APPENDIX HYD-1

MASTER DRAINAGE STUDY

Department of Water Resources
Matt Satow
Director

Divisions
Water Supply
Drainage
Administrative Services/Finance

County of Sacramento

Date: 05/30/2024

To: Michael Motroni, P.E.
Michael Nowlan, P.E.
Wood Rodgers, Inc.

Subject: Upper Westside Specific Plan (PLNP2018-00284) Master Drainage Study – Resubmittal 3 Approval Letter

The Sacramento County Department of Water Resources (Water Resources) reviewed the drainage master plan dated 05/24/2024 and deemed it technically sufficient to support the proposed preliminary backbone drainage infrastructure and initial entitlements. Level 2 and 3 drainage studies will be required prior to approval of subsequent entitlements, and level 4 drainage studies will be required to support eventual improvement plans.

Please feel free to call if you have any questions.

Sincerely,

J. Luis Rodriguez, P.E., M.S., C.F.M.
Associate Civil Engineer
Sacramento County Department of Water Resources
Drainage Development and Floodplain Management
Phone: (916) 874-7172

Cc
Emma Patten
County PER
Michael Durkee, P.E.
County DWR
Nick Avdis
Applicant

May 29, 2024

Kevin King
General Manager
Reclamation District 1000
1633 Garden Highway
Sacramento, CA 95833

Subject: **Review of Upper Westside Planning Area Level 1 Master Drainage Study Report**

Introduction/Background

The proposed Upper Westside (UWS) is planned for 2,066 acres of residential and commercial development. The UWS Specific Plan Area is bound by Interstate 80 (I-80) to the southeast, the West Drainage Canal to the northeast, Garden Highway to the west, and the Sacramento city limits and Fisherman's Lake to the north. The site is undeveloped land that drains west to east through existing canals, generally draining through culverts into the Reclamation District 1000 (RD1000) West Drainage Canal between Fisherman's Lake and I-80. Outlets to the West Drainage Canal are supplemented by pumping to achieve required stormwater evacuation during significant rainfall events. As proposed, the UWS would be improved with a network of stormwater infrastructure, improved drainage canals, detention storage, and new and upgraded pump stations to deliver stormwater from the development via two outfalls to the RD1000 West Drainage Canal.

Mead & Hunt, with the assistance of West Yost, has completed reviews of multiple iterations of the drainage studies and modeling prepared for the UWS. The current version of the Master Drainage Study (MDS) reporting was completed by Wood Rodgers on May 24, 2024, and is the subject of this review.

The following updated documents were provided to RD1000 for review:

- Upper Westside Specific Plan, Master Drainage Study, Wood Rodgers, May 24, 2024
- UWS XP SWMM Modeling, Dated April 9, 2024[a]
- Responses to Mead & Hunt's April 29, 2024 comments

Mead & Hunt Comment Response Backcheck:

Drainage Study

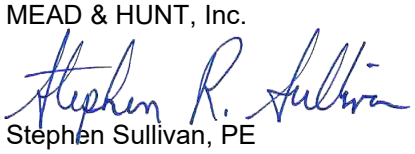
Mead & Hunt's previous master drainage study report comments have been addressed and there are no further comments.

[a] According to email correspondence between Mike Motroni and Luis Rodriguez, the model was updated previously to address Sacramento County comments on the revised Nolte model to the satisfaction of Sacramento County. The model update was not separately reviewed by RD1000.

Conclusions

Based upon the analysis as documented in the Level 1 Drainage Study, the proposed plan is compatible with the RD1000 standards and mission, to avoid impacting operations and maintenance, as well as the drainage services provided to properties outside of the project area. We understand that as the project design progresses, additional design details will be provided for RD1000's review and we look forward to providing feedback.

Sincerely,
MEAD & HUNT, Inc.



Stephen Sullivan, PE
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cc: Gabriel Holleman, RD1000 Operations Manager
Mike Motroni, Wood Rodgers
Mike Nowlan, Wood Rodgers
J. Luis Rodriguez, Sacramento County
Mark Kubik, West Yost
Jeff Kashiwada, Mead & Hunt

Enclosures:
Wood Rodgers Response to Comments from Mead & Hunt's April 29, 2024 Review

Upper Westside Specific Plan - Master Drainage Study

Response to Comments

Dept: Mead & Hunt (RD-1000)
By: Steve Sullivan
Date: 4/29/2024

#	Submittal Comment	Wood Rodgers Response
1.	**Page 39, 3.3, El Centro West Drainage Canal**: Report indicates that the El Centro Road Crossing of the West Drainage Canal culverts will be replaced or extended to accommodate road widening. Include language to indicate that "The County will consult with RD1000 on the details of modifying the culvert encroachments on the West Drainage Canal, the condition of existing features, and the potential impacts to adjacent features."	Comment addressed as noted.
2.	**Page 41, Ag-Buffer Drainage, 1st paragraph**: Clarify the statement that "additional channel and storm drain improvements would be constructed primarily within existing easements dedicated to RD1000 and to the Natomas Mutual Water Company." The improvements to accommodate drainage collection and rerouting should not encroach upon the existing RD1000 and NMWC easements. The Ag Buffer runoff collection features were not part of the RD1000 system and will be operated and maintained by the project proponent's designee.	Sentence revised to read: *Where required to facilitate ag-buffer runoff, any additional channel and storm drain improvements would be constructed primarily within existing easements dedicated to RD 1000 and to the Natomas Central Mutual Water Company but not in conflict with their facilities. Drainage improvements will be subject to County jurisdiction will require quitclaim by RD1000.*
3.	**Page 42, Figure 3.1 Ag-Buffer Urban Interface**: The figure indicates ditch placed directly against the fenced Ag-Buffer with no access to permit maintenance along the left bank. Notes indicate this is "To be considered with tentative maps." It is assumed that this facility will not be operated and maintained by RD1000, please confirm intent (see above).	Added, "Drainage facilities along the ag-buffer constructed to convey runoff per County Standards will be operated and maintained by the County."
4.	**Page 65, Onsite 200-year analysis**: Prior iteration indicated that the project would include levee strengthening, raising, and retrofit of culverts. The latest report no longer includes this commitment and appears to indicate that no levee work will be required to meet 200-year level of protection and includes a justification.	Correct. The project grading has been designed such that pads will be at or above the 200-year water surface elevation. While not required, the future design will set back proposed detention basins from the West Drainage Canal to prevent failure during the 200-year, while maintaining no increases to existing ground separation or to peak water surface elevations currently contained in the West Drainage Canal channel banks.

#	Submittal Comment	Wood Rodgers Response
	a. The reference Figure 4.6 contains no topographic labeling and is therefore difficult to confirm assumptions. Include labeling of elevation contours.	Comment addressed in updated Figure 4.6.
	b. The statement that "While the project does not rely on the containment of the West Drainage Canal to protect pads, the project will be designed to keep the West Drainage Canal within its banks" could be misconstrued. The statement can be made that the project will not increase the 200-year, 10-day levels in the West Drainage Canal and therefore the project in an of itself does not increase the extent of mapped inundation shown.	First two paragraphs revised to read: *While the project does not rely on the containment of the West Drainage Canal to protect pads, the project will be designed to maintain the West Drainage Canal within its banks. The project will not increase the 200-year, 10-day water surface elevations in the West Drainage Canal and therefore does not increase the extent of mapped inundation.*
	c. The statement of that "This will prevent intentional flow leaving the West Drainage Canal and entering the Plan Area through overtopping or piping" could be misconstrued and can be left out, as no project work related to the 200-year assessment is planned on the levee.	Comment addressed in revised text.
	d. The statement that "Wood Rodgers does not anticipate any modifications will be required to the existing containment features to achieve this goal," does not define the "goal".	Comment addressed as noted. Removed "…to achieve this goal."

Upper Westside Specific Plan
Level 1 Master Drainage Study

May 24, 2024

Prepared for

Upper Westside, LLC

Prepared by

WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME
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Vertical Datum: NAVD88

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GLOSSARY

2-Year	Having a 50% chance of occurrence in any given flood season
10-Year	Having a 10% chance of occurrence in any given flood season
100-Year	Having a 1% chance of occurrence in any given flood season
200-Year	Having a 0.5% chance of occurrence in any given flood season
500-Year	Having a 0.2% chance of occurrence in any given flood season
44 CFR 65.10	Code of Federal Regulations pertaining to levees
BASH	Bird/Wildlife Aircraft Strike Hazard program
CDFW	California Department of Fish and Wildlife
CFS	Cubic Feet per Second
CLOMR	Conditional Letter of Map Revision (FEMA assessment of future conditions)
CVFED	Central Valley Floodplain Evaluation and Delineation program (California)
CVFPB	The Central Valley Flood Protection Board
CVRWQCB	Central Valley Regional Water Quality Control Board – under the SWRCB
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map, published by FEMA
Freeboard	Height of a flood facility above the design water surface elevation
GIS	Geographic Information System
HEC-1	A US Army Corps of Engineers hydrology program
HEC-RAS	A US Army Corps of Engineers hydraulics program
HGL	Hydraulic Grade Line – water surface elevations in channels and pipes
HMP	Hydromodification
Hydromodification	The human-induced alteration of the natural flow of water through a landscape
LID	Low Impact Development
LiDAR	Light Detection and Ranging (topographic data collection method)
NAVD 88	North American Vertical Datum of 1988
NFIP	National Flood Insurance Program – administered by FEMA
NGVD 29	National Geodetic Vertical Datum of 1929
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
Orographic	Pertaining to the effects of elevation and changing terrain on precipitation
Plan Area	Upper Westside Specific Plan
RD 1000	Reclamation District 1000
SacCalc	Hydrologic pre-processor program developed by SCDWR
SAFCA	Sacramento Area Flood Control Agency
SAHM	Sacramento Area Hydrology Model
SCDWR	Sacramento County, Department of Water Resources
SMUD	Sacramento Municipal Utilities District
SQDM	Stormwater Quality Design Manual
SWRCB	California State Water Resources Control Board
ULDC	Urban Levee Design Criteria in the state of California
ULOP	Urban Level of Protection associated with flooding in California
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey (federal agency)
UWS	Upper Westsid
UWSP	Upper Westside Specific Plan
WQV	Water Quality Volume (expressed in acre-feet)
WSE	Water Surface Elevation
XPSWMM	A commonly utilized private stormwater management modeling software

1.0 Introduction

Upper Westside (UWS) is a 2,066-acre Specific Plan Area (Plan Area) in Sacramento County (County) located within the Natomas Basin. The Plan Area is bound by Interstate 80 (I-80) to the southeast, the West Drainage Canal (also known as the Witter Canal) to the northeast, Garden Highway to the west, and the Sacramento city limits and Fisherman's Lake to the north.

1.1 Existing Conditions

The Plan Area currently encompasses land with primarily Agricultural and Agricultural-Residential designations, with some Commercial designations. Developed lands within the Plan Area include approximately 55 acres of commercial areas adjacent to the West El Camino Road interchange with I-80, approximately 40 acres of the partially-developed Natomas Estates residential development, and various individual residential areas along the east side of El Centro Road. Natomas Estates is located along El Centro Road from just north of the intersection of El Centro Road and Radio Road to the intersection of El Centro Road and the West Drainage Canal. The fully developed River View #2 subdivision area consisting of approximately 80 acres north of San Juan Road and west of the West Drainage Canal is not included in the Plan Area.

North and east of the Plan Area lies existing residential development in North Natomas that is nearing build-out. The community of South Natomas, which is also nearing build-out, is situated southeast of I-80. Across the Sacramento River to the west is Yolo County, where parcels along the river are zoned Agriculture Intensive (A-N) and are within the Federal Emergency Management Agency (FEMA) 100-year floodplain. Large development projects within 10 miles of the Plan Area that have begun planning or construction processes include Northlake (Greenbrier), The Panhandle, Grandpark (North Precinct), and Metro Air Park. **Figure 1.2: Vicinity Map** presents an existing conditions vicinity map for the Plan Area.

1.2 Project Description

The proposed project will consist of development within the Plan Area, including approximately 9,356 residential dwelling units and 3.11 million square feet of commercial and mixed land use. Roadway improvements, parks and open space, greenbelts and urban farm programs, and schools will also be included.

The Plan Area currently encompasses Agricultural and Agricultural-Residential designations; however, the project location makes the Plan Area suitable for a compact urban form based on the surrounding conditions. Because the project's center is within 3.5 miles of downtown Sacramento, the Plan Area provides an opportunity to create a sustainable urban Greenfield project that meets the needs of the growing Sacramento region.

The Plan Area includes a large, centrally-located open channel water feature that will be used as a conveyance as part of the storm drainage system. Drainage improvements include open channels and a backbone storm drain system to convey runoff from the Plan Area to detention basins and pump stations that will discharge into the West Drainage Canal.

1.3 Applicable Standards

This report is intended to comply with the requirements for a Level 1 Master Drainage Plan according to the Sacramento County Department of Water Resources (SCDWR) *Drainage Study Requirements* dated March 2020. Drainage improvements will be designed in accordance with the following design standards:

1. "Sacramento City/County Drainage Manual", Volume 2, Hydrology Standards, 1996.
2. "Sacramento Region Stormwater Quality Design Manual" (SQDM), July 2018.
3. Sacramento County Improvement Standards, Storm Drainage Design (Section 9), 2006.
4. Sacramento County Improvement Standards, Streets (Section 4), 2009.
5. "City of Sacramento Design and Procedure Manual", Section 11, Stormwater Collection Systems.
6. "City of Sacramento Design and Procedure Manual", Section 12, Storm Drainage Design Standards, Pump Stations.

SCDWR Pump Station and Detention Basin Design Criteria

The SCDWR pump station and storage volume criteria are presented below in **Table 1.1: Pump Station Design Criteria**.

Table 1.1: Pump Station Design Criteria
Source: Sacramento County, Department of Water Resources

Frequency	Duration	Pump Operation	Peak Water Surface Criteria
10-year	All durations	Pumps 1 and 2 Operating	For pipe design and setting on elevation for 3rd pump
100-year	24 and 36 hours	All pumps operating	Minimum 1 foot freeboard in basin (designated flooding storage areas)
100-year	5 and 10 day	All pumps operating	Minimum 1 foot freeboard in basin (designated flooding storage areas)
100-year	24 and 36 hours	50% of pumps not operating	Not to exceed 1 foot over the street gutter flowline
100-year	5 and 10 day	50% of pumps not operating	Not to exceed 1 foot over the street gutter flowline

Notes:
1. All scenarios do not include the low flow pump operation
2. 50% of pumps not operating; assumes that 2 of the 4 pumps (3 primary and 1 back up) are not operating.

Nolte Hydraulic Grade Line Requirements for Storm Drain Pipe

Per Section 9 of the Sacramento County Improvement Standards, the Nolte hydraulic grade line (HGL) shall maintain a minimum of one-foot freeboard below the top-of-manhole for storm drain systems. The worst-case duration (varies) of the 10-year storm event was used to set the tailwater condition for the Nolte analysis. **Figure 1.1: Maximum WSE Exhibit, Street Section** below presents a visual display of freeboard criteria for street sections within the Plan Area. The Nolte method was used in determining pipe design using the maximum 10-year conditions with climate change tailwater conditions from either the 24-hour, 5-day or 10-day durations.

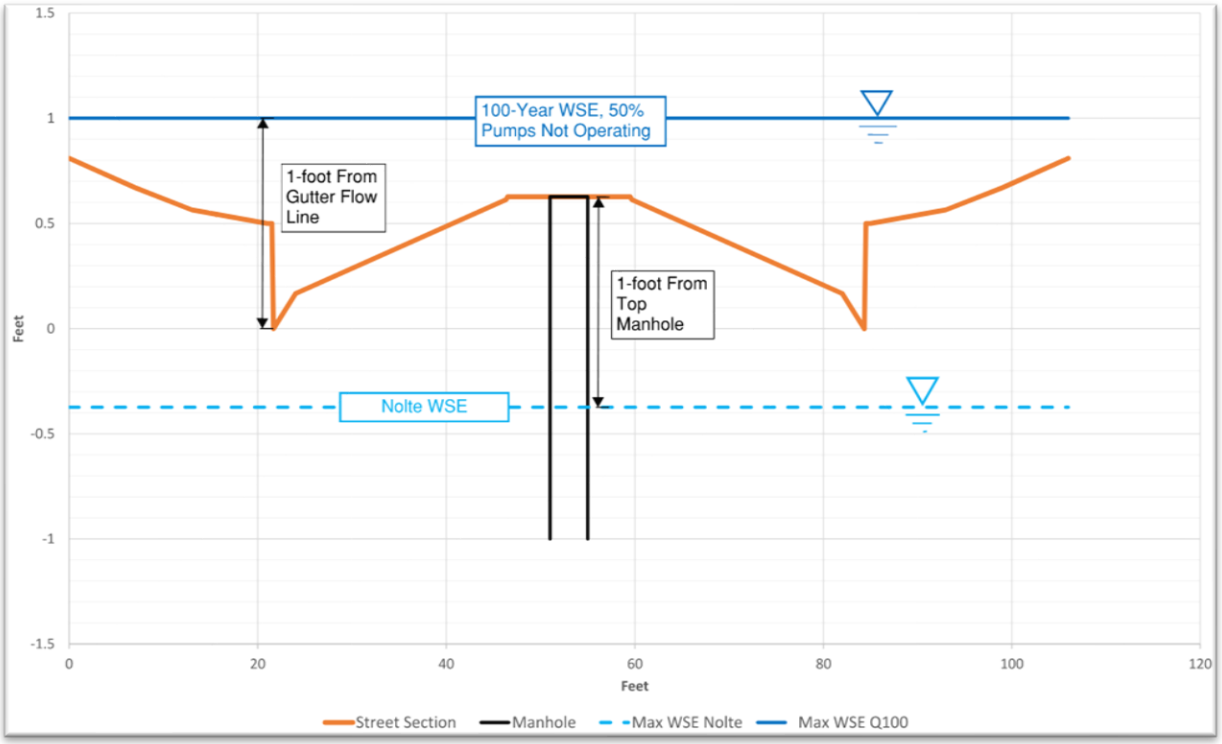


Figure 1.1: Maximum WSE Exhibit, Street Section

RD 1000 Design Criteria

Reclamation District (RD) 1000 maintains and operates seven pump stations, over 42 miles of levees and over 30 miles of open channels within the Natomas Basin. To aid in evaluating the effects of development projects within the Natomas Basin, RD 1000 and its consultants, Mead and Hunt and West Yost Associates (WYA), developed and maintain a basin-wide XPSWMM hydrologic and hydraulic model of the Natomas Basin drainage system. Wood Rodgers has coordinated with RD 1000, Mead and Hunt, and WYA to determine the allowable measure of discharges into the West Drainage Canal so that development within the Plan Area would have no adverse impacts on the performance of storm drainage facilities within the Natomas Basin drainage system operated by RD 1000. Based on conversations with RD 1000 and Mead and Hunt, development within the Plan Area will not be allowed to increase peak flow rates from existing conditions into the West Drainage Canal. In addition, increased flow volumes from the Plan Area are not allowed to create adverse impacts to the RD 1000 drainage facilities.

The RD1000 XPSWMM system model evaluates worst-case conditions using the 100-year 10-day storm event, requiring the project to also evaluate 100-year 10-day conditions accordingly. The current RD1000

operational model (using XPSWMM) is expected to be replaced by the Natomas Basin 2D HEC-RAS model. Once adopted, new modeling representing the Upper Westside will need to incorporate the latest RD1000 system representations.

Referenced Studies

Studies and materials reviewed in the preparation of this report include:

1. North Natomas Comprehensive Drainage Plan, Borcalli and Associates, June 1992.
2. Flood Insurance Study (FIS), FEMA, Effective date July, 19, 2018.
3. Flood Insurance Study (Historical), FEMA, February 4, 1998.
4. Natomas Comprehensive Drainage Plan, North Natomas Levee Project, As-built drawings, Ensign and Buckley, 1997.
5. River Oaks Master Drainage Plan, Balance Hydrologics, September 2018.
6. Basins 7 and 8C Drainage Study with Gateway West, Morton & Pitalo, Inc., June 27, 1997.
7. Upper Westside Development Geology and Soils Technical Report, ENGEO, February 2021.
8. Upper Westside Specific Plan Administrative Draft, Wood Rodgers, Inc., July 2023.
9. Technical Memorandum No. 3, Natomas North Precinct Flood Control & Storm Drainage Master Plan, Comparison of RD-1000 Hydrology to Sacramento Method, Civil Engineering Solutions/McKay and Somps, April 4, 2018.
10. Riverside Canal Phase 2 Relocation Project, Improvement Plans, Mead & Hunt, Inc., May 29, 2019.
11. American River Common Features Natomas Basin Reach B Volume 4 Riverside Canal Phase 2 Relocation Project, Mead and Hunt, US Army Corps of Engineers, Sacramento District, Final Design plans issued June 7, 2019.
12. “Creating Land Cover, Manning’s N Values, and % Impervious Layers” (HEC-RAS 2D User’s Manual), United States Army Corps of Engineers, Version 6.0, June 2021.

13. River View Drainage Study, Wood Rodgers, Inc., April 1999.

14. Sacramento Stormwater Quality Partnership Hydromodification Management Plan, cbec eco engineering, et al, January 28, 2011 (finalized December 31, 2017).

1.4 Objectives of Analysis

The purposes of this Study are to:

- Determine existing and proposed conditions drainage patterns and flow rates to demonstrate that the development within the Plan Area will not cause adverse impacts to adjacent properties;
- Determine detention basin sizes, including the capacity necessary to meet freeboard, and required water quality volume (WQV) storages;
- Determine preliminary backbone storm drainage trunkline and channel sizes considering freeboard requirements;
- Show no adverse impacts to RD 1000 facilities from existing to proposed conditions;
- Develop approaches to meet post-construction National Pollutant Discharge Elimination System (NPDES) requirements following the guidelines in the SQDM; and
- Comply with requirements from the SCDWR guidance for a Level 1 Master Plan.

It is important to note that all determinations made as part of this study are preliminary, with all basin sizes, pumping, channels, culverts, pipe sizes, and alignments being subject to change during future tentative map and final design efforts.

Procedural Memorandums

Based on discussions with the SCDWR and the Sacramento County Planning Department, the Project applicant has been tasked with providing a series of four procedural memorandums related to cumulative impacts, residual flood risks, the FEMA Conditional Letter of Map Revision (CLOMR) approval process,

and the financing of capital and operation and maintenance costs[1]. These topics will be covered in the procedural memorandums which will be delivered separately and apart from this Master Drainage Study.

[1] Including the costs associated with operating and maintaining the central canal. Financing of capital drainage improvements is included as part of the project's Public Facilities Financing Plan.

VICINITY MAP

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY

SACRAMENTO COUNTY, CA
MAY 2024

Specific Plan Area Boundary
Sacramento City Limits
Sacramento County Boundary
West Drainage Canal
Existing Developments
Interstate

0 1,000 2,000
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG1.2_UpperWestVicinityMap.mxd 9/7/2023 3:39:26 PM jcarey

FIGURE 1.2

2.0 Baseline Existing Conditions

2.1 Historical Land Use

The Plan Area is within the Natomas Basin, which is a reclaimed floodplain protected by levees on all sides. This area has been utilized for agricultural use for many decades. Review of historical topographic maps from 1915 and 1916 (see **Figure 2.2**) show the planning area partially inundated by Bush Lake, which is connected to Fisherman's Lake. By 1950, (see **Figure 2.3**) the West Drainage Canal had been constructed and Bush Lake had been drained. Also by 1950, the Natomas East Main Drainage Canal was constructed, which diverted Dry Creek runoff away from the Plan Area and into the American River.

RD 1000 was created as a Special District in 1911 by Act 930 as passed by the California State Legislature. RD 1000 replaced any other districts in the area and continues to be responsible for the operation and maintenance of the drainage facilities that receive and will continue to receive runoff from the Plan Area.

2.2 Topographic Data Sources

The existing conditions topographic mapping is based on a survey performed by Wood Rodgers in April 2019. Additional surveys identifying invert elevations and sizes of key culverts within the Plan Area were performed in August 2020 and December 2020. The Plan Area was surveyed using the National Geodetic Vertical Datum of 1929 (NGVD 29); NGVD 29 also serves as the City's vertical datum. The RD 1000 XPSWMM model developed by RD 1000 and its contractors was created using North American Vertical Datum of 1988 (NAVD 88) data. The Existing Conditions HEC-RAS model was developed in NAVD 88. The local transformation from NAVD 88 to NGVD 29 is -2.08 feet (NGVD 29 = NAVD 88 – 2.08'), per City of Sacramento benchmarks 276-H5B and 276-H6E within the Plan Area. Unless otherwise specified this study utilizes the NAVD 88 datum.

2.3 Offsite Drainage

Offsite Flows from Southeast

Figure 2.4: Offsite Flows present Offsite Drainage to the Plan Area from I-80 and areas South of I-80. The River Oaks development site (Reference 5) has historically overflowed to the north through dual 36-inch culverts under I-80 with most drainage being directed to Sump 160 to the south. The modeling provided

by the City of Sacramento was used to identify when the overflow occurs. The River Oaks development conveys 10-year flows south towards the City of Sacramento Sump 160 pump station, leaving flows greater than the 10-year storm event to flow via overland release through the existing culverts under I-80.

An existing 36-inch culvert located under I-80 and approximately 2,700 feet southwest of the El Centro interchange conveys discharge from I-80 into the Plan Area. This culvert conveys only runoff from I-80.

River View #2 Subdivision

The River View #2 development as shown in **Figure 2.5: Offsite Drainage River View #2** is an existing development adjacent to the Plan Area located north of San Juan Road. Runoff from River View #2 drains southward towards San Juan Road where the flow is collected in a 60-inch storm drain, which conveys the 100-year runoff eastward under the West Drainage Canal and into the City of Sacramento Sump 17 Pond 7B detention basin southeast of the intersection of San Juan Road and the West Drainage Canal. In an extreme flooding event overland releases from the River View development will overflow into the existing open channels adjacent to San Juan Road and conveyed via the San Juan Pump Station into the West Drainage Canal. Figure 3B presents the on-site drainage system within the River View #2 development. Excerpts from the River View #2 drainage study are located in **Appendix A**.

The Natomas Estates development to the east of El Centro Road and north of Radio Road is mostly built out (fully developed) and currently drains by gravity directly into the West Drainage Canal.

Riverside Canal

It is assumed for the existing condition that the Riverside Canal Phase 2 Relocation project is complete and operational. Per Reference 10, Riverside Canal has been revised to an underground pipe. The Natomas Mutual Water Company's (NMWC) Riverside Main Canal runs along the western edge of the Plan Area. The system delivers water from the Sacramento River to a series of lateral highline irrigation canals at Radio Road, Farm Road, and Parker Road that flow eastward through the plan area. The Riverside Main is open canal north of Radio Road and buried low pressure pipeline south of Radio Road. At Bryte Road the pipeline returns to open canal and serves highline canals flowing north along Bryte Road and northeast along Tree Road. The pipeline includes irrigation water services along its alignment for properties to the

east and west. The Riverside Canal alignment has been shifted westward from the Radio Road lift station to Farm Road. South of Farm Road, the Riverside Canal continues south along existing RD 1000 and Natomas Central Mutual Water Company (NCMWC) easements. The water supply ditch along Radio Road is served by a 30-inch high-density polyethylene pipe (HDPE) turnout, which conveys flows along this ditch and eventually to the Riverside Pump Station.

2.4 Onsite Drainage

Onsite flows originating from undeveloped agricultural lands are conveyed via drainage and irrigation canals to various RD 1000 ditches that collect field runoff and then convey the water to the West Drainage Canal. Runoff is conveyed from the existing Plan Area to the West Drainage Canal by two pump stations operated by RD 1000 and by various gravity systems including field drains, canal drains, and storm drains. **Figure 2.6: West Drainage Canal Existing Storm Drain Connections** presents the location and size of drains and pump stations that convey flows into the West Drainage Canal. The Riverside Pump Station is located just north of the existing development that is situated north of San Juan Road. The San Juan Pump Station is located along San Juan Road adjacent to the West Drainage Canal. **Figure 2.7: RD 1000 XPSWMM Conduits** shows how these connections to the West Drainage Canal are represented in the RD 1000 XPSWMM model.

Existing agricultural areas provide some floodplain storage. Agricultural areas are graded relatively flat with typical slopes less than 0.5% and are situated adjacent to berms and leveed irrigation canals. Flows in and out of the agricultural fields are typically limited by adjacent berms that usually measure two feet to three feet in height. Flows are typically controlled by 18-inch or 24-inch corrugated metal pipe (CMP) or by HDPE culverts installed under the berms, which creates some floodplain storage within the fields.

2.5 Hydrologic & Hydraulic Modeling Assumptions

An existing conditions HEC-RAS model using rain on grid precipitation was developed to determine baseline conditions for localized flows entering the West Drainage Canal. Examination of the RD 1000 XPSWMM model revealed that the existing culverts, storm drains, and field drains are not all individually represented, and most of the existing UWS Plan Area was represented by several large 1D storage areas. Based on discussions with Mead and Hunt and WYA on September 14, 2022, Wood Rodgers proposed to

utilize an existing conditions hydrologic and hydraulic model to determine more accurate runoff values from the existing Plan Area entering the West Drainage Canal. Rainfall was distributed across the model domain, with infiltration losses standardized to 0.014 inch/hour across the project as recommended by SCDWR and referenced from Technical Memorandum No. 3, Natomas North Precinct Flood Control & Storm Drainage Master Plan, (Reference 9). In addition, Wood Rodgers has prepared a Technical Memorandum that concludes that using a HEC-RAS rain on a grid precipitation model with a loss rate of 0.014 within the UWS Plan Area generates a total runoff value consistent with runoff values from the RD 1000 XPSWMM model. The technical memorandum is presented in **Appendix B**.

The existing conditions HEC-RAS model was run with the same (non-climate change) 100-year 10-day storm as the RD 1000 XPSWMM model in order to provide input hydrographs from the UWS Plan Area and to integrate the models. Wood Rodgers updated the evaluations with the RD 1000 provided model and RD 1000 staff will review and approve all models accordingly to establish the baseline condition for confirming that the proposed project would have no adverse impacts to the RD 1000 drainage facilities in the 100-year 10-day storm.

The existing conditions HEC-RAS model will also serve as a basis for comparison with the proposed condition to show compliance with the Sacramento County Floodplain Management Ordinance (January 13, 2017) which states that the proposed project shall result in no adverse impacts. The ordinance defines this as the following:

> *…causing increased flood stages, increased flood velocity, or increased flows in or near a special or local flood hazard area, to an extent including to but not limited to an increase in base flood elevation equal or greater than 0.1 foot on upstream, downstream, or adjacent properties.*"

The design storms are assumed to occur during winter months, when the weirs are removed and canals are free-flowing. The West Drainage Canal was not included in the HEC-RAS model domain because RD 1000 will utilize the RD 1000 XPSWMM model to evaluate the impacts of the proposed project on the existing RD 1000 drainage system. The hydraulic connection of the HEC-RAS model outflows into the XPSWMM model as inflow can be adequately defined and achieved without combining the geometry of the

RD1000 system model into the HEC-RAS model domain by using stage hydrographs as boundary conditions for HEC-RAS.

Some small culverts along roadside ditches are not included in the model. In these areas, the Digital Elevation Model (DEM) was revised to create a uniform channel representing roadside ditches. It is assumed that these DEM revisions will not have a significant impact on model results, because these ditches typically do not have large drainage areas or flows. The water supply transmission line (Riverside Canal) has been revised to the current configuration of an underground pipe.

Description of HEC-RAS Model

The existing condition HEC-RAS model is full 2D with rain-on-grid precipitation. The model was developed using site-specific surveys including field determinations of culvert sizes and inverts, and irrigation channel cross sections. The model includes a 2D grid with internal 2D-to-2D connections representing existing culverts within the model domain. The Riverside and San Juan Pump Stations are represented with the same on/off elevations (NAVD 88) and pumping capacities as represented in the RD 1000 XPSWMM model.

The existing conditions HEC-RAS model was developed to simulate how the complexities of the terrain impact the flows going into the existing drainage system. The existing conditions models were created using the site topographic data described in Section 2.2 of this report. The models include a 2D grid with internal 2D to 2D connections representing culverts. The model domain encompasses the existing 2,066-acre Plan Area and adjacent lands south and west of the West Drainage Canal, the adjacent River View #2 Development, and the adjacent I-80 freeway. The existing River Oaks development south of the I-80 freeway influences are represented by running the XPSWMM model provided by the City of Sacramento for Sump 160. The River Oaks development overland release and the existing dual 36-inch culverts under I-80 are included in the model domain to ensure there are no adverse impacts from the proposed project on the existing development.

The Existing Condition 100-year HEC-RAS Model includes existing culverts within the existing Plan Area, the River View #2 development on-site storm drain, and the 60-inch storm drain in San Juan Road that

conveys runoff from the on-site storm drain east under the West Drainage Canal and to the City of Sacramento Sump 17 Pond 7B detention basin. One purpose of the existing condition 100-year HEC-RAS Model is to develop a baseline condition WSE for the 100-year design storms. The 100-year 24-hour, 100-year 5-day, and 100-year 10-day design storms with climate change are evaluated to show that the proposed project will not have adverse effects to peak WSE within the River View #2 development and adjacent off-site areas, as required by the County Floodplain Management Ordinance.

The RD 1000 system model is run for the 100-year 10-day storm only with a total rainfall value of 10.69 inches (without climate change), therefore the HEC-RAS model was also run with precipitation input that matches the total rainfall value used in the RD 1000 XPSWMM model to assess impacts to the RD 1000 system. Rainfall was distributed uniformly across the model domain for each storm scenario, with infiltration losses as noted above.

Model Layout

Figure 2.8: Existing Topography presents the project topography and existing culverts used to develop the existing conditions model. **Figure 2.9: Existing Conditions HEC-RAS Model** presents a schematic layout of the existing conditions HEC-RAS model.

Software Application and Version

HEC-RAS version 6.3 was used for the existing conditions hydrologic and hydraulic analysis.

Limits of Study

The limits of study are the Plan Area and adjacent areas west and south of the West Drainage Canal, the adjacent tributary roadway areas along I-80, the influences of the River Oaks development (located south of I-80), and the River View #2 development.

The River Oaks development conveys runoff for events larger than the 10-year event north through an existing dual 36-inch reinforced concrete pipe (RCP) culvert under I-80. Existing runoff from these culverts is conveyed to the existing San Juan Pump Station via existing earthen canals. The proposed Project will convey flows from these culverts to the proposed East Detention Basin via an earthen channel and dual 60-inch RCP pipe. The River Oaks development and the existing dual 36-inch culverts under I-80 were

modeled in a combined 1D XPSTORM model with The CORE development provided by the City of Sacramento, and the precipitations were modified to include climate change. The 24-hour storm scenarios for the 100-year, 200-year, and 500-year reached the existing dual 36-inch RCP culverts and flowed into the plan area.

The River View #2 development conveys runoff via a 60-inch storm drain in San Juan Road east under the West Drainage Canal to the City of Sacramento Sump 17 Pond 7B detention basin. The River View development is included in the 2D model domain to compare the impacts of the proposed project on the existing development and verify that these projects are hydraulically separated and do not influence each other.

See **Appendix A** for referenced information from the River Oaks Drainage Study, River View #2 drainage study, and for Improvement plans for the City of Sacramento Sump 17 Pond 7B detention basin.

Soils

Figure 2.10: Hydrologic Soils Groups Map presents soils with hydrologic soils group (HSG) values as determined by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database. Soils in the project area are composed primarily of HSG C and D soils, with some HSG A soils in the undeveloped area along the Sacramento River Levee. The HSG values are provided as background but were not a factor in the analysis due to the alternative basis for the infiltration rate that was used.

Land Use

Figure 2.11: Existing Condition Land Use presents existing condition land uses for the UWS. These land uses include Agricultural-Residential, Agricultural, Wetlands, Park, Very Low Density Residential, Low Density Residential, High Density Residential, Very High Density Residential, and Commercial.

Infiltration

In lieu of watershed and runoff hydrograph calculations, rainfall was distributed evenly across the two-dimensional flow areas within the Plan Area. Infiltration losses were standardized to 0.014 inch/hour (for

pervious areas only) across the project, consistent with the analysis performed by Civil Solutions in Reference 9 and verified in the Technical Memorandum provided by Wood Rodgers in **Appendix B**.

Routing

Routing was accomplished using culverts, canals and 2D areas in the HEC-RAS model. No hydrologic flood routing was needed because rainfall was applied to the ground surface and all routing was performed using hydraulic routing.

Storage

Two existing detention basins are present in the existing Plan Area. They are located next to the freeway and represented in the existing conditions DEM. To account for the effective migration of floodplain storage within agricultural fields, the project DEM was first modified to cut small channels near the locations where pipe culverts convey flows from agricultural fields into and out of adjacent irrigation canals to represent field drains. Due to the field culverts contributing to attenuation within the fields, culverts and small berms were added back to the enhanced topography to represent the limited conveyance capacities of the field culverts. Culvert locations through adjacent berms were determined from inspection of the topographic data, aerial imagery, and from site visits performed by Wood Rodgers.

Boundary Conditions

Boundary conditions in the West Drainage Canal for pump stations were determined from information provided by WYA from the RD 1000 XPSWMM model. Stage hydrographs were set in the West Drainage Canal at the existing Riverside and San Juan Pump Stations. **Figure 2.1: 100-year, 10-day Stage Hydrograph** represents the updated RD 1000 XPSWMM model that utilizes the existing conditions HEC-RAS model outputs to the West Drainage Canal. The figure represents the 100-year 10-day stage hydrograph in the West Drainage Canal at the existing Riverside and San Juan Pump Stations.

The Existing Condition 100-year HEC-RAS Model includes the on-site storm drain system within the River View #2 development as well as the connecting 60-inch storm drain within San Juan Road that conveys runoff east under the West Drainage Canal and to the City of Sacramento Sump 17 Pond 7B detention basin. It is assumed that the starting WSE in the Sump 17 Pond 7B Detention Basin is 7.1 feet NAVD 88,

which corresponds to the peak 100-year WSE in Pond B from the RD1000 XPSWMM model less one foot to account for peak flow timing preceding peak detention levels.

Pump On/Off data for the Riverside and San Juan pump stations was also obtained from the RD 1000 XPSWMM model and is shown below in **Table 2.1: Existing Pump On / Off and Flow Capacity**. Please note that pump curve data was not available in the RD 1000 XPSWMM model. It is understood that pump flow rates may vary with the total dynamic head, and subsequent studies will require specific pump curve data for design of the proposed pump stations. The existing Riverside and San Juan pump stations currently pump one-way from onsite to the West Drainage Canal.

Table 2.1: Existing Pump On / Off and Flow Capacity
Source: RD-1000, XPSWMM System Wide Model

Location	Riverside		San Juan	
Pump #	1	2	1	2
Capacity (cfs)	5	20	5	55
On elevation (feet NAVD)	10.17	11.67	7.42	8.92
Off elevation (feet NAVD)	9.17	10.42	6.42	7.67

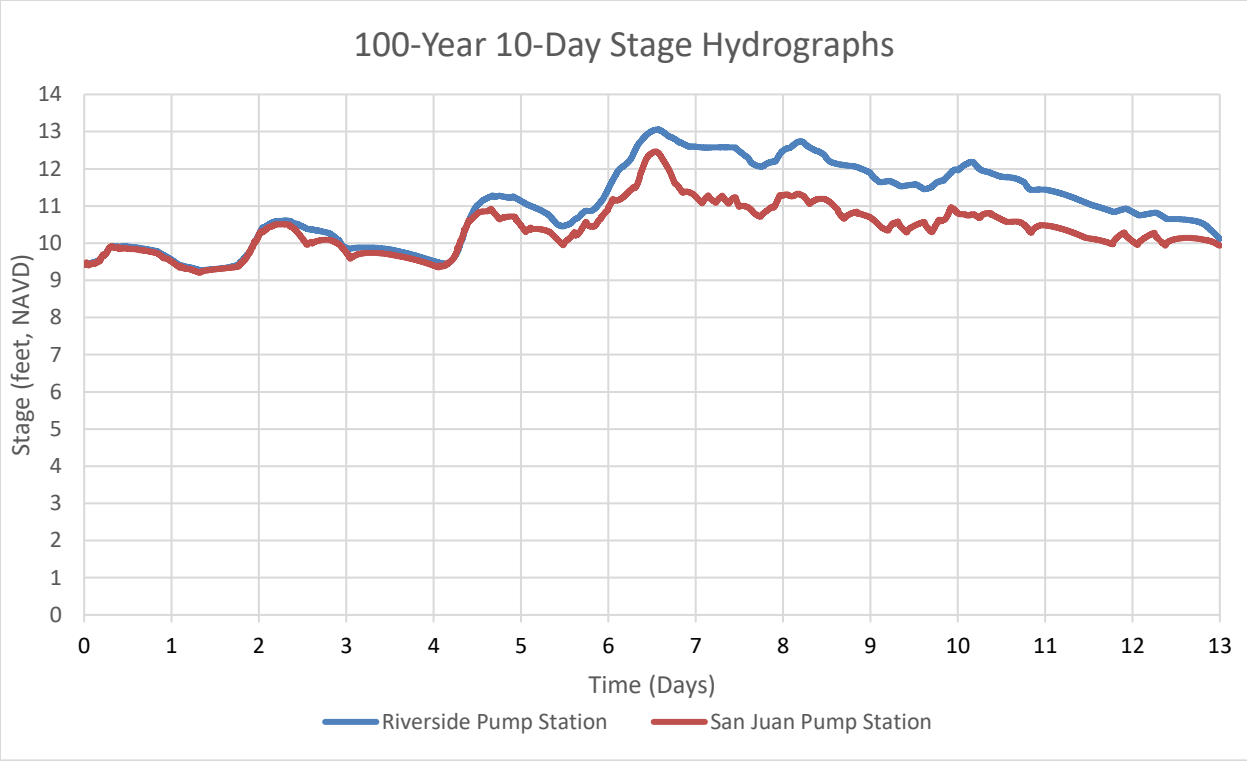


Figure 2.1: 100-year, 10-day Stage Hydrograph
Source: Updated RD-1000 XPSWMM System Wide Model by Wood Rodgers

Manning's "n" Values and Local Losses

Manning's "n" values for CMP culverts were assumed to be 0.024. Manning's 'n' values for concrete culverts were assumed to be 0.013. Entrance and exit losses were calculated within HEC-RAS for existing culverts. Entrance loss coefficients for existing culverts are typically 0.5 and exit loss coefficients are typically 1.0. Manning's "n" values for drainage canals were assumed to be 0.035. Manning's "n" values for 2D flow areas are based on land use as shown in **Figure 2.11: Existing Condition Land Use**, and developed based on a combination of suggested values from various literature sources such as the HEC-RAS 2D user's manual (Reference 12) and on engineering judgement. **Table 2.2: Manning's Roughness Coefficient for 2D Flow Areas** presents Manning's 'n' values corresponding to existing land use values used in the Existing Condition HEC-RAS model.

Table 2.2: Manning's Roughness Coefficient for 2D Flow Areas

Land Use Description	Roughness Coefficient
Agricultural	0.04
Agricultural-Residential	0.04
Roadway	0.025
Wetlands	0.04
Park	0.04
Very Low Density Residential	0.06
Low Density Residential	0.08
High Density Residential	0.12
Very High Density Residential	0.12
Commercial	0.16

2.6 Summary of Discharges and Stages

Model results for all storm events in the existing conditions HEC-RAS model are presented in **Appendix C**. Please note that all existing condition flows discharge into the West Drainage Canal. The existing conditions HEC-RAS model was run with the same 100-year 10-day storm as was the RD 1000 XPSWMM model in order to provide updated input hydrographs from the UWS Plan Area. Inflow hydrographs from the existing conditions HEC-RAS modeling will be input into the RD 1000 XPSWMM model to demonstrate that the project will have no adverse impacts on the RD 1000 drainage facilities. It is assumed that RD 1000 and its consultants will review the HEC-RAS model and input hydrographs and Wood Rodgers updated RD1000 XPSWMM model to confirm that the proposed project would have no adverse impacts on the RD 1000 drainage facilities in the 100-year 10-day storm. County DWR is not expected to review and approve models meant to satisfy RD-1000.

Profiles

No profiles for existing facilities were prepared for the existing conditions analysis. The existing drainage system of irrigation canals and culverts will be replaced in the proposed condition with storm drain systems designed to meet SCDWR criteria.

Floodplain Extents

Figure 2.12 thru **Figure 2.15** presents the existing conditions floodplain extents as determined by the existing conditions HEC-RAS model for the 100-year 24-hour, , 100-year 5-day and 100-year 10-day storm

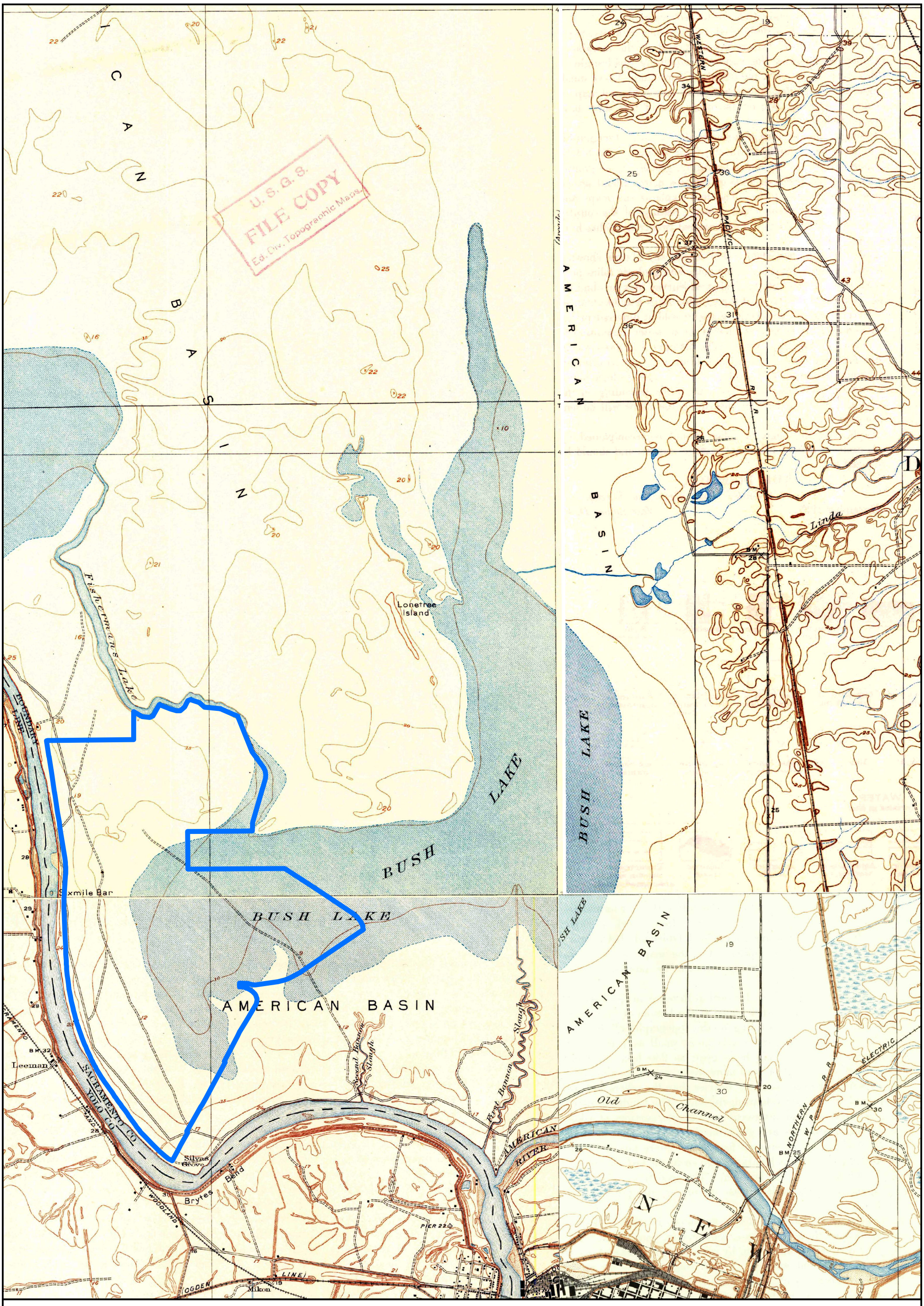
events with climate change factors applied. **Figure 2.16: Existing Conditions Maximum Floodplain Depth, 100-year, 10-day No Climate Change** is also provided to represent the 100-year 10-day storm event without climate change for consistency with RD1000 modeling. Floodplain depths measuring over two feet were common within existing fields, as floodwater backs up from existing drainage canals due to existing pump station capacity limitations and existing berms delaying ponded water from reaching the canals.

2.7 RD1000 XPSWMM System Model Modifications

The onsite baseline conditions modeling using HEC-RAS (described above) produces runoff estimates that enter and influence the RD1000 canal and pumping system. The RD1000 system is modeled separately using XPSWMM. The interface between the HEC-RAS model domain and the RD1000 system model is the West Drainage Canal. There are two types of hydraulic connections; gravity and pumping. Culverts which drain by gravity into the West Drainage Canal must be evaluated consistently in both models, with the tailwater system conditions being defined in the XPSWMM model based on the gravity inflow estimates from the HEC-RAS model. Both models require a hand-off approach, where output from each model is used as the input for the other at these culvert locations, iteratively. This approach was performed until the XPSWMM output stages using HEC-RAS inflow (based on XPSWMM tailwater) converged to within 0.1 feet. Pumped connections do not require this hand-off approach as pumping rates are not influenced by tailwater conditions in the West Drainage Canal.

The RD1000 system model previously defined the watershed areas that define the Upper Westside plan area (north of I-80 and west of the West Drainage Canal) using XPSWMM hydrology. Wood Rodgers replaced the XPSWMM results for the Plan Area with the results from the existing conditions HEC-RAS model (100-year 10-day without climate change influences). The final baseline modeling for onsite uses HEC-RAS estimated inflows at each of the locations shown on **Figure 2.6: West Drainage Canal Existing Storm Drain Connections**. There is not a unique node in the XPSWMM model for each of the small culvert inflow locations, therefore smaller locations have been clustered together as inflow into the XPSWMM model at the nearest adjacent location. The RD1000 system model with updated inflows from the

undeveloped Upper Westside plan area establishes the baseline condition in the RD1000 system for assessing proposed conditions impacts.



1915/1916 HISTORICAL TOPOGRAPHIC MAP

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

UWS Plan Area

NOTES: USGS 1:24000-scale Quadrangle maps shown for Elkhorn Wer, CA (1915) and Lovdal, CA (1916)

0 1,500 3,000
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.2_HistoricalMaps_1.mxd 9/7/2023 3:54:48 PM jcarey

FIGURE 2.2

1948/1950 HISTORICAL TOPOGRAPHIC MAP

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY

SACRAMENTO COUNTY, CA
MAY 2024

UWS Plan Area

NOTES: USGS 1:24000-scale Quadrangle maps shown for West Sacramento, CA (1948) and Taylor Monument, CA (1950)

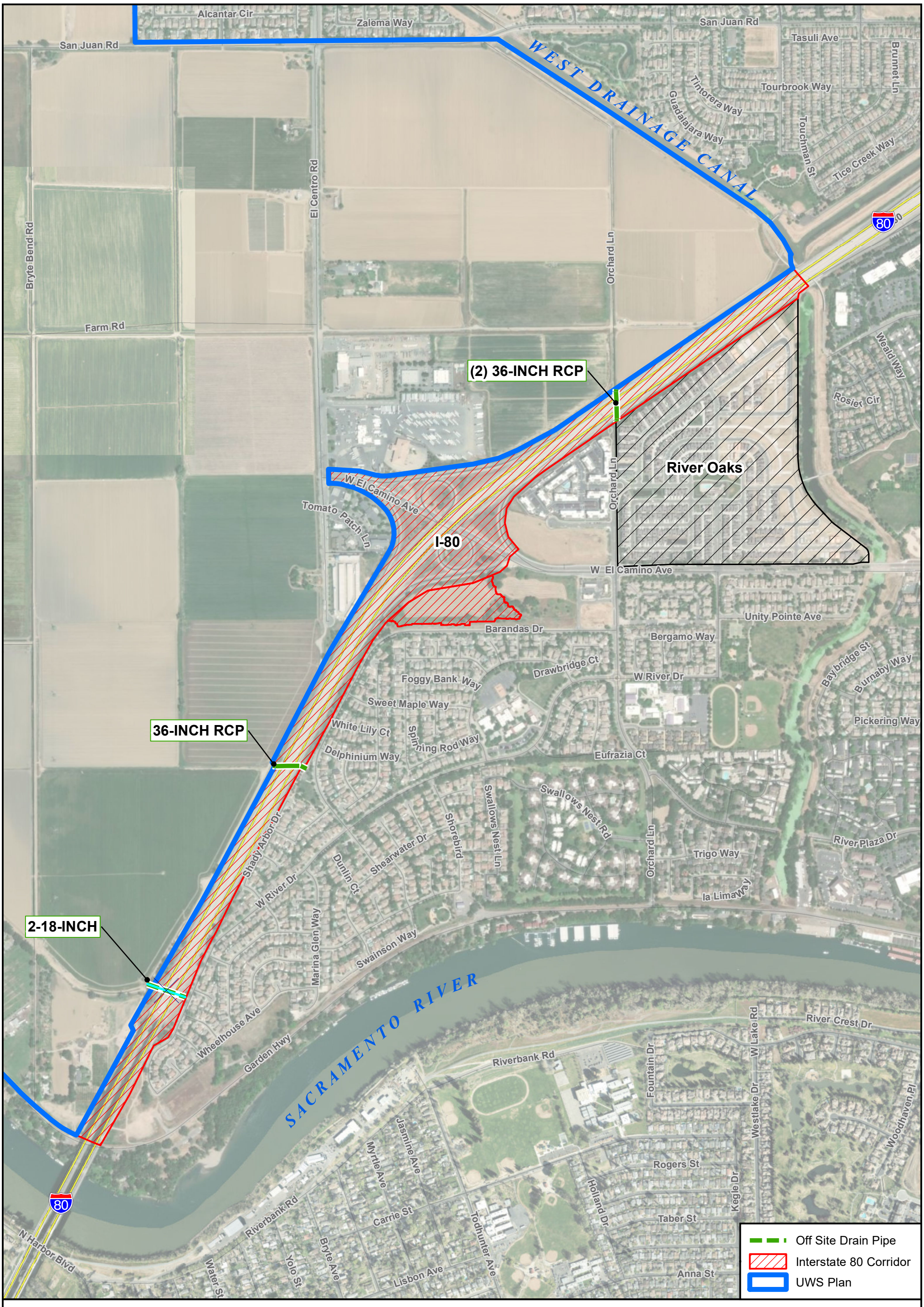
0 1,500 3,000
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.3_HistoricalMaps_2.mxd 9/22/2023 4:13:32 PM jcarey

FIGURE 2.3



OFF-SITE FLOWS
UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

0 400 800
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.4_Offsite Flows.mxd 9/22/2023 11:46:54 AM jcarey

FIGURE 2.4

FIGURE 2.5

OFF-SITE FLOWS
RIVER VIEW #2

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY

SACRAMENTO COUNTY, CA
MAY 2024

WEST DRAINAGE CANAL

POND 7B
DETENTION BASIN

Legend

- River View #2
- UWS Plan Area

River View SD Pipe
DIA_IN

- 12
- 15
- 18
- 21
- 24
- 30
- 36
- 54
- 60

- River View Manhole
- River View Inlet
- River View Outfall
- PS — Pump Station

0 150 300 600
Feet

NORTH

WOOD RODGERS

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.5_Offsite Flows River View 2.mxd 9/8/2023 1:26:58 PM jcarey

C-10
F-27
F-24
F-23
F-21
C-9
S-20
S-18
S-17
S-16
C-7
C-6
C-5
C-15
F-17A
F-17

Riverside Pump Station
Pump 1 Capacity = 5 cfs
Pump 2 Capacity = 20 cfs

San Juan Pump Station
Pump 1 Capacity = 5 cfs
Pump 2 Capacity = 55 cfs

PS Pump Station
UWS Plan
SIZE-IN, MATERIAL
18, CMP
24, CMP
24, RCP
30, RCP
36, RCP
48, RCP

WEST DRAINAGE CANAL
EXISTING STORM DRAIN CONNECTIONS
UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

NOTES: Storm drain labels based on facility call-outs from as-built drawings for North Natomas Levee Project, Phase 1 (Ensign & Buckley, 1997)

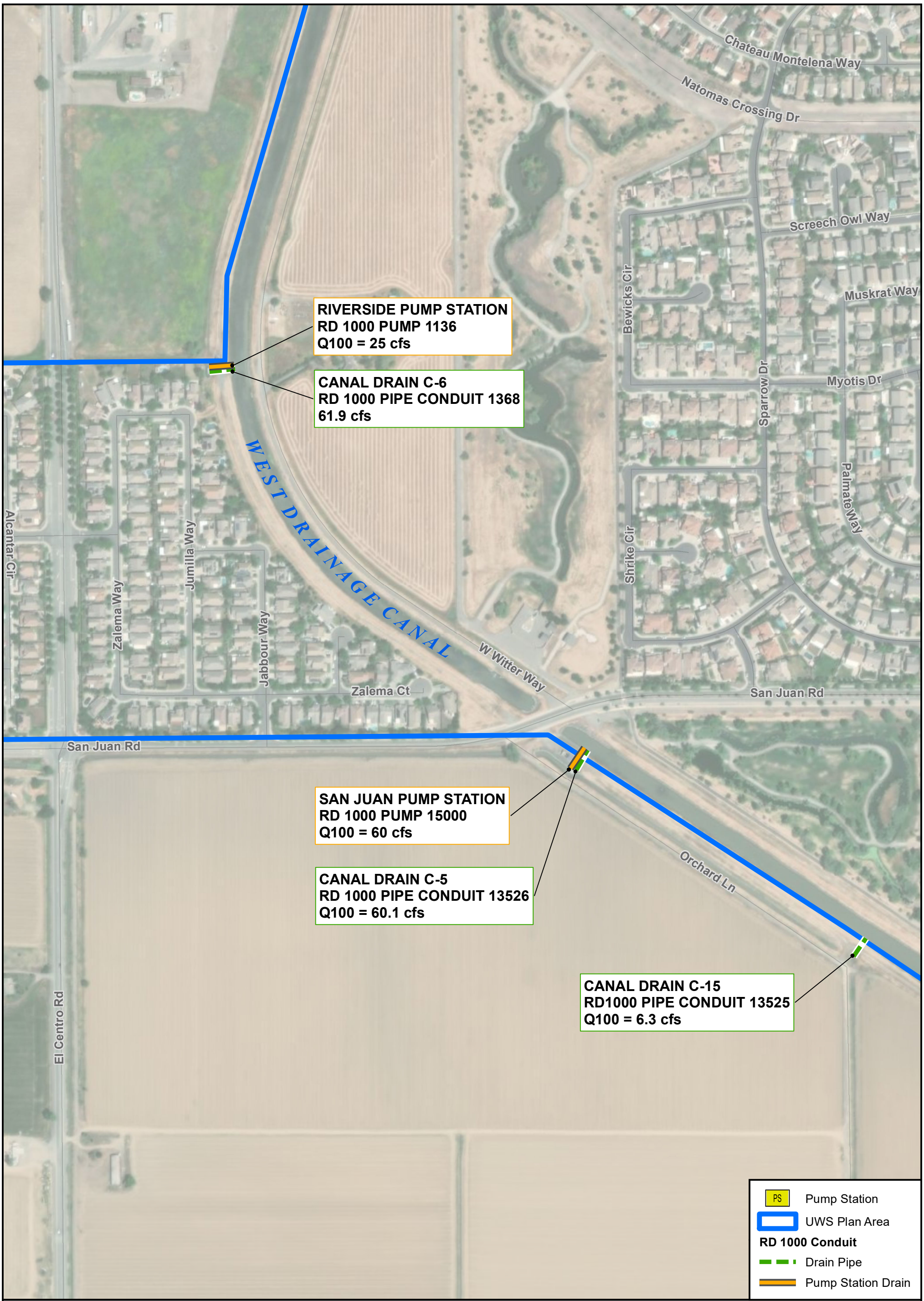
0 500 1,000
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.6_Existing_StormDrain.mxd 9/7/2023 4:08:06 PM jcarey

FIGURE 2.6



RD1000 XPSWMM CONDUITS

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY

SACRAMENTO COUNTY, CA
MAY 2024

NOTES:
CONDUIT 1368 ASSUMED TO INCLUDE ALL FIELD DRAINS, STORM DRAINS, AND CANAL DRAINS FROM RIVERSIDE PUMP STATION UPSTREAM TO FISHERMAN'S LAKE.
SEE FIGURE 3A.
FLOW RATES ARE FROM A MODEL RUN FOR THE 100-YEAR, 10-DAY STORM EVENT

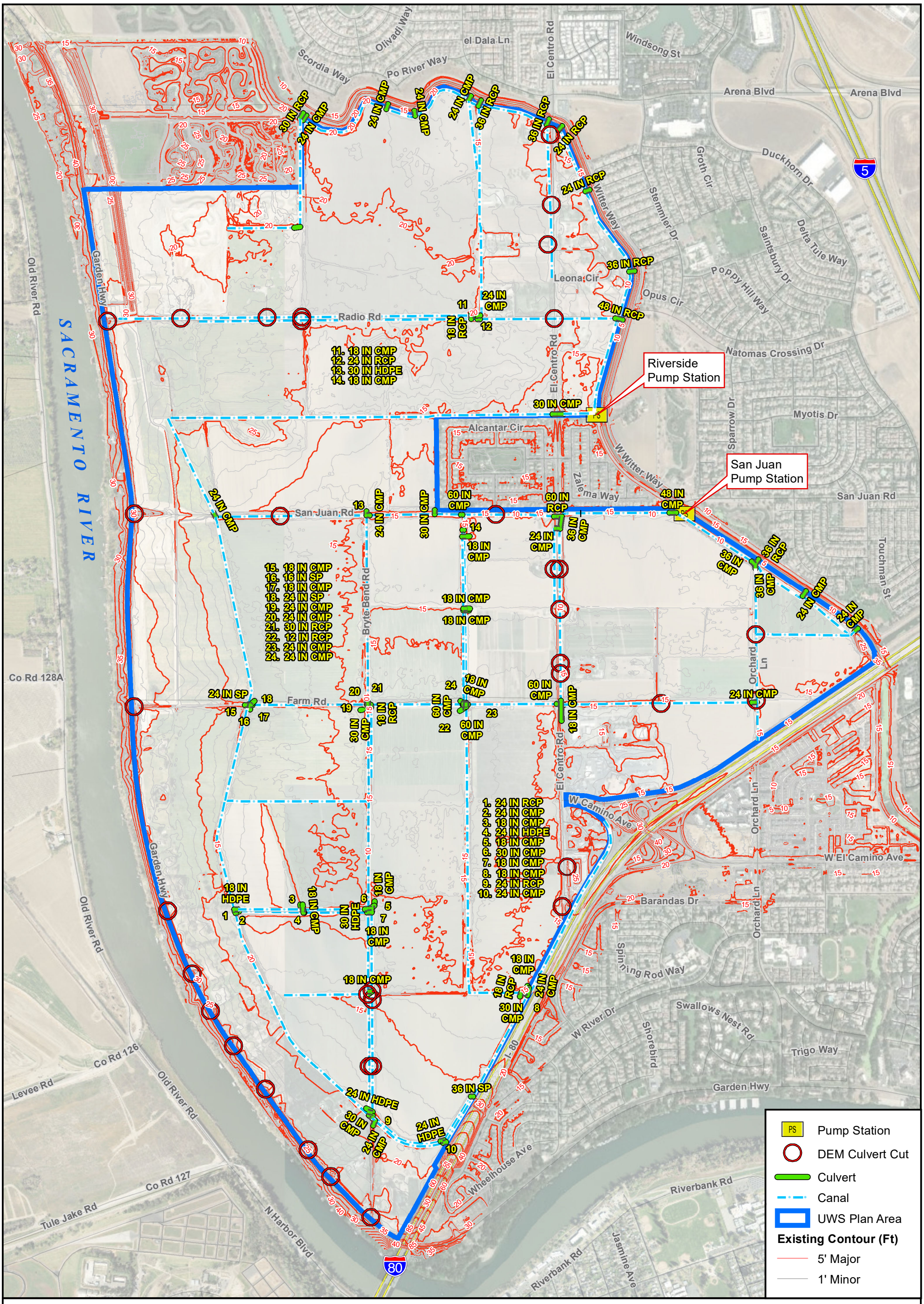
0 150 300
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.7_XPSWMM_StormDrain.mxd 9/7/2023 4:12:04 PM jcarey

FIGURE 2.7



EXISTING TOPOGRAPHY

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID,

0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.8_EX_Topography.mxd 9/7/2023 4:15:35 PM jcarey

FIGURE 2.8

EXISTING CONDITIONS HEC-RAS MODEL

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID,

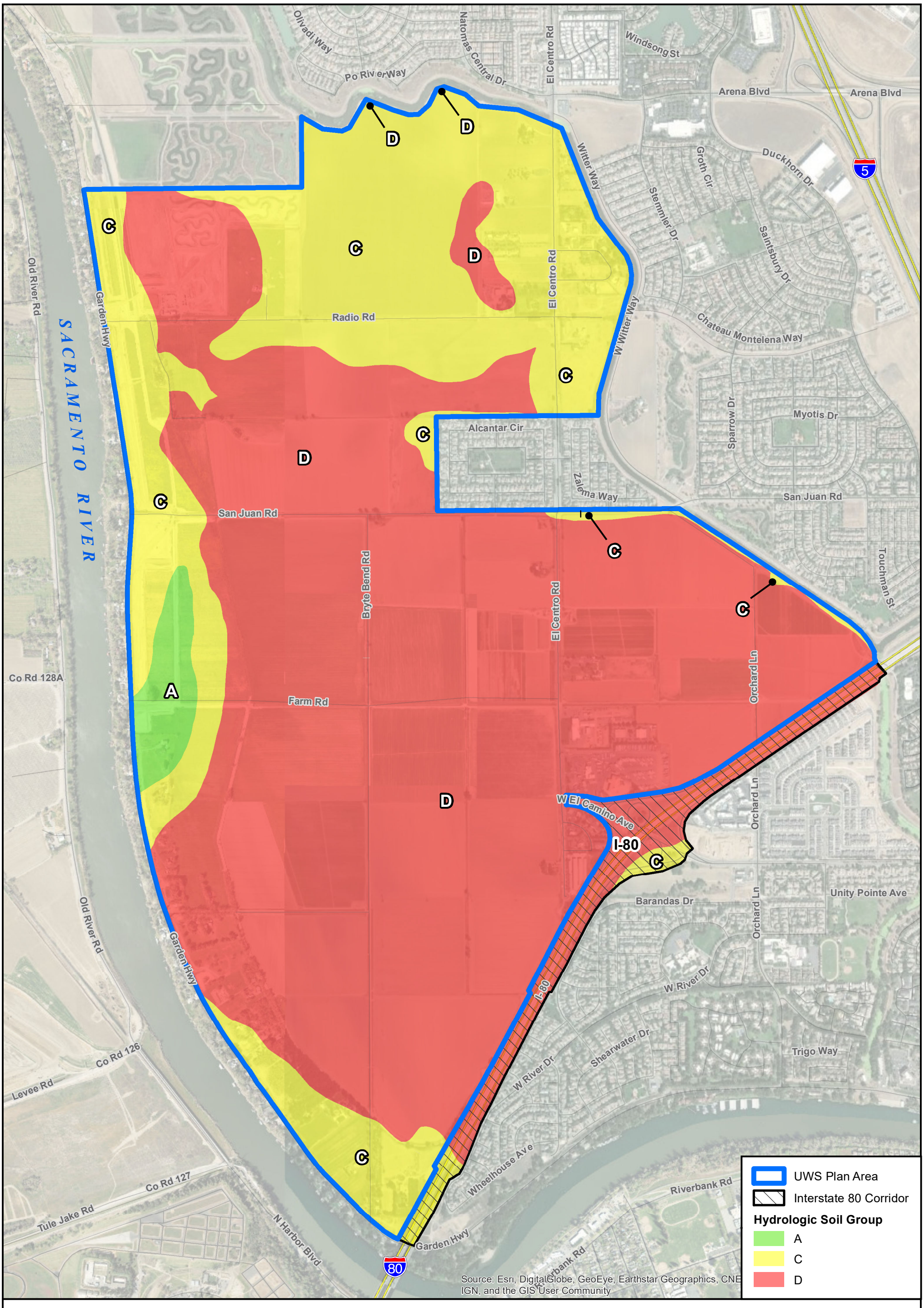
0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.9_HECRAS_EX.mxd 9/7/2023 4:19:37 PM jcarey

FIGURE 2.9



HYDROLOGIC SOIL GROUPS MAP

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY

SACRAMENTO COUNTY, CA
MAY 2024

Data Source: Natural Resources Conservation Service (NRCS) soil Survey, https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/

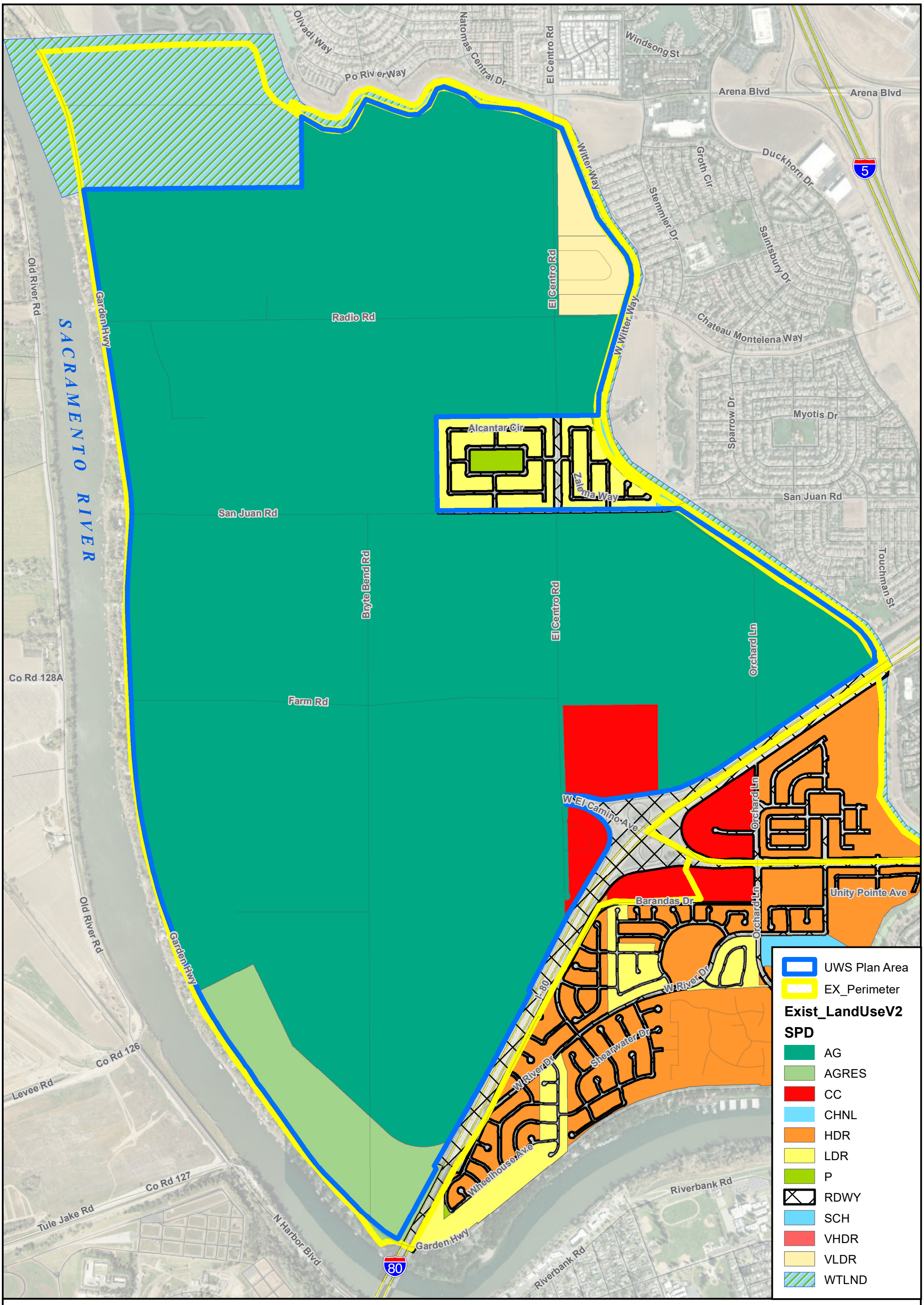
0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.10_SoilsMap.mxd 9/7/2023 4:25:09 PM jcarey

FIGURE 2.10



EXISTING CONDITIONS LAND USE PLAN

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

Data Source: Land use data provided by Sacramento County GIS Data Base, Dated JAN 2020.

0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.11_Existing_LandUseMap.mxd 9/7/2023 4:29:25 PM jcarey

FIGURE 2.11

Riverside Pump Station

San Juan Pump Station

Legend

Depth

Feet

0 - 1

1 - 2

2 - 3

3 - 4

4+

EX_culverts

River View SD Pipe

EXISTING CONDITIONS MAXIMUM FLOODPLAIN DEPTH
100-YEAR, 24-HOUR EVENT

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY

SACRAMENTO COUNTY, CA
MAY 2024

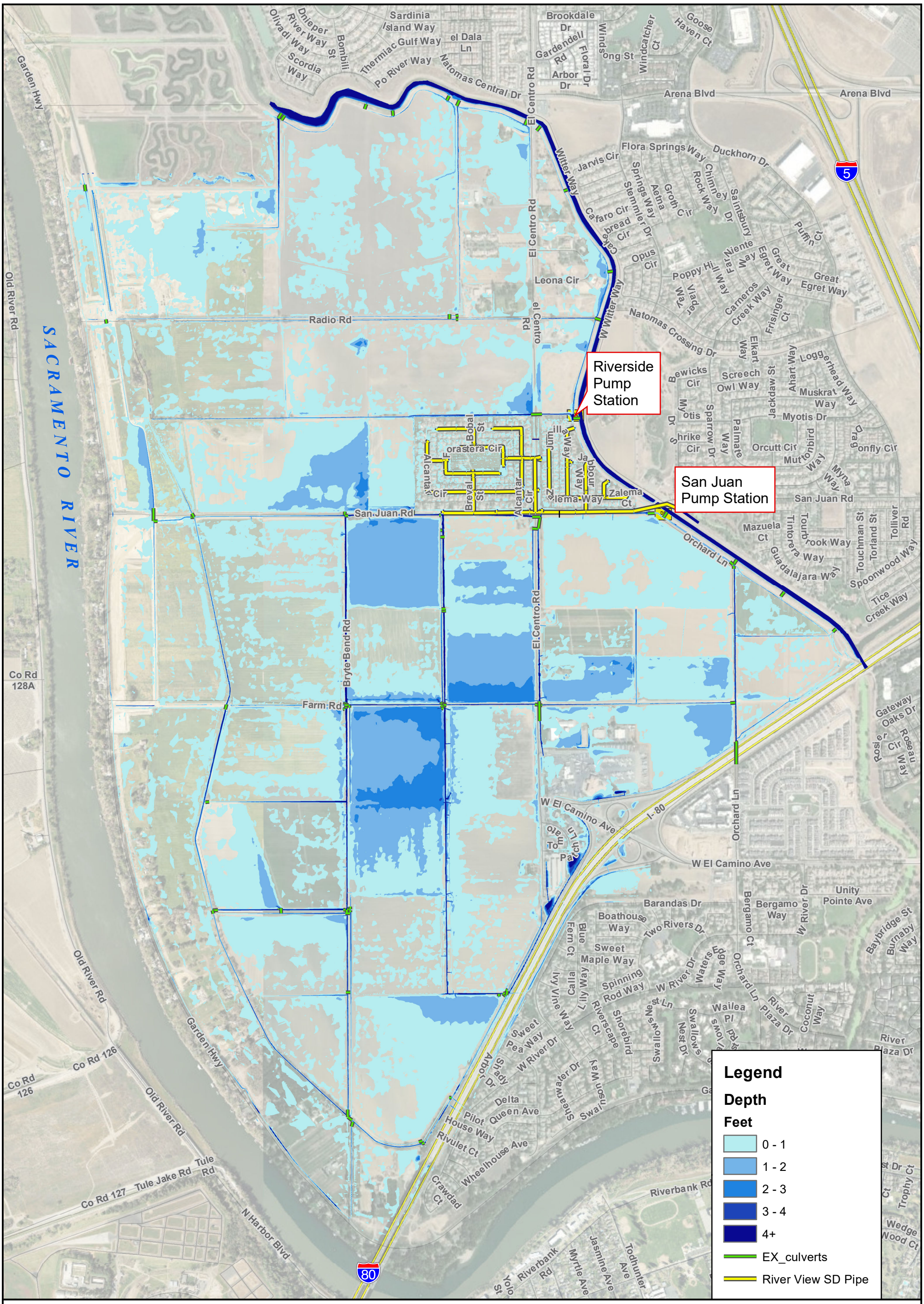
0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.12_Existing_FloodDepthQ100_24.mxd 1/29/2024 2:31:26 PM jcarey

FIGURE 2.12



EXISTING CONDITIONS MAXIMUM FLOODPLAIN DEPTH
100-YEAR, 36-HOUR EVENT
UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

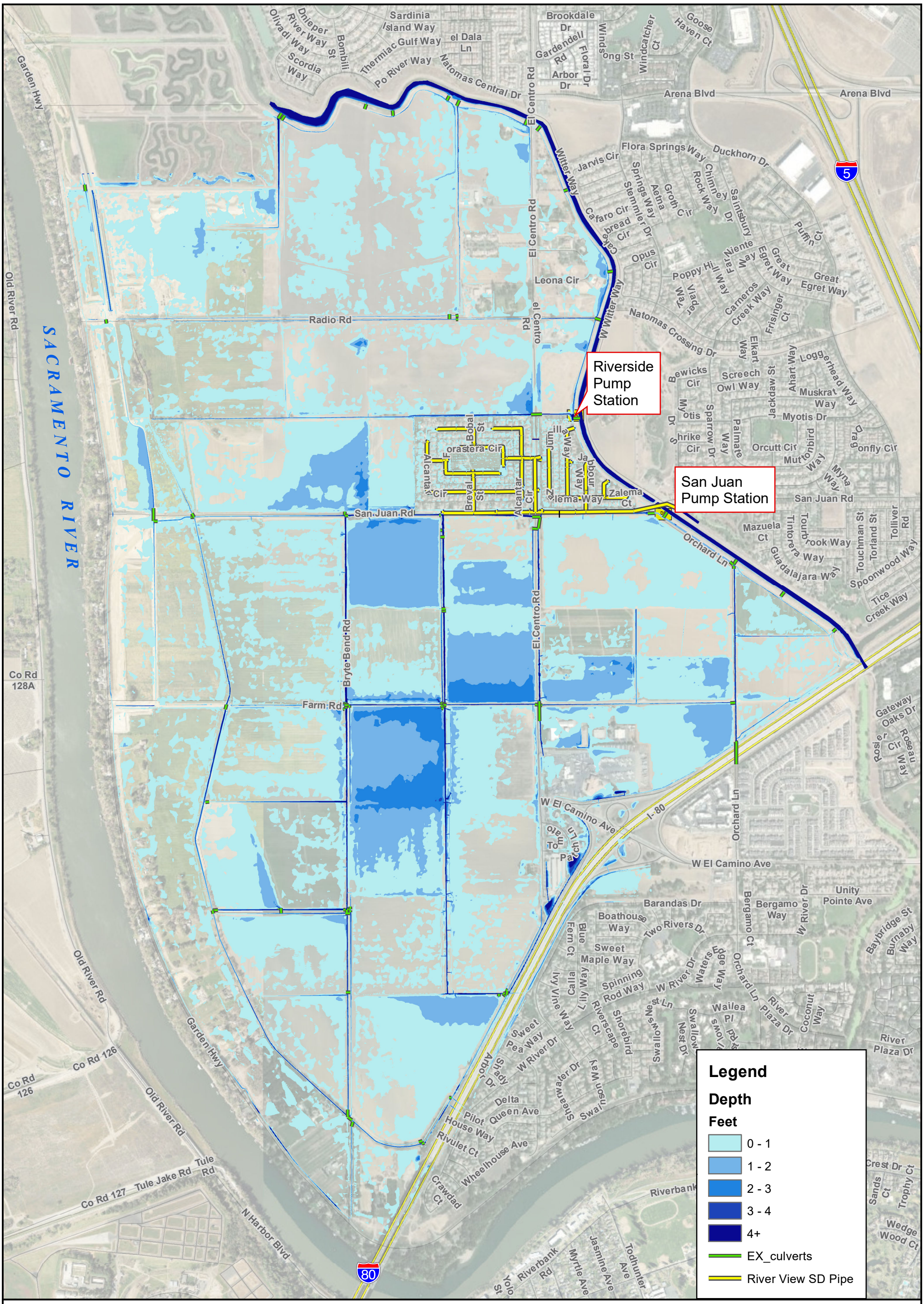
0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.13_Existing_FloodDepthQ100_36.mxd 1/29/2024 2:34:15 PM jcarey

FIGURE 2.13

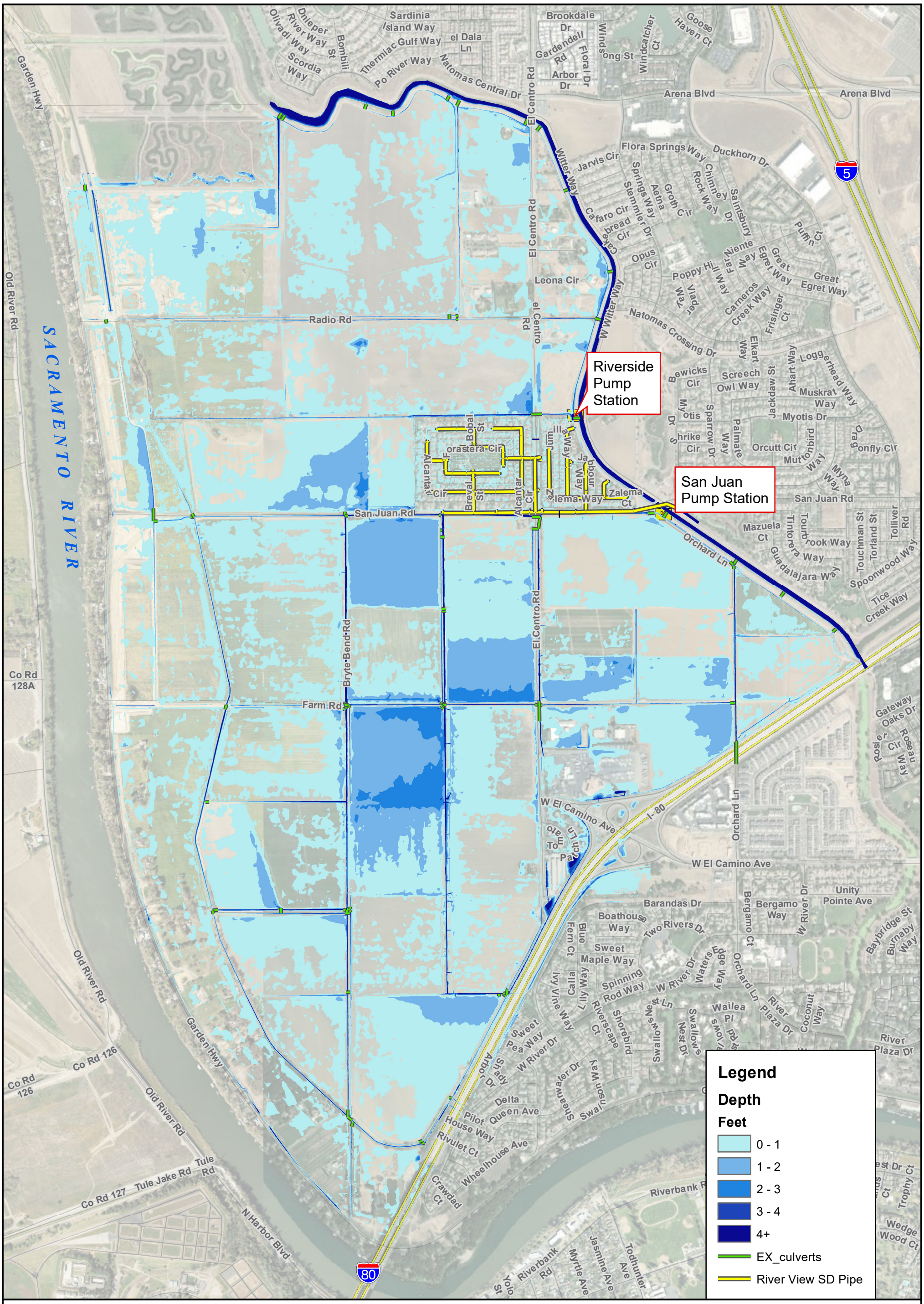


EXISTING CONDITIONS MAXIMUM FLOODPLAIN DEPTH
100-YEAR, 5-DAY EVENT
UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.14_Existing_FloodDepthQ100_5.mxd 1/29/2024 2:36:14 PM jcarey

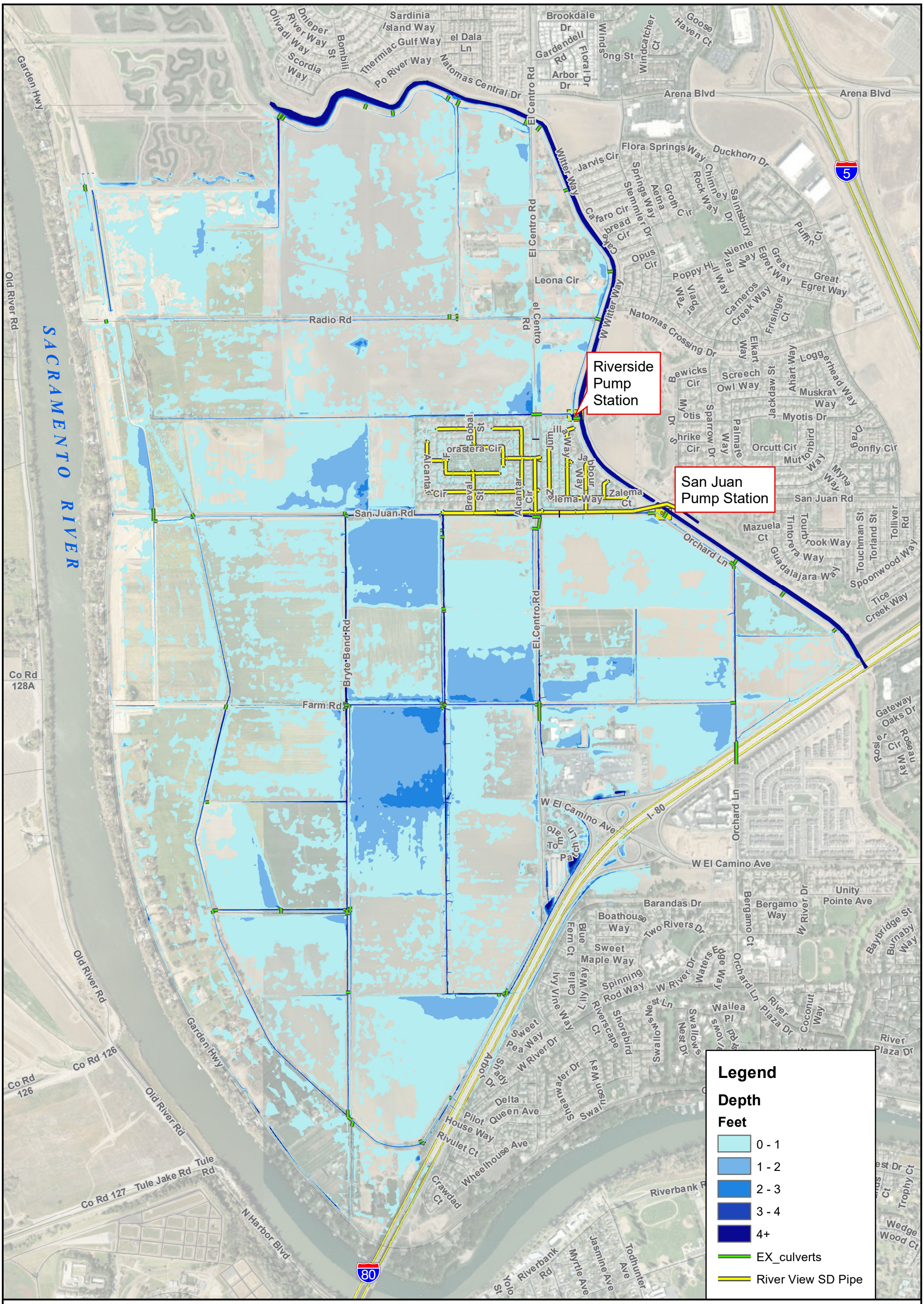
FIGURE 2.14



EXISTING CONDITIONS MAXIMUM FLOODPLAIN DEPTH
100-YEAR, 10-DAY EVENT
UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.15_Existing_FloodDepthQ100_10.mxd 1/29/2024 2:38:19 PM jcarey

FIGURE 2.15



EXISTING CONDITIONS MAXIMUM FLOODPLAIN DEPTH
100-YEAR, 10-DAY NO CLIMATE CHANGE EVENT
UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20230908\FIG2.16_Existing_FloodDepthQ100_10noCC.mxd 1/29/2024 2:40:16 PM jcarey

FIGURE 2.16

3.0 Mitigated Project / Proposed Conditions

3.1 Proposed Land Use

Figure 3.2: Proposed Conditions Land Use Plan presents proposed land uses in the Plan Area. The proposed project envisions five distinct planning districts as defined in the Specific Plan, including the central Town Center District, the residential West "C" District, the residential and commercial East Triangle District, the educational and residential Young Scholars District, and the Ag-Buffer District that will sit outside of the 1,566-acre Developable Area. **Table 3.1: Proposed Land Use Summary** below contains a summary of the proposed land uses.

The Town Center District is the urban core of the Plan Area and is set on a pedestrian friendly street grid system. The Town Center will feature a main street along West El Camino Avenue and a north-south recreational canal which also provides for drainage conveyance. The West "C" District will predominantly consist of residential neighborhoods that surround the Town Center to the north, west and south. The East Triangle District will feature Employment / Highway Commercial uses near the I-80 and West El Camino Avenue interchange. The Young Scholar's District will be centered around three educational facilities: a high school, a K-8 school, and a satellite campus for the Los Rios Community College District. The Ag-Buffer District will preserve the existing Ag-Cropland (AG – 421.6 acres) and Ag-Residential (AR – 93.3 acres) land uses.

Table 3.1: Proposed Land Use Summary
Source: Wood Rodgers, Preliminary Land Use Plan – Missing Middle Density Bonus, dated September 1, 2023.

Land Use District	Area (acres)	Estimated Dwelling Units	Estimated Square Footage
Very Low Density Residential	166.7	168	
Low Density Residential	390.8	2,149	
Low / Medium Density Residential	134.9	1,079	
Medium Density Residential	61.9	743	
High Density Residential	36.4	910	
Very High Density Residential	22.6	791	
Commercial Mixed Use	83.6	3,216	2,184,970
Employment / Highway Commercial	52.9		921,730
School	124.2		
Park	79.1		
Green Belt / Urban Farm	44.1		
Open Space (Basins & Channels)	167.9		
Open Space (Ag Buffer)	36.6		
Ag Cropland	414.3		
Ag Residential	86.1		
Open Space Water (Canal)	15.0		
Landscape Corridor	27.8		
Major Roads A	115.9		
Major Roads B (Within Ag Buffer)	5.4		
Missing Middel Density Bonus		300	
Total	**2066.2**	**9,356**	**3,106,700**

3.2 Grading Plan

Figure 3.3: Proposed Conditions Conceptual Grading Plan presents the proposed Conceptual Grading Plan for the Plan Area. The site was graded to balance cut and fill areas and to direct flows towards one of four detention basins that are proposed to provide sufficient storage to eliminate adverse impacts in RD 1000 facilities (to meet RD 1000 requirements) and in adjacent properties (to meet the County Floodplain Management Ordinance). The proposed detention basins, or a portion of the basin, would be excavated to an elevation of minus three (-3) feet (NAVD 88) to provide the necessary earth fill material. Preliminary geotechnical investigations and a review of historical groundwater levels indicate groundwater as high as elevation 10 feet. Therefore, the detention basins will be equipped with dedicated groundwater pumps to evacuate groundwater to elevation five (5) feet for the proposed condition hydraulic analysis, and to ensure

sufficient flood mitigation storage during periods of high seasonal groundwater. **Appendix D** presents the Preliminary Grading Exhibit for the Project Site.

The detention basin excavations will not encroach within the limits established for protection of the levee integrity. The limits are described as a no excavation within a 50-foot corridor from the levee toe and below a projected plane of 10 horizontal to 1 vertical beyond the 50-foot levee setback corridor. Upon completion of the site specific subsurface geotechnical investigations and analysis, further setback or other remediation measures may be warranted.

3.3 Offsite Considerations

No offsite drainage improvements are proposed, except as discussed below. It is not anticipated that offsite improvements to meet embankment freeboard, geometry and other criteria for the West Drainage Canal will be necessary. It is presumed that RD 1000 and its contractors will review the developed conditions RD 1000 XPSWMM model with included input hydrographs from the developed Planning Area in order to confirm that no adverse impacts occur at existing RD 1000 facilities.

The Riverside Water Supply Pump Station operated by NCMWC would remain operational during and after development of the proposed project in order to serve adjacent areas. The water supply transmission line (Riverside Canal) has been revised to an underground pipe per the Riverside Canal Phase 2 Relocation Project design plans (Reference 10). The water supply ditch along Radio Road is served by a 30-inch HDPE turnout. Any runoff generated from irrigated lands along the Radio Road ditch would eventually be drained via the on-site storm drain into the North Detention Basin following existing drainage patterns. South of Farm Road, the Riverside Canal continues south along existing RD 1000 and NCMWC easements.

The River View #2 development has been evaluated and Wood Rodgers has determined that the 100-year storm conditions within River View #2 are hydraulically separate from land outside of River View #2, as it is directed to drain under the West Drainage Canal to existing the existing Sump 17 Pond 7B Detention Basin.

El Centro Road West Drainage Canal Crossing

El Centro Road south of Arena Boulevard will require widening to accommodate the ultimate roadway section and a right turn pocket at Arena Boulevard. This will result in replacing or extending the existing

72-inch corrugated metal pipe culverts to account for the roadway widening. The sizing, type, and whether the culverts can be extended will be determined with future design efforts. Hydraulic analysis will be performed such that the hydraulic conditions in the canal are consistent with or better than pre-project conditions. The County will consult with RD1000 on the details of modifying the culvert encroachments on the West Drainage Canal, the condition of existing features, and the potential impacts to adjacent features.

3.4 Onsite Improvements

Onsite improvements are presented in **Figure 3.4: Proposed Conditions Onsite Improvements Map**. Runoff directed to the West Detention Basin will be detained and pumped into a proposed earthen channel flowing east towards the East Detention Basin. Runoff directed to the South Detention Basin will be detained and pumped into the Central Canal. This canal will be used primarily as a water feature but will have available conveyance capacity to direct flows from the South Detention Basin north to a proposed earthen channel along San Juan Road that will discharge into the East Detention Basin. The Central Canal will be drained via a 20-foot wide weir at elevation 12.0 and a low flow outlet (8-inch diameter orifice) at elevation 8.0, which will allow for a permanent pool in the canal below elevation 8.0 to be used as a water feature. The starting water surface elevation of the Central Canal has been set to 10-ft to match the high groundwater level.

Runoff directed to the North Detention Basin and East Detention Basin will be pumped into the West Drainage Canal via a proposed pump station at each basin. It is important to note that the existing development known as Natomas Estates is considered more than 50% built out and is assumed to continue to drain by gravity directly into the West Drainage Canal. There is no mechanism for forcing the existing developed parcels within Natomas Estates to drain into the North Basin and be pumped when they already drain by gravity or forcing the remnant parcels to build a separate drainage system and be responsible for paying for the entire subdivision drainage improvements and pumping in perpetuity. In the future tentative map analysis the North Basin will be modeled as two cells, and the connecting culvert between the cells will be evaluated in greater detail.

The onsite drainage system is designed to include reserved storage in the West Detention Basin that would be utilized once water surface elevations in the adjacent channels reach 9.5 feet in elevation. An equalization conveyance structure (such as an RCB culvert with a weir) at elevation 9.5 from the West Detention Basin to the adjacent outfall channel will allow flows to enter the West Drainage Basin instead of the East Detention Basin during times of extreme high flows.

Ag-Buffer Drainage

Several drainage canals are proposed to be built on the boundary of the proposed development and in areas within the Plan Area that will not be graded or developed (e.g., remaining agricultural areas). These proposed drainage canals would drain existing irrigation canals located within the remaining agricultural areas during winter months when no irrigation water supply is present in the system. The system configuration would allow for continued agricultural production after development of the Plan Area is completed by maintaining proper drainage. The channel improvements constructed with the Riverside Canal Phase 2 Relocation Project design plans (Reference 10) would be maintained. Where required to facilitate ag-buffer runoff, channel and storm drain improvements would be constructed primarily within existing easements dedicated to RD 1000 and to the Natomas Central Mutual Water Company but not in conflict with their facilities. Drainage improvements that are subject to County jurisdiction will require quitclaim by RD1000. These proposed channels will be sized to convey the 100-year design storm event with one foot of freeboard per Sacramento County standards. They will also be designed to provide enough capacity to reduce increases in peak water surface elevations to no more than 0.1 foot for the remaining agricultural areas (as per the Sacramento County Floodplain Management Ordinance).

Figure 3.1: Ag-Buffer Urban Interface below depicts the typical condition of a cut-off channel to intercept the Ag Buffer runoff and collect that runoff intermittently at Type F Drop Inlets. The drainage is then conveyed via drainage pipes to the North, West and South detention basins. This drainage report assesses all Ag Buffer runoff being conveyed within the Ag Buffer corridor consistent with the first cross section, draining directly into detention basins. A potential alternative section has also been presented depicting conveyance of the Ag Buffer runoff through the local street drainage system at intermittent locations. As an option, the alternative section can be studied during tentative map submittal reviews once streets and

lots have been located. Drainage facilities along the ag-buffer constructed to convey runoff per County Standards will be operated and maintained by the County.

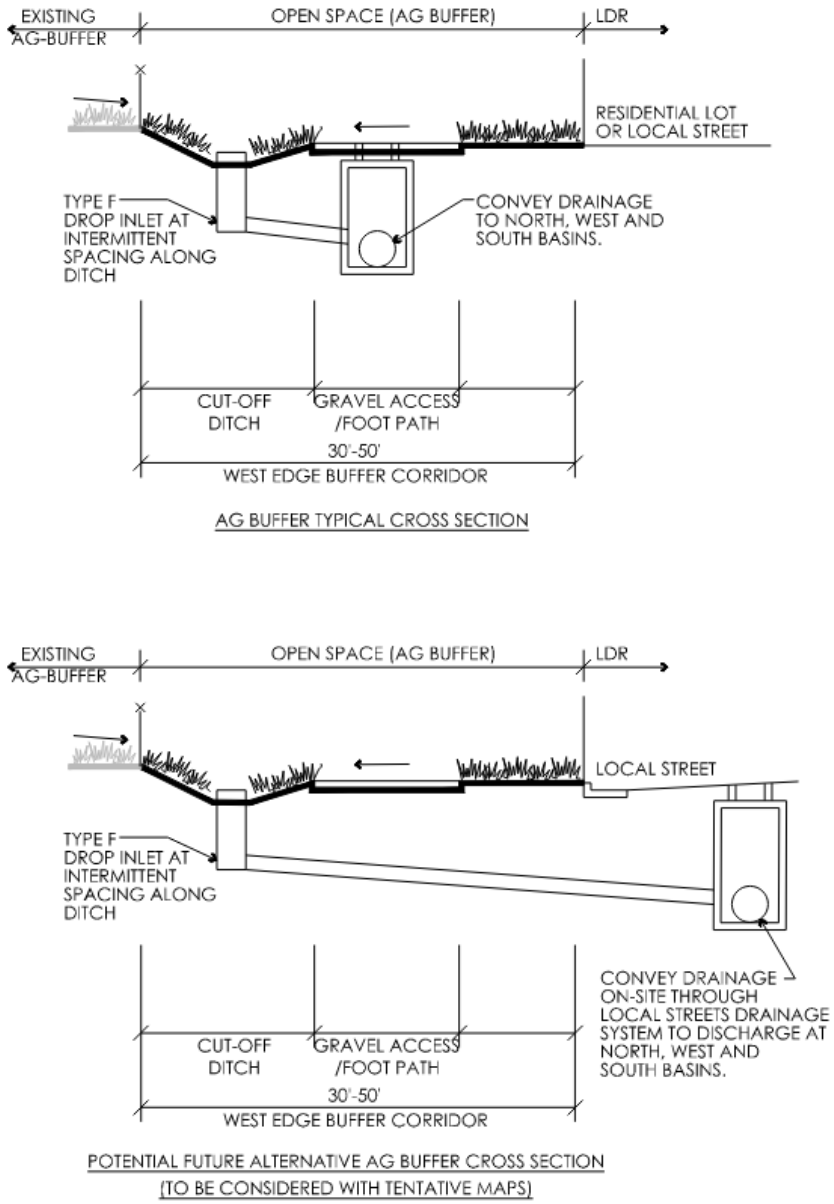


Figure 3.1: Ag-Buffer Urban Interface

Onsite Channels

All proposed channels will be designed to have the required freeboard relative to graded conditions immediately proximate to the channel banks (landscape corridors and/or access roads directly adjacent to channels). All proposed channels are anticipated to be operated and maintained by the County, except for the Central Canal feature. Final ownership and operation / maintenance responsibilities are expected to be determined in the future under Specific Plan implementation or Tentative Map efforts.

Natomas Mutual Company Irrigation Water

Phasing within the development will have to account for the continued operation of the Riverside Canal as well as all canals that are left to serve the remaining agricultural areas. While existing agricultural channels may be repurposed to convey drainage flow in the future, it is not the intent of this plan area to convey irrigation water supply flows through underground (newly constructed) storm drainage systems that fall under the operation and maintenance responsibility of SCDWR. All storm drainage facilities operated by SCDWR will be dedicated to drainage. Separate water supply facilities will be constructed as needed for phasing. Phasing is to be determined during the Tentative Map and improvement plan efforts, as discussed in Section 4.7 below. Additionally, sufficient analyses showing adherence to the Sacramento County Floodplain Management Ordinance will be provided during the Tentative Map process and with grading plans.

3.5 Hydrologic & Hydraulic Modeling Assumptions

The proposed condition XPSWMM model is intended to:

1. Determine the total runoff to the west drainage canal for the 100-year 10-day storm event;
2. Show that the proposed condition is in compliance with the Sacramento County Floodplain Management Ordinance;
3. Show that the proposed detention basins meet freeboard requirements per SCDWR Pump Station and Detention Basin Design Criteria; and

4. Show the peak floodplain water surface elevations in the 200-year design storm within the West Drainage Canal.

The proposed condition XPSWMM model is also intended to evaluate proposed trunk storm drains per the Nolte Method and street ponding, and to show compliance with 50% pump operating criteria as required by the SCDWR Pump Station and Detention Basin Design Criteria.

The proposed condition XPSWMM model has been developed to determine proposed condition flows into the West Drainage Canal using the 100-year 10-day design storm consistent with what was used in the RD 1000 XPSWMM model to evaluate the impacts of the proposed project on the existing RD 1000 drainage system. It is assumed that RD 1000 will review the XPSWMM models and input hydrographs and the Wood Rodgers updated RD 1000 XPSWMM model to confirm that the proposed project would have no adverse impacts to the RD 1000 drainage facilities in the 100-year 10-day storm.

The proposed condition XPSWMM model will also serve as a basis of establishing compliance with the County Floodplain Management Ordinance which states that the proposed project shall result in no adverse impacts. This is defined as:

> *…causing increased flood stages, increased flood velocity, or increased flows in or near a special or local flood hazard area, to an extent including to but not limited to an increase in base flood elevation equal or greater than 0.1 foot on upstream, downstream, or adjacent properties*.

The West Drainage Canal was not included in the model domain because RD 1000 will continue to utilize the RD 1000 XPSWMM system model to evaluate the impacts of the proposed project on the existing RD 1000 drainage system. The pump stations were modeled using single-flow pumps instead of pump curves. Subsequent studies advancing the design of the pump stations will require pump curves that are specific to each selected motor/pump configuration.

Most of the culverts shown on **Figure 2.6: West Drainage Canal Existing Storm Drain Connections** are in areas that are not participating in this development and will not be modified by this project and will continue to drain into the West Drainage Canal. Culverts C-6, C-5, C-15, F-17A, and F-17 will be removed as this project develops in those locations.

The water supply transmission line (Riverside Canal) has been revised to an underground pipe. The existing conditions HEC-RAS 2D models include the new geometry for the Riverside Canal and associated culverts, as well as ditches per the Riverside Canal Phase 2 Relocation Project design plans (Reference 10).

3.6 Description of XPSWMM Model

An on-site 1D hydrologic and hydraulic XPSWMM model was developed to model estimated pipes using the Nolte method and to show compliance with the SCDWR Pump Station and Detention Basin Design Criteria for 50% of pumps not operating scenario as shown in **Figure 1.1: Maximum WSE Exhibit, Street Section**.

The proposed conditions XPSWMM model utilizes 1D hydrology to represent areas that are modified and unmodified by the project. Project areas that are proposed to be graded are represented by 1D model elements, with watersheds delineated based on proposed grading. Infiltration losses are standardized to 0.014 inch/hour across the project, and a backbone trunk storm drainage system including proposed pipes and drainage channels are designed to meet SCDWR criteria. Detention basins and pump stations were designed to meet the criteria presented in **Table 1.1: Pump Station Design Criteria**. The backbone storm drain system was evaluated using the Nolte method and a starting WSE in the downstream detention basin set to the maximum 10-year WSE from subsequent model runs.

The remaining agricultural areas within the Plan Area that are located adjacent to proposed graded areas are represented by 1D hydrology, with infiltration losses standardized to 0.014 inch/hour.

3.7 Watershed Delineation

Figure 3.5: Proposed Conditions Watershed Map presents the proposed condition watershed map. Watersheds were delineated based on the general drainage patterns developed with the conceptual grading plan to facilitate development of the backbone storm drain system. The average watershed size is approximately 25 acres. Runoff from the watersheds was directed to each adjacent trunk drainage system or drainage channel represented as 1D links in the proposed condition XPSWMM model.

Model Layout

Figure 3.6: Proposed Conditions XPSWMM Model presents the proposed conditions XPSWMM model layout. Runoff hydrograph calculations were performed for the watersheds shown on **Figure 3.5** with infiltration losses standardized to 0.014 inch/hour across the project, and injected to the hydraulic network shown on **Figure 3.6**.

The trunk drainage system within the Plan Area is represented using the multi-link option within XPSWMM. With the multi-link option, multiple parallel conveyances, such as a pipe and the street above it, can be represented with a single model link. Street sections are based on the preliminary street sections provided from the Upper Westside Specific Plan Administrative Draft dated July 20, 2023.

Software Application and Version

XPSWMM version 17.1 with the Sacramento method module were used for the proposed conditions hydrologic and hydraulic analysis. The historical storm option was utilized to account for climate change precipitation factors.

Limits of Study

The limits of study are the Plan Area and adjacent areas west and south of the West Drainage Canal, the adjacent tributary roadway areas along I-80, the River Oaks development located south of I-80, and the River View #2 development.

Climate Change Precipitation Factors

Precipitation factors were provided by the County for the proposed condition analysis in order to account for potential increases in precipitation due to climate change. Climate change precipitation factors are currently under development by the County and have not been finalized. **Table 3.2: Climate Change Scaling Factors used in Proposed Conditions Model** presents climate change factors used for proposed conditions models for UWS. For design storms with a duration of 24 hours, the scaling factors were applied to each individual value within the hyetograph ranging from the 5-minute precipitation value to the 24-hour precipitation value. For design storms with a duration longer than 24 hours, the scaling factors were applied

to the total design storm precipitation values. These factors were used in the preliminary design of the proposed drainage facilities.

These interim climate change factors are provided by the County. It is understood that, once approved and adopted, all future studies within the Plan Area will be subject to the County's final version of the climate change analysis and methodology.

Table 3.2: Climate Change Scaling Factors used in Proposed Conditions Model
Source: Sacramento County, Department of Water Resources

Duration	Recurrence Interval (year)				
	10	50	100	200	500
5-min	1.30	1.36	1.47	1.59	1.72
10-min	1.30	1.36	1.47	1.59	1.72
15-min	1.30	1.36	1.47	1.59	1.72
30-min	1.30	1.36	1.47	1.59	1.72
1-hour	1.30	1.36	1.47	1.59	1.72
3-hour	1.22	1.34	1.44	1.55	1.69
6-hour	1.20	1.38	1.43	1.56	1.68
12-hour	1.20	1.30	1.36	1.39	1.42
24-hour	1.16	1.25	1.30	1.31	1.33
36-hour	1.15	1.17	1.17	1.21	1.23
5-day	1.15	1.17	1.17	1.16	1.16
10-day	1.08	1.07	1.09	1.09	1.10

Soils

Figure 2.10: Hydrologic Soils Groups Map presents soils with HSG values as determined by the USDA NRCS SSURGO Database. Soils in the project area are composed primarily of HSG C and D soils, with some HSG A soils in the undeveloped area along the Sacramento River Levee. The HSG values are provided as background but were not a factor in the analysis due to the alternative basis for the infiltration rate that was used.

Land Use

Table 3.3: Proposed Conditions Land Use below presents the various land uses within the Plan Area for proposed conditions along with the corresponding Sacramento County land use (SacCalc) code. Corresponding published impervious area percentages are listed. Infiltration rates were standardized to

0.014 inch/hour across the project consistent with the RD 1000 Natomas Basin-wide modeling as presented in Reference 9 and **Appendix B**.

Table 3.3: Proposed Conditions Land Use
Source: Sacramento City/County Drainage Manual Volume 2: Hydrology Standards

Land Use Designation	Sacramento County SacCalc Code	Description	Zoning	Density (units/acre)	Impervious Percentage
AG	R16	General Agriculture	IR	N/A	2
AG/RES	R14	Agricultural Reserve	AR-1, AR-2	0.2-0.5	10
CC	R02	Commercial & Office	LC	-	90
CHNL	R17	Flood Control Channel	F	-	2[2]
CMU	R02	Mixed-Use	CMC	-	90
E/HC	R02	Highway Commercial	GC	-	90
HDR	R04	High Density Residential	RD-25	25	80
LC	R17	Landscape Corridor	N/A	N/A	5
LDR	R09	Low Density Residential	RD-5	4-6	40
LMDR	R08	Low-Medium Density Residential	RD-7	6-8	50
MDR	R06	Medium Density Residential	RD-10	10	70
P	R17	Park	O	-	5
RDWY	R01	Roadway	N/A	-	95
SCHOOL	R08	Public/Quasi-Public	P/QP	-	50
UF	R16	Agricultural Urban Reserve	UR	-	5
VHDR	R04	Very High Density Residential	RD-40	40	80
VLDR	R12	Very Low Density Residential	RD-2	1-2	20
W	R01	Detention Basin	O	-	5[3]
WTLND	R17	Open Space/Natural Reserve	O	-	2

Lag Transformation Method

Lag transformation was calculated using the Basin "n" method as described in the *"Sacramento City/County Drainage Manual Volume 2: Hydrology Standards"*, Chapter 7 – Basin Lag. The formula for lag transformation is:

$$L_g = Cn\langle LL_c|S^{0.5}\rangle^{0.33}$$

Where:
L_g = Lag time, minutes
$C =$ 1,560

[2] The Central Canal impervious percentage is 95%.

[3] At the request of SCDWR the impervious percentage for detention basins is to be 95%.

$n =$ Basin "n"
$L =$ Length of longest watercourse, miles
$L_c =$ Length along the watercourse to a point close to the centroid of basin, miles
$S =$ Slope of longest watercourse, feet/mile

Table 3.4: Lag Parameters, Proposed Condition presents the Basin "n" values for proposed land uses within the Plan Area. The "Developed Pipe/Channel" channelization description values were chosen for the proposed buildout condition. Composite Basin "n" calculations were performed for each watershed by the Sacramento module for the XPSWMM program.

Table 3.4: Lag Parameters, Proposed Condition
Source: Table 7-1 of City/County of Sacramento Drainage Manual, Volume 2

Land Use Designation	Basin "n"
AG	0.07
AG/RES	0.06
CC	0.031
CMU	0.031
E/HC	0.031
HDR	0.033
LC	0.075
LDR	0.042
LMDR	0.04
MDR	0.035
P	0.075
RDWY	0.03
SCHOOL	0.04
UF	0.07
VHDR	0.033
VLDR	0.053
W	0.03
WTLND	0.075

Routing

Routing was accomplished hydraulically using the proposed drainage system and proposed detention basins in the XPSWMM model. Runoff will drain by gravity through a combination of storm drain pipes, streets, and open channels into four detention basins. **Figure 3.5: Proposed Conditions Watershed Map** identifies the areas tributary to each of the four basins: East, West, North and South.

Water Quality Volume

For each detention basin, a preliminary water quality volume (WQV) based on pre-LID requirements was calculated at the request of SCDWR. **Table 3.5: Preliminary (Pre-LID) Water Quality Volume Calculations** presents the results of hypothetical WQV calculations based on the tributary area to each detention basin and the weighted impervious area for each tributary area. The contributions of I-80 were accounted for in both the southern and eastern detention basins. The detentions basins will be designed consistent with Table DB-1 of the SQDM.

Table 3.5: Preliminary (Pre-LID) Water Quality Volume Calculations

Basin Location	Basin Shed Area (acre)	Impervious Area (acre)	Impervious Percentage	P_0	Pre-LID WQV (ac-ft)	1.25 Pre-LID WQV (ac-ft)
North	431.4	151.8	35.2	0.27	10	12
South	517.9	225.8	43.6	0.33	14	18
West	524.7	176.9	33.7	0.25	11	14
East	508.1	323.3	63.6	0.46	20	24
Combined to East Basin	1550.8	726.0	46.8	0.35	45	57

Detention Basin Storage & Pumping

Stage storage definitions for proposed detention basins are provided below in **Table 3.6: Proposed Detention Basin Stage Storage**. The detention basin pumps are configured to allow for the flexibility of use as water quality detention basins as well as regional detention basins. The determination of the number of pumps and the sizes of pumps as well as the detention basin sizes was accomplished iteratively by checking for impacts in the RD 1000 system and within the plan area under various storm scenarios.

Table 3.6: Proposed Detention Basin Stage Storage

	North Basin		West Basin		South Basin		East Basin	
Maximum Allowable WSE[4]:	**14.6 ft**		**13.3 ft**		**13.0 ft**		**13.3 ft**	
Elevation	**Area (acres)**	**Volume[5] (ac-ft)**	**Area (acres)**	**Volume[5] (ac-ft)**	**Area (acres)**	**Volume[5] (ac-ft)**	**Area (acres)**	**Volume[5] (ac-ft)**
-3	0	0	0	0	0	0	0	0
5	21.2	0	28.3	0	21.4	0	28.2	0
6	21.9	21.5	28.8	28.6	21.8	21.6	28.6	28.4
7	22.7	43.8	29.3	57.6	22.2	43.6	29.1	57.3
8	23.5	66.9	29.8	87.1	22.7	66.1	29.6	86.6
9	24.2	90.8	30.3	117.2	23.1	89	30.1	116.5
10	25.0	115.4	30.7	147.6	23.5	112.3	30.6	146.8
11	25.8	140.8	31.2	178.6	23.9	136	31.1	177.7
12	26.6	167.0	31.7	210.0	24.4	160.1	31.6	209
13	27.4	194.1	32.2	242.0	24.8	184.7	32	240.8
14	28.4	222.0	-	-	-	-	-	-

Basin pump station capacities for the proposed pumps are presented below in **Table 3.7: Proposed Pump Stations.** To control groundwater and nuisance flows, a low-flow pump will be required. For the purposes of this study, the low-flow and redundant pump is not considered in hydraulic calculations. Subsequent studies will determine the rate of infiltration and size of low-flow pumps at each basin location.

The first three pump's on/off elevations are determined based on *"City of Sacramento Design and Procedure Manual"*, Section 12, Storm Drainage Design Standards. Calculations specific to Section 12.6.1.4. "Pump Calculations in Natomas" were not included in this analysis and will be performed to these standards in a future analysis.

The Pump 1 "on elevation" for each detention basin was assumed to account for the volume of water quality storage and estimated at 6-inches above the water quality permanent pool. The Pump 2 "on elevation" is set at one foot above the assumed water quality storage volume. The Pump 3 "on elevation" is set at the

[4] The maximum allowable water surface elevation is estimated using the 100-year storm event, reflecting climate change influences, while not exceeding one-foot of flooding at the gutter flow line anywhere in the system.

[5] Storage not considered for wet portion of detention basin. Starting water surface elevation assumed at elevation 5 feet.

maximum WSE for the 10-year storm event, requiring a separately modeled 10-year scenario with only two pumps running to determine the peak value without the third pump. Subsequent pumps are added as needed to balance storage and freeboard requirements to meet SCDWR Pump Station and Detention Basin Design Criteria including under climate change scenarios.

The simulation of the 100-year 24-hour storm with climate change was extended to capture the drawdown time back to the permanent pool elevation for the on-site detention basins. The resilience of the on-site detention systems was also analyzed using Sacramento County standardized 100-year 10-day and 100-year 5-day storms while not exceeding the maximum allowable water quality elevation. The longest drain time (from peak to permanent pool elevations) occurs in the East Detention Basin, taking several days to drain the storage volume to starting conditions. The analysis of the hydraulic behavior of the basins during long duration storm simulations is considered sufficient to establish the reliability of the proposed basins under multiple cloudburst conditions (successive storm events) using determined peak pumping rates.

Table 3.7: Proposed Pump Stations

Location	North	South	West	East
No. of Pumps[6]	**3**	**3**	**4**	**5**
Capacity (cfs)	10 – 10 – 10	15 – 15 – 15	30 – 30 – 30 – 30	20 – 20 – 20 – 20 – 20
Elevation On	5.5 – 6.0 – 9.5	5.5 – 7.0 – 9.4	5.5 – 6.0 – 10.7 – 11.0	5.5 – 6.0 – 10.7 – 12.1 – 12.1
Elevation Off	5.0 – 5.0 – 8.5	5.0 – 5.0 – 9.0	5.0 – 5.5 – 6.0 – 8.0	5.0 – 5.0 – 5.0 – 5.0 – 5.0
Excavated Bottom Elevation[7]	-3.0 feet	-3.0 feet	-3.0 feet	-3.0 feet
Water Quality Volume (acre-feet)	9.6	14.9	11.1	48.5[8]
Top of Basin Elevation[7]	14.0 feet	13.0 feet	13.0 feet	13.0 feet
Assumed Starting WSE[7]	5.0 feet	5.0 feet	5.0 feet	5.0 feet

[6] Redundant pumps and low-flow pump to be provided at each detention basin. These are not included in the hydraulic modeling or the above table.

[7] NAVD 88 vertical datum.

[8] East basin WQV alone is 21 acre-feet. Value shown is a cumulative value of the South, West, and East basins combined.

Boundary Conditions

The Proposed Conditions XPSWMM analysis assumes that areas that are not changing their development levels and that are draining by gravity to the West Drainage Canal will continue to drain. Some of these culverts will operate with reduced drainage areas due to implementation of development within Upper Westside. It is the intent of this preliminary layout and analysis to route undeveloped areas directly to the RD1000 system under gravity flow conditions, without creating increases, to limit treatment and pumping. Significant areas along the western (ag buffer) boundary must be collected and routed through the plan area facilities to prevent offsite impacts.

Each RD1000 XPSWMM model node adjacent to the project is further described below.

Model Node 11011

The gravity outfalls into the West Drainage Canal west of El Centro Road are represented as two remnant watersheds being combined and injected into the RD 1000 model at node 11011 using peak stage as backwater. These watersheds are discussed below:

- Watershed OFFN02: Models simple upstream attenuation using storage node capacity before the flows are routed through the existing drainage channels that drain to C-10.
- Watershed OFFN03: Watershed is applied directly into the existing culvert C-9.

Model Node 11010

- Watershed NORT09C: Watershed is applied directly to existing culvert S-18 and injected at the RD1000 model node 11010.

Model Node 170

The following water sheds outflows are combined and injected into the RD1000 Model at node 170.

- Watershed NORT09A: Watershed flows to existing culvert S-16
- Watershed NORT09B: Watershed flows to existing culvert S-17.

Model Node 11577

For the proposed condition, the constructed wetland areas to the northwest of the plan area remain unchanged from baseline conditions. They continue to be defined by the baseline conditions HEC-RAS model as separate drainage. The watershed is injected to the RD1000 system near Pump Station 3 at the model node labeled 11577.

River View #2 Subdivision

Also, for the proposed conditions, no runoff from the Upper Westside project is connected / interacting with the River View #2 project area. All hydrologic inputs from the River View #2 area are assumed to be accounted for in the Sump 17A watershed within the RD1000 XPSWMM model. The hydraulic boundary conditions for baseline conditions was set at 7.1 feet elevation as cited above for River View #2 draining to Sump 17A.

Boundary Routing Contributions

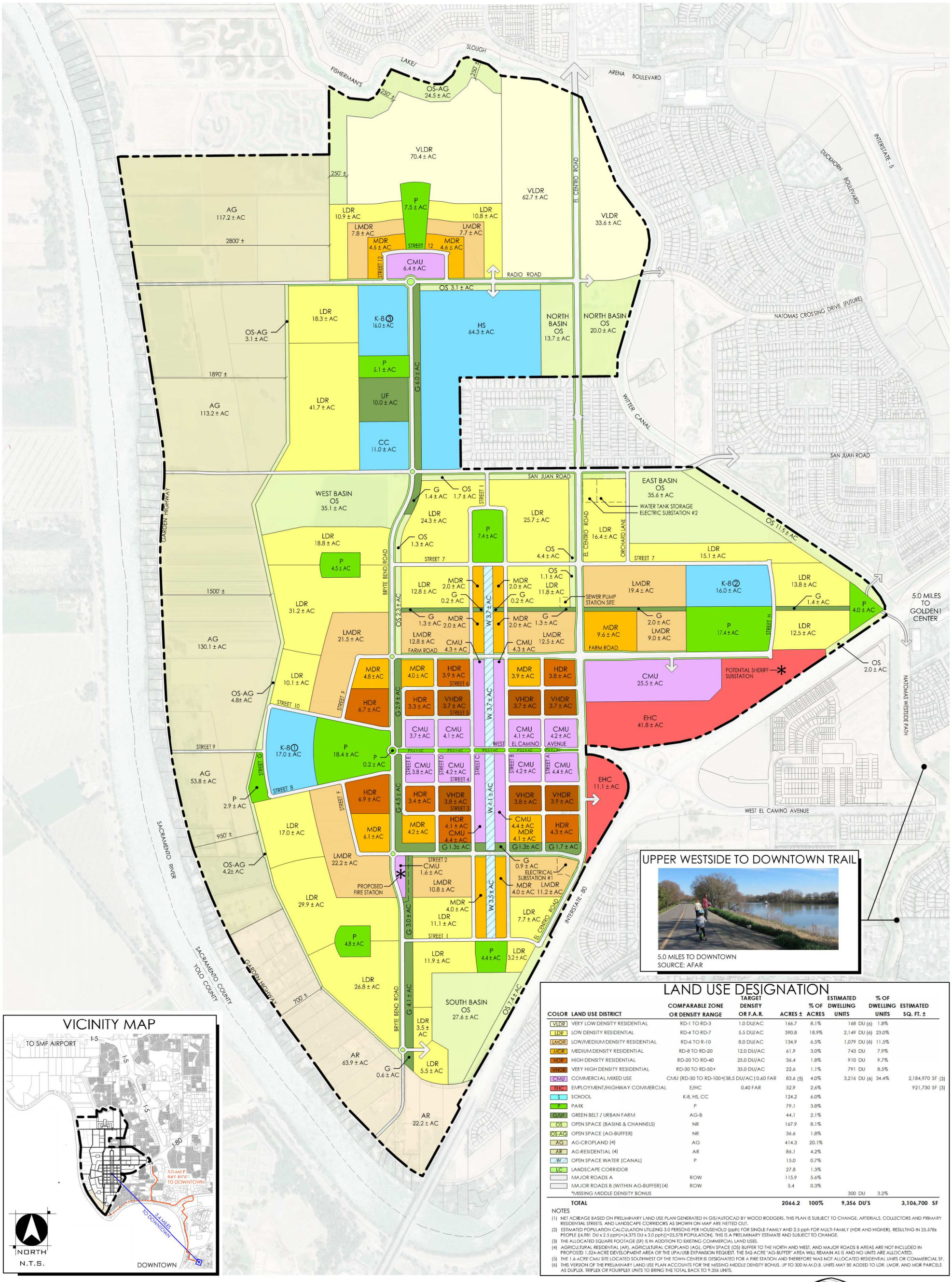
The modeled outfalls from the proposed conditions XPSWMM model to the West Drainage Canal are configured to align with the existing gravity culverts C-9 C-10, S-18, S-17, and S-16 (shown on **Figure 2.6**), with the East and North Pump Stations being pumped outfalls. The existing gravity culvert labeling is consistent with the North Natomas Levee Project documentation, provided by Mead & Hunt. The flow results were combined to the nearest RD1000 model nodes as the model does not separately define every small culvert entering the system. Boundary conditions within the West Drainage Canal will not have any effect on the proposed condition hydraulic analysis for the pumped basins.

PRELIMINARY LAND USE PLAN - MISSING MIDDLE DENSITY BONUS

UPPER WESTSIDE

COUNTY OF SACRAMENTO, CALIFORNIA

MAY 2024



VICINITY MAP

LAND USE DESIGNATION

COLOR	LAND USE DISTRICT	COMPARABLE ZONE OR DENSITY RANGE	TARGET DENSITY OR F.A.R.	ACRES ±	% OF ACRES	ESTIMATED DWELLING UNITS	% OF DWELLING UNITS	ESTIMATED SQ. FT. ±
VLDR	VERY LOW DENSITY RESIDENTIAL	RD-1 TO RD-3	1.0 DU/AC	166.7	8.1%	168 DU (6)	1.8%	
LDR	LOW DENSITY RESIDENTIAL	RD-4 TO RD-7	5.5 DU/AC	390.8	18.9%	2,149 DU (6)	23.0%	
LMDR	LOW/MEDIUM DENSITY RESIDENTIAL	RD-6 TO R-10	8.0 DU/AC	134.9	6.5%	1,079 DU (6)	11.5%	
MDR	MEDIUM DENSITY RESIDENTIAL	RD-8 TO RD-20	12.0 DU/AC	61.9	3.0%	743 DU	7.9%	
HDR	HIGH DENSITY RESIDENTIAL	RD-20 TO RD-40	25.0 DU/AC	36.4	1.8%	910 DU	9.7%	
VHDR	VERY HIGH DENSITY RESIDENTIAL	RD-30 TO RD-50+	35.0 DU/AC	22.6	1.1%	791 DU	8.5%	
CMU	COMMERCIAL MIXED USE	CMU (RD-30 TO RD-100+)	38.5 DU/AC | 0.60 FAR	83.6 (5)	4.0%	3,216 DU (6)	34.4%	2,184,970 SF (3)
EHC	EMPLOYMENT/HIGHWAY COMMERCIAL	E/HC	0.40 FAR	52.9	2.6%			921,730 SF (3)
S	SCHOOL	K-8, HS, CC		124.2	6.0%			
P	PARK	P		79.1	3.8%			
G/UF	GREEN BELT / URBAN FARM	AG-B		44.1	2.1%			
OS	OPEN SPACE (BASINS & CHANNELS)	NR		167.9	8.1%			
OS-AG	OPEN SPACE (AG-BUFFER)	NR		36.6	1.8%			
AG	AG-CROPLAND (4)	AG		414.3	20.1%			
AR	AG-RESIDENTIAL (4)	AR		86.1	4.2%			
W	OPEN SPACE WATER (CANAL)	P		15.0	0.7%			
LC	LANDSCAPE CORRIDOR			27.8	1.3%			
	MAJOR ROADS A	ROW		115.9	5.6%			
	MAJOR ROADS B (WITHIN AG-BUFFER) (4)	ROW		5.4	0.3%			
	*MISSING MIDDLE DENSITY BONUS					300 DU	3.2%	
	TOTAL			2066.2	100%	9,356 DU'S		3,106,700 SF

NOTES

(1) NET ACREAGE BASED ON PRELIMINARY LAND USE PLAN GENERATED IN GIS/AUTOCAD BY WOOD RODGERS. THIS PLAN IS SUBJECT TO CHANGE. ARTERIALS, COLLECTORS AND PRIMARY RESIDENTIAL STREETS, AND LANDSCAPE CORRIDORS AS SHOWN ON MAP ARE NETTED OUT.

(2) ESTIMATED POPULATION CALCULATION UTILIZING 3.0 PERSONS PER HOUSEHOLD (pph) FOR SINGLE-FAMILY AND 2.5 pph FOR MULTI-FAMILY (HDR AND HIGHER). RESULTING IN 25,578± PEOPLE [(4,981 DU x 2.5 pph)+(4,375 DU x 3.0 pph)]=25,578 POPULATION]. THIS IS A PRELIMINARY ESTIMATE AND SUBJECT TO CHANGE.

(3) THE ALLOCATED SQUARE FOOTAGE (SF) IS IN ADDITION TO EXISTING COMMERCIAL LAND USES.

(4) AGRICULTURAL RESIDENTIAL (AR), AGRICULTURAL CROPLAND (AG), OPEN SPACE (OS) BUFFER TO THE NORTH AND WEST, AND MAJOR ROADS B AREAS ARE NOT INCLUDED IN PROPOSED 1,524-ACRE DEVELOPMENT AREA OR THE UPA/USB EXPANSION REQUEST. THE 542-ACRE "AG-BUFFER" AREA WILL REMAIN AS IS AND NO UNITS ARE ALLOCATED.

(5) THE 1.6-ACRE CMU SITE LOCATED SOUTHWEST OF THE TOWN CENTER IS DESIGNATED FOR A FIRE STATION AND THEREFORE WAS NOT ALLOCATED RESIDENTIAL UNITS OR COMMERCIAL SF.

(6) THIS VERSION OF THE PRELIMINARY LAND USE PLAN ACCOUNTS FOR THE MISSING MIDDLE DENSITY BONUS. UP TO 300 M.M.D.B. UNITS MAY BE ADDED TO LDR, LMDR, AND MDR PARCELS AS DUPLEX, TRIPLEX OR FOURPLEX UNITS TO BRING THE TOTAL BACK TO 9,356 UNITS.

NORTH

0 600 1200 2400

FIGURE 3.2

PRELIMINARY LAND USE PLAN - UPPER WESTSIDE INFILL

WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME
3301 C St, Bldg. 100-B
Sacramento, CA 95816
Tel 916.341.7760
Fax 916.341.7767

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\Planning\Exhibits\ACAD-EXH_LWI_LAND-USE_2019.dwg 9/15/2023 2:22 PM Nicholas Wik

North Shed
431.4 acres

West Shed
524.7 acres

East Shed
488.8 acres

South Shed
459.5 acres

PS

Proposed Pump Station

Detention Basin

UWS Plan

Finished Grade

Value

High : 96.8465

Low : -3

PROPOSED CONDITIONS CONCEPTUAL GRADING PLAN

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

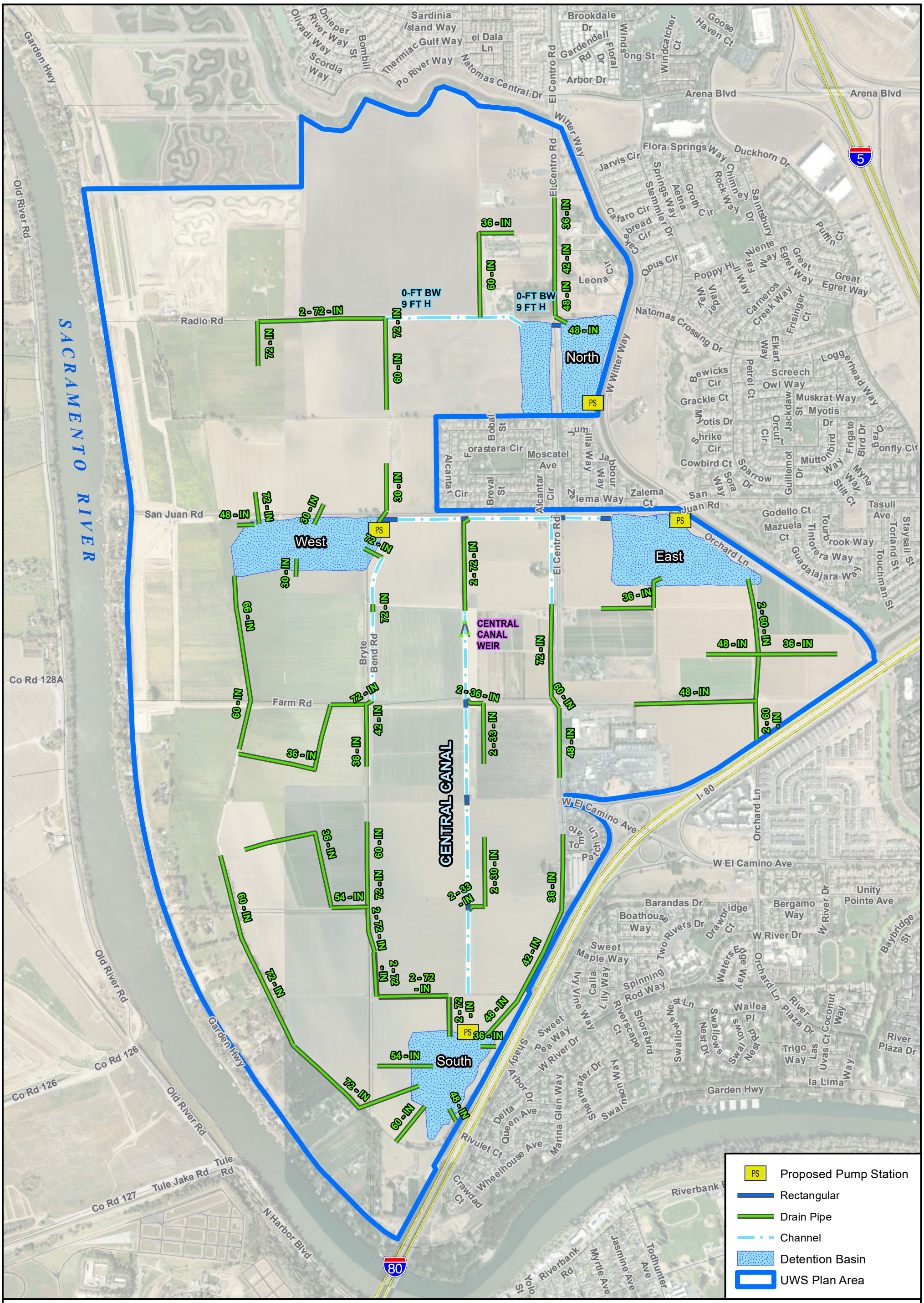
0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20240202\FIG3.3_Proposed_Grading.mxd 2/16/2024 8:11:15 AM jcarey

FIGURE 3.3



PROPOSED CONDITIONS ON-SITE IMPROVEMENTS MAP

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

NOTE: All proposed channels are assumed to have a 3:1 side slope on both sides.

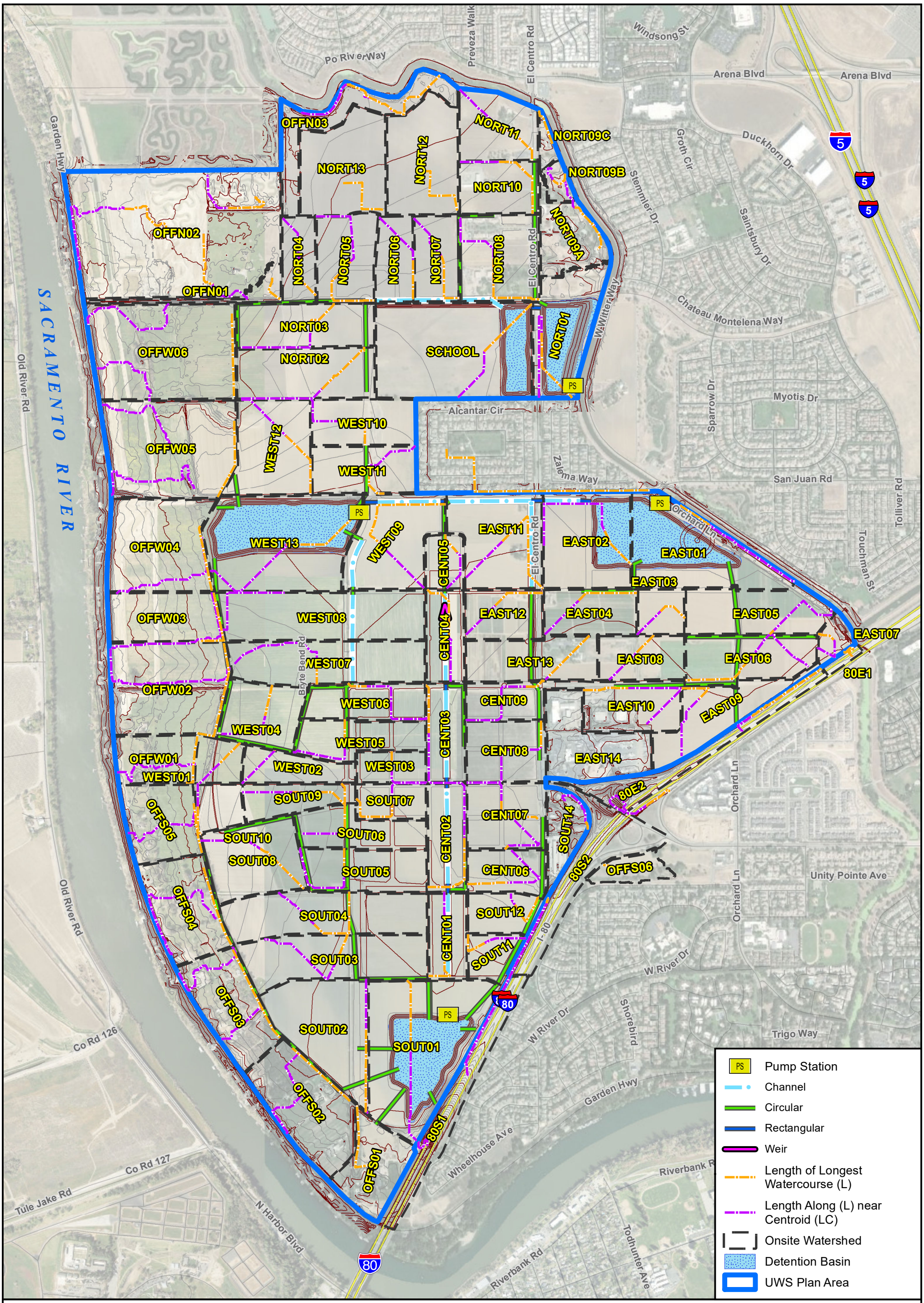
0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20240202\FIG3.4_Proposed_Onsite_Imprvt.mxd 2/20/2024 9:25:32 AM jcarey

FIGURE 3.4



PROPOSED CONDITIONS WATERSHED MAP

XPSWMM MODEL ONLY
UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

NOTE: XPSWMM Model utilized for Nolte method and for 50% pumps operating scenarios only

0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20240202\FIG3.5_Proposed_WatershedMap.mxd 2/16/2024 11:12:40 AM jcarey

FIGURE 3.5

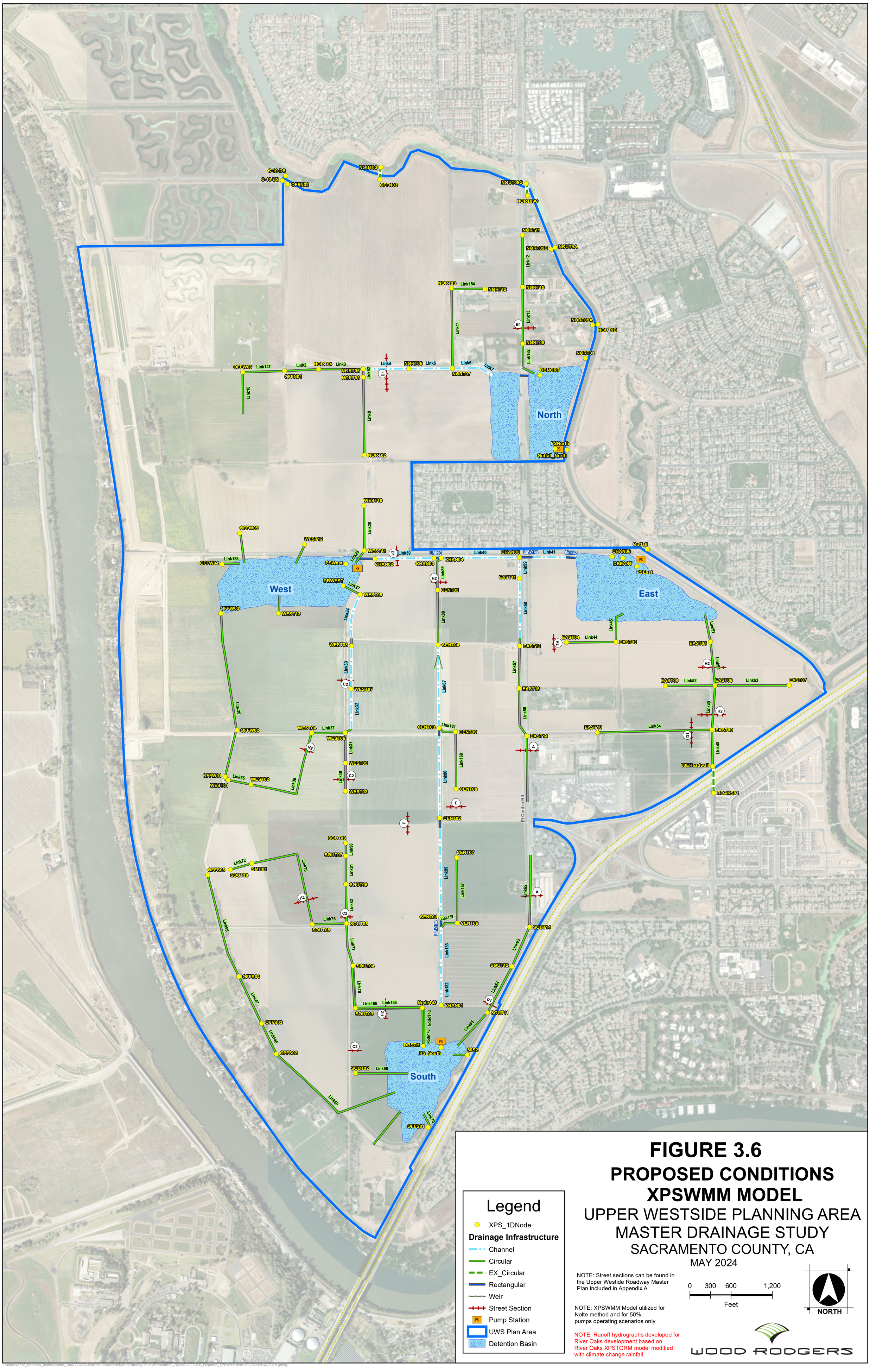


FIGURE 3.6

PROPOSED CONDITIONS XPSWMM MODEL

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

Legend

- XPS_1DNode

Drainage Infrastructure

- Channel
- Circular
- EX_Circular
- Rectangular
- Weir
- Street Section
- Pump Station
- UWS Plan Area
- Detention Basin

NOTE: Street sections can be found in the Upper Westside Roadway Master Plan included in Appendix A

NOTE: XPSWMM Model utilized for Nolte method and for 50% pumps operating scenarios only

NOTE: Runoff hydrographs developed for River Oaks development based on River Oaks XPSTORM model modified with climate change rainfall

0 300 600 1,200
Feet

NORTH

WOOD RODGERS

4.0 Proposed Project Discharges and Stages

Model results for all storm events in the proposed conditions XPSWMM model are presented in **Appendix B**. Detailed conduit profiles from proposed condition XPSWMM model runs are provided in **Appendix E**.

4.1 Onsite Watershed Summary

Floodplain Extents

The onsite floodplain extents were not mapped given the proposed conditions flooding was modeled using XPSWMM 1D modeling of pipes and streets. Tabular output data is provided in **Appendix E**. No adverse impacts to offsite properties are allowed for peak 100-year water surfaces outside of the plan area.

Storm Drain Trunk Line Results

Figure 4.1: 100-year 24-hour Design Storm Freeboard and **Figure 4.2: 100-year 10-day Design Storm Freeboard** show the freeboard values form the proposed condition XPSWMM model for the 100-year 24-hour and 10-day storm events, respectively. The exhibits show that the water surface elevation is no greater than 1-foot above the gutter flow line elevations. The project is located within the Sacramento Method (Sacramento City and County Rainfall) Hydrology Zone 2.

Figure 4.3: Nolte Design Storm Freeboard presents freeboard values from the proposed condition XPSWMM model for the Nolte Design storm. A minimum of 6-inches of freeboard measured from the gutter flow line is provided for each run of pipe in this scenario. The project area is located with the Nolte Hydrologic Zone 3.

Detention Basin & Pump Station Summary

Table 4.1: WSE for Storm Events in Proposed Condition XPSWMM Model presents water surface elevations for various storm events in the proposed condition at the detention basins. The results in **Table 4.1** include the use of climate precipitation factors as described in **Section 3.7** and **Table 3.2: Climate Change Scaling Factors used in Proposed Conditions Model**. A minimum freeboard of 1.0 foot to the lowest adjacent gutter flow line was met in all the model scenarios up to the 100-year storm event.

Table 4.1: WSE for Storm Events in Proposed Condition XPSWMM Model

	East Basin		North Basin		South Basin		West Basin	
Lowest Adjacent Gutter Flow Line Elevation (feet)	**13.8ft**		**14.6 ft**		**13.0 ft**		**13.8 ft**	
Storm Event	**Peak WSE (feet)**	**Freeboard (feet)**	**Peak WSE (Feet)**	**Freeboard (feet)**	**Peak WSE (feet)**	**Freeboard (feet)**	**Peak WSE (feet)**	**Freeboard (feet)**
100-yr 24-hr	11.4	2.4	11.2	3.5	12.0	1.0	11.4	2.4
100-yr 5-day	12.5	1.3	10.9	3.7	11.5	1.5	12.5	1.3
100-yr 10-day	12.2	1.6	10.5	4.1	10.7	2.3	12.2	1.6
200-yr 24-hr	12.1	1.6	11.8	2.8	12.8	0.2	12.0	1.8
200-yr 5-day	13.3	0.5	11.8	2.8	12.5	0.5	13.3	0.5
200-yr 10-day	12.9	0.9	11.3	3.3	11.7	1.3	12.9	0.9
500-yr 24-hr	12.7	1.1	12.8	1.8	14.0	-1.0	12.7	1.1
500-yr 5-day	14.3	-0.5	12.8	1.8	13.8	-0.8	14.3	-0.5
500-yr 10-day	14.2	-0.4	12.4	2.3	13.1	-0.1	14.1	-0.3

50% Pumps Not Operating

For this scenario, 50% of the pumps (including redundant pumps) for each pump station are turned off (see **Table 3.7**), and the 50-percent requirement is met because a redundant pump assumed to be included at each pump station which will also not be operating in this event. Because of the multi-pump configurations in all the onsite basins, multiple combinations of inactive pumping were tested to find the configuration of inactive pumps that yielded the highest water surface elevations. It was consistently found that the highest water surface elevations resulted when the bottom two pumps were left off in all four basins.

The maximum water surface criteria for the 100-year 10-day storm event with 50 percent of the pumps not operating is one foot above the gutter flow line, as shown in **Figure 1.1**. To meet freeboard criteria in the East Basin, an additional redundant pump must be installed to allow for the operation of four pumps during the 50% pumps no operating scenarios. The analysis shows that the maximum water surface standard of

1.0 foot above the gutter flow line is met at all locations for the 100-year 24-hour and 100-year 10-day storm events. The results from the proposed condition XPSWMM model are shown in **Figure 4.4: 100-year 24-hour Design Storm Freeboard, 50% Pumps Not Operating** and **Figure 4.5: 100-year 10-day Design Storm Freeboard, 50% Pumps Not Operating.**

4.2 River View & I80 Discharges to Plan Area

Table 4.2: Peak Stage Comparison Draining Existing Across Interstate 80 presents a comparison of existing and proposed condition stages at the downstream headwall of the dual 36-inch RCP under I-80. The existing River Oaks development only conveys runoff for storms exceeding the 10-year event north into the existing dual 36-inch RCP culverts. The 100-year peak flow information for all three storm durations was calculated using the XPSWMM model provided by the City of Sacramento and adding climate change factors to the rainfall. The 24-hour storm scenarios for the 100-year, 200-year, and 500-year reached the existing dual 36-inch RCP culverts and flowed into the plan area.

Table 4.2 shows the proposed condition peak stages are lower than the corresponding existing condition peak stage in all 100-year storm events at the downstream headwall of the dual 36-inch RCP. This lowers the tailwater below existing conditions and allows all runoff from River Oaks to travel north as it does today, without worsening the hydraulic conditions within River Oaks. Therefore, it is assumed the proposed project will not result in adverse impacts to the existing River Oaks development because of the decreased peak stages in all design storms in the 100-year storm events.

Additionally, a similar comparison of existing and proposed water surface elevations downstream of the I-80 culverts discharging into the South Detention Basin is provided in **Table 4.2.** The results show that drainage along I-80 is not adversely impacted. **Figure 2.4** provides a graphical representation of the I-80 crossings onto the Plan Area.

Table 4.2: Peak Stage Comparison Draining Existing Across Interstate 80

Storm Event	Peak Water Surface Elevation					
	River Oaks Crossing		I-80 Dual 18-inch Crossing		I-80 Single 36-inch Crossing	
	Existing Condition	Proposed Condition	Existing Condition	Proposed Condition	Existing Condition	Proposed Condition
100-year 24-hour	13.8	13.4	16.1	15.0	14.8	12.4
100-year 5-day	13.6	12.1	15.7	14.0	14.7	11.5
100-year 10-day	13.5	12.2	15.7	14.0	14.7	11.5

4.3 Ag-Buffer Discharges

The proposed ditches along the boundary between the Ag and Ag Res properties to the west of the project provide adequate conveyance and depth to prevent the outflows in all 100-year scenarios from spilling out of the channels and impacting the existing properties. **Table 4.3: Peak Stage Comparison At the Ag Res Buffer** shows that the proposed conditions peak stages are lower than the corresponding peak existing condition peak stages in all 100-year storm events.

Table 4.3: Peak Stage Comparison At the Ag Res Buffer

Storm Event	Peak Water Surface Elevation					
	OFFN02		OFFW03		OFFS02	
	Existing Condition	Proposed Condition	Existing Condition	Proposed Condition	Existing Condition	Proposed Condition
100-year 24-hour	20.8	20.3	17.4	11.4	18.0	15.7
100-year 5-day	20.7	19.7	17	12.5	17.4	11.6
100-year 10-day	20.7	20.0	17	12.2	17.5	11.6

4.4 Natomas Estates Discharges

Table 4.4: Peak Stage Comparison At Natomas Estates contains the peak stage comparison at the interface between the proposed development and Natomas Estates. The water surface elevations were taken at the existing culverts that the offsite sheds drain through in both existing and proposed conditions.

Table 4.4: Peak Stage Comparison At Natomas Estates

Storm Event	Peak Water Surface Elevation					
	NORT09C		NORT09B		NORT09A	
	Existing Condition	Proposed Condition	Existing Condition	Proposed Condition	Existing Condition	Proposed Condition
100-year 24-hour	14.9	14.2	14.4	13.9	14.0	13.4
100-year 5-day	14.4	13.2	13.7	13.1	13.5	13.1
100-year 10-day	14.0	13.2	13.6	13.0	13.5	13.2

4.5 West Drainage Canal Summary

Table 4.5: Peak WSE Comparison, RD 1000 XPSWMM Model presents the peak WSEs in the West Drainage Canal from the preliminary RD 1000 XPSWMM model, utilizing input hydrographs from the existing conditions HEC-RAS and proposed conditions XPSWMM models for the 100-year 10-day event (without climate change) as these models were specifically created to assess RD 1000 impacts. **Table 4.5** shows the proposed project will not result in increased peak stages in the West Drainage Canal at any location adjacent to the UWS Plan Area. A comparison of peak flows entering the West Drainage Canal in the Wood Rodgers created existing conditions and the conditions this project proposes including onsite drainage improvements yield lower peak runoff entering the canal. The peak flow entering in the existing conditions is 269.7-cfs (190.7 cfs upstream of San Juan Road and 79 cfs downstream of San Juan Road) and the peak flow entering in the proposed conditions is 132.1-cfs (72.1 cfs upstream of San Juan Road and 60 cfs downstream of San Juan Road. It is assumed RD 1000 and its contractors will verify these values using the RD 1000 XPSWMM model. County DWR is not expected to review and approve models meant to satisfy RD-1000.

Table 4.5: Peak WSE Comparison, RD 1000 XPSWMM Model

Location (XPSWMM NODE)	Existing Condition	Proposed Condition	Change in WSE (feet)
	Peak WSE[9] (feet)	Peak WSE[9] (feet)	
169	13.404	13.355	-0.049
11011	13.392	13.344	-0.048
11010	13.077	13.014	-0.063
170	13.056	12.988	-0.068
171	13.049	12.98	-0.069
11008	13.023	12.947	-0.076
172	12.203	12.151	-0.052
11509	12.18	12.132	-0.048
11520	12.148	12.112	-0.036
173	12.138	12.099	-0.039
1914	11.87	11.833	-0.037
11558	11.542	11.511	-0.031
11511	11.457	11.424	-0.033
174	11.125	11.09	-0.035

Complete Model results for all storm events in the proposed conditions XPSWMM model, including XPSWMM modeling without climate change for assessing RD1000 impacts as well as onsite modeling including climate change for County requirements are presented in **Appendix E**.

4.6 Onsite 200-year Analysis

The project is designed such that the proposed pads will be above the 200-year, 10-day storm event water surface elevation within the West Drainage Canal. The best available data at the time of this study is the preliminary maximum water surface elevations of the West Drainage Canal, provided by Civil Solutions in 2021, ranging from an elevation of 14.17 in the north at Fisherman's Lake to 13.26 at I80. **Figure 4.6: Maximum Floodplain Depth Assuming Full Levee Failure 200-year, 10-day Event** shows the areas of the proposed project site that are below a hypothetical water surface plane that extends from the West Drainage Canal. This conservative approach assumes no containment of the West Drainage Canal to show that the proposed land uses will be above the 200-year, 10-day water surface elevation. The figure does show inundation in the proposed project detention basins, drainage channels, and existing low-lying areas of parcels currently improved.

[9] NAVD 88 vertical datum.

While the project does not rely on the containment of the West Drainage Canal to protect pads, the project will be designed to maintain the West Drainage Canal within its banks. The project will not increase the 200-year, 10-day water surface elevations in the West Drainage Canal and therefore does not increase the extent of mapped inundation. This can be accomplished by maintaining the containment conditions that exist under pre-project conditions and limiting developed outflow to not exceed existing maximum water surface elevations in the RD1000 system. Wood Rodgers does not anticipate any modifications will be required to the existing containment features. The analysis will be confirmed during Tentative Map and/or subsequent design level efforts.

4.7 Project Phasing

Conceptual project phasing has been identified in **Figure 4.7: Conceptual Phasing Plan** for purposes of the Public Facilities Financing Plan. In general, each of the four detention basins correspond to an assumed project phase. The deeper excavation of the detention basins is intended to produce material for the proposed development and generally corresponds to the project phasing.

Actual phasing will be dependent on the timing of development and improvements necessary to avoid adverse impacts. Subsequent entitlement applications (tentative map) or grading plan submission should address interim or phased improvements to support the specific proposal. Each project should address at a minimum the following phasing topics:

- Detention and pump station phasing (including anticipated interim and permanent locations).
- Earthwork / mass grade phasing.
- Natomas Mutual Water Company is phasing of facilities to convey irrigation water.
- Interim drainage of parcels that will develop in subsequent phases and are tributary to the developing parcel.
- The need for downstream / offsite improvements.
- How the phasing complies with the County's Floodplain Management Ordinance.

Prior to grading and/or improvement plan submittals a pump station design report will be required for each of the detention basins. Additionally, a geotechnical report will be necessary to anticipate the rate at which groundwater will infiltrate into the detention basins and to determine appropriate slope stability measures. Prior to construction of downstream improvements, the developing property owner will need to obtain easements and construction access to offsite properties requiring infrastructure improvements.

While some property owners are overburdened with specific plan infrastructure, including drainage infrastructure and detention basins, the Public Facilities Financing Plan provides for the costs and fees associated with constructed the backbone infrastructure. These costs include a component for land acquisition.

4.8 Wildlife Management Plan

It is anticipated that a wildlife management plan will be required at the time of grading plan submittal. The purpose of the wildlife mitigation plan is to deter wildlife that may present hazards to aircraft approaching and departing Sacramento International Airport. The wildlife management plan will articulate specific design features for the canal and detention basins that will deter wildlife. It will also include operation recommendations. The plan will require review and approval by Sacramento County Airports.

100-YEAR, 24-HOUR DESIGN STORM FREEBOARD

UPPER WESTSIDE PLANNING AREA

MASTER DRAINAGE STUDY

SACRAMENTO COUNTY, CA

MAY 2024

NOTES: 100-year freeboard to gutter flow line shown
RED = Maximum WSE Standard Not Met
GREEN = Maximum WSE Standard Met
Maximum WSE = 1.0-foot above gutter flow line

NOTE: Street sections can be found in the Upper Westide Roadway Master Plan included in Appendix A

0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20240202\FIG4.1_XPSWMM_100YR_24HR.mxd 2/20/2024 9:24:05 AM jcarey

FIGURE 4.1

100-YEAR, 10-DAY DESIGN STORM FREEBOARD

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

NOTES: 100-year freeboard to gutter flow line shown
RED = Maximum WSE Standard Not Met
GREEN = Maximum WSE Standard Met
Maximum WSE = 1.0-foot above gutter flow line

NOTE: Street sections can be found in the Upper Westside Roadway Master Plan included in Appendix A

0 600 1,200
Feet

NORTH

WOOD RODGERS

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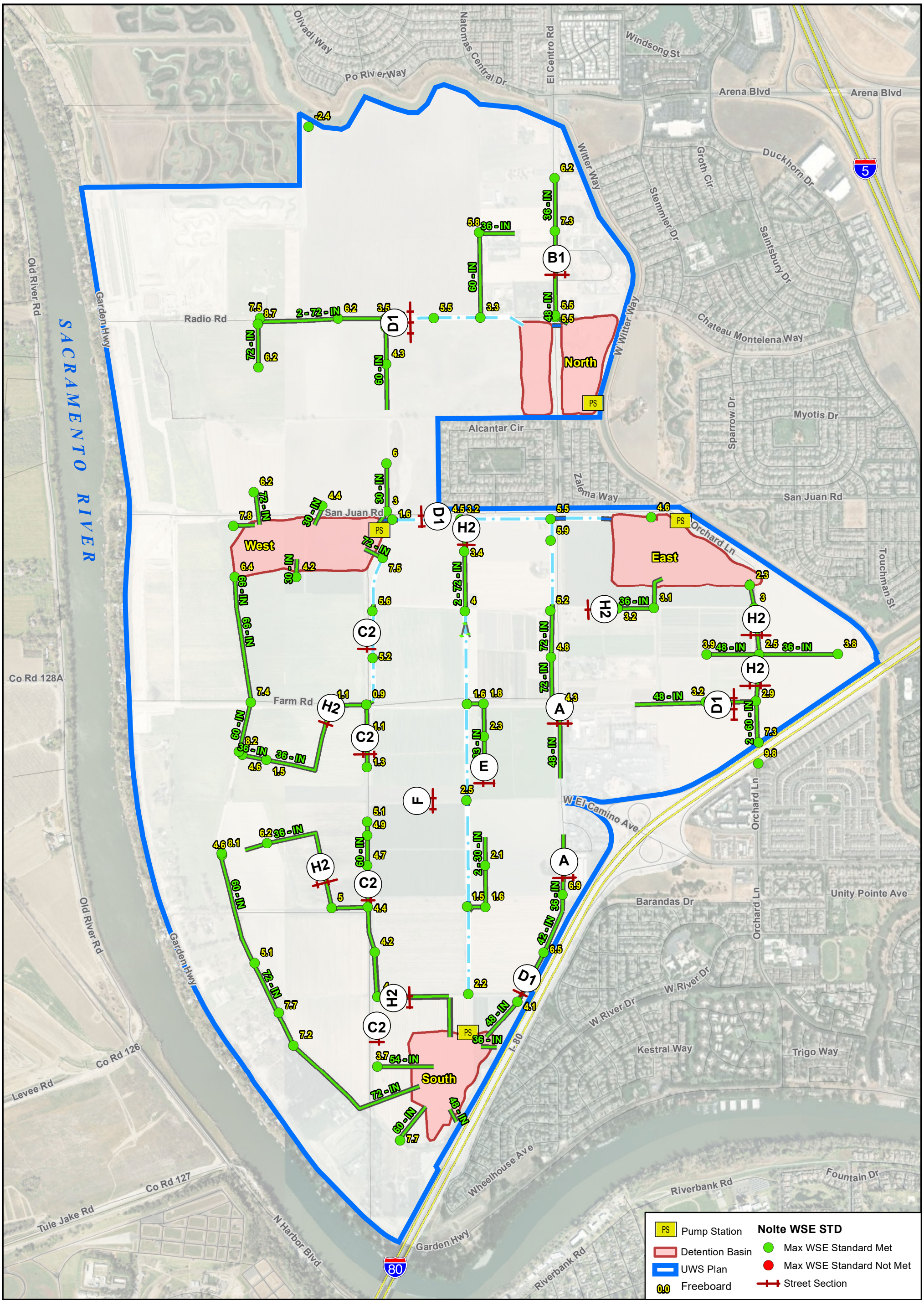
FIGURE 4.2



NOLTE DESIGN STORM FREEBOARD

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

NOTES: Nolte freeboard to gutter flow line shown
RED = Maximum WSE Standard Not Met
GREEN = Maximum WSE Standard Met
Maximum WSE = 0.5-foot below gutter flow line

NOTE: Street sections can be found in the Upper Westside Roadway Master Plan included in Appendix A

0 600 1,200
Feet

NORTH

WOOD RODGERS

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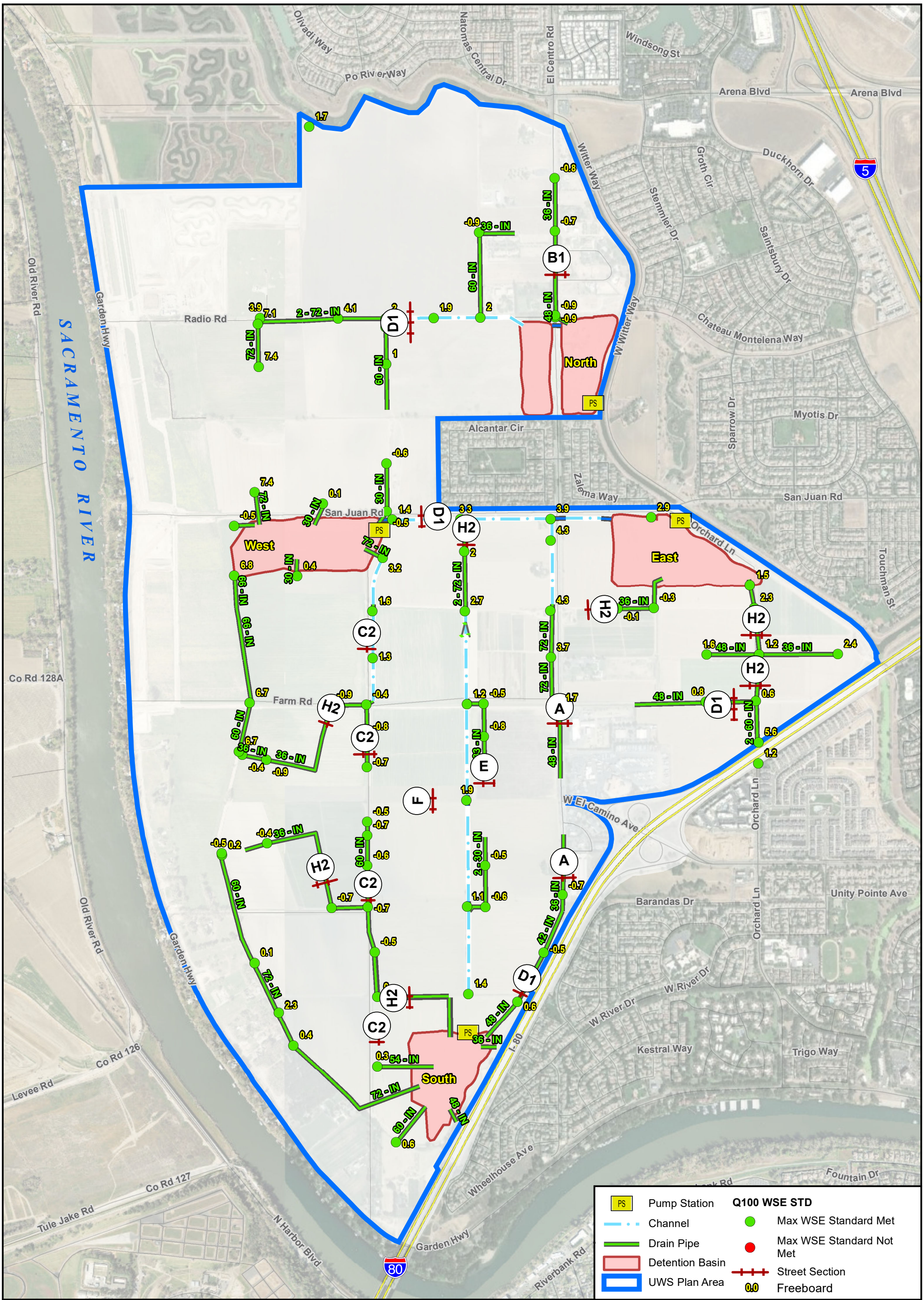
FIGURE 4.3



100-YEAR, 24-HOUR DESIGN STORM
FREEBOARD WITH 50% OF PUMPS NOT OPERATING
UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

NOTES: 100-year freeboard to gutter flow line shown
RED = Maximum WSE Standard Not Met
GREEN = Maximum WSE Standard Met
Maximum WSE = 1.0-foot above gutter flow line

NOTE: Street sections can be found in the Upper Westside Roadway Master Plan included in Appendix A

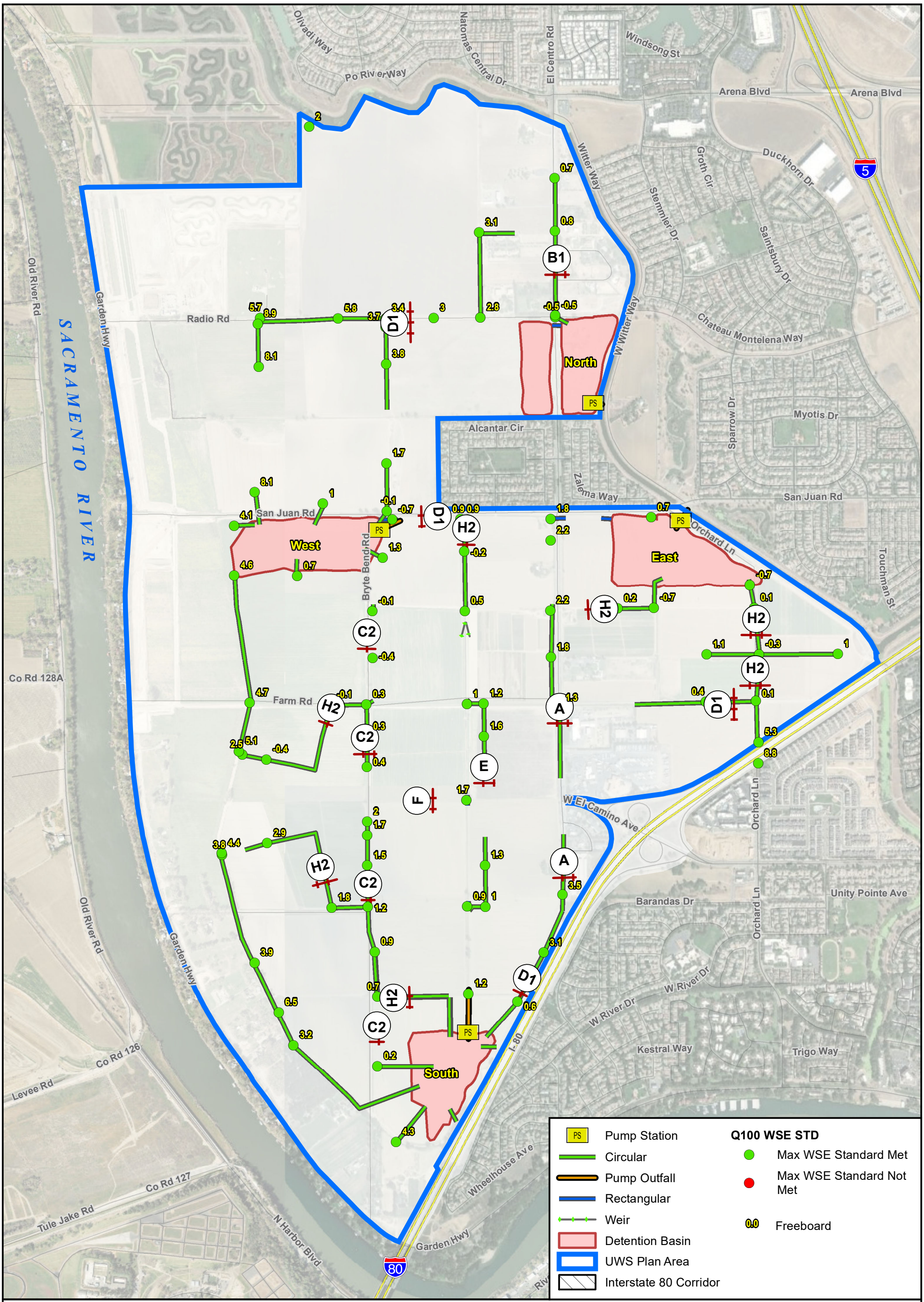
0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20240202\FIG4.4_Half_Pump_100YR_24HR.mxd 2/20/2024 9:19:16 AM jcarey

FIGURE 4.4



100-YEAR, 10-DAY DESIGN STORM
FREEBOARD WITH 50% OF PUMPS NOT OPERATING

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

NOTES: 100-year freeboard to gutter flow line shown
RED = Maximum WSE Standard Not Met
GREEN = Maximum WSE Standard Met
Maximum WSE = 1.0-foot above gutter flow line

NOTE: Street sections can be found in the Upper Westside Roadway Master Plan included in Appendix A

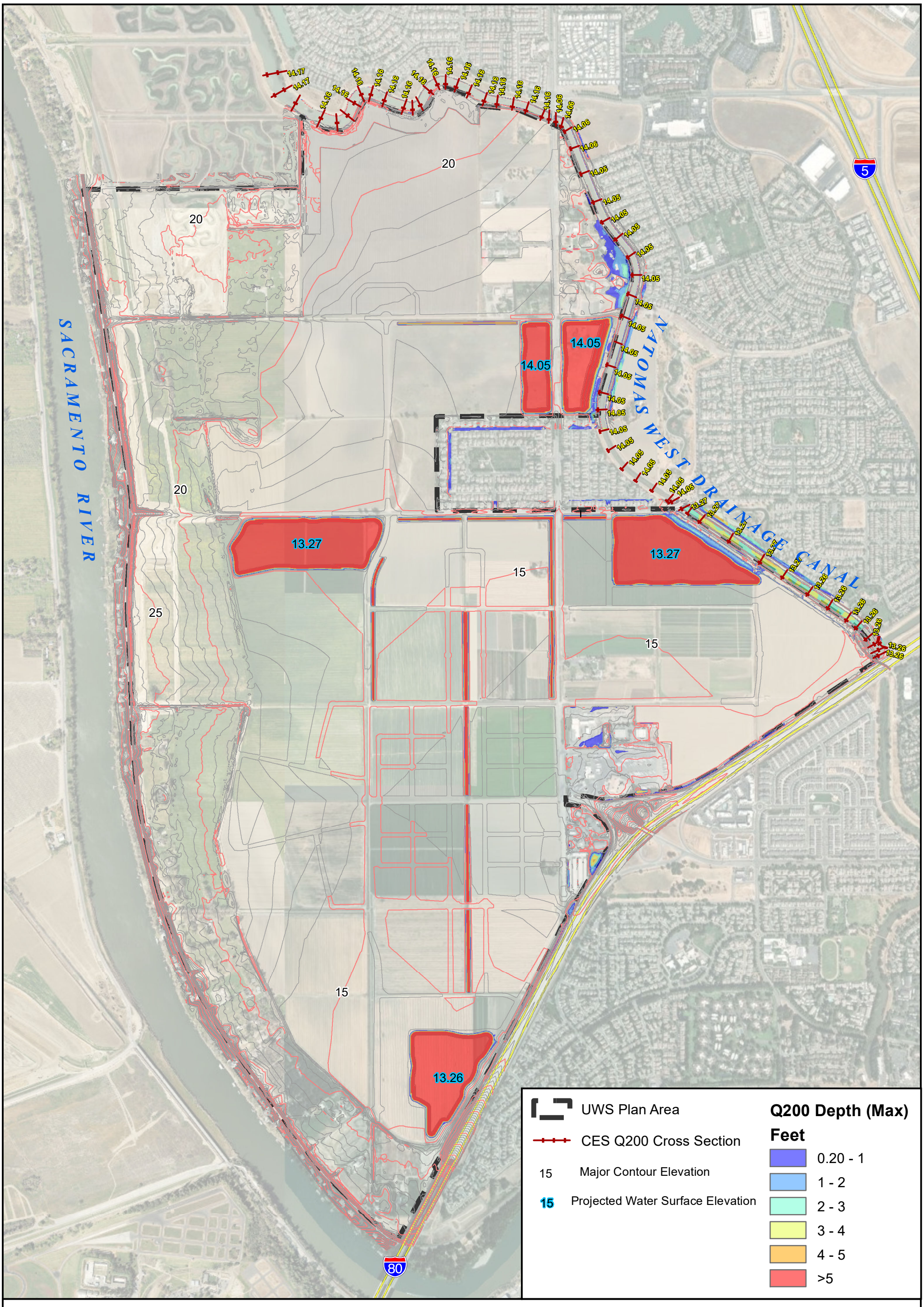
0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20240202\FIG4.5_Half_Pump_100YR_10DAY.mxd 2/20/2024 9:17:36 AM jcarey

FIGURE 4.5



MAXIMUM FLOODPLAIN DEPTH
ASSUMING FULL LEVEE FAILURE
200-YEAR, 10-DAY EVENT

UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

Data Source: Civil Engineering Solutions,
Preliminary Maximum Water Surface Elevations
in West Drainage Canal
10-day, 200-year storm event

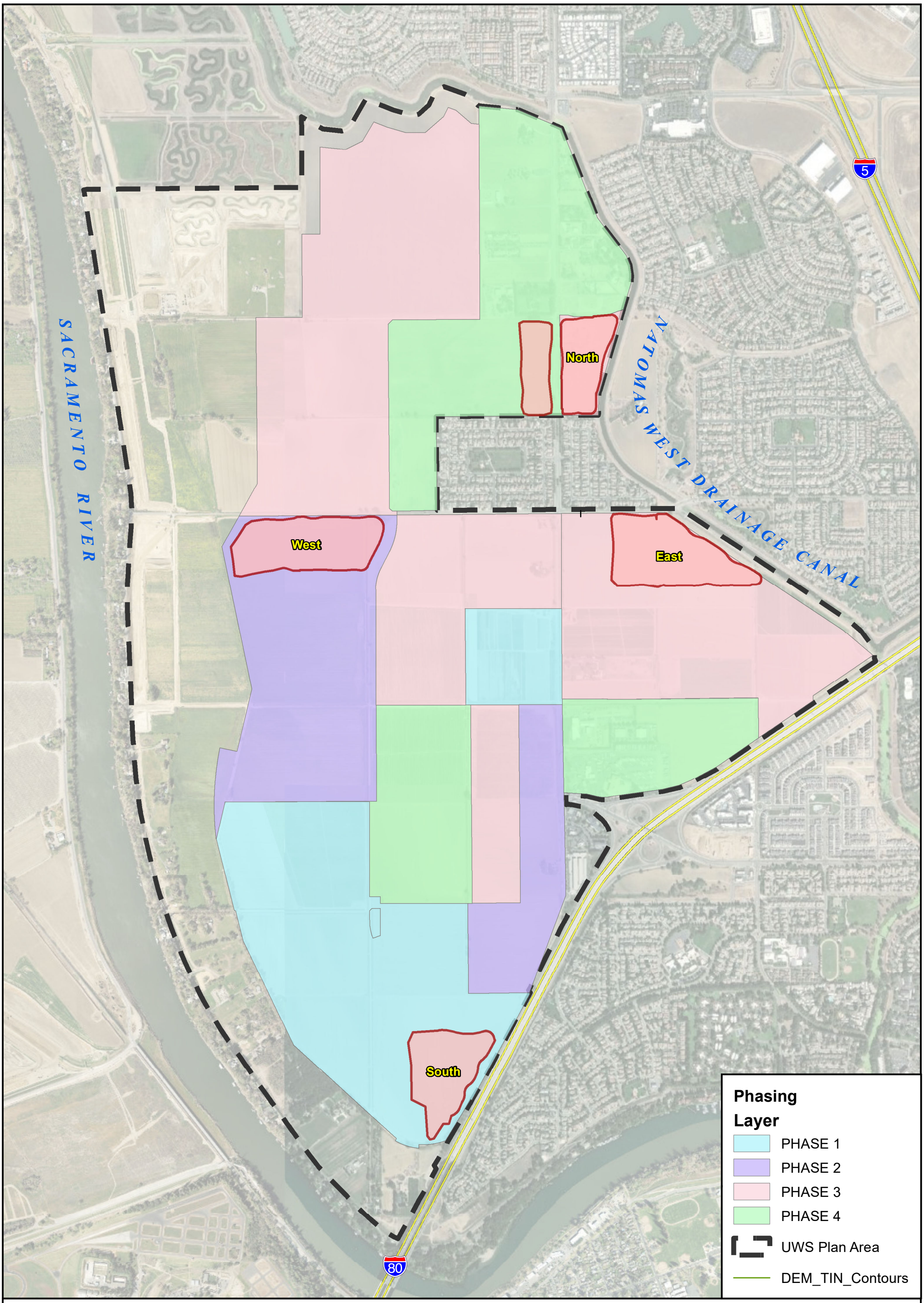
0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20240202\FIG4.6_200yrLeveeFailure.mxd 5/8/2024 7:25:17 AM jcarey

FIGURE 4.6



CONCEPTUAL PHASING EXHIBIT
UPPER WESTSIDE PLANNING AREA
MASTER DRAINAGE STUDY
SACRAMENTO COUNTY, CA
MAY 2024

0 600 1,200
Feet

NORTH

WOOD RODGERS

J:\3000-s\3616_Natomas_Boot\Natomas_Boot-OA\GIS\Tasks\Studies\Drain\MasterDrainage Study\Resubmittal_20240202\FIG4.7_ConceptualPhasing.mxd 2/16/2024 10:26:55 AM jcarey

FIGURE 4.7

5.0 Low Impact Development

The Project will be required to comply with the Sacramento Area-wide NPDES Municipal Stormwater Permit (Order No. R5-2008-0142). This Level 1 Master Drainage Study (MDS) addresses post-construction flow reduction and treatment requirements. The requirements for urban development are detailed in the SQDM. The SQDM provides instructions for how to plan a project to comply with the stormwater quality requirements, how to prepare calculations to support detailed design of flow reduction and treatment control measures, and how to document the plan and analysis to support it.

According to Table 3-2 in the SQDM, the project is required to incorporate source control measures, Low Impact Development (LID) control measures, and treatment controls throughout the site. Full trash capture control measures are required in areas with more than 10 dwelling units per acre, and in commercial areas and parking lots. In subsequent phases of design, trash capture loading rates will be calculated, and regional trash capture methods will be determined. At this time the plan assumes capture of trash at the detention basins as flows enter the pump stations. Table 3-3 in the SQDM provides a matrix of stormwater quality control measures that can be applied to meet the requirements for the various land use categories. Hydromodification management will not be required as discussed below.

The final determination of LID measures and implementation will be determined as the project's design evolves. Information presented in this MDS is provided to demonstrate that LID criteria can be achieved; however, the quantities presented may change or other Best Management Practices (BMPs) may be selected with the final design.

LID measures are typically integrated into site landscaping (including open space, yards, streetscapes, road medians, and parking lot and sidewalk planters) or into the design of paved and other impervious areas, such as building rooftops. Small-scale runoff controls integrated into the project design and located close to the source of the water and pollutants can help reduce the need to convey water and treat it in the large, end-of-pipe facilities that would be located at the downstream end of drainage areas.

Each priority, new development or redevelopment project is required to earn a minimum of 100 points based upon the LID measures selected and implemented. The computational procedure for residential projects

differs somewhat from commercial projects. Compliance with LID principles is required at all stages of approval, including master planning and final improvement or grading plans for individual projects.

LID is intended to reduce the increase in runoff volume that would otherwise be expected from a development by at least 50 percent. Reducing runoff using LID measures reduces the amount of runoff that needs to flow into treatment BMPs.

For this Master Drainage Study, a "high level" plan that explains how the project could achieve the required 100 points of LID credit is required. The Level 1 MDS needs to demonstrate an understanding of the quantity of LID measures that will be required. The SQDM includes detailed submittal requirements (Appendix A of the SQDM) and worksheets (Appendix D of the SQDM) to demonstrate compliance of specific projects that are in the design phase. This Level 1 MDS used the worksheets to assess the effectiveness of LID options. Overall project area land use information was used to identify the number of LID and treatment measures that might be needed to meet the requirements. For this initial evaluation, two "watersheds" (not actual topographic watersheds) were evaluated for the contributing areas to each detention basin, one for the areas that could use the form for residential development and one for the remainder of the project using the form for commercial development. Based on Table D-1a on the Residential calculation spreadsheet, the spreadsheet only applies to residential areas with no more than 20 dwelling units per acre. As detailed plans for project areas are developed, the actual measures that will be implemented will be determined and the appropriate forms and calculations will be provided.

If early phases of the project include more LID than required, future phases can incorporate less LID as long as the required LID credits up to any point in time have been implemented. In other words, future planned work cannot be used to meet the LID credit requirements, but previously completed measures can be counted toward future requirements.

5.1 Hydromodification

Per the Sacramento Stormwater Quality Partnership, Hydromodification Management Plan (HMP), the City of Sacramento's North Natomas Basin and unincorporated Metro Air Park are considered Special Drainage Areas and are exempt from hydromodification. This is primarily because the drainage facilities within North

Natomas are engineered to limit post-development discharges and drain to engineered canals that are maintained and operated by RD 1000. The UWS project shares the same drainage discharge characteristics as the City's North Natomas Basin and unincorporated area of Metro Air Park. The project will not increase water surface elevations in the West Drainage Canal which is an engineered canal operated and maintained by RD 1000. Therefore, the project will be exempt from hydromodification.

5.2 LID Evaluation / Open Space Credit

Open space is defined as "non-impervious area within the project that is subtracted from the total project area to reduce the area used in sizing treatment BMPs". Because of this benefit, open space is awarded LID credit points. The percentage of open space is translated directly into LID points on a 1:1 ratio (one (1) LID point for each one percent (1%) of open space in relation to the total project area).

For LID implementation, open space includes, but is not limited to, natural storage reservoirs, drainage corridors, buffer zones for natural water bodies, stream setbacks and buffers, and flood control detention basins.

For the purpose of this analysis, the total area of the Project is 2,066 acres. The schools will cover approximately 146 acres and are considered as commercial development in the appropriate LID spreadsheets. Areas designated for agricultural uses (including Urban Farm, landscape corridors, parks, open channels and basins) cover approximately 807 acres, or 42 percent of the net project area. Therefore, the project's open space is expected to provide 42 LID points overall.

Table 5.1: Land Use Summary for LID Evaluations provides a summary of the land uses[10], areas and dwelling units used as a basis for the LID evaluation. **Table 5.2** and **Table 5.3** provide land use and open space areas for the residential and commercial area LID evaluations, respectively, for the North Basin as an example of the methodology used for all four basins. The residential and commercial LID worksheets are included in **Appendix F**.

[10] Land uses and acreages may differ from those presented in Section 3.7 due to iterating of the land use plan. Differences produce negligible results at this scale and will be confirmed with subsequent studies.

The columns in **Table 5.2** and **Table 5.3** under the Residential and Commercial Open Space heading correspond to the LID credit calculations forms for the rows in Section 1b, “Project Drainage Shed” for distinguishing the categories of “Project-Specific Open Space (In-project, communal**).” The categories indicated by “b,” “c,” “d” and “e” correspond to “Buffer zones for natural water bodies,” “Natural areas including existing trees, other vegetation and soil,” “Landscape area/park,” and “Flood control/Drainage basins,” respectively.

Table 5.1: Land Use Summary for LID Evaluations

Code	Land Use Description for LID Evaluation	North Basin Area (acres)	West Basin Area (acres)	South Basin Area (acres)	East Basin Area (acres)
AGRES	Agricultural Urban Reserve	3	18.5	13.9	9.7
CC	Commercial & Office	0	0	1.2	0
CHNL	Flood Control Channel	1.5	10.7	3.7	8.8
AG	General Agriculture	113.2	126.72	139.14	0
HDR	High Density Residential	0	17.8	18.1	23.1
E/HC	Highway Commercial	0	0	11.1	41.8
LC	Landscape Corridor	7.7	4.6	11.8	14.2
LDR	Low Density Residential	218.4	143.1	124.3	108.2
LMDR	Low-Medium Density Residential	14.5	34.3	44.2	40
MDR	Medium Density Residential	9.8	8.6	10.3	33.8
CMU	Mixed-Use	6.4	7.7	7.9	59.9
OS	Open Space	24.2	0	0	11.5
SCHOOL	Public/Quasi-Public	80.6	35.7	8.6	16
P	Recreation	12.4	18.1	22.7	29
RDWY	Roadway	17.5	25.3	20.7	56.6
W	Water/Detention	20	20	20	36.4
	Grand Total	529.2	471.12	457.64	489

Table 5.2: Residential Areas and Open Space for LID Evaluation (North Basin)

Code	Residential Watershed Area (acres)	Residential Open Space Area (acres)		
		1b.c	1b.d	1b.e
LDR	218.4			
LMDR	14.5			
MDR	9.8			
P	12.4			
AG	113.2	113.2		
AGRES	3		3	
LC	7.7		7.7	
OS	24.2		24.2	
P	12.4		12.4	
W	20			20
Total	**435.60**	**113.2**	**47.3**	**20**

Table 5.3: Commercial Areas and Open Space for LID Evaluation (North Basin)

Code	Commercial Watershed Area (acres)	Commercial Open Space Area (acres)		
		1b.c	1b.d	1b.e
HDR	0			
VHDR	0			
CMU	6.4			
(Road)	17.5			
CC	0			
E/HC	80.6			
LC			8.7	
Totals	**587.6**	**0**	**8.7**	**0**

5.3 Runoff Reduction

Projects receive one (1) LID point for every one percent (1%) of the project area managed through impervious area disconnection and interceptor trees.

Disconnected pavement can be used with a ratio of an impervious-to-pervious surface of 2:1 or less. Impervious surfaces can drain to landscaped areas or to pervious pavement with an area of 50 percent of the tributary impervious area.

Disconnected roof drains can be a highly effective tool to reduce runoff within the Low Density Residential land use areas including VLDR, LDR and LMDR categories. However, disconnected roof drains require detailed planning of minimum travel distance across vegetation and may involve the use of pop-up emitters.

Evergreen trees count for 200 square feet of managed project area and deciduous trees count for 100 square feet of managed project area. The project will include extensive tree plantings. This MDS makes conservative assumptions to estimate the minimum number of trees that will be in areas that count for runoff reduction.

5.4 Disconnected Impervious Areas

Disconnected impervious areas can be readily integrated into low- and medium-density lots. A preliminary estimate is that on-lot imperviousness for VLDR, LDR, LMDR and MDR could have an average efficiency factor of 0.45 for 60 percent of the roof drains. The project is calling for extensive use of separated sidewalks in the residential areas. For this MDS it has been assumed that 80 percent of the sidewalks in the residential areas will be separated.

5.5 Trees

Trees will be planted along most streets throughout the project area. On average, trees will be planted 30 feet on-center. An average of one tree every 35 feet was assumed to account for locations without trees, such as driveways. On arterials and major collectors that have a 20-foot landscape setback with a separated walk, it has been assumed that there will be two rows of trees: one row of deciduous trees and one row of evergreens. For primary residential streets, it has been assumed that there will be one row of deciduous trees. Our assumptions for tree planting also include trees at 30 feet on-center along the medians with two rows where a plaza is planned. An average tree spacing of 50 feet was assumed to account for areas without trees. For in-tract residential streets, it has been assumed that there would be four trees per VLDR lot, three trees per LDR lot, two trees per LMDR lot and one tree per MDR lot, all deciduous. Although many other trees will be planted, only trees within 25 feet of ground level impervious areas count for flow reduction.

For the MDS, is has been assumed that 3,000 evergreen trees and 7,700 deciduous trees will be planted for LID credit in the residential areas. Estimates for roadway corridor trees in the areas included in the commercial area LID evaluation are for 1,575 evergreen trees and 7,748 deciduous trees. It is likely that additional trees will ultimately be included in some parking areas and other locations. The current estimates

are thought to be conservative, but higher estimates for trees would not be expected to significantly impact the requirements for other BMPs.

5.6 Runoff Management

Projects receive 2 LID points for every 1 percent of project area effectively managed though the following runoff management measures:

- Porous Pavement
- Alternative Driveways
- Green Roof
- Capture and Re-Use
- Compost-Amended Soil – 25% of tributary impervious area
- Bioretention BMPs (which may be located in the detention basins, above the permanent pool elevation)

5.7 Limitations

Shallow groundwater may limit specific on-the-ground runoff management strategies, such as porous pavement which can only be used where the depth to high groundwater is at least 10 feet. Porous pavement also requires consideration of soil permeability, need for an underdrain and local County permitting. Similarly, compost-amended soil is allowed in areas where the water table is more than 10 feet from the surface. Use of dispersion trenches requires a 10-foot separation to groundwater below trench. Based upon initial groundwater elevation monitoring at the site we anticipate a majority of the plan area to be able to use these methods as solutions toward runoff management.

Local capture and use by rain barrels or cisterns is not expected to be a practical means to achieve significant flow reduction due to the relatively high cost of small rainfall storage tanks. One acre of treatment credit was assumed because it is likely that some demonstration projects will use these types of systems.

Some buildings may incorporate green roofs, but at this preliminary stage no green roofs have been assumed.

It may be feasible to provide stormwater capture and use on a larger scale by providing some landscape irrigation flows from the regional stormwater basins. The feasibility of such systems may be explored in the future, but they have not been included at this stage.

5.8 Runoff Management Credits

It is anticipated that bioretention planters will need to be used to manage roadway runoff from the other impervious surfaces. After all other measures were estimated, the area required for bioretention to meet 100 points was determined in the residential areas and in the commercial areas for each detention basin watershed. It is assumed that bioretention planters will be configured with underdrains to meet the design criteria specified in Table BP-1, Bioretention Planter Design Criteria and located in a benched area within the flood detention basins, above the permanent pool elevation. Based on these assumptions, both the residential and commercial areas would achieve 100 LID credits.

The LID measures that would provide the required LID credits do not eliminate the need for supplemental water quality treatment. The worksheets indicate that WQV with a 48-hour drawdown time would be needed to meet the water quality treatment requirements. Numerous options are available to meet the stormwater quality treatment requirement. Options include:

- Providing additional LID measures;
- Providing distributed flow-based or volume-based treatment BMPs; and
- Operating the regional stormwater basins to function as wet stormwater quality detention basins in addition to meeting high flow requirements.

Use of the regional basins for water quality treatment would require a maximum treatment volume of 55 acre-feet (North basin 12 acre-feet, East basin 21 acre-feet, South basin 11 acre-feet, and West basin 10 acre-feet) based on the sum of the volume-based treatment. The method utilizes the same basic assumptions of weighted percent imperviousness and area in establishing the watershed depth and

calculating the required volume as found in Appendix E of the SQDM. The analysis uses the equation WQV = P_0 x A/12, as already described in **Table 3.5: Preliminary (Pre-LID) Water Quality Volume Calculations**. If the East Basin were to incorporate all such water quality treatment for the East Basin, the West Basin and the South Basin, the combined volume would be 43 acre-feet.

The design volume would be 1.25 times the treatment volume to meet the wet basin design criteria. Therefore, the design volume, or minimum permanent pool, would be 61.16 acre-feet for water quality distributed over the planned basins. Considering that there are over 100 acres dedicated to the regional drainage basins and that the basins within these areas are planned to have deep (4-8 feet), permanent pools, the design details necessary to meet the minimum requirements for water quality wet basins are not expected to be complex and can be developed at basin improvement plan design, providing a minimum of 400 acre-feet of treated storage. With LID measures accounted for the volume required would be reduced. Additional information for how the water quality treatment requirements will be met will be determined when the Project advances to more detailed planning phases. Water balancing calculations will be required in the next level of analysis to ensure the permanent pool will be maintained in the dry season. Also, a supplemental source of water may be required to maintain the permanent pool during the dry season. The requirement for makeup water will be determined during detention basin design to meet SCDWR requirements.

6.0 Quality Assurance / Quality Control

6.1 Model Calibration

Model calibration was not performed for the existing or proposed condition models. However, Wood Rodgers prepared a TM to verify the loss rate of 0.014 which is presented in **Appendix B**.

GEI Consultants has been retained by the Sacramento County Department of Water Resources to perform detailed reviews of all modeling efforts.

6.2 Model Warnings and Errors Have Been Addressed

All warnings were investigated and changes to the model have been made as necessary.

7.0 Future Considerations

In accordance with SCDWR drainage study requirements, subsequent drainage studies will be required as the project moves forward. Level 2 studies will be required to be submitted with tentative subdivision map applications. Level 3/4 drainage studies are required before approval of improvement plans and construction drainage facilities. Subsequent studies will further refine the infrastructure to serve the project.

The following items are assumed to be required as part of subsequent drainage studies:

7.1 Low Impact Development

Low impact development design to be evaluated during tentative map design efforts.

7.2 Trunk Storm Drain Infrastructure Design

The onsite storm drainage systems conveying runoff into the proposed detention basins, including storm drains and overland release paths, will be evaluated and refined as appropriate to meet requirements under Nolte, 10-year, 100-year, and 200-year conditions under the Tentative Map level and subsequent analyses. This evaluation includes overland release. Drainage inlets will be sized, and overland release estimates will account for 50% clogging, in accordance with County standards.

As previously discussed, climate change was accounted for in the development of this study. SCDWR is expected in the near future to approve the climate change hydrology presented in this report. However, there are no design standards relating to the trunk storm drain infrastructure design under climate change. It is important to note that this report designed storm drain infrastructure utilizing current design standards but with flows resulting from climate change. Therefore, the trunk conveyance infrastructure presented in this report is likely oversized.

Absent of climate change design standards, further discussion with SCDWR will be required to define the appropriate design standards when utilizing climate change hydrology. As a result, it is anticipated that the infrastructure presented in this report will be downsized. This is anticipated to be assessed during subsequent Level 2 drainage studies.

7.3 Detention Basin & Pump Station Design

Geotechnical Considerations

Basin design will require a geotechnical report which discusses the following geotechnical considerations:

- Groundwater and required low-flow pumping
- Proximity to the West Drainage Canal embankments
- Proximity to the Regional San Northwest Sewer Interceptor

Final Configuration

The final configurations of detention basin design will fully account for all design features affecting the sizes of facilities. Design features include but are not limited to basin ramps (where required), setbacks, side slopes, easements, buffers, inlet structures, outlet structures, walls, and all other features deemed necessary by SCDWR.

For areas tributary to the North Detention Basin, modeling will separately consider the proposed two-cell basin design based on final design considerations.

Water Quality

The Level 3-4 study shall include a full and detailed explanation of the water quality volumes and LID features proposed within the basins. It is important to note that with the implementation of permanent pools in the bottoms of detention basins, the water quality treatment volume requirements can be easily achieved. This is because the permanent pool provides volumes that far exceed the requirements, as further discussed in **Section 5.0 Low Impact Development**.

Per SCDWR direction, the future Level 3/4 flood assessment is anticipated to discount the volume of the dead storage within LID features. The dead storage provides limited localized temporary storage that relies on infiltration to evacuate otherwise trapped runoff.

Submerged Pipes

The plan area is anticipated to contain trunk drainage conduits that contain flow lines below the permanent pool elevations of the detention basins. This is due to the relatively flat topography of the Plan Area.

Additionally, State domestic water requirements, relating to utility separation requirements, result in deeper storm drain systems that operate below the domestic water system. Submerged pipes are expected to occur, however submergence of storm drains within the system will be evaluated and eliminated where possible to optimize operation and maintenance concerns.

Wildlife Management Plan

As previously discussed in Section 4.8 a wildlife management plan will be required concurrent with Level 3/4 drainage studies.

Number of Pumps including Redundant Pumps

Wood Rodgers recognizes that the SCDWR is in the process of considering changes to its current standards, which may result in modifications with respect to how pumping, redundancy, and flood resiliency are evaluated. This would include how 50% pumping capacity is defined, how modeled failure of pumps is determined, and the maximum flooding associated with such a scenario. Wood Rodgers will continue to collaborate with SCDWR in identifying the design challenges associated with storm drain pump stations standards, to determine the most efficient and cost-effective means of achieving the intent of the standards. Wood Rodgers will work collaboratively with SCDWR to meet the final approved standards, in whatever form they take, at the time of implementation,

7.4 500-year Design Storm

The 500-year storm event will be evaluated at the Tentative Map level to ensure building pad elevation requirements are met. The 500-year storm event requirement will only be applicable to the internal watershed and onsite runoff. It will not be based on offsite watersheds including the West Drainage Canal and Sacramento River.

7.5 Basin Wide HEC-RAS Model

As discussed in Section 1.3, once the new Natomas Basin 2D HEC-RAS model is adopted, it will be utilized accordingly in subsequent study and modeling efforts.

7.6 Ownership, Operation & Maintenance of Facilities

It is anticipated that ownership, operation, and maintenance of Plan Area drainage facilities will be determined during Specific Plan implementation. Further discussion of the varies fundings sources is discussed in the project's Urban Services Plan.

8.0 Summary & Conclusions

8.1 Summary

The resultant floodplain elevation summary showed that the proposed project resulted in no impacts to the existing floodplain depths. The proposed Project is in compliance with the Sacramento County Floodplain Management Ordinance.

The Mitigated Project includes detention and pump stations to reduce runoff so that no impacts to peak water surface elevations are shown in the West Drainage Canal. Preliminary analysis of the RD 1000 XPSWMM model using input hydrographs generated from the Plan Area for the existing and proposed conditions shows no increase in all areas of the RD 1000 drainage system.

The maximum WSE at the upstream headwall of the dual 36-inch reinforced concrete pipe under I-80 accepting flows from the existing River Oaks development is lower than existing conditions in all 100-year modeling scenarios, with only one of the 100-year scenarios generating overflow and spilling into the Plan Area with climate change factors applied. Therefore, the proposed project will not have adverse impacts on the existing River Oaks development. Other culvert crossings under I-80 draining to the South Basin were analyzed and found to have no adverse impacts. Existing River View development was also analyzed and found to be hydraulically separate from the Plan Area, as it fully drains under the West Drainage Canal in the 100-year storm as originally designed.

Agricultural and Agricultural/Residential properties to the west of the plan area and areas along the I-80 corridor will be modeled at tentative map levels and improvement plans to verify the intent of having no adverse impacts once onsite grading and storm drainage facilities are more defined.

8.2 Conclusions

This Level 1 Master Drainage Study identifies the improvements required in the Plan Area to meet SCDWR and other applicable standards. Drainage improvements include a backbone trunk system including drainage channels and pipes, detention basins, and pump stations to discharge flows to the West Drainage Canal.

Based on the analysis performed with this Study, the proposed project:

- Will not deviate from existing drainage patterns;
- Will not cause adverse impacts to the West Drainage Canal or RD 1000 facilities;
- Will not cause adverse impacts to the existing River View #2 development;
- Will not cause adverse impacts to culverts crossing under I-80
- Will not cause adverse impacts to the existing River Oaks Development; and
- Will not cause increases to WSEs and floodplain extents for Remaining Agricultural Areas within the Plan Area and, therefore, is in compliance with Sacramento County Floodplain Management Ordinance.

The Study has also developed approaches to meet post-construction NPDES requirements following the guidelines in the Sacramento Stormwater Quality Manual.