CITY OF WEST SACRAMENTO

Storm Drainage/Storm Water
MASTER PLAN UPDATE

April 2022

WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

WEST YOST

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EXECUTIVE SUMMARY

I. INTRODUCTION

In January of 2017, the City of West Sacramento (City) contracted with Wood Rodgers, Inc. (Wood Rodgers) to prepare a city-wide Storm Drainage/Storm Water Master Plan Update (SD/SW MP Update) for the City's internal drainage system. The purposes of the SD/SW MP Update were as follows:

- Document the existing drainage system components (pipes, manholes, pump stations) as well as the physical condition of the components;
- Document the performance of the drainage system for existing conditions and future conditions based on build-out;
- Identify necessary storm drainage system/facility upgrades;
- Ensure compliance with the City's Municipal Separate Storm Sewer System (MS4) Stormwater Permit relating to internal drainage; and
- Provide the California Environmental Quality Act (CEQA) evaluation of proposed improvement alternatives.

The SD/SW MP Update only considers the internal drainage within the City and does not consider any impacts from the levees and waterways surrounding the City. The North Basin of the City (the area north of the Sacramento River Deep Water Ship Channel (DWSC)) has a longer history of development, is almost fully developed, and is characterized by a more complex system of existing drainage infrastructure. The South Basin (the area south of the DWSC) consists of more recent development that was based on community master planning. Build-out of the South Basin is still in progress, and it realizes greater potential to incorporate future changes in drainage standards as development progresses.

The SD/SW MP Update developed hydraulic models (one in the North Area and one in the South Area) to assess the existing drainage conditions. Improvements were identified and proposed within the SD/SW MP Update to correct existing problems and to accommodate full build-out of the General Plan.

The proposed improvements covered by the SD/SW MP Update were analyzed for environmental documentation consistent with the City's General Plan 2035 (as occurred with other infrastructure master plans developed by the City). In general, the storm drain master plan produces alternatives that are consistent with the general plan and, therefore, fall under the environmental analysis documentation that was prepared for in support of the City's General Plan. Any project-specific impacts that may result from implementation of the storm drain master plan will need to be analyzed and resolved as part of more detailed environmental analyses of the individual projects.

II. EXISTING FLOODING CONDITIONS

All internal drainage within the City is collected through gravity storm drains and drainage canals and conveyed by a series of pump stations into either the Sacramento River, the DWSC, or the Yolo Bypass. The design event for the analyses is the 100-year 24-hour storm event. The DWSC and the Sacramento Port area create a hydraulic separation between the drainage occurring within the North Basin and that which occurs in the South Basin. Accordingly, two separate hydraulic models were developed to analyze the City's stormwater drainage systems. The hydraulic models for the North Basin and South Basin were configured using the XPSWMM stormwater modeling software. The models use system data collected from field surveys, as-built plans, light detection and ranging (LiDAR) topographic data, operations data (provided by City staff), ariel photos showing land use patterns, Natural Resources Conservation Service (NRCS) soils survey data, and the latest Yolo County design rainfall data.

For the North Basin, the output of the hydraulic modeling for the existing system shows widespread flooding occurring during a 100-year storm event, ranging generally from zero (0) to three (3) feet in flood depth.

For the South Basin, the output of the hydraulic modeling for the existing system shows minor flooding (0 to 3 feet in depth) in undeveloped areas and some street flooding along Lake Washington and Stonegate Drive (next to the detention basin).

III. WATER QUALITY COMPLIANCE

The City's drainage system was designed and constructed in accordance with state and federal water quality regulations that were in place at the time of their construction.

KEY FINDING: Existing development is in compliance (grandfathered).

More recent regulations, specifically the Phase II National Pollutant Discharge Elimination System (NPDES) regulations of the US Environmental Protection Agency, focus on constructing distributed water quality improvement measures instead of the regional treatment facilities that have been constructed by the City in the past. Distributed facilities will need to be constructed in the future as a part of individual development projects (either infill or master planned community projects) as they are constructed.

KEY FINDING: Distributed (on-site) treatment is required for new development.

The City's stormwater runoff drains through urbanized constructed waterways (as well as discharges to tidally influenced waters) that could exempt the City from hydromodification requirements (i.e.: the on-site retention of more frequent storm flows for the purpose of reducing the potential for downstream erosion) and requirements associated with NPDES permitting. The City can obtain this exemption by coordinating with the California Regional Water Control Board.

KEY FINDING: A City-wide application for exemption from hydromodification requirements could be prepared.

IV. FUTURE CONDITIONS AND IMPROVEMENT ALTERNATIVES

In addition to planning for build-out of future growth areas within the City (as noted above), there are also a number of areas that have significant existing system deficiencies. The approach used to address future conditions within the SW/SD MP Update was to first determine the improvements for correcting existing problems and then to define additional improvements for accommodating full build-out of the General Plan.

For the North Basin, improvement alternatives were developed to reduce existing flooding to within acceptable levels (street-level flooding). There are numerous options for improving pump stations, channels and storm drains, as well as for adding new detention basins to achieve this purpose. Full build-out of the General Plan land uses does not change the size or configuration of the alternative improvements identified for the North Basin.

For the South Basin, there were two primary locations of flooding to address through new storm drainage facilities. These included the Gateway/Stonegate watershed and the Yarbrough watershed. Both watersheds have significant flooded areas under current developed conditions that need to be addressed before additional development can be added. Future development plans for these watersheds will govern the ultimate improvements to be constructed.

V. CONDITION ASSESSMENT

The SD/SW MP Update dedicated a portion of the master plan to evaluating the condition of City-owned drainage facilities in order to determine if near-term repairs or replacements are required. Storm drain manholes, channels, and pump stations were evaluated in the field and specific concerns were identified. In summary, approximately 15 percent of the City's manholes were found to have at least one component that was defective or in poor condition. The channels within the North Basin generally showed no signs of significant erosion, while some isolated locations were found to have mild sedimentation and heavy vegetation. The channels within the South Basin were generally in good condition with only minor maintenance needed for vegetation and debris accumulation.

A detailed assessment of pump stations was performed in the North Basin, evaluating and rating several components and factors. At the onset of the work, the City-owned pump stations (as opposed to those owned by Reclamation District 900 at the time) were determined by the City to be more likely at risk, thus requiring a more detailed condition assessment. In general, North Basin pump stations were assigned a medium level of risk for failure. The South Basin pump stations were not evaluated for failure but were reviewed to ensure pump station capacities were accurately modeled.

KEY FINDINGS:

- 85% of surveyed manholes are in good condition
- 15% of surveyed manholes are in poor condition with one or more deficiencies

- North Area channels are in fair condition (minor erosion, mild sedimentation, some vegetation)
- South Area channels are in good condition (minor vegetation and debris)
- North Area pump stations have a medium level of risk of failure
- South Area pump stations were not assessed and are presumed in good condition

VI. IMPROVEMENT PROGRAM

For the North Basin, the SD/SW MP Update establishes an in-depth prioritization methodology for defining the implementation of the future projects' framework to correct existing deficiencies.

The projects identified for the South Basin are primarily required to address future development that will likely be funded by private development interests through the City's entitlement process. Therefore, a city-wide prioritization methodology for the South Basin was not necessary.

All projects defined within the report were assigned an opinion of probable construction cost and were evaluated for additional implementation factors such as project sequencing, land acquisition or easement requirements, and probable stakeholder cooperation. Maintenance projects and their costs are also identified in the SD/SW MP Update. Maintenance of the existing system requires performing activities to replace and optimize components of the existing system. The total cost of the recommended maintenance projects for the North Basin is $2.7 million. For the South Basin, only minor costs associated with the repair of two manholes is required.

A summary of the individual proposed improvement project costs for the North Basin and South Basin is provided in the following table. The projects are grouped by watershed and, in some cases, provide multiple alternatives that achieve similar/overlapping results (North Basin only, the South Basin does not contain a range of alternatives). The project alternatives that can address the same deficiency share the same number and are marked as option "A", "B", or, "C". All the projects listed in the table are not required to cumulatively achieve 100-year standards for the North Basin because various combinations of individual alternatives can achieve the overall mitigation goal. It is noted that individual alternatives may experience differing levels of implementation risk as the plan evolves, including land acquisition and environmental impacts. Given the potential for variation as the plan evolves, each watershed (by name) has been summarized under a range of estimated low and high cumulative costs. For the RD 811/RD 537 Watershed, the range of costs for total watershed mitigation is between $38.0 million and $41.4 million. For the Causeway and Racetrack Watershed, the range of costs for total watershed mitigation is between $62.7 million and $82.2 million. For Lock costs total $4.8 Million, Deerwood costs $4.5 million.

TABLE ES - 1					
Watershed Name	Project Name**	Primary Design Oversight *			
		Total	City	RD 900	Caltrans
		Cost, $ (Millions)			
North Basin					
RD 537/RD 811 (East)	5th Street Pump Station (1A)	10.5	10.5		
	5th Street Pump Station with Underground Storage Vault (1B)	7.1	7.1		
	Alyce Norman School Detention Basin	4.8	4.8		
	Arthur Drive Pipe Reroute	1.2	1.2		
	Bryte Avenue Pipe Upsize	2.1	2.1		
	Citrus Street Culvert Upsize	0.3		0.3	
	Douglas Pipe Upsize	0.2	0.2		
	Fourness Drive Pipe Upsize	6.3	6.3		
	Harbor Boulevard Culvert Upsize	1.6		1.6	
	Jefferson Boulevard Pump Station	6.5	6.5		
	Railroad Culvert Upsize	1.3	1.3		
	Railroad to Jefferson Channel Expansion	0.6		0.6	
	Sacramento Avenue Detention Basin	1.5	1.5		
RD 537/RD 811 (West)	Highway 80 Culvert Upsize	4.1			4.1
	Harbor Boulevard to Railroad Channel Expansion	0.6	0.6		
Deerwood	Deerwood Detention Basin	2.1	2.1		
Deerwood	Deerwood Pump Station Relocation	2.4	2.4		
Lock	Jefferson Boulevard Pipe Upsize	4.8	4.8		
Causeway and Racetrack (East)	Clarendon Street Pipe Upsize	0.7	0.7		

TABLE ES - 1					
Watershed Name	Project Name**	Primary Design Oversight *			
		Total	City	RD 900	Caltrans
		Cost, $ (Millions)			
	Michigan Boulevard Detention Basin	5.0	5.0		
	Westfield School Detention Basin	5.1	5.1		
	South River Road Detention Basin (2A)	1.3	1.3		
	South River Road Pipe Upsize (2B)	2.9	2.9		
	El Rancho Court Detention Basin	2.0	2.0		
Causeway and Racetrack (Central)	Harbor Boulevard Pipe Upsize	1.8	1.8		
	Houston Street Culvert Upsize	0.9		0.9	
	Walnut Street Pipe Upsize	4.8	4.8		
	Westmore Oak School Detention Basin	24.9	24.9		
Causeway and Racetrack (West)	Enterprise Boulevard Pipe Upsize	3.5	3.5		
	Racetrack Pump Station - Pump Station Only (3A)	29.9		29.9	
	West Capitol Culvert Expansion (3A, 3C)	0.4	0.4		
	Estes Terminal Detention Basin (3B)	1.9	1.9		
	Lake Washington Expansion (3B)	1.4		1.4	
	Racetrack Pump Station - Pump Station and Detention (3C)	15.0		15.0	
	West Capitol Avenue Detention Basin (3B, 3C)	9.3	9.3		
	Racetrack Culvert Expansion (3A, 3C)	0.2		0.2	
North Basin High End Range Subtotal (Includes 1A, 2B, 3A)		132.8	94.9	33.9	4.1
North Basin Low End Range Subtotal (Includes 1B, 2A, 3B)		109.9	101.1	4.7	4.1

TABLE ES - 1					
Watershed Name	Project Name**	Primary Design Oversight *			
		Total	City	RD 900	Caltrans
		Cost, $ (Millions)			
South Basin					
Gateway/Stonegate	Gateway/Stonegate Pump Station Capacity Increase	6.6		6.6	
	Location 1	0.6	0.6		
	Location 2	1.5	1.5		
South Basin (Common Facility)	Location 3	1.65	1.65		
	Location 4	3.3	3.3		
East Tapley	Location 5	0.075	0.075		
	Location 6	0.075	0.075		
	Location 7	3.3	3.3		
Yarbrough	Location 8	3.3	3.3		
	Location 9	3.3	3.3		
	Location 10	3.3	3.3		
	Location 11	0.14	0.14		
South Basin (Common Facility)	Main Drain Ultimate Pump Station	0.2		0.2	
South Basin Total		27.34	20.54	6.8	-

* *Does not necessarily denote funding responsibility*

***The project alternatives that can address the same deficiency share the same number and are marked as option "A", "B", or, "C".*

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1.0 INTRODUCTION

In January of 2017, the City of West Sacramento (City) contracted with Wood Rodgers, Inc. (Wood Rodgers) to prepare a Storm Drainage/Storm Water Master Plan Update (SD/SW MP Update) for the City of West Sacramento. The purpose of the SD/SW MP Update is to document existing drainage conditions and drainage system components (including functional deficiencies), identify necessary storm drainage facility upgrades, and ensure compliance with the City's MS4 Stormwater Permit.

The City of West Sacramento is located just west of the city of Sacramento within Yolo County, California. The City is surrounded by levees that protect its interior from external waterways including the Sacramento River (located north and east of the City), the Sacramento River DWSC and Yolo Bypass (located west of the City), and Babel Slough and other existing irrigation and drainage channels located south of the City that are separated from the City by the South Cross Levee. Within the City, two distinct hydraulic basins are present, identified as the North and South Basins, and are separated by the DWSC and the W.G. Stone Lock (Lock). Along the Port of West Sacramento, the DWSC and Lock were constructed in the early 1960s by the US Army Corps of Engineers (USACE) to provide for a dedicated shipping channel between the Sacramento-San Joaquin Delta and the Sacramento metropolitan area. The North Basin has a longer history of development and urbanization while the South Basin can be characterized as rural with areas of more recent and master-planned residential and commercial developments.

A map of the City of West Sacramento and its primary existing storm drainage system components is presented on **Figure 1-1**.

For this large study, Wood Rodgers assembled a team that included West Yost Associates, Frisch Electrical, and Ascent Environmental, Inc. (Ascent). Wood Rodgers provided the overall project management and led the detailed evaluations for the South Basin, and the evaluation of Water Quality requirements. West Yost led the detailed evaluations of the North Basin and also led the condition assessment activities. Frisch Electrical provided evaluations and recommendations for pump stations and Ascent provided California Environmental Quality Act (CEQA) evaluations.

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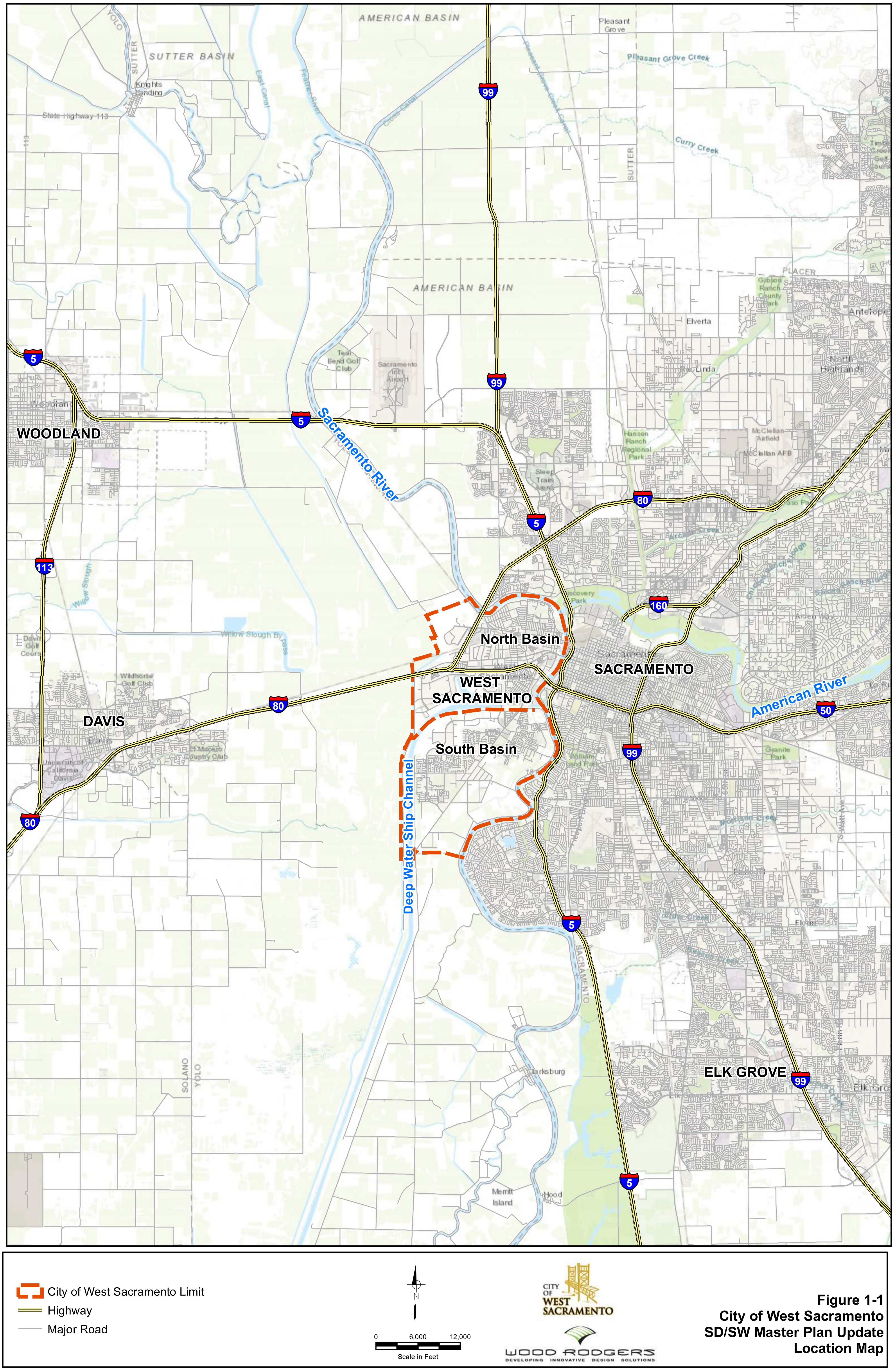

Figure 1-1
City of West Sacramento
SD/SW Master Plan Update
Location Map

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2.0 BACKGROUND

As noted above, the North and South Basins have different histories with respect to development and corresponding storm drain infrastructure planning and construction. A single area-wide storm drainage master plan for the North Basin has not previously been prepared. While the City has as-built information for the majority of drainage infrastructure constructed in the north, it did not follow a basin-wide storm drain planning process.

In the South Basin, a number of studies have been prepared to identify existing and future storm drainage facility needs. These documents were completed as part of the City's 1990 General Plan.

The following studies were prepared for drainage analyses in the South Basin:

- City of West Sacramento, South Basin Drainage Master Plan, February 1995 (**Reference 1**)
- City of West Sacramento, South Basin drainage Master Plan, May 2001 (**Reference 2**).
- City of West Sacramento, Subbasin MC10 Drainage Master Plan, February 2000 (**Reference 3**)
- City of West Sacramento, Subbasins MC80 and MC81 South Basin Drainage Master Plan, February 2003 (**Reference 4**).

A number of ancillary standards, cost allocation reports, and other documents were also prepared as part of the previous master drainage studies for the South Basin. Development in each of the basins has now been constructed, or is in the process of being constructed, following several years of idle construction during the economic downturn of 2009 through 2013. To the extent these documents form a basis for development of the updated SD/SW MP, they were reviewed by the team for reasonableness and consistency with applicable current standards. For a full list of references pertinent to the development of the SD/SW MP Update, see Section 12.

In November of 2016, after a comprehensive update process that originally began in 2007, the City Council approved a general plan update identified as "General Plan 2035" to guide future development within the City. Drainage analyses for future conditions performed in this SD/SW MP Update target the proposed development outlined in General Plan 2035. There have been some modifications to the General Plan assumptions in the southernmost part of the plan area relating to the Liberty, Yarbrough and Riverpark development areas that will also be accommodated as part of this analysis.

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3.0 TOPOGRAPHIC AND SYSTEM SURVEYING AND MAPPING

A systematic program of surveying and mapping was performed in support of the SD/SW MP Update and to add data to the City's Geospatial Utility Asset Infrastructure Database (a Geographic Information System (GIS) -based database of all City utility assets). The surveying consisted of conventional and Global Positioning System (GPS)-based point surveys at identified storm drainage facilities throughout the City including drainage inlets, pipe outfalls, pipe inverts and diameters at manholes (pipes greater than 21-inches in diameter), pump stations (sump inlets, inverts, and pump on and off set points), drainage channels (regular cross sections) and storm drainage detention basins. Field surveys performed in support of the SD/SW MP Update were performed with respect to the North American Vertical Datum of 1988 (NAVD 88) for vertical values and the North American Datum of 1983 (NAD 83) for horizontal values.

Topographic surface information for use in modeling of overland terrain was sourced from the DWR (Central Valley Floodplain Evaluation and Delineation Program, or CVFED). The CVFED LiDAR dataset was collected during the spring of 2008. Survey data is preferred where areas require a high degree of detail, or where channels have standing water. For overland terrain and minor ditches, the CVFED LiDAR was used. **Figure 4-1** depicts the locations in the North Basin where surveys were used versus CVFED LiDAR.

The original dataset is referenced to NAD 83 Universal Transverse Mercator (UTM) Zone 10 N coordinates, in units of feet. Vertical elevations are referenced to NAVD 88, in units of Feet. In this project, the original CVFED LiDAR dataset was re-projected to NAD 83 California Stage Plane II coordinates in units of feet. Vertical datum conversion was also applied to convert the NAVD 88 to National Geodetic Vertical Datum of 1929 (NGVD 29) (NAVD 88 – CF = NGVD 29) using the referenced local conversion factor (CF) of 2.685 feet for the North Basin and 2.536 feet for the South Basin (obtained from the VERTCON tool developed by the National Oceanic and Atmospheric Administration (NOAA) available from the following website:

https://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html)

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4.0 AS-BUILT RECORDS REVIEW

Where available, as-built drawings of the City's storm drainage system were used to verify or supplement surveys performed in the field. As noted, the City has a relatively complete set of as-built drawings for facilities constructed in the recent past (i.e., the past 20 to 30 years), mostly in the South Basin. In the North Basin, where existing storm drainage facilities are significantly older, the availability of as-built drawings is more limited. However, between surveys performed and the as-builts that are available, the data was sufficient to perform the analyses as required for the SD/SW MP Update. In some cases, differences were noted in field surveys and as-built information. Where such differences were noted, the as-built value of the pipe invert and/or diameter were used. This decision was made in consultation with the City given the limitations in performing surveys of pipe inverts and diameters without physically entering manholes (particularly where pipes were recessed from the location of the manhole lid**. Figure 4-1** depicts these pipe locations in the North Basin where the City's as-built data was utilized.

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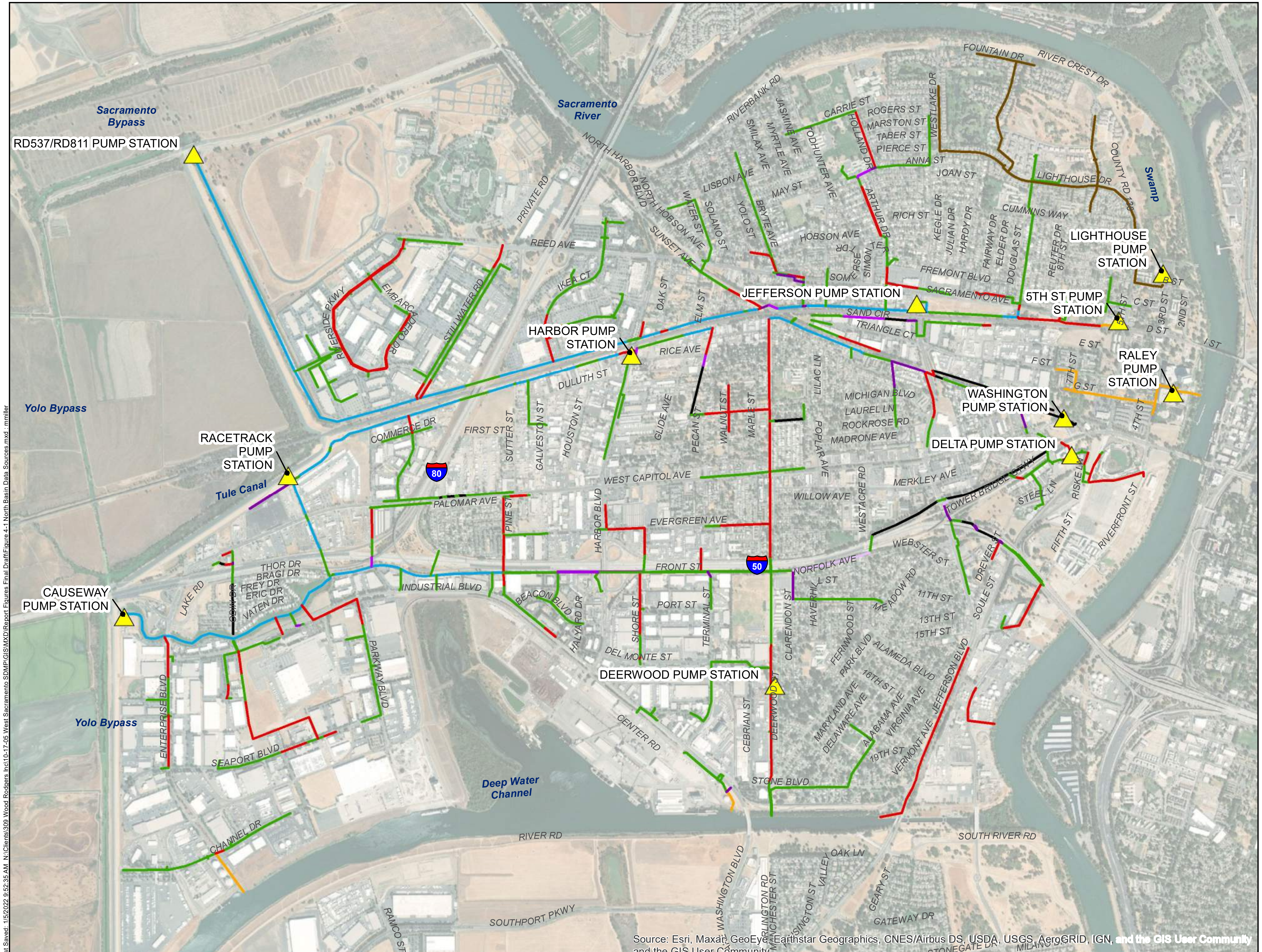

Data Source

- Study Survey
- City Survey
- Record Drawing
- Rivers Phase 2 SDMP
- Channel or Ditch (Survey)
- Channel or Ditch (LiDAR)
- Storm Pump Station

Data Assumptions

- Interpolation of Downstream Invert Elevation
- Interpolation of Upstream Invert Elevation
- Interpolation of Upstream and Downstream Invert Elevation

Note:
1. Where data gaps exist for invert elevations, a downstream or upstream source of data was used to interpolate the missing invert elevation value.
2. Channels or ditches with permanent water surface elevations were surveyed to ensure accuracy of the flow line elevations.

0 1,000 2,000
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 4-1

North Basin Data Sources

Storm Drainage/
Storm Water Master Plan Update

Last Saved: 1/5/2022 9:52:35 AM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 4-1 North Basin Data Sources.mxd : mmiller

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5.0 CEQA ANALYSES AND DOCUMENTATION

In order to determine if there are potential environmental impacts associated with implementation of the proposed SD/SM MP Update, an assessment of the facilities as proposed in this SD/SWMP Update was undertaken by Ascent. In general, these improvements would occur over a 20-year period through 2035, consistent with the timeline for implementation of General Plan 2035. The CEQA efforts also included areas of future development (Liberty, Yarbrough and Riverpark) that are outside of General Plan 2035. Generally, construction activities associated with replacement and maintenance of existing storm drainage facilities is relatively minor and would not require a substantial commitment of resources. As these utilities are intended to serve existing uses, construction activities would generally be expected to occur within previously disturbed areas, including within existing public right-of-way. Some of the more significant projects, like addressing flow restrictions at culverts along the RD 900 main canal, would require up to a year to implement. Most of the construction activities would be conducted and managed by the City, although some improvements may require coordination with other agencies (e.g., the California Department of Transportation (Caltrans)) for projects that may fall within their respective right-of way. For some drainage facilities there may be multiple agencies/entities involved in the design review, construction oversight, and/or operation and maintenance activities because there are overlapping jurisdictions between the City and RDs 537, 811 and 900; local/regional entities (e.g.: the West Sacramento Area Flood Control Agency (WSAFCA), the Central Valley Flood Protection Board (CVFPB)); state agencies (e.g.: the California DWR, State Water Resources Control Board); and federal agencies (e.g.: the Federal Emergency Management Agency (FEMA), the US Army Corps of Engineers). This reality may cause certain facilities, such as channels, to have a segmented jurisdiction, and could complicate operations and maintenance activities because of differing standards, practices, funding and scheduling. If implementation of a subsequent project or later activity has effects that were not examined in the General Plan 2035 Environmental Impact Report (EIR), the City would evaluate those impacts and determine if an appropriate environmental document should be prepared as indicated in CCR Section 15168(d) of the CEQA Guidelines. Any project-specific impacts that are too speculative to define at the program level would be resolved during the CEQA review of the individual projects.

For Ascent's technical memorandum analyzing the adequacy of the City of West Sacramento's General Plan 2035 for coverage of projects identified within the SD/SW MP Update, see **Appendix A**.

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6.0 EXISTING CONDITIONS ANALYSES

6.1 Performance Criteria

Section 4 of the City's Standard Specifications (Storm Drainage) identifies drainage standards, criteria, and specifications for development and construction within the City. Consistent with the previous South Basin Drainage Master Plan Update (Reference 2), the City has identified two types of drainage facilities:

Type 1 - Facilities including channels (and culverts relating to those channels), bridges, detention ponds and pump stations.

Type 2 - Facilities including roadside ditches (including culverts associated with ditches), pipe systems, and overland conveyance systems.

In the South Basin, existing Type 1 facilities are assumed to have been designed to meet City Standards and in concurrence with the City's General Plan land use designations based on their construction dates that generally post-date the incorporation of the City. Conversely, much of the North Basin was constructed prior to City incorporation, Type 1 facilities design criteria development, and any City General Plan. All protection of property is ultimately based on the 100-year storm, which is the appropriate standard for use as the basis for assessing existing conditions storm drainage and system deficiencies. Therefore, there is no need to evaluate other storm events, such as a 10-year storm event, which is sometimes allowed at the City Engineer's discretion.

The duration of the storm used in the analysis should represent the worst-case flooding scenarios with respect to the combination of both peak flow and volume. In the existing conditions analysis (and given the sizing of channels, detention storage and pumping from the previous master plan), the 100-year 24-hour storm event was used to evaluate the Type 1 drainage facilities. Though it is not explicitly called out in the standards, a minimum of one foot of freeboard for the 100-year 24-hour storm was used as the performance criteria for detention ponds. Open channels should typically have 3 horizontal:1 vertical (3:1) side slopes (or flatter), and a minimum of one foot of freeboard should be provided (**Reference 6**). The Manning's roughness coefficient for evaluating open channels should be based on the cover conditions in the bed and side slopes of the open channel. While the channel roughness stipulated in Table 4-7 of the City's standards defines maximum roughness for design conditions, defining existing conditions and flood impacts requires analysis of actual physical conditions when they exceed design. If existing roughness is less than design allowances, the culverts associated with channels should use a Manning's roughness coefficient consistent with the pipe material using Table 4-7 of the City's standards. As a Type 1 facility, the design of pump stations should also be based on the worst-case 100-year design storm, and a backup pump the same size of the duty pump should be incorporated in the design. In addition, backup power should be provided for each pump station to supply the drainage pumps running at design capacity.

For the City of West Sacramento, the storm drainage pipes should be sized based on design flows generated from the Nolte Method (referenced in the "*Sacramento City/County Drainage Manual, Volume 2: Hydrology Standards*") (**Reference 12**). The Manning's roughness coefficient for concrete pipes should be 0.015. For the 100-year 24-hour storm when capacity of the storm drainage pipe system is exceeded, the overland conveyance system should be designed to ensure that water surface elevations remain below the pad elevation of adjacent structures and provide overland flow paths from the streets to the detention pond or pump station.

6.2 Hydrology

6.2.1 <u>Design Storm</u>

The City of West Sacramento currently utilizes Sacramento County hydrology standards that were published in 1996 (Reference 7) as the basis for assessing storm runoff hydrology within the City's boundary. In 2009, Wood Rodgers developed the updated design rainfall for Yolo County based on an expanded number of short-duration and long-duration rainfall gage and record data located within Yolo County and the immediate surrounding area. These 2009 design precipitation determinations included the City of West Sacramento within the boundary of Yolo County. A comparison of the 1996 Sacramento County design rainfall and the updated Yolo County design rainfall was performed with Yolo County rainfall depths consistently larger than those produced by the 1996 Sacramento rainfall. Therefore, the City decided to discontinue use of the 1996 Sacramento County design rainfall and begin using the Yolo County design rainfall in drainage studies accompanying development proposals. All other hydrologic parameters previously defined under the 1996 standards did not require modification and still apply within the City. Therefore, the calculation programs associated with Sacramento County standards (Reference 7) can still be utilized, while substituting only the rainfall component of the hydrology. **Appendix B** provides the data sources and comparison in selecting the design rainfall standard for the SD/SW MP Update.

Wood Rodgers determined that the 24-hour duration storm (as opposed to a longer duration 10-day storm) would be the most critical storm to consider in evaluating the drainage system that relies on the combination of flood conveyance, pumping and storage. The South Basin detention and pumping systems effectively drain the 24-hour storm event in less than 24 hours after the storm peaks. The North Basin drains detention basins in less than 48 hours. With such a fast drainage response, the system will effectively drain between storms, preventing long duration storm patterns from governing, as defined under Sacramento County hydrology standards (Reference 7) and Yolo County hydrology standards (Reference 8). For the existing and future conditions analyses contained within the SD/SW

MP Update, the design rainfall data for a 100-year 24-hour storm from the Yolo County Hydrology Manual (Reference 8) was used.

6.2.2 Land Use

Historically, the predominant land use in the South Basin was agriculture, while the North Basin has been nearly built-out with various residential, commercial and industrial land uses. Over the last two decades, large residential developments have been built in the South Basin, primarily along the major roadways including Jefferson Boulevard and Southport Parkway. The City provided current land use designations for the entire city. Wood Rodgers and West Yost performed an initial review of the land use data and found several issues, including the following:

1. The City's design standards do not have impervious values associated with all current land use designations identified by the City.
2. A range of development densities are included within a single land use classification and require the selection of a value that represents a reasonable estimation of potential runoff.
3. Current land use conditions, particularly those in the South Basin, deviate from the land use designations published in the previous General Plan.
4. Published land use and design imperviousness correlations may underestimate runoff. Several land uses appear to have higher as-constructed impervious levels than published design values.

To address these issues, the analysis team sampled the existing impervious coverage associated with existing development designations within the City. When streets are accounted for, the composite imperviousness for a given land use was found to be significantly higher than published values in the General Plan, especially for low-density and medium-density residential development.

The published design standards for the City do not associate dwelling-units-per-acre density values to assigned land use classifications, so it can be difficult to correlate the land use designations with imperviousness levels. However, the SD/SW MP Update must correlate runoff factors to ensure that all factors are consistent when quantifying existing development impacts and mitigating future development.

For the South Basin, the sampling of existing development imperviousness relative to land use impervious assumptions is summarized in **Appendix C**

In both the North and South Basins, it appears that low-density and medium-density residential areas are consistently 20-30 percent higher in imperviousness than published standards, once streets are lumped with lots. A more detailed assessment can be found in Appendix C. For the South Basin, constructed areas classified as medium density developments were estimated to be 72 percent impervious, and constructed areas classified as low density were estimated to be 66 percent impervious. **Figure 6-1** shows the 2017 land use condition for the North and South Basin.

The following **Table 6.1** hydrologic inputs were used in the analyses.

Table 6.1 – Soil and Impervious Percentage (Soils Group inches per hour)					
Descriptions	**Impervious Percentage**	**Hydrologic Soil Group**			**Basin Lag "n" Values**
		B	**C**	**D**	
Highways, Parking	90	0.14	0.07	0.04	0.032
Commercial	90	0.14	0.07	0.04	0.032
Business Park	90	0.14	0.07	0.04	0.032
Highway-Service Commercial	90	0.14	0.07	0.04	0.032
Central Business District (MU-C)	90	0.14	0.07	0.04	0.032
Riverfront Mixed Use	90	0.14	0.07	0.04	0.032
Corridor Mixed Use	90	0.14	0.07	0.04	0.032
Light Industrial	85	0.162	0.082	0.052	0.032
Heavy Industrial	85	0.162	0.082	0.052	0.032
Water-Related Industrial	85	0.162	0.082	0.052	0.032
Mixed-Commercial/Industrial	85	0.162	0.082	0.052	0.032
Neighborhood Mixed Use (MU-NC)	80	0.17	0.09	0.06	0.033
High-Density Residential	70	0.17	0.09	0.06	0.035
Medium High-Density Residential	68	0.18	0.1	0.07	0.037
Medium-Density Residential	65	0.18	0.1	0.07	0.036
Low-Density Residential	55	0.18	0.1	0.07	0.039
Public/Quasi-Public	50	0.18	0.1	0.07	0.040
Rural Residential	15	0.18	0.1	0.07	0.056
Rural Estates	10	0.18	0.1	0.07	0.060
Recreation and Park	5	0.18	0.1	0.07	0.065
Open Space Grassland (AG)	2	0.18	0.1	0.07	0.075
Agriculture	2	0.18	0.1	0.07	0.075

6.2.3 Soil

For uncovered terrain within each watershed, the amount of runoff generated is directly impacted by the infiltrative capacity of the exposed soils. The Natural Resources Conservation Service (NRCS) publishes soil surveys and classifications, including estimates of infiltrative capacity (**Reference 9**). The NRCS soil survey classification information expressed in the Hydrologic Soil Group classification category was used as the basis for assigning rainfall infiltration estimates using current published values consistent with Sacramento County Standards. Soils types with a Type C/D designation were modeled as Type D to assume lower infiltration potential and maximum runoff. For areas where NRCS soil survey data is unavailable, it is recommended that the proximate soil zones be used to inform the selection of assumed values, deferring to more conservative values when interpolation is unclear. **Figure 6-2** shows the NRCS hydrologic soil group designation and areas within the City where the information is unavailable.

6.2.4 Topography

The CVFED LiDAR is not well-represented in areas of existing detention and in channels where water was present at the time of the survey. Wood Rodgers performed bathymetric surveys for those areas throughout the City to properly capture the full storage and conveyance capacity of these major drainage features. For detention areas, bathymetric survey points were collected at the bottom of the detention basins to represent the basin storage geometry. For channels, bathymetric survey points were collected at cross sections that were spaced regularly along the channel reach. At road crossings along the channel, dimensions and invert elevations of hydraulic structures present (such as culverts and bridges) were also surveyed in order to properly define the conveyance capacity. **Figure 6-3** shows the topographic and survey data collected in the South Basin.

Watershed Delineation

Watershed boundaries were delineated based on the topographic data presented in Figure 6-3. For open space and rural areas where runoff generally follows routes defined by the surface terrain, watershed delineations based on the topographic data are sufficient. For developed areas, such as residential and commercial lots where large impervious areas are present, the majority of the surface runoff is directed to underground storm drain pipes. The City of West Sacramento provided Wood Rodgers with the existing storm drain network in a GIS database that was used to inform the delineation of sub-watersheds for developed areas in the City. Overland runoff exceeding the storm drainage network capacity will travel overland following the surface terrain, which was also modeled hydraulically within the XPSWMM model.

<u>Naming Convention</u>

In consultation with the City of West Sacramento, the following naming convention was developed for major watershed areas in the study area. The major watershed areas were named following the collecting drainage area or downstream receiving facility, such as channel, detention pond or pump station. The names for the South Basin are as follows:

- Bridgeway Lakes (Formerly MC80/81) = "BL"
- South Basin Industrial Park/Bridgeway Island (Formerly MC60) = "II"
- Lake Washington (Formerly MC20) = "LW"
- Gateway/Stonegate (Formerly MC10) = "GS"
- Parlin Ranch (Formerly NC10) = "PR"
- High School (Formerly NC20) = "HS"
- Rivermont (Formerly MC71/75) = "RM"
- Touchstone Lake (Formerly MC30) = "TL"
- Larchmont Development (Formerly MC50) = "LD"

The following naming conventions were used for channels in the South Basin:

- Main Canal (Drain) = "MC"
- Morton Blacker Canal (Formerly Morton East Drain)= "BM"
- East Tapley = "ET"
- West Tapley = "WT"
- Toe Drain = "TD"
- Channel parallel to Toe Drain from BL = "BC"
- Channel tributary to "II" = "CI"
- Channel along Clarksburg (Railroad) Trail = "CT"
- Channel called Dorris Ditch along Village Parkway = "DV"

The following naming conventions were used for watersheds in the North Basin:

- Lighthouse Pump Station = "LH"
- Racetrack Pump Station = "RT"
- Raley Pump Station = "RY"
- Sacramento River = "SM"
- Turning Basin = "TB"
- Port of West Sacramento = "PW"
- RD 537/RD 811 Pump Station = "81"
- Causeway Pump Station = "CW"
- Lock = "LK"
- Deep Water Ship Channel = "DC"

Hydrologic Modeling Program Selection

The City of West Sacramento currently utilizes the 1996 Sacramento County hydrology standards for calculating runoff hydrographs. The Sacramento County standards include many physical parameters and hydrologic routing/transformation methods for design rainfall definition and the estimation of infiltration, storage effects, timing and routing of surface runoff. Wood Rodgers used the Sacramento County Hydrologic Calculator (SacCalc) program which preforms the Sacramento County Method in the South Basin. West Yost used the Sacramento County Method hydrology calculations within the XPSWMM software for the North Basin, which produced consistent results.

Sacramento County Method and Rainfall

Existing conditions hydrology was developed using the SacCalc program for the City, defining it as a unique storm event under the "historical storm rainfall" tool. Yolo County 100-year 24-hour design rainfall was imported into SacCalc as the precipitation input. Initial loss of precipitation at the beginning of a storm is set to 0.1 inch for the 100-year return interval (in accordance with the Sacramento County Hydrology Standard). Wood Rodgers calculated the watershed parameters in GIS, including tributary area, slope, length of watershed, length to centroid, and land use. The watershed parameters were then input to SacCalc and XPSWMM program, producing runoff hydrographs. **Appendix D** provides the calculated existing condition watershed parameters for SacCalc input for the North and South Basins.

6.3 Hydraulics

The City has provided significant data in GIS and as-built format to the team depicting the storm drain pipes/manholes/inlets for the purposes of modeling the underground capacity of the system using XPSWMM. Supplemental survey information (described in Section 4) was also used. **Figure 6-4** shows the storm drain pipes used in the hydraulic analyses for the North and South Basins.

6.4 North Basin

The North Basin relies on a series of underground pipes, open channels, and detention pond/lakes to convey and store flows before being discharged to the receiving water bodies. Pump Stations are located throughout the North Basin to lift water at underpasses, low-lying neighborhoods, and discharge points where internal flows are conveyed over levees to exit the City.

The City of West Sacramento is protected from external flooding by a series of levees along the Yolo Bypass, the Sacramento River DWSC, and the Sacramento River. The current FEMA effective floodplain map shows the North Basin as Zone X, or "Other Flood Areas". Within the North Basin, FEMA defines this designation as "The area protected from the one percent annual chance (100-year) flood by levee, dike, or other structures subject to possible failure or overtopping during larger floods." Lake Washington (north of DWSC) and Washington Lake (Turning Basin) are designated as Zone A "No base flood elevations determined." For the purpose of this study, the North Basin is considered fully protected from the external flooding sources. It is noted the City has been actively engaged in a program to provide a 200-year level of protection from these external flooding sources by the year 2025.

The following section documents the North Basin boundary conditions, pump station capacities and set points, and hydraulic results by watershed.

6.4.1 Boundary Conditions

The watersheds draining to the DWSC use a 10-year water surface elevation (WSE) based on MBK Engineers (MBK) in the Technical Memorandum entitled: US Army Corps of Engineers Memorandum for Record – Sacramento River Basin HEC-RAS Model Release 4, June 2012 (**Reference 10**). The watersheds draining to the Sacramento River use a 100-year base flood elevation (BFE) as there is no available 10-year WSE data. The difference in tailwater elevation is not significant because the watersheds draining to the Sacramento River are pumped out to the river or sit higher than WSE levels, and both function as a free outfall.

The City and the Consultant team determined that the DWSC boundary condition should be set at the 10-year WSE. Four watersheds (Deerwood, Lock, Port of West Sacramento, and DWSC) flow by gravity to the DWSC, and use of a higher starting water surface elevation would inappropriately result in widespread City flooding.

The DWSC water levels are mostly controlled by water surface elevations in the Sacramento River and Delta channels. The Sacramento River/Delta watershed is extremely large and takes days to peak, compared to hours for the local watersheds in West Sacramento. Assuming a peak 100-year local storm (a storm within the City limits) occurring on top of a peak 100-year stage in the DWSC is not appropriate.

Two watersheds (Lighthouse and Raley) are pumped to the Sacramento River through lift stations. The 100-year water surface elevation of the Sacramento River is below the force main elevations for Lighthouse and Raley, and so these discharges function as free outfalls. One watershed (Sacramento River) is high in topographical elevation, serving crucial industrial facilities, and drains by gravity to the Sacramento River as a free outfall.

It is noted that the majority of the Deerwood watershed is drained by gravity and influenced by tailwater conditions as outlined in the table below. There is a Deerwood Pump Station; however, it only services one neighborhood (Deerwood Street at Lakewood Drive), representing a small portion of the overall watershed.

The following boundary conditions have been presented by watershed below in **Table 6.2**.

Table 6.2 – North Basin Boundary Conditions		
Watershed	**Tailwater Elevation, ft. NGVD 29**	**Receiving Water Body, Source**
Raley Pump Station	Free Outfall	Sacramento River, FEMA
Sacramento River	Free Outfall	Sacramento River, FEMA
Deerwood	9.32	Deep Water Ship Channel, 10-year WSE (MBK 2015)
Lock	9.32	Deep Water Ship Channel, 10-year WSE (MBK 2015)
Deep Water Ship Channel	9.32	Deep Water Ship Channel, 10-year WSE (MBK 2015)
Port of West Sacramento	9.32	Deep Water Ship Channel, 10-year WSE (MBK 2015)
Causeway and Racetrack Pump Stations	Free Outfall	Yolo Bypass, FEMA
RD 537/RD 811 Pump Station	Free Outfall	Yolo Bypass, FEMA
Lighthouse Pump Station	Free Outfall	Rivers Phase 2 Storm Drainage Master Plan dated February 2017 by NV5 Global, Inc. (NV5)

ft = feet
FEMA = Federal Emergency Management Agency
NGVD 29 = National Geodetic Vertical Datum of 1929

6.4.2 Pump Station Capacities and Set Points

Pump Station capacities and set points for pump start up and shut down within the hydraulic models, as well as other pertinent pump station information assumed are outlined in **Table 6.3** below. Surveyed set points were surveyed for Causeway Pump Station. All other set points were made based on record drawings, typical pump operation, set point data obtained at the pump station and staff accounts.

Table 6.3 – Summary of Pump Station Capacities and Set Points										
Pump Station	Original Construction Date	Pump No.	Pump Type	Pump HP	Pump Capacity (cfs)	Pump On		Pump Off		Backup Generator?
						Depth (a), (ft)	Elev. (ft) (NGVD 29)	Depth (a), (ft)	Elev. (ft) (NGVD 29)	
City Pump Stations										
5th Street	1987	1	Vertical Turbine	5	1	8.25	7.48	7.00	6.23	No
Deerwood	1960	1	Submersible	2 to 5	1	3.50	6.50	1.00	4.00	No
Delta Lane	2016	1	Submersible	7.5	7	5.50	5.50	2.00	2.00	Yes
		2	Submersible	7.5	7	5.50	5.50	2.00	2.00	
		3	Submersible	7.5	7	7.50	7.50	2.40	2.40	
Harbor	1995	1	Centrifugal	3	1	6.00	3.80	3.00	0.80	No
Jefferson	1985	1	Submersible	3	1	5.00	1.60	2.50	-0.90	No
Lighthouse	1991	1	Vertical Turbine	20	3	4.32	-4.25	2.57	-6.00	Yes
		2	Vertical Turbine	200	31	7.97	-0.60	6.97	-1.60	
		3	Vertical Turbine	200	31	9.27	0.70	6.97	-1.60	
		4	Vertical Turbine	450	70	10.57	2.00	6.97	-1.60	
		5	Vertical Turbine	450	70	12.07	3.50	6.97	-1.60	
Raley	1988	1	Vertical Turbine	100	31	14.00	8.23	4.00	-1.77	No
		2	Vertical Turbine	100	31	14.50	8.73	4.00	-1.77	
		3	Vertical Turbine	250	38	15.00	9.23	5.00	-0.77	
		4	Vertical Turbine	250	38	15.50	9.73	5.00	-0.77	
RD 811/ RD 537	1950	1	Vertical Turbine	300	84	8.00	0.55	6.50	-0.95	No
		2	Vertical Turbine	300	84	7.25	-0.20	6.00	-1.45	

Table 6.3 – Summary of Pump Station Capacities and Set Points										
Pump Station	**Original Construction Date**	**Pump No.**	**Pump Type**	**Pump HP**	**Pump Capacity (cfs)**	**Pump On**		**Pump Off**		**Backup Generator?**
						Depth (a), (ft)	**Elev. (ft) (NGVD 29)**	**Depth (a), (ft)**	**Elev. (ft) (NGVD 29)**	
		3	Vertical Turbine	300	84	7.22	-0.23	5.95	-1.50	
		4	Vertical Turbine	250	67	7.18	-0.27	6.05	-1.40	
		5	Vertical Turbine	200	67	6.75	-0.70	5.75	-1.70	
Washington	1930	1	Vertical Turbine	5	1	6.00	2.50	1.00	-2.50	No
		2	Vertical Turbine	5	1	6.50	3.00	0.50	-3.00	
RD 900 Pump Stations										
Causeway	1986	1	Vertical Turbine	200	40	11.25	4.00	10.75	3.50	No
		2	Vertical Turbine	200	40	11.35	4.10	10.85	3.60	
		3	Vertical Turbine	200	40	11.45	4.20	10.95	3.70	
		4	Vertical Turbine	200	40	11.55	4.30	11.05	3.80	
		5	Vertical Turbine	300	32	11.65	4.40	11.15	3.90	
		6	Vertical Turbine	300	32	11.75	4.50	11.25	4.00	
Racetrack	1978	1	Vertical Turbine	125	57	4.99	4.60	4.49	4.10	No
		2	Vertical Turbine	125	57	5.09	4.70	4.59	4.20	

(a) *Depth is measured from the invert of the Wet Well*

The City pump stations were modeled using a combination of manufacturer curves and operating capacities to set the pumping rates. The elevation data for the City pump stations were obtained from record drawings and the on/off levels were provided by City staff. There are three pump stations located at road underpasses for which no pump data/capacities were available. For these pump stations, the pumping capacity was estimated based on a review of the pump station components (general pump type, horsepower, pumping head). A capacity of 400 gallons per minute (roughly 1 cubic-foot-by second) was estimated. At the Causeway Pump Station, an actual survey of the set points was performed for the Master Plan. For all other locations, the pump was assumed to turn on when the incoming pipe is flowing full (water surface elevation meets the pipe crown elevation) and turn off when incoming pipe is empty (water surface elevation meets the pipe invert elevation). **Table 6.4** (below) provides a brief description of the basis of set points cited in Table 6.4 and utilized with the modeling:

Table 6.4 – Pump Station Assumptions

Pump Station Name	Assumptions
5th Street	Capacity estimated to be 1 cfs (400 gpm) Pump on when incoming pipe is full, pump off when incoming pipe is empty
Deerwood	Capacity estimated to be 1 cfs (400 gpm) Assumption of wet well elevation to be 4 feet below invert of upstream manhole
Harbor	Capacity assumption of 1 cfs (400 gpm) Pump operation based on record drawings
Racetrack P1	Manually Operated Assumption for pump to turn on 0.1 ft after Causeway Pump 6 is running
Racetrack P2	Manually Operated Assumption for pump to turn on 0.1 ft above Racetrack P1 on level
Jefferson	Capacity estimated to be 1 cfs (400 gpm) Pump on when incoming pipe is full, pump off when incoming pipe is empty
Washington P1	Capacity assumption of 1 cfs (400 gpm) Pump operation based on record drawings
Washington P2	Capacity assumption of 1 cfs (400 gpm) Pump operation based on record drawings

6.4.3 North Basin – Typical Cross Sections

Typical cross sections were used to model the capacity of the street to convey flow. The typical cross sections are based on the City of West Sacramento Standard Specifications and Details (**Reference 13**) Vertical Curb and Gutter with Sidewalk detail number 201. The streets contain one 2-foot gutter in each traffic direction at a 1.5-inch fall. The curb has a 6-inch height and pitches at 2 percent up to the roadway crown. Standard roadways sizes were developed from the City of West Sacramento Standard Specifications and Details Section 3 Street Design from 36-foot-wide residential collector to a 110-foot wide major arterial. Standard street sections were then compared against aerials before application in the model. A full table of cross sections can be found in Appendix D.

6.4.4 North Basin Results By Watershed

The North Basin Watersheds are presented below from north to south, starting with the western side. **Figure 6-5** shows all the major watersheds and receiving waterbodies in the North Basin. **Table 6.5** shows the watershed areas as a percentage of the North Basin.

Table 6.5 – North Basin Watershed Areas

Watershed by Outfall	Area (Acres)	Percentage of the North Basin
Lighthouse Pump Station	275	5%
Raley Pump Station	111	2%
Sacramento River	12	0%
Turning Basin	17	0%
RD537/RD811 Pump Station	1,339	23%
Lock	71	1%
Deerwood	303	5%
Deep Water Channel	202	4%
Causeway and Racetrack	2,510	44%
Port of West Sacramento	10	0%
East Shed Infiltration	94	2%
Areas Outside of Study Criteria	355	6%
CHP	466	8%
Total Area	**5,765**	**100%**

6.4.4.1 CHP Academy Watershed (466 Acres)

The California Highway Patrol Academy Watershed was modeled by Wood Rodgers in 2018 (**Reference 11**) under a separate contract with the California Department of General Services. Outfall hydrographs from the 100-year storm were input into the RD 537/RD 811 Pump Station Watershed model.

The CHP Academy Watershed is a State-owned facility and internal flows were not evaluated as part of this study.

6.4.4.2 RD 537/RD 811 Pump Station Watershed (1,339 Acres)

The RD 537/RD 811 Watershed is located between the Sacramento River and the Union Pacific Railroad (UPRR) as shown in **Figure 6-6** and **Figure 6-7**. The watershed is bounded to the east by the Lighthouse Watershed and the Raley Pump Station Watershed. The RD 537/RD 811 watershed relies on a channel (main channel) that flows from east to west terminating at the RD 537/RD 811 Pump Station, which is located at the northwest end of the watershed, just west of the CHP Academy. The pump station discharges to the Sacramento Bypass. Most of the watershed is drained by an underground pipe system that flows to the main channel.

The model results show the RD 537/RD 811 Watershed is predicted to receive spill flows during the 100-year storm from the Lighthouse Watershed at Lighthouse Drive based on the modeling results from this study.

Portions of the main channel and several culverts within it, restrict the flow and cause increased water surface elevations. During the 100-year design storm, high water surface elevations in the main channel reduce the performance of discharging trunk drains. As a result, low lying building pads, such as those on Arthur Drive from Milton Street to Fremont Boulevard (Nodes 81M742, 81M821, and 81M824) and at Douglas Street and Elkhorn Place (Node 81M772) are predicted to flood during the 100-year storm. Even if the water surface elevations in the channel are lowered, there are some trunk pipes that do not have adequate capacity to convey the 100-year design flow. This is the case for the pads adjacent to Hobson Avenue at Bryte Avenue (Node 81M619) and at 8th Street and Elizabeth Street (Node 81M846). Insufficient overland flow capacity is also a contributing factor at these nodes. As described below, West Yost developed conceptual solutions for these flood problems.

6.4.4.3 Causeway Pump Station and Racetrack Pump Station Watershed (2,510 Acres)

The Causeway Pump Station and Racetrack Pump Station (Causeway and Racetrack) Watershed is located south of the UPRR and spans the area between the Yolo Bypass and the Sacramento River. The Causeway and Racetrack Watershed is shown from west to east on **Figure 6-8**, **Figure 6-9**, and **Figure 6-10**. Runoff in the watershed is conveyed from east to west and is discharged to the Yolo Bypass by way of the Causeway Pump Station and the Racetrack Pump Station. The Causeway and Racetrack Watershed relies on an east-west multi-pipe trunk drain that runs from Westacre Road to Pine Street where it transitions into an open channel. The northern section of the watershed relies on a main channel that runs along the southern embankment of the UPRR and terminates at the Racetrack Pump Station.

The Causeway and Racetrack Watershed receives flow from the Deerwood Watershed that comes from an overland spill on Del Monte Street and travels through an 18-inch pipe connection running through Westmore Oaks Elementary School (formerly the old high school). Although the 18-inch pipe is below the minimum pipe size of 21 inches established for this master plan, it has been included because it is an important path for excess flows to be conveyed from the Deerwood Watershed to the Causeway Watershed.

In the 100-year design storm, the Causeway Pump Station does not pump incoming flows quickly enough and, as a result, flooding is predicted at areas adjacent to Lake Washington (Nodes CWO010, CWO013, and CWO016). In addition, the east-west multi-pipe trunk drain has limited capacity to convey the 100-year design flows that drive up the tailwater elevations for connecting trunk drains. This situation results in flooding of low-lying building pads that are located north of US Route 50 (US 50) and west of Sycamore Avenue (Node CWM577 and CWM556), Merkley Avenue from El Rancho Court to Jefferson Boulevard (Nodes CWM607, CWM608 and CWI720), Poplar Avenue and Rockrose Road (Node CWM896 and CWI900), and Portsmouth Court and Michigan Boulevard (Node CWI918, CWI924, CWI992, and CWI994). At some locations there are trunk pipes that do not have adequate capacity to convey the 100-year design storm and that lack the overland flow capacity necessary to convey the excess flows without flooding. This situation results in predicted flooding at Seaport Boulevard at Enterprise Boulevard (Nodes CWM184, CWM187), and Clarendon Street (Node CWM685).

During the 100-year design storm, the Racetrack Pump Station does not have the capacity to pump incoming flows quickly enough and, as a result, flooding occurs at Doran Avenue at Marigold Street (Nodes RTM163 and RTM166) and West Capitol Avenue (Nodes RTO082 and RTO085). In addition, there is one location where the capacity of the trunk pipe and overland flow paths is inadequate to convey the 100-year flood flows. This situation causes flooding to be predicted at Harbor Boulevard and West Capitol Boulevard (Node RTM229).

6.4.4.4 Raley Pump Station Watershed (111 Acres)

The Raley Pump Station Watershed is located along the Sacramento River between the Lighthouse Pump Station Watershed and the Causeway and Racetrack Watershed. The Raley Pump Station Watershed is shown in **Figure 6-11**. The watershed is pumped via the Raley Pump Station to the Sacramento River.

The trunk system and roadway have adequate capacity to contain the 100-year storm.

6.4.4.5 Bridge District East Shed Infiltration (94 Acres)

The Bridge District Infrastructure Improvements Drainage Technical Memorandum No. 6 (**Reference 14**) has specified that the East Shed infiltrates 100-year storm flows. For this reason, the Bridge District East Shed has no contributing flows, and was not modeled under this study.

The trunk system and roadway have adequate capacity to contain the 100-year storm.

6.4.4.6 Sacramento River Watershed (12 Acres)

The Sacramento River Watershed is located along the Sacramento River west of South River Road. The watershed drains by gravity to the Sacramento River via one trunk line. The Sacramento River Watershed is shown in **Figure 6-12**.

The trunk system and roadway have adequate capacity to contain the 100-year storm

6.4.4.7 DWSC Watershed (202 Acres)

The DWSC Watershed is located just north of the Sacramento River DWSC on the western-most side of the City. The watershed flows from either end towards the center trunk system on Channel Drive. Flows from the DWSC Watershed flow by gravity to the DWSC. The DWSC Watershed is shown in **Figure 6-13**.

The trunk system and roadway have adequate capacity to contain the 100-year storm.

6.4.4.8 Port of West Sacramento Watershed (10 Acres)

The Port of West Sacramento Watershed is located west of the Deerwood Watershed and discharges directly to the DWSC. The watershed contains one trunk line that conveys flow from the area south of Terminal Street and Industrial Boulevard. The Port of West Sacramento Watershed is shown in **Figure 6-14**.

The trunk system and roadway have adequate capacity to contain the 100-year storm.

6.4.4.9 Deerwood Watershed (303 Acres)

The Deerwood Watershed is located north of the DWSC and south of Westmore Oaks Elementary School (formerly the old high school). The Deerwood Watershed is between the Port of West Sacramento Watershed and the Lock Watershed. The Deerwood Watershed is shown in **Figure 6-15**. The Deerwood Watershed drains from north to south, discharging into the DWSC. The Deerwood Pump Station acts as a sump pump for the Deerwood Street and Lakewood Drive neighborhood.

The Deerwood Watershed and Lock Watershed have been modeled together as they are hydraulically connected during large storms. In the 100-year design storm, flows from the Lock Watershed surcharge the trunk drain and flow into the Deerwood Watershed.

The Deerwood Watershed is also hydraulically connected to the Causeway Pump Station Watershed through an existing 18-inch pipe running through Westmore Oaks Elementary School and at an overland spill path on Del Monte Street.

The Deerwood Watershed relies on a north-to-south trunk link that has adequate capacity to convey 100-year design storm flows. The Deerwood Pump Station does not have adequate capacity to drain the tributary neighborhood in the 100-year design storm. As a result, pad flooding is predicted in the low areas that drain to the pump station. The Deerwood Pump Station only services one neighborhood (Deerwood Street at Lakewood Drive), representing a small portion of the overall Deerwood Watershed. The outfall mechanism of the watershed is not via lift station, but through a gravity drain which is influenced by tailwater.

6.4.4.10 Lock Watershed (71 Acres)

The Lock Watershed drains south to the DWSC and is located just east of the Deerwood Watershed. The Lock Watershed relies on one trunk system that runs from north to south along Jefferson Boulevard. The Lock Watershed is shown in Figure 6-15.

The Lock Watershed trunk drain does not have adequate capacity to convey the 100-year design flows and the overland release paths are inadequate to convey the excess flows. Consequently, flood flows spill from the Lock Watershed to the Deerwood Watershed along Circle Street into the Alabama Avenue and 13th Street neighborhood. The spill causes flooding above pad elevations adjacent to Node LKOV16.

6.4.4.11 Lighthouse Pump Station Watershed (275 Acres)

The Lighthouse Pump Station Watershed is in the northeast corner of the City along the Sacramento River. The majority of the watershed drains to the Lighthouse Pump Station where it is discharged to the Sacramento River. The existing conditions model assumes that the improvements from the Rivers Phase 2 Storm Drainage Master Plan, dated February 2017 by NV5 (**Reference 15**) have been implemented. It has been confirmed that the trunk system and the roadway together have adequate capacity to contain the 100-year storm. The Lighthouse Pump Station is shown on **Figure 6-16**.

The Lighthouse Pump Station Watershed is hydraulically connected to the RD 537/RD 811 watershed via an overland spill. The Lighthouse Pump Station hydraulic model uses the Sacramento Method per the Rivers Phase 2 Storm Drainage Master Plan (NV5, February 2017) (Reference 15).

The trunk system and roadway have adequate capacity to contain the 100-year storm.

6.4.4.12 North Basin Areas Outside of Study Criteria

As directed by the City, areas of the North Basin that do not flow through public storm drainage pipes 21-inches or larger have been omitted from the Study. This includes the area east of the Lock Watershed, the Port of West Sacramento private system, areas draining to the Port of West Sacramento private system, the George Kristoff Water Treatment Plant private system, and settling and infiltration basins east of the Water Treatment Plant. Areas of the North Basin that sheet flow directly to Lake Washington, the Sacramento River, the Yolo Bypass, or the DWSC have been omitted from this study. Refer to Figure 6-5 for these areas.

6.5 South Basin

The South Basin of the City relies on many important drainage facilities (i.e., underground storm drain pipes, channels, detention basins/lakes and pump stations) to collect and convey stormwater runoff. The selected software (XPSWMM) is an effective and commonly-used platform to model the hydraulic connectivity of all the important drainage facilities, and was used for South Basin analyses.

The City of West Sacramento is protected from external flooding by a series of levees along the Yolo Bypass, the Sacramento Bypass, the Sacramento River DWSC, and the Sacramento River. The current FEMA effective floodplain map shows the South Basin as Zone X, or "Other Flood Areas". For this study, the South Basin is considered fully protected from the external flooding sources. It is noted that the City has been actively engaged in a program to provide a 200-year level of protection from these external flooding sources. Elements of that program have been constructed; however, others are in design or will be constructed at some point in the future. Because there is a defined program to prevent this source of flooding from affecting interior areas, flows from these sources are not accounted for in the SD/SW MP Update. Since the initiation of the SD/SW MP Update, the City has constructed its Southport Setback Levee along the Sacramento River adjacent to the South Basin. This levee effectively reduces the tributary area of the internal watershed and, therefore, reduces the flow to internal drainage facilities. This reduction in flow was not incorporated into the existing conditions analyses; however, it was considered in the future conditions analyses.

RD 900 has been the primary agency responsible for operating and maintaining storage, conveyance and pumping facilities within the South Basin. Recently, RD 900 has come under the authority of the City to allow for a clearer administrative structure to address operation and maintenance activities in the future regulatory landscape. Within urbanized areas of the City, the City's Public Works Department has been responsible for maintaining the storm drainage pipe system within public rights-of-way outside of state-owned facilities such as highways and the CHP Academy campus and facilities under the jurisdiction of other agencies, such as RD 900. Bathymetric surveys performed to determine channel cross section geometry were modeled as 1-D links in the XPSWMM model. Furthermore, a thorough review of data collected for storm drain pump stations within the South Basin was performed to ensure that the operation of the stations (including pump start and pump stop elevations) were properly represented in the XPSWMM model. **Table 6.6** summarizes the pump station capacity, operation elevation and tributary watersheds. In addition, the Main Drain pump station and the South Basin Industrial Park Pump Station are assumed to act independently of external water surface elevation in the DWSC.

As discussed above, the interior drainage for developed areas in the South Basin is conveyed by underground storm drainage pipes that collect and deliver flow into either drainage channels or detention basins. For storm events that exceed the drainage inlet and pipe capacity, overland flow occurs alongside roadside curbs and gutters within streets. This overland flow is modeled in XPSWMM with a link representing the street/roadway cross section between the manholes. For rural areas where surface runoff will generally follow flatter surface terrain with ponding, the overland storage capacity is calculated using the terrain data and represented using a 1-D storage node.

6.5.1 Boundary Conditions

There are no gravity discharges from the South Basin to external channels because all runoff is pumped over levees to the DWSC via one of two pump stations. Tailwater conditions within the DWSC do not affect the hydraulic operations of the Main Drain Pump Station or the Southport Industrial Park Pump Station because pump discharge lines are over the levees with a siphon break at the high point of each discharge line. All other elements of the South Basin system are tied to one of these two pump stations. The overall watersheds for the South Basin are depicted on **Figure 6-17**.

6.5.2 Pump Station Capacities and Set Points

The following pump station capacities and set points for the South Basin are provided below in **Table 6.6**.

Table 6.6 – Summary of Pump Station Capacities and Set Points				
Pump Station	**Pump Number**	**Pump Capacity, (cfs)**	**Pump On Elev. (ft) (NGVD 29)**	**Pump Off Elev. (ft) (NGVD 29)**
RD 900 Pump Stations				
Gateway/Stonegate (Formerly MC 10)	1	18	0.61	0.11
	2	83	0.86	0.16
	3	83	2.61	2.11
Touchstone	1	1	1.52	0.82
	2	6	2.02	1.02
Larchmont	1	8	0.55	-1.46
	2	31	1.05	-0.46
Rivermont	1	12	0.40	-0.60
Main Drain	1	167	3.00	2.60
	2	167	2.40	2.00
Southport Industrial Park	1	56	0.14	-0.86
	2	56	0.64	0.24
	3	56	1.64	-0.76
High School	1	8	2.50	1.50
Parlin Ranch	1	4	-0.60	-1.60
	2	16	-0.10	-1.10

6.5.3 South Basins Results By Watershed

The South Basin Watersheds are presented in a clockwise fashion starting with Bridgeway lakes. South Basin Watershed Areas are shown in **Table 6.7**.

Table 6.7 – South Basin Watershed Areas		
Watershed by Outfall	**Area (Acres)**	**Percentage of the South Basin**
Bridgeway Lakes	405	6%
South Basin Industrial Park	1,089	17%
Lake Washington	379	6%
Gateway/Stonegate	937	14%
Main Drain North	91	1%

Table 6.7 – South Basin Watershed Areas		
Watershed by Outfall	**Area (Acres)**	**Percentage of the South Basin**
Parlin Ranch	223	3%
High School	89	1%
Rivermont	50	1%
Touchstone Lake	146	2%
Larchmont	242	4%
Morton Blacker	365	5%
East Tapley Drain	355	5%
Main Drain South	1,373	21%
Clarksburg	932	14%
Total Area	**6.676**	**100%**

6.5.3.1 Bridgeway Lakes Watershed (405 Acres)

The Bridgeway Lakes watershed (BL) is an area characterized by residential community development and other rural residential parcels. The drainage in this area is mainly conveyed through an underground storm drainage pipe network draining into a network of interconnected detention basins, which also serve a recreational function as lakes during the dry season. These detention basins are connected through a network of channels to the Main Drain pump station. **Figure 6-18** shows the flooding depth results obtained from the existing condition XPSWMM modeling for the 100-year 24-hour design storm. As indicated on Figure 6-18, the underground storm drainage pipe system collects and diverts runoff to its full capacity, resulting in some minor street flooding (depths less than 1.6 feet above the gutter flow line). Furthermore, the Bridgeway Lakes existing detention basins were able to attenuate the 100-year storm with sufficient freeboard to protect all residential (habitable) structures within the watershed.

6.5.3.2 South Basin Industrial Park Watershed (1089 Acres)

The South Basin Industrial Park (II/SI) area is a partially constructed mixed industrial and residential development with a remaining open space area for future development. The drainage in this area is conveyed through underground storm drainage pipes, channels, and a detention basin with a pump station. The II/SI Pump Station operates automatically to pump drainage water to the Sacramento River DWSC as the water surface elevation in the detention basin rises above a preset elevation. **Figure 6-19** shows the flooding depth that results in this area based on the existing condition XPSWMM model for the 100-year 24-hour storm. As shown in Figure 6-18, the underground pipe and channels serving II/SI in the north are capable of collecting and conveying 100-year runoff without flooding. The residential areas in the south portion of the watershed show minor street flooding (with depths of up to 1.6 feet above gutter flow line) due to the capacity of the underground pipe system being exceeded during the 100-year event. The pump station capacity serves to maintain the water surface elevation in the detention basin below flooding levels.

6.5.3.3 Lake Washington Watershed (379 Acres)

The Lake Washington (LW) watershed is comprised of Lake Washington and adjacent open space, as well as a few developed industrial parcels. The drainage in this area is conveyed overland or through underground storm drainage pipes that discharge directly to Lake Washington, which drains to the Main Drain. The culvert connecting Lake Washington with the Main Drain channel allows for the slow and delayed release of drain water from Lake Washington to the Main Drain during a high-water event. **Figure 6-20** shows the maximum flooding depth that results from the 100-year 24-hour storm for existing conditions using the XPSWMM model. As shown in Figure 6-19, existing underground pipes and streets are able to collect and convey drainage flows to Lake Washington without flooding. The peak water surface elevation in Lake Washington is below the flooding level in the area for the 100-year storm event.

6.5.3.4 Gateway/Stonegate Watershed (937 Acres)

The Gateway/Stonegate (GS) watershed (formerly MC10) contains one of the larger residential developments in the South Basin. There are a few remaining open space parcels that are slated for development in the future. The drainage in this area is conveyed through underground storm drainage pipes, a two-celled detention basin, and a pump station. The pump station discharges runoff that has collected in the detention basin to the upstream end of the Main Drain channel. **Figure 6-21** shows the maximum flooding depth results for existing conditions under the 100-year 24-hour storm event using the existing XPSWMM model. As shown in Figure 6-20, the detention basin in this area has a maximum water surface elevation exceeding the banks and flooding the adjacent streets. In addition, the majority of the underground pipes are insufficient to collect and convey the runoff during a 100-year storm event, resulting in street flooding with a depth of up to three feet above the gutter flow line.

6.5.3.5 Parlin Ranch Watershed (223 Acres)

The Parlin Ranch (PR) watershed is a partially constructed mixed residential development with the remaining open space slated for development in the future. The drainage in this area is conveyed through underground storm drainage pipes, a detention basin, and a pump station. The pump station directs runoff from the detention basin to the channel along the Clarksburg Trail, which ultimately drains to the Main Drain channel and pump station via the Blacker Morton (BM) Drain. **Figure 6-22** shows the flooding depth results for the 100-year 24-hour design storm from the existing XPSWMM model. As shown in Figure 6-21, some of the underground pipes have their capacity exceeded and street flooding results with depths of up to three feet. The pump station is capable of maintaining the water surface elevation in the detention basin below the flooding level.

6.5.3.6 High School Watershed (89 Acres)

The High School area is mainly comprised of River City High School and a few adjacent open space parcels. The drainage in this area is mainly handled by underground storm drainage pipes, detention basins, and pump stations. **Figure 6-23** shows the flooding depth that results under the 100-year 24-hour storm for existing conditions using the XPSWMM model. As shown in Figure 6-22, the pump station operation is capable of maintaining the water surface elevation in the detention basin below the flooding level.

6.5.3.7 Rivermont Watershed (50 Acres)

The Rivermont (RM) watershed is a fully-developed residential area next to the left bank (looking downstream) of the Main Drain channel. The drainage in this area is conveyed through underground storm drainage pipes, a detention basin, and a pump station before discharging to the Main Drain. **Figure 6-24** shows the flooding depth resulting from the 100-year 24-hour storm for existing conditions from the existing XPSWMM model.

6.5.3.8 Touchstone Lake Watershed (146 Acres)

The Touchstone Lake (TL) watershed is fully developed with the majority of the development being residential interspersed with a few industrial and commercial parcels. The drainage in this area is conveyed through underground storm drainage pipes, a detention basin, and a pump station before discharging to the Main Drain. **Figure 6-25** shows the flooding depth resulting from the 100-year 24-hour storm for existing conditions from the existing XPSWMM model. As shown in Figure 6-24, some of the underground pipes have their capacity exceeded with street flooding depth of up to 1.6 feet. The pump station is capable of maintaining the peak water surface elevation in the detention basin below flooding levels.

6.5.3.9 Larchmont Watershed (242 Acres)

The Larchmont Development (LD) watershed is fully developed with most of the development being residential with one major dry basin (Summerfield Park) serving as detention during high flow events. The drainage in this area is conveyed through underground storm drainage pipes, a detention basin, and a pump station before discharging to the Main Drain. **Figure 6-26** shows the flooding depth resulting from the 100-year 24-hour storm for existing conditions obtained from the existing XPSWMM model. As shown in Figure 6-25, most of the underground pipes have their capacity exceeded with street flooding to a depth of up to 1.6 feet. The pump station is capable of maintaining the peak water surface elevation in the detention basin below flooding levels.

6.5.3.10 Morton Blacker Canal Watershed (365 Acres)

The Morton Blacker Canal (BM) watershed is mostly developed with much of the development being rural residential with no constructed detention. The drainage in this area is conveyed through channels and stored during high flow events within natural low-lying areas before discharging to the Main Drain. **Figure 6-27** shows the flooding depth resulting from the 100-year 24-hour storm for existing conditions obtained from the existing XPSWMM model.

6.5.3.11 East Tapley Drain Watershed (355 Acres)

The East Tapley Drain (ET) watershed is partially developed with most of the development being rural residential with no constructed detention. The drainage in this area is conveyed through channels before discharging to the Main Drain. **Figure 6-28** shows the flooding depth resulting from the 100-year 24-hour storm for existing conditions obtained from the existing XPSWMM model.

6.5.3.12 Main Drain North Watershed (91 Acres)

The Main Drain North (MCN) watershed is mostly developed with most of the development being a combination of commercial and residential with no constructed detention. The drainage in this area is conveyed through storm drains along Jefferson Boulevard before discharging to the Main Drain. **Figure 6-29** shows the flooding depth resulting from the 100-year 24-hour storm for existing conditions obtained from the existing XPSWMM model.

6.5.3.13 Main Drain South (1,343 Acres) and Clarksburg (932 Acres) Watersheds

The Main Drain South and Clarksburg watersheds are entirely undeveloped and were not reported with deficiencies resulting from the 100-year 24-hour storm for existing conditions obtained from the existing XPSWMM model.

6.6 Summary of Existing Deficiencies

6.6.1 North Basin

The following deficiencies have been documented at locations with flood depth greater than 1.6 feet as outlined in **Table 6.8.** The criteria of 1.6 feet was established by the City to represent the approximate maximum flood depth that would be contained within the public right-of-way for a typical street section, with one foot of freeboard to adjacent building pads. Specific pad elevations have been estimated from the available LiDAR topographic data (**Reference 5**) to establish if a given location will have significant flooding in the 100-year storm. Flooding deficiencies were found in the RD 537/RD 811 Watershed, Deerwood and Lock Watershed, and Causeway and Racetrack Watershed and can be seen in Figure 6-6 RD 537/RD 811 Watershed (West), Figure 6-7 RD 537/RD 811 Watershed (East), Figure 6-8 Causeway and Racetrack Watershed (West), Figure 6-9 Causeway and Racetrack Watershed (Central), Figure 6-10 Causeway and Racetrack Watershed (East), Figure 6-15 Deerwood and Lock Watershed Flood Results. The remaining watersheds have flood depths less than or equal to 1.6 feet. A full table of all results can be found in Appendix D.

Table 6.8 – North Basin: Deficiencies						
Node ID	**Ground Elevation (ft) NGVD 29**	**Pad Elevation (ft) NGVD 29**	**Existing Conditions WSEL (ft) NGVD 29**	**Existing Flood depth above ground (ft)**	**Existing Flood depth above pad (ft)**	**Notes**
RD 537/RD 811 Watershed						
81M095	11.0	19.0	14.4	3.4	-4.6	Under-pass
81M619	15.5	16.6	17.9	1.3	1.5	
81M742	11.6	13.1	14.0	2.4	0.9	
81M821	11.9	13.3	14.2	2.2	0.9	
81M069	7.6	14.0	9.5	1.9	-4.5	Under-pass
81M824	12.4	14.2	14.3	1.9	0.1	
81M846	16.5	16.8	18.1	1.6	1.3	
81M544	13.6	17.9	16.0	2.4	-1.9	
81M772	14.0	14.8	15.5	1.5	0.7	
Deerwood and Lock Watershed						
DW_WW	12.1	12.1	14.3	2.2	2.2	
LKOV16	14.6	15.6	16.8	2.2	1.2	
Causeway and Racetrack Watershed						
CWM160	11.2	16.0	14.2	3.0	-1.8	Under-pass
CWI918	11.9	13.3	14.7	2.7	1.4	
CWI914	10.8	13.0	13.5	2.7	0.5	
CWI994	12.0	14.0	14.6	2.5	0.6	
CWM896	11.0	11.0	13.4	2.4	2.4	
RTM229	11.8	13.8	14.2	2.4	0.4	
CWI898	11.1	12.9	13.4	2.4	0.5	
CWM608	11.6	13.7	13.9	2.4	0.2	
CWM577	10.4	10.9	12.7	2.3	1.8	

Table 6.8 – North Basin: Deficiencies						
Node ID	**Ground Elevation (ft) NGVD 29**	**Pad Elevation (ft) NGVD 29**	**Existing Conditions WSEL (ft) NGVD 29**	**Existing Flood depth above ground (ft)**	**Existing Flood depth above pad (ft)**	**Notes**
CWI900	11.1	12.9	13.4	2.3	0.5	
CWOVS25	14.0	17.0	16.2	2.2	-0.8	
CWI952	12.0	14.0	14.0	2.0	0.0	
CWM912	12.0	13.0	13.9	1.9	0.9	
CWI208	11.6	15.0	13.5	1.9	-1.5	
CWI720	13.3	16.0	15.2	1.9	-0.8	
CWI924	11.6	13.2	13.5	1.9	0.3	
CWO148	13.0	15.0	14.9	1.9	-0.1	
CWM685	14.8	14.6	16.7	1.9	2.1	
CWI202	11.7	15.0	13.5	1.8	-1.5	
CWI397	7.2	8.7	9.1	1.8	0.4	
CWM607	12.0	13.7	13.8	1.8	0.1	
RTM163	8.1	9.0	9.9	1.8	0.9	
CWI992	12.6	14.0	14.4	1.8	0.4	
CWM187	14.6	16.0	16.3	1.7	0.3	
CWI746	19.1	20.0	20.8	1.7	0.8	
RTM166	8.2	9.0	9.9	1.7	0.9	
CWI544	13.9	16.0	15.6	1.7	-0.4	
CWI972	12.2	14.0	13.8	1.6	-0.2	
CWM184	14.6	16.0	16.3	1.6	0.3	
CWM556	11.1	12.8	12.8	1.6	0.0	
CWI541	14.0	16.0	15.6	1.6	-0.4	
CWM863	10.2	14.0	11.8	1.6	-2.2	Under-pass

6.6.2 South Basin

The largest system deficiency in the existing South Basin is located within the Gateway/Stonegate watershed. Due to the use of increased imperviousness values to represent the existing condition and 2009 Yolo County rainfall frequency data, the current pipe/detention/pump system is not sized to handle the 100-year storm without flooding existing structures. The detention basin footprint and depth cannot be expanded due to the physical site constraints associated with existing streets and structures and the depth to groundwater.

In order to alleviate flooding for existing development within the Gateway/Stonegate watershed, conveyance and pumping improvements should be implemented to more effectively drain existing detention storage. Increased pumping will increase flow in the Main Drain, which will trigger culvert improvements at Jefferson Boulevard (at the intersection of Lake Washington Boulevard), at Marshall Road, and at Jefferson Boulevard (at the intersection of Bevan Road).

The second area affected by system deficiencies is within the Parlin Ranch development. However, the localized street flooding occurring under existing conditions is due to undeveloped land to the east being temporarily routed through developed streets. These areas will be directed along a different overland flow path to the detention basin once final developed street layouts are constructed. In the interim period, the existing flooding could be addressed with the construction of a temporary earthen barrier to redirect undeveloped runoff southward and into open space areas that drain to the upstream end of the Blacker Morton Drain.

Performance History

Fortunately, recent development portions of the South Basin (those constructed within the last 20 years) have not experienced a severe storm event. The evaluation of existing development constructed prior to 2000 shows those systems as capable of withstanding a 100-year event without flooding houses/structures. No information is available to indicate that significant historical flood damage has occurred within the South Basin during large flood events such as those that occurred in 1997, 1995, or 1986. This is consistent with the findings under this SD/SW MP Update.

Results

Results of the existing condition XPSWMM model for South Basin are provided in Appendix D, which summarizes the maximum hydraulic grade line (HGL), ground elevation and depth deficiency for all of the hydraulic nodes in the XPSWMM model. Figures 6-17 through 6-29 shows the locations of the deficient nodes in the drainage system for the South Basin. As shown by Figures 6-17 through 6-29, the major deficiency of the South Basin drainage system is the Gateway/Stonegate detention pond and pump station, as well as the culvert crossings along the Main Drain channel. Section 8 will discuss the approaches for future conditions modeling and proposed facility improvements in the South Basin.

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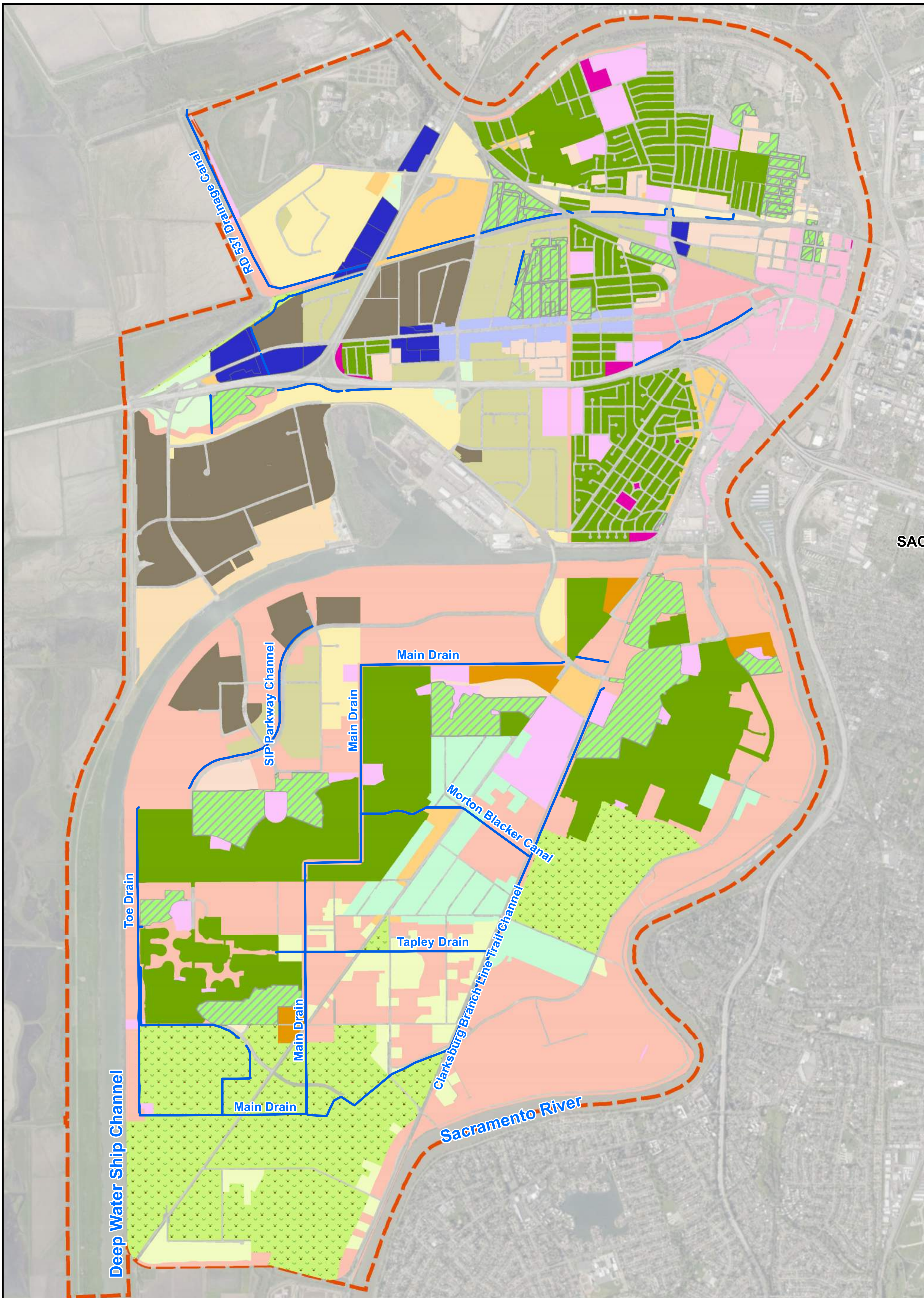

Land Use

- Agricultural
- Business Park
- Central Business District
- Commercial
- Corridor Mixed-Use
- Heavy-Industrial
- High-Density Residential
- Highway-Service Commercial
- Light-Industrial
- Low Density Residential
- Medium High-Density Residential
- Medium-Density Residential
- Mixed-Commercial/Industrial
- Neighborhood Mixed-Use
- Open Space
- Public/Quasi-Public
- Recreation and Parks
- Riverfront Mixed Use
- Rural Estates
- Rural Residential
- Water-Related Industrial
- City of West Sacramento Limit
- Open Channel

N

0 1,250 2,500
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-1
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Land Use Map

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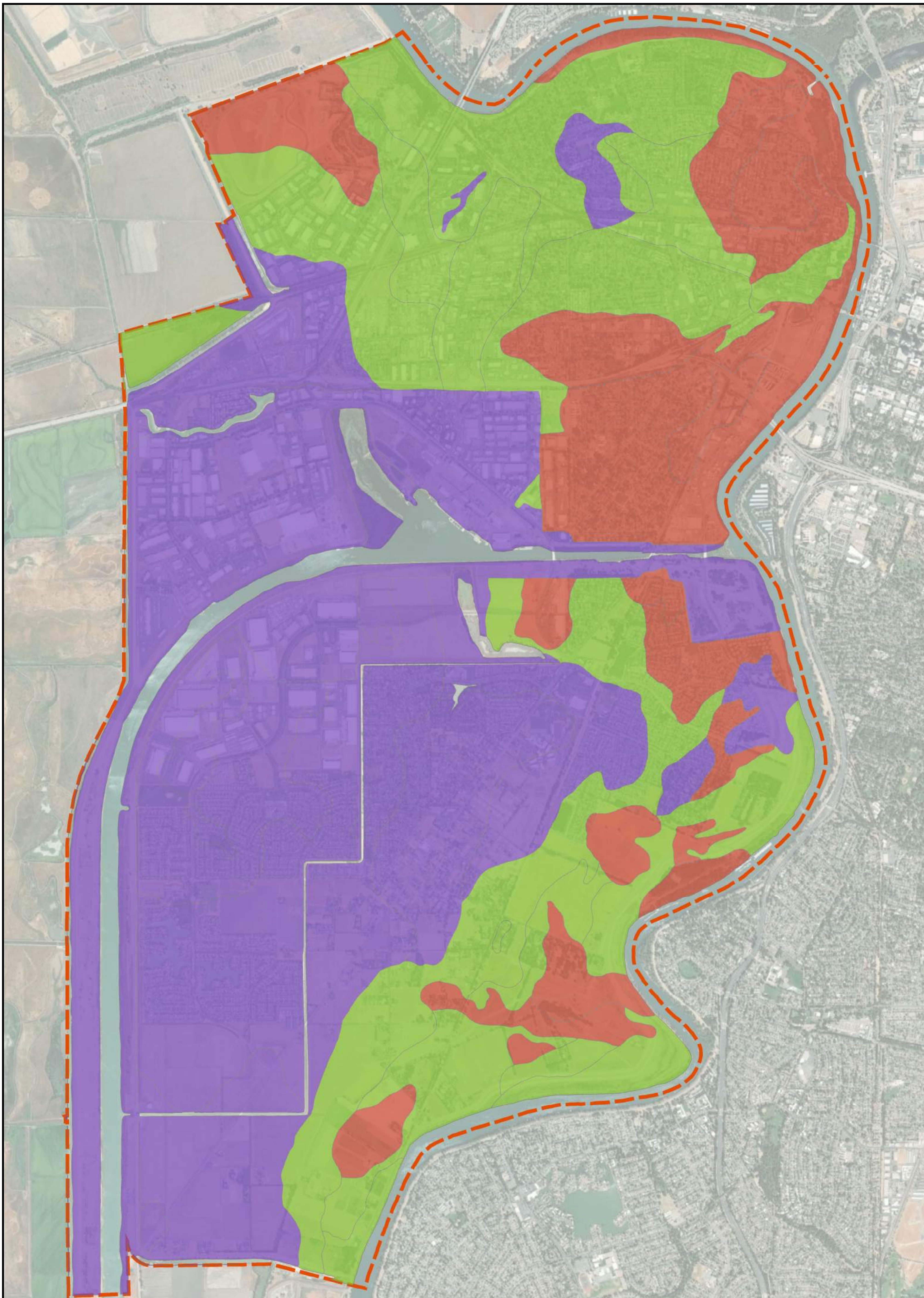

Hydrological Soil Group

- B
- C
- D*
- City of West Sacramento Limit

Source: NRCS, 2017

*Note: All data classified as "C/D" is mapped and utilized as type "D" soils.

N

0 1,250 2,500
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
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Figure 6-2
City of West Sacramento
SD/SW Master Plan Update
Soil Map

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Bathymetric Survey Points
City of West Sacramento Limit

CVFED LIDAR
Value
High : 63.9335
Low : -1.98769

0 1,250 2,500
Scale in Feet

N

CITY OF WEST SACRAMENTO

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DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-3
City of West Sacramento
SD/SW Master Plan Update
Topographic and Survey Map

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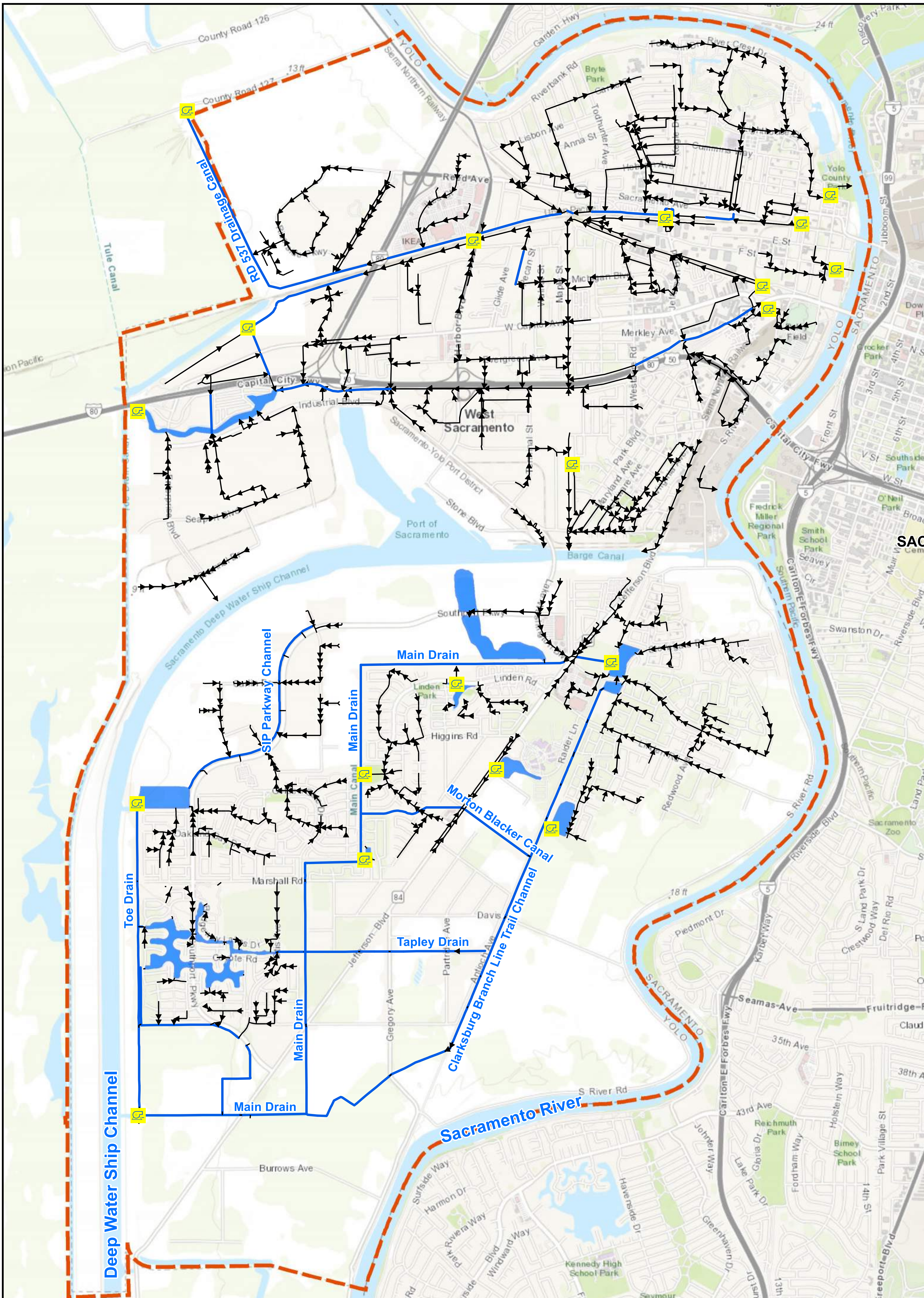

Existing Pump Station

Open Channel

Storm Drain Pipes

Open Channel

Existing Detention Pond/Lake

City of West Sacramento Limit

N

0 1,500 3,000

Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS

DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-4
City of West Sacramento
SD/SW Master Plan Update
Storm Drain Network Map

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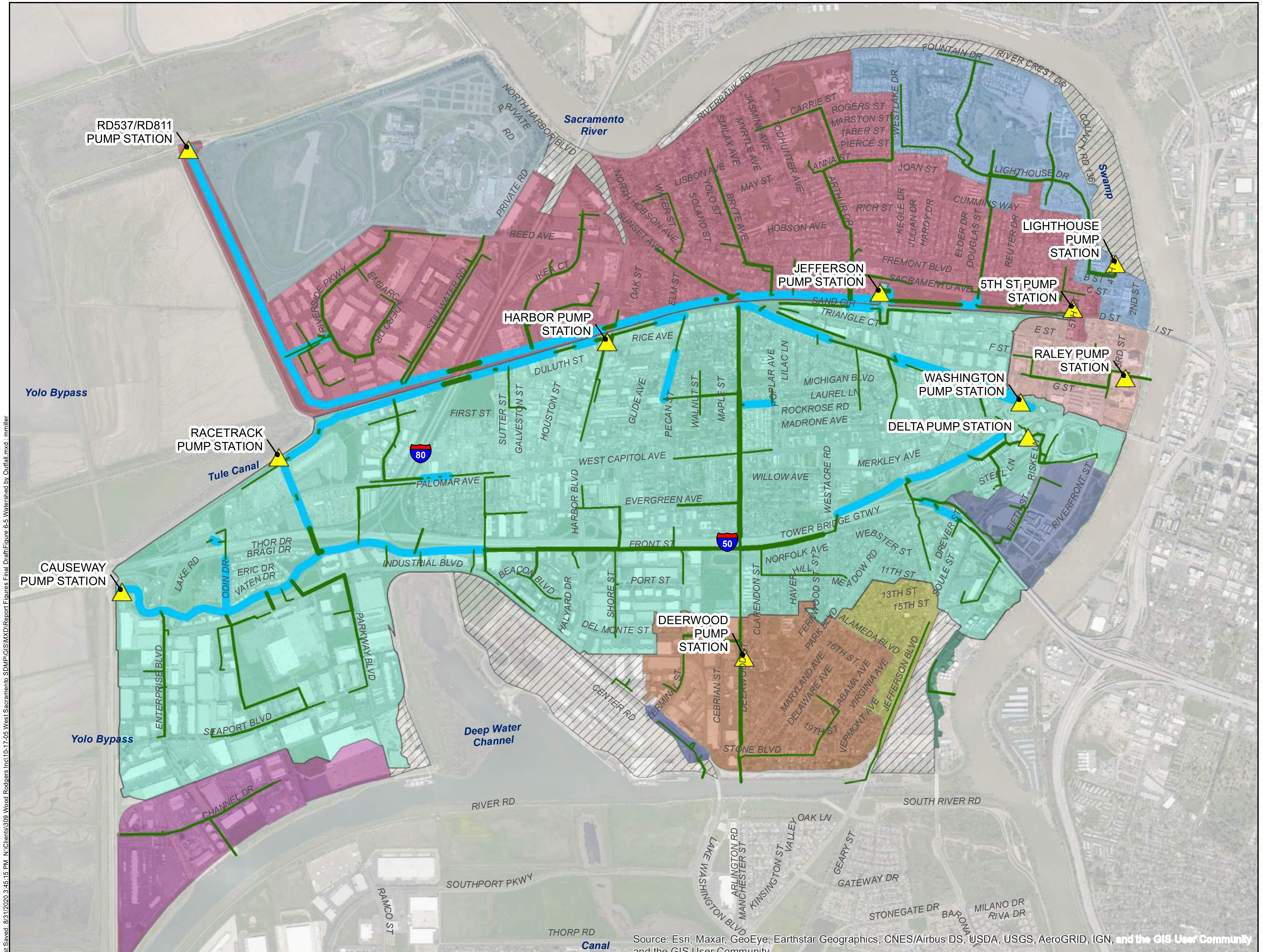

Watershed by Outfall (Acres)

- Areas Outside of Study Criteria (355)
- Causeway and Racetrack (2510)
- Deep Water Channel (202)
- Deerwood (303)
- Bridge District East Shed Infiltration (94)
- Lighthouse Pump Station (275)
- Lock (71)
- Port of West Sacramento (10)
- RD537/RD811 Pump Station (1339)
- Raley Pump Station (111)
- Sacramento River (12)
- CHP Academy (466)

Pipe Diameter (inches)

- 0 - 33
- 33 - 54
- 54 - 72
- 72 - 96
- Channel or Ditch
- Storm Pump Station

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 6-5
Major Watersheds by Outfall

City of West Sacramento
Storm Drainage/
Storm Water Master Plan Update

Last Saved: 8/31/2020 3:45:15 PM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 6-5 Watershed by Outfall.mxd : mmiller

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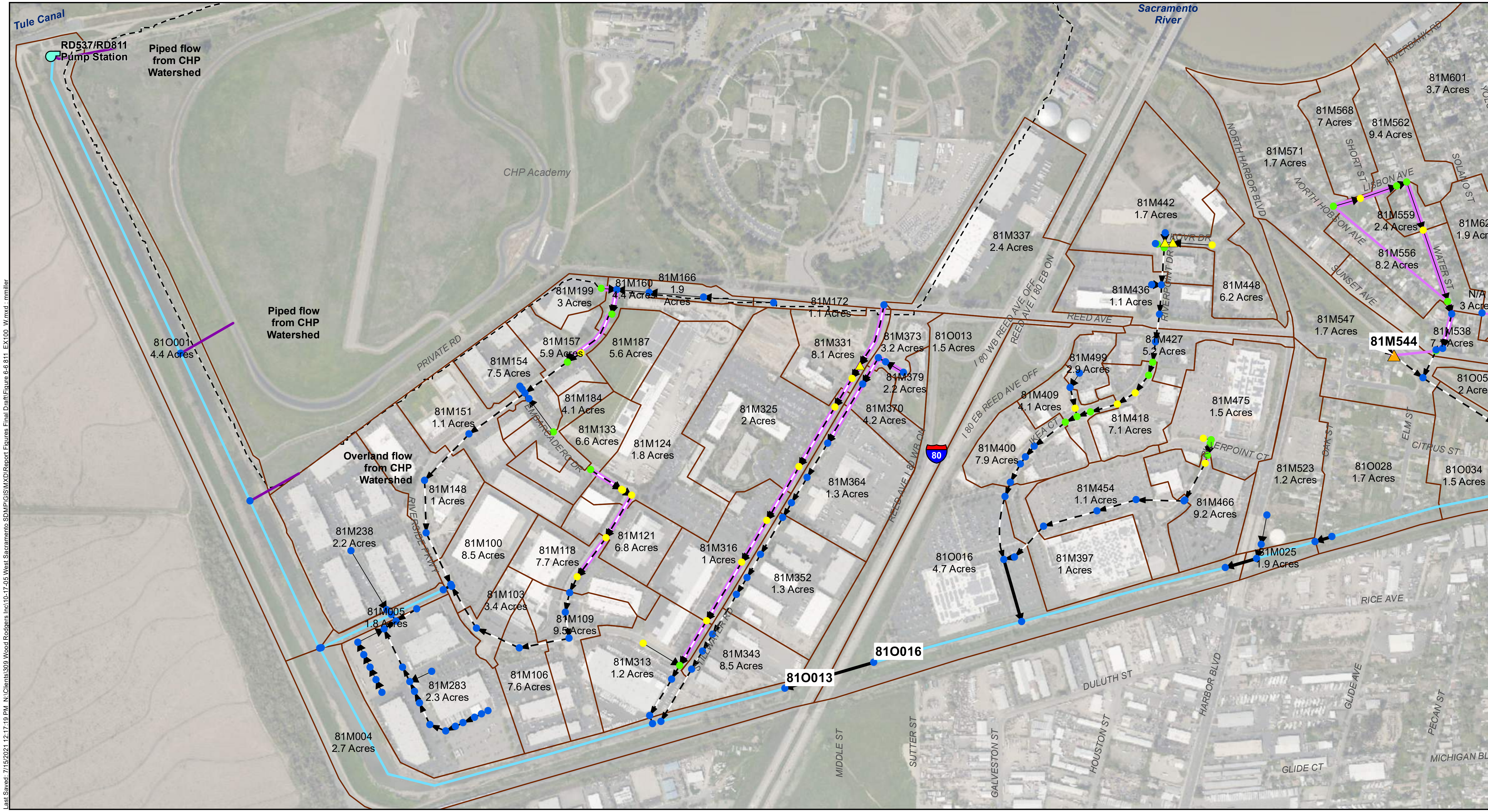

Existing Components

- Pump
- CHP Watershed
- Overland Flow
- Inter-Watershed Flow
- Open Channel
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch
- Subshed
- Drains to Model Node ID Subshed Area in Acres

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 450 900

Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 6-6
RD537/RD811 Watershed (West) Flood Results

Existing Conditions
100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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Existing Components

- Pump
- Lighthouse Watershed
- Overland Flow
- Inter-Watershed Flow
- Open Channel Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch
- Subshed
- Drains to Model Node ID
  Subshed Area in Acres

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.

N

0 450 900
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 6-7
RD537/RD811 Watershed (East) Flood Results

Existing Conditions
100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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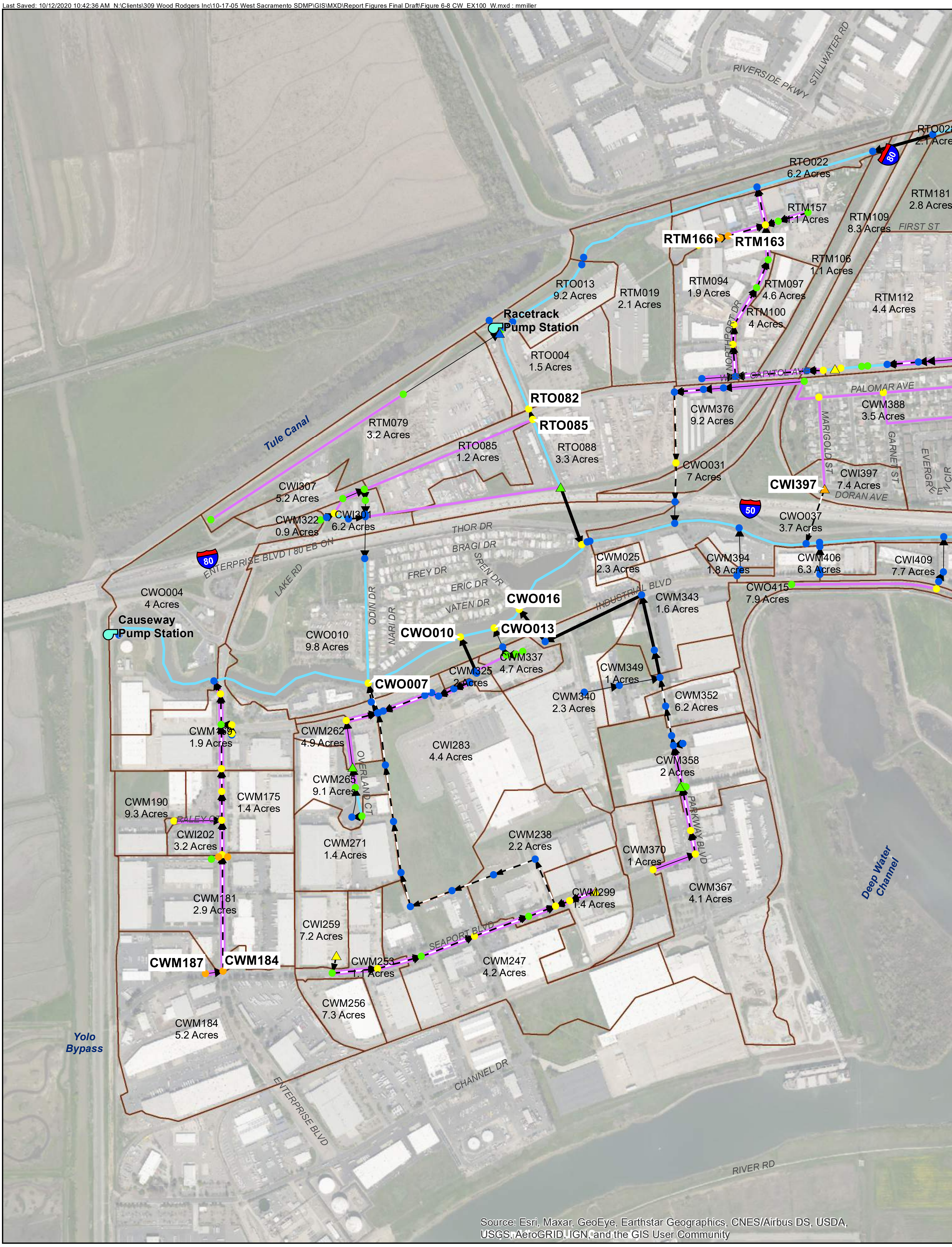

Existing Components

- Pump
- Inter-Watershed Flow
- Overland Flow
- Open Channel Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch
- Subshed

Drains to Model Node ID
Subshed Area in Acres

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.

Figure 6-8
Causeway and Racetrack Watershed (West) Flood Results

Existing Conditions 100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

N

0 500 1,000
Scale in Feet

WEST YOST ASSOCIATES

CITY OF WEST SACRAMENTO

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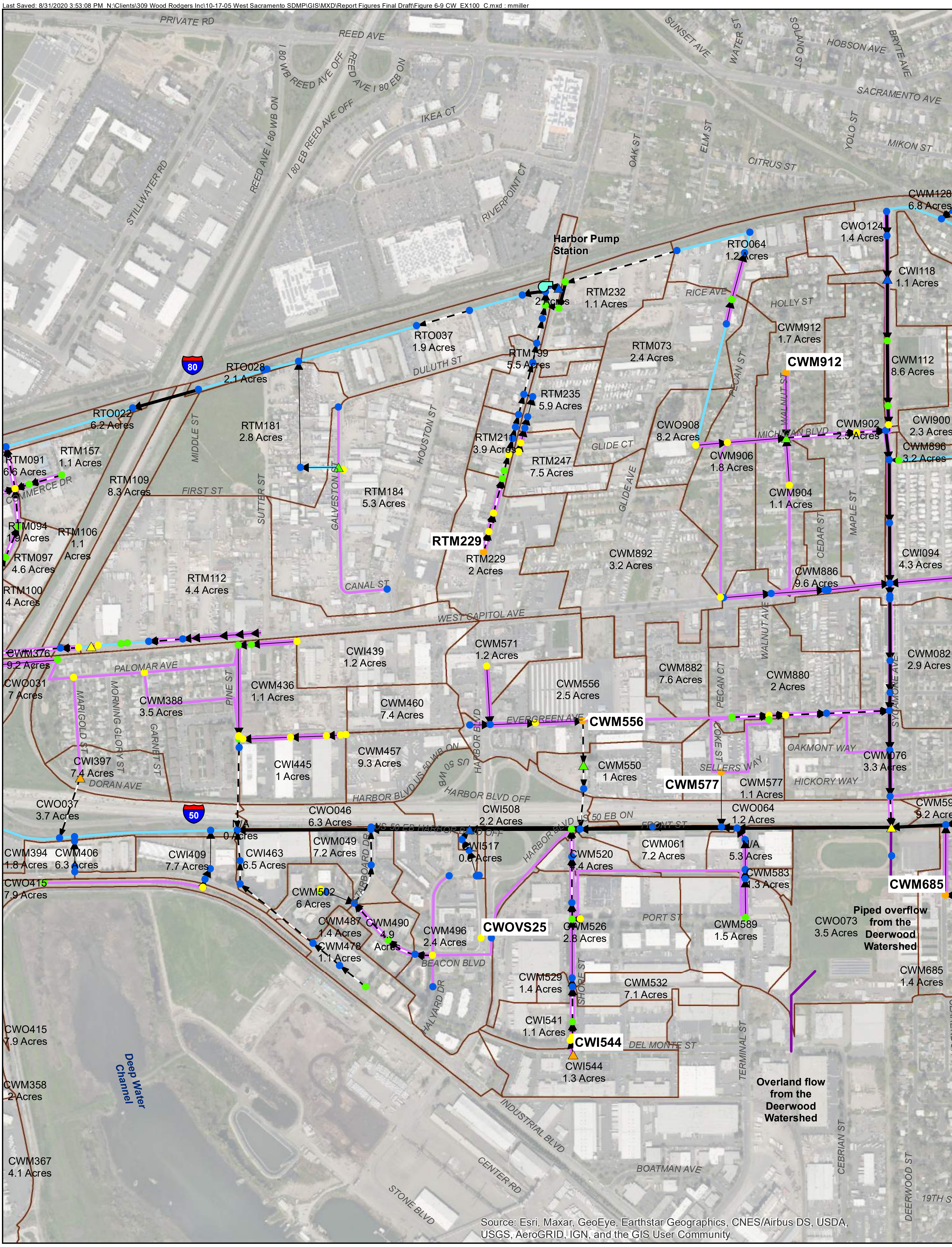
Last Saved: 8/31/2020 3:53:08 PM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 6-9 CW_EX100_C.mxd : mmiller



Existing Components

- Pump
- Inter-Watershed Flow
- Overland Flow
- Open Channel Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch
- Subshed

Drains to Model Node ID
Subshed Area in Acres

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.

Figure 6-9
Causeway and Racetrack Watershed (Central) Flood Results

Existing Conditions
100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

N

0 500 1,000
Scale in Feet

WEST YOST ASSOCIATES

CITY OF WEST SACRAMENTO

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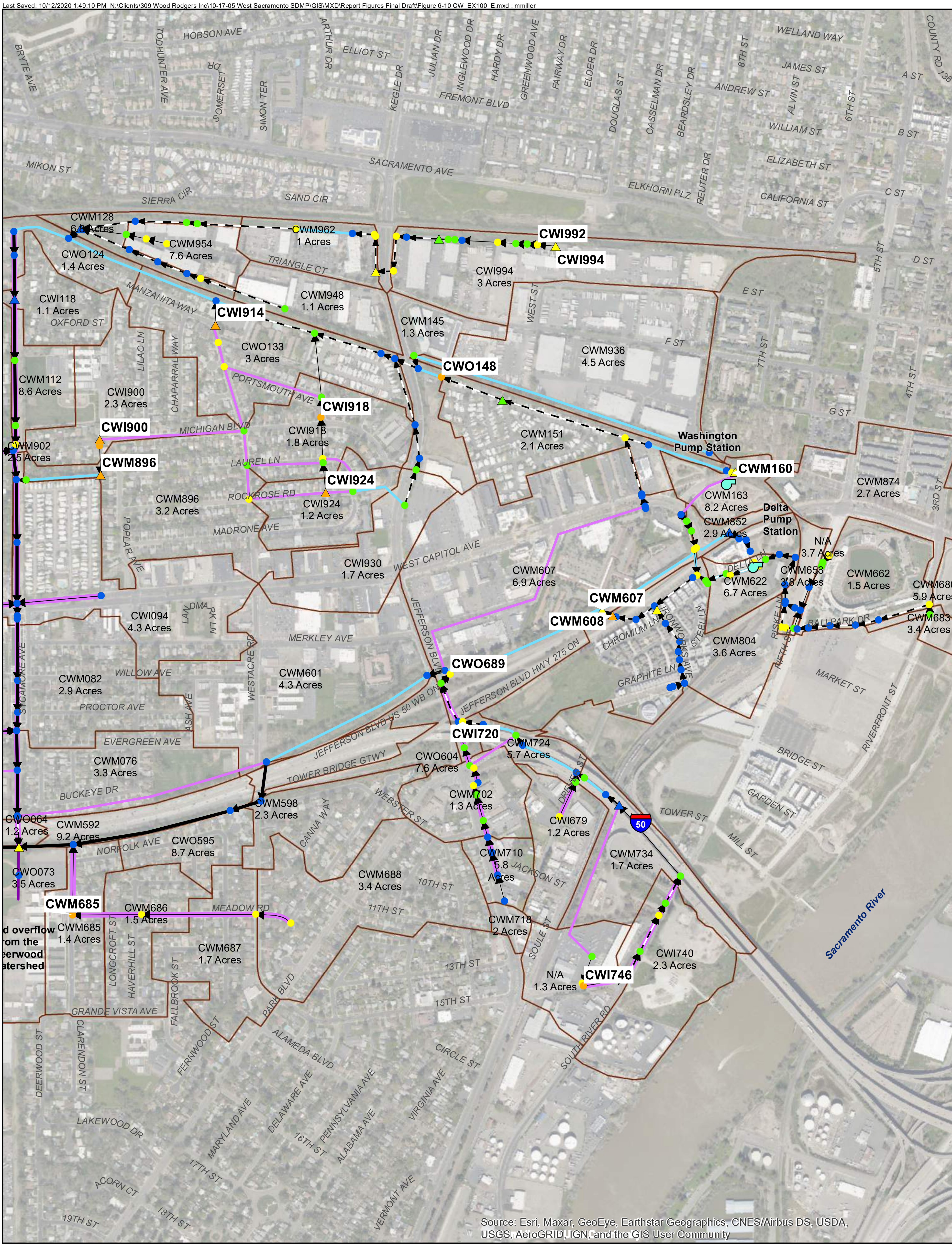
Last Saved: 10/12/2020 1:49:10 PM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 6-10 CW_EX100_E.mxd : mmiller



Existing Components

- Pump
- Inter-Watershed Flow
- Overland Flow
- Open Channel Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch
- Subshed

Drains to Model Node ID
Subshed Area in Acres

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.

0 500 1,000
Scale in Feet

Figure 6-10
Causeway and Racetrack Watershed (East) Flood Results

Existing Conditions 100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

WEST YOST ASSOCIATES

CITY OF WEST SACRAMENTO

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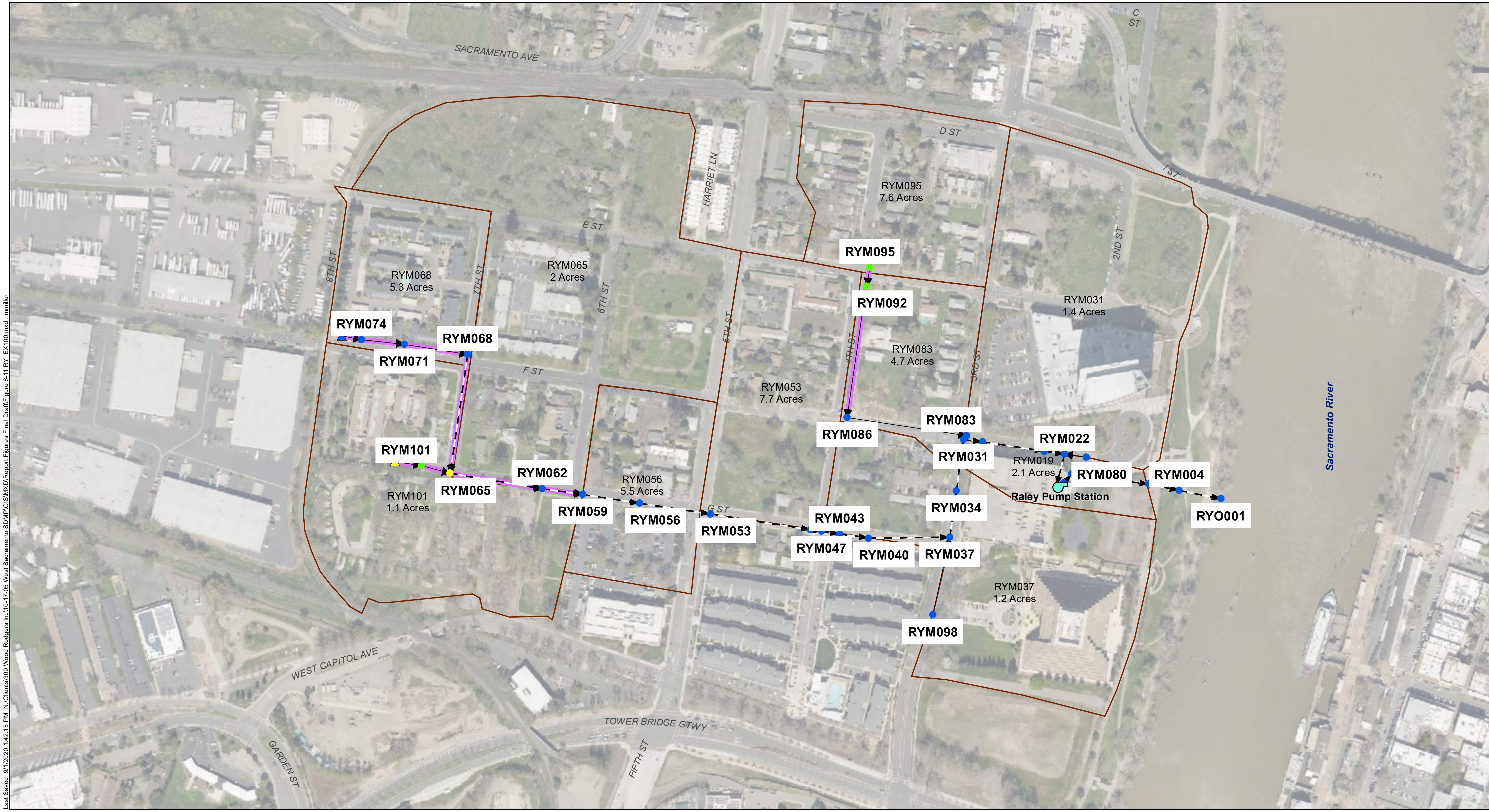

Existing Components

- Pump
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch
- Subshed

Drains to Model Node ID
Subshed Area in Acres

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 150 300
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 6-11
Raley Pump Station Watershed Flood Results

Existing Conditions
100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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Last Saved: 9/1/2020 1:41:32 PM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 6-12 SM_EX100.mxd : mmiller

Existing Components

- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch
- Subshed

Drains to Model Node ID
Subshed Area in Acres

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 150 300
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 6-12
Sacramento River Watershed Flood Results

Existing Conditions
100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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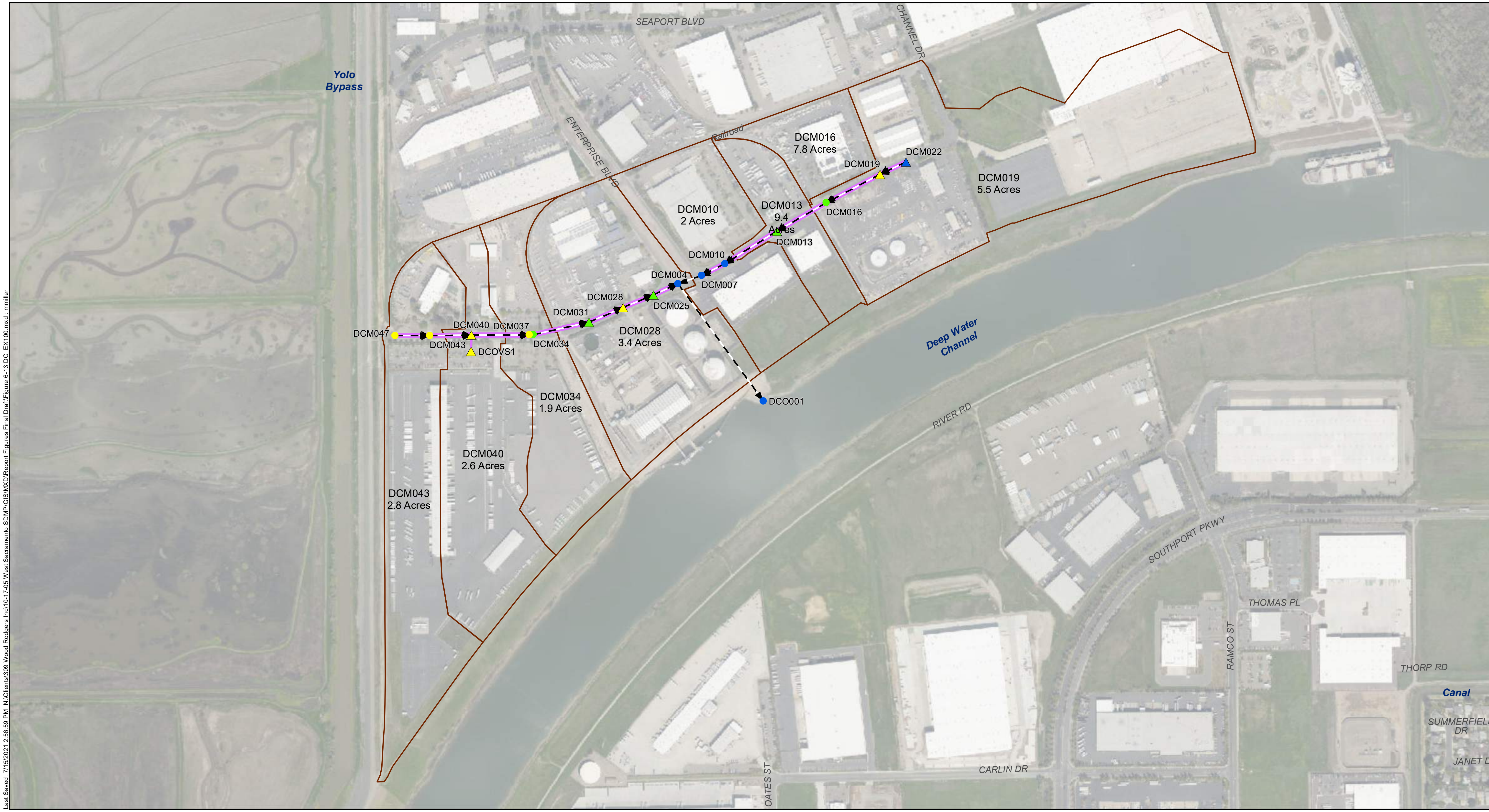

Last Saved: 7/15/2021 2:56:59 PM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 6-13 DC_EX100.mxd : mmiller

Model Components

- Overland Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Subshed

Drains to Model Node ID
Subshed Area in Acres

Storage Node - Flood Depth (feet)	Model Node - Flood Depth (feet)
No Flooding	No Flooding
0.0 - 0.6	0.0 - 0.6
0.6 - 1.6	0.6 - 1.6
1.6 - 3.0	1.6 - 3.0
3.0 - 4.1	3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 300 600
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 6-13
Deep Water Channel Watershed Flood Results

Existing Conditions
100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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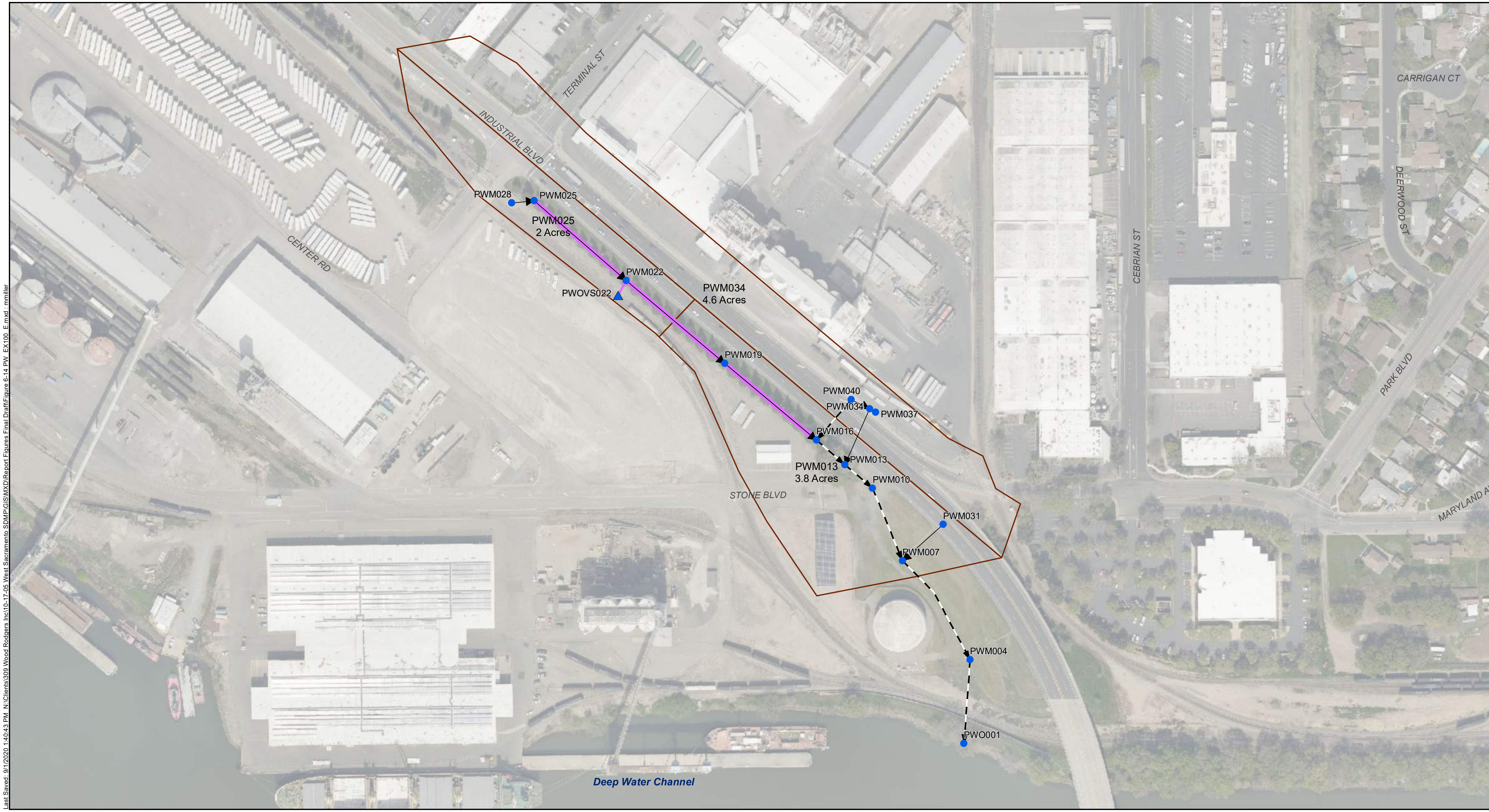

Existingl Components

- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch
- Subshed

Drains to Model Node ID
Subshed Area in Acres

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 100 200
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 6-14
Port of West Sacramento Watershed Flood Results

Existing Conditions
100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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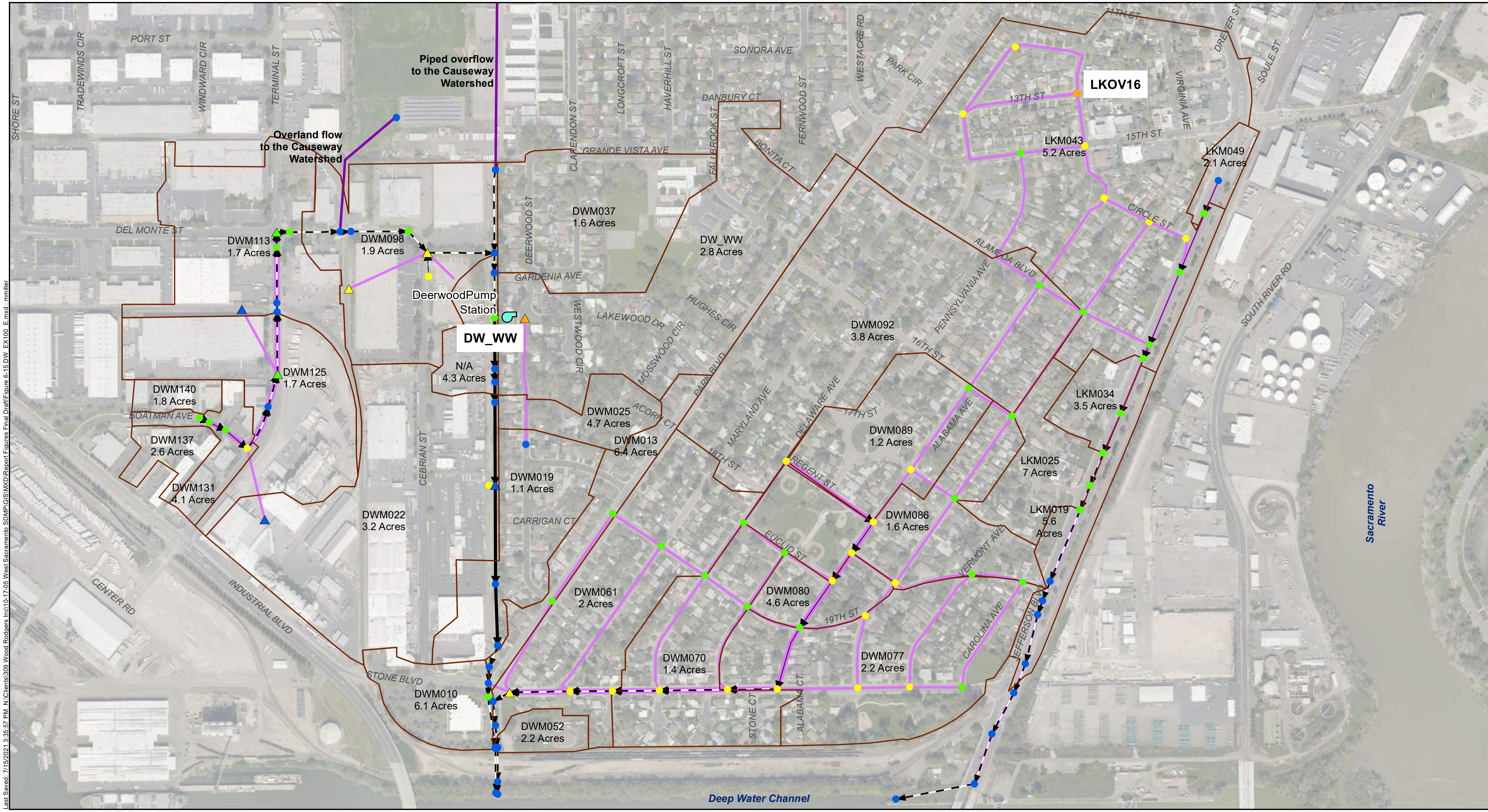

Existing Components

- Storm Pump Station
- Inter-Watershed Flow
- Overland Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

- Subshed
- Drains to Model Node ID Subshed Area in Acres

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.

N

0 250 500
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 6-15
Deerwood and Lock Watershed Flood Results

Existing Conditions
100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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Model Components

- Pump
- Lighthouse Watershed Boundary
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch
- Inter-Watershed Flow

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:

1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section
2. Lighthouse watershed analysis was preformed under the River Phase 2 Storm Drainage Master Plan dated February 2017 by NV5

0 300 600
Scale in Feet

Figure 6-16
Lighthouse Watershed Flood Results

Existing Conditions
100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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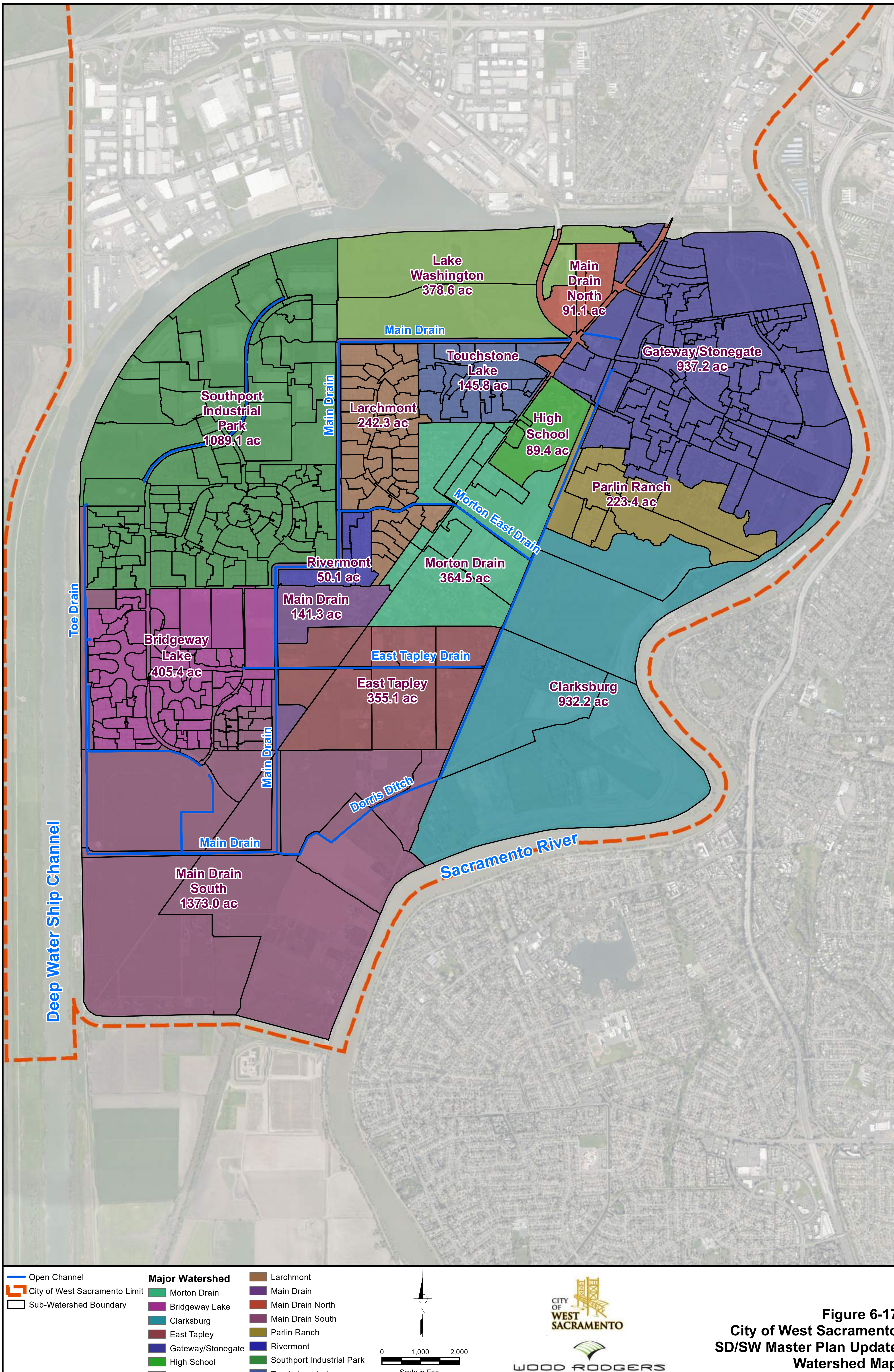

Figure 6-17
City of West Sacramento
SD/SW Master Plan Update
Watershed Map

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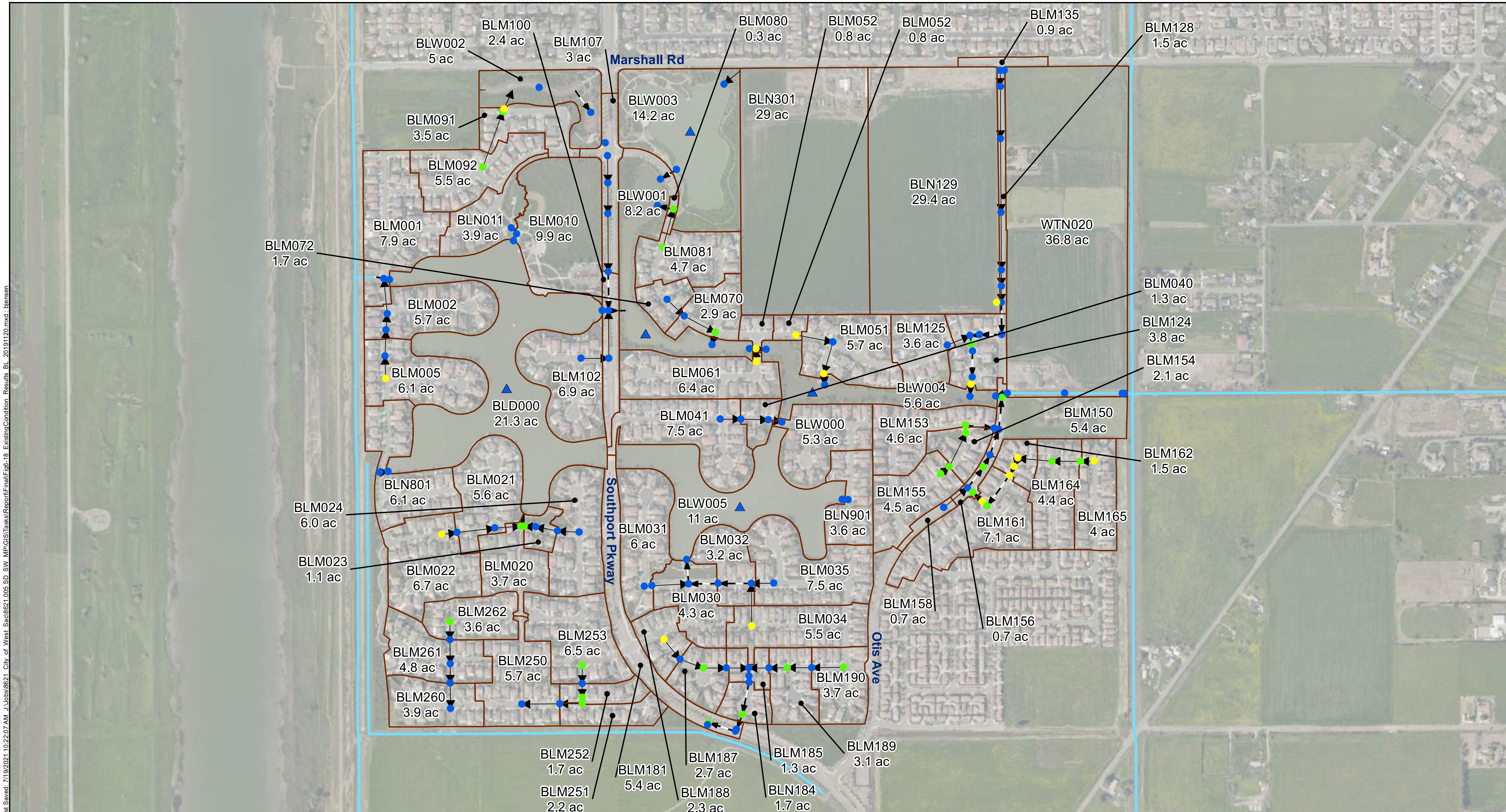

Model Components

- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 300 600
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-18
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Bridgeway Lake Watershed

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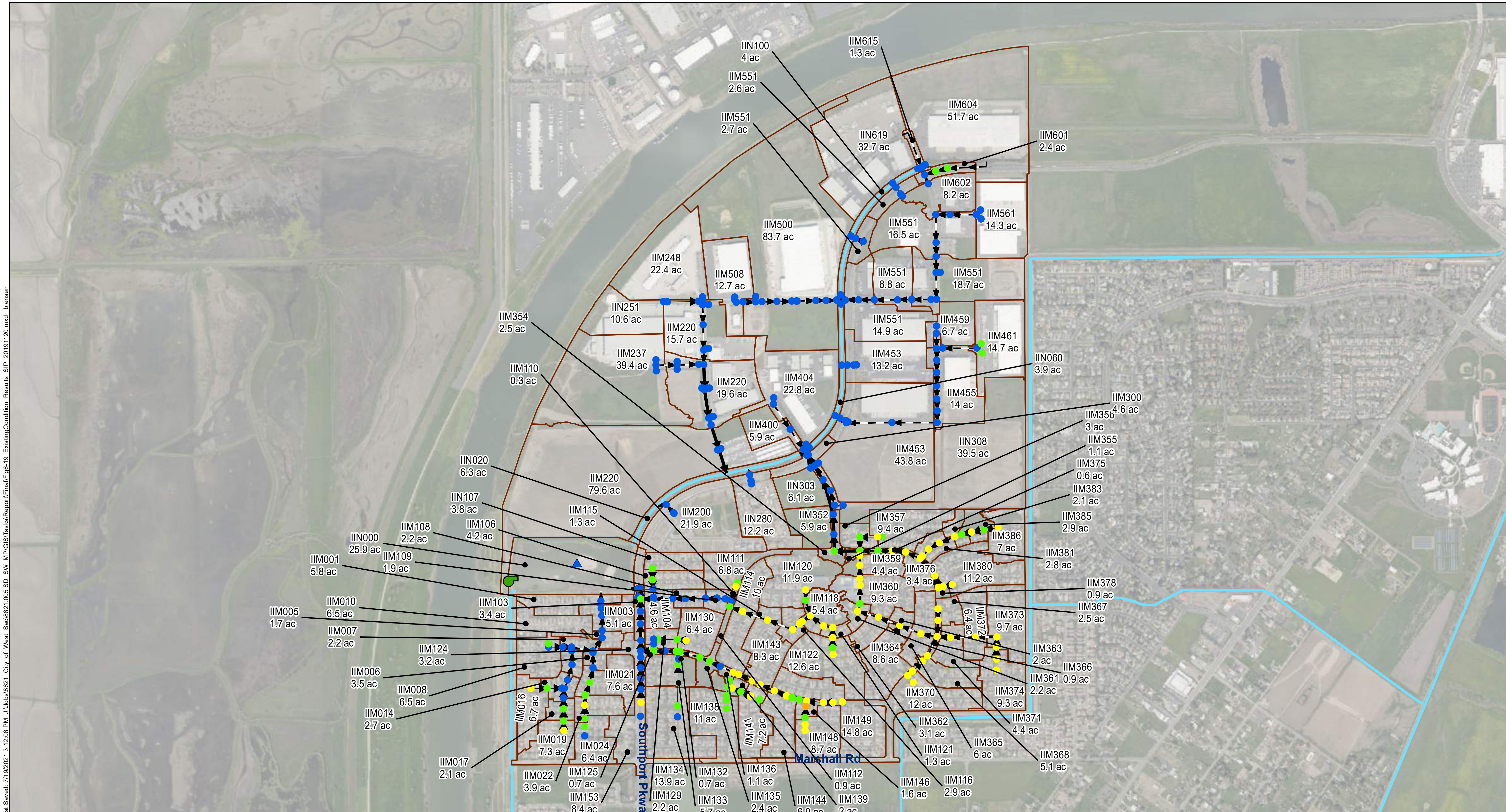

Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 600 1,200
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-19
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Southport Industrial Park Watershed

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Model Components

- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 300 600
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-20
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Lake Washington Watershed

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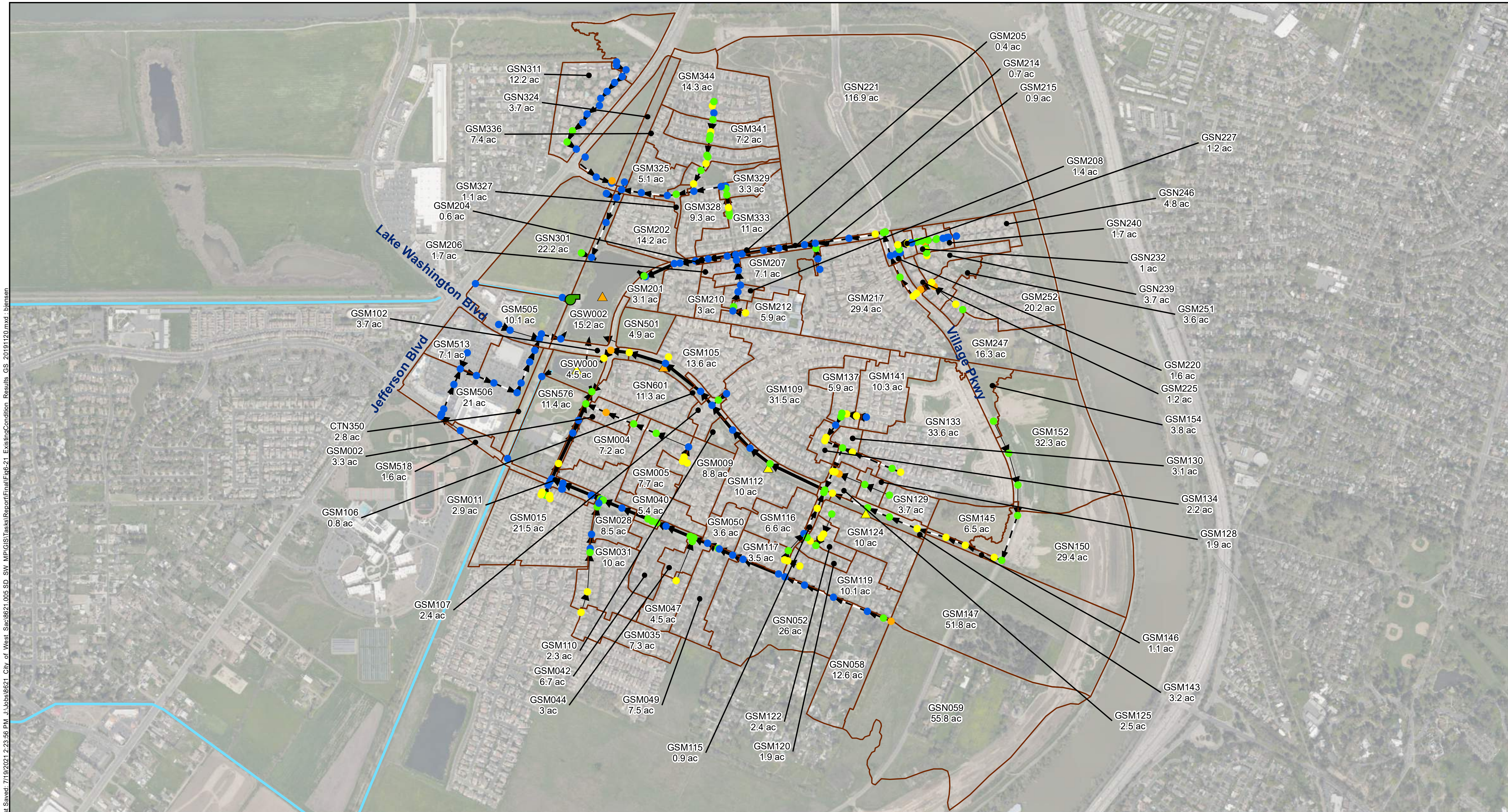

Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 500 1,000
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-21
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Gateway/Stonegate Watershed

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Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 250 500
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-22
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Parlin Ranch Watershed

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Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)	Manhole - Flood Depth (feet)
No Flooding	No Flooding
0.0 - 0.6	0.0 - 0.6
0.6 - 1.6	0.6 - 1.6
1.6 - 3.0	1.6 - 3.0
Greater than 3.0	Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 200 400
Scale in Feet

Figure 6-23
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
High School Watershed

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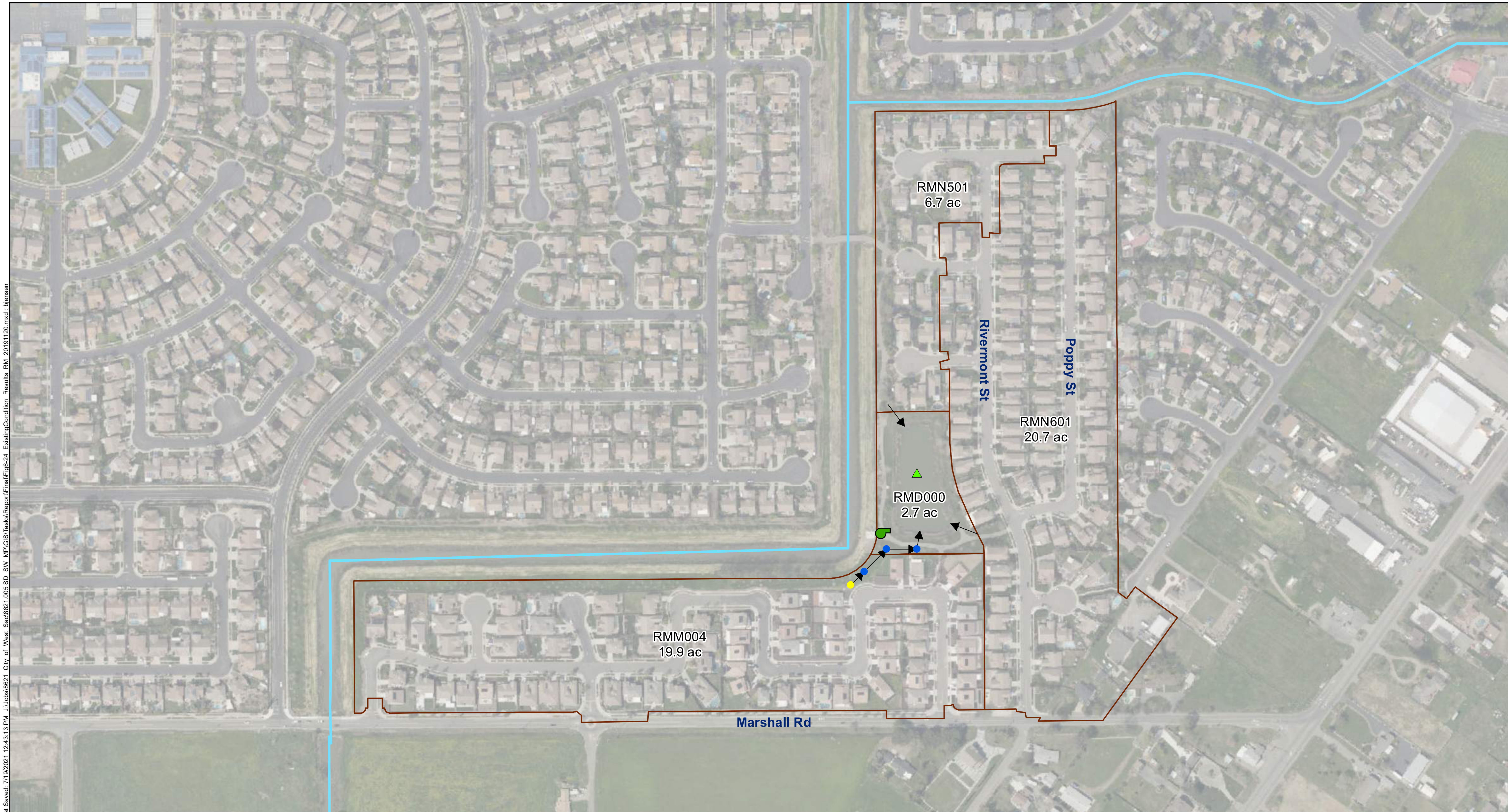

Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 250 500
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-24
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Rivermont Watershed

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Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 150 300
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-25
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Touchstone Lake Watershed

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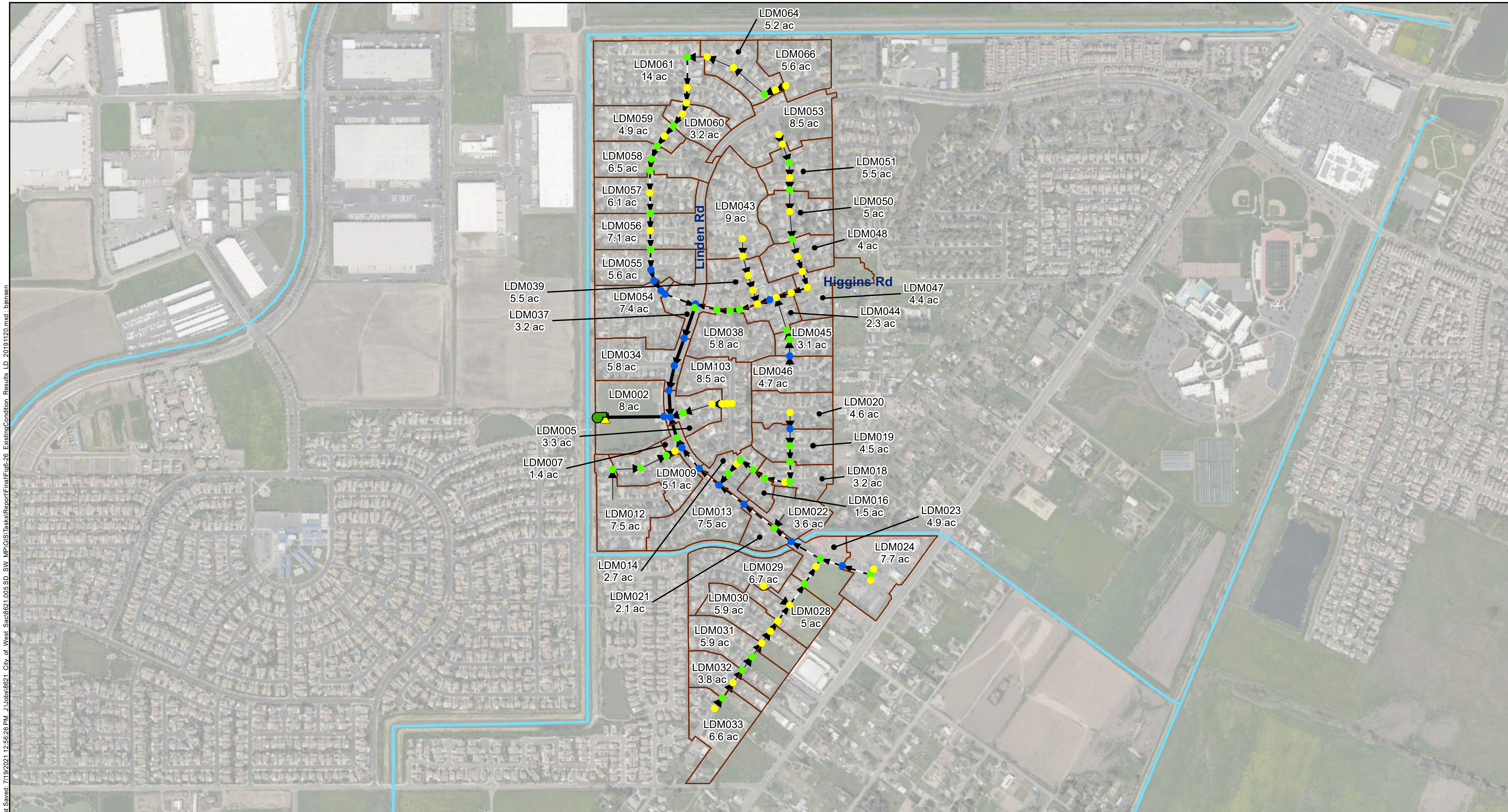

Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 400 800
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-26
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Larchmont Watershed

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Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 350 700
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-27
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Morton Drain Watershed

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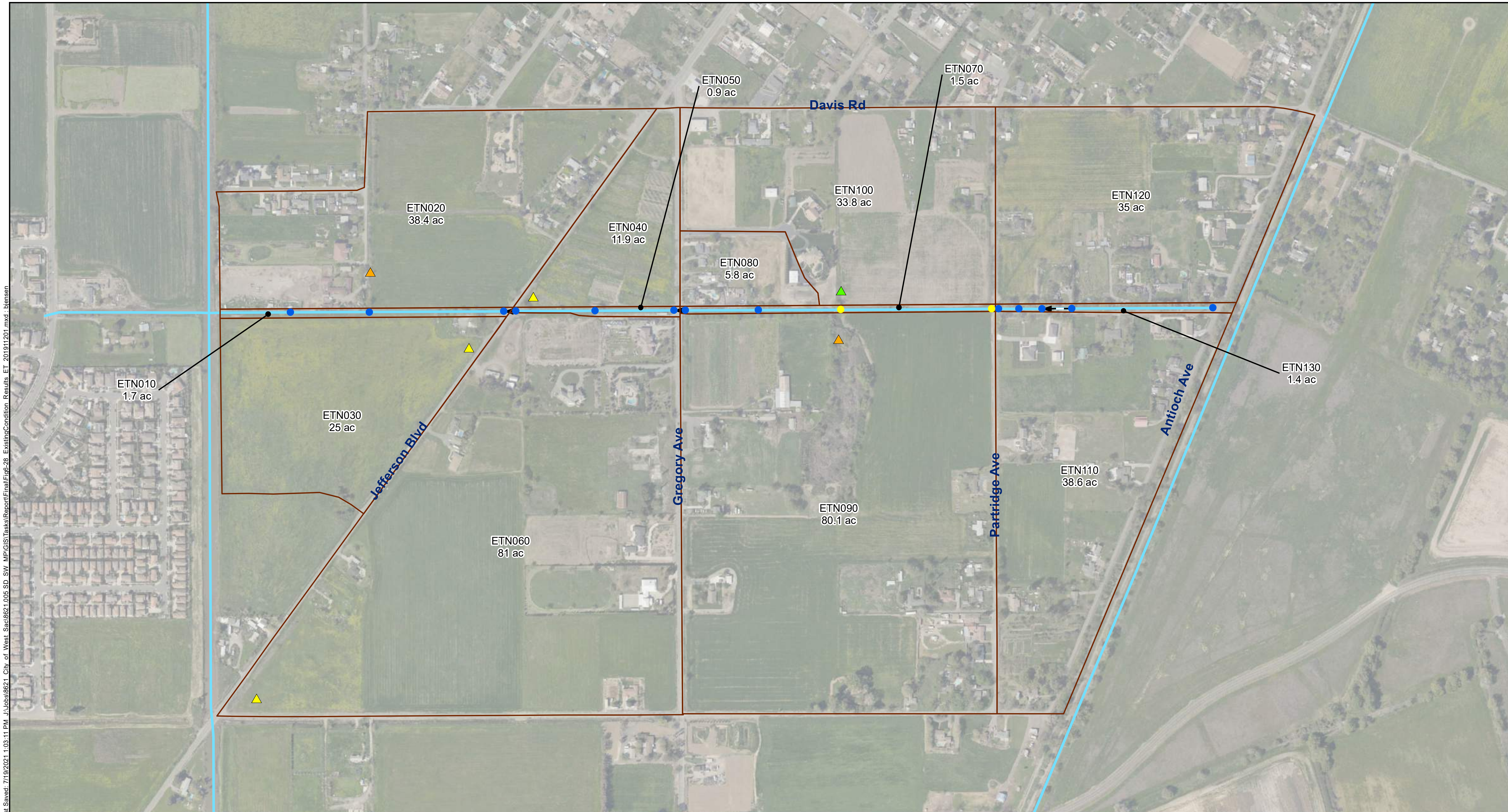

Model Components

- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 250 500

Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-28
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
East Tapley Drain Watershed

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Model Components

- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 300 600
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 6-29
City of West Sacramento
SD/SW Master Plan Update
Existing Condition Results
Main Drain - North Watershed

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7.0 WATER QUALITY COMPLIANCE

Post-construction storm water quality involves compliance with the Phase II National Pollutant Discharge Elimination System (NPDES) Permit. The Phase II NPDES Permit provides standards to reduce runoff and pollutants from new development and redevelopment areas. The City adopted the *Post-Construction Standards Plan*, (**Reference 16**) prepared by WGR Southwest, Inc. (2015) for a group of collaborating municipalities. The Phase II NPDES Permit and *Post-Construction Standards Plan* call for:

- Source control practices, such as trash enclosures and litter control, to reduce pollutants in stormwater;
- Low-impact development site design measures, such as pervious pavement and disconnected roof drains, to reduce runoff;
- Stormwater treatment that is at least as effective as bioretention for water quality event discharge remaining after the implementation of site design measures; and
- Hydromodification management measures to mitigate for increases in the 2-year, 24-hour storm.

Some portions of the City's drainage system have been constructed in phases to support growth of the City as outlined in the 1990 General Plan and subsequent Specific Plans. These projects were implemented consistent with the provisions of the General Permit in place at the time (Water Quality Order No. 2003-0005-DWQ). For some of the basins, funding agreements were established and basins were constructed for the General Plan buildout of parcels that did not yet have vesting tentative maps. Portions of the future developments envisioned by the 1990 General Plans have not yet been constructed. Under the new California State Water Resources Control Board (SWRCB) General Permit (Water Quality Order No. 2013-0001-DWQ), under which these partially-completed projects now fall, the requirements are more prescriptive. Specifically, the current General Permit requires Regulated Projects (those that create or replace 5,000 square feet of impervious area) to implement Low Impact Development (LID) site design measures to reduce runoff and treat stormwater. Remaining runoff must be treated using a system that is at least as effective at reducing runoff, lowering pollutants, protecting against shock loadings, and provide ease of accessibility as a specifically-configured bioretention system that covers approximately four percent of the tributary impervious area. The new General Permit applies to projects that did not have a vesting tentative map prior to July 1, 2013. These post-July 2013 projects will need to comply with the General Permit and will not be able to rely on the Water Quality Features associated with backbone drainage infrastructure constructed in compliance with the previous Water Quality Order.

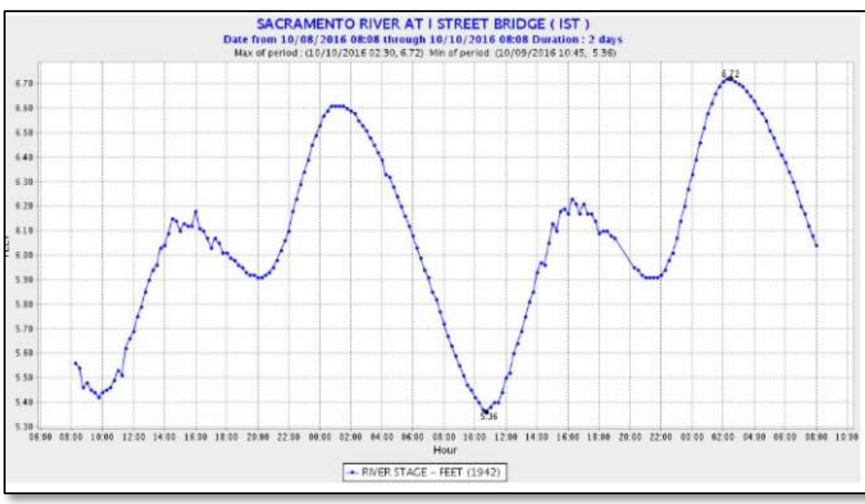
Hydromodification mitigation is another aspect of the Phase II NPDES Permit that is now required for compliance with the General Order. Hydromodification is defined as the alternation of the natural flow of water through a landscape, and it often takes the form of channelization or channel modifications constructed in support of new development. These changes have the effect of impacting downstream areas through the introduction of greater flow velocities or volumes. The NPDES Permit requires that newly-constructed facilities address hydromodification impacts by limiting the discharge rate downstream of a project to the pre-project rate and, further requires retaining the volume of water that is associated with the 85th percentile storm event on site (not discharging to downstream areas). Section E.12.f of the Permit states:

> *"Post-project runoff shall not exceed estimated pre-project flow rates for the 2-year, 24-hour storm."*

There is also a provision that states:

> *"Alternatively, the Permittee may use a geomorphically based hydromodification standard or set of standards and analysis procedures designed to ensure that Regulated Projects do not cause a decrease in lateral (bank) and vertical (bed) stability in receiving stream channels. The alternative hydromodification management standard or set of standards and analysis procedures must be reviewed and approved by the Regional Board Executive Officer."*

The City's internal drainage system does not contain stream channels that are susceptible to geomorphologic degradation. The City's internal drainage system conveys runoff to pump stations that discharge into the Sacramento River and the DWSC and Yolo Bypass. Both of these channels are tidally influenced as illustrated by the stage data on the Sacramento River at I Street as shown in the DWR, California Data Exchange Center chart for the gage at I Street, below. Note the cyclical peaks occurring within a 24-hour period, which is indicative of tidally-influenced waterways.



Therefore, it is appropriate for the City to request that areas that can meet the alternative geomorphically-based hydromodification standard (areas that do not cause a decrease in lateral or vertical stability in receiving stream channels) be approved without the need to hold the 85th percentile flow volume on site.

The Municipal Regional Permit, R2-2015-0049 (**Reference 17**), adopted on November 19, 2015, that covers the San Francisco Bay Region states:

> *C.3.g. Hydromodification Management*
>
> *i. Hydromodification Management (HM) Projects are Regulated Projects that create and/or replace one acre or more of impervious surface except where one of the following applies. All HM Projects shall meet the Hydromodification Management Standard of Provision C.3.g.ii.*
>
> > *(1) The post-project impervious surface area is less than, or the same as, the pre-project impervious surface area.*
> >
> > *(2) The project is located in a catchment that drains to a hardened (e.g., continuously lined with concrete) engineered channel or channels or enclosed pipes that extend continuously to the Bay, Delta, or flow-controlled reservoir, or drains to channels that are tidally influenced.*
> >
> > *(3) The project is located in a catchment or subwatershed that is highly developed (i.e., that is 70% or more impervious).*

The same logic that justifies the exemption from hydromodification management requirements in the San Francisco Bay Region are applicable to the City because the discharge rates from the City into the large, tidally-influenced channels are insignificant compared to channel capacity and geomorphology. Based on standards that are applied elsewhere and on qualitative analysis, projects within the City should not be subject to hydromodification management requirements.

Furthermore, the pump discharge rates from the multiple purpose basins that would serve the main areas of future development in the South Basin Area significantly attenuate peak flows relative to the discharges into the basins. The City's 2001 Drainage Master Plan calls for the flood control storage to be pumped at a rate between one-quarter and one-half of the peak two-year (post-project) flow. A criterion tied to the pre-project flows into receiving waters is not applicable to the City's setting. Based on these cited conditions present within the City's system today, the City could request the Central Valley Regional Water Quality Control Board (CVWQCB) to approve a condition for alternative hydromodification management compliance that accepts conditions consistent with a master-planned detention basin, a manmade channel, and pump station capacities.

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8.0 FUTURE CONDITIONS ANALYSES

8.1 Approach for Future Conditions Modeling

8.1.1 North Basin

The North Basin existing land uses are largely consistent with the future land uses identified in the 2035 General Plan. There are a few parcels that are currently undeveloped in the Causeway and Racetrack Watershed, the RD 811/RD 537 Watershed, and the Sacramento River DWSC Watershed, which are anticipated for future development based on the General Plan.

The approach for evaluating potential drainage facility improvements that will be required for future development includes: 1) identifying vacant parcels that can be developed in each watershed; 2) developing future conditions hydrologic modeling to determine the potential increases to peak flows and runoff volumes; and 3) determining whether improvement projects that were sized to eliminate existing deficiencies (see Section 6) are sized appropriately to accommodate future development using the hydraulic modeling program (XPSWMM).

8.1.2 South Basin

As development continues to progress in the South Basin, the deficiencies associated with the existing facilities will become more significant if facility improvements are not implemented to offset or reduce the impacts of future development. This section focuses on evaluating the potential infrastructure improvements in the South Basin that will be necessary to mitigate impacts associated with future buildout of the entire South Basin. The anticipated future buildout land uses are depicted in the 2035 General Plan.

The approach for evaluating potential drainage facility improvements includes: 1) identifying the existing system deficiency and the level of proposed future development in each major drainage area; 2) developing future conditions hydrology; and 3) optimizing the facility improvements in each drainage shed as well as the overall backbone infrastructure in the South Basin using the approved numeric hydraulic modeling program (XPSWMM).

8.2 Hydrology

8.2.1 North Basin

The hydrologic models prepared for existing conditions were updated for buildout conditions. The watershed boundaries delineated under the existing conditions modeling are consistent with those anticipated, which are limited to infill development of parcels. **Figure 8-1** shows the future condition watershed boundaries and land use plan for the

North Basin, with vacant parcels noted. The hydrologic model was revised to represent development of the vacant parcels per the 2035 General Plan.

8.2.2 South Basin

Evaluation of future conditions hydrology for the South Basin was also accomplished using the SacCalc program.

The watershed boundaries delineated under the existing conditions modeling representing existing development and infrastructure are adopted for most of the future development areas where it can be assumed that grading plans for future infill development will not vary significantly from existing terrain. Future condition watersheds adjacent to the Sacramento River were adjusted to reflect the presence of the setback levee alignment that was provided by the City. For some of the major drainage areas where major planning projects are proposed, the watershed boundaries and hydrologic parameters were evaluated separately to confirm that the proposed projects will conform to the City's design guidelines. These major planning projects are anticipated to be constructed within the next 20 years as market influences allow and include:

- Yarbrough Master Plan – The area of Yarbrough Village is approximately 711 acres in size and comprises a major portion of the Southwest Village within the South Basin. It is located on both sides of Jefferson Boulevard. The site is bounded by the Bridgeway Lakes community and Bevan Road on the north, the City limits on the south, and the DWSC on the west. The project will support a mix of land uses including approximately 3,004 dwelling units; 150,000 square feet of commercial space; an 18-hole public golf course; and a 56-acre interconnected lake, park, and canal system. Wood Rodgers received preliminary planning and grading files from the City for the proposed project. Watershed boundaries were delineated based on the grading file, and the hydrologic parameters of the watersheds were calculated using the soil classification and proposed land use plan for the project.
- Liberty Specific Plan – The Liberty Project is located in the Northwest Village of the South Basin Plan area and includes approximately 340 acres of new development. The project is bounded on the east by the new Sacramento River Levee, on the south by Davis Road, on the west by the Clarksburg Trail, and on the north by Linden Road. The proposed project will consist of up to 1,503 residential units, a 17-acre elementary and junior high school campus; an area of up to 10,000 square feet for retail commercial use; and parks, greenbelts, and trails. Based on previous studies and developer consultation with the City, it was determined that, for their future development, the Liberty Project can propose and design drainage facilities to mitigate its own impacts. These facilities are anticipated to include a relocated detention basin and new pump station. Wood Rodgers was directed by the City to

consider a constant pumped flow rate of 22 cubic feet per second (cfs) out of the future Liberty Project for the future condition hydrologic analysis.

- River Park Master Plan – The River Park area is located in the Southeast Village of the South Basin Plan area and is approximately 373.5 acres in size. It is bounded on the southeast by the Sacramento River levee, on the north by Davis Road, and on the west by the Clarksburg Trail. The proposed project would consist of up to 2,732 residential units and a 10-acre elementary and junior high school campus, as well as several parks. Similar to the Liberty Project, the River Park Project can propose and design drainage facilities to mitigate its own impact within its own boundaries. These facilities are anticipated to include a detention basin and pump station. Wood Rodgers was directed by the City to consider a constant pumped flow rate of 35 cfs for the future River Park Project under the future condition hydrologic analysis.
- Lake Washington Area – The Lake Washington Area is located at the northern end of the South Basin and is bounded on the east by Arlington Road and on the west by the industrial buildings situated next to Ramco Street. According to General Plan 2035, the proposed land use for this area is mainly Water-Related Industrial and Business Park. The future condition drainage in this area will travel through Lake Washington in a manner that is similar to the existing condition. Watershed boundaries under existing conditions were re-used for future conditions hydrologic analysis with updated watershed parameters reflecting development.
- Stone Lock Area – The Stone Lock area is currently undeveloped open space, except for Village Parkway which connects areas northward to the Pioneer Bluff Area and southward to the existing Gateway/Stonegate residential development. Under the future conditions analysis, the Stone Lock area will have Mixed-Use and Neighborhood Commercial development according to General Plan 2035. Watershed boundaries under existing conditions were re-used for future condition hydrologic analysis with updated watershed parameters.

Figure 8-2 shows the future condition watershed boundaries for the South Basin. **Figure 8-3** shows the future condition land use plan for the South Basin.

8.3 Hydraulics

8.3.1 North Basin

The potential effects of full buildout in the North Basin were evaluated by inserting the buildout condition flow hydrographs into the previously developed North Basin existing condition hydraulic models. For watersheds with existing deficiencies, the buildout condition hydrographs were inserted into the hydraulic models. The results were reviewed to determine if additional improvements are required to accommodate future buildout. For watersheds without existing deficiencies, the buildout hydrographs were inserted into the existing conditions models to determine if the new development would trigger a new deficiency.

The results from the North Basin buildout evaluation show that no additional improvements are required to support buildout in the North Basin beyond the improvements that are necessary to eliminate the existing deficiencies identified in Section 6. The reason for this is that the area of the North Basin parcels that can be developed in the future represents a small percentage of the overall watershed area. The total North Basin area is approximately 5,754 acres, while the area of the vacant land for future development is only 122 acres, or approximately two percent of the total area. Therefore, although there is some increase in runoff for buildout conditions, it is too small to result in significant increases to water surface elevations. For example, in the Causeway Racetrack Watershed, full buildout is predicted to increase the water surface elevation at the downstream end of the system near the Causeway Pump Station by only 0.03 foot.

Although no additional improvements beyond those identified in Section 6 are needed to support future buildout in the North Basin, many of the future development areas will benefit from these improvements. For example, in the lower end of the Causeway/Racetrack watershed, several of the vacant parcels are currently flooded during the 100-year storm. The improvements identified in Section 9 will eliminate this flooding, which will allow the vacant parcels to be developed. Based on this, some share of the cost for the improvements in this watershed could be applied to future development, if desired by the City.

The one exception is the Lighthouse Watershed. There is more significant development anticipated in this watershed as part of The Rivers Phase 2 development. A separate master plan, The Rivers Phase 2 Storm Drainage Master Plan, (NV5, Reference 15), was prepared in February 2017. The Phase 2 Storm Drainage Master Plan identifies the required drainage improvements (including a new detention basin) that are required to support the development. These improvements are needed solely for the Rivers 2 Project and will be constructed by and paid for by the developer, therefore; these improvements are not included in the list of Improvement Projects (IPs) in Section 11 of this report. **Appendix E** provides digital files/documentation of the XPSWMM model results.

8.3.2 South Basin – Results by Watershed

It is noted that the existing conditions watershed names, including the Main Drain South, Parlin Ranch, and Clarksburg watershed boundaries and names are different in the future conditions analysis due to the developments proposed within the South Basin Area. New future condition watershed names are Yarbrough, Liberty, and River Park.

8.3.2.1 Bridgeway Lakes

The greater part of the Bridgeway Lakes area has been developed as residential lots under the existing condition, except for a few open space and rural estate parcels. Under the future condition, adding development and imperviousness to the limited open space area increases the runoff slightly when compared with the existing condition. However, the increased runoff can be fully mitigated with the existing detention basin and does not cause deterioration of the performance of the existing drainage facilities. As a result, no new drainage facilities are proposed for the Bridgeway Lakes area for future conditions. **Figure 8-4** shows the resulting 100-year water surface depth at the manholes and detention basin under the future condition.

8.3.2.2 South Basin Industrial Park (SIP)

Under existing conditions, the southern portion of the SIP area is fully developed with low-density and medium-density residential lots. The northern portion of the SIP area is partially developed with industrial facilities. Full buildout of industrial development will increase the runoff discharging to the open channel and detention basin. Compared to the existing condition, the peak water surface elevation in the detention basin increases by approximately 0.5 foot. However, the existing detention basin and pump station are adequately sized to maintain the water surface elevation below flooding level in the detention basin. **Figure 8-5** shows the flooding depth at the manholes and detention basin under the future condition.

8.3.2.3 Lake Washington

The majority of the Lake Washington area is currently undeveloped land adjacent to Lake Washington. Under future conditions, all the open space area will be developed as Business Park or Water Related Industrial according to the City's General Plan. The added development increases the runoff discharging to Lake Washington. Compared to the existing condition, the peak water surface elevation in Lake Washington increased by approximately 0.32 ft. However, there is sufficient storage within Lake Washington to attenuate the runoff generated by the added development. **Figure 8-6** shows the flooding depth at the manholes and detention basin under the future condition.

8.3.2.4 Gateway/Stonegate

The greater part of the Gateway/Stonegate area is developed with low-density and medium-density residential lots, with some of the remaining vacant land available for development under the future condition. From the existing conditions results, it was determined that the drainage facilities are already experiencing deficiencies under a 100-year 24-hour storm. Both cells of the detention basin experience overbank flows that flood adjacent streets. In addition, the capacity of the underground drainage pipes is exceeded, causing street flooding. The Gateway/Stonegate area has limited vacant areas in which to create new detention. Expansion of the existing detention basin is considered infeasible. By upgrading the existing pump station and adding two more duty pumps (each approximately 75 cfs) future condition runoff from the Gateway/Stonegate area can be accommodated while maintaining the peak water surface elevation at or below flooding level near the basin. With increased pumped discharge from the detention basin, the Main Drain channel culverts under Jefferson Boulevard and Marshall Road should be upgraded in order to convey the increased discharge downstream.

To help alleviate the street flooding that is occurring along Lake Washington Boulevard upstream of the detention basin, the existing depressed storage area south of Lake Washington Boulevard between Marlin Street and Stonegate Drive will be connected by new 30-inch culverts under Redwood Avenue, Highland Drive and Stonegate Drive. To prevent flooding of the existing detention basin's southern cell, a new 6-foot by 5-foot box culvert should be constructed between the detention basin cells under Lake Washington Boulevard, while maintaining the existing 48-inch pipe to drain all runoff efficiently to the expanded pump station.

As part of the Gateway/Stonegate watershed, the City's future Stone Lock project must construct a detention basin somewhere within its boundary to attenuate developed flow before discharging to the existing storm drain along Stonegate Drive. While the land use plan is not finalized for Stone Lock, Wood Rodgers recommends that, for maximum effectiveness, the detention basin be constructed as close to Stonegate Drive as possible. Using the current land use designations and existing pipeline and topographic elevations, Wood Rodgers estimates a basin footprint of 1.0 acre with approximately 5.1 acre-feet of storage volume to accommodate the 100-year 24-hour storm. Final sizing and location can be decided when the land use plan in finalized.

Figure 8-7 shows the flooding depth at the manholes and detention basin under the future condition.

8.3.2.5 <u>High School</u>

The High School area will remain unchanged in terms of land use under the future condition. Since there is no deficiency under the existing condition, there is no facility improvement required for this area. **Figure 8-8** shows the flooding depth at the manholes and detention basin under the future condition.

8.3.2.6 <u>Rivermont</u>

The Rivermont area is fully developed under the existing condition and has no system deficiency under the existing condition. Therefore, there is no facility improvement required for this area. **Figure 8-9** shows the flooding depth at the manholes and detention basin under the future condition.

8.3.2.7 Touchstone Lake

The Touchstone Lake area is fully developed and has no system deficiency under the existing condition. Therefore, there is no facility improvement required for this area. **Figure 8-10** shows the flooding depth at the manholes and detention basin under the future condition.

8.3.2.8 Larchmont

The Larchmont area is fully developed except for a few rural residential parcels that will remain unchanged under future condition. Therefore, there is no facility improvement required for this area. **Figure 8-11** shows the flooding depth at the manholes and detention basin under the future condition.

8.3.2.9 Yarbrough

The proposed Yarbrough Project has an interconnected lake and canal system that will connect with the portions of the existing Main Drain Channel that will remain, while also replacing other portions of the existing Main Drain Channel, while detaining local runoff and draining to the Main Drain pump station. This proposed lake and canal system has sufficient capacity to convey runoff from the upstream watershed areas and the Yarbrough Project. With increased runoff from the Yarbrough Project and all of the upstream watersheds draining to the Main Drain, while incorporating most of the South Basin area, the existing pump station needs to be upgraded to maintain the peak water surface elevation at or below flooding level in the Main Drain Channel system, including the Yarbrough Lake and canal system. As part of the XPSWMM future condition modeling, the system was evaluated with full design pump capacity at the Main Drain pump station in service. It is understood that at the time of this Report, the newly constructed pump station has only installed two of four duty pumps (each approximately 145 cfs) to serve existing development. **Figure 8-12** shows the flooding depth at the manholes and detention basin under the future condition.

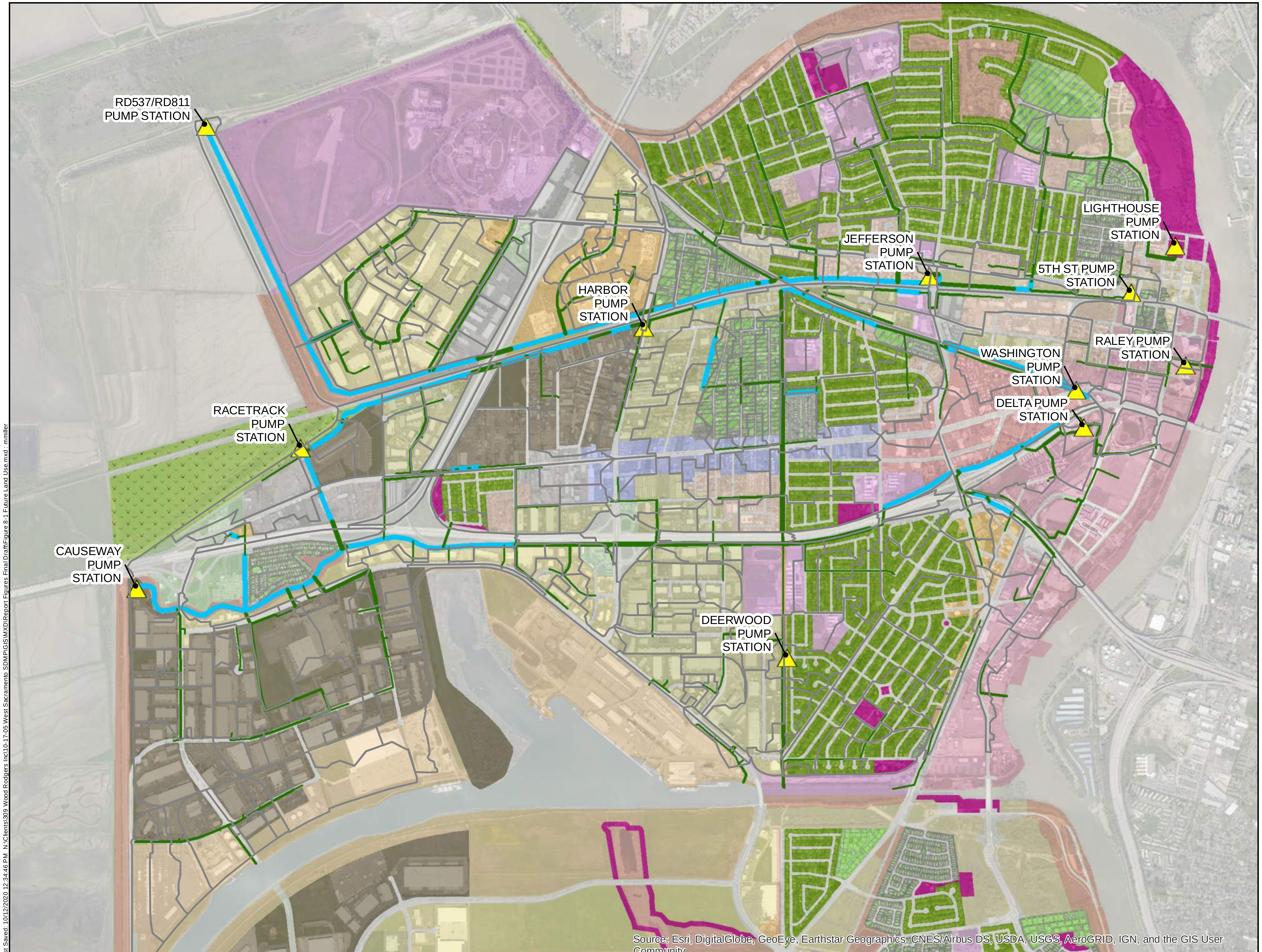
8.3.2.10 Liberty

As discussed in the previous section, the proposed Liberty project will design its own drainage facility in order to mitigate the impact that would result from new development and increased imperviousness. As directed by the City, Wood Rodgers has modeled a total discharge flow of 22 cfs under the future condition from Liberty development. A more detailed evaluation of the drainage facilities inside the project boundary under the future condition is not included in this master plan update.

8.3.2.11 River Park

As discussed in the previous section, the proposed River Park Project will design its own drainage facility in order to mitigate the impact that would result from new development and increased imperviousness areas. As directed by the City, a total discharge flow of 35 cfs has been modeled under future conditions for the River Park development. A more detailed evaluation of the drainage facilities inside the project boundary under future conditions is not included in this master plan update.

Figure 8-13 summarizes the drainage facility improvements required under future conditions. Appendix E provides digital files/documentation of the XPSWMM modeling input/output.



Pipe Diameter (inches)

- 0 - 33
- 33 - 54
- 54 - 72
- 72 - 96
- Channel or Ditch
- Storm Pump Station
- North Basin Watersheds

Future Condition Land Use

- AG
- BP
- C
- CBD
- HI
- HR
- HSC
- LI
- LR
- MCI
- MHR
- MR
- MU-C
- MU-NC
- OS
- PQP
- RE
- RMU
- RP
- RR
- WRI

0 1,000 2,000
Scale in Feet

N

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 8-1
Future Land Uses

City of West Sacramento
Storm Drainage/
Storm Water Master Plan Update

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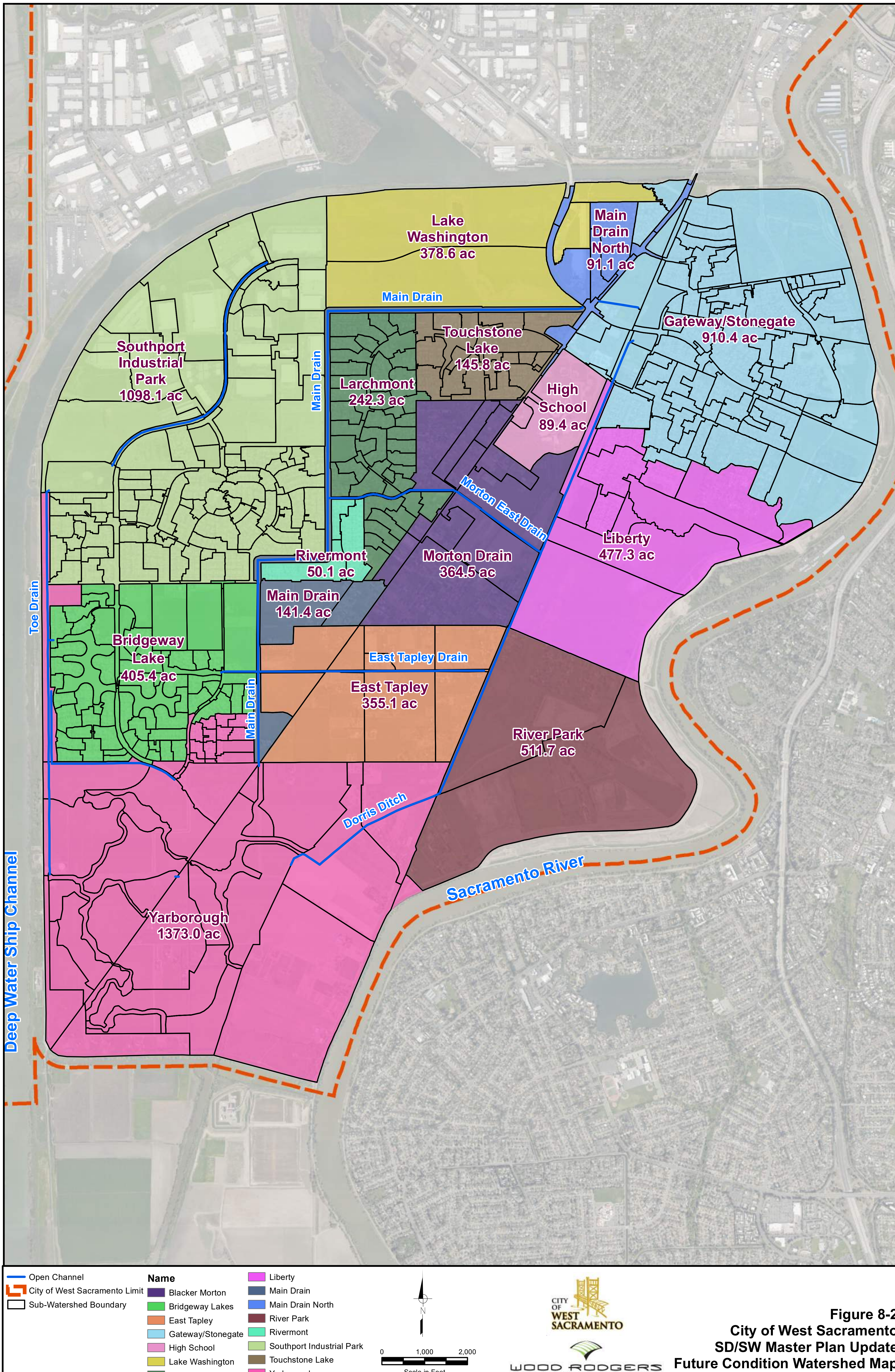

Figure 8-2
City of West Sacramento
SD/SW Master Plan Update
Future Condition Watershed Map

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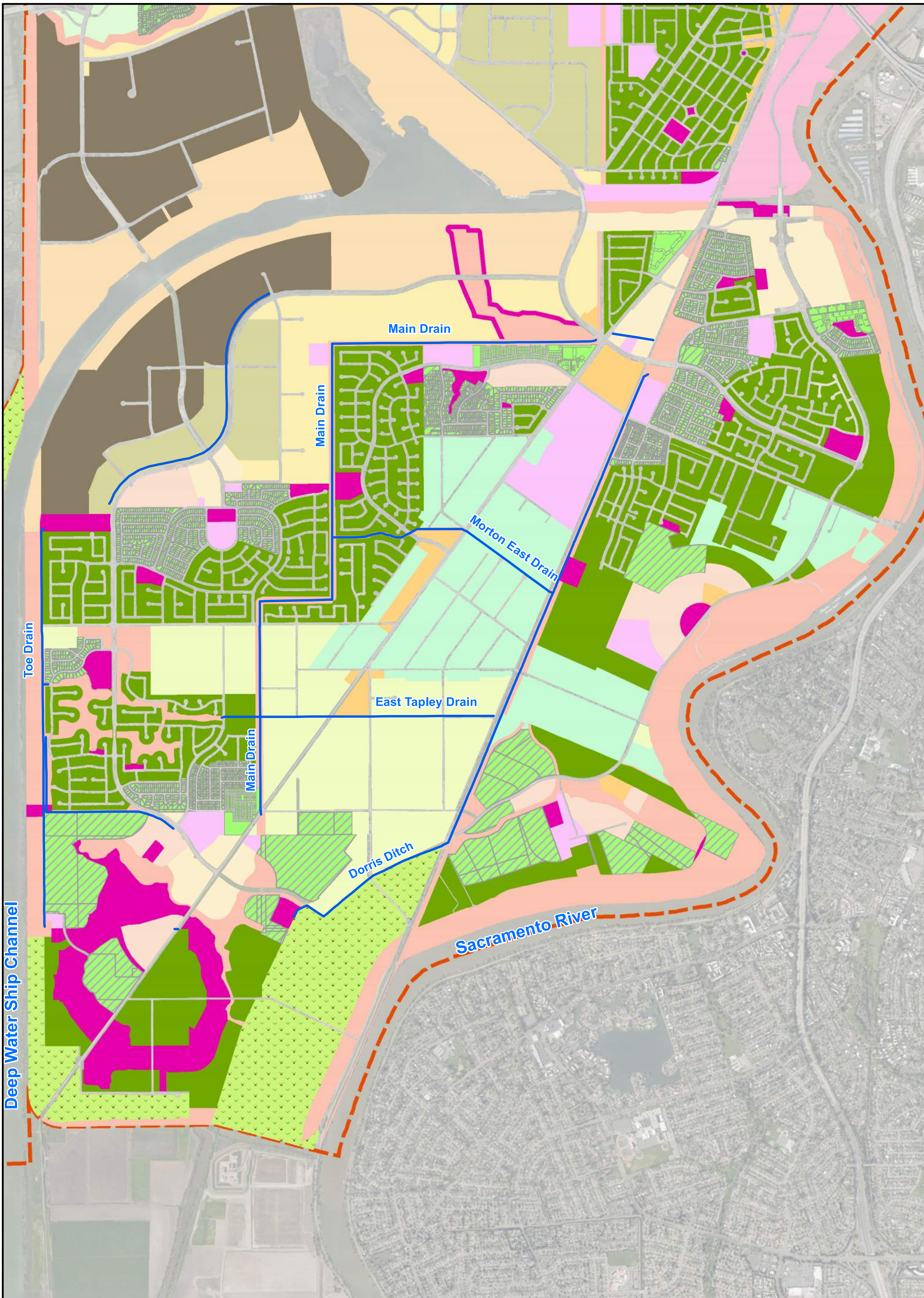

Future Condition Land Use

AG
BP
C
CBD
HI
HR
HSC
LI
LR
MCI
MHR
MR
MU-C
MU-NC
OS
PQP
RE
RMU
RP
RR
WRI

City of West Sacramento Limit
Open Channel

N

0 1,000 2,000
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-3
City of West Sacramento
SD/SW Master Plan Update
Future Condition Land Use Map

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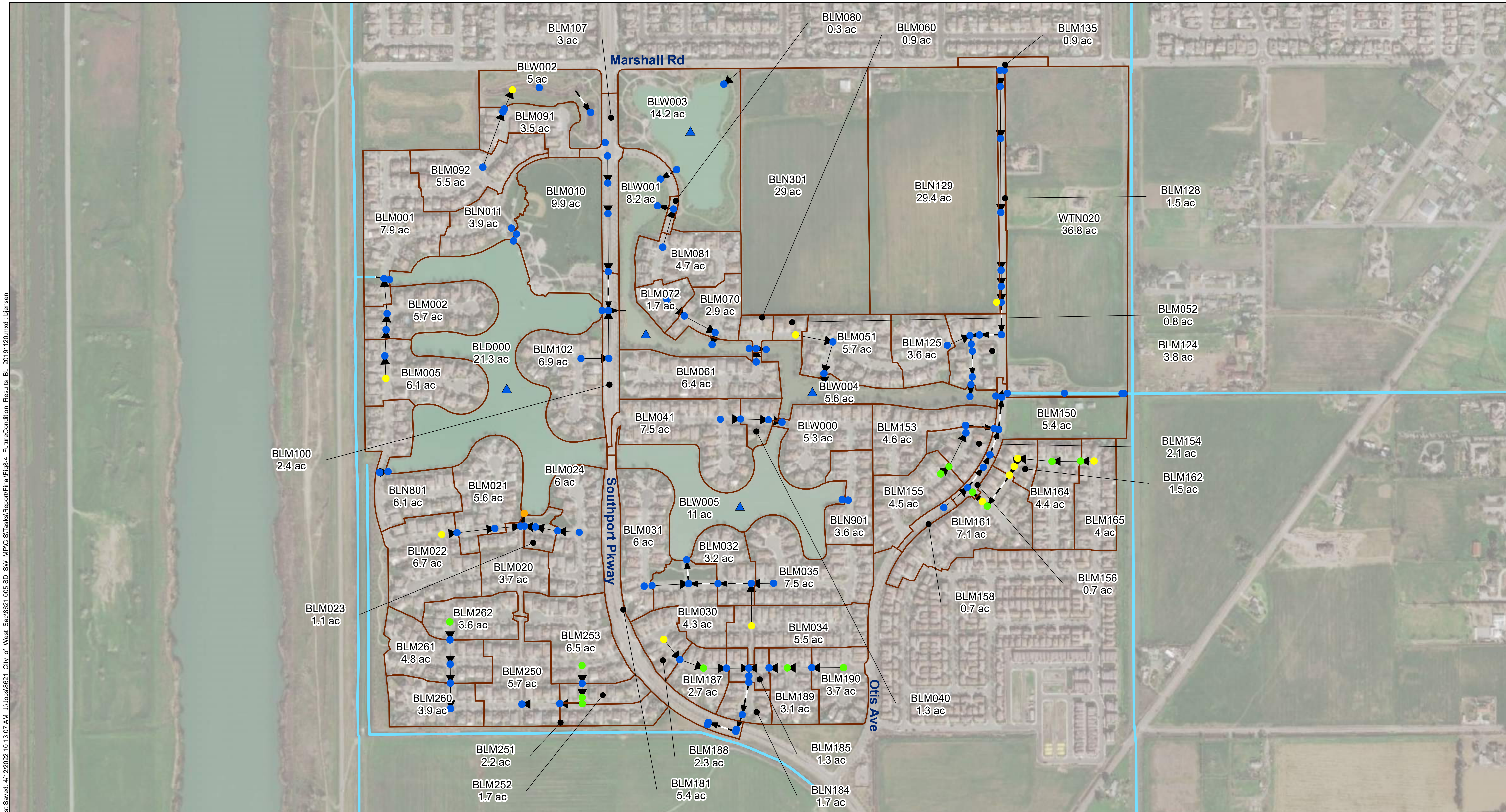

Model Components

- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:

1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 300 600

Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-4
City of West Sacramento
SD/SW Master Plan Update
Future Condition Results
Bridgeway Lakes Watershed

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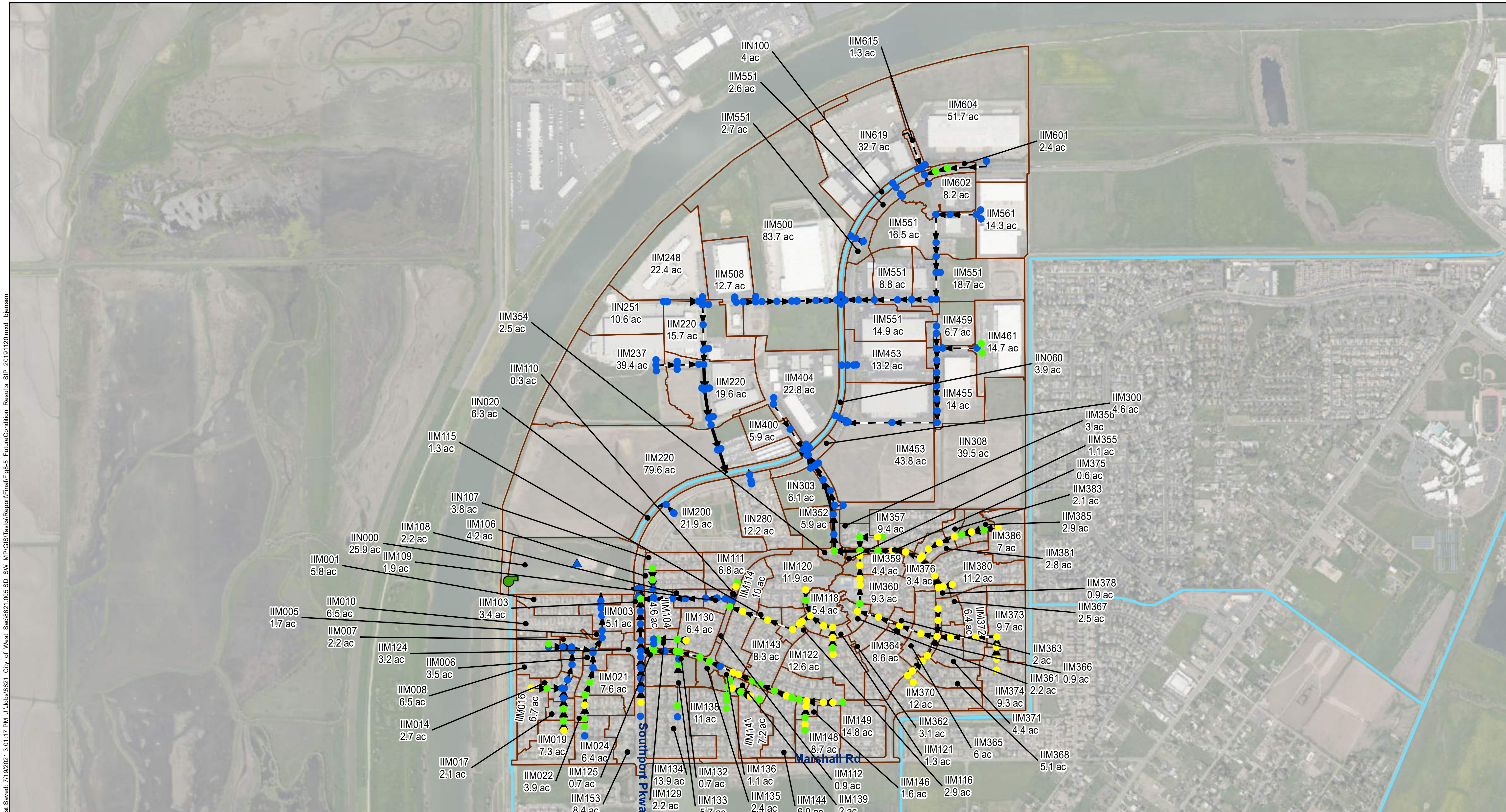

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Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-5
City of West Sacramento
SD/SW Master Plan Update
Future Condition Results
Southport Industrial Park Watershed

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Model Components

- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 300 600

Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-6
City of West Sacramento
SD/SW Master Plan Update
Future Condition Results
Lake Washington Watershed

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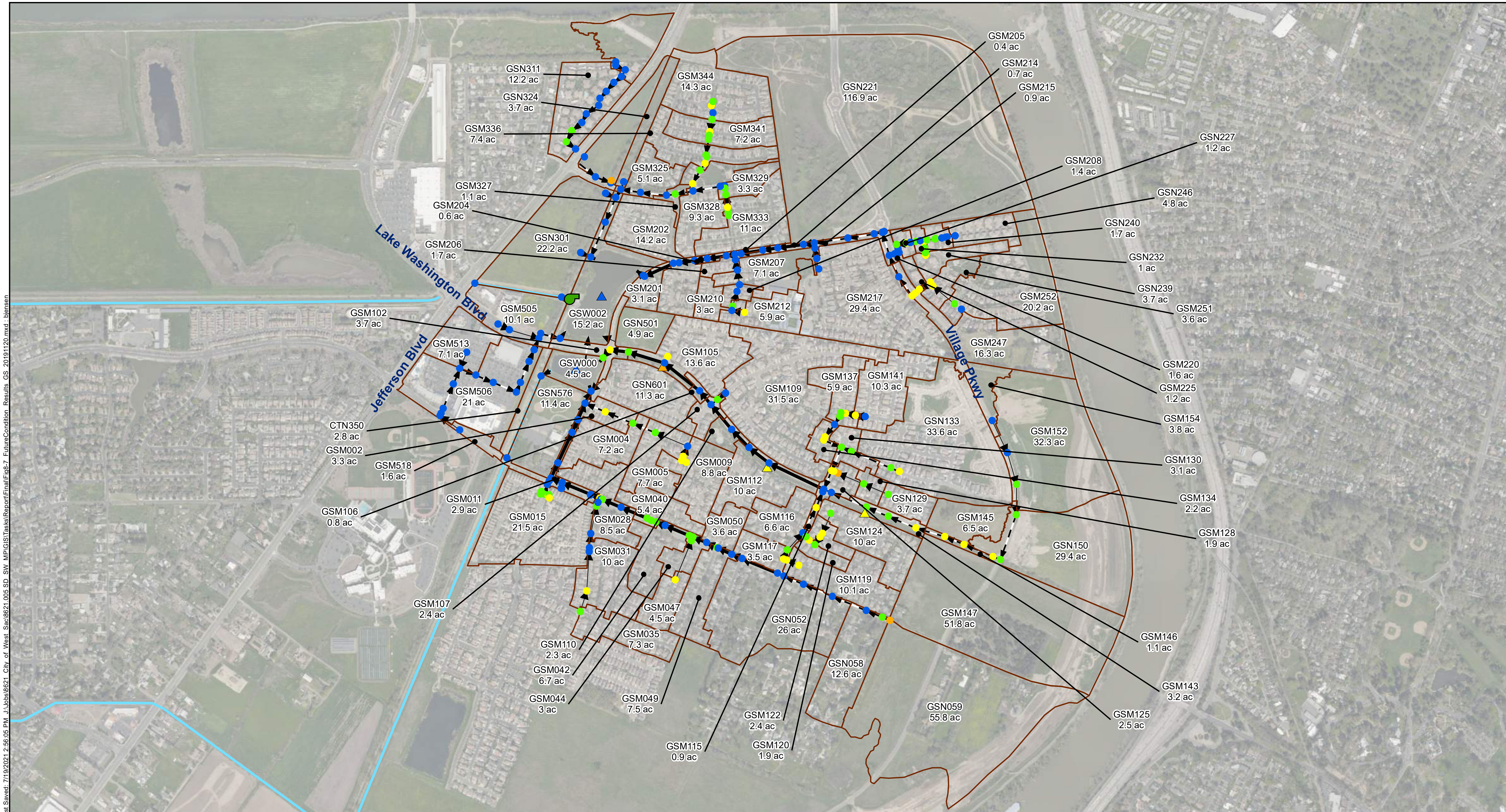

Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 500 1,000
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-7
City of West Sacramento
SD/SW Master Plan Update
Future Condition Results
Gateway/Stonegate Watershed

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Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 200 400
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-8
City of West Sacramento
SD/SW Master Plan Update
Future Condition Results
High School Watershed

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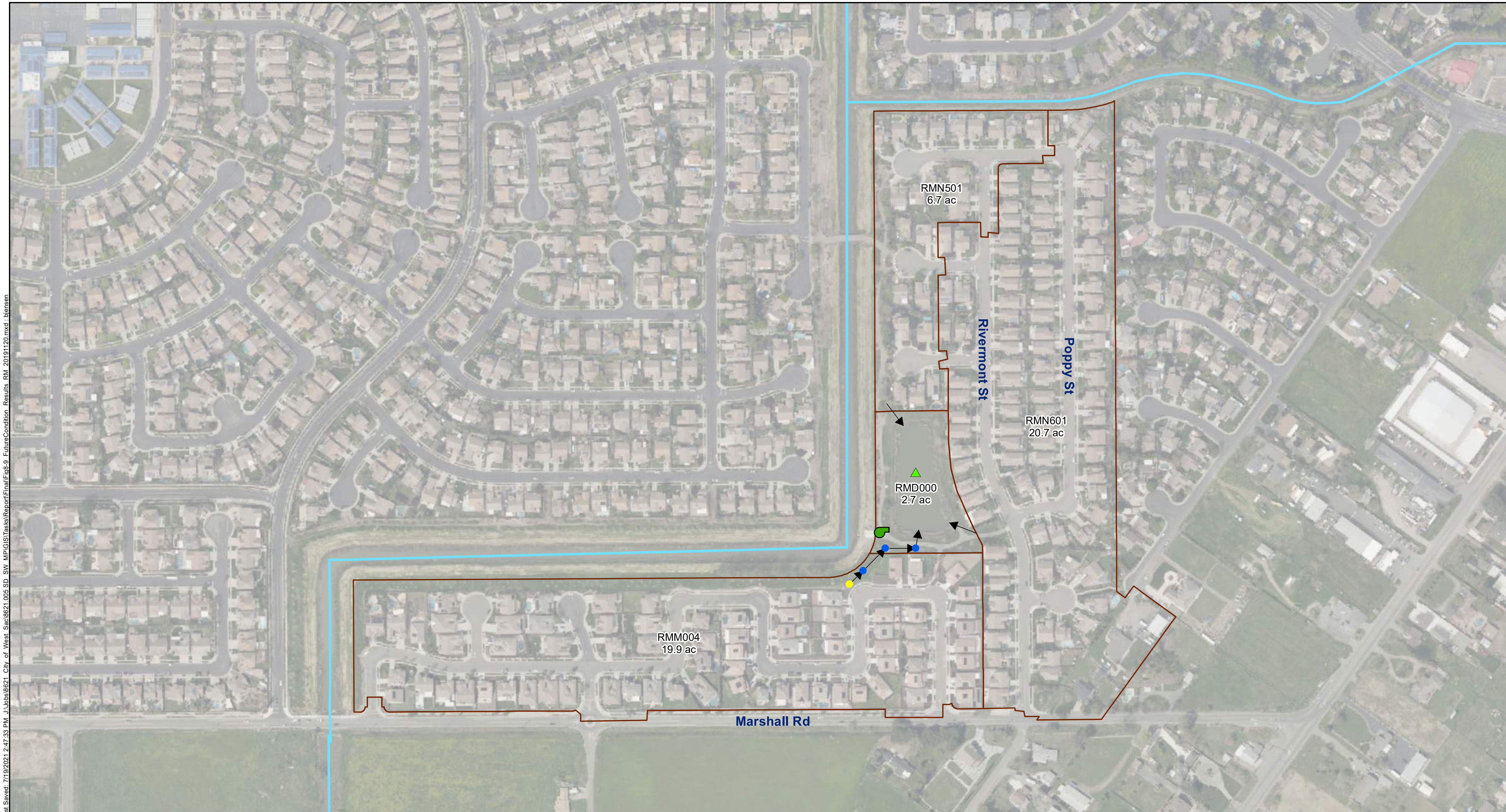

Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 250 500
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-9
City of West Sacramento
SD/SW Master Plan Update
Future Condition Results
Rivermont Watershed

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Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 150 300
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-10
City of West Sacramento
SD/SW Master Plan Update
Future Condition Results
Touchstone Lakes Watershed

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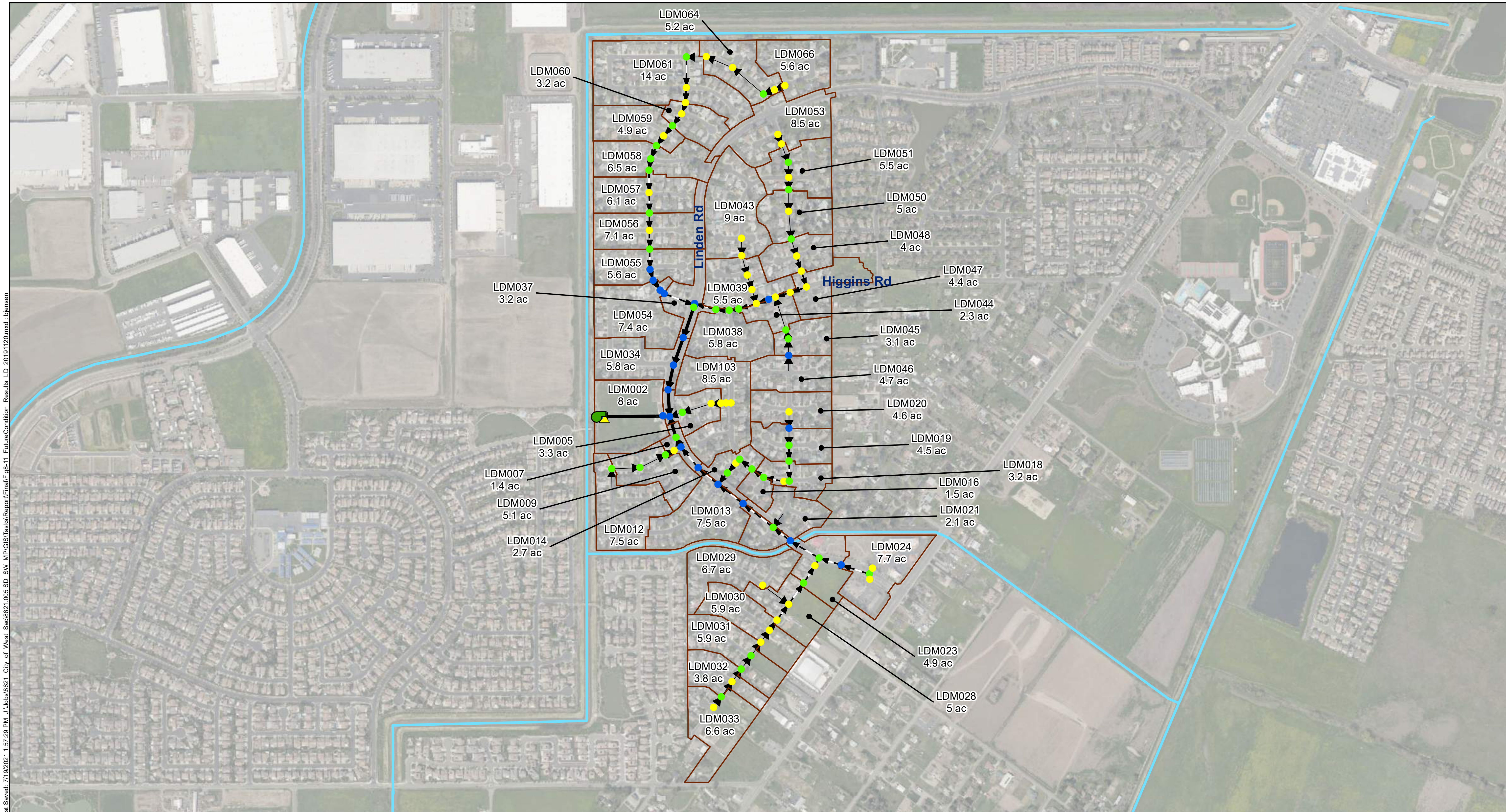

Model Components

- PumpStation
- Catchment
- Open Channel
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Manhole - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 400 800
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-11
City of West Sacramento
SD/SW Master Plan Update
Future Condition Results
Larchmont Watershed

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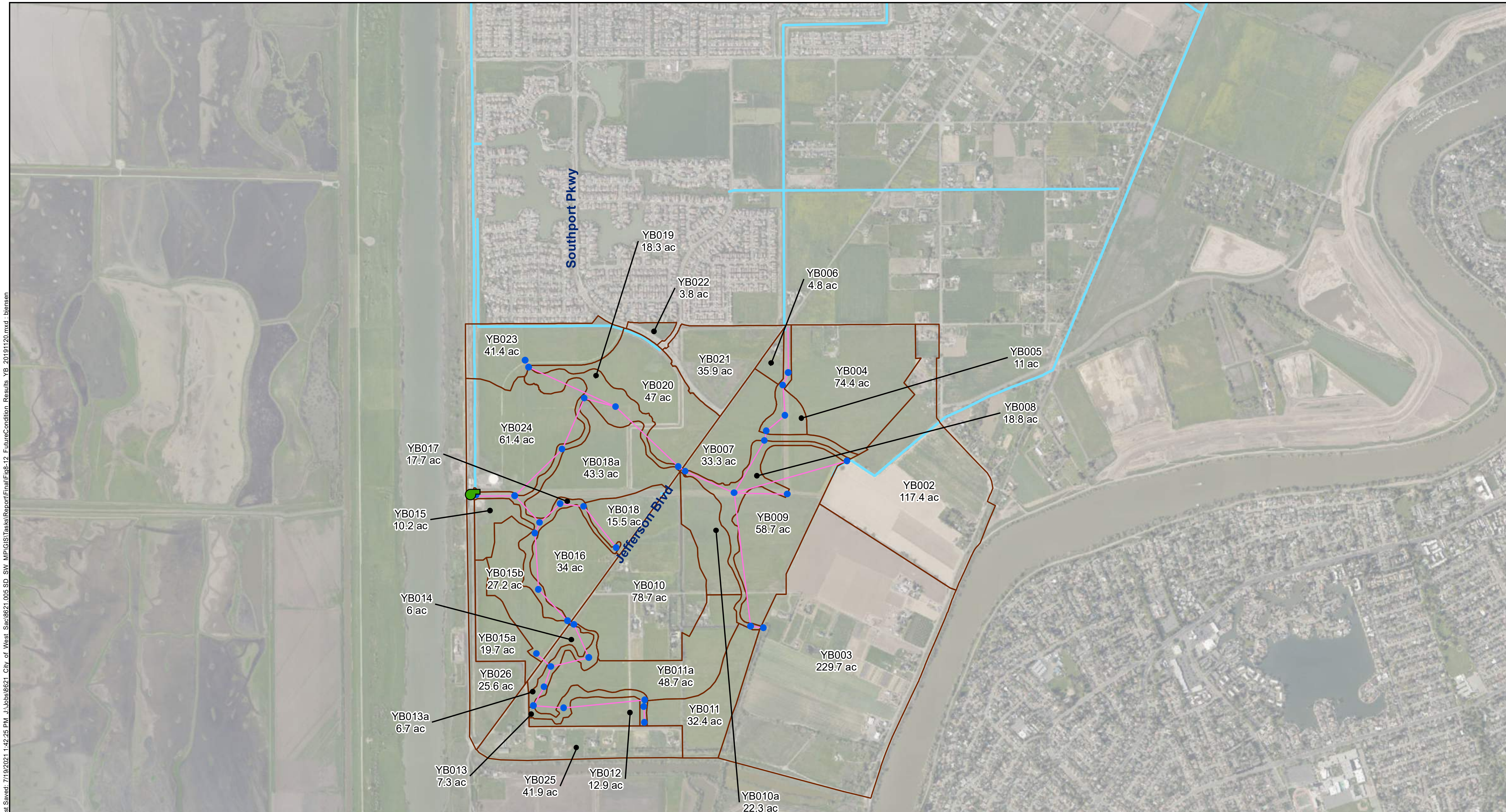

Model Components

- PumpStation
- Open Channel
- XPSWMM Link
- Catchment

Hydraulic Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- Greater than 3.0

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section

N

0 750 1,500
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 8-12
City of West Sacramento
SD/SW Master Plan Update
Future Condition Results
Yarborough Watershed

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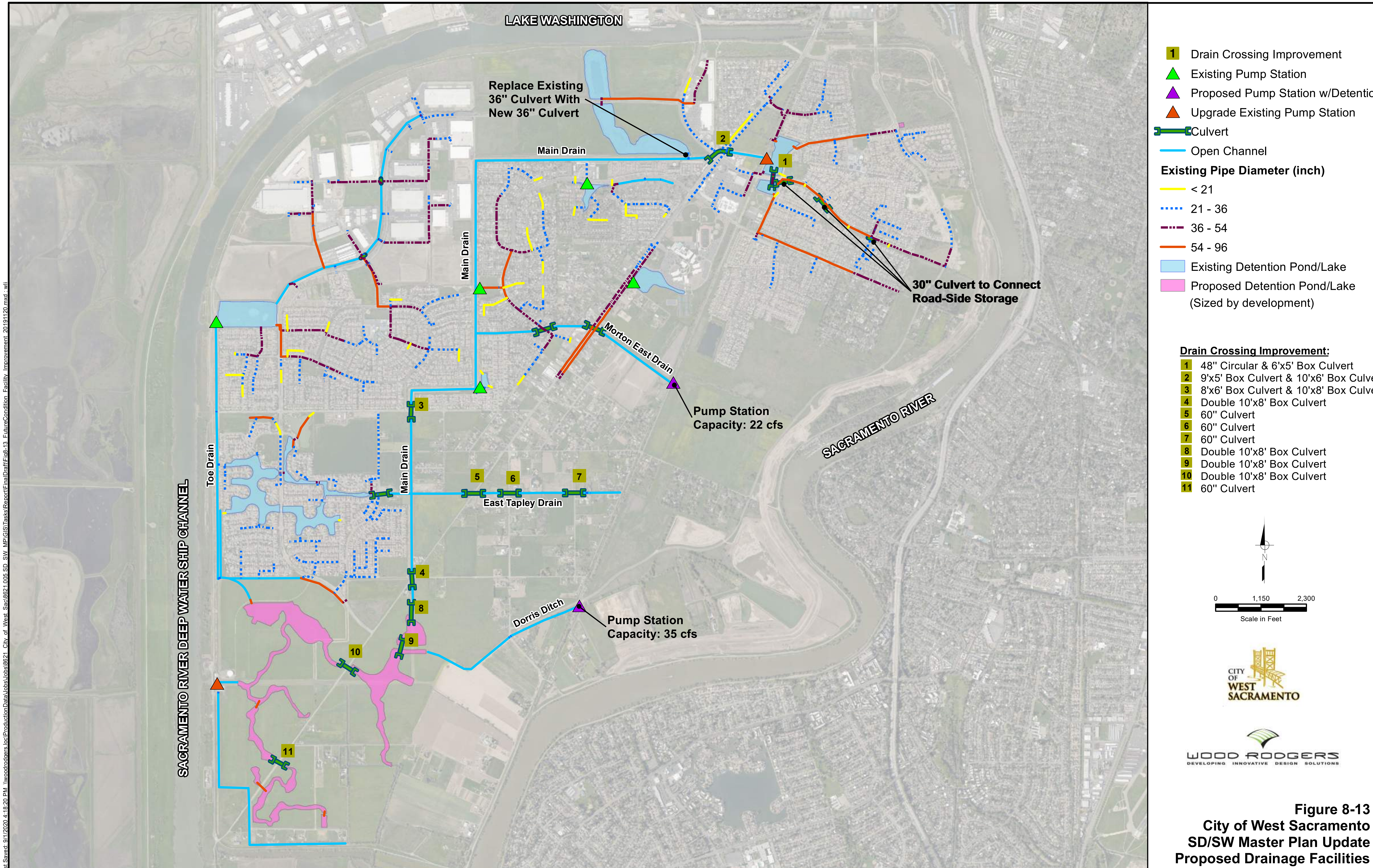

Figure 8-13
City of West Sacramento
SD/SW Master Plan Update
Proposed Drainage Facilities

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9.0 EVALUATION OF IMPROVEMENT PROJECTS

Improvements projects are presented by Basin to address existing watershed deficiencies. Improvement projects location are described to include their individual components and the cost estimated.

9.1 Project Cost Estimating

For the cost of each capital improvement project, unit prices were developed and material quantities were determined based on high-level descriptions of the work. Because the facilities have yet to be designed, it is appropriate to apply rule-of-thumb estimates for capturing planning, engineering, environmental permitting, and other costs associated with project implementation. It is also appropriate to apply an overall contingency representative of costs that may escalate or be better understood as the designs are developed.

Unit prices for typical construction activities such as clearing and grubbing, excavation, fill, concrete construction, rock slope protection, and borrow were determined based upon recent contractor bid summaries for drainage and flood control improvement projects in Northern California. Where recent bid tabulations were not available, cost-estimating publications, such as *RS Means' Heavy Construction Cost Data*, were used to develop costs. Pump station costs were determined using parametric cost estimates built on historical costs associated with similar municipal pump stations constructed recently and adjusted to reflect market conditions at the time of the writing of this SD/SW MP Update.

Preliminary cost estimates include a 20-percent construction contingency, a 10-percent planning and design contingency, a 10-percent construction management contingency, a 5-percent environmental review and mitigation contingency, and a 5-percent program implementation contingency. These factors are applied progressively, with each applied to the total after the previous factor is applied. The cost for land acquisition can be a significant amount of the total project cost for drainage improvements, especially for acquisition of detention storage sites. Land acquisition costs are highly variable and are not included with the implementation costs. In certain cases, the implementation of one project requires that another project be installed first. A general rule is that a conveyance project should not be implemented where downstream conditions could be made worse. Ancillary downstream improvements that are required as a result of an alternative's implementation are noted within the "requires" sentence at the end of each project statement.

9.2 North Basin

Improvement projects for the North Basin are described in the following section and are shown in **Figure 9-1** RD 537/RD 811 Watershed (West), **Figure 9-2** RD 537/ RD 811 Watershed (East), **Figure 9-3** Causeway and Racetrack Watershed (West), **Figure 9-4** Causeway and

Racetrack Watershed (Central), **Figure 9-5** Causeway and Racetrack Watershed (East), and **Figure 9-6** Deerwood and Lock Watershed Improvement Projects. Watersheds that had no deficiencies are not listed in this section. Nodes within the improvement figures show a flood depth with all of the improvement projects implemented together.

Improvement projects are summarized by watershed and follow this format:

- Categories of Improvement Projects
- Summary of Improvement Projects to Address Flood Locations
- Description of Improvement Projects

9.2.1 RD 537/RD 811 Pump Station

Improvement projects are needed throughout the watershed to reduce the flood depths during a 100-year design storm to reduce water surface elevations to below or equal with the building pad elevations. The two primary mechanisms to reduce water surface elevations are through conveyance improvements (to move flows more quickly downstream) and detention improvements (to temporarily store excess flood flows and decrease the peak flows in the system). Four main categories of projects have been used to reduce water surface elevation:

1. Locations that flood due to high main channel stages require a combination of improvement projects. Several culverts along the main channel are undersized for 100-year design storm flows and require a larger conveyance capacity through the addition of a second culvert. Widening the main channel bottom width by 15 feet from Jefferson Boulevard to Harbor Boulevard, along with culvert upsizing, allows flow to reach the RD 537/RD 811 Pump Station with less restriction. Channel widening also offers the opportunity to add storage within the storm system.
2. Locations that have pipes/overland flow paths unable to convey the 100-year design storm flow that can be addressed through trunk drain upsizing alone. Upsizing may require the replacement of a pipe with an increased diameter or, if cover is limited, with the addition of a second pipe.
3. Locations with flooding that cannot be mitigated through main channel widening, culvert upsizing, and trunk drain upsizing alone can be addressed through the addition of detention storage:
   - Offline (meaning located adjacent to and not in-line with the conveyance facility) detention basins are recommended to add storage capacity to a system when water surface elevations exceed a specified elevation. When water surface elevations reach the maximum allowable limit, flows will spill over a weir and into the storage area. As the water surface elevations recede, stored water can be released from the offline

detention basin to the trunk drain by gravity flow. In smaller storm events, the offline detention basin remains dry and may serve other uses throughout the year (e.g.: sport fields or passive recreational use).

- Online detention basins add capacity to a system in a variety of storm events and are probably unsuitable for public access. Stormwater will enter and exit the online detention at the same elevation as the drainage system.

4. Locations representing a roadway underpass that must be kept dry during the 100-year event can be addressed by increasing existing pumping capacity. This applies to the Jefferson Boulevard and 5th Street underpasses at the UPRR. Because these underpasses are designated as evacuation routes by the City, the pumping capacities will need to be increased in order to reach the all-lanes-dry condition.

Summary of Improvement Projects to Address Flood Locations

The proposed improvements for the RD 537/RD 811 Watershed are shown on **Figure 9-1** *RD 537/RD 811 Watershed (West),* and **Figure 9-2** *RD 537/RD 811 Watershed (East)*. The type of improvements applicable to each of the problem locations are described below:

- Hobson Avenue at Bryte Avenue (Node 81M619): Pipe upsizing.
- Arthur Drive and Milton Street (Node 81M824): Pipe upsizing.
- Arthur Drive and Fremont Boulevard (Node 81M742): Culvert upsizing and main channel widening.
- Douglas Street and Elkhorn Place (Node 81M772): Culvert upsizing, main channel widening, and online detention basin.
- 8th Street and Elizabeth Street (Node 81M846): Culvert upsizing, main channel widening, and online detention basin.
- Arthur Drive and Charles Street (Node 81M821): Pipe upsizing, culvert upsizing, main channel widening, and offline detention basin.
- Jefferson Underpass serviced by the Jefferson Pump Station (Node 81M069): Pump upsizing.
- 5th Street Underpass serviced by the 5th Street Pump Station (Node 81M095): Pump upsizing.

There is one node on **Figure 9-2** *RD 537/RD 811 Watershed (East)* that is highlighted in yellow, indicating that the 100-year flood depth exceeds the allowable flood depth, but that no improvements are proposed to address this flooding. The flooding on Elm Street west of Oaks Street (Node 81M544) is the result of a pipe with insufficient capacity to convey the 100-year design storm. Although the predicted flood depths are relatively large, the peak water surface elevation is well below the nearby building pad elevations.

Description of Improvement Projects

Projects within the RD537/RD811 Watershed have been described in detail to better understand flood location, individual project components, preliminary costs, and required project sequence.

Detention Basin

The Alyce Norman School Detention Basin addresses flooding at homes along Arthur Drive and Charles Street (represented by Node 81M821). The Alyce Norman Detention Basin has a 4-acre footprint and stores 9.6 acre-feet in the 100-year design storm. The detention basin will be mostly dry during typical storms up to the 5-year event. During larger, less frequent events, flows will inundate a larger portion of the basin. The detention basin is proposed to be graded with 3 horizontal to 1 vertical (3H:1V) side slopes and will retain multi-use functionality. The Alyce Norman Detention Basin is offline and requires an inflow and outflow pipe to deliver water to the basin via gravity. The inflow connection is proposed as two 4-foot-diameter pipes that discharge to the basin in a 5.5-foot by 10-foot inlet structure that is 40 feet long with a two-foot weir slot along the top. The outlet structure contains a 2-foot-diameter flap gate to drain the detention basin as the water surface elevation within the trunk system recedes. The implementation cost for the project is estimated to be $4.8 million. *Requires: Fourness Drive Pipe Upsize.*

The Sacramento Avenue Detention Basin addresses flooding in two areas: the first area includes homes along Douglas Street and Elkhorn Place (represented by Node 81M772); and the second area encompasses 8th Street at Elizabeth Street (represented by Node 81M846). The detention basin is proposed to have a 1.0-acre footprint and a storage capacity of 5.4 acre-feet for the 100-year design storm. The proposed location of the basin adjacent to Sacramento Avenue has been identified by the City as a vacant or underutilized parcel. The detention basin is online and will store floodwater for a range of storm frequencies. The parcel is proposed to be graded with 3H:1V side slopes. A weir and headwall need to be added at the upstream pipe to stabilize the proposed detention basin bank. The implementation cost for the project is estimated to be $1.5 million. *Requires: None.*

Pipe Upsize

The Arthur Drive Pipe Reroute addresses 100-year design storm flooding of homes along Arthur Drive and Charles Street (represented by Node 81M821). Dual 4-foot pipes are proposed to increase conveyance capacity. The existing 1.5-foot-diameter pipe passing between private homes along Cummins way and Arthur Drive will remain. This diameter pipe is smaller than the trunk line diameters studied in this scope and will need to be confirmed in the field. The implementation cost for the project is estimated to be $1.2 million. *Requires: Interstate 80 Culvert Upsize, Harbor Boulevard Culvert Upsize,* *Harbor Boulevard to Railroad Channel Expansion, Citrus Street Culvert Upsize, Railroad Culvert Upsize, Railroad to Jefferson Channel Expansion, and Alyce Norman School Detention Area.*

The Fourness Drive Pipe Upsize will address flooding at homes on Arthur Drive from Milton Street to Cummings Way, represented by Node 81M824 and Node 81M821. The existing trunk drain will be replaced with dual 4-foot diameter pipes and then dual 4-foot by 5-foot boxes. The Fourness Drive Pipe Upsize reduces water levels on Anna Street and prevents flows from spilling to Arthur Street. The upsized pipes also deliver flows more efficiently to the Alyce Norman Detention Basin. This implementation cost for the project is estimated to be $6.3 million. *Requires: Interstate 80 Culvert Upsize, Harbor Boulevard Culvert Upsize, Harbor Boulevard to Railroad Channel Expansion, Citrus Street Culvert Upsize, Railroad Culvert Upsize, Railroad to Jefferson Channel Expansion, Sacramento Avenue Detention Basin, Alyce Norman School Detention Basin Culvert Upsize.*

The Bryte Avenue Pipe Upsize will address flooding at homes on Hobson Avenue adjacent to Bryte Avenue (represented by Node 81M619). The existing trunk drain will be replaced by a 5-foot-diameter pipe and a 2-foot-diameter overflow pipe to provide the additional conveyance capacity that is needed during large storms. This implementation cost for the project is estimated to be $2.1 million. *Requires: Interstate 80 (I-80) Culvert Upsize, Harbor Boulevard Culvert Upsize, Harbor Boulevard to Railroad Channel Expansion, Citrus Street Culvert Upsize, Railroad Culvert Upsize, and Railroad to Jefferson Channel Expansion.*

The Douglas Pipe Upsize will address flooding at homes along Douglas Street and Elkhorn Place (represented by Node 81M772). The existing trunk drain will be replaced by a 5-foot-diameter pipe. This implementation cost for the project is estimated to be $0.2 million. *Requires: Sacramento Avenue Detention Basin.*

The following culverts along the main channel are a major constriction and push the water surface elevations up. Increasing the culvert sizes will allow for water to move downstream more with less restriction resulting in lowered water surface elevations in the main channel. The culvert expansions should be implemented downstream to upstream in the following order:

Interstate 80 Culvert Upsize will add an additional 7.5-foot diameter pipe to the existing 7.5-feet diameter pipe. This implementation cost for the project is estimated to be $4.1 million. *Requires: None.*

Harbor Boulevard Culvert Upsize will add an additional 7.5-feet diameter pipe to the existing dual 5-foot-diameter pipes. This implementation cost for the project is estimated to be $1.6 million. *Requires: Interstate 80 Culvert Upsize.*

Citrus Street Culvert Upsize will add an additional 6.5-foot-diameter pipe to the existing 6-foot-diameter pipe. This implementation cost for the project is estimated to be $0.3 million. *Requires: Interstate 80 Culvert Upsize, Harbor Culvert Upsize, and Harbor Boulevard to Railroad Channel Expansion.*

Railroad Culvert Upsize will add an additional 6.0-foot diameter pipe to the existing 6.5-foot-diameter pipe. A second pipe under the railroad will add an additional 7.5-foot-diameter pipe to the existing 4.5-feet diameter pipe. This implementation cost for the project is estimated to be $1.3 million. *Requires: Interstate 80 Culvert Upsize, Harbor Culvert Upsize, and Harbor Boulevard to Railroad Channel Expansion, and Citrus Culvert Upsize.*

Channel Expansion

The south bank of the Harbor Boulevard to Railroad Channel will be excavated by 15 feet to increase capacity while maintaining a minimum 15-foot vehicle access bench. In conjunction with culvert upsizing, the main channel tailwater elevation will be lowered from Harbor Boulevard moving upstream, benefiting flood locations adjacent to Node 81M742, Node 81M772, and Node 81M846. The implementation cost for the project is estimated to be $0.6 million. *Requires: Interstate 80 Culvert Upsize and Harbor Culvert Upsize. Project will also require right-of-way verification.*

The south bank of the Railroad to Jefferson Channel will be excavated by 15 feet to increase capacity while maintaining a minimum 15-foot vehicle access bench and has similar benefits to the south bank of the Harbor Boulevard to Railroad Channel. This implementation cost for the project is estimated to be $0.6 million. *Requires: Interstate 80 Culvert Upsize, Harbor Culvert Upsize, and Harbor Boulevard to Railroad Channel Expansion, Citrus Culvert Upsize, and Railroad Culvert Upsize. Project will also require right-of-way verification.*

Pump Station

The retrofit of two pump stations is proposed to keep underpasses dry in the 100-year design storm:

- The Jefferson Pump Station requires a capacity increase to 8 cfs to address 100-year flooding on Jefferson Boulevard under the railroad, represented by Node 81M069. The implementation cost for the project is estimated to be $6.5 million. *Requires: Interstate 80 Culvert Upsize, Harbor Culvert Upsize, and Harbor Boulevard to Railroad Channel Expansion, Citrus Culvert Upsize, Railroad Culvert Upsize, Railroad to Jefferson Channel Expansion, and Sacramento Avenue Detention Basin.*
- The 5th Street Pump Station (5th Street Underpass Alternative 1) requires a capacity increase to 22 cfs to address 100-year flooding on 5th Street under the railroad, represented by Node 81M095. The implementation cost for the project

is estimated to be $10.5 million. One alternative to the 22 cfs pump upgrade is to increase the pump station capacity to 8 cfs and add 0.8 acre-feet of detention storage in an underground vault (5th Street Underpass Alternative 2). The underground detention vault requires excavation and the construction of a reinforced concrete vault but would allow development on the surface, such as a parking lot or park. This implementation cost for the project is estimated to be $7.1 million. *Requires: Interstate 80 Culvert Upsize, Harbor Culvert Upsize, and Harbor Boulevard to Railroad Channel Expansion, Citrus Culvert Upsize, Railroad Culvert Upsize, Railroad to Jefferson Channel Expansion, and Sacramento Avenue Detention Basin.*

9.2.2 Causeway and Racetrack Pump Stations

Improvement projects are needed throughout both the Causeway and Racetrack Pump Station watersheds to reduce flood depths to below or equal with the building pad elevations. The two primary mechanisms to reduce water surface elevations involve conveyance improvements to move flows more quickly downstream and detention improvements to decrease the peak flows in the system. Four main categories of projects have been identified to reduce water surface elevations:

1. Locations that have pipes/overland flow paths with insufficient capacity to convey the 100-year design storm flow can be addressed through trunk drain upsizing alone. Upsizing may require the replacement of a pipe with an increased diameter or if cover is limited, the addition of a second pipe.

2. At most locations where flooding cannot be mitigated through trunk drain upsizing alone, detention storage is added. The following detention basins are proposed: Westmore Oak School Detention Basin, Westfield School Detention Basin, El Rancho Detention Basin, Michigan Boulevard Detention Basin, and 5th Street Detention Basin. All basins are proposed to be offline. The Michigan Boulevard Detention Basin and Westfield School Detention Basins require isolation (flap gates) to prevent backflow from downstream trunk drains.

3. Locations of flooding near the downstream end of the drainage systems that cannot be mitigated through trunk drain upsizing alone can be addressed through one of three alternatives: additional pumping, additional downstream detention, or a combination of both.

    - Downstream Alternative 1: Pump Station Only - A pump capacity increase of 226 cfs will be applied to the Racetrack Pump Station to mitigate flooding, for a total pump station capacity of 340 cfs. Two culvert expansions will be required to convey flow more quickly to the Racetrack Pump Station, the Racetrack Culvert Expansion and the West Capitol Culvert Expansion. The implementation cost for this project is estimated to be $30.5 million.

- Downstream Alternative 2: Detention Only - Instead of added pumping capacity, construction of 74.8 acre-feet of detention storage near the downstream end of the watershed can mitigate the flooding. This scenario would include offline detention basins at the West Capitol Avenue Detention Basin, the Estes Terminal Detention Basin, and the Lake Washington Expansion. One culvert expansion is required at West Capitol Avenue to improve conveyance. The estimated implementation cost for this project is $12.6 million, which does not include property acquisition.
- Downstream Alternative 3: Pump Station and Detention - A third option is to increase pumping capacity to the desired magnitude and add a portion of the 74.8 acre-feet of detention storage volume in order to mitigate the nearby flooding. For example, the Racetrack Pump Station would require a 90-cfs pump capacity increase for a total pump station capacity of 194 cfs and 40 acre-feet of detention to provide the remaining system capacity. The West Capitol Avenue Detention Basin was used to estimate the cost of this alternative, but a variety of other sites could be used. The Racetrack Culvert Expansion and the West Capitol Culvert Expansions are included with this option to increase upstream conveyance. The estimated implementation cost for this project is $24.9 million.

Summary of Improvement Projects to Address Flood Locations

The type of improvement applicable to each of the problem locations are described below:

- Seaport Boulevard at Enterprise Boulevard **Figure 9-3** (Node CWM184 and Node CWM187), Claredon Street **Figure 9-5** (Node CWM685), Harbor Boulevard and West Capitol Boulevard (Node RTM229): Trunk drain upsizing.
- Merkley Avenue from El Rancho Court to Jefferson Boulevard **Figure 9-5** (Node CWM607, CWM608, CWI720, CWO689) and north of US 50 and west of Sycamore Avenue (Node CWM577): Detention.
- Walnut Street north of Michigan Boulevard **Figure 9-4** (Node CWM912): Detention storage and trunk drain upsizing.
- 5th Street and South River Road **Figure 9-5** (Node CWI746): Detention storage or trunk drain upsizing.
- Poplar Avenue and Rockrose Road **Figure 9-5** (Node CWM896, Node CWI896, and Node CWI900) and Portsmouth Court and Michigan Boulevard (Node CWI918 and Node CWI924): Detention storage and isolation (Flap Gate).
- Area adjacent to Lake Washington **Figure 9-3** (Nodes CWO007, CWO010, CWO013, CWO016, RTO082, and RTO085) and Doran Avenue at Marigold Street (Nodes RTM163, RTM166, and CWI397): Pump upsizing and/or detention.

There are nodes on the Figures (Causeway and Racetrack Watershed (West), Causeway and Racetrack Watershed (Central), and Causeway and Racetrack Watershed (East)) that are highlighted in orange, indicating that the 100-year flood depth exceeds the allowable flood depth; however, no improvements are proposed to address this flooding. The flooding at Nodes CWOVS25, CWI544, CWM556, and CWI992 is the result of a pipe with insufficient capacity to convey the 100-year design storm. Although the flood depths are relatively large, the peak water surface elevation is at or below the nearby building pad elevations. The flooding at Node CWM160 represents the West Capitol Avenue roadway underpass that contains water in the 100-year storm. Although the underpass is flooded in the 100-year storm, adjacent building pad elevations are unaffected. If this underpass is designated as an evacuation route by the City, the pumping capacity should be increased. The flooding at Nodes CWO148 and CWI914 is the result of a lack of capacity within the trunk system, but does not produce pad flooding.

Descriptions of Improvements

Projects within the Causeway and Racetrack Watersheds have been described in detail in order to better understand flood location, individual project components, preliminary costs, and required project sequence. The Projects are shown on **Figure 9-3** Causeway and Racetrack Watershed (West), **Figure 9-4** Causeway and Racetrack Watershed (Central), and **Figure 9-5** Causeway and Racetrack Watershed (East).

Pipe Upsize

The Walnut Street Pipe Upsize (**Figure 9-4**) will address flooding at homes on Walnut Street north of Michigan Boulevard (represented by Node CWM912). The existing trunk drain will upsize several sections of pipe to dual diameters at a maximum of 4.5-feet. One section of proposed pipe on Walnut Street is rectangular pipe due to a shallow pipe cover. The implementation cost for this project is estimated to be $4.8 million. *Requires: Westfield School Detention Basin.*

The Enterprise Boulevard Pipe Upsize (**Figure 9-3**) will address flooding at businesses on Seaport Boulevard at Enterprise Boulevard (represented by Nodes CWM187 and CWM184). The existing trunk drain is undersized and will be increased from a 4.5-foot-diameter pipe to a 6-foot- diameter pipe. Upstream, the pipe will be increased from a 3.5-foot diameter pipe to a 4-foot-diameter pipe. The implementation cost for this project is estimated to be $3.5 million. *Requires: Downstream Detention Basins or Downstream Pumping.*

The Clarendon Street Pipe Upsize (**Figure 9-5**) will address flooding at businesses on Claredon Street (represented by Nodes CWM685). The existing trunk drain is undersized and will be increased from 2-foot-diameter pipe to dual 5-foot-diameter pipe. The implementation cost for this project is estimated to be $0.7 million. *Requires: Downstream Detention Basins or Downstream Pumping.*

The Houston Street Culvert Upsize (**Figure 9-4**) will address flooding at businesses on Harbor Boulevard north of West Capitol Boulevard (represented by Node RTM229). The existing culvert is undersized and will be increased from a 4-foot-diameter pipe to a 6-foot-diameter pipe. The intent of this project is to work in tandem with the Harbor Boulevard Pipe Upsize. The implementation cost for this project is estimated to be $0.9 million. *Requires: Harbor Boulevard Pipe Upsize*, *Downstream Detention Basins or Downstream Pumping.*

The Harbor Boulevard Pipe Upsize (**Figure 9-4**) will address flooding at businesses on Harbor Boulevard north of West Capitol Boulevard (represented by Node RTM229). Sections of the existing trunk sewer are undersized and will be increased from a 4-foot-diameter pipe to 5-foot-diameter pipe. Upstream, the pipe size will be increased from 2.5 feet to 4 feet in diameter. The implementation cost for this project is estimated to be $1.8 million. *Requires: Houston Street Culvert Upsize and Downstream Detention Basins or Downstream Pumping.*

The Racetrack Culvert Expansion (**Figure 9-3**) will address flooding at businesses along Commerce Drive at Northport Drive (represented by Node RTM166 and Node RTM163). The existing culvert is undersized and will be increased from a 3.5-foot-diameter pipe to a 5-foot-diameter pipe. The implementation cost for this project is estimated to be $0.2 million. *Requires: Downstream Pumping.*

The West Capitol Culvert Expansion (**Figure 9-3**) will address flooding at homes along the northern shore of Lake Washington (represented by Node CWO007, Node CWO010, Node CWO013, and Node CWO016); and businesses along the drainage ditch at 4235 and 4203 West Capitol Avenue (represented by Node RTO082 and Node RTO085). The existing dual culverts are undersized and will be increased from dual 3-foot-diameter pipes to dual 5.5-foot-diameter pipes. City staff noted that a new 16-inch water main is proposed at this location that may prevent future installation of larger culverts. Cover may also be an issue for larger culverts. Therefore, this improvement may need to be a larger number of smaller pipe culverts or a series of box culverts. This should be defined as a part of the detailed design for this facility. This implementation cost for the project is estimated to be $0.4 million. *Requires: Harbor Boulevard Pipe Upsize*, *Downstream Detention Basins or Downstream Pumping.*

Upstream Detention Basins

The following detention basins address local flood problems and provide benefits to locations downstream.

The Westmore Oaks School Detention Basin (**Figure 9-4**) addresses flooding at buildings north and south of US 50 and west of Sycamore Avenue (represented by Node CWM577). This detention basin has a 28.12-acre footprint and stores 83.7 acre-feet in the 100-year design storm. The detention basin will be mostly dry during typical storms up to the 5-year event. During larger, less frequent events, flows will inundate a larger portion of the basin. The detention basin is proposed to be graded with 3H:1V side slopes and will retain multi-use functionality. The existing twin 6-foot pipes located north of Westmore Oaks would be removed and replaced with an open channel. The south bank of the channel would be built with a riprap edge acting as an inflow weir to the detention basin. Water would exit the detention basin via a separate discharge pipe with a flap gate. The implementation cost for this project is estimated to be $24.9 million. *Requires: None.*

The El Rancho Court Detention Basin (**Figure 9-5**) addresses flooding on Merkley Avenue from El Rancho Court to Jefferson Boulevard (represented by Node CWI720, Node CWO689, Node CWM607, and Node CWM608). The El Rancho Court Detention Basin is a 2.2-acre basin that will store 12.8 acre-feet in the 100-year design storm. The detention basin will be mostly dry during typical storms up to the 5-year event. During larger, less frequent events, flows will inundate a larger portion of the basin. The detention basin will be graded with 3H:1V side slopes. The Rancho Court Detention Basin is offline and water in the adjacent channel will spill over the banks to enter and exit the basin. The implementation cost for this project is estimated to be $2.0 million. *Requires: None.*

The Westfield School Detention Basin (**Figure 9-4**) addresses flooding at homes on Poplar Avenue and Rockrose Road (represented by Node CWI900 and Node CWM896). Currently, flows from the 6.5-foot trunk drain backflow through a ditch to Poplar Avenue and Rockrose Road. The culvert at the end of the ditch will be fitted with a flap date to eliminate this occurrence. The detention basin will also relieve flooding at Walnut Street north of Michigan Boulevard. The Westfield School Detention Basin has a 4.5-acre footprint and stores 22.0 acre-feet of volume in the 100-year design storm. The detention basin will be mostly dry during typical storms up to the 5-year event. During larger, less frequent events, flows will inundate a larger portion of the basin. The detention basin is proposed to be graded with 3H:1V side slopes and higher-elevation tiers will retain full multi-use functionality. Flows will spill into the detention basin through two inlet structures: one on Polar Avenue and one at the southwest corner of the school playfield. The existing 1.75-foot-diameter pipe will be increased to a 2.5-foot-diameter pipe in order to increase conveyance to the inlet structure on Poplar Avenue. Flows will return to the 6.5-foot trunk drain through a discharge pipe fitted with a flap gate. The implementation cost for this project is estimated to be $5.1 million. *Requires: None.*

The Michigan Boulevard Detention Basin (**Figure 9-5**) addresses flooding at homes on Portsmouth Court and Michigan Boulevard (represented by Node CWI918) and at Rockrose Road and Laurel Lane represented by (Node CWI924). Currently, flows from the 4-foot trunk drain backflow through an overland ditch to Portsmouth Court. A 24-inch flap gate will be installed to eliminate this occurrence. The Michigan Boulevard

Detention Basin has a 2.3-acre footprint and stores 6.4 acre-feet of volume in the 100-year design storm. The detention basin will be mostly dry during typical storms up to the 5-year event. During larger, less frequent events, flows will inundate a larger portion of the basin. Flows will spill into the detention basin through a rectangular 2-foot by 6-foot-diameter inflow pipe running from the intersection of Portsmouth Court and Michigan Boulevard. This unusual size is a result of shallow pipe cover from the existing surface grades. This implementation cost for the project is estimated to be $5.0 million. *Requires: None.*

The South River Road Detention Basin (**Figure 9-5**), South River Road Alternative 1, addresses flooding at businesses on 5th Street west of South River Road (represented by Node CWI746). The South River Street Detention Basin has a 2.26-acre footprint and stores 2.3 acre-feet of volume in the 100-year design storm. The detention basin will be mostly dry during typical storms up to the 5-year event. During larger, less frequent events, flows will inundate a larger portion of the basin. Flows will spill into the detention basin through a 2-foot by 4-foot inflow pipe running from the existing 2.5-foot diameter pipe. The implementation cost for this project is estimated to be $1.3 million. *Requires: None.*

An alternative project to the South River Detention Basin would be conveyance improvements at the existing pipe system on South River Road (South River Road Alternative 2). The existing 2-foot-diameter pipe would be upsized to dual 3-foot-diameter pipes. This implementation cost for the project is estimated to be $2.9 million. *Requires: El Rancho Court Detention Basin or Westmore Oaks School Detention.*

Downstream Detention Basins

The following detention basins work collectively to address flooding at the four following areas: homes along the northern shore of Lake Washington (represented by Node CWO007, Node CWO010, Node CWO013, and Node CWO016); businesses along the drainage ditch at 4235 and 4203 West Capitol Avenue (represented by Node RTO082 and Node RTO085); business along Commerce Drive at Northport Drive (represented by Node RTM166 and Node RTM163); and homes on Doran Avenue at Marigold Street. The potential flooding at these locations requires the water surface elevation to be reduced through detention or pumping.

- The Lake Washington Expansion includes a 2.7-acre expansion to Lake Washington and adds 21.5 acre-feet of volume to the lake for the 100-year design storm. The expansion will utilize 3H:1V side slopes. Three headwalls will need to be added at the three existing storm pipes discharging into the lake. The implementation cost for this project is estimated to be $1.4 million. *Requires: None.*

- The West Capitol Avenue Detention Basin is a 14.8-acre basin and contains 41.7 acre-feet of flood storage for the 100-year design storm. The detention basin is dry in a 5-year design storm as intended to be used as a multi-use facility. The detention basin is proposed to be graded with 3H:1V side slopes. The West Capitol Detention Basin is offline and water in the adjacent channel will spill over the banks to enter and exit the basin. The implementation cost for this project is estimated to be $9.3 million. *Requires: None.*
- The Estes Terminal Detention Basin is a 4-acre basin and contains 11.6 acre-feet of storage volume for the 100-year design storm. The detention basin will be mostly dry during typical storms up to the 5-year event. During larger, less frequent events, flows will inundate a larger portion of the basin. The Estes Terminal Detention Basin is offline and water in the adjacent channel will spill over a rip-rap weir to inflow and discharge will be regulated by an outlet pipe fitted with a one 24-inch flap gate. The implementation cost for this project is estimated to be $1.9 million. *Requires: None.*

Downstream Pump Station

The Racetrack Pump Station has been identified by the City as needing additional capacity as an alternative to expansion of the downstream detention basins at Lake Washington, West Capitol Avenue, and Estes Terminal. The current Racetrack Pump Station needs to be fully refurbished and the operation is not well understood. RD 900 has requested the new pump station to be constructed at the elevation of the City's perimeter levee. A pump capacity of 340 cfs is required to accommodate 100-year design storm flows. The implementation cost for this project is estimated to be $29.9 million. *Requires: Racetrack Culvert Expansion and West Capitol Culvert Expansion.*

9.2.3 Deerwood

Improvement projects are needed to reduce flood depths to be below or equal to the building pad elevations. The two primary mechanisms to reduce water surface elevations are conveyance improvements to move flows more quickly downstream and detention improvements to decrease the peak flows in the system.

Summary of Improvement Projects to Address Flood Locations

The main categories of projects that have been evaluated to reduce water surface elevations are:

- Flooding caused by a lack of capacity at the Deerwood Pump Station requires the addition of detention storage, increased pumping capacity, or a combination of both.

  The proposed improvements are shown on the **Figure 9-6** Deerwood and Lock Watershed Improvement Projects. The type of improvement applicable to each of the problem locations are described below:

- Deerwood Street at Lakewood Drive (Node DW_WW): Added detention storage OR additional pumping OR downstream detention and additional pumping.

Descriptions of Improvements

Projects within the Deerwood and Lock Watershed have been described in detail to better understand flood location, individual project components, preliminary costs, and required project sequence. Preliminary costs are described in the Project Cost Estimating Section above.

Pump Station

The Deerwood Pump Station addresses potential flooding at homes along Deerwood Street at Lakewood Drive (represented by Node DW_WW). The Deerwood Pump Station Relocation project will move the 9-cfs pump station from the existing location to the northeast corner of the Deerwood Detention Basin. The Deerwood Pump Station will be rebuilt as a submersible pump with a pump station capacity of 9 cfs. A two-foot discharge line will be added to empty the flows into the existing trunk drain. At this capacity, the downstream portion of the trunk drain size is adequate. This implementation cost for the project is estimated to be $2.1 million. *Requires: Deerwood Detention Basin.*

Detention Basin

The Deerwood Detention Basin stores flows in excess of the pump station capacity during 100-year storm. Peak incoming flows from the Deerwood Street at Lakewood Drive neighborhood are 25 cfs. The Deerwood Detention Basin has a 0.93-acre footprint and stores 2.7 acre-feet in the 100-year design storm. Flows from the existing inlet will be piped in a 24-inch storm line below existing 60-inch Sacramento Regional County Sanitation District (SRCSD) forcemain, the elevation of which needs to be confirmed at this location. The basin will be inundated in all storms and will be emptied by the Deerwood Pump Station Relocation project. The implementation cost for this project is estimated to be $2.1 million. *Requires: Deerwood Pump Station Relocation.*

9.2.4 Lock

Improvement projects are needed to reduce flood depths to below or equal with the building pad elevations. The two primary mechanisms to reduce water surface elevations are conveyance improvements to move flows more quickly downstream and detention improvements to decrease the peak flows in the system. Locations that have pipes/overland flow paths that are unable to accommodate the 100-year design storm flow can be addressed through trunk drain upsizing alone. Upsizing may require the replacement of a pipe with one having an increased diameter or, if cover is limited, the addition of a second pipe.

Summary of Improvement Projects to Address Flood Locations

The main categories of projects that have been evaluated to reduce water surface elevation are:

- Alabama Avenue at 13th Street (Node LKOV16): Trunk drain upsizing to prevent overland flow from spilling to surrounding neighborhoods.

Descriptions of Improvements

Projects within the Lock Watershed have been described in detail to better understand flood location, individual project components, preliminary costs, and required project sequence.

Pipe Upsize

The Jefferson Boulevard pipe upsize will address the flooding along Alabama Avenue at 13th Street (represented by Node LKOV16 on **Figure 9-6**). Currently, flows from Jefferson Boulevard discharge to the northwest from Circle Street to Alabama Avenue at 13th Street. The existing pipe will need to be upsized to a 5-foot-diameter pipe for adequate conveyance capacity. The most downstream portion of the pipeline discharging to the DWSC will be 6 feet in diameter. The estimated implementation cost for this project is estimated to be $4.8 Million. *Requires: None.*

9.3 South Basin

In the South Basin, existing drainage facilities have been laid out in a manner more consistent with community master planning. The Main Drain channel corridor is the backbone of the drainage system, collecting the majority of the South Basin runoff and flowing through existing developed areas until it reaches the Main Drain Pump Station where the flows are discharged to the DWSC. The Main Drain Pump Station has been upgraded during the last 10 years and has been sized to match the current conveyance capacity of the Main Drain channel.

All watersheds draining into the Main Drain system have been configured to locally detain their own runoff and limit the peak flow reaching the Main Drain channel in order to stay within the capacity of the Channel. Given the flatness of the South Basin terrain, the most efficient way to configure local detention and maximize development has been to construct deeper detention basins and to pump from these detention basins into the Main Drain conveyance system. In this manner, the pumping provides a relatively constant outflow of the stored volume, controlling the flow conditions in the Main Drain. If a gravity detention basin can be configured to drain into the Main Drain channel without pumping, the cost of the pump station can be eliminated; however, the footprint size of the detention basin must be increased, which in turn decreases the amount of developable land. Gravity basins are subjected to the downstream tailwater constraints and must hold all water until downstream channels have receded enough to allow for gravity drainage.

The improvements to the South Basin proposed under this master plan work well within these constraints but limit the number of feasible alternatives for evaluation. While some alternatives may exist that allow for reconfiguration of local detention and pumping, any major reconfiguration of the Main Drain channel is considered infeasible. The following alternatives were considered in concept only for local detention and pumping to serve the approved General

Plan land uses, but were ultimately considered significantly less feasible than the proposed master plan layout. The following concepts were considered but not further evaluated in detail as improvement alternatives for the reasons noted in each specific watershed discussion below. Note that, because Liberty and River Park are future specific plan areas where drainage plans will be developed by the project proponent, no detailed concepts were evaluated as part of this master plan.

9.3.1 Lake Washington (south of DWSC)

In order to serve development under the current City's general land use plan, the runoff must be detained and/or discharged safely. The Lake Washington watershed can be configured to drain either to the Main Drain channel or to the DWSC. While gravity drainage to the Main Drain channel has been proven feasible, gravity drainage to the DWSC is significantly less feasible. The elevations of the ground surface within the watershed are only slightly higher than the normal operating conditions in the DWSC. Any gravity drainage consideration would need to perform significant evaluations of the timing and coincidence of raised water surfaces in the DWSC during the wet season. If water levels are raised for longer periods of time, due to backwater from the Yolo Bypass, all local runoff in the watershed could potentially need to be stored for weeks. Once waters recede, it would be very difficult to drain stored water by gravity with very low elevation differences, requiring very large gravity pipe connections through the DWSC levee which currently protects the South Basin from external flooding.

Pumping to the DWSC would be more expensive than incorporating detention and internal pump stations, as water would need to be lifted to higher elevations and would require approval from the State of California for increasing discharges to the regional flood system and potentially impacting the integrity of the levee protection system.

Pumping to the Main Drain channel could allow for a reduction in the footprint of Lake Washington. However, the existing lake area has been considered a wetland, and any reclamation of the existing lake footprint would be very difficult from an environmental permitting and cost perspective.

9.3.2 Gateway/Stonegate and Stone Lock

The future Gateway/Stonegate and Stone Lock area will incorporate new low- and medium-density residential development occupying the currently vacant areas planned for development within the General Plan. If additional runoff is not discharged to the Main Drain channel without pumping, then additional runoff could conceptually be stored and or discharged to the Sacramento River. Detention that drains by gravity would require significant changes to the General Plan and reduce development footprints, which is considered infeasible. Detention with drainage by gravity to the Sacramento River is also a feasible concept but is impossible to size and configure for discharge given the lower interior ground elevations relative to the peak river water surface elevations. Pumping to the

Sacramento River would be very costly and difficult to design while maintaining the integrity of the levee system.

9.3.3 Yarbrough

The proposed Yarbrough project is located at the downstream end of the Main Drain system, with only a short distance to the existing Main Drain pump station. Given the proximity to this existing discharge point, the most feasible alternative for this project is to convey upstream runoff through the project site while also detaining onsite runoff enough to prevent offsite impacts and safely elevate new development above proposed water levels. The current configuration of storage and conveyance through the Yarbrough site was provided in the form of a grading plan to Wood Rodgers from the City. It is Wood Rodgers' understanding that this grading was developed by the project proponent.

The grading within the Yarbrough site works very well to both store and convey runoff and protect all existing and proposed development within the General Plan. There may be opportunity to optimize this concept during detailed design in the future, and decrease storage/conveyance without adversely impacting development, however, until more detail site layouts are developed, it is not advantageous to adjust grading from that already provided by the project proponent.

Any other alternatives would involve creating new pumped discharge which would be more inefficient than utilizing the full design discharge capacity of the already-constructed Main Drain pump station.

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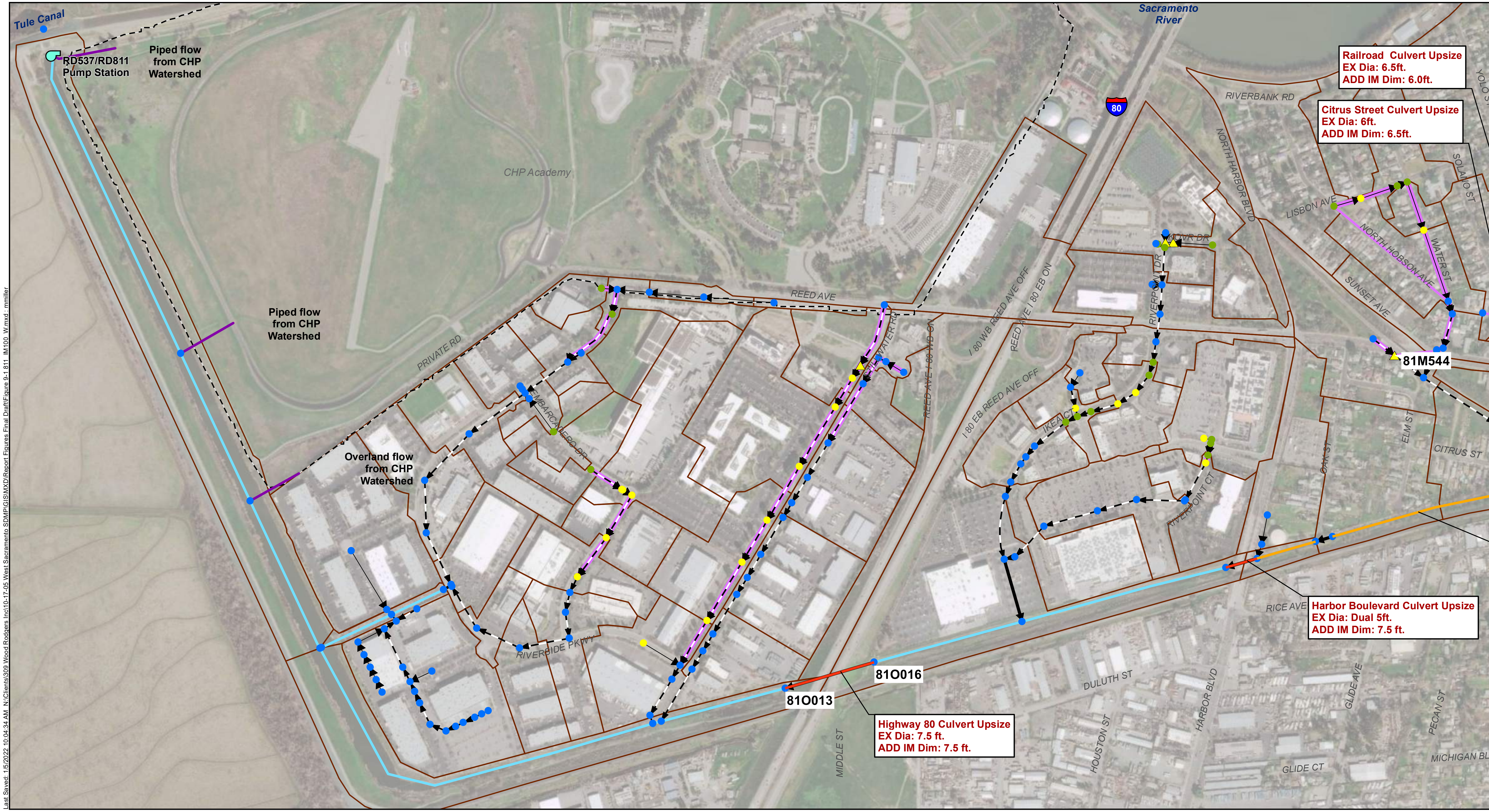

Existing Components

- Pump
- Subshed
- CHP Watershed
- Overland Flow
- Inter-Watershed Flow
- Open Channel
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Proposed Projects

- Pipe Implementation Project
- Channel Expansion Project (10-15 foot width increase)

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section
2. The proposed improvement projects meet the performance criteria of 100-year, 24-hour flood depth at or below pad elevation.
3. Improvement project diameters have been added to the plan as "ADD IM Dia:" The existing trunk line diameters are labeled as "EX Dia:".

N

0 450 900
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 9-1
RD537/RD811 Watershed (West) Improvement Projects

100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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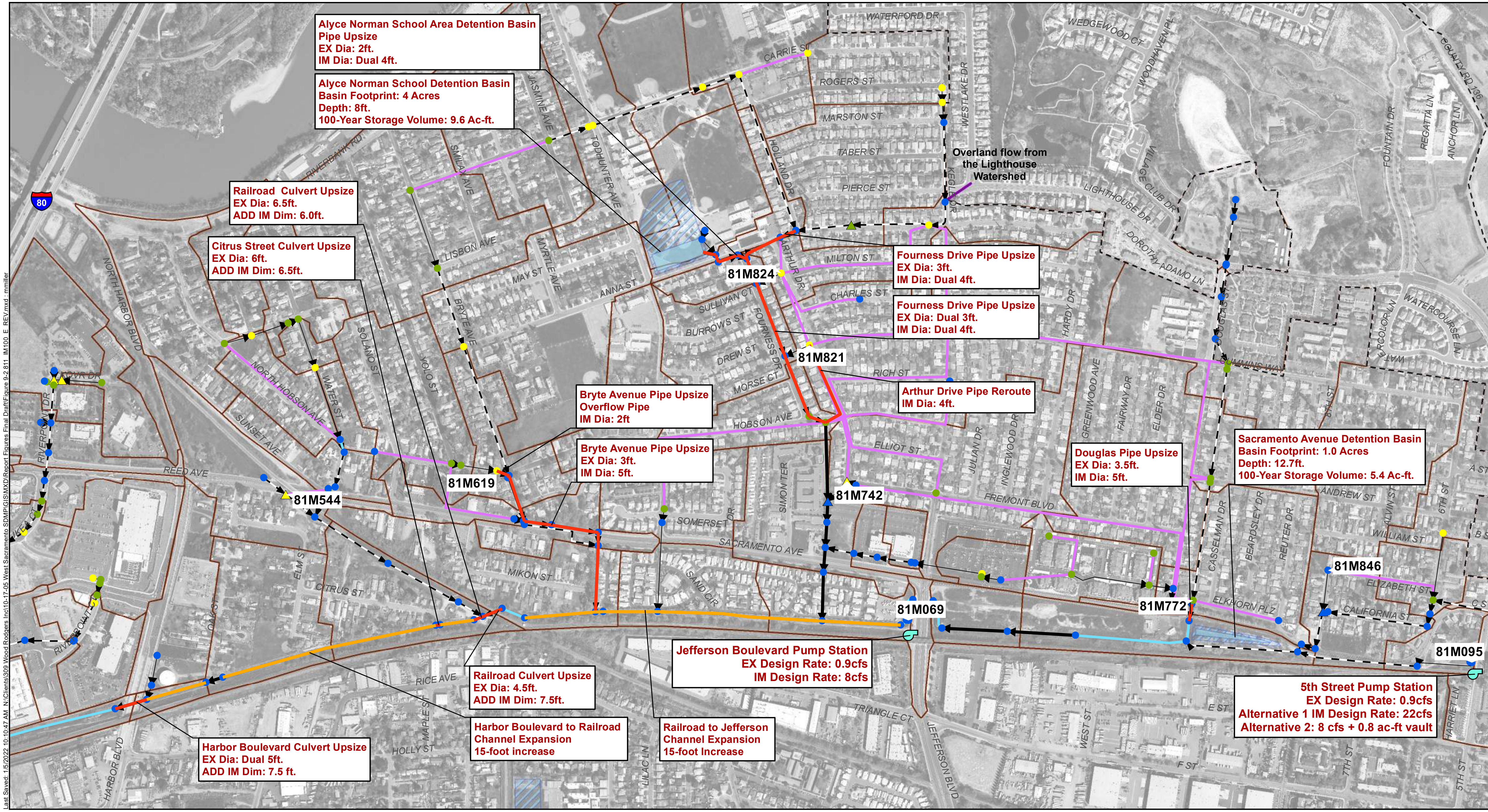

Existing Components

- Subshed
- Lighthouse Watershed
- Overland Flow
- Inter-Watershed Flow
- Open Channel Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Proposed Projects

- Pipe Upsize Project
- Channel Expansion Project (10-15 foot width increase)
- Detention Basin Footprint
- 5-Year Storm Inundation Area

Storage Node - Flood Depth (feet)	Model Node - Flood Depth (feet)
No Flooding	No Flooding
0.0 - 0.6	0.0 - 0.6
0.6 - 1.6	0.6 - 1.6
1.6 - 3.0	1.6 - 3.0
3.0 - 4.1	3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.
2. The proposed improvement projects meet the performance criteria of 100-year, 24-hour flood depth at or below pad elevation.
3. Improvement project diameters have been added to the plan as "ADD IM Dia:" The existing trunk line diameters are labeled as "EX Dia:".

0 450 900
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 9-2
RD537/RD811 Watershed (East) Improvement Projects

100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

Last Saved: 1/5/2022 10:10:47 AM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 9-2 811 IM100 E REV.mxd : mmiller

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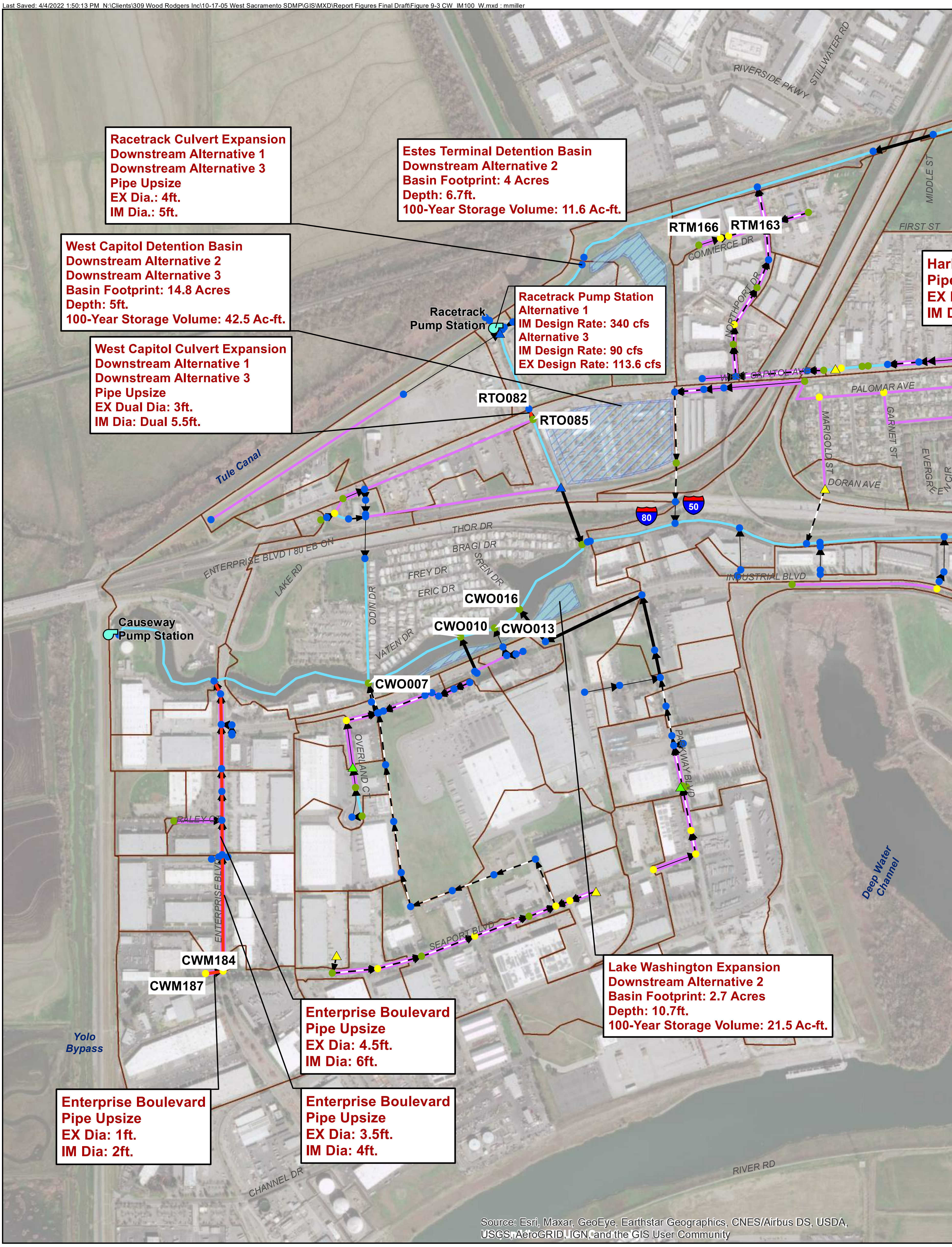
Last Saved: 4/4/2022 1:50:13 PM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 9-3 CW_IM100_W.mxd : mmiller



Existing Components
- Pump
- Subshed
- Inter-Watershed Flow
- Overland Flow
- Open Channel Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)
- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)
- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Proposed Projects
- Pipe Upsize Project
- Open Channel with Weir
- 5-Year Storm Inundation Area
- Detention Basin Footprint

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.
2. The proposed improvement projects meet the performance criteria of 100-year, 24-hour flood depth at or below pad elevation.
3. Improvement project diameters have been added to the plan as "ADD IM Dia:" The existing trunk line diameters are labeled as "EX Dia:".

N

0 500 1,000
Scale in Feet

Figure 9-3
Causeway and Racetrack Watershed (West) Improvement Projects

100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

WEST YOST ASSOCIATES

CITY OF WEST SACRAMENTO

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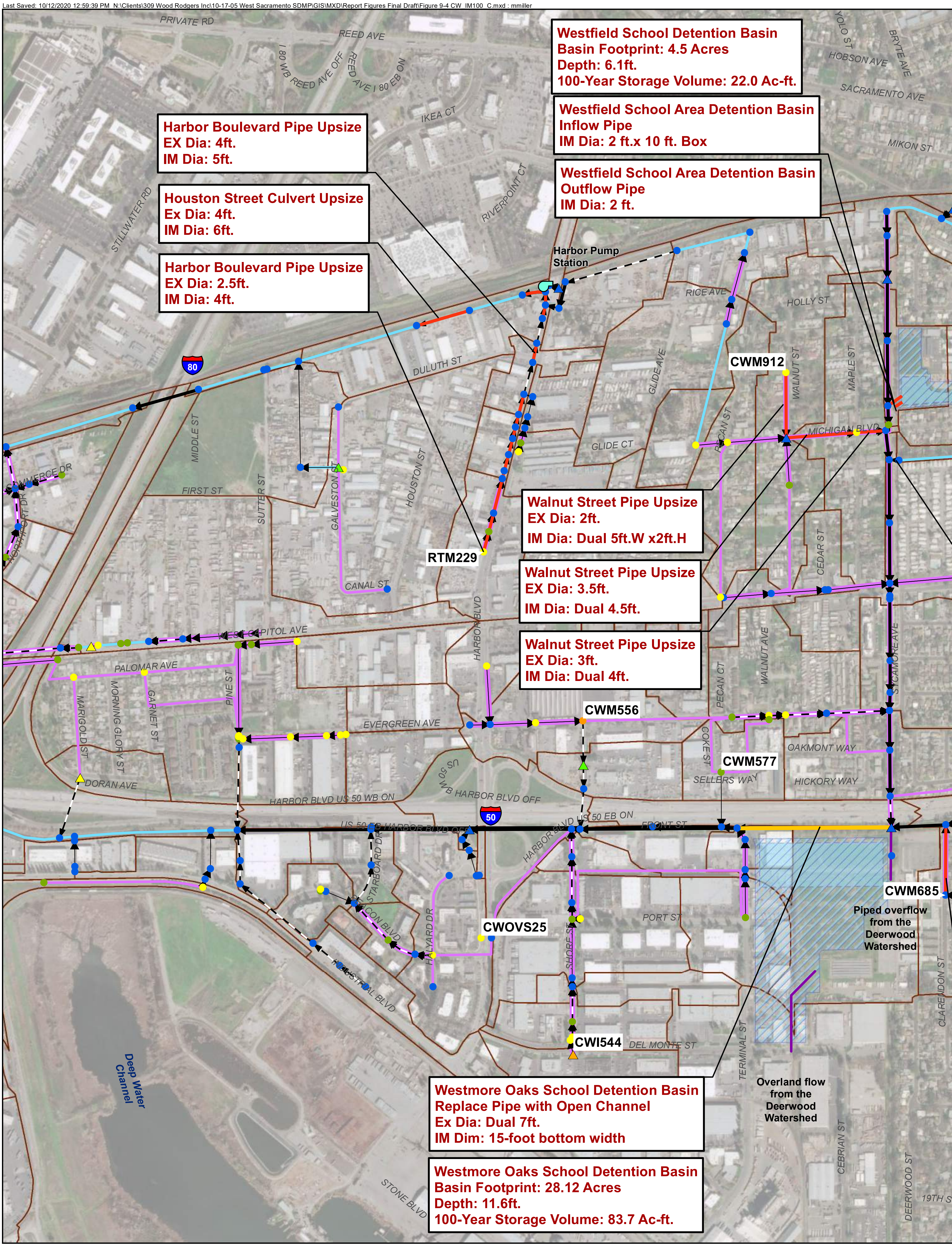
Last Saved: 10/12/2020 12:59:39 PM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 9-4 CW_IM100_C.mxd : mmiller



Existing Components

- Pump
- Subshed
- Inter-Watershed Flow
- Overland Flow
- Open Channel Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Proposed Projects

- Pipe Upsize Project
- Open Channel with Weir
- 5-Year Storm Inundation Area
- Detention Basin Footprint

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.
2. The proposed improvement projects meet the performance criteria of 100-year, 24-hour flood depth at or below pad elevation.
3. Improvement project diameters have been added to the plan as "ADD IM Dia:" The existing trunk line diameters are labeled as "EX Dia:".

0 500 1,000
Scale in Feet

N

Figure 9-4
Causeway and Racetrack Watershed (Central) Improvement Projects

100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

WEST YOST ASSOCIATES

CITY OF WEST SACRAMENTO

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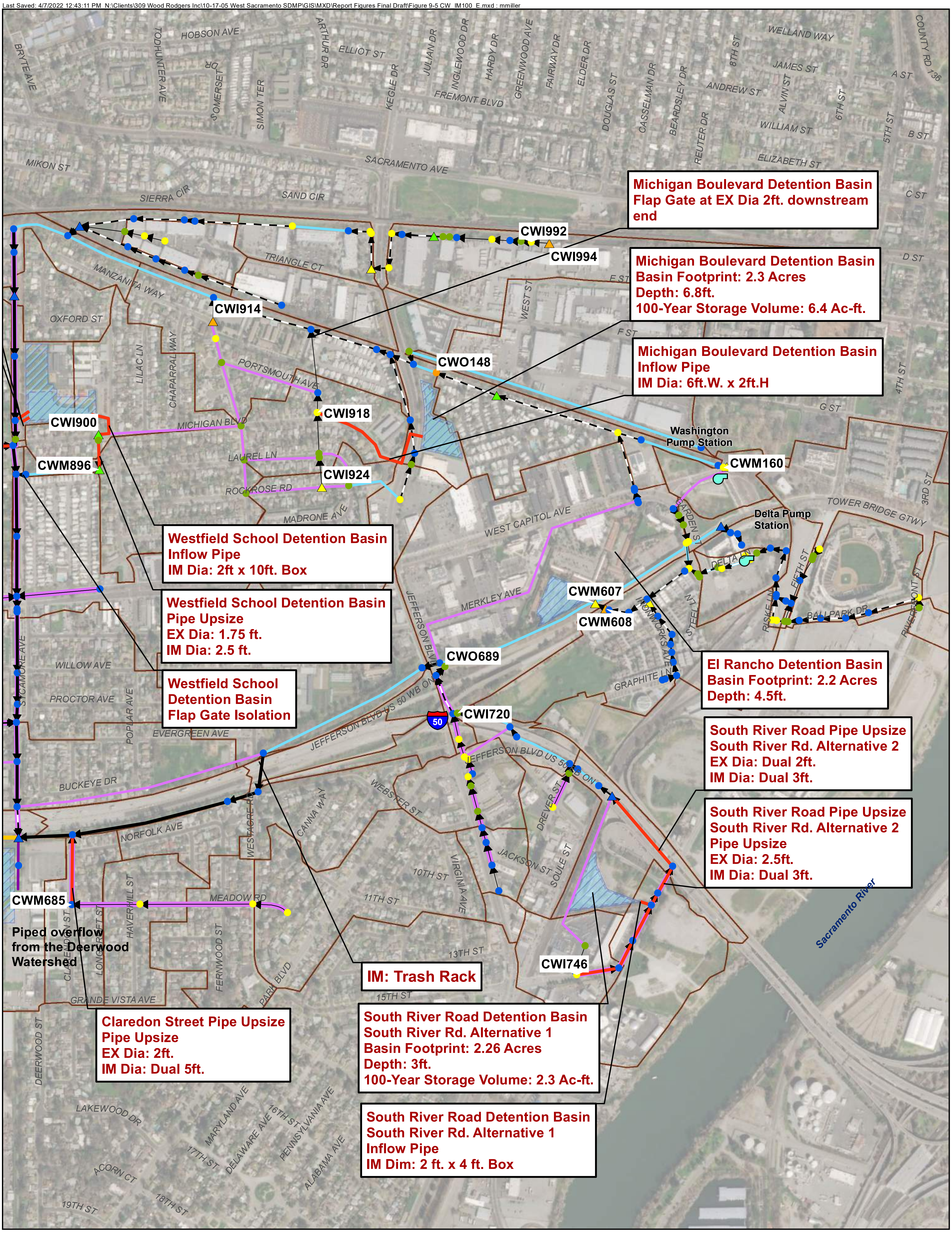
Last Saved: 4/7/2022 12:43:11 PM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure 9-5 CW_IM100_E.mxd : mmiller



Existing Components

- Pump
- Subshed
- Inter-Watershed Flow
- Overland Flow
- Open Channel Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Model Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Storage Node - Flood Depth (feet)

- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Proposed Projects

- Pipe Upsize Project
- Open Channel with Weir
- 5-Year Storm Inundation Area
- Detention Basin Footprint

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.
2. The proposed improvement projects meet the performance criteria of 100-year, 24-hour flood depth at or below pad elevation.
3. Improvement project diameters have been added to the plan as "ADD IM Dia:" The existing trunk line diameters are labeled as "EX Dia:".

0 500 1,000
Scale in Feet

Figure 9-5
Causeway and Racetrack Watershed (East) Improvement Projects

100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

WEST YOST ASSOCIATES

CITY OF WEST SACRAMENTO

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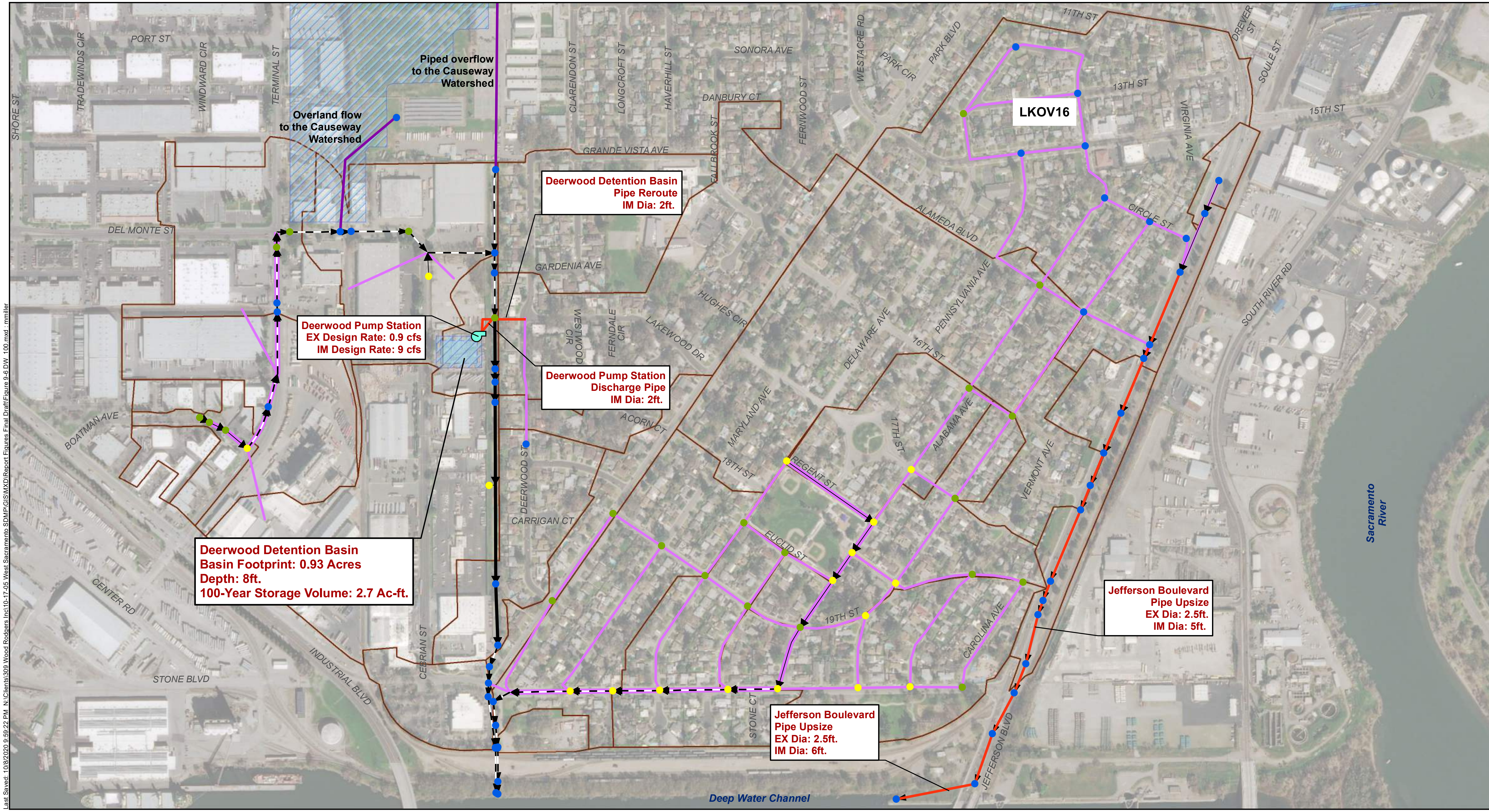

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Existing Components
- Pump
- Subshed
- Inter-Watershed Flow
- Overland Flow
- Conduit and Overland Flow
- Conduit - 21-inch to 30-inch
- Conduit - 30-inch to 54-inch
- Conduit - Greater than 54-inch

Proposed Projects
- Pipe Upsize Project
- Detention Basin Footprint
- 5-Year Storm Inundation Area

Storage Node - Flood Depth (feet)
- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Model Node - Flood Depth (feet)
- No Flooding
- 0.0 - 0.6
- 0.6 - 1.6
- 1.6 - 3.0
- 3.0 - 4.1

Notes:
1. 0.6-foot represents the approximate flood depth contained within the public right-of-way for a typical street section.
2. The proposed improvement projects meet the performance criteria of 100-year, 24-hour flood depth at or below pad elevation.
3. Improvement project diameters have been added to the plan as "ADD IM Dia:" The existing trunk line diameters are labeled as "EX Dia:".

N

0 250 500
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 9-6
Deerwood and Lock Watershed Improvement Projects

100-Year Storm

City of West Sacramento
Storm Drainage/Storm Water Master Plan Update

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10.0 CONDITION ASSESSMENT

10.1 Condition Assessment Overview

The condition assessment included evaluation of three facility types within the City's drainage system: manholes, drainage channels, and pump stations. Site visits were conducted to perform visual inspections of selected assets. This section provides descriptions of the condition assessment methodology and results for each of the three facility types inspected.

10.2 Condition Assessment Approach and Findings

10.2.1 Manhole Condition Assessments

The Wood Rodgers and West Yost team conducted site visits of 147 manholes (of approximately 1,782 manholes in the trunk line system) between September 11, 2017 and October 5, 2017. The number and location of manholes were chosen to provide a representative sample of manhole condition. The evaluations were conducted by a condition assessment team that included City O&M staff and at least one engineer from West Yost or Wood Rodgers. Condition assessments included visual observations and documentation of the existing manhole physical condition in accordance with the National Association of Sewer Service Companies (NASSCO) Level 1 Manhole Assessment Certification Program (MACP) protocol. Level 1 inspections are conducted from the surface (avoiding confined space entry into the manhole) and are intended to evaluate the general condition of a manhole based upon what is visible from the surface. Each of the components inside the manhole, labeled on **Figure 10-1**, was assigned a condition rating for a MACP Level 1 criteria. Descriptions of the various condition ratings are as follows:

- Sound – No visible defects observed.
- Defective – visible defects observed other than the specific issues identified by other ratings (corroded or cracked, for example).
- Broken – Broken and in loose pieces observed.
- Corroded – Component shows signs of corrosion; surface is so corroded or pitted, it cannot seal/seat/function properly.
- Cracked – Component is cracked or fractured, but still in one piece.
- Missing (or Not Present) – Component is misplaced, not in the vicinity of the manhole, or in the bottom of the manhole and was not retrieved. It could also indicate that a component was not present in a manhole, such as a manhole that doesn't have a bench.

The specific issues observed at each given manhole can be determined by reviewing the completed manhole inspection forms that are provided in **Appendix F**. In addition to the visual inspection, scratch tests were performed to assess the condition of the manhole concrete. For this test, the inspector used a hard metal object, such as a manhole cover hook or hammer, to assess the hardness of the concrete. If the concrete is in good condition, no concrete or aggregate should be removed when scratching the surface of the manhole. If the concrete is in fair condition, some concrete may be scratched off. If the concrete is in poor condition, larger pieces of aggregate or the concrete may crumble when scratched. The inspection teams assigned a rating to the concrete based on the scratch test results using the following scale:

1 - Good, 2 - Fair, or 3 - Poor.

During the inspections, photographs were taken and any visible inventory information (e.g., size, material, etc.) was gathered. The specific data that was collected at each manhole was documented in a standardized form. The completed forms for the inspected manholes are provided in Appendix F.

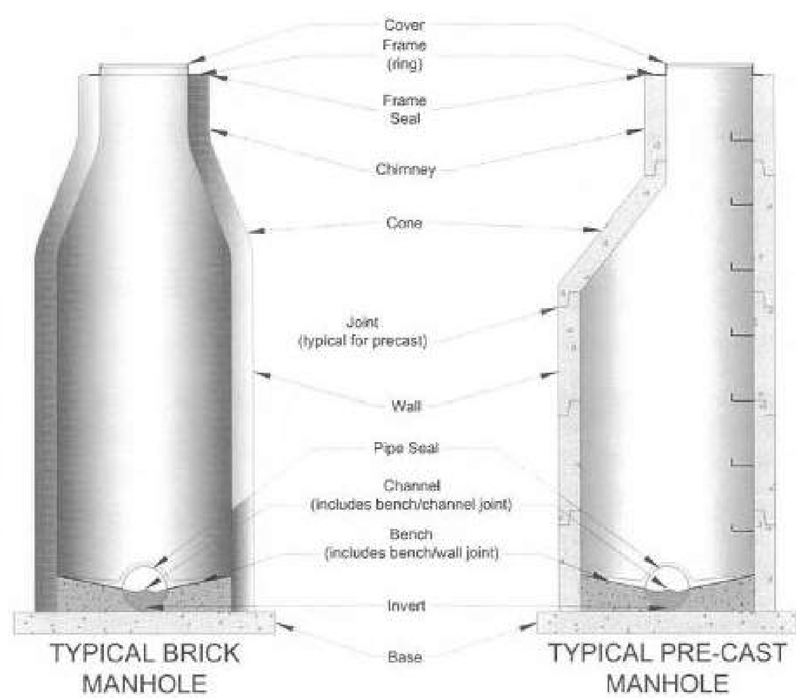

Figure 10-1 – Typical Manhole Diagram

Table 10.1 (below) provides a summary of the overall findings from the manhole inspections. Manholes classified as “Missing (or Not Present)” were due to inaccessibility of manhole, a component was missing, or the reviewer was unable to make a determination for another reason. For instance, manholes without a bench were classified as “Missing (or Not Present).”

Table 10.1 – Summary of Manhole Condition Findings							
Condition Finding	**Condition Rating by Component**						
	Cover	**Ring**	**Frame**	**Bench**	**Wall**	**Cone**	**Chimney**
Sound	144	122	146	91	135	131	132
Missing (or Not Present)	0	25	0	55	5	13	2
Defective	-	-	-	1	7	3	13
Broken	0	0	1	-	-	-	-
Corroded	2	0	0	-	-	-	-
Cracked	1	0	0	-	-	-	-
Total Ratings	**147**	**147**	**147**	**147**	**147**	**147**	**147**

As indicated in the table, the manholes reviewed during this study are in relatively good condition. A large majority of the manholes were found to be in good condition with no observed defects or condition issues. Of the 147 manholes reviewed, 23 were found to have at least one component that was defective or in poor condition. Thirteen were found to have defective chimneys, seven were found to have defective walls and a handful of issues related to the manhole cover, ring, or frame were observed.

The results of the concrete scratch tests are summarized in **Table 10.2**. As indicated, at six manholes, the scratch test revealed that the concrete is in fair condition while at the remaining 141 manholes, it is in good condition. No serious issues with the concrete conditions were observed at any of the manholes.

Table 10.2 – Summary of Manhole Scratch Tests at Manholes	
Concrete Condition Rating	**Total**
Good	141
Fair	6
Total	**147**

The results of the manhole condition assessment review are presented on **Figure 10-2**, which shows each manhole that was assessed and provides a summary of the findings at each. **Table 10.3** lists each of the eight manholes that were found to have at least one deficiency. These manholes can be seen on Figure 10-2.

Table 10.3 – Summary of Manholes Defects and Recommended Repairs

WSID (GIS ID)	Defect Description	Recommended Action	Project ID	Estimated Cost to Correct
North Basin Manholes				
730	Cracked cover	Replace cover.	M-M1	$500
810	Moisture barrier at frame/chimney failing	Replace the frame and chimney.	M-M2	$5,000
837	Cracked wall	Monitor. Replace if concrete begins to fail.	-	-
857	Minor cracking in bench	Minor issue. Monitor and repair if concrete begins to fail.	-	-
868	Surface scoring, visible aggregate on lower manhole wall.	Monitor and replace manhole if conditions worsen.	-	-
20877	Poorly-formed concrete. Exposed aggregate and rebar.	Reconstruct manhole.	M-M3	$7,500
25546	Wood forming exposed in chimney	Reconstruct frame and chimney.	M-M4	$5,000
South Basin Manholes				
406	Cracked frame	Replace the frame and chimney		$5,000

The manhole repairs are included in the Improvement Plan that is presented in Section 11. Prioritization of improvements are provided in that section.

10.3 Drainage Channel Condition Assessments

West Yost and Wood Rodgers conducted site visits of the major channels and ditches that convey runoff from the City's trunk drainage system. Site visits were conducted between the fall of 2017 and summer of 2018. For these assessments, staff visited key sections of the channels and reviewed photographs collected during land surveying activities. Staff also recorded visual observations of areas of erosion, sedimentation, areas of heavy vegetation, or any other issues that could affect capacity or function of the channels. The conditions of major channel culverts were also observed and recorded. Numerous photos were taken during the field review, and some are presented in this section. All the photos are provided in **Appendix G**, which also includes an index figure that shows the photo locations and the names of the image files.

10.3.1 North Basin Channel Conditions

The channels assessed in the North Basin are shown on **Figure 10-3** and the findings for each of these channels is summarized below. Overall, the channels in the North Basin are in good condition and few significant problems were observed.

Causeway Channel

The Causeway Channel is a backbone channel within the Causeway/Racetrack Watershed. The channel generally conveys runoff from east to west and ultimately drains to the Causeway Pump Station, which pumps runoff into the Yolo Bypass. The upper reach of this vegetated earthen channel begins on the north side of Tower Bridge Gateway near the Delta Lane Pump Station (see Figure 10-3). The channel continues along the north side of Tower Bridge Gateway and I-80 until reaching Westacre Road. At this location, runoff enters a 7-foot by 7-foot concrete box culvert that conveys runoff to the south and under the freeway. Runoff is then conveyed west in multiple large diameter pipes/culverts for approximately 1.3 miles to the lower reach of the Causeway Channel. The lower reach of the Causeway Channel begins west of Freeboard Drive. This vegetated earth channel continues along the south side of the freeway for approximately 3,400 feet where the channel significantly widens. This wider reach of the channel, which is a remnant of Lake Washington, continues west for almost a mile before reaching the Causeway Pump Station. The lower reach of the Causeway Channel is typically partially full of water and the conditions of the channel bottom could not be observed.

No significant condition issues were noted along this channel. There were no areas of observed erosion, and the only location where sediment accumulation was observed was at the culvert under Jefferson Boulevard. However, the sediment accumulation at this location was classified as minor and not significant enough to warrant action beyond normal maintenance.

One known issue along this channel was identified by RD 900 staff. As described above, the Causeway Channel crosses from north to south under I-80 in a 7-foot by 7-foot concrete box culvert near Westacre Road. The upstream end of the culvert (north side of freeway) does not have a trash/access control rack, which has caused repeated problems for RD 900. Although the culvert is owned by Caltrans, the drainage system downstream (and upstream) is owned and operated by RD 900. Because the Caltrans culvert has no access control, large items can be washed into the culvert which typically end up lodged in the RD 900 system downstream. In addition, people have repeatedly entered the drainage system at this junction and left trash and other bulky items behind that ultimately wash downstream during a storm event and restrict or plug the RD 900 system. It is recommended that a trash/access control rack be installed on the upstream side of the culvert. However, because this is a Caltrans facility, the City will need to coordinate with Caltrans and RD 900 to get this solution implemented.

<u>Racetrack Channel and Racetrack/Causeway Connector Channel</u>

The Racetrack Channel is the second major drainage channel serving the Causeway/Racetrack Watershed. The Racetrack Channel begins on the south side of the UPRR tracks, west of the Sycamore Trail. The channel conveys runoff from east to west, ultimately discharging to the Racetrack Pump Station. The Racetrack Pump Station only operates during large storms when the flood flows exceed the capacity of the Causeway Pump Station. Because of this, for most storms, runoff from the Racetrack Channel is conveyed past the Racetrack Pump Station to the Causeway Channel in the Racetrack/Causeway Connector Channel. As shown on Figure 10-3, this channel extends approximately 1,500 feet to the south of the Racetrack Pump Station, crossing West Capitol Avenue (two 36-inch corrugate metal pipes) and I-80 (6-foot by 8.5-foot concrete box culvert) before reaching the Causeway Channel.

No areas of significant erosion or sediment accumulation were observed along either the Racetrack Channel or the Connector Channel. One issue was noted at the culvert at West Capitol Avenue. The culvert headwall on the downstream (south) side of the road has started to collapse as shown in **Photo 10-1**. As seen in the photo, it appears that the headwall is leaning against metal fence posts, which may be preventing a complete collapse. It is recommended that this headwall be reconstructed. However, as discussed previously, potential flooding issues were identified in the Causeway/Racetrack Watershed and three alternative solutions were developed to address the flooding. Causeway/Racetrack Alternatives 1 and 3 both include increased pumping capacity at the Racetrack Pump Station. For these two alternatives to function correctly, the culvert under West Capitol Avenue needs to be replaced with larger culverts. Thus, for those two alternatives, reconstruction of the failing headwall will occur as part of the culvert replacement. Causeway/Racetrack Alternative 2 relies primarily on creation of detention storage in the lower part of the watershed. For this alternative, no improvements are recommended to the culvert under West Capitol Avenue; therefore, if this alternative is selected, reconstruction of the failing headwall will be required.

Photo 10-1 Racetrack/Causeway Connector Channel – Failing Headwall at West Capitol Avenue

<u>Washington Channel</u>

The Washington Channel conveys runoff in the upper end of the Causeway/Racetrack Watershed. This excavated earth channel begins near the Washington Pump Station located at the West Capitol Avenue underpass at the UPRR, just west of 5th Street. The channel continues west along the south side of the railroad tracks to the Sycamore Trail. RD 900 has noted a high point in the existing channel downstream of the Washington Pump Station that causes water to backwater and pond to the pump station. Regrading of the channel could offer an improvement to conveyance. At that location, runoff is collected into an underground trunk pipe, as shown in **Photo 10-2**.

The channel conditions were found to be generally good with no observed areas of erosion, sedimentation, or excessive vegetation. Culverts along the channel also appeared to be in good condition.

Photo 10-2 Washington Channel – Entrance to Sycamore Trail Trunk Pipe

<u>RD 537/RD 811 Channel</u>

The RD 537/RD 811 Channel is the primary drainage facility for the RD 537/RD 811 Watershed. The channel begins just upstream of Jefferson Boulevard, north of the UPRR tracks. The channel continues west along the north side of the UPRR for approximately 2.3 miles to the west edge of the City limits, where it turns to the north. The channel continues north, parallel to the Yolo Bypass levee, for just over one mile to the RD 537/RD 811 Pump Station. This excavated earth channel has a uniform trapezoid shape for most of its length. At Jefferson Boulevard, the channel is lined with concrete upstream and downstream of the road culvert. Standing water was observed in the bottom of the channel from the RD 537/RD 811 Pump Station upstream beyond Harbor Boulevard (See **Photo 10-3**). According to City staff, the channel is not pumped dry due to the pump submergence requirements. Hydraulically, this is not a problem and does not compromise the capacity of the channel.

Photo 10-3 RD 537/RD 811 Channel - Standing Water Downstream of Harbor Boulevard

No areas of significant erosion were observed; however, mild sediment accumulation and heavy vegetation was observed in the vicinity of the Jefferson Boulevard culvert, as shown on **Photo 10-4**. This is not a major problem, but it is recommended that the channel be cleared of vegetation and sediment upstream and downstream of the Jefferson Boulevard in order to promote hydraulic efficiency at this culvert.

Photo 10-4 RD 537/RD 811 Channel – Heavy vegetation and mild sedimentation were observed upstream of Jefferson Boulevard

10.3.2 South Basin Channel Conditions

The conditions of the drainage channels within the South Basin were generally very good at the time of inspection in 2017. The channels that were inspected are shown on **Figure 10-4**, and the findings are discussed below.

Main Drain Channel

The Main Drain Channel flows from the Gateway/Stonegate detention basin outfall under the intersection of Jefferson Boulevard and Lake Washington Boulevard, two pedestrian bridges, Marshall Road, and back under Jefferson Boulevard twice, before ending at the Main Drain Pump Station. The Main Drain channel is the backbone of the South Basin drainage system, with several tributary channels as described below. Observations indicate a reasonably well-maintained channel cross section with minimal vegetative obstruction and negligible signs of bank erosion.

Minor signs of erosion were noted at various locations along the channel. The high turbidity of the water in the channel that was present during field visits indicated that some fine sediments were suspended within the channel. It is uncertain if the turbidity was due to temporary entrainment of fine channel bed sediments or was due to rainfall carrying fine particles from open fields that drain into the channel system. Some minor degradation of the channel cross sections was observed with some minor bank sloughing, as shown on **Photo 10-5**. Some minor exposure of soil is also noted along the top edge of a concrete slab at the Larchmont Pump Station, opposite of the discharge pipes as shown on **Photo 10-6**. There does not appear to be any imminent failure of the concrete slab, although if undermining of the slab continues, the slab could settle and potentially break (allowing additional flow beneath the slab). This condition may be the result of the liner not having enough height to fully dissipate the energy of the Larchmont Pump Station discharge. Additional rock placed above the slab would help alleviate this condition.

Photo 10-5 Main Drain Channel – Minor Bank Degradation

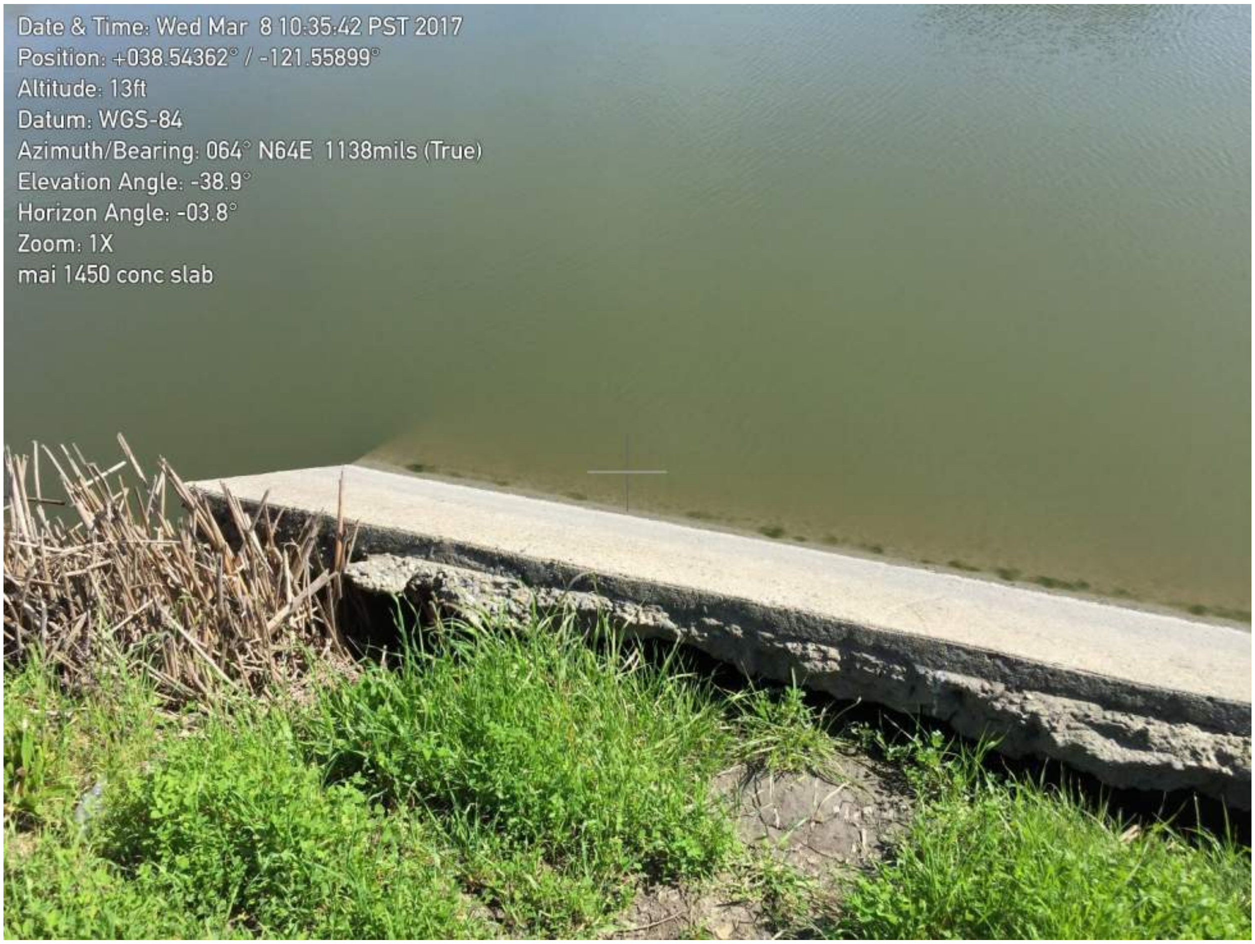

Photo 10-6 Main Drain Channel – Undermining at Concrete Slab near Larchmont Pump Station Outfall

Southport Industrial Park (SIP) Parkway Channel

The SIP Parkway Channel was constructed in the 1990s and is located within the South Basin area. The channel drains the northwestern portion of the South Basin into the dedicated detention basin and pump station for the Industrial Park/Bridgeway Island watershed. The upstream end of the channel is near the intersection of Ramco Street and Southport Parkway, which parallels the channel. Because it was constructed relatively recently, the channel cross section is very uniform and in very good shape. Most of the channel banks are covered with low-lying grasses. There is a minor amount of taller volunteer vegetation along both banks at the water line of the channel because water was present in the channel during the field visits. The northwest bank of the channel appears to be kept free of obstructive vegetation, such as shrubs and trees within the channel, by current maintenance operations. Only intermittent shrubs are present at the right (facing downstream) bank. At the left bank, closest to Southport Parkway, intermittent small trees have been planted along the upper bank to create a landscaped buffer for the industrial properties adjacent to Southport Parkway. These trees appear well maintained, with only trunks and a few evergreen trees within the high-water portion of the channel geometry. These landscaped areas were accounted for in the channel sizing analysis and do not create a significant hydraulic obstruction.

Near the channel crossings (culverts), the channel is generally clear of obstructive vegetation with hydraulic openings able to flow freely and no signs of erosion. An example of the channel and vegetative conditions is shown on **Photo 10-7**.

Photo 10-7 SIP Parkway Channel – Typical Vegetation Conditions

Morton Blacker Canal

The Morton Blacker Canal flows from the Clarksburg Branch Line Trail (CBLT) westward to the Main Drain, and crosses under Jefferson Boulevard and Linden Road. While this channel is smaller than the Main Drain, the channel conditions were very similar to those of the Main Drain, with no significant obstructions or erosion. The channel section between the CBLT and Jefferson Boulevard cannot be accessed due to a lack of maintenance easement, which should be acquired to ensure future capacity. Between the Jefferson Boulevard and Linden Road crossings there are some voluntary trees that have been allowed to grow over the years in the high bank areas and that give the channel a more natural appearance. If these trees are kept reasonably trimmed/pruned, they should not pose a significant obstruction to flow. An example of these channel conditions is shown on **Photo 10-8**. RD 900 has noted that the section just west of the Linden Road crossing has slowly become wider and shallower. Available maintenance space is not adequate for regular maintenance activities. It is assumed that clearing and dredging the channel will allow for better maintenance in the future within the existing right-of-way.

Photo 10-8 Morton Blacker Canal – Typical Conditions

<u>Tapley Drain</u>

The Tapley Drain also flows from the Clarksburg Trail into the Main Drain, flowing along Tapley Road and under Partridge Avenue, Gregory Avenue and Jefferson Boulevard, approximately three-quarters of a mile south of the Blacker Morton Drain. There was some minor accumulation of vegetation and floating vegetative debris observed on the upstream side of the Jefferson Boulevard crossing. The downstream portion of the crossing appears very clean. Normal clearing and cleaning should eliminate any significant obstruction in the future. At the Gregory Avenue crossing, the culvert has been recently cleared and armored with grouted rock slope protection. In 2017, the right (facing downstream) bank of the channel upstream of the crossing had some heavy vegetation (shrubs) that could encroach the channel if left unmaintained. Since initial site visits were performed in 2017, the right bank has been significantly pruned (as publicly viewable on Google Earth Street View photographs) preserving the channel capacity.

The crossing at Partridge Avenue appears to be unobstructed and, according to the City, was recently replaced after the time of inspection. Upstream of Partridge Avenue the channel is smaller, acting as a roadside ditch along Tapley Road, which has rural residential development along both sides. There are more trees in this upper reach, and there are driveway crossings. The stretch of the channel should be cleared of vegetation within the channel prism regularly to prevent accumulation of leaf litter and small branches over time, as shown on **Photo 10-9**.

Photo 10-9 Tapley Drain – Typical Conditions Upstream of Partridge Avenue

Clarksburg Branch Line Trail (CBLT) Channel

The Clarksburg Branch Line Trail Channel parallels the CBLT, which is a reclaimed railroad alignment. This channel drains all land to the east of the CBLT and discharges into the Morton Blacker Canal, the Tapley Drain, and the Bevan Road Drain, all of which drain into the Main Drain. Portions of this channel flow north and portions flow south, depending upon the proximity to their discharge into the three channels. As this channel currently drains mostly undeveloped properties, it has the most opportunity for accumulating vegetation and debris. There do not appear to be any significant trees and shrubs along the channel banks north of Davis Road, but there does appear to be a moderate accumulation of floating grasses and vegetation at the connection to the Blacker Morton Drain, as shown on **Photo 10-10**. The bar rack installed across the opening is intended to capture most of this floating debris. It is assumed that this bar rack is operated by a private property owner who will suffer higher flooding on their agricultural property if it is allowed to clog. Downstream assessments have assumed no clogging. Upgrading this facility provides no benefit to the City in the interim condition. South of Davis Road there are more trees adjacent to the channel that are mostly associated with existing rural development along the south side of Davis Road.

Photo 10-10 Clarksburg Trail Channel – Debris near Confluence with Blacker Morton Drain

Toe Drain

The Toe Drain channel collects limited drainage along the western boundary of the South Basin at the landside toe of the eastern levee of the DWSC. At one time, the Toe Drain connected the Main Drain Pump Station and the Industrial Park Pump Station systems and currently serves as an emergency connection in the case of catastrophic failure of one of the pump stations. This connectivity still exists via manually-operated gated pipes. Most of the land north of Marshall Road drains via storm drains into the Industrial Park detention basin, without using the Toe Drain. South of Marshall Road, the Bridgeway Lakes development flows through storm drains into the internal lake system, discharging into a dedicated channel that flows separately into the Main Drain. There are two gated culverts that connect the internal Bridgeway Lakes drainage channel to the Toe Drain, and they were open during the 2017 site visit. Thus, the Toe Drain is currently connected as a secondary outlet to the Main Drain. **Photo 10-11** shows the channel to be well maintained at the time of observation.

Photo 10-11. Toe Drain – Typical Conditions

10.3.3 Recommended Channel Maintenance Projects

Based on the condition assessment reviews, several maintenance projects are recommended as described below in **Table 10.4**.

Table 10.4 – Summary of Recommended Channel Maintenance Projects				
Channel	**Description of Issue**	**Recommended Action**	**Project ID**	**Estimated Cost to Correct**
Causeway – Upper	Upstream end of 7'x7' box culvert lacks a trash rack.	Caltrans owns box culvert and RD 900 owns/operations channel. City to coordinate with Caltrans and RD 900 to get rack installed.	M-C1	$10,000
Racetrack/Causeway Connector	Headwall on south side of West Capitol Avenue is failing.	Solution dependent on Causeway/ Racetrack flood solution that is implemented: Alt. 1 and 3: New headwall to be constructed with culvert replacement (increased capacity) Alt 2: Remove and replace headwall	M-C2	$40,000
RD 811/RD 537	Heavy vegetation at Jefferson Blvd. culvert	Clear vegetation	M-C3	$1,000

The channel maintenance repairs listed in Table 10.4 are included in the Improvement Plan that is presented in Section 11. Prioritization of recommended improvements are provided in that section.

10.4 Pump Station Condition Assessment

There are numerous drainage pump stations serving the City of West Sacramento and all are owned/maintained by the City or by RD 900. The City owns and operates nine pump stations located in the North Basin. West Yost conducted site visits to eight of those pump stations on April 20 and 21, 2017. The City's Delta Lane Pump Station was not assessed due to its relatively recent construction. The other pump stations, mostly in the South Basin, are owned, operated, and maintained by RD 900. At the time the condition assessments were performed, the City did not have maintenance responsibilities for the RD 900 pump stations and, therefore, they were not inspected under this study. With the new organizational structure between the City and RD 900, these pump stations may need to be re-evaluated.

The condition assessments were conducted by a team that included a City pump station operator, an engineer from West Yost, and an Electrical Engineer from Frisch Engineering. The locations of the pump stations that were assessed are shown on **Figure 10-5**. **Table 10.5** provides an overview of each of the eight City-owned pump stations that were assessed.

Table 10.5 – Pump Station Condition Assessments - Summary of Pump Stations Evaluated

Pump Station	Original Construction Date	Pump Number	Pump Type	Pump Horse-power	Pump Capacity (cfs)	Backup Generator?	Notes
5th Street	1987	1	Vertical Turbine	5	1	No	Roadway underpass pump. Capacity estimated based on field observations and City staff input.
Deerwood	1960	1	Submersible	2 to 5	1	No	Roadway underpass pump. Capacity estimated based on field observations and City staff input.
Harbor	1995	1	Centrifugal	3	1	No	Roadway underpass pump. Capacity estimated based on field observations and City staff input.
Jefferson	1985	1	Submersible	3	1	No	Roadway underpass pump. Capacity estimated based on field observations and City staff input.
Lighthouse	1991	1	Vertical Turbine	20	3	Yes	Standby unit.
		2	Vertical Turbine	200	31		
		3	Vertical Turbine	200	31		
		4	Vertical Turbine	450	70		
		5	Vertical Turbine	450	70		

Pump Station	Original Construction Date	Pump Number	Pump Type	Pump Horse-power	Pump Capacity (cfs)	Backup Generator?	Notes
Table 10.5 – Pump Station Condition Assessments - Summary of Pump Stations Evaluated							
Raley	1988	1	Vertical Turbine	100	31	No	
		2	Vertical Turbine	100	31		
		3	Vertical Turbine	250	38		
		4	Vertical Turbine	250	38		
RD 811/ RD 537	1950	1	Vertical Turbine	300	84	No	
		2	Vertical Turbine	300	84		
		3	Vertical Turbine	300	84		
		4	Vertical Turbine	250	67		
		5	Vertical Turbine	200	67		
Washington	1930	1	Vertical Turbine	5	1	No	Roadway underpass pump. Capacity estimated based on field observations and City staff input.
		2	Vertical Turbine	5	1		

The condition assessments included visual observations and documentation of the existing pump stations' physical conditions. The ranking index described in **Table 10.6** was used to rate the condition and performance of the mechanical, civil, structural, electrical and instrumentation components of the pump stations based on external observations. Photographic documentation was taken and visible inventory information (e.g., manufacturer, model number, size, etc.) was obtained. A total of 209 individual components were documented and assessed at the eight pump stations.

Table 10.6 – Condition and Performance Rating Index		
Score	**Condition Rating**	**Performance Rating**
1	Excellent	Component functioning as intended
2	Slight visible degradation	In service, but higher than expected O&M costs
3	Visible degradation	In service, but function is impaired
4	Integrity of component moderately compromised	In service, but function is highly impaired
5	Integrity of component severely compromised	Component is not functioning as intended

Information collected was documented on a customized Pump Station Condition Assessment Form. The detailed results of the condition assessment for each pump station are included in Appendices 10C, 10D, and 10E, which also include the following items:

- **Appendix H** - Pump Station Inspection Forms – These forms were completed during the field reviews. These forms include descriptions of individual pump station assets, photos, estimates of remaining useful life, and ratings for condition and performance.
- **Appendix I** - Pump Station Asset Registry – This includes a list of each major pump station component at the assessed pump stations. The purchase year of each component is listed with the estimated replacement cost. This information is provided in printed form in Appendix H and is also available in a MS Access Database.
- **Appendix J** - Component Risk Assessment Results – This appendix lists the assessed components at each pump station and provides the risk assessment results for them. This includes the assigned likelihood of failure scores and the consequence of failure scores.

A summary of the pump station condition assessment evaluation approach and findings is provided below.

10.4.1 Pump Station Condition Assessment Summary

A summary of the condition and performance results is provided in **Table 10.7**. The table lists combined findings for all the components (209 total) at the eight pump stations. Each reviewed component was assigned a condition score and a performance score, and Table 10-7 lists the number of components found for each possible rating combination of condition and performance. As indicated in the table, the conditions of the components were generally good, with 67 percent of the components found to be in excellent condition or with only slight visible degradation and no significant issues with performance. Another 30 percent of the components were found to have visible degradation but more than half of those were still found to be performing effectively. Only two components (1 percent of total) were found to have significant condition issues.

Table 10.7 – Pump Station Condition Assessment Summary

		Performance Assessment Score					
Number of Assets		(1) Component functioning as intended	(2) In service but higher than expected O&M costs	(3) In service but function is impaired	(4) In service but function is highly impaired	(5) Component is not functioning as intended	Percent of Total Assets
Condition Assessment Score	(1) Excellent	43	3	-	-	-	22%
	(2) Slight visible degradation	94	4	-	-	-	47%
	(3) Visible degradation	34	2	23	-	4	30%
	(4) Integrity of component moderately compromised	-	-	-	-	-	0%
	(5) Integrity of component severely compromised	-	-	-	-	2	1%
Percent of Total Assets		**82%**	**4%**	**11%**	**0%**	**3%**	**100%**

10.5 Pump Station Risk Assessment

The discussion above provides an overview of the conditions of individual pump station components that were assessed, but does not provide specific information that can be used by the City to identify and prioritize corrective maintenance actions. A risk assessment was performed to provide more specific recommendations based on the criticality of the identified deficiencies. This section discusses the methodology used to assess the risk of the City's pump station assets and summarizes the risk assessment results. The risk assessment identifies which assets and pump stations present the highest risk to the City and allows repair or rehabilitation efforts to be prioritized.

10.5.1 Methodology

This risk assessment considers the likelihood of failure and the consequence of failure of each individual pump station component. The likelihood of failure assesses the probability that a failure will occur, and the consequence of failure considers the impact a component's failure may have on the level of service provided by the drainage system.

Each component is assigned a rating on both metrics (likelihood of failure and consequence of failure) as shown on **Figure 10-6** to determine the component's overall risk. The aggregate risk of these individual components determines the likelihood of failure for each pump station facility. Combined with the consequence of failure for each pump station facility, a final facility risk is calculated that represents the facility's criticality within the system.

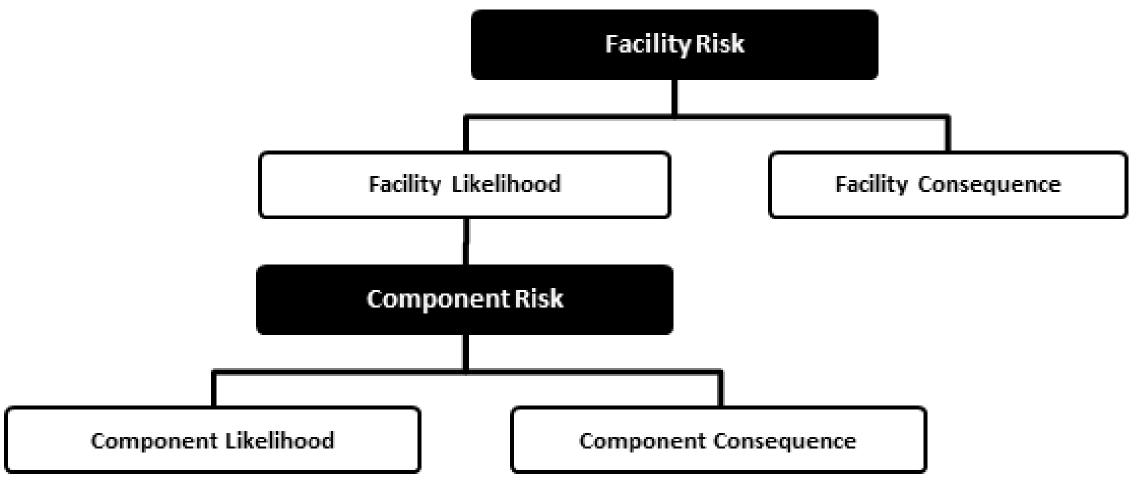

Figure 10-6 – Facility Risk Assessment Methodology

10.5.2 Component Risk Levels

The risk for each pump station component was evaluated based on the likelihood and consequence of failure of the component. This section summarizes the analysis.

Likelihood of Component Failure Analysis

The likelihood of component failure analysis considers the probability that a failure will occur in a given component. For this analysis, a failure is defined by the component's inability to work as intended or as needed in its application. Failure modes include physical mortality (complete failure) and level of service failure (reduced performance level). **Table 10.8** describes the factors considered in determining the estimated likelihood of a failure.

Table 10.8 – Likelihood of Component Failure - Criteria		
Failure Mode	**Criteria/Factor**	**Description**
Physical Mortality	Percent of Remaining Useful Life (RUL)	The percent of useful life remaining considers that older assets are more likely to fail than newer ones due to the age of materials and wear from repeated use. The percent of useful life remaining was determined by comparing the number of remaining years estimated during the field assessments to the industry standard lifetime for each asset.
	Condition Rating	An asset with visible degradation is more likely to fail. While condition and age are often dependent, newer components may be in poor condition due to environmental conditions or improper maintenance.
Level of Service	Performance Rating	Impaired function of assets can cause higher O&M costs or the reduced ability of the facility to meet system demands. An asset's performance may affect the level of service provided by the facility, depending on the asset's role in day-to-day operations.

Likelihood of failure is rated on a five-point scale, with five indicating the highest likelihood of failure. Each component is evaluated for each failure mode and an overall likelihood of failure ranking is determined. The factors and their range of potential ratings for each category are summarized in **Table 10.9**, for a given asset. For the various scores indicated in Table 10.9, the maximum rating for each failure mode is dependent on the weight, so that for a pump station component, the aggregated score would range from 1 to 5.

Table 10.9 – Likelihood of Failure (LOF) Rating Factors								
Failure Mode	**Weight**	**Factor**	**Rating (1 being the lowest, 5 being the highest)**					**Scoring Logic**
			1	**2**	**3**	**4**	**5**	
Physical Mortality	20%	Percent of Useful Life Remaining	≥ 70%	40% to 70%	10% to 40%	5% to 10%	≤ 5%	Rating based on weights
	40%	Condition Rating	Excellent	Slight Visible Degradation	Visible Degradation	Integrity Moderately Compromised	Integrity Severely Compromised	
Level of Service	40%	Performance Rating	Functioning as Intended	In Service but Higher than Expected O&M Costs	In Service but Function is Impaired	In Service but Function is Highly Impaired	Not Functioning as Intended	Single Rating

<u>Consequence of Failure Analysis</u>

The consequence of failure analysis considers the impact that a component failure may have on operation of the pump station as a whole and maintaining service reliability. For each category, one or more consequences are considered in determining the potential consequence of a failure. **Table 10.10** describes the criteria evaluated in considering a consequence of failure rating. Criteria used in the consequence of failure analysis, as listed in Table 10-10, were assigned to each component.

Table 10.10 – Consequence of Component Failure Criteria		
Category	**Criteria/Factor**	**Description**
Operating Ability	Functionality of Facility	Operating ability considers the functionality of the pump station if a component fails. Component failure will have a varying degree of impact on the ability of the station to pump stormwater depending on the role of the component and the configuration of the pump station. Component failure may lead to a lack of redundancy, reduced efficiency, or decreased ability/inability to convey wastewater.
Service Reliability	Repair/Replacement Difficulty	Reliability of service decreases as the time and/or resources required to repair or replace a component increase. An easy repair or replacement is defined as taking one person no more than one day to complete the task. A difficult repair or replacement would take more than one person and/or more than one day to complete. If the repair or replacement requires the facility to be taken offline, even for a short amount of time, this has an even greater service impact. If the component is obsolete, it is assumed that a partial redesign or programming of the controls would need to occur.

The consequences of failure were translated into numeric rankings of 1 to 5, with 5 indicating the highest or worst consequence. Each component reviewed at each of the assessed pump stations was evaluated for the categories described above, and an overall consequence of failure score was calculated. The factors and their potential ratings for each consequence are listed in **Table 10.11**. For a given component, for the various scores indicated in Table 10.11, the maximum rating for each failure mode is additive, so that for a pump station component, the aggregated score would range from 2 to 10.

Table 10.11 – Consequence of Component Failure Rating Factors							
Consequence	Factor	Rating (1 represents the least significant consequences due to failure, 5 represents the highest)					Scoring Logic
		1	2	3	4	5	
Operating Ability	Functionality of Facility	Operates Normally Without	Lack of Redundancy/ Potential Reduced Efficiency	Reduced Efficiency	Reduced Capacity/ Pressure	Cannot Operate Without	Single Factor
Service Reliability	Repair/ Replacement Difficulty	Easy <1 day of effort	Easy, but >1 day of effort	Some Difficulty	Very Difficult to repair/ access, or No Rating	Off-Line or Obsolete	Single Factor

Component Risk Assessment Results

A model was developed within an MS Access database to perform the risk assessment calculations. The aggregate score for consequence of failure ranges from 2 to 10 and for likelihood of failure, from 1 to 5. The model applies a series of algorithms to calculate total consequence and likelihood of failure scores for each reviewed pump station component.

By plotting the consequence of failure and the likelihood of failure scores against each other, an overall risk level was assigned to each component. **Table 10.12** shows the total number of components that fall into each likelihood and consequence of failure category. Risk levels are prioritized into one of five risk levels: Low Risk, Medium-Low Risk, Medium Risk, Medium-High Risk, or High Risk, each of which is color-coded in Table 10.12. The severity of each risk level is assigned to each potential rating using engineering judgment to determine which combinations of scores warrant the highest levels of concern.

Table 10.12 – Summary of Component Risk Levels							
Number of Components		Consequence of Failure Score					
		2-3	4	5	6-7	8-10	Total
Likelihood of Failure Score	1	25	1	10	5	-	**46**
	2	25	65	22	3	-	**118**
	3	-	12	16	17	2	**64**
	4	-	2	2	-	-	**4**
	5	-	-	-	2	-	**4**
	Total	**50**	**80**	**50**	**27**	**2**	**209**

*Risk: **Red** = High, **Orange** = Med-High, **Yellow** = Medium, **Light Green** = Med-Low, **Dark Green** = Low*

The risk assessment results are summarized in **Table 10.13**, which lists the total number of components that fall in each risk level. As seen in the table, 24 percent of the components were determined to be in the low or medium-low risk categories, 46 percent in the medium risk category, and 29 percent are in the medium-high risk and high-risk categories.

Table 10.13 – Summary of Component Risk Assessment Results		
Risk Level	No. of Components	% of Total
Low	25	12%
Medium-Low	26	12%
Medium	97	46%
Medium-High	57	27%
High	4	2%
Total	**209**	**100%**

10.5.3 Pump Station Facility Risk Levels

The discussion above is focused on the risk associated with the individual components that were assessed at each pump station. This information was then used to assess the overall risk for each pump station based on the likelihood and consequence of failure of the facility, as well as the combined risk level of the component assets within the facility. For this analysis, a failure is defined by the inability of a pump station to meet service demands. This section summarizes the analysis. The analysis of overall pump station risk is similar to the analysis for individual components but is focused on the pump stations as a whole based on consideration of the composite risks for the various components as determined above, plus additional pump station specific risk factors as discussed below.

Likelihood of Pump Station Failure Analysis

The likelihood of failure analysis for pump stations as a whole considers the probability that a failure will occur at a given pump station. Since the risk assessment for each component within each facility considers the likelihood that a failure will occur and its overall effect on the facility as a whole, the likelihood of a facility failure increases as the risk level of the components within it increase. For example, if a motor control center at a pump station received a high-risk rating because it is in poor condition and the pump station cannot operate without the motor control center, that pump station would have a higher likelihood of failure than another pump station that does not have any high-risk components.

The example given above is a simplified one. In this analysis, each pump station has components that have high-risk levels. Therefore, it is necessary to develop a statistical method to evaluate the risk levels of the components in each facility to compare them against each other. **Figure 10-7** shows the percentage of components in each facility at each risk level. The median risk level of each facility was compared to the median risk level of the total of all components in this evaluation. Facilities with median risk levels (shown as black dots on Figure 10-7) that fall above the line (which is equal to the median risk level of all of the components evaluated), are considered to be more likely to fail than those below the line since a greater percentage of the components in that facility are considered to be higher risk.

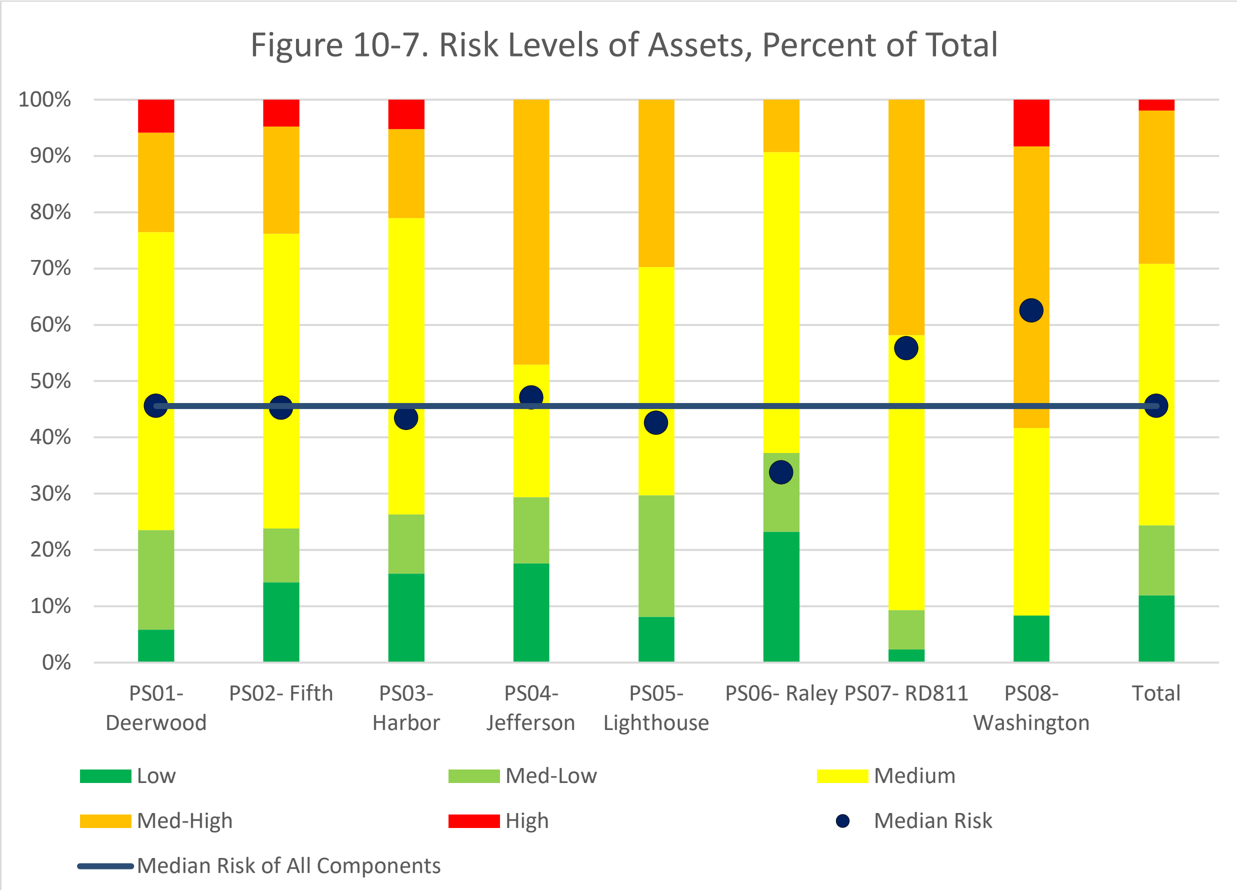

Figure 10-7 – Risk Levels of Assets, Percent of Total

Each facility is evaluated by calculating the deviation of the midpoint of the median risk level from the midpoint of the median risk level when all of the components evaluated are combined (shown on Figure 10-7 as "Total"). Likelihood of failure is rated on a one-to-five scale, with five indicating the highest likelihood and with the level of deviation scored as shown in **Table 10.14**. The key takeaway from Figure 10-7 is that the Washington and RD 811 Pump Stations are estimated to have the highest likelihood of failure and the Raley Pump Station the lowest.

Table 10.14 – Facility Likelihood of Failure Rating Factors

Failure Mode	Factor	Rating (1 being the lowest, 5 being the highest)					Scoring Logic
		1	2	3	4	5	
Component Failure	Deviation of Median Risk Level from the Median Risk Level of the Total of All Components	=> 9% below	3% to 8% below	4% above to 2% below	5 to 10% above	=> 11% above	Single Factor

Consequence of Failure Analysis

The consequence of failure considers the impact that a facility's failure may have on the level of service provided by the City's storm drainage system. This section describes the specific criteria and associated rating factors used in assigning consequence of failure scores to each facility.

Table 10.15 presents a summary of the factors used to assess each facility's consequence of failure.

Table 10.15 – Facility Consequence of Failure Criteria

Category	Criteria/Factor	Description
Criticality	Overflow/Flood Impact	The consequence of a pump station failure would be flooding of a certain area adjacent to the station. The magnitude of consequence depends on various factors: the area served by the station; the purpose of the station (some serve underpass sump pumps, while others serve an entire watershed); the type of flooding that would occur (local street flooding; emergency route flooding, local structure flooding, watershed-wide structure flooding, etc.); and the level and type of development in the flooded area. A rating was assigned to each station by using engineering judgement in each of these factors.

To assess the potential consequence of a reduced level of service or complete failure at a pump station, the data and results from the hydrologic and hydraulic models created for the capacity evaluations were reviewed. The rating method and scoring logic for each factor of the consequence of failure analysis is shown in **Table 10.16**. Each pump station is rated on a scale of 1 to 5 based on engineering judgement, with 5 having the most severe (highest) consequence. A low consequence of failure rating could be applied to a pump station that has a small tributary area and limited flooding area in the event of a failure, such as a roadway underpass pump. In this same example, if the road being served by the pump were designated as an emergency access route, then the consequence rating would increase. A high consequence of failure rating would be applied to a pump station that serves a large tributary area, and a failure would result in wide-spread structure flooding.

Table 10.16 – Consequence of Failure Rating Factors						
Factor	Rating (1 being the lowest, 5 being the highest)					Scoring Logic
	1	2	3	4	5	
Overflow/ Flood Impact	Low	Medium	-	Med-High	High	Single Rating

10.5.4 Facility Risk Assessment Results

An MS Access database model was used to perform the risk assessment calculations. The model applies a series of algorithms to calculate total consequence and likelihood of failure scores for each facility. By plotting the consequence of failure and the likelihood of failure scores against each other, an overall risk level was assigned to each facility. Risk levels increase as likelihood and consequence of failure increase as generally depicted in **Table 10.17**, with green indicating lowest risk and red indicating highest risk.

Table 10.17 – Pump Station Facility Risk Levels						
Facility		Consequence Score				
		1	2	3	4	5
Likelihood Score	1				Raley PS	
	2				Lighthouse PS	
	3	Fifth PS Jefferson PS	Deerwood PS			
	4					
	5	Washington PS	Harbor PS			RD 811/RD 537 PS

RISK: ***Red*** *= High,* ***Orange*** *= Med-High,* ***Yellow*** *= Medium,* ***Light Green*** *= Med-Low,* ***Dark Green*** *= Low*

The facilities were then ranked from highest risk to lowest risk and placed in an overall risk group, as shown below in **Table 10.18**. The RD 811/ RD 537 pump station is considered to have the highest overall risk for the possibility of failure (due largely to the age of the pump station) and for consequence of failure (because this pump station serves the largest watershed of all the City pump stations). Note that the rankings are not purely scored-based; engineering judgement is applied in deciding the final risk-level ranking. This can be seen with the relatively high ranking of the Washington Pump Station.

Table 10.18 – Summary of Facility Risk Assessment Results			
Facility Name	**Risk Score (COF x LOF)**	**Risk Level**	**Notes**
RD 811 / RD 537	25	High	
Harbor	10	High	
Deerwood	6	Med-High	Pump station proposed to be reconstructed at new location as IP project.
Washington	5	Med-High	
Lighthouse	8	Medium	
Raley	4	Medium	
Jefferson	3	Medium	Pump station proposed to be reconstructed as IP project.
Fifth Street	3	Medium	Pump station proposed to be reconstructed as IP project.

10.5.5 Recommended Pump Station Maintenance Projects

Based on the condition assessment evaluations, maintenance recommendations are provided for the pump stations below. A summary of the recommendations is provided in **Table 10.19** at the end of this section.

RD 811/RD 537 Pump Station

As indicated in Table 10.18, the RD 811/RD 537 pump station is estimated to have the highest risk level of all the assessed pumps. The rating is primarily due to the age of the facility and its importance in protecting the City from flooding (high consequence of failure score). However, no significant condition issues were identified during the review and, as a result, the highest likelihood of failure score for any component is 3, which indicates there may be some visible wear on the components (but they are functioning properly). Based on this, no specific maintenance project is recommended. However, because the condition reviews were visual only, it is recommended that some additional testing of the pumps and motors be performed to ensure that they are capable of pumping the anticipated capacities. Also, maintenance staff indicated that security has been an issue at this pump station, so it is recommended that a site-specific security review be performed to develop recommendations on improving security.

Harbor RD 811/RD 537 Pump Station

The Harbor Pump Station is the only other pump station that was included in the high-risk category. Although there were no major issues identified during the review of individual pump station components, City maintenance staff indicated that the entire pump station has been sinking, which has resulted in broken conduits. It is recommended that structural and geotechnical reviews of this pump station be performed to determine whether it is possible that the settling will be a continuing problem and whether measures can be taken to reduce or arrest the settling.

Deerwood Pump Station

This pump station was classified as a medium high-risk facility. The condition reviews of individual pump station components did not reveal any significant issues, but City maintenance staff identified design issues that affect the function of the pump station. The wet well is very shallow and the upstream drainage system surcharges before the pump starts. The pump capacity also appears to be inadequate. The hydrologic and hydraulic modeling performed for this master plan confirmed staff observations about the pump capacity and, as a result, this pump station is recommended for replacement. As described in Section 9, it is recommended that this pump station be reconstructed at a new location with a larger capacity. Based on this, no maintenance recommendations are provided.

Washington Pump Station

This pump station was classified as a medium high-risk facility. The condition reviews of individual pump station components revealed that an 8-inch steel discharge pipe from the pump station is in poor condition and with a visible leak noted. It is recommended that this discharge pipe be replaced.

Lighthouse Pump Station

This pump station was classified as medium risk, despite having a higher overall risk score than the Deerwood and Washington Pump Stations. This high score is primarily due to a high consequence of failure score rather than poor conditions. No significant condition issues were observed. However, maintenance staff shared that the electrical switches and controls are old, and the on-site generator does not have adequate power to run the largest motors at the plant (450 horsepower). It is recommended that a full review of the electrical system be performed to determine if the electrical issues are preventing the pump station from achieving its full design capacity and, if so, that recommendations for resolving the issue be provided.

Raley Pump Station

This medium-risk pump station did not have any significant observed condition issues. However, maintenance staff shared that the pump station has old electrical switches and controls and the auto transfer switch does not work. It is recommended that a full review of the electrical system be performed.

Jefferson and Fifth Street Pump Stations

Both of these medium-risk pump stations serve roadway underpasses. Based on the findings from the hydrologic and hydraulic analyses performed for this master plan (see Section 10), both pump stations lack adequate capacity and are recommended for reconstruction. Therefore, no maintenance recommendations are provided.

Table 10.19 – Summary of Recommended Pump Station Maintenance Projects

Pump Station	Recommended Action
RD 811/ RD 537	Test critical components such as pumps and motors. Prepare a security review to develop recommendations on improving security. Add Backup Generator
Harbor	Perform a structural/geotechnical evaluation of settling issue. Add Backup Generator
Deerwood	Reconstruct pump station at new location.
Washington	Replace the 8-inch steel discharge pipe. Add Backup Generator
Lighthouse	Perform electrical system review to determine if electrical issues are preventing the design capacity of being achieved.
Raley	Perform electrical system review. Correct issue with inoperable auto-transfer switch. Add Backup Generator
Jefferson	Reconstruct pump station with a larger capacity.
Fifth Street	Reconstruct pump station with a larger capacity.

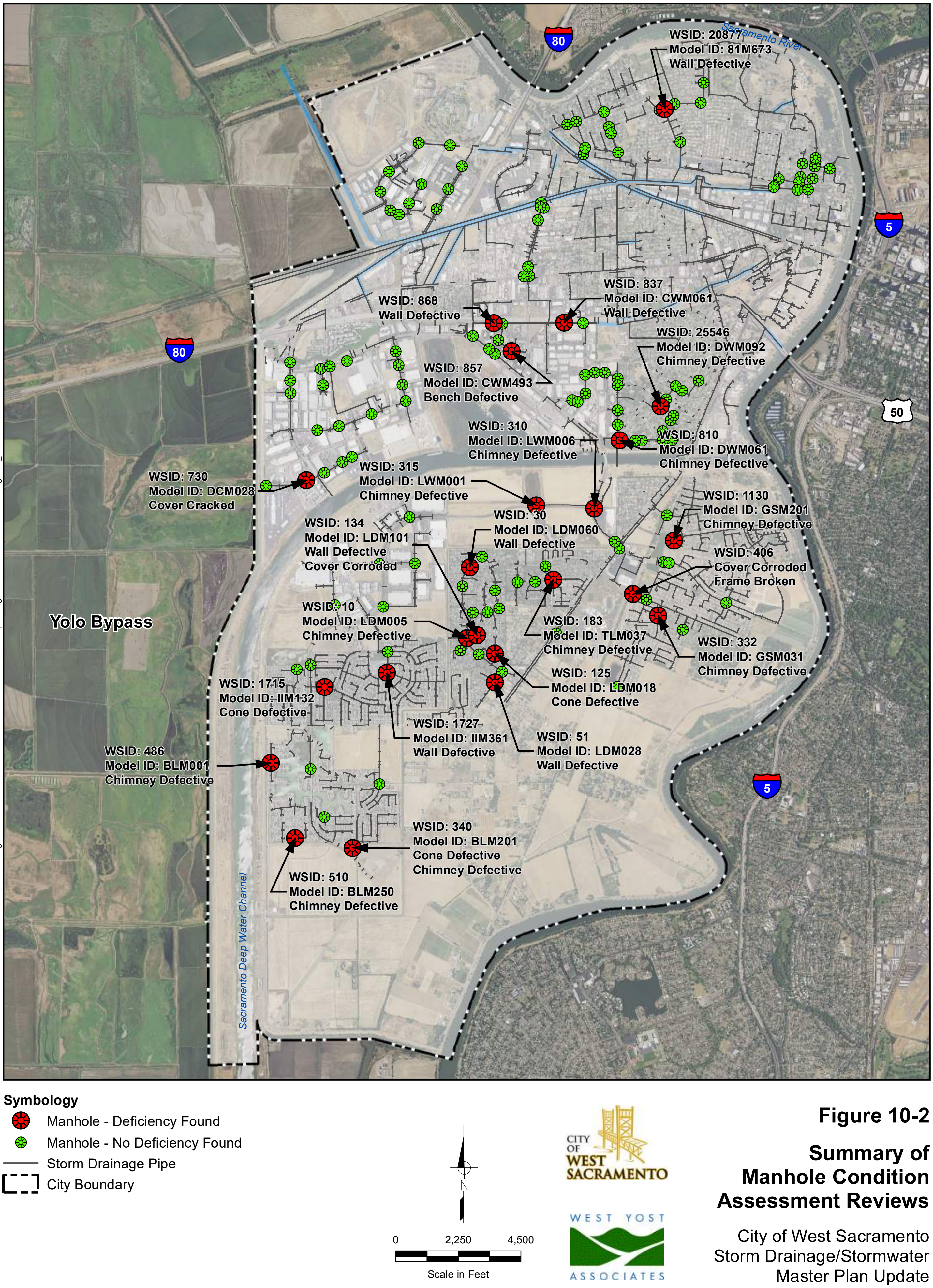

Figure 10-2

Summary of Manhole Condition Assessment Reviews

City of West Sacramento
Storm Drainage/Stormwater
Master Plan Update

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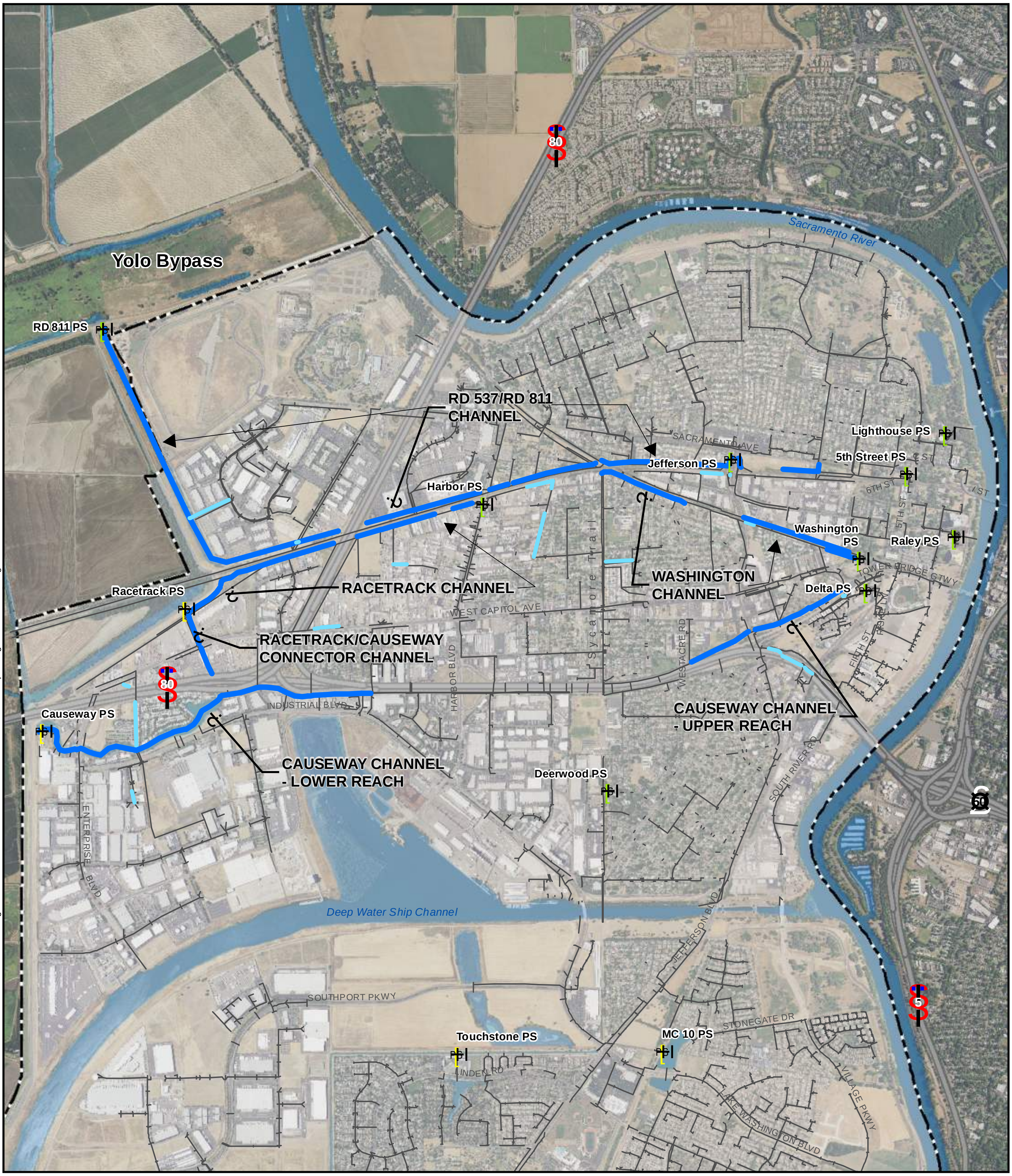

Last Saved: 8/24/2020 4:18:20 PM N:\Clients\309 Wood Rodgers Inc\10-17-05 West Sacramento SDMP\GIS\MXD\Report Figures Final Draft\Figure10-3 Channel Assessment.mxd : mmiller

Symbology

- Open Channel - Not Surveyed
- Open Channel - Surveyed
- Storm Drainage Pipe
- City Pump Station
- RD 900 Pump Station
- City Boundary

Notes:

1. See Figure 10-4 for channels assessed in South Basin (south of Deep Water Ship Channel).

N

0 1,500 3,000

Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 10-3

North Area Channel Assessment

City of West Sacramento
Storm Drainage/Stormwater
Master Plan Update

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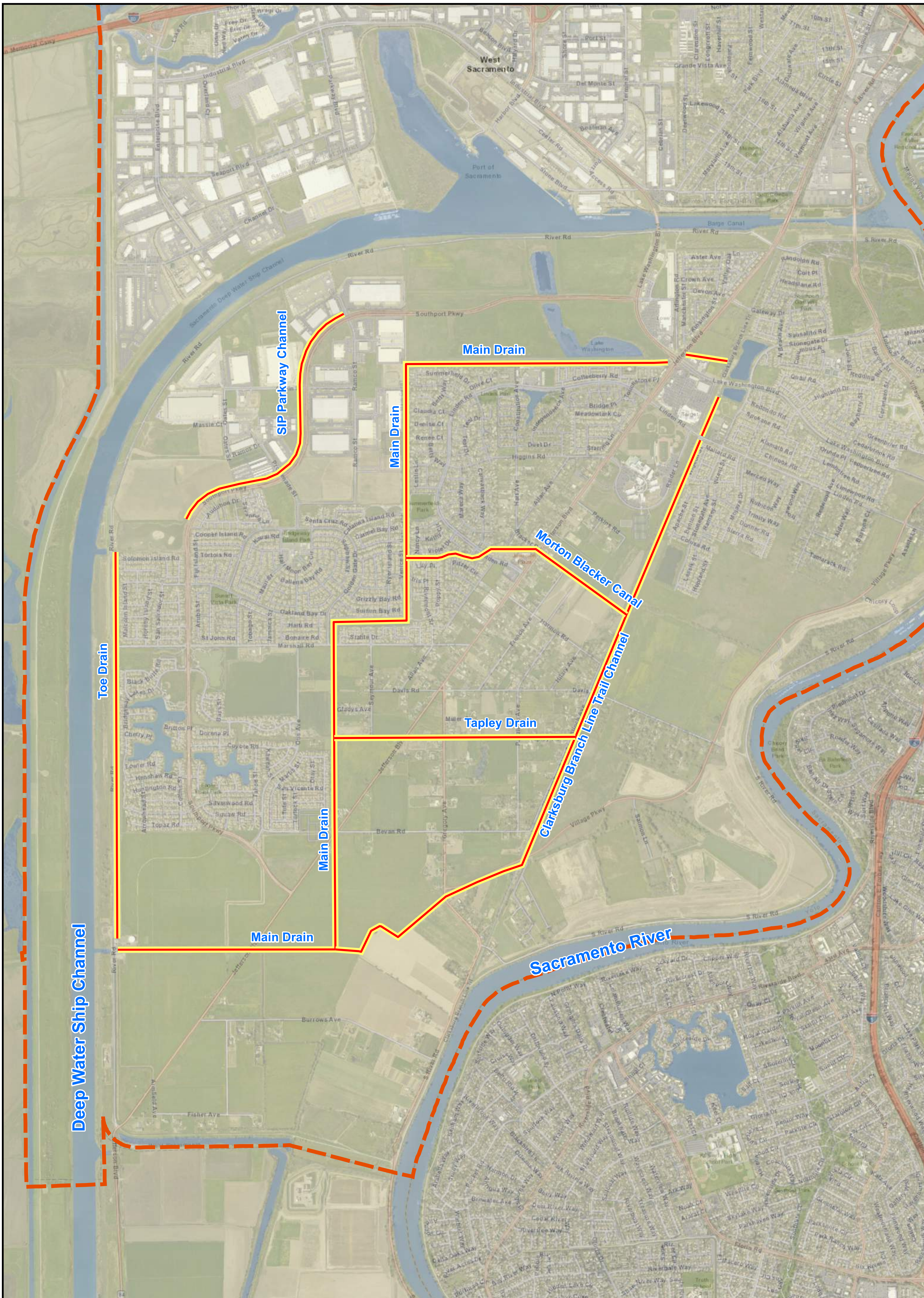

Channel and Ditch - Inspection
City of West Sacramento Limit

N

0 1,000 2,000
Scale in Feet

CITY OF WEST SACRAMENTO

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Figure 10-4
City of West Sacramento
SD/SW Master Plan Update
Channel and Ditch Conditions Assessment Map

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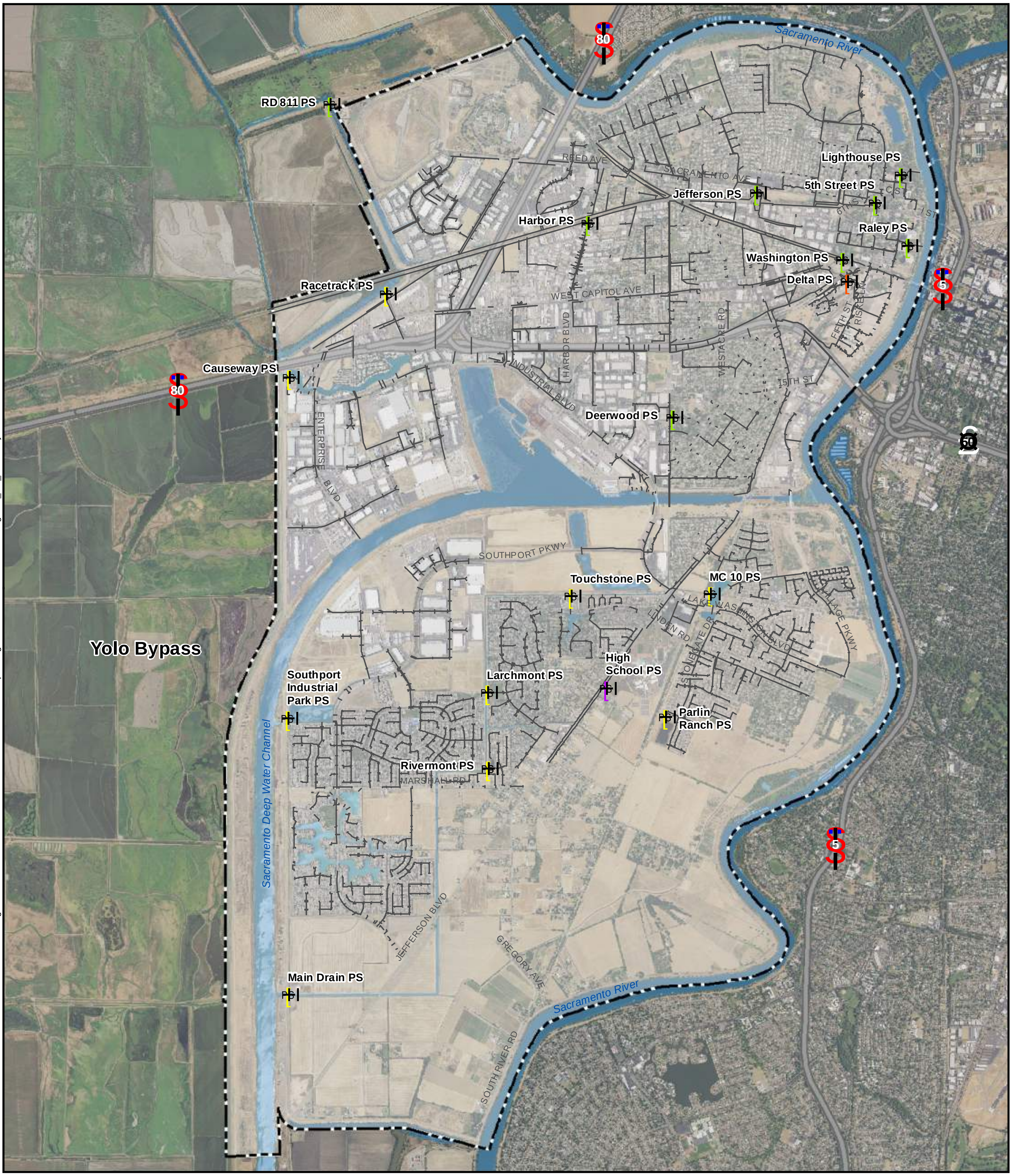

Symbology

Storm Drainage Pump Station

- City Pump Station (inspection)
- City Pump Station (no inspection)
- RD 900 Pump Station (no inspection)
- Washington Unified School District (no inspection)

- Storm Drainage Pipe
- City Boundary

N

0 2,250 4,500
Scale in Feet

CITY OF WEST SACRAMENTO

WEST YOST ASSOCIATES

Figure 10-5

Pump Station Summary

City of West Sacramento
Storm Drainage/Stormwater
Master Plan Update

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11.0 IMPROVEMENT PROGRAM

11.1 Improvement Projects Summary

There are several classifications for grouping drainage improvement projects within the master plan. Improvements can serve both public and private interests and can be funded in a number of ways. As ownership/maintenance of drainage infrastructure rests on multiple stakeholders (e.g.: the City, Caltrans, RD 900, and private developers), construction and implementation must be coordinated with other agencies in order to avoid negative downstream impacts. For purposes of this plan, the proposed improvements are classified and explained in the respective sections:

1. Section 11.2 - Improvements which are primarily publicly-funded projects serving existing development.
2. Section 11.3 - Maintenance improvement projects which are projects restoring facilities to their design capacity and funded primarily through the City's general fund.
3. Section 11.4 - Development improvement projects, which mitigate flooding related to the approval of new development. Because new development is triggering all improvements in the South Basin, prioritization of improvements is not required.

Both Item 1 and Item 2 (above) do not have specific collected utility fees.

11.2 Improvement Program

The improvement program (IP) provides a prioritized list of drainage improvement projects with estimated costs to implement them. Funding for improvement projects will depend on the owner of the facility and the scope of work. This section includes a description of a framework that was developed for prioritizing the implementation of new Improvement Projects (IP Projects). The IP Projects are described in detail in prior Sections (Sections 9 and 10). Estimated costs for the improvements were determined in those sections when appropriate. This section provides a summary of the recommended IP Projects and presents recommended priorities of the improvements.

11.2.1 Prioritization of IP Projects

The City of West Sacramento Storm Drainage/Stormwater Masterplan City-Consultant team developed a framework for prioritizing IP Projects for implementation. Flood Area Criticality criteria was first created to compare flood areas, establishing which areas of the City may be most impacted by surface flooding. Criteria for flood area criticality include the presence of evacuation corridors, the presence of critical facilities as defined by the City, past flood complaints as documented by the City, the social equity of flood location, and the magnitude of flooding as measured by the number of homes or structures affected. Each of the criteria was assigned a "1" or "0" following the scoring rationale below.

The social equity of flood location was determined through the CalEPA designation of Disadvantaged Communities Senate Bill 535 (SB 535). Senate Bill 535 requires CalEPA to take a multi-pronged approach to identifying disadvantaged communities that includes socioeconomic, public health and environmental hazard criteria. The 25-percent highest scoring California census tracts from the multi-pronged approach are eligible to receive Greenhouse Gas Reduction Fund fiscal support for improvement projects.

The flood area criticality composite score is a summation of the five criteria scores for each flood area. **Table 11.1** (below) summarizes the flood criteria and scoring and **Figure 11.1** shows the criteria geographically. These assessments apply primarily to projects in the North Basin.

Table 11.1 – Criteria for Flood Area Criticality

Criteria	Source	Score
Evacuation Corridors	City of West Sacramento Evacuation Map (2017)	1=Yes, contains an Evacuation Corridor* 0=No, does not contain an Evacuation Corridor
Critical Facilities	City Planning Documents	1=Yes, contains a Critical Facility* 0=No, does not contain a Critical Facility
Flood Complaints	City Maintenance Records	1=Yes, contains complaints 0=No, does not contain complaints
Social Equity	Disadvantaged Communities SB 535	1=Yes, contains a DC 0=No, does not contain a DC
Magnitude (Flooded Structures)	Number of Buildings in a Flood Area	Number of Buildings included in flood area divided by 100. No distinction is made between residential or office/industrial buildings.
*Note: * indicates as designated by the City*		

Table 11.2 (below) summarizes the flood area's criticality results, sorting them by the Flood Area Criticality Composite Score.

Table 11.2 – Flood Area Criticality Composite Score (North Basin Only)								
Flood Area	**Watershed**	**Flood Area Model Nodes**	**Evacuation Corridor Score**	**Critical Facilities Score**	**Flood Complaints Score**	**Social Equity Score**	**Magnitude (Flooded Structures)**	**Flood Area Criticality Composite Score**
Hobson Avenue at Bryte Avenue	RD 537/ RD 811	81M619	1	0	0	1	2.92	4.9
Poplar Ave. and Rockrose Road	Causeway and Racetrack	CWM896 CWI900 CWI898	0	0	0	1	2.48	3.5
Douglas St. and Elkhorn Place	RD 537/ RD 811	81M772	1	1	0	1	1.44	3.4
Alabama Ave. at 13th Street	Lock Watershed	LKOV16	1	1	0	0	1.31	3.3
Meadow Road at Clarendon Street	Causeway and Racetrack	CWM685	0	0	0	1	2.11	3.1
Doran Avenue at Marigold Street	Causeway and Racetrack	CWI397	0	1	0	1	0.82	2.8
Lake Washington	Causeway and Racetrack	CWO007 CWO010 CWO013 CWO016	0	0	0	1	1.69	2.7
Arthur Drive	RD 537/ RD 811	81M824 81M821 81M742	0	0	0	1	1.54	2.5
North of US 50 and Sycamore Avenue	Causeway and Racetrack	CWM556 CWM577	0	1	0	1	0.53	2.5
8th Street and Elizabeth Street	RD 537/RD 811	81M846	1	0	0	1	0.45	2.5
Deerwood Street at Lakewood Drive	Deerwood	DW_WW	0	1	0	1	0.24	2.2

Table 11.2 – Flood Area Criticality Composite Score (North Basin Only)								
Flood Area	**Watershed**	**Flood Area Model Nodes**	**Evacuation Corridor Score**	**Critical Facilities Score**	**Flood Complaints Score**	**Social Equity Score**	**Magnitude (Flooded Structures)**	**Flood Area Criticality Composite Score**
Jefferson Boulevard Underpass	RD 537/RD 811	81M069	1	0	0	1	0.23	2.2
Commerce Drive at Northport Drive	Causeway and Racetrack	RTM163 RTM166	0	1	0	1	0.21	2.2
Harbor Boulevard and West Capitol Boulevard	Causeway and Racetrack	RTM229	1	0	0	1	0.06	2.1
Seaport Boulevard at Enterprise Boulevard	Causeway and Racetrack	CWM184 CWM187 CWM208	1	0	0	1	0.06	2.1
Portsmouth Court and Michigan Boulevard	Causeway and Racetrack	CWI914 CWI918 CWI924	0	0	0	1	1.03	2.0
Walnut St. north of Michigan Blvd.	Causeway and Racetrack	CWM912	0	0	0	1	0.51	1.5
5th Street and South River Road	Causeway and Racetrack	CWI746	0	0	0	0	0.01	0.0
Merkley Ave. from El Rancho Court to Jefferson Blvd.	Causeway and Racetrack	CWM608 CWM607	0	0	0	0	0.01	0.0

11.2.2 IP Project Prioritization Framework

In addition to the Flood Area Criticality, other benefits of and challenges to the implementation of each improvement project were considered for the final project ranking. The following benefits and challenges are presented below in **Table 11.3**.

Benefits of implementation include:

- Mitigating the critical flood areas identified by the Flood Area Criticality Composite Score in Section 11. If an improvement project can mitigate multiple flood areas, the Flood Area Criticality Composite Score will be a summation of all flood areas. Individual Flood Area Criticality scores are listed in Table 11.2.
- Eliminating risk by levels identified in Section 10 Conditional Assessment. Refer to Table 10.17 and Table 10.18 for additional information.

Challenges to implementation include:

- Sequencing the construction of improvement projects to avoid downstream flooding from Section 9. Increasing upstream conveyance without the required downstream project could result in a worsening of flood depth or spread.
- Land acquisition or easements required outside of the City right-of-way from Section 9.
- Estimated implementation cost, excluding land acquisition from Section 9. The estimated implementation cost of preceding projects is listed in parentheses.
- Stakeholder cooperation will be required. Stakeholder cooperation will require increased coordination, but also presents opportunities for innovation and cost sharing.

Table 11.3 also presents relevant figure names, ownership, and whether the IP Project is included in an alternative. Several improvement projects may be included in one alternative and must all be implemented for full mitigation. Alternatives offer agencies flexibility to solve deficiencies and meet stakeholder goals. Refer to Section 9 for a full description of alternatives. Environmental clearance for channel widening and detention basins is a factor for each IP and should be accounted for in implementation.

IP Projects will be assigned a rank for implementation by the City, falling into Group A, Group B, or Group C. Group A has the most critical need and should be implemented first. Group B has barriers that make implementation challenging, but future implementation should be considered as funds become available. Group C has significant barriers or modest benefits that may make implementation infeasible unless specific funding became available or existing conditions change.

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Table 11.3 – IP Prioritization by Group Ranking (North Basin Only)

				Benefits of Implementation			Challenges to Implementation				
IP Project	**Figure Showing Proposed Improvements**	**Alternative**	**Agency Responsible**	**Flood Area Nodes**	**Flood Area Priority Composite Score**	**Condition Assessment Risk Level**	**Preceding Projects Required (Downstream to Upstream)**	**Land Easement/ Acquisition Required**	**Estimated Implementation Cost, Cost of Preceding Projects (Millions)**	**Stakeholder Cooperation**	**City Assigned Group Rank**
5th Street Pump Station	Figure 9-2 RD 537/RD 811 Watershed (East)	5th Street Underpass Alternative 1: Pump Station Only	City	Jefferson Boulevard Underpass	2.2	Medium Risk	I 80 Culvert Upsize Harbor Boulevard Culvert Upsize Harbor Boulevard to Railroad Channel Expansion Citrus Street Culvert Upsize Railroad Culvert Upsize Railroad to Jefferson Channel Expansion Sacramento Avenue Detention Basin	No	$10.5 ($9.4)	No	C
5th Street Pump Station and Underground Storage Vault	Figure 9-2 RD 537/RD 811 Watershed (East)	5th Street Underpass Alternative 2: Pump Station and Underground Detention Vault	City	Jefferson Boulevard Underpass	2.2	Medium Risk	I 80 Culvert Upsize Harbor Boulevard Culvert Upsize Harbor Blvd. to Railroad Channel Expansion Citrus Street Culvert Upsize Railroad Culvert Upsize Railroad to Jefferson Channel Expansion Sacramento Avenue Detention Basin	No	$7.1 ($9.4)	No	C
Alyce Norman School Detention Basin	Figure 9-2 RD 537/RD 811 Watershed (East)		City	Arthur Drive	2.5		I 80 Culvert Upsize Harbor Blvd. Culvert Upsize Harbor Blvd. to Railroad Channel Expansion Citrus Street Culvert Upsize Railroad Culvert Upsize Railroad to Jefferson Channel Expansion Harbor Blvd. Culvert Upsize Fourness Drive Pipe Upsize	Easement	$4.8 ($7.9)	School District	C
Arthur Drive Pipe Reroute	Figure 9-2 RD 537/RD 811 Watershed (East)		City	Arthur Drive	2.5		I-80 Culvert Upsize Harbor Blvd. Culvert Upsize Harbor Blvd. to Railroad Channel Expansion Citrus Street Culvert Upsize Railroad Culvert Upsize Railroad to Jefferson Channel Expansion Alyce Norman School Detention Area	No	$1.2 ($12.7)	No	B

				Benefits of Implementation			Challenges to Implementation				
IP Project	**Figure Showing Proposed Improvements**	**Alternative**	**Agency Responsible**	**Flood Area Nodes**	**Flood Area Priority Composite Score**	**Condition Assessment Risk Level**	**Preceding Projects Required (Downstream to Upstream)**	**Land Easement/ Acquisition Required**	**Estimated Implementation Cost, Cost of Preceding Projects (Millions)**	**Stakeholder Cooperation**	**City Assigned Group Rank**
Bryte Avenue Pipe Upsize	Figure 9-2 RD 537/RD 811 Watershed (East)		City	Hobson Avenue at Bryte Avenue	4.9		I 80 Culvert Upsize Harbor Boulevard Culvert Upsize Harbor Boulevard to Railroad Channel Expansion Citrus Street Culvert Upsize Railroad Culvert Upsize Railroad to Jefferson Channel Expansion	No	$2.1 ($7.9)	No	A
Citrus Street Culvert Upsize	Figure 9-2 RD 537/RD 811 Watershed (East)	Removal of Citrus St. Culvert & widen channel	RD 900	Arthur Drive Hobson Avenue at Bryte Avenue Douglas Street and Elkhorn Place 8th St. and Elizabeth St.	13.4		I 80 Culvert Upsize Harbor Boulevard Culvert Upsize Harbor Boulevard to Railroad Channel Expansion	No	$0.3 ($5.8)	RD 900	A
Douglas Pipe Upsize	Figure 9-2 RD 537/RD 811 Watershed (East)		City	Douglas Street and Elkhorn Place	3.4		Sacramento Avenue Detention Basin	No	$0.2 ($1.5)	No	B
Fourness Drive Pipe Upsize	Figure 9-2 RD 537/RD 811 Watershed (East)		City	Arthur Drive	2.5		I 80 Culvert Upsize Harbor Boulevard Culvert Upsize Harbor Boulevard to Railroad Channel Expansion Citrus Street Culvert Upsize Railroad Culvert Upsize Railroad to Jefferson Channel Expansion Sacramento Avenue Detention Basin Alyce Norman School Detention Basin	No	$6.3 ($14.2)	No	B

Table 11.3 – IP Prioritization by Group Ranking (North Basin Only)

IP Project	Figure Showing Proposed Improvements	Alternative	Agency Responsible	Benefits of Implementation			Challenges to Implementation				City Assigned Group Rank
				Flood Area Nodes	Flood Area Priority Composite Score	Condition Assessment Risk Level	Preceding Projects Required (Downstream to Upstream)	Land Easement/ Acquisition Required	Estimated Implementation Cost, Cost of Preceding Projects (Millions)	Stakeholder Cooperation	
Harbor Boulevard Culvert Upsize	Figure 9-2 RD 537/RD 811 Watershed (East)		RD900	Portsmouth Court & Michigan Boulevard Arthur Drive Doran Avenue at Marigold Street Jefferson Boulevard Underpass	9.6		I 80 Culvert Upsize	No	$1.6 ($4.1)	No	A
Jefferson Boulevard Pump Station	Figure 9-2 RD 537/RD 811 Watershed (East)		City	Jefferson Boulevard Underpass	2.2	Medium	I 80 Culvert Upsize Harbor Boulevard Culvert Upsize Harbor Boulevard to Railroad Channel Expansion Citrus Street Culvert Upsize Railroad Culvert Upsize Railroad to Jefferson Channel Expansion Sacramento Avenue Detention Basin	No	$6.5 ($9.4)	No	A
Railroad Culvert Upsize	Figure 9-2 RD 537/RD 811 Watershed (East)	Consider LNWI conflict	City	8th Street and Elizabeth Street Doran Avenue at Marigold Street West Capitol Avenue roadway underpass 5th Street and South River Road	6.6		I 80 Culvert Upsize Harbor Blvd. Culvert Upsize Harbor Blvd. to Railroad Channel Expansion Citrus Street Culvert Upsize	No	$1.3 ($6.1)	Sacramento Regional County Sanitation District, UPRR	B
Railroad to Jefferson Channel Expansion	Figure 9-2 RD 537/RD 811 Watershed (East)		RD 900	West Capitol Ave. roadway underpass north of US 50 and Sycamore Ave. Deerwood St. at Lakewood Dr. Merkley Ave. from El Rancho Court to Jefferson Boulevard	6.1		I 80 Culvert Upsize Harbor Blvd. Culvert Upsize Harbor Blvd. to Railroad Channel Expansion Citrus Street Culvert Upsize Railroad Culvert Upsize	No	$0.6 ($7.4)	Sacramento Regional County Sanitation District	B

Table 11.3 – IP Prioritization by Group Ranking (North Basin Only)											
				Benefits of Implementation			Challenges to Implementation				
IP Project	Figure Showing Proposed Improvements	Alternative	Agency Responsible	Flood Area Nodes	Flood Area Priority Composite Score	Condition Assessment Risk Level	Preceding Projects Required (Downstream to Upstream)	Land Easement/ Acquisition Required	Estimated Implementation Cost, Cost of Preceding Projects (Millions)	Stakeholder Cooperation	City Assigned Group Rank
Sacramento Avenue Detention Basin	Figure 9-2 RD 537/RD 811 Watershed (East)		City	Arthur Drive 8th Street and Elizabeth Street	5.0		None	Yes	$1.5 ($0.0)	No	C
US 80 Culvert Upsize	Figure 9-1 RD 537/RD 811 Watershed (West)		Caltrans	North of US 50 & Sycamore Avenue Alabama Avenue at 13th Street Walnut Street north of Michigan Boulevard Harbor Boulevard & West Capitol Boulevard	9.4		None	No	$4.1 ($0.0)	Caltrans	A
Harbor Blvd. to Railroad Channel Expansion	Figure 9-1 RD 537/RD 811 Watershed (West)		RD900	Doran Avenue at Marigold St. Douglas St. & Elkhorn Place north of US 50 & Sycamore Ave Commerce Dr. at Northport Dr.	11.0		Interstate 80 Culvert Upsize, Harbor Boulevard Culvert Upsize	No	$0.6 ($5.7)	No	B
Deerwood Detention Basin	Figure 9-6 Deerwood and Lock Watershed Improvement Projects		City	Deerwood St. at Lakewood Dr.	2.2		Deerwood Pump Station Relocation	Yes	$2.1 ($2.4)	No	C
Deerwood Pump Station Relocation	Figure 9-6 Deerwood and Lock Watershed Improvement Projects		City	Deerwood St. at Lakewood Dr.	2.2	Medium-High	Deerwood Detention Basin	Yes	$2.4 ($2.1)	No	A
Jefferson Boulevard Pipe Upsize	Figure 9-6 Deerwood and Lock Watershed Improvement Projects		City	Alabama Avenue at 13th Street	3.3		None	No	$4.8 ($0.0)	No	A

Table 11.3 – IP Prioritization by Group Ranking (North Basin Only)

IP Project	Figure Showing Proposed Improvements	Alternative	Agency Responsible	Benefits of Implementation: Flood Area Nodes	Benefits of Implementation: Flood Area Priority Composite Score	Benefits of Implementation: Condition Assessment Risk Level	Challenges to Implementation: Preceding Projects Required (Downstream to Upstream)	Challenges to Implementation: Land Easement/ Acquisition Required	Challenges to Implementation: Estimated Implementation Cost, Cost of Preceding Projects (Millions)	Challenges to Implementation: Stakeholder Cooperation	City Assigned Group Rank
Clarendon Street Pipe Upsize	Figure 9-5 Causeway and Racetrack Watershed (East)		City	Seaport Boulevard at Enterprise Boulevard	3.1		Downstream Alternative 1 OR Downstream Alternative 2 OR Downstream Alternative 3	No	$0.7 ($30.5, $12.6, $24.9)	No	C
Michigan Boulevard Detention Basin	Figure 9-5 Causeway and Racetrack Watershed (East)		City	Portsmouth Court & Michigan Boulevard	2.0		None	Yes	$5.0 ($0.0)	No	B
Westfield School Detention Basin	Figure 9-5 Causeway and Racetrack Watershed (East)		City	Walnut Street north of Michigan Boulevard Poplar Avenue and Rockrose Road	5.0		None	Easement	$5.1 ($0.0)	School District	C
South River Road Detention Basin	Figure 9-5 Causeway and Racetrack Watershed (East)	South River Road Alternative 1: Detention Basin	City	5th Street and South River Road	0.0		None	Yes	$1.3 ($0.0)	No	C
South River Road Pipe Upsize	Figure 9-5 Causeway and Racetrack Watershed (East)	South River Road Alternative 2: Pipe Upsize	City	5th Street and South River Road	0.0		El Rancho Count Detention Westmore Oaks School Detention Basin	No	$2.9 ($26.9)	No	C
El Rancho Court Detention Basin	Figure 9-5 Causeway and Racetrack Watershed (East)		City	North of US 50 & Sycamore Avenue Merkley Ave. from El Rancho Court to Jefferson Boulevard	2.5		None	Yes	$2.0 ($0.0)	No	C
Harbor Boulevard Pipe Upsize	Figure 9-4 Causeway and Racetrack Watershed (Central)		City	Harbor Boulevard & West Capitol Boulevard	2.1		Downstream Alternative 1 OR Downstream Alternative 3	No	$1.8 ($30.5, $24.9)	No	C

Table 11.3 – IP Prioritization by Group Ranking (North Basin Only)

IP Project	Figure Showing Proposed Improvements	Alternative	Agency Responsible	Benefits of Implementation			Challenges to Implementation				City Assigned Group Rank
				Flood Area Nodes	Flood Area Priority Composite Score	Condition Assessment Risk Level	Preceding Projects Required (Downstream to Upstream)	Land Easement/ Acquisition Required	Estimated Implementation Cost, Cost of Preceding Projects (Millions)	Stakeholder Cooperation	
Houston Street Culvert Upsize	Figure 9-4 Causeway and Racetrack Watershed (Central)		RD 900	Harbor Boulevard & West Capitol Boulevard	2.1		Downstream Alternative 1 OR Downstream Alternative 2 OR Downstream Alternative 3 Harbor Boulevard Pipe Upsize	No	$0 .9 ($30.5, $12.6, $24.9, $1.8)	No	C
Walnut Street Pipe Upsize	Figure 9-4 Causeway and Racetrack Watershed (Central)		City	Walnut Street north of Michigan Boulevard	1.5		Downstream Alternative 1 OR Downstream Alternative 2 OR Downstream Alternative 3	No	$4.8 ($30.5, $12.6, $24.9)	No	A
Westmore Oak School Detention Basin	Figure 9-4 Causeway and Racetrack Watershed (Central)		City	Seaport Blvd. at Enterprise Blvd. North of US 50 & Sycamore Avenue Walnut St. north of Michigan Blvd. Poplar Avenue & Rockrose Road	10.6		None	Yes, Easement	$24.9 ($0.0)	School District	C
Enterprise Boulevard Pipe Upsize	Figure 9-3 Causeway and Racetrack Watershed (West)		City	Seaport Boulevard at Enterprise Boulevard	3.1		Downstream Alternative 1 OR Downstream Alternative 2 OR Downstream Alternative 3	No	$3.5 ($30.5, $12.6, $24.9)	No	C
Racetrack Pump Station - Pump Station Only	Figure 9-3 Causeway and Racetrack Watershed (West)	Downstream Alternative 1: Pump Station Only	RD 900	Seaport Blvd. at Enterprise Blvd. Harbor Blvd. & West Capitol Blvd. Commerce Drive at Northport Drive Lake Washington	7.4	High	Racetrack Culvert Expansion West Capital Culvert Expansion	No	$29.9 ($0.6)	No	A
West Capitol Culvert Expansion	Figure 9-3 Causeway and Racetrack Watershed (West)	Downstream Alternative 1: Pump Station Only	City	Lake Washington	0.0		None	No	$0.4 ($0.0)	No	A
Estes Terminal Detention Basin	Figure 9-3 Causeway and Racetrack Watershed (West)	Downstream Alternative 2: Detention Only	City	Lake Washington	0.0		None	Yes	$1.9 ($0.0)	No	C

Table 11.3 – IP Prioritization by Group Ranking (North Basin Only)

IP Project	Figure Showing Proposed Improvements	Alternative	Agency Responsible	Benefits of Implementation			Challenges to Implementation				City Assigned Group Rank
				Flood Area Nodes	Flood Area Priority Composite Score	Condition Assessment Risk Level	Preceding Projects Required (Downstream to Upstream)	Land Easement/ Acquisition Required	Estimated Implementation Cost, Cost of Preceding Projects (Millions)	Stakeholder Cooperation	
Lake Washington Expansion	Figure 9-3 Causeway and Racetrack Watershed (West)	Downstream Alternative 2: Detention Only	RD 900	Lake Washington	0.0		None	Yes	$1.4 ($0.0)	No	C
Racetrack Pump Station - Pump Station and Detention	Figure 9-3 Causeway and Racetrack Watershed (West)	Downstream Alternative 3: Detention + Pump Station	RD 900	Seaport Blvd. at Enterprise Blvd. Harbor Blvd. and West Capitol Blvd. Commerce Drive at Northport Drive Lake Washington	7.4	High	Racetrack Culvert Expansion West Capital Culvert Expansion	Yes	$15.0 ($0.6)	No	C
West Capitol Avenue Detention Basin	Figure 9-3 Causeway and Racetrack Watershed (West)	Downstream Alternative 2: Detention Only OR Downstream Alternative 3: Detention + Pump Station	City	Lake Washington	0.0		None	Yes	$9.3 ($0.0)	No	C
Racetrack Culvert Expansion	Figure 9-3 Causeway and Racetrack Watershed (West)	Downstream Alternative 1: Pump Station Only OR Downstream Alternative 3: Detention + Pump Station	RD 900	Commerce Drive at Northport Drive	2.2		None	No	$0.2 ($0.0)	No	A

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11.3 Maintenance Projects

Based on the condition assessment evaluations described in Section 10, the following list of maintenance projects are recommended for implementation. **Table 11.4** summarizes the project and associated cost of implementation. Maintenance projects are critical to maintaining system functionality and are given equal importance for implementation.

Table 11.4 – Maintenance Projects

Maintenance Project	Recommended ACTION	Estimated Cost
RD 811 / RD 537 Pump Station	Test critical components such as pumps and motors. Prepare a security review to develop recommendations on improving security. Add Backup Generator	$500,000
Harbor Pump Station	Perform a structural/geotechnical evaluation of settling issue. Add Backup Generator	$500,000
Washington Pump Station	Replace the 8-inch steel discharge pipe. Add Backup Generator	$400,000
Lighthouse Pump Station	Perform electrical system review to determine if electrical issues are preventing the design capacity of being achieved.	$300,000
Raley Pump Station	Perform electrical system review. Correct issue with inoperable auto-transfer switch. Add Backup Generator	$500,000
Causeway – Upper Channel	City to coordinate with Caltrans and RD 900 to get rack installed.	N/A Performed by Others
Racetrack/Causeway Connector Channel	Solution dependent on Causeway/Racetrack flood solution that is implemented: Alt. 1 and 3: New headwall to be constructed with culvert replacement (increased capacity) Alt 2: Remove and replace headwall	$400,000
RD 811 / RD 537 Channel	Clear vegetation	N/A Performed by City Staff
810 Manhole	Manhole	$5,000
20877 Manhole	Manhole	$7,500
25546 Manhole	Manhole	$5,000
730 Manhole	Manhole	$5,000
406 Manhole	Manhole	$5,000

NOTES:

- *Although projects above are most critical, section 10 indicates that 15% have defects based on a limited number of manholes evaluated. By extrapolation, 1,782 x (0.15) = 270 manholes have deficiencies. Using a conservative cost of $3,000/mh (unit costs provided by City), a Citywide MH maintenance project would be approximately $800k.*
- *This report excluded pipe condition assessment effort. However, City staff have witnessed many pipes in need of basic periodic cleaning. The drainage system consists of approximately 130 miles (686,400 feet) of pipe. At a cost of $4 per foot (unit costs provided by City), a Citywide maintenance project would be approximately $2.8M.*

11.4 Development Projects

The majority of new development is planned to occur within the South Basin. New development drainage improvements are typically funded by the developers through development impact fees, and the projects listed below are predominantly triggered by the impacts created by new development. There are two identified deficiencies where flooding may be occurring within existing streets while not flooding homes/structures, and where ultimate development improvements will eliminate the need for temporary fixes. The City-Consultant team reviewed current large-scale development plans including those for the Liberty, Riverpark and Yarbrough developments, to inform the modeling for the South Basin and determine the projects necessary to mitigate for new development. Those projects are listed in **Table 11.5** below (as shown on Figure 8-13). Assessments of criticality and prioritization do not apply to South Basin projects.

Table 11.5 – Development Projects

Development Project	Type	Cost	Priority
Gateway/Stonegate Capacity Increase (150 cfs)	Pump Station	$6,600,000	Development Trigger
Location 1	Drainage Crossing	$600,000	Development Trigger
Location 2	Drainage Crossing	$1,500,000	Development Trigger
Location 3	Drainage Crossing	$1,650,000	Development Trigger
Location 4	Drainage Crossing	$3,300,000	Development Trigger
Location 5	Drainage Crossing	$75,000	Development Trigger
Location 6	Drainage Crossing	$75,000	Development Trigger
Location 7	Drainage Crossing	$75,000	Development Trigger
Location 8	Drainage Crossing	$3,300,000	Development Trigger
Location 9	Drainage Crossing	$3,300,000	Development Trigger
Location 10	Drainage Crossing	$3,300,000	Development Trigger
Location 11	Drainage Crossing	$140,000	Development Trigger
Main Drain Ultimate Pump Installation	Pump Station	$200,000	Development Trigger

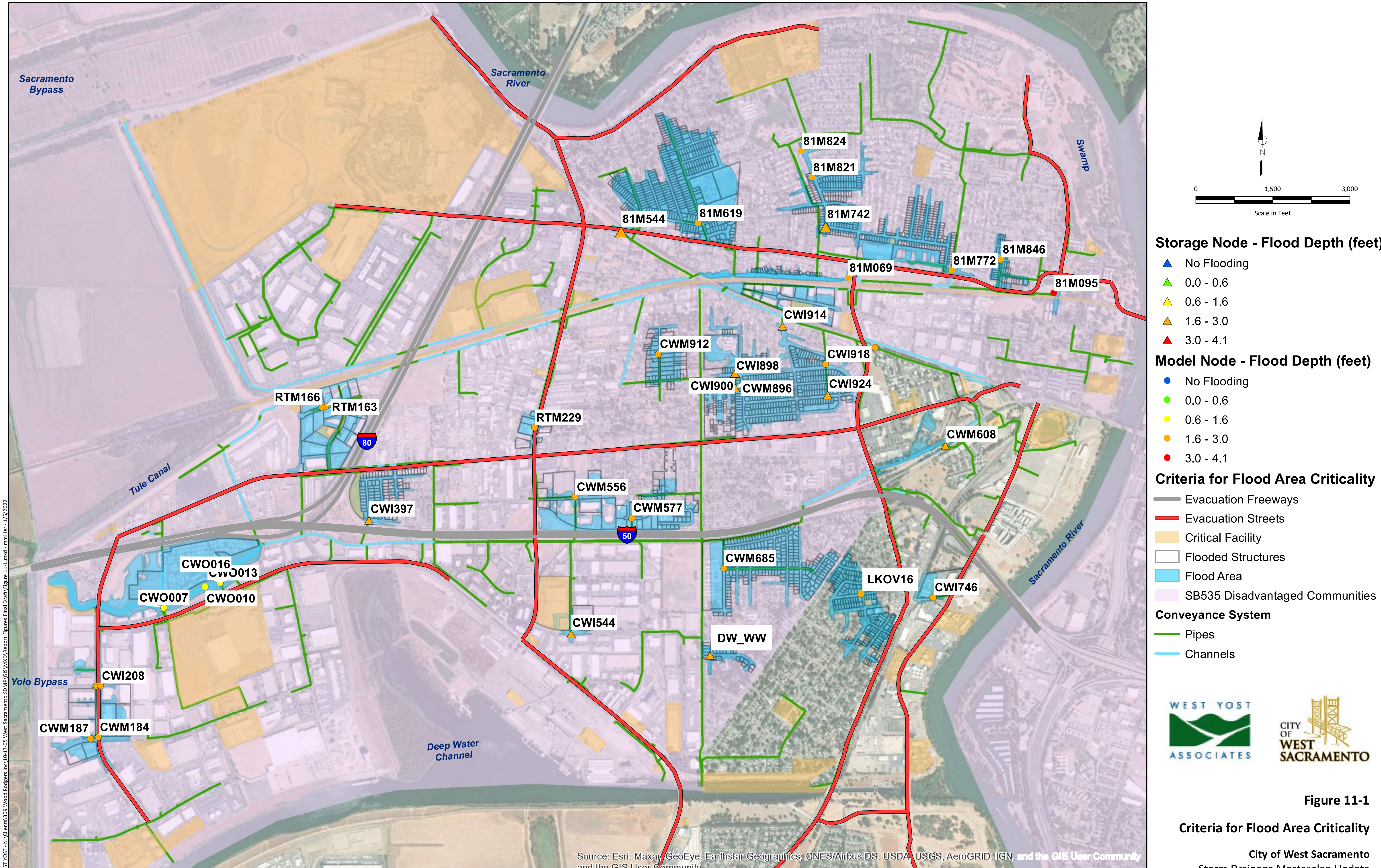

Figure 11-1

Criteria for Flood Area Criticality

City of West Sacramento
Storm Drainage Masterplan Update

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12.0 REFERENCES

Reference 1 City of West Sacramento, South Basin Drainage Master Plan, February 1995

Reference 2 City of West Sacramento, South Basin drainage Master Plan, May 2001

Reference 3 City of West Sacramento, Subbasin MC10 Drainage Master Plan, February 2000

Reference 4 City of West Sacramento, Subbasins MC80 and MC81 South Basin Drainage Master Plan, February 2003

Reference 5 LiDAR Topography, California Department of Water Resources, 2008

Reference 6 Open Channel Hydraulics, Chow, V.T., McGraw-Hill, New York, 1959

Reference 7 Hydrology Manual, Sacramento County Department of Water Resources, 1996

Reference 8 Yolo County Hydrology Manual, Yolo County, 2010

Reference 9 Soil Surveys, Natural Resources Conservation Service

Reference 10 MBK Engineers Technical Memorandum – US Army Corps of Engineers Memorandum for Record – Sacramento River Basin HEC-RAS Model Release 4 (June, 2012)

Reference 11 California Highway Patrol (CHP) Academy

Reference 12 Sacramento City/County Drainage Manual, Volume 2: Hydrology Standards"

Reference 13 Standard Specifications and Details, City of West Sacramento (2002)

Reference 14 Bridge District Infrastructure Improvements Drainage TM No. 6

Reference 15 Rivers Phase 2 Storm Drainage Master Plan (NV5, February 2017)

Reference 16 Post-Construction Standards Plan, WGR Southwest, Inc. (2015) General Plan 2035, City of West Sacramento, Adopted 2016

Reference 17 Municipal Regional Permit, R2-2015-0049

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13.0 ACRONYMS AND ABBREVIATIONS

AEP – Annual Exceedance Probability
AC – Acre
CEQA – California Environmental Quality Act
CFS – Cubic Feet Per Second
CHP – California Highway Patrol
CIP – Capital Improvement Program
CVFED – Central Valley Floodplain Evaluation and Delineation Project
CVFPB – Central Valley Flood Protection Board
DWR – California Department of Water Resources
DWSC – Deep Water Ship Canal
DWSE – Design Water Surface Elevation
FEMA – Federal Emergency Management Agency
FIRM – Floodplain Insurance Rate Maps
FIS – Flood Insurance Study
FT – Feet or Foot
GIS – Geographic Information System
HEC – Hydraulic Engineering Center
LiDAR – Light Detection and Ranging
LF – Lineal Feet
MOU – Memorandum of Understanding
NAVD 88 – The North American Vertical Datum of 1988
NGVD 29 – The National Geodetic Vertical Datum of 1929
NEPA – National Environmental Policy Act of 1969
O&M – Operation and Maintenance
OMRRR – Operation, Maintenance, Repair, Replacement, and Rehabilitation
RD – Reclamation District
SR – State Route
SDSWMP – Storm Drain Storm Water Master Plan
USACE – US Army Corps of Engineers
WSE – Water Surface Elevation

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Appendices

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WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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