

Project No.
17373.000.002

April 7, 2026

Ms. Kathy Torru
Diablo Community Services District
P.O. Box 321
Diablo, CA 94528

Subject: Embankment Repair near 2121 Alameda Diablo Avenue
Diablo, California

SOIL DESIGN PARAMETERS FOR PERMANENT EMBANKMENT REPAIR

Dear Ms. Torru:

This letter provides soil parameters for use in design of the permanent embankment repair near 2121 Alameda Diablo Avenue in Diablo, California. We understand a soil nail wall stabilization solution is being considered for the project. We do not have on-site data available for use in design, and have prepared the recommendations herein based on our experience in the area.

PRE-SCOUR AND POST-SCOUR CONDITION

The pre-scoured bank condition included a slope inclined at a gradient of approximately $\frac{3}{4}$:1 (horizontal:vertical) in the upper portion and roughly 1:1 in the lower portion, with planted landscape shrubs at the top and ivy/ground covering below.

The emergency backfilled, post-scour bank condition consists primarily of 2-foot-dimensioned riprap fill roughly 30 feet long, 20 feet high (vertical), and inclined at a gradient of approximately 1:1. The post-scour soil condition behind the riprap was inclined at roughly $\frac{1}{2}$:1 for the lower portion, and vertical for the upper roughly 5 to 6 feet prior to receiving filter fabric and riprap backfill.

GEOLOGY AND SEISMICITY

Dibblee (2005) maps the subject creek embankment repair site within Green Valley and underlain by alluvial deposits (Qa) consisting of alluvial pebble gravel, sand, and clay of valley areas. Other mapping indicates the alluvium is Holocene-aged. The site is located in a seismically active area that contains numerous faults. Small earthquakes occur every year in the San Francisco Bay region and larger earthquakes have been recorded and can be expected to occur in the future. Faults have been cataloged and mapped by the United States Geological Survey (USGS) in the Quaternary Fault and Fold Database of the United States. An active fault is defined by the California Geologic Survey as one that experienced surface displacement within Holocene time (about the last 11,700 years) (CGS, 2018).

For soil nail wall design purposes, a peak ground acceleration of 1.00g for the maximum considered earthquake should be considered, along with a seismic coefficient (K_h) of 0.24g for pseudostatic analysis (using the 15-centimeter threshold).

SOIL NAIL WALL DESIGN PARAMETERS

We anticipate the embankment repair will consist of a soil nail wall with either a shotcrete facing or a high-strength steel mesh facing, inclined at a gradient of roughly 1:1 over the existing riprap. The following parameters should be considered in the design of soil nail wall, assuming rotary drilled construction methods.

TABLE 1: Soil Nail Wall Design Parameters

SOIL MATERIAL	UNIT WEIGHT (pcf)	FRICTION ANGLE (degrees)	COHESION (psf)	ULTIMATE BOND STRESS (psi)
Holocene Alluvium (Qa)	125	30	50	15
Existing 2' Dia. Riprap (Fill) – UngROUTED	120	44	0	40*
Existing 2' Dia. Riprap (Fill) – Grouted (if incorporated)	165	34	1000	40

*Note: ultimate bond stress is only available where soil nail grout is in contact with soil or riprap material; neglect bond stress for where soil nail is located within void space.

In order to ensure that grout flows along the length of the soil nail and no voids form during grouting within the bonded zone, soil nails should be designed and constructed with a minimum inclination of 15 degrees below horizontal. We defer to the designer to determine horizontal and vertical spacing necessary to achieve adequate global stability and satisfy design requirements. Section 5.3 of FHWA-NHI-14-007 discusses current LRFD and ASD design methodologies used for design of soil nail walls.

If shotcrete facing with grouted riprap is utilized, the shotcrete facing should be provided with a drainage facility to prevent the build-up of hydrostatic pressure. Wall drainage can be provided using prefabricated synthetic wall drain panels that are suitably attached to the riprap face and hydraulically connected to routine weep holes or a subdrain collector pipe.

CLOSING

We strive to perform our services in accordance with generally accepted principles and practices currently employed in the area; there is no warranty, express or implied. If you have any questions or comments, please contact us.

Sincerely,

ENGEO Incorporated



Ian D. McCreery, GE

idm/jam/cb



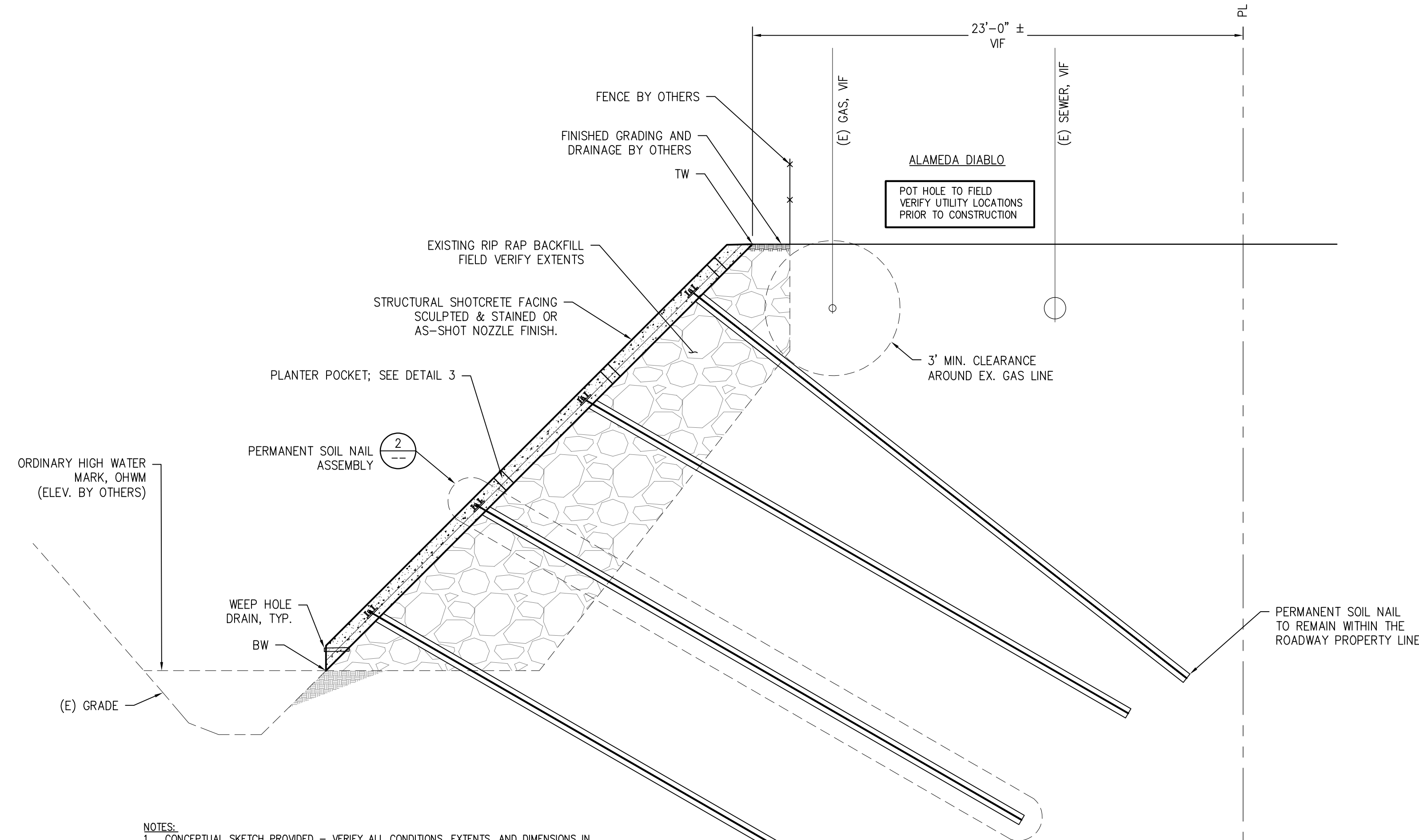

Julia A. Moriarty, GE

SCOPE OF WORK:

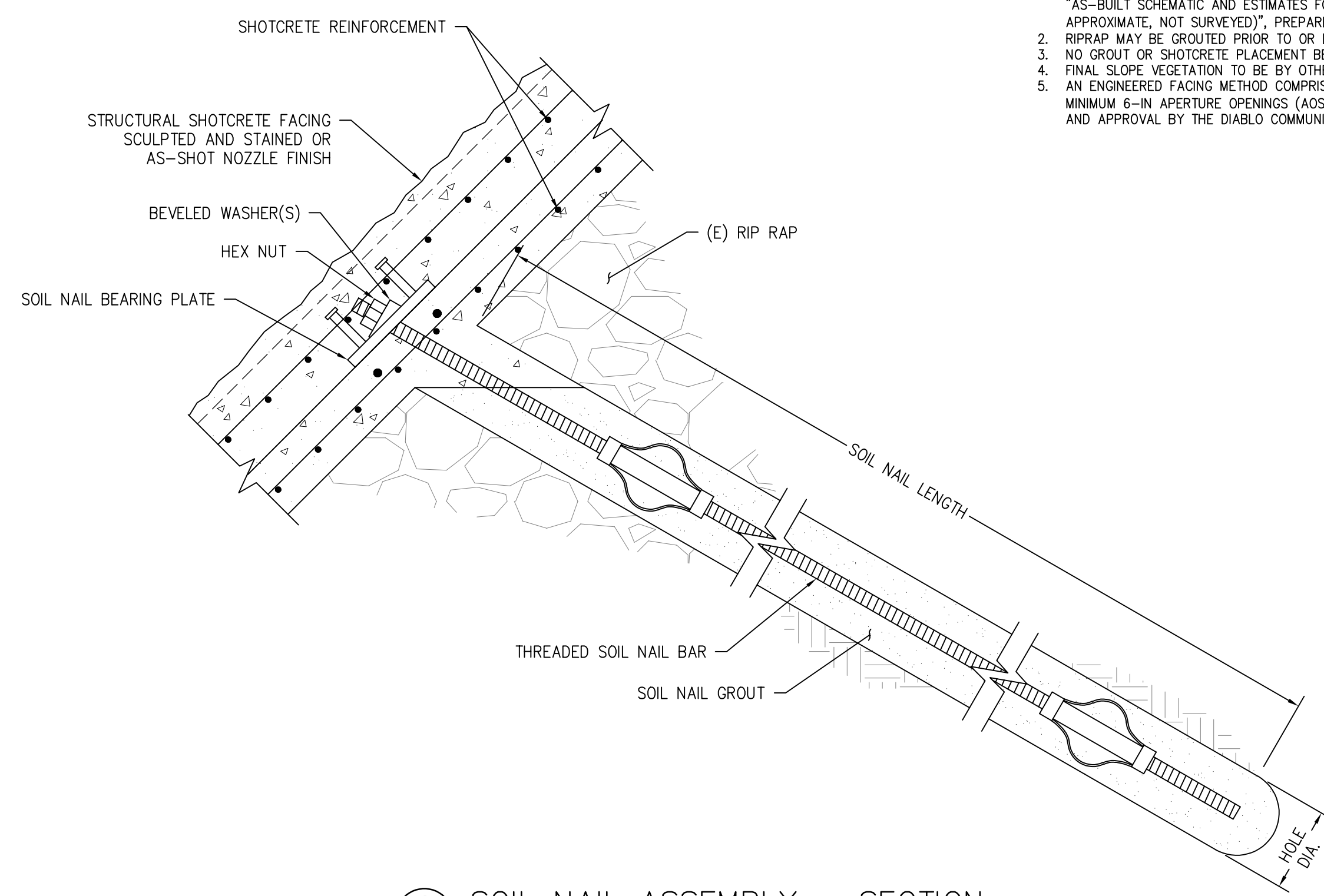
- DESIGN AND CONSTRUCT A PERMANENT EMBANKMENT REPAIR TO STABILIZE THE EXISTING RIPRAP AND SLOPE. THE CONCEPT SHOWN IN THESE DRAWINGS CONSISTS OF PERMANENT SOIL NAILS AND A STRUCTURAL SHOTCRETE FACING.
- ALTERNATIVE, STABILIZATION, AND SLOPE FACING METHODS MAY BE ACCEPTABLE UPON SUBMITTAL TO AND APPROVAL BY THE DIABLO COMMUNITY SERVICES DISTRICT.

GENERAL NOTES:

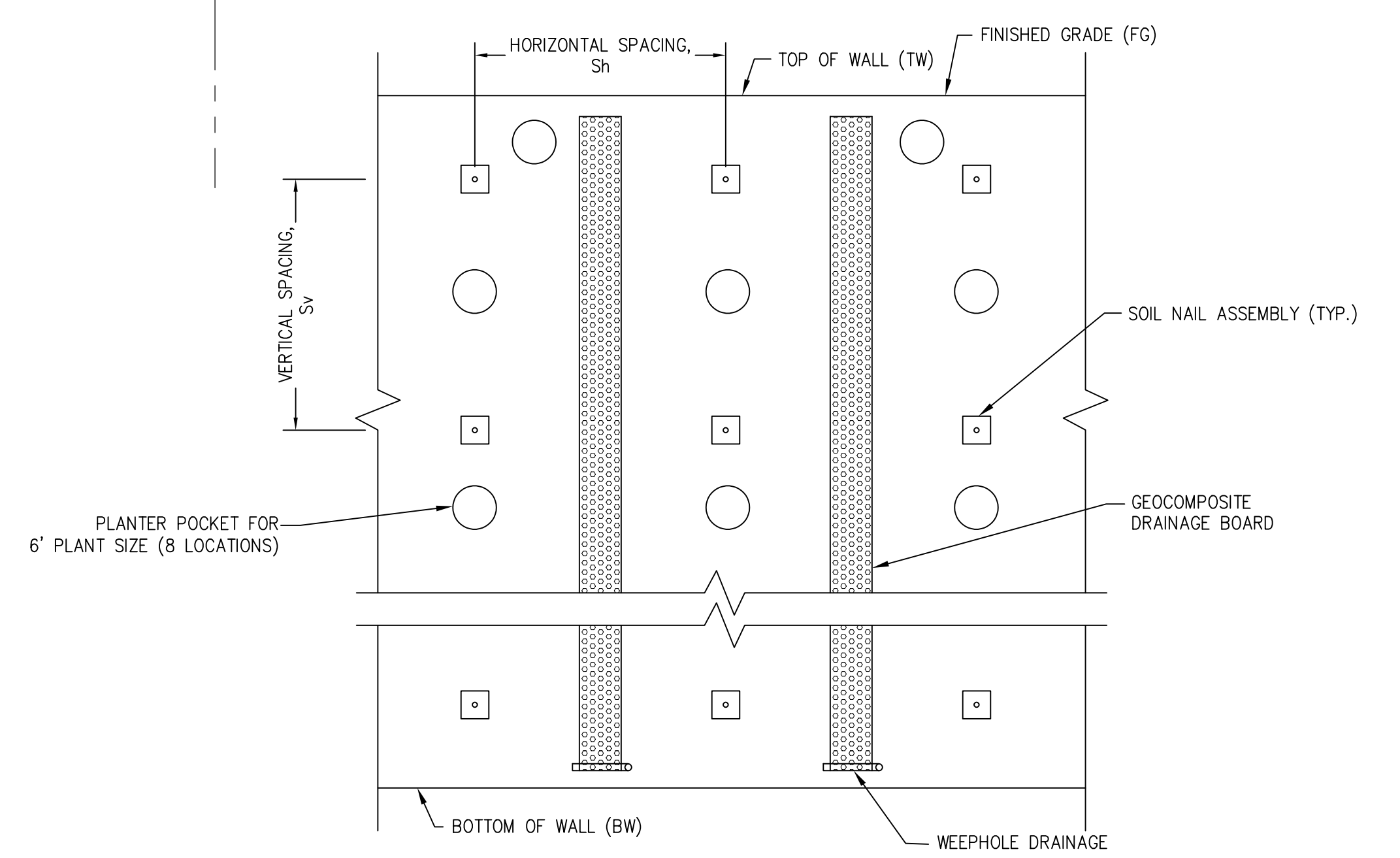
- THE SOIL NAIL WALL STRUCTURE SHALL BE DESIGNED IN ACCORDANCE WITH THE PROCEDURES CONTAINED IN THE FHWA "MANUAL FOR DESIGN AND CONSTRUCTION MONITORING OF SOIL NAIL WALLS", REPORT NO. FHWA-SA-96-069, AND FHWA "SOIL NAIL WALLS REFERENCE MANUAL", REPORT NO. FHWA-NHI-14-007.
- SOIL NAIL AND SHOTCRETE MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH FHWA SPECIFICATIONS, CBC 2025, AND THE REQUIREMENTS OF THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION DATED 2022.
- REFERENCE MATERIALS:
 - "PRELIMINARY ENGINEERS REPORT: CREEK BANK STABILIZATION", PREPARED BY ENGeo, INC., DATED JULY 14, 2023.
 - TECHNICAL MEMORANDUM "AS-BUILT SCHEMATIC AND ESTIMATES FOR EMERGENCY RIP RAP BACKFILL (FIELD APPROXIMATE, NOT SURVEYED)", PREPARED BY ENGeo, INC., DATED AUGUST 17, 2023.
 - "SUPPLEMENTAL INFORMATION FOR PERMANENT REPAIR ALTERNATIVES AND CONSIDERATION FOR RWQCB COMMENTS", PREPARED BY ENGeo, INC., DATED NOVEMBER 27, 2024.
 - "SOIL DESIGN PARAMETERS FOR PERMANENT EMBANKMENT REPAIR", PREPARED BY ENGeo, INC., DATED APRIL 7, 2026.
 - "ACOE REQUESTED INFORMATION FOR PERMANENT EMBANKMENT REPAIR", PREPARED BY ENGeo, INC., DATED APRIL 8, 2026.
- THE GENERAL CONTRACTOR SHALL VERIFY ALL GRADES AND DIMENSIONS. SEE CONTRACT DRAWINGS AND SPECIFICATIONS FOR ALL INFORMATION RELATIVE TO THE NEW AND EXISTING CONSTRUCTION AND CONDITIONS. THE GC SHALL RESOLVE CONFLICTS BETWEEN THESE DRAWINGS AND OTHER CONTRACT DRAWINGS WITH THE ENGINEER BEFORE PROCEEDING WITH CONSTRUCTION.
- EXISTING UTILITIES AND OTHER IMPROVEMENTS SHOWN ON THE DRAWING ARE APPROXIMATE LOCATIONS AND NOT BASED ON FIELD EXPLORATION. ADDITIONAL UTILITIES MAY BE PRESENT AND/OR IN OTHER LOCATIONS. THE GENERAL CONTRACTOR SHALL CONFIRM AND DETERMINE THE LOCATION OF ALL UTILITIES AND DRILLING CLEARANCE PRIOR TO PROCEEDING WITH DRILLING OPERATIONS. THE GC SHALL OPEN EXISTING MANHOLES AND VAULTS, MEASURE INVERTS AND CONFIRM CLEARANCE OF SOIL NAILS FROM VAULTS AND EXISTING CONDITIONS. THE GC SHALL PERFORM POT HOLEING AS NECESSARY TO CONFIRM UTILITY DEPTHS WITH THE GROUND ANCHOR ZONE OF INFLUENCE.



- NOTES:**
- CONCEPTUAL SKETCH PROVIDED - VERIFY ALL CONDITIONS, EXTENTS, AND DIMENSIONS IN THE FIELD PRIOR TO CONSTRUCTION. REFERENCE SKETCH IN TECHNICAL MEMORANDUM "AS-BUILT SCHEMATIC AND ESTIMATES FOR EMERGENCY RIP RAP BACKFILL (FIELD APPROXIMATE, NOT SURVEYED)", PREPARED BY ENGeo, INC. DATED AUGUST 17, 2023.
 - RIPRAP MAY BE GROUTED PRIOR TO OR DURING SOIL NAIL CONSTRUCTION AS NECESSARY.
 - NO GROUT OR SHOTCRETE PLACEMENT BELOW THE OHWM.
 - FINAL SLOPE VEGETATION TO BE BY OTHERS.
 - AN ENGINEERED FACING METHOD COMPRISING OF HIGH-TENSILE STEEL MESH FACING WITH MINIMUM 6-IN APERTURE OPENINGS (AOS) IS ALSO AN ALTERNATIVE UPON SUBMITTAL TO AND APPROVAL BY THE DIABLO COMMUNITY SERVICES DISTRICT.



2 SOIL NAIL ASSEMBLY - SECTION
NO SCALE



- NOTE:**
- REINFORCEMENT NOT SHOWN FOR CLARITY
 - SOIL NAIL SPACING AND LAYOUT PER CONTRACTOR DESIGN

3 PARTIAL ELEVATION
NO SCALE

REVISION:	DATE:	DESCRIPTION/REASON:	DESIGN BY:	SCALE: AS SHOWN	<p style="text-align: center;">EMBANKMENT REPAIR 2121 ALAMEDA DIABLO DIABLO, CA</p>	SHEET:
			CHECKED BY:	JOB NUMBER:		
			DATE:	CONTRACT NO:		
						SHEET OF