Ventura County Public Works Agency
Watershed Protection

Ventura River Levee 2 (VR-2) Levee System

Ventura County, California

Preliminary Design Project Study Report

March 2022

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Prepared for:

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Prepared by:

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1. INTRODUCTION

1.1. Existing Levee and Levee System Background

The Ventura River 2 (VR-2) Levee System is located in the community of Casitas Springs, Ventura County, California (Figure 1.1). The VR-2 Levee System is located along the east bank (or left bank if looking downstream) side of the Ventura River. The levee system consists of embankment levees, floodwalls, high ground, and side drainage penetrations. The levee system is intended to protect existing residential, commercial, and potentially developable property in low-lying areas within the base flood floodplain of the Ventura River Watershed. The VR-2 Levee System is currently owned and maintained by the Ventura County Public Works Agency - Watershed Protection (VCPWA-WP), previously known as the Ventura County Watershed Protection District (VCWPD).

The original levee system included an east bank levee and bank protection that began at Edison Hill at the downstream extent and ended at the confluence of San Antonio Creek (Ventura County 1978, 1995) at the upstream extent. The levee has since been improved with levee raising, floodwalls, and additional bank protection. There are seven (7) levee penetrations that convey interior drainage through the levee to the river, which are described in Section 2.4 (Interior Drainage / Joint Probability Analysis). An access road runs along the crest of the levee and is approximately 12 to 14 feet wide.

The VR-2 Levee System was originally constructed with funding from the Natural Resources Conservation Service (formerly the Soil Conservation Service) in 1979. Approximately 250 linear feet (LF) of the levee near the upstream end was restored in 1995 after being damaged by flood flows. The levee was improved in two phases between 2004 and 2007. Phase I raised the levee by 3 to 5 feet from Fresno Canyon Drain to the south end of Arroyo Mobile Home Park (Ventura County 2004). Phase II raised the remainder of the levee by 3 to 5 feet, including floodwalls along the mobile home park, and tied into high ground at Highway (Hwy) 33 and Sulphur Mountain Road (shown in Figure 1.1) (Ventura County 2006). The alignment of the levee has shifted due to this improvement.

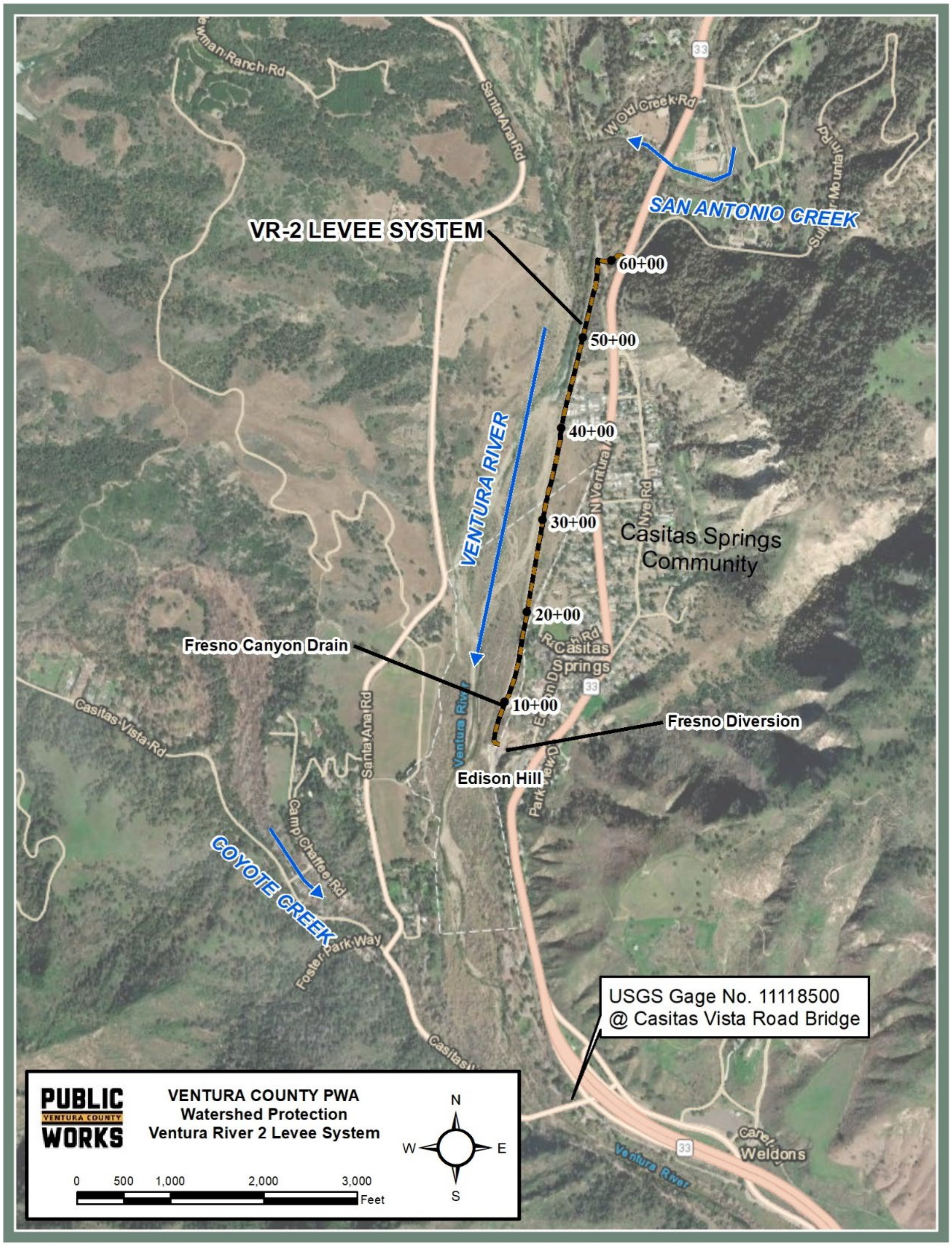

Figure 1.1: VR-2 Levee System Location Map

1.2. Current Study

The VR-2 Levee System has been determined to have deficiencies in freeboard and toe-down protection depth and does not meet requirements to be certified by the Federal Emergency FEMA. Using available information, this study is meant to summarize the selection and development of the levee alternative that was determined to be most appropriate for the VR-2 Levee System. This report describes the progression of the study in two parts: 1) Alternatives Analysis and 2) 30% Preliminary Design.

The Alternatives Analysis was used to compare multiple alternatives and evaluate what levee improvement should be applied to this system. The 30-percent Preliminary Design evaluates the selected alternative in more detail. More information discussing these two phases of the study is provided in the sections below.

1.2.1. Alternatives Analysis

Section 3 (Alternative Development) of this report documents the alternatives that have been investigated for the VR-2 Levee System Project. This alternatives analysis evaluates four alternatives: three alternative alignments and one no-project alternative. The three alternatives (alignments) were evaluated in conjunction with four different material type variations resulting in a total of twelve (12) design alternative variations evaluated for the VR-2 Levee System. It was determined that the following material types would be evaluated: 1.5 horizontal (H):1 vertical (V) Soil Cement, 2H:1V Riprap, 2H:1V Concreted Rock Riprap, 1.5H:1V Concreted Rock Riprap. Section 3 of this report summarizes the alternative basis of design and the description and comparison of each of the alternative variations. The comparison for the alternatives includes comparing costs and impact area.

The documents in Appendix I provide supplemental information related to the alternatives analysis.

1.2.2. Selected Alternative

Section 4 (Selected Alternative and 30% Design Development) of this report documents the development of the selected alternative. This alternative was selected by VCPWA after reviewing the information and evaluation included in Section 4of this report. Section 4 includes a review of the selected alternative project components, which includes embankment protection, side-drainage structures, access road, maintenance requirements, utilities, right-of-way, environmental considerations, and future considerations.

The documents in Appendix II provide supplemental information related to the alternatives analysis.

1.3. Purpose and Grant Support

The purpose of this project is to rehabilitate the VR-2 Levee System to protect the adjacent Casitas Springs community from the 100-year Annual Chance Exceedance (ACE) probability flood from the Ventura River and obtain FEMA Levee Certification. This project is a downstream component of the Matilija Dam Removal Project. The Matilija Dam Removal Project has been active for several years. Support and funding for the Matilija Dam Removal have grown significantly in recent years and rehabilitating the VR-2 Levee System is one project of a series of projects occurring along the Ventura River.

The VCPWA has funded this alternatives analysis and 30-percent design for the VR-2 Levee System with a grant from the California Department of Water Resources (DWR). A grant application for the Local Levee Assistance Program was submitted in 2015 and was subsequently approved.

Along with the VCPWA and DWR, other stakeholders currently involved (or to be involved) in this project include the City of San Buenaventura, the Ventura River County Water District, Ojai Valley Land Conservancy, Casitas Municipal Water District, and the Arroyo Mobile Home Park.

2. TECHNICAL STUDIES

2.1. Topographic Mapping and Survey

Topographic mapping of the project area was performed by Tetra Tech. The topographic mapping effort included collecting LiDAR, conventional survey, and orthophotography. All data collection was performed consistent with the guidance outlined in USACE *Engineering Manual* (*EM) 1110-1-1000, Photogrammetric LiDAR Mapping,* (USACE 2015) and mapping is consistent with all FEMA protocols and formats to ensure that the mapping meets 44 CFR 65.10 requirements for the levee and floodplain delineation and accreditation.

The field survey was performed by MNS Engineers in January 2018. The purpose of the survey was to recover existing control to establish 8 new control panels for aerial mapping and to provide local control for supplemental topography work. VCPWA-WP provided the survey control from the "Fresno Canyon Drain Control Report VCFB No. 2011-029" to use as a reference. Figure 2.1 and Figure 2.2 below show maps of the local control points and GPS vectors.

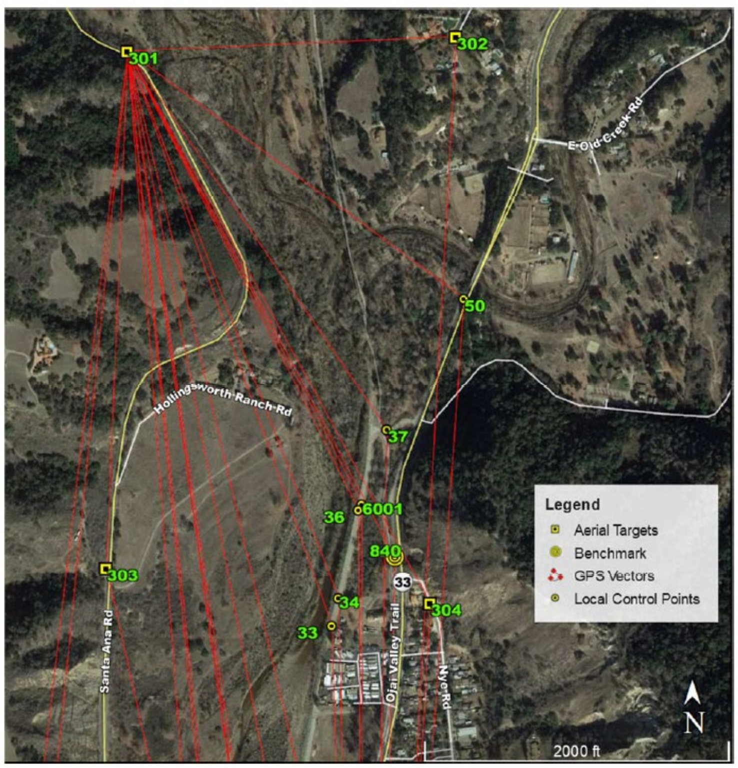

Figure 2.1: Northerly GPS Control Exhibit

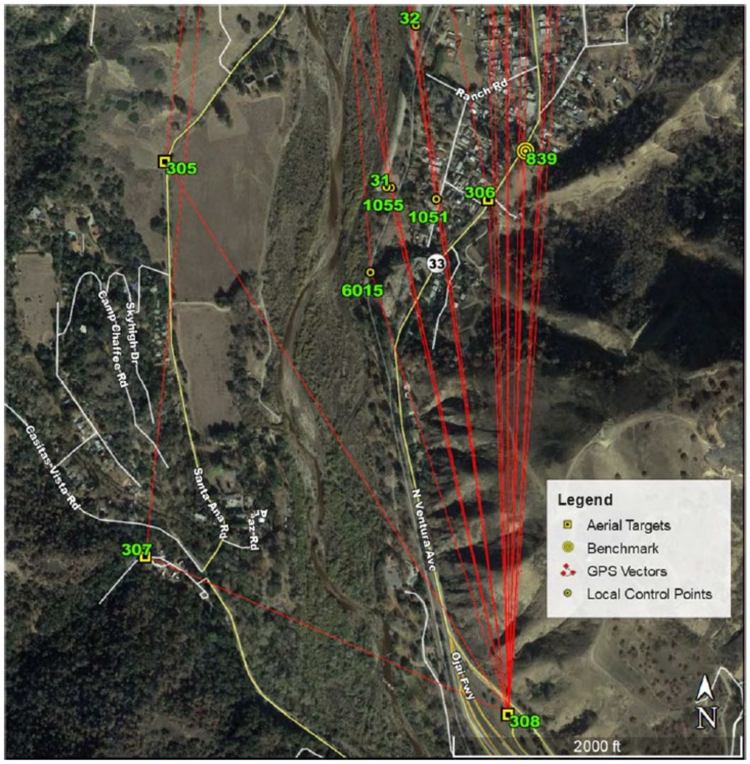

Figure 2.2: Southerly GPS Control Exhibit

The aerial flight to collect the LiDAR and orthophotography was flown on January 30th, 2018, by Keystone Aerial Surveys.

Tetra Tech used the raw LiDAR data and the survey to then generate the topographic mapping that would support 40-scale mapping and provide ground earth elevations (buildings removed). The generated mapping files were then merged into the 2018 Countywide LiDAR and the Fresno Canyon Diversion Survey files provided by VCWPA-WP. Tetra Tech provided both a digital terrain model surface and a 1-foot contour file as deliverables.

This mapping was used as the basis for other technical studies described in subsequent sections.

2.1.1. Vertical & Horizontal Datum

The LiDAR and aerial survey and topographic maps for this project are based on State Plane Coordinate System North American Datum (NAD) 1983 Zone V, Feet. The vertical datum is based on North American Vertical Datum (NAVD) 1988, Feet. Construction record drawings from the District and the City of Ventura are in National Geodetic Vertical Datum (NGVD) 1929, Feet. The NAVD 1988 elevations are higher than the NGVD 1929 elevations by a vertical datum shift of approximately 2.51 feet.

2.2. Hydrology, Hydraulics, Sediment Transport, and Scour

Tetra Tech has put together a finalized copy of the *Ventura River 2 Levee System Hydrology, Hydraulics, and Sediment Transport Report* (Tetra Tech 2022a). This report contains the full documentation of the topics covered in the following subsections. It should be noted that the alternative development (discussed in Section 3) began in 2019 and the design parameters used for the alternatives is based on the information that was prepared in an earlier version of the hydraulics report, the *Draft Ventura River 2 Levee System Hydrology and Hydraulics Report* (Tetra Tech 2019). Since this draft of this report was completed in 2019, Tetra Tech went on to complete the sediment transport analysis and make final revisions to the models and report. The following subsections describe the finalized report of the *Ventura River 2 Levee System Hydrology, Hydraulics, and Sediment Transport Report* (Tetra Tech 2022a), which was used to support the 30% Design of the Selected Alternative discussed in Section 4 (Selected Alternative and 30% Design Development).

2.2.1. Hydrology

The hydrologic evaluation for the design of the alternatives is documented in the *Ventura River 2 Levee System Hydrology and Hydraulics Report* (Tetra Tech 2022a). In this report, the hydraulic evaluation included reviewing historical flow events, reviewing previous hydrologic studies, and adopting the appropriate design discharges.

The following reports were reviewed to obtain hydrologic information pertaining to the levee:

- Corps 1941 Report – Preliminary Examination and Survey of Ventura River
- USBR/Corps Feasibility Study
- Ventura River Watershed Hydrology Model
- Ventura River Design Storm Modeling Report
- FEMA Flood Insurance Study Report
- FEMA FIS HEC-RAS Model (Updated by HDR)

The recommended 100-year peak flow of 67,239 cfs at the downstream end of the VR-2 Levee System was increased by 10 percent at the direction of VCPWA-WP to be used as the design discharge for this VR-2 Levee System Evaluation and Rehabilitation Study. The design discharge has a peak flow of 73,963 cfs and is referenced as the “Design Flow” throughout this report.

Table 2-1 lists the recommended T-year peak flows of the VR-2 Levee System and its tributaries used in the final design study.

Table 2-1 – VR-2 and Tributaries Recommended Peak Flows

Location	Return Period								Design Peak Discharge[1] (cfs)
	2-Year Peak (cfs)	5-Year Peak (cfs)	10-Year Peak (cfs)	25-Year Peak (cfs)	50-Year Peak (cfs)	100-Year Peak (cfs)	200-Year Peak (cfs)	500-Year Peak (cfs)	
VR-2 Levee System									
VR-2 Levee	4,170	9,910	35,529	44,416[3]	57,135	67,239[7]	76,762[3]	90,127	73,963[7]
VR-2 Tributaries									
Coyote Creek[5]	17	340	680	1,360	1,980	3,410	4,060	4,830	N/A[4]
Fresno Canyon[5]	218[6]	434[6]	611[6]	869	1,082[6]	1,316	1,770[6]	2,569[6]	N/A[4]
San Antonio Creek[5]	1,650	5,450	9,960	18,390	27,020	38,000	51,110	74,180	N/A[4]

1. Design discharge is a 10 percent increase from the 100-year peak.
2. 10-year, 50-year, 100-year, and 500-year values for the main stem are taken from the FEMA FIS Model discussed in Section 2.2.1.
3. 25-year value is interpolated between 10- and 50-year values; 200-year values are interpolated between 100- and 500-year peaks using probability/discharge plot.
4. Not applicable.
5. Available values for the tributaries were taken from the *Ventura River Watershed Design Storm Modeling Final Report and Addendum 1* (Ventura County 2010a, 2010b).
6. Estimated from Ventura County undeveloped/developed T-year peak flows multipliers with respect to the 100-year peak flow.
7. The most upstream cross-section within the VR-2 Levee System Limits, XS 41472.49, and cross-sections extending upstream to the San Antonio Creek Confluence were assigned a 100-year peak value of 66,600 cfs in the FEMA FIS Model discussed in Section 2.2.1. This value was adopted for this reach (XS 41472.49 to SAC confluence), which results in a design flow of 73,260 cfs at this cross-section and within this reach.

2.2.2. Hydraulics

The hydraulic parameters used for this design of the alternatives are based on the hydraulic model associated with the *Ventura River 2 Levee System Hydrology and Hydraulics Report* (Tetra Tech 2022a). In this report, the hydraulic evaluation included reviewing previous studies, developing a baseline hydraulic HEC-RAS 1-D model, and developing a HEC-RAS 2-D model.

The following reports were reviewed to obtain hydraulic information pertaining to the levee:

- USBR/USACE Feasibility Study
- Conditional Letter of Map Revision (CLOMR) Hydraulic Model
- FEMA FIS Report / HEC-RAS Model
- AECOM / Stillwater Sciences Hydraulic Model and Report

Of the available hydraulic models, the FEMA FIS Model, which was prepared by HDR (HDR 2010), was determined to be the most appropriate model to use as a baseline for the purposes and intent of future FEMA certification. The FEMA 2010 FIS HEC-RAS model for the main stem of the Ventura River was prepared by HDR, the FEMA study contractor (HDR 2010). The peak discharge of the base flood used in the HEC-RAS model for the reach below San Antonio Creek varies from 66,600 to 69,700 cfs. This model extends along the Ventura River from the Matilija Dam downstream to the Pacific Ocean.

For the alternatives analysis of the VR-2 Levee System, the 2019 baseline hydraulic model was developed by revising the FEMA 2010 FIS model with changes that included: updating topography (cross-section data), adding and extending cross-sections, adding ineffective flow areas, updating Manning's roughness coefficient values, and correcting existing floodwall/levee heights.

The model was run using HEC-RAS v5.0.6 (USACE 2018). The hydraulic model was run for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, 200-year, 500-year, and Design Flow (as shown in Table 2-1).

A full documentation of the approach, methodology, results, and conclusions can be found in the *Ventura River 2 Levee System Hydrology and Hydraulics Report* (Tetra Tech 2022a). The summary of the hydraulics results used for design is shown in Table 2-4.

2.2.2.1. Sediment Transport

A sediment transport analysis was performed for the project area to support the freeboard, embankment protection, and embankment stability analyses (Tetra Tech 2022a). The sediment analysis was developed to account for two scenarios: 1) Matilija Dam in place with current sediment supply above the VR-2 reach, and 2) Matilija Dam removed with established dynamic equilibrium in sediment supply above the VR-2 reach.

A three-level approach was used to evaluate the overall system sediment continuity and river stability under the two possible scenarios.

- Level I - Historic aerial photography and topography, as well as historical data such as the information shown on as-built drawings and previous study reports, were used to perform a qualitative, Level I analysis using principles of fluvial geomorphology to ascertain what the river system once was, what it is today, and what it might become if past and current watershed and river management practices were to remain unchanged.

- Level II - Appropriate bed-material sediment-transport relationships were then used to conduct a Level II analysis, which included performing equilibrium slope calculations to identify and quantify current system sediment discontinuities and to project long-term system changes, as the river seeks dynamic equilibrium, should current watershed and river management practices remain unchanged.
- Level III - Utilized detailed sediment-transport computer modeling previously conducted by Reclamation, the Level I and Level II results was compared to and, where appropriate, superimposed upon the results of Reclamation's detailed sediment transport modeling. The three-level analysis provided insight into long-term system sediment discontinuity and expected future channel degradation, should current watershed and river management practices remain unchanged.

After completion of the three-level analysis described above, appropriate local-scour equations were utilized to predict single-event scour associated with specific storm events along the Ventura River. Components of single-event scour will include, where appropriate, General Scour; Bedform Scour, Bend Scour, Local Scour at Hydraulic Structures (bridges, groins, etc.), and Thalweg Scour.

2.2.2.2. Aggradation

Modeling results indicate that while the dominant long-term trend around VR-2 is degradation, hydraulic conditions that lead to periodic aggradation are expected as well. The timing and magnitude of future aggradation will be primarily dependent on the sequence and scale of the large storms that drive channel morphology. In particular, San Antonio Creek has the potential to input significant sediment at the confluence above VR-2 that may overwhelm the capacity of the main river for a period of time. For the 1950-2017 hydrology, the expected maximum average aggradation for the VR-2 subreaches range between 0.2 ft and 0.9 ft for the With-Dam condition and 0.2 ft and 1.0 ft for the Without-Dam condition (Table 2-2). These values represent the amount of aggradation expected above the existing channel profile at the start of the modeling run. Maximum values are expected at the upstream end of VR-2 and primarily reflect input from San Antonio Creek.

Table 2-2 – Predicted Long-Term Aggradation

Subreach	HEC-RAS River Station		With-Dam (ft)	Without-Dam (ft)	Difference (ft)
	Upstream	Downstream			
3	412+27	394+10	0.9	1.0	0.2
4	394+09	387+00	0.7	0.8	0.1
5	386+99	373+98	0.2	0.3	0.1
6	373+97	330+01	0.2	0.3	0.1

2.2.2.3. Scour

Tetra Tech performed a local scour analysis, which considers potential; low-flow, anti-dune, contraction, and bend scour in the vicinity of the levee. Based on the river geometry, bed materials, and general hydraulics that are expected within this river system, it was determined that bend scour would be the only appropriate local sour component. Through this evaluation, the Maynord

Equation (1996) was selected for determining estimated bend scour. The local scour analysis is based on the hydraulic properties output from Tetra Tech's hydraulic model.

Tetra Tech also performed a long-term scour analysis to estimate the general degradation of the river using the three-level analysis described in Section 2.2.2.1 (Sediment Transport).

The total vertical scour expected throughout the study area is the sum of the general degradation and local scour depths discussed above. Under existing conditions, these depths range from 9.4 feet to 10.8 feet (Table 2-3). Removing the dam is expected to decrease the total scour to a range between 8.4 and 10.6 feet. In general, scour depth from the existing thalweg should be used for determining the necessary levee toe-down depth throughout the study area.

Table 2-3 – Predicted Total Vertical Scour

Subreach	HEC-RAS River Station		Bend Scour (ft)	With Dam		Without Dam	
	Upstream	Downstream		Long Term Scour (ft)	Total Vertical Scour* (ft)	Long Term Scour (ft)	Total Vertical Scour* (ft)
3	412+27	394+10	2.5	6.7	9.2	5.9	8.4
4	394+09	387+00	2.5	6.9	9.4	6.1	8.6
5	386+99	373+98	6.1	4.7	10.8	4.5	10.6
6	373+97	330+01	6.4	3.2	9.6	3.0	9.4

*Total Vertical Scour = Bend Scour + Long Term Scour

2.2.3. Summary of Hydraulics and Future Conditions

For future conditions, the "2019 Baseline HEC-RAS" model (as described in Section 2.2.2 [Hydraulics] of this report) was updated to reflect the sediment transport analysis described in Section 2.2.2.1 (Sediment Transport). The Total Vertical Scour (Section 2.2.2.3) [Scour] was applied to the existing thalweg elevation to estimate the anticipated channel scour elevation. It should be noted that the most scour is anticipated with Matilija Dam left in place. The aggradation (Section 2.2.2.2 [Aggradation]) was applied to cross-sectional geometry in the hydraulic model. The aggradation was uniformly applied to the bed of the active channel. It should be noted that the most aggradation is anticipated with Matilija Dam removed. These values are summarized in Table 2-4 below.

Table 2-4 shows the hydraulic cross-sections that are deficient of the required freeboard with future aggradation considered. Table 2-4 also shows that the levee is deficient of toe protection along the entire reach. At this time, it is expected that VCPWA-WP will improve the VR-2 Levee System along the entire alignment with the adequate bank protection, toe-down protection, and top-of-levee heights to meet FEMA Levee Certification requirements. If these requirements are met, the levee could be certified and provide flood insurance relief to the community of Casitas Springs.

A full documentation of the approach, methodology, results, and conclusions can be found in the *Ventura River 2 Levee System Hydrology and Hydraulics Report* (Tetra Tech 2022a). The summary of the hydraulics results used for design is shown in Table 2-4.

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Table 2-4 – Future Conditions Hydraulic Results

Sediment Subreach	Approximate Exist. Levee Station	HEC-RAS Station	Channel Thalweg[1] (feet)	Total Scour Depth	Existing Toe-Down Protection Elevation[1]	Existing Toe-Down Deficiency	Existing Conditions Computed Water-Surface Elevation[5] (feet)		Future Dam Removal Conditions Computed Water-Surface Elevation[6] (feet)		Top-of-Levee Elevation[1] (feet)	Future Dam Removal Conditions - Computed Freeboard[8] (feet)		FEMA Required Freeboard
							100-Year	Design Flow	100-Year	Design Flow		100-Year	Design Flow	
3	Upstream Limit (Along Curve Tie-In)													
	1+79[3,4]	414+72.49	290.38	9.20	299.00	-17.82	311.15	312.54	311.15[4]	312.54[4]	315.68	4.53	3.14	3.50
	Tie-In to Ventura Riverbank													
	58+76	414+72.49	290.38	9.20	285.53	-4.35	307.23	307.74	307.91	308.38	311.47	3.56	3.09	3.00
	56+24	412+26.26	289.14	9.20	289.73	-9.79	306.72	307.24	307.21	307.64	310.97	3.76	3.33	3.00
	53+43	409+44.61	285.44	9.20	287.20	-10.96	304.10	304.82	304.98	305.65	308.58	3.60	2.93	3.00
	50+85	406+89.6	284.78	9.20	284.99	-9.41	302.38	302.93	303.08	303.58	306.07	2.99	2.49	3.00
	48+30	404+34.64	285.23	9.20	282.95	-6.92	300.17	300.61	300.71	301.14	303.60	2.89	2.46	3.00
	45+84	401+83.5	285.07	9.20	281.03	-5.16	298.47	298.91	299.01	299.43	301.21	2.20	1.78	3.00
	43+35[2]	399+32.47	279.52	9.20	279.79	-9.47	295.90	296.41	296.63	297.08	298.69	2.06	1.61	3.00
	40+70[2]	396+70.7	278.52	9.20	278.46	-9.14	293.85	294.30	294.51	295.02	295.69	1.18	0.67	3.00
4	38+05	394+08.97	277.47	9.40	276.55	-8.48	291.40	291.86	291.98	292.43	293.11	1.13	0.68	3.00
	35+61	391+59.9	275.04	9.40	274.60	-8.96	288.88	289.28	289.27	289.71	291.50	2.23	1.79	3.00
	33+14	389+10.90	274.87	9.40	272.62	-7.15	286.57	286.97	287.07	287.44	288.79	1.72	1.35	3.00
5	31+04	386+98.9	273.47	10.80	270.94	-8.27	283.52	283.89	283.79	284.14	287.36	3.57	3.22	3.00
	28+90	384+87.06	268.40	10.80	269.23	-11.63	281.32	281.67	281.63	281.97	285.44	3.81	3.47	3.00
	25+34	381+70.8	265.54	10.80	266.38	-11.64	278.13	278.49	278.42	278.79	282.24	3.82	3.45	3.00
	21+76	378+54.71	261.58	10.80	260.60	-9.82	276.04	276.47	276.35	276.77	279.67	3.32	2.90	3.00
6	18+08	373+96.83	258.72	9.60	256.97	-7.85	271.71	272.11	271.98	272.41	277.09	5.11	4.68	3.00
	15+67	371+26.7	255.32	9.60	255.05	-9.33	269.63	270.08	269.92	270.36	275.28	5.36	4.92	3.00
	13+46	368+56.66	253.69	9.60	253.28	-9.19	268.29	268.75	268.58	269.03	273.56	4.98	4.53	3.00
	9+71	364+35.54	251.35	9.60	250.51	-8.76	264.86	265.32	265.14	265.59	269.46	4.32	3.87	3.00
	8+44	363+11.96	251.52	9.60	249.61	-7.69	264.02	264.50	264.31	264.79	263.94	-0.37	-0.85	3.00
	5+22[6]	360+23.13	249.38	9.60	246.53	-6.75	262.24	262.81	262.53	263.11	270.58	8.05	7.47	3.00

1. NAVD 88. Based on as-built drawing elevations.
2. Top of floodwall elevations are listed at approximate levee stations 43+35 and 40+70.
3. This stationing reflects the revised alignment that is the curved tie-in to Hwy 33 at Sulphur Mountain Road. Station 58+49 along original levee alignment = Station 0+00 along levee improvement tie into Hwy 33 (at Sta. 3+20).
4. The 2-D model described in Section 2.2.2 shows a freeboard-deficient section in this reach. It should be noted that the 2-D Model was not updated to reflect aggradation. Furthermore, the aggradation is expected to occur in the active channel, and the water surfaces at this location are due to ponding behind the originally constructed levee (i.e., not in the active Ventura Riverbed).
5. These water surface elevations represent the existing "current" conditions.
6. These water surface elevations represent the future condition with the dam removed.
7. The elevation shown at Levee Station 5+22 does not reflect the elevation of the existing levee alignment. Instead, it reflects a proposed floodwall structure, as part of the Fresno Canyon Diversion Project, that the levee embankment will tie into.
8. The red numbers in this column indicate where the existing levee does not meet FEMA Deterministic Freeboard Requirements.

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2.3. Geotechnical Evaluation

The geotechnical evaluation for the VR-2 Levee System is documented in the *Preliminary Geotechnical Report for the Ventura River Levee at Casitas Springs (VR-2)* (Tetra Tech 2022b). In this report, the geotechnical evaluation included reviewing available background data, site reconnaissance, notification of underground service alert, subsurface evaluation of two test pits, subsurface evaluation of four borings, laboratory testing of selected samples, engineering evaluation, and the preparation of the report.

Based on the evaluation of the existing levee system it is recommended that some form of improvement be implemented in areas where the existing riverside or landside slopes are steeper than 2(H):1(V). Based on the results of the preliminary assessment, several improvement methods were considered for the improvement of the levee slopes.

For areas of steep landside slopes, construction of a continuous trench subdrain at the toe of the slope appears to be the most cost-efficient remedial method. However, this method is only feasible if the drain is located at a suitable depth below the slope toe (minimum of 2 feet), and a suitable gravity outlet can be achieved. If this form of subdrainage is not possible flattening or structurally supporting the slope may then be considered. The construction of sheetpile wall may be the least intrusive structural method, however, the feasibility of installing sheetpile would be significantly impacted by the presence of numerous cobbles and boulders within underlying alluvial sediments. Field evaluation of the test pit excavations indicated layers of alluvium with cobble and boulder contents ranging from 10 percent to in excess of 50 percent. The average cobble and boulder content in TP-2 was estimated to be approximately 33 percent. Depending on the necessary depth of penetration required for a sheetpile design, installation could be very difficult. Based on these conditions, structural support would likely need to be provided by a conventional retaining wall with an adequate foundation keyway and subdrain to control underseepage and uplift pressures.

For areas of steep riverside slopes, the most efficient remediation method appears to be flattening the slope to 2(H):1(V). However, this slope gradient combined with deeper erosion protection requirements will likely require significant encroachment into the river floodplain. The use of an 8 feet wide soil cement buttress or concreted rock riprap revetment with 8 feet wide bottom constructed at a slope gradient of 1.5(H):1(V) and with appropriate subdrainage and weepholes would reduce this encroachment. The toe of the soil cement buttress and concreted rock riprap revetment should extend at least 2 feet below the scour elevation of the riverbed. Based on the findings, the use of either soil cement buttress or a concreted rock riprap revetment as described herein is anticipated to meet FEMA requirements for levee certification.

2.3.1. Recommendations Going Forward

As part of the ongoing design process, preliminary cost estimates of the levee improvement methods should be performed in order to select one or more of the levee improvement methods for the design phase. The topography and drainage conditions landward of the levee should be further evaluated with regard to the feasibility of installation of a landside toe subdrain.

There are three alternative alignments that have been developed during the course of the project, which are discussed in Section 3 (Alternative Development). The preliminary geotechnical investigation for this project focused on the evaluation of conditions along the current levee alignment (Alternative 1). Two additional alignments (Alternatives 2 and 3) were considered as part of the alternatives analysis but were not evaluated from a geotechnical perspective. Alternative 2 deviates from the Alternative 1 alignment upstream of the MHP (roughly Station 45+00) and includes a setback levee that ties into high ground at Highway 33. Alternative 3 follows the Alternative 2 alignment except for an additional setback levee at the downstream end of the project (roughly Station 10+00 to 0+00).

After an alignment alternative is selected it is recommended that supplemental geotechnical exploration be performed to support the project through final design.

A full summary of the geotechnical evaluation, including the approach, results, and detailed recommendations, can be found in *Preliminary Geotechnical Report for the Ventura River Levee at Casitas Springs (VR-2).*

2.4. Interior Drainage / Joint Probability Analysis

The interior drainage /joint probability analysis for the VR-2 Levee System is documented in the *Ventura River 2 (VR-2) Levee System Interior Drainage Report* (Tetra Tech 2022c). In this report, the effort for interior drainage analysis was documented, which included reviewing available background data, developing interior hydrology (in accordance with the Ventura County Hydrology Manual), performing a river flow duration analysis, performing a pipe capacity analysis, performing a coincident frequency analysis, the mapping the interior drainage inundation areas.

Based on the field investigation and review of the available penetration as-built/construction drawings, there are seven (7) storm drain penetrations through the levee (Figure 2.3 and Figure 2.4). The drainage area associated with each of the penetrations is shown on Figure 2.5. The penetrations are shown on Figures Most of the storm drains have a flap gate except Penetration No.'s 1, 2, and 4. Descriptions of each penetration are included in Table 2-5.

Table 2-5 – VR-2 Levee Penetrations

Penetration No.	Approximate Exist. Levee Station	Descriptions
1	2+39	18-inch RCP, without flap gate
2	2+60	108-inch RCP, without flap gate, Fresno Canyon Diversion
3	2+85	48-inch RCP, with flap gate
4[1]	9+00	10' W x 5.5' H RCC, Existing Fresno Canyon Drain
5	21+15	24-inch CSP, with flap gate
6	45+19	24-inch CSP, with flap gate
7	58+37	36-inch RCP, with flap gate

[1.] Flap gate is proposed in the VR-2 Levee improvements.
Note: RCP: reinforced concrete pipe; RCC: reinforced concrete channel; CSP: corrugated steel pipe

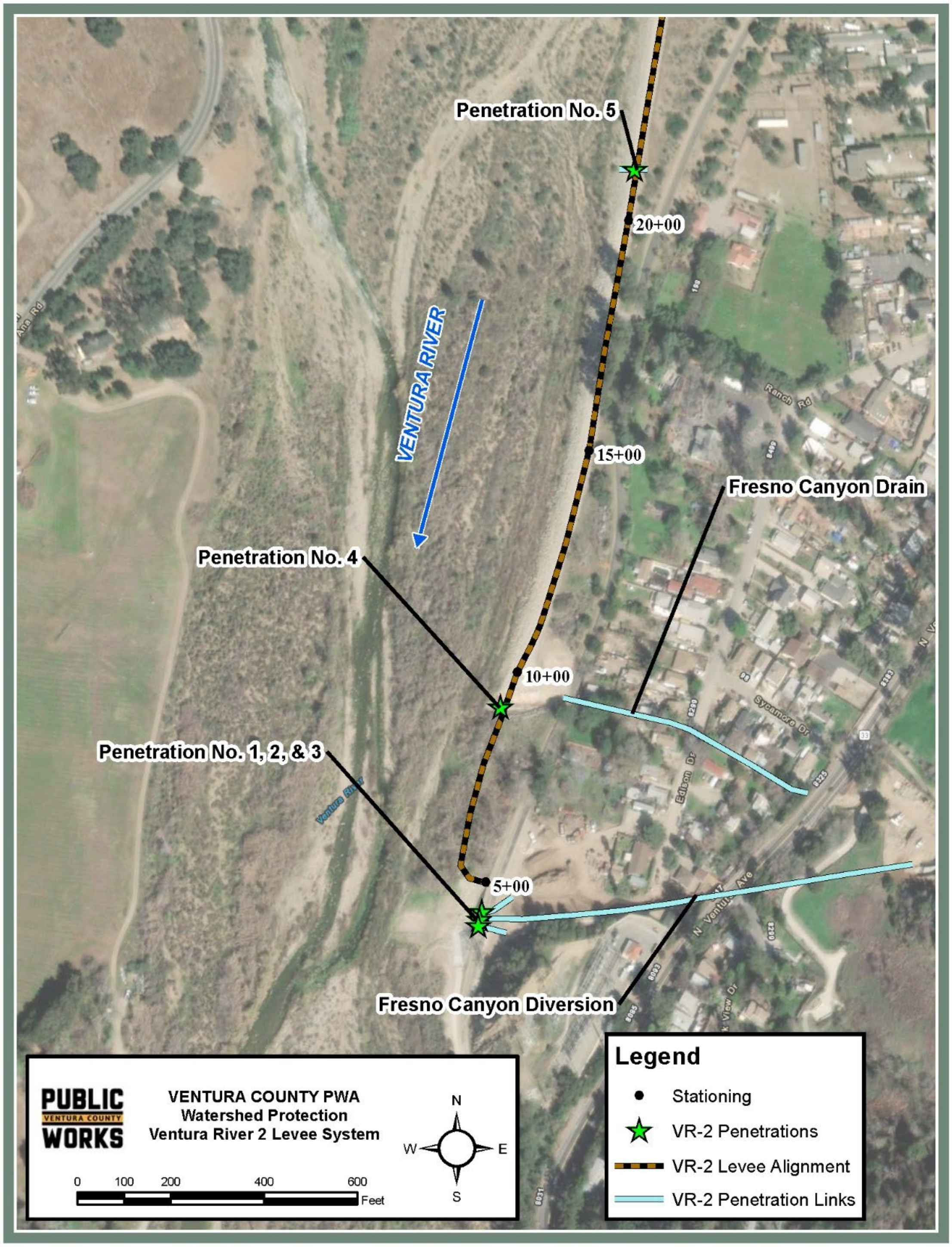

Figure 2.3: VR-2 Levee Penetrations No. 1 Through No. 5

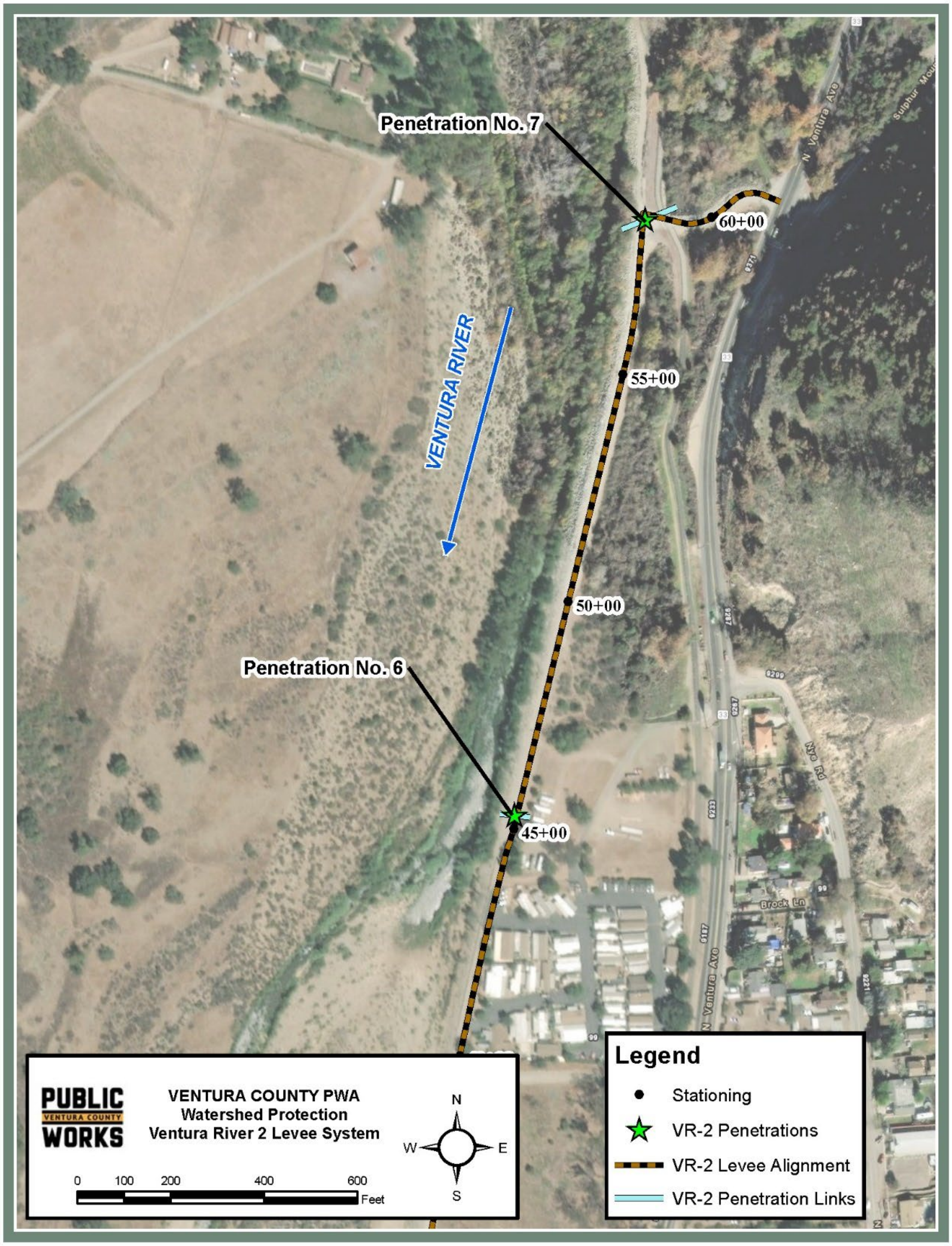

Figure 2.4: VR-2 Levee Penetrations No. 6 and No. 7

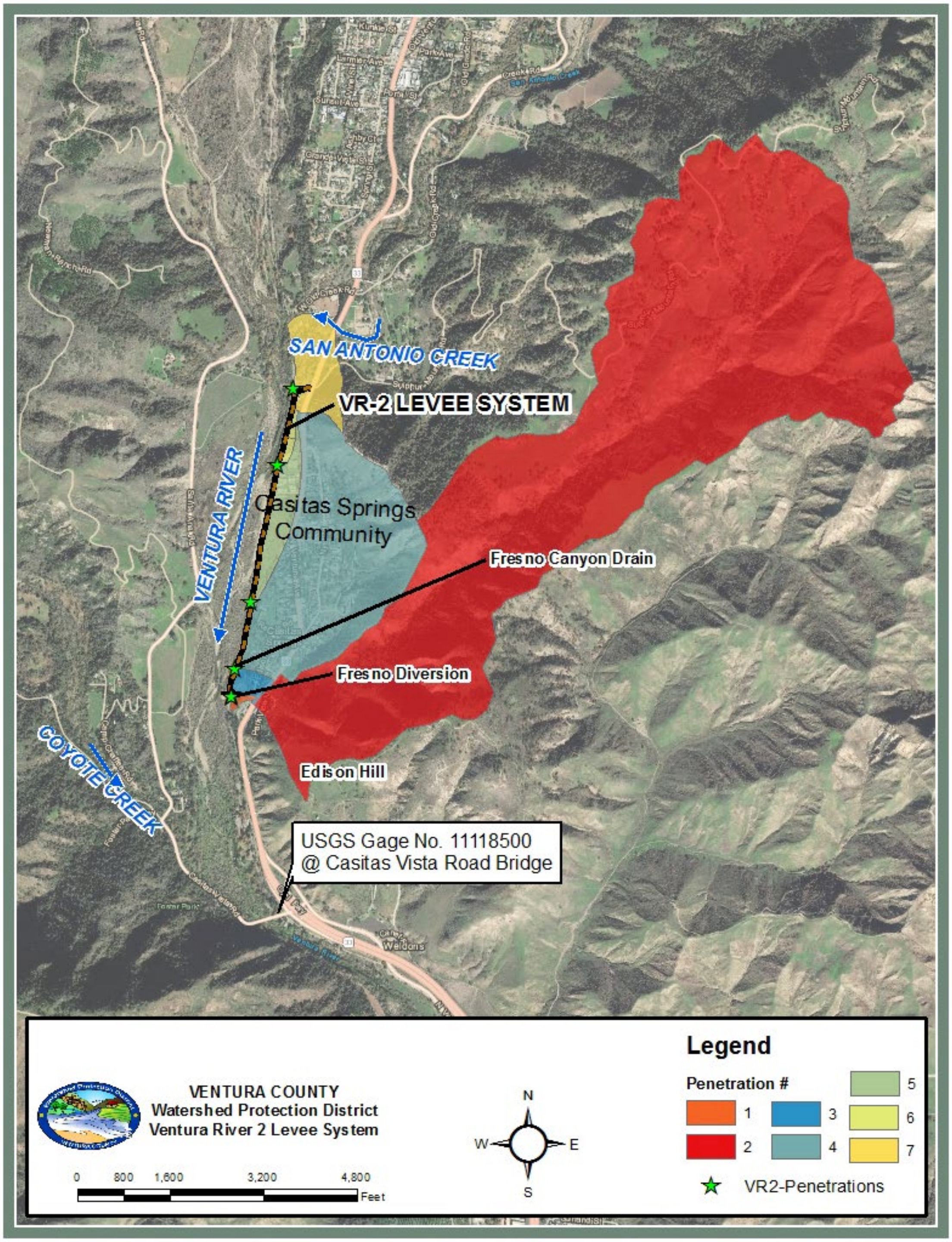

Figure 2.5: VR-2 Levee Penetrations Sub-Basin Drainage Areas Map

Interior drainage hydrology for this study was determined in accordance with *Ventura County Hydrology Manual* (VCWPD 2017). The time of concentration (Tc) calculation spreadsheet and VCRat2.64 rainfall-runoff-frequency computer program published by the VCPWA-WP were used in developing the hydrology for all the levee penetrations except Penetration No. 2 (Fresno Canyon Diversion) because its 100-year runoff hydrograph was provided by VCPWA-WP.

The drainage areas tributary to the VR-2 Levee penetrations were determined using the topographic data described in Section 2.1 (Topographic Mapping and Survey) supplemented with the available penetration as-built/construction drawings and existing storm drain networks provided by the County of Ventura. The total interior drainage area of all the penetrations is approximately 1,110 acres.

Using delineated drainage areas, hydrologic soil types, land use and cover types, and rainfall zones, the sub-basin Tc of each penetration was computed using the VCPWA-WP's Tc calculation spreadsheet and then entered into VCPWA-WP's VCRat2.64 to generate the 10-, 25-, 50-, and 100-year runoff hydrograph at each levee penetration. Runoff hydrographs of the other return frequencies were plotted and extrapolated from the probability paper.

The interior drainage analysis is based on a joint probability analysis (or coincident frequency analysis) of both the interior (the storm drain tributary area) and the exterior (the Ventura River) to satisfy the FEMA levee certification requirements. The main steps involved in this analysis are:

1. Evaluation of the Ventura River to define the percent of time the stage of the river exceeds a given elevation. This evaluation, based on available gage data, uses the HEC-SSP software (USACE 2019).
2. Evaluation of the watershed area associated with each storm drain to define a flood flow frequency curve. This evaluation, based on hydrologic parameters, uses the VCRat2.64. Most of the penetrations are hydrologically independent (i.e., self-contained) except for Penetration No. 2 and No. 4. Any overflows from a 60-inch reinforced concrete pipe which diverts flow from Penetration No. 2 (Fresno Canyon Diversion) to Penetration No. 4 (existing Fresno drain) is considered.
3. Combination of the river stage data (Step 1) and storm drain hydrology data (Step 2) to determine the 1% annual exceedance flood elevation associated with the storm drain, using HEC-SSP software (USACE 2019).

Based on the results of the hydrologic-hydraulic routing model and the coincident frequency analysis, the 1-percent annual exceedance probability (AEP) interior flood elevations were computed. The N-year interior drainage events evaluated ranged from the 2-year to 500-year frequencies. Analysis results indicate no interior flooding for Penetration No. 1, No. 6, and No. 7 for the range of N-year interior drainage area events evaluated. Penetration No. 2, Fresno Canyon Diversion, is not subject to any interior flooding per the 2017 VCWPD study for coincident 1-percent annual exceedance probability events on the river and interior area runoff. A subsequent, supplemental drainage analysis needs to be performed to understand the existing infrastructure and needs in order to reduce or eliminate the effects of local flooding occurring at Penetrations 3 and 4. There is minor ponding within the low-lying areas adjacent associated to Penetration No. 5, but the identified 1-percent ponding areas do not currently encompass any buildings or the infrastructure.

2.4.1. Recommendations Going Forward

Regarding Penetration No. 4, although flooding is occurring in this area, it should be noted that the Fresno Canyon Diversion improvements (constructed in April 2020) have directed approximately 1,400 cfs away from the existing Fresno Canyon Drain. If these improvements had not been constructed, there would be significantly more flooding in this area. It should also be noted that a primary assumption of this analysis is that the runoff from the entire drainage area reaches the existing Fresno Canyon Drain. Based on this assumption, the existing Fresno Canyon Drain is currently undersized for the volume of water expected from this subarea. A Master Plan of Drainage Study needs to be performed to understand the existing infrastructure and needs in order to reduce or eliminate the effects of the local interior flooding that likely results from the flat slopes, lack of curb and gutter, insufficient storm drains and catch basins, and inability to drain to major infrastructure. This supplemental drainage analysis needs to be performed to understand the existing infrastructure and needs in order to reduce or eliminate the effects of local flooding occurring at Penetrations 3 and 4.

It should also be noted that there are three alternative alignments that have been developed during the course of the project, which are discussed in Section 3 (Alternative Development). The interior drainage analysis for this project focused on evaluation of conditions along the current levee alignment (Alternative 1). Two additional alignments (Alternatives 2 and 3) were considered as part of the alternatives analysis but were not evaluated with regards to interior drainage. Alternative 2 deviates from the Alternative 1 alignment upstream of the MHP (roughly Station 46+00) and includes a setback levee that ties into high ground at Highway 33. Alternative 3 follows the Alternative 2 alignment except for an additional setback levee at the downstream end of the project (roughly Station 10+00 to 0+00).

After an alignment alternative is selected, it is recommended that a supplemental interior drainage analysis be performed to support the defined project through final design.

A full documentation of the approach, methodology, results, and conclusions can be found in the Ventura *River 2 (VR-2) Levee System Interior Drainage Report* (Tetra Tech 2022c).

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3. ALTERNATIVE DEVELOPMENT

3.1. Alternative Basis Of Design

3.1.1. Alternatives (Alignments) and Material Type Configurations

Four alternatives are presented as part of this study, which include three designed alternatives and the No-Project Alternative. Each of the designed alternatives represents an alignment. Alternative 1 represents the existing levee alignment as it is today. Alternative 2 and Alternative 3 represent variations of Alternative 1 that provide an alignment that is set further away from the river

The project is split into four different reaches in this study: Reach I from Edison Hill to Fresno Canyon Drain, Reach II from Fresno Canyon Drain to Arroyo Mobile Home Park, Reach III along Arroyo Mobile Home Park, and Reach IV from Arroyo Mobile Home Park to Hwy 33. The reaches are shown on the alternative figures described below and summarized in Table 3-1.

Alternative 1 represents the existing levee alignment as it is today. A figure of the alignment for Alternative 1 is shown in Figure 3.1.

Alternative 2 is similar to Alternative 1. However, Alternative 2 differs from Alternative 1 in Reach IV, where it is set back from the river just upstream of the Mobile Home Park and ties into Highway 33. In Reaches I, II, and III, Alternative 1 and Alternative 2 follow the same path. It should be noted that an easement for multiple parcels would be required for Alternative 2 in the area upstream of the Mobile Home Park. A figure of the alignment for Alternative 2 is shown in Figure 3.2.

Alternative 3 is the same as Alternative 2 in Reach II, Reach III, and Reach IV. However, downstream of Fresno Canyon Drain in Reach I, Alternative 3 represents an alignment that is setback from the river. The alignment for this alternative is set back by approximately 50 feet but is constrained by excavation limits to access the 42-inch Casitas Municipal Water District (CMWD) waterline that runs parallel to the existing levee. A figure of the alignment for Alternative 3 is shown in Figure 3.3.

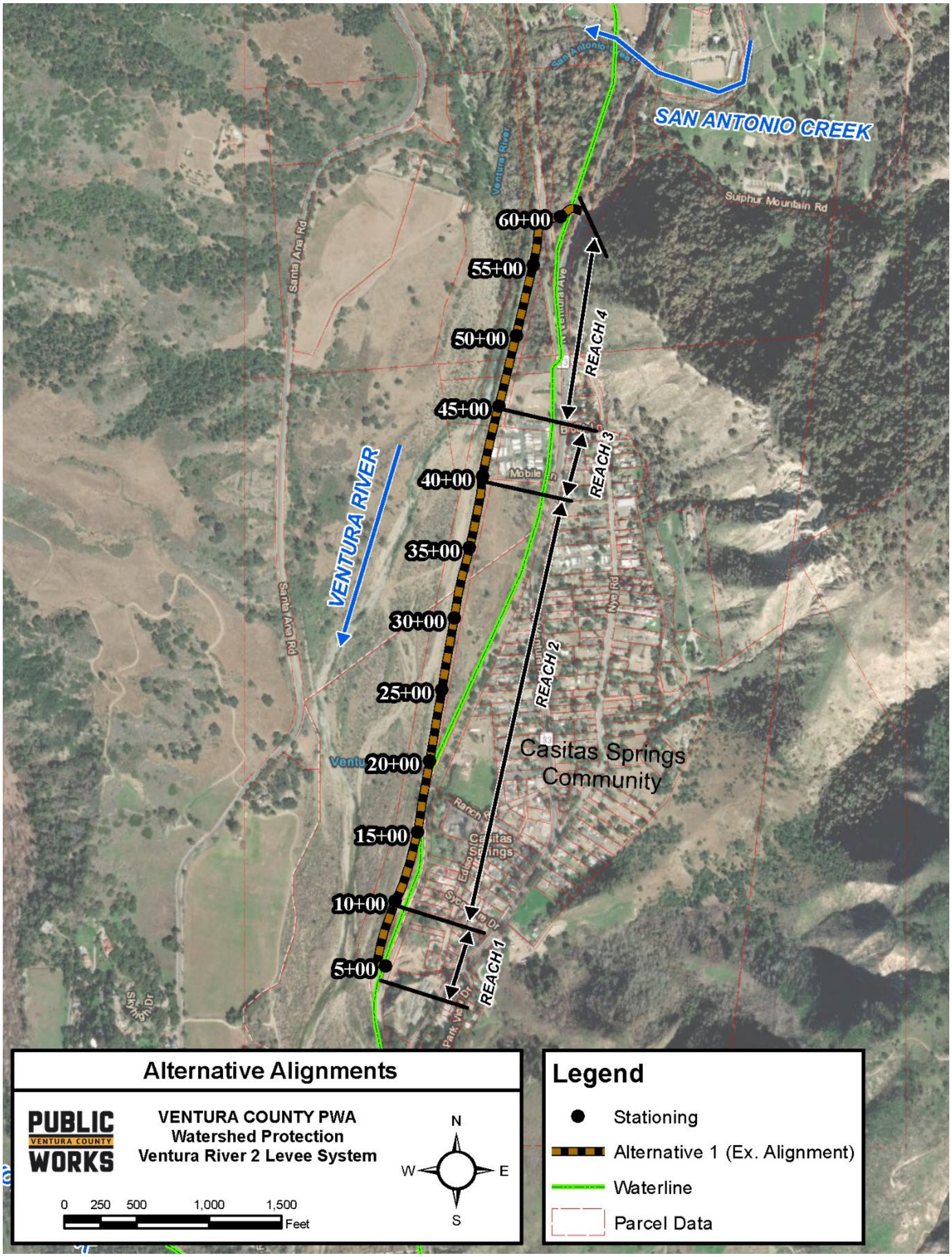

Figure 3.1: Alternative 1 Alignment

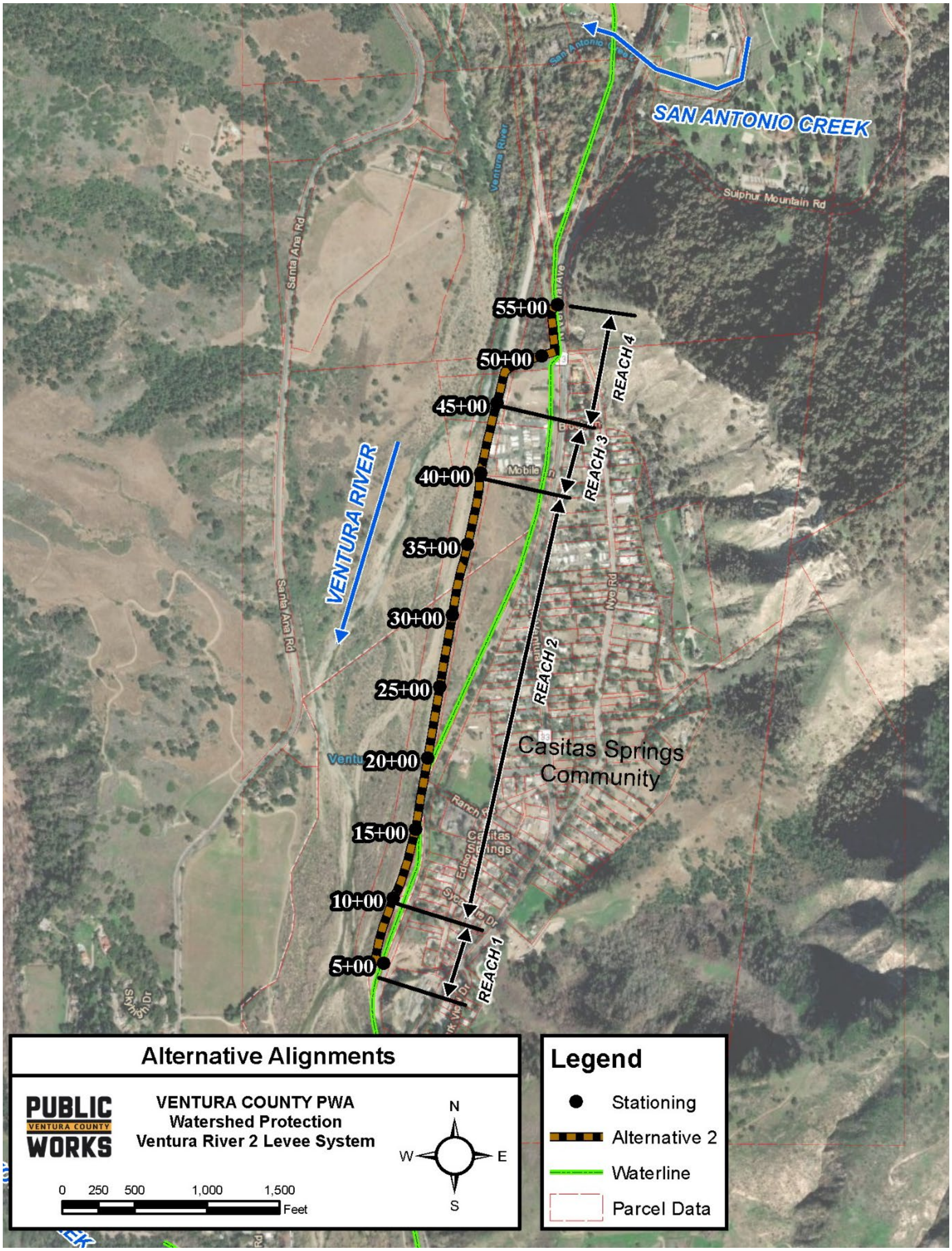

Figure 3.2: Alternative 2 Alignment

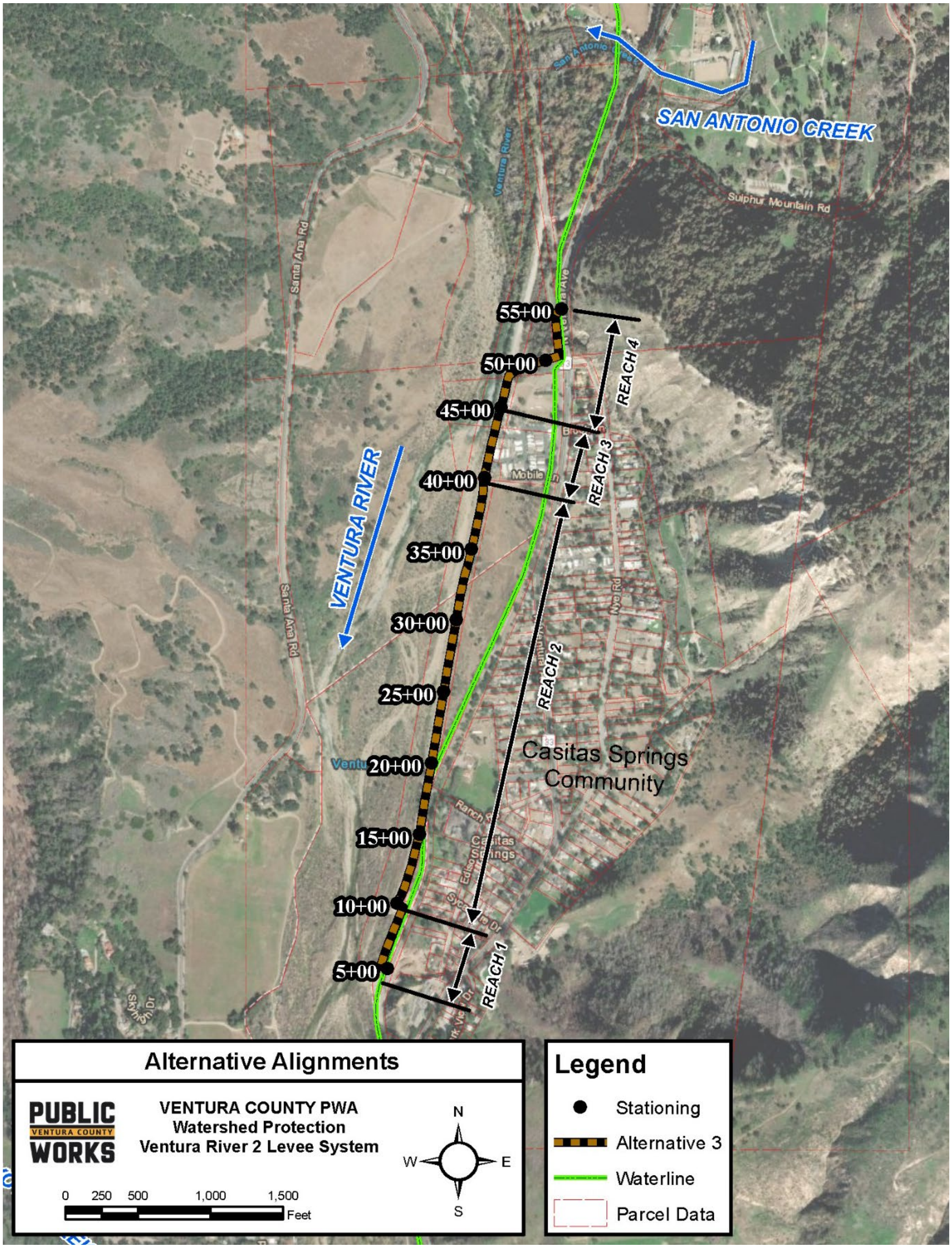

Figure 3.3: Alternative 3 Alignment

Table 3-1 – Summary of Alternatives

Alternative 1	Project along the existing levee alignment as it is today
Alternative 2	Project along a setback alignment upstream of the Mobile Home Park
Alternative 3	Project along setback alignment upstream of the Mobile Home Park and Downstream of Fresno Canyon Drain
Alternative 4	No Project Alternative

In addition to the alignments described in the table above. Four different material type variations were evaluated in combination with each of the alternatives, which included: a) 1.5H:1V Soil Cement, b) 2H:1V Riprap, c) 2H:1V Concreted Rock Riprap, and d) 1.5H:1V Concreted Rock Riprap. A list of the alternative combinations is shown in the Table 3-2 below.

Table 3-2 – Summary of Alternatives and Material Type Combinations

Alternative and Material Type	Description
Alternative 1	
A	1A: 1.5H:1V Soil Cement along Alternative 1
B	1B: 2H:1V Riprap along Alternative 1
C	1C: 2H:1V Concreted Rock Riprap along Alternative 1
D	1D: 1.5H:1V Concreted Rock Riprap along Alternative 1
Alternative 2	
A	2A: 1.5H:1V Soil Cement along Alternative 2
B	2B: 2H:1V Riprap along Alternative 2
C	2C: 2H:1V Concreted Rock Riprap along Alternative 2
D	2D: 1.5H:1V Concreted Rock Riprap along Alternative 2
Alternative 3	
A	3A: 1.5H:1V Soil Cement along Alternative 3
B	3B: 2H:1V Riprap along Alternative 3
C	3C: 2H:1V Concreted Rock Riprap along Alternative 3
D	3D: 1.5H:1V Concreted Rock Riprap along Alternative 3
Alternative 4	No Project Alternative

The plan views and cross-sections for each of the designed alternative variations are shown in Appendix I-A. The plan views included in Appendix I-A show the available parcel data.

3.1.2. Top-of-Levee Elevation Design

The alternative development began in 2019 and the design parameters used for the alternatives are based on the information that was prepared in an earlier version of the hydraulics report, the *Draft Ventura River 2 Levee System Hydrology, Hydraulics, and Sediment Transport Report* (Tetra Tech 2019). The model included the runs for the 100-year flow, and the “Design Flow”, which is the 100-year flow bulked by 10%. The Design Flow water surface elevations (WSELs) were extracted from each of the cross-sections in the hydraulic model.

At the time of the development of these alternatives, the team was still working on a sediment study to estimate potential deposition that may occur near the VR-2 Levee System. In the meanwhile, Tetra Tech used aggradation information from *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a) to assist in understanding what some of the expected water surface elevation increases may be. That study considers the hydraulics with potential sediment aggradation occurring throughout the system. The WSEL increases identified in that report were added to the Design Flow WSEL’s extracted from Tetra Tech’s hydraulic model for use in the alternative design.

FEMA deterministic freeboard requirements were applied to the Design Flow water surface elevations and the above-mentioned increases to develop a design top-of-levee profile. FEMA deterministic freeboard requires that the top-of-levee height provide at least three feet of freeboard throughout the levee system and an additional half foot at the upstream tie-in (3.5 feet total).

Results showed that the existing levee is deficient in freeboard requirements at several locations along the system: for a reach downstream of Fresno Canyon Drain; the floodwall reach along the Arroyo Mobile Home Park; and for a segment upstream of the Arroyo Mobile Home Park. The existing slump stone block floodwall would need to be increased by up to 1.5 to 2 feet, and in preliminary evaluation of increasing the floodwall height may not meet the appropriate factors of safety to withstand hydraulic loading. For this reason, it is assumed that the slump stone floodwall will need to be replaced with a reinforced concrete floodwall with an appropriately sized footing.

It should be noted that a 2-D hydraulic analysis was performed for this system. The results indicate potential ponding along the upstream limit of Alternative 1 (Reach IV), and along Reach IV of Alternatives 2 and 3. For Alternative 1, removing the originally constructed levee (levee lowering) (near Station 58+50) and constructing a spillover section so that the ponded water could return to the river would be required to reduce the ponded water surface elevation in this area. For Alternatives 2 and 3, the same improvement is recommended at the same location and an additional levee lowering is recommended where the water would pond along the levee for Alternatives 2 and 3. These improvements are included in the cost estimates and are shown on alternative drawings as a "levee lowering."

A table showing the approximate top of levee design elevations for the alternatives is shown in Appendix I-C.

3.1.3. Toe-Down Protection Elevation

The alternative development began in 2019 and the design parameters used for the alternatives is based on the information that was prepared in an earlier version of the hydraulics report, the *Draft Ventura River 2 Levee System Hydrology, Hydraulics, and Sediment Transport Report* (Tetra Tech 2019). At the time of the development of the alternatives, the team was still working on a sediment study to evaluate the sediment transport and scour that may occur near the VR-2 Levee System. In the meanwhile, Tetra Tech used bed degradation information from *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a) to assist in understanding how much bed degradation may occur along the VR-2 Levee System. The single-event and long-term scour components were extracted from the figures at the end of the Stillwater Sciences sediment study and the larger of the two components were applied (AECOM/Stillwater Sciences 2019b).

Tetra Tech also performed a local scour analysis, which considers potential; low-flow, anti-dune, contraction, and bend scour in the vicinity of the levee. Based on the river geometry, bed materials and general hydraulics that are expected within this river system, it was determined that bend scour would be the only appropriate local sour component. Through this evaluation, the Maynord Equation (1996) was selected for determining estimated bend scour. The local scour analysis was performed for the 100-year hydraulic output and the Design Flow output and is based on the hydraulic properties output from Tetra Tech's hydraulic model. In this instance, the Design Flow hydraulic output resulted in a larger magnitude of scour, and therefore, was applied to calculate total estimated scour depth.

Total estimated scour is the sum of the local scour components and either the single-event scour component or the long-term scour component, whichever is larger. The total estimated scour depth was applied to the channel thalweg (at each of the hydraulic cross-sections) to determine a minimum toe-down protection elevation.

A table summarizing the hydraulic output and scour components is provided in Appendix I-D. The summary of hydraulics and design table presented in Appendix I-C shows how the scour was applied and toe-down protection elevations were established.

3.1.4. Protection Sizing

Three material types were considered while performing this alternatives analysis. The material types were sized based on available guidance specific to that material type. Based on the hydraulics, the average channel velocities range from approximately 11.7 feet per second (ft/s) to approximately 16.4 ft/s.

3.1.4.1. <u>Soil Cement</u>

A soil cement blanket with an 8-foot horizontal width was determined to be appropriate for the VR-2 Levee System. There is no federal, state, or local guidance available that provides explicit sizing guidance for soil cement along levees or channels. However, WEST Consultants, Inc has developed the *Soil-Cement Guide for Water Resource Applications* (WEST Consultants 2006). This document states that, "For more than 50 years, soil-cement has proven to be effective and economical construction material for use in water resources applications including streambank protection, slope protection, channel and pond linings, and grade control structures." The document goes on to describe some of the case studies that highlight the resiliency of soil cement as embankment protection.

This documentation also indicates the following in regard to sizing and performance:

> *A typical section consists of 8- to 9-ft- (2.4- to 2.7-m-) wide horizontal layers placed in stair-step fashion along stream bank slopes (Figure 1-7). If the design calls for a "soft" channel bottom, the soil-cement is carried below the existing channel invert elevation to a depth equal to the maximum scour depth that could be expected over the life of the project…. To withstand the abrasive force of stormwater flows at velocities up to 20 ft/sec (6m/sec), the soil-cement typically is designed in stair-step fashion with a minimum 7-day compressive strength between 600 and 750 psi (4.2 and 5.2 MPa).*

Using this information, it was determined that an 8-foot horizontal width section (assuming 750 psi 7-day compressive strength) would provide adequate embankment protection along the VR-2 Levee System.

3.1.4.2. <u>Riprap</u>

Riprap for this system was sized using the USACE guidance in the *EM 1110-2-1601* (USACE 1991). The CHANLPRO V2.0 Program uses the equations provided in *EM 1110-2-1601* and was used to determine the required revetment rock size based on the hydraulic results discussed in Section 2.2.2 (Hydraulics).

While the average channel velocities range up to 16.5 ft/s along the VR-2 Levee Reach, max velocities within the channel can be much higher (up to 23 ft/s). The channel thalweg along this system has migrated laterally in the past such that the highest velocities are against the bank during large storm events. Therefore, max velocity was used for sizing of the riprap blanket.

Channel depth is assumed to be the computed hydraulic depth associated with the maximum flow velocity. Channel top width, to be used in bend reach, is set equal to the distance between two bank stations and average flow velocity greater than 3 feet per second (ft/sec).

The computed riprap D100 sizes for the 100-year and Design Flow conditions are summarized in Table 3-3 below.

Table 3-3 - Riprap Sizing Output Results

River Station	Approx. Exist. Levee Station	100-Year Flow: 100-yr Flow Channel Hydraulics		100-Year Flow: Riprap Size		Design Flow: Design Flow Channel Hydraulics		Design Flow: Riprap Size	
		Velocity (ft/sec)	Bend Radius (feet)	D100 Max (in)	Thickness (in)	Velocity (ft/sec)	Bend Radius (feet)	D100 Max (in)	Thickness (in)
414+72.49	58+76	19.51	1200	N/A		20.31	1200	N/A	N/A
412+26.26	56+24	16.87	1200	48	48	17.6	1200	54	54
409+44.61	53+43	22.82	1200	N/A	N/A	23.04	1200	N/A	N/A
406+89.60	50+85	21.43	1200	N/A	N/A	21.89	1200	N/A	N/A
404+34.64	48+30	20.28	1200	N/A	N/A	20.86	1200	N/A	N/A
401+83.50	45+84	18.5	1200	N/A	N/A	19.05	1200	N/A	N/A
399+32.47	43+35	19.31	1200	N/A	N/A	19.69	1200	N/A	N/A
396+70.70	40+70	15.48	N/A	42	42	15.97	N/A	42	42
394+08.97	38+05	14.69	N/A	33	33	15.14	N/A	42	42
391+59.90	35+61	17.68	N/A	54	54	18.21	N/A	54	54
389+10.90	33+14	15.31	N/A	42	42	15.62	N/A	42	42
386+98.90	31+04	16.6	N/A	48	48	16.92	N/A	48	48
384+87.06	28+90	14.45	N/A	36	36	14.91	N/A	36	36
381+70.80	25+34	14.4	N/A	36	36	14.9	N/A	42	42
378+54.71	21+76	12.93	N/A	27	27	13.33	N/A	27	27
373+96.83	18+08	16.68	N/A	48	48	17.04	N/A	48	48
371+26.70	15+67	14.02	N/A	30	30	14.4	N/A	33	33
368+56.66	13+46	12.69	N/A	24	24	12.98	N/A	27	27
364+35.54	9+71	20.12	N/A	N/A		20.58	N/A	N/A	
363+11.96	8+44	19.37	N/A	54	54	19.74	N/A	54	54
360+23.13	5+22	17.79	N/A	54	54	18.08	N/A	54	54
358+22.91	N/A	17.82	N/A	54	54	18.48	N/A	54	54

N/A : No stable gradation fund by CHANLPRO

In the upstream reach (Reach IV), velocities are too high along the bend to reach a stable gradation. Further downstream, riprap sizing gradations could be found and require rock sizing with a D100 up to 54 inches. There is one cross-section at Station 9+71 where a stable gradation of riprap could not be found, however, there this is near the proposed outlet of Fresno Canyon Drain where there will likely be additional protection with concrete or grout.

Since loose riprap could not be sized in the upstream reach, Table 3-4 below provides the recommendations for this material type by Reach for the Design Flow Condition.

Table 3-4 - Riprap Material Type Recommendations by Reach

Reach	Description
I	54-Inch-Thick Riprap (1-ton)
II	54-Inch-Thick Riprap (1-ton)
III	54-Inch-Thick Riprap (1-ton)
IV	48-Inch-Thick Concreted Rock Riprap (1/2-ton) [see Section 3.1.4.3 for Concreted Rock Riprap sizing]

3.1.4.3. Concreted Rock Riprap

Concreted rock riprap was sized using guidance from the Federal Highway Administration (FHWA) *HEC 11 Design of Riprap Revetment Manual* (FHWA 1987). The FHWA sizing guidance has been used on other levee projects within the watershed. It should be noted, the USACE does not have guidance for sizing grouted stone blanket layers for levee protection.

While the average channel velocities range up to 16.5 ft/s along the VR-2 Levee Reach, max velocities within the channel can be much higher (up to 23 ft/s). The channel thalweg along this system has migrated laterally in the past such that the highest velocities are against the bank during large storm events. Therefore, max velocity was used for sizing of the concreted rock riprap blanket.

The sizing for the FHWA presents concreted riprap blanket thickness as a function of flow velocity as shown in Figure 3.4. Based on the results of the hydraulic modeling, Reaches I, II, and III experience max velocities up to 20 ft/s, and Reach IV experiences velocities up to 23 ft/s. Using the graphic presented below, it was determined that a blanket thickness of about 3 feet would be required through Reaches I-III, and a blanket thickness of approximately 4 feet would be required along Reach IV.

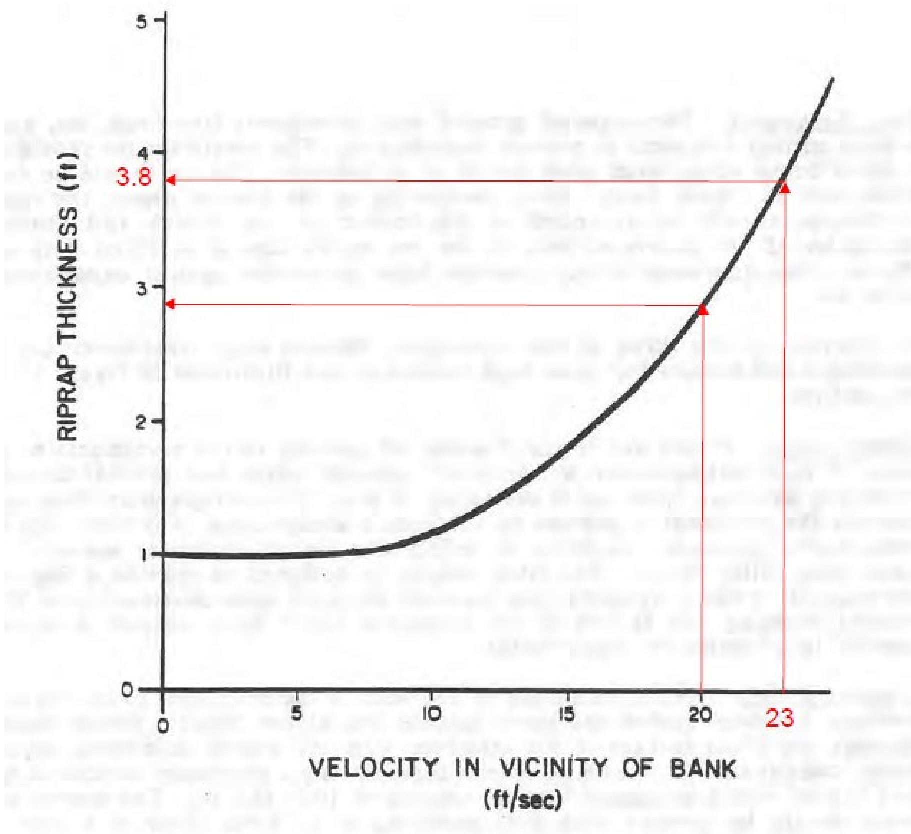

Figure 3.4: Required Concreted Blanket Thickness as a Function of Flow Velocity

Based on the gradation requirements in the FHWA document, ¼-ton rock is recommended for the 36-inch-thick blanket layer and ½-ton rock is recommended for the 48-inch-thick blanket layer. Table 3-5 below provides the recommendations for this material type by Reach for the Design Flow Condition.

Table 3-5 - Concreted Rock Material Type Recommendations by Reach

Reach	Description
I	36-Inch-Thick Concreted Rock Riprap (¼-ton)
II	36-Inch-Thick Concreted Rock Riprap (¼-ton)
III	36-Inch-Thick Concreted Rock Riprap (¼-ton)
IV	48-Inch-Thick Concreted Rock Riprap (½-ton)

3.2. Alternatives Descriptions And Assumptions

This alternatives analysis compares twelve (12) alternative and material type combinations for the VR-2 Levee System. The material type configurations (1.5H:1V Soil Cement, 2H:1V Riprap, 2H:1V Concreted rock riprap, and 1.5H:1V Concreted rock riprap) were applied to each alternative.

Table 3-6 summarizes the impacts, cost, benefits, and constraints/challenges associated with each of the alternatives considered as part of this analysis. The following subsections describe each of the alternative variations in further detail.

Plan views and multiple cross-sections for each alternative are included in Appendix I-A of this report. The cross-section geometry is based on the hydrology, hydraulics, and sediment transport effort described in Section 2.2 (Hydrology, Hydraulics, Sediment Transport, and Scour) of this report.

Quantities for cost and impacts were calculated using the multiple cross-sections for each alternative, the levee alignment lengths, and corridors generated in AutoCAD. The cost estimates and estimated impact area for each alternative are summarized in Table 3-6. The preliminary cost estimates for the alternatives are included in Appendix I-B.

Table 3-6 - Summary of Alternatives Impacts, Costs, Benefits, and Constraints

Alternative	Description	Est. Impact Area[1] (Acres)	Est. Cost[2]	Benefits	Challenges/Constraints
1A	1.5H:1V Soil Cement	12.11	$18,885,723	Smaller impact area. Prevents burrowing through protection.	Ensuring soil mixture and strength. Doesn't meet standard USACE levee geometry requirements.
1B	2H:1V Riprap	14.99	$19,436,904	Can reuse acceptable existing rock.	Potential burrowing through protection. Higher long-term maintenance costs. Larger impact area.
1C	2H:1V Concreted Rock Riprap	14.70	$18,792,840	Prevents burrowing through protection. Can reuse acceptable existing rock.	Larger impact area.
1D	1.5H:1V Concreted Rock Riprap	12.79	$19,701,653	Prevents burrowing through protection. Can reuse acceptable existing rock.	Would need full grout penetration and thick toe. Doesn't meet standard USACE levee geometry requirements.
2A	1.5H:1V Soil Cement	10.30	$17,194,431	Smaller impact area. Prevents burrowing through protection.	Ensuring soil mixture and strength. Doesn't meet standard USACE levee geometry requirements.
2B	2H:1V Riprap	12.77	$18,092,123	Can reuse acceptable existing rock.	Potential burrowing through protection. Higher long-term maintenance costs. Larger impact area.
2C	2H:1V Concreted Rock Riprap	12.38	$17,412,697	Prevents burrowing through protection. Can reuse acceptable existing rock.	Larger impact area.
2D	1.5H:1V Concreted Rock Riprap	10.88	$18,261,047	Prevents burrowing through protection. Can reuse acceptable existing rock.	Would need full grout penetration and thick toe. Doesn't meet standard USACE levee geometry requirements.

Table 3-6 - Summary of Alternatives Impacts, Costs, Benefits, and Constraints

Alternative	Description	Est. Impact Area[1] (Acres)	Est. Cost[2]	Benefits	Challenges/Constraints
3A	1.5H:1V Soil Cement	10.29	$17,040,649	Smaller impact area. Prevents burrowing through protection.	Ensuring soil mixture and strength. Doesn't meet standard USACE levee geometry requirements.
3B	2H:1V Riprap	12.68	$17,985,431	Can reuse acceptable existing rock.	Potential burrowing through protection. Higher long-term maintenance costs. Larger impact area.
3C	2H:1V Concreted Rock Riprap	12.37	$17,322,678	Prevents burrowing through protection. Can reuse acceptable existing rock.	Larger impact area.
3D	1.5H:1V Concreted Rock Riprap	10.87	$18,231,221	Prevents burrowing through protection. Can reuse acceptable existing rock.	Would need full grout penetration and thick toe. Doesn't meet standard USACE levee geometry requirements.

[1]The estimated impact area includes both the permanent and temporary impact areas. Permanent – footprint of structural features. Temporary – footprint of excavation. The impact area does not include a buffer for temporary construction easement area (TCE) or temporary work area (TWA). This is factored in and discussed in Section 4.3 of this report.

[2] The estimated costs are based on the cost estimates provided in Appendix I-B. It should be noted, the mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimate shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3.2.1. Alternative 1A: 1.5H:1V Soil Cement Protection

The design of Alternative 1A (Figure 3.5) consists of a soil cement revetment at a slope of 1.5H:1V with an 8-foot horizontal thickness along Alternative 1. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A weephole system would be required with this alternative. A 3H:1V soil overlay would be placed on top of the soil cement to cover the riverside slope protection where it is exposed. Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. The soil cement would extend laterally at the top to provide a surface for the CMB access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the soil cement protection. An asphalt concrete access road is required in Reach III in the vicinity of the floodwall.

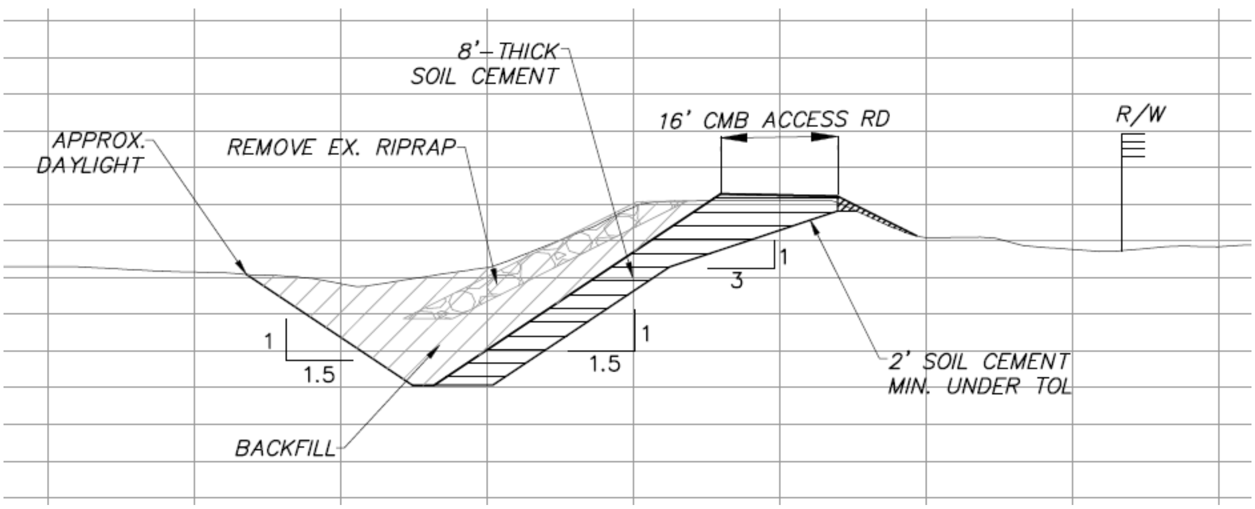

Figure 3.5: Alternative 1A – Typical Section

This 8-foot-wide soil cement slope at 1.5H:1V would provide sufficient stability from a geotechnical standpoint. This soil cement slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce, but not eliminate, the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee. However, burrowing and root penetration could still occur on the unprotected landside of the levee. A 15-foot buffer for vegetation from the apparent toe of both the riverside and landside would still be required.

Some of the considerations associated with this alternative included the following:

- An 11-foot-wide soil cement section would need to be placed. It is assumed 8 feet of the soil cement layer will serve as the structural embankment protection and the additional 3 feet will be uncompacted and/or sacrificial.
- It is estimated that approximately 40% to 50% of the on-site excavated material would need to be screened out in order to provide a soil matrix for soil cement. This would increase soil

import costs during construction (the import of additional, appropriate fill was assumed to increase the cost of the soil cement by approximately 30%). These increased costs are factored into the construction cost estimates shown in this report.

- Testing of the available materials will need to be done to ensure that the soil cement meets strength and abrasion resistance standards.
- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the entire levee system. The weephole system would consist of continuous PVC piping wrapped with filter material behind the soil cement, with PVC piping outlets through the soil cement protection every 100 feet. In addition, a continuous landside toe drainage structure (similar to the weephole structure on the riverside) is required from Station 48+00 to Station 60+00.
- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00. The location of this levee lowering is shown on Sheet 4 for Alternative 1A in Appendix I-A.
- All existing rock riprap would need to be exported off-site. Since rock riprap is not required for this alternative, the large rock could not be reused and would need to be properly disposed at the nearest accepting quarry.

<u>General Maintenance Requirements:</u> Inspect facility routinely, especially after large storm events and when the soil overlay has been eroded away. Soil cement would need to be inspected for loss of material and inspected for any deterioration (cracking, shifting, settlement). All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

3.2.2. Alternative 1B: 2H:1V Riprap Protection

The design of Alternative 1B (Figure 3.6) consists of a riprap blanket at a slope of 2H:1V with 1-ton riprap at 54 inches thick along Alternative 1. However, based on the sizing analysis described in Section 3.1.4 (Protection Sizing), a stable gradation of riprap size could not be determined using USACE sizing guidance in Reach IV. Therefore, Reach IV was designed with a 2H:1V slope with a 48-inch-thick Concreted Rock Riprap (½-ton) blanket (Figure 3.7). The revetment extends from the top of the levee down to an elevation below the potential scour limit.

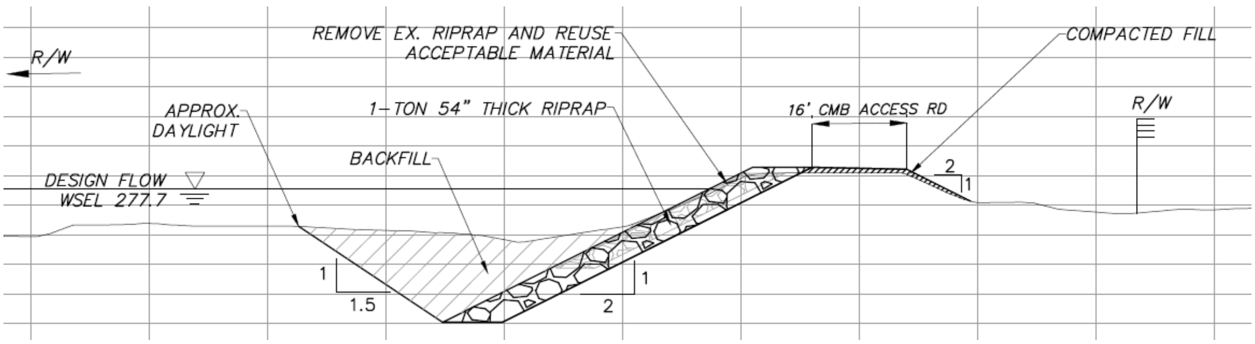

Figure 3.6: Alternative 1B – Typical Section (Reach I through Reach III)

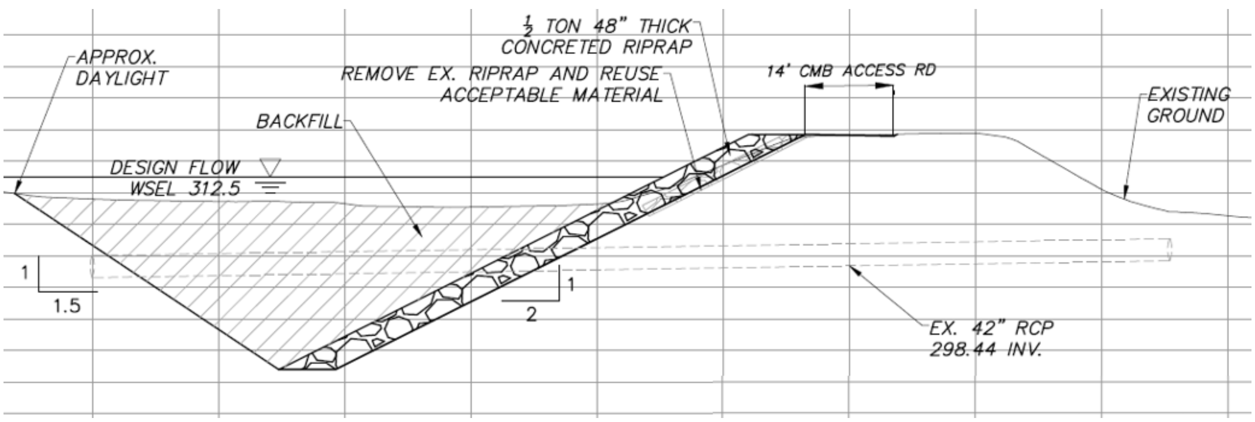

Figure 3.7: Alternative 1B – Typical Section (Reach IV)

Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. CMB material would extend laterally from the top of the riprap along the top of the levee to provide an access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the riprap protection. An asphalt concrete access road would be required in Reach III in the vicinity of the floodwall.

This riprap slope at 2H:1V and the concreted rock riprap slope at 2H:1V would provide sufficient stability from a geotechnical standpoint. Riprap currently exists along the levee and this material type would provide the most similar-looking option to what is currently observed today. Of the evaluated material types, the riprap is the only permeable protection blanket. This alternative

would allow for groundwater to permeate through the rock protection naturally. Reach IV would be concreted rock riprap and would not provide a permeable protection blanket. A 15-foot buffer for vegetation from the apparent toe of both the riverside and landside would still be required.

Based on the geotechnical investigation performed on this levee, the existing riprap was noted to generally be in good condition in the location where the test pits were trenched.

Some of the considerations associated with this alternative included the following:

<u>Loose Riprap</u>

- The riprap slope protection would allow for burrowing through from rodents.
    - This would likely result in the need to more actively control vegetation and rodents, which can have some environmental concerns depending on the type of control used.
- A general concern from the VCPWA-WP for loose rock riprap is that some of the rock would be pulled off of the slope and taken downstream during larger storm events.
- Since there is riprap available along the existing levee, it was assumed that 33% of the removed riprap removed could be reused along the system for the construction of a new riprap blanket. This would include removing the existing rock and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there was not a mix of well-graded riprap sizes. In addition, there are some uncertainties about the quality of riprap between the test pits and further down along the toe-down protection. Therefore, 33% of riprap reuse was determined to be an appropriate assumption.
- An 18-inch filter layer would be required beneath the riprap blanket.

<u>Concreted Rock Riprap</u>

- Since there is riprap available along the existing levee, it was assumed that 57% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along Reach IV. This would result in a total of 90% reuse of the removed existing riprap (33% for riprap, 57% for concreted rock riprap). Since riprap used for a concreted rock blanket typically has less stringent rock quality requirements, it was assumed the more rock could be used for concreted riprap blanket compared to the loose riprap blanket. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so a 90% total rock reuse was determined to be an appropriate assumption.
- A 6-inch filter layer would be required beneath the concreted rock riprap blanket.
- A weephole system would be required along the concreted rock riprap blanket.

- Concreted rock riprap is generally a brittle material that may crack under differential stress conditions.
- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the reach with a concreted rock riprap blanket (Reach IV). The weephole system would consist of continuous PVC piping wrapped with filter material behind the concreted rock riprap, with PVC piping outlets through the concreted rock riprap protection every 100 feet. In addition, a continuous landside toe drainage structure (similar to the weephole structure on the riverside) is required from Station 48+00 to Station 60+00.

General

- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00. The location of this levee lowering is shown on Sheet 4 for Alternative 1B in Appendix I-A.

General Maintenance Requirements: Inspect riprap material and concreted rock riprap for signs of degradation routinely, especially after large storm events. Repair stress cracking on concreted rock riprap surface as necessary. Actively maintain levee to prevent animal/rodent burrowing and vegetation root systems in the vicinity of the levee, particularly on the riverside where roots and burrowing can penetrate the riprap layer. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary.

3.2.3. Alternative 1C: 2H:1V Concreted Rock Riprap Protection

The design of Alternative 1C (Figure 3.8) consists of a concreted rock riprap blanket placed on a 2H:1V slope along Alternative 1. Based on the blanket sizing evaluation described in Section 3.1.4 (Protection Sizing), the concrete rock riprap blanket layer was designed to be 36 inches thick (¼ - ton rock) in Reaches I, II, and II, and 48 inches thick (½ - ton rock) in Reach IV. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A weephole system would be required with this alternative.

Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. CMB material would extend laterally from the top of the concreted rock riprap along the top of the levee to provide an access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the concreted rock riprap protection. An asphalt concrete access road is required in Reach III in the vicinity of the floodwall.

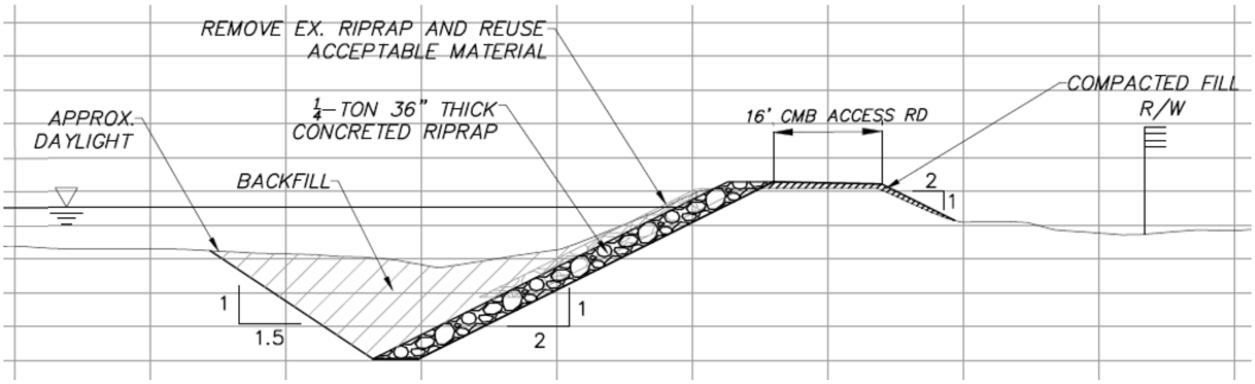

Figure 3.8: Alternative 1C – Typical Section

This concreted rock riprap slope at 2H:1V would provide sufficient stability from a geotechnical standpoint. This concreted rock riprap slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce, but not eliminate, the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee. However, burrowing and root penetration could still occur on the unprotected landside of the levee. A 15-foot buffer for vegetation from the apparent toe of the riverside and landside would still be required.

Some of the considerations associated with this alternative included the following:

- Concreted rock riprap is generally a brittle material that may crack under differential stress conditions.
- Since there is riprap available along the existing levee, it was assumed that 90% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along the levee system. This would include removing the existing rock, washing and processing it, and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so a 90% total rock reuse was determined to be an appropriate assumption.
    - A 6-inch filter layer would be required beneath the concreted rock riprap blanket.
    - A weephole system would be required along the concreted rock riprap blanket.
- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the entire concrete rock riprap protection. The weephole system would consist of continuous PVC piping wrapped with filter material behind the concreted rock riprap, with PVC piping outlets through the concreted rock riprap protection every 100 feet. In addition, a continuous landside toe drainage structure (similar to the weephole structure on the riverside) is required from Station 48+00 to Station 60+00.

- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00. The location of this levee lowering is shown on Sheet 4 for Alternative 1C in Appendix I-A.

General Maintenance Requirements: Inspect facility routinely, especially after large storm events. Repair stress cracking on concreted rock riprap surface. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

3.2.4. Alternative 1D: 1.5H:1V Concreted Rock Riprap Protection

The design of Alternative 1D (Figure 3.9) consists of a concreted rock riprap blanket placed on a 1.5H:1V slope along Alternative 1. Based on the blanket sizing evaluation described in Section 3.1.4 (Protection Sizing), the concrete rock riprap blanket layer was designed to be 36 inches thick (¼ -ton rock) in Reaches I, II, and II, and 48 inches thick (½ - ton rock) in Reach IV. However, the lowest 12 feet of the embankment protection is designed to have an 8-foot horizontal width. The upper portion of the slope would transition to the required thickness of 36 inches or 48 inches as described above. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A weephole system would be required with this alternative.

Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. CMB material would extend laterally from the top of the concreted rock riprap along the top of the levee to provide an access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the concreted rock riprap protection. An asphalt concrete access road is required in Reach III in the vicinity of the floodwall.

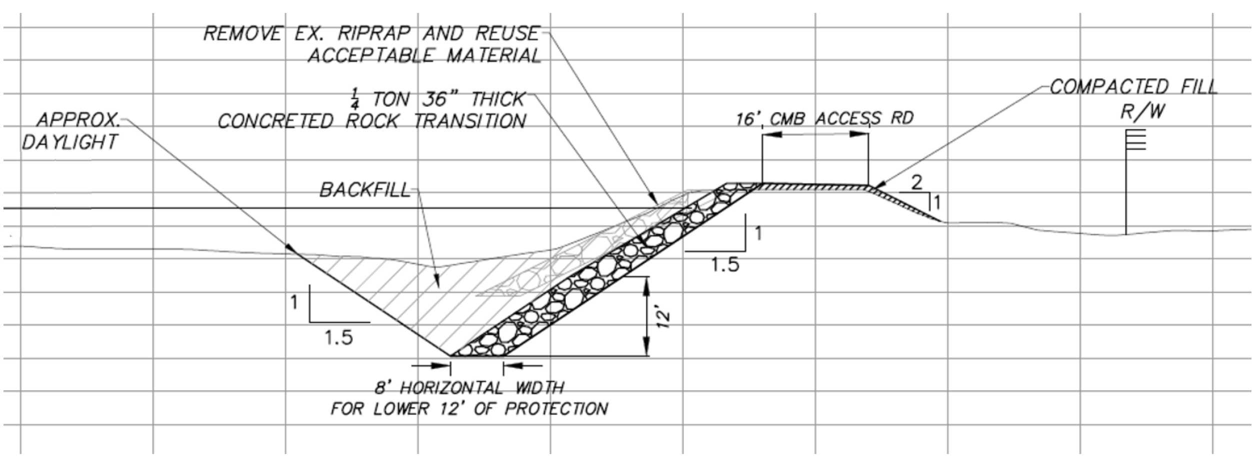

Figure 3.9: Alternative 1D – Typical Section

This concreted rock riprap slope at 1.5H:1V would provide sufficient stability from a geotechnical standpoint but would require a thickened toe and full grout penetration. This concreted rock riprap slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce, but not eliminate, the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee. However, burrowing and root penetration could still occur on the unprotected landside of the levee. A 15-foot buffer for vegetation from the apparent toe of the riverside and landside would still be required.

Some of the considerations associated with this alternative included the following:

- Concreted rock riprap is generally a brittle material that may crack under differential stress conditions.
- In order to meet the required factors of safety for slope stability, the concreted rock riprap at 1.5H:1V would need to have an 8-foot horizontal thickness for the lowest 12 feet of the slope. In addition, full grout penetration would be required. These elements significantly increase costs for this alternative and may create difficulties during construction.
- Since there is riprap available along the existing levee, it was assumed that 90% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along the levee system. This would include removing the existing rock, washing and processing it, and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so a 90% total rock reuse was determined to be an appropriate assumption.
- A 6-inch filter layer would be required beneath the concreted rock riprap blanket.
- A weephole system would be required along the concreted rock riprap blanket.
- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the entire concrete rock riprap protection. The weephole system would consist of continuous PVC piping wrapped with filter material behind the concreted rock riprap, with PVC piping outlets through the concreted rock riprap protection every 100 feet. In addition, a continuous landside toe drainage structure (similar to the weephole structure on the riverside) is required from Station 48+00 to Station 60+00.
- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00. The location of this levee lowering is shown on Sheet 4 for Alternative 1D in Appendix I-A.

General Maintenance Requirements: Inspect facility routinely, especially after large storm events. Repair stress cracking on concreted rock riprap surface. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

3.2.5. Alternative 2A: 1.5H:1V Soil Cement Protection

The design of Alternative 2A (Figure 3.10) consists of a soil cement revetment at a slope of 1.5H:1V with an 8-foot horizontal thickness along Alternative 2. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A weephole system would be required with this alternative. A 3H:1V soil overlay would be placed on top of the soil cement to cover the riverside slope protection where it is exposed. Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. The soil cement would extend laterally at the top to provide a surface for the CMB access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the soil cement protection. An asphalt concrete access road is required in Reach III in the vicinity of the floodwall.

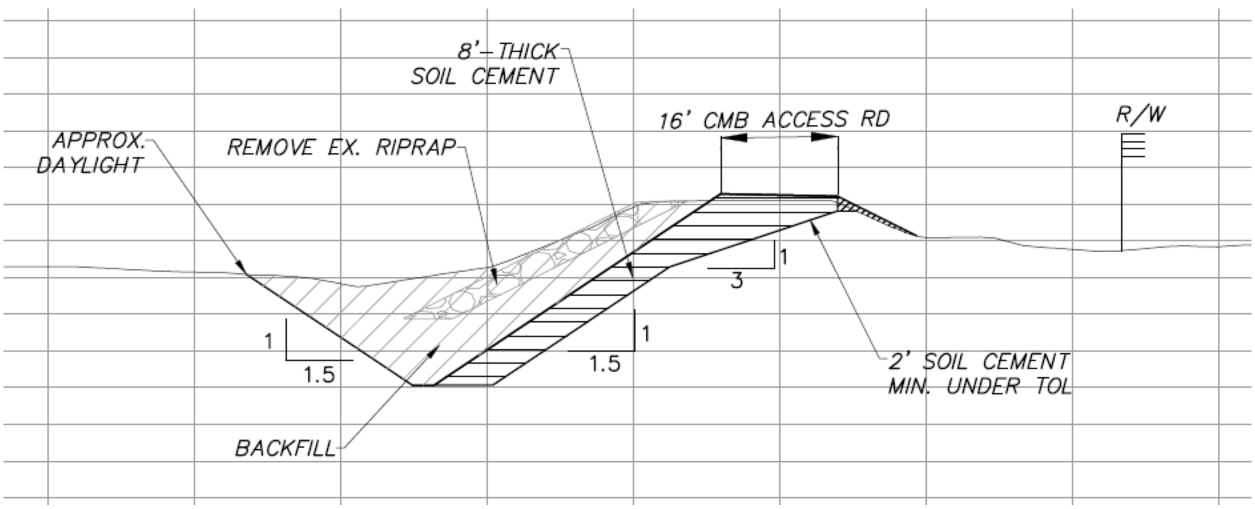

Figure 3.10: Alternative 2A – Typical Section

This 8-foot-wide soil cement slope at 1.5H:1V would provide sufficient stability from a geotechnical standpoint. This soil cement slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce, but not eliminate, the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee. However, burrowing and root penetration could still occur on the unprotected landside of the levee. A 15-foot buffer for vegetation from the apparent toe of both the riverside and landside would still be required.

Some of the considerations associated with this alternative included the following:

- An 11-foot-wide soil cement section would need to be placed. It is assumed 8 feet of the soil cement layer will serve as the structural embankment protection and the additional 3 feet will be uncompacted and/or sacrificial.
- It is estimated that approximately 40% to 50% of the on-site excavated material would need to be screened out in order to provide a soil matrix for soil cement. This would increase soil

import costs during construction (the import of additional, appropriate fill was assumed to increase the cost of the soil cement by approximately 30%). These increased costs are factored into the construction cost estimates shown in this report.

- Testing of the available materials will need to be done to ensure that the soil cement meets strength and abrasion resistance standards.
- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the entire levee system. The weephole system would consist of continuous PVC piping wrapped with filter material behind the soil cement, with PVC piping outlets through the soil cement protection every 100 feet.
- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00 (of the existing levee). Additionally, a similar levee lowering would be required to prevent ponding where Alternative 2 deviates from the existing alignment in Reach IV. The location of these levee lowerings are shown on Sheet 4 for Alternative 2A in Appendix I-A.
- All existing rock riprap would need to be exported off-site. Since rock riprap is not required for this alternative, the large rock could not be reused and would need to be properly disposed at the nearest accepting quarry.
- Right-of-way would need to be acquired from the Ventura River County Water District and the Ojai Valley Land Conservancy to construct and maintain this setback alternative in Reach IV.
- This alternative would require the relocation of the CMWD 42-inch Waterline near the upstream limit within Reach IV. Estimated costs of relocation are included in the cost estimates.

<u>General Maintenance Requirements:</u> Inspect facility routinely, especially after large storm events and when the soil overlay has been eroded away. Soil cement would need to be inspected for loss of material and inspected for any deterioration (cracking, shifting, settlement). All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

3.2.6. Alternative 2B: 2H:1V Riprap Protection

The design of Alternative 2B (Figure 3.11) consists of a riprap blanket at a slope of 2H:1V with 1-ton riprap at 54 inches thick along Alternative 2. However, based on the sizing analysis described in Section 3.1.4 (Protection Sizing), a stable gradation of riprap size could not be determined using USACE sizing guidance in Reach IV. Therefore, Reach IV was designed with a 2H:1V slope with a 48-inch-thick Concreted Rock Riprap (½-ton) blanket (Figure 3.12). The revetment extends from the top of the levee down to an elevation below the potential scour limit.

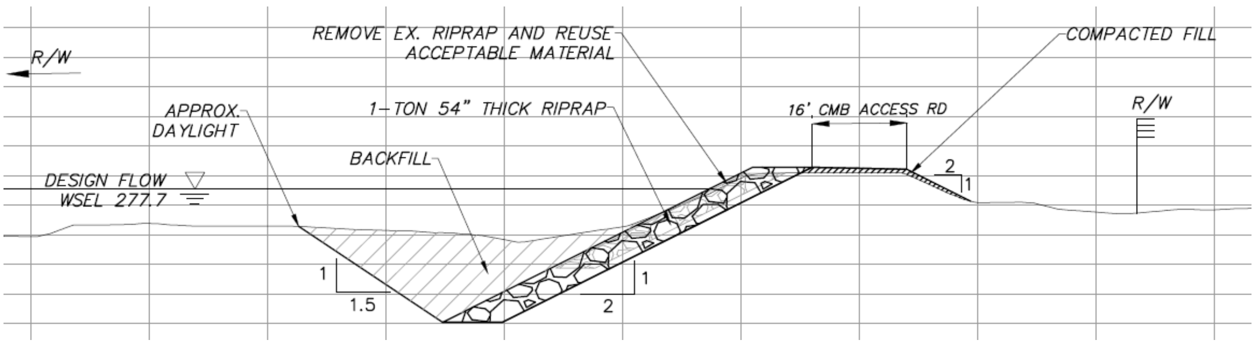

Figure 3.11: Alternative 2B – Typical Section (Reach I through Reach III)

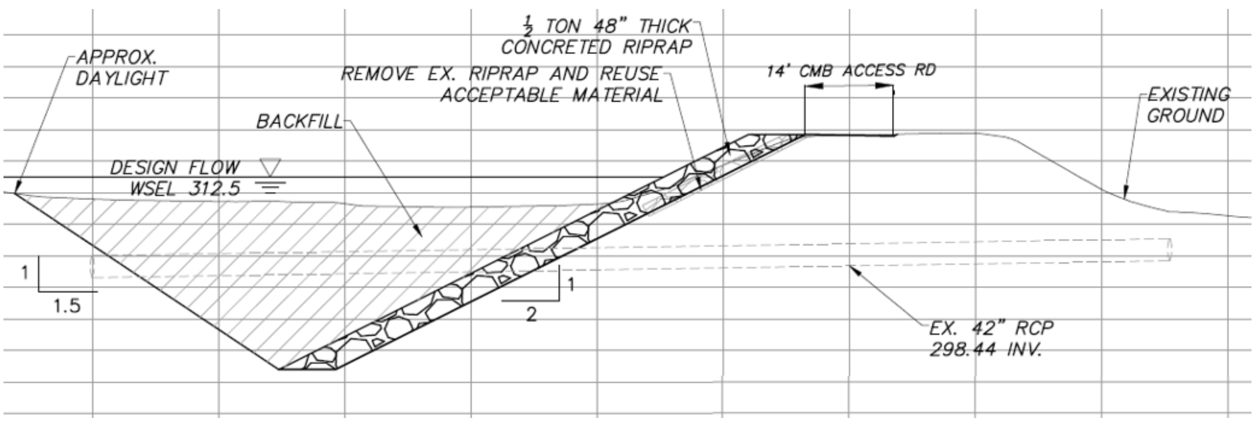

Figure 3.12: Alternative 2B – Typical Section (Reach IV)

Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. CMB material would extend laterally from the top of the riprap along the top of the levee to provide an access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the riprap protection. An asphalt concrete access road would be required in Reach III in the vicinity of the floodwall.

This riprap slope at 2H:1V and the concreted rock riprap slope at 2H:1V would provide sufficient stability from a geotechnical standpoint. Riprap currently exists along the levee and this material type would provide the most similar looking option to what is currently observed today. Of the evaluated material types, the riprap is the only permeable protection blanket. This alternative

would allow for groundwater to permeate through the rock protection naturally. Reach IV would be concreted rock riprap and would not provide a permeable protection blanket. A 15-foot buffer for vegetation from the apparent toe of both the riverside and landside would still be required.

Based on the geotechnical investigation performed on this levee, the existing riprap was noted to generally be in good condition in the location where the test pits were trenched.

Some of the considerations associated with this alternative included the following:

<u>Loose Riprap</u>

- The riprap slope protection would allow for burrowing through from rodents.
  - This would likely result in the need to more actively control vegetation and rodents, which can have some environmental concerns depending on the type of control used.
- A general concern from the VCPWA-WP for loose rock riprap is that some of the rock would be pulled off of the slope and taken downstream during larger storm events.
- Since there is riprap available along the existing levee, it was assumed that 33% of the removed riprap removed could be reused along the system for the construction of a new riprap blanket. This would include removing the existing rock and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there was not a mix of well-graded riprap sizes. In addition, there are some uncertainties about the quality of riprap between the test pits and further down along the toe-down protection. Therefore, 33% of riprap reuse was determined to be an appropriate assumption.
- An 18-inch filter layer would be required beneath the riprap blanket.

<u>Concreted Rock Riprap</u>

- Since there is riprap available along the existing levee, it was assumed that 57% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along Reach IV. This would result in a total of 90% reuse of the removed existing riprap (33% for riprap, 57% for concreted rock riprap). Since riprap used for a concreted rock blanket typically has less stringent rock quality requirements, it was assumed the more rock could be used for concreted riprap blanket compared to the loose riprap blanket. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so a 90% total rock reuse was determined to be an appropriate assumption.
- A 6-inch filter layer would be required beneath the concreted rock riprap blanket.
- A weephole system would be required along the concreted rock riprap blanket.

- Concreted rock riprap is generally a brittle material that may crack under differential stress conditions.
- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the reach with a concreted rock riprap blanket (Reach IV). The weephole system would consist of continuous PVC piping wrapped with filter material behind the concreted rock riprap, with PVC piping outlets through the concreted rock riprap protection every 100 feet.

General

- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00 (of the existing levee). Additionally, a similar levee lowering would be required to prevent ponding where Alternative 2 deviates from the existing alignment in Reach IV. The location of these levee lowerings are shown on Sheet 4 for Alternative 2A in Appendix I-A.
- Right-of-way would need to be acquired from the Ventura River County Water District and the Ojai Valley Land Conservancy to construct and maintain this setback alternative in Reach IV.
- This alternative would require the relocation of the CMWD 42-inch Waterline near the upstream limit within Reach IV. Estimated costs of relocation are included in the cost estimates.

General Maintenance Requirements: Inspect riprap material and concreted rock riprap for signs of degradation routinely, especially after large storm events. Repair stress cracking on concreted rock riprap surface as necessary. Actively maintain levee to prevent animal/rodent burrowing and vegetation root systems in the vicinity of the levee, particularly on the riverside where roots and burrowing can penetrate the riprap layer. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary.

3.2.7. Alternative 2C: 2H:1V Concreted Rock Riprap Protection

The design of Alternative 2C (Figure 3.13) consists of a concreted rock riprap blanket placed on a 2H:1V slope along Alternative 2. Based on the blanket sizing evaluation described in Section 3.1.4 (Protection Sizing), the concrete rock riprap blanket layer was designed to be 36 inches thick (¼ - ton rock) in Reaches I, II, and II, and 48 inches thick (½ - ton rock) in Reach IV. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A weephole system would be required with this alternative.

Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. CMB material would extend laterally from the top of the concreted rock riprap along the top of the levee to provide an access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the concreted rock riprap protection. An asphalt concrete access road is required in Reach III in the vicinity of the floodwall.

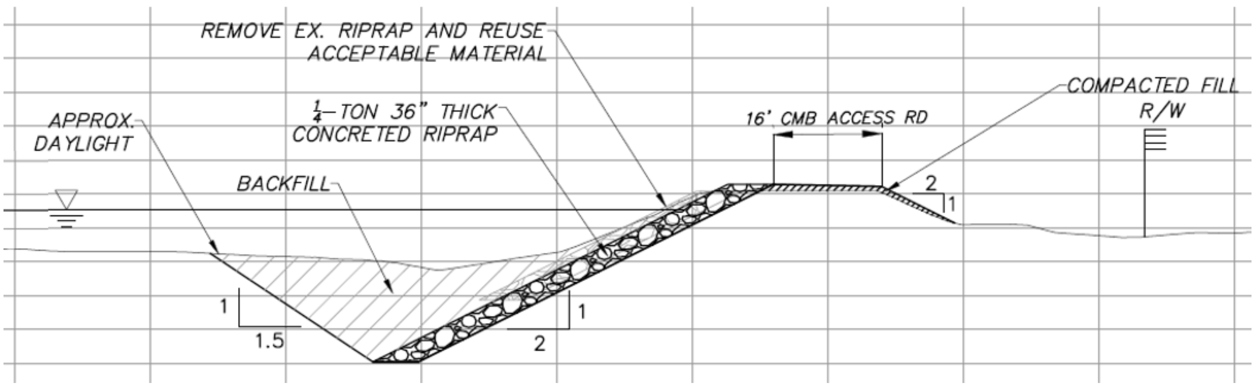

Figure 3.13: Alternative 2C – Typical Section

This concreted rock riprap slope at 2H:1V would provide sufficient stability from a geotechnical standpoint. This concreted rock riprap slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce, but not eliminate, the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee. However, burrowing and root penetration could still occur on the unprotected landside of the levee. A 15-foot buffer for vegetation from the apparent toe of the riverside and landside would still be required.

Some of the considerations associated with this alternative included the following:

- Concreted rock riprap is generally a brittle material that may crack under differential stress conditions.
- Since there is riprap available along the existing levee, it was assumed that 90% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along the levee system. This would include removing the existing rock, washing and processing it, and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so a 90% total rock reuse was determined to be an appropriate assumption.
    - o A 6-inch filter layer would be required beneath the concreted rock riprap blanket.
    - o A weephole system would be required along the concreted rock riprap blanket.

- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the entire concrete rock riprap protection. The weephole system would consist of continuous PVC piping wrapped with filter material behind the concreted rock riprap, with PVC piping outlets through the concreted rock riprap protection every 100 feet.
- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00 (of the existing levee). Additionally, a similar levee lowering would be required to prevent ponding where Alternative 2 deviates from the existing alignment in Reach IV. The location of these levee lowerings are shown on Sheet 4 for Alternative 2A in Appendix I-A.
- Right-of-way would need to be acquired from the Ventura River County Water District and the Ojai Valley Land Conservancy to construct and maintain this setback alternative in Reach IV.
- This alternative would require the relocation of the CMWD 42-inch Waterline near the upstream limit within Reach IV. Estimated costs of relocation are included in the cost estimates.

General Maintenance Requirements: Inspect facility routinely, especially after large storm events. Repair stress cracking on concreted rock riprap surface. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

3.2.8. Alternative 2D: 1.5H:1V Concreted Rock Riprap Protection

The design of Alternative 2D (Figure 3.14) consists of a concreted rock riprap blanket placed on a 1.5H:1V slope along Alternative 2. Based on the blanket sizing evaluation described in Section 3.1.4 (Protection Sizing), the concrete rock riprap blanket layer was designed to be 36 inches thick (¼ -ton rock) in Reaches I, II, and II, and 48 inches thick (½ - ton rock) in Reach IV. However, the lowest 12 feet of the embankment protection is designed to have an 8-foot horizontal width. The upper portion of the slope would transition to the required thickness of 36 inches or 48 inches as described above. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A weephole system would be required with this alternative.

Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. CMB material would extend laterally from the top of the concreted rock riprap along the top of the levee to provide an access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the concreted rock riprap protection. An asphalt concrete access road is required in Reach III in the vicinity of the floodwall.

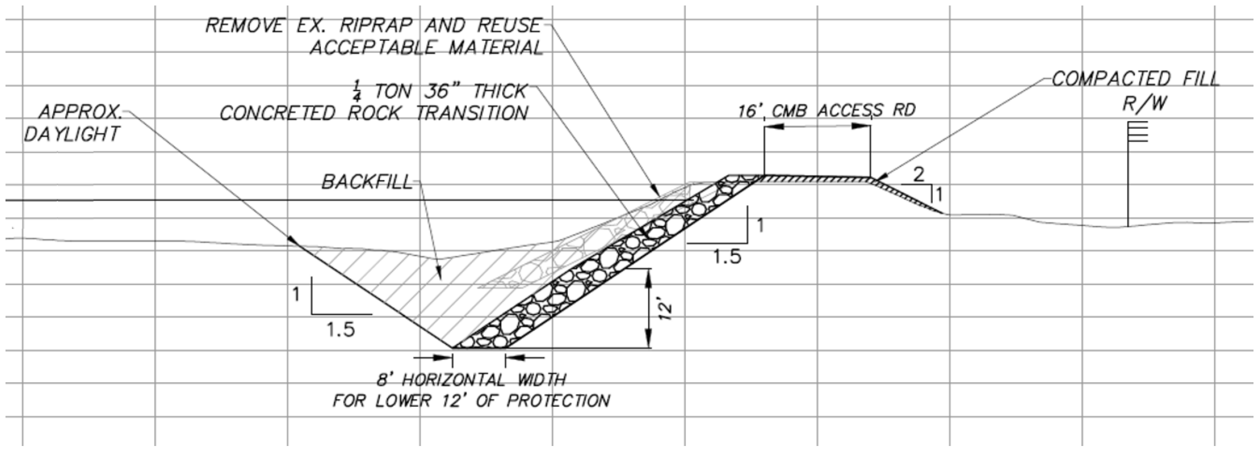

Figure 3.14: Alternative 2D – Typical Section

This concreted rock riprap slope at 1.5H:1V would provide sufficient stability from a geotechnical standpoint but would require a thickened toe and full grout penetration. This concreted rock riprap slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce, but not eliminate, the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee. However, burrowing and root penetration could still occur on the unprotected landside of the levee. A 15-foot buffer for vegetation from the apparent toe of the riverside and landside would still be required.

Some of the considerations associated with this alternative included the following:

- Concreted rock riprap is generally a brittle material that may crack under differential stress conditions.
- In order to meet the required factors of safety for slope stability, the concreted rock riprap at 1.5H:1V would need to have an 8-foot horizontal thickness for the lowest 12 feet of the slope. In addition, full grout penetration would be required. These elements significantly increase costs for this alternative and may create difficulties during construction.
- Since there is riprap available along the existing levee, it was assumed that 90% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along the levee system. This would include removing the existing rock, washing and processing it, and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so a 90% total rock reuse was determined to be an appropriate assumption.
- A 6-inch filter layer would be required beneath the concreted rock riprap blanket.
- A weephole system would be required along the concreted rock riprap blanket.

- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the entire concrete rock riprap protection. The weephole system would consist of continuous PVC piping wrapped with filter material behind the concreted rock riprap, with PVC piping outlets through the concreted rock riprap protection every 100 feet.
- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00 (of the existing levee). Additionally, a similar levee lowering would be required to prevent ponding where Alternative 2 deviates from the existing alignment in Reach IV. The location of these levee lowerings are shown on Sheet 4 for Alternative 2A in Appendix I-A.
- Right-of-way would need to be acquired from the Ventura River County Water District and the Ojai Valley Land Conservancy to construct and maintain this setback alternative in Reach IV.
- This alternative would require the relocation of the CMWD 42-inch Waterline near the upstream limit within Reach IV. Estimated costs of relocation are included in the cost estimates.

General Maintenance Requirements: Inspect facility routinely, especially after large storm events. Repair stress cracking on concreted rock riprap surface. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

3.2.9. Alternative 3A: 1.5H:1V Soil Cement Protection

The design of Alternative 3A (Figure 3.15) consists of a soil cement revetment at a slope of 1.5H:1V with an 8-foot horizontal thickness along Alternative 3. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A weephole system would be required with this alternative. A 3H:1V soil overlay would be placed on top of the soil cement to cover the riverside slope protection where it is exposed. Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. The soil cement would extend laterally at the top to provide a surface for the CMB access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the soil cement protection. An asphalt concrete access road is required in Reach III in the vicinity of the floodwall.

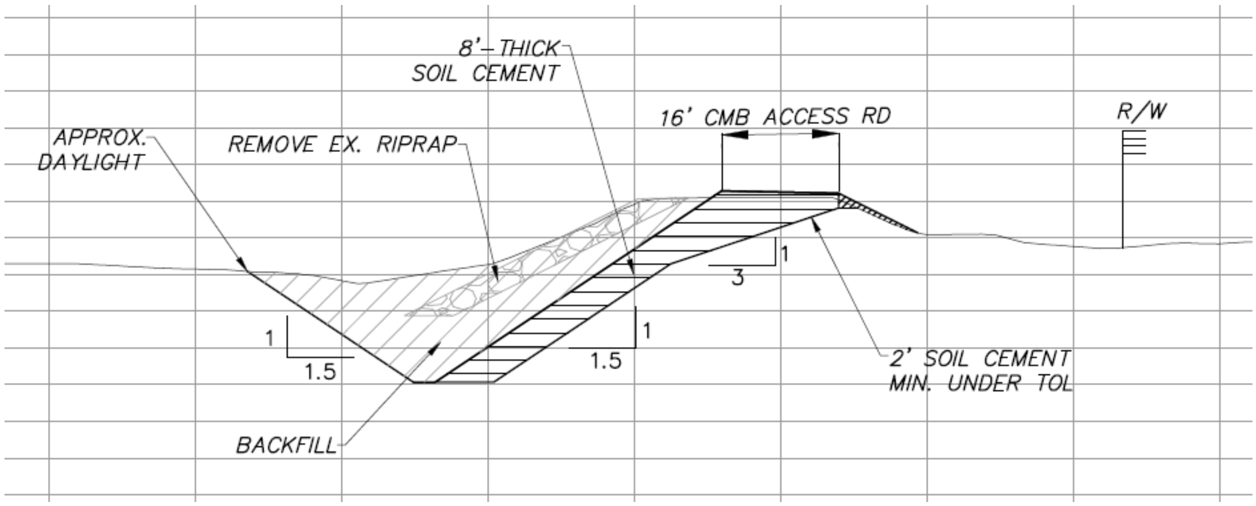

Figure 3.15: Alternative 3A – Typical Section

This 8-foot-wide soil cement slope at 1.5H:1V would provide sufficient stability from a geotechnical standpoint. This soil cement slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce, but not eliminate, the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee. However, burrowing and root penetration could still occur on the unprotected landside of the levee. A 15-foot buffer for vegetation from the apparent toe of both the riverside and landside would still be required.

Some of the considerations associated with this alternative included the following:

- An 11-foot-wide soil cement section would need to be placed. It is assumed 8 feet of the soil cement layer will serve as the structural embankment protection and the additional 3 feet will be uncompacted and/or sacrificial.
- It is estimated that approximately 40% to 50% of the on-site excavated material would need to be screened out in order to provide a soil matrix for soil cement. This would increase soil import costs during construction (the import of additional, appropriate fill was assumed to increase the cost of the soil cement by approximately 30%). These increased costs are factored into the construction cost estimates shown in this report.
- Testing of the available materials will need to be done to ensure that the soil cement meets strength and abrasion resistance standards.
- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the entire levee system. The weephole system would consist of continuous PVC piping wrapped with filter material behind the soil cement, with PVC piping outlets through the soil cement protection every 100 feet.
- A portion of the pre-existing levee embankment that provides access to the bridge along

San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00 (of the existing levee). Additionally, a similar levee lowering would be required to prevent ponding where Alternative 3 deviates from the existing alignment in Reach IV. The location of these levee lowerings are shown on Sheet 4 for Alternative 3A in Appendix I-A.

- All existing rock riprap would need to be exported off-site. Since rock riprap is not required for this alternative, the large rock could not be reused and would need to be properly disposed at the nearest accepting quarry.
- Right-of-way would need to be acquired from the Ventura River County Water District and the Ojai Valley Land Conservancy to construct and maintain this setback alternative in Reach IV. Additional right-of-way will need to be acquired at the downstream end of the system where there is a setback in Reach I.
- This alternative would require the relocation of the CMWD 42-inch Waterline near the upstream limit within Reach IV. Estimated costs of relocation are included in the cost estimates.

General Maintenance Requirements: Inspect facility routinely, especially after large storm events and when the soil overlay has been eroded away. Soil cement would need to be inspected for loss of material and inspected for any deterioration (cracking, shifting, settlement). All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

3.2.10. Alternative 3B: 2H:1V Riprap Protection

The design of Alternative 3B (Figure 3.16) consists of a riprap blanket at a slope of 2H:1V with 1-ton riprap at 54 inches thick along Alternative 3. However, based on the sizing analysis described in Section 3.1.4 (Protection Sizing), a stable gradation of riprap size could not be determined using USACE sizing guidance in Reach IV. Therefore, Reach IV was designed with a 2H:1V slope with a 48-inch-thick Concreted Rock Riprap (½-ton) blanket (Figure 3.17). The revetment extends from the top of the levee down to an elevation below the potential scour limit.

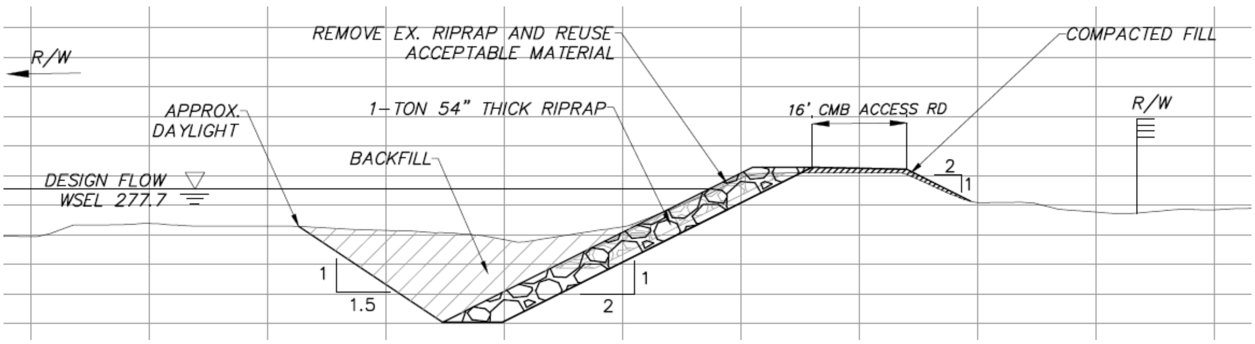

Figure 3.16: Alternative 3B – Typical Section (Reach I through Reach III)

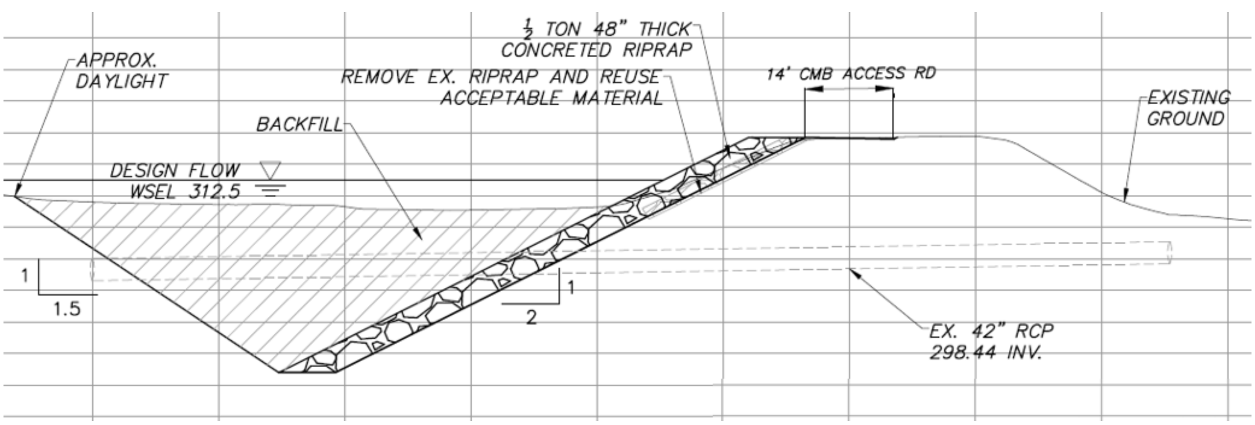

Figure 3.17: Alternative 3B – Typical Section (Reach IV)

Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. CMB material would extend laterally from the top of the riprap along the top of the levee to provide an access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the riprap protection. An asphalt concrete access road would be required in Reach III in the vicinity of the floodwall.

This riprap slope at 2H:1V and the concreted rock riprap slope at 2H:1V would provide sufficient stability from a geotechnical standpoint. Riprap currently exists along the levee and this material type would provide the most similar looking option to what is currently observed today. Of the evaluated material types, the riprap is the only permeable protection blanket. This alternative

would allow for groundwater to permeate through the rock protection naturally. Reach IV would be concreted rock riprap and would not provide a permeable protection blanket. A 15-foot buffer for vegetation from the apparent toe of both the riverside and landside would still be required.

Based on the geotechnical investigation performed on this levee, the existing riprap was noted to generally be in good condition in the location where the test pits were trenched.

Some of the considerations associated with this alternative included the following:

<u>Loose Riprap</u>

- The riprap slope protection would allow for burrowing through from rodents.
    - This would likely result in the need to more actively control vegetation and rodents, which can have some environmental concerns depending on the type of control used.
- A general concern from the VCPWA-WP for loose rock riprap is that some of the rock would be pulled off of the slope and taken downstream during larger storm events.
- Since there is riprap available along the existing levee, it was assumed that 33% of the removed riprap removed could be reused along the system for the construction of a new riprap blanket. This would include removing the existing rock and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there was not a mix of well-graded riprap sizes. In addition, there are some uncertainties about the quality of riprap between the test pits and further down along the toe-down protection. Therefore, 33% of riprap reuse was determined to be an appropriate assumption.
- An 18-inch filter layer would be required beneath the riprap blanket.

<u>Concreted Rock Riprap</u>

- Since there is riprap available along the existing levee, it was assumed that 57% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along Reach IV. This would result in a total of 90% reuse of the removed existing riprap (33% for riprap, 57% for concreted rock riprap). Since riprap used for a concreted rock blanket typically has less stringent rock quality requirements, it was assumed the more rock could be used for concreted riprap blanket compared to the loose riprap blanket. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so a 90% total rock reuse was determined to be an appropriate assumption.
- A 6-inch filter layer would be required beneath the concreted rock riprap blanket.
- A weephole system would be required along the concreted rock riprap blanket.

- Concreted rock riprap is generally a brittle material that may crack under differential stress conditions.
- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the reach with a concreted rock riprap blanket (Reach IV). The weephole system would consist of continuous PVC piping wrapped with filter material behind the concreted rock riprap, with PVC piping outlets through the concreted rock riprap protection every 100 feet.

General

- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00 (of the existing levee). Additionally, a similar levee lowering would be required to prevent ponding where Alternative 3 deviates from the existing alignment in Reach IV. The location of these levee lowerings are shown on Sheet 4 for Alternative 3A in Appendix I-A.
- Right-of-way would need to be acquired from the Ventura River County Water District and the Ojai Valley Land Conservancy to construct and maintain this setback alternative in Reach IV. Additional right-of-way will need to be acquired at the downstream end of the system where there is a setback in Reach I.
- This alternative would require the relocation of the CMWD 42-inch Waterline near the upstream limit within Reach IV. Estimated costs of relocation are included in the cost estimates.

General Maintenance Requirements: Inspect riprap material and concreted rock riprap for signs of degradation routinely, especially after large storm events. Repair stress cracking on concreted rock riprap surface as necessary. Actively maintain levee to prevent animal/rodent burrowing and vegetation root systems in the vicinity of the levee, particularly on the riverside where roots and burrowing can penetrate the riprap layer. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary.

3.2.11. Alternative 3C: 2H:1V Concreted Rock Riprap Protection

The design of Alternative 3C (Figure 3.18) consists of a concreted rock riprap blanket placed on a 2H:1V slope along Alternative 3. Based on the blanket sizing evaluation described in Section 3.1.4 (Protection Sizing), the concrete rock riprap blanket layer was designed to be 36 inches thick (¼ - ton rock) in Reaches I, II, and II, and 48 inches thick (½ - ton rock) in Reach IV. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A weephole system would be required with this alternative.

Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. CMB material would extend laterally from the top of the concreted rock riprap along the top of the levee to provide an access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the concreted rock riprap protection. An asphalt concrete access road is required in Reach III in the vicinity of the floodwall.

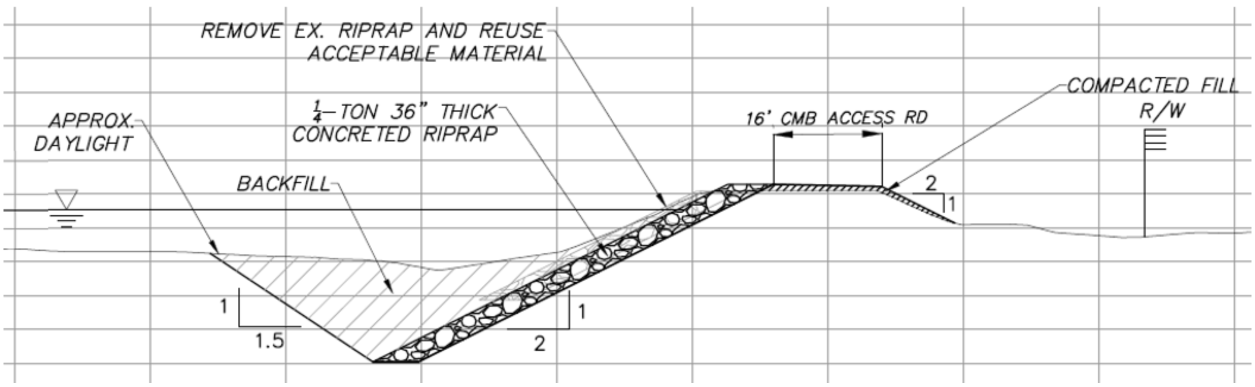

Figure 3.18: Alternative 3C – Typical Section

This concreted rock riprap slope at 2H:1V would provide sufficient stability from a geotechnical standpoint. This concreted rock riprap slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce, but not eliminate, the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee. However, burrowing and root penetration could still occur on the unprotected landside of the levee. A 15-foot buffer for vegetation from the apparent toe of the riverside and landside would still be required.

Some of the considerations associated with this alternative included the following:

- Concreted rock riprap is generally a brittle material that may crack under differential stress conditions.
- Since there is riprap available along the existing levee, it was assumed that 90% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along the levee system. This would include removing the existing rock, washing and processing it, and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so a 90% total rock reuse was determined to be an appropriate assumption.
    - A 6-inch filter layer would be required beneath the concreted rock riprap blanket.

- A weephole system would be required along the concreted rock riprap blanket.

- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the entire concrete rock riprap protection. The weephole system would consist of continuous PVC piping wrapped with filter material behind the concreted rock riprap, with PVC piping outlets through the concreted rock riprap protection every 100 feet.
- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00 (of the existing levee). Additionally, a similar levee lowering would be required to prevent ponding where Alternative 3 deviates from the existing alignment in Reach IV. The location of these levee lowerings are shown on Sheet 4 for Alternative 3A in Appendix I-A.
- Right-of-way would need to be acquired from the Ventura River County Water District and the Ojai Valley Land Conservancy to construct and maintain this setback alternative in Reach IV. Additional right-of-way will need to be acquired at the downstream end of the system where there is a setback in Reach I.
- This alternative would require the relocation of the CMWD 42-inch Waterline near the upstream limit within Reach IV. Estimated costs of relocation are included in the cost estimates.

General Maintenance Requirements: Inspect facility routinely, especially after large storm events. Repair stress cracking on concreted rock riprap surface. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

3.2.12. Alternative 3D: 1.5H:1V Concreted Rock Riprap Protection

The design of Alternative 3D (Figure 3.19) consists of a concreted rock riprap blanket placed on a 1.5H:1V slope along Alternative 3. Based on the blanket sizing evaluation described in Section 3.1.4 (Protection Sizing), the concrete rock riprap blanket layer was designed to be 36 inches thick (¼ -ton rock) in Reaches I, II, and II, and 48 inches thick (½ - ton rock) in Reach IV. However, the lowest 12 feet of the embankment protection is designed to have an 8-foot horizontal width. The upper portion of the slope would transition to the required thickness of 36 inches or 48 inches as described above. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A weephole system would be required with this alternative.

Based on VCPWA-WP standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits. CMB material would extend laterally from the top of the concreted rock riprap along the top of the levee to provide an access road. The design for Reach III includes replacing the existing floodwall with a concrete floodwall that abuts against the concreted rock riprap protection. An asphalt concrete access road is required in Reach III in the vicinity of the floodwall.

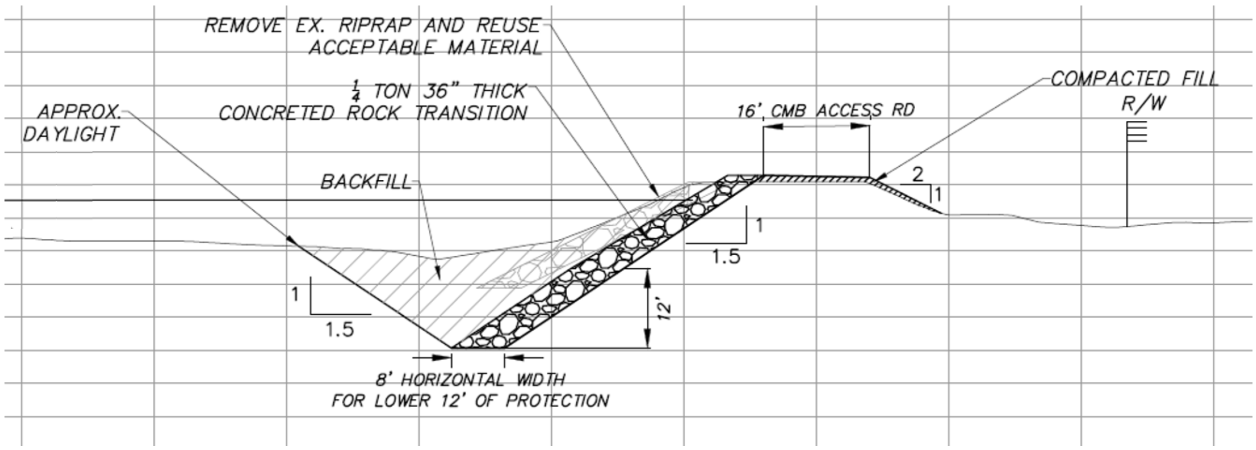

Figure 3.19: Alternative 3D – Typical Section

This concreted rock riprap slope at 1.5H:1V would provide sufficient stability from a geotechnical standpoint but would require a thickened toe and full grout penetration. This concreted rock riprap slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce, but not eliminate, the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee. However, burrowing and root penetration could still occur on the unprotected landside of the levee. A 15-foot buffer for vegetation from the apparent toe of the riverside and landside would still be required.

Some of the considerations associated with this alternative included the following:

- Concreted rock riprap is generally a brittle material that may crack under differential stress conditions.
- In order to meet the required factors of safety for slope stability, the concreted rock riprap at 1.5H:1V would need to have an 8-foot horizontal thickness for the lowest 12 feet of the slope. In addition, full grout penetration would be required. These elements significantly increase costs for this alternative and may create difficulties during construction.
- Since there is riprap available along the existing levee, it was assumed that 90% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along the levee system. This would include removing the existing rock, washing and processing it, and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so a 90% total rock reuse was determined to be an appropriate assumption.
- A 6-inch filter layer would be required beneath the concreted rock riprap blanket.
- A weephole system would be required along the concreted rock riprap blanket.

- To meet seepage requirements, a continuous weephole drainage structure is required on the riverside along the entire concrete rock riprap protection. The weephole system would consist of continuous PVC piping wrapped with filter material behind the concreted rock riprap, with PVC piping outlets through the concreted rock riprap protection every 100 feet.
- A portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek would need to be lowered to an elevation so that adjacent flows do not pond and overtop the levee near Station 59+00 (of the existing levee). Additionally, a similar levee lowering would be required to prevent ponding where Alternative 3 deviates from the existing alignment in Reach IV. The location of these levee lowerings are shown on Sheet 4 for Alternative 3A in Appendix I-A.
- Right-of-way would need to be acquired from the Ventura River County Water District and the Ojai Valley Land Conservancy to construct and maintain this setback alternative in Reach IV. Additional right-of-way will need to be acquired at the downstream end of the system where there is a setback in Reach I.
- This alternative would require the relocation of the CMWD 42-inch Waterline near the upstream limit within Reach IV. Estimated costs of relocation are included in the cost estimates.

General Maintenance Requirements: Inspect facility routinely, especially after large storm events. Repair stress cracking on concreted rock riprap surface. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

3.2.13. Alternative 4: No-Project Alternative

The No-Project Alternative for this project would include keeping the existing levee as-is. There would be no construction cost for the levee, but the levee would not meet FEMA Levee Certification requirements. A non-certified levee would result in a no-levee condition. The future dam removal condition (with aggradation) with no levee in place would result in the 100-year floodplain shown in Figure 3.20.

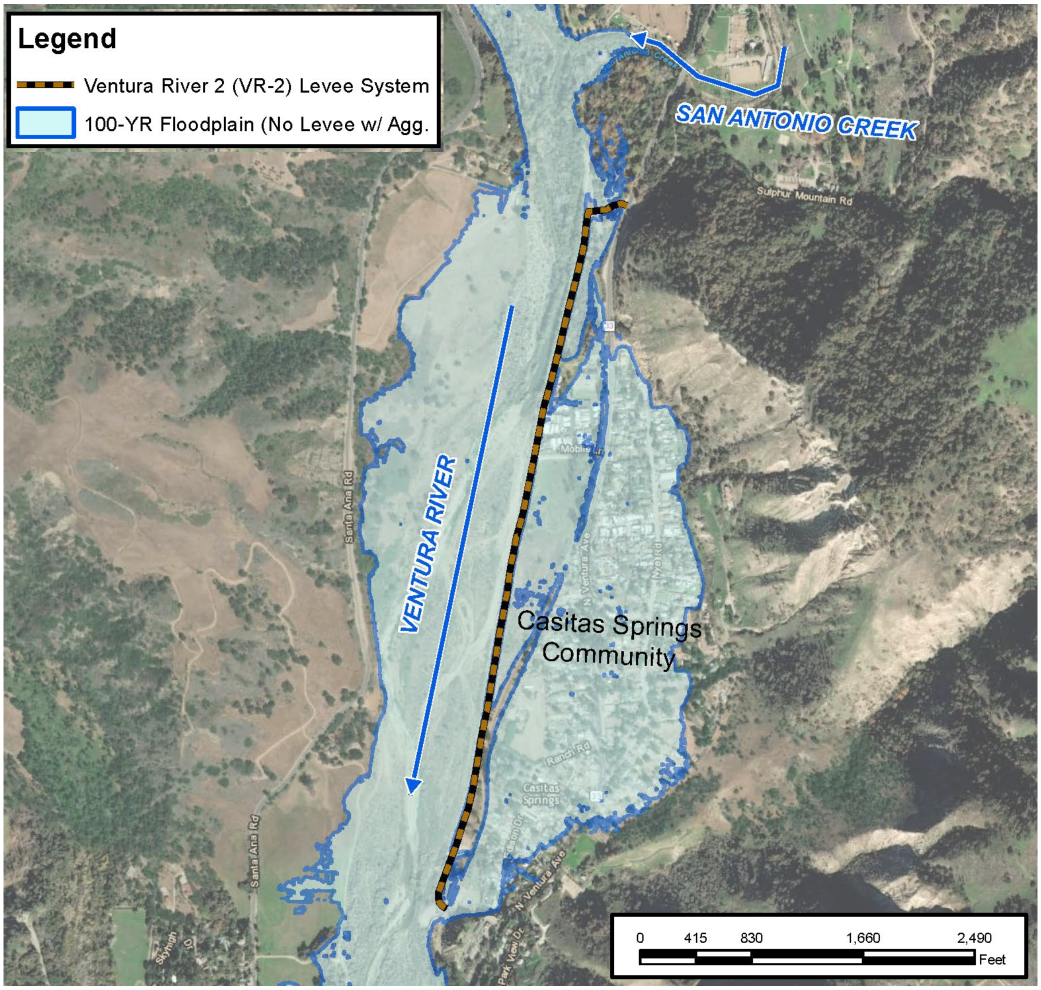

Figure 3.20: 1-D Floodplain Map - No Levee Condition with Future Aggradation (100-Year Flow)

Details describing the impacts of the No-Project Alternative are further discussed in Section 3.3.2.

3.2.14. Additional Alternative Considerations

During the course of the project, there were considerations to other potential setback alignments that would require acquiring right-of-way from the City of Ventura and relocating the mobile home park. These alternatives were initially put forth with the intent to reduce impacts to habitat in the river.

Over the course of the project, the VCPWA-WP met with the Arroyo Mobile Home Park representatives, project stakeholders and regulatory agencies. However, in a project meeting on November 29, 2021, it was relayed to the team that these type of alignment variations were viewed as less favorable due to the potential of the terrace providing an area for homeless encampments. Therefore, these alignments were not further pursued.

Various work was performed in pursuit of these alternative alignments, including cross-sections, figures, cost estimates, etc. This developed documentation can be found in Appendix I-F of this report.

3.3. Alternative Evaluation

The following subsections describe supplemental evaluations of each of the alternatives as part of the VR-2 Levee System Project.

3.3.1. Environmental Impacts and Mitigation

Tetra Tech developed a *Preliminary Alternatives Impacts Analysis Memorandum* (Tetra Tech 2022d), which provided a preliminary evaluation of the environmental impacts that may result from the construction of each of the proposed alternatives, in order to assist in determining the preferred alternative. The evaluation provided in this document is based on the alternatives analysis and the 30% design.

The potential impacts resulting from the construction and operation of each of the proposed alternatives was evaluated for their impacts to environmental resources, following resource categories and significance thresholds as described in the *Ventura County Initial Study Checklist Guidelines* (County of Ventura 2011). A desktop survey of environmental resources within the project area was conducted to provide the baseline conditions. This included a review of online information from the following sources and previously completed reports: *Final Environmental Impact Report for the Ventura Riverbank Protection Upgrade Project* (VR-2 EIR) (VCWPC 2003), including its addendum (VCWPC 2006), and the *Draft Environmental Impact Report Fresno Canyon Flood Mitigation Project* (Fresno Canyon EIR) (Impact Sciences, Inc. 2013).

Table 3-7 provides a summary of the permanent, temporary, and impervious surfaces impacts for each alternative, as well as truck trips and expected construction duration. Table 3-8 shows the potential unavoidable adverse impacts, mitigable impacts, and less than significant impacts to the environmental resources in the project area.

Significant Unavoidable Adverse Impacts: Based on previous studies conducted in the study area or vicinity, it is anticipated that the use of construction equipment would create noise that could not be mitigated to levels below significance thresholds. This corresponds to the findings of the *VR-2 EIR* (VCWPC 2003 and 2006) and the *2016 Fresno Canyon EIR* (Impact Sciences, Inc. 2013), which found that significant unavoidable adverse impacts would result from construction noise, which could not be mitigated.

Significant Adverse Mitigable Impacts: For several resource categories, expected significant adverse impacts would be mitigated through avoidance and minimization measures. Resources for which mitigation would likely reduce impacts to less than significant are expected to include air quality, water resources, biological resources, scenic resources, transportation, and recreation.

Less Than Significant or No Impacts: Several of the environmental resources in the project area would be expected to experience some impacts, though they would not exceed the threshold for significance. However, additional mitigation measures may be implemented. Several additional resources would likely not be impacted, including mineral, agricultural, cultural, and paleontological resources, as well as hydraulic hazards, fire hazards, aviation hazards, hazardous materials and waste, daytime glare, public health, community character, housing, waste treatment and disposal, utilities, greenhouse gases, flood control, law enforcement and emergency services, and education.

Beneficial Impacts: Since the purpose of the project is to improve flood control for the neighborhoods in the vicinity, construction of any proposed alternative would be expected to provide beneficial impacts to flood control, FEMA-related hydraulics, law enforcement, and emergency services.

Table 3-7 - Alternatives Evaluated for VR-2 Levee Rehabilitation

Material/Variation	Permanent Impact Area (Levee, Hardscape) (AC)	Temporary Impacts (Laydowns, TCE) (AC)	Impervious Surface (AC)	Total Truck Trips	Construction Duration in Months
Alternative 1					
A – 1.5H:1V Soil Cement Protection	9.47	2.64	8.05	6,366	15.7
B – 2H:1V Riprap	12.24	2.76	3.17	7,353	13.2
C – 2H:1V Concreted Rock Riprap	11.96	2.74	8.66	4,850	13.6
D – 1.5H:1V Concreted Rock Riprap	10.14	2.65	6.85	4,565	13.4
Alternative 2					
A – 1.5H:1V Soil Cement Protection	7.82	2.48	6.94	5,553	14.4
B – 2H:1V Riprap	10.25	2.51	1.83	7,443	12.4
C – 2H:1V Concreted Rock Riprap	9.89	2.49	7.71	4,920	12.7
D – 1.5H:1V Concreted Rock Riprap	8.39	2.48	5.83	4,689	12.5

Table 3-7 - Alternatives Evaluated for VR-2 Levee Rehabilitation

Material/Variation	Permanent Impact Area (Levee, Hardscape) (AC)	Temporary Impacts (Laydowns, TCE) (AC)	Impervious Surface (AC)	Total Truck Trips	Construction Duration in Months
Alternative 3					
A – 1.5H:1V Soil Cement Protection	7.80	2.50	6.93	5,456	14.3
B – 2H:1V Riprap	10.13	2.54	1.82	7,235	12.4
C – 2H:1V Concreted Rock Riprap	9.83	2.54	7.28	4,709	12.7
D – 1.5H:1V Concreted Rock Riprap	8.37	2.50	5.81	4,619	12.5

Table 3-8 - Summary of Likely Impacts and Studies Needed to Assess Environmental Impacts for Proposed Alternatives

Initial Impact	Resource	Mitigation Measures	Mitigated Impact	Associated Requirements
Significant Unavoidable Adverse Impact	Noise	• Time of day and day of week construction restrictions • Construction equipment noise suppression • Construction phasing and duration	Significant Unavoidable Adverse Impact	• Noise Modeling Study • Noise Control Plan according to *Ventura County Construction Noise Threshold Criteria and Control Plan* (Noise Plan) • Preparation of Statement of Overriding Considerations
Significant Mitigable Adverse Impacts	Air Quality	• Measures to suppress fugitive dust • Measures to reduce combustion emissions	Less Than Significant with Mitigation	• Air Quality Modeling Study (CalEEMod) • Mitigation Plan and Permit according to *Ventura County Air Pollution Control District Rules*
	Water	• Mitigation measures identified in permits and certifications, especially preparation of the Stormwater Pollution Prevention Plan		• Clean Water Act 404 Permit • Clean Water Act 401 Certification • Streambed Alteration Agreement • NPDES General Construction Stormwater Permit
	Biological	• Minimize construction footprint and timing • Dewatering, exclusion fencing • Replace trees removed • Pre-construction biological surveys • Wetland mitigation • In-water and breeding bird work windows		• Jurisdictional Wetland Delineation • Vegetation Mapping • Biological Surveys • Section 7 ESA Consultation with USFWS and NMFS • Consultation with California Department of Fish and Game
	Scenic	• Public meetings • Following applicable aesthetic guidelines		• None
	Transportation	• Traffic Control Plan measures		• Traffic Study
	Recreation	• Traffic Control Plan measures • Safe detour for Ojai Valley Trail closure in a portion of the project area		• Traffic Study
No Significant Impacts	Mineral, Agricultural, Cultural, Geologic, Hydraulic Hazards, Fire Hazards, Aviation Hazards, Hazardous Waste and Materials, Daytime Glare, Public Health, community Character, Housing, Waste Treatment and Disposal Facilities, Utilities, Greenhouse Gases			

A full documentation of the approach, methodology, results, and conclusions can be found in the *Ventura River 2 (VR-2) Levee System Preliminary Alternatives Impacts Analysis Memo* (Tetra Tech 2022d). The Future CEQA Scope of Work can be found in Appendix II-L of this report.

3.3.2. Economic Analysis

Tetra Tech prepared the *VR-2 Economic Analysis Memorandum* (Tetra Tech 2022e), which was used to determine the magnitude of potential economic benefits which support the implementation of these levee improvements. The analysis estimates the expected flood damages in the Ventura River floodplain with and without implementation of the improvements, facilitating estimation of project net benefits, and a benefit to cost ratio. This report documents the methods, assumptions, and conclusions of the economic analysis.

The economic analysis includes the development of a detailed structure inventory, estimation of depreciated structure values, calculation of estimated flood damages using HAZUS-MH (HAZUS) software, and calculation of resulting benefit-cost ratios. In using HAZUS to estimate flood damages, other economic indicators are to be analyzed including damages to essential facilities, transportation systems, utility systems, vehicles, debris, direct social loss, and indirect losses for the study area.

As a result of the economic analysis, the total benefit-cost ratios were calculated for each alternative as shown in Table 3-9. The total benefit-cost ratios included the other economic damage categories reflected in HAZUS. These categories include relocation costs as well as business impacts which include income losses, rental income losses, and wage losses.

Table 3-9 - Total Benefit-Cost Ratios

Alternative	Annual Benefits	Total Construction Cost	Annualized Costs	Benefit-Cost Ratio
1A	$1,359,792	$18,885,723	$926,348	1.47
1B	$1,359,792	$19,436,904	$953,384	1.43
1C	$1,359,792	$18,792,840	$921,793	1.48
1D	$1,359,792	$19,701,653	$966,370	1.41
2A	$1,359,792	$17,194,431	$843,390	1.61
2B	$1,359,792	$18,092,123	$887,422	1.53
2C	$1,359,792	$17,412,697	$854,096	1.59
2D	$1,359,792	$18,261,047	$895,708	1.52
3A	$1,359,792	$17,040,649	$835,847	1.63
3B	$1,359,792	$17,985,431	$882,189	1.54

Table 3-9 - Total Benefit-Cost Ratios

Alternative	Annual Benefits	Total Construction Cost	Annualized Costs	Benefit-Cost Ratio
3C	$1,359,792	$17,322,678	$849,681	1.60
3D	$1,359,792	$18,231,221	$894,245	1.52

As indicated in the table above, each of the alternatives presented results in a Benefit-Cost Ratio greater than 1.

A full documentation of the approach, methodology, results, and conclusions can be found in the *VR-2 Economic Analysis Memorandum* (Tetra Tech 2022e).

3.3.3. Comparison and Evaluation

In addition to the evaluations presented in Section 3.3.1 (Environmental Impacts and Mitigation) and Section 3.3.2 (Economic Analysis), a scoring tool was developed to further compare each of the alternatives. Below is a table that lists the "Evaluation Score" for each of the alternatives (Table 3-10). The "Evaluation Score" is based on the following components for each alternative: impact area, cost, technical feasibility of the design, and maintenance requirements. Table 3-10 summarizes and explains the ratings for each of the alternatives.

Plan views and multiple cross-sections for each alternative are included in Appendix I-A of this report. The cross-section geometry is based on the hydrology, hydraulics, and sediment transport effort described in Section 2.2 (Hydrology, Hydraulics, Sediment Transport, and Scour) of this report.

Table 3-10 - Summary of Alternatives Impacts and Cost

Alternative	Alternative	Impact Area Rating[1] (Interpolated 1-10)	Cost Rating[2] (Interpolated 1-10)	Technical Feasibility Rating[3] (Scored 1-3 based on complexity)	Maintenance Rating[4] (Scored 1-3 based on maintenance reqs)	Evaluation Score[5] Averaged Score
1A	Alternative 1A: 1.5H:1V Soil Cement Protection	6.5	3.8	1	3	3.6
1B	Alternative 1B: 2H:1V Riprap	1	1.9	3	1	1.7
1C	Alternative 1C: 2H:1V Concreted Rock Riprap	1.6	4.1	2	3	2.7
1D	Alternative 1D: 1.5H:1V Concreted Rock Riprap	5.2	1	1	3	2.6
2A	Alternative 2A: 1.5H:1V Soil Cement Protection	10	9.5	1	3	5.9
2B	Alternative 2B: 2H:1V Riprap	5.3	6.4	3	1	3.9
2C	Alternative 2C: 2H:1V Concreted Rock Riprap	6	8.7	2	3	4.9
2D	Alternative 2D: 1.5H:1V Concreted Rock Riprap	8.9	5.9	1	3	4.7
3A	Alternative 3A: 1.5H:1V Soil Cement Protection	10	10	1	3	6.0
3B	Alternative 3B: 2H:1V Riprap	5.4	6.8	3	1	4.1
3C	Alternative 3C: 2H:1V Concreted Rock Riprap	6	9	2	3	5.0
3D	Alternative 3D: 1.5H:1V Concreted Rock Riprap	8.9	6	1	3	4.7

Notes:

1 Impact Area Rating is based on an interpolation of the alternative's impact area from 1 to 10; 10 being the smallest impact area.

2 Cost Rating is based on an interpolation of the alternative's construction cost from 1 to 10; 10 being the least expensive.

3 Technical Feasibility Rating is based on a scoring of the alternative's technical feasibility from 1 to 3; 3 being the alternative with the least amount of potential construction complications.

4 Maintenance Rating is based on a scoring of 1 to 3; a 3 was assigned to solid impervious alternatives that would reduce the need for herbicides/pesticides on the riverside; a 1 was assigned to others.

5 Evaluation Score is an average of the other ratings assigned to the alternative. The higher the score, the better.

4. SELECTED ALTERNATIVE AND 30% DESIGN DEVELOPMENT

Based on the information provided in Section 3 (Alternative Development) of this report, the VCPWA-WP determined that Alternative 3 would be the selected alternative moving forward. Alternative 3 was selected with 1.5H:1V Concreted Riprap protection in Reaches I, III, and IV, and 2H:1V Riprap along Reach II. The VCPWA-WP highlighted the importance of reusing the existing rock that is currently on the levee. Alternative 3 (with the discussed protection) will now be referred to as the selected alternative in the remainder of this report.

Section 4 details the development of the selected alternative and the associated 30% Design. Of the two sets of Appendices included as part of this report, Appendix II includes all of the references related to the 30% Design of the Selected Alternative.

4.1. Selected Alternative Basis of Design

The proposed improvements (and supporting technical analyses) as part of this study are based on parameters that would satisfy the requirements of Title 44 of the Code of Federal Regulations, Section 65.10 (44 CFR, 65.10). These requirements are necessary for levee certification from FEMA.

The plans for the selected alternative were prepared to include the following: title sheet, plans and profiles (1-inch = 40-foot horizontal scale and 1-inch = 4-foot vertical scale), typical sections and details, and cross-sections (at no less frequent than 100 feet on center, and at sections with critical information, using a 1-inch = 10-foot horizontal and vertical scale).

The plan set for the 30% Design can be found in Appendix II-G and the details of the design development are described in the subsections below.

4.1.1. Alignment

As described in Section 3.1.1 (Alternatives and Material Type Configurations) of this report, the alignment for Alternative 3 was developed as a setback from the existing alignment in Reach I and Reach IV in order to reduce impacts in the river. This alignment for Alternative 3 is also shorter in length than Alternative 1 but still protects the same areas that contain economic damages, which means similar benefits but lower construction costs associated with this alternative. Figure 4.1 shows the updated Selected Alternative alignment.

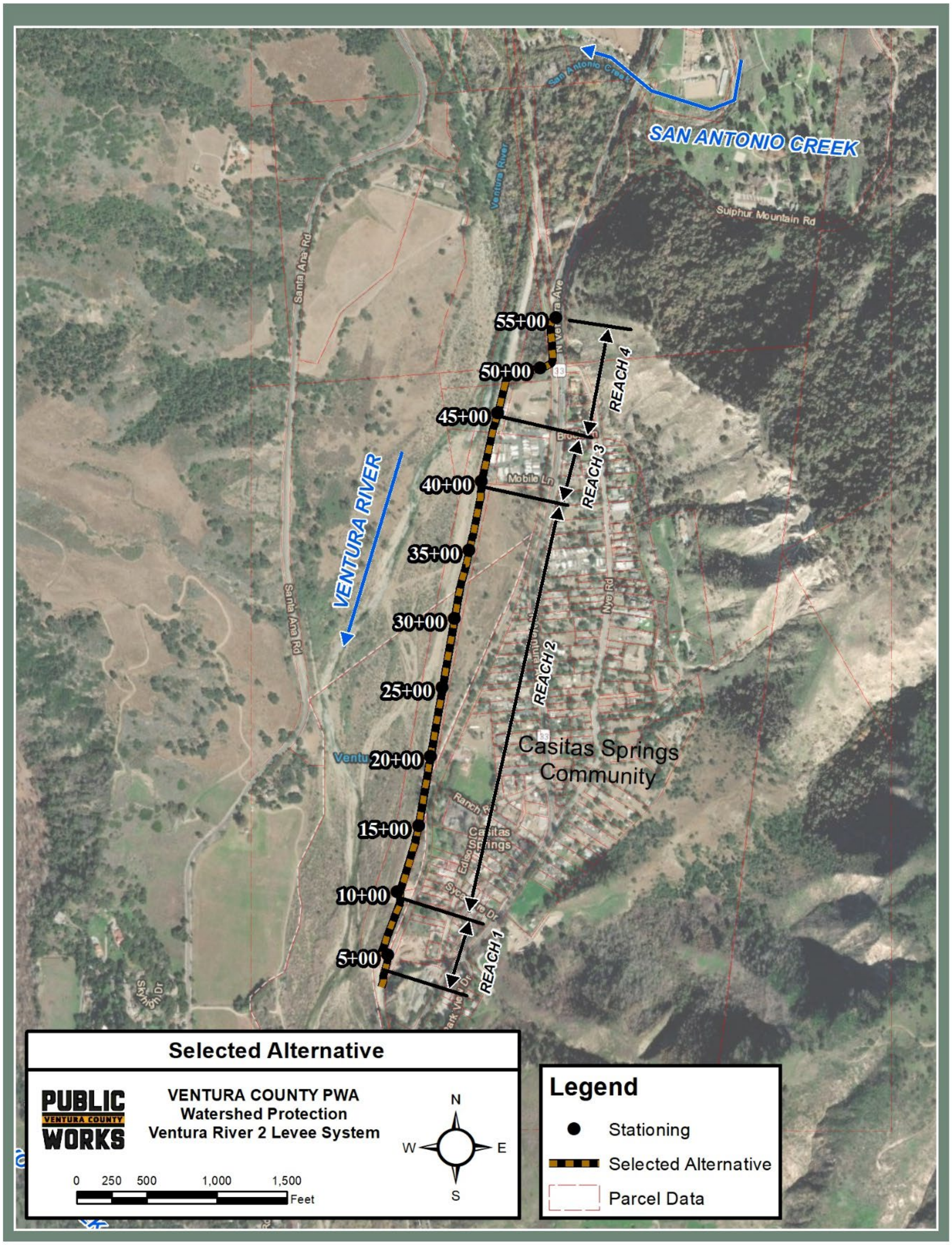

Figure 4.1: Selected Alternative Alignment

The following bullets include important notes about the alignment and updates to the alignment that were made since the alternatives analysis described in Section 3 (Alternative Development).

- This alignment will tie into the Highway 33 road embankment at the upstream end to tie into high-ground. The alignment ties into the Fresno Canyon Diversion project outlet headwall as it ties into high-ground at the downstream end. The levee system will include already constructed portions of the Fresno Canyon Diversion project.
- This alignment will require right-of-way acquisition in both Reach I and Reach IV to construct and maintain the design of the Selected Alternative. Right-of-way would need to be acquired from the City of Ventura in Reach I and from the Ventura River County Water District and the Ojai Valley Land Conservancy in Reach IV.
- This alignment will require the relocation of the CMWD 42-inch Waterline in two locations: 1) between Station 16+00 to Station 19+00, and 2) near the upstream limit within Reach IV. In Reach I, the alignment was offset from the waterline to allow excavation access in the future.
- Stationing has shifted slightly since the alternatives-level alignment because of minor design changes at the upstream and downstream ends of the system.
- Curves and transitions were added to the alignment where necessary. In particular, curves with an adequate radius were required where the alignment makes sharp turns at approximately Station 5+50, Station 47+50, Station 51+00, and Station 53+50.

4.1.2. Top-of-Levee Elevation

The hydraulic parameters used for the 30% Design are based on the hydraulic model associated with the *Ventura River 2 Levee System Hydrology, Hydraulics, and Sediment Transport Report* (Tetra Tech 2022a) described in Section 2.2.2 (Hydraulics). The model includes the runs for the 100-year flow, and the "Design Flow", which is the 100-year flow bulked by 10%. A sediment transport analysis was performed to understand and to estimate potential deposition that may occur near the VR-2 Levee System. This sediment transport study was used to assist in understanding what some of the expected water surface elevation increases may be in the vicinity of the VR-2 Levee System due to the "Future Dam Removal Condition," which is the condition that results in the largest increases to the WSELs. It should be noted that the increases resulting from this study were similar in trend to those resulting from the *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a). The Future Dam Removal Condition Design Flow WSELs were extracted from each of the cross-sections in the hydraulic model.

FEMA deterministic freeboard requirements were applied to the Design Flow water surface elevations and the above-mentioned increases to develop a design top-of-levee profile. FEMA deterministic freeboard requires that the top-of-levee height provide at least three feet of freeboard throughout the levee system and an additional half foot at the upstream tie-in (3.5 feet total).

Results showed that the existing levee is deficient in freeboard requirements at several locations along the system: for a reach downstream of Fresno Canyon Drain; the floodwall reach along the Arroyo Mobile Home Park; and for a segment upstream of the Arroyo Mobile Home Park. The existing slump stone block floodwall along the Arroyo Mobile Home Park would need to be increased by up to 1.5 to 2.5 feet, and in preliminary evaluation of increasing the floodwall height may not meet the appropriate factors of safety to withstand hydraulic loading. For this reason, it is assumed that the slump stone floodwall will need to be replaced with a reinforced concrete floodwall with an appropriately sized footing.

It should be noted that a 2-D hydraulic analysis was performed for this system. The results indicate potential ponding in two places that would need the existing levee to be lowered: 1) a portion of the pre-existing levee embankment that provides access to the bridge along San Antonio Creek, and 2) along the existing levee where the Selected Alternative alignment deviates from the existing alignment in Reach IV.

Table 4-1 summarizes the 30% Design top-of-levee elevations at each hydraulics cross-section. The following details should be noted about the 30% Design top-of-levee profile:

1) The design top-of-levee elevations (Table 4-1) were adjusted to avoid unnecessary grade breaks in the profile and to replace abrupt changes in elevation with smoother transitions. These design elevations are also provided in the profiles of the 30% Design drawings (Appendix II-G).
2) In locations where the height of the existing ground was higher than the required levee, the top of levee was designed at or near the existing levee elevation. By matching the existing ground with the top of levee, at these locations, the amount of excavation and backfill material is minimized. In addition, this would prevent lowering the existing levels of flood protection.

Table 4-1 - Hydraulic Output and Top-of-Levee (TOL) Design

Selected Alternative Levee Station	HEC-RAS Station	Existing Condition Computed WSEL (feet)		Future Dam Removal Condition Computed WSEL (feet)		Existing Levee Elev. Along CL (feet)	FEMA Required Freeboard	Min. Design Levee TOL Elev.	Design Levee TOL Elev.
		100-Year	Design Flow	100-Year	Design Flow				
52+67	406+89.6	302.38	302.93	303.08	303.58	306.07	3.50	307.40	309.00
48+88	404+34.64	300.17	300.61	300.71	301.14	303.60	3.00	306.22	307.00
45+79	401+83.5	298.47	298.91	299.01	299.43	301.21	3.00	302.43	303.00
43+30	399+32.47	295.90	296.41	296.63	297.08	298.69	3.00	300.08	301.00
40+65	396+70.7	293.85	294.30	294.51	295.02	295.69	3.00	298.02	299.00
38+00	394+08.97	291.40	291.86	291.98	292.43	293.11	3.00	295.43	296.00
35+56	391+59.9	288.88	289.28	289.27	289.71	291.50	3.00	292.71	293.00
33+09	389+10.90	286.57	286.97	287.07	287.44	288.79	3.00	290.44	291.00
30+99	386+98.9	283.52	283.89	283.79	284.14	287.36	3.00	287.14	287.36
28+85	384+87.06	281.32	281.67	281.63	281.97	285.44	3.00	284.97	285.44
25+29	381+70.8	278.13	278.49	278.42	278.79	282.24	3.00	281.79	282.24
21+71	378+54.71	276.04	276.47	276.35	276.77	279.67	3.00	279.77	280.00
18+03	373+96.83	271.71	272.11	271.98	272.41	277.09	3.00	275.41	277.09
15+62	371+26.7	269.63	270.08	269.92	270.36	275.28	3.00	273.36	275.28
13+41	368+56.66	268.29	268.75	268.58	269.03	273.56	3.00	272.03	273.56
9+71	364+35.54	264.86	265.32	265.14	265.59	269.46	3.00	268.59	269.46
8+35	363+11.96	264.02	264.50	264.31	264.79	263.94	3.00	267.79	268.00
4+84	360+23.13	262.24	262.81	262.53	263.11	270.58	3.00	266.11	270.58
3+45	358+22.91	260.26	260.70	260.57	261.01	269.41	3.00	264.01	269.41

Notes: 1) Design TOL ties into Fresno Canyon Diversion Headwall improvements. 2) Floodwall elevations are shown at Station 43+30 and 40+65.

4.1.3. Toe-Down Protection Elevation

A sediment transport analysis was performed to understand and to estimate potential scour that may occur near the VR-2 Levee System. Of the conditions evaluated, the "Current Condition with Dam In Place Condition" yielded the deepest scour potential.

The total vertical scour expected throughout the study area is the sum of the general degradation and local scour depths. Under existing conditions, these depths range from 9.4 feet to 10.8 feet (Table 4-2).

Tetra Tech performed a local scour analysis, which considers potential; low-flow, anti-dune, contraction, and bend scour in the vicinity of the levee. Based on the river geometry, bed materials and general hydraulics that are expected within this river system, it was determined that bend scour would be the only appropriate local sour component. Through this evaluation, the Maynord Equation (1996) was selected for determining estimated bend scour. The local scour analysis was performed for the 100-year hydraulic output and the Design Flow output and is based on the hydraulic properties output from Tetra Tech's hydraulic model. In this instance, the Design Flow hydraulic output resulted in a larger magnitude of scour, and therefore, was applied to calculate total estimated scour depth.

Tetra Tech also performed a long-term scour analysis to estimate the general degradation of the river using the three-level analysis described in Section 2.2.2.1 (Sediment Transport).

Total estimated scour is the sum of the local scour components and either the single-event scour component or the long-term scour component, whichever is larger. The total estimated scour depth was applied to the channel thalweg (at each of the hydraulic cross-sections) to determine a minimum toe-down protection elevation. The summary of the scour calculations is shown in Table 4-2.

Table 4-2 – Predicted Total Vertical Scour

Subreach	HEC-RAS River Station		Bend Scour (ft)	With Dam		Without Dam	
	Upstream	Downstream		Long Term Scour (ft)	Total Vertical Scour* (ft)	Long Term Scour (ft)	Total Vertical Scour* (ft)
3	412+27	394+10	2.5	6.7	9.2	5.9	8.4
4	394+09	387+00	2.5	6.9	9.4	6.1	8.6
5	386+99	373+98	6.1	4.7	10.8	4.5	10.6
6	373+97	330+01	6.4	3.2	9.6	3.0	9.4
*Total Vertical Scour = Bend Scour + Long Term Scour							

The design levee toe elevations (Table 4-3) were developed based on the information and calculations described above. It should be noted that the elevations in the 30% Design were adjusted to avoid unnecessary grade breaks in the profile and to replace abrupt changes in elevation with smoother transitions. It should also be noted that the toe of the levee is designed to be at least two feet below the maximum estimated scour depth to allow for the embedment of the embankment protection. Without a 2-foot embedment of the slope protection, the levee would likely not meet the required factors of safety for stability, as indicated in the geotechnical evaluation. These finalized design toe elevations are provided in the profiles of the 30% Design drawings (Appendix II-G).

Table 4-3 - Hydraulic Output and Design Scour Parameters (Toe)

Selected Alternative Levee Station	HEC-RAS XS RM	Channel Thalweg (feet)	Total Scour Depth	Min. Scour Levee Toe Elev.	Design Levee Toe Elev.
52+67	406+89.6	284.78	9.20	275.58	273.00
48+88	404+34.64	285.23	9.20	276.03	273.00
45+79	401+83.5	285.07	9.20	275.87	273.00
43+30	399+32.47	279.52	9.20	270.32	268.00
40+65	396+70.7	278.52	9.20	269.32	267.00
38+00	394+08.97	277.47	9.40	268.07	266.00
35+56	391+59.9	275.04	9.40	265.64	263.50
33+09	389+10.90	274.87	9.40	265.47	263.00
30+99	386+98.9	273.47	10.80	262.67	260.00
28+85	384+87.06	268.40	10.80	257.60	255.00
25+29	381+70.8	265.54	10.80	254.74	252.00
21+71	378+54.71	261.58	10.80	250.78	248.00
18+03	373+96.83	258.72	9.60	249.12	247.00
15+62	371+26.7	255.32	9.60	245.72	243.00
13+41	368+56.66	253.69	9.60	244.09	242.00
9+71	364+35.54	251.35	9.60	241.75	239.00
8+35	363+11.96	251.52	9.60	241.92	239.00
4+84	360+23.13	249.38	9.60	239.78	237.00
3+45	358+22.91	245.49	9.60	235.89	233.50

4.2. Selected Alternative Description

4.2.1. Embankment Protection

The design of the selected alternative consists of a concreted rock riprap revetment at a slope of 1.5H:1V in Reaches I, III, and IV, and riprap revetment at a slope of 2H:1V in Reach II. See Section 3.2.10 (Alternative 3B) and 3.2.12 (Alternative 3D) of this report to see a description of the alternatives-level design.

A minimum 16-foot-wide access road was designed on the levee crown for the entire reach, except in the vicinity of the Arroyo Mobile Home Park. A 14-foot-wide access road is required in Reach III adjacent to the Arroyo Mobile Home Park and floodwall. Crown material is proposed to be CMB in Reaches I, II, and IV, and AC pavement in Reach III adjacent to the Arroyo Mobile Home Park. Additional details regarding the access road are described in Section 4.2.2.

Table 4-4 shown below provides a summary of the embankment protections (riverside and crown) used along the system. The following subsections provide additional detail on the embankment protection.

Table 4-4 - Summary of Embankment Protection Improvements

Station		Description
Start	End	
2+92	5+00	• Riverside: 54-inch-thick rock riprap toe-down protection at 2H:1V slope wrapping around existing Fresno Canyon Diversion outlet improvements • Crown: Follows recently constructed path over Fresno Canyon Diversion
5+00	5+50	• Riverside: 54-inch-thick 2H:1V riprap slope transitions to 36-inch-thick 1.5H:1V concreted rock riprap slope • Crown: 6-inch layer of CMB along 16-foot-wide crown (2% slope towards the landside)
5+50	10+16	• Riverside:36-inch-thick concreted rock riprap at top of 1.5H:1V slope. Lowest 12 feet of section has 8-foot-horizontal width. • Crown: 6-inch layer of CMB along 16-foot-wide crown (2% slope towards the landside)
10+16	10+46	• Riverside: 36-inch-thick 1.5H:1V concreted rock riprap slope transitions to 54-inch thick 2H:1V riprap slope • Crown: 6-inch layer of CMB along 16-foot-wide crown (2% slope towards the landside)
10+46	39+45	• Riverside: 54-inch-thick rock riprap toe-down protection at 2H:1V slope (uniform thickness). • Crown: 6-inch layer of CMB along 16-foot-wide crown (2% slope towards the landside)
39+45	39+75	• Riverside: 54-inch thick 2H:1V riprap slope transitions to 36-inch-thick 1.5H:1V concreted rock riprap slope • Crown: 6-inch layer of CMB along 16-foot-wide crown (2% slope towards the landside)
39+75	44+36	• Riverside:36-inch-thick concreted rock riprap at top of 1.5H:1V slope. Lowest 12 feet of section has 8-foot-horizontal width. Reinforced concrete floodwall up to 5 feet above adjacent grade on riverside edge of crown.

		• Crown: AC Pavement along 14-foot-wide crown (2% slope towards the landside)
44+36	54+12	• Riverside:48-inch-thick concreted rock riprap at top of 1.5H:1V slope. Lowest 12 feet of section has 8-foot-horizontal width. • Crown: 6-inch layer of CMB along 16-foot-wide crown (2% slope towards the landside)

4.2.1.1.Concreted Rock Riprap

The design of the selected alternative consists of a concreted rock riprap revetment at a slope of 1.5H:1V in Reaches I, III, and IV. See Section 3.2.12 (Alternative 3D) of this report to see a description of the alternatives-level design.

In Reaches I, III, and IV, a prism would be built up to the required top-of-levee elevation. Based on the blanket sizing evaluation described in Section 3.1.4 (Protection Sizing), the concrete rock riprap blanket layer was designed to be 36 inches thick (¼ -ton rock) in Reaches I and III, and 48 inches thick (½ - ton rock) in Reach IV. However, the lowest 12 feet of the embankment protection is designed to have an 8-foot horizontal width. The upper portion of the slope would transition to the required thickness of 36 inches or 48 inches as described above. The revetment extends from the top of the levee down to an elevation below the potential scour limit. A few general items related to the design are below:

- The lowest 12 feet of the embankment protection is designed to have an 8-foot horizontal width. The upper portion of the slope would transition to the required thickness of 36 inches or 48 inches as described above.
- A 6-inch filter layer would be required beneath the concreted rock riprap blanket.
- The excavation cut (towards the river) (or back cut) for the toe-down construction is shown at a 1.5H:1V slope.
- Since there is riprap available along the existing levee, it was assumed that 90% of the removed riprap removed could be reused for the construction of the concreted riprap blanket along the levee system. This would include removing the existing rock, washing and processing it, and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there are some uncertainties about the quality and size of riprap throughout the existing levee alignment that could be used for the concreted riprap blanket, so 90% total rock reuse was determined to be an appropriate assumption.
- A weephole system will be constructed along the entire length of the concreted rock riprap blanket protection. Weepholes will be constructed on the riverside slope, with two weephole outlet pipes at no less frequent than 100-foot on center. One layer of weepholes is also present through the landside soil cement protection on the landside.

A typical section detailing the design of the concreted riprap section is shown below in Figure 4.2. Note that "S" is equal to 1.5 on Figure 4.2 but will vary as the slope transitions to the 2H:1V riprap sections (Section 4.2.1.2 [Loose Riprap]).

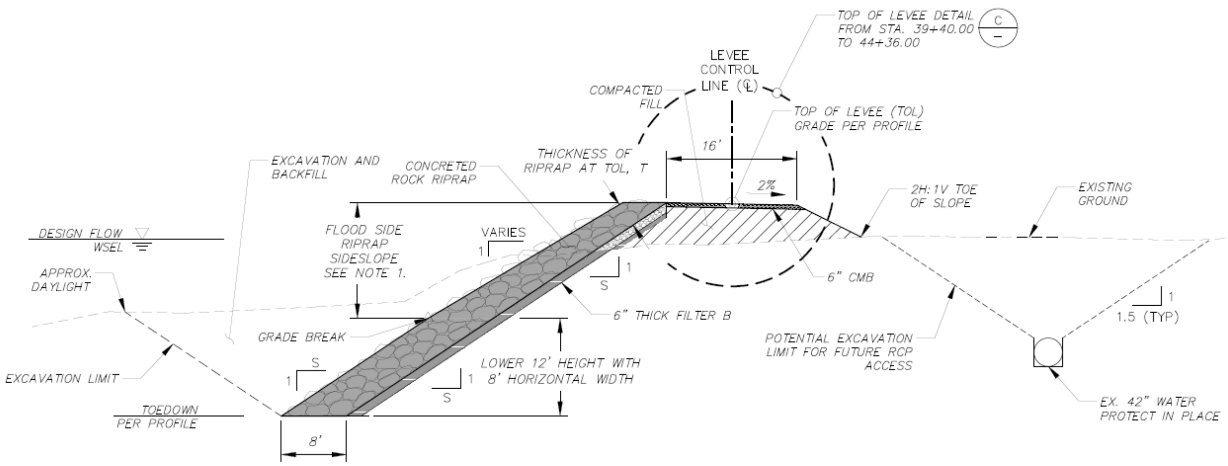

Figure 4.2: Selected Alternative Typical Concreted Riprap Section (Reach I, III, and IV)

4.2.1.2. <u>Loose Riprap</u>

The design of the selected alternative consists of a riprap revetment at a slope of 2H:1V in Reach II. See Section 3.2.10 (Alternative 3B) of this report to see a description of the alternatives-level design.

In Reach II, a prism would be built up to the required top-of-levee elevation. Based on the blanket sizing evaluation described in Section 3.1.4 (Protection Sizing), the riprap blanket layer was designed to be 54 inches thick (1-ton rock) The revetment extends from the top of the levee down to an elevation below the potential scour limit. A few general items related to the design are below:

- An 18-inch filter layer would be required beneath the riprap blanket: 12-inches with Filter Material "A" and 6 inches with Filter Material "B."
- The excavation cut (towards the river) (or back cut) for the toe-down construction is shown at a 1.5H:1V slope.
- Since there is riprap available along the existing levee, it was assumed that 33% of the removed riprap removed could be reused along the system for the construction of a new riprap blanket. This would include removing the existing rock and mixing it with imported rock to ensure that a stable gradation and quality is produced. While the geotechnical analysis generally indicated a good quality of rock observed at the test pits, there was not a mix of well-graded riprap sizes. In addition, there are some uncertainties about the quality of riprap between the test pits and further down along the toe-down protection. Therefore,

33% of riprap reuse was determined to be an appropriate assumption.

A typical section detailing the design of the loose riprap section is shown below in Figure 4.3.

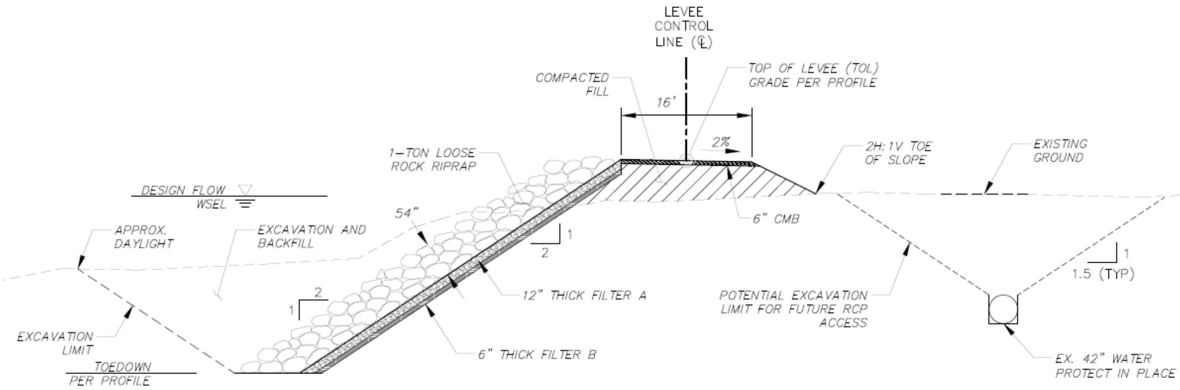

Figure 4.3: Selected Alternative Typical Loose Riprap Section (Reach II – Sta. 10+46 to Sta. 39+40)

4.2.2. Access Road

An access road is proposed to be constructed along the crown of the entire levee and would vary from 16 feet to 14 feet wide (Figure 4.4 and Figure 4.5). It is designed at a two percent grade towards the landside of the levee. In Reach III, the access road will maintain the existing 14-foot width as to not encroach on the adjacent Arroyo Mobile Home Park. The access road material will consist of 6-inch CMB material in Reaches I, II, and IV, and will consist of AC pavement in Reach III.

VCPWA-WP expressed the desire to maintain access to the levee from the entry point near Sulphur Mountain Road. Therefore, the existing levee access road will be maintained in place. In addition, there will be an access road constructed along the levee lowering discussed in Section 4.2.5 (Levee Lowering / Dip Crossing).

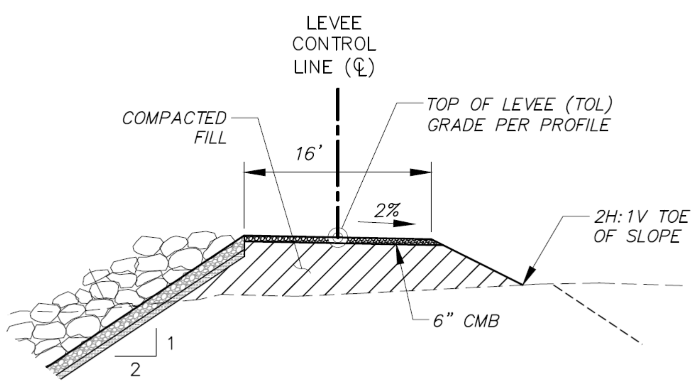

Figure 4.4: Typical Detail of Access Road in Reaches I, II, and IV

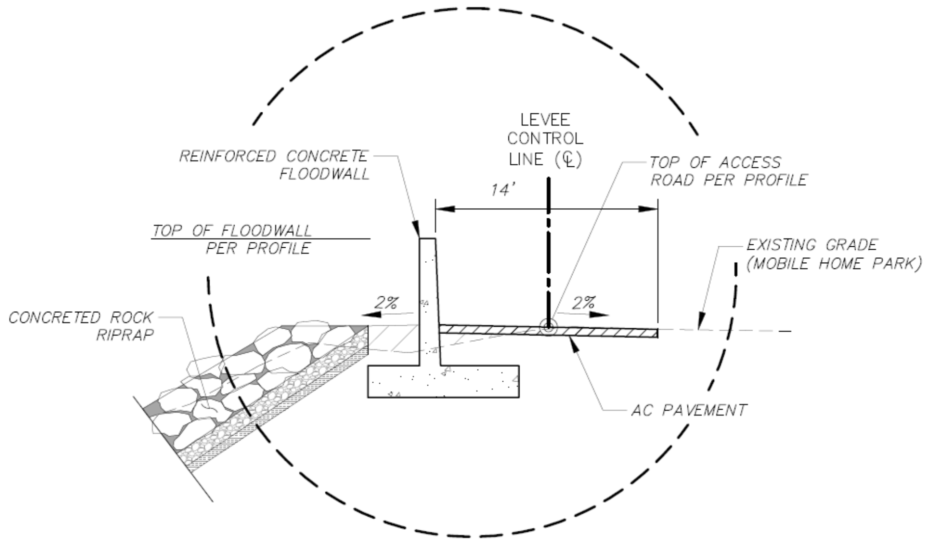

Figure 4.5: Typical Detail of Access Road in Reach III

4.2.3. Side-Drainage Structures

The side-drainage structures shown on the design along this levee system are based on the existing side-drainage structures designed in previous improvements of the VR-2 Levee System. Penetration No. 1 – No. 3 do not require any improvements.

Penetration No. 4 (Fresno Canyon Drain) will require the most improvement, which will include extending the outlet of Fresno Canyon Drain and constructing a penetration through the levee. Based on the existing interior drainage analysis, all the flows within this drainage area are not contained within the channel. However, in designing the outlet channel and RCB, it was assumed that all anticipated flows for the 100-year event are conveyed through the outlet. Sizing for Penetration No. 4 was determined based on preliminary calculations using the Water Surface Pressure Gradient (WSPG) program.

The two side-drainage structures, Penetrations No. 5 and No. 6. are located at Station 21+15 and Station 45+19, respectively, are 24-inch CSP's and would be replaced with 24-inch RCPs. The most upstream side-drainage structure No. 7 at Station 58+37 is no longer part of the Selected Alternative alignment and no improvements are required at this location. See Table 4-5 for a summary of the penetrations and proposed improvements.

Table 4-5 – VR-2 Levee Penetrations Summary of Improvements.

Penetration No.	Approx. Levee Station	Descriptions	Proposed Improvement
1	2+39	18-inch RCP, without flap gate	None
2	2+60	108-inch RCP, without flap gate, Fresno Canyon Diversion	None
3	2+85	48-inch RCP, with flap gate	None
4[1]	9+00	10' W x 5.5' H RCC, Existing Fresno Canyon Drain	Extend channel from the outlet of existing Fresno Canyon Drain, transition to 10' W x 5.5 H RCB through the levee, concrete outlet structure, and flap gate
5	21+15	24-inch CSP, with flap gate	Replace pipe with 24-inch RCP, replace outlet structure, replace flap gate
6	45+19	24-inch CSP, with flap gate	Replace pipe with 24-inch RCP, replace outlet structure, replace flap gate
7	58+37 (existing levee stationing)	36-inch RCP, with flap gate	None

1. Flap gate is proposed in the VR-2 Levee improvements.
Note: RCP: reinforced concrete pipe; RCC: reinforced concrete channel; CSP: corrugated steel pipe

While the design decision at this time is to replace the Penetrations No. 4 and No. 5 in their existing location, a supplemental drainage analysis is recommended as indicated in Section 2.4 (Interior Drainage). The number, sizes, and locations of penetrations required may vary as more information becomes available during a subsequent phase of design.

4.2.4. Utilities and Other Potential Conflicts

Formal utility requests were not sent during this phase of design. However, utilities within the project area were collected from the available as-built and record drawings.

The identified utilities and their approximate locations are listed below:

- Overhead electrical wires and poles
  - At Station 15+75, the pole is well outside of the footprint of the levee and just outside of right-of-way but may need to be relocated during construction.
  - At Station 54+00, the poles are adjacent to the proposed levee prism and electrical wires pass over the proposed levee.
- Reinforced Concrete Structure (potential drainage structure)
  - At Station 39+40, an unidentified reinforced concrete structure is on the crown just south of the mobile home park. It is assumed that this is part of a local water structure. This was protected in place in previous levee improvements and the same was assumed for the current design.
- 42-inch CMWD Waterline
  - From Station 2+32 to Station 6+50, some of the levee improvements will be constructed over the waterline. However, at this time, relocation of the waterline is not determined to be required in this area. The improvements in this area should not impede the ability to access the waterline.
  - From Station 15+50 to Station 19+00, the waterline crosses under the footprint of the levee crown. While more recent levee improvements by the VCPWA-WP have not required relocation, the relocation of the waterline in this area was included in the cost estimate at this time. Details about where the waterline is relocated will need to be refined when more information about other utilities are available.
  - From Station 51+00 to Station 54+27, the alignment runs adjacent to the waterline and crosses over the waterline at one location. The slope protection would interfere with the waterline at this location and it is recommended that the waterline be relocated in this area. This relocation was included in the cost estimate. However, details about where the waterline is relocated will need to be refined when more information about other utilities near Highway 33 is available.

The utilities discussed above are shown on the design plans in Appendix II-G. A formal utility request will need to be performed to document the utilities and potential conflicts within the project area.

4.2.5. Levee Lowering / Dip Crossing

The area between the new levee embankment and the existing levee embankment naturally ponds in the wetlands area. The ponding heights could build up to an elevation which causes the proposed levee to not meet FEMA freeboard requirements. To reduce the ponding against the new levee embankment and prevent diminished freeboard, a lowering of the existing levee embankment would be required. The lowering is designed to an elevation of 295 feet for a distance of 275 feet to allow water to flow freely back into the river. The VCPWA-WP would like to maintain access along the existing levee embankment, so ramps (constructed at 10% grade) would be constructed on each side of the levee lowering. A concrete approach slab will be placed on the southern access ramp to spread the load of vehicles as it runs along the concreted rock riprap slope. The lowering / dip crossing will be constructed with a 6-inch layer of crushed aggregate base (CAB) along the 16-foot-wide access road. Figure 4.6 shows the plan view of the levee lowering / dip crossing.

Previously during the alternatives analysis, it was assumed that an additional levee lowering / dip crossing would be required between the existing levee and the embankment that provides access to the bridge along San Antonio Creek. However, at this time, it is assumed that the existing pipes at this location will be able to adequately drain ponded water as the storm passes. Therefore, this dip crossing is not included as part of this 30% Design.

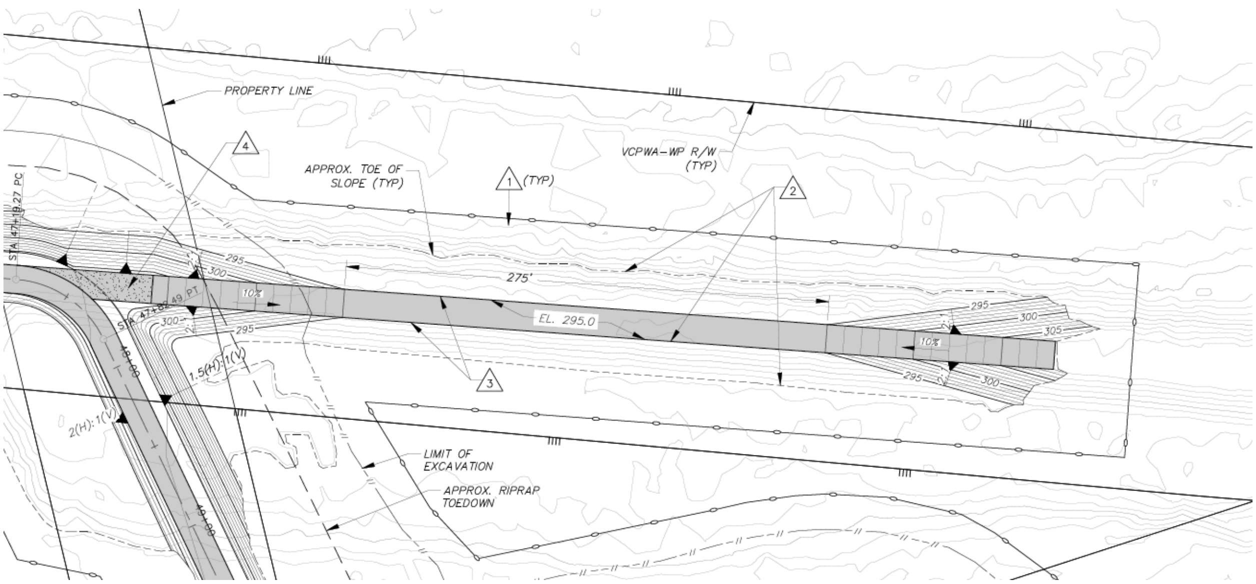

Figure 4.6: Plan View of Levee Lowering / Dip Crossing

4.2.6. Right-of-Way Assessment

As discussed in other places in this report, right-of-way would need to be acquired from the Ventura River County Water District and the Ojai Valley Land Conservancy to construct and maintain this setback alternative in Reach IV. Additional right-of-way will need to be acquired at the downstream end of the system where there is a setback in Reach I.

Figure 4.7 shows the Ventura River County Water District property in a pink shade and the Ojai Valley Land Conservancy property in yellow shade near the upstream end of the levee system. Figure 4.8 shows the City of Ventura property in a green shade near the downstream end of the levee system.

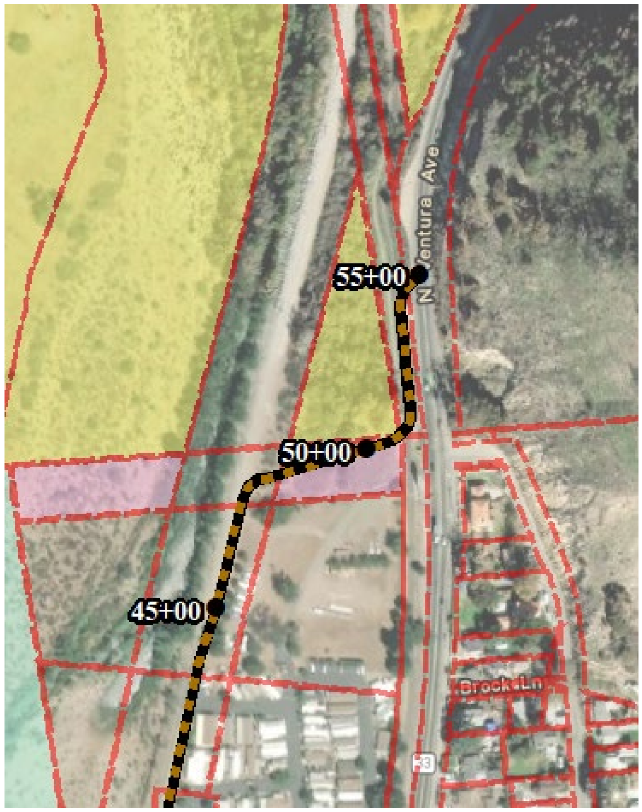

Figure 4.7: Right-of-Way Acquisition Near Upstream Limit

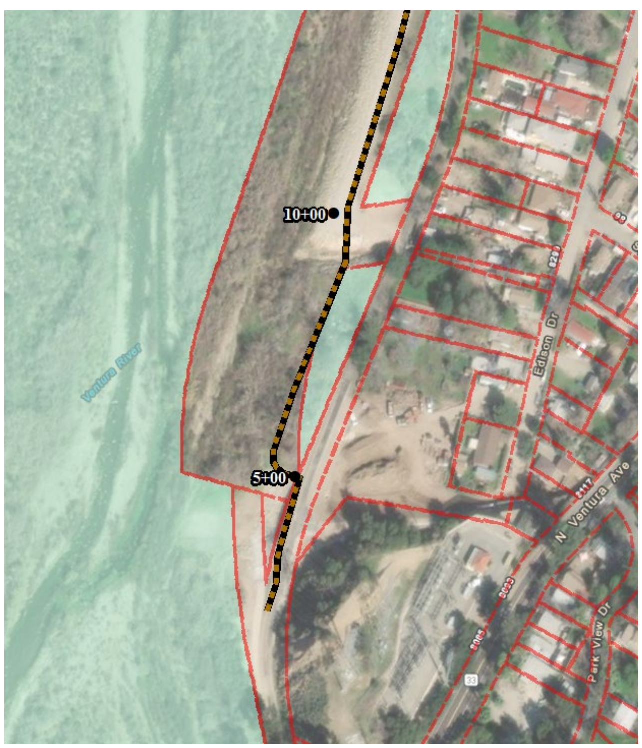

Figure 4.8: Right-of-Way Acquisition Near Downstream Limit

4.2.7. Maintenance Requirements

The general maintenance requirements of the selected alternative used in the 30% Design primarily include routine facility inspections, especially after large storm events. Concreted rock riprap would need to be inspected for deterioration and repair of stress cracking would need to occur frequently. Weepholes would need to be cleared on an annual basis to ensure the backside can drain. Riprap would also need to be inspected for deterioration and will need to be replaced as necessary if significant rock degradation occurs. All vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside and riverside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary on the landside.

4.3. Environmental Considerations

4.3.1. Impact Areas

Table 4-6 shows the potential permanent impact area, temporary impact area, TCE, and total impact area for the design of the Selected Alternative total impact area, including these elements, for the 30% Design. It should be noted that the TCE includes a 20-foot buffer from the excavation limit on the riverside and has a varying buffer on the landside. The buffer on the landside varies on the landside and follows the VCPWA-WP right-of-way for most of the levee extent. The TCE (or temporary work area) is shown on the drawings presented in Appendix II-G.

Table 4-6: Summary of Impact Areas

Permanent Impact Area (acres)	Temporary Impact Area (acres)	Additional TCE (acres)	Total Impact Area (acres)
11.0	3.7	6.3	21.0
TCE = Temporary Construction Easement. This is calculated assuming an additional 20-foot buffer from the excavation limit on the riverside and a varying buffer on the landside.			

4.3.2. Potential Stockpiling Locations and Staging Areas

A potential stockpiling and staging area has been identified in Figure 4.9. This is an open area just south of the Arroyo Mobile Home Park that is owned by the City of Ventura. At this phase, this is only a potential location for staging and stockpiling. Actual use for this area is subject to property owner approval. Other areas may be included at a later time and will be confirmed after the 30% Design.

Figure 4.9: Potential Stockpiling Locations and Staging Areas

4.3.3. Supplemental Environmental Information

It is estimated that construction will last 13.1 months (or 1.1 years), including weekends and non-work periods. The average daily labor and equipment that enter and exit the construction site and the duration of time the equipment will operate for the Selected Alternative are estimated below:

<u>Average Daily Labor:</u>

- Estimated 25 laborers (including OH staff) per day on average

<u>Average Daily Equipment (that enter and exits the construction site):</u>

- Estimated 41 haul trucks would enter and exit the site per day on average.
    - It should be noted that most other equipment will enter the site on the first day and remain on site until construction is completed.

<u>Duration of time the equipment will operate:</u>

- Equipment will operate onsite for 8 hours per day
- Estimated 197 working days (approximately 39.4 weeks assuming 5-day work weeks)

The information above was calculated by breaking out the durations of each of component of the items included in the cost estimate. See Appendix II-J for the Calculations of Durations and Vehicle Trips.

4.4. Future Considerations

A few items that will need to be considered in future phases of technical analysis and design have been identified and briefly summarized in the subsections below.

4.4.1. Supplemental Geotechnical Investigation

As indicated in Section 2.3 (Geotechnical Evaluation), supplemental geotechnical investigation will be required to appropriately support the Selected Alternative for Final Design. The geotechnical evaluation during this phase was performed for the existing alignment (Alternative 1) and not the Selected Alternative. The geotechnical report currently recommends supplemental field exploration of four additional borings along the proposed levee system along with the associated evaluation of settlement, seepage, and stability. The details of the recommendations can be found in the *Preliminary Geotechnical Report for the Ventura River Levee at Casitas Springs (VR-2)*(Tetra Tech 2022b).

4.4.2. Supplemental Interior Drainage Analyses

As discussed in Section 2.4 (Interior Drainage / Joint Probability Analysis), a Master Plan of Drainage Study needs to be performed to understand the existing infrastructure and needs in order to reduce or eliminate the effects of the local interior flooding that likely results from the flat slopes, lack of curb and gutter, insufficient storm drains and catch basins, and inability to drain to major infrastructure. This supplemental drainage analysis needs to be performed to understand the existing infrastructure and needs in order to reduce or eliminate the effects of local flooding occurring at Penetrations No. 3 and 4.

It should also be noted that the interior drainage analysis for this project focused on the evaluation of conditions along the current levee alignment (Alternative 1). Therefore, additional analysis will be required to support the Final Design of the Selected Alternative.

A full documentation of the approach, methodology, results, and conclusions can be found in the Ventura River 2 (VR-2) Levee System Interior Drainage Report (Tetra Tech 2022c).

4.4.3. Structural Analyses

Structural analysis was not included in the scope of work for this project and will need to be performed during subsequent phases of analysis and design. Structural calculations will be needed to:

1) Confirm the required dimensions of the floodwall at Arroyo Mobile Home Park,
2) Appropriately design the Fresno Canyon Drain channel, RCB, headwall, and outlet structure,
3) Design the other pipe penetrations through the levee and their associated inlet/outlet structures,
4) Confirm the headwall along the Fresno Canyon Diversion will meet levee certification requirements since it will serve as part of the levee system.

Additional structural analysis may be required as the project continues to develop.

4.4.4. Right-of-Way

As discussed in Section 4.2.6 (Right-of-Way Assessment), right-of-way acquisition will be required to construct and maintain the Selected Alternative. If there are any issues with obtaining the right-of-way to construct the levee, there will be variations made to the Selected Alternative. Discussions with the local stakeholders will ultimately determine if the Selected Alternative is feasible.

4.4.5. Landside Protection Improvements

During the course of the project, several landside protection improvements have been discussed to help with the maintenance of vegetation and rodent burrowing. The landside improvements included the following: landside slope embankment protection (i.e., concreted rock riprap on the landside), wire mesh embedded into the slope, and raptor perches / owl boxes. Based on initial feedback from the VCPWA-WP, they currently prefer bare earth as that is the only way to keep damaging materials away from the levee. However, further discussion will need to take place during future phases of design to evaluate the potential of helpful landside remedies.

A placeholder cost was placed into the cost estimate to account for a potential layer of concreted riprap to protect the landside slope. Typical sections showing the potential landside improvements discussed during the project are shown in Appendix II-K.

4.4.6. Safety Railing / Cable Guard Fencing

Safety railing and/or cable guard fencing should be considered as the design of the VR-2 Levee System continues to develop. With a steep slope of 1.5H:1V for the concreted rock riprap on the riverside, it is recommended that safety railing or cable guard fencing be considered as a safety measure. The cost for this item is not currently included in the cost estimate and will need to be added during a future phase of design if the VCPWA-WP determines that railing and/or fencing is required.

4.4.7. Stormwater Capture and Treatment

On other levee projects within the County, the VCPWA-WP has designed and constructed stormwater capture and treatment for the runoff resulting from the levee project. These improvements can occur on either the landside or riverside of the levee. The stormwater capture and treatment options will be evaluated in the final design stage and will need to be designed consistent with the *Ventura County Stormwater Technical Guidance Manual* (VCWPD 2011).

4.4.8. Closure for Fresno Canyon Drain Outlet (Penetration No. 4)

Currently, the 30% Design cost estimate includes a rectangular flap gate at the outlet of the designed 10-foot by 5.5-foot RCB. However, other options will need to be evaluated during the next phase of the design. Other potential options include a light-duty gate (to ensure flows can push through the gate), a slide gate structure, or some type of motorized gate. These options will be considered during the next design phase.

4.5. Cost

4.5.1. Cost and Quantity Calculations

An engineer's estimate for construction cost has been prepared on the basis of the 30% Design (Appendix II-H).

This cost estimate is based on the quantities calculated from the cross-sections shown in the attached 30% Design plans. The quantity calculations assume typical conditions between the cross-sections. The quantities were completed using AutoCAD programming to allow for accurate estimating of lengths, areas, and volumes. Further calculation assumptions and quantity summaries were then calculated using Excel. Detailed information on the quantity calculations is provided in Appendix II-I.

The unit prices reflected in the cost estimate are assumed to account for all necessary construction activities to complete each item as discussed in this report. The unit prices in the cost estimate have been developed with detailed breakdowns of construction activities to the sub-feature level. The unit prices used for these sub-feature items have been taken from various sources. These sources include RS Means, previous contractor bids, and recent vendor quotes. All sourced unit prices have been escalated and adjusted to reflect current prices at the project location.

As the project advances to a final design stage, further information will become available and further technical analyses will be performed (geotechnical investigation, interior drainage, structural, etc.). This information and results may alter the quantities, unit costs, and general assumptions used during this phase of design. Additionally, any fees or permits required for construction or maintenance activities and real estate requirements are not included.

4.5.2. Key Cost Estimate Assumptions

The unit prices and quantities used in the cost estimate for the 30% Design are based on several key assumptions. The following are the assumptions for the primary construction items:

- **Availability.** All required import materials (fill, cement, asphalt, etc.) are readily available from a nearby distributor at market value.
- **Backfill.** All material for use as backfill would come from the excavated materials. No borrow fill is assumed to be delivered to the project site for backfill (only for compacted fill of the prism and crossing).
- **Excavation.** All excavated material would be stockpiled on-site and made available for reuse as backfill.
- **Export.** It is assumed that there would be no export or disposal necessary. Excess material is assumed to be reused or stockpiled by the County.
- **Landscaping.** No vegetation, planting, or landscaping costs are included.
- **Concreted Rock Riprap.** It was assumed that 90% of the removed riprap could be reused for concreted rock riprap construction.

- **Rock Riprap.** It was assumed that 33% of the removed riprap could be reused for riprap construction.
- **Landside Improvement.** Placeholder for landside improvements assumes 2-foot-thick layer of concreted riprap along landside.
- **Total Construction Costs.** The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimate shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

4.5.3. Total Project Cost Estimate

A summary of the total cost for the 30% Design is provided in Table 4-7.

Table 4-7: Total Project Cost

	Contract Items	Unit	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$1,822,000	$1,822,000
2	Clearing and Grubbing	ACR	6.0	$5,000	$30,000
3	Diversion and Control of Water	LS	1	$2,250,000	$2,250,000
4	Downstream Improvements at Fresno Canyon Diversion Outlet	LF	259	$1,921	$496,904
5	Reach I Levee Construction	LF	259	$2,896.07	$1,580,387
6	Reach II Levee Construction	LF	2,894	$2,848	$8,242,575
7	Reach III Levee Construction	LF	496	$3,404	$1,688,602
8	Reach IV Levee Construction	LF	976	$3,044.62	$2,971,549
9	Levee Lowering / Dip Crossing	LS	1	$336,377.78	$336,378
10	Fresno Canyon Drain Channel, RCB, and Outlet	LS	1	$443,750	$443,750
11	Storm Drain Replacements	EA	2	$32,000	$64,000
12	Other Improvements	LS	1	$2,373,065	$2,373,065
				Total Project Cost	**$22,299,209**

See Appendix II-H and Appendix II-I for a detailed breakout of the quantities and cost estimate sub items.

5. <u>REFERENCES</u>

AECOM/ Stillwater Sciences. 2019a. *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum.* August 26.

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APPENDIX I

Alternatives Documents

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APPENDIX I-A

Alternative Plans

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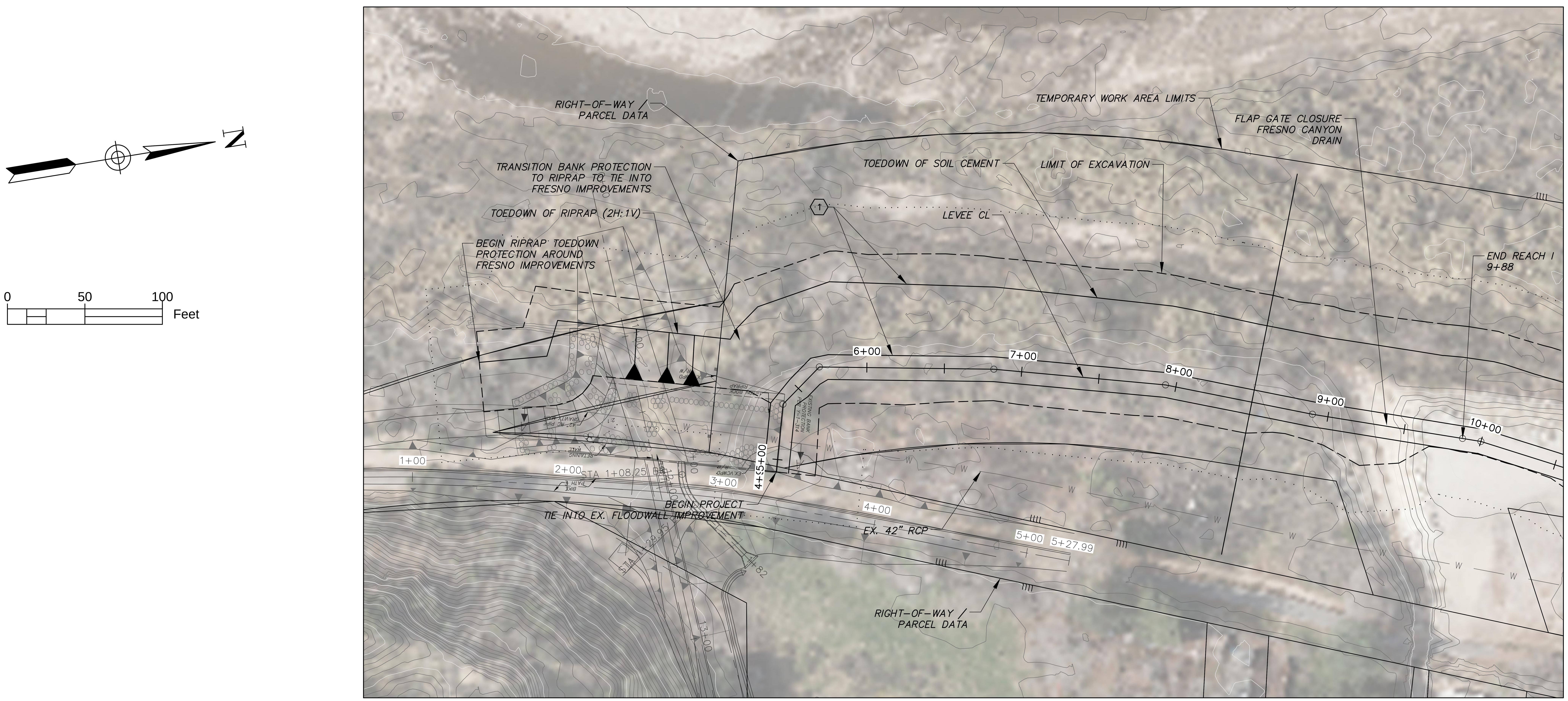
VR-2 LEVEE – REACH I
ALTERNATIVE 1A
SOIL CEMENT (1.5H:1V)

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1A
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

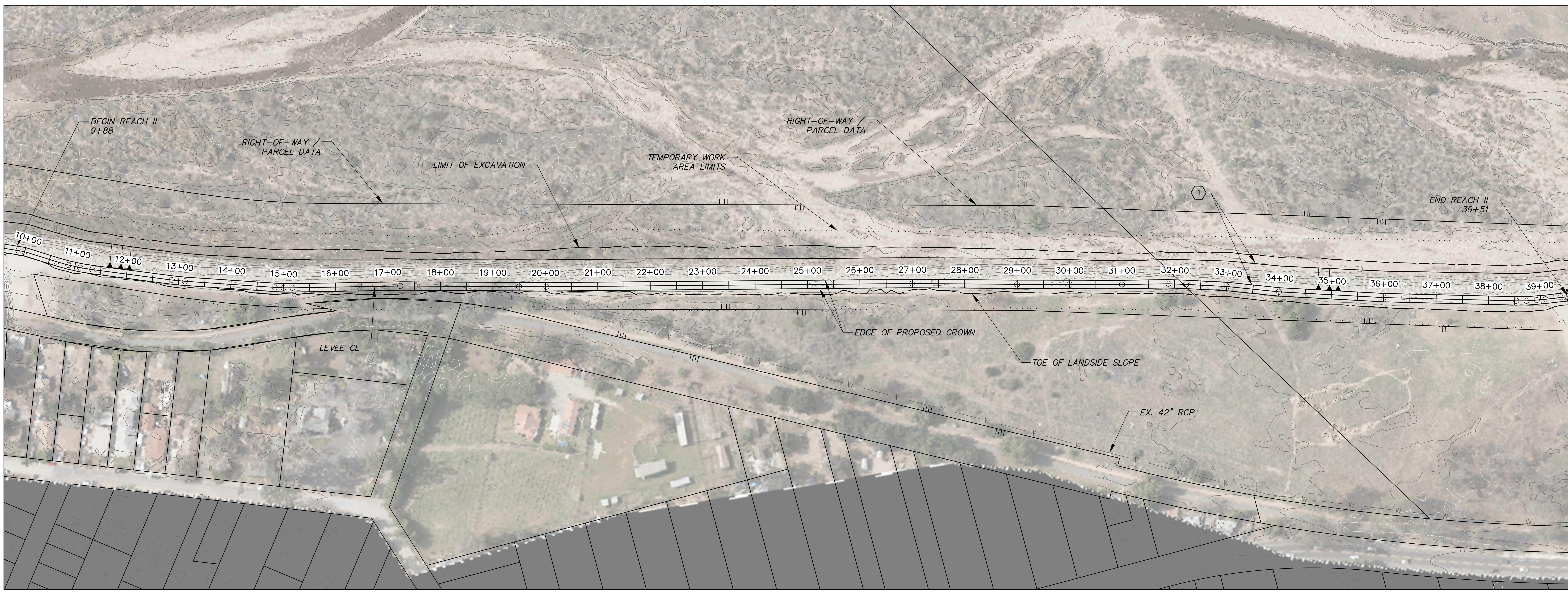
SHEET 1 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH II
ALTERNATIVE 1A
SOIL CEMENT (1.5H:1V) ALTERNATIVE

0 200 400
Feet

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1A
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

SHEET 2 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH III
ALTERNATIVE 1A
SOIL CEMENT (1.5H:1V) ALTERNATIVE

N

0 100 200
Feet

NOTES:

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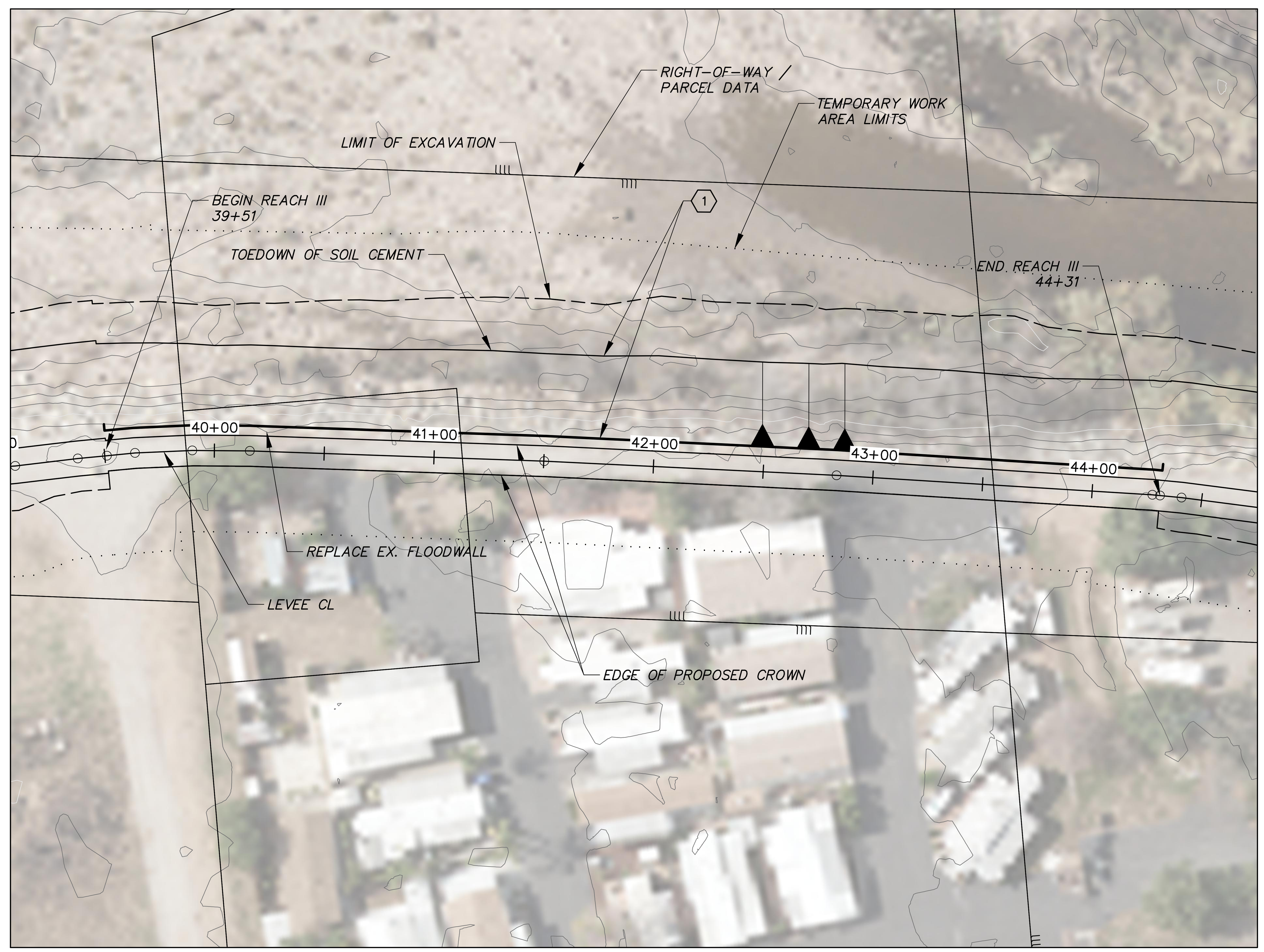

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1A
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH IV
ALTERNATIVE 1A
SOIL CEMENT (1.5H:1V) ALTERNATIVE

0 200 400
Feet

N

NOTES:

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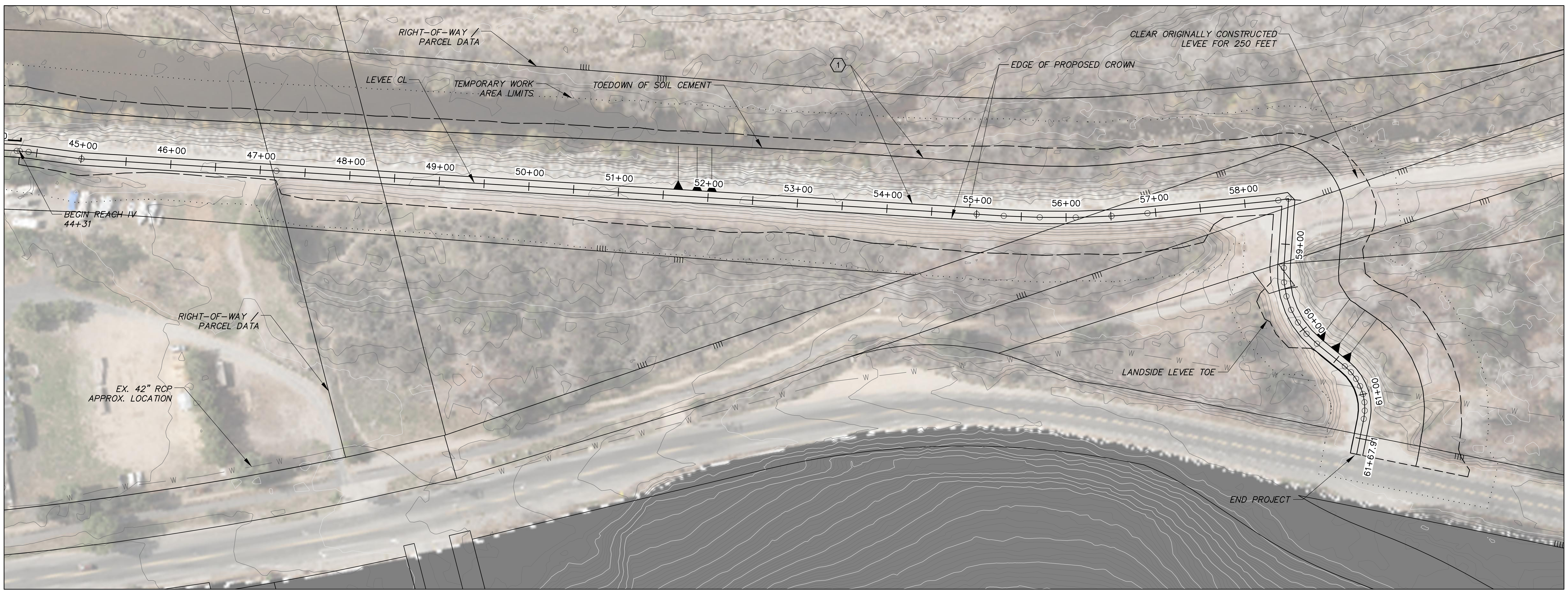

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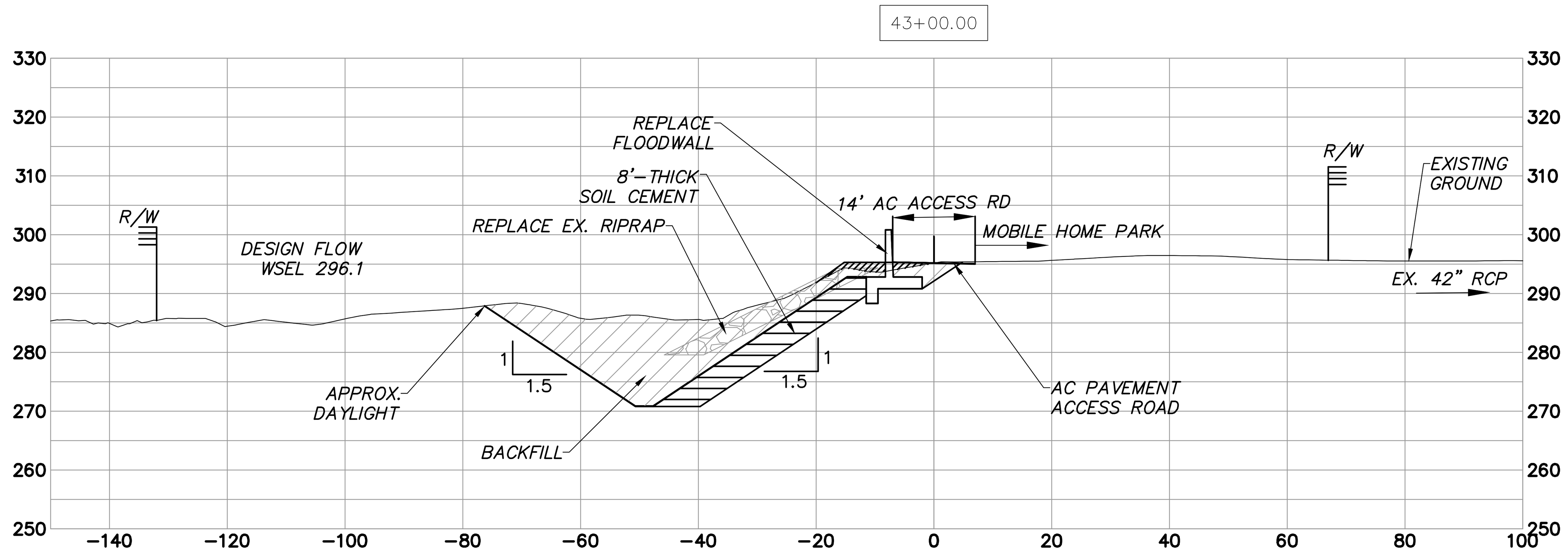
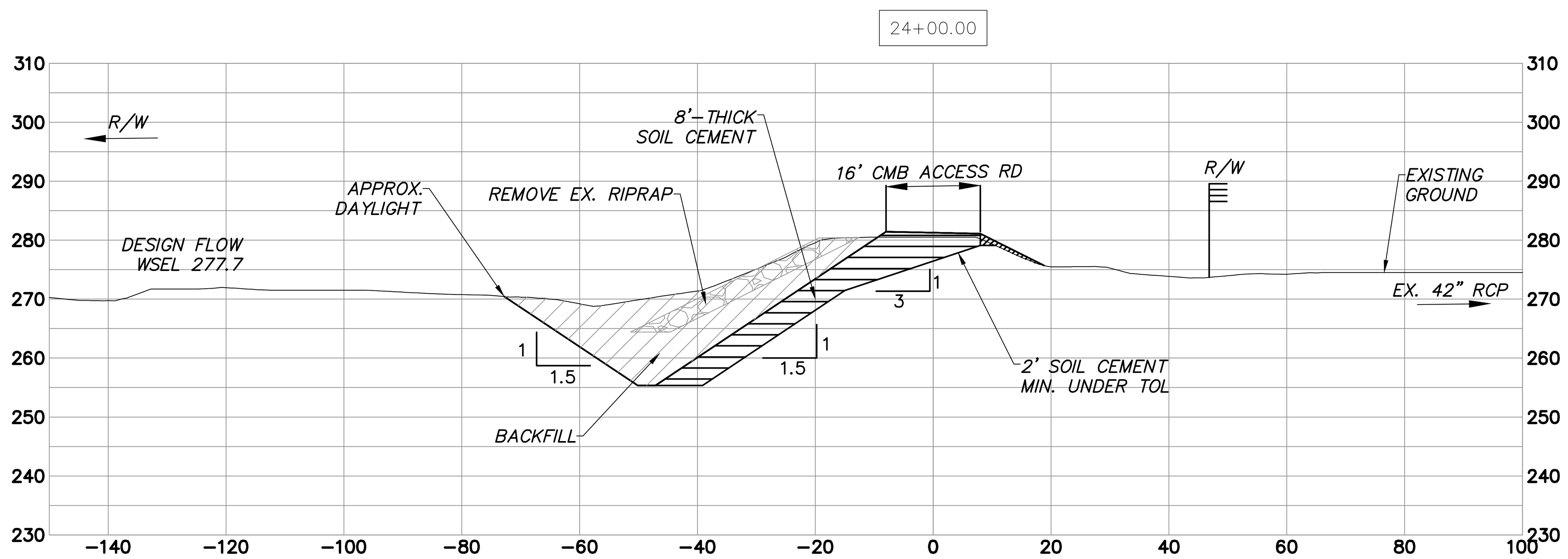
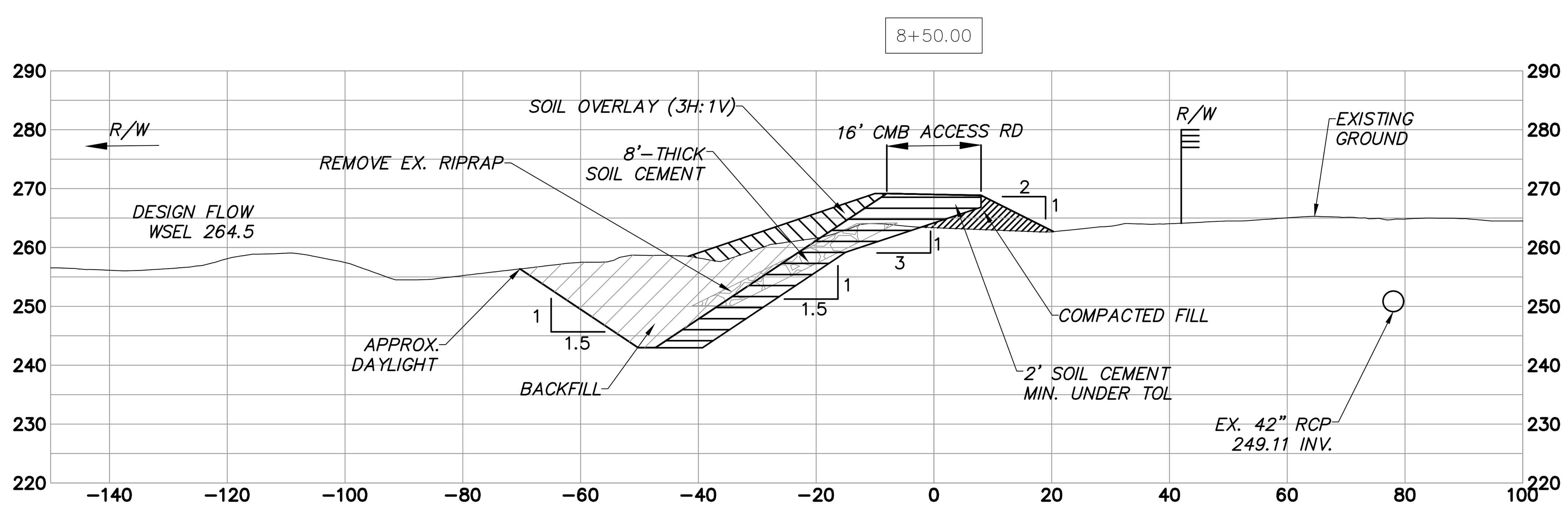
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1A
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

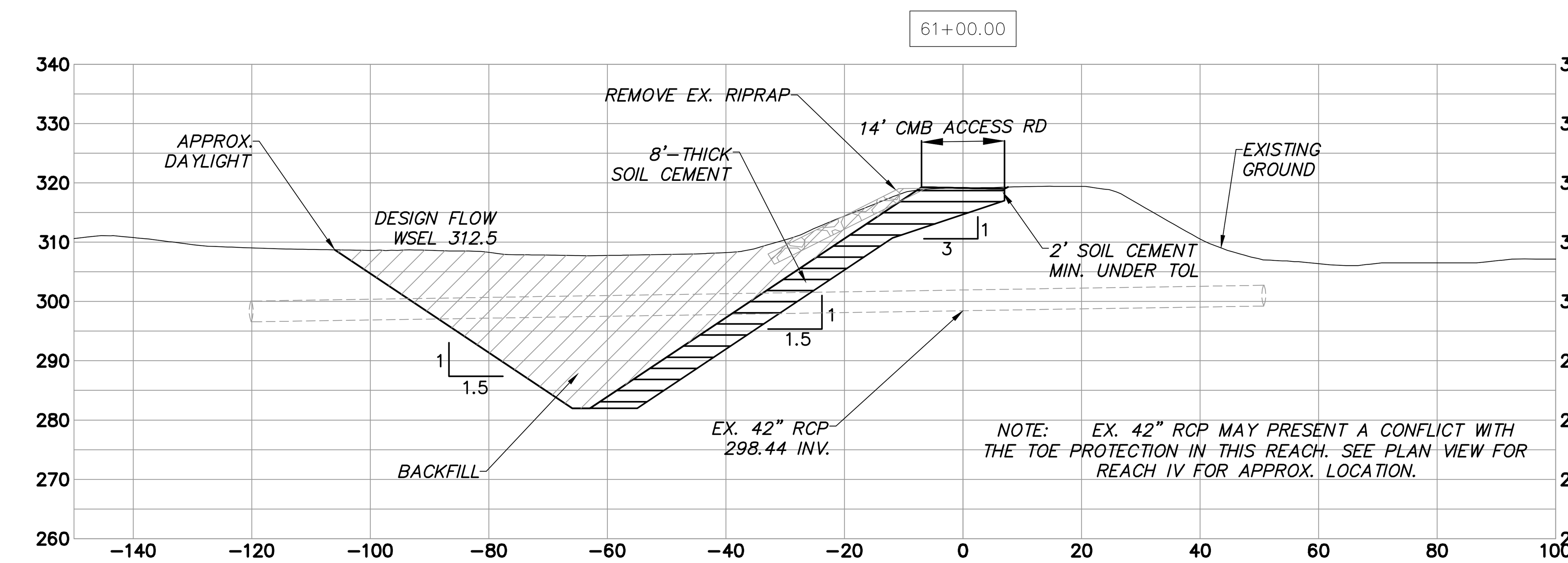
SHEET 4 OF 5
DRAWING NO. Y-?-?

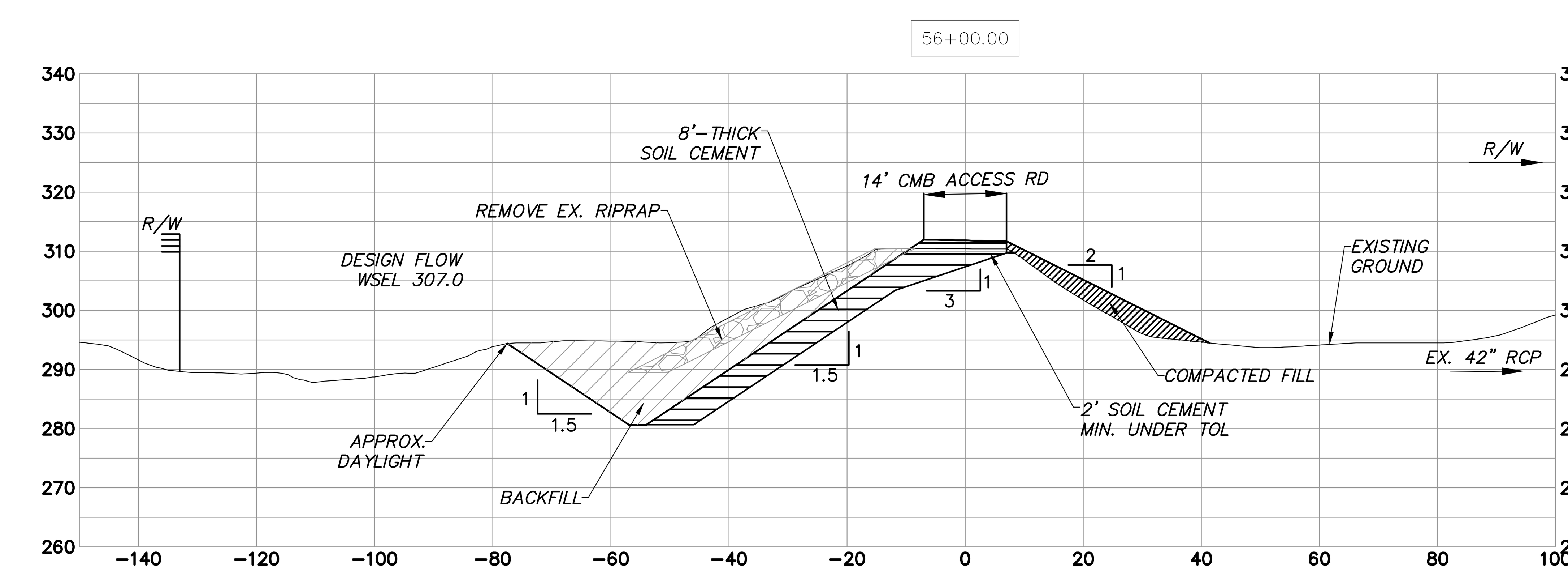
NOTE: CROSS-SECTIONS DO NOT SHOW WEEPHOLES THROUGH REVETMENT AND LANDSIDE TOE DRAINAGE IMPROVEMENTS ALONG REACH IV. HOWEVER, THESE HAVE BEEN CONSIDERED IN THE COST ESTIMATE.











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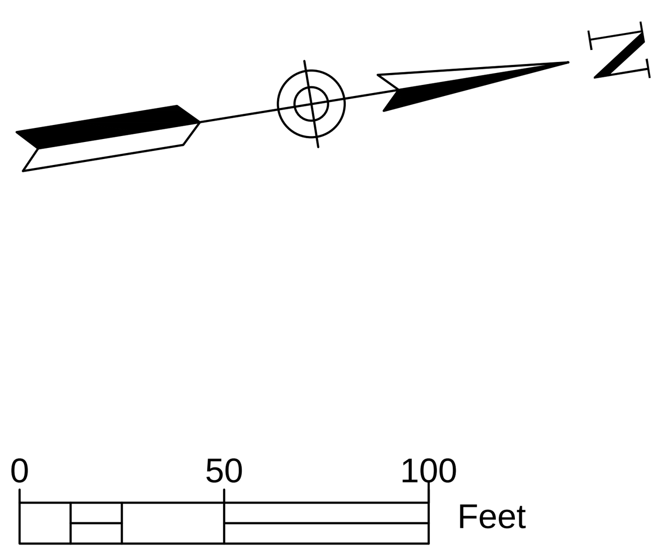
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1A
PLAN AND CROSS-SECTIONS
CROSS-SECTIONS

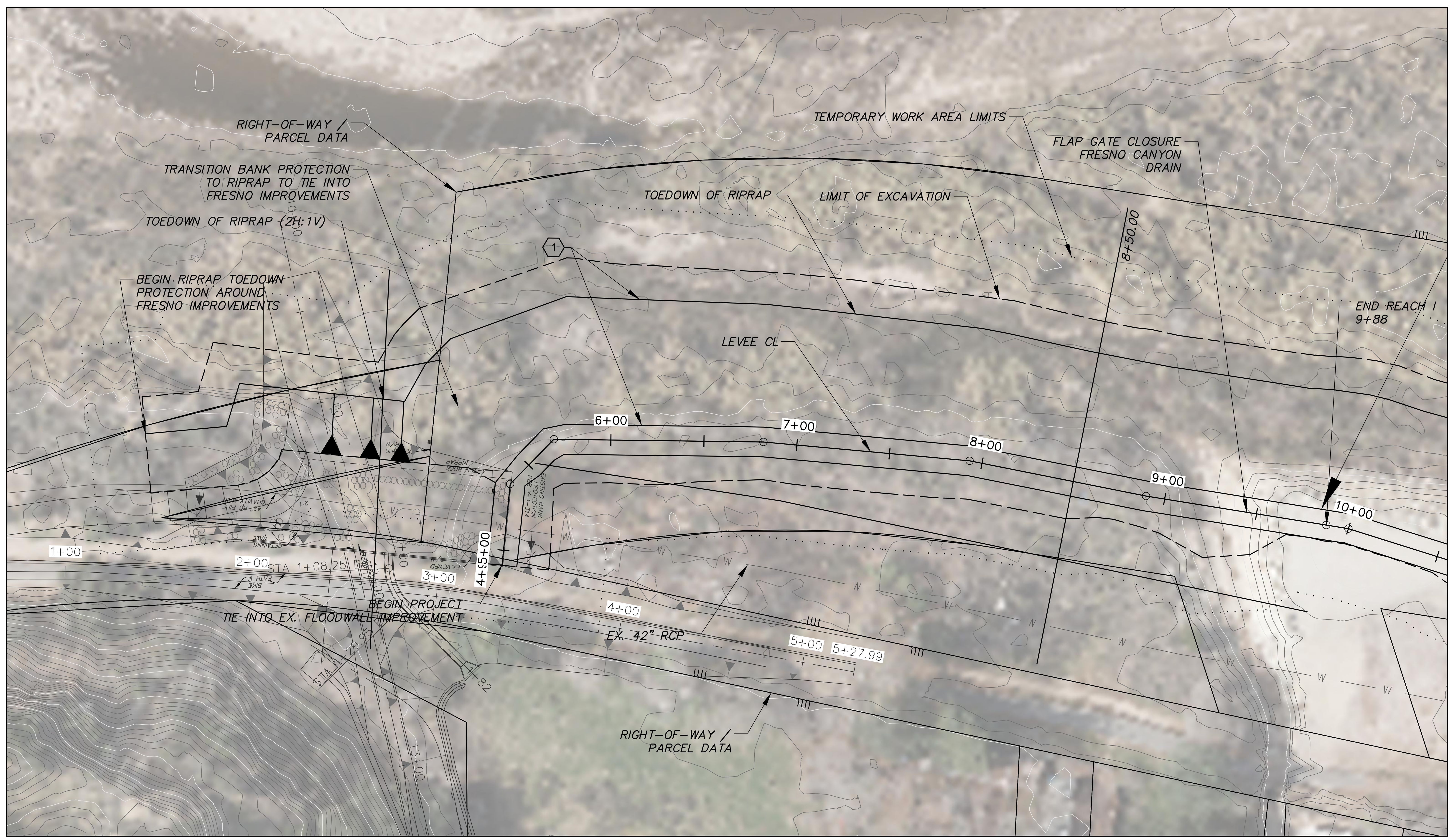
SHEET 5 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH I
ALTERNATIVE 1B
RIPRAP (2H:1V) ALTERNATIVE

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.





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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1B

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

SHEET 1 OF 5

DRAWING NO. Y-?-?

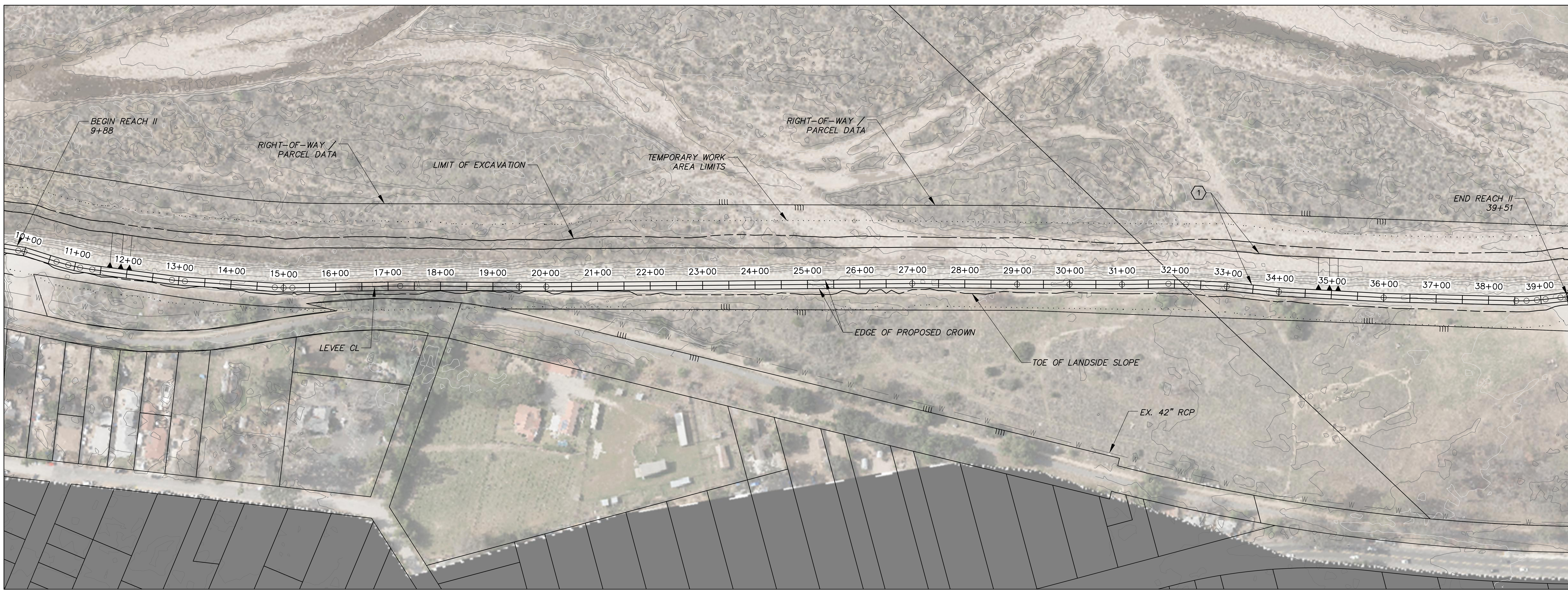
VR-2 LEVEE – REACH II
ALTERNATIVE 1B
RIPRAP (2H:1V) ALTERNATIVE

N

0 200 400 Feet

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1B

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

SHEET 2 OF 5

DRAWING NO. Y-?-?

VR-2 LEVEE – REACH III
ALTERNATIVE 1B
RIPRAP (2H:1V) ALTERNATIVE

0 100 200 Feet

NOTES:

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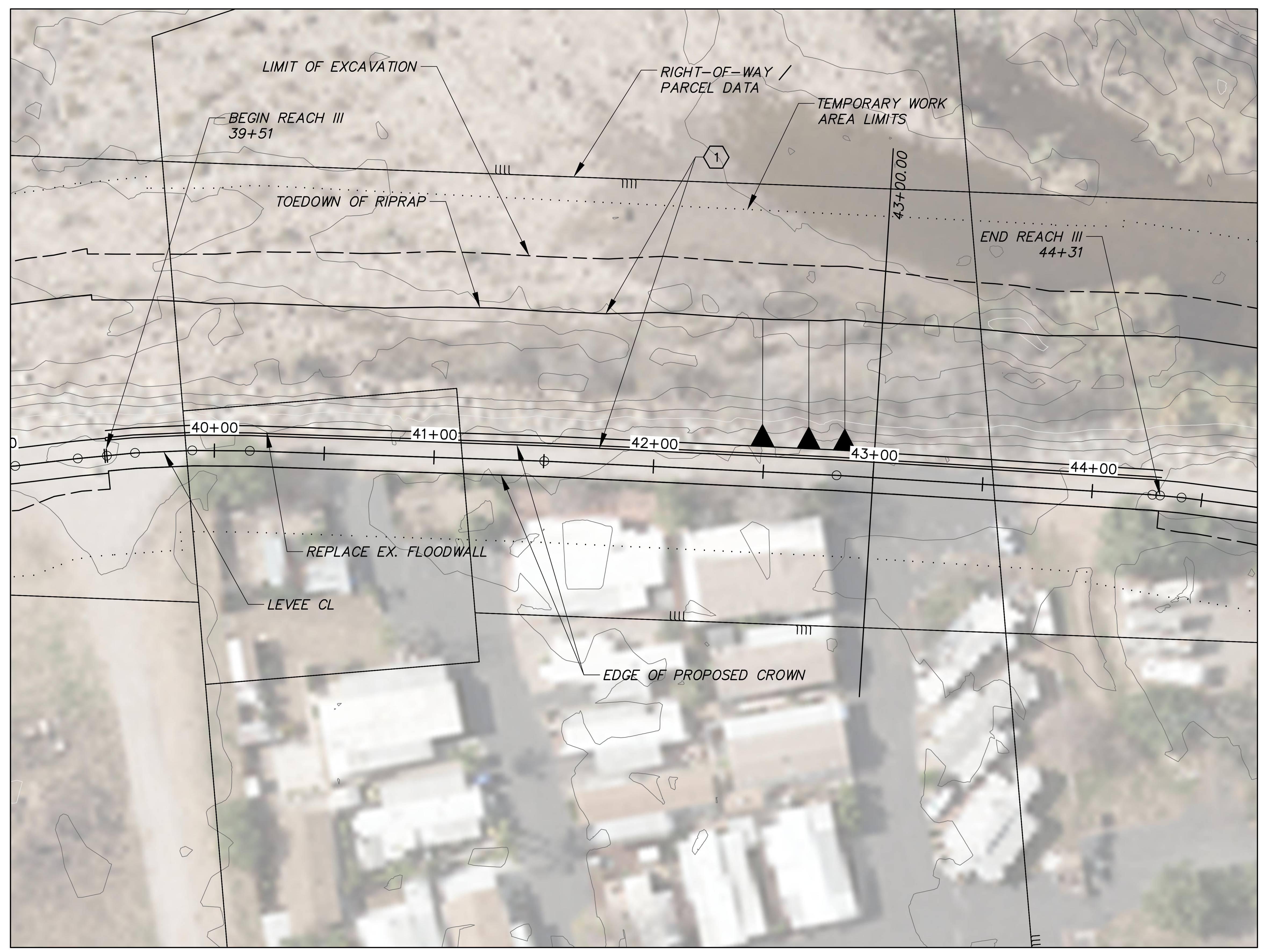

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1B
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH IV
ALTERNATIVE 1B
RIPRAP (2H:1V) ALTERNATIVE

0 200 400
Feet

NOTES:

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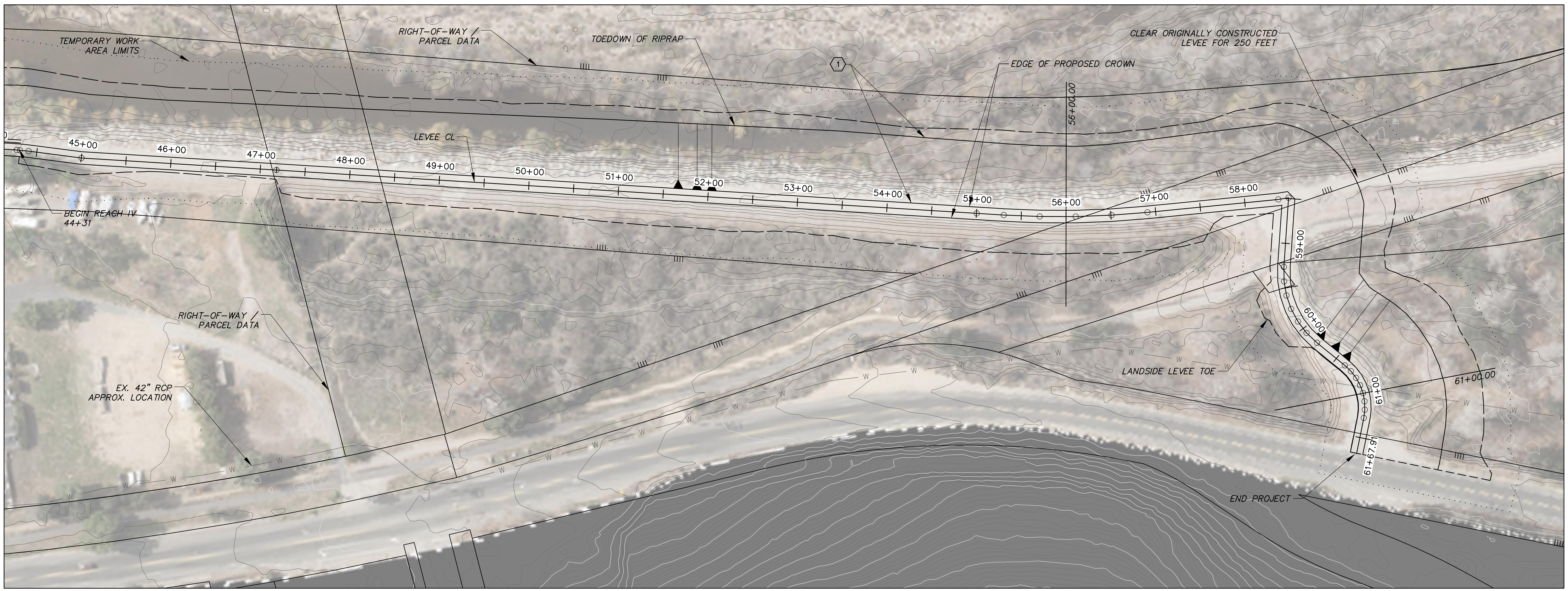

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1B

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?

NOTE: CROSS-SECTIONS DO NOT SHOW LANDSIDE TOE DRAINAGE IMPROVEMENTS ALONG REACH IV. HOWEVER, THIS HAS BEEN CONSIDERED IN THE COST ESTIMATE.

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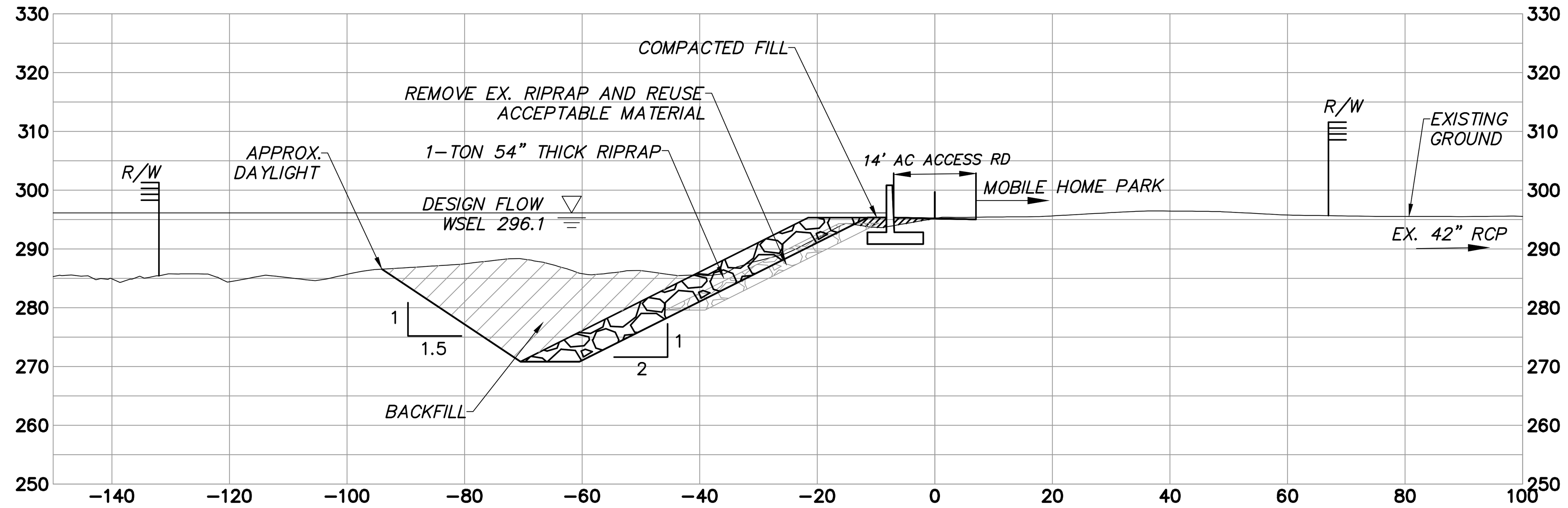

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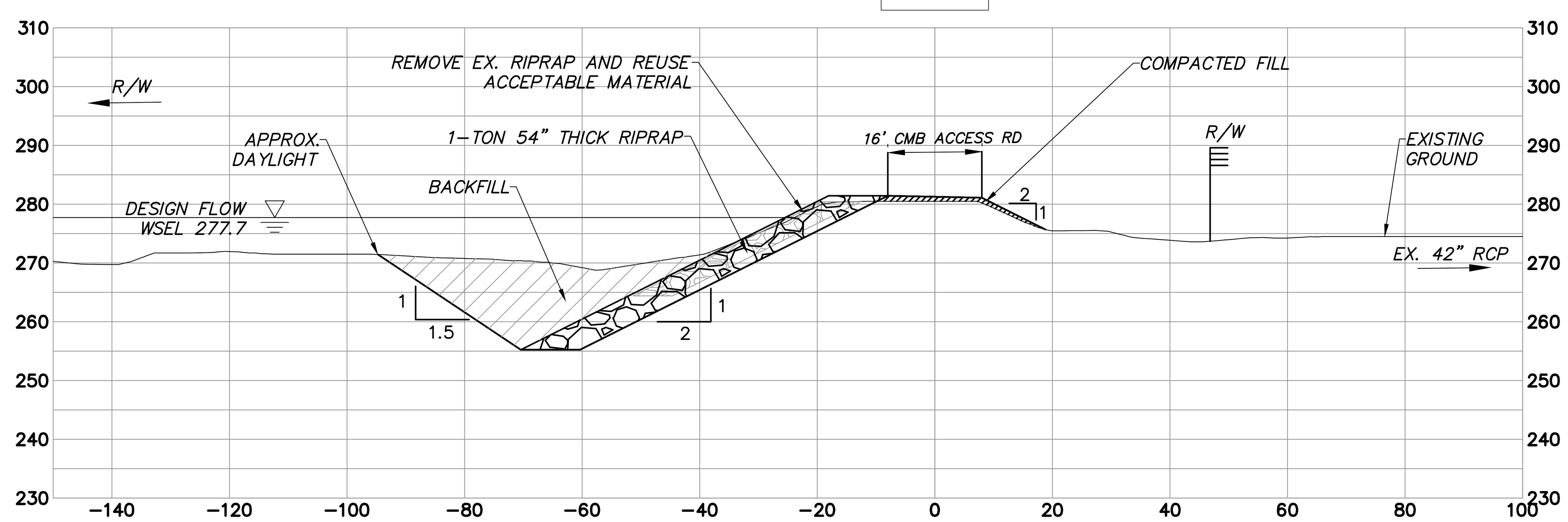

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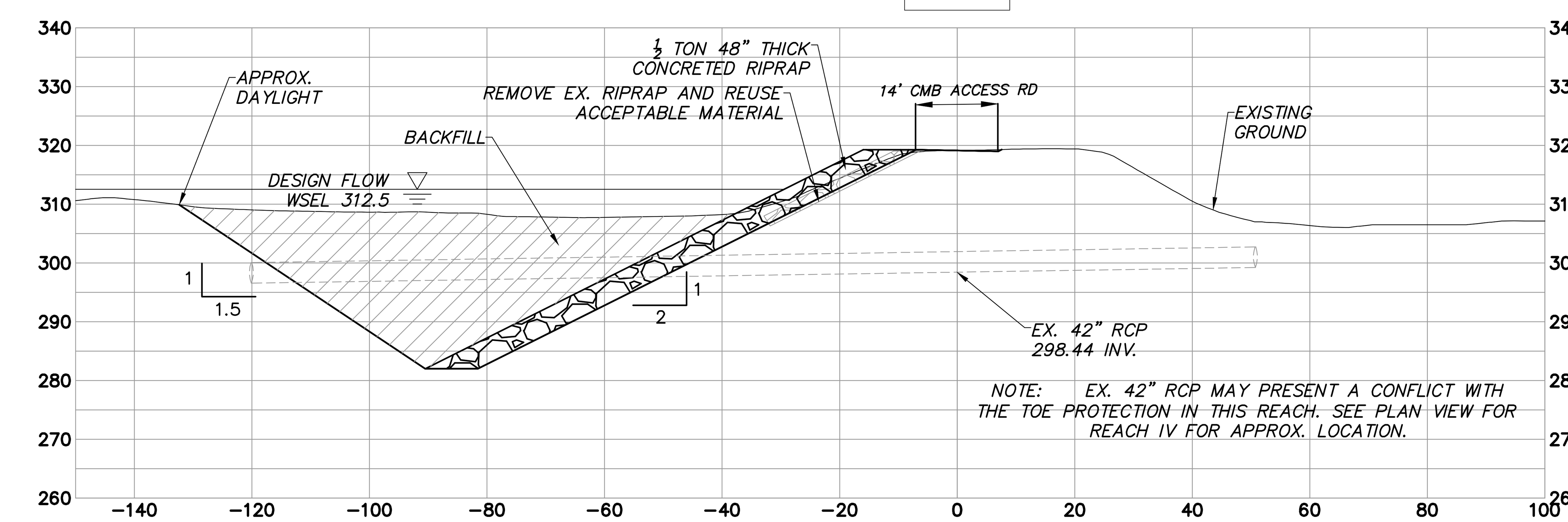

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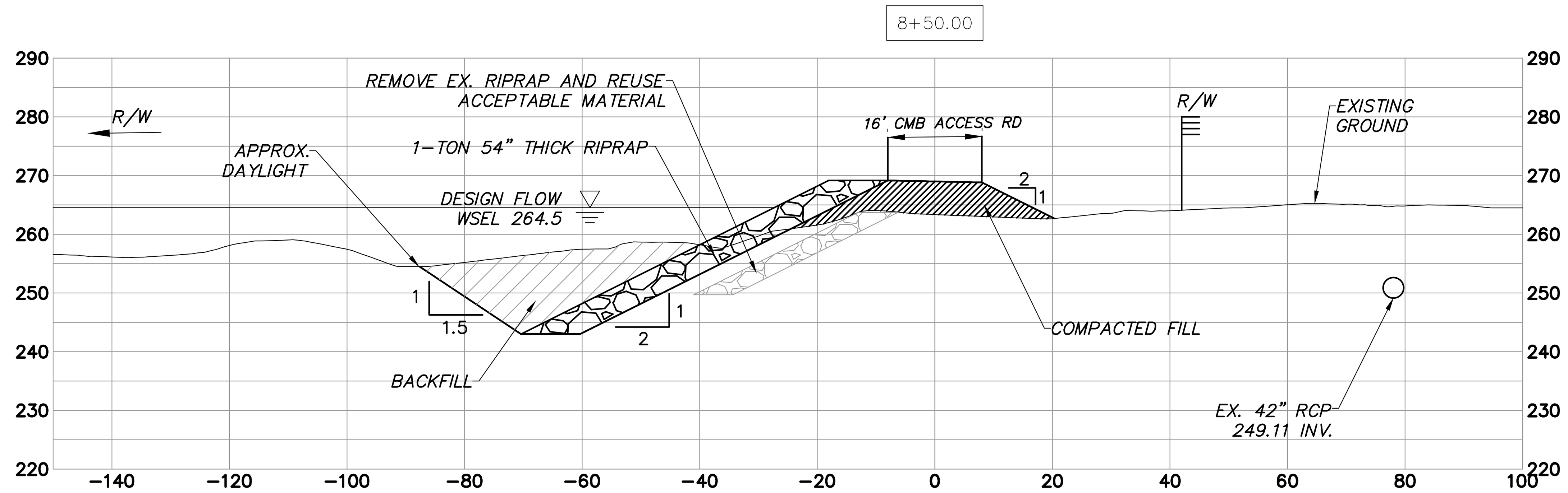

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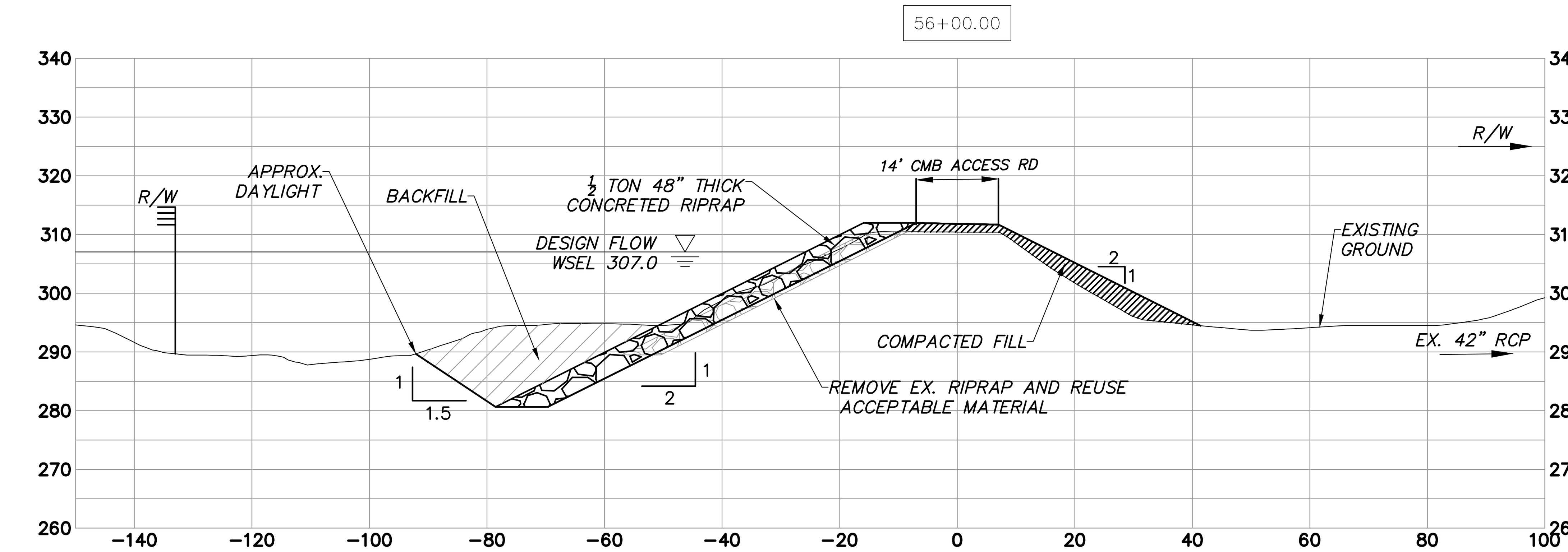

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1B

PLAN AND CROSS-SECTIONS
CROSS-SECTIONS

SHEET 5 OF 5
DRAWING NO. Y-?-?

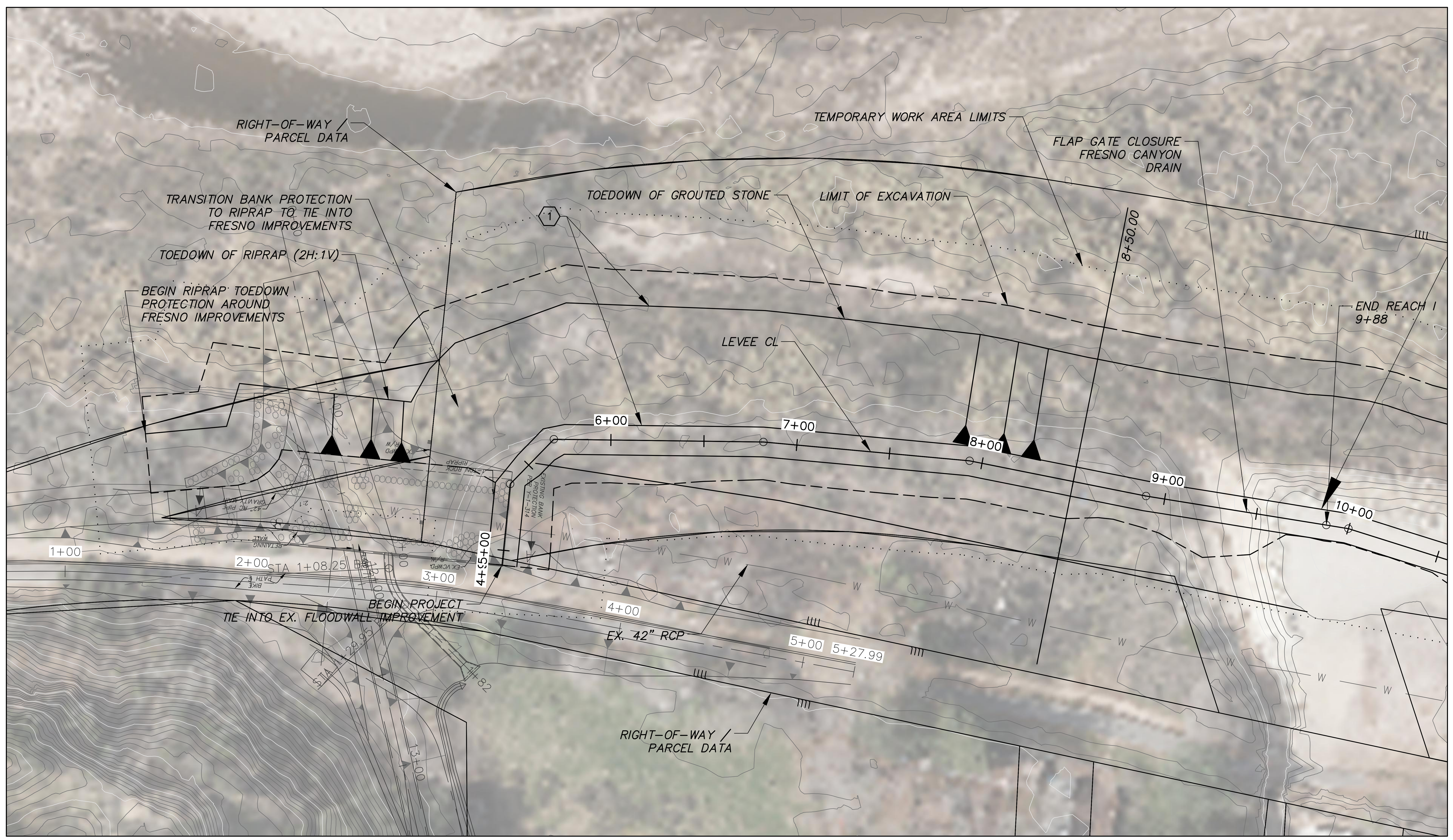
VR-2 LEVEE – REACH I
ALTERNATIVE 1C
GROUTED STONE (2H:1V) ALTERNATIVE

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.

N

0 50 100 Feet



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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1C
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

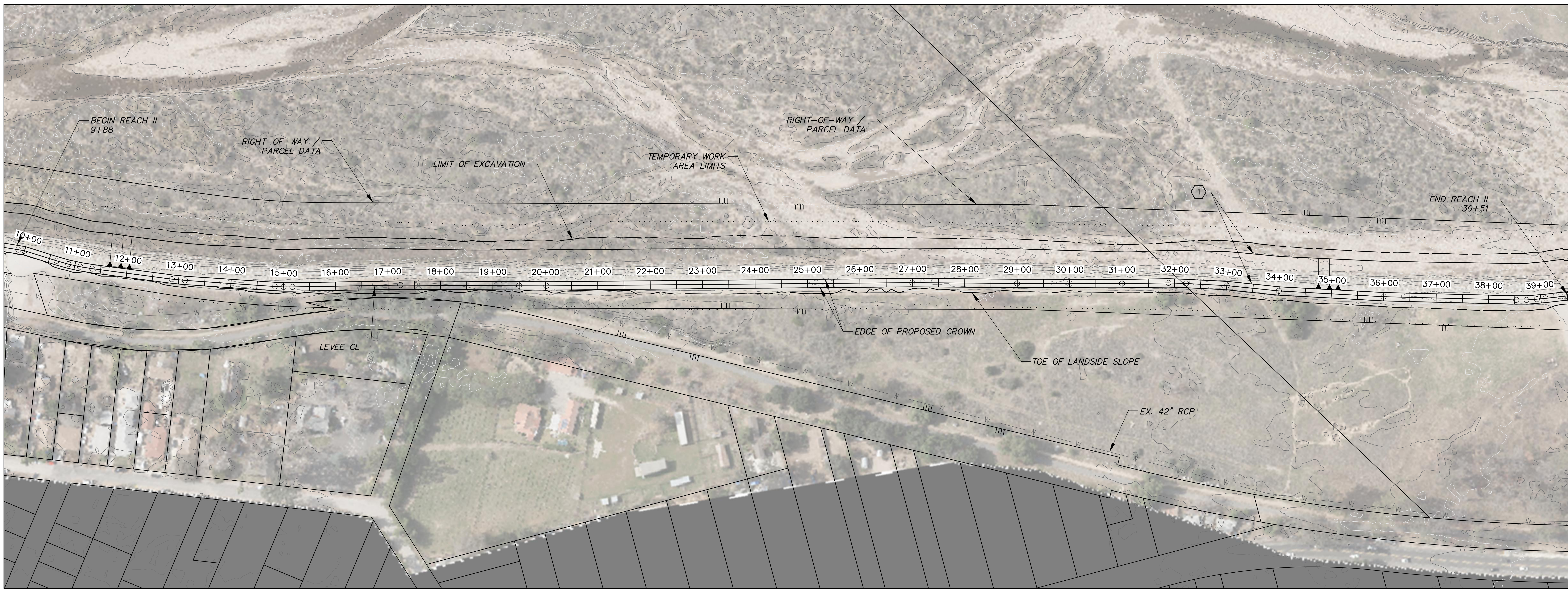
SHEET 1 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH II
ALTERNATIVE 1C
GROUTED STONE (2H:1V) ALTERNATIVE

0 200 400 Feet

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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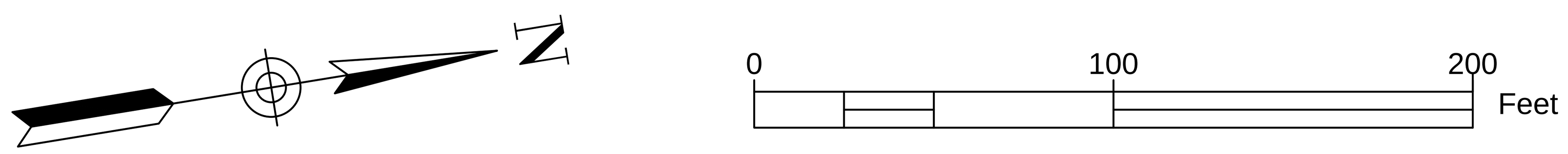
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1C
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

SHEET 2 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH III
ALTERNATIVE 1C
GROUTED STONE (2H:1V) ALTERNATIVE



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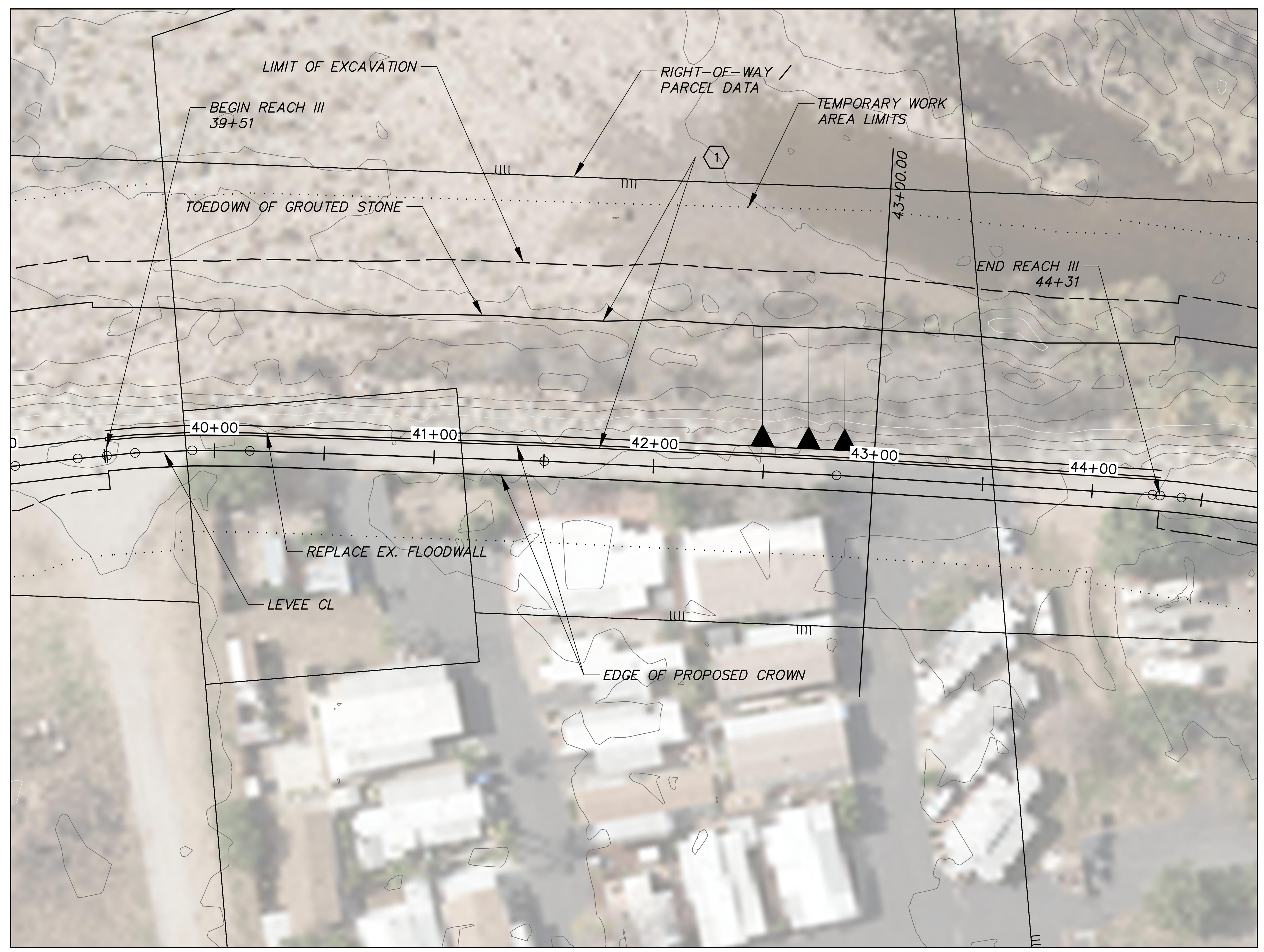

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1C
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH IV
ALTERNATIVE 1C
GROUTED STONE (2H:1V) ALTERNATIVE

0 200 400
Feet

NOTES:

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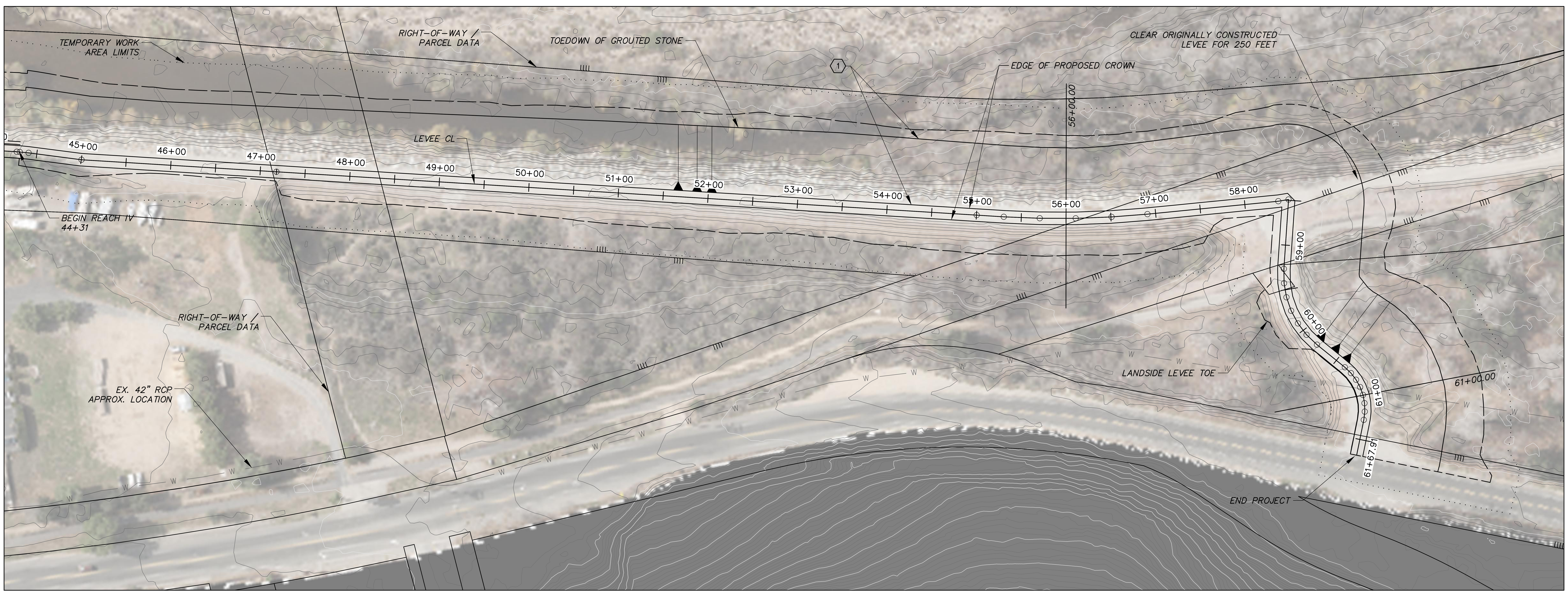

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1C
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?

NOTE: CROSS-SECTIONS DO NOT SHOW WEEPHOLES THROUGH REVETMENT AND LANDSIDE TOE DRAINAGE IMPROVEMENTS ALONG REACH IV. HOWEVER, THESE HAVE BEEN CONSIDERED IN THE COST ESTIMATE.

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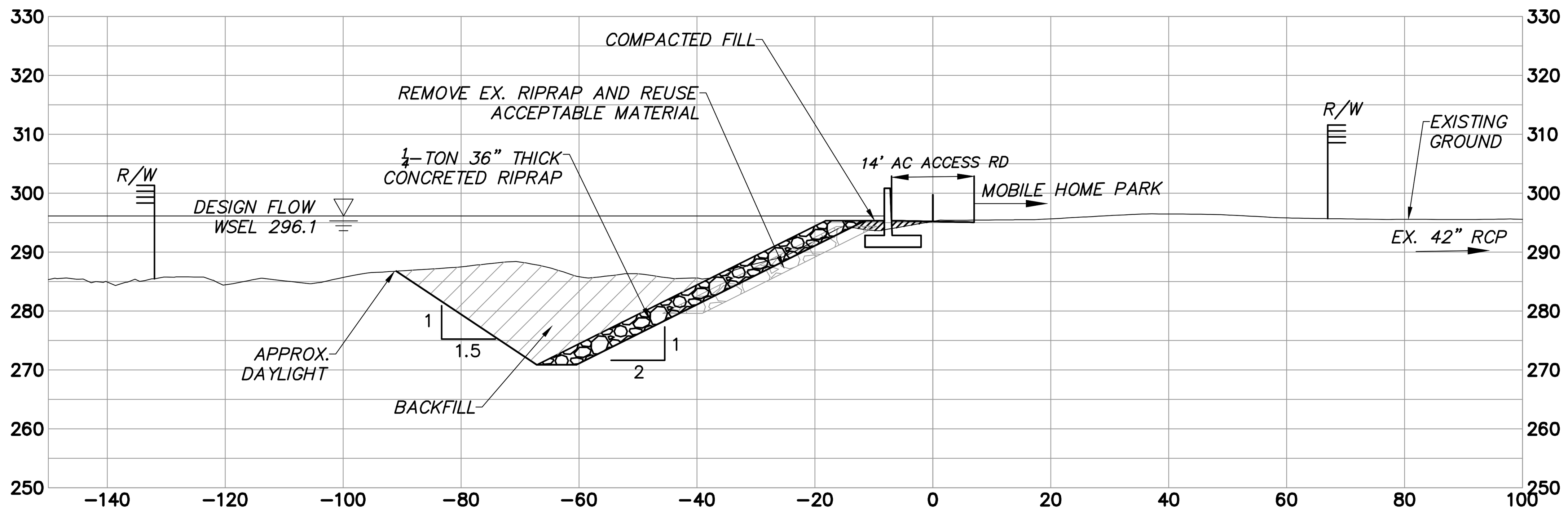

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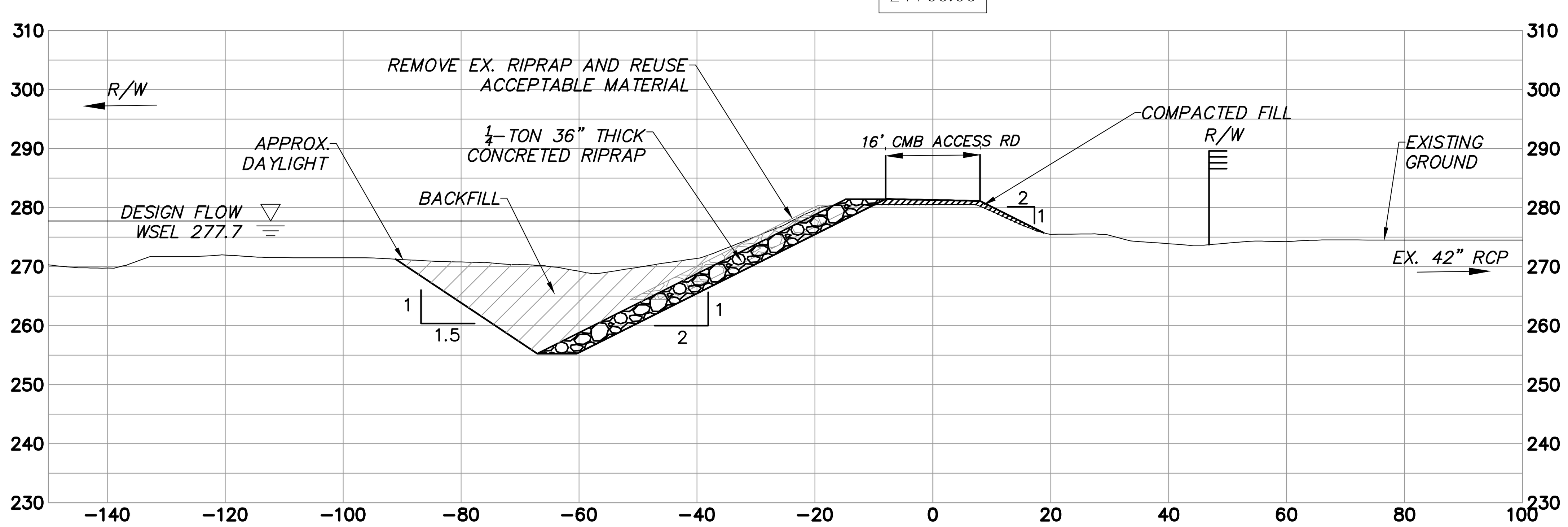

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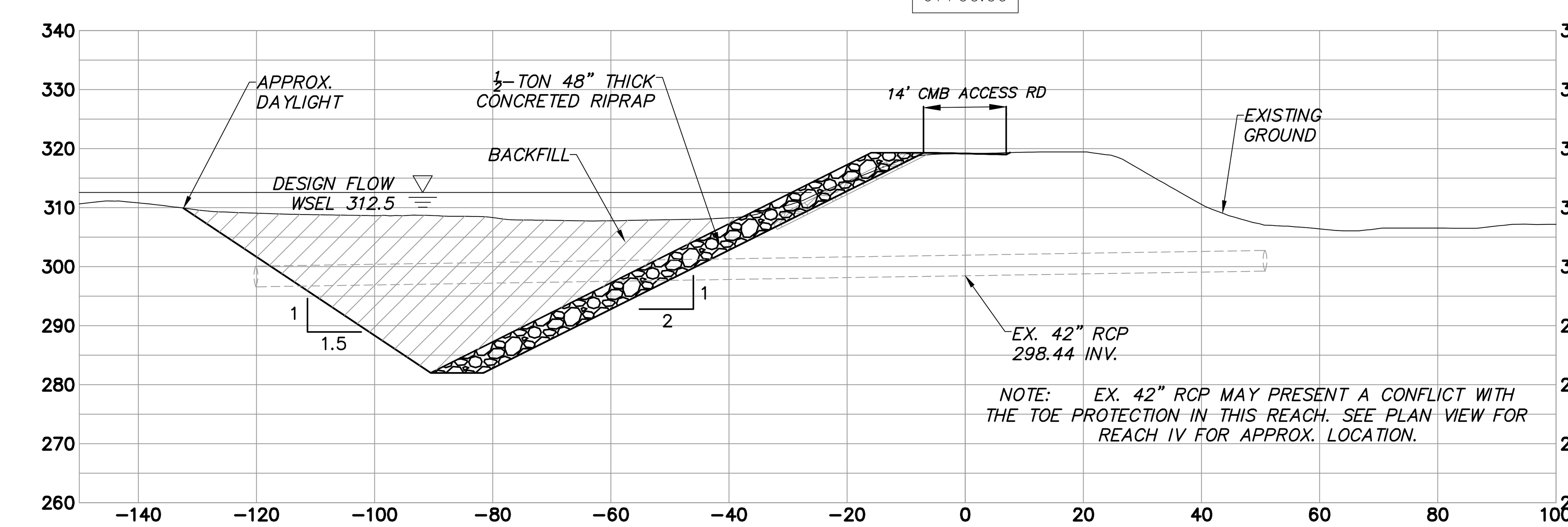

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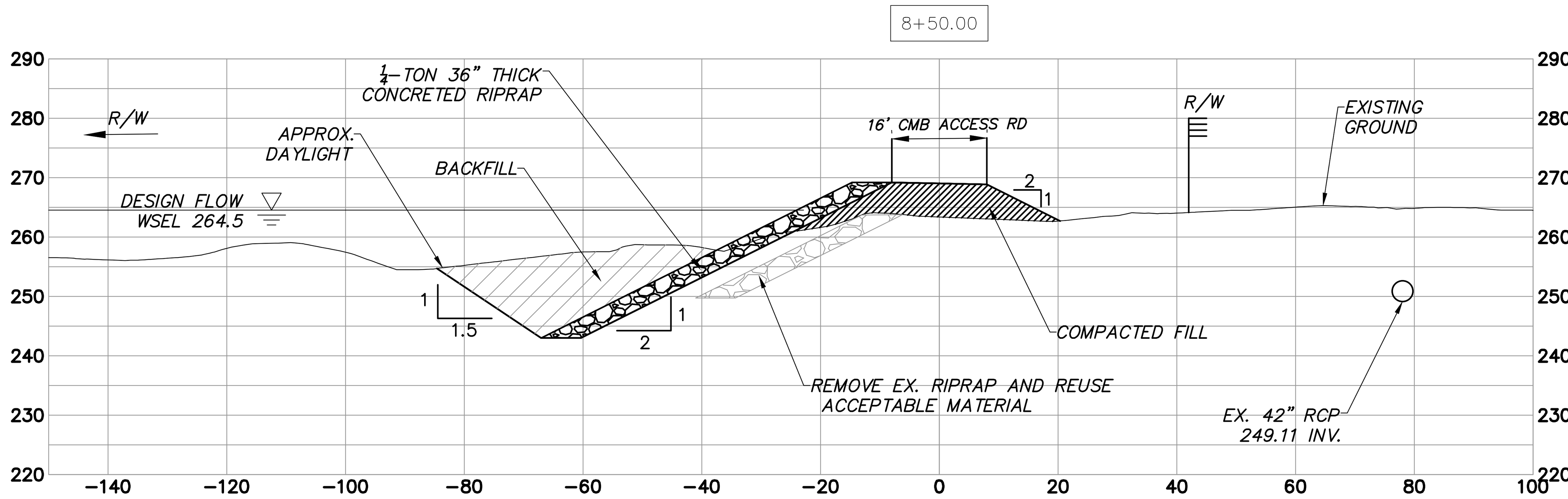

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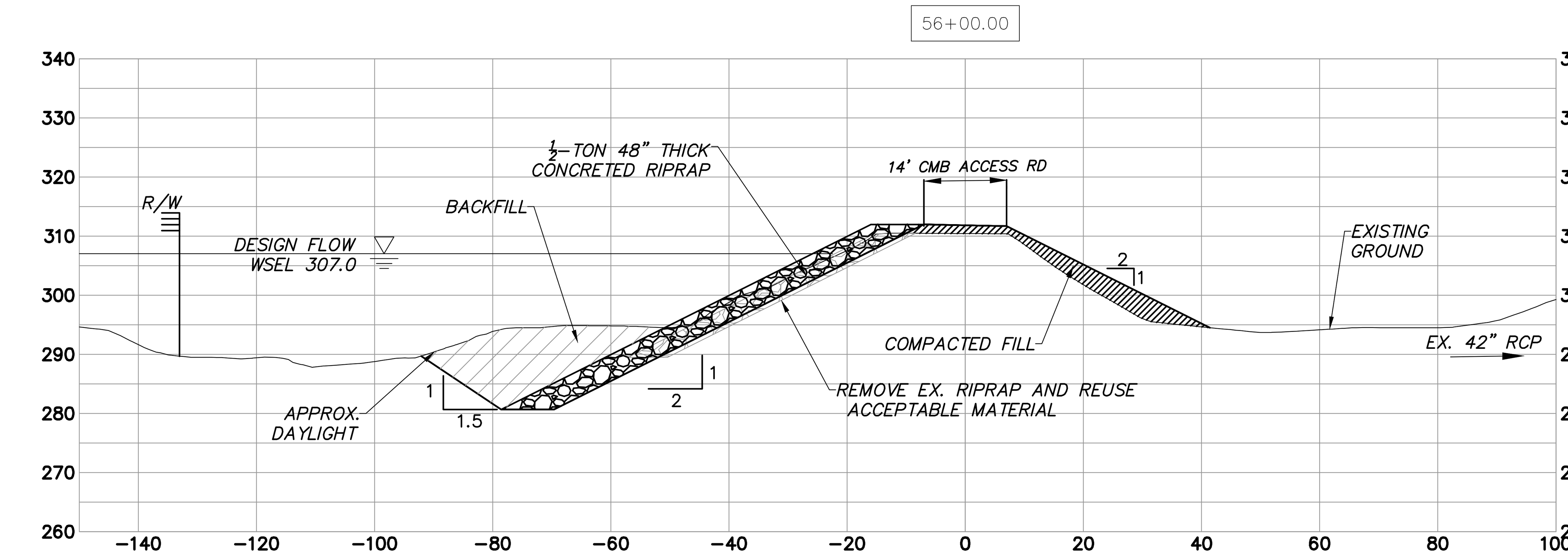

PLOT DATE: 3/4/22

SAVE DATE: 3/4/22 KIM.NGUYEN1 P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT1C PLAN XS.DWG

	REVISION DESCRIPTION	APP.	DATE
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DISTRICT DIRECTOR DATE

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

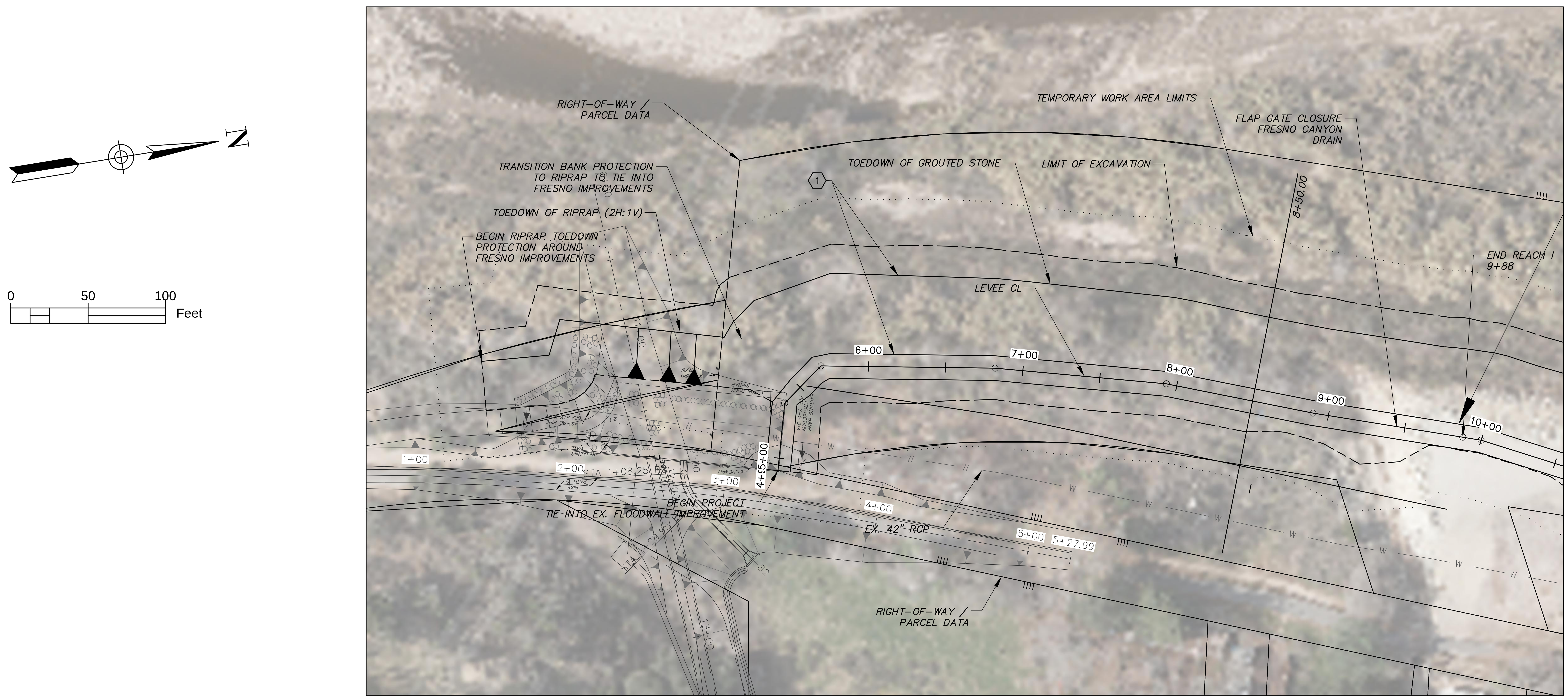
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1C
PLAN AND CROSS-SECTIONS
CROSS-SECTIONS

SHEET 5 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE - REACH I
ALTERNATIVE 1D
GROUTED STONE (1.5H:1V) ALTERNATIVE

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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SAVE DATE: 3/4/22 KIM.NGUYEN1 P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT1D PLAN XS.DWG

PLOT DATE: 3/4/22

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CHECKED –

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DISTRICT DIRECTOR DATE

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1D

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

SHEET 1 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH II
ALTERNATIVE 1D
GROUTED STONE (1.5H:1V) ALTERNATIVE

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.

PLOT DATE: 3/4/22

SAVE DATE: 3/4/22 KIM.NGUYEN1 P:\WATR\T37983_VR-2_LEVEE\11_DESIGN\01_FEASIBILITY_DESIGN\PLAN_SHEETS\ALT1D_PLAN_XS.DWG

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COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1D

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

SHEET 2 OF 5
DRAWING NO. Y-?-?

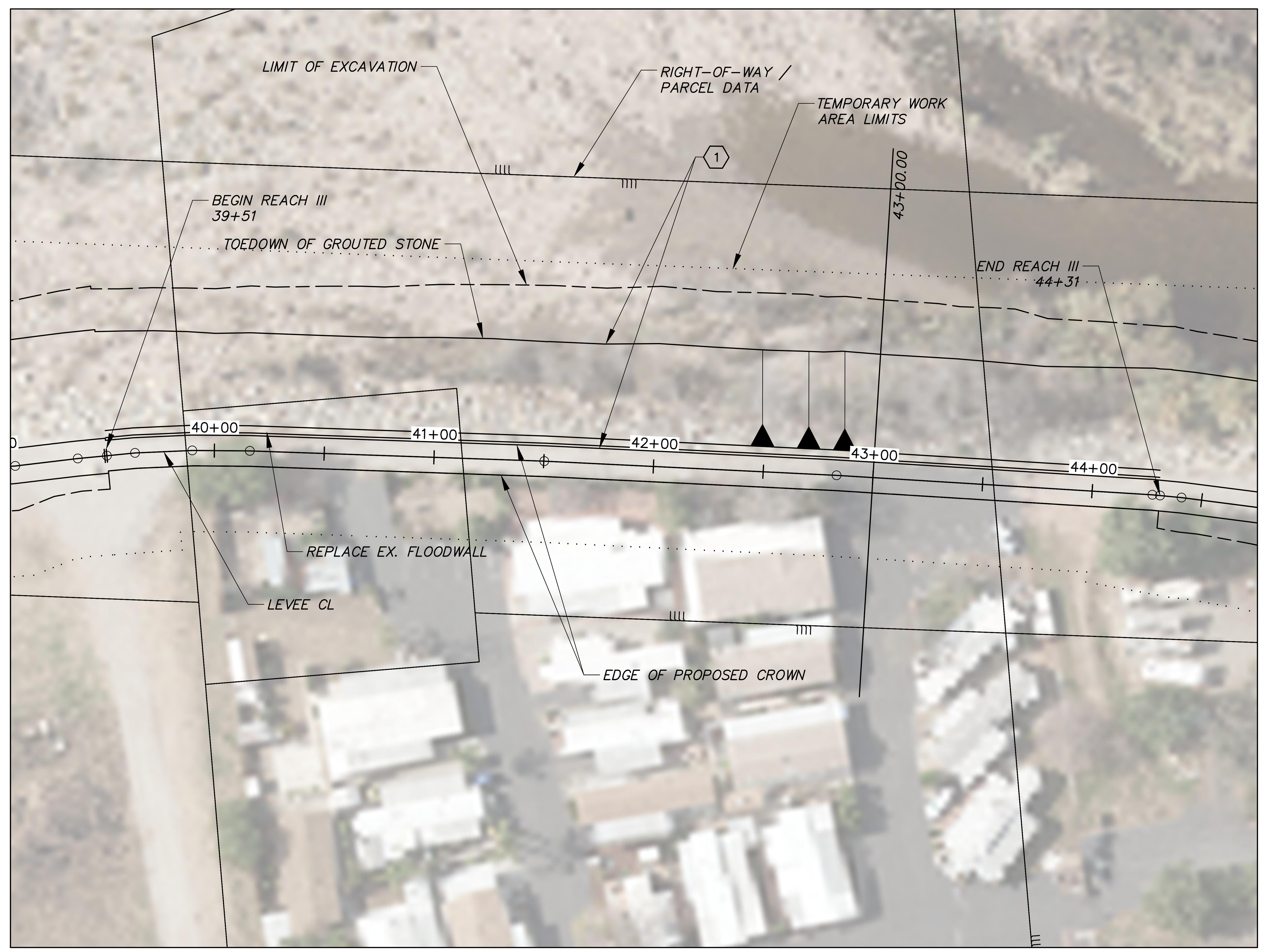
VR-2 LEVEE – REACH III
ALTERNATIVE 1D
GROUTED STONE (1.5H:1V) ALTERNATIVE

N

0 100 200
Feet

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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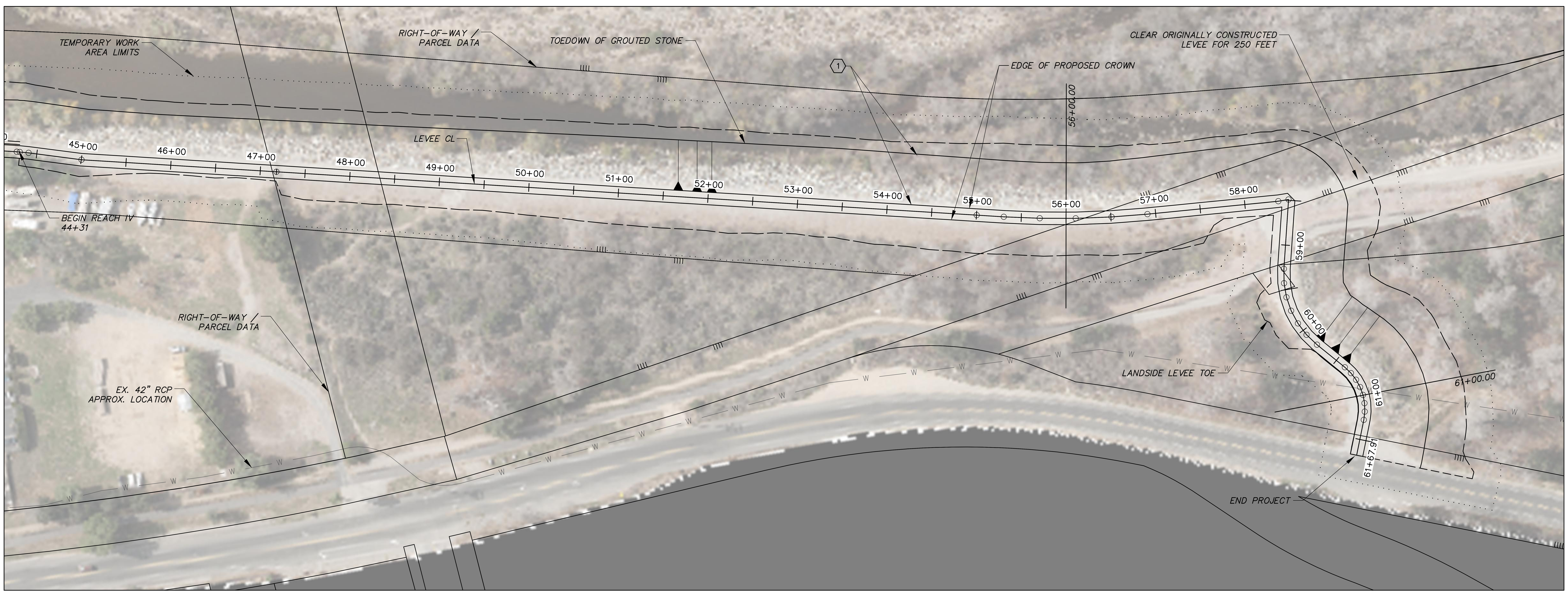
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1D
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH IV
ALTERNATIVE 1D
GROUTED STONE (1.5H:1V) ALTERNATIVE

0 200 400
Feet

NOTES:
1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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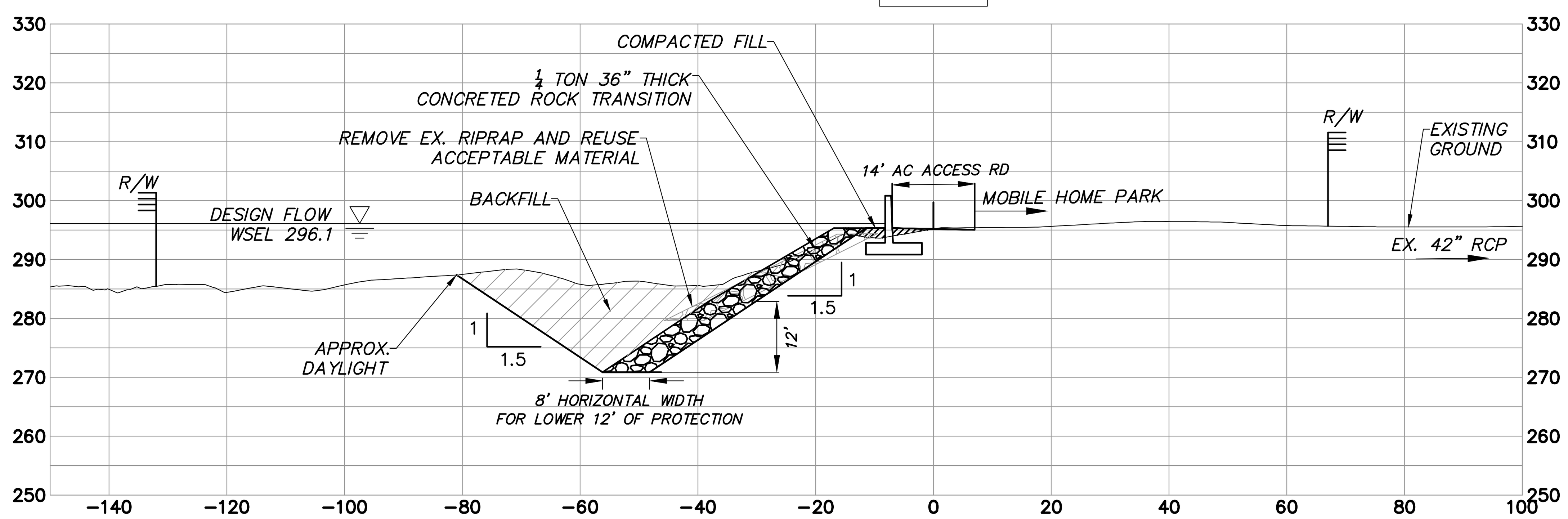
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1D
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?

NOTE: CROSS-SECTIONS DO NOT SHOW WEEPHOLES THROUGH REVETMENT AND LANDSIDE TOE DRAINAGE IMPROVEMENTS ALONG REACH IV. HOWEVER, THESE HAVE BEEN CONSIDERED IN THE COST ESTIMATE.

43+00.00



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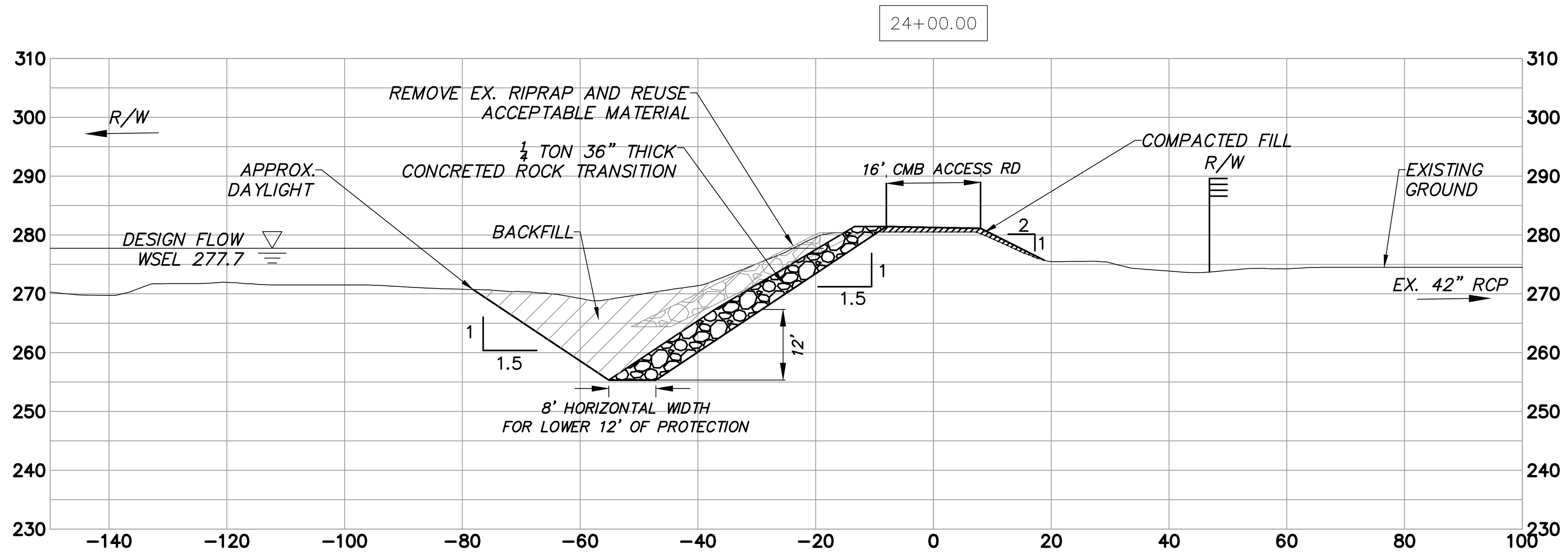

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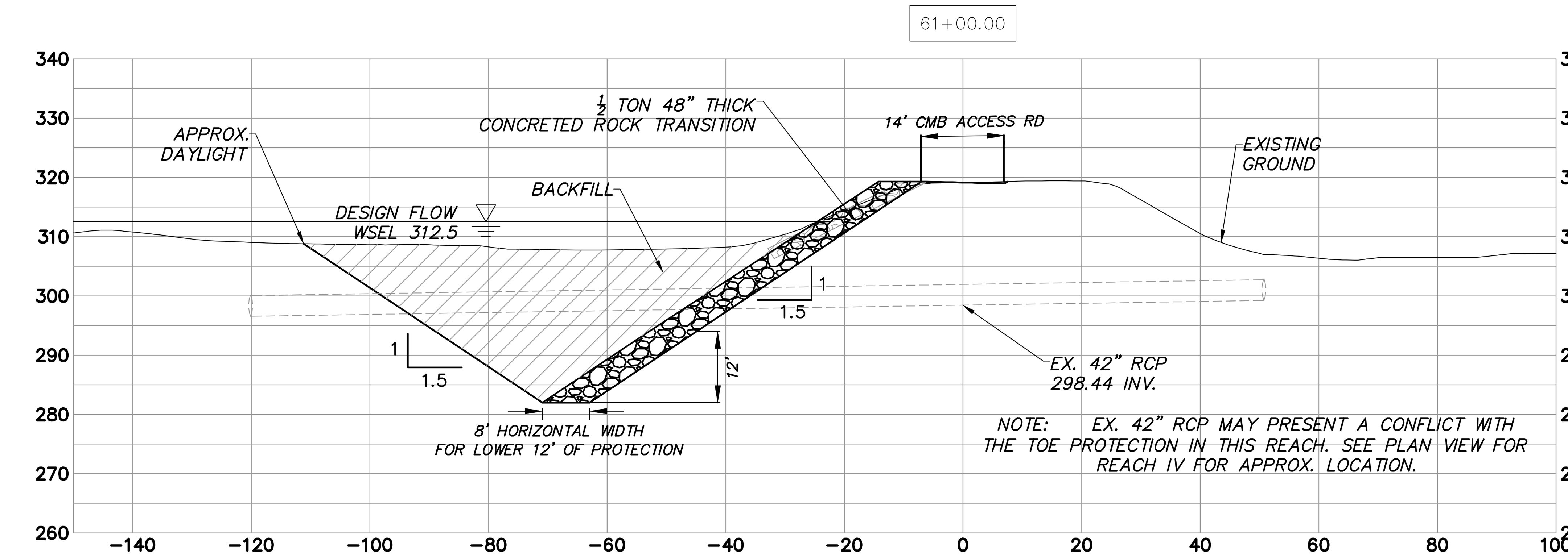

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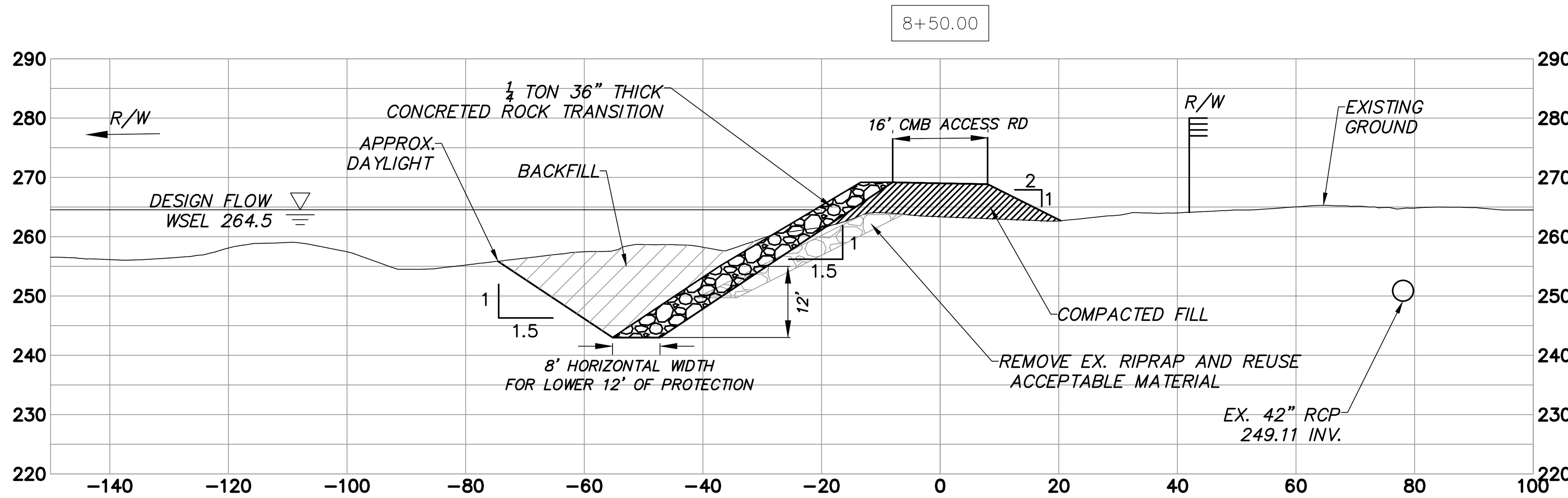

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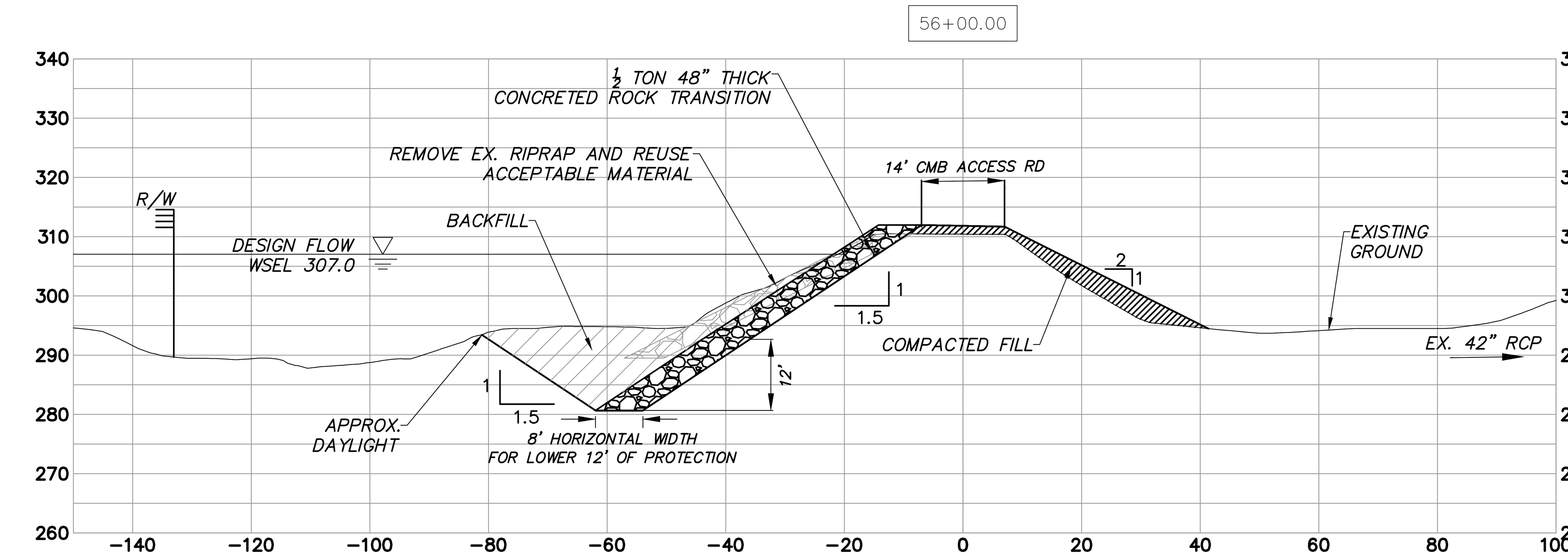

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 1D
PLAN AND CROSS-SECTIONS
CROSS-SECTIONS

SHEET 5 OF 5
DRAWING NO. Y-?-?

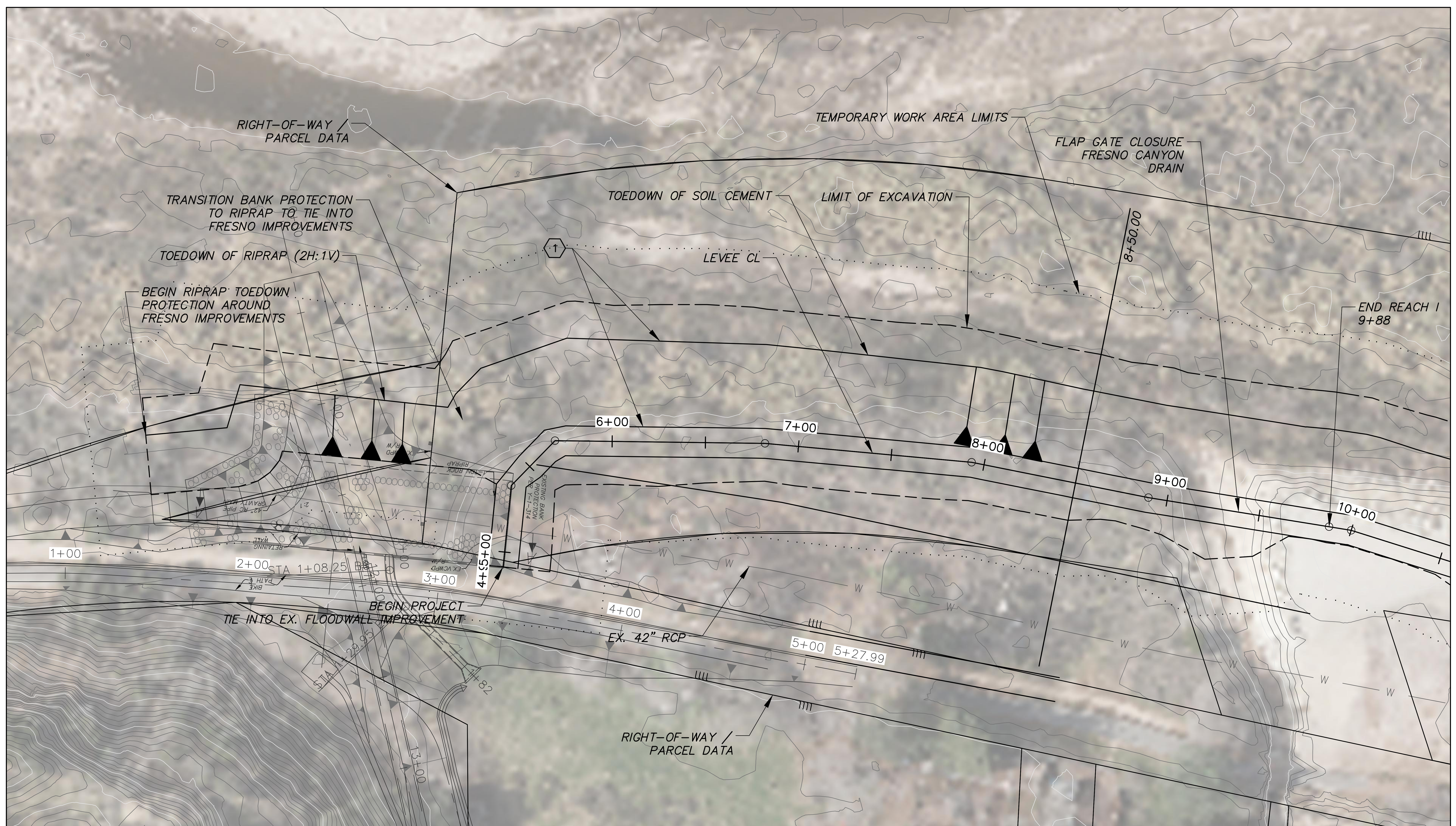
VR-2 LEVEE – REACH I
ALTERNATIVE 2A
SOIL CEMENT (1.5H:1V) ALTERNATIVE

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.

N

0 50 100 Feet



PLOT DATE: 3/4/22

SAVE DATE: 3/4/22 KRISTINA.GATES P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT2A PLAN XS.DWG

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PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2A
PLAN AND CROSS-SECTIONS
PLAN VIEW Reach I

SHEET 1 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH II
ALTERNATIVE 2A
SOIL CEMENT (1.5H:1V) ALTERNATIVE

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.

PLOT DATE: 3/4/22

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COUNTY OF VENTURA
PUBLIC WORKS AGENCY
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SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2A
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

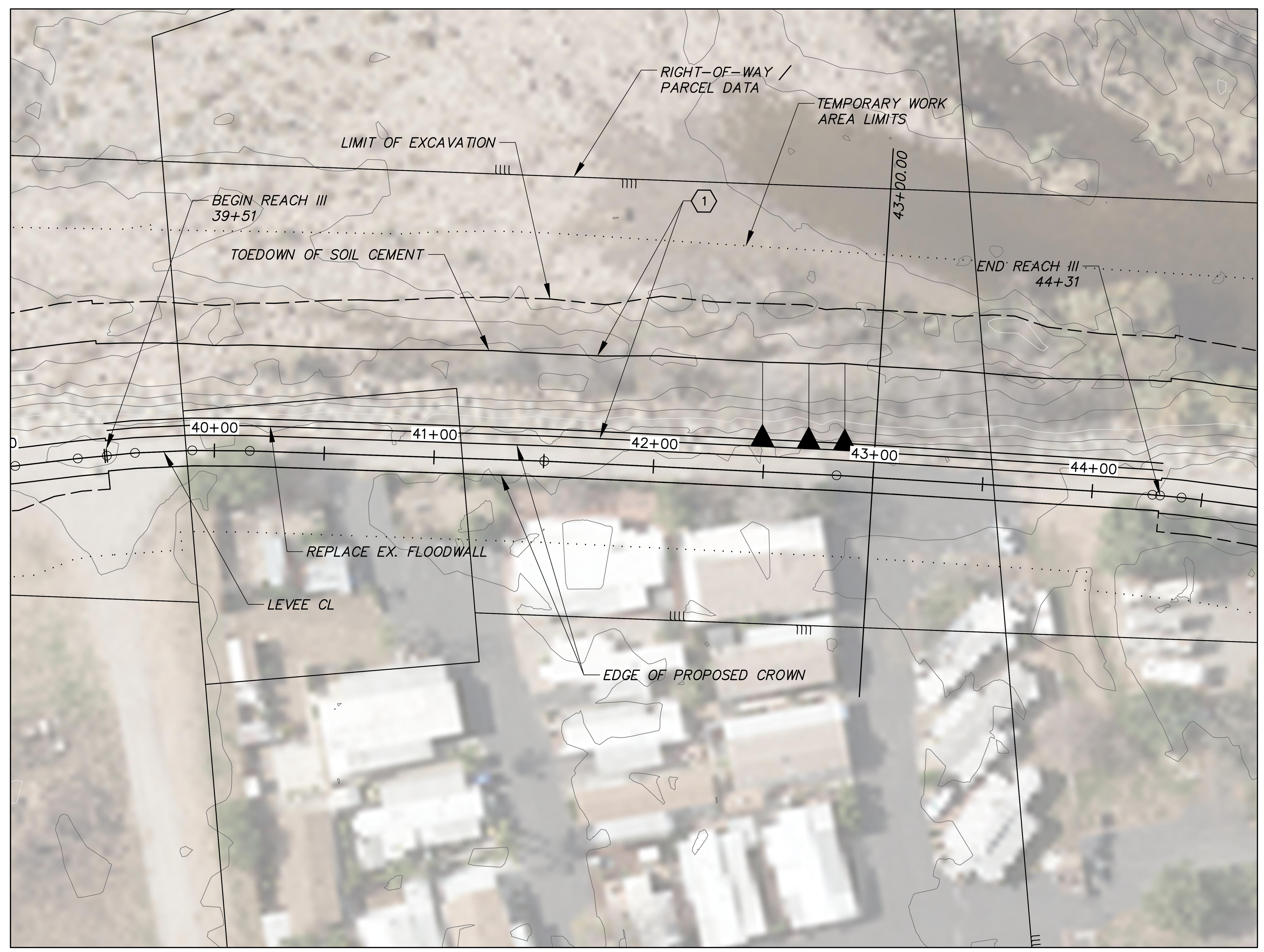
SHEET 2 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH III
ALTERNATIVE 2A
SOIL CEMENT (1.5H:1V) ALTERNATIVE

0 100 200 Feet

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2A

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5

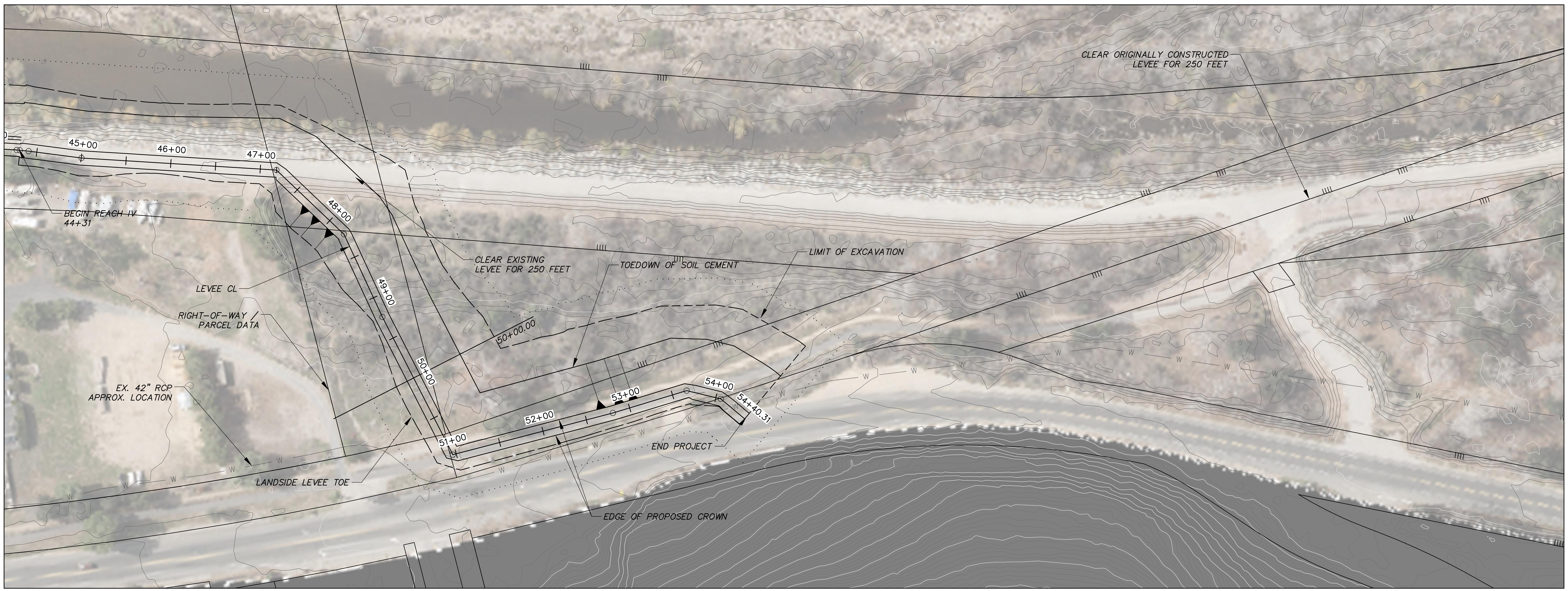
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH IV
ALTERNATIVE 2A
SOIL CEMENT (1.5H:1V) ALTERNATIVE

N

0 200 400
Feet

NOTES:
(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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COUNTY OF VENTURA
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SPEC. NO. –
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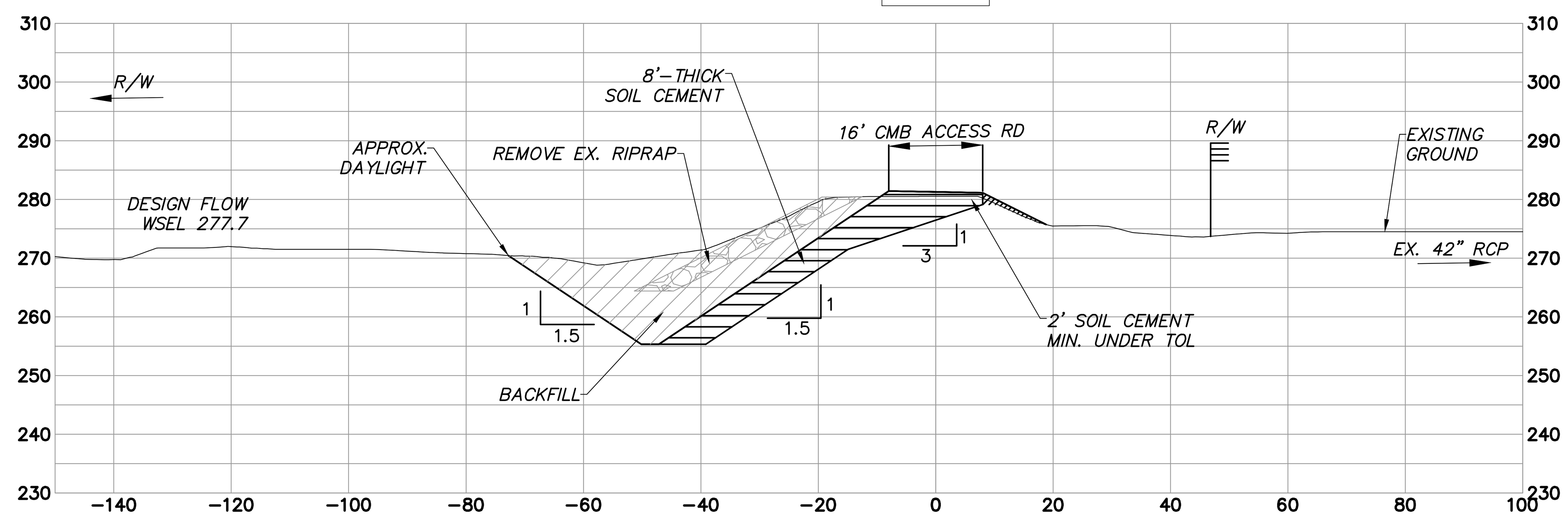
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2A
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?

24+00.00



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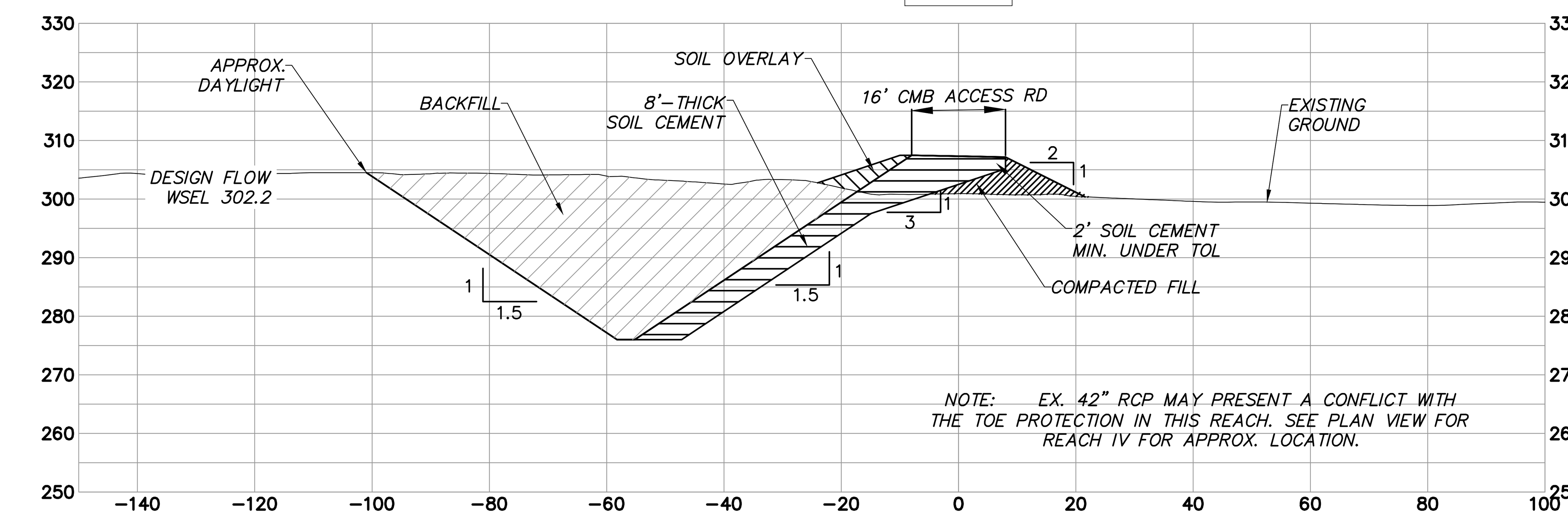

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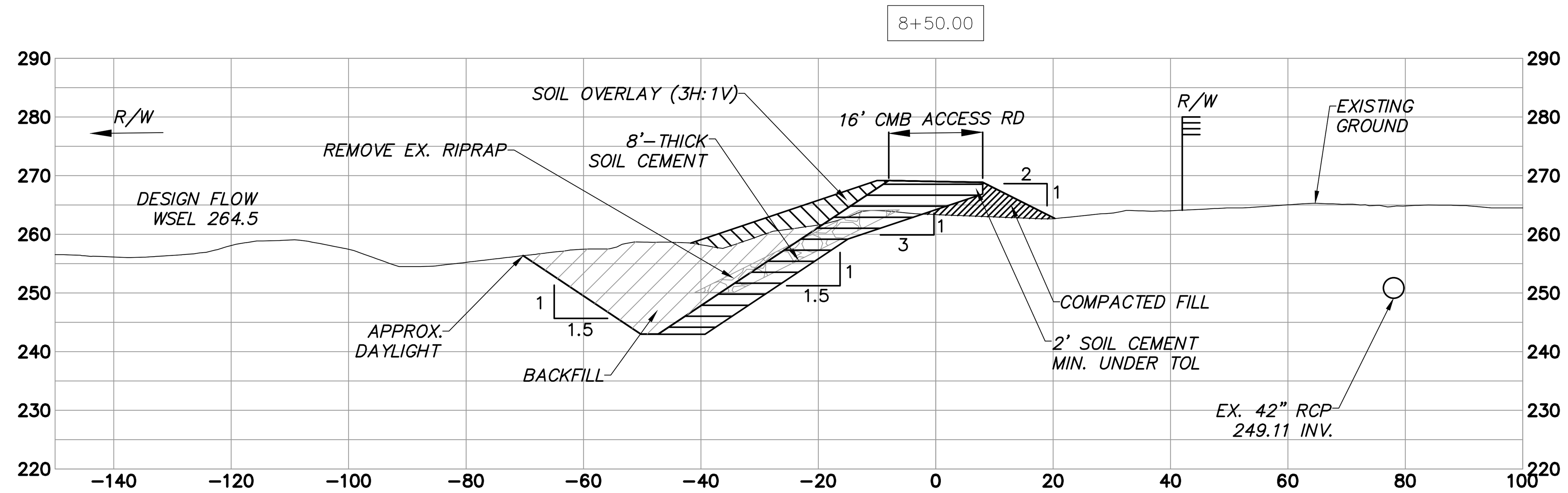

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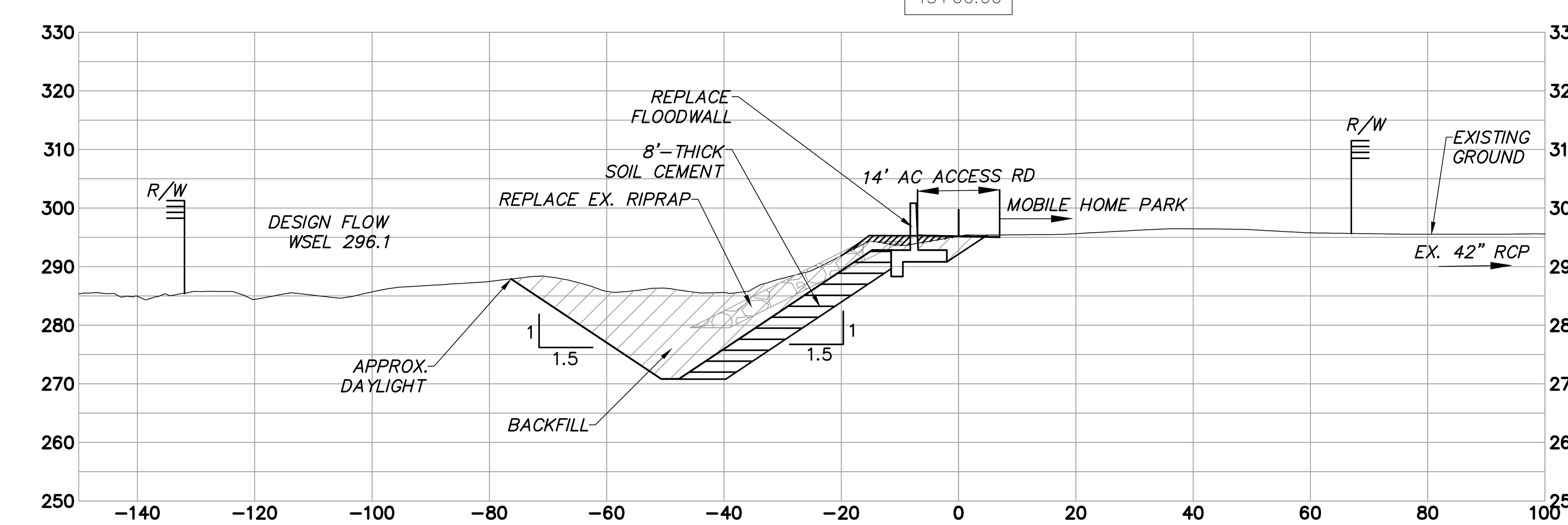

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PUBLIC WORKS AGENCY
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SPEC. NO. –
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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2A

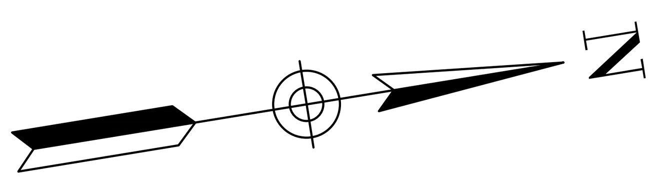
PLAN AND CROSS-SECTIONS
CROSS-SECTIONS

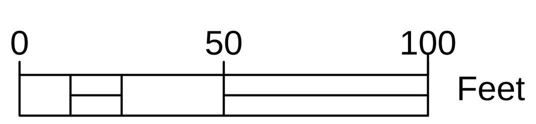
SHEET 5
OF 5
DRAWING NO. Y-?-?

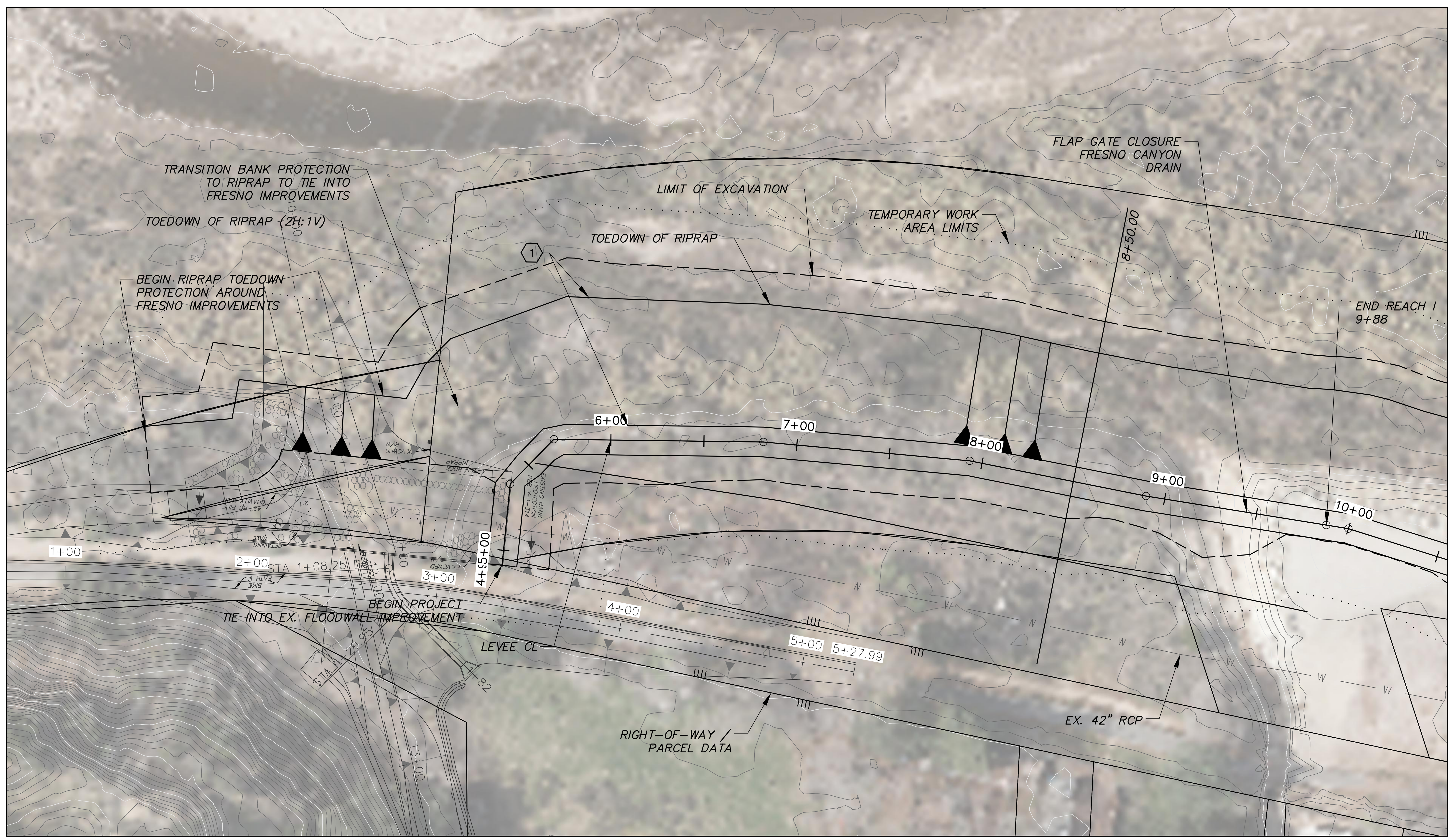
VR-2 LEVEE – REACH I
ALTERNATIVE 2B
RIPRAP (2H:1V) ALTERNATIVE

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.







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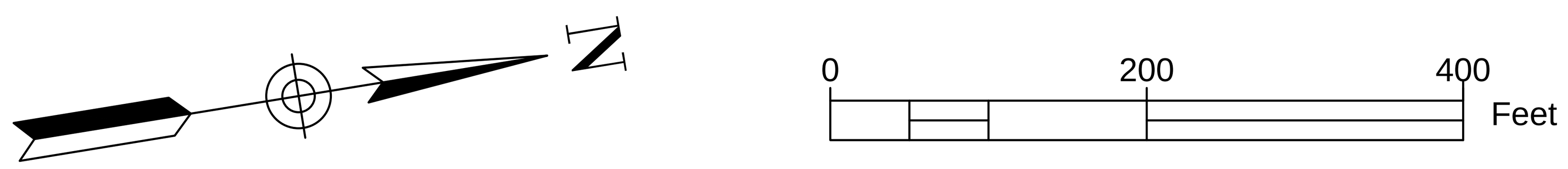
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2B

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

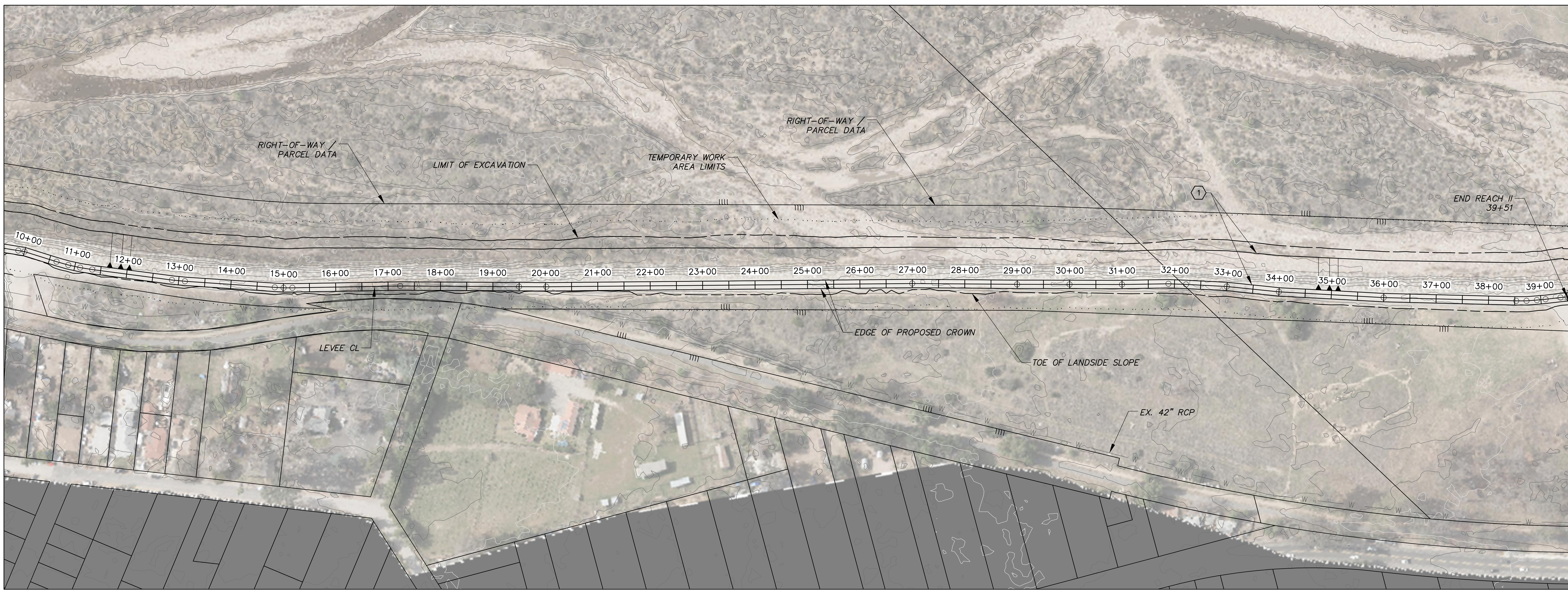
SHEET 1 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH II
ALTERNATIVE 2B
RIPRAP (2H:1V) ALTERNATIVE



NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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COUNTY OF VENTURA
PUBLIC WORKS AGENCY
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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2B
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH 11

SHEET 2 OF 5
DRAWING NO. Y-?-?

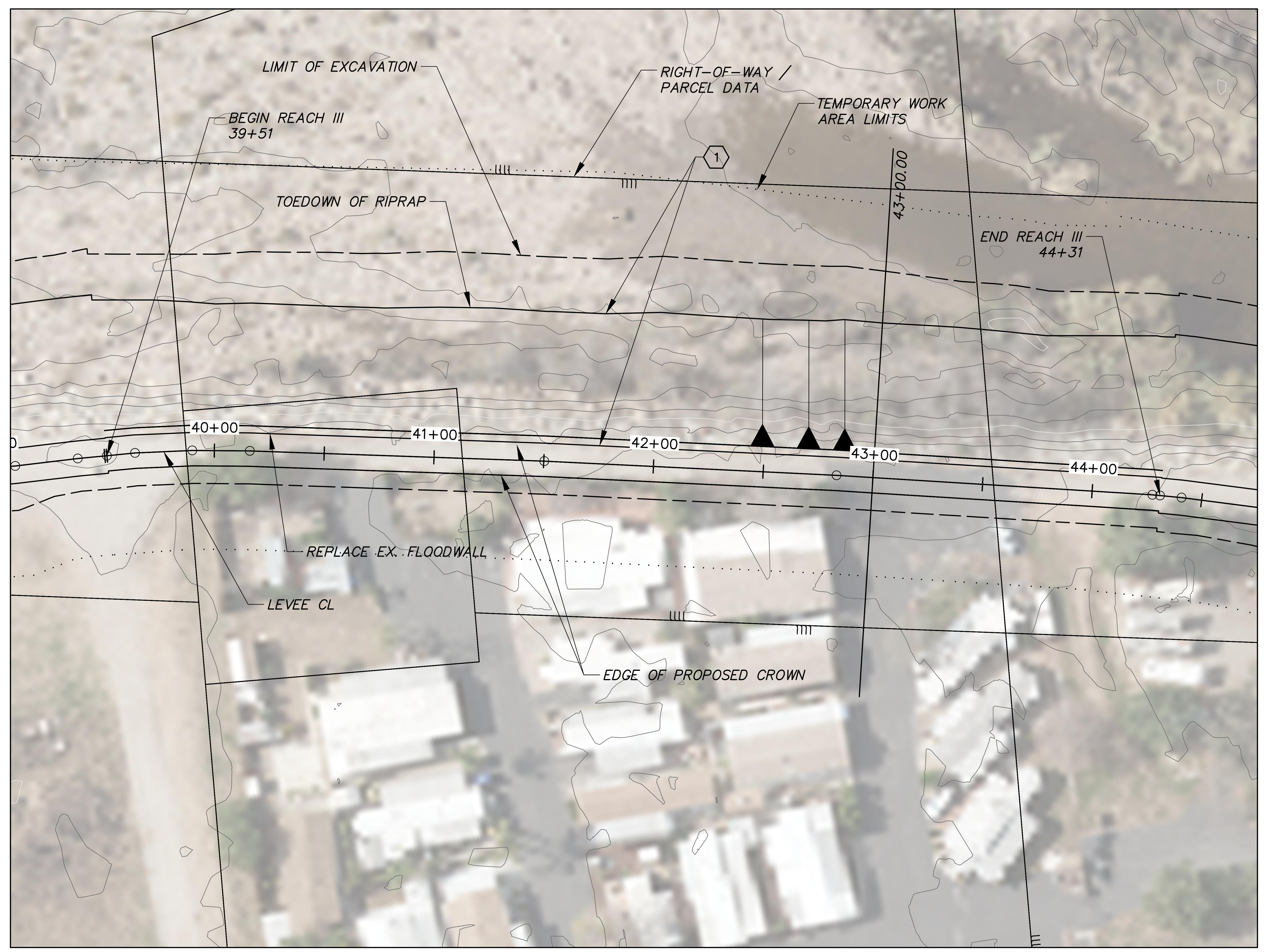
VR–2 LEVEE – REACH III
ALTERNATIVE 2B
RIPRAP (2H:1V) ALTERNATIVE

N

0 100 200 Feet

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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COUNTY OF VENTURA
PUBLIC WORKS AGENCY
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VENTURA RIVER LEVEE 2 (VR–2) PROJECT
ALTERNATIVE 2B

PLAN AND CROSS–SECTIONS
PLAN VIEW REACH III

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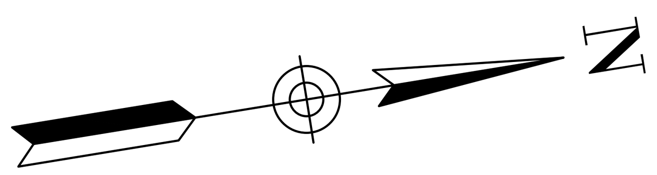
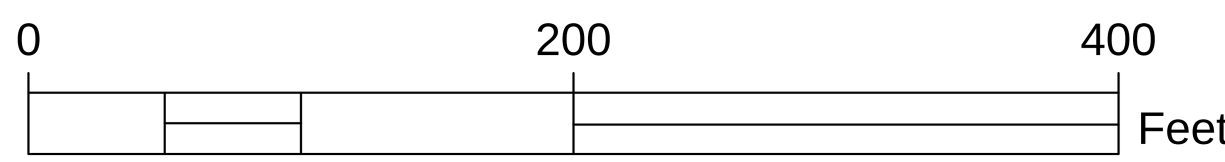
DRAWING NO. Y–?–?

VR-2 LEVEE – REACH IV
ALTERNATIVE 2B
RIPRAP (2H:1V) ALTERNATIVE





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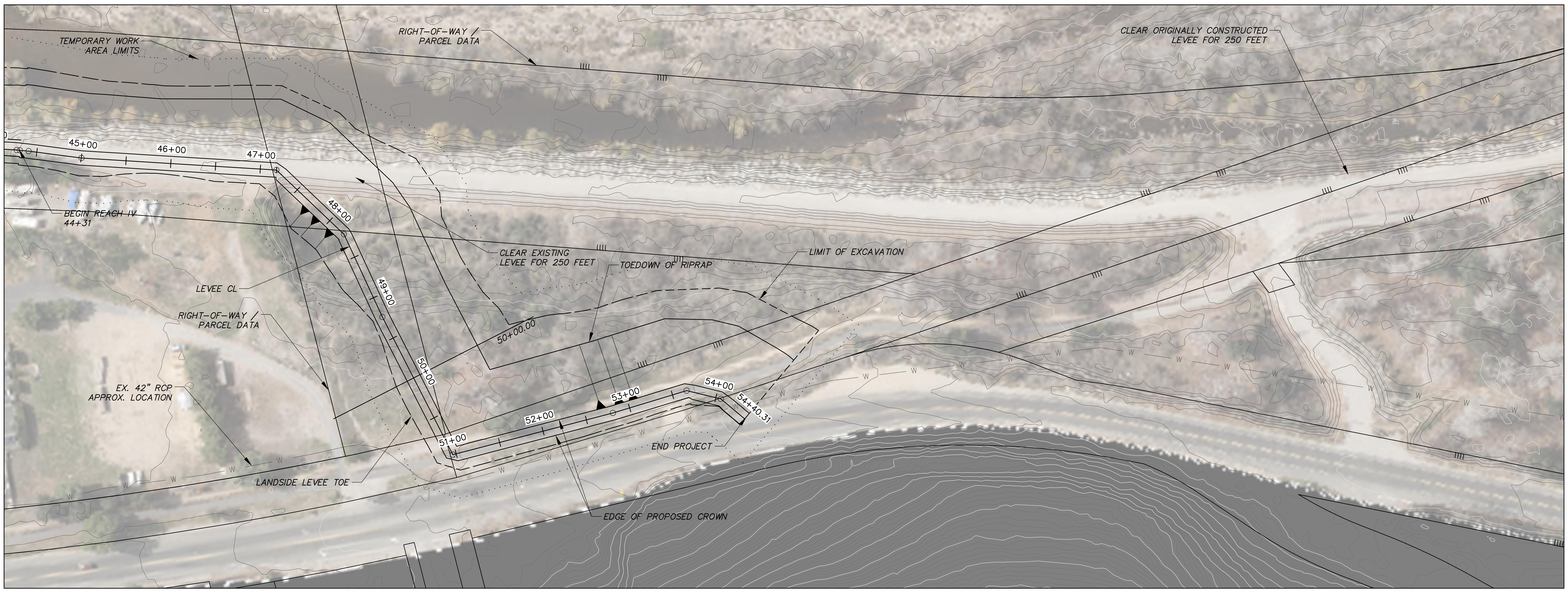

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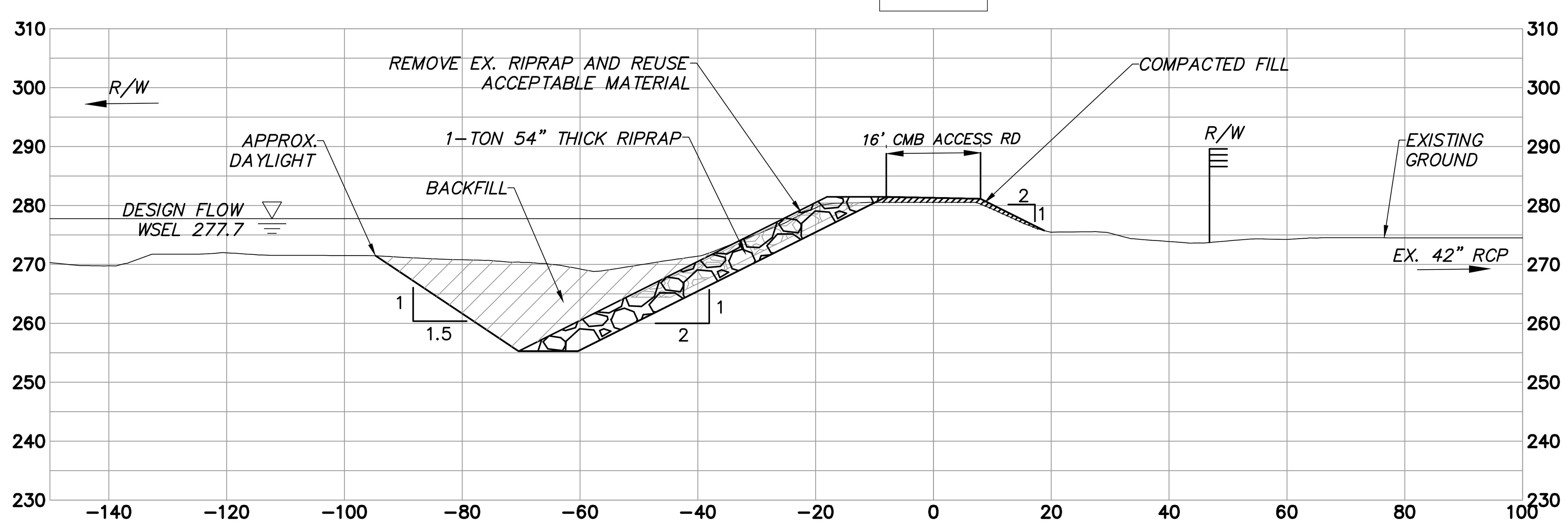
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2B

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?

24+00.00



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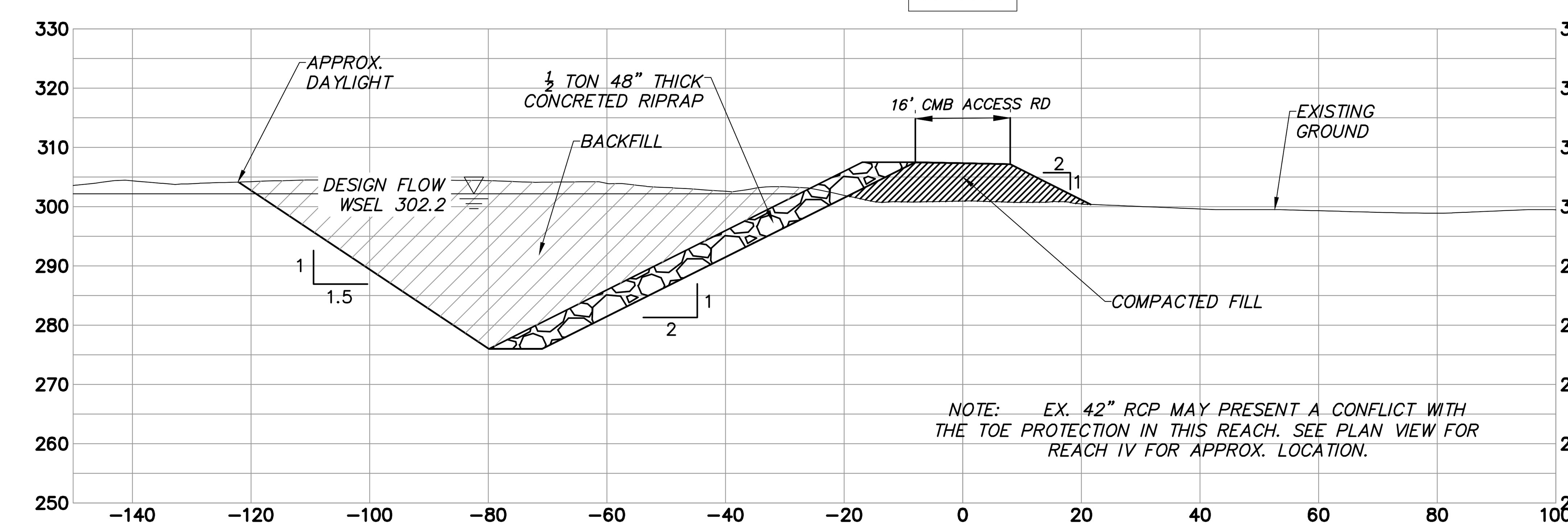

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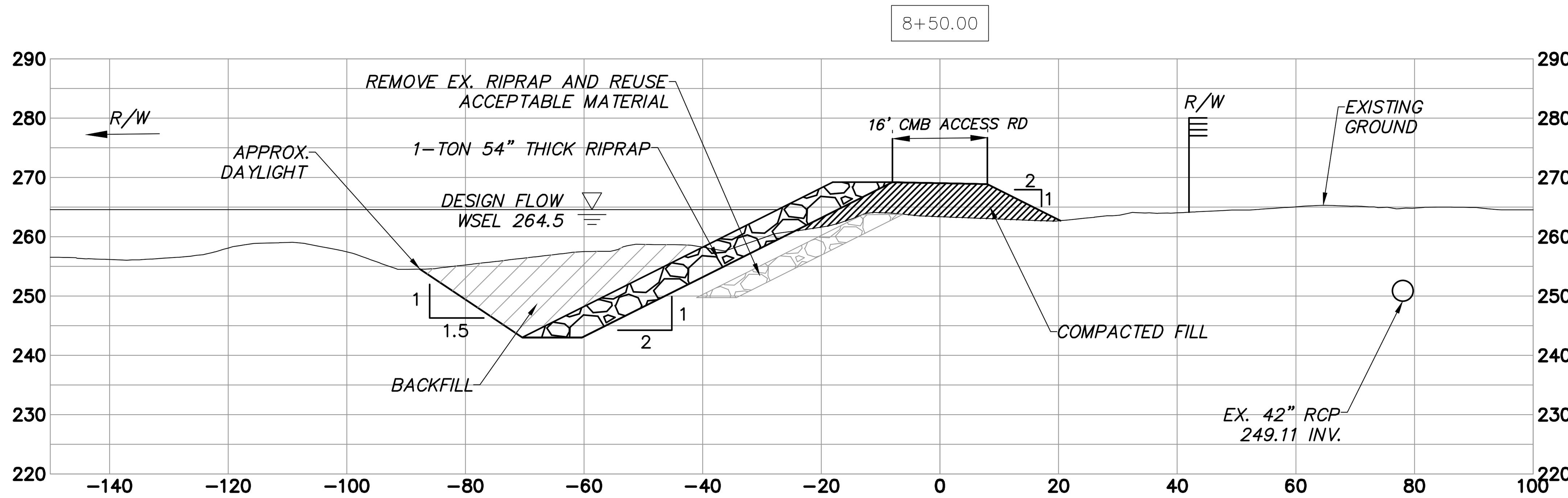

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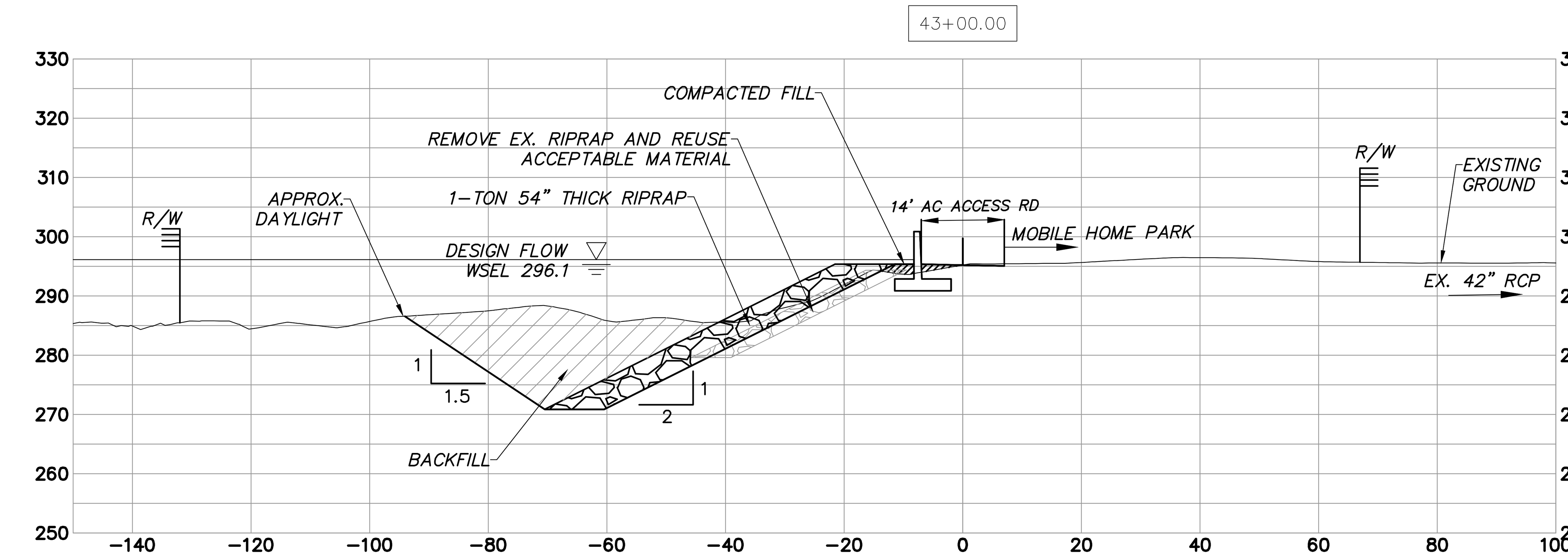

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SAVE DATE: 3/4/22 KRISTINA.GATES P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT2B PLAN XS.DWG

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SHEET 5 OF 5
DRAWING NO. Y-?-?

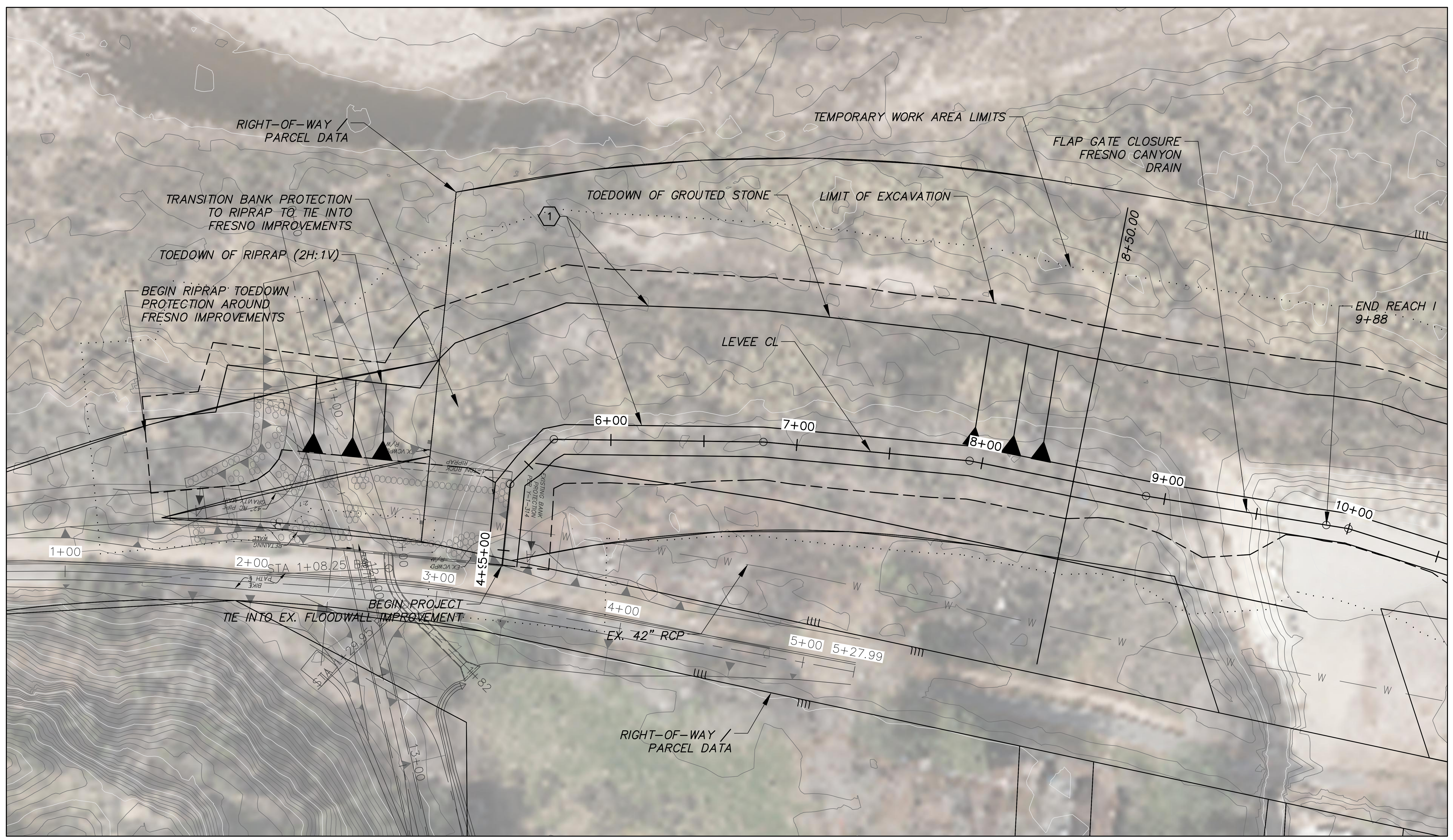
VR-2 LEVEE – REACH I
ALTERNATIVE 2C
GROUTED STONE (2H:1V) ALTERNATIVE

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.

N

0 50 100
Feet



PLOT DATE: 3/4/22

SAVE DATE: 3/4/22 KRISTINA.GATES P:\WATR\T37983_VR-2_LEVEE\11_DESIGN\01_FEASIBILITY_DESIGN\PLAN_SHEETS\ALT2C_PLAN_XS.DWG

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△	REVISION DESCRIPTION	APP.	DATE

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COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2C
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

SHEET 1 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH II
ALTERNATIVE 2C
GROUTED STONE (2H:1V) ALTERNATIVE

0 200 400 Feet

NOTES:
1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.

PLOT DATE: 3/4/22

SAVE DATE: 3/4/22 KRISTINA.GATES P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT2C PLAN XS.DWG

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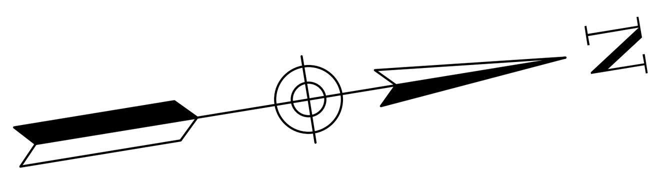
SPEC. NO. –
PROJ. NO. –

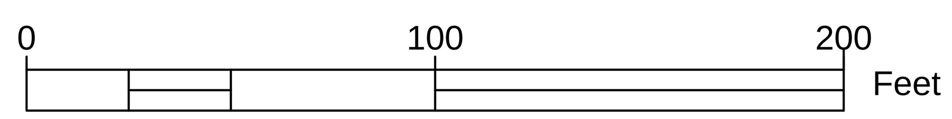
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2C

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

SHEET 2 OF 5
DRAWING NO. Y-?-?

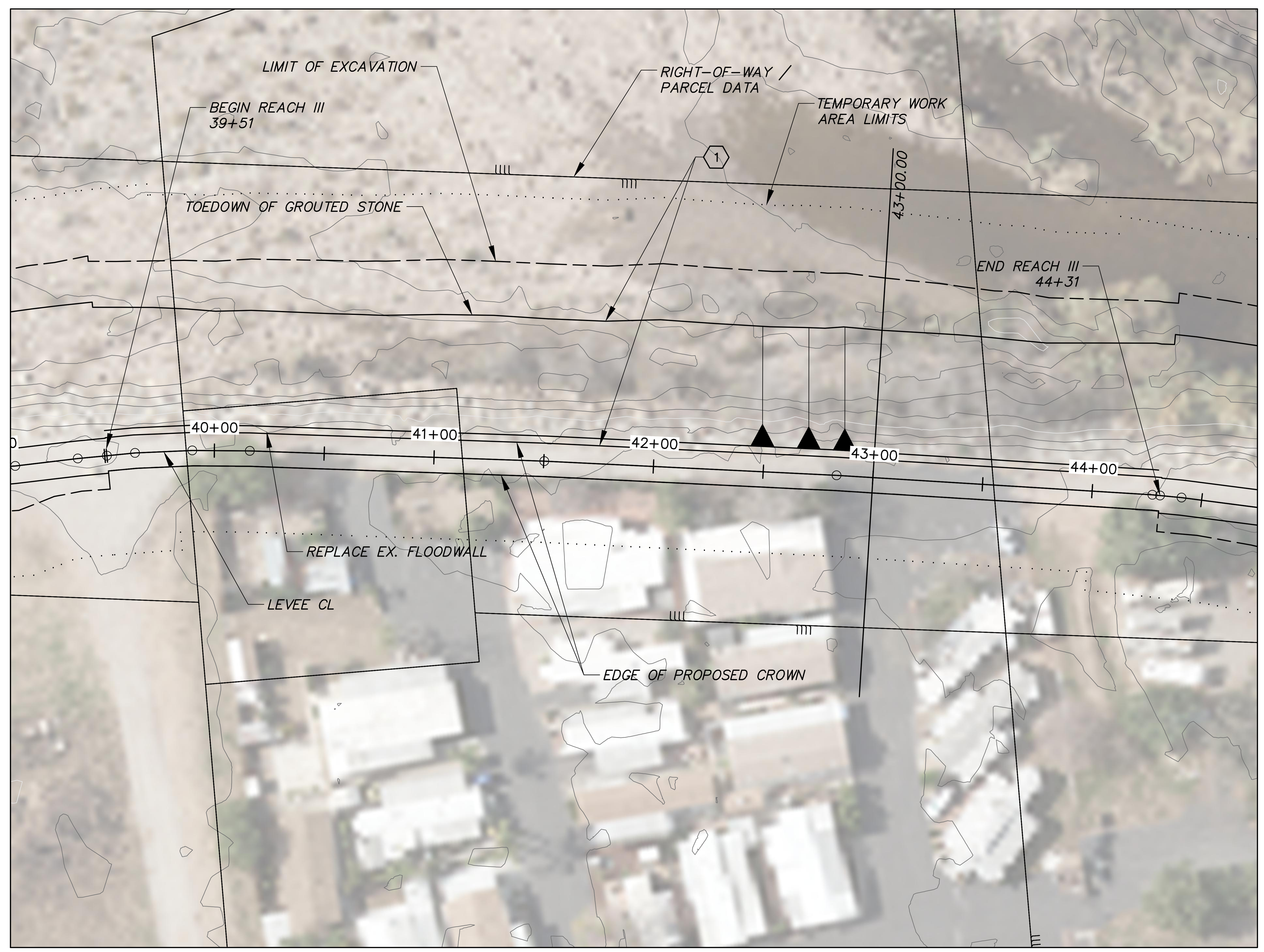
VR-2 LEVEE – REACH III
ALTERNATIVE 2C
GROUTED STONE (2H:1V) ALTERNATIVE





NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



PLOT DATE: 3/4/22

SAVE DATE: 3/4/22 KRISTINA.GATES P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN_SHEETS\ALT2C_PLAN_XS.DWG

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COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2C

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5
DRAWING NO. Y-?-?

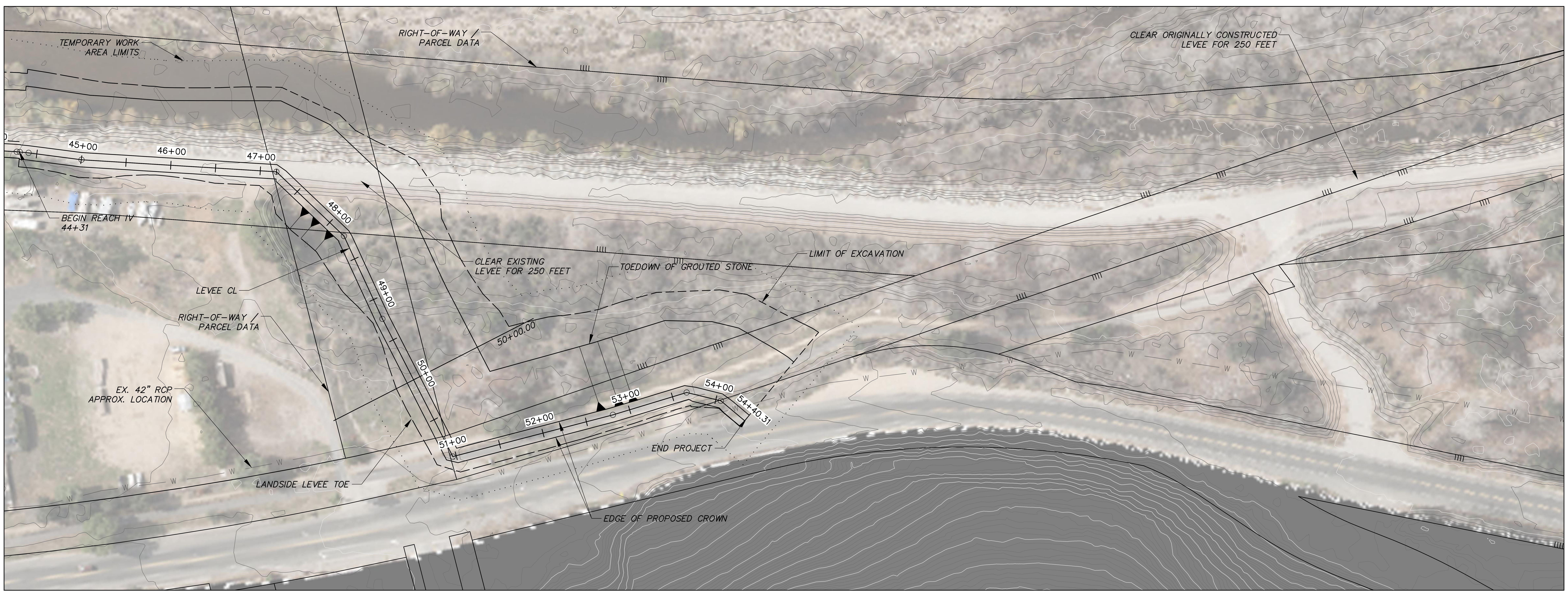
VR-2 LEVEE – REACH IV
ALTERNATIVE 2C
GROUTED STONE (2H:1V) ALTERNATIVE

N

0 200 400 Feet

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



PLOT DATE: 3/4/22

SAVE DATE: 3/4/22 KRISTINA.GATES P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT2C PLAN XS.DWG

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SPEC. NO. –
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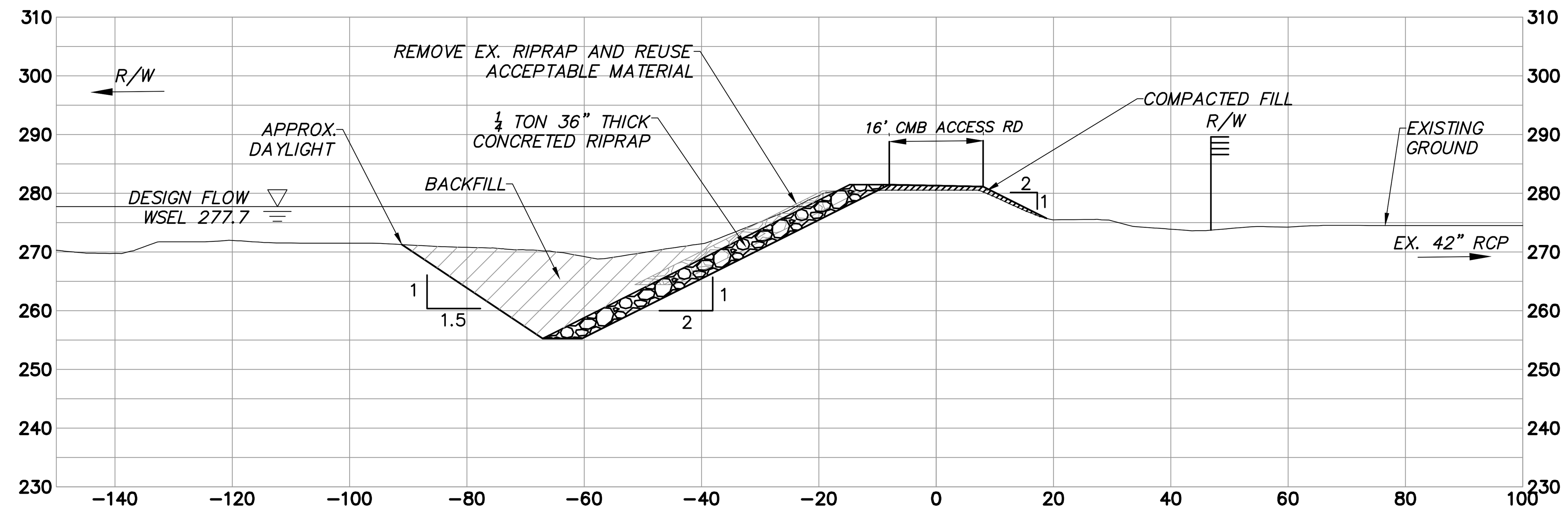
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2C

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?

24+00.00



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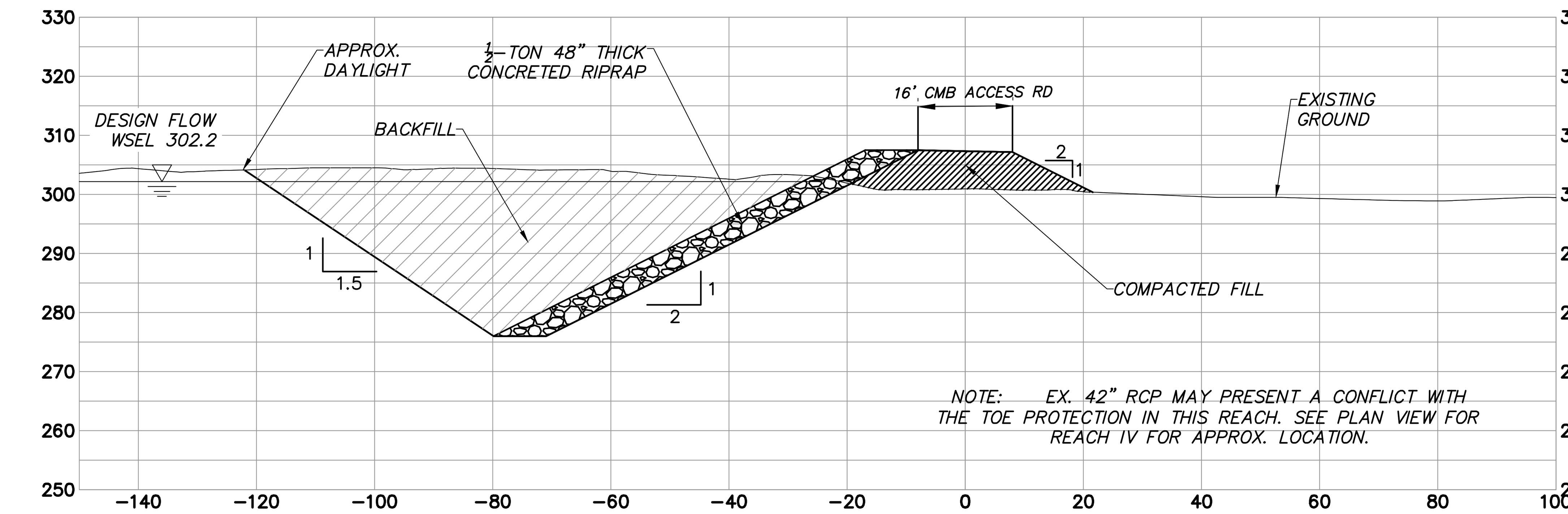

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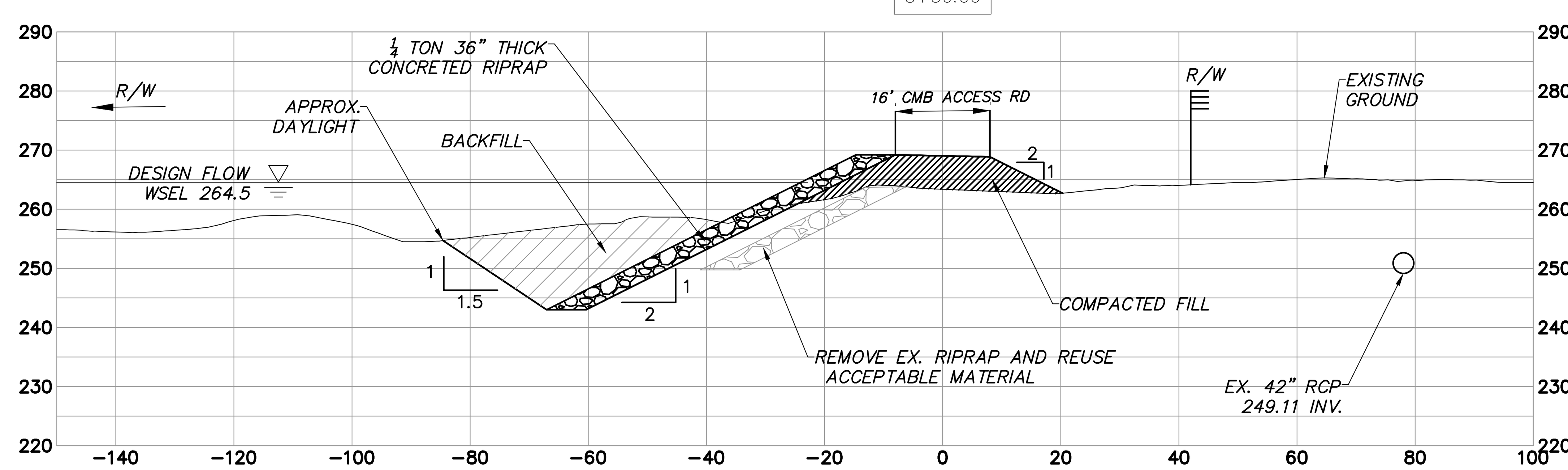
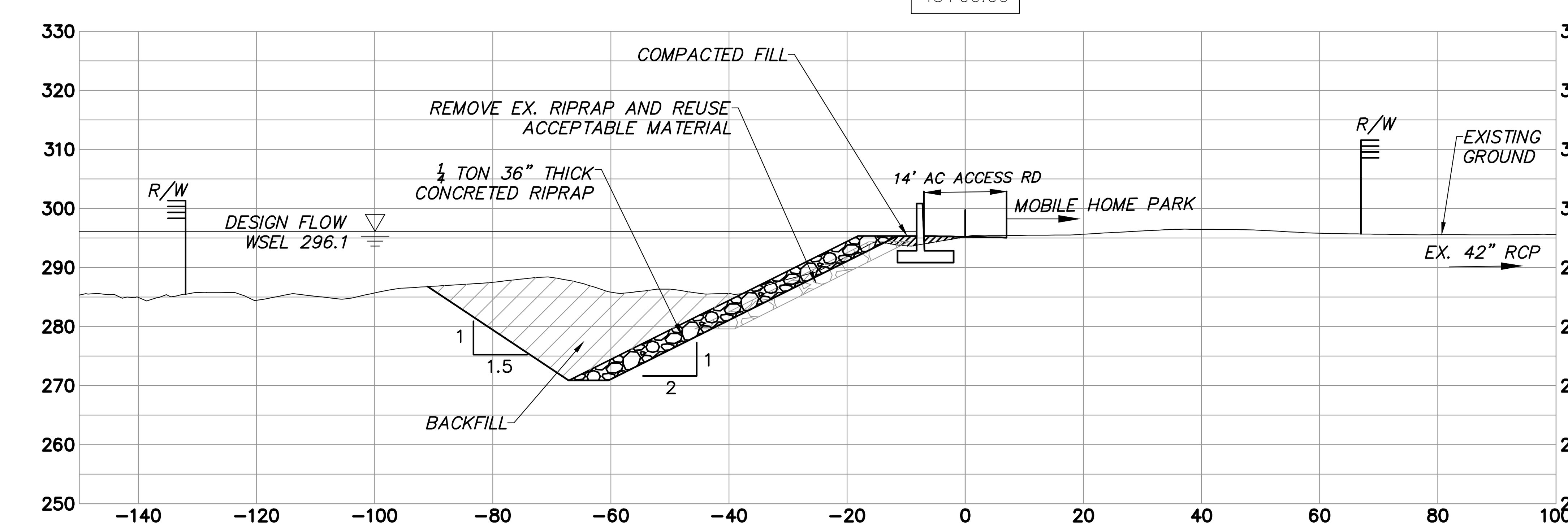


43+00.00



PLOT DATE: 3/4/22

SAVE DATE: 3/4/22 KRISTINA.GATES P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT2C PLAN XS.DWG

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WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 2C

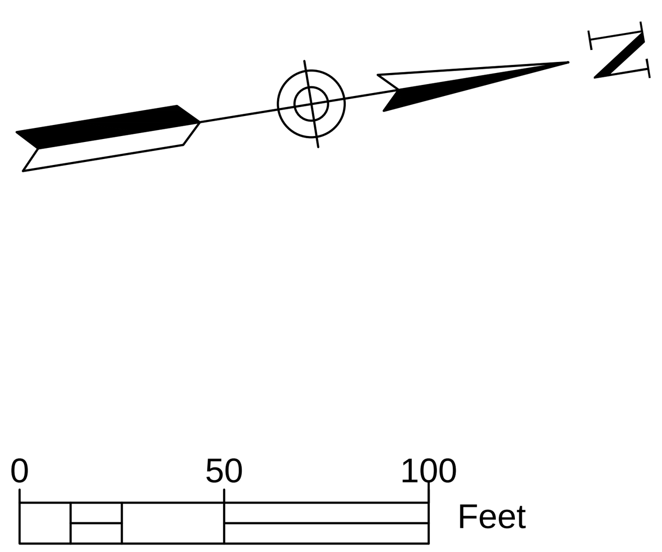
PLAN AND CROSS-SECTIONS
CROSS-SECTIONS

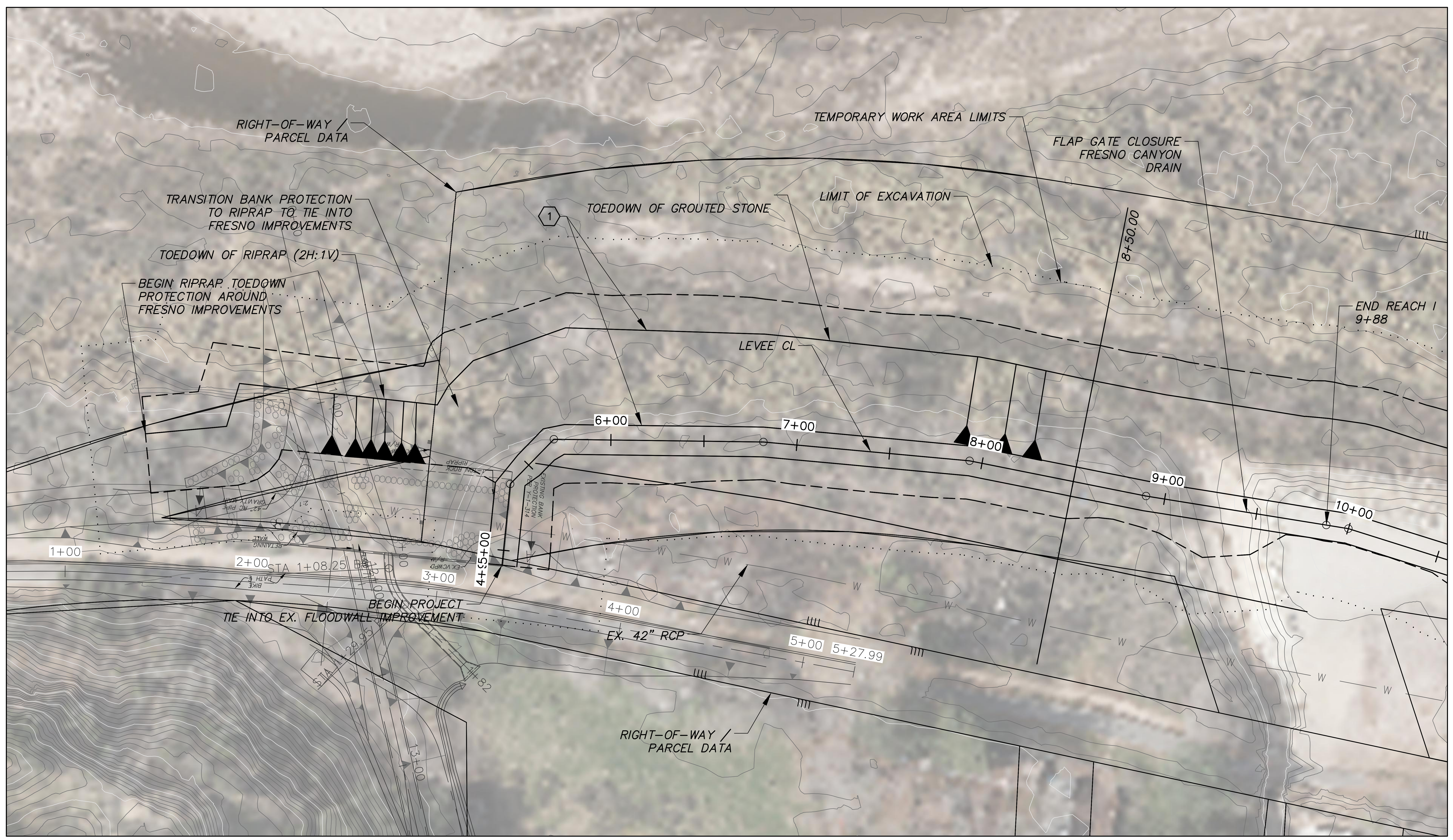
SHEET 5
OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH I
ALTERNATIVE 3D
GROUTED STONE (1.5H:1V) ALTERNATIVE

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.





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PUBLIC WORKS AGENCY
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SPEC. NO. –
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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3D
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

SHEET 1 OF 5
DRAWING NO. Y-?-?

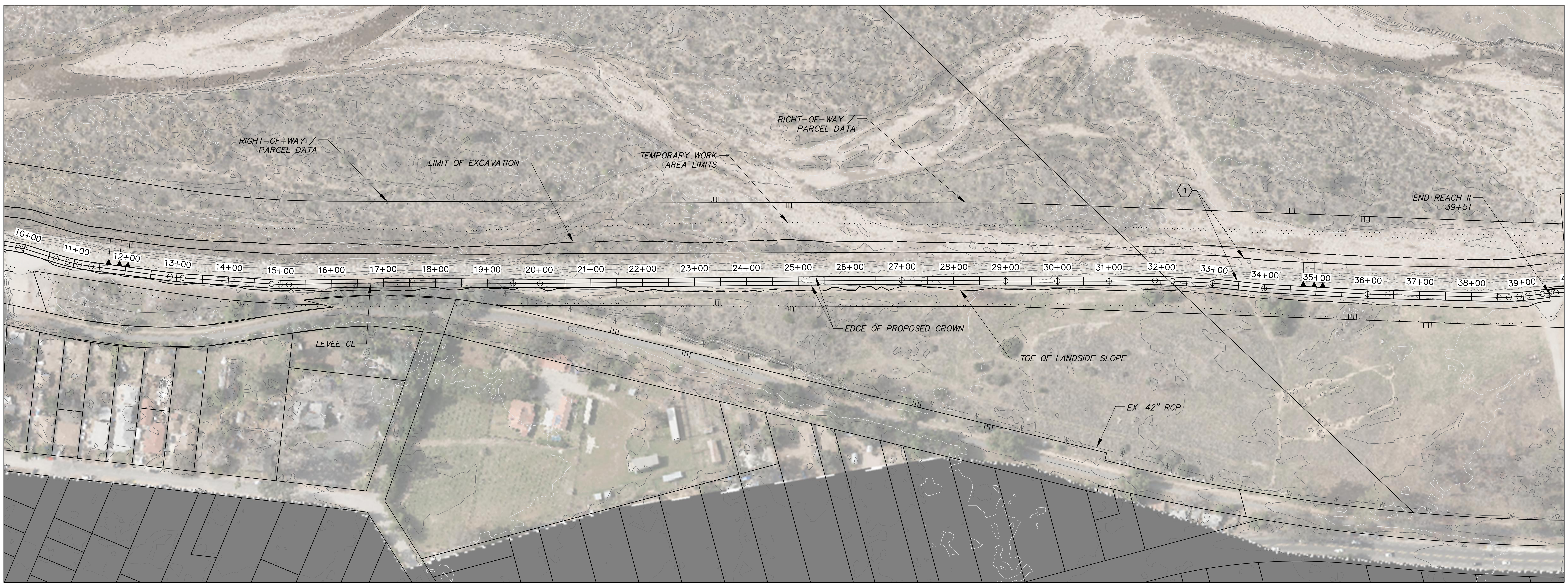
VR-2 LEVEE – REACH II
ALTERNATIVE 3D
GROUTED STONE (1.5H:1V) ALTERNATIVE

N

0 200 400 Feet

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



PLOT DATE: 3/4/22

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SPEC. NO. –
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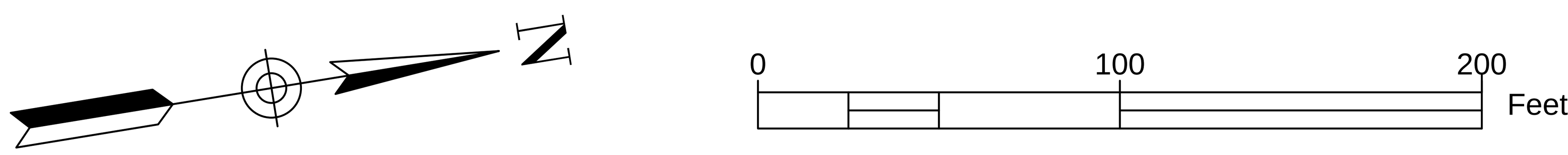
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3D
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

SHEET 2 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH III
ALTERNATIVE 3D
GROUTED STONE (1.5H:1V) ALTERNATIVE



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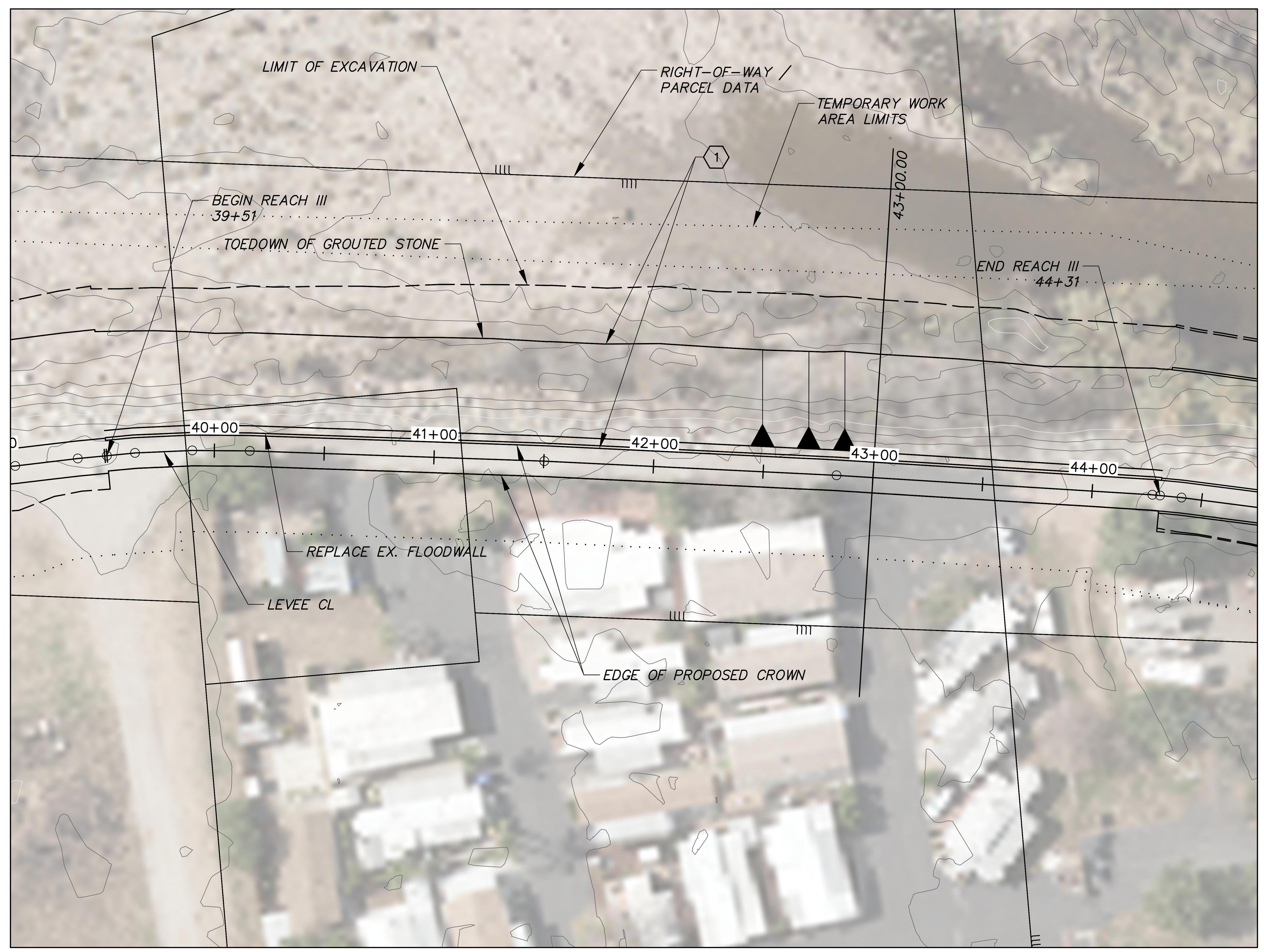

PLOT DATE: 3/4/22

SAVE DATE: 2/24/22 ERIC.OLEA P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN_SHEETS\ALT2D_PLAN_XS.DWG

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PUBLIC WORKS AGENCY
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SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3D

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5

DRAWING NO. Y-?-?

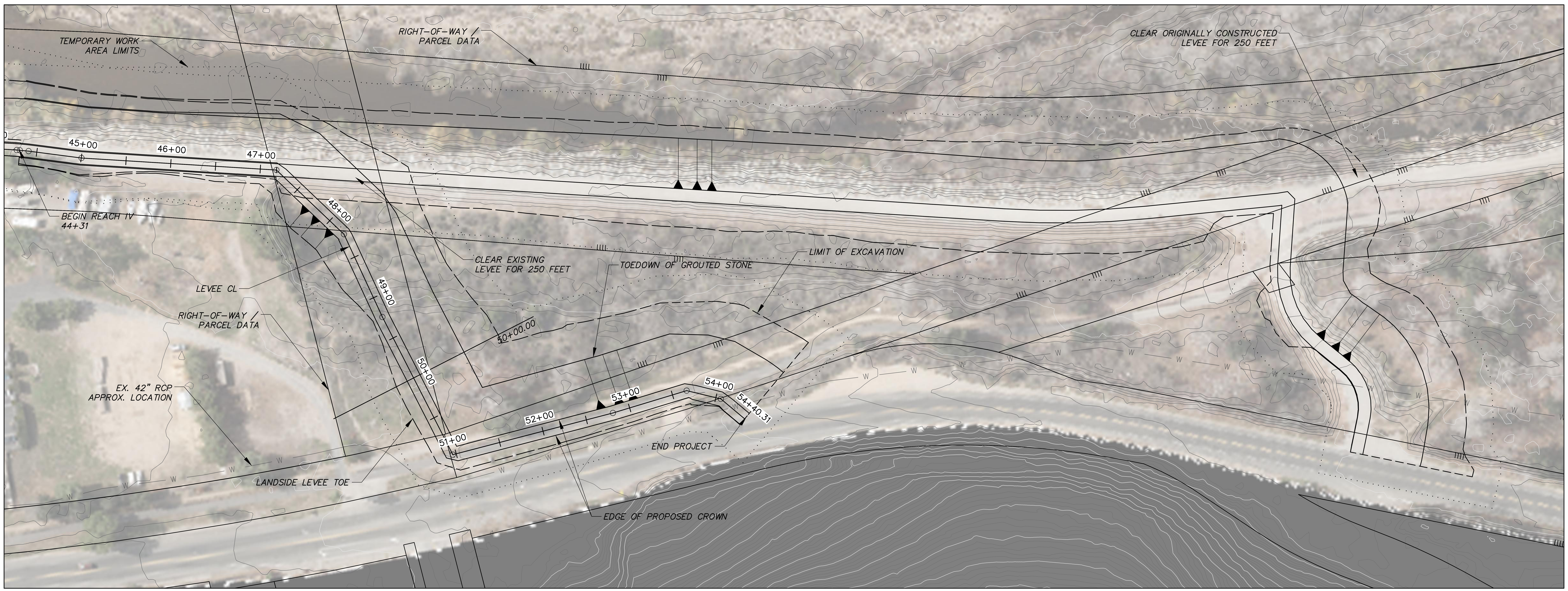
VR-2 LEVEE – REACH IV
ALTERNATIVE 3D
GROUTED STONE (1.5H:1V) ALTERNATIVE

N

0 | 200 | 400 Feet

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



PLOT DATE: 3/4/22

SAVE DATE: 2/24/22 ERIC.OLEA P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN_SHEETS\ALT2D_PLAN_XS.DWG

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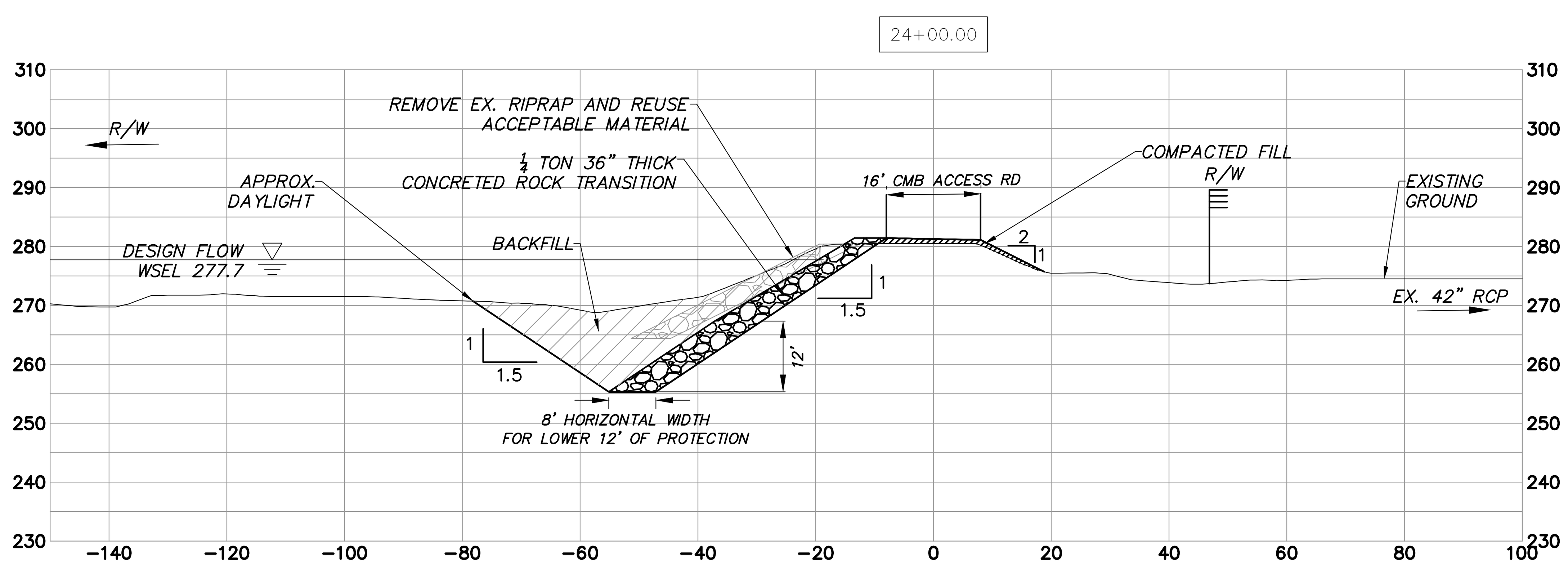
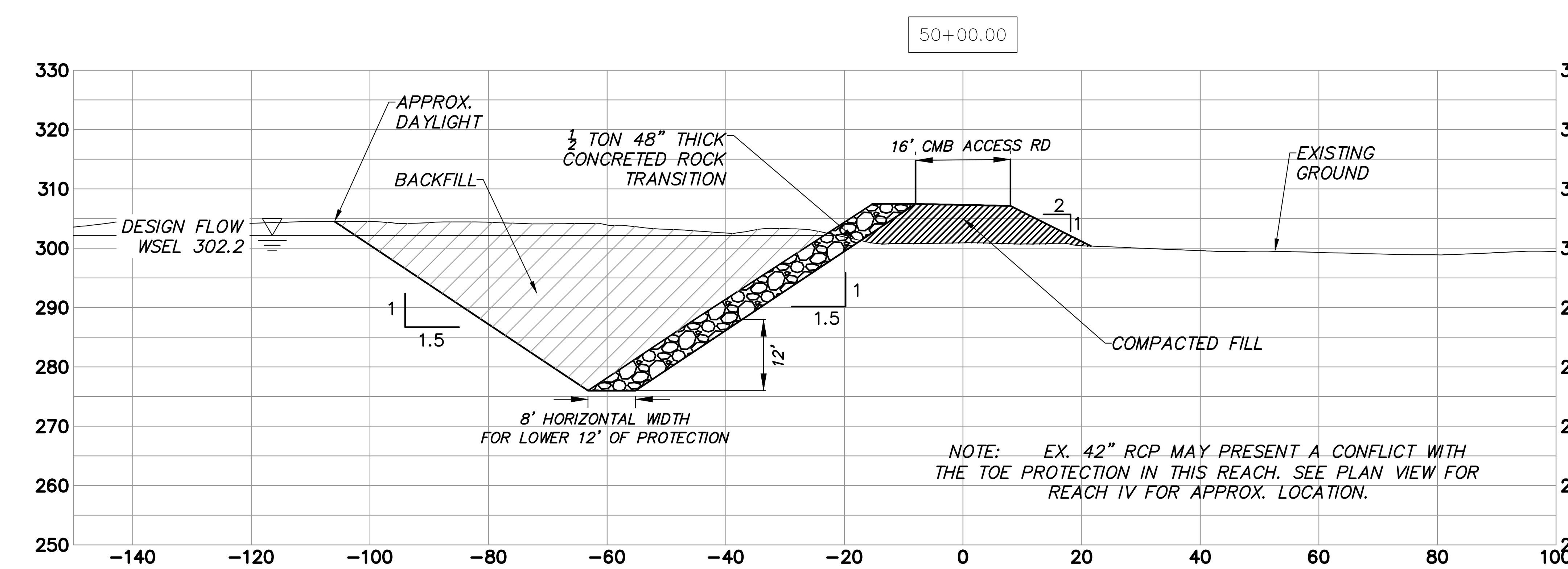
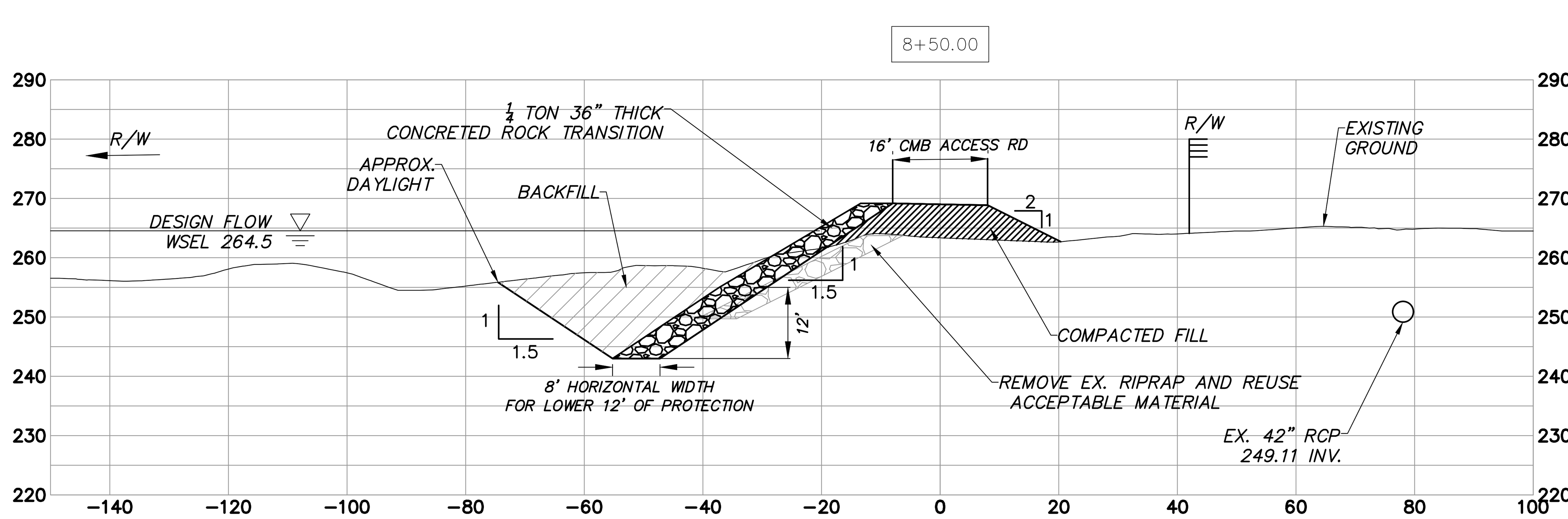
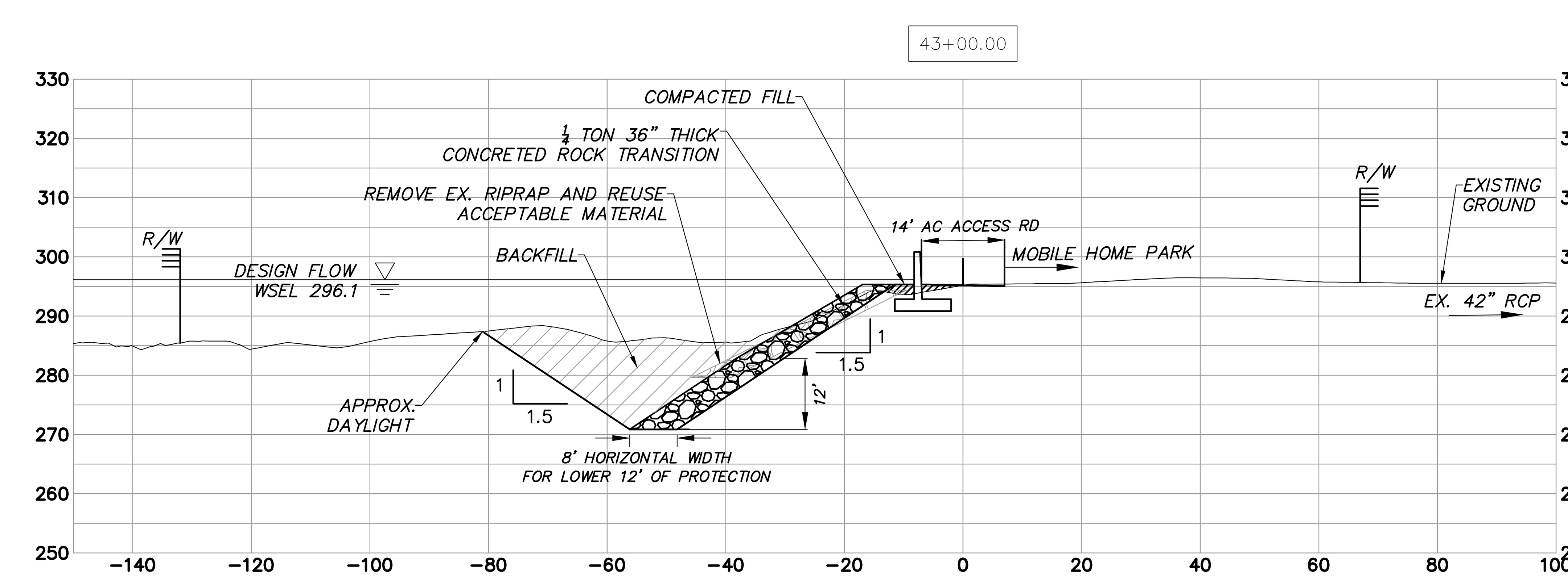
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3D
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?









PLOT DATE: 3/4/22

SAVE DATE: 2/24/22 ERIC.OLEA P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT2D PLAN XS.DWG

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VENTURA RIVER LEVEE 2 (VR–2) PROJECT
ALTERNATIVE 2D

PLAN AND CROSS–SECTIONS
CROSS–SECTIONS

SHEET 5 OF 5
DRAWING NO. Y–?–?

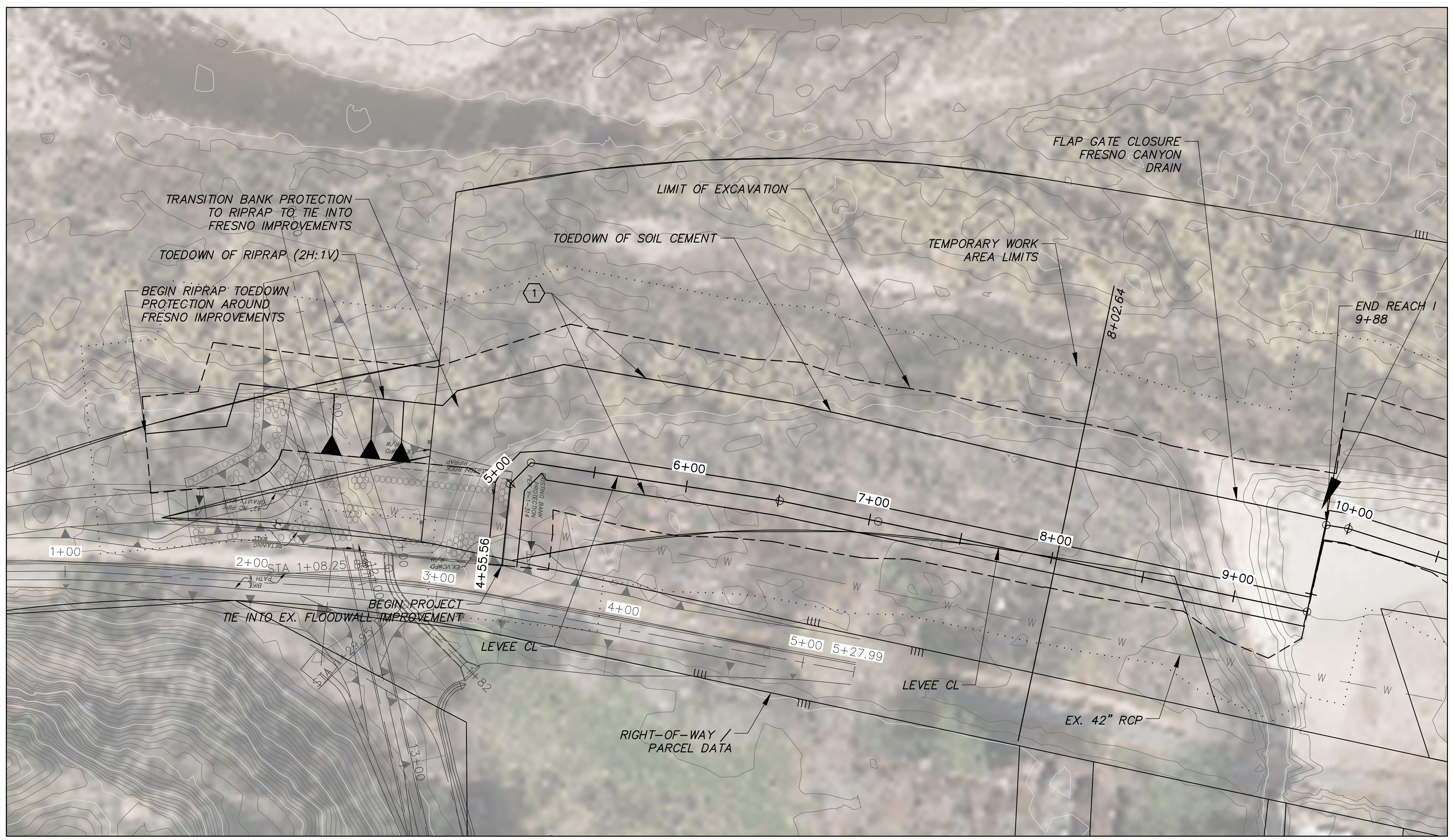
VR-2 LEVEE – REACH I
ALTERNATIVE 3A
SOIL CEMENT (1.5H:1V) ALTERNATIVE

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.

N

0 50 100 Feet



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PLOT DATE: 3/4/22

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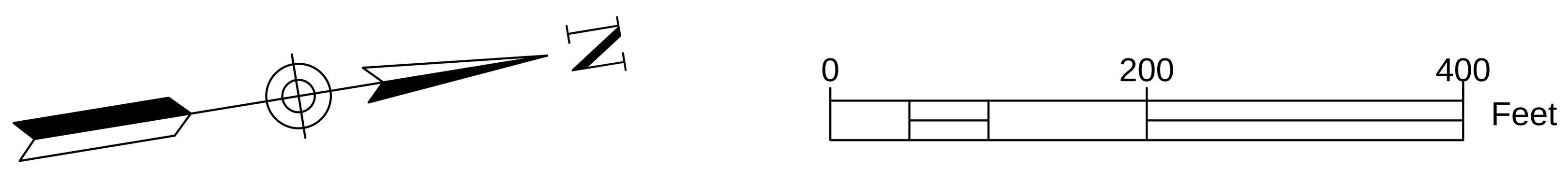
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3A
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

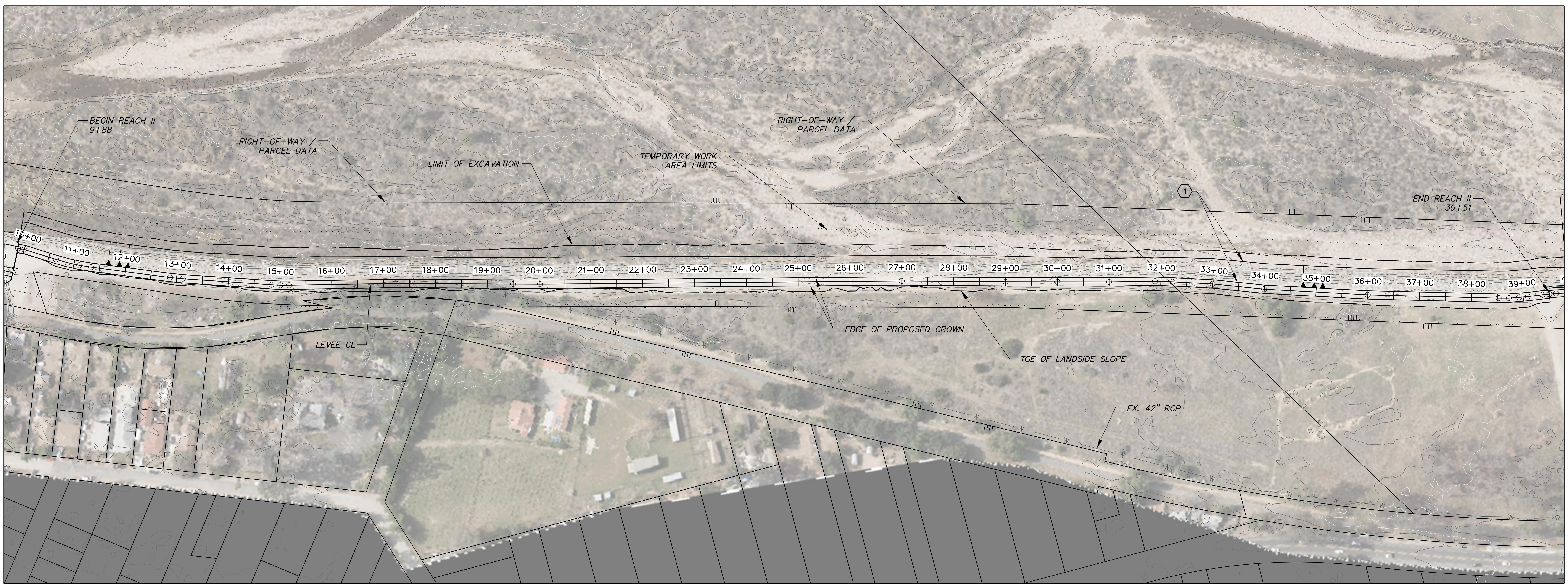
SHEET 1 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH II
ALTERNATIVE 3A
SOIL CEMENT (1.5H:1V) ALTERNATIVE



NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



PLOT DATE: 3/4/22

SAVE DATE: 2/24/22 KIM.NGUYEN1 P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN_SHEETS\ALT3A_PLAN_XS.DWG

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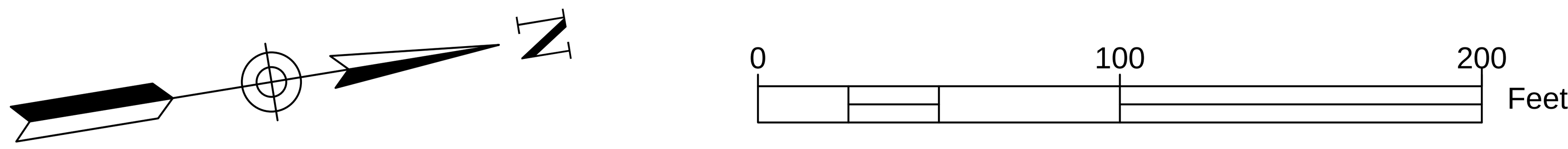
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3A

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

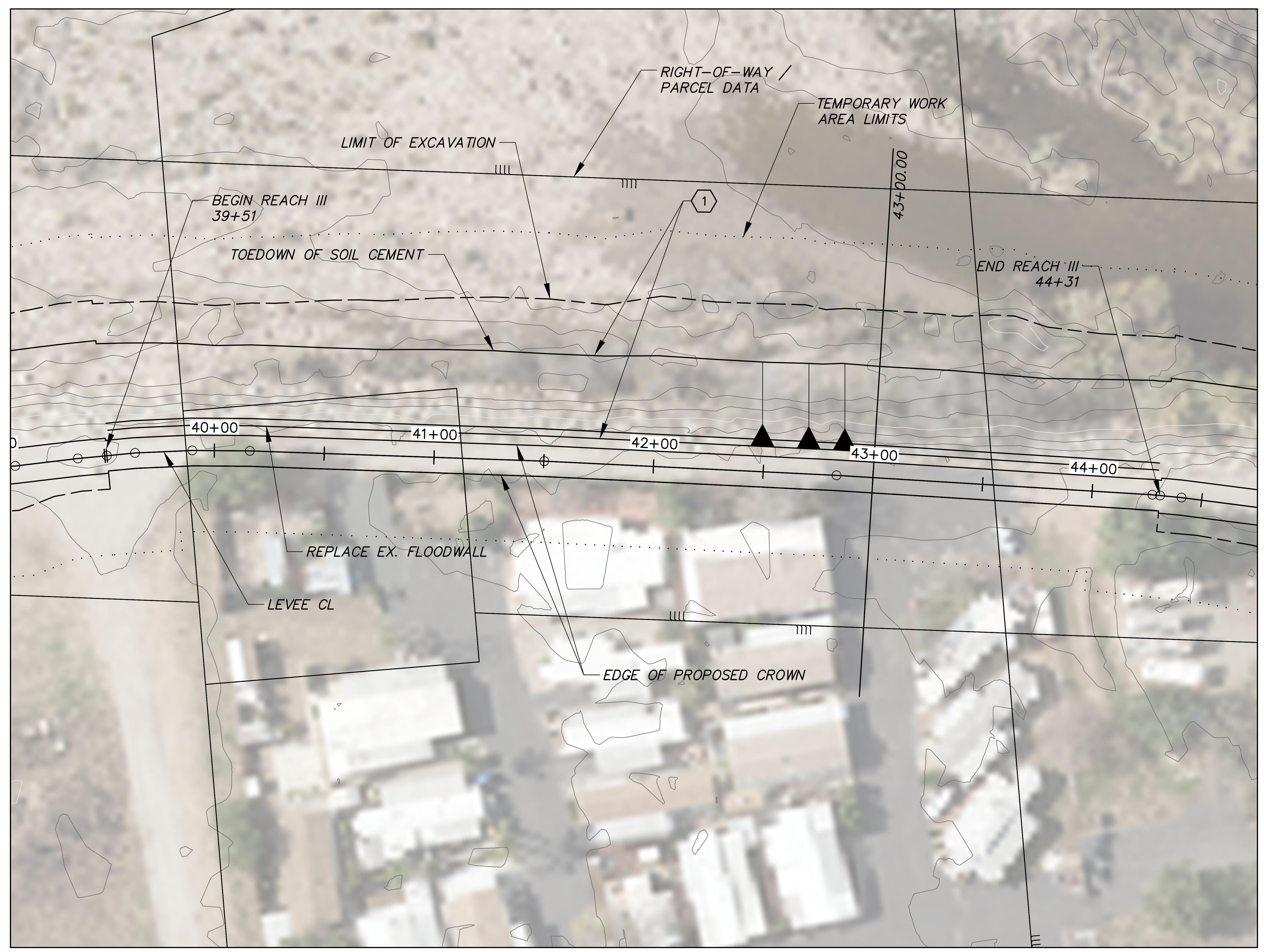
SHEET 2 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH III
ALTERNATIVE 3A
SOIL CEMENT (1.5H:1V) ALTERNATIVE



NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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SAVE DATE: 2/24/22 KIM.NGUYEN1 P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN_SHEETS\ALT3A_PLAN_XS.DWG

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3A
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5
DRAWING NO. Y-?-?

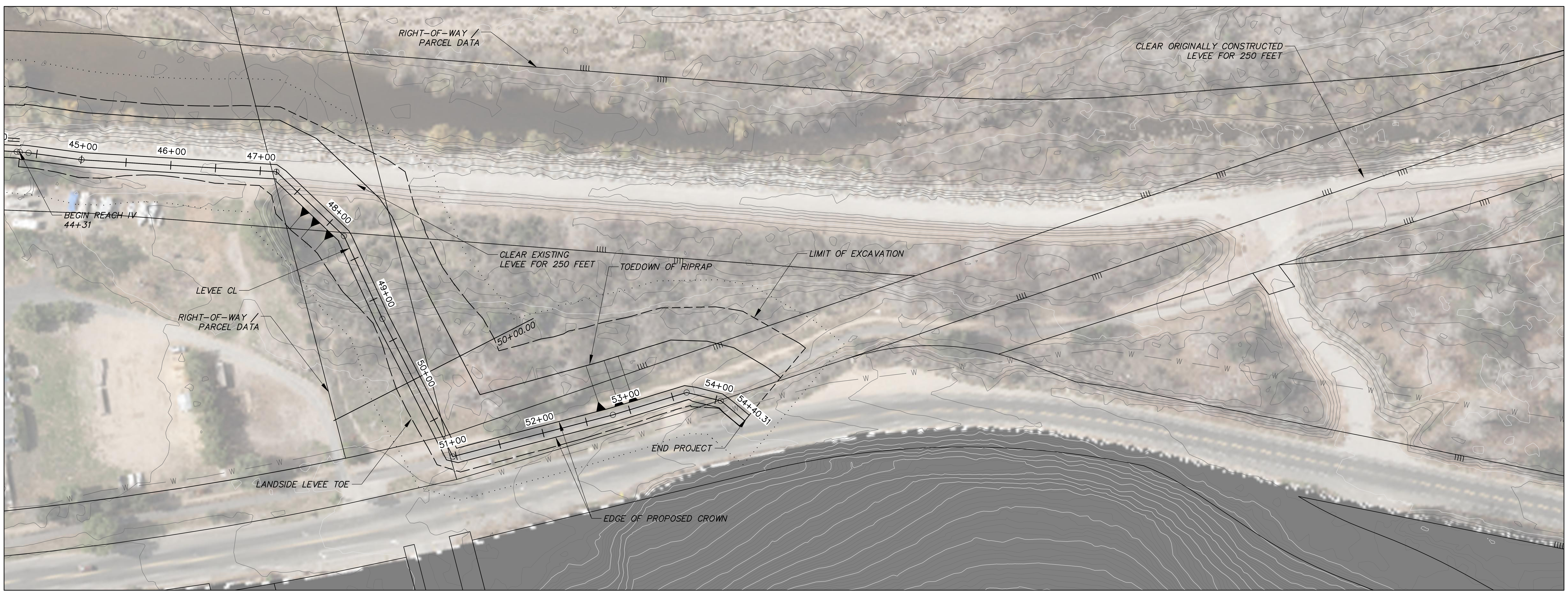
VR-2 LEVEE – REACH IV
ALTERNATIVE 3A
SOIL CEMENT (1.5H:1V) ALTERNATIVE

N

0 200 400
Feet

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



PLOT DATE: 3/4/22

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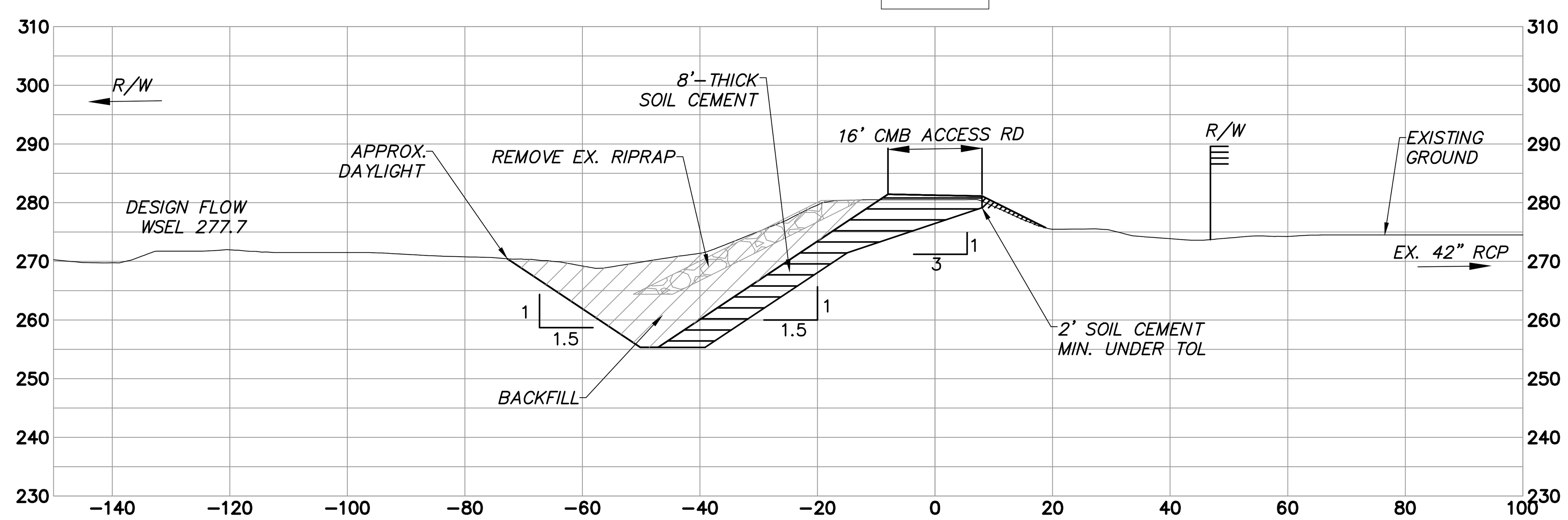
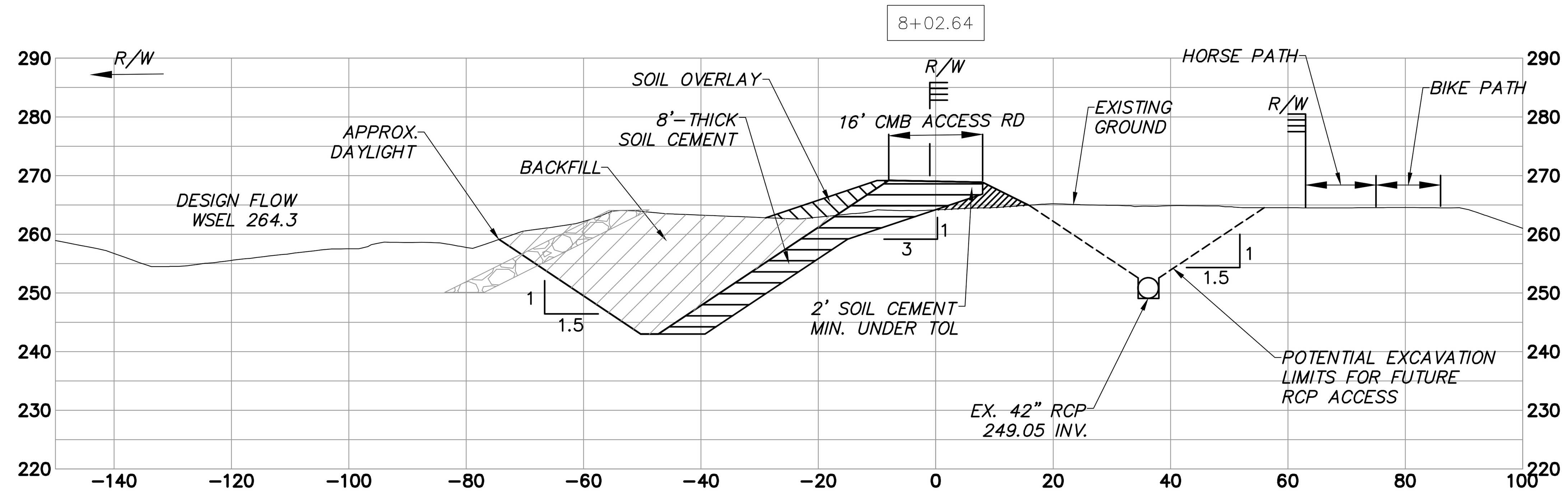
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3A
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?

24+00.00



8+02.64



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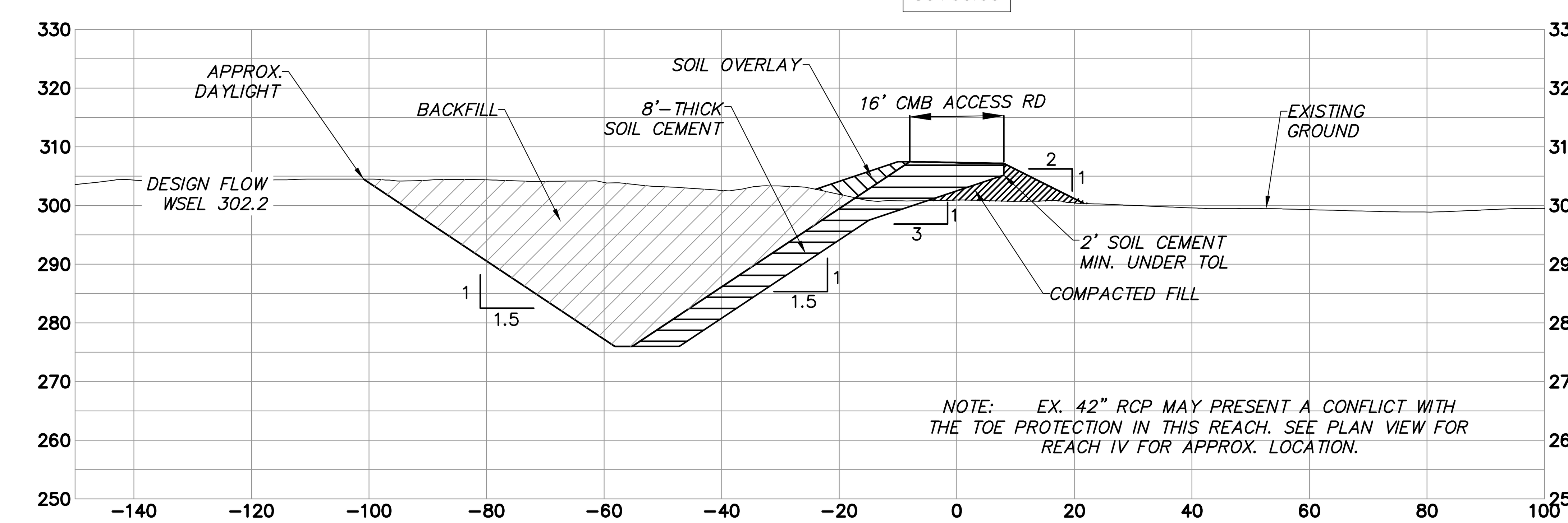

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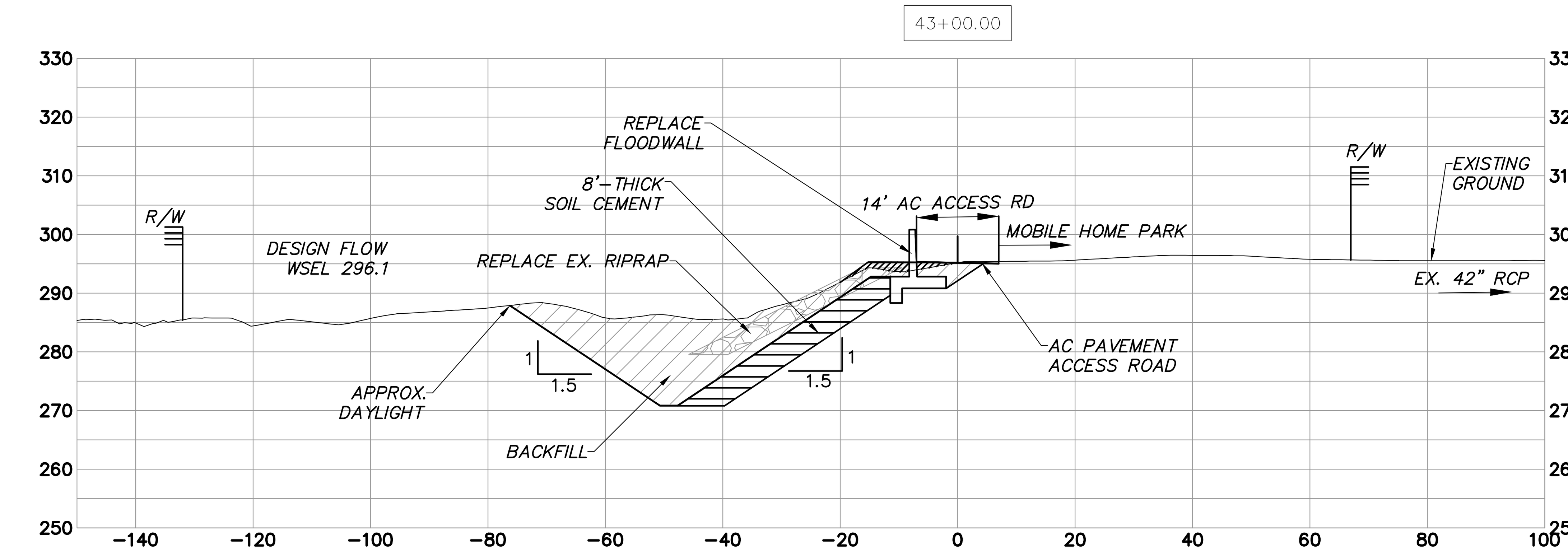

PLOT DATE: 3/4/22

SAVE DATE: 2/24/22 KIM.NGUYEN1 P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT3A PLAN XS.DWG

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3A
PLAN AND CROSS-SECTIONS
CROSS-SECTIONS

SHEET 5
OF 5
DRAWING NO. Y-?-?

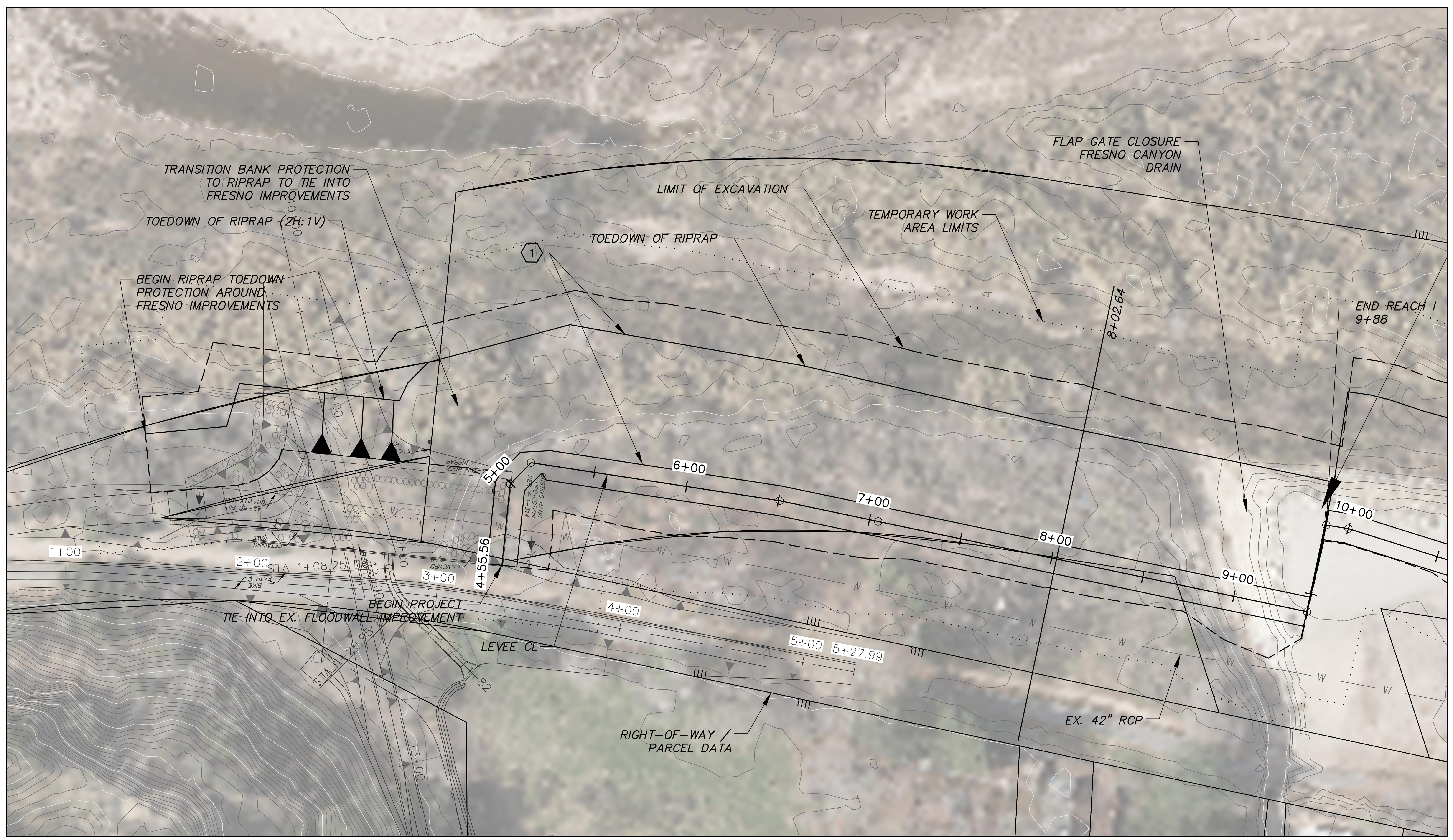
VR-2 LEVEE – REACH I
ALTERNATIVE 3B
RIPRAP (2H:1V) ALTERNATIVE

NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.

N

0 50 100
Feet



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SAVE DATE: 3/4/22 KIM.NGUYEN1 P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\01 FEASIBILITY DESIGN\PLAN SHEETS\ALT3B PLAN XS.DWG

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3B
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

SHEET 1 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH II
ALTERNATIVE 3B
RIPRAP (2H:1V) ALTERNATIVE

0 200 400
Feet

NOTES:

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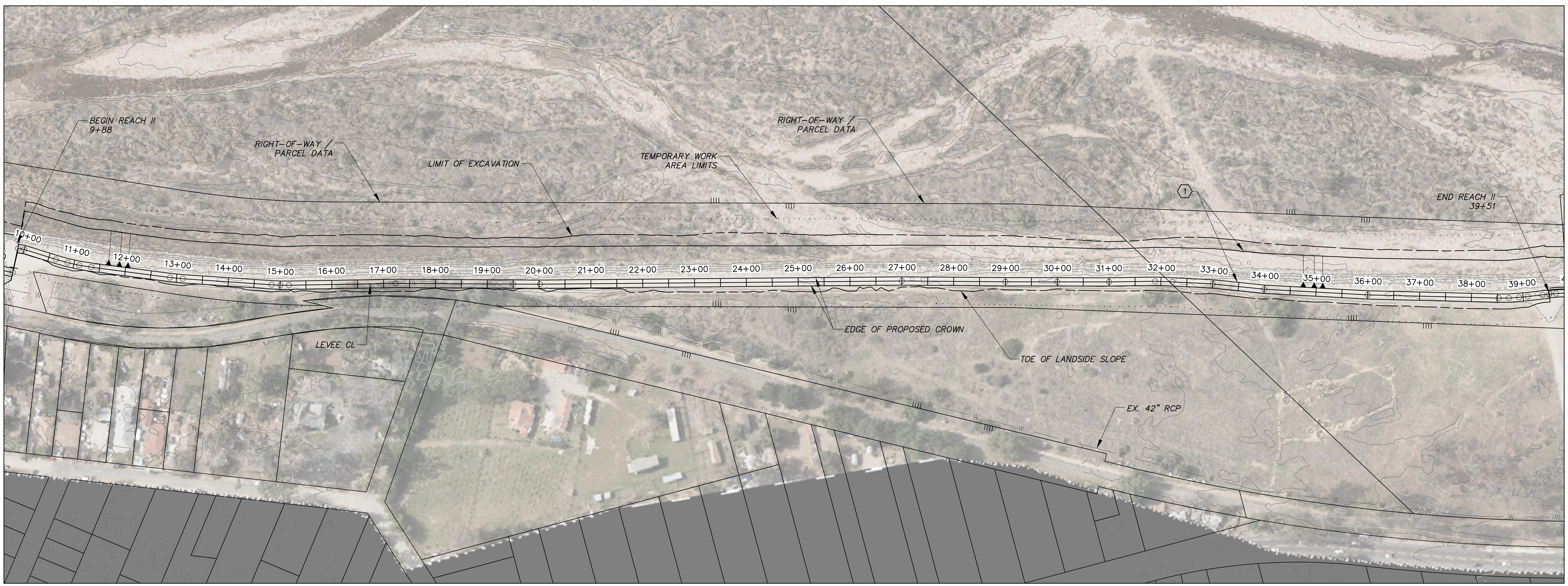

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COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
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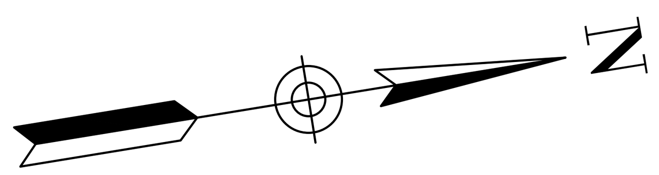
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3B
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

SHEET 2 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH III
ALTERNATIVE 3B
RIPRAP (2H:1V) ALTERNATIVE



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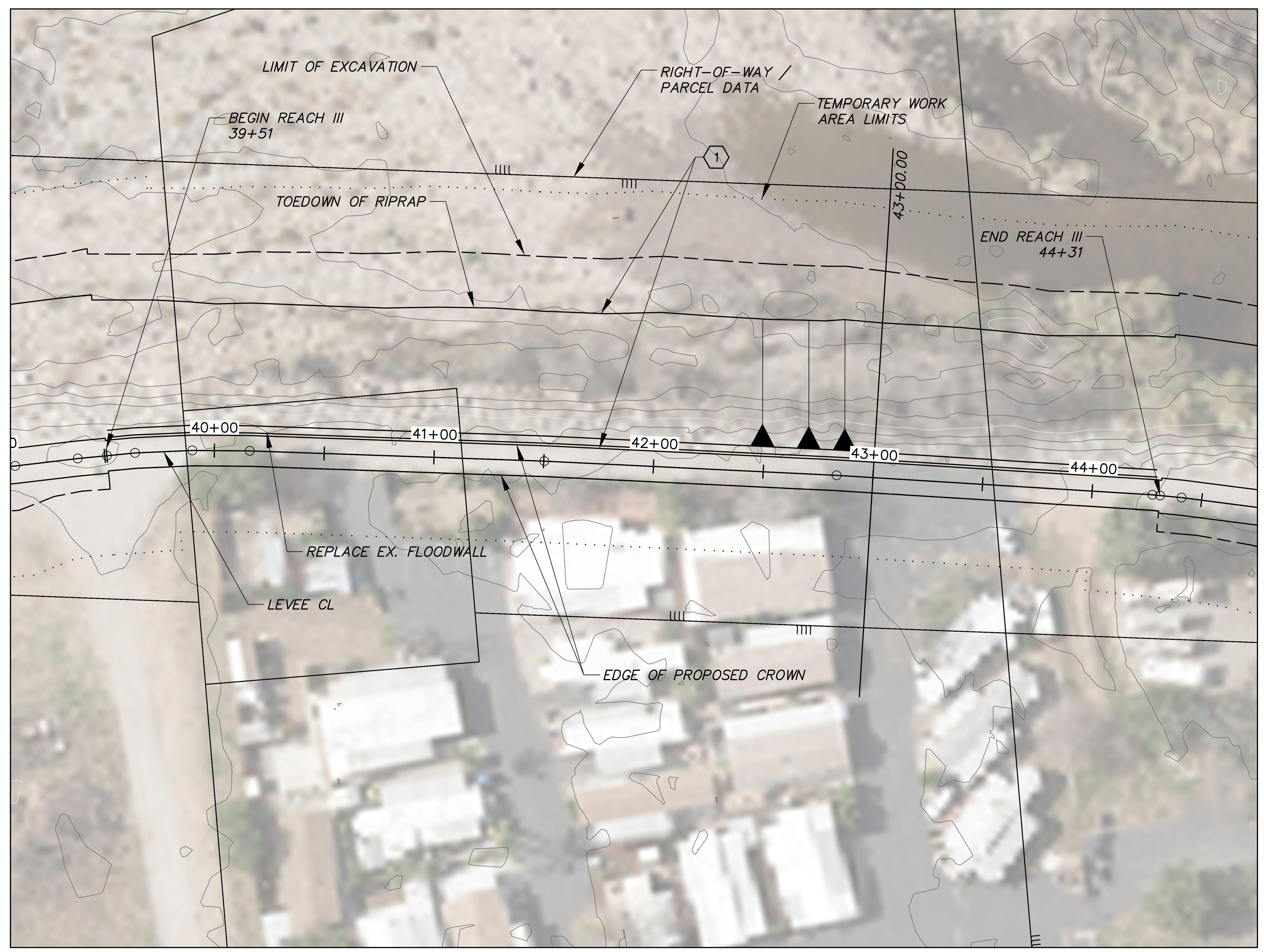

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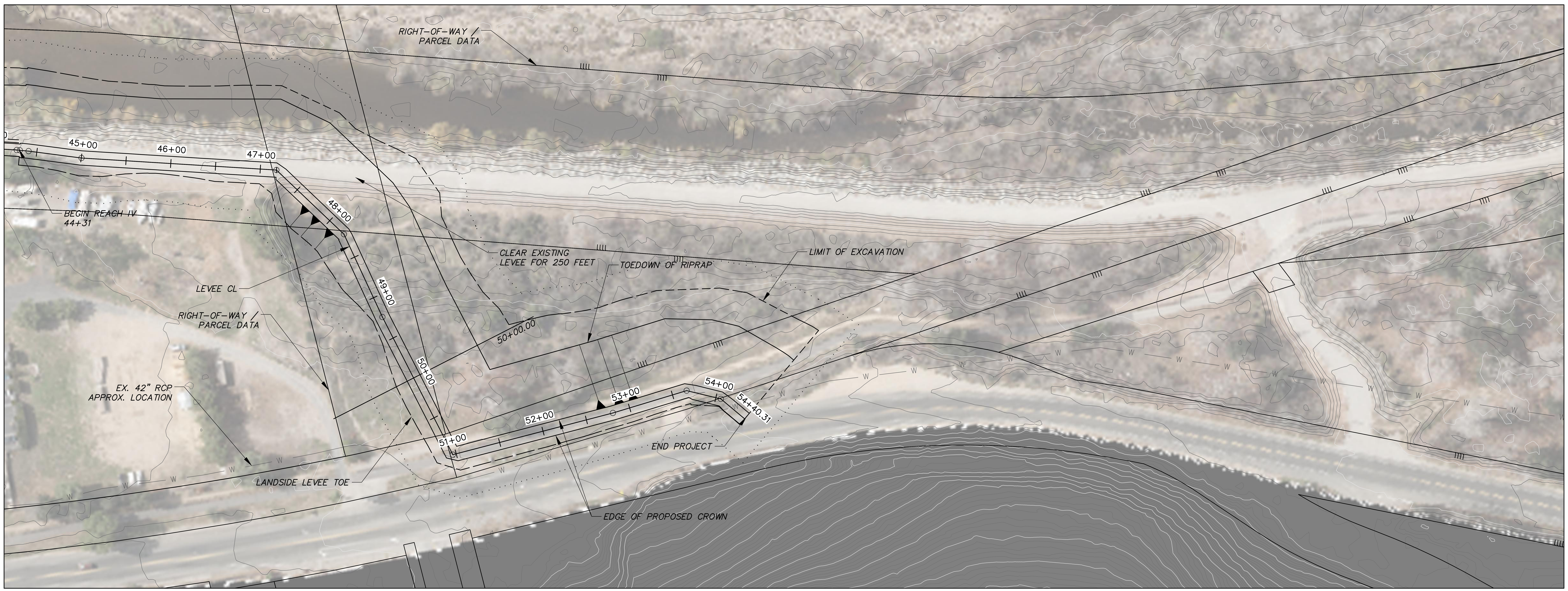
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3B
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH IV
ALTERNATIVE 3B
RIPRAP (2H:1V) ALTERNATIVE

0 200 400
Feet

NOTES:
1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3B
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?

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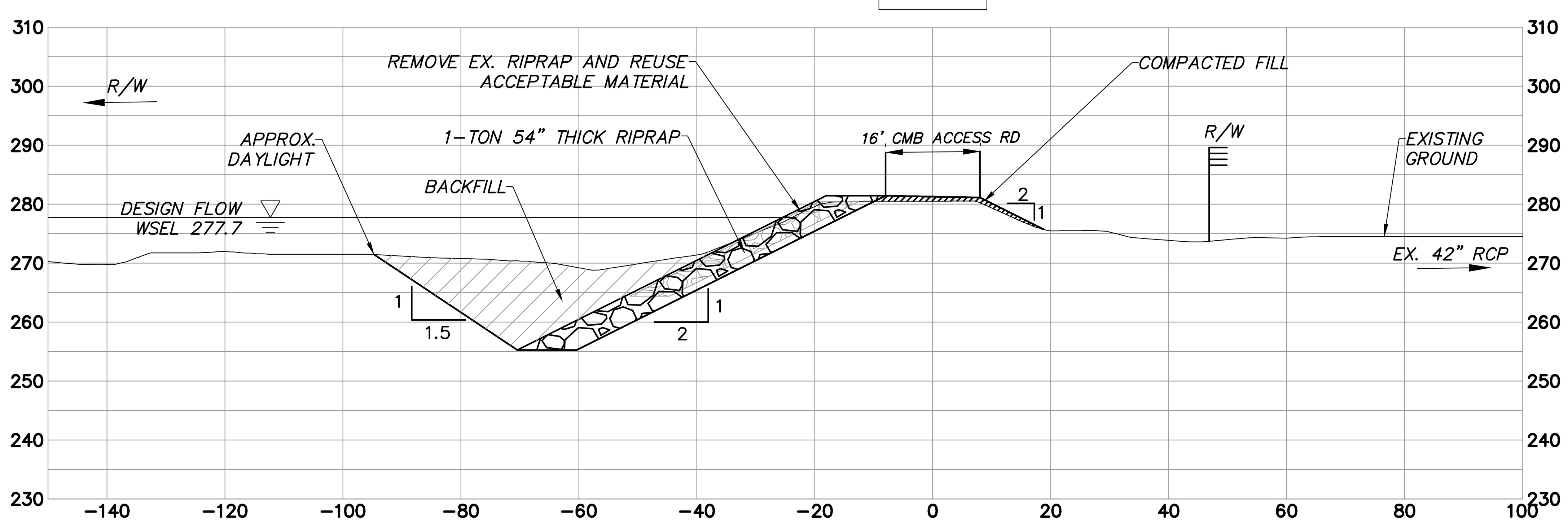

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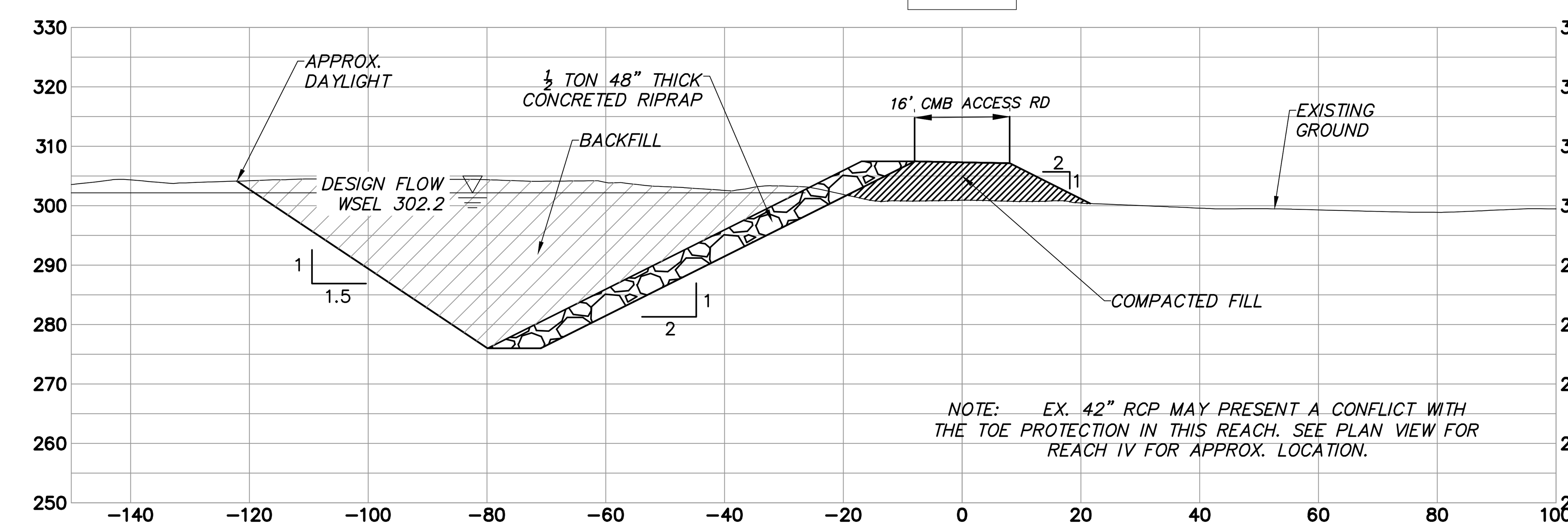

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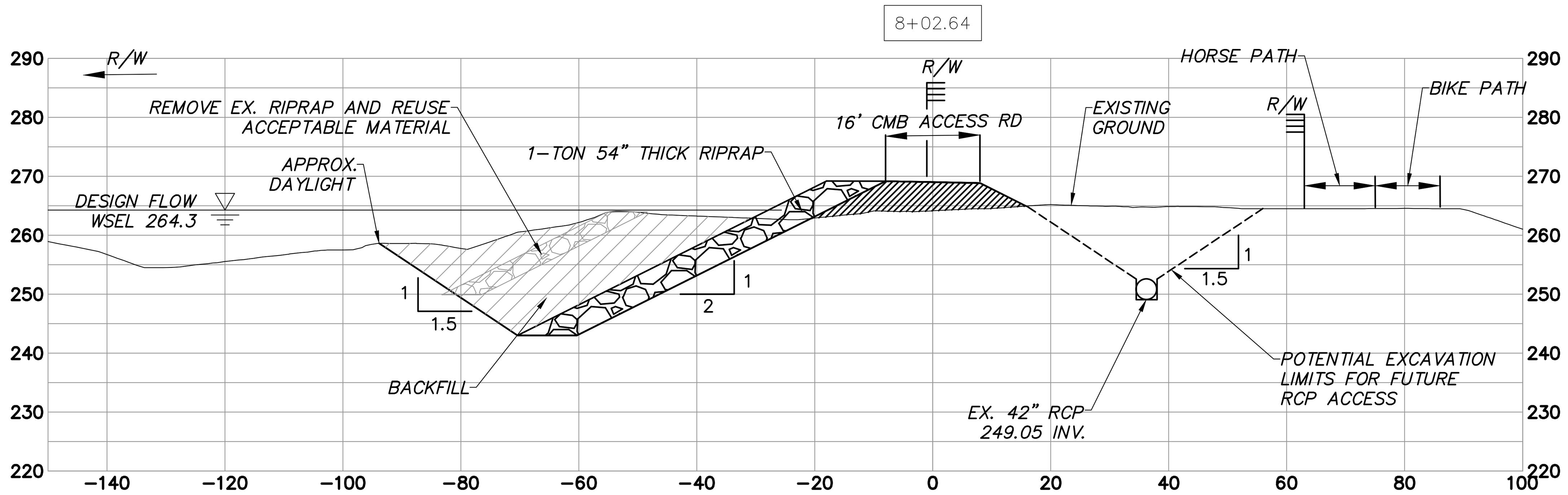

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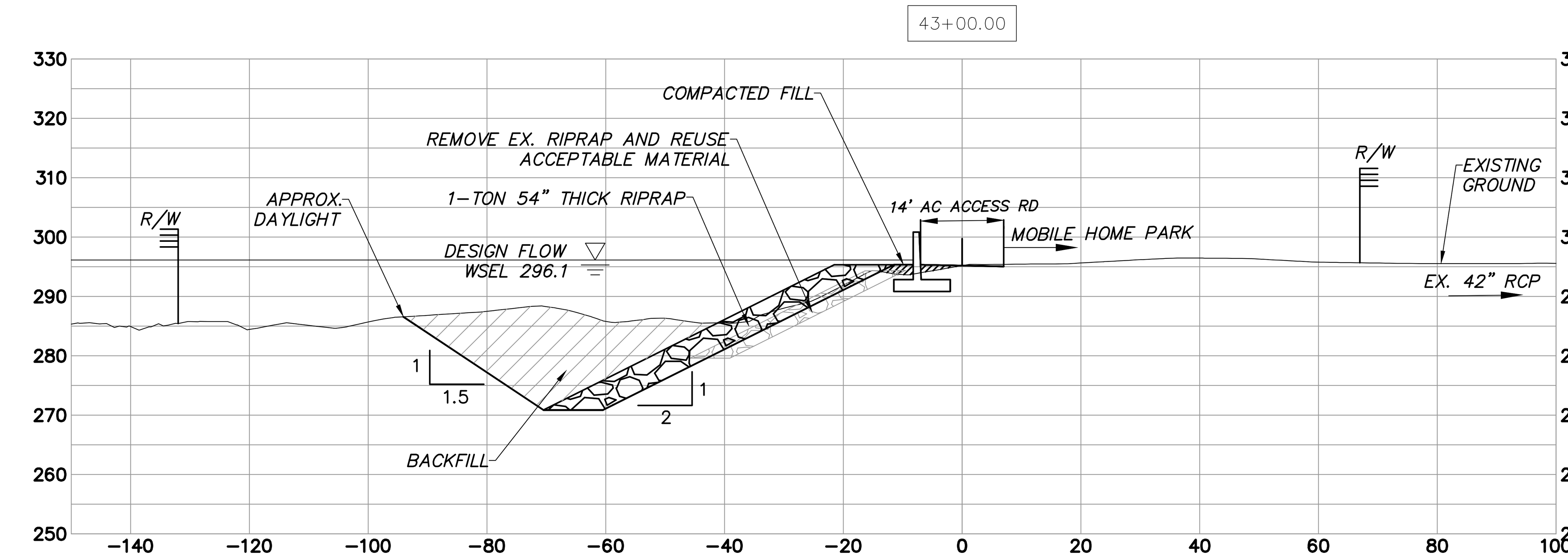

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3B
PLAN AND CROSS-SECTIONS
CROSS-SECTIONS

SHEET 5 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH I
ALTERNATIVE 3C
GROUTED STONE (2H:1V) ALTERNATIVE

NOTES:

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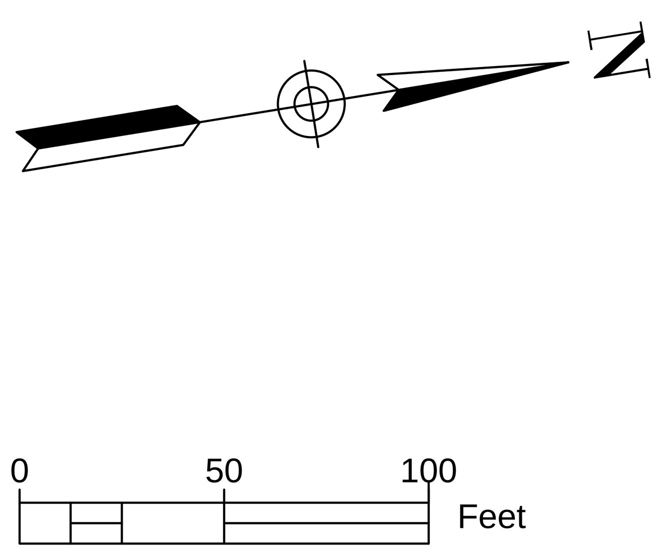

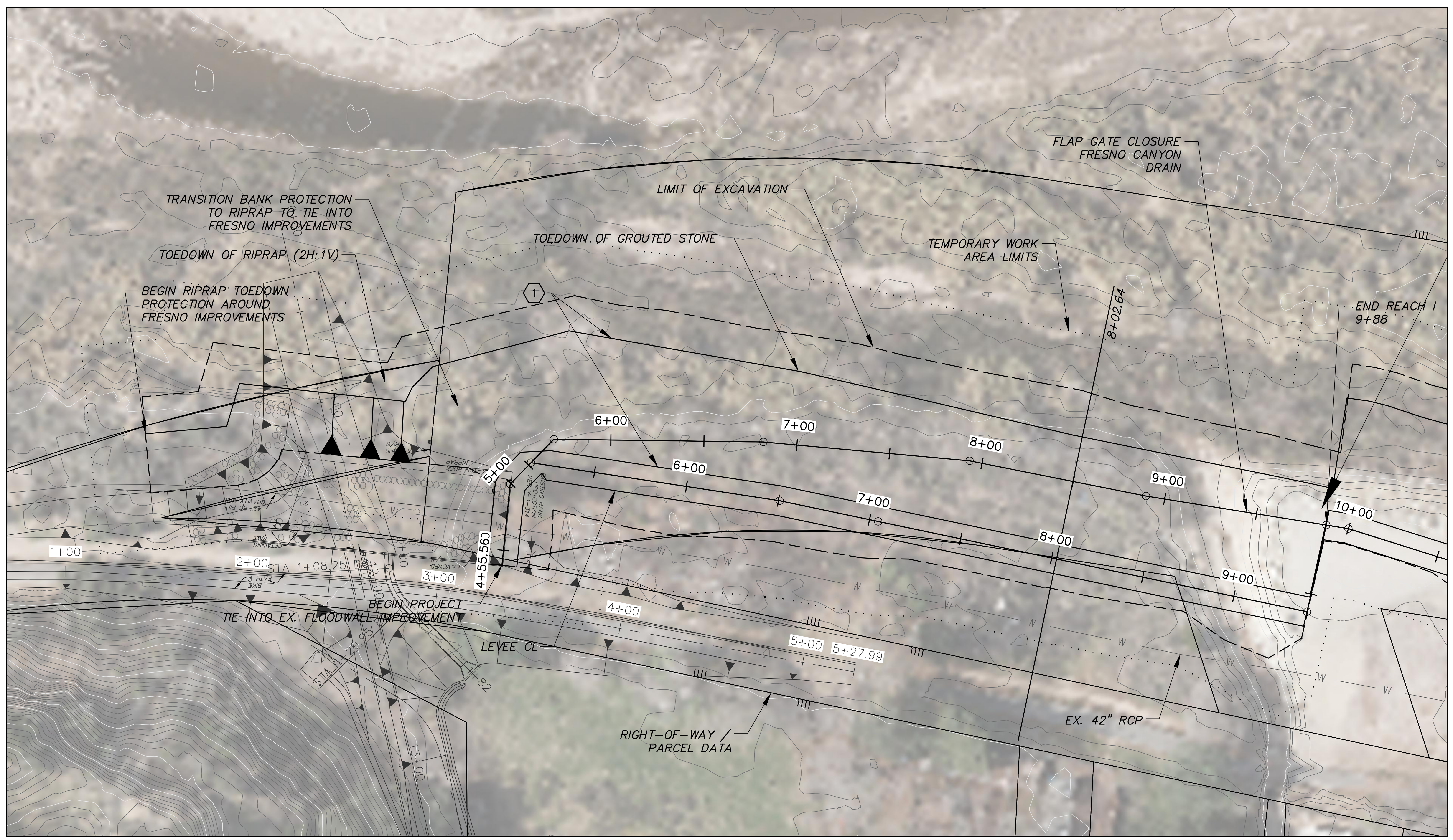

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3C

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

SHEET 1 OF 5

DRAWING NO. Y-?-?

VR-2 LEVEE – REACH II
ALTERNATIVE 3C
GROUTED STONE (2H:1V) ALTERNATIVE

0 200 400 Feet

NOTES:
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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3C
PLAN AND CROSS-SECTIONS
PLAN VIEW II

SHEET 2 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH III
ALTERNATIVE 3C
GROUTED STONE (2H:1V) ALTERNATIVE

N

0 100 200 Feet

NOTES:

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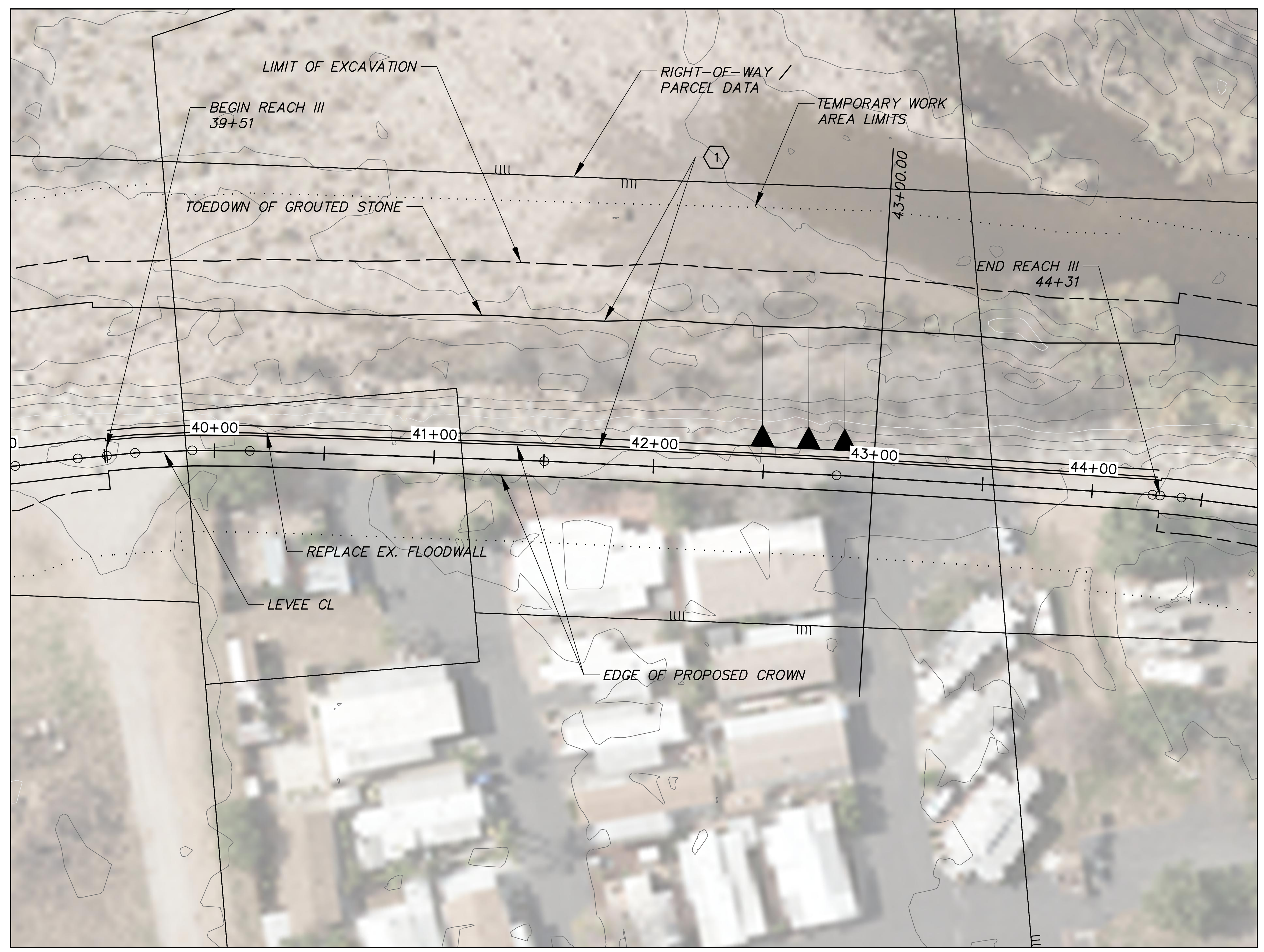

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3C

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5
DRAWING NO. Y-?-?

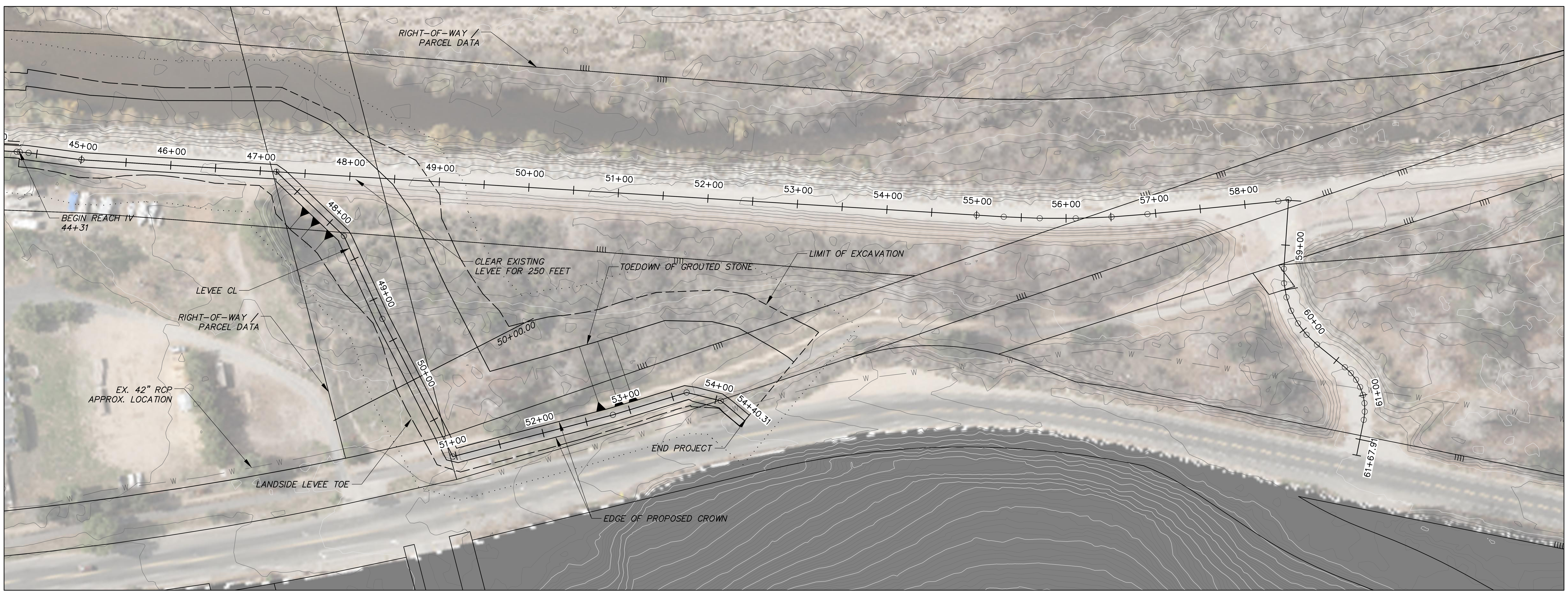
VR-2 LEVEE – REACH IV
ALTERNATIVE 3C
GROUTED STONE (2H:1V) ALTERNATIVE

N

0 200 400 Feet

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3C

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y-?-?

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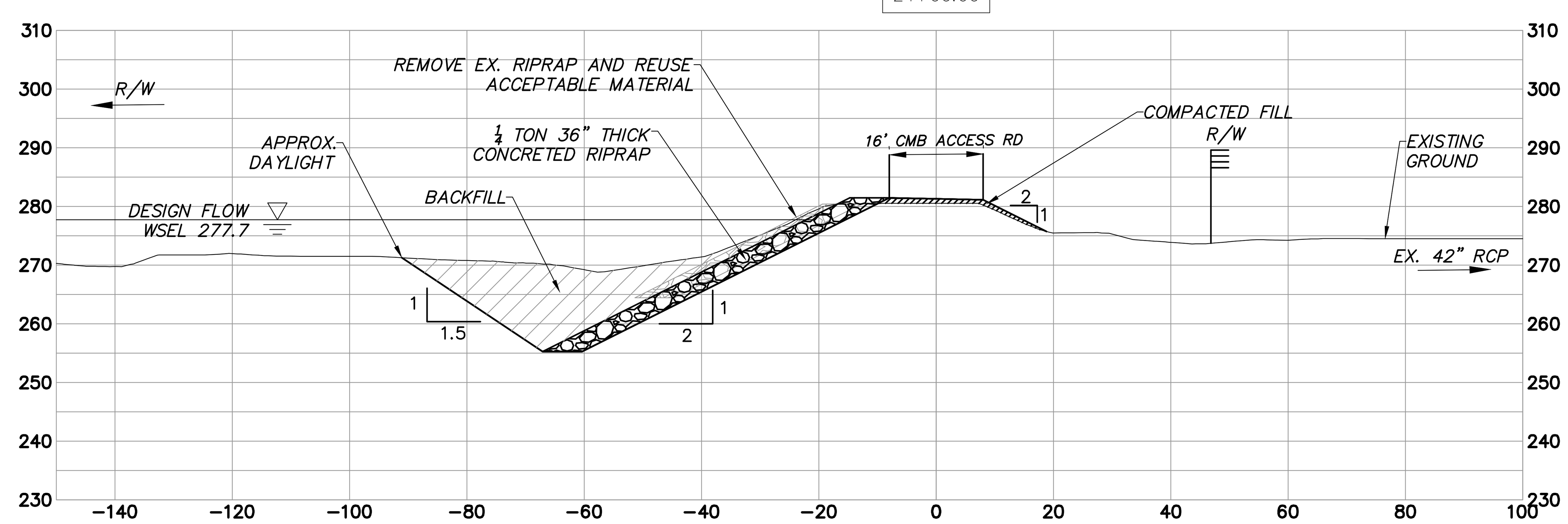

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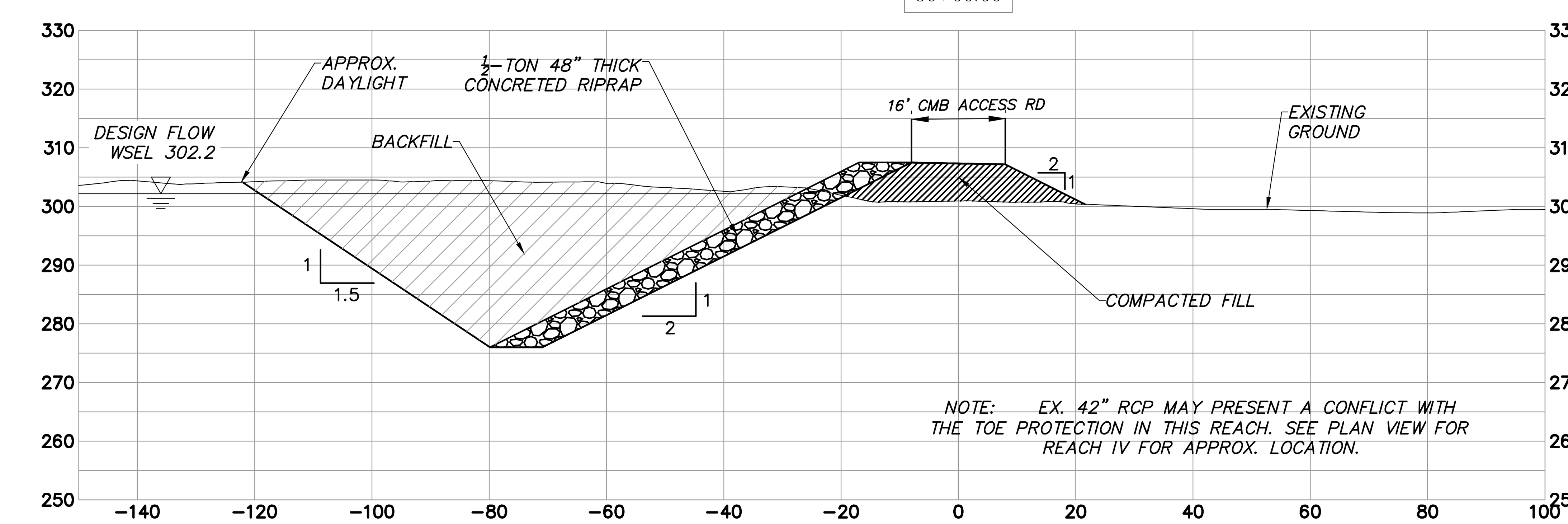

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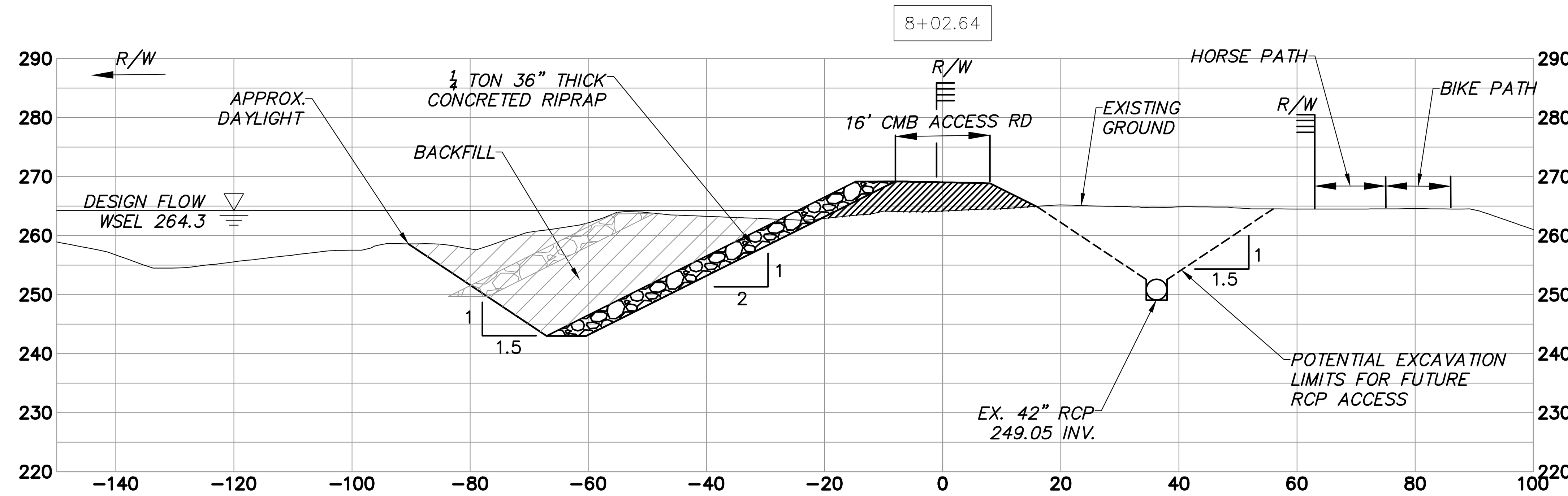

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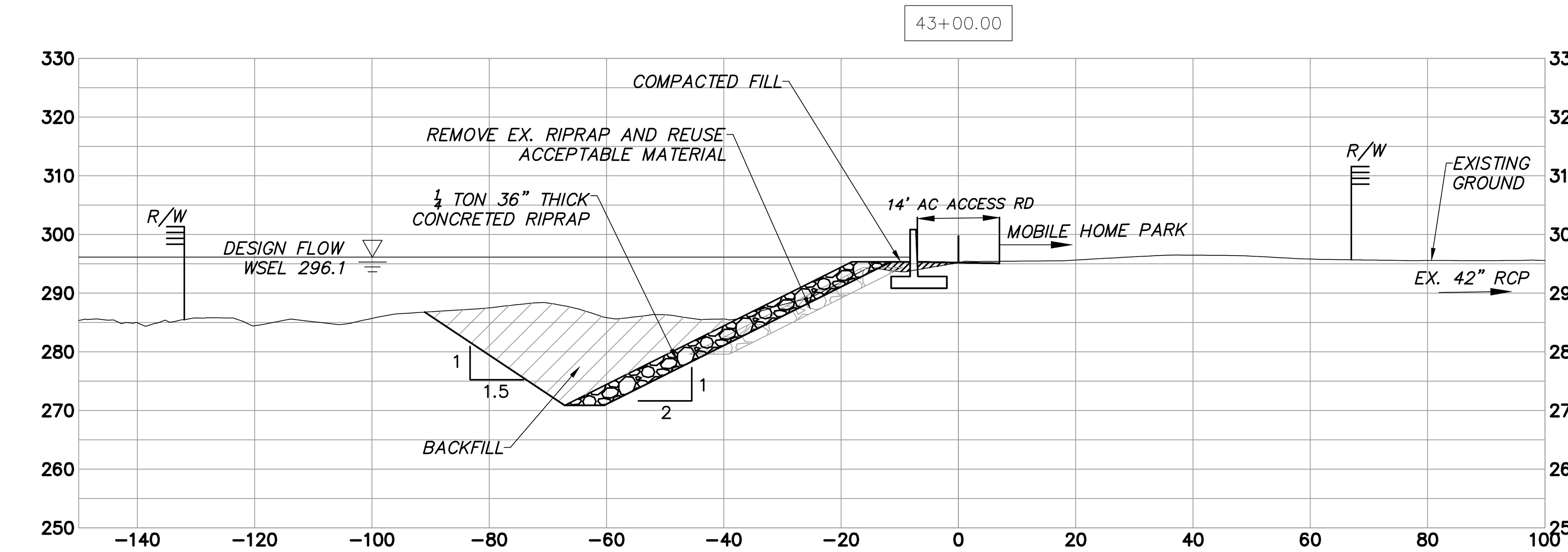

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VENTURA RIVER LEVEE 2 (VR–2) PROJECT
ALTERNATIVE 3C

PLAN AND CROSS–SECTIONS
CROSS–SECTIONS

SHEET 5 OF 5
DRAWING NO. Y–?–?

VR-2 LEVEE – REACH I
ALTERNATIVE 3D
GROUTED STONE (1.5H:1V) ALTERNATIVE

NOTES:

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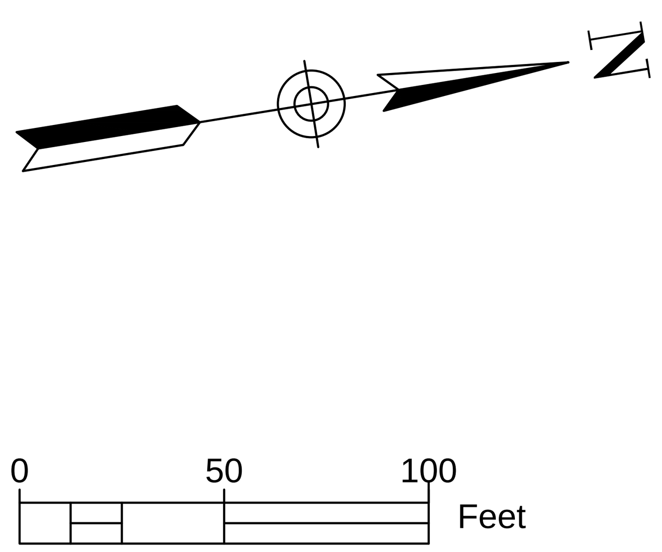

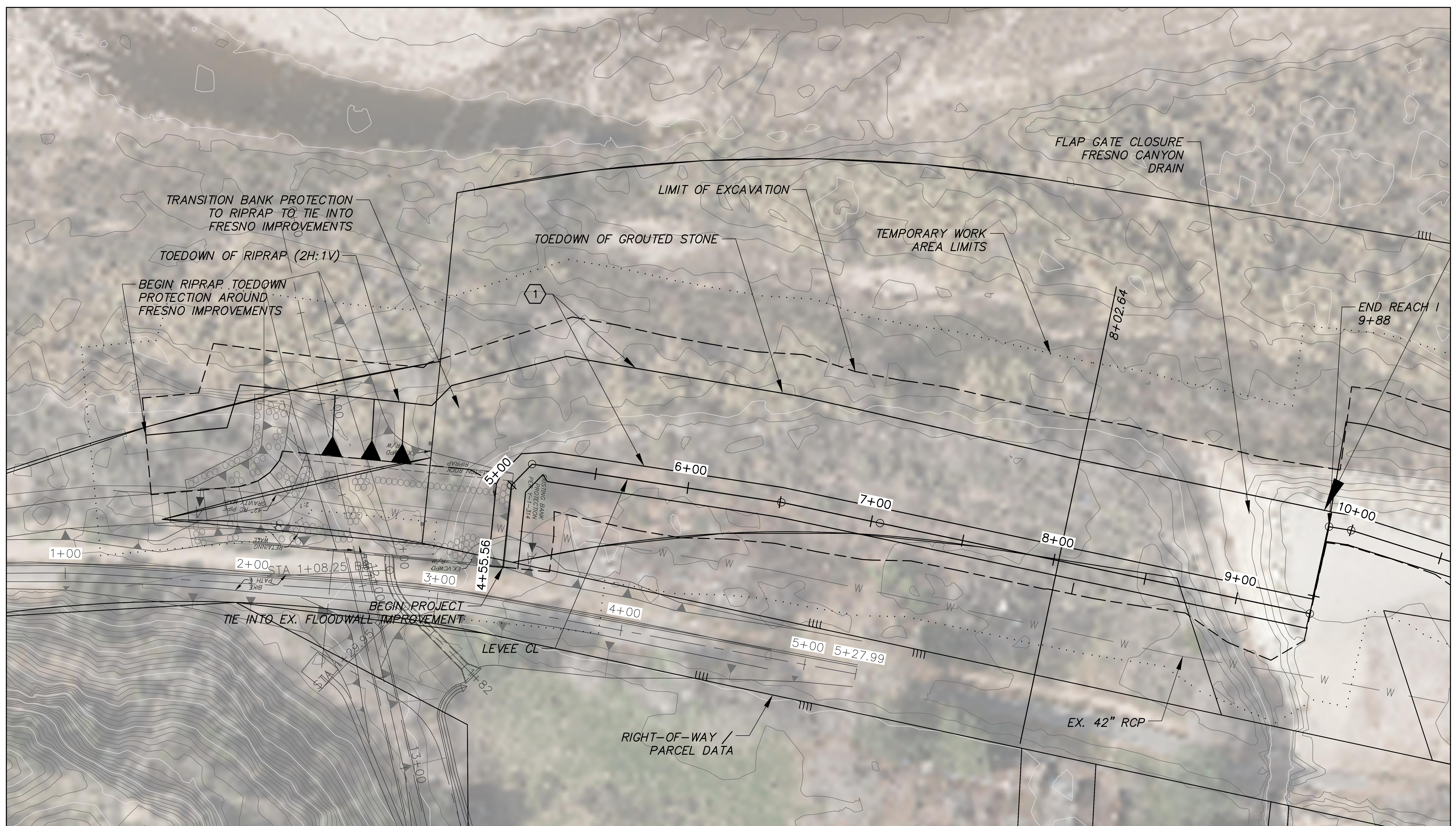

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3D
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH I

SHEET 1 OF 5
DRAWING NO. Y-?-?

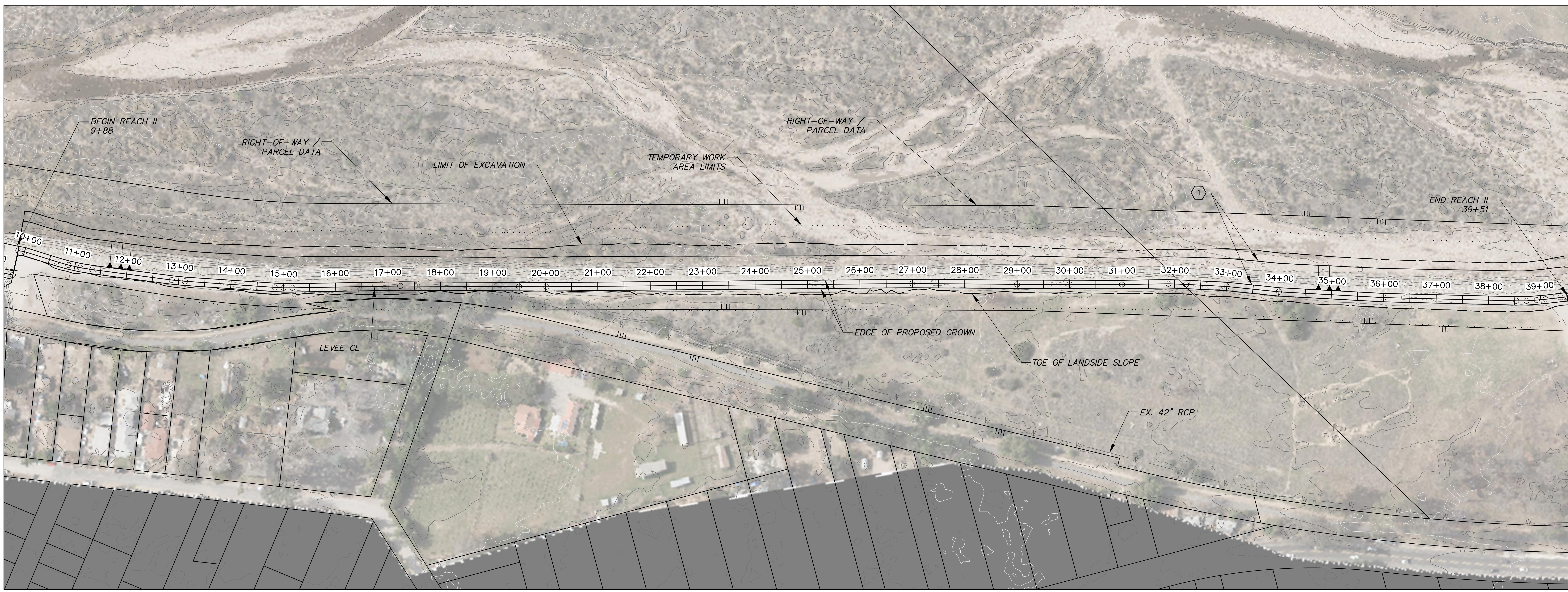
VR-2 LEVEE – REACH II
ALTERNATIVE 3D
GROUTED STONE (1.5H:1V) ALTERNATIVE

N

0 200 400 Feet

NOTES:

1 CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 5.



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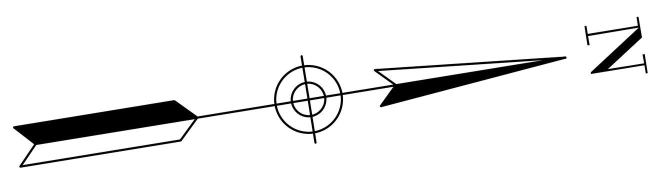
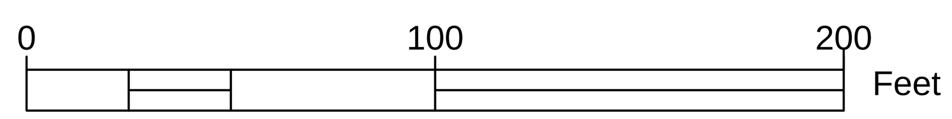
VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3D
PLAN AND CROSS-SECTIONS
PLAN VIEW REACH II

SHEET 2 OF 5
DRAWING NO. Y-?-?

VR-2 LEVEE – REACH III
ALTERNATIVE 3D
GROUTED STONE (1.5H:1V) ALTERNATIVE





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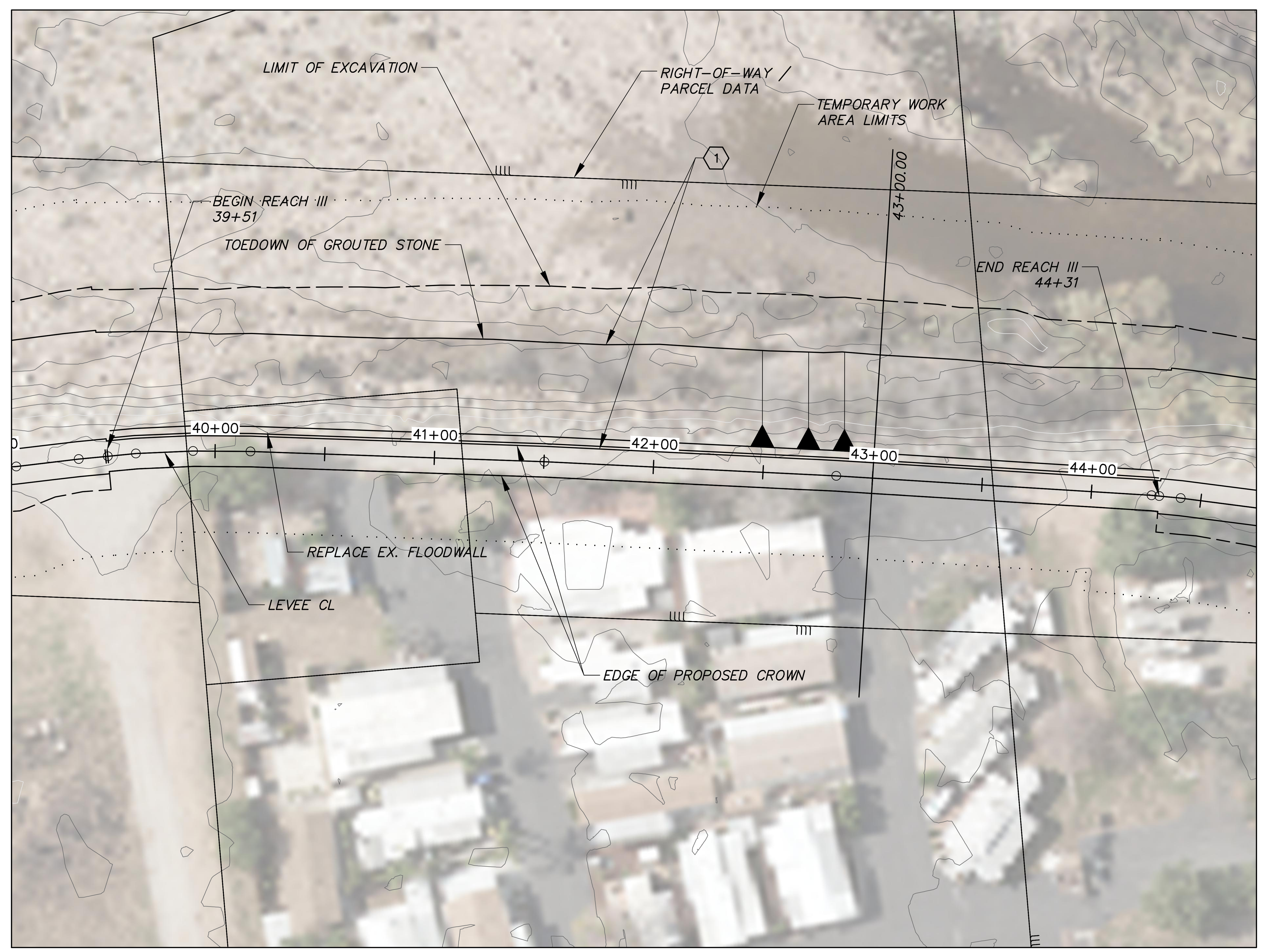

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VENTURA RIVER LEVEE 2 (VR-2) PROJECT
ALTERNATIVE 3D

PLAN AND CROSS-SECTIONS
PLAN VIEW REACH III

SHEET 3 OF 5
DRAWING NO. Y-?-?

VR–2 LEVEE – REACH IV
ALTERNATIVE 3D
GROUTED STONE (1.5H:1V) ALTERNATIVE

N

0 200 400 Feet

NOTES:

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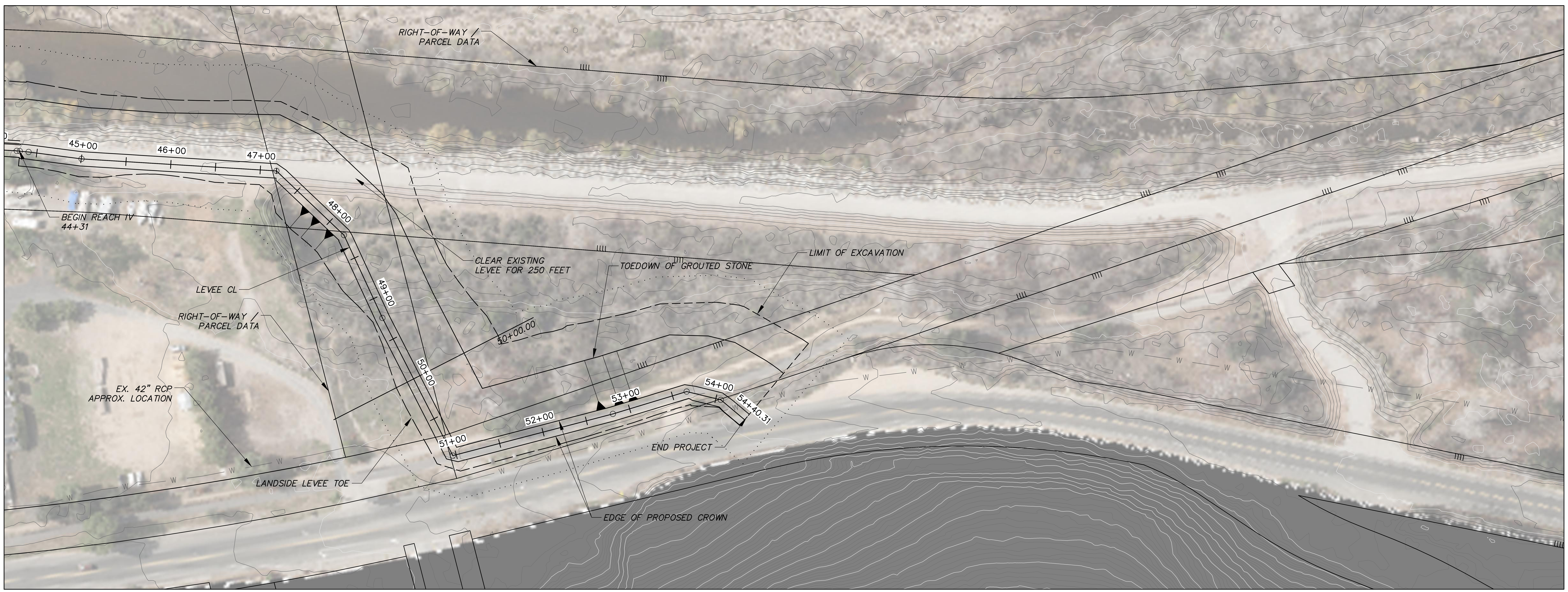

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ALTERNATIVE 3D

PLAN AND CROSS–SECTIONS
PLAN VIEW REACH IV

SHEET 4 OF 5
DRAWING NO. Y–?–?

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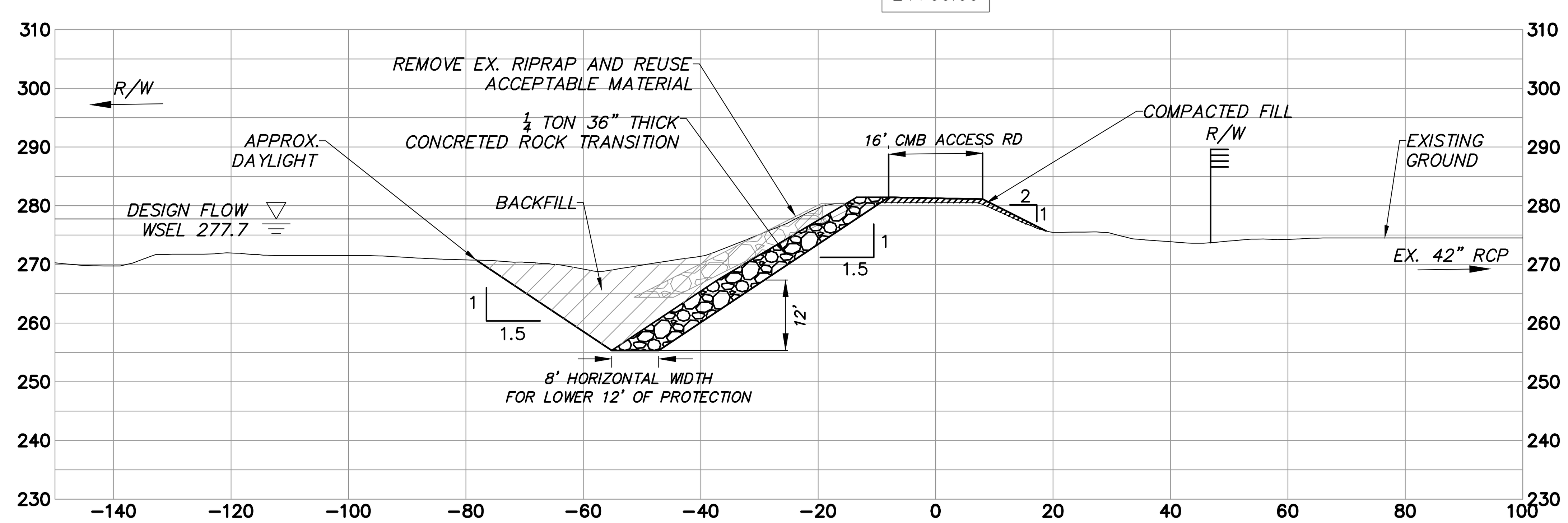

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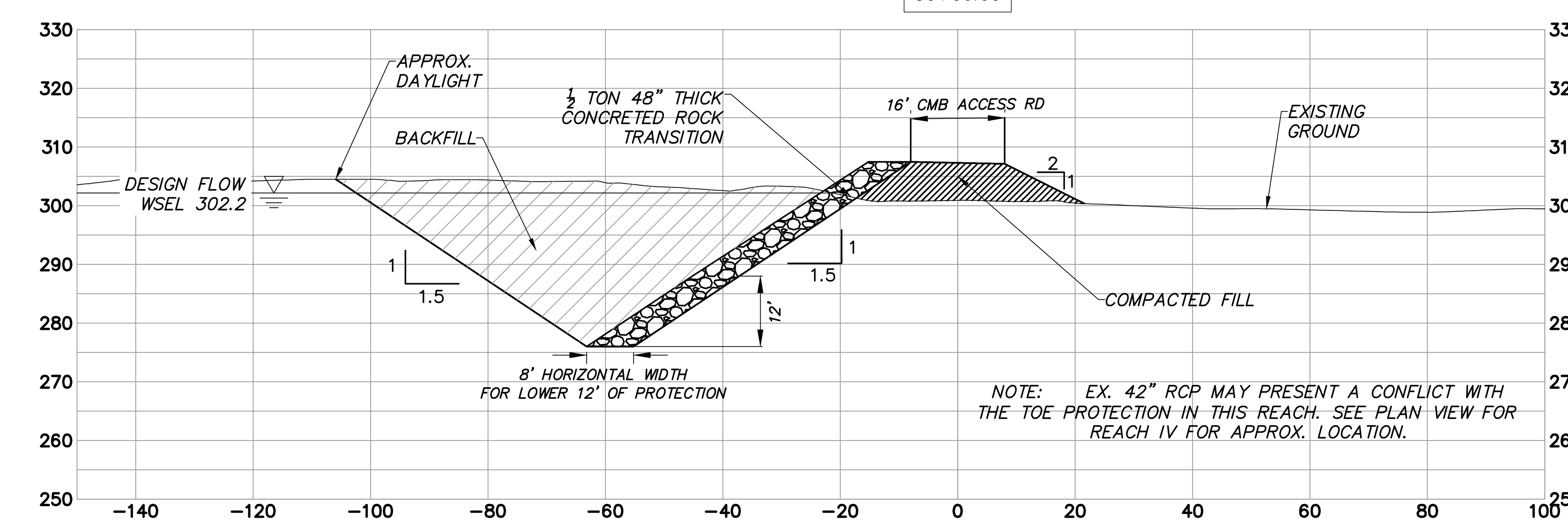

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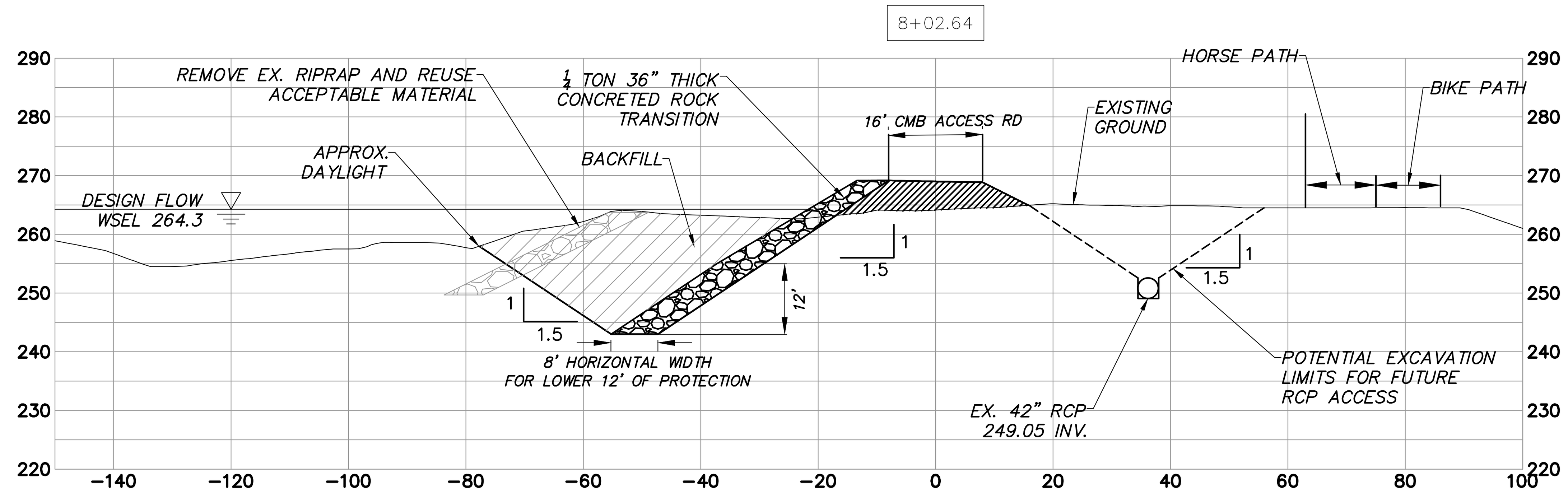

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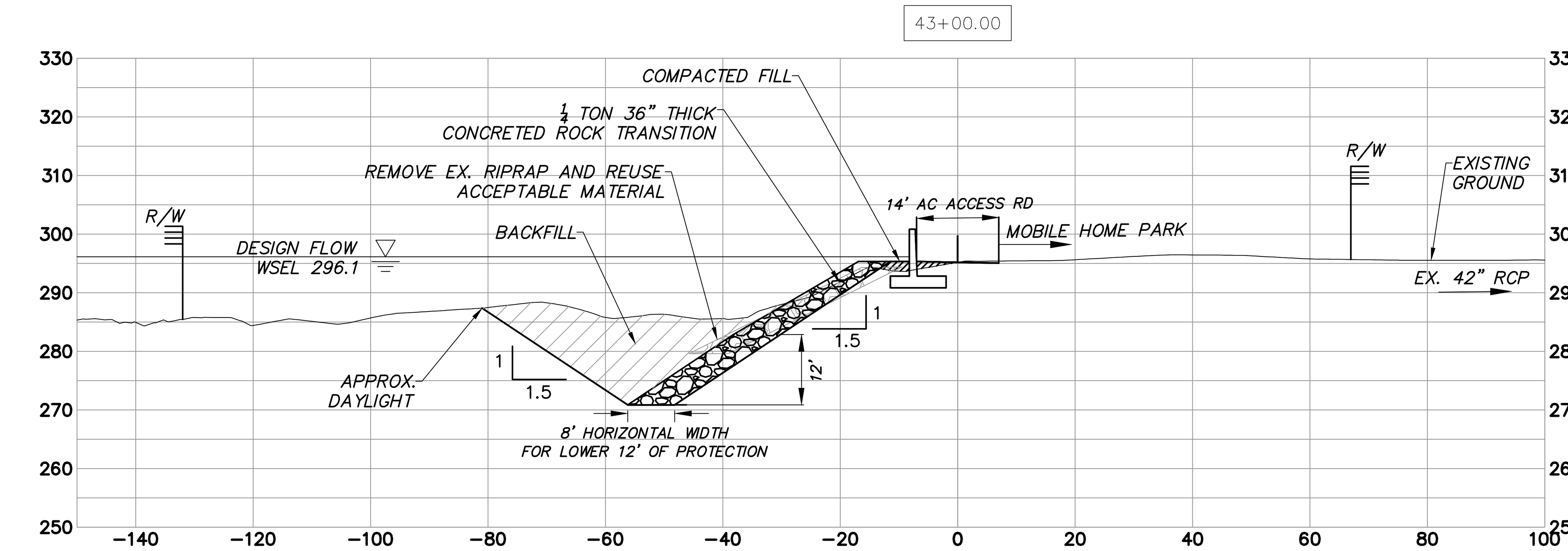

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VENTURA RIVER LEVEE 2 (VR–2) PROJECT
ALTERNATIVE 3D

PLAN AND CROSS–SECTIONS
CROSS–SECTIONS

SHEET 5 OF 5
DRAWING NO. Y–?–?

APPENDIX I-B

Alternative Cost Estimates

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VR-2 Alternatives

Alternative 1A: 1.5H:1V Soil Cement Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,717,000.00	$ 1,717,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	5,677	$ 2,496.36	$ 14,171,613
4.1	Soil Cement (11' Untrimmed)	CY	75,161	$ 110.00	$ 8,267,657
4.2	Excavation	CY	145,806	$ 8.00	$ 1,166,447
4.3	Backfill (Toedown Construction)	CY	112,715	$ 6.50	$ 732,646
4.4	Compacted Fill (Levee Prism)	CY	7,253	$ 72.50	$ 525,852
4.5	Weepholes	LF	5,677	$ 115.00	$ 652,845
4.6	Riprap Removal	CY	23,404	$ 15.00	$ 351,060
4.7	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,750.00	$ 840,000
4.8	Soil Overlay	CY	1,638	$ 45.00	$ 73,722
4.9	Riprap (for Tie-In to Fresno Improvements)	CY	1,148	$ 162.00	$ 186,000
4.10	Filter Material (for Tie-In to Fresno Improvements) [6-inch]	CY	389	$ 125.00	$ 48,611
4.11	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.12	Export Surplus Riprap Rock	CY	23,404	$ 45.00	$ 1,053,180
4.13	Landside Toe Seepage Drainage (Weephole) - Reach IV	LF	1,200	$ 80.00	$ 96,000
4.14	6" CMB Access Road - Reaches I, II, & IV	CY	1,475	$ 90.00	$ 132,795
5	Levee Clearing (to prevent ponding)	EA	1	$ 145,810.00	$ 145,810
5.1	Excavation	CY	3,500	$ 39.50	$ 138,250
5.2	Riprap Removal	CY	420	$ 18.00	$ 7,560
6	Storm Drains	EA	4	$ 142,825.00	$ 571,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 25,500.00	$ 76,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Replace 36-inch Flap Gate	EA	1	$ 8,500.00	$ 8,500
6.4	Fresno Canyon Drain 140'-Long RCC, RCB, & Outlet Structure	EA	1	$ 475,000.00	$ 475,000
				Subtotal (1)	$ 18,885,723
7				[3]Planning, Engineering, and Design:	
8				[3]Construction Management:	
				Subtotal (2):	$ 18,885,723
9				[3]Contingency (30%):	
				Total Project Cost:	**$ 18,885,723**

Notes: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 1B: 2H:1V Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,767,000.00	$ 1,767,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	5,677	$ 2,584.60	$ 14,672,794
4.1	Riprap (1-ton)	CY	31,551	$ 162.00	$ 5,111,305
4.2	Reuse Existing Riprap	CY	7,801	$ 32.50	$ 253,543
4.3	Excavation	CY	137,383	$ 8.00	$ 1,099,061
4.4	Backfill (Toedown Construction)	CY	90,127	$ 6.50	$ 585,826
4.5	Compacted Fill (Levee Prism)	CY	11,627	$ 72.50	$ 842,981
4.6	Filter Material (18-inch for RR; 6-inch for CRR)	CY	15,478	$ 125.00	$ 1,934,717
4.7	Riprap Removal	CY	23,404	$ 15.00	$ 351,060
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,580.00	$ 758,400
4.9	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.10	Concreted Rock Riprap (1/2-ton) - Reach IV	CY	5,362	$ 265.00	$ 1,420,996
4.11	Concreted Rock Riprap (1/2-ton) Reusing Existing Riprap (Process, Place, Grout) - Reach IV	CY	13,340	$ 148.00	$ 1,974,361
4.12	Weepholes - Reach IV	LF	1,737	$ 115.00	$ 199,745
4.13	Landside Toe Seepage Drainage (Weephole) - Reach IV	LF	1,200	$ 80.00	$ 96,000
4.14	6" CMB Access Road - Reaches I, II, & IV	CY	1,475	$ 90.00	$ 132,795
5	Levee Clearing (to prevent ponding)	EA	1	$ 145,810.00	$ 145,810
5.1	Excavation	CY	3,500	$ 39.50	$ 138,250
5.2	Riprap Removal	CY	420	$ 18.00	$ 7,560
6	Storm Drains	EA	4	$ 142,825.00	$ 571,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storn	EA	3	$ 25,500.00	$ 76,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Replace 36-inch Flap Gate	EA	1	$ 8,500.00	$ 8,500
6.4	Fresno Canyon Drain 140'-Long RCC, RCB, & Outlet Structure	EA	1	$ 475,000.00	$ 475,000
	Subtotal (1)				$ 19,436,904
7	[3]Planning, Engineering, and Design:				
8	[3]Construction Management:				
	Subtotal (2):				$ 19,436,904
9	[3]Contingency (30%):				
	Total Project Cost:				**$ 19,436,904**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 1C: 2H:1V Concreted Rock Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,708,000.00	$ 1,708,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	5,677	$ 2,481.54	$ 14,087,730
4.1	Concreted Rock Riprap (1/4-ton)	CY	4,406	$ 245.00	$ 1,079,480
4.2	Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, Place, Grout)	CY	21,064	$ 127.00	$ 2,675,076
4.3	Concreted Rock Riprap (1/2-ton) - Reach IV	CY	18,703	$ 265.00	$ 4,956,168
4.4	Excavation	CY	122,047	$ 8.00	$ 976,375
4.5	Backfill (Toedown Construction)	CY	92,484	$ 6.50	$ 601,143
4.6	Compacted Fill (Levee Prism)	CY	11,627	$ 72.50	$ 842,981
4.7	Weepholes	LF	5,677	$ 115.00	$ 652,845
4.8	Riprap Removal	CY	23,404	$ 15.00	$ 351,060
4.9	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,580.00	$ 758,400
4.10	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.11	Riprap (for Tie-In to Fresno Improvements)	CY	1,148	$ 162.00	$ 186,000
4.12	Filter Material (18-inch for RR; 6-inch for CRR)	CY	6,939	$ 125.00	$ 867,402
4.13	Landside Toe Seepage Drainage (Weephole) - Reach IV	LF	1,200	$ 80.00	$ 96,000
4.14	6" CMB Access Road - Reaches I, II, & IV	CY	1,475	$ 90.00	$ 132,795
5	Levee Clearing (to prevent ponding)	EA	1	$ 145,810.00	$ 145,810
5.1	Excavation	CY	3,500	$ 39.50	$ 138,250
5.2	Riprap Removal	CY	420	$ 18.00	$ 7,560
6	Storm Drains	EA	4	$ 142,825.00	$ 571,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm D	EA	3	$ 25,500.00	$ 76,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Replace 36-inch Flap Gate	EA	1	$ 8,500.00	$ 8,500
6.4	Fresno Canyon Drain 140'-Long RCC, RCB, & Outlet Structure	EA	1	$ 475,000.00	$ 475,000
				Subtotal (1)	$ 18,792,840
7				[3]Planning, Engineering, and Design:	
8				[3]Construction Management:	
				Subtotal (2):	$ 18,792,840
9				[3]Contingency (30%):	
				Total Project Cost:	**$ 18,792,840**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 1D: 1.5H:1V Concreted Rock Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,791,000.00	$ 1,791,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	5,677	$ 2,627.01	$ 14,913,543
4.1	Concreted Rock Riprap (1/4-ton) [8-foot horizontal base width]	CY	6,631	$ 270.00	$ 1,790,401
4.2	Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, Place, Grout)	CY	21,064	$ 150.00	$ 3,159,539
4.3	Concreted Rock Riprap (1/2-ton) - Reach IV	CY	16,175	$ 300.00	$ 4,852,599
4.4	Excavation	CY	114,347	$ 8.00	$ 914,774
4.5	Backfill (Toedown Construction)	CY	87,532	$ 6.50	$ 568,957
4.6	Compacted Fill (Levee Prism)	CY	11,280	$ 72.50	$ 817,821
4.7	Weepholes	LF	5,677	$ 115.00	$ 652,845
4.8	Riprap Removal	CY	23,404	$ 15.00	$ 351,060
4.9	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,580.00	$ 758,400
4.10	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.11	Riprap (for Tie-In to Fresno Improvements)	CY	1,148	$ 162.00	$ 186,000
4.12	Filter Material (18-inch for RR; 6-inch for CRR)	CY	5,763	$ 125.00	$ 720,349
4.13	Landside Toe Seepage Drainage (Weephole) - Reach IV	LF	1,200	$ 80.00	$ 96,000
4.14	6" CMB Access Road - Reaches I, II, & IV	CY	1,475	$ 90.00	$ 132,795
5	Levee Clearing (to prevent ponding)	EA	1	$ 145,810.00	$ 145,810
5.1	Excavation	CY	3,500	$ 39.50	$ 138,250
5.2	Riprap Removal	CY	420	$ 18.00	$ 7,560
6	Storm Drains	EA	4	$ 142,825.00	$ 571,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 25,500.00	$ 76,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Replace 36-inch Flap Gate	EA	1	$ 8,500.00	$ 8,500
6.4	Fresno Canyon Drain 140'-Long RCC, RCB, & Outlet Structure	EA	1	$ 475,000.00	$ 475,000
				Subtotal (1)	$ 19,701,653
7				[3]Planning, Engineering, and Design:	
8				[3]Construction Management:	
				Subtotal (2):	$ 19,701,653
9				[3]Contingency (30%):	
				Total Project Cost:	**$ 19,701,653**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 2A: 1.5H:1V Soil Cement Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,540,000.00	$ 1,540,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	4,949	$ 2,484.29	$ 12,295,511
4.1	Soil Cement (11' Untrimmed)	CY	64,668	$ 110.00	$ 7,113,510
4.2	Excavation	CY	148,596	$ 8.00	$ 1,188,766
4.3	Backfill (Toedown Construction)	CY	118,566	$ 6.50	$ 770,677
4.4	Compacted Fill (Levee Prism)	CY	4,865	$ 72.50	$ 352,718
4.5	Weepholes	LF	4,949	$ 115.00	$ 569,171
4.6	Riprap Removal	CY	15,361	$ 15.00	$ 230,411
4.7	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,750.00	$ 840,000
4.8	Soil Overlay	CY	2,872	$ 45.00	$ 129,234
4.9	Riprap (for Tie-In to Fresno Improvements)	CY	1,148	$ 162.00	$ 186,000
4.10	Filter Material (for Tie-In to Fresno Improvements) [6-inch]	CY	389	$ 125.00	$ 48,611
4.11	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.12	Export Surplus Riprap Rock	CY	15,361	$ 45.00	$ 691,232
4.13	6" CMB Access Road - Reaches I, II, & IV	CY	1,449	$ 90.00	$ 130,382
5	Levee Clearing (to prevent ponding)	EA	2	$ 145,810.00	$ 291,620
5.1	Excavation	CY	7,000	$ 39.50	$ 276,500
5.2	Riprap Removal	CY	840	$ 18.00	$ 15,120
6	Storm Drains	EA	3	$ 179,100.00	$ 537,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	2	$ 25,500.00	$ 51,000
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Fresno Canyon Drain 140'-Long RCC, RCB, & Outlet Structure	EA	1	$ 475,000.00	$ 475,000
7	Relocation	EA	1	$ 250,000.00	$ 250,000
	Waterline Relocation	EA	1	$ 250,000.00	$ 250,000
				Subtotal (1)	$ 17,194,431
8				[3]Planning, Engineering, and Design:	
9				[3]Construction Management:	
				Subtotal (2):	$ 17,194,431
10				[3]Contingency (30%):	
				Total Project Cost:	**$ 17,194,431**

Notes: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.
2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.
3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 2B: 2H:1V Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,622,000.00	$ 1,622,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	4,949	$ 2,649.10	$ 13,111,203
4.1	Riprap (1-ton)	CY	34,232	$ 162.00	$ 5,545,642
4.2	Reuse Existing Riprap	CY	5,120	$ 32.50	$ 166,408
4.3	Excavation	CY	158,595	$ 8.00	$ 1,268,762
4.4	Backfill (Toedown Construction)	CY	111,483	$ 6.50	$ 724,638
4.5	Compacted Fill (Levee Prism)	CY	12,473	$ 72.50	$ 904,263
4.6	Filter Material (18-inch for RR; 6-inch for CRR)	CY	14,524	$ 125.00	$ 1,815,465
4.7	Riprap Removal	CY	15,361	$ 15.00	$ 230,411
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,580.00	$ 758,400
4.9	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.10	Concreted Rock Riprap (1/2-ton) - Reach IV	CY	908	$ 265.00	$ 240,516
4.11	Concreted Rock Riprap (1/2-ton) Reusing Existing Riprap (Process, Place, Grout) - Reach IV	CY	8,756	$ 148.00	$ 1,295,829
4.12	Weepholes - Reach IV	LF	1,009	$ 115.00	$ 116,071
4.13	6" CMB Access Road - Reaches I, II, & IV	CY	1,449	$ 90.00	$ 130,382
5	Levee Clearing (to prevent ponding)	EA	2	$ 145,810.00	$ 291,620
5.1	Excavation	CY	7,000	$ 39.50	$ 276,500
5.2	Riprap Removal	CY	840	$ 18.00	$ 15,120
6	Storm Drains	EA	3	$ 179,100.00	$ 537,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm	EA	2	$ 25,500.00	$ 51,000
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Fresno Canyon Drain 140'-Long RCC, RCB, & Outlet Structure	EA	1	$ 475,000.00	$ 475,000
7	Relocation	EA	1	$ 250,000.00	$ 250,000
	Waterline Relocation	EA	1	$ 250,000.00	$ 250,000
				Subtotal (1)	$ 18,092,123
8				[3]Planning, Engineering, and Design:	
9				[3]Construction Management:	
				Subtotal (2):	$ 18,092,123
10				[3]Contingency (30%):	
				Total Project Cost:	**$ 18,092,123**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 2C: 2H:1V Concreted Rock Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,560,000.00	$ 1,560,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	4,949	$ 2,524.35	$ 12,493,777
4.1	Concreted Rock Riprap (1/4-ton)	CY	11,645	$ 245.00	$ 2,853,024
4.2	Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, Place, Grout)	CY	13,825	$ 127.00	$ 1,755,728
4.3	Concreted Rock Riprap (1/2-ton) - Reach IV	CY	9,663	$ 265.00	$ 2,560,750
4.4	Excavation	CY	142,900	$ 8.00	$ 1,143,202
4.5	Backfill (Toedown Construction)	CY	113,827	$ 6.50	$ 739,878
4.6	Compacted Fill (Levee Prism)	CY	12,473	$ 72.50	$ 904,263
4.7	Weepholes	LF	4,949	$ 115.00	$ 569,171
4.8	Riprap Removal	CY	15,361	$ 15.00	$ 230,411
4.9	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,580.00	$ 758,400
4.10	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.11	Riprap (for Tie-In to Fresno Improvements)	CY	1,148	$ 162.00	$ 186,000
4.12	Filter Material (18-inch for RR; 6-inch for CRR)	CY	5,985	$ 125.00	$ 748,150
4.13	6" CMB Access Road - Reaches I, II, & IV	CY	1,475	$ 90.00	$ 132,795
5	Levee Clearing (to prevent ponding)	EA	2	$ 145,810.00	$ 291,620
5.1	Excavation	CY	7,000	$ 39.50	$ 276,500
5.2	Riprap Removal	CY	840	$ 18.00	$ 15,120
6	Storm Drains	EA	3	$ 179,100.00	$ 537,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm [	EA	2	$ 25,500.00	$ 51,000
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Fresno Canyon Drain 140'-Long RCC, RCB, & Outlet Structure	EA	1	$ 475,000.00	$ 475,000
7	Relocation	EA	1	$ 250,000.00	$ 250,000
	Waterline Relocation	EA	1	$ 250,000.00	$ 250,000
				Subtotal (1)	$ 17,412,697
8				[3]Planning, Engineering, and Design:	
9				[3]Construction Management:	
				Subtotal (2):	$ 17,412,697
10				[3]Contingency (30%):	
				Total Project Cost:	**$ 17,412,697**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 2D: 1.5H:1V Concreted Rock Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,637,000.00	$ 1,637,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	4,949	$ 2,680.20	$ 13,265,127
4.1	Concreted Rock Riprap (1/4-ton) [8-foot horizontal base width]	CY	13,870	$ 270.00	$ 3,744,919
4.2	Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, Place, Grout)	CY	13,825	$ 150.00	$ 2,073,695
4.3	Concreted Rock Riprap (1/2-ton) - Reach IV	CY	8,361	$ 300.00	$ 2,508,322
4.4	Excavation	CY	127,208	$ 8.00	$ 1,017,665
4.5	Backfill (Toedown Construction)	CY	101,076	$ 6.50	$ 656,997
4.6	Compacted Fill (Levee Prism)	CY	11,842	$ 72.50	$ 858,519
4.7	Weepholes	LF	4,949	$ 115.00	$ 569,171
4.8	Riprap Removal	CY	15,361	$ 15.00	$ 230,411
4.9	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,580.00	$ 758,400
4.10	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.11	Riprap (for Tie-In to Fresno Improvements)	CY	1,148	$ 162.00	$ 186,000
4.12	Filter Material (18-inch for RR; 6-inch for CRR)	CY	4,930	$ 125.00	$ 616,228
4.13	6" CMB Access Road - Reaches I, II, & IV	CY	1,475	$ 90.00	$ 132,795
5	Levee Clearing (to prevent ponding)	EA	2	$ 145,810.00	$ 291,620
5.1	Excavation	CY	7,000	$ 39.50	$ 276,500
5.2	Riprap Removal	CY	840	$ 18.00	$ 15,120
6	Storm Drains	EA	3	$ 179,100.00	$ 537,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	2	$ 25,500.00	$ 51,000
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Fresno Canyon Drain 140'-Long RCC, RCB, & Outlet Structure	EA	1	$ 475,000.00	$ 475,000
7	Relocation	EA	1	$ 250,000.00	$ 250,000
	Waterline Relocation	EA	1	$ 250,000.00	$ 250,000
				Subtotal (1)	$ 18,261,047
8				[3]Planning, Engineering, and Design:	
9				[3]Construction Management:	
				Subtotal (2):	$ 18,261,047
10				[3]Contingency (30%):	
				Total Project Cost:	**$ 18,261,047**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 3A: 1.5H:1V Soil Cement Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,526,000.00	$ 1,526,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	4,985	$ 2,450.50	$ 12,215,729
4.1	Soil Cement (11' Untrimmed)	CY	64,493	$ 110.00	$ 7,094,276
4.2	Excavation	CY	153,176	$ 8.00	$ 1,225,407
4.3	Backfill (Toedown Construction)	CY	122,448	$ 6.50	$ 795,909
4.4	Compacted Fill (Levee Prism)	CY	4,337	$ 72.50	$ 314,449
4.5	Weepholes	LF	4,937	$ 115.00	$ 567,791
4.6	Riprap Removal	CY	14,636	$ 15.00	$ 219,538
4.7	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,750.00	$ 840,000
4.8	Soil Overlay	CY	2,006	$ 45.00	$ 90,270
4.9	Riprap (for Tie-In to Fresno Improvements)	CY	1,148	$ 162.00	$ 186,000
4.10	Filter Material (for Tie-In to Fresno Improvements) [6-inch]	CY	389	$ 125.00	$ 48,611
4.11	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.12	Export Surplus Riprap Rock	CY	14,636	$ 45.00	$ 658,615
4.13	6" CMB Access Road - Reaches I, II, & IV	CY	1,445	$ 90.00	$ 130,062
5	Levee Clearing (to prevent ponding)	EA	2	$ 145,810.00	$ 291,620
5.1	Excavation	CY	7,000	$ 39.50	$ 276,500
5.2	Riprap Removal	CY	840	$ 18.00	$ 15,120
6	Storm Drains	EA	3	$ 159,100.00	$ 477,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	2	$ 25,500.00	$ 51,000
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Fresno Canyon Drain 90'-Long RCC, RCB, & Outlet Structure	EA	1	$ 415,000.00	$ 415,000
7	Relocation	EA	1	$ 250,000.00	$ 250,000
	Waterline Relocation	EA	1	$ 250,000.00	$ 250,000
				Subtotal (1)	$ 17,040,649
8				[3]Planning, Engineering, and Design:	
9				[3]Construction Management:	
				Subtotal (2):	$ 17,040,649
10				[3]Contingency (30%):	
				Total Project Cost:	**$ 17,040,649**

Notes: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.
2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.
3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 3B: 2H:1V Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,612,000.00	$ 1,612,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	4,985	$ 2,622.77	$ 13,074,511
4.1	Riprap (1-ton)	CY	34,135	$ 162.00	$ 5,529,884
4.2	Reuse Existing Riprap	CY	5,100	$ 32.50	$ 165,756
4.3	Excavation	CY	160,406	$ 8.00	$ 1,283,251
4.4	Backfill (Toedown Construction)	CY	115,682	$ 6.50	$ 751,931
4.5	Compacted Fill (Levee Prism)	CY	11,680	$ 72.50	$ 846,789
4.6	Filter Material (18-inch for RR; 6-inch for CRR)	CY	14,484	$ 125.00	$ 1,810,549
4.7	Riprap Removal	CY	15,301	$ 15.00	$ 229,508
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,580.00	$ 758,400
4.9	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.10	Concreted Rock Riprap (1/2-ton) - Reach IV	CY	918	$ 265.00	$ 243,296
4.11	Concreted Rock Riprap (1/2-ton) Reusing Existing Riprap (Process, Place, Grout) - Reach IV	CY	8,745	$ 148.00	$ 1,294,276
4.12	Weepholes - Reach IV	LF	1,009	$ 115.00	$ 116,071
4.13	6" CMB Access Road - Reaches I, II, & IV	CY	1,475	$ 90.00	$ 132,795
5	Levee Clearing (to prevent ponding)	EA	2	$ 145,810.00	$ 291,620
5.1	Excavation	CY	7,000	$ 39.50	$ 276,500
5.2	Riprap Removal	CY	840	$ 18.00	$ 15,120
6	Storm Drains	EA	3	$ 159,100.00	$ 477,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm	EA	2	$ 25,500.00	$ 51,000
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Fresno Canyon Drain 90'-Long RCC, RCB, & Outlet Structure	EA	1	$ 415,000.00	$ 415,000
7	Relocation	EA	1	$ 250,000.00	$ 250,000
	Waterline Relocation	EA	1	$ 250,000.00	$ 250,000
				Subtotal (1)	$ 17,985,431
8				[3]Planning, Engineering, and Design:	
9				[3]Construction Management:	
				Subtotal (2):	$ 17,985,431
10				[3]Contingency (30%):	
				Total Project Cost:	**$ 17,985,431**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 3C: 2H:1V Concreted Rock Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,552,000.00	$ 1,552,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	4,985	$ 2,501.86	$ 12,471,758
4.1	Concreted Rock Riprap (1/4-ton)	CY	11,718	$ 245.00	$ 2,870,895
4.2	Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, Place, Grout)	CY	13,673	$ 127.00	$ 1,736,530
4.3	Concreted Rock Riprap (1/2-ton) - Reach IV	CY	9,663	$ 265.00	$ 2,560,750
4.4	Excavation	CY	144,666	$ 8.00	$ 1,157,328
4.5	Backfill (Toedown Construction)	CY	118,165	$ 6.50	$ 768,071
4.6	Compacted Fill (Levee Prism)	CY	11,680	$ 72.50	$ 846,789
4.7	Weepholes	LF	4,937	$ 115.00	$ 567,791
4.8	Riprap Removal	CY	15,193	$ 15.00	$ 227,891
4.9	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,580.00	$ 758,400
4.10	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.11	Riprap (for Tie-In to Fresno Improvements)	CY	1,148	$ 162.00	$ 186,000
4.12	Filter Material (18-inch for RR; 6-inch for CRR)	CY	5,972	$ 125.00	$ 746,512
4.13	6" CMB Access Road - Reaches I, II, & IV	CY	1,475	$ 90.00	$ 132,795
5	Levee Clearing (to prevent ponding)	EA	2	$ 145,810.00	$ 291,620
5.1	Excavation	CY	7,000	$ 39.50	$ 276,500
5.2	Riprap Removal	CY	840	$ 18.00	$ 15,120
6	Storm Drains	EA	3	$ 159,100.00	$ 477,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm D	EA	2	$ 25,500.00	$ 51,000
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Fresno Canyon Drain 90'-Long RCC, RCB, & Outlet Structure	EA	1	$ 415,000.00	$ 415,000
7	Relocation	EA	1	$ 250,000.00	$ 250,000
	Waterline Relocation	EA	1	$ 250,000.00	$ 250,000
				Subtotal (1)	$ 17,322,678
8				[3]Planning, Engineering, and Design:	
9				[3]Construction Management:	
				Subtotal (2):	$ 17,322,678
10				[3]Contingency (30%):	
				Total Project Cost:	**$ 17,322,678**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

VR-2 Alternatives

Alternative 3D: 1.5H:1V Concreted Rock Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,635,000.00	$ 1,635,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Levee Slope Protection	LF	4,985	$ 2,667.46	$ 13,297,301
4.1	Concreted Rock Riprap (1/4-ton) [8-foot horizontal base width]	CY	14,324	$ 270.00	$ 3,867,454
4.2	Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, Place, Grout)	CY	13,285	$ 150.00	$ 1,992,820
4.3	Concreted Rock Riprap (1/2-ton) - Reach IV	CY	8,361	$ 300.00	$ 2,508,322
4.4	Excavation	CY	130,299	$ 8.00	$ 1,042,389
4.5	Backfill (Toedown Construction)	CY	104,974	$ 6.50	$ 682,329
4.6	Compacted Fill (Levee Prism)	CY	11,182	$ 72.50	$ 810,677
4.7	Weepholes	LF	4,937	$ 115.00	$ 567,791
4.8	Riprap Removal	CY	14,762	$ 15.00	$ 221,424
4.9	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,580.00	$ 758,400
4.10	Access Road (AC Pavement) - Reach III	SY	747	$ 60.00	$ 44,800
4.11	Riprap (for Tie-In to Fresno Improvements)	CY	1,148	$ 162.00	$ 186,000
4.12	Filter Material (18-inch for RR; 6-inch for CRR)	CY	4,919	$ 125.00	$ 614,895
4.13	6" CMB Access Road - Reaches I, II, & IV	CY	1,475	$ 90.00	$ 132,795
5	Levee Clearing (to prevent ponding)	EA	2	$ 145,810.00	$ 291,620
5.1	Excavation	CY	7,000	$ 39.50	$ 276,500
5.2	Riprap Removal	CY	840	$ 18.00	$ 15,120
6	Storm Drains	EA	3	$ 159,100.00	$ 477,300
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	2	$ 25,500.00	$ 51,000
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,650.00	$ 11,300
6.3	Fresno Canyon Drain 90'-Long RCC, RCB, & Outlet Structure	EA	1	$ 415,000.00	$ 415,000
7	Relocation	EA	1	$ 250,000.00	$ 250,000
	Waterline Relocation	EA	1	$ 250,000.00	$ 250,000
				Subtotal (1)	$ 18,231,221
8				[3]Planning, Engineering, and Design:	
9				[3]Construction Management:	
				Subtotal (2):	$ 18,231,221
10				[3]Contingency (30%):	
				Total Project Cost:	**$ 18,231,221**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA’s direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) These estimates are only meant to be used as a comparison tool and should not be used for planning or budgeting purposes.

APPENDIX I-C

Alternatives Summary of Hydraulics

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VR-2 Summary of Hydraulics and Design
(Alternative 1)

Approximate Levee Station	HEC-RAS Station	Channel Thalweg[1] (feet)	Total Scour Depth	Existing Toe Down Protection Elevation	Existing Toe Down Defiency	Computed Water-Surface Elevation[1] (feet)		Increase in WSE from AECOM/ Stillwater Study (feet)	Top-of-Levee Elevation[1] (feet)	Computed Freeboard (feet)		FEMA Required Freeboard	Required TOL Elev.[1] (feet)		Design Toe El (feet)	Design TOL (feet)
						100-Year	Design Flow			100-Year	Design Flow		100-Year	Design Flow		
Upstream Limit (Along Curve Tie-In)																
1+79	414+72.49	290.38	6.00	299.00	-14.62	311.15	312.54	1.05	315.68	4.53	3.14	3.50	315.70	317.09	282.00	316.50
Tie-In to Ventura River Bank																
58+76	414+72.49	290.38	6.00	285.53	-1.15	307.23	307.74	1.05	311.47	3.19	2.68	3.00	311.28	311.79	282.00	312.00
56+24	412+26.26	289.14	6.00	289.73	-6.59	306.72	307.24	1.19	310.97	3.05	2.53	3.00	310.91	311.43	281.00	312.00
53+43	409+44.61	285.44	6.00	287.20	-7.76	304.10	304.82	1.35	308.58	3.13	2.41	3.00	308.45	309.17	277.00	310.00
50+85	406+89.6	284.78	6.00	284.99	-6.21	302.38	302.93	0.99	306.07	2.70	2.15	3.00	306.37	306.92	276.00	307.50
48+30	404+34.64	285.23	6.00	282.95	-3.72	300.17	300.61	0.48	303.60	2.95	2.51	3.00	303.65	304.09	276.00	305.00
45+84	401+83.5	285.07	6.00	281.03	-1.96	298.47	298.91	0.35	301.21	2.39	1.95	3.00	301.82	302.26	276.00	303.00
43+35	399+32.47	279.52	6.00	279.79	-6.27	295.90	296.41	0.32	298.69	2.47	1.96	3.00	299.22	299.73	271.00	300.00
40+70	396+70.7	278.52	6.00	278.46	-5.94	293.85	294.30	0.26	295.69	1.58	1.13	3.00	297.11	297.56	270.00	298.00
38+05	394+08.97	277.47	6.00	276.55	-5.08	291.40	291.86	0.19	293.11	1.53	1.07	3.00	294.59	295.05	269.00	296.00
35+61	391+59.9	275.04	6.00	274.60	-5.56	288.88	289.28	0.20	291.50	2.42	2.02	3.00	292.08	292.48	267.00	293.00
33+14	389+10.90	274.87	6.00	272.62	-3.75	286.57	286.97	0.25	288.79	1.97	1.57	3.00	289.82	290.22	266.00	291.00
31+04	386+98.9	273.47	6.00	270.94	-3.47	283.52	283.89	0.21	287.36	3.63	3.26	3.00	286.73	287.10	265.00	287.36
28+90	384+87.06	268.40	6.00	269.23	-6.83	281.32	281.67	0.13	285.44	3.99	3.64	3.00	284.45	284.80	260.00	285.44
25+34	381+70.8	265.54	6.00	266.38	-6.84	278.13	278.49	0.05	282.24	4.06	3.70	3.00	281.18	281.54	257.00	282.24
21+76	378+54.71	261.58	6.00	260.60	-5.02	276.04	276.47	0.03	279.67	3.60	3.17	3.00	279.07	279.50	253.00	279.67
18+08	373+96.83	258.72	5.50	256.97	-3.75	271.71	272.11	0.10	277.09	5.29	4.89	3.00	274.81	275.21	251.00	277.09
15+67	371+26.7	255.32	5.50	255.05	-5.23	269.63	270.08	0.15	275.28	5.50	5.05	3.00	272.78	273.23	247.00	275.28
13+46	368+56.66	253.69	5.50	253.28	-5.09	268.29	268.75	0.20	273.56	5.06	4.60	3.00	271.49	271.95	246.00	273.56
9+71	364+35.54	251.35	5.50	250.51	-4.66	264.86	265.32	0.50	269.46	4.10	3.64	3.00	268.36	268.82	243.00	269.46
8+44	363+11.96	251.52	5.50	249.61	-3.59	264.02	264.50	0.62	263.94	-0.70	-1.18	3.00	267.64	268.12	243.00	269.00
D/S	360+23.13	249.38	5.50	246.53	-2.65	262.24	262.81	0.46	270.58	7.88	7.31	3.00	265.70	266.27	241.00	270.58

Orange	Headwall/floodwall Construction as part of Fresno Canyon Diversion
Green	Floodwall Reach along Mobile Home Park
Yellow	WSE taken from 2-D model

VR-2 Summary of Hydraulics and Design
(Alternative 2)

Approximate Levee Station	HEC-RAS Station	Channel Thalweg[1] (feet)	Total Scour Depth	Existing Toe Down Protection Elevation	Existing Toe Down Defiency	Computed Water-Surface Elevation[1] (feet)		Increase in WSE from AECOM/ Stillwater Study (feet)	Top-of-Levee Elevation[1] (feet)	Computed Freeboard (feet)		FEMA Required Freeboard	Required TOL Elev.[1] (feet)		Design Toe El (feet)	Design TOL (feet)
						100-Year	Design Flow			100-Year	Design Flow		100-Year	Design Flow		
U/S	409+44.61	285.44	6.00	287.20	-7.76	304.10	304.82	1.35	308.58	3.13	2.41	3.50	308.95	309.67	277.00	310.50
52+80	406+89.6	284.78	6.00	284.99	-6.21	302.38	302.93	0.99	306.07	2.70	2.15	3.00	306.37	306.92	276.00	309.00
48+90	404+34.64	285.23	6.00	282.95	-3.72	300.17	300.61	0.48	303.60	2.95	2.51	3.00	303.65	304.09	276.00	307.00
45+84	401+83.5	285.07	6.00	281.03	-1.96	298.47	298.91	0.35	301.21	2.39	1.95	3.00	301.82	302.26	276.00	303.00
43+35	399+32.47	279.52	6.00	279.79	-6.27	295.90	296.41	0.32	298.69	2.47	1.96	3.00	299.22	299.73	271.00	300.00
40+70	396+70.7	278.52	6.00	278.46	-5.94	293.85	294.30	0.26	295.69	1.58	1.13	3.00	297.11	297.56	270.00	298.00
38+05	394+08.97	277.47	6.00	276.55	-5.08	291.40	291.86	0.19	293.11	1.53	1.07	3.00	294.59	295.05	269.00	296.00
35+61	391+59.9	275.04	6.00	274.60	-5.56	288.88	289.28	0.20	291.50	2.42	2.02	3.00	292.08	292.48	267.00	293.00
33+14	389+10.90	274.87	6.00	272.62	-3.75	286.57	286.97	0.25	288.79	1.97	1.57	3.00	289.82	290.22	266.00	291.00
31+04	386+98.9	273.47	6.00	270.94	-3.47	283.52	283.89	0.21	287.36	3.63	3.26	3.00	286.73	287.10	265.00	287.36
28+90	384+87.06	268.40	6.00	269.23	-6.83	281.32	281.67	0.13	285.44	3.99	3.64	3.00	284.45	284.80	260.00	285.44
25+34	381+70.8	265.54	6.00	266.38	-6.84	278.13	278.49	0.05	282.24	4.06	3.70	3.00	281.18	281.54	257.00	282.24
21+76	378+54.71	261.58	6.00	260.60	-5.02	276.04	276.47	0.03	279.67	3.60	3.17	3.00	279.07	279.50	253.00	279.67
18+08	373+96.83	258.72	5.50	256.97	-3.75	271.71	272.11	0.10	277.09	5.29	4.89	3.00	274.81	275.21	251.00	277.09
15+67	371+26.7	255.32	5.50	255.05	-5.23	269.63	270.08	0.15	275.28	5.50	5.05	3.00	272.78	273.23	247.00	275.28
13+46	368+56.66	253.69	5.50	253.28	-5.09	268.29	268.75	0.20	273.56	5.06	4.60	3.00	271.49	271.95	246.00	273.56
9+71	364+35.54	251.35	5.50	250.51	-4.66	264.86	265.32	0.50	269.46	4.10	3.64	3.00	268.36	268.82	243.00	269.46
8+44	363+11.96	251.52	5.50	249.61	-3.59	264.02	264.50	0.62	263.94	-0.70	-1.18	3.00	267.64	268.12	243.00	269.00
D/S	360+23.13	249.38	5.50	246.53	-2.65	262.24	262.81	0.46	270.58	7.88	7.31	3.00	265.70	266.27	241.00	270.58

	Headwall/floodwall Construction as part of Fresno Canyon Diversion
	Floodwall Reach along Mobile Home Park
	WSE taken from 2-D model

VR-2 Summary of Hydraulics and Design
(Alternative 3)

Approximate Levee Station	HEC-RAS Station	Channel Thalweg[1] (feet)	Total Scour Depth	Existing Toe Down Protection Elevation	Existing Toe Down Defiency	Computed Water-Surface Elevation[1] (feet)		Increase in WSE from AECOM/ Stillwater Study (feet)	Top-of-Levee Elevation[1] (feet)	Computed Freeboard (feet)		FEMA Required Freeboard	Required TOL Elev.[1] (feet)		Design Toe El (feet)	Design TOL (feet)
						100-Year	Design Flow			100-Year	Design Flow		100-Year	Design Flow		
U/S	409+44.61	285.44	6.00	287.20	-7.76	304.10	304.82	1.35	308.58	3.13	2.41	3.50	308.95	309.67	277.00	310.50
52+80	406+89.6	284.78	6.00	284.99	-6.21	302.38	302.93	0.99	306.07	2.70	2.15	3.00	306.37	306.92	276.00	309.00
48+90	404+34.64	285.23	6.00	282.95	-3.72	300.17	300.61	0.48	303.60	2.95	2.51	3.00	303.65	304.09	276.00	307.00
45+84	401+83.5	285.07	6.00	281.03	-1.96	298.47	298.91	0.35	301.21	2.39	1.95	3.00	301.82	302.26	276.00	303.00
43+35	399+32.47	279.52	6.00	279.79	-6.27	295.90	296.41	0.32	298.69	2.47	1.96	3.00	299.22	299.73	271.00	300.00
40+70	396+70.7	278.52	6.00	278.46	-5.94	293.85	294.30	0.26	295.69	1.58	1.13	3.00	297.11	297.56	270.00	298.00
38+05	394+08.97	277.47	6.00	276.55	-5.08	291.40	291.86	0.19	293.11	1.53	1.07	3.00	294.59	295.05	269.00	296.00
35+61	391+59.9	275.04	6.00	274.60	-5.56	288.88	289.28	0.20	291.50	2.42	2.02	3.00	292.08	292.48	267.00	293.00
33+14	389+10.90	274.87	6.00	272.62	-3.75	286.57	286.97	0.25	288.79	1.97	1.57	3.00	289.82	290.22	266.00	291.00
31+04	386+98.9	273.47	6.00	270.94	-3.47	283.52	283.89	0.21	287.36	3.63	3.26	3.00	286.73	287.10	265.00	287.36
28+90	384+87.06	268.40	6.00	269.23	-6.83	281.32	281.67	0.13	285.44	3.99	3.64	3.00	284.45	284.80	260.00	285.44
25+34	381+70.8	265.54	6.00	266.38	-6.84	278.13	278.49	0.05	282.24	4.06	3.70	3.00	281.18	281.54	257.00	282.24
21+76	378+54.71	261.58	6.00	260.60	-5.02	276.04	276.47	0.03	279.67	3.60	3.17	3.00	279.07	279.50	253.00	279.67
18+08	373+96.83	258.72	5.50	256.97	-3.75	271.71	272.11	0.10	277.09	5.29	4.89	3.00	274.81	275.21	251.00	277.09
15+67	371+26.7	255.32	5.50	255.05	-5.23	269.63	270.08	0.15	275.28	5.50	5.05	3.00	272.78	273.23	247.00	275.28
13+46	368+56.66	253.69	5.50	253.28	-5.09	268.29	268.75	0.20	273.56	5.06	4.60	3.00	271.49	271.95	246.00	273.56
9+71	364+35.54	251.35	5.50	250.51	-4.66	264.86	265.32	0.50	269.46	4.10	3.64	3.00	268.36	268.82	243.00	269.46
7+99	363+11.96	251.52	5.50	249.61	-3.59	264.02	264.50	0.62	263.94	-0.70	-1.18	3.00	267.64	268.12	243.00	269.00
D/S	360+23.13	249.38	5.50	246.53	-2.65	262.24	262.81	0.46	270.58	7.88	7.31	3.00	265.70	266.27	241.00	270.58

	Headwall/floodwall Construction as part of Fresno Canyon Diversion
	Floodwall Reach along Mobile Home Park
	WSE taken from 2-D model

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APPENDIX I-D

Alternatives Summary of Scour Calculations

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VR-2 Summary of Scour Calculations

	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Hydr Depth C (ft)	Bend Radius-Rc (ft)	Width of flow at upstream end of bend-W (ft)	Bend Scour Depth (ft)	Long Term Scour	Single Event Scour	**Total**
VR-2	Main	43146.77	Design-Flow	32014	311.3	319.18	7.25	1350	696	3.5	2.5	0	**6.0**
	Main	42824.65	Design-Flow	32014	304.89	319.46	11.5	1350	696	3.5	2.5	0	**6.0**
	Main	42425.58	Design-Flow	73260	299.43	316.33	11.42	1350	696	3.5	2.5	0	**6.0**
	Main	42246.24	Design-Flow	73260	297.50	312.99	11.18	1350	696	3.5	2.5	0	**6.0**
	Main	42028.91	Design-Flow	73260	293.70	312.02	10.37	1350	696	3.5	2.5	0	**6.0**
	Main	41920.52	Design-Flow	73260	293.53	310.72	9.61	1350	696	3.5	2.5	0	**6.0**
	Main	41472.49	Design-Flow	73260	290.38	307.74	10.00	1350	696	3.5	2.5	0	**6.0**
	Main	41226.26	Design-Flow	73963	289.14	307.24	11.57	1350	696	3.5	2.5	0	**6.0**
	Main	40944.61	Design-Flow	73963	285.44	304.82	10.43	1350	696	3.5	2.5	0	**6.0**
	Main	40689.6	Design-Flow	73963	284.78	302.93	10.22	1350	696	3.5	2.5	0	**6.0**
	Main	40434.64	Design-Flow	73963	285.23	300.61	8.68	1350	696	3.5	2.5	0	**6.0**
	Main	40183.5	Design-Flow	73963	285.07	298.91	8.62	1350	696	3.5	2.5	0	**6.0**
	Main	39932.47	Design-Flow	73963	279.52	296.41	8.96	1350	696	3.5	2.5	0	**6.0**
	Main	39670.7	Design-Flow	73963	278.52	294.30	8.54	1350	696	3.5	2.5	0	**6.0**
	Main	39408.97	Design-Flow	73963	277.47	291.86	8.8	1350	696	3.5	2.5	0	**6.0**
	Main	39159.9	Design-Flow	73963	275.04	289.28	7.59	1350	696	3.5	2.5	0	**6.0**
	Main	38910.9	Design-Flow	73963	274.87	286.97	7.31	1350	696	3.5	2.5	0	**6.0**
	Main	38698.9	Design-Flow	73963	273.47	283.89	6.17	1350	696	3.5	2.5	0	**6.0**
	Main	38487.06	Design-Flow	73963	268.40	281.67	5.97	1350	696	3.5	2.5	0	**6.0**
	Main	38170.8	Design-Flow	73963	265.54	278.49	6.01	1350	696	3.5	2.5	0	**6.0**
	Main	37854.71	Design-Flow	73963	261.58	276.47	6.79	1350	696	3.5	2.5	0	**6.0**
	Main	37396.83	Design-Flow	73963	258.72	272.11	6.69	1340	772	3.0	2.5	0	**5.5**
	Main	37126.7	Design-Flow	73963	255.32	270.08	7.29	1340	772	3.0	2.5	0	**5.5**
	Main	36856.66	Design-Flow	73963	253.69	268.75	7.93	1340	772	3.0	2.5	0	**5.5**
	Main	36435.54	Design-Flow	73963	251.35	265.32	7.54	1340	772	3.0	2.5	0	**5.5**
	Main	36311.96	Design-Flow	73963	251.52	264.50	7.84	1340	772	3.0	2.5	0	**5.5**
	Main	36023.13	Design-Flow	73963	249.38	262.81	8.38	1340	772	3.0	2.5	0	**5.5**
	Main	35822.91	Design-Flow	73963	245.49	260.70	7.83	1340	772	3.0	2.5	0	**5.5**
	Main	35537.26	Design-Flow	73963	242.72	257.93	7.27	1340	772	3.0	2.5	0	**5.5**
	Main	35363.82	Design-Flow	73963	242.50	256.44	7.41	1340	772	3.0	2.5	0	**5.5**
	Main	35129.01	Design-Flow	73963	242.13	255.48	8.28	1340	772	3.0	2.5	0	**5.5**
	Main	34949.3	Design-Flow	73963	241.59	254.86	9.12	1340	772	3.0	2.5	0	**5.5**
	Main	34769.73	Design-Flow	73963	239.97	252.45	7.84	1340	772	3.0	2.5	0	**5.5**
	Main	34269.52	Design-Flow	73963	236.04	248.34	7.83	1340	772	3.0	2.5	0	**5.5**

Note: The bend scour depth is a function of the bend radius, the crossing width, the crossing depth and the max depth.
Single event scour based on Figures D-31 through D-35 from AECOM/Stillwater Sciences Sediment Report.
Long Term scour is taken from Figures D-1 through D-5 and D-16 through D-20 from AECOM/Stillwater Sciences Sediment Report.

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APPENDIX I-E

Alternatives Calculations of Durations and Vehicle Trips

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TITLE: VR-2 Preliminary Design
SUBJECT: Construction Durations
MADE BY: OL
CHECKED BY: SKV

JOB NO.:
DATE: 3/8/2022

Alternative 1A

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Soil Cement (11' Untrimmed)	100.000	100%	8	CY	75,161	1	751.6	93.95
Excavation	196.000	100%	8	CY	145,806	4	186.0	23.25
Backfill (Toedown Construction)	102.000	100%	8	CY	112,715	4	276.3	34.53
Compacted Fill (Levee Prism)	102.000	100%	8	CY	7,253	1	71.1	8.89
Weepholes	100.000	100%	8	LF	5,677	1	56.8	7.10
Riprap Removal	75.000	100%	8	CY	23,404	2	156.0	19.50
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Soil Overlay	102.000	100%	8	CY	1,638	1	16.1	2.01
Riprap (for Tie-In to Fresno Improvements)	60.000	100%	8	CY	1,148	2	9.6	1.20
Filter Material (for Tie-In to Fresno Improvements) [6-inch]	100.000	100%	8	CY	389	1	3.9	0.49
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Export Surplus Riprap Rock	15.000	100%	8	CY	23,404	2	780.1	97.52
Landside Toe Seepage Drainage (Weephole) - Reach IV	50.000	100%	8	LF	1,200	1	24.0	3.00
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,475	2	11.3	1.42
Levee Clearing								
Excavation	196.000	100%	8	CY	3,500	4	4.5	0.56
Riprap Removal	75.000	100%	8	CY	420	2	2.8	0.35
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	3	1	120.0	15.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1		
Replace 36-inch Flap Gate	0.125	100%	8	EA	1	1		
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1		
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

TITLE:	VR-2 Preliminary Design
SUBJECT:	Construction Durations
MADE BY:	OL
CHECKED BY:	SKV

JOB NO.:
DATE: 3/8/2022

Alternative 1A

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Cement Delivery	CY	30,064	16	1880
Excess Excavation	CY	33091	16	2069
Borrow Fill	CY	7253	16	454
Soil Overlay	CY	1,638	16	103
Excess Riprap	CY	23,404	16	1463
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	3,500	16	219
CMB	CY	1,480	12	124
Concrete Channel Concrete	CY	150	12	13

Total Haul Truck Trips:	**6366**
Total Construction Days:	252
Avg. Haul Trucks per Day:	**25.2**
Assumed No. of Laborers per Day (avg.):	20
Assumed No. of Mgmt. and OH Staff per Day :	5
Total Staff Vehicle Trips per Day:	25
Avg. Daily Vehicle Trips:	**50.2**

TITLE: VR-2 Preliminary Design
SUBJECT: Construction Durations
MADE BY: OL
CHECKED BY: SKV

JOB NO.:
DATE: 3/8/2022

Alternative 1B

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Riprap (1-ton)	60.000	100%	8	CY	31,551	2	262.9	32.87
Reuse Existing Riprap	60.000	100%	8	CY	7,801	2	65.0	8.13
Excavation	196.000	100%	8	CY	137,383	4	175.2	21.90
Backfill (Toedown Construction)	102.000	100%	8	CY	90,127	4	220.9	27.61
Compacted Fill (Levee Prism)	102.000	100%	8	CY	11,627	1	114.0	14.25
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	15,478	2	77.4	9.67
Riprap Removal	75.000	100%	8	CY	23,404	2	156.0	19.50
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	5,362	2	134.1	16.76
Concreted Rock Riprap (1/2-ton) Reusing Existing Riprap (Process, P	20.000	100%	8	CY	13,340	2	333.5	41.69
Weepholes - Reach IV	100.000	100%	8	LF	1,737	1	17.4	2.17
Landside Toe Seepage Drainage (Weephole) - Reach IV	50.000	100%	8	LF	1,200	1	24.0	3.00
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,475	2	11.3	1.42
Levee Clearing								
Excavation	196.000	100%	8	CY	3,500	4	4.5	0.56
Riprap Removal	75.000	100%	8	CY	420	2	2.8	0.35
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	3	1	120.0	15.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Replace 36-inch Flap Gate	0.125	100%	8	EA	1	1	8.0	1.00
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

TITLE:	VR-2 Preliminary Design
SUBJECT:	Construction Durations
MADE BY:	OL
CHECKED BY:	SKV

JOB NO.:
DATE: 3/8/2022

Alternative 1B

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Riprap	CY	31,551	16	1972
Excess Excavation	CY	47255	16	2954
Borrow Fill	CY	11627	16	727
Filter Material	CY	15,478	16	968
Concreted Riprap	CY	5,362	16	336
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	3,500	16	219
CMB	CY	1,475	12	123
Concrete Channel Concrete	CY	150	12	13

Total Haul Truck Trips:	**7353**
Total Construction Days:	199
Avg. Haul Trucks per Day:	**36.9**
Assumed No. of Laborers per Day (avg.):	20
Assumed No. of Mgmt. and OH Staff per Day :	5
Total Staff Vehicle Trips per Day:	25
Avg. Daily Vehicle Trips:	**61.9**

TITLE: VR-2 Preliminary Design
SUBJECT: Construction Durations
MADE BY: OL
CHECKED BY: SKV

JOB NO.:
DATE: 3/8/2022

Alternative 1C

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Concreted Rock Riprap (1/4-ton)	30.000	100%	8	CY	4,406	2	73.4	9.18
Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, P	30.000	100%	8	CY	21,064	2	351.1	43.88
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	18,703	2	467.6	58.45
Excavation	196.000	100%	8	CY	122,047	4	155.7	19.46
Backfill (Toedown Construction)	102.000	100%	8	CY	92,484	4	226.7	28.33
Compacted Fill (Levee Prism)	102.000	100%	8	CY	11,627	1	114.0	14.25
Weepholes	100.000	100%	8	LF	5,677	1	56.8	7.10
Riprap Removal	75.000	100%	8	CY	23,404	2	156.0	19.50
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Riprap (for Tie-In to Fresno Improvements)	60.000	100%	8	CY	1,148	2	9.6	1.20
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	6,939	2	34.7	4.34
Landside Toe Seepage Drainage (Weephole) - Reach IV	50.000	100%	8	LF	1,200	1	24.0	3.00
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,475	2	11.3	1.42
Levee Clearing								
Excavation	196.000	100%	8	CY	3,500	4	4.5	0.56
Riprap Removal	75.000	100%	8	CY	420	2	2.8	0.35
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	3	1	120.0	15.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Replace 36-inch Flap Gate	0.125	100%	8	EA	1	1	8.0	1.00
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

TITLE:	VR-2 Preliminary Design
SUBJECT:	Construction Durations
MADE BY:	OL
CHECKED BY:	SKV

JOB NO.:
DATE: 3/8/2022

Alternative 1C

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Concreted Riprap Import	CY	23,109	16	1445
Excess Excavation	CY	29,563	16	1848
Borrow Fill	CY	11,627	16	727
Filter Material	CY	6,939	16	434
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	3,500	16	219
CMB	CY	1,475	12	123
Concrete Channel Concrete	CY	150	12	13
			Total Haul Truck Trips:	**4850**
			Total Construction Days:	207
			Avg. Haul Trucks per Day:	**23.5**
			Assumed No. of Laborers per Day (avg.):	20
			Assumed No. of Mgmt. and OH Staff per Day :	5
			Total Staff Vehicle Trips per Day:	25
			Avg. Daily Vehicle Trips:	**48.5**

TITLE: VR-2 Preliminary Design
SUBJECT: Construction Durations
MADE BY: OL
CHECKED BY: SKV

JOB NO.:
DATE: 3/8/2022

Alternative 1D

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Concreted Rock Riprap (1/4-ton) [8-foot horizontal base width]	30.000	100%	8	CY	6,631	2	110.5	13.81
Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, P	30.000	100%	8	CY	21,064	2	351.1	43.88
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	16,175	2	404.4	50.55
Excavation	196.000	100%	8	CY	114,347	4	145.9	18.23
Backfill (Toedown Construction)	102.000	100%	8	CY	87,532	4	214.5	26.82
Compacted Fill (Levee Prism)	102.000	100%	8	CY	11,280	1	110.6	13.82
Weepholes	100.000	100%	8	LF	5,677	1	56.8	7.10
Riprap Removal	75.000	100%	8	CY	23,404	2	156.0	19.50
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Riprap (for Tie-In to Fresno Improvements)	60.000	100%	8	CY	1,148	2	9.6	1.20
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	5,763	2	28.8	3.60
Landside Toe Seepage Drainage (Weephole) - Reach IV	50.000	100%	8	LF	1,200	1	24.0	3.00
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,475	2	11.3	1.42
Levee Clearing								
Excavation	196.000	100%	8	CY	3,500	4	4.5	0.56
Riprap Removal	75.000	100%	8	CY	420	2	2.8	0.35
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	3	1	120.0	15.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Replace 36-inch Flap Gate	0.125	100%	8	EA	1	1	8.0	1.00
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

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Alternative 1D

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Concreted Riprap Import	CY	22,806	16	1426
Excess Excavation	CY	26,815	16	1676
Borrow Fill	CY	11,280	16	706
Filter Material	CY	5,763	16	361
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	3,500	16	219
CMB	CY	1,475	12	123
Concrete Channel Concrete	CY	150	12	13

Total Haul Truck Trips:	**4565**
Total Construction Days:	202
Avg. Haul Trucks per Day:	**22.6**
Assumed No. of Laborers per Day (avg.):	20
Assumed No. of Mgmt. and OH Staff per Day :	5
Total Staff Vehicle Trips per Day:	25
Avg. Daily Vehicle Trips:	**47.6**

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Alternative 2A

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Soil Cement (11' Untrimmed)	100.000	100%	8	CY	64,668	1	646.7	80.84
Excavation	196.000	100%	8	CY	148,596	4	189.5	23.69
Backfill (Toedown Construction)	102.000	100%	8	CY	118,566	4	290.6	36.33
Compacted Fill (Levee Prism)	102.000	100%	8	CY	4,865	1	47.7	5.96
Weepholes	100.000	100%	8	LF	4,949	1	49.5	6.19
Riprap Removal	75.000	100%	8	CY	15,361	2	102.4	12.80
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Soil Overlay	102.000	100%	8	CY	2,872	1	28.2	3.52
Riprap (for Tie-In to Fresno Improvements)	60.000	100%	8	CY	1,148	2	9.6	1.20
Filter Material (for Tie-In to Fresno Improvements) [6-inch]	100.000	100%	8	CY	389	1	3.9	0.49
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Export Surplus Riprap Rock	15.000	100%	8	CY	15,361	2	512.0	64.00
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,449	2	11.1	1.39
Levee Clearing								
Excavation	196.000	100%	8	CY	7,000	4	8.9	1.12
Riprap Removal	75.000	100%	8	CY	840	2	5.6	0.70
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	2	1	80.0	10.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Relocation								
Waterline Relocation	0.025	100%	8	EA	1	1	40.0	5.00
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

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Alternative 2A

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Cement Delivery	CY	25,867	16	1617
Excess Excavation	CY	30030	16	1877
Borrow Fill	CY	4865	16	305
Soil Overlay	CY	2,872	16	180
Excess Riprap	CY	15,361	16	961
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	7,000	16	438
CMB	CY	1,450	12	121
Concrete Channel Concrete	CY	150	12	13

Total Haul Truck Trips:	**5553**
Total Construction Days:	224
Avg. Haul Trucks per Day:	**24.8**
Assumed No. of Laborers per Day (avg.):	20
Assumed No. of Mgmt. and OH Staff per Day :	5
Total Staff Vehicle Trips per Day:	25
Avg. Daily Vehicle Trips:	**49.8**

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Alternative 2B

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Riprap (1-ton)	60.000	100%	8	CY	34,232	2	285.3	35.66
Reuse Existing Riprap	60.000	100%	8	CY	5,120	2	42.7	5.33
Excavation	196.000	100%	8	CY	158,595	4	202.3	25.29
Backfill (Toedown Construction)	102.000	100%	8	CY	111,483	4	273.2	34.16
Compacted Fill (Levee Prism)	102.000	100%	8	CY	12,473	1	122.3	15.29
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	14,524	2	72.6	9.08
Riprap Removal	75.000	100%	8	CY	15,361	2	102.4	12.80
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	908	2	22.7	2.84
Concreted Rock Riprap (1/2-ton) Reusing Existing Riprap (Process, P	20.000	100%	8	CY	8,756	2	218.9	27.36
Weepholes - Reach IV	100.000	100%	8	LF	1,009	1	10.1	1.26
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,449	2	11.1	1.39
Levee Clearing								
Excavation	196.000	100%	8	CY	7,000	4	8.9	1.12
Riprap Removal	75.000	100%	8	CY	840	2	5.6	0.70
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	2	1	80.0	10.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Relocation								
Waterline Relocation	0.025	100%	8	EA	1	1	40.0	5.00
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

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Alternative 2B

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Riprap	CY	34,232	16	2140
Excess Excavation	CY	47112	16	2945
Borrow Fill	CY	12473	16	780
Filter Material	CY	14,524	16	908
Concreted Riprap	CY	908	16	57
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	7,000	16	438
CMB	CY	1,449	12	121
Concrete Channel Concrete	CY	150	12	13
			Total Haul Truck Trips:	**7443**
			Total Construction Days:	180
			Avg. Haul Trucks per Day:	**41.4**
			Assumed No. of Laborers per Day (avg.):	20
			Assumed No. of Mgmt. and OH Staff per Day :	5
			Total Staff Vehicle Trips per Day:	25
			Avg. Daily Vehicle Trips:	**66.4**

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Alternative 2C

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Concreted Rock Riprap (1/4-ton)	30.000	100%	8	CY	11,645	2	194.1	24.26
Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, P	30.000	100%	8	CY	13,825	2	230.4	28.80
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	9,663	2	241.6	30.20
Excavation	196.000	100%	8	CY	142,900	4	182.3	22.78
Backfill (Toedown Construction)	102.000	100%	8	CY	113,827	4	279.0	34.87
Compacted Fill (Levee Prism)	102.000	100%	8	CY	12,473	1	122.3	15.29
Weepholes	100.000	100%	8	LF	4,949	1	49.5	6.19
Riprap Removal	75.000	100%	8	CY	15,361	2	102.4	12.80
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Riprap (for Tie-In to Fresno Improvements)	60.000	100%	8	CY	1,148	2	9.6	1.20
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	5,985	2	29.9	3.74
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,475	2	11.3	1.42
Levee Clearing								
Excavation	196.000	100%	8	CY	7,000	4	8.9	1.12
Riprap Removal	75.000	100%	8	CY	840	2	5.6	0.70
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	2	1	80.0	10.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Relocation								
Waterline Relocation	0.025	100%	8	EA	1	1	40.0	5.00
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

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Alternative 2C

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Concreted Riprap Import	CY	21,308	16	1332
Excess Excavation	CY	29,073	16	1818
Borrow Fill	CY	12,473	16	780
Filter Material	CY	5,985	16	375
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	7,000	16	438
CMB	CY	1,475	12	123
Concrete Channel Concrete	CY	150	12	13
			Total Haul Truck Trips:	**4920**
			Total Construction Days:	187
			Avg. Haul Trucks per Day:	**26.3**
			Assumed No. of Laborers per Day (avg.):	20
			Assumed No. of Mgmt. and OH Staff per Day :	5
			Total Staff Vehicle Trips per Day:	25
			Avg. Daily Vehicle Trips:	**51.3**

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Alternative 2D

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Concreted Rock Riprap (1/4-ton)	30.000	100%	8	CY	13,870	2	231.2	28.90
Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, P	30.000	100%	8	CY	13,825	2	230.4	28.80
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	8,361	2	209.0	26.13
Excavation	196.000	100%	8	CY	127,208	4	162.3	20.28
Backfill (Toedown Construction)	102.000	100%	8	CY	101,076	4	247.7	30.97
Compacted Fill (Levee Prism)	102.000	100%	8	CY	11,842	1	116.1	14.51
Weepholes	100.000	100%	8	LF	4,949	1	49.5	6.19
Riprap Removal	75.000	100%	8	CY	15,361	2	102.4	12.80
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Riprap (for Tie-In to Fresno Improvements)	60.000	100%	8	CY	1,148	2	9.6	1.20
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	4,930	2	24.6	3.08
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,475	2	11.3	1.42
Levee Clearing								
Excavation	196.000	100%	8	CY	7,000	4	8.9	1.12
Riprap Removal	75.000	100%	8	CY	840	2	5.6	0.70
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	2	1	80.0	10.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Relocation								
Waterline Relocation	0.025	100%	8	EA	1	1	40.0	5.00
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

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Alternative 2D

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Concreted Riprap Import	CY	22,231	16	1390
Excess Excavation	CY	26,132	16	1634
Borrow Fill	CY	11,842	16	741
Filter Material	CY	4,930	16	309
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	7,000	16	438
CMB	CY	1,475	12	123
Concrete Channel Concrete	CY	150	12	13

Total Haul Truck Trips:	**4689**
Total Construction Days:	183
Avg. Haul Trucks per Day:	**25.7**
Assumed No. of Laborers per Day (avg.):	20
Assumed No. of Mgmt. and OH Staff per Day :	5
Total Staff Vehicle Trips per Day:	25
Avg. Daily Vehicle Trips:	**50.7**

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Alternative 3A

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Soil Cement (11' Untrimmed)	100.000	100%	8	CY	64,493	1	644.9	80.62
Excavation	196.000	100%	8	CY	153,176	4	195.4	24.42
Backfill (Toedown Construction)	102.000	100%	8	CY	122,448	4	300.1	37.51
Compacted Fill (Levee Prism)	102.000	100%	8	CY	4,337	1	42.5	5.32
Weepholes	100.000	100%	8	LF	4,937	1	49.4	6.17
Riprap Removal	75.000	100%	8	CY	14,636	2	97.6	12.20
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Soil Overlay	102.000	100%	8	CY	2,006	1	19.7	2.46
Riprap (for Tie-In to Fresno Improvements)	60.000	100%	8	CY	1,148	2	9.6	1.20
Filter Material (for Tie-In to Fresno Improvements) [6-inch]	100.000	100%	8	CY	389	1	3.9	0.49
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Export Surplus Riprap Rock	15.000	100%	8	CY	14,636	2	487.9	60.98
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,445	2	11.1	1.39
Levee Clearing								
Excavation	196.000	100%	8	CY	7,000	4	8.9	1.12
Riprap Removal	75.000	100%	8	CY	840	2	5.6	0.70
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	2	1	80.0	10.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Relocation								
Waterline Relocation	0.025	100%	8	EA	1	1	40.0	5.00
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

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Alternative 3A

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Cement Delivery	CY	25,797	16	1613
Excess Excavation	CY	30728	16	1921
Borrow Fill	CY	4337	16	272
Soil Overlay	CY	2,006	16	126
Excess Riprap	CY	14,636	16	915
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	7,000	16	438
CMB	CY	1,450	12	121
Concrete Channel Concrete	CY	100	12	9

Total Haul Truck Trips:	**5456**
Total Construction Days:	222
Avg. Haul Trucks per Day:	**24.6**
Assumed No. of Laborers per Day (avg.):	20
Assumed No. of Mgmt. and OH Staff per Day :	5
Total Staff Vehicle Trips per Day:	25
Avg. Daily Vehicle Trips:	**49.6**

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Alternative 3A

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Riprap (1-ton)	60.000	100%	8	CY	34,135	2	284.5	35.56
Reuse Existing Riprap	60.000	100%	8	CY	5,100	2	42.5	5.31
Excavation	196.000	100%	8	CY	160,406	4	204.6	25.58
Backfill (Toedown Construction)	102.000	100%	8	CY	115,682	4	283.5	35.44
Compacted Fill (Levee Prism)	102.000	100%	8	CY	11,680	1	114.5	14.31
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	14,484	2	72.4	9.05
Riprap Removal	75.000	100%	8	CY	15,301	2	102.0	12.75
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	918	2	23.0	2.87
Concreted Rock Riprap (1/2-ton) Reusing Existing Riprap (Process, P	20.000	100%	8	CY	8,745	2	218.6	27.33
Weepholes - Reach IV	100.000	100%	8	LF	1,009	1	10.1	1.26
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,475	2	11.3	1.42
Levee Clearing								
Excavation	196.000	100%	8	CY	7,000	4	8.9	1.12
Riprap Removal	75.000	100%	8	CY	840	2	5.6	0.70
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	2	1	80.0	10.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Relocation								
Waterline Relocation	0.025	100%	8	EA	1	1	40.0	5.00
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

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Alternative 3B

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Riprap	CY	34,135	16	2134
Excess Excavation	CY	44725	16	2796
Borrow Fill	CY	11680	16	730
Filter Material	CY	14,484	16	906
Concreted Riprap	CY	918	16	58
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	7,000	16	438
CMB	CY	1,475	12	123
Concrete Channel Concrete	CY	100	12	9

Total Haul Truck Trips:	**7235**
Total Construction Days:	180
Avg. Haul Trucks per Day:	**40.1**
Assumed No. of Laborers per Day (avg.):	20
Assumed No. of Mgmt. and OH Staff per Day :	5
Total Staff Vehicle Trips per Day:	25
Avg. Daily Vehicle Trips:	**65.1**

TITLE: VR-2 Preliminary Design
SUBJECT: Construction Durations
MADE BY: OL
CHECKED BY: SKV

JOB NO.:
DATE: 3/8/2022

Alternative 3A

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Concreted Rock Riprap (1/4-ton)	30.000	100%	8	CY	11,718	2	195.3	24.41
Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, P	30.000	100%	8	CY	13,673	2	227.9	28.49
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	9,663	2	241.6	30.20
Excavation	196.000	100%	8	CY	144,666	4	184.5	23.07
Backfill (Toedown Construction)	102.000	100%	8	CY	118,165	4	289.6	36.20
Compacted Fill (Levee Prism)	102.000	100%	8	CY	11,680	1	114.5	14.31
Weepholes	100.000	100%	8	LF	4,937	1	49.4	6.17
Riprap Removal	75.000	100%	8	CY	15,193	2	101.3	12.66
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Riprap (for Tie-In to Fresno Improvements)	60.000	100%	8	CY	1,148	2	9.6	1.20
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	5,972	2	29.9	3.73
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,475	2	11.3	1.42
Levee Clearing								
Excavation	196.000	100%	8	CY	7,000	4	8.9	1.12
Riprap Removal	75.000	100%	8	CY	840	2	5.6	0.70
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	2	1	80.0	10.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Relocation								
Waterline Relocation	0.025	100%	8	EA	1	1	40.0	5.00
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

TITLE:	VR-2 Preliminary Design
SUBJECT:	Construction Durations
MADE BY:	OL
CHECKED BY:	SKV

JOB NO.:
DATE: 3/8/2022

Alternative 3C

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Concreted Riprap Import	CY	21,381	16	1337
Excess Excavation	CY	26,501	16	1657
Borrow Fill	CY	11,680	16	730
Filter Material	CY	5,972	16	374
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	7,000	16	438
CMB	CY	1,475	12	123
Concrete Channel Concrete	CY	100	12	9

Total Haul Truck Trips:	**4709**
Total Construction Days:	188
Avg. Haul Trucks per Day:	**25.1**
Assumed No. of Laborers per Day (avg.):	20
Assumed No. of Mgmt. and OH Staff per Day :	5
Total Staff Vehicle Trips per Day:	25
Avg. Daily Vehicle Trips:	**50.1**

TITLE: VR-2 Preliminary Design
SUBJECT: Construction Durations
MADE BY: OL
CHECKED BY: SKV

JOB NO.:
DATE: 3/8/2022

Alternative 3A

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Concreted Rock Riprap (1/4-ton) [8-foot horizontal base width]	30.000	100%	8	CY	14,324	2	238.7	29.84
Concreted Rock Riprap (1/4-ton) Reusing Existing Riprap (Process, P	30.000	100%	8	CY	13,285	2	221.4	27.68
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	8,361	2	209.0	26.13
Excavation	196.000	100%	8	CY	130,299	4	166.2	20.77
Backfill (Toedown Construction)	102.000	100%	8	CY	104,974	4	257.3	32.16
Compacted Fill (Levee Prism)	102.000	100%	8	CY	11,182	1	109.6	13.70
Weepholes	100.000	100%	8	LF	4,937	1	49.4	6.17
Riprap Removal	75.000	100%	8	CY	14,762	2	98.4	12.30
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Riprap (for Tie-In to Fresno Improvements)	60.000	100%	8	CY	1,148	2	9.6	1.20
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	4,919	2	24.6	3.07
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,475	2	11.3	1.42
Levee Clearing								
Excavation	196.000	100%	8	CY	7,000	4	8.9	1.12
Riprap Removal	75.000	100%	8	CY	840	2	5.6	0.70
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	2	1	80.0	10.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Relocation								
Waterline Relocation	0.025	100%	8	EA	1	1	40.0	5.00
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

TITLE:	VR-2 Preliminary Design
SUBJECT:	Construction Durations
MADE BY:	OL
CHECKED BY:	SKV

JOB NO.:
DATE: 3/8/2022

Alternative 3D

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Concreted Riprap Import	CY	22,685	16	1418
Excess Excavation	CY	25,325	16	1583
Borrow Fill	CY	11,182	16	699
Filter Material	CY	4,919	16	308
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	7,000	16	438
CMB	CY	1,475	12	123
Concrete Channel Concrete	CY	100	12	9

Total Haul Truck Trips:	**4619**
Total Construction Days:	183
Avg. Haul Trucks per Day:	**25.3**
Assumed No. of Laborers per Day (avg.):	20
Assumed No. of Mgmt. and OH Staff per Day :	5
Total Staff Vehicle Trips per Day:	25
Avg. Daily Vehicle Trips:	**50.3**

APPENDIX I-F

Supplemental Alternative Documentation (Setback Levees)

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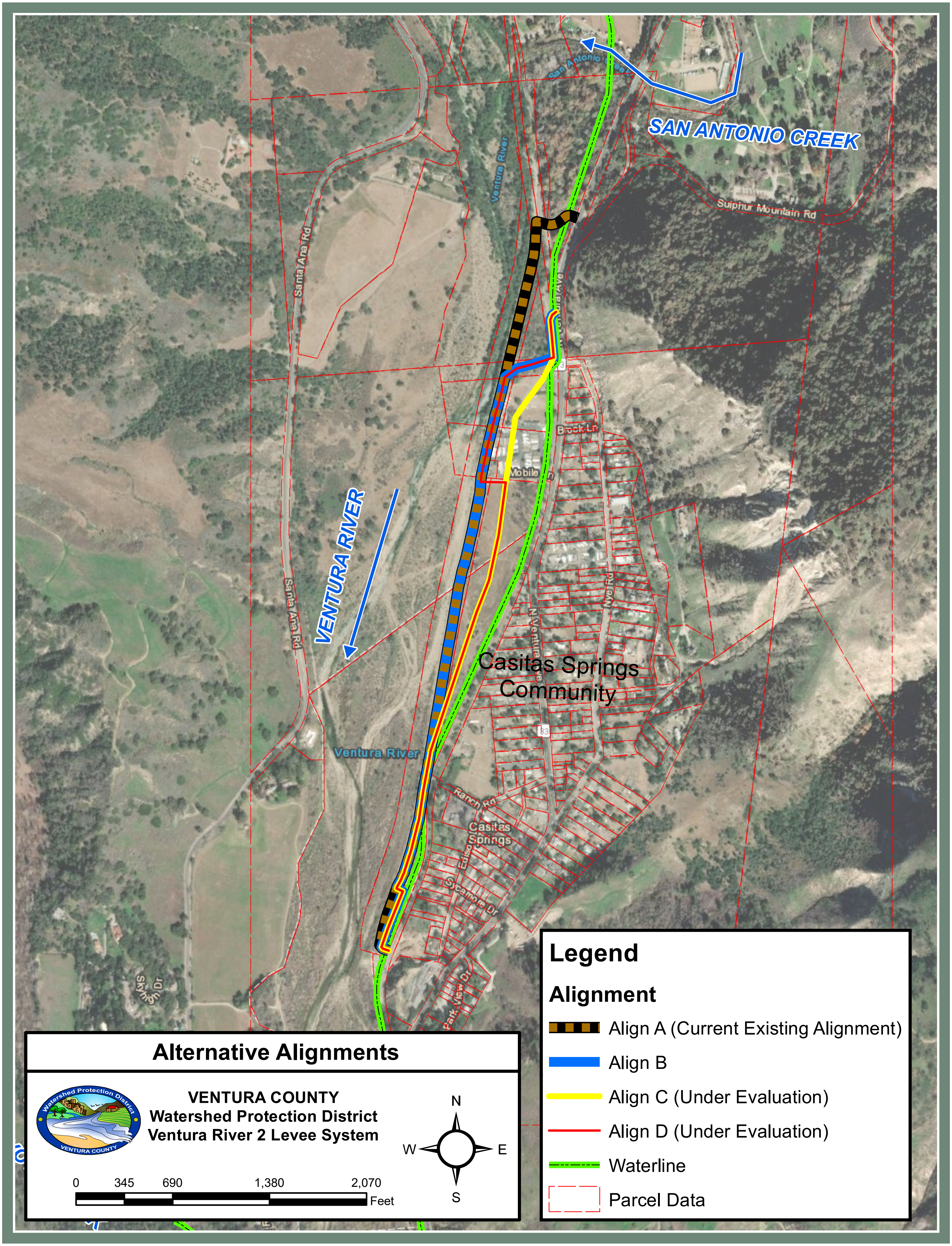
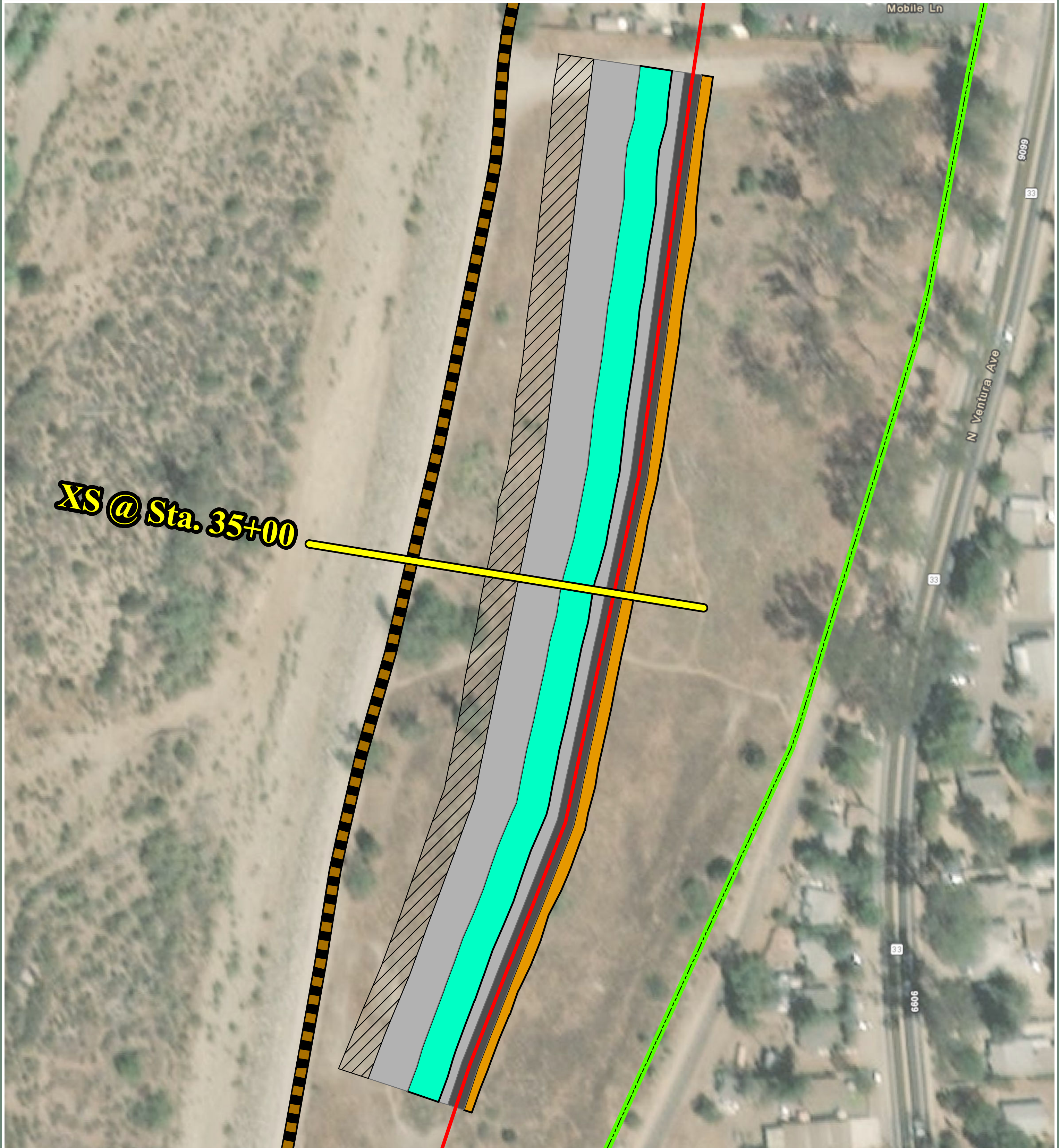


SAN ANTONIO CREEK
San Antonio Creek
Sulphur Mountain Rd
Santa Ana Rd
Ventura River
Brock Ln
Mobile
VENTURA RIVER
N Ventura Ave
Nye Rd
Casitas Springs Community
Ventura River
Ranch Rd
Casitas Springs
Sycamore Dr
Park View Dr
Skyhigh Dr
Legend
Alignment
Align A (Current Existing Alignment)
Align B
Align C (Under Evaluation)
Align D (Under Evaluation)
Waterline
Parcel Data
Alternative Alignments
VENTURA COUNTY
Watershed Protection District
Ventura River 2 Levee System
Watershed Protection District
VENTURA COUNTY
0
345
690
1,380
2,070
Feet
N
W
E
S



Material Comparison - Grouted Stone (2:1)

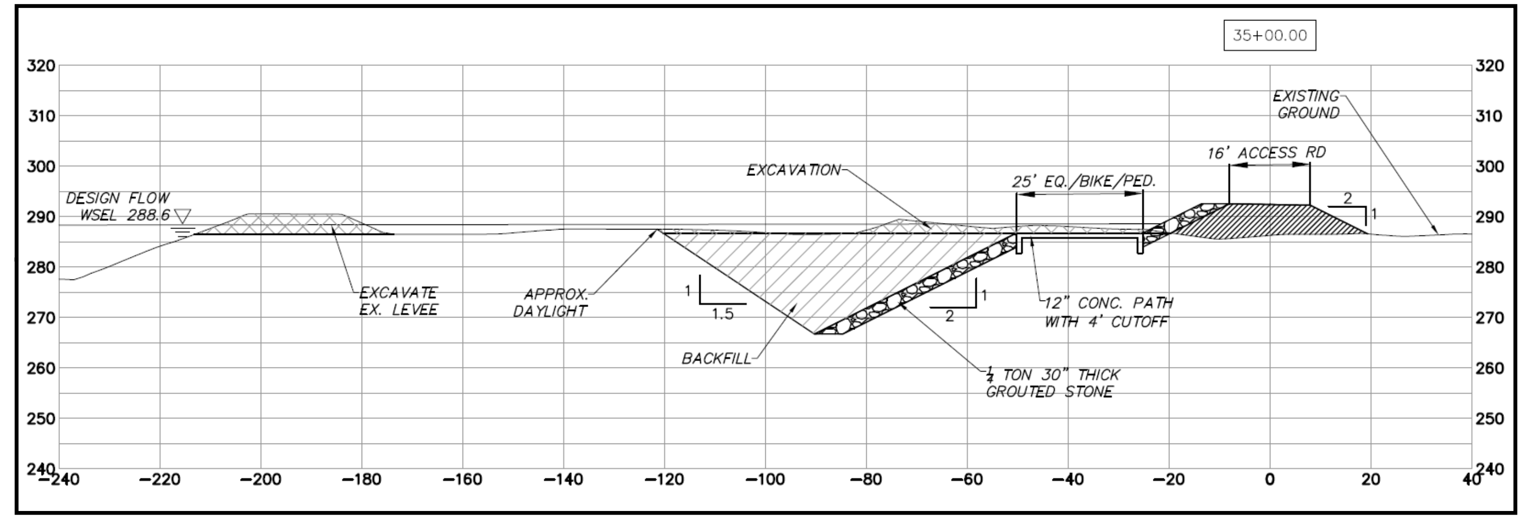
VENTURA COUNTY
Watershed Protection District
Ventura River 2 Levee System

0 50 100 200 300 Feet

N W E S

Legend

- Ex. Align
- Align C
- Waterline
- Crown
- Excavation
- Landside
- Path (GS)
- Grouted Stone



2H:1V Grouted Stone Relative Costs

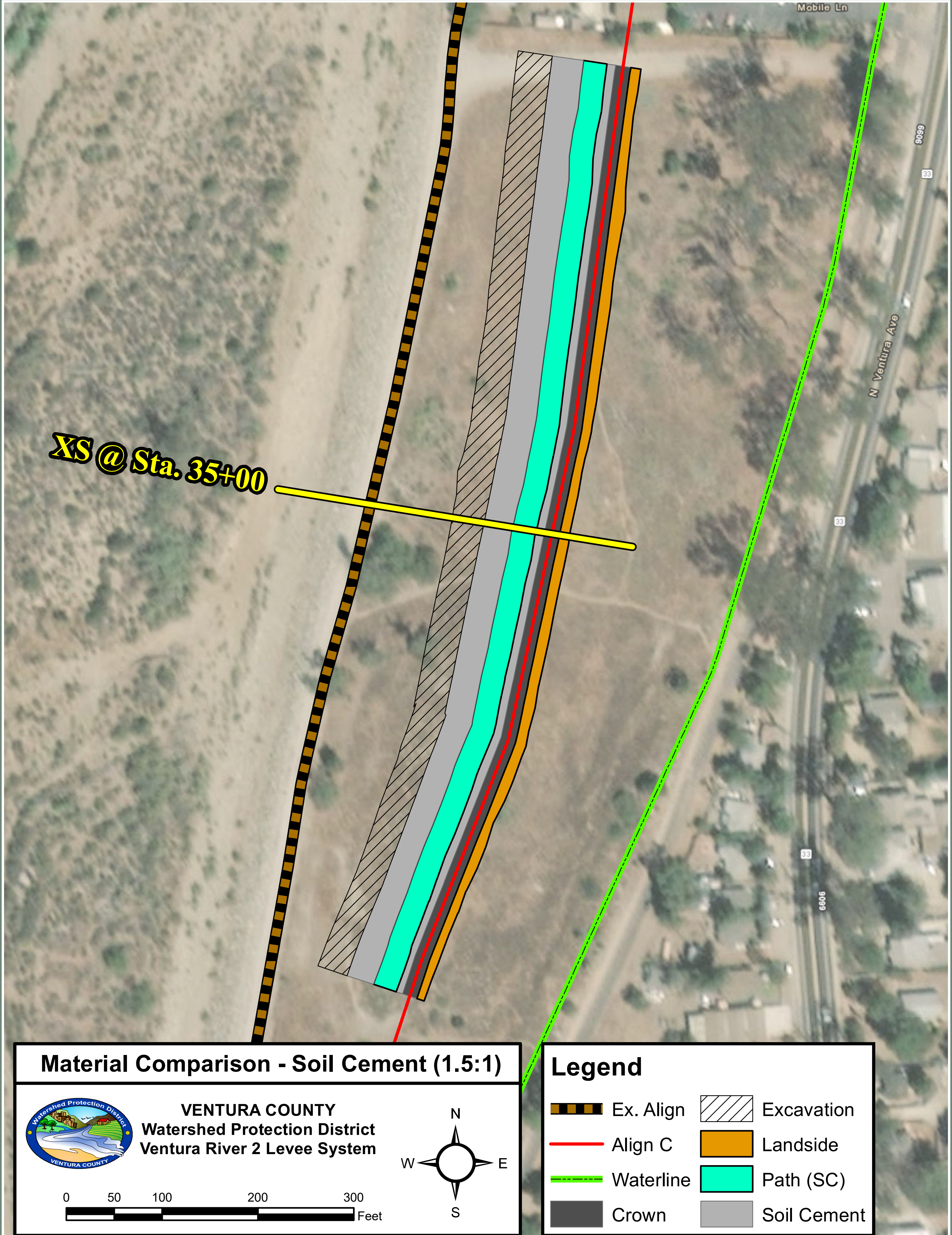
Item	XS Area	Length	Quantity	Unit	Unit Cost	Relative Cost
Grouted Stone Reusing Existing Riprap (Process, Place, Grout)	32	2000	2370	CY	$ 90.00	$ 213,333
Grouted Stone	145	2000	8370	CY	$ 200.00	$ 1,674,074
Excavation	1036	2000	76741	CY	$ 6.00	$ 460,444
Backfill (Toedown Construction	701	2000	51926	CY	$ 5.75	$ 298,574
Compacted Fill (Levee Prism)	174	2000	12889	CY	$ 40.00	$ 515,556
Concrete Path	31	2000	2296	CY	$ 900.00	$ 2,066,667
Access Road	-	2000	32000	SF	$ 5.00	$ 160,000
					TOTAL	$ 5,388,648

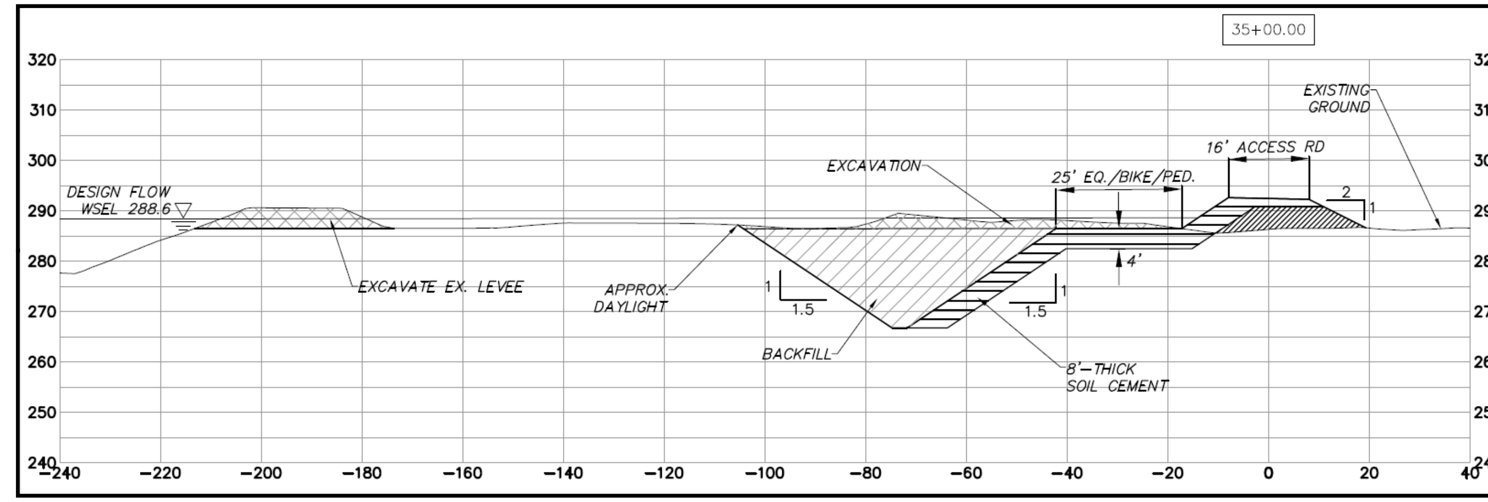
Note: The quantities and costs shown here are reflective of one cross-section along a 1,000-foot reach along the levee system. This table was developed to only be used as a comparative tool, so not all associated construction costs are reflected. These estimates should not be used for planning or budgeting. Unit costs were taken from previous estimates on this project developed in January 2020.

2H:1V Grouted Stone Relative Impact Area

Footprint Type	SF	Acreage
Permanent	107923	2.48
Temporary (Excavation)	29861	0.69
	Total Impacted Area	3.16

Note: The impact areas shown in this table only reflect the 1,000-foot reach shown on the graphic.



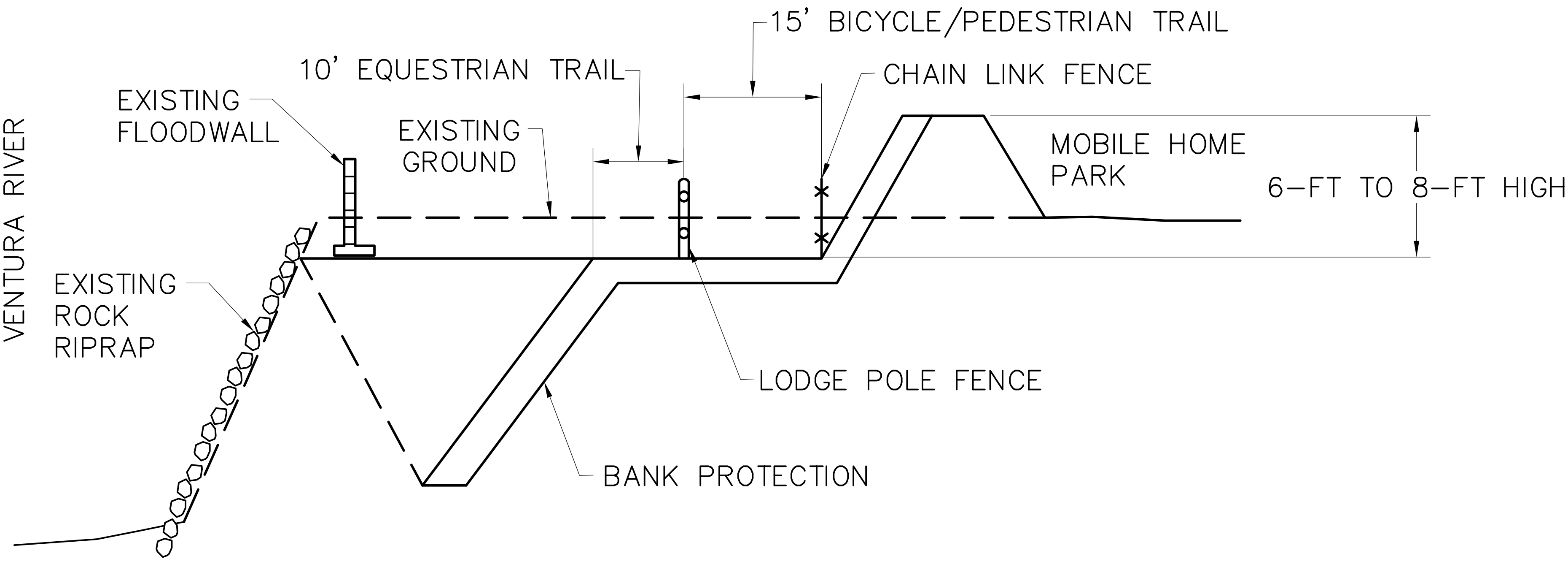


1.5H:1V Soil Cement Relative Costs						
Item	XS Area	Length	Quantity	Unit	Unit Cost	Relative Cost
Soil Cement	401	2000	29704	CY	$ 90.00	$ 2,673,333
Excavation	1077	2000	79778	CY	$ 6.00	$ 478,667
Backfill (Toedown Construction	641	2000	47481	CY	$ 5.75	$ 273,019
Compacted Fill (Levee Prism)	96	2000	7111	CY	$ 40.00	$ 284,444
					TOTAL	$ 3,709,463

Note: The quantities and costs shown here are reflective of one cross-section along a 1,000-foot reach along the levee system. This table was developed to only be used as a comparative tool, so not all associated construction costs are reflected. These estimates should not be used for planning or budgeting. Unit costs were taken from previous estimates on this project developed in January 2020.

1.5H:1V Soil Cement Relative Impact Area		
Footprint Type	SF	Acreage
Permanent	89815	2.06
Temporary (Excavation)	33118	0.76
	Total Impacted Area	2.82

Note: The impact areas shown in this table only reflect the 1,000-foot reach shown on the graphic.



DETAIL

N.T.S.

WATERSHED PROTECTION

DATE AUGUST 2020	PUBLIC VENTURA COUNTY WORKS	VENTURA RIVER LEVEE VR-2	PROJECT NO. 81025 –

VR2 - Alternatives Estimated Cost						
	Alternative / Alignment	Levee Length (ft.)	Project Cost	MHP Relocation Cost	Total Project Cost	Total Impact Area
1.5:1 Soil Cement	1A	5,677	$ 21,605,358		$ 21,605,358	12.14
	1B	4,938	$ 20,185,386		$ 20,185,386	10.29
	1C	4,858	$ 23,381,424	TBD (1)	$ 23,381,424	16.32
	1D	5,192	$ 23,973,153	TBD (2)	$ 23,973,153	14.7
2:1 Riprap	2A	5,677	$ 19,951,814		$ 19,951,814	14.76
	2B	4,938	$ 19,009,729		$ 19,009,729	12.45
	2C	4,858	$ 24,386,951	TBD (1)	$ 24,386,951	18.08
	2D	5,192	$ 24,814,587	TBD (2)	$ 24,814,587	17.15
2:1 Grouted Stone	3A	5,677	$ 19,754,172		$ 19,754,172	14.47
	3B	4,938	$ 18,953,106		$ 18,953,106	12.19
	3C	4,858	$ 27,310,034	TBD (1)	$ 27,310,034	17.96
	3D	5,192	$ 27,833,227	TBD (2)	$ 27,833,227	17
1.5:1 Grouted Stone	4A	5,677	$ 23,567,943		$ 23,567,943	12.81
	4B	4,938	$ 22,508,373		$ 22,508,373	10.87
	4C	4,858	$ 29,755,051	TBD (1)	$ 29,755,051	16.62
	4D	5,192	$ 30,616,377	TBD (2)	$ 30,616,377	13.56

Notes

(1) Purchase City land, and miscellaneous items. MHP relocation; demo existing mobile homes, relocate utilities, purchase land, purchase new mobile homes, roadway, and misc items. (Provided by County)

(2) Purchase City land, and miscellaneous items. (Provided by County)

VR-2 Alternatives

Alternative 1A: 1.5H:1V Soil Cement Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,193,000.00	$ 1,193,000
2	Clearing and Grubbing	ACR	6.0	$ 4,500.00	$ 27,000
3	Diversion and Control of Water	LS	1	$ 2,000,000.00	$ 2,000,000
4	Levee Slope Protection	LF	5,677	$ 1,706.06	$ 9,685,286
4.1	Soil Cement (11' Untrimed)	CY	67,149	$ 90.00	$ 6,043,436
4.2	Excavation	CY	157,749	$ 6.00	$ 946,494
4.3	Backfill (Toedown Construction)	CY	113,115	$ 5.75	$ 650,410
4.4	Compacted Fill (Levee Prism)	CY	7,374	$ 40.00	$ 294,951
4.5	Weephole	LF	5,677	$ 80.00	$ 454,153
4.6	Riprap Removal	CY	23,404	$ 16.00	$ 374,464
4.7	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,550.00	$ 744,000
4.8	Soil Overlay	CY	1,657	$ 40.00	$ 66,267
4.9	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
5	Levee Clearing (to prevent ponding)	EA	1	$ 129,220.00	$ 129,220
5.1	Excavation	CY	3,500	$ 35.00	$ 122,500
5.2	Riprap Removal	CY	420	$ 16.00	$ 6,720
6	Storm Drains	EA	4	$ 21,250.00	$ 85,000
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
6.3	Replace 36-inch Flap Gate	EA	1	$ 7,500.00	$ 7,500
				Subtotal (1)	$ 13,119,506
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 16,619,506
9				Contingency (30%):	$ 4,985,852
				Total Project Cost:	**$ 21,605,358**

VR-2 Alternatives

Alternative 1B: 1.5H:1V Soil Cement Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,093,000.00	$ 1,093,000
2	Clearing and Grubbing	ACR	6.0	$ 4,500.00	$ 27,000
3	Diversion and Control of Water	LS	1	$ 2,000,000.00	$ 2,000,000
4	Levee Slope Protection	LF	4,938	$ 1,735.78	$ 8,571,280
4.1	Soil Cement (11' Untrimed)	CY	56,752	$ 90.00	$ 5,107,696
4.2	Excavation	CY	162,133	$ 6.00	$ 972,795
4.3	Backfill (Toedown Construction)	CY	119,109	$ 5.75	$ 684,879
4.4	Compacted Fill (Levee Prism)	CY	6,005	$ 40.00	$ 240,191
4.5	Weephole	LF	4,937	$ 80.00	$ 394,985
4.6	Riprap Removal	CY	14,618	$ 16.00	$ 233,887
4.7	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,550.00	$ 744,000
4.8	Soil Overlay	CY	2,043	$ 40.00	$ 81,736
4.9	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 12,027,220
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 15,527,220
9				Contingency (30%):	$ 4,658,166
				Total Project Cost:	**$ 20,185,386**

VR-2 Alternatives

Alternative 1C: 1.5H:1V Soil Cement Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,317,000.00	$ 1,317,000
2	Clearing and Grubbing	ACR	22.0	$ 4,500.00	$ 99,000
3	Diversion and Control of Water	LS	1	$ 1,500,000.00	$ 1,500,000
4	Levee Slope Protection	LF	4,858	$ 2,312.43	$ 11,233,771
4.1	Soil Cement (11' Untrimed)	CY	68,759	$ 90.00	$ 6,188,310
4.2	Excavation	CY	218,117	$ 6.00	$ 1,308,702
4.3	Backfill (Toedown Construction)	CY	133,544	$ 5.75	$ 767,878
4.4	Compacted Fill (Levee Prism)	CY	13,371	$ 40.00	$ 534,840
4.5	Weephole	LF	4,858	$ 80.00	$ 388,640
4.6	Riprap Removal	CY	9,865	$ 16.00	$ 157,840
4.7	Floodwall (Remove Existing) - Reach III	LF	480	$ 1,550.00	$ 744,000
4.8	Soil Overlay	CY	1,883	$ 40.00	$ 75,320
4.9	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
4.10	Access Road	SY	7,330	$ 65.00	$ 476,450
4.11	DG EQ Trail	SY	4,345	$ 40.00	$ 173,800
4.12	Guard Cable Fence	LF	4,858	$ 35.00	$ 170,030
4.13	Wooden Post Fence (EQ Trail)	LF	3,910	$ 35.00	$ 136,850
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 14,485,711
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 17,985,711
9				Contingency (30%):	$ 5,395,713
				Total Project Cost:	**$ 23,381,424**

VR-2 Alternatives

Alternative 1D: 1.5H:1V Soil Cement Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,358,000.00	$ 1,358,000
2	Clearing and Grubbing	ACR	23.0	$ 4,500.00	$ 103,500
3	Diversion and Control of Water	LS	1	$ 1,750,000.00	$ 1,750,000
4	Levee Slope Protection	LF	5,192	$ 2,194.42	$ 11,393,447
4.1	Soil Cement (11' Untrimed)	CY	70,008	$ 90.00	$ 6,300,720
4.2	Excavation	CY	221,546	$ 6.00	$ 1,329,276
4.3	Backfill (Toedown Construction)	CY	150,554	$ 5.75	$ 865,686
4.4	Compacted Fill (Levee Prism)	CY	14,919	$ 40.00	$ 596,760
4.5	Weephole	LF	5,192	$ 80.00	$ 415,360
4.6	Riprap Removal	CY	9,229	$ 16.00	$ 147,664
4.7	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.8	Soil Overlay	CY	1,505	$ 40.00	$ 60,200
4.9	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
4.10	Access Road	SY	7,000	$ 65.00	$ 455,000
4.11	DG EQ Trail	SY	3,780	$ 40.00	$ 151,200
4.12	Guard Cable Fence	LF	5,192	$ 35.00	$ 181,720
4.13	Wooden Post Fence (EQ Trail)	LF	3,050	$ 35.00	$ 106,750
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 14,940,887
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 18,440,887
9				Contingency (30%):	$ 5,532,266
				Total Project Cost:	**$ 23,973,153**

VR-2 Alternatives

Alternative 2A: 2H:1V Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,077,000.00	$ 1,077,000
2	Clearing and Grubbing	ACR	6.0	$ 4,500.00	$ 27,000
3	Diversion and Control of Water	LS	1	$ 2,000,000.00	$ 2,000,000
4	Levee Slope Protection	LF	5,677	$ 1,502.44	$ 8,529,329
4.1	Riprap	CY	39,658	$ 125.00	$ 4,957,269
4.2	Reuse Existing Riprap	CY	7,218	$ 16.00	$ 115,495
4.3	Excavation	CY	117,779	$ 6.00	$ 706,673
4.4	Backfill (Toedown Construction)	CY	94,306	$ 5.75	$ 542,261
4.5	Compacted Fill (Levee Prism)	CY	11,627	$ 40.00	$ 465,093
4.6	Geotextile	SY	20,592	$ 3.50	$ 72,073
4.7	Riprap Removal	CY	23,404	$ 16.00	$ 374,464
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.9	Access Road	SY	9,600	$ 65.00	$ 624,000
5	Levee Clearing (to prevent ponding)	EA	1	$ 129,220.00	$ 129,220
5.1	Excavation	CY	3,500	$ 35.00	$ 122,500
5.2	Riprap Removal	CY	420	$ 16.00	$ 6,720
6	Storm Drains	EA	4	$ 21,250.00	$ 85,000
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
6.3	Replace 36-inch Flap Gate	EA	1	$ 7,500.00	$ 7,500
				Subtotal (1)	$ 11,847,549
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 15,347,549
9				Contingency (30%):	$ 4,604,265
				Total Project Cost:	**$ 19,951,814**

VR-2 Alternatives

Alternative 2B: 2H:1V Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,011,000.00	$ 1,011,000
2	Clearing and Grubbing	ACR	6.0	$ 4,500.00	$ 27,000
3	Diversion and Control of Water	LS	1	$ 2,000,000.00	$ 2,000,000
4	Levee Slope Protection	LF	4,938	$ 1,569.24	$ 7,748,928
4.1	Riprap	CY	32,459	$ 125.00	$ 4,057,374
4.2	Reuse Existing Riprap	CY	7,218	$ 16.00	$ 115,495
4.3	Excavation	CY	141,753	$ 6.00	$ 850,520
4.4	Backfill (Toedown Construction)	CY	117,340	$ 5.75	$ 674,708
4.5	Compacted Fill (Levee Prism)	CY	11,680	$ 40.00	$ 467,194
4.6	Geotextile	SY	17,416	$ 3.50	$ 60,958
4.7	Riprap Removal	CY	17,946	$ 16.00	$ 287,131
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.9	Access Road	SY	8,670	$ 65.00	$ 563,550
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 11,122,868
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 14,622,868
9				Contingency (30%):	$ 4,386,860
				Total Project Cost:	**$ 19,009,729**

VR-2 Alternatives

Alternative 2C: 2H:1V Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,387,000.00	$ 1,387,000
2	Clearing and Grubbing	ACR	22.0	$ 4,500.00	$ 99,000
3	Diversion and Control of Water	LS	1	$ 1,500,000.00	$ 1,500,000
4	Levee Slope Protection	LF	4,853	$ 2,459.77	$ 11,937,253
4.1	Riprap	CY	32,430	$ 125.00	$ 4,053,750
4.2	Reuse Existing Riprap	CY	7,311	$ 16.00	$ 116,976
4.3	Excavation	CY	212,720	$ 6.00	$ 1,276,320
4.4	Backfill (Toedown Construction)	CY	141,123	$ 5.75	$ 811,457
4.5	Compacted Fill (Levee Prism)	CY	31,584	$ 40.00	$ 1,263,360
4.6	Geotextile	SY	15,372	$ 3.50	$ 53,802
4.7	Riprap Removal	CY	10,593	$ 16.00	$ 169,488
4.8	Floodwall (Remove Existing) - Reach III	LF	480	$ 250.00	$ 120,000
4.9	Access Road	SY	7,330	$ 65.00	$ 476,450
4.10	DG EQ Trail	SY	4,345	$ 40.00	$ 173,800
4.11	Wooden Post Fence (EQ Trail)	LF	3,910	$ 35.00	$ 136,850
4.12	RC Slab for EQ / Bicycle Trails	CY	3,650	$ 900.00	$ 3,285,000
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 15,259,193
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 18,759,193
9				Contingency (30%):	$ 5,627,758
				Total Project Cost:	**$ 24,386,951**

VR-2 Alternatives

Alternative 2D: 2H:1V Riprap

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,417,000.00	$ 1,417,000
2	Clearing and Grubbing	ACR	23.0	$ 4,500.00	$ 103,500
3	Diversion and Control of Water	LS	1	$ 1,750,000.00	$ 1,750,000
4	Levee Slope Protection	LF	5,192	$ 2,307.72	$ 11,981,704
4.1	Riprap	CY	40,373	$ 125.00	$ 5,046,625
4.2	Reuse Existing Riprap	CY	7,467	$ 16.00	$ 119,472
4.3	Excavation	CY	197,669	$ 6.00	$ 1,186,014
4.4	Backfill (Toedown Construction)	CY	152,599	$ 5.75	$ 877,444
4.5	Compacted Fill (Levee Prism)	CY	14,722	$ 40.00	$ 588,880
4.6	Geotextile	SY	17,099	$ 3.50	$ 59,847
4.7	Riprap Removal	CY	9,592	$ 16.00	$ 153,472
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.9	Access Road	SY	7,000	$ 65.00	$ 455,000
4.10	DG EQ Trail	SY	3,780	$ 40.00	$ 151,200
4.11	Wooden Post Fence (EQ Trail)	LF	3,050	$ 35.00	$ 106,750
4.12	RC Slab for EQ / Bicycle Trails	CY	2,850	$ 900.00	$ 2,565,000
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 15,588,144
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 19,088,144
9				Contingency (30%):	$ 5,726,443
				Total Project Cost:	**$ 24,814,587**

VR-2 Alternatives

Alternative 3A: 2H:1V Grouted Stone

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,063,000.00	$ 1,063,000
2	Clearing and Grubbing	ACR	6.0	$ 4,500.00	$ 27,000
3	Diversion and Control of Water	LS	1	$ 2,000,000.00	$ 2,000,000
4	Levee Slope Protection	LF	5,677	$ 1,478.12	$ 8,391,297
4.1	Grouted Stone	CY	12,947	$ 200.00	$ 2,589,477
4.2	Grouted Stone Reusing Existing Riprap (Process, Place, Grout)	CY	21,655	$ 90.00	$ 1,948,976
4.3	Excavation	CY	103,960	$ 6.00	$ 623,758
4.4	Backfill (Toedown Construction)	CY	91,872	$ 5.75	$ 528,265
4.5	Compacted Fill (Levee Prism)	CY	11,627	$ 40.00	$ 465,093
4.6	Weepholes	LF	5,677	$ 80.00	$ 454,153
4.7	Riprap Removal	CY	23,404	$ 16.00	$ 374,464
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.9	Access Road	SY	9,600	$ 65.00	$ 624,000
4.9	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
5	Levee Clearing (to prevent ponding)	EA	1	$ 129,220.00	$ 129,220
5.1	Excavation	CY	3,500	$ 35.00	$ 122,500
5.2	Riprap Removal	CY	420	$ 16.00	$ 6,720
6	Storm Drains	EA	4	$ 21,250.00	$ 85,000
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
6.3	Replace 36-inch Flap Gate	EA	1	$ 7,500.00	$ 7,500
				Subtotal (1)	$ 11,695,517
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 15,195,517
9				Contingency (30%):	$ 4,558,655
				Total Project Cost:	**$ 19,754,172**

VR-2 Alternatives

Alternative 3B: 2H:1V Grouted Stone Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,007,000.00	$ 1,007,000
2	Clearing and Grubbing	ACR	6.0	$ 4,500.00	$ 27,000
3	Diversion and Control of Water	LS	1	$ 2,000,000.00	$ 2,000,000
4	Levee Slope Protection	LF	4,938	$ 1,561.23	$ 7,709,373
4.1	Grouted Stone	CY	11,494	$ 200.00	$ 2,298,822
4.2	Grouted Stone Reusing Existing Riprap (Process, Place, Grout)	CY	16,293	$ 90.00	$ 1,466,379
4.3	Excavation	CY	130,014	$ 6.00	$ 780,082
4.4	Backfill (Toedown Construction)	CY	116,494	$ 5.75	$ 669,843
4.5	Compacted Fill (Levee Prism)	CY	11,680	$ 40.00	$ 467,194
4.6	Weepholes	LF	4,937	$ 80.00	$ 394,985
4.7	Riprap Removal	CY	17,838	$ 16.00	$ 285,407
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.9	Access Road	SY	8,670	$ 65.00	$ 563,550
4.10	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 11,079,313
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 14,579,313
9				Contingency (30%):	$ 4,373,794
				Total Project Cost:	**$ 18,953,106**

VR-2 Alternatives

Alternative 3C: 2H:1V Grouted Stone Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,592,000.00	$ 1,592,000
2	Clearing and Grubbing	ACR	22.0	$ 4,500.00	$ 99,000
3	Diversion and Control of Water	LS	1	$ 1,500,000.00	$ 1,500,000
4	Levee Slope Protection	LF	4,858	$ 2,877.89	$ 13,980,778
4.1	Grouted Stone	CY	26,414	$ 200.00	$ 5,282,800
4.2	Grouted Stone Reusing Existing Riprap (Process, Place, Grout)	CY	7,009	$ 90.00	$ 630,810
4.3	Excavation	CY	207,067	$ 6.00	$ 1,242,402
4.4	Backfill (Toedown Construction)	CY	135,451	$ 5.75	$ 778,843
4.5	Compacted Fill (Levee Prism)	CY	30,203	$ 40.00	$ 1,208,120
4.6	Weepholes	LF	4,745	$ 80.00	$ 379,600
4.7	Riprap Removal	CY	9,687	$ 16.00	$ 154,992
4.8	Floodwall (Remove Existing) - Reach III	LF	480	$ 250.00	$ 120,000
4.9	Access Road	SY	7,330	$ 65.00	$ 476,450
4.10	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
4.11	DG EQ Trail	SY	4,345	$ 40.00	$ 173,800
4.12	Wooden Post Fence (EQ Trail)	LF	3,910	$ 35.00	$ 136,850
4.13	RC Slab for EQ / Bicycle Trails	CY	3,650	$ 900.00	$ 3,285,000
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 17,507,718
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 21,007,718
9				Contingency (30%):	$ 6,302,316
				Total Project Cost:	**$ 27,310,034**

VR-2 Alternatives

Alternative 3D: 2H:1V Grouted Stone Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,628,000.00	$ 1,628,000
2	Clearing and Grubbing	ACR	23.0	$ 4,500.00	$ 103,500
3	Diversion and Control of Water	LS	1	$ 1,750,000.00	$ 1,750,000
4	Levee Slope Protection	LF	5,192	$ 2,714.32	$ 14,092,735
4.1	Grouted Stone	CY	28,059	$ 200.00	$ 5,611,800
4.2	Grouted Stone Reusing Existing Riprap (Process, Place, Grout)	CY	7,456	$ 90.00	$ 671,040
4.3	Excavation	CY	196,381	$ 6.00	$ 1,178,286
4.4	Backfill (Toedown Construction)	CY	144,962	$ 5.75	$ 833,532
4.5	Compacted Fill (Levee Prism)	CY	29,199	$ 40.00	$ 1,167,960
4.6	Weepholes	LF	5,192	$ 80.00	$ 415,360
4.7	Riprap Removal	CY	9,606	$ 16.00	$ 153,696
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.9	Access Road	SY	7,000	$ 65.00	$ 455,000
4.10	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
4.11	DG EQ Trail	SY	3,780	$ 40.00	$ 151,200
4.12	Wooden Post Fence (EQ Trail)	LF	3,050	$ 35.00	$ 106,750
4.13	RC Slab for EQ / Bicycle Trails	CY	2,850	$ 900.00	$ 2,565,000
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 17,910,175
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 21,410,175
9				Contingency (30%):	$ 6,423,052
				Total Project Cost:	**$ 27,833,227**

VR-2 Alternatives

Alternative 4A: 1.5H:1V Grouted Stone

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,330,000.00	$ 1,330,000
2	Clearing and Grubbing	ACR	6.0	$ 4,500.00	$ 27,000
3	Diversion and Control of Water	LS	1	$ 2,000,000.00	$ 2,000,000
4	Levee Slope Protection	LF	5,677	$ 1,947.85	$ 11,057,967
4.1	Grouted Stone (8' Horizontal Base Width)	CY	19,093	$ 250.00	$ 4,773,279
4.2	Grouted Stone Reusing Existing Riprap (Process, Place, Grout)	CY	21,655	$ 112.50	$ 2,436,220
4.3	Excavation	CY	107,776	$ 6.00	$ 646,657
4.4	Backfill (Toedown Construction)	CY	89,543	$ 5.75	$ 514,872
4.5	Compacted Fill (Levee Prism)	CY	11,280	$ 40.00	$ 451,211
4.6	Weepholes	LF	5,677	$ 80.00	$ 454,153
4.7	Riprap Removal	CY	23,404	$ 16.00	$ 374,464
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.9	Access Road	SY	9,600	$ 65.00	$ 624,000
4.10	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
5	Levee Clearing (to prevent ponding)	EA	1	$ 129,220.00	$ 129,220
5.1	Excavation	CY	3,500	$ 35.00	$ 122,500
5.2	Riprap Removal	CY	420	$ 16.00	$ 6,720
6	Storm Drains	EA	4	$ 21,250.00	$ 85,000
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
6.3	Replace 36-inch Flap Gate	EA	1	$ 7,500.00	$ 7,500
				Subtotal (1)	$ 14,629,187
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 18,129,187
9				Contingency (30%):	$ 5,438,756
				Total Project Cost:	**$ 23,567,943**

VR-2 Alternatives

Alternative 4B: 1.5H:1V Grouted Stone Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,256,000.00	$ 1,256,000
2	Clearing and Grubbing	ACR	6.0	$ 4,500.00	$ 27,000
3	Diversion and Control of Water	LS	1	$ 2,000,000.00	$ 2,000,000
4	Levee Slope Protection	LF	4,938	$ 2,064.64	$ 10,195,193
4.1	Grouted Stone (8' Horizontal Base Width)	CY	18,062	$ 250.00	$ 4,515,454
4.2	Grouted Stone Reusing Existing Riprap (Process, Place, Grout)	CY	16,293	$ 112.50	$ 1,832,973
4.3	Excavation	CY	127,332	$ 6.00	$ 763,990
4.4	Backfill (Toedown Construction)	CY	106,867	$ 5.75	$ 614,488
4.5	Compacted Fill (Levee Prism)	CY	11,182	$ 40.00	$ 447,270
4.6	Weepholes	LF	4,937	$ 80.00	$ 394,985
4.7	Riprap Removal	CY	17,461	$ 16.00	$ 279,371
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.9	Access Road	SY	8,670	$ 65.00	$ 563,550
4.10	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 13,814,133
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 17,314,133
9				Contingency (30%):	$ 5,194,240
				Total Project Cost:	**$ 22,508,373**

VR-2 Alternatives

Alternative 4C: 1.5H:1V Grouted Stone Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,763,000.00	$ 1,763,000
2	Clearing and Grubbing	ACR	22.0	$ 4,500.00	$ 99,000
3	Diversion and Control of Water	LS	1	$ 1,500,000.00	$ 1,500,000
4	Levee Slope Protection	LF	4,858	$ 3,229.84	$ 15,690,561
4.1	Grouted Stone (8' Horizontal Base Width)	CY	28,377	$ 250.00	$ 7,094,250
4.2	Grouted Stone Reusing Existing Riprap (Process, Place, Grout)	CY	7,134	$ 112.50	$ 802,575
4.3	Excavation	CY	162,699	$ 6.00	$ 976,194
4.4	Backfill (Toedown Construction)	CY	122,092	$ 5.75	$ 702,029
4.5	Compacted Fill (Levee Prism)	CY	27,316	$ 40.00	$ 1,092,640
4.6	Weepholes	LF	4,858	$ 80.00	$ 388,640
4.7	Riprap Removal	CY	10,062	$ 16.00	$ 160,992
4.8	Floodwall (Remove Existing) - Reach III	LF	480	$ 250.00	$ 120,000
4.9	Access Road	SY	7,330	$ 65.00	$ 476,450
4.10	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
4.11	DG EQ Trail	SY	4,345	$ 40.00	$ 173,800
4.12	Guard Cable Fence	LF	4,858	$ 35.00	$ 170,030
4.13	Wooden Post Fence (EQ Trail)	LF	3,910	$ 35.00	$ 136,850
4.14	RC Slab for EQ / Bicycle Trails	CY	3,650	$ 900.00	$ 3,285,000
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 19,388,501
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 22,888,501
9				Contingency (30%):	$ 6,866,550
				Total Project Cost:	**$ 29,755,051**

VR-2 Alternatives

Alternative 4D: 1.5H:1V Grouted Stone Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,823,000.00	$ 1,823,000
2	Clearing and Grubbing	ACR	23.0	$ 4,500.00	$ 103,500
3	Diversion and Control of Water	LS	1	$ 1,750,000.00	$ 1,750,000
4	Levee Slope Protection	LF	5,192	$ 3,089.10	$ 16,038,619
4.1	Grouted Stone (8' Horizontal Base Width)	CY	30,356	$ 250.00	$ 7,589,000
4.2	Grouted Stone Reusing Existing Riprap (Process, Place, Grout)	CY	7,374	$ 112.50	$ 829,575
4.3	Excavation	CY	165,693	$ 6.00	$ 994,158
4.4	Backfill (Toedown Construction)	CY	122,101	$ 5.75	$ 702,081
4.5	Compacted Fill (Levee Prism)	CY	27,898	$ 40.00	$ 1,115,920
4.6	Weepholes	LF	5,192	$ 80.00	$ 415,360
4.7	Riprap Removal	CY	9,359	$ 16.00	$ 149,744
4.8	Floodwall (Remove Existing and Replace) - Reach III	LF	480	$ 1,400.00	$ 672,000
4.9	Access Road	SY	7,000	$ 65.00	$ 455,000
4.10	Riprap (for Tie-In to Fresno Improvements)	CY	889	$ 125.00	$ 111,111
4.11	DG EQ Trail	SY	3,780	$ 40.00	$ 151,200
4.12	Guard Cable Fence	LF	5,192	$ 35.00	$ 181,720
4.13	Wooden Post Fence (EQ Trail)	LF	3,050	$ 35.00	$ 106,750
4.14	RC Slab for EQ / Bicycle Trails	CY	2,850	$ 900.00	$ 2,565,000
5	Levee Clearing (to prevent ponding)	EA	2	$ 129,220.00	$ 258,440
5.1	Excavation	CY	7,000	$ 35.00	$ 245,000
5.2	Riprap Removal	CY	840	$ 16.00	$ 13,440
6	Storm Drains	EA	4	$ 19,375.00	$ 77,500
6.1	Replace Inlet/Outlet Structures and Extend Riverside End of Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.2	Replace 24-inch Flap Gates	EA	2	$ 5,000.00	$ 10,000
				Subtotal (1)	$ 20,051,059
7				Planning, Engineering, and Design:	$ 2,000,000
8				Construction Management:	$ 1,500,000
				Subtotal (2):	$ 23,551,059
9				Contingency (30%):	$ 7,065,318
				Total Project Cost:	**$ 30,616,377**

VR-2 Levee Project

PROGRESS MEETING

November 29, 2021

Meeting Minutes

These minutes summarize the items discussed or issues resolved at the meeting to the best of the writer's ability. If the recipients understand differently, please notify the writer as soon as possible so corrections can be made.

Attendees:

NAME	AFFILIATION	PHONE	E-MAIL
Kirk Norman	VCPWA - WP	805-654-2017	Kirk.Norman@ventura.org
Masood Jilani	VCPWA - WP	805-654-2029	Masood.Jiliani@ventura.org
Robin Jester	VCPWA - WP	805-654-3986	Robin.Jester@ventura.org
Ike Pace	Tetra Tech	949-809-5120	Ike.Pace@tetratech.com
Doug Bell	Tetra Tech	909-860-7777	Doug.Bell@tetratech.com
Orlando Lopes	Tetra Tech	949-809-5108	Orlando.Lopes@tetratech.com

- Robin Jester stated that as recently as last week Alignment C and Alignment D have lost traction. As it stands, these alignments are viewed as less favorable due to the potential of the terrace providing an area for homeless encampments. For this and other reasons, Alignment C and Alignment D (as shown on current graphics) should not be pursued any further at this time.
    - While a full evaluation of these alignments will not be included in the report, the VCPWA-WP asked that a short write-up describing the effort and conclusion for these alignments be briefly described in the alternatives report and the work developed thus far be included in an appendix.
- Based on discussion, the District has advised to move forward with the following alternatives to be included in the alternatives report:
        - Alternative 1: Alignment A as shown on current graphics – the current existing levee alignment.
        - Alternative 2: An alignment with the levee bending towards Hwy 33 at the upstream end just upstream of the Mobile Home Park to avoid an area of habitat.

    - Alternative 3: Alignment B as shown in the current graphics - an alignment where the levee bends towards Hwy 33 along with an offset at the downstream end of the levee to adjust it away from the active riverbed.
    - No Action Alternative
  - The report will include an evaluation of each alignment with the different revetment options: 1.5H:1V Soil Cement, 2H:1V Riprap, 2H:1V Grouted Stone, and 1.5H:1V Grouted Stone.
  - Tetra Tech will work on revising the current report such that it follows the alternatives as described above. The report needs to be revised to reflect that the alternatives are related to levee alignment rather than to material type.
  - For the riprap material option, Ike Pace described that overlaying the existing riprap with a new rock layer would (1) increase the footprint of the improvements, and (2) limit the amount of rock that could be reused. The existing revetment will need to be removed and sorted in order to meet a stable gradation. However, material conforming to the design standards for quality and size may be stockpiled and reused in construction of the new levee.
- Report Review
  - Comments on the following reports were provided: H&H Sediment Report (July 2020), Interior Drainage Report (July 2020), and the VR-2 Alternatives Report (February 2020). These reports were reviewed by Krassimir Roussev. Kirk Norman indicated that no further comments will be provided on these reports, and that the comments appear to not interrupt the progress of the design. Tetra Tech can continue with addressing these comments to prepare the finalized reports.
  - Robin mentioned that she is currently reviewing the Draft Geotechnical Report. She anticipates providing the review comments to Tetra Tech by early next week (12/6).
- Schedule
  - VCPWA-WP confirmed that the intent is still to have the 30% package completed by the end of March 2022.
  - Orlando Lopes indicated that to meet this expedited schedule, the team will have to shorten the review periods and modify the technical studies meetings (as identified in the scope) to fast-track the schedule. Technical studies meetings will likely need to be performed virtually.
  - It was agreed to schedule follow up meetings, as needed, within a few days of work product completion and delivery to WP by Tetra Tech rather than having regular monthly meetings.

- Contracting
    - Currently, the contract has an end date of 12/31/2021. Ike mentioned that the project should be extended through the end of June 2022 to give some buffer at the end of the project. The District agreed. VCPWA-WP will initiate the revised contract end date.

Action Items:

<u>Tetra Tech</u>

1) Revise the current report such that it follows the alternatives as described in these meeting minutes.
2) Address provided review comments in corresponding reports.
3) Reach out to coordinate meetings as necessary to continue the project.

<u>VCPWA-WP</u>

1) Provide review comments on the geotechnical report.
2) Extend the contract through the end of June 2022.

APPENDIX II

30% Design Documents

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APPENDIX II-G

30% Design Plan Set

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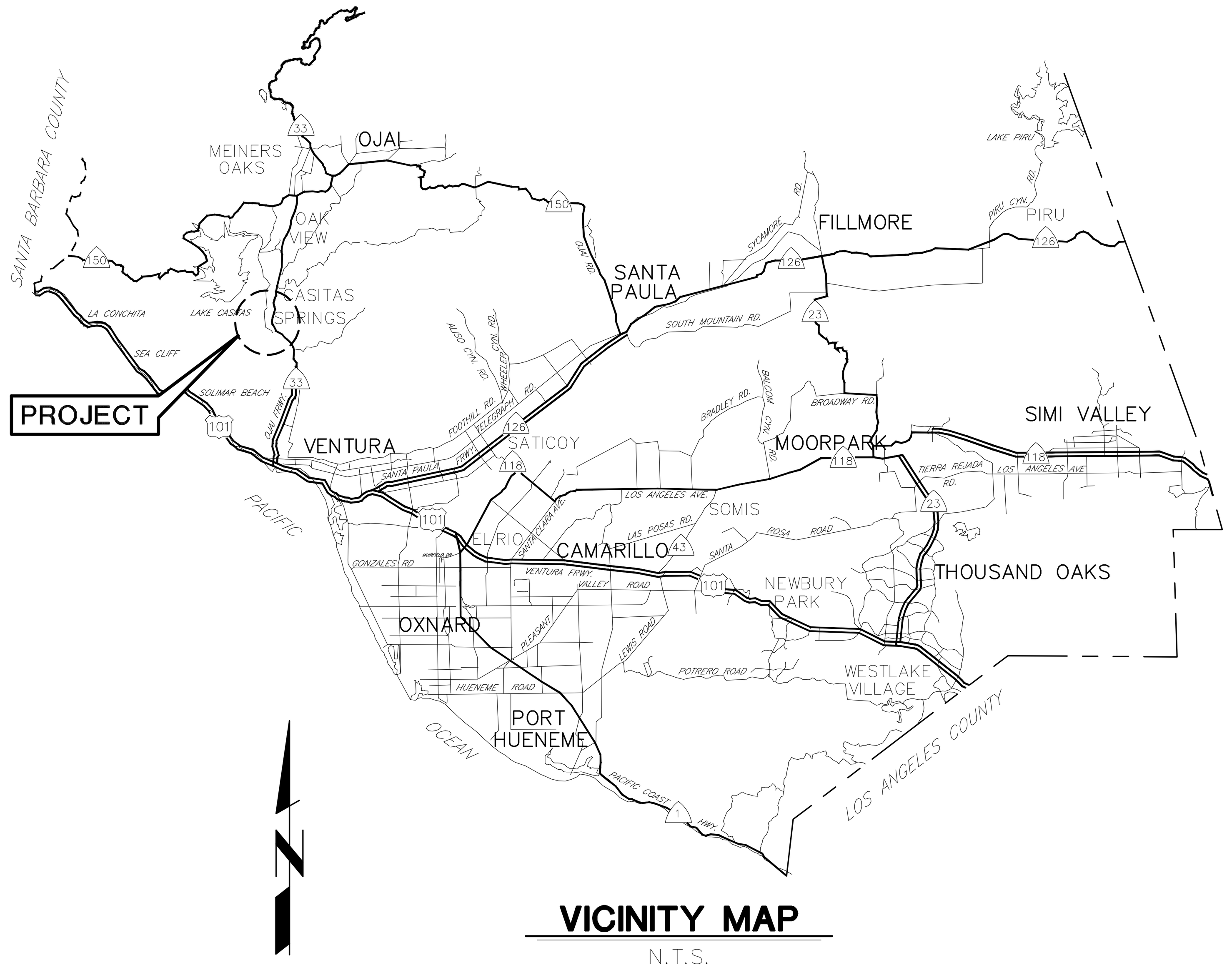


VICINITY MAP

N.T.S.

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

ZONE NO. 1

VENTURA RIVER LEVEE 2 (VR-2)
LEVEE IMPROVEMENT PROJECT

STA. 2+32 TO 54+12

INDEX TO SHEETS

GENERAL NOTES

1. ELEVATIONS SHOWN ARE IN US FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
2. STATIONS SHOWN ON DRAWINGS ARE ALONG CONTROL LINE OF STRUCTURE.
3. E.G.L. AND H.G.L. ARE SHOWN FOR FUTURE REFERENCE BY THE DISTRICT ONLY.
4. NUMBERS IN ⟨–⟩ INDICATE BID ITEMS FOR WHICH PAYMENT WILL BE MADE.
5. LETTER AND NUMBER IN ⊖ INDICATE THE DETAIL CALL-OUT AND SHEET ON WHICH REFERENCE DETAIL IS SHOWN.
6. NUMBERS IN △ REFER TO NOTES ON SAME SHEET UNLESS OTHERWISE NOTED.
7. ALL VEGETATION WITHIN PROJECT FOOTPRINT, INCLUDING TREES, SHALL BE REMOVED UNLESS INDICATED OTHERWISE.
8. DELINEATES LIMITS OF VCWPD RIGHT OF WAY.
9. DELINEATES LIMITS OF TEMPORARY WORK AREA.
10. TOPOGRAPHY AND CROSS SECTIONS FOR THIS PROJECT WERE TAKEN FROM SURVEYS PERFORMED IN 12/2016.
11. SYMBOL ▲ INDICATES THE LOCATION OF HORIZONTAL AND VERTICAL CONTROL POINTS WHICH WILL BE FURNISHED BY THE AGENCY FOR CONSTRUCTION USE.

    SURVEY CONTROL POINTS

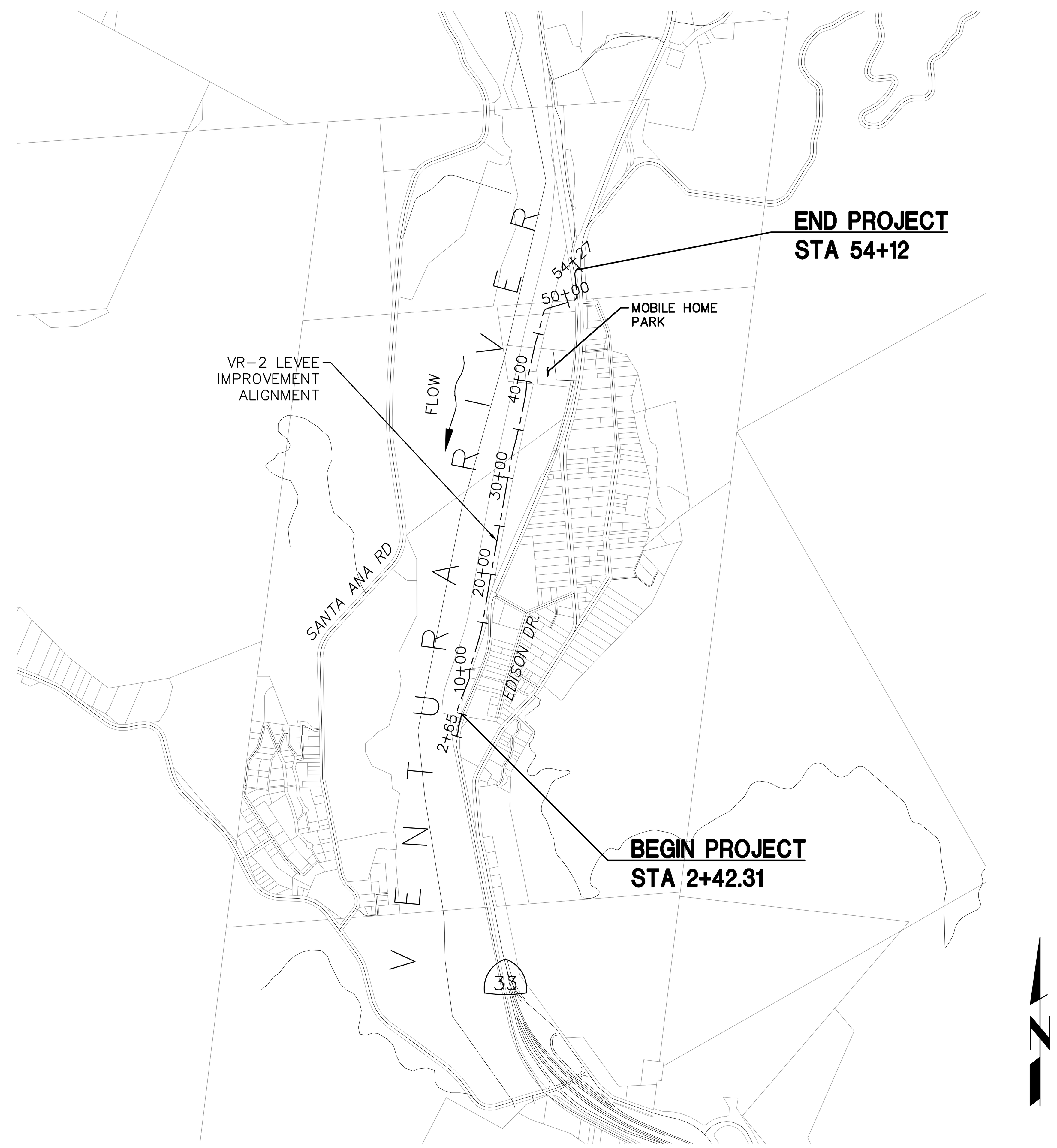
PT 1000	NORTHING/Y: 1,912,375.88	EASTING/X: 6,202,678.15	ELEV/Z: 73.30
PT 1001	NORTHING/Y: 1,912,770.27	EASTING/X: 6,203,042.61	ELEV/Z: 80.89
PT 1002	NORTHING/Y: 1,913,134.14	EASTING/X: 6,203,458.15	ELEV/Z: 81.74

    HORIZONTAL DATUM AND BASIS OF BEARINGS PER CCS83, ZONE 5, 2000.35 EPOCH (US SURVEY FEET). VERTICAL DATUM PER NAVD 88, VC. ADJ. 1992. FIELD SURVEY NOTES ARE ON FILE IN THE OFFICE OF THE VENTURA COUNTY SURVEYOR. CONTACT JOE DeCHELLIS, DEPUTY COUNTY SURVEYOR FOR ADDITIONAL INFORMATION.
12. SOIL TEST BORINGS SHOWN FOR THE PROJECT WERE MADE ON OCTOBER 2 THROUGH 4, OCTOBER 8 AND 9, 2018. REFER TO THE SPECIFICATIONS FOR ADDITIONAL GEOTECHNICAL REPORT INFORMATION. SUBSURFACE SOIL INVESTIGATION RESULTS ARE FURNISHED FOR INFORMATION ONLY IN ACCORDANCE WITH SUBSECTION 2-7 OF THE STANDARD SPECIFICATIONS, AND NO WARRANTY IS MADE THEREFOR.
13. EXISTING IMPROVEMENTS WITHIN THE RIGHT OF WAY AND WORK AREAS SHALL REMAIN AND SHALL BE PROTECTED UNLESS OTHERWISE NOTED. DAMAGED IMPROVEMENTS SHALL BE REPLACED IN KIND TO A CONDITION EQUAL TO OR BETTER THAN THAT WHICH EXISTED PRIOR TO CONSTRUCTION.
14. UTILITIES ARE SHOWN AS KNOWN TO EXIST AT TIME OF SURVEY. UTILITIES MAY HAVE BEEN OMITTED, MISPLACED, AND/OR RELOCATED. CONTRACTOR SHALL EXERCISE CARE IN EXCAVATION AND SHALL PROTECT ALL UTILITIES.
15. CONTRACTOR SHALL NOTIFY UTILITY OWNERS A MINIMUM OF 48 HOURS PRIOR TO STARTING WORK IN AREAS AFFECTING THEIR FACILITIES.

CITY OF OXNARD	*TEL. NO. (805) 385–8141*	*TIMOTHY BEAMAN*
CALIFORNIA RESOURCES CORPORATION	*TEL. NO. (805) 232–9637*	*MARK BLAKENSHIP*
CALTRANS	*TEL. NO. (213) 897–3206*	*VITAVAT BURANABUL*
SOUTHERN CALIFORNIA EDISON COMPANY	*TEL. NO. (805) 654–7215*	*FABIOLA GUERRA*
SOUTHERN CALIFORNIA GAS COMPANY	*TEL. NO. (818) 701–3228*	*JACK RUSSO*
UNITED WATER CONSERVATION DISTRICT	*TEL. NO. (805) 695–3627*	*BRAM SERCU*

UNDERGROUND SERVICE ALERT

1–800–422–4133
CALL USA/SC
FOR UNDERGROUND LOCATION
2 WORKING DAYS BEFORE YOU DIG



GENERAL PLAN

1000 500 0 1000 2000
SCALE OF FEET

INDEX OF STANDARD PLANS USED BY REFERENCE

CALTRANS STANDARD PLANS, 2018 EDITION:

SPPWC STANDARD PLANS, 2021 EDITION:

RECORD DRAWINGS

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/20/22

SAVE DATE: 3/20/22 SUH, JUNG   P:\WATR\T32983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T32983VR2-TS01.DWG

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

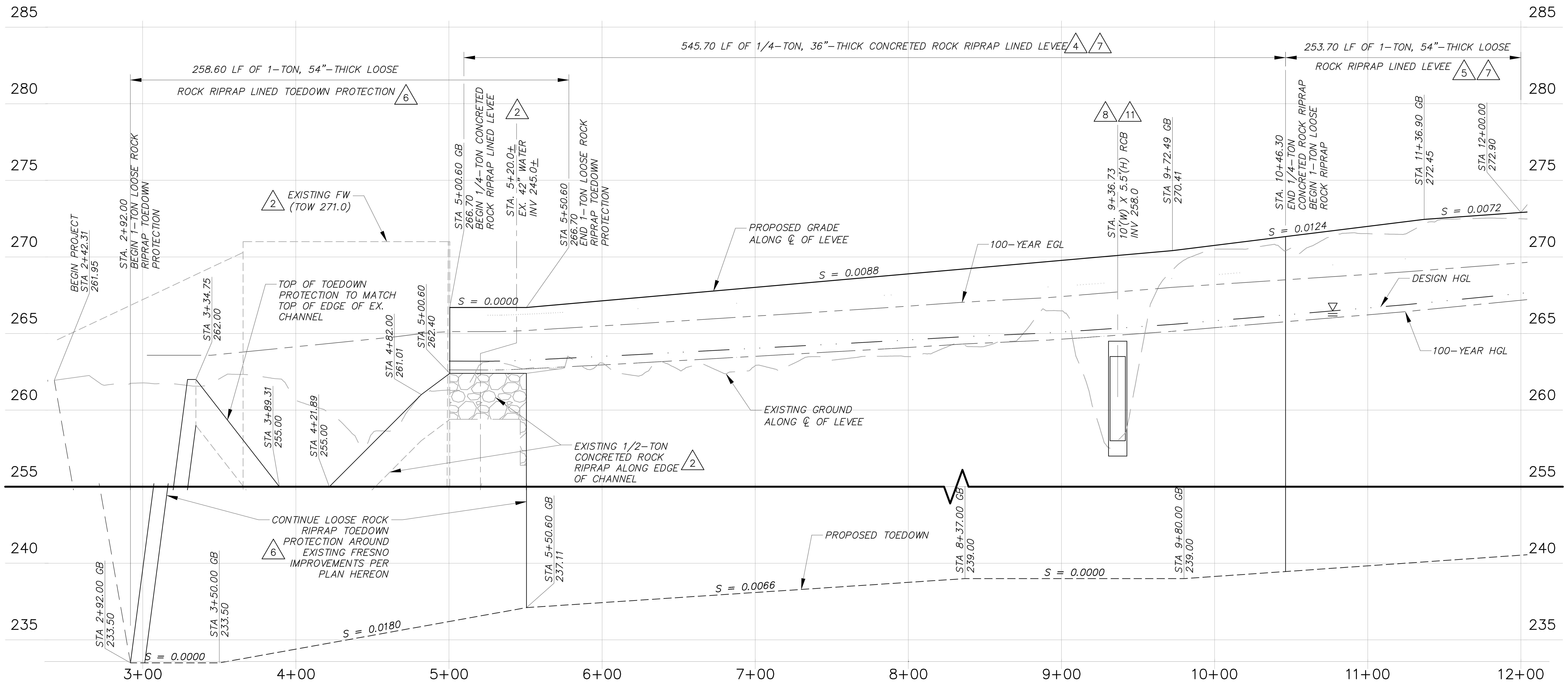
WATERSHED DEPUTY DIRECTOR   DATE
WATERSHED DIRECTOR   DATE
AGENCY DIRECTOR   DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
GENERAL PLAN

SHEET 1 OF 35
DRAWING NO. WPD–1–Y–X–X

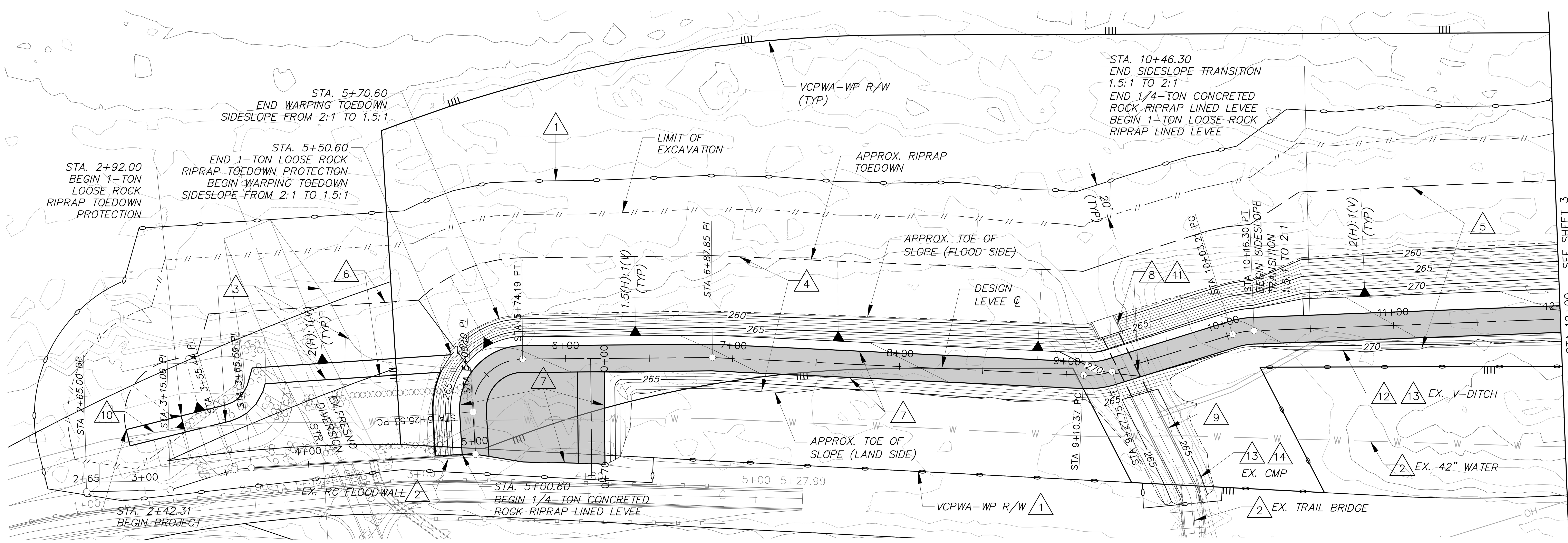


PROFILE

SCALE: HORZ: 1" = 40'
VERT: 1" = 4'

NOTES:

1. TEMPORARY WORK AREA LIMITS SHALL BE STAKED AND ALL EQUIPMENT SHALL BE OPERATED WITHIN THE TEMPORARY WORK AREA LIMITS.
2. PROTECT IN PLACE EXISTING FACILITIES. ANY DAMAGE SHALL BE REPAIRED OR REPLACED IN KIND AT CONTRACTOR'S EXPENSE TO OWNER'S SATISFACTION.
3. REMOVE AND RECONSTRUCT INTERFERING PORTIONS OF EXISTING DIVERSION FACILITIES PER PLAN HEREON.
4. CONSTRUCT 1/4-TON 36"-THICK CONCRETED ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
5. CONSTRUCT 1-TON 54"-THICK LOOSE ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
6. CONSTRUCT 1-TON 54"-THICK LOOSE ROCK RIPRAP TOEDOWN PROTECTION AROUND EXISTING FRESNO DIVERSION STRUCTURE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
7. CONSTRUCT 6" CMB ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
8. CONSTRUCT 10'(W) X 5.5'(H) RCB AND OUTLET STRUCTURE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET XX.
9. CONSTRUCT 10'(W) X 5.5'(H) RC CHANNEL PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET XX.
10. PROVIDE UTILITY PENETRATION FOR EX. 42" WATER PIPE AT TOEDOWN PROTECTION.
11. INSTALL A FLAP GATE FOR RCB ON ITS OUTLET STRUCTURE PER PLAN.
12. RECONSTRUCT EXISTING V-DITCH AFTER COMPLETION OF LEVEE ALONG SIMILAR DITCH ALIGNMENT AND PROVIDE THE SAME POSITIVE DRAINAGE OF SURFACE RUNOFF.
13. REMOVE INTERFERING PORTIONS OF EXISTING FACILITIES PER PLAN HEREON.
14. RECONSTRUCT EXISTING CMP TO CONNECT TO NEW RC CHANNEL PER PLAN.



PLAN

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SCALE OF FEET

30% DESIGN
NOT FOR CONSTRUCTION

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH
TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

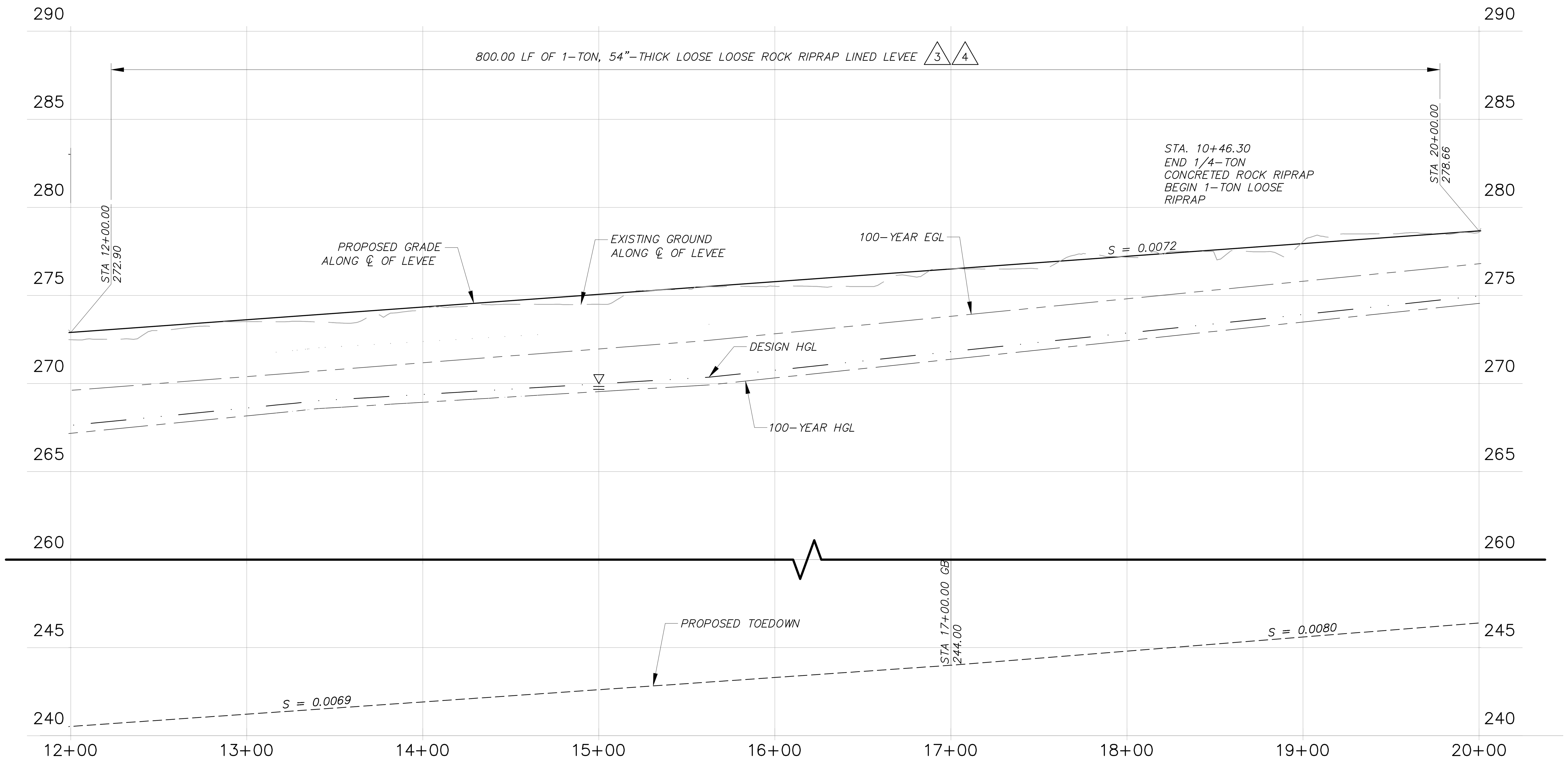
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. ----

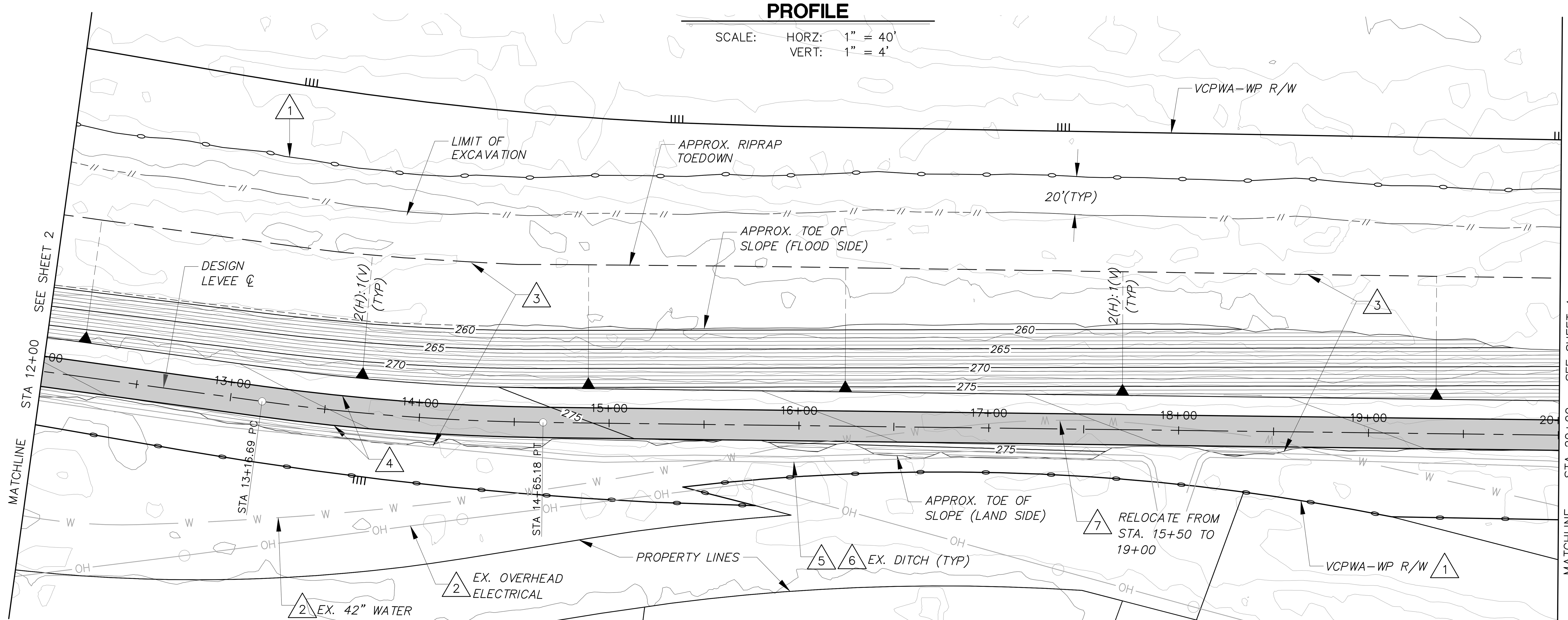
VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
PLAN & PROFILE STA. 2+42.31 TO STA. 12+00

SHEET 2 OF 35
DRAWING NO. WPD-1-Y-X-X



PROFILE

SCALE: HORZ: 1" = 40'
VERT: 1" = 4'



PLAN

SCALE OF FEET

NOTES:

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2. PROTECT IN PLACE EXISTING FACILITIES. ANY DAMAGE SHALL BE REPAIRED OR REPLACED IN KIND AT CONTRACTOR'S EXPENSE TO OWNER'S SATISFACTION.
3. CONSTRUCT 1-TON 54"-THICK LOOSE ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
4. CONSTRUCT 6" CMB ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
5. RECONSTRUCT EXISTING V-DITCH AFTER COMPLETION OF LEVEE ALONG SIMILAR DITCH ALIGNMENT AND PROVIDE THE SAME POSITIVE DRAINAGE OF SURFACE RUNOFF.
6. REMOVE INTERFERING PORTIONS OF EXISTING FACILITIES PER PLAN HEREON.
7. RELOCATE EXISTING 42" WATER LINE PER PLAN HEREON.

30% DESIGN
NOT FOR CONSTRUCTION

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

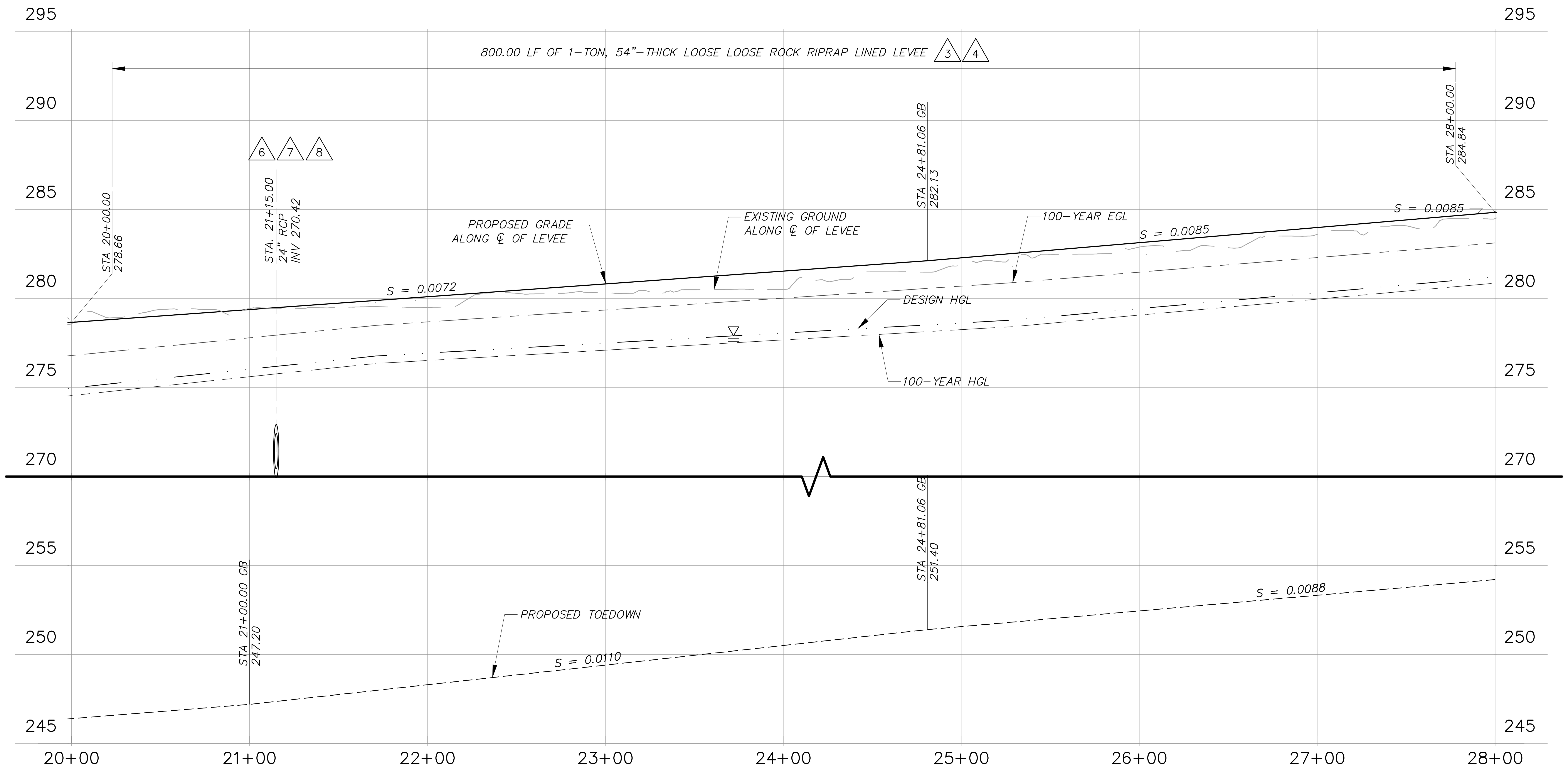
WATERSHED DEPUTY DIRECTOR — DATE
WATERSHED DIRECTOR — DATE
AGENCY DIRECTOR — DATE

VENTURA COUNTY PUBLIC WORKS AGENCY WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. ––––

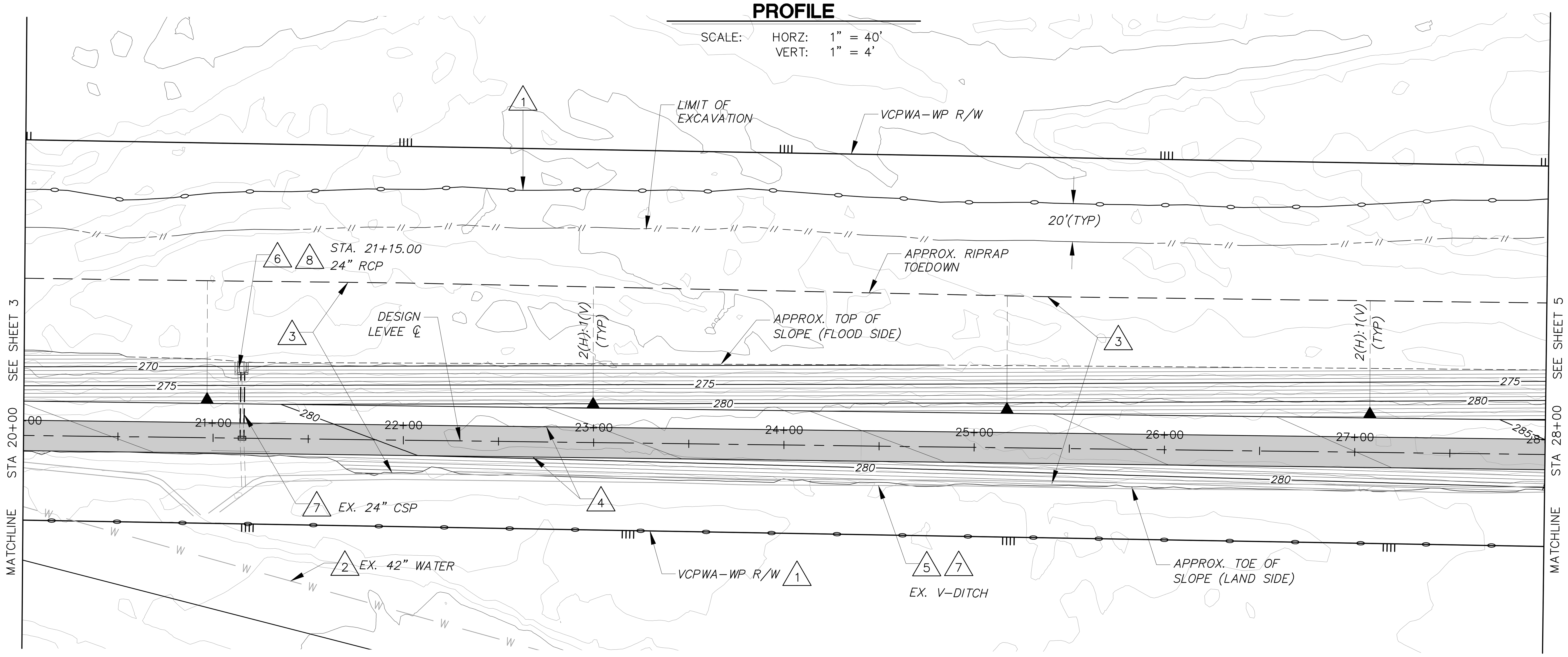
VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
PLAN & PROFILE STA. 12+00 TO STA 20+00

SHEET 3 OF 35
DRAWING NO. WPD-1-Y-X-X



PROFILE

SCALE: HORZ: 1" = 40'
VERT: 1" = 4'



PLAN

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SCALE OF FEET

NOTES:

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2. PROTECT IN PLACE EXISTING FACILITIES. ANY DAMAGE SHALL BE REPAIRED OR REPLACED IN KIND AT CONTRACTOR'S EXPENSE TO OWNER'S SATISFACTION.
3. CONSTRUCT 1-TON 54"-THICK LOOSE ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
4. CONSTRUCT 6" CMB ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
5. RECONSTRUCT EXISTING V-DITCH AFTER COMPLETION OF LEVEE ALONG SIMILAR DITCH ALIGNMENT AND PROVIDE THE SAME POSITIVE DRAINAGE OF SURFACE RUNOFF.
6. REPLACE EXISTING SD PIPE WITH NEW 24" RCP, OUTLET STRUCTURE, AND CONCRETE COLLAR TO CONNECT TO THE REMAINING PORTION OF EXISTING PIPE PER PLAN HEREON.
7. REMOVE INTERFERING PORTIONS OF EXISTING FACILITIES PER PLAN HEREON.
8. INSTALL A FLAP GATE FOR STORM DRAIN PIPE ON ITS OUTLET STRUCTURE PER PLAN HEREON.

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/18/22 SUH, JUNG P:\WATR\137983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\137983VR2-P&P03.DWG

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TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

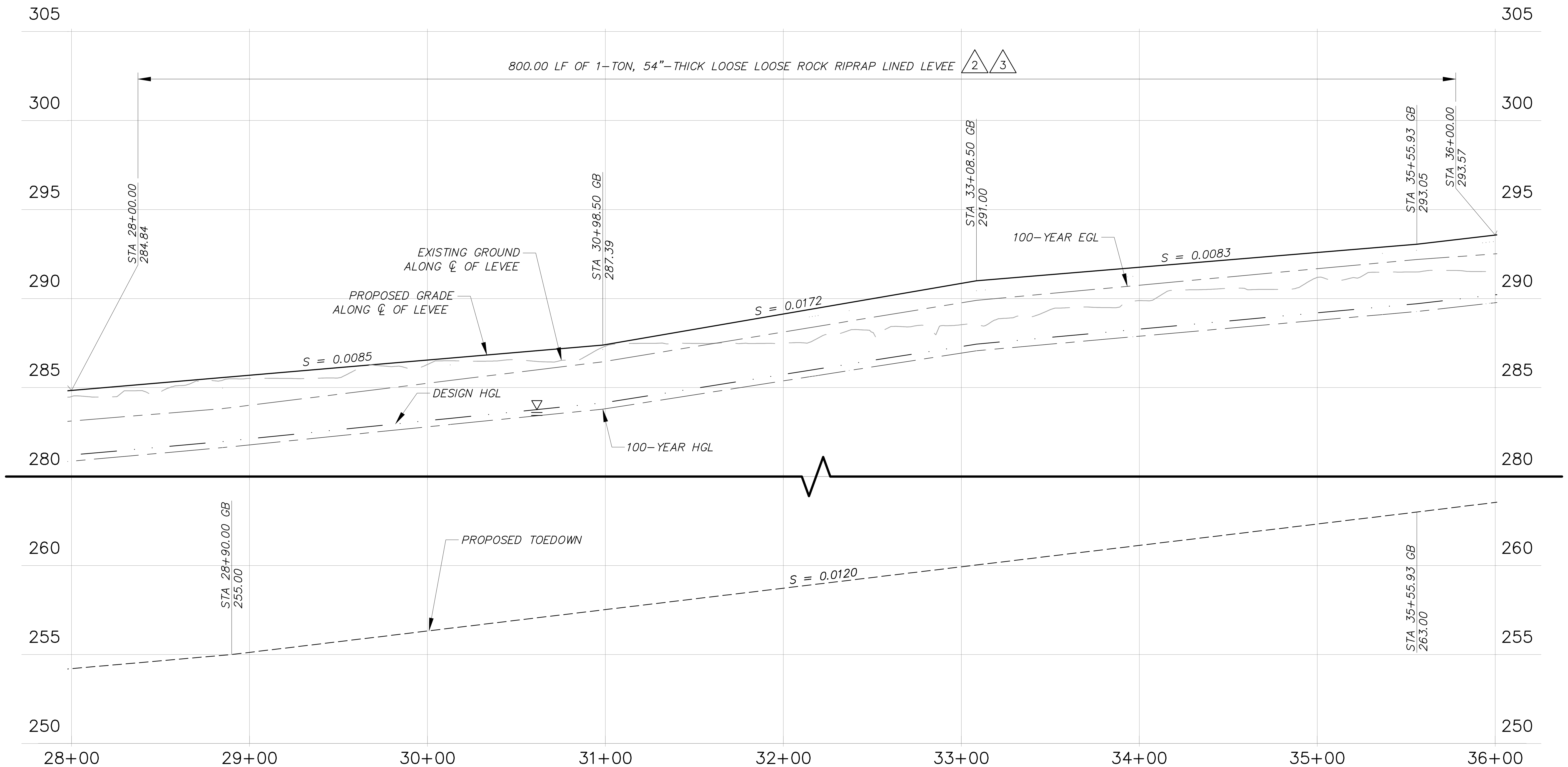
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. ––––

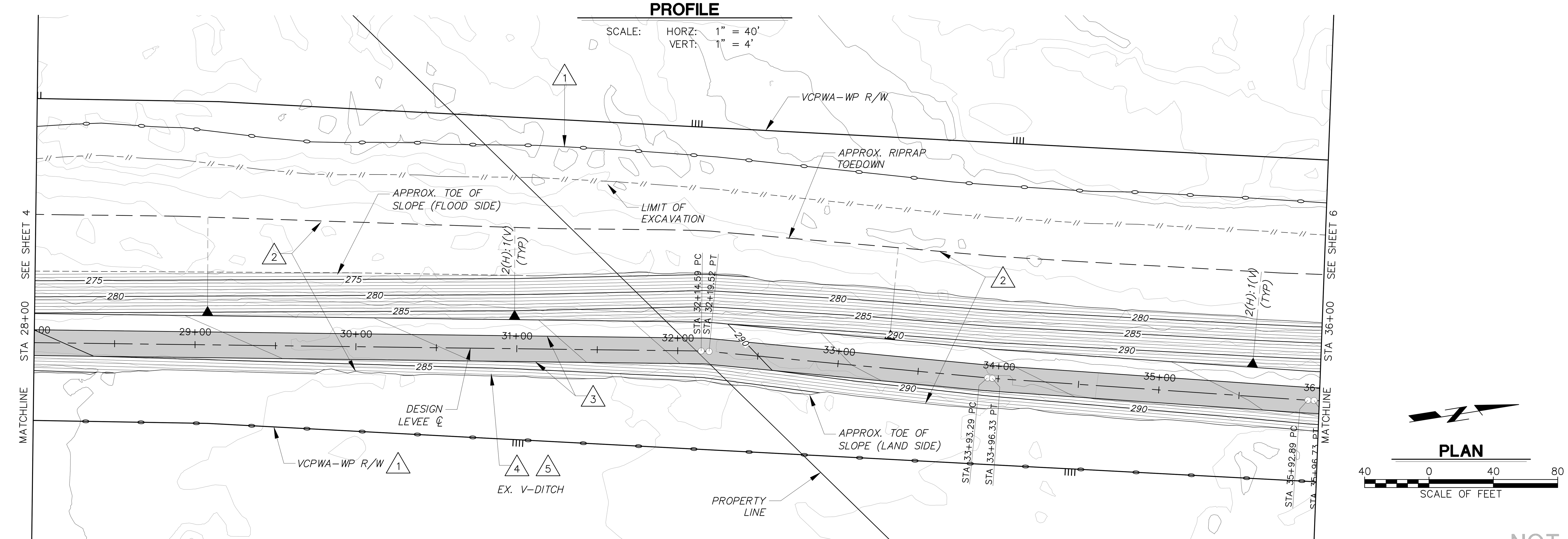
VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
PLAN & PROFILE STA. 20+00 TO STA 28+00

SHEET 4 OF 35
DRAWING NO. WPD-1-Y-X-X



PROFILE

SCALE: HORZ: 1" = 40'
VERT: 1" = 4'



PLAN

NOTES:

1. TEMPORARY WORK AREA LIMITS SHALL BE STAKED AND ALL EQUIPMENT SHALL BE OPERATED WITHIN THE TEMPORARY WORK AREA LIMITS.
2. CONSTRUCT 1-TON 54"-THICK LOOSE ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
3. CONSTRUCT 6" CMB ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
4. RECONSTRUCT EXISTING V-DITCH AFTER COMPLETION OF LEVEE ALONG SIMILAR DITCH ALIGNMENT AND PROVIDE THE SAME POSITIVE DRAINAGE OF SURFACE RUNOFF.
5. REMOVE INTERFERING PORTIONS OF EXISTING FACILITIES PER PLAN HEREON.

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/20/22 SUH, JUNG P:\WATR\137983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\137983VR2-P&P04.DWG

PLOT DATE: 3/20/22

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

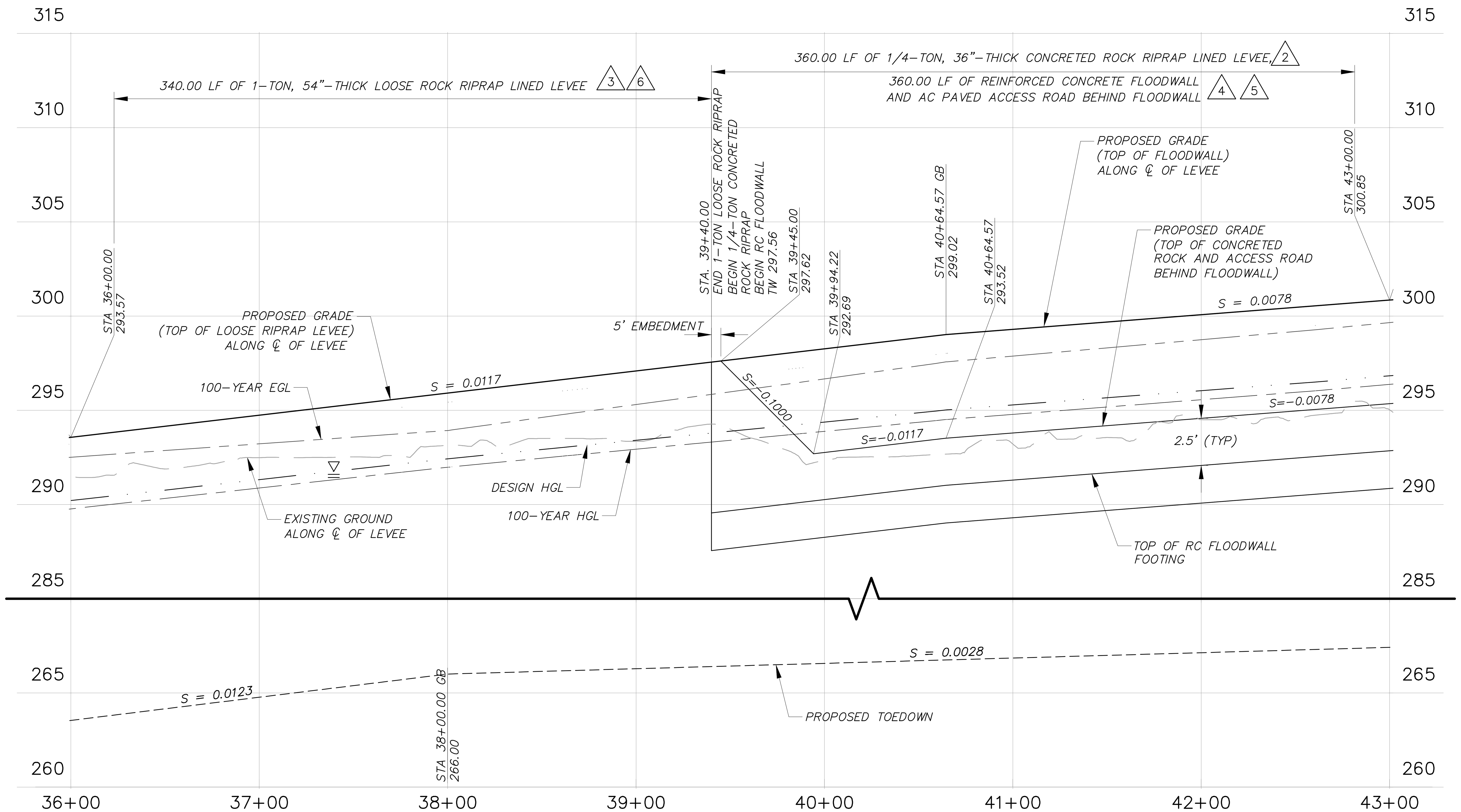
WATERSHED DEPUTY DIRECTOR	DATE
WATERSHED DIRECTOR	DATE
AGENCY DIRECTOR	DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. ----

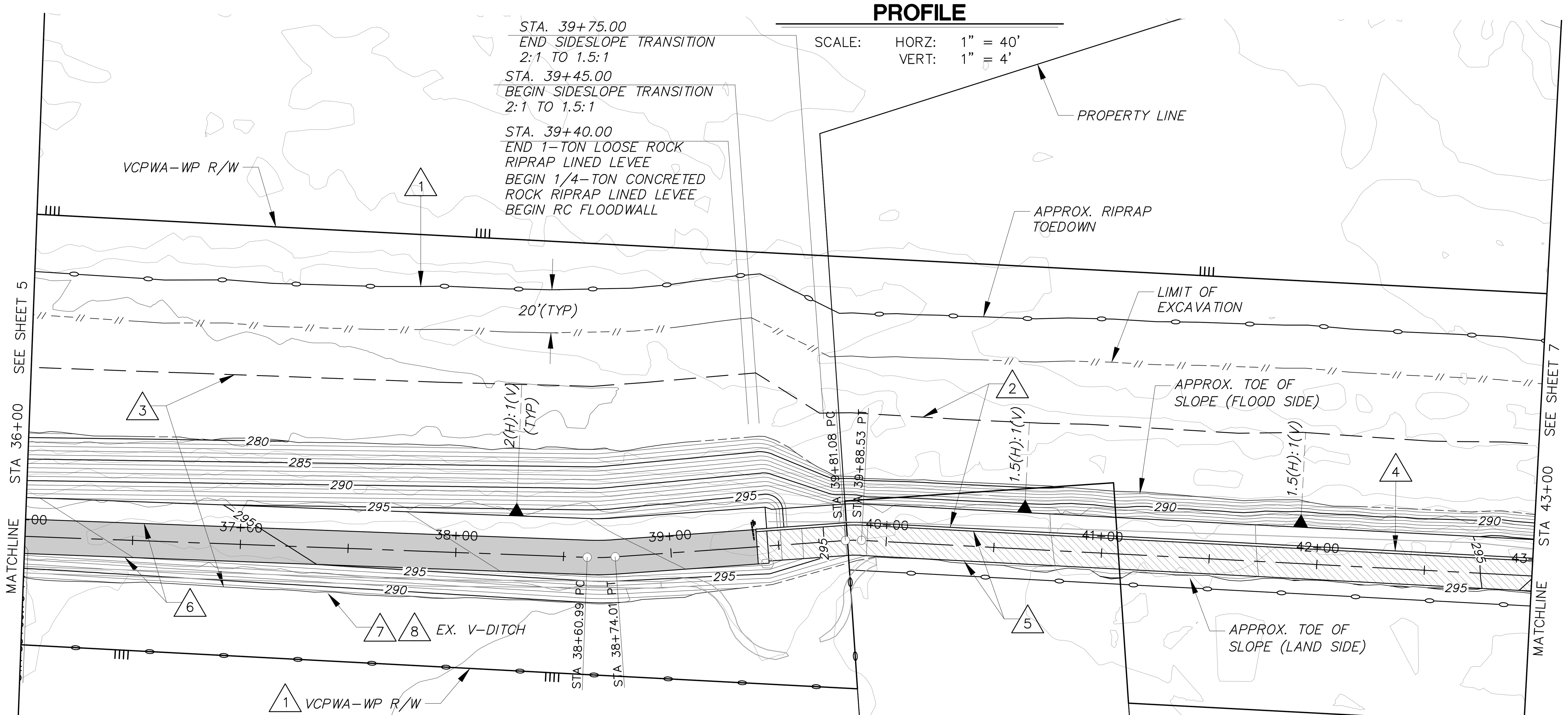
VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
PLAN & PROFILE STA. 28+00 TO STA 36+00

SHEET 5 OF 35
DRAWING NO. WPD-1-Y-X-X



PROFILE

SCALE: HORZ: 1" = 40'
VERT: 1" = 4'



PLAN

40 0 40 80
SCALE OF FEET

NOTES:

1. TEMPORARY WORK AREA LIMITS SHALL BE STAKED AND ALL EQUIPMENT SHALL BE OPERATED WITHIN THE TEMPORARY WORK AREA LIMITS.
2. CONSTRUCT 1/4–TON 36"–THICK CONCRETED ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
3. CONSTRUCT 1–TON 54"–THICK LOOSE ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
4. CONSTRUCT REINFORCED CONCRETE FLOODWALL ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
5. CONSTRUCT AC PAVED ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
6. CONSTRUCT 6" CMB ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
7. RECONSTRUCT EXISTING V–DITCH AFTER COMPLETION OF LEVEE ALONG SIMILAR DITCH ALIGNMENT AND PROVIDE THE SAME POSITIVE DRAINAGE OF SURFACE RUNOFF.
8. REMOVE INTERFERING PORTIONS OF EXISTING FACILITIES PER PLAN HEREON.

30% DESIGN
NOT FOR CONSTRUCTION

D			
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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

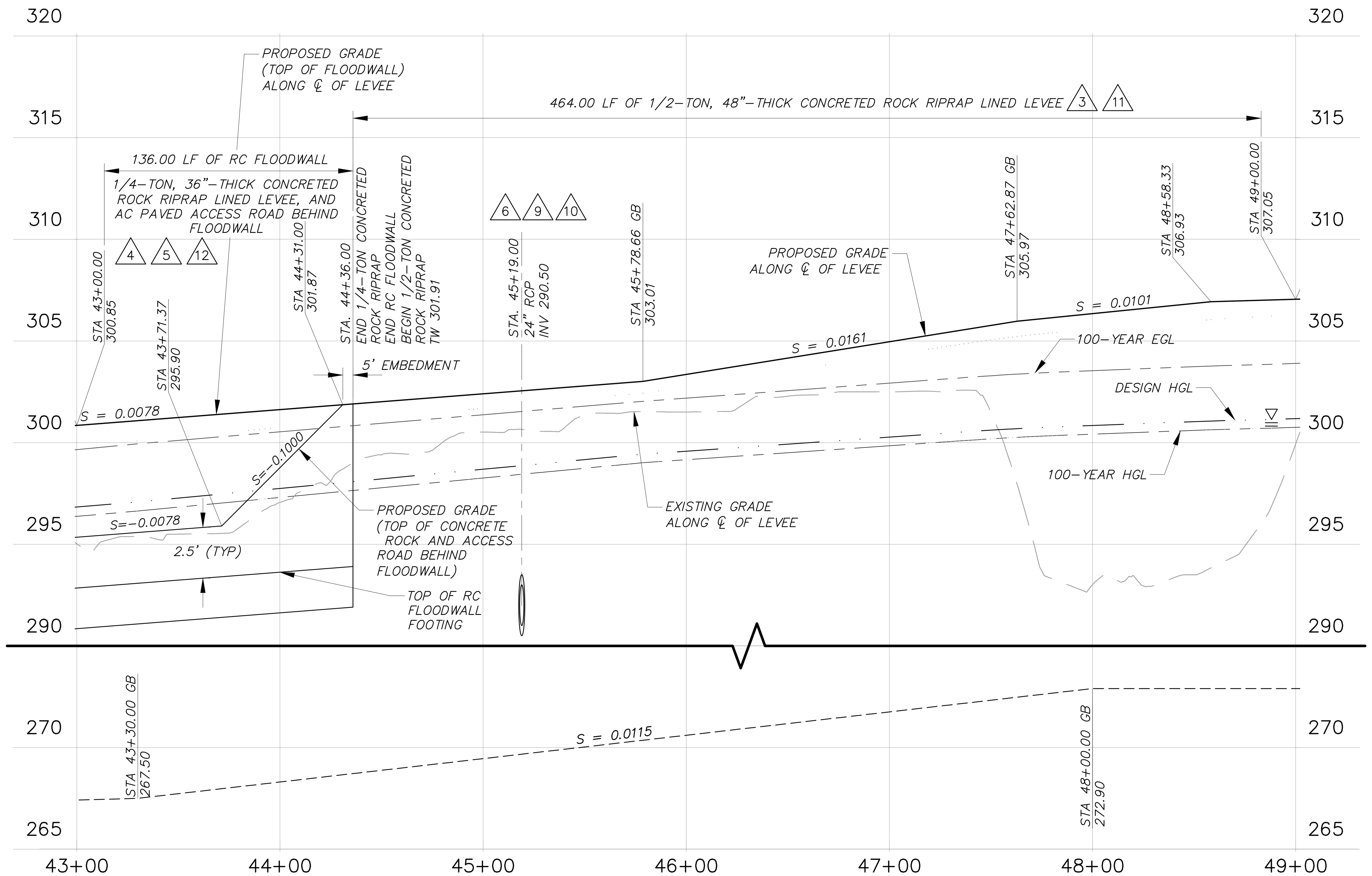
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

**VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION**

SPEC. NO. –
PROJ. NO. ––––

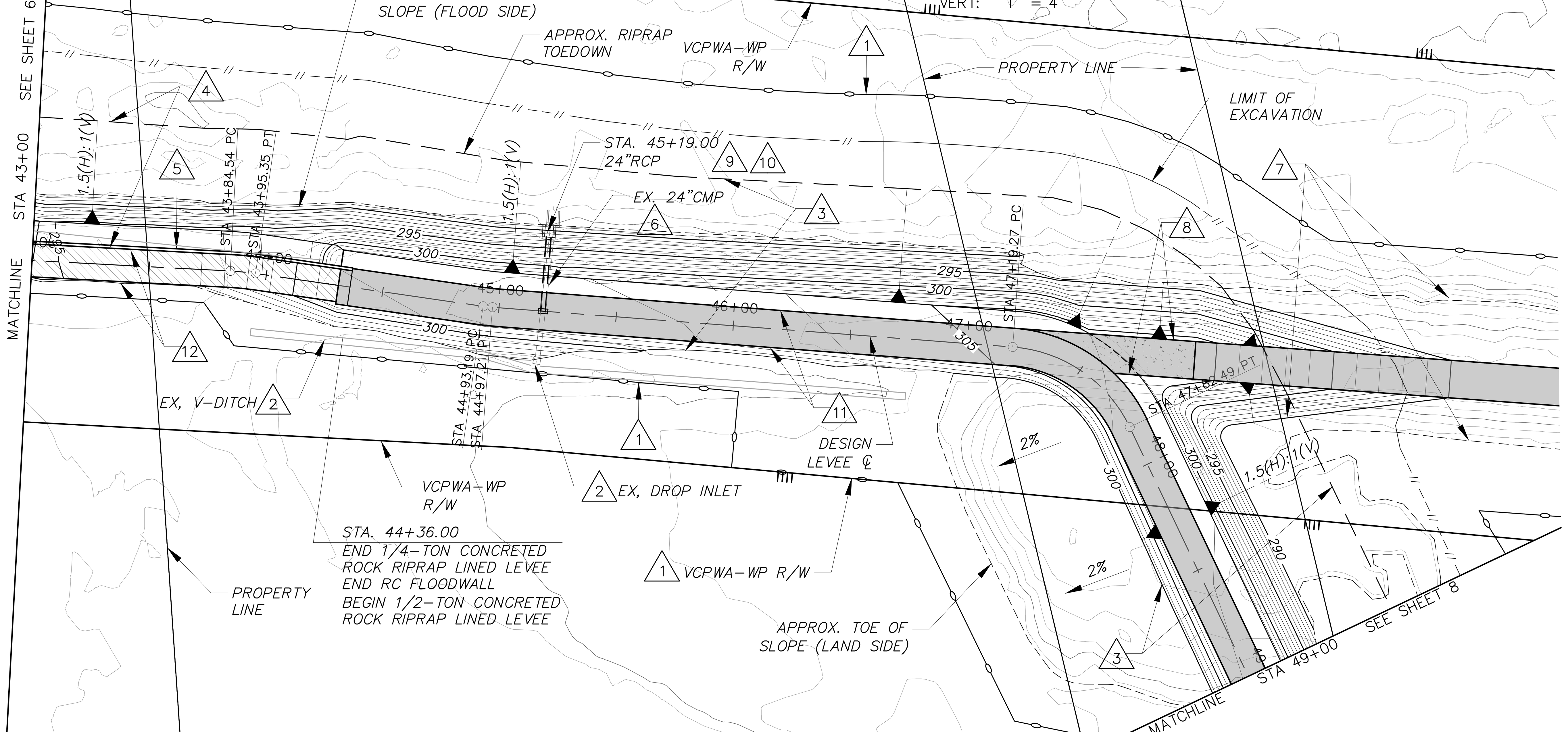
**VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT**
PLAN & PROFILE STA. 36+00 TO STA 43+00

SHEET 6 OF 35
DRAWING NO. WPD–1–Y–X–X



PROFILE

SCALE: HORZ: 1" = 40'
VERT: 1" = 4'



PLAN

40 0 40 80
SCALE OF FEET

NOTES:

1. TEMPORARY WORK AREA LIMITS SHALL BE STAKED AND ALL EQUIPMENT SHALL BE OPERATED WITHIN THE TEMPORARY WORK AREA LIMITS.
2. PROTECT IN PLACE EXISTING FACILITIES. ANY DAMAGE SHALL BE REPAIRED OR REPLACED IN KIND AT CONTRACTOR'S EXPENSE TO OWNER'S SATISFACTION.
3. CONSTRUCT 1/2-TON 48"-THICK CONCRETED ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
4. CONSTRUCT 1/4-TON 36"-THICK CONCRETED ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
5. CONSTRUCT REINFORCED CONCRETE FLOODWALL ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
6. REMOVE INTERFERING PORTIONS OF EXISTING FACILITIES PER PLAN HEREON.
7. LOWER EXISTING LEVEE PER PLAN ON SHEET 9.
8. CONSTRUCT REINFORCED CONCRETE APPROACH SLAB PER PLAN HEREON.
9. REPLACE EXISTING SD PIPE WITH NEW 24" RCP, OUTLET STRUCTURE, AND CONCRETE COLLAR TO CONNECT TO THE REMAINING PORTION OF EXISTING PIPE PER PLAN HEREON.
10. INSTALL A FLAP GATE FOR STORM DRAIN PIPE ON ITS OUTLET STRUCTURE PER PLAN HEREON.
11. CONSTRUCT 6" CMB ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
12. CONSTRUCT AC PAVED ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/20/22
SAVE DATE: 3/20/22 SUH, JUNG P:\WATR\137983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\137983VR2-P&P06.DWG

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△ REVISION	DESCRIPTION	APP.	DATE

TETRA TECH
TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

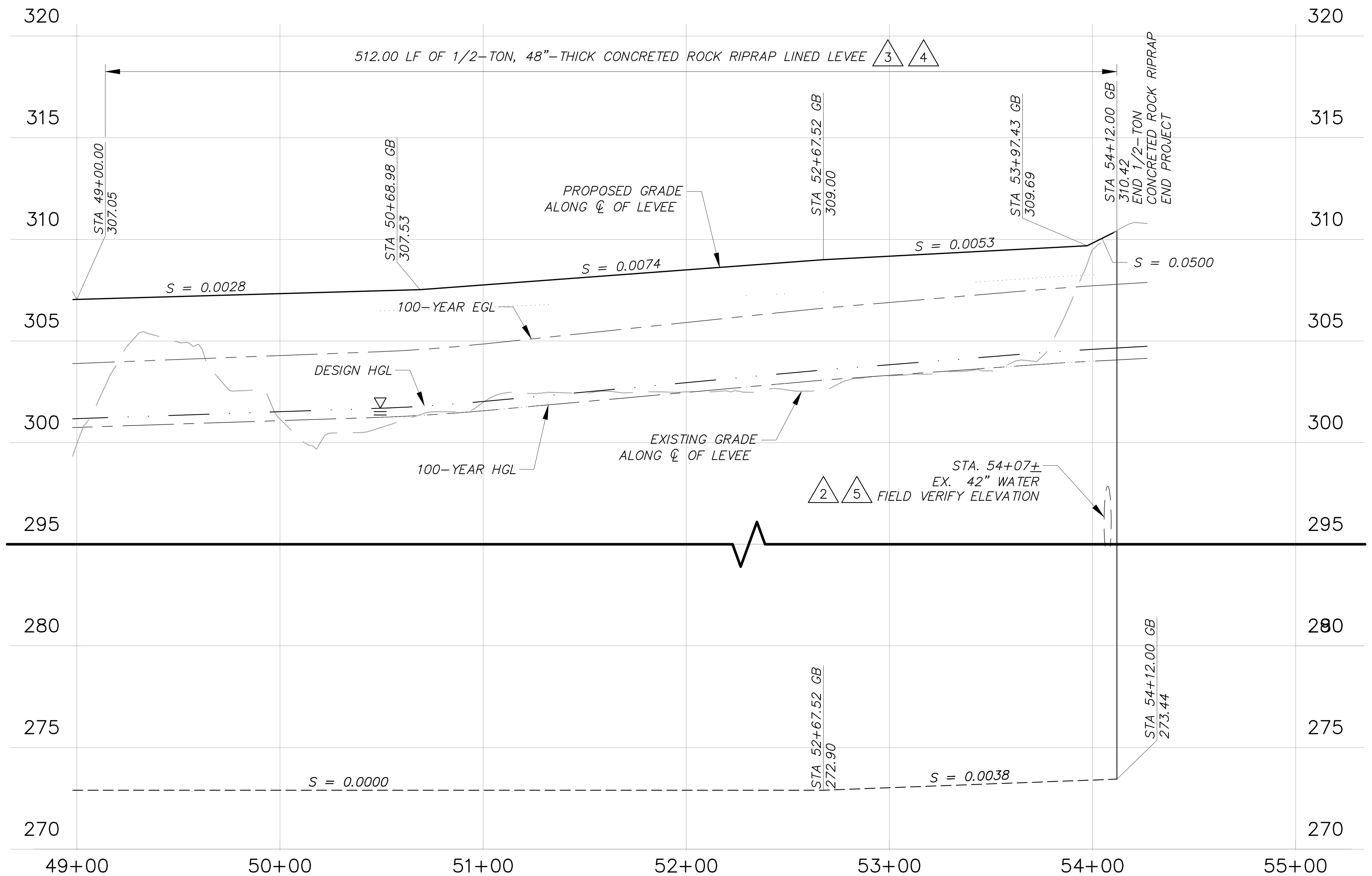
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. ––––

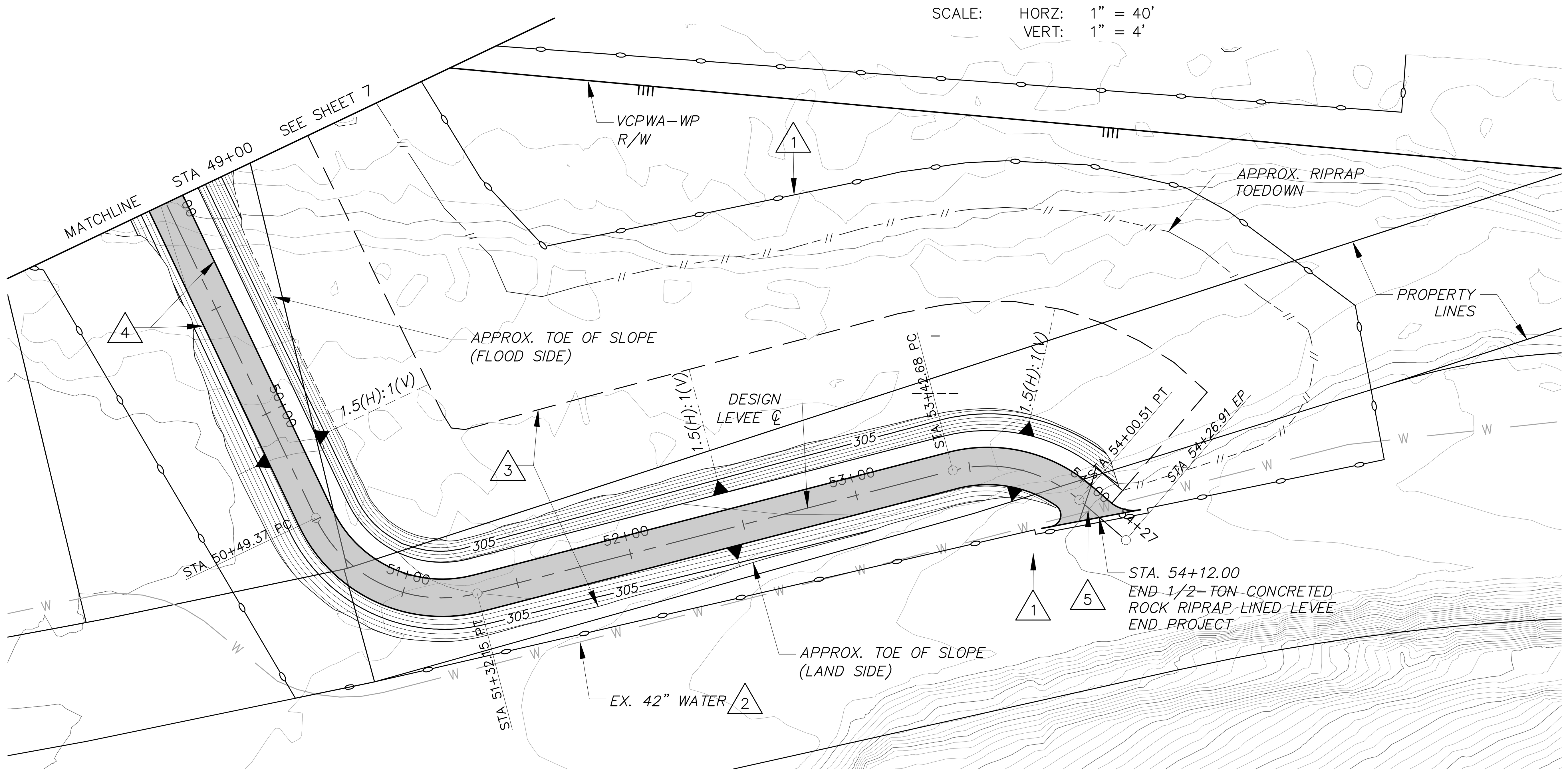
VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
PLAN & PROFILE STA. 43+00 TO STA 49+00

SHEET 7 OF 35
DRAWING NO. WPD-1-Y-X-X



PROFILE

SCALE: HORZ: 1" = 40'
VERT: 1" = 4'



PLAN

40 0 40 80
SCALE OF FEET

NOTES:

1. TEMPORARY WORK AREA LIMITS SHALL BE STAKED AND ALL EQUIPMENT SHALL BE OPERATED WITHIN THE TEMPORARY WORK AREA LIMITS.
2. PROTECT IN PLACE EXISTING FACILITIES. ANY DAMAGE SHALL BE REPAIRED OR REPLACED IN KIND AT CONTRACTOR'S EXPENSE TO OWNER'S SATISFACTION.
3. CONSTRUCT 1/2-TON 48"-THICK CONCRETED ROCK RIPRAP LINED LEVEE PER PLAN AND PROFILE HEREON AND TYPICAL SECTION ON SHEET 10.
4. CONSTRUCT 6" CMB ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON AND TYPICAL SECTION ON SHEET 10.
5. RELOCATE EX. 42" WATER PIPE WITHIN LEVEE FOOTPRINT.

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/20/22 SUH, JUNG P:\WATR\137983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\137983VR2-P&P07.DWG

	REVISION	DESCRIPTION	APP.	DATE
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△				

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

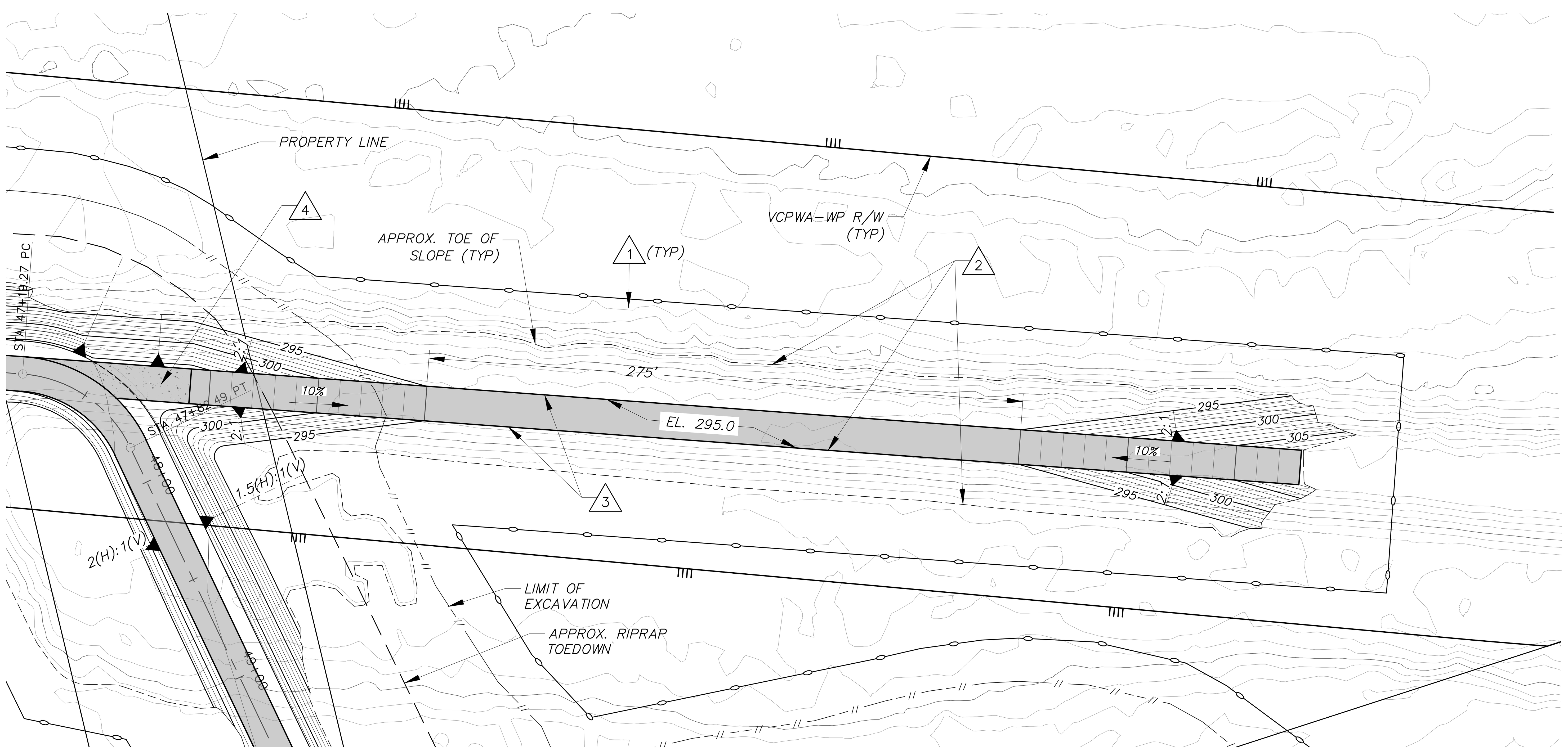
SPEC. NO.
PROJ. NO.

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
PLAN & PROFILE STA. 49+00 TO STA 54+12

SHEET 8 OF 35
DRAWING NO. WPD-1-Y-X-X

NOTES:

1. TEMPORARY WORK AREA LIMITS SHALL BE STAKED AND ALL EQUIPMENT SHALL BE OPERATED WITHIN THE TEMPORARY WORK AREA LIMITS.
2. LOWER EXISTING LEVEE PER PLAN HEREON.
3. CONSTRUCT 6" CAB ACCESS ROAD ON TOP OF LEVEE PER PLAN HEREON.
4. CONSTRUCT REINFORCED CONCRETE APPROACH SLAB PER PLAN HEREON.



PLAN

40 0 40 80

SCALE OF FEET

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/20/22 SUH, JUNG P:\WATR\137983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\137983VR2-PAP08.DWG

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△ REVISION	DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

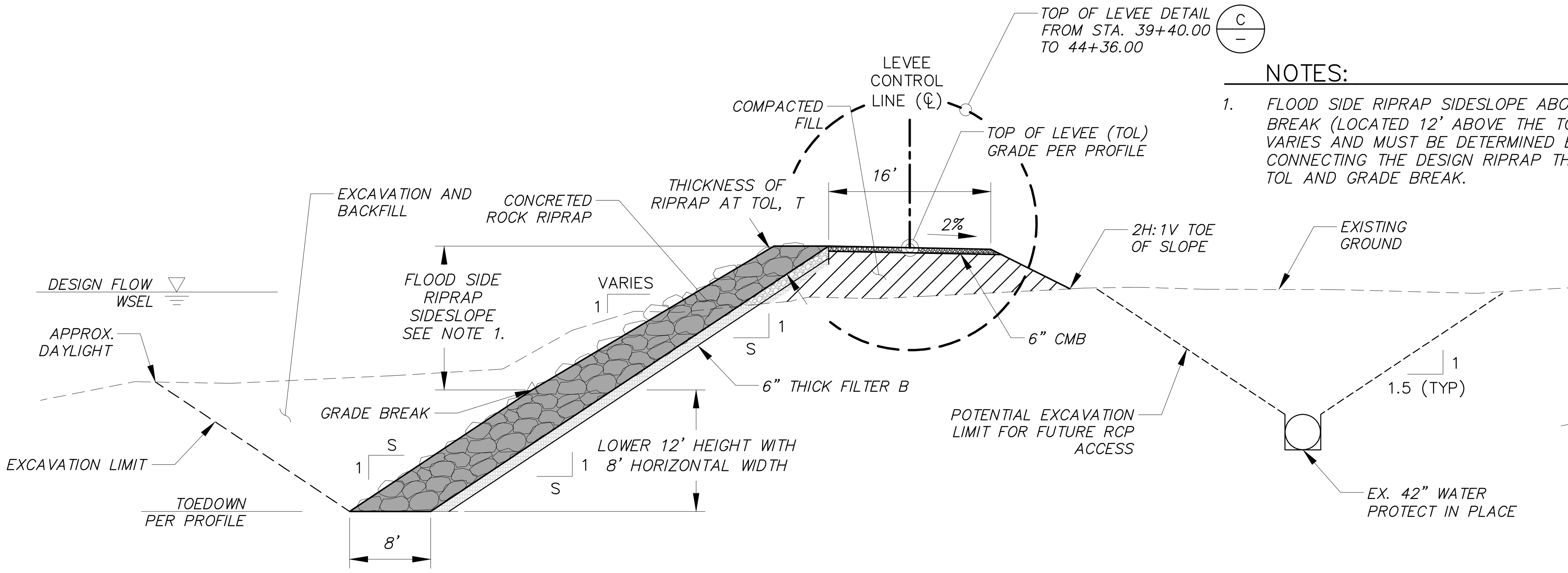
VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
UPSTREAM LEVEE LOWERING AREA

SHEET 9 OF 35

DRAWING NO. WPD-1-Y-X-X



NOTES:

1. FLOOD SIDE RIPRAP SIDESLOPE ABOVE THE GRADE BREAK (LOCATED 12' ABOVE THE TOEDOWN) VARIES AND MUST BE DETERMINED BY CONNECTING THE DESIGN RIPRAP THICKNESS AT TOL AND GRADE BREAK.

TYPICAL LEVEE SECTION
CONCRETED ROCK RIPRAP LINED LEVEE

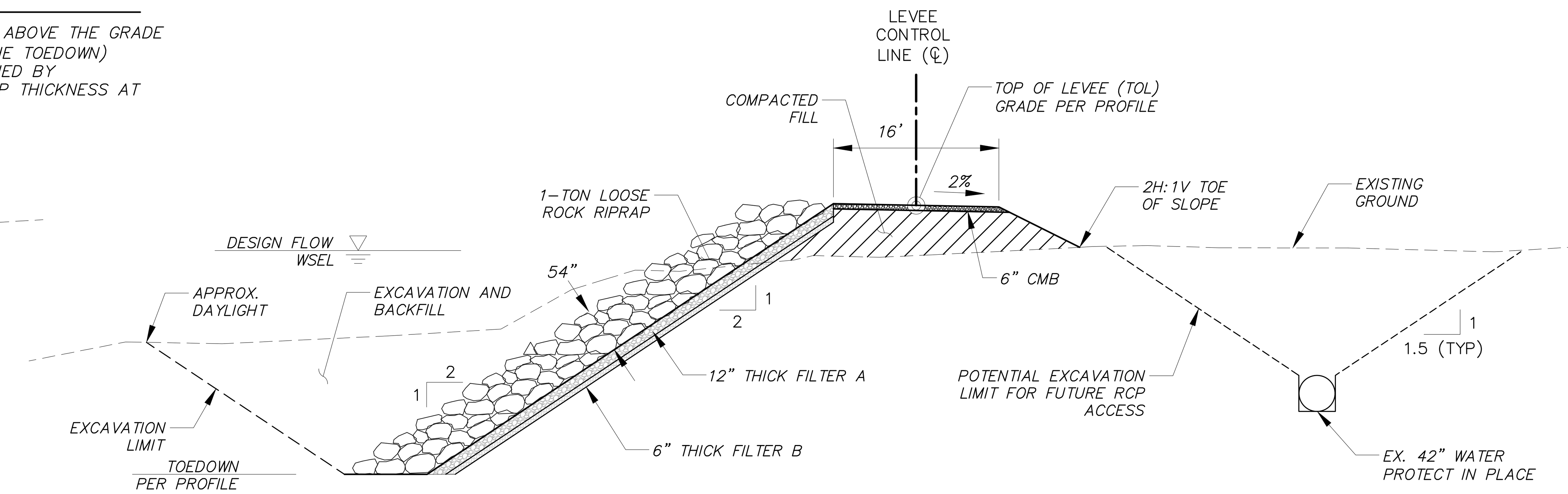
REACH I – STA. 5+00.60 TO 10+46.30
REACH III – STA. 39+40.00 TO 44+36.00
REACH IV – STA. 44+36.00 TO 54+12.00

A
–

NOT TO SCALE

TABLE – CONCRETED ROCK RIPRAP

REACH	STATION FROM	STATION TO	CONCRETED / LOOSE	RIPRAP CLASSIFICATION	T	S
I	5+00.60	10+16.30	CONCRETED	1/4-TON	36"	1.5
	10+16.30	10+46.30	CONCRETED	1/4-TON	36"	1.5 TO 2
III	39+40.00	39+45.00	CONCRETED	1/4-TON	36"	2
	39+45.00	39+75.00	CONCRETED	1/4-TON	36"	2 TO 1.5
	39+75.00	44+36.00	CONCRETED	1/4-TON	36"	1.5
IV	44+36.00	54+12.00	CONCRETED	1/2-TON	48"	1.5

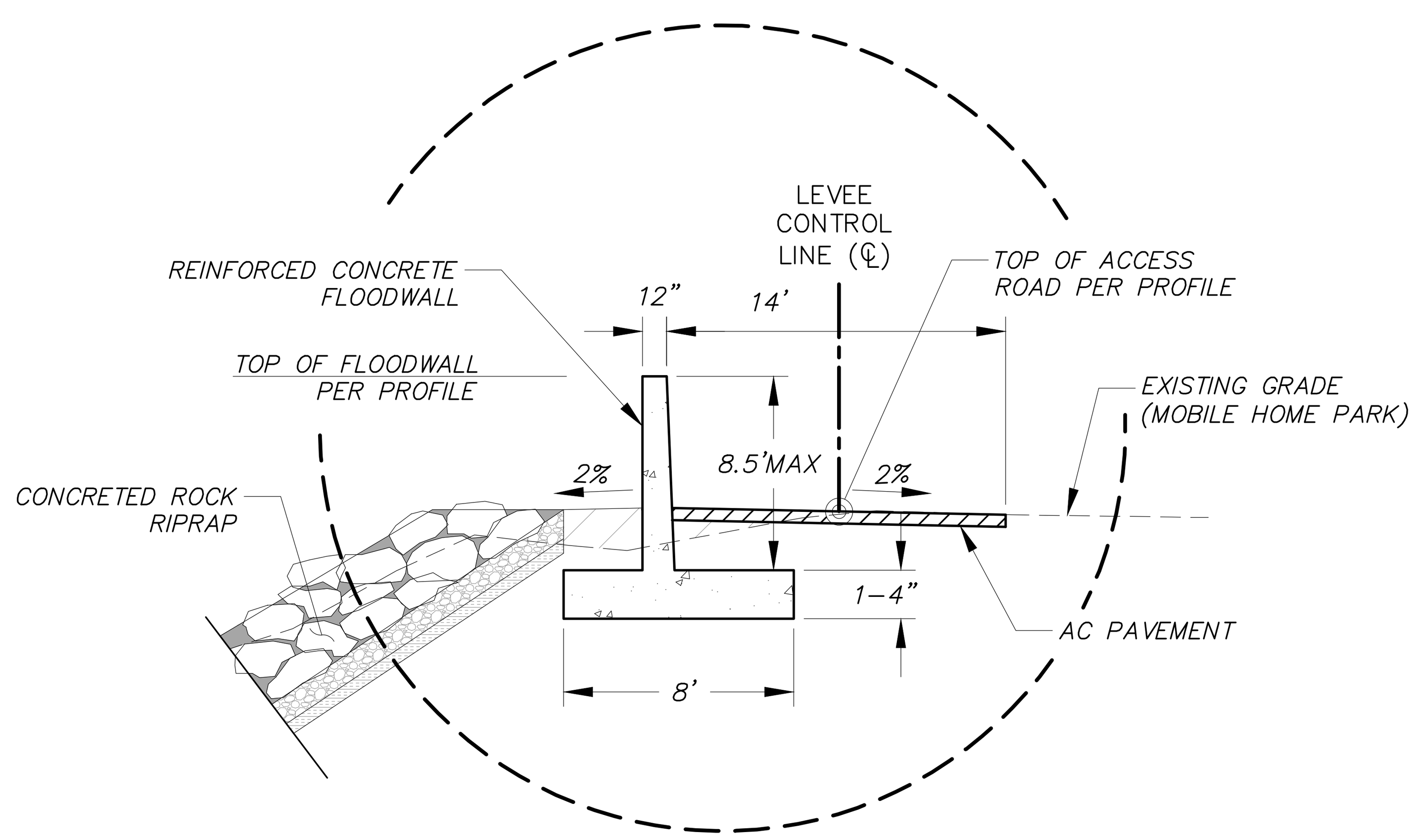


TYPICAL LEVEE SECTION
LOOSE ROCK RIPRAP LINED LEVEE

REACH II – STA. 10+46.30 TO 39+40.00

B
–

NOT TO SCALE

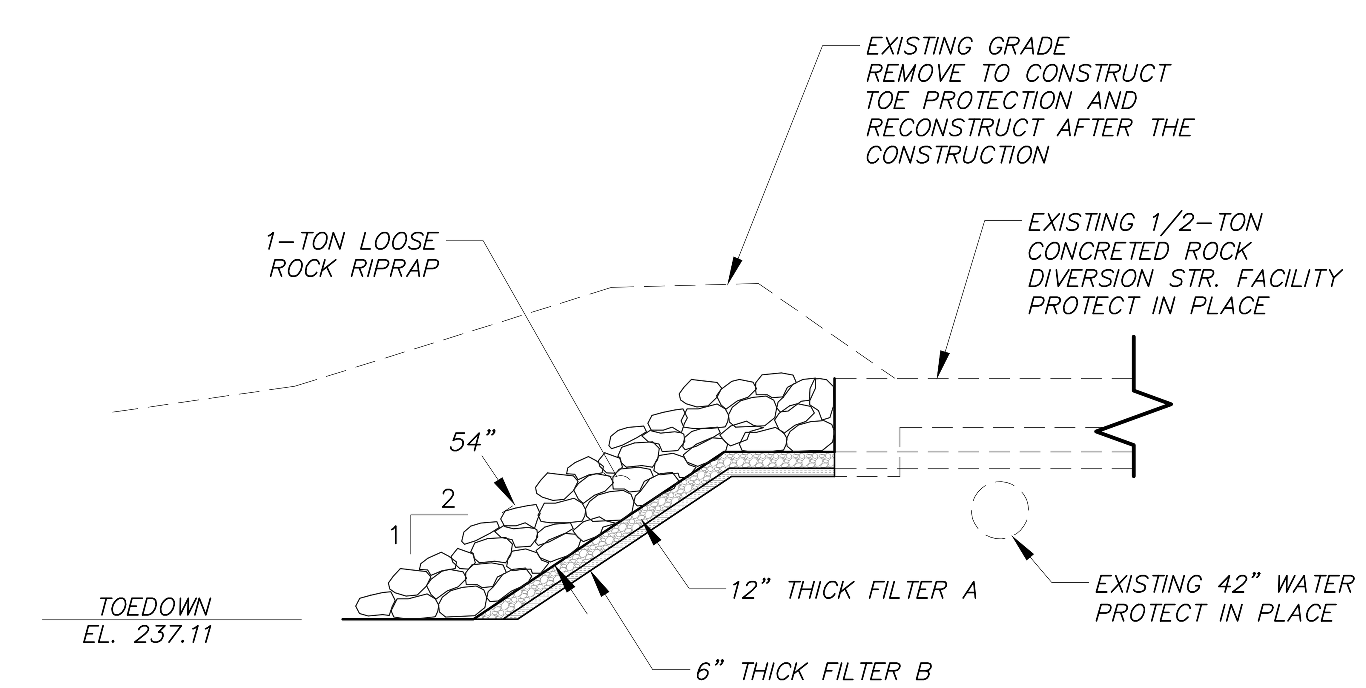


TOP OF LEVEE DETAIL

FROM STA. 39+40.00 TO 44+36.00

C
–

NOT TO SCALE



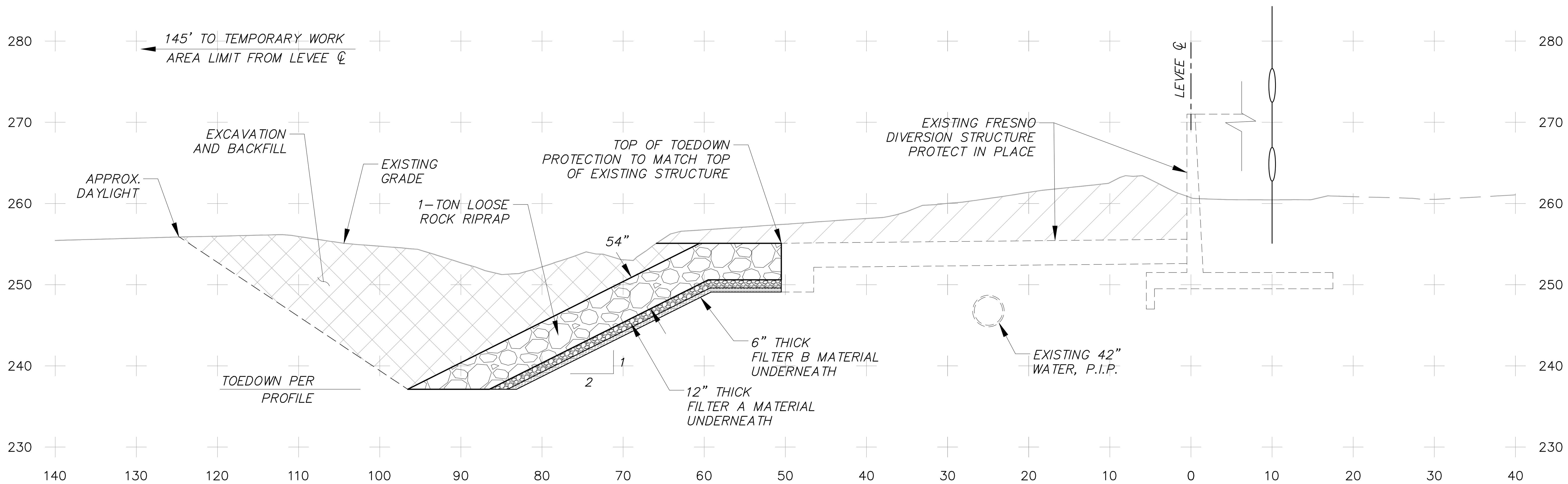
TYPICAL LEVEE SECTION
FRESNO DIVERSION STRUCTURE TOE PROTECTION

STA. 2+92 TO 5+50.60

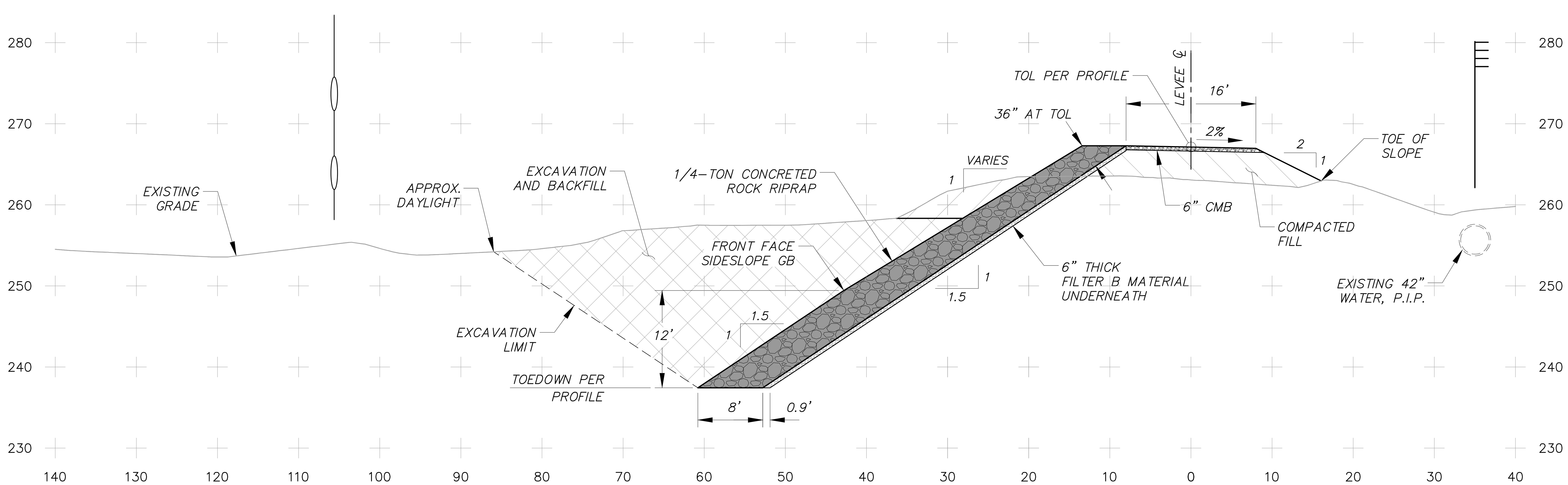
B
–

NOT TO SCALE

30% DESIGN
NOT FOR CONSTRUCTION



STA. 4+00



STA. 6+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/20/22
SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC01.DWG

D			
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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

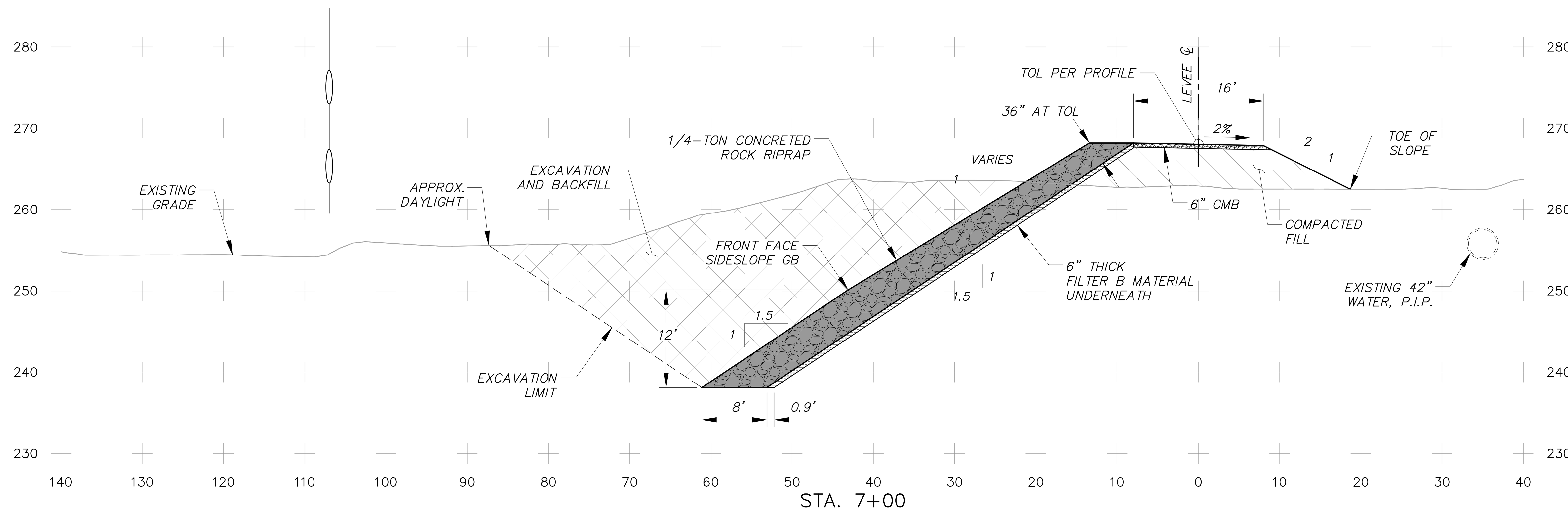
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

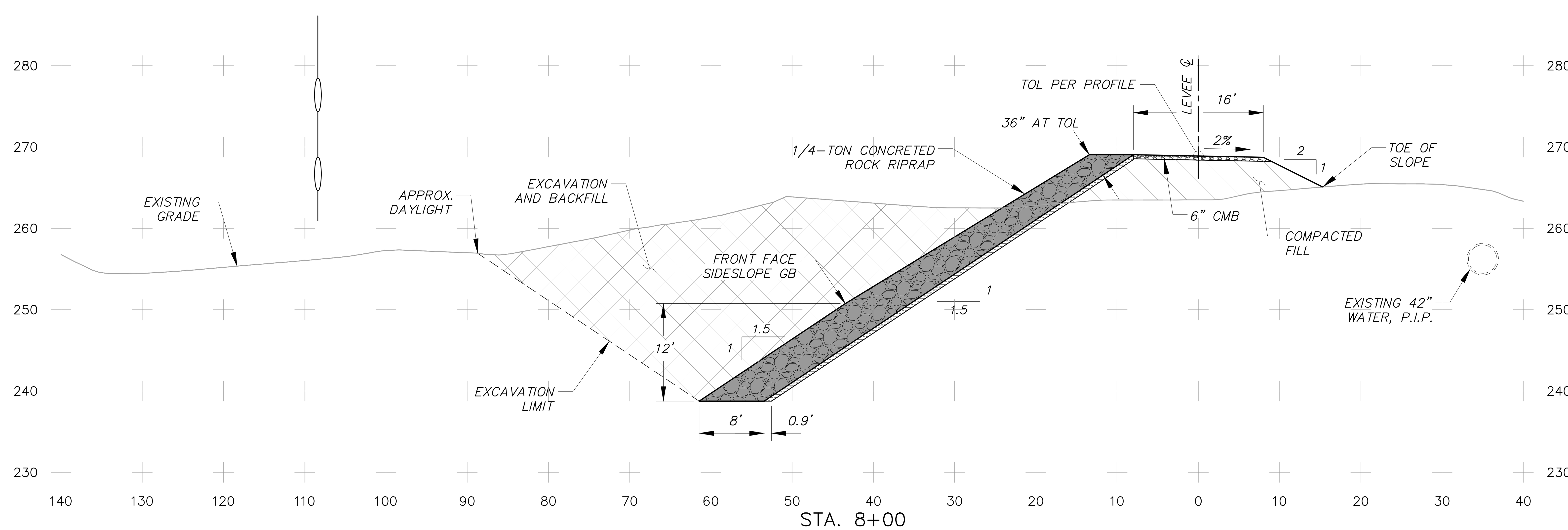
VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 4+00 TO STA 6+00

SHEET 11
OF 35
DRAWING NO.
WPD-2-Y-X-X





CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/18/22
SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC02.DWG

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

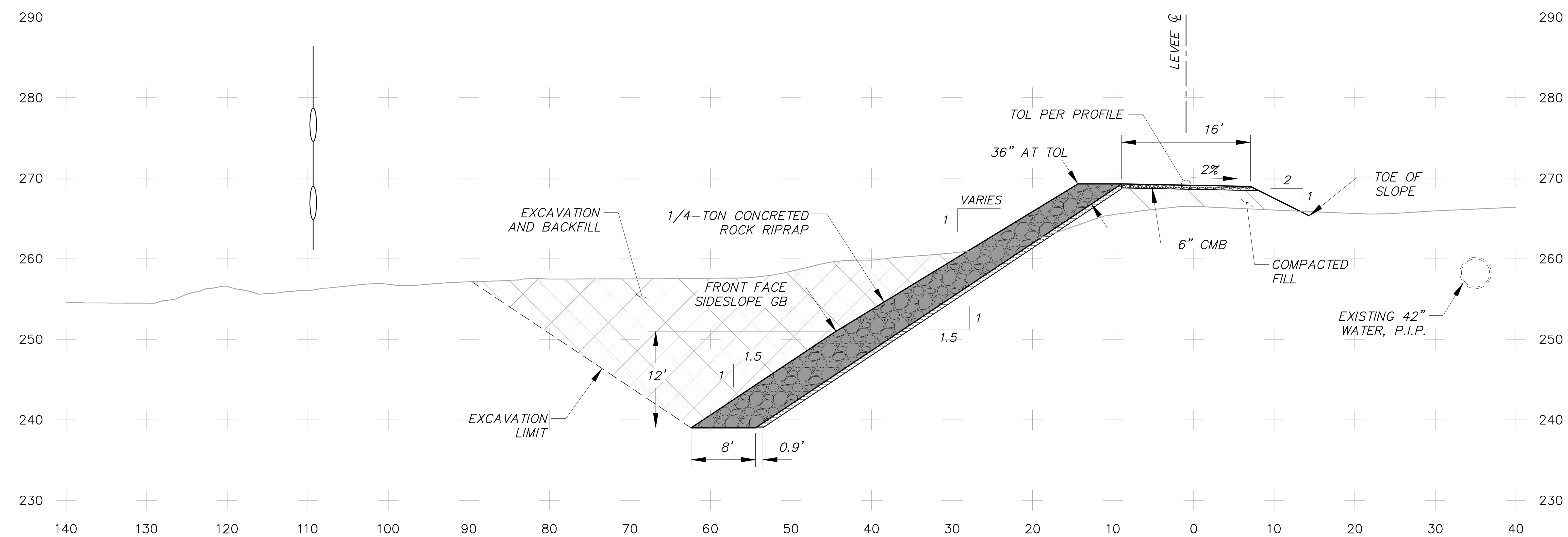
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

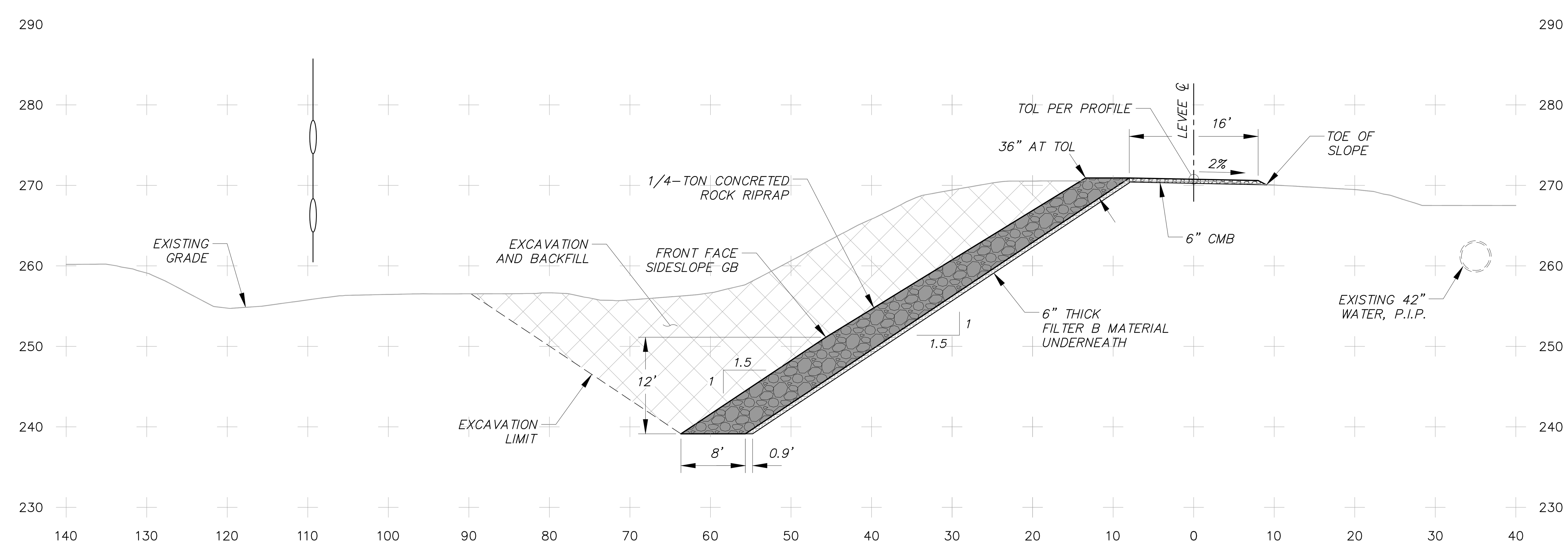
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 7+00 TO STA 8+00

SHEET 12
OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 9+00



STA. 10+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC01.DWG

PLOT DATE: 3/18/22

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

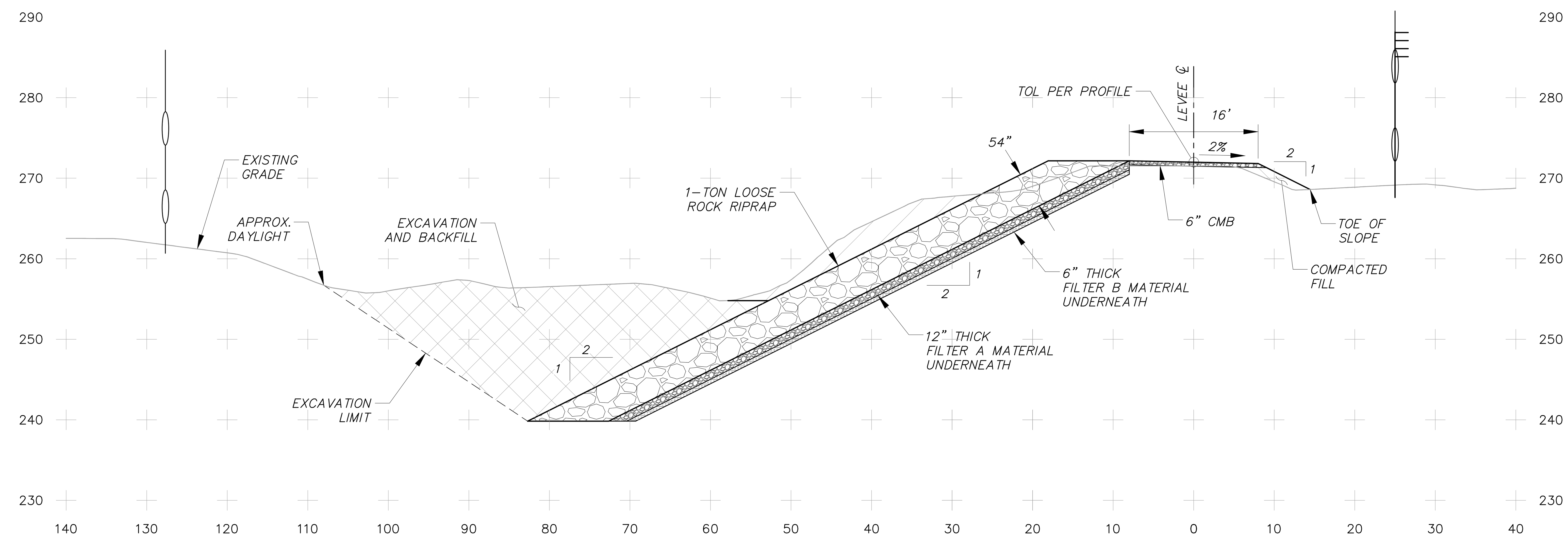
WATERSHED DEPUTY DIRECTOR	DATE
WATERSHED DIRECTOR	DATE
AGENCY DIRECTOR	DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

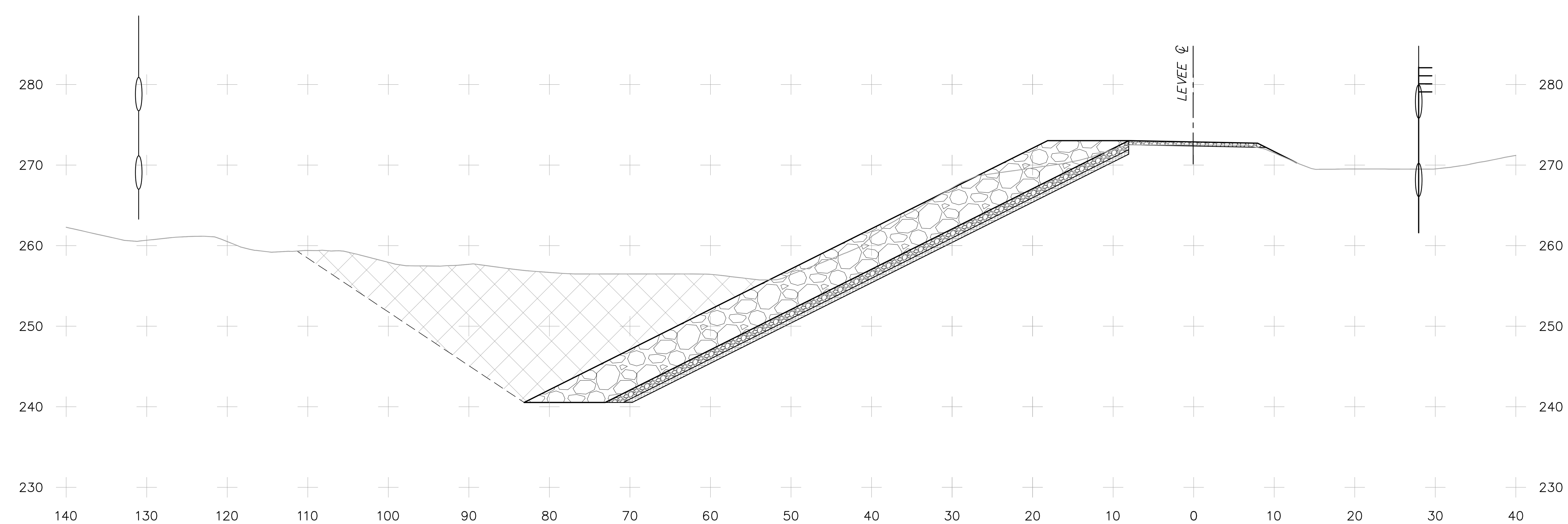
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 9+00 TO STA 10+00

SHEET 13
OF 35
DRAWING NO.
WPD-2-Y-X-X



STA. 11+00



STA. 12+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC04.DWG

PLOT DATE: 3/18/22

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

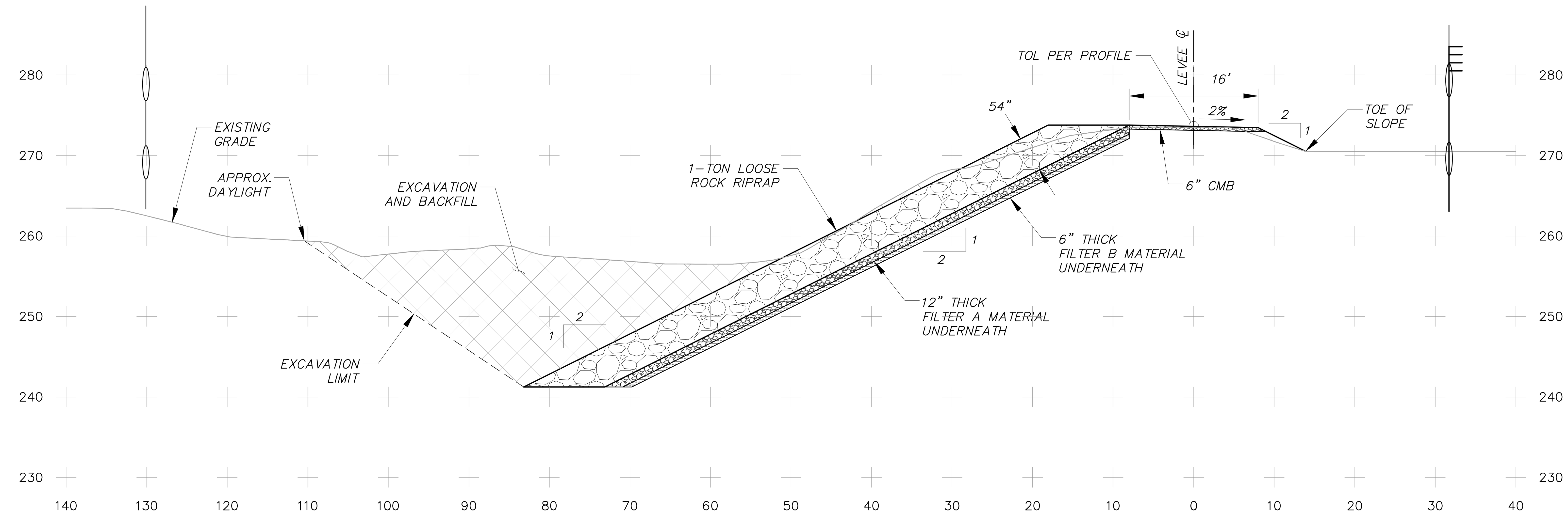
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

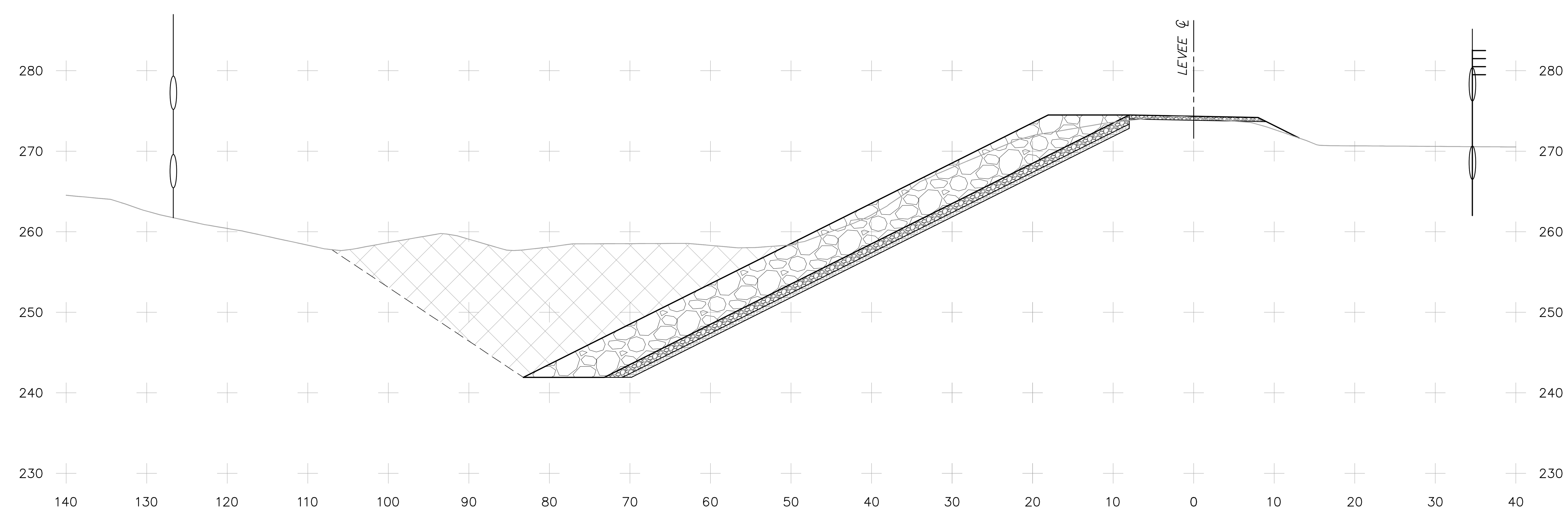
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 11+00 TO STA 12+00

SHEET 14
OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 13+00



STA. 14+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC05.DWG

PLOT DATE: 3/18/22

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

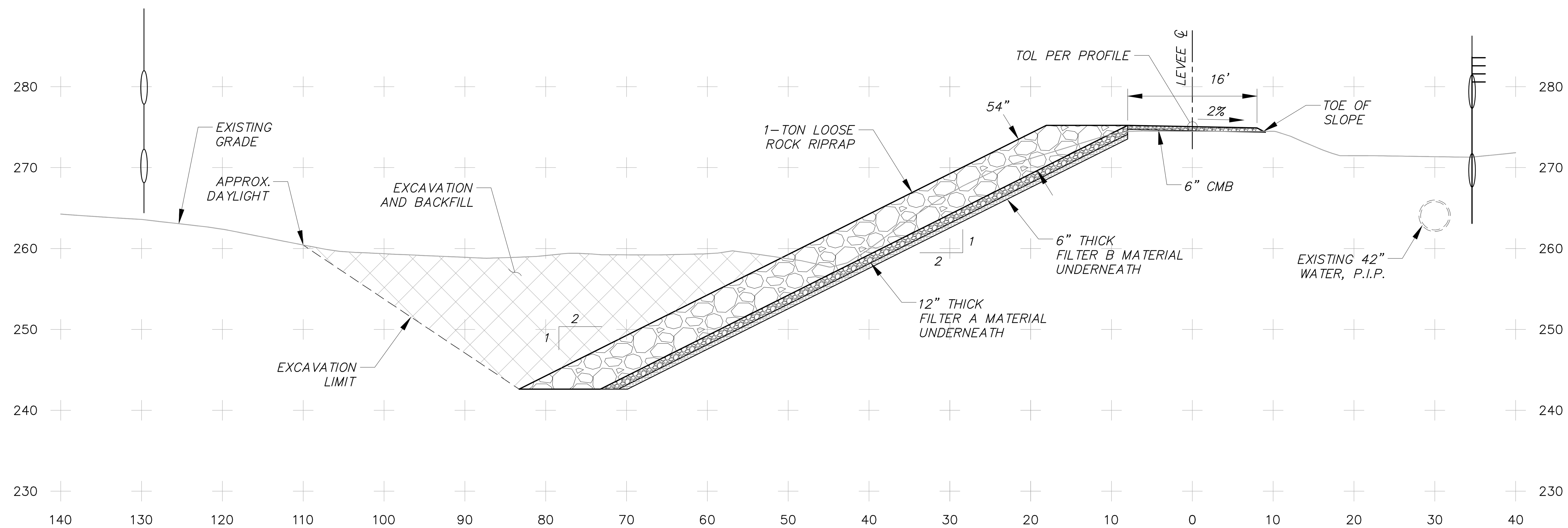
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

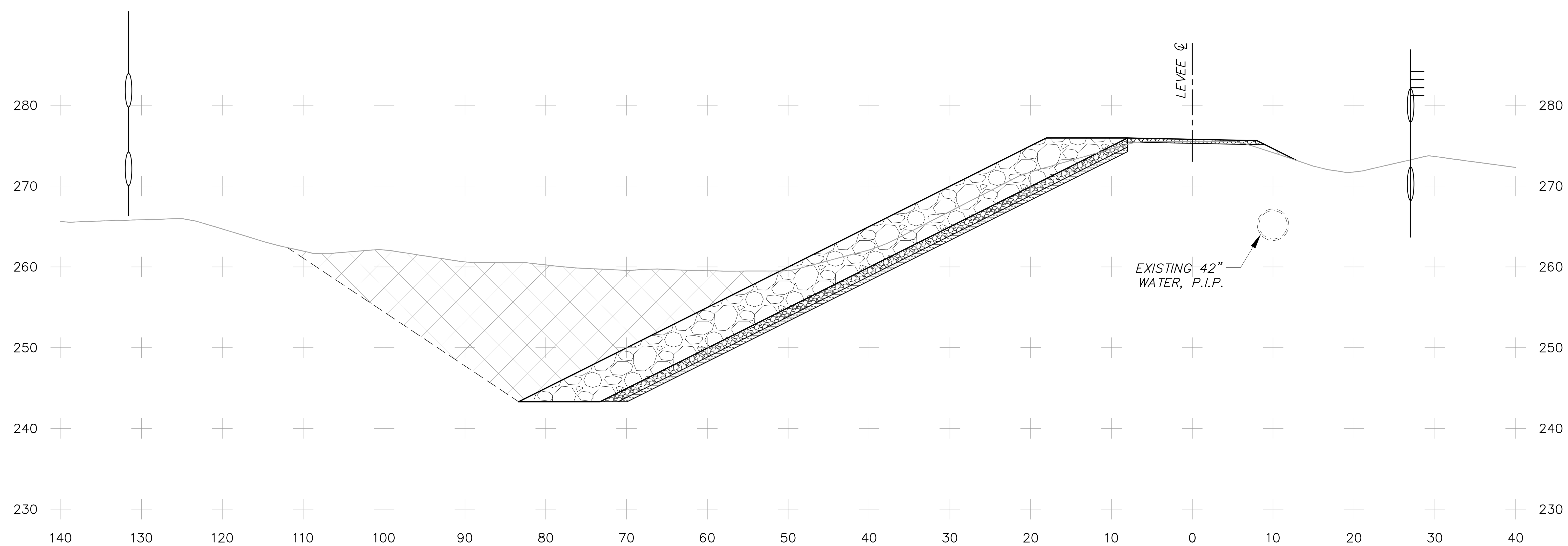
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 13+00 TO STA 14+00

SHEET 15 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 15+00



STA. 16+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/17/22

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

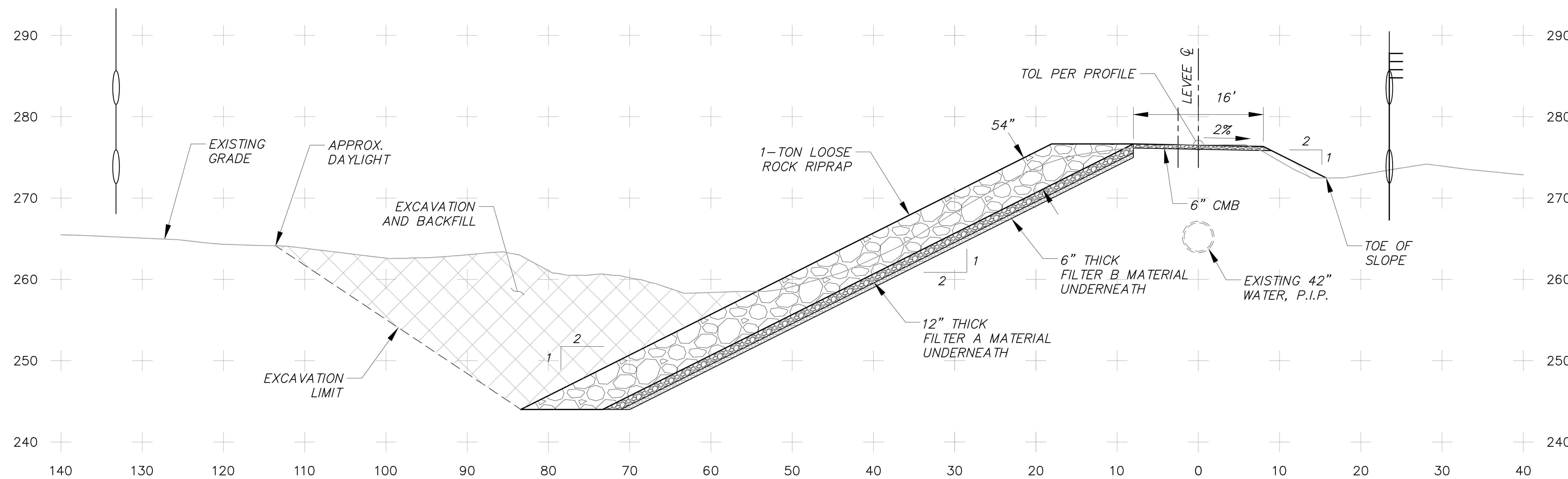
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

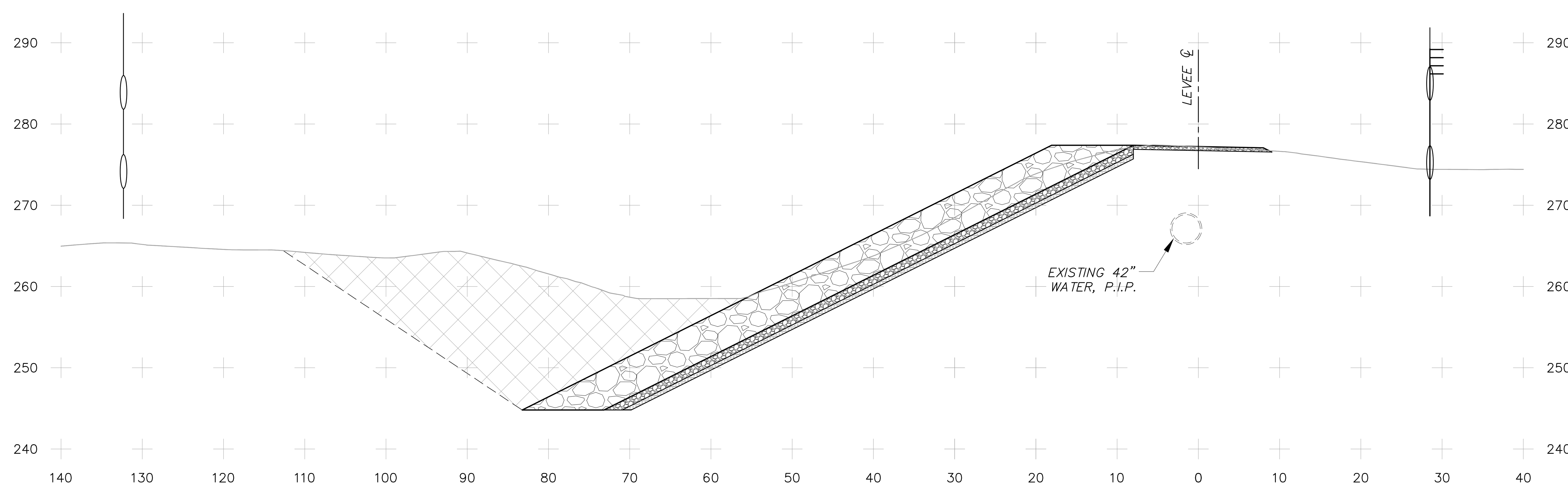
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 15+00 TO STA 16+00

SHEET 16 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 17+00



STA. 18+00

CROSS SECTIONS
SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/16/22
SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\137983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\137983VR2-SEC07.DWG

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH
TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

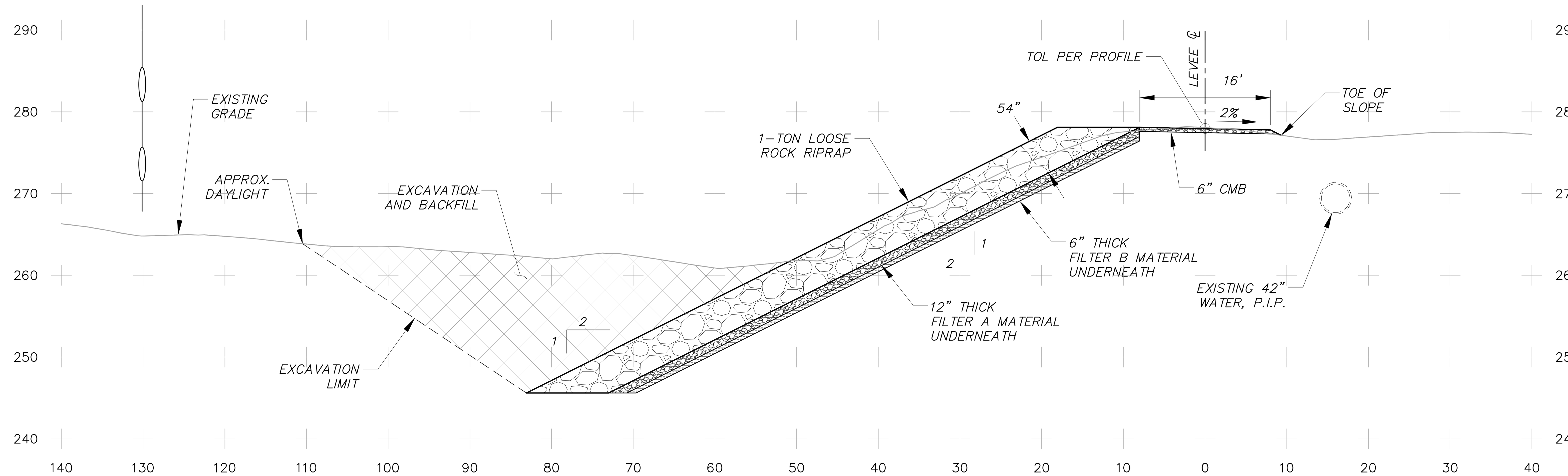
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

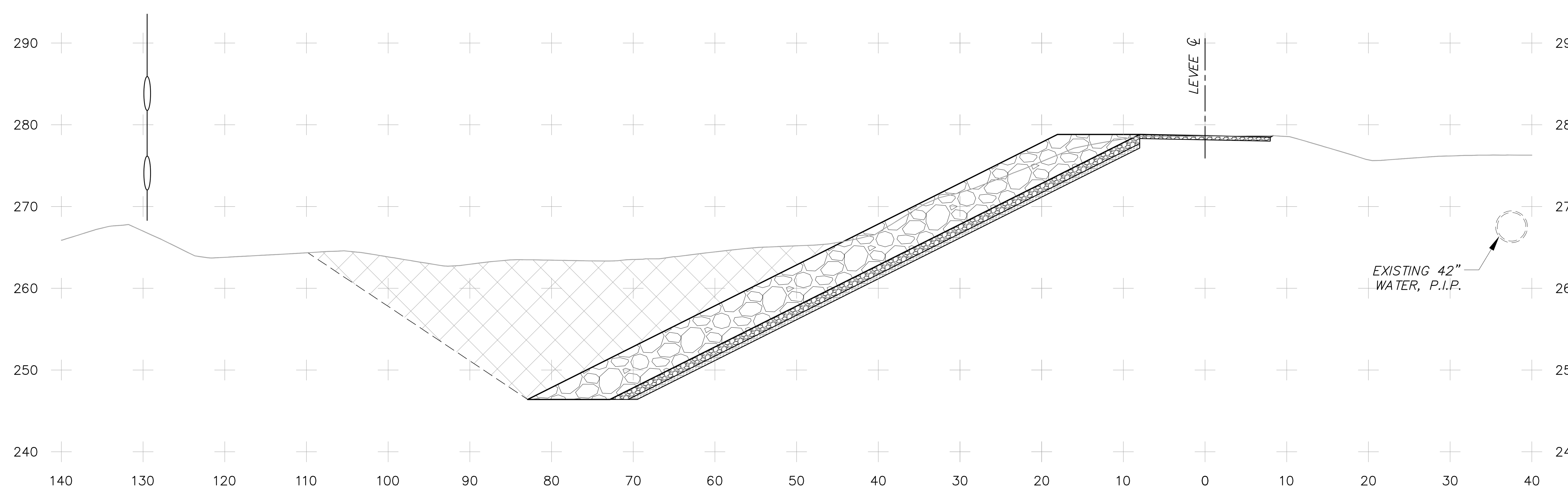
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 17+00 TO STA 18+00

SHEET 17
OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 19+00



STA. 20+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

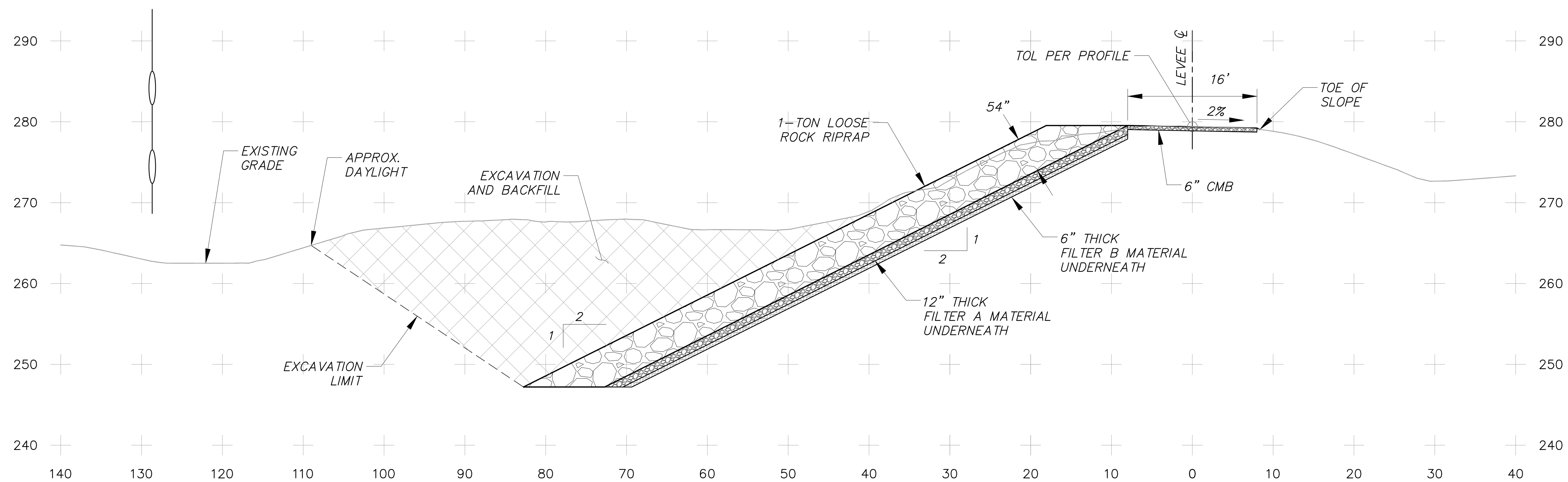
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

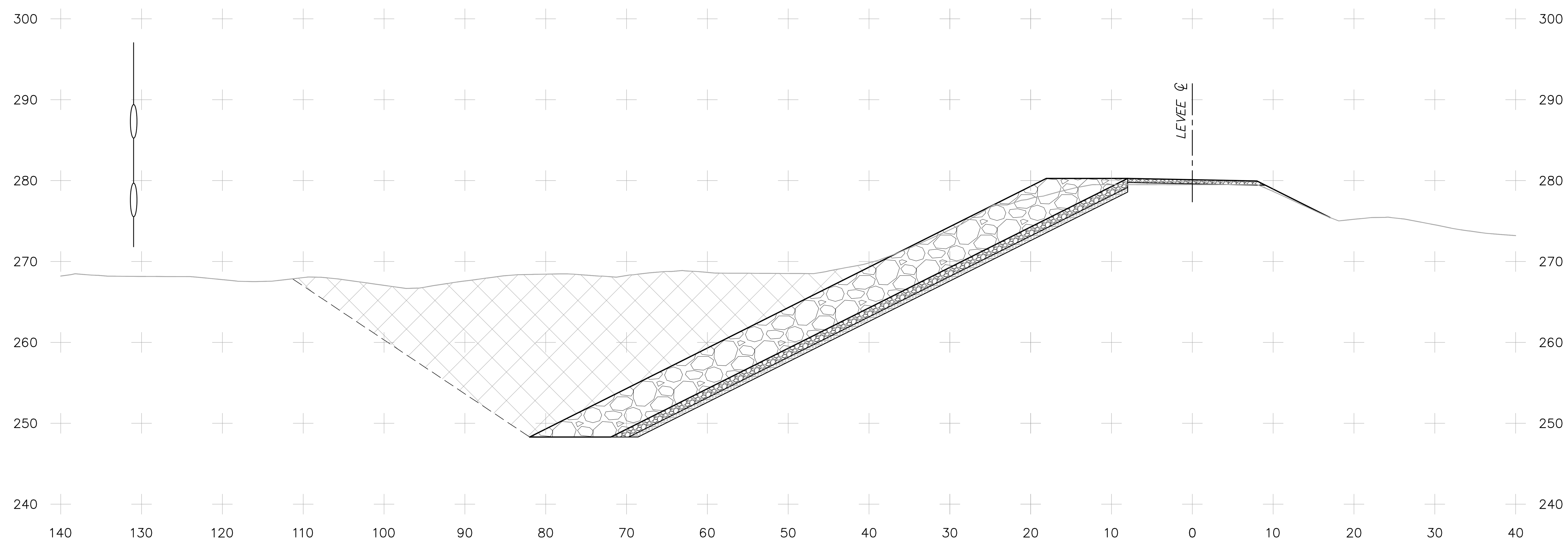
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 19+00 TO STA 20+00

SHEET 18
OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 21+00



STA. 22+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

D			
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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

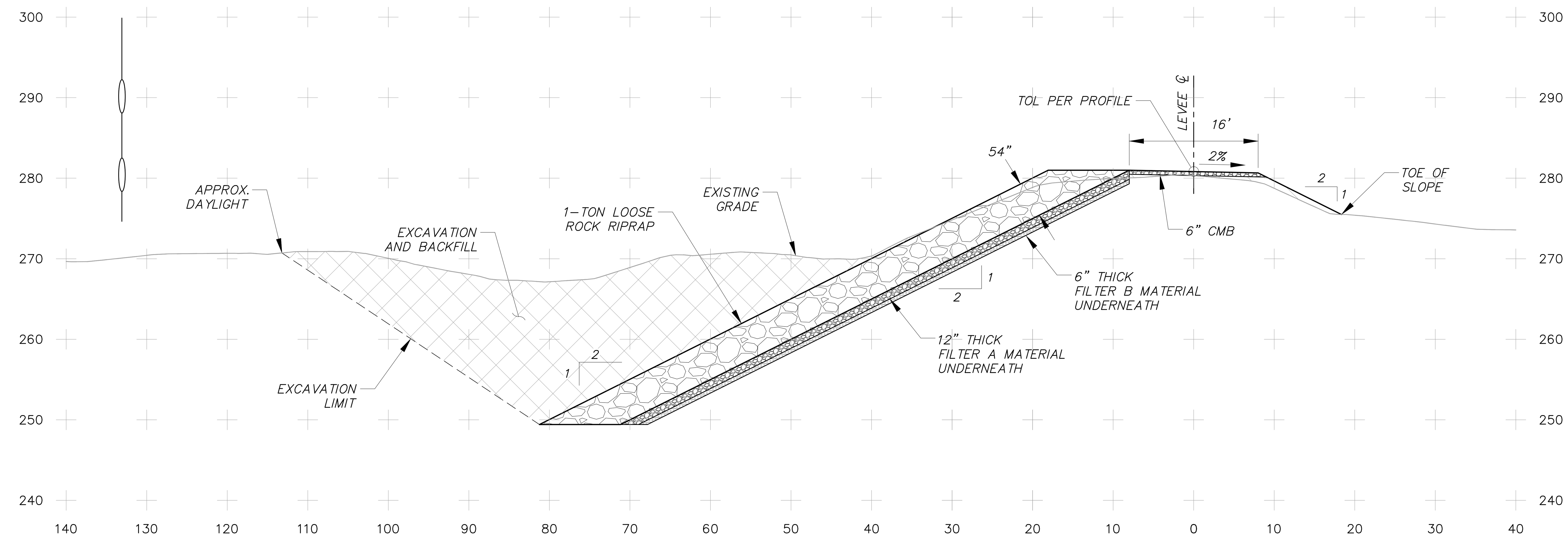
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

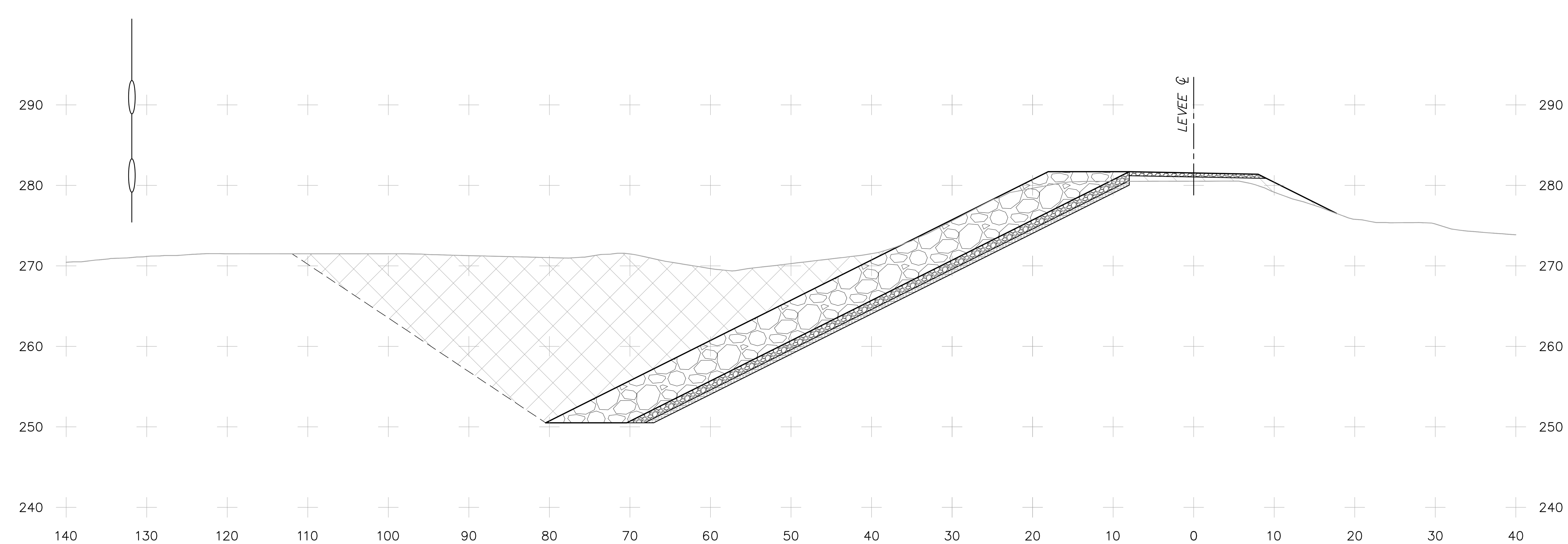
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 21+00 TO STA 22+00

SHEET 19 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 23+00



STA. 24+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/18/22

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\137983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\137983VR2-SEC10.DWG

D			
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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

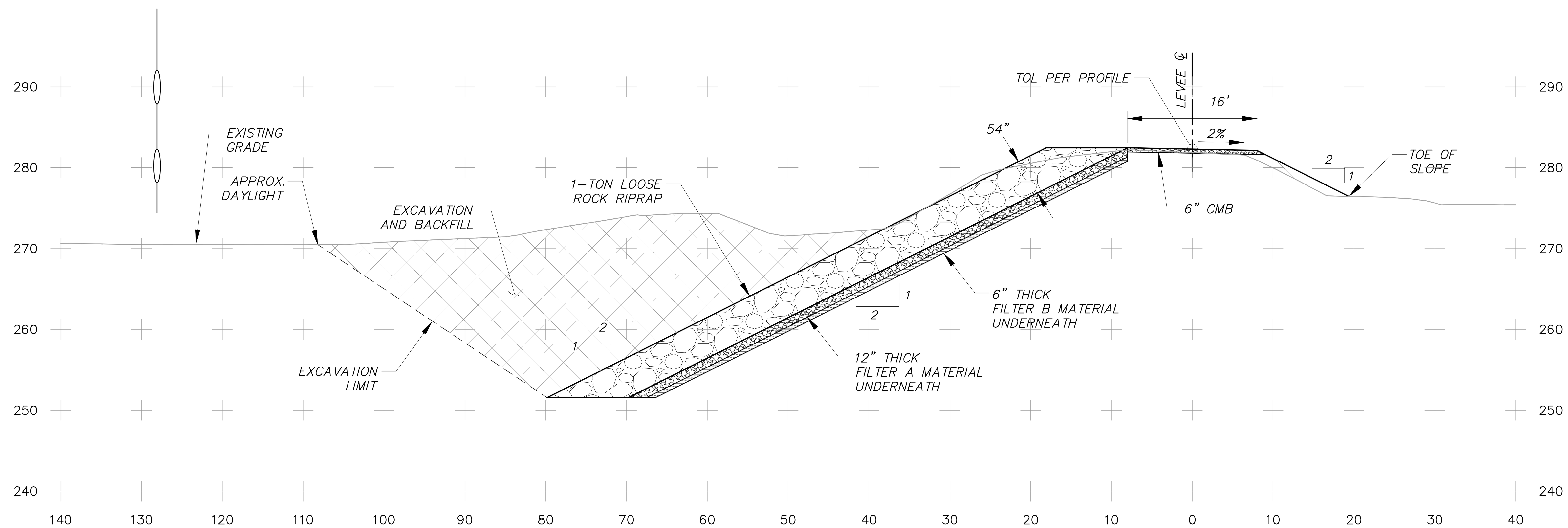
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

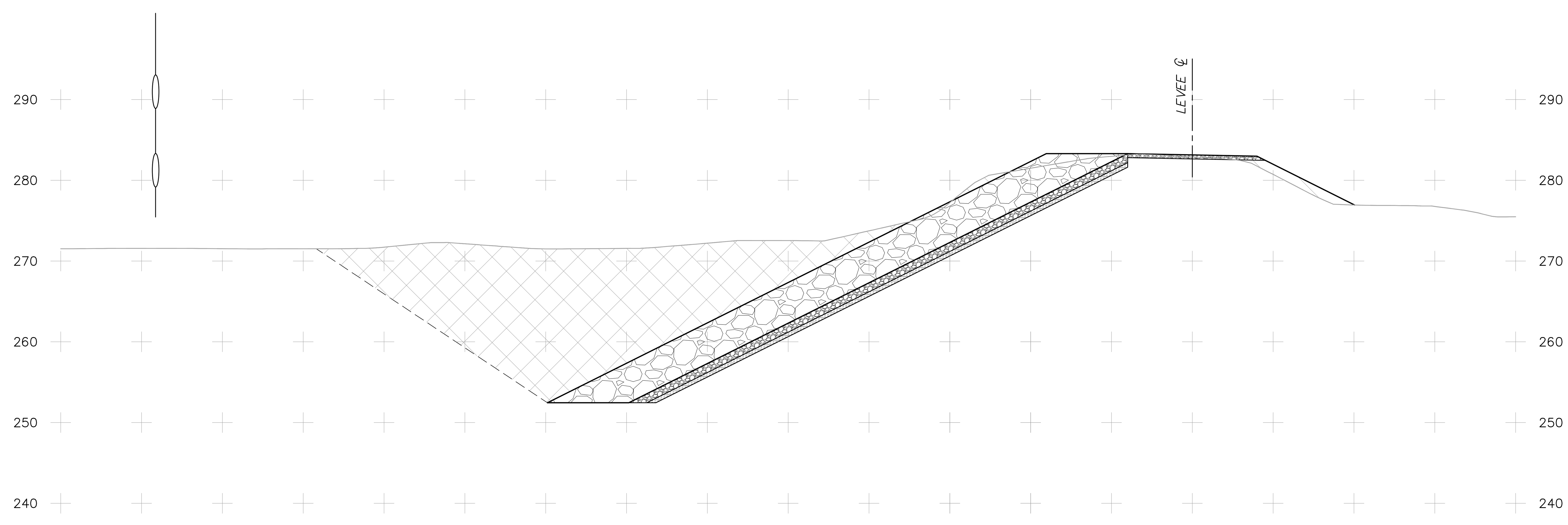
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 23+00 TO STA 24+00

SHEET 20
OF 35
DRAWING NO.
WPD-2-Y-X-X



STA. 25+00



STA. 26+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/18/22

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC11.DWG

	REVISION DESCRIPTION	APP.	DATE
D			
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TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

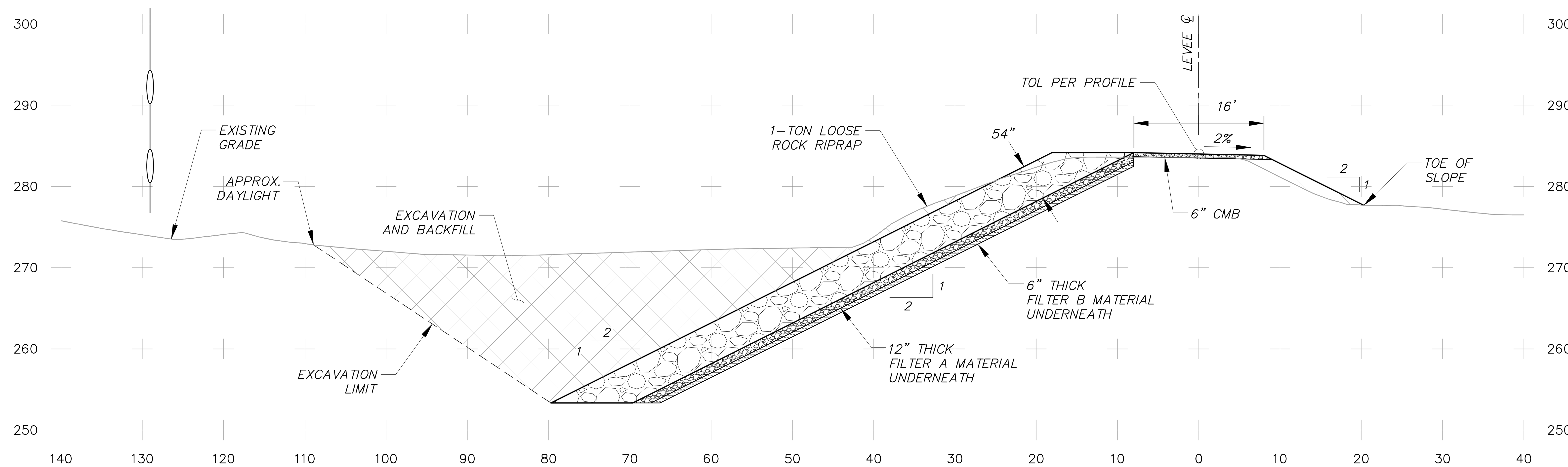
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

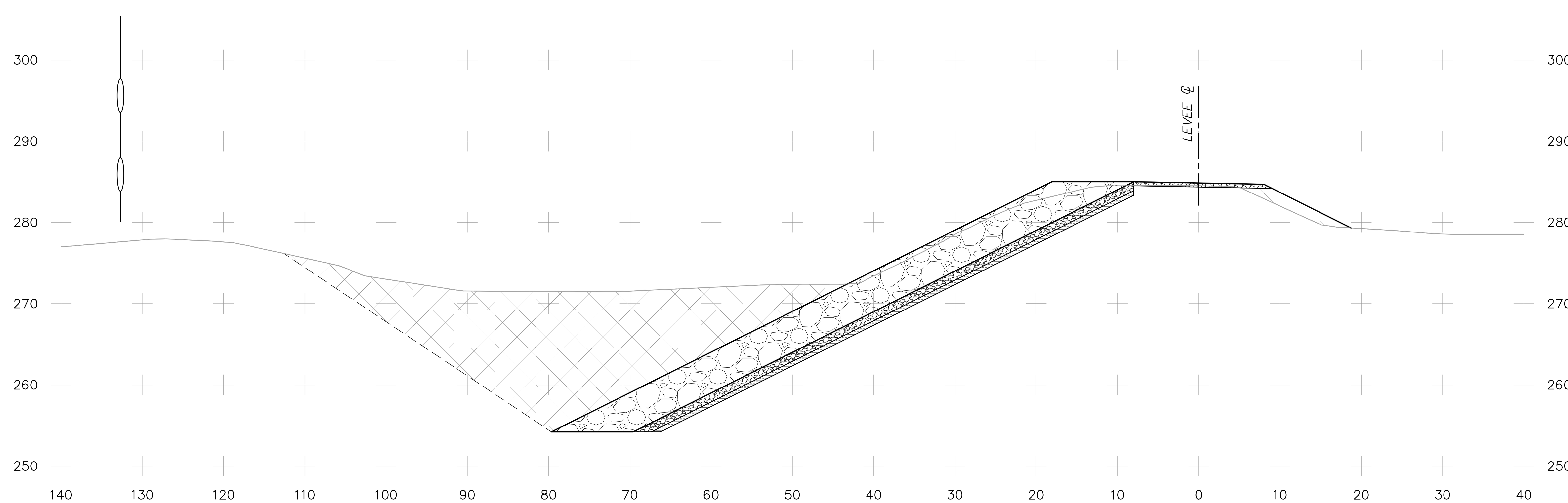
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 25+00 TO STA 26+00

SHEET 21 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 27+00



STA. 28+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983_VR-2_LEVEE\11_DESIGN\02_30%_DESIGN\SHEETS\T37983VR2-SEC12.DWG

PLOT DATE: 3/18/22

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

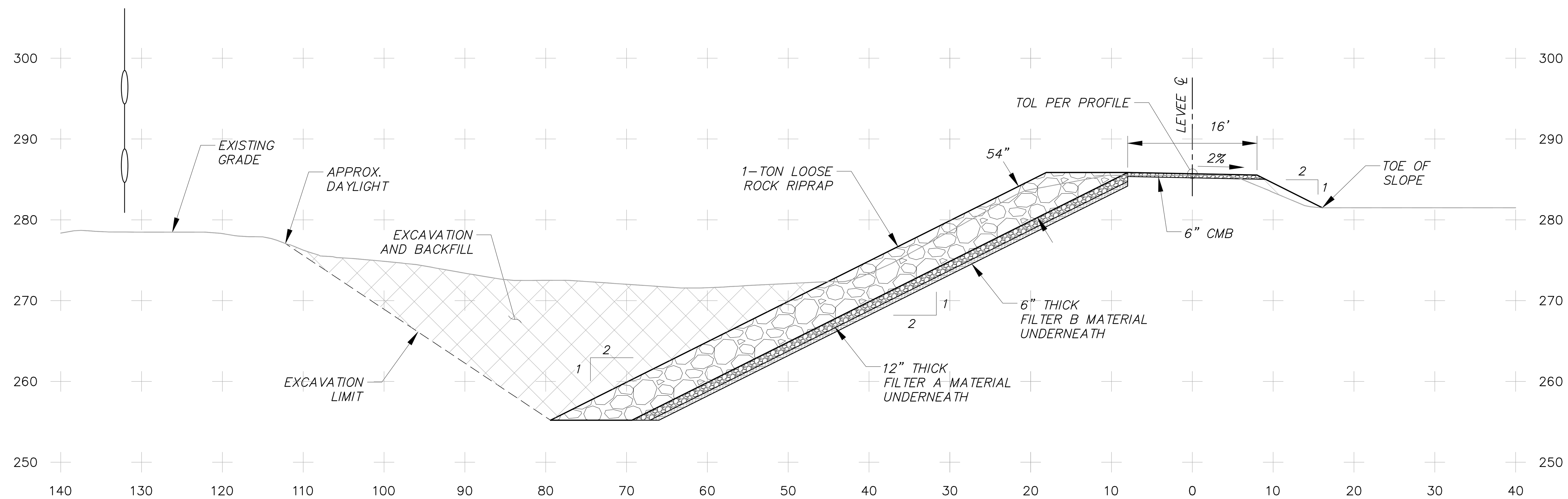
WATERSHED DEPUTY DIRECTOR	DATE
WATERSHED DIRECTOR	DATE
AGENCY DIRECTOR	DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

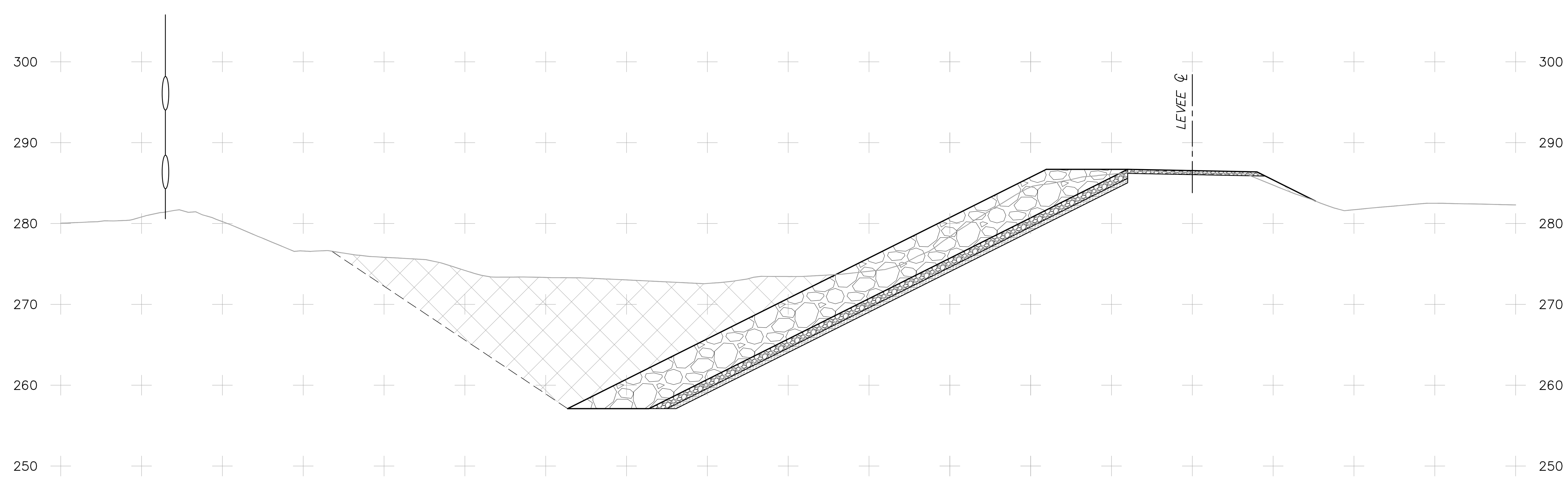
SPEC. NO. –
PROJ. NO. ----

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 27+00 TO STA 28+00

SHEET 22 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 29+00



STA. 30+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/18/22

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC13.DWG

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

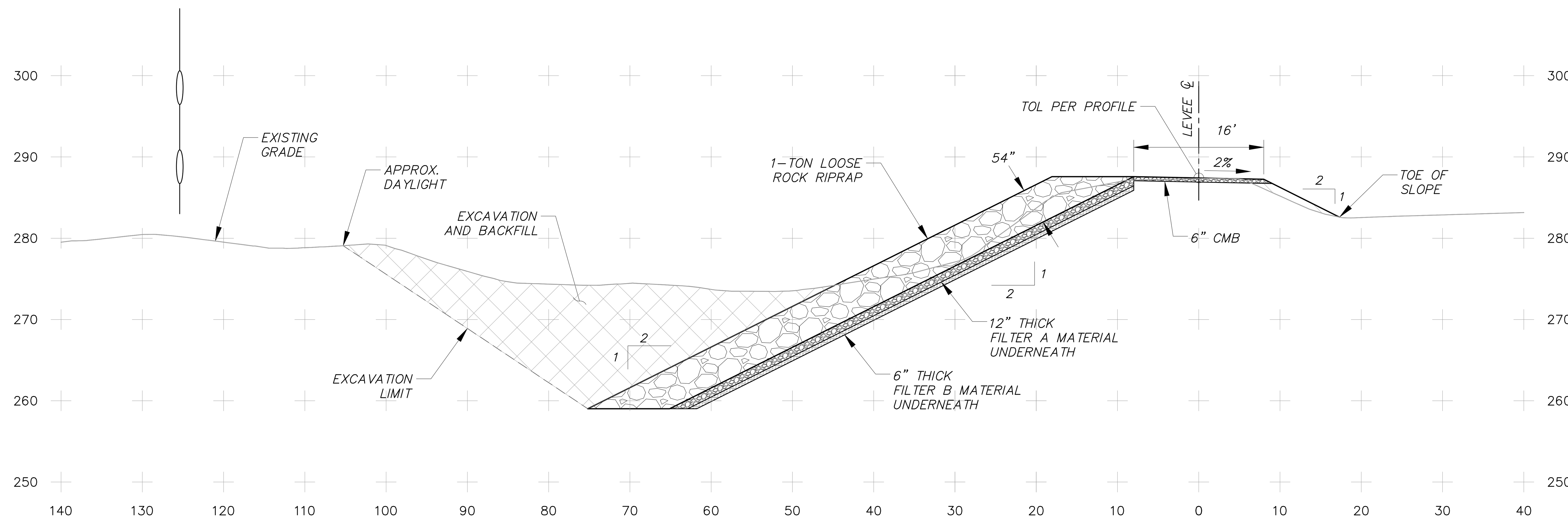
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

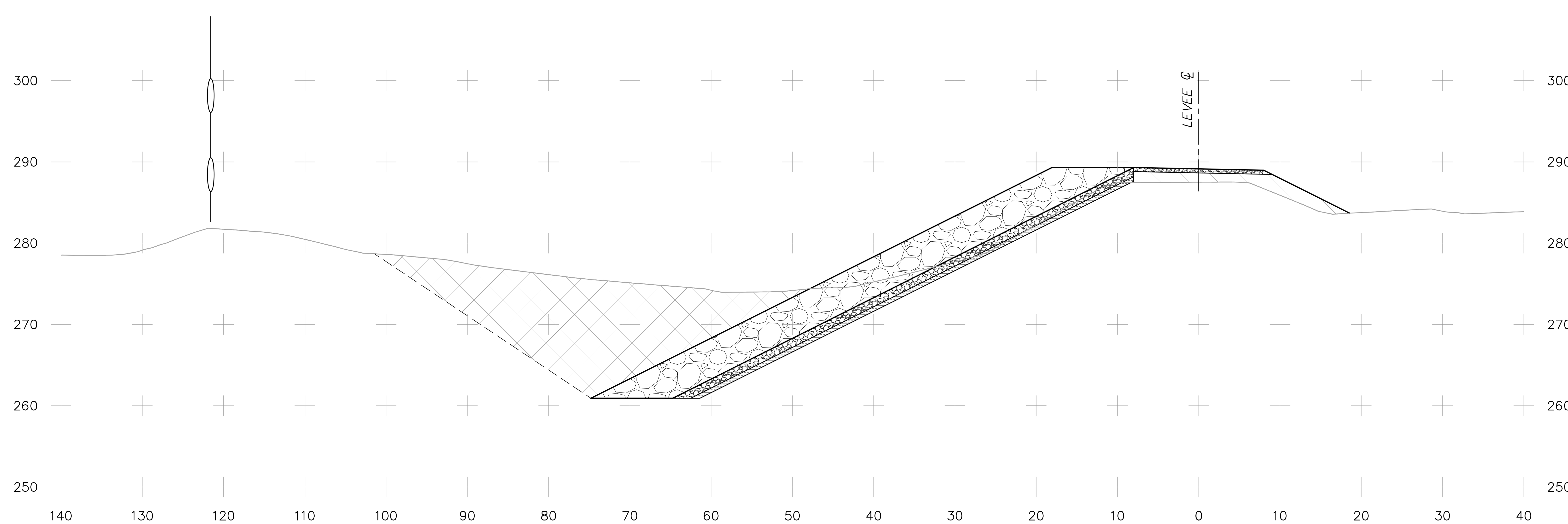
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 29+00 TO STA 30+00

SHEET 23
OF 35
DRAWING NO.
WPD-2-Y-X-X



STA. 31+00



STA. 32+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\137983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\137983VR2-SEC14.DWG

PLOT DATE: 3/18/22

D			
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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

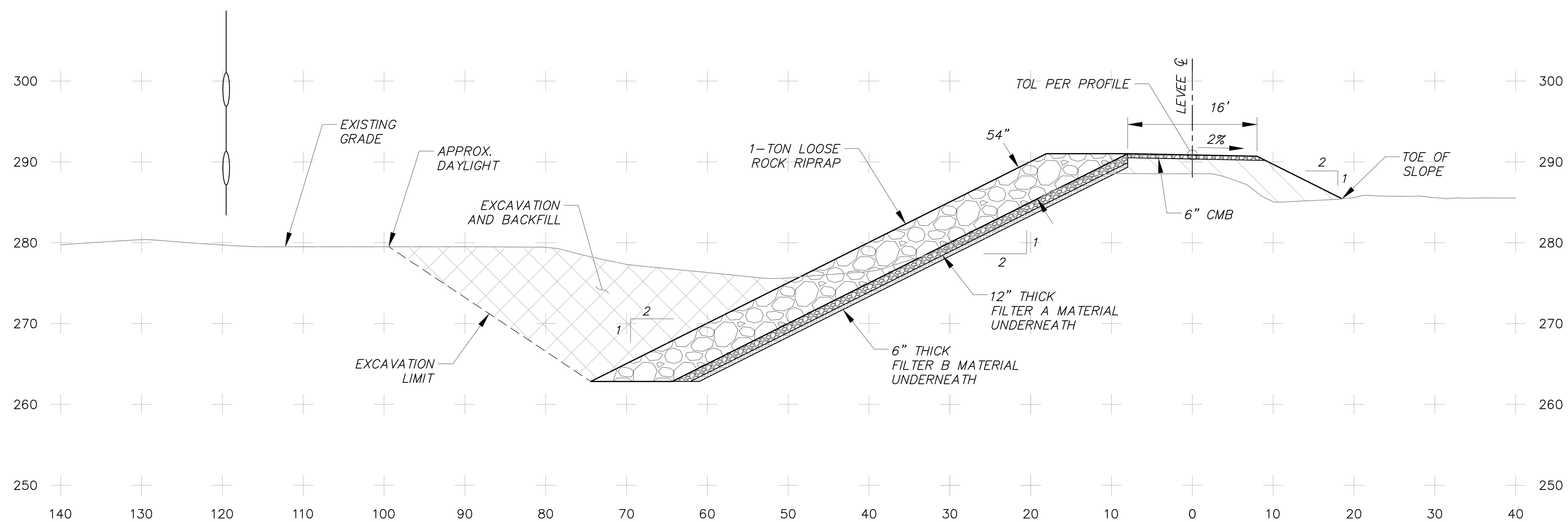
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

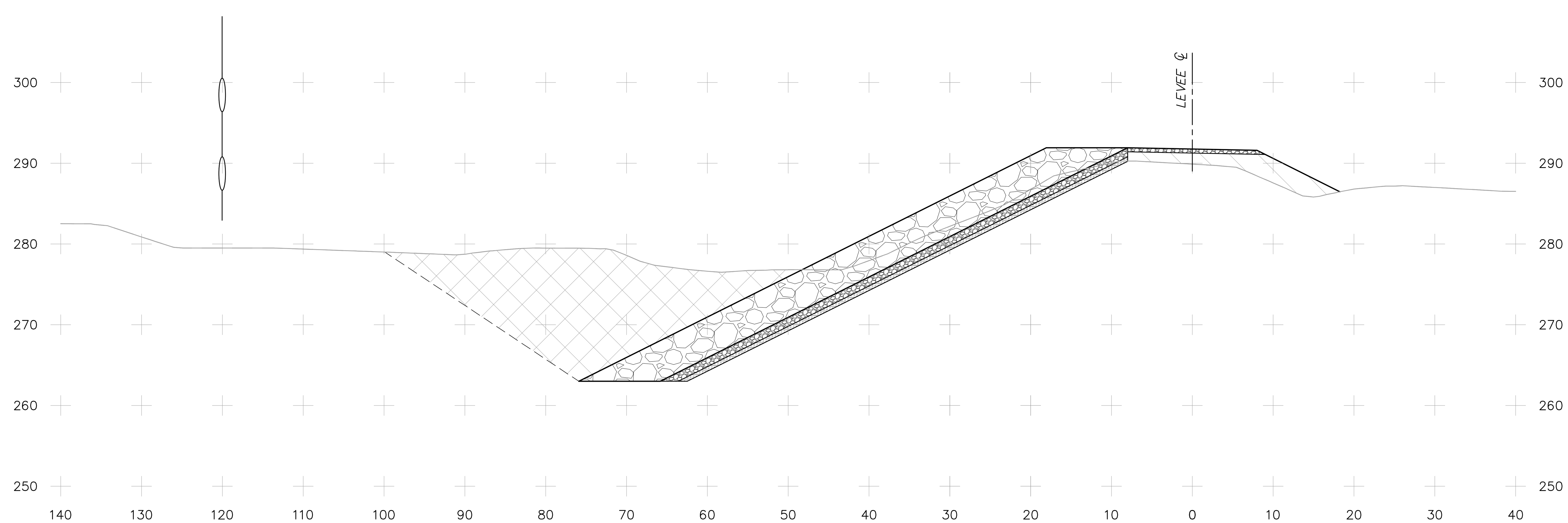
SPEC. NO. –
PROJ. NO. ----

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 31+00 TO STA 32+00

SHEET 24 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 33+00



STA. 34+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

D			
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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

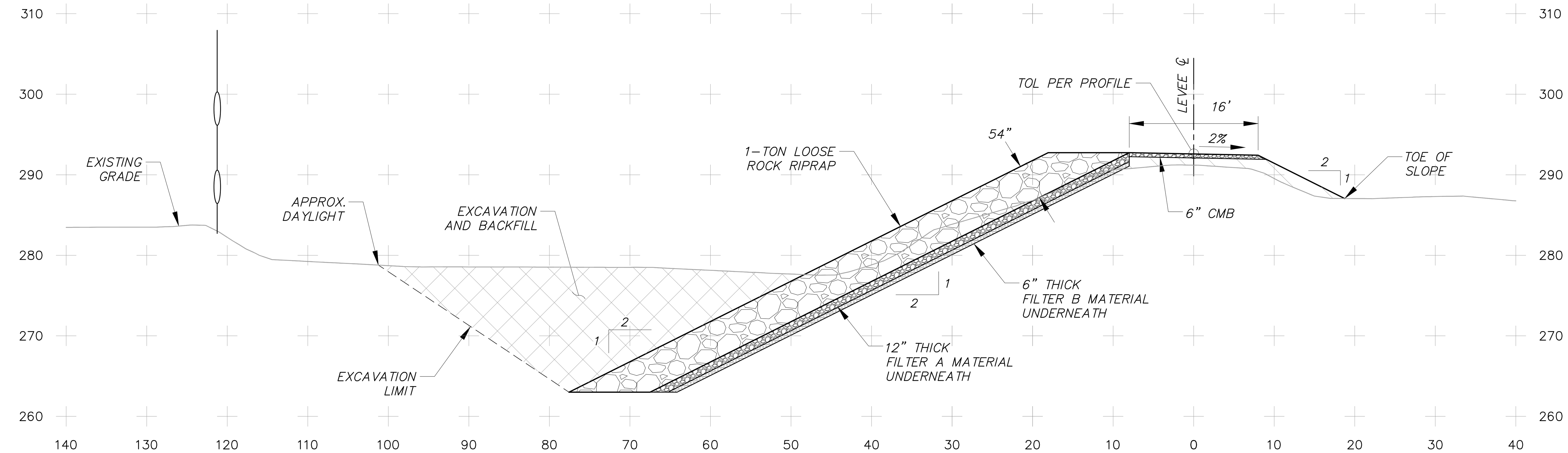
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

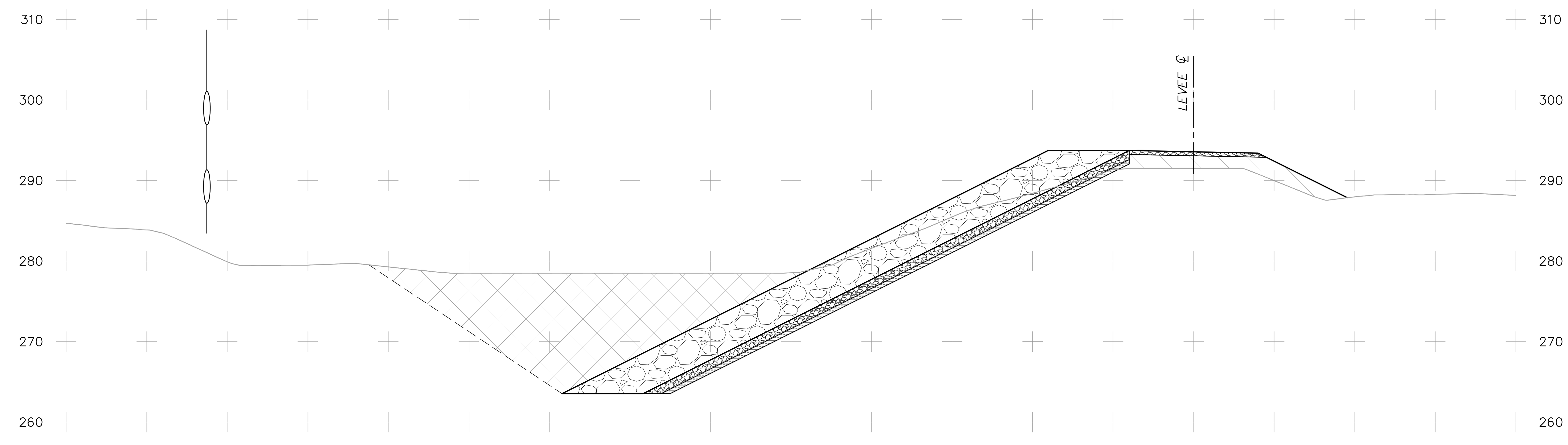
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 33+00 TO STA 34+00

SHEET 25 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 35+00



STA. 36+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

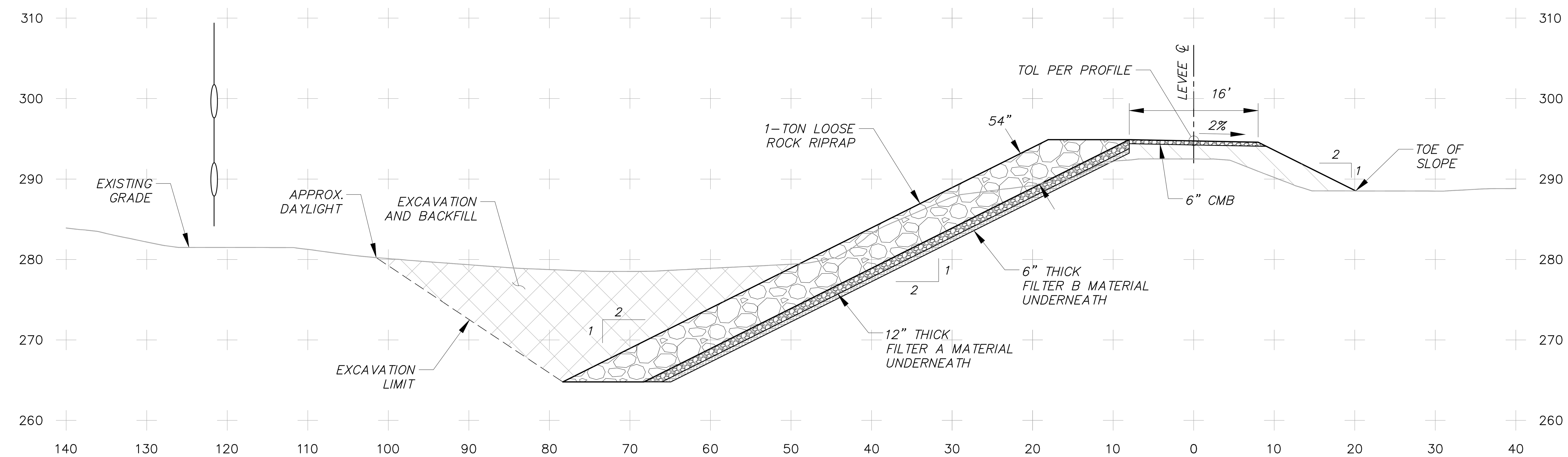
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

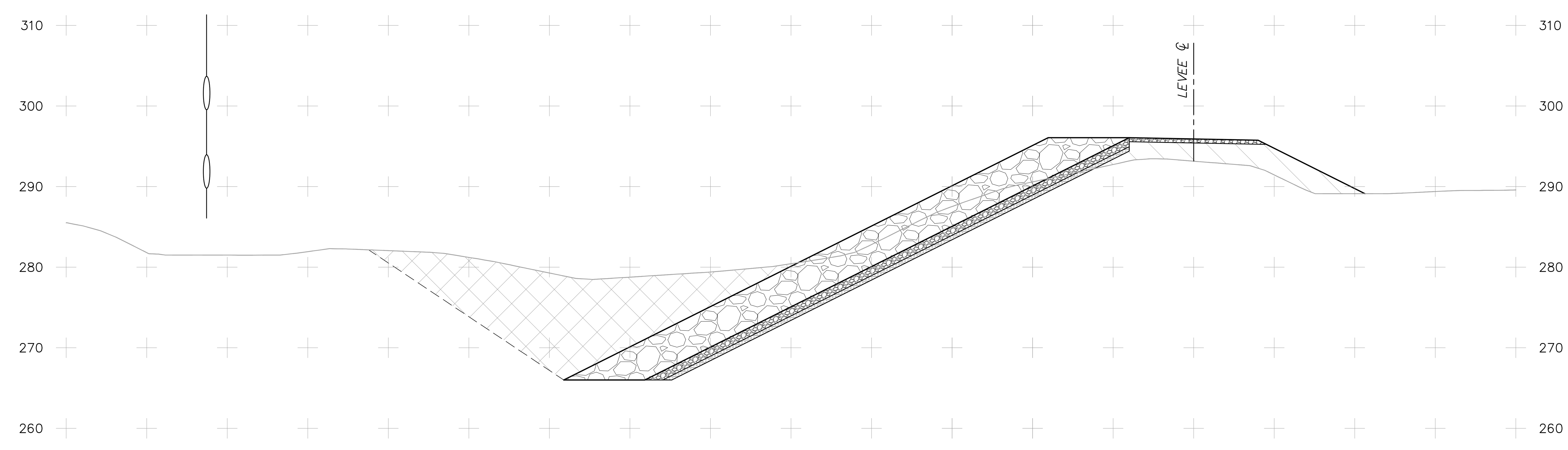
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 35+00 TO STA 36+00

SHEET 26 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 37+00



STA. 38+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/18/22

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T3798\VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T3798VR2-SEC17.DWG

	REVISION DESCRIPTION	APP.	DATE
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TETRA TECH
TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

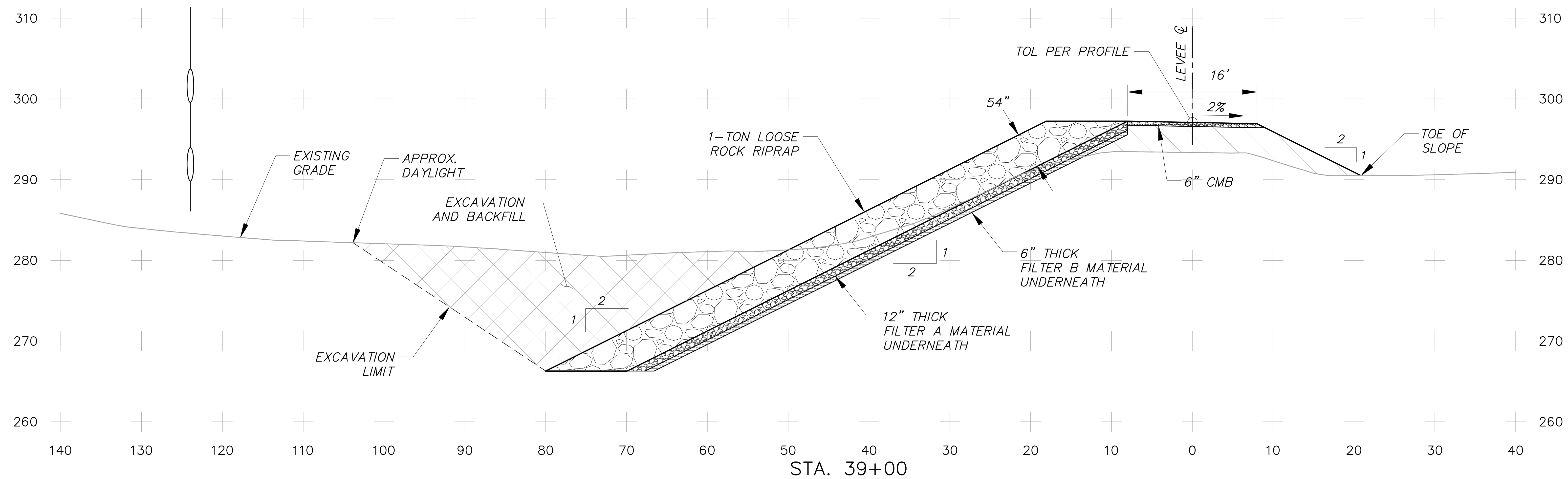
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

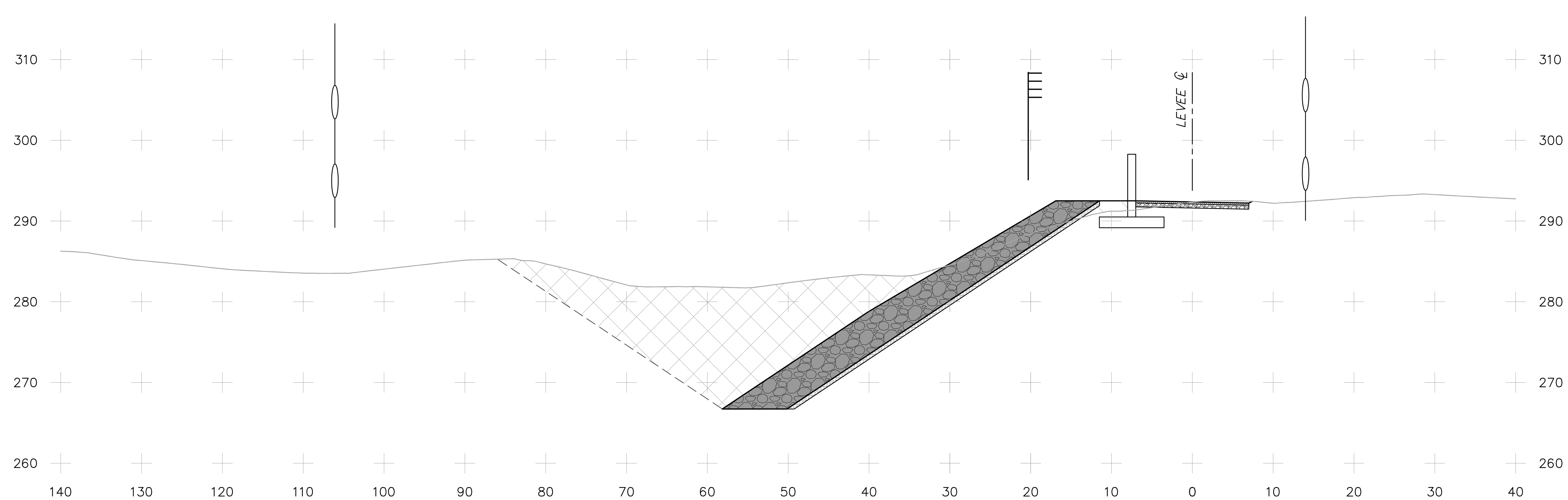
SPEC. NO. –
PROJ. NO. ----

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 37+00 TO STA 38+00

SHEET 27
OF 35
DRAWING NO.
WPD-2-Y-X-X



STA. 39+00



STA. 40+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/18/22

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC18.DWG

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

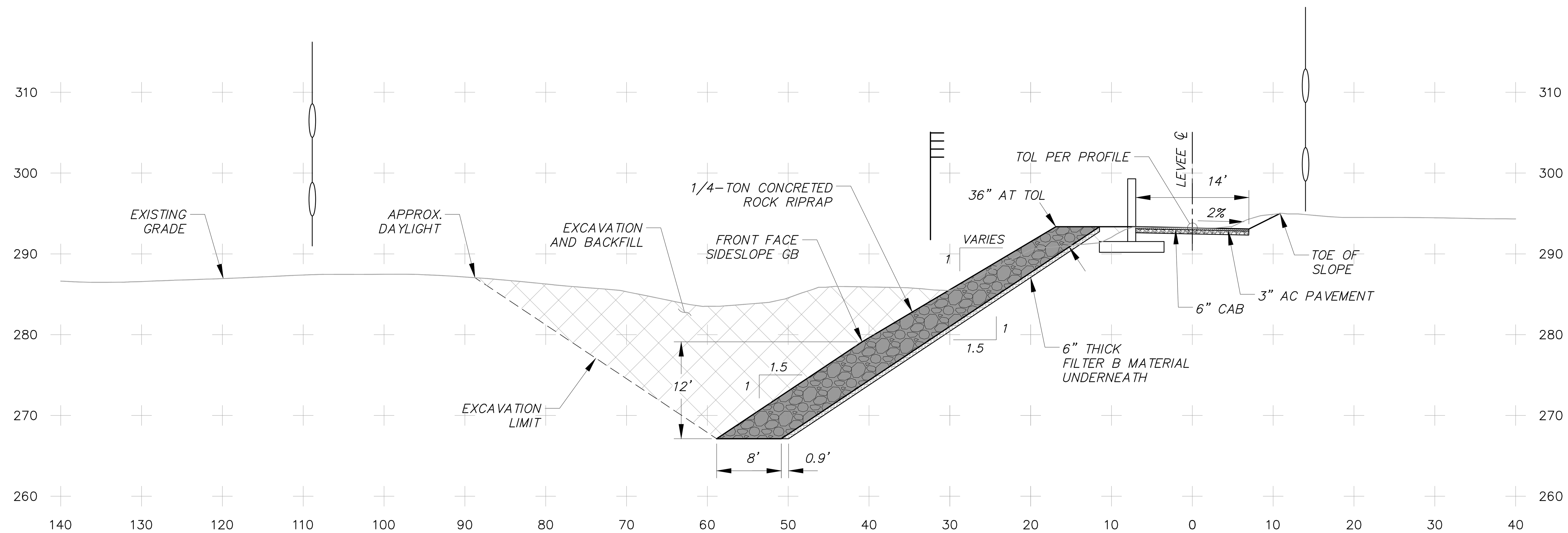
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

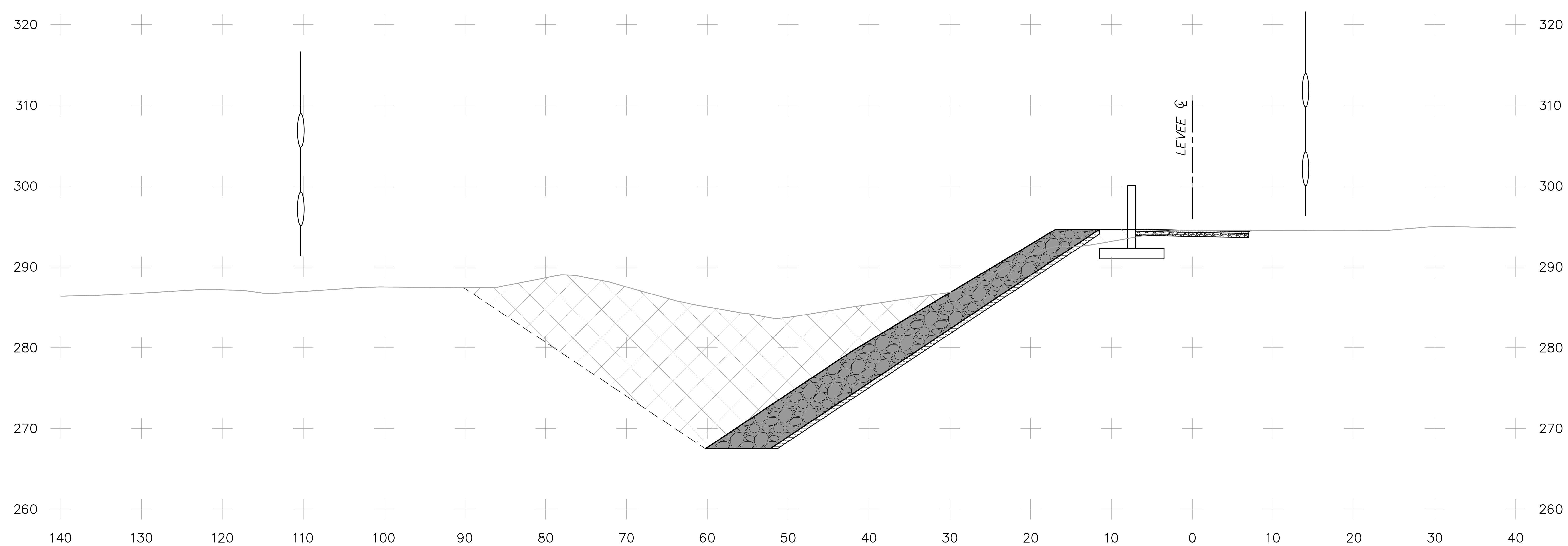
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 39+00 TO STA 40+00

SHEET 28 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 41+00



STA. 42+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

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△	REVISION DESCRIPTION	APP	DATE

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC19.DWG

PLOT DATE: 3/18/22

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

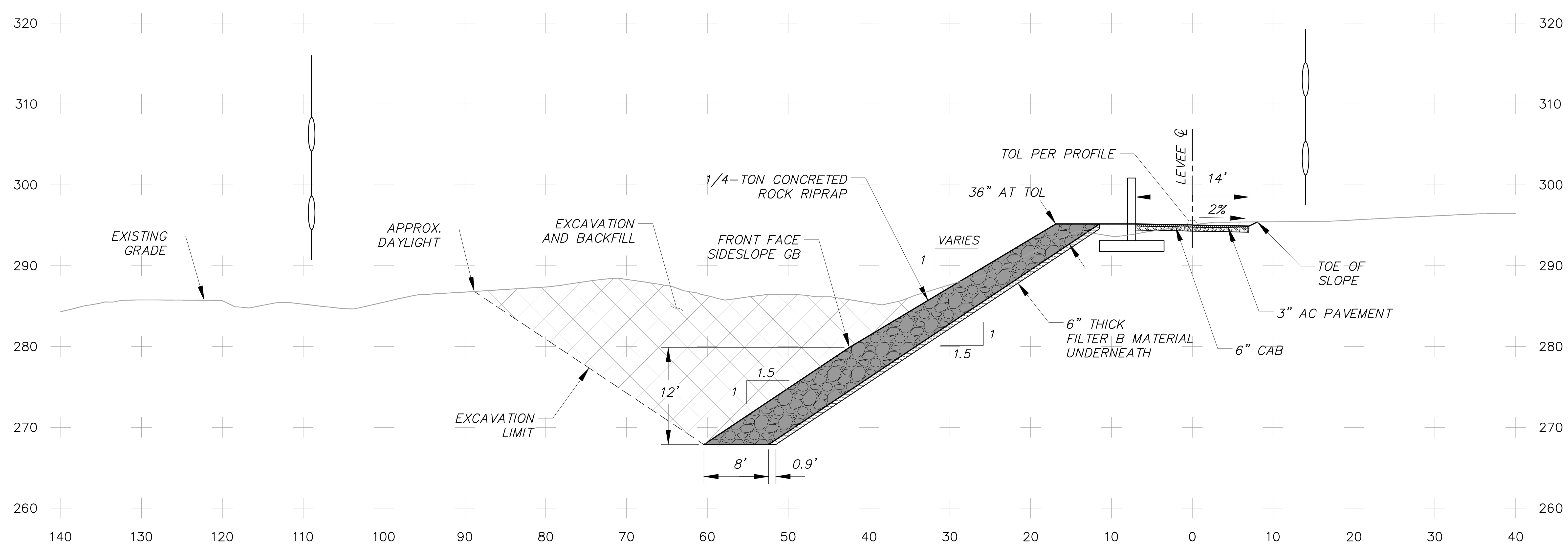
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

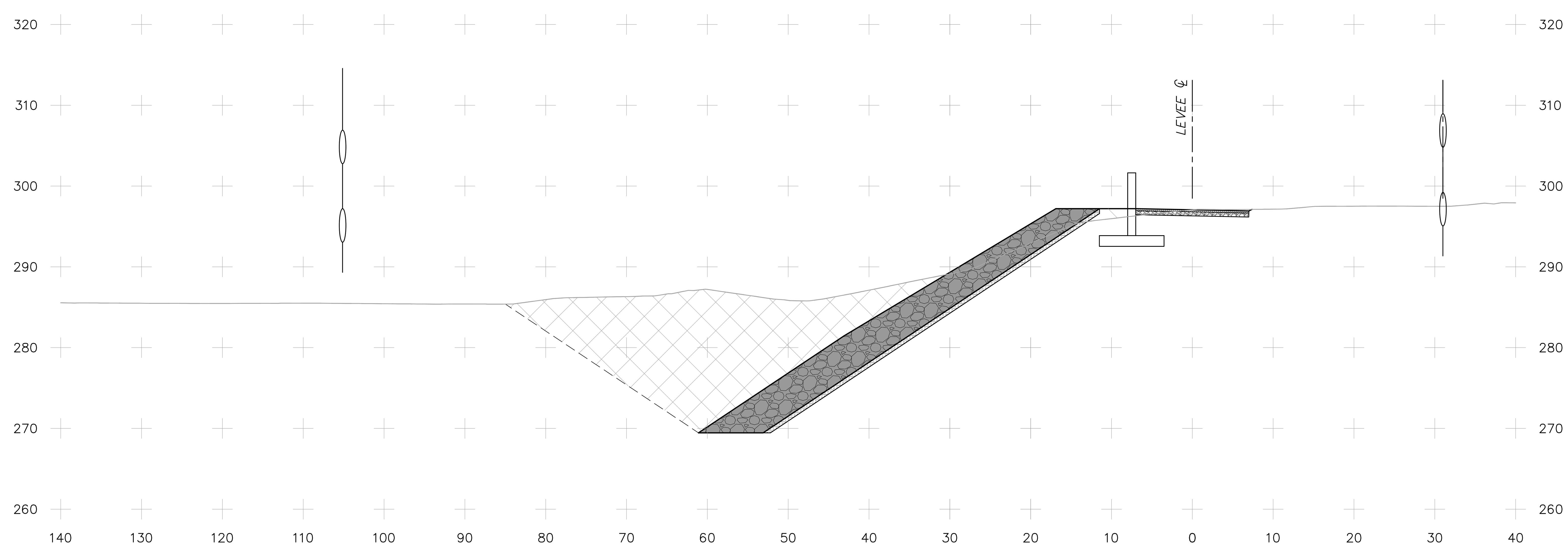
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 41+00 TO STA 42+00

SHEET 29
OF 35
DRAWING NO.
WPD-2-Y-X-X



STA. 43+00



STA. 44+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/18/22

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\137983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\137983VR2-SEC20.DWG

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

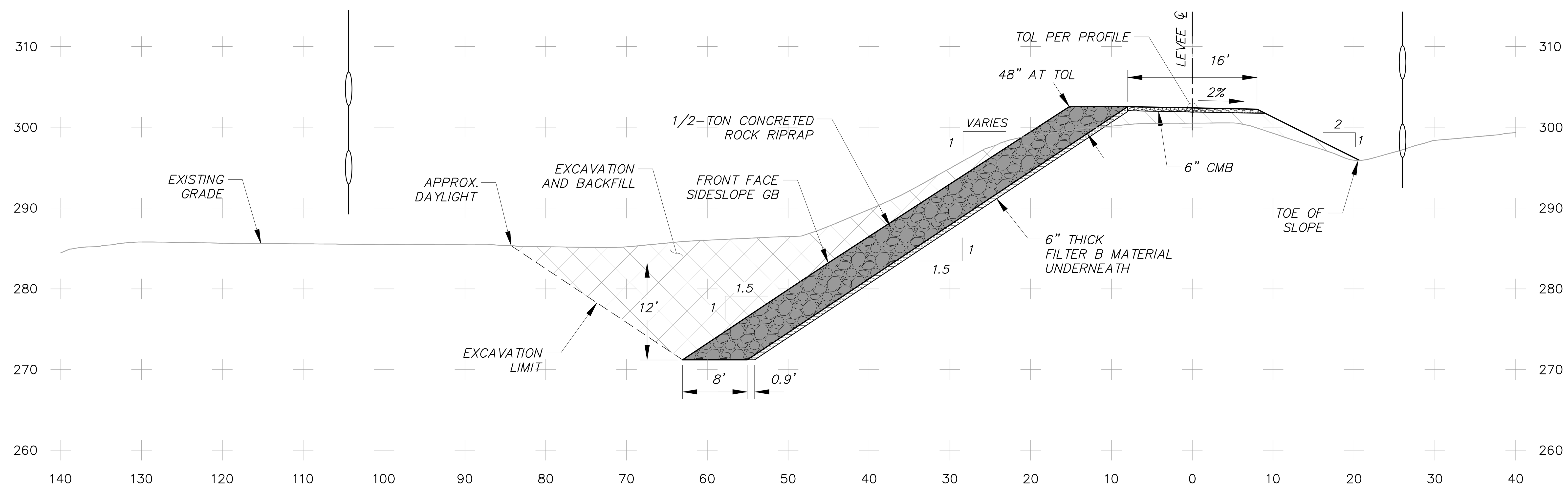
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

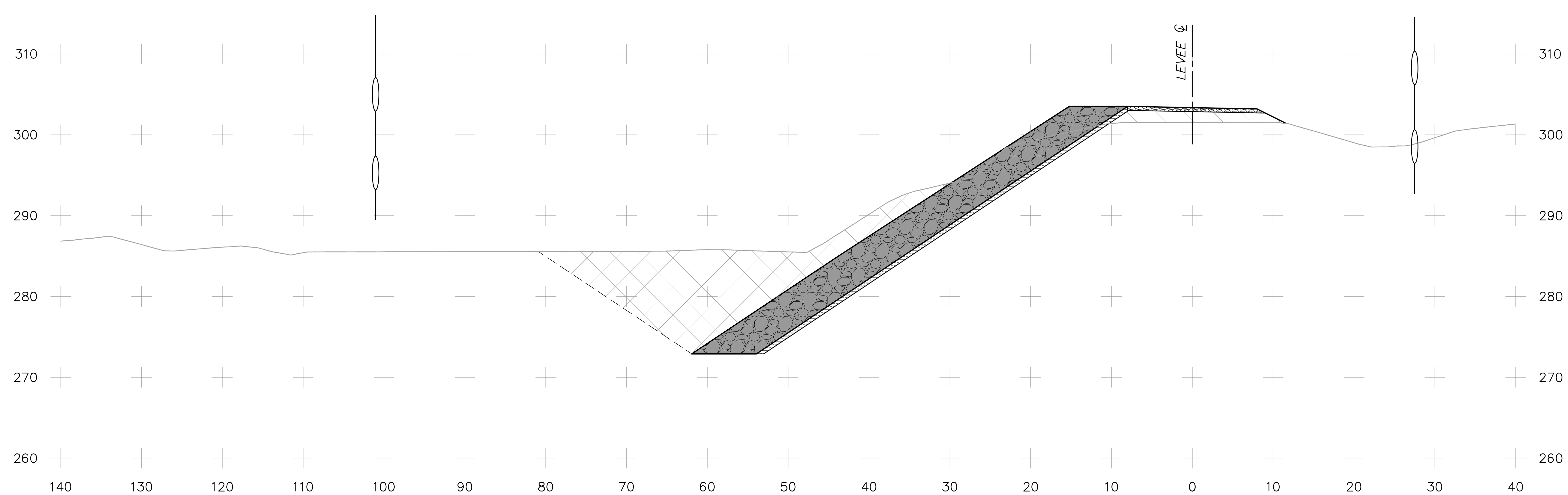
SPEC. NO. –
PROJ. NO. ----

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 43+00 TO STA 44+00

SHEET 30 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 45+00



STA. 46+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/20/22

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC21.DWG

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

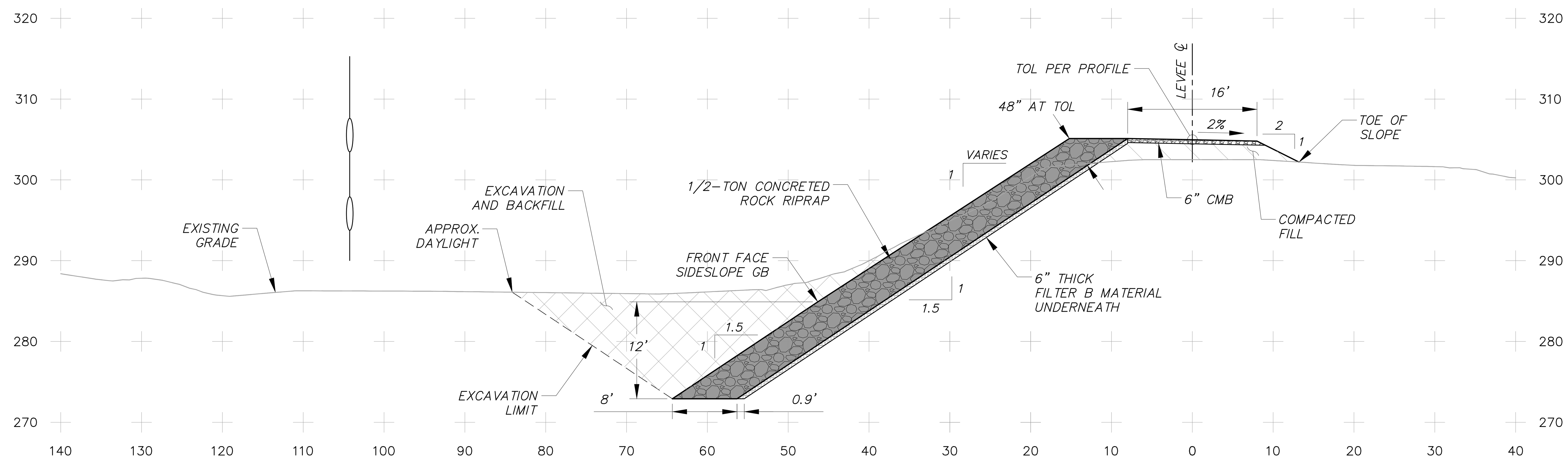
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

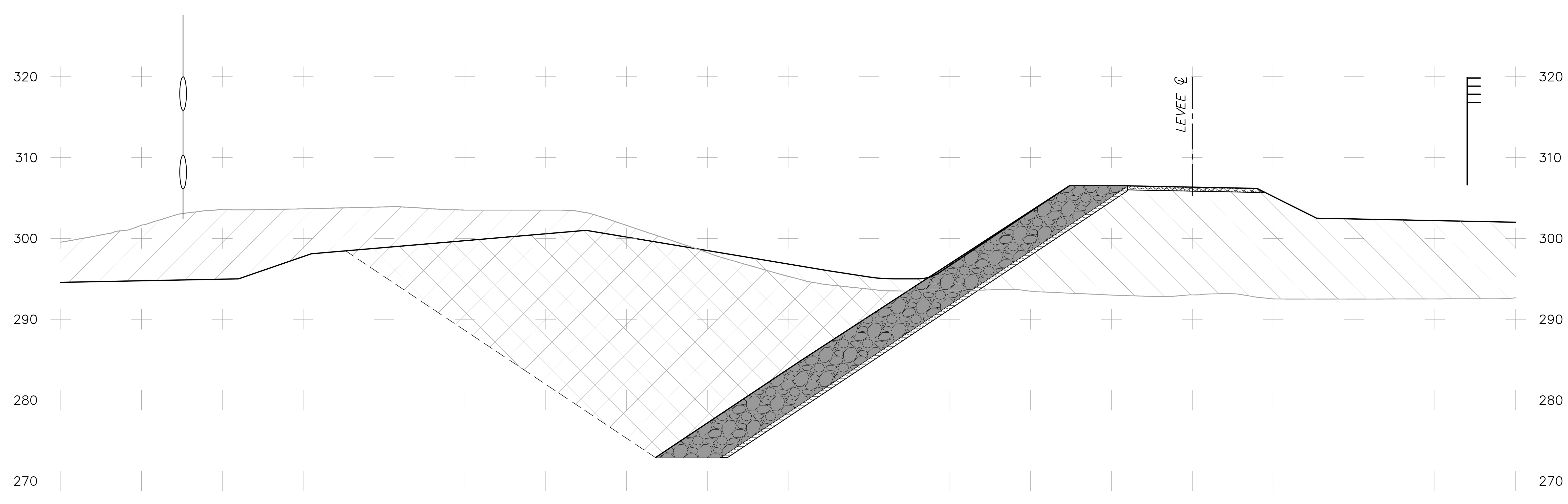
SPEC. NO. –
PROJ. NO. ----

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 45+00 TO STA 46+00

SHEET 31
OF 35
DRAWING NO.
WPD-2-Y-X-X



STA. 47+00



STA. 48+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

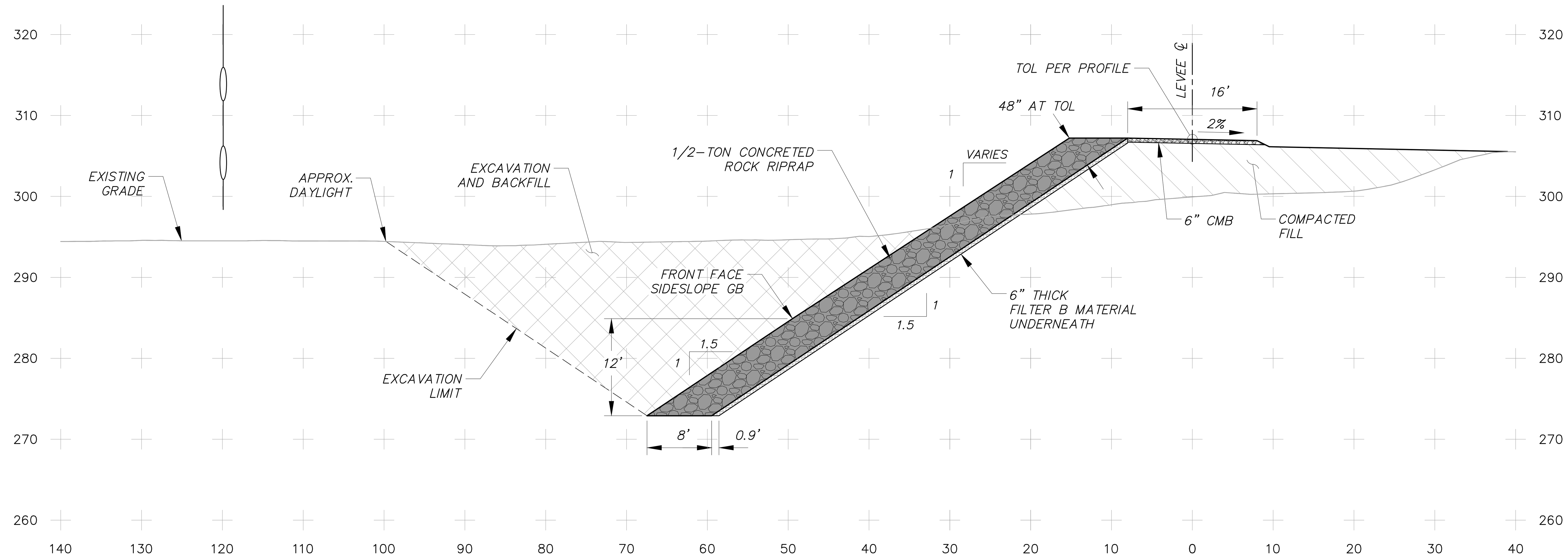
WATERSHED DEPUTY DIRECTOR — DATE
WATERSHED DIRECTOR — DATE
AGENCY DIRECTOR — DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

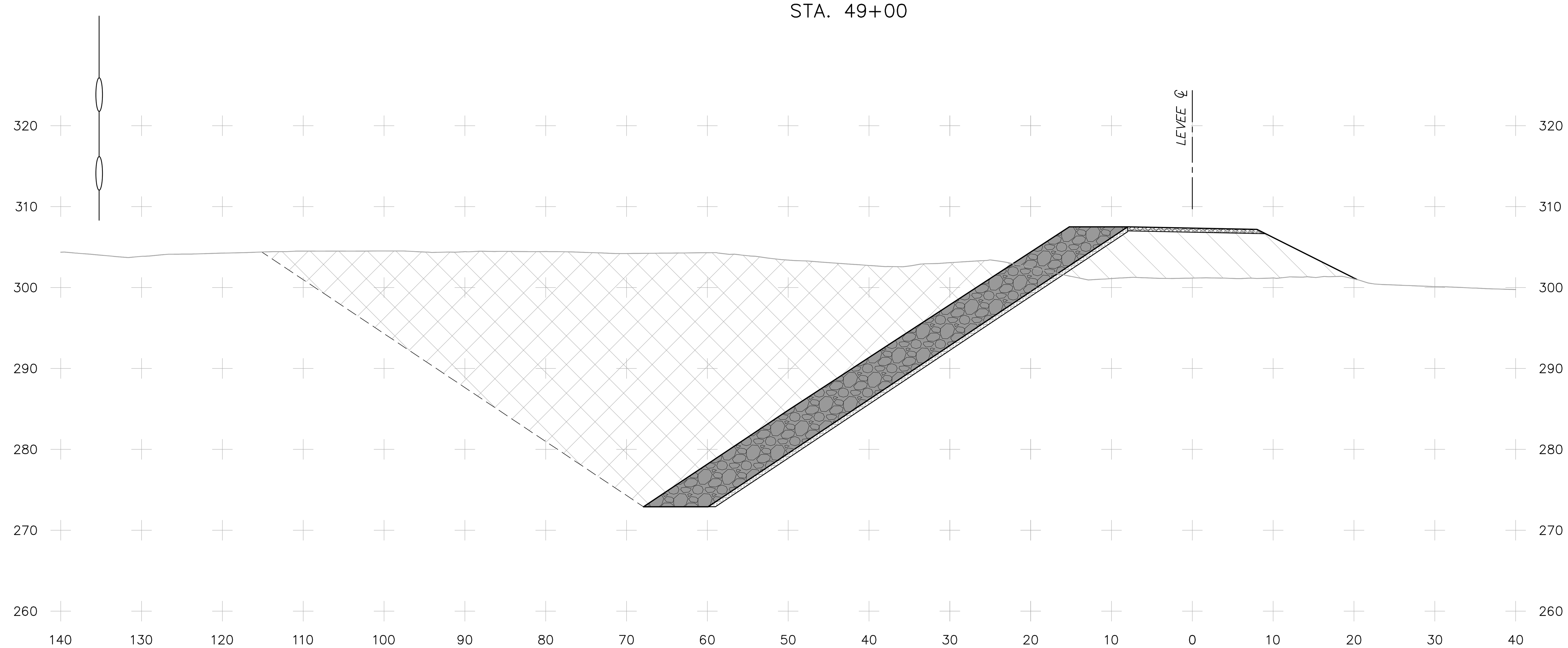
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 47+00 TO STA 48+00

SHEET 32
OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 49+00



STA. 50+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

PLOT DATE: 3/20/22
SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983 VR-2 LEVEE\11 DESIGN\02 30% DESIGN\SHEETS\T37983VR2-SEC23.DWG

	REVISION	DESCRIPTION	APP.	DATE
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TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

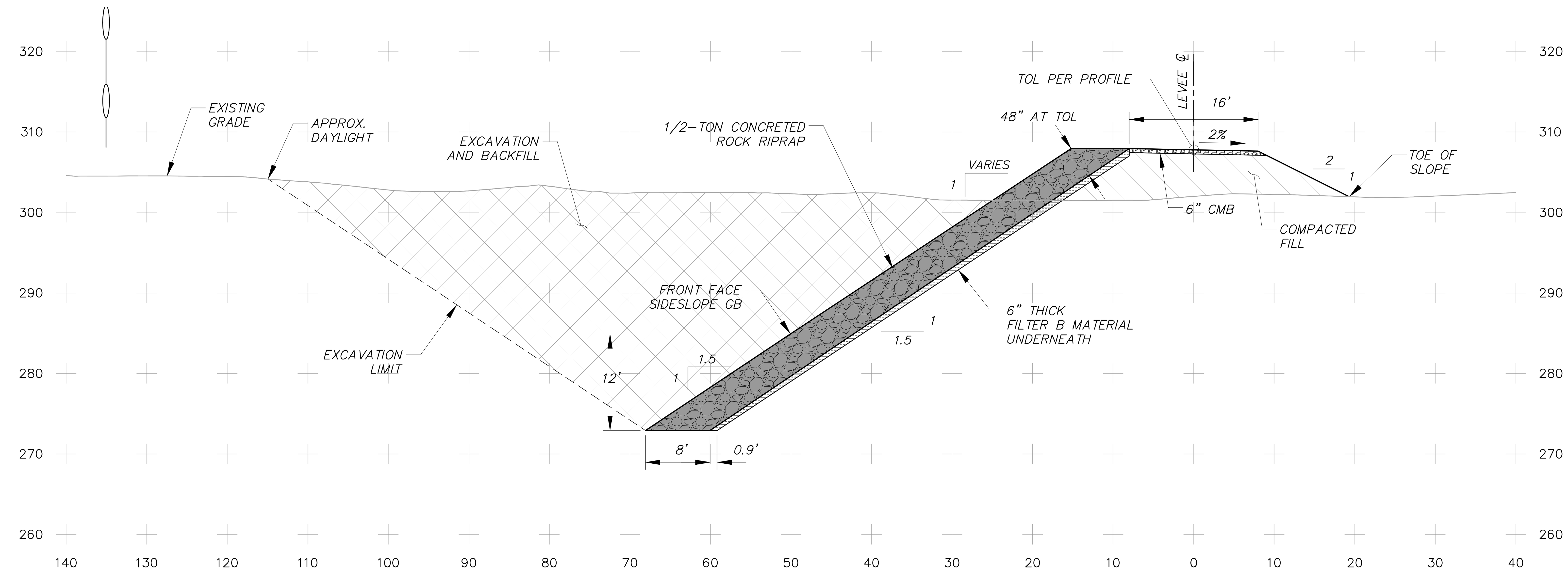
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

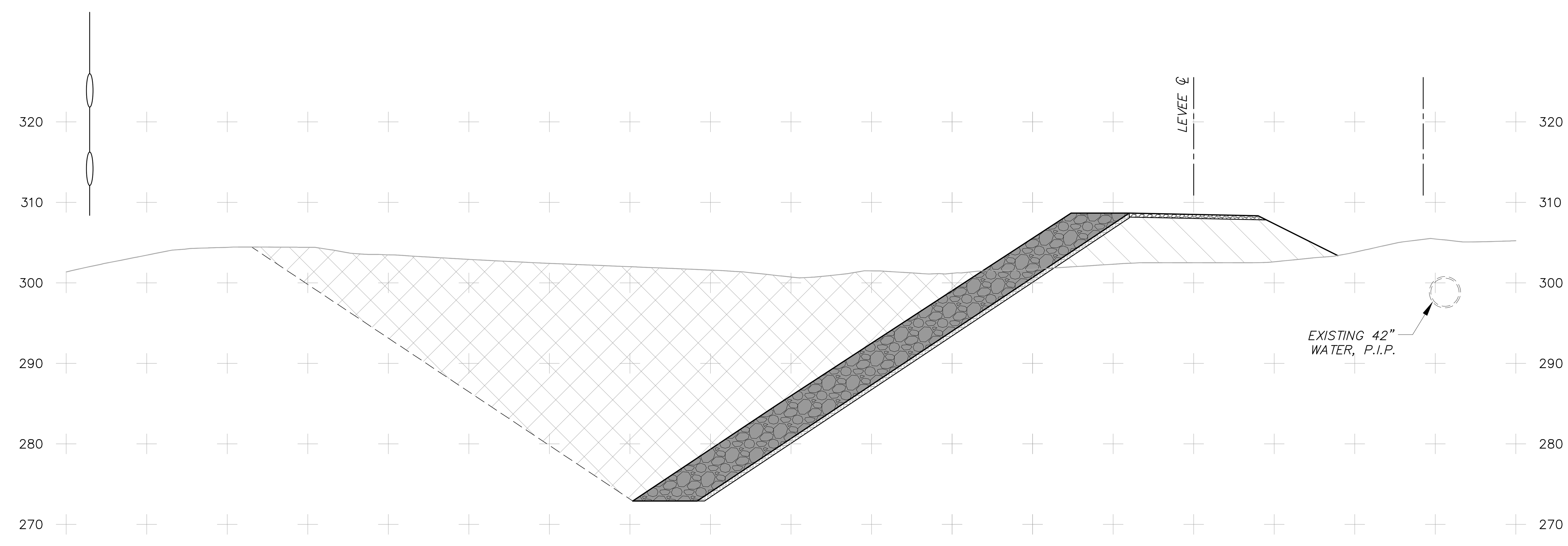
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 49+00 TO STA 50+00

SHEET 33 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 51+00



STA. 52+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

SAVE DATE: 3/17/22 SUH, JUNG P:\WATR\T37983_VR-2_LEVEE\11_DESIGN\02_30%_DESIGN\SHEETS\T37983VR2-SEC24.DWG

PLOT DATE: 3/20/22

D			
C			
B			
A			
△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

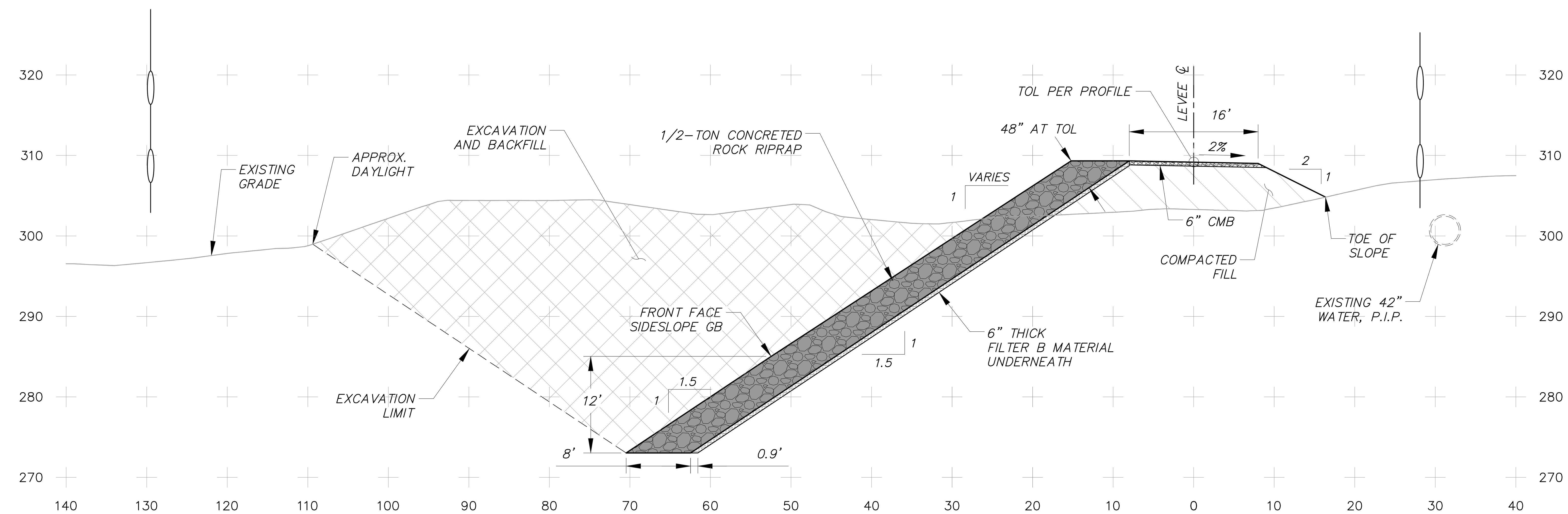
WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

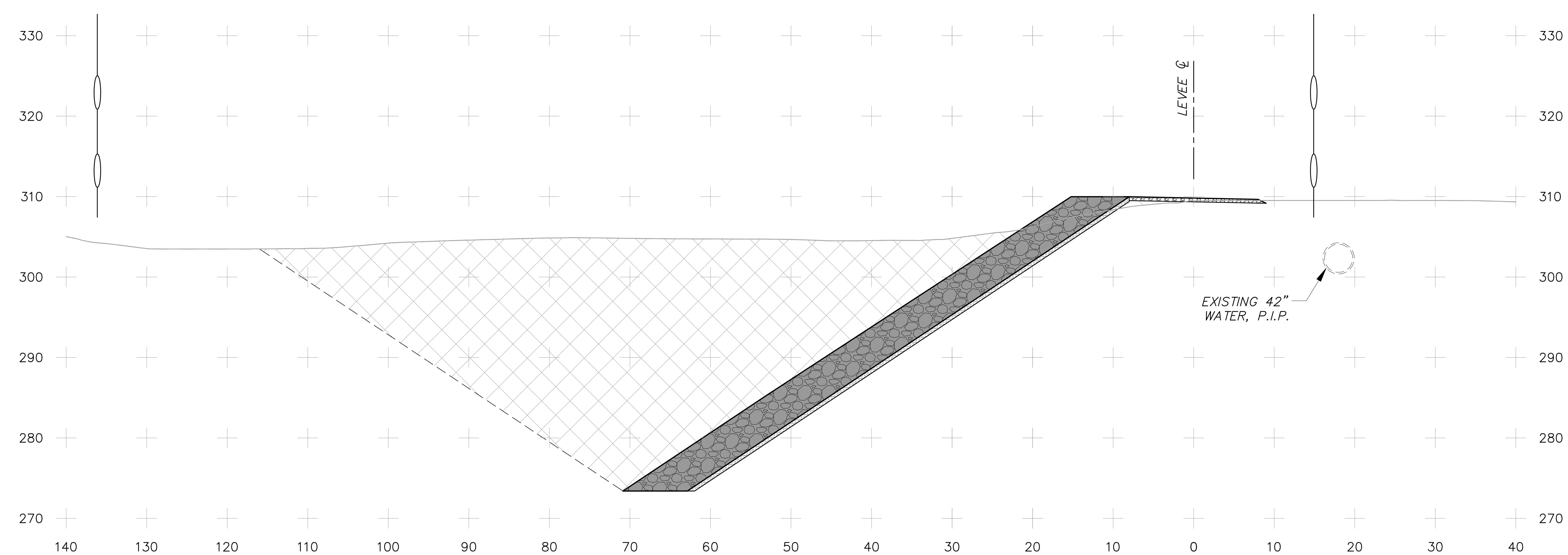
SPEC. NO. –
PROJ. NO. ––––

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 51+00 TO STA 52+00

SHEET 34 OF 35
DRAWING NO. WPD-2-Y-X-X



STA. 53+00



STA. 54+00

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

30% DESIGN
NOT FOR CONSTRUCTION

D			
C			
B			
A			
△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH

TETRA TECH
17885 VON KARMAN AVE.
SUITE 500
IRVINE, CA 92614

WATERSHED DEPUTY DIRECTOR DATE
WATERSHED DIRECTOR DATE
AGENCY DIRECTOR DATE

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. ----

VENTURA RIVER LEVEE (VR-2)
LEVEE IMPROVEMENT PROJECT
CROSS SECTIONS – STA. 53+00 TO STA 54+00

SHEET 35 OF 35
DRAWING NO. WPD-2-Y-X-X

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APPENDIX II-H

30% Design Cost Estimate

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VR-2 Levee

30% Level Design

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,822,000.00	$ 1,822,000
2	Clearing and Grubbing	ACR	6.0	$ 5,000.00	$ 30,000
3	Diversion and Control of Water	LS	1	$ 2,250,000.00	$ 2,250,000
4	Loose Rock Toedown Protection (Sta. 2+92.00 to 5+50.60)	LF	259	$ 1,921.52	$ 496,904
4.1	Loose Rock Riprap	CY	1,734	$ 180.00	$ 312,044
4.2	Filter Material A	CY	374	$ 135.00	$ 50,427
4.3	Filter Material B	CY	178	$ 135.00	$ 24,050
4.4	Excavation	CY	4,923	$ 8.00	$ 39,384
4.5	Backfill	CY	4,923	$ 6.50	$ 31,999
4.6	Reconstructing Ex. Concreted rock	CY	144	$ 270.00	$ 39,000
5	Reach I - 1/4-TON Concreted Rock Riprap Lined Levee (Sta. 5+00.60 to 10+46.30)	LF	546	$ 2,896.07	$ 1,580,387
5.1	1/4-TON, 36" Thick Concreted Rock Riprap (Import)	CY	3,398	$ 270.00	$ 917,460
5.2	1/4-TON, 36" Thick Concreted Rock Riprap (Reuse Ex. Riprap)	CY	1,035	$ 150.00	$ 155,250
5.3	Filter Material B	CY	548	$ 135.00	$ 73,980
5.4	6" CMB Access Road	CY	167	$ 90.00	$ 15,030
5.5	Excavation	CY	17,705	$ 8.00	$ 141,640
5.6	Backfill (Toedown Construction)	CY	13,134	$ 6.50	$ 85,371
5.7	Compacted Backfill (Levee Prism)	CY	1,540	$ 72.50	$ 111,650
5.8	Weephole	LF	546	$ 115.00	$ 62,756
5.9	Riprap Removal	CY	1,150	$ 15.00	$ 17,250
6	Reach II -1-TON Loose Rock Riprap Lined Slope Protection (Sta. 10+46.30 to 39+40)	LF	2,894	$ 2,848.46	$ 8,242,575
6.1	1-TON, 54" Thick Loose Rock Riprap (Import)	CY	29,604	$ 162.00	$ 4,795,822
6.2	1-TON, 54" Thick Loose Rock Riprap (Reuse Ex. Riprap)	CY	3,911	$ 120.00	$ 469,339
6.3	Filter Material A	CY	7,314	$ 135.00	$ 987,390
6.4	Filter Material B	CY	3,557	$ 135.00	$ 480,195
6.5	6" CMB Access Road	CY	883	$ 90.00	$ 79,470
6.6	Excavation	CY	92,485	$ 8.00	$ 739,880
6.7	Backfill (Toedown Construction)	CY	55,264	$ 6.50	$ 359,216
6.8	Compacted Backfill (Levee Prism)	CY	2,117	$ 72.50	$ 153,483
6.9	Riprap Removal	CY	11,852	$ 15.00	$ 177,780
7	Reach III - 1/4-TON Concreted Rock Riprap Lined Levee with Floodwall (Sta. 39+40 to 44+36)	LF	496	$ 3,404.44	$ 1,688,602
7.1	1/4-TON, 36" Thick Concreted Rock Riprap (Import)	CY	2,002	$ 270.00	$ 540,540
7.2	1/4-TON, 36" Thick Concreted Rock Riprap (Reuse Ex. Riprap)	CY	1,584	$ 150.00	$ 237,600
7.3	Filter Material B	CY	438	$ 135.00	$ 59,130
7.4	Excavation	CY	13,272	$ 8.00	$ 106,176
7.5	Backfill (Toedown Construction)	CY	8,807	$ 6.50	$ 57,246
7.6	Compacted Backfill (Levee Prism)	CY	106	$ 72.50	$ 7,685
7.7	Weephole	LF	496	$ 115.00	$ 57,040
7.8	Floodwall	LF	496	$ 1,140.00	$ 565,440
7.9	3" AC Paving	SY	772	$ 32.00	$ 24,690
7.10	6" Aggregate Base Course undert AC Paving	CY	128	$ 52.00	$ 6,656
7.11	Riprap Removal	CY	1,760	$ 15.00	$ 26,400
8	Reach IV - 1/2-TON Concreted Rock Riprap Lined Levee with Floodwall (Sta. 44+36 to 54+12)	LF	976	$ 3,044.62	$ 2,971,549
8.1	1/2-TON, 48" Thick Concreted Rock Riprap (Import)	CY	1,970	$ 300.00	$ 591,108
8.2	1/2-TON, 48" Thick Concreted Rock Riprap (Reuse Ex. Riprap)	CY	7,512	$ 150.00	$ 1,126,746
8.3	Filter Material B	CY	1,124	$ 135.00	$ 151,740
8.4	6" CMB Access Road	CY	298	$ 90.00	$ 26,820
8.5	Excavation	CY	44,144	$ 8.00	$ 353,152
8.6	Backfill (Toedown Construction)	CY	34,385	$ 6.50	$ 223,503
8.7	Compacted Backfill (Levee Prism)	CY	5,664	$ 72.50	$ 410,640
8.8	Weephole	LF	976	$ 90.00	$ 87,840
9	Existing Levee Lowering / Dip Crossing	LS	1	$ 336,377.78	$ 336,378
9.1	Excavation and Grading	CY	7,644	$ 40.00	$ 305,778
9.2	Riprap Removal	CY	840	$ 15.00	$ 12,600
9.3	6" CAB Access Road	CY	180	$ 100.00	$ 18,000
10	10' (W) X 5.5' (H) RCB	LS	1	$ 443,750.00	$ 443,750
10.1	RCB and Outlet Structure	EA	1	$ 142,500.00	$ 142,500
10.2	Flap Gate	EA	1	$ 187,500.00	$ 187,500
10.3	RC Channel	EA	1	$ 113,750.00	$ 113,750
11	Storm Drain Outlet Replacement (24" RCP)	EA	2	$ 32,000.00	$ 64,000
11.1	Replace Outlet Structures and Extend Riverside End of SD	EA	2	$ 26,000.00	$ 52,000
11.2	Replace Flap Gate	EA	2	$ 6,000.00	$ 12,000
12	Reconstruct Existing V-Ditch	LS	1	$ 105,900.00	$ 105,900
12.1	Remove Existing V-Ditch	LS	1	$ 19,700.00	$ 19,700
12.2	New V-Ditch System	LS	1	$ 86,200.00	$ 86,200
13	Reinforced Concrete Approach Slab	LS	1	$ 11,250.00	$ 11,250
13.1	Concrete Approach Slab	CY	15	$ 750.00	$ 11,250
14	Relocation	EA	2	$ 250,000.00	$ 500,000
14.1	Waterline Relocation	EA	2	$ 250,000.00	$ 500,000
15	Landside Improvements	EA	1	$ 1,755,915.00	$ 1,755,915
15.1	Landside Improvements Placeholder (CRR)	CY	7,167	$ 245.00	$ 1,755,915
				Subtotal (1):	$ 22,299,209
				[2] Planning, Engineering, and Design:	$ -
				[2] Construction Management:	$ -
				Subtotal (2):	$ 22,299,209
				[2] Contingency (0%):	
				Total Project Cost:	**$ 22,299,209**

Note: 1) Unit costs were established based on available construction contractor bids, cost quotes from vendors, and the MCACES cost estimating database for 2022 Q1.

2) The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimate shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

3) This is a preliminary cost estimate is based on available information at this point. Actual construction costs will differ based on changes to the design elements and changes to costs at the time of the project construction.

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APPENDIX II-I

30% Quantity Calculations

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Levee Construction

Following are the assumptions for quantity estimates:

a) The quantities shown here are based on the cross sections created using Civil 3D.

Summary - Station 5+00.60 to 54+12

				[SF]										[CY]									
	Station	Distance	Description	Concreted Rock	Loose Rock	Excavation	Backfill (Front)	Compacted fill (Behind)	Filter A	Filter B	CMB	CAB	Asphalt	Concreted Rock	Loose Rock	Excavation	Backfill (Front)	Compacted fill (Behind)	Filter A	Filter B	CMB	CAB	Asphalt
I	500.6		Cemented Rock	215.71		820.45	568.82	84.47		26.64	8.26												
I	600	99.4	Cemented Rock	215.71		820.45	568.82	84.47		26.64	8.26			794.1		3020.5	2094.1	311.0		98.1	30.4		
I	700	100	Cemented Rock	217.19		923.98	712.78	121.52		26.84	8.26			801.7		3230.4	2373.3	381.5		99.0	30.6		
I	800	100	Cemented Rock	218.66		944.73	741.02	109.81		27.04	8.26			807.1		3460.6	2692.2	428.4		99.8	30.6		
I	900	100	Cemented Rock	218.66		756.06	561.35	58.16		27.04	8.26			809.9		3149.6	2411.8	311.1		100.1	30.6		
I	1000	100	Cemented Rock	228.56		965.43	707.48	0.00		28.37	8.26			828.2		3187.9	2349.7	107.7		102.6	30.6		
I	1046.3	46.3	Cemented Rock	228.56		965.43	707.48	0.00		28.37	8.26			391.9		1655.5	1213.2	0.0		48.6	14.2		
II	1046.3		Loose Rock		325.19	943.63	470.96	7.60	71.01	34.57	8.26												
II	1100	53.7	Loose Rock		325.19	943.63	470.96	7.60	71.01	34.57	8.26				646.8	1876.8	936.7	15.1	141.2	68.8	16.4		
II	1200	100	Loose Rock		327.06	867.34	482.24	0.62	71.43	34.78	8.26				1207.9	3353.6	1765.2	15.2	263.8	128.4	30.6		
II	1300	100	Loose Rock		327.63	884.60	465.17	3.37	71.56	34.84	8.26				1212.4	3244.3	1754.5	7.4	264.8	128.9	30.6		
II	1400	100	Loose Rock		327.89	870.09	477.87	2.33	71.61	34.87	8.26				1213.9	3249.4	1746.4	10.6	265.1	129.1	30.6		
II	1500	100	Loose Rock		328.15	801.86	484.83	1.26	71.67	34.90	8.26				1214.9	3096.2	1782.8	6.7	265.3	129.2	30.6		
II	1600	100	Loose Rock		328.40	844.07	514.44	1.98	71.73	34.93	8.26				1215.8	3048.0	1850.5	6.0	265.6	129.3	30.6		
II	1700	100	Loose Rock		328.66	868.05	521.71	5.56	71.79	34.96	8.26				1216.8	3170.6	1918.8	14.0	265.8	129.4	30.6		
II	1800	100	Loose Rock		327.86	832.00	486.17	0.00	71.61	34.87	8.26				1215.8	3148.2	1866.4	10.3	265.5	129.3	30.6		
II	1900	100	Loose Rock		327.06	857.71	494.39	0.06	71.43	34.78	8.26				1212.8	3129.1	1815.8	0.1	264.9	129.0	30.6		
II	2000	100	Loose Rock		326.26	932.02	537.04	0.00	71.25	34.69	8.00				1209.8	3314.3	1910.0	0.1	264.2	128.6	30.1		
II	2100	100	Loose Rock		325.45	1112.19	697.47	0.00	71.07	34.60	8.00				1206.9	3785.6	2286.1	0.0	263.6	128.3	29.6		
II	2200	100	Loose Rock		321.61	1095.57	690.90	3.22	70.22	34.17	8.26				1198.3	4088.4	2571.1	6.0	261.7	127.4	30.1		
II	2300	100	Loose Rock		317.77	1102.39	703.60	11.11	69.36	33.74	8.26				1184.0	4070.3	2582.4	26.5	258.5	125.8	30.6		
II	2400	100	Loose Rock		313.92	1127.95	731.40	16.09	68.51	33.32	8.26				1169.8	4130.2	2657.4	50.4	255.3	124.2	30.6		
II	2500	100	Loose Rock		310.75	1148.86	745.74	12.81	67.81	32.97	8.26				1156.8	4216.3	2735.5	53.5	252.4	122.7	30.6		
II	2600	100	Loose Rock		310.46	1080.62	687.15	14.20	67.74	32.93	8.26				1150.4	4128.7	2653.5	50.0	251.0	122.0	30.6		
II	2700	100	Loose Rock		310.17	1024.59	632.02	17.85	67.68	32.90	8.26				1149.3	3898.5	2442.9	59.4	250.8	121.9	30.6		
II	2800	100	Loose Rock		309.88	952.97	568.45	15.75	67.61	32.87	8.26				1148.2	3662.1	2223.1	62.2	250.5	121.8	30.6		
II	2900	100	Loose Rock		308.55	918.39	548.77	7.77	67.32	32.72	8.26				1145.2	3465.5	2068.9	43.6	249.9	121.5	30.6		
II	3000	100	Loose Rock		297.88	823.98	484.74	3.13	64.95	31.54	8.26				1123	3226.6	1913.9	20.2	244.9	119.0	30.6		
II	3100	100	Loose Rock		287.35	734.02	442.96	7.79	62.61	30.37	8.26				1083.8	2885.2	1718	20.2	236.2	114.6	30.6		
II	3200	100	Loose Rock		285.43	595.06	381.80	35.80	62.18	30.15	8.26				1060.7	2461.3	1527.3	80.7	231.1	112.1	30.6		
II	3300	100	Loose Rock		283.52	604.40	391.97	63.81	61.75	29.94	8.26				1053.6	2221.2	1432.9	184.5	229.5	111.3	30.6		
II	3400	100	Loose Rock		290.98	663.61	403.45	47.34	63.41	30.77	8.26				1063.9	2348.2	1473.0	205.8	231.8	112.4	30.6		
II	3500	100	Loose Rock		299.31	682.35	412.33	32.99	65.26	31.69	8.26				1093.1	2492.5	1510.7	148.8	238.3	115.7	30.6		
II	3600	100	Loose Rock		303.72	700.53	396.07	46.67	66.24	32.18	8.26				1116.7	2560.9	1497.0	147.5	243.5	118.3	30.6		
II	3700	100	Loose Rock		303.17	663.96	356.30	60.57	66.12	32.12	8.26				1123.9	2526.8	1393.3	198.6	245.1	119.1	30.6		
II	3800	100	Loose Rock		302.61	625.20	341.72	72.47	66.00	32.06	8.26				1121.8	2387.3	1292.6	246.4	244.7	118.9	30.6		
II	3900	100	Loose Rock		311.57	642.42	391.25	87.96	67.99	33.06	8.26				1137.4	2347.4	1357.4	297.1	248.1	120.6	30.6		
II	3940	40	Loose Rock		311.57	642.42	391.25	87.96	67.99	33.06	8.26				461.6	951.7	579.6	130.3	100.7	49.0	12.2		
III	3940		Cemented Rock + Floodwall	188.34		612.23	392.14	5.99		22.94		7.00	3.50										
III	4000	60	Cemented Rock + Floodwall	188.34		612.23	392.14	5.99		22.94		7.00	3.50	418.5		1360.5	871.4	13.3		51.0		15.5	7.8
III	4100	100	Cemented Rock + Floodwall	191.47		740.12	497.92	5.52		23.36		7.00	3.50	703.3		2504.4	1648.3	21.3		85.7		25.9	13.0
III	4200	100	Cemented Rock + Floodwall	197.66		778.44	529.86	6.45		24.19		7.00	3.50	720.6		2812.1	1903.3	22.2		88.0		25.9	13.0
III	4300	100	Cemented Rock + Floodwall	198.56		788.42	541.73	5.96		24.31		7.00	3.50	733.7		2901.6	1984.4	23.0		89.8		25.9	13.0
III	4400	100	Cemented Rock + Floodwall	201.53		701.00	438.56	4.82		24.71		7.00	3.50	740.9		2758.2	1815.3	20.0		90.8		25.9	13.0
III	4436	36	Cemented Rock + Floodwall	201.53		701.00	438.56	4.82		24.71		7.00	3.50	268.7		934.7	584.7	6.4		32.9		9.3	4.7
IV	4436		Cemented Rock	243.31		617.24	382.15	41.17		28.01	8.26												
IV	4500	64	Cemented Rock	243.31		617.24	382.15	41.17		28.01	8.26			576.7		1463.1	905.8	97.6		66.4	19.6		
IV	4600	100	Cemented Rock	237.57		507.85	280.98	25.83		27.33	8.26			890.5		2083.5	1228.0	124.1		102.5	30.6		
IV	4700	100	Cemented Rock	249.78		516.64	283.86	40.92		28.77	8.26			902.5		1897.2	1046.0	123.6		103.9	30.6		
IV	4710	10	Cemented Rock	249.78		516.64	283.86	40.92		28.77	8.26			92.5		191.3	105.1	15.2		10.7	3.1		
IV	4710		Cemented Rock	260.30		1495.02	939.44	650.73		30.02	8.26												
IV	4800	90	Cemented Rock	260.30		1495.02	939.44	650.73		30.02	8.26			850.1		3352.8	2038.8	1152.7		98.0	27.5		
IV	4900	100	Cemented Rock	265.66		914.05	705.24	273.65		30.66	8.22			974.0		4461.3	3045.7	1711.8		112.4	30.5		
IV	4910	10	Cemented Rock	265.66		914.05	705.24	273.65		30.66	8.22			98.4		338.5	261.2	101.4		11.4	3.0		
IV	4910		Cemented Rock	267.82		1705.56	1462.22	150.11		30.92	8.25												
IV	5000	90	Cemented Rock	267.82		1705.56	1462.22	150.11		30.92	8.25			892.7		5685.2	4874.1	500.4		103.1	27.5		
IV	5100	100	Cemented Rock	268.30		1575.96	1334.51	137.87		38.99	8.26			992.8		6076.9	5179.1	533.3		129.4	30.6		
IV	5200	100	Cemented Rock	276.69		1547.99	1307.41	143.18		31.96	8.26			1009.2		5785.1	4892.4	520.5		131.4	30.6		
IV	5300	100	Cemented Rock	280.87		1595.24	1349.34	138.02		32.46	8.26			1032.5		5820.8	4919.9	520.7		119.3	30.6		
IV	5400	100	Cemented Rock	282.90		1756.87	1475.97	3.03		32.70	7.84			1044.0		6207.6	5232.0	261.2		120.7	29.8		
IV	5412	12	Cemented Rock	282.90		1756.87	1475.97	3.03		32.70	7.84			125.7		780.8	656.0	1.3		14.5	3.5		

Reach	Type	Station	Concreted Rock	Loose Rock	Excavation	Backfill (Front)	Compacted fill (Behind)	Filter A	Filter B	CMB	CAB	Asphalt	
I	Concreted Rock	Sta. 5+00.60 to 10+46.30	**4433**	**0**	**17705**	**13134**	**1540**	**0**	**548**	**167**	**0**	**0**	[CY]
II	Loose Rock	Sta. 10+46.30 to 39+40	**0**	**33515**	**92485**	**55264**	**2117**	**7314**	**3557**	**883**	**0**	**0**	[CY]
III	Concreted Rock + Floodwall	Sta. 39+40 to 44+36	**3586**	**0**	**13272**	**8807**	**106**	**0**	**438**	**0**	**128**	**65**	[CY]
IV	Concreted Rock	Sta. 44+36 to 47+10	**2462**	**0**	**5635**	**3285**	**361**	**0**	**284**	**84**	**0**	**0**	[CY]
IV	Concreted Rock (RS graded)	Sta. 47+10 to 49+10	**1923**	**0**	**8153**	**5346**	**2966**	**0**	**222**	**61**	**0**	**0**	[CY]
IV	Concreted Rock	Sta. 49+10 to 54+12	**5097**	**0**	**30356**	**25754**	**2337**	**0**	**618**	**153**	**0**	**0**	[CY]
		Subtotal:	**9482**	**0**	**44144**	**34385**	**5664**	**0**	**1124**	**298**	**0**	**0**	
	Total		**17501**	**33515**	**167606**	**111590**	**9427**	**7314**	**5667**	**1348**	**128**	**65**	[CY]

APPENDIX II-J

Calculations of Durations and Vehicle Trips

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TITLE: VR-2 Preliminary Design
SUBJECT: Construction Durations
MADE BY: OL
CHECKED BY: SKV

JOB NO.:
DATE: 3/8/2022

Alternative 3A

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.125	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.125	100%	8	ACRE	6.0	2	24.0	3.00
Diversion and Control of Water	0.013	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Riprap (1-ton)	60.000	100%	8	CY	31,377	2	261.5	32.68
Reuse Existing Riprap	60.000	100%	8	CY	3,911	2	32.6	4.07
Excavation	196.000	100%	8	CY	172,529	4	220.1	27.51
Backfill (Toedown Construction)	102.000	100%	8	CY	116,513	4	285.6	35.70
Compacted Fill (Levee Prism)	102.000	100%	8	CY	9,427	1	92.4	11.55
Filter Material (18-inch for RR; 6-inch for CRR)	100.000	100%	8	CY	13,533	2	67.7	8.46
Riprap Removal	75.000	100%	8	CY	15,602	2	104.0	13.00
Floodwall (Remove Existing and Replace) - Reach III	2.500	100%	8	LF	480	1	192.0	24.00
Access Road (AC Pavement) - Reach III	150.000	100%	8	SY	747	1	5.0	0.62
Concreted Rock Riprap (1/2-ton) - Reach IV	20.000	100%	8	CY	6,724	2	168.1	21.01
Concreted Rock Riprap (1/2-ton) Reusing Existing Riprap (Process, P	20.000	100%	8	CY	10,301	2	257.5	32.19
Weepholes	100.000	100%	8	LF	2,018	1	20.2	2.52
6" CMB Access Road - Reaches I, II, & IV	65.000	100%	8	CY	1,348	2	10.4	1.30
Levee Clearing								
Excavation	196.000	100%	8	CY	7,644	4	9.8	1.22
Riprap Removal	75.000	100%	8	CY	840	2	5.6	0.70
Storm Drain Replacement								
Replace Inlet/Outlet Structures and Extend Riverside End of Storm Dra	0.025	100%	8	EA	2	1	80.0	10.00
Replace 24-inch Flap Gates	0.200	100%	8	EA	2	1	10.0	1.25
Fresno Canyon Drain RCC, RCB, and Flap Gate Closure	0.010	100%	8	EA	1	1	100.0	12.50
Relocation								
Waterline Relocation	0.025	100%	8	EA	2	1	80.0	10.00
Demobilization	0.125	100%	8	DAY	10	1	80.0	10.00

TITLE:	VR-2 Preliminary Design		
SUBJECT:	Construction Durations		
MADE BY:	OL	JOB NO.:	
CHECKED BY:	SKV	DATE:	3/8/2022

Selected Alternative

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Riprap	CY	31,377	16	1962
Excess Excavation	CY	56016	16	3501
Borrow Fill	CY	9427	16	590
Filter Material	CY	13,533	16	846
Concreted Riprap	CY	6,724	16	421
Floodwall Concrete	CY	650	16	41
Levee Clearing Excavation	CY	7,644	16	478
CMB	CY	1,348	12	113
Concrete Channel Concrete	CY	100	12	9
			Total Haul Truck Trips:	**7961**
			Total Construction Days:	197
			Avg. Haul Trucks per Day:	**40.5**
			Assumed No. of Laborers per Day (avg.):	20
			Assumed No. of Mgmt. and OH Staff per Day :	5
			Total Staff Vehicle Trips per Day:	25
			Avg. Daily Vehicle Trips:	**65.5**

APPENDIX II-K

Landside Improvement Exhibits

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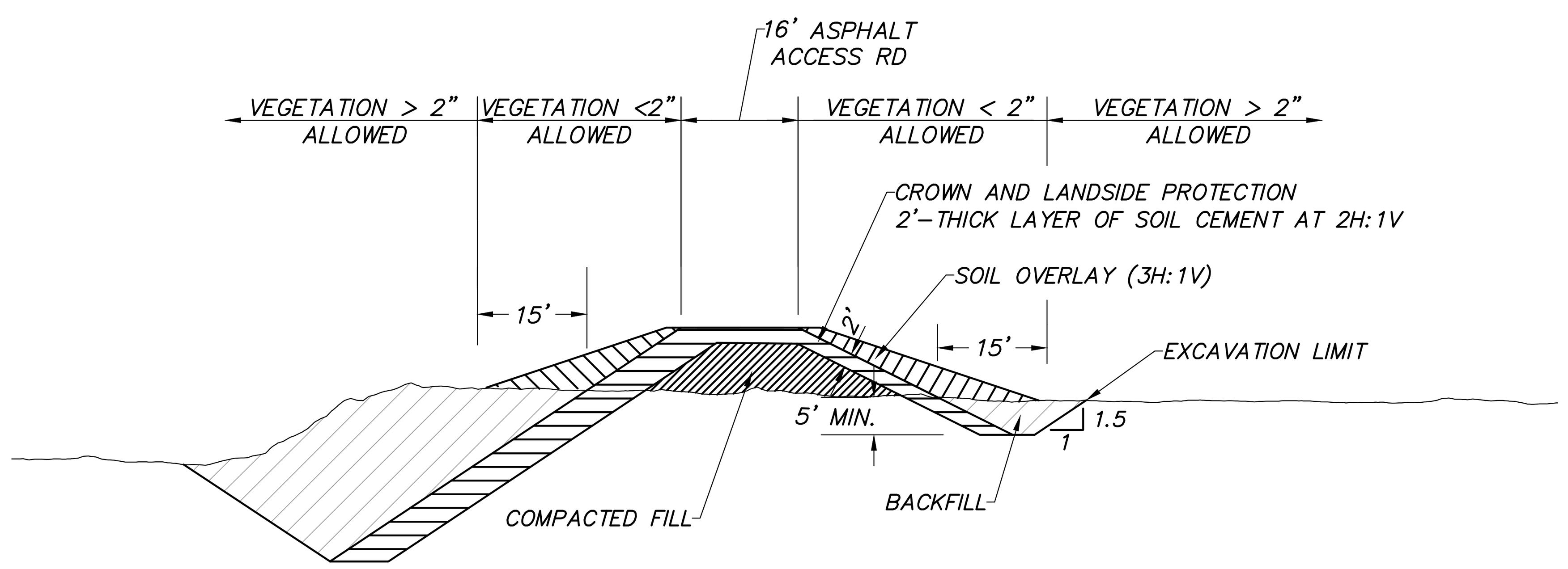
VR-2 LEVEE PROJECT
LANDSIDE IMPROVEMENT TYPICAL DETAILS

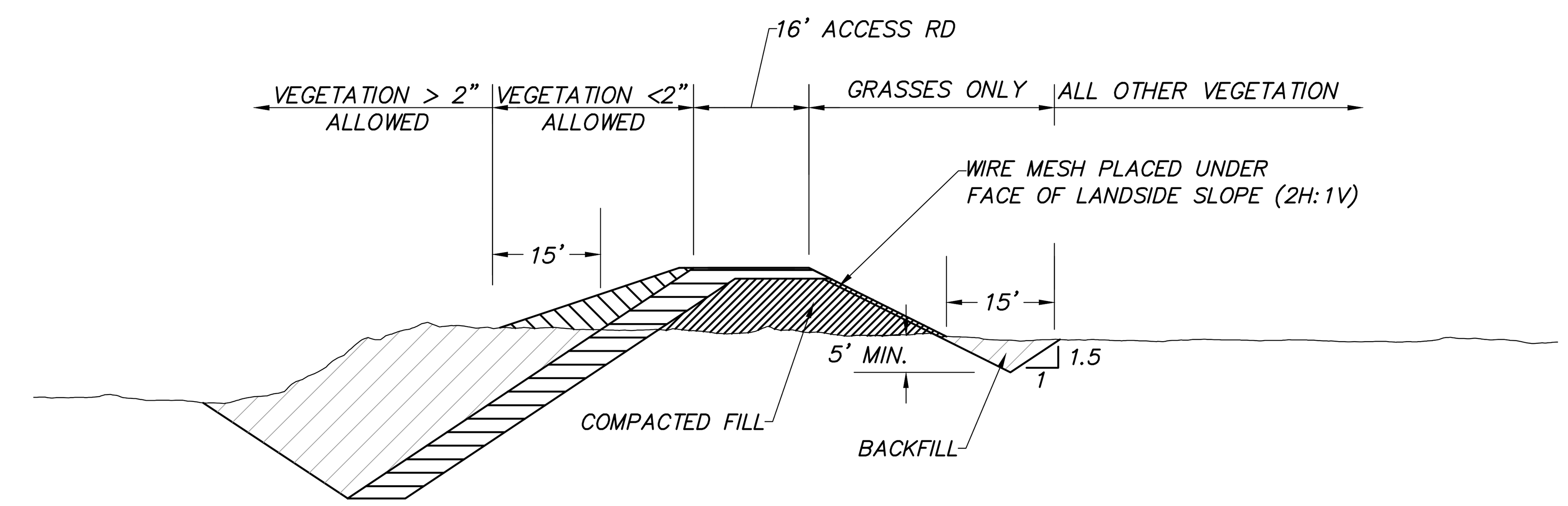
LANDSIDE IMPROVEMENT W

CONTINUATION OF RIVERSIDE MATERIAL ONTO
CROWN AND LANDSIDE



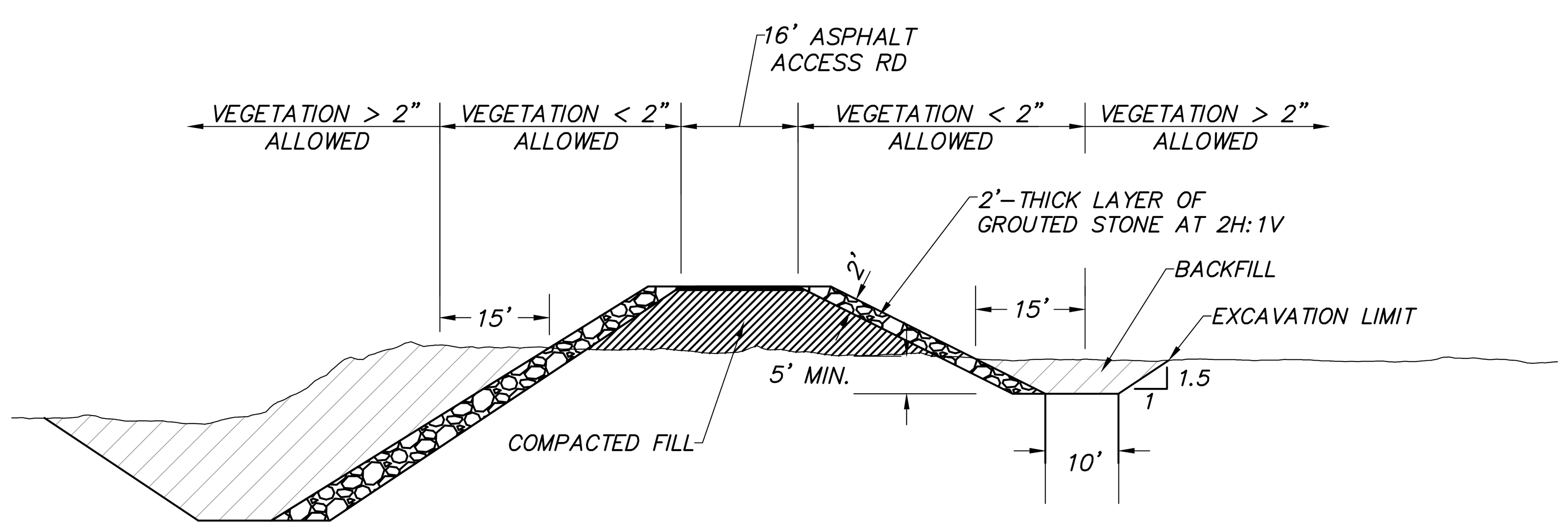
LANDSIDE IMPROVEMENT Y

WIRE MESH



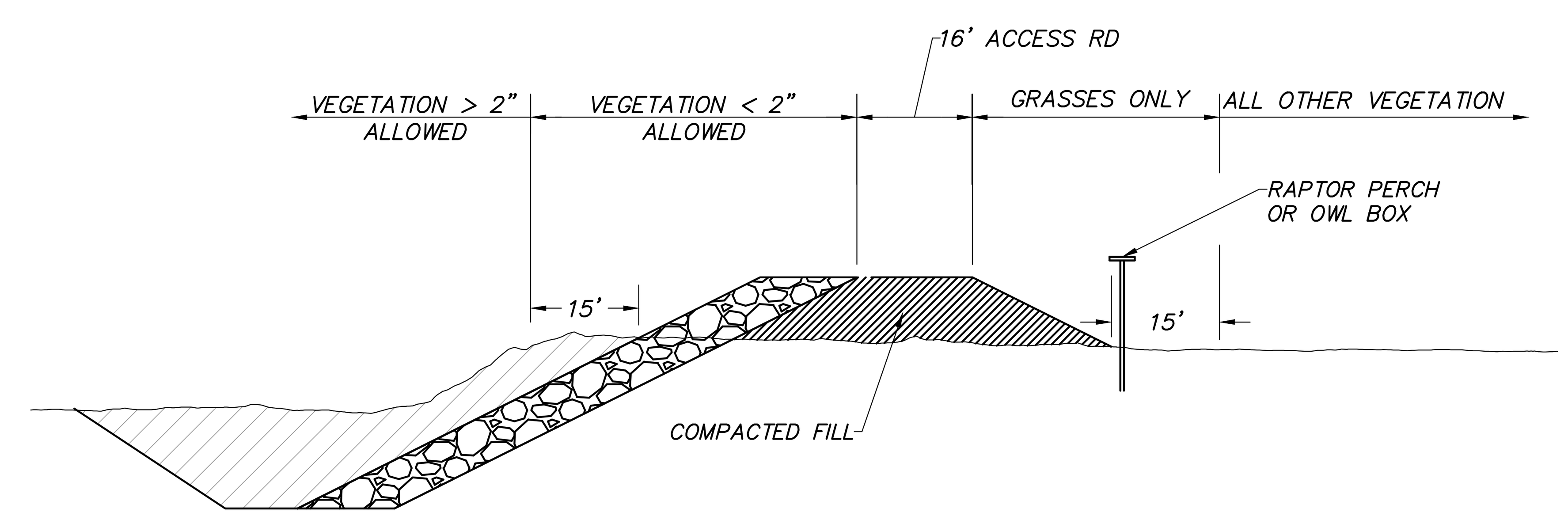
LANDSIDE IMPROVEMENT X

GROUTED STONE ON LANDSIDE SLOPE



LANDSIDE IMPROVEMENT Z

RAPTOR PERCH/OWL BOX



NOTES:

1. FOR SOLID RIVERSIDE SLOPE PROTECTION (i.e., SOIL CEMENT AND GROUTED STONE) VEGETATION LESS THAN 2 INCHES IS PERMITTED WITHIN 15 FEET OF THE RIVERSIDE TOE; HOWEVER, FOR RIPRAP SLOPE PROTECTION ONLY GRASSES ARE PERMITTED IN THIS AREA.

PLOT DATE:1/31/20
SAVE DATE:1/31/20 JAKE.COMER P:\WATR\T39679 MEINERS OAKS AND LIVE OAK ACRES ALTERNATIVES\10 DESIGN\LANDSIDE IMPROVEMENTS.DWG

D			
C			
B			
A			
△	REVISION DESCRIPTION	APP.	DATE

– DESIGNED
– DRAWN
– CHECKED

PROJECT MANAGER DATE
DEPUTY DIRECTOR DATE
DISTRICT DIRECTOR DATE

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION DISTRICT

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER 2 LEVEE PROJECT
VR-2 LEVEE
TYPICAL LANDSIDE IMPROVEMENTS

SHEET –
OF –
DRAWING NO. Y-?-?

1/2" x 1/2" mesh

Galvanized core wire mesh is coated with a thick layer of black PVC, tightly bonded to the wire. The entire hardware cloth mesh is thoroughly sealed and protected against rust and corrosion. This material will last! The 1/2" mesh, sometimes called 2 mesh, is lighter in weight and strength than the 16 gauge 1/2"x1/2" mesh and therefore costs less. Particularly useful for animal enclosures and exclusion barriers - applications where a light mesh, rust prevention and long life are desired. It can be used as low cost flooring for chukar pens, though we recommend the heavier 16 gauge material. 1/4" mesh is ideal for problem wildlife exclusion. The black color is virtually invisible when installed. And the mesh will last for years.

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 24"x100' - 48 lbs.

SKU: HCVC224B-J @ **$129.72**

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 36"x100' - 72 lbs.

SKU: HCVC236B-J @ **$194.34**

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 48"x100' - 96 lbs.

SKU: HCVC248B-J (black), SKU: HCVC248G (green) @ **$258.90**

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 60"x100' - 120 lbs.

SKU: HCVC260B-J @ **$333.36**

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 72"x100' - 144 lbs.

SKU: HCVC272B-J @ **$400.04**

-J Standard gauge (Made in China)
-A American Made
-C Italian Made

Louis E. Page, Inc. is a family owned business. For three generations we've been dedicated to serving the needs of our customers. Our goal is to give you prompt and informative service at fair prices. Since 1893, we've taken great pride in our commitment to be a one-source distributor specializing in mesh and fencing. We keep an extensive inventory and we can special order items from many different mills. Let us help you find what you need.

Connie & Ben Houlihan *Houlihan Fence - St Louis. M*

Congratulations on this milestone! When our clients request mesh or welded wire, you are our go-to source! Thanks for being a leader in the industry & one we can reliably count on!

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* Website prices reflect the prices from our default vendors. Occasionally we are unable to obtain the wire from these vendors; substitutions may be available and may result in a higher price. We will inform you of any price difference if this occurs. Prices are subject to change based on current vendor availability and current price of steel. If this occurs we will inform you of any price difference before processing your order.

Raptor Perch Design