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CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

December 2007

Prepared For:
CITY OF GUADALUPE
918 Obispo Street
Guadalupe, California 93434

Funded by:
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Prepared by:
RM Associates

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Municipality: City of Guadalupe
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TABLE OF CONTENTS

Table of Contents

List of Documentation Contained in the TABS

TAB	Description	No. Pages	Author
	GENERAL INFORMATION		
1	General Location Map	1	----
2	Overview map- Santa Maria watershed	1	RM Associates
3	Land Use and Demographics (Chapter 2)	4	Water Master Plan, May 2002, Wallace & Associates
4	Delineation of Study Area	1	RM Associates
5	Labeling & naming of individual basins with the study area	1	RM Associates
	SOILS INFORMATION		
6	Soil Survey of the northern Santa Barbara County area, with various accompanying maps	34	U.S. Soil Conservation Service
	GROUND WATER		
7	Maps of groundwater Basins in Santa Barbara County	2	
8	Santa Maria River Valley Groundwater Basin	7	California's Groundwater Bulletin No. 118
9	Santa Maria Groundwater Basin – recent litigation	16	SBCWA
10	Natural Resources in the Santa Maria Valley	21	Santa Barbara County Grand Jury
11	Response to Grand Jury Report	5	Santa Maria Valley Water Conservation District
12	Santa Barbara County Groundwater Report	20	Santa Barbara County Public Works Department
	SANTA MARIA RIVER		
13	Santa Maria River Estuary, Enhancement and Management Plan, FINAL	19	Science Applications International Corporation
14	Thesis on Santa Maria Project	8	U.S. Bureau of Reclamation
15	Municipal Service Review of the Santa Maria Valley Water Conservation District	7	Santa Barbara County LAFCO
	SANTA MARIA RIVER LEVEE		
16	Zaca Fire Watershed Issues Project Reporting September 28, 2007 (Power Point presentation)	15	Santa Barbara Country Flood Control District
17	Excerpt of FEMA Map, City of Guadalupe, excerpt USGS topographic map showing contour elevations	2	FEMA/USGS
18	Santa Maria levee is topic of City T.V.	1	Santa Maria News

	show		
18	U.S. Corps of Engineers Los Angeles District Cover Story Santa Maria Levee	2	U.S. Corps of Engineers
18	Article: "Levee fund opions are drying out", undated	1	Santa Maria Times
18	Article: "Levee woes – little protection between thousand of homes and the Santa Maria River", dated 4/13/2006	4	Santa Maria Sun
18	Article: "Santa Maria River Levee", dated December 28, 2007 with proposed changes to FEMA map which will require Santa Maria citizens to purchase flood insurance.	3	City of Santa Maria
18	Article: "Preparing for the storm", dated January 16, 2008	2	Santa Maria Sun
18	Efforts to Address Your Concerns about the Santa Maria Levee	1	City of Santa Maria
19	Advanced Measures Report Based On Technical Assistance Investigation	52	U.S. Corps of Engineers
	HYDRAULIC ENGINEERING/ HYDRA SOFTWARE RUNS		
20	Standard Conditions of Project Plan Approval (drainage)	5	Santa Barbara County Flood Control
21	HYDRA Run – wetlands area		RM Associates
22	HYDRA Run 1: side ditch conveyance canal down Main St. (SR-166)		RM Associates
23	HYDRA Run 2: side ditch conveyance canal down Main St. (SR-166)		RM Associates
24	HYDRA Run: system at Eleventh St. outfall		RM Associates
25	HYDRA Run: system at P.S.D. and Bonita sub-division		RM Associates
26	HYDRA Run: Peralta & 11th St (possible future development)		RM Associates
27	HYDRA Run: Obispo Street, outfall at wetlands		RM Associates
28	HYDRA Run: railroad corridor area to the east of Guadalupe St.		RM Associates
29	HYDRA Run: D.J. Farms (preliminary only)		RM Associates

Section 1 Executive Summary

RM Associates has conducted a study to comprehensively plan for current and future storm drain requirements and flood protection for the City of Guadalupe. This executive summary presents an overview and conclusions that are contained with the City of Guadalupe's Storm Drainage Master Plan (SDMP).

1.1 Overview of the watershed area

The City of Guadalupe is located in the Santa Maria watershed which is about 468,000 acres (731 square miles) in size. The major river tributaries which create runoff are the Sisquic and the Cuyama. Both drain into the Santa Maria River which in turn ultimately outfalls to the Pacific Ocean just to the west of the City. Discharges from Twitchell Dam also influence flows down the Santa Maria River.

1.2 Master Plan Watershed Study Area

The watershed study area identifies only that portion of the larger watershed which has the potential to directly impact the City's storm drain system. This study area encompasses about 4,600 acres (7.2 square miles) and was determined to be the agricultural area just to the east and south of Guadalupe. This area is roughly bounded by the Santa Maria River to the north, Bonita School Road to the east, Brown Road to the south, and the City limits to the west. The study area was further distinguished as either being "off-site" or "on-site" drainage basins, the difference being that the City is mostly responsible for addressing its own "on-site" drainage. Therefore the on-site drainage area can be defined as the area within the City limits itself, or about 1.4 square miles. The D.J. Farms development will add another 350 acres (0.5 square miles), or 2.0 square miles total to the "on-site" category. The off-site watershed would be everything else, or about 5.2 square miles. Offsite basins were further subdivided into twelve distinct sub-basins and were labeled Basins I through Basin XII., while the on-site City basins were delineated into 18 different parts of town.

1.3 Planning Criteria

The development of a Storm Drain Master Plan involves an engineering assessment of a number of variables, all of which have the ability to affect the amount of runoff that a city system would have to deal with. On the watershed itself, the two primary variables to consider are land usage and the soil types. Here the predominate "off-site" land use is agricultural (72%), while within the city limits, the typical land uses (residential, commercial, etc) apply. The predominate soils type was determined to be "well-drained" or "somewhat well-drained", or in other words mostly sandy soil conditions.

The primary hydraulic variable which effects storm water runoff is storm intensity. Hydrologist classify storms statistically and call them a 2-year to a 100-year storm event (range), with a 100 year storm being the most severe. This study used a 10-year event to study smaller systems (residential), a 25 year storm event to evaluate the performance of major infrastructure, and a 100 year event to evaluate storm water storage (detention ponds).

Floodway and floodplain requirements are another important aspect of a SDMP study. This involves a review of FEMA's flood maps, which are a part of its National Flood Insurance Program (FIRM). For Guadalupe, this involves an assessment of the threat of flooding from the Santa Maria River, and of course the status of the river levee. Strictly speaking, an engineering assessment of the Santa Maria River basin is outside the scope of a city SDMP, per say. However, a review of this issue is critical because of the serious potential for flooding from this source. At some point, it should be addressed and made a part of a City policy concerning the levee.

1.4 Storm Drain Infrastructure Analysis

The technical engineering assessment of the study area involved the development of a hydraulic storm drain model. The study used a software program called "HYDRA". The software models and designs urban drainage systems. It allows the analyst to model the system and therefore get an indication of the system's performance. This model was prepared and an assessment of the performance of the existing infrastructure was done. Several "what-if" scenarios were also run to scope and size various proposed improvements.

1.5 Recommended Capital Improvement Projects

Based on the above engineering study, the following recommendations were developed:

Priority One is for the City to make sure that the existing development inside the Santa Maria River flood plain (i.e. all property located in FEMA Flood Map, Zone "A") is adequately protected from high flows down the Santa Maria River during a major storm event. Most notably, this would include the City of Guadalupe Wastewater Treatment Plant facilities. Should these facilities be inundated, the entire City water and sewer system could be threatened. At the present, the Corp of Engineer levee stops at the SR-1 Bridge. Other properties "at-risk" include the Boys/Girls club, LeRoy Park, and its immediate area. Additional improvement work should be considered to protect these low lying properties.

Priority Two involves the City wetlands. Currently this environmentally sensitive area is conveying agricultural and urban runoff through it. Additional infrastructure should be considered to route storm drainage around the property. This would solve the pollution problem and help restore the water to a more pristine condition.

Priority Three addresses the side ditch along SR-166 (Main Street) from Simas Street all the way to Jack O'Connell Park to the west. This channel is conveying mostly off-site drainage coming from the uphill watersheds to the east. The City is actually contributing very little to this flow, but is incurring the flooding that is occurring at the driveway into the Waste water treatment plant (Jack O'Connell Park).

Priority Four Capital Improvement projects is a list of other minor and routine work. The study came up with a list of ten potential improvement projects. These improvements all involve the construction of additional drain inlets and in some locations additional piping. These projects will eliminate spot flooding now occurring at various locations throughout the city.

1.6 Project Budgets

The Engineer's opinion of probable cost for each proposed capital improvement project is as outlined below:

PROPOSED CAPITAL IMPROVEMENT PROJECT:	**AMOUNT**
PRIORITY ONE PROJECTS	
Santa Maria River flood control improvements (levee/berm)	to be determined
PRIORITY TWO PROJECTS	
1) Wetlands	1,488,750
PRIORITY THREE PROJECTS	
1) Main Street No. 1	
2) Main Street No. 2	
3) Detention Basin	879,000
PRIORITY FOUR PROJECTS	
1) 10th & Pioneer	
2) 11th & Obispo St	
3) 11th & Peralta	
4) Guadalupe & 8th	
5) Guadalupe & 6th	
6) Guadalupe St. between 2nd and 5th Street	
7) Tognazzini, Campodonico, & Guadalupe	
8) Obispo St. & Wetlands	
9) 9th St beteen Olivera & Pacheco	
10) 4th & Obispo	635,250
TOTAL SUM OF ESTIMATES[1]:	**$3,003,000**

[1]All the above figures are not necessarily additive. Some improvements are alternatives to each other. Additional engineering is required to select the best choice of improvement combinations.

Section 2

Introduction

2.1 Background

The City of Guadalupe applied to the State of California, Department of Housing and Community Development, State CDBG Program, for a Planning and Technical Assistance Grant (PT/A) for the development of the City's first Storm Drain Master Plan (SDMP).

This study will first identify the City's existing storm drain infrastructure system. It will also identify the extent of surrounding watershed area which drains into the existing system. The SDMP will then identify deficiencies and develop improvements that will accommodate both existing demands as well as future demands in order for the overall system to function according to established standards.

The Master Plan will also assist in securing future grant funds for construction projects to cover the costs of addressing drainage/flooding problems throughout the City. The final product will be a Drainage Master Plan that will identify drainage system problems and provide solutions and a plan to meet the ultimate needs of the city's residents.

2.1.1 City of Guadalupe Storm Drainage System

The City of Guadalupe owns and operates a municipal storm drainage system for the residents and businesses within its service area. To adequately plan for storm drainage facilities for existing and future users, the City requested that RM Associates (RMA) prepare a Storm Drain Master Study. This report presents the City of Guadalupe's Storm Drainage Master Plan (SDMP).

2.2 Scope of Services

To prepare the Storm Drainage Master Plan, the following tasks were completed.

- Task 1 - Project Management/Coordination and PDT Meeting
- Task 2 - Develop Planning Criteria
- Task 3 – Report/Analysis of Existing Data.
- Task 4 - Identify existing storm drain systems, drainage plans and subdivision plans, development plans and FEMA maps.

- Task 5 - Identify tributary watershed areas
- Task 7 - Storm Drainage System Design and Analysis
- Task 8 - Recommend Capital Improvement Program
- Task 9 - Final Report and Presentations

2.3 Study Area

The City of Guadalupe is located in the northwestern boundaries of Santa Barbara County and is directly south of the Santa Maria River. Guadalupe was incorporated as a City on May 19, 1946 and derives its name from the Arabic words "valley" and "river." Guadalupe is the oldest of the three towns in the Santa Maria Valley. The current Guadalupe population is about 6,500 as compared to Santa Maria's 80,000 and its neighbor Orcutt which has a population of 35,000.

TAB-1 contains a general location map.

TAB-2 contains an overview map of the Santa Maria Watershed. The Santa Maria River begins within the mountains to the east and ends with runoff draining into the Pacific Ocean. The distance from the Pacific Ocean to the north boundaries of Santa Maria is approximately 12 miles long. With the river sitting at a close distance from two Cities, a levee system was developed in 1959 for flood prevention. The Santa Maria levee system was under major construction between the years 1959-1963 by the U.S. Army Corps of Engineers. It is composed of 26 miles of compacted sand with a rock slope protection system. The levee is connected from Santa Maria and travels west to the City of Guadalupe and crosses both the Southern Pacific Railroad and Highway 1. The Santa Maria River levee system is now owned and operated by the Santa Barbara County Flood Control District. This levee system was designed to flow 150,000 cfs and to protect residents and thousands of acres of land which is mainly utilized in the agriculture industry.

The proposed growth of Guadalupe is controlled by the land use element of the adopted General Plan. At this time, both the City's sphere of influence (SOI) and its city limits are the same. But in terms of possible future growth, this study did take into account the possible development of the Minami property located to the north-east of town. The proposed D.J. Farms development is already in the city limits and was also considered.

Each major watershed mapping includes identity of the drainage courses and those points that divide a watershed/drainage basin where a "drop of water" will flow towards certain drainage courses. A set of points indicates a "grade break," or commonly referred to as a Ridge Line, where said drop of water on one side flow towards a certain drainage course, whereas another drop of water on the other side of said ridge line flows to a different (adjoining) watercourse. **TAB-3** is an extract from Chapter 2 of the City Water Master Plan which discusses the land use and demographics for Guadalupe.

TAB-4 delineates the watershed study area and **TAB-5** labels and names the individual basins within the study area. Mapping of each major watershed is a process that commences first with the determined boundary of various sub-basins which join together to create a basin and basins and then join together to create an individual watershed. The mapping proceeds so that run off characteristics of each individual sub-basin is retained. This combining of watershed and areas of development define the ultimate limits of the Guadalupe SDMP study areas. The watershed study area encompasses an area of 7.2 square miles or approximately 4,600 acres.

2.3.1 History of Flooding

Flooding from the Santa Maria River is a constant concern to the City of Guadalupe. The Santa Maria Levee does not extend downstream beyond Highway 1. This exposes LeRoy Park and its youth center building, as well as exposed housing on both sides of lower Pioneer Street. The City's requests to Santa Barbara County for mitigation of the flooding danger have been unsuccessful. County flood control officials state that funds are unavailable.

Historical records indicate that floods are endemic to the area and have caused extensive damage to agricultural land and to residential, highway, and railroad property. Along the Santa Maria River, floods have caused damage of major proportions by cutting stream banks and changing the shape and location of the channels, damaging, or destroying communication and transportation facilities and inundating rural and urban property. The most recent floods that have occurred in the Santa Maria River basin, those of January 1952 and April 1958, caused estimated damages of $250,000 and $110,000, respectively

2.3.2 Guadalupe Wetlands

An ancient slough (wetlands) on private property has been an unofficial junk disposal for many years. The City had previously planned to clean it up and develop it as a nature conservation project, a city recreational facility and a site for children to learn about nature. It is the City's view that endangered species of birds and animal should be concentrated in well-protected appropriate sites. This is part of the City's overall plan to turn blight into beauty with public benefits.

In the western U.S., a slough is a secondary channel of a river delta or a narrow channel in a shallow salt-water marsh, usually flushed by the tide. While this is in essence the same application of the term as used in the eastern U.S., a singular difference is that there exist no native trees in the west that would grow out into the waterway to form a swamp.

As the water table to the west end of the Valley continues to rise, and the water flow from the Orcutt/Solomon Creek watershed continues to grow, it seems likely the crop production will become increasingly difficult and costly, with profitable crops diminishing in number. Should a multi-use lake restoration project come into being, Guadalupe leadership may consider participation.

The Guadalupe Wetlands act as a storage basin for stormwater runoff. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. The Guadalupe Wetlands function as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater and flood waters. Trees, root mats, and other wetland vegetation also slow the speed of flood waters and distributes them more slowly over the floodplain. This combined water storage and braking action lowers flood heights and reduces erosion. Wetlands within and downstream of urban areas are particularly valuable, counteracting the greatly increased rate and volume of surface- water runoff from pavement and buildings. The holding capacity of wetlands helps control floods and prevents water logging of crops. Preserving and restoring wetlands, together with other water retention, can often provide the level of flood control otherwise provided by expensive dredge operations and levees.

It is reasonable to assume that aquifers identified offsite are contributing to the flooding problem associated with the wetlands. Surface water may also contribute to the influx of runoff. Overflow conditions currently exists to the south of the Wetland area. It appears that the water level is above the observed high water mark. In a previous study, it was suggested that the culvert across Obispo Street may be obstructed, preventing the flow of water. Apparently, the area has accumulated silt, vegetative growth and probably other debris, to such an extent, that it has raised the elevation equal to that in the Wetland area, not allowing for the flow of water to continue down the ditch. The City did clean out this culvert in order to improve hydraulic performance.

According to the Natural Resources Conservation Service, the Guadalupe Wetlands is made up of a myriad of soils including MaA (Mariana Sand), Rs (Riverwash), and SaA (Salinas loan). Riverwash is defined as barren alluvial areas of unstablilized sand silt, clay or gravel reworked frequently by stream activity. Wetland soils (classified by the Soil Conservation Service as hydric soils) occur in areas with high water tables or frequent, long-lasting flooding or ponding. Although these soils are usually high in clay content, they can also be sandy. Where organic matter has accumulated, soils such as peats or mucks are found.

Just as maintaining natural hydrology of a wetland is the key to protecting it, activities that alter hydrology of a wetland, can severely degrade it. Even small changes in hydrology, like changing the amount of surface water entering and leaving a wetland or changing the ground water table a few inches either up or down, can have dramatic impacts on the way a wetland functions, including how much flood protection a wetland provides, how much sediment and pollutants it can remove from surface water, what sort of vegetation can live there, what wildlife habitat it provides, and how the wetland relates to other bodies of water.

Conveying additional water to a wetland results in the raising of surface and ground water levels. Impounding water or otherwise increasing the water that enters a wetland can cause changes in the vegetation community, the animals that live there, water quality maintenance functions, and flood storage and conveyance.

The flip-side of flooding a wetland is draining it. The United States has a long history of draining wetlands. Since the early years of this country, there have been governmental programs to fund the draining of wetlands. Activities that result in draining wetlands include ditch construction, the laying of field tiles (subsurface pipes with holes that collect water from the soil and convey it to a lower point), and the removal or alteration of structures that impound water. Drainage has many adverse effects on wetlands and the surrounding watershed.

Land use changes in the watershed can affect how a wetland functions. With respect to changes in hydrology, the most typical land use changes are those which involve the conversion of natural vegetation or farmland to areas where much of the land surface is covered with impervious surfaces (roofs, pavement, etc.). The changes to wetland hydrology are twofold: 1) a reduction in the amount of precipitation that can percolate into the soil and then be discharged slowly into a wetland as ground water, and 2) a dramatic increase in the speed and amount of water that flows into a wetland via surface water runoff. Both of these effects combine to create a situation where the major inputs of water become flashy, causing the amplitude of the fluctuations between high water and low water in the wetland to become more extreme. An additional concern is the presence of sediment, nutrients, and other pollutants in stormwater runoff. Although wetlands do serve as natural filters, the amount of pollutants in urban stormwater runoff is typically greater than what wetlands can handle. This degraded water quality can severely impact functions. Like other changes in wetland hydrology, the result is a change vegetation community, wildlife habitat, and the ability of the wetland to critical functions such as flood storage and water quality protection.

2.3.3 Guadalupe Groundwater

The groundwater underlying the offsite watersheds is predominately replenished by precipitation. The formation of groundwater is within the process known as the hydrologic cycle. After water evaporates, water vapor forms in the atmosphere. The water vapor condenses and forms clouds. As condensation continues, precipitation occurs and rain falls. When the water reaches the earth's surface, some of it flows along the surface of the earth as runoff, while the rest soaks through the soil (natural recharge). The water continues to percolate through the soil profile until it becomes groundwater and stored within an aquifer. Water in soil is dispersed into a region where the pores of the soil or rock are filled with water. The water in this zone of saturation is called the groundwater. Above the zone of saturation is a capillary fringe and water table, in which smaller pores contain water lifted by capillary action from the zone of saturation Municipal, agricultural and private wells penetrate the soil profile and draw groundwater for a variety of purposes. Water bearing strata that are saturated with groundwater are called aquifers. The water, when pumped, can then be used as a source for domestic, agricultural and/or commercial purposes. The groundwater forms a water table, which is the level of water available at a given depth. When groundwater is drawn the water table forms a cone of depression that drives down surrounding water; therefore, it is important that wells be located and spaced from each other where there is minimal influence from these draw down curves. Groundwater can occur in such varied geologic settings as fractures in hard rock or pores in sedimentary rocks and deposits. Separated from external sources of impact, groundwater is relatively clean; however, there are scenarios where groundwater may become contaminated.

Groundwater contamination stems from, but not limited to, underground tanks that store gasoline, landfills, and pesticides used in commercial agriculture. When pollutants leak, spill, or are carelessly dumped they can move through the soil profile and into the underlying groundwater. In some cases, when groundwater becomes contaminated the economic cost of cleanup is too expensive.

2.4 Acronyms & Abbreviations

AF	Acre feet
CEQA	California Environmental Quality Act
CFS	Cubic feet per second
CIP	Capital Improvement Plan
CT	Caltrans
ENR	Engineering News Record
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
Ft	Feet
GIS	Geographic Information System
In	Inch
In/hr	Inch per hour
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resource Conservation Service (formally SCS)
RMA	RM Associates
SBUH	Santa Barbara Urban Hydrograph
SCS	Soil Conservation Service
SDMP	Storm Drain Master Plan
SOI	Sphere of Influence

Section 3 Storm Drainage System

3.1 Introduction

The overall study area was determined through the delineation of the individual watersheds that contribute runoff into the City limits. The study area is bordered on the northerly side by the Santa Maria River Levee; on the southerly side by US Highway 166 and DJ Farms; on the westerly side by the Sewage Disposal facility; and on the easterly side by the Bonita School Road. Although the DJ Farms area is a part of the study, it will be independently analyzed in relation to its storm drainage system. The DJ Farms area includes two agricultural areas and is bounded on the east by Simas Road. This report focuses on how the City's existing storm drainage systems is affected by storm drainage areas found within the City limits and those found outside City limits.

Drainage designs must strive to maintain compatibility and minimize interference with existing drainage patterns; control flooding of property, structures and roadways for design flood events; and minimize potential environmental impacts on stormwater runoff. Stormwater collection systems must be designed to provide adequate surface drainage while at the same time meeting the City's Stormwater Management Goals such as water quality, stream bank channel protection, habitat protection and groundwater recharge.

There are two stormwater drainage systems that must be considered: the minor system and the major system. Three factors influence the design of these systems: flooding; public safety; and, water quality. The purpose of the minor drainage system, which is designed for a 25-year storm event, is to remove stormwater from areas such as streets and sidewalks for public safety reasons. This system consists of inlets, street and roadway gutters, roadside ditches, small channels and swales, and small underground pipe systems which collect stormwater runoff and transport it downstream. The major system's purpose is defined by flow paths for runoff from less frequent storms, up to the 100-yr frequency. It consists of natural waterways, large man-made conduits, and large water impoundments. In addition, the major system includes some less obvious drainage-ways such as overload relief swales and infrequent temporary ponding areas. The major system includes not only the trunk line system that receives the water from the minor system, but also the natural backup system which functions in case of overflow from or failure of the minor system. Overflow relief must not flood or damage houses, buildings or other property. The minor/major concept may be described as a 'system within a system' for it comprises two distinct, but conjunctive, drainage networks. The minor/major systems are closely interrelated, and the design of components for each must be done in conjunction with the City's Stormwater Management Goals. Three factors influence the design of these systems: flooding; public safety; and water quality.

3.2 Overview of Major Offsite Watersheds

The City of Guadalupe is located in the Santa Maria watershed which is about 468,000 acres (731 square miles) in size (USGS Watershed No. 18060008). The major river tributaries which create runoff are the Sisquic and Cuyama. Both drain into the Santa Maria River which in turn ultimately outfalls to the Pacific Ocean just to the west of the City. Discharges from Twitchell Dam also influence flows down the Santa Maria River. **TAB-2** contains an overview map of the entire Santa Maria watershed.

The United States Geologic Society (USGS) maintains an extensive catalog and mapping of all watersheds in the country. The USGS defines the State of California as Region 18. In order to quantify the watersheds, the USGS subdivides the number of watersheds by counties. The City of Guadalupe is located within Santa Barbara County. Santa Barbara County, according to the USGS, has (9) nine watersheds. The City of Guadalupe is located within the Santa Maria Watershed (USGS No. 18060008). The Santa Maria Watershed drains into the Pacific Ocean from the Pescadero Creek Basin boundary to and including the Rincon Creek Basin.

The Santa Maria River Watershed is about 468,000 acres in size. Large acreage of irrigated cropland occurs along the river valleys. These valleys comprise one of the most important agricultural areas in the state. Foothills are used for vineyards. The surrounding hills are used for rangeland. The major resource concern in this watershed is water quality and water quantity. The California Department of Food and Agriculture has listed Santa Maria River Basin as a Nitrate-Sensitive area. The Santa Maria Watershed lies within The Santa Maria River Basin. The recent conversion from other land uses, particularly native range to vineyards on steep slopes has dramatically increased the erosion and sedimentation rates in these watersheds. Nearly 7,000 acres of vineyards are farmed currently, with another 5,000 acres projected to be put in over the next five years. The recent conversion of more traditional vegetable crops to strawberries grown under plastic mulch has contributed to increased erosion and sedimentation rates on 4,376 acres of cropland.

The Santa Maria River Basin includes the north half of Santa Barbara County and very small portions of San Luis Obispo, Ventura, and Kern Counties. The Santa Maria River (SMR) is formed at the confluence of the Sisquoc River and the Cuyama River. The SMR is ephemeral; discharges that occur are highly variable. Historically, the stream meander eroded the banks, stripped farmland of soil, and undercut portions of the flood control levees. The Cuyama River is located in San Luis Obispo County. This stretch of the Cuyama River is 15 miles long. The Cuyama River flows in an east-to-west direction. The river is impounded approximately 24 miles from the ocean by the Twitchell Dam. The Sisquoc River is a river in Santa Barbara County, California. The 50-mile long river originates at 6,590 feet atop San Rafael Mountain, which are part of the California Coast Range. The Sierra Madre Mountains form the watershed's boundary to the north, while the San Rafael Mountains form the southern boundary. The first half of the river, in the Los Padres National Forest, specifically the San Rafael Wilderness, travels roughly northwest.

The average annual flow of the Cuyama River, which is dammed about six miles above its confluence with the Sisquoc is 40,400 acre-feet (a-f). The river is dry much of the year, with a sizable stream flow occurring only following the storms of the wet season (winter). Santa Maria is characterized by a brief rainy season in the winter months and a long dry season the remainder of the year. The basin averages fourteen inches of rain per year, though it, too, has exhibited wildly fluctuating amounts of precipitation, from a low of four inches to a high of thirty.

The Twitchell Dam (formerly the Vaquero Dam; it was renamed in 1957 in honor of T.A. "Cap" Twitchell). The dam is located on the Cuyama River about six miles upstream from that river's junction with the Sisquoc and where the river becomes the Santa Maria River.

The Twitchell Dam and Reservoir were constructed in accordance with instructions contained in Engineering Regulation 1110-2-240, dated December 1958, and Civil Works engineering Manual 1110-2-3600, dated May 1959, issued by the Office Chief of Engineers (Santa Barbara County, 2006). The Twitchell Dam and Reservoir is a multiple-purpose structure for water conservation and flood control. The Twitchell Dam mainly provides flood control and allows water to be released gradually so that as much of it will seep into the soil, recharging the groundwater. The water is released as quickly as possible while still allowing it to percolate into the ground. The river and the reservoir are usually dry during the summer, when there is little to no rain. The Twitchell Reservoir provides ample groundwater recharge for residents and agriculture. The importance of this process is necessary for the economy and drinking water supply. While other ecosystems may provide a variety of functions, here, the reservoir is needed for groundwater recharge. The water continues to percolate through the soil profile until it becomes groundwater and stored within an aquifer. The drainage area above Twitchell Dam comprises 1,125 square miles of the 1,845 square miles in the Santa Maria River basin. A study of historical accounts and records of floods that have occurred in adjacent basins indicate that severe floods occurred in the years 1862, 1868, 1884, 1886, 1909, and 1914. The peak discharge for the 1909 flood was estimated at 100,000, cubic feet per second on the Santa Maria River (Twitchell Reservoir Regulation Manual, N.D.).

Within the City of Guadalupe, the office of the City Engineer has identified twelve (12) major offsite watersheds which directly impact the City of Guadalupe. These twelve (12) watersheds are not categorized by the USGS, but have been identified for the purpose of this report. The offsite watershed area lies easterly of the City. For the purpose of this report, these watersheds have been given Roman numeral titles (I-XII).

3.3 Basin and Sub-Basin Delineation

The watershed study area identifies only that portion of the larger watershed which has the potential to directly impact the City's storm drain system. This study area encompasses about 4,600 acres (7.2 square miles) and was determined to be the agricultural area just to the east and south of Guadalupe. This area is roughly bounded by the Santa Maria River to the north, Bonita School Road to the east, Brown Road to the south, and the City limits to the west. The study area was further distinguished as either being "off-site" or "on-site" drainage basins, the difference being that the City of mostly responsible for addressing its own "on-site" drainage. Therefore the on-site drainage area can be defined as the area within the City limits itself, or about 1.4 square miles. The D.J. Farms development has the potential to add another 350 acres (0.5 square miles), or 2.0 square miles total to the "on-site" category. The off-site watershed would be everything else, or about 5.2 square miles. Offsite basins were further subdivided into twelve distinct sub-basins and were labeled Basins I through Basin XII., while the on-site City basins were delineated into 18 different parts of town. **TAB-4** contains a delineation of the study area, and **TAB-5** labels and/or names all the individual drainage basins within the watershed.

3.4 Existing Onsite Drainage Basins

This section discusses the storm drain collection system within the current city limits. The areas have been divided between 18 drainage areas. (See Figure 2-3, City Drainage Basin Map).

Treasure Park Drainage Area

This includes the areas bounded by West Main Street, Obispo Street and Fourth Street. All flows are currently collected in the storm drain collection system and directed to the adjacent storm drain parallel to Obispo Street. This storm drain consists of an 18-inch diameter drainage pipe. The 18-inch drainage pipe serves as a stormwater storage line. When it fills it overflows into the Guadalupe Wetlands.

Simas Road/State Highway 166 Drainage Area

Flower Street, West Main Street and Fourth Street bound this drainage area. It appears that most of the runoff is diverted during flood events westerly to the Guadalupe Wetlands.

Waller Drainage Area

The northerly part of this drainage area is developed by the Guadalupe wetlands. It is bounded by Obispo Street on the west. The runoff collects in pipes adjacent to Obispo Street to 18-inch storm drain pipes, which lead runoff to the Guadalupe wetlands.

Guadalupe Wetlands and Gularte Tracts Subdivision Drainage Area

The Guadalupe Wetlands is bounded by the downtown area on the west; the Mary Jane Freitas Outfall Drainage Area and Minami Samu Trustee Exemption Trust on the north; and the Waller Drainage area and Simas Road Drainage area to the south. The wetlands area is approximately 70.3 acres.

Light Industrial "A" Drainage Area

Stormwater runoff collected in this drainage area discharges to a system of drainage pipes, which range from 24-30 inches. The storm drainage system is connected to a 24-inch storm drain, which flows northerly to a 30-inch storm drain and discharges into the Guadalupe Wetlands.

Light Industrial "B" Drainage Area

Stormwater runoff collected in this drainage area discharges to the south toward said water channel (West Main Street Ditch) which runs parallel to State Highway 166. It appears from the delineation of the runoff, that flood waters are being diverted into said channel toward the Pacific Ocean.

Minami and Samu Trustee Exemption Trust

This drainage system is bounded by the Guadalupe Wetlands to the south and the Mary Jane Freitas Outfall Drainage Area to the west. Stormwater runoff is discharged directly into the Santa Maria River.

Mary Jane Freitas Outfall Drainage Area

The Mary Jane Freitas Outfall Drainage Area is bounded between the 12th Street Drainage Area, Downtown Guadalupe, the Guadalupe Wetlands, and the Minami County and Samu Trustee Exemption Trust. Runoff is discharged thru the Santa Maria River Levee. This drainage area is approximately 20.3 acres.

The Mary Jane Freitas Outfall Drainage (MJFOD) area also serves the City as a discharge area for stormwater runoff. Water flows northerly, to a 24-inch storm drain and discharges onto the MJFOD property.

12th Street Drainage Area

This drainage area consists of a holding pond where the Santa Maria River ends. Runoff is then channeled to the Pacific Ocean.

11th Street Drainage Area

This drainage area is approximately 30.3 acres. Runoff is channeled and discharged toward the Santa Maria River.

Downtown Drainage Area

This downtown area is bounded by State Highway 1on the east. Runoff is collected thru the City's storm drain pipes and channeled toward the Santa Maria River.

State Highway 1 Commercial Corridor Drainage Area

Runoff is channeled thru said storm drain pipes to the storm drain pipe parallel to State Highway 166.

Guadalupe Subdivision Drainage Area

This area is bounded by the Guadalupe Cemetery to the south. Runoff is collected and channeled thru to the storm drain pipe parallel to West Main and to the Santa Maria River Levee.

Cemetery Drainage Area

This drainage area is bounded by West Main. Runoff is collected and channeled thru the storm drain pipe parallel to West Main toward the Pacific Ocean.

Bonita Subdivision Area

This drainage area is bounded by West Main. Runoff is collected and channeled thru the storm drain pipe parallel to West Main toward the Pacific Ocean.

Point Sales Dunes Subdivision Drainage Area

This drainage area is bounded by West Main. Runoff is collected and channeled thru the storm drain pipe parallel to West Main toward the Pacific Ocean.

Riverview Subdivision Drainage Area

This drainage area is bounded by West Main. Runoff is collected and channeled thru the storm drain pipe parallel to West Main toward the Pacific Ocean.

3.5 Offsite Drainage Basins

This includes that portion of study area outside the city limit line. This section discusses the offsite watershed areas which contribute to the City's flooding problems. The areas have been divided between 12 drainage areas. (See Figure 2-3, City Drainage Basin Map).

3.5.1 Soils

In terms of soil texture, soil type usually refers to the different sizes of mineral particles in a particular sample. Soil is made up in part of finely ground rock particles, grouped according to size as sand, silt, and clay. Each size plays a significantly different role. **TAB-6** contains a soils survey of the Northern Santa Barbara county area, with various accompanying maps.

3.5.2 Agriculture Runoff

Agricultural runoff is surface water leaving farm fields because of excessive precipitation, irrigation, or snowmelt. In the early 20th century, there was considerable concern about erosion of farm fields caused by rainfall washing away valuable topsoil from the fields and resulting in loss of productivity. With the passage of the Federal Water Pollution Control Act Amendments of 1972, the potential for pollution of surface waters from agricultural runoff was officially recognized and an assessment of the nature and extent of such pollution was mandated (USEPA, 2002a; Stewart et al., 1976).

Agricultural runoff is grouped into the category of nonpoint-source pollution because the potential pollutants originate over large areas and the point of entry into water bodies cannot be precisely identified. It is largely assumed that runoff is collected in the Guadalupe wetlands through runoff or captured thru underground aquifers. Nonpoint sources of pollution are particularly problematic because it is difficult to capture and treat the polluted water before it enters a stream. Because agricultural runoff is considered nonpoint-source pollution, efforts to minimize or eliminate pollutants focus on practices applied on or near farm fields.

One of the primary pollutants in agricultural runoff is eroded soil. Excessive erosion can cause farmers to use more fertilizer and water, plant more tolerant crops, or abandon fields for agricultural production.

Many of these sediments are heavy and will settle in slow-moving portions of streams or in reservoirs, dramatically altering the ecology of the streambed. Aquatic plants, insects, and fish all have specific requirements related to composition of the streambed for them to live and reproduce.

3.5.3 Surface Runoff

Surface runoff is a term used to describe the flow of water, from rain, snowmelt, or other sources, over the land surface, and is a major component of the water cycle. Runoff that occurs on surfaces before reaching a channel is also called a nonpoint source. If a nonpoint source contains man-made contaminants, the runoff is called nonpoint source pollution. A land area which produces runoff draining to a common point is called a watershed. When runoff flows along the ground, it can pick up soil contaminants such as petroleum, pesticides (in particular herbicides and insecticides), or fertilizers that become discharge or nonpoint source pollution.

3.5.4 Off-site watershed Delineation

Drainage Area I

This drainage area is approximately 90.2 acres and lies east of the City. Drainage area I lies parallel to the Santa Maria River Levee. Water is collected underground and channeled towards the city's wetlands and basin area. An overflow of runoff is associated with the City's flooding.

Drainage Area IIa and Drainage Area IIb

Drainage areas IIa and IIb are bounded by Drainage Area III and the Guadalupe wetlands.

Drainage Area III

Drainage area III is bounded by Drainage areas I, II, V, VI, and VII.

Drainage Area IVa, IVb, and IVc

Drainage area IV (a, b, & c) is bounded by drainage area V.

Drainage Area V

This area is bounded by drainage area II, II, and VI. There is an agricultural channel for irrigation purposes to the east of the property.

Drainage Area VI

This area is bounded by drainage area XI, V, III, VII, and VIII. There are two agricultural channels for irrigation purposes.

Drainage Area VIII

This area is bounded by drainage area VI, XI, and VII.

Drainage Area IX

This drainage area is bounded by drainage areas I and XI.

Drainage Area X

This drainage area is bounded by areas VII, VIII, XI, and IX.

Drainage Area XI

This drainage area is runs parallel to said water channel and State Highway 166.

Drainage Area XII

This drainage area is runs parallel to said water channel and State Highway 166.

3.6 Santa Maria Valley Levee

The Santa Maria Valley levees provide flood control protection to the Santa Maria Valley including the residents of the Cities of Santa Maria and Guadalupe. The project consists of 17 miles of stone-revetted levee along the south side of the Santa Maria River which protects the City of Santa Maria and about 5 miles of stone-revetted levee along the north side of the river, which largely protects agricultural land. The levees were designed and constructed by the U.S. Army Corps of Engineers. Construction began in 1959 and was completed in 1963. The levee stops in Guadalupe at the Highway One bridge crossing. The lower portions of the floodplain within the Guadalupe city limits therefore do not have flood protection from this structure.

The Santa Maria Valley levees have long proven to be deficient despite remedial action by the USACE and ongoing improvements by the local sponsor. The design capacity of the levees is a minimum of 150,000 cfs but river flows as low as 8,000 cfs have routinely caused significant damage. Typically the damage has been caused by low to moderate flows that do not fill the entire river but rather meander across the river and impinge upon the levees at sharp angles. These concentrated flows undermine the levee toe and have repeatedly placed the levee and hence the City of Santa Maria in jeopardy. The levees have been damaged this way several times. These impinging flow conditions have not been reported on the levee that is in the vicinity of Guadalupe however. It should be noted that the original riprap revetment on the levee has deteriorated significantly since the project construction was completed, in that much of the rock has fractured and broken down into smaller pieces. Relatively recent geotechnical explorations and hydraulic calculations by the Corps have concluded that the existing revetment does not meet current Corps design standards for parallel flow conditions for larger floods. Given the condition of the project the Corps of Engineers had declined to certify that the levee. The levee is now on a national list of levees at risk of failing. FEMA therefore is currently revising its flood insurance maps with the assumption that the levee project no longer offers protection to the City of Santa Maria. Thousands of property owners within the city limits will be affected. This decertification will not be expected to change the FIRM map for the City of Guadalupe however.

TAB-16 contains a Power Point presentation by the Santa Barbara County Flood Control district concerning the threat of flooding along the Santa Maria River due to the Zaca Fire of 2007. **TAB-17** contains an excerpt of the FEMA Flood map. It shows the areas of the City which are in the floodplain Zone "A". It also contains a topographic map which shows the actual elevations of these low lying areas. **TAB-18** contains several articles concerning the status of the Santa Maria Levee. **TAB-19** contains a technical engineering report on the Levee prepared by the Corps of Engineers.

There has been a lot of recent activity to address this problem. Several field inspections by the County, COE, and City of Santa Maria have recently transpired. Also, the County of Santa Barbara has recently been working along the levee to perform some improvements. These have included constructing pilot channels to steer low flows away from the levee proper. In Guadalupe, the County cleared away vegetation in the vicinity of the Highway 1 bridge in order to allow flows to move more quickly. On January 9, 2008 the Corps of Engineers announced that it had secured funding in the amount of $280,000 to study possible additional repairs to the levee. Also a watershed coordination group has been meeting on a regular basis to discuss the condition of the levee.

A recent Grand Jury Report stated; (that) *"The Santa Maria River flooding is a constant threat to the City. The protective levee does not extend downstream beyond Highway 1. This exposes LeRoy Park and its youth center building, as well as exposing housing on both sides of lower Pioneer Street. The City's requests to the County for mitigation of the flooding danger has been unsuccessful. County Flood Control officials say the funds are unavailable. In March 2007, the Santa Maria River berm along the Fraitis/DeGraspari property failed, and causes water and soil erosion damage."*

Among its findings, it concluded that LeRoy Park, and its valuable community buildings, may sustain flood damage in the future. It recommended that in combination with County

Flood Control, Guadalupe should seek to protect LeRoy Park and consider extending the Santa Maria River levee west of Highway 1, and create an earth berm (i.e, not necessary a levee) around the unprotected three-acre site as an affordable first step in solving Guadalupe's flooding issues.

The City's waste water treatment facilities have a similar berm. In the back of the facilities, the drying beds are protected by dirt berms that were constructed by the City in 1982 and also 1993. During the severe 1996-1997 flooding which occurred statewide, a corner of this berm gave way. Actually, waste water flowed out of the breach, not flood water into the plant (potential discharge of pollutants). These dirt berms are currently holding but could use some additional improvement work. Recent heavy rains that occurred in the last few weeks of February, 2008 were of no threat to the berms. The plant itself is relatively safe, but it is not inconceivable that flooding could occur on a 100-year storm event.

The recommendations of the SDMP concerning the levee are as follows:

- The City should endeavor to stay informed as to the extent of planning of potential repair work and remedies that other agencies and groups are now pursuing.
- In consultation with the Santa Barbara County Flood Control District, the City should conduct a preliminary engineering assessment and field survey of the lower flood plain area to see if additional earth berm construction is warranted to protect the LeRoy Park, Boys/Girls club and other possible improvements to the area. An inspection of the levee upstream of Highway 1 that is specifically in the vicinity of Guadalupe should also be conducted.
- Other protective measures might be the planting of willows at strategic locations.
- The City should conduct a field survey on the status of the existing berm located at the waste water treatment facilities to see if it is in need of additional repairs.
- The City should consider pursuing Grant funding to pay for these needed flood protection measures.

Section 4

Planning Criteria

This section presents the planning criteria used for the storm drain system analysis. The criteria include:

- Land uses
- Hydrologic criteria
- Hydraulic criteria
- Other criteria

4.1 Land Uses

TAB-3 contains a decription of land uses and demographics for the City of Guadalupe.

These land uses consist of:

- Existing land uses in developed areas within the current City boundary obtained from the City's General Plan. Future land uses according to the General Plan for undeveloped areas within the current City boundary as well as the proposed D.J. Farms development. Other possible development now outside the city limits that was considered is the Minami property.

4.2 Hydrologic Criteria

4.2.1 Method for Flow Generation

For this master plan a HYDRA model was used to generate and route flows. There are three possible methods of generating storm flows in HYDRA: hydrologic true simulation, a modified Rational Method, and a modified SCS method. The Santa Barbara Urban Hydrograph Method (modified SCS method) was used for this master plan.

4.2.2 Design Storm (level of protection)

This study used the following design storm be used for design of drainage facilities:

- 25-year storm in commercial and industrial areas, and for major trunks; and
- 10-year storm for residential and local facilities.

This study also specified that the depth of water in streets is not to exceed curb heights for these return periods.

This master plan evaluated the 10-year and 100-year storms, as the area within the current boundary is essentially built out.

- The 25-year storm criterion applies to drainage sub-areas that are primarily commercial and industrial, and the trunk lines that convey runoff from those areas to the discharge outlet.

- The 10-year storm criterion applies to drainage sub-areas that are primarily residential and to local facilities, and the trunk lines that convey water from those areas to the discharge outlet. Residential facilities draining to a 25-year trunk line serving commercial/industrial areas are sized for the 25-year storm. A trunk line serving only residential areas would be sized for the 10-year storm.

This study also evaluated the following storms: 25-year storm for basins that were mostly commercial or industrial land uses; and the 10-year storm for basins that were predominantly residential or public land uses. The 25-year storm was evaluated in response to the Santa Barbara County Water Resources Agency recommendations that the system be evaluated under the dual criteria of no ponding for the 10-year storm, and only street ponding for the 25-year storm. The 10-year rainfall amount is close to 20 percent higher than the 5-year rainfall, and the 25-year rainfall amount is about 5 percent higher than the 20-year rainfall.

4.2.3 Collection System PASS/FAIL Criteria

The following specification was used to analyze the proposed storm drain collection system for the Storm Drain Master Plan.

STORM DRAIN SYSTEM DESIGN YEAR CRITERIA:

Design Storm (years)	Design Storm return period applied to:
2	(Not Used)
5	(Not Used)
10	Residential and "local", where local is defined as schools, parks, and the golf course
20	(Not Used)
25	Commercial/Industrial/Major trunk lines
100	Offsite runoff "Q" must be 100-year storm event

COLLECTION SYSTEM "PASS/FAIL" CRITERIA

	PIPELINES
1	Residential: The hydraulic grade line (HGL) must be no higher than 2.0 feet below the gutter.
2	Commercial/Industrial: The HGL must be no more than 1.0 feet below the gutter
3	Main Trunks: The HGL must be no more than 0.5 below the gutter.
4	Pipe velocities must be between the range of 2 to 8 fps.
5	New pipes must be less than running 100% full at the design storm.
100	Offsite watersheds runoff "Q" must be 100-year storm event
	PONDING BASINS
6	Both the upper and lower retention basins must have enough capacity to hold runoff produced from a 100-year, 24 hour storm event.

4.2.4 Design Storm Rainfall

HYDRA uses a "Storm File" to analyze the hydraulics of the collection system using the Santa Barbara Urban Hydrograph (SBUH) method. HYDRA needs information on rainfall in order to calculate the storm water runoff and storm water inflow that is injected into the collection system during a storm event. A Storm File is a text file that describes the rainfall over the basin for a certain period of time. This rainfall is described by using what is called a single hyetograph storm. This is a single storm cell that can be used to cover the entire basin, or that has defined size and can be routed over the basin for a certain period of time. HYDRA can also employ a multiple hyetograph storm. By using multiple hyetographs (rain gauges), you can describe very complex patterns of rainfall over a basin for a certain period of time. Information on the storm event is maintained in an ASCII text file with a STO extension, such as 5YR.STO or WILD.STO.

4.2.4.1 Synthetic Rainfall Distributions

Hyetograph data is developed from rain gauges located within the basin(s) of interest. The Natural Resource Conservation Service (NRCS) has already developed synthetic rainfall distributions for the entire continental United States. The following discusses the methodology:

Different rainfall distributions can be developed for each watershed to emphasize the critical duration for the peak discharges. However, to avoid the use of a different set of rainfall intensities for each drainage area size, a set of synthetic rainfall distributions having "nested" rainfall intensities was developed by the NRCS. The set "maximizes" the rainfall intensities by incorporating selected short duration intensities within those needed for longer durations at the same probability level.

For the size of the drainage areas for which NRCS usually provides assistance, a storm period of 24 hours was chosen for the synthetic rainfall distributions. The 24-hour storm, while longer than needed to determine peaks for drainage areas, is appropriate for determining runoff volumes. Therefore, a single storm duration and associated synthetic rainfall distribution can be used to represent not only the peak discharges but also the runoff volumes for a range of drainage area sizes. The use of this method is a widely accepted engineering practice.

The intensity of rainfall varies considerably during a storm as well as geographic regions. To represent various regions of the United States, NRCS developed four synthetic 24-hour rainfall distributions (I, IA, II, and III) from available National Weather Service (NWS) duration-frequency data. Type IA is the least intense and Type II is the most intense short duration rainfall. Types I and IA represent the Pacific maritime climate with wet winters and dry summers. Guadalupe is in the Type I geographical area, which is between the Type IA and Type II storm. Therefore it can be characterized as being subject to "average intense" short duration rainfall events.

Generally, the falling off of the infiltration rate from the maximum to the minimum value during the storm is an exponential decay function the rate of decrease of the infiltration rate depends on the initial soil moisture content at the start of the storm, with saturated soils having higher runoff. The rate can be set to decrease rapidly to simulate saturated soil conditions, which could occur with back-to-back storms. Based on experience with similar studies, a typical decay rate of 0.00115 per second is used to estimate the time that it takes the infiltration capacity of the soil to go from its maximum to minimum rates. Generally, the minimum infiltration rate is reached within an hour after the start of the storm.

Table 1 depicts the fractions of 24-hour storm rainfall for each type storm that has been published by the NRCS:

TABLE 1: SCS Cumulative Dimensionless 24-hour Storms

	Pacific maritime climate with wet winters and dry summers		Rest of U.S.	Gulf of Mexico & Atlantic Coastal areas
Time (hr)	Type I Storm	Type IA Storm	Type II Storm	Type III Storm
0	0	0	0	0
0.5	0.008	0.010	0.005	0.005
1.0	0.017	0.020	0.011	0.010
1.5	0.026	0.035	0.016	0.015
2.0	0.035	0.050	0.022	0.020
2.5	0.045	0.067	0.028	0.025
3.0	0.055	0.082	0.035	0.031
3.5	0.065	0.098	0.041	0.037
4.0	0.076	0.116	0.048	0.043
4.5	0.087	0.135	0.056	0.050
5.0	0.099	0.156	0.063	0.057
5.5	0.112	0.180	0.071	0.064
6.0	0.126	0.206	0.080	0.072
6.5	0.140	0.237	0.089	0.081
7.0	0.156	0.268	0.098	0.091
7.5	0.174	0.310	0.109	0.102
8.0	0.194	0.425	0.120	0.114
8.5	0.219	0.480	0.133	0.128
9.0	0.254	0.520	0.147	0.146
9.5	0.303	0.550	0.162	0.166
10.0	0.515	0.577	0.181	0.189
10.5	0.583	0.601	0.204	0.212
11.0	0.624	0.624	0.235	0.250
11.5	0.655	0.645	0.283	0.298
12.0	0.682	0.664	0.663	0.500
12.5	0.706	0.683	0.735	0.702
13.0	0.728	0.701	0.772	0.750
13.5	0.748	0.719	0.799	0.784
14.0	0.766	0.736	0.820	0.811
14.5	0.783	0.753	0.838	0.834
15.0	0.799	0.769	0.854	0.854
15.5	0.815	0.785	0.868	0.872
16.0	0.830	0.800	0.880	0.886
16.5	0.844	0.815	0.891	0.898
17.0	0.857	0.830	0.902	0.910
17.5	0.870	0.844	0.912	0.920
18.0	0.882	0.858	0.921	0.928
18.5	0.893	0.871	0.929	0.936
19.0	0.905	0.884	0.937	0.943
19.5	0.916	0.896	0.945	0.950
20.0	0.926	0.908	0.952	0.957
20.5	0.936	0.920	0.959	0.963
21.0	0.946	0.932	0.965	0.969
21.5	0.956	0.944	0.972	0.975
22.0	0.965	0.956	0.978	0.981
22.5	0.974	0.967	0.984	0.986
23.0	0.983	0.978	0.989	0.991
23.5	0.991	0.989	0.995	0.996
24.0	1.000	1.000	1.000	1.000

4.2.4.2 Modeling a Single Hyetograph Storm

The following six step procedure was followed to develop a single hyetograph storm file for input into HYDRA:

- Select the appropriate IDF Curve.
- Convert the curve to total inches of rain for a 24 hour period for each return period.
- Use the above described NRCS "Synthetic Rainfall Distribution and Rainfall Data Sources" method to develop a rainfall distribution for the City of Guadalupe.
- Select the appropriate "step" duration (i.e., time increment).
- Calculate both the cumulative precipitation as well as the incremental precipitation. A graph of cumulative precipitation versus time produces the SCS 24-hour rainfall distribution curve and a graph of incremental precipitation versus time produces that desired design hyetograph.

The IDF Curve obtained from Caltrans was taken as the adapted IDF Curve for the City of Guadalupe:

TABLE 2: IDF Curve for Various Return Periods, Guadalupe Station:

Duration	Design storm			
	2 year (in/hr)	10 year (in/hr)	25 year (in/hr)	100 year (in/hr)
5 min.	1.51	2.48	2.98	3.69
10 min	1.01	1.66	2.00	2.47
15 min	0.80	1.31	1.58	1.96
30 min	0.54	0.88	1.06	1.31
60 min	0.36	0.59	0.71	0.88
2 hours	0.24	0.40	0.48	0.59
4 hours	0.16	0.27	0.32	0.40
8 hours	0.11	0.18	0.21	0.27
16 hours	0.73	0.12	0.14	0.18
24 hours	0.08	0.11	0.12	0.14

The above IDF Curve produces the following precipitation amounts for 24 hour storms:

TABLE 3: Storm Intensity and Precipitation Totals

Design Storm	Intensity (inches/hour)	Precipitation (inches)
10	0.11	2.75"
25	0.13	3.00"
100	0.14	3.50"

4.2.4.3 Incremental Precipitation Calculation

Table 4 is an Excel spreadsheet which calculates the incremental precipitation for the 10, 25, and 100 year return periods based on the IDF intensity and design precipitation depth described above and using incremental 15 minutes steps. The resulting incremental precipitation amounts were then put into the HYDRA program as the appropriate "storm file" for which to analyze the hydraulics of the collection system. The ASCII text files produced were labeled 10_YR_SCS.STO, 25_YR_SCS.STO, and 100_YR_SCS.STO respectively.

References	**Pages 3-12 to 3-37**
1. Table 4	Pages 3-12 to 3-15
2. Appendix B Synthetic Rainfall Distributions and Rainfall Data Sources	Pages 3-16 to 3-18
3. Hydrograph Synthesis Santa Barbara Urban Hydrograph	Pages 3-19 to 3-27
4. Appendix C – Santa Barbara Urban Hydrograph Method	Pages 3-28 to 3-33
5. Figure 6.12. SCS 24-hour rainfall distributions	Page 3-34
6. Relationship between Hyetographs and Hydrographs	Pages 3-35 to 3-37

HYDRA Storm File
Convert IDF Curve to Hyteograph

1	Steps	15	min
2	Return Period:	10	year
3	IDF Intensity@24 hr:	0.09	
	Design depth:	2.16	in

t hr	Fraction	Cum, P in	Incr, P in
0	0.000	0.0000	0.0000
0.25	0.004	0.0086	0.0086
0.5	0.008	0.0173	0.0086
0.75	0.013	0.0270	0.0097
1	0.017	0.0367	0.0097
1.25	0.022	0.0464	0.0097
1.5	0.026	0.0562	0.0097
1.75	0.031	0.0659	0.0097
2	0.035	0.0756	0.0097
2.25	0.040	0.0864	0.0108
2.5	0.045	0.0972	0.0108
2.75	0.050	0.1080	0.0108
3	0.055	0.1188	0.0108
3.25	0.060	0.1296	0.0108
3.5	0.065	0.1404	0.0108
3.75	0.071	0.1523	0.0119
4	0.076	0.1642	0.0119
4.25	0.082	0.1760	0.0119
4.5	0.087	0.1879	0.0119
4.75	0.093	0.2009	0.0130
5	0.099	0.2138	0.0130
5.25	0.106	0.2279	0.0140
5.5	0.112	0.2419	0.0140
5.75	0.119	0.2570	0.0151

1	Steps	15	min
2	Return Period:	25	year
3	IDF Intensity@24 hr:	0.11	
	Design depth:	2.64	in

t hr	Fraction	Cum, P in	Incr, P in
0	0.000	0.0000	0.0000
0.25	0.004	0.0106	0.0106
0.5	0.008	0.0211	0.0106
0.75	0.013	0.0330	0.0119
1	0.017	0.0449	0.0119
1.25	0.022	0.0568	0.0119
1.5	0.026	0.0686	0.0119
1.75	0.031	0.0805	0.0119
2	0.035	0.0924	0.0119
2.25	0.040	0.1056	0.0132
2.5	0.045	0.1188	0.0132
2.75	0.050	0.1320	0.0132
3	0.055	0.1452	0.0132
3.25	0.060	0.1584	0.0132
3.5	0.065	0.1716	0.0132
3.75	0.071	0.1861	0.0145
4	0.076	0.2006	0.0145
4.25	0.082	0.2152	0.0145
4.5	0.087	0.2297	0.0145
4.75	0.093	0.2455	0.0158
5	0.099	0.2614	0.0158
5.25	0.106	0.2785	0.0172
5.5	0.112	0.2957	0.0172
5.75	0.119	0.3142	0.0185

1	Steps	15	min
2	Return Period:	100	year
3	IDF Intensity@24 hr:	0.14	
	Design depth:	3.36	in

t hr	Fraction	Cum, P in	Incr, P in
0	0.000	0.0000	0.0000
0.25	0.004	0.0134	0.0134
0.5	0.008	0.0269	0.0134
0.75	0.013	0.0420	0.0151
1	0.017	0.0571	0.0151
1.25	0.022	0.0722	0.0151
1.5	0.026	0.0874	0.0151
1.75	0.031	0.1025	0.0151
2	0.035	0.1176	0.0151
2.25	0.040	0.1344	0.0168
2.5	0.045	0.1512	0.0168
2.75	0.050	0.1680	0.0168
3	0.055	0.1848	0.0168
3.25	0.060	0.2016	0.0168
3.5	0.065	0.2184	0.0168
3.75	0.071	0.2369	0.0185
4	0.076	0.2554	0.0185
4.25	0.082	0.2738	0.0185
4.5	0.087	0.2923	0.0185
4.75	0.093	0.3125	0.0202
5	0.099	0.3326	0.0202
5.25	0.106	0.3545	0.0218
5.5	0.112	0.3763	0.0218
			0.0235
5.75	0.119	0.3998	

6	0.126	0.2722	0.0151
6.25	0.133	0.2873	0.0151
6.5	0.140	0.3024	0.0151
6.75	0.148	0.3197	0.0173
7	0.156	0.3370	0.0173
7.25	0.165	0.3564	0.0194
7.5	0.174	0.3758	0.0194
7.75	0.184	0.3974	0.0216
8	0.194	0.4190	0.0216
8.25	0.207	0.4460	0.0270
8.5	0.219	0.4730	0.0270
8.75	0.237	0.5108	0.0378
9	0.254	0.5486	0.0378
9.25	0.279	0.6016	0.0529
9.5	0.303	0.6545	0.0529
9.75	0.409	0.8834	0.2290
10	0.515	1.1124	0.2290
10.25	0.549	1.1858	0.0734
10.5	0.583	1.2593	0.0734
10.75	0.604	1.3036	0.0443
11	0.624	1.3478	0.0443
11.25	0.640	1.3813	0.0335
11.5	0.655	1.4148	0.0335
11.75	0.669	1.4440	0.0292
12	0.682	1.4731	0.0292
12.25	0.694	1.4990	0.0259
12.5	0.706	1.5250	0.0259
12.75	0.717	1.5487	0.0238
13	0.728	1.5725	0.0238
13.25	0.738	1.5941	0.0216
13.5	0.748	1.6157	0.0216
13.75	0.757	1.6351	0.0194
14	0.766	1.6546	0.0194
14.25	0.775	1.6729	0.0184
14.5	0.783	1.6913	0.0184
14.75	0.791	1.7086	0.0173
15	0.799	1.7258	0.0173

6	0.126	0.3326	0.0185
6.25	0.133	0.3511	0.0185
6.5	0.140	0.3696	0.0185
6.75	0.148	0.3907	0.0211
7	0.156	0.4118	0.0211
7.25	0.165	0.4356	0.0238
7.5	0.174	0.4594	0.0238
7.75	0.184	0.4858	0.0264
8	0.194	0.5122	0.0264
8.25	0.207	0.5452	0.0330
8.5	0.219	0.5782	0.0330
8.75	0.237	0.6244	0.0462
9	0.254	0.6706	0.0462
9.25	0.279	0.7352	0.0647
9.5	0.303	0.7999	0.0647
9.75	0.409	1.0798	0.2798
10	0.515	1.3596	0.2798
10.25	0.549	1.4494	0.0898
10.5	0.583	1.5391	0.0898
10.75	0.604	1.5932	0.0541
11	0.624	1.6474	0.0541
11.25	0.640	1.6883	0.0409
11.5	0.655	1.7292	0.0409
11.75	0.669	1.7648	0.0356
12	0.682	1.8005	0.0356
12.25	0.694	1.8322	0.0317
12.5	0.706	1.8638	0.0317
12.75	0.717	1.8929	0.0290
13	0.728	1.9219	0.0290
13.25	0.738	1.9483	0.0264
13.5	0.748	1.9747	0.0264
13.75	0.757	1.9985	0.0238
14	0.766	2.0222	0.0238
14.25	0.775	2.0447	0.0224
14.5	0.783	2.0671	0.0224
14.75	0.791	2.0882	0.0211
15	0.799	2.1094	0.0211

6	0.126	0.4234	0.0235
6.25	0.133	0.4469	0.0235
6.5	0.140	0.4704	0.0235
6.75	0.148	0.4973	0.0269
7	0.156	0.5242	0.0269
7.25	0.165	0.5544	0.0302
7.5	0.174	0.5846	0.0302
7.75	0.184	0.6182	0.0336
8	0.194	0.6518	0.0336
8.25	0.207	0.6938	0.0420
8.5	0.219	0.7358	0.0420
8.75	0.237	0.7946	0.0588
9	0.254	0.8534	0.0588
9.25	0.279	0.9358	0.0823
9.5	0.303	1.0181	0.0823
9.75	0.409	1.3742	0.3562
10	0.515	1.7304	0.3562
10.25	0.549	1.8446	0.1142
10.5	0.583	1.9589	0.1142
10.75	0.604	2.0278	0.0689
11	0.624	2.0966	0.0689
11.25	0.640	2.1487	0.0521
11.5	0.655	2.2008	0.0521
11.75	0.669	2.2462	0.0454
12	0.682	2.2915	0.0454
12.25	0.694	2.3318	0.0403
12.5	0.706	2.3722	0.0403
12.75	0.717	2.4091	0.0370
13	0.728	2.4461	0.0370
13.25	0.738	2.4797	0.0336
13.5	0.748	2.5133	0.0336
13.75	0.757	2.5435	0.0302
14	0.766	2.5738	0.0302
14.25	0.775	2.6023	0.0286
14.5	0.783	2.6309	0.0286
14.75	0.791	2.6578	0.0269
15	0.799	2.6846	0.0269

15.25	0.807	1.7431	0.0173
15.5	0.815	1.7604	0.0173
15.75	0.823	1.7766	0.0162
16	0.830	1.7928	0.0162
16.25	0.837	1.8079	0.0151
16.5	0.844	1.8230	0.0151
16.75	0.851	1.8371	0.0140
17	0.857	1.8511	0.0140
17.25	0.864	1.8652	0.0140
17.5	0.870	1.8792	0.0140
17.75	0.876	1.8922	0.0130
18	0.882	1.9051	0.0130
18.25	0.888	1.9170	0.0119
18.5	0.893	1.9289	0.0119
18.75	0.899	1.9418	0.0130
19	0.905	1.9548	0.0130
19.25	0.911	1.9667	0.0119
19.5	0.916	1.9786	0.0119
19.75	0.921	1.9894	0.0108
20	0.926	2.0002	0.0108
20.25	0.931	2.0110	0.0108
20.5	0.936	2.0218	0.0108
20.75	0.941	2.0326	0.0108
21	0.946	2.0434	0.0108
21.25	0.951	2.0542	0.0108
21.5	0.956	2.0650	0.0108
21.75	0.961	2.0747	0.0097
22	0.965	2.0844	0.0097
22.25	0.970	2.0941	0.0097
22.5	0.974	2.1038	0.0097
22.75	0.979	2.1136	0.0097
23	0.983	2.1233	0.0097
23.25	0.988	2.1330	0.0097
23.5	0.992	2.1427	0.0097
23.75	0.996	2.1514	0.0086
24	1.000	2.1600	0.0086

15.25	0.807	2.1305	0.0211
15.5	0.815	2.1516	0.0211
15.75	0.823	2.1714	0.0198
16	0.830	2.1912	0.0198
16.25	0.837	2.2097	0.0185
16.5	0.844	2.2282	0.0185
16.75	0.851	2.2453	0.0172
17	0.857	2.2625	0.0172
17.25	0.864	2.2796	0.0172
17.5	0.870	2.2968	0.0172
17.75	0.876	2.3126	0.0158
18	0.882	2.3285	0.0158
18.25	0.888	2.3430	0.0145
18.5	0.893	2.3575	0.0145
18.75	0.899	2.3734	0.0158
19	0.905	2.3892	0.0158
19.25	0.911	2.4037	0.0145
19.5	0.916	2.4182	0.0145
19.75	0.921	2.4314	0.0132
20	0.926	2.4446	0.0132
20.25	0.931	2.4578	0.0132
20.5	0.936	2.4710	0.0132
20.75	0.941	2.4842	0.0132
21	0.946	2.4974	0.0132
21.25	0.951	2.5106	0.0132
21.5	0.956	2.5238	0.0132
21.75	0.961	2.5357	0.0119
22	0.965	2.5476	0.0119
22.25	0.970	2.5595	0.0119
22.5	0.974	2.5714	0.0119
22.75	0.979	2.5832	0.0119
23	0.983	2.5951	0.0119
23.25	0.988	2.6070	0.0119
23.5	0.992	2.6189	0.0119
23.75	0.996	2.6294	0.0106
24	1.000	2.6400	0.0106

15.25	0.807	2.7115	0.0269
15.5	0.815	2.7384	0.0269
15.75	0.823	2.7636	0.0252
16	0.830	2.7888	0.0252
16.25	0.837	2.8123	0.0235
16.5	0.844	2.8358	0.0235
16.75	0.851	2.8577	0.0218
17	0.857	2.8795	0.0218
17.25	0.864	2.9014	0.0218
17.5	0.870	2.9232	0.0218
17.75	0.876	2.9434	0.0202
18	0.882	2.9635	0.0202
18.25	0.888	2.9820	0.0185
18.5	0.893	3.0005	0.0185
18.75	0.899	3.0206	0.0202
19	0.905	3.0408	0.0202
19.25	0.911	3.0593	0.0185
19.5	0.916	3.0778	0.0185
19.75	0.921	3.0946	0.0168
20	0.926	3.1114	0.0168
20.25	0.931	3.1282	0.0168
20.5	0.936	3.1450	0.0168
20.75	0.941	3.1618	0.0168
21	0.946	3.1786	0.0168
21.25	0.951	3.1954	0.0168
21.5	0.956	3.2122	0.0168
21.75	0.961	3.2273	0.0151
22	0.965	3.2424	0.0151
22.25	0.970	3.2575	0.0151
22.5	0.974	3.2726	0.0151
22.75	0.979	3.2878	0.0151
23	0.983	3.3029	0.0151
23.25	0.988	3.3180	0.0151
23.5	0.992	3.3331	0.0151
23.75	0.996	3.3466	0.0134
24	1.000	3.3600	0.0134

Appendix B Synthetic Rainfall Distributions and Rainfall Data Sources

The highest peak discharges from small watersheds in the United States are usually caused by intense, brief rainfalls that may occur as distinct events or as part of a longer storm. These intense rainstorms do not usually extended over a large area and intensities vary greatly. One common practice in rainfall-runoff analysis is to develop a synthetic rainfall distribution to use in lieu of actual storm events. This distribution includes maximum rainfall intensities for the selected design frequency arranged in a sequence that is critical for producing peak runoff.

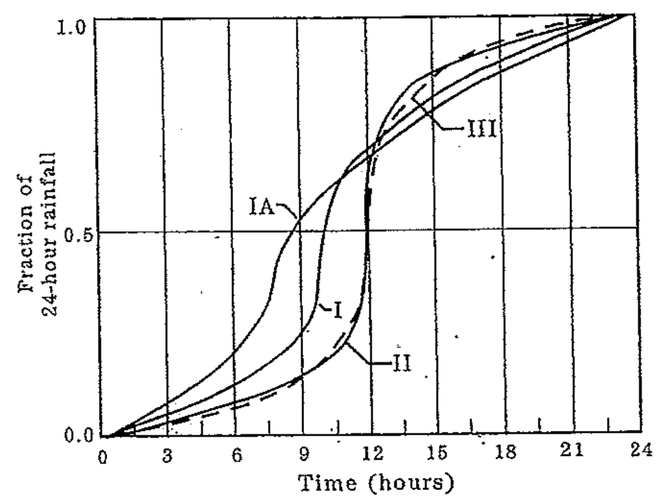
Synthetic rainfall distributions

The length of the most intense rainfall period contributing to the peak runoff rate is related to the time of concentration (T_c) for the watershed. In a hydrograph created with NRCS procedures, the duration of rainfall that directly contributes to the peak is about 170 percent of the T_c. For example, the most intense 8.5-minute rainfall period would contribute to the peak discharge for a watershed with a T_c of 5 minutes. The most intense 8.5-hour period would contribute to the peak for a watershed with a 5-hour T_c.

Different rainfall distributions can be developed for each of these watersheds to emphasize the critical rainfall duration for the peak discharges. However, to avoid the use of a different set of rainfall intensities for each drainage area size, a set of synthetic rainfall distributions having "nested" rainfall intensities was developed. The set "maximizes" the rainfall intensities by incorporating selected short duration intensities within those needed for longer durations at the same probability level.

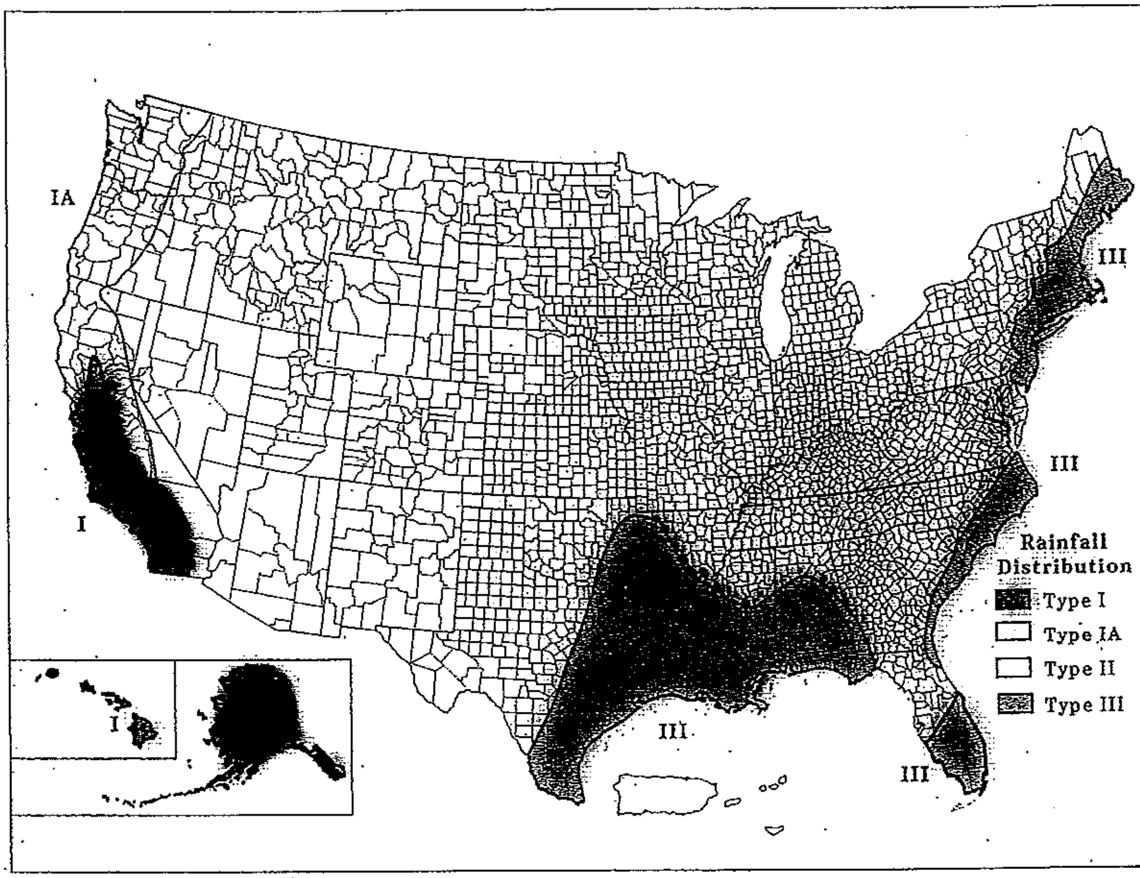
For the size of the drainage areas for which NRCS usually provides assistance, a storm period of 24 hours was chosen the synthetic rainfall distributions. The 24-hour storm, while longer than that needed to determine peaks for these drainage areas, is appropriate for determining runoff volumes. Therefore, a single storm duration and associated synthetic rainfall distribution can be used to represent not only the peak discharges but also the runoff volumes for a range of drainage area sizes.

Figure B-1 SCS 24-hour rainfall distributions



The intensity of rainfall varies considerably during a storm as well as geographic regions. To represent various regions of the United States, NRCS developed four synthetic 24-hour rainfall distributions (I, IA, II, and III) from available National Weather Service (NWS) duration-frequency data (Hershfield 1061; Frederick et al., 1977) or local storm data. Type IA is the least intense and type II the most intense short duration rainfall. The four distributions are shown in figure B-1, and figure B-2 shows their approximate geographic boundaries.

Types I and IA represent the Pacific maritime climate with wet winters and dry summers. Type III represents Gulf of Mexico and Atlantic coastal areas where tropical storms bring large 24-hour rainfall amounts. Type II represents the rest of the country. For more precise distribution boundaries in a state having more than one type, contact the NRCS State Conservation Engineer.



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

Table 6.5. SCS Cumulative Dimensionless 24-hour Storms

Time (h)	Type I Storm	Type IA Storm	Type II Storm	Type III Storm
0	0	0	0	0
0.5	0.008	0.010	0.005	0.005
1.0	0.017	0.020	0.011	0.010
1.5	0.026	0.035	0.016	0.015
2.0	0.035	0.050	0.022	0.020
2.5	0.045	0.067	0.028	0.025
3.0	0.055	0.082	0.035	0.031
3.5	0.065	0.098	0.041	0.037
4.0	0.076	0.116	0.048	0.043
4.5	0.087	0.135	0.056	0.050
5.0	0.099	0.156	0.063	0.057
5.5	0.112	0.180	0.071	0.064
6.0	0.126	0.206	0.080	0.072
6.5	0.140	0.237	0.089	0.081
7.0	0.156	0.268	0.098	0.091
7.5	0.174	0.310	0.109	0.102
8.0	0.194	0.425	0.120	0.114
8.5	0.219	0.480	0.133	0.128
9.0	0.254	0.520	0.147	0.146
9.5	0.303	0.550	0.162	0.166
10.0	0.515	0.577	0.181	0.189
10.5	0.583	0.601	0.204	0.212
11.0	0.624	0.624	0.235	0.250
11.5	0.655	0.645	0.283	0.298
12.0	0.682	0.664	0.663	0.500
12.5	0.706	0.683	0.735	0.702
13.0	0.728	0.701	0.772	0.750
13.5	0.748	0.719	0.799	0.784
14.0	0.766	0.736	0.820	0.811
14.5	0.783	0.753	0.838	0.834
15.0	0.799	0.769	0.854	0.854
15.5	0.815	0.785	0.868	0.872
16.0	0.830	0.800	0.880	0.886
16.5	0.844	0.815	0.891	0.898
17.0	0.857	0.830	0.902	0.910
17.5	0.870	0.844	0.912	0.920
18.0	0.882	0.858	0.921	0.928
18.5	0.893	0.871	0.929	0.936
19.0	0.905	0.884	0.937	0.943
19.5	0.916	0.896	0.945	0.950
20.0	0.926	0.908	0.952	0.957
20.5	0.936	0.920	0.959	0.963
21.0	0.946	0.932	0.965	0.969
21.5	0.956	0.944	0.972	0.975
22.0	0.965	0.956	0.978	0.981
22.5	0.974	0.967	0.984	0.986
23.0	0.983	0.978	0.989	0.991
23.5	0.992	0.989	0.995	0.996
24.0	1.000	1.000	1.000	1.000

2.3.3 Hydrograph Synthesis – Santa Barbara Urban Hydrograph

The Santa Barbara Urban Hydrograph (SBUH) method is described below. It is given here as a guideline only, as it is only one of the many SCS-based hydrograph methods that are available for use.

The SBUH method, like the Soil Conservation Service Unit Hydrograph (SCSUH) method, is based on the curve number (CN) approach, and also uses SCS equations for computing soil absorption and precipitation excess. The SCSUH method works by converting the incremental runoff depths (precipitation excess) for a given basin and design storm into a runoff hydrograph via application of a dimensionless unit hydrograph. The shape of the SCS unit hydrograph (time to peak, time base, and peak) are determined by a single parameter - the basin time of concentration. The SBUH method, on the other hand, converts the incremental runoff depths into instantaneous hydrographs that are then routed through an imaginary reservoir with a time delay equal to the basin time of concentration.

The SBUH method was developed by the Santa Barbara County Flood Control and Water Conservation District, California. The SBUH method directly computes a runoff hydrograph without going through an intermediate process (unit hydrograph) as the SCSUH method does. By comparison, the calculation steps of the SBUH method are much simpler and can be programmed on a calculator or a spreadsheet program.

The SBUH method uses two steps to synthesize the runoff hydrograph:

- Step one - computing the instantaneous hydrograph, and
- Step two - computing the runoff hydrograph.

The instantaneous hydrograph, I(t), in cfs, at each time step, dt, is computed as follows:

I_t $= 60.5\ R_t A / d_t$

Where R_t = total runoff depth (both impervious and pervious runoffs) at time increment dt, in inches (also known as precipitation excess)

A = area in acres

d_t = time interval in minutes*

*NOTE: A maximum time interval of 10 minutes should be used for all design storms of 24-hour duration. A maximum time interval of 60 minutes should be used for the 100-year, 7-day design storm.

The runoff hydrograph, Q_t, is then obtained by routing the instantaneous hydrograph I_t, through an imaginary reservoir with a time delay equal to the time of concentration, T_c, of the drainage basin. The following equation estimates the routed flow, Q_t:

$Q_{t+1} = Q_t + w[I_t + I_{t+1} - 2Q_t]$

Where: $w = d_t/(2T_c + d_t)$

d_t = time interval in minutes

Example: To illustrate the SBUH method, Tables 2.6 and 2.7 show runoff hydrograph values computed by this method for both existing and developed conditions. Figure 2.3 illustrates the hydrographs for existing and developed conditions. Note, this example was prepared using the Excel 5.0 spreadsheet program and illustrates how the method can be used with a personal computer. Copies of this program and a Fortran version are available (with minimal documentation) from King County Surface Water Management Division.

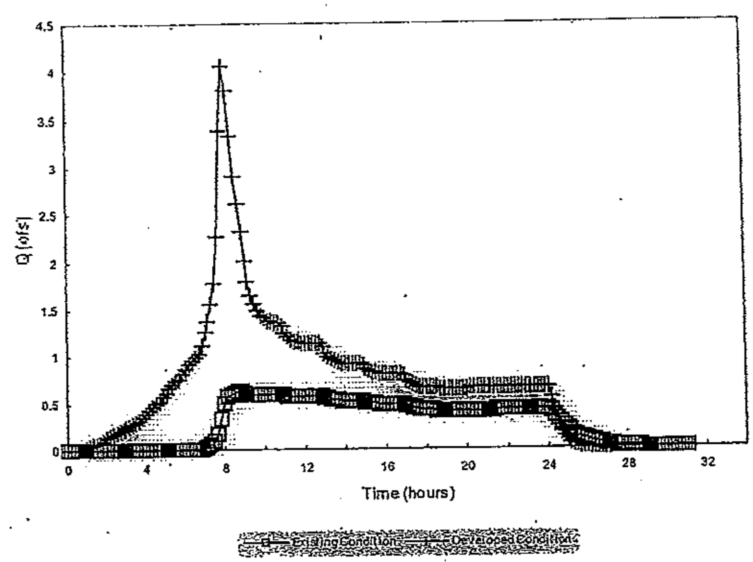


Figure 2.3 SBUH Hydrograph for Existing and Developed Site Conditions

Table 2.6
SBUH Values for Existing Site Condition

Given: Area = 10 acres	P = 2.9 inches (10-yr, 24-hr. event)			dt = 10 minutes
PERVIOUS AREA:	Area = 10 acres	CN = 74	S = 3.513514	0.2S = 0.70
IMPERVIOUS AREA:	Area = 0 acres	CN = 98	S = 0.204082	0.2S = 0.04
Tc = 73 minutes	w = 0.064103	where S = potential maximum natural detention (as defined earlier)		

Column (1) = Time Increment
Column (2) = Time (min)
Column (3) = Type IA Storm Distribution
Column (4) = Column (3) * P
Column (5) = Accumulated sum of Column (4)
Column (6) = If (P < 0.2S) = 0, If (P > 0.2S) = (Column (5) - 0.2S)^2/(Column (5) + 0.8S), where the PERVIOUS AREA S value is used
Column (7) = Column (6) of the present step - Column (6) of the previous step
Column (8) = Same as Column (6) except use IMPERVIOUS AREA S value
Column (9) = Column (8) of the present step - Column (8) of the previous step
Column (10) = (PERVIOUS AREA/TOTAL AREA)*Column (7)+(IMPERVIOUS AREA/TOTAL AREA)*Column (9)
Column (11) = (60.5*Column (10)*Total Area)/dt, where dt = 10 or 60 minutes
Column (12) = Column (12) of previous time step + w * [(Column (11) of previous time step + Column (11) of present time step) - (2 * Column (12) of previous time step)] where w = routing constant = dt/(2Tc + dt) = 0.0641

(1) Time Increment	(2) Time (minute)	(3) Rainfall Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS Accum. Runoff (inches)	(7) PERVIOUS Incre. Runoff (inches)	(8) IMPERVIOUS Accum. Runoff (inches)	(9) IMPERVIOUS Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
1	0	0	0	0	0	0	0	0	0	0.0	0.0
2	10	0.004	0.012	0.012	0.000	0.000	0.000	0.000	0.000	0.0	0.0
3	20	0.004	0.012	0.023	0.000	0.000	0.000	0.000	0.000	0.0	0.0
4	30	0.004	0.012	0.035	0.000	0.000	0.000	0.000	0.000	0.0	0.0
5	40	0.004	0.012	0.046	0.000	0.000	0.000	0.000	0.000	0.0	0.0
6	50	0.004	0.012	0.058	0.000	0.000	0.001	0.001	0.000	0.0	0.0
7	60	0.004	0.012	0.070	0.000	0.000	0.004	0.002	0.000	0.0	0.0
8	70	0.004	0.012	0.081	0.000	0.000	0.007	0.003	0.000	0.0	0.0
9	80	0.004	0.012	0.093	0.000	0.000	0.011	0.004	0.000	0.0	0.0
10	90	0.004	0.012	0.104	0.000	0.000	0.015	0.005	0.000	0.0	0.0
11	100	0.004	0.012	0.116	0.000	0.000	0.020	0.005	0.000	0.0	0.0
12	110	0.005	0.015	0.131	0.000	0.000	0.027	0.007	0.000	0.0	0.0
13	120	0.005	0.015	0.145	0.000	0.000	0.035	0.008	0.000	0.0	0.0
14	130	0.005	0.015	0.160	0.000	0.000	0.044	0.008	0.000	0.0	0.0
15	140	0.005	0.015	0.174	0.000	0.000	0.053	0.009	0.000	0.0	0.0
16	150	0.005	0.015	0.189	0.000	0.000	0.062	0.009	0.000	0.0	0.0
17	160	0.005	0.015	0.203	0.000	0.000	0.072	0.010	0.000	0.0	0.0
18	170	0.006	0.017	0.220	0.000	0.000	0.084	0.012	0.000	0.0	0.0
19	180	0.006	0.017	0.238	0.000	0.000	0.097	0.013	0.000	0.0	0.0
20	190	0.006	0.017	0.255	0.000	0.000	0.110	0.013	0.000	0.0	0.0
21	200	0.006	0.017	0.273	0.000	0.000	0.123	0.013	0.000	0.0	0.0
22	210	0.006	0.017	0.290	0.000	0.000	0.137	0.014	0.000	0.0	0.0
23	220	0.006	0.017	0.307	0.000	0.000	0.151	0.014	0.000	0.0	0.0
24	230	0.007	0.020	0.328	0.000	0.000	0.168	0.017	0.000	0.0	0.0
25	240	0.007	0.020	0.348	0.000	0.000	0.185	0.017	0.000	0.0	0.0
26	250	0.007	0.020	0.368	0.000	0.000	0.202	0.017	0.000	0.0	0.0
27	260	0.007	0.020	0.389	0.000	0.000	0.219	0.017	0.000	0.0	0.0
28	270	0.007	0.020	0.409	0.000	0.000	0.237	0.018	0.000	0.0	0.0
29	280	0.007	0.020	0.429	0.000	0.000	0.255	0.018	0.000	0.0	0.0
30	290	0.008	0.024	0.453	0.000	0.000	0.276	0.021	0.000	0.0	0.0
31	300	0.008	0.024	0.477	0.000	0.000	0.297	0.021	0.000	0.0	0.0
32	310	0.008	0.024	0.501	0.000	0.000	0.318	0.021	0.000	0.0	0.0
33	320	0.008	0.024	0.524	0.000	0.000	0.340	0.022	0.000	0.0	0.0
34	330	0.008	0.024	0.548	0.000	0.000	0.362	0.022	0.000	0.0	0.0
35	340	0.008	0.024	0.572	0.000	0.000	0.384	0.022	0.000	0.0	0.0
36	350	0.010	0.028	0.599	0.000	0.000	0.409	0.026	0.000	0.0	0.0
37	360	0.010	0.028	0.627	0.000	0.000	0.435	0.026	0.000	0.0	0.0
38	370	0.010	0.028	0.655	0.000	0.000	0.461	0.026	0.000	0.0	0.0

(1) Time Increment	(2) Time (minute)	(3) Rainfall Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS	(7)	(8) IMPERVIOUS	(9)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
					Accum. Runoff (inches)	Incre. Runoff (inches)	Accum. Runoff (inches)	Incre. Runoff (inches)			
39	380	0.010	0.028	0.682	0.000	0.000	0.486	0.026	0.000	0.0	0.0
40	390	0.010	0.028	0.710	0.000	0.000	0.512	0.026	0.000	0.0	0.0
41	400	0.010	0.028	0.737	0.000	0.000	0.539	0.026	0.000	0.0	0.0
42	410	0.013	0.039	0.776	0.001	0.001	0.575	0.037	0.001	0.1	0.0
43	420	0.013	0.039	0.815	0.003	0.002	0.613	0.037	0.002	0.1	0.0
44	430	0.013	0.039	0.854	0.006	0.003	0.650	0.037	0.003	0.2	0.0
45	440	0.018	0.052	0.906	0.011	0.005	0.700	0.050	0.005	0.3	0.1
46	450	0.018	0.052	0.958	0.017	0.006	0.750	0.050	0.006	0.4	0.1
47	460	0.034	0.099	1.057	0.032	0.015	0.846	0.096	0.015	0.9	0.2
48	470	0.054	0.157	1.213	0.065	0.032	0.999	0.153	0.032	2.0	0.3
49	480	0.027	0.078	1.292	0.085	0.020	1.075	0.077	0.020	1.2	0.5
50	490	0.018	0.052	1.344	0.099	0.014	1.127	0.051	0.014	0.9	0.6
51	500	0.013	0.039	1.383	0.110	0.011	1.165	0.038	0.011	0.7	0.6
52	510	0.013	0.039	1.422	0.122	0.012	1.203	0.038	0.012	0.7	0.6
53	520	0.013	0.039	1.460	0.134	0.012	1.241	0.038	0.012	0.7	0.6
54	530	0.009	0.026	1.486	0.143	0.008	1.266	0.025	0.008	0.5	0.6
55	540	0.009	0.026	1.511	0.151	0.009	1.291	0.025	0.009	0.5	0.6
56	550	0.009	0.026	1.537	0.160	0.009	1.317	0.025	0.009	0.5	0.6
57	560	0.009	0.026	1.563	0.169	0.009	1.342	0.025	0.009	0.5	0.6
58	570	0.009	0.026	1.588	0.178	0.009	1.367	0.025	0.009	0.6	0.6
59	580	0.009	0.026	1.614	0.188	0.009	1.392	0.025	0.009	0.6	0.6
60	590	0.009	0.026	1.639	0.197	0.010	1.417	0.025	0.010	0.6	0.6
61	600	0.009	0.026	1.665	0.207	0.010	1.442	0.025	0.010	0.6	0.6
62	610	0.009	0.026	1.690	0.217	0.010	1.468	0.025	0.010	0.6	0.6
63	620	0.009	0.026	1.716	0.227	0.010	1.493	0.025	0.010	0.6	0.6
64	630	0.009	0.026	1.741	0.237	0.010	1.518	0.025	0.010	0.6	0.6
65	640	0.009	0.026	1.767	0.247	0.010	1.543	0.025	0.010	0.6	0.6
66	650	0.007	0.021	1.788	0.256	0.009	1.564	0.021	0.009	0.5	0.6
67	660	0.007	0.021	1.808	0.265	0.009	1.585	0.021	0.009	0.5	0.6
68	670	0.007	0.021	1.829	0.274	0.009	1.605	0.021	0.009	0.5	0.6
69	680	0.007	0.021	1.850	0.283	0.009	1.626	0.021	0.009	0.5	0.6
70	690	0.007	0.021	1.871	0.292	0.009	1.647	0.021	0.009	0.5	0.6
71	700	0.007	0.021	1.892	0.301	0.009	1.667	0.021	0.009	0.6	0.6
72	710	0.007	0.021	1.913	0.310	0.009	1.688	0.021	0.009	0.6	0.6
73	720	0.007	0.021	1.934	0.319	0.009	1.709	0.021	0.009	0.6	0.6
74	730	0.007	0.021	1.955	0.329	0.009	1.729	0.021	0.009	0.6	0.6
75	740	0.007	0.021	1.975	0.338	0.010	1.750	0.021	0.010	0.6	0.6
76	750	0.007	0.021	1.996	0.348	0.010	1.771	0.021	0.010	0.6	0.6
77	760	0.007	0.021	2.017	0.358	0.010	1.791	0.021	0.010	0.6	0.6
78	770	0.006	0.017	2.034	0.366	0.008	1.808	0.016	0.008	0.5	0.6
79	780	0.006	0.017	2.050	0.374	0.008	1.824	0.016	0.008	0.5	0.6
80	790	0.006	0.017	2.067	0.382	0.008	1.841	0.016	0.008	0.5	0.5
81	800	0.006	0.017	2.083	0.389	0.008	1.857	0.016	0.008	0.5	0.5
82	810	0.006	0.017	2.100	0.398	0.008	1.873	0.016	0.008	0.5	0.5
83	820	0.006	0.017	2.116	0.406	0.008	1.890	0.016	0.008	0.5	0.5
84	830	0.006	0.017	2.133	0.414	0.008	1.906	0.016	0.008	0.5	0.5
85	840	0.006	0.017	2.149	0.422	0.008	1.923	0.016	0.008	0.5	0.5
86	850	0.006	0.017	2.166	0.430	0.008	1.939	0.016	0.008	0.5	0.5
87	860	0.006	0.017	2.183	0.439	0.008	1.955	0.016	0.008	0.5	0.5
88	870	0.006	0.017	2.199	0.447	0.008	1.972	0.016	0.008	0.5	0.5
89	880	0.006	0.017	2.216	0.455	0.008	1.988	0.016	0.008	0.4	0.5
90	890	0.005	0.015	2.230	0.463	0.007	2.003	0.014	0.007	0.5	0.5
91	900	0.005	0.015	2.245	0.470	0.007	2.017	0.014	0.007	0.5	0.5
92	910	0.005	0.015	2.259	0.478	0.008	2.031	0.014	0.008	0.5	0.5
93	920	0.005	0.015	2.274	0.485	0.008	2.046	0.014	0.008	0.5	0.5
94	930	0.005	0.015	2.288	0.493	0.008	2.060	0.014	0.008	0.5	0.5
95	940	0.005	0.015	2.303	0.501	0.008	2.075	0.014	0.008	0.5	0.5

(1) Time Increment	(2) Time (minute)	(3) Rainfall Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS Accum. Runoff (inches)	(7) PERVIOUS Incre. Runoff (inches)	(8) IMPERVIOUS Accum. Runoff (inches)	(9) IMPERVIOUS Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
96	950	0.005	0.015	2.317	0.508	0.008	2.089	0.014	0.008	0.5	0.5
97	960	0.005	0.015	2.332	0.516	0.008	2.103	0.014	0.008	0.5	0.5
98	970	0.005	0.015	2.346	0.524	0.008	2.118	0.014	0.008	0.5	0.5
99	980	0.005	0.015	2.361	0.532	0.008	2.132	0.014	0.008	0.5	0.5
100	990	0.005	0.015	2.375	0.539	0.008	2.147	0.014	0.008	0.5	0.5
101	1000	0.005	0.015	2.390	0.547	0.008	2.161	0.014	0.008	0.5	0.5
102	1010	0.004	0.012	2.401	0.554	0.006	2.173	0.012	0.006	0.4	0.5
103	1020	0.004	0.012	2.413	0.560	0.006	2.184	0.012	0.006	0.4	0.5
104	1030	0.004	0.012	2.424	0.566	0.006	2.196	0.012	0.006	0.4	0.4
105	1040	0.004	0.012	2.436	0.573	0.006	2.207	0.012	0.006	0.4	0.4
106	1050	0.004	0.012	2.448	0.579	0.006	2.219	0.012	0.006	0.4	0.4
107	1060	0.004	0.012	2.459	0.585	0.006	2.230	0.012	0.006	0.4	0.4
108	1070	0.004	0.012	2.471	0.592	0.006	2.242	0.012	0.006	0.4	0.4
109	1080	0.004	0.012	2.482	0.598	0.006	2.253	0.012	0.006	0.4	0.4
110	1090	0.004	0.012	2.494	0.605	0.007	2.265	0.012	0.007	0.4	0.4
111	1100	0.004	0.012	2.506	0.611	0.007	2.276	0.012	0.007	0.4	0.4
112	1110	0.004	0.012	2.517	0.618	0.007	2.288	0.012	0.007	0.4	0.4
113	1120	0.004	0.012	2.529	0.625	0.007	2.299	0.012	0.007	0.4	0.4
114	1130	0.004	0.012	2.540	0.631	0.007	2.311	0.012	0.007	0.4	0.4
115	1140	0.004	0.012	2.552	0.638	0.007	2.322	0.012	0.007	0.4	0.4
116	1150	0.004	0.012	2.564	0.644	0.007	2.334	0.012	0.007	0.4	0.4
117	1160	0.004	0.012	2.575	0.651	0.007	2.346	0.012	0.007	0.4	0.4
118	1170	0.004	0.012	2.587	0.658	0.007	2.357	0.012	0.007	0.4	0.4
119	1180	0.004	0.012	2.598	0.664	0.007	2.369	0.012	0.007	0.4	0.4
120	1190	0.004	0.012	2.610	0.671	0.007	2.380	0.012	0.007	0.4	0.4
121	1200	0.004	0.012	2.622	0.678	0.007	2.392	0.012	0.007	0.4	0.4
122	1210	0.004	0.012	2.633	0.685	0.007	2.403	0.012	0.007	0.4	0.4
123	1220	0.004	0.012	2.645	0.691	0.007	2.415	0.012	0.007	0.4	0.4
124	1230	0.004	0.012	2.656	0.698	0.007	2.426	0.012	0.007	0.4	0.4
125	1240	0.004	0.012	2.668	0.705	0.007	2.438	0.012	0.007	0.4	0.4
126	1250	0.004	0.012	2.680	0.712	0.007	2.449	0.012	0.007	0.4	0.4
127	1260	0.004	0.012	2.691	0.719	0.007	2.461	0.012	0.007	0.4	0.4
128	1270	0.004	0.012	2.703	0.726	0.007	2.472	0.012	0.007	0.4	0.4
129	1280	0.004	0.012	2.714	0.732	0.007	2.484	0.012	0.007	0.4	0.4
130	1290	0.004	0.012	2.726	0.739	0.007	2.496	0.012	0.007	0.4	0.4
131	1300	0.004	0.012	2.738	0.746	0.007	2.507	0.012	0.007	0.4	0.4
132	1310	0.004	0.012	2.749	0.753	0.007	2.519	0.012	0.007	0.4	0.4
133	1320	0.004	0.012	2.761	0.760	0.007	2.530	0.012	0.007	0.4	0.4
134	1330	0.004	0.012	2.772	0.767	0.007	2.542	0.012	0.007	0.4	0.4
135	1340	0.004	0.012	2.784	0.774	0.007	2.553	0.012	0.007	0.4	0.4
136	1350	0.004	0.012	2.796	0.781	0.007	2.565	0.012	0.007	0.4	0.4
137	1360	0.004	0.012	2.807	0.788	0.007	2.576	0.012	0.007	0.4	0.4
138	1370	0.004	0.012	2.819	0.795	0.007	2.588	0.012	0.007	0.4	0.4
139	1380	0.004	0.012	2.830	0.803	0.007	2.599	0.012	0.007	0.4	0.4
140	1390	0.004	0.012	2.842	0.810	0.007	2.611	0.012	0.007	0.4	0.4
141	1400	0.004	0.012	2.854	0.817	0.007	2.623	0.012	0.007	0.4	0.4
142	1410	0.004	0.012	2.865	0.824	0.007	2.634	0.012	0.007	0.4	0.4
143	1420	0.004	0.012	2.877	0.831	0.007	2.646	0.012	0.007	0.4	0.4
144	1430	0.004	0.012	2.888	0.838	0.007	2.657	0.012	0.007	0.4	0.4
145	1440	0.004	0.012	2.900	0.845	0.007	2.669	0.012	0.007	0.4	0.4

Table 2.7
SBUH Values for Developed Site Condition

Given: Area = 10 acres   P = 2.9 inches (10-yr., 24-hr. event)   dt = 10 minutes
PERVIOUS AREA: Area = 6.1 acres   CN = 89   S = 1.235955   0.2S = 0.25
IMPERVIOUS AREA: Area = 3.9 acres   CN = 98   S = 0.204082   0.2S = 0.04
Tc = 28 minutes   w = 0.151515   where S = potential maximum natural detention (as defined earlier)

Column (1) = Time Increment Column (2) = Time (min)
Column (3) = Type IA Storm Distribution
Column (4) = Column (3) * P
Column (5) = Accumulated sum of Column (4)
Column (6) = If (P < 0.2S) = 0, If (P > 0.2S) = (Column (5) - 0.2S)^2/(Column (5) + 0.8S), where the PERVIOUS AREA S value is used
Column (7) = Column (6) of the present step - Column (6) of the previous step
Column (8) = Same as Column (6) except use IMPERVIOUS AREA S value
Column (9) = Column (8) of the present step - Column (8) of the previous step
Column (10) = (PERVIOUS AREA/TOTAL AREA)*Column (7)+(IMPERVIOUS AREA/TOTAL AREA)*Column (9)
Column (11) = (60.5*Column (10)*Total Area)/dt, where dt = 10 or 60 minutes
Column (12) = Column (12) of previous time step + w * [(Column (11) of previous time step + Column (11) of present time step) - (2 * Column (12) of previous time step)] where w = routing constant = dt/(2Tc + dt) = 0.0641

(1)	(2)	(3)	(4)	(5)	(6) PERVIOUS	(7) PERVIOUS	(8) IMPERVIOUS	(9) IMPERVIOUS	(10)	(11)	(12)
Time Increment	Time (minute)	Rainfall Distrib. (fraction)	Incre. Rainfall (inches)	Accumul. Rainfall (inches)	Accum. Runoff (inches)	Incre. Runoff (inches)	Accum. Runoff (inches)	Incre. Runoff (inches)	Total Runoff (inches)	Instant Flowrate (cfs)	Design Flowrate (cfs)
1	0	0	0	0	0	0	0	0	0	0.0	0.0
2	10	0.004	0.012	0.012	0.000	0.000	0.000	0.000	0.000	0.0	0.0
3	20	0.004	0.012	0.023	0.000	0.000	0.000	0.000	0.000	0.0	0.0
4	30	0.004	0.012	0.035	0.000	0.000	0.000	0.000	0.000	0.0	0.0
5	40	0.004	0.012	0.046	0.000	0.000	0.000	0.000	0.000	0.0	0.0
6	50	0.004	0.012	0.058	0.000	0.000	0.001	0.001	0.000	0.0	0.0
7	60	0.004	0.012	0.070	0.000	0.000	0.004	0.002	0.001	0.1	0.0
8	70	0.004	0.012	0.081	0.000	0.000	0.007	0.003	0.001	0.1	0.0
9	80	0.004	0.012	0.093	0.000	0.000	0.011	0.004	0.002	0.1	0.0
10	90	0.004	0.012	0.104	0.000	0.000	0.015	0.005	0.002	0.1	0.1
11	100	0.004	0.012	0.116	0.000	0.000	0.020	0.005	0.002	0.1	0.1
12	110	0.005	0.015	0.131	0.000	0.000	0.027	0.007	0.003	0.2	0.1
13	120	0.005	0.015	0.145	0.000	0.000	0.035	0.008	0.003	0.2	0.1
14	130	0.005	0.015	0.160	0.000	0.000	0.044	0.008	0.003	0.2	0.1
15	140	0.005	0.015	0.174	0.000	0.000	0.053	0.009	0.003	0.2	0.2
16	150	0.005	0.015	0.189	0.000	0.000	0.062	0.009	0.004	0.2	0.2
17	160	0.005	0.015	0.203	0.000	0.000	0.072	0.010	0.004	0.2	0.2
18	170	0.006	0.017	0.220	0.000	0.000	0.084	0.012	0.005	0.3	0.2
19	180	0.006	0.017	0.238	0.000	0.000	0.097	0.013	0.005	0.3	0.2
20	190	0.006	0.017	0.255	0.000	0.000	0.110	0.013	0.005	0.3	0.3
21	200	0.006	0.017	0.273	0.001	0.000	0.123	0.013	0.006	0.3	0.3
22	210	0.006	0.017	0.290	0.001	0.001	0.137	0.014	0.006	0.4	0.3
23	220	0.006	0.017	0.307	0.003	0.001	0.151	0.014	0.006	0.4	0.3
24	230	0.007	0.020	0.328	0.005	0.002	0.168	0.017	0.008	0.5	0.4
25	240	0.007	0.020	0.348	0.008	0.003	0.185	0.017	0.008	0.5	0.4
26	250	0.007	0.020	0.368	0.011	0.003	0.202	0.017	0.009	0.5	0.4
27	260	0.007	0.020	0.389	0.015	0.004	0.219	0.017	0.009	0.5	0.5
28	270	0.007	0.020	0.409	0.019	0.004	0.237	0.018	0.009	0.6	0.5
29	280	0.007	0.020	0.429	0.023	0.005	0.255	0.018	0.010	0.6	0.5
30	290	0.008	0.024	0.453	0.029	0.006	0.276	0.021	0.012	0.7	0.6
31	300	0.008	0.024	0.477	0.036	0.007	0.297	0.021	0.012	0.7	0.6
32	310	0.008	0.024	0.501	0.043	0.007	0.318	0.021	0.013	0.8	0.7
33	320	0.008	0.024	0.524	0.051	0.008	0.340	0.022	0.013	0.8	0.7
34	330	0.008	0.024	0.548	0.059	0.008	0.362	0.022	0.013	0.8	0.7
35	340	0.008	0.024	0.572	0.068	0.009	0.384	0.022	0.014	0.8	0.8
36	350	0.010	0.028	0.599	0.078	0.011	0.409	0.026	0.016	1.0	0.8
37	360	0.010	0.028	0.627	0.089	0.011	0.435	0.026	0.017	1.0	0.9
38	370	0.010	0.028	0.655	0.101	0.012	0.461	0.026	0.017	1.0	0.9

(1) Time Increment	(2) Time (minute)	(3) Rainfall Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS Accum. Runoff (inches)	(7) PERVIOUS Incre. Runoff (inches)	(8) IMPERVIOUS Accum. Runoff (inches)	(9) IMPERVIOUS Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
39	380	0.010	0.028	0.682	0.113	0.012	0.486	0.026	0.018	1.1	1.0
40	390	0.010	0.028	0.710	0.126	0.013	0.512	0.026	0.018	1.1	1.0
41	400	0.010	0.028	0.737	0.139	0.013	0.539	0.026	0.018	1.1	1.0
42	410	0.013	0.039	0.776	0.158	0.019	0.575	0.037	0.026	1.6	1.1
43	420	0.013	0.039	0.815	0.179	0.020	0.613	0.037	0.027	1.6	1.3
44	430	0.013	0.039	0.854	0.200	0.021	0.650	0.037	0.027	1.7	1.4
45	440	0.018	0.052	0.906	0.229	0.029	0.700	0.050	0.037	2.3	1.6
46	450	0.018	0.052	0.958	0.260	0.031	0.750	0.050	0.038	2.3	1.8
47	460	0.034	0.099	1.057	0.320	0.061	0.846	0.096	0.074	4.5	2.3
48	470	0.054	0.157	1.213	0.424	0.103	0.999	0.153	0.123	7.4	3.4
49	480	0.027	0.078	1.292	0.478	0.054	1.075	0.077	0.063	3.8	4.1
50	490	0.018	0.052	1.344	0.516	0.037	1.127	0.051	0.043	2.6	3.8
51	500	0.013	0.039	1.383	0.544	0.028	1.165	0.038	0.032	1.9	3.3
52	510	0.013	0.039	1.422	0.572	0.028	1.203	0.038	0.032	2.0	2.9
53	520	0.013	0.039	1.460	0.601	0.029	1.241	0.038	0.032	2.0	2.6
54	530	0.009	0.026	1.486	0.620	0.019	1.266	0.025	0.021	1.3	2.3
55	540	0.009	0.026	1.511	0.639	0.019	1.291	0.025	0.022	1.3	2.0
56	550	0.009	0.026	1.537	0.659	0.019	1.317	0.025	0.022	1.3	1.8
57	560	0.009	0.026	1.563	0.678	0.019	1.342	0.025	0.022	1.3	1.7
58	570	0.009	0.026	1.588	0.698	0.020	1.367	0.025	0.022	1.3	1.5
59	580	0.009	0.026	1.614	0.717	0.020	1.392	0.025	0.022	1.3	1.5
60	590	0.009	0.026	1.639	0.737	0.020	1.417	0.025	0.022	1.3	1.4
61	600	0.009	0.026	1.665	0.757	0.020	1.442	0.025	0.022	1.3	1.4
62	610	0.009	0.026	1.690	0.777	0.020	1.468	0.025	0.022	1.3	1.4
63	620	0.009	0.026	1.716	0.797	0.020	1.493	0.025	0.022	1.3	1.4
64	630	0.009	0.026	1.741	0.818	0.020	1.518	0.025	0.022	1.3	1.4
65	640	0.009	0.026	1.767	0.838	0.020	1.543	0.025	0.022	1.3	1.4
66	650	0.007	0.021	1.788	0.855	0.017	1.564	0.021	0.018	1.1	1.3
67	660	0.007	0.021	1.808	0.871	0.017	1.585	0.021	0.018	1.1	1.3
68	670	0.007	0.021	1.829	0.888	0.017	1.605	0.021	0.018	1.1	1.2
69	680	0.007	0.021	1.850	0.905	0.017	1.626	0.021	0.018	1.1	1.2
70	690	0.007	0.021	1.871	0.922	0.017	1.647	0.021	0.018	1.1	1.2
71	700	0.007	0.021	1.892	0.939	0.017	1.667	0.021	0.018	1.1	1.1
72	710	0.007	0.021	1.913	0.956	0.017	1.688	0.021	0.018	1.1	1.1
73	720	0.007	0.021	1.934	0.973	0.017	1.709	0.021	0.019	1.1	1.1
74	730	0.007	0.021	1.955	0.990	0.017	1.729	0.021	0.019	1.1	1.1
75	740	0.007	0.021	1.975	1.008	0.017	1.750	0.021	0.019	1.1	1.1
76	750	0.007	0.021	1.996	1.025	0.017	1.771	0.021	0.019	1.1	1.1
77	760	0.007	0.021	2.017	1.042	0.017	1.791	0.021	0.019	1.1	1.1
78	770	0.006	0.017	2.034	1.056	0.014	1.808	0.016	0.015	0.9	1.1
79	780	0.006	0.017	2.050	1.070	0.014	1.824	0.016	0.015	0.9	1.0
80	790	0.006	0.017	2.067	1.084	0.014	1.841	0.016	0.015	0.9	1.0
81	800	0.006	0.017	2.083	1.097	0.014	1.857	0.016	0.015	0.9	1.0
82	810	0.006	0.017	2.100	1.111	0.014	1.873	0.016	0.015	0.9	0.9
83	820	0.006	0.017	2.116	1.125	0.014	1.890	0.016	0.015	0.9	0.9
84	830	0.006	0.017	2.133	1.139	0.014	1.906	0.016	0.015	0.9	0.9
85	840	0.006	0.017	2.149	1.153	0.014	1.923	0.016	0.015	0.9	0.9
86	850	0.006	0.017	2.166	1.167	0.014	1.939	0.016	0.015	0.9	0.9
87	860	0.006	0.017	2.183	1.181	0.014	1.955	0.016	0.015	0.9	0.9
88	870	0.006	0.017	2.199	1.195	0.014	1.972	0.016	0.015	0.9	0.9
89	880	0.006	0.017	2.216	1.209	0.014	1.988	0.016	0.015	0.9	0.9
90	890	0.005	0.015	2.230	1.222	0.012	2.003	0.014	0.013	0.8	0.9
91	900	0.005	0.015	2.245	1.234	0.012	2.017	0.014	0.013	0.8	0.9
92	910	0.005	0.015	2.259	1.246	0.012	2.031	0.014	0.013	0.8	0.8
93	920	0.005	0.015	2.274	1.259	0.012	2.046	0.014	0.013	0.8	0.8
94	930	0.005	0.015	2.288	1.271	0.012	2.060	0.014	0.013	0.8	0.8
95	940	0.005	0.015	2.303	1.284	0.012	2.075	0.014	0.013	0.8	0.8

(1) Time Increment	(2) Time (minute)	(3) Rainfall Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS Accum. Runoff (inches)	(7) PERVIOUS Incre. Runoff (inches)	(8) IMPERVIOUS Accum. Runoff (inches)	(9) IMPERVIOUS Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
96	950	0.005	0.015	2.317	1.296	0.012	2.089	0.014	0.013	0.8	0.8
97	960	0.005	0.015	2.332	1.309	0.012	2.103	0.014	0.013	0.8	0.8
98	970	0.005	0.015	2.346	1.321	0.012	2.118	0.014	0.013	0.8	0.8
99	980	0.005	0.015	2.361	1.334	0.013	2.132	0.014	0.013	0.8	0.8
100	990	0.005	0.015	2.375	1.346	0.013	2.147	0.014	0.013	0.8	0.8
101	1000	0.005	0.015	2.390	1.359	0.013	2.161	0.014	0.013	0.8	0.8
102	1010	0.004	0.012	2.401	1.369	0.010	2.173	0.012	0.011	0.6	0.8
103	1020	0.004	0.012	2.413	1.379	0.010	2.184	0.012	0.011	0.6	0.7
104	1030	0.004	0.012	2.424	1.389	0.010	2.196	0.012	0.011	0.6	0.7
105	1040	0.004	0.012	2.436	1.399	0.010	2.207	0.012	0.011	0.6	0.7
106	1050	0.004	0.012	2.448	1.409	0.010	2.219	0.012	0.011	0.6	0.7
107	1060	0.004	0.012	2.459	1.419	0.010	2.230	0.012	0.011	0.6	0.7
108	1070	0.004	0.012	2.471	1.429	0.010	2.242	0.012	0.011	0.6	0.7
109	1080	0.004	0.012	2.482	1.439	0.010	2.253	0.012	0.011	0.6	0.7
110	1090	0.004	0.012	2.494	1.449	0.010	2.265	0.012	0.011	0.6	0.7
111	1100	0.004	0.012	2.506	1.460	0.010	2.276	0.012	0.011	0.6	0.7
112	1110	0.004	0.012	2.517	1.470	0.010	2.288	0.012	0.011	0.6	0.6
113	1120	0.004	0.012	2.529	1.480	0.010	2.299	0.012	0.011	0.6	0.6
114	1130	0.004	0.012	2.540	1.490	0.010	2.311	0.012	0.011	0.6	0.6
115	1140	0.004	0.012	2.552	1.500	0.010	2.322	0.012	0.011	0.6	0.6
116	1150	0.004	0.012	2.564	1.510	0.010	2.334	0.012	0.011	0.6	0.6
117	1160	0.004	0.012	2.575	1.521	0.010	2.346	0.012	0.011	0.6	0.6
118	1170	0.004	0.012	2.587	1.531	0.010	2.357	0.012	0.011	0.6	0.6
119	1180	0.004	0.012	2.598	1.541	0.010	2.369	0.012	0.011	0.6	0.6
120	1190	0.004	0.012	2.610	1.551	0.010	2.380	0.012	0.011	0.6	0.6
121	1200	0.004	0.012	2.622	1.562	0.010	2.392	0.012	0.011	0.6	0.6
122	1210	0.004	0.012	2.633	1.572	0.010	2.403	0.012	0.011	0.7	0.6
123	1220	0.004	0.012	2.645	1.582	0.010	2.415	0.012	0.011	0.7	0.6
124	1230	0.004	0.012	2.656	1.592	0.010	2.426	0.012	0.011	0.7	0.7
125	1240	0.004	0.012	2.668	1.603	0.010	2.438	0.012	0.011	0.7	0.7
126	1250	0.004	0.012	2.680	1.613	0.010	2.449	0.012	0.011	0.7	0.7
127	1260	0.004	0.012	2.691	1.623	0.010	2.461	0.012	0.011	0.7	0.7
128	1270	0.004	0.012	2.703	1.633	0.010	2.472	0.012	0.011	0.7	0.7
129	1280	0.004	0.012	2.714	1.644	0.010	2.484	0.012	0.011	0.7	0.7
130	1290	0.004	0.012	2.726	1.654	0.010	2.496	0.012	0.011	0.7	0.7
131	1300	0.004	0.012	2.738	1.664	0.010	2.507	0.012	0.011	0.7	0.7
132	1310	0.004	0.012	2.749	1.675	0.010	2.519	0.012	0.011	0.7	0.7
133	1320	0.004	0.012	2.761	1.685	0.010	2.530	0.012	0.011	0.7	0.7
134	1330	0.004	0.012	2.772	1.695	0.010	2.542	0.012	0.011	0.7	0.7
135	1340	0.004	0.012	2.784	1.706	0.010	2.553	0.012	0.011	0.7	0.7
136	1350	0.004	0.012	2.796	1.716	0.010	2.565	0.012	0.011	0.7	0.7
137	1360	0.004	0.012	2.807	1.726	0.010	2.576	0.012	0.011	0.7	0.7
138	1370	0.004	0.012	2.819	1.737	0.010	2.588	0.012	0.011	0.7	0.7
139	1380	0.004	0.012	2.830	1.747	0.010	2.599	0.012	0.011	0.7	0.7
140	1390	0.004	0.012	2.842	1.758	0.010	2.611	0.012	0.011	0.7	0.7
141	1400	0.004	0.012	2.854	1.768	0.010	2.623	0.012	0.011	0.7	0.7
142	1410	0.004	0.012	2.865	1.778	0.010	2.634	0.012	0.011	0.7	0.7
143	1420	0.004	0.012	2.877	1.789	0.010	2.646	0.012	0.011	0.7	0.7
144	1430	0.004	0.012	2.888	1.799	0.010	2.657	0.012	0.011	0.7	0.7
145	1440	0.004	0.012	2.900	1.810	0.010	2.669	0.012	0.011	0.7	0.7

2.3.4 Hydrograph Routing (Sizing Detention Facilities)

A methodology is presented here for routing a hydrograph through an existing retention/detention facility or closed depression, and for sizing a new retention/detention facility using hydrograph analysis.

Storage Routing Technique: The "level pool routing" technique presented here is one of the simplest and most commonly used hydrograph routing methods. This method is described in "Handbook of Applied Hydrology," Chow, V. Te, 1964, and elsewhere, and is based on the continuity equation:

Inflow - Outflow = Change in Storage

$$\left[\frac{I_1 + I_2}{2} - \frac{O_1 + O_2}{2}\right] = \frac{\Delta S}{\Delta t} = \frac{S_2 - S_1}{\Delta t}$$

Where I = Inflow at time 1 and time 2
O = Outflow at time 1 and time 2
S = Storage at time 1 and time 2
Δt = Time interval, 2-1

The time interval, Δt, must be consistent with the time interval used in developing the inflow hydrograph. The time interval used for a 24-hour storm is 10 minutes while the time interval used for a 7-day storm is 60 minutes. The Δt variable can be eliminated by dividing it into the storage variables to obtain the following rearranged equation:

$$I_1 + I_2 + 2S_1 - O_1 = O_2 + 2S_2$$

If the time interval, Δt, is in minutes and the units of storage (S) are in cubic feet (cf), this can be converted to cubic feet per second (cfs) by dividing by 60.

The terms I_1, I_2, O_1, and S_1 are known from the inflow hydrograph and from the storage and outflow values of the previous time step. The unknowns O_2 and S_2 can be solved interactively from the given stage-storage and stage-discharge curves.

Appendix C
SANTA BARBARA URBAN HYDROGRAPH METHOD

INTRODUCTION

The Santa Barbara Urban Hydrograph (SBUH) method was developed by the Santa Barbara County Flood Control and Water Conservation District to determine a runoff hydrograph for an urbanized area. It is a simpler method than some other approaches, as it computes a hydrograph directly without going through intermediate steps (i.e., a unit hydrograph) to determine the runoff hydrograph.

The SBUH method is a popular method for calculating runoff, since it can be done with a spreadsheet or by hand relatively easily. The SBUH method is the method approved by the Bureau of Environmental Services (BES) for determining runoff when doing flow control calculations.

ELEMENTS OF THE SBUH METHOD

The SBUH method depends on several variables:

- Pervious (A_p) and impervious (A_{imp}) land areas
- Time of concentration (T_c) calculations
- Runoff curve numbers (CN) applicable to the site
- Design storm

These elements shall all be presented as part of the submittal process for review by BES staff. In addition, maps showing the pre-development and post-development conditions shall be presented to BES to help in the review.

Land Area

The total area, including the pervious and impervious areas within a drainage basin, shall be quantified in order to evaluate critical contributing areas and the resulting site runoff. Each area within a basin shall be analyzed separately and their hydrographs combined to determine the total basin hydrograph. Areas shall be selected to represent homogenous land use/development units.

Time of Concentration

Time of concentration, T_c, is the time for a theoretical drop of water to travel from the furthest point in the drainage basin to the facility being designed. (In this case, T_c is derived by calculating the overland flow time of concentration and the channelized flow time of concentration.) T_c depends on several factors, including ground slope, ground roughness, and distance of flow. The following formula for determining T_c is found in BES's *Sewer Design Manual.*

Figure C-1 - NRCS 24-Hour Type 1A Hyetograph

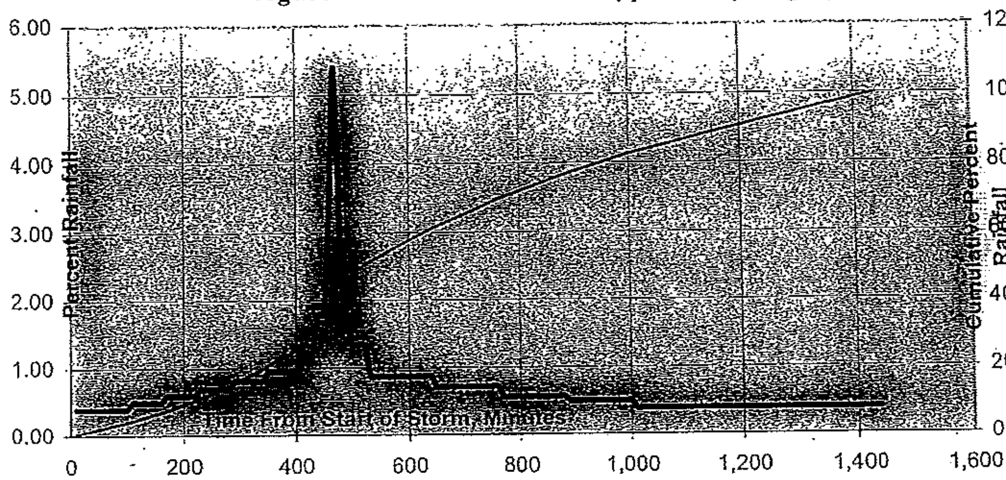
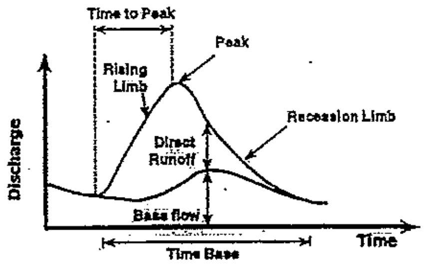


Table C-3 - NRCS Type 1A Hyetographic Distrubution - For Use In Water Quality/Quantity Design

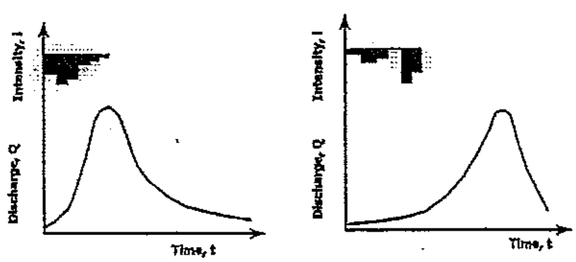
Time From Start of Storm Minutes		% Rainfall	Cumulative % Rainfall
0	10	0.40	0.40
10	20	0.40	0.80
20	30	0.40	1.20
30	40	0.40	1.60
40	50	0.40	2.00
50	60	0.40	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
80	90	0.40	3.60
90	100	[illegible]	4.00
100	110	0.50	4.50
110	120	0.50	5.00
120	130	0.50	5.50
130	140	0.50	6.00
140	150	0.50	6.50
150	160	0.50	7.00
160	170	0.60	7.60
170	180	0.60	8.20
180	190	0.60	8.80
190	200	0.60	9.40
200	210	0.60	10.00
210	220	0.60	10.60
220	230	0.70	11.30
230	240	0.70	12.00
240	250	0.70	12.70
250	260	0.70	13.40
260	270	0.70	14.10
270	280	0.70	14.80
280	290	0.82	15.62
290	300	0.82	16.44
300	310	0.82	17.26
310	320	0.82	18.08
320	330	0.82	18.90
330	340	0.82	19.72
340	350	0.95	20.67
350	360	0.95	21.62
360	370	0.95	22.57
370	380	0.95	23.52
380	390	0.95	24.47
390	400	0.95	25.42
400	410	1.34	26.76
410	420	1.34	28.10
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
440	450	1.80	33.04
450	460	[illegible]	[illegible]
460	470	5.40	41.24
470	480	2.70	[illegible]
480	490	1.80	[illegible]
490	500	1.34	47.68
500	510	1.34	49.02
510	520	[illegible]	50.36
520	530	0.88	51.24
530	540	0.88	52.12
540	550	0.88	53.00
550	560	0.88	53.88
560	570	0.88	54.76
570	580	0.88	55.64
580	590	0.88	56.52
590	600	0.88	57.40
600	610	0.88	58.28
610	620	0.88	59.16
620	630	0.88	60.04
630	640	0.88	60.92
640	650	0.72	61.64
650	660	0.72	62.36
660	670	0.72	63.08
670	680	0.72	63.80
680	690	0.72	64.52
690	700	0.72	65.24
700	710	0.72	65.96
710	720	0.72	66.68
720	730	0.72	67.40
730	740	0.72	[illegible]
740	750	0.72	[illegible]
750	760	0.72	69.56
760	770	0.57	70.13
770	780	0.57	70.70
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.57	[illegible]
[illegible]	[illegible]	0.57	[illegible]
820	830	0.57	73.55
830	840	0.57	74.12
840	850	0.57	74.69
850	860	0.57	[illegible]
860	870	0.57	[illegible]
870	880	0.57	76.40
880	890	0.50	76.90
890	900	0.50	77.40
900	910	0.50	77.90
910	920	0.50	78.40
920	930	0.50	78.90
930	940	0.50	79.40
940	950	0.50	79.90
950	960	0.50	80.40
960	970	0.50	80.90
970	980	0.50	81.40
980	990	0.50	81.90
990	1000	0.50	82.40
1000	1010	0.40	82.80
1010	1020	0.40	83.20
1020	1030	0.40	83.60
1030	1040	0.40	84.00
1040	1050	0.40	84.40
1050	1060	0.40	84.80
1060	1070	0.40	85.20
1070	1080	0.40	85.60
1080	[illegible]	[illegible]	[illegible]
1090	[illegible]	[illegible]	[illegible]
1100	[illegible]	[illegible]	[illegible]
1110	1120	[illegible]	[illegible]
1120	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
1180	1190	0.40	[illegible]
1190	1200	[illegible]	90.40
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
1220	[illegible]	[illegible]	91.60
1230	1240	0.40	92.00
1240	1250	0.40	92.40
1250	1260	0.40	92.80
1260	1270	0.40	93.20
1270	1280	0.40	93.60
1280	1290	0.40	94.00
1290	1300	0.40	94.40
1300	1310	0.40	94.80
1310	1320	0.40	95.20
1320	1330	0.40	95.60
1330	1340	0.40	96.00
1340	1350	0.40	96.40
1350	1360	0.40	96.80
1360	1370	0.40	97.20
1370	1380	0.40	97.60
1380	1390	0.40	98.00
1390	1400	0.40	98.40
1400	1410	0.40	98.80
1410	1420	0.40	99.20
1420	1430	0.40	99.60
1430	1440	0.40	100.00

Runoff Hydrograph



- Runoff volume is represented as the area under the hydrograph and above base flow.

Hyetographs and Hydrographs



- Hyetograph: time variation of precipitation.
- Hydrograph: time variation of discharge.

4.2.5 **Losses Between Rainfall and Runoff**

In both the SCS method and the SBUH method, several parameters are specified to model the losses between the rainfall and the runoff due to the percolation into the soil, interception by vegetation, or depression storage in small surface puddles.

Soil infiltration rates are used to account for the losses due to percolation of rainfall into the soil. The infiltration rates are obtained from the permeability rates for the various soil types. The Soil Conservation Service (SCS) has mapped the major soil groups within the study area. Hydrologic group classifications have also been mapped by the SCS, which indicate the general potential of various soils to generate runoff from rainfall. The following definitions of hydrologic soils groups are used:

Group A: (Low runoff potential). Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands or gravel

Group B: Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils, with moderately fine to moderately course textures.

Group C: Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture.

Group D: (High runoff potential). Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of clay soils with a high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.

TAB-6 contains a soils survey for Northern Santa Barbara County area, with various accompanying maps.

Table 4-4 shows the maximum and minimum infiltration rates of the soils within the study area. The infiltration rates are obtained from the permeability rates for the mapped hydrologic soil groups in the Soil Survey of Santa Barbara County (SCS, April 1978). The maximum infiltration rate is when the soil is dry. The minimum infiltration rate is when the soil is fully saturated, and is the rate that soil will continue to absorb water no mater how long the storm lasts.

Table 4-4 Infiltration Rates			
	Infiltration Rate		
Hydrologic Soil Group	Maximum (in/hr)	Minimum (in/hr)	
A	6.0	2.0	
B	2.0	0.6	
C	0.6	0.2	
D	0.2	0.06	

In addition to infiltration losses, depression storage losses are also estimated. Depression storage is a volume that must be filled prior to the occurrence of runoff on both pervious and impervious areas. It represents an initial loss caused by such phenomena as surface ponding, surface wetting, interception and evaporation.

The HYDRA model allows the fraction of the land segment covered by depression storage to be estimated, and the depth of the depression storage on this fraction to be specified. For this study, we will use an average depth over the entire sub-area, based on experience from previous studies. Generally, the depression storage for the impervious areas is negligible. The value for pervious areas ranges from approximately 0.1 to 0.2 inches on average over the entire sub-area.

For this study, the following depression storage values will be used in the model as average values for the entire sub-area, based on experience from previous studies:

Pervious Areas	0.18 inches
Impervious Areas	0.06 inches

There are also losses from interception storage by vegetation and evaporation-transpiration. Such losses are minimal during rainy season conditions, and are typically not a significant factor in urban areas. For urban areas, the HYDRA model suggests assuming that only half the sub-area is affected by interception storage, if no detailed data is available. The minimum value of 0.1 inches will be used for interception storage. Because depression storage and interception storage are small, these parameters do not significantly affect peak runoff.

4.3 Hydraulic Criteria

4.3.1 Pipe Hydraulic Capacity Criteria

The storm drainage system analysis identifies capacity deficiencies and calculates additional capacity needs based on a set of parameters related to hydraulics. These hydraulic parameters include Manning's "n", the trigger for capacity deficiencies, and percent full for sizing new pipes. The theoretical capacity of the pipe is calculated using Manning's equation.

A trigger for capacity deficiencies of 100 percent full is used to initially identify those pipes that have inadequate capacity. However, recommended improvements to existing pipes are prioritized based on a higher trigger that allows for acceptable surcharging in the storm drain system. For example, existing pipes that have surcharged flow under design storm conditions, but with a hydraulic gradeline below ground level, would be classified as low priority for improvement.

New pipes would be sized to flow at 100 percent full (without surcharge).

4.3.2 Friction Factors

Table 4-6 shows the Manning friction factors for pipes to be used for this study. The table also shows the factors that would be used for channels, if applicable. These values are typical of those used in other communities.

Table 4-6
Friction Factors for Pipes and Channels

Type of Facility	Friction Factor
Reinforced Concrete Pipe	
Under 24" diameter	0.0015
24" and larger diameter	0.0013
Concrete-Lined Channels	
Smooth-trowled	0.015
Rough	0.017
Earth Channels	
Smooth Geometric	0.030
Irregular or Natural	0.050

4.3.3 Routing Method

The HYDRA model is used to route flows through the storm drain system and to generate hydrographs. HYDRA routes the hydrographs through the system based on the travel time in the system, and the time of concentration of the sub-areas. When two hydrographs are added together, such as where two pipes meet, the hydrographs are attenuated based on the differences in routing time.

4.3.4 Allowable Slopes and Velocities

The City's design standards specify that pipe slopes must be sufficient to provide a velocity of not less than 2.0 or more than 8.0 feet per second, when flowing full.

These criteria will be used in sizing new pipes. Existing pipes that can convey the design flow will be not identified as recommended improvements solely on that basis of not meeting these criteria.

4.3.5 Minimum Pipe Sizes

For the purpose of this study, the minimum allowable diameter for storm drains is 15 inches, and the 12 inches for catch basin laterals.

4.4 Storm Water Retention

The city requires that new development and redevelopment to provide storm water retention to mitigate increases in storm water discharges between pre-development and post-development conditions.

Drainage system design must also be in accordance with the Santa Barbara County Water Resources Agency detention criteria for new development discharging to the Santa Maria River. County criteria for storm water detention is to limit discharge to the 10-year pre-development rate, and store the difference between 10-year pre-development and 100-year post-development runoff.

Retention basins must be sized to accommodate the highest storage volume that would be needed under either of the following conditions:

1) To limit discharge to the 10-year pre-development rate, and store the difference between the 10-year pre-development and 100-year post-development runoff; or
2) To limit discharge to the available capacity of the downstream drainage facilities.

The required storage volume is determined using a 24-hour duration design storm. The discharge rate from the basin cannot exceed the available capacity of the City's downstream drainage facilities.

Regional retention basin locations, as identified in Section 5, are required when development occurs in new areas. All new development must either construct retention storage as part of the planned development or participate in implementation of the regional basins.

A detention basin has a small outlet, and flow returns to the downstream drainage system at a low rate. A retention basin has no outlet, and water leaves only by evaporation or percolation into the ground. The City prefers that detention basins be used rather than retention basins due to the proximity of major drainage channels, and the relatively low soil permeability and (slow percolation characteristics) in much of the City. The retention basin constructed in areas with soil layers beneath the bottom of basin with high permeability and low groundwater during periods of stormwater storage will decrease the area and storage requirements compare to retention basin constructed in areas with soil of low permeability. Preliminary design of retention basin must be based on a City approved geotechnical testing methods for retention basins, such as the double ring infiltration test per ASTM D3385. On the completion of the rough excavation of the stormwater basin it shall be tested to confirm that the basin has a sustainable infiltration rate (percolation rate) at least equal to the infiltration rate used for the design of the basin. Also it shall be confirmed that the depth to the nearest groundwater and that no cemented soil layers exist below the bottom of the basin.

Each basin must have an uncontrolled spillway to keep storm water from overtopping the banks. A surface route for overflows downstream from the basin is required, so that downstream properties and facilities will not be damaged. Outlets release incoming flows to downstream facilities at retard rates, but not greater than the capacity of the downstream facilities.

Basin design must incorporate features that provide storm water quality benefits, while still meeting flood control needs. Basin design must include appropriate landscaping, and recreational features that can be used during the dry season.

The Storm Water Management Practice Handbook for New Development and Redevelopment (California Storm Water Quality Association, 2003 or most current version) is the basis for design of the storm water quality features. All new basins must include a de-silting chamber or sediment forebay. Basins must provide adequate detention time for runoff from the small storm events that have the greatest impact on water quality, as specified in the Handbook.

Detention basins must drain within a maximum of 48-72 hours to prevent mosquito/vector control problems, unless a longer draining time is required due to downstream capacity constraints.

4.5 Storm Water Quality

Storm drainage system design must be in compliance with the storm water quality requirements of the National Pollutant Discharge Elimination System (NPDES). Storm water quality best management practices (quality control measures) must be incorporated as part of all new and redevelopment projects.

The City needs to develop a standard which specified the requirements for storm water quality controls. A possible reference is the California Storm Water Quality Association's Storm Water Management Practice Handbook for New Development and Redevelopment (2003 or current version) as the basis for selection and design of best management practices (BMPs) for storm water quality.

Source control BMPs and treatment control BMPs, as described in the Storm Water Management Practice Handbook, must be incorporated into the design as needed to control sources of potential pollutants. A combination of measures may be needed depending on the type and size of the project and the potential for storm water quality impacts.

4.6 Floodway and Floodplain Requirements

The current Flood Insurance Study (FIS) for Santa Barbara County prepared by the Federal Emergency Management Agency (FEMA) is dated September 30, 2005. The cities of Buellton, Guadalupe, and Solvang do not have their own specific FIS report. The City's Flood Insurance Rate Map (FIRM) is Panel 0155F of Map Number 06083C015SF, an excerpt of which is contained in **TAB-17**.

4.7 Other Federal and State Requirements

There are also Federal and State requirements related to storm water quality and other environmental concerns.

Federal

- Wetlands Protection – Clean Water Act Section 404 Permit program for projects constructed within wetlands, administered by the Corps of Engineers.
- National Marine Fisheries Services 4D listing of steelhead in the Salinas River as a threatened species. Steelhead fish require specific flow conditions to migrate to spawning and rearing habitat in certain tributaries. The major migration periods are from December 1 through April 15 for adults migrating upstream to spawn; and from January 15 to May 31 for adults returning downstream to the ocean. Minimum flows must be maintained in the river during these periods to allow for fish migration, and the river mouth must be open to the ocean.
- National Pollution Discharge Elimination System (Clean Water Act, NPDES program for construction, industrial, and municipal permits).

State

- Protect and continue the fish and game resources in lakes and streams (Fish & Game Code Sections 1600 through 1603).
- Water Quality Control Plan, Central Coast Basin (Regional Water Quality Control Board).

Section 5
Storm Drainage Systems Analysis

5.1 Storm Water Models

The technical engineering assessment of the study area involves the development of a hydraulic storm drain model. The study used a software program called "HYDRA". The software models and design urban drainage systems. It allows the analyst to model the system and therefore get an indication of the system's performance. This model was prepared and an assessment of the performance of the existing infrastructure was done. Several "what-if" scenarios were also run to scope and size various proposed improvements.

The HYDRA model was used to generate and route flows for the drainage system analysis. The database was developed from both AutoCAD (release 2007), drawing files (DWG and DXF) and GIS (ARC View). The HYDRA model store information required in GIS format conversion programs and are required to convert the DWG files (AutoCAD) and shape files (ARC View).

Prior to selecting the HYDRA model, an evaluation was done of available hydraulic models and their applicability for the master plan study. Appendix "D" contains a technical memorandum describing this evaluation.

Figures are provided in the report and large maps showing the modeled storm drainage system and sub-basins are included in rear pockets in this report. The modeled storm system includes all main collector pipes for the proposed D.J. Farms subdivision and only trunk lines and outfall lines with existing city drainage basins and sub-basins.

The proposed D. J. Farms system proposes to retains all storm water runoff from the subdivisions within three retention basins.

It is important in the development of the watershed model, for future developments, that the concepts of the proposed storm water collection, storage and disposal is the first task of work. RMA reviewed a preliminary storm drainage system that was included as part of the proposed tentative subdivision maps for the D.J. Farms subdivision. The engineering concepts of the storm drainage collection and storage disposal system of the drainage pipes and basins addresses the natural drainage channels and the critical points of natural convergence of runoff to be included as part of the proposed storm drainage system.

The Santa Barbara Urban Hydrograph Method for generating flows (runoff hydrographs) in the HYDRA model was selected as the most appropriate for a citywide urban system.

HYDRA routes the hydrographs through the system based on the travel time in the system, and the time of concentration of the sub areas. When two hydrographs are added together, such as where two pipes meet, the hydrographs are attenuated based on the differences in routing time.

The backwater of the Santa Maria River and drainage basin (retention and detention) are taken into account by specifying the beginning water surface elevations in those water bodies. The model then computes the hydraulic grade line in pipes discharging to these water bodies based on that water surface elevation. The beginning water surface elevation was obtained from FEMA studies.

Information on the modeled pipes was obtained from inventorying the various system components as well as by reviewing improvement plans for newer areas when they were available. The modeled pipes were digitized to provide the spatial information (geographic coordinates for mapping purposes) and flow direction (upstream to downstream). The model input parameters for pipes include diameter, slope, and roughness coefficient.

The pipe slopes for proposed development were determined from invert and rim elevation from tentative subdivision maps with proposed improvements and the preliminary design information. For existing drainage systems, manhole inlet rim and invert elevations were not available. In lieu of "as-built" elevation data, RMA referred to Guadalupe contour maps and assigned this elevation as manhole rim elevations. Due to a lack of manhole invert elevations, an assumption had to be made, namely that the top of all pipes are six feet below the existing ground elevations. Therefore the manhole invert elevations are assumed to be six feet, plus the diameter of the pipe, down from the rim elevation.

Sub-areas were identified within each watershed draining to concentration points along the modeled storm drain system. These sub-areas are hydraulically isolated drainage areas that define the peak flows at a single point on the modeled storm drain system. The sub-areas were identified through review of the storm drain system maps, street maps, aerial photos, and topographic mapping.

The runoff hydrographs are based on the physical characteristics of each sub-area, which are specified as input parameters in the model. These parameters include sub-area size, overland flow length/width, percent of impervious area based on composite land uses, soil infiltration rates, and depression storage and surface roughness.

The numbering system for the pipe and sub-area identification include numbered Watershed Designation followed by Branch Number followed by Pipe Number (XX-XXXX-XXX).

Each branch was identified first by the watershed designation, and then numbered to show its location within the watershed. The branches were generally numbered from south to north and west to east, i.e., the lowest numbers were in the southwest part of the watershed. Within each branch, the last three digits of the identification number show the pipe's location in the branch, with the discharge outlet of each branch numbered 000, and then the numbers increase in the upstream direction.

Initial model runs were done to check the reasonableness of the model results and the hydraulic grade line profiles. After the checking was completed, the model was used for the storm drainage system analysis.

In addition (if the city so chooses in the future) a recently available add-on module that links the SWMM-EXTRAN to the HDRA model can be used for detailed hydraulic analysis of complex part of the system, i.e., areas with many flow splits, looped pipes and surcharge locations. The SWMM-EXTRAN module provides dynamic routing, which more accurately simulates these conditions.

5.2 Analysis Methodology

This master plan evaluated the 10 year, 25 year and 100 year design storms as discussed in Section 3.

- The 10 year storm criteria applied to sub-areas that are primarily residential and public facilities (schools, parks, golf courses), and those trunk lines that only convey from those areas to the discharge outlet.

- The 25 year storm criteria applied to sub-areas that are primarily commercial, industrial or mixed use of commercial and multifamily residential and those trunk lines that only convey from those areas to the discharge outlet, and also those trunk lines that convey combined sub-areas from both residential and commercial from those to the discharge outlet.

- The 100 year storm criteria applied to offsite watersheds and onsite open spaces that are part of an original watershed and those trunk lines that convey runoff from those areas to the discharge outlet. The design capacity of trunk lines that share flows from both residential and offsite drainage are designed to conveyed the stormwater from a 10 year storm for residential and the 100 year storm from offsite watersheds and onsite open spaces.

The hydraulic models were used to conduct simulations of the proposed, existing and future drainage systems for these design storms. The individual model results were to identify capacity deficiencies for both proposed and existing drainage systems and design both detention basin or basins, trunk and outfall lines for the future drainage system. The following steps were used to review and prioritize capacity deficiencies.

- The initial screening capacity deficiencies identified all pipes that are flowing more than 100 percent full.

- These pipes flowing more than 100 percent full are then analyzed in more detail by reviewing the hydraulic profile to determine if the surcharge (hydraulic grade line) would remain below the ground.

- Those locations where surcharge would remain below ground are screened out as not requiring improvement. Such surcharging is acceptable for a storm drain system.

- For those locations where surcharge would pond above ground, an evaluation is done of the volume of anticipated ponding to see if it would be negligible (nuisance) or significant.

- For those locations with nuisance overflows, no improvements are recommended. Nuisance overflow is considered to be less that 0.5 AF over a 30-minute period. Such overflow may occur at catch basin inlets until capacity becomes available. This nuisance overflow would not damage property or significantly affect the public.

- For those locations with significant overflows, the need for improvements is evaluated. Significant overflow is considered to be 0.5 AF or greater for more than 30 minutes.

For locations where significant overflows do occur, the following alternative improvements would be considered in determining the most effective solution:

- Enlarge proposed detention basin and pipelines (D. J. Farms).

- For existing drainage, install parallel pipelines to increase capacity and enlarge existing detention or retention basins; increase proposed trunk and outfall pipelines above those indicated in the current Master Plan

- Diversion or bypasses, where flows from a deficient pipe or branch are conveyed to another pipe or branch with available capacity in order to eliminate or reduce deficiencies. Because of the layout of the city's system with many small branches and discharge locations, this option has limited applicability.

- Relief or replacement pipes to provide additional capacity and eliminate overflows. Relief pipes would be used if the existing pipes were in good structural condition. Replacement pipes would be used if the existing pipes were in poor structural condition. Where pipe improvements are recommended, the new pipes would be sized to flow at 100 percent full.

- Lowering the beginning water surface elevations at the discharge outlets in order to lower the hydraulic grade line and reduce or eliminate overflows.

- Install storm drain pumping stations at drainage basins and interconnect the downstream gravity drainage system to certain drainage basins with force mains. A feasibility analysis would be required to determine if a pump station would increase the discharge volume of existing storm drain pipes, increase volume of existing or proposed basin by lowering the bottom of basin below the discharge elevation of the basin outfall pipeline, against installation cost, power cost, maintenance cost and replacement cost. It also would be required that the storm drain pump station be included in a future maintenance assessment district.

5.3 Storm Water Quality Features

Many California municipalities typically rely on detention and retention basins for flood control. The basins also provide storm water quality benefits. Sediment and other pollutants tend to settle out in the detention basins rather than being discharged into the downstream system. The longer the detention time, the greater the storm water quality benefits. These basins are usually sized to handle a 100-year storm event.

To enhance the water quality benefits of basins, it would be beneficial to detain or retain runoff from smaller storms. Statewide studies have found that the maximum water quality benefits occur from detaining the runoff from the 2 year storm or less. The City has no existing flood basins (other than the natural wetlands area). However, D.J. Farms is proposing to use several basins to contain runoff within the development.

For basins in parks, the city should consider modifying the basin outlets to have a stepped detention or retention discharge. Low flows, 2 year flow or less, would be retained in the basin and infiltrated if soil conditions are suitable, or detained for at least 24-hours prior to discharge, while higher flows would cause the outlet to operate as intended for flood control purposes, i.e., higher flows would bypass the low flow retention/detention control and discharge to the outlet as designed for flood control purposes.

Detention basin discharge outlets should also be outfitted with debris and sediment traps to prevent these pollutants from entering the downstream storm drain system. Regular maintenance is required at the outlets to ensure that high storm flows do not wash accumulated sediment and debris into the downstream system.

The design of new detention basins and related storm water quality best management practices should meet the criteria discussed in prvious sections. The Storm Water Management Practice Handbook for New Development and Redevelopment (California Storm Water Quality Association, 2003 or most current version) can be used as the basis for design of storm water quality features.

Section 6
Recommended Capital Improvement Program

The report's storm drainage system final recommendations are based on the following:

6.1 Assumptions

A number of assumptions have been made in developing the recommended capital improvement projects:

- Pipe sizing may be revised due to differences in the modeled versus the actual design tributary sub-area, slope of existing pipe, or material of the proposed pipe. Detailed sizing and routing studies should be performed during pre-design to determine project specific criteria and to investigate alternate alignments and pipe materials.

- The new pipelines were generally routed along streets, parks and open space. In most cases the modeled pipes were based on current GIS contour maps or contour maps provided by the developers engineering firm, and in most cases pipe slopes were estimated from ground elevations, which is reasonable overall, but may not reflect the actual pipe slope within a reach. Also, the modeled tributary drainage areas may not be exactly the same as the actual tributary areas.

- Replacement pipes are generally not recommended if the required replacement pipe diameter is only one standard pipe size larger than the existing pipe size, and surface flows would not result in ponding or flooding. During re-design, the age and condition of the existing storm drains should also be considered in determining if replacement is warranted.

- The Capital Improvement Projects cost estimates are planning level capital costs and include construction costs plus 45 percent for legal, administration, engineering, and contingencies. All costs presented are in 2007 dollars and are based on the unit prices shown in tables 5-1 through 5-6.

- Facilities to serve future developments are a part of the capital improvement projects. Future storm drain extensions will need to be designed to accommodate specific developments as they are planned and constructed. The City will need to review projects that are designed and built by developers to ensure adequate ultimate capacity in the system. The information presented herein is intended to serve as a sizing guideline.

6.2 Capital Improvement Projects

The list of recommended capital improvements in Table 6-1 includes the following:

- To correct capacity deficiencies of existing drainage system.
- Improvements required for proposed and future development for next 20 years. This includes the proposed D.J. Farms residential development as well as possible future development which may occur on the property that is on the north-east corner of Peralta and Eleventh Street.

Unit capital costs include construction costs, but do not include 45 percent for engineering, legal, administration, and contingencies. Different unit cost alternatives are used in this analysis. These storm drain piping alternatives are outlined below:

- Unit costs reflect Reinforced Concrete Pipe (RCP), where the piping is to be installed in existing city streets, and where existing utilities and improvements will restrict access.
- Unit costs reflect High Density Polyethylene (HDPE) Pipe, where the piping is to be installed in open fields or along existing rural streets where existing utilities and improvements are minimal.
- Unit cost is added for manholes, catch basins, and/or pavement reconstruction, depending on where the new storm drain is located.
- Unit costs are based on Saylor's 2007 Current Construction Costs Publication, recent bids on similar work, and engineering experience.

The calculations for the various drainage basins show the future storm drains, peak flows to accommodate build out development, and pipe sizes for build out flows. Table 6-1 summarizes the estimated improvements and related capital costs for the recommended improvements. The list of capital improvement projects needed is based on the aforementioned calculations to correct both existing deficiencies and to accommodate growth.

Table 6.1- List of Recommended Capital Improvement Projects

Item	Location	Description of Improvement:
Proposed Priority One Capital Improvement Projects:		
1	Santa Maria River Bottom	Construct additional berms and levees.
Proposed Priority Two Capital Improvement Projects:		
2	Wetlands	New system to relieve flow into wetlands and also to accommodate possible future development: construct piping system, detention basin, and new pump station.
Proposed Priority Three Capital Improvement Projects:		
3	Main Street between Guadalupe St. and Jack O'Connell Park	Concrete line ditch to improve capacity; miscellaneous improvements at Jack O'Connell Park to minimize flooding into park; replace culverts and repair crossings.
4	Main Street between Guadalupe St. and Flower St.	Concrete line ditch to improve capacity. Location is in front of proposed DJ Farms development.
5	SR-166 and Simas Road	Construct detention basin to retard high flows from upper watersheds (optional).
Proposed Priority Four Capital Improvement Projects:		
6	10th and Pioneer	Construct improvements to eliminate ponding at dead end location (move water past Pioneer St).
7	11th and Obispo Street	Add valley gutters and drain inlet.
8	11th and Peralta	Add drain inlet and 24" piping, connect to proposed wetlands work (item 1 above).
9	Guadalupe St. and 8th	Add drain inlet at sag location (coordinate with Caltrans).
10	Guadalupe St. and 6th	Add drain inlet at sag location (coordinate with Caltrans).
11	Guadalupe Street between Second and Fifth Street	Add drain inlet and piping to collect water flowing into right-of-way from adjacent private property.
12	Tognazzini, Campodonico, and Guadalupe Streets	Long gutter flow (time of concentration); new piping infrastructure to relieve excessive spread condition.
13	Obispo Street at Wetlands	Add downspout at sag location.
14	9th Street between Olivera and Pacheco St.	Clear constricted drain inlet.
15	4th and Obispo St.	New piping down 4th and connect to existing, or connect to other side of Obispo Street.

6.3 Future Development

6.3.1 D.J. Farms

All drainage improvements being proposed by the developer appear to be separate and independent of the City's existing/proposed storm drain system. This is largely due to topography as well as by the restraints placed on the property by the railroad right-of-way. The track elevation is set high to withstand a 500 year flood event. Therefore all drainage must be pass through rail-road culverts, which forces the developer to deal with all runoff on-site. Whereas most of the existing City infrastructure outfalls towards the northwest (ie., towards the Santa Maria River flood plain), the D.J. Farms Development outfalls to the creek which runs to the south of town.

6.3.2 Other Future Development

New storm drain trunk mains will be required to serve future development to the north of the City. For the purposes of planning, the trunk facilities proposed are assumed to serve the multiple adjacent developments. The local trunk storm drain piping within these developments will be the responsibility of the developer to size, install, and finance. When the developer installs pipe as outlined in the SDMP and provides calculations stating the size of the pipe required to serve the development alone, a reimbursement agreement should be prepared for the cost differential between the required and CIP proposed pipes should be approved by the City as part of the subdivision agreement. The reimbursement should come from future development to connect to CIP storm drain trunk mains. The sizes of the future development trunk mains are intended to serve as a guideline for the City to use in evaluating said projects. The slopes are based on existing available grade. The actual design details for the future storm drain trunk mains will depend upon specific development plans and studies.

6.4 Project Feasibly Studies

RMA recommends that the City consider conducting a specific engineering study which addresses the flood treat from high flows emanating from the Santa Maria River. A project feasibility study should also address the need for future permit requirements of a Municipal Separate Storm Sewer System (MS4) Permit, issued by the EPA as part of the National Pollution Discharge Elimination System (NPDES).

6.5 Project Priorities

The priorities of the identified projects will be dependent on funding and development. In many cases, development is dependent on the construction of one or more of these projects. Interim detention ponds may be used to facilitate continued development, until the City has collected sufficient funds for the respective projects. The following list is based on availability of storm capacity and probability of the commencement of development projects. Any priority could be changed as development proposals change or as other conditions change.

Priority One is for the City to make sure that the existing development inside the Santa Maria River flood plain (i.e. all property located in FEMA Flood Map, Zone "A") is adequately protected from high flows down the Santa Maria River during a major storm event. Most notably, this would include the City of Guadalupe Wastewater Treatment Plant facility. Should the facilities be inundated, the entire City water and sewer system could be threatened. At the present, the Corp of Engineer levee stops at the SR-1 bridge. At a minimum, additional berm work (i.e., not necessarily a full levee) should be considered to protect these low lying properties/improvements.

Priority Two involves the City wetlands. Currently this environmentally sensitive area is conveying agricultural and urban runoff through it. Additional infrastructure should be considered to route storm drainage around the property. This would minimize/mitigate the pollution problem and help restore the water to a more pristine condition.

Priority Three addresses the side ditch along SR-166 (Main Street) from Simas Street all the way to Jack O'Connell Park to the west. This channel is conveying mostly off-site drainage coming from the uphill watersheds to the east. The City is actually contributing very little to this flow, but is incurring the flooding that is occurring at the driveway into the Waste water treatment plant (Jack O'Connell Park).

Priority Four Capital Improvement projects is a list of more minor work and routine work. The study came up with a list of ten potential improvement projects. These improvements all involve the construction of additional drain inlets and in some locations additional piping. These projects will eliminate spot flooding now occurring at various locations throughout the city.

Goals:

- Divert water from over capacity existing storm drain facilities.
- Divert runoff flows into storm drain infrastructure with available capacity.
- Relatively small cost projects that have large storm drainage impact.
- Serve areas with a development currently under construction that has no down stream trunk storm drain facilities.
- Improve existing infrastructure, or divert water from existing storm drain facilities that currently have no remaining capacity.

6.6 Implementation

Implementation of the capital improvement projects should be undertaken as soon as funding is available. Implementation activities should include:

- Incorporate capital improvement projects recommendations into the City's capital improvement projects list.
- Develop a plan for environmental review of projects.
- Coordinate the storm drainage projects with other construction projects such as sanitary sewers, water, gas electric, or telephone transmission facilities, or street paving projects that may share common alignments.

6.7 Engineer's Opinion of Probable Cost

Tables 6-2 through 6-5 itemize possible costs to fully implement the recommendations contained in this report.

TABLE 6-2: Proposed Priority One Capital Improvement Projects

Item	Description	Qty	Unit	Budget
1	**Construct Santa Maria River flood control improvements**	1	ls	To be determined

TABLE 6-3: Proposed Priority Two Capital Improvement Projects:

Item	Description	Qty	Unit	Unit Price	Extension
2	**Wetlands Improvements**				
	Site purchase (unknown)				-0-
	Piping: 18"	400	lf	85	$34,000
	Piping: 24"	1,600	lf	100	160,000
	Piping: 30"	600	lf	210	126,000
	Piping: 36"	800	lf	225	180,000
	Piping: 48"	1,100	lf	250	275,000
	Asphalt pavement	750	lf	30	22,500
	Traffic control	1	ls	15,000	15,000
	Jack & bore under RR: 36"	100	lf	750	75,000
	Open channel construction	600	lf	50	30,000
	Construct detention basin	20	AF	2,500	50,000
	Pump lift station	1	ls	25,000	25,000
	Subtotal				**$992,500**
Sub-Total; All Priority One Improvements:					**992,500**
Contingencies 25%					248,125
Construction Total					1,240,625
Engineering 20%					248,125
TOTAL ESTIMATE:					**$1,488,750**

TABLE 6-4: Proposed Priority Three Capital Improvement Projects

Item	Description	Qty	Unit	Unit Price	Extension
3	**Main Street Improvements No.1**				
	Concrete line ditch	5,200	lf	38	$197,600
	Culvert(s) (allowance)	3	ea	15,000	45,000
	Repair crossings (allowance)	3	ea	50,000	150,000
	Subtotal				**$392,600**
4	**Main Street Improvements No.2**				
	Concrete line ditch	1,800	lf	38	**$68,400**
	(all other future work by DJ Farms)				
	Subtotal				
5	**Detention Basin**				
	Site purchase (allowance)	1	ls	50,000	$50,000
	Construct detention basin	20	AF	2,500	50,000
	Piping (allowance)	1	ls	25,000	25,000
	Subtotal				**$125,000**
Sub-Total; All Priority Three Improvements:					**$586,000**
Contingencies 25%					146,500
Construction Total					732,500
Engineering 20%					146,500
TOTAL ESTIMATE:					**$879,000**

TABLE 6-5: Proposed Priority Four Capital Improvement Projects:

Item	Description	Qty	Unit	Unit Price	Extension
6	**10^{th} & Pioneer**				
	Allowance only	1	ls	25,000	**$25,000**
7	**11^{th} & Obispo Street**				
	Allowance only	1	ls	25,000	**$25,000**
8	**11^{th} & Peralta**				
	Drain Inlet	1	ea	5,000	$5,000
	Piping: 24"	1,600	lf	100	160,000
	Subtotal				**$165,000**
9	**Guadalupe & 8^{th}**				
	Drain inlet	1	ea	5,000	**$5,000**
10	**Guadalupe & 6^{th}**				
	Drain inlet	1	ea	5,000	**$5,000**
11	**Tognazzini, Campodonico & Guadalupe Streets**				
	Drain Inlets	6	ea	5,000	$30,000
	Piping: 18"	800	lf	85	68,000
	Asphalt pavement	800	lf	30	24,000
	Traffic control	1	ls	15,000	15,000
	Subtotal:				**$137,000**
12	**Obispo Street at Wetlands**				
	Add downspout	1	ea	5,000	$5,000
13	**9^{th} Street between Olivera & Pacheco**				
	Repair drain inlet	1	ea	7,500	$7,500
14	**4^{th} & Obispo Street**				
	Drain inlet	2	ea	5,000	$10,000
	Piping: 18"	400	lf	85	34,000
	Asphalt pavement	400	lf	30	12,000
	Traffic control	1	ls	5,000	5,000
	Subtotal:				**$49,000**
Sub-Total, All Priority Four Improvements:					**$423,500**
Contingencies 25%					105,875
Construction Total					529,375
Engineering 20%					105,875
TOTAL ESTIMATE:					**$635,250**

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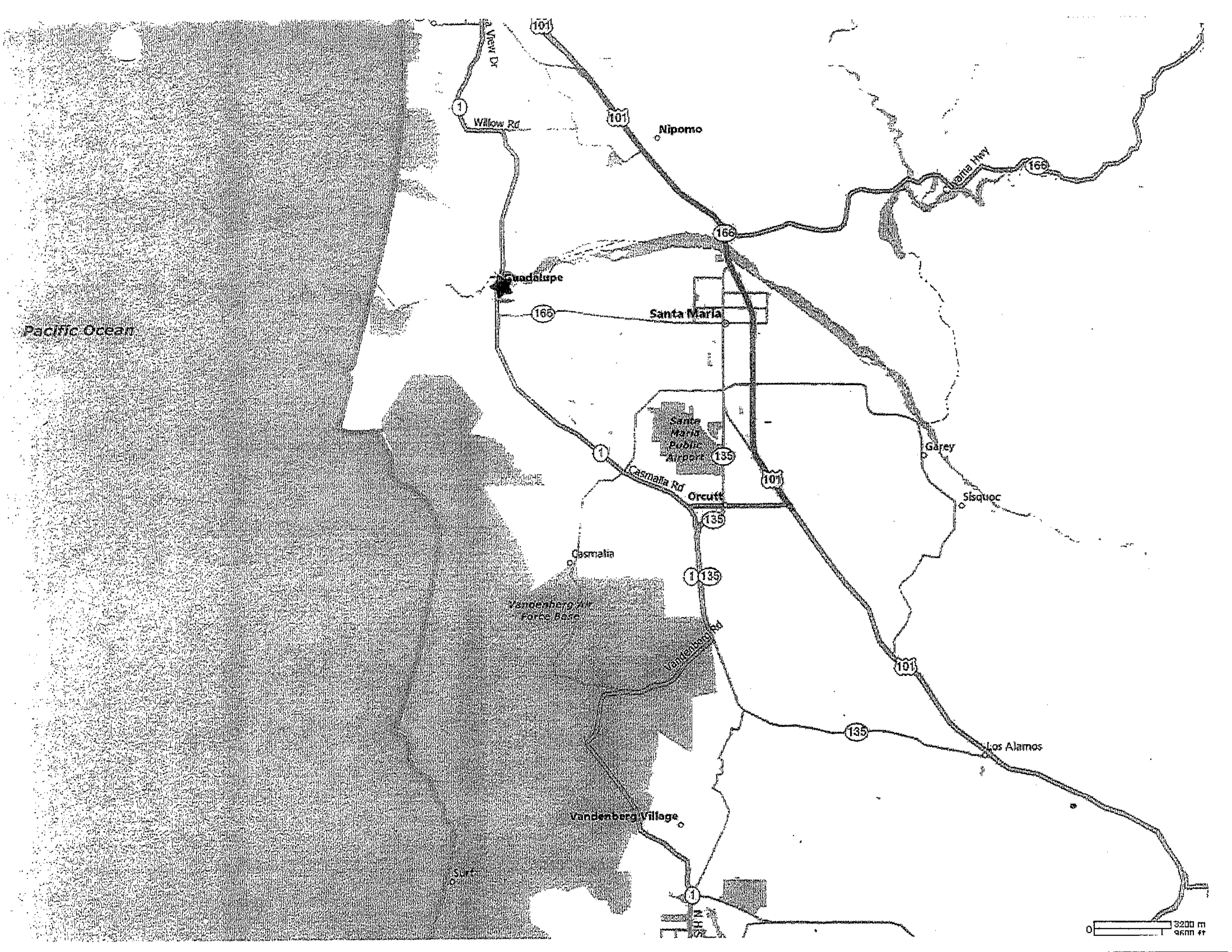

Pacific Ocean
101
Nipomo
166
Willow Rd
1
Guadalupe
Santa Maria
Santa Maria Public Airport
135
Casmalia Rd
Orcutt
Casmalia
Vandenberg Air Force Base
Vandenberg Rd
Garey
Sisquoc
Los Alamos
Vandenberg Village
Surf
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3200 m
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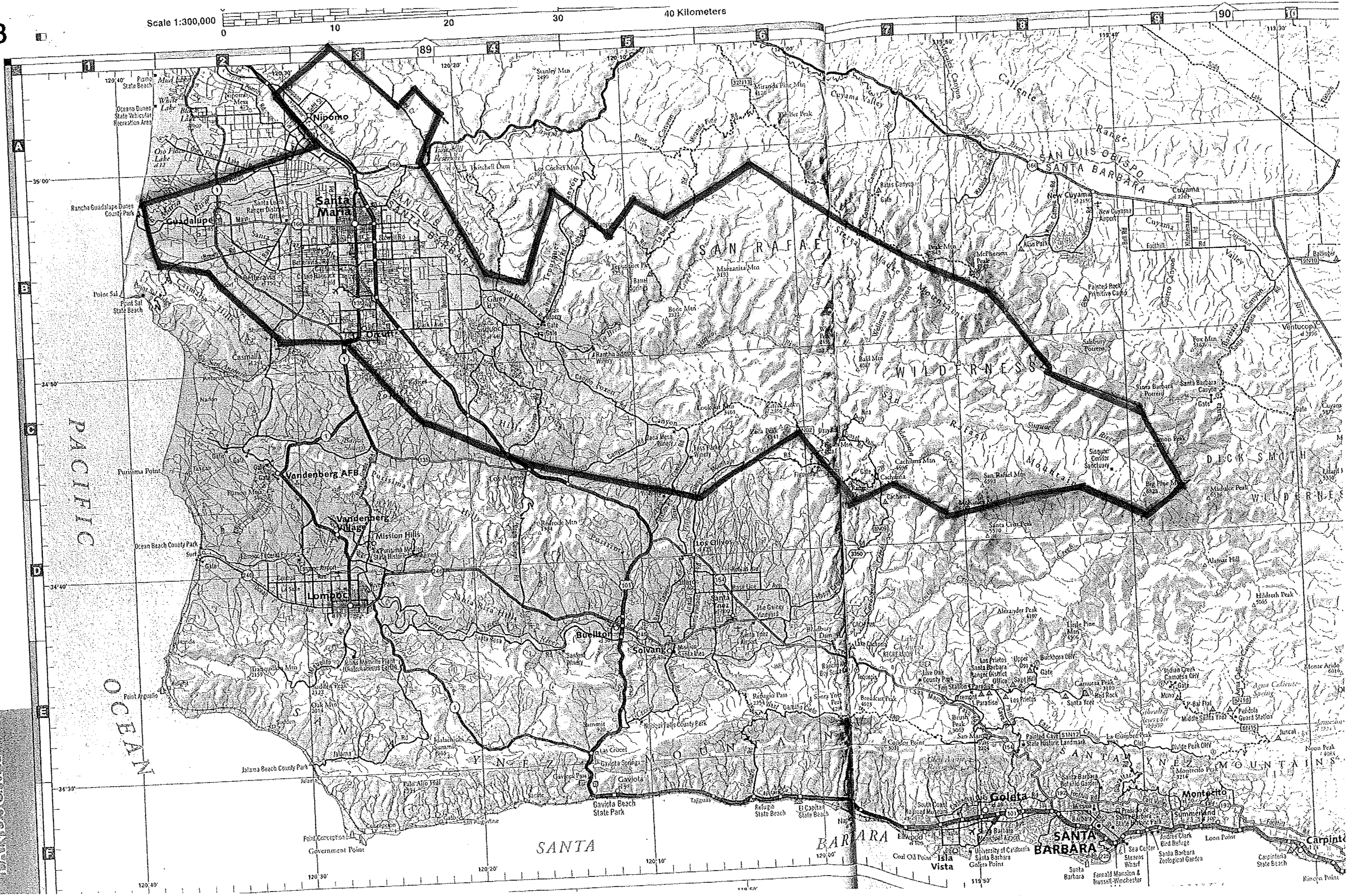
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40 Kilometers
89
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PACIFIC
OCEAN
SANTA
BARBARA
Nipomo
Santa Maria
Guadalupe
Betteravia
Orcutt
Garey
Sisquoc
Casmalia
Point Sal
Point Sal State Beach
Rancho Guadalupe Dunes County Park
Oceano Dunes State Vehicular Recreation Area
Pismo State Beach
Vandenberg AFB
Vandenberg Village
Mission Hills
Purisima Point
Lompoc
Los Alamos
Los Olivos
Buellton
Solvang
Santa Ynez
Point Arguello
Point Conception
Government Point
Jalama Beach County Park
Gaviota
Gaviota Beach State Park
Refugio State Beach
El Capitan State Beach
Goleta
Isla Vista
SANTA BARBARA
Montecito
Summerland
Carpinteria
SAN RAFAEL
WILDERNESS
DICK SMITH
WILDERNESS
New Cuyama
Cuyama
Ventucopa
SAN LUIS OBISPO
SANTA BARBARA
Cuyama Valley
Caliente Range
SANTA YNEZ MOUNTAINS
Ocean Beach County Park
Cachuma Lake
Figueroa Mtn
San Rafael Mtn
Big Pine Mtn
Madulce Peak
Alamar Hill
Alexander Peak
Little Pine Mtn
Twitchell Dam
Twitchell Reservoir
Sierra Madre Mountains
Tranquillon Mtn
Ellwood
Coal Oil Point
University of California Santa Barbara
Stearns Wharf
Loon Point
Carpinteria State Beach
Rincon Point

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3

CHAPTER 2

LAND USE AND DEMOGRAPHICS

This Chapter includes information gathered from several sources regarding existing and future land use and population projections. The sources include the 2000 California Census data, the City of Guadalupe Planning Department, the City of Guadalupe General Plan adopted in 1986, the DJ Farms Specific Plan, and the City of Guadalupe Housing Element, which was prepared in 1992 and amended in 1998. The existing Sphere of Influence (SOI) was also considered, however, it should be noted that presently the SOI is the same as the existing City boundary.

BACKGROUND

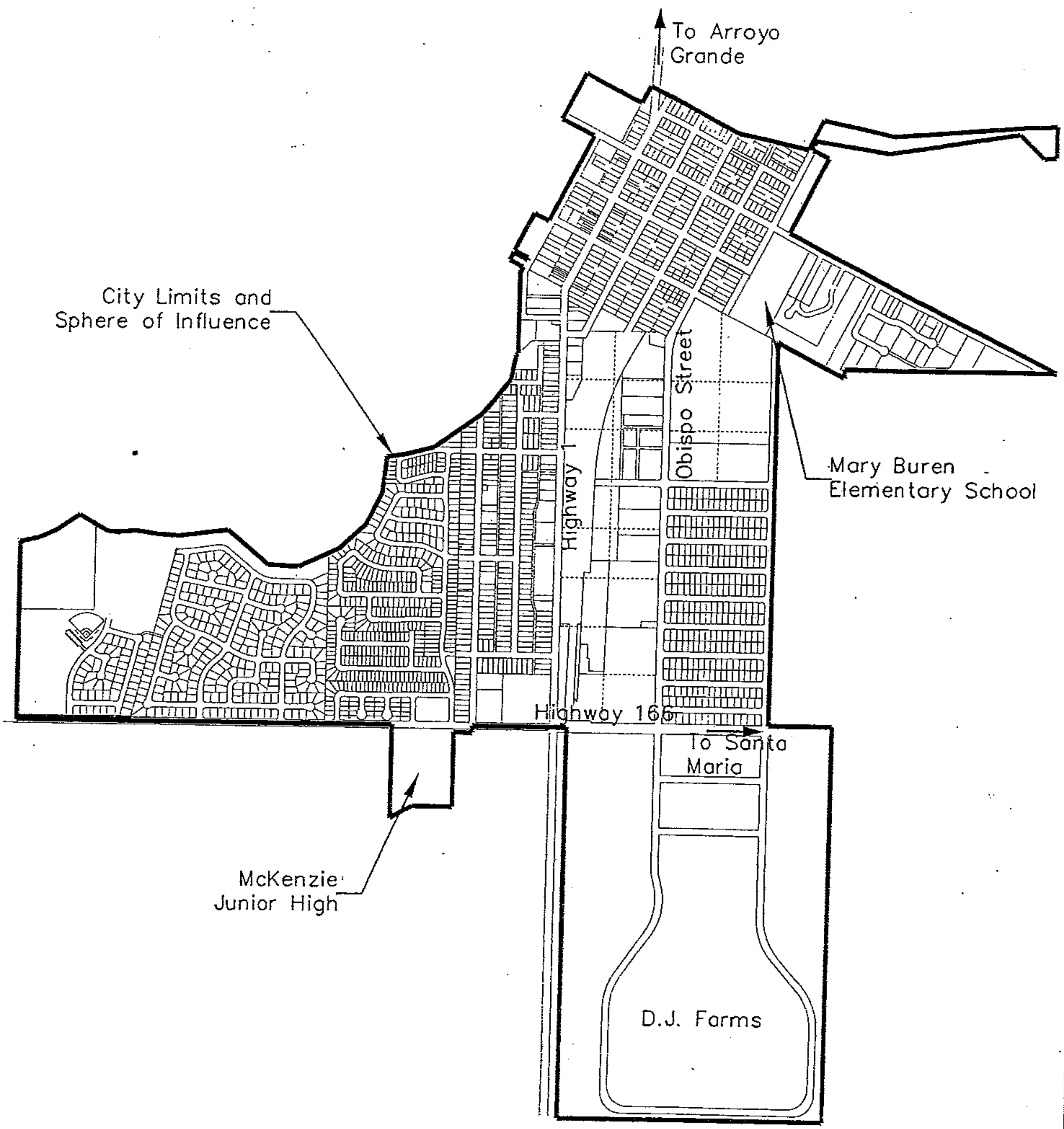
The City of Guadalupe, incorporated in 1946, is a general law city, governed by a pro-active five-member City Council. The City is located in the northwest corner of Santa Barbara County at the intersection of California Highway 166 and U.S. Highway 1. The dominant economic activity in the City of Guadalupe is agriculture and food processing.

LAND USE

As indicated earlier, the boundaries of the existing City limits and SOI are the same at this time. Thus, there are no areas immediately abutting existing City boundaries that are likely to be annexed in the foreseeable future. Figure 2-1 depicts the City limits of Guadalupe. The Santa Barbara Local Agency Formation Commission (LAFCo) administers annexations and maintains maps that illustrate the SOI. As noted previously, since almost all the land surrounding the City is agriculturally intensive and held in Williamson Act contracts, the prospect of further annexation may not exist in the near future. Water demand projections for this water master plan are based on those demands anticipated within the established SOI.

The land use zones within the City are established by the land use element of the City's General Plan. Current zoning calls for approximately 435 acres of residential, 291 acres of commercial/industrial, 13 acres of Public facilities and 86 acres of open space. Table 2-1 provides a breakdown of the various zoning types and sizes throughout the City.

Approximately 35 percent of the total area within the City of Guadalupe is associated with one potential development project area, known as DJ Farms (284 acres). The DJ Farms land is located in the southeast corner of Guadalupe, south of Highway 166 between Highway 1 and Obispo Street (See Figure 2-1). Table 2-1 provides the zoning types associated with this project and the specific details of the development are further discussed in the DJ Farms Specific Plan.



1" = 1,400'
0 350 700 1,400

Existing City Limits

Figure 2-1

City of Guadalupe

Water Master Plan

John L. Wallace & Associates

JLWA

Table 2-1. Zoning Type by Area

Zoning	Description	Acres
	City Limits (Excluding D.J. Farms)	
R-1	Single Family Residential (low density)	143.5
R-1-M	Single Family Residential (medium density)	58.4
R-2	Multiple Dwelling Residential (medium density)	22.3
R-3	Multiple Dwelling Residential (high density)	37.6
G-C	General Commercial	42.0
G-1	General industrial	119.2
M-C	Industrial Commercial	9.8
O	Open Space	52.5
R/N-SP-CZ	Neighborhood Residential - Specific Plan - Coastal Zone	42.4
PF-CZ	Public Facilities - Coastal Zone	13
	Subtotal	540.7
	DJ Farms Development	
R-1-SP	Single Family Residential - Specific Plan	107.6
C-S-SP	Commercial Service - Specific Plan	9.7
C-N-SP	Commercial - Neighborhood - Specific Plan	11.3
C-R-SP	Commercial - Recreation - Specific Plan	50.1
MIX-SP	Mixed Use - Specific Plan	3.1
R-1-M-SP	Medium Density Residential - Specific Plan	4.3
R-2-SP	High Density Residential - Specific Plan	19.3
O-SP	Park - Specific Plan	33.1
UR/I-SP	Urban Reserve/Light Industrial - Specific Plan	18.7
I-SP	Light Industrial - Specific Plan	27.1
	Subtotal	284.3
	Total	825

According to the 2000 California Census data, there are 1,450 existing residential units, of which 36 units were vacant at the time of the census. There are two major developments within City limits. The first is the Point Sal Dunes Development, which will have 254 units at build-out. The existing development is currently 70% built-out. The second development is known as the DJ Farms Development. The DJ Farms Development has a build-out potential of an estimated 481 units (according to the DJ Farms Specific Plan) of which 100% is to be developed. In addition to these two developments there are approximately 22 units remaining as in-fill throughout the older established residential neighborhoods. The total future residential development within the City at build-out is estimated at 2,025 units.

POPULATION

The 2000 California Census data indicates that the City of Guadalupe's existing population is 5,659. The census also states that the existing average household size is 4.0 persons per household, which is significantly higher than other municipalities such as Nipomo CDP at 3.13 persons per household and Oceano CDP at 2.96 persons per household. This higher density per dwelling unit is likely the result of the lower income levels of the majority of City residents.

Using this average household density of 4.0 persons per household, the future population within the City is projected to be 8,100 persons. This population estimate incorporates the planned 481 units for the DJ Farms development in addition to the remaining development at Point Sal Dunes, the vacant units not counted in the 2000 Census, and the in-fill throughout the established residential neighborhoods. The build-out of 8,100 persons will be used to project future water demand for the City.

GROWTH RATE ANALYSIS

The projected growth rate for the City of Guadalupe is estimated at 2.0 percent per year. This growth rate is a conservative estimate based on the average growth rate from 1990 through 2000 of neighboring City of Santa Maria. Therefore, the City is projected to be completely built-out by the year 2019. Figure 2-2 depicts the anticipated population growth for the City, based on a projected 2.0 percent growth rate.

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4

RM-ASSOCIATES
WATERSHED AREA OF INTEREST

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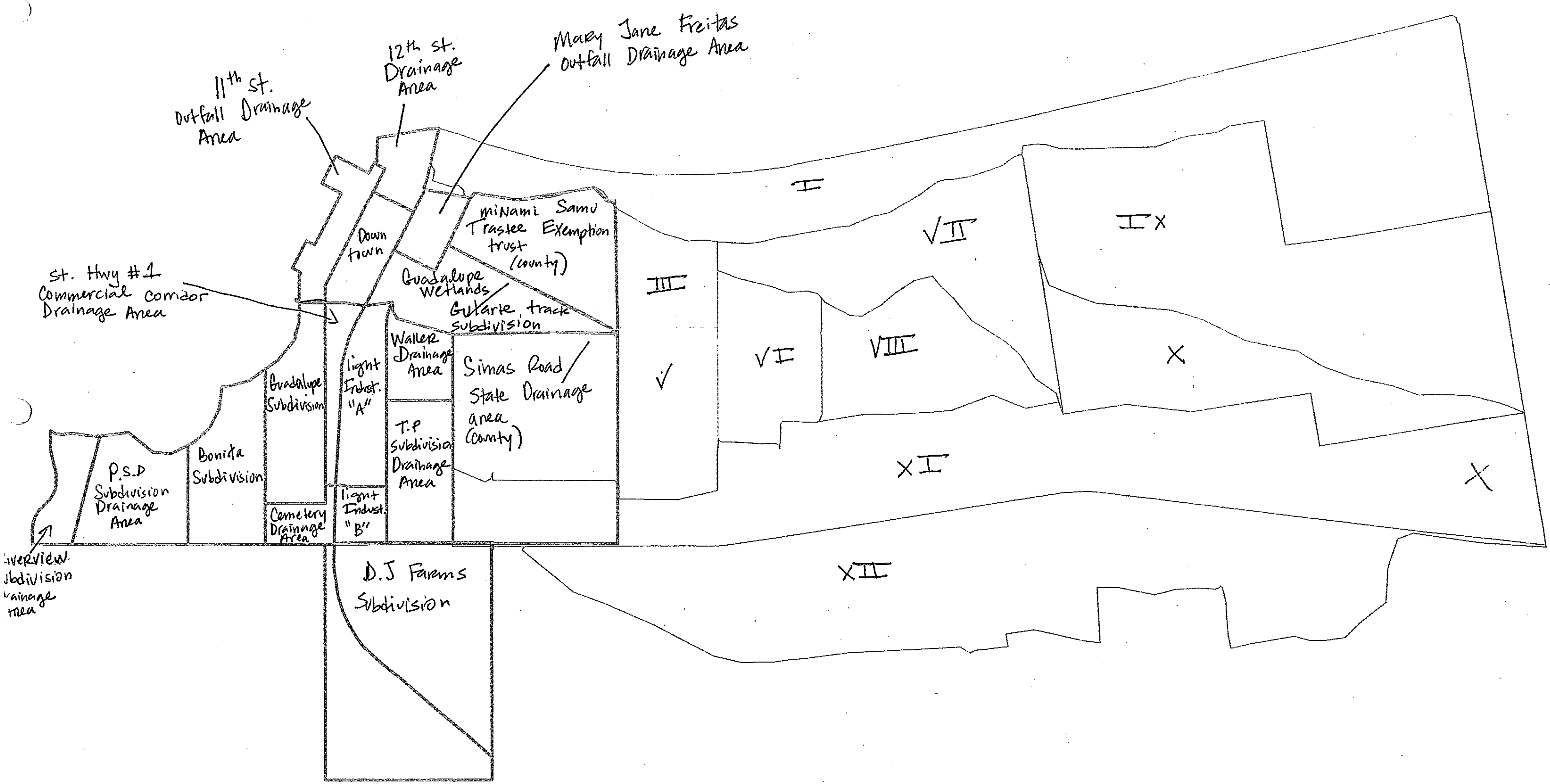

11th St. Outfall Drainage Area
12th St. Drainage Area
Mary Jane Freitas Outfall Drainage Area
St. Hwy #1 Commercial Corridor Drainage Area
Down town
Minami Samu Trastee Exemption trust (county)
Guadalupe Wetlands
Gutarte track Subdivision
Waller Drainage Area
Simas Road State Drainage area (county)
Guadalupe Subdivision
Light Indust. "A"
Light Indust. "B"
T.P Subdivision Drainage Area
Bonita Subdivision
P.S.D Subdivision Drainage Area
Cemetery Drainage Area
iverview ubdivision rainage rea
D.J Farms Subdivision
I
III
V
VI
VII
VIII
IX
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XI
X
XII

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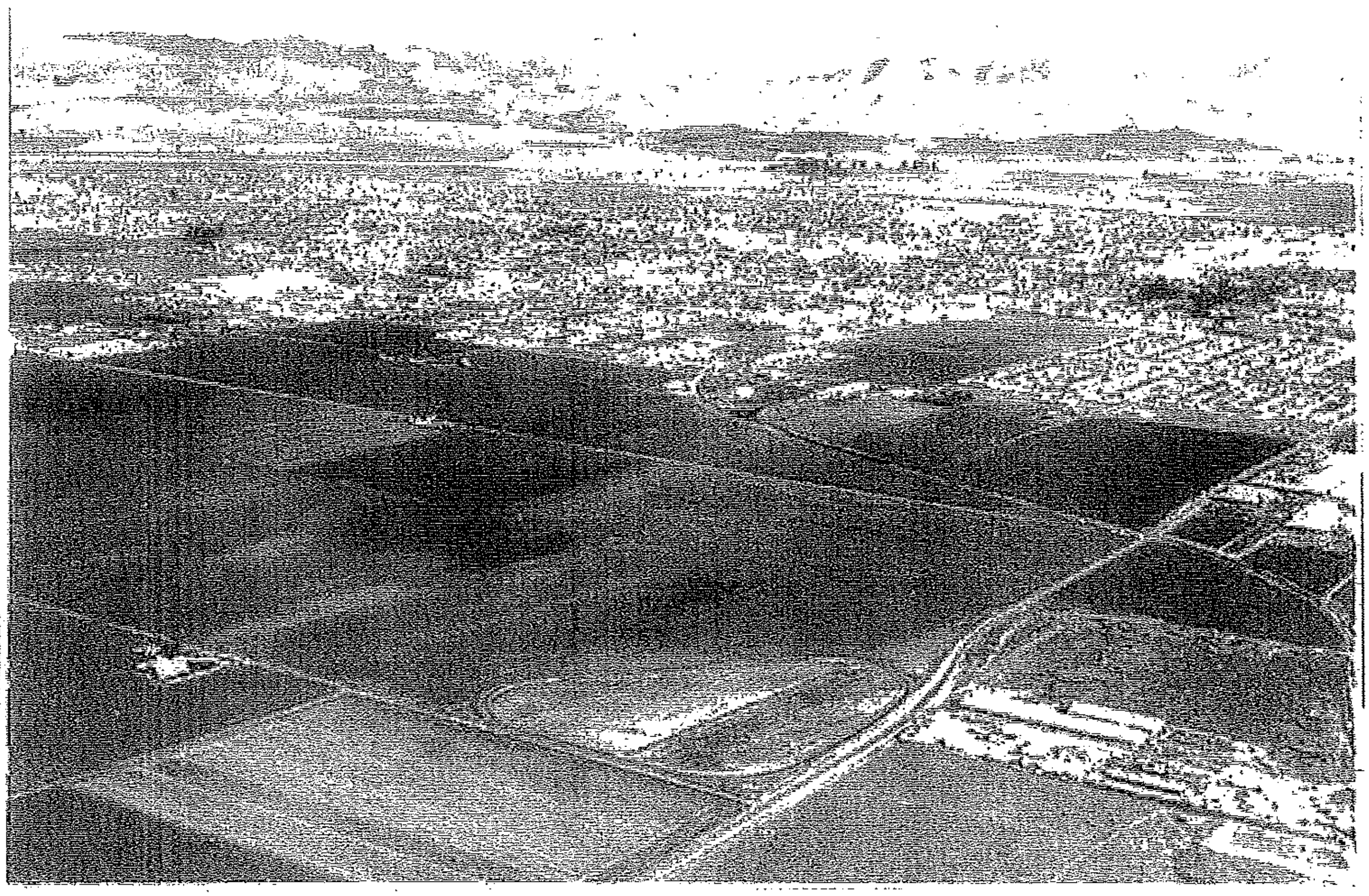
6

SOIL SURVEY OF

Northern Santa Barbara Area, California



U. S. Department of Agriculture
Soil Conservation Service
In cooperation with
University of California
Agricultural Experiment Station

Issued July 1972

This soil is used for irrigated alfalfa, sugar beets, and walnuts and for dryland crops. Capability unit IIe-1(14).

Sorrento sandy loam, sandy substratum, 0 to 2 percent slopes (SuA).--This soil has a profile similar to the one described as representative for the series except that it has a sandy loam surface layer underlain by sand and gravel at depths of 40 to 50 inches. It occurs on flood plains in the Santa Maria Valley.

Included in mapping are a number of areas that have sand and gravel substrata at depths of 30 to 40 inches, and in some places at more than 50 inches. Also included are areas that have some gravel throughout the profile.

Permeability is moderately rapid and rapid. Surface runoff is very slow, and the erosion hazard is none to slight. Fertility is moderate. The available water capacity is 5 to 7 inches in the 40- to 50-inch root zone.

This soil is used for a variety of irrigated crops. Capability unit IIs-0(14).

Sorrento loam, 0 to 2 percent slopes (SvA).--This soil occurs on flood plains, mainly in the Santa Maria Valley. It has the profile described as representative for the series.

Included in mapping are small areas of soils that have silty clay loam below a depth of 40 inches. Small areas of Sorrento clay loam and areas of Mocho and Salinas soils are also included.

Permeability is moderate. Surface runoff is very slow, and the erosion hazard is none to slight. Fertility is very high. The available water capacity is 10 to 12 inches in the 60-inch root zone.

This soil is used for a variety of irrigated and dryland crops. Capability unit I-1(14).

Sorrento loam, 2 to 9 percent slopes (SvC).--This soil is gently sloping to moderately sloping and occurs in small irregularly shaped areas on terrace breaks and alluvial fans.

Included in mapping are small areas of soils that are moderately or severely eroded and from which much of the surface layer has been removed. Also included are areas of Mocho soils and of Sorrento clay loam.

Permeability is moderate. Surface runoff is slow to medium, and the erosion hazard is slight to moderate. Fertility is very high. The available water capacity is 10 to 12 inches in the 60-inch root zone.

This soil is used for irrigated alfalfa, sugar beets, and walnuts and for dryland crops. Capability unit IIe-1(14).

Sorrento clay loam, 0 to 5 percent slopes, eroded (SwB2).--This gently sloping soil occurs on small, scattered, alluvial fans and flood plains. It has a profile similar to the one described as representative for the series except that this soil is clay loam throughout. In addition, this soil is subject to occasional overflow by runoff from surrounding areas.

Included in mapping are some eroded areas that are cut by shallow gullies; about half of the surface layer has been removed from these areas. Also included are some areas of Mocho and Salinas soils.

Permeability is moderately slow. Surface runoff is slow, and the erosion hazard is slight. Fertility is high. The available water capacity is 11 to 13 inches in the 60-inch root zone.

This Sorrento soil is used for dryland and irrigated crops. Capability unit IIe-1(14).

Stutzville Series

The Stutzville series consists of somewhat poorly drained silty clay loams. They occur in low basins in the Cuyama Valley, chiefly north and east of New Cuyama. Slopes are 0 to 2 percent. The vegetation is salt-tolerant forbs, shrubs, and annual grasses. Elevations range from 1,800 to 2,000 feet. Natural deepening of drainageways and pumping for irrigation have lowered the water table under these soils with the result that drainage is no longer a problem. The average annual rainfall is about 6 to 7 inches, the average annual air temperature is about 59° F., and the frost-free season is 190 to 220 days. Stutzville soils are associated with Panoche soils.

In a representative profile, dark-brown to pale-brown and light yellowish-brown silty clay loam and silty clay extend to a depth of 66 inches. In some areas the surface layer is loamy sand, sandy loam, or loam. Unless reclaimed, the soil is strongly saline throughout the profile. Most uncultivated areas have a salty crust 1/4 to 1 inch thick.

Stutzville soils are used mainly for range. Small areas have been reclaimed and are used for irrigated crops, including alfalfa, and for irrigated pasture.

Representative profile of the Stutzville series (in the Cuyama Valley, 3 miles east of Russell Brothers Ranch headquarters, approximately 650 feet north of ranch road):

C1--0 to 3/4 inch, (salty crust) pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; weak, coarse and very coarse, platy structure; hard, friable, sticky and plastic; common fine interstitial pores; strongly effervescent, strongly saline, strongly alkaline (pH 8.5); abrupt, smooth boundary.

C2sa--3/4 inch to 7 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) when moist; strong, very coarse, prismatic structure; very hard, firm, sticky and plastic; few micro roots, very few fine and many medium roots; few fine tubular pores and many medium and coarse interstitial pores; strongly effervescent; disseminated lime; thin coatings of crystalline salt on dry ped faces and faint mycelia-like salt accumulation within peds; strongly effervescent, strongly saline, strongly alkaline (pH 8.5); abrupt, wavy boundary.

C3sa--7 to 35 inches, dark-brown (10YR 4/3d, 4/3m) silty clay loam, with common fine, prominent mottles of very pale brown and very dark gray; massive; hard, friable, sticky and plastic;

Included in mapping are areas of Cobbly alluvial land, which make up about 10 to 20 percent of the mapping unit. These cobbly areas are so mixed with the Metz soils that they cannot be mapped separately.

Permeability is rapid. Surface runoff is slow to medium, and the erosion hazard is slight to moderate. Fertility is low. The available water capacity is 4 to 5 inches in the 60-inch effective rooting depth.

This soil is used chiefly for alfalfa, dry lima beans, and sugar beets. Limited areas are in orchards. Some areas are used for range. Capability unit IIIs-4(17); Arid Sandy range site.

Metz loamy sand, overflow, 0 to 2 percent slopes (MoA).--This soil has a profile similar to the one described as representative for the series except that it contains more stratified sediments that are finer textured. It occurs mainly along the Santa Maria River in the lower Santa Maria Valley, although there are numerous small areas along the Sisquoc River, Santa Ynez River, and San Antonio Creek. In the Cuyama Valley this soil occupies broad, nearly level flood plains. This soil is subject to overflow and flooding during severe storms. However, the area along the Santa Maria River has largely been protected by levees and dikes.

Included in mapping are small areas of Sandy alluvial land and Cobbly alluvial land.

Permeability is moderately rapid. Surface runoff is very slow, and the erosion hazard is slight. Fertility is low. The available water capacity is 4 to 5 inches in the 60-inch root zone.

Where it is protected from flooding, this soil is used for alfalfa. Unprotected areas are used for range and wildlife. Capability units IIIs-4(14) and IIIs-4(17); Sandy range site in the coastal part of the Area; Arid Sandy range site in the Cuyama Valley.

Mine Pits and Dumps

Mine pits and dumps (MpG) consists of pits from which raw diatomaceous earth is taken in mining and areas where the waste materials from these pits is dumped. Most mining for diatomaceous earth is in the Santa Ynez Mountains near Lompoc. Diatomaceous earth deposits occupy large areas and are several hundred feet thick. They are made up of nearly pure, siliceous, skeletal deposits from microscopic algae.

Also in this unit are smaller areas of flagstone rock quarries, chiefly in the Tepusquet area, and a few rock quarries for road building and other construction.

This land type has no value for farming but has value as a source of raw material. Capability unit VIIIs-1(15).

Mocho Series

The Mocho series consists of well-drained silty clay loams developed from recently deposited alluvium. These soils occur on alluvial fans and on flood plains in the Santa Maria and Santa Ynez Valleys and to a minor extent in the smaller valleys of the surface area. Slopes are 0 to 2 percent. Vegetation is annual grasses and forbs. Elevations range from 40 to 1,800 feet. The average annual rainfall is 12 to 20 inches, the average annual air temperature is about 59° F., and the frost-free season is about 190 to 320 days. Mocho soils are associated with the Metz and Sorrento soils.

In a representative profile, the surface layer is grayish-brown, calcareous silty clay loam about 26 inches thick. Below is grayish-brown and pale-olive, calcareous, stratified silty clay loam extending to a depth of 60 inches and more.

Most areas of Mocho soils are irrigated and are used for a variety of crops. Some areas are used for nonfarm purposes.

Representative profile of the Mocho series (approximately 0.8 mile north of Central Avenue, Lompoc Valley, 75 feet east of Union Sugar Avenue and 70 feet north of farm road):

Ap1--0 to 4 inches, grayish-brown (2.5Y 5/2) light silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; weak, coarse, platy and weak, medium, subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores and many medium interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.0); clear, smooth boundary.

Ap2--4 to 13 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine pores, many medium tubular pores, and common fine and very fine interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.0); clear, smooth boundary.

A1--13 to 26 inches, grayish-brown (2.5Y 5/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; massive; hard, friable, sticky and plastic; few micro roots; common very fine and medium tubular pores and many micro interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.2); gradual, wavy boundary.

C1--26 to 41 inches, grayish-brown (2.5Y 5/2) light silty clay loam, dark brown (10YR 4/3) when moist; massive; hard, sticky and plastic; few micro roots; common very fine and medium tubular pores and many micro interstitial pores; strongly effervescent; disseminated lime and lime in fine irregular soft masses; moderately alkaline (pH 8.2); gradual, smooth boundary.

C2--41 to 67 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark brown (10YR 4/3) when moist; massive; hard, friable, sticky and plastic; very few micro roots; many very fine tubular pores and common micro interstitial pores; strongly effervescent; disseminated lime and lime in fine irregular soft masses; moderately alkaline (pH 8.2); gradual, smooth boundary.

In a representative profile, the surface layer is brown, calcareous loamy sand about 17 inches thick. The underlying layer is pale-brown and light yellowish-brown, calcareous, stratified loamy sand and loamy coarse sand extending to a depth of 60 inches and more. Many areas are subject to overflow. During floods, fresh deposits of material are laid down and removed. As a result, the appearance of the surface may change from year to year.

Metz soils are used for irrigated vegetables and field crops and for range.

Representative profile of the Metz series (in Lompoc Valley, 0.6 mile west of the north end of Union Sugar Ave., 36 feet south of the center of the farm road):

Ap1--0 to 6 inches, brown (10YR 5/3) loamy sand, dark yellowish brown (10YR 4/4) when moist; weak, fine and medium, crumb structure; slightly hard, very friable, slightly sticky and nonplastic; few micro roots; few micro tubular pores and many very fine interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.0); abrupt, wavy boundary.

Ap2--6 to 17 inches, brown (10YR 5/3) loamy sand, dark yellowish brown (10YR 4/4) when moist; massive; hard, very friable, slightly sticky and nonplastic; very few micro roots; few micro tubular pores and many very fine interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.0); abrupt, smooth boundary.

C1--17 to 32 inches, pale-brown (10YR 6/3) light loamy sand, yellowish brown (10YR 5/4) when moist; massive; slightly hard, very friable, nonsticky and nonplastic; very few micro roots; few very fine and fine tubular pores and many very fine interstitial pores; slightly effervescent; moderately alkaline (pH 8.0); clear, wavy boundary.

C2--32 to 51 inches, pale-brown (10YR 6/3) light loamy sand, dark yellowish brown (10YR 4/4) when moist; massive; soft, very friable, nonsticky and nonplastic; few micro and coarse roots; common micro and medium tubular pores and many very fine interstitial pores; slightly effervescent; moderately alkaline (pH 8.0); gradual, wavy boundary.

C3--51 to 72 inches, light yellowish-brown (10YR 6/4) loamy coarse sand, yellowish brown (10YR 5/4) when moist; massive; soft, very friable, nonsticky and nonplastic; very few micro and medium roots; very few medium tubular pores and many very fine interstitial pores; slightly effervescent; moderately alkaline (pH 8.0). The C3 horizon contains discontinuous bands, 1/4 inch to 1 1/2 inches thick, that are silty clay loam in texture, dark brown (10YR 4/3) when moist, and strongly effervescent.

The main variations in the Metz soils are the result of stratification. Texture of the A horizon ranges from loamy coarse sand to loamy fine sand. Color ranges from grayish brown to brown and pale brown. Stratification in this soil varies widely; most profiles contain layers of fine, medium, and coarse sand. The Ap1 horizon is not discernible everywhere, particularly in the dryer parts of Cuyama Valley, and is weakly discernible in other areas.

Metz loamy sand, 0 to 2 percent slopes (MnA).--Strips of this soil are along streams in the coastal part of the survey area. They are not subject to flooding except during highly intensive storms. The largest areas are close to the Santa Ynez River in the Lompoc Valley. Numerous small areas are along the Santa Maria River and San Antonio Creek. Large areas that are affected occasionally by overflow occupy nearly level flood plains in the eastern part of the Cuyama Valley.

This soil has the profile described as representative for the series.

Included in mapping are small areas of Mocho and Panoche soils, particularly around the fringes of the valley where the Metz soils blend with the finer textured soils.

Permeability is rapid. Surface runoff is very slow, and the erosion hazard is none to slight. Fertility is low. The available water capacity is 4 to 5 inches in the 60-inch effective rooting zone.

This soil is used for irrigated vegetables and field crops and for alfalfa. Capability units IIIs-4(14) and IIIs-4(17); Sandy range site in the coastal part of the Area; Arid Sandy range site in the Cuyama Valley.

Metz loamy sand, 2 to 9 percent slopes (MnC).--This soil occupies small areas in alluvial fans and sloping flood plains in the coastal part of the survey area. This soil has a profile similar to the one described as representative for the series except that it contains more coarse sand throughout the profile. The soil is subject to occasional flooding.

Included in mapping are areas of Sandy Alluvial Land.

Permeability is rapid. Surface runoff is slow, and the erosion hazard is slight. Fertility is low. The available water capacity is 4 to 5 inches in the 60-inch rooting zone.

Because the areas of this soil are small and irregular in shape, they are used mainly for range. Selected areas are used for irrigated vegetables and field crops. Capability unit IIIs-4(14); Sandy range site.

Metz loamy sand, 2 to 9 percent slopes, eroded (MnC2).--This soil is gently sloping and sloping and occurs on alluvial fans in the Cuyama Valley. It is subject to frequent flooding during the rainy season. This soil has a profile similar to the one described as representative for the series except that it contains more coarse sand. In most areas the surface is raw and uneven and is dissected by numerous shallow channels.

This soil is used for late-growing annual pasture and range. Some areas are used for dryland grain and for sugar beets. Capability unit IIIw-2(14); Clayey range site.

Camarillo Series

The Camarillo series consists of somewhat poorly drained very fine sandy loams to silty clay loams that developed in recently deposited alluvium derived from sandstone and shale. These soils are on low alluvial fans and flood plains. Slopes are 0 to 2 percent. The vegetation consists of a wide variety of water-tolerant plants. Annual grasses and forbs grow in areas where the drainage problem is least severe. The most poorly drained areas are covered with willows and sedges. Elevations range from near sea level to 100 feet. The average annual rainfall is 12 to 15 inches, the average annual air temperature is about 59° F., and the frost-free season is 275 to 330 days. Camarillo soils are associated with Mocho soils.

In a representative profile, the surface layer is calcareous, brown and grayish-brown very fine sandy loam about 36 inches thick. Below this is stratified, mottled, calcareous sand to very fine sandy loam extending to a depth of 80 inches or more. Surface texture ranges from sandy loam to silty clay loam.

Camarillo soils are used for pasture, small grain, and hay. Some areas are used for irrigated crops.

Representative profile of the Camarillo series (in an open field on Vandenberg Air Force Base property, 1 3/8 miles east of Surf and 370 feet south of a fence on the north edge of the Lompoc Valley):

A11--0 to 7 inches, brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) when moist; massive; hard, friable, slightly sticky and slightly plastic; common micro roots and very fine and medium roots; few very fine and fine tubular pores and many micro interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.2); clear, smooth boundary.

A12--7 to 18 inches, grayish-brown (2.5Y 5/2) very fine sandy loam, very dark grayish brown (2.5Y 3/2) when moist; massive; hard, friable, slightly sticky and slightly plastic; few micro and fine roots and common medium roots; common very fine tubular pores and many micro interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.2); gradual, smooth boundary.

A13--18 to 31 inches, brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) when moist; few, fine, distinct mottles of strong brown (7.5YR 5/6) and dark yellowish brown (10YR 4/4); massive; hard, friable, slightly sticky and slightly plastic; few micro and fine roots; many micro interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8/2); abrupt, smooth boundary.

IIA14b--31 to 36 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; massive; hard, friable, sticky and plastic; common micro and few fine roots; very few tubular pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.2); abrupt, smooth boundary.

IIIC1--36 to 40 inches, light yellowish-brown (2.5Y 6/4) fine sand, light olive brown (2.5Y 5/4) when moist; massive; soft, very friable, nonsticky and nonplastic; very few micro and fine roots; few very fine and fine tubular pores and many micro interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.2); clear, smooth boundary.

IVC2--40 to 62 inches, brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) mottled with grayish brown (2.5Y 5/2) when moist; many, fine, distinct mottles of light yellowish brown (2.5Y 6/4); massive; hard, friable, slightly sticky and slightly plastic; very few micro and fine roots; many micro interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.1); gradual, smooth boundary.

IVC3--62 to 72 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) mottled with olive brown (2.5Y 4/4) and light reddish brown (5YR 6/4) when moist; many, medium, distinct mottles of light olive brown (2.5Y 5/4) and reddish brown (2.5YR 5/4); massive; slightly hard, friable, slightly sticky and slightly plastic; very few micro and fine roots; many micro interstitial pores; strongly effervescent; disseminated lime; moderately alkaline (pH 8.1); clear, smooth boundary.

Color of the A horizon is generally brown, grayish brown, dark grayish brown, gray, or dark gray. Texture of the A horizon varies widely from one mapped area to another and within mapped areas. It ranges from sandy loam to silty clay loam. Texture of the C horizon varies widely because of stratification, ranging from sandy loam to silty clay loam at a depth of about 10 to 36 inches; in some places there is an underlying layer of coarse material below a depth of 36 inches. The C horizon is mottled. A water table is within 5 feet of the surface at some time during the year. The water table fluctuates seasonally and at times is within a foot or two of the surface, dropping to more than 5 feet in depth late in summer and in fall. In areas that are drained artificially, the water table is maintained at depths below 5 to 6 feet.

Camarillo sandy loam (Ca).--This nearly level soil occupies flood plains. A fairly large area is in the lower Lompoc Valley within 1 or 2 miles of the ocean. Widely scattered small areas of this soil are in the Santa Maria, Lompoc, and San Antonio Valleys. This soil has a profile similar to that described as representative for the series except that it is sandy loam throughout. The water table fluctuates from 3 to 6 feet below the surface, depending upon the time of year.

Included in mapping are areas where the water table is at or near the surface during parts of the year. In other included areas the surface layer is loamy sand.

Permeability is moderately rapid. Water stands on the surface, and there is no erosion hazard. Fertility is moderate. Where the soil is drained, the available water capacity is 6.0 to 7.0 inches. The effective rooting depth is limited by the water table, which is at depths of 3 to 6 feet.

This soil is used for pasture or range. If drained, it is suited to a wide variety of crops. Capability unit IIw-2(14); Loamy range site.

Camarillo sandy loam, drained (Cb).--This nearly level soil occupies flood plains mainly along the Green Canyon drainageway west of Santa Maria. It has a profile similar to that described as representative for the series except that this soil is sandy loam throughout. Colors are grayish brown, gray, and dark gray. This soil has been drained artificially, but most areas need additional drainage to maintain the water table below a depth of 5 feet.

Included in mapping are small areas where the water table is 20 to 30 inches below the surface.

Permeability is moderately rapid. Water stands on the surface, and there is no erosion hazard. Fertility is moderate. Where the soil is drained, its capacity for holding water available to plants is 6.0 to 7.0 inches. The effective rooting depth is about 60 inches.

This soil is used for all crops normally grown in the Area except those that have deep roots. Capability unit IIw-2(14).

Camarillo very fine sandy loam (Cc).--This soil is nearly level. It occupies flood plains in the Lompoc Valley within 1 or 2 miles of the ocean, and a small acreage in the San Antonio Valley. This soil has the profile described as representative for the series. Depth to the water table varies. The water table generally is within 3 feet of the surface in winter and spring and at a depth of 6 feet or more late in summer and in fall.

Included in mapping are areas of Camarillo sandy loam and areas that are underlain by sand below a depth of 30 inches.

Permeability is moderate. Surface runoff is slow, and the erosion hazard is none to slight. Fertility is high. Where the soil is drained, the capacity for holding water available to plants is 9.0 to 11.0 inches. Root penetration is limited to a depth of 3 to 5 feet by the water table.

This soil is used for annual pasture and range and to a limited extent for dryland hay and grain. Some shallow-rooted row crops are also grown on this soil. Capability unit IIw-2(14); Loamy range site.

Camarillo silty clay loam (Cd).--This soil is nearly level and occupies low flood plains in the Lompoc Valley about midway between Lompoc and the ocean. The surface layer is dark grayish-brown or dark-gray silty clay loam, and the profile is loam to clay loam throughout; otherwise this soil has a profile similar to the one described as representative for the series. The water table normally is within 2 feet of the surface during the rainy season, but drops to a depth of about 5 feet or more during the dry season.

Included in mapping are small areas of Mocho soils and areas of Camarillo very fine sandy loam.

Permeability is moderately slow. Water stands on the surface, and there is no erosion hazard. Fertility is high. The soil is difficult to work when moist or when dry. Where the soil is drained, the capacity for holding water available to plants is 11.0 to 13.0 inches. The effective rooting depth is limited by the water table to about 24 inches.

This soil is used for dryland hay, grain, and beans. It is also used for shallow-rooted, irrigated row crops and for flowers. Capability unit IIw-2(14).

Chamise Series

The Chamise series consists of well-drained soils that developed over gravelly beds of silt and clay and sandy water-deposited materials. These soils have a sandy loam, loam, clay loam, or shaly loam surface layer and a shaly clay subsoil. Chamise soils normally contain a large number of water-rounded fragments of Monterey Shale. These soils are on dissected high terraces in widely scattered areas, extending from the coast to the vicinity of Los Alamos. Slopes are 2 to 72 percent. The vegetation consists of annual grasses and oak trees; brush grows on the steeper and eroded areas. Elevations range from 200 to 1,500 feet. The average annual rainfall is 12 to 20 inches, the average annual air temperature is about 58° F., and the frost-free season is 240 to 300 days. Chamise soils are associated with Tierra soils.

In a representative profile, the surface layer is dark-gray and gray shaly loam about 18 inches thick. The upper part of the subsoil is light brownish-gray shaly clay and very shaly heavy clay loam about 19 inches thick. The lower part of the subsoil is pale-brown very shaly clay loam to a depth of 60 inches and more. In places the surface layer is sandy loam, shaly sandy loam, loam, or clay loam.

Chamise soils are used mainly for range. Small areas are used for dryland hay and grain and for irrigated crops.

Representative profile of the Chamise series (1 1/4 miles south and slightly east of Luton Ranch Headquarters, approximately 11 miles north of Buellton, California):

A11--0 to 2 inches, dark-gray (10YR 4/1) shaly loam, very dark grayish brown (10YR 3/2) when moist; strong, fine, granular structure; slightly

Positas fine sandy loam, 9 to 15 percent slopes, severely eroded (PtD3).--This strongly sloping soil is on dissected terraces. It has a profile similar to the one described as representative for the series except that much of the surface layer has been eroded away. The surface layer is only 6 to 12 inches thick, and the soil is dissected by numerous gullies and rills. This soil occupies a very small acreage in the survey area.

Included in mapping are noneroded areas. Also included are areas on slopes of less than 9 percent or of more than 15 percent where erosion is severe. Some areas where less than 6 inches of surface soil remains are also included.

Permeability is very slow. Surface runoff is rapid, and the erosion hazard is high. Fertility is very low. The available water capacity is 1 to 2 inches in the 6- to 12-inch root zone. Some moisture is available very slowly from the clay subsoil.

This soil is used for range. Capability unit VIIe-1(15); Claypan range site.

Positas fine sandy loam, 15 to 30 percent slopes (PtE).--This soil is strongly sloping and occurs on terrace breaks along drainagways. The areas of this soil are long, narrow, and irregular in shape. Depth to the clay subsoil ranges from 6 to 26 inches. About 10 to 25 percent of the entire soil profile is gravel and cobblestones.

Included in mapping are small areas of very gravelly or cobbly Positas soils and areas of severely eroded Positas soils.

Permeability is very slow. Surface runoff is rapid, and the erosion hazard is high. Fertility is low. The available water capacity is 1 to 4 inches in the 6- to 26-inch root zone. Some water is available very slowly from the clay subsoil.

This soil is used for range. Capability unit VIe-3(15); Claypan range site.

Positas cobbly fine sandy loam, 2 to 15 percent slopes (PuD).--This gently sloping to strongly sloping soil occurs on old alluvial fans on the south side of the Santa Ynez River in the vicinity of Lake Cachuma. These fans are at the mouths of drainageways that originate in the Santa Ynez Mountains. This soil has a profile similar to the one described as representative for the series except that 20 to 35 percent of the entire soil profile is well-rounded sandstone cobblestones and boulders. The surface layer is 10 to 20 inches thick.

Included in mapping are fairly large areas in which 35 to 60 percent of the soil profile is cobblestones and boulders.

Permeability is very slow. Surface runoff is medium, and the erosion hazard is moderate. Fertility is very low. The available water capacity is 1 to 2 inches in the 10- to 20-inch root zone. Very little moisture is available from the clay subsoil.

This soil is used for limited range. Capability unit VIe-3(15); Claypan range site.

Riverwash

Riverwash (Rs) is a miscellaneous land type that consists of water-deposited sand, gravel, cobblestones, and stones in active stream channels. It in inundated when water flows, and fresh deposits of materials are laid down and removed as a result of streambank erosion. Little or no vegetation grows in these areas except for a few clumps of sagebrush and scattered willows.

This land type has no value for farming, but is valuable as a source of sand and gravel. Capability unit VIIIw-4(14).

Rough Broken Land

Rough broken land (RuG) consists of steep to extremely steep, shallow soil materials over soft sandstone or semiconsolidated gravelly sediments (pl. V, bottom). Materials from Arnold, Chamise, and Kettleman soils make up most of this mapping unit. Slopes range from 30 to more than 75 percent. The vegetation is mainly sparse brush, grasses, forbs, and scattered small oak trees. Surface runoff is very rapid, and the erosion hazard is very severe. This land type contributes large amounts of runoff water and sediment to lower lying areas. These sediments often cause severe damage to buildings, fences, roads, soils, and crops. Dams built in watersheds occupied by this land type fill rapidly with sediment.

The sparse vegetation is needed to slow runoff and reduce erosion and should be protected from grazing and burning. Rough broken land should be used only as watershed. Capability unit VIIIe-1(14).

Salinas Series

The Salinas series consists of well-drained silty clay loams that formed on alluvial fans and flood plains. These soils are in scattered areas in the Santa Ynez, Santa Maria, and Los Alamos Valleys. Slopes are 0 to 15 percent. The vegetation is grasses, forbs, and scattered oak trees. Elevations range from 50 to 1,000 feet. The average annual rainfall is 10 to 15 inches, the average air temperature is about 58° F., and the frost-free season is 230 to 300 days. Salinas soils are associated with Agueda soils.

In a representative profile, the surface layer is dark-gray silty clay loam about 26 inches thick. The subsoil is gray silty clay loam about 15 inches thick, and is underlain by light brownish-gray silty clay loam that extends to a depth of more than 60 inches. In some areas the texture of the surface layer is loam.

Where water is available, the Salinas soils are used for irrigated crops. Otherwise, they are used for dryland crops. Small isolated areas are used for range.

Representative profile of the Salinas series (less than 1/2 mile south of Los Olivos, 0.3 mile

Soil Map–Northern Santa Barbara Area, California; and San Luis Obispo County, California, Coastal Part
(Guadalupe SDMP Soil's map)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 5, Jan 9, 2007

Soil Survey Area: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 3, Dec 14, 2006

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/3/1994; 9/15/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Northern Santa Barbara Area, California (CA672)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AdA	Agueda loam, 0 to 2 percent slopes	105.4	1.7%
Bd	Bayshore loam, drained	67.7	1.1%
Be	Bayshore loam, sandy substratum, drained	9.4	0.2%
Bh	Bayshore silty clay loam, drained	139.2	2.3%
Ca	Camarillo sandy loam	295.6	4.8%
Cc	Camarillo very fine sandy loam	31.7	0.5%
CuA	Corralitos loamy sand, 0 to 2 percent slopes	366.0	6.0%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	31.0	0.5%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	54.3	0.9%
MaA	Marina sand, 0 to 2 percent slopes	9.7	0.2%
Mh	Marsh	7.3	0.1%
MnA	Metz loamy sand, 0 to 2 percent slopes	343.0	5.6%
MnC	Metz loamy sand, 2 to 9 percent slopes	7.8	0.1%
MoA	Metz loamy sand, overflow, 0 to 2 percent slopes	63.2	1.0%
Mt	Mocho sandy loam, sandy substratum, overflow	31.7	0.5%
Mu	Mocho fine sandy loam	148.9	2.4%
Mv	Mocho loam	142.7	2.3%
Mx	Mocho silty clay loam	13.1	0.2%
Rs	Riverwash	142.1	2.3%
SaA	Salinas loam, 0 to 2 percent slopes	1,660.3	27.1%
SaC	Salinas loam, 2 to 9 percent slopes	59.2	1.0%
SdA	Salinas silty clay loam, 0 to 2 percent slopes	141.4	2.3%
SeD	Salinas and Sorrento loams, 9 to 15 percent slopes	5.6	0.1%
Sh	Sandy alluvial land	22.7	0.4%
StA	Sorrento sandy loam, 0 to 2 percent slopes	1,121.1	18.3%

Northern Santa Barbara Area, California (CA672)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
StC	Sorrento sandy loam, 2 to 9 percent slopes	8.8	0.1%
SvA	Sorrento loam, 0 to 2 percent slopes	981.8	16.0%
SvC	Sorrento loam, 2 to 9 percent slopes	99.4	1.6%

San Luis Obispo County, California, Coastal Part (CA664)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
194	Riverwash	11.9	0.2%

Totals for Area of Interest (AOI)	6,121.9	100.0%

Hydrologic Soil Group—Northern Santa Barbara Area, California; and San Luis Obispo County, California, Coastal Part
(Guadalupe SDMP)

N

Meters: 0, 500, 1,000, 2,000, 3,000
Feet: 0, 2,000, 4,000, 8,000, 12,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 5, Jan 9, 2007

Soil Survey Area: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 3, Dec 14, 2006

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/3/1994; 9/15/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AdA	Agueda loam, 0 to 2 percent slopes	B	105.4	1.7%
Bd	Bayshore loam, drained	C	67.7	1.1%
Be	Bayshore loam, sandy substratum, drained	B	9.4	0.2%
Bh	Bayshore silty clay loam, drained	B	139.2	2.3%
Ca	Camarillo sandy loam	C	295.6	4.8%
Cc	Camarillo very fine sandy loam	C	31.7	0.5%
CuA	Corralitos loamy sand, 0 to 2 percent slopes	A	366.0	6.0%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	A	31.0	0.5%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	A	54.3	0.9%
MaA	Marina sand, 0 to 2 percent slopes	B	9.7	0.2%
Mh	Marsh	D	7.3	0.1%
MnA	Metz loamy sand, 0 to 2 percent slopes	B	343.0	5.6%
MnC	Metz loamy sand, 2 to 9 percent slopes	B	7.8	0.1%
MoA	Metz loamy sand, overflow, 0 to 2 percent slopes	B	63.2	1.0%
Mt	Mocho sandy loam, sandy substratum, overflow	B	31.7	0.5%
Mu	Mocho fine sandy loam	B	148.9	2.4%
Mv	Mocho loam	B	142.7	2.3%
Mx	Mocho silty clay loam	B	13.1	0.2%
Rs	Riverwash	D	142.1	2.3%
SaA	Salinas loam, 0 to 2 percent slopes	B	1,660.3	27.1%
SaC	Salinas loam, 2 to 9 percent slopes	B	59.2	1.0%
SdA	Salinas silty clay loam, 0 to 2 percent slopes	B	141.4	2.3%
SeD	Salinas and Sorrento loams, 9 to 15 percent slopes	B	5.6	0.1%

Hydrologic Soil Group— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Sh	Sandy alluvial land	B	22.7	0.4%
StA	Sorrento sandy loam, 0 to 2 percent slopes	B	1,121.1	18.3%
StC	Sorrento sandy loam, 2 to 9 percent slopes	B	8.8	0.1%
SvA	Sorrento loam, 0 to 2 percent slopes	B	981.8	16.0%
SvC	Sorrento loam, 2 to 9 percent slopes	B	99.4	1.6%

Hydrologic Soil Group— Summary by Map Unit — San Luis Obispo County, California, Coastal Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
194	Riverwash	D	11.9	0.2%

Totals for Area of Interest (AOI)	6,121.9	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Component

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Component" returns the attribute value associated with the component with the highest percent composition in the map unit. If more than one component shares the highest percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher attribute value should be returned in the case of a percent composition tie.

The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit.

Component Percent Cutoff: *None Specified*

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Depth to Water Table—Northern Santa Barbara Area, California; and San Luis Obispo County, California, Coastal Part
(Guadalupe SDMP)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 5, Jan 9, 2007

Soil Survey Area: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 3, Dec 14, 2006

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/3/1994; 9/15/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Drainage Class—Northern Santa Barbara Area, California; and San Luis Obispo County, California, Coastal Part
(Guadalupe SDMP)

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- Excessively drained
- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- Not rated or not available

Political Features

Municipalities

- Cities
- Urban Areas

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails

Roads

- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 5, Jan 9, 2007

Soil Survey Area: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 3, Dec 14, 2006

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/3/1994; 9/15/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Depth to Water Table

Depth to Water Table— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
AdA	Agueda loam, 0 to 2 percent slopes	>200	105.4	1.7%
Bd	Bayshore loam, drained	137	67.7	1.1%
Be	Bayshore loam, sandy substratum, drained	76	9.4	0.2%
Bh	Bayshore silty clay loam, drained	137	139.2	2.3%
Ca	Camarillo sandy loam	137	295.6	4.8%
Cc	Camarillo very fine sandy loam	137	31.7	0.5%
CuA	Corralitos loamy sand, 0 to 2 percent slopes	>200	366.0	6.0%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	>200	31.0	0.5%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	>200	54.3	0.9%
MaA	Marina sand, 0 to 2 percent slopes	>200	9.7	0.2%
Mh	Marsh	0	7.3	0.1%
MnA	Metz loamy sand, 0 to 2 percent slopes	>200	343.0	5.6%
MnC	Metz loamy sand, 2 to 9 percent slopes	>200	7.8	0.1%
MoA	Metz loamy sand, overflow, 0 to 2 percent slopes	>200	63.2	1.0%
Mt	Mocho sandy loam, sandy substratum, overflow	>200	31.7	0.5%
Mu	Mocho fine sandy loam	>200	148.9	2.4%
Mv	Mocho loam	>200	142.7	2.3%
Mx	Mocho silty clay loam	>200	13.1	0.2%
Rs	Riverwash	31	142.1	2.3%
SaA	Salinas loam, 0 to 2 percent slopes	>200	1,660.3	27.1%
SaC	Salinas loam, 2 to 9 percent slopes	>200	59.2	1.0%
SdA	Salinas silty clay loam, 0 to 2 percent slopes	>200	141.4	2.3%
SeD	Salinas and Sorrento loams, 9 to 15 percent slopes	>200	5.6	0.1%

Depth to Water Table— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	**Map unit name**	**Rating (centimeters)**	**Acres in AOI**	**Percent of AOI**
Sh	Sandy alluvial land	>200	22.7	0.4%
StA	Sorrento sandy loam, 0 to 2 percent slopes	>200	1,121.1	18.3%
StC	Sorrento sandy loam, 2 to 9 percent slopes	>200	8.8	0.1%
SvA	Sorrento loam, 0 to 2 percent slopes	>200	981.8	16.0%
SvC	Sorrento loam, 2 to 9 percent slopes	>200	99.4	1.6%

Depth to Water Table— Summary by Map Unit — San Luis Obispo County, California, Coastal Part				
Map unit symbol	**Map unit name**	**Rating (centimeters)**	**Acres in AOI**	**Percent of AOI**
194	Riverwash	31	11.9	0.2%

Totals for Area of Interest (AOI)	6,121.9	100.0%

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

Drainage Class

Drainage Class— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AdA	Agueda loam, 0 to 2 percent slopes	Well drained	105.4	1.7%
Bd	Bayshore loam, drained	Somewhat poorly drained	67.7	1.1%
Be	Bayshore loam, sandy substratum, drained	Somewhat poorly drained	9.4	0.2%
Bh	Bayshore silty clay loam, drained	Somewhat poorly drained	139.2	2.3%
Ca	Camarillo sandy loam	Somewhat poorly drained	295.6	4.8%
Cc	Camarillo very fine sandy loam	Somewhat poorly drained	31.7	0.5%
CuA	Corralitos loamy sand, 0 to 2 percent slopes	Somewhat excessively drained	366.0	6.0%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	Somewhat excessively drained	31.0	0.5%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	Somewhat excessively drained	54.3	0.9%
MaA	Marina sand, 0 to 2 percent slopes	Somewhat excessively drained	9.7	0.2%
Mh	Marsh	Very poorly drained	7.3	0.1%
MnA	Metz loamy sand, 0 to 2 percent slopes	Somewhat excessively drained	343.0	5.6%
MnC	Metz loamy sand, 2 to 9 percent slopes	Somewhat excessively drained	7.8	0.1%
MoA	Metz loamy sand, overflow, 0 to 2 percent slopes	Somewhat excessively drained	63.2	1.0%
Mt	Mocho sandy loam, sandy substratum, overflow	Well drained	31.7	0.5%
Mu	Mocho fine sandy loam	Well drained	148.9	2.4%
Mv	Mocho loam	Well drained	142.7	2.3%
Mx	Mocho silty clay loam	Well drained	13.1	0.2%
Rs	Riverwash	Excessively drained	142.1	2.3%
SaA	Salinas loam, 0 to 2 percent slopes	Well drained	1,660.3	27.1%
SaC	Salinas loam, 2 to 9 percent slopes	Well drained	59.2	1.0%
SdA	Salinas silty clay loam, 0 to 2 percent slopes	Well drained	141.4	2.3%

Drainage Class— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
SeD	Salinas and Sorrento loams, 9 to 15 percent slopes	Well drained	5.6	0.1%
Sh	Sandy alluvial land	Excessively drained	22.7	0.4%
StA	Sorrento sandy loam, 0 to 2 percent slopes	Well drained	1,121.1	18.3%
StC	Sorrento sandy loam, 2 to 9 percent slopes	Well drained	8.8	0.1%
SvA	Sorrento loam, 0 to 2 percent slopes	Well drained	981.8	16.0%
SvC	Sorrento loam, 2 to 9 percent slopes	Well drained	99.4	1.6%

Drainage Class— Summary by Map Unit — San Luis Obispo County, California, Coastal Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
194	Riverwash	Excessively drained	11.9	0.2%

Totals for Area of Interest (AOI)	6,121.9	100.0%

Description

"Drainage class (natural)" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized-excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Flooding Frequency Class–Northern Santa Barbara Area, California; and San Luis Obispo County, California, Coastal Part
(Guadalupe SDMP)

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- None
- Very Rare
- Rare
- Occasional
- Frequent
- Very Frequent

Political Features

Municipalities

- Cities
- Urban Areas

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails

Roads

- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 5, Jan 9, 2007

Soil Survey Area: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 3, Dec 14, 2006

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/3/1994; 9/15/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Flooding Frequency Class

Flooding Frequency Class— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AdA	Agueda loam, 0 to 2 percent slopes	Rare	105.4	1.7%
Bd	Bayshore loam, drained	Rare	67.7	1.1%
Be	Bayshore loam, sandy substratum, drained	Rare	9.4	0.2%
Bh	Bayshore silty clay loam, drained	Rare	139.2	2.3%
Ca	Camarillo sandy loam	None	295.6	4.8%
Cc	Camarillo very fine sandy loam	None	31.7	0.5%
CuA	Corralitos loamy sand, 0 to 2 percent slopes	None	366.0	6.0%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	None	31.0	0.5%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	None	54.3	0.9%
MaA	Marina sand, 0 to 2 percent slopes	None	9.7	0.2%
Mh	Marsh	Frequent	7.3	0.1%
MnA	Metz loamy sand, 0 to 2 percent slopes	Occasional	343.0	5.6%
MnC	Metz loamy sand, 2 to 9 percent slopes	Occasional	7.8	0.1%
MoA	Metz loamy sand, overflow, 0 to 2 percent slopes	Occasional	63.2	1.0%
Mt	Mocho sandy loam, sandy substratum, overflow	Occasional	31.7	0.5%
Mu	Mocho fine sandy loam	None	148.9	2.4%
Mv	Mocho loam	None	142.7	2.3%
Mx	Mocho silty clay loam	None	13.1	0.2%
Rs	Riverwash	Frequent	142.1	2.3%
SaA	Salinas loam, 0 to 2 percent slopes	None	1,660.3	27.1%
SaC	Salinas loam, 2 to 9 percent slopes	None	59.2	1.0%
SdA	Salinas silty clay loam, 0 to 2 percent slopes	None	141.4	2.3%
SeD	Salinas and Sorrento loams, 9 to 15 percent slopes	None	5.6	0.1%

Flooding Frequency Class— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Sh	Sandy alluvial land	Occasional	22.7	0.4%
StA	Sorrento sandy loam, 0 to 2 percent slopes	None	1,121.1	18.3%
StC	Sorrento sandy loam, 2 to 9 percent slopes	None	8.8	0.1%
SvA	Sorrento loam, 0 to 2 percent slopes	None	981.8	16.0%
SvC	Sorrento loam, 2 to 9 percent slopes	None	99.4	1.6%

Flooding Frequency Class — Summary by Map Unit — San Luis Obispo County, California, Coastal Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
194	Riverwash	Frequent	11.9	0.2%

Totals for Area of Interest (AOI)		
Totals for Area of Interest (AOI)	6,121.9	100.0%

Description

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.

"Occasional" means that flooding occurs infrequently under normal weather conditions. The chance of flooding is 5 to 50 percent in any year.

"Frequent" means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year.

"Very frequent" means that flooding is likely to occur very often under normal weather conditions. The chance of flooding is more than 50 percent in all months of any year.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

Representative Slope–Northern Santa Barbara Area, California; and San Luis Obispo County, California, Coastal Part
(Guadalupe SDMP)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- 0 - 5
- 5 - 15
- 15 - 30
- 30 - 45
- 45 - 60
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northern Santa Barbara Area, California
Survey Area Data: Version 5, Jan 9, 2007

Soil Survey Area: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 3, Dec 14, 2006

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/3/1994; 9/15/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Representative Slope

Representative Slope— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
AdA	Agueda loam, 0 to 2 percent slopes	1.0	105.4	1.7%
Bd	Bayshore loam, drained	1.0	67.7	1.1%
Be	Bayshore loam, sandy substratum, drained	1.0	9.4	0.2%
Bh	Bayshore silty clay loam, drained	1.0	139.2	2.3%
Ca	Camarillo sandy loam	1.0	295.6	4.8%
Cc	Camarillo very fine sandy loam	1.0	31.7	0.5%
CuA	Corralitos loamy sand, 0 to 2 percent slopes	1.0	366.0	6.0%
CuC	Corralitos loamy sand, 2 to 9 percent slopes	6.0	31.0	0.5%
CuD	Corralitos loamy sand, 9 to 15 percent slopes	12.0	54.3	0.9%
MaA	Marina sand, 0 to 2 percent slopes	1.0	9.7	0.2%
Mh	Marsh	1.0	7.3	0.1%
MnA	Metz loamy sand, 0 to 2 percent slopes	1.0	343.0	5.6%
MnC	Metz loamy sand, 2 to 9 percent slopes	6.0	7.8	0.1%
MoA	Metz loamy sand, overflow, 0 to 2 percent slopes	1.0	63.2	1.0%
Mt	Mocho sandy loam, sandy substratum, overflow	1.0	31.7	0.5%
Mu	Mocho fine sandy loam	1.0	148.9	2.4%
Mv	Mocho loam	1.0	142.7	2.3%
Mx	Mocho silty clay loam	1.0	13.1	0.2%
Rs	Riverwash	3.0	142.1	2.3%
SaA	Salinas loam, 0 to 2 percent slopes	1.0	1,660.3	27.1%
SaC	Salinas loam, 2 to 9 percent slopes	6.0	59.2	1.0%
SdA	Salinas silty clay loam, 0 to 2 percent slopes	1.0	141.4	2.3%
SeD	Salinas and Sorrento loams, 9 to 15 percent slopes	12.0	5.6	0.1%

Representative Slope— Summary by Map Unit — Northern Santa Barbara Area, California				
Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
Sh	Sandy alluvial land	3.0	22.7	0.4%
StA	Sorrento sandy loam, 0 to 2 percent slopes	1.0	1,121.1	18.3%
StC	Sorrento sandy loam, 2 to 9 percent slopes	6.0	8.8	0.1%
SvA	Sorrento loam, 0 to 2 percent slopes	1.0	981.8	16.0%
SvC	Sorrento loam, 2 to 9 percent slopes	6.0	99.4	1.6%

Representative Slope— Summary by Map Unit — San Luis Obispo County, California, Coastal Part				
Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
194	Riverwash	1.0	11.9	0.2%

Totals for Area of Interest (AOI)	6,121.9	100.0%

Description

Slope gradient is the difference in elevation between two points, expressed as a percentage of the distance between those points.

The slope gradient is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Interpret Nulls as Zero: No

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

7

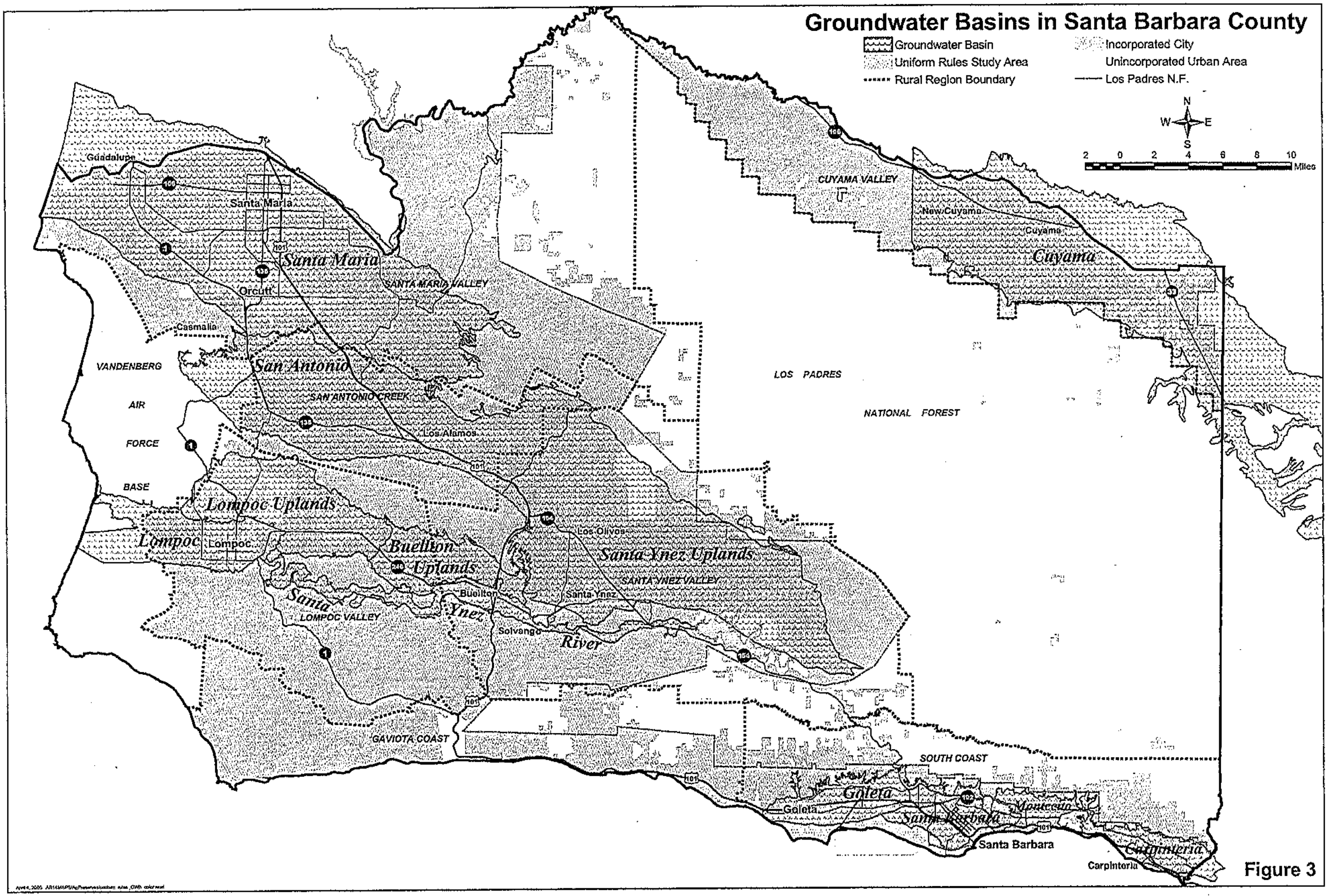

Groundwater Basins in Santa Barbara County
Groundwater Basin
Uniform Rules Study Area
Rural Region Boundary
Incorporated City
Unincorporated Urban Area
Los Padres N.F.
N
W
E
S
2 0 2 4 6 8 10 Miles
Guadalupe
Santa Maria
Orcutt
Casmalia
Santa Maria
SANTA MARIA VALLEY
San Antonio
SAN ANTONIO CREEK
Los Alamos
VANDENBERG
AIR
FORCE
BASE
Lompoc Uplands
Lompoc
Lompoc
Buellton
Uplands
Buellton
Santa
Ynez
LOMPOC VALLEY
Solvango
River
Los Olivos
Santa Ynez Uplands
SANTA YNEZ VALLEY
Santa Ynez
GAVIOTA COAST
CUYAMA VALLEY
New Cuyama
Cuyama
Cuyama
LOS PADRES
NATIONAL FOREST
SOUTH COAST
Goleta
Goleta
Santa Barbara
Montecito
Santa Barbara
Carpinteria
Carpinteria

Figure 3

Subregion 1806 -- Central California Coastal: The drainage into the Pacific Ocean from the Pescadero Creek Basin boundary to and including the Rincon Creek Basin. California.

Area = 11400 sq.mi.

Accounting Unit 180600 -- Central California Coastal. California.

Area = 11400 sq.mi.

Cataloging Units

18060001 -- San Lorenzo-Soquel. California.
Area = 374 sq.mi.

18060002 -- Pajaro. California.
Area = 1290 sq.mi.

18060003 -- Carrizo Plain. California.
Area = 440 sq.mi.

18060004 -- Estrella. California.
Area = 930 sq.mi.

18060005 -- Salinas. California.
Area = 3250 sq.mi.

18060006 -- Central Coastal. California.
Area = 1070 sq.mi.

18060007 -- Cuyama. California.
Area = 1130 sq.mi.

18060008 -- Santa Maria. California.
Area = 675 sq.mi.

18060009 -- San Antonio. California.
Area = 219 sq.mi.

18060010 -- Santa Ynez. California.
Area = 893 sq.mi.

18060011 -- Alisal-Elkhorn Sloughs. California.
Area = 232 sq.mi.

18060012 -- Carmel. California.
Area = 305 sq.mi.

18060013 -- Santa Barbara Coastal. California.
Area = 381 sq.mi.

18060014 -- Santa Barbara Channel Islands. California.
Area = 187 sq.mi.

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

8

to the upper parts of the unit (Woodring and Bramlette 1950). The Orcutt Formation can reach a maximum thickness of 225 feet, particularly along the axis of the Santa Maria Valley syncline (Worts 1951).

Paso Robles Formation. The Pliocene-Pleistocene age Paso Robles Formation typically consists of unconsolidated to poorly consolidated coarse to fine-grained gravel, sand, silt, and clay (DWR 2002). In this basin, the Paso Robles Formation ranges from about 40 feet near Pismo Creek (DWR 2002) to 2,000 feet (Woodring and Bramlette 1950; Worts 1951) near Orcutt (Worts 1951). Specific yield of the Paso Robles Formation ranges from 4 to 20 percent, with median values of 6 to 11 percent for different parts of the basin in San Luis Obispo County (DWR 2002). Specific yield for the Paso Robles Formation in Santa Barbara County is estimated to average about 12 percent (DWR 1969).

Careaga Formation. The late Pliocene age Careaga Formation is described as unconsolidated deposits of fine- to medium-grained, marine sand with some silt (Worts 1951), and unconsolidated to well consolidated, coarse- to fine-grained sand, gravel, silty sand, silt, and clay (DWR 2002). Thickness of this unit ranges from about 150 to 700 feet in the San Luis Obispo County portion of the basin (DWR 2002) and ranges from 50 to 2,250 feet thick (Woodring and Bramlette 1950) elsewhere in the basin. Specific yield of the Careaga Formation ranges from 5 to 26 percent, with median values of 8 to 10 percent for different parts of the basin in San Luis Obispo County (DWR 2002).

Pismo Formation. The late Pliocene age Squire Member of the Pismo Formation is an important source of groundwater in the basin north of the Santa Maria River fault. The Squire Member consists of coarse- to fine-grained sand interbeded with discontinuous layers of silt and clay, and ranges from about 50 to 550 feet thick (DWR 2002). Specific yield of the Squire Member of the Pismo Formation ranges from 3 to 19 percent, with median values from 7 to 10 percent for parts of the basin north of the Santa Maria River fault in San Luis Obispo County (DWR 2002).

Restrictive Structures

In Santa Barbara County, the north-trending Santa Maria and Bradley Canyon faults displace the Paso Robles and Careaga Formations, but do not appear to displace younger sediments (Worts 1951). The Santa Maria fault displaces Pliocene units vertically by about 150 feet, and a steepening of the hydraulic gradient near the trace of this fault indicates that this fault is a partial barrier to groundwater flow (SBCWA 1977). The Santa Maria River fault cuts northwestward through the basin in San Luis Obispo County (DWR 2002). Water levels at different elevations across some sections of this fault suggest that it is a barrier to groundwater movement in formations below the Pleistocene dune sand deposits (DWR 2002).

Recharge

Natural recharge to the basin comes from seepage losses from the major streams, percolation of rainfall, and subsurface flow (DWR 2002). Percolation of flow in Pismo Creek provides recharge for the northern portion of the basin (DWR 2002). Percolation of flow in Arroyo Grande

Creek, controlled by releases from Lopez Dam, provides recharge for the Tri-Cities Mesa, Arroyo Grande Plain, and Arroyo Grande Valley portions of the basin (DWR 2002). Percolation of flow in Santa Maria River, controlled in part by releases from Twitchell Dam, provides recharge for the Santa Maria Valley portion of the basin (DWR 1999; 2002). Both Twitchell and Lopez Dams are operated so as to optimize groundwater recharge for the Santa Maria Groundwater Basin (DWR 2002). Incidental recharge includes deep percolation of urban and agricultural return water, treated wastewater return and septic tank effluent. Some subsurface inflow comes from consolidated rocks surrounding the basin and also from San Antonio Creek Valley Groundwater Basin (SBCWA 1977).

Groundwater Level Trends

Hydrographs show that water levels near Tri-Cities Mesa generally remained stable in the Paso Robles Formation and the alluvium from about 1965 through 2000 (DWR 2002). Groundwater levels in the deeper Squire Member of the Pismo Formation near Tri-Cities Mesa declined during the 1980s and partially recovered by 2000 to about 4 to 11 feet below late 1970s-early 1980s levels (DWR 2002). Groundwater levels beneath Nipomo Mesa declined from 1 to 10 feet in the northern part during 1975 through 2000 and as much as 58.6 feet in the central part during 1968 through 2000; whereas water levels were stable in the western and southeastern parts, generally following rainfall cycles (DWR 2002). Groundwater levels beneath Santa Maria Valley generally declined during 1945 through 1977, recovered by about 1986, declined again until about 1992, then recovered to near historic high levels by 1998 (DWR 2002).

Groundwater flow is generally westward toward the Pacific Ocean. A large groundwater depression beneath Nipomo Mesa, in the northern part of the basin, has directed groundwater flow locally toward the depression (DWR 2002).

Groundwater Storage

Groundwater Storage Capacity. The total storage capacity of the portion of the basin in San Luis Obispo County is estimated to be about 4,000,000 af, with about 784,000 of that capacity residing above mean sea level (DWR 2002). Based on estimates of groundwater in storage for 1968 (DWR 1969), the total storage capacity of the basin must be greater than 14,900,000 af.

Groundwater in Storage. The maximum historical water levels occurred in 1918 and the groundwater in storage above mean sea level, for that year, in the Santa Maria Valley part of the basin is estimated to have been about 3,070,000 af (SBCWA 1977). Groundwater in storage in the Santa Barbara County portion of the basin during spring 1968 was estimated to have been about 11,000,000 af, and in the San Luis Obispo County portion to have been about 3,870,000 af (DWR 1969). Groundwater in storage for the Santa Maria Valley portion above sea level is estimated to have been 2,500,000 af in 1984 and 2,300,000 af in 2000 (SBCWA 1999; 2001). Groundwater in storage in the San Luis Obispo County portion of the basin is estimated to have been 3,411,100 af in 1985 and 3,399,700 af in 1995 with groundwater in storage above mean sea level estimated to have been 231,100 af in 1985, and 219,700 af in 1995 (DWR 2002).

Groundwater Budget (Type A)

Groundwater budget information for the years 1959 through 1975 was estimated by Jones (1979). Annual recharge from flow in the Santa Maria and Sisquoc Rivers is estimated to have been about 6,000 af during 1978 through 1980 (Lipinski 1985). A study of the water resources of the San Luis Obispo County portion of the basin estimated water budgets for the years 1975 through 1995, with projected budgets for the years 2010 and 2020 (DWR 2002). This study estimates the average total annual inflow for 1984 through 1995 at 29,200 af and the average total outflow at 33,100 af for the San Luis Obispo County portion of the basin (DWR 2002). A groundwater budget chiefly for the Santa Barbara County portion of the basin estimates a mean annual recharge to the basin of 85,300 af and a total outflow for 1975 conditions of 105,100 af/yr (SBCWA 1977).

Groundwater Quality

Characterization. Groundwater character in this basin is variable and classified as a mixed–ion type, where there is no dominant cation or anion (DWR 2002). The central part of the basin in San Luis Obispo County is chiefly calcium-magnesium sulfate; whereas, groundwater in the northwestern part of the basin is more commonly calcium bicarbonate or calcium sulfate in character (DWR 2002). TDS concentrations vary throughout the basin, but tend to increase from east to west (SBCWA 1999; 2001) and increase toward the center of the basin beneath the cities of Santa Maria and Guadalupe in Santa Barbara County (DWR 1964). TDS concentrations also increase southward, away from the recharge area of the Santa Maria River (SBCWA 1999; 2001). East of Guadalupe, TDS concentrations increased to more than 3,000 mg/L in 1975 (SBCWA 1999; 2001). Water from 78 public supply wells has an average TDS content is 598 mg/L and ranges from 139 to 1,200 mg/L.

Impairments. Historically, the Santa Maria Valley Groundwater Basin has been subject to high nitrate concentrations, particularly in the vicinity of the City of Santa Maria and in Guadalupe (SBCWA 1999; 2001; DWR 2002). Nitrate concentrations have been recorded as high as 240 mg/L (DWR 2002). A small number of wells sampled during 1990 through 2000 show nitrate concentrations that exceed the MCL, mostly in the northern part of the basin (DWR 2002). High TDS, sulfate or chloride content impairs groundwater in some parts of the basin (DWR 2002).

Water Quality in Public Supply Wells

Constituent Group[1]	Number of wells sampled[2]	Number of wells with a concentration above an MCL[3]
Inorganics – Primary	81	2
Radiological	79	1
Nitrates	81	15
Pesticides	79	0
VOCs and SVOCs	79	1
Inorganics – Secondary	81	19

[1] A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).
[2] Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.
[3] Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

Well Production characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: Alluvium 13-2,300 Paso Robles Fm. 1-2,500 Squire Member, Pismo Fm. 90 – 1,000	Median: 60 45-1,580 270 (DWR 2002)
	Total depths (ft)	
Domestic	Range: 16-1,220 ft	Average: 281 ft (1,188 well completion reports)
Municipal/Irrigation	Range: 25-1,470 ft	Average: 337 ft (616 well completion reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
USGS	Groundwater levels	72
San Luis Obispo County	Groundwater Levels	214/spring and fall
USGS	Miscellaneous water quality	10
Department of Health Services and cooperators	Title 22 water quality	108

Basin Management

Groundwater Management:	Groundwater beneath San Luis Obispo County Flood Control and Water Conservation District Zone 3, the northwestern coastal portion of the basin, has been cooperatively managed since 1983. An agreement among landowners and cities in Zone 3 was formalized in 2002 that provides for allocation of groundwater supplies and cooperative groundwater management (Santa Maria Groundwater Litigation 2002).
Water agencies	
Public	City of Santa Maria, City of Guadalupe, City of Arroyo Grande, City of Pismo Beach, Casmalia CSD, Nipomo CSD, Oceano CSD, Santa Maria WCD, County of San Luis Obispo Department of Public Works, Santa Barbara County Water Agency.
Private	California Cities Water Company, Rural Water Company, Southern California Water Company.

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Errata

Changes made to the basin description will be noted here.

Santa Maria River Valley Groundwater Basin

- Groundwater Basin Number: 3-12
- County: Santa Barbara and San Luis Obispo
- Surface Area: 184,000 acres (288 square miles)

Basin Boundaries and Hydrology

This groundwater basin underlies the Santa Maria Valley in the coastal portion of northern Santa Barbara and southern San Luis Obispo Counties. The basin also underlies Nipomo and Tri-Cities Mesas, Arroyo Grande Plain, and Nipomo, Arroyo Grande and Pismo Creek Valleys (DWR 2002). The basin is bounded on the north by the San Luis and Santa Lucia Ranges, on the east by the San Rafael Mountains, on the south by the Solomon Hills and the San Antonio Creek Valley Groundwater Basin, on the southwest by the Casmalia Hills, and on the west by the Pacific Ocean. Several rivers and creeks drain westward to the Pacific Ocean. The Santa Maria Valley is drained by the Sisquoc, Cuyama, and Santa Maria Rivers and Orcutt Creek. Tri-Cities Mesa and Arroyo Grande Plain are drained by Arroyo Grande and Pismo Creeks. Nipomo Valley is drained by Nipomo Creek into the Santa Maria River. Annual precipitation ranges from 13 to 17 inches, with an average of 15 inches.

Hydrogeologic Information

Water Bearing Formations

Groundwater is found in alluvium, dune sands, and the Orcutt, Paso Robles, Pismo, and Careaga Formations. Groundwater is unconfined throughout most of the basin except in the coastal portion where it is confined. Specific yield of sediments in the basin ranges from 3 to 21 percent, with a mean specific yield of about 12 percent for parts of the basin in San Luis Obispo County (DWR 2002), and up to about 15 percent in Santa Barbara County (Lipinski 1985; DWR 1999). The average total thickness of the water-bearing materials is about 1,000 feet with a maximum thickness of 2,800 (SBCWA 1996) to 3,000 feet (Worts 1951).

Alluvium and Dune Deposits. Holocene alluvium consists of unconsolidated lenticular bodies of gravel, sand, silt, and clay. This alluvium reaches a maximum thickness of about 250 feet (Miller and Evenson 1966). Specific yield of Holocene alluvium ranges from about 6 to 23 percent and has a median value of about 12 percent for deposits in San Luis Obispo County (DWR 2002); the specific yield of deposits in Santa Barbara County is likely similar. Pleistocene and Holocene dune deposits consist of well-rounded, fine- to coarse-grained sand. Holocene dune deposits are typically found along a coastal belt and attain a maximum thickness of 100 feet (Woodring and Bramlette 1950; DWR 2002). Pleistocene dune deposits found under Tri-Cities Mesa range to about 60 feet thick and those under Nipomo Mesa range to about 300 feet thick (DWR 2002). Specific yield of Pleistocene dune deposits ranges from 5 to 26 percent and has an median value of about 13 percent for Tri-Cities Mesa and 17 percent for Nipomo Mesa (DWR 2002).

Orcutt Formation. The Pleistocene age Orcutt Formation consists of sand and interbeds of coarse gravel, with minor amounts of silt and clay restricted

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

9

Santa Maria Groundwater Basin

Recent Litigation

Litigation regarding the status and use of groundwater in the Santa Maria Basin was initiated in 1997. This litigation may affect the rights of water users within the basin and may result in development of a management process. Records of these proceedings are available at the website:

http://www.sccomplex.org/home/index.htm.

When final judgment is entered in this litigation, a subsequent ground-water report will contain a discussion of its implications to the groundwater resources monitored by the County.

Overdraft is defined as more water being taken out the basin than is being recharged, over a long period of time. In other words overdraft can be defined as exceeding the safe yield of the basin (please see groundwater terms section, page 3).

The Water Agency has evaluated the status of the basin, as well as the USGS, DWR, and private entities. Most all parties have agreed historically that the basin is in overdraft to a small, but significant amount. Any amount of overdraft in the basin **is** significant because overdraft may contribute to water quality changes; not only the buildup of nitrates, sulfates and total dissolved solids, but the threat of salt-water intrusion.

SBCWA has an extensive network of water level monitoring wells throughout the basin and when utilized to calculate the storage of groundwater they show that there is indeed a long-term decline in the amount of stored water above sea level in the basin. SBCWA has used a 1943-1999 base period that is believed by staff to be the most representative of the basins long-term climate. **Recharge to the system, and thus the base period used, is the dominant factor when evaluating the water budget of a basin, and by moving the base period around one can show any result of an analysis desired, either overdraft, balance, or surplus.**

Whatever the outcome of the litigation, SBCWA staff will continue monitoring the basin and sharing any information collected to all parties interested in protecting its water supply for the continuation of the extensive and historical agricultural base as well as urban usage and development.

Physical Description

The *Santa Maria Main Groundwater Basin* is an alluvial basin of 170 mi^2 that is bordered by the Nipomo Mesa and Sierra Madre Foothills to the north, the San Rafael Mountains to the east, the Solomon-Casmalia Hills to the south and the Pacific Ocean to the west. The Basin is situated in the northwest portion of Santa Barbara County and extends into the southwest portion of San Luis Obispo County. The Valley is approximately 28 miles long and 12 miles wide. Average rainfall varies from about 12 to 16 inches per year within the basin. Surface drainage is primarily from the Sisquoc and Santa Maria Rivers that traverse the north side of the basin from east to west. Orcutt Creek, Bradley

Canyon, Cat Canyon and Foxen Canyon are the primary drainages on the south side of the basin. The aquifer is considered to be essentially continuous hydrologically with the exception of clay lenses that cause localized confinement. Depressions of the water table occur in areas of heavy pumping.

The Santa Maria Groundwater Basin has three distinguishable units that appear to have only limited interaction: the Main Basin unit, the Nipomo Mesa unit, and the Arroyo Grande unit. In previous reports by SBCWA only the Main Basin unit has been addressed. The California Department of Water Resources (DWR) has recently released Water Resources of the Arroyo Grande – Nipomo Mesa Area which focuses on the Arroyo Grande, Nipomo Mesa and Valley, and Oso Flaco areas. This report has not yet been thoroughly reviewed by SBCWA staff. The report concludes that no overdraft currently exists in the areas of the study using a climatic base period of 1984-1995..

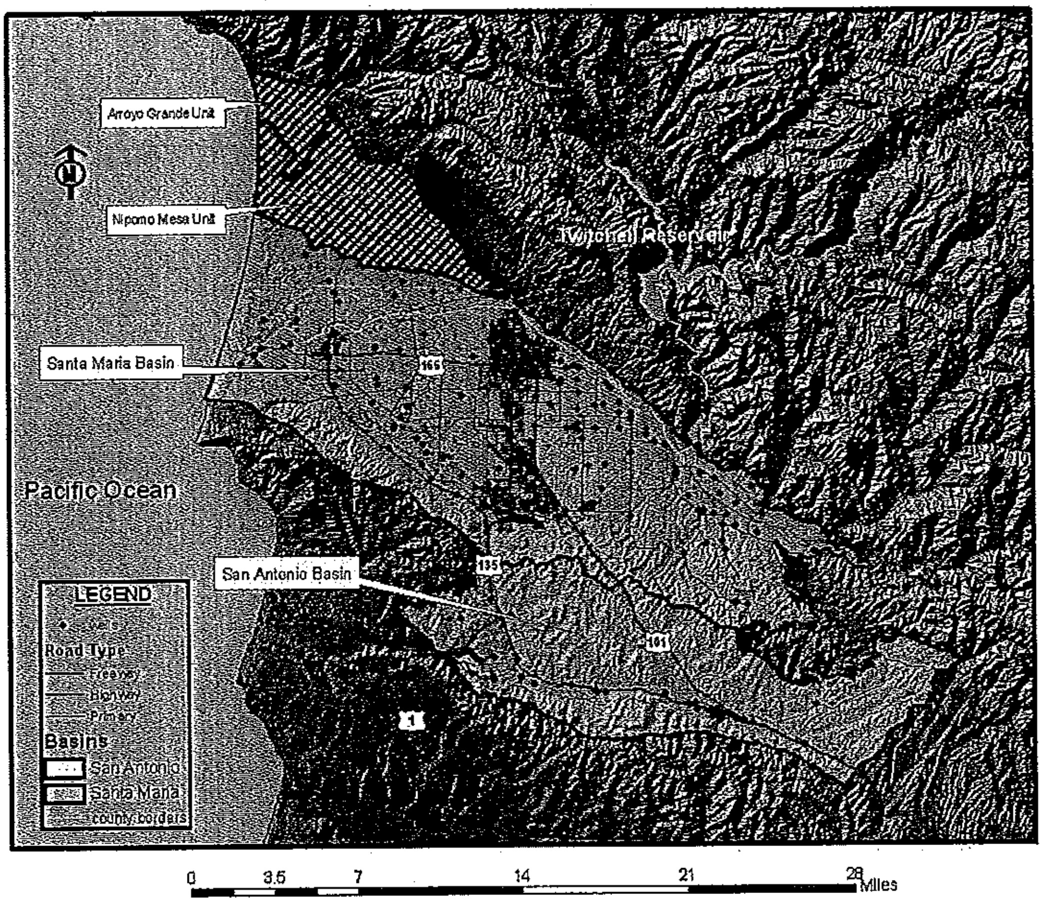
The *Nipomo Mesa* and *Arroyo Grande* units are completely within San Luis Obispo County, and as previously mentioned have not been the subject of previous investigation or analysis by SBCWA. The Nipomo Mesa consists of older dune sands and alluvial deposits resting atop the Paso Robles formation that thins north of the Santa Maria River and the *Santa Maria Main Basin*. The Arroyo Grande unit consists of well-sorted alluvial deposits resting atop a thin veneer of the Paso Robles formation, terminating in the 5 cities area in San Luis Obispo County

The following sections pertain to only the *Santa Maria Main Basin* in Santa Barbara County and the *Oso Flaco* area in the southwest corner of San Luis Obispo County.

History and Analyses

The Basin is best described by Worts (1947,1951), Miller and Evanson (1966), SBCWA (1977) and Naftaly (1994). As one of the largest agricultural and historically important oil producing coastal valleys of California, this basin has been studied extensively. Modern exploration began in 1888 when the State mineralogist arrived in the area for the purpose of geological mapping in conjunction with the University of California Geology Program and the USGS. In 1903 development of the area rapidly intensified for oil, and in 1907 the first comprehensive report on the area was published, USGS Bulletin 322 which focused on the geology as well as some mention of water resources. Water resources examined in this report were limited to surface water diversions, springs, and artesian wells in the western part of the basin.

Santa Maria Groundwater Basin



In 1921 the first soil survey of the basin was made. Examination of the basin continued to be limited to oil until 1931 when Lippincott established baseline hydrologic conditions for consideration of federal and state funding towards a project to curb runoff problems on wet years and establishing a need for water conservation practices.

In 1946 USGS Bulletin 222 was released, mentioning a 12,000 AF annual overdraft. The period of the *most comprehensive evaluation* of the basin began in 1947 and continued until 1966 with work by Worts, Miller and Evanson. During this period the perennial yield of the basin was established to be 70,000 AF (revised from 57,000 AF) and an approximate annual overdraft of 20,000 AF was calculated. In 1976 the Toups Corporation was hired by the City of Santa Maria to perform a thorough Water Resources study of the basin. This report concluded that in 1976 the annual average overdraft of the basin was 6,000 AF and projected to be 25,000 AF by the year 2025 without implementation of additional water sources. The USGS did a report in 1976 focusing of water quality of the basin, specifically increasing nitrogen levels. This report listed the calculated average annual overdraft to be 10,000 AF.

In 1977 the Water Agency (Ahlroth et al) completed a comprehensive report of the basin using all of the latest data and climate trends that concluded an average annual overdraft of 20,000 AF existed and projected a 30,000 AF overdraft by the year 2000. In

1985 the USGS produced report 85-4129 which focused on recharge of the basin. In 1994 the Water Agency (Naftaly) assembled the "Santa Maria Valley Water Resources Report" which updated and organized all information from previous reports and studies on the basin. This very thorough report served as a precursor to a water management plan for the basin. It presented no new information, but to this day serves as the most complete overview of the groundwater resources of the basin.

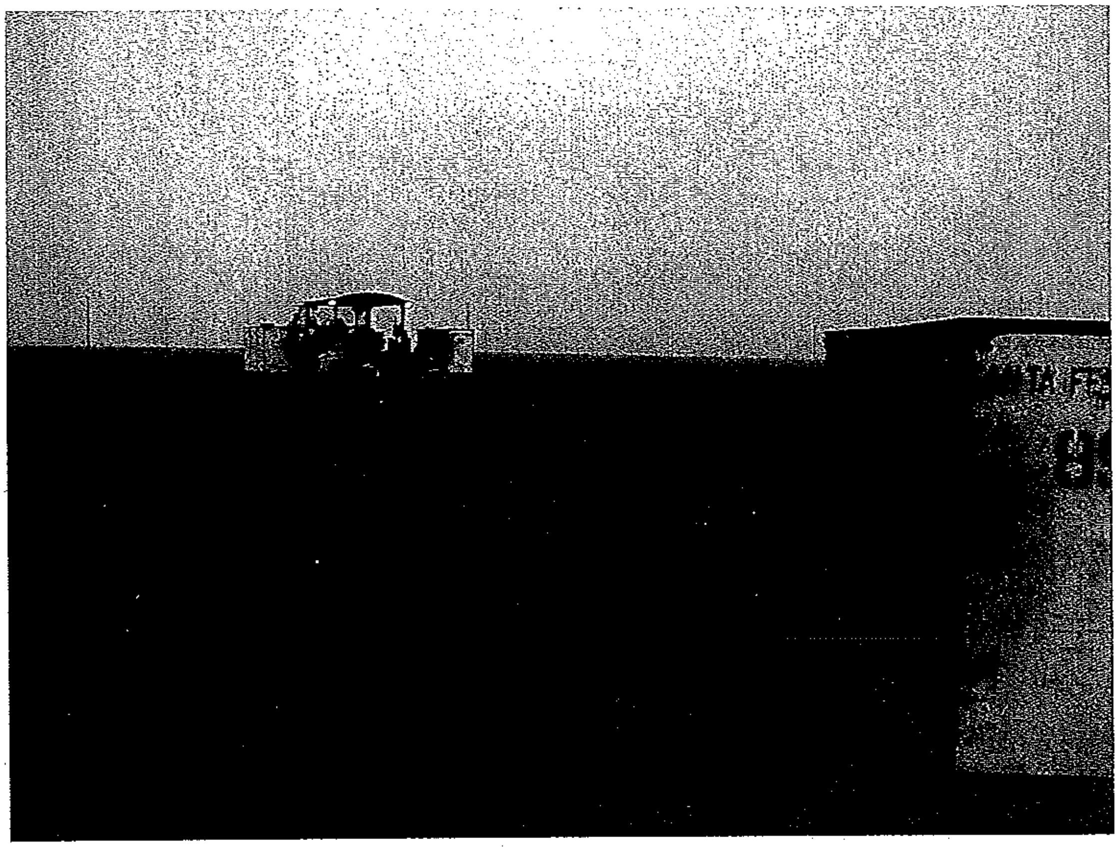
In 1991 the Water Agency with the help of Boyle Engineering produced the report "Santa Barbara County Growth Inducement Potential of State Water Importation" to consider growth inducement potential at the water purveyor level. The report serves as an analysis of 1990 water supply conditions as well as projections for the 21st century. This report calculates the annual average overdraft at about 37,000 AF at 1990 without state water and about 15,700 AF in the year 2000 with the implementation of state water.

In 1997 the Santa Maria Valley Water Conservation District (SMVWCD) hired Luhdorff and Scalmanini Engineers (L&S) to do a report on "Special Assessments of Groundwater Management" for the district as proposition 218, approved by the voters of California in 1996 required such a report before new assessments could be levied on property owners. This report states that the hydrologic conditions of the basin imply a long-term stability comprised of periodic groundwater level declines and recoveries, as versus an average annual overdraft. Luhdorff and Scalmanini were again hired by the SMVWCD to expand on their investigation of the basin and in March 2000 released a report utilizing a numerical flow model to establish an up-to-date perennial yield of the basin based on most recent recharge and discharge conditions. This report concluded that the basin was essentially in balance, relying on a base study period of 1968 to 1989. SBCWA had concerns about the base period and methodology of this report, and requested that Luhdorff and Scalmanini furnish basis for some of the calculations that differ from previous work done on the basin. A letter was sent to SMVWCD in July 2000 requesting the additional information and initiation of discussion between L&S and SBCWA but no response was received by SBCWA to this invitation. Thus, SBCWA has not formally adopted the conclusions found in this report.

Vegetable Crops being 'Flood' irrigated near Guadalupe, Fall 2003

In 2001 SBCWA was commissioned by the Santa Barbara County Administrators Office to update the 1991 "Santa Barbara County Growth Inducement Potential of State Water Importation" report as part of the strategic scan of resources the County was going through (the title of this report is "Santa Barbara County Water Supply and Demand Comparisons 2002 Update"). Analyses generated for this report show that a 2,368 AF groundwater overdraft exists (Ahlroth, 2001) and under current trends of usage and climate by 2020 a slightly higher overdraft will exist (the reduction in overdraft from previous SBCWA analyses is mainly due to State Water importation). This analysis is a model result quantifying all inputs and outputs from the basin and using a 1943-1999 base period. The results of this modeling effort are confirmed by water level readings made throughout the basin by the County and USGS. Due to the conflicting conclusions and significance of such previous work SBCWA hired Hopkins Groundwater Consultants Inc. to perform an unbiased evaluation of the methodologies and conclusions of SBCWA work on this basin. Hopkins concluded the overdraft is indeed somewhere between 2,000 to 3,000 AF per year and that the SBCWA methodologies, including use of the SBCWA Santa Maria Valley water budget model (SMVWBM) to assess basin conditions, to be both effective and comprehensive. **It should be noted that a overdraft of 3,000 AF per year lies in the "gray area" of groundwater calculations and as well as previous work which implies the basin is in surplus or balance, is a function of climate, which nobody really can predict. In all the *analyses* of groundwater conditions, the parameter of "base period" of climate is the dominant variable, and by using different "base periods" the analysis shows a range deficit or surplus conditions.** Certainly, the importation of state water takes considerable pressure off of the resource of groundwater in this basin.

The utilization of transplants and drip irrigation systems has substantially increased water efficiency in the Santa Maria Basin

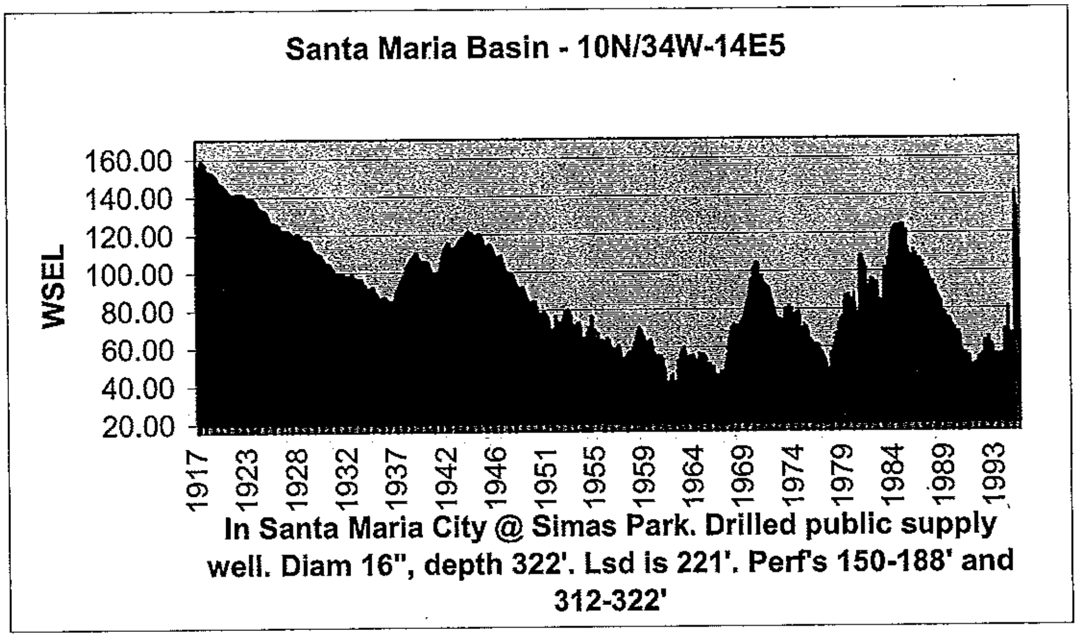


Water Supply and Usage

The basin supplies groundwater to the City of Santa Maria, the California Cities Water Company, the City of Guadalupe, the Casmalia Community Services District, oil operations and private agriculture throughout the Valley. Groundwater was previously the only source of water used within the Valley, however State Water has been providing an additional source since the end of 1997.

Fluctuations in Basin "Water in Storage"

The conditions of the basin can be assessed by looking at the hydrograph below from observation well 10N/34W-14E5:



Note how during the early part of the record whether the basin storage is increasing or decreasing (as depicted here by water level elevation), the slope is less than that of the later part of the century. The higher rate of *filling* in the later part of the century is a function of the presence of the Twitchell Reservoir Project, which adds on average an additional 18,000 AF per year recharge to the basin. The higher rate of *dewatering* is due to increased pumpage of the basin. One can expect that given an extreme drought such as the 1987-1991 or 1945-1951 droughts that the basin would be dewatered at an alarming rate, and may result in the lowest water levels in the history of the basin.

The gross perennial yield of the basin is estimated to be approximately 125,000 acre-feet per year. Water storage above sea level within the Santa Maria Groundwater Basin was estimated to be about 2.5 million AF (MAF) in 1984 and 1.97 MAF in 1991, and now, in 2002 probably greater than 2.5 MAF (Ahlroth, 2002). The maximum storage level of record occurred in 1918 and was estimated to be over 3 MAF. The portion of the groundwater basin located in San Luis Obispo County in 1975 was estimated by the Department of Water Resources to contain about 226,000 AF, a part of which is included in the SBCWA estimate.

Groundwater Production in the Santa Maria Basin by Purveyor Acre-Feet				
Year	City of Santa Maria	California Cities Water Company	City of Guadalupe	Casmalia Community Services District
1990	12,057	8,691	724	no data
1991	11,478	8,210	685	no data
1992	11,636	8,381	718	no data
1993	11,835	8,174	653	no data
1994	12,133	8,572	668	no data
1995	12,265	8,447	662	no data
1996	12,323	9,906	585	no data
1997	8,011	9,375	622	no data
1998	410	8,113	303	no data
1999	454	9,026	265	no data
2000	547	9,130	300	no data
2001	2,698	8,750	434	no data
2002	468	9,210	384	no data
2003	1,178	8,862	no data	22
2004	1,223	9,141	no data	no data
2005	897	9,890	415	29

The table above lists groundwater extractions from the water purveyors within the Santa Maria Basin. Note that the town of Casmalia lies outside the Santa Maria Basin but the water supplied to the town is drawn from just within the Basin boundaries. In addition, agricultural, oil industry and farmstead usage is estimated to be around 120,000 Acre-Feet per year (gross amount).

The Cities of Santa Maria and Guadalupe, and California Cities Water Company (formally Southern California Water Company) of Orcutt have contracted to receive a combined total of 17,250 AFY from the State Water Project (SWP). Actual deliveries in 2003 were 12,317 AF to the City of Santa Maria, 329 AF to the City of Guadalupe and 205 AF to California Cities Water Company. Santa Maria holds 16,200 AFY of entitlement. (Please see State Water Project, page 6). According to the City of Santa Maria Water Master Plan, approximately two-thirds of its SWP supply is designated for blending purposes to meet established City water quality objectives and will not be used to support new development. Thus, this use of SWP water represents a corresponding reduction in long-term pumpage (and overdraft) of the basin. Another benefit of SWP water importation is the relative high quality of return flows from water use in the City. This serves to improve overall water quality in the basin.

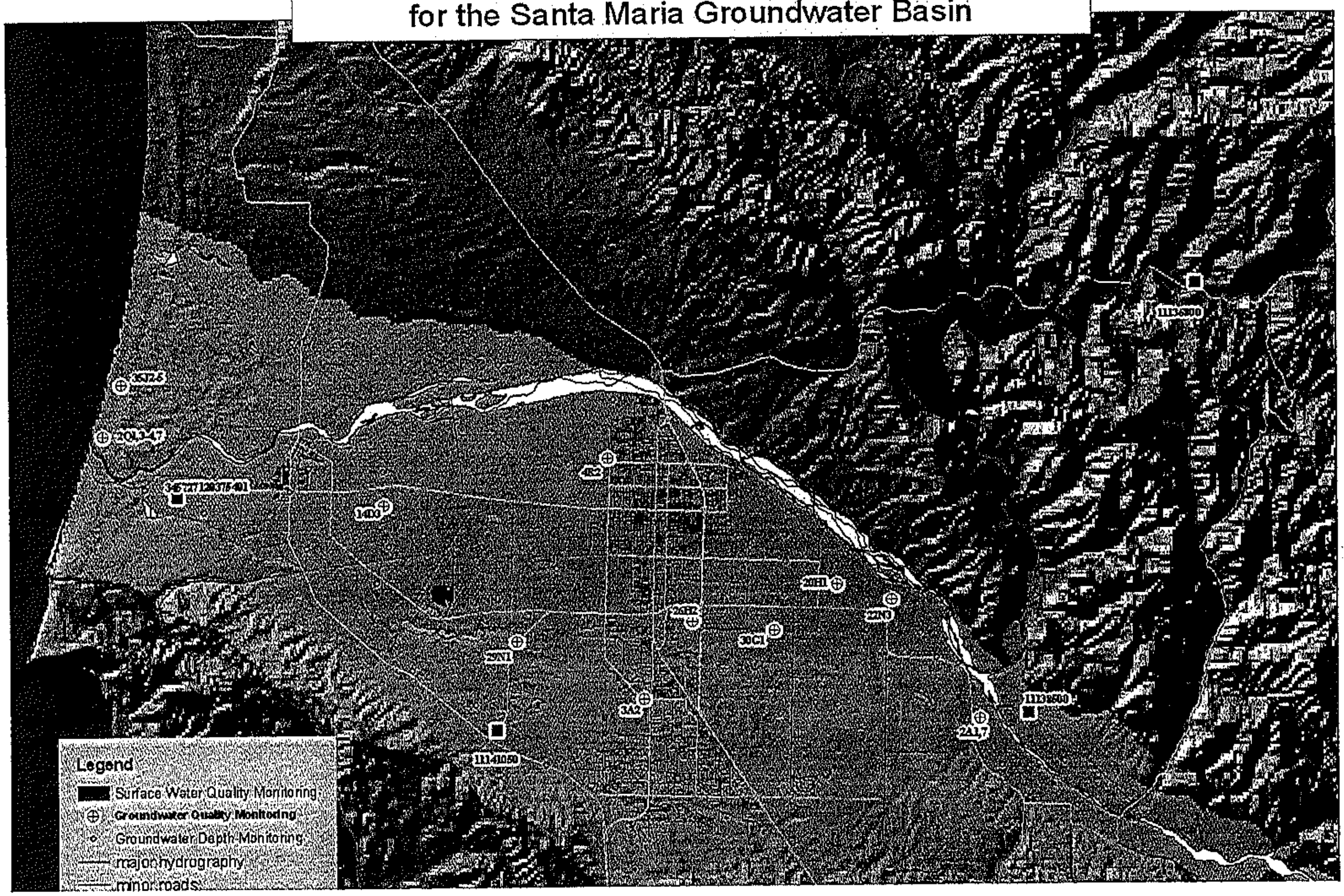
Water Quality

Reports by Worts (1951), Toups Corporation (1976), Brown and Caldwell (1976) and Hughes (USGS, 1976) best describe the conditions of water quality within the Basin. Also, the Cachuma Resource Conservation District (CRCD) produced the *Santa Maria Watershed Non-point Source Pollution Management Plan* in September 2000, which serves as a mitigation plan for water quality impairments in the basin and summarizes water quality conditions. To a large degree water quality within the basin has been affected by the operations of Twitchell Reservoir in a positive manner as Sulfate and Salt loading have been reduced since "low flows" emanating from the Cuyama Valley have been intercepted and replaced by releases from Twitchell which includes runoff from the Huasna and Alamo watersheds (Note that the recharge from Twitchell has been revised from 20,000 AF per year to 18,000 AF per year due to siltation and thus loss of storage of the reservoir and also not accounting for the cloudseeding program and surcharging of the reservoir as they are not long-term approved programs). It is important to realize, as with most groundwater basins that there is a significant difference between the quality of water extracted from the shallow or water table aquifer as versus the deeper or confined aquifer; the shallow zones *usually* contain the most water quality impairments. The importation of State Water, better quality water than the local sources, provides for higher quality "return flows" and thus helps the basin water quality. In addition to improvements provided by the operations of Twitchell Reservoir and state water importation, the Laguna Sanitation District helps improve water quality in the basin by utilizing a reverse osmosis process to remove and a **deep** injection well to dispose of approximately 8000 lbs. per day of salts, which would otherwise accumulate in the basin system. Water quality data is currently collected as part of the County Water Resources-USGS monitoring program as well as from area specific programs, such as the City of Santa Maria and Laguna Sanitation District sewage treatment plants and also Southern California Water Company, which serves water to the Orcutt area.

Total Dissolved Solids

Data collected from observation wells in a *1976-1977 USGS study* indicated that TDS concentrations generally increase from east to west, with the highest levels occurring in the western part of the basin and TDS concentrations near Guadalupe at over 3,000 mgl. It must be noted that these measurements most likely were made from wells

Surface and Ground Water Quality Monitoring Stations for the Santa Maria Groundwater Basin



Water Quality Monitoring in the Santa Maria Basin Conducted through the United States Geological Survey - Santa Barbara County Water Agency Cooperative Program

Depth and Screen/Perforation Information
For Groundwater Monitoring Sites

(Listed East to west)

State Well ID	USGS Number	Depth	Screen Intervals
9N/33W-2A1	345324120184201	48'	
9N/33W-2A7	345325120184201	512'	125'-507'
10N/33W-22N3[1]	345535120204401		
10N/33W-20H1	345552120220001	175'	100'-175'
10N/33W-30G1	345459120232301	662'	325'-662'
10N/34W-26H2	345459120250301	445'	unknown
9N/34W-3A2	345340120261801	331'	247'-331'
10N/34W-4R2	345808120271401	401'	160'-400'
10N/34W-29N1	345441120291301	112'	107'-
10N/35W-14D3[2]	345712120321701	308'	102'-
10N/36W-2Q1*	345823120383901	671'	568'-671'
10N/36W-2Q3*	345823120383903	444'	397'-444'
10N/36W-2Q4*	345823120383904	378'	291'-378'
10N/36W-2Q7*	345823120383907	44.2'	18.5'-46.5'
11N/36W-35J2*	345921120381601	615'	527'-615'
11N/36W-35J3*	345921120381602	495'	247'-495'
11N/36W-35J4*	345921120381603	228'	175'-228'
11N/36W-35J5*	345921120381604	138'	74'-138'

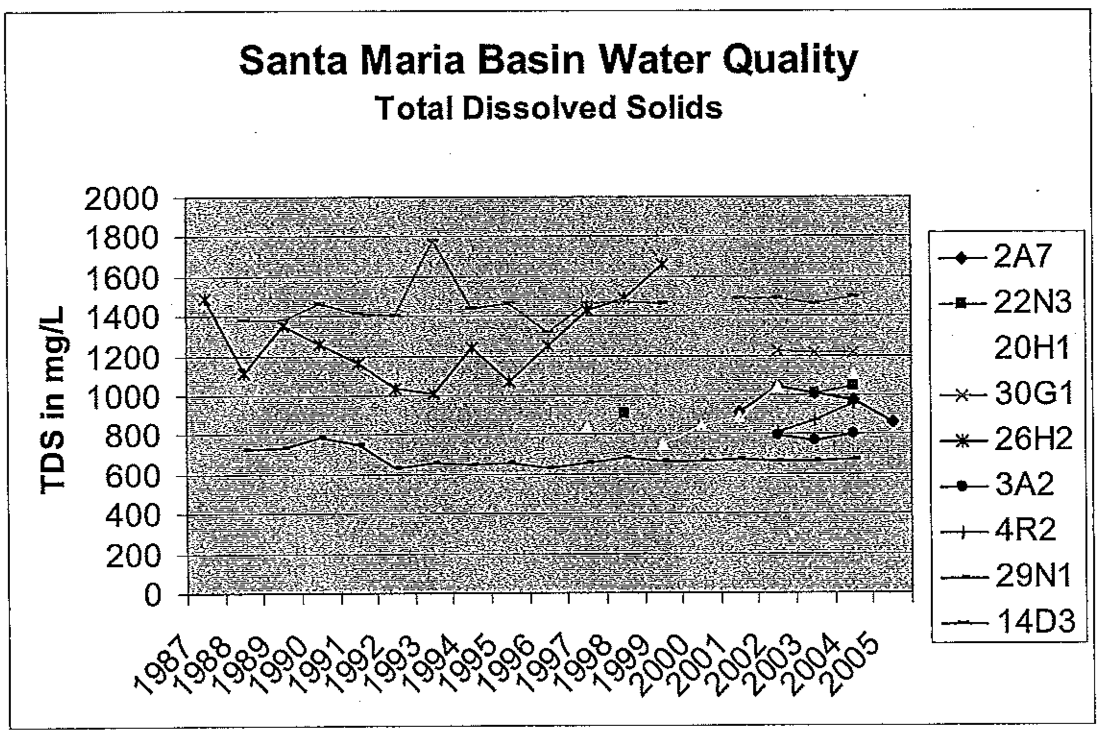
Description of Surface Water Quality Monitoring Sites

Station Number	Description	Watershed Size
11136800	Cuyama River below Buckhorn Canyon	886 sq. mi.
11138500	Sisquoc River near Sisquoc	281 sq. mi.
11141050	Orcutt Creek near Orcutt	18.5 sq. mi.
345727120375401[3]	Green Canyon Creek @ Main St. near Guadalupe	5.28 sq. mi

[1]Still searching for construction information on this site
[2]This information is actually from well 10N/35W-14D1, assumed to be similar to 14D3
[3]This is actually a "site ID" as no "station ID" is listed for this site

drawing from the shallow water table and may not be indicative of the complete aquifer. Currently TDS concentrations near Guadalupe are measured at around 1500 mgl and in the center of the basin under the town of Santa Maria appear to be also be high (well 10N/34W-26H2) but again this is most likely due to recycling of shallow water from irrigation and may not be representative of the aquifer as a whole in that area. At the time of the writing of this report construction records to ascertain *screen* or *perforation* intervals for the water quality wells were not available but are being investigated for future reporting.

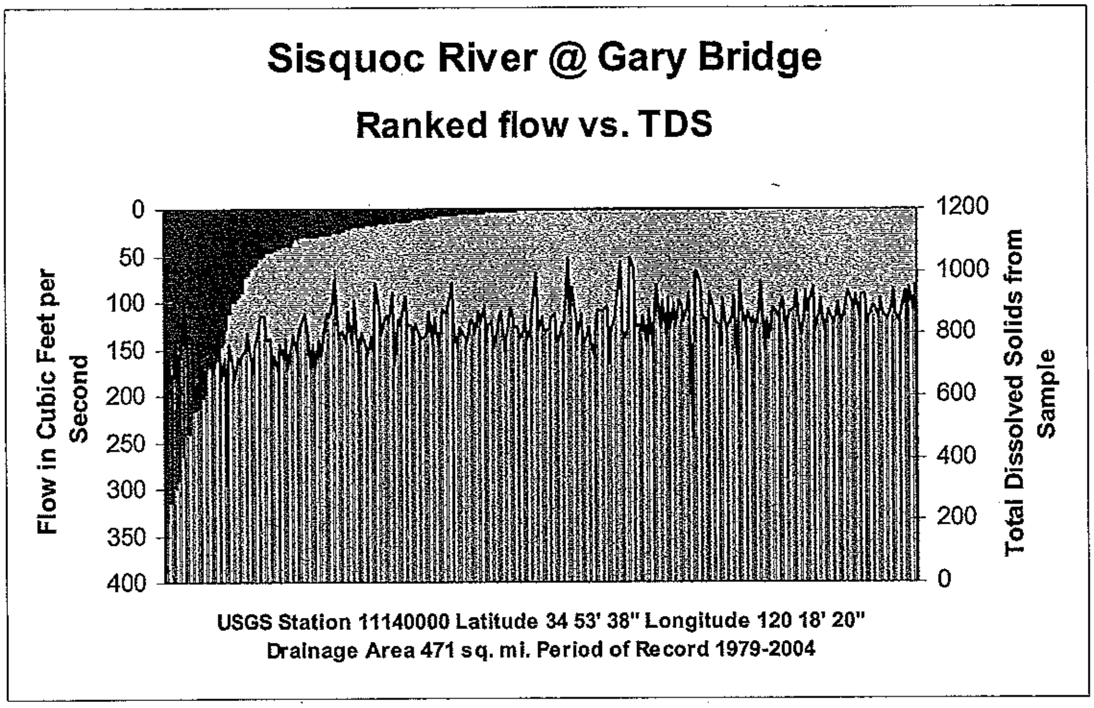
TDS levels increased significantly in Orcutt area wells after the 1930's but have remained relatively stable or even decreased since 1987. The importation and domestic use of State Water Project water now results in better quality discharge water from the City of Santa Maria treatment plant on Black Road and also from Laguna Sanitation District to the south. This may greatly aide future water quality within the basin. The table on the previous page lists recent TDS measurements made as a result for the County Water Resources-USGS monitoring program.

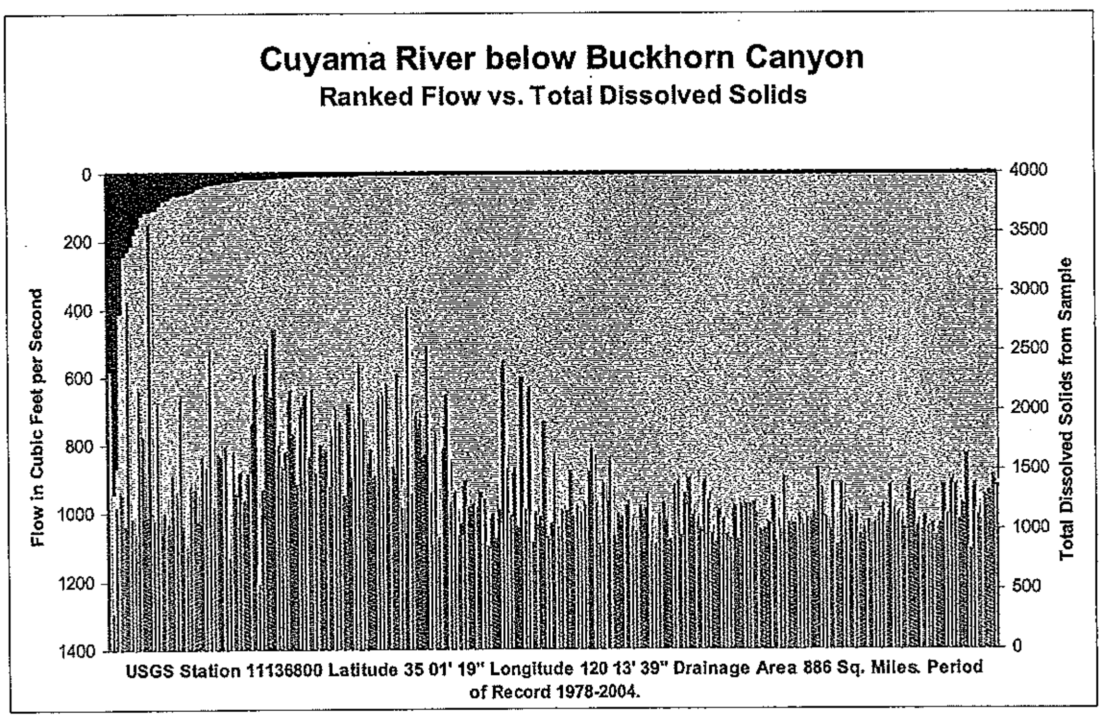


Nitrates-Sulfates

A study conducted by the State of California Regional Water Quality Control Board (1995) indicates that the basin is subject to nitrate contamination, particularly in the vicinity of the City of Santa Maria and in Guadalupe. The study shows that nitrate concentrations have increased from less than 30 mgl in the 1950's to over 100 mgl in the 1990's in some parts of the basin. It is again important to note that there is a significant difference in water quality between shallow and deep water. Movement between these different aquifer zones is not well documented and dependant on many factors.

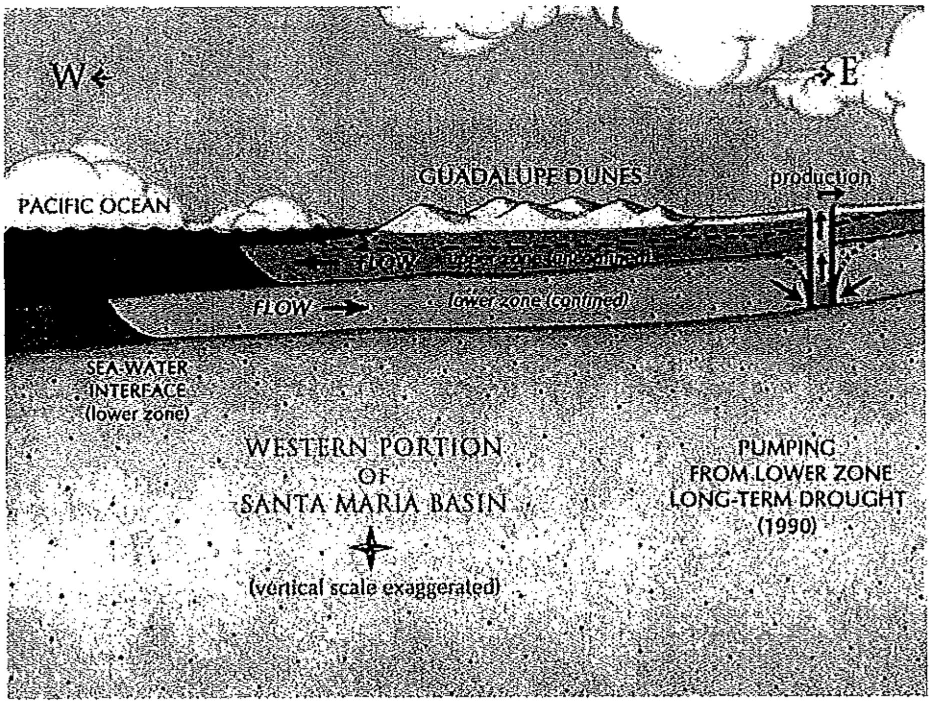
Certainly, the flushing of the basin from a combination of wetter climate and lower usage would help protect against water quality impairments.



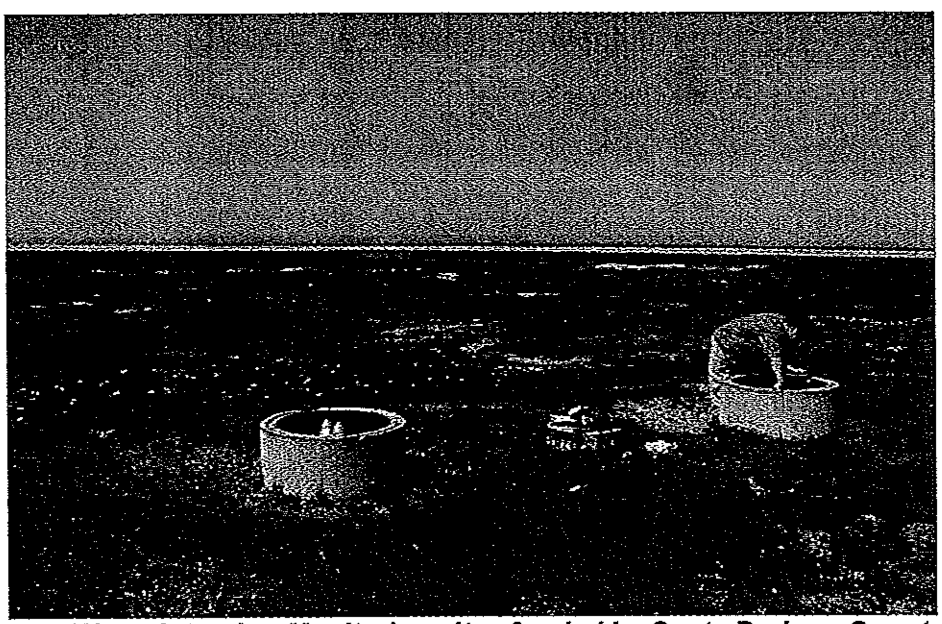


Sea Water Intrusion

Coastal monitoring wells are measured biannually for any indication of seawater intrusion, to date there has been no evidence of seawater intrusion.



Conceptual Drawing of Sea-Water Interface Migration, Santa Maria Basin



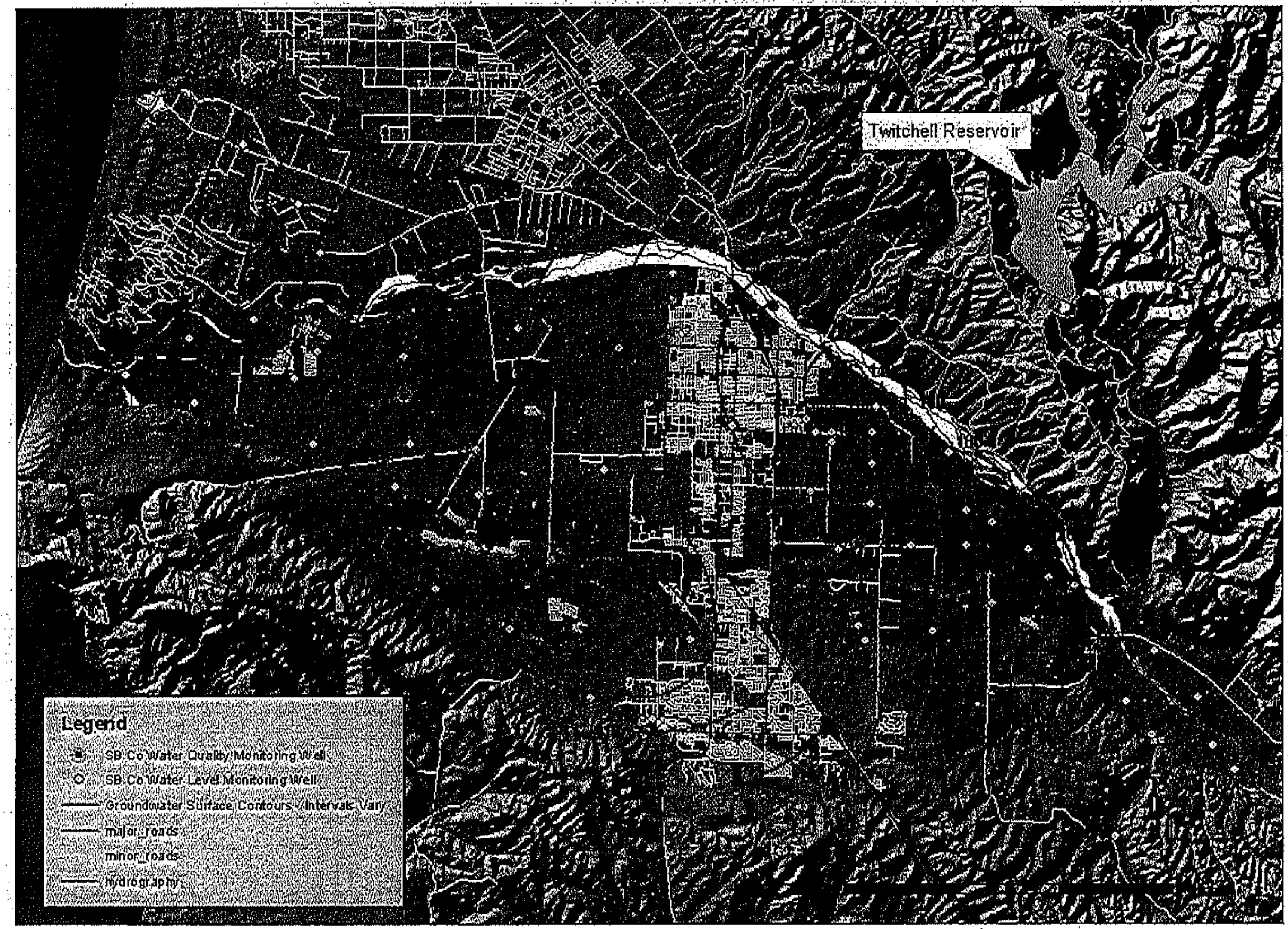
Salt Water Intrusion Monitoring sites funded by Santa Barbara County-USGS

The concern of seawater intrusion is based on evidence that the Careaga Sand crops out on the ocean floor several miles west and there are no known barriers to seawater intrusion. Although it is possible that the seawater-fresh water interface has migrated shoreward during drought periods, the slope of groundwater has remained to the west in the westernmost part of the basin. The graphic on the previous page describes how this seawater fresh water interface can migrate during periods of basin overdraft:

Basin Wide "Salts Balance"

Sources of salt inflow to the Santa Maria Groundwater Basin include surface runoff, precipitation, M&I accretions and agricultural return flows. Salt disposal from the basin occurs through the processes of surface and subsurface outflow. The Water Agency estimated in 1977 that net salt addition to the basin was about 48,000 tons per year (Ahlroth et al) under 1975 conditions and that by 2000 it would be about 53,000 tons per year. A revised analysis of salt loading is a significant task and the Agency is unaware of any other work in this area to date.

Santa Maria Groundwater Basin Water Surface Contours Spring 2004



CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

10

NATURAL RESOURCES IN THE SANTA MARIA VALLEY

INTRODUCTION

The high quality of land, water and air, in combination with a moderate year-round climate, are the natural resources that have made the development of the Santa Maria Valley possible. In this report the Grand Jury has selected natural resource topics that it considers to be the most important concerns that affect the quality of life, prosperity, and projected growth needs in the Valley, and has studied the local government entities that protect them.

The Grand Jury decided to begin the process of studying and evaluating the effectiveness of county, city and special district operations in this economically important part of the County and to identify some of the most difficult problems that exist that affect all of the County's citizens.

This report is anticipated to bring continued Grand Jury interest and study of the local organs of Santa Maria Valley government to increase the efficiency and effectiveness of the many local government entities that provide services to the public in the Valley.

LAND

Whose Beaches? Whose Seashores?

The seashore and beaches marking the western boundary of the Santa Maria Valley have been the subject of controversies for many years. The features that have been discussed are the Santa Maria River Estuary, Guadalupe Beach, Mussel Point, Paradise Beach, and Point Sal. The interested and active parties to date have mostly been outside the organization of local government, and include large, national non-profit organizations (recreational or conservationist activists) and/or private citizens (landowners, tenants).

They include:

- The Federal Government, which is studying the possibility of including the area in a larger National Seashore.
- Conservation groups such as The Nature Conservancy, which would like to extend the Nipomo Dunes Preserve that it manages; The Gaviota Seashore Preserve; and The Sierra Club.

Public officials and residents of the Santa Maria Valley have shown little interest and taken little action to protect these natural resources in a way that will preserve options for diverse future benefits for present and future residents. There is limited access to these resources, by either car or foot.

Finding 1a: The Santa Maria Valley seashore and beaches have been neglected by the local governments for years.

Finding 1b: Vehicular access to these beaches is either non-existent or across private land. Hiking access to these beaches also traverses private land.

Finding 1c: Point Sal Beach State Park has been neglected for years and has no parking places or toilet facilities, and lacks even a safe footpath to the beach.

Finding 1d: An estimated 5% of coastal property has been placed into various types of government preserves, and efforts are underway to place more into dedicated use, with little input offered by the local jurisdictions in the Valley.

Finding 1e: Non-local organizations may give little consideration for beach access and benefits for local residents.

Recommendation 1: Elected officials in the Santa Maria Valley should express the needs of the citizens to Federal, State and County officials before much more of the seashore is dedicated to specific use, and becomes managed for the benefit of non-local populations.

Oil and Gas

Oil was discovered in the Santa Maria Valley near what is now Orcutt in 1904 with a huge gusher at the first exploratory well drilled ("Old Maud"). An increasing number of new oil discoveries in many areas of the Valley created an oil boom. For the next 80 years, thousands of wells were drilled and put into production. The Santa Maria Valley grew and prospered to a major extent from the oil and gas production. Santa Barbara County also prospered from the tremendous increase in taxable land values.

In 1969, the blow-out of an offshore well in the Santa Barbara Channel unleashed an anti-oil campaign (mostly on the South coast) that resulted in the first major environmental activism in the County. This environmental activism, and anti-oil sentiment, continues. Public attitudes toward oil and gas exploration and production are cited as one of the differences between the North and South parts of the County.

Santa Barbara County regulation, and diminished crude oil prices, caused most local oil production and refining operations to close in the 1990s. Residents of the Santa Maria Valley, except relative newcomers, are aware of the benefits that came from the Valley's oil and gas resources. Many local political, economic, and commercial leaders are unimpressed by the arguments of anti-oil activists and favor resumption of nearby offshore exploration in Federal leases currently under development moratoria.

Due to the recent two-year increase in oil prices and other energy-related shortages, the economics of drilling, pumping, and refining oil in the County are once more making oil a topical issue. Public hearings by the Federal Minerals Management Service are scheduled for early July 2001 in both Santa Barbara and Santa Maria. These hearings will concern a proposal to drill five exploratory wells at offshore locations in both the South County and the North County. This will give the public an opportunity to weigh-in on the subject.

Ancient Sand Dunes

Much of Santa Maria and Guadalupe are built on prime agricultural land.

The use of prime agricultural land for housing and other urban development, simply because it is conveniently adjacent to the City's boundaries, eliminates a unique, finite and extremely valuable natural resource. However, the latest sphere of influence, boundary expansions, and annexations by the Cities of Santa Maria and Guadalupe were mostly on contiguous prime agricultural land.

The Local Agency Formation Commission (LAFCO), as recently as June 2001, has identified a way for local governments to expand or annex areas that are not contiguous. This offers benefits for citizens in jurisdictions that are unwilling to annex prime farmland into their urban boundaries.

The ancient dune lands are presently and potentially the least productive agriculturally zoned lands in the Santa Maria Valley. The ancient dune lands, in order to be significantly productive, require irrigation. Due to the absorptive nature of sandy soils, these soils use much more water than the clay-loam soils on the floor of the Valley.

There are thousands of acres of ancient sand dunes in the Santa Maria Valley. They exist in two main areas:

- Northwest of Brown Road adjacent to the floor of the Valley (which is mostly highly productive prime agricultural land) and extending west to the ocean cliffs between Point Sal and Mussel Rock.
- East of Highway 101 from the mostly prime agricultural floor of the Valley to the hills south of Clark Avenue, east to Dominion Road and beyond to the hills west and south of Foxen Canyon Road in the Garey-Sisquoc area.

Planning for and expanding urban growth on nearby ancient sand dune areas has many advantages over continued urban growth onto contiguous but prime agricultural land. Protecting prime agricultural land and water conservation are two important benefits. Additionally, by building on the periphery of the agricultural valley, the land values will increase without compromising the number of acres in agricultural production, and therefore there will be a net increase in property tax income to the County. Homes built on the ancient sand dunes would also afford views across the Valley or to the ocean, providing more upscale housing in the Valley, thus creating a better overall mix of housing types and costs in North County.

Finding 2a: The conversion of prime agricultural land for housing and other urban developments conflicts with long-standing County policy. It has been done in the past simply because the prime agricultural land was located conveniently adjacent to a City's boundaries when the need for expansion existed.

Finding 2b: The ancient sand dunes in the Santa Maria Valley are presently and potentially the least productive agriculturally zoned lands in the Santa Maria Valley, and thus contribute the least to the revenue base of the County.

Finding 2c: Expansion of city boundaries, by Guadalupe or Santa Maria, does not now need to be into contiguous land, most of which is devoted to agricultural production and is designated prime agricultural land.

Recommendation 2a: Housing needs for the population growth in the Santa Maria Valley, as projected in the County's Strategic Scan 2000, should be best met by cities and the County by carefully planned development on these ancient dune lands, rather than on highly productive prime agricultural land.

Recommendation 2b: Investigate promptly and thoroughly the feasibility of locating urban growth on one or more of these ancient sand dune areas in the Santa Maria Valley.

The Rural Resources Protection Program
The Grading Ordinance

This ordinance has been the subject of much public and private controversy in recent years. Large-scale removal of oaks and wetlands, usually in connection with the conversion of open space and grazing land (sub-prime farm land) to vineyards, strawberries, vegetables, and cut flowers (high-value crops), alerted the County to the fact that agricultural grading regulations were not always being followed. This resulted in the issuance of a number of grading violation notices and some very costly lawsuits. Many agriculturists charged that the regulations were imprecise, lacked certainty, and were sometimes interpreted in a way that was punitive and costly to farmers and ranchers who claimed the right to carry out time-honored and necessary agricultural practices.

The Board of Supervisors (The Board) recognized the seriousness of this vexing problem and on February 9, 1999 directed the Planning and Development Department (P&D) to develop policies and draft a new ordinance to regulate agricultural grading and vegetation clearance to provide greater certainty as to if and when a permit would be required. The Board further directed P&D management to work with the public to craft a program of options for achieving these goals.

During the Year 2000, P&D staff conducted seven public workshops aimed at working out a comprehensive Rural Resource Protection Program. (Land grading regulation was an essential component of all elements of the program.) The workshops were followed in November and December 2000, with open houses held throughout the County, so that the public could assess and review existing data on biological resources, streams, and wetlands from the U.S. Fish and Wildlife Service and the California Fish and Game Department. From public input at all these meetings, P&D staff prepared a draft project description with multiple options.

What became increasingly clear at these meetings were the inflexible attitudes of both agriculturists and conservationists, and their mutual distrust. About the only matter on which they were in agreement was a strong distrust of County staff generally, and P&D personnel specifically. A further serious roadblock to progress was the large but changing attendance at these meetings. This precluded any thorough discussion of critically important technical and scientific details which would be essential components of any practical project program.

P&D leaders then went back to the Board of Supervisors and obtained their approval, on December 5, 2000, to form a technical advisory committee (TAC) made up of local and other expert representatives of principal types of agriculture, and of locally based environmental and conservation experts. The Board of Supervisors agreed to a TAC membership representing grazing and dry farming, orchards, row crops, vineyards, the Farm Bureau, archeology, botany, wildlife, hydrology (wetlands), the Chumash, the University of California Extension (two members), and the US Department of Agriculture's Natural Resources Conservation Service.

The persons named to the TAC by P&D were known for their open minds, personal integrity, recognized leadership skills, professional knowledge and experience and, above all, a desire to work out a fair and practical balance for protecting both the environment and agriculture. They came from all areas of the County.

To help ensure the success of TAC, P&D managers recruited a broadly experienced and exceptionally able facilitator to conduct the TAC meetings.

The Technical Advisory Committee

After 11 meetings (nearly all attended by Grand Jury members), it became obvious that P&D had designed a winning team and process that was capable of accomplishing the goals set by the Board of Supervisors for natural resource protection and agricultural support. The evidence of this has been visible at every meeting.

- Committee members are listening to each other attentively and with respect. Definitions of all the important words are worked out in such precise detail that there can be no misunderstanding of their meaning.
- Proposals are critiqued, worked over, and polished down to the finest details.
- P&D staff has played a background supporting role, leaving discussion to the committee members and the facilitator.
- Members of the public attending the TAC meetings are a diverse group of some 25 to 30 persons. Many of these attend regularly and "speak their piece" during the periods set aside for public comment.
- TAC meetings are several months behind their initially published schedule of dates selected for discussion of key subjects, but for the right reasons. The Committee discusses each subject until all the relevant details and objections have been explored and nailed down, and a consensus agreed upon.

Finding 3a: The process of revision and improvement of the County's controversial agricultural grading ordinance is being moved along steadily by the Planning and Development Department as directed by the Board of Supervisors.

Finding 3b: The appointment and organizing of a Natural Resource Technical Advisory Committee (which concerns, among other issues, agricultural grading), guided by a skilled facilitator, was a process conceived by the Planning and Development Department. P&D's flexibility in creating TAC, after the inability to obtain consensus during the prior two-year process (involving public hearings, workshops, and drafts of goals, programs and regulations), is commendable.

Finding 3c: TAC members have shown an ability to communicate with each other with courtesy, sensitivity, and understanding, while devising the optimum viable compromises needed to honor both environmental and agricultural laws and concerns.

Finding 3d: P&D staff have provided excellent support, thus enabling the TAC to focus on its deliberations while staff provided maps, visual aids, basic information, and expert outside speakers, as well as producing agendas and summaries of each meeting's results.

Finding 3e: In the course of 11 scheduled meetings, each usually lasting over three hours, and one field trip, the TAC has made slow but solid progress featured by incisive questions, creative suggestions, and meticulous care to eliminate possible sources of future confusion, misunderstandings, and disputes.

Finding 3f: TAC members development of a two-track protection system is a key element in their consensus building. The landowner has the option of following an inexpensive, totally voluntary process or of following the staff regulatory process.

Finding 3g: TAC's success in working out a consensus for its draft two-track Archaeological Protection Program (including grading and clearing activities) and

two-track Riparian Setback Protection Program are notable positive achievements that can serve as a model for the more complex TAC goals still remaining. These include protecting wetlands and endangered species.

Recommendation 3a: The TAC should be encouraged to continue its work no matter how long it takes.

Recommendation 3b: The services of the facilitator should be retained until the Resource Protection Program drafts and the Agricultural Grading drafts are completed and approved by County decision-makers.

Recommendation 3c: The Planning and Development Department should continue to lead, support, and build on this thus-far remarkably successful program, and use it as a model for planning and addressing other important P&D program responsibilities.

COMMENDATIONS

The Grand Jury commends P&D management and staff for devising the innovative procedures that offer real hope for the development of revised ordinances that will be so equitable and practical that concerned constituencies and the general public will give their support, while the rancorous, unproductive and unsatisfying hearings of the past will be no more.

The Grand Jury commends the Board of Supervisors for its wisdom and foresight in approving P&D's proposal to implement its innovative TAC-plus-facilitator approach to solving the long-festering and seemingly intractable land use, conservation, and grading conflicts that have bedeviled applications, inspections, and public hearings for many years.

Betteravia Lake

Betteravia Lake, located two miles east of the Santa Maria City limit, and about four miles northwest of Orcutt, was originally one of the few natural lakes in California outside the Sierra Nevada Mountains. During the Mexican rule of California, ownership of this valuable lake was divided approximately in half, between the Rancho Guadalupe Land Grant and the Punta de la Laguna Land Grant. Because of its natural clay subsoil, this lake held rainwater and the perennial flow from the Solomon Creek watershed, a mountainous area of approximately 150,000 acres.

Betteravia Lake water began to be used in 1898 when the Union Sugar Company established its sugar beet processing factory near the northeast end of the lake. Sugar beets require much rinse water, and the northeast portion of the lake was converted to settling ponds by the factory to dump silt-laden wastewater from the beet processing.

The sugar factory pumped several thousand acre-feet of water into Betteravia Lake in the years that the factory was in operation, or from 1898 until the national depression of the 1930s.

Union Sugar developed the company town of Betteravia (from the French for sugar beet), adjacent to the factory, and built over 300 homes. Recreational facilities for the Betteravia town residents were developed at the Lake, which included boating, sailing, fishing, duck blinds, and a tourist hotel, bar, and restaurant. However, by the 1930s, all were closed down and the townsite was cleared of all structures.

Because the sugar factory and the town were located on top of a steeply wooded escarpment, the Lake was virtually invisible to all but the residents and workers. The main roads and Santa Maria Valley Railroad lines that serviced Betteravia had no view of the lake because of intervening hills and trees that fully blocked the view. There was no public road access anywhere near the east and west ends of the Lake. Highway 1 and the Southern Pacific Railroad line that run parallel but at some distance from the south side of the Lake have a few good views, but were seldom traveled in those days. Betteravia Lake was a treasured secret for those few Santa Maria Valley residents that knew of its existence.

At present, it is a rare person that has ever even heard of Betteravia Lake and few have ever seen it. Those old enough to remember it are "old-timers" who recall the wonderful recreation that was enjoyed in the Santa Maria Valley 60 or more years ago, and who regret that few recreational opportunities are available for Valley residents today.

In fact, it is claimed, Betteravia Lake does not exist anymore; it is a rare old map of the Valley that even has it noted. Property owners of land parcels that included portions of the Lake (and who collectively owned the entire Lake bottom) began efforts to convert the Lake to farmland after the sugar factory closed in the 1930s. The huge clumps of tules that characterized much of the Lake perimeter were grubbed out and their roots were burned. The surface water and the underlying perched ground water was pumped out near the west end of the Lake, into the lower end of the Orcutt/Solomon Creek, which then flowed into the Santa Maria River estuary. This fresh water then flowed west into the ocean and was lost.

Draining swamps and sloughs was a common and encouraged activity during that era. Gradually the Lake was converted to prime productive farmland. Tiles were installed to facilitate the efficiency of water removal from the top three-or-so feet of waterlogged soil so that the maximum number of field crops could be grown each year. Migratory flights of ducks and other waterfowl ceased to come to the area and private shooting clubs closed down. Fish and other aquatic denizens of the Lake became extinct.

In 1972, a new Federal law was passed (EPA's Clean Water Act) and, later, the Endangered Species Protection legislation was passed. Part of the area that was the former site of Betteravia Lake was designated a wetland. This designation was no longer valid for most of the lake bed, however, because the Clean Water law provided an agricultural exemption for land that had been drained and farmed for a minimum of four consecutive years.

In recent years, Mother Nature, urban construction, and irrigated agricultural expansion into the ancient sand dune land surrounding the Lake (see above) have resulted in expanded surface water runoff that eventually enters the Orcutt/Solomon Creek and drains into the Lake. This watershed drainage, coupled with high recent precipitation, recreated Betteravia Lake approximately as it was originally (excepting the tules, fish, ducks, and other wildlife). As urban development and irrigated agricultural crops expand onto former grazing lands to the east, it seems inevitable that the increasing costs of pumping the increasing water drainage into the lake will become uneconomic for field crops.

It may become advantageous for some, if not all, of the Lake bottom property owners to sell their land to organizations that would like to restore Betteravia Lake for

multi-purpose uses of engineered wetlands, tertiary water treatment, public recreation, wetland preservation and endangered species protection.

Preliminary efforts were made by the County several years ago to initiate action on a restoration of the Lake, with its many potential public benefits. That proposal was underfunded and soon abandoned.

It now seems technically and economically feasible, however, to restore Betteravia Lake to its historic, recreational use, in addition to other uses. Substantial grant opportunities now and for the next three years exist (namely State Fund #319, State Parks Propositions 12 and 13, US Fish and Wildlife Funds, and the State Habitat Conservation Fund to fund Wetland Restoration Projects). These multimillion dollar grants and low- or no-interest rate loans are designed to encourage just such ideas. Taking advantage of these funding opportunities can significantly benefit the people of the entire Santa Maria Valley.

Laguna Sanitation District

The Laguna Sanitation District, located adjacent to Betteravia Lake, may be the key to the Lake's restoration. This District, the County's only utility in North County, provides wastewater processing for Orcutt. It currently cannot process to its existing full industrial capacity because it is no longer able to distribute all of the clean wastewater it produces, based on its available acreage and water distribution contracts, per the dictates of the Regional Water Quality Control Board. This constraint exists because of the insufficiency of land acreage over which to disperse water. While the District is purchasing, with County Capital Fund money, about 200 acres, it still needs and is attempting to secure additional acreage for long-term water irrigation contracts. Even if acreage is identified and long-term contracts are entered into, however, there will be excess surface water produced by the processing plant in winter months. Thus, Laguna Sanitation will need (surface) water storage facilities, which will create significant continuing capital expenses for the County.

Unlike other less modern facilities, the Laguna Sanitation wastewater processing does not rely on bioactivation, so the processing plant has low incidence of plant upset. This, in addition to the reverse osmosis process with which it treats much of the processed water effluent, argues for a productive use of the processed water in the form of an engineered wetland (as exists at Arcata in Humboldt County, and at the Santee Lakes Park in San Diego County).

An engineered wetland, as part of a multi-use project at Betteravia Lake, would seem to be a benefit to County taxpayers, recreationalists, and conservationists. The engineers and management of Laguna Sanitation have the skills and knowledge to manage an engineered wetland project.

Finding 4a: There is a growing need for more public recreational facilities in the Santa Maria Valley as the population continues to grow.

Finding 4b: There is a significant potential to redevelop part of Betteravia Lake as a protected preserve for endangered species of water-related wildlife. This could allow the concentration of endangered species in a suitable habitat that could serve as a mitigation trade-off of other more valuable prime farmlands.

Recommendation 4: The County's Laguna Sanitation District, which already owns a significant amount of Betteravia Lake, is a potential and early direct beneficiary of a multipurpose tertiary treatment pond and water storage in the Lake, and should play a leading role in trying to get the Lake restoration project started.

Finding 5a: It appears that the owners of the Betteravia Lake bottom are likely to face increasing production costs in the future as well as diminished growing seasons, thus less income and profit.

Finding 5b: There may be significant incentive for some of the landowners to sell their land and use the proceeds to make more profitable investments.

Finding 5c: At least one Betteravia Lake landowner is in bankruptcy and may need to sell much, if not all, of his land around the Lake.

Finding 5d: The public is unaware of the recreational and conservation potential of Betteravia Lake.

Finding 5e: There is insufficient local funding available for the restoration of Betteravia Lake.

Recommendation 5a: The leadership of Santa Maria, Orcutt, Guadalupe, and Santa Barbara County should form a coalition of experts to study the potential benefits and feasibility of restoring some or all of Betteravia Lake.

Recommendation 5b: After a reasonable amount of preliminary research has been completed, participating entities should schedule a series of public meetings at locations in Santa Maria, Orcutt, and Guadalupe, including ample visual aid material, to ensure that the public is well informed about this long-hidden natural lake in Santa Maria Valley.

Recommendation 5c: Participating government entities should collaborate in identifying, and preparing applications for, both public and private grants for which this project qualifies.

AIR

Santa Maria Valley has been blessed with good air. It flows most of the year from northwest to southeast. In the early days, the brisk cool morning fogs and afternoon breezes from the ocean resulted in mild winters with little frost, and cool summers. On the negative side, there were huge clouds of dust all over the Valley, which was a sandy, alluvial semi-arid region.

Several decades later, eucalyptus trees (mostly blue gum) were planted to serve as windbreaks and diminish the dust. Irrigation and crops began to cover the sandy plain. Multiple crops were planted each year because of the favorable climate. Instead of seeds, shoots, which held soil better, were planted. Better farming practices also were employed. Appropriate grading, crop timing, and more efficient and frequent irrigation eliminated most of the dust and wind problems for farmers and downwind residents. In recent decades the eucalyptus windbreaks were no longer needed and were cut down and removed in order to gain more farmland.

With the increased use of engines, cars, trucks, generators, etc., air pollution gradually became a serious problem. In recent years, the lack of housing on the South Coast of the County induced increasing daily commuting to and from Santa Maria and other North County and San Luis Obispo County towns. Currently there are many thousands of commuter vehicles moving along Highway 101 through the Santa Maria Valley Monday through Friday, producing air pollution.

There is only one official State and Local Air Monitoring Station (SLAMS) in the Santa Maria Valley. Operated by the California Air Resource Board (CARB), this is the only measure of non-point source air pollution in the Valley. (There is currently no State and Local Air Monitoring Station in the City of Santa Barbara.) This station has been located at 906 S. Broadway (Highway 135) in Santa Maria for the past three years; for the 17 years prior to this, it was located four blocks north of this site, near the Santa Maria City Library.

These two locations have given a misleading measurement of air pollution in Santa Maria. Over half of the City's housing, all of the heavy commuting and much of the City's north-south travel occur on Highway 101. These sources are downwind from the monitoring station and therefore are not included in the air pollution being measured.

Finding 6: The two locations measuring air pollution for the past 20 years in Santa Maria have given a misleading measurement, because these locations do not include the contribution to air pollution caused by ever-increasing traffic.

Recommendation 6a: Santa Barbara's Air Pollution Control District should request that the California Air Resource Board relocate this Santa Maria air monitoring station promptly to a site that more accurately registers the air quality by including the commuter traffic and new demographics of this growing City. The station should be relocated east of Highway 101, and east of Marian Medical Center (along South Suey Road) in order to get truer readings of air quality and pollution in Santa Maria.

Recommendation 6b: The Board of Supervisors should direct the Planning Commission to begin a priority revision of South Coast Land Use and Zoning Plans and its housing policies with the goal of actually meeting South Coast housing needs.

Instead of continuing the County's longstanding policy of inadequately addressing the South Coast housing needs, available South Coast housing would be the only possible way of mitigating the Santa Maria Valley air pollution resulting from South Coast employees having to crowd Highway 101 to obtain affordable housing.

WATER

Water for all uses in the Santa Maria Valley is provided by three sources:

- Groundwater pumped from the Valley aquifer which contains storage of approximately 2.3 million acre-feet of water above sea level. This is primarily provided by rainfall collected on the land above the Valley aquifer, in the Cuyama and Sisquoc River watersheds. Currently, some 15,000 acre-feet per year (AFY) of "significant water" flow from the Cuyama watershed into the Twitchell Dam basin. Its release into the Santa Maria River is controlled. Released water and a smaller AFY of rainfall from the Sisquoc River watershed percolates the soil in the riverbed between the Dam and the Bonita Crossing and so recharges the aquifer. Management of the Dam is the responsibility of the Santa Maria Valley Water Conservation District (SMVWCD, or District).
- State Water, of 16,000 AFY and 500 AFY, is contractually delivered to the Cities of Santa Maria and Guadalupe, respectively.
- Cal Cities Water Company, a private, for-profit utility, which pumps 8,700 AFY from the Orcutt sub-basin of the Santa Maria Valley aquifer, and purchases a 500 AFY water allocation from the State to meet new urban growth requirements as set forth in the Orcutt Community Plan.

Responsibilities for Water Supply in the Santa Maria Valley

In 1991, a task force known as the Santa Maria Valley Water Conservation Committee was created to review water conservation efforts in the Santa Maria Valley, and to recommend appropriate future water conservation efforts of water purveyors and users. Another purpose was to provide data for the Santa Maria Valley Ground Water Management Plan, which was recommended by the Santa Barbara County Water Agency in its 1994 Santa Maria Valley Water Resources Report. The providers of water in the Valley (City of Santa Maria, Santa Maria Valley Water Conservation District, and Cal Cities Water) began to draft this Santa Maria Ground Water Management Plan as required by AB 3030. It, however, was never completed.

The City of Santa Maria has, for many years, successfully engaged in long-term planning and funding, ensuring that all necessary infrastructure improvements are in place and are sufficient to meet population growth requirement for years to come. Contracting for State Water was a complicated process, which required many years of complex planning, but this was completed, and the piping installed, in 1998. Prior to State Water deliveries to Santa Maria and Guadalupe, the net overdraft to the aquifer was estimated by the County Water Agency to average approximately 20,000 AFY. The purchase of State Water by the City of Santa Maria has significantly reduced the groundwater overdraft, markedly improved the quality of water for Santa Maria City customers, and has improved the quality of water recharged into the basin from the city's flood and sewer percolation ponds. In addition to providing 16,000 AFY, Santa Maria City's use of State Water is estimated to reduce the overdraft of the aquifer by approximately 8,000 AFY, through the water recharged into the aquifer from the City's flood and sewer percolation ponds.

However, use of water from the valley aquifer continues to grow, based on the expansion of agriculture in this fertile valley.

Desalinization of Sea Water—An Impossible Dream

This potentially unlimited source of water has been studied repeatedly during the past 20 years. It has invariably been found to be many times more costly than the available alternatives. The City of Santa Barbara bought a desalinization plant and installed it near the ocean slightly above sea level in downtown Santa Barbara. It was used briefly near the end of a six-year drought but was closed down and mothballed when the next year brought ample rain, which replenished the water storage to be used by the City. If this project at the water's edge in the County's most populous city was abandoned, this would indicate that a desalinization project for the less populous City of Santa Maria, which is located 12 miles from the ocean and several hundred feet above ocean level, would be even less economical.

Santa Maria Valley Water Conservation District

The major source of recharge to the Santa Maria aquifer is the percolation of surface water through the absorptive sands of the Santa Maria River bed, below Twitchell Dam, from Fugler's Point to the Bonita Crossing. Rainwater flows down the Cuyama River to the Twitchell Reservoir where it is stored until it can be metered out and absorbed into the Valley aquifer. This recharge of the aquifer currently averages about 15,000 AFY. Management of Twitchell Dam and continued contribution to the aquifer is the responsibility of the Santa Maria Valley Water Conservation District.

The Santa Maria groundwater basin has water quality problems related to its geology, the number of many former dairy sites, and the past and current agricultural practices. In the groundtable water there are high levels of total dissolved solids (TDS), salts (specifically chloride), and high levels of nitrates caused by the percolation of wash through the former dairy sites and the point-source fertilization of high-value agricultural crops. Several of the Cal Cities wells supplying Orcutt households with water were closed earlier this year, due to the high level of nitrates. The SMVWCD has not been concerned with "preserving and protecting" groundwater quality, despite its apparent acceptance of this responsibility in its 1995 Five-Year AB3030 Groundwater Management Plan. Thus, the measurement and amelioration of nitrate contamination and the elevated level of TDS in the aquifer has thus far been unaddressed.

Quantity of Groundwater in the Santa Maria Valley Basin

The importance of managing the net use of water from the groundwater basin is critical to continued successful agriculture in the Valley. Should seawater intrude into the aquifer (as it has begun to do in Salinas County), the health of the soil, and the production of crops grown, would diminish. Coastal monitoring wells have not indicated any seawater intrusion into the Valley aquifer and the County wants to keep it that way. Careful measurement and management of the net use of water from the groundwater basin is done by many government agencies.

In a report issued by the County in 1999, and in a report issued by the Cachuma Resource Conservation District published in November 2000, it was reported that the Santa Maria Valley aquifer was in overdraft, or more water was being used than was being contributed to it.

While Santa Maria City officials, County Flood Control, County Water Agency (who report to the Region and State), and Laguna Sanitation District have a close, cooperative relationship that has been in place for many years, Santa Maria City and SMVWCD cooperation has been minimal following the filing of a lawsuit by SMVWCD against the City in 1997. The SMVWCD and its agricultural members are seeking to prevent the City from "banking" surplus State Water in the aquifer, which would eliminate the County Water Agency identified overdraft, in order to prevent the City from claiming any "prescriptive rights" to water from the aquifer. This "banking," it is claimed, might compromise the future rights of farmers to pump water from the aquifer.

In a private hydrological report commissioned by the SMVWCD in connection with its lawsuit ("The Scalmanini Report"), the Santa Maria aquifer is claimed to be in balance and without a current overdraft. Thus, the District claims, there is no space to bank the current surplus of State Water in the aquifer.

It is an ongoing concern, however, to the SMVWCD that approximately 45,000 acre feet of conservation water storage capacity has been lost from the Twitchell Reservoir as a result of silt deposits (averaging 1,000 AFY) deposited at the dam by the drainage from the Cuyama River. Contributions to the aquifer from the reservoir are now 15,000 AFY, versus 22,000 AFY when Twitchell Dam was completed in 1958.

The District is continuing to seek solutions to the siltation problem. To make up for some of the water storage loss from siltation, the SMVWCD and County Flood Control applied for and received a one-time authorization from the Army Corps of Engineers in the 1990s to reduce the amount of flood water (pool) storage and allowed the flood water to be used to make up for some of the water conservation storage that was lost from siltation. The District is again applying to the Army Corps of Engineers for a new authorization to use the maximum allowable amount of flood pool storage further to mitigate the continuing conservation storage loss in the Reservoir from accumulated siltation. Additionally, a one-time $500,000 grant has been approved by Congress for the District, which, if funded, will pay to begin to clear some of the debris below the dam, in the absorptive sands.

The SMVWCD Directors have consistently throughout the history of the District been conservative and frugal stewards of Twitchell Dam and Reservoir and its water conservation and flood control functions. This has included management of the Santa Maria Valley water table replenishment, by carefully calculating releases into the absorptive sands in the bed of the Santa Maria River. The District Directors state that the problem of progressive siltation of the Twitchell Reservoir was known to the Bureau of Reclamation and the Army Corps of Engineers at the time Twitchell Dam was planned and built, but the Bureau's estimates of the siltation rate were only half of the actual rate in the forty-two years that the Dam has been in operation.

Although a number of ideas have been articulated for solving the problem of reservoir siltation and loss of water storage, the SMVWCD points out that other government entities were and are responsible, and that the District does not have the necessary funding to remediate the loss of water storage at the Dam. At their monthly meetings, discussions continue to consider hiring specialists to draft grant applications that might fund the extremely complex and costly studies that will be necessary to devise an effective solution. Studies to date have not found any economically and technically feasible methods of mitigation for the loss of water storage, and the potential loss of this major source of recharge to the Santa Maria aquifer.

Finding 7: The recharge to the aquifer in the Santa Maria Basin has been diminished due to the continued siltation at Twitchell Reservoir.

Recommendation 7a: Resolve the conflicts in estimates of discharge to the Santa Maria Valley aquifer as soon as possible.

Recommendation 7b: If an economical solution to the siltation issues at Twitchell Reservoir cannot be found in the near future, all local authorities should work cooperatively to find another source of recharge to cope with the growing need for water from the Santa Maria aquifer.

Quality of Groundwater in the Santa Maria Valley

In 1999, the Regional Water Quality Control Board notified all water quality control districts that management and measurements of groundwater quality were being mandated by Federal law, and that districts would have two years to draft a plan, creating voluntary guidelines for their district. If this deadline is not met (in 2002), there would be a systematic loss of local control over groundwater management in the District.

As a consequence, in 2000, the Cachuma Resource Conservation District completed a comprehensive study of non-point sources of pollution in the Valley watershed with a corresponding set of recommendations for improving the quality of groundwater. These recommendations to improve groundwater quality are based on encouraging "best farming practices" (appropriate ground cover, contour grading, riparian buffers, etc.).

These recommendations were discussed by SMVWCD, and a hydrologic consultant was hired and asked to comment on the Cachuma Report and on the District's responsibility for groundwater quality, as a result of new State legislation. The consultant confirmed that the Cachuma report was fastidiously prepared, meticulously researched, and presented recommendations that were based on "best farming practices." The consultant further recommended that a voluntary commitment to best farming practices could and should be encouraged by the District. Otherwise, the District's local control of water quality issues, as mandated by the new State legislation, would be mandated by Regional and State authorities.

Finding 8: In 1999, the Regional Water Quality Control Board notified all water quality control districts that management and measurement of groundwater quality were being mandated by Federal law, and that each district would have two years to draft a plan that would create voluntary guidelines for the district. Failure to meet the deadline by 2002 would result in a systematic loss of local control over groundwater management in that district.

Recommendation 8a: Before the State Water Quality Control Board mandates measures to improve groundwater quality in the Santa Maria Basin, the SMVWCD should insist on voluntary "best farming practices" among its membership, and provide local leadership in that area.

Recommendation 8b: The SMVWCD should work with the Cachuma Resource Conservation District in implementing these recommendations to improve groundwater quality and provide leadership promoting "best farming practices" in the District.

Representation on the Santa Maria Valley Water Conservation District Board

Water conservation storage and quality protection are significantly affected by water flows, flooding, wild fires, siltation and soil erosion, cattle grazing, brush and tree removal, road building, irrigation and farming practices, and many other events that occur throughout the entire watersheds of the Santa Maria, Cuyama and Sisquoc rivers and their tributaries. SMVWCD boundaries include only the northwestern half (approximately two-thirds) of the Santa Maria Valley Water aquifer.

SMVWCD has not adjusted its boundaries or its seven voting divisions since the District was founded in 1937. These boundaries were initially selected for economic reasons (irrigated crop production). The SMVWCD is divided into seven divisions. The City of Santa Maria (Division 5) has a resident population many times larger than the total of all of the other six rural Divisions, and yet has only one vote on the Board.

The SMVWCD directors have nearly always been local farmers, due to the current configuration of the voting divisions. The dominant interest in the District is by farmers, and non-farmer city residents are generally apathetic about SMVWCD issues. Therefore, the representative from Division 5 (Santa Maria City) is a minority voice, and controversial votes are usually 6 to 1. In 1999, the County Water Agency, after studying historic trends and hydrologic balance studies, characterized the Santa Maria Valley aquifer as having a "slight to moderate" overdraft. No single agency of government claims responsibility for assuring the health and efficiency of the entire Santa Maria Valley watershed by appropriate planning and management.

The California legislature has ordered all special districts that do not choose at-large delegates, including the SMVWCD, to revise their voting districts not later than six months prior to next district elections (in 2002). Each division of each district must now have equal numbers of residents, based on the 2000 decennial Federal census data, and based on the population of the entire District.

Finding 9: The SMVWCD political boundaries do not reflect the boundaries of the groundwater basin it is charged with protecting and managing, and six of the seven divisions of the District currently have a very small population of eligible voters because of the historic configuration of the District.

Recommendation 9a: The District should move forward on expanding its boundaries, at least those within Santa Barbara County, to provide for better groundwater management before the next election.

Recommendation 9b: The SMVWCD should adjust its boundaries to include all of the SMV groundwater aquifer.

Recommendation 9c: The SMVWCD should charge fees on the annexed lands at the same rate structure applied to existing district landowners, both rural and urban.

Recommendation 9d: The District should revise its divisional boundaries in the near future to comply with the new Special District election laws.

In this way, any remedy to the problems facing the groundwater in the Valley would be based on the needs of all users, and could be funded comprehensively.

Orcutt and the Orcutt Sub-aquifer of the Santa Maria Valley Aquifer

Cal Cities, a subsidiary of the private, for-profit, Southern California Water Company Incorporated, supplies all water in Orcutt. A Board of Supervisor's amendment to the Orcutt Community Plan requires that new developments in Orcutt use only the State water allotment or supplemental water. No groundwater can be supplied to new subdivisions. Cal Cities made an oral commitment to the City of Santa Maria during its negotiations with the State, for a 7,500 AFY allotment of State Water in 1991. It later contracted for only 500 AFY, leaving a water supply for all future new Orcutt housing development of only 500 AFY.

Santa Maria officials have consistently refused to consider annexation of the Orcutt urban area even though it is contiguous to the boundaries of the City and is in the City's Sphere of Influence. City officials' disinterest in annexation is based on their opinions that Orcutt's infrastructure does not meet City minimum standards. It is claimed that Orcutt's infrastructure would be expensive to bring up to City standards (capital costs) and Orcutt's sales tax, bed tax, and other revenues would not meet its proportionate share of municipal operational costs.

A vocal majority of Orcutt residents have no desire to become a minor part of Santa Maria City. The Grand Jury was told that many Orcutt community leaders would actively oppose any proposal for annexation to the City. The County's revised development standards, as set forth in the Orcutt Community Plan, might increase Orcutt's ability to meet many of Santa Maria's infrastructure standards, but Orcutt's operating revenues from taxes, fees, etc., would not likely be sufficient to fund Orcutt's share of municipal operating costs.

Finding 10: Orcutt does not have sufficient operating revenues to fund operating costs equivalent to Santa Maria's standards.

Recommendation 10: Santa Maria should not be encouraged to underwrite Orcutt's operating costs, and it should continue to resist discussions of Orcutt annexation.

The Health of the Santa Maria River Levee

The Santa Maria River levee is decades old and showing its age. It is a dirt, stonefaced berm that has been breached several times over the years. People are not generally well informed about the levee, but there is widespread concern that it might fail and destroy thousands of homes in northern Santa Maria. County Flood Control is planning to increase the integrity of the Santa Maria River levee by planting and maintaining a 50-foot-wide willow forest to help protect the levee.

Finding 11a: The integrity of the Santa Maria River levee is important to the recharge of the aquifer, as well as the safety of all who live, school, and work near it.

Finding 11b: Many Santa Maria Valley residents are questioning the flood protection capability of the levee on the Santa Maria River.

Recommendation 11: County Flood Control should continue with its plans to repair the Santa Maria River levee.

THE CITY OF GUADALUPE

Guadalupe is the oldest of the three towns in the Santa Maria Valley. In its early years, it exceeded Santa Maria in population, business, leadership, and overall prosperity. After the Pacific Coast Railway began serving Santa Maria in the 1880s, the first bridge was constructed across the Santa Maria River. Santa Maria boomed and Guadalupe began to decline. Although packing and shipping facilities were built for fresh vegetables grown in the west end of the Valley, Guadalupe lost much of its business and political leadership, which moved to fast-growing Santa Maria.

The current Guadalupe population is about 6,500 as compared to Santa Maria's 80,000 and Orcutt's 35,000. Despite limited financial resources, Guadalupe leaders have been remarkably successful in recent years in supplying high quality water services to everyone in the City. City officials have a good working relationship with the Regional Water Quality Control Board, which has assisted the City with water quality improvement to meet and exceed minimum required standards.

Water

The City also bought a 500 AFY allotment of State Water that it mixes with its local wellwater to improve the municipal water quality.

To the extent possible, the City has oversized its new water and sewer main to be able to accommodate future growth without again digging up the two miles of Guadalupe Street (State Highway 1). By coordinating with CalTrans, the City was thus able to achieve a lower cost replacement of the ancient water and sewer mains.

City officials are concerned that the aquifer from which they pump the City's water may be increasingly contaminated by

- the agricultural operations that surround it, and
- the diluent that leaked underground from UNOCAL's operations north of the Santa Maria River's mouth.

City leadership sought to establish a ring of test wells outside the City's perimeter to provide early warning, and applied for a grant from the UNOCAL mitigation funds to finance them. The application was rejected.

Flooding

The Santa Maria River flooding is a constant threat to the City. The protective levee does not extend downstream beyond Highway 1. This exposes LeRoy Park and its youth center building, as well as exposing housing on both sides of lower Pioneer Street. The City's requests to the County for mitigation of the flooding danger have been unsuccessful. County Flood Control officials say the funds are unavailable. In March the Santa Maria River berm along the Fraitis/DeGaspari property failed, and caused water and soil erosion damage.

A flood water channel known as the West Main Street Ditch is an unlined dirt cavity and has reportedly failed a number of times. Because there are increasing water flows from the agricultural fields east of the City in recent years, the City is concerned that the channel might seriously overflow, flooding McKenzie Junior High School and undermining parts of Main Street.

Land

Guadalupe is surrounded by richly productive farmland, and the Santa Maria River to the north. Like many cities in agricultural areas, it has no way to grow to meet the needs of its growing population except by annexing prime agricultural land. This has been done piecemeal and has thus far met the City's needs. More land is now needed and the City has identified a potential seller for 80 acres immediately adjacent to the City limits. If an agreement is worked out, the City can start the long process with the Local Area Formation Commission (LAFCO) for authority to add the land to its sphere of influence and ultimately to include it inside the City limits so that housing construction can be authorized.

Apart from this 80-acre parcel, most of the agricultural land is concentrated in the hands of a relatively small number of farmers, with a large part of the former Rancho Guadalupe still in the hands of the heirs of a non-resident foreign investor, as it has been since 1862. Many of the lands are farmed by tenants, including some large local agricultural corporations.

There are non-prime agricultural lands several miles outside the City that might be possible to annex to the City and develop for housing, recreation, and conservation of local flora and fauna. This annexation would be a long and complex project, but one that could ultimately conserve prime agricultural land, while still increasing Guadalupe's tax base, and provide a site for the City to zone for upscale housing that would balance the City's current modest housing stock.

Recreation

An ancient slough on private property has been an unofficial junk disposal site for many years. The City now plans to clean it up and develop it as a nature conservation project, a city recreational facility and a site for children to learn about nature. It is the City's view that endangered species of birds and animal should be concentrated in well-protected appropriate sites. This is part of the City's overall plan to turn blight into beauty with public benefits.

The City is also aware of possible changes of use in the nearby Betteravia Lake (formerly known as Guadalupe Lake) area. As the water table in the west end of the Valley has continued to rise, and the water flow from the Orcutt/Solomon Creek watershed continues to grow, it seems likely that crop production will become increasingly difficult and costly, with profitable crops diminishing in number. Should a multi-use lake restoration project come into being, Guadalupe leadership would consider participation.

Finding 12: Guadalupe's Mayor, City Council and staff are determined to increase the City's municipal income and resources to improve city services.

Recommendation 12: Guadalupe officials should increase efforts to improve City finances and thus the City's ability to develop local and needed natural resources to benefit residents, by expanding efforts to obtain more grant financing.

Finding 13: It is legally possible for Guadalupe to annex currently non-contiguous land for urban growth needs. This would allow the City to plan its future growth on marginal farm land instead of converting adjacent highly profitable prime agricultural farm land to housing tracts.

Recommendation 13: Guadalupe officials should continue plans and programs to obtain LAFCO approvals for expanding the City's Sphere of Influence and City limits to meet City population growth needs as projected by the County through 2030. They should annex ancient sand dunes (sub-prime agricultural land) northeast of Brown Road and an access corridor across prime agricultural land for needed upscale housing in the Santa Maria Valley. This development of "Guadalupe South" could increase the future real estate tax base and support local businesses.

Finding 14: The Regional Water Quality Control Board (RWQCB) provided a large grant and technical advice so that the water supply and sewer treatment facilities of Guadalupe were upgraded to comply with all governmental regulations.

Recommendation 14: Guadalupe officials should continue to work with RWQCB to further improve the quality of water and of sewage effluent treated by the City of Guadalupe sewer farm.

Finding 15: City leaders are working on plans and negotiating with adjacent property owners to develop the Guadalupe City Slough into an attractive multipurpose City Park with numerous amenities.

Recommendation 15: Guadalupe officials should continue these efforts with respect to the City Slough and apply for funding grants.

Finding 16: The Nature Conservancy, manager of the Guadalupe Dunes, has improved Oso Flaco Lakes just north of the County border with amenities, but it has done nothing to provide similar recreational facilities at the Santa Maria rivermouth estuary.

Recommendation 16: Guadalupe should continue with its requests to the County and the Nature Conservancy to expedite the improvement of public recreational facilities at Guadalupe Beach Park as the Conservancy has done at its facility at Oso Flaco.

Finding 17: The City has done a commendable job to redevelop a blighted area (the City Slough) into a multipurpose park.

Recommendation 17: Guadalupe officials should continue plans to develop the Guadalupe City Slough into an attractive multipurpose park featuring a general cleanup, conservation of nature species, childrens' educational facilities, boating, fishing, picnicking, etc.

Finding 18: Paradise Beach has the potential to be improved to become a multipurpose County/City recreational and conservation park.

Recommendation 18: Paradise Beach (through efforts of the City of Santa Maria, Orcutt, and the County) should be developed into a County park similar to the beach at the base of the cliff at Summerland on the South Coast. Additionally, the County, the City of Santa Maria, and Orcutt in combination with input from the City of

Guadalupe should encourage the State legislature and the local representatives to bring Point Sal Beach State Park up to a reasonable standard (regarding access, parking, and sanitation facilities) for safer and enhanced public use.

Finding 19: Restoration of Betteravia Lake could provide recreational and educational benefits for Guadalupe, its residents, and visitors.

Recommendation 19: Guadalupe officials should participate in planning and promoting restoration of Betteravia Lake, or portions thereof, into a multipurpose park.

Finding 20: LeRoy Park, currently Guadalupe's only park, and its valuable community buildings, may sustain flood damage in the future.

Recommendation 20: In combination with County Flood Control, Guadalupe should seek to protect LeRoy Park and consider extending the Santa Maria River levee west of Highway 1, and create an earth berm around the unprotected three-acre site as an affordable first step in solving Guadalupe's flooding issues.

AFFECTED AGENCIES

KEY	AGENCY
A	County Administrator (CAO) *
B	Board of Supervisors (BOS) *
C	Planning and Development (P&D) *
D	Public Works and Flood Control (PWD) *
E	Santa Maria Mayor and City Council
F	Guadalupe Mayor and City Council
G	Air Pollution Control District (APCD) *
H	County Parks *
I	Local Agency Formation Commission (LAFCO)
J	S. B. County Association of Governments (SBCAG)
K	Agricultural Commissioner *
L	Water Agency *
M	Clerk-Recorder-Assessor *
N	Laguna Sanitation District

O	Santa Maria Valley Water Conservation District (SMVWCD)
P	Treasurer/Tax Collector *
Q	Cachuma Resource Conservation District (CRCD)
R	County Counsel *
S	Auditor-Controller *
T	Planning Commission *

* Santa Barbara County Agencies.

Notes:

1. The following presentation of the list of Affected Agencies and the associated Findings and Recommendations is a departure from previous practice. The layout is easy to follow but to make it even easier, we suggest that after you locate your agency's Key Letter in the sequence across the top of the matrix, you might wish to use a highlighter to mark that column.

2. In the leftmost column of the matrix, F = Finding and R = Recommendation

3. A list of the Agencies sorted alphabetically is presented on page 27.

	PAGE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
F-1a	2		X	X		X	X		X												X
F-1b	2		X	X		X	X		X												X
F-1c	2	X	X			X	X		X												X
F-1d	2		X	X		X	X		X		X			X							
F-1e	2	X	X	X		X	X		X												X
R-1	2		X			X	X														
F-2a	3	X	X	X						X		X									X
F-2b	4		X	X		X	X					X		X		X					X

F-2c	4		X	X		X	X		X			X									X
R-2a	4		X	X		X	X		X	X		X									X
R-2b	4		X	X		X	X		X	X		X									X
F-3a	6		X	X								X									X
F-3b	6	X	X	X								X									X
F-3c	6		X	X								X									X
F-3d	6		X	X								X									X
F-3e	6		X	X								X									X
F-3f	6		X	X								X									X
F-3g	6		X	X								X									X
R-3a	6	X	X	X								X									
R-3b	6	X	X	X								X									
R-3c	7		X	X																	X
F-4a	10		X	X		X	X		X		X										
F-4b	10		X	X		X	X		X			X	X		X			X			
R-4	10		X	X	X	X	X		X		X	X	X		X			X			X

	PAGE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
F-5a	11		X	X	X	X	X		X		X	X	X		X			X			X
F-5b	11		X	X	X	X	X		X		X	X	X		X			X			X

F-5c	11		X	X	X	X	X		X		X	X	X		X			X			X
F-5d	11		X	X		X	X		X												
F-5e	11		X	X		X	X		X						X						
R-5a	10		X	X	X	X	X		X				X		X			X			
R-5b	10		X	X		X	X		X				X		X			X			
R-5c	10		X	X	X	X	X		X				X		X			X			
F-6	11				X	X		X			X										
R-6a	11	X	X	X		X		X			X										
R-6b	11		X	X							X										X
F-7	15				X	X							X			X		X			
R-7a	15				X	X							X			X		X			
R-7b	15				X	X							X			X		X			
F-8	16				X	X	X				X				X	X		X			
R-8a	16			X								X				X		X			
R-8b	16			X								X				X		X			
F-9	17									X						X					
R-9a	17									X						X					
R-9b	17		X	X	X	X				X	X	X	X			X					
R-9c	17		X	X	X	X				X	X	X	X			X					
R-9d	17		X			X	X			X						X					

	PAGE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
F-10	18	X		X		X				X										X	X
R-10	18	X		X		X				X										X	X
F-11a	18			X	X	X	X									X					
F-11b	18			X	X	X	X									X					
R-11	18			X	X	X	X									X					
F-12	20						X														
R-12	20						X														
F-13	20			X			X			X									X		X
R-13	21			X			X			X				X							
F-14	21						X						X								
R-14	21						X						X								
F-15	21						X		X												
R-15a	21						X														
F-16	21		X	X			X		X												

R-16	21			X			X		X												
F-17	21						X		X												
R-17	21						X		X												
F-18	21		X	X		X	X		X												X
R-18	21		X	X		X	X		X												X
F-19	22		X	X	X	X	X		X				X		X			X			X
R-19	22		X	X	X	X	X		X				X		X			X			X
F-20	22				X		X														
R-20	22				X		X														

KEY	AGENCY
K	Agricultural Commissioner *
G	Air Pollution Control District (APCD) *
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P	Treasurer/Tax Collector *
L.	Water Agency *

* Santa Barbara County Agencies.

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

11

Officers

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Arthur Tognazzini

Vice President
Daryl J. Souza

Secretary
Debi Askew

Directors

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SANTA MARIA VALLEY
WATER CONSERVATION DISTRICT

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August 21, 2001

Grand Jury Foreperson
1100 Anacapa Street
Santa Barbara, CA 93101

Dear Grand Jury Foreperson:

Following are the responses to the 2000-2001 Grand Jury Report on the "Natural Resources in the Santa Maria Valley" from the board of Directors of the Santa Maria Valley Water Conservation District:

Finding 2b: The ancient sand dunes in the Santa Maria Valley are presently and potentially the least productive agriculturally zoned lands in the Santa Maria Valley, and thus contribute the least to the revenue base of the County.

The District agrees with this statement. The District supports the preservation of prime agricultural land.

Finding 7: The recharge to the aquifer in the Santa Maria Basin has been diminished due to the continued siltation at Twitchell Reservoir.

The District disagrees with this statement. There has been no diminishment of recharge to the basin as a result of sedimentation in the Twitchell Project to date. When necessary, the Army Corp of Engineers has allowed the District to store excess water in the flood control portion of the reservoir. As a result, the operations of the reservoir for storage and for in-stream recharge have sustained the refunded recharge of groundwater, and prevented water from being lost to the ocean.. In the long run, if no changes in operation are made, there will be a reduction in recharge. The District and County are working with federal agencies to reallocate the conservation and flood control storage space to address the lost storage capacity in the conservation pool.

Recommendation 7a: Resolve the conflicts in estimates of discharge to the Santa Maria Valley aquifer as soon as possible.

The recommendation requires further analysis. The District is not aware of conflicts in the estimates of recharge from the project. Joe Scalmanini, the District hydrologist has been tasked with researching this item, based on an analysis of historical records and will report back to the district with his conclusion before the December 27, 2001 deadline.

Recommendation 7b: If an economical solution to the siltation issues at Twitchell Reservoir cannot be found in the near future, all local authorities should work cooperatively to find another source of recharge to cope with the growing need for water from the Santa Maria aquifer.

The recommendation has been implemented. The District is committed to both short term and long term solutions to the sedimentation issues at Twitchell. It has completed a sediment management plan and has hired a firm to research and develop grant applications in order to secure funding for this purpose. The County and District received $500,000 grant for emergency sediment removal around the outlet works and are progressing with that work. Addressing sedimentation issues has also emerged as a central issue in the current groundwater litigation and may result in additional resources for solutions from those entities that benefit from the project but have so far not financially supported it.

The District has discussed various projects that would enhance recharge of surface waters as part of an AB3030 groundwater management plan. Until litigation issues are resolved, the likelihood of moving forward on such projects is not likely. There are ongoing discussions with various mining entities and the District regarding the potential reclamation of in-channel and terrace-mining excavations into spreading basins for augmented groundwater recharge, all as part of an effort to settle the litigation.

Finding 8: In 1999, the Regional water quality control Board notified all water quality control districts that management and measurement of groundwater quality were being mandated by Federal law, and that each district would have two years to draft a plan that would create voluntary guidelines for the district. Failure to meet the deadline by 2002 would result in a systematic loss of local control over groundwater management in that district.

The District agrees with this statement. The District's AB3030 groundwater management plan states that it will "protect water quality and quantity for all basin users." The District has not made groundwater quality a priority and the Directors are divided on whether this is an appropriate task for the District. The District has contracted with a consultant to prepare a water quality report, which should be released by October 1, 2001.

Recommendation 8a: Before the State Water Quality Control Board mandates measures to improve groundwater quality in the Santa Maria Basin, the SMVWCD should insist on voluntary "best farming practices" among its membership, and provide local leadership in that area.

The recommendation has not yet been implemented. The District Directors are divided on what appropriate policy or action would be in this area. The majority is concerned *about becoming a regulatory agency although it has been explained that authorities are looking for voluntary management plans that address water quality issues. The District appreciates the fact that voluntary water quality management plans are the first option of choice before other external regulations are applied. The District has not committed itself to water quality management in its actions and has, so far, provided no leadership even though it takes "protecting water quality" as one of its primary responsibilities. The Districts expert consultant has advised it to do more in this area.*

Recommendation 8b: The SMVWCD should work with the Cachuma Resource Conservation District in implementing these recommendations to improve groundwater quality and provide leadership promoting "Best farming practices".

The recommendation has been implemented. The District has endorsed the general recommendations of the Cachuma Resource Conservation District's non-point source pollution study of the basin. The District has expressed a willingness to work with Cachuma Resource Conservation District on these issues but has not taken a leadership role.

Finding 9: The SMVWCD political boundaries do not reflect the boundaries of the groundwater basin it is charged with protecting and managing, and six of the seven divisions of the District currently have a very small population of eligible voters because of the historic configuration of the District.

The District agrees with the finding. In conformance with AB2543, which was signed into law by the governor on September 12, 1999, the District will be reconfiguring its division based on population and a "one person one vote" principal prior to the 2002 elections. This will result in each of the seven divisions having approximately 10,000 residents, which means that urban voters will dominate the voting electorate.

Recommendation 9a The District should move forward on expanding its boundaries, at least those within Santa Barbara County, to provide for better groundwater management before the next election.

The recommendation requires further analysis. The District has studied the process of expanding its boundaries and has met with LAFCO representatives. The Directors are divided on this topic and the majority voted down a proposal to move forward on annexing overlying basin lands within Santa Barbara County. There are concerns related to whether the District could afford to run elections in the new territories and also giving representation to persons who have not paid for the Twitchell project. The LAFCO process would indicate early on whether there would be enough revenue from the new lands to pay for elections, before the process is finalized. In fact, the District could not proceed if it were financially infeasible (its application would not be approved).

Recommendation 9b: The SMVWCD should adjust its boundaries to include all of the SMV groundwater aquifer.

The recommendation has not yet been implemented. In addition to the response in 9a, there exists a factual disagreement over the northern boundary of the basin. Once this issue is resolved (a central point in the current litigation) the district could move forward in annexing lands overlying the basin if it had the will to do so.

Recommendation 9c: The SMVWCD should charge fees on the annexed lands at the same rate structure applied to existing district landowner, both rural and urban.

The recommendation has not yet been implemented. Assessing newly annexed lands would be somewhat problematic given provisions of Prop 218, which requires a public vote. The current litigation may result in provision for court ordered assessments to support groundwater management and Twitchell sedimentation projects.

Recommendation 9d: The District should revise its division boundaries in the near future to comply with the new Special District election laws. In this way, any remedy to the problems facing the groundwater in the Valley would be based on the needs of all users, and could be funded comprehensively.

The recommendation has not yet been implemented, but will be implemented in the future. The District will be working with Santa Barbara County staff to redraw the division boundaries once the Supervisorial districts are finalized and staff has more free time to devote to this project.

Finding 11a: The integrity of the Santa Maria River levee is important to the recharge of the aquifer, as well as the safety of all who live, school, and work near it.

The District agrees with the finding. The District has no authority over the Santa Maria River levee. The District has managed Twitchell releases in order to protect the levee and cooperate with other agencies.

Finding 11b: Many Santa Maria Valley residents are questioning the flood protection capability of the levee on the Santa Maria River.

The District agrees with the finding. In addition, as noted above the District has no authority over the Santa Maria River levee. The District has managed Twitchell releases in order to protect the levee and cooperate with other agencies. The District shares concern about the levee and support its rehabilitation. The District has provided verbal and written input to various agencies on levee issues.

Recommendation 11: County Flood Control should continue with its plans to repair the Santa Maria River levee.

The recommendation will not be implemented because it is not warranted or is not reasonable. The District has no authority over County Flood Control.

The District appreciates the opportunity to respond to the 2000-2001 Grand Jury Report. If any additional information is needed, please contact the District Secretary, Debi Askew-Verdin.

The District would like to request a copy of the Responses by Affected Agencies To the Reports of the 2000-2001 Grand Jury when it is completed.

Thank you.

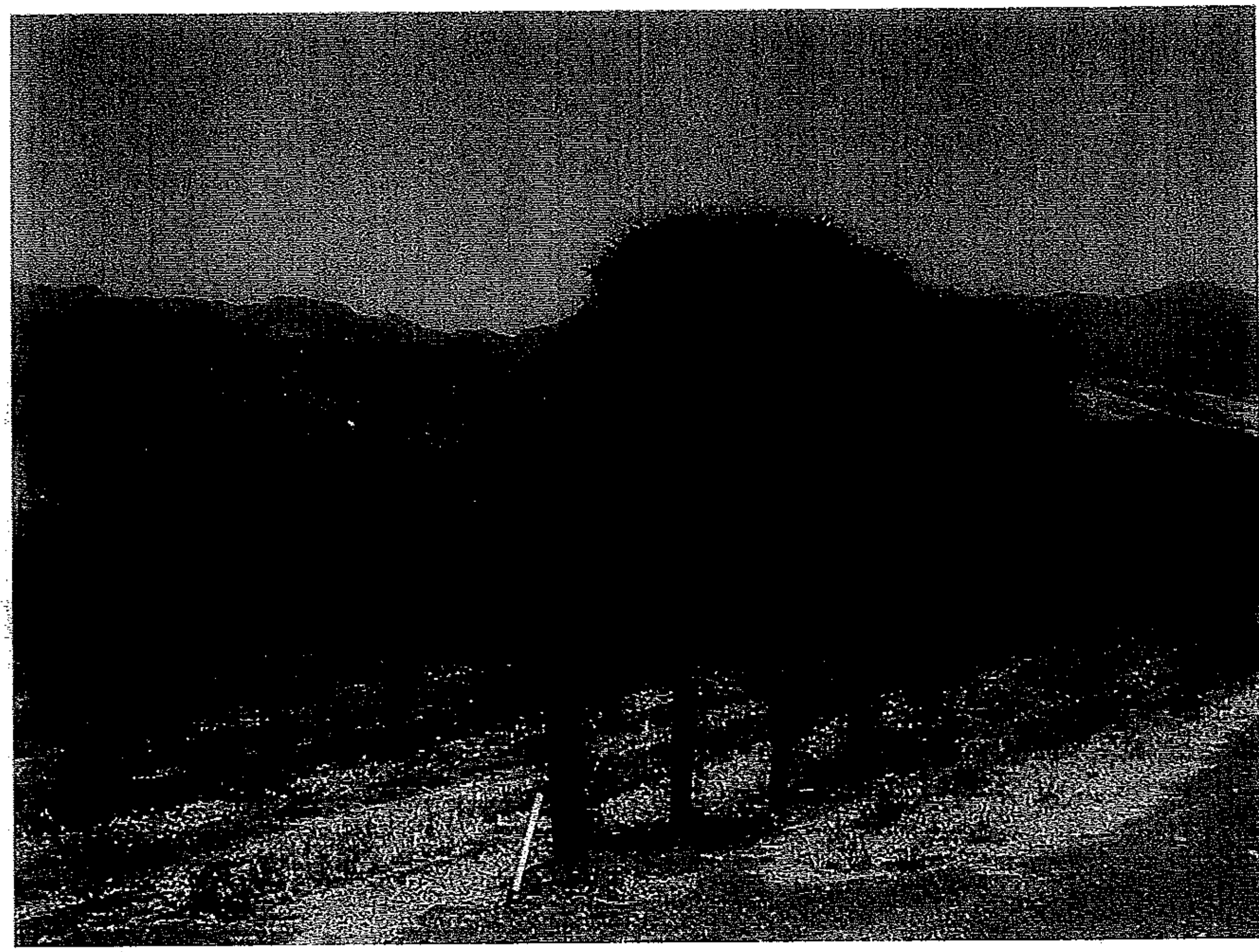
Sincerely,

Arthur Tognazzini,
President

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

12

2005
Santa Barbara County Groundwater Report



Santa Barbara County Public Works
Water Resources Department
Water Agency Division

123 East Anapamu Street
Santa Barbara, CA 93101
(805) 568-3440

March 28, 2006

A report on the conditions of groundwater and the status of groundwater basins throughout Santa Barbara County during the calendar year 2005

On the Cover:

Young vineyards in the Santa Ynez Uplands Basin with the San Rafael Mountains in the background

Forward

This report satisfies requirements of the Santa Barbara County Comprehensive Plan, Conservation Element, Groundwater Resources Section that was adopted May 24, 1994, and amended November 8, 1994.

Specifically, Conservation Element Goal 4, Policy 4.1, Action 4.1.1 states that:

The County Water Agency shall continue to monitor water levels from existing monitoring wells and, in coordination with the U.C. Cooperative Extension/Farm Advisor, shall request, on a voluntary basis, private and public water purveyors and major private groundwater users, including agricultural users, to provide periodic records of groundwater production. Unless deemed unnecessary by the Water Agency's Board of Directors for any year, the Agency shall compile an annual report on the status of pumping amounts, water levels, overdraft conditions, and other relevant data, and shall submit this report to the Board of Supervisors for its acceptance and possible further action. The annual report to the Board shall include a review of the results of all groundwater quality monitoring conducted in the County.

Upon completion of this report, the Water Agency will forward it to the County's Planning and Development Department to aid in land use decisions. According to Conservation Element Policy 3.2, "The County shall conduct its land use planning and permitting activities in a manner which promotes and encourages the cooperative management of groundwater resources by local agencies and other affected parties, consistent with the Groundwater Management Act and other applicable law." The annual report is part of that effort but is not to be the sole basis for any land use decisions.

In addition, as other local agencies complete groundwater management plans, the Water Agency will review these plans and both forward salient information from those plans to the Planning and Development Department and reflect that information in the next groundwater report update. Conservation Element Policy 3.3 States, "The County shall use groundwater management plans, as accepted by the Board of Supervisors, in its land use planning and permitting decisions and other relevant activities."

The information and conclusions contained in this report reflect data developed by the Water Agency and data contained in documents and reports listed in the "References". The Water Agency recognizes that other individuals/agencies might reach different conclusions based on different sources of data or interpretations.

As Conservation Element Action 4.1.3 states, "The County recognizes the need for more accurate data on all groundwater basins within the County and shall continue to support relevant technical studies, as feasible". As a result, the Agency continues to gather water resources data through cooperative programs, and its own collection of data. Finally, as stated in the Conservation Element, "The County recognizes that it has no authority to regulate or manage the use of groundwater except as provided for in the Groundwater Management Act (*Water Code ss 10750. Et seq.*) and other applicable law. Further, the County does not assume any authority under this section to make a determination of the water rights of any person or entity".

TABLE OF CONTENTS

Executive Summary

Climate

1. Rainfall during the 2004-2005 Winter Season was 188% of average countywide and as such produced significant recharge to groundwater basins and inflow to reservoirs. This is the first significant recharge to groundwater basins and runoff to reservoirs since the winter of 2000-2001. A detailed description of rainfall from late 2004 through 2005 can be found on page 18.

Status of Groundwater Basins

2. The Cuyama Groundwater Basin is in a state of overdraft of 28,525 Acre-Feet per year based on a 1992 study. This overdraft pertains to safe yield and not perennial yield. Water levels have fallen significantly but no regional economic or water quality problem has yet been documented. For more information on this basin please see page 71. For definitions of safe yield and perennial yield see page 4.

3. The Santa Maria Groundwater Basin within Santa Barbara County and also that area within San Luis Obispo County known as the *Oso Flaco* unit are in overdraft of 2,368 Acre-Feet per year based on a 2001 study. This overdraft pertains to safe yield and not perennial yield. Water levels have declined since agricultural development of the basin began but no regional economic or water quality problem has yet been documented. In the recent litigation *Santa Maria Valley Water Conservation District versus the City of Santa Maria et al.* the court ruled that based on a preponderance of evidence the groundwater basin is not currently in a state of overdraft. No "safe yield" number for groundwater extraction has been decided upon and thus it is Water Agency opinion that no further Santa Barbara County study is warranted at this time based on this "tentative" decision. For more information on this basin please see page 55.

4. The San Antonio Groundwater Basin is in a state of overdraft of 9,540 Acre-Feet per year based on a 2003 study. This overdraft pertains to safe yield and not perennial yield. Water levels have fallen significantly but no regional economic or water quality problem has yet materialized. For more information on this basin please see page 49.

5. The Lompoc Plain Groundwater Basin is basically in equilibrium under State of California Water Resources Control Board decision WR 89-18 and management by the Santa Ynez River Water Conservation District as natural recharge is augmented with periodical water releases that are

made from Cachuma Reservoir to maintain ground water levels in the basin. For more information on this basin please see page 44.

6. The Lompoc Uplands Groundwater Basin has apparently reached equilibrium as over time water levels have been lowered to approach the elevation of the Lompoc Plain and Santa Ynez River, which now regulate the water levels in the Uplands Basin. For more information on this basin please see page 46.

7. The Santa Rita sub-area of the Lompoc Basin is in a state of overdraft of 799 Acre-Feet per year based on a 2001 study. This overdraft pertains to safe yield and not perennial yield. However, water levels in some parts of this area have declined significantly in the past few years and thus in the future some economic effects may be realized as the balance between energy costs and commodity prices fluctuate. For more information on this basin please see pages 44 through 48.

8. The Buellton Uplands Groundwater Basin is in a state of surplus of 800 Acre-Feet per year based on a 1995 study. For more information on this basin please see page 42.

9. The Santa Ynez Uplands Groundwater Basin is in a state of overdraft of 2,028 Acre-Feet per year based on a 2001 study. This overdraft pertains to safe yield and not perennial yield, thus water levels have declined in many areas but no regional economic or water quality problem has yet materialized. For more information on this basin please see page 34.

10. The South Coast Basins are in equilibrium or surplus through management by local water districts and the Wright Settlement. For more information on these basins please see pages 22-31.

Considerations

11. Santa Barbara County is situated at latitude 34°-35° north in a *semi-arid* climate belt and as such is susceptible to prolonged wet and dry periods such as the wet period 1991-2001 and the droughts of 1945-1951 and 1987-1990. Thus, analysis of groundwater basins must occur over long-term climate and cannot be made year by year. For more information please see the "cumulative departure from mean" chart on page 16.

12. Recharge or precipitation is the dominant parameter in the calculation of the status of a groundwater basin (surplus, equilibrium, or overdraft). Selection of "base period" of climate (recharge) can substantially alter the outcome of such a calculation.

13. Santa Barbara County's cooperative water resources monitoring program through contract with the United States Geological Survey, and involving Water Resources Division staff is an essential task and should be

continued in order to adequately assess changing groundwater basin and watershed conditions.

Introduction

Groundwater supplies about 77% percent of Santa Barbara County's domestic, commercial, industrial and agricultural water. It is also the last line of defense against the periodic droughts that occur in the County. Historic records, combined with tree ring analysis indicate that local drought periods of several years or longer have occurred 2 to four times per century over the last 460 years (Turner, 1992).

To better understand the supply and limitations of each groundwater basin and aquifer, local, state and federal agencies regularly monitor water quantity and quality. This information about our groundwater resources is essential for a thorough understanding of the condition of the aquifers and thereby can help avoid overuse of aquifers which can lead to depletion, seawater intrusion, diminished storage capacity, lower water quality, or land subsidence within a basin. These potential consequences depend on the characteristics of the aquifer. In areas with low recharge rates, excessive pumping might render portions of an aquifer unusable indefinitely. The lowering of water tables might increase pumping "lifts" which could make pumping economically infeasible for some existing uses. In contrast, with proper management the lowering of groundwater basins can sometimes make them more effective by reducing rejected recharge. Since the consequence of long-term groundwater overuse can include permanent impairment of aquifers, careful evaluation of long-term records of use and groundwater response is essential to successful management of groundwater supplies.

In Santa Barbara County significant changes in groundwater basins generally occur over a period of years, or in some cases decades. In larger basins, trends in groundwater level and groundwater quality are recognizable only by examining data the length of one or more hydrologic (rainfall) cycles. Some factors likely to affect the condition of the basins, such as the importation of supplemental water supplies, the implementation of basin management plans, and climatic influences, may change from year to year.

Because of these concerns and various studies indicating slight to moderate levels of overdraft in several groundwater basins within the County and substantial overdraft in one basin, the County developed a set of goals and policies to protect local groundwater. These goals and policies are contained in the Santa Barbara County Comprehensive Plan, Conservation Element, Groundwater Resources Section, which was formally adopted on November 8, 1994. The effects of County permitted projects which may involve new extractions of water resources are evaluated under the California Environmental Quality Act pursuant to the adopted Environmental Thresholds and Guidelines Manual, 1995, and assessed for consistency with County Land Use Plan policy.

Included in this **ninth** annual report are updated water level data and hydrographs for selected wells, a general discussion of basin characteristics, a discussion of climate through late 2005 with its likely effect on groundwater basin conditions and developments in supplemental supplies and basin management plans, if significant.

Groundwater Terms

There are several terms used in this section that warrant definition. **Safe Yield** is defined as the maximum amount of water which can be withdrawn from a basin (or aquifer) on an average annual basis without inducing a long-term progressive drop in water level. **Perennial Yield** is defined as the amount of water that can be withdrawn from a basin (or aquifer) on an average annual basis without inducing economic or water quality consequences (Muir, 1964). **Net yield** is the Safe Yield value with the return flows subtracted. The Net Yield value refers to consumptive use of water that can be removed (without accounting for return flows) on an average annual basis without causing severe adverse affects. The Perennial yield value is always greater than the Net yield value. **Return flows** consist of water that has been rejected from evapotranspiration and thus is returned to the groundwater basin.

Overdraft is defined as the level by which long-term average annual demand exceeds the estimated Safe Yield of the basin and thus, in the long term, may result in significant negative impacts on environmental, social or economic conditions. A basin in which Safe Yield is greater than estimated average annual pumpage is defined as being in a state of **Surplus**. The term Overdraft does not apply to a single year or series of a few years, but to a long-term trend extending over a period of many years that are representative of long-term average rainfall conditions. Thus, the estimated overdraft accounts for both drought periods and periods of heavy rainfall.

Available Storage is the volume of water in a particular basin that can be withdrawn economically without substantial environmental effects. This storage value reflects the amount of water in the basin on a long-term basis (a point on a long-term trend line of water levels), not the current storage level in the basin. This volume of water is also referred to as the **Usable Storage** or **Working Storage** of a basin.

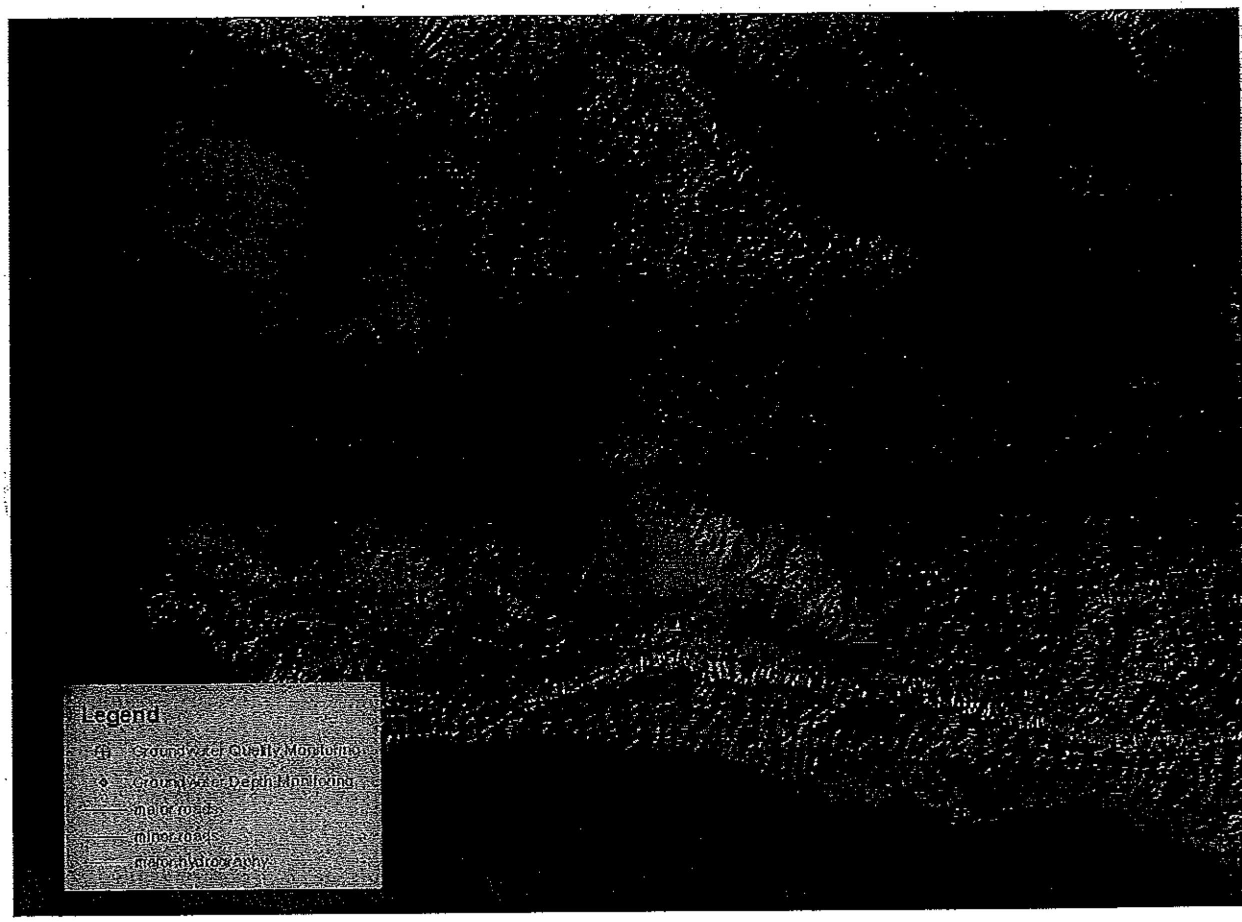
The term **Confined** is used to describe an aquifer, the upper surface of which is overlain by an impermeable layer that prevents any significant upward flow when the aquifer is totally saturated (filled) with water. When this type of aquifer is penetrated by a well the water in the well may rise above ground surface, due to the pressure head exerted on the aquifer, and if so may be described as **Artesian**.

Recharge is the sum of water entering the aquifer from direct deep **percolation** of rainfall, **seepage** from streams and rivers and return flows from irrigation. It is rainfall less losses of evaporation, evapotranspiration, diversion and outflow of the basin. It is the dominant parameter in the calculation of the status of a groundwater basin (surplus, equilibrium or overdraft). Data on actual net recharge by stream seepage and deep percolation of rainfall is very limited and thus is usually estimated or prorated from adjacent areas or historical studies. By utilizing differing "base periods" of climate (recharge) one can easily alter the outcome of the calculation of the status of a particular groundwater basin.

Well Monitoring and Data Collection

The Santa Barbara County Water Agency (SBCWA) currently monitors 283 wells for depth to groundwater throughout the County in cooperation with the United States Geological Survey (USGS). 27 sites include water quality. Individual water districts monitor many more wells. The illustration below shows the groundwater basins and indicates the locations of SBCWA observation wells.

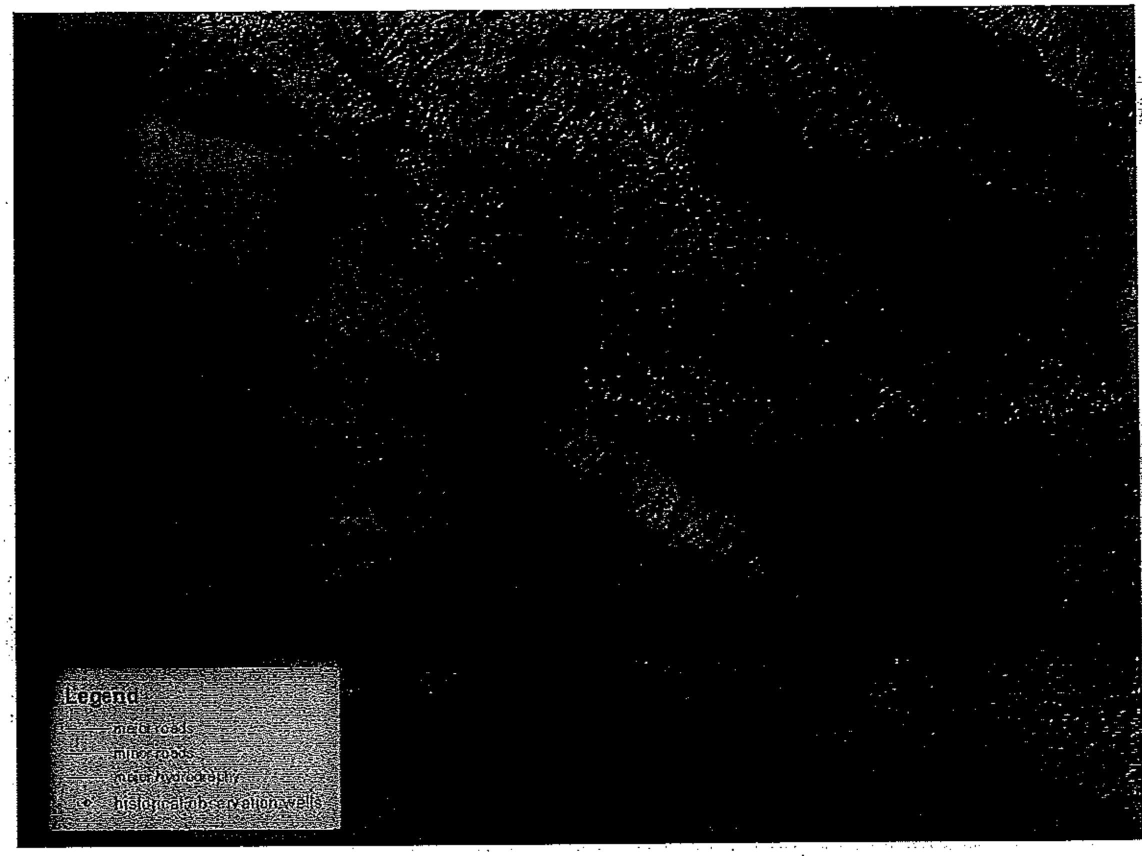
Current SBCWA groundwater quantity and quality observation sites



The County and local water districts cooperate with the United States Geological Survey (USGS) to collect and publish groundwater data. Because it is not feasible to include a discussion of each of these wells in this document, specific wells have been selected because each represents some hydrologic influence or portion of the basins in which they are located. Considerations include long-term record, lack of use or consistent water use over the period of record and centralized location with respect to the aquifers. Selected hydrographs for the entire period of record for representative wells are included in Appendix A.

There are historical records on many more sites than are currently being measured. These records were developed for a number of purposes including USGS investigations, prior inclusion in the County monitoring network, or measurements to address specific issues. The current monitoring network is sufficient to accurately reflect groundwater conditions throughout the County while being measured with a reasonable amount of resources. The graphic below describes the locations of these historical records.

Historical Groundwater Observation Sites



Note that most monitoring well records are from the low lying groundwater basins and Santa Ynez River Riparian Corridor.

Local water districts and municipalities currently monitor or fund monitoring of many sites in addition to those measured by Santa Barbara County. Agencies that currently have cooperative agreements with the USGS for *groundwater monitoring* besides the County Water Agency are the Carpinteria Valley Water District, City of Santa Barbara, Goleta Water District, Santa Ynez River Water Conservation District, United States Bureau of Reclamation (USBR), City of Lompoc and the Santa Maria Valley Water Conservation District. Agencies that provide information for this report but are not participants in the USGS program are Montecito Water District, the City of Santa Maria and California Cities Water Company. Monitoring frequencies vary among agencies and wells and reflect the data needs of the individual agency.

Carpinteria Valley Water District

The Carpinteria Valley Water District has an extensive network of monitoring wells in and near the Carpinteria Basin to track water level, quality and storage changes within the basin. Measurements are made bi-monthly or quarterly. A list of current monitoring sites by the Carpinteria Valley Water District is included in Appendix E.

Montecito Water District

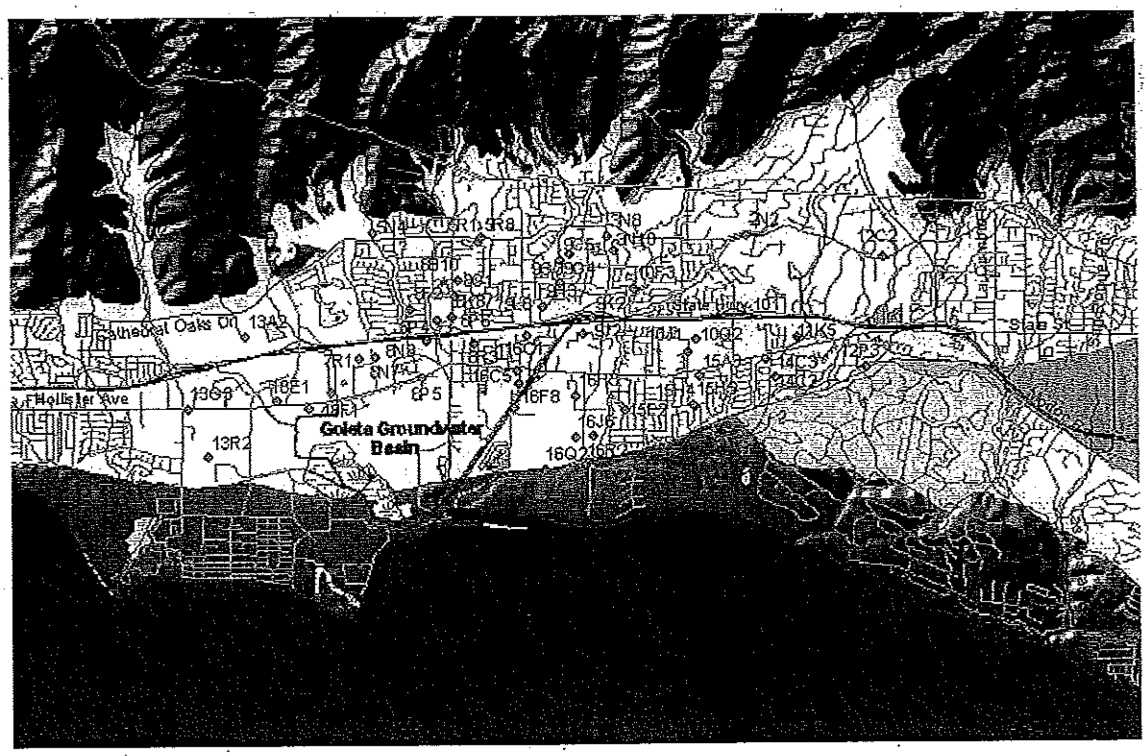
The Montecito Water District monitors 69 wells in and near the Montecito Basin to track water level, quality and storage changes within the basin. Most of the sites do not have an official State Well ID but the water districts own internal numbering system. For more information in this area please contact the Montecito Water District directly at 805-969-2271.

City of Santa Barbara

The City of Santa Barbara collects groundwater information in cooperation with the USGS on the sites listed in Appendix E. Data for these observation wells can be found on the City water website at http://www.santabarbaraca.gov/Government/Departments/PW/WaterData.htm Storage unit I pertains to the eastside and downtown parts of the City of Santa Barbara, Storage unit III pertains to the hidden valley and westside areas of the City, and the Foothill area pertains to the San Roque and La Cumbre areas of the City.

Goleta Water District

The Goleta Water District has an extensive network of monitoring wells in and near the Goleta Basin to track water level, quality and storage changes within the basin. The map below illustrates the spatial location of these sites.



United States Bureau of Reclamation

The USBR currently measures around 28 wells monthly listed in Appendix E in the Santa Ynez River Riparian Corridor to assess downstream groundwater conditions per California Water Resources Control Board Decision 89-18.

Water Quality Data Collection

Although partially funded through SBCWA programs, groundwater quality data is not collected directly by the SBCWA. Much of the data used in this report comes from the USGS, the Regional Water Quality Control Board, or local water agencies. This report discusses total dissolved solids (TDS) as an indication of general water quality, nitrates as an indication of possible return flow contamination and chlorides as an indication of possible seawater intrusion.

Data Collection Methodology

The majority of the representative wells used to create the hydrographs displayed in this report are currently measured by the County Water Agency. For these wells, groundwater depth is measured directly, one or two times per year, using a graduated steel tape. If conditions in a well preclude the use of the steel tape (such as if the well casing leaks), an electric sounder is used. Under ideal conditions, it has been the experience of Water Agency personnel that the steel tape is accurate to within two or three one hundredths of a foot. The accuracy of the electric sounder used by the Water Agency has been found to be somewhat less, typically five one hundredths of a foot.

Other methods for acquiring well measurements might include water stage (float) recorders that record water depths on graphs or punched tape. Stage recorders most often consist of a float and pulley device inserted into a well. Similarly, airline systems measure the pressure required to bubble gas out of a tube, the bottom of which is inserted below water in the well. If the precise elevation of the lower end of the tube is known, it is possible to determine the water depth. However, this method might only have an accuracy of plus or minus a foot (or more) depending on the accuracy of the pressure gage.

Geographic Information System

SBCWA has developed a GIS (geographic information system) to track and record groundwater data, and for analyzing and displaying historical groundwater data. Groundwater data may also be obtained from USGS at the website waterdata.usgs.gov, local water districts as well as SBCWA publications and files.

Drinking Water Standards

The following standards are provided for comparison purposes: the California Department of Health Services (DHS) secondary standard for total dissolved solids (TDS) in drinking water is 1,000 milligrams per liter (mg/l), maximum contaminant level. Secondary standards are applied at the point of delivery to the consumer. The DHS primary standard for nitrates (as NO3) in public drinking water systems is 45 mg/l and the DHS secondary standard for chloride in drinking water is 250 mg/l. DHS is in charge of "Source Water Assessments" and they are required of all "public water supplies" (with over 200 connections). For more information on the Drinking Water Source Assessment and Protection (DWSAP) Program please see the website at www.dhs.ca.gov/ps/ddwem/dwsap/guidance/index.htm.

Conclusions

The period 1991-2001 brought abundant precipitation to the local area and thus groundwater basins recovered after the drought of 1987-1990. Most basins peaked in 1999 after the historical wet year of 1998 however some down basin areas such as Guadalupe peaked as late as 2003. 2002-2004 were not recharge years. Even though 2003 was slightly above average in terms of precipitation the storms were so spread out that moisture never really exceeded soil capacity. Now after the extremely wet winter of 2004-2005 shallow wells have shown dramatic increases while the deeper wells were still falling as of early summer.

The County Public Works Department and the United States Geological Survey will continue the cooperative water resources monitoring program providing groundwater depth and quality (as well as surface water flow and quality) to evaluate water resources throughout the County. Groundwater observations of the last year revealed little change to significant conclusions reached in previous annual reports. Observations well measurements indicate that in the Cuyama Valley the downward groundwater level trend continues, in the Eastern Santa Maria Basin levels have dropped off dramatically, while in the Western Santa Maria Basin near Guadalupe levels appear to have just peaked in the past two years from water moving through the basin from the extremely wet 1990's and 2001 and now are beginning to decline. In the San Antonio Valley most well levels are declining. In the Santa Ynez and Lompoc Basins water levels have remained stable or only slightly declined.

Work on Groundwater management plans continue. Plans have been adopted for the Carpinteria, Montecito and Buellton Uplands Basins. A court action in 1989 set limits on pumping in the Goleta Basin and protects it from overdraft. Litigation continues on the Santa Maria Basin. Planning has been initiated for the Lompoc Plain Basin. State Water Project deliveries began in 1997 and most likely will have a beneficial impact on groundwater supply and quality with time.

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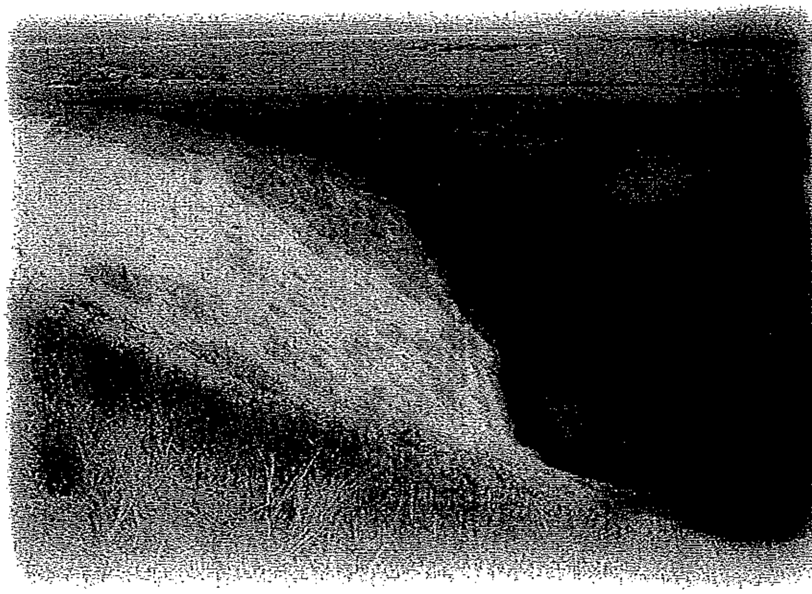
CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

13

Final

Santa Maria River Estuary
Enhancement and Management Plan



Prepared for:

The Dunes Center

March 2004

Coastal Conservancy

DUNES CENTER

Prepared by:

Science Applications International Corporation
An Employee-Owned Company

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- The Growers and Landowners in the Santa Maria Valley
- Members of the Technical Advisory Committee (listed in Table 1, Page 16)
- Liz Scott Graham and Oonagh Duggan, formerly with The Dunes Center
- Daniel Mountjoy, Natural Resources Conservation Service
- Rebecca Kramer, National Fish and Wildlife Foundation

Final

Santa Maria River Estuary Enhancement and Management Plan

March 2004

Prepared for

The Dunes Center

The State Coastal Conservancy

Central Coast Regional Water Quality Control Board

This enhancement and management plan was funded by the RWQCB through a grant to the State Coastal Conservancy using funds from the Unocal settlement agreement for projects that will serve to enhance water quality and provide other enhancement benefits in the Guadalupe-Nipomo Dunes complex. Funding for this project has been provided in full or in part through an agreement with the Central Coast Regional Water Quality Control Board (RWQCB) and the National Fish and Wildlife Federation (NFWF) pursuant to terms and conditions of the Guadalupe Settlement Fund. The contents of this document do not necessarily reflect the views and policies of RWQCB or NFWF, nor does mention of trade names or commercial products constitute endorsement of recommendation for use.

Prepared by

Science Applications International Corporation

Moffatt & Nichol Engineers

Swanson Hydrology and Geomorphology

MNS Engineers

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

ASBS	Areas of Special Biological Significance
CCAMP	Central Coast Ambient Monitoring Program
CDP	Coastal Development Permit
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CNDDB	California Natural Diversity Database
CNLM	Center for Natural Lands Management
CNPS	California Native Plant Society
CUP	Conditional Use Permit
CWA	Clean Water Act
cm	centimeters
EIR	Environmental Impact Report (State/Local)
EIS	Environmental Impact Statement (Federal)
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information Science
GOF	Guadalupe Oil Field
L	liter
LUP	Land Use Permit
mg	milligrams
ml	milliliter
mm	millimeter
MNE	Moffat & Nichol Engineers
MNS	MNS Engineers
NEPA	National Environmental Policy Act
NFWF	National Fish and Wildlife Federation
NMFS	National Marine Fisheries Service (now NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
P&D	Santa Barbara County Planning & Development Department
ppm	parts per million
RCD	Cachuma Resources Conservation District
RWQCB	Central Coast Regional Water Quality Control Board
SBCWA	Santa Barbara County Water Agency
SBFCD	Santa Barbara County Flood Control District
SCC	State Coastal Conservancy
SHG	Swanson Hydrology & Geomorphology, Inc.
SMP	Twitchell Sediment Management Plan
TAC	Technical Advisory Committee
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TPH	Total Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

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EXECUTIVE SUMMARY

The Santa Maria River watershed is one of the larger coastal drainage basins in California, draining approximately 1,880 square miles (or approximately 1,203,200 acres) of land. The watershed includes the Cuyama River and the Sisquoc River, which join to form the Santa Maria River. Solomon-Orcutt Creek also drains approximately 50,000 acres of land southeast of the Santa Maria River estuary and this creek discharges into the river just upstream of the estuary. The Santa Maria River runs through a broad flat valley that supports significant areas of prime agricultural land, the cities of Santa Maria and Guadalupe, instream sand and gravel mining, as well as oil production fields and related facilities, the most notable being the former Guadalupe Oil Field which is located in the Guadalupe-Nipomo Dunes complex north of the Santa Maria River mouth and estuary. This river system has undergone considerable alteration over the years for flood control purposes. The two principal flood control projects include Twitchell Dam (located approximately seven miles upstream of the confluence with the Sisquoc River) and the U.S. Army Corps of Engineers levee, which extends from Fugler Point west to the City of Guadalupe, ending immediately east of the Highway 1 bridge.

As a result of the many human uses and physical changes that have occurred on this river system and its tributaries, the study reach (from Highway 1 to the Pacific Ocean, approximately 5 miles, shown in Figure ES-1) has become degraded. Collectively, flood control projects, urban development and runoff, oil field development and agricultural practices have adversely affected water quality as well as the extent and quality of native habitats. Perhaps the greatest challenge of this plan is that the study reach accounts for approximately 1,200 acres (or less than 1% of the watershed) at the downstream end of a very large watershed, and is affected by all activities occurring upstream.

For example, the water quality has been degraded by runoff across thousands of acres of cultivated lands, and has elevated levels of fertilizer and pesticide by-products, such as nitrate, and dissolved solids (salts). Urban runoff has contributed fertilizers, pesticides, grease and trash to the system. Oil field development and extraction activities degraded surface and ground water quality over several decades as diluent (a petroleum hydrocarbon used to aid in extraction of crude oil) was released into the aquifer and subsequently migrated to the surface or west and southward to the ocean and the river, respectively. Sediment transport processes and the sediment budget has been affected by the presence of Twitchell Dam and to some extent by sand and gravel mining, which affects long-term sediment transport to the coast and along the coast, as well as the long-term sediment supply that feeds the dune complex over geologic time. Native habitats have been affected by activities such as levee construction in the floodway, expansion of cultivated agriculture into the river bottom, and in-stream cattle grazing. Flooding has damaged low-lying homes in the river floodplain near the City of Guadalupe and agricultural levees constructed by farming interests downstream of the City have constricted the historic floodway. In addition, the water quality in the estuary is substantially affected by input from the Solomon-Orcutt Creek watershed.

Goals of the Plan

The goals of the plan were developed by the Dunes Center, in consultation with public and private property owners located in and adjacent to the project area, and staff members of the participating public agencies. The goals of the plan are to:

- Improve water quality in the study reach.
- Enhance physical and ecological processes while protecting important agricultural resources in the study reach from erosion and flooding.
- Improve habitat quality and quantity while also improving erosion protection along river terraces in the study reach that support urban or agricultural uses.
- Identify feasible management actions that can be cooperatively implemented by public and private land managers.
- Adaptively manage[1] the resources as conditions change over time.
- Identify regulatory and associated permitting requirements for implementation of the preferred alternative recommendations and avoid imposing additional regulation or burden on other agencies or land owners as a result of the plan.

Landowner participation and continued dialog with other stakeholders as the recommended actions are implemented would serve to:

- Foster trust and stewardship among all of the stakeholders.
- Facilitate a coordinated approach to implementation of recommended actions.
- Reduce the regulatory burdens that individual landowners may face in the future with respect to existing and proposed water quality improvements, sensitive species protection requirements, and flood management activities.
- Protect agricultural land from flooding, reduce soil erosion and sedimentation.

Achieving these goals requires a comprehensive, technically sound understanding of the physical processes and natural resources in the lower Santa Maria River and the estuary, as well as consideration for other projects (i.e., sediment management at Twitchell Dam, Santa Maria River Riparian Habitat Enhancement Plan planned and implemented by the Cachuma Resources Conservation District (Cachuma RCD) and Santa Barbara County Flood Control District (SBCFCD)). In addition, assessing the influence of the Solomon-Orcutt Creek watershed on the estuary will be a priority. Information gathered during preparation of this plan serves as the basis for promoting and improving water quality, sediment transport, and ecological functions over the long-term, and improving erosion protection for adjacent high floodplain terraces that support cultivated fields. With input from private landowners and other stakeholders, the plan also provides feasible land use recommendations to ensure that

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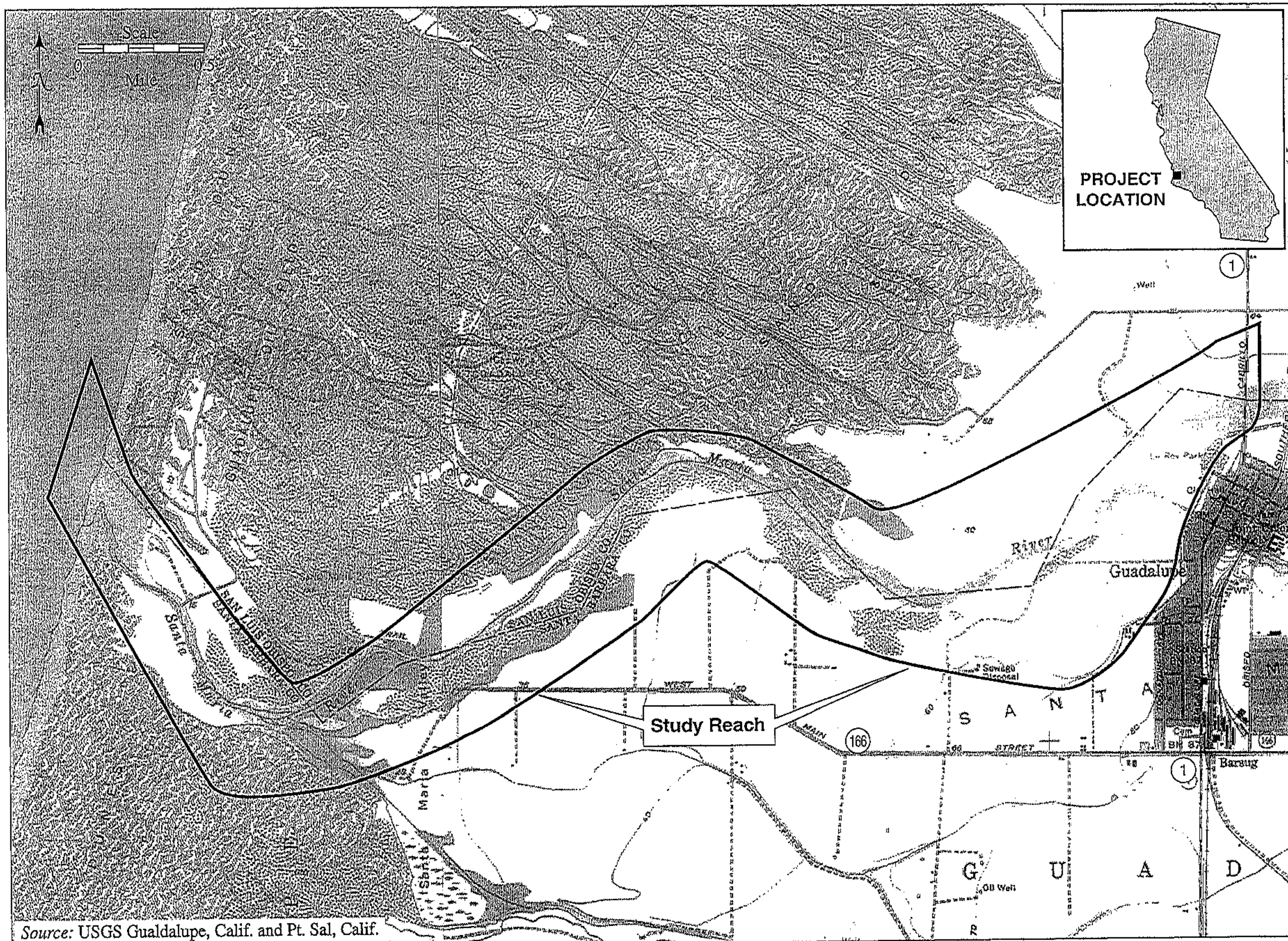
1 An adaptive management approach allows for changes or adjustments to the plan or recommended management actions as physical or ecological conditions change, as determined through periodic monitoring and reporting, as funding becomes available, or as new technologies emerge.



Source: USGS Gualdalupe, Calif. and Pt. Sal, Calif.

Figure ES-1. Study Reach

compatible agricultural uses and natural resources functions are maintained for future generations.

The plan was developed following review and analysis of existing information, and collection and analysis of new physical and ecological data. This process was guided by input and participation by a Technical Advisory Committee (TAC) that included the Dunes Center, agency representatives, landowners in the study reach and other stakeholders. Studies and analyses completed for this plan included new aerial photo and topographic data of the study reach, geomorphological conditions of the river up to Twitchell Dam, measurement of sediment budgets and the sediment transport process, collection of water quality data and comparisons with existing data, analysis of flooding under existing conditions and several alternative vegetation management scenarios, collection of biological resources information, and information on current and historic agricultural and grazing practices.

Based on these efforts, the plan identifies the existing conditions of and stresses on the natural resources and proposes feasible short-term and long-term enhancement and management actions to improve water quality and habitats in the study reach while protecting important and valuable agricultural resources from flooding and erosion.

The plan's programmatic approach to these complex issues identifies the need for cooperation and coordination between landowners, the Dunes Center, the Cachuma Resources Conservation District (RCD), the Natural Resources Conservation Service (NRCS), the Santa Barbara County Flood Control District (SBFCD), and others. The plan also provides an analysis of vegetation management options in the study reach to address water quality degradation, sediment transport, and flooding. An adaptive management approach to vegetation growth in the river will focus on problem areas to improve water quality, native habitats and ecological functions in the study reach over the long term.

Benefits to landowners that agree to participate in implementing the plan's recommended actions are expected to include one or more of the following:

- Protection of agricultural land from erosion and flooding;
- Volunteer implementation of management actions on private lands versus mandatory regulatory requirements;
- Financial assistance for implementing enhancement measures;
- Collection of biological resources information including sensitive species data for future management, potential mitigation banking possibilities, and "safe harbor" agreements with wildlife protection agencies[2];
- Financial incentives for developing mitigation banks on suitable lands;
- Reduced tax burden and financial compensation from the sale of land, or conservation easements;

2 U.S. Fish and Wildlife Service. Safe Harbor Agreements and Candidate Conservation Agreements with Assurances; Final Rule. *Federal Register* 64: 32705-32716. June 17, 1999. See Appendix J for description of Safe Harbor Agreements.

- Participation in alternative land use studies through established programs; and
- Improved surface water quality.

Organization of this Document

Section 1 provides an introduction and background information on the project area and the work completed to develop this plan.

Section 2 describes the purpose and need for the plan as well as an approach to implementation and potential benefits to landowners.

Section 3 provides detailed information on the existing setting of the project area and the study reach specifically.

Section 4 describes management actions associated with the preferred alternative, the locations where these actions would occur, and the potential outcomes of the action.

Section 5 discusses other alternatives to vegetation management that were considered and modeled but that would not meet the project objectives with respect to erosion protection and habitat enhancement.

Sections 6 and 7 include references and persons and agencies contacted in preparation of this plan.

Appendices provide the complete set of management actions, full copies of technical reports and other supporting information.

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

14

The Santa Maria Project is one of three large-scale Federal water projects in the region. These "seacoast projects"capture the seasonal floodwaters that would otherwise "waste" to the sea. The other two are the Cachuma and Ventura projects.

Santa Maria Project

(Second Draft)

Thomas A. Latousek
Bureau of Reclamation History Program
Denver, Colorado

Historic Reclamation Projects Book

1996

Table of Contents

The Santa Maria Project

The beautiful, broad Santa Maria Basin opens eastward from the Pacific Ocean toward the Sierra Madre Mountains where the sources of the rivers that sculpted the valley lie. Upon viewing such fertile grandeur, sea-going travelers as far back as the the eighteenth- and nineteeenth-centuries were so impressed that they described the area as a future agricultural paradise. Years later, corporate interests would see opportunity in the valley's deep, alluvial soil and extensive underground fresh water supply, constructing the first, albeit short-lived, irrigation project in Santa Maria.

Before long, though, such bounty brought forth problems. By the 1930's, farmers were pumping for water deeper, more often, and at more expense than ever before. Floods often plagued Santa Maria's wide, low-lying floodplain of a valley. Consultants were brought in and told locals that they were pumping the aquifer faster than it was being naturally replenished and that if they continued to do so salt water might intrude upon their source. First, Santa Marians needed to recharge their aquifer resource. If they built levees and cleared the river channel they might also be able to protect their property from floods.

At about the same time, local water developers such as T.A. "Cap" Twitchell and "Brad" Bradbury (after whom the Cachuma Dam was renamed) were just beginning to learn how to build large, local water projects. The desperately thirsty residents of the Santa Barbara area were first in line and got their needs quenched in 1948 with the Cachuma Project authorization. Santa Maria wanted their own "Cachuma" for the northern portion of the county. Not until a Reclamation meeting with the Army Corps of Engineers took place in November, 1949, at which it was agreed to investigate a joint conservation and flood control project for the basin was the Santa Maria Project provided with the impetus it needed to be built. Perhaps now, with the help of two federal water resource managers, the success predicted by early travelers for the

The Vaquero Dam's name was changed to Twitchell during ceremonies on September 20, 1957, in order to honor the recently-deceased, former director of the SMVWCD, T.A. "Cap" Twitchell. The dam was finished on June 28, 1958, at a final cost of $12.04 million, a remarkable 30 percent under the originally authorized figure of $16.9 million. This was due primarily to Reclamation being able to procure flowage easements on lands needed for the reservoir, instead of having to purchase the land outright, reducing the project's costs substantially. Since the maximum reservoir water level would be rarely if ever hit, nearby landowners were allowed by their easements to graze their cattle inside the reservoir area.(23)

Reclamation transferred operation of the Twitchell Dam to the SBCWA and physical operation of it to the SMVWCD on June 1, 1959.

Post-Construction History

The first river flowage to pass through Twitchell Dam and replenish Santa Maria's underlying aquifers occurred in early 1959, with outlet gates not being closed for floodwater storage purposes until February, 1962.

Southern California's dry chapparal landscape, wildfires, and rainstorm-induced landslides caused perennial sedimentation problems in most all water projects in the region, with the Santa Maria Project proving to be no exception. Silting problems were observed by 1967, less than ten years into the life of Twitchell Dam, when the stilling basin elevation was measured at a 425-foot elevation and the silt deposit level at 459.5.(24) Log booms were soon placed near the reservoir inlet to help block much of the incoming sediment, but by 1990 it was estimated that ten percent of the reservoir's capacity was lost to sedimentation.

With regard to the outlet works, the water district installed steel plates on the trashrack of the intake structure to elevation 512 to prevent silt from also entering the outlet works. Such preventive procedures also provided a measure of flood-control since they prevented a build-up of silt in the river channel downstream.(25)

Another problem that the Santa Maria Project shared with other Southern California water developments was dealing with the seismicity of the region. Although it was not originally believed that Twitchell Dam was located within one mile of a fault, a 1983 SEED Report (Safety Evaluation of Existing Dams) stated that recent seismotectonic studies suggested that "blind thrust" faults capable of quakes of a 7.0 (Richter Scale) or more may exist near Twitchell. The SEED report stated, furthermore, that based on descriptions of the dam's foundation materials consisting of poorly-graded, uncompacted sands and gravel, "there appears to exist a significant potential for seismic-induced liquefaction of the foundation of Twitchell Dam."(26) Consequently, the dam was given a "Poor" safety classification grade in the report. These problems have since been mitigated and the dam's safety classification grade satisfactory.

The Santa Maria water district was also pressured into converting Twitchell Reservoir into a recreational area much like its Reclamation neighbor to the southwest, Lake Cachuma, which drew one million visitors to its shores in 1980. Although Twitchell was dry most of the year, commercial developers in the area called for a change in the project's objectives, adding recreational boating, fishing, camping, and other activities to the agenda. The water district, however, claimed it was financially incapable of doing so, since the project's funding was based on an ad valorem tax that precluded recreation; consequently, the water district had neither the capital to purchase the necessary lands near the reservoir inlet, where the only public access was and upon which it only held easements, nor did it have the legal means by which it could have broadened its operation into the recreation arena.(27)

The Santa Maria Project, like the nearby Cachuma Project, underwent demographic pressures that rendered it, in part, unable to fulfill its original goal - that of providing for the valley's water needs for decades to come. Little did the project's founding fathers know that such increased demands would come to bear on the project that by 1990 municipal population growth would cause an estimated 15,000-30,000 af overdraft and force the community to take part in the State Water Project to satisfy its increasing needs.

Settlement of the Project

The Santa Maria area was largely settled by the 1950's when the project began to take shape but the growth of Vandenberg Air Force Base to the south near Lompoc brought with it much new residential development to Santa Maria's south in a sandy area near the sea called Orcutt. When the Santa Maria Project began in the 1950's, this area was home to perhaps one thousand people. By 1990, over 40,000 people would populate what had become a small city.(28) Combined with the still-burgeoning agriculture of the region (particularly in strawberry and grape production), that put much pressure on the water supply, causing the aforementioned overdraft and forcing the city of Santa Maria to participate in the State Water Project. While Santa Maria's needs were met for the time being (although State water comes at a price of $800-$900 per ac-ft), Orcutt, like Santa Barbara in 1979, rejected participation in State water due to non-growth issues (Santa Barbara would later approve participation in 1991). The Santa Maria agricultural community's future is also up in the air. While the underground supply still meets its base demand, it is finite. Consequently, should Orcutt and agriculture need a larger supply some day, it would not be from the aquifer. They, too, would probably either have to participate in the State Water Project at a great price, or, ironically, even purchase water from Santa Barbara's desalination plant.

Despite its uncertain future, the Santa Maria Project's agricultural legacy has been prodigious. Its tradition of high-value farming has given the project membership in Reclamation's "Billionaire's Club," making it one of nineteen projects that have grossed over one billion dollars worth of crops (or, in Santa Maria's case, two billion dollars) over the life of the project (1990). It is also the youngest Reclamation project on the list.(29)

Uses of Project Water

Project water replenishes the underground water body from which the Santa Maria water district customers pump all of their water supply. From this, the Santa Maria area's total water requirement, as it stood in the 1950's and upon which project planning was based, was 82,200 a-f per year. Of that, approximately 60,000 a-f fills irrigation needs; 11,000 a-f goes to irrigation losses; 6,500 a-f to municipal and industrial needs; and 4,900 a-f is used to prevent sea water intrusion into the basin.(30) By the 1990's, irrigation and municipal needs would skew these figures, increasing their demands drastically and causing the current 15,000-30,000 a-f overdraft which endangers the future of this critical and finite supply base.

Seventy-five percent of the supply in the Santa Maria Valley goes to irrigation, watering crops such as sugar beets, strawberries, alfalfa, and, more recently, grapes. The area is now home to over twenty wineries. There is no recreation at Twitchell Reservoir.

Conclusion

The Santa Maria area may still be called the "Valley of Gardens" but how much longer it will decribed as such remains in doubt. Municipal growth, in particular, has put tremendous pressure on the underground supply and irrigation needs show no sign of slowing down, either. The municipal population of the Santa Maria area approaches 150,000 (1995). The project was planned primarily with irrigation in mind, certainly not for such an exploding municipal demand. The new combination of water needs means neither has enough supply to take it comfortably into the future. In the meantime, the area's quality of life continues to attract a stream of former Los Angeles residents even though there is little water for them.

Floods do not besiege the area anymore and the valley remains a top agricultural producer. The Santa Maria Project ensured this for at least a few decades. But like much of Southern California, there never seems to be enough water. People keep streaming in, increasing the overdraft of the water supply.

The "Cap" Twitchells of the region could not have possibly planned for such high levels of future consumption of water - and from a dwindling supply. Santa Marians believed themselves very fortunate for a long time, living over a huge freshwater supply that took care of their present needs and future hopes. But the bounty that even early day travelers saw present in the valley could not last forever. While the Santa Maria Project met past, obsolete needs, as well as most present demands, its future depends on how area water managers come to grips with the new, difficult, and complex water issues they currently face.

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beautiful, wide, sea coastal plain would be assured long into the future.

Project Location

The Santa Maria Project took shape in its namesake river basin - the Santa Maria, in northern Santa Barbara County, sixty miles northwest of the city of Santa Barbara and 130 miles from Los Angeles. The Santa Maria River Basin is comprised of 1,880 square miles, making it one of the larger coastal drainage basins in California. The Santa Maria watershed includes the north half of Santa Barbara County (with Santa Barbara's Cachuma Project taking up the southern half) and very small portions of San Luis Obispo, Ventura, and Kern Counties. The Santa Maria River is formed by the confluence of the Cuyama and Sisquoc Rivers, which meet about twenty miles from the coast, flowing westward to the Pacific as the Santa Maria. The largest town in the area served by the project is Santa Maria, which lies on the river about eleven miles inland and is the second most populated city in Santa Barbara County.(1)

The annual average flow of the Cuyama River, which is dammed about six miles above its confluence with the Sisquoc is 40,400 acre-feet (a-f). The river is dry much of the year, with a sizeable stream flow occurring only following the storms of the wet season. Like the project area of its neighboring Reclamation project in southern Santa Barbara County, Cachuma, Santa Maria is characterized by a brief rainy season in the winter months and a long dry season the remainder of the year. The basin averages fourteen inches of rain per year, though it, too, has exhibited wildly fluctuating amounts of precipitation, from a low of four inches to a high of thirty.(2)

The primary feature of the Santa Maria Project is the Twitchell Dam (formerly named the Vaquero Dam; it was renamed in 1957 to honor T.A. "Cap" Twitchell, a long-time, local proponent of the project and head of the local water district). The dam is located on the Cuyama River about six miles upstream from that river's junction with the Sisquoc and where the river becomes the Santa Maria.

Prehistoric Setting

Spaniards observed forty-nine Chumash Indian villages in the Santa Maria area when they first visited the area briefly in the late 1700's. By the time the basin was settled in the mid-1800's, the natives were largely gone.

Evidence still exists of the Chumash and their predecessors in the valley in the form of petrographs appearing on rock formations in the Sisquoc backcountry east of Santa Maria and Twitchell Dam, and of shell mounds located near the coast. The Chumash subsisted largely on fish and shellfish from the sea (a steelhead salmon run took place on the Santa Maria River until the early 1900's) and game taken from the mountain regions.(3)

Historic Setting

The first visit to the Santa Maria area by Europeans occurred in 1776 when the Juan Bautista De Anza expedition camped in the valley, recognizing it for its fertile plain and agricultural possibilities.

Others also saw the potential in the broad basin. Duflot de Mofras, traveling on a Spanish ship in the early 1800's, described his travels along the Pacific coast and referred to Santa Maria. "The eighteen leagues that separate the Mission de la Concepcion (near Lompoc) from that of San Luis Obispo consist primarily of an extensive plain called La Larga (a name used by early explorers for the Santa Maria Basin). This, watered by the San Geraldo River, is noted for its fine grazing."(4)

Settlement of the region did not take place until 1840, though, when the Mexican government issued the 30,000 acre, Rancho Guadalupe land grant to Teodoro Orrellanes and Diego Olivera. They raised cattle on their lands, as did the others that followed until the disastrous drought of the 1860's killed most of the livestock. After this, the American farmers of the valley switched their agriculture activity to growing grain and fruit.(5)

The San Francisco Journal of Commerce extolled the agricultural virtues of the area when it stated in April, 1887, "There are unmistakeable evidences that the Santa Maria Valley was in the remote past an extensive bay, extending inland from the ocean, and the soil shows a richness for a depth of 75 feet in many places that cannot be surpassed in any other section of the country."(6)

Heeding this call was the Union Sugar Company of San Francisco, precursor of agribusiness in the Santa Maria Valley. It appeared on the scene in 1897 and had the means to search out and then construct the first irrigation system in the basin. They were followed in 1905 by a private irrigation venture organized for the purpose of taking water from the Sisquoc River and transporting it to Santa Maria by gravity canal. However, when a flood destroyed this operation in 1909, no efforts were made to reconstruct it.(7) Agriculture in the area had come to rely on the huge aquifer residents had discovered underlaying nearly the entire valley.

The presence of this underground water, in addition to the aforementioned floods, explain Santa Maria's water history - past, present, and future. The Santa Maria Valley consists mostly of a broad, alluvial floodplain area known as the Santa Maria Plain. Bordering the plain on the north and south are elevated terraces or mesas, with the Sierra Madre Mountains rising to the east. As the observant Duflot de Motras related in the eighteenth century, the plain was, in fact, not too long ago part of the Pacific, as is evident in the area's hydrogeology. When the land receded and lifted, the alluvium stayed put. Streams running down from the mountains such as the Sisquoc and Cuyama replenished the vacated space with freshwater, creating the water source that Santa Maria's farmers would tap for years to come.(8) Hydrogeologists studying this source believe the main water body is as much as 8 miles wide and underlies approximately 110,000 acres of the basin. The total freshwater volume is estimated to be 10 million a-f, but only a small portion (approximately 50,000 a-f/yr) of the total volume can be withdrawn for use without exceeding the annual average yield. Exceeding that amount could allow sea water to degrade the freshwater source (9)

By 1950 some deep wells which had formerly produced 1,000 gallons per minute (GPM) from the principal water-bearing alluvium were reduced to 250 GPM. Farmers in those areas were forced either to pump elsewhere, to pump deeper, or to pump more often to make up for the less efficient production, all expensive options. Without a source of aquifer replenishment, increasingly expensive pumping would become even more widespread in the valley.(10)

The conspicuous topography of the broad, alluvial Santa Maria Plain, together with the strong Pacific storms that deluge the area from time to time, conspired to make this valley, in particular, one fraught with flooding problems. Historical accounts of floods dating back to 1811 show twenty-five flood events sufficient to cause widespread damage.(11) To make matters worse, recent siltation of the Santa Maria River has increasingly clogged the channel for storm runoff, making the likelihood of future floods very real. The annual average value of property damage caused by floods in the Santa Maria Valley prior to the Santa Maria Project was $710,000 (1950).(12)

Despite the growing need to confront these recurrent issues, this roughly thirty-five mile long, three- to ten-mile wide basin known as the "Valley of Gardens" continued to make itself known for its agricultural production, particularly with regard to its vegetable and flower seed crops. With the area's fortuitous climate allowing for an annual growing season of over 275 days, and, hence, two to three harvests per year - and a sizeable local water source - the area had become one of the top agricultural producers in the region.

Authorization

The first discussions concerning the valley's water needs were prompted in 1924 in response to lowering underground water levels. The Santa Maria Chamber of Commerce initiated the first comprehensive survey of the Cuyama River watershed. From this study, directed by irrigation engineer Martin C. Polk of Chico, California, the Chamber of Commerce concluded that the cost of a viable, local water project was prohibitive at that point in time.(13)

A subsequent hydrologic report by J.B. Lippincott submitted to Santa Barbara County in 1931 discussed, for the first time, the feasibilty of storage reservoirs on the Cuyama and Sisquoc Rivers, but the report was shelved until after World War II.(14)

In 1937, the water issue became pressing enough to put the creation of a local water conservation district to a vote. When a flood struck three days before the election, ripping out highways, bridges, and powerlines, and drowning cattle, any opposition was squelched and the pro-district side won easily. T.A. "Cap" Twitchell, the son of a Santa Maria pioneer, a strong proponent of water development in the valley, and instigator of Santa Barbara's Cachuma Project, was voted to head the Santa Maria Valley Water Conservation District (SMVWCD).(15)

Reclamation's first activity in Santa Maria was a land classification survey in 1942. This was followed in 1946 by a report on the Santa Maria Basin as part of a Santa Barbara County-wide analysis of its water resources. Although this activity resulted in the eventual construction of Santa Barbara's Cachuma Project, Santa Maria's needs were not, at that moment, deemed quite as critical as were Santa Barbara's, so their report was shelved. Not Reclamation and the Corps of Engineers met in Los Angeles, in November, 1949, was impetus given for construction of the Santa Maria Project. At that conference the two parties, together with the SMVWCD, agreed to investigate a joint conservation and flood-control project for the basin.(16)

The reconnaissance geologic survey made of the Santa Maria Basin during Reclamation's investigation included profiling 68 miles of river and 14 damsites, the seven most promising of which were studied in more detail. Three foundation explorations were made before the site of Twitchell Dam was finally selected. The resultant "Report on Santa Maria Project, Southern Pacific Basin, California," formed the basis of ultimate authorization for the project on September 3, 1954.(17)

In Santa Maria, the directors of the SMVWCD decided to form the "Committee of 35," a unique advisory group comprised of a cross-section of Santa Maria citizens selected to help the directors formulate a fair project repayment plan. The committee voted unanimously in favor of calling an election on a special ad valorem assessment on lands to be taxed to provide for repayment. The directors then placed the $13.96 million Vaquero Project (its original name) repayment contract with the SMVWCD on the ballot for voter approval. On January 31, 1956, the Santa Maria Project was given the official go-ahead.(18)

The objectives of the Santa Maria Project were to recharge the critically-depleted groundwater reservoir underlying the basin and to eliminate the future flood threat to valley lands. There would be no surface water deliveries from the new reservoir since what water was captured would typically be immediately released to replenish underground supplies. Since the reservoir would be empty most of the year, Reclamation made no plans for recreation.

Being a conservation and flood-control project, both Reclamation and the Army Corps of Engineers participated. The percentage breakdown of total costs were 82.25% to irrigation and, hence, Reclamation, and 17.75% to flood control and the Corps of Engineers. The planned 239,000 af capacity reservoir was slated to reserve 150,000 af for conservation purposes and 89,000 af for flood control. It was planned that a reservoir this size could reduce a potential 230,000 cfs, 400-year flood to one that becomes a less threatening 150,000 cu-ft-sec, and at the same time produce an average annual yield of 18,500 af of increased recharge to groundwater basins, overcoming a 14,000 af overdraft and providing for municipal and industrial needs as well.(19)

Operation of the conservation side of the project would be such that dam operators would attempt to most closely replicate the stream channel's percolation rate, releasing flood water stored in the conservation space of the reservoir at a rate that was determined to be approximately 300 cfs. Anything less would be absorbed by the river channel and fail to make it to deposits tapped downstream; too large a flow would waste to the sea.(20)

The Corps' flood control design consisted of a series of levees and channel improvements along the Santa Maria River to protect the city and its valley lands. One levee was raised on the south bank extending from Fugler Point (the confluence of the Cuyama and Sisquoc Rivers) westward for seventeen miles, and another on the opposite bank stretching five miles downstream. Bradley Canyon, a smaller side canyon and notoriously flood-prone, was outfitted with a 1.9-mile levee to divert its floodwaters into the newly-reinforced Santa Maria River. The Corps' channel clearing project on the Santa Maria from Fugler Point to the sea was designed to increase the river's capacity, which had been reduced by heavy sedimentation. The Corps' plan would protect Santa Maria from a 150,000 cu-ft-sec flood peak, assuming partial capture (89,000 ac-ft) by Twitchell Dam.(21)

Construction History

The contract for construction of the Vaquero Dam was awarded to Mittry Construction of Los Angeles for $6.17 million. They began work on the structure in July, 1956.

The outlet works were constructed early on in order to divert Cuyama River flowage, allowing Mittry to place the embankment the entire length of the dam. The outlet works consist of: an inlet structure, 350-feet of concrete conduit 15-feet in diameter; 322-feet of concrete-lined circular tunnel 15-feet in diameter; 422-feet of concrete-lined horseshoe tunnel 19-feet by 17-feet; and a chute 30-feet long with 56-foot high vertical walls. A vertical shaft bisects the outlet works tunnel at the end of the circular section. This vertical shaft is for the placement, operation, and maintenance of four 4-foot by 7-foot control gates for the outlet works. The control gates provided measured releases to coincide with the river bed's natural percolation rate.

Mittry also constructed a spillway for protection of the dam to allow uncontrolled spillage when the reservoir's water surface elevation reaches 651.5 feet (the crest of the dam is at 692). The spillway is a steep, inclined, concrete-lined shaft bored through the mountain-side to the right of the dam's right abutment. The shaft connects with a concrete-lined tunnel 23-feet in diameter and 695-feet long, with a 125-foot concrete chute at the end. This allows spilled water to flow into an adjacent canyon which joins the Cuyama River downstream from the dam.

The dam itself is 218 feet high with a crest length of 1804 feet. It is an earthfill structure containing 5.8 million cubic yards of material.(22)

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

15

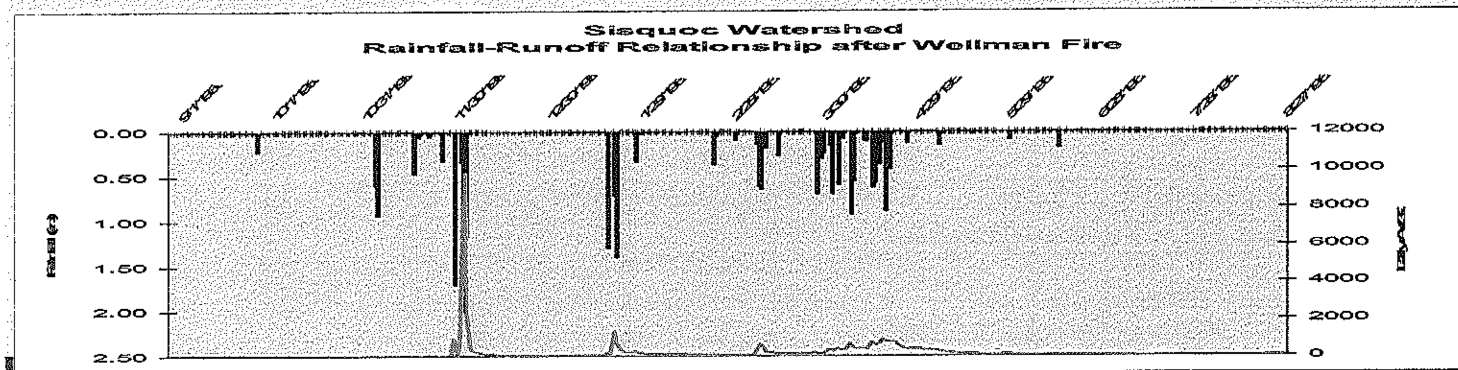
CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

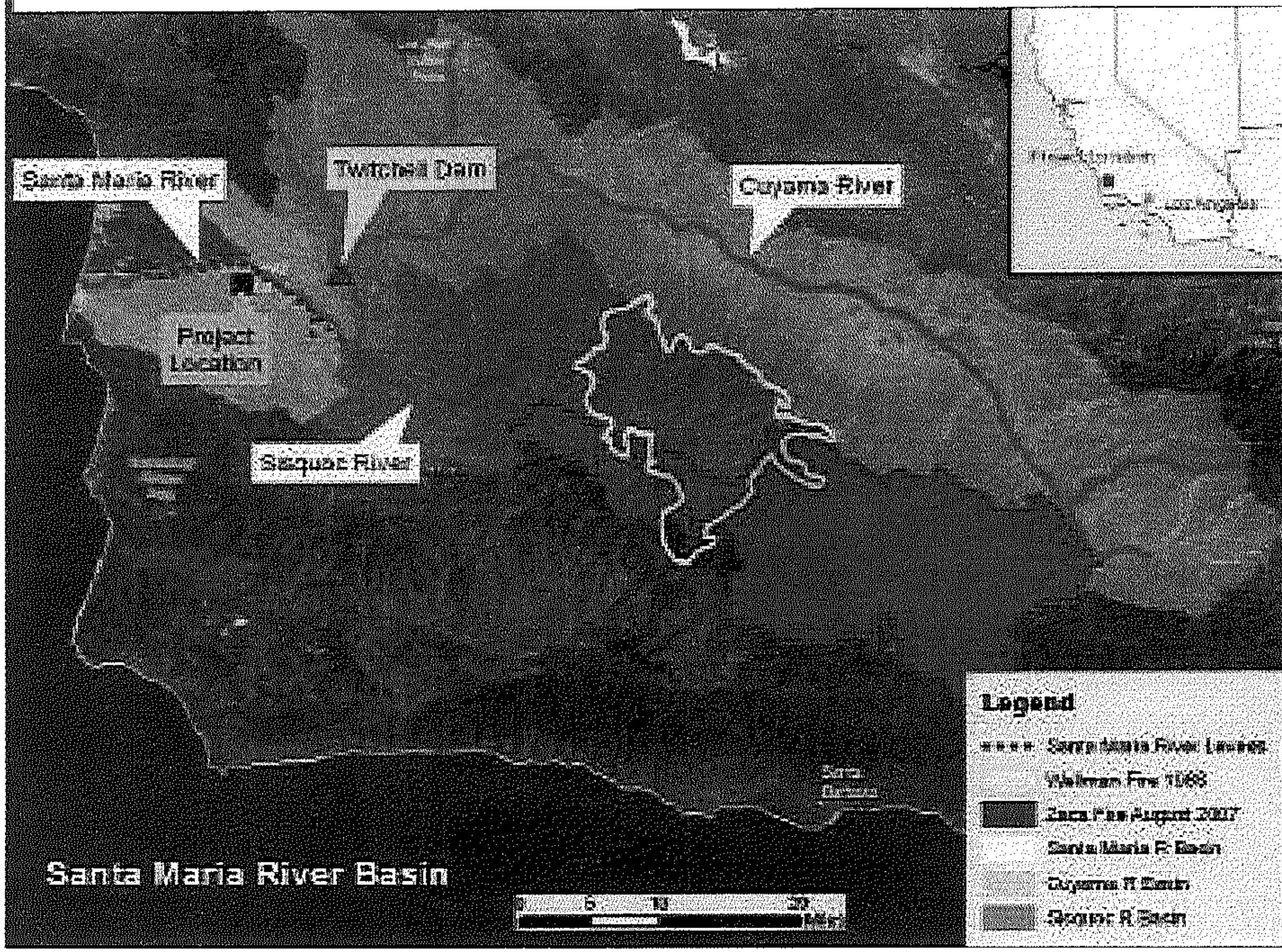
16

Zaca Fire Watershed Issues
Project Reporting
September 28, 2007

SM River 1966 Following Wellman Fire

Wellman Fire 1966

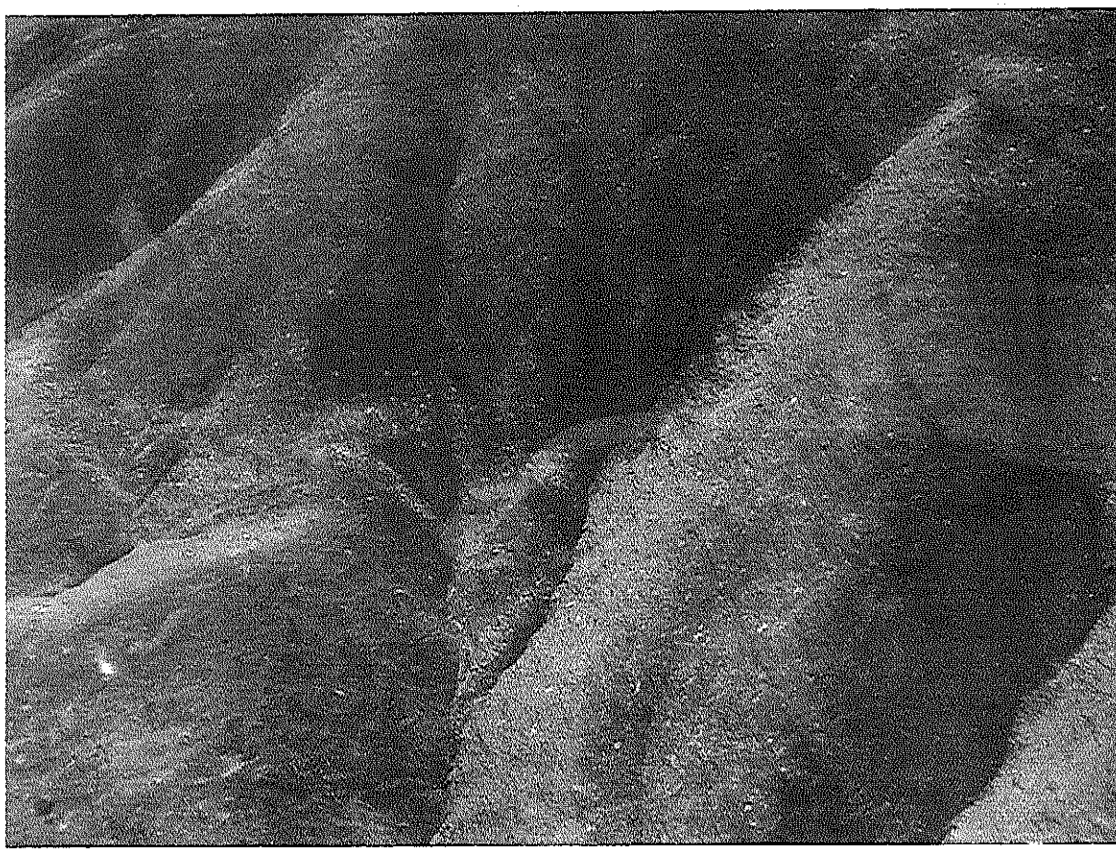




- Similar Fire in Same Watershed
- First Major Flow against the Levees
- First Exposure to Levee's Problem
- Modest Rain (early) Triggers Large Flow

Status Update Items

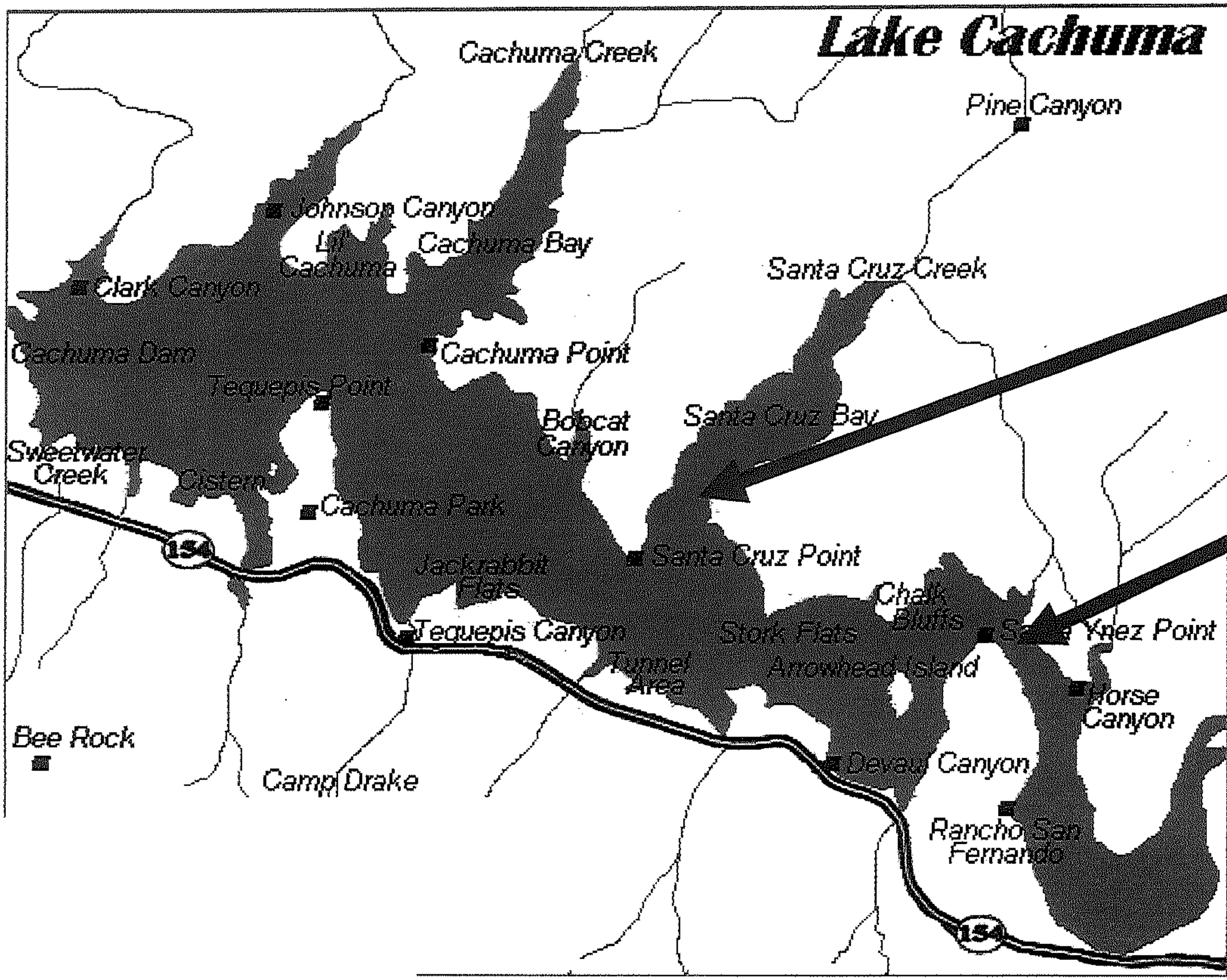
- Watershed Coordination Group
- Cachuma Debris Boom
- Santa Maria River Initiatives



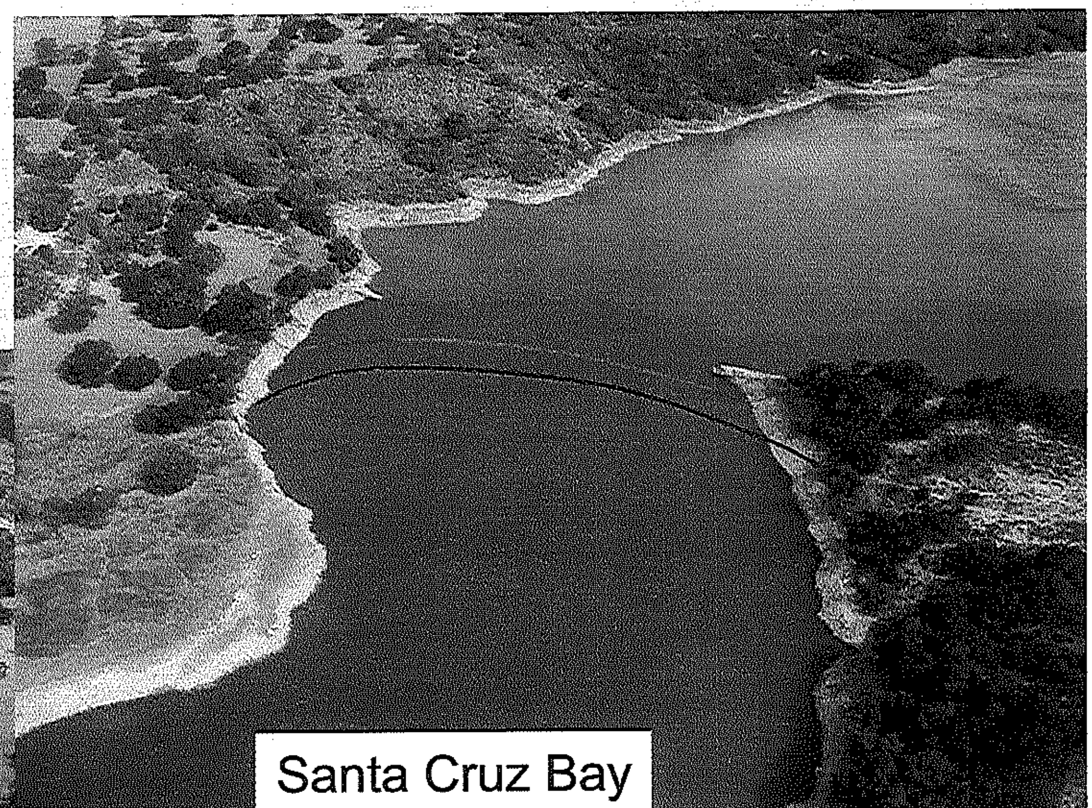
Watershed Coordination Group Meets Every Monday

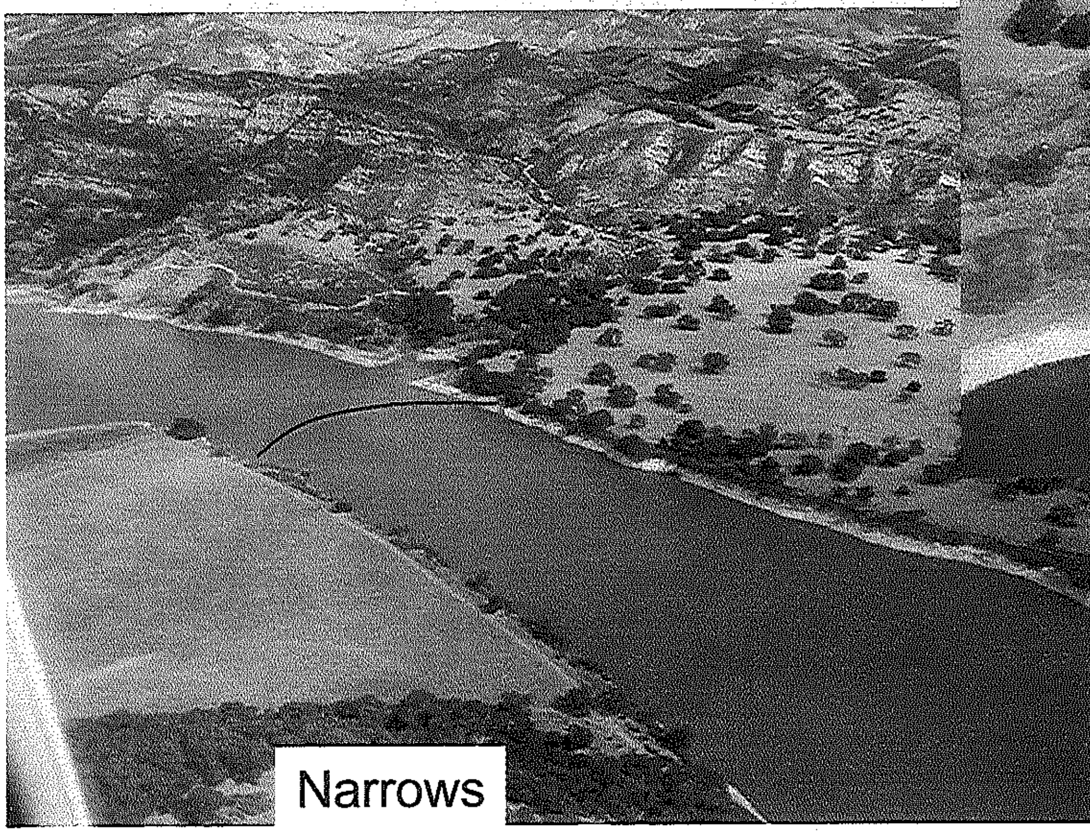
- Federal
  - Bureau of Reclamation
  - NRCS
  - USFS
  - Corps Of Engineers
- State
  - Dept Water Resources
  - State OES
  - Caltrans
- Local
  - County; Public Works, Parks, OES
  - Cities; Santa Barbara, Santa Maria
  - Other; Cachuma OMB, RCD, SM Valley Water Cons District,

Cachuma Debris Control
New Debris Lines

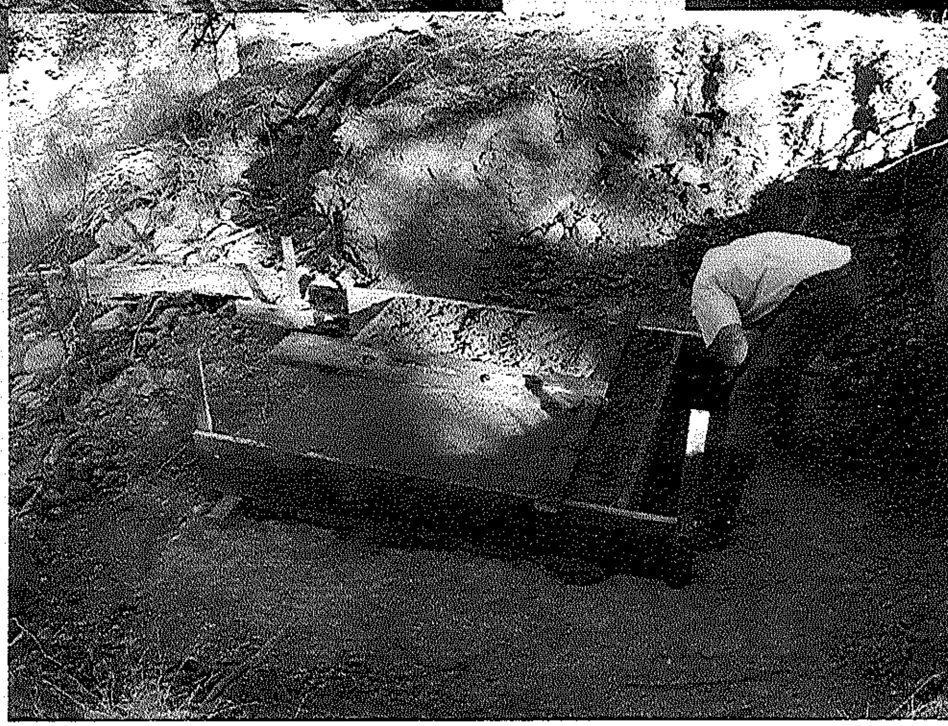


Cachuma Debris Control

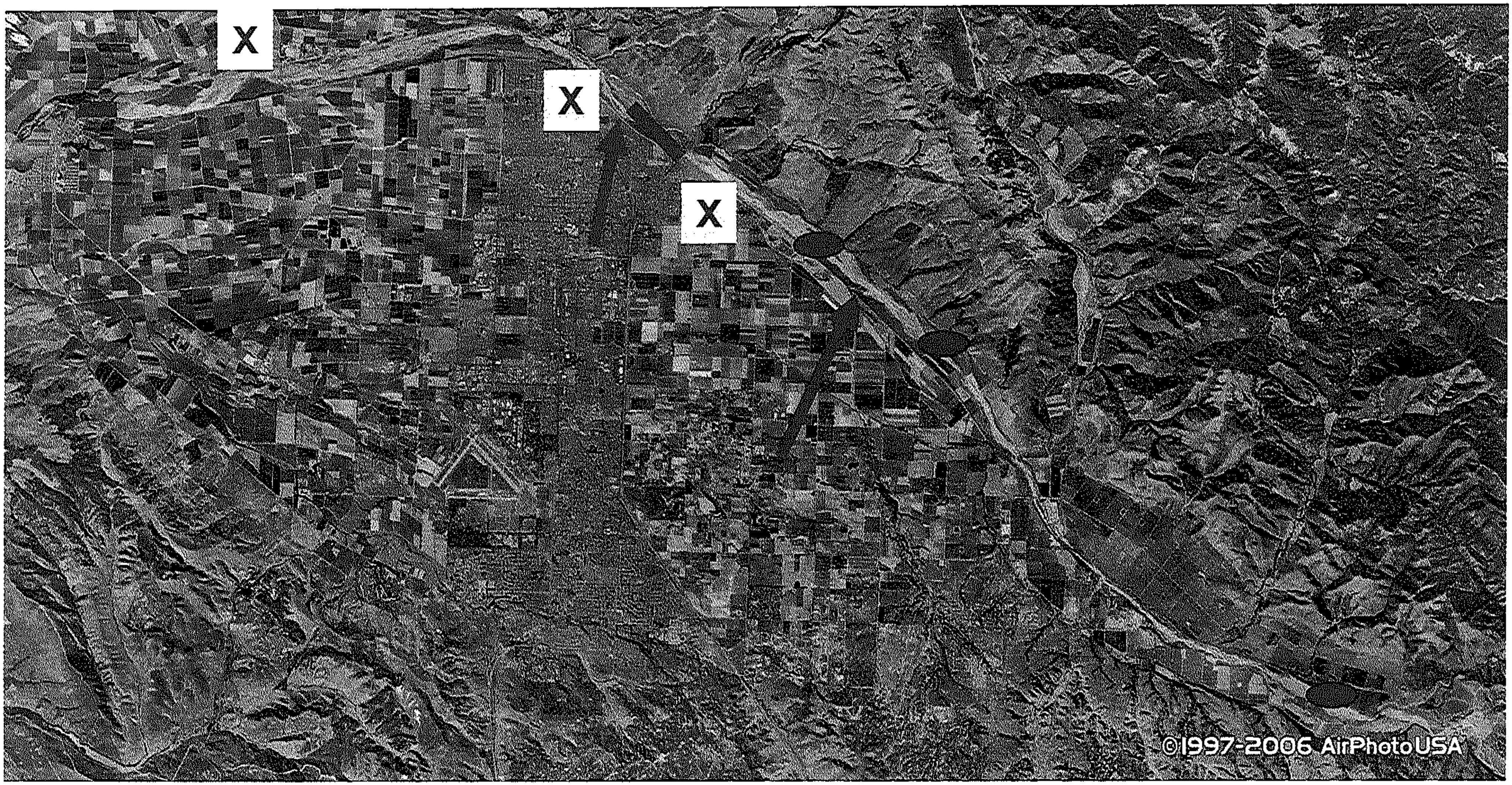




Anchor Work Under Way



Santa Maria River Initiatives



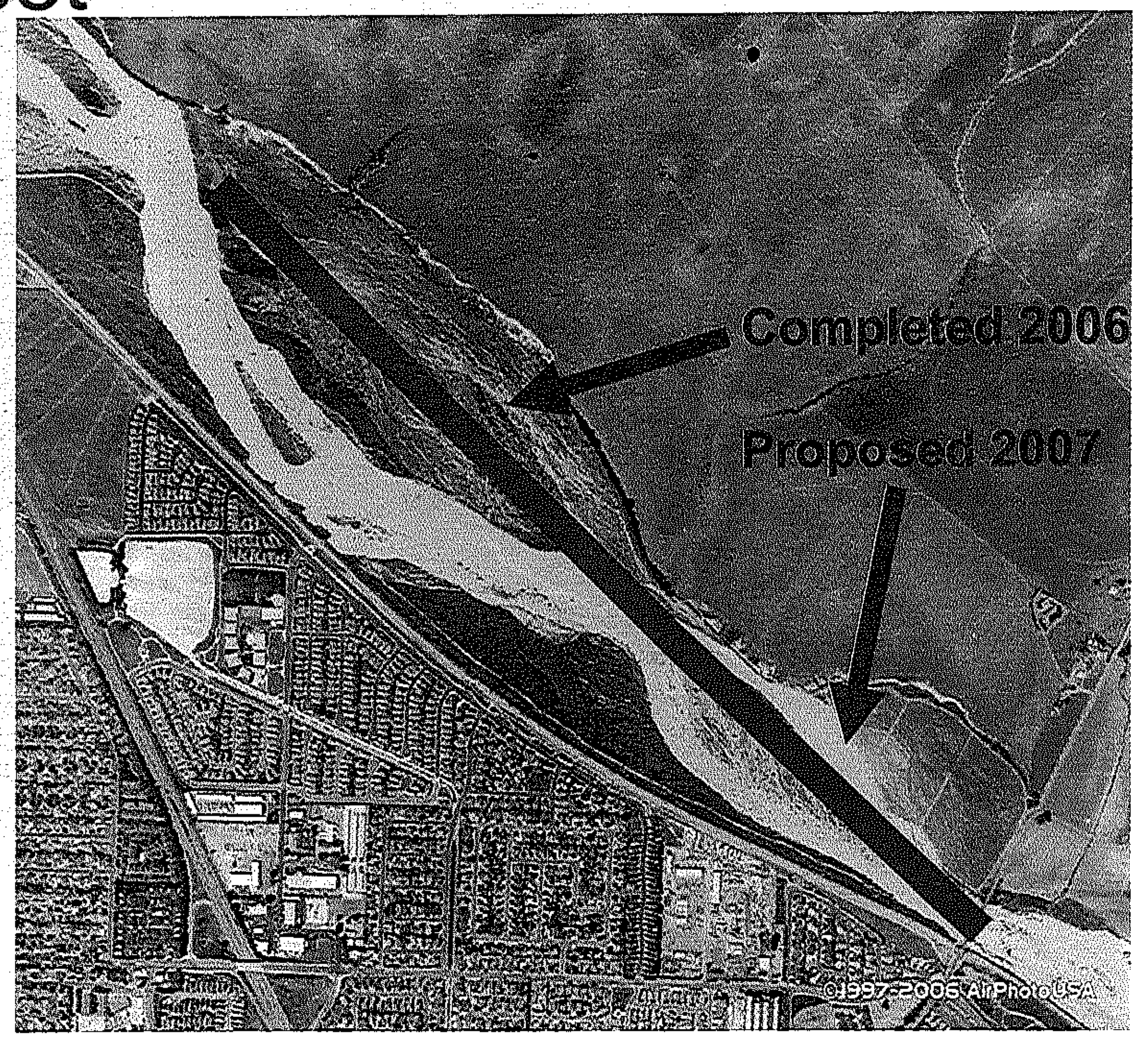
Pilot Channels
Sediment Basins

Rock Stockpiles
Equipment Staging

Channel Clearing Guadalupe

Pilot Channel - Santa Maria

- Work Begins Monday
- Some Revenue Offset from Material Sale Possible.



Outside Funding Opportunities

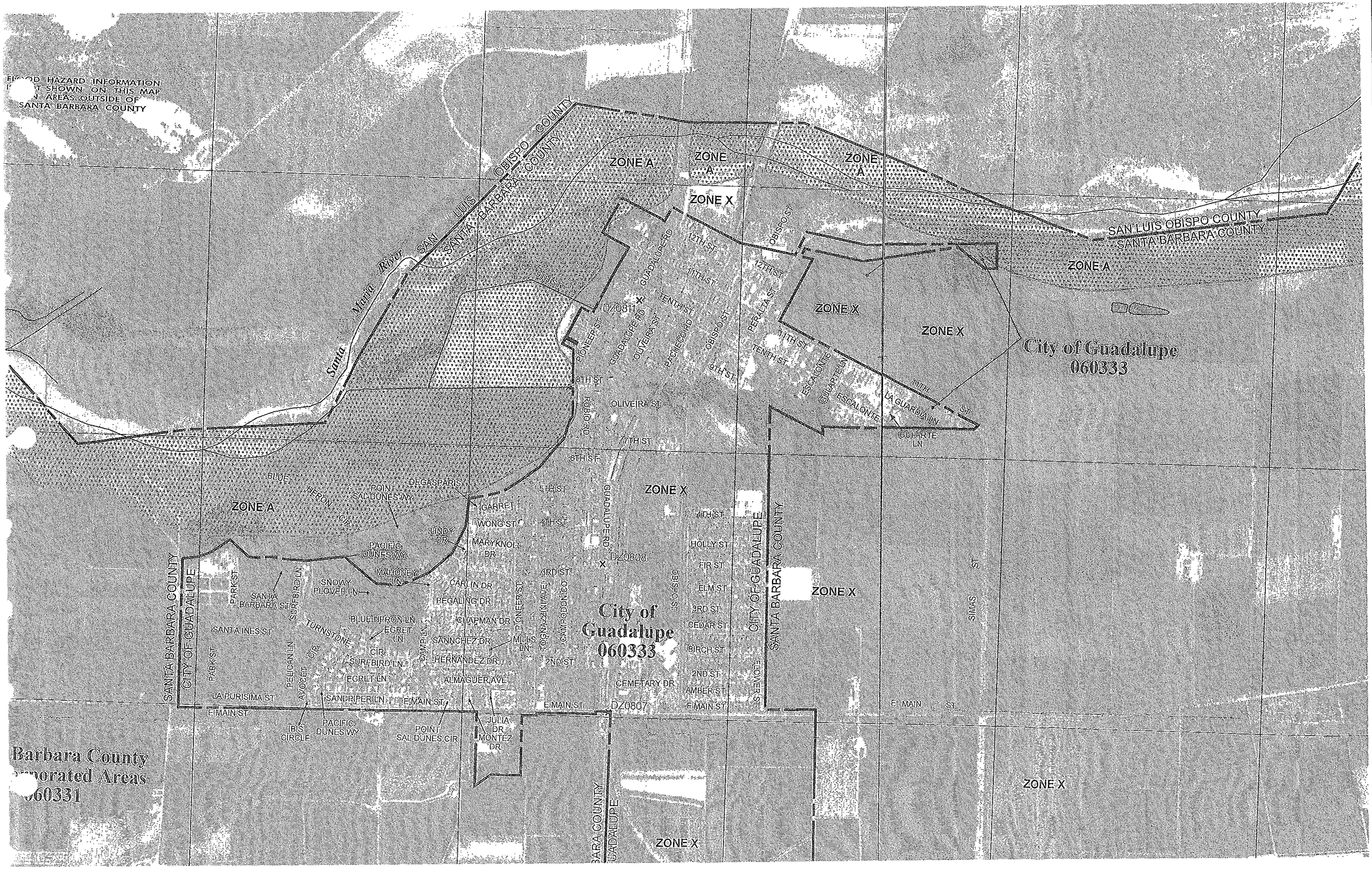
- Corps of Engineers
- NRCS
- Bureau of Reclamation
- US Forest Service
- FEMA
- State Dept of Water Resources
- State OES
- COMB
- COUNTY

Outside Funding Opportunities

- **COUNTY**
- **COMB**

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

17



FLOOD HAZARD INFORMATION
NOT SHOWN ON THIS MAP
AREAS OUTSIDE OF
SANTA BARBARA COUNTY
SAN LUIS OBISPO COUNTY
SANTA BARBARA COUNTY
Santa Maria River
ZONE A
ZONE A
ZONE A
ZONE X
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MARY KNOLL DR
PACIFIC DUNES WY
HOLLY ST
DZ0808
3RD ST
FIR ST
MAHONEY LN
SNOWY PLOVER LN
CARLIN DR
ELM ST
PARK ST
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SURFBIRD LN
PEGALING DR
3RD ST
ZONE X
City of Guadalupe
060333
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CHAPMAN DR
CEDAR ST
SANTA INES ST
TURNSTONE
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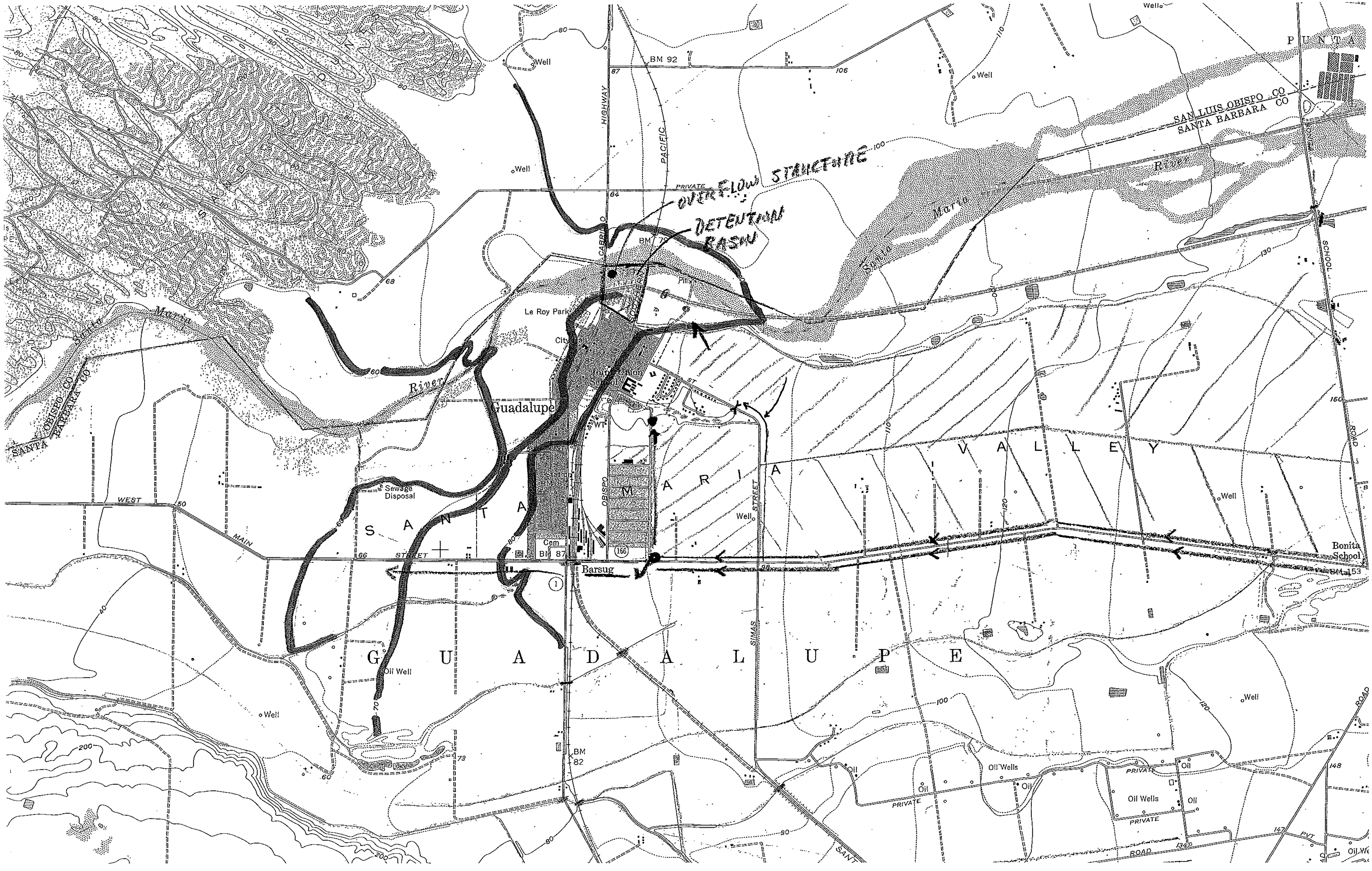


OVERFLOW STRUCTURE
DETENTION BASIN
Guadalupe
Le Roy Park
Sewage Disposal
Barsug
S A N T A M A R I A V A L L E Y
G U A D A L U P E
Santa Maria River
SAN LUIS OBISPO CO
SANTA BARBARA CO
PUNTA
Bonita School
WEST MAIN STREET
CABRILLO HIGHWAY
PACIFIC
OBISPO
SIMAS STREET
SCHOOL ROAD
Oil Wells
Well
BM 92
BM 82

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

18

SANTA MARIA News
An All-America City Since 1998

NEWS RELEASE
April 18, 2007

Santa Maria River Levee is Topic of City TV Show

Vigorous ongoing attempts to fix the Santa Maria River Levee's flawed design – and the looming issue of flood insurance for property owners - are discussed in the new episode of *Santa Maria Today*, a City government television program airing on Comcast public access Channel 23 now through mid-May.

Most of the show is a presentation by Tom Fayram of the Santa Barbara County Flood Control District explaining the Levee's history and what the City and County are doing to get Federal assistance.

The 26-mile-long levee was built between 1959 and 1963 by the Corps of Engineers and then ownership and maintenance were transferred to the Santa Barbara County Flood Control District. The City and County have maintained that the problem is not with maintenance but design.

In March 2006, the U.S. Army Corps of Engineers declared that the Levee could no longer be certified to withstand major storm flows in the Santa Maria River. It was placed on a nationwide list of levees at risk of failure. This month, the Federal Emergency Management Agency (FEMA) shared with City officials its preliminary revised flood maps that would put about 80 percent of the City and a significant portion of the Santa Maria Valley in the 100-year flood zone.

FEMA identified 20,000 parcels and 17,000 structures within the City that would be in its revised flood plain. Most of the City's property owners would be required to buy flood insurance, based on the preliminary Federal maps. The cost could be hundreds of dollars or thousands of dollars per year, per property. The approximate area covers land from Betteravia Road north and east to the Santa Maria River Levee. FEMA's preliminary maps are expected to be released to the public this fall in public hearings.

Santa Maria Today is broadcast at 7 p.m. Wednesdays and Fridays and at 3 p.m. Saturdays on public access television Channel 23 to Comcast subscribers throughout the Santa Maria Valley. The monthly show focuses on City departments, programs and services, and is hosted by Management Analyst Mark van de Kamp of the City Manager's Office. This is the 19th episode.

Questions may be directed to the City Manager's Office, 925-0951, ext. 372.

Department: **City Manager's Office**
Contact Person: **Mark van de Kamp, Management Analyst II**
Telephone Number: **(805) 25-0951 ext. 372**
Email Address: **mvandekamp@ci.santa-maria.ca.us**

Corps, Capps, partners meet at Santa Maria Levee
By Daniel J. Calderon

(Left to right) Tom Fayram, Deputy Public Works Director for the Water Resources Division for Santa Barbara County, Congresswoman Lois Capps and Lt. Col Glen Reed, chief of the synchronization group for the USACE L.A. District, discuss work the county has accomplished in the Santa Maria River near the levee. The Corps is currently studying ways to repair the levee in order to provide improved flood protection for the local community.

SANTA MARIA, Calif. -- Representatives from the U.S. Army Corps of Engineers Los Angeles District, met with Congresswoman Lois Capps, representatives from Santa Barbara County and the mayors of two cities Jan. 9 at the Santa Maria Levee to inform the public of recent developments with the project.

"We were able to secure $280,000 to authorize the Army Corps of Engineers to study this levee," Capps said. "The Corps has been very involved [with this project]. We have a great deal of work to do."

The key, according to officials at the event, was to highlight the teamwork aspect of the levee project. Cooperation among the Corps, the congresswoman's office, the county and the cities of Santa Maria and Guadalupe, which is downstream from Santa Maria, is crucial to timely and successful completion of the project, according to officials who were present. Lt. Col. Glen Reed, the chief of the synchronization group for the L.A. District, said the project to help protect residents of Santa Maria and other affected communities was very important to the district.

"This project has received national attention at the headquarters level in the Corps," he said.

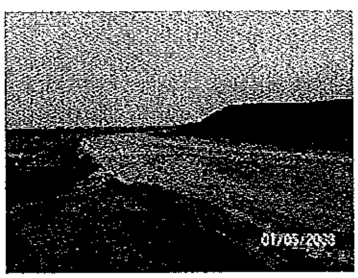
Congresswoman Lois Capps greets Lt. Col Glen Reed and shakes hands with Esahn Eshraghi at a Jan. 9 meeting at the Santa Maria Levee. Capps announced $280,000 is available for the project, Eshraghi, as the Los Angeles District's project manager for the Santa Maria Levee, said the Corps is currently studying ways to repair the protective barrier.

Reed and Capps both said the money would be used to study ways to improve the level of protection the levee provides to the surrounding community. Esahn Eshraghi, the project manager for the levee project had a simple response when asked by media attending the announcement when work would begin on the study.

"We began yesterday," he told them.

Tom Fayram, Deputy Public Works Director for the Water Resources Division for Santa Barbara County, said he appreciated the district's participation as a partner in the levee project.

"This is a team effort," he said. "We're really happy with the Los Angeles District with regards to the levee. My hope is that we can expedite the work on the levee."



Water flows downstream from the Suey Rd. Crossing in the Santa Maria River Jan. 5 after heavy rains had passed through the area. Officials estimate the water flow at 11,000 cubic feet per second.

The county maintains the channel and has been involved with two major projects over the last couple of years. The projects created a pilot channel to divert water flow away from the levee. A major cause of damage was water striking the levee at certain angles and eroding portions of the protective wall in the vicinity of homes. The county's projects successfully diverted the water during heavy rains in early January when the flows reached more than 11,000 cubic feet per second.

"The county has done a tremendous job out here," said Reed. "Clearly, you can tell the pilot channel did its job.

Currently, the district is studying possible plans for repairing the levee. The county paid to have studies done and the Corps is using those plans as a jumping-off point. Several plans are under consideration at the moment so a timeline for completion of the project is currently unavailable.

Capps said Reed's personal participation in the announcement of the funding and current studies is invaluable to the communities affected by the levee.

"You coming here in person speaks highly of the importance of the project to the Corps," Capps said. "It sends a strong message of commitment."

Back To Top

< Prev Next >

[Back]

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Levee funding options drying up

By Malia Spencer/Senior staff writer

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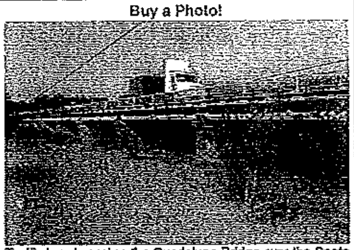


Traffic travels across the Guadalupe Bridge over the Santa Maria River. //Bryan Walton/Staff

Local officials continue to seek federal funds to deal with the inadequacies of the Santa Maria River Levee, but even with the added urgency caused by the second-largest wildfire in state history, the competition for the money is stiff due to the demands on the federal budget.

As a result, Santa Barbara County flood-control officials are dipping into their meager reserves in order to do some remedial work before the rains hit.

Officials see the potential for major problems because about 25 percent of the drainage area for the Santa Maria River was charred in the Zaca Fire. This damage means rainwater won't be absorbed as fast, and more runoff can make its way into the river quicker - all adding a burden to the levee.

Crews are expected to begin adding to a pilot channel that was dug last year near Suey Crossing, said Tom Fayram, deputy director of public works and water resources. Additional work to clear willows and other debris near Guadalupe is expected to begin in the next few weeks.

The 2007-08 budget for maintaining the Santa Maria River Levee is roughly $175,000, Fayram said. He authorized an additional $250,000 be to released from a $1 million reserve fund to cover preventative work.

Fayram had been hoping to secure emergency federal funding to finance the work, but so far has come up empty. A request to the U.S. Army Corps of Engineers, which was recommended for approval by the Los Angeles field office, was rejected by officials in the Washington, D.C., office, he said.

Cover Story

Levee woes

Little protection remains between thousands of homes and the Santa Maria River

BY CRAIG SHAFER

Date: 04/13/2006

With an unusual series of early spring storms pounding the Central Coast—spawning hail, heavy downpours, and even the anticipation of tornados and water spouts—it's hard not to be interested in the Santa Maria River, particularly if you know anything about its history of flooding.

Just another band-aid: *Water Resources Deputy Director Tom Fayram gestured to the recently purchased granite boulders used to shore up a weakened section of the Santa Maria levee. Work crews began on March 14 and took about a week to place 200 tons of rock at the foot of the levee, where erosion was evident. The boulders cost $35,000, taken from the $100,000 annual levee assessment.*

PHOTO BY CRAIG SHAFER

During the first week of April, the river was flowing in one of its rare bank-to-bank exhibitions. It was a spectacle for the curious, but a point of concern for flood control experts. Prior to the levee's construction, which lasted from 1959 to 1963, flooding was a part of life during Santa Maria's wet winters. The river meandered—through row crops and even through downtown—as it sought the swiftest path to the Pacific Ocean.

Despite the sometimes raging waters in the otherwise typically bone-dry riverbed, a heightened level of concern for the big pile of sand and rock holding back the river's occasional floodwaters came about primarily due to recent national tragedies. Had it not been for the devastation wrought by Hurricane Katrina, the Santa Maria levee might have continued its life as just another sand berm with a slowly deteriorating rockface along an insignificant river.

Few people east of Gary—if any—would have ever taken notice of the regular application of band-aids, applied in the form of boulders carefully tucked here and there in an ongoing effort to protect the thousands of homes on the other side of the 15-foot wall. That wall was seriously breached in 1998, causing damage mostly to farmland and crops.

Before Hurricane Katrina raised alarms around the state, there was some local interest. The 1998 breach set off a series of discussions, inspections, and memos among local officials. In 2001, the levee became the focus of a County Grand Jury report, which—to no one's surprise—highlighted concern for its continued health.

"The levee is decades old and showing its age,�? the report stated. "It is a dirt, stone-faced berm that has been breached several times over the years. People are not generally well informed about the levee, but there is widespread concern that it might fail and destroy thousands of homes in northern Santa Maria.�?

Awash with history: *****cover.levee.flood1.4/13**** Santa Maria was victim to routine flooding before the protection of the levee system. This photo was taken at the corner of Broadway and Cook in 1913.*

PHOTO COURTESY SANTA MARIA HISTORICAL MUSEUM

Despite the dire predictions, the jury's only conclusion at the time was to recommend that county Flood Control "continue with its plans to repair the Santa Maria River levee.�?

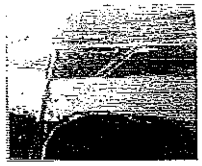
In the wake of the levee collapse in Louisiana in 2005, the Santa Maria City Council solicited its emergency personnel to outline the city's preparedness in case of a disaster. Fire Chief Frank Ortiz responded in a written memo that was presented to the City Council on Oct. 18, 2005.

"Mitigation activities are pre-emergency prevention type activities,�? the chief wrote. "This could include a wide range of activities such as infrastructure improvement to our levee system.�?

The chief acknowledged that the city had recently participated in a disaster roundtable hosted by

Congresswoman Lois Capps, during which the city emphasized the need for levee improvements. That meeting also brought up the suggestion of relaxing environmental regulations in areas where brush clearance might be necessary to prevent flooding in North County.

Officials have also been on heightened alert because the Santa Maria River changed its course recently. It made a 90-degree turn and now attacks the levee between Suey Crossing and Highway 101 directly opposite a housing development.



Water, water everywhere: *This aerial view is looking south toward downtown Santa Maria during a flood in 1952.*

PHOTO COURTESY SANTA MARIA HISTORICAL MUSEUM

In mid-March of this year, county Flood Control brought in tons of boulders—at a cost of $35,000—to help protect an apparently weakened section at the base of the levee wall to keep it from collapsing. The river doesn't have to be a fierce floodwater to be a threat. Even a low flow, as seen after the early April rains, can erode away protection at the base, which could ultimately unleash a damaging flood on the city, according to County Water Resources Deputy Director Tom Fayram.

Despite Fayram's 15 years of calling attention to the potential for disaster, federal agencies are only now giving serious attention to the pile of sand on the most northerly edge of Santa Barbara County. The Corps of Engineers, which built the flood-control system, and the Federal Emergency Management Agency's (FEMA) Homeland Security Division have grown increasingly interested in this 26-mile-long stretch of flood protection.

The Corps has traditionally given certification to the county in an annual inspection report, providing something like a passing grade for the levee's ability to hold back floodwaters. Even last year—as winter rains flowed bank to bank, and emergency rock was trucked into threatened zones near the city landfill and just west of the city boundary—the Corps again gave the levee two thumbs up.

But this year, following a site visit in February, the Corps was unwilling to give a clean bill of health to the aging wall.

The difference this time was that the feds had heard resounding warning bells that first went off along the Gulf Coast and then echoed out of Sacramento, prompting the governor to show heightened concern for the state's entire levee system. That concern, however, seemed to exclusively translate into interest in the levees around the state capitol and in his infrastructure ballot initiative, which didn't qualify for the upcoming June election. No money was intended for the ailing Central Coast levee.

Now, there's a call to arms.

When Col. Alex Dornstauder, district engineer of the Los Angeles District Corps of Engineers, addressed the Santa Barbara County Board of Supervisors on March 28, there were no couched terms or phrases about the state of the levee. Instead, the message was peppered with words like "critical�? and "urgent.�?

The colonel said that concern wasn't based on a question of "if�? the levee would fail, but a question of "when�? it would, bringing widespread destruction and the possible loss of life and property with it.

"We've been dodging bullets since 1998,�? Dornstauder said, conceding that he couldn't certify the levee today.

The facing stone, he pointed out, isn't adequate and is, in fact, deteriorating. The board received his message with an animated and heightened sense of urgency.

Fierce channel: *In the storms of 2004 and 2005, the river flowed bank to bank—nearly breaching the levee near the Bonita School Crossing. This year's recent storms also sent torrents of water down the riverbed.*

"Dealing with the possible loss of property and life, it's never too soon to elevate the urgency,�? said 1st District Supervisor Salud Carbajal.

Fourth District Supervisor Joni Gray acknowledged that she was unaware that the situation was as dire as the colonel said.

Before the colonel addressed the board, Supervisor Gray, County Water Resources Deputy Director Fayram, and Santa Maria Mayor Larry Lavignino had already planned to visit Washington, D.C., for the first week of April. At the board hearing, 3rd District Supervisor Brooks Firestone said he might be able to pull some strings and offered to join the delegation, which lined up to plead its case for federal dollars to begin shoring up the levee.

Lavignino said it's clear that the annual assessment used to fund levee maintenance has been inadequate.

"The county and the city both recognize the fact that this is a first-priority

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SANTA MARIA RIVER LEVEE

Overview (See below for important links.)
This page was updated on December 28, 2007

The Santa Maria River Levee was designed and built by the U.S. Army Corps of Engineers from 1959 to 1963 and is owned and operated by the County of Santa Barbara Department of Public Works' Flood Control District. The levee is built of river sand. The portion of the levee facing the river is covered with a layer of rock.


Click photo for larger view.

Following the Hurricane Katrina Disaster, the Army Corps of Engineers began a systematic assessment of flood control structures and facilities throughout the United States to measure their risk of potential failure. After their assessment of the Santa Maria River Levee, in March 2006, the Army Corps of Engineers placed the Santa Maria River Levee on the nationwide list of levees at risk of failure and declined to certify that it could withstand a 100-year flood. Subsequent to that, the Federal Emergency Management Agency (FEMA) then began preparing revised flood maps. Preliminary results of FEMA's effort appears to place most of the City and a large portion of the Santa Maria Valley in the 100-year flood zone which will no doubt lead to mandatory flood insurance for thousands of property owners.

While the Flood Control District of the County of Santa Barbara is the agency responsible for the condition of the Levee and not the City of Santa Maria, the City has nonetheless taken the initiative and a leadership role in urging County, State and Federal leaders to make critical repairs to strengthen the Levee. The City has worked in conjunction with the County Flood Control District to stockpile rock to assist in the event of a breach. Consequently, the restoration of the Santa Maria River Levee is one of the most vital issues to the community's future.

To enable the Army Corps to perform the necessary study to identify acceptable alternatives, it is necessary for Congress to appropriate funding and direct the Army Corps to perform the study. City and County staff as well as elected officials urged Federal Representatives to secure this funding. Congress approved the money, and on December 26, 2007, President Bush signed the $555 billion Fiscal Year 2008 Omnibus spending bill (HR 2765) which includes $280,000 for the Army Corps of Engineers to study ways to fix the Levee.

The following information (below) is designed to address common questions:

- Efforts to Address Your Concerns
- Fact Sheet
- Report by U.S. Army Corps of Engineers (September 2007)
  This file is 7.85 MB and may required some time to download.

Facts About The Santa Maria River Levee

What is the City's role?

The City and the County have for several years partnered to lobby the Federal government for funding to fix the Levee, which was built using a faulty design. City and County staff have sought funding from Congress including Representative Lois

Capps, and Senators Dianne Feinstein and Barbara Boxer. In addition, the County has proceeded with some engineering work on alternatives to strengthen the Levee. The City retained the services of a Washington, D.C.-based firm to assist in lobbying efforts, and the Mayor traveled to the nation's capitol to meet in person with representatives. Now that the President has approved the funding, the City will continue to assist the County and Army Corps in making sure the study is completed.

What is the status of any study of the Levee repairs? Can local funding be used for the study or must Congress appropriate the money?

The study has not begun. The President has approved $280,000 in Federal funding for the study. The City/County may be able to help pay for some additional costs.

Why did the City approve development on land near the Levee?

The City followed all State and Federal development guidelines and could not deny property owners the right to develop their land. Furthermore, when residential developments were approved, the Santa Maria River Levee was certified at that time to provide 100-year flood protection.

What document or other ruling was the basis for the Army Corps of Engineers to decline to certify the Levee?

As explained in the Overview (at top of this page), FEMA requested that the Corps provide certification of the Levee to FEMA. The Corps did not provide said certification.

How many properties could be placed in the flood plain maps?

Preliminary maps shown to the City and County by FEMA in early 2007 identified approximately 20,000 parcels and 17,000 structures within the City that may be placed in a flood zone. The approximate area covers land from Betteravia Road north and east to the Santa Maria River Levee.

When will the flood plain maps be available to the public?

The preliminary map is available. Click here to view a preliminary FEMA map depicting the potential flood zone. FEMA has indicated that actual draft maps will not be released until September 2008, which means that final flood maps may not be issued until March 2009. FEMA has adjusted dates on several prior occasions. Initially, the maps were to be ready in June 2007.

Tell me about flood insurance.

Property owners within the flood zone depicted in the Federal maps would be required to buy flood insurance. The cost could be upwards of thousands of dollars per year, per property. When the map becomes effective, Federal regulations require homeowners to get Flood Insurance, if they have a Federally guaranteed mortgage (consult your lending institution).

It is important that people who will end up in this new flood zone obtain flood insurance before the map becomes effective. In doing so, people can lower their eventual cost for flood insurance. FEMA decides the timetable for flood map processing.

However, it should be noted that a Flood Insurance requirement imposed on the residents of Santa Maria does nothing to fix the overall problem. Flood insurance does help reimburse a family for damages should a flood occur, but the money does not go towards fixing the Levee which would prevent the problem from happening in the first place.

Will residents have to carry flood insurance during Levee repairs?

The requirement for insurance will be lifted only when repairs are complete and certification is achieved. There is a possibility that when funding is secure to complete the restoration of the Levee that an AR Zone designation may be granted by FEMA.

Draft FEMA map June 2007
City of Santa Maria potential flood zone

News

Preparing for the storm

Recently acquired federal funds to be used to repair the Santa Maria Levee

BY AMY ASMAN

Date: 01/16/2008

A team effort:
U.S. Rep. Lois Capps, D-Calif., welcomed county and city officials to a special on-site meeting at the Santa Maria Levee to discuss new federal funding for repairs. From left: Guadalupe Mayor Lupe Alvarez Santa Maria Mayor Larry Lavagnino Capps Lt. Col. Anthony Reed of the Army Corps of Engineers Tom Fayram, deputy director of Santa Barbara County Water Resources Department Santa Barbara County Supervisor Joe Centeno, and project manager Ehsan Eshraghi of the Army Corps of Engineers.

PHOTO BY AMY ASMAN

State, county, and city officials announced Jan. 9 during an on-site meeting at the Suey Crossing Road entrance to the Santa Maria River Levee that they have received $280,000 to stabilize the aging levee.

The money set aside for the levee is part of nearly $1 million in funds secured by legislation introduced by U.S. Rep. Lois Capps, D-Calif., and U.S. Sen. Diane Feinstein, D-Calif., for critical infrastructure, transportation, and community development projects in the city of Santa Maria.

The funding is part of the fiscal year 2008 Omnibus Spending Bill, which was passed by the Senate in December.

"This has been a huge team effort," Capps said, also speaking on behalf of Feinstein, who was unable to attend the meeting.

"We knew with the summer fires that we'd be facing a lot of challenges during the rainy season. This [recent storm] was the first big test," she said.

Last year, Santa Barbara County Supervisors Brooks Firestone and Joni Gray, along with Santa Maria Mayor Larry Lavagnino and Guadalupe Mayor Lupe Alvarez, hand-delivered a letter to Congress asking for funds to repair the levee.

City and county officials feared that winter rains would weaken the 40-year-old levee, which has been breached several times in the past.

The newly acquired funds will allow the Army Corps of Engineers, which built the levee in the 1960s, to study the levee and design a plan to fix it.

"It's very important that this project reach a solution," Lt. Col. Anthony Reed of the Army Corps of Engineers said. "The community of Santa Maria is at risk any given day until we get this fixed."

While most studies can take one to two years to complete, Reed said that the Santa Maria study is a high priority.

"This isn't business as usual. We have to expedite this study as fast as we can," he said.

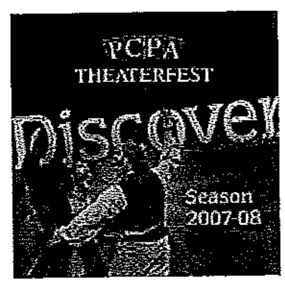
Reed said when the Corps repairs the levee, it likely won't be necessary to repair the whole structure. The levee runs 26 miles from Foxen Canyon Road out to the city of Guadalupe.

Tom Fayram, who is Santa Barbara County's deputy director of water resources, said that he flew over areas burned by the Zaca Fire on Jan. 7 to assess the effect of debris and erosion on the Santa Maria River watershed.

Fayram has said about 25 percent of the Santa Maria River drainage area was burned by the fire. This means that rain water won't be absorbed as quickly and will therefore put more strain on the levee.

City and county officials maintained contact with the Army Corps of Engineers on Jan. 5 while monitoring the levee in response to heavy rain, Fayram said "We heard [the water] coming before we saw it," he said, adding that erosion caused by the fire enables the water to move at approximately 11,000 square feet per second.

"But the levee didn't even have to work because the water never touched it," Fayram said. "Our goal was to



keep all of the water pushed into the pilot channel, which it did."

Last year, the county budgeted about $175,000 for the levee, and an additional $250,000 was authorized by Fayram to be used from a $1 million reserve fund.

The money was used to dig the pilot channel near Suey Crossing Road, and to clear willow trees and other debris in the Guadalupe area.

Recently, the Santa Maria River Levee appeared on an Army Corps of Engineers national list of levees at risk of failing. The federal agency declined to certify that the levee could withstand a 100-year flood--the most severe flood that could be expected in any given 100 years.

This decertification allows the Federal Emergency Management Agency (FEMA) to place Santa Maria in a flood plain and require thousands of homeowners to carry flood insurance.

In a preliminary map released by FEMA, 17,000 buildings within Santa Maria city limits are considered part of the flood plain.

However, county and city officials said repairing the levee might mean that flood insurance no longer will be necessary.

"When the project is completed and the levee is recertified, there will be no need [for flood insurance]," Santa Maria Mayor Larry Lavagnino said.

Contact staff writer Amy Asman at aasman@santamariasun.com

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Efforts to Address Your Concerns about the Santa Maria Levee

This page was updated October 8, 2007

While the Flood Control District of the County of Santa Barbara is the agency responsible for the condition of the Levee and not the City of Santa Maria, the City has nonetheless taken the initiative and a leadership role in urging County, State and Federal leaders to make critical repairs to strengthen the Levee.

The City has worked in conjunction with the County Flood Control District to:

- Stockpile rock in strategic areas to assist in the event of a breach.
- Travel to Washington, D.C. three times to meet with representatives to emphasize the critical need to include funding for a study of potential fixes to the Levee.
- Engage the services of a Washington, D.C. legislative advocate to help secure funding.
- Write and call Federal representatives on numerous occasions in attempts to get funding included in the Federal budget.
- Initiate efforts to construct debris basins in the riverbed to intercept debris from the watershed burned by the Zaca Fire of 2007.

The County Flood Control District has taken these actions:

- Rock armor in some of the critical areas of the Levee has been upgraded.
- A number of fence groins have been placed adjacent to the Levee to slow water flows adjacent to the Levee.
- A pilot channel has been constructed on the northern side of the river in areas adjacent to the City to direct water away from the Levee.
- Engaged the services of an engineering firm to perform a study of possible solutions to the Levee. The intent of the study is to present a range of possible solutions to the Army Corps of Engineers, to make a selection.

CITY OF GUADALUPE
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19

US Army Corps
of Engineers®

Los Angeles District

Advanced Measures Report Based on Technical Assistance Investigation

Santa Maria Valley Levees
Santa Barbara County, CA

September 2007

Table of Contents

I. EXECUTIVE SUMMARY

The Santa Maria Valley levees provide flood control protection to the Santa Maria Valley including 66,000 residents of the City of Santa Maria. The project is located in Santa Barbara County about 160 miles northwest of Los Angeles, California. The project consists of 17 miles of a stone-revetted levee along the south side of the Santa Maria River which protects the City of Santa Maria and about 5 miles of stone-revetted levee along the north side of the river, which largely protects agricultural land. This report focuses on the south levee which protects the urban areas. The levees were designed and constructed by the U.S. Army Corps of Engineers. Construction began in 1959 and was completed in 1963.

The Santa Maria Valley levees have long proven to be deficient despite remedial action by the USACE and ongoing improvements by the local sponsor. The design capacity of the levees is a minimum of 150,000 cfs but river flows as low as 8,000 cfs have routinely caused significant damage. Typically the damage has been caused by low to moderate flows that do not fill the entire river bed but rather meander across the river and impinge upon the levee at sharp angles. These concentrated flows undermine the levee toe and have repeatedly placed the levee and hence the City of Santa Maria in jeopardy. The levees have been damaged this way several times. It should also be noted that the original riprap revetment on the levee has deteriorated significantly since the project construction was completed, in that much of the rock has fractured and broken down into smaller pieces. Relatively recent geotechnical explorations and hydraulic calculations by the Corps have concluded that the existing revetment does not meet current Corps design standards for parallel flow conditions for larger floods. Given the condition of the project the Corps of Engineers has declined to certify the levee and FEMA is currently revising its flood insurance maps with the assumption that the levee project no longer offers any protection to the City of Santa Maria.

Twelve peak flows of between 8,000 cfs and 35,000 cfs have been observed since 1963 and nine times, or 75% of the time, the levee suffered significant damage. In 1998, the damage caused by impinging flow was so severe that the north levee actually breached. Furthermore, if it had not been for aggressive flood fighting operations by the local sponsor, similar breaches in the levee almost certainly would have occurred at several other locations in the past.

Greatly exacerbating the problem and creating an unusual threat to the City of Santa Maria is the recent Zaca wildfire that burned about 26% (122 square miles) of uncontrolled watershed above the Santa Maria Valley levees. The low to moderate flows that threaten the levee are now considered to be even more likely to occur this coming flood season due to the potential for increased runoff from the burned areas. This potential was clearly demonstrated in 1966. In 1966 the Wellman wildfire burned a similar amount of the Sisquoc River watershed. Later that year, a relatively small amount of rainfall (< 2-year frequency) generated a relatively large peak flow (~ 20-year) that caused significant damage to the south levee. It was later concluded that the only reason the levee didn't fail completely was because of the short duration of the peak.

Santa Barbara County is requesting emergency Advance Measures prior to the approaching flood season to reduce the significant flood threat to the City of Santa Maria. The proposed measures are to construct a pilot channel to direct low flows away from the south levee, stockpile sufficient quantities of large rock at strategic locations to flood fight an impending levee breach, and preparation of a flood fighting plan of action. The total cost of the proposed advance measures is $730,000 while the annual benefits are $11.7 million. The resulting benefit to cost ratio is 70. There is clearly an extremely strong economic justification for implementation of emergency measures to protect the City of Santa Maria.

II. BASIC REPORT

1. Name and Location

The Santa Maria Valley levees are located in Santa Barbara County, California about 160 miles northwest of Los Angeles, California. The project consists of a set of stone–revetted levees on either side of the Santa Maria River. The 17-mile long levee along the southern side of the Santa Maria River largely protects the City of Santa Maria and the 5-mile long levee along the northern side of the river primarily protects agricultural land. The southern levee is the focus of this PIR.

The Santa Maria River is formed by the confluence of the Cuyama and Sisquoc Rivers. Runoff from the Cuyama River watershed is largely controlled by Twitchell Dam which is located upstream of the confluence. However, about 500 square miles above the levee project including the entire Sisquoc River watershed (471 sq. miles) is uncontrolled. About 26% of the Sisquoc River watershed (24% of all of the uncontrolled area) burned during the Zaca wildfire this summer. Figure 1 shows the general location of the project, the Santa Maria River watershed, and extent of the Zaca wildfire. Figure 2 shows the location of the Santa Maria Valley levees and the areas of critical concern.

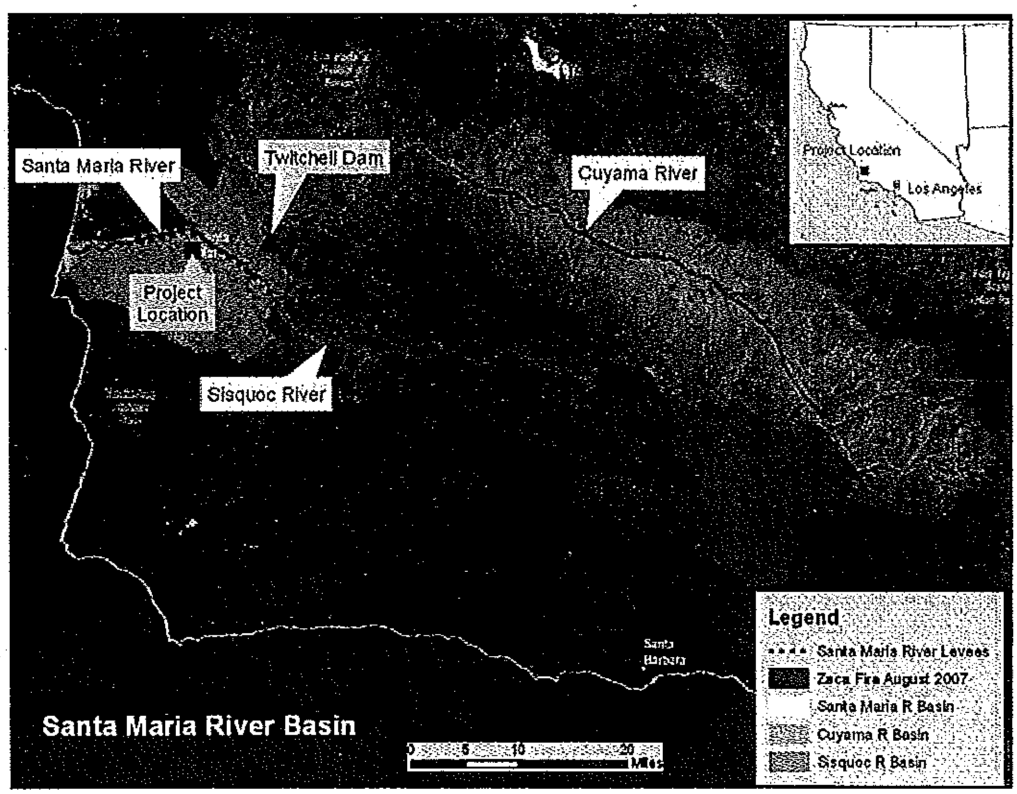

Figure 1: Santa Maria River Basin

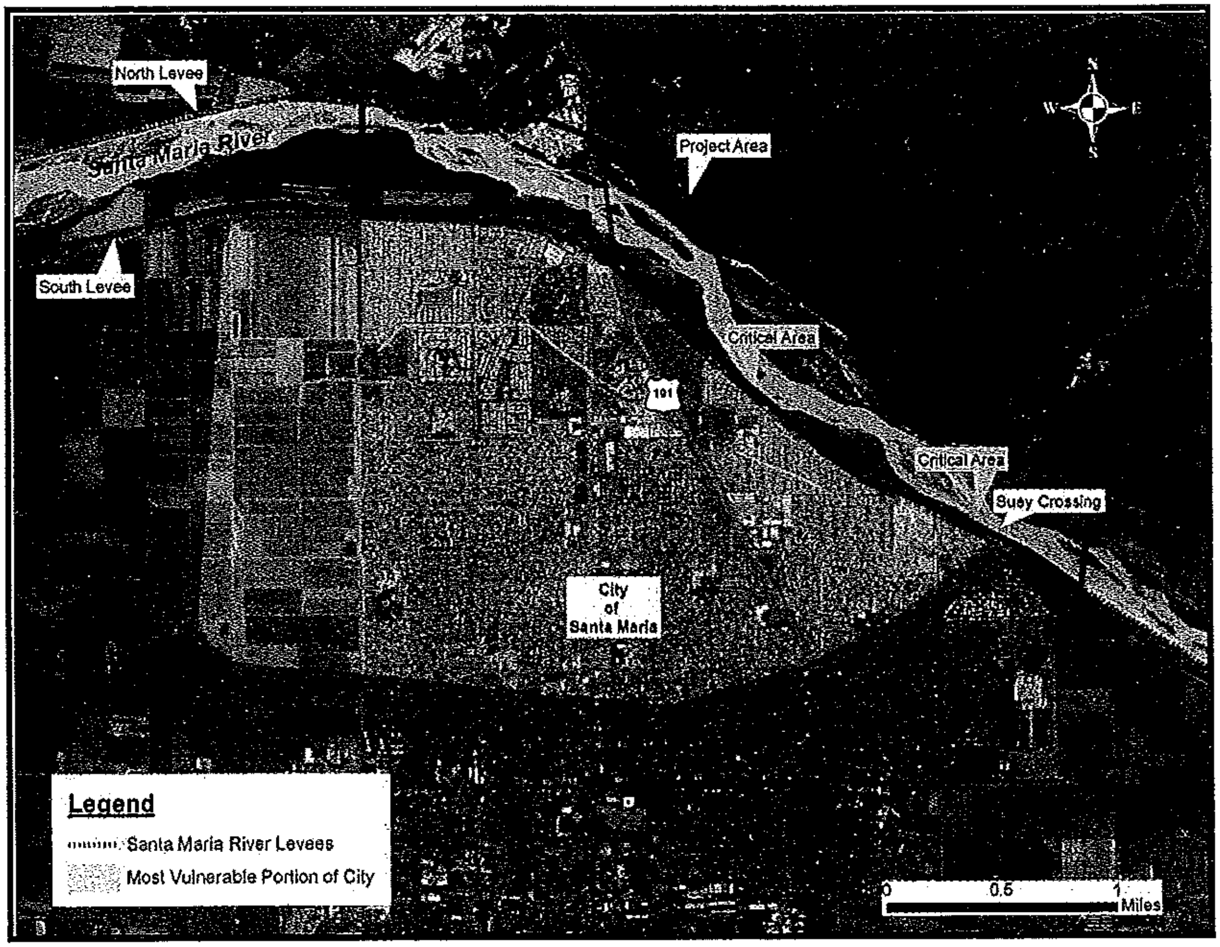

Figure 2: Project Area

2. Public Sponsor

Santa Barbara County
Public Works Department
123 E. Anapamu St.
Santa Barbara, CA 93101

Contact: Thomas Fayram, PE, CFM - Deputy Public Works Director
Telephone: (805) 568-3436
Email: tfayram@cosbpw.net

3. Summary of Conditions Causing the Imminent Threat of Unusual Flooding

The Santa Maria Valley levees were intended to protect the valley from a standard project flood (minimum of 150,000 cfs) but beginning with the very first significant flow following completion of the project the levees have proven to be chronically deficient. The levees have been repeatedly damaged by low to moderate flows that do not fill the entire river bed but rather are concentrated in narrower sub channels that meander and strike the levee at a sharp angle. These concentrated flows undermine the levee toe and have repeatedly placed the levee and hence the City of Santa Maria in jeopardy. The levees have been damaged this way several times. River flows as low as 8,000 cfs (5-year flow) caused significant damage to the levee in 1966, twice in 1969, 1978, 1980, 1983, 1995, 1998, and 2001. In 2005, low flows caused scouring around the groin and required dumping of rock during the event. In 1998, the damage caused by impinging flow was so severe that the north levee actually breached. Only diligent patrolling of the levee during flood flows and timely and aggressive flood fighting has prevented similar breaches of the south levee.

No comprehensive record of flows through the project area exists but a reasonable estimate of annual peak flows is available by referring to the US Geological Survey stream gage No. 11140000 Sisquoc River near Garey. This gage is located just upstream of the project area and monitors flow from about 94% of the uncontrolled drainage area. As Figure 3 shows, during the 44-year life of the project the annual peak discharge on the Sisquoc River has exceeded 8,000 cfs twelve times or once every 3.7-years. Seventy-five percent of the time that the peak discharge exceeded 8,000 cfs the levee suffered significant damage, nearly breached, or actually breached. The maximum flow during this period is less than 35,000 cfs, which is less than 25% of design capacity.

Recognizing the levee deficiency early on, the Corps began restudying the project in the 1970's and in 1981 attempted to correct the deficiency by constructing a series of groins to protect the levee from impinging flows. Only about a fourth of the entire project length was protected with the additional groins. However, low flows in 2005 scoured the riverbed adjacent to the groins and levee toe, requiring a flood fighting response by the county. It appears that the groins effectiveness may be limited in providing protection against cross-channel flows that impinge upon a levee between the groins. Of further concern is the condition of the original riprap revetment. The levee rock has deteriorated significantly since the project construction was completed and much of the rock has fractured and broken down into smaller pieces. Relatively recent geotechnical explorations and hydraulic calculations by the Corps have concluded that the existing revetment does not meet current Corps design standards for parallel flow conditions for larger floods.

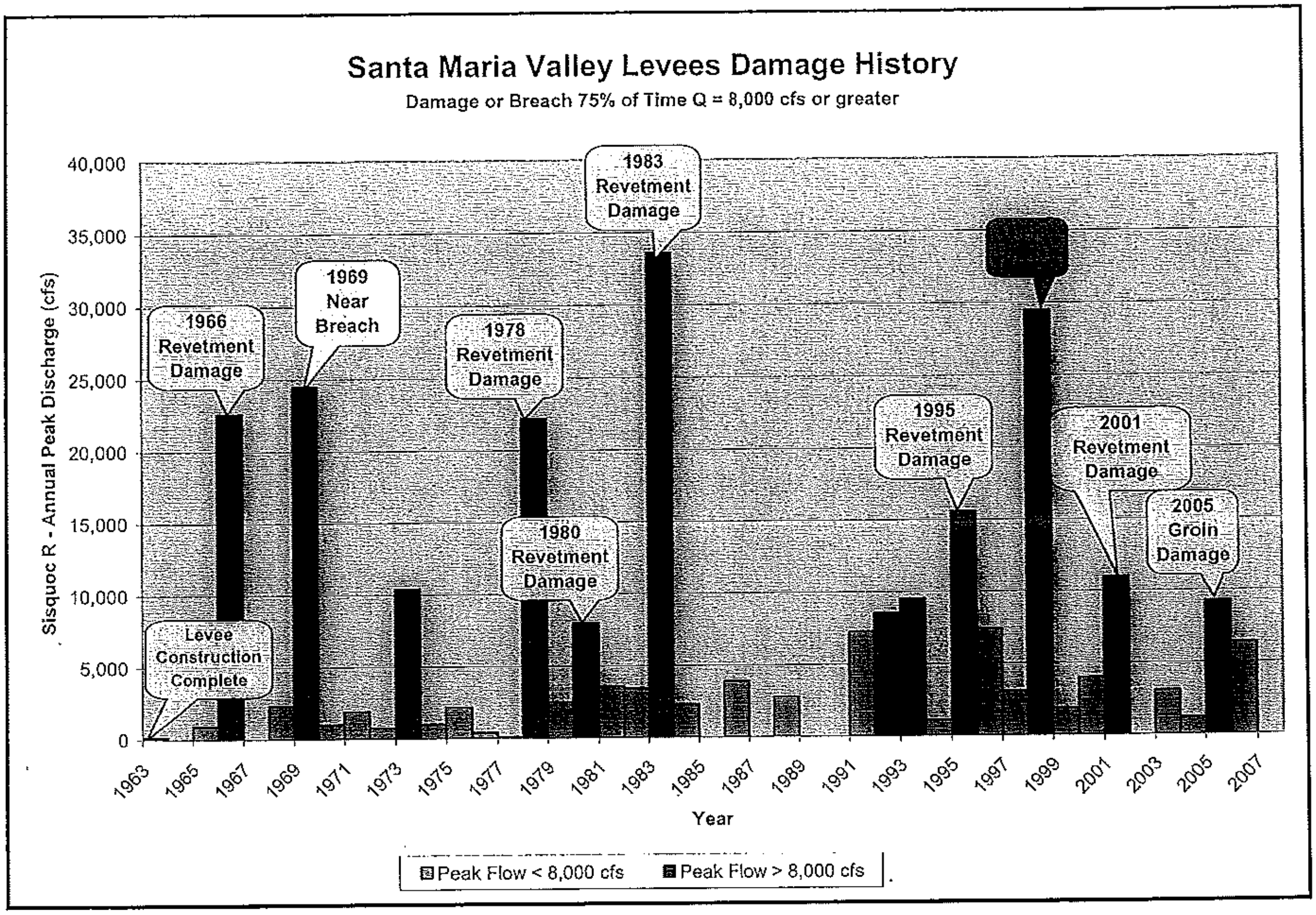

Figure 3: History of Damaging Flows

It is clear from the project performance since the 1981 improvements that the levee still remains vulnerable to breaching from relatively frequent floods along most of its length. A future breach is now considered likely without close monitoring of the project and rapid and aggressive flood fighting. Given the condition of the project the Corps of Engineers has declined to certify the levee and FEMA is currently revising its flood insurance maps with the assumption that the levee no longer provides any protection to the City of Santa Maria. Figure 2 shows the extent of flooding resulting from a breach at Suey Crossing and Figure 4 shows FEMA's draft flood map for the valley.

Figure 4: Draft FEMA Flood Map June 2007

Greatly exacerbating the problem and creating an unusual threat to the City of Santa Maria is the recent Zaca wildfire that burned about 26% (122 square miles) of uncontrolled watershed above the Santa Maria Valley levees. The low to moderate flows that threaten the levee are now considered to be even more likely to occur this coming flood season due to the potential for increased runoff from the burned areas. Additionally, increased sediment load from the burn areas may increase the likelihood that sediment deposition will fill in the existing natural flow channels in the riverbed. New low flow channels would then be formed which would increase the uncertainty of the location of a levee breach and increase the severity of flood fighting operations.

The current situation is very similar to 1966, three years after construction of the Santa Maria Valley levees. In the summer of that year, the Wellman wildfire burned 29% of the Sisquoc watershed, which is approximately the same acreage (26%) burned in the recent Zaca wildfire (see Figure 5). During the first significant storm after the wildfire in December of 1966, the basin received less than 2-year rainfall per NOAA Atlas II for 24- and 6-hour durations. However, the resulting peak flow was 22,600 cfs, which is the fourth highest flow recorded since the levees were built and has about a 20-year return per the updated frequency curve (see Appendix B-1). The flow caused significant damage to the levee. The post-flood conclusion was that the only reason the levee did not fail completely was because of the short duration of the peak flow. Photographs of the damage caused by the 1966 and other past events are located in Appendix B-4.

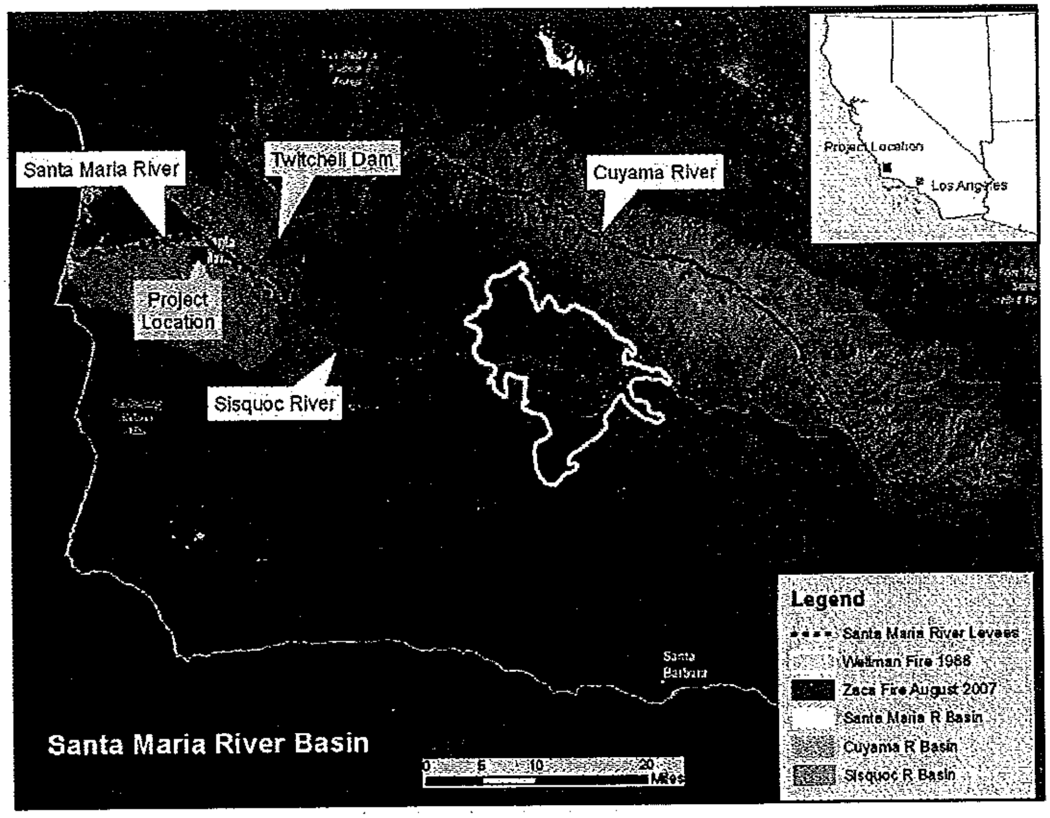

Figure 5: Extent of 1966 Wellman Wildfire

One of the requirements for Advance Measures funding is the demonstration of an "imminent threat of unusual flooding" as called for in ER 500-1-1. Like many streams and rivers in the western United States, the Santa Maria River only flows intermittently and only in response to recent rainfall. Furthermore, the watershed can respond rapidly to rainfall and flow can rise from near zero to high discharges in a matter of hours. Figure 6 is an example of quickly the watershed reacts to rainfall. Future rainfall for this coming winter can not be predicted but it is clear that the well documented levee deficiencies and the Zaca wildfire have created the potential for a catastrophic failure the next time a moderate amount of rain falls in the Santa Maria River watershed. The potential for a significant flood flow generated by commonly occurring rainfall amounts was vividly demonstrated by the events of 1966.

In summary, the Zaca wildfire and the levee deficiency has created an unacceptably high risk that a catastrophic level of flooding could be triggered by commonly occurring, relatively small amounts of rainfall. The failure of the south levee would endanger thousand of lives and extensive urban areas in the City of Santa Maria.

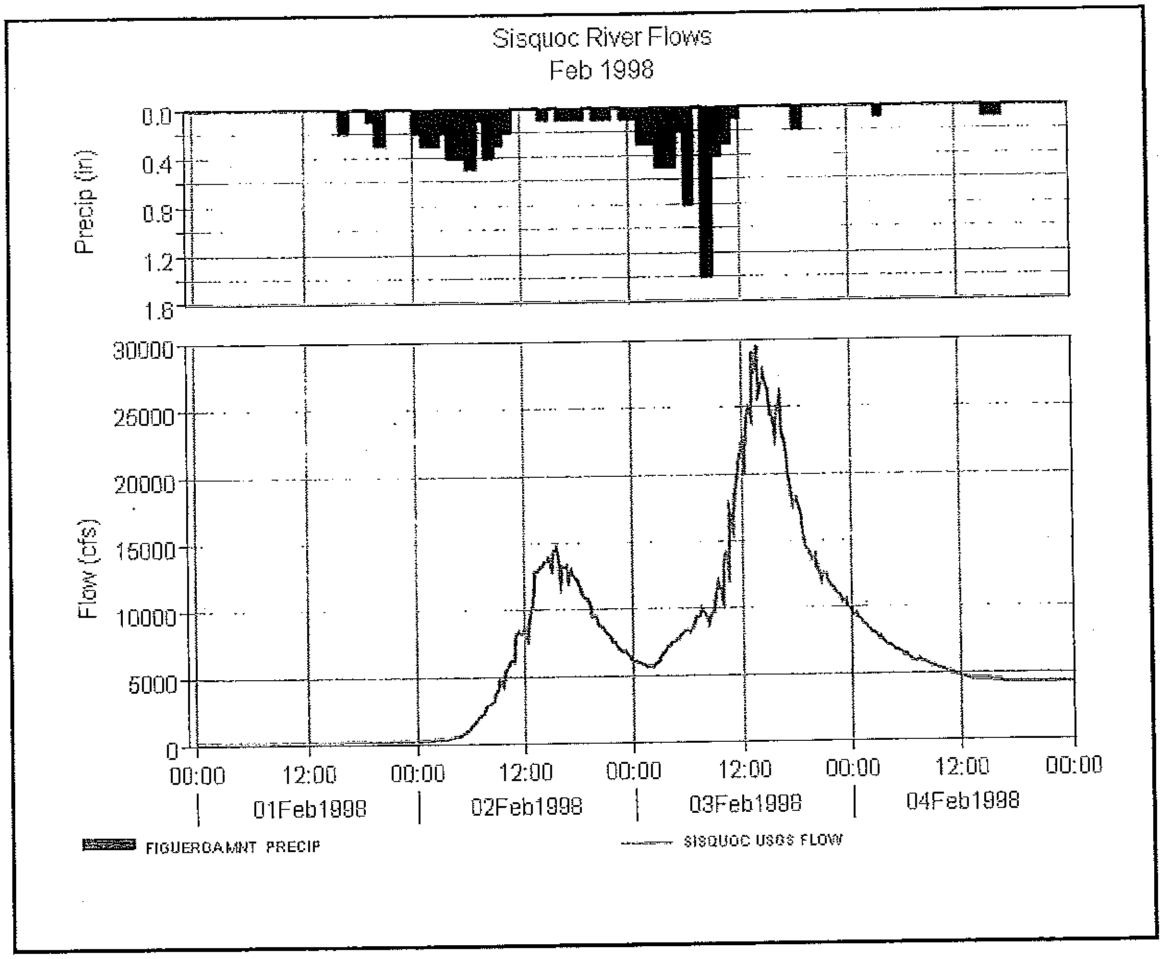

Figure 6: February 1998 Flow

4. Course of Action Options

Two alternatives were considered including the no action plan and the recommended plan. It has been determined that without implementation of the recommended plan, the levees offer minimal protection to the City of Santa Maria. The well documented past performance of this project clearly indicates that without preparing to rapidly and aggressively flood fight future flows, another breach of the levee is considered likely in the future. A breach of the south levee would endanger the lives of tens of thousands of people and potentially damage thousand of commercial and residential structures. The Zaca wildfire, which burned about 24% of the uncontrolled watershed above the project area, has greatly exacerbated this risk. This no action plan is unacceptable due to the strong likelihood of a partial or total failure of the levee in the near future.

The recommended plan includes construction of a pilot channel to direct frequently occurring low flows away from the levee at the location of greatest concern, stockpiling large rock for flood fighting at key locations immediately adjacent to the levee, and developing a detailed flood fighting response plan. The recommended plan will provide immediate protection to the levee from the effects of meandering low flows and facilitate timely and aggressive flood fighting of larger flows with sufficient quantities of large rock.

Strategically placing stockpiles of rock also enhances the ability to respond to new locations of flow concentration or impingement that will likely develop in the future.

5. Proposed Work

The proposed work has structural and non-structural components. These components are described below and the location of the structural portion of the proposed work is shown on Figure 7.

- Stockpiling Large Rock. The first structural proposal is to stockpile sufficient quantities of rock suitable for flood fighting a potential levee breach. It is recommended to stockpile enough rock to protect 1,000 feet of levee. The amount of rock required to offer that protection is estimated to be 13,500 tons. The City of Santa Maria has already stockpiled 1,300 tons that can be used during a flood fight. Additionally, the County has 1,300 tons of rock leftover from the 1998 breach repair, but this rock must be moved to a location closer to areas of greatest concern. The cost of purchasing the 10,900 tons of rock still needed and relocating 1,300 tons is estimated to be $495,000.

- Extend existing pilot channel. In the fall of 2006 the Santa Barbara County constructed a 300' wide pilot channel to direct low flows away from a critical area where flow impingement on the levee has long been observed. It is proposed to extend this channel 3,850' upstream to just above Suey Crossing. The new channel would also be 300' wide. The existing low flow path currently impinges upon the levee or is concentrated parallel against it in this reach and the proposed channel would direct these flows away from this problematic area. The alluvial material removed during construction of the channel would be strategically place along the toe of the levee where possible, and in areas above the ordinary high water mark or locations acceptable to resource agencies. Where place, the alluvial material will help buffer the levees from the effects of impinging flow. The cost of extended the pilot channel is $215,000.

- Develop Flood Fighting Plan. A detailed flood fighting plan will be developed that will address inspection mobilization, execution of inspections, mobilization of flood fighting crews including qualified local construction contractors, methods to determine where rock is needed to prevent a breach, and coordination with the Corps and other agencies. It is estimated that the cost of creating comprehensive flood fighting plan is $20,000.

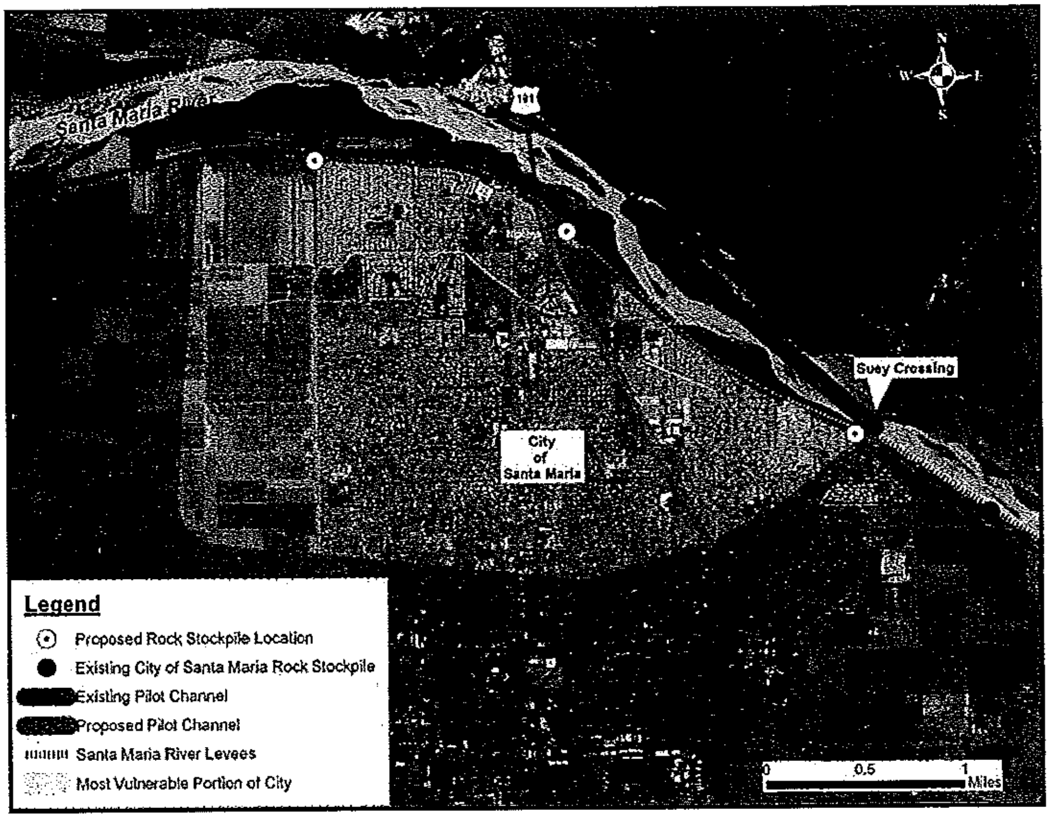

Figure 7: Location of Proposed Work

6. Economics

The Santa Maria Valley Levees protect 66,000 people and many thousands of residential, commercial, and public structures located in the City of Santa Maria. It is estimated that the total structure and content value of the city located in the overflow area associated with a breach at Suey Crossing (see Figure 3) is $1.4 billion.

Based on the past performance of the levee and field reconnaissance by USACE engineers the level of protection provided by the levee was judged to be only adequate for a flood with a recurrence interval only in the range of 10 to 15 years. A 10-year level of protection was assumed for the economic analysis because of the effects of the Zaca wildfire and the resulting potential for significantly higher peak discharges. The proposed project is expected to provide benefits at the 25- and 50-year event frequency but is conservatively assumed to provide no benefits for events larger than the 50-year event. However, the rock stockpiling component of the proposed plan would likely provide benefits beyond the 50-year event. The emergency measures are assumed to have an effective life of five years and are expected to cost $730,000 to implement.

As summarized in Table 1, the annualized cost of the project is $168,000 and the annual benefits are $11.7 million, which results in annual net benefits of over $11.5 million and a benefit to cost ratio of 70. There is an extremely strong economic justification for the implementation of advance emergency measures to reduce the risk of flood damages in the project area.

Table 1: Net Benefits and B/C

Average Annual Benefits	Annualized Cost	Annual Net Benefits	B/C
$11,710,000	$168,029	$11,541,971	70

7. Public Sponsor's Share or Contribution

Santa Barbara County is the local sponsor and the lead agency responsible for the maintenance of the Santa Maria Valley levees. As such, the County has diligently and consistently devoted significant resources to the proper care, repair, and upkeep of the levees. The State of California and the City of Santa Maria have also made significant contributions.

Summary of Recent State and Local Actions:

a. 2003 – Installation of pipe & wire groins

b. 2003 to Present – Willow planting as a buffer along levee

c. Spring 2006 – Heavy Rock Reinforcement

d. Fall 2006 – Construction of 2 pilot channels

e. Winter 2006/2007 – In a cooperative project with state, place additional rock at levee toe and install 1,100' of pipe & wire groins.

f. 2007 – County hires engineering consultant to develop permanent solution to the levee deficiency. Study is complete.

g. Summer 2007 - City of Santa Maria creates stockpile of large rock for future flood fighting

h. Summer 2007 – State of California declares state of emergency because of Zaca wildfire and promises financial assistance to local agencies to reimburse the cost incurred because of the fire. The total cost of fighting the fire is about $120 million so far.

Photographs and further information about the efforts of state and local agencies can be found in Appendix E.

8. Environmental Considerations

A statement on the effect of the proposed work on the environment and any needed mitigation measures will be developed. The areas proposed for stockpiling of rock are existing maintenance staging areas, currently barren, with well defined and permanent access roads, and are entirely absent of vegetation and wildlife habitat. The environmental impact of stockpiling rock at these locations is limited to temporary air quality and sound issues associated with the movement of large trucks and hauling equipment, and possibly longer term visual aesthetic issues.

The County has prepared an Environmental Impact Report (EIR) addressing the impacts and mitigation associated with construction of the pilot channel. This EIR is based on a previous plan to remove alluvial material to an upland site outside of the river. The current plan is identical except that that with the new plan the alluvial material would be placed within the river boundaries instead of trucked to an offsite location. All material relocated within the river would be placed above the ordinary high water mark. Any negative impacts are considered minimal and appropriate mitigation measures will be undertaken. A summary of USACE staff preliminary findings is contained in Appendix E.

9. Permits

The proposed work has two distinct structural features, stockpiling large rock at three locations and extending an existing pilot channel 3,850' upstream. The three proposed stockpile locations (see Figure 5) are located on non-wetland areas behind the levee. All of these areas are owned by the County and commonly used as staging areas or for other maintenance activities. None of these areas have any existing habitat. No permit is required for stockpiling rock on these sites. If the levee does fail and flood fighting with rock is initiated, an emergency permit may be required. However, the emergency permit process is not expected to negatively impact flood fighting efforts.

Santa Barbara County has obtained a Section 404 permit for extending the existing pilot channel 3,850' upstream past Suey Crossing. However, the permit was originally granted with the understanding that the alluvial material removed during construction would be disposed of at an off site location. The current plan proposed for advance measures calls for relocating the material within the river, strategically placed along the toe of the levee in areas above the ordinary high water mark. Staff from the Los Angeles District Regulatory Branch has performed a field visit and preliminarily reviewed the County's revised material disposal plan. The revised disposal plan appears to satisfy Section 404 criteria and no revision to the existing permit is anticipated. Appendix E contains additional information on the permits required for this project.

APPENDIX A

Request for Assistance

Santa Barbara County Public Works Department
Flood Control & Water Agency

August 8, 2007

Governor's Office of Emergency Services
3650 Schriever Avenue
Mather, CA 95655

California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

RE: Corps of Engineers Technical Assistance - Zaca Fire (County of Santa Barbara)

Dear Sirs:

For the last several weeks, Santa Barbara County has been subject to the effects of the Zaca Fire. The fire has burned areas in both the Santa Ynez River and Santa Maria River Watersheds. Most of the vegetation on the mountain area has been lost.

The Santa Maria River has the weakened Levees downstream of the Fire area. Impacts of the fire are an increase in debris and accelerated water runoff. As a result of the Zaca Fire, we expect an increased potential for high runoff this winter, on a Levee systems that is of great concern.

The Santa Barbara County Flood Control District requests that the U.S. Army Corps of Engineers provide technical assistance to Santa Barbara County relating to the impacts of the Zaca Fire.

While the Zaca Fire still burns, the full impacts to the County are not yet known. However, we request assistance with the Fire's impacts relating to; Hydrology & Hydraulics, Erosion Control, Mapping, Modeling, and any other necessary mitigation measures to ensure the safety of our citizens.

We also understand that additional assistance in terms of Advanced Measures must be requested separately, we are currently developing areas of assistance in that regard.

If you have any questions, please contact me at 805.568.3436

Sincerely,

Thomas D. Fayram
Deputy Public Works Director

cc: U.S. Army Corps of Engineers, Los Angeles District Office

Phillip M. Demery
Public Works Director

123 East Anapamu Street, Santa Barbara, California 93101
PH: 805 568-3440 FAX: 805 568-3434 www.countyofsb.org/pwd/water

Thomas D. Fayram
Deputy Public Works Director

STATE OF CALIFORNIA – THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, Governor

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

AUG 2 4 2007

Colonel Thomas H. Magness, IV
U.S. Army Corps of Engineers
Los Angeles District
915 Wilshire Boulevard, Suite 980
Los Angeles, California 90017

Request for Technical Assistance of the U.S. Army Corps of Engineers

Dear Colonel Magness:

On behalf of the Santa Barbara County Public Works Department, the Department of Water Resources (DWR) is requesting technical assistance from the U.S. Army Corps of Engineers (Corps) under authority granted to them by Public Law 84-99, to assess the potential for increased storm runoff and debris flows as a result of the Zaca Fire.

As stated in the attached August 8, 2007 letter from Santa Barbara County Public Works Department, the Zaca Fire has burned areas in both the Santa Ynez and Santa Maria River Watersheds. As of August 13, the fire has consumed nearly 90,000 acres and is only 68 percent contained. As you may know, there is a 19-mile long levee on the Santa Maria River that was recently rated "poor" during a recent national levee inventory. The potential for increased storm runoff and debris flows into the Santa Maria River is of great concern to Santa Barbara County.

Assessing the potential for increased storm runoff and debris flows as a result of the Zaca Fire is necessary to better understand the actions that may need to be taken to reduce the risk for loss of life and property damage. Therefore, I request technical assistance to the Corps as authorized by Public Law 84-99.

If you have any questions, please call me at (916) 653-7007, or your staff may contact Brian Heiland, Acting Chief of DWR's Flood Operations Branch, at (916) 574-2616.

Sincerely,

Lester A. Snow
Director

cc: (See attached list.)

APPENDIX B

Data and Documentation Addressing the Imminent Threat of Unusual Flooding

Section B-1: Summary of Hydrology and Sediment/Yield Calculations

Section B-2: Site Visit Memorandum for Record – Hydraulics Section

Section B-3: Site Visit Memorandum for Record – Geotechnical Section

Section B-4: Damage and Flood Fight Photographs

Section B-1: Summary of Hydrology and Sediment Yield Calculations

Sisquoc River drainage area: 471 mi^2 (using USGS stream gage Sisquoc River nr Garey)

Zaca Wildfire 2007

Total area burned: 375 mi^2
Area burned in Sisquoc River watershed: 122 mi^2 (26%)
Fire contained, but not controlled

Wellman Wildfire 1966

Total area burned: 152 mi^2
Area burned in Sisquoc River watershed: 138 mi^2 (29%)

Precipitation for Figueroa Mtn. precipitation gage (from NCDC database)

Daily precipitation Dec. 5, 1966: 2.70 inches
- max. 6-hr: 1.30 in
- max. 1-hr: 0.30 in

Daily precipitation Dec. 6, 1966: 1.90 inches
- max. 6-hr: 0.90 in
- max. 1-hr: 0.30 in

Frequency Precipitation from NOAA Atlas II for Sisquoc River watershed:

2-yr 24-hr Mean	3.86 in
2-yr 6-hr Mean	2.10 in

Pre-fire discharge estimates (for USGS Gage 11140000 Sisquoc R near Garey):

FFA Results

500-yr	83,600 ft^3/s
100-yr	50,100 ft^3/s
50-yr	37,700 ft^3/s
20-yr	23,600 ft^3/s
10-yr	15,000 ft^3/s
5-yr	8,140 ft^3/s
2-yr	2,120 ft^3/s

Post-fire discharge estimates:

Using FEMA simplified method to provide a quick approximation of peak discharges source: "The Hydrologic and Hydraulic Methodology Used To Estimate Post-Burn Floodplain Hazards"; (FEMA-1498-DR-CA)

100-yr:	78,300 ft^3/s (+36%)
5-yr:	13,900 ft^3/s (+41%)

Debris Yield estimates:

Using LAD Debris Method

pre-fire:	100-yr	1,000 af
post-fire:	100-yr	1,260 af (+21%)
pre-fire:	5-yr	160 af
post-fire:	5-yr	200 af (+20%)

CESPL-ED-HH 11 September 2007

MEMORANDUM FOR RECORD

SUBJECT: Santa Maria Levees – Site Visit for Technical Assistance

1. On 30 August 2007, engineering staff from the Los Angeles District office of the Corps of Engineers participated in a coordination meeting and site visit to the Santa Maria Levees. The objective of the meeting and visit were to provide technical assistance to local officials on advance measures to protect the city of Santa Maria from flooding caused by a levee breach resulting from impinging low flows. Flows that impinge upon the levee at a sharp angle not only greatly increase the likelihood of directly eroding the riprap revetment, but also create a high potential for local scour that undermines and destabilizes the riprap. Attending the meeting and site visit were Messrs. Doug Chitwood of the Soils Design and Materials Section, Greg Peacock of the Reservoir Regulation Section, and David Cozakos of the Hydrology and Hydraulics Section. The meeting and site visit were led by Mr. Tom Fayram, Deputy Public Works Director of the Santa Barbara County Flood Control and Water Conservation District, with assistance from Messrs. Rick Tomasini and Larry Fausett. Attending as an observer was Mr. Chang Lee of the California Department of Water Resources, Division of Planning and Local Assistance. Before the site visit Mr. Fayram gave a presentation in the county's local office in Santa Maria to explain the measures the county has already put into place, as well as other measures currently being considered. Summarized herein are notable aspects of the presentation and subsequent discussion, as well as observations from the site visit.

2. A recent incident that has prompted the planning of advance measures at the present time is the so-called Zaca wildfire that has burned a very large area in the watershed tributary to the project and has still not been extinguished. Local officials are concerned that the fire will increase runoff and sediment into the project reach during this upcoming flood season. These concerns are well-founded and will be addressed by the Corps team in the project information report that will accompany the request for advance measures.

3. Mr. Fayram began the meeting by pointing out that the Santa Maria Levees project has suffered from localized erosion of the toe of the levee revetment from impinging cross-channel flows several times since the project was completed in the mid 1960's. Aggressive floodfighting by the county has been required more than once to prevent a breach. However, a breach occurred in the right (north) levee just downstream of the Bonita School Road crossing on 4 February 1998 before floodfighting forces could be mobilized. Presently, the most problematic location for a breach that could cause wide-spread flooding in the city of Santa Maria is roughly a mile upstream of the U. S. Highway 101 crossing. The existing natural low flow path crosses from the right to the left side of the river and impinges upon the levee at a sharp angle.

4. The next most problematic area extends for a considerable distance upstream of Suey Road, where the existing low flow path either impinges upon the levee or is concentrated parallel against it. However, a sizable landfill is located immediately adjacent to the levee in this reach. For about a mile downstream of the Bradley Canyon

confluence, the landfill is roughly a thousand feet wide and at least 30 feet high. The massive volume of material in the landfill provides considerable protection against a breakout onto the floodplain should the levee itself be breached. The downstream end of the landfill, extending about a mile upstream of Suey Road, is considerably narrower and shorter, and therefore will not provide nearly as much protection against a breakout in the event of a breach. Mr. Fayram point out that a sand and gravel mining operation in this reach has recently trained much of the along the right side of the river, significantly reducing the threat of flows impinging upon the levee. Downstream of U. S. Highway 101, the low flow pattern is presently concentrated along the right side of the river essentially parallel to the levee. No immediate threat of impinging low flows causing a levee breach is apparent throughout the entire reach the levee from the highway to the downstream city limits, where existing development ends.

5. To redirect low flows away from the levee at the location of most concern, the county excavated a pilot channel in 2006 along the right side of the river for a distance of roughly mile. The pilot channel is about 300 feet wide and 4 feet deep, and essentially cuts off the low flow meander. The county has also placed a pole and wire retarding fence for several hundred feet long along the toe of the levee at the impinging flow location. The county proposes augmenting these advance measures by extending the pilot channel about two-thirds of a mile further upstream to connect to the Suey Road low flow crossing.

6. As additional advance measures, the county proposes to stockpile large rock for floodfighting at key locations immediately adjacent to the levee that are readily accessible. The county already has stockpile sites prepared at the Broadway offramp to the U.S. Highway 101 freeway, and two additional sites just upstream and downstream of the Suey Road crossing. The county also has a fourth site at Blosser Road, which is at the very downstream end of the Santa Maria city limits. A large stockpile of rock from the 1998 floodfighting is presently located adjacent to the right levee just downstream of Bonita School Road. The county proposes hauling this rock to one of the aforementioned other stockpile locations. As an alternative, additional rock suitable for floodfighting can be acquired in large quantities from a quarry located in Santa Margarita, roughly 40 miles from the project site. Mr. Fayram pointed out that in addition to the county's own operation and maintenance staff and equipment, the agency has already contracted with local construction companies to provide additional floodfighting services on short notice.

7. The Corps staff believes the advance measures constructed and proposed by the county are prudent and appropriate given the extremely limited funding and time available. The only notable recommendation that the Corps staff can offer is to place at least as much emphasis, if not more, on stockpiling sufficient quantities of rock suitable for floodfighting. The length of time that a pilot channel will provide protection against impinging or concentrated flows is relatively limited. If low flows persist long enough, the pilot channel will be reshaped by scour and deposition of sediment, and the river will once again naturally establish typical impinging or concentrated flow patterns. A much more reliable and longer-lasting method of preventing a levee breach is timely and aggressive floodfighting with sufficient quantities of large rock. Strategically placing stockpiles of rock has the additional advantage of providing flexibility for floodfighting at new locations of flow concentration or impingement that may develop during a particular flood season, or even during a single flood. It also has another advantage of being potentially useful for larger floods that tend to flow more parallel to the levee rather than impinge upon it at an angle. In particular, the original riprap revetment on the levee has

deteriorated significantly since the project construction was completed, in that much of the rock has fractured and broken down into smaller pieces. Relatively recent geotechnical explorations and hydraulic calculations by the Corps have concluded that the existing revetment does not meet current Corps design standards for parallel flow conditions for larger floods.

8. On a related note, county staff pointed out significant scour immediately adjacent two of the project groins constructed to protect the levee from undermining. These groins are located in the general area of the impinging flow pattern about a mile upstream of U. S. Highway 101. Low flows in 2005 scoured the riverbed adjacent to the groins and levee toe, requiring a floodfighting response by the county. Groins and other similar training structures have long been demonstrated to be reliable in protecting from erosion caused by concentration of flows parallel to a levee or a streambank. However, it appears from this observation that their effectiveness may be limited in providing similar protection against cross-channel flows that impinge upon a levee between the groins. This apparent performance problem should be carefully considered when evaluating various alternatives of permanent project modifications to protect against levee undermining.

DAVID P. COZAKOS, P.E.
Hydraulic Engineer

Section B-3: Site Visit Memorandum for Record – Geotechnical Section

CESPL-ED-GD (1110) 12 September 2007

MEMORANDUM FOR RECORD

Subject: Support for Request for Advanced Technical Assistance and Annual Levee Inspection, Santa Maria River, 30 August 2007

1. On 30 August 2007, Engineering Division staff Dave Cozakos, Greg Peacock and the undersigned met with Santa Barbara County Flood Control and Water Conservation District (FCWCD) staff. The primary purpose was to provide technical support for FCWCD's request for advanced technical assistance resulting from concerns over the vulnerability of the Santa Maria River levees to erosion. In addition, the annual inspection of the levees was conducted as a part of the same trip. The FCWCD participants were Tom Fayram, Larry Fausett, and Rick Tomasini. In addition, the California Department of Water Resources was represented, as was the City of Santa Maria Fire Department. Further detail on the technical assistance request is summarized in the MFR prepared by Mr. Cozakos.

2. While the focus of the advanced technical assistance request was on that portion of the south levee adjacent to Santa Maria (between Suey and Blosser Roads), the entire south levee west of Suey Road and portion of the north levee east of Bonita School Road were also inspected for the annual inspection. The inspection was made from a vehicle driving along the top of the levees. Stops were requested by the undersigned at both random locations and those of particular interest or concern. There was no significant flow in the river during the time of the inspection.

3. Based upon this inspection, the undersigned is of the opinion that the levees are well- maintained. Bullet items identified in last year's inspection have been addressed. In all areas, trimming of the willows adjacent to the levees had been completed prior to the inspection. There was no significant vegetation on the levees, the access roads and landside toes were in very good condition, and there was no rilling (surface erosion) on the slopes. Stockpiles of rock are maintained just east of Suey Road and adjacent to the levee at the location of the 1998 flood fight (north levee, west of Bonita Canyon School Road).

4. With respect to the request for advanced measures, the 1996 investigation report summarizes the results of test trenches and large scale gradations that were conducted along the SMR levees to quantify the size and thickness of the riprap. The report shows that the rock failed to meet the size criteria under which it was designed 60 percent of the time, and the existing criteria 90 percent of the time. In addition, a frequent concern is the ongoing disintegration of the riprap stone. One of the conclusions of the 1996 report is that, though the stone is breaking down on surface, it has maintained its original size at depth. While that is true, the extent of the degraded stone and the impact that it has on the effective thickness of the section, continues to be a concern for the undersigned. Figures 1 through 4 below provide examples of the stone in typical areas.

5. During the 30 August meeting, the FCWCD identified two possible advanced measures, the excavation of a low channel at a critical area and the advanced stockpiling of riprap at designated areas. I will defer to the expertise of Mr. Cozakos and others as to which is the more appropriate measure. However, due its proven effectiveness and the ability to deliver to specific sites as needed, I would suggest that rock is preferable for the larger events. In addition, funding should require the development of an emergency action (flood fighting) plan which will address at least the following critical items: inspection mobilization, execution of inspections, mobilization of flood fighting crews, methods to determine where rock is needed to prevent a breach, and coordination with the Corps and other agencies.

6. If there are any questions, please feel free to give me a call.

Douglas E. Chitwood, P.E., G.E.
District Geotechnical Specialist
Geotechnical Branch

Figure 4 - Station 520+00

The largest stone in Figure 1, located in the lower left corner, weighs less than 1500 lbs (about a 30-inch diameter, assuming spherical shape). Note the split faces.

Figure 5 - Typical breakdown beginning in basalt riprap

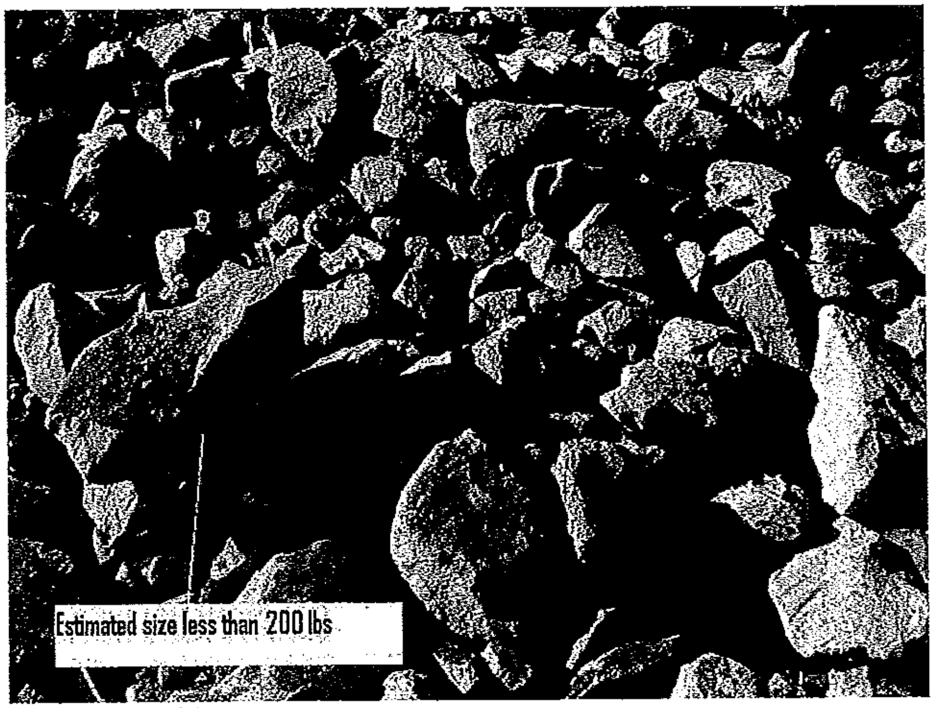

Figure 6 - Station 870+00

Note that the 200-lbs stone is possibly the largest in the photo. Note also that on examination of this picture, multiple likely split faces can be identified, illustrating the disintegration of the rock.

Figure 7 - Station 1070+00 – badly disintegrated sandstone riprap. Largest stone less than 500 lbs.

Section B-4: Damage and Flood Fight Photographs

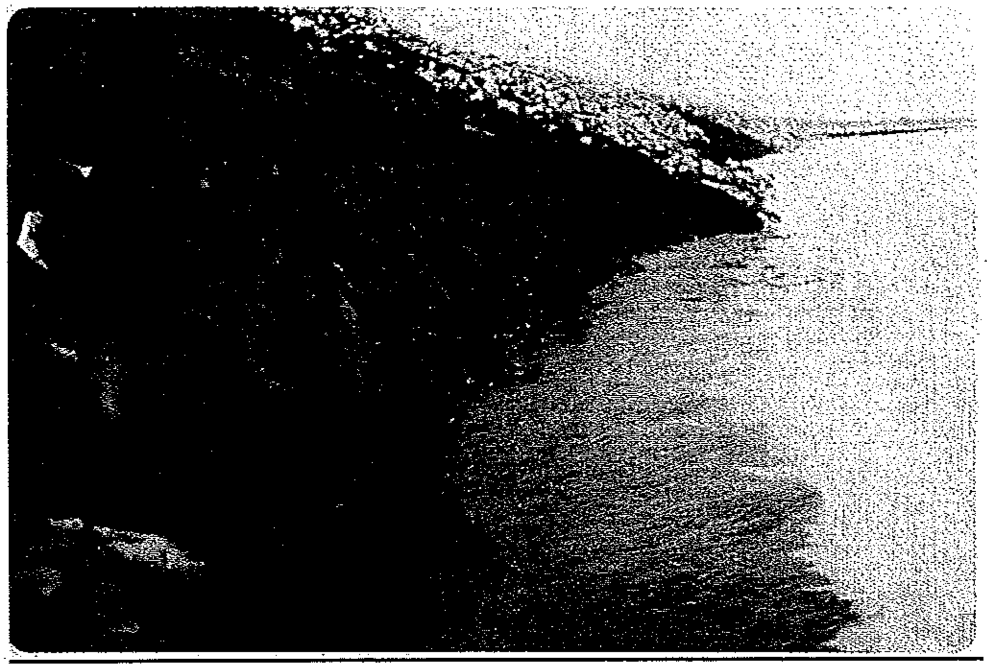

Figure B-4 (1): Two Crescent Shape Failures – Dec 1966

Figure B-4 (2): 1969 Flood Fight

Figure B-4 (3): 1969 Flood Fight

Figure B-4 (4): 1998 North Levee Breach

APPENDIX C

Economic Data

US Army Corps
of Engineers®

Flood Damage Analysis
Santa Maria Levee Project

Prepared By:
USACE Los Angeles District, Economics Section

Purpose

This Economic Analysis will present the methods and results of a flood damage analysis conducted for the Santa Maria Levee Project. The analysis is intended to determine whether there is a Federal interest in making emergency improvements to portions of the Santa Maria Levee that would be expected to reduce the risk of levee failure, thus reducing the risk of economic damages from flooding in the surrounding area.

Methodology & Delimitation

The principal guidance of the analysis comes from the U. S. Army Corps of Engineer's (USACE) "*Planning Guidance Notebook*", ER 1105-2-100, with specific guidance from Appendix D – Economic and Social Considerations. Guidance on the use of emergency resources comes from ER 500-1-1, *Emergency Employment of Army and Other Resources*. Benefits and costs are expressed in average annual terms at 2007 price levels using the fiscal year 2007 federal discount rate of 4.875%. Importantly, for purposes of this Economic Analysis, the period of analysis is limited to five years because that is the length of time that roughly corresponds with the expected effective life of the emergency measures. However, the effectiveness of the emergency measures in preventing a levee breach in this location could, in reality, last much longer than this. While the actual effective life of the emergency measures (assuming no other actions are taken) is uncertain, it is expected that the effective life is much more likely to be greater than five years than it is to be less than five years. Since project benefits are positively correlated with project life, this project life assumption means that overall benefits are likely greater (or much greater) than shown here. Also, the Corps is currently pursuing options for making improvements to the levees that will address existing deficiencies that are resulting in a level of protection that is less than the authorized level. However, beyond the emergency measures, it is uncertain what type of longer-term improvements will be made and when they will be implemented. It is hoped that such long-term improvements can be completed prior to the end of the useful life of the advanced protective measures recommended in this report.

Given the urgency associated with this analysis and potential repair work, and given the limited funding and time available for this analysis, it was necessary to simplify the analysis in numerous ways. First, the damage estimate was limited to structures and their contents. In a flooding analysis for highly developed, urbanized floodplains such as this, damage to structures and contents is expected to constitute the vast majority of economic damages from flooding. Second, as opposed to collecting a detailed, updated floodplain property inventory, the analysis relied on aerial photography, real estate records, and conversations with local officials. As described in more detail below, this information was combined with local construction cost data in order to value the total property at risk in the floodplain. Third, event-based damages were calculated for three events, using adjusted overflow depth data from a prior USACE report from 1980[1]. Given that significant urbanization and development has occurred in the floodplain since 1980, it is assumed for purposes of this analysis that the average flood depths for a given frequency have increased by 25%[2]. Damages to structures were calculated using structure and content depth-damage curves developed by either the Institute for Water Resources or FEMA. Expected Annual Damages (EAD) were calculated in a Microsoft Excel spreadsheet given the estimated damages per event and the corresponding probability of flooding.

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[1] *Supplement to Design Memorandum No. 1 for Santa Maria Valley Levees and Channel Improvements*, USACE Los Angeles District, March 1980.

[2] Source: USACE Hydrology and Hydraulics Branch

The Study Area and the Current Flooding Threat

The Santa Maria River Levee is located 160 miles north of Los Angeles in Santa Barbara County, CA. The City of Santa Maria has approximately 85,000 residents, 28,000 housing units, and over 1,500 business establishments. Since 1980, the population has more than doubled – from 32,000 to 84,000 residents.

Figure 1 below shows the approximate floodplain[3]. The floodplain is approximately 2,600 acres in size (4 square miles). This floodplain encompasses approximately one-fifth of the City of Santa Maria, but approximately one-third of the developed land in the city. According to USACE engineers, the floodplain outlined in Figure 1 is the most likely area of inundation in the event of a levee breach. Under the existing conditions, it is expected that the non-damaging frequency event is the ten-year storm, which is a storm that has a 10% probability of occurring in any given year. According to USACE Engineers, it is reasonable to assume that, while the depths differ, the extent of the floodplain is roughly equivalent for the 100-, 50-, and 25-year frequency events.

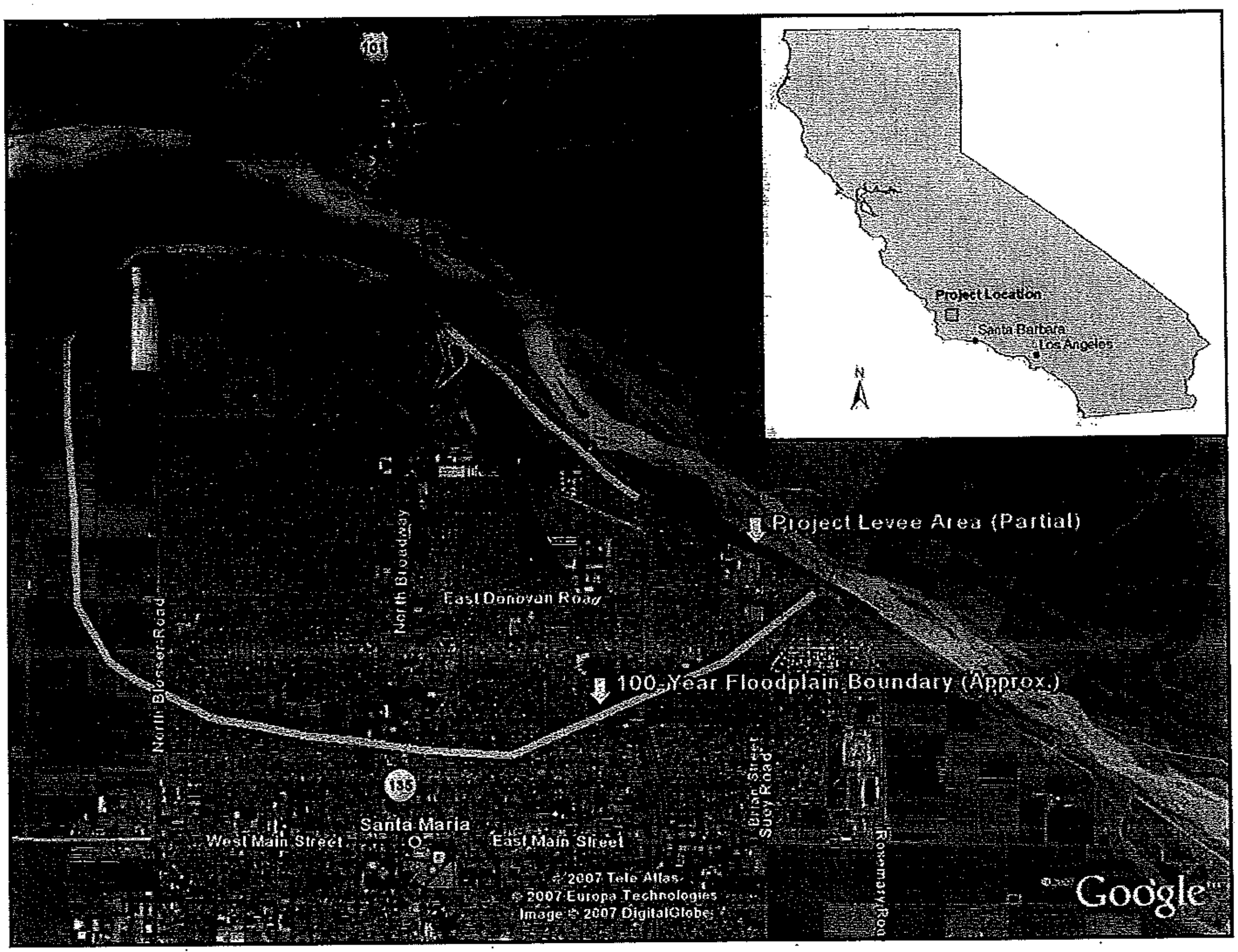

Figure 8: Extent of Floodplain (Approx.)

[3] Approximates the Breach No. 3 floodplain boundary delineated in the 1980 design memorandum

Floodplain Inventory

In order to estimate the economic impact of potential future flood damages to the residences and businesses in the study area's floodplain, it is necessary to estimate the total value of these structures and their contents. As a result of funding and time constraints, no detailed structure inventory was completed. Instead, this estimate was made by using a combination of previous USACE studies, aerial photography, real estate records, and telephone interviews with local officials. This information was combined with data from the Marshall & Swift (M&S) valuation service, which provides the relevant cost components that serve as the basis for the value calculations, to arrive at a rough approximation for the value of property in the floodplain.

As stated above, the floodplain encompasses approximately one-third of the developed land in the city. Compared to the overall land use in the City of Santa Maria, the land use in the floodplain is to a greater extent comprised of residential use, and less of industrial and manufacturing use. For purposes of this analysis, however, it is assumed that the land use pattern in the floodplain is consistent with the land use in the broader city. Using one-third as an approximation of the proportion of the city's structures that are contained in the floodplain, it is possible to make a rough estimate the number of the various types of structures at risk in the floodplain. The results of this inventory are shown below.

Table 1: Structure Inventory - Units in Floodplain

Structure Type	Total Units in City^	Number of Units in 100-Year Floodplain
SFR	19,000	6,333
MFR	7,000	2,333
MH	1,700	567
Office	440	147
Retail	347	116
Other Commercial	470	157
Manuf./Ind.	80	27
Restaurant	165	55
Churches*	NA	6
Schools*	NA	6

*Estimated directly from aerial photography.

^Source: U.S. Census Bureau. Commercial - includes retail and wholesale trade; Offices - includes professional services and healthcare facilities; Manufacturing & Industrial - those classified as manufacturing by the U.S. Census Bureau.

The value of the structures was calculated by multiplying the square footage of the structure by an estimate of the per square foot value of the structure, which depends on the structure use type (residential, commercial, etc.). The per square foot values were taken from Marshall & Swift, which are based on the following factors: the type of structure, the quality of the construction, the condition of the structures, a locality multiplier (Santa Barbara County in this case), and a cost multiplier (western region). The aerial photographs in Figure 2 below are examples of the type of residential and commercial structures that are found in the floodplain.

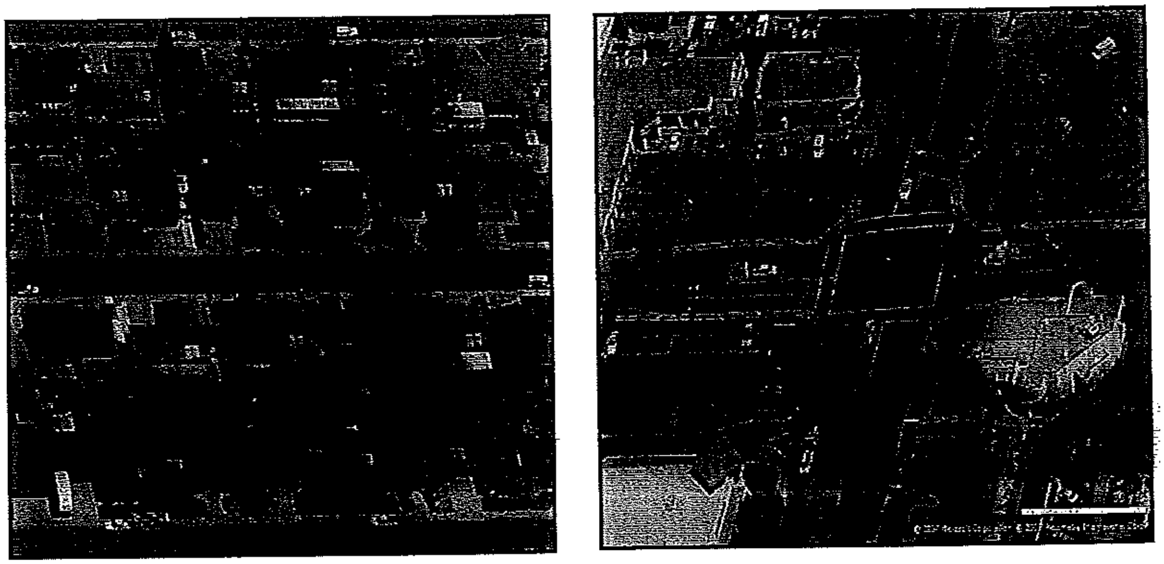

Figure 9: Example of Residential and Commercial Structures in the Floodplain
Source: www.local.live.com

Given the funding and time restrictions of this analysis, it was necessary to make several assumptions regarding the characteristics of the property in the floodplain. For the single-family residential structure valuation, an examination of aerial photographs and real estate records indicates that it is reasonable to assume for purposes of this analysis that the average single-family residence is 1,700 square feet. For USACE economic analyses, the appropriate structure value to use is the depreciated replacement value. Date of construction; which is used here as a partial indication of structure condition was estimated from real estate data collected via an internet site specializing in real estate information[4]. According to this source, most of the residences in the floodplain were constructed between thirty and fifty years ago. As such, it is assumed for this analysis that, according to the M&S classification system for Class D (wood fame) structures, the structures are of "average" construction quality and in "average" condition. Given this, a per square foot construction cost of $63 is assumed, which incorporates a regional adjustment and depreciation percentage. Combining this value with the average square footage of the structures and multiplying this value by the total number of structures in the floodplain gives a rough estimate of the total structure value of single-family residences in the 100-yr floodplain. The same methodology was followed to estimate the total structure value of multi-family residences, mobile homes, and commercial structures.

Another important component of this preliminary evaluation is an estimation of the content value of those structures in the floodplain. For the purpose of this assessment, it is assumed that the content to structure value of the all residential structures is one-half. That is, the total value of the contents is assumed to be half of the depreciated replacement value of the structure. Value ratios for other structure types were assumed based on USACE guidance documents and previous empirical studies. Table 2 below shows the per-square-foot and content to structure ratio values used for each of the structure types included in the analysis.

[4] www.zillow.com

Table 2: Structure & Content Value Assumptions

Structure Type	$/SF, Including Depreciation*	Square Footage Per Unit	Content to Structure Value Ratio
SFR	63	1,700	0.5
MFR	55	800	0.5
MH	37	800	0.5
Office	79	2,500	0.8
Retail	58	2,500	1.4
Other Commercial	58	2,500	1.4
Manuf./Ind.	37	5,000	1.7
Restaurant	91	2,500	0.4
Churches	55	5,000	0.3
Schools	103	40,000	0.3

*Depreciated Replacement Cost - In accordance with Marshall & Swift

Table 3 below shows the estimated values of the depreciated replacement cost of the structures and contents in the 100-year floodplain.

Table 3: Depreciated Structure & Content Value, 100-Year Floodplain

Structure Type	Units in 100-Year Floodplain	Total Depreciated Structure Value*	Total Depreciated Content Value	Total Structure and Content Value
SFR	6,333	$683,401	$341,700	$1,025,101
MFR	2,333	$102,522	$51,261	$153,782
MH	567	$16,926	$8,463	$25,390
Office	147	$29,084	$23,267	$52,350
Retail	116	$16,860	$23,604	$40,465
Other Commercial	157	$22,834	$31,968	$54,802
Manuf./Ind.	27	$4,970	$8,450	$13,420
Restaurant	55	$12,548	$5,019	$17,567
Churches	6	$1,658	$497	$2,156
Schools	6	$24,774	$8,175	$32,949
TOTAL	9,746	915,577	502,405	1,417,981

*In accordance with Marshall & Swift, Depreciation Index. All dollars in thousands.

Without-Project Damage to Property from Flooding

Damage to property from flooding is of course to a large extent a function of the depth of flooding. For this analysis, because of funding, time, and informational constraints, the flood depths at each structure type were derived from a previous USACE report, *Supplement to Design Memorandum No. 1, for Santa Maria Valley Levees and Channel Improvements*, from March of 1980. The depths associated with the 1980 report's Breach No. 3 were utilized here because, according to USACE engineers, that is currently the location at greatest risk of levee failure. USACE Hydrology and Hydraulics (H&H) division have stated that, given the urbanization and growth in the floodplain since 1980, it is reasonable to assume that the flood depths in the floodplain as a result of a levee breach in this area would be twenty-five percent greater as compared to the 1980 data. Also, the 1980 report does not include an estimate of 25-year flood depths. USACE H&H states that it is reasonable to assume that the 25-year depth is two-thirds of the 50-year depth. The adjusted internal structure depth data is shown in the table below[5]. Depth-damage curves are not available for as many structure categories as is shown in the structure valuation tables. As a result, the ten structure categories shown above were condensed into six broader categories as shown in the table below.

Table 4: Internal Structure Flood Depths by Type & Frequency

Structure Type	100-Year	50-Year	25-Year
	Depth (ft)	Depth	Depth
SFR	1.13	0.63	0.41
MFR	1.75	1.00	0.66
MH	0.00	0.00	0.00
Commercial	2.38	1.63	1.07
Manuf./Ind.	5.63	4.25	2.81
Public	2.00	1.13	0.74

Source: *Santa Maria Valley Levees and Channel Improvements*, USACE Los Angeles, 1980. See document text for an explanation of adjustments and assumptions.

Tables 5 and 6 below show the estimate of percent damage to structures and structure contents in the floodplain for three storm events. It should be noted that Table 6 shows the damage to contents of residential structures as a percentage of the total depreciated content value, and not as a percentage of structure value, which is sometimes the convention in USACE flood damage analyses.

Table 5: Percent Damage to Structures by Type and Frequency

Structure Type	100-Year		50-Year		25-Year	
	Depth (ft)	% Damage	Depth	% Damage	Depth	% Damage
SFR	1.13	24.2	0.63	19.3	0.41	17.4
MFR	1.75	12.7	1.00	9.9	0.66	8.4
MH	0.00	0	0.00	0	0.00	0
Commercial	2.38	26.2	1.63	21.3	1.07	17.2
Manuf./Ind.	5.63	41.3	4.25	30	2.81	27.1
Public	2.00	24.7	1.13	17.2	0.74	13.5

Source: Damage Percent from FEMA and USACE Economic Guidance Memorandum 03-01

[5] This is the calculated as the difference between total flood depth at the structure and the first floor elevation of the structure. Taken from the 1980 report.

Table 6: Percent Damage to Contents by Structure Type and Frequency

Structure Type	100-Year		50-Year		25-Year	
	Depth (ft)	% Damage	Depth	% Damage	Depth	% Damage
SFR	1.13	27.5	0.63	22.4	0.41	20.4
MFR	1.75	16.1	1.00	9.8	0.66	9
MH	0.00	0	0.00	0	0.00	0
Commercial	2.38	26	1.63	21.3	1.07	18.2
Manuf./Ind.	5.63	76.5	4.25	61.3	2.81	42.6
Public	2.00	23.7	1.13	18.2	0.74	15.5

Source: Damage Percent from FEMA and USACE Economic Guidance Memorandum 03-01

Table 7 below shows the estimated structure and content damages by frequency event. The total structure and content damages from a levee breach in this area associated with the 100-year event are estimated to be just under $341 million.

Table 7: Structure & Content Damages by Event

Structure Type	100-Year		
	Structure Damage	Content Damage	Total
SFR	$165,383	$93,968	$259,351
MFR	$13,020	$8,253	$21,273
MH	$0	$0	$0
Commercial	$21,307	$21,803	$43,110
Manuf./Ind.	$2,053	$6,464	$8,517
Public	$6,529	$2,055	$8,584
TOTAL	$208,292	$132,543	$340,835
Structure Type	**50-Year**		
SFR	$131,896	$76,541	$208,437
MFR	$10,150	$5,024	$15,173
MH	$0	$0	$0
Commercial	$17,322	$17,862	$35,184
Manuf./Ind.	$1,491	$5,180	$6,671
Public	$4,546	$6,389	$10,935
TOTAL	$165,406	$110,995	$276,401
Structure Type	**25-Year**		
SFR	$118,912	$69,707	$188,619
MFR	$8,612	$4,613	$13,225
MH	$0	$0	$0
Commercial	$13,988	$15,262	$29,250
Manuf./Ind.	$1,347	$3,600	$4,947
Public	$3,568	$1,344	$4,913
TOTAL	$146,427	$94,526	$240,953

All dollars in thousands.

Figure 3 below graphically depicts the without-project damages to structures and contents by frequency event. The total without-project expected annual damages (EAD), which is the sum of the area below the damage curve in the figure below, is $18.2 million.

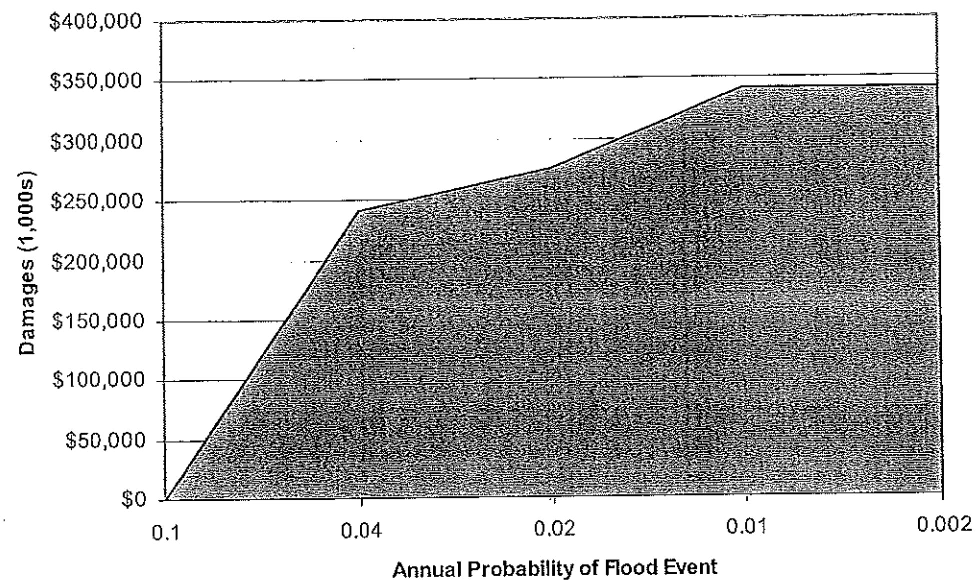

Figure 10: Without-Project Damages by Frequency

Damages Not Estimated

As stated previously, damage to structures and their contents is expected to constitute the vast majority of total economic damages from flooding as a result of a levee breach in this area. For this reason, and because they are two damage categories that are most readily quantifiable, the damage estimate was limited to these two categories. There are numerous other damage categories that were not included in the analysis however. These include both physical and non-physical costs, for which in many cases there are few commonly accepted generalized functions similar to what exists for structure and content damages. These other categories include structure dewatering and cleanup costs, temporary relocation costs incurred on residents, vehicle damage, emergency costs associated with the flooding, traffic delay and detour costs, and non-recoverable income losses to businesses (such as the destruction of perishable items such as food).

With-Project Damage to Property from Flooding

The proposed plan includes stockpiling sufficient quantities of rock suitable for flood fighting and protecting a 1,000' foot long section of the levee, extending an existing pilot channel to redirect low flows from critical areas where flow impingement is an ongoing problem, and developing a detailed flood fighting plan to address mobilization and execution of flood fighting. It is estimated that the implementation of these measures will reduce the probability of a levee breach in the study area, and that over the course of the project's life the measures would enable the levee to withstand a storm corresponding to a range of between a 25-year and 50-year magnitude, which are storms that have a four percent and two percent chance of occurring in any one year, respectively.

Figures 4 and 5 below show the frequency-damage curves for a 25-year and 50-year level of protection, respectively. The EAD associated with each of these protection levels is $8.6 million and $4.3 million, respectively. This EAD can be considered the residual damages associated with the implementation of the emergency measures, depending on the actual level of protection provided by the project.

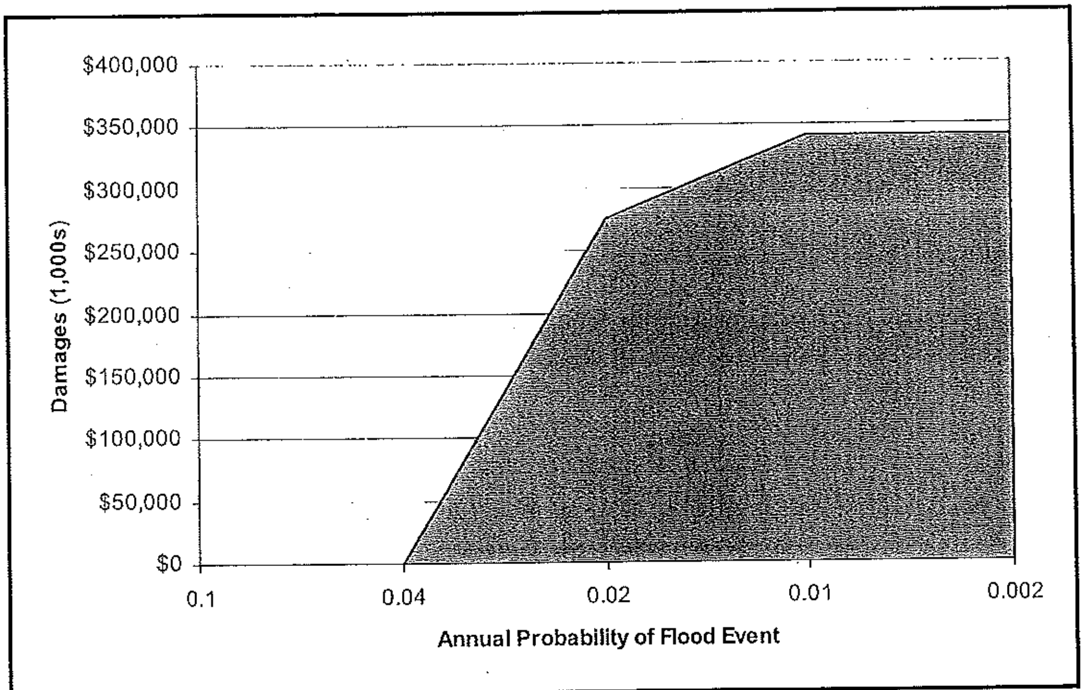

Figure 11: With-Project Damages, 25-Year Protection Level

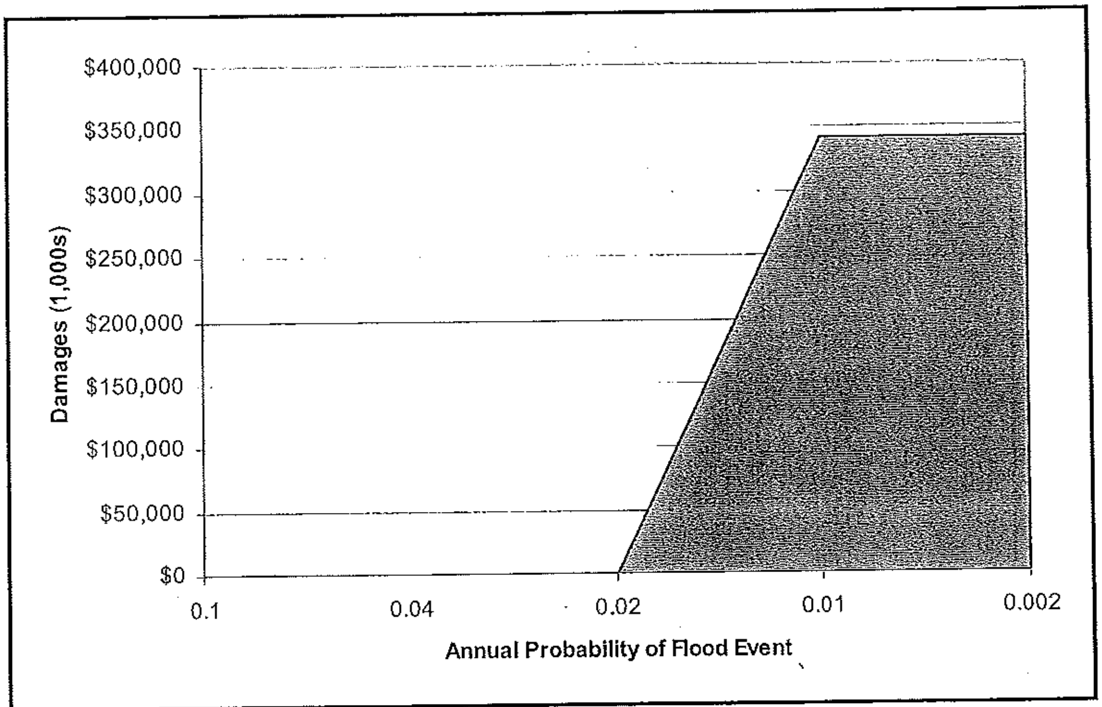

Figure 12: With-Project Damages, 50-Year Protection Level

Averaging the damage reduction that is associated with these two protection levels, the reduction in EAD totals just over $11.7 million. The table below shows the difference in damages between the without- and with-project conditions, and shows the reduced and residual EAD associated with the project. As the table shows, the project is expected to provide benefits at the 25- and 50-year event frequency, but is assumed to provide no benefits for events larger than the 50-year event. Again, because the project is expected to be effective for frequency events between the 25- and 50-year, the final with-project damage reduction incorporates the average of the damage reduction between these two protection levels.

Table 8: With-Project Damages & Damages Reduced

Frequency Event	Without-Project Damages	With-Project Damages			With-Project Damage Reduction
		25-Year Protection	50-Year Protection	Average of 25- and 50-Year	
0.1	$0	$0	$0	$0	$0
0.04	$241,000	$0	$0	$0	$241,000
0.02	$276,000	$276,000	$0	$138,000	$138,000
0.01	$341,000	$341,000	$341,000	$341,000	$0
0.005	$341,000	$341,000	$341,000	$341,000	$0
EAD	$18,213	$8,573	$4,433	$6,503	$11,710

All damages in thousands.

Net Benefits of the Emergency Measures

As stated previously, it is estimated that the completion of these features will reduce the probability of a levee breach in the study area, and that over the effective life of the project the non-damaging storm event will be increased to a level between the 25 and 50-year event. As explained previously, the emergency measures are assumed to have an effective life of five years, and are expected to cost $730,000 to implement. Using a five-year period of analysis and an interest rate of 4.875%, the annualized cost of the project is $168,000. The annual benefits are $11.7 million, which results in annual net benefits of over $11.5 million and a benefit to cost ratio of 70. According to this analysis, there is strong economic justification for implementation of the emergency measures to reduce the risk of flood damages in the project area.

Table 9: Net Benefits and B/C

Average Annual Benefits	Annualized Cost	Annual Net Benefits	B/C
$11,710,000	$168,029	$11,541,971	70

APPENDIX D

Documentation of Public Sponsor's Contribution

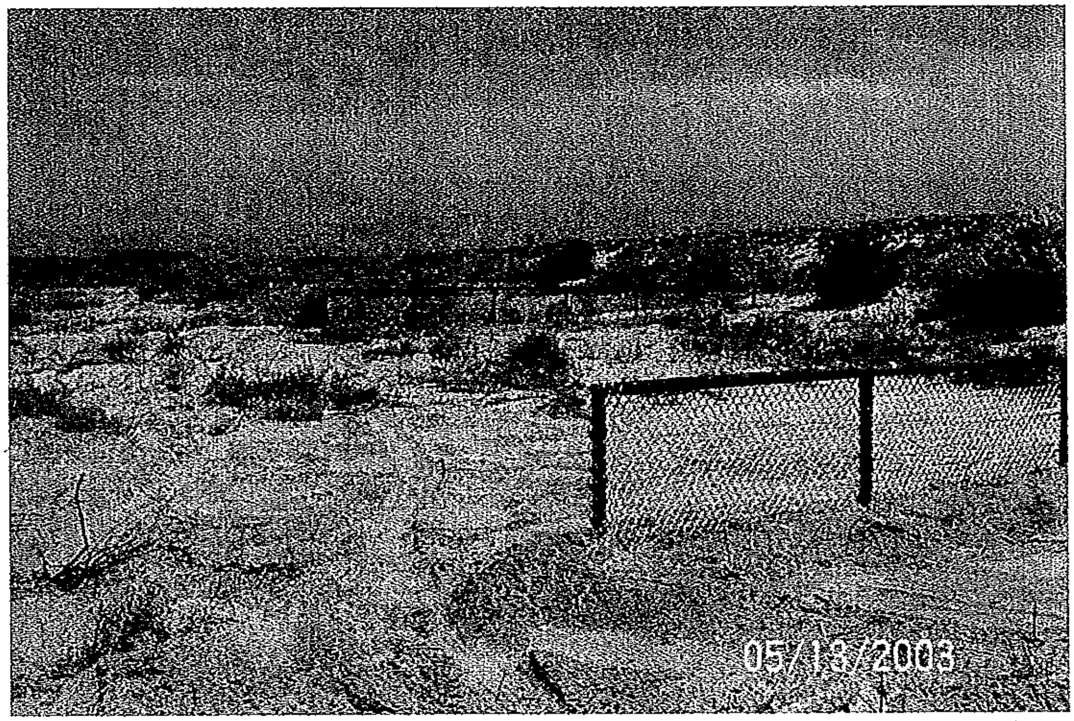

Figure D-1: Santa Barbara County Installs Pipe & Wire Groins in 2003

Figure D-2: County Begins Planting of Willows in 2003

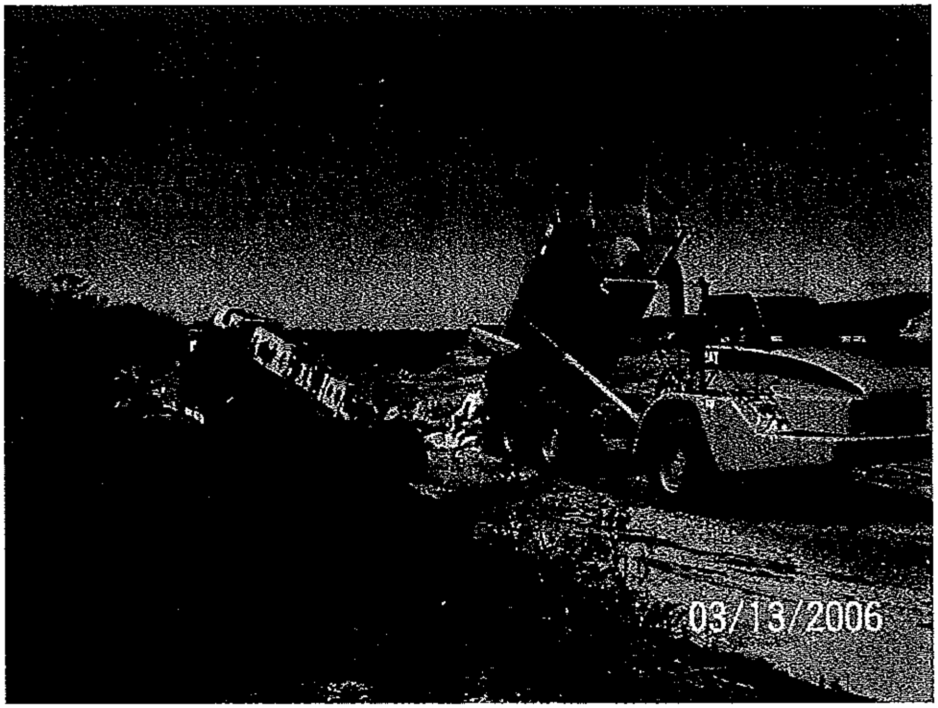

Figure D-3: County Places Heavy Rock Reinforcement in Spring 2006

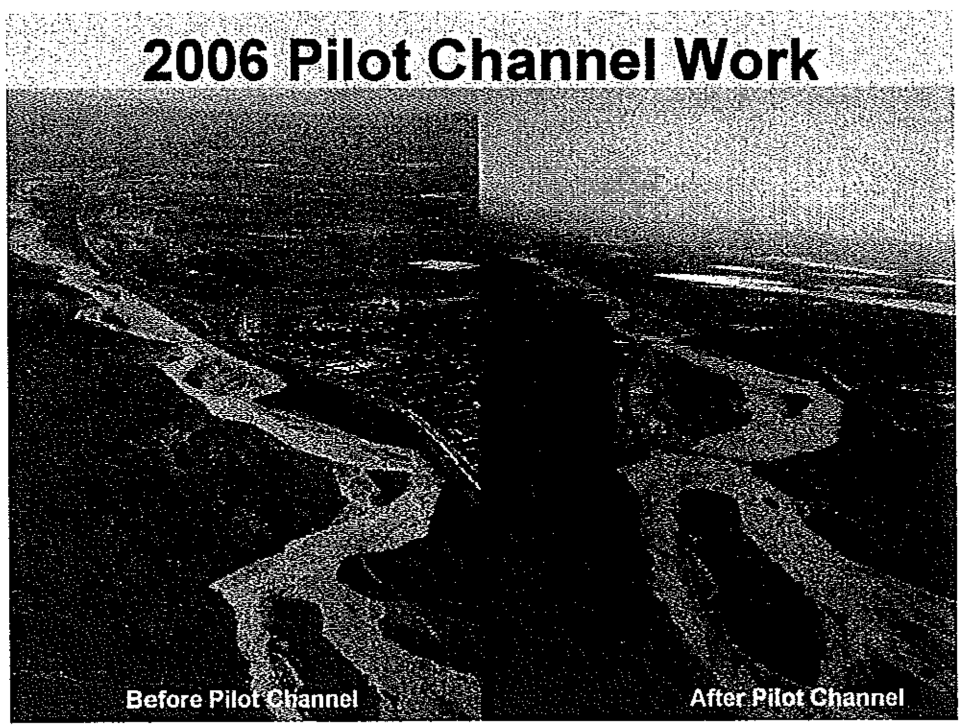

Figure D-4: County Constructs Pilot Channel in Fall 2006

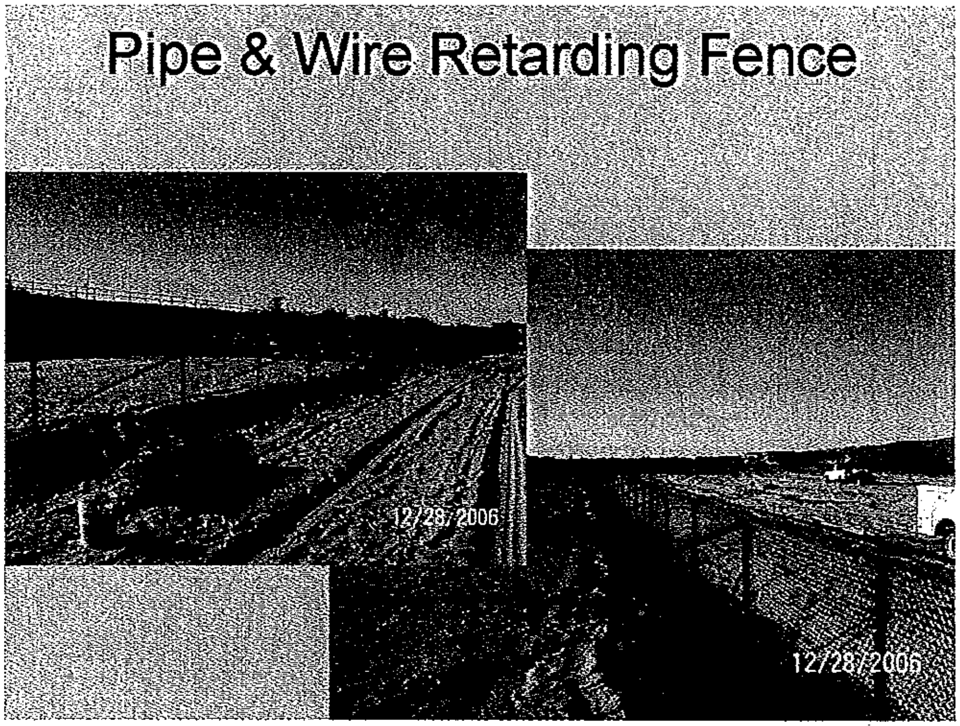

Figure D-5: Cooperative Project between County and State of California
Winter 2006/2007

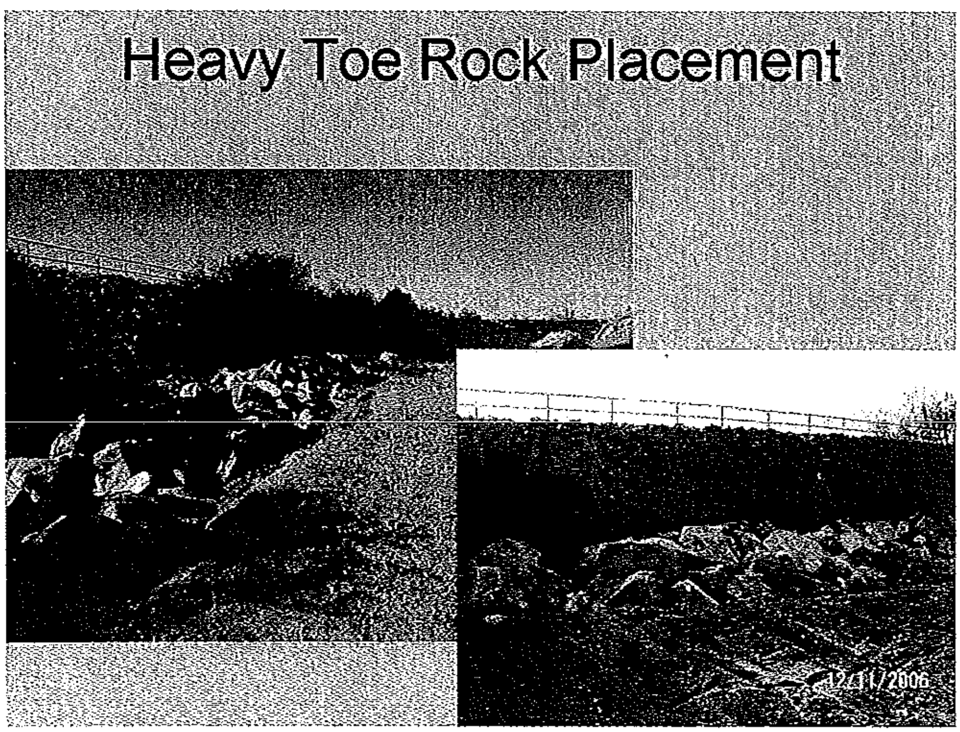

Figure D-6: Cooperative Project between County and State of California
Winter 2006/2007

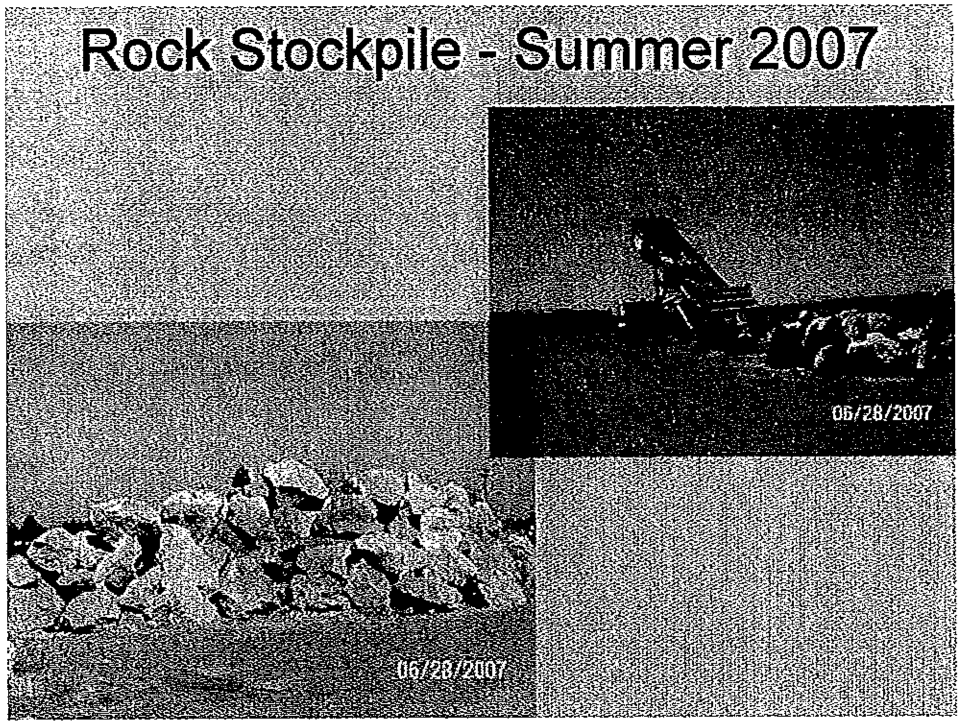

Figure D-7: City of Santa Maria Stockpiles Large Rock

APPENDIX E

Environmental and Permit Data

Memorandum for the Record September 14, 2007

Subject: Santa Maria Levee Protection, Advance Measures

Project Description:

The County of Santa Barbara Flood Control Department proposes to implement the following measures within the Santa Maria River in order to reduce the likelihood of catastrophic flooding within the City of Santa Maria: 1) the construction of a 100-foot-wide, 4-foot-deep pilot channel, beginning at the Sucy Road River crossing and extending 3,650 feet downstream; 2) the re-use of the pilot channel material to build a berm upon a historic flood terrace along the south side of the floodplain, running the length of the pilot channel; 3) the stockpiling of large riprap at several (3) locations behind the existing Levee; and, 4) the discharge of the stockpiled riprap at (future) locations where the Levee has been damaged or breached.

Environmental Conditions:

The proposed pilot channel location is in a low gradient reach of the lower Santa Maria River. Surface flow is absent, which is typical of this reach at this time of year. There are two channels identified in the project reach, a "low-flow" dominant channel on the north edge of the floodplain and a secondary channel in the middle of the floodplain that appeared to be activated regularly. With the exception of a narrow (10-foot-wide) band of vegetation that meanders through the dominant channel, both channels are predominantly devoid of vegetation. Vegetation present is characterized by a relatively limited number of young alluvial scrub species, consisting of mulefat (*Baccharis salicifolia*), Spanish broom (*Spartium junceum*), and sandbar willow (*Salix exigua*), as well as introduced grasses, including ripgut brome (*Bromus diandrus*) and soft chess (*Bromus mollis*).

The pilot channel material is proposed for re-use at an adjacent location, to the south of the pilot channel, in order to further protect the levee. Material would be removed from the pilot channel and then dumped onto a historic terrace, creating a low berm that would run approximately the length of the pilot channel. Actual dimensions of the berm are to be determined. The vegetation upon the terrace is dense scrub and is well established, comprised predominantly of coastal sage scrub species and a few alluvial scrub species. Dominant species include coyote brush, chamise (*Adenostoma fasciculatum*), coast goldenbush (*Isocoma menziesii*), spanish broom, sandbar willow, and mulefat, as well as introduced grasses. Adverse effects to wildlife are expected to be minor to moderate, as the area covered could be up to 4 acres (3,500 feet-long x 50-feet-wide). Impacts would likely be restricted to several species of small burrowing mammals and reptiles. However, the County intends to conduct pre-construction surveys for sensitive species within the berm footprint and its vicinity, seeking to reduce wildlife impacts as much as possible.

There are currently three designated rock storage locations, spread over a three mile reach of the Santa Maria River. These locations have been chosen because of their immediate proximity to a three-mile-long stretch of residential developments that back up to the Levee. The storage areas are used regularly by various entities (i.e., City of SM, County FC, USACE) for staging and stockpiling, and are entirely absent of vegetation and wildlife habitat.

The Corps staff biologist also visited several locations along the north and south Levee where damage or breaching has occurred in the recent past (i.e., last 10 years). The Levee has been repaired or rebuilt in these locations, and at one location (terminus of Carlotti Drive) was further protected by additional, large toe rock and pipe and wire revetment. These areas continue to remain in the path of the dominant "low-flow" channel and therefore are predominantly devoid of vegetation and wildlife habitat. For the same reason, these areas may be at greater risk during future large flow events. In the areas visited, a low, narrow (10-foot-wide) bench occurs along the levee toe, vegetated by a strip of maturing alluvial scrub and drier species, including sandbar willow, mulefat, coyote brush (*Baccharis pilularis*) and tree tobacco (*Nicotiana glauca*).

Corps Regulatory had previously determined that the pilot channel project would have no effect on the Federally-endangered southern steelhead or its designated critical habitat. This determination was based upon the absence of the species and its suitable rearing/spawning habitat within the project area or its vicinity, the timing of the project (late summer/fall), and the implementation of several additional avoidance and minimization measures, including pre-project biological surveys.

Permit Requirements:

Santa Barbara County has obtained approval of the pilot channel project from the following Regulatory agencies:

- USACE Regulatory, nationwide permit (NWP) authorization (NWP31, *maintenance of existing flood control facilities*), (August 8, 2007).
- Central Coast Regional Water Quality Control Board, conditioned water quality (section 401) certification (dated August 10, 2007).
- California Department of Fish and Game, Streambed Alteration Agreement (dated August 1, 2007).

Santa Barbara County is seeking approval of the berm project from the following Regulatory agencies*:

- California Department of Fish and Game, amendment to existing Streambed Alteration Agreement.

*The County will be placing this material in "uplands", located landward of the Ordinary High Water Mark (limit of USACE Regulatory jurisdiction), and will therefore not need permit authorization from USACE Regulatory, and likely not from the Regional Board as well. With the exception of a 900-linear-foot section at the downstream end of the project area, USACE Regulatory staff designated the OHWM boundary in the field (see attachment). Regulatory staff will coordinate with the County to ensure that the entire berm will be located outside of Regulatory's jurisdiction.

As the stockpile locations are located on the backside of the Levee, upon either City or County property, there are no permit requirements for this element of the project. Should the County need to utilize adjacent private lands to stockpile additional material or equipment, the County will obtain the appropriate permissions.

Should the County need to place/dump rock on the River-side of the levee (e.g., to replace eroded toe), the abovementioned agencies (including USACE Regulatory) should be notified. If threat to life, property, and/or public services has occurred or appears imminent, USACE Regulatory is able to authorize such activities under an emergency general permit (i.e., Regional General Permit No. 63), provided that the actions are the "minimum necessary to alleviate the existing emergency."

Prepared by:

J. Markham

John W. Markham, M.P.H.
Project Manager
North Coast Branch
Regulatory Division

Enclosures

Cc: Larry Fausett and Maureen Spencer (Santa Barbara County Flood Control)

Department of Public Works
County of Santa Barbara

Legend

- Potential Pilot Chnl HWY 1
- PilotChannel100ft
- roads
- Existing sediment basin
- Potential Sediment Basins
- Proposed Rock Rip-rap
- parcel_layers

SANTA BARBARA COUNTY
FLOOD CONTROL AND
WATER CONSERVATION DISTRICT
123 E. ANAPAMU STREET
SANTA BARBARA, CA 93101
(805) 568-3440

Santa Maria River Levee

Interim Measures Plan


USACE

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

SANTA BARBARA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
STANDARD CONDITIONS OF PROJECT PLAN APPROVAL

1. Hydrologic studies shall be made of the entire watershed area contributing drainage to the project. Both calculations and clearly marked watershed maps shall be submitted at the plan check submittal for approval by the Flood Control Engineer. Contributing areas are based on natural contours or an accepted master drainage plan. Drainage quantities shall be derived from considerations of expected future development of the watershed, soil types, historical storm data, gradient of terrain, etc. These considerations must receive approval by the Flood Control Engineer. For most major channels, flow quantities may be supplied by the Flood Control Engineer if available. The Hydrologic studies shall provide pre-development and post development analysis for 5 through 100 year storm events. New development shall mitigate for increased runoff by directing drainage to an acceptable watercourse, improving downstream facilities, or by mitigating the increased runoff on-site at the discretion of the Flood Control Engineer.

2. Improvements may be required to intercept and convey off-site and on-site runoff through the project site to a District approved water course or drainage facility.

3. Watercourses shall be placed in closed conduits where the flow requires pipe diameter of 48 inches or less. Artificial water courses which convey runoff generated within the tract shall be in a closed conduit regardless of size.

4. Storm drains and drainage inlets shall be sized for a peak 25-year runoff event with a positive overland escape design for a 100-year storm. Minimum size for Storm Drains shall be 18 inches unless otherwise approved by the Flood Control Engineer.

5. Storm drains and drainage inlets in sump conditions shall be sized for a 100-year storm and shall provide positive overland escape.

6. Drainage inlets shall be designed and located in a manner which will assure adequate travel lanes with no more than 10 cfs conveyed per gutter, within the curbs, in a 10-year storm. A 25-year storm flows should be contained within the curbs; 100-year storm flows should be contained within the right-of-way or private street easement.

7. Development located within the limits of floodplain/floodway as shown on the current Federal Insurance Rate Maps (FIRM) may be required to process a FIRM map revision/amendment prior to land use clearance and/or recordation of a final map. Development within the floodplain/floodway as shown on the current FIRM maps shall meet all requirements in the County's Floodplain Management Ordinance No. 3898 and the County's Setback Ordinance No. 3095.

8. Grading and improvement plans for drainage improvements signed by a civil engineer shall include the following information:

a) The Design energy and hydraulic grade lines shall be on the Improvement or Underground Storm Drain profiles. Junction losses are to be calculated by a momentum analysis.

b) The 100-year Energy and Hydraulic Grade Line shall be shown on plans and profiles for open channel designs.

c) Hydraulic data shall be included on engineering plans for all drainage channel, pipes, etc. as required by the Flood Control Engineer.

d) Storm drain center lines and drainage inlet locations shall be identified on the Grading Plans.

e) Hydraulic/hydrologic studies shall be prepared and signed by the California Registered Engineer who signs the improvement plans. The use of District computer programs for designing drainage improvements and retention basins is encouraged.

9. Projects shall be designed with a clearly defined permanent overland escape path (preferably a street) for storm runoff. The escape path should be free of obstructions such as fencing, sound walls, etc. Downhill sump cul-de-sacs shall have an improved dedicated overland escape.

10. Pursuant to County Ordinance 3898, the lowest finish floor elevation of all new structures shall be at least 2 feet above the 100 year water surface elevation. Graded lot pads with slab on grade foundations shall be at least 1.5 feet above the 100-year water surface elevation, with finish floor 2' above 100 year elevation. Finish floor elevations may be increased if deemed necessary by the Flood Control Engineer. Finish floor elevations shall be higher than overland escape of adjacent streets, bridges and other obstructions.

11. Retention basins are required by the District in the Orcutt/Santa Maria area to reduce peak runoff generated from the development site. Basins are also required for Greenhouse Development. Basins may be required in other areas of the County if downstream facilities are determined to be inadequate by the Flood Control Engineer. Basins shall be designed to meet the following standards:

a) Greenhouses: Retention Basins are required for greenhouse development. Basins shall provide retardation for the 5 through 100 year storm events, where appropriate. Post-development runoff shall not exceed 75 percent of the calculated pre-development runoff.

b) Hydraulic Analysis: The hydraulic analysis of retention basins shall be performed by a Registered Civil Engineer using the Santa Barbara Urban Hydrograph Computer Program or District approved equivalent. The Santa Barbara Urban Hydrograph (SBUH) computer program is available from the District under a license agreement.

c) Volume: Retention Basins shall be sized to provide capacity for a 25 year storm event (minimum) and to meet the outflow requirements listed below. Generally, the minimum volume provided should not be less than .07 acre feet per acre for residential developments, or .10 acre feet per acre for commercial developments for sites that are 3 acres or less. Sites greater than 3 acres shall be designed with the SBUH computer program. The volume capacity for retention basins may be increased as determined by the Flood Control Engineer based upon downstream conditions.

d) Outflow Device: All retention basins are to be designed to be free draining. Inlet structures shall be located next to the outlet structure where feasible. Terminal basins (i.e. pumped basins) are not allowed. Outlet pipes shall be oversized (18 inch minimum) with an orifice restriction to limit outflow to .07 cubic feet per second per acre of developed land or as determined by the Flood Control Engineer. Orifice restriction plates shall be removable for emergency situations. A removable trash rack shall be provided at the outlet. Orifice plates and trash racks shall be galvanized. Mounting hardware shall utilize stainless steel bolts.

e) Slopes: Maximum side slopes shall be four horizontal to one vertical on interior slopes and two horizontal to one vertical on exterior slopes. A District-approved soil cement core mix design, or a two sack slurry trench shall be required on all filled levee sections. A soils engineering and geotechnical engineering report shall be provided for all fill levee sections. The report shall address remedial grading, benching, and slope stability of the level sections.

f) Emergency Overflow: An emergency overflow spillway shall be sized for the peak 100 year storm runoff. The spillway shall be engineered and shall be reinforced concrete. The spillway should be designed with a minimum of 1'0" of freeboard above the 100 year spill water surface elevation.

g) Low flow drainage: The bottom of the basin shall have a minimum gradient of 2% draining to the outlet; or a low flow reinforced concrete swale shall be provided with a minimum gradient of .5% draining to the basin outlet.

h) Access Ramp: A graded 16' wide maintenance access ramp shall be provided down into the basin near the outlet. A 16' wide commercial driveway approach shall be provided where curb and gutter front the maintenance ramp.

i) Fencing: Perimeter fencing (minimum height of 42 inches) shall be required on all basins exceeding two feet in depth or where interior side slopes are steeper than six horizontal to one vertical. A double eight foot wide swing gate (16 feet total) shall be provided at the access ramp.

j) Landscaping: The Flood Control District shall require review and approval of any proposed basin landscape plan. Landscape planting shall be selected to be as maintenance free as possible. No trees and /or shrubs are to be planted within 15 feet of the basin outlet. Floating objects such as railroad ties and landscape bark are not permissible.

k) Maintenance: Prior to recordation of the final map or final development approval, the applicant shall enter into a maintenance agreement with the District to assure perpetual maintenance of the basin and related on-site private drainage improvements and to allow the County emergency access. A copy of the CC&R's shall be submitted to the District for approval. Maintenance of the basin is the responsibility of the development.

12. A Plan Check fee deposit made payable to the Santa Barbara County Flood Control and Water Conservation District shall accompany the initial Grading and/or Improvement plan submittal. The plan check fee deposit shall be the amount as shown in the current District fee schedule.

13. Where drainage waters are discharged from the project site in a concentrated manner, e.g. streets, channels, culverts, such drainage shall be conveyed to established water courses in a non-erosive manner. Easements for off-site drainage conveyances shall be acquired and presented to the Flood Control office prior to recordation or zoning clearance. A title report shall accompany these easements.

14. Easements, fencing, grading, etc. for Flood Control facilities, access roads and ramps shall be provided in accordance with current policies of the Flood Control District. Easements shall be dedicated on the Final Map or dedicated by a separate instrument. The cost for easement acceptance by the District and processing with the Real Property Department will be paid by the Developer.

15. A Surety Bond for drainage improvements will be posted with the Public Works Department in an amount approved by the Flood Control Engineer prior to recordation of the Final Map or Zoning Clearance. Bond amounts will be based on the submitted cost estimates of proposed drainage improvements to be constructed outside the Public Road right-of-way.

16. One copy of District approved Grading and/or Drainage Plans, and Improvement Plans and Final Map shall be submitted on aperture cards as well as one copy of signed prints of the same shall be furnished to the District prior to recordation or zoning clearance.

17. The Flood Control District shall be notified 5 working days in advance of storm drain and attendant auxiliary construction. The District may provide periodic inspection during construction. A note shall be placed on the plans to this effect.

18. The California Registered Civil Engineer that signs the Grading and/or Improvement Plans shall be responsible for the inspection of drainage improvements located outside the Public Road right-of-way. When required, special inspection will be performed for construction of drainage facilities. An inspection fee deposit agreement along with an inspection fee deposit will be required. Inspections will be charged at an hourly rate against the deposit. A note shall be placed on the Grading and/or Improvement Plans to this effect.

19. A Drainage Improvement Certification will be required prior to occupancy clearance. The District certification form requires that the California Registered Engineer certify that all drainage improvements (i.e. ditches, swales, channels, storm drains, drainage inlets, junctions, retention basins, revetment, etc.) were constructed in substantial conformance with the approved Plans. A note shall be placed on the plans to this effect.

20. During the construction process, the District will review and approve in writing any significant design revisions to the approved Plans prior to construction of the proposed revisions.

21. Prior to occupancy clearance, the "As-Built" Plans shall be submitted to the Santa Barbara County Flood Control and Water Conservation District.

22. A Flood Control Encroachment Permit is required for improvements in the Flood Control District right-of-way. An Encroachment Permit shall be executed prior to the start of construction within District right-of-way. District notification shall be required 5 working days prior to the start of construction. An Encroachment Permit fee is required. A note shall be placed in the plans to this effect.

23. Review by the District of plans and granting of encroachment permits does not relieve the applicant, developer, contractor and/or owner from the responsibility to obtain all other required permits and approvals required by law, including but not limited to grading permits, building permits, environmental review for CEQA/NEPA requirements, Fish & Game permits, Army Corps of Engineers permits and other City, CalTrans or other County department approvals and the approval of the underlining property owner(s) of record.

24. The District reserves the right to modify these conditions as site conditions warrant.

Filename: SANTA BARBARA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
Directory: G:\WATER_AG\ProjCleanWater\Storm Water Management Program\Annual Reporting\Annual Report Yr 1\Chapter 5.0 Appendices
Template: H:\Office2003\Templates\Normal.dot
Title: SANTA BARBARA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
Subject:
Author: mparker
Keywords:
Comments:
Creation Date: 8/27/2007 2:58:00 PM
Change Number: 1
Last Saved On: 8/27/2007 2:59:00 PM
Last Saved By: mparker
Total Editing Time: 1 Minute
Last Printed On: 8/27/2007 3:01:00 PM
As of Last Complete Printing
Number of Pages: 4
Number of Words: 1,964 (approx.)
Number of Characters: 11,197 (approx.)

- 25 year wetland and Capital Improvement Plan (CIP).
- 1D.93 x ID.91 under Hydraulic Grade Line (HGL) high
- Reservoir diameter 24 and 30 respectfully
- 1D.90 submerged (urban area)
- 1D.96 working full capacity
- 1D.65.66 condition submerged and possible flooding of streets
- Larger diameter 36" – 42"?

STORM DRAIN MASTER PLAN GUADALUPE CA
RM ASSOCIATES
C.I.P. & Wetlands sys.combo 25yr Sto.

SD25yCmb 2/11/2008 11:28:55 AM

System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 109											
109 25	109	MAN	4.00	76.50 76.50	73.50 73.50			4.66 0.00		76.50 86.77	No
90 26	90	EPI	390.40	76.50 86.00	75.00 74.50	0.0013	18	4.66 2.64	3.539 -1.121	86.21 86.00	Yes
Lateral Starting at Entity 111											
111 27	111	MAN	4.00	94.10 94.10	91.10 91.10			89.57 0.00		94.10 153.32	No
92 28	92	EPI	418.77	94.10 88.00	89.00 83.00	0.0143	24	89.57 28.51	25.492 -64.074	90.41 88.00	Yes
112 29	112	MAN	4.00	88.00 88.00	83.00 83.00			89.16 0.00		88.00 279.32	No
93 30	93	EPI	1,250.81	88.00 76.00	83.00 74.50	0.0068	24	89.16 28.38	17.556 -71.599	130.54 86.00	Yes
108 31	108	MAN	4.00	86.00 86.00	74.50 74.50			138.12 0.00		86.00 151.12	No
91 32	91	EPI	599.32	86.00 83.50	74.50 73.50	0.0017	30	138.12 28.14	15.773 -122.350	138.76 83.50	Yes
110 33	110	MAN	4.00	83.50 83.50	73.50 73.50			154.41 0.00		83.50 106.06	No
94 34	94	EPI	573.24	83.50 78.00	73.50 72.50	0.0017	36	154.41 21.84	26.226 -128.181	76.87 75.50	Yes
113 35	113	MAN	4.00	78.00 78.00	72.50 72.50			153.49 0.00		73.94 73.94	-4.06
105 36	105	EPI	267.45	78.00 78.00	72.50 66.00	0.0243	300	161.48 14.34	27,943.574 27,782.097	73.94 67.44	No

Lateral Starting at Entity 80

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
47		MAN	4.00	82.90	73.30			39.89		74.60	-8.3
1	80			82.90	73.20			0.00		74.60	
46		EPI	407.21	80.00	73.30	0.0327	300	48.13	10,528.033	74.60	No
2	67			78.00	60.00			5.07	10,479.901	61.30	
48		RES	0.00	60.00	60.00			27.38		60.00	No
3	81			60.00	72.50			0.00		60.00	
54		EPI	0.10	78.00	72.50	1.6	36	27.38	258.133	74.74	No
4	70			80.00	72.34			21.06	230.749	74.74	
53		MAN	4.00	80.00	72.34			27.30		74.74	-5.26
5	84			80.00	72.24			0.00		74.74	
52		EPI	80.08	80.00	72.34	0.0022	36	27.30	29.770	74.74	No
6	69			80.00	72.16			4.54	2.466	74.68	
50		MAN	4.00	80.00	72.16			27.30		74.68	-5.32
7	82			80.00	72.06			0.00		74.68	
49		EPI	207.28	80.50	72.16	0.0008	300	29.85	1,618.489	74.68	No
8	68			81.30	72.00			1.16	1,588.642	74.52	
51		RES	0.00	72.00	72.00			34.11		72.00	No
9	83			72.00	72.00			0.00		72.00	
55		EPI	248.82	81.30	72.00	0.0048	36	34.11	14.172	81.03	Yes
10	71			82.00	70.80			4.83	-19.936	74.90	
43		MAN	4.00	81.30	70.80			34.07		74.90	-6.4
11	79			81.30	70.70			0.00		74.90	
42		EPI	40.00	82.00	70.80	0.0075	36	34.07	54.379	74.80	Yes
12	64			82.00	70.50			7.41	20.307	74.80	
32		MAN	4.00	82.00	70.50			34.05		74.80	-7.2
13	72			82.00	70.40			0.00		74.80	
31		EPI	392.11	82.00	70.50	0.0046	300	34.45	3,946.957	74.80	No
14	60			74.80	68.70			2.29	3,912.506	74.80	
33		MAN	4.00	74.80	68.70			34.98		74.80	No
15	73			74.80	68.60			0.00		74.91	
44		EPI	40.00	74.80	68.70	0.0075	36	34.98	54.379	74.80	Yes
16	65			74.80	68.40			7.49	19.401	74.80	
35		MAN	4.00	74.80	68.40			34.98		74.80	No
17	74			74.80	68.30			0.00		75.94	
34		EPI	293.49	74.80	68.40	0.0041	36	35.79	40.151	75.43	Yes
18	61			75.10	67.20			6.07	4.363	75.10	
36		MAN	4.00	75.10	67.20			36.80		75.10	No
19	75			75.10	67.10			0.00		75.22	
45		EPI	40.00	75.10	67.20	0.0075	36	36.80	54.379	75.17	Yes
20	66			75.10	66.90			7.60	17.582	75.10	
38		MAN	4.00	75.10	66.90			37.05		75.10	No
21	76			75.10	66.80			0.00		75.25	
37		EPI	374.94	75.10	66.90	0.0048	48	37.21	93.698	75.00	Yes
22	62			75.00	65.10			6.26	56.491	75.00	
39		MAN	4.00	75.00	65.10			38.91		75.00	No
23	77			75.00	65.00			0.00		86.77	
40		EPI	3,479.25	75.00	65.10	0.0006	300	38.91	1,464.871	86.77	No
24	63			68.00	62.90			1.17	1,425.960	86.77	

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 85											
56 37	85	EPI	357.93	78.00 78.00	75.00 75.00	0	24	0.00 0.20	0.000 0.000	75.00 75.00	No
87 38	87	RES	0.00	66.00 66.00	66.00 68.00			55.16 0.00		66.00 66.00	No
104 39	104	EPI	0.10	78.00 78.00	68.00 72.42	-44.2	36	55.16 7.80	0.000 0.000	76.89 76.89	Yes
115 40	115	MAN	4.00	78.00 78.00	72.42 72.42			55.16 0.00		76.89 76.89	-1.11
95 41	95	EPI	146.99	78.00 80.50	72.42 72.34	0.0005	36	55.16 7.80	14.649 -40.509	76.89 75.89	Yes
114 42	114	MAN	4.00	80.50 80.50	72.34 72.34			55.15 0.00		75.89 75.89	-4.61
96 43	96	EPI	107.47	80.50 80.50	72.34 72.16	0.0017	36	55.15 7.80	25.697 -29.457	75.41 75.16	Yes
116 44	116	MAN	4.00	80.50 80.50	72.16 72.16			55.15 0.00		74.62 74.62	-5.88
97 45	97	EPI	290.76	80.50 82.00	71.50 70.80	0.0024	48	55.15 5.54	66.352 11.201	74.62 74.62	No

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
					Lateral Starting at Entity 86						
57		EPI	340.12	82.00	74.00	0.0103	24	0.00	21.604	74.62	No
46	86			82.00	70.50			0.20	21.604	74.62	
88		MAN	4.00	82.00	70.50			55.15		74.62	-7.38
47	88			82.00	70.50			0.00		74.62	
98		EPI	83.40	82.00	70.80	0.0036	36	55.15	37.660	74.62	Yes
48	98			82.00	70.50			7.80	-17.485	74.06	
119		MAN	4.00	82.00	70.50			55.14		74.06	-7.94
49	119			82.00	70.50			0.00		74.06	
101		EPI	312.78	82.00	70.50	0.0058	48	55.14	102.587	74.06	Yes
50	101			74.80	68.70			7.52	47.445	73.60	
123		MAN	4.00	74.80	68.70			55.13		73.60	-1.2
51	123			74.80	68.70			0.00		73.60	
102		EPI	40.00	74.80	68.70	0.0075	48	55.13	117.113	73.60	Yes
52	102			74.80	68.40			8.23	61.978	73.54	
106		MAN	4.00	74.80	68.40			55.12		73.54	-1.26
53	106			74.80	68.40			0.00		73.54	
89		EPI	256.73	74.80	68.40	0.0047	48	55.12	92.453	73.54	Yes
54	89			75.10	67.20			7.00	37.333	73.16	
107		MAN	4.00	75.10	67.20			56.99		73.16	-1.94
55	107			75.10	67.20			0.00		73.16	
103		EPI	40.00	75.10	67.20	0.0075	48	56.99	117.112	73.16	Yes
56	103			75.10	66.90			8.32	60.125	73.10	
122		MAN	4.00	75.10	66.90			57.80		73.10	-2
57	122			75.10	66.90			0.00		73.10	
100		EPI	735.37	75.10	66.90	0.0024	48	57.80	66.905	73.10	Yes
58	100			75.00	65.10			5.65	9.103	71.92	
120		MAN	4.00	75.00	65.10			57.75		71.92	-3.08
59	120			75.00	65.10			0.00		71.92	
99		EPI	3,118.79	75.00	65.10	0.0007	48	57.75	35.916	69.30	Yes
60	99			68.00	62.90			4.60	-21.837	66.90	

CIP, wetland, and combo 25 year streams

- Storage under capacity in wetland area
- System stressed at reservoir CIP capacity to hold water for piping

25 year reservoir volume

Diversion of water between railroad and Guadalupe to new system, elevates downstream 36" diameters

STORM DRAIN MASTER PLAN GUADALUPE CA
RM ASSOCIATES
C.I.P. & Wetland cmb 25yr sto Org_Vol_RES. Calc

SD25yCmb

Reservoirs - Sorted by User's ID

UserID SEQ	G_ID	Rim Elev	Inverts In/Over/Out	Over ID	DesignQ In/Over/Out	Reservoir Cap Max/Stored	HGL Up/Dn	Surcharge
48		60.00	60.00	37	52.67	800,000.00	60.00	No
3	81		72.50		0.00	111,294.41	60.00	
			72.50		27.38			
51		72.00	72.00	46	48.06	327,740.00	72.00	No
9	83		72.00		0.00	139,031.46	72.00	
			72.00		34.11			
87		66.00	66.00	0	160.60	612,370.00	66.00	No
38	87		68.00		0.00	560,472.07	66.00	
			68.00		55.16			

STORM DRAIN MASTER PLAN GUADALUPE CA
RM ASSOCIATES
C.I.P. & Wetlands combo 25yr Sto. RES calc.

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SD25allV

Reservoirs - Sorted by User's ID

UserID SEQ	G_ID	Rim Elev	Inverts In/Over/Out	Over ID	DesignQ In/Over/Out	Reservoir Cap Max/Stored	HGL Up/Dn	Surcharge
48		60.00	60.00	37	52.67	9,000,000.00	60.00	No
3	81		72.50		0.00	111,294.41	60.00	
			72.50		27.38			
51		72.00	72.00	46	48.06	9,000,000.00	72.00	No
9	83		72.00		0.00	139,031.46	72.00	
			72.00		34.11			
87		66.00	66.00	0	160.60	9,000,000.00	66.00	No
38	87		68.00		0.00	560,472.07	66.00	
			68.00		55.16			

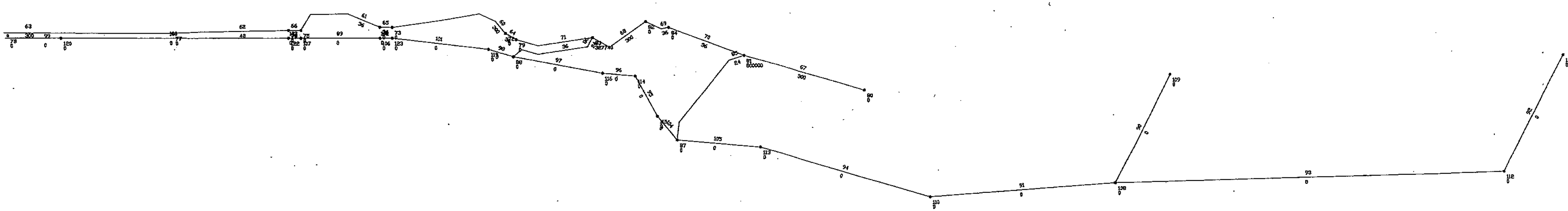
SD25RvrV

Reservoirs - Sorted by User's ID

UserID SEQ	G_ID	Rim Elev	Inverts In/Over/Out	Over ID	DesignQ In/Over/Out	Reservoir Cap Max/Stored	HGL Up/Dn	Surcharge
48		60.00	60.00	0	52.67	9,000,000.00	60.00	No
24	81		72.50		0.00	111,294.41	60.00	
			72.50		27.38			
51		72.00	72.00	46	48.06	9,000,000.00	72.00	No
30	83		72.00		0.00	139,031.46	72.00	
			72.00		34.11			
87		66.00	66.00	23	160.60	9,000,000.00	66.00	No
15	87		68.00		0.00	560,472.07	66.00	
			68.00		55.16			

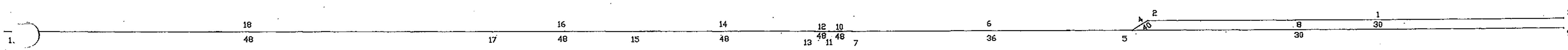
CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

21



CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

22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SDMP GAUDALUPE CA
RM ASSOCIATES
HWY166 10yr Sto CIP org

2/5/2008 8:24:46 PM

West10yr
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 3											
3		MAN	4.00	100.80	94.80			76.35		100.80	No
1	3			100.80	94.70			0.00		187.06	
1		EPI	2,699.63	100.80	94.80	0.0025	30	76.35	19.380	104.26	Yes
2	1			94.00	88.00			15.55	-56.967	94.00	
2		MAN	4.00	94.00	88.00			87.49		94.00	No
3	2			94.00	87.90			0.00		95.17	
4		EPI	120.11	94.00	88.00	0.005	40	87.49	58.777	94.13	Yes
4	4			94.00	87.40			10.03	-28.710	94.00	
Lateral Starting at Entity 9											
9		MAN	4.00	100.80	94.80			76.35		100.80	No
5	9			100.80	94.70			0.00		190.58	
8		EPI	2,801.83	100.80	94.80	0.0026	30	76.35	19.845	104.65	Yes
6	8			94.00	87.40			15.55	-56.502	94.00	
5		MAN	4.00	94.00	87.40			162.10		94.00	No
7	5			94.00	87.30			0.00		195.83	
6		EPI	1,811.80	94.00	87.40	0.0024	36	162.31	30.590	145.05	Yes
8	6			89.10	83.10			22.96	-131.715	89.10	
7		MAN	4.00	89.10	83.10			163.47		89.10	No
9	7			89.10	83.00			0.00		91.02	
10		EPI	149.26	89.10	83.10	0.0047	48	163.47	92.607	90.08	Yes
10	10			89.10	82.40			13.01	-70.859	89.10	
11		MAN	4.00	89.10	82.40			163.67		89.10	No
11	11			89.10	82.30			0.00		90.18	
12		EPI	91.16	89.10	82.40	0.0055	48	163.67	100.154	89.60	Yes
12	12			89.00	81.90			13.02	-63.515	89.00	
13		MAN	4.00	89.00	81.90			163.61		89.00	No
13	13			89.00	81.80			0.00		99.25	
14		EPI	1,176.07	89.00	81.90	0.0037	48	166.14	81.770	92.26	Yes
14	14			83.60	77.60			13.22	-84.372	83.60	
15		MAN	4.00	83.60	77.60			165.86		83.60	No
15	15			83.60	77.50			0.00		92.31	
16		EPI	925.56	83.60	77.60	0.0039	48	166.08	84.338	86.45	Yes
16	16			80.00	74.00			13.22	-81.746	80.00	
17		MAN	4.00	80.00	74.00			165.97		80.00	No
17	17			80.00	73.90			0.00		202.40	
18		EPI	3,160.68	80.00	74.00	0.0044	48	165.97	90.001	201.20	Yes
18	18			66.00	60.00			13.21	-75.971	161.87	

SDMP GAUDALUPE CA
RM ASSOCIATES
HWY166 25yr Sto CIP org

2/5/2008 8:24:56 PM

West25yr
System Summary

Lateral Starting at Entity 3

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
3		MAN	4.00	100.80	94.80			119.72		100.80	No
1	3			100.80	94.70			0.00		322.83	
1		EPI	2,699.63	100.80	94.80	0.0025	30	119.72	19.380	126.35	Yes
2	1			94.00	88.00			24.39	-100.340	94.00	
2		MAN	4.00	94.00	88.00			138.74		94.00	No
3	2			94.00	87.90			0.00		96.95	
4		EPI	120.11	94.00	88.00	0.005	40	138.74	58.777	94.43	Yes
4	4			94.00	87.40			15.90	-79.960	94.00	

Lateral Starting at Entity 9

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
9		MAN	4.00	100.80	94.80			119.72		100.80	No
5	9			100.80	94.70			0.00		331.49	
8		EPI	2,801.83	100.80	94.80	0.0026	30	119.72	19.845	127.58	Yes
6	8			94.00	87.40			24.39	-99.875	94.00	
5		MAN	4.00	94.00	87.40			252.37		94.00	No
7	5			94.00	87.30			0.00		348.28	
6		EPI	1,811.80	94.00	87.40	0.0024	36	252.92	30.590	126.53	Yes
8	6			89.10	83.10			35.78	-222.330	89.10	
7		MAN	4.00	89.10	83.10			252.20		89.10	No
9	7			89.10	83.00			0.00		93.68	
10		EPI	149.26	89.10	83.10	0.0047	48	252.20	92.607	89.79	Yes
10	10			89.10	82.40			20.07	-159.595	89.10	
11		MAN	4.00	89.10	82.40			252.86		89.10	No
11	11			89.10	82.30			0.00		91.81	
12		EPI	91.16	89.10	82.40	0.0055	48	252.86	100.154	89.45	Yes
12	12			89.00	81.90			20.12	-152.703	89.00	
13		MAN	4.00	89.00	81.90			253.09		89.00	No
13	13			89.00	81.80			0.00		120.94	
14		EPI	1,176.07	89.00	81.90	0.0037	48	256.65	81.770	90.19	Yes
14	14			83.60	77.60			20.42	-174.881	83.60	
15		MAN	4.00	83.60	77.60			257.01		83.60	No
15	15			83.60	77.50			0.00		109.54	
16		EPI	925.56	83.60	77.60	0.0039	48	257.33	84.338	85.21	Yes
16	16			80.00	74.00			20.48	-172.989	80.00	
17		MAN	4.00	80.00	74.00			257.79		80.00	No
17	17			80.00	73.90			0.00		355.99	
18		EPI	3,160.68	80.00	74.00	0.0044	48	257.79	90.001	355.99	Yes
18	18			66.00	60.00			20.51	-167.794	254.73	

SDMP GAUDALUPE CA
RM ASSOCIATES
HWY166 100yr Sto CIP org

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West100y
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 3											
3		MAN	4.00	100.80	94.80			191.41		100.80	No
1	3			100.80	94.70			0.00		678.91	
1		EPI	2,699.63	100.80	94.80	0.0025	30	191.41	19.380	106.13	Yes
2	1			94.00	88.00			38.99	-172.027	94.00	
2		MAN	4.00	94.00	88.00			224.38		94.00	No
3	2			94.00	87.90			0.00		101.71	
4		EPI	120.11	94.00	88.00	0.005	40	224.38	58.777	94.16	Yes
4	4			94.00	87.40			25.71	-165.603	94.00	
Lateral Starting at Entity 9											
9		MAN	4.00	100.80	94.80			191.41		100.80	No
5	9			100.80	94.70			0.00		701.05	
8		EPI	2,801.83	100.80	94.80	0.0026	30	191.41	19.845	106.59	Yes
6	8			94.00	87.40			38.99	-171.562	94.00	
5		MAN	4.00	94.00	87.40			409.85		94.00	No
7	5			94.00	87.30			0.00		772.39	
6		EPI	1,811.80	94.00	87.40	0.0024	36	410.67	30.590	117.54	Yes
8	6			89.10	83.10			58.10	-380.077	89.10	
7		MAN	4.00	89.10	83.10			408.76		89.10	No
9	7			89.10	83.00			0.00		101.12	
10		EPI	149.26	89.10	83.10	0.0047	48	408.76	92.607	89.64	Yes
10	10			89.10	82.40			32.53	-316.152	89.10	
11		MAN	4.00	89.10	82.40			407.22		89.10	No
11	11			89.10	82.30			0.00		96.29	
12		EPI	91.16	89.10	82.40	0.0055	48	407.22	100.154	89.37	Yes
12	12			89.00	81.90			32.41	-307.062	89.00	
13		MAN	4.00	89.00	81.90			404.78		89.00	No
13	13			89.00	81.80			0.00		181.16	
14		EPI	1,176.07	89.00	81.90	0.0037	48	414.84	81.770	89.03	Yes
14	14			83.60	77.60			33.01	-333.072	83.60	
15		MAN	4.00	83.60	77.60			408.70		83.60	No
15	15			83.60	77.50			0.00		154.85	
16		EPI	925.56	83.60	77.60	0.0039	48	409.58	84.338	84.46	Yes
16	16			80.00	74.00			32.59	-325.245	80.00	
17		MAN	4.00	80.00	74.00			409.86		80.00	No
17	17			80.00	73.90			0.00		658.40	
18		EPI	3,160.68	80.00	74.00	0.0044	48	409.86	90.001	658.40	Yes
18	18			66.00	60.00			32.62	-319.861	406.53	

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

23

SDMP GUADALUPE CA
RM ASSOCIATES
West WWY166 25yr Sto. Lrgr. Cpct.

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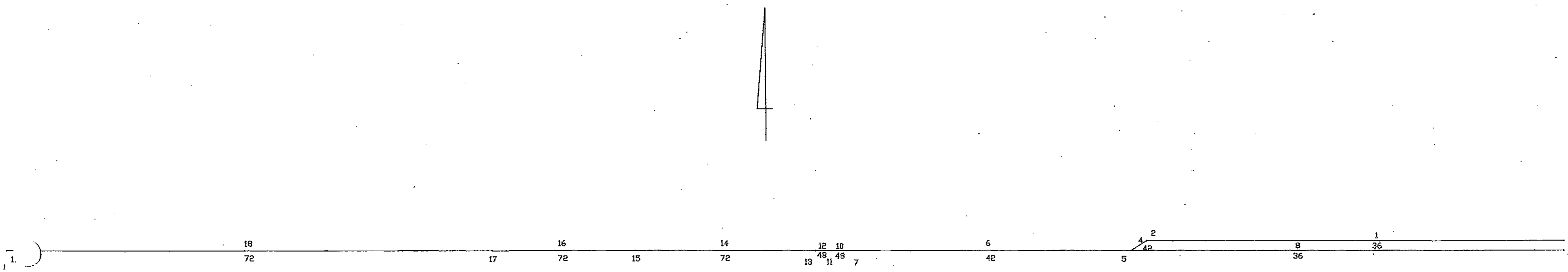
West25y1
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 3											
3		MAN	4.00	100.80	94.80			119.72		100.80	No
1	3			100.80	94.70			0.00		180.53	
1		EPI	2,699.63	100.80	94.80	0.0025	36	119.72	31.514	106.23	Yes
2	1			94.00	88.00			16.94	-88.206	94.00	
2		MAN	4.00	94.00	88.00			137.16		94.00	No
3	2			94.00	87.90			0.00		96.22	
4		EPI	120.11	94.00	88.00	0.005	42	137.16	66.944	94.31	Yes
4	4			94.00	87.40			14.26	-70.216	94.00	
Lateral Starting at Entity 9											
9		MAN	4.00	100.80	94.80			119.72		100.80	No
5	9			100.80	94.70			0.00		183.80	
8		EPI	2,801.83	100.80	94.80	0.0026	36	119.72	32.270	106.70	Yes
6	8			94.00	87.40			16.94	-87.450	94.00	
5		MAN	4.00	94.00	87.40			249.85		94.00	No
7	5			94.00	87.30			0.00		200.50	
6		EPI	1,811.80	94.00	87.40	0.0024	42	250.14	46.143	155.49	Yes
8	6			89.10	83.10			26.00	-203.994	89.10	
7		MAN	4.00	89.10	83.10			252.25		89.10	No
9	7			89.10	83.00			0.00		93.68	
10		EPI	149.26	89.10	83.10	0.0047	48	252.25	92.607	93.50	Yes
10	10			89.10	82.40			20.07	-159.647	89.10	
11		MAN	4.00	89.10	82.40			252.72		89.10	No
11	11			89.10	82.30			0.00		90.13	
12		EPI	91.16	89.10	82.40	0.0055	48	252.72	100.154	90.13	Yes
12	12			89.00	81.90			20.11	-152.565	87.32	
13		MAN	4.00	89.00	81.90			252.81		87.32	-1.68
13	13			89.00	81.80			0.00		87.32	
14		EPI	1,176.07	89.00	81.90	0.0037	72	256.37	241.087	87.32	No
14	14			83.60	77.60			9.55	-15.285	83.37	
15		MAN	4.00	83.60	77.60			255.92		83.37	-0.23
15	15			83.60	77.50			0.00		83.37	
16		EPI	925.56	83.60	77.60	0.0039	72	256.23	248.660	80.52	No
16	16			80.00	74.00			9.78	-7.573	80.00	
17		MAN	4.00	80.00	74.00			255.09		80.00	No
17	17			80.00	73.90			0.00		258.38	
18		EPI	3,160.68	80.00	74.00	0.0044	72	255.09	265.357	258.38	Yes
18	18			66.00	60.00			10.24	10.270	247.87	



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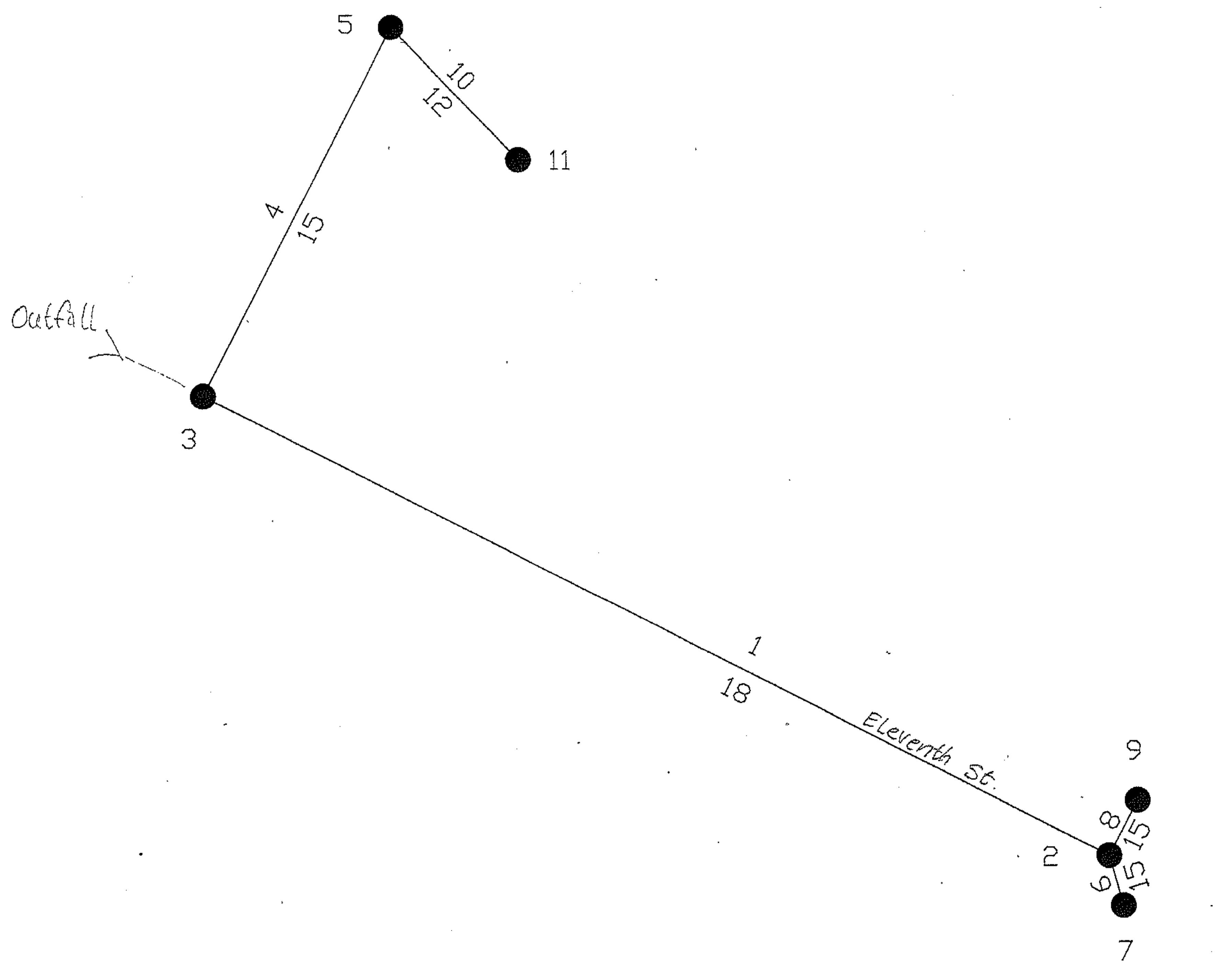
CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

24



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SDMP GUADALUPE CA
RM ASSOCIATES
W. Eleventh St 10y Sto

Elvnth10 2/5/2008 5:11:34 PM

System Summary

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
				Lateral Starting at Entity 11							
11		MAN	4.00	74.10	73.10			0.61		73.46	-0.64
7	11			74.10	73.00			0.00		73.46	
10		EPI	71.06	74.10	73.10	0.007	12	0.61	2.813	73.46	No
8	10			73.90	72.60			2.55	2.199	73.36	
5		MAN	4.00	73.90	72.60			1.84		73.36	-0.54
9	5			73.90	72.50			0.00		73.36	
4		EPI	160.55	73.90	72.60	0.0025	15	1.84	3.035	73.36	No
10	4			73.50	72.20			2.36	1.196	72.96	
				Lateral Starting at Entity 7							
7		MAN	4.00	74.60	73.60			0.37		74.24	-0.36
1	7			74.60	73.50			0.00		74.24	
6		EPI	19.84	74.60	73.60	0.0151	15	0.37	7.478	74.24	No
2	6			74.50	73.30			2.92	7.111	74.24	
				Lateral Starting at Entity 9							
9		MAN	4.00	74.50	73.50			1.26		74.24	-0.26
3	9			74.50	73.40			0.00		74.24	
8		EPI	24.06	74.50	73.50	0.0083	15	1.26	5.544	74.24	No
4	8			74.50	73.30			3.26	4.282	74.24	
2		MAN	4.00	74.50	73.30			2.10		74.24	-0.26
5	2			74.50	73.20			0.00		74.24	
1		EPI	392.19	74.50	73.30	0.0028	18	3.31	5.237	74.24	No
6	1			73.50	72.20			2.87	1.923	73.46	

SDMP GUADALUPE CA
RM ASSOCIATES
W. Eleventh St 25y Sto

Elvnth25 2/5/2008 5:11:42 PM
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 11											
11 7	11	MAN	4.00	74.10 74.10	73.10 73.00			0.92 0.00		73.65 73.65	-0.45
10 8	10	EPI	71.06	74.10 73.90	73.10 72.60	0.007	12	0.92 2.85	2.813 1.898	73.65 73.60	No
5 9	5	MAN	4.00	73.90 73.90	72.60 72.50			2.74 0.00		73.60 73.60	-0.3
4 10	4	EPI	160.55	73.90 73.50	72.60 72.20	0.0025	15	2.74 2.67	3.035 0.292	73.60 73.20	No
Lateral Starting at Entity 7											
7 1	7	MAN	4.00	74.60 74.60	73.60 73.50			0.54 0.00		74.50 74.50	-0.1
6 2	6	EPI	19.84	74.60 74.50	73.60 73.30	0.0151	15	0.54 3.20	7.478 6.934	74.50 74.50	No
Lateral Starting at Entity 9											
9 3	9	MAN	4.00	74.50 74.50	73.50 73.40			1.87 0.00		74.50 74.50	No
8 4	8	EPI	24.06	74.50 74.50	73.50 73.30	0.0083	15	1.87 3.64	5.544 3.670	74.50 74.50	No
2 5	2	MAN	4.00	74.50 74.50	73.30 73.20			3.12 0.00		74.50 74.52	No
1 6	1	EPI	392.19	74.50 73.50	73.30 72.20	0.0028	18	4.93 3.22	5.237 0.312	74.52 73.65	No

SDMP GUADALUPE CA
RM ASSOCIATES
W. Eleventh St 100yr Sto

Elvnt100 2/5/2008 5:11:53 PM

System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 11											
11		MAN	4.00	74.10	73.10			1.40		74.01	-0.09
7	11			74.10	73.00			0.00		74.01	
10		EPI	71.06	74.10	73.10	0.007	12	1.40	2.813	74.01	Yes
8	10			73.90	72.60			3.27	1.412	73.90	
5		MAN	4.00	73.90	72.60			4.20		73.90	No
9	5			73.90	72.50			0.00		74.13	
4		EPI	160.55	73.90	72.60	0.0025	15	4.20	3.035	74.13	Yes
10	4			73.50	72.20			3.42	-1.166	73.45	
Lateral Starting at Entity 7											
7		MAN	4.00	74.60	73.60			0.83		74.50	-0.1
1	7			74.60	73.50			0.00		74.50	
6		EPI	19.84	74.60	73.60	0.0151	15	0.83	7.478	74.50	No
2	6			74.50	73.30			3.59	6.648	74.50	
Lateral Starting at Entity 9											
9		MAN	4.00	74.50	73.50			2.86		74.50	No
3	9			74.50	73.40			0.00		74.50	
8		EPI	24.06	74.50	73.50	0.0083	15	2.86	5.544	74.50	No
4	8			74.50	73.30			4.12	2.684	74.50	
2		MAN	4.00	74.50	73.30			4.76		74.50	No
5	2			74.50	73.20			0.00		76.01	
1		EPI	392.19	74.50	73.30	0.0028	18	7.52	5.237	76.01	Yes
6	1			73.50	72.20			4.26	-2.283	74.01	

SDMP GUADALUPE CA
RM ASSOCIATES
W. Eleventh St 25yr Sto OEF74.3'

Elvnt25s 2/5/2008 5:12:30 PM

System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
					Lateral Starting at Entity 11						
11 7	11	MAN	4.00	74.10 74.10	73.10 73.00			0.92 0.00		73.65 73.65	-0.45
10 8	10	EPI	71.06	74.10 73.90	73.10 72.60	0.007	12	0.92 2.85	2.813 1.898	73.65 73.60	No
5 9	5	MAN	4.00	73.90 73.90	72.60 72.50			2.74 0.00		73.60 73.60	-0.3
4 10	4	EPI	160.55	73.90 73.50	72.60 72.20	0.0025	15	2.74 2.67	3.035 0.292	73.60 73.20	No
					Lateral Starting at Entity 7						
7 1	7	MAN	4.00	74.60 74.60	73.60 73.50			0.54 0.00		74.50 74.50	-0.1
6 2	6	EPI	19.84	74.60 74.50	73.60 73.30	0.0151	15	0.54 3.20	7.478 6.934	74.50 74.50	No
					Lateral Starting at Entity 9						
9 3	9	MAN	4.00	74.50 74.50	73.50 73.40			1.87 0.00		74.50 74.50	No
8 4	8	EPI	24.06	74.50 74.50	73.50 73.30	0.0083	15	1.87 3.64	5.544 3.670	74.50 74.50	No
2 5	2	MAN	4.00	74.50 74.50	73.30 73.20			3.12 0.00		74.50 74.52	No
1 6	1	EPI	392.19	74.50 73.50	73.30 72.20	0.0028	18	4.93 3.22	5.237 0.312	74.52 73.65	No

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

SDMP GUADALUPE CA
RM ASSOCIATES
P.S.D. & Riverview Subdv. 10yr Sto.

2/8/2008 5:49:57 PM

SDM10y
System Summary

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 13											
13		MAN	4.00	71.90	71.90			4.06		71.90	No
1	13			71.90	71.80			0.00		72.84	
12		EPI	707.90	71.90	71.90	0.004	24	5.07	13.394	72.84	No
2	12			69.10	69.10			3.52	8.322	70.04	
Lateral Starting at Entity 16											
16		MAN	4.00	76.50	76.50			3.01		76.50	No
3	16			76.50	76.40			0.00		77.22	
15		EPI	598.43	76.50	76.50	0.004	24	3.01	13.487	77.22	No
4	15			74.10	74.10			3.06	10.478	74.82	
17		MAN	4.00	74.10	74.10			10.89		74.10	No
5	17			74.10	74.00			0.00		75.78	
122		EPI	1,238.79	74.10	74.10	0.004	30	17.35	24.532	75.78	No
6	122			69.10	69.10			5.00	7.180	70.78	
14		MAN	4.00	69.10	69.10			23.31		69.10	No
7	14			69.10	69.00			0.00		70.12	
123		EPI	184.58	69.10	69.10	0.0439	30	23.31	80.890	70.12	No
8	123			61.00	61.00			12.59	57.581	62.02	
124		MAN	4.00	61.00	61.00			22.75		61.00	No
9	124			61.00	60.90			0.00		61.90	
125		EPI	834.02	61.00	61.00	0.0036	300	22.75	4,587.277	61.90	No
10	125			58.00	58.00			4.22	4,564.524	58.90	
Lateral Starting at Entity 19											
19		MAN	4.00	69.50	69.50			0.97		69.50	No
11	19			69.50	69.40			0.00		69.90	
18		EPI	132.07	69.50	69.50	0.0106	18	1.26	10.181	69.90	No
12	18			68.10	68.10			3.47	8.925	68.50	
Lateral Starting at Entity 22											
22		MAN	4.00	68.10	68.10			0.30		68.10	No
13	22			68.10	68.00			0.00		68.42	
21		EPI	282.69	68.10	68.10	0.0025	12	0.30	1.669	68.42	No
14	21			67.40	67.40			1.42	1.373	67.72	
Lateral Starting at Entity 31											
31		MAN	4.00	68.00	68.00			0.00		68.00	No
15	31			68.00	67.90			0.00		68.52	
30		EPI	440.25	68.00	68.00	0.0011	18	0.69	3.333	68.52	No
16	30			67.50	67.50			1.32	2.646	68.02	
32		MAN	4.00	67.50	67.50			0.58		67.50	No
17	32			67.50	67.40			0.00		68.04	
33		EPI	658.75	67.50	67.50	0.0053	18	1.59	7.208	68.04	No
18	33			64.00	64.00			2.91	5.619	64.54	

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 35											
35 19	35	MAN	4.00	70.50 70.50	70.50 70.40			1.64 0.00		70.50 71.02	No
34 20	34	EPI	347.86	70.50 68.10	70.50 68.10	0.0069	18	1.64 3.24	8.214 6.570	71.02 68.62	No
20 21	20	MAN	4.00	68.10 68.10	68.10 68.00			4.34 0.00		68.10 69.04	No
127 22	127	EPI	145.93	68.10 67.40	68.10 67.40	0.0048	18	4.34 3.75	6.849 2.507	69.04 68.34	No
23 23	23	MAN	4.00	67.40 67.40	67.40 67.30			6.64 0.00		67.40 68.44	No
24 24	24	EPI	259.41	67.40 66.00	67.40 66.00	0.0054	24	6.99 4.35	15.645 8.658	68.44 67.04	No
25 25	25	MAN	4.00	66.00 66.00	66.00 65.90			6.59 0.00		66.00 67.16	No
26 26	26	EPI	408.71	66.00 64.00	66.00 64.00	0.0049	24	8.25 4.41	14.898 6.645	67.16 65.16	No
27 27	27	MAN	4.00	64.00 64.00	64.00 63.90			9.41 0.00		64.00 64.74	No
28 28	28	EPI	228.69	64.00 58.00	64.00 58.00	0.0262	30	9.41 8.14	62.546 53.135	64.74 58.74	No
29 29	29	MAN	4.00	58.00 58.00	58.00 57.90			30.76 0.00		58.00 59.34	No
126 30	126	EPI	2,457.19	58.00 55.00	58.00 55.00	0.0012	300	30.76 3.07	2,672.530 2,641.774	59.34 56.34	No

2/8/2008 5:50:10 PM

SnDums25
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 13											
13		MAN	4.00	71.90	71.90			5.84		71.90	No
1	13			71.90	71.80			0.00		73.06	
12		EPI	707.90	71.90	71.90	0.004	24	7.30	13.394	73.06	No
2	12			69.10	69.10			3.97	6.096	70.26	
Lateral Starting at Entity 16											
16		MAN	4.00	76.50	76.50			4.33		76.50	No
3	16			76.50	76.40			0.00		77.36	
15		EPI	598.43	76.50	76.50	0.004	24	4.33	13.487	77.36	No
4	15			74.10	74.10			3.38	9.157	74.96	
17		MAN	4.00	74.10	74.10			15.78		74.10	No
5	17			74.10	74.00			0.00		76.28	
122		EPI	1,238.79	74.10	74.10	0.004	30	25.08	24.532	76.28	No
6	122			69.10	69.10			5.56	-0.549	71.28	
14		MAN	4.00	69.10	69.10			33.79		69.10	No
7	14			69.10	69.00			0.00		70.34	
123		EPI	184.58	69.10	69.10	0.0439	30	33.79	80.890	70.34	No
8	123			61.00	61.00			14.00	47.104	62.24	
124		MAN	4.00	61.00	61.00			33.00		61.00	No
9	124			61.00	60.90			0.00		62.06	
125		EPI	834.02	61.00	61.00	0.0036	300	33.00	4,587.277	62.06	No
10	125			58.00	58.00			4.62	4,554.274	59.06	
Lateral Starting at Entity 19											
19		MAN	4.00	69.50	69.50			1.44		69.50	No
11	19			69.50	69.40			0.00		69.98	
18		EPI	132.07	69.50	69.50	0.0106	18	1.87	10.181	69.98	No
12	18			68.10	68.10			3.84	8.308	68.58	
Lateral Starting at Entity 22											
22		MAN	4.00	68.10	68.10			0.44		68.10	No
13	22			68.10	68.00			0.00		68.50	
21		EPI	282.69	68.10	68.10	0.0025	12	0.44	1.669	68.50	No
14	21			67.40	67.40			1.61	1.228	67.80	
Lateral Starting at Entity 31											
31		MAN	4.00	68.00	68.00			0.00		68.00	No
15	31			68.00	67.90			0.00		68.64	
30		EPI	440.25	68.00	68.00	0.0011	18	1.02	3.333	68.64	No
16	30			67.50	67.50			1.48	2.308	68.14	
32		MAN	4.00	67.50	67.50			0.84		67.50	No
17	32			67.50	67.40			0.00		68.16	
33		EPI	658.75	67.50	67.50	0.0053	18	2.41	7.208	68.16	No
18	33			64.00	64.00			3.25	4.800	64.66	

SnDums25
System Summary

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 35											
35		MAN	4.00	70.50	70.50			2.45		70.50	No
19	35			70.50	70.40			0.00		71.12	
34		EPI	347.86	70.50	70.50	0.0069	18	2.45	8.214	71.12	No
20	34			68.10	68.10			3.58	5.763	68.72	
20		MAN	4.00	68.10	68.10			6.49		68.10	No
21	20			68.10	68.00			0.00		69.34	
127		EPI	145.93	68.10	68.10	0.0048	18	6.49	6.849	69.34	No
22	127			67.40	67.40			4.24	0.361	68.64	
23		MAN	4.00	67.40	67.40			9.94		67.40	No
23	23			67.40	67.30			0.00		68.70	
24		EPI	259.41	67.40	67.40	0.0054	24	10.46	15.645	68.70	No
24	24			66.00	66.00			4.91	5.189	67.30	
25		MAN	4.00	66.00	66.00			9.89		66.00	No
25	25			66.00	65.90			0.00		67.50	
26		EPI	408.71	66.00	66.00	0.0049	24	12.37	14.898	67.50	No
26	26			64.00	64.00			4.99	2.530	65.50	
27		MAN	4.00	64.00	64.00			14.67		64.00	No
27	27			64.00	63.90			0.00		64.92	
28		EPI	228.69	64.00	64.00	0.0262	30	14.67	62.546	64.92	No
28	28			58.00	58.00			9.19	47.873	58.92	
29		MAN	4.00	58.00	58.00			44.02		58.00	No
29	29			58.00	57.90			0.00		59.58	
126		EPI	2,457.19	58.00	58.00	0.0012	300	44.02	2,672.530	59.58	No
30	126			55.00	55.00			3.40	2,628.513	56.58	

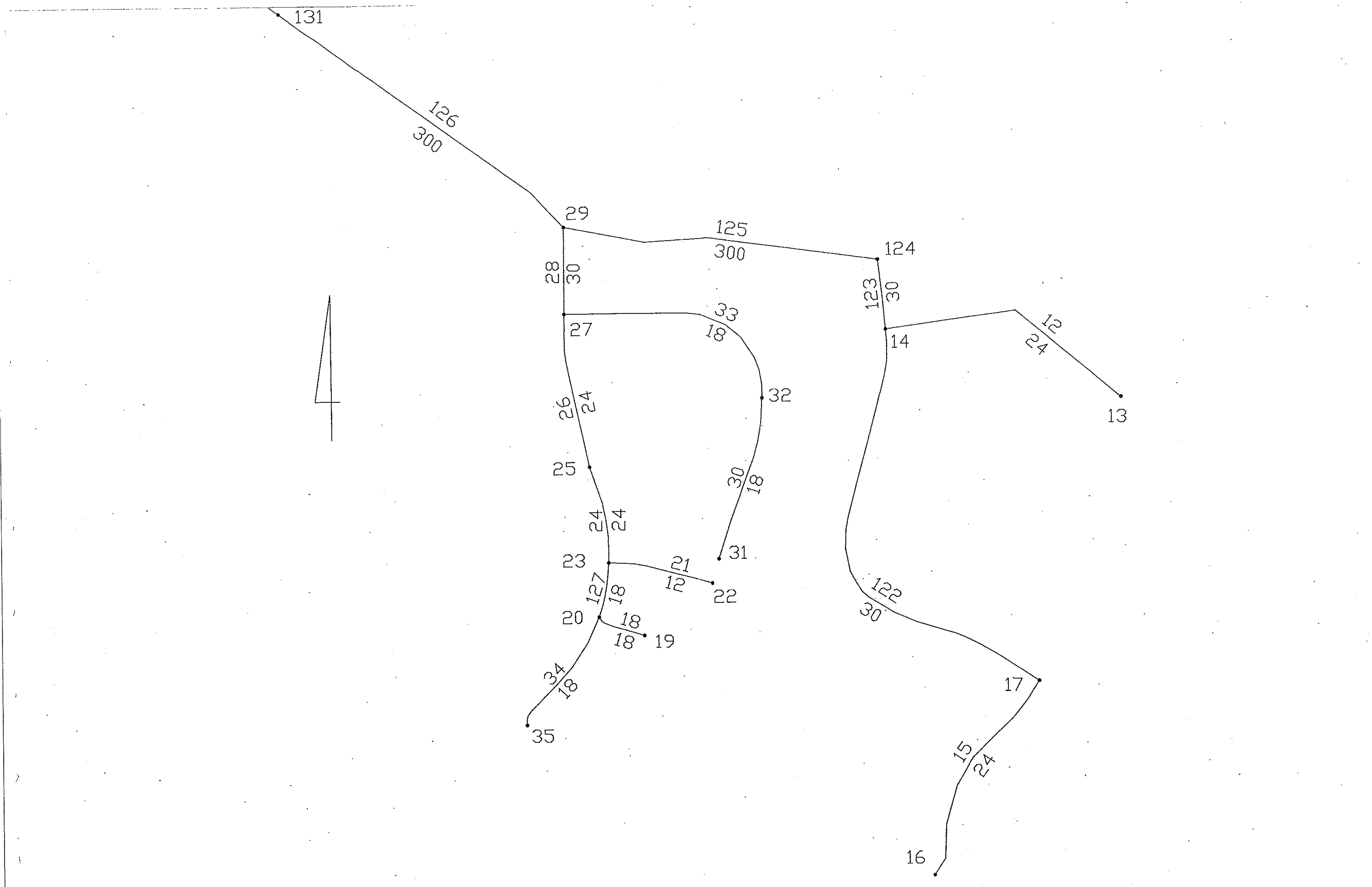
SDMP GUADALUPE CA
RM ASSOCIATES
P.S.D. & Riverview Subdv. 100yr Sto.

2/8/2008 5:50:20 PM

SnDUMS00
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 13											
13 1	13	MAN	4.00	71.90 71.90	71.90 71.80			8.66 0.00		71.90 73.36	No
12 2	12	EPI	707.90	71.90 69.10	71.90 69.10	0.004	24	10.82 4.43	13.394 2.570	73.36 70.56	No
Lateral Starting at Entity 16											
16 3	16	MAN	4.00	76.50 76.50	76.50 76.40			6.42 0.00		76.50 77.58	No
15 4	15	EPI	598.43	76.50 74.10	76.50 74.10	0.004	24	6.42 3.83	13.487 7.065	77.58 75.18	No
17 5	17	MAN	4.00	74.10 74.10	74.10 74.00			23.43 0.00		74.10 81.75	No
122 6	122	EPI	1,238.79	74.10 69.10	74.10 69.10	0.004	30	37.22 7.58	24.532 -12.692	81.75 71.60	Yes
14 7	14	MAN	4.00	69.10 69.10	69.10 69.00			52.20 0.00		69.10 70.68	No
123 8	123	EPI	184.58	69.10 61.00	69.10 61.00	0.0439	30	52.20 16.03	80.890 28.691	70.68 62.58	No
124 9	124	MAN	4.00	61.00 61.00	61.00 60.90			50.99 0.00		61.00 62.32	No
125 10	125	EPI	834.02	61.00 58.00	61.00 58.00	0.0036	300	50.99 5.22	4,587.277 4,536.285	62.32 59.32	No
Lateral Starting at Entity 19											
19 11	19	MAN	4.00	69.50 69.50	69.50 69.40			2.21 0.00		69.50 70.10	No
18 12	18	EPI	132.07	69.50 68.10	69.50 68.10	0.0106	18	2.87 4.35	10.181 7.313	70.10 68.70	No
Lateral Starting at Entity 22											
22 13	22	MAN	4.00	68.10 68.10	68.10 68.00			0.68 0.00		68.10 68.60	No
21 14	21	EPI	282.69	68.10 67.40	68.10 67.40	0.0025	12	0.68 1.81	1.669 0.994	68.60 67.90	No
Lateral Starting at Entity 31											
31 15	31	MAN	4.00	68.00 68.00	68.00 67.90			0.00 0.00		68.00 68.80	No
30 16	30	EPI	440.25	68.00 67.50	68.00 67.50	0.0011	18	1.57 1.67	3.333 1.764	68.80 68.30	No
32 17	32	MAN	4.00	67.50 67.50	67.50 67.40			1.31 0.00		67.50 68.34	No
33 18	33	EPI	658.75	67.50 64.00	67.50 64.00	0.0053	18	3.74 3.72	7.208 3.463	68.34 64.84	No

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 35											
35		MAN	4.00	70.50	70.50			3.75		70.50	No
19	35			70.50	70.40			0.00		71.28	
34		EPI	347.86	70.50	70.50	0.0069	18	3.75	8.214	71.28	No
20	34			68.10	68.10			4.06	4.462	68.88	
20		MAN	4.00	68.10	68.10			10.06		68.10	No
21	20			68.10	68.00			0.00		70.23	
127		EPI	145.93	68.10	68.10	0.0048	18	10.06	6.849	70.23	Yes
22	127			67.40	67.40			5.69	-3.215	68.90	
23		MAN	4.00	67.40	67.40			15.67		67.40	No
23	23			67.40	67.30			0.00		69.20	
24		EPI	259.41	67.40	67.40	0.0054	24	16.46	15.645	69.20	No
24	24			66.00	66.00			5.57	-0.811	67.80	
25		MAN	4.00	66.00	66.00			15.60		66.00	No
25	25			66.00	65.90			0.00		68.99	
26		EPI	408.71	66.00	66.00	0.0049	24	19.40	14.898	68.99	Yes
26	26			64.00	64.00			6.17	-4.500	66.00	
27		MAN	4.00	64.00	64.00			23.02		64.00	No
27	27			64.00	63.90			0.00		65.16	
28		EPI	228.69	64.00	64.00	0.0262	30	23.02	62.546	65.16	No
28	28			58.00	58.00			10.45	39.526	59.16	
29		MAN	4.00	58.00	58.00			68.03		58.00	No
29	29			58.00	57.90			0.00		62.22	
126		EPI	2,457.19	58.00	58.00	0.0012	300	68.03	2,672.530	62.22	No
30	126			55.00	55.00			3.88	2,604.495	62.22	



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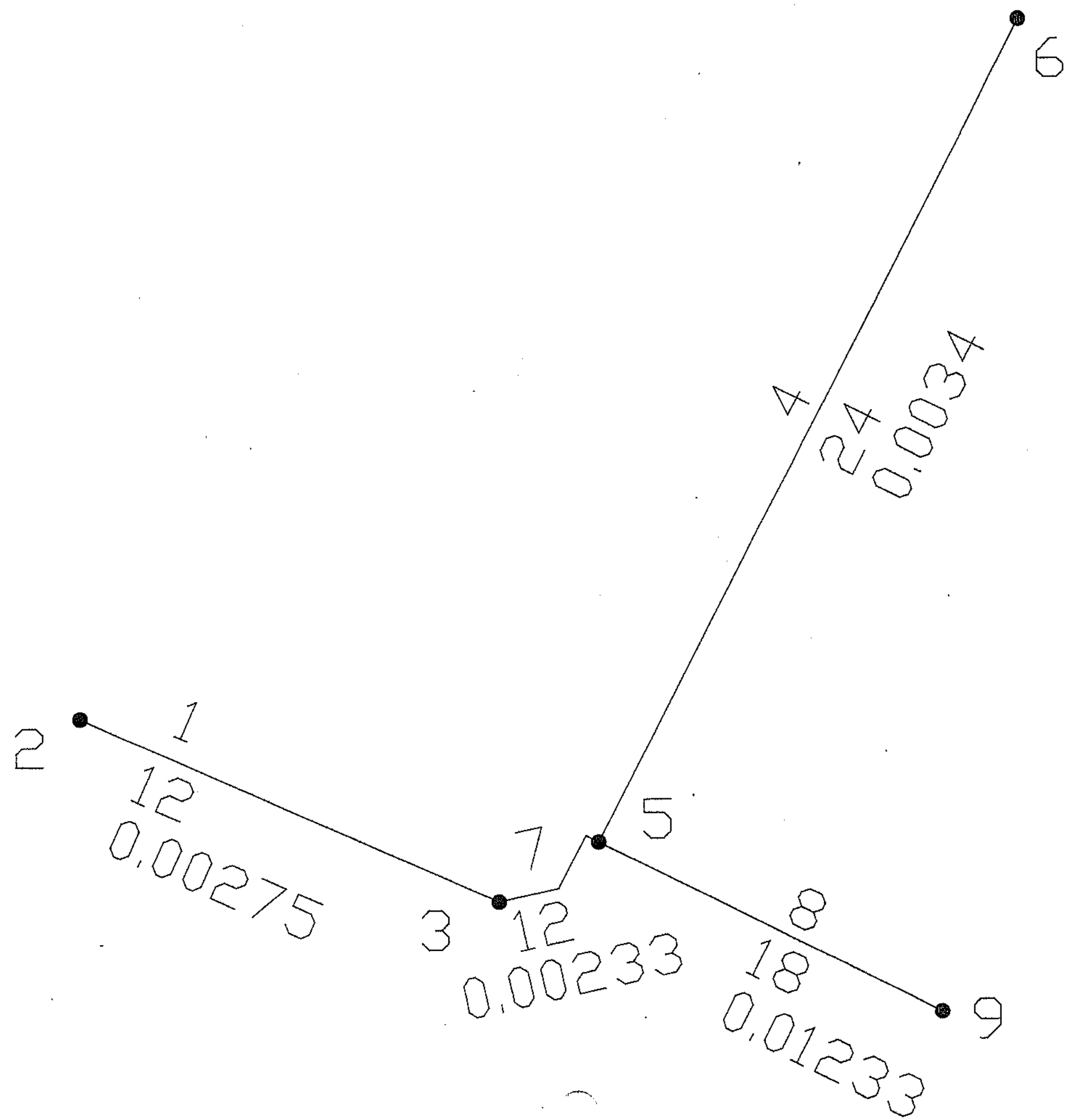
CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN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SDMP GUADALUPE CA
RM ASSOCIATES
Peralta SD w/Devl 10y Sto

Prlta10D 2/5/2008 2:33:04 PM
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 2											
2 1	2	MAN	4.00	87.00 87.00	85.00 84.90			5.60 0.00		87.00 94.14	No
1 2	1	EPI	289.87	86.10 87.00	85.00 84.20	0.0028	12	5.60 7.14	1.762 -3.843	94.14 87.00	Yes
3 3	3	MAN	4.00	87.00 87.00	84.20 84.10			6.91 0.00		87.00 88.82	No
7 4	7	EPI	85.79	87.00 87.00	84.20 84.00	0.0023	12	6.91 8.80	1.619 -5.294	88.82 85.60	Yes
Lateral Starting at Entity 9											
9 5	9	MAN	4.00	87.00 87.00	87.00 86.90			11.94 0.00		87.00 88.73	No
8 6	8	EPI	243.23	88.70 87.00	87.00 84.00	0.0123	18	11.94 6.75	10.982 -0.954	88.73 85.60	Yes
5 7	5	MAN	4.00	85.60 85.60	84.00 83.90			17.93 0.00		85.60 88.94	No
4 8	4	EPI	586.75	87.00 85.60	84.00 82.00	0.0034	24	20.81 6.63	12.434 -8.380	88.94 84.00	Yes

SDMP GUADALUPE CA
RM ASSOCIATES
Peralta SD w/Devl 25y Sto

Prlt25yD 2/5/2008 2:33:16 PM
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
					Lateral Starting at Entity 2						
2 1	2	MAN	4.00	87.00 87.00	85.00 84.90			8.36 0.00		87.00 102.87	No
1 2	1	EPI	289.87	86.10 87.00	85.00 84.20	0.0028	12	8.36 10.64	1.762 -6.594	91.43 87.00	Yes
3 3	3	MAN	4.00	87.00 87.00	84.20 84.10			10.59 0.00		87.00 93.14	No
7 4	7	EPI	85.79	87.00 87.00	84.20 84.00	0.0023	12	10.59 13.48	1.619 -8.968	87.80 85.60	Yes
					Lateral Starting at Entity 9						
9 5	9	MAN	4.00	87.00 87.00	87.00 86.90			18.65 0.00		87.00 93.23	No
8 6	8	EPI	243.23	88.70 87.00	87.00 84.00	0.0123	18	18.65 10.56	10.982 -7.670	87.45 85.60	Yes
5 7	5	MAN	4.00	85.60 85.60	84.00 83.90			28.50 0.00		85.60 96.27	No
4 8	4	EPI	586.75	87.00 85.60	84.00 82.00	0.0034	24	32.80 10.44	12.434 -20.366	87.42 84.00	Yes

SDMP GUADALUPE CA
RM ASSOCIATES
Peralta SD without/Devl 10y Sto

Prlt10y
System Summary

2/5/2008 2:33:56 PM

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 2											
2		MAN	4.00	87.00	85.00			5.60		87.00	No
1	2			87.00	84.90			0.00		94.14	
1		EPI	289.87	86.10	85.00	0.0028	12	5.60	1.762	94.14	Yes
2	1			87.00	84.20			7.14	-3.843	87.00	
3		MAN	4.00	87.00	84.20			6.91		87.00	No
3	3			87.00	84.10			0.00		88.64	
7		EPI	85.79	87.00	84.20	0.0023	12	6.91	1.619	88.64	Yes
4	7			87.00	84.00			8.80	-5.294	85.42	
Lateral Starting at Entity 9											
9		MAN	4.00	87.00	87.00			0.00		87.00	No
5	9			87.00	86.90			0.00		87.00	
8		EPI	243.23	88.70	87.00	0.0123	18	0.00	10.982	87.00	No
6	8			87.00	84.00			0.20	10.982	85.42	
5		MAN	4.00	85.60	84.00			6.74		85.42	-0.18
7	5			85.60	83.90			0.00		85.42	
4		EPI	586.75	87.00	84.00	0.0034	24	9.62	12.434	85.42	No
8	4			85.60	82.00			4.06	2.810	83.42	

CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

27

SDMP GUADALUPE CA
RM ASSOCIATES
T.P. & Waller sbdv 10yr Sto.

TPWllr10 2/7/2008 3:00:01 PM
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 10											
10		MAN	4.00	89.70	88.20			0.00		89.70	No
1	10			89.70	88.10			0.00		89.99	
9		EPI	281.58	89.70	87.20	0.0021	18	5.93	4.565	89.33	Yes
2	9			89.10	86.60			3.36	-1.364	89.10	
11		MAN	4.00	89.10	86.60			8.37		89.10	No
3	11			89.10	86.50			0.00		90.43	
112		EPI	274.40	89.10	86.60	0.0015	18	8.37	3.776	89.15	Yes
4	112			88.70	86.20			4.74	-4.594	88.70	
113		MAN	4.00	88.70	86.20			10.30		88.70	No
5	113			88.70	86.10			0.00		90.72	
139		EPI	274.35	88.70	86.20	0.0022	18	10.30	4.625	88.80	Yes
6	139			88.10	85.60			5.83	-5.672	88.10	
140		MAN	4.00	88.10	85.60			12.16		88.10	No
7	140			88.10	85.50			0.00		91.83	
153		EPI	274.45	88.10	85.60	0.0026	18	13.37	4.994	88.62	Yes
8	153			87.40	84.90			7.57	-8.379	87.40	
142		MAN	4.00	87.40	84.90			13.85		87.40	No
9	142			87.40	84.80			0.00		91.85	
141		EPI	274.40	87.40	84.90	0.0011	18	13.85	3.270	88.42	Yes
10	141			87.10	84.60			7.84	-10.579	87.10	
143		MAN	4.00	87.10	84.60			15.53		87.10	No
11	143			87.10	84.50			0.00		92.59	
144		EPI	275.50	87.10	84.60	0.0018	18	15.53	4.213	88.32	Yes
12	144			86.60	84.10			8.79	-11.318	86.60	
145		MAN	4.00	86.60	84.10			17.16		86.60	No
13	145			86.60	84.00			0.00		89.41	
146		EPI	92.20	86.60	84.10	0.0011	18	18.72	3.257	87.34	Yes
14	146			86.50	84.00			10.59	-15.459	86.50	
147		MAN	4.00	86.50	84.00			18.28		86.50	No
15	147			86.50	83.90			0.00		97.22	
148		EPI	398.97	86.50	84.00	0.0033	18	18.28	5.645	88.92	Yes
16	148			85.20	82.70			10.34	-12.634	85.20	
149		MAN	4.00	85.20	82.70			18.52		85.20	No
17	149			85.20	82.60			0.00		95.57	
150		EPI	400.00	85.20	82.70	0.005	18	18.52	6.992	87.14	Yes
18	150			83.20	80.70			10.48	-11.526	83.20	
151		MAN	4.00	83.20	80.70			18.40		83.20	No
19	151			83.20	80.60			0.00		104.18	
152		EPI	687.67	83.20	80.70	0.0035	18	18.40	5.842	104.18	Yes
20	152			80.80	78.30			10.41	-12.553	83.19	
154		MAN	4.00	84.00	78.30			18.25		83.19	-0.81
21	154			84.00	78.20			0.00		83.19	
135		EPI	139.59	80.80	78.30	0.0057	18	18.25	7.486	80.21	Yes
22	135			80.00	77.50			10.33	-10.765	79.00	

SDMP GUADALUPE CA
RM ASSOCIATES
T.P. & Waller sbdv 100yr Sto.

TPWllr00
System Summary

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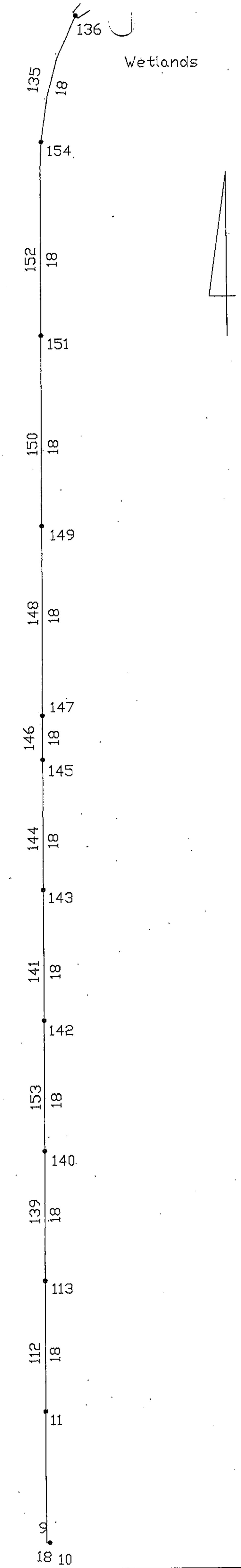
UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 10											
10		MAN	4.00	89.70	88.20			0.00		89.70	No
1	10			89.70	88.10			0.00		93.75	
9		EPI	281.58	89.70	87.20	0.0021	18	13.53	4.565	90.50	Yes
2	9			89.10	86.60			7.66	-8.968	89.10	
11		MAN	4.00	89.10	86.60			19.17		89.10	No
3	11			89.10	86.50			0.00		97.80	
112		EPI	274.40	89.10	86.60	0.0015	18	19.17	3.776	91.47	Yes
4	112			88.70	86.20			10.85	-15.395	88.70	
113		MAN	4.00	88.70	86.20			24.22		88.70	No
5	113			88.70	86.10			0.00		102.62	
139		EPI	274.35	88.70	86.20	0.0022	18	24.22	4.625	88.66	Yes
6	139			88.10	85.60			13.70	-19.594	88.10	
140		MAN	4.00	88.10	85.60			29.23		88.10	No
7	140			88.10	85.50			0.00		112.78	
153		EPI	274.45	88.10	85.60	0.0026	18	32.02	4.994	87.90	Yes
8	153			87.40	84.90			18.12	-27.022	87.40	
142		MAN	4.00	87.40	84.90			34.08		87.40	No
9	142			87.40	84.80			0.00		115.85	
141		EPI	274.40	87.40	84.90	0.0011	18	34.08	3.270	87.70	Yes
10	141			87.10	84.60			19.29	-30.813	87.10	
143		MAN	4.00	87.10	84.60			38.91		87.10	No
11	143			87.10	84.50			0.00		124.22	
144		EPI	275.50	87.10	84.60	0.0018	18	38.91	4.213	87.42	Yes
12	144			86.60	84.10			22.02	-34.696	86.60	
145		MAN	4.00	86.60	84.10			43.69		86.60	No
13	145			86.60	84.00			0.00		105.07	
146		EPI	92.20	86.60	84.10	0.0011	18	47.25	3.257	86.93	Yes
14	146			86.50	84.00			26.74	-43.996	86.50	
147		MAN	4.00	86.50	84.00			46.25		86.50	No
15	147			86.50	83.90			0.00		162.18	
148		EPI	398.97	86.50	84.00	0.0033	18	46.25	5.645	87.07	Yes
16	148			85.20	82.70			26.17	-40.605	85.20	
149		MAN	4.00	85.20	82.70			47.96		85.20	No
17	149			85.20	82.60			0.00		166.20	
150		EPI	400.00	85.20	82.70	0.005	18	47.96	6.992	85.43	Yes
18	150			83.20	80.70			27.14	-40.972	83.20	
151		MAN	4.00	83.20	80.70			47.01		83.20	No
19	151			83.20	80.60			0.00		221.08	
152		EPI	687.67	83.20	80.70	0.0035	18	47.01	5.842	138.75	Yes
20	152			80.80	78.30			26.60	-41.168	84.00	
154		MAN	4.00	84.00	78.30			46.11		84.00	No
21	154			84.00	78.20			0.00		105.77	
135		EPI	139.59	80.80	78.30	0.0057	18	46.11	7.486	79.87	Yes
22	135			80.00	77.50			26.09	-38.620	79.00	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CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

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RR10y
System Summary

Lateral Starting at Entity 2

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
2		MAN	4.00	88.50	86.50			0.67		86.40	-2.1
1	2			88.50	86.40			0.00		86.40	
1		EPI	107.21	88.50	85.50	0.0056	12	0.67	2.509	85.94	No
2	1			87.90	84.90			2.41	1.835	85.90	
3		MAN	4.00	87.90	84.90			3.73		85.90	-2
3	3			87.90	84.80			0.00		85.90	
31		EPI	395.00	87.90	84.90	0.003	24	4.94	11.738	85.90	No
4	31			86.70	83.70			3.19	-6.800	84.82	
32		MAN	4.00	86.70	83.70			4.49		84.82	-1.88
5	32			86.70	83.70			0.00		84.82	
33		EPI	349.00	86.70	83.70	0.002	24	4.91	9.538	84.82	No
6	33			86.00	83.00			2.77	4.628	84.14	
34		MAN	4.00	86.00	83.00			5.20		84.14	-1.86
7	34			86.00	82.90			0.00		84.14	
35		EPI	240.46	86.00	83.00	0.0021	24	5.20	9.711	84.14	No
8	35			85.60	82.50			2.85	4.516	83.64	
36		MAN	4.00	85.60	82.50			7.80		83.62	-1.98
9	36			85.60	82.40			0.00		83.62	
37		EPI	363.00	85.60	82.50	0.0041	30	8.39	24.822	83.62	No
10	37			84.00	81.00			4.07	16.435	82.22	

Lateral Starting at Entity 6

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
6		MAN	4.00	84.00	82.00			0.42		81.90	-2.1
11	6			84.00	81.90			0.00		81.90	
4		EPI	152.72	84.00	81.00	0.0046	15	0.42	4.117	81.73	Yes
12	4			83.30	80.30			1.91	3.693	81.72	

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 9											
9		MAN	4.00	84.70	82.70			1.31		82.60	-2.1
13	9			84.70	82.60			0.00		82.60	
7		EPI	152.72	84.70	81.70	0.0046	15	1.31	4.117	82.24	No
14	7			84.00	81.00			2.65	2.809	82.22	
8		MAN	4.00	84.00	81.00			9.15		82.22	-1.78
15	8			84.00	80.90			0.00		82.22	
38		EPI	200.00	84.00	81.00	0.0035	30	9.15	22.845	82.22	No
16	38			83.30	80.30			3.92	13.698	81.72	
5		MAN	4.00	83.30	80.30			9.05		81.72	-1.58
17	5			83.30	80.20			0.00		81.72	
39		EPI	466.00	83.30	80.30	0.003	30	11.21	21.165	81.72	No
18	39			84.00	78.90			3.96	9.951	80.34	
40		MAN	4.00	84.00	78.90			11.48		80.34	-3.66
19	40			84.00	78.80			0.00		80.34	
41		EPI	136.00	84.00	78.90	0.0029	30	11.48	20.942	80.34	No
20	41			82.50	78.50			3.95	9.464	79.94	
42		MAN	4.00	82.50	78.50			11.83		79.86	-2.64
21	42			82.50	78.40			0.00		79.86	
43		EPI	231.00	82.50	78.50	0.0043	30	12.49	25.406	79.86	No
22	43			81.50	77.50			4.64	12.912	78.86	
44		MAN	4.00	81.50	77.50			12.42		78.08	-3.42
23	44			81.50	77.40			0.00		78.08	
45		EPI	64.00	81.50	77.50	0.1172	30	12.42	132.187	78.08	No
24	45			74.00	70.00			15.02	119.770	70.58	

SDMP GAUDALUPE CA
RM ASSOCIATES
RailRoad sys 25yr Sto

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RR25y
System Summary

Lateral Starting at Entity 2

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
2		MAN	4.00	88.50	86.50			1.00		86.40	-2.1
1	2			88.50	86.40			0.00		86.40	
1		EPI	107.21	88.50	85.50	0.0056	12	1.00	2.509	86.23	Yes
2	1			87.90	84.90			2.73	1.505	86.14	
3		MAN	4.00	87.90	84.90			5.57		86.14	-1.76
3	3			87.90	84.80			0.00		86.14	
31		EPI	395.00	87.90	84.90	0.003	24	7.36	11.738	86.14	No
4	31			86.70	83.70			3.60	4.374	85.12	
32		MAN	4.00	86.70	83.70			6.73		85.12	-1.58
5	32			86.70	83.70			0.00		85.12	
33		EPI	349.00	86.70	83.70	0.002	24	7.35	9.538	85.12	No
6	33			86.00	83.00			3.12	2.185	84.46	
34		MAN	4.00	86.00	83.00			7.80		84.46	-1.54
7	34			86.00	82.90			0.00		84.46	
35		EPI	240.46	86.00	83.00	0.0021	24	7.80	9.711	84.46	No
8	35			85.60	82.50			3.21	1.911	83.96	
36		MAN	4.00	85.60	82.50			11.70		83.88	-1.72
9	36			85.60	82.40			0.00		83.88	
37		EPI	363.00	85.60	82.50	0.0041	30	12.58	24.822	83.88	No
10	37			84.00	81.00			4.57	12.240	82.52	

Lateral Starting at Entity 6

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
6		MAN	4.00	84.00	82.00			0.63		82.12	-1.88
11	6			84.00	81.90			0.00		82.12	
4		EPI	152.72	84.00	81.00	0.0046	15	0.63	4.117	82.12	Yes
12	4			83.30	80.30			2.17	3.484	82.10	

RR25y
System Summary

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 9											
9		MAN	4.00	84.70	82.70			1.95		82.66	-2.04
13	9			84.70	82.60			0.00		82.66	
7		EPI	152.72	84.70	81.70	0.0046	15	1.95	4.117	82.66	Yes
14	7			84.00	81.00			3.01	2.167	82.52	
8		MAN	4.00	84.00	81.00			13.74		82.52	-1.48
15	8			84.00	80.90			0.00		82.52	
38		EPI	200.00	84.00	81.00	0.0035	30	13.74	22.845	82.52	No
16	38			83.30	80.30			4.44	9.102	82.10	
5		MAN	4.00	83.30	80.30			13.62		82.10	-1.2
17	5			83.30	80.20			0.00		82.10	
39		EPI	466.00	83.30	80.30	0.003	30	16.85	21.165	82.10	No
18	39			84.00	78.90			4.45	4.316	80.74	
40		MAN	4.00	84.00	78.90			17.11		80.74	-3.26
19	40			84.00	78.80			0.00		80.74	
41		EPI	136.00	84.00	78.90	0.0029	30	17.11	20.942	80.74	No
20	41			82.50	78.50			4.45	3.832	80.34	
42		MAN	4.00	82.50	78.50			17.40		80.20	-2.3
21	42			82.50	78.40			0.00		80.20	
43		EPI	231.00	82.50	78.50	0.0043	30	18.35	25.406	80.20	No
22	43			81.50	77.50			5.21	7.056	79.20	
44		MAN	4.00	81.50	77.50			18.29		78.20	-3.3
23	44			81.50	77.40			0.00		78.20	
45		EPI	64.00	81.50	77.50	0.1172	30	18.29	132.187	78.20	No
24	45			74.00	70.00			16.67	113.901	70.70	

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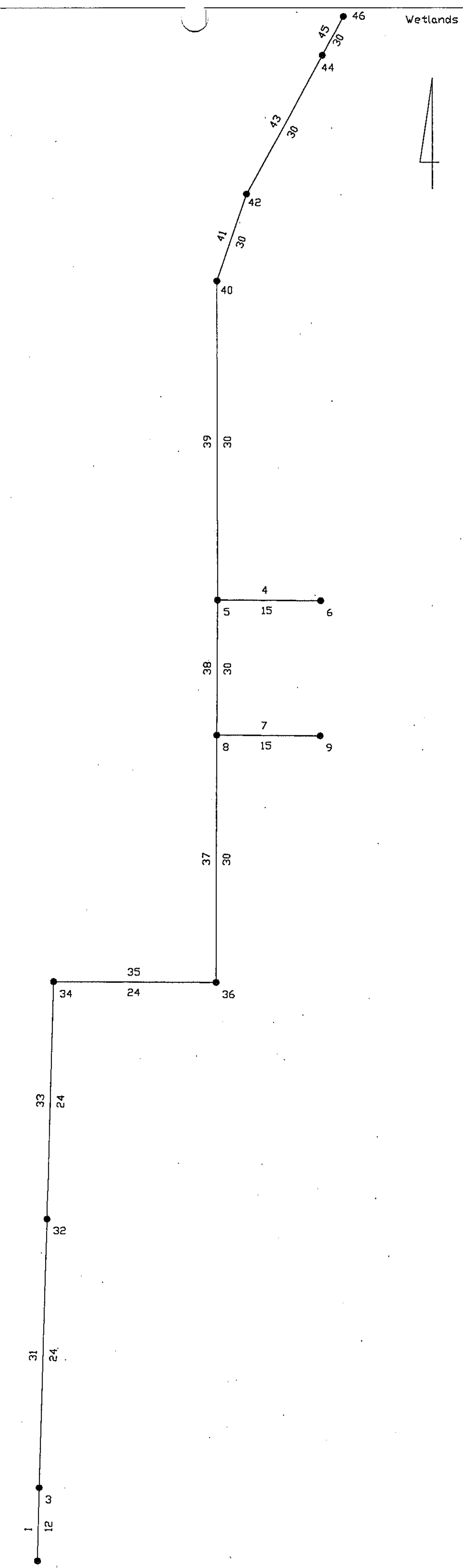
RR100y
System Summary

UserID / SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ / Vel	MaxQ / ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 2											
2		MAN	4.00	88.50	86.50			1.54		87.36	-1.14
1	2			88.50	86.40			0.00		87.36	
1		EPI	107.21	88.50	85.50	0.0056	12	1.54	2.509	87.36	Yes
2	1			87.90	84.90			3.08	0.971	87.16	
3		MAN	4.00	87.90	84.90			8.52		87.16	-0.74
3	3			87.90	84.80			0.00		87.16	
31		EPI	395.00	87.90	84.90	0.003	24	11.28	11.738	87.16	Yes
4	31			86.70	83.70			4.09	0.459	86.18	
32		MAN	4.00	86.70	83.70			10.35		86.18	-0.52
5	32			86.70	83.70			0.00		86.18	
33		EPI	349.00	86.70	83.70	0.002	24	11.31	9.538	86.18	Yes
6	33			86.00	83.00			3.60	-1.768	85.32	
34		MAN	4.00	86.00	83.00			12.03		85.32	-0.68
7	34			86.00	82.90			0.00		85.32	
35		EPI	240.46	86.00	83.00	0.0021	24	12.03	9.711	85.32	Yes
8	35			85.60	82.50			3.83	-2.321	84.64	
36		MAN	4.00	85.60	82.50			18.03		84.64	-0.96
9	36			85.60	82.40			0.00		84.64	
37		EPI	363.00	85.60	82.50	0.0041	30	19.38	24.822	84.64	Yes
10	37			84.00	81.00			5.20	5.442	83.83	
Lateral Starting at Entity 6											
6		MAN	4.00	84.00	82.00			0.97		83.33	-0.67
11	6			84.00	81.90			0.00		83.33	
4		EPI	152.72	84.00	81.00	0.0046	15	0.97	4.117	83.33	Yes
12	4			83.30	80.30			2.42	3.148	83.30	

UserID SEQ	 G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
				Lateral Starting at Entity 9							
9 13	 9	MAN	4.00	84.70 84.70	82.70 82.60			2.99 0.00		84.16 84.16	-0.54
7 14	 7	EPI	152.72	84.70 84.00	81.70 81.00	0.0046	15	2.99 3.39	4.117 1.131	84.16 83.83	Yes
8 15	 8	MAN	4.00	84.00 84.00	81.00 80.90			21.21 0.00		83.83 83.83	-0.17
38 16	 38	EPI	200.00	84.00 83.30	81.00 80.30	0.0035	30	21.21 5.04	22.845 1.639	83.83 83.30	Yes
5 17	 5	MAN	4.00	83.30 83.30	80.30 80.20			21.05 0.00		83.30 83.67	No
39 18	 39	EPI	466.00	83.30 84.00	80.30 78.90	0.003	30	26.00 5.30	21.165 -4.836	83.67 81.81	Yes
40 19	 40	MAN	4.00	84.00 84.00	78.90 78.80			27.19 0.00		81.81 81.81	-2.19
41 20	 41	EPI	136.00	84.00 82.50	78.90 78.50	0.0029	30	27.19 5.54	20.942 -6.245	81.81 81.21	Yes
42 21	 42	MAN	4.00	82.50 82.50	78.50 78.40			27.82 0.00		81.21 81.21	-1.29
43 22	 43	EPI	231.00	82.50 81.50	78.50 77.50	0.0043	30	29.80 6.07	25.406 -4.396	81.21 80.00	Yes
44 23	 44	MAN	4.00	81.50 81.50	77.50 77.40			28.38 0.00		78.38 78.38	-3.12
45 24	 45	EPI	64.00	81.50 74.00	77.50 70.00	0.1172	30	28.38 18.95	132.187 103.811	78.38 70.88	No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CITY OF GUADALUPE
2007 STORM DRAIN MASTER PLAN

29

SDMP GUADALUPE CA
RM ASSOCIATES
D.J. Farms 100yr Sto Pond concd.

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DJf100y
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
Lateral Starting at Entity 10											
10		MAN	4.00	90.80	84.80			161.60		87.26	-3.54
1	10			90.80	84.70			0.00		87.26	
9		EPI	1,717.95	90.80	84.80	0.0015	500	161.60	26,700.308	87.26	No
2	9			87.60	82.30			5.01	26,538.703	84.76	
11		RES	0.00	82.30	82.30			64.71		82.30	No
3	11			82.30	0.00			0.00		82.30	
12		EPI	193.59	87.60	82.30	0.0041	300	64.71	11,522.743	84.14	No
4	12			87.40	81.50			5.86	11,458.036	84.14	
Lateral Starting at Entity 16											
16		EPI	224.59	87.60	87.10	0.0249	300	0.00	28,303.891	87.10	No
5	16			87.40	81.50			0.20	28,303.891	84.14	
13		MAN	4.00	87.40	81.50			64.71		84.14	-3.26
6	13			87.40	81.40			0.00		84.14	
14		EPI	228.61	87.40	81.50	0.0048	48	64.71	93.805	84.14	No
7	14			87.00	80.40			7.41	29.100	83.04	
15		MAN	4.00	80.90	80.40			64.70		80.90	No
8	15			80.90	80.30			0.00		81.60	
17		EPI	1,143.45	87.00	80.40	0.0045	500	64.70	47,200.342	81.60	No
9	17			80.80	75.20			5.88	47,135.638	76.40	
2		RES	0.00	75.20	75.20			25.67		75.20	No
10	2			75.20	0.00			0.00		75.20	
1		EPI	340.58	80.80	75.20	0.0029	300	25.67	9,712.690	76.18	No
11	1			80.70	74.20			4.05	9,687.018	75.78	
Lateral Starting at Entity 8											
8		EPI	417.22	80.80	80.30	0.0146	300	0.00	21,673.476	80.30	No
12	8			80.70	74.20			0.20	21,673.476	75.78	
3		MAN	4.00	80.70	74.20			25.67		75.78	-4.92
13	3			80.70	74.10			0.00		75.78	
4		EPI	225.00	80.70	74.20	0.0049	48	25.67	94.554	75.78	No
14	4			80.60	73.10			5.65	68.882	74.68	
5		MAN	4.00	80.60	73.10			25.67		74.32	-6.28
15	5			80.60	73.00			0.00		74.32	
6		EPI	150.00	80.60	73.10	0.0007	500	25.67	18,071.975	74.32	No
16	6			80.60	73.00			2.27	18,046.303	74.22	

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D.J. Farms 100yr Sto Vol. calc.

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DJf100VI

Reservoirs - Sorted by User's ID

UserID SEQ	G_ID	Rim Elev	Inverts In/Over/Out	Over ID	DesignQ In/Over/Out	Reservoir Cap Max/Stored	HGL Up/Dn	Surcharge
11		82.30	82.30	5	212.46	1,000,000.00	82.30	No
3	11		0.00		38.52	1,000,000.00	82.30	
			0.00		59.15			
2		75.20	75.20	12	112.56	1,000,000.00	75.20	No
10	2		0.00		74.03	1,000,000.00	75.20	
			0.00		9.64			

SDMP GUADALUPE CA
RM ASSOCIATES
D.J. Farms 100yr Sto Vol. calc.

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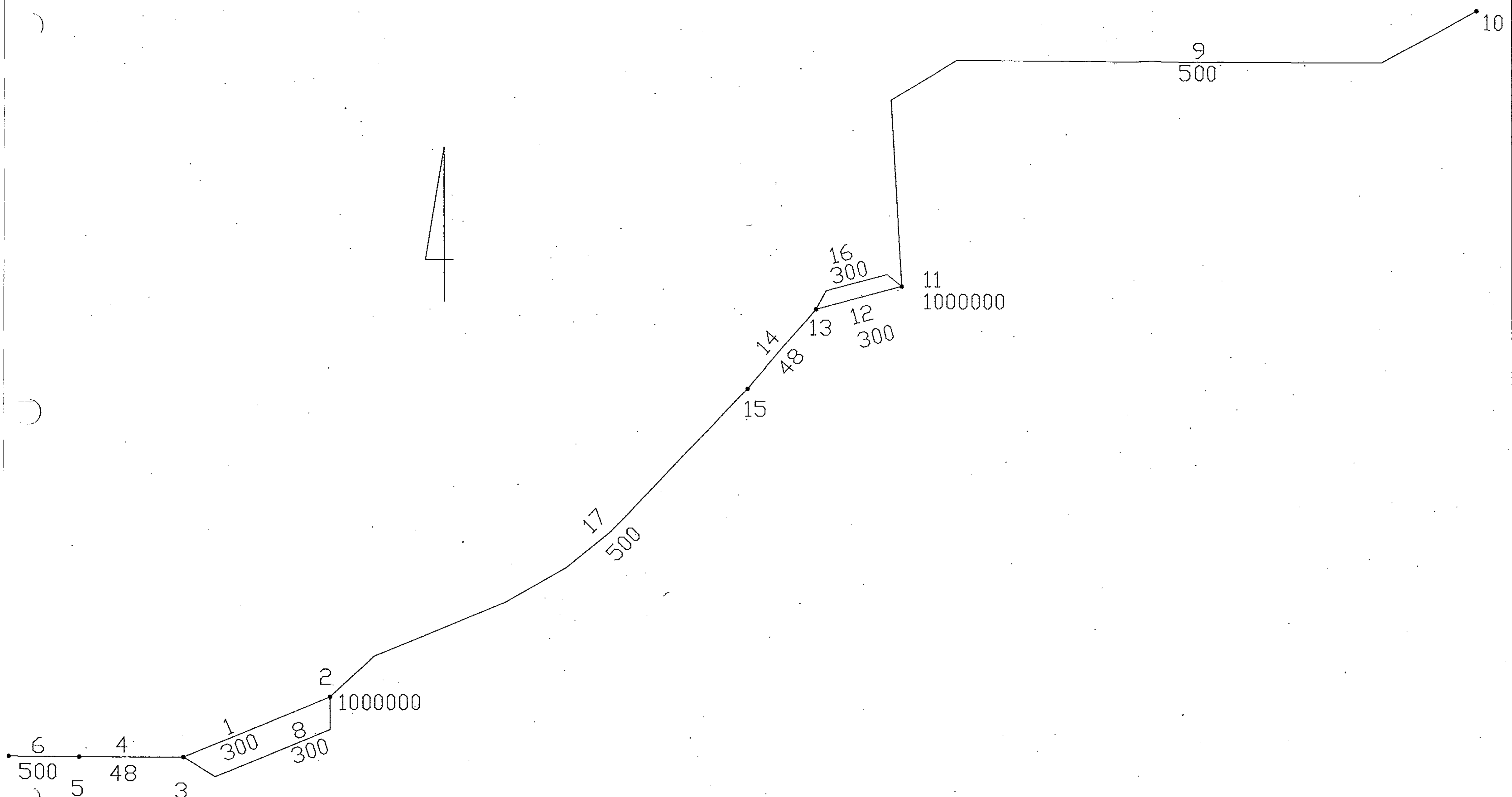
DJf100VI
System Summary

UserID SEQ	G_ID	Type	Length	Ground Up/Dn	Invert Up/Dn	Slope	Diam	DesignQ Vel	MaxQ ExcessQ	HGL Up/Dn	Surchg
					Lateral Starting at Entity 10						
10		MAN	4.00	90.80	84.80			161.60		87.26	-3.54
1	10			90.80	84.70			0.00		87.26	
9		EPI	1,717.95	90.80	84.80	0.0015	500	161.60	26,700.308	87.26	No
2	9			87.60	82.30			5.01	26,538.703	84.76	
11		RES	0.00	82.30	82.30			59.15		82.30	No
3	11			82.30	0.00			0.00		82.30	
12		EPI	193.59	87.60	82.30	0.0041	300	59.15	11,522.743	84.96	No
4	12			87.40	81.50			5.70	11,463.589	84.96	
					Lateral Starting at Entity 16						
16		EPI	224.59	87.60	87.10	0.0249	300	38.52	28,303.891	87.82	No
5	16			87.40	81.50			9.79	28,265.369	84.96	
13		MAN	4.00	87.40	81.50			95.48		84.96	-2.44
6	13			87.40	81.40			0.00		84.96	
14		EPI	228.61	87.40	81.50	0.0048	48	95.48	93.805	84.96	No
7	14			87.00	80.40			8.28	-1.678	83.86	
15		MAN	4.00	80.90	80.40			93.67		80.90	No
8	15			80.90	80.30			0.00		81.84	
17		EPI	1,143.45	87.00	80.40	0.0045	500	93.67	47,200.342	81.84	No
9	17			80.80	75.20			6.52	47,106.673	76.64	
2		RES	0.00	75.20	75.20			9.64		75.20	No
10	2			75.20	0.00			0.00		75.20	
1		EPI	340.58	80.80	75.20	0.0029	300	9.64	9,712.690	80.64	No
11	1			80.70	74.20			3.08	9,703.051	80.64	
					Lateral Starting at Entity 8						
8		EPI	417.22	80.80	80.30	0.0146	300	74.03	21,673.476	81.42	No
12	8			80.70	74.20			9.60	21,599.442	80.64	
3		MAN	4.00	80.70	74.20			82.53		80.64	-0.06
13	3			80.70	74.10			0.00		80.64	
4		EPI	225.00	80.70	74.20	0.0049	48	82.53	94.554	80.64	Yes
14	4			80.60	73.10			8.00	12.024	79.90	
5		MAN	4.00	80.60	73.10			81.82		79.90	-0.7
15	5			80.60	73.00			0.00		79.90	
6		EPI	150.00	80.60	73.10	0.0007	500	81.82	18,071.975	79.90	No
16	6			80.60	73.00			3.11	17,990.151	79.90	

DJf100y

Reservoirs - Sorted by User's ID

UserID SEQ	G_ID	Rim Elev	Inverts In/Over/Out	Over ID	DesignQ In/Over/Out	Reservoir Cap Max/Stored	HGL Up/Dn	Surcharge
11		82.30	82.30	5	212.46	,000,000,000.00	82.30	No
3	11		0.00		0.00	1,089,987.77	82.30	
			0.00		64.71			
2		75.20	75.20	12	92.66	,000,000,000.00	75.20	No
10	2		0.00		0.00	2,661,650.75	75.20	
			0.00		25.67			



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