City of San Marcos

1 Civic Center Drive
San Marcos, CA 92069

Staff Report

File #: TMP-2227

MEETING DATE:
FEBRUARY 25, 2025

SUBJECT:

RESOLUTION 2025-9409 - ADOPTING AN UPDATED CITYWIDE DRAINAGE MASTER PLAN

Recommendation
ADOPT resolution approving an updated Citywide Drainage Master Plan.

Board or Commission Action
Not Applicable

Relevant Council Strategic Theme
Planning for the Future
Good Governance

Executive Summary
An updated analysis of the 1990 Master Plan of Drainage has been performed, and the updated Plan is presented to the City Council for its consideration. Recommended adoption will facilitate future storm drainage infrastructure and will also support the basis of the recently adopted Public Facilities Fees taking effect March 3, 2025.

Discussion
In 1990, the City completed a Master Plan of Drainage, providing a comprehensive analysis of the storm drain conveyance system. This plan identified necessary future drainage facilities to support the City's growth and has served as the guiding document for storm infrastructure since its adoption. Over the past 35 years, both City and private development projects have implemented improvements outlined in the Master Plan.

The Master Plan also formed the basis for the City's Public Facilities Fees (PFF) for Drainage. It identified capital improvements and their costs, which were used to determine impact fees collected from new developments to fund necessary drainage facilities.

In 2019, the City conducted another comprehensive analysis of the drainage system, assessing existing infrastructure, key concerns, and future development areas. This resulted in a new Drainage Master Plan ("Plan"), which updated the City's drainage system needs. The Plan also informed updates to the PFF, which were approved by the City Council in late 2024.

At this time, staff recommends adoption of the updated Plan, officially replacing the 1990 Master Plan of

Drainage. Adoption of the Plan will facilitate future development and will also provide a direct link between necessary infrastructure and the updated PFF.

Environmental Review

This Project is categorically exempt from the California Environmental Quality Act (CEQA) in accordance with Section 15262 of Title 14 of the California Code of Regulations, as it consists only of the preparation of a feasibility or planning study for possible future actions.

Fiscal Impact

No direct fiscal impacts are anticipated as part of this approval.

Attachment(s)

Resolution -A Resolution adopting a Citywide Drainage Master Plan.
Attachment A - Drainage Master Plan

Prepared by: Isaac Etchamendy, Director of Development Services/City Engineer
Approved by: Michelle Bender, City Manager

RESOLUTION NO. 2025-XXXX

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SAN MARCOS ADOPTING AN UPDATED CITYWIDE DRAINAGE MASTER PLAN

WHEREAS, the City must periodically evaluate is critical infrastructure for current deficiencies and future needs; and

WHEREAS, the City's drainage system is a critical component of the City's infrastructure; and

WHEREAS, the City recognizes the importance of comprehensive drainage systems that protect residents, businesses, and critical transportation infrastructure from flooding and storm related damage; and

WHEREAS, the City has conducted a comprehensive assessment of the City's existing drainage system in an effort to identify deficiencies as well as identify improvements to accommodate future demand; and

WHEREAS, the results of the City's assessment is an updated Citywide Drainage Master Plan ("Plan") which has been developed to guide future infrastructure improvements; and

WHEREAS, the current Master Plan of Drainage, adopted in 1990, would no longer be used to guide infrastructure development following the adoption of the Plan; and

WHEREAS, the Plan would allow for the orderly development and implementation of storm drain infrastructure; and

WHEREAS, the City finds that the adoption of the Plan is in the best interest of public safety, health and welfare.

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of San Marcos as follows:

1. The foregoing recitals are true and correct;
2. The updated Plan, Attachment A to this Resolution, is herby adopted as the Master Drainage Plan for the City of San Marcos.

PASSED, APPROVED, and ADOPTED by the City Council of the City of San Marcos, California, this 25th day of February, 2025, by the following vote:

AYES: COUNCIL MEMBERS:
NOES: COUNCIL MEMBERS:

ABSENT: COUNCIL MEMBERS:

Rebecca D. Jones, Mayor
City of San Marcos

ATTEST:

PHILLIP SCOLLICK, CITY CLERK
City of San Marcos

Attachment A

Drainage Master Plan

DRAINAGE MASTER PLAN
FOR
CITY OF SAN MARCOS

Prepared For:

City of San Marcos
Storm Water Division
1 Civic Center Way
San Marcos, California 92069

Prepared By:

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Associate Principal

March 2019

AGENDA ITEM
#5.6

Table of Contents

Figures

Tables

Appendices

Limitations:

The City of San Marcos Drainage Master Plan is a comprehensive plan for existing and future drainage needs within the City of San Marcos. This report has been prepared for master planning purposes only, as a guide for engineers, planners, developers, and City staff. Detailed engineering calculations and investigations should be prepared for the implementation of any of the facilities outlined in this study. In addition, coordination with adjacent municipalities or state agencies may be required to coordinate drainage improvement efforts that cross jurisdictional boundaries.

1.0 EXECUTIVE SUMMARY

The *Drainage Master Plan* (DMP) has been prepared for the City of San Marcos (City) as a useful tool to highlight existing storm water conveyance system deficiencies and inform future decisions pertaining to public storm drain infrastructure improvements. The City is responsible for managing the public storm drain system within the City limits, and ensuring that an adequate level of service is provided to protect the public from excessive surface flooding conditions. To this end, the need for a comprehensive and high-resolution hydrologic and hydraulic (H&H) analysis to evaluate the existing storm water conveyance system level of service citywide was identified.

To comply with the City's flood control needs of evaluating the existing storm drain infrastructure performance and locating deficiencies, a deep understanding of the watershed hydrology and hydraulics was required. For this study, a Geographic Information System (GIS) centric watershed-scale approach utilizing PCSWMM to model the 2-year, 10 year, 50-year, and 100-year (24-hour) storm events was used. The modeling efforts analyzed **over 5,000 pipes** showing approximately **188,185 LF of hydraulically deficient pipes**. The H&H modeling performed for this project considered a 1-D approach (i.e., the effects of surface attenuation and storage were not explicitly considered in the model).

Table 1-1 summarizes the storm drain results in the existing condition.

Table 1-1: Existing Condition Storm Drain Results

Conduits	2-Year Capacity		10-Year Capacity		50-Year Capacity		100-Year Capacity	
	LF	%	LF	%	LF	%	LF	%
Only Upstream Surcharging	7,717	1.3	15,379	2.5	34,403	5.6	44,220	7.1
Only Downstream Surcharging	9,982	1.6	18,724	3.0	40,163	6.5	50,683	8.2
Both Upstream and Downstream Surcharging	9,421	1.5	24,126	3.9	62,296	10.1	93,282	15.0
Subtotal of Deficiencies (LF)	27,120	4.4	58,229	9.4	136,862	22.2	188,185	30.3
Number of Junctions Surcharging	130	2.4	323	5.9	788	14.4	1,102	20.1
Not Deficient (LF)	592,151		561,042		482,409		431,086	
Number of Junctions Not Surcharging	5,353	97.6	5,160	94.1	4,695	85.6	4,381	79.9
Total (LF)	**619,271**		**619,271**		**619,271**		**619,271**	
Total Junctions	**5,483**		**5,483**		**5,483**		**5,483**	

Based on the existing condition model, during a 100-year storm, 44,220 LF of pipe have an upstream structure surcharging, 50,683 LF of pipe have a downstream structure surcharging and 93,282 LF of pipe have both upstream and downstream structures surcharging.

This DMP developed a Capital Improvement Program (CIP) to identify, model, and produce order of magnitude probable construction costs drainage improvement projects throughout the City. The CIP as outlined in this report results in **thirteen (13) CIP projects** with a total order of magnitude opinion of probable construction **cost of $25,135,300.** These CIP projects are inclusive of providing new infrastructure, and replacing/realigning existing infrastructure. In addition to the drainage improvement projects, regional improvement projects were also identified for the purpose of water quality and/or flood storage benefits. The costs of drainage improvements for each watershed, broken down by project type, are as follows:

Table 1-2: Recommended Improvements Costs

Hydrologic Basins	CIP Projects	Recommended Improvements	Total Costs
San Marcos Creek – North Basin	$6,377,005	$1,636,649	$8,013,654
San Marcos Creek – East Basin	$5,468,463	$9,968,988	$15,437,451
San Marcos Creek – Main Basin	$2,373,703	$4,046,621	$6,420,324
Las Posas Basin	$8,900,893	$8,995,762	$17,896,655
North Outlying Basin	$2,015,175	$7,493,078	$9,508,253
South Outlying Basin	$0	$1,511,991	$1,511,991

Based on the *San Diego County Hydraulic Design Manual*, dated September 2014 storm drains in conjunction with surface drainage are to be designed to the convey the 100-year storm. Based on conversations with the City staff, the 100-year design storm is the basis of recommendations with the improvements for the deficient pipes being recommended to achieve a minimum 10-year level of service within the storm drain. Further discussion of the modeling approach is detailed later in this section.

From this study, the "combined recommendations condition" also referred to as "proposed condition model" in the report is described by implementation of recommended infrastructure improvements and the CIP projects in conjunction. The combined recommendations condition includes storm drain improvements recommended to achieve a minimum 10-year level of service in conjunction with the thirteen CIPs. The intent of this model was to analyze the impact of the combined recommendations on the City's storm drain infrastructure. Refer to Table 1-3 for the for the results of the combined recommendations model. The total costs shown in Table 1-2 are representative of the results in Table 1-3.

Table 1-3: Combined Recommendations Storm Drain Results

Conduits	2-Year Capacity		10-Year Capacity		50-Year Capacity		100-Year Capacity	
	LF	%	LF	%	LF	%	LF	%
Only Upstream Surcharging	2,430	0.4	3,271	0.5	28,822	4.7	40,851	6.6
Only Downstream Surcharging	2,637	0.4	3,601	0.6	26,479	4.3	39,921	6.5
Both Upstream and Downstream Surcharging	515	0.1	1,424	0.2	31,115	5.0	60,657	9.8
Subtotal of Deficiencies (LF)	5,582	0.9	8,296	1.3	86,416	14.0	141,429	22.9
Number of Junctions Surcharging	15	0.3	31	0.6	479	8.7	819	14.9
Not Deficient (LF)	613,689		610,975		532,855		477,842	
Number of Junctions Not Surcharging	5,468	99.7	5,452	99.4	5,004	91.3	4,664	85.1
Total (LF)	**619,271**		**619,271**		**619,271**		**619,271**	
Total Junctions	**5,483**		**5,483**		**5,483**		**5,483**	

Table 1-4 provides a comparison of results between existing condition model and combined recommendations model.

Table 1-4: Comparison of Storm Drain Results

	Conduits	2-Year Capacity		10-Year Capacity		50-Year Capacity		100-Year Capacity	
		LF	%	LF	%	LF	%	LF	%
Existing Condition	Subtotal of Deficiencies (LF)	27,120	4.4	58,229	9.4	136,862	22.2	188,185	30.3
	Number of Junctions Surcharging	130		323		788		1,102	
Combined Recommended Condition	Subtotal of Deficiencies (LF)	5,582	0.9	8,296	1.3	86,416	14.0	141,429	22.9
	Number of Junctions Surcharging	15		31		479		819	
Flood Reduction Benefit from Ex. To Rec.	**Subtotal of Deficiencies Resolved (LF)**	**21,538**	**79**	**49,933**	**86**	**50,446**	**37**	**46,756**	**25**
	Number of Junctions Surcharging	**115**	**88**	**292**	**90**	**309**	**39**	**283**	**26**

The results are in agreement with the goal of the proposed condition model, which is to provide a cost effective solution to improve the existing drainage in the City. By achieving a minimum 10-year level of service, there is a significant flood reduction during the 50-year and 100-year storm.

The first iteration of recommended improvements involved sizing the deficient storm drains to 100-year constrained flows. The basis of sizing the deficient storm drains to 100-year constrained flows is to not result in continuous iterations of improvements, opening the existing restrictions in the system (causing a “domino effect”), and thereby resulting in significant capital costs and increase flows to downstream infrastructure. This iteration provided a similar level of service to the final approach, as outlined in the section “Proposed Condition Modeling” of the report, but resulted in costs in excess of $100 million to the City. Through this iteration, it was determined that relying on storm drain only to achieve 100-year level of service was not a fiscally responsible approach.

The provision of 100-year level of service is still the basis of recommendations with the improvements for the deficient pipes. However, the approach outlined in the **Proposed Condition Modeling** section of the report does not rely exclusively on storm drain infrastructure, and instead on the combination of storm drain and surface conveyance. The reliance on storm drain conveyance for the 100-year event is not feasible at this time due to existing constraints in the storm drain system. These constraints include but are not limited to FEMA floodplains and jurisdictional boundaries (i.e., Caltrans, NCTD and neighboring municipalities).

The recommended storm drain improvements presented in this DMP would provide increased level of service for smaller and more frequently occurring storm events up to the 10-year storm. The data from the first iteration is available in GIS format for the City to further the storm drain development and provide additional level of service for future efforts.

This approach was agreed to during conversations with the City staff as the fiscally responsible approach to handling the City’s drainage needs.

2.0 INTRODUCTION

The City of San Marcos study area limit is approximately 21 square miles in area. However, the entire watershed area tributary to the City of San Marcos study area covers approximately 33 square miles due to inflow from San Diego County and the City of Escondido. The City is bordered by San Diego County to the north and south, the City of Escondido to the east, the City of Vista to the northwest, and the City of Carlsbad to the west. The study area also contains a portion of San Diego County which lies within the western portion of the City of San Marcos and contains Lake San Marcos. State Route 78 runs in east – west direction, along the central portion of the City, and Interstate 15 runs north – south just outside the east edge of the City of San Marcos.

The study area is primarily tributary to San Marcos Creek, discharging to the County of San Diego and Lake San Marcos located within the Carlsbad Watershed. The study area is comprised of six (6) hydrologic basins; San Marcos Creek – North Basin, San Marcos Creek – East Basin, and Las Posas Basin are all tributary to San Marcos Creek – Main Basin, and there are also the North and South Outlying Basins. There is also an area in the southwest corner of the City that drains to Escondido that is not associated with one of the six basins.

2.1 Major Drainage Basins

The overall watershed is comprised of six (6) hydrologic basins; San Marcos Creek – North Basin , San Marcos Creek – East Basin, San Marcos Creek – Main Basin, Las Posas Basin, North Outlying Basin and South Outlying Basin. San Marcos Creek – North Basin, San Marcos Creek – East Basin and Las Posas Basin are all tributary to the San Marcos Creek – Main Basin and there are also the North and South Outlying Basins.

The San Marcos Creek – North Basin is approximately 7,100 acres and consists of San Diego County to the north and the City of San Marcos to the south. Flows from the basin are primarily conveyed through Twin Oaks Valley Creek until the basin outfalls at the confluence with San Marcos Creek just south of the intersection of North Twin Oaks Valley Road and West San Marcos Boulevard.

The San Marcos Creek – East Basin is approximately 4,500 acres and consists of portions of San Diego County, City of Escondido and City of San Marcos and is tributary to the upstream end of San Marcos Creek to the outfall of the basin at the confluence with Twin Oaks Valley Creek.

The Las Posas Basin is approximately 2,100 acres and is the only basin entirely within the City of San Marcos and conveys flows through a system of channels and culverts that make up Las Posas Creek. This basin also consists of a portion of the Northern Split from the San Marcos Creek which ties into Las Posas Creek and outfalls with the basin at the confluence with San Marcos Creek southeast of the intersection of West San Marcos Boulevard and Discovery Street.

The San Marcos Creek – Main Basin is approximately 6,200 acres and consists of San Diego County, City of San Marcos, and a small portion of the City of Carlsbad. This basin is primarily conveyed through San Marcos Creek and includes Lake San Marcos. This basin outfalls at the border of the City of San Marcos and the City of Carlsbad.

The North Outlying Basin is approximately 2,500 acres and consists primarily of the City of San Marcos with small portions of the City of Vista and San Diego County. The flow from this basin is primarily conveyed through local drainage networks that outfall in multiple locations that are tributary to (2) channels; in the north Agua Hedionda Creek and south to an unnamed tributary to San Marcos Creek.

The South Outlying Basin is approximately 2,100 acres and consists primarily of the City of San Marcos with small portions of San Diego County. The flow from this basin is primarily conveyed through local drainage networks to the south where it outfalls in two locations to San Diego County.

2.2 Drainage Sub-Basins

The (6) major drainage basins are further subdivided into smaller sub-basins with a maximum area of approximately 20 acres. The original sub-basin delineations provided by the City of San Marcos were accurate in reference to the provided elevation contours. However, these were not always delineated to the storm drain infrastructure provided. As a result of this study the major drainage basins were updated based on the updated sub-basin delineations.

2.3 Drainage Subcatchments

New subcatchment delineations, similar to the City provided sub-basin delineations, were created for modeling purposes. These subcatchments have been revised to reflect the location of drainage infrastructure while also providing key hydrologic attributes for routing such as: longest flow path, general slope, and characteristic width of the subcatchment (area of subcatchment divided by length of the longest flow path). Approximately 3,100 subcatchments were delineated and assigned all the hydrologic parameters necessary for modeling:

a. percent impervious
b. n-impervious
c. n-pervious (from General Plan Land Use)
d. soil suction head
e. soil conductivity
f. initial moisture deficit from NRCS Soil map.

When it was determined that land use or s oil type within a subcatchment were not uniform, the hydrologic values are area-weighted, based on the intersecting land use and soil polygons using GIS tools.

3.0 SOFTWARE

The rainfall data used for the San Marcos stormwater model was NOAA Atlas 14 data for the watershed to better reflect local precipitation patterns. This data was used in lieu of the San Diego County isopluvials. A 1-Dimensional model was used for engineered drainage improvements such as pipes, culverts, and channels along with existing regional storage facilities in order to assess the impacts of storage on the peak flow rates and times to peak. The modeling approach allows a more resolved description of the conveyance and storage deficiencies. Refer to section 4 for more specific information.

3.1 Software Selected

The proposed hydraulic model setup is a 1-D model utilizing the PCSWMM modeling platform. PCSWMM was selected as the modeling program for this drainage master plan for its ability to model storm water flow rates and volumes in watersheds with complex drainage networks such as those with multiple laterals and dual drainage systems (i.e. surface and/or storm drain conveyance). PCSWMM also provides the opportunity of expanding the models to include 2-D surface and/or integrated water quality modeling for both single-storm and continuous events. With an ever-growing focus on regional water quality conditions of receiving waters, these models offer a great foundation for subsequent water quality modeling efforts. Additional detail on the selected modeling software along with comparisons of alternative modeling software can be found in the document titled, “City of San Marcos Drainage Master Plan (DMP) – Model Selection Memo,” dated June 7, 2016 (See Appendix H).

4.0 BASE INFORMATION

4.1 Geospatial Data

With the recent collection of highly detailed aerial imagery and Light Detection and Ranging (LiDAR) data, rapid and accurate assessment of the critical inputs to hydrologic and hydraulic models is possible. The success of this DMP is entirely dependent on the synthesis of the existing data sets, with strategic field assessments to validate the data and fill in unknowns, where necessary.

In 2014, the San Diego Geographic Information Source (SanGIS), San Diego Association of Governments (SANDAG), National Geospatial Intelligence Agency (NGA), San Diego Law Enforcement Coordinating Council (LECC), Regional Public Safety GIS, and all 18 incorporated cities in San Diego County collected LiDAR data for the urbanized area of San Diego County, including the City of San Marcos. The data was collected at a resolution of 2 points per square meter (Level 2) and was used to generate 2-foot contours and a digital elevation model (DEM) over the coverage area; while the raw elevation data is even more accurate than a 2-foot contour interval. The LiDAR collection effort also generated ortho-rectified aerial imagery at 0.1-meter (approximately 4-inch) resolution. The vertical datum was the North American Vertical Datum of 1988 (NAVD88).

Table 4.1.1: Geospatial Data Inventory

Data Layer	Version Date	Source (Agency)
LiDAR	June 15, 2015	SanGIS, SANDAG, NGA, LECC, Regional Public Safety GIS, 18 Incorporated Cities
Aerial Imagery	June 19, 2015	SanGIS, SANDAG, NGA, LECC, Regional Public Safety GIS, 18 Incorporated Cities
City of San Marcos General Plan Land Use	April 19, 2016	City of San Marcos
City of San Marcos Specific Plan Land Use	April 19, 2016	City of San Marcos
Other Land Use	October 9, 2014	SanGIS, SANDAG
Hydrologic Soil Groups (SSURGO)	November 11, 2013	National Resources Conservation Service
Storm Drain Network Files (Drain Conveyance, Drain Structures) in City of San Marcos	April 19, 2016	City of San Marcos
Storm Drain Network Files (Drain Conveyance, Drain Structures) County of San Diego	October 2008	County of San Diego
Storm Drain Network Files (Drain Conveyance, Drain Structures) Other	August 2015	SanGIS
Storm Hot Spots	April 19, 2016	City of San Marcos
Floodplain Layers	December 1, 2016	Federal Emergency Management Agency
Municipal Boundaries	July 25, 2011	SanGIS, SANDAG
Assessor's Parcel Boundaries & Ownership data	April 2016	SanGIS

4.2 Hydrologic Soil Type

The soil data utilized was compiled from the 2013 Soil Survey Geographic (SSURGO) database from the United States Department of Agriculture - National Resources Conservation Service (USDA-NRCS). This database includes hydrologic soil type classifications assigned to each soil type by the USDA-NRCS. Soil data was necessary in order to quantify the infiltration parameters for calculating sub-basin runoff potential.

Soils are classified by the Natural Resources Conservation Service into four (4) Hydrologic Soil Groups based on the soil's runoff potential. The four (4) Hydrologic Soils Groups are A, B, C, and D, where type A generally has the smallest runoff potential and D has the greatest.

Within the City of San Marcos, hydrologic soil groups A, B, C, and D are all present. The following table, Table 4.2.1 summarizes the relative percentage of each hydrologic soil group within the study area.

Table 4.2.1: Summary of Hydrologic Soil Data

Soil Type	Percent Area	Runoff Potential
Type A	0.1%	Low
Type B	12%	Moderate
Type C	27%	High
Type D	60.9%	Highest
Total	100%	

4.3 Land Use Data

All hydrologic modeling parameters were based on the City's general plan land use. Where necessary, land use areas identified as open space, vacant, natural, or specific plan areas were assigned vegetative cover data based on visual observation of the watersheds. There were 56 specific plan land use designation areas within the study area which were all inspected and assigned vegetative cover data individually. Exhibits showing the General Plan land use data are included in Appendix A.

4.4 Stormwater Conveyance Infrastructure

The City supplied a nearly complete Geographic Information System (GIS) network of the storm drain data to be used for the DMP modeling.

Attributes in the inventory included but were not limited to the facility type, facility size, material, location, elevations, as well as corresponding drawing numbers, plan date, construction date, as-built date, and ownership.

The inventory was supplemented with aerial observation, field observation, and field survey of key drainage facilities important to the overall drainage patterns and conveyance within the City. However, not all features' missing data were surveyed.

The GIS data provided by the City of San Marcos was reviewed to correct for major errors including duplicate attributes along connecting pipe segments, incorrect storm drain diameter causing “telescoping”, and incorrect elevation values from conflicting vertical datums. Global assumptions were applied to correct elevations for different vertical datums based on the installation year in the storm drain inventory. Missing inventory attributes were populated using as-built drawings, field survey information, and engineering judgment based on pre vious project experience (where applicable).

The initial GIS data received from the City of San Marcos included 7,128 pipes, culverts, and other conveyance structures. An initial review was performed to assign missing information based on connecting upstream and downstream pipes. I nvert elevations were assigned from connecting segments assuming no offset through the structure. Pipe diameters and material type were assigned in segments when both connecting pipes (upstream and downstream) had the same diameter and material.

Given the large amount of critical data missing, survey teams could not be sent to determine all of the missing information in a timely manner. The solution was to create an approach to determine critical surveying locations (as described below) to streamline the modeling effort.

Critical Survey Locations:

g. Within 500-feet of a hot spot and/or in area with slope of less than 1%
h. No as-built drawing information specified in GIS
i. Missing either diameter, or material

After the surveying effort, the remaining limitations of the current data were supplemented with as-built checks where available and engineering judgment where no other means were available. All data in the provided GIS database was utilized unless otherwise noted in the assumptions.

The following Table 4.4.1 quantifies the number of storm drains in the City provided inventory that were missing critical data and needed to either be populated through survey or populated based on engineering judgment.

Table 4.4.1: City Provided Storm Drain Inventory Missing Critical Data

	# of Conduits
Missing Diameter	1,339
Missing Material	246
Missing Invert Elevation	3,232
Number of Conduits Missing at Least One Piece of Critical Data	4,817
Number of Conduits in Inventory	7,128
Percent of Conduits Missing Data	67.6%

In the provided City inventory there were a total of four hundred and three (403) channel segments. Of these channel segments the missing critical information is outlined below in Table 3.4.2 Channel material and condition were determined by aerial imagery and site visit, all other missing information was populated from sampling cross sections from the DEM. There are conduits with more than one missing field. The purpose of the table is to report the number of conduits with missing parameters individually (i.e., material, bottom width, side slope, depth and top width). Refer to Table 4.4.2 for the number of conduits missing at least one piece of critical data.

Table 4.4.2: City Provided Channel Inventory Missing Critical Data

	# of Conduits
Missing Material	66
Missing Bottom Width	358
Missing Side Slope	403
Missing Depth	403
Missing Top Width	296
Number of Channel Segments Missing Data	403
Number of Channel Segments in Inventory	403
Percent of Channel Segments Missing Data	100%

5.0 HYDROLOGIC AND HYDRAULIC ANALYSIS

5.1 Modeling Methodology

5.1.1 Rainfall Data

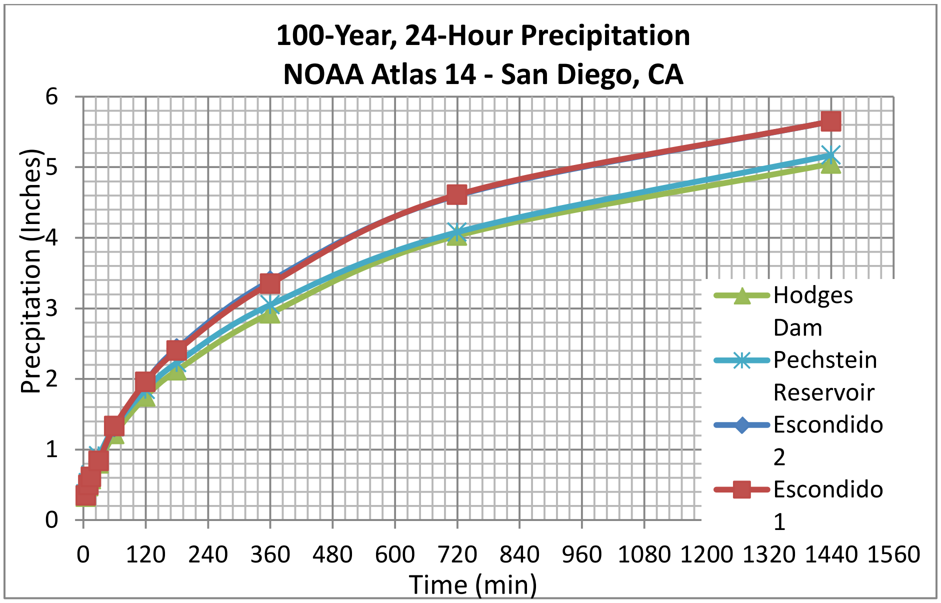
The City of San Marcos currently defaults to the County of San Diego's hydrologic methodology as outlined in the June 2003 *San Diego County Hydrology Manual (SDCHM).* However it was decided that it was more appropriate to use precipitation data from NOAA Atlas 14 for this DMP. The following text identifies the comparisons between NOAA Atlas 14 and the County of San Diego's hydrology manual that led to the selection of NOAA as the most appropriate method.

The NOAA Atlas 14 data (compiled in 2007) contains more recent data as well as a longer period of record compared to the SDCHM (published in 2003). Given the ability to select rain gauge data based on the study area the NOAA Atlas 14 data provides site specific intensities (relative to gauge locations) rather than a standard countywide equation. Also, in previous studies the NOAA Atlas 14 data has been shown to be more representative of local rainfall patterns. NOAA Atlas 14 data currently differs from the standard countywide criteria typically used in design level projects; however, it is believed that the County will be adopting the NOAA Atlas 14 data into the next SDCHM.

A center distributed hyetograph was generated by manipulating the NOAA precipitation data as reflected within the USACE's guidance, *Hydrologic Analysis of Ungaged Watersheds Using HEC-1*, HEC TD-15 (USACE 1982). The created hyetographs were required for the City of San Marcos DMP hydrologic modeling.

To develop the unit intensity duration relationship for the City of San Marcos study, NOAA rainfall depth data from 4 point locations was obtained for the 2-, 10-, 50-, and 100-year storm events. Rainfall data was obtained from the NOAA Precipitation Frequency Data Server (PFDS), and the resulting data used to generate an updated intensity-duration relationship for use within the City of San Marcos shown in Figure 5-5-1 (NOAA 2011).

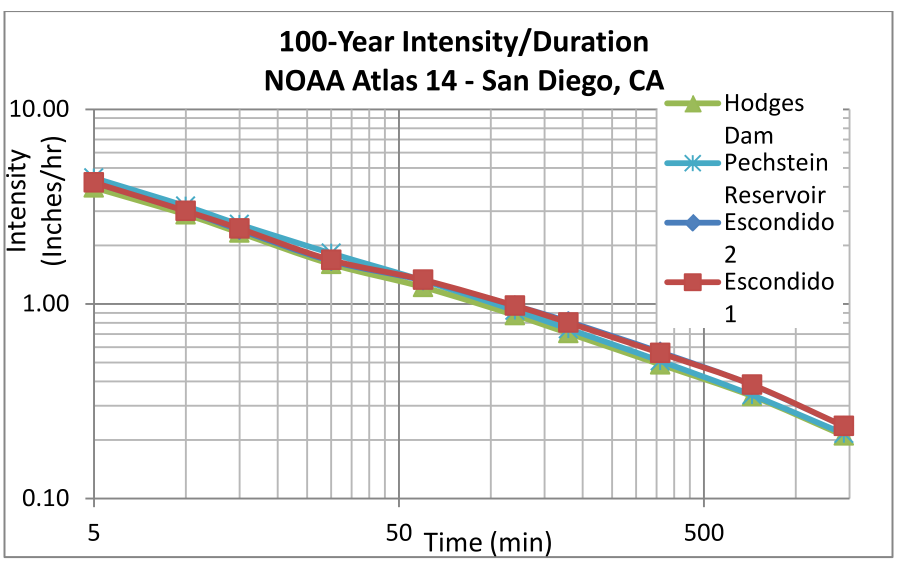
Figure 5-1. NOAA 24-Hr Precipitation Values



Source: NOAA 2011.

The rainfall intensity-duration data from NOAA was reviewed, and the resulting rainfall intensity-duration rainfall relationships were plotted for comparison (NOAA 2011). The results were that the rainfall intensity-duration relationship yielded parallel lines for most gauges in Figure 5-2. The Pechstein Reservoir gauge and Hodges Dam gauge were determined to be most representative for the study area based on location with respect to the NOAA Atlas 14 100-year, 24-hour Isopluvial map (Appendix A).

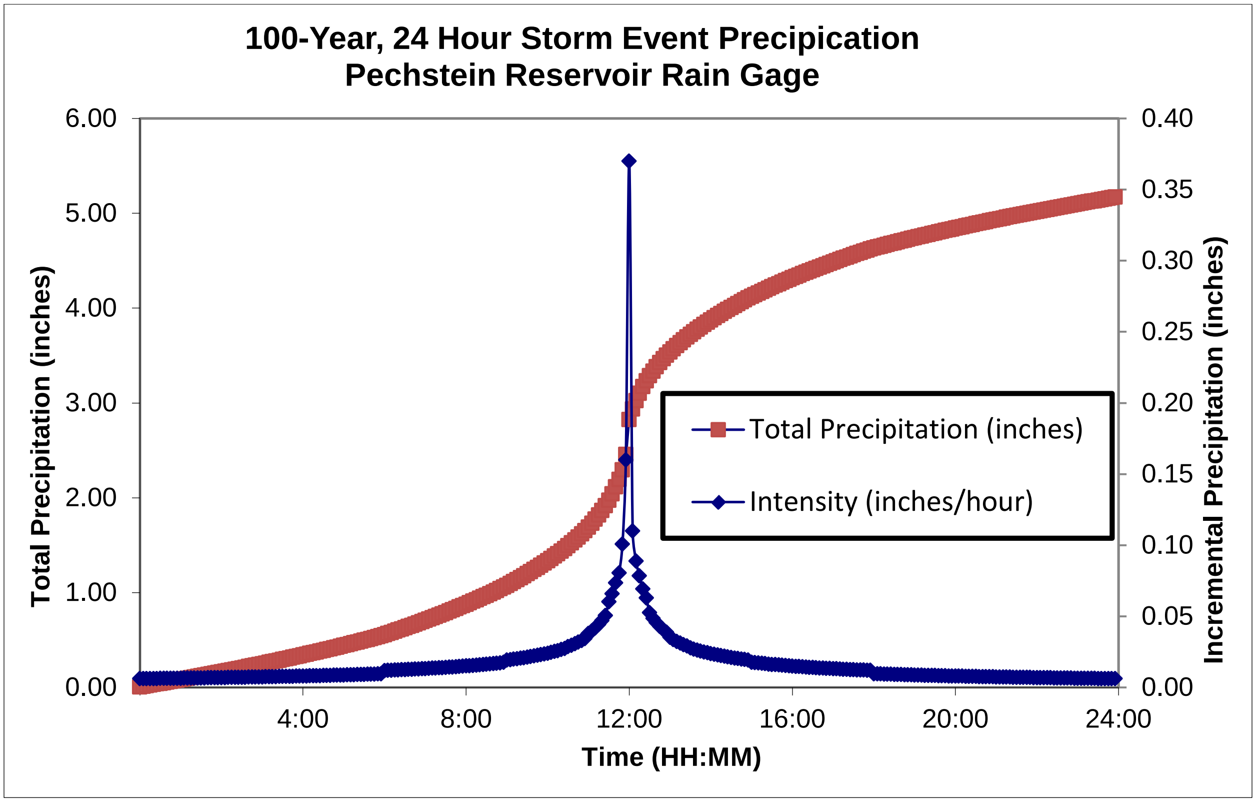
Figure 5-2. 100-Year Intensity-Duration Relationship



Source: NOAA 2011.

The hyetographs were developed by log-log interpolation of point precipitation data (NOAA). Log-log interpolation induces linearity to the non-linear relationship of precipitation based on s torm events. The point precipitation data is used to generate a hyetograph depicting the distribution of total precipitation and incremental precipitation with time. The hyetographs were developed for the 2-, 10-, 50- and 100-year, 24-hour storm events using 5-minute time intervals.

Figure 5-3. Pechstein Reservoir Hyetograph and S-Curve



Source: NOAA 2011.

These hyetographs are input as rainfall time series into PCSWMM and are converted into runoff through modeling of various loss methods such as infiltration (i.e. green ampt) and evapotranspiration per each drainage area. The resultant runoff hydrographs are used to model the 1-D infrastructure.

5.1.2 Hydrologic Modeling

The developed rainfall hyetographs were imported into PCSWMM as a DAT file with 5-minute time steps. Both the existing and proposed condition hydraulic models used the rainfall hyetographs to generate the runoff hydrographs for each sub-basin. See Section 4.1.3 for more information regarding the hydraulic analysis methodology and modeling.

PCSWMM uses EPA's Storm Water Management Model Version 5 (SWMM5) engine; therefore, it uses the same methodology in estimating the rainfall-runoff relationship for a subarea: the nonlinear reservoir model. The nonlinear reservoir model utilizes a combination of mass conservation and the Manning Equation to determine the volumetric flow rate from a subarea. PCSWMM requires several parameters to calibrate each subarea. The parameters include area (in ac), width of the sub-basin, slope, percent impervious, Manning's "n" for pervious and impervious overland surfaces, depression storage for pervious and impervious surfaces, percent of impervious area with no depression storage, and infiltration parameters. The Green-Ampt Method was used to estimate infiltration potential, which requires the following parameters: soil capillary suction head, soil saturated hydraulic conductivity, and the initial moisture deficit (i.e., the difference between soil porosity and initial moisture content).

Each sub-basin is connected via a conveyance node and link network (e.g., manholes and pipes) which routes runoff generated towards the outlet of a subwatershed. See Section 4.1.3 for more information regarding the hydraulic analysis methodology and modeling procedures.

To determine the n-pervious and percent impervious parameters, an area-weighting analysis was performed. The general plan land use feature class was used to determine the percent impervious for each sub-catchment based on assumed impervious percentages. Values for Manning's overland "n" values also were determined using the land cover feature class based on assumed values. Each land cover type and its assumed percent impervious and Manning's overland "n" value are provided in Table 5.1.1.

Table 5.1.1: Summary of Hydrologic Land Use

Last_Desig	Percent Impervious	N-Impervious	N-Pervious
Public/Institutional	85	0.012	0.10
Mixed Use 1	80	0.012	0.10
Office Professional	90	0.012	0.10
Business Park	80	0.012	0.10
Commercial	85	0.012	0.10
Light Industrial	90	0.012	0.10
Industrial	95	0.012	0.10
Neighborhood Commercial	80	0.012	0.10
Medium High Density Residential	80	0.012	0.10
Medium Density Residential 2	65	0.012	0.10
Medium Density Residential 1	50	0.012	0.10
Low Medium Density Residential	45	0.012	0.10
Low Density Residential	40	0.012	0.10
Very Low Density Residential	30	0.012	0.10
Rural Residential	20	0.012	0.10
Hillside Residential 2	10	0.012	0.10
Hillside Residential 1	5	0.012	0.10
County Rural Residential	20	0.012	0.10
Agricultural/Residential	30	0.012	0.10
Open Space	0	0.012	0.10
Parks	5	0.012	0.10
Specific Plan Area	0 - 90	0.012	0.10

5.1.3 Hydraulic Modeling

The hydraulic calculations in SWMMM are governed by the equations for conservation of mass and momentum also known as the Saint Venant flow equations. The Saint-Venant flow equations are basic differential equations from gradually varied, unsteady flow equations for open channels. These equations can be solved either by steady flow, kinematic wave or dynamic wave routing methods. Dynamic wave was chosen for modeling because it is more accurate for calculation of pressure flow and also allows surcharging within conduits.

The flow through pipes is calculated using Manning's equation. For pipes with circular force main cross-sections, Hazen-Williams equation is used in lieu of Manning's equation for fully pressurized flow.

Table 5.1.2 consists of Manning's n roughness values assigned to pipes.

Table 5.1.2: Manning's "n" roughness values

Material	Roughness	Description
ABS	0.013	Acrylonitrile butadiene styrene
ACP	0.013	Asbestos Cement Pipe
ADS	0.013	Advanced Drainage System
CIPCP	0.015	Cast in place concrete pipe
CMP	0.024	Corrugated Metal pipe
CSP	0.024	Corrugated Steel pipe
CONCRETE	0.018	Concrete
EARTHERN	0.075	Earthen channel
HDPE	0.013	High-Density Polyethylene
PVC	0.013	Poly Vinyl Chloride
RCP	0.013	Reinforced Concrete Pipe
DITCHES	0.020	
SRP	0.012	Spiral Rib Pipe

5.1.4 Modeling Assumptions

Every junction in the model was allowed to surcharge in order to account for the volume of water that would otherwise be ponding or flowing on the surface.

H&H analysis is being completed through local systems and ending at discharge locations located within a FEMA floodplain with the assumption that FEMA flow rates will be used where applicable, or at the downstream edge of the City limits.

The Specific Plan areas were assigned hydrologic values to be used in area-weighting calculations for the sub-basins based on the provided descriptions of the future land use. The hydrologic values include percent imperviousness, n-impervious, and n-pervious and runoff coefficient C. City Staff has reviewed and verified these Specific Plan area values. Refer to Appendix J for the hydrologic values of the specific plan areas.

5.2 Existing Condition Modeling

The existing condition modeling was performed to assess the response of the drainage area and the performance of storm drain pipes and infrastructure to the 2-, 10-, 50- and 100-yr storm events**.** The H&H modeling of existing pipes was necessary to determine deficient pipes. The methodology used to perform H&H modeling of existing condition is discussed in greater detail in section 4.2.1.

5.2.1 Methodology

H&H modeling was performed on the existing storm drain network. Channels and ditches were modeled by creating transects along the floodplains to assess their response to varying storm scenarios. The storm drain pipes and infrastructure within the FEMA floodplain were not modeled with the assumption that FEMA flow rates will be used where applicable. Manning's "n" roughness values (see Table 4.2) were assigned to all the pipes based on their material.

The drainage areas discussed in section 3.5 were reviewed to make sure that they are directed to the correct outlet location. The sub-basins were then assigned hydrologic values such as percent impervious, N-impervious, N- pervious, suction head, conductivity and initial deficit based on land use and soil type.

5.2.2 Results

H&H modeling was performed on 619,271 LF of existing pipes to determine the conveyance capacity of the pipes and to identify deficient entities. The 619,271 LF of existing pipes do not include channels, ditches, or culverts within the FEMA floodplain. Channels and ditches were modeled but were not analyzed for deficiencies. Analysis of deficiencies was focused on storm drain infrastructure.

The deficiency of the pipes was quantified by surcharging junctions upstream and downstream of the pipe. Surcharging junctions were considered as junctions with maximum Hydraulic Gradient Line (HGL) 1 foot or more above the surface. The deficiencies are subcategorized into pipes with only upstream surcharging, pipes with only downstream surcharging and pipes with both upstream and downstream.

For a 100-year 24-hour storm event, 44,220 LF of a total 188,185 LF of deficient pipe has only upstream surcharging. 50,683 LF of a total 188,185 LF of deficient pipe has only downstream surcharging. 93,232 LF of a total 188,185 LF of deficient pipe has both upstream and downstream surcharging. The junctions with surcharge depth greater than one (1) have been reported. 1,102 of 5,483 junctions surcharged. Channel or ditch confluences were modeled but not considered for this analysis. The results for 2-, 10-, 50- and 100-year storm events are summarized in Table 5.2.1.

Table 5.2.1: Existing Condition Discharge vs. Capacity

Conduits	2-Year Capacity		10-Year Capacity		50-Year Capacity		100-Year Capacity	
	LF	%	LF	%	LF	%	LF	%
Only Upstream Surcharging	7,717	1.3	15,379	2.5	34,403	5.6	44,220	7.1
Only Downstream Surcharging	9,982	1.6	18,724	3.0	40,163	6.5	50,683	8.2
Both Upstream and Downstream Surcharging	9,421	1.5	24,126	3.9	62,296	10.1	93,282	15.0
Subtotal of Deficiencies (LF)	27,120	4.4	58,229	9.4	136,862	22.2	188,185	30.3
Number of Junctions Surcharging	130	2.4	323	5.9	788	14.4	1,102	20.1
Not Deficient (LF)	592,151		561,042		482,409		431,086	
Number of Junctions Not Surcharging	5,353	97.6	5,160	94.1	4,695	85.6	4,381	79.9
Total (LF)	**619,271**		**619,271**		**619,271**		**619,271**	
Total Junctions	**5,483**		**5,483**		**5,483**		**5,483**	

5.3 Proposed Condition Modeling

5.3.1 Methodology

Based on the *San Diego County Hydraulic Design Manual*, dated September 2014 storm drains in conjunction with surface drainage are to be designed to the convey the 100-year storm. However, due to development occurring over a long period of time and existing constraints in the system, the process identified for recommendations was to provide additional capacity without continuing to iterate the improvements (causing a “domino effect”), opening the existing restrictions in the system and resulting in significant capital costs and increases in flow to downstream infrastructure.

The deficient pipes identified through the existing condition H&H modeling effort were initially upsized to the smallest allowable diameter based on the potentially restricted flow rate getting to the pipe, supplemented by focused upsizing to help achieve a minimum level of service in known flooding areas. However, after reviewing the modeling results with City staff it was determined that the following methodology was better suited to balance the City’s needs and maximize the benefit of the recommended improvements.

Pursuant to the *San Diego County Hydraulic Design Manual*, dated September 2014, the goal of the proposed condition modeling is to provide a 100-year level of service to improve the existing drainage in the City.

The first iteration of recommended improvements involved sizing the deficient storm drains to 100-year constrained flows. The basis of sizing the deficient storm drains to 100-year constrained flows is to not result in continuous iterations of improvements, opening the existing restrictions in the system (causing a “domino effect”) and resulting in significant capital costs and increase flows to downstream infrastructure. This iteration provided a similar level of service to the final approach, as outlined in the section "Proposed Condition Modeling" of the report, but resulted in costs in excess of $100 million to the City. Through this iteration, it was determined that relying on storm drain only to achieve 100-year level of service was not a fiscally responsible approach.

Based on c onversations with the City staff, improvements for the deficient pipes identified in the existing condition H&H model were recommended to achieve a minimum 10-year level of service. It is of the understanding that achieving a minimum level of service for frequent storms like the 2-year and 10-year would also improve the drainage during the 50-year and 100-year storms.

The provision of 100-year level of service is still the basis of recommendations with the improvements for the deficient pipes. However, the recommended approach does not rely exclusively on storm drain infrastructure, and instead on the combination of storm drain and surface conveyance. The reliance on s torm drain conveyance for the 100-year event is not feasible at this time due to existing constraints in the storm drain system. These constraints include but are not limited to FEMA floodplains and jurisdictional boundaries (i.e., Caltrans, NCTD and neighboring municipalities).

The recommended storm drain improvements presented in this DMP would provide increased level of service for smaller and more frequently occurring storm events up to the 10-year storm. The data from the first iteration is available in GIS format for the City to further the storm drain development and provide additional level of service for future efforts.

In the process of achieving that goal, all the junctions surcharging during a 10-year storm were identified. As stated previously, surcharging junctions are junctions with maximum HGL 1 foot above the rim of the structure (surface). Surcharging is an indication of the pressurized flow in the pipe upstream, downstream or both upstream and downstream of the junction.

The pipes with upstream, downstream, or both of the associated junctions surcharged were upsized to alleviate the pressure in the pipe. Upsizing of pipes was not limited by shape or size. Circular pipes were upsized to convey flow without surcharging. Culverts (both circular and rectangular) were upsized by adding additional barrels. The intent of adding additional barrels is to honor the existing depth of the culvert which is generally a constraint for culverts. Deficient CMP pipes were replaced RCP pipes wherever applicable, thereby utilizing the City's CMP replacement program. In this way, majority of the surcharging was eliminated for a 10-year storm.

There were a few exclusions to recommendations. Pipes downstream of detention basins were excluded because the purpose of the detention basin is to retain/detain water for an extended period of time. It is not practical to upsize pipes in this scenario. Similarly, recommendations were not made for pipes/culverts downstream of canyon depressions, which are considered natural detention basins. Recommendations were not made to pipes affected by tailwater condition of downstream channels.

5.3.2 Results

Based on the proposed condition model; 23,603 LF of 619,271 LF of pipe were upsized. The results from the proposed model can be found in the "Recommended Geometry" column in Appendix E. The results for 2-, 10-, 50- and 100-year storm events are summarized in Table 5.3.1.

Table 5.3.1: Proposed Condition Discharge vs. Capacity

Conduits	2-Year Capacity		10-Year Capacity		50-Year Capacity		100-Year Capacity	
	LF	%	LF	%	LF	%	LF	%
Only Upstream Surcharging	2,430	0.4	3,271	0.5	28,822	4.7	40,851	6.6
Only Downstream Surcharging	2,637	0.4	3,601	0.6	26,479	4.3	39,921	6.5
Both Upstream and Downstream Surcharging	515	0.1	1,424	0.2	31,115	5.0	60,657	9.8
Subtotal of Deficiencies (LF)	5,582	0.9	8,296	1.3	86,416	14.0	141,429	22.9
Number of Junctions Surcharging	15	0.3	31	0.6	479	8.7	819	14.9
Not Deficient (LF)	613,689		610,975		532,855		477,842	
Number of Junctions Not Surcharging	5,468	99.7	5,452	99.4	5,004	91.3	4,664	85.1
Total (LF)	**619,271**		**619,271**		**619,271**		**619,271**	
Total Junctions	**5,483**		**5,483**		**5,483**		**5,483**	

For a 10-year 24-hour storm event, there is an 86% reduction for conduits and 90% for junctions in the amount of deficiencies in the system compared to the existing condition. By establishing a minimum 10-year level of service, the deficiencies in the 50-year and 100-year 24-hour storms were also reduced significantly. Table 5.3.2 prov ides comparison of results between the proposed condition modeling and existing condition model. In order to compare results appropriately these tables only reflect storm drain systems that were replaced or realigned and do not reflect the addition of new storm drain systems.

Table 5.3.2: Comparison of Storm Drain Results

	Conduits	2-Year Capacity		10-Year Capacity		50-Year Capacity		100-Year Capacity	
		LF	%	LF	%	LF	%	LF	%
Existing Condition	Subtotal of Deficiencies (LF)	27,120	4.4	58,229	9.4	136,862	22.2	188,185	30.3
	Number of Junctions Surcharging	130		323		788		1,102	
Recommended Condition	Subtotal of Deficiencies (LF)	5,582	0.9	8,296	1.3	86,416	14.0	141,429	22.9
	Number of Junctions Surcharging	15		31		479		819	
Flood Reduction Benefit from Ex. To Rec.	**Subtotal of Deficiencies Resolved(LF)**	**21,538**	**79**	**49,933**	**86**	**50,446**	**37**	**46,756**	**25**
	Number of Junctions Surcharging	**115**	**88**	**292**	**90**	**309**	**39**	**283**	**26**

6.0 CAPITAL IMPROVEMENT PROGRAM

6.1 Capital Improvement Program

Enclosed in Appendix C is a Map of Results from the 100-year storm event model. This map visually highlights the deficiencies within the citywide drainage system encountered during the modeling efforts. A visual observation of the drainage infrastructure displayed on this map led to the conclusion that the City's drainage deficiencies are not concentrated within one central location, but rather they are distributed throughout various neighborhoods and watersheds. This data is crucial for determination of implementation strategies.

As a goal of this study, the results from the Citywide DMP have been leveraged to develop and establish a Capital Improvement Program for the City of San Marcos and to address the drainage deficiencies where they occur. This was accomplished via a series of steps:

a. Hydrologic and hydraulic analysis of the backbone storm drain infrastructure throughout the City.
b. Recommending storm drain pipe size improvements for infrastructure which was determined to have deficient conveyance capacity and require at least a 36" storm drain.
c. Determining a preliminary opinion of probable cost associated with the proposed recommendations for improving the storm drain infrastructure.
d. Determining individual priority for the recommended storm drain infrastructure improvements based on hydrologic and hydraulic analysis results and other applicable data.
e. Grouping individual high priority infrastructure improvements into CIP project bundles,
f. Working closely with City staff to verify and determine additional infrastructure improvements based on knowledge of known problem areas, and locations currently lacking drainage infrastructure.

This process led to the development of bundled CIP projects which were then evaluated in more detail to determine potential benefits and/or consequences that may arise during the implementation process. After these projects were vetted, the recommended improvements were entered into a hydrologic and hydraulic model to determine the extent of the benefit yielded by the recommendations. After this point, a more detailed opinion of probable cost was determined for each of the projects. The following sections provide further explanations of this process.

6.2 Selection Criteria

The method for selecting Capital Improvement Program (CIP) projects involved the development of scoring criteria, as outlined in Figure 6-1. This criteria was developed to rate the efficiency of all existing storm drain segments and generate a simplified ranking system ranging from a score of 0 - 110 with 110 being the highest possible score to determine the importance of providing recommendations for the system. Once all existing storm drains were scored, the criteria was further refined to prioritize and focus on storm drains with a recommended pipe size of 36-inches or larger. Each storm drain segment that was recommended for replacement was then assigned an estimated construction cost based on unit prices that have been established for this DMP. A visual observation of the high scoring storm drain showed that multiple pipe deficiencies occurred in the similar geographic regions and along the same storm drain systems. Recommendations for these storm drain segments were then bundled based on geographic location and connectivity to become CIP projects. Additional consideration for CIP project selections were also based on input from City staff discussing regions where no known drainage infrastructure is currently present and known flooding conditions occur. The extent of the project sizes were determined by implementing the necessary conveyance size, considering adverse effects downstream (i.e. telescoping), and constrained by jurisdictional limits.

CIP projects are then modeled on a n individual level to determine their impact on connecting systems. All CIP projects are then verified by closer observation of: location, GIS, and modeling data to determine their validity and generate a final list of recommended CIP projects. The projects in the CIP section are grouped based on the major hydrologic basins.

Table 6-1: CIP Selection Criteria

San Marcos DMP Rating Criteria—Flood Control (Drainage) Facilities		
Rating Criteria	**Max. Score**	**Subcriteria Score**
Public Safety	**85**	
Land Use Impacts		**(0 to 15)**
Adjacent to High-Priority Land Use		15
Adjacent to Developed Land Use		10
Adjacent to Vacant Land Use		0
Conveyance Characteristics		**(0 to 45)**
Existing Culvert or Storm Drain—Conveyance Ratio		
100-year Flow/Existing Drainage Facility Capacity: 200% +		45
100-year Flow/Existing Drainage Facility Capacity: 150% to 200%		30
100-year Flow/Existing Drainage Facility Capacity: 100% to 150%		15
Within Major Roads		**(0 to 10)**
Flooding History – City of San Marcos Flood Hot Spots		**(0 to 15)**
Ease of Implementation	**15**	
Projects within Existing City Ownership, Right-of-Way, or Easement		15
Projects Located on Unimproved Property/Vacant		10
Raw Total	**100**	
Synergy Bonus Points	**0 to 10**	
CMP Replacement Program		10
Synergy Total	**10**	
Overall Project Score	***110***	

All land uses were based on the City of San Marcos 2016 General Plan Land Use Data. The high priority and vacant land uses are identified in Table 6.1.1. All other recommended drainage facility locations were assumed to fall within the "developed land use" category. A 100-foot buffer around high priority and vacant land uses was used to include improvements that may be in the street in front of or next to a high priority land use.

Table 6.1.1: City of San Marcos General Plan Land Use High and Vacant Land Uses

Land Use Code	Land Use Definition	Land Use Priority Designation
OP	Office Professional	High
PI	Public/Institutional	High
OS	Open Space	Vacant

6.3 Order of Magnitude Opinion of Probable Construction Cost

The order of magnitude opinions of probable construction costs for this DMP were calculated in a two stage process. First, opinion of probable construction costs were assigned to the replaced drainage conveyance segments from the proposed condition model to aid in the CIP selection process. The second stage of opinion of probable construction costs were performed once the CIP projects were selected and consisted of a project specific opinion of probable construction costs and included additional site specific line items.

Unit prices established for this master plan's opinion of probable construction costs were based on a review of current similar drainage projects within the region, as well as an evaluation of Caltrans (2015) and City of San Diego (2009) unit price lists. Unit prices for conveyance facilities were developed on a linear-foot basis. Unit prices for structure facilities were developed based on price per structure, relative to the size of the structure.

The initial round of opinion of probable construction costs was performed using Table 6.1 which utilizes the GIS attribute data from the proposed condition models. This attribute data was leveraged to apply opinions of probable construction costs to replaced drainage conveyance segments which were upsized due to deficiency in conveyance capacity. These general opinions of probable construction costs were used in the CIP selection process explained in section 6.1.

Table 6.2.1: General Order of Magnitude Opinion of Probable Construction Cost

Item Description	Variable 1	Variable 2	Function	Unit	Unit Price
Conveyance					
18" Reinforced Concrete Pipe	D	1.5	geom1	LF	$180.00
24" Reinforced Concrete Pipe	D	2	geom1	LF	$220.00
30" Reinforced Concrete Pipe	D	2.5	geom1	LF	$240.00
36" Reinforced Concrete Pipe	D	3	geom1	LF	$250.00
42" Reinforced Concrete Pipe	D	3.5	geom1	LF	$260.00
48" Reinforced Concrete Pipe	D	4	geom1	LF	$275.00
54" Reinforced Concrete Pipe	D	4.5	geom1	LF	$350.00
60" Reinforced Concrete Pipe	D	5	geom1	LF	$450.00
72" Reinforced Concrete Pipe	D	6	geom1	LF	$600.00
84" Reinforced Concrete Pipe	D	7	geom1	LF	$700.00
96" Reinforced Concrete Pipe	D	8	geom1	LF	$800.00
Reinforced Concrete Box, W x H ≤ 40 SF	X	Area	=geom1x geom2	LF	$465.00
Reinforced Concrete Box, W x H >40 SF and ≤ 70 SF	X	Area	=geom1x geom2	LF	$670.00
Reinforced Concrete Box, W x H >70 SF	X	Area	=geom1x geom2	LF	$1,550.00
Open Channel, Bottom Width ≤ 20'	C	<20	geom1	LF	$415.00
Open Channel, Bottom Width > 20' and ≤40'	C	>20, <40	geom1	LF	$600.00
Open Channel, Bottom Width > 40'	C	>40	geom1	LF	$850.00
Misc. Lump Sum Items					
Mobilization				LS	2.5%
Bonds/Payment Performance				LS	2.0%
Traffic Control				LS	2.5%
SWPPP/WPCP Implementation				LS	2.5%
Field Orders				LS	2.5%
Contingency				LS	28.0%
Total					40.0%

After full segments of CIP projects were selected, a more detailed project specific opinion of probable construction costs was produced for each CIP project. These opinions of probable construction costs are provided in Appendix F. The opinion of probable construction costs are explained in the following table, Table 6.2.2.

Table 6.2.2: CIP Order of Magnitude Opinion of Probable Construction Cost

Item Description	Unit	Unit Price	Comments
Mobilization	LS	$10,000.00	Assumed lump sum assigned to all projects
Traffic Control	1.5 – 3% of subtotal	$0.00	Based on the location of the project and proximity to major roads
Clearing and Grubbing	LS	$10,000.00	Lump sum applied only to projects disturbing natural or vegetated areas
Prepare Storm Water Pollution Prevention Plan	LS	$6,500.00	Applied if the total project site is over 1 acre
Water Pollution Control	LS	$5,000.00	Applied if the total project site is under 1 acre
Project ID Sign	EA	$1,200.00	Assigned to every project
Temporary Concrete Washout (Portable)	LS	$3,000.00	Assigned to projects within the roadway
Reinforced Concrete Box Culverts (Class A)	CY	$1,500.00	Priced based on the cubic yards of concrete from the county standard drawings
Dewatering	LS	$10,000.00	Only applies to perennial streams or water bodies
Remove Existing Pipe	LF	$20.00	Cost for removing existing pipe for both replacing and realigning
Connect Existing Facility	EA	$1,500.00	Cost per instance to connect existing facilities into new or replaced structures
Cleanout (Type A)	EA	$5,000.00	Per unit price for replacing or adding a type A cleanout
Wing Type Headwall / Box Culvert Wingwall	CY	$1,500.00	Priced based on the cubic yards of concrete from the county standard drawings
Curb Inlet, L <10'	EA	$5,500.00	Unit price for inlets with less than a ten foot opening
Curb Inlet, L >10	EA	$11,000.00	Unit price for inlets with greater than a ten foot opening
18" Reinforced Concrete Pipe	LF	$180.00	Total price per linear foot for constructing linear pipe
24" Reinforced Concrete Pipe	LF	$220.00	Total price per linear foot for constructing linear pipe
30" Reinforced Concrete Pipe	LF	$240.00	Total price per linear foot for constructing linear pipe
36" Reinforced Concrete Pipe	LF	$260.00	Total price per linear foot for constructing linear pipe
42" Reinforced Concrete Pipe	LF	$280.00	Total price per linear foot for constructing linear pipe
48" Reinforced Concrete Pipe	LF	$325.00	Total price per linear foot for constructing linear pipe
54" Reinforced Concrete Pipe	LF	$375.00	Total price per linear foot for constructing linear pipe
60" Reinforced Concrete Pipe	LF	$450.00	Total price per linear foot for constructing linear pipe
72" Reinforced Concrete Pipe	LF	$600.00	Total price per linear foot for constructing linear pipe
Grading, Excavation (1,000-20,000 C.Y.)	CY	$45.00	Price for excavation for open channel segments
Grading, Export or Import (1,001 + C.Y.)	CY	$40.00	Price per cubic yard for export or import of excavation
Saw Cut (AC/PCC Pvt.)	LF	$2.00	Cost per linear foot of saw cutting
Paving, AC	SF	$1.50	Cost per square foot of paving
Energy Dissipater (D-40)	LS	$7,500.00	Unit price for energy dissipaters

6.4 Results

From the extensive and detailed modeling came many potential CIP projects. However, this DMP has provided more detailed information on the top thirteen (13) feasible CIP projects with the most favorable flood control benefits. These 13 CIP projects are viable drainage improvements which can be implemented to provide a better level of service for their respective areas with minimal adverse effect on the connecting systems. These projects have been selected to address known hotspots within the City and reduce existing deficiencies by adding infrastructure, realigning infrastructure, and upsizing existing infrastructure. Realigning of infrastructure is done primarily to improve O&M efficiency over the long term. The projects in this section are not based on priority.

The CIP projects range in price from three hundred thousand ($300,000) to five and a half million ($5,500,000), and include storm drain, culvert, and storage improvements. This spectrum of project sizes and types allows the City a broad array of projects from which to select. As part of the selection process deficient structures have been assigned recommended sizes, order of magnitude opinion of probable construction costs, and prioritization rankings. These additional recommendations provide the City the data necessary to implement the improvements along with other types of CIP projects where areas overlap.

For a 100-year 24-hour storm event, 40,473 LF of a total 154,063 LF of deficient pipe has only upstream surcharging. 37,417 LF of a total 154,063 LF of deficient pipe has only downstream surcharging. 76,173 LF of a total 154,063 LF of deficient pipe has both upstream and downstream surcharging. The junctions with surcharge depth greater than one (1) have been reported. 943 of 5,483 junctions surcharged. Channel or ditch confluences were modeled but not considered for this analysis. The results for 2-, 10-, 50- and 100-year storm events are summarized in Table 6.4.1.

Table 6.4.1: CIP Program Storm Drain Results

Conduits	2-Year Capacity		10-Year Capacity		50-Year Capacity		100-Year Capacity	
	LF	%	LF	%	LF	%	LF	%
Only Upstream Surcharging	5,502	0.9	13,449	2.2	31,743	5.1	40,473	6.5
Only Downstream Surcharging	6,293	1.0	10,647	1.7	31,042	5.0	37,417	6.0
Both Upstream and Downstream Surcharging	2,283	0.4	14,912	2.4	47,410	7.7	76,173	12.3
Subtotal of Deficiencies (LF)	14,078	2.3	39,008	6.3	110,195	17.8	154,063	24.9
Number of Junctions Surcharging	72	1.3	248	4.5	651	11.9	943	17.2
Not Deficient (LF)	605,193		580,263		532,855		465,208	
Number of Junctions Not Surcharging	5,411	98.7	5,235	95.5	4,832	88.1	4,540	82.8
Total (LF)	**619,271**		**619,271**		**619,271**		**619,271**	
Total Junctions	**5,483**		**5,483**		**5,483**		**5,483**	

For a 100-year 24-hour storm event, there is a 18% reduction for conduits and 14% for junctions in the amount of deficiencies in the system compared to the existing condition by implementing the CIP projects only. The deficiencies in the 50-year, 10-year and 2-year 24-hour storms were also reduced significantly. Table 6.4.2 provides comparison of results between the CIP projects and existing condition model.

Table 6.4.2: Comparison of CIP Program Storm Drain Results

	Conduits	2-Year Capacity		10-Year Capacity		50-Year Capacity		100-Year Capacity	
		LF	%	LF	%	LF	%	LF	%
Existing Condition	Subtotal of Deficiencies (LF)	27,120	4.4	58,229	9.4	136,862	22.2	188,185	30.3
	Number of Junctions Surcharging	130		323		788		1,102	
CIP Projects	Subtotal of Deficiencies (LF)	14,078	2.3	39,008	6.3	110,195	17.8	154,063	24.9
	Number of Junctions Surcharging	72		248		651		943	
Flood Reduction Benefit from Ex. To CIP Program	**Subtotal of Deficiencies Resolved(LF)**	**13,042**	**48**	**19,221**	**33**	**26,667**	**20**	**34,122**	**18**
	Number of Junctions Surcharging	**58**	**45**	**75**	**23**	**137**	**17**	**159**	**14**

6.4.1 CIP Projects

The CIP model is a streamlined model which only contains the improvements of the selected CIP projects. The remainder of the storm drain system was modeled as per the existing condition. This was primarily done to assess downstream impacts on the existing conveyance network resulting from only implementing the selected CIPs. The main concern was to not impact the existing downstream system beyond its current level of service.

The proposed CIP projects were modeled with the following general assumptions: the storm drain system data being used for modeling is accurate and complete, the full runoff generated from the delineated catchment area is routed to the storm drain structure, and all major utility conflicts can be resolved during final design. For detailed discussion on the selection criteria, refer to Section 6.2. The projects below are not based on priority. CIP projects have not been prioritized as a part of this project.

6.4.1.1 **CIP_West Mission Road (West Mission Road and North Pacific Street)**

- Existing Facility and Location:

The project is located within the Las Posas Basin. The proposed storm drain infrastructure is within Palomarcos Avenue and North Pacific Street. In addition to the proposed infrastructure, the project also proposes to upsize current storm drain infrastructure along West Mission Road. The proposed infrastructure would tie into the existing infrastructure along West Mission Road. The existing infrastructure ultimately discharges into San Marcos Creek.

The current system consists of a 30-inch RCP system in West Mission Road.

- Need and Purpose:

The existing condition modeling shows that the existing 30-inch RCP system along West Mission Road is undersized. The current system constrains the runoff so that a large portion of the flow bypasses the system and contributes to flooding a portion of West Mission Road. The majority of the runoff originates in the existing residential neighborhood immediately upstream of the system. In the existing condition, the runoff from the residential area is conveyed on the surface of the existing neighborhood street system. The introduction of the proposed storm drain system in Palomarcos Avenue and North Pacific Street would capture runoff from the upstream neighborhood thereby helping to eliminate flooding at the sump on West Mission Road. The upsizing of the existing facilities in West Mission Road would also aid in eliminating flooding and would support potential redevelopment in the area.

This project contributes to the City's drainage goals by increasing the efficiency of an existing deficient system adjacent to a major arterial road next to a floodplain and the extension into the neighborhood provides additional conveyance. The project would also act to update the floodplain and floodway limits which could positively affect the neighboring developments.

- Proposed Engineering Features:

The contributing area of 40 acres of 58% imperviousness results in a 100-year 24 hour constrained peak flow of 97 cfs and an unconstrained peak flow of 108 cfs. The project is in City right-of-way so it would not require property accusation or establishment of a City drainage easement.

Through this project, a 36-inch diameter RCP storm drain conveyance system is proposed along roughly 300 feet span of North Pacific Street and extending west along 800 feet span of Palomarcos with an average slope of 1.2%. The existing 30-inch RCP system in West Mission Road is upsized to a dual 36-inch configuration to convey runoff from the proposed system as well as eliminate flooding at the sump on West Mission Road.

As a part of the CIP, the proposed storm drain along Palomarcos Avenue and North Pacific Road would be connected to the existing storm drain system along West Mission Road. In the proposed condition the existing 30-inch RCP system on West Mission Road are upsized to a dual 36-inch RCP, system. More details on proposed alignment and profile can be found in Appendix F.

- Cost Estimates:

The opinion of probable construction cost for this project is **$840,965** and is broken down into further detail in Appendix F of this report.

- Project Considerations:
  - Constraints:
    - The system is constrained by the downstream culvert under West Mission Road that is not being recommended for replacement at this time due to jurisdictional constraints like NCTD and FEMA. This would also result in moving flooding from one area to another. Another constraint is the location of the system in a sump which restricts the system vertically.
  - Alternatives:
    - One other alternative was considered and that was to bring the improvements on North Pacific Street and Palomarcos Avenue across West Mission Road at the intersection of West Mission Road and North Pacific Street to connect into the drainage ditch that runs parallel to West Mission Road on the south side of the railway tracks. This alternative was not chosen because of the likely conflicts with major utilities and NCTD facilities that run along and parallel to West Mission Road.
  - Right-of-Way Requirements:
    - The project is within the existing City right-of-way, so no property acquisition or drainage easement is anticipated.

Figure 6-1: West Mission Road east of North Pacific Street

Figure 6-2 : Culvert across West Mission Road acting as a constraint

6.4.1.2 **CIP_Bingham Drive (Bingham Drive and Armorlite Drive)**

❖ Existing Facility and Location:

The project is located in the Business/Industrial Neighborhood within the Las Posas Basin. The proposed infrastructure is completely within the ROW and extends south and east of Armorlite Drive for a span of 350-feet and extends south along Bingham Drive north of Los Vallecitos Boulevard for a span of 1300-feet. The existing infrastructure ultimately discharges into San Marcos Creek.

The existing conveyance system consists of single 18-inch and 24-inch RCP along Armorlite Drive tying into single 30-inch RCP and 36-inch RCP storm drain network along Bingham Drive which is connected to triple 6 feet wide by 3 feet high box culvert across Los Vallecitos Boulevard. The average slope of the storm drain conveyance system is 0.7%.

❖ Need and Purpose:

The existing condition modeling shows that the existing storm drain infrastructure is significantly undersized. The current system constrains the runoff so majority of the flow bypasses the system on Armorlite Road and Bingham Drive and would eventually flood Los Vallecitos Boulevard. The upsizing of the existing storm drain system would reduce flooding.

This project contributes to the City's drainage needs by reducing the potential for flooding for a large tributary area.

❖ Proposed Engineering Features:

The contributing area of 195 acres of 74% impervious results in a 100yr 24hr constrained peak flow of 88 cfs and an unconstrained peak flow of 257 cfs. The project is in City right-of-way so it would not require property acquisition or establishment of a City drainage easement.

Through this project, both the existing single 18-inch RCP and single 24-inch RCP are replaced with dual 54-inch RCP along Armorlite Drive and existing single 30-inch RCP and single 36-inch RCP with dual 60-inch RCP along Bingham Drive.

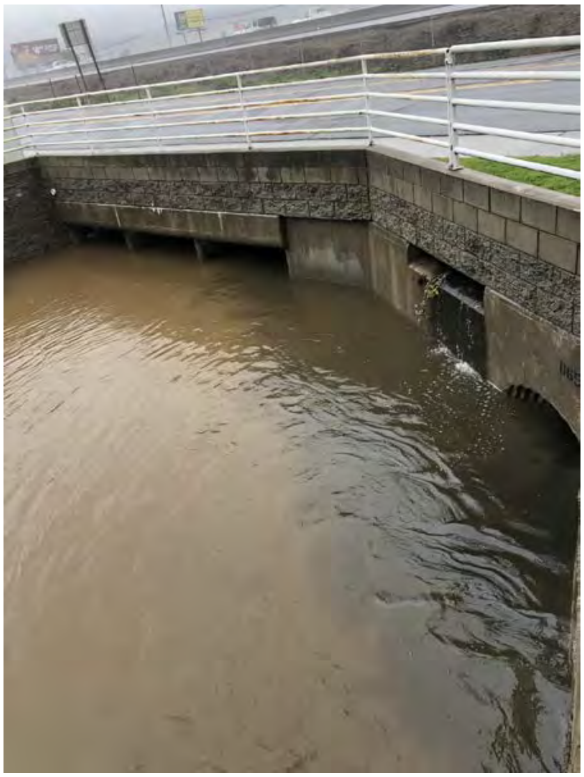
As a part of the CIP, the existing storm drain system would be upsized along Armorlite Drive and Bingham Drive, thereby improving the efficiency of the storm drain system. In the proposed condition existing single 18-inch RCP and single 24-inch RCP are replaced with dual 54-inch RCP along Armorlite Drive and existing single 30-inch RCP and single 36-inch RCP with dual 60-inch RCP along Bingham Drive. More details on proposed alignment and profile can be found in Appendix F.

- Cost Estimates:

  - The opinion of probable construction cost for this project is **$2,406,239** and is broken down into further detail in Appendix F of this report.

- Project Considerations:
  - Constraints:
    - The major constraint of this system was the available depths and shallow slopes along Bingham Drive.
  - Alternatives:
    - One alternative that was considered was to realign the storm drain system that currently flows through the parking lot north of Armorlite Drive and west of Bingham Drive east to the downstream end of the next culvert that crosses West Mission Road to be routed through Mission Sports Park and tie in with the old alignment before the culvert crossing the CA-78.
  - Right-of-Way Requirements:
    - The project is within the existing City right-of-way, so no prope rty acquisition or drainage easement is anticipated.

Figure 6-3: Triple 6-ft (W) by 3-ft (H) RCB downstream constraint across Los Vallecitos Boulevard



6.4.1.3 **CIP_West Mission Road (West Mission Road and Liberty Drive)**

❖ Existing Facility and Location:

The project is located in the within the Las Posas Basin. The upsized infrastructure is within Liberty Drive at Richmar Avenue and spans approximately 450 feet south along Liberty Drive to West Mission Road and continues 1700 feet west on West Mission Boulevard. The existing infrastructure ultimately discharges into San Marcos Creek.

The existing system consists of single 36-inch RCP along Liberty Drive which is connected to 42-inch RCP on West Mission Road. The single 42-inch RCP conveyance system is connected to a single 7 feet wide by 2.75 feet high reinforced concrete box culvert.

❖ Need and Purpose:

The existing condition modeling shows that the existing storm drain infrastructure is significantly undersized. The potential impacts of the existing deficiencies are the possibility of flooding Mission Road along with neighboring school and commercial uses. The current system constrains the runoff so that flow bypasses the system onto West Mission Road, a major arterial road. The upsizing of the existing undersized storm drain network would increase efficiency and minimize flooding.

This project contributes to the City's drainage goals by improving the efficiency of an existing deficient storm drain backbone system for residential area adjacent to a major arterial road.

❖ Proposed Engineering Features:

The contributing area of 73 acres of 67% impervious results in a 100yr 24hr constrained peak flow of 155 cfs and an unconstrained peak flow of 257 cfs. The project is in City right-of-way so it would not require property accusation or establishment of a City drainage easement.

Through this project, the 36-inch RCP along Liberty Drive is upsized to a single 54-inch RCP system. The single 42-inch RCP conveyance system connected is upsized to a dual 54-inch RCP system. The average slope of the system is 0.6%.

As a part of the CIP, the existing storm drain system along Liberty Drive and West Mission Road would be upsized thereby improving the efficiency of the storm drain system. In the proposed condition the existing 36-inch and 42-inch RCP systems on Liberty Drive and West Mission Road are upsized to a single 54-inch and dual 54-inch RCP system respectively. More details on proposed alignment and profile can be found in Appendix F.

❖ Cost Estimates:

The opinion of probable construction cost for this project is **$1,989,404** and is broken down into further detail in Appendix F of this report.

- ❖ Project Considerations:
  - ➢ Constraints:

The constraints of this system were the downstream elevation controls and available depth below finished grade for upsizing storm drain in the existing alignment and the downstream tie in to the culvert crossing West Mission Road. The culvert is proposed to be upsized as a part of a CIP (CIP_ West Mission Road (Culvert across West Mission Road and Liberty Drive).

  - ➢ Alternatives:
    - ▪ No alternatives were analyzed because the storm drains are being upsized in the existing alignment.
  - ➢ Right-of-Way Requirements:
    - ▪ The project is within the existing City right-of-way, so no property acquisition or drainage easement is anticipated.

6.4.1.4 **CIP_West Mission Road (Culvert across West Mission Road and Liberty Drive)**

- ❖ Existing Facility and Location:

The project is located in the Las Posas Basin. The upsized infrastructure is within Liberty Drive at Richmar Avenue spanning approximately 450 feet south along Liberty Drive to West Mission Road and spanning 1700 f eet west on W est Mission Boulevard. The existing infrastructure ultimately discharges into San Marcos Creek.

The culvert currently has a single 30-inch RCP across Aberdeen Avenue and a single 42-inch RCP along West Mission Road connected upstream and a concrete channel running along the railway tracks connected downstream.

- ❖ Need and Purpose:

The existing condition modeling shows that the existing storm drain infrastructure are very undersized. The potential impacts of this of the existing deficiencies are the possibility of flooding Mission Road along with neighboring "Commercial" planned land use. The current system constrains the runoff so that flow bypasses the system onto West Mission Road, a major arterial road. The upsizing of the existing undersized storm drain network would increase efficiency and eliminate flooding.

This project contributes to the City's drainage goals by improving the efficiency of an existing deficient storm drain backbone system for residential area adjacent to a major arterial road

- ❖ Proposed Engineering Features:

The contributing area of 107 acres of 56% impervious results in a 100yr 24hr constrained peak flow of 216 cfs and an unconstrained peak flow of 322 cfs. The project is in City right-of-way so it would not require property accusation or establishment of a City drainage easement.

Through this project, the single 7 feet wide by 2.75 feet high reinforced box c ulvert spanning approximately 100 feet south across West Mission Drive an additional barrel is added making it a dual 7 feet wide by 2.75 feet high reinforced box culvert with an average slope of 0.4%.

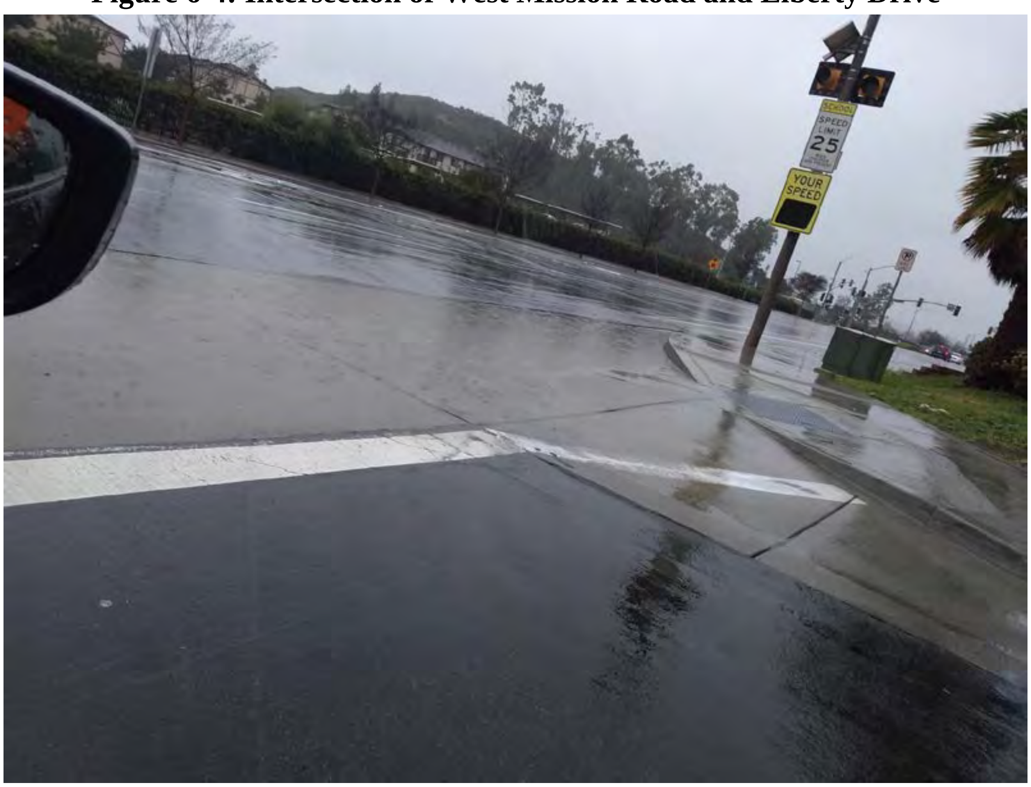
As a part of the CIP, the conveyance of the existing single 7 feet wide by 2.75 feet high reinforced box culvert is increased by adding an additional barrel, making it a dual 7 feet wide by 2.75 feet high reinforced box culvert. More details on proposed alignment and profile can be found in Appendix F.

❖ Cost Estimates:

The opinion of probable construction cost for this project is **$313,060** and is broken down into further detail in Appendix F of this report.

❖ Project Considerations:
- Constraints:
  - The constraint for this project is the tie in of the culvert into the channel along the south side of West Mission Road providing shallow slopes across West Mission Road.
- Alternatives:
  - No alternatives were analyzed because the culvert is being upsized in the existing alignment.
- Right-of-Way Requirements:
  - The project is within the existing City right-of-way, so no property acquisition or drainage easement is anticipated.

Figure 6-4: Intersection of West Mission Road and Liberty Drive



6.4.1.5 CIP_South Rancho Santa Fe Road (South Rancho Santa Fe Road and Grand Avenue)

- Existing Facility and Location:

The project is in the Business/Industrial Neighborhood within the Las Posas Basin. The project starts at the intersection of Grand Avenue and South Rancho Santa Fe Road and spans 1140 feet along South Rancho Santa Fe Road from Grand Avenue to La Mirada Drive and spans 2800 feet east of La Mirada Drive to South Las Posas Road. Existing infrastructure discharges into Las Posas Creek (Lower) and ultimately discharges into San Marcos Creek.

The existing infrastructure consists of an abandoned storm drain network in Grand Avenue which includes plugged inlets and laterals connected to 24-inch and 36-inch RCP backbone storm drain with an average slope of 2.1% along Grand Avenue. There is not any existing drainage infrastructure in S. Rancho Santa Fe or La Mirada Drive.

- Need and Purpose:

This project would provide a backbone storm drain system for the roughly 60-acres of residential and industrial area currently being conveyed on the surface. Existing storm drain networks in the area that are out letting onto the street could be connected into the backbone system during development or redevelopment.

This project contributes to the City's drainage goals by providing backbone storm drain system for new developments/ redevelopments for a planned mixed use residential and commercial area adjacent to a major arterial road. The project is in Rancho Santa Fe Road which is identified as a focus area per the City of San Marcos General Plan.

- Proposed Engineering Features:

The contributing area of 78 acres of 80% impervious results in a 100-year 24-hour unconstrained peak flow of 254 cfs. The project is in City right-of-way, so it would not require property accusation or establishment of a City drainage easement.

Through this project, the existing 24-inch and 36-inch RCP backbone storm drain spanning 1600 feet with an average slope of 2.1% along Grand Avenue will be unplugged and put into operation. The new backbone storm drain along South Rancho Santa Fe Road between Grand Avenue and Cherokee Street consists of 1140 feet of 36-inch RCP with an average slope of 0.5%, 900 feet of 42-inch RCP at 2.5% slope, 475 feet of 48-inch RCP at 1.3% slope, 675 feet of 54-inch RCP at 1.1% slope and 800 feet of 60-inch RCP at 0.8% slope.

As a part of the CIP, the existing storm drain system along Grand Avenue is unplugged, and a new backbone system is proposed along South Rancho Santa Fe Road and La Mirada Drive to provide tie-ins for new development and/or redevelopment. The system is constrained by an existing 24-inch RCP lateral at the intersection of Cherokee Street and South Rancho Santa Fe Road.

More details on proposed alignment and profile can be found in Appendix F.

❖ Cost Estimates:

The opinion of probable construction cost for this project is **$2,244,653**and is broken down into further detail in Appendix F of this report.

❖ Project Considerations:

- Constraints:
  - The project has upstream constraints at Grand Avenue and South Rancho Santa Fe Road with the inverts of the existing infrastructure, lateral slope constraints of existing storm drain along South Rancho Santa Fe Road south of Cherokee Street and downstream slope constraints of existing storm drain at La Mirada Road and South Las Posas Road.
- Alternatives:
  - No feasible alternatives were analyzed because the proposed alignment follows existing right-of-way along a path that supports new development and redevelopment areas.
- Right-of-Way Requirements:
  - The project is within the existing City right-of-way, so property acquisition or drainage easement is not anticipated. Since the City's general plan identifies widening of South Rancho Santa Fe, this project can be bundled up as a part of the improvement.

Figure 6-5: Flooding along La Mirada Drive

Figure 6-6: Runoff overtopping the curb along La Mirada Drive

6.4.1.6 **CIP_ Las Flores Drive (Las Flores Drive between 9th Street and Perdido Street)**

❖ Existing Facility and Location:

The project is located in the Business/Industrial Neighborhood within the Las Posas Basin. The upsized infrastructure is within Las Flores Drive between 9th Street and Perdido Street spanning 1200 feet and extends east of Perdido Street 700 feet where it connects to Starstone Drive. The system ultimately discharges into Las Posas Creek (Lower) and ultimately discharges into San Marcos Creek.

The existing system within Las Flores Drive between 9th Street and La Mirada Drive consists of 24-inch RCP at an average slope of 2.6%. The 24-inch RCP is connected to 43-inch by 27-inch CMP culvert across La Mirada Drive. The flow from the culvert is conveyed along Las Flores Drive southwest of La Mirada Drive and Las Flores Drive via a series of brow ditches which run along Las Flores Drive and in between residential buildings. There is a dual 16-inch by 25-inch CMPA which connects the inlets approximately 275 feet south of La Mirada from the sump in the street to the brow ditch. The brow ditch leaves Las Flores and is directed behind existing homes in private property and connects to a 42-inch RCP storm drain system with an average slope of 1.9% which ultimately is connected to 48-inch RCP at the intersection of Perdido Street and Starstone Drive. The existing alignment, behind existing homes in private property, is assumed to be removed/abandoned as a part of the CIP.

- ❖ Need and Purpose:

Based on City input this area is a known flood hot spot and the existing condition modeling shows that the existing storm drain infrastructure is undersized. The potential impacts of the current deficient system are flooding in the intersection of La Mirada Drive and Las Flores Drive due to the deficient 43-inch by 27-inch CMP. Also, the existing alignment is not easily accessible for maintenance. The upsizing of the existing undersized storm drain network as well as replacing surface drainage with sub-surface drainage (storm drain backbone) would increase efficiency and eliminate flooding.

This project contributes to the City's drainage goals by eliminating undersized pipes in driveways which will reduce flooding as well as replacing the existing storm drain to increase the conveyance capacity for a planned residential area. The realignment of the system will also provide better access for maintenance of the system.

- ❖ Proposed Engineering Features:

The contributing area of 59 acres of 28% impervious results in a 100yr 24hr constrained peak flow of 131 cfs and an unconstrained peak flow of 192 cfs. A section of the proposed storm drain system is not in City right-of-way so it would require establishment of a City drainage easement following an existing private street.

Through this project, the existing 24-inch RCP along Las Flores Drive between 9th Street and La Mirada Drive will be replaced with 36-inch RCP at an average slope of 2.3%.The existing 43-inch by 27-inch CMP culvert is replaced with 36-inch RCP at 2.8% slope which is connected to a new storm drain backbone in lieu of the existing brow ditches. The new storm drain system consists of 42-inch RCP at 2.4% slope and 48-inch RCP and dual 36-inch RCP at 2.3% slope which is connected to the existing 48-inch RCP at 7.1 % slope at Perdido Street and Starstone Drive. The existing dual 16-inch by 25-inch CMPA lateral between La Mirada Drive and Perdido Street are replaced by dual 24-inch-inch RCP. More details on proposed alignment and profile can be found in Appendix F.

- ❖ Cost Estimates:

The opinion of probable construction cost for this project is **$1,106,572** and is broken down into further detail in Appendix F of this report.

- ❖ Project Considerations:
  - ➢ Constraints:
    - ▪ The system is constrained by a storm drain lateral system across Las Flores Drive between La Mirada Drive and Perdido Street. The storm drain lateral system consists of dual 16-inch by 25-inch CMPA which is replaced with dual 24-inch RCP as a part of the CIP.

- Alternatives:
  - One other alternative was considered and that was to connect the 48-inch RCP to the existing storm drain system between residential buildings west of Starstone Drive. This alternative was not chosen because of the limited access to construct improvements between residential structures the future maintenance needs of the system.
- Right-of-Way Requirements:
  - The project is not within the existing City right-of-way, so property acquisition or drainage easement is anticipated.

Figure 6-7: Surface flow via driveway culverts along Las Flores Drive

Figure 6-8: Perdido Street east of Las Flores Drive

6.4.1.7 CIP_ South Santa Fe Avenue

❖ Existing Facility and Location:

The project is located in the Business/Industrial District within the North Outlying Basin. The proposed infrastructure includes improvements to the existing earthen channel also known as Villa Vista Channel south of Springdale Estates. The channel is connected to an existing 60-inch RCP culvert across West Mission Road. The system ultimately discharges into a concrete channel within the jurisdiction of County of San Diego.

The existing infrastructure consists of an earthen channel also known as Villa Vista Channel. The channel has not been surveyed as a part of the CIP effort. Hence, the exact dimensions are unknown. As a part of the CIP, the existing earthen channel is replaced with a sub-surface culvert to convey runoff.

❖ Need and Purpose:

Based on City input this area is a known flood hot spot and the existing condition modeling shows that the existing channel is undersized. The potential impact of the current deficient system is flooding of surrounding residential units. This project contributes to the City’s drainage goals by reducing flooding of the surrounding residential units.

- ❖ Proposed Engineering Features:

The contributing area of 147 acres of 59% impervious results in a 100yr 24hr constrained peak flow of 332 cfs and an unconstrained peak flow of 387 cfs. The project is assumed to be within an established drainage so it is assumed that it would not require property accusation or establishment of a City drainage easement. Two alternatives were provided as a part of the project.

The major source of inflow into the channel is conveyed by 6-feet wide and 4-feet deep RCB upstream of the channel. The flow from the channel is conveyed downstream across CA 78 highway by a single 5-feet deep RCP culvert and is discharged into the downstream channel. Two (2) alternatives are proposed for this CIP.

The first alternative is to give the channel a defined trapezoidal cross-section with a width of 5 feet and depth of 4 feet with a side slope of 3 feet horizontal to 1 foot vertical at a longitudinal slope of 2.5%. The proposed channel should be lined with grass or suitable vegetation for the stabilization of channel. An additional barrel is added to the downstream existing single 5-feet deep RCP culvert.

The second alternative is to replace surface conveyance from the channel with sub-surface conveyance in the form of a storm drain system. The CIP includes deepening the downstream end of the existing 6-feet wide by 4-feet deep RCP and extending along the channel at an average longitudinal slope of 2%. The 6-feet wide by 4-feet deep RCP transitions to four barrel 42-inch RCP due to width constraints. More details on proposed alignment and profile can be found in Appendix F.

- ❖ Cost Estimates:

The opinion of probable construction cost for this project is **$2,015,175** and is broken down into further detail in Appendix F of this report.

- ❖ Project Considerations:
  - ➢ Constraints:
    - ▪ The system is constrained the single 5-feet deep RCP culvert which is replaced with dual 5-feet deep RCP as a part of the CIP.
  - ➢ Alternatives:
    - ▪ Based on the preferred approach, the remaining one would be used as an alternative.
  - ➢ Right-of-Way Requirements:
    - ▪ The project is within the existing drainage easement, so property acquisition or drainage easement is not anticipated.

Figure 6-9: Existing Channel at South Santa Fe Avenue

6.4.1.8 CIP_East Mission Road (East Mission Road and Mulberry Drive)

❖ Existing Facility and Location:

The project is in the Richland Neighborhood within the San Marcos Creek East Basin. The upsized infrastructure is in private parcels west of Mulberry Drive and spanning 900 feet north of East Mission Road. Existing infrastructure ultimately discharges into San Marcos Creek.

The existing dual drainage system consists of 36-inch Cast-in-place concrete pipe (CIPCP) with an average slope of 1.1% as sub surface drainage which conveys low flows and a shallow defined natural ditch as surface drainage. The 36-inch low flow system ties into triple barrel 8-feet wide by 4-feet high RCB culverts across East Mission Road.

❖ Need and Purpose:

Based on City input this area is a known flood hot spot and existing condition modeling shows that the existing storm drain infrastructure is significantly undersized. The current system constrains the runoff so that surface flow via the natural ditch floods the private parcel (parking lot). The impacts of the existing surface conveyance through the project area result in the City receiving complaints from the property owners adjacent to the ditch.

The upsizing of the existing undersized storm drain network would increase efficiency and eliminate flooding.

This project contributes to the City's drainage goals by increasing the efficiency of an existing deficient storm drain backbone system for an existing industrial area as well as reduces flooding on a private parking lot.

- Proposed Engineering Features:

The contributing area of 360 acres of 35% impervious results in a 100yr 24hr constrained peak flow of 656 cfs and an unconstrained peak flow of 746 cfs. The project is not in City right-of-way, so it would require property accusation or establishment of a City drainage easement.

Through this project, the defined natural ditch as surface drainage is replaced with triple 8 feet wide by 3 feet high RCB with an average slope of 1% which would ultimately connect to existing triple 8 feet wide by 4 feet high RCB culvert across East Mission Road.

As a part of the CIP, the undersized natural ditch providing surface drainage in a private parcel west of Mulberry Drive and north of East Mission Drive would be replaced with sub-surface drainage thereby improving the efficiency of the storm drain system. In the proposed condition, the installation of triple 8 feet wide by 3 feet high RCB system replaced the surface ditch. More details on proposed alignment and profile can be found in Appendix F.

- Cost Estimates:

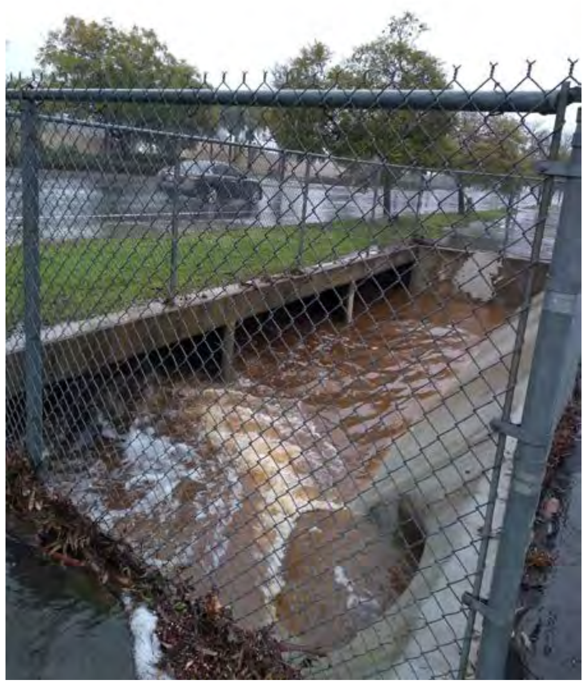
The opinion of probable construction cost for this project is **$5,468,463** and is broken down into further detail in Appendix F of this report.

- Project Considerations:
  - Constraints:
    - The constraints of this system were the downstream elevation controls and available depth below finished grade for upsizing storm drain in the existing alignment.
  - Alternatives:
    - No alternatives were analyzed because the storm drains are being upsized in the existing alignment.
  - Right-of-Way Requirements:

    The street is at its ultimate width. However, the project is not within the existing City right-of-way, so property acquisition or drainage easement is anticipated.

Figure 6-10: Flooding in the private parking lot north of East Mission Road

Figure 6-11: Triple 8-ft (W) by 4-ft (H) RCB across East Mission Road



6.4.1.9 **CIP_Los Vallecitos Boulevard**

❖ Existing Facility and Location:

The project is located in a Business/Industrial District within the San Marcos Creek Main Basin. The majority of the proposed infrastructure is within Los Vallecitos Boulevard, spanning from roughly 675 feet east of Bingham Drive and extending east along Los Vallecitos Boulevard to the southern limit of North Echo Lane. The existing infrastructure ultimately discharges into San Marcos Creek.

The current storm drain infrastructure consists of a single 39-inch RCP and single 42-inch RCP which discharge to a dual 5 feet wide by 3 feet high reinforced concrete box (RCB) culvert across Los Vallecitos Boulevard and SR-78. At the easterly limits of the proposed project there is an 18-inch storm drain running along a private alleyway conveying flow from the currently open space area north of Los Vallecitos Boulevard between Vallecitos De Oro and Knoll Road. This storm drain system outlets directly to Los Vallecitos Boulevard and is conveyed as surface flow until it is intercepted by the inlets at the intersection of Los Vallecitos Boulevard and Vallecitos De Oro.

❖ Need and Purpose:

The existing condition model shows that the existing storm drain infrastructure is significantly undersized. In the current system, the flow bypasses the inlets and surface flows onto Los Vallecitos Boulevard. Flooding on L os Vallecitos Boulevard could extend into the neighboring "Light Industrial" and "Office Professional" land uses directly north of the street. The introduction of a storm drain system in Los Vallecitos Boulevard would not only support potential redevelopment in the area, but would also upsize and increase the efficiency of the existing undersized storm drain network.

This project contributes to the City's drainage goals by improving the efficiency of an existing deficient storm drain backbone system for an existing industrial/office professional adjacent to a major arterial road.

❖ Proposed Engineering Features:

The contributing area of 50 acres of 86% impervious results in a 100yr 24hr constrained peak flow of 112 cfs and an unconstrained peak flow of 156 cfs. The project is in City right-of-way so it would not require property accusation or establishment of a City drainage easement.

The proposed conveyance system consists of two parts. The first part of the project is a single 36-inch RCP backbone with an average slope of 0.7 % to capture upstream run-on and intercept the existing 18-inch lateral currently discharging to the street. This backbone will also serve as the tie-in point for current development and any future redevelopment.

The second part of the project is the replacement of the single 39-inch RCP and 42-inch RCP with a single 60-inch RCP. The backbone conveyance system is connected to the upstream dual 60-inch RCP with a slope of 0.1% owing to outlet control.

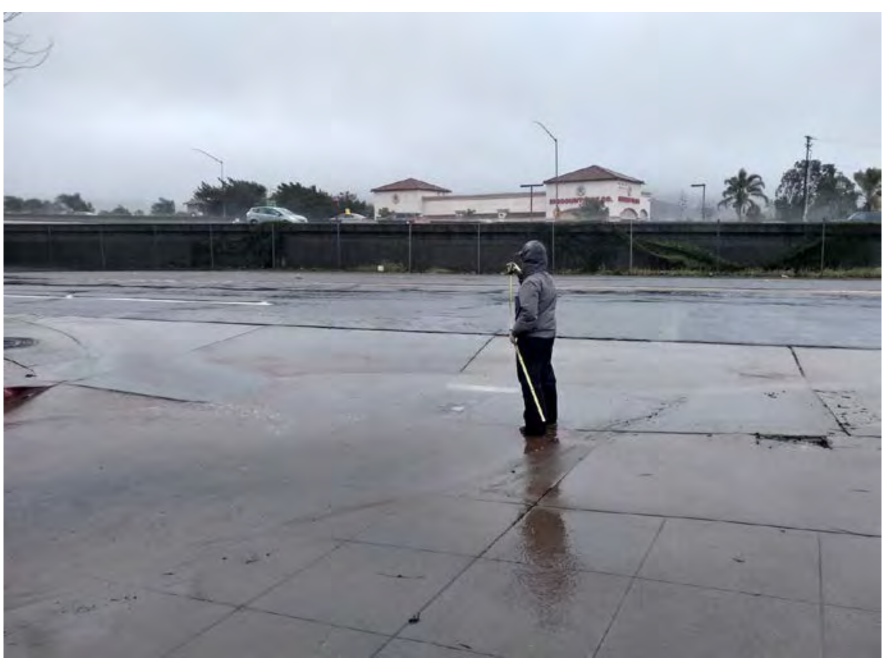
❖ Cost Estimates:

The opinion of probable construction cost for this project is **$1,768,909** and is broken down into further detail in Appendix F of this report.

❖ Project Considerations:

- Constraints:
  - The system is constrained by the dual 5 feet wide by 3 feet high (RCB) culvert crossing the CA-78 (Los Vallecitos Boulevard) which is not being replaced. It is also constrained by the existing systems slopes and lateral tie-ins that are causing the very shallow slope in the proposed 60-inch storm drains. It is financially infeasible to upsize the existing crossing under SR-78 as a drainage project. Upsizing the crossing should be done in conjunction with any freeway improvements of significant size.
- Alternatives:
  - One alternative would be to replace the connections for the existing laterals and increase the slope of the replaced segments of pipe to allow more capacity without having to increase the diameter. While the alternative is feasible, the proposed project allows the system to capture runoff further upstream and provides a backbone system that can service future redevelopment in the area. The alternative was not chosen because it was assumed that the system can extend further east if the grades are not steepened.
- Right-of-Way Requirements:
  - The project is within the existing City right-of-way, so no property acquisition or drainage easement is anticipated.

Figure 6-12: Flooding at the driveway crossing across Jerome's Furniture complex along Los Vallecitos Boulevard.



*6.4.1.10*CIP_ Discovery Street (Discovery Street and La Sombra Drive)

❖ Existing Facility and Location:

The project is located in the Barham/Discovery Community within the San Marcos Creek Main Basin. The existing infrastructure is within a private parcel east of La Sombra Drive and extends 200 feet in the northerly direction where it crosses Discovery Street and continues 700 feet in the northerly direction through more private land and discharges into San Marcos Creek.

The existing system consists of two single 36-inch RCP pipes along a private parcel with an average slope of 0.3% connected to a dual 36-inch CMP culvert across Discovery Street. The culvert is connected to single 42-inch CMP with an average slope of 0.2% which runs partly along Discovery Street before it outlets into a canyon through a private developed land.

❖ Need and Purpose:

The existing condition modeling shows that the existing storm drain infrastructure is undersized. The possible impacts of the existing deficient system are the known issues with CMP erosion and degradation causing sink holes and flooding in the existing development that is directly above the existing system.

The upsizing and upgrading of the pipe material for the existing undersized storm drain network increase efficiency of the storm drain system and eliminate flooding.

This project contributes to the City's drainage goals by improving the efficiency of an existing deficient storm drain system for residential area as well as utilizes the City's CMP Replacement Program.

❖ Proposed Engineering Features:

The contributing area of 28 acres of 43% impervious results in a 100yr 24hr constrained peak flow of 44 cfs and an unconstrained peak flow of 84 cfs. The project is not in City right-of-way so it would require property accusation or establishment of a City drainage easement.

Through this project, single 36-inch CMP system along a private parcel with an average slope of 0.3% connected is replaced with 48-inch RCP system with the same slope. The dual 36-inch CMP culvert across Discovery Street is replaced with dual 42-inch RCP culvert with the same slope. The culvert is connected to single 42-inch CMP with an average slope of 0.2% which runs partly along Discovery Street before it outlets into a canyon through a private developed land. The single 42-inch CMP is replaced with single 48-inch RCP.

As a part of the CIP, the existing CMP system within a private parcel east of La Sombra Drive, across Discovery Street and a private development north of Discovery Street would be replaced with a RCP system. This would increase the capacity of the existing system and thereby increase the efficiency of storm drain system and reducing flooding. More details on proposed alignment and profile can be found in Appendix F.

- Cost Estimates:

The opinion of probable construction cost for this project is **$604,794** and is broken down into further detail in Appendix F of this report.

- Project Considerations:
  - Constraints:
    - The constraint for this project is the alignment through private property and the City boundary ending on the eastern edge of La Sombra Drive where realignment would be beneficial.
  - Alternatives:
    - An alternative to replacing the CMP in place would be to realign the system into La Sombra Drive and connect downstream to the channel. However, this alternative was not considered feasible because the City boundary ends along the eastern edge of La Sombra Drive.
  - Right-of-Way Requirements:

  The project is not within the existing City right-of-way, so property acquisition or drainage easement is anticipated.

Figure 6-13: Discovery Road at West San Marcos Boulevard closed due to flooding

6.4.1.11 **CIP_West Mission Road (West Mission Road and Firebird Lane)**

❖ Existing Facility and Location:

The project is located in the Richmar Neighborhood within the San Marcos Creek Basin. The upsized infrastructure is within Firebird lane at Richmar Avenue spans approximately 450 feet to the south along Firebird Lane to West Mission Road and continues 850 feet east on West Mission Boulevard. The existing infrastructure ultimately discharges into San Marcos Creek.

The existing conveyance system consists of three single 24-inch RCP with slopes of 0.7% and 1.83% along Firebird Lane which are connected to a single 48-inch backbone system with an average slope of 0.8% a long West Mission Road. The 48-inch backbone system ties into a s eries of five barrel 11’W x 10’H RCB culverts across W Mission Road.

❖ Need and Purpose:

The existing condition modeling shows that the existing storm drain infrastructure is significantly undersized. The current system constrains the runoff so that flow bypasses the system onto West Mission Road, a major arterial road. The upsizing of the existing undersized storm drain network would increase efficiency and minimize flooding.

This project contributes to the City’s drainage goals by improving the efficiency of an existing deficient storm drain backbone system for a planned mixed use residential and commercial area adjacent to a major arterial road.

❖ Proposed Engineering Features:

The contributing area of 77 acres of 65% impervious results in a 100yr 24hr constrained peak flow of 184 cfs and an unconstrained peak flow of 261 cfs. The project is in City right-of-way so it would not require property accusation or establishment of a City drainage easement.

Through this project, the existing 24-inch RCP system within Firebird lane at Richmar Avenue spanning approximately 450 feet south along Firebird Lane to West Mission Road is upsized to 48-inch RCP system and the existing 48-inch RCP system spanning 850 feet east on W est Mission Boulevard is upsized to 66-inch and 72-inch RCP system with an average slope of 0.8%.

As a part of the CIP, the existing storm drain system along Firebird Lane and West Mission Road would be upsized thereby improving the efficiency of the storm drain system. An assumption being made for this CIP is that the currently undeveloped lots neighboring the system along Firebird Lane would be developed and need a location to tie laterals into. In the proposed condition the existing 24-inch and 48-inch RCP systems on Firebird Lane and West Mission Road are upsized to a 48-inch, 66-inch and 72-inch RCP system respectively. More details on proposed alignment and profile can be found in Appendix F.

❖ Cost Estimates:

The opinion of probable construction cost for this project is **$1,321,825** and is broken down into further detail in Appendix F of this report.

❖ Project Considerations:

- Constraints:
  - The constraint for this CIP is the downstream tie in to the culvert crossing East Mission Road. The culvert conveys the north San Marcos Creek branch to the main branch of San Marcos Creek. Changes at this point of connection could affect the FEMA SFHA and so it is avoided.
- Alternatives:
  - No alternatives were analyzed because the storm drains are being upsized in the existing alignment.

- Right-of-Way Requirements:
  - The replaced infrastructure follows the same alignment as the existing storm drain facilities and is located completely within the existing right-of-way.

Figure 6-14: Undeveloped lots along Firebird Lane

Figure 6-15: South of Firebird Lane at West Mission Road

6.4.1.12 CIP_ Mulberry Drive (Mulberry Drive and La Cienega Drive)

❖ Existing Facility and Location:

The project is located in the Twin Oaks Valley Neighborhood within the San Marcos Creek North Basin. The proposed infrastructure includes improvements within Mulberry Drive, Richland Road, E La Cienega, and within private property. The proposed system collects runoff from the cul-de-sac at Marilyn Lane and connects to a new backbone system in Mulberry Drive. Another section of the proposed system begins approximately 750 feet west of Mulberry Drive along Richland Road which ties into the backbone system within Mulberry Road. The backbone system spans 1050 feet south of Mulberry Drive and ties into existing infrastructure at La Cienega Road. The existing infrastructure within La Cienega Road is upsized and spans 1050 feet before discharging into an existing drainage network in Twin Oaks Golf Course. The existing infrastructure discharges into Twin Oaks Valley Creek and ultimately discharges into San Marcos Creek.

The existing system includes brow ditches along Mulberry Drive, Richland Road and between the cul-de-sac of Marilyn Lane and Mulberry Drive. The brow ditch system along Mulberry Drive is connected to a series of existing 54-, 60- and 66-inch RCP system within La Cienega Drive at an average slope of 0.5%, 0.9% and 0.9% respectively.

- Need and Purpose:

Based on City input this area is a known flood hot spot and the existing condition modeling shows that the existing storm drain infrastructure are undersized. The potential impacts of the current deficient system are flooding within Mulberry Drive as well as La Cienega Road. The upsizing of the existing undersized storm drain network as well as replacing surface drainage (existing brow ditches) with sub-surface drainage (storm drain backbone) would provide backbone for future development/redevelopment as well as increase efficiency and reduce flooding.

This project contributes to the City's drainage goals by providing underground conveyance of flows in an area that is currently surface conveyance.

- Proposed Engineering Features:

The contributing area of 323 acres of 34% impervious results in a 100yr 24hr constrained peak flow of 362 cfs and an unconstrained peak flow of 630 cfs. The contributing area of the project consists of offsite flows from County of San Diego and City of Escondido. The storm drain system per the CIP has been designed per planned land use of the contributing area. A part of the project is not within the City right-of-way so it would require property accusation or e stablishment of a City drainage easement.

Through this project, the existing surface conveyance via brow ditches along Mulberry Drive, Richland Road and between the cul-de-sac of Marilyn Lane and Mulberry Drive will be conveyed via sub-surface by storm drain infrastructure. The proposed storm drain system consists of a backbone system along Mulberry Drive. The backbone storm drain within Mulberry Drive consists of a series of 42-, 48-, 54- and 66-inch RCP at 2.2%, 2.3%, 2.2% a nd 2.3% respectively. The backbone system has two (2) laterals tying into it. The first storm drain lateral system consists of series of new 42-inch RCP system at 3.1% slope in lieu of the existing concrete ditch in between Marilyn Lane and Mulberry Road. The 42-inch RCP system is connected to the backbone storm drain along Mulberry Road. The second storm drain lateral system within Richland Road consists of 42-inch, 48-inch RCP at an average slope of 5.4% a nd 2.9% respectively in lieu of the existing brow ditch. The existing storm drain along La Cienga Road is replaced with a series of 72-, 78-, 84- and 90-inch RCP at an average slope of 0.5%, 0.9% and 0.9% respectively. More details on proposed alignment and profile can be found in Appendix F.

- Cost Estimates:

The opinion of probable construction cost for this project is **$3,163,198** and is broken down into further detail in Appendix F of this report.

- Project Considerations:
  - Constraints:
    - The system is constrained by the downstream storm drain along La Cienga Road.

- Alternatives:
  - No alternatives were analyzed because the backbone storm drain is being proposed in the existing alignment of the brow ditches.
- Right-of-Way Requirements:
  - The project is not within the existing City right-of-way, so property acquisition or drainage easement is anticipated.

Figure 6-16: Surface conveyance via ditches along Mulberry Drive

6.4.1.13 CIP_A_North Twin Oaks Valley Road

- Existing Facility and Location:

The project is located in the Twin Oaks Valley Neighborhood within the San Marcos Creek North Basin. The majority of the proposed infrastructure is within North Twin Oaks Valley Road, spanning from roughly 200 feet south of Olive St. and extending south along North Twin Oaks Valley Road to the southern limit roughly 500 f eet north of East La Cienega Rd. The proposed project outfall discharges to and existing City detention basin in Twin Oaks Valley Creek.

The current storm drain infrastructure consists of 24-inch and 42-inch reinforced concrete pipe (RCP) laterals on C assou Rd. that cross under North Twin Oaks Valley Road through Twin Oaks Elementary. There is not currently any storm drain facilities along this stretch of Twin Oaks Valley Road.

- Need and Purpose:

Based on City input this area is a known flood hot spot and the existing condition modeling shows that the existing laterals extending into the school site are undersized The current system constrains the runoff so that roughly half of the flow bypasses the system onto Twin Oaks Valley Road. The introduction of a storm drain system in Twin Oaks would not only support potential redevelopment in the area, but would also upsize the existing undersized storm drain network to eliminate flooding.

This project contributes to the City's drainage needs by providing backbone storm drain infrastructure for roughly 200 a cres of contributing area, reducing the potential for flooding, and providing infrastructure required for future development in the area.

- Project Considerations:

  - Constraints:
    - The existing system's alignment currently conveys runoff under Twin Oaks Elementary School, which limits the ability to upsize and/or maintain the storm drain infrastructure.

  - Alternatives:
    - Two feasible alternatives were considered along with the preferred alternative of the new backbone system down North Twin Oaks Valley Road. One was to upsize the storm drain system maintaining the existing alignment. The other was to catch the large drainage area north and west of the intersection of Olive Street and North Twin Oaks Valley Road by adding inlets to the intersection and new storm drain extending east on Olive Street to the channel that runs along Sycamore Drive. While both alternatives are feasible, the proposed project allows the system to capture more drainage area and provides a backbone system that can service more future development area.

  - Right-of-Way Requirements:
    - Based on the Mobility Element section of the City of San Marcos General Plan Dated February 14, 2012, North Twin Oaks Valley Road has a road classification of "4 Lane (Rural)" with a street topology of "Arterial with Enhanced Bicycle/Pedestrian Facilities" and a plan for "Class I Bicycle Facility – Future." No other deficiencies or improvements for the project area are outlined in the City of San Marcos General Plan.

❖ Proposed Engineering Features:

The 199 acre contributing area in the proposed condition has a percent impervious of 35% and results in a 100-year 24-hour unconstrained peak flow of 320 cfs. The project is in City right-of-way so it would not require property acquisition or establishment of a City drainage easement.

Through this project, a 48-inch diameter and 60-inch diameter RCP storm drain backbone conveyance system is proposed along the roughly 2,200 feet span of North Twin Oaks Valley Road from roughly 200 feet south of Olive St. and extending south along North Twin Oaks Valley Road to the southern limit roughly 500 feet north of East La Cienega Rd. with an average slope of 1%.

As a part of the CIP, the existing storm drain system along Cassou Road would be connected to the proposed storm drain system along North Twin Oaks Valley Road as opposed to the deficient storm drain system across Twin Oaks Elementary School, thereby improving the efficiency of the storm drain system. The existing alignment in the school can be removed, abandoned or utilized for local drainage from the school. In the proposed condition the existing 24-inch and 42-inch RCP laterals on Cassou Road are upsized to a 42-inch and 54-inch RCP, respectively. More details on proposed alignment and profile can be found in Appendix F.

❖ Cost Estimates:

The opinion of probable construction cost for this project is **$1,892,046** and is broken down into further detail in Appendix F of this report.

Figure 6-17: Google street view of North Twin Oaks Valley Road

Apart from the thirteen (13) CIP projects presented in this section of the report, other potential CIP opportunities were considered and analyzed as a part of the CIP effort. These opportunities were not selected as CIP projects due to various constraints which include but are not limited to right-of-way, FEMA floodplains, small contributing area and jurisdictional boundaries. These opportunities can be considered and further analyzed during future improvements in the vicinity. Refer to Appendix I for a summary of the potential CIP opportunities.

7.0 REGIONAL IMPROVEMENT OPPORTUNITIES

7.1 Methodology

Regional Improvement Opportunities that could provide detention or w ater quality benefits were identified through visual observation. The size of the contributing drainage areas and land parcel ownership were the major contributing factors for identifying regional opportunities. A conscious effort was made to limit the identification of regional opportunities to parcels owned by the City of San Marcos; however, some locations on private parcels were identified as well in certain circumstances due to constraints. Possible alternate locations were also identified.

7.2 Results

In total, thirteen (13) locations are currently identified as potentially viable regional improvement opportunities. Runoff from approximately 7,000 acres of 22,000 acres of the watershed could be treated through these improvement opportunities. Vicinities of these recommended locations should be considered for implementation of regional opportunities if there are constraints with these locations.

Table 7.1: Regional Improvement Opportunities

Regional Improvement Opportunities			
Facility ID	**Contributing Area (ac)**	**Impervious Area (ac)**	**Parcel Ownership**
A1_1	353.1	138.0	Private
A2_1	1739.9	576.3	City of San Marcos
A2_2	69.6	31.8	San Marcos Unified School District
A2_3	3108.2	1310.8	Private
A2_4	382.7	120.5	Private
A2_5	309.8	84.3	City of San Marcos
A2_6	360.0	126.0	Private
A3_1	453.0	320.7	City of San Marcos
	453.0	320.7	City of San Marcos
	453.0	320.7	City of San Marcos
	453.0	320.7	City of San Marcos
	453.0	320.7	City of San Marcos
	453.0	320.7	City of San Marcos
	453.0	320.7	City of San Marcos
	453.0	320.7	City of San Marcos
	453.0	320.7	City of San Marcos
A3_2	1747.8	1267.1	City of San Marcos
A4_1	145.0	21.6	City of San Marcos
A4_2	160.3	109.4	Private
A4_3	407.3	315.7	City of San Marcos
	407.3	315.7	City of San Marcos
A4_4	662.7	524.8	Public

This study identifies properties that may lend themselves for future treatment areas. Several of the sites have zoning, or de velopment restrictions that should be further evaluated. For example, Opportunity A1_1 is zoned open space, A2_4 is the Woodland interchange project, A3_1 is under agreement for the City to sell for redevelopment and includes a CIP project, A4-1 does not have a significant treatable area and is designated open space, A4_2 has already been incorporated into a tentative map and is sensitive habitat and will accommodate 2 circulation roads, and A4_3 has a master plan for development and has a right of purchase agreement.