AGENDA ITEM NO. 10.2

CITY OF ELK GROVE
CITY COUNCIL STAFF REPORT

AGENDA TITLE:	**Receive a presentation regarding an update to the 200-year floodplain study and provide direction as appropriate**
MEETING DATE:	**July 24, 2019**
PREPARED BY:	**Jeff Werner, Engineering Services Manager** **Amittoj Thandi, Engineering Services Support Manager**
DEPARTMENT HEAD:	**Robert Murdoch, P.E., Public Works Director/ City Engineer**

RECOMMENDED ACTION:

Receive a presentation regarding an update to the 200-year floodplain study and provide direction as appropriate.

BACKGROUND INFORMATION:

In 2007, the California Legislature passed Senate Bill (SB) 5, which requires all new or reconstruction projects constructed within the Sacramento-San Joaquin Valley to achieve an urban level of flood protection by 2025, which is defined as the level of flood protection necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year. SB 5 and SB 1278 also requires cities and counties to amend their General Plans and Zoning Ordinances by no later than July 2016 to address 200-year flooding by requiring certain findings to be made as part of the development review process. The intent of the legislation is to strengthen the link between flood management and land use.

On July 27, 2016, the City adopted amendments to its General Plan and Elk Grove Municipal Code (EGMC) Title 23 (the Zoning Code) to comply with the requirements of SB 5 and SB 1278. These amendments included:

A. Identifying 100 and 200-year floodplains and required development standards.

B. Prohibiting approval of building permits, entitlements, tentative maps, or parcel maps for a project that is within the 200-year floodplain unless it has met one or more of the following findings:

   1. The project has an Urban Level of Flood Protection (ULOP);
   2. Conditions imposed on the project will provide for an ULOP;
   3. Adequate progress has been made toward construction of a flood protection system to provide an ULOP for the project;
   4. The project is a site improvement that would not result in the development of a new habitable structure. Improvements that qualify for the exemption include, but are not limited to, the replacement or repair of a damaged or destroyed habitable structure with substantially the same building footprint area, interior repairs or remodels to existing structures, and new nonhabitable structures.

Concurrent with these changes, the City also adopted new Flood Damage Prevention regulations (EGMC Chapter 16.50) to address design and construction requirements for projects within the 100-year floodplain consistent with federal and state regulations.

As part of the General Plan amendments, Policy SA-21 was adopted, which directs the City to work with other regional, county, and state agencies to develop mechanisms to finance the design and construction of improvements to achieve an urban level of flood protection in affected areas. Staff coordinates regularly with regional agencies including the Sacramento Area Flood Control Agency (SAFCA) and Sacramento County Department of Water Resources to identify regional projects affecting Elk Grove and potential funding opportunities.

ANALYSIS

The 200-year floodplain does not have a direct relationship with the Federal Emergency Management Agency (FEMA) National Flood Insurance Program requirements; the insurance requirements only apply to properties located in FEMA mapped 100-year floodplains. Furthermore, the Laguna West levee system has been accredited by FEMA as meeting 100-year standards and and provides properties in the Laguna West and Lakeside areas with significant flood protection.

At the January 10, 2018, Council meeting, staff provided information on the 200-year floodplain and Urban Levee Design Criteria (ULDC) and provided results from the Laguna West Levee System Problem Identification Report (PIR), prepared by MBK Engineers (MBK). Results from the PIR indicated that the Laguna West levee system would need to be raised by an average of approximately 3.5 feet in order to comply with the 200-year flood protection standard. The PIR identified an estimated cost of approximately $12.2 million to raise 4.5 miles of existing Laguna West levees by 3.5 feet, with an additional $3.0 million that may be required to extend the levees in some areas. This estimate only covers the improvements needed to raise and extend the levees. As stated in the PIR, along with the need to raise the height of the levees, there is also the potential for under-seepage and stability issues within the levee system. The potential costs to address these issues could add anywhere between $7 million and $30 million to the cost of achieving 200-year flood protection.

Upon receiving the PIR in 2018, Council directed staff to research other flood control projects being constructed in the region and their potential for lowering the 200-year water surface elevation (WSE). Staff tasked MBK with updating the flood depth map and 200-year WSEs for the Laguna West Levee system area. The updated map is included with this report as Attachment 2. As discussed in the attached Technical Memorandum (Attachment 1), MBK constructed a hydraulic model from existing models, with the most current hydrology applied and breach parameters selected, to evaluate the floodplain that has a 1-in-200 annual exceedance. The results of the study revealed that there was no significant change in the 200-year WSE from what was reported to Council in January 2018.

At this time, staff does not recommend moving forward with levee improvements, due to lack of funding. Furthermore, the City has already complied with requirements of SB 5 and 1278 by incorporating additional flood risk considerations into floodplain management and planning by amending the City's General Plan and Zoning Code to include development requirements for proposed projects within the 200-year floodplain. No further action by the City is required in order to comply with SB 5 and 1278.

There is a need to assess the condition of the existing Laguna West Levee System to determine the potential for under seepage and stability issues. As stated above these levees provide properties in the Laguna West and Lakeside areas with protection from a 100-year flood as currently defined by FEMA. Decertification of the levees due to structural deficiencies would result in these areas being entered into the 100-year floodplain, thus requiring all properties in these areas to obtain flood insurance. The structural integrity of the levees has not been fully assessed since their construction in the 1990s. The first step in conducting a levee condition assessment is to perform geotechnical data collection and analysis of the levee system. The estimated cost of performing this geotechnical analysis is $520,000 and has been included in the City's current fiscal year budget. Staff recommends moving forward with the geotechnical analysis by conducting a consultant selection process and entering into a consultant contract for these services, which would be returned to the City Council for consideration and approval. Once the geotechnical analysis is complete, staff would return to the City Council with the results and information on whether improvements are needed to maintain the 100-year flood protection rating.

ALTERNATIVE ACTIONS:

Staff met with representatives from the Sacramento Area Flood Control Agency (SAFCA) and the County of Sacramento Department of Water Resources to discuss potential regional opportunities that may be available that could benefit the City. Staff was informed that the rural reach of the Sacramento River levee (east-side), downstream of the Beach Lake Levee could be strengthened and the improvements would need to meet FEMA and ULDC standards. Preliminary costs for this project are estimated at $15 million per mile. With approximately six to nine miles of levee needing to be improved, the total cost could range from $90 million to $135 million.

Due to the greater cost, the location of the improvements (outside of the City limits), lack of project control due to coordination with various partnering agencies and other unknown factors – most notably right-of-way acquisition – staff does not recommend pursuing this alternative.

FISCAL IMPACT:

The FY2019-2024 Capital Improvement Program (CIP) and FY2019-2020 Budget include funding for the geotechnical investigation in the amount of $520,000. Should the City Council direct staff to move forward with this effort, the funding is available for work to proceed immediately following consultant selection.

ATTACHMENTS:

1. MBK Technical Memorandum
2. 1-in-200 Year Floodplain Map

MBK ENGINEERS
Water Resources ◆ Flood Control ◆ Water Rights

TECHNICAL MEMORANDUM

DATE: March 12, 2019

TO: Amittoj Thandi, P.E., City of Elk Grove

PREPARED BY: Brian A. Brown, P.E.

REVIEWED BY: Don Trieu, P.E.

SUBJECT: Determination of 1-in-200 Year Floodplain for City of Elk Grove Laguna West Area Urban Level of Flood Protection (ULOP) Determination

1.0 Introduction

In 2007, the California legislature enacted Senate Bill 5 (SB 5) in order to strengthen the link between flood management and land use. SB 5 relied on the due diligence of cities and counties to incorporate flood risk considerations into floodplain management and land use planning. The provisions of SB 5 require cities and counties within the Sacramento-San Joaquin Valley to make findings related to an urban level of flood protection (ULOP). A finding necessary for the ULOP determination is to demonstrate that property within an urban or urbanizing area is protected from the 1-in-200 chance of flood occurrence[1].

2.0 Purpose

The California Department of Water Resources (DWR) developed the Urban Level of Flood Protection Criteria, in order to fulfill the requirements that were outlined in the 2007 California Flood Legislation, and later amended by subsequent legislation; specifically, California Government Code Section 65007(n):

> "Urban level of flood protection" means the level of protection that is necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year using criteria consistent with, or developed by, the Department of Water Resources. Urban level of flood protection shall not mean shallow flooding or flooding from local drainage that meets the criteria of the national Federal Emergency Management Agency standard of flood protection.

To meet the requirements of SB 5, on July 27, 2016, the City adopted amendments to its General Plan. These amendments included:

[1] The flood with a 1-in-200 chance of occurring in any given year is also known as the 1-in-200 annual exceedance probability (AEP) flood or 200-year flood.

- An amendment to the Safety Element of the General Plan that prohibits the City from approving a building permit or entitlement, or approving a tentative or parcel map for a project that is within the 200-year floodplain, unless that project provides an Urban Level of Flood Protection (ULOP).
- An amendment to the Elk Grove Municipal Code (EGMC) Section 23.42.040, which will include both 100- and 200-year floodplains, and identify required development standards.
- The addition of EGMC Chapter 16.50 (Flood Damage Prevention).

As part of the Safety Element of the General Plan, a 200-year floodplain was previously developed for the City. MBK Engineers (MBK) has been tasked with updating the flood depth map and 200-year water surface elevation (WSE) for the Laguna West Levee system. This memorandum documents the analysis.

3.0 Methodology

In order to evaluate the floodplain based on a levee failure, hydrologic input; geotechnical information; and a riverine and floodplain model are needed. The hydrologic data for the rivers is needed to quantify the flows for the 1-in-200 AEP flood. The riverine model is needed to route the flow in the riverine system, and to quantify the flow that leaves the riverine system, as a result of a simulated levee breach. Overland flow hydraulics will be computed to route the levee breach flows in order to quantify the depths of flooding and the inundation extents. Geotechnical information is also needed to determine the parameters for the levee breach.

4.0 Hydrology

The hydrologic inputs for the hydraulic model come from three different sources: the Central Valley Hydrology Study (CVHS), by DWR, used for the Sacramento River system; the Cosumnes River and Mokelumne River watersheds hydrology, by David Ford (Ford, 2004), used for the North Delta area; and the South Sacramento Streams Group (SSSG) Hydrology, developed by CDM in association with HDR, and the Sacramento Area Flood Control Agency (SAFCA) used for Morrison Creek (CDM, 2003). The Cosumnes River and Mokelumne River Watersheds hydrology and the SSSG hydrology are appropriate for use, as developed in a 1-in-200 AEP analysis.

Hydrologic inputs to the Sacramento River System portion of the hydraulic model are based on the CVHS. The only local application of CVHS hydrology is taken from the guidance DWR provided for the development of the SB 1278/Assembly Bill (AB) 1965 ULOP informational maps for the Sacramento area. In this guidance, storm patterns and scalings were defined for the 200-year and 500-year events for the Sacramento area, close to the confluence with the American River. The centerings do not consider the North Delta area, downstream of the Sacramento Urban Area or the Folsom Joint Federal Project (JFP). Due to these factors, the CVHS methodology had to be applied to develop CVHS based hydrology for this analysis.

To develop 200-year hydrology appropriate for the Elk Grove area that is consistent with CVHS procedures, the CVHS 1986 storm pattern was used to produce scaling factors for the Sacramento and American rivers. A scaling factor of 140% was used for the American River, and a scaling factor 90% was used for the Sacramento River. These scalings were used to compute the Pocket Area Levee Design Water Surface Elevation (WSE) for the Sacramento Area Flood Control Agency (SAFCA) levee certification project. The hydrologic analysis used to develop the CVHS scalings, and the coincident peak analysis used to correlate the timing of the peaks to the other hydrologic input, is documented in Appendix A.

5.0 Hydraulic Model

A hydraulic model will need to be constructed from existing models, with the latest hydrology applied and breach parameters selected, to evaluate the floodplain that has a 1-in-200 AEP.

There are existing HEC-RAS models for the Sacramento River System, North Delta, and SSSG streams. HEC-RAS is a computer software program developed by the U.S. Army Corps of Engineers (USACE), specifically the Hydrologic Engineering Center (HEC), for public use. The software is designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels. The software models riverine areas with cross sections, and overland floodplain areas with storage areas, connecting the two with lateral weirs that compute flow that overtops the riverine levees and flows into the overland floodplain.

5.1 Sacramento River System Model

The Sacramento River System model is the Central Valley Floodplain Evaluation and Delineation (CVFED) model, developed by DWR, and used to quantify and route flows in the Sacramento River. This model contains the complete Sacramento River Flood Control System, including the Sutter and Yolo bypasses, from Shasta Lake to the San Francisco Bay. The system model was truncated to only include the reaches necessary to evaluate potential levee breaches that could inundate the Elk Grove area – specifically the Sacramento River, downstream of Verona to the confluence of Steamboat Slough; the American River; and the flow Split at the Sacramento Weir.

The truncated model was calibrated to the 2006 event, and verified to the 1997 event. The calibration used gages on the Sacramento River: at Verona, above Freemont Weir, I Street, Freeport, Snodgrass Slough, Walnut Grove, and Georgiana Slough; on the Natomas East Main Drainage Canal: at Arcade Creek and Jefferson; Georgiana Slough at the Sacramento River; Miner Slough at the Highway 84 bridge; and on Steamboat Slough at Sutter Slough. The purpose of the calibration and verification was to ensure that when truncating the large DWR system model, it could accurately reproduce historic stages above and below the confluence of the American River.

5.2 SSSG Hydraulic Model

The hydraulic model for the SSSG stream system was developed for the *SSSG Letter of Map Revision* (Wood Rodgers, 2013), updated with the Florin Creek channel widening and off-site detention basin. The model extends, from directly upstream of the Union Pacific Railroad (UPRR) tracks for each stream, to just downstream of Interstate 5 on Morrison Creek. In addition to the major streams, the model includes overbank storage areas, detention basins, and the drainage pumps that pump the storm water into the streams. The model was truncated to Franklin Road on the upstream end, in order to simplify the model, as these upstream reaches are not needed for the study area. The output from the complete model was used at the upstream boundary conditions at the truncated locations.

5.3 North Delta Hydraulic Model

MBK Engineers developed the hydraulic model for the North Delta in 2003 for a regional study, tasked with examining flood control and ecosystem improvements. The model simulates the Cosumnes River, Dry Creek, Mokelumne River, Beach Stone Lake floodplain, and the Franklin Pond.

In 2014, MBK updated the 2003 model to reflect new topographic and bathymetry data in the region. The model was also truncated at the Cosumnes River at Highway 99 to simplify the model, as these upper reaches are not needed for the North Delta area. Once the model was truncated, the output from the 2003 model at these locations was used as an upstream boundary condition for the truncated model. The truncated model was then converted to the NAVD88 datum, and updated in order to reflect the most recent available topography in the region. The topography used includes the CVFED LiDAR (DWR, 2008), DWR digital elevation maps for the San Francisco Bay and Sacramento-San Joaquin Delta (Wang, 2012), and bathymetric surveys acquired by MBK in 2004.

The model was calibrated to the 1997 event and then verified to the 1995 event, ensuring that the model represented the terrain, prior to the Cosumnes River Mitigation Bank Project, as this regional project reflects the current condition, but was constructed after the calibration and verification events. The model was then updated with the design levee elevations for the Laguna West Levees based on as-built and improvement plans, provided by the City of Elk Grove and Sacramento County. The updated Laguna West levees are shown in Figure 1.

Figure 1. Laguna West Levees Updated Based on As-Built Plans

5.4 Combining Hydraulic Models for Analysis

The individual truncated models for the Sacramento River System, North Delta area, and SSSG system described in the previous sections need to be combined to form one model for the area. The new combined hydraulic model will allow flow to be routed from a levee breach on the Sacramento River over the adjacent lands to compute a resulting WSE along the Laguna West Levees.

The first step in combining the hydraulic models was to add the truncated model of the Sacramento River System to the North Delta hydraulic model. Where both models had the same overbank storage areas, the storage areas from the North Delta model were used, as they were defined on a smaller scale than the larger overbank storage areas in the Sacramento River System model. The lateral structures in the hydraulic model, which represent the berms in the floodplain, we adjusted to ensure they accurately represented the underlying terrain and that the models had hydraulic connections between them. The truncated model for the SSSG system was then added to this hydraulic model, with lower Morrison Creek as the tie-in point for the two models. For the overlapping portion of lower Morrison Creek, in the two models the definition from the

SSSG model superseded Morrison Creek from the North Delta model. The combined hydraulic model to be used to compute the resulting WSE from the levee breaches is shown in Figure 2.

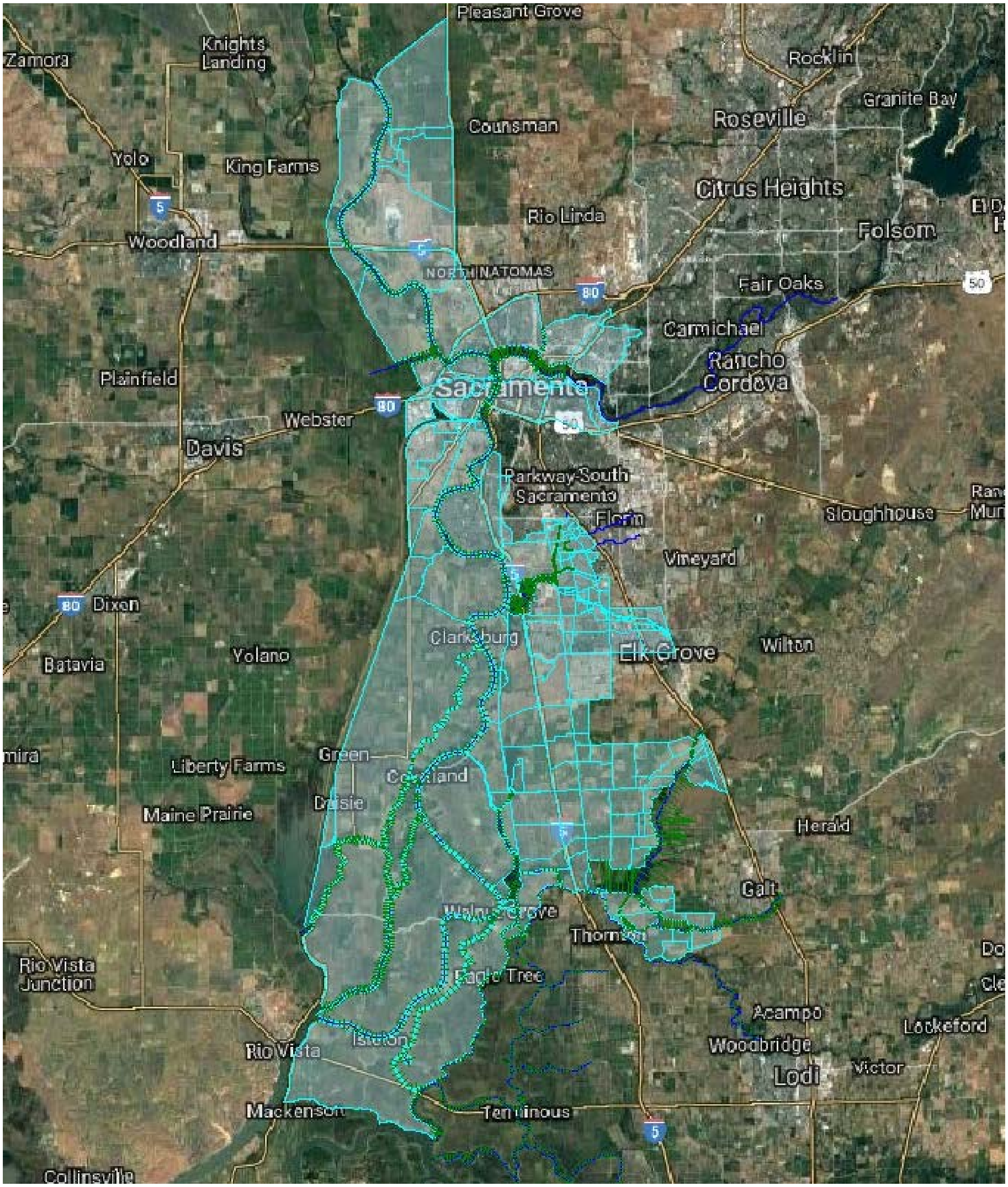

Figure 2. Combined Hydraulic Model

6.0 Analysis

With the hydraulic model configured and hydrology selected, the model can be used to route the flows for a flood that has a 1-in-200 AEP. The storage area in the hydraulic model will allow flows to leave the riverine system based on a levee failure. The floodplain that has a 1-in-200 AEP will be determined for the following two scenarios:

Scenario 1: A breach on the non-urban levee of the Sacramento River levee, downstream of Freeport, with Laguna West levees overtopping without failure.

Scenario 2: A breach on the non-urban levee of the Sacramento River levee, downstream of Freeport, with Laguna West levees failing.

All other levees in the system will be assumed not to fail, and will act as weirs if overtopped.

6.1 Analysis Assumptions

The analysis assumes current conditions with consideration for Urban Levee Design Criteria (ULDC) developed by DWR. The ULDC provides guidance for design, evaluation, operation, and maintenance of levees and floodwalls that provide protection from a 1-in-200 AEP event. To be consistent with ULDC analysis the following assumptions were incorporated into the Sacramento River system model:

- Urban levees were assumed to be no less than the 200-year WSE plus 3-feet of freeboard
- The non-urban levees were assumed to be no less than the authorized height, based on the 1957 USACE design profile
- All levees were assumed to overtop without failure
- Debris loading for bridges was considered
- Sea level rise was included in the downstream boundary condition (approximately 1-foot in the San Francisco Bay [OPC-SAT, 2017])

This analysis assumes the DWR Lower Elkhorn Basin Levee Setback (LEBLS) Project is implemented, which includes setting back the north levee of the Sacramento Bypass, and the east levee of the Yolo Bypass in the Lower Elkhorn Basin. This project is currently in the design phase and is anticipated to be completed in 2022. This project will reduce flood stages on the Sacramento River, downstream of the Sacramento Weir.

This analysis assumes McCormack-Williamson Tract levees are at pre-February 2017 flood elevations. High flow rates on the Cosumnes River and stages in the Franklin Pond caused the levee along the Mokelumne River levee to breach. This breach is located downstream of the east levee of McCormack, and would not have a significant impact to the water surface elevations in the Laguna West area.

Currently, The Nature Conservancy (TNC) and DWR are undergoing a design study to construct a multi-benefit project on McCormack-Williamson Tract. The project would consist of degrading the east and southwest levees. Degrading the levees would allow for habitat restoration and allow floodwaters to flow through the tract during large flow events. Once the project is complete, the additional floodplain storage could lower water surfaces in the region. The reduction in water surface associated with this project is unclear, as there are environmental constraints the team is working through that may limit the ability to degrade the existing east levee. Due to the uncertainty concerning what the project will accomplish (from a water surface reduction standpoint, as well as the timing of construction), this project is not included in the hydraulic analysis.

6.2 Scenario 1: Sacramento River Breach

As part of the DWR CVFED program, DWR developed reliable levee height elevations based on geotechnical information from DWR Urban (ULE) and Non-Urban Evaluation Program (NULE). These reliable levee height elevations are defined as the height of floodwater, for which the levee meets accepted performance or design criteria. The methods for describing the levee reliability data are documented in the *Levee Reliability Technical Memorandum,* dated September 27, 2012, and the *Addendum to Levee Reliability Technical Memorandum,* dated July 9, 2013, prepared by URS for DWR. Levees that provide protection to populated areas were designated as urban, and underwent a higher level of geotechnical evaluation. Levee geotechnical reliability information was derived from levee geotechnical investigations, data, analyses, and levee performance assessments, which have been completed to date, under DWR's ULE and NULE programs.

For this mapping effort, it was assumed that the levee breach would be triggered when the water surface reached the reliable levee height. The breach trigger elevation was set from the top of levee elevation, minus the levee reduction height for each levee segment (URS, 2012; URS, 2013a). Along with this method to determine the trigger elevation, the previous levee breach methodology parameters were used for SB 1278/AB 1965 ULOP informational maps, specifically:

- Weir coefficient of 2.0
- Breach formation time of 6 hours
- Breach width 50 times the difference between top of levee and landside toe elevation
- Breach bottom elevation at the levee toe elevation
- Breach trigger elevation at the reliable levee elevation (which is the top of levee minus the geotechnical reduction height from ULE/NULE program)

The above methodology was used, with the exception of the breach width. With respect to the breach width, 50 times the difference between the computed 1-in-200 AEP peak WSE and the toe of levee was used, which is more realistic for the area, based on the levee freeboard in the 1-in-200 AEP.

Four sights along the Sacramento River were reviewed and breached, as were the subsequent, downstream breaches of the abandoned railroad embankment. The ponding from the levee breach would likely cause the embankment downstream to fail. The location of each breach and the subsequent downstream embankment breaches are shown in Figure 3.

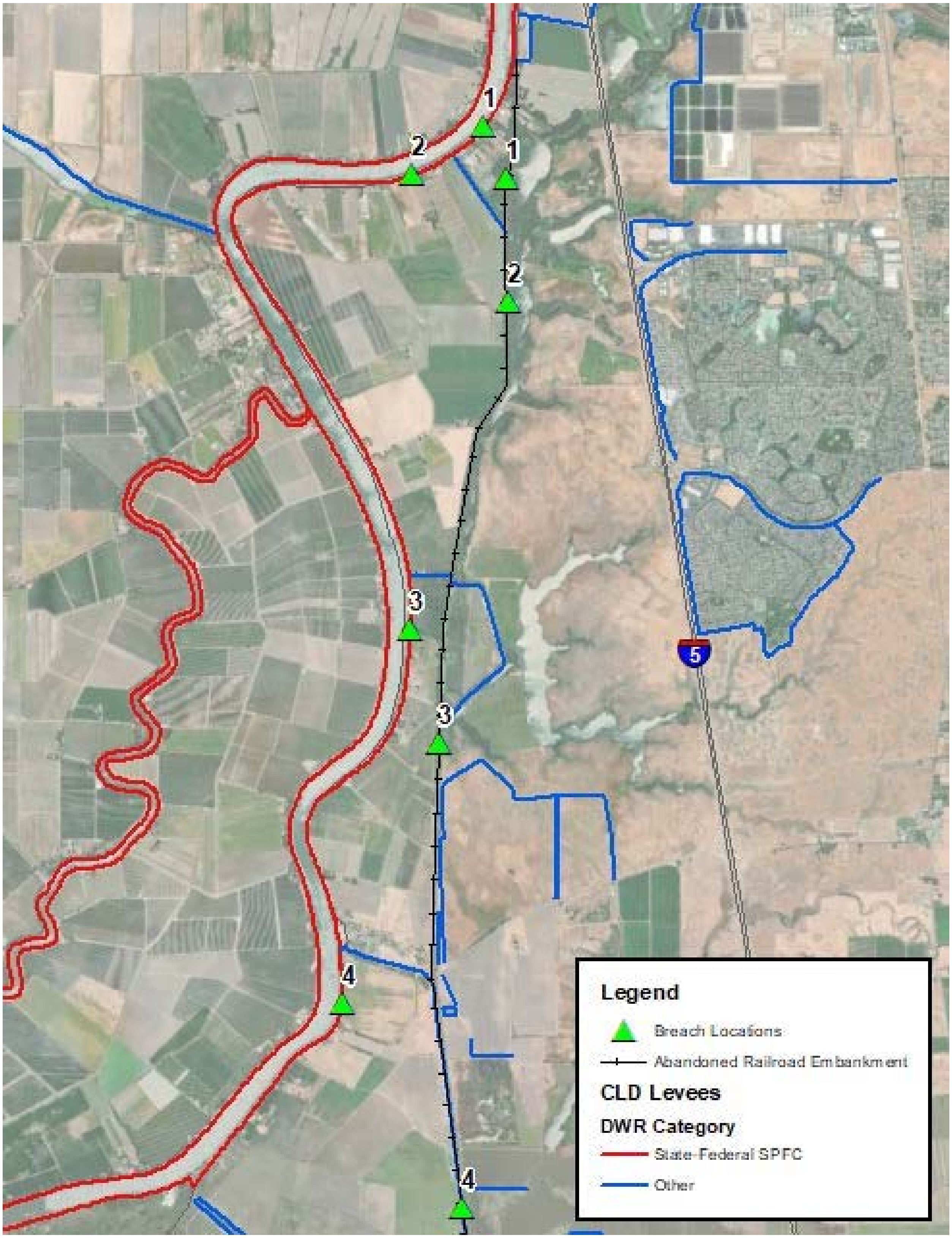

Figure 3. Sacramento Levee Breaches and Subsequent Downstream Embankment Breaches

6.3 SCENARIO 2: LAGUNA WEST LEVEE BREACHES

In Scenario 2, four levee breach locations were assumed. A breach location was chosen for each representative reach of levee that had different hydraulic conditions upstream and downstream. The breach locations are shown in Figure 4.

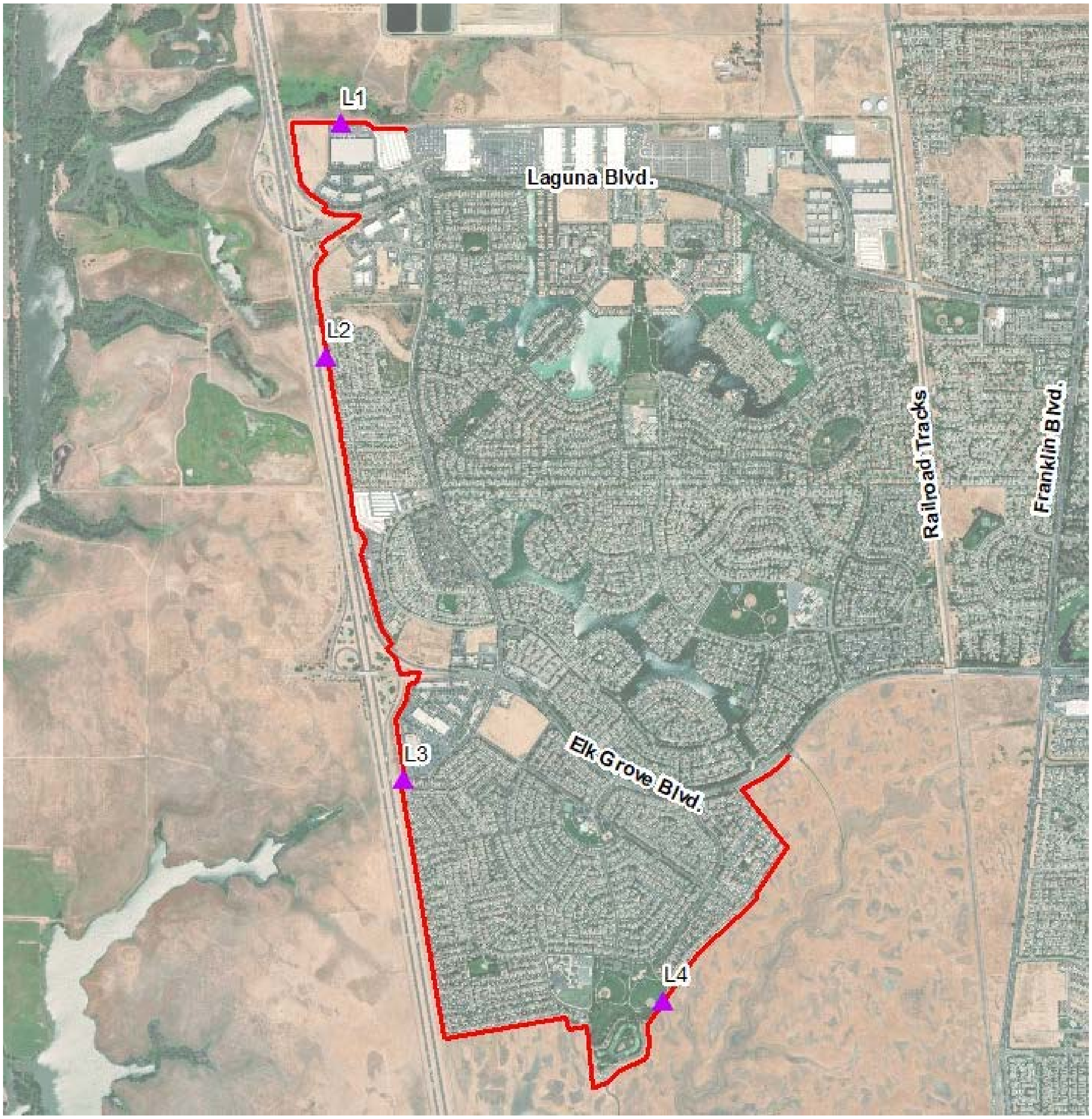

Figure 4. Laguna West Levee Breach Location

The breach parameters used to evaluate these levees will be based on a combination of CVFED and FEMA guidance, as appropriate for the area. The breach parameters are:

- Weir coefficient of 2.0
- Breach formation time of 6 hours

- Breach width of 500 feet (minimum FEMA breach width for sand and clay levees)
- Breach trigger elevation 3-feet below top of levee (there is no ponded water on levee in existing condition)
- Breach fails to toe of levee

The parameters for the levee breaches are listed in Table 1.

Table 1. Breach Parameters for Laguna West Levees (Elevations in NAVD88)

Breach Number	Top of Levee	Toe of Levee	Trigger Elevation	Breach Width (feet)
L1	21.7	16	17.7	500
L2	21.7	16	17.7	500
L3	21.7	17	17.7	500
L4	21.7	14	17.7	500

7.0 Results

The hydraulic model was configured with the hydrology, assumptions, and breach parameters described in the previous sections and simulated for Scenarios 1 and 2. For Scenario 2, each of the breach locations were simulated individually. Table 2 tabulates the maximum water surface elevation for the area behind the Laguna West levees, for all the simulation runs.

Table 2. Computed 1-in-200 AEP WSE (NAVD88)

Breach Number	200-yr WSE
Scenario 1	21.5
Scenario 2 L1	21.5
Scenario 2 L2	21.5
Scenario 2 L3	21.5
Scenario 2 L4	21.5

The analysis shows that the floodplain within Laguna West is the same for Scenario 1 (Laguna West levees overtop without failure) and Scenario 2 (failure of Laguna West levee system). This is due to the flat water surface elevation along the entire reach of the Laguna West levees and sufficient volume in Beach-Stone Lake to fill the floodplain behind the Laguna West levees in the event of overtopping, outflanking or failure of the levee. The resulting depth of flooding is shown on Exhibit 1. As per the *Urban Level of Flood Protection Criteria* (DWR, 2013), areas of flooding less than 3 feet of flood depth are exempt from SB 5.

REFERENCES

(CDM, 2003). *South Sacramento County Streams Project, Hydrology Review- Contract No. 501*. July 2003.

(DWR, 2008). Central Valley Floodplain Evaluation and Delineation program LiDAR, acquired in 2008.

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(Ford, 2004). *Cosumnes and Mokelumne River watersheds- Design storm runoff analysis*. David Ford Consulting Engineers. February 2004.

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(URS, 2012). *Levee Reliability Technical Memorandum*, September 12, 2012.

(URS, 2013). *DWR Levee Breach Database*. September 4, 2013.

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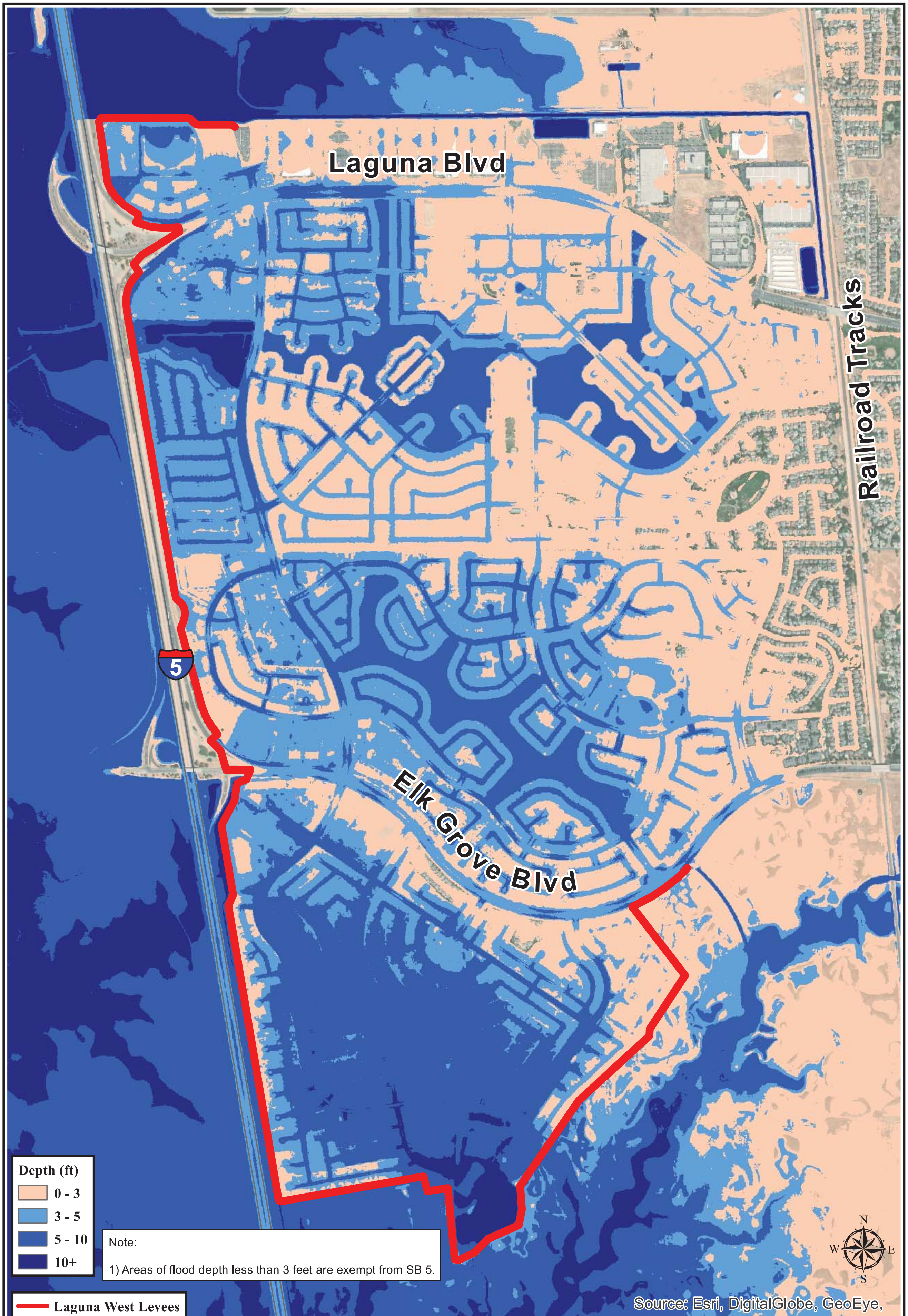
(Wang, 2012). *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Mars, 23rd Annual Progress Report to the State Water Resources Control Board*. "A Continuous Surface Elevation Map for Modeling" (Chapter 6). California Department of Water Resources, Bay-Delta Office, Delta Modeling Section. June 2012.

(Wood Rodgers, 2013). *South Sacramento County Streams Group Morrison, Elder, Florin and Unionhouse Creeks Application for Letter of Map Revision*. June 2013.



MBK ENGINEERS
455 University Ave, Suite 100
Sacramento, CA 95825
Phone: 916-456-4400 Fax: 916-456-0253
www.mbkengineers.com

City of Elk Grove Laguna West Area ULOP Determination

1-in-200 Year Floodplain

0 500 1,000
Feet

Exhibit 1

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Water Resources ◆ Flood Control ◆ Water Rights

TECHNICAL MEMORANDUM

DATE: August 29, 2018

TO: Don Trieu and Brian Brown

PREPARED BY: Ben Tustison, P.E.

SUBJECT: Development of 1-in-200 Year Sacramento River Centering for Elk Grove ULOP Finding

1.0 BACKGROUND

The Central Valley Hydrology Study (CVHS) was completed in 2015 (USACE, 2015). This work presented a new methodology for constructing hydrologic patterns on the Sacramento and San Joaquin River System in California's Central Valley. A key part of that methodology involved scaling historical flood events to desired frequencies, such as the 1-in-200 year flood event.

For the City of Elk Grove's (City) 1-in-200 year Urban Levee of Protection (ULOP) finding, it was determined that the failure of an event, centered on the Sacramento River System (Sacramento River centering), would provide the highest water surface for the City. This document provides the information that supports the development of that hydrologic dataset.

2.0 METHODOLOGY

2.1 SACRAMENTO RIVER - PATTERN AND MAGNITUDE

In order to construct a representative 1-in-200 year hydrologic dataset for the Sacramento River, the CVHS methodology was applied. This work was initially done on behalf of the Sacramento River Flood Control Association (SAFCA), to construct a 1-in-200 water surface profile in the Pocket Area of the Sacramento River, for an Urban Level of Protection (ULOP) finding. MBK Engineers (MBK) documented that work, and showed that a scaling factor of 140% was used for the American River, and a scaling factor 90% was used for the Sacramento River for the 1986 historical flood event. For more detail on the development of this pattern, please see the (MBK, 2016) reference at the end of this document.

2.2 COSUMNES/MOKELUMNE – MAGNITUDE

As with the Sacramento River watershed, the largest historical flood events on the Cosumnes/Mokelumne River system were the 1986 and 1997 events. This suggest that there is strong correlation between the flows in the Cosumnes/Mokelumne and Sacramento River watersheds for these large, system-wide events. Review of historical data and frequency estimates on the Cosumnes/Mokelumne system (Ford, 2004), indicated that the 1986 and 1997 flood events were nearly or slightly in excess of 1-in-100 year; therefore, more extreme than the estimated frequencies on the Sacramento River for those events. In Consideration of these facts, the 1-in-200 year Cosumnes/Mokelumne hydrology was adopted for the Sacramento River Centering used in this analysis.

The hydrologic data from Ford (Ford, 2004) was used for the North Delta Area (Cosumnes River and Mokelumne River watersheds) in constructing the Sacramento River centering. The 1-in-200 year event, specifically, was selected because it was one of the frequencies available from this hydrologic study.

2.3 South Sacramento Streams Group – Magnitude

The South Sacramento Streams Group (SSSG) includes Morrison, Elder, Florin, and Union House creeks. These are primarily foothill fed streams, which represent much smaller drainage areas than both the Sacramento and Cosumnes/Mokelumne River systems. As such, some of the largest historical storm events for the SSSG are not necessarily the same as those occurring at other watersheds. For example, the 1995 flood event was one of the largest in the SSSG, while this event was not in the top ten historical events for the Sacramento River system. Taking this into consideration, a 1-in-100 year event was assumed on the SSSG coincident with the 1-in-200 year Sacramento River centering. The 1-in-100 year event was specifically selected, because it was one of the frequencies available from the hydrologic study used (CDM, 2003).

2.4 Relative Timing

The 1997 flood event was used as the basis relative timing between flood flows on the Sacramento River and the Cosumnes/Mokelumne system. This event was selected, because it was the largest event for which data of the adequate hourly temporal resolution was available. As shown in Figure 1, from the available data it was determined that the Sacramento River at Freeport would peak 21 hours after the Cosumnes River at Michigan Bar. As such, the constructed Sacramento River centering adopted this timing differential for the 1-in-200 year flood event that was developed.

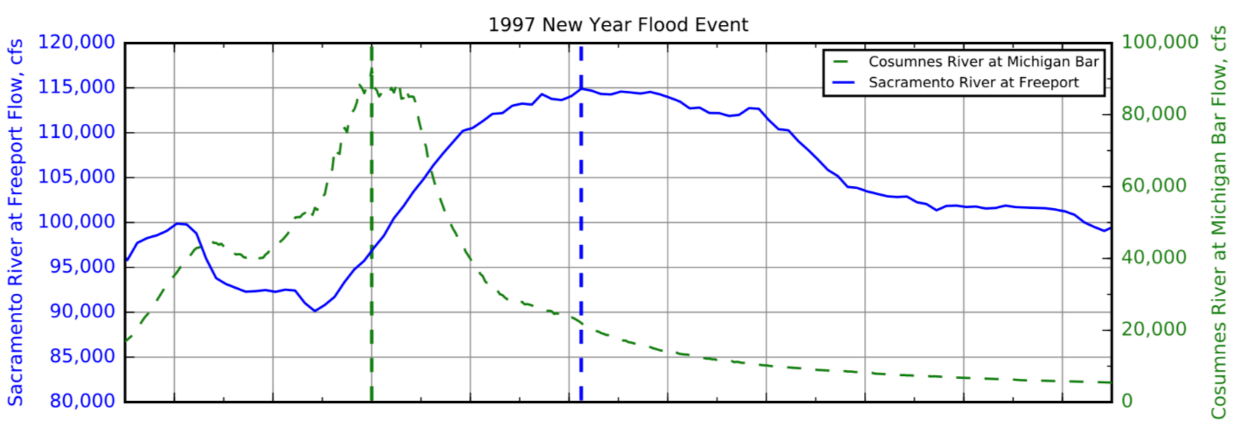

Figure 1. Comparison of flood peak timing from New Year 1997 flood event for Sacramento River at Freeport and Cosumnes River at Michigan Bar.

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(CDM, 2003). South *Sacramento County Streams Project, Hydrology Review- Contract No. 501*. July 2003.

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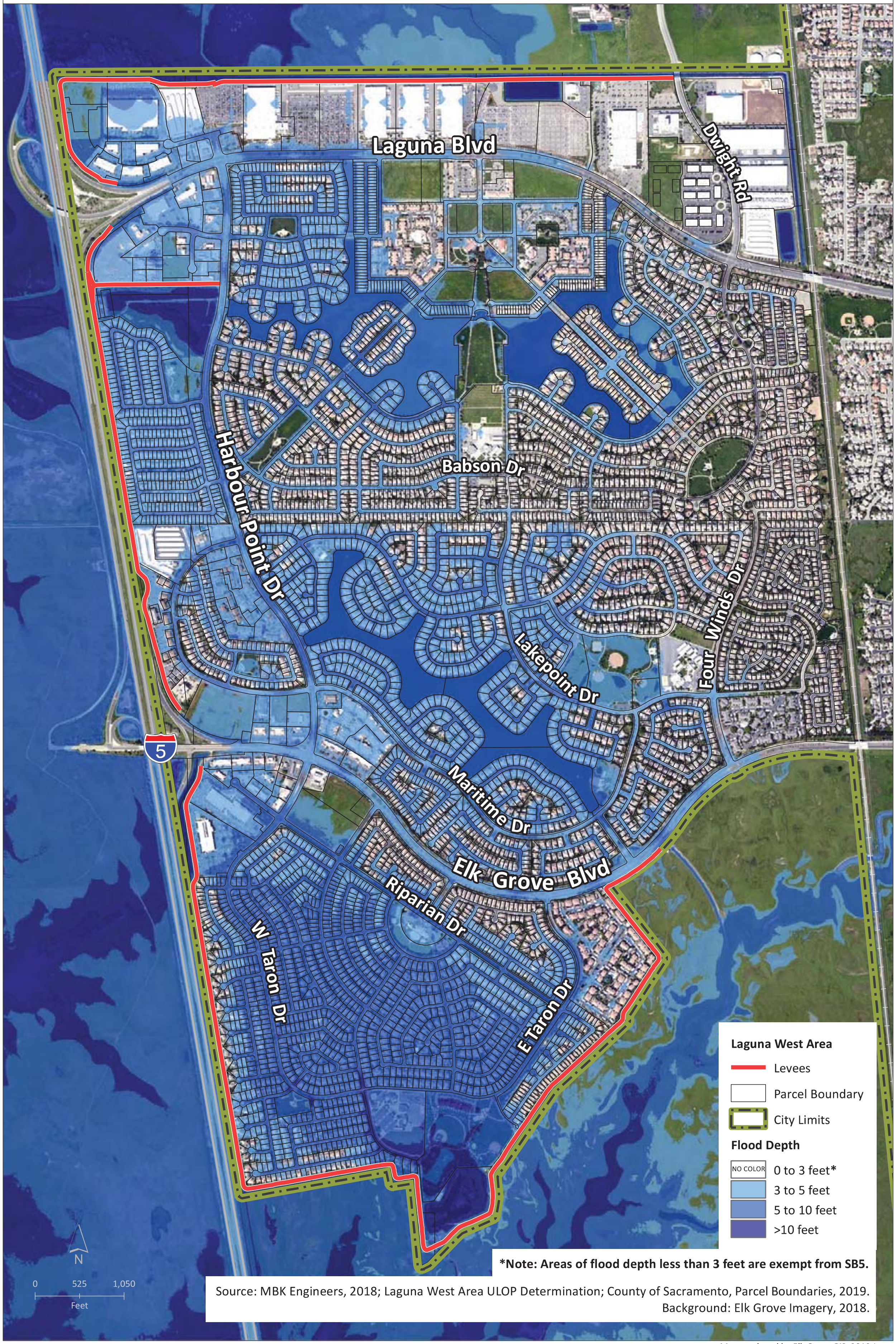
1-in-200 Year Floodplain



*Note: Areas of flood depth less than 3 feet are exempt from SB5.

Source: MBK Engineers, 2018; Laguna West Area ULOP Determination; County of Sacramento, Parcel Boundaries, 2019.
Background: Elk Grove Imagery, 2018.

Map produced by Elk Grove GIS, 2019 June.