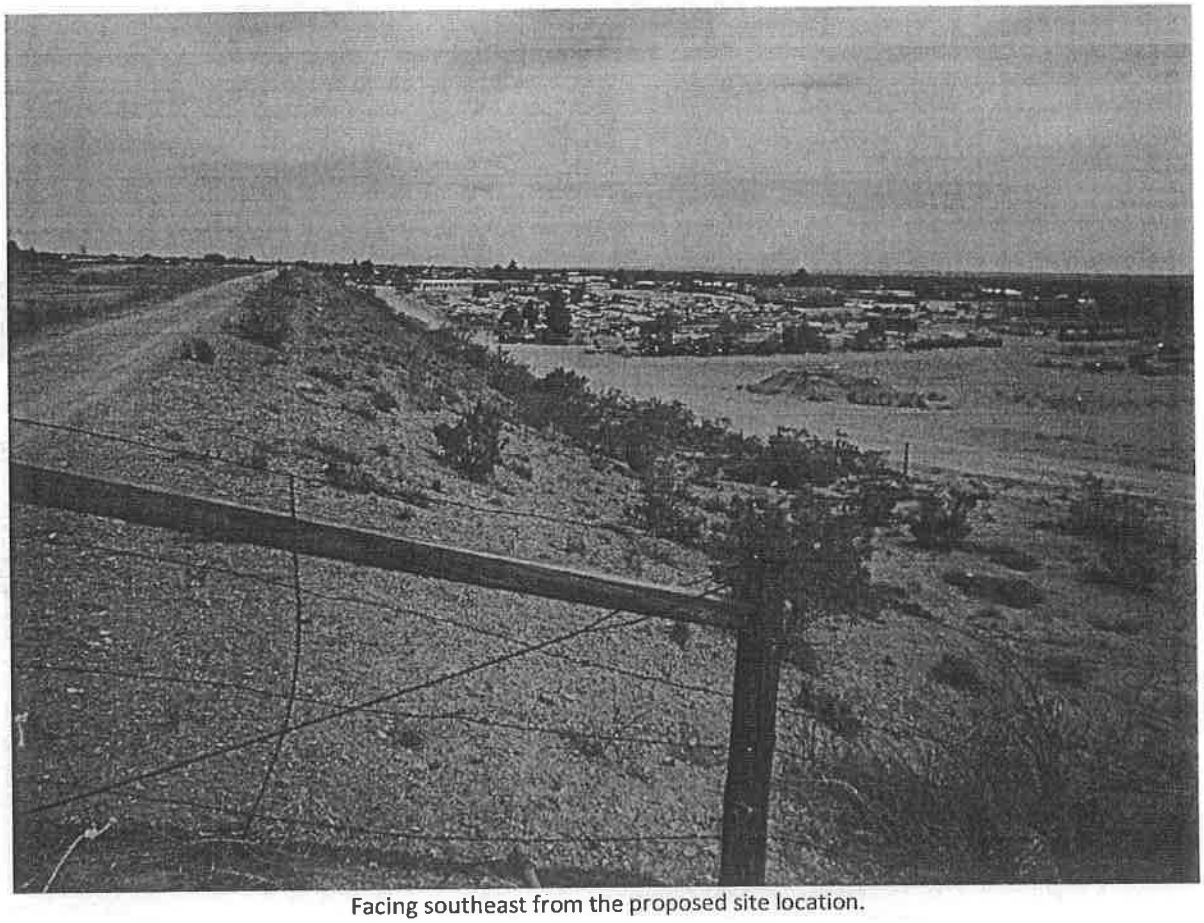
Looking west at the proposed site location, within the fence at Chaparral Middle School.

MS-6 Doña Ana Site 1

Site Location:	Doña Ana Site 1 Dam	GPS Coordinates:	32.392776, -106.799908
Site Type:	Combination	Property Ownership:	Private
Access:	Good	Security:	Poor
Distance to Nearest Paved Road:	0.25 miles		

Site Description:

The Doña Ana Site 1 Dam is a perfect location to provide excellent coverage to the Doña Ana Site 1 risk center. It is easily accessible from Thorpe Road off Del Rey Boulevard. Line-of-sight telemetry is available to Twin Peaks Mountain. There is no adjacent power, making solar power the best option. Security is a concern given that the property, owned by a private landowner, is so easily accessible.



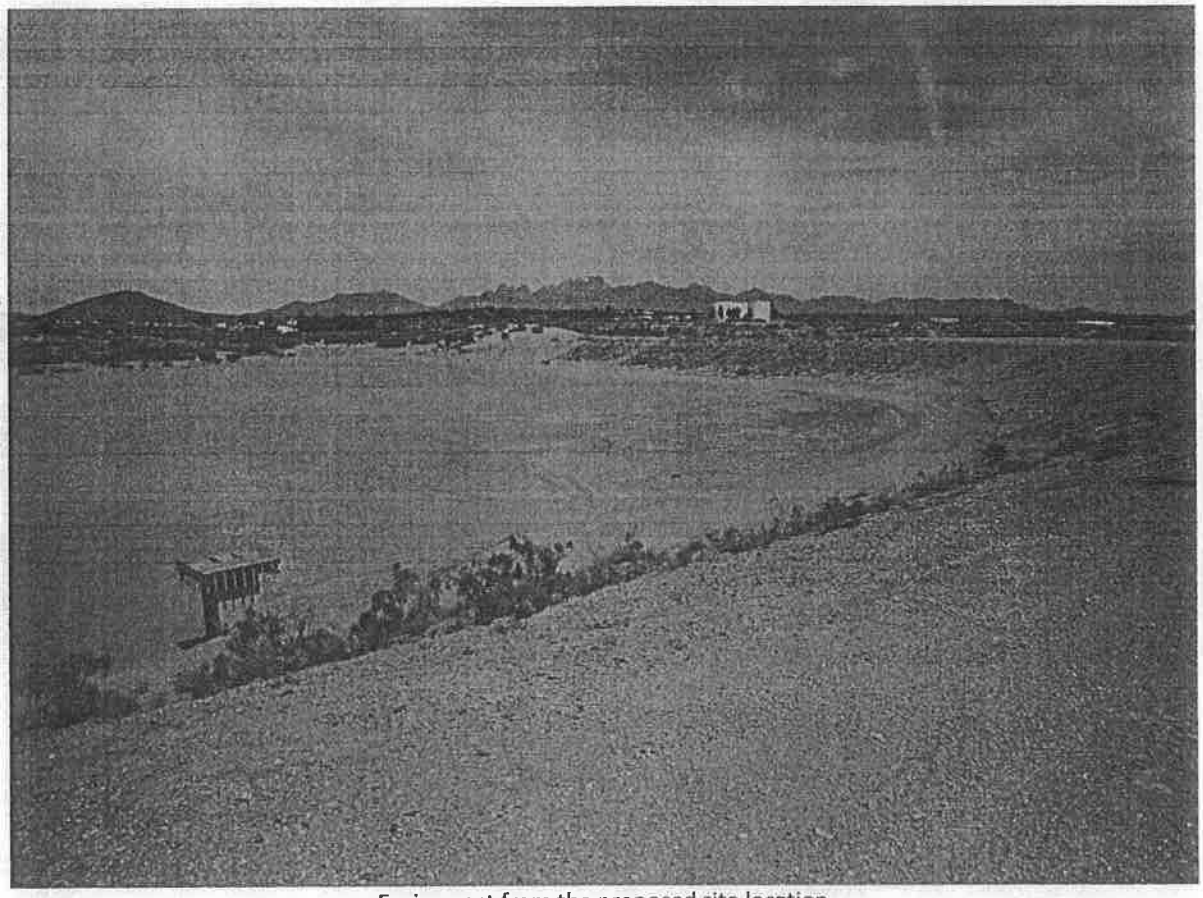
Facing southeast from the proposed site location.

MS-7 Doña Ana Site 2

Site Location:	Doña Ana Site 2 Dam	GPS Coordinates:	32.394637, -106.810198
Site Type:	Combination	Property Ownership:	Private
Access:	Good	Security:	Poor
Distance to Nearest Paved Road:	500 feet		

Site Description:

The Doña Ana Site 2 Dam is a perfect location to provide excellent coverage to the Doña Ana Site 2 risk center. DAC parcel data indicates that this property is owned by EBID. It is easily accessible from Calle Las Lomas off Del Rey Boulevard. Line-of-sight telemetry is available to Twin Peaks Mountain. There is no adjacent power, making solar power the best option. Security is a concern given that the property is so easily accessible.



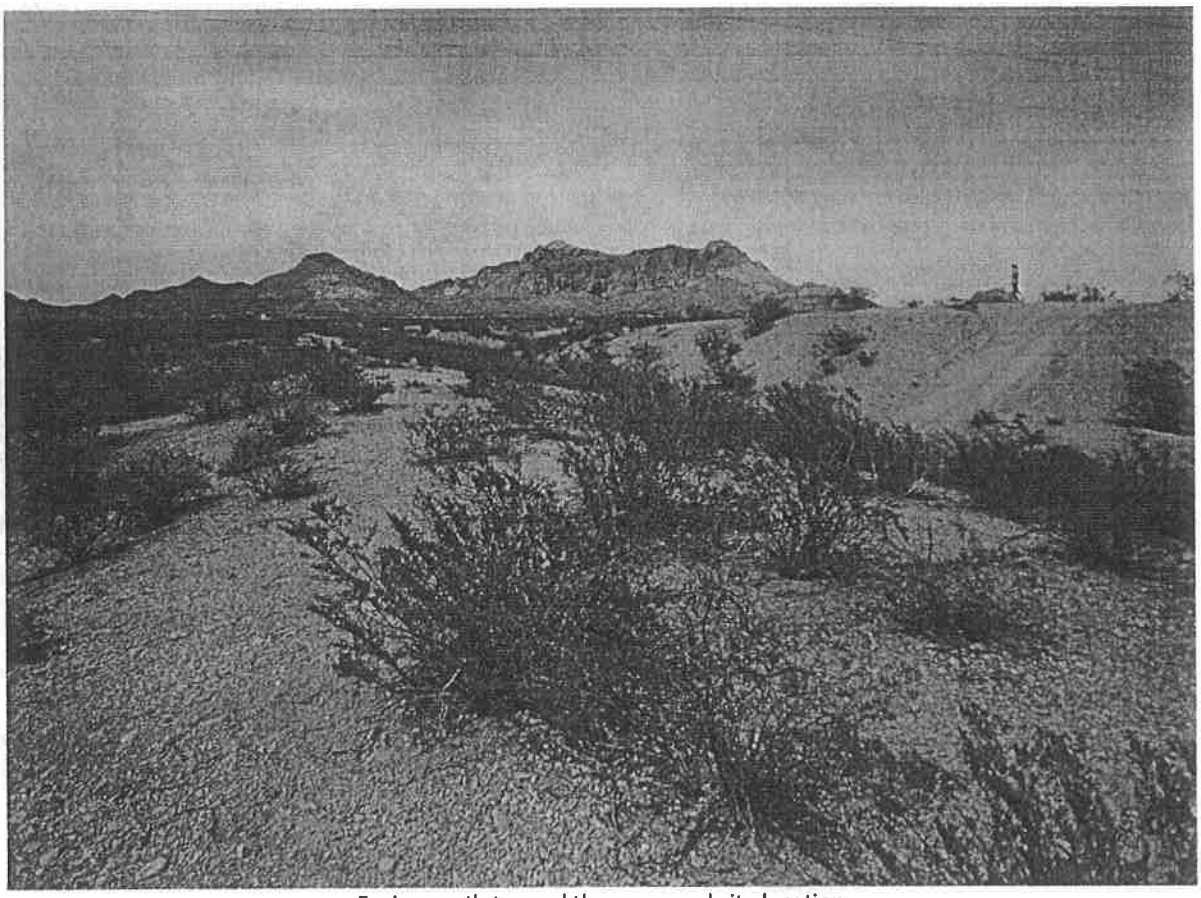
Facing east from the proposed site location.

MS-8 Doña Ana South

Site Location:	Alvillar Dam 4-C	GPS Coordinates:	32.425436, -106.808644
Site Type:	Rainfall	Property Ownership:	Private
Access:	Poor	Security:	Poor
Distance to Nearest Paved Road:	1.07 miles		

Site Description:

To provide good coverage for the Doña Ana South risk center, AMEC identified that a rainfall monitoring station is necessary at one of the Allivar Dams. Given the difficult, sandy approach to this area, AMEC selected Allivar Dam 4-C as the location for the proposed monitoring station. There is adequate space on the east-southeast side of the dam for a rainfall monitoring station. Power is available via transmission lines running over the dam. Line-of-site telemetry was verified to Twin Peaks Mountain.



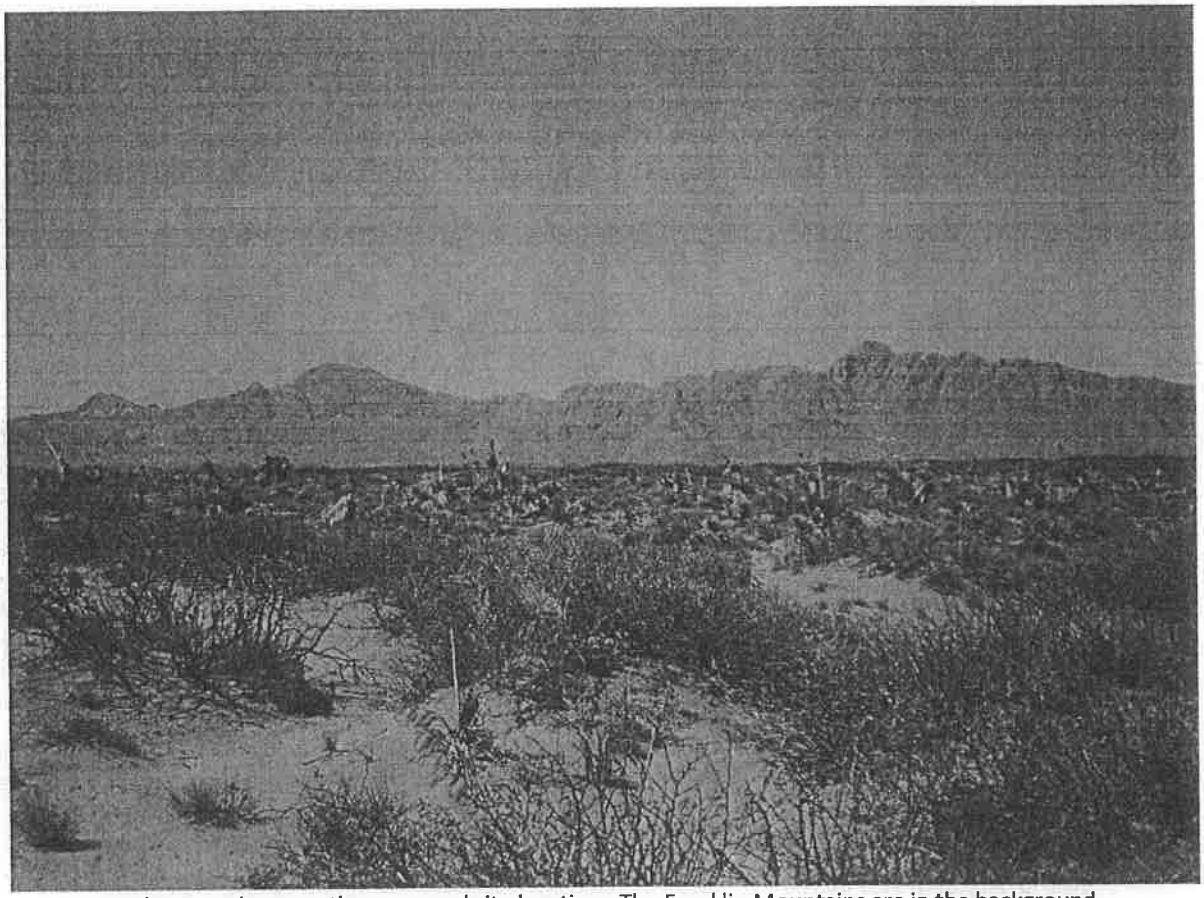
Facing north toward the proposed site location.

MS-9 East Lisa

Site Location:	North of Chaparral	GPS Coordinates:	32.065942, -106.398645
Site Type:	Rainfall	Property Ownership:	Federal
Access:	Good	Security:	Good
Distance to Nearest Paved Road:	2.7 miles		

Site Description:

The proposed location for a rainfall monitoring station covering the East Lisa risk center is on a Lake Section Water Company easement on BLM land north of Chaparral. This site is easily accessible via a wide and smooth gravel road, suitable for any type of vehicle. Access is gated, but the water company is cooperative and will allow access when necessary. Although it was unable to be assessed during reconnaissance, line-of-sight telemetry is likely available from the St. Jude or North Franklin Mountain radio antennae. Power is a concern as the nearest source is the distribution line coming off Wicker Road to the southwest. It is likely that solar power will be the most feasible option at this location. Security is also a concern given the remoteness of the location. Another concern at this location is damage from blowing sand.



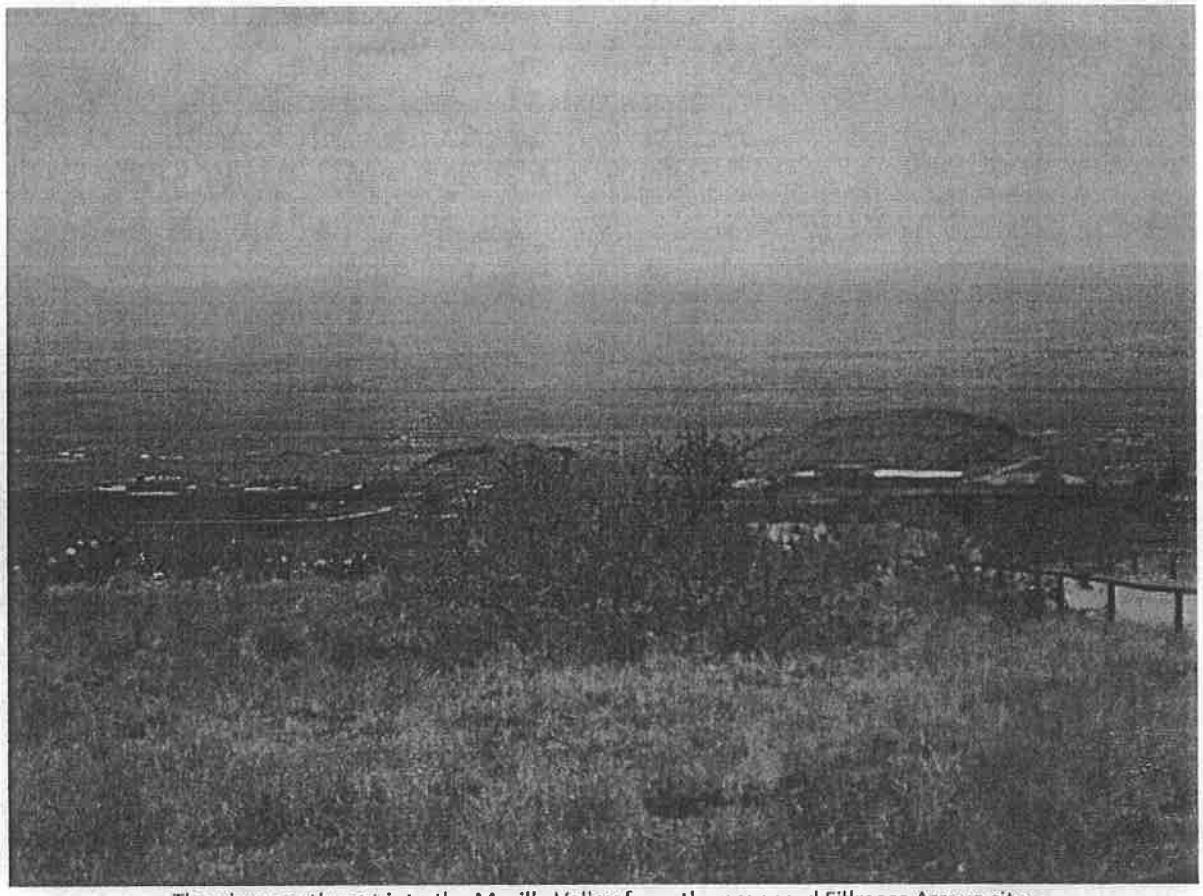
Looking southeast at the proposed site location. The Franklin Mountains are in the background.

MS-10 Fillmore Arroyo

Site Location:	Soledad Canyon Road	GPS Coordinates:	32.304254, -106.594604
Site Type:	Rainfall	Property Ownership:	Federal
Access:	Excellent	Security:	Poor
Distance to Nearest Paved Road:	0 miles		

Site Description:

The proposed site location for the Fillmore Arroyo is located near the turnaround area for a day use area on BLM land at the end of Soledad Canyon Road. Although there is no security in this area, it is likely that, due to the site's proximity to high-end residential developments, the site will remain unharmed. It is easily accessible for service by DAC personnel directly from the turnaround area, has power located in the adjacent subdivision, and direct line-of-sight telemetry with the radio antenna on Tortugas Mountain.



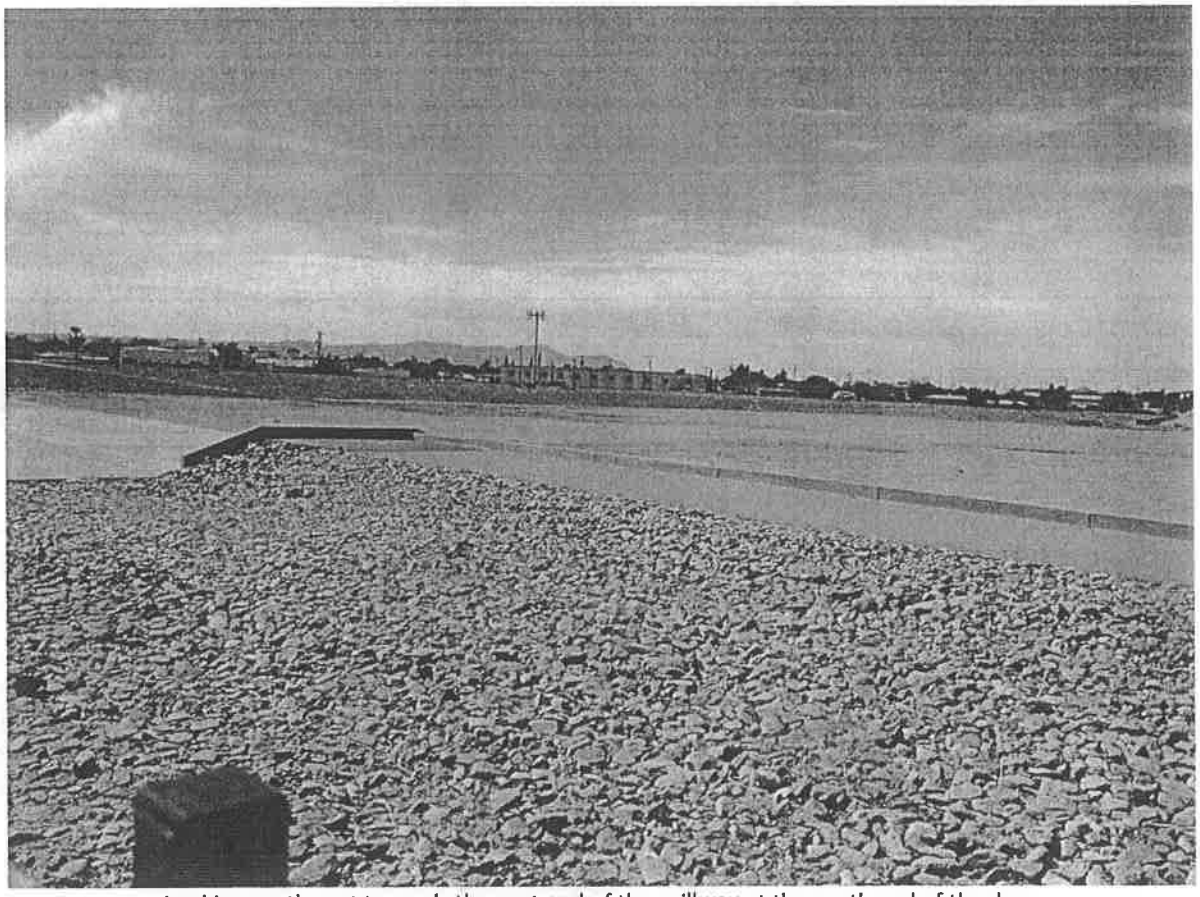
The view southwest into the Mesilla Valley from the proposed Fillmore Arroyo site.

MS-11 Flowpath 6 & 7

Site Location:	Gallagher Pond	GPS Coordinates:	32.319694, -106.779193
Site Type:	Combination	Property Ownership:	Municipal
Access:	Excellent	Security:	Excellent
Distance to Nearest Paved Road:	0 miles		

Site Description:

At the recommendation of DAC Flood Commission staff, AMEC focused their reconnaissance for the Flowpath 6 & 7 risk center on potential locations for rainfall or combination monitoring stations adjacent to the dams north of downtown Las Cruces. AMEC settled on this location at the overflow spillway to Gallagher Pond, adjacent to Chestnut Avenue, just off Main Street in Las Cruces. The property, owned by the City of Las Cruces, is easily accessible via Chestnut Street, and has several flat open areas along the dam where a rainfall gauge can be placed. Security is not a concern because the entire area around the pond is surrounded by an eight-foot-tall wrought iron fence. DAC Flood Commission staff servicing a gauge at this location would need to receive access permission through the gate at the southeast corner of the dam. Line-of-sight communications also should not be an issue, given its location in downtown Las Cruces. Power is available via distribution lines running down Chestnut Street.



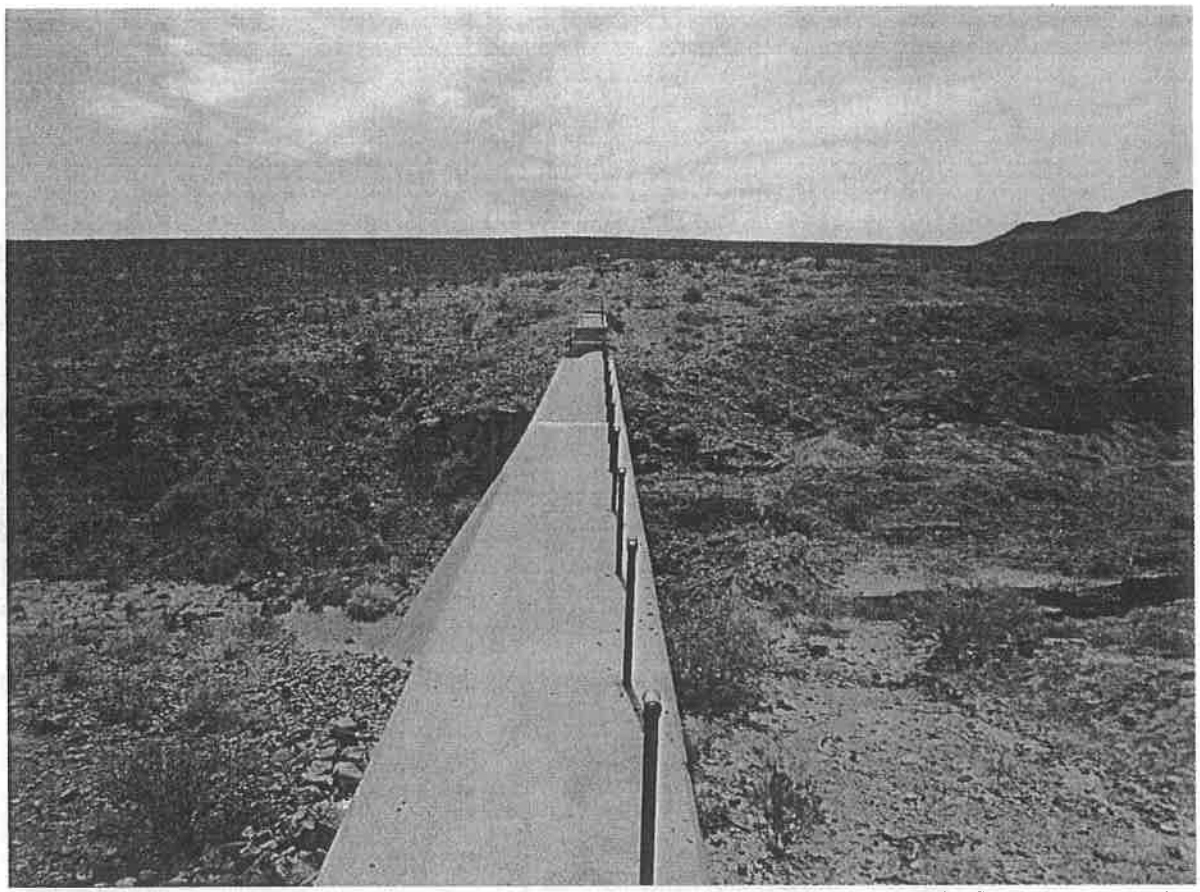
Looking northwest towards the east end of the spillway at the south end of the dam.

MS-12 Hatch

Site Location:	Spring Canyon Dam	GPS Coordinates:	32.640021, -107.157148
Site Type:	Combination	Property Ownership:	Private
Access:	Good	Security:	Poor
Distance to Nearest Paved Road:	2.3 miles		

Site Description:

The proposed site location protecting the majority of the Village of Hatch is Spring Canyon Dam. The dam is located on property owned by DEM-PROP, LLC., a Las Cruces-based company. Access to the site is relatively easy via County Road E005. Security is a concern, and thus a small fence surrounding the site is recommended. There is no power in the area, making solar power the best available option. Line-of-sight telemetry may be available using the radio towew in Hatch, but this will need to be confirmed using a more detailed signal-strength analysis.



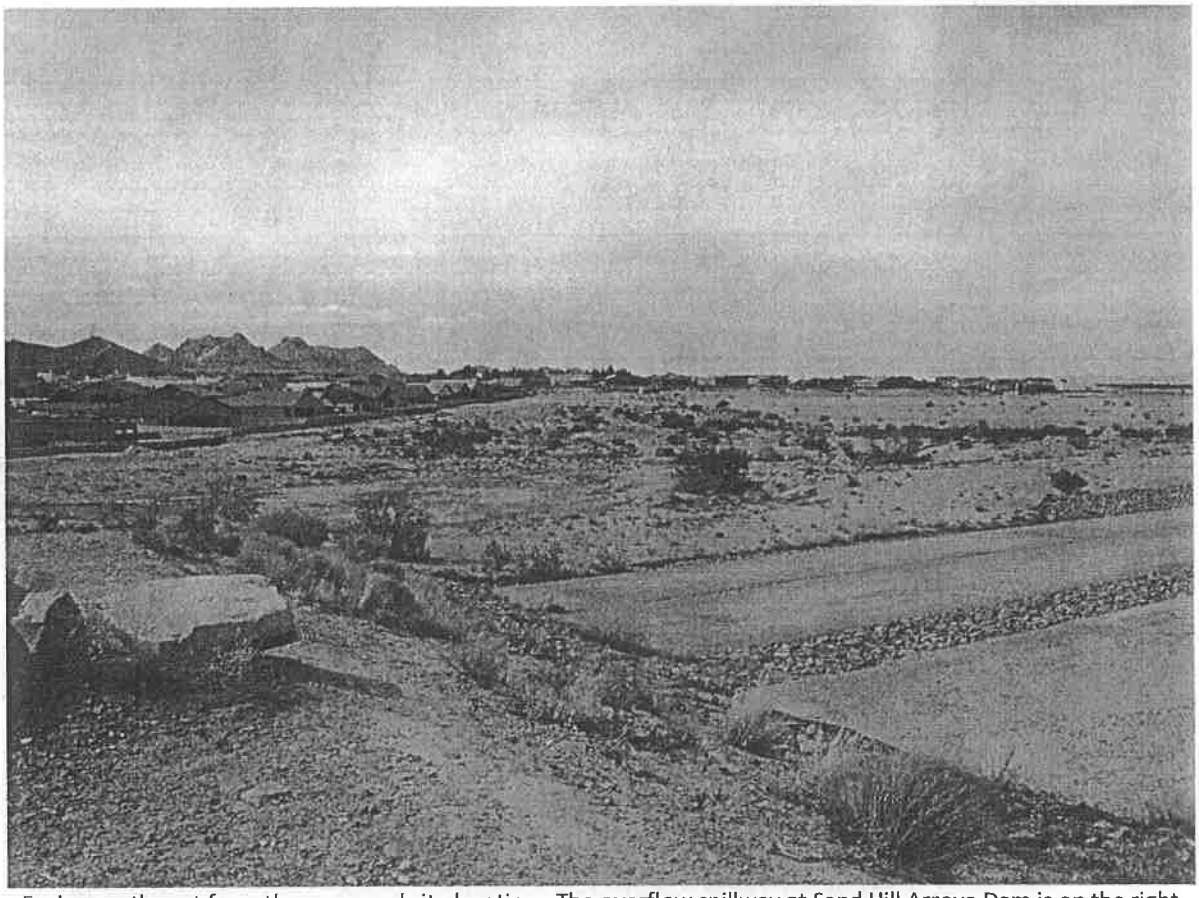
Looking east across Spring Canyon Dam. The proposed site location is across the dam in the flat, open area to the right.

MS-13 High Ridge / Las Colinas

Site Location:	Sand Hill Arroyo Dam	GPS Coordinates:	32.379625, -106.742048
Site Type:	Combination	Property Ownership:	Municipal
Access:	Excellent	Security:	Poor
Distance to Nearest Paved Road:	0 miles		

Site Description:

The proposed site location for the High Ridge / Las Colinas risk center is the Sand Hill Arroyo Dam. In addition to providing excellent coverage for this risk center, it will also provide good coverage for the Settler's Ridge / Vista Del Rio risk center, which is another downstream center with a high potential for loss. The location is easily accessible via Vista de Sobre Drive or Sonoma Ranch Boulevard. Although there is technically no security at this location, it is located near enough to highly traveled roads that a small fence should be enough deterrent to vandalism. Line-of-sight telemetry is available to Twin Peaks Mountain to the northwest. There is power via distribution lines adjacent to the dam, less than 200 feet away.



Facing northwest from the proposed site location. The overflow spillway at Sand Hill Arroyo Dam is on the right and Twin Peaks Mountain is on the left in the distance.

MS-14 Las Cruces Arroyo North

Site Location:	North Fork Dam	GPS Coordinates:	32.351552, -106.699922
Site Type:	Combination	Property Ownership:	State
Access:	Poor	Security:	Poor
Distance to Nearest Paved Road:	1.9 miles		

Site Description:

The North Fork Dam is a low hazard dam located east of Las Cruces along the North Fork of the Las Cruces Arroyo. A combination rainfall and dam level monitoring station is proposed at this location, with the most important aspect for downstream flood warning being the dam level. The site can be accessed via a rough and narrow gravel path beginning at the eastern terminus of Sedona Hills Parkway near the water tank. This path is rather eroded with several ups and downs as it crosses the many small arroyos, and is most suited to an all-terrain vehicle. The site is on State property, and would need to be secured by constructing a tall fence around the station. Line-of-site communications to Twin Peaks Mountain are available. Power is available via the transmission lines approximate 200 yards away from the site.

Looking north-northwest across the dam. Note transmission lines and Twin Peaks Mountain on the left.

MS-15 Las Cruces Arroyo South

Site Location:	South Fork Dam	GPS Coordinates:	32.336169, -106.707247
Site Type:	Combination	Property Ownership:	State
Access:	Good	Security:	Poor
Distance to Nearest Paved Road:	1.28 miles		

Site Description:

The proposed site location on the South Fork Dam, upstream of the Las Cruces Arroyo South risk center, is just east of Las Cruces, and is easily accessible off Sonoma Ranch Boulevard between Lohman Avenue and Camino Coyote. Although there is a power substation approximately 1,700 linear feet away from the site, solar power is recommended at this location given the rough terrain that would need to be crossed by power lines. Security is also a concern at this location. Site reconnaissance noted numerous spent shotgun shells in the area, indicating that the monitoring station would be at-risk for vandalism. Line-of-site telemetry is available via the antenna on Tortugas Mountain to the south. The property is owned by the State of New Mexico, and the access road travels through BLM property.

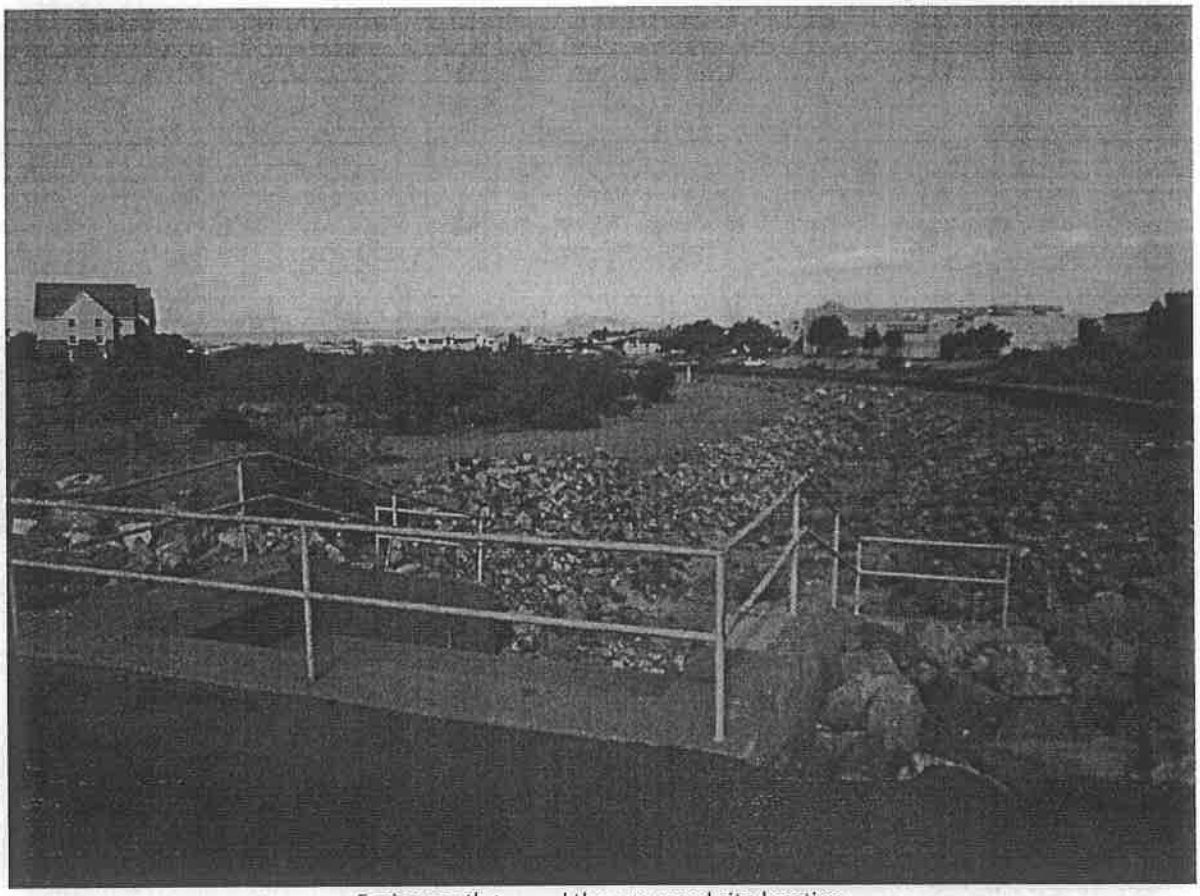
Looking north-northwest across the South Fork Dam.

MS-16 Las Cruces Dam

Site Location:	Las Cruces Dam	GPS Coordinates:	32.245611, -106.763121
Site Type:	Combination	Property Ownership:	Private
Access:	Excellent	Security:	Poor
Distance to Nearest Paved Road:	0 miles		

Site Description:

DAC Flood Commission staff indicated the desire to have a combination stage and rainfall monitoring station at the north outlet to Las Cruces Dam. AMEC identified a site at the north end of the parking lot behind the Northrise Business Park as ideal for this station. Access is easy from the parking lot, and power is available from the adjacent business areas. Security is lacking, given that this is a heavily traveled pedestrian greenway. Line-of-sight telemetry seems possible.



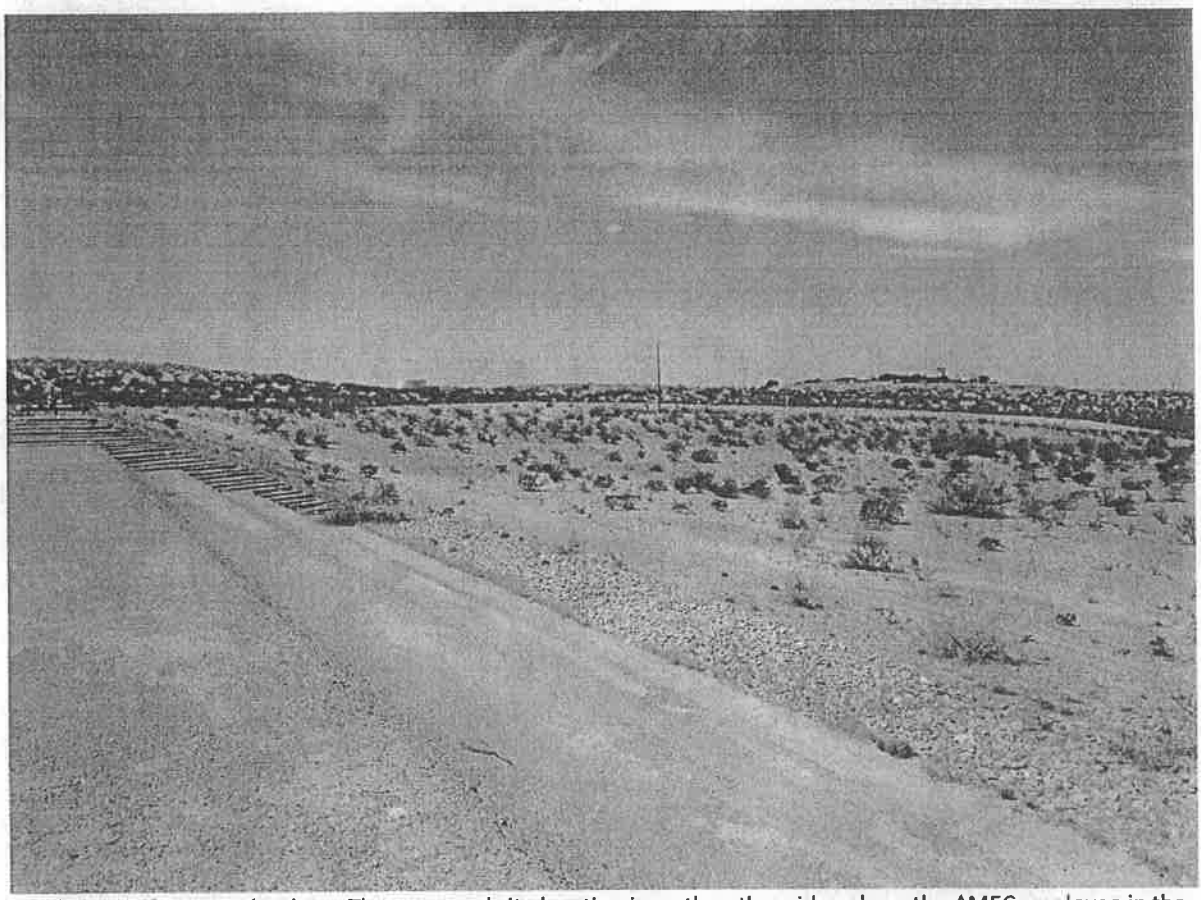
Facing north toward the proposed site location.

MS-17 Lauson Arroyo

Site Location:	Lauson Arroyo Dam	GPS Coordinates:	32.02772, -106.577649
Site Type:	Combination	Property Ownership:	Federal
Access:	Good	Security:	Poor
Distance to Nearest Paved Road:	0.7 miles		

Site Description:

The proposed site location for the Lauson Arroyo risk center is the south side of the Lauson Arroyo dam on property owned by the BLM. The dam provides flood protection to the risk center, and the location would provide good excellent coverage for flood warning. The location is easily accessible from a gravel road extending from Mathis Road, just off Interstate 10 at the Highway 404 interchange. A number of spent shotgun shells were observed in the site area, making security a concern. Line-of-sight telemetry was not able to be verified through field reconnaissance. Power is available approximate 400 feet from the south side of the dam.



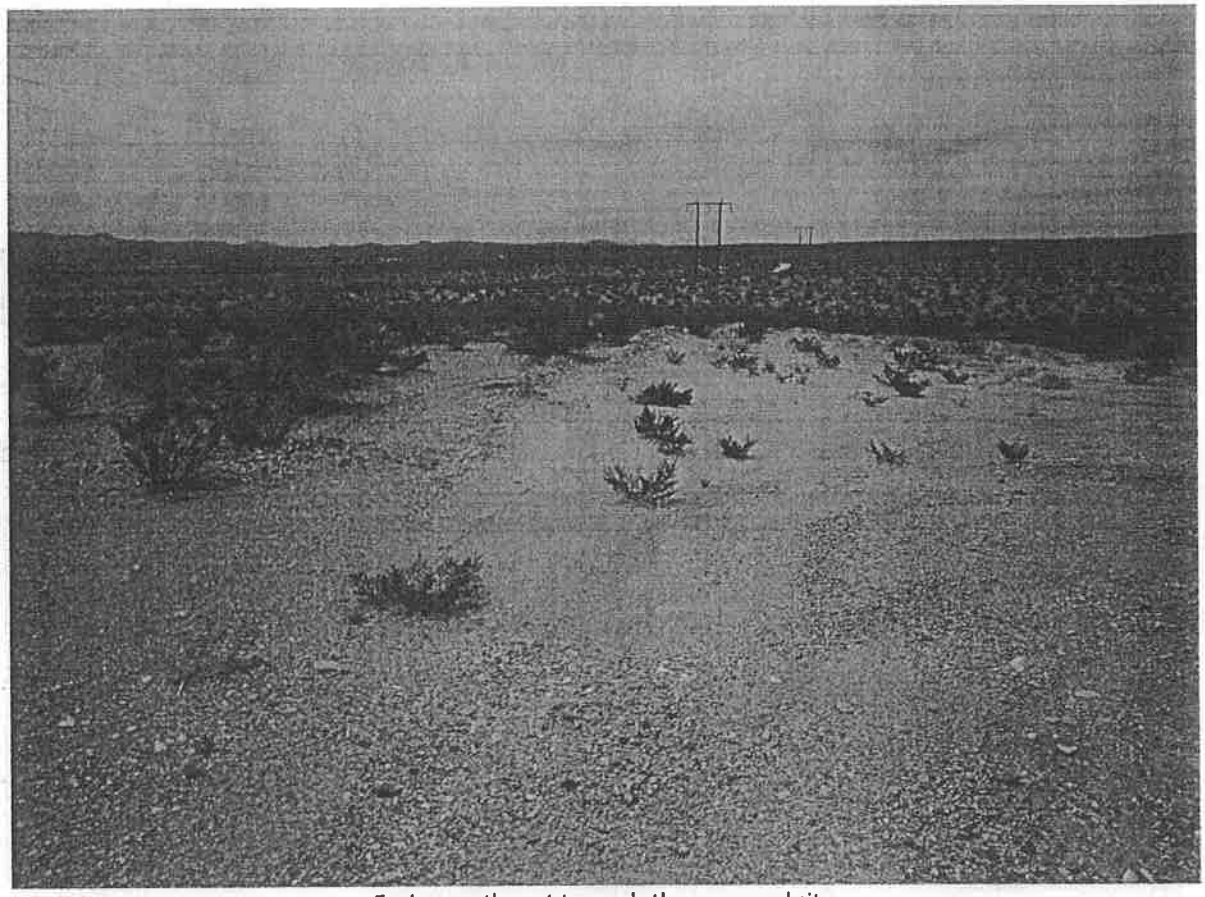
Looking south across the dam. The proposed site location is on the other side, where the AMEC employee in the orange vest is standing. Notice the power lines running east-west along the site area.

MS-18 Leesburg Main

Site Location:	State Land	GPS Coordinates:	32.471959, -106.862034
Site Type:	Rainfall	Property Ownership:	State
Access:	Poor	Security:	Poor
Distance to Nearest Paved Road:	3.73 miles		

Site Description:

Access to the proposed site for the Leesburg Main risk center, which is on land owned by the State of New Mexico, requires driving up one of the unnamed arroyos crossing Doña Ana Road, under a low railroad bridge, through a 10 foot by 10 foot concrete culvert under Interstate 25, and across the many arroyos that flow to the west off the Doña Ana Mountains. This drive is best suited for an all-terrain vehicle. The proposed site has power from adjacent transmission lines. Line-of-sight telemetry was unable to be verified during field reconnaissance.



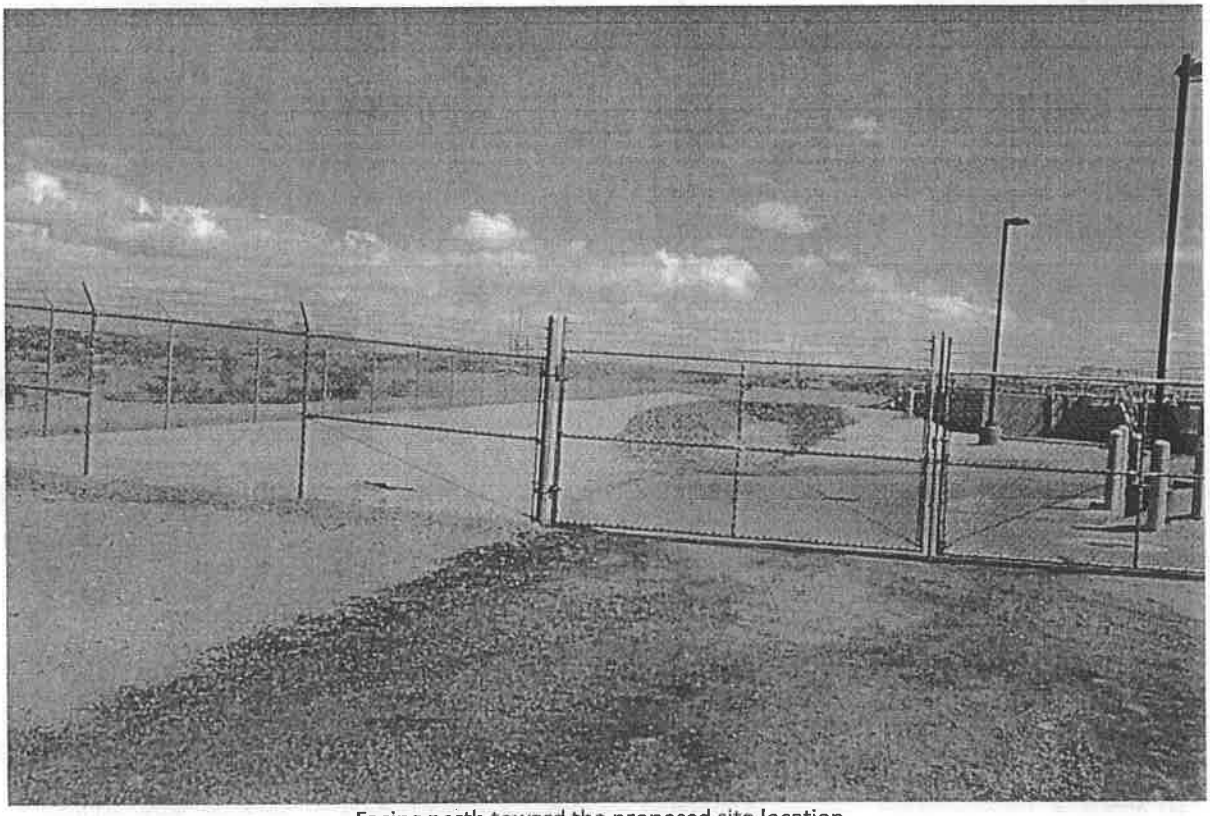
Facing northwest towards the proposed site.

MS-19 Little Dam Arroyo

Site Location:	Water Facility	GPS Coordinates:	32.330668, -106.717258
Site Type:	Rainfall	Property Ownership:	Private
Access:	Good	Security:	Excellent
Distance to Nearest Paved Road:	0.3 miles		

Site Description:

The ideal location for a rainfall monitoring station for the Little Dam Arroyo would have been the City of Las Cruces landfill at the east end of Lohman Avenue. Access to this site was not granted, and thus an alternative location was selected at the East Mesa Water Reclamation Facility, operated by the City of Las Cruces. Although this location is technically within an adjacent watershed, it would provide fair coverage to the Little Dam Arroyo. The site is completely secure and is monitoring 24-hours a day by cameras and guards. Power is available at the site and line of site telemetry looks to be available to the east.



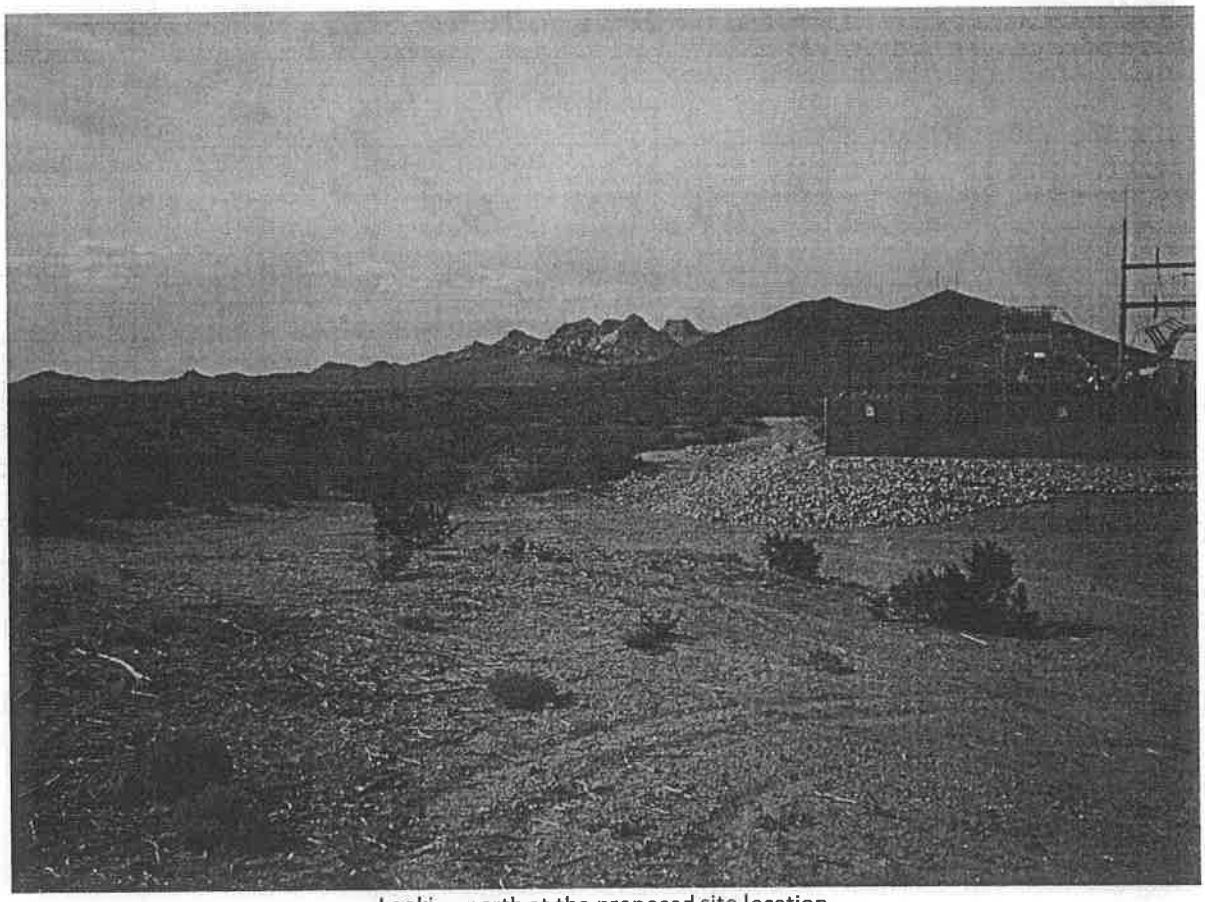
Facing north toward the proposed site location.

MS-20 Moreno North

Site Location:	El Paso Electric	GPS Coordinates:	32.386668, -106.759869
Site Type:	Rainfall	Property Ownership:	Private
Access:	Excellent	Security:	Poor
Distance to Nearest Paved Road:	0 miles		

Site Description:

The El Paso Electric Substation at the intersection of Thurmond Road with Calle Paraiso is an ideal location for a rainfall monitoring station for the Moreno North risk center. Access is easy from Thurmond Road. Although there is technically no security, it is located in an area that should be free from vandalism. Line-of-sight telemetry is obvious via the radio antenna on Twin Peak Mountain to the north, and power is available from the adjacent substation.



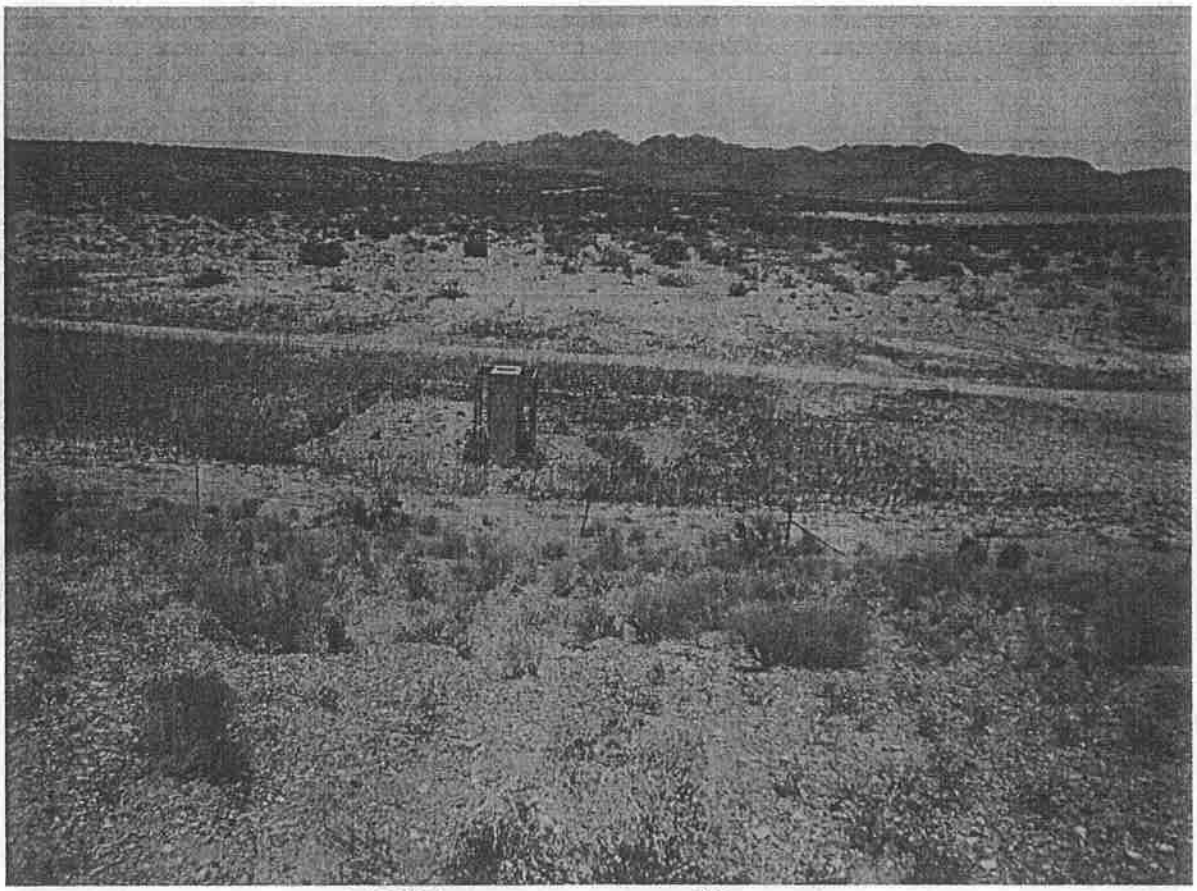
Looking north at the proposed site location.

MS-21 Mossman Arroyo

Site Location:	Mesquite Site 3	GPS Coordinates:	32.17623, -106.657901
Site Type:	Combination	Property Ownership:	State
Access:	Excellent	Security:	Poor
Distance to Nearest Paved Road:	0 miles		

Site Description:

A combination rainfall and stage monitoring station on the Apache Brazito Mesquite Site 3 Dam provides good coverage to the Mossman Arroyo risk center. It is accessible directly from County Road B059 on property owned by the State of New Mexico. Line-of-sight telemetry was unable to be verified through field reconnaissance. There is no adjacent power, making solar power the best option. Security is a concern given that the property is so easily accessible.



Facing east from the proposed site location.

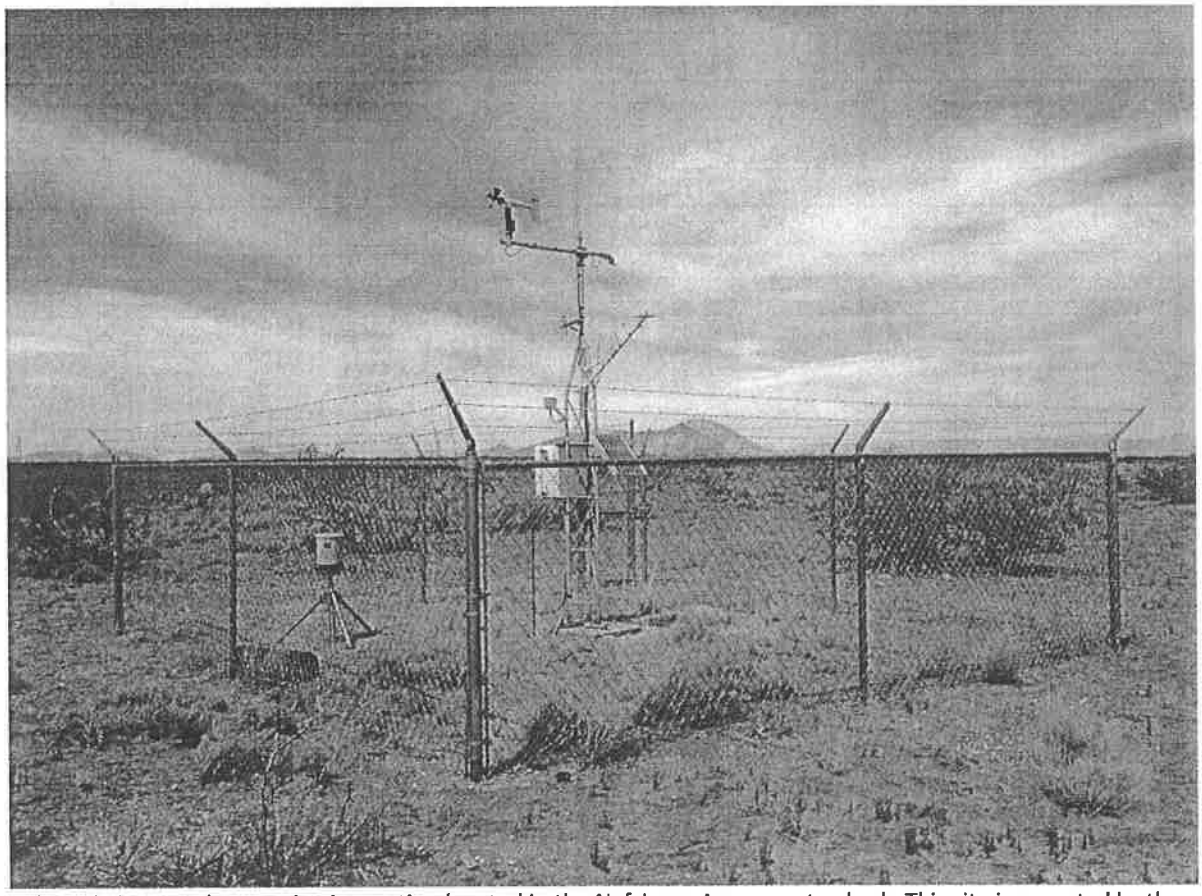
MS-22 Nafzinger Arroyo

Site Location:	Box Canyon Road	GPS Coordinates:	32.307168, -106.90944
Site Type:	Rainfall	Property Ownership:	Municipal
Access:	Good	Security:	Excellent
Distance to Nearest Paved Road:	2.34 miles		

Site Description:

At the urging of DAC Flood Commission staff, AMEC recommends incorporation of the existing weather station, owned by EBID, into the flood warning system for Doña Ana County. This station is located adjacent to Box Canyon Road, north of the Las Cruces Airport, on property owned by the City of Las Cruces. Solar power is used at this site, and line-of-site telemetry must be available, as evidenced by the radio antenna on the station. The site itself represents an ideal setup for other rainfall monitoring stations installed by DAC Flood Commission, with a chain-link fence and barbed wire for extra security.

Given that this location is located north of the area desired to provide good coverage for the Nafzinger Arroyo, AMEC recommends that DAC Flood Commissionconsider adding a second site in the watershed as a future improvement to the system. An ideal location for placement of this additional site would off Box Canyon Road, closer to the airport, south of the old gravel pit. This location would be able to utilize the same line-of-sight telemetry as the existing Placitas Arroyo site.



The existing weather monitoring station located in the Nafzinger Arroyo watershed. This site is operated by the EBID.

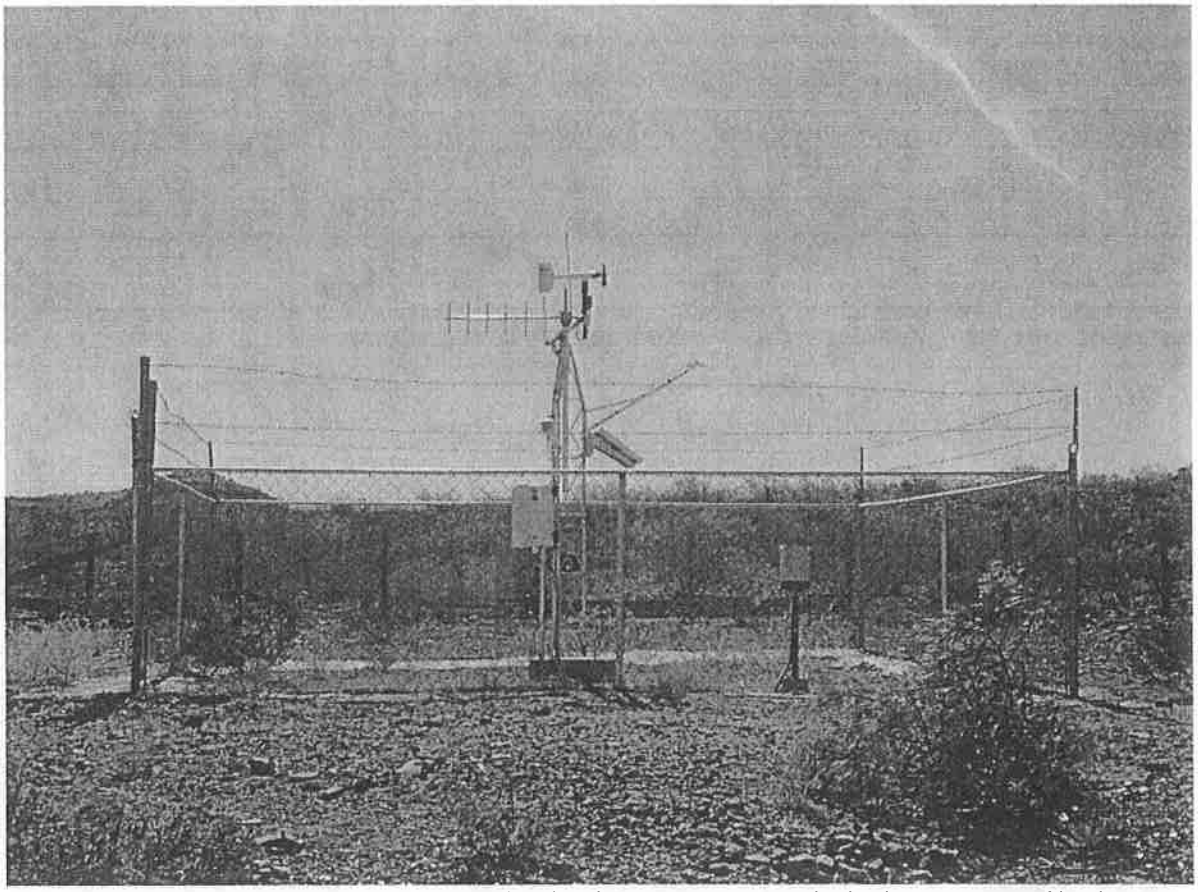
MS-23 Placitas Arroyo

Site Location:	Las Uvas Ranch	GPS Coordinates:	32.583554, -107.239327
Site Type:	Rainfall	Property Ownership:	State
Access:	Good	Security:	Excellent
Distance to Nearest Paved Road:	2.95 miles		

Site Description:

At the urging of DAC Flood Commission staff, AMEC recommends incorporation of the existing weather station, owned by EBID, into the flood warning system for Doña Ana County. This station is located at the end of County Road E002 near the historic location of the Las Uvas Ranch. To access the site, one must pass through the Las Uvas Dairy property. Solar power is used at this site, and line-of-site telemetry must be available, as evidenced by the radio antenna on the station. The site itself represents an idea setup for other rainfall monitoring stations installed by DAC Flood Commission, with a chain-link fence and barbed wire for extra security.

In addition to this site, AMEC recommends that DAC Flood Commission consider adding a second site in the watershed contributing to the Placitas Arroyo. An ideal location for placement of this additional site would be near Souse Springs, at the end of County Road E004. This location has gated access, which would provide a level of security, and would be able to utilize the same line-of-sight telemetry as the existing Placitas Arroyo site.



The existing weather monitoring station located in the Placitas Arroyo watershed. This site is owned by the EBID.

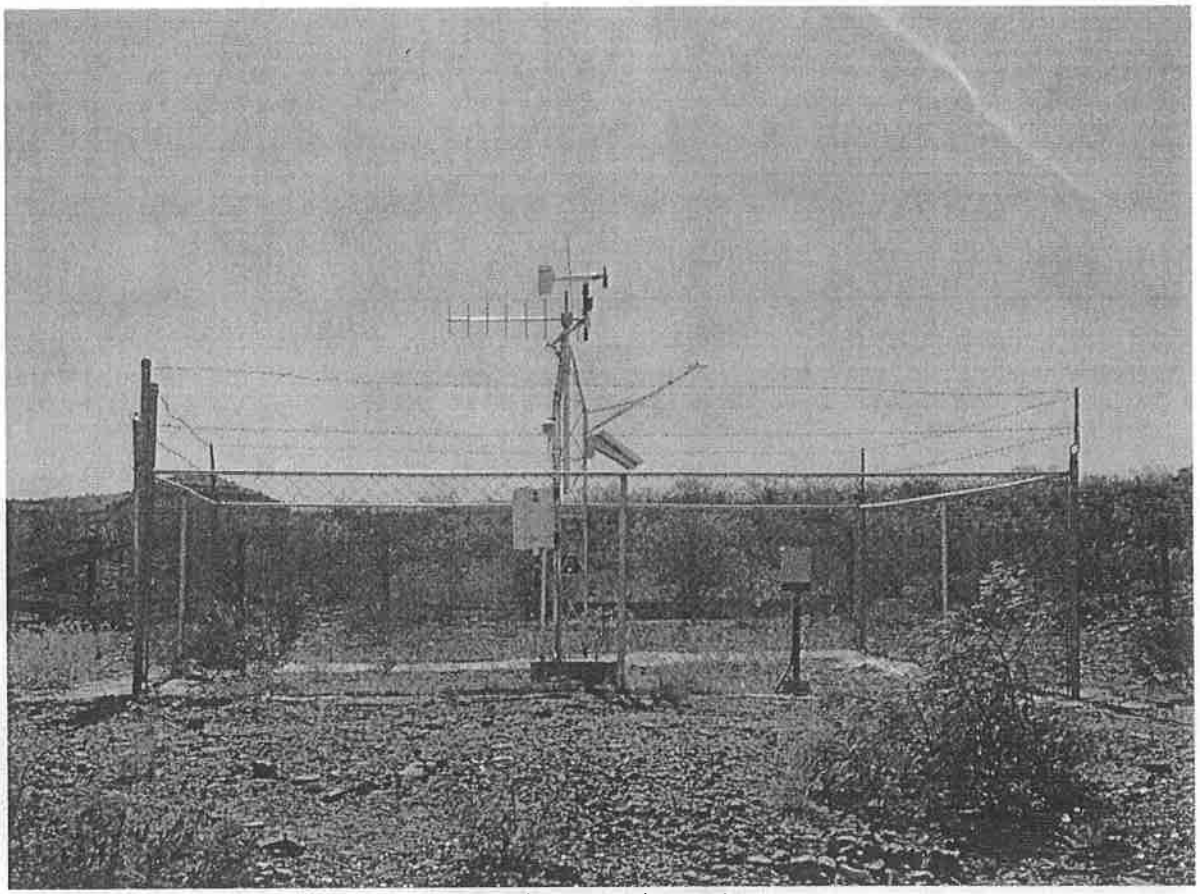
MS-24 Rincon Arroyo

Site Location:	Conniff Cattle Ranch	GPS Coordinates:	32.706044, -107.021314
Site Type:	Rainfall	Property Ownership:	Private
Access:	Poor	Security:	Excellent
Distance to Nearest Paved Road:	4.13 miles		

Site Description:

At the urging of DAC Flood Commission staff, AMEC recommends incorporation of the existing weather station, owned by EBID, into the flood warning system for Doña Ana County. This station is located on property owned by Conniff Cattle Company. To access the site, one must pass down a very rough dirt and sand road. AMEC was unable to reach this site during field reconnaissance. It is assumed that, similar to other EBID weather monitoring stations, solar power is used at this site, and line-of-site telemetry is available.

In addition to this site, AMEC recommends that DAC Flood Commission consider adding a second site in the watershed contributing to the Rincon Arroyo. An ideal location for placement of this additional site would be near the Point of Rocks tank where County Roads E070 and E075 meet.



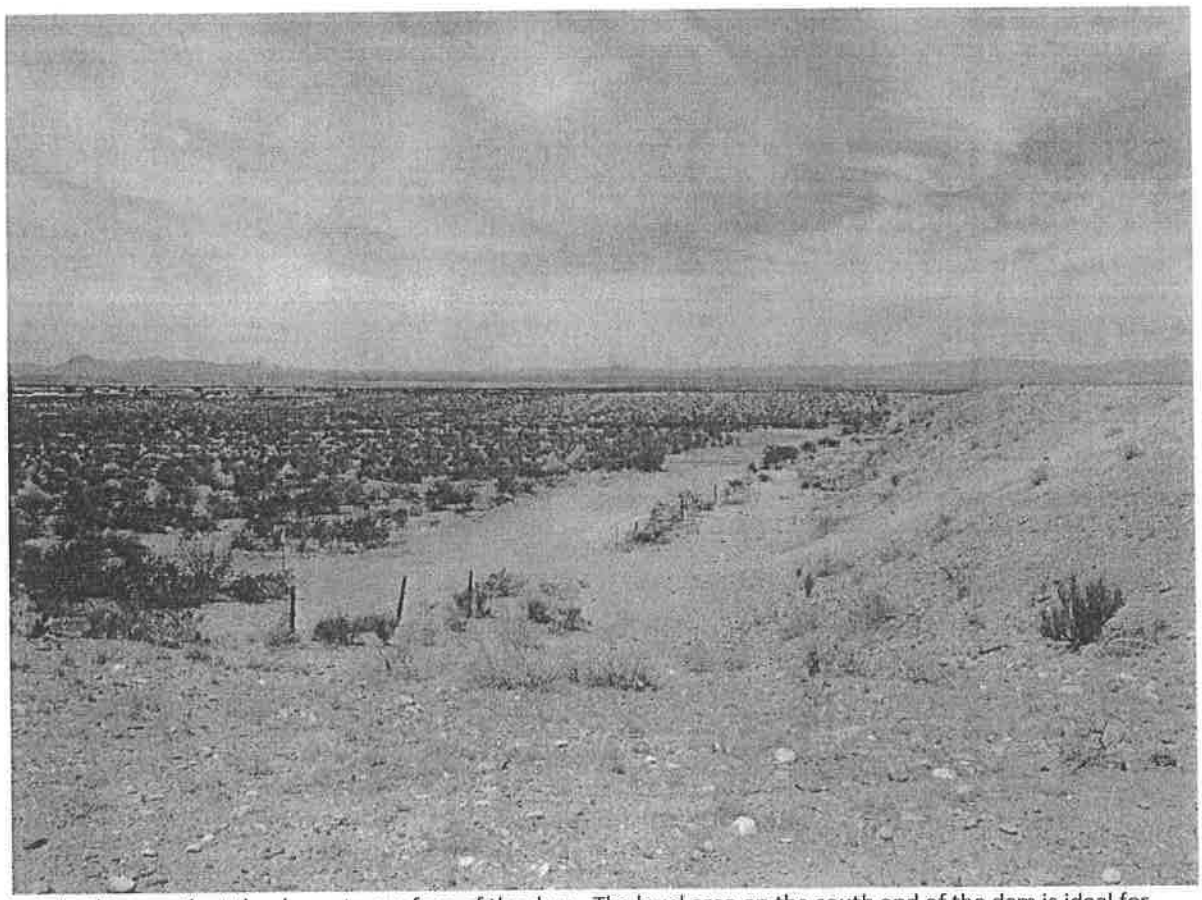
A typical EBID weather station.

MS-25 Salem

Site Location:	Hatch Valley Arroyo Site 2	GPS Coordinates:	32.716915, -107.209136
Site Type:	Combination	Property Ownership:	Federal
Access:	Good	Security:	Poor
Distance to Nearest Paved Road:	0.5 miles		

Site Description:

AMEC proposes a combination rainfall and dam level monitoring station on the Hatch Valley Arroyo Site 2 dam for the purpose of covering the Salem risk center for flood warning. Though it is the larger of two dam sites that protect Salem, the site alone will only provide good coverage. Power is available from nearby Salem, but solar power will likely be the best option. AMEC was unable to verify line-of-site telemetry from field reconnaissance at this location.



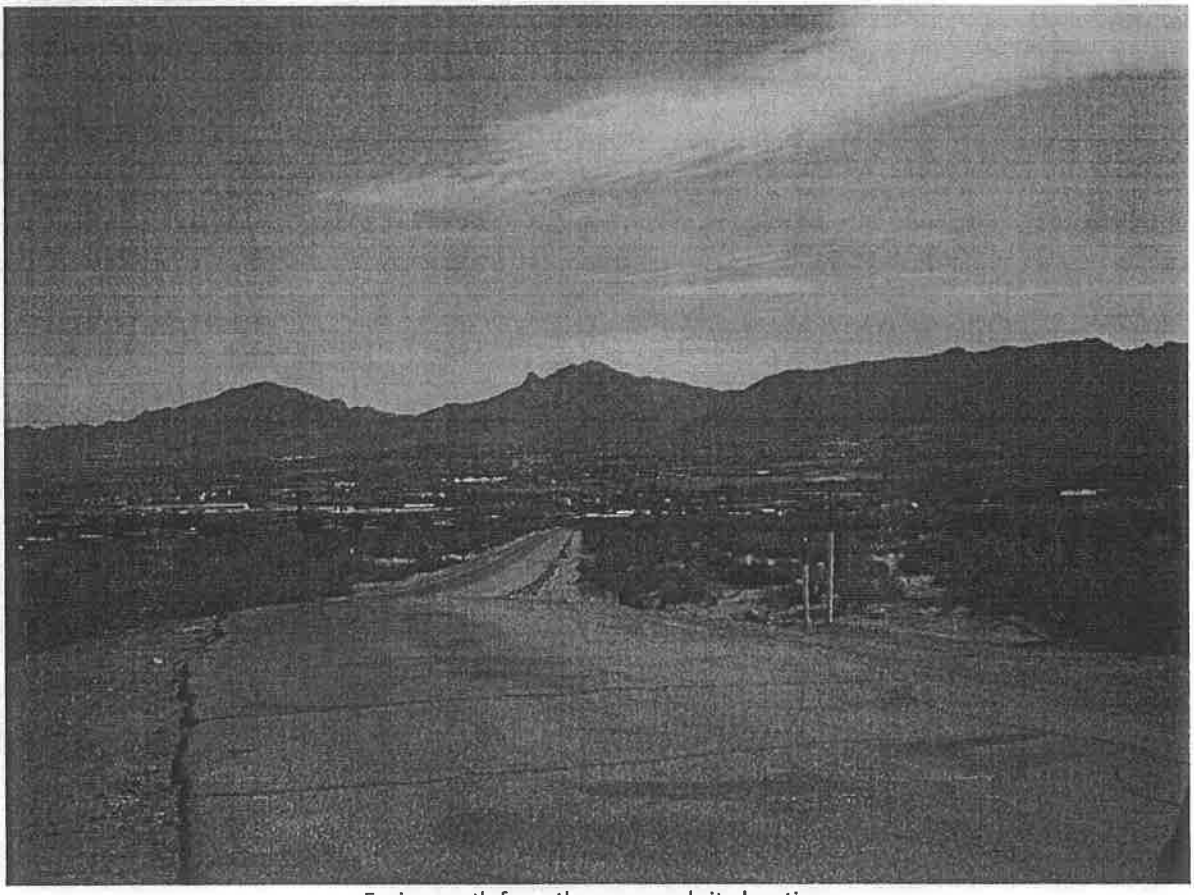
Looking north at the downstream face of the dam. The level area on the south end of the dam is ideal for placement of a rainfall monitoring station.

MS-26 Sunland Park

Site Location:	Anapra Road	GPS Coordinates:	32.784249, -106.568895
Site Type:	Rainfall	Property Ownership:	Private
Access:	Excellent	Security:	Good
Distance to Nearest Paved Road:	0 miles		

Site Description:

The best available location for a rainfall monitoring station near providing at least fair coverage to Sunland Park is along the U.S.-Mexico border near the old border crossing to Rancho Anapra at the end of Anapra Road. There is a small piece of property across the railroad track that is owned by the Union Pacific Railroad Company with adjacent power. The area is well lit at night and is routinely patrolled by border patrol. AMEC was unable to determine line-of-sight telemetry during field reconnaissance.



Facing north from the proposed site location.

MS-27 Tierra Grande

Site Location:	Waterfalls Pond	GPS Coordinates:	32.395068, -106.665472
Site Type:	Combination	Property Ownership:	State
Access:	Excellent	Security:	Good
Distance to Nearest Paved Road:	0 miles		

Site Description:

Waterfalls Regional Detention Pond is a 744-acre-foot pond built in 2009-2010 near the intersection of U.S. Highway 70 and Dunn Drive. The purpose of the project was to alleviate many of the flooding problems that plagued the East Mesa. In addition to providing excellent coverage for the Tierra Grande risk center, having a rainfall monitoring station at this site would provide fair-to-good coverage for the Mesa/Dos Suenos and Homestead risk centers. The entire site is surrounded by a five-foot tall stock fence, which limits vehicle access. Pedestrians can access the site, but given its open location adjacent to the highway, vandalism would only be a concern during nighttime hours. According to DAC parcel data, the property is owned by the State of New Mexico. AMEC was unable to access the site during their field reconnaissance, and thus an exact site location was not determined. DAC Flood Commission personnel servicing this location would need to receive permission from the State of New Mexico to access the site through gate on the north side of the pond, approximate one-quarter of a mile west-southwest of the New Mexico Department of Transportation facility. Line-of-site telemetry should not be an issue, given its proximity to the City of Las Cruces. Power is available via the transmission lines parallel to U.S. 70.

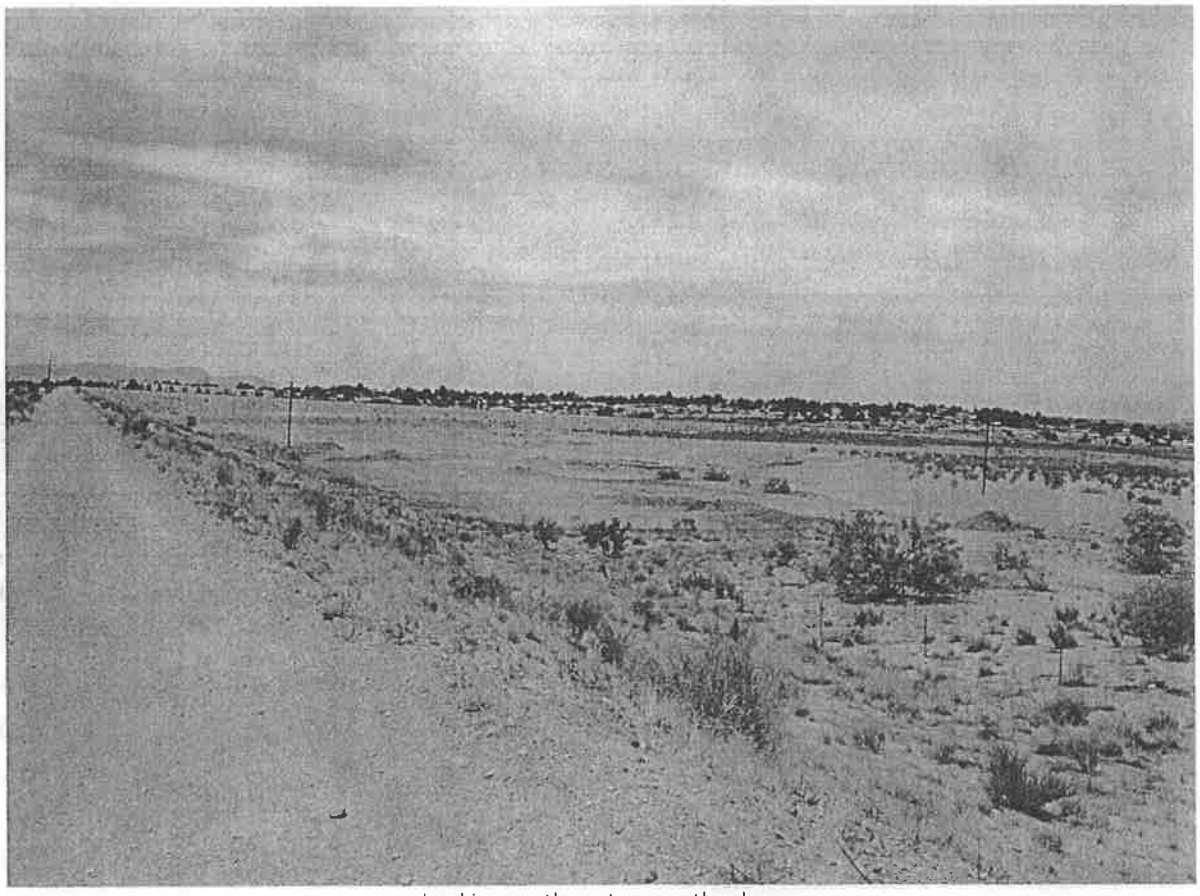
Plan View of the Proposed Monitoring Station at Waterfalls Pond

MS-28 Tortugas Arroyo

Site Location:	Tortugas Site 1 Dam	GPS Coordinates:	32.288711, -106.724503
Site Type:	Combination	Property Ownership:	Private
Access:	Good	Security:	Poor
Distance to Nearest Paved Road:	0.7 miles		

Site Description:

A combination dam level and rainfall monitoring station is proposed on Tortugas Site 1 Dam on the Tortugas Arroyo. DAC parcel data indicates that this site is owned by EBID. This site has excellent line-of-sight telemetry to Tortugas Mountain and power approximate 0.3 miles down the dam. Although the areas is heavily traveled by off-road enthusiasts from the local University, its location in plain sight of the golf course and Geothermal Drive makes it relative safe from vandalism.



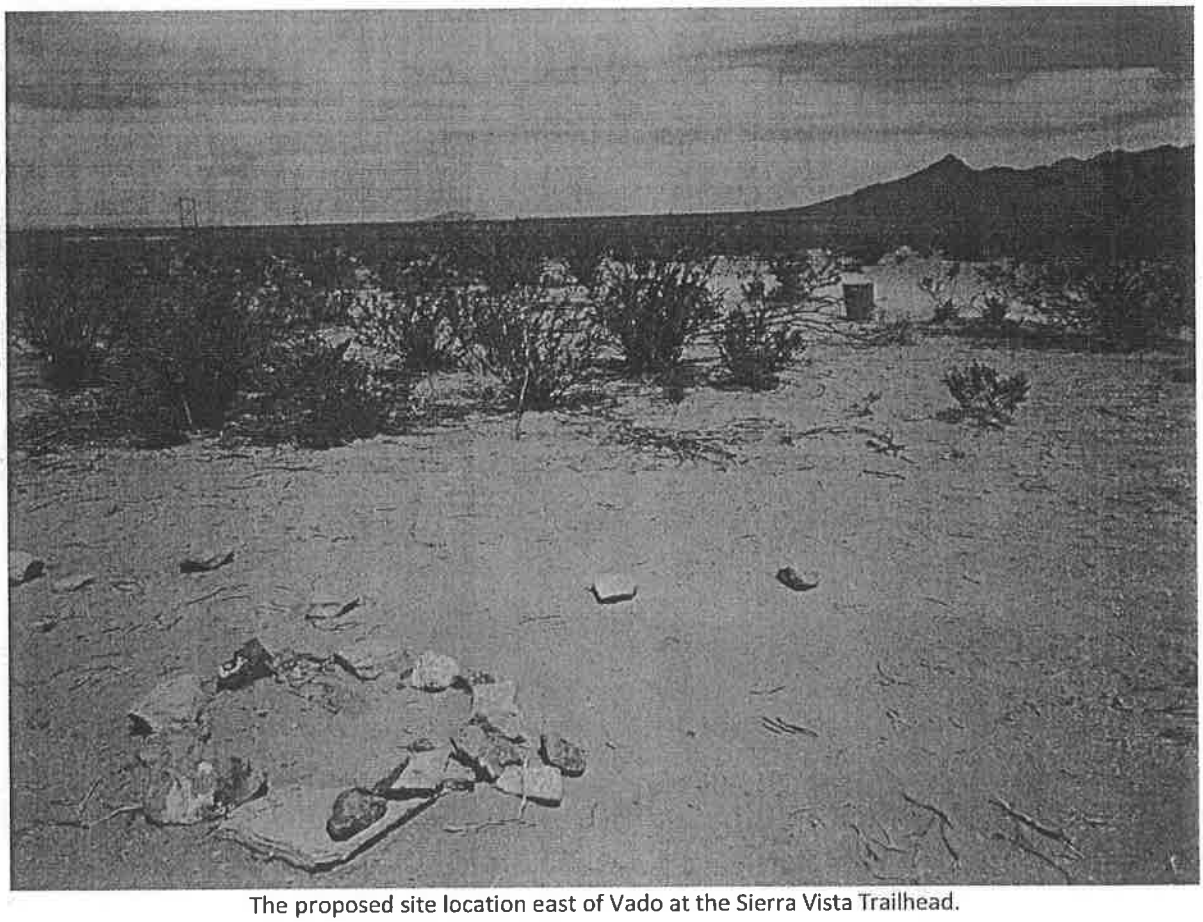
Looking northwest across the dam.

MS-29 Vado

Site Location:	Sierra Vista Trailhead	GPS Coordinates:	32.304254, -106.594604
Site Type:	Rainfall	Property Ownership:	Federal
Access:	Good	Security:	Poor
Distance to Nearest Paved Road:	720 feet		

Site Description:

The target location for a site that would provide coverage for the Vado risk center was open to anywhere close to the middle of the South Vado Arroyo watershed. An easily accessible site location within this area was found at the parking area for the Sierra Vista Trail, just off High Valley Road east of I-25. This location is on BLM land with no security, and thus would require a small fence to protect the site. There are signs at this trailhead that have not been damaged, so vandalism of the site may not be a concern. The nearest power source is transmission lines approximate 480 feet away, making solar power a more feasible option. Line-of-sight telemetry is available via radio antennae on St. Jude and North Franklin Mountains.



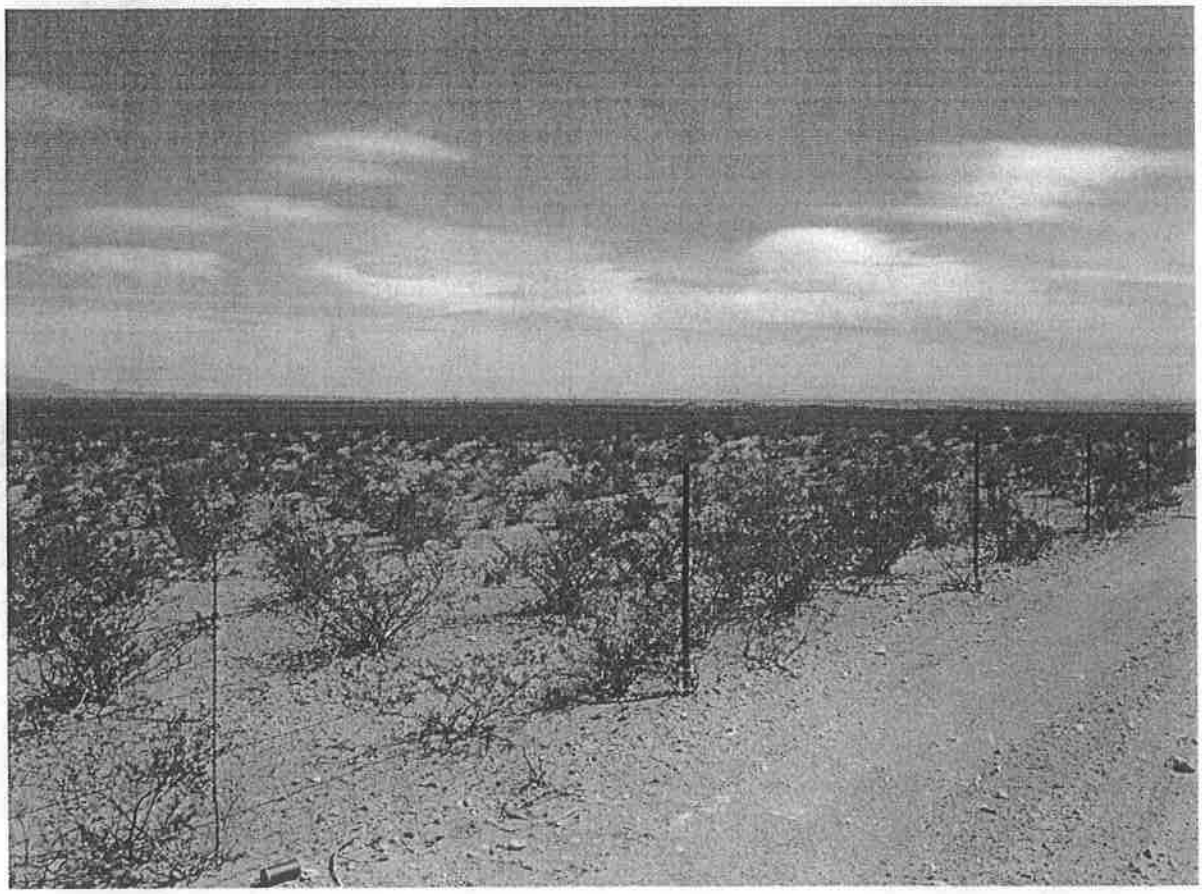
The proposed site location east of Vado at the Sierra Vista Trailhead.

MS-30 West Sagewood

Site Location:	Highway 404	GPS Coordinates:	32.019718, -106.499466
Site Type:	Rainfall	Property Ownership:	Federal
Access:	Excellent	Security:	Good
Distance to Nearest Paved Road:	0 miles		

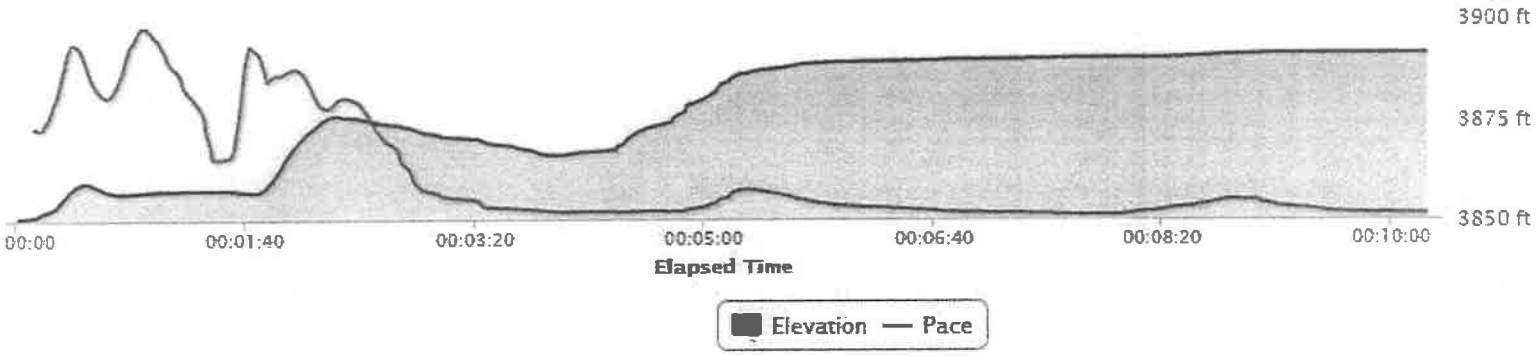
Site Description:

Desired rainfall monitoring station locations in the watershed contributing to the West Sagewood risk center were found to be inaccessible by AMEC staff. The best location available for reconnaissance was along New Mexico Highway 404, approximately 2.4 miles southwest of the traffic circle at Highway 213. Although the land in this area is owned by BLM, there is a utility easement along Highway 404 for gas lines. The ideal location for the monitoring station would be on the opposite side of the fence, adjacent to the easement such that vehicles could not damage the station. The nearest power source is over one-half mile away, making solar power the best option. Although it was not able to be fully verified through field reconnaissance, line-of-sight telemetry looks to be available via the radio antenna at St. Jude Mountain.

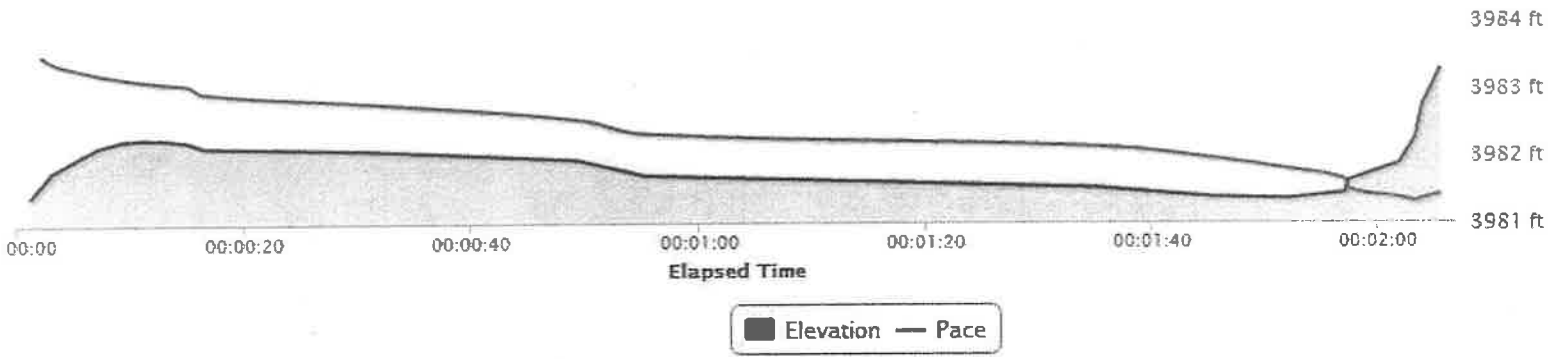


Looking north-northwest along the gas line easement.

Breedlove Arroyo



Mossman Arroyo



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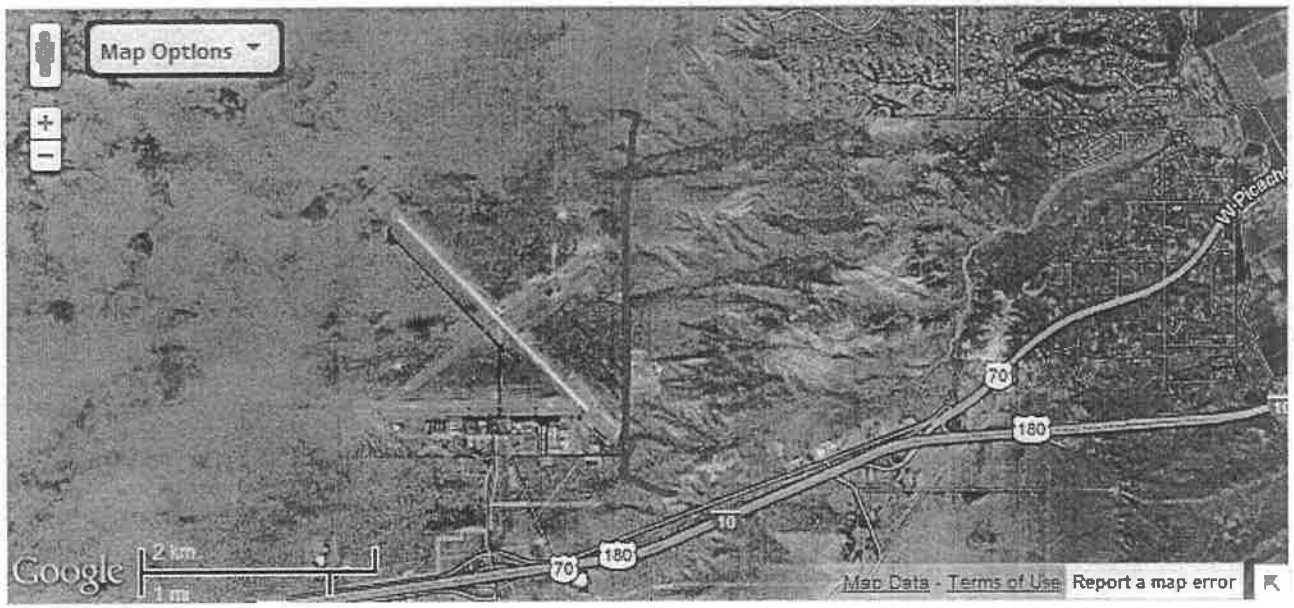
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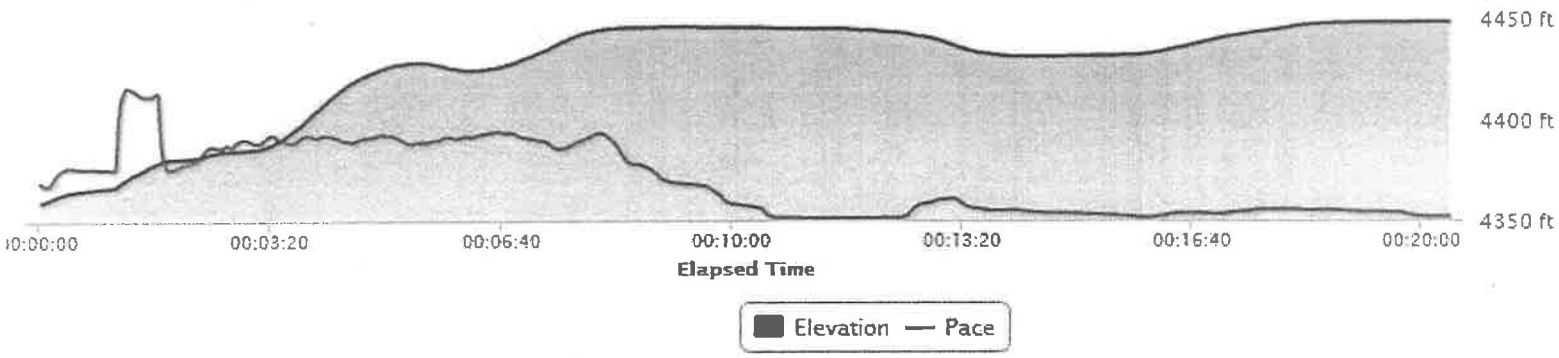
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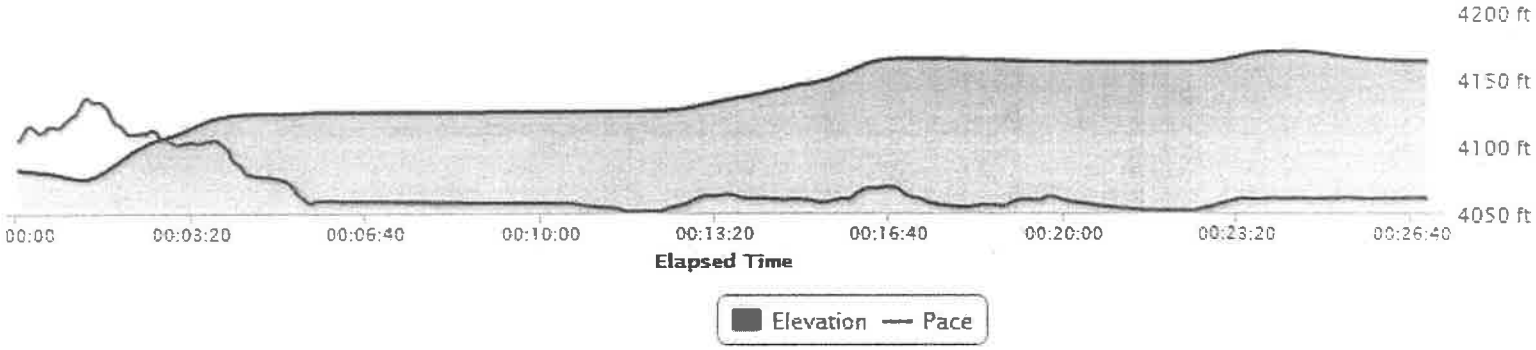
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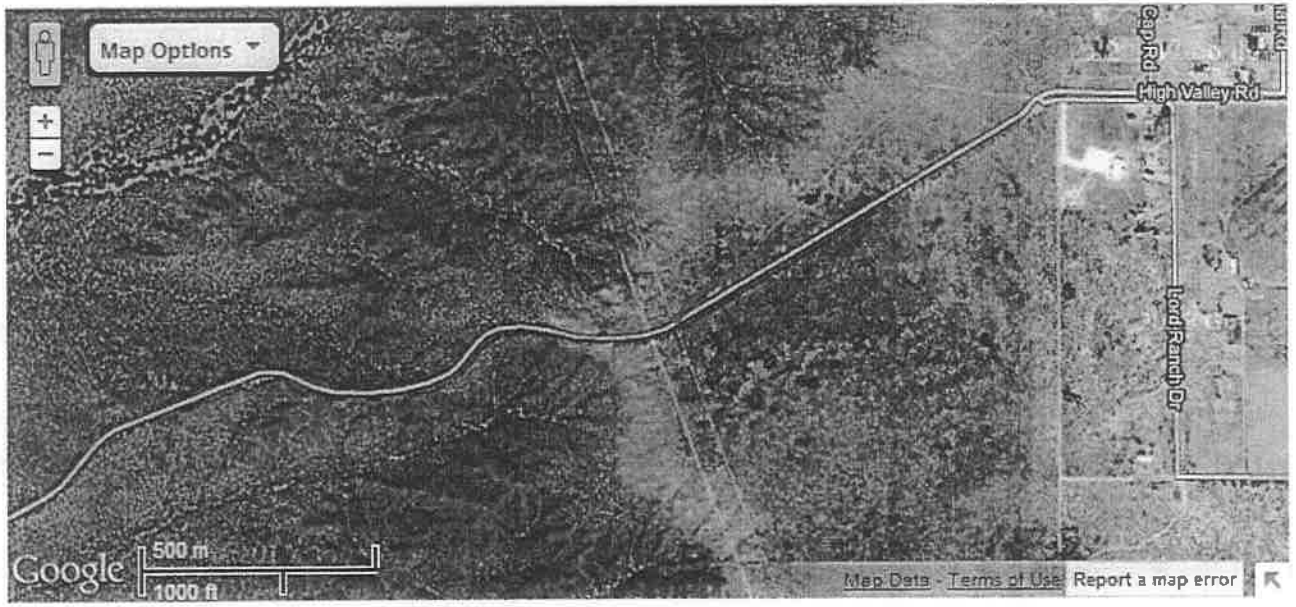
Vado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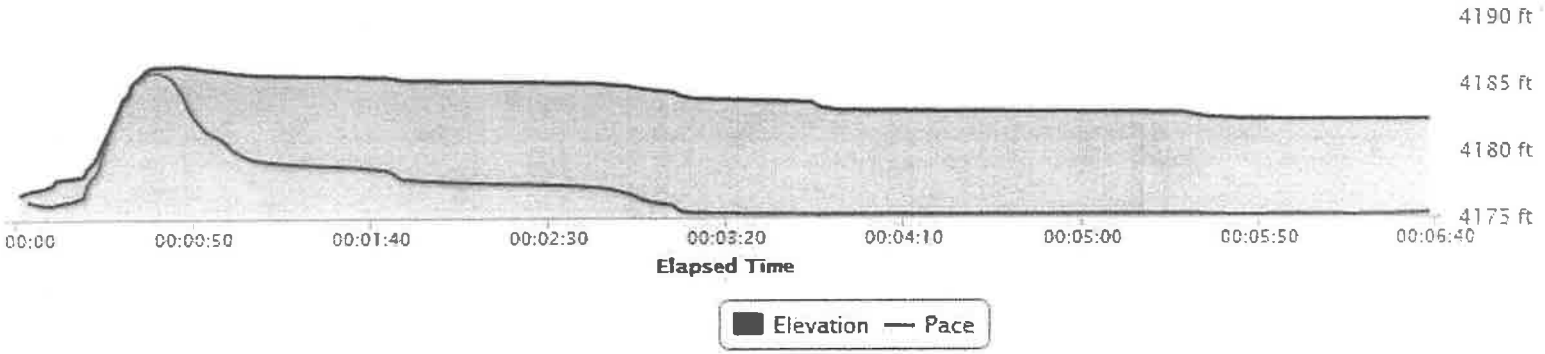
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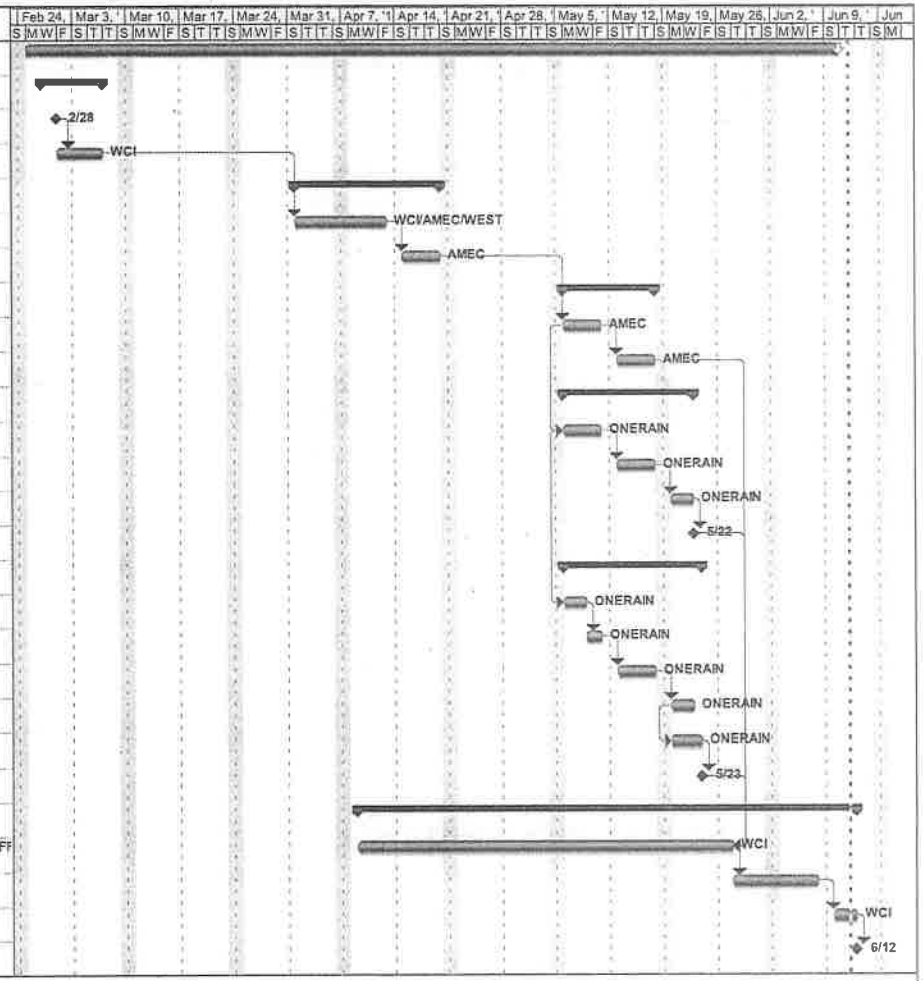
Appendix C

Project Schedule

Project Meeting History

ID	Task Name	Duration	Start	Finish	Predecessors
1	Task Management	76 days	Mon 2/25/13	Mon 6/10/13	
2	**Data Collection/Evaluation**	6 days	Wed 2/27/13	Wed 3/6/13	
3	Kick off Meeting	2 days	Wed 2/27/13	Thu 2/28/13	
4	Develop Information Needs List	4 days	Fri 3/1/13	Wed 3/6/13	3
5	**Identify Flood Threat Recognition Monitoring Locations**	**15 days**	**Mon 4/1/13**	**Fri 4/19/13**	
6	Prioritize Sites	10 days	Mon 4/1/13	Fri 4/12/13	4FS+17 days
7	Contact Property Owners	5 days	Mon 4/15/13	Fri 4/19/13	6
8	**Remote Sensor Station Location Verification**	**10 days**	**Mon 5/6/13**	**Fri 5/17/13**	
9	Site Survey	5 days	Mon 5/6/13	Fri 5/10/13	7FS+10 days
10	Develop Technical Memorandum	5 days	Mon 5/13/13	Fri 5/17/13	9
11	**Remote Sensor Station Design Concept**	**13 days**	**Mon 5/6/13**	**Wed 5/22/13**	
12	Provide Comments for Each Proposed Gauging Location	5 days	Mon 5/6/13	Fri 5/10/13	9SS
13	Provide Typical Sensor/Site/Repeater/Base Installation Drawings	5 days	Mon 5/13/13	Fri 5/17/13	12
14	Provide General Network Map for ALERT2 Network	3 days	Mon 5/20/13	Wed 5/22/13	13
15	Submit Technical Memorandum	0 days	Wed 5/22/13	Wed 5/22/13	14
16	**User Interface**	**14 days**	**Mon 5/6/13**	**Thu 5/23/13**	
17	Collecting Real-time Data	3 days	Mon 5/6/13	Wed 5/8/13	12SS
18	Data Processing	2 days	Thu 5/9/13	Fri 5/10/13	17
19	Outputs (Notifications, Maps, Graphing, etc)	5 days	Mon 5/13/13	Fri 5/17/13	18
20	Historical Analysis Tools	3 days	Mon 5/20/13	Wed 5/22/13	19
21	Maintenance Support Tools	4 days	Mon 5/20/13	Thu 5/23/13	20SS
22	Submit Technical Memorandum	0 days	Thu 5/23/13	Thu 5/23/13	21
23	**Develop Draft Master Plan**	**47 days**	Tue 4/9/13	Wed 6/12/13	
24	Incorporate Team Information Into Master Plan	35 days	Tue 4/9/13	Mon 5/27/13	22FF+2 days,10FF
25	DAC Review	9 days	Tue 5/28/13	Fri 6/7/13	24
26	Revisions	3 days	Mon 6/10/13	Wed 6/12/13	25
27	Submit Flood Warning System Master Plan	0 days	Wed 6/12/13	Wed 6/12/13	26



Project: DAC Schedule
Date: Wed 6/12/13

Task — Progress — Summary — External Tasks — Deadline
Split — Milestone — Project Summary — External Milestone

Page 1

WILSON &COMPANY
4900 Lang Ave NE
Albuquerque, NM 87109
505-348-4000 phone
505-348-4055 fax

June 12, 2013

Doña Ana County

Flood Warning System Meeting History

AGENDA

February 25, 2013

Kick-off Meeting

May 1, 2013

75% Submittal Review Meeting

May 16, 2013

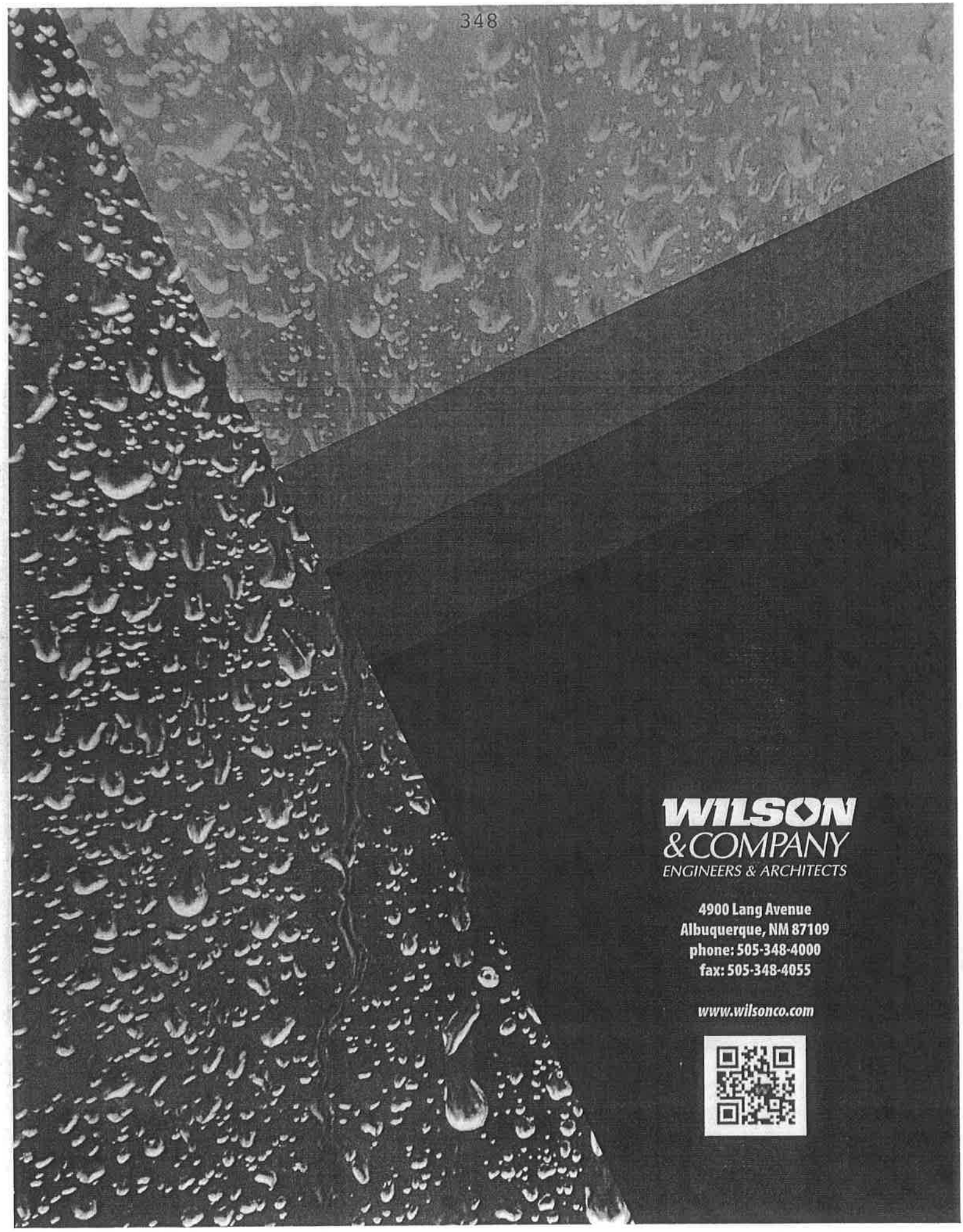
Conference Call to Discuss Site Survey Results

June 10, 2013

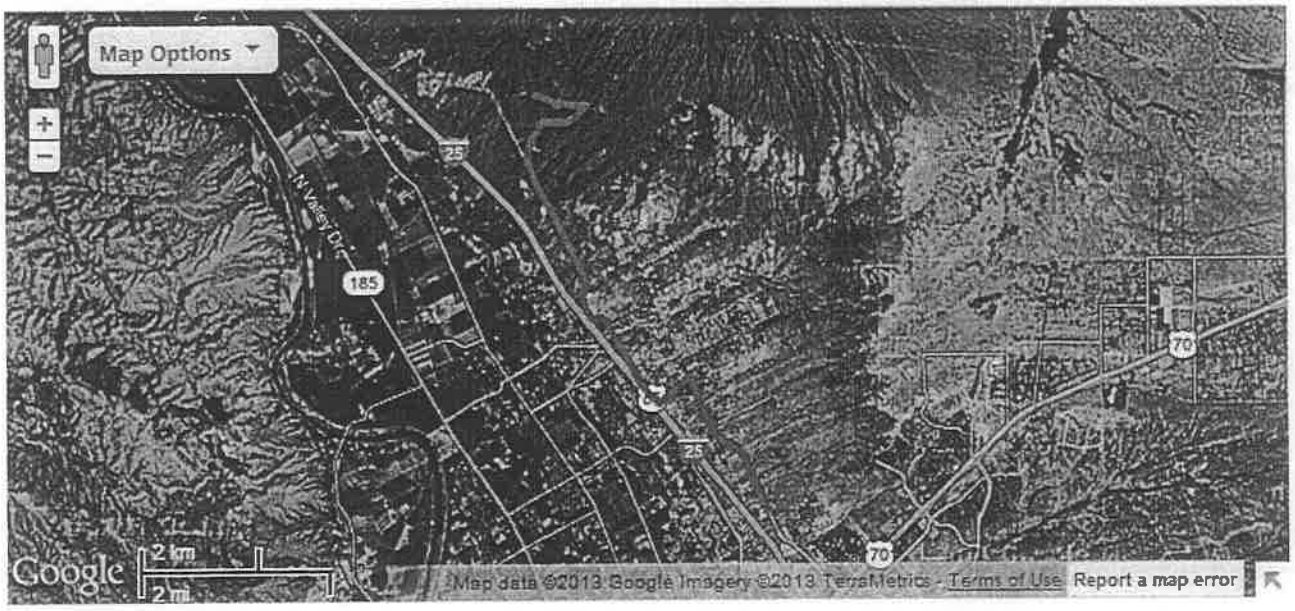
Conference Call to Discuss 95% Submittal Review Comments

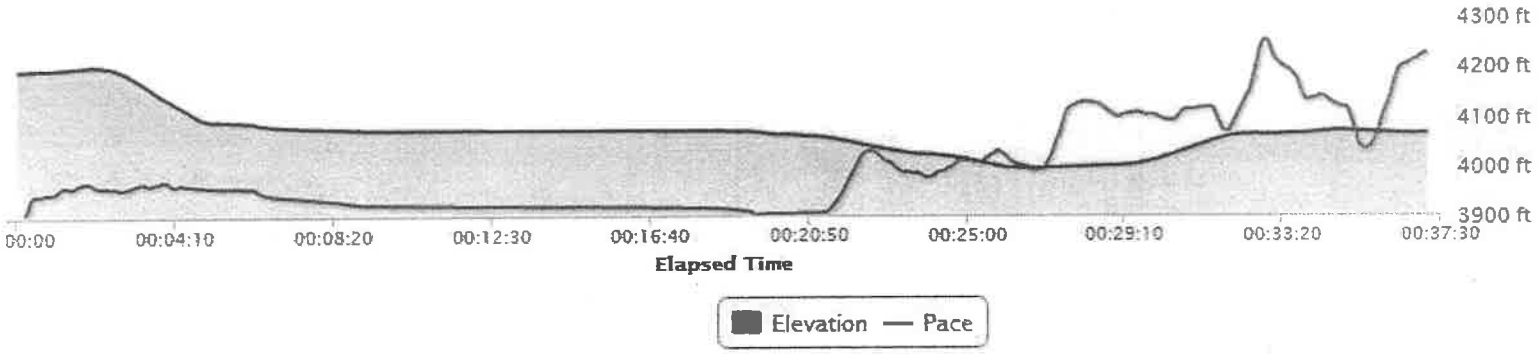
June 27, 2013

Project Close-Out Meeting

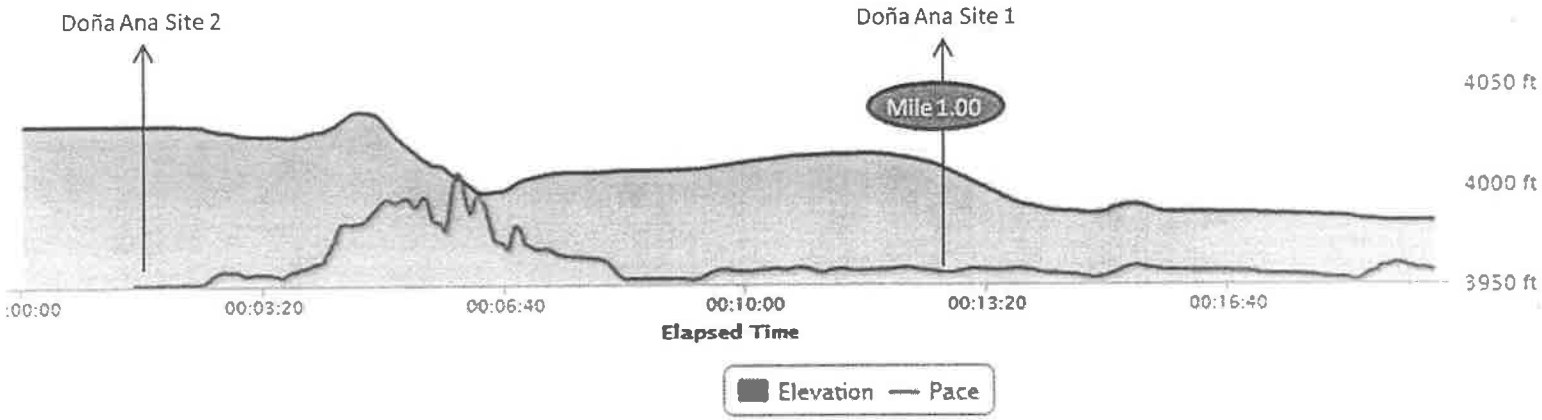


Doña Ana South

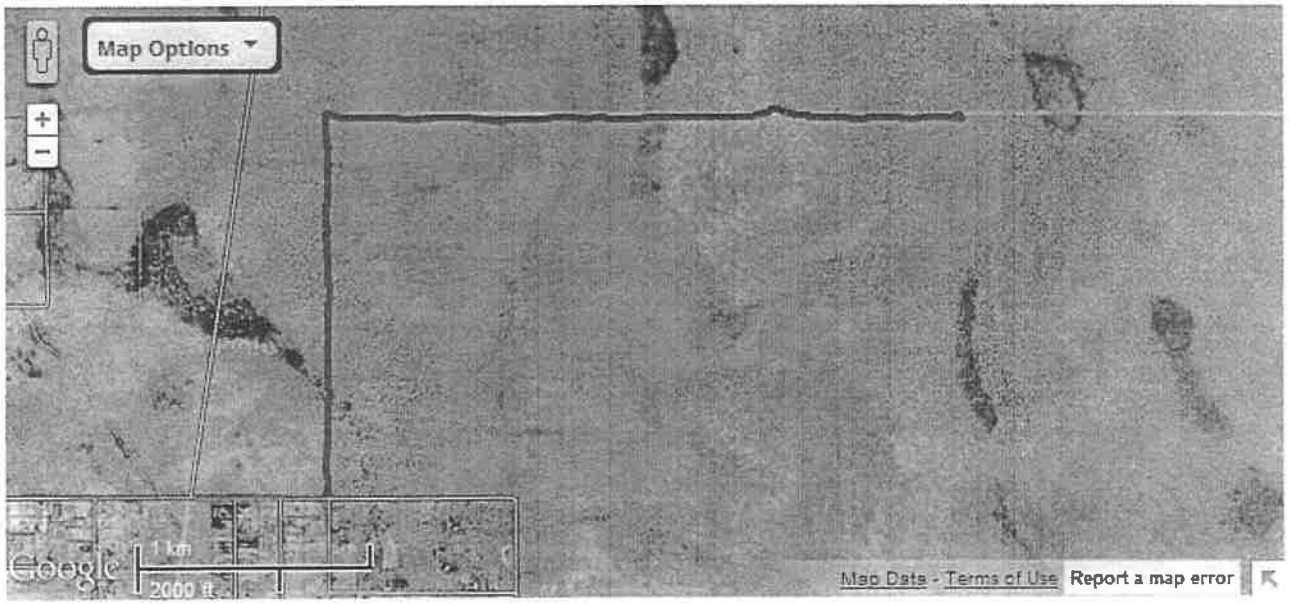




Doña Ana Site 2 and Doña Ana Site 1



East Lisa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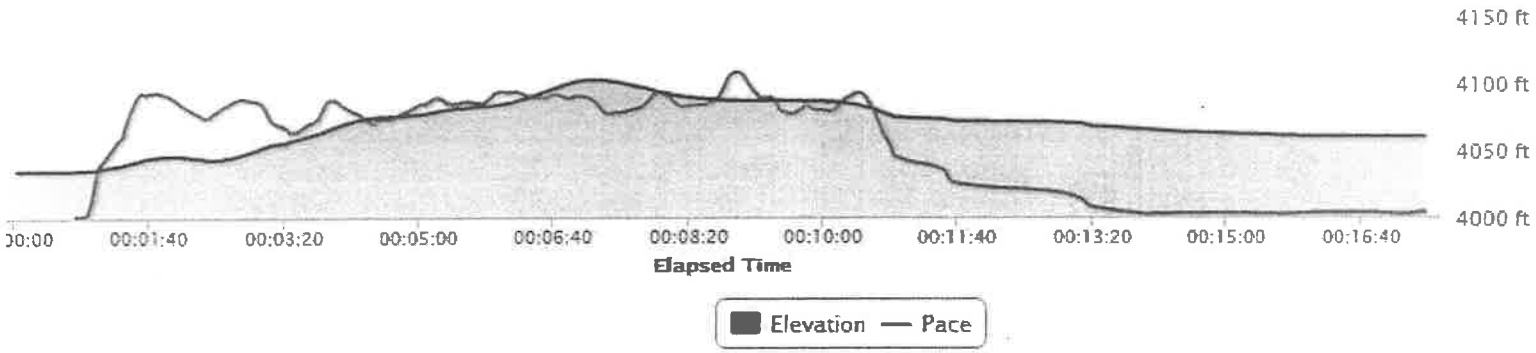
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Hatch


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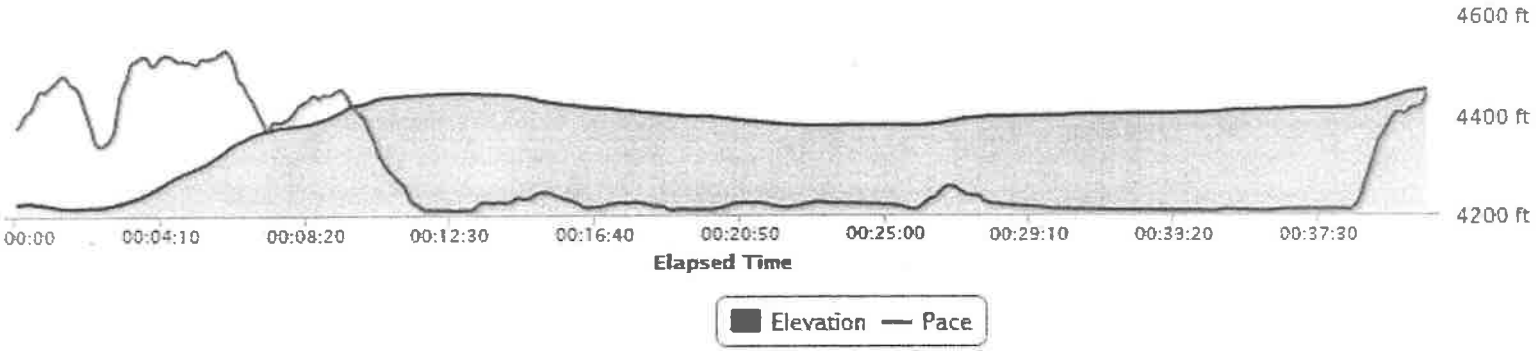
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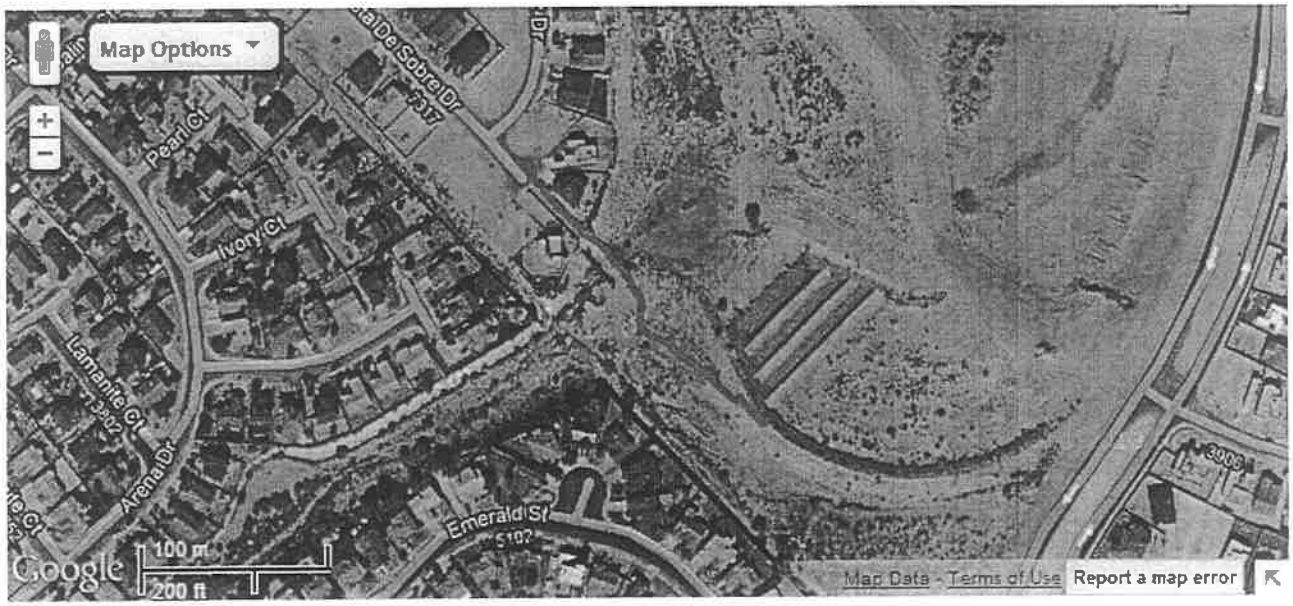
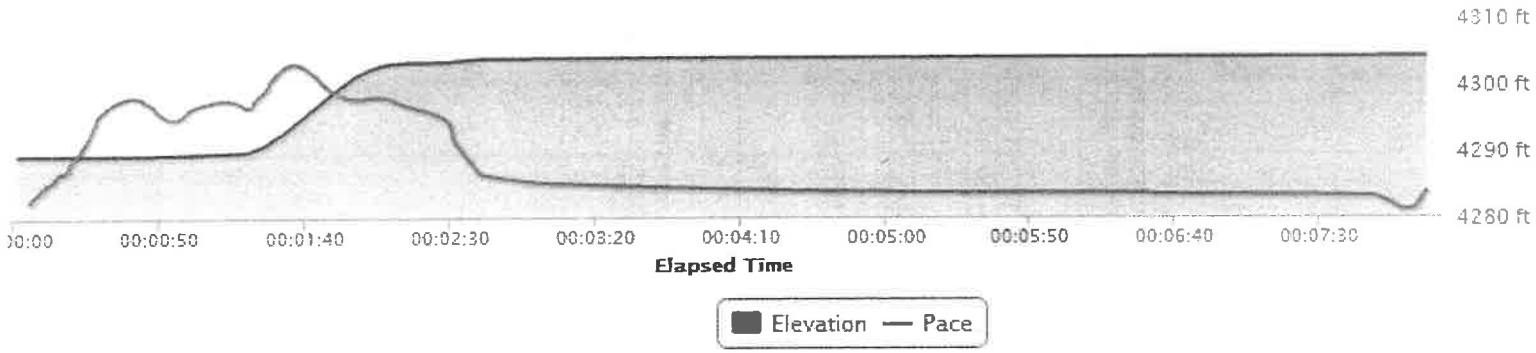
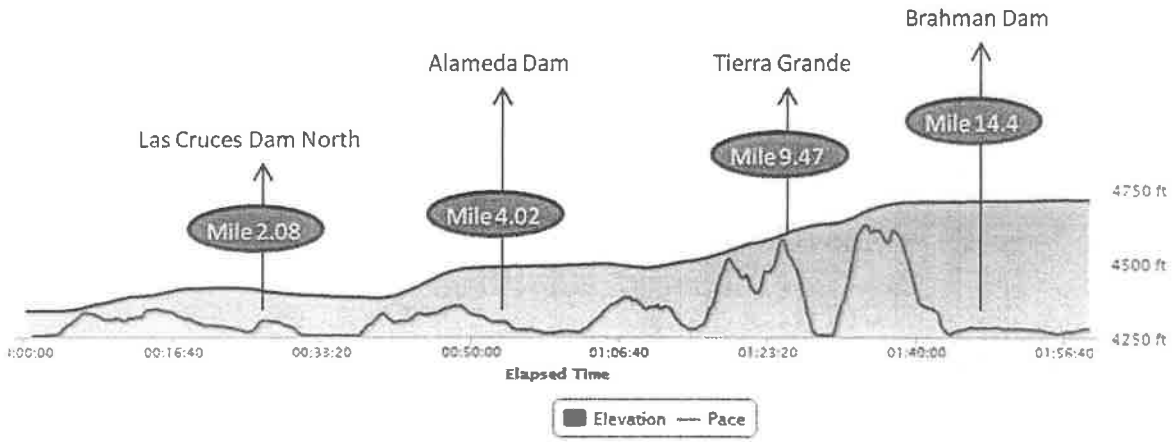
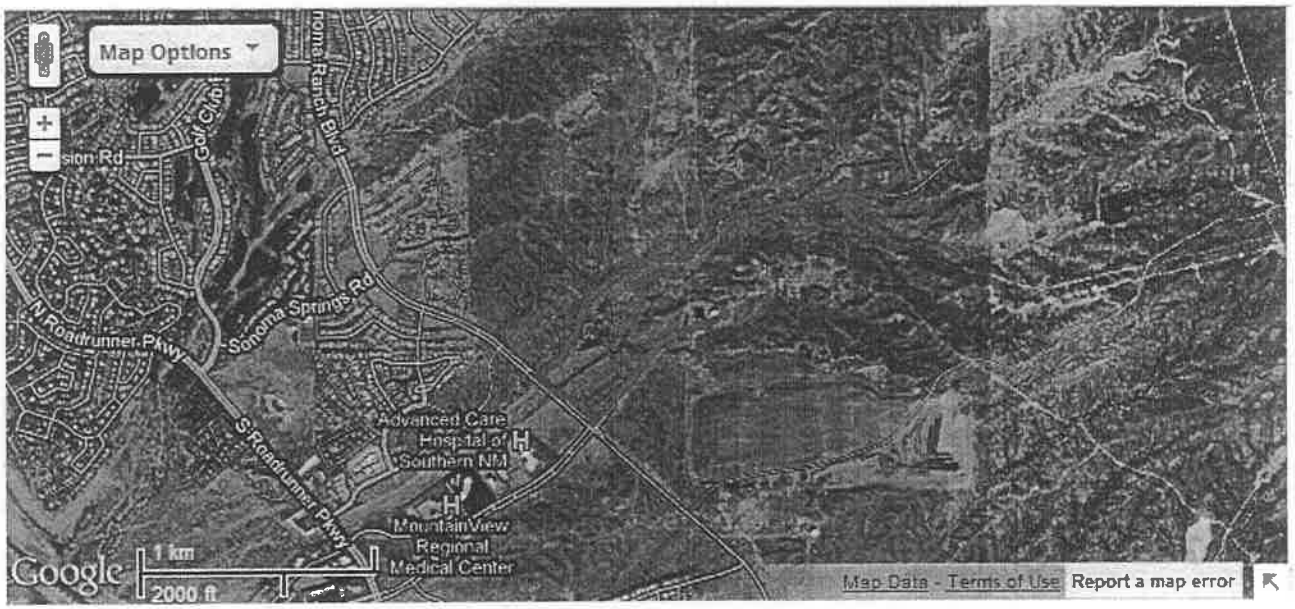


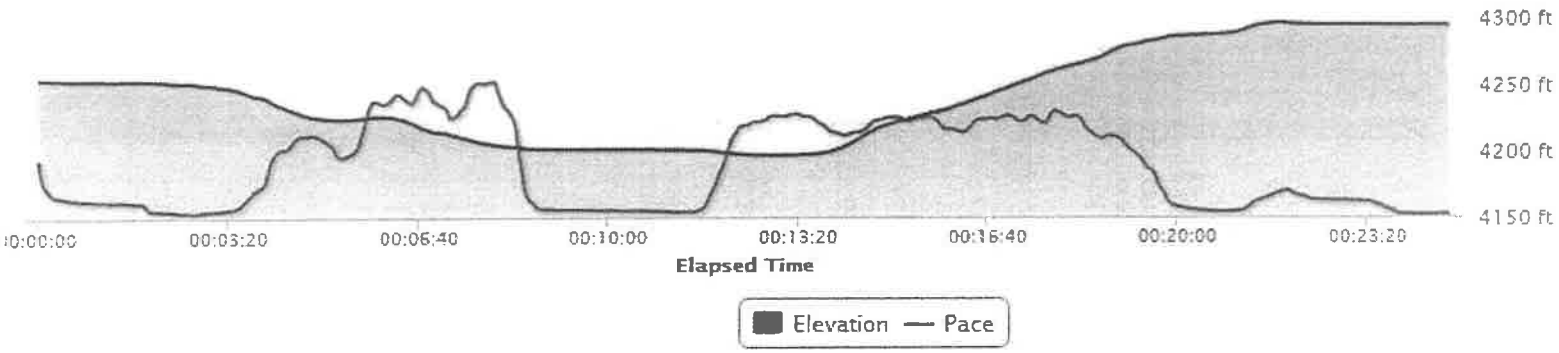


Las Cruces Arroyo North, Alameda Dam, Tierra Grande, and Brahman Dam



Las Cruces Arroyo South





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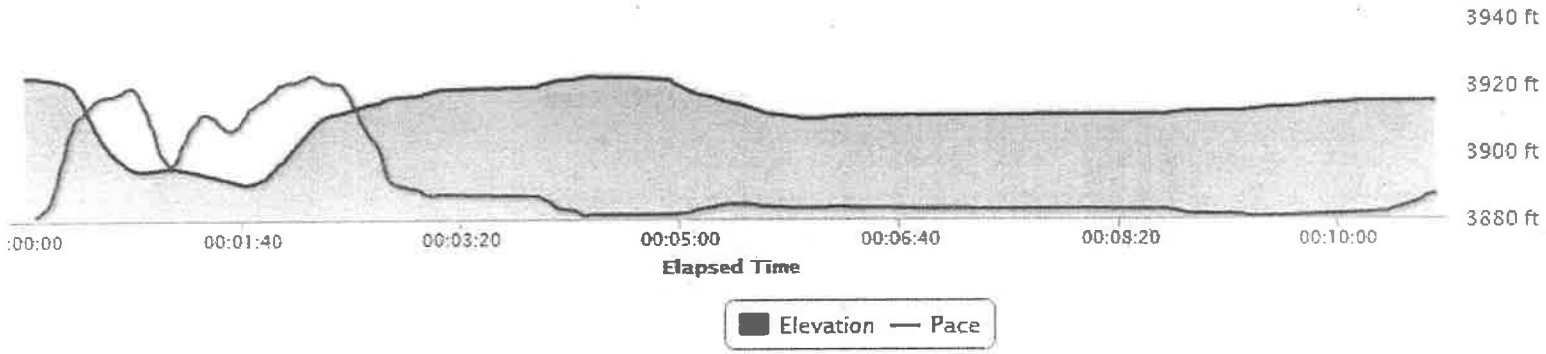

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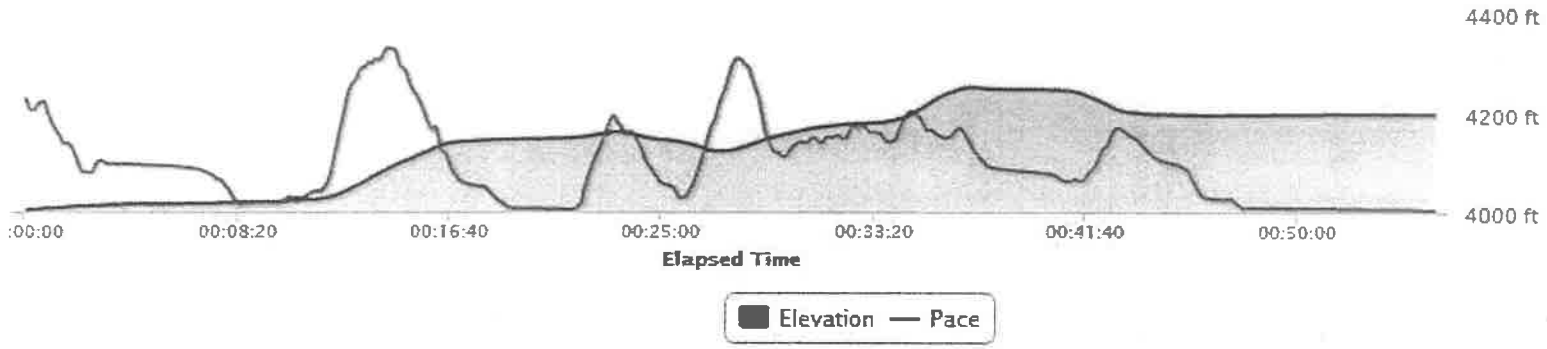

Moreno North