TECHNICAL MEMORANDUM

WEST Consultants, Inc.
11440 W Bernardo Ct.
Suite 360
San Diego, CA 92127
(858) 487-9378
www.westconsultants.com

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To: Pauline Block
Company: CPSA Old Redwood Hwy, LLC
Date: 8/30/2024
From: David S. Smith, PE, CFM, BC.WRE
Subject: Adobe Lumber Fill Evaluation

Background

This technical memorandum describes the changes in the 100-year floodplain depths (increases and decreases) that would occur when removing approximately 11,500 cubic yards of fill at 5600 Old Redwood Highway North. The City of Petaluma (City) HEC-RAS 2D model v6.3.1 is the basis of this evaluation.

From a hydraulic perspective, the 11,500 cubic yards of fill introduces a "blockage" to the flow path of the Willow Brook breakout. This blockage has both positive and negative effects for nearby buildings, depending on whether flow is redirected towards or away from a particular street or structure. Two fill removal scenarios will be explored in this memo:

Scenario 1: 100% of fill blockage removed

Scenario 2: About 90% of fill blockage removed leaving a small strip of ground on the leading edge of the fill with the intent of replicating the flow split around the fill that occurs in existing conditions.

2D Hydraulic Model Edits

Model parameters such as Manning's *n* values, mesh extents and cell sizes, unsteady flows, and boundary conditions were not modified for this evaluation. The 24- hour 100-year storm event was used to evaluate the difference in flood depths, as this storm results in Willow Brook breakout flows towards the subject property.

The original topographic data is a DEM compilation that includes the County Veg Map topography with modifications to represent a bare earth terrain surface. This terrain was copied and the fill at 5600 Old Redwood Highway North was removed in the RAS Mapper utility using the terrain modification tool. Two terrain modifications were evaluated in this study. The modification identified above as Scenario 1 with 100% fill blockage removed was accomplished by lowering the terrain to match the surrounding grade (see Figure 1). The volume of fill removed was calculated using the geographic information system (GIS

[ArcMap10.5.1]) program as 11,690 cubic yards which is about 4.3 feet. The modification identified above as Scenario 2 with about 90% of fill removed was accomplished in the same manner as completed for Scenario 1, with the exception that fill was not removed at the upstream end to provide a similar flow distribution as existing conditions (see Figure 2).

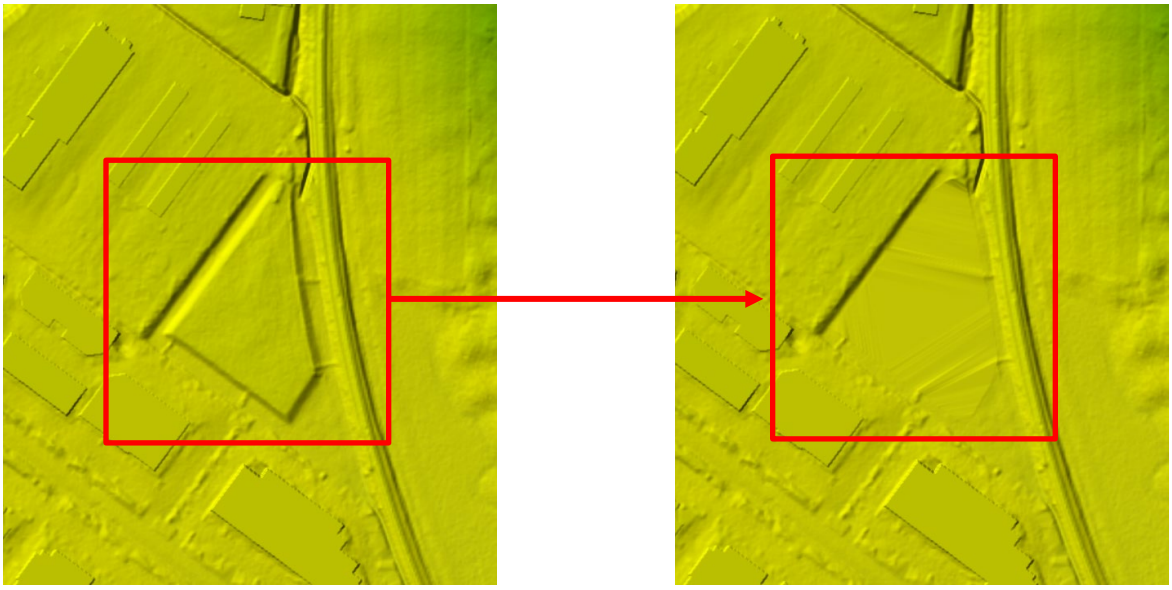

Figure 1: Existing terrain (left) and modified terrain for Scenario 1 - 100% of fill blockage removal (right).

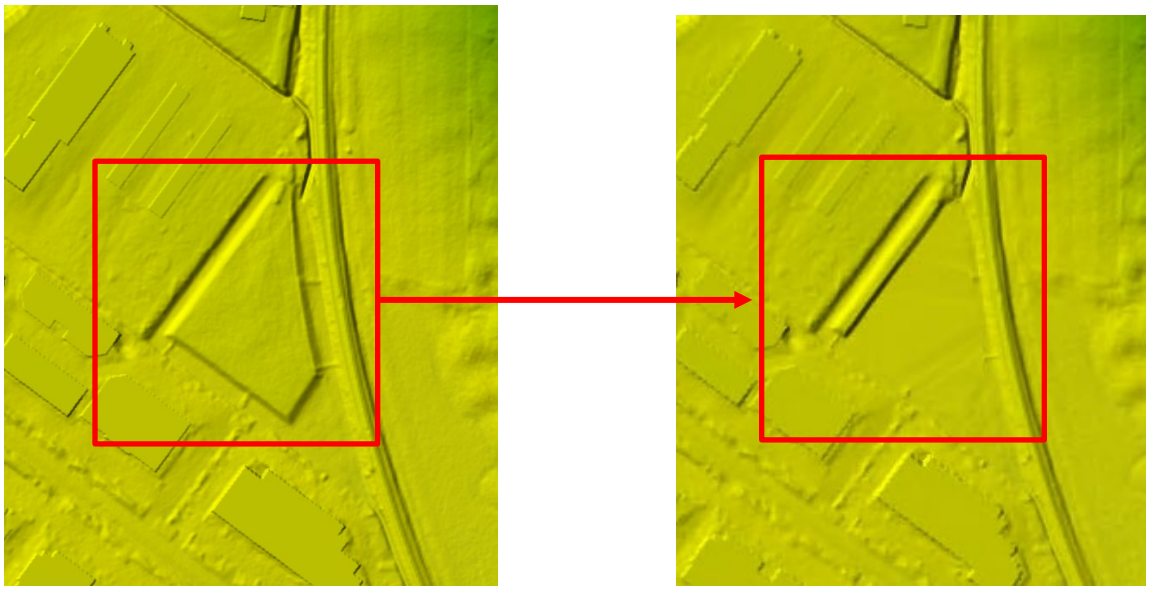

Figure 2: Existing terrain (left) and modified terrain for Scenario 2 – about 90% of fill removal (right).

Results

A comparison of 100-year depth results to existing conditions for Scenarios 1 and 2 are provided in Exhibits 1 and 2, respectively. The difference values are calculated as modified minus existing, so positive values (red) occur when depths with fill removal are greater than the original condition, and the negative values (green) occur when depths with fill removal are less than the original condition. The amount of depth reduction considered to be "significant" was selected as 0.01 feet, which is the standard used by FEMA in mapping determinations. Exhibit 1 and 2 values shaded either red or green are greater than 0.01 feet. The additional depth zones shown (0.01 – 0.05, 0.05 – 0.25, etc.) were included to illustrate how the depth differences vary spatially. In addition, the depth difference values at affected buildings are included as a positive or negative number to each affected building (positive corresponds to red or increase, and negative corresponds to green or decrease). The color white in Exhibits 1 and 2 indicate areas of no change.

The increases in depth that occur between the fill site and Willow Brook are due to flow getting redirected around the fill site in a different manner than existing conditions, resulting in slight increases in depth in affected areas. One example of flow redistribution is illustrated in Figure 3 for the profile line identified by the red circle. The flow hydrograph in the upper right corner of Figure 3 is for the location identified by the red circle. There are two lines in the flow hydrograph—the darker blue line is the Scenario 1 flow and the lighter blue line is the existing condition flow. The increase in flow with Scenario 1 is also evidenced by the high velocities (yellow and red colors in Figure 3) in Old Redwood Highway North. This is just one example of how flow is redistributed due to fill removal, and similar trends occur in both modeled scenarios.

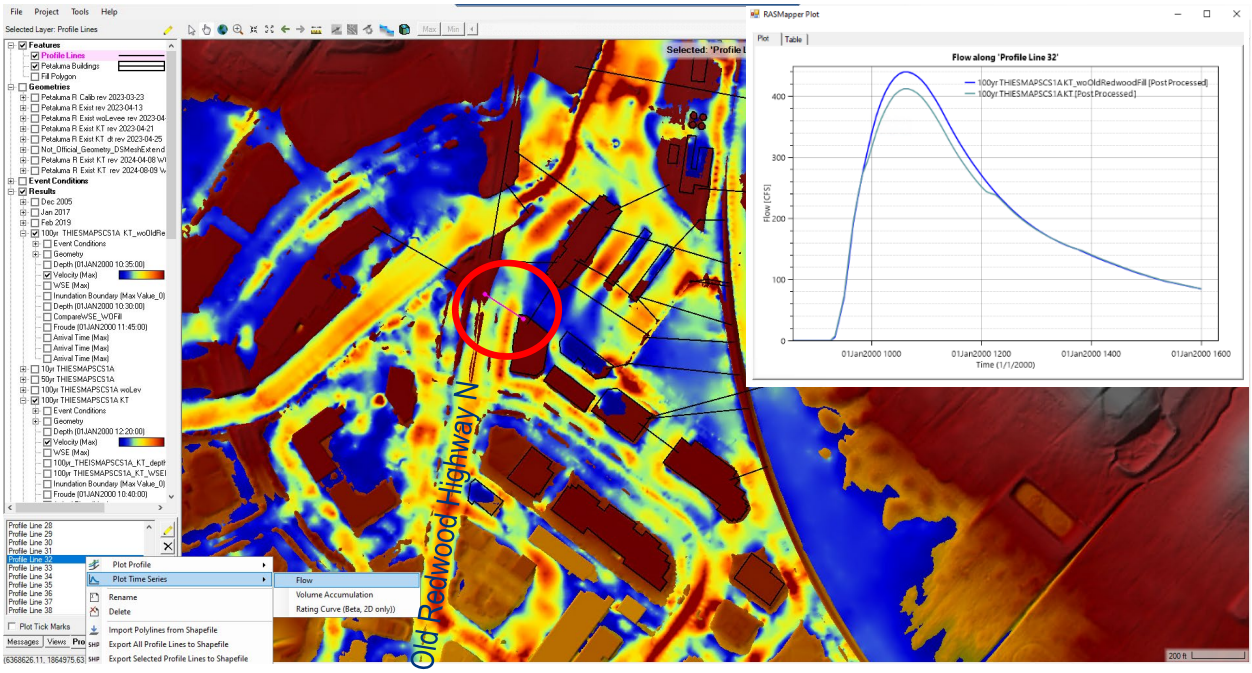

Figure 3. Scenario 1 maximum velocity and flow at selected location on Old Redwood Highway N.

Conclusions

Both fill removal scenarios result in flow changes compared to existing conditions which result in both depth increases and decreases for other nearby buildings. There is one building adjacent to the fill removal that

benefits more than any others, with a 100-year flow depth decrease of about 0.5 feet for both scenarios. Most other areas of increase and decrease are within the 0.01 to 0.05 range. However, because the depth reductions are not significant and there are increases in depth for other properties when fill is removed, the fill removal is not recommended. Additional depth increases for properties, whether they are within the effective 100-year floodplain or not, would not be tolerable unless there were significant benefits to the rest of the community—which is not occurring in this case.

Exhibit 1. Scenario 1 vs. Existing Conditions

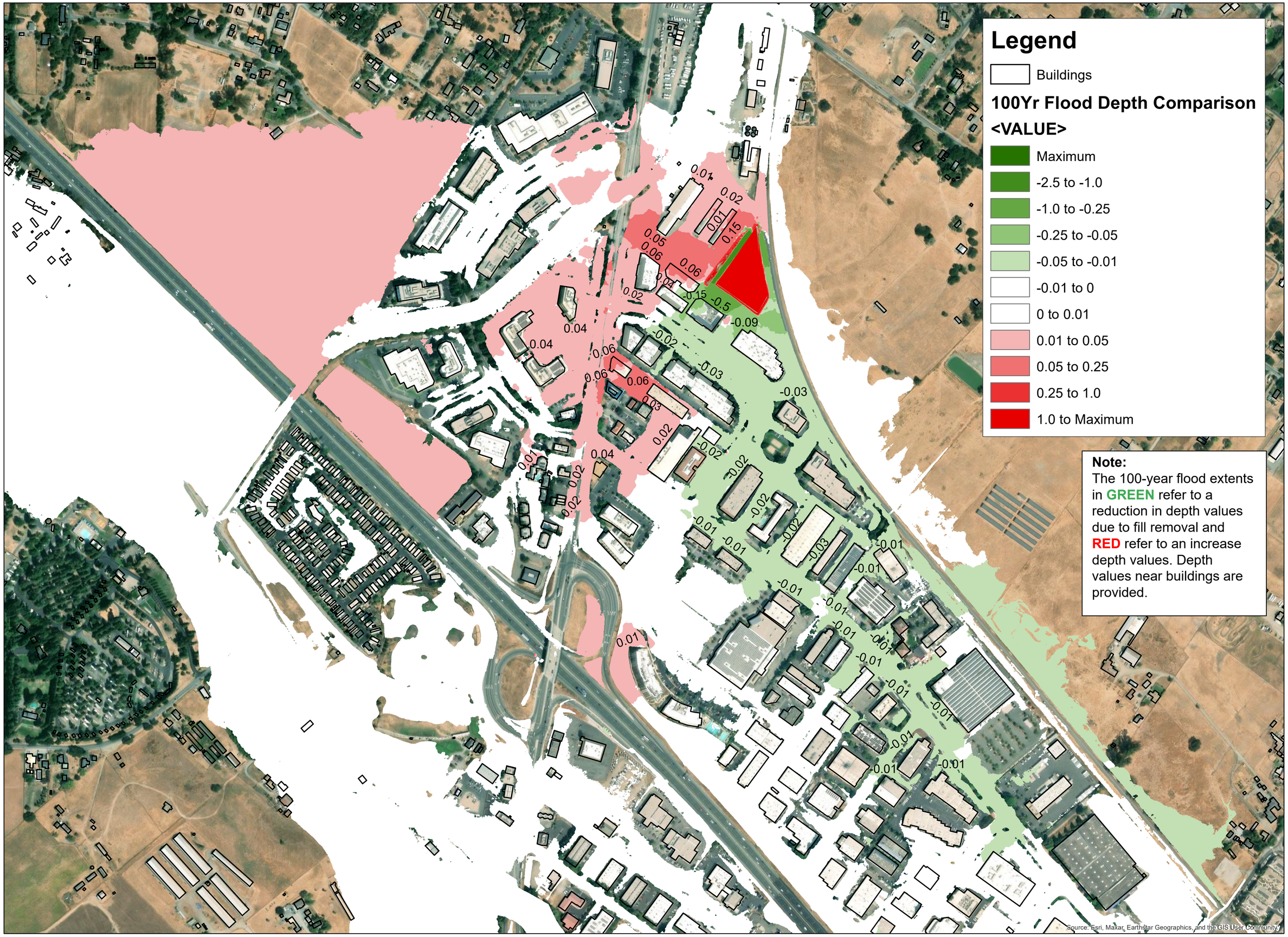

Exhibit 2. Scenario 2 vs. Existing Conditions