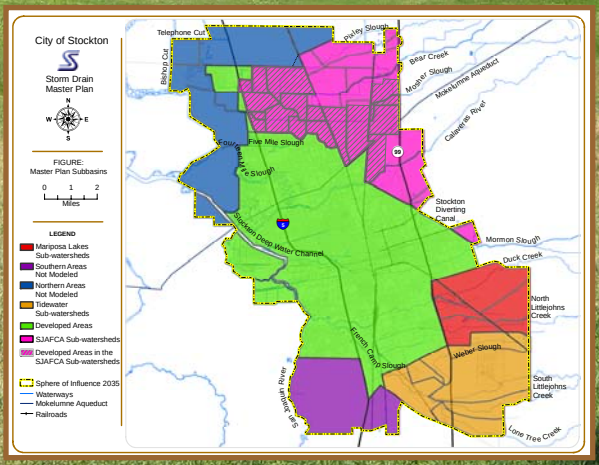
City of Stockton Conceptual Storm Drain Master Plan



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City of Stockton Conceptual Storm Drain Master Plan

Prepared for
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Contents

1 Executive Summary 2
2 Introduction & Purpose 3
3 Background 4
3.1 References 4
4 Master Planning 6
4.1 Sub-watershed Delineation 6
4.2 Sub-watershed Planning 9
4.3 Sub-watershed Discharge Limitations 10
5 Hydrology Methodology 16
6 Discharge Water Quality Constraints 17
6.1 NPDES Permit 17
6.2 Storm Water Management Plan 17
6.3 Storm Water Quality Control Criteria Plan 17
6.4 Guidance on Developer Responsibility 18
Appendix 1 – NPDES Program, Permitting, and Compliance Measures 19
Appendix 2 – Sub-Watershed Master Plan Procedural Handout 30
Appendix 3 – Storm Water Infrastructure Design Guidance Handout 34
City of Stockton Standards 35
San Joaquin County Draft Hydrology Manual 35
Use of this Plan, City Standards and the Hydrology Manual 36
Receiving Water Limitations 38

Figures

Figure 4-1 Sub-watersheds in the General Plan Boundary 7
Figure 4-2 City of Stockton Watersheds incorporated into Hydrologic Models 8
Figure 4-3 Northwestern and Western Drainage Area in the General Plan Boundary 11
Figure 4-4 Current Area Undergoing Planning for Area BT2 11
Figure 4-5 SJAFCA Model Sub-Watersheds in the General Plan Boundary 11
Figure 4-6 Southern General Plan Boundary Sub-watersheds 11

Tables

Table A1-1 Waterways in the Stockton Urbanized Area on the EPA's 2002 303(d) list 11
Table A3-1 Guidance on Sizing Storm Water Infrastructure 11
Table A3-2 Guidance on Sizing Storm Water Detention Facilities 11
Table A3-3 Maximum Pumping Rate for the SJAFCA Sub-watersheds 11

1 Executive Summary

The City of Stockton Conceptual Storm Drain Master Plan is a framework document for developers and City Staff to define a process and criteria for future detailed sub-watershed storm drain planning in growth areas of the City's General Plan Boundary. The primary purposes of this Plan include:

- Develop sub-watersheds within the 2035 General Plan Boundary
- Define receiving water quantity constraints based on previously approved hydrologic and hydraulic models.
- Review existing storm water policies and update as necessary

The area within the General Plan Boundary was divided into drainage sub-watersheds. This Plan focuses on undeveloped areas around the internal perimeter of the General Plan Boundary.

The situation arises too often in storm water planning that a conveyance system is built without fully considering the impact of upstream development and resulting changes in runoff characteristics. This Plan attempts to discourage that by implementing strategic planning measures to create an appropriate storm water system for each sub-watershed. Therefore, the entire area in each sub-watershed will be planned for storm water runoff collection, conveyance, detention and discharge prior to approval of any development within that sub-watershed. This Plan presents guidelines for developing a sub-watershed storm drain master plan.

In areas where waterway improvements are governed by hydrologic and hydraulic models, discharge limitations were refined in order to maintain a sustainable conveyance capacity. Additional limitations have been developed as safety factors and guidelines for the operation of discharge facilities including:

1. Zero discharge from the sub-watershed once the water surface elevation in the receiving water reaches 0.5-feet below the FEMA 100-year water surface profile at the discharge point.
2. At a minimum, detention basins in the sub-watershed must be sized to store at least four (4) hours of the prescribed pumping rate to accommodate a discharge shutdown.

Storm water infrastructure improvements within the City of Stockton and local urbanized areas of San Joaquin County are primarily based on hydrologic methodologies presented in two documents: the City Standards and the Draft Hydrology Manual developed by San Joaquin County. These documents will still be used and a discussion is presented on the use of these documents in conjunction with this Plan in Section 5 Hydrology Methodology.

The City's NPDES permit establishes waste discharge requirements and stipulates the City implement a Storm Water Management Plan (SWMP). The City has developed a Storm Water Management Plan and Storm Water Quality Control Criteria Plan to comply with the State Water Resources Control Board Regulations. Both of these Plans are discussed.

2 Introduction & Purpose

This Storm Drain Master Plan (Plan) establishes policies and design parameters for the future development of storm drain infrastructure in the City of Stockton's 2035 General Plan Boundary. This Plan is not intended to supersede the draft San Joaquin County Hydrology Manual or City of Stockton Storm Water Management Plan. Rather, this Plan supplements those documents and defines the process for planning and constructing storm drain facility improvements within the General Plan Boundary.

The purposes of this Plan include the following:

- Define the sub-watersheds within the 2035 General Plan Boundary. These sub-watersheds were developed with input from the City of Stockton Municipal Utilities Department and the various Developers in the region. The majority of these sub-watersheds have already been defined in the following studies:
    - Federal Emergency Management Agency, Flood Insurance Study, prepared on December 16, 2005 (revised). This study reflects hydrology and hydraulics developed by the San Joaquin Area Flood Control Agency (SJAFCA).
    - The Mariposa Lakes Development Off-Site Regional Hydrologic Investigation, prepared by Pacific Advanced Civil Engineering, Inc. on August 8, 2006.
    - The Tidewater Crossing Draft Hydrology/Hydraulic Analysis and Pre-Design Report, prepared by Domenichelli and Associates on September 15, 2006.
- Review the existing City Storm Drain Standards.
- Define receiving water quantity constraints based on previously approved hydrologic and hydraulic models.
- Summarize the discharge water quality constraints.
- Develop guidelines for Sub-watershed Storm Drain Master Planning.

3 Background

The City of Stockton is situated on the eastern boundary of the Sacramento/San Joaquin River Delta. The City is characterized by flat topography with a complex network of streams and rivers running through it. The northern portion of the City is protected by levees, and drainage is typically pumped into receiving waters. The southern portion of the City does not have many levees and is characterized by various floodplain designations. A detailed description of the area including its history, climate, various waterways, storage facilities, hydrology, principal flood problems, soil characteristics, flood protection measures, etc., is provided in the FEMA Flood Insurance Study (FIS) referenced below.

Improvements have been made on the majority of the waterways in the northern part of the City. At this time, these improvements provide 100-year flood protection to the surrounding areas. The developed portion of the City already has storm water infrastructure and it is therefore not addressed in this Plan.

Studies have been performed on the southern portion of the General Plan Boundary including the initial and subsequent revisions of the FIS. Most recently, hydrologic modeling of the main waterways for that area was performed as part of the planning for the Mariposa Lakes and Tidewater Crossing Developments. The studies attempt to characterize the approximate conveyance capacities, operations, and flood problems in that area and recommend improvements for their respective developments.

The Mariposa Lakes study presents a description of the previous studies, flow control measures, conveyance capacities, and operational methodologies of Farmington Dam and the flood control structures on Duck Creek and North Littlejohns Creek. The Tidewater Crossing study includes a description of South Littlejohns Creek, Lone Tree Creek, and French Camp Slough area.

Information on climate, geotechnical, or hydrologic information has been well documented in previous documents listed below and is therefore not re-visited here.

3.1 References

The following documents are referenced in this Plan and should be used during the planning and design of storm water infrastructure:

- Boyle Engineering, *Draft Hydrology Manual for San Joaquin County Department of Public Works*, September 1997
- City of Stockton *Standard Specifications*, adopted November 25, 2003
- City of Stockton Department of Municipal Utilities *Pump Station Design Guidelines*, revised August 27, 2001
- Domenichelli and Associates, *The Tidewater Crossing Draft Hydrology/Hydraulic Analysis and Pre-Design Report*, September 15, 2006.
- Ensign and Buckley Consulting Engineers, *North Little Johns Creek Drainage Study*

- Federal Emergency Management Agency, *Flood Insurance Study, San Joaquin County, California, Unincorporated Areas*, revised December 16, 2005

- Larry Walker Associates, City *of Stockton Storm Water Management Plan*, September 2003

- Larry Walker Associates, *City of Stockton Storm Water Quality Control Plan*, November 2003

- Pacific Advanced Civil Engineering, Inc., *Mariposa Lakes Development Off-Site Regional Hydrologic Investigation*, August 8, 2006.

4 Master Planning

This Plan is a framework document for developers and City Staff to define a process and criteria for future detailed sub-watershed storm drain planning in growth areas of the City's General Plan Boundary. Engineering of storm drainage systems in flat areas is highly sensitive to development land uses, street layouts, and grading plans. In addition, storm drainage systems tend to be de-centralized, draining to local channels or pump stations leading to channels. Past experience has shown that detailed Storm Drainage Master Plans are typically changed substantially once development-level planning and mapping occurs, so much of the technical effort involved in producing the Master Plan is wasted effort. However, receiving water systems have limits, and the City or its designee must control the fundamentals of storm drainage planning so that the incremental and cumulative impact of development is consistent with the design criteria for the San Joaquin Area Flood Control Agency (SJAFCA) and San Joaquin County Flood Control and Water Conservation District facilities.

Comparatively, master planned sewer systems are much less sensitive to final development mapping because they are not as sensitive to surface grading, and sewage production depends only on indoor uses, which is relatively predictable. Sewer systems also generally drain to a single point in a city, so it is both practical and necessary to master plan the backbone sewer piping systems to the outer limits of expected development, usually the General Plan Boundary. Additionally, water systems are fully interconnected pressurized systems which are relatively insensitive to grading, street layouts, and specific land uses, so prudent practice calls for establishing backbone piping and production systems in a Water System Master Plan.

Because storm drainage system planning is most efficiently planned in conjunction with planning of specific developments or groups of developments, the City's Storm Drainage Master Plan focuses on establishing a framework for subsequent planning by developers, and review by City staff. This Master Plan is structured to facilitate planning by presenting methodologies for use by community planners during the development phase. This document acts as the starting point for sub-watershed planning, presenting required information for planning and also directing the developer to other key documents that have been prepared for use in design.

4.1 Sub-watershed Delineation

The area within the General Plan Boundary was divided into drainage sub-watersheds as shown in Figure 4-1 This Plan focuses on undeveloped areas including the areas in the north, south and eastern portion of the City General Plan Boundary. Developed areas, predominantly in the center portion of the General Plan Boundary as shown in Figure 4-1, are not addressed by this Plan.

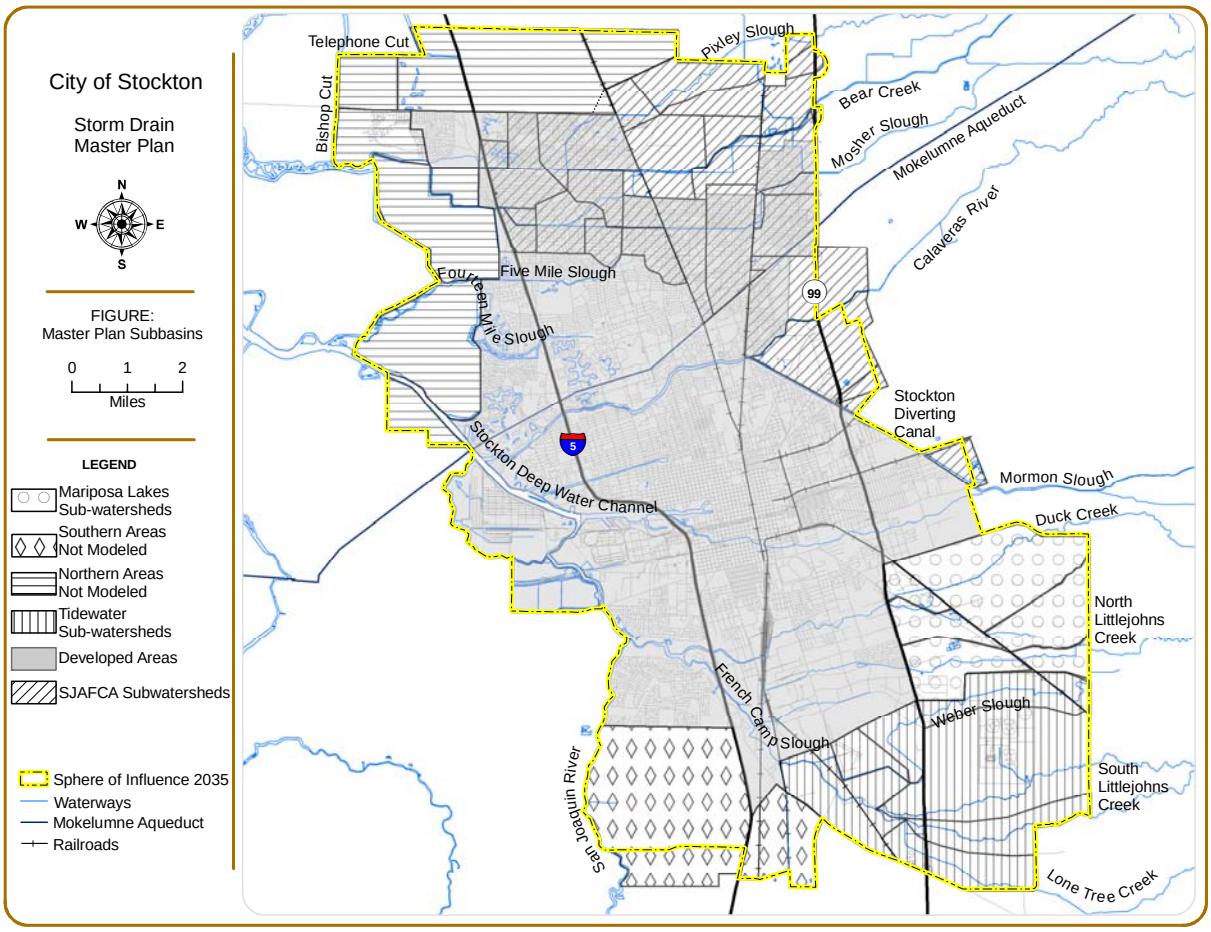

Figure 4-1 Sub-watersheds in the General Plan Boundary

Three hydrologic models were used to delineate sub-watershed boundaries including the Federal Emergency Management Agency (FEMA) approved San Joaquin Area Flood Control Agency (SJAFCA) models and two models developed separately for the Tidewater and Mariposa Lakes Developments in South Stockton. The SJAFCA models were approved by FEMA for use in the effective Flood Insurance Study, prepared in December, 2005 (revised). Neither the Tidewater or Mariposa Lakes models have been approved by the City, SJAFCA or FEMA at this time, but they are recognized as the best source of modeling information available. However, these models are subject to change pending final approval. No other hydrologic modeling was used in the development of this Plan.

As shown in Figure 4-1, the models represent sub-watersheds along the eastern portion of the General Plan Boundary. Areas in the northeastern portion of the General Plan Boundary were developed using the SJAFCA models. Waterways in the SJAFCA models include Pixley Slough, Bear Creek, Mosher Slough, Calaveras River, Diverting Canal and Mormon Slough. The Mariposa Lakes and Tidewater models represent the areas in the southeastern portion of the General Plan Boundary. Waterways in the Mariposa Lakes Model include Duck Creek, Branch Creek and North Littlejohns Creek. Waterways in the

Tidewater Model include Weber Slough, both North South Forks of South Littlejohns Creek, Duck Creek, North Littlejohns Creek, French Camp Slough and Lone Tree Creek.

As shown on Figure 4-2, the upstream watersheds for the Tidewater and Mariposa Lakes models overlap. This is due to a common upper watershed, with two diversion structures which alter the natural drainage patterns. The bifurcation points are both near Farmington Dam; one on Duck Creek and the other on Littlejohns Creek. At the most upstream diversion point, a diversion canal was constructed to divert water from Duck Creek to Littlejohns Creek. Downstream of that there is a bifurcation point on Littlejohns Creek where water can be diverted either to North Littlejohns Creek or South Littlejohns Creek.

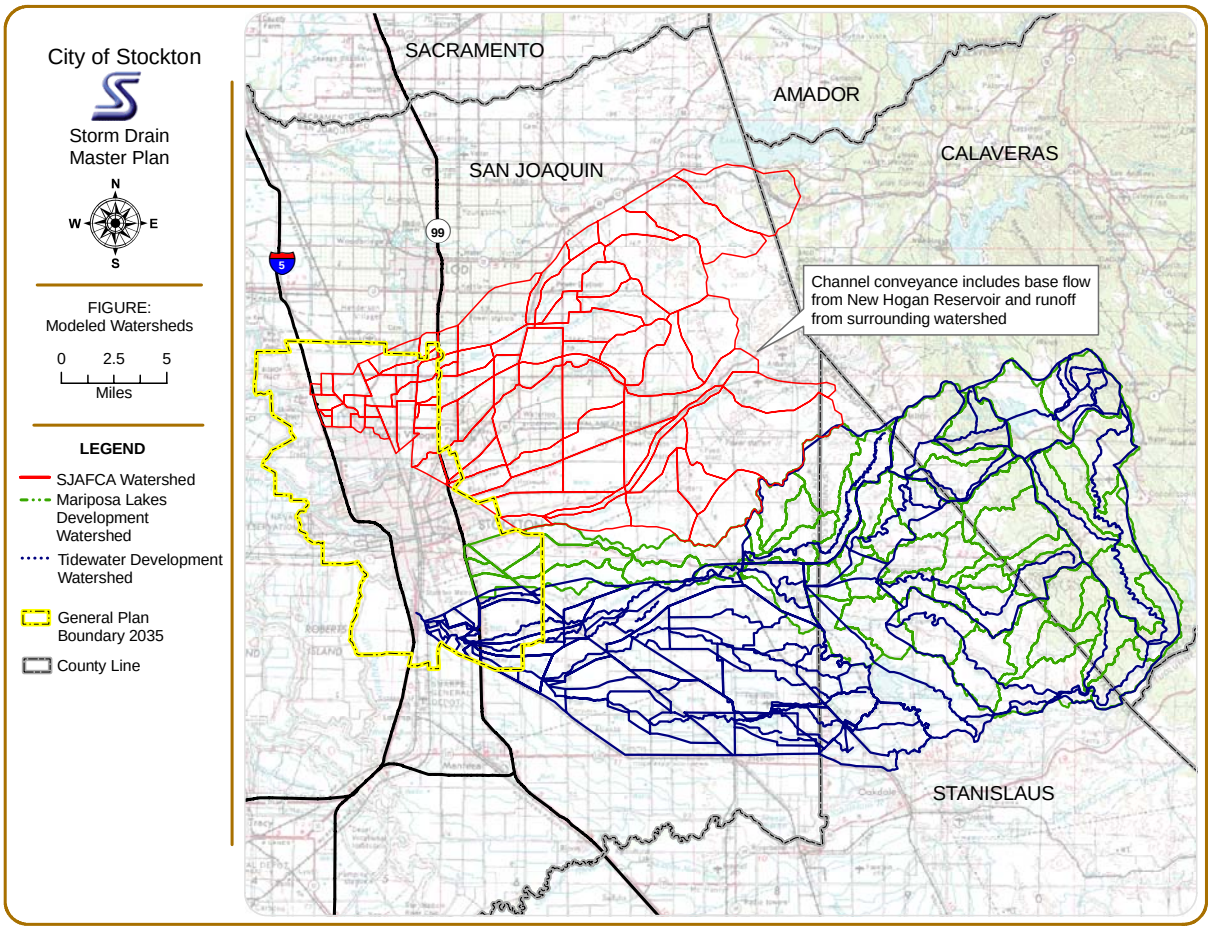

Figure 4-2 City of Stockton Watersheds incorporated into Hydrologic Models

The remaining subwatersheds were developed by the City with appropriate input from regional developers. The City considered a number of factors while developing the boundaries including the following considerations:

- Location and extent of currently planned developments

- Proximity to receiving waters
- Existing drainage patterns/boundaries
- Upstream runoff characteristics/limitations
- Current land use

4.2 Sub-watershed Planning

The situation arises too often in storm water planning that a conveyance system is built without fully considering the impact of upstream development, tributary areas and land use changes that result in modified runoff characteristics. This Plan attempts to avoid that pitfall by implementing strategic planning measures to create an appropriate storm water system for each sub-watershed.

The City of Stockton is located near the downstream end of a number of large watersheds as portrayed in Figure 4-2. Runoff from these watersheds is conveyed through the numerous waterways in the proposed General Plan Boundary. The high peak flows that runoff from these areas combined with the flat topography pose significant planning and design challenges. In addition, development changes drainage patterns and land use, which typically results in increased runoff, higher peak discharges and reduced time of concentration.

Large areas, such as the sub-watersheds presented in this Plan, are rarely developed all at once. Typically, the area will be built out in stages which can result in disjointed storm water systems if proper planning is not implemented. Therefore, it must be decided how to manage all the runoff from the sub-watershed, its upstream drainage, and downstream impacts before developing any portion of the area. The Stockton Municipal Code Section 16.355.210 sets the criteria for development within a drainage area. The following planning measure supports that code section.

> **Planning Measure One –** The entire area in each sub-watershed will be planned for storm water runoff collection, conveyance, detention and discharge prior to approval of any significant development within the sub-watershed.

Developers must be able to provide the proper facilities necessary to safely convey, store and discharge storm water. Measures will be taken to account for runoff upstream of the development and for downstream conveyance and storage. Detailed criteria for developing a sub-watershed master plan and criteria for design of infrastructure are presented in this plan.

It is crucial that Planning Measure One is implemented in the south eastern portion of the General Plan Boundary. The areas recently studied in the Mariposa Lakes and Tidewater Crossing studies have highlighted discrepancies between their findings and those presented in the FEMA FIS as well as other studies for that area. Both studies concluded that higher peak flows likely occur as opposed to those presented in the FIS and the other previously completed studies. The studies reiterate the need to implement improvements discussed in previous planning documents.

Developers shall work together as they develop the sub-watershed master plan as well as work closely with the City. Developments that overlap sub-watershed boundaries shall plan appropriately. Storm drain financing shall be done in accordance with the Stockton Municipal Code.

The second planning measure has been established to limit the amount of discharge from each sub-watershed so that the waterways in the City do not exceed channel conveyance capacities and that available capacity is fairly distributed among the sub-watersheds.

> **Planning Measure Two –** Storm water discharge from each sub-watershed shall be controlled to accommodate a sustainable conveyance capacity in each of the predominant waterways in the City.

Established discharge limitations for each sub-watershed are presented herein but are not established for sub-watersheds bordering the Delta waterways (i.e. San Joaquin River, Telephone Cut, Bishop Cut, Disappointment Slough, etc.), because incremental increases in Delta discharges due to the urbanization of these areas will not dramatically alter the water surface elevation due to the vast conveyance capacities and storage volume available in the Delta waterways.

Constraints are not established in this Plan, for the southern portion of the General Plan Boundary including Duck Creek, the Littlejohns Creeks, Weber Slough, Lone Tree Creek, and French Camp Slough. Although attempts have been made to identify the capacities of the waterways in the past, such as those in the Ensign and Buckley report, it is clear from the conclusions of the Mariposa Lakes and Tidewater Crossing studies that a comprehensive master plan for this area is needed to apportion flood flows between channels, and design functional and complete channels and protection systems.

4.3 Sub-watershed Discharge Limitations

The following section presents planning discussions, recommendations, and requirements for the areas identified in Figure 4-1. Section 5 Hydrology Methodology also contains more design requirements.

4.3.1 Northwestern Section

The sub-watershed division for the Northwestern Section of the General Plan Boundary is presented in Figure 4-3. All of areas BT4, Atlas, Shima and a portion of BT2 were undergoing planning as of the writing of this Plan. Planning has not begun for BT3 at this time.

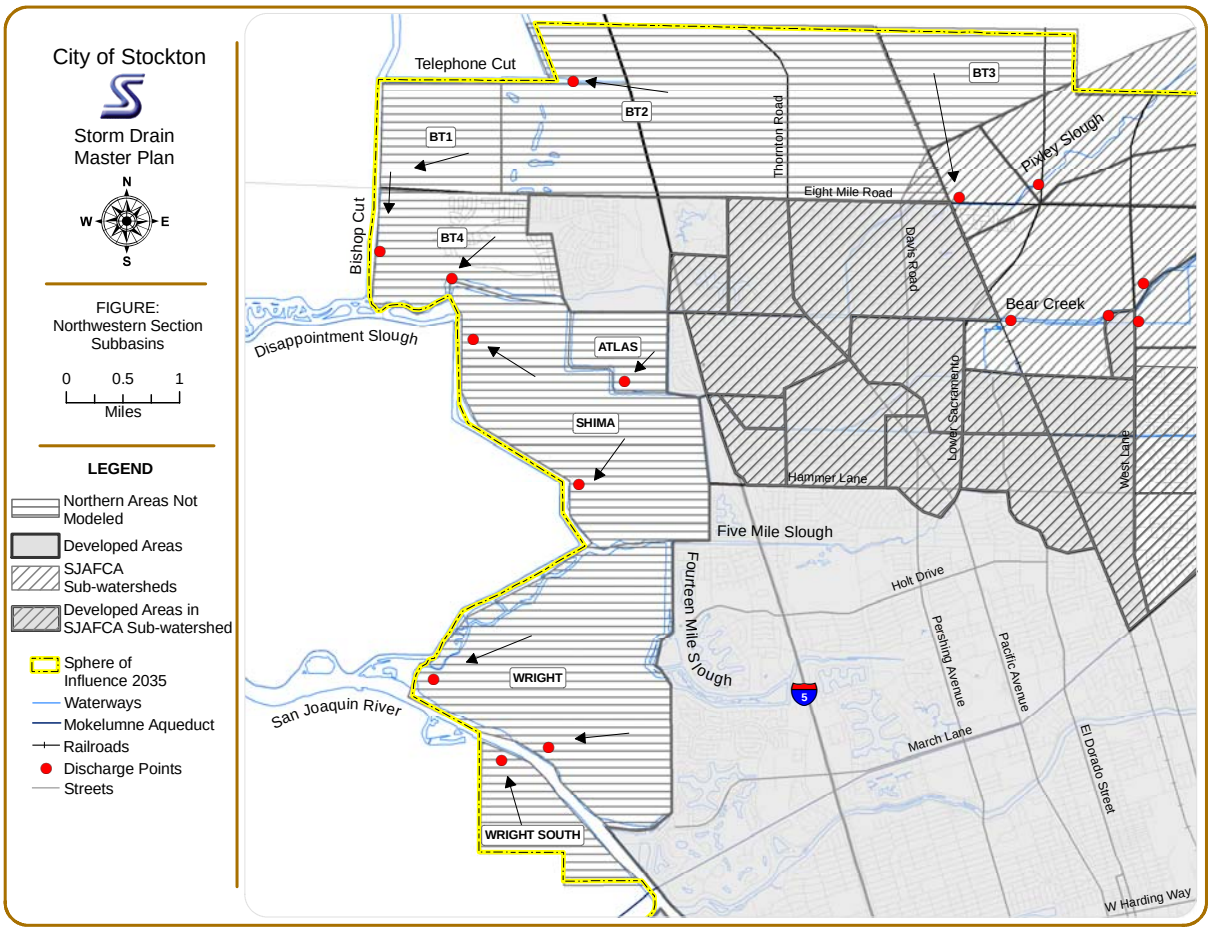

Figure 4-3 Northwestern and Western Drainage Area in the General Plan Boundary

Area BT1 – Planning is underway for this area. Receiving water quantity limitations are not stipulated for this area. Currently, water is pumped into Bishop Cut via a pump station at the southwest corner of the area. The pump station is approximately 2,800 feet south of Eight Mile Road and there is an existing drainage easement through BT4 for BT1 storm water. It is recommended that this pump station location continue to be utilized for the area post-development. However, should a pump station location north of Eight Mile Road become more favorable in the future, the station could be relocated. A condition assessment will be performed and any necessary improvements or additions will be implemented at the time of construction.

Area BT2 –Water naturally drains from east to west in this area (Figure 4-4). On the north side of the sub-watershed is the General Plan Boundary and to the south is existing development. Along the eastern portion of the sub-watershed, the Western Pacific Railroad acts as a natural barrier diverting runoff from area BT 3 to the north and south. Finally, on the west is area BT1.

Planning is well underway for the majority of this area. Planners have designed a series of detention basins and pipelines that ultimately discharge into Telephone Cut. The current plan does not cover the entire BT2 sub-watershed (Figure 4-4). It is recommended that the current planning efforts be adjusted to accommodate runoff from both isolated areas, with discharge to Telephone Cut.

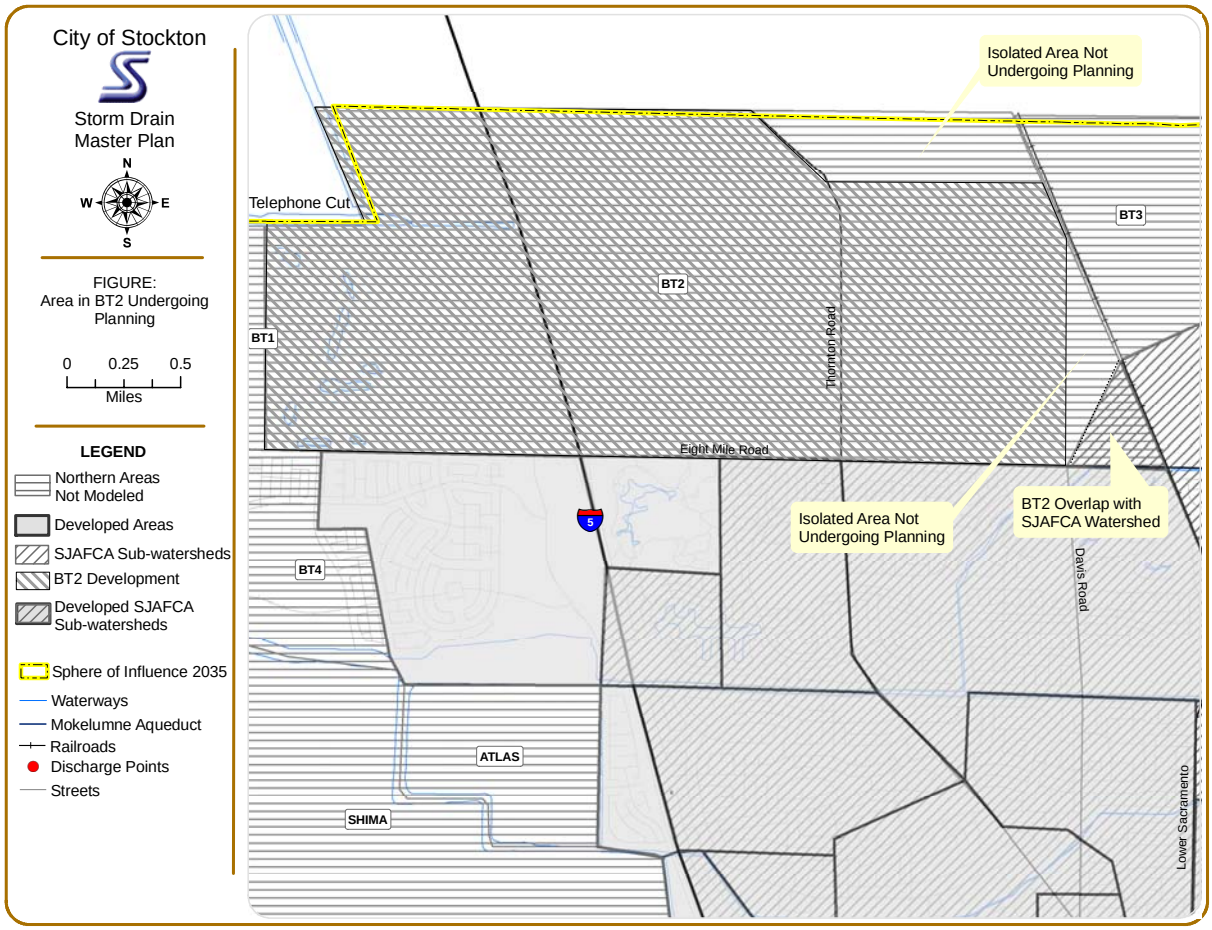

Figure 4-4 Current Area Undergoing Planning for Area BT2

Area BT3 – The area is bounded by the General Plan Boundary and the Western Pacific Railroad. Directly south lies undeveloped land that was included as part of the drainage area in the SJAFCA model. BT3 will discharge to Pixley Slough to the south and be included as part of the planning efforts for the areas directly to the south. Runoff in BT3 will have to be detained so that Pixley Slough will not be impacted.

Area BT4 – Planning for this entire area has begun. Storm water is intended to be discharged into Disappointment Slough. No planning modifications are required for this area.

4.3.2 Western Section

There are no receiving water constraints on the discharge flowrate for the areas in the Western Section of the City as shown in Figure 4-3. Planning is underway for the Atlas and Shima Tracts. Discharge for the Atlas Tract will go directly into Mosher Slough and the Shima Tract will discharge directly into 14-mile Slough. Discharge from the Wright-Elmwood Tract shall go directly into 14-mile Slough or the Stockton Deep Water Channel. Runoff from the Wright-Elmwood Tract South shall discharge directly to the Stockton Deep Water Channel.

4.3.3 Northeastern Section

The Northeastern Section is comprised of sub-watersheds that were developed as part of the SJAFCA study. The study was the basis for water body and levee improvements for Pixley Slough, Bear Creek, Mosher Slough, the Lower and Upper Calaveras River, the Stockton Diverting Canal and Mormon Slough. The improvements to these waterways were based on the conveyance capacities established in the SJAFCA model; therefore, it is appropriate to limit the discharges to those presented in the model. The planning and design criteria for these areas is presented in Appendix 3.

The majority of these areas within the General Plan Boundary have been developed. For areas within the General Plan Boundary that have not been developed, the sub-watersheds developed as part of the SJAFCA study will be used for future planning efforts as shown in Figure 4-5.

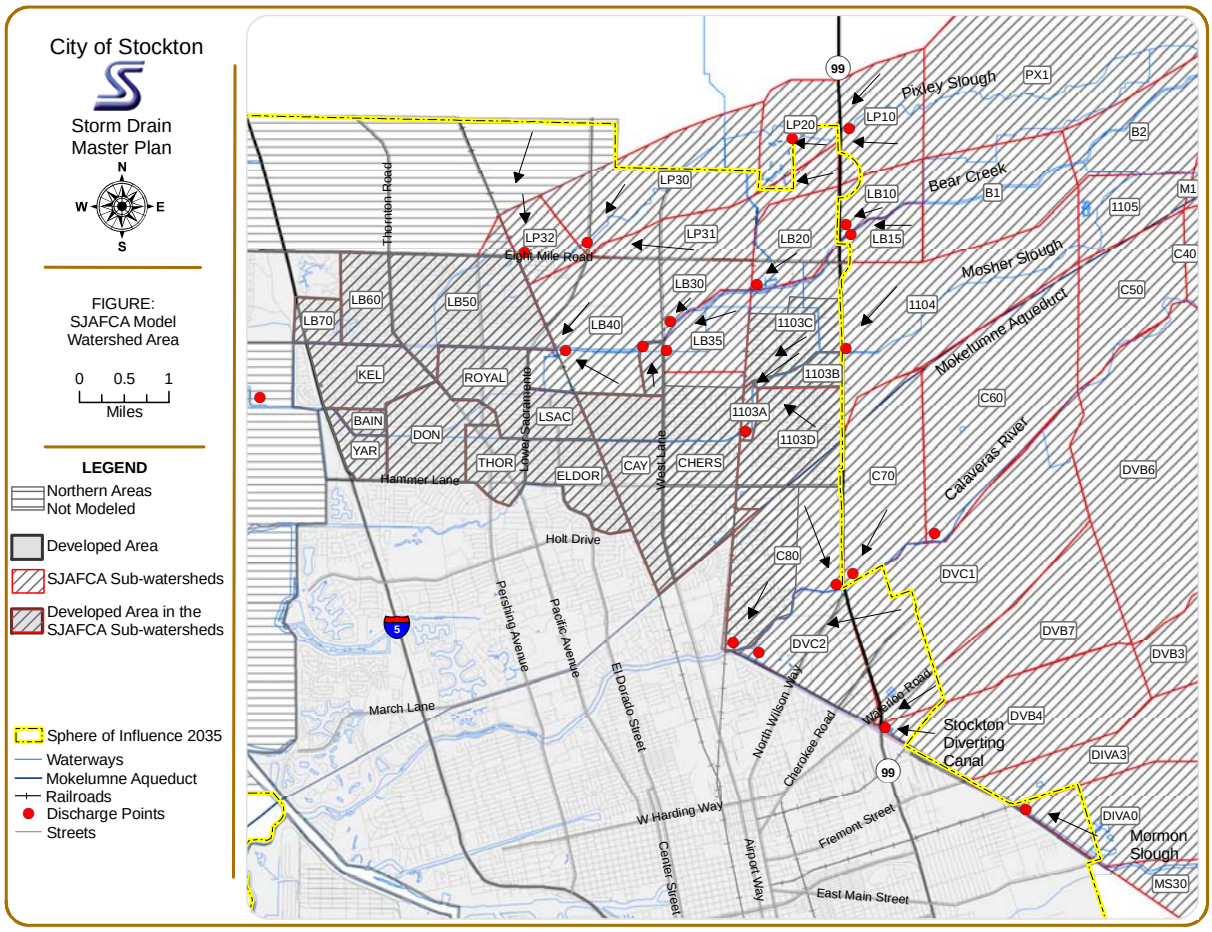

Figure 4-5 SJAFCA Model Sub-Watersheds in the General Plan Boundary

Area LP32 – Storm water is discharged into Pixley Slough. Discharge from the North (BT3) will be conveyed through this area.

Area LP30, LP20, LP10, LP31 – Storm water is discharged into Pixley Slough.

Area LB10, LB15, LB20, LB30, LB35, LB40 – Storm water is discharged to Bear Creek.

Area 1104, 1103C – Storm water is discharged into Mosher Slough.

Area C60, C70, C80, DVC1, DVC2 – Storm water shall be discharged into the Calaveras River.

Area DVB4, DVB7 – Storm water shall be discharged into the Stockton Diverting Canal.

4.3.4 Undeveloped Areas in the Southern Portion of the General Plan Boundary

The undeveloped areas in the southern portion of the General Plan Boundary include the sub-watersheds titled Southern Non-Modeled Areas, Mariposa Lakes Area, and the Tidewater Area as shown in Figure

4-6. These areas are not part of the SJAFCA modeling and do not have channel/levee improvements certified to FEMA specifications.

A comprehensive plan for flood management improvements in this region has not been completed, although recommendations have been made for isolated improvements. Discharge constraints cannot be developed without proper hydraulic modeling of the conveyance systems as previously discussed in this section. Comprehensive flood management planning is recommended for the entire French Camp Slough in order to properly size facilities, apportion discharge, prevent redirected impacts of development, and provide for operation and maintenance of facilities.

Prior to completion of the south area flood management plan, development in these areas must adhere to flood proofing standards, elevation, or new flood control measures on a case-by-case basis.

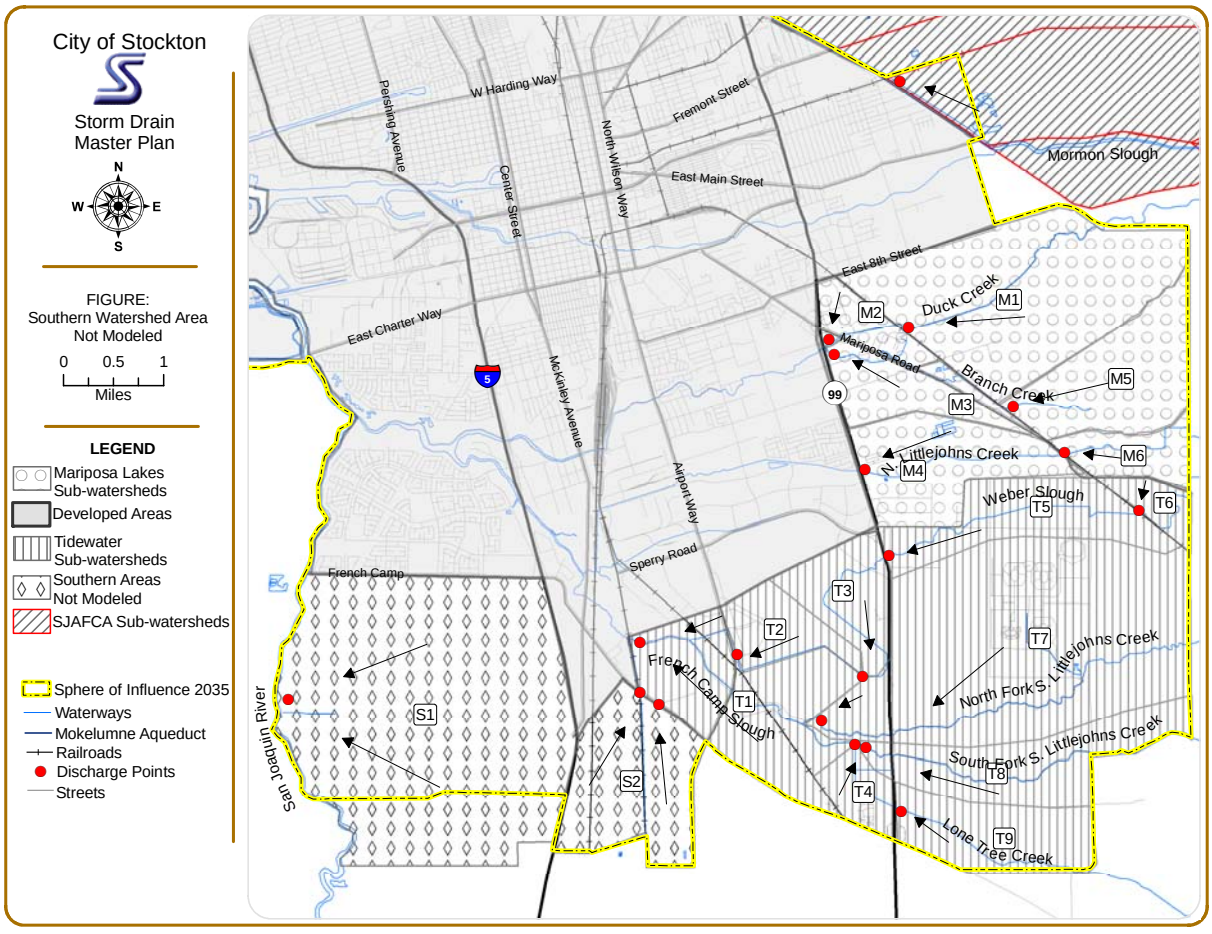

Figure 4-6 Southern General Plan Boundary Sub-watersheds

5 Hydrology Methodology

Storm water infrastructure improvements within the City of Stockton and local urbanized areas of San Joaquin County are primarily based on hydrologic/hydraulic methodologies presented in two documents: the City Standards and the Draft Hydrology Manual developed by San Joaquin County. The City Standards present design methods for improvements to pipelines, detention basins and appurtenant infrastructure whereas the Hydrology Manual presents hydrologic and hydraulic methodologies for design.

In addition to traditional methods used to design storm drainage systems, the design of these systems may also be based on detailed hydrologic and/or hydraulic modeling.

This Plan ties both those documents together and implements supplemental criteria. Planning and design requirements are presented in Appendix 3.

6 Discharge Water Quality Constraints

The City of Stockton rests at the confluence of two major Rivers, the San Joaquin and Calaveras Rivers, and on the boundary of the Sacramento-San Joaquin River Delta. Storm water discharges to these Rivers and other water bodies in the region not only impact the water quality of the receiving waters, but also the Sacramento-San Joaquin River Delta. Due to the size of the community, the City of Stockton is required to obtain a NPDES municipal storm water permit as discussed below.

The NPDES permit establishes waste discharge requirements and stipulates the City implement a Storm Water Management Program (SWMP). Additionally, on October 5, 2000, the State Board adopted Order WQ 2000-11 concerning the use of Standard Urban Storm Water Mitigation Plans that establish development standards for new developments and significant redevelopment by the private sector. In response to these requirements, the City developed a Storm Water Management Plan and Storm Water Quality Control Criteria Plan (SWQCCP) which must be incorporated into Storm Drain Master Planning. Both of these Plans are described below.

6.1 NPDES Permit

The City of Stockton and County of San Joaquin are joint permit holders of the NPDES Permit Number CAS083470. The permit was issued by the Central Valley Region, California Regional Water Quality Control Board in Order Number R5-2002-0181. Information on the NPDES program and important aspects of the City's permit are presented in Appendix 1. The full permit can be downloaded from the following websites:

Central Valley Regional Water Quality Control Board,
http://www.swrcb.ca.gov/rwqcb5/adopted_orders/index.html#joaquin

City of Stockton Municipal Utilities Department Document Room,
http://www.stocktongov.com/mud/General/reports_forms.cfm

6.2 Storm Water Management Plan

The NPDES permit requires permittees to develop and implement a SWMP designed to reduce the discharge of pollutants through their MS4s to the Maximum Extent Practicable (MEP). The City of Stockton in association with Larry Walker Associates completed a SWMP in September 2003. The SWMP is summarized in Appendix 1, but is not meant to replace it in any manner. The SWMP will be reviewed in its entirety in conjunction with sub-watershed master planning. This Plan can be found on the City of Stockton Document Room website listed above.

6.3 Storm Water Quality Control Criteria Plan

The SWQCCP was developed in response to the requirements of the NPDES permit. The SWQCCP will be reviewed in its entirety in conjunction with sub-watershed master planning. It is summarized in Appendix 1. This Plan can be found on the City of Stockton Document Room website listed above.

6.4 Guidance on Developer Responsibility

To comply with the standards established in the NPDES Permit, developers must review both the SWMP and SWQCCP. The Sub-Watershed Master Plan will include the following elements:

- Characterize expected pollutants, sources and measures to reduce and/or eliminate expected pollutants.

- Describe water quality control measures and BMPs included in the Sub-Watershed Master Plan. Describe how these measures will avoid, minimize, or mitigate the potential adverse impacts to storm water. For example, describe how pervious and impervious areas are connected and what actions were taken to minimize impervious areas. Describe how riparian corridors, wetlands and/or buffer zones were protected or enhanced. Additional ways to reduce adverse impacts are presented in Section 7 of the SWMP. Section 3 of the SWQCCP presents site design control measures that will be used to protect natural areas. Section 4 presents site-specific source control methods and Section 5 presents treatment control measures.

- Identify specific control requirements for the sub-watersheds. For example, if the receiving water is on the EPA 303d list, present what special efforts were taken to protect the water body.

Appendix 1 – NPDES Program, Permitting, and Compliance Measures

NPDES and the City of Stockton

Background

Storm water permitting dates back to 1972 when the federal Water Pollution Control Act (also known as the Clean Water Act [CWA]) was amended to provide that the discharge of pollutants to waters of the United States from any point source is unlawful unless the discharge is in compliance with a NPDES permit. The 1987 amendments to CWA added section 402(p), which established a framework for regulating storm water discharges under the NPDES Program. Subsequently, in 1990, the U.S. Environmental Protection Agency (U.S. EPA) promulgated regulations for permitting storm water discharges from industrial sites (including construction sites that disturb five acres or more) and from municipal separate storm sewer systems (MS4s) serving a population of 100,000 people or more. These regulations, known as the Phase I regulations, require operators of medium and large MS4s to obtain storm water permits. On December 8, 1999, U.S. EPA promulgated regulations, known as Phase II, requiring permits for storm water discharges from Small MS4s and from construction sites disturbing between one and five acres of land.

An "MS4" is a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) designed or used for collecting or conveying storm water; (ii) which is not a combined sewer; and (iii) which is not part of a Publicly Owned Treatment Works (POTW). [See Title 40, Code of Federal Regulations (40 CFR) §122.26(b)(8).]

A "Small MS4" is an MS4 that is not permitted under the municipal Phase I regulations, and which is "owned or operated by the United States, a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity…." (40 CFR §122.26(b)(16)).[1]

The CWA provides that MS4 permits must "require controls to reduce the discharge of pollutants to the maximum extent practicable (MEP), including management practices, control techniques and system, design and engineering methods, and such other provisions as the U.S. EPA Administrators or the State determines appropriate fro the control of such pollutants." The SWRCB has issued a memorandum interpreting the meaning of MEP to include technical feasibility, cost, and benefit derived with the burden being on the municipality to demonstrate compliance with MEP by showing that a BMP is not technically feasible in the locality or that BMPs costs would exceed any benefit to be derived. Numeric limits have not been established for any of the pollutants in storm water discharges.

[1] Fact Sheet for State Water Resources Control Board (SWRCB) Water Quality Order No. 2003-0005-DWQ (http://www.waterboards.ca.gov/stormwtr/phase_ii_municipal.html)

City of Stockton NPDES Permit

The City of Stockton qualifies as a medium municipality because the City's population is greater than 100,000 but less than 250,000 people. The County of San Joaquin contains urbanized areas and areas of potential growth surrounding the City and owns storm drains that are connected to the City's system. As a result, and due to other factors, the RWQCB designated the County as part of the medium MS4 system and designated both agencies as joint permittees. On October 18, 2002, the Regional Board adopted Waste Discharge Requirements and Monitoring and Reporting Program Order No. R5-2002-0181, NPDES No. CAS083470, prescribing waste discharges requirements for the City and portions of San Joaquin County. On September 5, 2003, the Regional Board adopted an Amendment of Waste Discharge Requirements Resolution No. R5-2003-0133 to the NPDES permit. Both of the documents can be viewed at the Central Valley RWQCB website[2].

The City and County have identified 114 and 48 outfalls, respectively, within their jurisdictions. Dating back to 1995, the City has sampled three storms per year at five locations representing Residential, Commercial, and Industrial storm water discharges. Their assessments and assessments by DeltaKeeper, and the Regional Board have identified impairment, or threatened impairment, of beneficial uses of water bodies in the Stockton Urbanized Area. The causes of impairment include oxygen demanding substances, certain heavy metals, pesticides, and pathogens.

Section 303(d) of the Clean Water Act requires the identification of waterbodies that do not meet, or are not expected to meet, water quality standards, or are considered impaired. The affected water body, and associated pollutant or stressor, is then prioritized in the 303(d) list. The Clean Water Act further requires the development of a Total Maximum Daily Load (TMDL) for each listing. The current list, approved by the EPA, is the 2002 303(d) list.[3]

Waterways in the Stockton Urbanized Area that are on the list are presented in Table A1-1.

The State Board has issued two statewide general NPDES permits for storm water discharges: one for storm water from industrial sites and the other for storm water from constructions sites. The Regional Board has issued a General Permit for dewatering and other low threat discharges, which authorizes such discharge to the MS4s owned and operated by Permittees. The NPDES permit requires the Permittees to conduct compliance inspections at industries and construction sites that discharge to their MS4s. The Permittees have adopted Ordinance Nos. 013-95 and 005-97, which allow the authority to protect and enhance the water quality of watercourses, water bodies, and wetlands in the Stockton Urbanized Area.

Storm water discharges from agricultural, rural or open space land use types are not subject to federal storm water regulations and are therefore exempt from the requirements of the NPDES permit unless they discharge directly to the Permittees' conveyance system.

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[2] From the State Water Resources Control Board website: http://www.swrcb.ca.gov/rwqcb5/adopted_orders/index.html#joaquin November 3, 2006

[3] From the Central Valley Regional Water Quality Control Board website: http://www.waterboards.ca.gov/centralvalley/programs/tmdl/index.htm#303d, October 31, 2006.

The NPDES permit is intended to develop, achieve, and implement a timely, comprehensive, cost-effective storm water pollution control program to reduce the discharge of pollutants in storm water to the MEP from the permitted areas in the Stockton Urbanized Area subject to the Permittees' jurisdiction. The Board requires that these requirements be addressed through the effective implementation of BMPs. A Storm Water Management Plan must be implemented during the entire duration of the permit and an annual report must be published that demonstrates compliance with the NPDES permit. The SWMP must act to reduce the discharge of pollutants in storm water to the MEP, and to effectively prohibit non-storm water discharges into municipal storm drain systems within the Permittees' jurisdiction during the five-year duration of the permit.

The NPDES permit orders the permittees to comply with a number of measures to comply with the CWC and CWA. A summary of these orders are presented below for reference:

- **Order A: Discharge Prohibitions – Storm Water Discharges**. This order prohibits discharges from MS4s in a manner causing, or threatening to cause, a condition of pollution, contamination, or nuisance as defined in the CWC; prohibits discharges which cause or contribute to exceedances of receiving water quality standards for surface and ground water; and prohibits discharges containing pollutants which have not been reduced to the MEP.

- **Order B: Discharge Prohibitions – Non-Storm Water Discharges.** This order prohibits non-strom water discharges into MS4s unless they are covered by a separate permit. Examples of such discharges include car washing runoff, irrigation water, diverted stream flows, etc. Emergency fire flows are allowed, but non-emergency fire flows must be mitigated using BMPs to the MEP.

- **Order C: Receiving Water Limitations.** This order sets receiving water limitations and requires that discharges from MS4s shall not cause certain conditions to exist. For example limitations are set on the amount of dissolved oxygen, oils, grease, waxes, chlorine, fungi, slime, turbidity, pH, sediment, radionuclides, toxic pollutants, and pathogens in the water. The discharge shall not violate the Basin Plan and the limitations set therein. The order requires the permittees to comply with the discharge constraints through timely implementation of control measures and other actions in accordance the SWMP and requirements of the order. The SWMP is meant to act as a living document that recognizes violations and acts to correct the occurrence. If a violation persists, the permittees must report the violation to the RWQCB via a report of water quality exceedance (RWQE). The RWQE shall identify current and proposed BMPs that will be used correct the violation. The RWQE shall be incorporated into the SWMP.

- **Order D: Provisions.** This order identifies the measures that the permittees are required to take to comply with the permit. The measures include such items as:

    - Establish conditions for approving new developments, adopt a Storm Water Quality Control Criteria Plan, adopt/update their standard specifications and plans to incorporate storm water quality provisions.

- Require coordinate among internal agencies/outside agencies
- Develop budget expenditure for storm water quality protection projects
- Develop a Storm Water Management Program
- Establish legal authority to implement the requirements of the permit
- Establish a program management program to ensure all aspects of the SWMP are implemented in accordance with the permit. The program should address the annual work plan, annual report, SWMP implementation, SWMP modification, departmental coordination, etc.
- Establish core programs to ensure compliance with the permit for the construction, industrial, commercial and municipal industries.
- Establish operations procedures and management for the various storm drain infrastructure components.
- Establish water quality based programs

The NPDES permit also establishes the Monitoring and Reporting Program (MRP). The MRP identifies what is required in the annual report. The annual report presents what efforts the permittees have made in protecting water quality, implementing BMPs, meeting the requirements of the MRP, etc.

Table A1-1 Waterways in the Stockton Urbanized Area on the EPA's 2002 303(d) list

Waterway	303(d) list pollutant	Potential Sources
Lower Calaveras River	Diazinon	Urban Runoff/Storm Sewers
	Organic Enrichment/Low Dissolved Oxygen	Urban Runoff/Storm Sewers
	Pathogens	Urban Runoff/Storm Sewers; Recreational and Tourism Activities (non-boating)
Delta Waterways (eastern portion)	Chlorpyrifos	Agriculture; Urban Runoff/Storm Sewers
	DDT	Agriculture
	Diazinon	Agriculture; Urban Runoff/Storm Sewers
	Group A Pesticides	Agriculture
	Mercury	Resource Extraction
	Unknown Toxicity	Source Unknown
Delta Waterway (Stockton Ship Channel)	Chlorpyrifos	Agriculture; Urban Runoff/Storm Sewers
	DDT	Agriculture
	Diazinon	Agriculture; Urban Runoff/Storm Sewers
	Group A Pesticides	Agriculture
	Mercury	Resource Extraction
	Organic Enrichment/Low Dissolved Oxygen	Municipal Point Sources; Urban Runoff/Storm Sewers
	Unknown Toxicity	Source Unknown
Five Mile Slough (Alexandria Place to 14-Mile Slough)	Chlorpyrifos	Urban Runoff/Storm Sewers
	Diazinon	Agriculture; Urban Runoff/Storm Sewers

Waterway	303(d) list pollutant	Potential Sources
	Organic Enrichment/Low Dissolved Oxygen	Urban Runoff/Storm Sewers
	Pathogens	Urban Runoff/Storm Sewers; Recreational and Tourism Activities (non-boating)
Mormon Slough (Commerce Street to Stockton Deep Water Channel)	Organic Enrichment/Low Dissolved Oxygen	Urban Runoff/Storm Sewers
	Pathogens	Urban Runoff/Storm Sewers; Recreational and Tourism Activities (non-boating)
Mormon Slough (Stockton Diverting Canal to Commerce Street)	Pathogens	Urban Runoff/Storm Sewers; Recreational and Tourism Activities (non-boating)
Mosher Slough (downstream of I-5)	Chlorpyrifos	Urban Runoff/Storm Sewers
	Diazinon	Agriculture; Urban Runoff/Storm Sewers
	Organic Enrichment/Low Dissolved Oxygen	Urban Runoff/Storm Sewers
	Pathogens	Urban Runoff/Storm Sewers
Mosher Slough (upstream of I-5)	Pathogens	Urban Runoff/Storm Sewers
San Joaquin River (Merced River to South Delta Boundary)	Boron	Agriculture
	Chlorpyrifos	Agriculture
	DDT	Agriculture
	Diazinon	Agriculture
	Electrical Conductivity	Agriculture
	Group A Pesticides	Agriculture
	Mercury	Resource Extraction
	Unknown Toxicity	Source Unknown
Stockton Deep Water Channel, Upper (Port Turning Basin)	Dioxin	Point Source
	Furan Compounds	Contaminated Sediments
	Pathogens	Urban Runoff/Storm Sewers; Recreational and Tourism Activities (non-boating)
	PCBs	Point Source

City of Stockton Storm Water Management Plan

The overall goals of the Plan, as stated in the SWMP, are to reduce the degradation, by urban runoff, of the beneficial uses of natural resources of the metropolitan area of Stockton. The objectives outlined in the SWMP include:

1. Identify and control those pollutants in urban runoff that pose significant threats to the natural resources and their beneficial uses;

2. Comply with the federal regulations to eliminate or control, to the maximum extent practicable, the discharge of pollutants from urban runoff associated with the metropolitan storm drainage system;
3. Develop a cost effective program which focuses on pollution prevention of urban storm water;
4. Seek cost effective alternative solutions where prevention is not a practical solution for a significant problem; and
5. Coordinate implementation of control measures with other agencies.

The SWMP is organized into ten sections as described below:

Section 1.0 Program Management - This section presents the overview and background of the SWMP. The section describes the methods for program coordination, fiscal analysis, and legal authority as required by the NPDES permit.

Section 2.0 Illicit Connections/Illegal Discharges - This section discusses the permit requirements for illicit discharges including control measures. The section describes in depth what are illicit discharges and how to handle illicit discharges when they occur.

Section 3.0 Public Education - This section describes the public education and outreach program that has been developed to enhance change in behavior and increase the knowledge of target communities to reduce pollutants to the storm drain systems.

Section 4.0 Municipal Operations - This section describes the program that has been developed to address municipal operations so that they are performed in a manner that is protective of water quality and minimizes the potential for pollutants to enter the storm drain system.

Section 5.0 Industrial and Commercial Businesses - This section describes the program that has been developed to inspect and outreach to industrial and commercial businesses.

Section 6.0 Construction - This section describes the program that has been developed to reduce pollutants from construction sites during all construction phases.

Section 7.0 Planning and Land Development - This section describes the program that has been developed to address the reduction of pollutants in new development through better site planning, design practices and post construction controls.

Section 8.0 Water Quality Based Programs - This section provides an overview of the various water quality based programs that are being developed and implemented such as the Pesticide Plan, Pathogens Plan, Dissolved Oxygen Plan and Smith Canal Study.

Section 9.0 Monitoring - This section describes the water quality monitoring program that was developed in order to assess the health of the local water bodies, evaluate selected treatment control Best Management Practices (e.g. detention ponds) and characterize storm water discharges.

Section 10.0 Program Implementation, Evaluation and Reporting - This section describes the implementation schedule and training program and identifies methods that will be used to evaluate the overall program and reporting requirements.

Storm Water Quality Control Criteria Plan

Generally, the SWQCCP presents Best Management Practices to optimize post-construction, on-site storm water pollution control. It identifies the process that each developer must undertake to get project approval. Primarily, developers must develop a Project Storm Water Quality Control Plan that demonstrates the development will comply with the requirements presented in the SWQCCP.

The SWQCCP is divided into five sections including:

- Section 1 – Background, Goals, and Subject Projects
- Section 2 – Overview and Use of Manual
- Section 3 – General Site Design Control Measures
- Section 4 – Site-specific Source Control Measures
- Section 5 – Treatment Control Measures

Section 1

As presented in Section 1, the SWQCCP was developed to accomplish the following goals:

- Assist new developments in reducing urban runoff pollution to the "maximum extent practicable";
- Ensure the implementation of measures in this Manual is consistent with NPDES permit and other State requirements;
- Provide development standards for developers, design engineers, agency engineers, and planners to use in the selection and implementation of appropriate storm water treatment and source control measures; and
- Provide maintenance procedures to ensure that the selected control measures will be maintained to provide effective, long-term pollution control.

Section 1 further defines the types of new development and significant redevelopment projects that are required to implement the controls identified in the SWQCCP include the following[4]:

1. **Significant Redevelopment –** Significant redevelopment is defined as the creation or addition of at least 5,000 square feet of impervious surfaces on an already developed site. Significant redevelopment includes, but is not limited to, expansion of a building footprint or addition or replacement of a structure; structural development including an increase in gross floor area and/or exterior construction or remodeling; replacement of impervious surface that is not part of a routine maintenance activity; and land disturbing activities related with structural or impervious surfaces. Where significant redevelopment results in an increase of less than fifty percent of the impervious surfaces of a previously existing development, and the existing development was not

[4] Information presented here is taken from the Storm Water Quality Control Criteria Plan

subject to development standards under this Plan, the numeric sizing criteria listed for items 2 through 8 below applies only to the addition, and not to the entire development.

2. **Home subdivisions of 10 housing units or more –** This category includes single-family homes, multi-family homes, condominiums, and apartments.
3. **Commercial developments greater than 100,000 square feet –** This category is defined as any development on private land that is not for heavy industrial or residential uses where the land area for development is greater than 100,000 square feet. The category includes, but is not limited to hospitals, laboratories and other medical facilities, educational institutions, recreational facilities, commercial nurseries, multi-apartment buildings, car wash facilities, mini-malls and other business complexes, shopping malls, hotels, office buildings, public warehouses, and other light industrial facilities.
4. **Automotive repair shops –** This category is defined as a facility that is categorized in any one of the following Standard Industrial Classification (SIC) codes: 5013, 5014, 5541, 7532-7534, or 7536-7539, where the total impervious area for development is greater than 5,000 square feet.
5. **Restaurants –** This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812), where the total impervious area for development is greater than 5,000 square feet.
6. **Parking lots 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to urban runoff –** Parking lot is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.
7. **Street and roads –** This category includes any paved surface in excess of one acre of impervious area used for the transportation of automobiles, trucks, motorcycles, and other vehicles.
8. **Retail Gasoline Outlets –** Retail Gasoline Outlet is defined as any facility engaged in selling gasoline with 5,000 square feet or more of impervious surface area.

Section 3

Section 3 presents General Site Design Control Measures that are designed to reduce storm water runoff peak flows and volumes. The intent of the control measures are to reduce downstream treatment controls and conveyance systems, reduced pollutant loading to treatment controls, and reduce hydraulic impact on receiving streams. The measures are required for all new categorical development and redevelopment projects. The control measures are organized as follows:

- **G-1: Conserve Natural Areas** – this measure requires structures be located on the least sensitive portion of the site and natural vegetated areas be conserved.
- **G-2: Protect Slopes and Channels –** this measure identifies appropriate slope protection measures to be utilized, such as rip rap.

- **G-3: Minimize Impervious Area** – this measure identifies ways to minimize impervious areas increase the amount of infiltration thereby reducing downstream pollute loading and a reduction in the runoff volume.

- **G-4: Minimize Effective Imperviousness –** this measure identifies ways to effectively use pervious areas by routing storm water runoff through the pervious area prior to entering the storm water conveyance system.

Section 4

This Section addresses site-specific, structural type source control measures consisting of specific design features or elements. Projects must use of appropriate control measures identified in the in this section. For example, a gas station will utilize different control measures than home subdivisions. Additionally, it is reiterated that nonstructural source control measures should be used in conjunction with the structural controls identified in this section. Eight examples of control measures are identified in this section including site signage, proper storage methods for trash and other outdoor objects, outdoor loading/unloading dock area design, outdoor repair/maintenance bay design, outside washing area design, fueling area design, and a maintenance plan.

Section 5

Section 5 identifies numerous BMPs that are to be used in varying degrees to accomplish the goals of the NPDES permit and this SWQCCP. Guidance is provided on what type of control measures are appropriate for the type of project. Methodology is presented to calculate to the storm water flow and volume produced during a storm event. This information is then used to size the BMPs.

Thirteen Treatment Control Measures are presented. Provided with each measure is a description, general application, advantages/disadvantages, performance, design criteria and procedures, design example, and maintenance requirements. The thirteen measures include vegetated buffer strips, vegetated swales, extended detention basin, wet pond, constructed wetland, detention basin/sand filter, porous pavement detention, porous landscape detention, infiltration basins, infiltration trenches, media filter, retention/irrigation, and alternative control measures and proprietary control measures.

Appendices

The Plan also presents eight appendices. The first appendix, Appendix A, presents a summary of the glossary of terms and list of acronyms. Appendix B presents the Standard Calculations for Diversion Structure Design. Storm water runoff in excess of the water quality flow or volume is to be diverted around or through the treatment control measure. This appendix provides equations and design criteria necessary to design diversion structures to divert runoff not captured by the control measure.

Appendix C is a sample Storm Water Treatment Device Access and Maintenance Agreement. Appendix D identifies the basic information and format for the Project Storm Water Quality Control Plan.

Appendix E discusses the properties of the Hydrologic Soil Groups in the region and discusses where to get soils information.

Appendix F discusses how to select appropriate plants suitable for vegetative control measures. Appendix G presents a number of design forms for use in designing the control measures and Appendix H lists the references used in the plan.

Appendix 2 – Sub-Watershed Master Plan Procedural Handout

City of Stockton Conceptual Storm Drain Master Plan

for the General Plan Boundary 2035

Handout on Preparation of a Storm Drain Master Plan

City of Stockton storm water sub-watersheds must be planned under an individual Sub-watershed Storm Drain Master Plan (SDMP). The SDMP should be submitted to the City at the same time as the environmental documentation. Submitters shall work with other land owners in the sub-watershed to develop a SDMP that works for the entire sub-watershed. If a proposed development is consistent with an existing SDMP on file with the City, a new one will not be required.

In addition to this Handout, the Stockton Municipal Code Chapter 16, Development Code Section 16-355.210 establishes standards for development of the SDMP.

The format and contents of the SDMP are further explained here. The SDMP must address:

- Proposed land use
- Pre- and post-project sub-watershed hydrology and hydraulics including upstream influences and receiving water constraints
- Planning methodology and assumptions
- Proposed storm drain infrastructure
- Water quality requirements
- Approximate staging and scheduling of improvements

The SDMPs must be clear, concise and generally contain the sections identified in this document. Where maps tell the story, it is not necessary to restate the information in text. The SDMP should be organized as follows:

Section 1 - Executive Summary

The executive summary shall present the key findings and recommendations of the SDMP in an easy to read concise layout. At a minimum the following items should be discussed:

- Provide a description of the watershed, developments, phasing, and expected timing of improvements
- Pre-project runoff characteristics and results.
- Post-project runoff characteristics and results, including interim phases plus buildout.
- Receiving water constraints and mitigation measures to control discharges.
- Water quality issues and best management practices that will be incorporated into the storm drain system.

Section 2 – Sub-Watershed Characteristics

This section shall include a description of the current and future land use, topography, and runoff characteristics. If intermediate phasing of development is contemplated, summarize conditions for each phase.

Provide a table and figure presenting both pre- and post-project land use. All pertinent information summarized in an exhibit will be provided on a 24" x 36" scale for City review.

Present the topography (1-foot contour intervals, unless better data exists) in the watershed, showing flow paths. In certain instances five foot contour intervals may be acceptable.

Present the soil information at the site including type and area. This information is readily available from the Natural Resources Conservation Service, NRCS, (formally known as the Soil Conservation Service) at their website http://soils.usda.gov/. Provide a tabular and graphical representation of the soil including infiltration and runoff characteristics.

Section 3 – Analysis Methodology

This section presents the tools and methods in which the designer used to develop the storm drain system. This section will be used by the City to verify the assumptions and methods used meet City criteria.

For both pre- and post-project scenarios, the designer shall reference drainage standards used in the analysis. If a hydrologic or hydraulic model was used, the designer shall identify which program and provide a description of the input and output parameters of that program.

All pertinent information summarized in an exhibit will be provided on a 24" x 36" scale for City review. This section should include figures that graphically present the following information:

1) Pre-project topography, drainage patterns, and major drainage facilities

2) Pre-project land use and runoff constraints (such as the CN and/or C values)

3) Post-project topography, drainage patterns, and major drainage facilities

4) Post Project land use

Section 4 – Sub-Watershed Analysis Results and Recommended Master Plan

This section should describe the results of the pre- and post-project analysis and describe the recommended plan. Results of the calculations and/or modeling for both scenarios shall be presented in a clear manner utilizing tables and figures. Compare and quantify the runoff differences between the pre- and post project scenarios. Discuss mitigation measures to reduce the peak discharge from the post project scenario to reduce it to the pre-project condition and/or adhere to receiving water limitations.

For the post-project scenario identify any changes that will be made. Changes include but are not limited to increased paved area, modified sub-watersheds, modification of drainage patterns, new infrastructure (including drainage inlets, piping, manholes outlets, storage basins), etc. If a model is being used, describe the input parameters and assumptions made.

Develop profiles that show the hydraulic grade lines for the design storm and 100-year storm. Discuss what happens and where the water goes when it exceeds the capacity of the storm drains.

Provide a discussion on the recommended project. Discuss the construction materials used for drainage inlets, piping, water quality features, pump stations, and storage basins. Discuss how the system operates. For storage basins, present the type, volume, location, etc. Pump stations should include wetwell volume, pump on/off setpoints, receiving water limitations, description of instrumentation and controls, pump curves and capacity.

All pertinent information summarized in an exhibit will be provided on a 24" x 36" scale for City review This section should include figures that graphically present the following information:

1) Recommended storm drain layout including drainage inlets, piping, hydraulic grade line and rim/invert elevations, detention basins, BMPs, etc (buildout and each phase).
2) Sections, elevations, plans and details sufficient to describe the SDMP features

Section 5 – Water Quality and Best Management Practices

This section should describe water quality constraints and proposed Best Management Practices (BMPs) that are to be incorporated into the project. Identify receiving water impairments and the methods used to eliminate the discharge of harmful pollutants to the receiving water. Best management practices shall be used during and after construction is completed and shall be consistent with the City's Storm Water Quality Control Criteria Plan (SWQCCP) and Storm Water Management Plan (SWMP). The following links provide additional valuable information on best management practices:

Literature on the Central Valley Regional Water Quality Control Board website located at http://www.waterboards.ca.gov/centralvalley/

The Construction Site Best Management Practices Manual by CalTrans, found at http://www.caltrans.ca.gov/manuals.htm.

The Storm Water Best Management Practice Handbooks by the California Storm Water Quality Association found at http://www.cabmphandbooks.com/

Section 6 – References

Develop and present a list of references used in the SDMP.

Appendix 3 – Storm Water Infrastructure Design Guidance Handout

City of Stockton Conceptual Storm Drain Master Plan

for the General Plan Boundary 2035

Handout on General Design Guidelines for Storm Water Infrastructure

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Design standards for storm water infrastructure in the General Plan Area are presented in two documents – the City Standards and the San Joaquin County Draft Hydrology Manual. Additional standards are presented as part of this Plan. The following information summarizes the two documents and their applicable uses and provides guidance on the combined use of those documents.

City of Stockton Standards

The City Standards present design criteria for pipes, valves, trench sections, manholes, drop inlets, detention basins, curb and gutter sections, and related improvements. The standards will be used in conjunction with this Plan for:

- Calculating the 10-year rainfall event instantaneous peak flow rate using the rational method for design of appropriate infrastructure.
- Sizing detention basins (with and without discharge limitations), wet detention basins, and retention basins.
- Establishing hydraulic grade line restrictions (It is required that the hydraulic grade line is a minimum of one-foot below the top of curb at any point in the subdivision).
- Making recommendations for improvements to storm water infrastructure.

San Joaquin County Draft Hydrology Manual

The San Joaquin County Draft Hydrology Manual contains detailed hydrology and hydraulic criteria for use in calculating storm water runoff in the County. The methodologies presented in the Hydrology Manual are appropriate for use within the General Plan Boundary because the General Plan Boundary area and its large tributary area are located in the County. The Hydrology Manual provides an in-depth analysis of area precipitation, losses, hydrographs, flow through basin analysis, streamflow routing, and various modeling procedures that are needed to develop hydrographs for sub-watershed master planning. It provides computational techniques and criteria for estimating runoff, discharges, and volumes for use in hydrology submittals to the County.

The following information available in the Hydrology Manual will be used for storm water infrastructure design:

- Precipitation data shall be used. The Manual provides 2, 5, 10, 25, 50 and 100-year precipitation data for durations of 5, 10, 15, and 30 minutes and 1, 2, 3, 6, 12 and 24 hours. There are depth-

duration-frequency and intensity-duration-frequency tables for these events, in addition to an isohyetal map of the County.

- The soils information shall be used. The County uses the SCS Curve Number Method to calculate runoff and the Manual provides the hydrologic soil groups, soil cover and hydrologic conditions necessary to calculate the runoff in the General Plan Boundary.

- The rational method will not be used. The City Standards provide a more detailed discussion of the rational method that is more appropriate for use in the City versus the County requirements.

- The Unit Hydrograph Method for Catchment Runoff Hydrographs and the Small Area Runoff Hydrograph Development shall be used to route storm water runoff (computer modeling) through the sub-watersheds when the area studied is too large or complex for use with the rational method.

- The Basin analysis shall be used conjunctively with the hydrograph routing methods for detention basin sizing. However, the detention basin criteria presented in the City Standards and the criteria presented in Table A3-1 takes precedence.

- The streamflow routing methods shall be used.

- The pipeflow routing method does not need to be used.

- The watershed modeling guidelines shall be used to support the other modeling efforts.

Use of this Plan, City Standards and the Hydrology Manual

As discussed, the City Standards and Draft Hydrology Manual will continue to both be used for developing Sub-Watershed Master Plans.

The City Standards shall be used for the design of specific infrastructure. For example, pipe materials, trenching, pump stations, construction methods, water quality control, etc. shall be governed by the standards.

The Hydrology Manual shall be used when developing the Sub-Watershed Master Plan. Generally, the methods presented in the Manual are for situations when the rational method alone will not suffice. This occurs when the area of interest is larger or more complex than what can be solved by simply using the rational method. The Manual presents routing methods that shall be used to route the runoff through the sub-watershed. The watershed characteristics, such as precipitation and losses shall be applied to the hydrograph routing methods for system planning. Table A3-1 presents guidelines for storm water infrastructure design using these documents.

Table A3-1 Guidance on Sizing Storm Water Infrastructure

Infrastructure	Design Standard
Inlets and Pipes[1]	• Convey the 10-year event for storm duration • Rational method (City Standards) or hydrologic and hydraulic models (Draft County Hydrology Manual) can be used
Pump Stations	• Maximum operating flow rate not to exceed values in Table A3-3 • Must have one redundant pump (does not contribute to the operating flow rate and is no smaller than largest pump at pump station) • Zero discharge from the sub-watershed once the water surface elevation in the receiving water reaches 0.5-feet below the FEMA 100-year water surface profile at the discharge point • Design governed by City of Stockton Department of Municipal Utilities Pump Station Guidelines

1) Design Standard consistent with the City of Stockton Standards and Specifications

Both the Hydrology Manual and the City Standards present methods for sizing detention basins. Additional criterion is presented in Table A3-2. The planner shall determine which detention basin sizing method is the most conservative by calculating the basin size using the criteria in the Standards, the Hydrology Manual and this Plan. The method that results in the largest detention basin shall govern.

Table A3-2 Guidance on Sizing Storm Water Detention Facilities

Infrastructure	Design Standard
Detention Basins[1]	Calculate the required detention using the following three methods. The calculation resulting in the most conservative detention volume shall be used (i.e. whichever detention volume is largest shall govern). • Volume is equal to 4 hours of maximum pumping rate (Volume already calculated and shown on Table A3-3), or • Volume is equal to 10-year 48-hour event (100 or 150 percent) with HGL at least 1-foot below top of curb at all points in system (Per City Standards), or • Volume is equal to Flow-through Basin Analysis as presented in the County Hydrology Manual.

Infrastructure	Design Standard
Sub-watershed Detention Storage and Grading Plan[2]	The detention volume calculated above must also contribute towards accomplishing the following requirements: • The overall storm water system (i.e. collection system, detention basins, street drainage swales, etc.) will convey the 100-year, 24-hour storm such that HGL is 1-foot below the finished floor elevation in all structures, without water draining to the adjacent basins • Street storage can be used in conjunction with detention basins for storms greater than the 10-year event • Starting water surface profile for the HGL for the 100-year 24-hour storm shall be the pump start elevation or the bottom of the lowest basin inlet pipe, whichever is lower (See the City Standards for the starting water surface elevation for the 10-year event) • Adjust basin size and/or grading to achieve desired result • 100-year storm will be evacuated from the system within 48 hours

1) The City of Stockton Standards and Specifications shall be used as the default standard when approved by the City authority.
2) Design Standards adopted as part of this Master Plan

Receiving Water Limitations

Improvements to City waterways in the north eastern area were based on the conveyance capacities established in the SJAFCA model; therefore, it is appropriate to limit the discharges to those presented in the model. Each sub-watershed is therefore allowed to discharge up to the values established in the SJAFCA model which are presented in Table A3-3. Beyond establishing discharge limits, it is also necessary to consider the timing of discharge to the receiving waters. The sub-watersheds in the General Plan Boundary are at the downstream end of large watershed areas. Peak discharges from the individual sub-watersheds generally occur before the upstream watershed peaks. Therefore, additional limitations have been developed for the operation of discharge facilities to accommodate the timing.

To effectively discharge storm water and take advantage of being located at the downstream end of the watershed, storm water runoff can be discharged as soon as it reaches the discharge point for each sub-watershed. However, caution must be taken as the upstream watershed peak runoff approaches. To accommodate for when the receiving water is at maximum capacity, the following measures shall be implemented:

- Zero discharge from the sub-watershed once the water surface elevation in the receiving water reaches 0.5-feet below the FEMA 100-year water surface profile at the discharge point.
- At a minimum, detention basins in the sub-watershed must be sized to store at least four (4) hours of the prescribed pumping rate to accommodate a discharge shutdown.

Table A3-3 Maximum Pumping Rate for the SJAFCA Sub-watersheds

Sub-watershed	Maximum Pumping Rate (cfs)	Area[4] (mi^2)	Volume (AF)
LP10	204	1.08	67
LP20	126	0.81	42
LP30	193	2.06	64
LP31	64	1.00	21
LP32	134	0.54	44
LB20	270	0.86	89
LB30	204	0.50	67
LB35	301	0.80	100
LB40	273	1.88	90
LB50	188	1.81	62
LB60	186	0.57	61
1103 A,B,C,D[1]	241	2.51	80
CHERS	673	1.85	222
C70	239	1.72	79
C80[5]	329	1.78	109
DVC1[2]	532	3.77	176
DVC2[2]	360	1.19	119
DVB4, DVB7[3]	100	2.46, 2.04	33
DIVA0[3]	16	5.00	5

1) Areas drain to SJAFCA Detention Basin 2. Peak pumping rate from Basin 2 to Mosher Slough shown.
2) Based on the modeling prepared by HDR in October, 2006 for the Conditional Letter of Map Revision (CLOMR) for the Oakmoore Gateway Specific Plan Area.
3) Discharge from these sub-watersheds cannot exceed the pumped discharge into the Diverting Canal as modeled in the SJAFCA HEC-1 model. DVB4 and DVB7 both drain to the same pump station in the SJAFCA model for which the maximum pumping rate for both subwatersheds combined is 100 cfs. Planners for this region must obtain the HEC-1 model from the City of Stockton for use in planning the drainage system.
4) All areas approximate.
5) The discharge for subwatershed C80 is shown as split; however, a water surface profile analysis is needed to verify the partial discharge at the reach does not violate the freeboard requirements in the Calaveras River. The SJAFCA project was constructed assuming all C80 pumping was discharged at the downstream end of the reach. Partial pumping capacity could be moved up stream, to the second discharge point indicated on Figure 4-5 if analysis by project proponent can verify that adequate freeboard would be maintained in the Calaveras River.

City of Stockton

Conceptual Storm Drain Master Plan

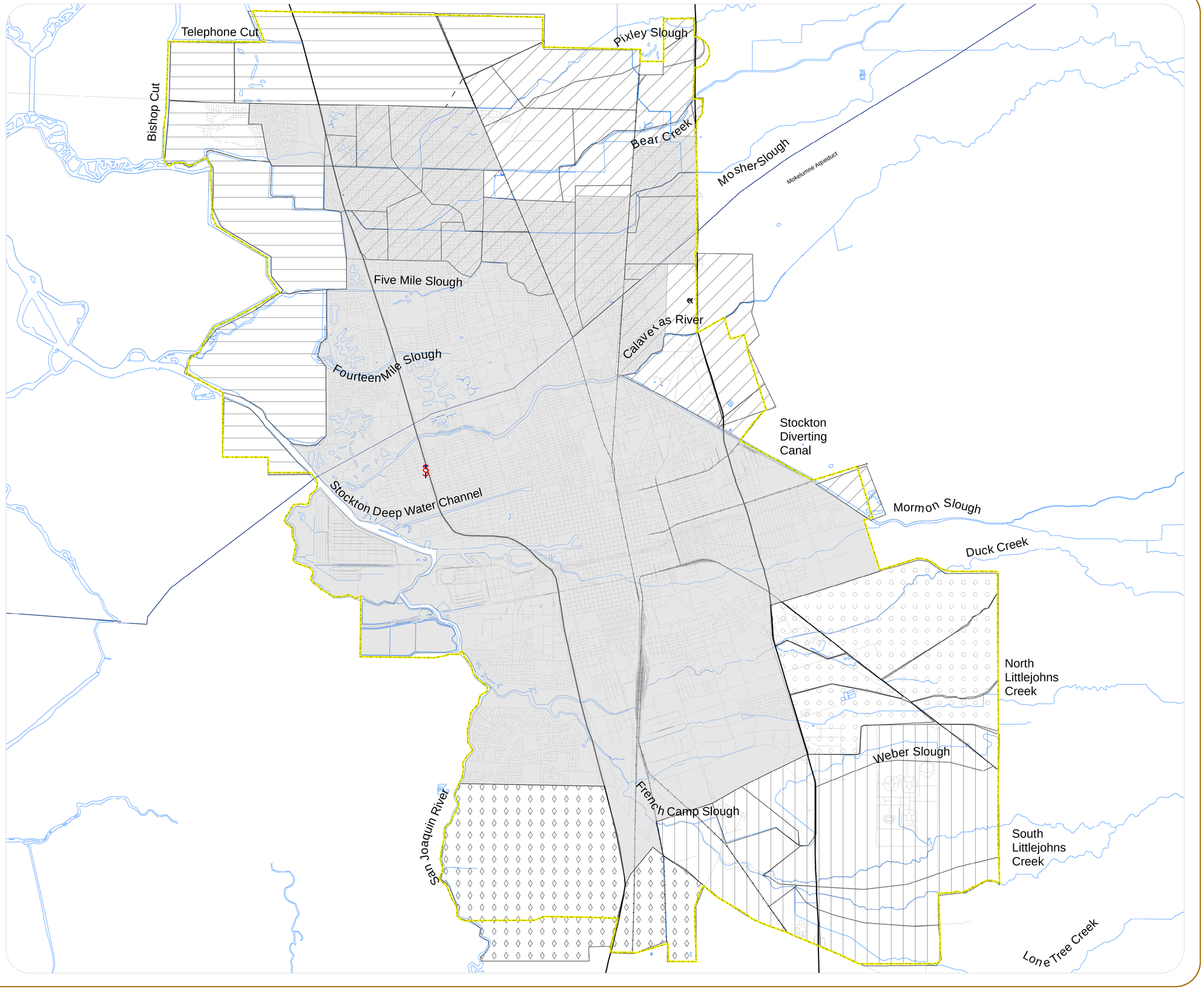
FIGURE 4-1:
Master Plan Subbasins

0 1 2
Miles

LEGEND

- Mariposa Lakes Sub-watersheds
- Southern Areas Not Modeled
- Northern Areas Not Modeled
- Tidewater Sub-watersheds
- Developed Areas
- SJAFCA Subwatersheds

- General Plan Boundary 2035
- Waterways
- Mokelumne Aqueduct
- Railroads



City of Stockton

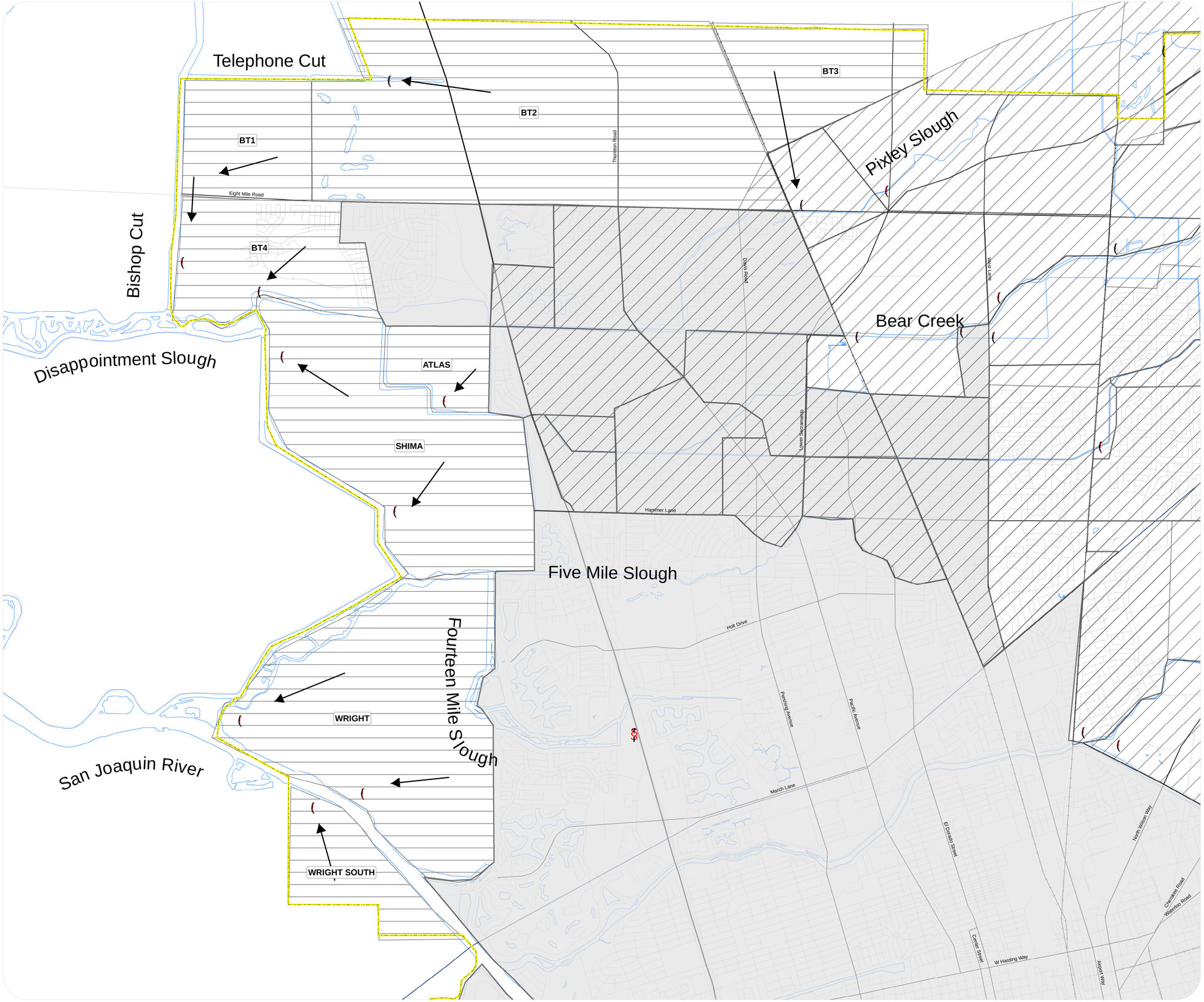
Conceptual Storm Drain Master Plan

FIGURE 4-3:
Northwestern Section Subbasins

0 0.5 1
Miles

LEGEND

- Northern Areas Not Modeled
- Developed Areas
- SJAFCA Sub-watersheds
- Developed Areas in SJAFCA Sub-watershed
- General Plan Boundary 2035
- Waterways
- Mokelumne Aqueduct
- Railroads
- Discharge Points
- Streets



City of Stockton

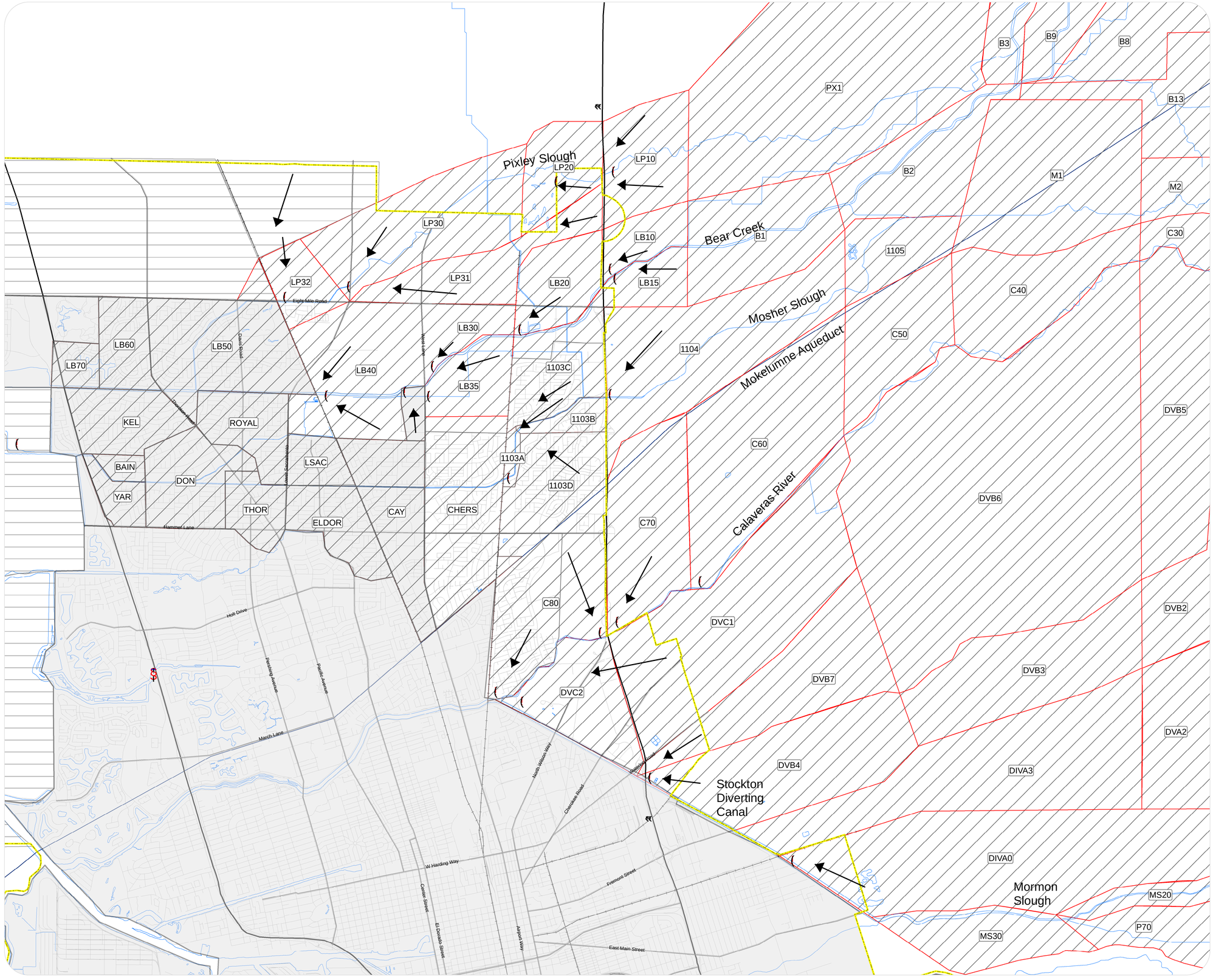
Conceptual Storm Drain Master Plan

FIGURE 4-5:
SJAFCA Model Watershed Area

0 0.5 1
Miles

LEGEND

- Northern Areas Not Modeled
- Developed Area
- SJAFCA Sub-watersheds
- Developed Area in the SJAFCA Sub-watersheds
- General Plan Boundary 2035
- Waterways
- Mokelumne Aqueduct
- Railroads
- Discharge Points
- Streets

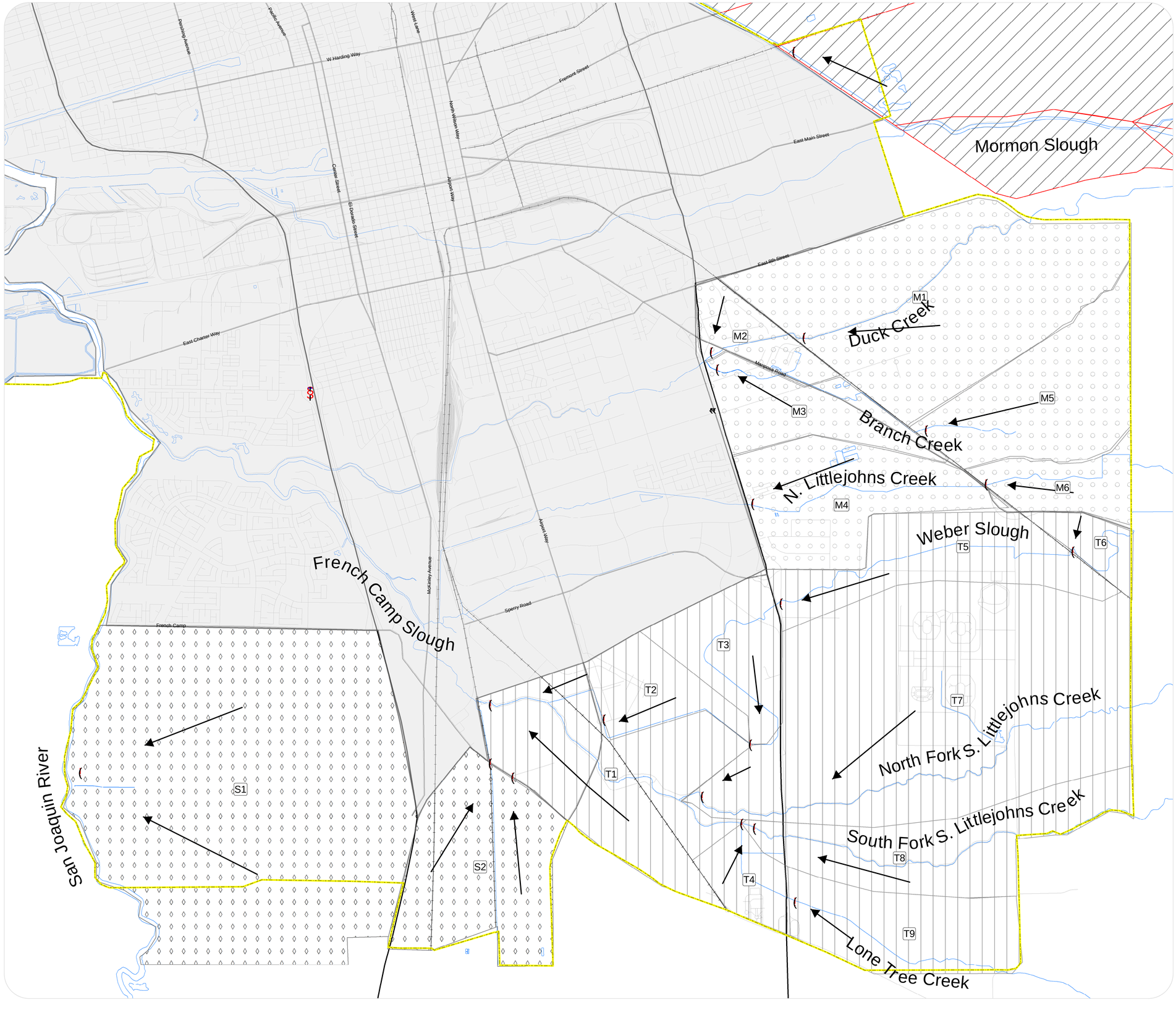


City of Stockton

Conceptual Storm Drain Master Plan

FIGURE 4-6:
Southern Watershed Area Not Modeled

0 0.5 1
Miles

LEGEND

- Mariposa Lakes Sub-watersheds
- Developed Areas
- Tidewater Sub-watersheds
- Southern Areas Not Modeled
- SJAFCA Sub-watersheds
- General Plan Boundary 2035
- Waterways
- Mokelumne Aqueduct
- Railroads
- Discharge Points
- Streets