City of Merced

Storm Drain Master Plan
City Project No. 199036

Final Report
April 19, 2002

Stantec File No. 84010156

CITY OF MERCED
STORM DRAIN MASTER PLAN

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STORM DRAIN MASTER PLAN

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EXECUTIVE SUMMARY

This report describes and presents the recommended Storm Drain Master Plan (SDMP) proposed for implementation for the City of Merced, California. The purpose of this SDMP is to provide a reference document that will facilitate the planning and implementation of drainage infrastructure improvements required to accommodate stormwater runoff under buildout conditions per the City of Merced Vision 2015 General Plan. The City's Specific Urban Development Plan area is the overall area of study in this SDMP.

The following standards have been applied to the formulation of required drainage infrastructure recommended herein:

- *Storm Drainage Conveyance Elements (Storm Drains and Open Channels)* – 10-year return period storm.

- *Stormwater Detention Basins* – 50-year return period storm under upstream buildout conditions (Inflow); 2-year return period storm under existing upstream conditions (Outflow).

This SDMP does not address regional flood control issues and proposals dealing with major streams passing through the City of Merced (such as Bear Creek and Black Rascal Creek and tributaries) or storm drainage requirements and issues associated with the future UC Merced campus.

In this SDMP, the overall area of study has been broken down into eleven (11) primary local watersheds, Watersheds A through K. Accordingly, recommended storm drainage infrastructure elements have been categorized (or grouped) for each of these watersheds. These watersheds are depicted on Figure ES-1 within this Executive Summary and on Exhibits A and B of this SDMP. A summary of the total storm drainage infrastructure implementation costs attributable to each watershed is provided in Table ES-1 within this Executive Summary, with more detailed cost data being provided on Table 7 of this SDMP.

FIGURE ES-1

CITY OF MERCED STORM DRAIN MASTER PLAN

MAP DEPICTING PRIMARY WATERSHEDS CITY OF MERCED JOB NO. 199036 FINAL

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JOB No. : 840-10156
APR. 19, 2002

LEGEND

- SPECIFIC URBAN DEVELOPMENT PLAN BOUNDARY
- EXISTING WATERWAYS
- EXISTING STORM DRAINS
- CP 5 — CONCENTRATION POINTS
- BRC24 — SUB-BASIN IDENTIFICATION
- SUB-BASIN BOUNDARY
- WATERSHED BOUNDARY
- Q_{50} = 94 CFS, Q_2 = 9 CFS — 50-YR DISCHARGE INFLOW UNDER FUTURE CONDITIONS (APPLIES TO PROPOSED DETENTION BASINS) / 2-YR DISCHARGE EXISTING CONDITIONS (APPLIES TO PROPOSED DETENTION BASINS)
- PROPOSED STORM DRAIN
- B1 — PROPOSED DETENTION BASIN AND PUMP STATION
- PROPOSED PIPE SIZE
- A — WATERSHED IDENTIFICATION
- EXISTING DETENTION POND
- EXISTING PUMP STATION

NOTE: PROPOSED STORM DRAINAGE INFRASTRUCTURE DEPICTED HEREIN IS LIMITED TO TRUNK SYSTEM IMPROVEMENTS (RCP'S = 24" DIAMETER OR GREATER). LOCAL SYSTEMS CONNECTING TO THE PROPOSED TRUNK SYSTEM WILL NEED TO BE DEVELOPED ON A SITE SPECIFIC BASIS.

NORTH

GRAPHIC SCALE
0 500 1000 1500 2000
SCALE:1"=1000'

INSET (SEE BELOW)

SEE INSET

DWG FILE: V:\3284\ACTIVE\840101156-1\CITY OF MERCED GIS\MODIFIED MERCED GIS DWGS\STORM DRAIN MASTER PLAN\SCREEN\11X17.DWG PRINTED: TUE 4/16/2002 10:10:24 LAYOUT: FIGURE ES-1

TABLE ES-1

Summary of Estimated Costs For Storm Drainage Infrastructure

Watershed	Outfall	Cost
A	Area Draining into Fahrens Creek	**$ 15,395,142**
B	Area Draining into Cottonwood Creek	**$ 4,061,540**
C	Area Draining into Black Rascal Creek	**$ 13,754,398**
D	Area Draining into Bear Creek	**$ 3,774,722**
E	Area Draining into West Avenue Storm Drain	**$ 11,923,408**
F	Area Draining into Zentner Lateral Canal	**$ 9,354,450**
G	Area Draining into Hartley Lateral Canal	**$ 10,287,256**
H	Area Draining into Doane Lateral Canal	**$ 11,657,884**
I	Area Draining into Farmdale Lateral	**$ 962,836**
J	Area Draining into Miles Creek	**$ 1,357,538**
K	Area Draining into El Capitan Canal	**$ 1,129,100**
TOTAL		**$ 83,658,274**

INTRODUCTION

This report describes and presents a recommended Storm Drain Master Plan (SDMP) for the City of Merced, California. The purpose of this SDMP is to provide a reference document that will facilitate the planning and implementation of drainage infrastructure improvements required to accommodate stormwater runoff under buildout conditions per the City of Merced Vision 2015 General Plan (General Plan). The City's Specific Urban Development Plan (SUDP) area is the overall area of study in this SDMP.

This SDMP has been prepared based on a review of existing information provided by the City of Merced, field reconnaissance, hydrologic analysis, hydraulic analysis, and input and directives from the City Council and City staff. Storm drainage infrastructure has also been formulated in consideration of existing planning documents, studies, and regulations. Cost estimates for implementation of various elements of the storm drainage infrastructure plan are also provided, along with recommendations pertaining to phasing and implementation priorities.

Based on direction provided by the City Council in June 2001, the storm drainage conveyance infrastructure recommended herein has been sized to accommodate runoff generated during a 10-year storm event under upstream buildout conditions per the General Plan. This is a standard that is utilized by many communities in Northern California. Per existing City standards, new stormwater detention basins recommended in this SDMP are sized to accommodate runoff generated during a 50-year storm by the contributing local watershed under buildout conditions per the General Plan, with the peak rate of outflow being limited to the discharge generated by the upstream local watershed during a 2-year storm under existing conditions.

Regional flood control issues and proposals dealing with major streams passing through the City of Merced (such as Bear Creek and Black Rascal Creek and tributaries) are outside of the scope of evaluation covered in this SDMP. This SDMP also does not address storm drainage requirements and issues associated with the future UC Merced campus.

PREVIOUS STUDIES

The following storm drainage master plans that were previously prepared address storm drainage concerns within the City of Merced:

- *1956 Storm Drain Plan (Adamson)*
- *1983 Merced County Critical Area Flooding and Drainage Plan (Nolte and Associates)*
- *2000 City of Merced Airport Storm Drainage Master Plan (HDR)*
- *2001 City of Merced Storm Drain Master Plan, Prototype Watershed Study (Stantec Consulting)*

1956 Storm Drain Plan

This storm drain plan was an early study of watersheds and proposed storm drainage facilities.

1983 Merced County Critical Area Flooding and Drainage Plan

The 1983 study was a master drainage study for a large area of Merced County (approximately 180 square miles located on the east side of the San Joaquin River and south of the Merced River). The 1983 study included the Cities of Livingston, Atwater and Merced as well as other communities.

2000 Airport Storm Drainage Master Plan

The Airport Storm Drainage Master Plan covers the area of the Merced Airport, generally bounded by Wardrobe Avenue on the north, West Avenue on the east, Thornton Road on the west and Dickenson Ferry Road on the south. The study also included two sub-basins within the existing development area northeast of the Airport. This analysis concentrated on identifying existing local flooding conditions and proposed solutions for this limited area. The current SDMP has merely adopted most of the information presented in the Airport Storm Drainage Master Plan.

2001 Prototype Watershed Study

Per City direction, a prototype analysis of the central watersheds within the City of Merced was performed at the early stages of preparing the current SDMP. These two prototype watersheds were named the Central Merced Watershed and the South Area Watershed by the City. The Central Merced Watershed included the existing developed area generally residing between Bear Creek on the north and west, G Street on the east

and the alignment of Highway 99 on the south. The South Area Watershed included the existing development area contiguous to the south of the Central Merced Watershed between roughly the alignment of Highway 99 on the north, West Avenue on the west, Childs Avenue on the south and G Street on the east. The prototype analysis included the following:

- *A hydrologic analysis using the HEC-1 computer model assuming upstream buildout conditions to estimate 10, 50 and 100-year peak discharges at several key locations.*

- *Determination of existing storm drain trunk line capacities and formulation of drainage "trunk" infrastructure required to bring the prototype watershed up to the existing City Standard (10-year storm).*

- *Estimated costs for implementation of the recommended storm drainage capital improvements.*

- *Rough approximation of the cost to upgrade the proposed system to a 100-year storm design level.*

- *Estimation of the cost per residential unit and commercial/industrial acre to fund the proposed improvements required to achieve City Standard (10-year) and to achieve a 100-year design level.*

- *Presentation to the City Council.*

The results of the prototype watershed analysis were presented to the City Council on June 4, 2001 along with a request for City Council direction regarding the "storm return period level of service (10-year or 100-year)" to apply to the preparation of the overall SDMP. The City Council directed the City Engineer to use the 10-year storm return period (existing City Standard) as the standard to size the proposed storm drain system for the overall SUDP area. In providing their direction, the City Council considered information presented to them pertaining to existing system capacities within the prototype watersheds, magnitude of prior storm events that produced documented flooding in the area, standards applied by other Northern California communities, and project implementation costs.

EXISTING DRAINAGE FACILITIES

The City of Merced has constructed a number of drainage facilities within the SUDP area to serve urban development and to provide a drainage network that ultimately drains to a suitable outfall. Existing drainage facilities in the study area generally consist of underground storm drain systems, detention ponds, underground storage pipes, pump stations and open channels.

The City has three major storm drain outfall systems that serve the area south of Bear Creek; the West Avenue storm drain trunk line which flows into Hartley Slough, the Auto Center Drive storm drain system that discharges into Bear Creek and the G Street storm drain which flows southward from Bear Creek into the Zentner Lateral (MID Canal) near Cone Avenue. There are numerous smaller storm drain systems serving smaller developed areas within local sub-basins that drain into Bear Creek, Black Rascal Creek, Fahrens Creek, Parkinson Creek and Cottonwood Creek.

Most of the existing storm drain systems do not have the capacity to convey the 10-year discharges that contribute to them. The storm drain systems within the downtown area (south of Bear Creek) have an average capacity roughly between the 2-year and 5-year storms and the remaining existing storm drain systems have an average capacity generally ranging between the 5-year and 10-year storms.

The City of Merced also operates and maintains several detention ponds, underground storage pipes and pump stations.

Exhibit A shows the location of existing storm drainage facilities, and Tables 5 and 6 show the capacities of existing stormwater storage facilities (detention/retention basins) and pump stations, respectively.

HYDROLOGY

Watershed Descriptions

The SDMP covers the City's Specific Urban Development Plan (SUDP) area that is generally bounded by Nevada Road on the north; Hillcrest Road, Golf Road, Gardner Avenue, McKee Road and California Drive on the east; Vassar Avenue and Mission Avenue on the south; and Thornton Road and Branam Road (west of Highway 59) on the west. The study area is approximately 31 square miles in area and includes a combination of residential, commercial, industrial, institutional, and recreational development and undeveloped agricultural land. Under existing conditions, approximately 50 percent of the study area remains undeveloped. Based on the General Plan, the remaining undeveloped areas are primarily planned for future residential and commercial/industrial uses. This SDMP has been prepared under the assumption that buildout conditions exist for the overall SUDP area.

Based on initial watershed delineations and categorizing areas having a common existing or proposed drainage outfall, the study area has been subdivided into eleven (11) primary local watersheds, Watersheds A though K. Each watershed has been further subdivided into sub-basins. In the hydrologic analysis, there are a total of 142 sub-basins ranging in size from nine (9) acres to 1,184 acres. Exhibit A depicts watersheds and sub-basin boundaries. The following is a brief description of each watershed under existing conditions:

Watershed A

Watershed A is located in the north portion of the study area and contributes runoff into Fahrens Creek. This watershed is approximately 6.3 square miles in area and mainly consists of agricultural land, with a limited number of residential structures associated with agricultural activities. No major storm drain system exists in this watershed except in the small residential area west of M Street and north of Yosemite Avenue.

Watershed B

Watershed B is approximately 2 square miles in area and drains into Cottonwood Creek. This watershed is bounded by Bellevue Road on the north, Sells Lateral Canal on the east, Yosemite Avenue on the south and G Street on the west. Watershed B also consists primarily of agricultural land uses, with some single family residential subdivisions south of Cottonwood Creek. Only the residential area is served by existing storm drainage systems, which include storm drains, underground storage detention pipes and pump stations.

Watershed C

Watershed C is a large watershed that drains into Black Rascal Creek at several locations. The total area of this watershed is approximately 7 square miles. The eastern portion of the watershed (about one-half) is currently developed and consists primarily of residential and commercial land uses. The western and northwestern portion consists of mostly agricultural land use. There is a network of storm drain systems serving the existing residential areas. The existing storm drainage systems include storm drain pipes, underground and surface detention facilities and pump stations.

Watershed D

Watershed D includes the areas that drain into Bear Creek from McKee Road on the east to Highway 99 on the west. This watershed is approximately 3.6 square miles and consists of a mix of residential, commercial and industrial land uses. A network of storm drain systems exist in this watershed and discharge into Bear Creek at various locations. The southwest portion of this watershed is located within the downtown area west of O Street and north of Highway 99. Within the downtown portion of this watershed, a larger storm drain system originates near 22nd Street and S Street and delivers flow to an existing detention basin at the west end of Auto Center Drive where it is discharged into Bear Creek via a pump station.

Watershed E

Watershed E is approximately 2.4 square miles and ultimately drains into the West Avenue storm drain system near the Merced Airport. The watershed is primarily developed with residential land uses, with a degree of commercial and industrial land uses near and north of Highway 99. Runoff from this watershed originates south of Bear Creek near 27th Street and Canal Street and flows into a storm drain trunk line that extends south along O Street to Childs Avenue, then west along Childs Avenue to West Avenue. The West Avenue storm drain system serves as an outfall for nearly one half of the City's existing storm drainage system. At the south end of West Avenue, south of Flamingo Avenue, an 84 inch storm drain discharges to an open channel (lower channel) owned and operated by the City of Merced. The channel continues south into the Merced Airport and passes beneath the approach to the runway via two 84 inch inverted siphon pipelines that drain into another open channel that eventually discharges into Hartley Slough to the south. The West Avenue storm drainage system also carries the Merced Irrigation District (MID) flows during the irrigation season (April 31 to October 31). A pump station at Riggs Avenue lifts irrigation water into the adjacent MID Canal (upper channel) during this period. During the non-irrigation season, stormwater in the storm drain system flows into the lower channel owned and operated by the City of Merced.

Watershed F

Watershed F drains into the Zentner Lateral (MID Canal). The upper portion of the watershed is bounded by Santa Fe Avenue on the north and east, G Street on the west and Yosemite Parkway on the south. The lower portion of the watershed is bounded by Highway 99 on the north, West Avenue on the west, Tyler Road on the east and Mission Avenue/Dickenson Ferry Road on the south. The area of this watershed is approximately 3 square miles. The upper watershed consists primarily of residential land uses and commercial land uses. The existing storm drain system within this area drains to the G Street storm drain which discharges into the Zentner Lateral near Cone Avenue south of Childs Avenue. The lower portion of the watershed is approximately 80 percent agricultural land use and 20 residential land use. There is no major storm drain system currently serving the lower portion of this watershed. Runoff generated in this area flows directly into the Zentner Lateral which discharges into Hartley Slough near the intersection of Dickenson Ferry Road and the south extension of West Avenue.

Watershed G

Watershed G is located in the southeast portion of the study area. This watershed is approximately 3 square miles in area and is bounded by Yosemite Parkway (Highway 140) on the north, Tyler Road on the west, Coffee Street on the east and Mission Avenue on the south. Runoff from this watershed drains into the Hartley Lateral (MID Canal) which discharges into Miles Creek near Tyler Road and Vassar Avenue. Highway 99 bisects this watershed from northwest to southeast. The northeast portion is mainly residential and commercial with some agricultural land use. The area south and west of Highway 99 is mostly agricultural land. There is a pump station near Parsons Street and Childs Avenue which pumps flow from a storm drain system within an existing subdivision into the Hartley Lateral. The remainder of the watershed does not contain any major storm drain systems. Runoff from this area flows into the Hartley Lateral by surface flow.

Watershed H

Watershed H is located in the extreme southeast corner of the study area. The land use in this watershed is mainly consists of agricultural land with some scattered residential units (farm houses). Runoff generated within this watershed flows into the Doane Lateral (MID Canal) which discharges into Miles Creek south Vassar Avenue and Highway 99. The total area of this watershed is approximately 2.7 square miles. There is no storm drain system serving this watershed.

Watershed I

Watershed I is approximately 166 acres in area (0.26 square miles) and is bordered by Gerard Avenue on the north, Coffee Street on the east, Mission Avenue on the south and Highway 99 on the west. Runoff from this watershed flows into the Farmdale Lateral

(MID Canal) near Mission Avenue and Alfarata Boulevard. Approximately 40 percent of this watershed is developed and consists of residential and commercial land use.

Watershed J

Watershed J is located west of Highway 99 between Mission Avenue and Vassar Avenue. It covers an area of approximately 170 acres (0.27 square mile). Runoff from this watershed flows into Miles Creek south of Vassar Avenue. Land use within this area is approximately 70 percent agricultural and 30 percent industrial. This watershed does not have any significant existing storm drain facilities.

Watershed K

Watershed K is located in the southwest portion of the study area just north of the Merced Airport. The watershed area is approximately 500 acres in area (0.78 square miles) and drains into the El Capitan Canal along Thornton Road. Land use within this watershed consists of residential, agricultural and industrial. The east and west portions of the watershed are served by an existing storm drain system that drains into a small local detention basin. The detention basin is equipped with a pump station that discharges flow into the El Capitan Canal. The rest of the area drains by surface flow into the canal.

Watershed Modeling

The U.S. Army Corps of Engineers' (COE) HEC-1 computer program was used to develop a rainfall/runoff computer simulation for the study area. The computer model develops a runoff hydrograph for individual sub-basins through the input of numerical representations of their physical and hydrological characteristics. The computed hydrographs are then routed and/or combined with hydrographs from other sub-basins to yield a dynamic numerical analysis of peak discharges that may be expected to occur at a number of key concentration points along a given flow path. The HEC-1 model was used to estimate flow discharges that would be expected at key locations within the study area during the 10-, 50- and 100-year storm events.

The input parameters utilized for sub-basins in the HEC-1 analysis are presented on Table 1 and are described in the following paragraphs:

Sub-basin Delineation

The boundaries for each sub-basin were determined based on field investigations, U.S. Geological Survey 7.5 minute quadrangle maps, a current aerial photograph at approximate scale of 1"=1000' covering the SUDP, maps contained in the 1956 Storm Drain Plan (revised Jan. 12, 1960), City of Merced Sewer and Storm Drain Plats, and the 1983 Merced County Critical Area Flooding and Drainage Plan. The location of existing

roadways, irrigation canals, storm drains, drainage channels and railroads were incorporated into the establishment of some sub-basins boundaries.

Watershed Soil Type

Watershed soil groups were determined using soil maps contained in a report entitled "Soil Survey of Merced Area, California", revised March 1991, prepared by the Natural Resources Conservation Service (NRCS).

Rainfall Loss

Rainfall loss is that portion of the precipitation depth that is lost due to evaporation, interception by vegetation, infiltration into soil, and surface depression storage. Rainfall excess is that portion of the precipitation depth that appears as surface or collected storm runoff during and after a storm event. Rainfall losses in this study were determined using the NRCS Curve Number (CN) Method that uses a soil cover complex for estimating watershed losses. The CN is related to the underlying hydrologic soil group (A, B, C, or D), land use, cover density, and antecedent soil moisture conditions. The four hydrologic soil groups are classified as follows:

Group A: *Low runoff potential* soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well-drained sands or gravels. These soils have a high rate of water transmission.

Group B: Soils having *moderate infiltration* rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well-drained sandy-loam with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C: Soils having a *low infiltration* rate when thoroughly wetted and consisting chiefly of silt-loam soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.

Group D: *High runoff potential* soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have slow rate of water transmission.

Land Use

Land uses and percent impervious cover values used in this study are based on Table A-2 of City of Merced Design Standards. The percent impervious area for each sub-basin was estimated by direct measurements of land use from the General Plan and represents an important input parameter in the HEC-1 computer model. The computer model relates the amount of impervious area to the total area of a given sub-basin to estimate the amount of runoff losses attributed to pervious areas.

Rainfall

The 24-hour rainfall depth of 2.06 inches for the 10-year storm and 2.74 inches for 50-year storm events utilized in the hydrologic model were taken from the City Design Standards which are based on California Department of Water Resources (DWR) statistics for the Merced area rain gage data from 1940 to 1974. The 100-year, 24-hour rainfall depth of 2.88 inches as contained in the "*City of Merced Airport, Storm Drainage Master Plan*" was used in this analysis. The rainfall data in said report is based on rain gage data from 1940 to 1998 for the same station.

Unit Hydrograph

For runoff computations from each sub-basin, the NRCS Dimensionless Unit Hydrograph option was utilized in the HEC-1 computer model.

Lag Time

Input data for NRCS dimensionless Unit Hydrograph includes the parameter, TLAG, which is equal to the lag (in hours) between the center of mass of rainfall excess and the peak of the unit hydrograph. Lag time was estimated utilizing the NRCS method of computing the watershed lag value from the time of concentration. The equation is as follows:

$$TLAG = 0.6\ tc$$

tc = time of concentration

The time required for storm water to flow in the form of runoff from the most hydraulically remote point in the drainage area to a collection point is called the time of concentration. Time of concentration is the sum of the minimum overland travel time (initial time of concentration) and the gutter flow time. The minimum overland travel time was taken from Table A-2 (City Design Standards) based on land use, and the gutter flow time was calculated by dividing the maximum length of travel in the gutter by the velocity of gutter flow. Due to extremely flat slopes in the study area, a one (1) foot per second average velocity was used for gutter flow.

Routing

Routing of runoff between sub-basins was performed utilizing the Muskingum–Cunge method for open channel flow and the Kinematic Wave method for routing flow through storm drains. The Modified Puls Reservoir Routing method was used to route flow through detention basins.

Results

The results of the HEC-1 analysis are summarized on Table 2, which contains the 10-year peak discharges calculated for individual sub-basins within the study area. The results of this study were compared with the 10-year discharges computed by the Merced Airport Storm Drainage Master Plan and the Merced County Critical Area Flooding and Drainage Plan. The peak discharges were compared in terms of cubic feet per second (cfs) per acre. The discharges estimated by HEC-1 for this study are reasonable and compare favorably with the discharges computed by the other two studies. HEC-1 input/output for the 10-, 50-, and 100-year storm events is included in the Appendix.

STORM DRAINAGE INFRASTRUCTURE PLAN

The storm drainage infrastructure plan presented in this SDMP has been formulated to serve the City of Merced Specific Urban Development Plan (SUDP) area. The proposed facilities consist of an integrated system of pipe and channel conveyance systems and detention facilities designed to attenuate (or reduce) peak flow rates generated from the SUDP area. This SDMP only addresses the requirements for the major trunk line (backbone) infrastructure system necessary to provide storm drainage conveyance and control and does not address individual local systems associated with individual developments. All storm drainage "conveyance" facilities specifically presented herein have been sized to accommodate a 10-year storm event. Proposed detention basins are sized for 50-year storm inflow (developed) with an outflow limited to a peak rate equivalent to a 2-year storm discharge that would occur under existing conditions. These parameters conform with existing City Design Standards. Storm drainage infrastructure elements incorporated into the SDMP are depicted on Exhibit B and include the following:

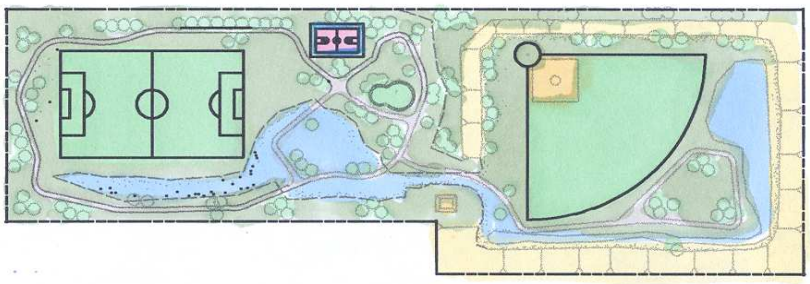
- ***Excavated Open Channels***
- ***Storm Drains***
- ***Stormwater Detention Facilities***
- ***Pump Stations***

The following is a brief description of the drainage infrastructure components proposed to accommodate stormwater runoff anticipated to occur under General Plan buildout conditions. Assumptions associated with these elements have been incorporated into the HEC-1 hydrologic model for the master plan condition provided in the Appendix..

Excavated Open Channels – 60-foot right-of-way (R/W) channels are proposed to convey runoff through areas where the estimated peak flow rates from a watershed exceed the capacity of a 66" storm drain in areas that are not currently developed. Open channels are proposed in Watershed A and Watershed H in the northwest and southeast portions of the study area, respectively. Open channels of lesser width can also be utilized as an option instead of large diameter pipes in areas where adequate ground cover does not exist for large size pipes. In conformance with General Plan policies, these open channels should include landscaping and bike paths to provide linear recreation opportunities. A minimum of one (1) foot of freeboard shall be maintained above the design 10-year water surface elevation to the top of banks. One side of the channel shall provide for all weather maintenance access unless the channel is adjacent to a public road. Exhibit C shows a typical cross-section of a typical open channel.

Storm Drains – Underground storm drain pipelines are proposed to be utilized to serve the majority of new development areas and as upgrades to many existing conveyance facilities in existing development areas. The proposed storm drain pipeline conveyance system depicted on Exhibit B consists of the major trunk line (backbone) system and is intended to provide master plan level guidance for future storm drain pipeline design. In areas where cover problems exist, multi-sized smaller diameter pipes or equivalent capacity alternatives can be used in place of the pipe sizes represented in this SDMP. In several locations in the downtown area (south of Bear Creek), where the existing storm drain pipes do not have the capacity to convey the design flows, the option of adding additional storm drains to work in conjunction with existing storm drains is proposed. Storm drain trunk lines are sized to convey the 10-year discharges operating under uniform flow conditions. All proposed storm drain lines are to be located in public streets in the existing developed areas. Exhibit B shows the location and sizes of the proposed storm drain trunk lines.

Stormwater Detention Facilities – Large excavated sites (detention basins) are proposed to be used for the purpose of storing runoff in a manner that significantly reduces peak flows that would otherwise overtax to the available downstream outfall system. Due to capacity limitations associated with the downstream outfall systems, there are 22 detention basins proposed in this SDMP. All of the detention basins are considered to have non–interruptible outlet facilities and have been sized for inflow from a 50-year 24-hour storm (developed condition) with outflow limited to a peak rate generated by a 2-year storm occurring under the existing level of development within the contributing watershed. Due to the close proximity of groundwater to the surface, detention basins have been conceptually designed with a maximum depth of five (5) feet below the existing ground surface, including one (1) foot of freeboard from the 50-year water surface elevation to the top of the basin. This constraint caused the proposed detention basins to have relatively large surface areas and shallow depths. At the time of actual design of the detention basins, the depth and surface area of the detention basins may be adjusted if the actual local groundwater depth is greater than seven (7) feet. Spillways should be provided above the 50-year water surface elevation to control overflow and provide for emergency releases. All proposed detention basins should have vehicular access to the lower areas to facilitate maintenance.



Schematic Joint-Use Detention Basin

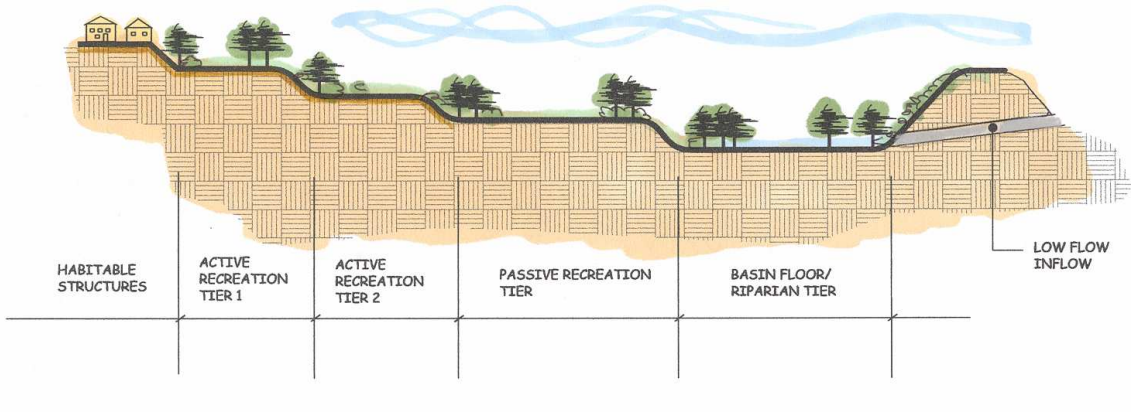
As a part of the actual design of stormwater detention basins recommended in this SDMP, consideration shall be given to the physical and economic feasibility of creating joint-use opportunities for active and passive recreation within these facilities. Active and passive recreation elements, where feasible, shall be appropriately sited in consideration of flood risk and shall be elevated above low flow

areas, ponding areas and other frequently inundated areas. If site conditions, recreation needs and funding create a favorable opportunity for the inclusion of active or passive recreation elements as a joint use within a given stormwater detention facility, the following fundamental design approaches should be utilized:

1. Low flow must be accommodated in a manner that confines the frequent inundation zones to areas that will characteristically require only limited maintenance.

2. Contouring within detention facilities is recommended to create internal elevation variations (or tiers) that have differing frequencies and depths of inundation and flood risk. The following use hierarchy may be utilized as a starting point in evaluating design opportunities:

   - Lowest lying areas - semi-natural riparian areas, ponds, cleared zones.
   - Lower elevated tiers - picnic areas, passive turf, and vegetation zones.
   - Intermediate elevated tiers - ball fields, soccer fields.
   - Upper elevated tiers - court games, parking areas.
   - Areas elevated above 100-year flood level - restrooms, habitable structures.



Schematic Cross Section Depicting Tiers Within a Joint-Use Detention Basin

3. Internal drainage within detention facilities should provide for positive flow across elevated tiers and to the basin's lowest lying areas to prevent the nuisance of residual standing water within active and passive recreation areas.

4. Hydraulic design components should be included as needed: inlet and outlet structures, spillways, sediment basins, etc.

5. Basin slopes should be flat enough to allow for mowing of turf areas and other routine recreation-related maintenance activities.

Exhibit B shows the locations and Table 3 contains summary data for proposed detention basins.

Pump Stations – Pumps are used to assist in the draining of stormwater detention basins in locations where gravity controlled structures are not feasible as the sole outflow mechanism. Given the flatness of topography in the study area, detention basins in this SDMP are assumed to be drained by pump stations to a downstream conveyance system. The pump stations have been conceptually sized to pump the 2-year discharges generated under existing land use assumptions. Detention basin pumping facilities are assumed to consist of a low flow pump, a high flow pump and a backup (redundant) pump. Table 4 shows the input data for the proposed pump stations.

EXISTING OUTFALL FACILITIES

The existing outfall facilities (outfall conveyance systems) within the study area consist of natural channels and various Merced Irrigation District (MID) Canals and Laterals. Runoff from existing developed and undeveloped areas within the City's SUDP area currently enters these natural channels and MID Canals. Given that there are currently limitations in downstream system capacities, it is recommended that the peak rates of runoff currently expected should be retained after the proposed storm drain system is in place. This peak rate of runoff is assumed to be the 2-year discharge occurring based on existing levels of development. Under this SDMP, the discharge from proposed developed areas to these outfall facilities has been limited to the 2-year existing condition peak rate of runoff, which will prevent flow in the downstream conveyance system from increasing significantly.

The following natural streams and MID Canals are within or adjacent to the study area and are currently being used as outfall facilities for stormwater runoff generated within the SUDP area:

- *Fahrens Creek*
- *Cottonwood Creek*
- *Black Rascal Creek*
- *Bear Creek*
- *Hartley Slough*
- *MID El Capitan Canal*
- *MID Zentner Lateral*
- *MID Hartley Lateral*
- *MID Doane Lateral*
- *MID Farmdale Lateral*

Fahrens Creek, Cottonwood Creek, Black Rascal Creek and Bear Creek are natural streams and serve as stormwater outfalls for City runoff in addition to their natural function as a drainage channels for flows generated within the hillsides and agricultural areas to the north and northeast of Merced. Fahrens Creek, Cottonwood Creek and Black Rascal Creek are tributaries of Bear Creek and pass through the north side of the SUDP area. Approximately 75 percent (75%) of the study area drains into these streams. Hartley Slough collects City runoff that discharges into it at a location south of the intersection of West Avenue and Dickenson Ferry Road and serves as a stormwater outfall for areas south of the downtown area as well as a discharge point for some MID Canals and Laterals. The flow carrying capacity of these natural streams range approximately between a 2-year and a 10-year storm event (Ref.1).

The MID Canals and Laterals that collect City runoff are located within the south and southeast portions of the study area generally south of Highway 140 and Childs Avenue. The primary function of these canals and laterals is to deliver irrigation water from Lake Yosemite to downstream agricultural users. They generally convey irrigation water from

the end of April to the end of October. The canals and laterals are also used as stormwater outfalls for City runoff as they traverse the entire study area. Most of the stormwater runoff from area east of G Street and south of Santa Fe Avenue and Highway 140 currently drains into MID Canals and Laterals. The flow carrying capacity of these canals ranges from approximately 20 to 80 cfs (Ref.1).

COST ESTIMATES

Construction cost estimates for primary drainage systems have been prepared for each of the eleven (11) watersheds represented in this SDMP. Table 7, Sheets 1 through 11 are cost estimates for storm drainage infrastructure recommended for each watershed. The recommended drainage systems consist of major storm drain trunk line and open channel conveyance facilities and detention basins to limit flow discharges into the downstream conveyance systems (outfalls). No improvements to the downstream conveyance systems are recommended except for the City's existing storm drain channel in Watershed E (West Avenue) and the upgrade of an existing pump station in Watershed D (Auto Center Drive detention basin).

The cost estimates contained in Table 7, Sheets 1 through 11 are based on estimated quantities and assumed unit costs for construction elements and land acquisition. These unit costs are generalized estimates and are considered to be reasonable for planning purposes. Generalized cost estimating data for pump stations of varying capacities is shown in Table 4. A contingency factor of 15% is added to the basic costs as well as an additional 25% factor to account for design and planning, construction management and program implementation.

PHASING AND PRIORITIES

Based upon economics and funding availability, it would be difficult to financially sustain the construction of the proposed storm drainage facilities all at one time. An appropriate approach is to prioritize improvements and proceed with construction of selected storm drainage improvements as funding becomes available and/or as new development occurs. Priority should be given to improving storm drainage systems in areas that have historically experienced flooding difficulties and on improving or providing storm drainage outfall systems. The next priority would be to provide storm drain improvements within the downtown area (Watersheds D & E) and along G Street and its downstream elements. Since most of the storm drainage facilities proposed in this SDMP are located in the areas which are not currently developed, the third priority will depend upon the location and magnitude of growth and future development within the SUDP area. When development is proposed to occur in any watershed shown on Exhibit B, the storm drainage facilities in the development should be designed to meet the proposed storm drainage system requirements represented in this SDMP.

Under the first phase of priorities, there are eight (8) areas that should be considered for storm drainage upgrades based on information provided by the City regarding existing flooding conditions or potential future flooding. The eight (8) areas have been identified as follows:

1- West Avenue Outfall
2- Martin Luther King Way/Childs Avenue
3- McSwain Road (Highway 140)/ Sydney Drive
4- Stonybrook Avenue
5- Carol Avenue/Childs Avenue
6- M Street/21st Street
7- Paseo Verde Drive/Black Rascal Creek
8- Auto Center Drive/Bear Creek

West Avenue Outfall: This phase of the storm drainage improvements is focused around the south end of West Avenue where a single 84" storm drain pipe discharges into the City's storm drain channel. The City's storm drain channel commences at Flamingo Avenue (Riggs Road) near the south end of West Avenue and continues south and ultimately discharges into Hartley Slough south of Dickenson Ferry Road. The channel and accompanying downstream facilities between Flamingo Avenue and Hartley Slough are severally undersized to carry the 10-year discharge (400 cfs) generated within Watershed E. The channel transitions to two 84 inch inverted siphons under the approach to the airport runway, then becomes a channel again that drains to a single 8'x 4' box culvert at Dickenson Ferry Road before discharging into Hartley Slough. The existing channel capacity is approximately between 200 and 300 cfs depending on location. Vegetation growth in the existing channel should be periodically mitigated as historical flows have on occasion escaped the channel banks. Due to capacity limitations in the downstream system, the upstream storm drain system can back up and cause overflow

along the areas of West Avenue and Childs Avenue. These conditions can be alleviated by the implementation of the following improvements:

- *Widening the City's storm drain channel to improve capacity.*
- *Replacing the 84" siphons under the airport runway with two 8'x 4' box culverts.*
- *Adding a 6'x 4'cell to the existing box culvert at Dickenson Ferry Road.*
- *Constructing a stormwater detention basin (Detention Basin 8) with a pump station at the southwest corner of Dickenson Ferry Road and West Avenue.*
- *Replacing the 1-42"corrugated metal pipe (CMP) at the Hartley Slough crossing of Hartley Road and the west extension of Vassar Avenue with two 60" RCPs.*

These proposed improvements will enhance the capacity of the West Avenue storm drain system by lowering the hydraulic grade line in the upstream storm drain pipes.

Martin Luther King Way/Childs Avenue: The City staff has indicated that the intersection of Martin Luther King Way (MLK Way) and Childs Avenue requires storm drainage capacity upgrades. The drainage sub-basin contributing runoff to this intersection is 97 acres and bounded by 13th Street on the north, MLK Way on the west, G Street on the east and Childs Avenue on the south. The area generates approximately 35 cfs during the 10-year storm event. There is no storm drain system along MLK Way except several disconnected catch basins, which provide temporary storage for minor flows. Stormwater runoff concentrating at the intersection of MLK Way and Childs Avenue is conveyed by a 24"storm drain pipe (capacity = 7 cfs) under Childs Avenue to a pump station located in the southeast corner of the intersection. The pump station discharges into the MID Canal along the south side of Childs Avenue. Since MLK Way is also a state highway (Highway 59), the pump station is owned and operated by the California Department of Transportation (CalTrans). According to the City's maintenance staff, the pump station has the capacity of approximately 1,500 gallons per minute (gpm), which is roughly equal to 3.3 cfs. The 24"storm drain under Childs Avenue and the pump station have a capacity that is less than the 2-year discharge (18 cfs). Hence, runoff ponds in MLK Way north of the intersection and in Childs Avenue east of the intersection during many smaller storm events.

In order to reduce the frequency of runoff collecting and ponding in this area, it is recommended that a detention basin be constructed at the northeast corner of MLK Way and Childs Avenue. A new 36" storm drain in MLK Way starting at 13th Street and changing to a 42" at 7th Street will deliver flow into the detention basin. A pump station is proposed to discharge approximately 4 cfs from the detention basin into a proposed 24" outlet pipe that will run south along Highway 59 and discharge into Zentner Lateral (MID Canal) along Gerard Avenue. The proposed storm drainage system for this area is shown on Exhibit B.

McSwain Road (Highway 140)/Sydney Drive: This area consists of single family residential development and is located north of Highway 140 and east of Massasso Street. A storm drain system and a pump station that discharges stormwater runoff to the north into Bear Creek serve the existing development. A portion of the storm drain from Demoss Avenue downstream is a 72"pipe that serves as an under ground stormwater storage facility. The storage volume is approximately 2.2 acre-feet (AF) while the 10-year and 50-year runoff volumes are 3 and 5 acre-feet, respectively. The total capacity of the pump station is 3.6 cfs, and the 10-year discharge from the sub-basin is approximately 10 cfs. It is recommended that the pump station be upgraded to increase the capacity to discharge the runoff generated during the 10-year storm event.

Stonybrook Avenue: This area is located along the west bank of Bear Creek, south of Atchison Topeka and Santa Fe Railroad and east of Highway 59. The area consists of single and multi family residential and a mobile home park. Runoff in the area is collected by a storm drain system and pumped into Bear Creek. A detention basin with storage capacity of approximately 2.2 AF is located north of Willowbrook Drive and west of Stonybrook Avenue. The runoff volumes for the 10-year and 50-year storms are 5 and 7 AF, respectively. The capacity of the pump station is approximately 11 cfs while the 10-year peak discharge is 14 cfs. The comparison of the capacity of existing detention basin and the pump station with the volume and peak discharge from the 10-year storm indicates that the existing facilities do not have the capacity to handle the incoming flow generated within the area. Therefore, it is imminent that flooding will occur in this area during any storm exceeding the 5-year event. It is recommended that the capacity of the existing detention basin and pump station be upgraded to at least the 10-year storm event.

Carol Avenue/Childs Avenue: This area receives runoff from a 50 acre sub-basin bordered by Merced Avenue on the north, Parsons Street on the east, Childs Avenue on the south and Highway 99 on the west. The 10-year discharge at this location is estimated to be 16 cfs. There is an 18" storm drain at the intersection of Carol Avenue and Childs Avenue, which discharges into Hartley Lateral. The 18" storm drain has a capacity of about 3.5 cfs when flowing full (with an assumed slope of 0.1%). Under pressure flow conditions the capacity would be slightly more. The SDMP proposes a 30" storm drain in Carol Avenue starting at a location approximately 600 feet south of Merced Avenue and discharging into Hartley Lateral.

M Street/21st Street: The intersection of M Street and 21st Street is located within the downtown area just east of the Courthouse Square. There is a 54" storm drain (2 blocks west of the intersection) that runs along O Street from 23rd Street to Childs Avenue. A 24" storm drain along 23rd Street and an 18" storm drain along 19th Street connect to the 54" storm drain system. At the intersection of M Street and 21st Street there is a 30" storm drain in M Street between 21st Street and 20th Street which is not connected to any downstream system. Runoff intercepted by this 30" storm drain does not have an outlet, and stormwater accumulates in the pipe and rises to an elevation above the drain inlets and causes flooding of the intersection. The SDMP proposes a 30" storm drain along 21st Street starting at MLK Way and continuing west along 21st Street to M Street, then turning south along M Street to 20th Street. At 20th Street the proposed storm drain

increases to a 36"pipe and connects with the 54" storm drain at O Street. This storm drain will intercept the 10-year runoff generated by area west of G Street between 22nd and 20th Streets.

Paseo Verde Drive/Black Rascal Creek: The drainage area contributing runoff to this vicinity is located west of R Street between the confluence of Fahrens Creek and Black Rascal Creek. The contributing area in the SDMP is designated as sub-basin BRC22 and covers approximately 105 acres, consisting of mainly single family residential. A network of existing storm drains that flow from north to south serves the area and discharges via a pump station into Black Rascal Creek downstream of the R Street bridge. The capacity of the existing pump station is approximately 20 cfs, and the estimated 10-year runoff generated by the contributing area is 25 cfs. No stormwater storage facility exists within this sub-basin. Two other short reaches of storm drain are located in R Street. An 18" storm drain originates at the intersection of R Street and Loughborough Drive and runs north along R Street, discharging into Black Rascal Creek. The second reach (24") starts just south of Buena Vista Drive and runs south along R Street and flows into Black Rascal Creek. These storm drain systems discharge into the reach of Black Rascal Creek which is located just upstream of the confluence with Fahrens Creek. Backwater created by the confluence of these two creeks may cause the storm drain systems to back up causing local flooding. In order to evaluate flooding in this area further, a more detailed site specific analysis may be required to examine the existing storm drain systems and to determine the cause of flooding.

Auto Center Drive/Bear Creek: Auto Center Drive is located in the downstream portion of the large portion of Watershed D south of Bear Creek and receives runoff from western one half portion of the downtown area. The contributing area is approximately 465 acres and is bounded by Bear Creek on the north and west, O Street on the east and Highway 99 on the south. The 10-year runoff generated by this area is estimated to be approximately 157 cfs. There is a storm drain system that starts at 22nd Street and S Street and continues south along T Street turning west along 16th Street and Auto Center Drive and discharging via a pump station into Bear Creek. The existing storm drain sizes range from 20" at the upstream portion to a maximum of 42" at the western end of Auto Center Drive near the outlet. A pump station is used to discharge flow into Bear Creek. A small (approximately one-acre) overflow detention basin is located to the west of the pump station between the south bank of Bear Creek and Highway 99. The capacity of the pump station is approximately 20 cfs, and the 2-year discharge is estimated to approximately 100 cfs. During a major storm event, the amount of runoff generated by the drainage area greatly exceeds the capacity of the existing detention basin and pump station and causes the stormwater in the storm drain system to back up and flood the streets and surrounding areas. The SDMP proposes to upgrade the storm drain system and the pump station to convey and discharge the 10-year runoff generated by the watershed. Exhibit B shows the proposed storm drain system.

MITIGATION OF STORMWATER QUALITY

Stormwater quality programs have been mandated by Phase I of the U S Environmental Protection Agency (EPA) program as a part of the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act (CWA) to regulate municipal and industrial discharges to surface waters of the U S. Phase I of the NPDES Program only impacted industrial sites, construction sites and municipal separate stormwater conveyance systems for communities having a population in excess of 100,000 people. However, on December 8, 1999 the EPA issued rules regarding the forthcoming implementation of Phase II of the NPDES regulations. Phase II of the program will include more than 5,000 U.S. local governments previously not regulated by federal stormwater rules, and these governments will be required to submit NPDES-permitted stormwater management plans by March 2003. Stormwater Phase II regulations will require cities, counties, regional authorities and other units of local government with municipal separate storm sewer systems located in urbanized areas to design, finance, and implement a comprehensive stormwater quality management program. Urbanized areas are defined by the U. S. Census Bureau to contain a cumulative population of 50,000 or more and a minimum average population density of 1,000 people per square mile. Per the General Plan, the City's population is in excess of 60,000 people, and thus, Merced would fall under these Phase II regulations.

The Phase II program requires that the stormwater management plan (SWMP) include a set of six minimum control measures. The six minimum measures are:

- Public education and outreach on storm water impacts
- Public participation/involvement in the SWMP
- Illicit discharge detection and elimination
- Construction site stormwater runoff control for sites one acre or larger
- Post-construction stormwater management for new development and redevelopment
- Pollution prevention/good housekeeping for municipal operations

The SWMP must also identify and implement best management practices (BMPs) and measurable goals for each control measure. These BMPs and goals must be evaluated in annual reports submitted to the Regional Water Quality Control Board. The SWMP must be fully implemented by the end of the first permit term, anticipated to be a five year period.

REFERENCES

1- Nolte and Associates, "*Draft Merced County Critical Area Flooding and Drainage Plan"*, January 1983.

2- HDR Engineering, "*City of Merced Airport Storm Drainage, Drainage Master Plan"*, February 2000.

3- City of Merced, "Standard Designs of Common Engineering Structures".

4- City of Merced, " *Vision 2015- General Plan*", 1997.

5- Natural Resources Conservation Service (NRCS), "*Soil Survey Merced Area, California*", March 1991.

6- Federal Emergency Management Agency*, "Flood Insurance Study, Merced County California and Incorporated Areas",* August 1995.

7- Corps Of Engineers, Hydrologic Engineering Center, "*HEC-1 Flood Hydrograph Package"*, Davis, California, September 1990.

8- Federal Emergency Management Agency, "*Flood Insurance Study, Merced County, California, Unincorporated Areas*", Revised March 1991.

9- Environmental Protection Agency, *"40 CFR, Parts 9,122,123,and 124, National Pollutant Discharge Elimination Program – Regulations for Revision of the Water Pollution Control Program Addressing Storm Water Discharges",* December 1999.

Table 1

Hydrologic Parameters Used in HEC-1 Model

CITY OF MERCED
Storm Drain Master Plan
Hydrologic Parameters Used in HEC-1 Computer Model

Table 1

Watershed	Outfall	Sub-Basin	Drainage Area (Acres)	Drainage Area (Sq. Mile)	Curve Number	Percent Impervious	Lag Time (hr.)
A	Fahrens Creek (Watershed A)	FAHR 1	1184	1.85	80	51	1.73
A	(Sub-basins Draining into Fahrens Creek)	FAHR 2	898	1.4031	76	33	1.95
A		FAHR 3	712	1.1125	72	37	1.78
A		FAHR 4	595	0.9297	73	37	1.28
A		FAHR 5	133	0.2078	80	41	0.7
A		FAHR 6	207	0.3234	71	35	1.03
B	Cottonwood Creek (Watershed B)	COT 1	135	0.2109	75	30	0.84
B	(Sub-basins Draining into Cottonwood Creek)	COT 2	120.64	0.1885	79	31	0.74
B		COT 3	151.1	0.236	66	38	0.84
B		COT 4	846.6	1.3228	76	39	1.7
B		COT 5	266	0.4156	67	15	1.08
C	Black Rascal Creek (Watershed C)	BRC 1	152	0.2375	76	30	0.76
C	(Sub-Basins Draining into Black Rasca Creek)	BRC 2	53.1	0.083	70	30	0.45
C		BRC 3	94.52	0.1477	71	28	1.01
C		BRC 4	93.55	0.1462	70	29	0.78
C		BRC 5	57.51	0.0899	71	30	0.53
C		BRC 6	59.4	0.0928	73	32	0.62
C		BRC 7	59.97	0.0937	75	30	0.53
C		BRC 8	58.14	0.0908	76	30	0.74
C		BRC 9	96.99	0.1515	74	29	0.83
C		BRC 10	81.44	0.1273	64	30	0.62
C		BRC 11	90.11	0.1408	77	35	0.78
C		BRC 12	20.66	0.0323	72	39	0.47
C		BRC 13	51.31	0.0802	71	30	0.87
C		BRC 14	31.34	0.049	70	34	0.53
C		BRC 14B	49.36	0.0771	70	61	0.45
C		BRC 15	49.07	0.0767	79	41	0.66
C		BRC 16	43.9	0.0686	72	15	0.45
C		BRC 17	68.01	0.1063	68	58	0.48

CITY OF MERCED
Storm Drain Master Plan
Hydrologic Parameters Used in HEC-1 Computer Model

Table 1

Watershed	Outfall	Sub-Basin	Drainage Area (Acres)	Drainage Area (Sq. Mile)	Curve Number	Percent Impervious	Lag Time (hr.)
C		BRC 18	209.54	0.3274	77	32	0.81
C		BRC 19	44	0.0688	74	30	0.83
C		BRC 20	85	0.1328	74	31	0.49
C		BRC 21	116.79	0.1825	71	77	0.51
C		BRC 22	104.91	0.1639	77	31	0.59
C		BRC 23	212.75	0.3324	64	50	1.76
C		BRC 24	706	1.1031	80	51	1.48
C		BRC 25	380	0.5938	80	58	1.07
C		BRC 26	376	0.5875	79	50	1.23
C		BRC 27	621	0.9703	79	84	1.35
C		BRC 28	32.43	0.0507	63	84	0.39
C		BRC 29	188.13	0.294	72	85	1.02
C		BRC 30	142	0.2219	80	36	0.55
C		BRC 31	78	0.1219	78	32	0.62
D	Bear Creek (Watershed D)	BC 1	92	0.1438	67	30	0.67
D	(Sub-Basins Draining into Bear Creek)	BC 2	37.02	0.0578	77	31	0.45
D		BC 3	87.81	0.1372	68	31	0.78
D		BC 4	156	0.2438	74	30	0.78
D		BC 5	74.04	0.1157	70	32	0.65
D		BC 6	18.37	0.0287	61	30	0.43
D		BC 7	48.78	0.0762	64	23	0.69
D		BC 8	54.64	0.0854	62	26	0.67
D		BC 9	139.18	0.2175	65	32	0.83
D		BC 10	83.16	0.1299	61	38	0.58
D		BC 11	11.48	0.0179	80	30	0.41
D		BC 12	42.47	0.0664	73	31	0.53
D		BC 13	97.57	0.1525	72	32	0.99
D		BC 14	149.28	0.2333	63	60	0.7
D		BC 15	18.5	0.0289	61	30	0.48

CITY OF MERCED
Storm Drain Master Plan
Hydrologic Parameters Used in HEC-1 Computer Model

Table 1

Watershed	Outfall	Sub-Basin	Drainage Area (Acres)	Drainage Area (Sq. Mile)	Curve Number	Percent Impervious	Lag Time (hr.)
D		BC 16	37.5	0.0586	61	30	0.53
D		BC 17	30.42	0.0475	61	30	0.47
D		BC 18	173	0.2703	62	69	1.06
D		BC 19	54	0.0844	74	43	0.62
D		BC 20	52	0.0813	68	32	0.53
D		BC 21	32	0.05	64	45	0.41
D		BC 22	117.65	0.1838	74	85	0.5
D		BC 23	54.78	0.0856	61	31	0.53
D		BC 24	47.64	0.0744	61	28	0.57
D		BC 25	100	0.1563	61	37	0.78
D		BC 26	33.2	0.0519	61	42	0.49
D		BC 27	26.3	0.0411	61	63	0.44
D		BC 28	20.8	0.0325	61	81	0.33
D		BC 29	17.7	0.0277	61	80	0.39
D		BC 30	52.8	0.0825	61	85	0.39
D		BC 31	30.2	0.0472	72	85	0.34
D		BC 32	27.5	0.043	61	85	0.33
D		BC 33	58	0.0906	61	85	0.56
D		BC 34	29	0.0453	61	48	0.42
D		BC 35	60	0.0938	61	30	0.66
D		BC 36	157	0.2453	63	30	0.31
E	West Ave SD Outfall (Watershed E)	WA 1	41	0.0641	61	27	0.62
E	(Sub-Basins Draining into West Ave Storm Drain)	WA 2	54.5	0.0852	61	53	0.62
E		WA 3	808	0.0138	61	30	0.41
E		WA 4	140	0.2188	72	76	0.75
E		WA 5	78.5	0.1227	67	46	0.68
E		WA 6	105.6	0.165	78	38	0.83
E		WA 7	122.2	0.1909	63	42	0.97
E		WA 8	61.5	0.0961	61	58	0.71

CITY OF MERCED
Storm Drain Master Plan
Hydrologic Parameters Used in HEC-1 Computer Model

Table 1

Watershed	Outfall	Sub-Basin	Drainage Area (Acres)	Drainage Area (Sq. Mile)	Curve Number	Percent Impervious	Lag Time (hr.)
E		WA 9	35.4	0.0553	67	57	0.84
E		WA 10	70.9	0.1108	71	56	0.87
E		WA 11	26.6	0.0416	77	73	0.58
E		WA 12	9	0.0141	61	83	0.27
E		WA 13	26.4	0.0413	79	76	0.77
E		WA 14	9	0.0141	61	82	0.27
E		WA 15	9.2	0.0144	80	80	0.25
E		WA 16	9	0.0141	65	80	0.27
E		WA 17	39.3	0.0614	72	81	0.43
E		WA 18	18.8	0.0294	80	80	0.31
E		WA 19	36.3	0.0567	80	79	0.47
E		WA 20	62.2	0.0972	80	82	0.6
E		WA 21	46	0.0718	80	65	0.55
E		WA 22	38	0.0594	74	25	0.91
E		WA 23	123.4	0.1928	72	53	0.84
E		WA 24	76.4	0.1909	61	40	0.63
E		WA 25	160.6	0.2509	78	34	1.04
E		WA 26	35.6	0.0556	80	41	0.58
E		WA 27	54	0.0844	78	50	0.6
E		WA 28	121	0.1891	68	30	1.02
E		WA 29	45.8	0.0715	63	35	0.45
F	Zentner Lateral (Watershed F)	ZEN 1	40.82	0.0638	80	47	0.66
F	(Sub-Basin Draining into Zentner Lateral)	ZEN 2	108.64	0.1698	80	42	0.83
F		ZEN 3	55.79	0.0872	75	31	0.53
F		ZEN 4	44.77	0.07	73	31	0.58
F		ZEN 5	90.11	0.1408	77	34	0.83
F		ZEN 6	40.58	0.0634	79	85	0.49
F		ZEN 7	49.07	0.0767	73	33	0.65
F		ZEN 8	76.91	0.1202	80	35	0.7

CITY OF MERCED
Storm Drain Master Plan
Hydrologic Parameters Used in HEC-1 Computer Model

Table 1

Watershed	Outfall	Sub-Basin	Drainage Area (Acres)	Drainage Area (Sq. Mile)	Curve Number	Percent Impervious	Lag Time (hr.)
F		ZEN 9	40.86	0.0639	80	56	0.63
F		ZEN 10	27.84	0.0434	80	80	0.39
F		ZEN 11	32.14	0.0502	80	72	0.45
F		ZEN 12	103.31	0.1613	80	30	0.93
F		ZEN 13	97	0.1516	78	30	0.93
F		ZEN 14	101	0.1578	76	30	0.85
F		ZEN 15	38	0.0594	80	27	0.61
F		ZEN 16	28.3	0.0442	80	75	0.29
F		ZEN 17	68.5	0.107	80	30	0.53
F		ZEN 18	118.2	0.1847	76	50	0.78
F		ZEN 19	253.3	0.3958	73	33	1.43
F		ZEN 20	164	0.2563	76	34	0.82
F		ZEN 21	158	0.2469	77	16	0.82
F		ZEN 22	59.4	0.0928	77	35	0.62
G	Hartley Lateral (Watershed G)	HRL 2	307	0.4797	78	37	0.78
G	(Sub-Basins Drianing into Hartley Lateral)	HRL 3	310	0.4844	78	14	1.23
G		HRL 4	50	0.0781	73	50	0.52
G		HRL 4B	125	0.1953	80	43	0.7
G		HRL 5	151	0.2359	80	65	0.66
G		HRL 6	294	0.4594	73	59	1.13
G		HRL 7	440	0.6875	73	45	1.55
H	Doane Canal (Watershed H)	DOA 1	480	0.75	76	85	1.43
H	(Sub-Basin Draining into Doane Canal)	DOA 2	149	0.2328	78	28	0.78
H		DOA 3	310	0.4844	69	58	1.14
H		DOA 4	640	1	67	85	1.33
H		DOA 5	170	0.2656	72	85	0.67
I	Farmdale Lateral (Watershed I)	FAR 1	166	0.2594	66	34	1.03
J	Miles Creek (Watershed J)	MIL 1	170	0.2656	72	85	0.67

CITY OF MERCED
Storm Drain Master Plan
Hydrologic Parameters Used in HEC-1 Computer Model

Table 1

Watershed	Outfall	Sub-Basin	Drainage Area (Acres)	Drainage Area (Sq. Mile)	Curve Number	Percent Impervious	Lag Time (hr.)
K	El Capitan Canal (Watershed K)	ELC 1	261	0.4078	62	30	0.72
K	(Sub-Basin Draining into EL Capitan Canal)	ELC 2	78	0.2516	70	45	0.73
K		ELC 3	161	0.1219	71	48	0.42

Table 2

10-yr Peak Discharges

CITY OF MERCED

Storm Drain Master Plan

10-Year Peak Discharges

Table 2

Watershed	Sub-Basin	Location of Concentration Point	Drainage Area (Acres)	Drainage Area (Sq. Mile)	10-Year Discharge (cfs)
A	FAHR 1	At Bellevue Rd. Between "G" St & Hwy 59	1184	1.85	238
A	FAHR 2	At Bellevue Rd. Between "G" St & Hwy 59	898	1.4031	114
A	FAHR 3	At Bellevue Rd. and Fahrens Creek (CP 1)	712	1.1125	94
A	FAHR 4	At Fahrens Creek & Lehigh Dr. (CP 2)	595	0.9297	96
A	FAHR 5	At Fahrens Creek & Lehigh Dr. (CP 2)	133	0.2078	38
A	FAHR 6	At Fahrens Creek & Yosemite Ave (CP 5)	207	0.3234	34
B	COT 1	At Cottonwood Ck. & Quail Ave (CP 3)	135	0.2109	24
B	COT 2	At Cottonwood Ck. & Quail Ave (CP 3)	120.64	0.1885	28
B	COT 3	At Cottonwood Ck. & "G" St (CP 4)	151.1	0.236	28
B	COT 4	At Cottonwood Ck. & "G" St. (CP 4)	846.6	1.3228	127
B	COT 5	At Cottonwood Ck. E of "G" St (CP 4A)	266	0.4156	18
C	BRC 1	Black Rascal Ck. & Mckee Rd. (CP 8)	152	0.2375	30
C	BRC 2	Black Rascal Ck. & Mckee Rd. (CP 8)	53.1	0.083	11
C	BRC 3	Black Rascal Ck. & Parsons Ave (CP 9)	94.52	0.1477	13
C	BRC 4	At Parsons Ave & El Portal Dr.	93.55	0.1462	15
C	BRC 5	Black Rascal Ck. S of Morain Dome Ct (CP 10)	57.51	0.0899	11
C	BRC 6	Black Rascal Ck. S of Morain Dome Ct (CP 10)	59.4	0.0928	12
C	BRC 7	Black Rascal Ck. S of Morain Dome Ct (CP 10)	59.97	0.0937	13
C	BRC 8	Black Rascal Ck. & Joerg ave (CP 11)	58.14	0.0908	12
C	BRC 9	Black Rascal Ck. & Cherokee Ave (CP 12)	96.99	0.1515	17
C	BRC 10	Black Rascal Ck. & Cordova Ave (CP 13)	81.44	0.1273	14
C	BRC 11	Black Rascal Ck. & Cordova Ave (CP 13)	90.11	0.1408	20
C	BRC 12	Olive Ave & Sycamore Dr.	20.66	0.0323	6
C	BRC 13	Black Rascal Ck. & El Capitan Ct. (CP 14)	51.31	0.0802	8
C	BRC 14	Black Rascal Ck. & "G" St. (CP 15)	31.34	0.049	7
C	BRC 14B	Black Rascal Ck & "G" St. (CP 15)	49.36	0.0771	20
C	BRC 15	At "G" St. and El Portal Dr.	49.07	0.0767	14
C	BRC 16	Black Rascal Ck. & Campus Dr. (CP 16)	43.9	0.0686	6
C	BRC 17	Black Rascal Ck. & "M" St. (CP 17)	68.01	0.1063	25

CITY OF MERCED

Storm Drain Master Plan

10-Year Peak Discharges

Table 2

Watershed	Sub-Basin	Location of Concentration Point	Drainage Area (Acres)	Drainage Area (Sq. Mile)	10-Year Discharge (cfs)
C	BRC 18	Black Rascal Ck. & "M" St. (CP 17)	209.54	0.3274	43
C	BRC 19	Black Rascal Ck. BTWN "M" St & "R" St. (CP 18)	44	0.0688	8
C	BRC 20	Black Rascal Ck. BTWN "M" St & "R" St. (CP 19)	85	0.1328	20
C	BRC 21	Black Rascal Ck. BTWN "M" St & "R" St (CP 19)	116.79	0.1825	56
C	BRC 22	Black Rascal Ck. West of "R" St (CP 20)	104.91	0.1639	25
C	BRC 23	Black Rascal Ck. & Chyanne Dr. (CP 21)	212.75	0.3324	34
C	BRC 24	Hwy 59 & Cardella Rd. (CP 22)	706	1.1031	155
C	BRC 25	Hwy 59 & Belcher Ave. (CP 23)	380	0.5938	108
C	BRC 26	Hwy 59 & Black Rascal Ck. (CP 7)	376	0.5875	88
C	BRC 27	Black Rascal Ck. & Santa Fee Railroad (CP 24)	621	0.9703	202
C	BRC 28	Black Rascal Ck. & Santa Fee Railroad (CP 24)	32.43	0.0507	19
C	BRC 29	Black Rascal Ck. & El Capitan Canal. (CP 25)	188.13	0.294	70
C	BRC 30	Flood Channel East of Hwy 59	142	0.2219	42
C	BRC 31	Black Rascal Ck. & Hwy 59 (CP 7)	78	0.1219	19
D	BC 1	Bear Ck. BTWN Mckee Rd & Bedford Ln (CP 26)	92	0.1438	15
D	BC 2	Bear Ck. & Bedford Ln (CP 27)	37.02	0.0578	10
D	BC 3	Bear Ck. & Bedford Ln (CP 27)	87.81	0.1372	14
D	BC 4	Santa Fee Ave & Green St.	156	0.2438	28
D	BC 5	Midge Ave south of East 27th St (CP 29)	74.04	0.1157	14
D	BC 6	Midge Ave & East 27th St (CP 30)	18.37	0.0287	4
D	BC 7	Midge Ave & East 27th St (CP 30)	48.78	0.0762	6
D	BC 8	Bear Ck. & Cameron Ln. (CP 28)	54.64	0.0854	8
D	BC 9	Bear Ck. & Cameron Ln. (CP 28)	139.18	0.2175	22
D	BC 10	Bear Ck. & Wainwright Ave (CP 31)	83.16	0.1299	18
D	BC 11	Near Parsons Ave & Oregon Dr. (CP 33)	11.48	0.0179	4
D	BC 12	Near Hensons Ave & Nottingham Ln (CP 34)	42.47	0.0664	9
D	BC 13	"G" Street & Craig Dr. (CP 35)	97.57	0.1525	16
D	BC 14	Bear Creek & "M" Street (CP 36)	149.28	0.2333	47
D	BC 15	Bear Creek & Ardell Dr. (CP 37)	18.5	0.0289	4

CITY OF MERCED

Storm Drain Master Plan

10-Year Peak Discharges

Table 2

Watershed	Sub-Basin	Location of Concentration Point	Drainage Area (Acres)	Drainage Area (Sq. Mile)	10-Year Discharge (cfs)
D	BC 16	Bear Creek & "R" Street (CP 38)	37.5	0.0586	7
D	BC 17	Bear Creek Near W 25th & "V" Street (CP 39)	30.42	0.0475	6
D	BC 18	Bear Creek @ Santa Fe Railroad (CP 40)	173	0.2703	51
D	BC 19	Bear Creek Near Creekside Dr. (CP 41)	54	0.0844	14
D	BC 20	Bear Creek Near Brookside Dr. (CP 42)	52	0.0813	10
D	BC 21	Bear Creek Near West 16th Street (CP 43)	32	0.05	10
D	BC 22	Bear Creek @ Auto Center SD Pump Station (CP 44)	117.65	0.1838	63
D	BC 23	22nd Street & "T" Street (CP 45)	54.78	0.0856	10
D	BC 24	20th Street & "T" Street & (CP 46)	47.64	0.0744	8
D	BC 25	22nd Street & "S" Street (CP 47)	100	0.1563	19
D	BC 26	18th Street & "T" Street (CP 48)	33.2	0.0519	9
D	BC 27	18th Street & "R" Street (CP 49)	26.3	0.0411	11
D	BC 28	16th Street & "T" St (CP 50)	20.8	0.0325	12
D	BC 29	16th Street & "Q" Street (CP 51)	17.7	0.0277	10
D	BC 30	16th Street & "U" Street (CP 52)	52.8	0.0825	31
D	BC 31	15th Street & "R" Street (CP 54)	30.2	0.0472	19
D	BC 32	15th Street & "U" Street (CP 53)	27.5	0.043	17
D	BC 33	Auto Center Strom Drain Pump Station (CP 44)	58	0.0906	29
D	BC 34	Grifin Street and Bear Creek	29	0.0453	9
D	BC 35	Massasso Street and Bear Creek	60	0.0938	10
D	BC 36	Massasso Street and Bear Creek	157	0.2453	35
E	WA 1	Lopes Ave & West Ave (CP 55)	41	0.0641	6
E	WA 2	18th Street & West Ave (CP 55)	54.5	0.0852	16
E	WA 3	Wardrobe Ave & West Ave (CP 56)	8.8	0.0138	2
E	WA 4	Grogan Ave & West Ave (CP 57)	140	0.2188	55
E	WA 5	19th Ave & "U" Street (CP 59)	78.5	0.1227	20
E	WA 6	Grogan Ave & West Ave (CP 57)	105.6	0.165	25
E	WA 7	23rd Street & "M" Street (CP 60)	122.2	0.1909	23
E	WA 8	23rd Street & "O" Street (CP 61)	61.5	0.0961	19

CITY OF MERCED

Storm Drain Master Plan

10-Year Peak Discharges

Table 2

Watershed	Sub-Basin	Location of Concentration Point	Drainage Area (Acres)	Drainage Area (Sq. Mile)	10-Year Discharge (cfs)
E	WA 9	22nd Street & "O" Street (CP 62)	35.4	0.0553	10
E	WA 10	20th Street & "O" Street & (CP 63)	70.9	0.1108	19
E	WA 11	19th Street & "M" Street (CP 64)	26.6	0.0416	12
E	WA 12	19th Street & "O" Street (CP 65)	9	0.0141	6
E	WA 13	18th Street & "M" Street (CP 66)	26.4	0.0413	11
E	WA 14	18th Street & "O" Street (CP 67)	9	0.0141	6
E	WA 15	Main Street & "M" Street (CP 68)	9.2	0.0144	6
E	WA 16	Main Street & "O" Street (CP 69)	9	0.0141	6
E	WA 17	16th Street & "O" Street (CP 70)	39.3	0.0614	21
E	WA 18	16th Street & MLK Way (CP 72)	18.8	0.0294	12
E	WA 19	13th Street & MLK Way (CP 73)	36.3	0.0567	19
E	WA 20	13th Street & "O" Street (CP 71)	62.2	0.0972	31
E	WA 21	11th Street & "O" Street (CP 74)	46	0.0718	20
E	WA 22	Childs Ave & "O" Street (CP 75)	38	0.0594	6
E	WA 23	Childs Ave & "N" Street (CP 76)	123.4	0.1928	33
E	WA 24	Childs Ave & "N" Street (CP 76)	76.4	0.1909	27
E	WA 25	Childs Ave & "R" Street (CP 77)	160.6	0.2509	31
E	WA 26	Childs Ave & West Ave (CP 58)	35.6	0.0556	11
E	WA 27	Riggs Road & West Ave (CP 78)	54	0.0844	18
E	WA 28	Gerard Ave & West Ave (CP 79	121	0.1891	16
E	WA 29	"N" Street south of Childs Ave	45.8	0.0715	10
F	ZEN 1	Anderegg Ave & Yosemite Parkway (CP 80)	40.82	0.0638	15
F	ZEN 2	Union Ave & Yosemite Parkwy (CP 81)	108.64	0.1698	29
F	ZEN 3	Glen Ave & 21th Street (CP 82)	55.79	0.0872	13
F	ZEN 4	Glen Ave & Yomemite Parkway (CP 83)	44.77	0.07	9
F	ZEN 5	Main Street & "D" Street (CP 84)	90.11	0.1408	19
F	ZEN 6	15th Street & "G" Street (CP 85)	40.58	0.0634	22
F	ZEN 7	Santa Fee Ave & "G" Street (CP 86)	49.07	0.0767	10
F	ZEN 8	20th Street & "G" Street (CP 87)	76.91	0.1202	20

CITY OF MERCED

Storm Drain Master Plan

10-Year Peak Discharges

Table 2

Watershed	Sub-Basin	Location of Concentration Point	Drainage Area (Acres)	Drainage Area (Sq. Mile)	10-Year Discharge (cfs)
F	ZEN 9	15th Street & "G" Street (CP 85)	40.86	0.0639	15
F	ZEN 10	16th Street & "G" Street (CP 88)	27.84	0.0434	16
F	ZEN 11	11th Street & "G" Street (CP 89)	32.14	0.0502	16
F	ZEN 12	Childs Ave & "G" Street (CP 90)	103.31	0.1613	22
F	ZEN 13	Cone Ave East of South "G" Street (CP 91)	97	0.1516	19
F	ZEN 14	South "G" Street BTWN Cone Ave & Gerard Ave (CP 92)	101	0.1578	19
F	ZEN 15	West of (CP 92) @ (CP 93)	38	0.0594	9
F	ZEN 16	11th Street & MLK Way	28.3	0.0442	17
F	ZEN 17	Childs Ave & MLK Way (CP 95)	68.5	0.107	19
F	ZEN 18	Gerard Ave BTWN "N" & "P" Street (CP 96)	118.2	0.1847	33
F	ZEN 19	Mission Ave & Hwy 59 (CP 97)	253.3	0.3958	35
F	ZEN 20	Dickenson Ferry Rd. BTWN Hwy 59 & West Ave (CP 98)	164	0.2563	34
F	ZEN 21	Dickenson Ferry Rd. & West Ave (CP 99)	158	0.2469	22
F	ZEN 22	Gerard Ave East of Hwy 59 (CP 4)	59.4	0.0928	15
G	HRL 2	Parsons Ave & Dinkey Ck Ave (CP 100)	307	0.4797	73
G	HRL 3	Childs Ave & Parsons Ave	310	0.4844	58
G	HRL 4	Childs Ave & Carol Ave	50	0.0781	16
G	HRL 4B	Merced Ave & I-99	125	0.1953	37
G	HRL 5	Childs Ave & Tyler Road (CP 101)	151	0.2359	62
G	HRL 6	Gerard Ave & Tyler Road (CP 102)	294	0.4594	75
G	HRL 7	Mission Ave & Tyler Road (CP103)	440	0.6875	75
H	DOA 1	Childs Ave & Doane Canal (CP 104)	480	0.75	151
H	DOA 2	Childs Ave & Doane Canal (CP 104)	149	0.2328	30
H	DOA 3	Mission Ave & Doane Canal (CP 105)	310	0.4844	75
H	DOA 4	Mission Ave & Doane Canal (CP 105)	640	1	205
H	DOA 5	Doane Canal & Miles Creek	170	0.2656	79
I	HRL 1	Mission Ave & Alfarata Blvd	166	0.2594	25
G	MIL 1	Miles Creek	170	0.2656	79

CITY OF MERCED

Storm Drain Master Plan

10-Year Peak Discharges

Table 2

Watershed	Sub-Basin	Location of Concentration Point	Drainage Area (Acres)	Drainage Area (Sq. Mile)	10-Year Discharge (cfs)
K	ELC 1	McSwain Rd (I-140) & Thornton Rd	261	0.4078	41
K	ELC 2	Lopes Ave BTWN East of Thornton Rd	161	0.2516	39
K	ELC 3	Lopes Ave & Thornton Rd	78	0.1219	26

Table 3

Hydrologic Parameters Used in HEC-1 Model

CITY OF MERCED

Storm Drain Master Plan

Proposed Detention Basin Data

Table 3

Detention Basins	Location	Surface Area (Ac)	50-Year Inflow (cfs)	2-Year * Outflow (cfs)	Storage Volume (Ac-Ft)	Depth of Water (ft)	Freeboard (ft)
1	At Bellevue Rd BTWN "G" St & Hwy 59	45	522	34	257	5.9	1
2	At Bellevue Rd BTWN "G" St & Hwy 59	20	143	9	73	3.8	1
3	At Cottonwood Ck & "G" St	25	197	12	95	3.9	1
4	Near Fahrens Ck & Lehigh Dr	18	147	9	62	3.6	1
5	At Belcher Ave & Hwy 59	37	366	25	149	4.1	1
6	Hwy 59 & Black Rascal Creek	20	155	9	84	4.3	1
7	Black Rascal Ck & Santa Fe Railroad	27	274	21	102	3.9	1
8	Dickenson Ferry Rd & West Ave	45	589	43	188	4.3	1
9	Cone Ave & South "G" St	25	306	19	97	3.8	1
10	MLK Way & Childs Ave	3	52	4	10	3.7	1
11	Gerard Ave east of Hwy 59	5	49	7	16	3.4	1
12	Mission Ave BTWN West Ave & Hwy 59	13	96	7	42	3.6	1
13	Parsons Ave & Dinkey Ck Ave	20	169	11	69	3.6	1
14	Childs Ave & Tyler Road	10	140	8	38	3.9	1
15	Gerard Ave & Tyler Road	10	106	8	38	3.9	1
16	Mission Ave & Tyler Road	13	111	8	50	4	1
17	Childs Ave & Doane Canal	25	241	16	97	4	1
18	Mission Ave & Doane Canal	37	380	24	146	4.1	1
19	Vassar Ave & Doane Canal	7	107	8	25	3.8	1
20	Mission Ave & Alfarata Blvd	3	36	5	11	3.9	1
21	Vassar Ave BTWN Henry St & I-99	7	107	8	25	3.8	1
22	McSwain Rd (I-140) & Thornton Rd	5	56	4	18	3.9	1

* Outflow is approximately equal to 2-year storm discharge under existing conditions.

Table 4

Cost Estimate for Proposed Pump Stations

CITY OF MERCED
Storm Drain Master Plan
General Cost Estimates for Pump Stations of Varying Capacities

Table 4

Input Data					Costs					
Max Flow Rate (cfs)	# of Pumps	Flow Rate per Pump	Pump Size (hp)	Discharge Pipe Size	Pump Equipment	Mechanical Equipment	Electrical Equipment	Structural/ Building	Site Improvements	Total
5	3	2.5	9.5	12"	$ 100,000	$ 40,000	$ 50,000	$ 50,000	$ 40,000	$ 280,000
10	3	5	18.9	16"	$ 100,000	$ 50,000	$ 60,000	$ 60,000	$ 40,000	$ 310,000
15	3	7.5	28.4	20"	$ 100,000	$ 60,000	$ 65,000	$ 65,000	$ 40,000	$ 330,000
20	3	10	37.8	24"	$ 100,000	$ 70,000	$ 70,000	$ 70,000	$ 60,000	$ 370,000
30	3	15	56.7	30"	$ 225,000	$ 100,000	$ 75,000	$ 75,000	$ 60,000	$ 535,000
40	3	20	75.6	30"	$ 260,000	$ 100,000	$ 100,000	$ 100,000	$ 60,000	$ 620,000

Table 5

Existing Stormwater Storage Facilities

CITY OF MERCED
Storm Drain Master Plan
Existing Stormwater Storage Facilities

Table 5

Fund #	Station #	Detention Type	Location	Storage Vol. (cf)	Storage Vol. (af)	SDMP Sub-Basins	10-Year Vol. (af)	50-Year Vol. (af)
101	31	Pipe & Pump Station	1590 Massasso St	97,000	2.22	BC 35	3	5
106	18	Pond & Pump Station	1813 Lopes Ave	150,000	3.44	WA 1	2	3
107	35	Pipe	3092 Queens Cr	66,300	1.50	BRC 12	2	3
108	16	Pond & Pump Station	1425 W.N Beer Ck	95,000	2.18	BC 19	5	7
109	19	Pond & Pump Station	71 E. Gerard Ave	217,800	5.00	ZEN 14	8	12
110	21	Pond & Pump Station	986 Auburn Ct	280,000	6.43	FAHR6	15	23
111	24	Pond & Pump Station	2090 Lopes Ave	260,000	5.97	ELC 2	14	21
113	22	Pond	912 W. Donna Dr	65,000	1.50	BRC19	3	5
116	30	Pipe	3505 Paulson Dr	26,000	0.60	BRC 9	7	11
117	27	Pond & Pump Station	Auto Center Dr	55,000	1.26	Auto Center	48	66
118	38	Pipe	5 Cormorant Dr	250,000	5.74	COT 1	10	15
121	11	Pipe & Pump Station	100 Parsons Ave	90,000	2.07	HRL 2	28	41
122	6	no storage added	1150 Paseo Verde Dr	N A	N A	BRC 22	8	13
124	4	Private Ret	1317 W.E. Beer Ck	20,000	0.46	BC 18	21	28
125	2	Pond & Pump Station	100 Campus Dr	125,000	2.87	BRC 18	17	26
127	20	Pond	1510 hansen Ave	52,000	1.19	BC 12	3	5
102/114	40	Pond	1200 E. El Portal Dr	387,000	8.88	BRC 6	4	7

Table 6

Existing Stormwater Pump Stations

CITY OF MERCED
Storm Drain Master Plan
Existing Stormwater Pump Stations

Table 6

Station #	Location	Number of Pumps	Pumping Capacity (gpm)	Total Capacity (gpm)	Pumping Capacity (cfs)	SDMP Sub-basins	10-Year Discharges (cfs)
1	Flamingo & West Ave	2	1 @ 5500 1 @ 1500	7000	15.60	West Ave Storm Drain **	405
2	Campus North	3	3000 ea	9000	20.05	BRC 18 (campus Dr)	43
3*	Cooper Ave	3	2 @ 15000 1 @ 3000	33000	73.52	BRC 29	70
4	Bear Ck (Olivewood II)	2	8000 ea	16000	35.65	BC 18	51
5*	Bismark	2	1 @ 11500 1 @ 2200	13700	30.52	BRC 23	34
6	Fahrans Park	3	3000 ea	9000	20.05	BRC 22	25
7*	Parsons & Hansen Ave		no data	no data	no data	BC 11	4
9*	Cameron Lane	2	1 @ 3000 1 @ 1000	4000	8.91	BC 4, 5, 6, 7 & 8	57
11	Childs & Parsons	2	1 @ 800 1 @ 1000	1800	4.01	HRL 2	73
16	Sunset	2	2450 ea	4900	10.92	BC 19	14
18	Lopes Ave	2	485 ea	970	2.20	WA1	6
19	Gerard Ave	2	320 ea	640	1.42	ZEN14	19
21	Auburn Ct	2	2400 ea	4800	10.69	FAHR 6	34
23*	1368 Griffin Street		no data	no data	no data	BC 34	9
24	Lopes Ave	2	485 ea	970	2.20	ELC2	39
25*	1801 Wardrobe Ave		no data	no data	no data	WA 1	6
27	Auto Center Dr	3	3000 ea	9000	20.05	Auto Center Storm Drain	160
31	Massasso	2	800 ea	1600	3.56	BC 35	10
35	3092 Queens Circle		no data	no data	no data	BRC 12	6
38	Tanager & Cormorant	2	3000 ea	6000	13.37	COT 1	24
40	Rahilly Park	2	5000 ea	10000	22.28	BRC 6 & BRC 8	24

* Stations outside of Maintenance Districts

** Station pumps water into MID Canal

Table 7

Cost Estimate

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into Fahrens Creek
Cost Estimate

Table 7

Watershed A

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basins				
(Onsite Detention Basins 1, 2 & 4)	447	AF	10,000	4,470,000
Pump Stations				
Detention Basin 1	1	LS	578,000	578,000
Detention Basin 2	1	LS	310,000	310,000
Detention Basin 4	1	LS	310,000	310,000
Channel				
60' R/W	5,200	LF	50	260,000
Storm Drain				
30" SD	8,707	LF	80	696,560
36" SD	2,547	LF	100	254,700
42" SD	18,020	LF	120	2,162,400
48" SD	1,812	LF	130	235,560
54" SD	2,639	LF	140	369,460
60" SD	5,300	LF	160	848,000
66" SD	1,383	LF	200	276,600
Subtotal Construction				**10,771,280**
Design & Planning @ 10%				1,077,128
Construction Management @10%				1,077,128
Land Acquisition				
Detention Basins 1, 2 & 4	83	AC	3,500	290,500
Channel	7	AC	3,500	24,850
Contingency @ 15%				1,615,692
Program Implementation @ 5%				538,564
TOTAL ESTIMATED COST				**$ 15,395,142**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into Cottonwood Creek
Cost Estimate

Table 7

Watershed B

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basin				
(Onsite Detention Basin 3)	122	AF	10,000	1,220,000
Pump Station				
Detention Basin 3	1	LS	330,000	330,000
Storm Drain				
30" SD	5,089	LF	80	407,120
36" SD	1,914	LF	100	191,400
48" SD	1,646	LF	130	213,980
54" SD	1,339	LF	140	187,460
60" SD	1,804	LF	160	288,640
Subtotal Construction				**2,838,600**
Design & Planning @ 10%				283,860
Construction Management @10%				283,860
Land Acquisition				
Detention Basin 3	25	AC	3,500	87,500
Contingency @ 15%				425,790
Program Implementation @ 5%				141,930
TOTAL ESTIMATED COST				**$ 4,061,540**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into Black Rascal Ck.
Cost Estimate

Table 7

Watershed C

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basins				
(Onsite Detention Basins 5, 6 & 7)	409	AF	10,000	4,090,000
Pump Stations				
Detention Basin 5	1	LS	453,000	453,000
Detention Basin 6	1	LS	310,000	310,000
Detention Basin 7	1	LS	390,000	390,000
Storm Drain				
36" SD	4,065	LF	100	406,500
42" SD	6,125	LF	120	735,000
48" SD	4,803	LF	130	624,390
54" SD	6,658	LF	140	932,120
60" SD	10,491	LF	160	1,678,560
Subtotal Construction				**9,619,570**
Design & Planning @ 10%				961,957
Construction Management @10%				961,957
Land Acquisition				
Detention Basins 5, 6 & 7	82	AC	3,500	287,000
Contingency @ 15%				1,442,936
Program Implementation @ 5%				480,979
TOTAL ESTIMATED COST				**$ 13,754,398**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into Bear Creek
Cost Estimate

Table 7

Watershed D

Item	Quantity	Unit	Unit Cost	Total Cost
Pump Station				
Upgrade Auto Center Dr. Pump Station	1	LS	705,000	705,000
Storm Drain				
30" SD	4,448	LF	80	355,840
36" SD	1,822	LF	100	182,200
42" SD	1,396	LF	120	167,520
48" SD	1,879	LF	130	244,270
72" SD	1,415	LF	240	339,600
78" SD	2,106	LF	300	631,800
1-48" RCP (Jack & Bore At SPRR)	100	LF	700	70,000
Subtotal Construction				**2,696,230**
Design & Planning @ 10%				269,623
Construction Management @10%				269,623
Contingency @ 15%				404,435
Program Implementation @ 5%				134,812
TOTAL ESTIMATED COST			**$**	**3,774,722**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into West Ave Storm Drain
Cost Estimate

Table 7

Watershed E

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basin				
(Detention Basin 8)	220	AF	10,000	2,200,000
Pump Station				
Detention Basin 8	1	LS	630,000	630,000
Storm Drains/Culverts				
24" SD	2,225	LF	60	133,500
30" SD	13,694	LF	80	1,095,520
36" SD	8,725	LF	100	872,500
42" SD	4,451	LF	120	534,120
48" SD	390	LF	130	50,700
72" SD	3,457	LF	240	829,680
78" SD	4,344	LF	300	1,303,200
1-30" RCP (Jack & Bore At SPRR)	100	LF	500	50,000
New 2-10'x4' RCB (airport runway)	1,600	LF	400	640,000
Add 1-6'x4' RCB (Dickenson Ferry Rd.)	1	LS	35,000	35,000
New 2-60" RCP (Hartley Slough Crossing)	100	LF	160	16,000
Channel Improvement				
City Storm Drain Channel	2,800	LF	5	14,000
Subtotal Construction				**8,404,220**
Design & Planning @ 10%				840,422
Construction Management @10%				840,422
Land Acquisition				
Detention Basin 8	45	AC	3,500	157,500
Contingency @ 15%				1,260,633
Program Implementation @ 5%				420,211
TOTAL ESTIMATED COST				**$ 11,923,408**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into Zentner Lateral Canal
Cost Estimate

Table 7

Watershed F

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basins				
(Detention Basins 9, 10, 11 & 12)	221	AF	10,000	2,210,000
Pump Stations				
Detention Basin 9	1	LS	370,000	370,000
Detention Basin 10	1	LS	280,000	280,000
Detention Basin 11	1	LS	280,000	280,000
Detention Basin 12	1	LS	310,000	310,000
Storm Drains				
24" SD	6,588	LF	60	395,280
30" SD	11,730	LF	80	938,400
36" SD	2,592	LF	100	259,200
42" SD	4,229	LF	120	507,480
48" SD	2,195	LF	130	285,350
54" SD	1,836	LF	140	257,040
60" SD	1,100	LF	160	176,000
66" SD	890	LF	200	178,000
1-30" RCP (Jack & Bore At Santa Fe RR)	100	LF	500	50,000
1-48" RCP (Jack & Bore at SPRR)	100	LF	700	70,000
Subtotal Construction				**6,566,750**
Design & Planning @ 10%				656,675
Construction Management @10%				656,675
Land Acquisition				
Detention Basin 9, 10, 11 & 12	46	AC	3,500	161,000
Contingency @ 15%				985,013
Program Implementation @ 5%				328,338
TOTAL ESTIMATED COST				**$ 9,354,450**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into Hartley Lateral Canal
Cost Estimate

Table 7

Watershed G

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basins				
(Detention Basins 13, 14, 15 & 16)	255	AF	10,000	2,550,000
Pump Stations				
Detention basin 13	1	LS	330,000	330,000
Detention basin 14	1	LS	310,000	310,000
Detention basin 15	1	LS	310,000	310,000
Detention basin 16	1	LS	310,000	310,000
Storm Drain				
30" SD	12,018	LF	80	961,440
36" SD	7,212	LF	100	721,200
42" SD	5,330	LF	120	639,600
48" SD	4,468	LF	130	580,840
54" SD	2,589	LF	140	362,460
1-48" RCP (Jack & Bore I-99)	200	LF	700	140,000
Subtotal Construction				**7,215,540**
Design & Planning @ 10%				721,554
Construction Management @10%				721,554
Land Acquisition				
Detention Basins 13, 14, 15 & 16	53	AC	3,500	185,500
Contingency @ 15%				1,082,331
Program Implementation @ 5%				360,777
TOTAL ESTIMATED COST				**$ 10,287,256**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into Doane Lateral Canal
Cost Estimate

Table 7

Watershed H

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basins				
(Detention Basins 17, 18 & 19)	335	AF	10,000	3,350,000
Channel				
60' R/W	2,500	LF	50	125,000
Pump Stations				
Detention Basin 17	1	LS	340,000	340,000
Detention Basin 18	1	LS	453,000	453,000
Detention Basin 19	1	LS	310,000	310,000
Storm Drain				
30" SD	1,248	LF	80	99,840
36" SD	1,318	LF	100	131,800
42" SD	6,073		120	728,760
48" SD	4,474	LF	130	581,620
54" SD	8,746	LF	140	1,224,440
60" SD	5,010	LF	160	801,600
Subtotal Construction				**8,146,060**
Design & Planning @ 10%				814,606
Construction Management @10%				814,606
Land Acquisition				
Detention Basins 17, 18 & 19	69	AC	3,500	241,500
Channel	3	AC	3,500	11,900
Contingency @ 15%				1,221,909
Program Implementation @ 5%				407,303
TOTAL ESTIMATED COST				**$ 11,657,884**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into Farmdale Lateral
Cost Estimate

Table 7

Watershed I

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basin				
(Detention Basin 20)	14	AF	10,000	140,000
Pump Station				
Detention Basin 20	1	LS	280,000	280,000
Storm Drain				
36" SD	1,310	LF	100	131,000
42" SD	1,077	LF	120	129,240
Subtotal Construction				**680,240**
Design & Planning @ 10%				68,024
Construction Management @10%				68,024
Land Acquisition				
Detention Basin 20	3	AC	3,500	10,500
Contingency @ 15%				102,036
Program Implementation @ 5%				34,012
TOTAL ESTIMATED COST				**$ 962,836**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into Miles Creek
Cost Estimate

Table 7

Watershed J

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basin				
(Detention Basin 21)	33	AF	10,000	330,000
Pump Station				
Detention Basin 21	1	LS	310,000	310,000
Storm Drain				
48" SD	1,389	LF	130	180,570
54" SD	940	LF	140	131,600
Subtotal Construction				**952,170**
Design & Planning @ 10%				95,217
Construction Management @10%				95,217
Land Acquisition				
Detention Basin 21	7	AC	3,500	24,500
Contingency @ 15%				142,826
Program Implementation @ 5%				47,609
TOTAL ESTIMATED COST				**$ 1,357,538**

CITY OF MERCED
Storm Drain Master Plan
Drainage Infrastructure Required to Serve Areas Draining Into El Capitan Canal
Cost Estimate

Table 7

Watershed K

Item	Quantity	Unit	Unit Cost	Total Cost
Detention Basin				
(Detention Basin 22)	24	AF	10,000	240,000
Pump Station				
Detention Basin 22	1	LS	280,000	280,000
Storm Drain				
36" SD	1,300	LF	100	130,000
42" SD	1,200	LF	120	144,000
Subtotal Construction				**794,000**
Design & Planning @ 10%				79,400
Construction Management @10%				79,400
Land Acquisition				
Detention Basin 22	5	AC	3,500	17,500
Contingency @ 15%				119,100
Program Implementation @ 5%				39,700
TOTAL ESTIMATED COST				**$ 1,129,100**

EXHIBIT 'A'

CITY OF MERCED

STORM DRAIN MASTER PLAN

EXISTING CONDITIONS

Map Showing Watershed and Sub-Basin Boundaries, Existing Storm Drain Trunk Lines, Detention Ponds and Pump Stations and 10-yr Discharges.

CITY OF MERCED JOB NO. 199036

FINAL

PREPARED BY:

Stantec Consulting Inc.
2590 Venture Oaks Way
Sacramento, CA 95833-3288
Tel. 916.569.2500
Fax. 916.921.9274
www.stantec.com

JOB No. : 840-10156
APR. 19, 2002

LEGEND

- SPECIFIC URBAN DEVELOPMENT PLAN BOUNDARY
- EXISTING WATERWAYS
- EXISTING STORM DRAINS
- EXISTING DETENTION POND
- EXISTING PUMP STATION
- CP 5 — CONCENTRATION POINTS
- BRC24 — SUB-BASIN IDENTIFICATION
- SUB-BASIN BOUNDARY
- WATERSHED BOUNDARY
- Q_{10}= 155 CFS — 10 YEAR DISCHARGE (WITH FUTURE DEVELOPMENT)
- A — WATERSHED IDENTIFICATION

N

GRAPHIC SCALE
0 500 1000 1500 2000
SCALE:1"=1000'

INSET (SEE BELOW)

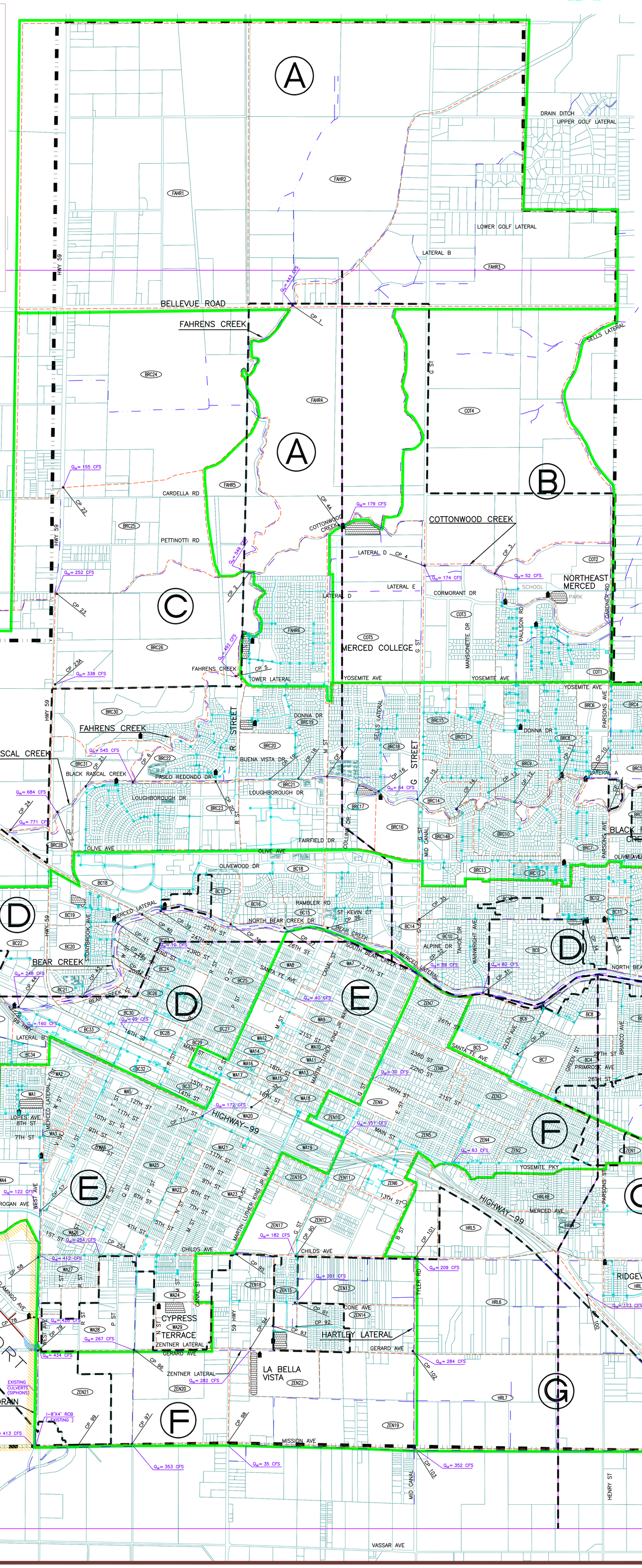


EXHIBIT 'B'

CITY OF MERCED

STORM DRAIN MASTER PLAN

PROPOSED INFRASTRUCTURE

Map Showing Proposed Storm Drain Trunk Lines, Detention Basins and Pump Stations

CITY OF MERCED JOB NO. 199036

NOTE: *PROPOSED STORM DRAINS SIZED FOR 10-YEAR EVENT, DETENTION BASINS SIZED FOR 50-YEAR (FUTURE) INFLOW / 2-YEAR (EXISTING) OUTFLOW PER CITY STANDARDS.*

FINAL

PREPARED BY:

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APR. 19, 2002

LEGEND

- SPECIFIC URBAN DEVELOPMENT PLAN BOUNDARY
- EXISTING WATERWAYS
- EXISTING STORM DRAINS
- CP 5 — CONCENTRATION POINTS
- BRC24 — SUB-BASIN IDENTIFICATION
- SUB-BASIN BOUNDARY
- WATERSHED BOUNDARY
- Q_{50} = 94 CFS, Q_{10} = 9 CFS — 50-YR DISCHARGE INFLOW UNDER FUTURE CONDITIONS (APPLIES TO PROPOSED DETENTION BASINS); 2-YR DISCHARGE EXISTING CONDITIONS (APPLIES TO PROPOSED DETENTION BASINS)
- PROPOSED STORM DRAIN
- DB 1 — PROPOSED DETENTION BASIN AND PUMP STATION
- 42"SD (NEW) — PROPOSED PIPE SIZE
- A — WATERSHED IDENTIFICATION
- EXISTING DETENTION POND
- EXISTING PUMP STATION

NOTE: PROPOSED STORM DRAINAGE INFRASTRUCTURE DEPICTED HEREIN IS LIMITED TO TRUNK SYSTEM IMPROVEMENTS (SD'S = 24" DIAMETER OR GREATER). LOCAL SYSTEMS CONNECTING TO THE PROPOSED TRUNK SYSTEM WILL NEED TO BE DEVELOPED ON A SITE SPECIFIC BASIS.

N

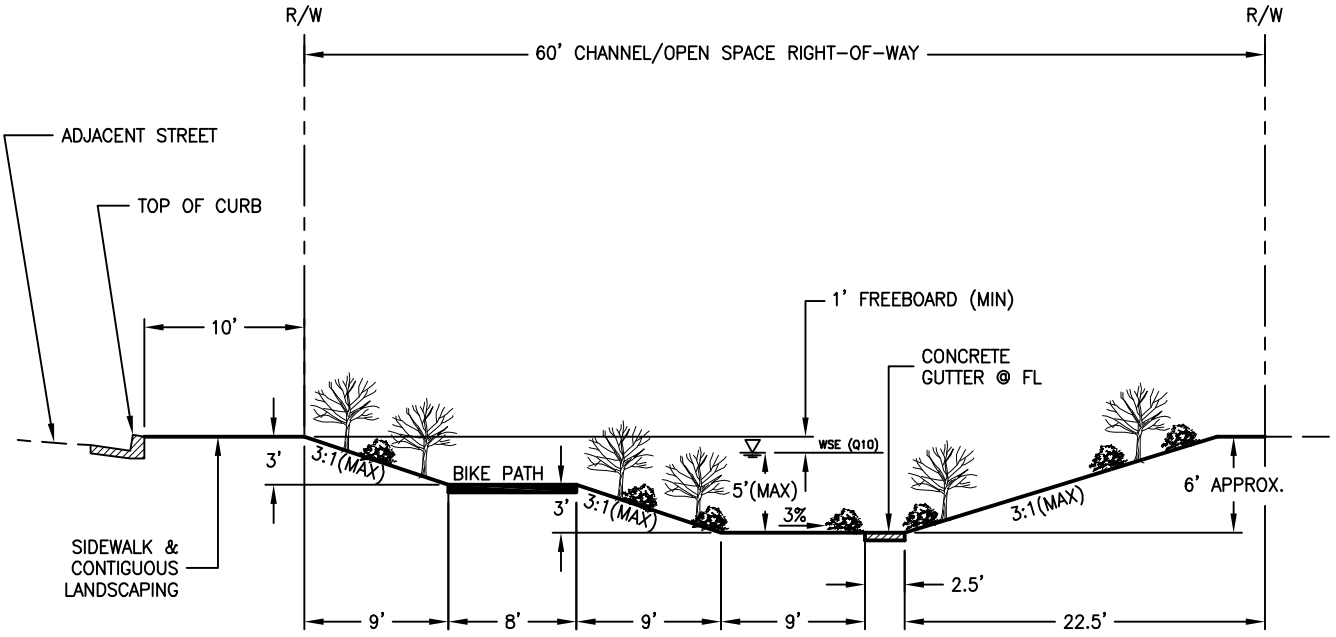
GRAPHIC SCALE
0 500 1000 1500 2000
SCALE:1" = 1000'

INSET (SEE BELOW)

HWY 59 · BELLEVUE ROAD · FAHRENS CREEK · CARDELLA RD · PETTINOTTI RD · BELCHER AVE · HWY 140 · LOPES AVE · WARDROBE AVE · MERCED AIRPORT · MACREADY DR · FLAMINGO AVE · HAWK DR · DICKENSON FERRY RD · GROGAN AVE · WEST AVE · MERCED AIRPORT STORM DRAINAGE MASTER PLAN BY: HDR · CITY STORM DRAIN CHANNEL · EXISTING CULVERT · 2-10'X4' RCB (NEW) · 1-8'X4' RCB (EXISTING) · 1-6'X4' RCB (ADD) · HARTLEY SLOUGH · 1-42" CMP (EXISTING) · 2-60" RCP (NEW) · GOVE RD · DRAIN DITCH UPPER GOLF LATERAL · LOWER GOLF LATERAL · LATERAL B · FAHR1 · FAHR2 · FAHR3 · FAHR4 · FAHR5 · FAHR6 · CH (NEW) · OH (NEW) · Q_{50} = 350 CFS · Q_{10} = 38 CFS · Q_{10} = 9 CFS · Q_{50} = 94 CFS · Q_{50} = 147 CFS · Q_{10} = 9 CFS · Q_{50} = 356 CFS · Q_{10} = 25 CFS · Q_{50} = 155 CFS · Q_{10} = 9 CFS · Q_{50} = 274 CFS · Q_{10} = 21 CFS · Q_{50} = 56 CFS · Q_{10} = 4 CFS · Q_{50} = 589 CFS · Q_{50} = 43 CFS · Q_{50} = 83 CFS · Q_{50} = 96 CFS · Q_{50} = 7 CFS · Q_{10} = 55 CFS · Q_{50} = 52 CFS · Q_{10} = 4 CFS · Q_{50} = 306 CFS · Q_{10} = 119 CFS · Q_{50} = 66 CFS · Q_{10} = 7 CFS · Q_{50} = 8 CFS · Q_{10} = 140 CFS · Q_{50} = 111 CFS · Q_{10} = 8 CFS · Q_{50} = 106 CFS · Q_{10} = 8 CFS · Q_{50} = 197 CFS · Q_{10} = 12 CFS · Q_{50} = 241 CFS · Q_{10} = 16 CFS · Q_{50} = 169 CFS · Q_{10} = 18 CFS · Q_{50} = 380 CFS · Q_{10} = 24 CFS · Q_{50} = 36 CFS · Q_{10} = 4 CFS · Q_{50} = 107 CFS · Q_{10} = 8 CFS · Q_{50} = 56 CFS · Q_{10} = 8 CFS · FAIRFIELD CANAL · KIBBY RD · D0A1 · D0A4 · LATERAL D · D AVE · MID · COTTONWOOD CREEK · NORTHEAST MERCED · COT1 · COT2 · COT3 · COT4 · COT5 · SCHOOL · PARK · CORMORANT DR · MANSIONETTE DR · PAULSON RD · GARDNER RD · SELLS LATERAL · C ST · G ST · M STREET · R STREET · BRC1 · BRC2 · BRC3 · BRC4 · BRC5 · BRC6 · BRC8 · BRC9 · BRC10 · BRC11 · BRC12 · BRC13 · BRC14 · BRC14B · BRC15 · BRC16 · BRC17 · BRC18 · BRC19 · BRC20 · BRC21 · BRC22 · BRC23 · BRC24 · BRC25 · BRC26 · BRC27 · BRC28 · BRC29 · BRC30 · BRC31 · DONNA DR · BUENA VISTA DR · PASEO REDONDO DR · LOUGHBOROUGH DR · COLLINS DR · FAIRFIELD DR · OLIVEWOOD DR · RAMBLER RD · ST KEVIN CT · NORTH BEAR CREEK DR · SOUTH BEAR CREEK DR · BEAR CREEK · BLACK RASCAL CREEK · BLACK RASCAL CREEK · LATERAL A · LATERAL C · LATERAL E · MID CANAL · OLIVE AVE · BRADLEY LATERAL · WHITE GATE DR · LEEDS RD · CROWN RD · KIBBY RD · MCKEE RD · PARSONS AVE · MAINWRIGHT AVE · TAHOE DR · ALPINE DR · GLEN AVE · BRANCO AVE · PIEDMONT DR · MYRTLE AVE · GREEN ST · 27TH ST · PRIMROSE AVE · 26TH ST · SANTA FE AVE · SANTA FE DRIVE · CANAL ST · MERCED LATERAL · 25TH ST · 24TH ST · 23RD ST · 22ND ST · 21ST ST · 20TH ST · 19TH ST · 18TH ST · 17TH ST · 16TH ST · 15TH ST · 14TH ST · 13TH ST · 12TH ST · 11TH ST · 10TH ST · 9TH ST · 8TH ST · 7TH ST · 6TH ST · 5TH ST · 4TH ST · MAIN ST · MARTIN LUTHER KING JR WAY · HIGHWAY-99 · MERCED AVE · YOSEMITE AVE · YOSEMITE PKY · YOSEMITE LATERAL · LAKE RD · STRETCH RD · HARTLEY LATERAL · LATERAL B · LATERAL C · DOANE CANAL · MID LATERAL · RIDGEVIEW · BLACK RASCAL CREEK · GERARD AVE · MISSION AVE · FARMDALE LATERAL · CHILDS AVE · CONE AVE · TOWER LATERAL · ZENTNER LATERAL · HARTLEY LATERAL · LA BELLA VISTA · CYPRESS TERRACE · ALFARATA DR · HENRY ST · TYLER RD · VASSAR AVE · MILES CREEK · EL CAPITAN CANAL · SANTA FE DR · BEACHWOOD DR · STONYBROOK AVE · MASSASO ST · THORNTON RD · WEST AVE · LOPES AVE · 8TH ST · 7TH ST · PRIVATE RD · ELC1 · ELC2 · ELC3 · WA1 · WA2 · WA3 · WA4 · WA5 · WA6 · WA7 · WA8 · WA9 · WA10 · WA11 · WA12 · WA13 · WA14 · WA15 · WA16 · WA17 · WA18 · WA19 · WA20 · WA21 · WA22 · WA23 · WA24 · WA25 · WA26 · WA27 · WA28 · WA29 · ZEN1 · ZEN2 · ZEN3 · ZEN4 · ZEN5 · ZEN6 · ZEN7 · ZEN8 · ZEN9 · ZEN10 · ZEN11 · ZEN12 · ZEN13 · ZEN14 · ZEN15 · ZEN16 · ZEN17 · ZEN18 · ZEN19 · ZEN20 · ZEN21 · ZEN22 · HRL1 · HRL2 · HRL3 · HRL4B · HRL5 · HRL6 · HRL7 · MIL1 · DB 1 · DB 2 · DB 3 · DB 4 · DB 5 · DB 6 · DB 7 · DB 8 · DB 9 · DB 10 · DB 11 · DB 12 · DB 13 · DB 14 · DB 15 · DB 16 · DB 17 · DB 18 · DB 19 · DB 20 · DB 21 · DB 22 · CP 1 · CP 2 · CP 4 · CP 4A · CP 5 · CP 6 · CP 7 · CP 8 · CP 9 · CP 10 · CP 11 · CP 12 · CP 13 · CP 14 · CP 15 · CP 16 · CP 17 · CP 18 · CP 19 · CP 20 · CP 21 · CP 22 · CP 23 · CP 24 · CP 25 · CP 26 · CP 27 · CP 28 · CP 29 · CP 30 · CP 31 · CP 32 · CP 33 · CP 34 · CP 35 · CP 36 · CP 37 · CP 38 · CP 39 · CP 40 · CP 41 · CP 42 · CP 43 · CP 44 · CP 45 · CP 46 · CP 47 · CP 48 · CP 49 · CP 50 · CP 51 · CP 52 · CP 53 · CP 54 · CP 55 · CP 56 · CP 57 · CP 58 · CP 59 · CP 60 · CP 61 · CP 62 · CP 63 · CP 64 · CP 65 · CP 66 · CP 67 · CP 68 · CP 69 · CP 70 · CP 71 · CP 72 · CP 73 · CP 74 · CP 75 · CP 76 · CP 77 · CP 78 · CP 79 · CP 80 · CP 81 · CP 82 · CP 83 · CP 84 · CP 85 · CP 86 · CP 87 · CP 88 · CP 89 · CP 90 · CP 91 · CP 92 · CP 93 · CP 94 · CP 95 · CP 96 · CP 97 · CP 98 · CP 99 · CP 100 · CP 101 · CP 102 · CP 103 · CP 104 · CP 105 · SEE INSET

CITY OF MERCED

STORM DRAIN MASTER PLAN



60' RIGHT-OF-WAY CHANNEL CROSS-SECTION

WITH BIKE PATH 3' ABOVE CHANNEL INVERT

NOTES:

1. ACCESS ROAD NOT NEEDED FOR CHANNEL REACHES THAT ARE LOCATED ADJACENT TO PUBLIC STREETS.

2. BIKE PATH ELEVATION TO UNDULATE BETWEEN 3' ABOVE CHANNEL BOTTOM AND TOP OF BANK.

CITY OF MERCED STORM DRAIN MASTER PLAN EXHIBIT C		
DATE: 2/11/2002	DRAWN: RAE	Stantec Consulting Inc. 2590 Venture Oaks Way Sacramento California 95833 USA Tel: (916) 925-5550 Fax: (916) 921-9274 www.stantec.com
SCALE: NOT TO SCALE	SHEET: 1 OF 1	
JOB NO: 84010156		