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Memorandum

Date: **January 7, 2022**

To: **John Pulliam, PE**
Kimley-Horn | 4637 Chabot Drive, Suite 300, Pleasanton, CA 94588

From: **Chris Sewell, Jeanette Newmiller, HDR | WRECO**

Subject: **Draft Santana Ranch Drainage System Interim Improvement Peer Review**

Summary of Recommendations

HDR | WRECO has reviewed the Swale Sizing Calculations for the Santana Ranch Development Project (Project) Drainage System performed by O'Dell Engineering (12/1/2021) and Drainage Improvement Plans (12/1/2021). These Improvement Plans are provided in response to the recommendations provided by HDR | WRECO (11/29/2021). The following summarizes our findings and recommendations in order of priority to reduce flooding along Fairview Road and the properties to the north of the Project.

1. The final Project is required to capture the 100-year event and discharge no more than the 10-year event. A 10-year event frequency was used to calculate the basin peak flow runoff for the interim drainage improvements. Increasing the event frequency to the 100-year event would increase the peak flow runoff by 33%. Confirm with the County that the 10-year event is sufficient for the interim drainage design.
2. The runoff coefficient, C of 0.4 was used in the peak flow runoff calculations. A value of 0.75 is recommended for compacted earth or aggregated base without paving due to the amount of heavy equipment activity on the drainage area. This leads to a 47% increase in peak flow runoff. This runoff coefficient would also reflect more saturated conditions with minimal attenuating surface ponding as observed at the site.
3. Ditch calculations use a Manning's n roughness coefficient of 0.03. This value is sufficient as long as the ditches are maintained and kept free of debris and long growth.
4. The grading plan calls out berm top elevations that in some locations appear to be at or below grade. The berm is adjacent to the swale and the elevation should be higher than the existing grade on the onsite side of the swale to provide protection from overtopping due to possible restrictions/ponding at the inlet.

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5. Increasing berm elevation near the basin inlet will provide additional storage at the basin inlet.

Details of the reviewed work can be found in the following sections.

Introduction

The Project is located east of Hollister in San Benito County, California (County). The Project is approximately 290 acres and is bounded on the west by Fairview Road near the intersection with Hillcrest Road. The Project design includes two drainage basins. Basin A is midway through the north edge and Basin B is at the northwest corner. The Project is currently partially built out.

In a letter dated February 3, 2021 from the County it was reported that discharge from Basin A is flooding neighboring properties and was described as "like a river". Flow from the Basin A area is also flooding Fairview Road at Mansfield Road. Additionally, it was reported that Basin B is flooding the existing drainage ditch on the east side of Fairview Road and encroaching onto the north bound lane.

After the initial recommendations made by HDR |WRECO (11/28/2021) O'Dell Engineering provided swale sizing calculations and grading for interim drainage improvements.

Purpose

The purpose of this study is to review the criteria and basis of design as well as the hydrologic and hydraulic analysis for the swale sizing calculations for the Santana Ranch drainage system interim improvements and proposed design improvements prepared by O'Dell Engineering. The purpose of these interim improvements is to provide flood protection from onsite runoff that is occurring during the phased building process of the Santana Ranch Development.

Equations Used

The design is based on County Code of Ordinances hydraulic criteria for improvement designs in subdivisions, Title 23, Chapter 31, Article III (Criteria).

Peak Flow for Watershed Runoff

Per Criteria § 23.31.041 on Design Storm Runoff, peak flow rates are determined using the Rational Method.

$Q = CIA$ where,

$Q =$ peak rate of flow in cubic feet per second
$C =$ Coefficient of runoff having a value between 0.0 and 1.0 depending on surface characteristics

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$I =$ The average intensity of rainfall in inches per hour for a duration equal to the critical time, usually the time of concentration
$A =$ The tributary area in acres corresponding to the critical time above

Swale Sizing

Swale sizing calculations use Manning's equation.

$Q = \frac{1}{n} A \left(\frac{A}{P}\right)^{\frac{2}{3}} \sqrt{S}$ where,

n = Manning's coefficient
A = Cross-sectional area (square feet)
P = Wetted perimeter (feet)
S = Channel Slope (feet/feet)

Work Reviewed

Printouts of spreadsheets used to perform the calculations are provided. Values in the spreadsheets were spot checked based on the respective equation used to ensure the spreadsheet was performing correctly. The values checked were all accurate within a reasonable difference from rounding.

The following sections include information on input parameters that were reviewed.

Intensity, I and Rainfall, R

As for the initial design work the intensity and rainfall depth for the Project were determined using the County isohyetal map 23.31.041(1), intensity duration chart 23.31.041(2), and volume chart 23.31.041(5) all provided in the Criteria. A mean annual precipitation (MAP) of 14 inches was used for the SD Calculations. The Project is located in an area with a MAP of 13 to 14 inches. Increasing the MAP will increase both the intensity and runoff volume. Using MAP equal to 14 inches would be recommended and conservative.

The final Project is required to capture the 100-year event and discharge no more than the 10-year event. A 10-year event frequency was used to calculate the basin peak flow runoff for the interim improvements. Increasing the event frequency to the 100-year event would increase the peak flow runoff by 33%. It should be confirmed with the County that the 10-year event meets the requirements for the interim drainage design.

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Runoff Coefficients

The County provides the basic runoff coefficients, C (see Table 1). The interim improvement calculations used a value of 0.4 for C, which corresponds to a midrange for hillside areas. However, considering the site has experienced some grading and use of heavy equipment this value is too low. It is recommended that a value of 0.75 corresponding to compacted earth or aggregated base without paving be used. A low estimate for C can contribute to a lower peak flow increasing C would provide a more conservative estimate of the peak flow rate.

Table 1. Basic Runoff Coefficients

Surface	Coefficients, C
Pavement	0.95
Roofs	0.80
Compacted earth or aggregated base without paving	0.75
Hillside areas (based on slope and soil character)	0.30 - 0.50
Lawns, open lands, agricultural fields and orchards	0.20

Source: San Benito County Table 23.31.041(1)

Drainage Area

The interim drainage improvements focus on three drainage areas that are portions of phase 9 and phase 11 of the development located at the northern most section of the site. The boundaries provided appear to be consistent with the available topography and capture the most likely sources of water that drain to the north and to Fairview Road (see Figure 1). There is an area east of Basin A that is not accounted for however, topography indicates this area should discharge east of the affected property.

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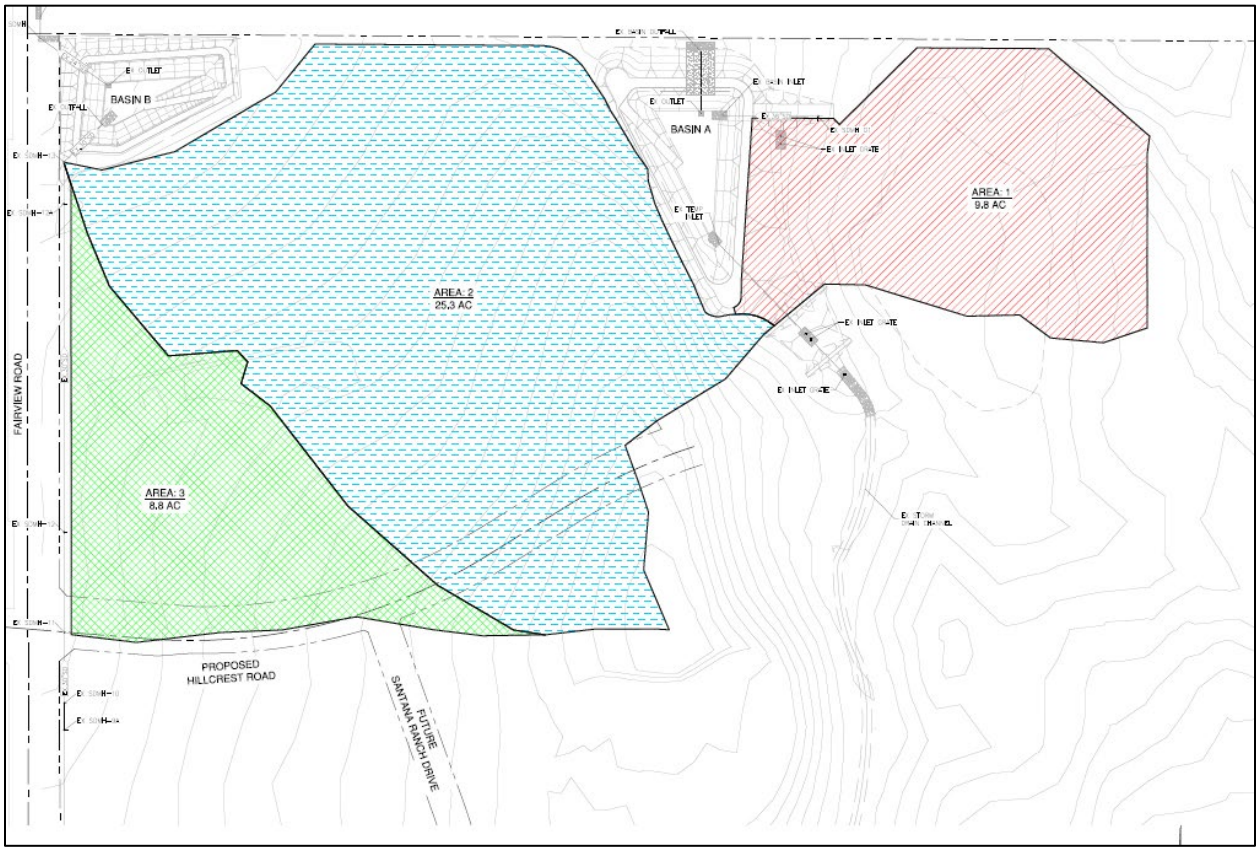

Figure 1. Drainage Areas for Interim Drainage Improvements
Source: O'Dell Engineering (1/12/2021)

Swale Sizing and Grading

The interim drainage improvements include a parallel swale and berm to bound portions of the undeveloped site on the north and west sides of the property. The berm is on the offsite side with the swale on the onside side (see cross section in Figure 2).

The swale calculations use a Manning's n roughness coefficient of 0.03. This value is sufficient as long as the swales are maintained and kept free of debris and weedy growth. The grading plan calls out berm top elevations that in some locations appear to be at or below grade as well as some swale location that appear to be at or above grade. It should be confirmed that at all

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locations the berm is higher than the existing grade and the swale is lower than the existing grade to ensure runoff is contained and routed to the basin. The berm is adjacent to the swale and the elevation should be higher than the existing grade on the onsite side of the swale to provide protection from overtopping due to possible restrictions/ponding at the basin inlet. Finally, there is an option of increasing berm elevation near the basin inlet to provide additional storage at the basin inlet and additional protection form restrictions/ponding at the basin inlet. See Figure 3 for a plan mark-up of these comments.

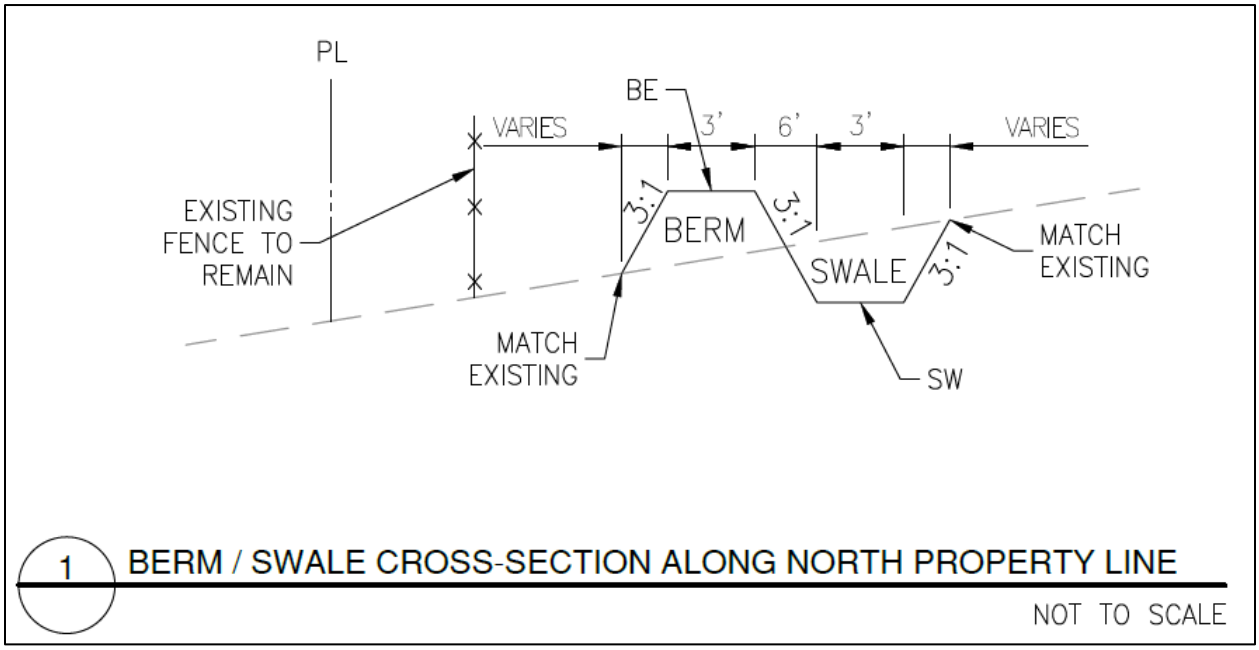

Figure 2. Cross Section of Swale and Berm Structure

Source: O'Dell Engineering (1/12/2021)

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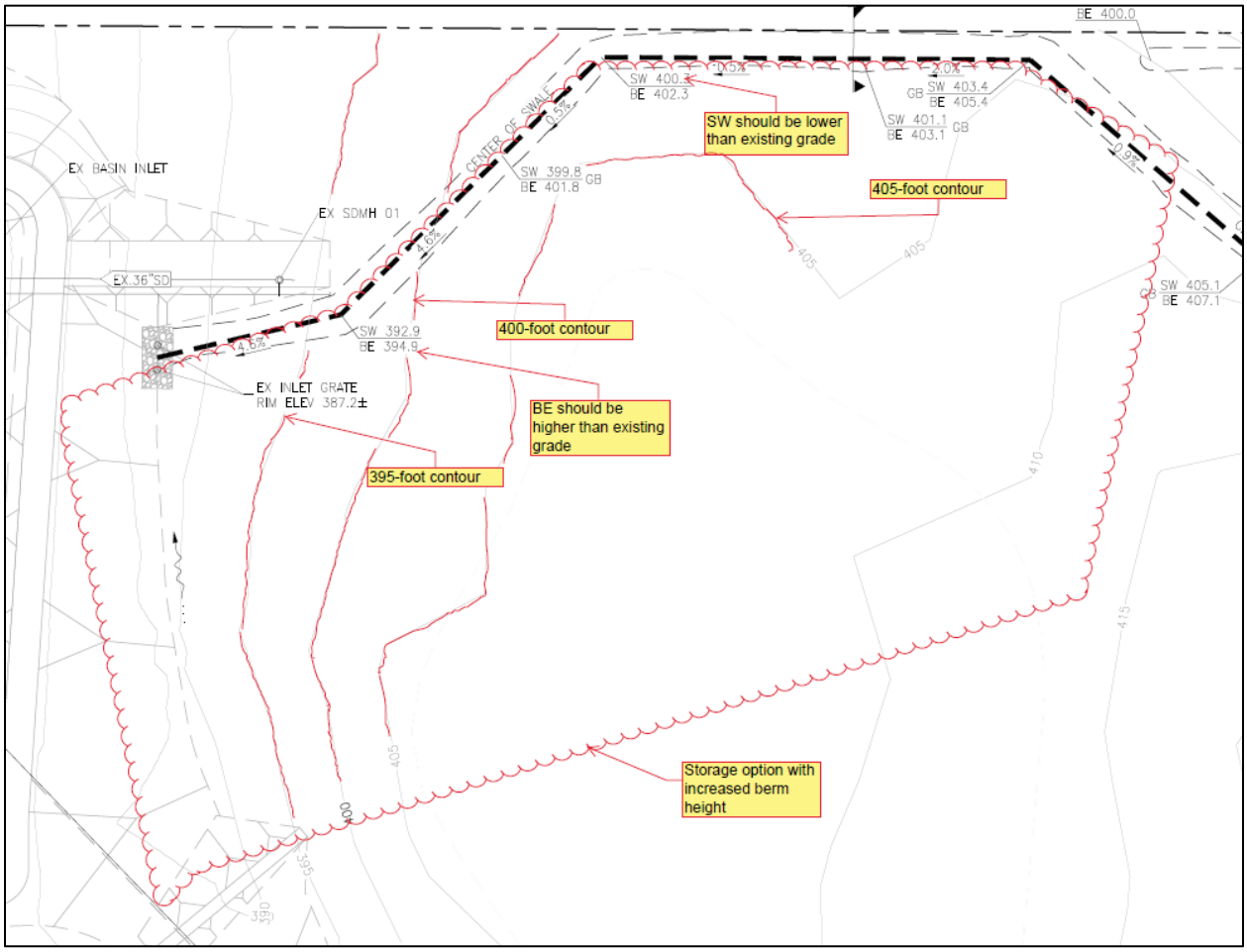

Figure 3. Grading Plan Mark-up

Source: O'Dell Engineering (1/12/2021)

Sensitivity

The runoff calculations were performed for a range of storm frequencies and runoff coefficients to determine the sensitivity to these values. Increasing the storm frequency to a 100-year event would increase the peak discharge rate by 33% Increasing the runoff coefficient to 0.75 would increase the peak discharge rate by 47%. A summary of results for various values in all three areas can be seen in Table 2.

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Table 2. Calculated Peak Discharge Rates

Area ID	Area (acre)	C	Peak Discharge (cfs)			
			10-year	25-year	50-year	100-year
Area 1	9.8	0.4	3.3	3.8	4.2	4.9
		0.5	4.1	4.8	5.3	6.1
		0.6	4.9	5.7	6.4	7.3
		0.75	6.1	7.1	7.9	9.1
Area 2	25.3	0.4	8.4	9.8	10.9	12.5
		0.5	10.5	12.3	13.7	15.7
		0.6	12.6	14.7	16.4	18.8
		0.75	15.7	18.4	20.5	23.5
Area 3	8.8	0.4	2.9	3.4	3.8	4.4
		0.5	3.7	4.3	4.8	5.5
		0.6	4.4	5.1	5.7	6.5
		0.75	5.5	6.4	7.1	8.2

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