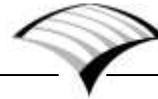


# Letter of Transmittal



**WOOD RODGERS**  
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Date: March 16, 2018

Job No.: 8303029

To: City of Woodland

Attn: **Mr. Christopher Fong, P.E., Senior Associate Civil Engineer**  
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City: Woodland State: CA ZIP: 95695

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From: Mr. Michael C. Nowlan, P.E., CFM *MCN*  
(916) 326-5777

Re: **City of Woodland Storm Drainage Facilities Master Plan  
South Urban Growth Area – Revised Update**

We are sending you via:

**E-mail**

We are sending you:

Exhibits  Plans

Reports  Maps

Copies

Specifications

Other:

These are transmitted as checked below:

Approval  Final Submittal  As Requested  Review/Comment

Copies	Description
1	City of Woodland Storm Drainage Facilities Master Plan South Urban Growth Area – February 2017 – Revised: March 2018

cc: Mr. Brent Meyer, PE, SE, TE (w/o attachment) [Brent.Meyer@cityofwoodland.org](mailto:Brent.Meyer@cityofwoodland.org)  
Mr. Tim Busch, PE, PMP (w/o attachment) [Tim.Busch@cityofwoodland.org](mailto:Tim.Busch@cityofwoodland.org)

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*City of Woodland*  
Update to:  
Storm Drainage  
Facilities Master Plan  
South Urban Growth Area

*County of Yolo  
State of California*

*Revised: March 2018  
February 2017*



**WOOD RODGERS**  
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME



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## **APPENDICES**

- Appendix A Hydraulic Model Input Data (Digital Files Only – Provided on Separate Disk)
- Appendix B Hydraulic Model and Output Data (Digital Files Only – Provided on Separate Disk)
- Appendix C Supporting Documents
  - 1. Downstream Alternatives Comparison
  - 2. Phasing Plan
- Appendix D Cost Estimates

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## INTRODUCTION

In 2006, the City of Woodland (City) contracted with Wood Rodgers, Inc. (Wood Rodgers) to prepare an update to its Storm Drainage Facilities Master Plan (2006 SDFMP Update), identified as **Reference 1**. The 2006 SDFMP Update identifies the master drainage facilities that were required to support build-out of the City's growth areas in accordance with the City's 2002 General Plan (**Reference 2**). In 2009, the City proposed a number of changes to the Housing Element of its 2002 General Plan, which are outlined in **Reference 3**. Due to changes in the planned development and increasing pressure on the part of the development community to advance projects (projects specifically within the City's South Urban Growth Area), in 2013 the City contracted with Wood Rodgers to update the 2006 SDFMP. This report represents the update to the 2006 SDFMP with respect to the South Urban Growth Area, and has been prepared in accordance with Contract Modification No. 000260 of the Master Agreement between the City and Wood Rodgers.

The South Urban Growth Area includes those portions of the City that drain to the South Canal, which runs parallel to the extension of County Road 103 from County Road 25 to the City's Outfall Channel. The land draining to the South Canal is primarily located west of County Road 103 and south of Interstate 5 (I-5), and includes all lands draining to the Gibson Road corridor. The South Urban Growth Area and its associated drainage sheds are shown on **Figure 1**.

## BACKGROUND

In addition to the City's 2009 General Plan Update discussed above, a number of recent developments have occurred which require consideration within this 2006 SDFMP Update. Some of the more prominent developments are discussed below.

Shortly after publication of the 2006 SDFMP Update, Wood Rodgers performed an Alternatives Analyses for the City to investigate additional detention storage options, including the use of the North Gibson Ponds for stormwater detention. The North Gibson Ponds are located north of County Road 24 and east of County Road 102, and were historically operated by the City's Wastewater Treatment Plant (WWTP) to evaporate effluent wastewater. The City has modified its WWTP processes in a manner that eliminates the need for the drying beds and makes them available for storm drainage attenuation. To accommodate this change in land use, the City consolidated accumulated bio-solids from all of the North Gibson Pond cells into the southeast corner cell. Recently, the northwest corner of the North Gibson Ponds was re-purposed to accommodate the Woodland Davis Clean Water Agency (WDCWA) Regional Water Treatment Facility. In support of this new purpose, the northwest corner was raised using fill materials to

elevate it above the 100-year floodplain associated with Cache Creek. Because of this alternate use, the northwest corner of the North Gibson Ponds is no longer available for stormwater detention.

Several technical memoranda were developed specifically for the South Area to evaluate additional alternatives and to determine phasing requirements for the storm drainage facilities. In particular, more detailed assessments were conducted for re-sizing the 250-cfs South Canal Pump Station located at the downstream end of the South Canal. Alternatives considered to accomplish this included adding more storage south of I-5 (to reduce the pumping and conveyance requirements under I-5), and diverting flow eastward to Conaway Ranch where it would be stored and eventually pumped by Conaway facilities.

In 2006, significant development occurred within the upper reaches of the Farmers Central Corridor, including the City of Woodland Community and Senior Center and the Woodland Sports Park, located just west of State Highway 113 (SH 113) and south of Sports Park Drive. This City project, combined with a new subdivision project just north of Sports Park Drive, spurred the construction of a portion of the West Regional Detention Facility, as described in Reference No. 1 (hereinafter referred to as the West Regional Pond). As full development upstream has not yet occurred, the size of the detention facility as constructed was less than the ultimate configuration, but it will need to be expanded as future development occurs. It was necessary to update the SDFMP to reflect this development within the City's Farmers Central Corridor.

In 2009, the floodSAFE Yolo Pilot Program (of which the City is a part) commissioned the development of a Yolo County Hydrology Manual. This manual was prepared by Wood Rodgers to develop hydrologic standards for Yolo County (County), including county-wide design rainfall parameters. These updated design parameters result in higher rainfall totals than previously identified within the 2006 SDFMP Update. It was judged that this change potentially could increase the volume and flows associated with peak runoff, which would affect the size of the conveyance, storage and pumping facilities within the system. This update to the 2006 SDFMP Update uses the more recent hydrology and ensures that the City is appropriately sizing backbone facilities to mesh with future development proposals.

The 2006 SDFMP Update used a software program created by the Danish Hydraulic Institute entitled *MIKE Stormwater Management Model* (MIKE-SWMM). The MIKE-SWMM model is based on the US Environmental Protection Agency (EPA) model called EPA-SWMM. Because the MIKE SWMM model is no longer supported by its developer, and a more robust program is

available to evaluate the interaction between surface water and piped sub-surface water, this update to the 2006 SDFMP Update was performed using the Infoworks Integrated Catchment Modeling (ICM) software program developed by Innovyze, Inc. InfoWorks ICM is an integrated modeling platform that incorporates both urban and river catchments into a single numerical modeling program. It allows for integration of one-dimensional and two-dimensional hydrodynamic simulations, incorporating both above-ground and below-ground elements of catchments. This modeling program, used in conjunction with the updated 2009 Yolo County hydrology, results in an assessment of the City's drainage system that is significantly more accurate than the 2006 SDFMP Update.

### **INFORMATION MADE AVAILABLE BY THE CITY**

The City has overseen considerable work related to its storm drainage system. Several key elements of the drainage system were partially constructed, and were surveyed to capture their configuration since the 2006 SDFMP Update. The City provided Wood Rodgers with topographic field surveys for the modified layout of the North Gibson Ponds (as discussed above).

The City considered making a portion of the City's Regional Park site, located south of County Road 25 and east of County Road 102, available for use in the treatment of storm drainage runoff with the intention of meeting EPA National Pollution Discharge Elimination System (NPDES) requirements. Detailed easement information was provided by the City to delineate the available lands at the Regional Park site, which was considered in the development this SDFMP update. At the writing of this document, the City has determined that the feasibility of successfully operating a stormwater treatment facility is restricted on the Regional Park site. The low-lying areas on the site do become inundated under high water conditions and will still be considered available in the future as existing floodplain storage.

The City has provided planning-level street layouts in the vicinity of the West Regional Pond, which are used as a guide for determining the maximum footprint of the West Regional Pond to be constructed, and its interface with the future extension of Matmor Road.

The City has determined that the allowable side slopes for planning-level analyses at the West Regional Pond and the North Gibson Pond are to be 6H:1V for the West Regional Pond equal-to-existing slopes at the North Gibson Ponds, and 4H:1V for all other proposed detention facilities within the South Urban Growth Area.

The City has amassed considerable data regarding the size and location of its existing storm drain pipes, including associated manholes and drainage inlets. The City provided Wood Rodgers with a Geographic Information Systems (GIS) database containing this information. Wood Rodgers used this data as provided, with the exception of a few items containing conflicting or questionable data. Wood Rodgers documented these instances and, upon request, can provide a listing of the data not used.

## **ITEMS OF SPECIAL CONSIDERATION**

As was outlined in the 2006 SDFMP Update, there are several existing drainage features and conditions affecting flooding within the City that require special consideration and discussion. Many of these relate to the north area drainage shed and, because this update relates primarily to the south area shed, are not discussed at length in this report. Items of Special Consideration for the South Urban Growth Area include:

- City of Woodland Lower Cache Creek Feasibility Study
- East Main Street Pump Station
- Reclamation District No. 2035 (RD 2035) Highline Ditch
- City-County Drainage Interactions
- Stormwater Quality Regulations
- Groundwater/Surface Water Interaction

## **Lower Cache Creek Feasibility Study**

The City and the US Army Corps of Engineers (USACE) have studied various projects in the past to protect the City from flood flows that emanate from Cache Creek during storm events exceeding a 1-in-20-year event. When this level of storm occurs, the south bank of Cache Creek is overtopped, and lands within the northern and eastern parts of the City are impacted. Existing facilities, including I-5 and the Cache Creek Settling Basin (CCSB), have been shown to exacerbate this flooding. Significant work has occurred to define a feasible project that will address Cache Creek flooding by intercepting and conveying these flows north of the City and discharging them directly to the Yolo Bypass. This project is referred to as the Lower Cache Creek Feasibility Study (LCCFS), and is anticipated to result in a significant project designed to address

this threat. This work is currently on hold, and it is not clear when it will resume. The facilities discussed within this report are not sized to accept flood flows from Cache Creek, and a determination of the coincidence of a local flood event and a Cache Creek flood event has not been performed. This analysis anticipates that a separate project will be constructed to address the Cache Creek flooding threat and funding for its study; design and construction are separate from the Storm Drainage Facilities Master Plan (by way of a dedicated special district as defined under Proposition 218).

### **South Canal/East Main Street Pump Stations**

Currently, a connection exists between the South Canal Pump Station and the East Main Pump Station. Wood Rodgers understands that it is the City's desire to decouple these facilities in order to keep the City's two drainage areas hydraulically independent. Ultimately, it makes good operational sense to keep the connection for use during emergencies or when maintenance of one of the facilities is required; however, for the purpose of this analysis, the two systems are assumed to be hydraulically separated under Ultimate Conditions only. It is noted that, during the initial drafting of this report, the 30-cfs pump within the South Canal Pump Station was pulled for repairs and the pump station was determined to no longer be operationally viable. The analysis assumes the existing pump is in place and fully functional only for Baseline (2002) Conditions as this pump was fully operational in 2002. Future conditions pumping at the same location assumes new facilities will be constructed accordingly.

### **Reclamation District 2035 Highline Ditch**

The RD 2035 Highline Ditch is located south of I-5, parallel and immediately east of the City's South Canal. RD 2035 owns and operates this channel to convey water for irrigation and drainage purposes within the RD 2035 system. This facility serves as a barrier to overland flow originating west of the channel and flowing east toward the Yolo Bypass. As a result of this channel, land becomes flooded along the western side of the South Canal, near the City's WWTP ponds. While flooding over the top of the Highline Ditch does occur under baseline conditions, the intent of the SDFMP is to not worsen flooding influences on RD 2035 under future developed conditions (either upstream or downstream of the facility).

### **City/County Drainage Interactions**

Development within the City can have impacts on drainage patterns and flooding of surrounding lands within Yolo County (County). The City's SDFMP has been prepared to mitigate the impacts

of development and not worsen flooding conditions for County lands. Conversely, the action of land owners outside of the City (within Yolo County) can either improve or worsen flooding within the City. As described at a City-wide level in the 2006 SDFMP Update, flood storage and timing influences are present upon the rural lands surrounding the City that provides attenuation and dampening of peak flow. While the City cannot directly control land outside of its jurisdiction, the City can and should monitor conditions within the watersheds affecting it, and take the actions necessary to ensure that impacts to the City from County properties are fully mitigated.

### **Stormwater Quality Regulations**

Since the 2006 SDFMP Update, stormwater quality regulations have become more complex. At one time, stormwater quality regulations were focused primarily on controlling potential pollutants from migrating off-site during construction. In recent years, the focus has grown to include controlling runoff to prevent worsening downstream erosion resulting from amplified peak flows, even for smaller events. The effort to address stormwater quality in this SDFMP is limited to assessing some regional volume-based attenuating approaches which offer limited treatment benefits, but is not meant to be a thorough evaluation of all treatment actions necessary to meet the EPA's NPDES Phase II requirements. In general, this study/report assesses high flow conditions for sizing flood conveyance and attenuation facilities, and conservatively assumes that upstream treatment facilities will attenuate only smaller events with no significant reduction to peak flows or volumes during larger flood-producing storm events. Addressing all the requirements for meeting EPA and state regulatory permitting was beyond the scope of this report and should be addressed under a stand-alone stormwater quality document.

### **Groundwater/Surface Water Interactions**

In general, constructing facilities below the elevation of the existing groundwater brings complex construction, operation, and regulatory challenges. Conversion of the North Gibson Ponds to a stormwater detention facility may be complicated by the presence of groundwater at or near the proposed bottom of pond elevation. If the groundwater elevation is near or above the elevation of the pond invert, the installation of dewatering facilities (similar to what was performed previously for use changes at the North Gibson Ponds) could impact construction of the facility, increasing construction costs. Operationally, groundwater entering the completed basin would introduce long-term operational costs for pumping groundwater seasonally. Lastly, depending on the quality of the groundwater in the area, commingling groundwater with surface water within the pond may introduce regulatory complications, such as the need for a pond liner or a treatment process.

While historical data is available to characterize the general elevation and fluctuations in groundwater levels at the North Gibson Ponds, the City is engaged in projects that may change groundwater conditions in the future. These projects include the construction of the WDCWA intake on the Sacramento River (which will replace groundwater pumping currently occurring within the City), and the initiation of a groundwater recharge program within the City. The WDCWA project may also discharge water from time to time due to operations/cleaning, which may require surface containment near the plant. The impact on groundwater levels in the North Gibson Pond due to these projects should be assessed and considered in the final design of the North Gibson Ponds for stormwater detention and/or treatment capacity.

## **HYDROLOGY**

California Urban Level of Protection (ULOP) standards (enacted as part of Senate Bill 5 in 2007) require 200-year flood protection with respect to stream-related and riverine-related flooding (such as flooding from Cache Creek). This standard, however, does not apply to interior drainage analyses such as the City's SDFMP where contributing tributary watersheds are less than 10 square miles or where flood depths are less than three feet. Therefore, the proposed interior drainage system has been sized to accommodate a 100-year storm event. Both 100-year storm events, including the 100-year 24-hour and 100-year 10-day events were run. This level of analysis is also consistent with the City's current design standards.

Major considerations for assessing hydrology involve the evaluation of the surrounding terrain to define the areas, depressions, slopes, and present roughness conditions impacting surface water runoff. After the shape and size of the contributing terrain is defined, it is important to determine the ability of the area soils to permit infiltration, along with the potential for land uses such as commercial and residential development to limit infiltration. Lastly, the appropriate amount and distribution of rainfall must be applied (over time and space) to the terrain to determine how much runoff is generated, accumulated, and passed through the system.

Urban area runoff is significantly different than rural area runoff. Urban environments contain roofs, gutters, streets, pipes, and other barriers that redirect and concentrate runoff. Rural environments are generally unpaved and vegetated, are more permeable, and provide for a slower hydrologic response. In the previous 2006 SDFMP Update, two methods were utilized, and later merged hydraulically, to quantify the overall hydrologic conditions within the South Urban Growth Area. The urban runoff areas were modeled internally using the MIKE SWMM program "RUNOFF" module. These parameters and shed definitions from the 2006 analysis were re-utilized for this analysis and converted to the ICM format. Infoworks recalculates the runoff

and integrates the runoff-response using a coupled one-dimensional and two-dimensional terrain surface model. The shed boundaries and labels for the urban sheds in the InfoWorks ICM model are shown on **Figure 2**, and the parameters for each shed are provided in **Appendix A**. The areas depicted on Figure 2 are modeled with buildout development under baseline conditions except for the sub-watersheds located east of County Road 102, known as the Gateway development. The soil conditions and hydrologic soil groups present within the watershed (including areas within the City) are shown on **Figure 3**.

For rural areas, including areas converting from rural to developed land uses, the previous 2006 SDFMP utilized the USACE Hydraulic Engineering Center (HEC) HEC-1 software program to define large rural watershed runoff to the south and west of the existing City in 2002. These areas affecting the City downstream contribute runoff directly to the system through the Farmers Central Channel and remnant Willow Slough watershed. The Willow Slough watershed is large (approximately 162 square miles); however, the majority of the watershed runoff is diverted to the Yolo Bypass directly through the Willow Slough Bypass channel near Davis. The downstream portions of the Willow Slough watershed flow northeast under larger storms and collect at County Road 102 at a point approximately 2.25 miles south of the intersection of Gibson Road and County Road 102. The crossing at County Road 102 is not large enough to convey the entire 100-year peak flow, and excess stormwater spills northward, entering the South Canal watershed. The amount of water that spills into the South Canal (approximately 1,145 acre-feet during a 100-year 10-day event) is directly attributable to the capacity of the downstream Willow Slough channel culvert. County Road 102 is elevated above the surrounding ground, which results in the storage of water within the fields adjacent to and upstream of County Road 102. When the ponding in the fields reaches a certain elevation, it spills into the South Canal watershed before overtopping the roadway.

The contributing rural watershed boundaries were re-evaluated and re-delineated using updated higher-resolution topographic mapping. The extents of the topographic mapping are shown on **Figure 4**. No major change in the overall drainage area is noted; however, there was a shift in the contributing area designations at the intersection of SH 113 and County Road 27. Based on more detailed topography and aerial photo inspection (which was not available in 2006), the drainage at this intersection appears to stay north of County Road 27 and migrate across the railroad alignment eastward, as shown on Figure 4.

The remnant Willow Slough watershed is not directly tributary to the South Canal, but spills north under higher flow conditions. It is therefore important to define the storage and flow split

dynamics associated with the Willow Slough watershed. The final hydrologic determinations for the contributions of the Willow Slough watershed to the South Canal watershed were performed as part of the overall hydraulic analysis.

The percent-impervious parameters assigned to baseline condition watersheds are shown on **Figure 5**. Ultimate development conditions were modeled using the USACE Hydraulic Engineering Center Hydraulic Modeling Software (HEC-HMS). The percent-impervious parameters within HEC-HMS for ultimate conditions watersheds are shown on **Figure 6**. In previous master planning studies, it was possible to assign a single imperviousness value to a specific land use classification within the South Urban Growth Area. However, special considerations are necessary where the latest General Plan land use classifications do not clearly represent already constructed areas. It is prudent to re-examine areas that are already constructed to determine if the impervious area impact is greater or less than current design guidelines for the assigned land use classification. In other words, as newly developed areas (post 2006) may not have been constructed according to their land use classification, it is important to model runoff for them as they actually were constructed.

Wood Rodgers determined that a discrepancy exists between the land use classifications originally planned and those currently constructed within Spring Lake. Two different land use categories have been used to describe neighboring housing areas that have essentially the same impervious values. In such cases, the as-constructed runoff condition was used for runoff assessments performed under this study. Figure 6 represents these adjusted imperviousness values as well as some interpreted values to represent ranges of density for each of the new General Plan land uses.

Some interpretation was also required to define a single maximum runoff condition for land uses yet to be constructed. For future development within the Spring Lake Specific Plan, if a planned area is defined with a range of density (e.g.: 5 to 14 dwelling units per acre), it can be imperative to account for the higher range value of runoff volumes in the case that the development interests maximize their land use density options. However, for less defined planning of areas outside of the Spring Lake Specific Plan, there are some land uses defined with very wide ranges of density (and imperviousness) that could create very large differences in required mitigation. For example, the designation of a large planning area of “Single Family Development” with a range of 2 to 18 dwelling units per acre should not be expected to mitigate for runoff with all acres having 18 dwelling units per acre. For such conditions, Wood Rodgers selected a value slightly above average, as depicted on Figure 6. It will be the City’s responsibility to ensure that future development does not exceed the assigned runoff conditions by allowing development

imperviousness to exceed the study value, unless additional facilities are identified and constructed to mitigate increases.

Watershed delineations for the ultimate conditions using HEC-HMS are shown on **Figure 7**. Outlines of the watershed areas tributary to the West Regional Detention Pond and the South Regional Detention Pond are also provided for clarification, consistent with assumed future drainage paths and delineated areas used for sizing each detention pond. Watershed areas may be redistributed differently during the final design, which would require adjusting the modeling and potentially re-sizing both detention ponds.

The limits of topographic mapping used to determine baseline conditions are shown on **Figure 8**, and revised topographic mapping for defining changes associated with the ultimate conditions are shown on **Figure 9**.

The design rainfall values utilized in this SDFMP Update are consistent with currently-published Yolo County design rainfall parameters contained within the 2009 Hydrology Manual (**Reference 5**). The design rainfall is spatially and statistically variable across Yolo County, and all of the watersheds affecting the SDFMP lie within the County boundary. The rainfall determined under the 2009 Hydrology Manual is higher than the values used for the 2006 SDFMP Update, which was based on the design rainfall derived by Mr. Jim Goodridge in 1991. While the 2009 rainfall determination uses the same methodology as the 2006 SDFMP Update, the 2009 hydrology contains more years of rainfall data (including years with more significant storm events), resulting in an increase in mean annual rainfall and associated statistical projections. The rainfall data itself uses several spatial parameters and is too complex to convey on a single map. All topographic, soil, imperviousness, and rainfall data utilized for assessing hydrology under this study are available in the database files provided in **Appendix B**.

## HYDRAULICS

The flow of water over time is generally characterized in pipes and surface flow systems by its height (as measured in absolute elevation), depth, and velocity. In order to accurately assess the flow of water through a large City drainage system, a detailed numerical simulation model is required. The model should incorporate appropriately-defined geometries for system pipes, channels, and detention facilities as well as overland release corridors and storage areas. Much of the City's existing system (including the South Area watershed) cannot contain the 100-year storm event, and flows pass overland along City streets during the design event, dispersing and re-collecting downstream at the South Canal.

As noted above, the analysis for this update to the SDFMP for the South Area was performed using the InfoWorks ICM modeling software package. The InfoWorks ICM platform defines the node and link locations representing manholes and pipes, as well as a terrain mesh to allow pressure flow and sheet flow to propagate openly from node to mesh in the network. All inflow defined for urban sheds using InfoWorks ICM as well as inflow defined using HEC-HMS were injected into the hydraulic routing module of the InfoWorks model.

Summary tables containing the model input parameters for the InfoWorks model (including conveyance geometry and hydrologic/hydraulic parameters) is provided in Appendix A. Copies of the operational InfoWorks models are provided in Appendix B.

### **DOWNSTREAM BOUNDARY CONDITIONS**

There are three primary outflow locations in the InfoWorks model representing downstream boundary conditions. The first location defines overflow flooding from the southern rural sheds by modeling the restricted flow of water leaving the model under County Road 102 and forcing overflow northward into the South Canal system. The second location is the pumped outfall condition at the end of the South Canal, near Main Street. The third outflow location is along the length of the South Canal, flowing eastward over the RD 2035 Highline Ditch. There are also two small overflow locations where upstream areas of Gibson Road drainage spill northward into the Main Street shed; but these are relatively minor, and are caused by pipe and terrain attributes in the area of overflow.

The split flow condition at County Road 102 and the Willow Slough crossing is a complex interaction based on inflow entering the area upstream of County Road 102, the hydraulic capacity of the culvert under County Road 102, and the downstream channel capacity within Willow Slough. The downstream Willow Slough channel passes through a water supply regulating basin operated by Conaway Ranch. The backwater condition created by the basin influences water surfaces in Willow Slough Channel upstream to County Road 102. A key approach within the model to address this interaction between the basin elevation and the spilling upstream at County Road 102 is to assume that the regulating basin is at full capacity during the design storm, with any increase in the water from upstream resulting in a spill downstream over the basin rim elevation of 35 feet North American Vertical Datum of 1988 (NAVD 88) into depressed areas to the south. This overflow at the regulating basin is assumed to drain overland and no longer influence the upstream water surface at County Road 102 (keeping the County Road 102 water surface elevation at a minimum elevation of 35 feet NAVD 88).

Field examination of the culvert crossing beneath County Road 102 indicates that flow capacity has been restored since 2006, as our previous visits to the location indicated a significant buildup of silt within the culvert. It is assumed that Yolo County, or another entity with operation and maintenance responsibility for the culvert, removed the sediment. The measured size of the culvert opening is six feet (horizontal) by four feet (vertical). Field measurements were taken from the crown of the culvert to the crown of the road) and correlated with existing terrain mapping to locate the culvert vertically. It is important to note that the previous 2006 SDFMP Update modeled a smaller culvert crossing at this location due to the unavailability of as-built drawings and observation of heavy siltation. With the actual opening larger than previously anticipated, more water will be able to drain under County Road 102, reducing spills into the South Canal system. It is in the City's interest to monitor this culvert and work collaboratively with Yolo County to maintain its current, unobstructed condition.

The SDFMP has always envisioned pumping from the South Canal to the Outfall Channel. Low flows within the South Canal system are unable to drain by gravity to the Outfall Channel and Yolo Bypass. This is particularly true during high water events, when the Yolo Bypass flooding will backwater into the Outfall Channel up to elevations equivalent to County Road 102. The downstream end of the South Canal, just south of Main Street, historically has contained a dedicated pump station with a nominal capacity of 30 cfs. The South Canal is also currently connected to the East Main Pump Station, and it shares the capacity of this pumping facility with other City watersheds.

This analysis did not include the remodeling of the remainder of the City's watersheds (areas not tributary to the South Canal) using the InfoWorks software. Accordingly, for baseline conditions modeling only, the results of the 2006 MIKE SWMM modeling were used to represent the ability of the South Canal to drain water to the East Main Pump Station during the 100-year storm event.

As noted above, the direction of overland release for flows exceeding the capacity of the South Canal system is eastward, over the RD 2035 Highline Ditch. The crest elevations of the overflow points were defined using the best available topographic mapping, as discussed in the hydrology section of this report. More detailed field surveying could be performed to better understand how this flooding would occur; however, for the purpose of this study, the available topographic mapping was considered suitable. The InfoWorks modeling incorporated the terrain of the Highline Ditch as well as areas located to the east. Once the 100-year local watershed flooding overtops the Highline Ditch, the floodwaters no longer hydraulically influence areas within the South Canal system. The amount of flow spilling into Conaway Ranch under baseline conditions

must be carefully evaluated to establish baseline volume conditions for the overflow. This baseline volume is used to evaluate how proposed development within the South Urban Growth Area impacts the lands of Conaway Ranch.

## REVISED BASELINE CONDITIONS

The analysis for assessing impacts related to future development within the South Area, and its mitigation, must begin with an accurate assessment of the pre-project (baseline) conditions. This baseline condition modeling sets the base levels, which future development must not exceed. In the 2006 SDFMP Update, the level of development present (representing development in the time frame of 1998-2000) was accounted for and modeled using MIKE SWMM. The Gibson Road shed was modeled in detail at the time, based on as-built documentation provided by the City. Since that time, a more detailed inventory of existing pipes and drainage infrastructure was provided by the City to Wood Rodgers in GIS database format. Timeline aerial photography is also available via Google Earth, which provides a visible indication of development in the recent past (for comparison to current aerial imagery).

Using the updated information noted above, Wood Rodgers re-evaluated the baseline conditions associated with the 2006 SDFMP Update, and re-modeled the scenario using the InfoWorks ICM software. All geometric and topographical representations of the revised baseline condition model are provided in the GIS database files and the model input files in Appendix B.

Together, the 100-year 24-hour and 100-year 10-day flood inundation extents comprise the 100-year flood inundation map included as **Figure 10**. The longer-duration flooding at the downstream end of the South Canal governs worse-case flood conditions due to the amount of available floodplain storage combined with the South Canal's limited pumping capacity. Shorter duration storms generally govern where flood conveyance facilities are limited in their capacity and where storage is limited, as at the upper Gibson Road drainage corridor. Therefore, the combination of these two 100-year events was used to produce the envelope of anticipated flooding within this study.

As described earlier in the report, the Gibson Road drainage system was included in the model to identify how runoff from the City reaches and affects the downstream areas of the South Canal system. The extent of flooding within the upstream portions of the City is not the main focus of this study, and is assumed to remain unmodified for the purpose of sizing downstream facilities. The drainage from future development south of the Gibson Road corridor does not affect the Gibson Road watershed upstream of County Road 102. Therefore, the upstream flood inundation

shown is not intended to be a detailed map of present-day conditions. This is because areas within the Gibson Road shed reflect terrain conditions within the model for the 1998-2000 timeframe. Before beginning the preparation of a detailed flood map for this area, additional surveys are recommended for defining this portion of the urban drainage system. It is clear that the existing upstream system is unable to contain the 100-year storm event. If the City decides to implement local flood solutions for areas upstream of County Road 102 along the Gibson Road drainage corridor, these facilities will need to operate without worsening the flooding conditions downstream. The model developed as part of this study should provide a basis for more detailed future analyses.

As mentioned above in the Downstream Boundary Conditions section of this report, the City's drainage system overflows eastward into Conaway Ranch once flows exceed the current pumping and storage capacity of the South Canal system. Establishing the amount of spilling under baseline conditions is critical, as any future modifications must not increase spilling eastward. There are two main locations where water currently enters RD 2035 lands to the east during a 100-year local event and potentially affect baseline flooding conditions. The remnant Willow Slough watershed will pass a portion of upstream runoff under County Road 102, spilling higher flows north into the City's system. This spill eventually combines with other City sheds and backs up within the South Canal, overflowing across the High Line Ditch, as described above. As future conditions may marginally affect the Willow Slough spill hydraulics, it was considered necessary to consider both the flows over the High Line Ditch and the flows under County Road 102 as the total flow impact to RD 2035. The combined spilling flow hydrograph for the 100-year 10-day storm is shown on **Figure 11**. The maximum overflow volume for the entire storm is calculated to be 2,094 acre-feet.

## GENERAL PLAN UPDATE

The City is in the process of updating future development plans through the year 2035. This effort is being led by the Department of Community Development, and draft land use information was provided to Wood Rodgers, as shown on **Figure 12**. A summary of the land use and percent imperviousness associated with the proposed land uses within the South Area model are included below in **Table 1**. Table 1 shows the land use and its associated percent imperviousness used in the modeling, with some exception for the Public/Quasi-Public designation. This land use assignment (Public/Quasi-Public) within the South Area is broad and encompasses the City's Sports Park, as well as Pioneer High School and Woodland Community College. Different levels of imperviousness were assigned to these areas based on engineering judgment, as indicated on Figure 6.

**Table 1: Land Use and Percent Imperviousness**

Land Use	du/ac*	Source 1: Yolo County Dr. Man. (Table 12)	Source 2: City of Woodland Standards (Figure 4c)	% Impervious Applied in SDFMP	Comments
		% Impervious	% Impervious		
Business Park	n/a	n/a	90	90	
Community Commercial	n/a	n/a	90	90	Equivalent to "Neighborhood Commercial"
Corridor Mixed Use	13, Partially			78	For "Residential" area, 60% of the land as 13du/ac (Impv = 70%), 40% Commercial/office (Impv = 90%), Impv = 0.6x70+0.4x90 =78
High Density Residential	24	80	80	85	Recalculated based on observed constructed areas
Industrial	n/a	85	85	85	
Low Density Residential	5	40	40	75	Recalculated based on observed constructed areas
Medium Density Residential	13	70	70	80	Recalculated based on observed constructed areas
Neighborhood Commercial	n/a	n/a	90	90	
Open Space	n/a	2	2	2	
Public/Quasi Public	n/a	n/a	n/a	n/a	Percentage imperviousness is assigned based on the aerial image
Regional Commercial	n/a	n/a	90	90	Equivalent to "General Commercial"
Urban Reserve	n/a	n/a	2	2	
Specific Plan - Residential	8	60	60	60	Equivalent to "Residential 8-10 du/ac"

\* Provided by the City's planning consultant Dyett Bhatia, Urban and Regional Planners

For the areas designated as “Specific Plan – Residential”, the City provided the acreages and total maximum number of units indicated in the table. As these areas are not yet fully planned, the average number of dwelling units per acre (du/ac) was estimated to be eight du/ac. The associated imperviousness from the City’s standards was selected to be 75 percent to account for roadways and lots with houses and yards consistent with other previously constructed areas of similar density within the Spring Lake Specific Plan area.

The General Plan land use map shows that the area of the South Canal north of the North Gibson Pond and south of I-5 is to be fully built out. This development is assumed to be in place and contributing to runoff generated in the future conditions model; however, consideration should be given to maintaining an unobstructed easement area for the South Canal channel and force main connecting the North Gibson Ponds to the proposed South Canal Pump Station and draining to the existing Outfall Channel.

## **ULTIMATE CONDITIONS DRAINAGE**

### **Stormwater Quality**

There are three flow corridors within the South Area that were evaluated for supplemental stormwater quality treatment. Two of these corridors primarily serve new development runoff, while the third primarily serves previously developed land adjacent to the Gibson Channel (upstream of its confluence with the outflow channel of the East Regional Pond).

Stormwater quality must be fully addressed as part of any plan serving the South Area. In the 2006 SDFMP Update, stormwater quality treatment was addressed by constructing a stormwater quality basin at the deepest elevations of the East Regional Pond, and all new development drainage was directed to/through it. Originally, all runoff from land outside of the City’s plan area was collected and steered around the City in an “interceptor channel”. After further study of development alternatives and Regional Park constraints, a portion of the South Area development drainage was re-directed to be drained by the formerly named interceptor channel. The interceptor channel begins at the southwest corner of the Regional Park site, continues east across the southern border of the Regional Park site, then turns northeast to connect with the South Canal at County Road 25 and County Road 103. In Wood Rodgers’ previous studies, a stand-alone water quality treatment pond was proposed just upstream of County Road 102 when development was to be initiated. As such, this channel became an extension of the South Canal and this reach has been re-designated as the Upper South Canal. In 2014, this Upper South Canal did not convey development runoff, but collected runoff from surrounding agricultural lands; therefore, no water

quality treatment was being provided at that time. Once development runoff is introduced to this channel, the City has determined that the most feasible location for constructing downstream water quality facilities is south of County Road 25A and west of County Road 102, as shown on **Figure 13**. This water quality basin location can be designed to capture and treat all flows from lands within the City that are tributary to the Upper South Canal channel (see Figure 13). To enable diversion of water quality volume to the proposed basin area, the South Canal channel can be outfitted with a hinged diversion weir which will drop under high flow (pressure) conditions; this is known as a bending weir, which does not require electrical power. While undeveloped land to the south is spilling/entering the channel under high flow (flood) conditions upstream of County Road 102, the terrain is currently sloped/configured to direct all low flow from adjacent agricultural lands toward County Road 102 and southward to the Willow Slough channel, thus isolating development runoff from agricultural runoff during low flow conditions consistent with the NPDES stormwater runoff treatment requirements.

The East Regional Pond was originally configured to provide stormwater quality capture and treatment, and still provides storage capacity for the new definitions of tributary land. As the pond was designed to accommodate all development within the 2006 Spring Lake Specific Plan and remainder General Plan Areas, the redistribution of land to the Upper South Canal Channel allows for new General Plan changes to be more efficiently accommodated within the existing East Regional Detention Pond.

The third location where limited stormwater quality storage is proposed is the North Gibson Pond area, which has been re-designated the North Regional Pond area for purposes of this update. While the vast majority of new development is captured in the East Regional Pond and the proposed 25A/102 Basin, a significant portion of the existing City and a small percentage of new development associated with the Gateway II area cannot drain to either of these locations. Therefore, this SDFMP update proposes the option of constructing a low flow weir that would direct Gibson Channel flows into the North Regional Pond where they can be treated prior to commingling with flows from the East Regional Pond and Upper South Canal. The low flow weir would consist of a 24-inch separation wall constructed within the Gibson Channel to direct outflow from the Gibson Road watershed through two of the three box culverts that were constructed as part of WDCWA Water Treatment Plant improvements. After flowing through the new road crossing, water would be directed through two new 24-inch pipes constructed at the north bank of Gibson Channel (south embankment of the North Regional Pond) and into the North Regional Pond, as shown on **Figure 14**.

While the inclusion of regional stormwater quality features (specifically downstream volume capture) has been made a part of this SDFMP, these facilities should not be assumed to fully satisfy all future stormwater quality requirements. On-site water quality treatment facilities and their related costs are not included as a part of this SDFMP. In the future, if the City determines that downstream treatment facilities are no longer an effective means of meeting future permitting requirements, the proposed water quality treatment projects can be eliminated without impacting the operations of the flood conveyance and storage/pumping facilities being proposed under this plan.

### **Flood Conveyance and Detention/Pumping**

As designed, facilities that accommodate future growth within the City allow for the conveyance of 100-year storm flows without flooding adjacent properties. However, there are portions of the City that were constructed before the current design standards were in place, and may experience flooding adjacent to drainage facilities. The main focus of this SDFMP is to determine what facilities are necessary to serve newly-developed areas (including areas with runoff received from upstream developed lands). For the purposes of determining the impacts of baseline development on downstream facilities, detailed analyses were performed to assess the piping and overland routing of drainage through developed areas, as described above under Revised Baseline Conditions.

The proposed development drains along two corridors: the Farmers Central Channel and pipe extension upstream of Highway 113 draining the West Regional Pond, and the Upper South Canal along County Road 25A to the proposed South Regional Pond, as shown on Figure 13. These two drainage corridors incorporate upstream throttling of flows at detention facilities to limit the size of downstream conveyance facilities. No improvements are proposed to existing channel segments and downstream facilities until the flow reaches the North Regional Pond area, where new treatment and storage is proposed under ultimate conditions. However, the combined storm runoff which reaches the County Road 102 culverts at County Road 25A is larger than originally estimated due to updated County rainfall/hydrology and more detailed evaluations of spill leaving the Willow Slough channel. To effectively pass the updated peak flows eastward through the existing culverts, water must back up higher behind County Road 102 to an elevation of 39.8 feet (NAVD 88) for approximately 400 feet, transitioning to 39.9 feet approximately 1,500 feet further upstream. To achieve this level of inundation requires a channel design n-value of 0.030 both upstream and downstream of County Road 102, with zero feet of freeboard, in accordance with direction provided by the City. Operation and maintenance activities required for maintaining

0.030 roughness conditions will be developed by City staff. Based on the existing culvert capacity, the maximum flood elevation is still higher than baseline (2002) conditions peak elevations. To mitigate the level of impact associated with the proposed design water surface, it will require the purchase of a flood easement for the acreage that was not flooded under baseline conditions but is now flooded, as shown on **Figure 15**.

The West Regional Pond was analyzed as part of the 2006 SDFMP Update to capture and detain flow upstream of State Highway (SH) 113 before discharging it beneath SH 113 through the existing 60-inch-diameter pipe. Wood Rodgers ran the hydraulic model using the existing pond size and proposed development and found that the resulting 100-year water surface increases to an elevation of approximately three feet above existing roadway levels, flooding adjacent lands. Therefore, the size of the West Regional Pond must be increased beyond what was estimated in 2006. The resulting pond configuration is shown on **Figure 16**.

The proposed storage volume, with minor modifications required at the existing pond outlet pipe, results in a maximum 100-year water surface elevation of 54.35 feet. The pond operates as a peak flow throttling device and is intended to empty by gravity through the proposed downstream pipe and channel, as shown on Figure 13. The current pond configuration has a flat invert elevation that may need to be modified if the City wishes to explore incorporating recreational amenities within the pond. The ultimate pond configuration should incorporate a 10-percent to 15-percent volume contingency to support grading of recreational fields. Similarly, consideration should be given to constructing a low flow channel that would more quickly drain smaller, more frequent storm events, allowing use of any recreational amenities sooner.

The Upper South Canal drains a small portion of the Spring Lake Specific Plan Area, as well as a large portion of the development around the intersection of County Road 25A and SH 113. This area encompasses the area shown on the City's current Draft General Plan as "SP-1A", "SP-1B" and "SP-1C". The area tributary to the Upper South Canal under ultimate conditions is larger than previously planned under the 2006 SDFMP Update. Many downstream facilities have already been sized and constructed, based on the previous 2002 General Plan. With more land upstream now proposed for development, a new detention pond is needed to lower peak flows within downstream capacities. For purposes of this analysis, a new detention facility has been designated and identified as the South Regional Pond. It is located within the City, as shown on Figure 13; however, there is flexibility to move the facility to the east, outside of the plan area. This pond operates similarly to the West Regional Pond, detaining drainage and metering it out to downstream facilities at a designated rate. The detention pond requires a footprint of

approximately eight acres, with a bottom elevation of 38.4 feet (NAVD 88). For the 100-year storm event, the pond provides approximately 52 acre-feet of detention with a maximum water surface elevation of 46.8 feet (NAVD 88). The outlet pipe immediately downstream of the pond has been sized at 48 inches. It connects with the new channel facilities along County Road 25A and drains into the downstream existing channel. The peak flow exiting the South Regional Pond is approximately 119 cfs, with local runoff from development within the City reaching approximately 354 cfs at a location approximately ½ mile west of County Road 102. The peak flow in the section of channel immediately downstream of new development and upstream of County Road 102 is most heavily influenced by overflow from the Willow Slough watershed, which peaks later in the storm event.

The downstream system improvements can be effectively addressed by a combination of detention storage and pumping. The relationship between storage and pumping is inversely proportional, creating an opportunity for many alternatives which produce the same result to be considered. During the course of preparing the SDFMP Update, the City tasked Wood Rodgers with evaluating three downstream alternatives which provided essentially the same mitigation results with different facility configurations. A Technical Memorandum was prepared for the analysis and is included as **Appendix C**. The City has selected Alternative C as the preferred alternative, which is described in more detail below.

Currently, the North Regional Pond is excavated to approximately elevation 17 (NAVD 88) at the northern and eastern portions of the pond boundary. From this low point, the depth of the pond decreases to the south and west, as the invert of the pond rises approximately to elevation 22 or 23 (NAVD 88). There is no current hydraulic connection between the North Gibson Pond area and the South Canal, however, the North Regional Pond area can provide flood detention volume after being connected to the South Canal system. While the design and viability of detention storage may be heavily influenced by the presence of groundwater at the site, it is assumed that the current basin depth is at or above the normal seasonal groundwater elevations. The proposed alternative utilizes the existing excavated area which can drain by gravity to the South Canal under Interstate 5, through the existing culverts, to the new proposed South Canal Pump Station. Any deepening of the pond design will need to assess the implications of pumping seasonal groundwater or providing a means to separate surface water from groundwater (such as constructing a pond liner). While the City has had some recent experience with dewatering this area during the repurposing of cells within the North Regional Pond, any permanent dewatering of this pond will require coordination with regional and state permitting agencies. It is Wood Rodgers' understanding that there is soil present in the southeast cell of the North Regional Pond area above the invert of the

South Canal channel. Removal of this soil is not included as part of the preferred alternative configuration, as the preferred alternative utilizes existing storage and adds pumping capacity to mitigate impacts. If the City is able to negotiate the removal of additional soil volume, this may lessen the requirement for proposed pumping.

Under ultimate conditions, all peak flow from the Gibson Channel watershed and South Canal watershed must reach the North Regional Pond through the existing channel system to a newly constructed inlet weir at the pond. At the same time that the overflow weir is constructed, a gravity pipe outlet structure (with flap gate) must be constructed to drain detained water from the pond. Wood Rodgers proposes that the inlet weir and gravity outlet pipe be constructed at the same location near the northeast corner of the North Regional Pond, as shown on **Figure 17**. This configuration essentially forces all high flow water from the South Urban Growth Area to flow in the South Canal along the eastern edge of the North Regional Pond before reaching the weir. To help facilitate this flow, Wood Rodgers recommends the removal of the existing culvert crossing of the Gibson Channel approximately 980 feet west of its confluence with the South Canal. A new larger culvert crossing was constructed in 2014 by the Davis Woodland Water Treatment Facility near the southwest corner of the North Regional Pond area, which allows operational access to the North Regional Pond, rendering the older smaller culvert crossing to the east unnecessary.

The City's preferred scenario evaluated the pumping that would be required if the North Regional Pond storage was connected in its current configuration (with an invert elevation ranging from 17 to 19 feet, and the southeast corner much higher), utilizing only the detention storage that can drain by gravity to the existing South Canal channel above elevation 25 feet (NAVD 88) as flood control storage. To fully mitigate development impacts, a new pump station would need to be constructed at the north end of the South Canal, just south of Main Street, with an ultimate pumping capacity of 120 cfs, as shown on **Figure 18**. The proposed pump station serving the lands adjacent to the South Canal would accommodate all South Area runoff and would allow decoupling the South Area's connection to the East Main Street pump station during a storm event, as described in the section entitled "South Canal/East Main Street Pump Stations". With the final combination of storage and pumping, the maximum spill over the High Line Ditch onto RD 2035 lands remains below the baseline condition volume.

With all the storage and conveyance facilities as described in place (and reflecting the connection of the North Regional Pond to the South Canal and the construction of 120 cfs pumping at the downstream of the South Canal), the combined spilling flow hydrograph for the 100-year 10-day

storm is shown on **Figure 19**. The maximum overflow volume for the entire storm is calculated to be 2,047 acre-feet.

Downstream of the proposed South Canal Pump Station, the City's Outfall Channel drains all storm runoff from the City, including water that is pumped from the East Main Street and North Canal pump stations. All flow from the City is pumped (lifted) into the Outfall Channel and then flows by gravity through the existing three 48-inch culverts under the west levee of the Yolo Bypass. As described in the 2006 SDFMP, the Outfall Channel outlet to the Yolo Bypass is not capable of conveying the full build-out pumped flow from the City's pump stations without overtopping the railroad embankment south of the Outfall Channel and flooding I-5. Currently, during high flow conditions, the City must monitor the Yolo Bypass and Outfall Channel to ensure that the City's pumped outflow does not overwhelm the Outfall Channel and cause a failure of the containing embankment.

The baseline condition modeled the capacity of the Outfall Channel outlet based on the pumps and their respective sizes that were in place in 2002. The largest pumped flow that could be safely accommodated was determined to be approximately 230 cfs, which is a combination of two pumps from the East Main Street Pump Station, and the South Canal Pump Station (operational in 2002). The Outfall Channel outlet structure was re-evaluated by Wood Rodgers with the proposed ultimate pumping capacity of 120 cfs from the South Canal Pump Station, pumping independent of the City's other pump stations during a storm event. With the implementation of the ultimate South Canal Pump Station, the same flow from the other pump stations cannot be accommodated through the outlet without increasing peak stages in the Outfall Channel. It is important that peak stages in the Outfall Channel not be increased because there is insufficient freeboard in the Channel to contain the flow. In addition, the outflow from the other pump stations cannot be diminished to offset increases from the South Canal Pump Station without creating impacts upstream of these pump stations. Therefore, the capacity of the Outfall Channel and outlet must be modified to accommodate the increase in peak flow created by the ultimate South Canal Pump Station.

The majority of flow through the Outfall Channel will ultimately be generated by the gravity drainage of the City's North Area and the pumped outflow from the East Main Street pump station, with a combined peak flow of approximately 1,323 cfs during the 100-year event, as described in the 2006 SDFMP. The addition of 120 cfs to the Outfall Channel by the South Area increases the total peak flow to 1,443 cfs, an approximate 10.7 percent of the peak flow conveyance capacity. It is uncertain when the gravity flow Outfall Channel configuration will be realized to mitigate North Area development relative to development proceeding in the South Area.

The 2006 SDFMP proposed an open channel connection from the Outfall Channel to the Yolo Bypass by removing the existing culverts and a short segment of the Yolo Bypass West Levee and constructing an open-span bridge over the Outfall Channel. This open connection of the Yolo Bypass to the Outfall Channel would essentially make the Outfall Channel an element of Yolo Bypass system, potentially subjecting it to significant federal flood control system design, construction, and operational criteria. As the environment surrounding federal flood control criteria has evolved substantially since the 2006 SDFMP update, this open type connection is no longer recommended.

To maintain a separation between the Outfall Channel and the Yolo Bypass, a culvert structure could be constructed that would act to drain City outflows when the Yolo Bypass water levels are low, and remain closed when the Yolo Bypass is experiencing higher flows and the City of Woodland is experiencing low or no local runoff. A multi-barrel circular pipe culvert outfitted with flap gates at the downstream end and incorporating a flow closure devices could be constructed. For the ultimate flow of 1,443 cfs, five 72-inch reinforced concrete pipe (RCP) culverts would be required.

### **SPRING LAKE SPECIFIC PLAN (PHASE 1)**

The South Area is anticipated to build out in phases, which may allow for phasing of supporting storm drainage infrastructure. A more in-depth phasing analysis technical memorandum was prepared by Wood Rodgers and is included in Appendix C of this document. For purposes of the overall SDFMP, the main phase of development for the South Area is considered as the full buildout of the Spring Lake Specific Plan. This SDFMP update included analysis of the ultimate buildout condition for the Spring Lake Specific Plan Area, with all other proposed development in the South Area in the watersheds shown on Figure 4 left unconstructed. The Spring Lake phasing analysis did include development of the watersheds within the existing City west of County Road 102, shown on Figure 2. Based on a phasing analysis of Appendix C, it was determined that existing drainage facilities in place today are not sufficient to mitigate the full impact of the Spring Lake development and the remaining General Plan area without increased pumping from the South Canal to the Outfall Channel. Some elements of the ultimate drainage plan serving the Spring Lake area have already been constructed, including the East Regional Pond and upstream conveyance facilities, and these facilities are proposed to remain as constructed. Since the previous phasing analysis and SDFMP update, the South Canal Pump Station has become inoperable and would be expensive to return to a safe and operable condition. The City directed Wood Rodgers to evaluate the future phasing without the South Canal Pump Station being in operation. The

remaining capacity for pumping South Area runoff resides in the East Main Street Pump Station, just north of Main Street. The East Main Street Pump Station simultaneously pumps water from three main inflows, the smallest of which is the South Canal connection. These three inflows are flowing at different rates at different times, competing for the same limited pumping capacity throughout the simulation. The South Canal flows at the lowest elevation in the system and will only flow by gravity to the East Main Street Pump Station when the other two inflows are lower than the maximum pumping capacity. Under baseline conditions the East Main Street Pump Station was operating at two-thirds capacity during the 100-year storm, when the South Canal pump was also operating. Therefore, eliminating the South Canal pumped discharge capacity forces that water to back up and potentially overflow, with no additional pumping capacity being added.

Given the existing facilities and the proposed ultimate facilities, the most economical first increment of flood mitigation would be the integration of the existing (currently excavated) North Regional Pond volume into the SDFMP. This would include the construction of the ultimate weir to direct flow into the North Regional Pond, and a new gravity outlet to the South Canal to drain all volume by gravity through the existing South Canal to the existing pumping capacity available at the downstream end of the channel. The analysis supporting this recommendation assumes that all currently-constructed detention facilities associated with the South Canal are in place and functional. **Figure 20** provides a summary of watershed boundaries for Spring Lake conditions, with **Figure 21** summarizing the percent imperviousness applied to each watershed area.

Adding the available (currently excavated) gravity detention storage alone does not fully mitigate development of the entire Spring Lake Specific Plan area with the South Canal Pump Station removed. In order to offset the impacts of the full development of Spring Lake, it is necessary to construct a portion of the new South Canal Pump Station as well in order to assist in draining the currently available storage area down to dewater the South Canal system into the City's Outfall Channel. Wood Rodgers added one-fourth of the total South Canal Pump Station of 120 cfs (30 cfs) as pump capacity for mitigating Spring Lake development, leaving the South Canal temporarily connected to the East Main Street Pump Station. With this configuration, the maximum water surface elevation in the South Canal is below baseline conditions, which is at an elevation of 33.3 feet (NAVD 88). Flow over the RD 2035 Highline Ditch still occurs, and the resulting overflow hydrograph is shown on **Figure 22**. The maximum volume entering RD 2035 lands under Phase 1 conditions is 1,800 acre-feet, which is 294 acre-feet below the baseline 100-year overflow conditions cited above. From a flood perspective, the addition of existing North Regional Pond detention volume and the new pump station is very close to being sufficient to

offset the impacts of full Spring Lake development. With some iteration, the exact pumping capacity needed to serve only the Spring Lake development could be determined. This would be informational, but unnecessary as pump stations are typically designed with even increments of pumping, and 30 cfs is an even increment to select. Using modeling of Spring Lake development without additional pumping and estimating changes in runoff volume due to development, Wood Rodgers estimates that the increment needed to serve Spring Lake only as approximately 21 cfs. With the increment of 30 cfs being added, Wood Rodgers estimates that approximately 80 acres beyond Spring Lake could be served while keeping the temporary East Main Street Pump Station connection. To reiterate, the full buildout of development within the Spring Lake Specific Plan boundary (including all school/college properties), as well as development within the existing City west of County Road 102 (from Figure 2), are considered as developed under this scenario. Lands east of County Road 102 and otherwise outside of the Spring Lake Specific Plan boundary are not developed under the Spring Lake Specific Plan Phase A analysis, consistent with their runoff conditions under baseline conditions. Moving from baseline to developed conditions necessitates the addition of new drainage facilities into the model which, in turn, necessitates regeneration of residual mesh coverage and re-interpolation of existing terrain. Due to this slight mesh variability, the hydraulic accuracy of the estimates of High Line Ditch overflow in the developed models (pre- and post-development conditions) is not exact; however, it is considered reasonable to quantify the level of estimated mitigation needed. Considering the long flat weir overflow conditions and long duration storm simulation, 294 acre-feet is less than 15 percent of the total volume reaching RD 2035. Wood Rodgers recommends that the phased mitigation for Spring Lake development be satisfied with the construction of the South Canal Pump Station at 30 cfs and the gravity connection of the North Regional Pond detention storage.

The Spring Lake Specific Plan development requires the full protection from out-of-bank flooding at the Upper South Canal upstream of County Road 102. As discussed previously, Figure 15 depicts the maximum extent of flooding at this location due to the blockage and redirection of flow from northern development and the estimated flood easement area that is necessary to mitigate the increases caused by development. Containment of flooding north of County Road 25A is achieved by new roadway and development grading, with the level of freeboard approved by the City under improvement plan review to contain the elevation of 39.8 feet near County Road 102 directed by the City.

## PROPOSED DRAINAGE FACILITIES

The maximum flooding associated with the 100-year event from local watershed contributions is contained within the existing system and proposed system improvements, as shown on Figure 13.

The Ultimate Conditions floodplain with all proposed storm drainage system improvements in place is shown on **Figure 23**, including peak flows and maximum 100-year water surface elevations. Spilling associated with the 100-year event from the South Canal over the Highline Ditch, as well as through the Willow Slough channel, is shown on Figure 19.

Some upstream elements of the 2006 SDFMP may still be necessary, depending upon design decisions that may be made by upstream development interests. For instance, the piping layout upstream of the West Regional Pond assumes a single pipeline flowing east along the Farmers Central alignment, with a sediment trap located at the upstream end to prevent siltation of downstream facilities. Once upstream development and associated street layouts are designed, the final pipe layouts and sizing can be finalized. The majority of storm drain pipe construction will be on a project-by-project basis directly associated with phases of development. Those storm drain facilities that are considered regional are included under this SDFMP update.

## ESTIMATED CONSTRUCTION COSTS

Wood Rodgers has prepared a planning-level cost estimate for construction of major facilities that have yet to be constructed, as shown on Figure 13. The tables containing these estimated quantities and costs are provided in **Appendix D**. These cost estimates can be utilized under future efforts by the City to perform cost allocation analysis and to determine potential revised drainage fees for future development. The changes that have occurred to the master plan facilities in the South Area warrant revisiting the cost allocations previously determined, which is being documented under a separate report. The previous cost allocation analysis was performed by Wood Rodgers as part of the 2006 SDFMP Update effort for the entire City and is simultaneously being updated under a separate document.

## CONCLUSIONS AND RECOMMENDATIONS

The proposed South Area ultimate development can be mitigated with new detention storage at the North Regional Pond area and the proposed South Canal Pump Station to drain the South Canal system with effectively-sized upstream conveyance and detention facilities, as shown on Figure 13.

The Spring Lake Specific Plan area can develop by incorporating the available gravity detention storage volume within the existing North Regional Pond with new pumping facilities operational at the South Canal with a minimum pumping rate of 30 cfs. The ultimate pumping capacity of the proposed South Canal Pump Station allows for the disconnection of the South Area watershed from the East Main Street Pump Station watershed.

Final design and cost estimates for the North Regional Pond and pump station may require additional review to understand what the potential is for groundwater and surface water to be commingled, and for design measures to keep them separate.

Final water quality treatment requirements for a NPDES Phase II community may necessitate the addition of on-site treatment facilities in excess of the proposed downstream volumetric enhancements discussed within this SDFMP Update.

The entire City drainage system is interconnected and behaves as one system under current conditions because of the cross flows and connections of all storm drains to the East Main Street Pump Station. Modeling of the South Area should be integrated with the remainder of the City to verify assumptions for baseline conditions, including overflows from the Gibson Road watershed into other areas within the City. If any changes to the SDFMP are contemplated for the rest of the City, these changes should be evaluated together with the South Area in order to ensure that all facilities work in a complementary and efficient fashion.

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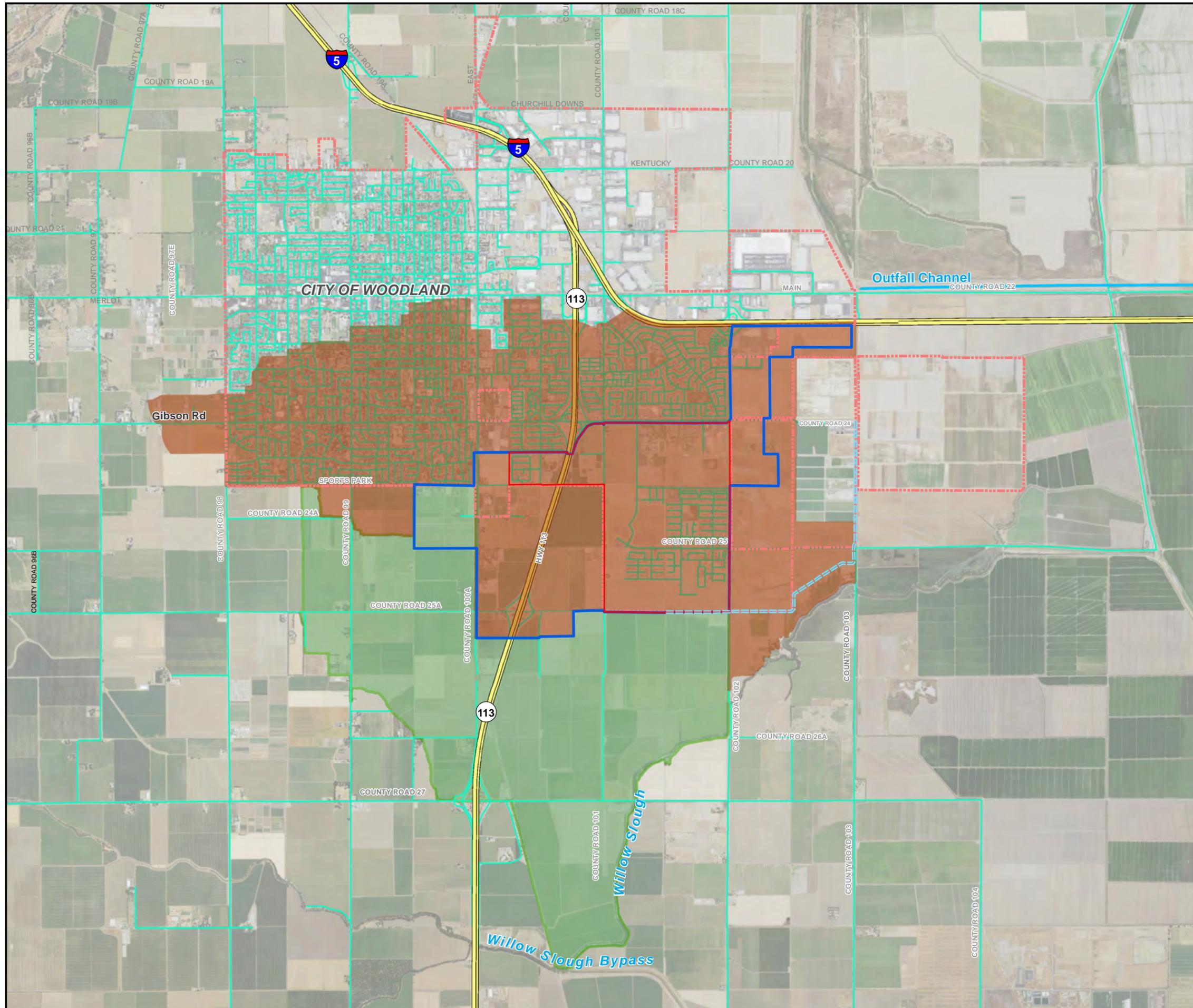
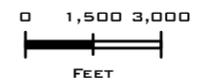
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3. Wood Rodgers, City of Woodland Storm Drainage Facilities Master Plan Update and Preliminary Engineering, February 22, 2006.
4. Wood Rodgers, Technical Memorandum, South Area Storm Drainage Master Plan, August 19, 2008.
5. Wood Rodgers, Yolo County City/County Drainage Manual, February 2010.
6. City of Woodland, Spring Lake Specific Plan, December 18, 2001.

## Figures



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA**  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE

-  SouthCanal
-  Boundary of Spring Lake Development
-  City of Woodland Boundary
-  Ultimate General Plan Outline
-  South Urban Growth Area Associated Drainage Sheds
-  Outfall Channel
-  Street Centerlines
-  Portion of Willow Slough Shed that overflows to South Canal

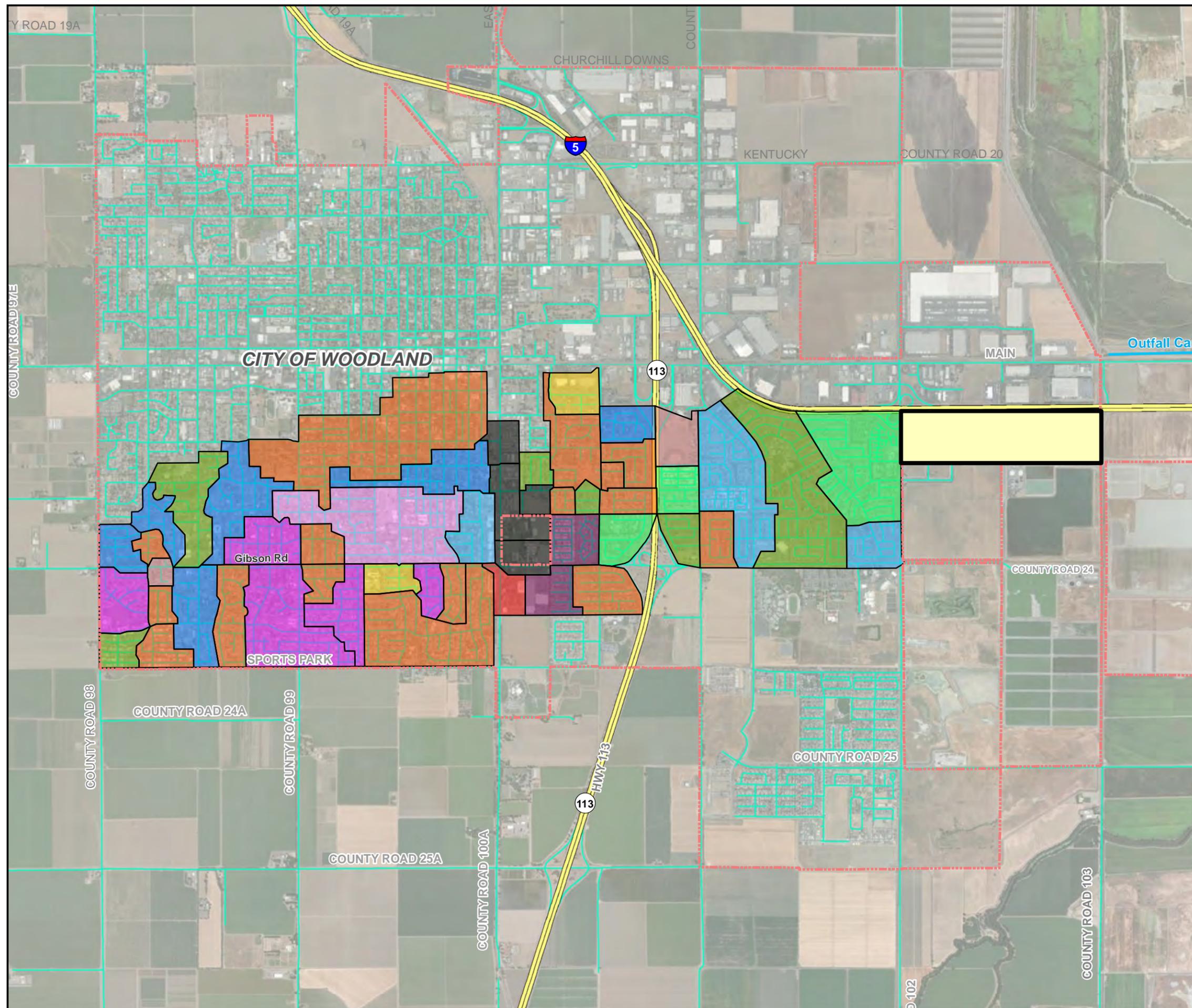


**SOUTH CANAL DRAINAGE AREA -  
PROJECT VICINITY**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA**

WOODLAND, CA  
FEBRUARY, 2017 - UPDATE  
REVISED MARCH 2018

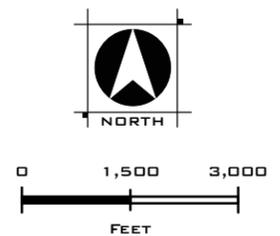


City of Woodland Boundary  
 Street Centerlines  
 Outfall Channel  
 ICM Watershed Boundaries

**Average Percent Imperviousness**

26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
51 - 55
56 - 60
61 - 65
66 - 70
71 - 75
76 - 80
81 - 85
86 - 95

2 (BASELINE), 76 - 80 (ULTIMATE)

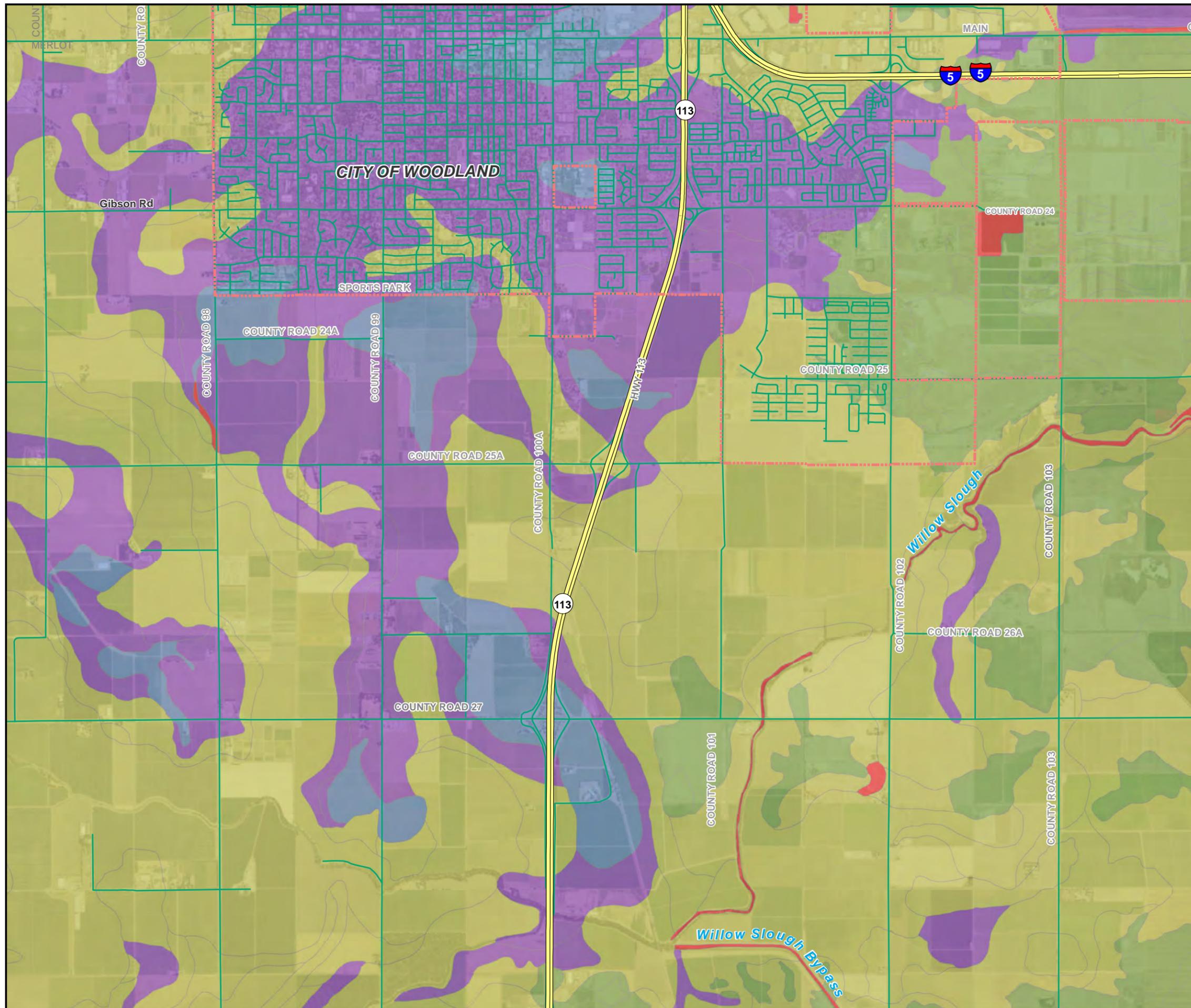


**BASELINE/ULTIMATE CONDITIONS  
URBAN WATERSHEDS IN INFOWORKS**



FIGURE 2

**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**

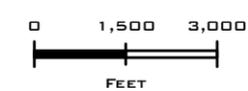


**City of Woodland Boundary**  
 City of Woodland Boundary

**Street Centerlines**  
 Street Centerlines

**Hydrologic Soil Group**

- Others \*
- A
- A/B/C
- A/C/D
- B
- B/C
- B/C/D
- B/D
- C
- C/D
- D



**NOTES:**  
 Soil Data obtained from the Natural Resources Conservation Service (NRCS) website; data version dated December 17, 2013.

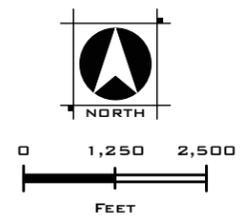
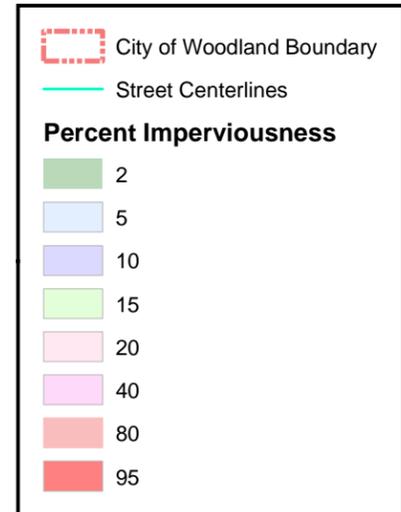
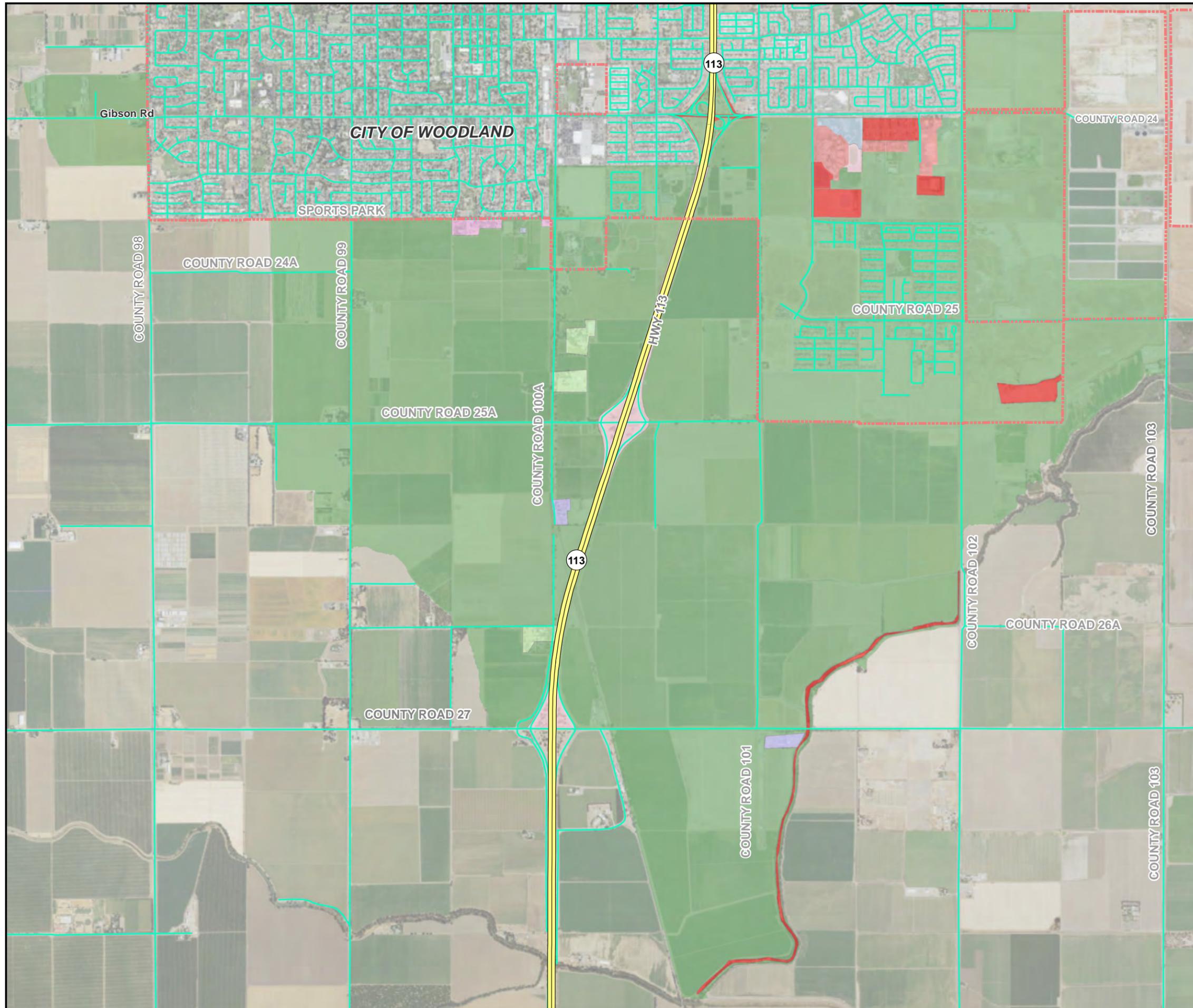
\* Hydrologic soil groups that are not defined in the NRCS data (here named as "Others") are considered to be Soil Type D, to calculate runoff.

**SOIL MAP**





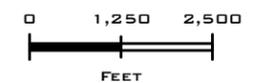
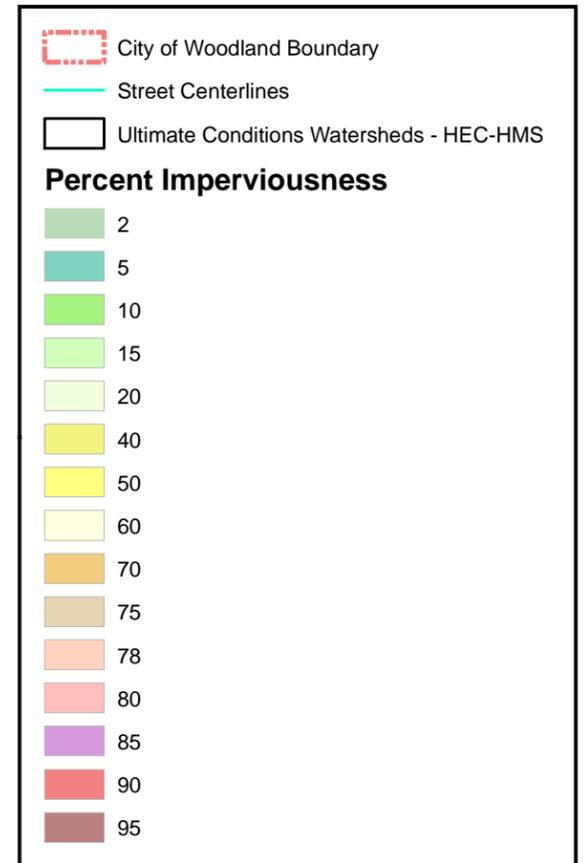
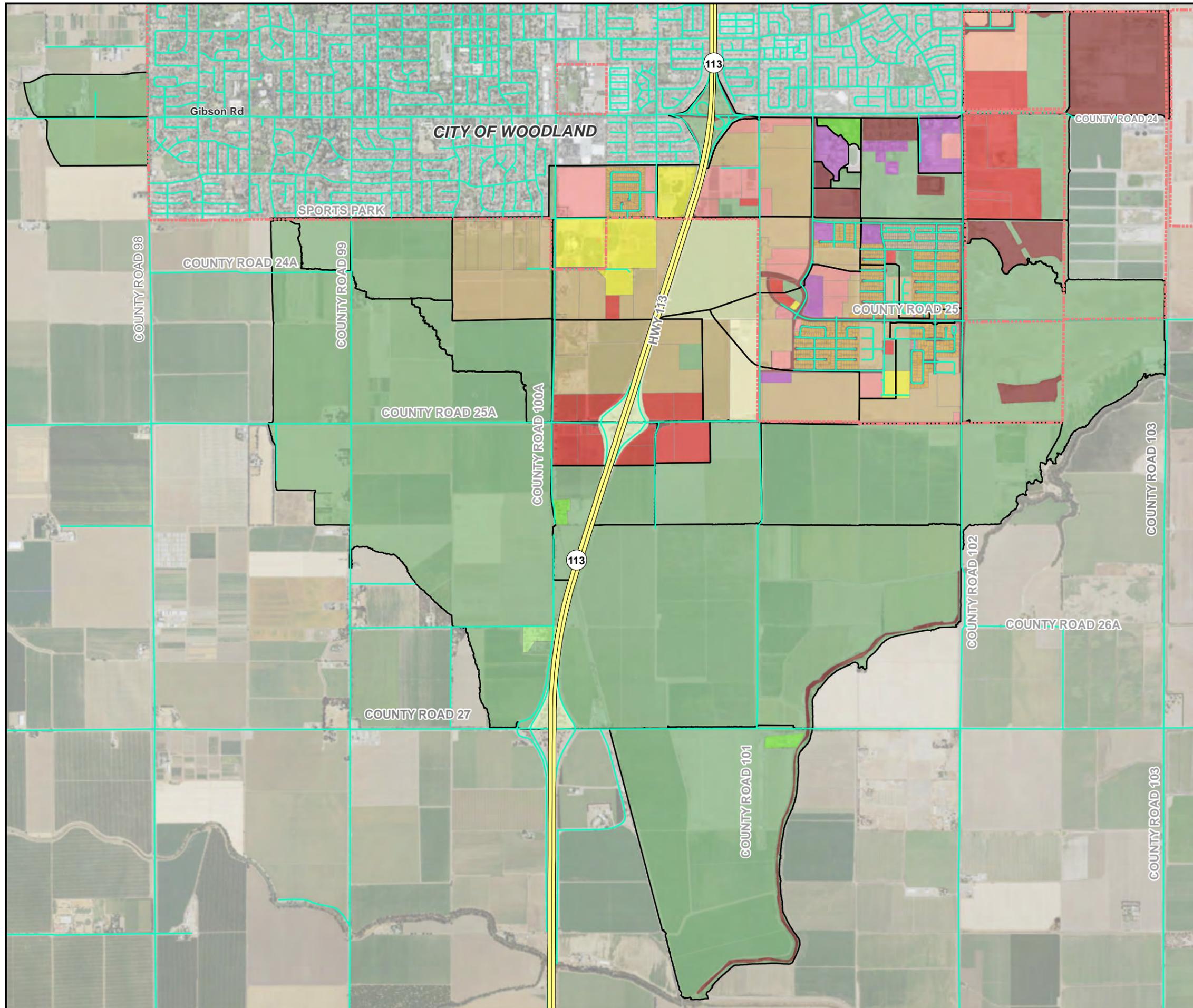
**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**



**PERCENT IMPERVIOUSNESS -  
BASELINE CONDITIONS**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**



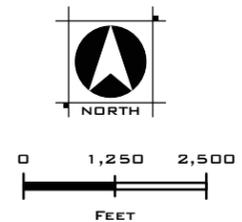
**PERCENT IMPERVIOUSNESS -  
ULTIMATE CONDITIONS**



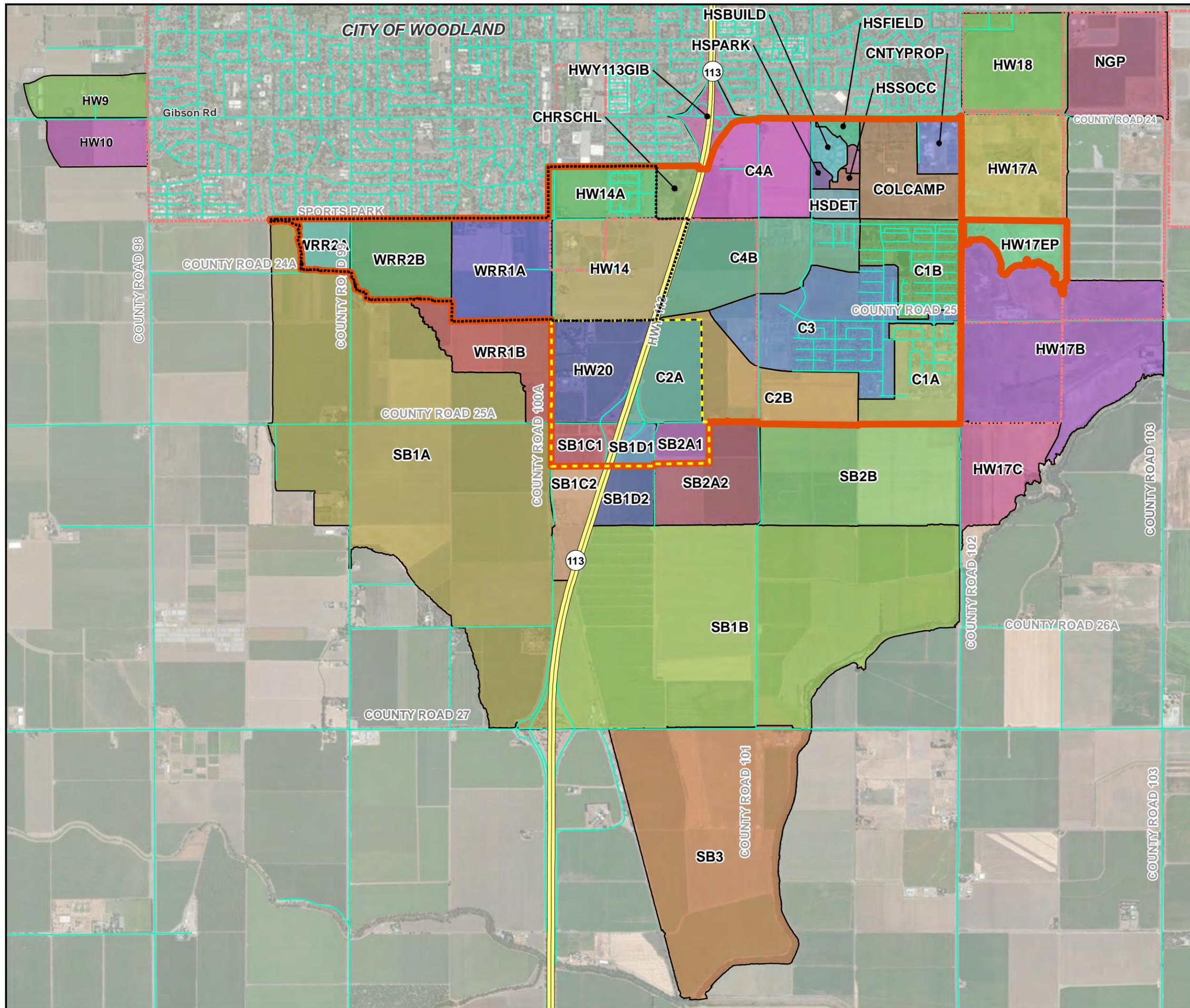
**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA**

WOODLAND, CA  
FEBRUARY, 2017 - UPDATE  
REVISED MARCH, 2018

-  City of Woodland Boundary
-  Street Centerlines
-  Ultimate Conditions Watersheds - HEC-HMS
-  West Regional Pond Tributary Area
-  East Regional Pond Tributary Area
-  South Regional Pond Tributary Area

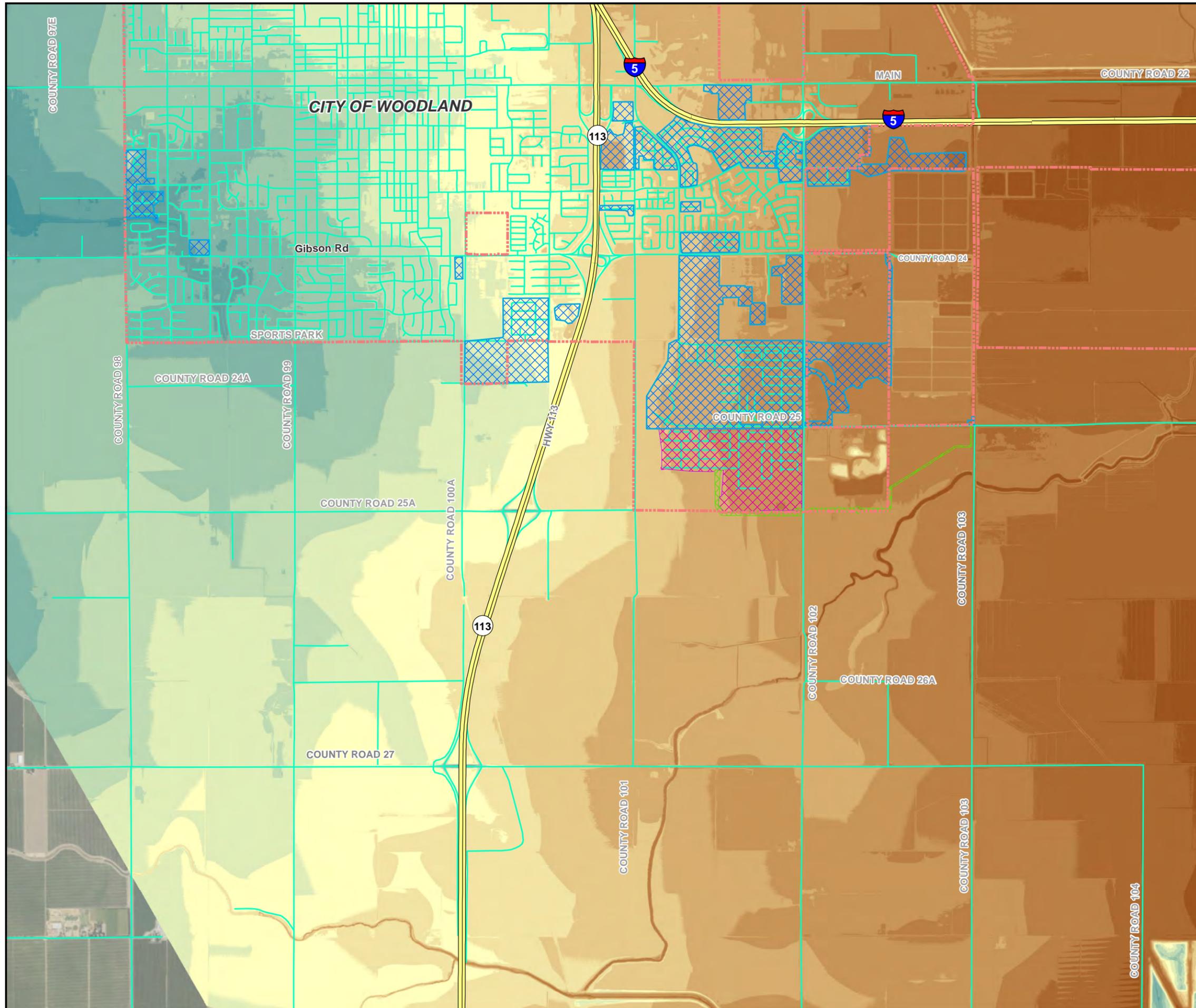


**ULTIMATE CONDITIONS WATERSHEDS -  
HEC-HMS**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA**

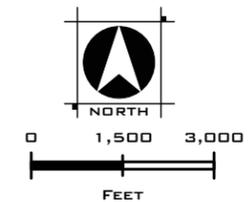
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE



**City of Woodland Boundary**  
 City of Woodland Boundary  
 Street Centerlines  
 Modified From LiDAR \*\*  
 Intermap Topo\*\*\*\*  
 USACE Topo\*\*\*

**Elevation (ft)\***

	21 - 25
	26 - 30
	31 - 35
	36 - 40
	41 - 45
	46 - 50
	51 - 55
	56 - 60
	61 - 65
	66 - 70
	71 - 75
	76 - 80
	81 - 85
	86 - 90
	91 - 95



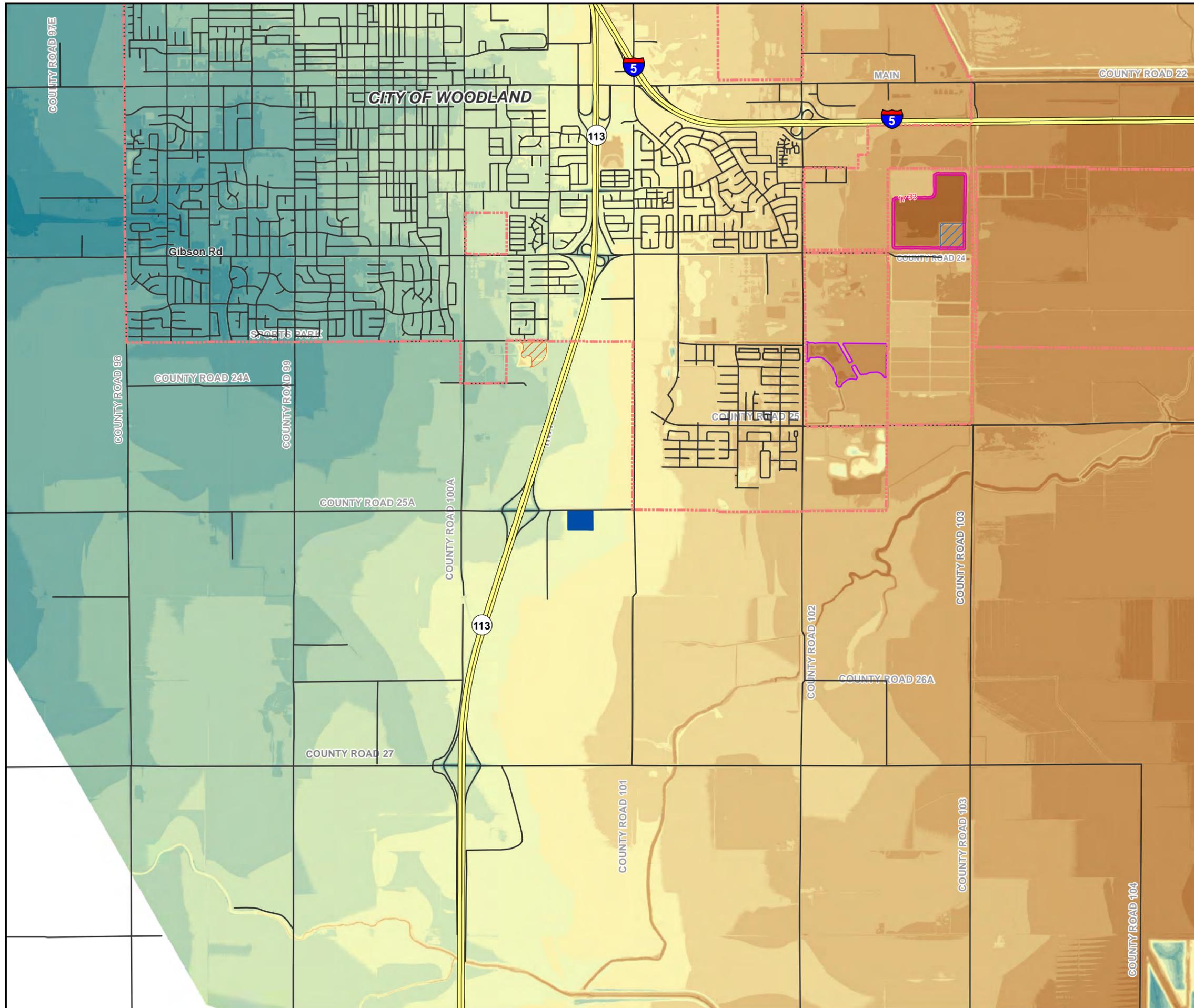
**NOTES:**

- \* Primary Source of the topo is the LiDAR data collected in 2008 by the California Department of Water Resources. This has been replaced by the data from the following sources in order to reflect the "Baseline Conditions."
- \*\* LiDAR data is "flattened out" using the topo at the banks of the canal that existed in 2008.
- \*\*\* Survey data by the US Army Corps of Engineers performed in 2000.
- \*\*\*\* Digital Terrain Model (DTM) data by Intermap Technologies, Inc. dated 2003.

**BASELINE CONDITIONS TOPOGRAPHY**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**

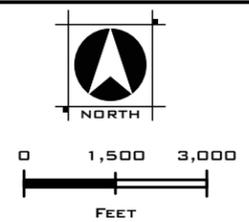


**Legend**

- City of Woodland Boundary
- Street Centerlines
- Extension of West Regional Pond (Bottom Elevation = 46.5 ft)
- Extension of North Gibson Pond (Bottom Elevation = 17.0 ft)
- Reggraded North Gibson Pond Contour \*\*
- Proposed Detention Pond (Bottom Elevation = 38.4 ft)
- East Regional Pond \*\*\*

**Elevation (ft) \***

	17
	18 - 20
	21 - 25
	26 - 30
	31 - 35
	36 - 40
	41 - 45
	46 - 50
	51 - 55
	56 - 60
	61 - 65
	66 - 70
	71 - 75
	76 - 80
	81 - 85
	86 - 90



**NOTES:**

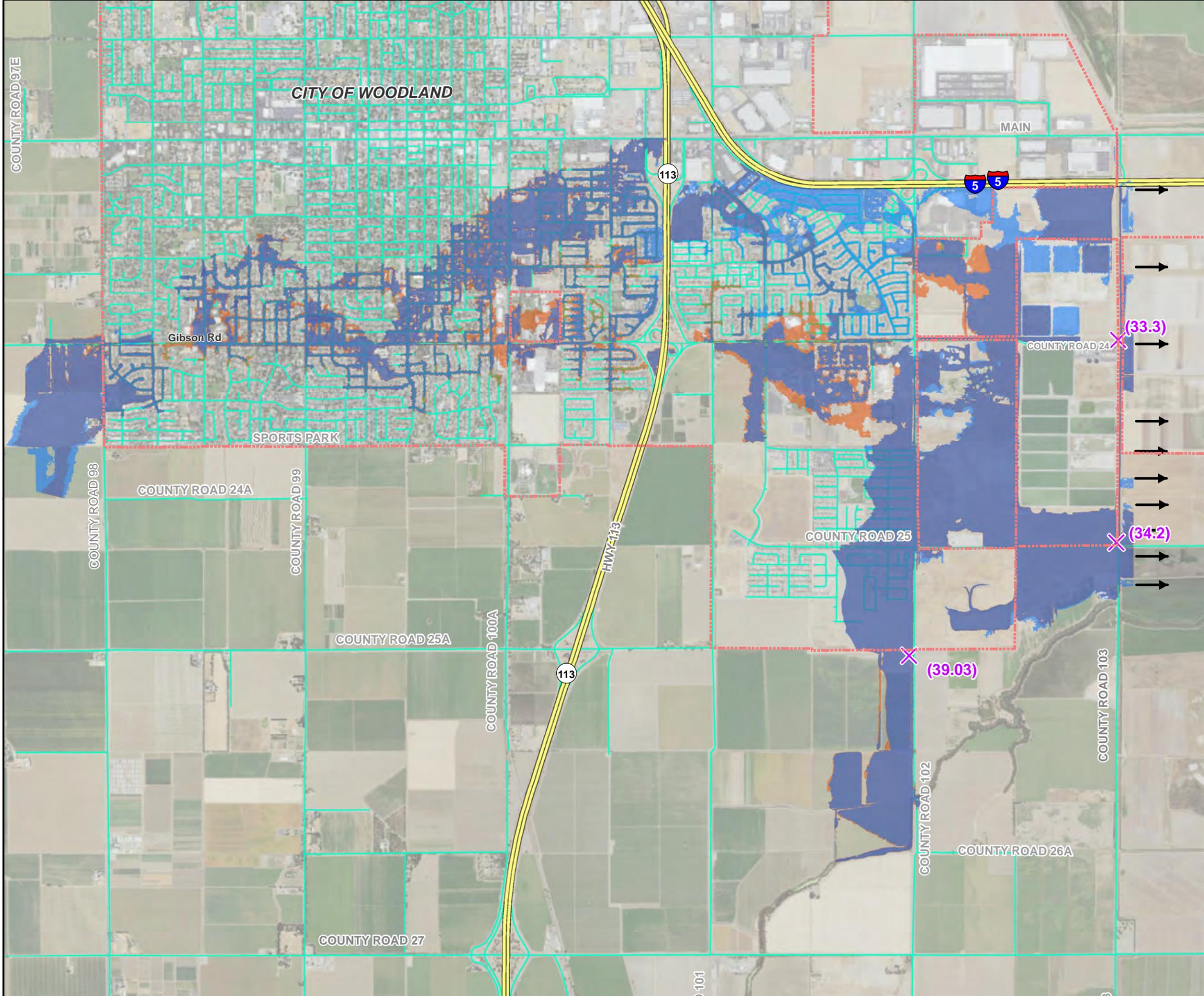
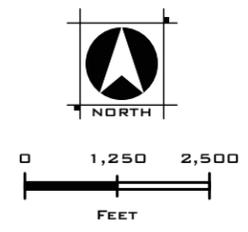
- \* Primary Source of the topo is the LiDAR data collected in 2008 by the California Department of Water Resources.
- \*\* Base topo within North Regional Pond was received from the City of Woodland on 12/17/2003.
- \*\*\* Topo within East Regional Pond was obtained from Record drawings of Project No. 02-36 - South Urban Growth Area Regional Storm Drainage Facilities (SLSPA-Phase 1), dated 6/18/2004.

**DEVELOPED CONDITIONS TOPOGRAPHY**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**

- Max. Flood Extent at 100-Year 10-Day Storm Event
- Max. Flood Extent at 100-Year 24-Hour Storm Event
- City of Woodland Boundary
- Street Centerlines
- × Peak 100-Year Stage (ft)
- Highline Ditch Overflow (See Figure 11)
- Overlap of 10-Day and 24-Hour Flood Extents

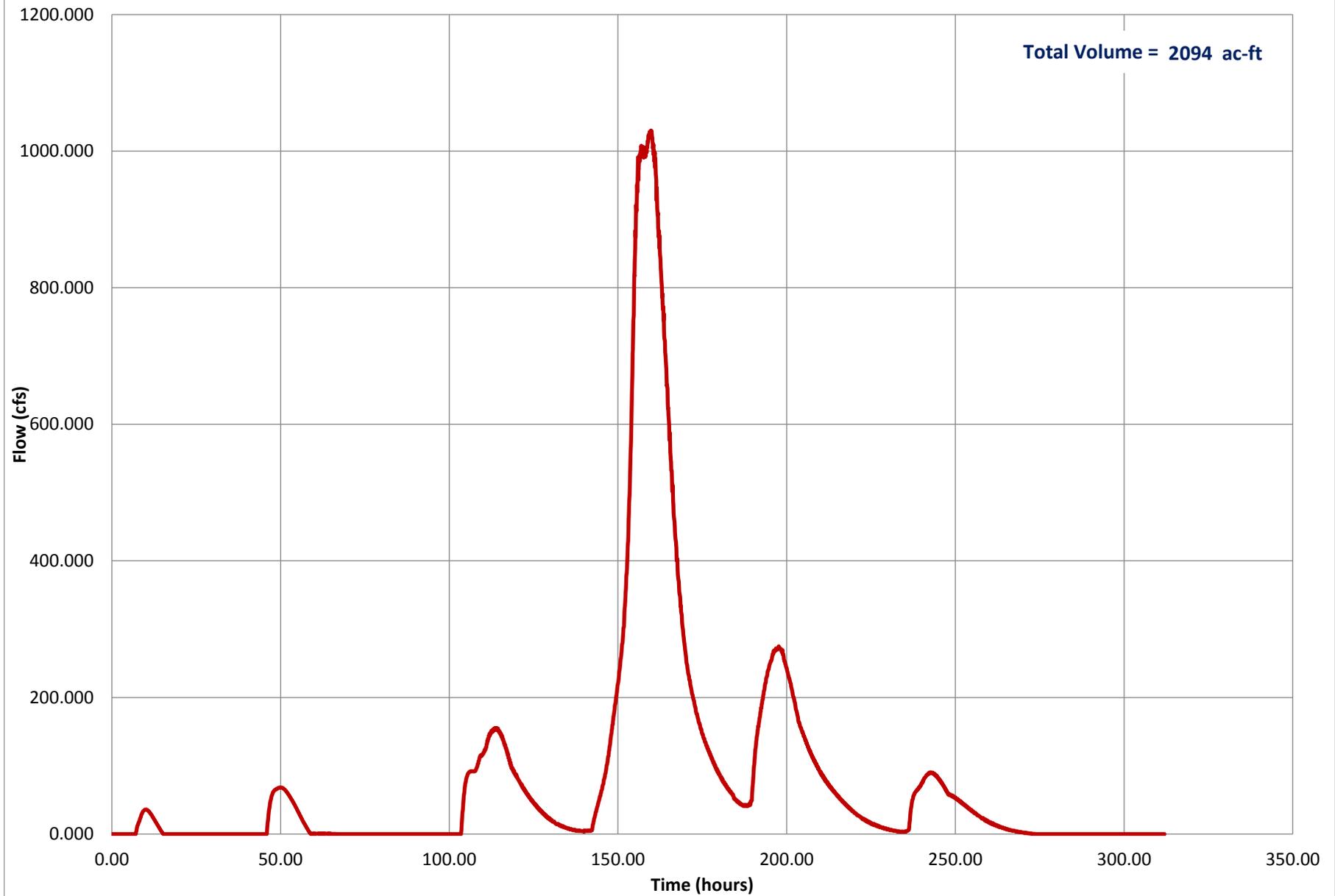


**100-YEAR FLOODPLAIN EXTENTS -  
BASELINE CONDITIONS**

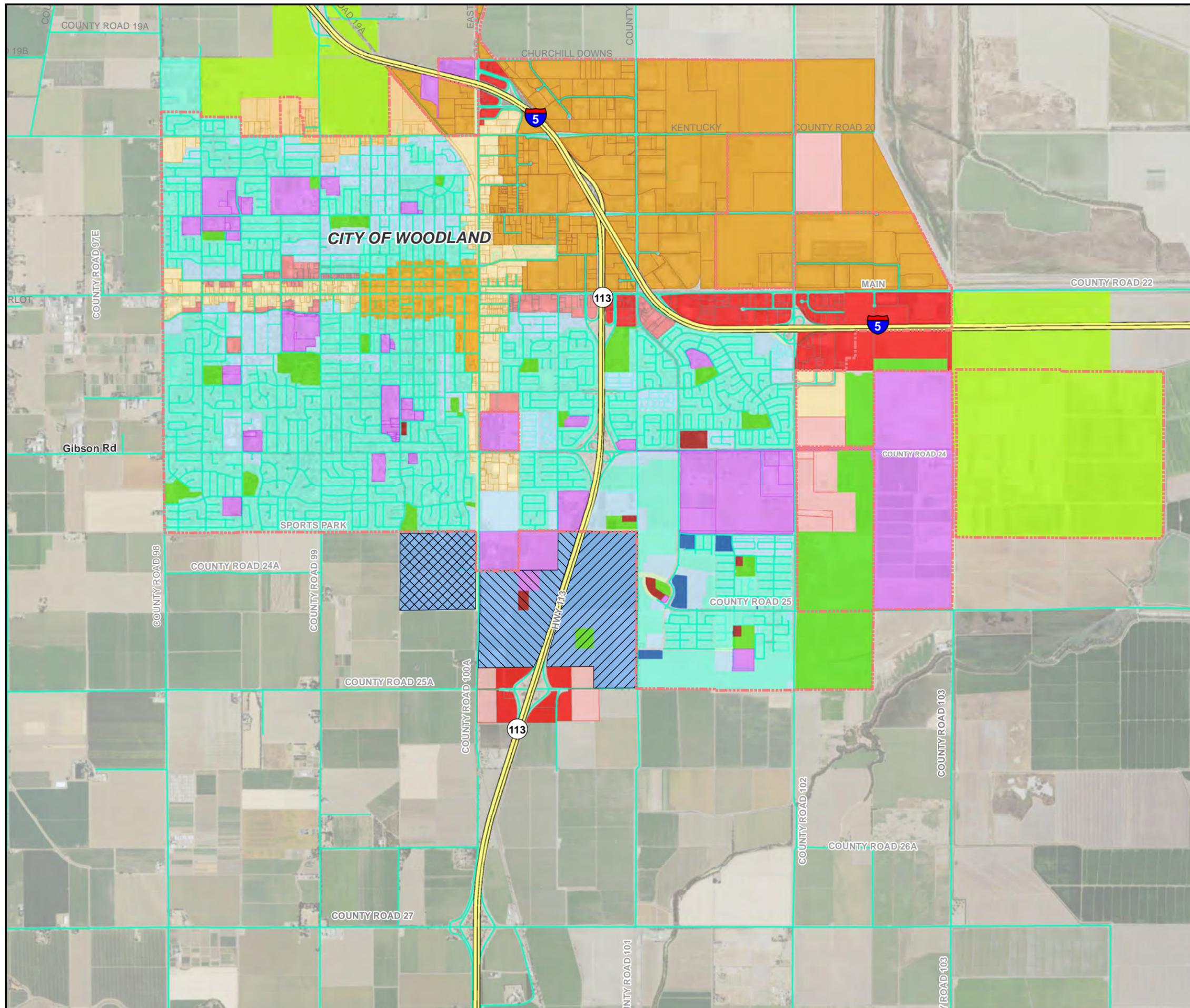


FIGURE 10

### RD 2035 SPILL HYDROGRAPH - BASELINE CONDITIONS 100-YEAR 10-DAY



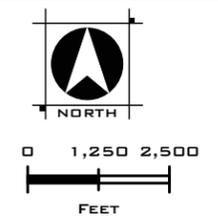
**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA**  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE



**City of Woodland Boundary**  
 City of Woodland Boundary  
 Street Centerlines

**General Plan**

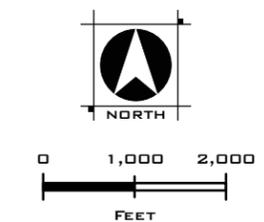
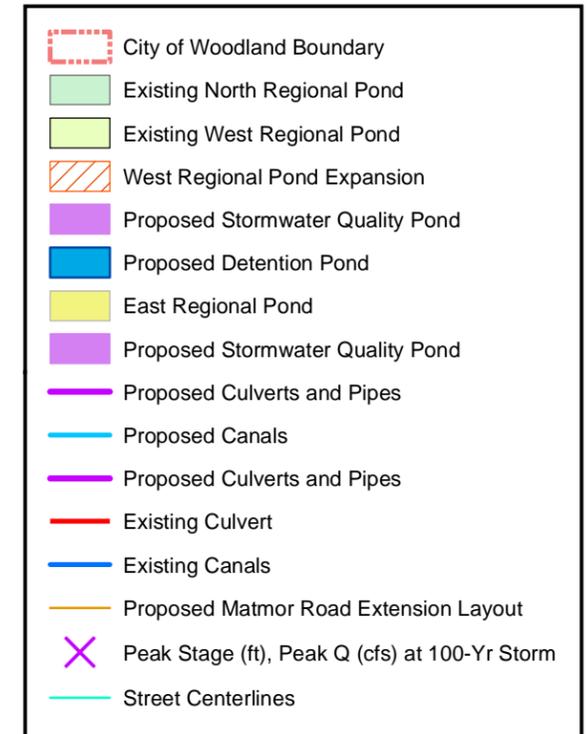
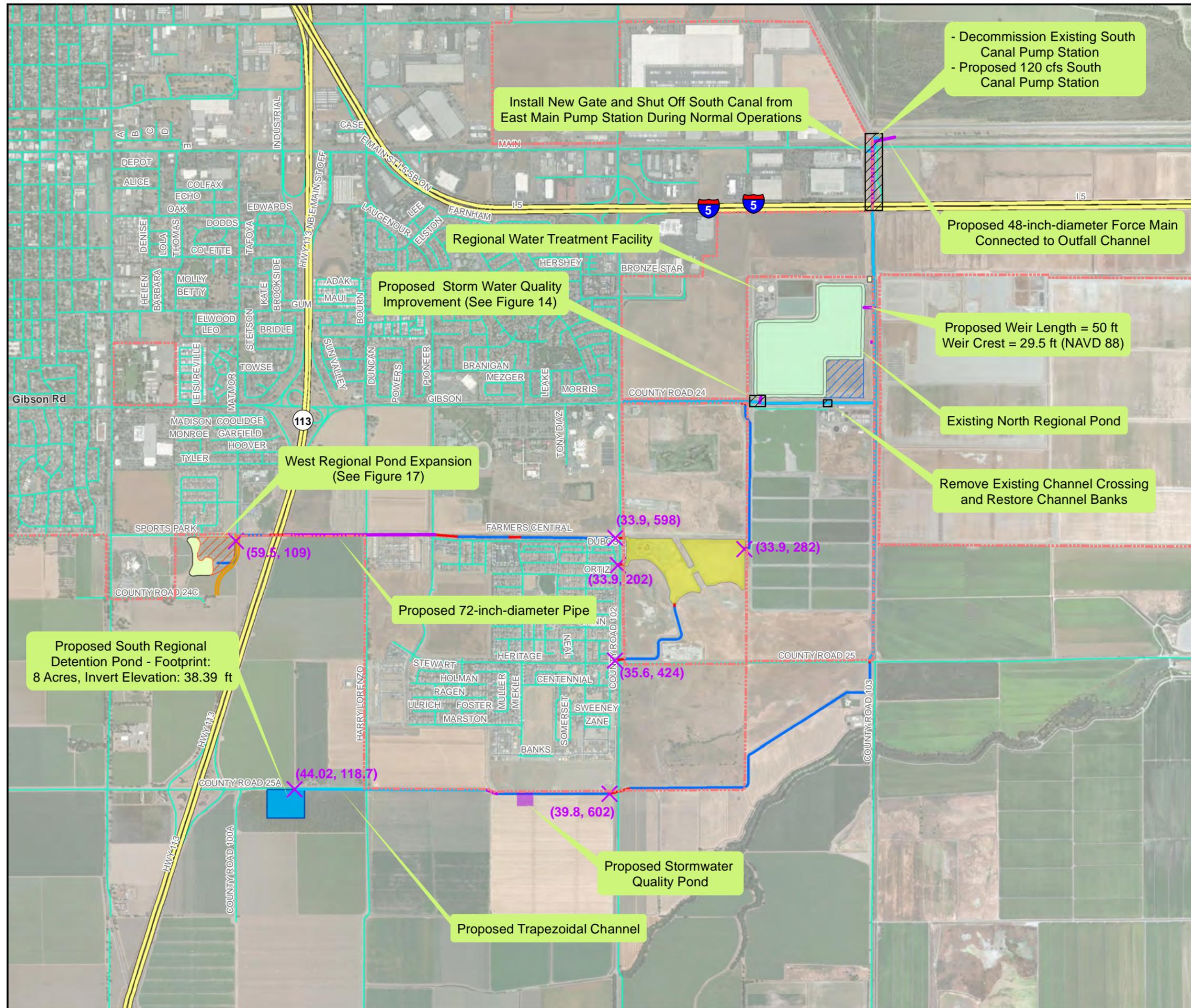
- Undefined
- Open Space
- Urban Reserve
- Low-Density Residential
- Medium-Density Residential
- Specific Plan Residential
- High-Density Residential
- Corridor Mixed Use
- Kentucky Mixed Use
- Downtown Mixed Use
- Industrial
- Business Park
- Community Commercial
- Regional Commercial
- Neighborhood Commercial
- Public/Quasi-Public
- Specific Plan - 1A
- Specific Plan - 1B
- Specific Plan - 1C



**PROPOSED GENERAL PLAN LAND USE**

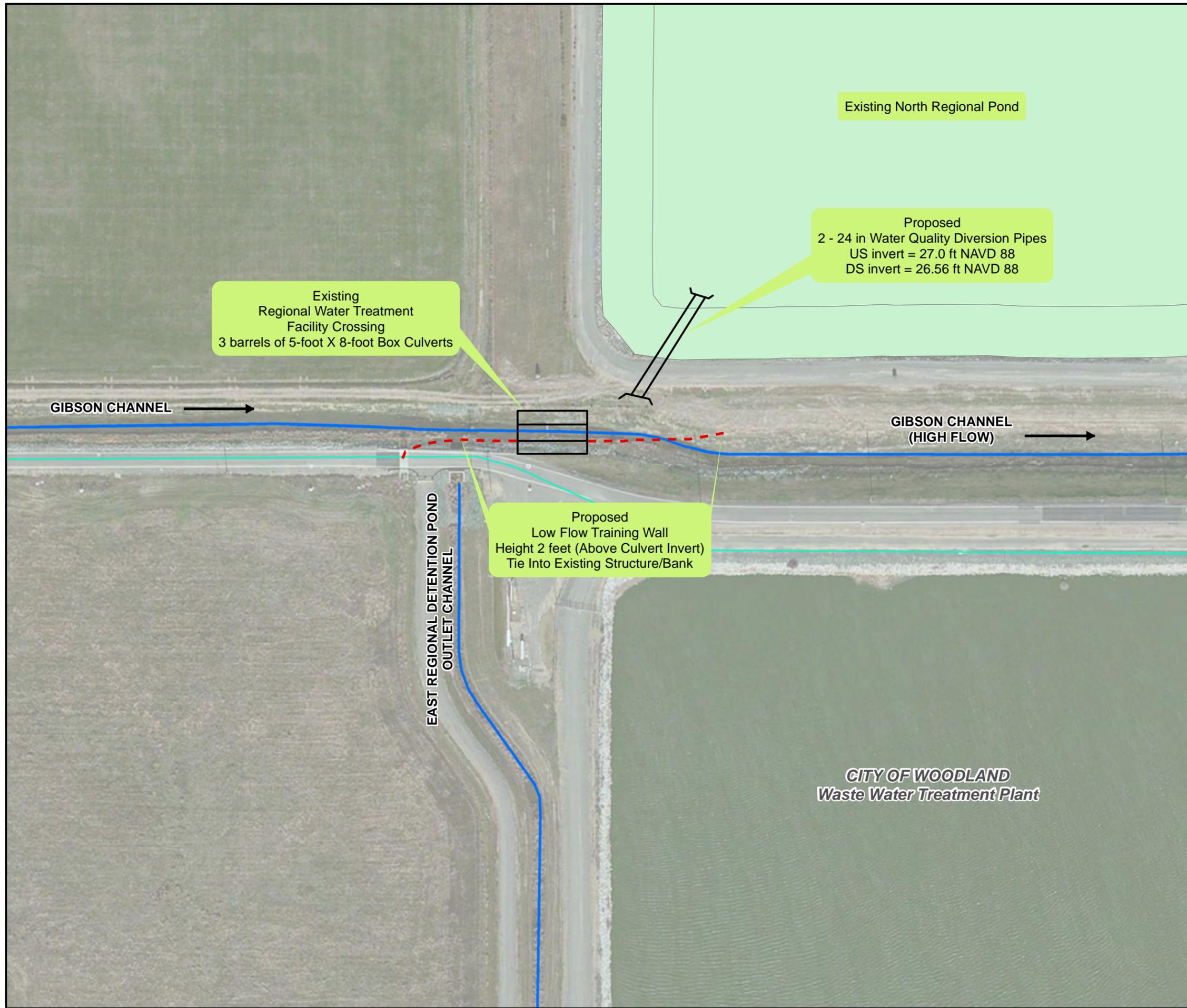


**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA**  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE  
REVISED MARCH, 2018

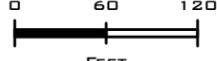


**PROPOSED DRAINAGE FACILITIES  
ULTIMATE CONDITIONS MODELING**





	North Regional Pond
	Existing Canals
	Street Centerlines

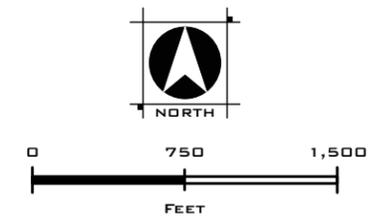
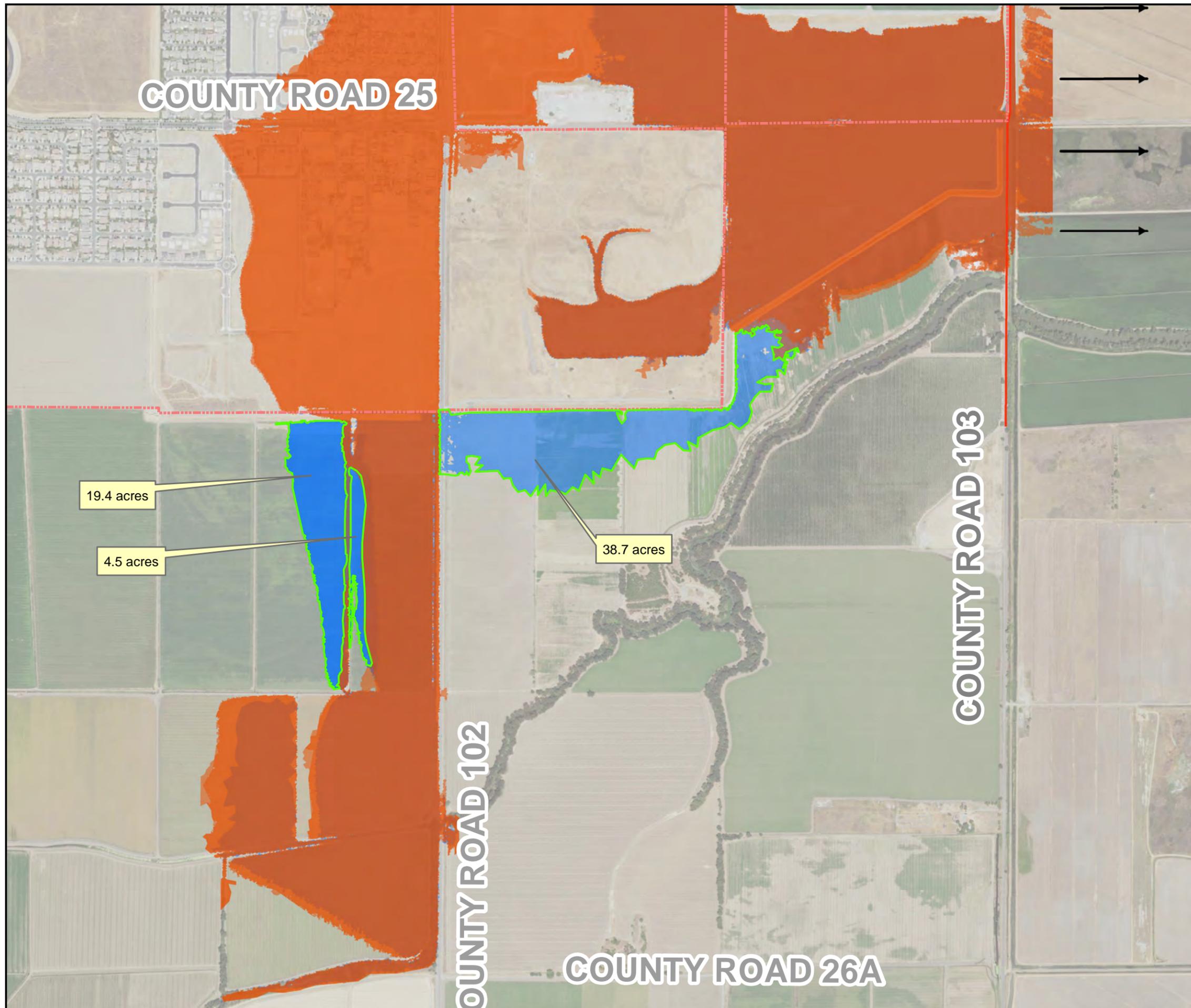
  
 NORTH  
  
 0 60 120  
 FEET

**PROPOSED WATER QUALITY IMPROVEMENTS  
NORTH REGIONAL POND**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**

-  Estimated Flood Easement
-  City of Woodland Boundary
-  South Canal Overflow Boundary Line
-  Highline Ditch Overflow (See Figure 18)
-  Overlap of 10-Day and 24-Hour Flood Extents
-  Ultimate Conditions 100-Year Flood Extent
-  Baseline Conditions 100-Year Flood Extent

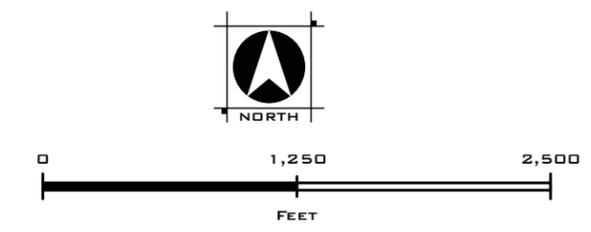
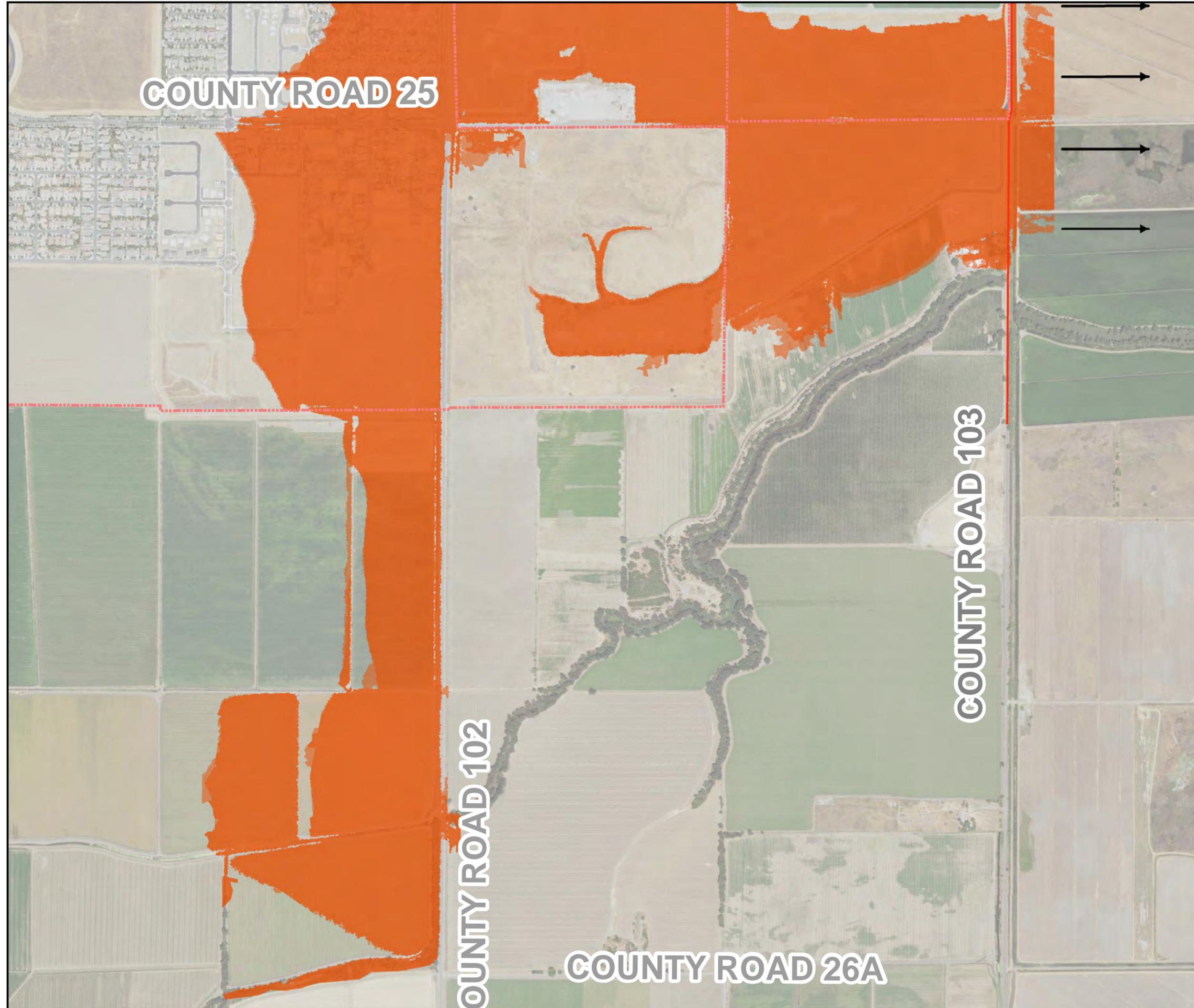


**100-YEAR FLOOD EASEMENT EXTENTS -  
ULTIMATE CONDITIONS BUILDOUT AND  
BASELINE CONDITIONS**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**

-  City of Woodland Boundary
-  South Canal Overflow Boundary Line
-  Highline Ditch Overflow (See Figure 18)
-  Baseline Condition 100-Year Flood Extent

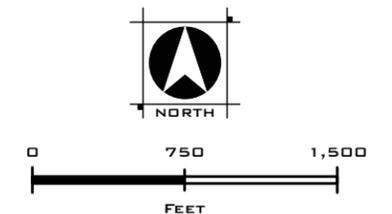
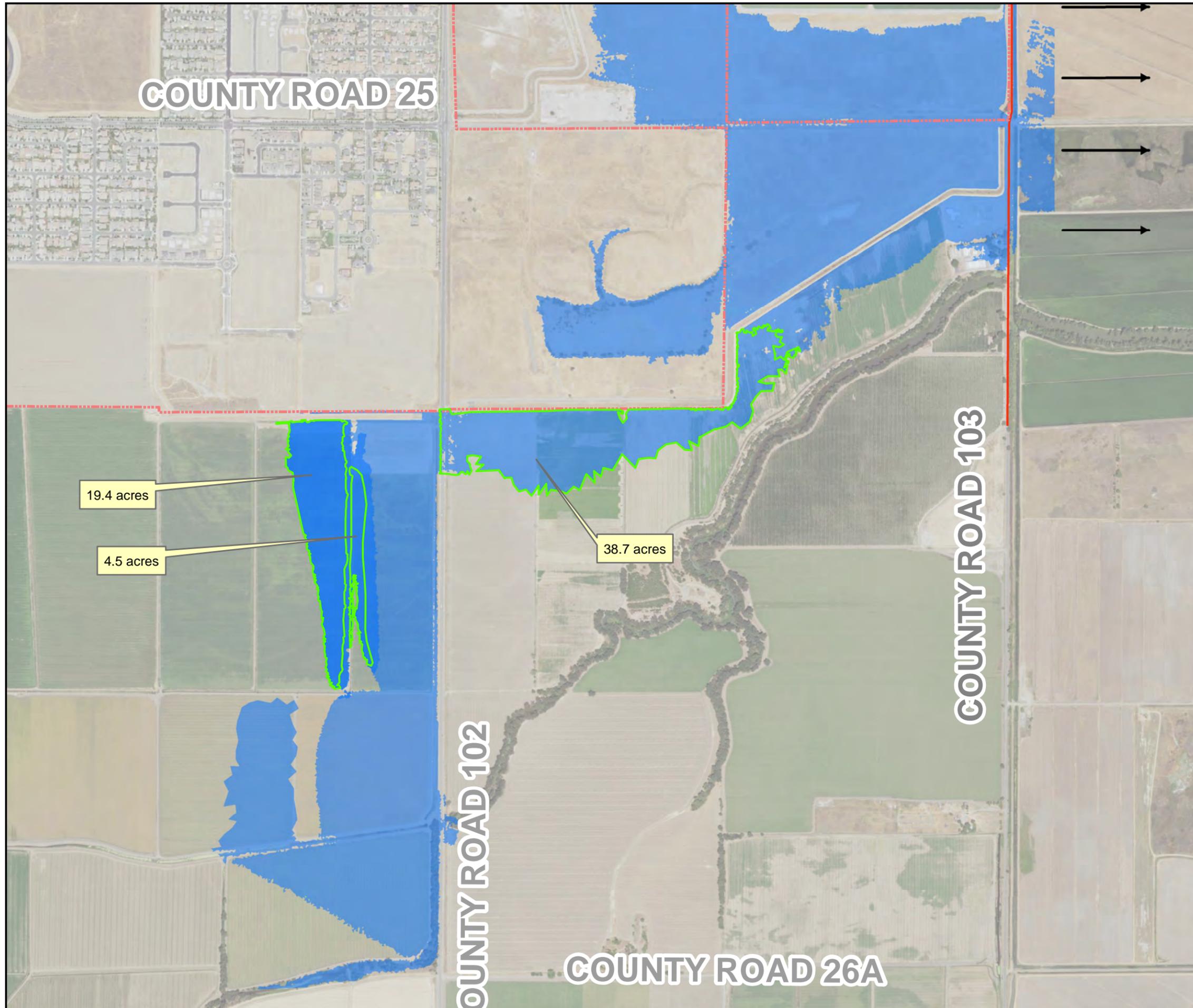


**100-YEAR  
BASELINE CONDITIONS FLOODPLAIN**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**

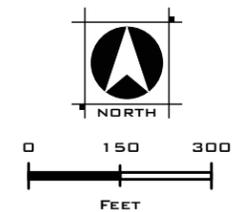
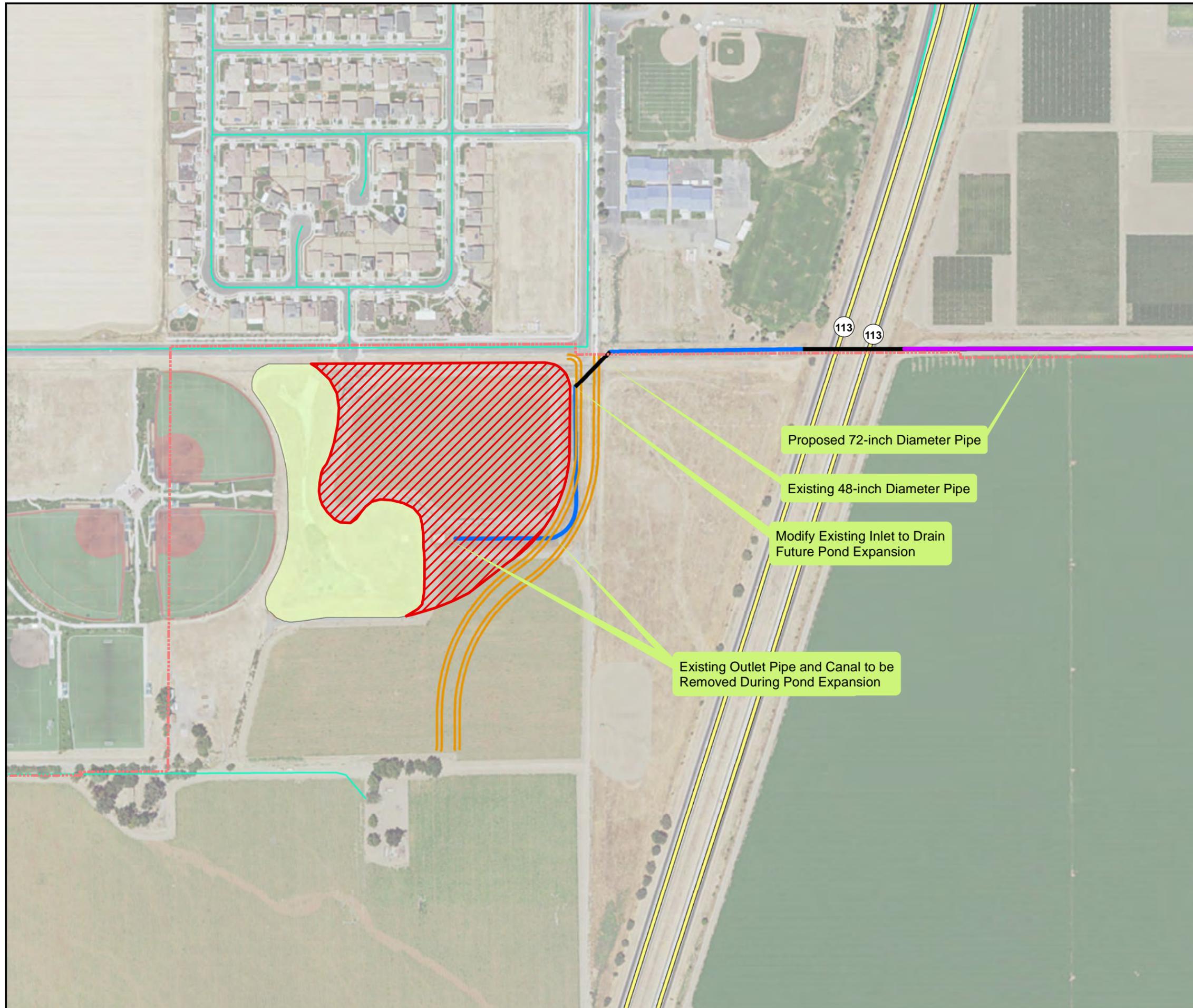
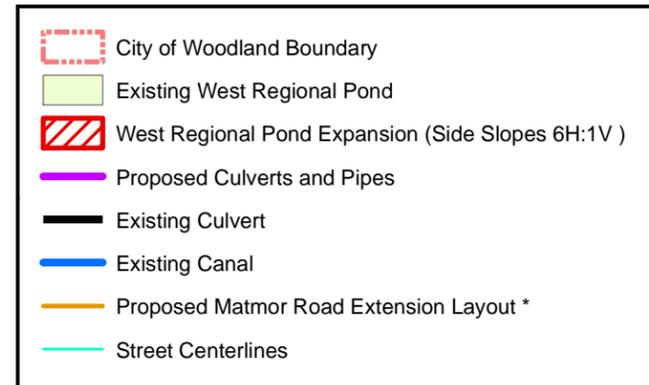
-  Estimated Flood Easement
-  City of Woodland Boundary
-  South Canal Overflow Boundary Line
-  Highline Ditch Overflow (See Figure 18)
-  Ultimate Conditions 100-Year Flood Extent



**100-YEAR FLOOD EASEMENT EXTENTS -  
ULTIMATE BUILDOUT CONDITIONS**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**



**NOTES:**

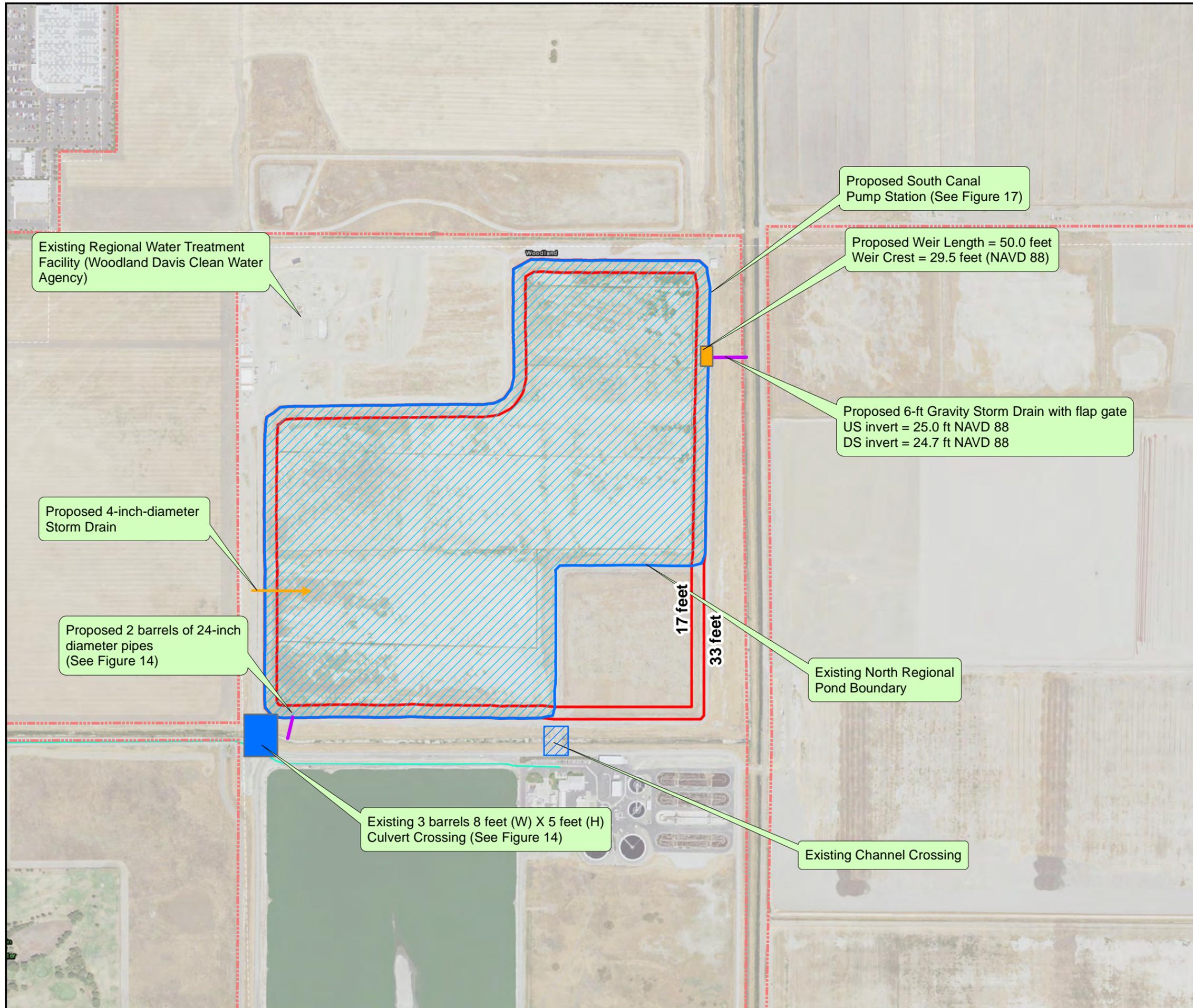
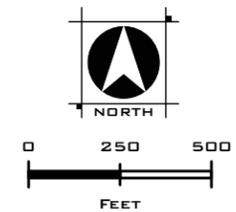
\* Provided by the City of Woodland. For maintenance access, a 20-foot-wide clearance is provided between this road layout and future pond expansion.

**PROPOSED WEST REGIONAL  
POND EXPANSION**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**

-  Proposed Culverts and Pipes
-  City of Woodland Boundary
-  Existing North Regional Pond
-  Proposed North Regional Pond Contour
-  Street Centerlines

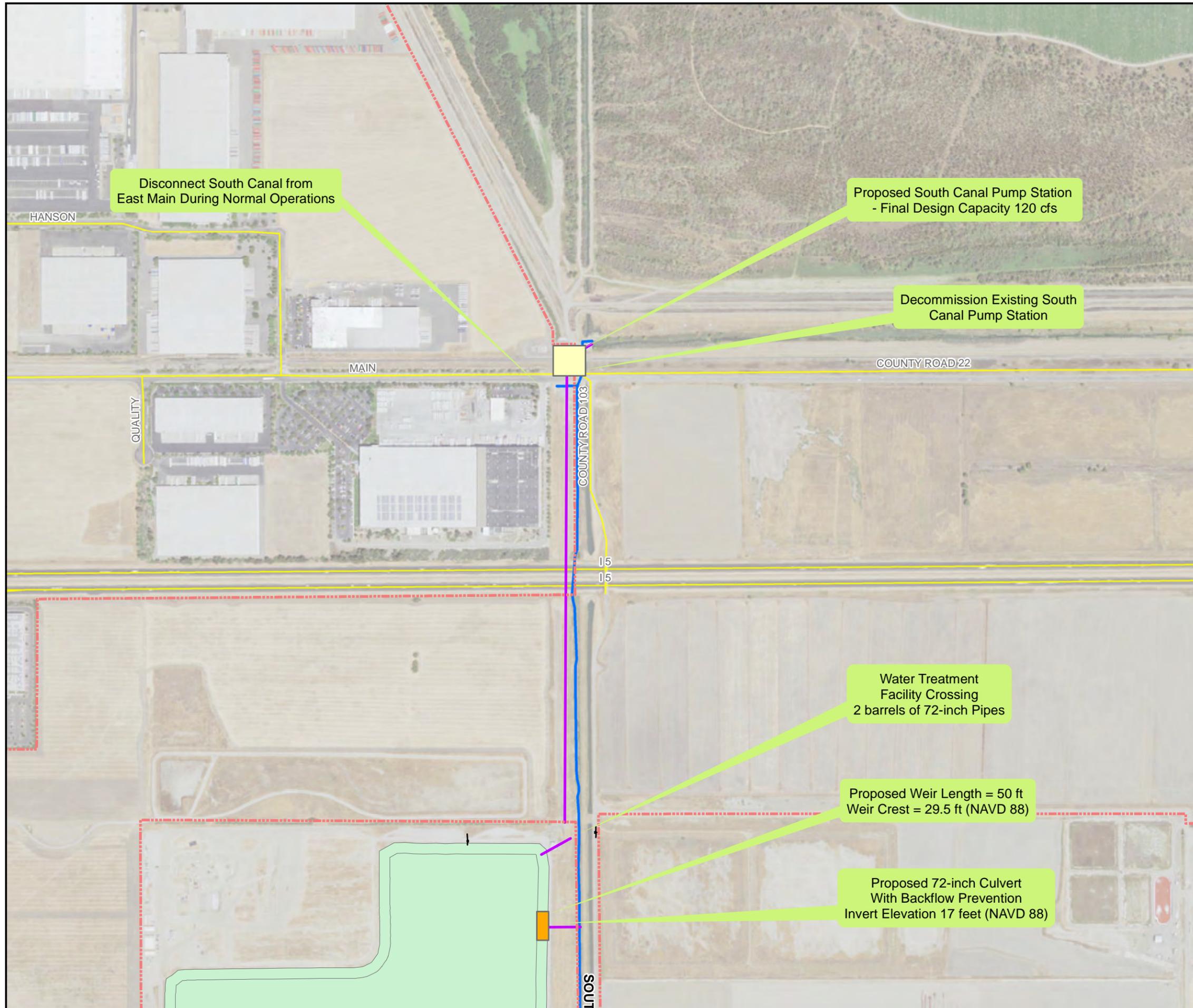


NOTES:  
 - Topographic Mapping of North Regional Pond Area Provided by City of Woodland;  
 - Proposed Contours May Require Adjustment Based on Final Design and Groundwater Assessment.

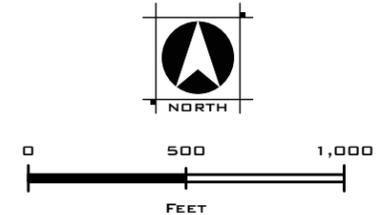
**NORTH REGIONAL  
POND AND VICINITY**



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**



-  City of Woodland Boundary
-  Existing North Regional Pond
-  Existing Canals
-  Street Centerlines

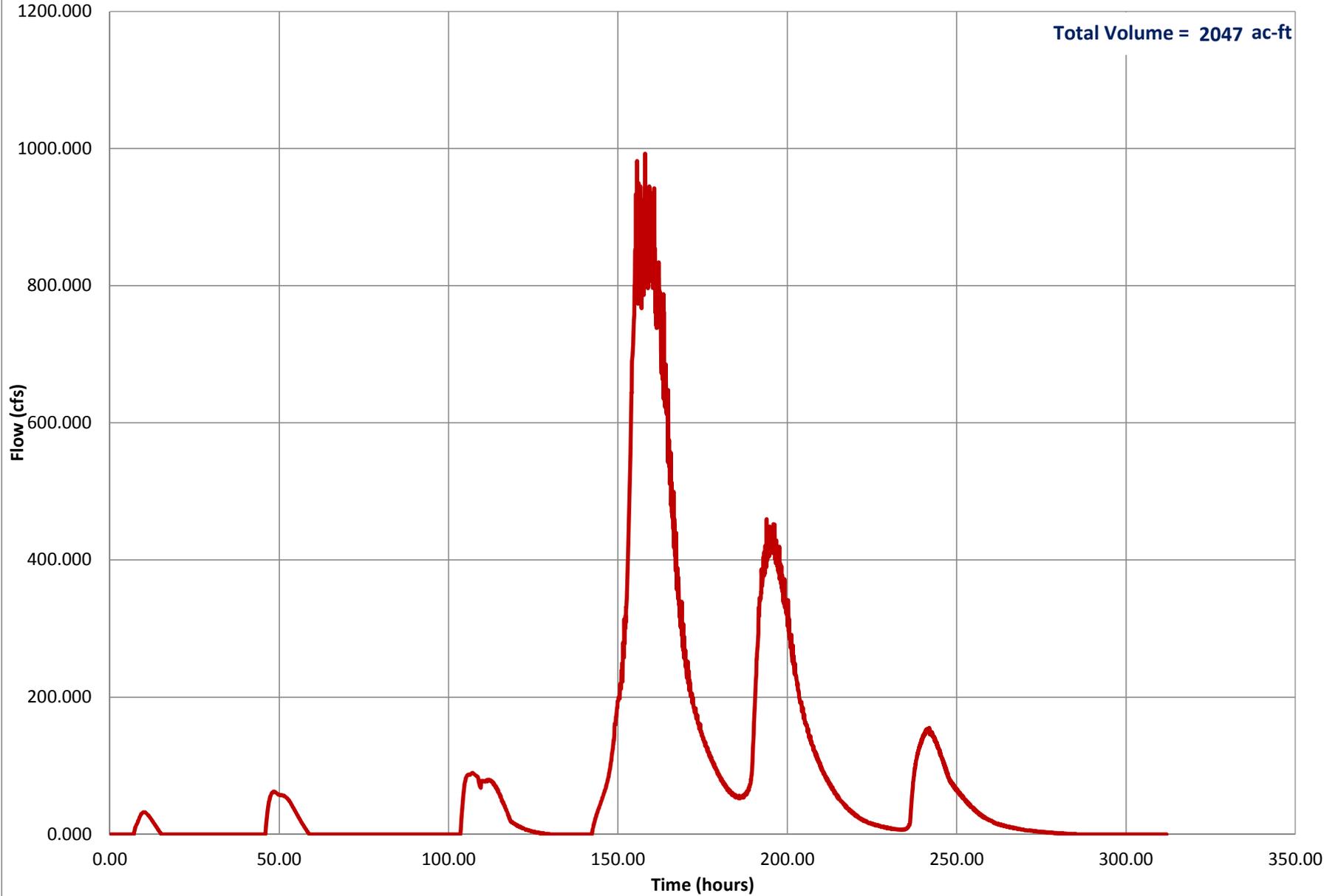


**PROPOSED SOUTH CANAL  
PUMP STATION**



**RD 2035 SPILL HYDROGRAPH - ULTIMATE CONDITIONS 100-YEAR 10-DAY**

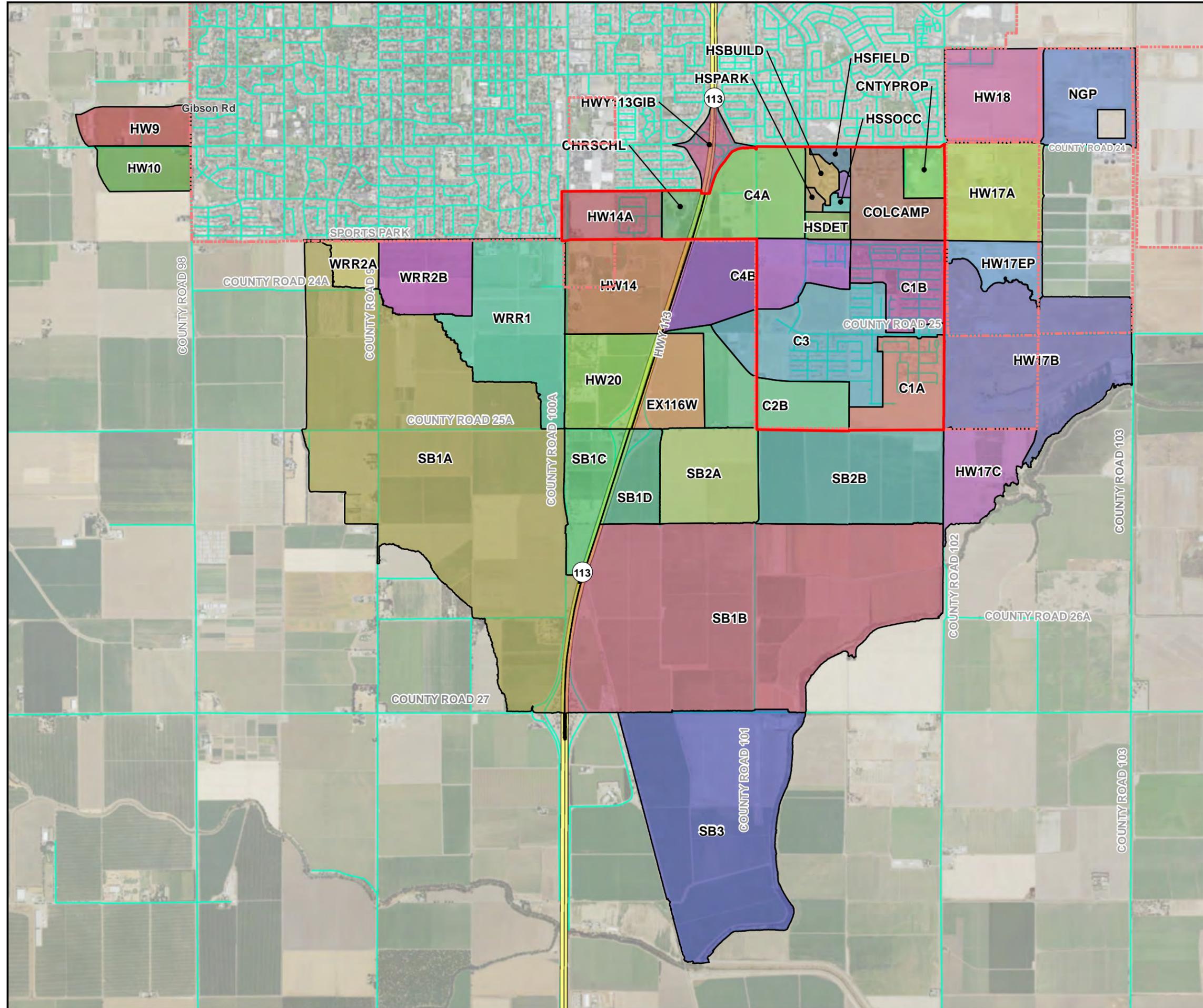
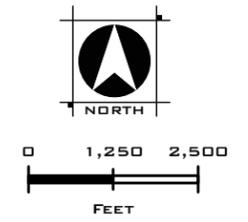
Total Volume = 2047 ac-ft



**FIGURE 19**

**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**

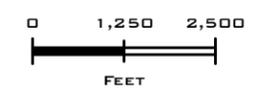
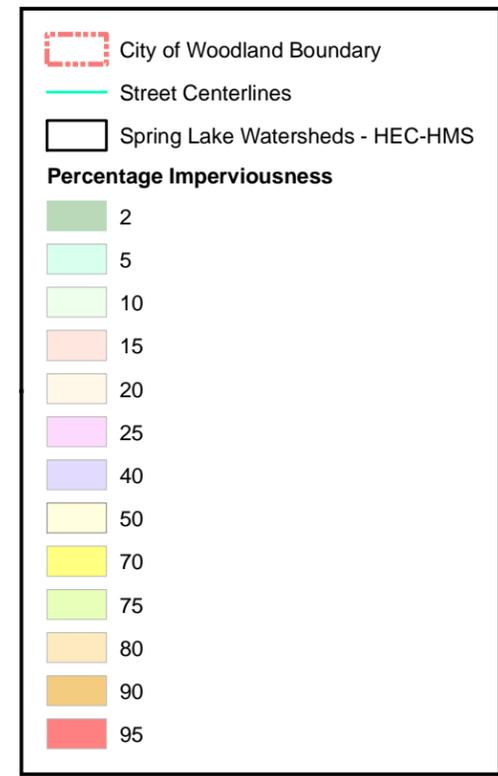
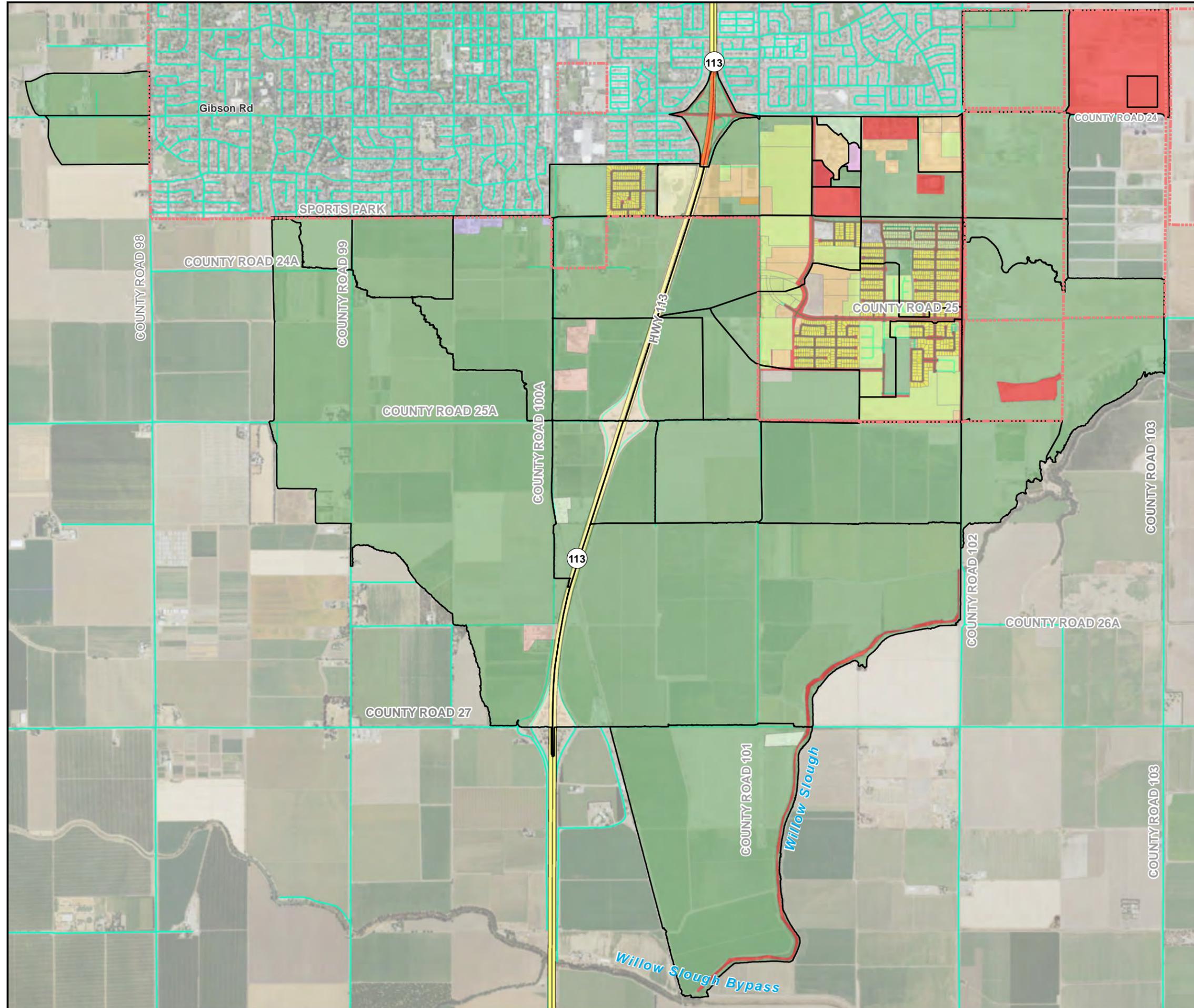
 City of Woodland Boundary  
 Spring Lake Buildout Watersheds - HEC-HMS  
 Boundary of Spring Lake Development  
 Street Centerlines



**SPRING LAKE BUILDOUT  
WATERSHEDS - HEC-HMS**



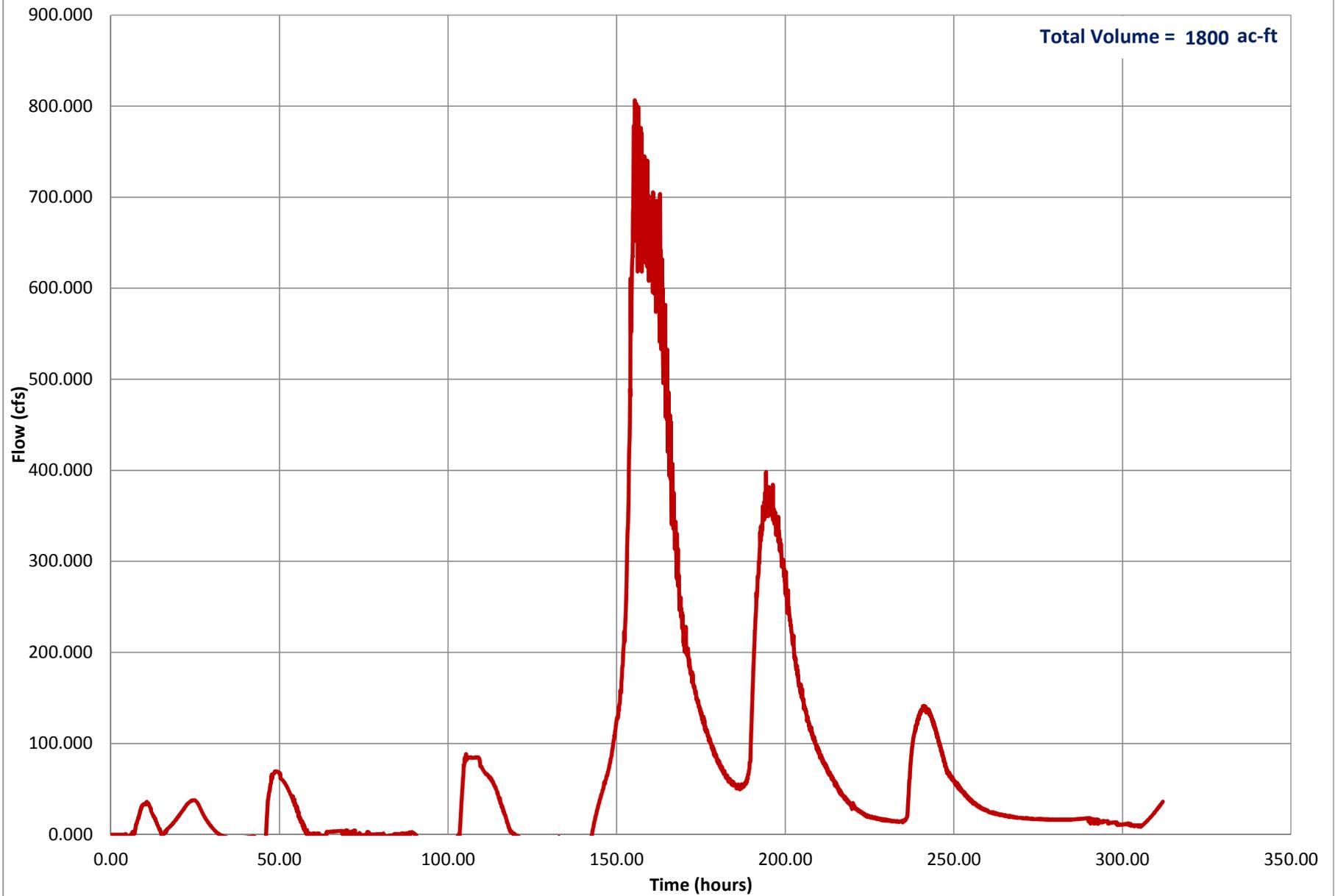
**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**



**PERCENT IMPERVIOUSNESS -  
SPRING LAKE BUILDOUT CONDITIONS**

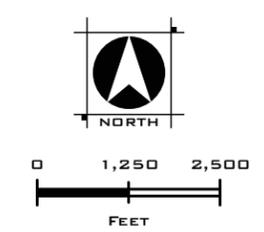
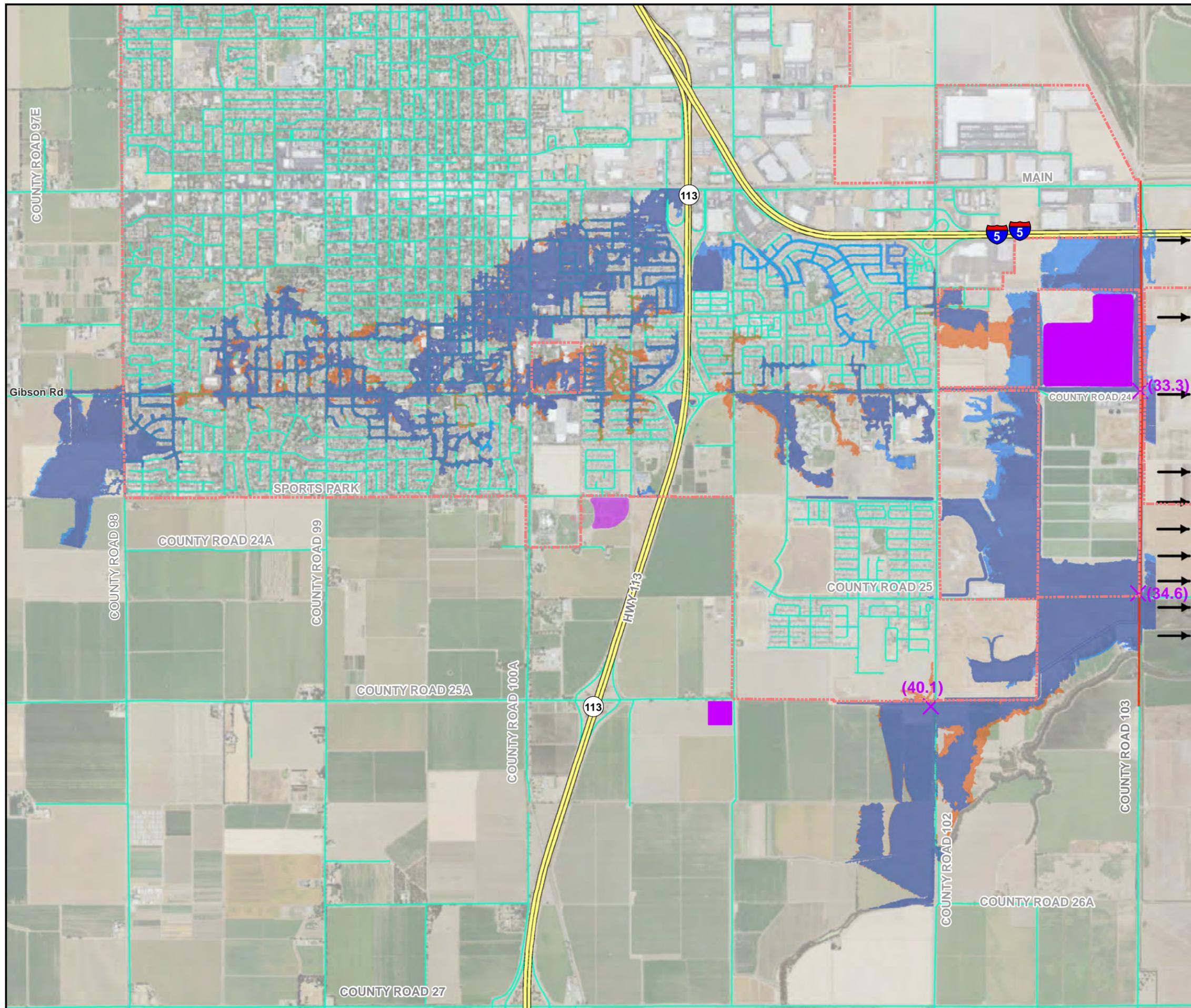


### RD 2035 SPILL HYDROGRAPH - SPRING LAKE BUILDOUT 100-YEAR 10-DAY



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**

- Max. Flood Extent at 100-Year 10-Day Storm Event
- Max. Flood Extent at 100-Year 24-Hour Storm Event
- City of Woodland Boundary
- Overlap of 10-Day and 24-Hour Flood Extents
- Detention Facilities
- ✕ Peak 100-Year Stage (ft)
- Highline Ditch Overflow (See Figure 19)
- South Canal Overflow Boundary Line
- Street Centerlines



**100-YEAR FLOODPLAIN EXTENTS -  
ULTIMATE CONDITIONS**



## Tables



**TABLE 1 - DRAINAGE FACILITIES COST**

<b>Continuing 2006 SDFMP Projects</b>	<b>2006 SDFMP Total Costs</b>	<b>2006 Exempt Land Portion of Total Costs</b>	<b>CCI Index</b>	<b>2017 SDFMP Total Costs</b>	<b>2017 Exempt Land Portion of Total Costs</b>
<b>NORTH AREA</b>					
Northwest Interceptor with Sediment Basins (A to B)	\$7,157,165	\$0	1.279	\$9,154,014	\$0
Volkl Pond Improvements	\$2,374,607	\$16,534	1.279	\$3,037,122	\$0
Volkl Trunk Facilities	\$2,765,427	\$19,255	1.279	\$3,536,981	\$0
Kentucky Trunk Diversions to Volkl	\$737,550	\$0	1.279	\$943,326	\$0
Volkl Outlet (B to C)	\$3,488,585	\$81,637	1.279	\$4,461,900	\$0
North Canal Improvements (C to D)	\$3,575,775	\$83,677	1.279	\$4,573,416	\$0
North Canal Improvements (D to E)	\$3,898,576	\$291,420	1.279	\$4,986,279	\$0
Beamer/Kentucky Channel	\$4,819,295	\$507,652	1.279	\$6,163,878	\$0
North Canal Bridge & RD2035 Facilities Relocation	\$709,500	\$53,035	1.279	\$907,451	\$0
Storm Drains - Volkl Trunk	\$3,527,865	\$24,564	1.279	\$4,512,139	\$0
Storm Drains - Beamer/Kentucky Trunk	\$11,375,752	\$1,198,292	1.279	\$14,549,587	\$0
North Area Fill	\$12,116,066	\$905,681	1.279	\$15,496,448	\$0
<b>SOUTH AREA</b>					
Farmers Central Trunk (West HWY 113)	\$1,482,045	\$373,402	1.279	\$1,895,536	\$0
South Interceptor/Conveyance (CONSTRUCTED)	\$2,440,531	\$367,537	N/A	\$2,440,531	\$0
Inlet Channel (CONSTRUCTED)	\$575,412	\$124,351	N/A	\$575,412	\$0
East Regional Detention Pond (CONSTRUCTED)	\$9,572,612	\$2,250,433	N/A	\$9,572,612	\$0
Outlet Channel (CONSTRUCTED)	\$1,258,986	\$295,976	N/A	\$1,258,986	\$0
Farmers Central Culvert (CONSTRUCTED)	\$601,952	\$76,162	N/A	\$601,952	\$0
County Road 102 Culvert (CONSTRUCTED)	\$302,489	\$38,465	N/A	\$302,489	\$0
Parkway Trunk Culvert (CONSTRUCTED)	\$491,544	\$106,226	N/A	\$491,544	\$0
Storm Drains - Farmers Central Trunk (West)	\$1,146,225	\$288,792	1.279	\$1,466,022	\$0
Storm Drains - Farmers Central Trunk (East)	\$2,479,500	\$626,808	1.279	\$3,171,281	\$0
Storm Drains - Parkway Trunk	\$3,016,073	\$676,191	1.279	\$3,857,557	\$0
Storm Drains - 25A Trunk (Revised 2008)	\$1,179,213	\$201,070	1.279	\$1,508,213	\$0
Storm Drains - County Road 102 Trunk	\$577,100	\$73,385	1.279	\$738,111	\$0
Storm Drains - Zone S4B Trunk	\$741,313	\$159,683	1.279	\$948,139	\$0
<b>COMMON</b>					
Outfall Channel Improvements (North and South Areas Combined)	\$5,145,937	\$423,406	1.279	\$6,581,653	\$0
Outfall Channel Improvements (South Area Only - 10.36% of Total Cost)				\$681,859	\$0
<b>OTHER PROJECTS (provided by City in 2006)</b>					
SD5 - Upgrade Kentucky Avenue Ditch	\$262,812	\$0	1.279	\$336,137	\$0
SD11 - Enclose Open Channel from Commerce to I-5	\$412,650	\$0	1.279	\$527,779	\$0
SD13 - Tanforan Avenue Trunk Line	\$1,150,090	\$0	1.279	\$1,470,965	\$0
SD21 - Enclose Open Channels N. & E. Kentucky Avenue I-5 Overpass	\$531,165	\$0	1.279	\$679,360	\$0
SD27 - Update Master Plan	\$975,000	\$161,750	N/A	975,000	\$0
SD28 - Cache Creek Levee Improvements (Removed due to Separate Prop 218 Funding)	N/A				
SD102 - Pump Station Flood Protection - Phase 1 (Design)	\$20,000	\$0	1.279	\$25,580	\$0
SD105 - Annual Storm Drainage System Maintenance Repair & Upgrade	\$1,400,000	\$0	1.279	\$1,790,600	\$0
SD114 - Storm Drainage System Maintenance, Testing & Inspection	\$2,275,000	\$0	1.279	\$2,909,725	\$0
SD116 - SCADA for Storm Drain Pump Stations	\$70,000	\$0	1.279	\$89,530	\$0
SD117/957 - Flood Protection Feasibility Study (Removed due to Separate Prop 218 Funding)	N/A				
<b>2017 SDFMP - Updated Projects (New Detailed Estimates)</b>					
<b>NORTH AREA</b>					
Outfall Channel Outlet Structure - North Area Portion (89.64%)	N/A	N/A	N/A	\$2,125,000	\$0
<b>SOUTH AREA</b>					
South Canal Pump Station	N/A	N/A	N/A	\$5,499,000	\$0
SCPS Force Main	N/A	N/A	N/A	\$973,000	\$0
North Regional Pond Improvements	N/A	N/A	N/A	\$1,642,000	\$0
80% Flood Easement (SLSP Areas Only)	N/A	N/A	N/A	\$680,700	\$0
20% Flood Easement (non-SLSP Areas)	N/A	N/A	N/A	\$170,175	\$0
Upper South Canal Channel (East of CR101)	N/A	N/A	N/A	\$448,000	\$0
Upper South Canal Channel (West of CR101)	N/A	N/A	N/A	\$450,000	\$0
South Regional Detention Pond	N/A	N/A	N/A	\$2,154,000	\$0
Farmers Central - 72-inch Storm Drain	N/A	N/A	N/A	\$3,265,000	\$0
West Regional Detention Pond (Expansion)	N/A	N/A	N/A	\$2,847,000	\$0
Outfall Channel Outlet - South Area Portion (10.36%)	N/A	N/A	N/A	\$246,000	\$0
Storm Water Quality Pond (CR25A)				\$586,971	\$0
Future Trash Screen (5mm)	N/A	N/A	N/A	\$1,386,000	\$0
<b>TOTAL</b>				<b>\$139,010,141</b>	<b>\$0</b>

**TABLE 2**  
**Storm Drainage Facilities Master Plan Update**  
**Summary of Opinion of Probable Costs - South Area**

Item	Estimated Cost	Contingencies	Total Cost
<b>North Regional Pond Corridor (Common Facilities)</b>			
1 North Regional Pond Improvements	\$1,066,000	\$575,640.00	\$1,641,640.00
2 South Canal Pump Station Force Main	\$632,000	\$341,280.00	\$973,280.00
3 South Canal Pump Station (120 cfs)	\$3,582,030	\$1,934,296.20	\$5,516,326.20
4 Outfall Outlet Structure (South Area Portion - 10.36% of Ultimate)	\$164,943	\$89,069.39	\$254,012.72
5 Future 5mm Pump Screen System** Contingencies, Design, CM, PM, Env. Mit. (total 54%)	\$900,000 \$3,426,286	\$486,000.00	\$1,386,000.00
<i>Subtotal</i>	<i>\$9,771,000</i>		<i>\$9,771,258.92</i>
<b>Farmers Central Corridor</b>			
1 West Regional Pond Expansion	\$1,849,000	\$998,460.00	\$2,847,460.00
2 72-Inch Diameter RCP Storm Drain Contingencies, Design, CM, PM, Env. Mit. (total 54%)	\$2,120,000 \$2,143,000	\$1,144,800.00	\$3,264,800.00
<i>Subtotal</i>	<i>\$6,112,000</i>		<i>\$6,112,260.00</i>
<b>Upper South Canal Corridor</b>			
1 South Regional Pond	\$1,926,000	\$1,040,040.00	\$2,966,040.00
2 South Canal Channel Extension	\$583,000	\$314,820.00	\$897,820.00
3 Storm Water Quality Pond (Upstream CR102) (SDFMP 2008 Cost with CCI)	\$381,150	\$205,821.00	\$586,971.00
4 Flood Easement (62.3 acres @ \$11,250/acre) Contingencies, Design, CM, PM, Env. Mit. (total 54%), except Easement Contingencies =\$150,000	\$700,875 \$1,710,681	\$150,000.00	\$850,875.00
<i>Subtotal</i>	<i>\$5,302,000</i>		<i>\$5,301,706.00</i>
<b>TOTAL</b>	<b>\$21,185,000</b>		<b>\$21,185,000</b>

\*\* - Future 5mm Mesh Trash Rack cannot be estimated - \$900k based on 125% of traditional screen system

**TABLE 3**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**North Regional Pond**  
**North Regional Pond Improvements**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 North Regional Pond</b>				
a. Silt Fencing/Straw Wattles	500	LF	\$5.50	\$2,750
b. Stabilized Construction Entrance	2	EA	\$4,000.00	\$8,000
c. 48-Inch RCP Storm Drain	300	LF	\$329.00	\$98,700
d. 48-Inch Outfall & Headwall Structure	2	EA	\$20,500.00	\$41,000
e. 72-Inch RCP Storm Drain	300	LF	\$580.00	\$174,000
f. 72-Inch Outfall & Headwall Structure	2	EA	\$26,500.00	\$53,000
g. 72-Inch Duckbill Check Valve	2	EA	\$115,000.00	\$230,000
h. Concrete for Weir	50	CY	\$600.00	\$30,000
i. Riprap Erosion Protection	250	CY	\$200.00	\$50,000
j. Dewatering	1	LS	\$150,000.00	\$150,000
k. 24-Inch RCP Storm Drain	300	LF	\$149.00	\$44,700
l. 24-Inch Outfall & Headwall Structure	4	EA	\$7,500.00	\$30,000
m. 2-Foot Training Wall	520	LF	\$180.00	\$93,600
n. Mobilization and Demobilization	1	LS	5%	\$50,288
o. Traffic Control (Rural)	1	LS	1%	\$10,058
<i>Subtotal</i>				<i>\$1,066,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$266,500
c. Construction Management and Inspection		%	12%	\$127,920
d. Engineering/Design		%	10%	\$106,600
e. Environmental Mitigation		%	1%	\$10,660
f. Preliminary Engineering		%	3%	\$31,980
g. Project Management		%	3%	\$31,980
<i>Subtotal</i>				<i>\$575,640</i>
<b>ESTIMATED TOTAL</b>				<b>\$1,642,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material assumed to be hauled to landfill

**TABLE 4**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**North Regional Pond**  
**South Canal Pump Station Force Main**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 South Canal Pump Station Force Main</b>				
a. Silt Fencing/Straw Wattles	1,600	LF	\$5.50	\$8,800
b. 48-Inch PVC Force Main	800	LF	\$340.00	\$272,000
c. South Canal Pump Station Decommissioning	1	EA	\$30,000.00	\$30,000
d. Plug and Cap Ex. Force Main	2	EA	\$10,000.00	\$20,000
e. UPRR Crossing & Coordination	1	LS	\$100,000.00	\$100,000
f. Asphalt Removal & Replacement	35	SY	\$150.00	\$5,250
g. Riprap Erosion Protection	50	CY	\$200.00	\$10,000
h. Dewatering	1	LS	\$150,000.00	\$150,000
i. Mobilization and Demobilization	1	LS	5%	\$29,803
j. Traffic Control (Rural)	1	LS	1%	\$5,961
<i>Subtotal</i>				\$632,000
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$158,000
c. Construction Management and Inspection		%	12%	\$75,840
d. Engineering/Design		%	10%	\$63,200
e. Environmental Mitigation		%	1%	\$6,320
f. Preliminary Engineering		%	3%	\$18,960
g. Project Management		%	3%	\$18,960
<i>Subtotal</i>				\$341,280
<b>ESTIMATED TOTAL</b>				<b>\$973,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels

**TABLE 5**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**North Regional Pond**  
**South Canal Pump Station**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 South Canal Pump Station</b>				
a. Intake Structure <sup>2</sup>	1	LS	\$1,337,200.00	\$1,337,200
b. Generator System <sup>2</sup>	1	LS	\$442,420.00	\$442,420
c. Electrical Controls System <sup>2</sup>	1	LS	\$101,950.00	\$101,950
d. Control Building <sup>2</sup>	1	LS	\$315,300.00	\$315,300
e. Trash Rack System	1	LS	\$703,650.00	\$703,650
f. Pumps and Motors (4 duty and 1 redundant - 30 cfs) <sup>2</sup>	5	EA	\$40,990.00	\$204,950
g. Site and Miscellaneous	1	LS	\$165,640.00	\$165,640
h. Dewatering	1	LS	\$250,000.00	\$250,000
i. Reconstruct Connection to East Main Pump Station	1	LS	\$50,000	\$50,000
<i>Subtotal</i>				<i>\$3,571,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$892,750
c. Construction Management and Inspection		%	12%	\$428,520
d. Engineering/Design		%	10%	\$357,100
e. Environmental Mitigation		%	1%	\$35,710
f. Preliminary Engineering		%	3%	\$107,130
g. Project Management		%	3%	\$107,130
<i>Subtotal</i>				<i>\$1,928,340</i>
<b>ESTIMATED TOTAL</b>				<b>\$5,499,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup> Facilities Elevated above Cache Creek Floodplain

**TABLE 6**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**North Regional Pond**  
**Outfall Outlet Structure**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 Outfall Outlet Structure</b>				
a. Stripping	125	CY	\$5.00	\$626
b. Clearing & Grubbing	0.25	AC	\$5,000.00	\$1,250
c. Excavation & Backfill	3,368	CY	\$12.00	\$40,410
d. Haul & Dispose	648.0	CY	\$15.00	\$9,720
e. Remove & Expose Ex. SD	200.0	LF	\$65.00	\$13,000
f. 72" RCP	500	LF	\$500	\$250,000
g. 72" Flapgate	5.0	EA	\$22,500.00	\$112,500
h. Valve Vault	1	LS	\$134,434.00	\$134,434
i. Positive Closure Sluice Gate	5.0	EA	\$70,000.00	\$350,000
j. Outfall Formwork	2,049.0	SF	\$17.50	\$35,858
k. Outfall Reinforced Concrete	51	LF	\$1,000	\$50,618
l. Outfall Trash Rack	10.0	CY	\$10,000.00	\$100,000
m. RSP	13.0	CY	\$250.00	\$3,250
n. Temporary Cofferdam and Dewatering	1	LS	\$437,500	\$437,500
<i>Subtotal</i>				<i>\$1,539,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$384,750
c. Construction Management and Inspection		%	12%	\$184,680
d. Engineering/Design		%	10%	\$153,900
e. Environmental Mitigation		%	1%	\$15,390
f. Preliminary Engineering		%	3%	\$46,170
g. Project Management		%	3%	\$46,170
<i>Subtotal</i>				<i>\$831,000</i>
<b>ESTIMATED TOTAL</b>				<b>\$2,370,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

**TABLE 7**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**Farmers Central Corridor**  
**West Regional Pond Expansion**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 West Regional Detention Pond</b>				
a. Land Acquisition - Agricultural	15	AC	\$25,000.00	\$375,000
b. Flood Easement		AC	\$18,750.00	\$0
c. Silt Fencing/Straw Wattles	3,300	LF	\$5.50	\$18,150
d. Stabilized Construction Entrance	2	EA	\$4,000.00	\$8,000
e. Erosion Control Seeding (Site)	15	AC	\$3,250.00	\$48,750
f. Stripping	15	AC	\$4,000.00	\$60,000
g. Pond Excavation <sup>2</sup>	158,107	CY	\$3.50	\$553,375
h. Placement and Compaction <sup>2</sup>	158,107	CY	\$3.50	\$553,375
i. 48-Inch RCP Storm Drain	200	LF	\$329.00	\$65,800
j. 48-Inch Outfall & Headwall Structure	2	EA	\$20,500.00	\$41,000
k. Riprap Erosion Protection	60	CY	\$200.00	\$12,000
l. Remove Existing Outfall Pipe	600	LF	\$50.00	\$30,000
m. Mobilization and Demobilization	1	LS	5%	\$69,522
n. Traffic Control (Rural)	1	LS	1%	\$13,904
<i>Subtotal</i>				<i>\$1,849,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$462,250
c. Construction Management and Inspection		%	12%	\$221,880
d. Engineering/Design		%	10%	\$184,900
e. Environmental Mitigation		%	1%	\$18,490
f. Preliminary Engineering		%	3%	\$55,470
g. Project Management		%	3%	\$55,470
<i>Subtotal</i>				<i>\$998,000</i>
<b>ESTIMATED TOTAL</b>				<b>\$2,847,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material to be used on adjacent lands when development occurs.

**TABLE 8**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**Farmers Central Corridor**  
**72-Inch Diameter RCP Storm Drain**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1</b> 72-Inch Storm Drain				
a. Silt Fencing/Straw Wattles	6,228	LF	\$5.50	\$34,254
b. 72-Inch RCP Storm Drain	3,114	LF	\$580.00	\$1,806,120
c. Junction Box MH	8	EA	\$18,500.00	\$148,000
d. Riprap Erosion Protection	60	CY	\$200.00	\$12,000
e. Mobilization and Demobilization	1	LS	5%	\$100,019
f. Traffic Control (Rural)	1	LS	1%	\$20,004
<i>Subtotal</i>				<i>\$2,120,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$530,000
c. Construction Management and Inspection		%	12%	\$254,400
d. Engineering/Design		%	10%	\$212,000
e. Environmental Mitigation		%	1%	\$21,200
f. Preliminary Engineering		%	3%	\$63,600
g. Project Management		%	3%	\$63,600
<i>Subtotal</i>				<i>\$1,145,000</i>
<b>ESTIMATED TOTAL</b>				<b>\$3,265,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material to be used on adjacent lands when development occurs.

**TABLE 9**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**Upper South Canal Corridor**  
**South Regional Pond**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 South Regional Pond</b>				
a. Land Acquisition - Agricultural	8	AC	\$25,000.00	\$200,000
b. Flood Easement		AC	\$18,750.00	\$0
c. Silt Fencing/Straw Wattles	2,400	LF	\$5.50	\$13,200
d. Stabilized Construction Entrance	2	EA	\$4,000.00	\$8,000
e. Erosion Control Seeding (Site)	8	AC	\$3,250.00	\$26,000
f. Stripping	8	AC	\$4,000.00	\$32,000
g. Pond Excavation <sup>2</sup>	142,000	CY	\$3.50	\$497,000
h. Placement and Compaction <sup>2</sup>	142,000	CY	\$3.50	\$497,000
i. 60-Inch Outfall & Headwall Structure	2	EA	\$23,000.00	\$46,000
j. Riprap Erosion Protection	60	CY	\$200.00	\$12,000
k. Mobilization and Demobilization	1	LS	5%	\$56,560
l. Traffic Control (Rural)	1	LS	1%	\$11,312
<i>Subtotal</i>				\$1,399,000
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$349,750
c. Construction Management and Inspection		%	12%	\$167,880
d. Engineering/Design		%	10%	\$139,900
e. Environmental Mitigation		%	1%	\$13,990
f. Preliminary Engineering		%	3%	\$41,970
g. Project Management		%	3%	\$41,970
<i>Subtotal</i>				\$755,000
<b>ESTIMATED TOTAL</b>				<b>\$2,154,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material to be used on adjacent lands when development occurs.

**TABLE 9**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**  
**Upper South Canal Corridor**  
**South Canal Channel Extension**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 CR25A Channel Extension East CR101</b>				
a. Silt Fencing/Straw Wattles	5,190	LF	\$5.50	\$28,545
b. Channel Excavation and Spoil Adjacent	19,012	CY	\$7.00	\$133,081
c. Maintenance Road 6"AB	1,168	TONS	\$45.00	\$52,549
d. Erosion Control Seeding	3.0	AC	\$3,250.00	\$9,827
e. Land Acquisition	3.6	AC	\$15,000.00	\$53,987
f. Mobilization and Demobilization	1	LS	5%	\$11,200
g. Traffic Control (Rural)	1	LS	1%	\$2,240
<i>Subtotal</i>				<i>\$291,000</i>
<b>2 CR25A Channel Extension West CR101</b>				
a. Silt Fencing/Straw Wattles	3,210	LF	\$5.50	\$17,655
b. Channel Excavation and Spoil Adjacent	18,056	CY	\$7.00	\$126,391
c. Maintenance Road 6"AB	722	TONS	\$45.00	\$32,501
d. Erosion Control Seeding	2.3	AC	\$3,250.00	\$7,593
e. Culvert Under CR101 (60")	100.0	LF	\$440.00	\$44,000
f. CR101 Headwalls	1.0	LS	\$10,000.00	\$10,000
g. Land Acquisition	2.7	AC	\$15,000.00	\$40,014
h. Mobilization and Demobilization	1	LS	5%	\$11,907
i. Traffic Control (Rural)	1	LS	1%	\$2,381
<i>Subtotal</i>				<i>\$292,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$145,750
c. Construction Management and Inspection		%	12%	\$69,960
d. Engineering/Design		%	10%	\$58,300
e. Environmental Mitigation		%	1%	\$5,830
f. Preliminary Engineering		%	3%	\$17,490
g. Project Management		%	3%	\$17,490
<i>Subtotal</i>				<i>\$315,000</i>
<b>ESTIMATED TOTAL</b>				<b>\$898,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material to be used on adjacent lands when development occurs.

## Appendix A

Hydraulic Model Input Data  
(Digital Files Only —  
Provided on Separate Disk)



## Appendix B

Hydraulic Model and Output  
Data  
(Digital Files Only —  
Provided on Separate Disk)



## Appendix C

### Technical Supporting Documents

1 - Downstream  
Alternatives  
Comparison

2 - Phasing  
Plan



## **TECHNICAL MEMORANDUM**

**TO:** Mr. Brent Meyer, P.E.  
City of Woodland

**FROM:** Mr. Jonathan Kors, P.E.  
Mr. Michael C. Nowlan, P.E., CFM

**SUBJECT:** City of Woodland Storm Drainage Facilities Master Plan  
South Urban Growth Area - Downstream Alternatives Comparison

**DATE:** November 11, 2016

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## **INTRODUCTION**

Wood Rodgers, Inc. (Wood Rodgers) has been working for the City of Woodland (City) to update the City's Storm Drainage Facilities Master Plan (SDFMP) for the South Urban Growth Area (South Area) of the City. In support of the SDFMP update, the City has asked Wood Rodgers to analyze alternatives relating to downstream storage and pumping in the South Area. The analysis seeks to identify the most feasible, cost-effective, and incrementally implementable alternative.

## **PURPOSE**

This technical memorandum is intended to provide a brief summary of the alternatives analysis performed and to present the associated results. Each of the alternatives considered provide hydraulic mitigation for full buildout of the South Area consistent with the City's 2016 General Plan update.

## **BACKGROUND**

The facilities needed to mitigate runoff impacts upstream of the confluence of the Gibson Channel and South Canal do not change between alternatives. While these upstream facilities will be included in the final SDFMP update, they are not included in this analysis because they do not impact the comparison of alternatives.

While the City has evaluated the possibility of temporarily increasing the baseline spill volume onto Conaway Ranch lands to the east (over the High Line Ditch), this analysis does not consider increasing the baseline spill volume. The alternatives consider mitigating development runoff through conveyance (pumping) and detention storage only.

## **PROPOSED FACILITIES**

The first component considered in the analysis is detention storage. The amount of available storage downstream of the confluence of the Gibson Channel and South Canal can vary depending upon the proposed pumping/gravity configuration. Currently, the North Gibson Ponds provide existing storage capacity, but they are not connected to either the Gibson Channel (at the pond array's southern border) or the South Canal (at the pond array's eastern border), and would remain essentially empty if a storm event were to occur. The storm runoff would overflow eastward onto Conaway Ranch lands before overtopping the North Gibson Ponds' perimeter berms. For the existing storage to become available (fillable and drainable), a weir, culverts, or other hydraulic connections would be required.

The second component considered for the analysis is pumping. Wherever pumping and storage are both utilized, there is an inversely-proportional relationship in that, when higher pumping rates are introduced, less storage is required and vice-versa. The three alternatives considered within this analysis reflect adjustments to the combination of detention storage and pumping and to the location of the pumping.

### **ALTERNATIVE A**

The draft update to the SDFMP was submitted to the City in January of 2014 and reflected the expansion of the North Gibson Ponds, as shown on **Figure 1** (attached). The storage proposed under Alternative A extends to a depth of Elevation 17 feet (NAVD 88), which is deeper than the South Canal. To activate this storage for flood control, it must be pumped from the bottom of the North Gibson Ponds to the City's Outfall Channel via a 48-inch diameter force main. The total pumping included in Alternative A is 65 cfs. The total volume of storage at the North Gibson Ponds is 1,530 acre-feet.

The downstream facilities for Alternative A are shown on Figure 1. The estimated costs of the storm drainage facilities included in Alternative A are summarized on **Table 1** (attached). It is noted that there are significant existing utilities at East Main Street, which must be crossed by the force main in this alternative. As there is little as-built information, a higher contingency cost has been included for the force main construction.

### **ALTERNATIVE B**

This alternative is essentially the same as Alternative A with respect to total storage and total pumping capacity (65 cfs) to the Outfall Channel; however, Alternative B incorporates a split pumping scenario, with 35 cfs at the North Gibson Ponds and a second 30-cfs pump station located just south of Main Street at the South Canal (the location of the City's previous South Canal Pump Station). This alternative would initially construct the 30-cfs South Canal

Pump Station to mitigate for development through buildout of the Spring Lake Specific Plan. The 35-cfs North Gibson Pond Pump Station (with a 30-inch diameter force main) would be constructed (along with full excavation of the North Gibson Ponds) to mitigate for the remainder of the South Area development. The initial and final volumes of storage considered at the North Gibson Ponds is 730 acre-feet and 1,530 acre-feet, respectively. The downstream facilities evaluated for Alternative B are shown on **Figure 2**.

The estimated cost of the storm drainage facilities needed for Alternative B are summarized on **Table 2**. Similar to Alternative A, Alternative B has a higher contingency cost associated with the force main construction between the North Gibson Ponds and the Outfall Channel.

### **ALTERNATIVE C**

Alternative C relies more heavily on pumping capacity and less on detention storage, and it is most similar to the approach taken under the 2006 SDFMP. Under Alternative C, all of the new pumping capacity is added at the new South Canal Pump Station location. An ultimate pumping rate of 125 cfs was determined for this alternative based on utilizing the existing detention storage capacity that exists at the North Gibson Ponds (the volume of the pond that is available above the invert elevation of the South Canal, allowing for drainage by gravity). The total volume at the North Gibson Ponds for this alternative is 730 acre-feet. However, the pumping at this location can be phased in such a way that the full Pump Station structure is constructed initially, but only the required pumping units for buildout of Spring Lake are installed.

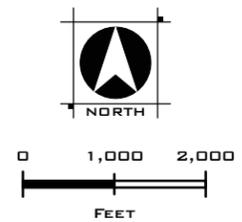
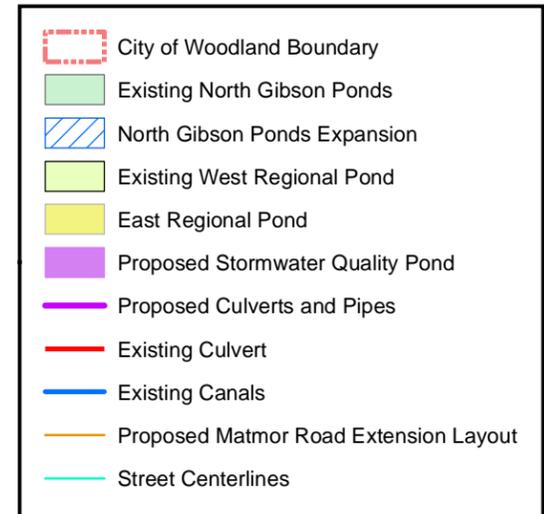
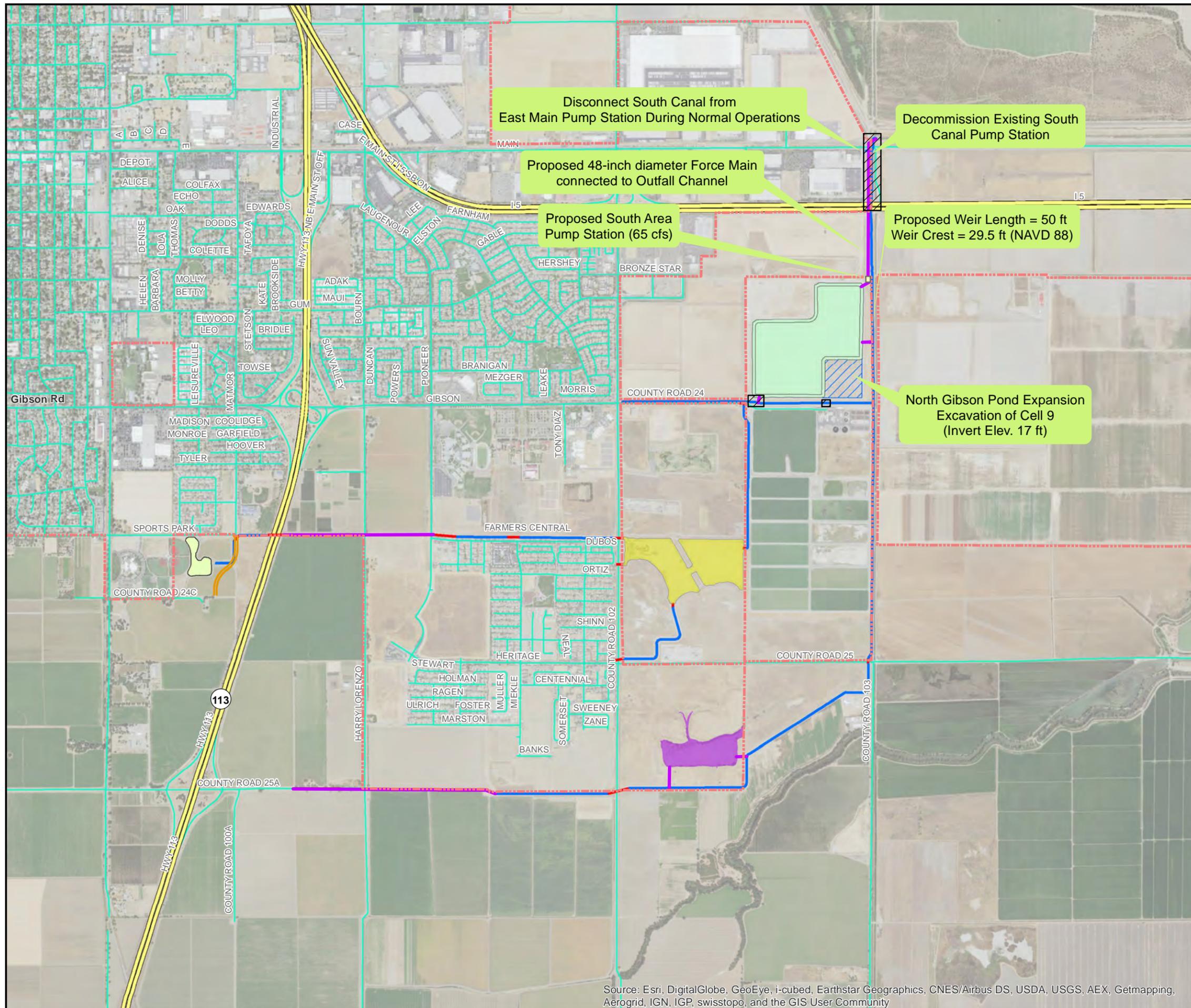
As Alternative C proposes using less detention volume (only the volume that can be drained by gravity), a higher pumping rate is required to maintain full mitigation of impacts. Because this alternative ultimately increases the flow from the south area reaching the City's Outfall Channel, the impact of additional flow to the Outfall Channel must also be considered. The capacity of the Outfall Channel is governed by the existing culverts connecting the Outfall Channel to the Yolo Bypass. By increasing the flow in the Outfall Channel, the water surface elevation within the Outfall Channel will increase. Because the Outfall Channel levees are not currently certified (and are not scheduled to be improved until full buildout of both the South Urban and North Area Master Plans), adding water will increase the loading on the levees. To mitigate this impact, Wood Rodgers proposes improving the Outfall Channel outlet configuration at the Yolo Bypass to accommodate the higher flow rate (increasing the capacity of the outfall culverts). It is noted that the improvements to the Outfall Channel outlet would not be required until after the Spring Lake buildout, and therefore could be phased.

The estimated costs of the storm drainage facilities shown on **Figure 3** are summarized on **Table 3**.

## **CONCLUSIONS**

Alternatives A and B rely on higher levels of detention volume that must be excavated, which would have a significant impact to their respective cost estimates. Both alternatives also rely on pumping from the North Gibson Ponds to the Outfall Channel via a lengthy force main (and a force main alignment that presents a higher risk of conflict with existing utilities). Alternative C proposes fully utilizing detention storage that currently exists, and locates the pump station in such a way that a much shorter force main to the Outfall Channel is required. While Alternative C requires modifications to the Outfall Channel outlet, the improvements can be phased so that the associated costs are deferred. Based on these attributes, Alternative C is considered the most feasible alternative with the lowest cost.

**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA**  
WOODLAND, CA  
NOVEMBER, 2016 - UPDATE



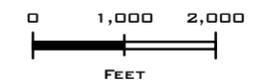
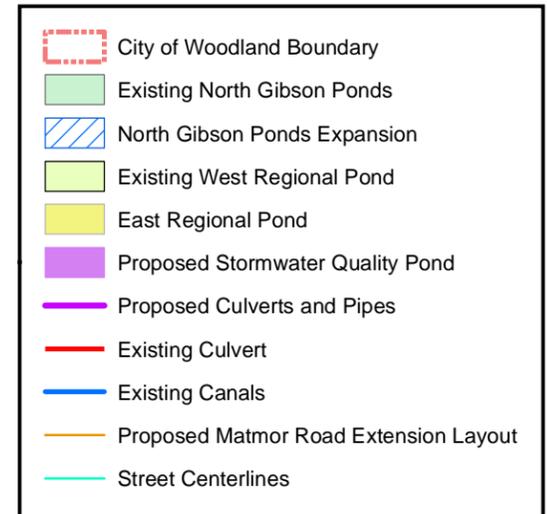
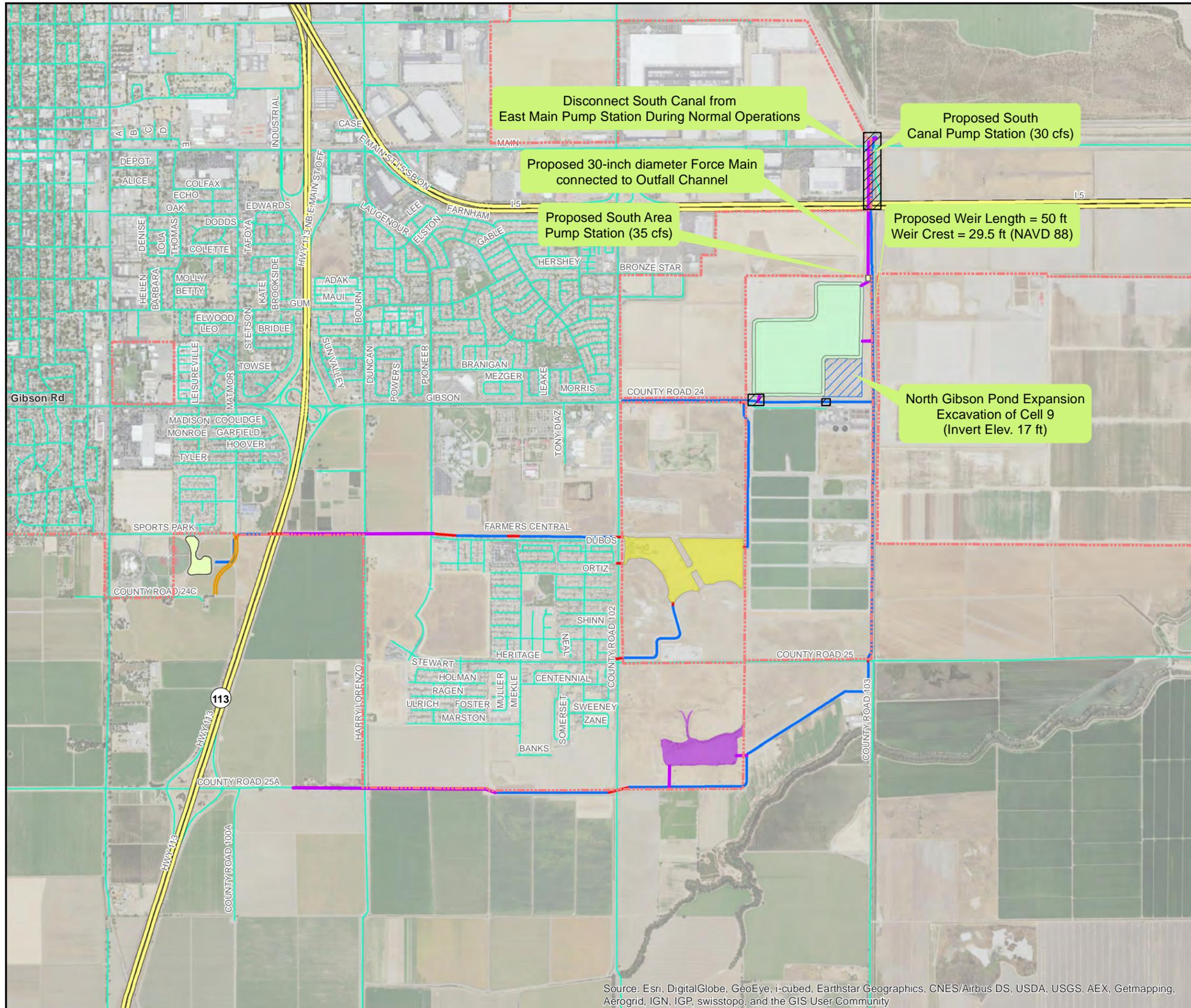
NOTE: UPSTREAM FACILITIES NOT SHOWN

**ALTERNATIVE A  
PROPOSED DRAINAGE FACILITIES -  
ULTIMATE CONDITIONS**



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA**  
WOODLAND, CA  
NOVEMBER, 2016 - UPDATE



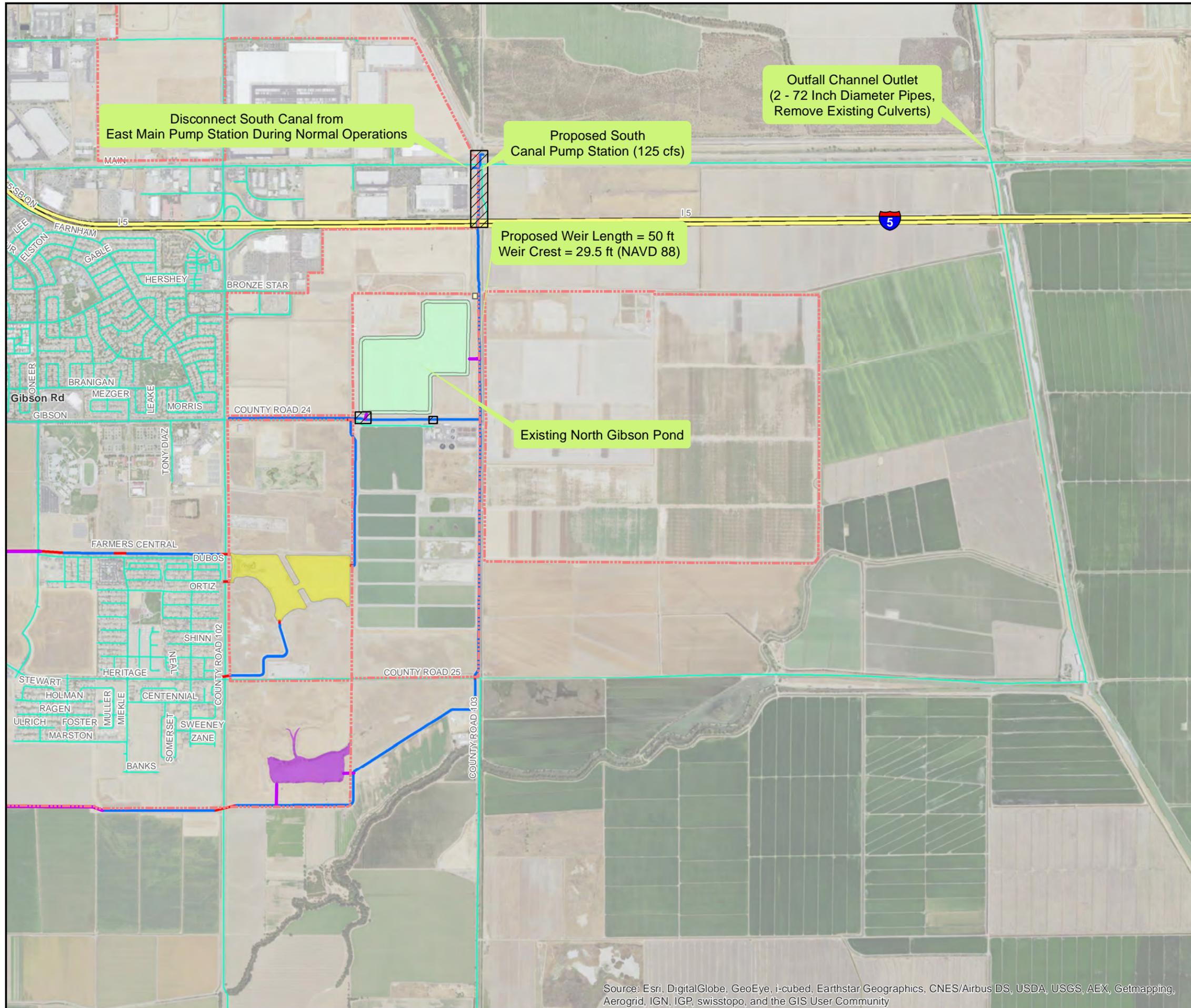
NOTE: UPSTREAM FACILITIES NOT SHOWN

**ALTERNATIVE B  
PROPOSED DRAINAGE FACILITIES -  
ULTIMATE CONDITIONS**



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
SOUTH URBAN GROWTH AREA  
WOODLAND, CA  
NOVEMBER, 2016 - UPDATE**



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

**ALTERNATIVE C  
PROPOSED DRAINAGE FACILITIES -  
ULTIMATE CONDITIONS**



**TABLE 1**  
**Storm Drainage Facilities Master Plan Update**  
**Summary of Opinion of Probable Costs - Alternative A**

Item		Estimated Cost
<b>North Gibson Pond Corridor</b>		
1	North Gibson Pond Expansion	\$6,355,000
2	Force Main	\$1,967,000
3	South Regional Pump Station (65 cfs)**	\$2,923,120
	Contingencies, Design, CM, PM (total 43%)	\$4,835,402
<i>Subtotal</i>		<b>\$16,081,000</b>
<b>Farmers Central Corridor</b>		
1	Farmers Central Pond Expansion	\$1,849,000
2	72-Inch Diameter RCP Storm Drain	\$2,120,000
	Contingencies, Design, CM, PM (total 43%)	\$1,707,000
<i>Subtotal</i>		<b>\$5,676,000</b>
<b>South Regional Pond Corridor</b>		
1	South Regional Pond	\$1,926,000
2	60-Inch Diameter RCP Storm Drain	\$2,182,000
3	Storm Water Quality Pond	\$503,000
	Contingencies, Design, CM, PM (total 43%)	\$1,983,000
<i>Subtotal</i>		<b>\$6,594,000</b>
<b>TOTAL</b>		<b>\$28,351,000</b>
<b>ESTIMATED PROJECT TOTAL (w/Escalation @ 2.5% for 1 year)</b>		<b>\$29,059,775</b>
	** Industry manufacturers have not yet developed a commercially-available trash rack compliant with RWQB future 5-mm mesh requirements; therefore, based on discussions with the City, a \$900K placeholder for each PS has been included.	

**TABLE 2**  
**Storm Drainage Facilities Master Plan Update**  
**Summary of Opinion of Probable Costs - Alternative B**

Item		Estimated Cost
<b>North Gibson Pond Corridor</b>		
1	North Gibson Pond Expansion	\$6,355,000
2	Force Main	\$1,547,000
3	South Regional Pump Stations (30 cfs+35 cfs)**	\$5,002,487
	Contingencies, Design, CM, PM (total 43%)	\$5,548,929
<i>Subtotal</i>		<b>\$18,453,000</b>
<b>Farmers Central Corridor</b>		
1	Farmers Central Pond Expansion	\$1,849,000
2	72-Inch Diameter RCP Storm Drain	\$2,120,000
	Contingencies, Design, CM, PM (total 43%)	\$1,707,000
<i>Subtotal</i>		<b>\$5,676,000</b>
<b>South Regional Pond Corridor</b>		
1	South Regional Pond	\$1,926,000
2	60-Inch Diameter RCP Storm Drain	\$2,182,000
3	Storm Water Quality Pond	\$503,000
	Contingencies, Design, CM, PM (total 43%)	\$1,983,000
<i>Subtotal</i>		<b>\$6,594,000</b>
<b>TOTAL</b>		<b>\$30,723,000</b>
<b>ESTIMATED PROJECT TOTAL (w/Escalation @ 2.5% for 1 year)</b>		<b>\$31,491,075</b>
	** Industry manufacturers have not yet developed a commercially-available trash rack compliant with RWQB future 5-mm mesh requirements; therefore, based on discussions with the City, a \$900K placeholder for each PS has been included.	

**TABLE 3**  
**Storm Drainage Facilities Master Plan Update**  
**Summary of Opinion of Probable Costs - Alternative C**

Item		Estimated Cost
<b>North Gibson Pond Corridor</b>		
1	North Gibson Pond Expansion	\$1,066,000
2	Force Main	\$632,000
3	South Regional Pump Station (125 cfs)**	\$3,578,316
4	Outfall Channel Improvements	\$416,000
	Contingencies, Design, CM, PM (total 43%)	\$2,447,696
<i>Subtotal</i>		<b>\$8,140,000</b>
<b>Farmers Central Corridor</b>		
1	Farmers Central Pond Expansion	\$1,849,000
2	72-Inch Diameter RCP Storm Drain	\$2,120,000
	Contingencies, Design, CM, PM (total 43%)	\$1,707,000
<i>Subtotal</i>		<b>\$5,676,000</b>
<b>South Regional Pond Corridor</b>		
1	South Regional Pond	\$1,926,000
2	60-Inch Diameter RCP Storm Drain	\$2,182,000
3	Storm Water Quality Pond	\$503,000
	Contingencies, Design, CM, PM (total 43%)	\$1,983,000
<i>Subtotal</i>		<b>\$6,594,000</b>
<b>TOTAL</b>		<b>\$20,410,000</b>
<b>ESTIMATED PROJECT TOTAL (w/Escalation @ 2.5% for 1 year)</b>		<b>\$20,920,250</b>
	** Industry manufacturers have not yet developed a commercially-available trash rack compliant with RWQB future 5-mm mesh requirements; therefore, based on discussions with the City, a \$900K placeholder for each PS has been included.	

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## FIGURES

Figure 1	Proposed Drainage Facilities – Ultimate Conditions Modeling
Figure 2	RD 2035 Spill Hydrograph – Baseline Conditions 100-Year 10-Day
Figure 3	Percent Imperviousness – 2015 Conditions
Figure 4	2015 Drainage Facilities
Figure 5	RD 2035 Spill Hydrograph – 2015 Unmitigated Conditions 100-Year 10-Day

## **I. INTRODUCTION**

The City of Woodland (City) has performed extensive planning for future development to occur within its projected city limits in accordance with its General Plan process over the last several decades. The last approved land use plan was developed and accepted by the City in 2002. Recently, the City again updated its General Plan and associated studies, which included an update to the Storm Drainage Facilities Master Plan (SDFMP) for the South Area of the City. According to the City, the South Area is the most likely location for growth to occur in the near future. This is due, in large part, to the previous efforts in developing the Spring Lake Specific Plan (SLSP).

The update for the SDFMP for the South Area focuses primarily on the ultimate facilities required for mitigation of ultimate development, while also evaluating an interim development scenario with the build-out of the Spring Lake Specific Plan. Development of the entire South Area will not occur all at one time, but will take many years to accomplish. Development typically requires a substantial capital investment and, therefore, often occurs in phases in order to generate the cash flow to enable the developer to construct all of the necessary infrastructure. Therefore, to effectively implement the SDFMP, it is prudent to also determine appropriate phasing for construction of drainage features associated with development. This phasing study report is intended to provide the City with the information necessary to phase implementation of the SDFMP's ultimate facilities, as shown on **Figure 1**.

## **II. BASIS OF STUDY**

This phasing study is a component of the City's 2017 SDFMP Update, and has been developed consistent with its findings. The definition of pre-development conditions and ultimate post-development mitigation is more fully documented in the SDFMP Update. This phasing document discusses some of the aspects of drainage mitigation raised in the SDFMP to facilitate a better understanding of the implications of facility phasing; however, it is not intended to be a complete description of the required South Area drainage facilities. Wood Rodgers, Inc. (Wood Rodgers) recommends that the SDFMP Update be reviewed in conjunction with this Phasing Analysis in order to gain a more complete understanding of the pertinent drainage issues affecting proposed drainage infrastructure in the South Area. For purposes of this study, "current" conditions development levels were set by the City, consistent with 2015 development, during the phasing analysis portion of the SDFMP which was authorized in 2015. Given the findings below, no significant development has been authorized since 2015.

## **III. REVISED BASELINE (2002) CONDITIONS**

Under the SDFMP update submitted in February 2017, the baseline conditions (2002 level of development) were re-evaluated using the InfoWorks ICM modeling platform to better establish the base-line flooding conditions. This involved using updated hydrology/rainfall information as

well as more detailed topography and modeling methods to establish overland flow capacities and routing/timing effects. The most important baseline condition re-established with the SDFMP Update is the quantification of the overflow volume exiting the City's drainage system and spilling onto Conaway Ranch (Reclamation District (RD) 2035) east of the City.

The interaction of drainage flow between Conaway Ranch and the City's proposed drainage system occurs along the Conaway Ranch High Line Ditch. The High Line Ditch runs north and south at the east side of the City, just east of the City's Wastewater Treatment Plant. The High Line Ditch creates a linear barrier to low-flow flooding originating from within the City and lands to the west. It is often described as being located along the County Road 103 alignment, although County Road 103 does not extend north of County Road 25. Most of the High Line Ditch flow barrier is located north of the Willow Slough channel, north and south of County Road 25. This overflow at the High Line Ditch occurs when the City's drainage system has reached its capacity and creates damage to the High Line Ditch embankments when spilling occurs. There is currently a shared understanding between the City and Conaway Ranch that the spilling represents a baseline condition, and the City's Storm Drainage planning documents seek to hold the rate and volume of the baseline spill to those determined in the 2002 analysis.

Flow also enters Conaway Ranch in a more controlled fashion under County Road 102 by way of the remnant Willow Slough channel at its culvert crossing beneath County Road 102. The culvert is located approximately 6,500 feet south of County Road 25. Upstream rural (county) lands west of County Road 102 drain toward the existing culvert crossing and, due to the capacity limitations of the culvert, back up under larger flood events. Spills out of the Willow Slough upstream of County Road 102 flow north overland along County Road 102 toward the City. This overflow enters the City with a maximum peak flow of approximately 600 cfs during a 100-year 10-day event, with an approximate volume of 1,145 acre-feet. The SDFMP has defined a means of containing the flow by increasing driving head on the County Road 102 culvert at the westward extension of County Road 25A, conveying it eastward under County Road 102 within the Upper South Canal.

The lands that are tributary to Willow Slough are outside of the City and are essentially undeveloped. For the purposes of this phasing study, no land use change is assumed to occur within the rural Willow Slough watershed upstream of County Road 102. The amount of flow reaching the Upper South Canal portion of the City's system from Willow Slough may be marginally influenced by development within the City, as portions of future City development redirect runoff from areas away from Willow Slough and toward the Upper South Canal. For this reason, Wood Rodgers has included an evaluation of Willow Slough in the report to provide a full understanding of all upstream drainage patterns that are affecting Conaway Ranch.

Also, to ensure that any impacts on Conaway Ranch created by the City are fully quantified, Wood Rodgers closely evaluated the effects of the City’s backwater on the amount of spill leaving Willow Slough. During a 100-year event, it was determined that there are no backwater effects on the amount of Willow Slough spilling resulting from the presence of the City’s drainage facilities. In other words, the exiting water levels of Willow Slough at County Road 102 are sufficiently high enough above the receiving water levels in the Upper South Canal to be hydraulically unaffected by the City’s facilities.

Given the amount of floodplain storage upstream of the High Line Ditch and the limited outfall discharge, the system is governed by flood events with higher volume and of longer duration. The peak rainfall of a 24-hour-duration storm may create peak flowing conditions in the upper parts of the watershed; however, once the storm enters the areas along the South Canal, the larger, volume-driven 10-day event governs storm drainage patterns. While the volume coming out of Willow Slough is unaffected by the backwater of the Upper South Canal, the City’s upstream development plan is affecting the land that is tributary to Willow Slough. A small portion of the City’s plan involves developing land that once drained to Willow Slough and redirecting it to the Upper South Canal. Because the amount of volume flowing through and spilling out of Willow Slough is slightly affected by the City’s development, the maximum volume affecting Conaway Ranch is reported as the volume flowing over the High Line Ditch for the 100-year 10-day flood event combined with the flow passing under County Road 102 within Willow Slough. The baseline condition, therefore, is the spilling into Conaway Ranch of approximately 2,100 acre-feet of flow during the 100-year 10-day event, as shown in the combined hydrograph on **Figure 2**.

#### **IV. 2015 CONDITIONS**

##### **A. Land Use Changes**

The implementation and timing of future drainage facility construction is governed by the current spill conditions as well as the baseline 2002 conditions. Since the 2006 SDFMP was approved, the City has approved tentative maps associated with SLSP Area development. A portion of this development has been constructed. The current representation of constructed development (provided by the City) is identified by the areas shown on **Figure 3**, as well as the associated local streets accessing these constructed lots/parcels.

As part of the early phasing analysis effort in establishing the 2015 conditions, Wood Rodgers determined that the level of impervious surfaces at the recent development exceeds what was originally planned for and modeled in the 2006 SDFMP. The 2017 SDFMP Update has therefore been modified to adjust the percentage of impervious surfaces within the South Urban Growth Area in order to reflect the larger homes on smaller lots with more expansive concrete work that were actually constructed.

## **B. Drainage Facilities**

Development that was built in the South Area prior to October 2015 has included the construction of a portion of the storm drainage facilities, as shown on **Figure 4**.

While facilities such as the East Regional Detention Pond and West Regional Pond have helped to mitigate development impacts, the loss of the South Canal Pump Station has impacted storm drainage within the South Area with respect to current development. The City is in the beginning phases of constructing a new South Canal Pump Station and incorporating detention storage at the North Gibson Ponds to mitigate this situation (as described within this Phasing Report).

## **C. Preliminary Results**

The 2015 amount of development runoff draining through the current City drainage infrastructure creates an increase in overflow volume spilling to Conaway Ranch. **Figure 5** shows the combined hydrograph of flow entering Conaway Ranch, representing approximately 2,750 acre-feet, which is approximately 655 ac-feet above baseline conditions.

## **V. PHASING CONSIDERATIONS**

Typically, phasing analysis begins with a fixed increment of development at a specific location in the watershed and determines what portion of the ultimate drainage facilities are needed to accommodate it. Using this typical approach, there are sometimes opportunities to construct interim facilities which are not a part of the ultimate facilities plan. These interim facilities allow a portion of development to connect downstream more economically in the short term but, ultimately, may be “throw away” costs. This approach can allow early projects to proceed by paying their respective fees for ultimate facilities while also constructing additional (less expensive) temporary facilities, thereby postponing the construction of ultimate facilities until more lands have contributed to the capital cost.

For the SDFMP Update, there are a number of facilities already constructed, and there are essentially only three facility phasing increments that can reasonably be implemented. With each of these three increments, a certain level of development can theoretically be mitigated. Thus, the approach to this phasing analysis will assess the implementation of certain increments of ultimate drainage facilities and provide an estimation of the level of development that can be accommodated by each increment. With this approach, no interim facilities are proposed and analyzed as part of this phasing analysis.

The first increment of the implementation consists of connecting the already excavated North Gibson Ponds area to the South Canal in order to enable it to fill and drain by gravity to the existing (2015) pumping facilities north of Interstate 5 (I-5). Currently, the berms around the perimeter of

the ponds, which originally were installed to separate the wastewater operations from drainage, now serve to isolate the North Gibson Ponds from receiving storm runoff from the system. The ultimate connection of the South Canal to the North Gibson Ponds from a flood control perspective is to construct an overflow weir that would allow South Canal flow to spill into the storage within the North Gibson Ponds area. A separate gravity drain pipe would be constructed, including a backflow prevention device, to drain detained water from the North Gibson Ponds back to the South Canal as the channel is pumped down. The North Gibson Ponds are referred to as the North Regional Pond under the SDFMP.

The second increment of SDFMP facilities construction is to re-establish 30 cfs of pumping capacity at the South Canal Pump Station, returning the drainage system to baseline facility conditions. The addition of 30 cfs of pumping capacity is considered to be a significantly more expensive increment than connecting existing gravity detention storage would be, making this the logical second increment of facilities phasing.

The third increment of phasing is to install the required ultimate pumping capacity for the South Canal Pump Station, accommodating full General Plan land use buildout. The installation of ultimate pumping capacity triggers improvements to the Outfall Channel, including the modification of its outlet at the Yolo Bypass, as described in the SDFMP.

**A. Phase 1 – North Regional Pond – Gravity Detention**

With the connection of gravity detention storage at the North Regional Pond site, more runoff volume can be held upstream of the High Line Ditch, which would allow less water to spill eastward over the High Line Ditch during a 100-year, 10-day event.

From the analysis and results relating to the 2015 development, it is clear that current development has increased spills out of the City's system to Conaway Ranch above the baseline condition. By connecting the North Regional Pond to the South Canal, the implementation of this Phase 1 facility reduces the Conaway spill; however, it does not fully mitigate the increase over baseline conditions. The volume reaching Conaway Ranch is approximately 2,305 acre-feet under this scenario.

To mitigate existing (2015) development, it is necessary to construct both the gravity connection of the North Regional Pond and some increment of pumping at the South Canal Pump Station.

**B. Phase 2 – Add 30 cfs Pumping Capacity at the South Canal (East Main Street Pump Connection In-Place)**

With construction of the Phase 1 facilities being insufficient to mitigate 2015 development levels, it is unnecessary to evaluate additional development with just Phase 1 facilities. The

second increment of SDFMP facilities must, therefore, be constructed to allow for additional development. The amount of additional development that may be supported by Phase 2 could require iterations to determine the number of acres of allowable development. As the North Regional Pond is required for all development moving forward, Wood Rodgers evaluated Phase 2 facilities with Spring Lake Buildout as a first iteration. It was then determined that all of Spring Lake can be developed with Phase 2 facilities, which would result in a total volume of approximately 1,800 acre-feet flowing onto Conaway Ranch (lower than the baseline condition). Developing land beyond SLSP build-out, an estimated 80 acres of additional development can be constructed without increasing the spill volume reaching Conaway Ranch. This estimation is based upon interpolation between modeled scenarios of development and storm drainage facilities construction.

**C. Phase 3 –120 cfs Pumping Capacity (East Main Street Pump Disconnected)**

Phase 3 of SDFMP facilities implementation is essentially the construction of the ultimate facilities required to mitigate all development within the South Urban Growth area, as defined in the SDFMP. Phase 3, therefore, increases the pumping capacity of the Phase 2 South Canal Pump Station from 30 cfs to its ultimate capacity of 120 cfs.

**VI. RESULTS AND CONCLUSIONS**

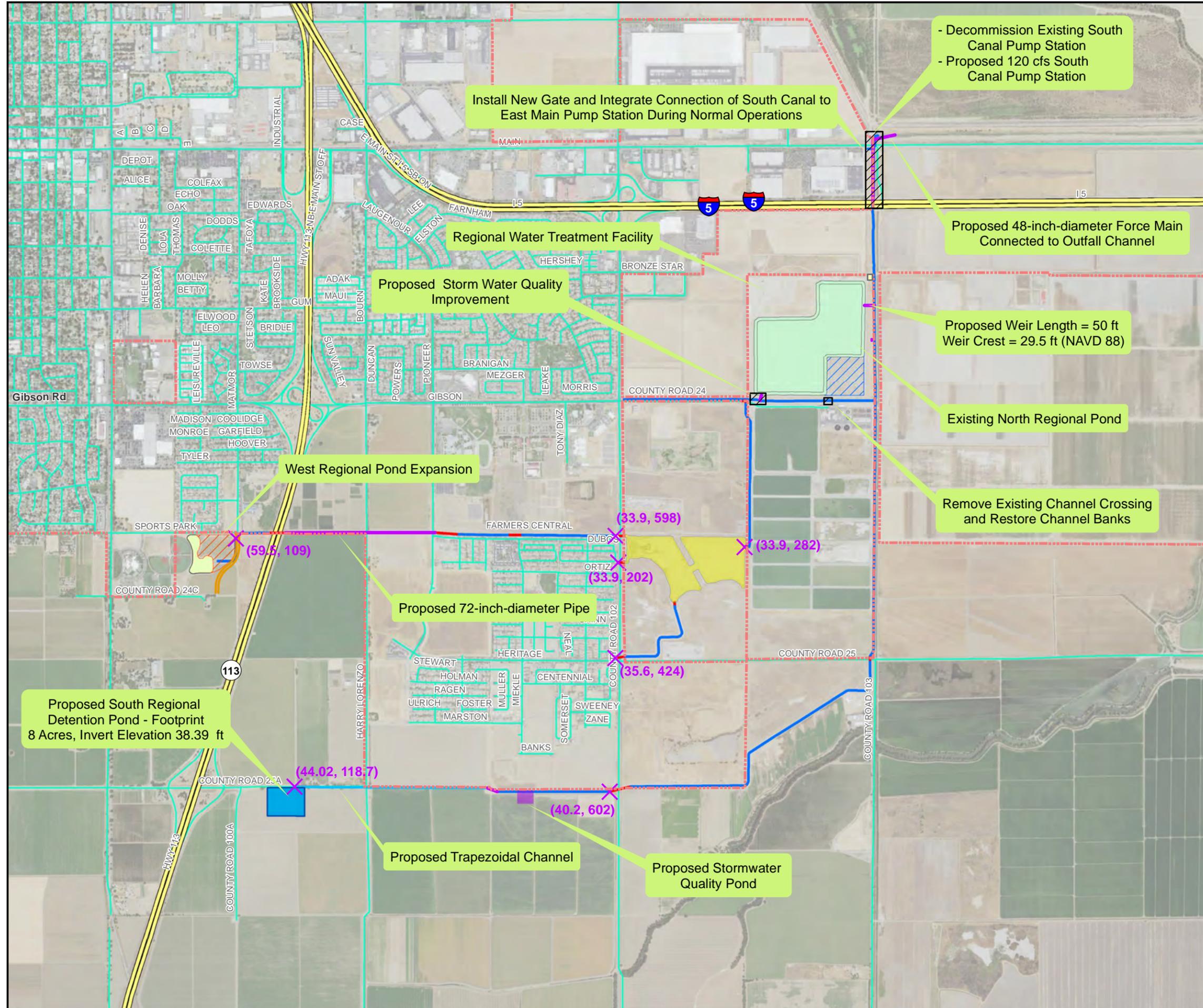
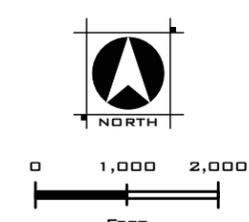
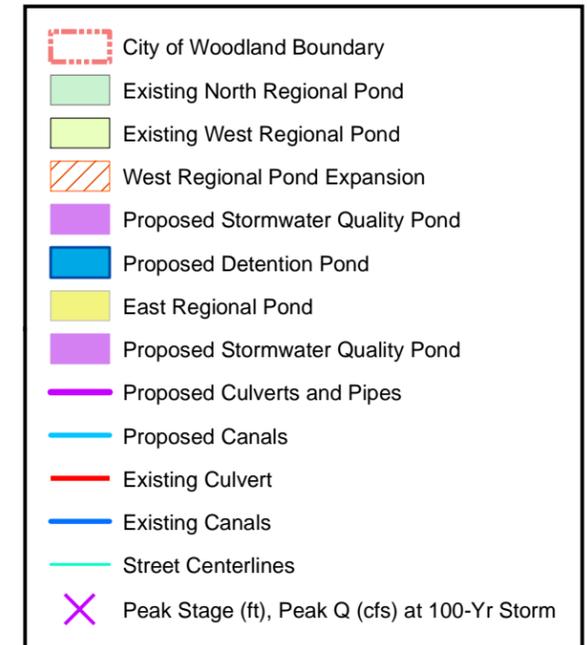
There are many factors which contribute to the baseline drainage conditions for the City’s Storm Drainage system and its potential to exceed system capacity and impact downstream lands. These factors include increased acres of development, increased runoff from existing development (due to higher constructed imperviousness than planned), increased runoff due to updated hydrologic data (specifically higher rainfall values associated with more recent Yolo County standards), and changes to existing facilities (pumping and storage) downstream.

At its current level of development and storm drainage facilities implementation, the South Urban Growth Area increases spilling into adjacent lands under the 100-year 10-day storm event. The addition of gravity storage at the North Regional Pond site is insufficient to return levels to below-baseline conditions. Additional pumping of the South Area runoff to the City’s Outfall Channel is necessary to both re-establish baseline conditions and, ultimately, to serve full buildout within the South Urban Growth Area.

The disconnection of the South Canal system from the East Main Street Pump Station will require a significant portion of the new 120-cfs pumping capacity at the South Canal Pump Station. While it is the City’s goal to disconnect these facilities during a storm event, additional analysis is required to determine when this disconnection should occur.

While this phasing memorandum is focused on the South Area of the City, ultimate buildout of the South Area in conjunction with North Area facilities construction will trigger the need for improvements to the City’s Outfall Channel Outlet structure, as defined in the SDFMP update.

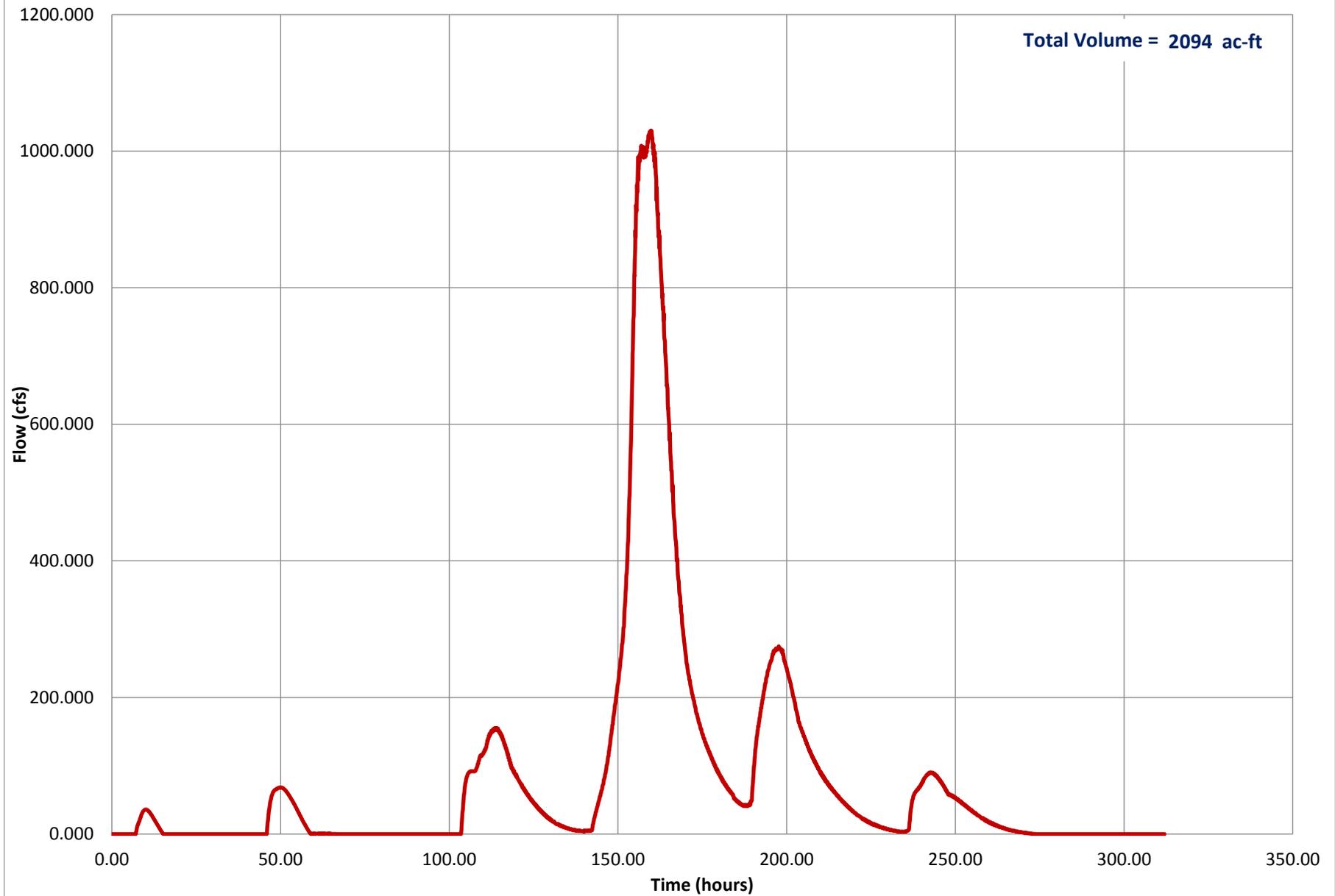
**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
PHASING REPORT**  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE



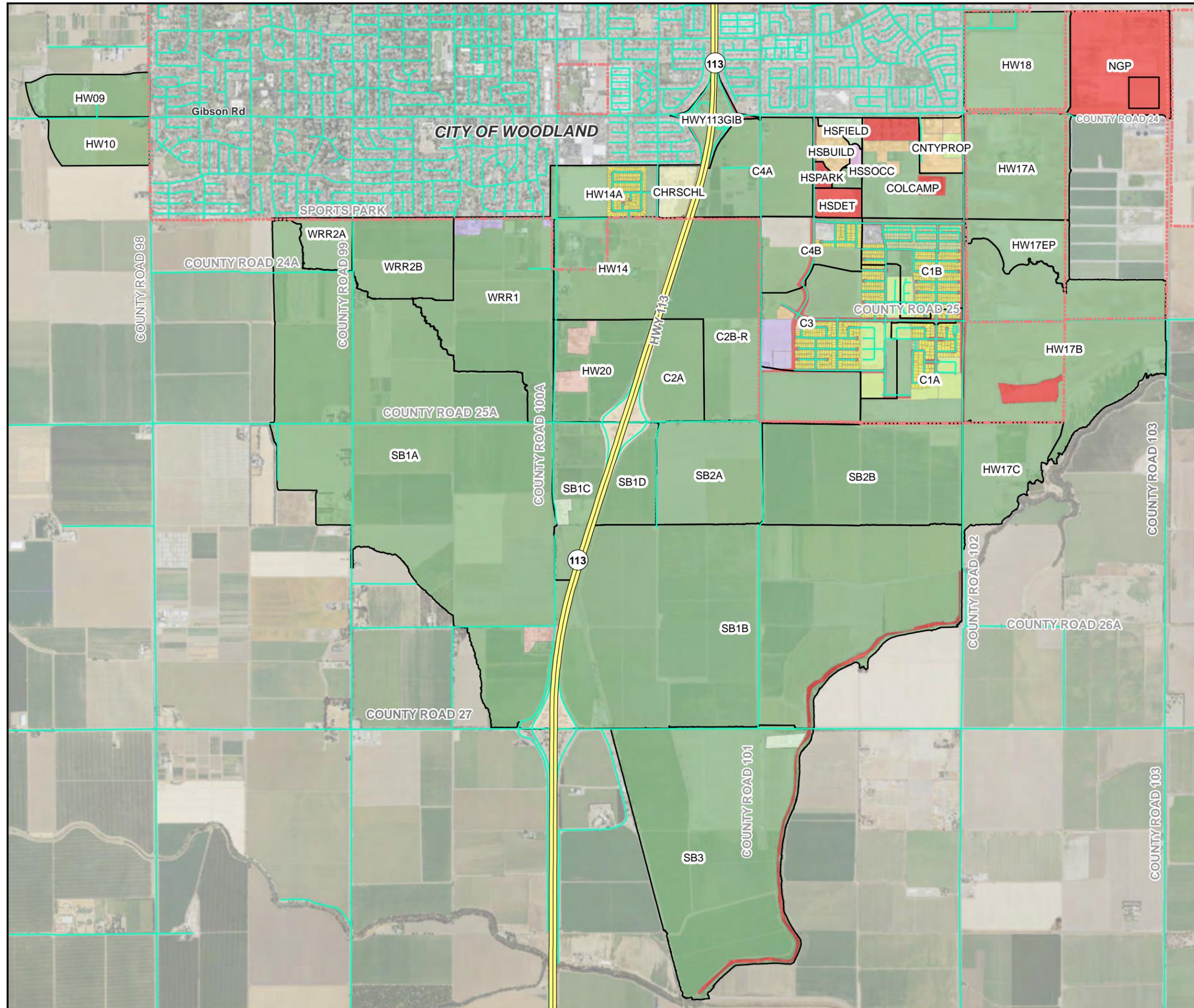
**PROPOSED DRAINAGE FACILITIES-  
ULTIMATE CONDITIONS MODELING**



### RD 2035 SPILL HYDROGRAPH - BASELINE CONDITIONS 100-YEAR 10-DAY



**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
PHASING REPORT  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE**



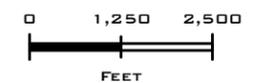
**City of Woodland Boundary**  
 City of Woodland Boundary

**Street Centerlines**  
 Street Centerlines

**2015 Conditions Watersheds - HEC-HMS**  
 2015 Conditions Watersheds - HEC-HMS

**Percentage Imperviousness**

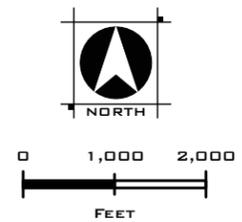
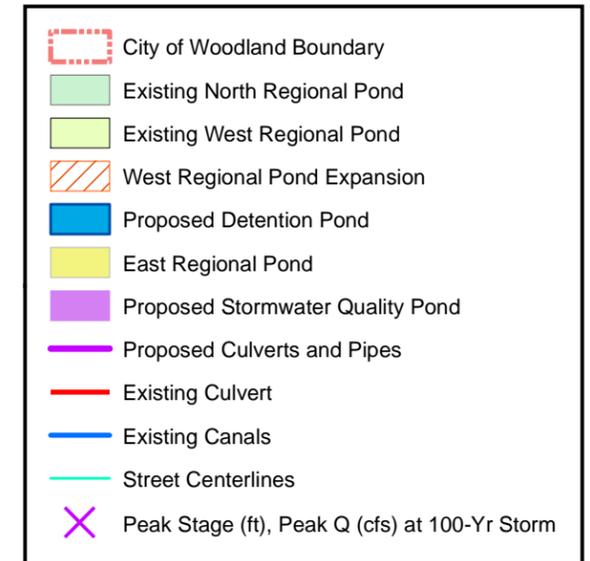
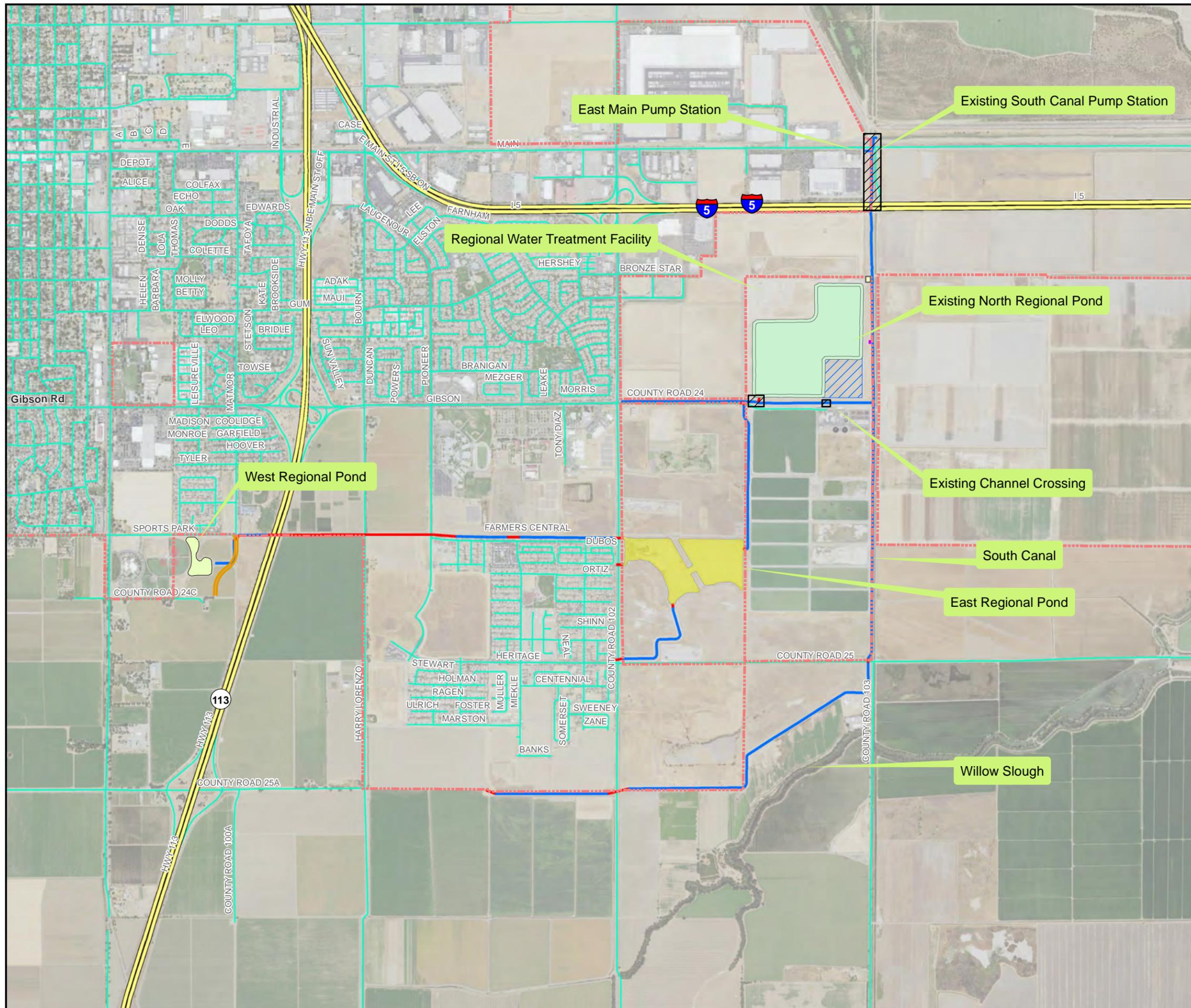
	2
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**PERCENT IMPERVIOUSNESS -  
2015 CONDITIONS**



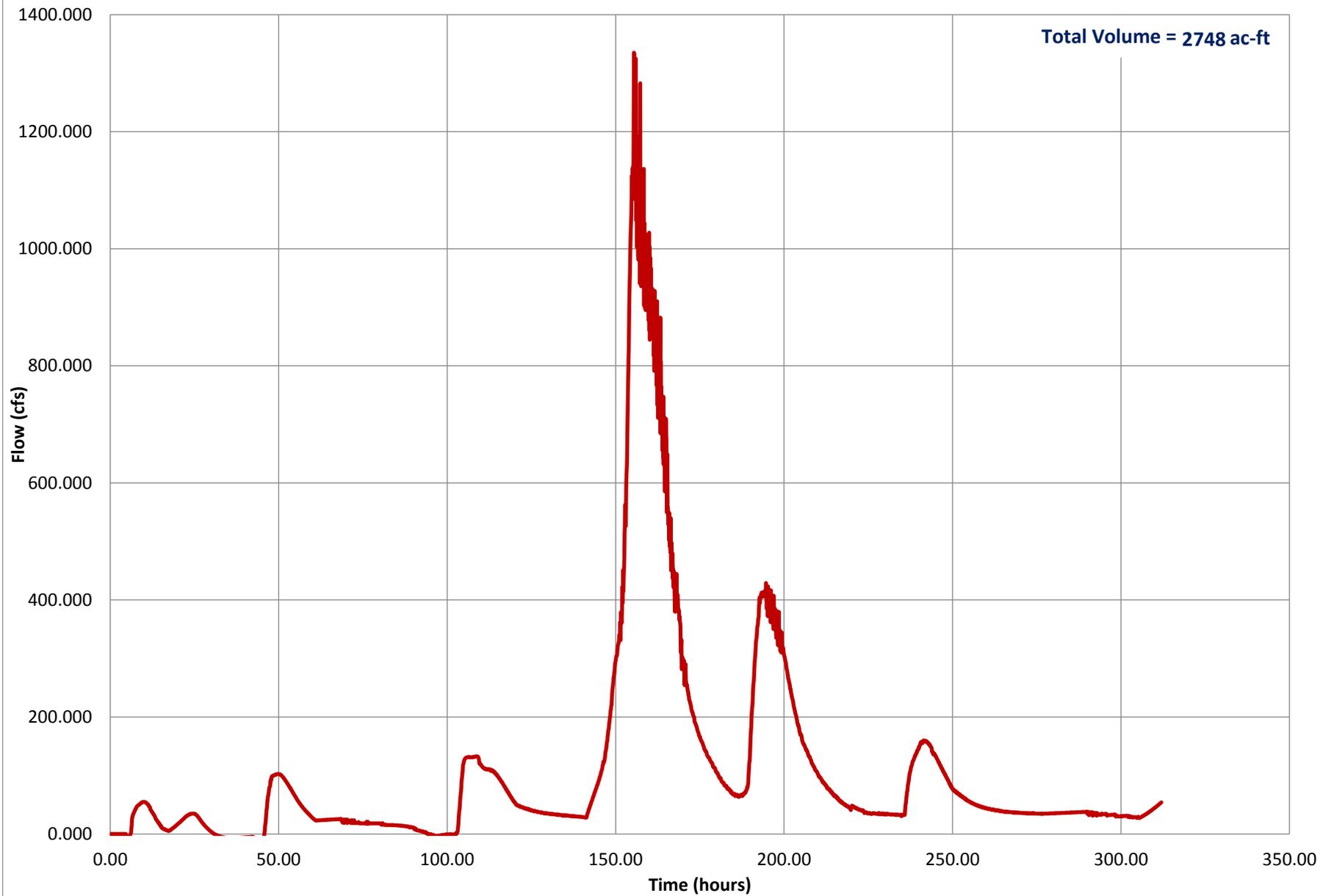
**CITY OF WOODLAND STORM DRAINAGE  
FACILITIES MASTER PLAN  
PHASING REPORT**  
WOODLAND, CA  
FEBRUARY, 2017 - UPDATE



**2015 DRAINAGE FACILITIES**



### RD 2035 SPILL HYDROGRAPH - 2015 UNMITIGATED CONDITIONS 100-YEAR 10-DAY



**Appendix D**  
**Cost Estimates**



**TABLE 1 - DRAINAGE FACILITIES COST**

<b>Continuing 2006 SDFMP Projects</b>	<b>2006 SDFMP Total Costs</b>	<b>2006 Exempt Land Portion of Total Costs</b>	<b>CCI Index</b>	<b>2017 SDFMP Total Costs</b>	<b>2017 Exempt Land Portion of Total Costs</b>
<b>NORTH AREA</b>					
Northwest Interceptor with Sediment Basins (A to B)	\$7,157,165	\$0	1.279	\$9,154,014	\$0
Volkl Pond Improvements	\$2,374,607	\$16,534	1.279	\$3,037,122	\$0
Volkl Trunk Facilities	\$2,765,427	\$19,255	1.279	\$3,536,981	\$0
Kentucky Trunk Diversions to Volkl	\$737,550	\$0	1.279	\$943,326	\$0
Volkl Outlet (B to C)	\$3,488,585	\$81,637	1.279	\$4,461,900	\$0
North Canal Improvements (C to D)	\$3,575,775	\$83,677	1.279	\$4,573,416	\$0
North Canal Improvements (D to E)	\$3,898,576	\$291,420	1.279	\$4,986,279	\$0
Beamer/Kentucky Channel	\$4,819,295	\$507,652	1.279	\$6,163,878	\$0
North Canal Bridge & RD2035 Facilities Relocation	\$709,500	\$53,035	1.279	\$907,451	\$0
Storm Drains - Volkl Trunk	\$3,527,865	\$24,564	1.279	\$4,512,139	\$0
Storm Drains - Beamer/Kentucky Trunk	\$11,375,752	\$1,198,292	1.279	\$14,549,587	\$0
North Area Fill	\$12,116,066	\$905,681	1.279	\$15,496,448	\$0
<b>SOUTH AREA</b>					
Farmers Central Trunk (West HWY 113)	\$1,482,045	\$373,402	1.279	\$1,895,536	\$0
South Interceptor/Conveyance (CONSTRUCTED)	\$2,440,531	\$367,537	N/A	\$2,440,531	\$0
Inlet Channel (CONSTRUCTED)	\$575,412	\$124,351	N/A	\$575,412	\$0
East Regional Detention Pond (CONSTRUCTED)	\$9,572,612	\$2,250,433	N/A	\$9,572,612	\$0
Outlet Channel (CONSTRUCTED)	\$1,258,986	\$295,976	N/A	\$1,258,986	\$0
Farmers Central Culvert (CONSTRUCTED)	\$601,952	\$76,162	N/A	\$601,952	\$0
County Road 102 Culvert (CONSTRUCTED)	\$302,489	\$38,465	N/A	\$302,489	\$0
Parkway Trunk Culvert (CONSTRUCTED)	\$491,544	\$106,226	N/A	\$491,544	\$0
Storm Drains - Farmers Central Trunk (West)	\$1,146,225	\$288,792	1.279	\$1,466,022	\$0
Storm Drains - Farmers Central Trunk (East)	\$2,479,500	\$626,808	1.279	\$3,171,281	\$0
Storm Drains - Parkway Trunk	\$3,016,073	\$676,191	1.279	\$3,857,557	\$0
Storm Drains - 25A Trunk (Revised 2008)	\$1,179,213	\$201,070	1.279	\$1,508,213	\$0
Storm Drains - County Road 102 Trunk	\$577,100	\$73,385	1.279	\$738,111	\$0
Storm Drains - Zone S4B Trunk	\$741,313	\$159,683	1.279	\$948,139	\$0
<b>COMMON</b>					
Outfall Channel Improvements (North and South Areas Combined)	\$5,145,937	\$423,406	1.279	\$6,581,653	\$0
Outfall Channel Improvements (South Area Only - 10.36% of Total Cost)				\$681,859	\$0
<b>OTHER PROJECTS (provided by City in 2006)</b>					
SD5 - Upgrade Kentucky Avenue Ditch	\$262,812	\$0	1.279	\$336,137	\$0
SD11 - Enclose Open Channel from Commerce to I-5	\$412,650	\$0	1.279	\$527,779	\$0
SD13 - Tanforan Avenue Trunk Line	\$1,150,090	\$0	1.279	\$1,470,965	\$0
SD21 - Enclose Open Channels N. & E. Kentucky Avenue I-5 Overpass	\$531,165	\$0	1.279	\$679,360	\$0
SD27 - Update Master Plan	\$975,000	\$161,750	N/A	975,000	\$0
SD28 - Cache Creek Levee Improvements (Removed due to Separate Prop 218 Funding)	N/A				
SD102 - Pump Station Flood Protection - Phase 1 (Design)	\$20,000	\$0	1.279	\$25,580	\$0
SD105 - Annual Storm Drainage System Maintenance Repair & Upgrade	\$1,400,000	\$0	1.279	\$1,790,600	\$0
SD114 - Storm Drainage System Maintenance, Testing & Inspection	\$2,275,000	\$0	1.279	\$2,909,725	\$0
SD116 - SCADA for Storm Drain Pump Stations	\$70,000	\$0	1.279	\$89,530	\$0
SD117/957 - Flood Protection Feasibility Study (Removed due to Separate Prop 218 Funding)	N/A				
<b>2017 SDFMP - Updated Projects (New Detailed Estimates)</b>					
<b>NORTH AREA</b>					
Outfall Channel Outlet Structure - North Area Portion (89.64%)	N/A	N/A	N/A	\$2,125,000	\$0
<b>SOUTH AREA</b>					
South Canal Pump Station	N/A	N/A	N/A	\$5,499,000	\$0
SCPS Force Main	N/A	N/A	N/A	\$973,000	\$0
North Regional Pond Improvements	N/A	N/A	N/A	\$1,642,000	\$0
80% Flood Easement (SLSP Areas Only)	N/A	N/A	N/A	\$680,700	\$0
20% Flood Easement (non-SLSP Areas)	N/A	N/A	N/A	\$170,175	\$0
Upper South Canal Channel (East of CR101)	N/A	N/A	N/A	\$448,000	\$0
Upper South Canal Channel (West of CR101)	N/A	N/A	N/A	\$450,000	\$0
South Regional Detention Pond	N/A	N/A	N/A	\$2,154,000	\$0
Farmers Central - 72-inch Storm Drain	N/A	N/A	N/A	\$3,265,000	\$0
West Regional Detention Pond (Expansion)	N/A	N/A	N/A	\$2,847,000	\$0
Outfall Channel Outlet - South Area Portion (10.36%)	N/A	N/A	N/A	\$246,000	\$0
Storm Water Quality Pond (CR25A)	N/A	N/A	N/A	\$586,971	\$0
Future Trash Screen (5mm)	N/A	N/A	N/A	\$1,386,000	\$0
<b>TOTAL</b>				<b>\$139,010,141</b>	<b>\$0</b>

**TABLE 2**  
**Storm Drainage Facilities Master Plan Update**  
**Summary of Opinion of Probable Costs - South Area**

Item	Estimated Cost	Contingencies	Total Cost
<b>North Regional Pond Corridor (Common Facilities)</b>			
1 North Regional Pond Improvements	\$1,066,000	\$575,640.00	\$1,641,640.00
2 South Canal Pump Station Force Main	\$632,000	\$341,280.00	\$973,280.00
3 South Canal Pump Station (120 cfs)	\$3,582,030	\$1,934,296.20	\$5,516,326.20
4 Outfall Outlet Structure (South Area Portion - 10.36% of Ultimate)	\$164,943	\$89,069.39	\$254,012.72
5 Future 5mm Pump Screen System** Contingencies, Design, CM, PM, Env. Mit. (total 54%)	\$900,000 \$3,426,286	\$486,000.00	\$1,386,000.00
<i>Subtotal</i>	<i>\$9,771,000</i>		<i>\$9,771,258.92</i>
<b>Farmers Central Corridor</b>			
1 West Regional Pond Expansion	\$1,849,000	\$998,460.00	\$2,847,460.00
2 72-Inch Diameter RCP Storm Drain Contingencies, Design, CM, PM, Env. Mit. (total 54%)	\$2,120,000 \$2,143,000	\$1,144,800.00	\$3,264,800.00
<i>Subtotal</i>	<i>\$6,112,000</i>		<i>\$6,112,260.00</i>
<b>Upper South Canal Corridor</b>			
1 South Regional Pond	\$1,926,000	\$1,040,040.00	\$2,966,040.00
2 South Canal Channel Extension	\$583,000	\$314,820.00	\$897,820.00
3 Storm Water Quality Pond (Upstream CR102) (SDFMP 2008 Cost with CCI)	\$381,150	\$205,821.00	\$586,971.00
4 Flood Easement (62.3 acres @ \$11,250/acre) Contingencies, Design, CM, PM, Env. Mit. (total 54%), except Easement Contingencies =\$150,000	\$700,875 \$1,710,681	\$150,000.00	\$850,875.00
<i>Subtotal</i>	<i>\$5,302,000</i>		<i>\$5,301,706.00</i>
<b>TOTAL</b>	<b>\$21,185,000</b>		<b>\$21,185,000</b>

\*\* - Future 5mm Mesh Trash Rack cannot be estimated - \$900k based on 125% of traditional screen system

**TABLE 3**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**North Regional Pond**  
**North Regional Pond Improvements**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 North Regional Pond</b>				
a. Silt Fencing/Straw Wattles	500	LF	\$5.50	\$2,750
b. Stabilized Construction Entrance	2	EA	\$4,000.00	\$8,000
c. 48-Inch RCP Storm Drain	300	LF	\$329.00	\$98,700
d. 48-Inch Outfall & Headwall Structure	2	EA	\$20,500.00	\$41,000
e. 72-Inch RCP Storm Drain	300	LF	\$580.00	\$174,000
f. 72-Inch Outfall & Headwall Structure	2	EA	\$26,500.00	\$53,000
g. 72-Inch Duckbill Check Valve	2	EA	\$115,000.00	\$230,000
h. Concrete for Weir	50	CY	\$600.00	\$30,000
i. Riprap Erosion Protection	250	CY	\$200.00	\$50,000
j. Dewatering	1	LS	\$150,000.00	\$150,000
k. 24-Inch RCP Storm Drain	300	LF	\$149.00	\$44,700
l. 24-Inch Outfall & Headwall Structure	4	EA	\$7,500.00	\$30,000
m. 2-Foot Training Wall	520	LF	\$180.00	\$93,600
n. Mobilization and Demobilization	1	LS	5%	\$50,288
o. Traffic Control (Rural)	1	LS	1%	\$10,058
<i>Subtotal</i>				<i>\$1,066,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$266,500
c. Construction Management and Inspection		%	12%	\$127,920
d. Engineering/Design		%	10%	\$106,600
e. Environmental Mitigation		%	1%	\$10,660
f. Preliminary Engineering		%	3%	\$31,980
g. Project Management		%	3%	\$31,980
<i>Subtotal</i>				<i>\$575,640</i>
<b>ESTIMATED TOTAL</b>				<b>\$1,642,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material assumed to be hauled to landfill

**TABLE 4**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**North Regional Pond**  
**South Canal Pump Station Force Main**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 South Canal Pump Station Force Main</b>				
a. Silt Fencing/Straw Wattles	1,600	LF	\$5.50	\$8,800
b. 48-Inch PVC Force Main	800	LF	\$340.00	\$272,000
c. South Canal Pump Station Decommissioning	1	EA	\$30,000.00	\$30,000
d. Plug and Cap Ex. Force Main	2	EA	\$10,000.00	\$20,000
e. UPRR Crossing & Coordination	1	LS	\$100,000.00	\$100,000
f. Asphalt Removal & Replacement	35	SY	\$150.00	\$5,250
g. Riprap Erosion Protection	50	CY	\$200.00	\$10,000
h. Dewatering	1	LS	\$150,000.00	\$150,000
i. Mobilization and Demobilization	1	LS	5%	\$29,803
j. Traffic Control (Rural)	1	LS	1%	\$5,961
<i>Subtotal</i>				\$632,000
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$158,000
c. Construction Management and Inspection		%	12%	\$75,840
d. Engineering/Design		%	10%	\$63,200
e. Environmental Mitigation		%	1%	\$6,320
f. Preliminary Engineering		%	3%	\$18,960
g. Project Management		%	3%	\$18,960
<i>Subtotal</i>				\$341,280
<b>ESTIMATED TOTAL</b>				<b>\$973,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels

**TABLE 5**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**North Regional Pond**  
**South Canal Pump Station**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 South Canal Pump Station</b>				
a. Intake Structure <sup>2</sup>	1	LS	\$1,337,200.00	\$1,337,200
b. Generator System <sup>2</sup>	1	LS	\$442,420.00	\$442,420
c. Electrical Controls System <sup>2</sup>	1	LS	\$101,950.00	\$101,950
d. Control Building <sup>2</sup>	1	LS	\$315,300.00	\$315,300
e. Trash Rack System	1	LS	\$703,650.00	\$703,650
f. Pumps and Motors (4 duty and 1 redundant - 30 cfs) <sup>2</sup>	5	EA	\$40,990.00	\$204,950
g. Site and Miscellaneous	1	LS	\$165,640.00	\$165,640
h. Dewatering	1	LS	\$250,000.00	\$250,000
i. Reconstruct Connection to East Main Pump Station	1	LS	\$50,000	\$50,000
<i>Subtotal</i>				<i>\$3,571,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$892,750
c. Construction Management and Inspection		%	12%	\$428,520
d. Engineering/Design		%	10%	\$357,100
e. Environmental Mitigation		%	1%	\$35,710
f. Preliminary Engineering		%	3%	\$107,130
g. Project Management		%	3%	\$107,130
<i>Subtotal</i>				<i>\$1,928,340</i>
<b>ESTIMATED TOTAL</b>				<b>\$5,499,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup> Facilities Elevated above Cache Creek Floodplain

**TABLE 6**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**North Regional Pond**  
**Outfall Outlet Structure**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 Outfall Outlet Structure</b>				
a. Stripping	125	CY	\$5.00	\$626
b. Clearing & Grubbing	0.25	AC	\$5,000.00	\$1,250
c. Excavation & Backfill	3,368	CY	\$12.00	\$40,410
d. Haul & Dispose	648.0	CY	\$15.00	\$9,720
e. Remove & Expose Ex. SD	200.0	LF	\$65.00	\$13,000
f. 72" RCP	500	LF	\$500	\$250,000
g. 72" Flapgate	5.0	EA	\$22,500.00	\$112,500
h. Valve Vault	1	LS	\$134,434.00	\$134,434
i. Positive Closure Sluice Gate	5.0	EA	\$70,000.00	\$350,000
j. Outfall Formwork	2,049.0	SF	\$17.50	\$35,858
k. Outfall Reinforced Concrete	51	LF	\$1,000	\$50,618
l. Outfall Trash Rack	10.0	CY	\$10,000.00	\$100,000
m. RSP	13.0	CY	\$250.00	\$3,250
n. Temporary Cofferd Dam and Dewatering	1	LS	\$437,500	\$437,500
<i>Subtotal</i>				<i>\$1,539,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$384,750
c. Construction Management and Inspection		%	12%	\$184,680
d. Engineering/Design		%	10%	\$153,900
e. Environmental Mitigation		%	1%	\$15,390
f. Preliminary Engineering		%	3%	\$46,170
g. Project Management		%	3%	\$46,170
<i>Subtotal</i>				<i>\$831,000</i>
<b>ESTIMATED TOTAL</b>				<b>\$2,370,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

**TABLE 7**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**Farmers Central Corridor**  
**West Regional Pond Expansion**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 West Regional Detention Pond</b>				
a. Land Acquisition - Agricultural	15	AC	\$25,000.00	\$375,000
b. Flood Easement		AC	\$18,750.00	\$0
c. Silt Fencing/Straw Wattles	3,300	LF	\$5.50	\$18,150
d. Stabilized Construction Entrance	2	EA	\$4,000.00	\$8,000
e. Erosion Control Seeding (Site)	15	AC	\$3,250.00	\$48,750
f. Stripping	15	AC	\$4,000.00	\$60,000
g. Pond Excavation <sup>2</sup>	158,107	CY	\$3.50	\$553,375
h. Placement and Compaction <sup>2</sup>	158,107	CY	\$3.50	\$553,375
i. 48-Inch RCP Storm Drain	200	LF	\$329.00	\$65,800
j. 48-Inch Outfall & Headwall Structure	2	EA	\$20,500.00	\$41,000
k. Riprap Erosion Protection	60	CY	\$200.00	\$12,000
l. Remove Existing Outfall Pipe	600	LF	\$50.00	\$30,000
m. Mobilization and Demobilization	1	LS	5%	\$69,522
n. Traffic Control (Rural)	1	LS	1%	\$13,904
<i>Subtotal</i>				<i>\$1,849,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$462,250
c. Construction Management and Inspection		%	12%	\$221,880
d. Engineering/Design		%	10%	\$184,900
e. Environmental Mitigation		%	1%	\$18,490
f. Preliminary Engineering		%	3%	\$55,470
g. Project Management		%	3%	\$55,470
<i>Subtotal</i>				<i>\$998,000</i>
<b>ESTIMATED TOTAL</b>				<b>\$2,847,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material to be used on adjacent lands when development occurs.

**TABLE 8**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**Farmers Central Corridor**  
**72-Inch Diameter RCP Storm Drain**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1</b> 72-Inch Storm Drain				
a. Silt Fencing/Straw Wattles	6,228	LF	\$5.50	\$34,254
b. 72-Inch RCP Storm Drain	3,114	LF	\$580.00	\$1,806,120
c. Junction Box MH	8	EA	\$18,500.00	\$148,000
d. Riprap Erosion Protection	60	CY	\$200.00	\$12,000
e. Mobilization and Demobilization	1	LS	5%	\$100,019
f. Traffic Control (Rural)	1	LS	1%	\$20,004
<i>Subtotal</i>				<i>\$2,120,000</i>
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$530,000
c. Construction Management and Inspection		%	12%	\$254,400
d. Engineering/Design		%	10%	\$212,000
e. Environmental Mitigation		%	1%	\$21,200
f. Preliminary Engineering		%	3%	\$63,600
g. Project Management		%	3%	\$63,600
<i>Subtotal</i>				<i>\$1,145,000</i>
<b>ESTIMATED TOTAL</b>				<b>\$3,265,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material to be used on adjacent lands when development occurs.

**TABLE 9**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**

**Upper South Canal Corridor**  
**South Regional Pond**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 South Regional Pond</b>				
a. Land Acquisition - Agricultural	8	AC	\$25,000.00	\$200,000
b. Flood Easement		AC	\$18,750.00	\$0
c. Silt Fencing/Straw Wattles	2,400	LF	\$5.50	\$13,200
d. Stabilized Construction Entrance	2	EA	\$4,000.00	\$8,000
e. Erosion Control Seeding (Site)	8	AC	\$3,250.00	\$26,000
f. Stripping	8	AC	\$4,000.00	\$32,000
g. Pond Excavation <sup>2</sup>	142,000	CY	\$3.50	\$497,000
h. Placement and Compaction <sup>2</sup>	142,000	CY	\$3.50	\$497,000
i. 60-Inch Outfall & Headwall Structure	2	EA	\$23,000.00	\$46,000
j. Riprap Erosion Protection	60	CY	\$200.00	\$12,000
k. Mobilization and Demobilization	1	LS	5%	\$56,560
l. Traffic Control (Rural)	1	LS	1%	\$11,312
<i>Subtotal</i>				\$1,399,000
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$349,750
c. Construction Management and Inspection		%	12%	\$167,880
d. Engineering/Design		%	10%	\$139,900
e. Environmental Mitigation		%	1%	\$13,990
f. Preliminary Engineering		%	3%	\$41,970
g. Project Management		%	3%	\$41,970
<i>Subtotal</i>				\$755,000
<b>ESTIMATED TOTAL</b>				<b>\$2,154,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material to be used on adjacent lands when development occurs.

**TABLE 9**  
**City of Woodland**  
**Storm Drainage Facilities Master Plan Update**  
**Upper South Canal Corridor**  
**South Canal Channel Extension**  
**Opinion of Probable Cost**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost \$
<b>1 CR25A Channel Extension East CR101</b>				
a. Silt Fencing/Straw Wattles	5,190	LF	\$5.50	\$28,545
b. Channel Excavation and Spoil Adjacent	19,012	CY	\$7.00	\$133,081
c. Maintenance Road 6"AB	1,168	TONS	\$45.00	\$52,549
d. Erosion Control Seeding	3.0	AC	\$3,250.00	\$9,827
e. Land Acquisition	3.6	AC	\$15,000.00	\$53,987
f. Mobilization and Demobilization	1	LS	5%	\$11,200
g. Traffic Control (Rural)	1	LS	1%	\$2,240
<i>Subtotal</i>				\$291,000
<b>2 CR25A Channel Extension West CR101</b>				
a. Silt Fencing/Straw Wattles	3,210	LF	\$5.50	\$17,655
b. Channel Excavation and Spoil Adjacent	18,056	CY	\$7.00	\$126,391
c. Maintenance Road 6"AB	722	TONS	\$45.00	\$32,501
d. Erosion Control Seeding	2.3	AC	\$3,250.00	\$7,593
e. Culvert Under CR101 (60")	100.0	LF	\$440.00	\$44,000
f. CR101 Headwalls	1.0	LS	\$10,000.00	\$10,000
g. Land Acquisition	2.7	AC	\$15,000.00	\$40,014
h. Mobilization and Demobilization	1	LS	5%	\$11,907
i. Traffic Control (Rural)	1	LS	1%	\$2,381
<i>Subtotal</i>				\$292,000
<b>Other Related Costs</b>				
a. Administration		%	0%	\$0
b. Construction Contingency		%	25%	\$145,750
c. Construction Management and Inspection		%	12%	\$69,960
d. Engineering/Design		%	10%	\$58,300
e. Environmental Mitigation		%	1%	\$5,830
f. Preliminary Engineering		%	3%	\$17,490
g. Project Management		%	3%	\$17,490
<i>Subtotal</i>				\$315,000
<b>ESTIMATED TOTAL</b>				<b>\$898,000</b>

<sup>1</sup>Unit Costs are based upon 2016 price levels.

<sup>2</sup>Excavated material to be used on adjacent lands when development occurs.

TABLE 11  
CITY OF WOODLAND  
TECHNICAL MEMORANDUM  
SOUTH AREA DRAINAGE FACILITIES ALTERNATIVES STUDY  
COUNTY ROAD 25A PROPOSED DRAINAGE (CHANNEL ALTERNATIVE)  
OPINION OF PROBABLE COST

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
<del>1. Interceptor Conveyance Channel</del>				
<del>a. Site Clearing</del>	<del>8.9</del>	<del>AC</del>	<del>385</del>	<del>3,427</del>
<del>b. Bulk Excavation</del>	<del>66,500</del>	<del>CY</del>	<del>4.52</del>	<del>300,580</del>
<del>c. Structural Backfill and Compaction</del>	<del>5,000</del>	<del>CY</del>	<del>1.52</del>	<del>7,600</del>
<del>d. Grouted Riprap</del>	<del>3,833</del>	<del>CY</del>	<del>108.87</del>	<del>417,335</del>
<del>e. Riprap, Random Broken Stone</del>	<del>3,322</del>	<del>CY</del>	<del>57.84</del>	<del>192,170</del>
<del>f. Maintenance Road (6-Inch AB)</del>	<del>7,083</del>	<del>SY</del>	<del>5.06</del>	<del>35,842</del>
<del>g. Mobilization and Demobilization (5% Construction)</del>	<del>1</del>	<del>LS</del>	<del>47,848</del>	<del>47,848</del>
2. Water Quality Treatment Basin				
a. Site Clearing	4.8	AC	385	1,848
b. Bulk Excavation	43,000	CY	4.52	194,360
c. Structural Backfill and Compaction	200	CY	1.52	304
d. Grouted Riprap	100	CY	108.87	10,887
e. Low Flow Drain	1	LS	5,000.00	5,000
f. Maintenance Road (6-inch AB)	3,233	SY	5.06	16,361
g. Mobilization and Demobilization (5% Construction)	1	LS	11,438	11,438
<del>Subtotal</del>				<del>1,244,999</del>
<del>Construction Contingency @ 25%</del>				<del>311,250</del>
<del>Engineering/Design @ 8%</del>				<del>186,750</del>
<del>Construction Management and Inspection @ 12%</del>				<del>124,500</del>
<del>Subtotal Construction</del>				<del>1,867,499</del>
Land Acquisition	4.8	AC	15,000.00	265,500
<b>TOTAL</b>				<b>2,132,999</b>

August 2008

<sup>1</sup>Unit costs are based upon 2005 price levels.

**2006**  
**COST ESTIMATE TABLES**

**TABLE 2**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**NORTHWEST INTERCEPTOR**  
**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1. Northwest Interceptor				
a. Channel and Sediment Basin Excavation (no Haul & Dump included)	389,412	cy	4.47	1,740,672
b. Place and Shape Fill	447,824	cy	2.35	1,052,386
c. Sediment Basin Outlet	5	ea	1,500.00	7,500
d. Dewatering	1	ls	30,000.00	30,000
e. Aggregate Surface - Access Road Along Channel	25,083	sy	3.38	84,782
f. Bore & Jack Under Railroad	100	lf	350.00	35,000
g. Box Culverts at Multiple Locations - Reinforced Concrete	1,066	cy	462.36	492,876
h. Traffic Control - Temporary Road Bypass	3	ls	50,000.00	150,000
i. Mobilization and Demobilization (1% Construction)	1	ls	172,161.00	172,161
Subtotal				3,765,376
Construction Contingency @ 25%				941,344
Preliminary Engineering @ 5%				188,269
Engineering/Design @ 15%				564,806
Construction Management and Inspection @ 10%				376,538
Administration @ 5%				188,269
Project Management @ 5%				188,269
Total (Construction Costs Only)				6,212,870
Land Acquisition				
a. Northwest Interceptor	57.2	ac	15,000	858,450
b. Habitat Mitigation (Estimate)	57.2	ac	1,500	85,845
Subtotal				944,295
<b>TOTAL</b>				<b>7,157,165</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

**TABLE 3**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**VOLKL POND IMPROVEMENTS**  
**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1. Volkl Pond Improvements				
a. Pond Excavation (no Haul & Dump included)	65,822	cy	4.47	294,224
b. Haul & Dump to Landfill	75,695	cy	6.00	454,172
c. Dewatering	1	ls	100,000.00	100,000
d. Pipe Connection to Outlet Structure	64	lf	260.00	16,640
e. Miscellaneous Reinforced Concrete	40	lf	462.36	18,494
f. Stone Protection	129	tons	28.18	3,635
g. Mobilization and Demobilization (1% Construction)	1	ls	42,420.00	42,420
Subtotal				929,586
Construction Contingency @ 25%				232,396
Preliminary Engineering @ 5%				46,479
Engineering/Design @ 15%				139,438
Construction Management and Inspection @ 10%				92,959
Administration @ 5%				46,479
Project Management @ 5%				46,479
Total (Construction Costs Only)				1,533,817
Land Acquisition				
a. Volkl Pond	20.3	ac	40,000	810,400
b. Habitat Mitigation (Estimate)	20.3	ac	1,500	30,390
Subtotal				840,790
<b>TOTAL</b>				<b>2,374,607</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

Wood Rodgers, Inc.  
February 2006

**TABLE 4**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**VOLKL TRUNK CHANNEL**  
**OPINION OF PROBABLE COST**

Item		Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1.	Volkl Trunk Channel				
a.	Channel Excavation (no Haul & Dump included)	187,118	cy	4.47	836,417
b.	Dewatering	1	ls	30,000.00	30,000
c.	Railroad Crossing (66" RCP)	200	lf	215.00	43,000
d.	Bore & Jack Under Railroad	200	lf	1,000.00	200,000
e.	Culvert Outlet Structures at Multiple Locations - Reinforced Concrete	258	cy	462.36	119,289
c.	Stone Protection	1,386	tons	28.18	39,057
c.	Access Road	5,500	sy	3.38	18,590
f.	Mobilization and Demobilization (1% Construction)	1	ls	61,435.00	61,435
	Subtotal				1,347,789
	Construction Contingency @ 25%				336,947
	Preliminary Engineering @ 5%				67,389
	Engineering/Design @ 15%				202,168
	Construction Management and Inspection @ 10%				134,779
	Administration @ 5%				67,389
	Project Management @ 5%				67,389
	Total (Construction Costs Only)				2,223,852
	Land Acquisition				
a.	Volkl Trunk Channel	13.1	ac	40,000	522,000
b.	Habitat Mitigation (Estimate)	13.1	ac	1,500	19,575
	Subtotal				541,575
<b>TOTAL</b>					<b>2,765,427</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

TABLE 5

CITY OF WOODLAND  
 STORM DRAINAGE FACILITIES MASTER PLAN  
 AND PRELIMINARY ENGINEERING  
 KENTUCKY DIVERSIONS TO VOLKL

OPINION OF PROBABLE COST

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1. Storm Drains - Kentucky Diversions to Volk				
a. 30" Diameter RCP	0	lf	85.00	0
b. 33" Diameter RCP	0	lf	95.00	0
c. 36" Diameter RCP	0	lf	100.00	0
d. 39" Diameter RCP	0	lf	110.00	0
e. 42" Diameter RCP	0	lf	120.00	0
f. 48" Diameter RCP	1,000	lf	140.00	140,000
g. 54" Diameter RCP	0	lf	175.00	0
h. 60" Diameter RCP	0	lf	195.00	0
i. 66" Diameter RCP	0	lf	215.00	0
j. 72" Diameter RCP	1,000	lf	235.00	235,000
k. 78" Diameter RCP	0	lf	300.00	0
l. 84" Diameter RCP	0	lf	350.00	0
m. 90" Diameter RCP	0	lf	400.00	0
n. Manhole - large diameter	0	ls	10,000.00	0
o. Manhole - small diameter	9	ls	8,000.00	72,000
Construction Subtotal				447,000
Construction Contingency @ 25%				111,750
Preliminary Engineering @ 5%				22,350
Engineering/Design @ 15%				67,050
Construction Management and Inspection @ 10%				44,700
Administration @ 5%				22,350
Project Management @ 5%				22,350
Item Total				737,550
Land Acquisition				
a. <i>Farmers Central Channel</i>	0.0	ac	40,000.00	0
Subtotal				0
<b>TOTAL</b>				<b>737,550</b>

Wood Rodgers, Inc.  
 February 2006

**TABLE 6**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**VOLKL OUTLET**

**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1. VolkI Outlet				
a. Pipeline Excavation (no Haul & Dump included)	15,165	cy	4.47	67,788
b. Dewatering	1	ls	100,000.00	100,000
c. Outlet Pipe (84" RCP)	2,837	lf	350.00	992,950
d. Bore & Jack Under Interstate 5	400	lf	1,100.00	440,000
d. Bore & Jack Under Interstate 5	120	lf	1,100.00	132,000
d. Bore & Jack Under Interstate 5	120	lf	1,100.00	132,000
e. Culvert Transition Structures at Multiple Locations - Reinforced Concrete	159	cy	462.36	73,515
c. Structural Recompaction	15,165	cy	4.11	62,328
f. Mobilization and Demobilization (1% Construction)	1	ls	96,913.00	96,913
Subtotal				2,097,494
Construction Contingency @ 25%				524,373
Preliminary Engineering @ 5%				104,875
Engineering/Design @ 15%				314,624
Construction Management and Inspection @ 10%				209,749
Administration @ 5%				104,875
Project Management @ 5%				104,875
Total (Construction Costs Only)				3,460,865
Land Acquisition				
a. VolkI Outlet	1.7	ac	15,000	25,200
b. Habitat Mitigation (Estimate)	1.7	ac	1,500	2,520
Subtotal				27,720
<b>TOTAL</b>				<b>3,488,585</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

Wood Rodgers, Inc.  
February 2006

**TABLE 7**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**NORTH CANAL (C to D)**

**OPINION OF PROBABLE COST**

Item		Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1.	North Canal (C to D)				
a.	Channel Excavation (no Haul & Dump included)	169,605	cy	4.47	758,134
b.	Place & Shape Fill	195,046	cy	2.35	458,358
c.	Dewatering	1	ls	30,000.00	30,000
d.	Aggregate Surface - Access Road Along Channel	16,667	sy	3.38	56,333
e.	Box Culvert Crossings - Reinforced Concrete	670	cy	462.36	309,781
f.	Traffic Control	2	ls	50,000.00	100,000
g.	Mobilization and Demobilization (1% Construction)	1	ls	85,630.00	85,630
	Subtotal				1,798,236
	Construction Contingency @ 25%				449,559
	Preliminary Engineering @ 5%				89,912
	Engineering/Design @ 15%				269,735
	Construction Management and Inspection @ 10%				179,824
	Administration @ 5%				89,912
	Project Management @ 5%				89,912
	Total (Construction Costs Only)				2,967,090
	Land Acquisition				
a.	North Canal (C to D)	36.9	ac	15,000	553,350
b.	Habitat Mitigation (Estimate)	36.9	ac	1,500	55,335
	Subtotal				608,685
<b>TOTAL</b>					<b>3,575,775</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

Wood Rodgers, Inc.  
February 2006

**TABLE 8**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**NORTH CANAL (D to E)**

**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
<b>I. North Canal (D to E)</b>				
a. Channel Excavation (no Haul & Dump included)	59,151	cy	4.47	264,405
b. Place & Shape Fill	68,024	cy	2.35	159,856
c. Dewatering	1	ls	100,000.00	100,000
d. Aggregate Surface - Access Road Along Channel	8,333	sy	3.38	28,167
e. Concrete Flume	1,480	cy	462.36	684,293
f. Floodwall	800	cy	462.36	369,888
g. Lined Channel	1,890	cy	200.00	378,000
h. Stone Protection	8,100	ton	28.18	228,258
i. Mobilization and Demobilization (1% Construction)	1	ls	99,230.00	99,230
Subtotal				2,312,096
Construction Contingency @ 25%				578,024
Preliminary Engineering @ 5%				115,605
Engineering/Design @ 15%				346,814
Construction Management and Inspection @ 10%				231,210
Administration @ 5%				115,605
Project Management @ 5%				115,605
Total (Construction Costs Only)				3,814,958
<b>Land Acquisition</b>				
a. North Canal (D to E)	1.6	ac	40,000	64,000
b. Habitat Mitigation (Estimate)	13.1	ac	1,500	19,618
Subtotal				83,618
<b>TOTAL</b>				<b>3,898,576</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

**TABLE 9**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**BEAMER/KENTUCKY CHANNEL**  
**OPINION OF PROBABLE COST**

Item		Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1.	Beamer/Kentucky Channel				
a.	Channel and WQ Pond Excavation (no Haul & Dump included)	253,156	cy	4.47	1,131,605
b.	Dewatering	1	ls	100,000.00	100,000
c.	Aggregate Surface - Access Road Along Channel	11,667	sy	3.38	39,433
d.	Box Culvert Crossing Under County Road 102	1	ls	600,000.00	600,000
e.	Traffic Control	1	ls	50,000.00	50,000
f.	Mobilization and Demobilization (1% Construction)	1	ls	96,052.00	96,052
	Subtotal				2,017,091
	Construction Contingency @ 25%				504,273
	Preliminary Engineering @ 5%				100,855
	Engineering/Design @ 15%				302,564
	Construction Management and Inspection @ 10%				201,709
	Administration @ 5%				100,855
	Project Management @ 5%				100,855
	Total (Construction Costs Only)				3,328,200
	Land Acquisition				
a.	Beamer/Kentucky Channel	35.9	ac	40,000	1,437,200
b.	Habitat Mitigation (Estimate)	35.9	ac	1,500	53,895
	Subtotal				1,491,095
<b>TOTAL</b>					<b>4,819,295</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

**TABLE 10**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**RD 2035 SIPHON REPLACEMENT**  
**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
I. RD2035 Siphon Replacement				
a. Site Preparation	1	ac	1,118.90	1,119
b. Structural Excavation	1,500	cy	11.43	17,145
c. 78" RCP Pipeline	157	lf	300.00	47,100
d. Outfall Structure Concrete	70	cy	462.36	32,365
e. Miscellaneous Metals & Gates	1	ls	10,000.00	10,000
f. Pipe Bedding	100	cy	38.00	3,800
g. Structural Backfill	1,207	cy	4.11	4,961
h. Landscaping - Hydroseeding	1	ls	1,000.00	1,000
i. Stone Protection	150	cy	45.08	6,762
j. Mobilization and Demobilization (5% Construction)	1	ls	6,213.00	6,213
Subtotal				130,465
Construction Contingency @ 25%				32,616
Preliminary Engineering @ 5%				6,523
Engineering/Design @ 15%				19,570
Construction Management and Inspection @ 10%				13,047
Administration @ 5%				6,523
Project Management @ 5%				6,523
<b>TOTAL</b>				<b>215,267</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

TABLE 11

CITY OF WOODLAND  
 STORM DRAINAGE FACILITIES MASTER PLAN  
 AND PRELIMINARY ENGINEERING  
 NORTH AREA STORM DRAIN NETWORK

OPINION OF PROBABLE COST

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1. Storm Drains - Volkl Trunk				
a. 30" Diameter RCP	2,673	lf	85.00	227,205
b. 33" Diameter RCP	0	lf	95.00	0
c. 36" Diameter RCP	0	lf	100.00	0
d. 39" Diameter RCP	0	lf	110.00	0
e. 42" Diameter RCP	0	lf	120.00	0
f. 48" Diameter RCP	1,315	lf	140.00	184,100
g. 54" Diameter RCP	1,733	lf	175.00	303,275
h. 60" Diameter RCP	0	lf	195.00	0
i. 66" Diameter RCP	3,732	lf	215.00	802,380
j. 72" Diameter RCP	1,724	lf	235.00	405,140
k. 78" Diameter RCP	0	lf	300.00	0
l. 84" Diameter RCP	0	lf	350.00	0
m. 90" Diameter RCP	0	lf	400.00	0
n. Manhole - large diameter	4	ls	10,000.00	40,000
o. Manhole - small diameter	22	ls	8,000.00	176,000
Construction Subtotal				2,138,100
Construction Contingency @ 25%				534,525
Preliminary Engineering @ 5%				106,905
Engineering/Design @ 15%				320,715
Construction Management and Inspection @ 10%				213,810
Administration @ 5%				106,905
Project Management @ 5%				106,905
Item Total				3,527,865
2. Storm Drains - Woodland Park Trunk				
a. 30" Diameter RCP	0	lf	85.00	0
b. 33" Diameter RCP	0	lf	95.00	0
c. 36" Diameter RCP	0	lf	100.00	0
d. 39" Diameter RCP	0	lf	110.00	0
e. 42" Diameter RCP	0	lf	120.00	0
f. 48" Diameter RCP	0	lf	140.00	0
g. 54" Diameter RCP	3,244	lf	175.00	567,700
h. 60" Diameter RCP	10,452	lf	195.00	2,038,140
i. 66" Diameter RCP	8,693	lf	215.00	1,868,995
j. 72" Diameter RCP	8,296	lf	235.00	1,949,560
k. 78" Diameter RCP	0	lf	300.00	0
l. 84" Diameter RCP	0	lf	350.00	0
m. 90" Diameter RCP	0	lf	400.00	0
n. Manhole - large diameter	15	ls	10,000.00	150,000
o. Manhole - small diameter	40	ls	8,000.00	320,000
Construction Subtotal				6,894,395

TABLE 11

**CITY OF WOODLAND  
STORM DRAINAGE FACILITIES MASTER PLAN  
AND PRELIMINARY ENGINEERING  
NORTH AREA STORM DRAIN NETWORK**

**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
Construction Contingency @ 25%				1,723,599
Preliminary Engineering @ 5%				344,720
Engineering/Design @ 15%				1,034,159
Construction Management and Inspection @ 10%				689,440
Administration @ 5%				344,720
Project Management @ 5%				344,720
Item Total				11,375,752
Land Acquisition				
a. <i>Vohl Storm Drain Alignments</i>	0.0	ac	0.00	0
b. <i>Woodland Park Storm Drain Alignments</i>	0.0	ac	0.00	0
Subtotal				0
<b>TOTAL</b>				<b>14,903,617</b>

Wood Rodgers, Inc.  
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**TABLE 12**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**NORTH AREA FLOODPLAIN FILL**  
**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1. North Area Fill Mitigation				
a. Site Preparation	410	ls	1,118.90	458,749
b. Purchase and Excavation (no Haul & Dump included)	377,939	cy	5.47	2,067,326
c. Haul and Dump to Woodland Park	434,630	cy	2.92	1,267,670
d. Excavation from City Pond Site to NW Woodland Park	75,000	cy	4.47	335,250
e. Place and Shape Fill (Hauled from offsite)	509,630	cy	2.35	1,197,630
f. Place and Shape Fill (from onsite)	531,532	cy	2.35	1,249,100
g. Dewatering (at fill source)	1	ls	500,000.00	500,000
h. Temporary Aggregate Surfacing	28,000	sy	3.38	94,640
i. Environmental Restoration	1	ls	100,000.00	100,000
j. Mobilization and Demobilization (1% Construction)	1	ls	72,704.00	72,704
Subtotal				7,343,070
Construction Contingency @ 25%				1,835,768
Preliminary Engineering @ 5%				367,154
Engineering/Design @ 15%				1,101,461
Construction Management and Inspection @ 10%				734,307
Administration @ 5%				367,154
Project Management @ 5%				367,154
Total (Construction Costs Only)				12,116,066
Land Acquisition				
a. Woodland Park Area	0.0	ac	15,000	0
b. Habitat Mitigation (Estimate)	0.0	ac	1,500	0
Subtotal				0
<b>TOTAL</b>				<b>12,116,066</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

**TABLE 13**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**SOUTH CANAL PUMP STATION**  
**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
<b>1. South Canal Pump Station</b>				
a. Site Preparation	1	ac	1,119	1,119
b. Concrete Structure/Pipe Demolition (Existing Structure)	1	ls	7,500	7,500
c. Structural Excavation	7,625	cy	11	87,154
d. Sheet Piling (along Main St. and High Line Ditch)	8,000	sf	22	176,000
e. Reinforced Concrete	1,110	cy	462	513,220
f. Pump (62.5 cfs) and Motor (125 hP)	5	ea	70,000	350,000
g. Low flow Pump and Motor (8 cfs)	1	ea	12,000	12,000
h. Backup Generator and Pad	1	ls	132,000	132,000
i. Electrical Building (12x20' CMU)	1	ls	50,000	50,000
j. Switchboard MCC	1	ls	180,000	180,000
k. Underground Conduit and Cablework	1	ls	50,000	50,000
l. Control Panel	1	ls	30,000	30,000
m. Lighting Grounding Instruments, Misc	1	ls	18,000	18,000
n. PG&E Connection Fee**	1	ls	100,000	100,000
o. Dupron Flex Rake (Self Cleaning Trashrack)	2	ea	75,000	150,000
p. Miscellaneous Metals	1	ls	50,000	50,000
q. Flap Gates	5	ea	5,000	25,000
r. Temporary Traffic Control (Incl Barrier)	1	ls	25,000	25,000
s. Dewatering	1	ls	115,000	115,000
t. Aggregate Surface	1,889	sy	3	6,384
u. Landscaping	1	ls	5,000	5,000
v. Fencing	700	lf	15	10,500
w. Miscellaneous Utilities Relocations	1	ls	15,000	15,000
x. Mobilization and Demobilization	1	ls	105,444	105,444
Subtotal				2,214,321
<b>2. Outlet Pipeline (connecting SC Pump Station to Outfall Channel)</b>				
a. Site Preparation	2	ac	1,119	2,238
b. Boring and Jacking Carrier Pipe	360	lf	900	324,000
c. Railroad Fees and Coordination	1	ls	15,000	15,000
d. Structural Excavation	13,275	cy	11	151,733
e. 72" RCP Pipeline	1,180	lf	193	227,740
f. Outfall Structure Concrete	96	cy	462	44,387
g. Miscellaneous Metals & Gates	1	ls	25,000	25,000
h. Dewatering	1	ls	121,450	121,450
i. Pipe Bedding	1,200	cy	38	45,600
j. Structural Backfill	10,393	cy	4	42,716
k. Pavement Removal	200	sy	4	890
l. Temporary Pavement	1	ls	38,000	38,000
m. Road Base Material	200	sy	13	2,566
n. Pavement Replacement	41	ton	84	3,417
o. Traffic Control	1	ls	10,000	10,000
p. Landscaping - Hydroseeding	1	ls	3,000	3,000
q. Stone Protection	150	cy	45	6,762
r. Mobilization and Demobilization (5% Construction)	1	ls	53,225	53,225
Subtotal				1,117,724
<b>SUBTOTAL CONSTRUCTION</b>				3,332,044
Construction Contingency @ 25%				833,011
Preliminary Engineering @ 5%				166,602
Engineering/Design @ 15%				499,807
Construction Management and Inspection @ 10%				333,204
Administration @ 5%				166,602
Project Management @ 5%				166,602
<b>Total (Construction Costs Only)</b>				5,497,873
<b>Land Acquisition</b>				
a. South Canal Pump Station	3.0	ac	40,000	120,000
b. Habitat Mitigation (Estimate)	3.0	ac	1,500	4,500
Subtotal				124,500
<b>TOTAL</b>				5,622,373

<sup>1</sup>Unit costs are based upon 2003 price levels.

\*\*Estimate must be verified after official PG&E application and determination

TABLE 14

**CITY OF WOODLAND  
STORM DRAINAGE FACILITIES MASTER PLAN  
AND PRELIMINARY ENGINEERING  
FARMERS CENTRAL TRUNK EAST**

**OPINION OF PROBABLE COST**

Item		Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1.	Storm Drains - Farmers Central Trunk East				
a.	30" Diameter RCP	0	lf	85.00	0
b.	33" Diameter RCP	0	lf	95.00	0
c.	36" Diameter RCP	0	lf	100.00	0
d.	39" Diameter RCP	0	lf	110.00	0
e.	42" Diameter RCP	0	lf	120.00	0
f.	48" Diameter RCP	0	lf	140.00	0
g.	54" Diameter RCP	0	lf	175.00	0
h.	60" Diameter RCP	1,700	lf	195.00	331,500
i.	66" Diameter RCP	0	lf	215.00	0
j.	72" Diameter RCP	1,300	lf	235.00	305,500
k.	78" Diameter RCP	0	lf	300.00	0
l.	84" Diameter RCP	0	lf	350.00	0
m.	90" Diameter RCP	0	lf	400.00	0
n.	Manhole - large diameter	0	ls	10,000.00	0
o.	Manhole - small diameter	9	ls	8,000.00	72,000
p.	Channel Construction	1	ls	742,500.00	742,500
	Construction Subtotal				1,451,500
	Construction Contingency @ 25%				362,875
	Preliminary Engineering @ 5%				72,575
	Engineering/Design @ 15%				217,725
	Construction Management and Inspection @ 10%				145,150
	Administration @ 5%				72,575
	Project Management @ 5%				72,575
	Item Total				2,394,975
	Land Acquisition				
a.	<i>Farmers Central Channel</i>	0.0	ac	40,000.00	0
	Subtotal				0
<b>TOTAL</b>					2,394,975

Wood Rodgers, Inc.  
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TABLE 15

**CITY OF WOODLAND  
STORM DRAINAGE FACILITIES MASTER PLAN  
AND PRELIMINARY ENGINEERING  
SOUTH AREA STORM DRAIN NETWORK**

**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1. Storm Drains - Farmer's Central East				
a. 30" Diameter RCP	1,000	lf	85.00	85,000
b. 33" Diameter RCP	0	lf	95.00	0
c. 36" Diameter RCP	2,700	lf	100.00	270,000
d. 39" Diameter RCP	0	lf	110.00	0
e. 42" Diameter RCP	1,450	lf	120.00	174,000
f. 48" Diameter RCP	2,500	lf	140.00	350,000
g. 54" Diameter RCP	600	lf	175.00	105,000
h. 60" Diameter RCP	1,500	lf	195.00	292,500
i. 66" Diameter RCP	900	lf	215.00	193,500
j. 72" Diameter RCP	0	lf	235.00	0
k. 78" Diameter RCP	0	lf	300.00	0
l. 84" Diameter RCP	0	lf	350.00	0
m. 90" Diameter RCP	0	lf	400.00	0
n. Manhole - large diameter	0	ls	10,000.00	0
o. Manhole - small diameter	30	ls	8,000.00	240,000
Construction Subtotal				1,710,000
Construction Contingency @ 25%				427,500
Preliminary Engineering @ 5%				85,500
Engineering/Design @ 15%				256,500
Construction Management and Inspection @ 10%				171,000
Administration @ 5%				85,500
Project Management @ 5%				85,500
Item Total				2,821,500
2. Storm Drains - Parkway Trunk				
a. 30" Diameter RCP	480	lf	85.00	40,800
b. 33" Diameter RCP	0	lf	95.00	0
c. 36" Diameter RCP	2,475	lf	100.00	247,500
d. 39" Diameter RCP	0	lf	110.00	0
e. 42" Diameter RCP	1,475	lf	120.00	177,000
f. 48" Diameter RCP	750	lf	140.00	105,000
g. 54" Diameter RCP	300	lf	175.00	52,500
h. 60" Diameter RCP	400	lf	195.00	78,000
i. 66" Diameter RCP	5,150	lf	215.00	1,107,250
j. 72" Diameter RCP	0	lf	235.00	0
k. 78" Diameter RCP	0	lf	300.00	0
l. 84" Diameter RCP	0	lf	350.00	0
m. 90" Diameter RCP	0	lf	400.00	0
n. Manhole - large diameter	0	ls	10,000.00	0
o. Manhole - small diameter	34	ls	8,000.00	272,000
Construction Subtotal				2,080,050
Construction Contingency @ 25%				520,013
Preliminary Engineering @ 5%				104,003
Engineering/Design @ 15%				312,008
Construction Management and Inspection @ 10%				208,005
Administration @ 5%				104,003
Project Management @ 5%				104,003
Item Total				3,432,083

TABLE 15

**CITY OF WOODLAND  
STORM DRAINAGE FACILITIES MASTER PLAN  
AND PRELIMINARY ENGINEERING  
SOUTH AREA STORM DRAIN NETWORK**

**OPINION OF PROBABLE COST**

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
<b>3. Storm Drains - County Road 25A Trunk</b>				
a. 30" Diameter RCP	1,050	lf	85.00	89,250
b. 33" Diameter RCP	0	lf	95.00	0
c. 36" Diameter RCP	650	lf	100.00	65,000
d. 39" Diameter RCP	0	lf	110.00	0
e. 42" Diameter RCP	1,950	lf	120.00	234,000
f. 48" Diameter RCP	750	lf	140.00	105,000
g. 54" Diameter RCP	11,150	lf	175.00	1,951,250
h. 60" Diameter RCP	0	lf	195.00	0
i. 66" Diameter RCP	0	lf	215.00	0
j. 72" Diameter RCP	0	lf	235.00	0
k. 78" Diameter RCP	0	lf	300.00	0
l. 84" Diameter RCP	0	lf	350.00	0
m. 90" Diameter RCP	0	lf	400.00	0
n. Manhole - large diameter	0	ls	10,000.00	0
o. Manhole - small diameter	40	ls	8,000.00	320,000
Construction Subtotal				2,764,500
Construction Contingency @ 25%				691,125
Preliminary Engineering @ 5%				138,225
Engineering/Design @ 15%				414,675
Construction Management and Inspection @ 10%				276,450
Administration @ 5%				138,225
Project Management @ 5%				138,225
Item Total				4,561,425
<b>4. Storm Drains - County Road 102 Trunk</b>				
a. 30" Diameter RCP	0	lf	85.00	0
b. 33" Diameter RCP	0	lf	95.00	0
c. 36" Diameter RCP	0	lf	100.00	0
d. 39" Diameter RCP	0	lf	110.00	0
e. 42" Diameter RCP	0	lf	120.00	0
f. 48" Diameter RCP	0	lf	140.00	0
g. 54" Diameter RCP	2,000	lf	175.00	350,000
h. 60" Diameter RCP	0	lf	195.00	0
i. 66" Diameter RCP	0	lf	215.00	0
j. 72" Diameter RCP	0	lf	235.00	0
k. 78" Diameter RCP	0	lf	300.00	0
l. 84" Diameter RCP	0	lf	350.00	0
m. 90" Diameter RCP	0	lf	400.00	0
n. Manhole - large diameter	0	ls	10,000.00	0
o. Manhole - small diameter	6	ls	8,000.00	48,000
Construction Subtotal				398,000
Construction Contingency @ 25%				99,500
Preliminary Engineering @ 5%				19,900
Engineering/Design @ 15%				59,700
Construction Management and Inspection @ 10%				39,800
Administration @ 5%				19,900
Project Management @ 5%				19,900
Item Total				656,700

TABLE 15

CITY OF WOODLAND  
 STORM DRAINAGE FACILITIES MASTER PLAN  
 AND PRELIMINARY ENGINEERING  
 SOUTH AREA STORM DRAIN NETWORK

OPINION OF PROBABLE COST

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
5. Storm Drains - Farmer's Central West				
a. 30" Diameter RCP	1,050	lf	85.00	89,250
b. 33" Diameter RCP	0	lf	95.00	0
c. 36" Diameter RCP	0	lf	100.00	0
d. 39" Diameter RCP	0	lf	110.00	0
e. 42" Diameter RCP	1,350	lf	120.00	162,000
f. 48" Diameter RCP	2,000	lf	140.00	280,000
g. 54" Diameter RCP	750	lf	175.00	131,250
h. 60" Diameter RCP	0	lf	195.00	0
i. 66" Diameter RCP	0	lf	215.00	0
j. 72" Diameter RCP	0	lf	235.00	0
k. 78" Diameter RCP	0	lf	300.00	0
l. 84" Diameter RCP	0	lf	350.00	0
m. 90" Diameter RCP	0	lf	400.00	0
n. Manhole - large diameter	0	ls	10,000.00	0
o. Manhole - small diameter	16	ls	8,000.00	128,000
Construction Subtotal				790,500
Construction Contingency @ 25%				197,625
Preliminary Engineering @ 5%				39,525
Engineering/Design @ 15%				118,575
Construction Management and Inspection @ 10%				79,050
Administration @ 5%				39,525
Project Management @ 5%				39,525
Item Total				1,304,325
6. Storm Drains - Zone S4B				
a. 30" Diameter RCP	0	lf	85.00	0
b. 33" Diameter RCP	0	lf	95.00	0
c. 36" Diameter RCP	0	lf	100.00	0
d. 39" Diameter RCP	0	lf	110.00	0
e. 42" Diameter RCP	0	lf	120.00	0
f. 48" Diameter RCP	1,200	lf	140.00	168,000
g. 54" Diameter RCP	0	lf	175.00	0
h. 60" Diameter RCP	1,350	lf	195.00	263,250
i. 66" Diameter RCP	0	lf	215.00	0
j. 72" Diameter RCP	0	lf	235.00	0
k. 78" Diameter RCP	0	lf	300.00	0
l. 84" Diameter RCP	0	lf	350.00	0
m. 90" Diameter RCP	0	lf	400.00	0
n. Manhole - large diameter	0	ls	10,000.00	0
o. Manhole - small diameter	10	ls	8,000.00	80,000
Construction Subtotal				511,250
Construction Contingency @ 25%				127,813
Preliminary Engineering @ 5%				25,563
Engineering/Design @ 15%				76,688
Construction Management and Inspection @ 10%				51,125
Administration @ 5%				25,563
Project Management @ 5%				25,563
Item Total				843,563

TABLE 15

CITY OF WOODLAND  
 STORM DRAINAGE FACILITIES MASTER PLAN  
 AND PRELIMINARY ENGINEERING  
 SOUTH AREA STORM DRAIN NETWORK

OPINION OF PROBABLE COST

Item	Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
<b>Land Acquisition</b>				
a. <i>Farmer's Central East Trunk</i>	0.0	ac	40,000.00	0
b. <i>Parkway Trunk</i>	0.0	ac	40,000.00	0
c. <i>County Road 25A Trunk</i>	0.0	ac	40,000.00	0
d. <i>County Road 102 Trunk</i>	0.0	ac	40,000.00	0
e. <i>Farmer's Central West Trunk</i>	0.0	ac	40,000.00	0
Subtotal				0
<b>TOTAL</b>				<b>13,619,595</b>

Wood Rodgers, Inc.  
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**TABLE 16**  
**CITY OF WOODLAND**  
**STORM DRAINAGE FACILITIES MASTER PLAN**  
**AND PRELIMINARY ENGINEERING**  
**OUTFALL CHANNEL**  
**OPINION OF PROBABLE COST**

Item		Quantity	Unit	Unit Cost, \$ <sup>1</sup>	Cost, \$
1.	Outfall Channel Improvements				
a.	Site Preparation	48.2	ac	1,119	53,941
b.	Excavation (no Haul & Dump included)	191,373	cy	4	855,437
c.	Haul and Dump to Woodland Park	220,079	cy	3	641,897
d.	Place and Shape Fill	220,079	cy	2	517,186
e.	Dewatering Upstream Diversion to Settling Basin	1	ls	298,000	298,000
f.	Aggregate Surface - Access Road Along Channel	28,000	sy	3	94,640
g.	Environmental Restoration	1	ls	50,000	50,000
h.	Mobilization and Demobilization (1% Construction)	1	ls	125,555	125,555
	Subtotal				2,636,656
	Construction Contingency @ 25%				659,164
	Preliminary Engineering @ 5%				131,833
	Engineering/Design @ 15%				395,498
	Construction Management and Inspection @ 10%				263,666
	Administration @ 5%				131,833
	Project Management @ 5%				131,833
	Total (Construction Costs Only)				4,350,483
	Land Acquisition				
a.	Outfall Channel	48.2	ac	15,000	723,140
b.	Habitat Mitigation (Estimate)	48.2	ac	1,500	72,314
	Subtotal				795,455
<b>TOTAL</b>					<b>5,145,937</b>

<sup>1</sup>Unit costs are based upon 2003 price levels.

Wood Rodgers, Inc.  
February 2006



**WOOD RODGERS**

**BUILDING RELATIONSHIPS ONE PROJECT AT A TIME**

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