APPENDIX C-1

Inadvertent Release Contingency Plan

HDD / BORE PROFILE
&
FRAC-OUT PLAN

(Inadvertent Release Contingency Plan)

Rio Dell HDD Pipeline
Eel River Crossing
Rio Dell, CA .

Campos EPC Project Number: 01758.2024.2198

Date: May 7, 2024

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1. Project Background

1.1 Project Description

J-C Engineering (henceforth referred to as the Contractor) is planning to install two 16-inch pipeline sections extending under the Eel River, starting approximately 500 feet east-northeast of SR-101 along N Pacific Avenue in Rio Dell, CA, utilizing horizontal directional drilling (HDD) techniques. HDD is a trenchless method for installing pipelines known to minimize impacts to railways, roadways, waterways, and sensitive habitats.

1.2 Environmentally Sensitive Resources

At this time, inadvertent returns from the drilling phase of this project are not expected to have an impact on water resources in the area. The HDDs are planned to cross under the Eel River, but cover depth of the drill is anticipated to be a minimum of 50 feet beneath the river channel, greatly reducing the likelihood of effects on the river.

1.3 Drilling Procedures

Drilling fluid is a critical component of installation by HDD methods. While drilling or during any activities that may impact the bore, the Contractor requires that an experienced Environmental Inspector be present on-site to monitor activities.

1.4 Drilling Mud

One of the primary components of HDD installation is the drilling mud. Drilling fluids vary, but generally consist of a base mixture of water and bentonite products. This mixture is referred to as "mud" or "drill mud" and can contain many additional additives. The drilling mud enters the borehole through the drill bit and circulates back to either the entry or exit pit through the borehole. The primary functions of the drilling fluid in a HDD are:

- Hydraulic excavation – when drilling mud leaves the bit at a high velocity it can excavate soil by erosion
- Transmission of hydraulic power – in rock, a mud motor is used and the drilling fluids transmit energy downhole to turn the mud motor and cut rock
- Transportation of soil
- Cleaning and cooling drill bits and reamers
- Reduction of friction
- Borehole stabilization

As mentioned, drilling fluids primarily consist of water and bentonite clay. Bentonite clay is predominantly comprised of montmorillonite which is not listed as a hazardous material/substance as defined by U.S. Environmental Protection Agency's (USEPA) Emergency Planning and Community Right-to-know Act (EPCRA) or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulatory criteria. If the product becomes a waste, it does not meet the criteria of a hazardous waste, as defined by the USEPA. Bentonite is non-toxic and commonly used in farming practices but has the potential to impact

aquatic habitats and wildlife if discharged to waterways in significant quantities due to increases in localized turbidity.

The Contractor may elect to use additives in their drilling mud to adjust the behavior and properties of the mud. Additives are supplementary to this mixture and often have more specialized properties for keeping positive balance within the bore. This balance is dictated by and tailored to based first-most on the prevailing geology and second-most the tooling used to perform the HDD.

Safety Data Sheets for all additives will be provided by the Contractor to the project team for pre-approval. If any products are to be used in the field without pre-approval, the Contractor will submit the required documentation and wait for approval prior to using the product.

When conditions change within the geology or the mud, mud is not maintained, or pressures are not monitored and maintained, a loss in circulation may occur, and drilling fluid can be released. This drilling fluid may be released to the formation or may inadvertently return to the surface.

1.5 Plan Objectives

Numerous steps should be taken to prevent, monitor, and react to any inadvertent returns. Campos EPC has laid out the following guidelines or recommendations to avoid the inadvertent releases of drilling fluid whilst drilling. This plan should be reviewed by the Contractor prior to the beginning of installation and proposed modifications should be discussed by the project team.

2. Inadvertent Release Mitigation Efforts

2.1 Geotechnical Exploration

A geotechnical exploration program was previously undertaken at the site by BSK Associates. Four borings were performed near the proposed alignment, two on each side of the river, to evaluate the subsurface soil and rock conditions. Data obtained during the previous investigation was utilized in preparation of this Inadvertent Release Contingency Plan.

2.2 Bore Path Design

The bore path designs were developed in consideration of the risks of an inadvertent release during installation. Typically, the greater soil/rock cover the lower the risk of having an inadvertent drilling fluid release. With this in mind, the minimum depth of cover beneath Eel River is planned to be 50 feet.

2.3 Hydrofracture Analysis

Hydrofracture occurs when the pressure of the drilling fluids in the bore hole exceeds the strength of the surrounding soils. The excess pressures fracture the soil around the bore hole and allow the fluids to escape the bore hole. A hydraulic fracture analysis was performed to evaluate the allowable drilling fluid pressures and how they compare to the anticipated fluid pressures during construction. The results of this analysis were utilized in the development of the designed HDD plan and profile.

2.4 Site Preparation Efforts

The Contractor is responsible for preparing the site prior to beginning any drilling, as well as maintaining the site during drilling. Preparation should follow environmental best management practices and consist of some number of thought out and well-placed environmental control devices. Upon arrival, the Contractor will walk and evaluate HDD entry and exit, and general centerline to determine which areas have increased potential for inadvertent return. Some of these areas may be locations where water pools naturally, waterways, areas of lower depth of cover, areas with transitions, areas that on the surface are loaded with cobbles and boulders, etc. This walk allows the Contractor to not only identify areas, but know which areas should be monitored more closely, and evaluate readiness for managing an IR should it occur in any area, regardless of difficulty reaching it. Within workspaces, containments should be set up around stationary equipment and ECDs/ECMs (erosion control measures) should be installed downslope of potential areas of immediate impact.

While Campos EPC respects the means and methods of contractors, recommendations of ECDs/ECMs/precautionary equipment may include the following:

1. Storm drain inlets will by secured silt sock (securing may be by sandbag)
2. Numerous rolls of vis-queen

3. Silt fence placed and dug-in downslope of heavy equipment or workspaces.
4. Containment areas, consisting of self-standing enviro-basin, or polyethylene sheeting that can be rolled over straw wattles or four-by-four boards to create a barrier.
5. Spill kits, to deal with other than drilling fluid releases
6. IR kit, which may contain haybales, trash-bags, additional silt socks, additional silt fence, stakes, stake mallet, etc.
7. It is recommended that these materials be readily available in quantity to replace existing materials or respond to IRs.

3. Inadvertent Release Monitoring Plan

This section of the plan addresses monitoring approaches for early detection and mitigation when high risk circumstances present themselves onsite.

During drilling operations, the Contractor will maintain the drilling fluid monitoring equipment onsite, and have personnel who are proficient in their use, having knowledge and experience pertinent to drilling fluid. As such, the personnel should be able to perform the following activities, with ease, or in order to evaluate the fluid properties and make adjustments to improve stability, increase cutting return, and reduce risk of IR:

1. Communicate directly with the driller at the driller's console/chair to receive reports of annular pressure, mud-motor stalls, and changing conditions that can only be immediately felt by the driller.
2. Maintain fluids in the mud tank, check levels, charge pressure, and measure the rate of depletion in relation to the progression of new-bore.
3. Monitor the condition of drill mud at least three times a day, and once for every observed change in material:
    a. Take mud weight with approved mud test kit and include units in notes
    b. Take viscosity with marsh funnel and accurate durational measurement
    c. Take sand content measurement by the book to monitor content of superfines that slip through filtration. If the sand content gets too high, disposal and remixture should be considered.
    d. Take PH measurements to ensure that the platelet content of the drill mud stays high (platelets are the armor that coats the bore-wall in permeable conditions and often help prevent seep progression leading to IR, acidic conditions destroy the ability for drill mud to form platelets and lowers the viscosity)
4. Recommend which surfactants/polymers (such as clay cutters (for balling), stabilizers, etc.) or natural remedies (ex. sawdust) should be used and recognize when deployment is necessary (surfactants and polymers are extremely potent, as in 1 quart can equal 50 bags of bentonite, product knowledge is critical)
5. Monitor the return pits for solids content accumulation as it relates to proper suspension and carrying. A pit that is full of dense cuttings, not being reclaimed by the mud reclaiming pump may indicate that the same situation is present in the bore, thus leading to an eventual build-up of down-hole material, which may cause annular pressure spikes and rises.
6. A competent person should visually inspect the bore path at the completion of each joint and inspect 100 feet upstream and downstream and if possible, laterally, along alignment.
7. Ensure with the driller that pressures do not exceed calculated predicted pressure for hydraulic fracturing and that spikes are noted, and steps taken to mitigate or reverse the rise in pressure. Steps can include tripping while rotating pipe, inspecting the degree of balling on tooling if it is suspected to be occurring, doing a bottoms-up (this is the circulation of mud equating to the entire current bore volume).

8. Inspect waterways and sites previously identified during the site work as areas of concern. When inspecting waterways, look for tan-brown to gray levels of turbidity that stand out and are joining the flow of water. Often, in slower waters, an IR will look like a cloud.
9. Contain all drilling fluids and cuttings for proper disposal at an approved facility and note the volume of cuttings in the spoils pit as it relates to drilled volume. The cutting volume should be within reasonable proximity of the drilled volume.
10. If possible, a vacuum truck with sufficient hoses to reach all areas along the bore alignments will be staged prior to and during drilling activities. If a vacuum truck cannot be staged onsite, the truck will be readily available. An interim pump will be onsite to reach low areas and aid the vacuum truck. It is recommended that this resource be capable of departing and arriving onsite within one hour.

4. Inadvertent Release Contingency Plan

This section of the plan lays out the response if an inadvertent release were to occur.

4.1 Materials

The drilling contractor shall have the necessary fluid containment and clean-up provisions onsite and readily available at all times during drilling operations. Examples of materials that should be kept onsite include:

- Brooms, squeegees, and shovels
- Disposal bags and ties
- Vac trucks
- Spill kits
- Straw bales (weed and invasive free)
- Compost filter sock (12-inch diameter minimum)
- Weighted sediment tube
- Wooden stakes and mallet
- Sand bags
- Silt fence
- Plastic sheeting
- Trash pumps
- Turbidity curtain

The Contractor will include a list of proposed inadvertent release response materials in their work plan for review by the project team. Quantities of one-time-use materials may need to be replenished if they are utilized during the course of work.

4.2 Loss of Fluid Returns to Entry Pit

A loss of fluid returns to the entry pit is often the first sign of an inadvertent fluid release. Therefore, if a loss of fluid returns to the entry pit is observed, care should be taken to evaluate the next steps forward.

Should a loss or significant reduction of returns to the entry pit be observed during drilling operations, it is recommended that the following steps be taken:

1. Stop drilling/pumping fluids as soon as a loss of returns is observed.
2. Walk the alignment to see if fluid has returned to the ground surface.
3. Restart mud pumps and trip rods back several joints until returns are re-established.
4. Re-drill the hole while advancing the drill bit paying close attention that fluid returns are maintained.

If this procedure does not re-establish returns, alternative approaches such as a complete trip out or enlarging the borehole may be considered.

4.3 Fluid Release Response

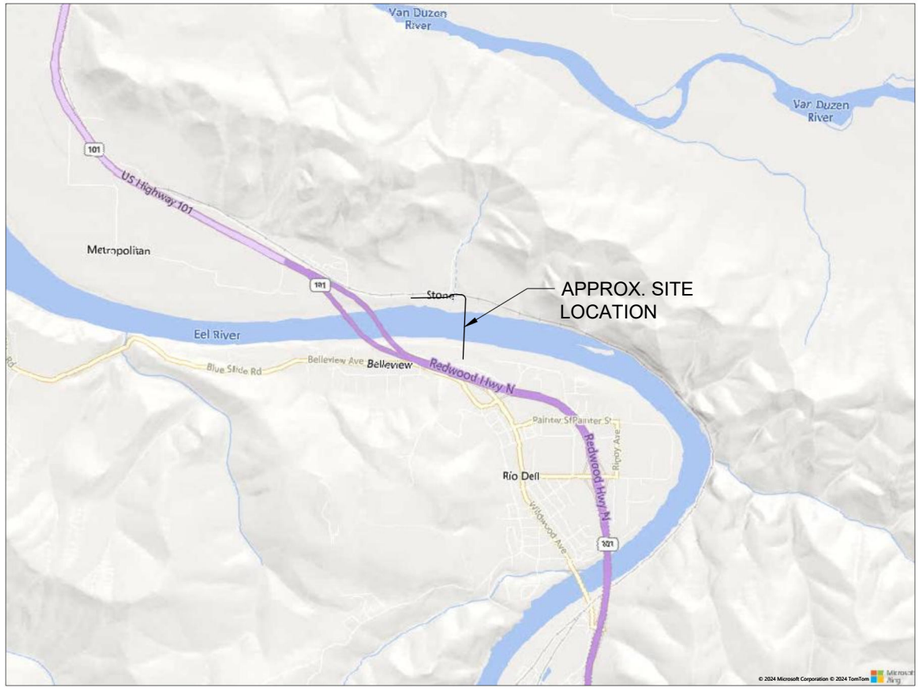
In the event of an inadvertent drilling fluid release, the following procedures can be implemented to contain, minimize, and potentially stop the inadvertent the return of drilling fluids:

1. Immediately and simultaneously kill charge pump and back trip (bottom-hole assembly) a full joint length off bottom (bore-face)
2. Get on location and characterize IR. Document location and proximity to centerline, size (volume), breadth, drilling conditions when IR occurred (hard/soft, rock/gravel, mud data, pressure data (over the last several joints) etc.), document setting (high grass, trees, marsh, waterway), and take pictures
3. Notify all appropriate personnel to include EI if onsite (environmental inspector).
4. Next check the return pit. This will be entry pit during pilot, but during ream can also be exit pit. Ensure that volume was as it was before IR. Next check mud recycler and ask when the mud tank was last topped off. Proceed by conveying with driller and move to inspect the remainder of the right-of-way/centerline vicinity (generously).
5. Make the best possible concise statement with the available information of fluid released and fluid lost (ex. T:1530, BHA at release STA 1000 + 75, Release at STA 1000 + 50 / 20 R off centerline, approx. 500 released, approx. 1,000 lost to shale formation, gravelly/discolored cuttings in returns, release amongst the pines and high-grass and accessible). Do NOT repeat hearsay.
6. Determine potential threats to the health and safety of workers by initiating cleanup (ex. river current estimated 5 MPH) and determine potential threats to the environment.
7. If environmental impacts are observed, remove and/or contain material to minimize affected area while minimizing disturbance to the area.
8. Consider countermeasure contingency simultaneously with consideration for what measures are necessary to monitor and control the potential continued release.
9. Once controls are in place, before resuming, allow formation to rest.
10. Once resuming or deploying LCM (loss circulation material), exercise extreme caution on flow rate and pressure. Check IR activity/dormancy in real-time, and returns, in real-time.
11. Consider other measures such as tripping all the way out or installing a burp-hole to relieve overhead pressure within the bore (ex. bore is 5 below grade in entry pit, lengthen pit so bore begins 10’ below grade, ex. dig pit where bore is 10’ lower than at entry and lower reclaiming pump to 7’ and pump reclaimed mud to recycler from newly created burp-hole), if tripping all the way out note clay that may be clinging to tooling, take pictures, communicate with mud-engineer.
12. If in the water, consider the use of a containment structure, such as a piece of pile that can be placed over the IR and secured/driven, place pump etc.
13. Inspect all IRs in the presence of all involved parties.
14. Request environmental monitors onsite if needed to ensure environmental requirements are met.

ATTACHMENTS

SITE LOCATION
Not to Scale

HORIZONTAL DIRECTIONAL DRILL DRAWINGS
RIO DELL
2 -16" HDPE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA



LOCATION MAP
1 in = 2000 ft

BASIS OF INFORMATION

1. AERIAL IMAGERY OBTAINED FROM AUTOCAD ONLINE MAP AND IS FOR REFERENCE ONLY AND IS NOT NECESSARILY AN ACCURATE REPRESENTATION OF EXISTING CONDITIONS.
2. TOPOGRAPHIC DATA OBTAINED FROM USGS LiDAR OBTAINED IN JANUARY 2018
3. DRAWING DATUM
   - 3.1. US SURVEY FEET
   - 3.2. HORIZONTAL: NAD83 CALIFORNIA STATE PLANE I NORTH (FEET)
   - 3.3. VERTICAL: NAVD88

PROJECT CONTACT INFORMATION

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TRENCHLESS DESIGN ENGINEER
CAMPOS EPC, LLC
ROMEO SHIPLEE, PE
PRINCIPAL ENGINEER
2251 SAN DIEGO AVE SUITE A-186
SAN DIEGO, CALIFORNIA 92110
858-429-5505

DRAWING INDEX

LEGEND

- PROPERTY LINES
- ACCESS ROADS
- WETLANDS (NWI MAPPED)
- TEMPORARY WORKSPACE (DURATION OF WORK)
- TEMPORARY WORKSPACE (PARTIAL DURATION)
- PROPOSED ALIGNMENT
- MAJOR CONTOUR (EXISTING)
- MINOR CONTOUR (EXISTING)
- GEOTECHNICAL BORING LOCATION
- PROPOSED HDD ENTRY / EXIT LOCATIONS

CAMPOS EPC
1401 Blake Street, Denver, CO 80202
(303) 623-3345

REGISTERED PROFESSIONAL ENGINEER
ROMEO SHIPLEE
No. 81127
Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION
0	05/01/24	ISSUED FOR REVIEW SET

0 2000 4000 6000
SCALE: 1" = 2000' SCALE IN FEET
ORIGINAL DRAWING SIZE IS 22 X 34

	NAME	DATE
DESIGN BY	ARR	4/29/24
DRAWN BY	ESB	4/29/24
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING

J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

SITE NAME
N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE
ISSUED FOR REVIEW SET

DRAWING TITLE
COVER SHEET

DRAWING NO.
C-1

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SCOPE

1. CONTRACTOR SHALL PROVIDE AND MOBILIZE ALL NECESSARY EQUIPMENT, INSTRUMENTATION, AND SUPPLIES TO INSTALL THE ASSEMBLED PIPE STRING USING HORIZONTAL DIRECTIONAL DRILLING (HDD) METHOD OF CONSTRUCTION.
2. CONTRACTOR SHALL ACTIVELY MONITOR THE DRILLED ALIGNMENT FOR IMPACTS THAT COULD OCCUR AS A RESULT OF HDD OPERATIONS (IE. SETTLEMENT, HEAVE, AND DRILLING FLUID FLOW). CONTRACTOR'S MONITORING PROCEDURES AND ASSOCIATED EMERGENCY RESPONSE PLANS SHALL BE APPROPRIATE TO ENSURE THAT PUBLIC SAFETY IS NOT COMPROMISED.

GENERAL NOTES

1. THE CONTRACTOR SHALL COMPLY WITH ALL CITY, COUNTY, STATE, AND FEDERAL GUIDELINES/REGULATIONS APPLICABLE TO CONSTRUCTION AT THIS SITE.
2. CONTRACTOR SHALL PERFORM A SITE VISIT AND VERIFY ALL COORDINATES AND DIMENSIONAL INFORMATION PRIOR TO CONSTRUCTION. IF DISCREPANCIES ARE OBSERVED, THE ENGINEER SHALL BE NOTIFIED PRIOR TO STARTING CONSTRUCTION.
3. ALL CONSTRUCTION METHODS AND MATERIALS SHALL CONFORM TO THE CURRENT SPECIFICATIONS AND STANDARDS OF OWNER.
4. ALL WORK SHALL BE IN COMPLIANCE WITH OSHA, TITLE 29 OF THE CODE OF FEDERAL REGULATIONS, AND ALL OTHER FEDERAL, STATE AND LOCAL LAWS AND REGULATIONS.
5. CONTRACTOR IS RESPONSIBLE FOR KNOWING LOCATION OF ALL ENVIRONMENTALLY SENSITIVE AREA RESTRICTIONS PERTAINING TO THIS PROJECT. CONTRACTOR TO VERIFY WETLANDS HAVE BEEN PERMITTED AND MITIGATED PRIOR TO DISTURBING ANY WETLAND AREAS.
6. CONTRACTOR SHALL REMAIN WITHIN THE CONSTRUCTION WORKING LIMITS. ACCESS TO AREAS OUTSIDE WORKING LIMITS MUST BE COORDINATED WITH THE OWNER OR OBTAINED DIRECTLY BY CONTRACTOR.
7. CONTRACTOR SHALL USE ALL NECESSARY MEANS TO ENSURE SAFE AND PROPER TRAFFIC FLOW DURING CONSTRUCTION, IN ACCORDANCE WITH OWNER AND LOCAL DOT STANDARDS.
8. CONTRACTOR IS SOLELY RESPONSIBLE FOR FOR EXECUTION OF THEIR WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND SPECIFICATIONS. CONTRACTOR IS RESPONSIBLE FOR THE CONSTRUCTION METHODS AND TECHNIQUES, SEQUENCES, TIME OF PERFORMANCE, AND ALL SAFETY PRECAUTIONS.

EXISTING UTILITIES

1. THE CONTRACTOR SHALL NOTIFY THE PUBLIC UTILITY LOCATING SYSTEM (811) AND OBTAIN A CLEARED, APPROVED TICKET PRIOR TO BEGINNING WORK.
2. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING AND POSITIVELY IDENTIFYING THE UTILITIES WITHIN THE WORKSPACE. CONTRACTOR IS RESPONSIBLE FOR PROTECTING ALL UNDERGROUND UTILITIES WITHIN THE CONSTRUCTION AREA AND WILL BE RESPONSIBLE FOR ALL LOSSES AND REPAIRS OCCASIONED BY DAMAGE TO UNDERGROUND FACILITIES / UTILITIES RESULTING FROM THEIR WORK.
3. IF EXISTING UTILITIES ARE IDENTIFIED IN THE FIELD AND DEEMED TO BE IN CONFLICT WITH THE PROPOSED BORE PROFILE, CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY SO THE CONFLICT MAY BE RESOLVED.

ALIGNMENT/PROFILE REFERENCE

1. STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND REFERS TO CENTERLINE OF PROPOSED BORE PATH.
2. DRILL PATH ELEVATIONS REFER TO THE CENTERLINE OF THE PILOT HOLE AND NOT TO THE TOP OF INSTALLED PIPE.
3. DRILL PATH ENTRY AND EXIT LABELS ARE FOR REFERENCE ONLY AND DO NOT SPECIFY WHICH SIDE OF THE BORE PATH A RIG WILL BE SET UP ON. CONTRACTOR MAY ELECT TO DRILL FROM EITHER OR BOTH SIDES BASED ON THEIR MEANS AND METHODS.

SUBMITTALS

1. THE CONTRACTOR SHALL SUBMIT TO THE OWNER AND ENGINEER A WRITTEN INADVERTENT RETURNS PLAN FOR APPROVAL TWO WEEKS PRIOR TO CONSTRUCTION. THE PLAN SHALL ADDRESS, BUT NOT BE LIMITED TO, THE FOLLOWING ITEMS:
   - 1.1. IDENTIFICATION OF AREAS REQUIRING PROTECTION (STREAMS, WETLANDS, PONDS, RESTRICTED PROPERTY, ETC.)
   - 1.2. DESCRIPTION OF THE METHOD(S) THAT WILL BE USED TO LOCATE INADVERTENT RETURNS WHEN THEY OCCUR.
   - 1.3. DESCRIPTION OF THE METHOD(S) THAT WILL BE USED TO CONTAIN, COLLECT, AND REMOVE/DISPOSE OF THE INADVERTENT RETURNS.
   - 1.4. METHOD TO RESTORE AREAS ONTO WHICH INADVERTENT RETURNS WERE CONTAINED.

PAD / SITE PREPARATIONS

1. CONTRACTOR SHALL ESTABLISH A TEMPORARY WORK AREA AT THE ENTRY AND EXIT SITES WITHIN THE LIMITS INDICATED ON THE APPROVED CONSTRUCTION DRAWINGS.
2. THE CONTRACTOR IS RESPONSIBLE FOR THEIR MEANS AND METHODS TO ANCHOR THEIR EQUIPMENT DURING CONSTRUCTION.
3. EROSION AND SEDIMENT CONTROL IS NOT DEPICTED ON THESE DRAWINGS. THE HDD CONTRACTOR IS RESPONSIBLE FOR INSTALLING AND MAINTAINING EROSION AND SEDIMENT CONTROL DEVICES IN ACCORDANCE WITH STATE AND LOCAL REGULATIONS.
4. TEMPORARY EXCAVATIONS SHALL BE IN ACCORDANCE WITH OSHA REGULATIONS.

DRILLING FLUIDS

1. DRILLING FLUIDS SHALL CONSIST OF BENTONITE AND WATER. IF MODIFICATIONS TO THE BASIC DRILLING FLUID ASSOCIATED WITH ADDITIVES IS PROPOSED A DESCRIPTION OF THE ADDITIVES TO BE USED AS WELL AS SDS SHEETS SHALL BE INCLUDED IN THE PLAN.
2. THE COMPOSITION OF ALL DRILLING FLUIDS PROPOSED FOR USE SHALL BE SUBMITTED TO THE OWNER FOR REVIEW AND APPROVAL. NO FLUID WILL BE APPROVED OR UTILIZED THAT DOES NOT COMPLY WITH PERMIT REQUIREMENTS AND ENVIRONMENTAL REGULATIONS.
3. AT A MINIMUM, MUD WEIGHT AND MARSH FUNNEL VISCOSITY SHALL BE CHECKED AT LEAST TWICE DAILY USING A CALIBRATED MUD BALANCE AND MARSH FUNNEL INTENDED FOR THIS USE.
4. DRILLING FLUID PRESSURES (ANNULAR AND INTERNAL DRILL ROD) SHOULD BE MONITORED ON A CONTINUOUS BASIS DURING THE PILOT HOLE OPERATIONS AND THE ANNULAR DRILLING FLUID PRESSURES SHOULD NOT EXCEED THE CALCULATED PRESSURE FOR HYDRAULIC FRACTURING.
5. DRILLING FLUID PUMP RATE SHOULD BE MONITORED DURING ALL DRILLING OPERATIONS.

FLUIDS MANAGEMENT

1. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, TRANSPORTING, AND STORING ANY WATER REQUIRED FOR DRILLING FLUIDS.
2. CONTRACTOR SHALL MAXIMIZE RECIRCULATION OF DRILLING FLUID SURFACE RETURNS.
3. CONTRACTOR SHALL PROVIDE SOLIDS CONTROL AND FLUID CLEANING EQUIPMENT OF A CONFIGURATION AND CAPACITY THAT CAN PROCESS SURFACE RETURNS AND PRODUCE DRILLING FLUID WITH APPROPRIATE PROPERTIES FOR REMOVAL OF EXCESS CUTTINGS FROM THE FLUID.
4. DISPOSAL OF EXCESS DRILLING FLUIDS IS THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE CONDUCTED IN COMPLIANCE WITH ALL ENVIRONMENTAL REGULATIONS, RIGHT-OF-WAY AND WORKSPACE AGREEMENTS, AND PERMIT REQUIREMENTS. DRILLING FLUID DISPOSAL PROCEDURES PROPOSED SHALL BE SUBMITTED TO THE OWNER FOR APPROVAL TWO WEEKS PRIOR TO CONSTRUCTION. UNDER NO CIRCUMSTANCES SHALL DRILLING FLUIDS BE DISPOSED OF IN WATER BODIES OR WETLANDS.

INADVERTENT FLUID RETURNS

1. THE CONTRACTOR SHALL CHECK THE ENTRY SITE, EXIT SITE, AND THE AREA IN THE VICINITY OF THE DRILL PATH FOR INADVERTENT RETURNS ON A ROUTINE BASIS. THIS INCLUDES UPLAND, WETLAND, AND WATER AREAS.
2. CONTRACTOR SHALL EMPLOY THEIR BEST EFFORTS TO MAINTAIN FULL ANNULAR CIRCULATION OF DRILLING FLUIDS. DRILLING FLUID RETURNS AT LOCATIONS OTHER THAN THE ENTRY AND EXIT POINTS SHALL BE MINIMIZED.
3. IN THE EVENT THAT ANNULAR CIRCULATION IS LOST, THE CONTRACTOR SHALL TAKE STEPS TO RESTORE CIRCULATION.
4. IF INADVERTENT SURFACE RETURNS OF DRILLING FLUIDS OCCUR, THEY SHALL IMMEDIATELY BE CONTAINED, COLLECTED, AND REMOVED/DISPOSED.
5. IF THE AMOUNT OF INADVERTENT RETURNS EXCEEDS THE CAPACITY OF CONTAINMENT, DRILLING OPERATIONS SHALL BE SUSPENDED UNTIL THE VOLUME OF INADVERTENT RETURNS CAN BE MANAGED WITHOUT EXCEEDING THE CAPACITY OF THE CONTAINMENT.

CASING

1. CONTRACTOR MAY ELECT TO USE TEMPORARY CASING TO REDUCE THE POTENTIAL INADVERTENT FLUID RETURNS NEAR THE ENTRY/EXIT AREAS. ALL TEMPORARY CASINGS SHALL BE REMOVED FOLLOWING PIPELINE INSTALLATION AND PRIOR TO REQUIRED POST-INSTALLATION TESTING.

PILOT HOLE

1. THE PILOT HOLE SHALL BE DRILLED ALONG THE PATH SHOWN ON THE PLAN AND PROFILE DRAWINGS WHILE MAINTAINING THE SPECIFIED TOLERANCES.
2. CONTRACTOR SHALL AT ALL TIMES PROVIDE AND MAINTAIN INSTRUMENTATION WHICH WILL ACCURATELY LOCATE THE PILOT HOLE, MEASURE DRILL STRING AXIAL AND TORSIONAL LOADS, AND MEASURE DRILLING FLUID DISCHARGE RATE AND ANNULAR PRESSURE.
3. A LOG OF ALL RECORDED READINGS SHALL BE MAINTAINED AND WILL BECOME PART OF THE "AS-BUILT" INFORMATION DEVELOPED BY THE CONTRACTOR AND SUBMITTED TO THE OWNER.
4. THE OWNER AND/OR THEIR SITE REPRESENTATIVE SHALL HAVE ACCESS TO SAID INSTRUMENTATION AND THEIR READINGS AT ALL TIMES.
5. AT THE COMPLETION OF THE PILOT HOLE DRILLING, THE CONTRACTOR SHALL PROVIDE A TABULATION OF COORDINATES, REFERENCED TO THE DRILL ENTRY POINT, WHICH ACCURATELY DESCRIBES THE LOCATION OF THE PILOT HOLE.

PILOT HOLE TRACKING

1. THE HDD PILOT HOLE SHALL BE TRACKED USING A METHOD THAT WILL LOCATE THE DRILL STRING IN BOTH PLAN AND PROFILE COMPARED TO THE PROPOSED BORE ALIGNMENT.
2. THE DOWN HOLE INSTRUMENTATION SHALL BE LINKED TO THE REFERENCED SURVEY GRID JUST BEFORE THE PILOT HOLE DRILLING PROCESS BEGINS. ADDITIONALLY, THE DOWN HOLE INSTRUMENTATION SHALL BE LINKED TO THE REFERENCED SURVEY GRID A SECOND TIME JUST AFTER THE PILOT HOLE DRILLING PROCESS IS COMPLETED.
3. THE CONTRACTOR SHALL PLOT THE ACTUAL HORIZONTAL AND VERTICAL ALIGNMENT OF THE PILOT HOLES AT INTERVALS NOT EXCEEDING ONE DRILL ROD LENGTH AND CORRESPONDING TO THE PROJECT STATIONING AND DATUM.
4. THE CONTRACTOR SHALL MAINTAIN AND UPDATE AN "AS-BUILT" PLAN AND PROFILE AS THE PILOT BORE IS ADVANCED.
5. CONTRACTOR SHALL GRANT THE OWNER AND/OR THEIR SITE REPRESENTATIVE ACCESS TO ALL DATA READOUTS PERTAINING TO THE POSITION AND INCLINATION OF THE BORE HEAD.
6. THE ENGINEER SHALL APPROVE THE ALIGNMENT OF THE PILOT BORE BEFORE THE REAMING PHASE OR PIPE PULLING MAY BEGIN.

REAMING

1. THE CONTRACTOR SHALL CONDUCT REAMING OPERATIONS TO ENSURE THAT A HOLE SUFFICIENT TO ACCOMMODATE THE PULL SECTION HAS BEEN PRODUCED.
2. AS A MINIMUM, THE HOLE SHALL BE REAMED TO THE LESSER OF 150% OF THE OUTSIDE DIAMETER OF THE PIPE SECTION OR 12 INCHES GREATER THAN THE OUTSIDE DIAMETER OF THE PIPE SECTION WITH A MINIMUM BORE HOLE OF AT LEAST 4 INCHES GREATER THAN THE OUTSIDE DIAMETER OF THE PIPE SECTION.
3. ANY DAMAGE TO THE PIPE RESULTING FROM INADEQUATE REAMING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

SWAB PASS

1. A FINAL SWAB PASS WITH A REAMER SHALL BE PERFORMED NO LONGER THAN 24 HOURS PRIOR TO THE PIPE PULLBACK. THE REAMER SHALL BE LARGER THAN THE PRODUCT PIPE BUT MAY BE SMALLER THAN OR EQUAL TO THE REAMED HOLE.
2. THE SWAB PASS SHALL BE PERFORMED IN THE DIRECTION OF THE PROPOSED PULLBACK UNLESS PRIOR APPROVAL IS GIVEN BY THE ENGINEER.
3. THE SWAB PASS SHALL BE PERFORMED WITH A MINIMUM FLUSH RATIO OF AT LEAST 2 TIMES THE THEORETICAL HOLE VOLUME.

EQUIPMENT FAILURES

1. IN THE EVENT OF DRILLING EQUIPMENT FAILURES, ALL PORTIONS OF THE FAILED EQUIPMENT SHALL BE RECOVERED FROM THE DRILL HOLE PRIOR TO PIPE PULLBACK.
2. FAILURE TO REMOVE ALL FAILED DRILLING EQUIPMENT WILL RESULT IN THE REQUIREMENT OF THE CONTRACTOR TO COMPLETE A NEW BORE AT NO ADDITIONAL COST TO THE OWNER.

PRE-INSTALLATION TESTING

1. CONTRACTOR SHALL VISUALLY INSPECT THE PIPE STRING FOR ANY DEFORMATION (IE. DENTS, BUCKLES, WRINKLES, ETC.) AND/OR DAMAGE (IE. SCRATCHES, GOUGES, ETC.) BEFORE THE INSTALLATION PROCESS.

PULLBACK

1. A SWIVEL SHALL BE USED TO CONNECT THE PULL SECTION TO THE REAMING ASSEMBLY TO MINIMIZE TORSIONAL STRESS IMPOSED ON THE PIPE SECTION.
2. A NON-AGGRESSIVE REAMER (IE. BARREL REAMER) SHALL BE USED AS A LEADING CENTRALIZER FOR THE PRODUCT PIPE DURING PULLBACK. THE REAMER SHALL BE SIZED LARGER THAN THE PRODUCT PIPE BUT SMALLER THAN THE REAMED HOLE.
3. DURING PULLBACK, THE MAXIMUM PULL FORCE SHOULD BE MONITORED TO CONFIRM THE PIPE IS NOT OVERSTRESSED.
4. THE PULL SECTION SHALL BE SUPPORTED AS IT PROCEEDS DURING PULLBACK SO THAT IT MOVES FREELY AND THE PIPE IS NOT DAMAGED OR OVERSTRESSED.
5. CONTRACTOR SHALL PULL AN ADDITIONAL MINIMUM OF 10 FEET OF PRODUCT PIPE OUT OF THE RIG SIDE OF THE HDD TO ALLOW FOR EXAMINATION OF THE LEADING EDGE PIPE CONDITION. PRODUCT PIPE SHALL BE PULLED AS CLOSE TO THE RIG AS POSSIBLE.

POST-INSTALLATION TESTING

1. THE LEADING EDGE OF THE PIPE STRING SHALL BE EVALUATED BY THE ENGINEER FOR DAMAGE.

TOLERANCES

1. TOLERANCES ARE PROVIDED IN THE INDIVIDUAL HDD PLAN AND PROFILE SHEETS.
2. CONTRACTOR SHALL IMMEDIATELY NOTIFY OWNER AND ENGINEER OF ANY DEVIATIONS THAT DO NOT COMPLY WITH THE TOLERANCES LISTED ON THESE DRAWINGS.
3. IN ALL CASES, RIGHT OF WAY RESTRICTIONS SHALL TAKE PRECEDENCE OVER LISTED TOLERANCES. NO PILOT HOLE WILL BE ACCEPTED IF IT WILL RESULT IN ANY OF THE PIPELINE BEING INSTALLED IN VIOLATION OF RIGHT OF WAY RESTRICTIONS.
4. CONCERN FOR ADJACENT UTILITIES AND / OR STRUCTURES SHALL TAKE PRECEDENCE OVER THE LISTED TOLERANCES. LISTING OF TOLERANCES DOES NOT RELIEVE CONTRACTOR FROM RESPONSIBILITY FOR SAFE OPERATION OR DAMAGE TO ADJACENT UTILITIES AND STRUCTURES.
5. IF THE PILOT BORE FAILS TO CONFORM TO THE SPECIFIED TOLERANCES, THE OWNER MAY, AT HIS OPTION, REQUIRE A NEW PILOT BORE TO BE MADE.
6. CURVES SHALL BE DRILLED AT A RADIUS GREATER THAN OR EQUAL TO THE ALLOWABLE RADIUS. THE DRILLED RADIUS WILL BE CALCULATED OVER ANY THREE TO FIVE JOINT SEGMENTS USING THE FOLLOWING FORMULA:

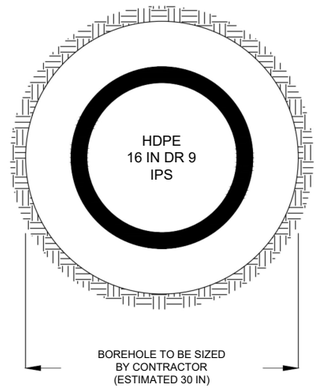
R = L / A * 57.296 WHERE: R = DRILLED RADIUS OVER LENGTH (L)
L = LENGTH DRILLED, NO LESS THAN 75 FEET AND NO GREATER THAN 100 FEET
A = TOTAL CHANGE IN ANGLE OVER LENGTH (L)

DESIGN CHANGE PROCEDURE

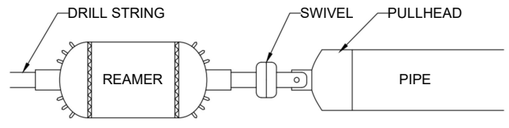
1. CONTRACTOR SHALL SUBMIT ANY REQUESTS FOR DEVIATION FROM THE DESIGN FOR REVIEW PRIOR TO CONSTRUCTION.
2. THE CONTRACTOR MAY REQUEST CHANGES TOT HE PROPOSED VERTICAL AND HORIZONTAL ALIGNMENT OF THE INSTALLATION AND THE LOCATION OF THE ENTRY AND EXIT POINTS FOR THE HDD BORES. PROPOSED CHANGES SHALL BE SUBMITTED TO THE ENGINEER AND RECEIVE APPROVAL OF THE ENGINEER PRIOR TO STARTING THE AFFECTED ACTIVITIES.

QUALITY CONTROL

1. THE HDD CONSTRUCTION SHOULD BE OBSERVED ON A FULL TIME BASIS BY A REPRESENTATIVE OF THE ENGINEER.
2. FOR OBSERVATION OF THE INSTALLATION, NOTIFY THE ENGINEER THAT WORK WILL START AT LEAST 3 DAYS PRIOR TO THE START OF WORK.



1 **TYPICAL BORE CROSS-SECTION**
NOT TO SCALE



CAMPOS EPC
1401 Blake Street, Denver, CO 80202
(303) 623-3345

REGISTERED PROFESSIONAL ENGINEER
ROMEO SHIPLEE
No. 81127
Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION
0	05/01/24	ISSUED FOR REVIEW SET

	NAME	DATE
DESIGN BY	ARR	4/29/24
DRAWN BY	ESB	4/29/24
CHECKED BY		
APPROVED BY		

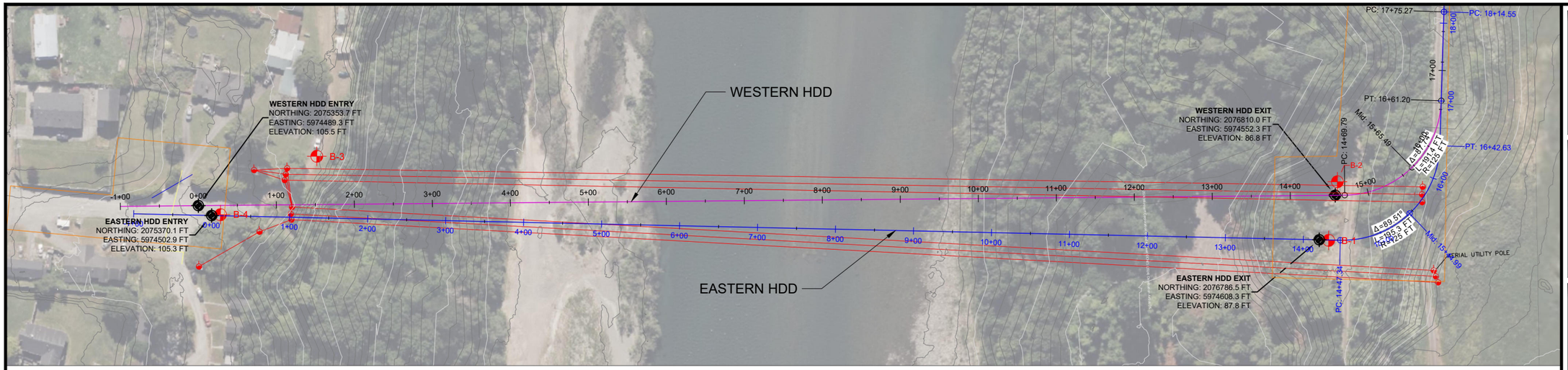
J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING
J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

SITE NAME
N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

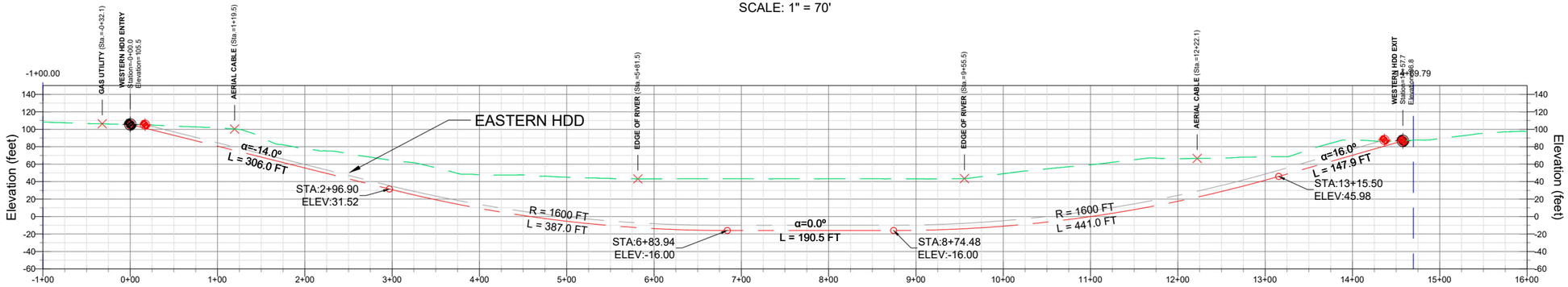
DRAWING STAGE
ISSUED FOR REVIEW SET

DRAWING TITLE
HDD NOTES

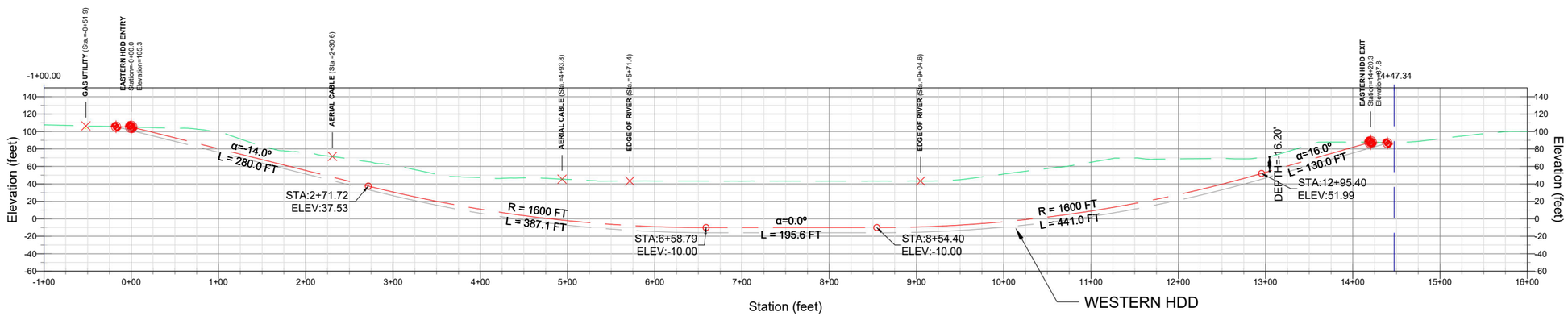
DRAWING NO.
HDD-1



PLAN VIEW
SCALE: 1" = 70'



PROFILE VIEW (WESTERN HDD)
HORIZONTAL SCALE: 1" = 70'
VERTICAL SCALE: 1"= 70'



PROFILE VIEW (EASTERN HDD)
HORIZONTAL SCALE: 1" = 70'
VERTICAL SCALE: 1"= 70'

NOTES
1. THE DRILL PATH STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND IS INDEPENDENT OF THE REST OF THE PROJECT ALIGNMENT.
2. DRILL PATH COORDINATES REFER TO THE CENTERLINE OF THE PILOT HOLE AND NOT TO THE TOP OF INSTALLED PIPE.

PILOT HOLE BORE PATH INSTALLATION TOLERANCES
- ENTRY LOCATION: +/-25 FT ALONG ALIGNMENT
- EXIT LOCATION: +25/-5 FT ALONG ALIGNMENT
- HORIZONTAL ALIGNMENT: +/- 5 FEET OF ALIGNMENT
- MINIMUM COMBINED RADIUS: 800 FT OVER 100 FT
- VERTICAL ELEVATION: +2/-15 FEET

PILOT HOLE BORE PROFILE SHOULD BE PROVIDED TO ENGINEER FOR REVIEW AND APPROVAL PRIOR TO COMMENCING REAMING OR PULLBACK OPERATIONS.

CAMPOS EPC
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REGISTERED PROFESSIONAL ENGINEER
ROMEO SHIPLEE
No. 81127
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CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION
0	05/01/24	ISSUED FOR REVIEW SET

0 70 140 210
SCALE: 1" = 70' SCALE IN FEET
ORIGINAL DRAWING SIZE IS 22 X 34

	NAME	DATE
DESIGN BY	ARR	4/29/24
DRAWN BY	ESB	4/29/24
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING

J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

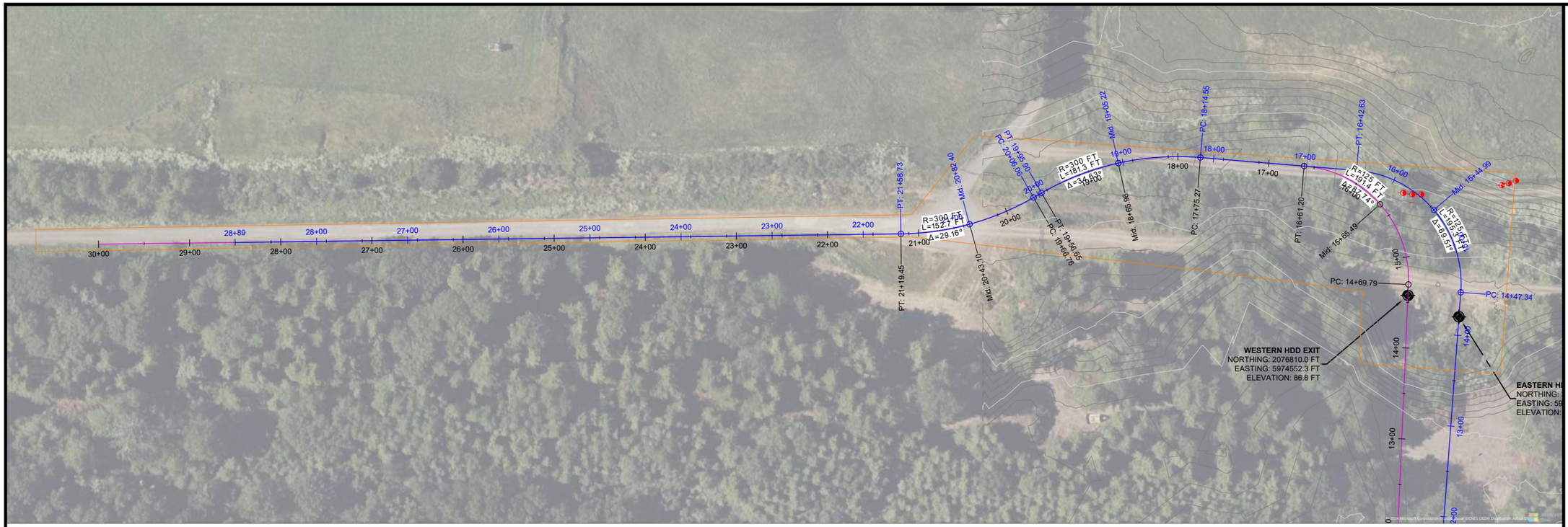
SITE NAME
N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE
ISSUED FOR REVIEW SET

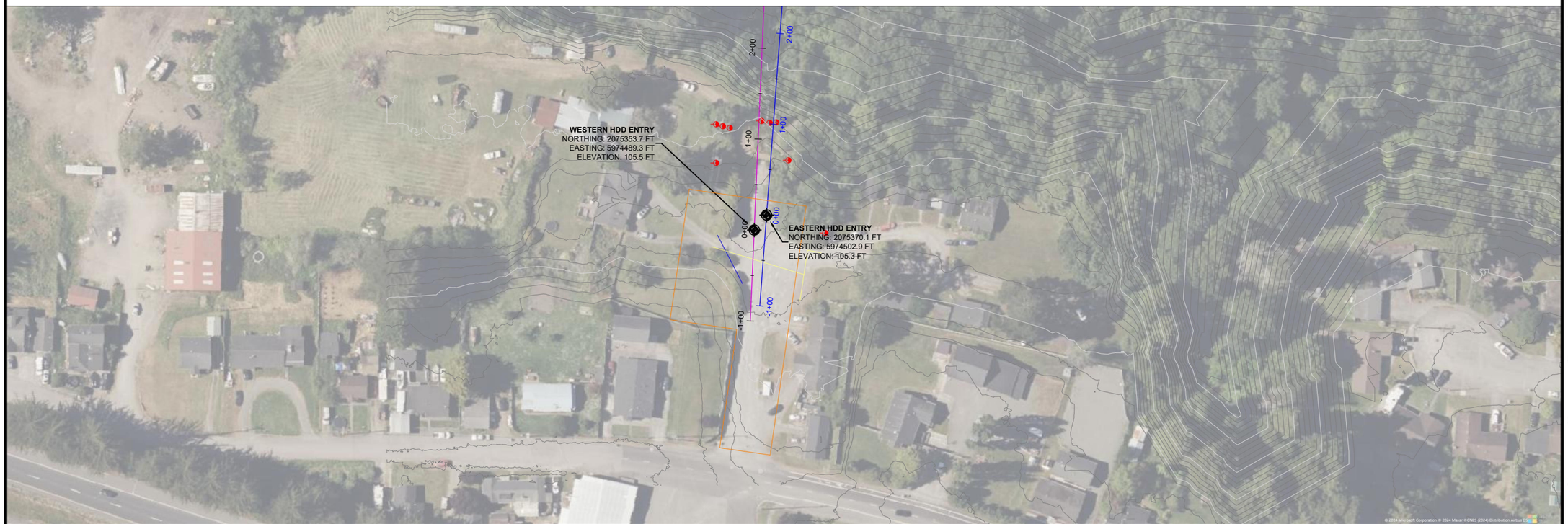
DRAWING TITLE
PLAN AND PROFILE

DRAWING NO.
HDD-2

X:\01 Project Folders\J-C Engineering\Rio Dell\04 ENG\4.08 Geotech Reports\Drawings\Rio Dell Drawing\HDD Drawing Rio Dell 20240506.dwg



EXIT SIDE PLAN VIEW
SCALE: 1" = 60'



ENTRY SIDE PLAN VIEW
SCALE: 1" = 60'

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REGISTERED PROFESSIONAL ENGINEER
ROMEO SHIPLEE
No. 81127
Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION
0	05/01/24	ISSUED FOR REVIEW SET

0 150 300 450
SCALE: 1" = 150' SCALE IN FEET
ORIGINAL DRAWING SIZE IS 22 X 34

	NAME	DATE
DESIGN BY	ARR	4/29/24
DRAWN BY	ESB	4/29/24
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING

J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

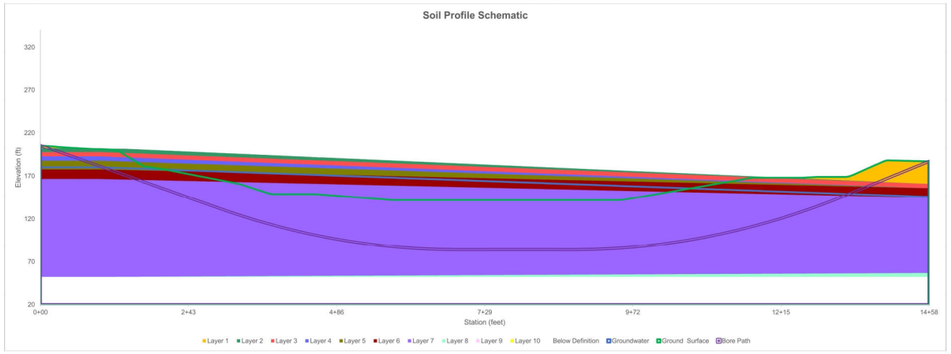
SITE NAME
N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE
ISSUED FOR REVIEW SET

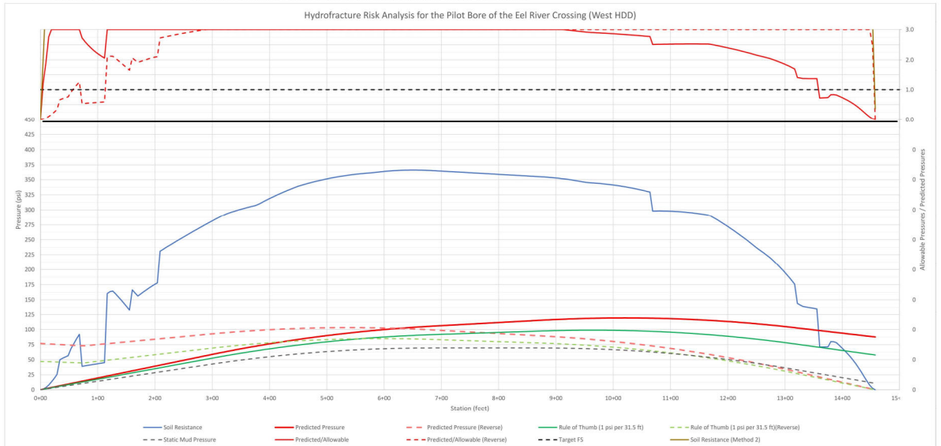
DRAWING TITLE
PLAN VIEW
(LAYDOWN AREA)

DRAWING NO.
HDD-3

Layer No.	Description	N-Value	Total Unit Weight (pcf)	Friction Angle (deg)	Cohesion (psf)	Shear Modulus (ksf)
1	Silty Sand (SM)	5	105	29	0	52
2	Silty Sand (SM)	20	118	32	0	88
3	Lean Clay (CL)	13	107	3	1300	389
4	Clayey Gravel (GC)	13	119	33	0	172
5	Fat Clay (CH)	7	101	2	785	79
6	Poorly graded Sand (SP)	30	127	34	0	170
7	Weathered Rock (Sandy)	50	145	38	0	160
8						
9						
10						



Note: An elevation offset of +100 feet has been applied to the above schematic for plotting purposes.



DRILL PATH DEFINITION

Entry Angle	14.0 deg
Exit Angle	16.0 deg
Total Drill Length	1,482.2 ft
Min. Design Combined Radius	1600 ft
Assumed Bore Diameter	24 in

PIPE PROPERTIES

Pipe Outside Diameter	16 in
Pipe Thickness	1.778 in
Dimension Ratio (DR)	9
Pipe Type	PE4710
MAOP	0 psi
HydroTest Pressure	0 psi
Pull Duration	12 hr
Short Term Elastic Modulus	78,750 psi
Long Term Elastic Modulus	36,250 psi
Ballasted	No

INSTALLATION CALCULATION RESULTS

Estimated Pull Force	64,182 lb
Allowable Tensile Load	114,183 lb
Check Pull Force < Allowable	Good
Check 2 x Pull Force < Allowable	**CDR=1.78**
Min. Recommended Rig Capacity (2 x Estimate)	128,363 lb
Maximum Axial Stress	808 psi
Safe Pull Stress	1,438 psi
Check Pull Stress < Allowable	Good
Factor of Safety for Pull Stress	1.8

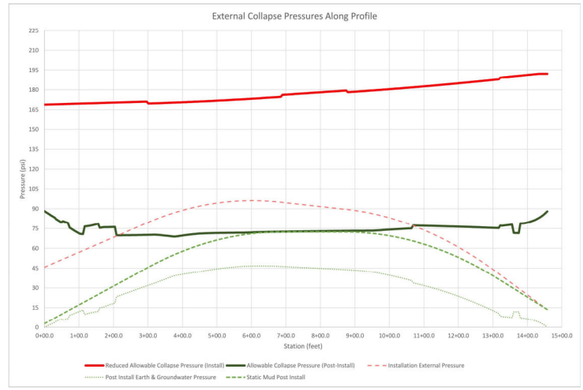
HYDROFRACTURE RISK ANALYSIS ASSUMPTIONS

Basis of Assumptions	Pre-Construction Submittal
Drill Rig Properties	
Rod Diameter	5 in
Collar Diameter	6.75 in
Pilot Hole Diameter	9.875 in
Mud Pump Output	500 gpm
Average Uphole Velocity	172 ft/min
Mud Properties	
Unit Weight	11.0 lb/gal
Yield Point	46 lb/100 ft^2
Plastic Viscosity	24 cP

Notes

Segment	Type	Length	Average Inclination	Vertical Radius	Horizontal Radius	Combined Radius
5	Tangent	147.9	-16.0	0	0	
4	Vertical Curve	446.8	-8.0	1600	0	1600
3	Tangent	190.5	0.0	0	0	
2	Vertical Curve	391.0	7.0	1600	0	1600
1	Tangent	306.0	14.0	0	0	

	Percent Ovality (%)	Maximum External Pressure (psi)	Allowable Collapse Pressure (psi)	Check Collapse Pressure
During Pullback	0.06	96.1	172.9	Good
Post Installation	2.98	46.7	72.0	Good



REFERENCES:

American Society of Civil Engineers. (2014). "ASCE Manuals and Reports on Engineering Practice No. 108 - Pipeline Design for Installation by Horizontal Directional Drilling", ASCE, Alexandria, VA.
ASTM. (2020). "Standard Guide for Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings," F1962, West Conshohocken, PA.
Bennett, David et. Al. (2017), "NASTT's Horizontal Directional Drilling (HDD) Good Practices Guidelines.", 4th edition. Cleveland, OH.
Baroid Drilling Fluids, Inc. (1998). "Baroid Fluids Handbook." , Houston, TX
Duyvestyn, Glenn. (2009). "Comparizon of Predicted and Observed HDD Installation Loads for Various Calculation Methods." NASTT International No-Dig Show 2009.
The Plastics Pipe Institute. (2008). "Handbook of Polyethylene Pipe," Second Edition, Irving, TX.
Willoughby, David A. (2005). "Horizontal Directional Drilling Utility and Pipeline Applications.", New York, NY.

Calculation By:	SL	Client	J-C Engineering		
Checked By	TD/RS	Project Number	01758.2024.21989	Print Date:	5/6/2024
Calculation Date	5/6/2024	Project Name	Rio Dell HDD	User:	Eric Backlund
Program Version	Beta 1.6 (Rev. 11/08/23)	Project Address	, Rio Dell, California		
File Location:	X:\01 Project Folders\J-C Engineering\Rio Dell\04 ENG\4.08 Geotech Reports\Calcs\[Eel River HDD-West Calc v.B.1.7.xlsm]Summary (Plastic)				

CAMPOS EPC
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(303) 623-3345

REGISTERED PROFESSIONAL ENGINEER
ROMEO SHIPLEE
No. 81127
Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION
0	05/01/24	ISSUED FOR REVIEW SET

	NAME	DATE
DESIGN BY	ARR	4/29/24
DRAWN BY	ESB	4/29/24
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING
J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

SITE NAME

N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE

ISSUED FOR REVIEW SET

DRAWING TITLE

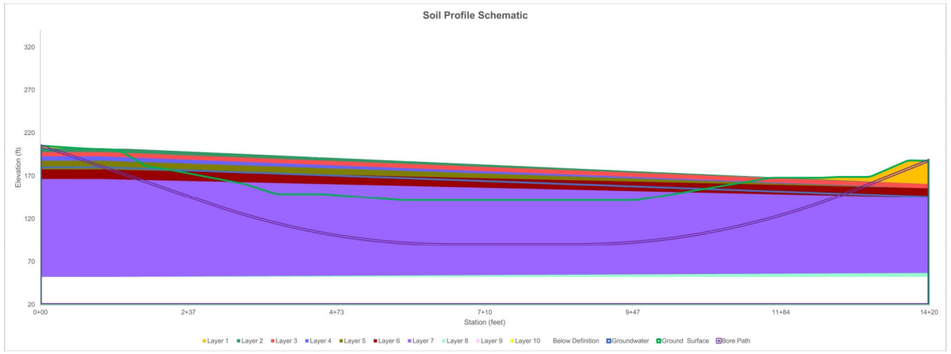
CALCULATIONS (WEST)

DRAWING NO.

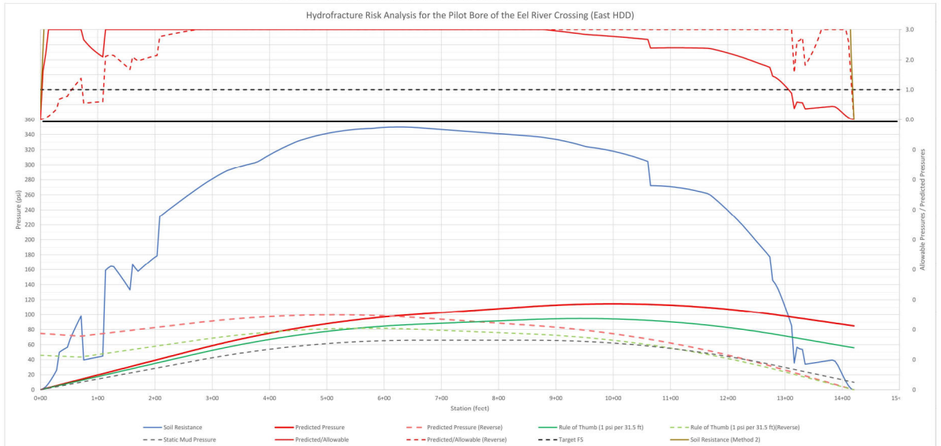
HDD-4

X:\01 Project Folders\J-C Engineering\Rio Dell\04 ENG\4.08 Geotech Reports\Drawings\Rio Dell Drawing\HDD Drawing Rio Dell 20240506.dwg

Layer No.	Description	N-Value	Total Unit Weight (pcf)	Friction Angle (deg)	Cohesion (psf)	Shear Modulus (ksf)
1	Silty Sand (SM)	5	105	29	0	52
2	Silty Sand (SM)	20	118	32	0	88
3	Lean Clay (CL)	13	107	3	1300	389
4	Clayey Gravel (GC)	13	119	33	0	172
5	Fat Clay (CH)	7	101	2	785	79
6	Poorly graded Sand (SP)	30	127	34	0	170
7	Weathered Rock (Sandy)	50	145	38	0	160
8						
9						
10						



Note: An elevation offset of +100 feet has been applied to the above schematic for plotting purposes.



DRILL PATH DEFINITION

Entry Angle	14.0 deg
Exit Angle	16.0 deg
Total Drill Length	1,443.4 ft
Min. Design Combined Radius	1600 ft
Assumed Bore Diameter	24 in

PIPE PROPERTIES

Pipe Outside Diameter	16 in
Pipe Thickness	1.778 in
Dimension Ratio (DR)	9
Pipe Type	PE4710
MAOP	0 psi
HydroTest Pressure	0 psi
Pull Duration	12 hr
Short Term Elastic Modulus	78,750 psi
Long Term Elastic Modulus	36,250 psi
Ballasted	No

INSTALLATION CALCULATION RESULTS

Estimated Pull Force	62,532 lb
Allowable Tensile Load	114,183 lb
Check Pull Force < Allowable	Good
Check 2 x Pull Force < Allowable	**CDR=1.83**
Min. Recommended Rig Capacity (2 x Estimate)	125,064 lb
Maximum Axial Stress	787 psi
Safe Pull Stress	1,438 psi
Check Pull Stress < Allowable	Good
Factor of Safety for Pull Stress	1.8

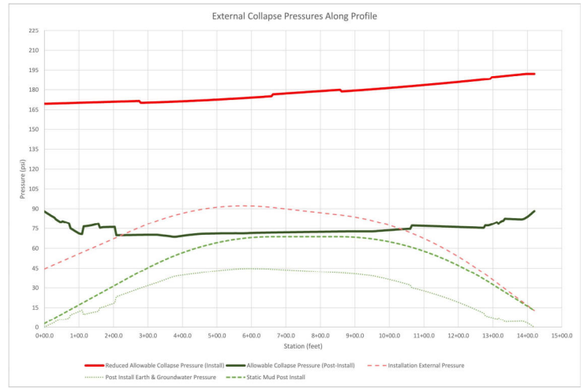
HYDROFRACTURE RISK ANALYSIS ASSUMPTIONS

Basis of Assumptions	Pre-Construction Submittal
Drill Rig Properties	
Rod Diameter	5 in
Collar Diameter	6.75 in
Pilot Hole Diameter	9.875 in
Mud Pump Output	500 gpm
Average Uphole Velocity	172 ft/min
Mud Properties	
Unit Weight	11.0 lb/gal
Yield Point	46 lb/100 ft^2
Plastic Viscosity	24 cP

Notes

Segment	Type	Length	Average Inclination	Vertical Radius	Horizontal Radius	Combined Radius
5	Tangent	130.0	-16.0	0	0	
4	Vertical Curve	446.8	-8.0	1600	0	1600
3	Tangent	195.6	0.0	0	0	
2	Vertical Curve	391.0	7.0	1600	0	1600
1	Tangent	280.0	14.0	0	0	

	Percent Ovality (%)	Maximum External Pressure (psi)	Allowable Collapse Pressure (psi)	Check Collapse Pressure
During Pullback	0.06	92.2	173.4	Good
Post Installation	3.02	44.8	71.3	Good



REFERENCES:

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ASTM. (2020). "Standard Guide for Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings," F1962, West Conshohocken, PA.
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The Plastics Pipe Institute. (2008). "Handbook of Polyethylene Pipe," Second Edition, Irving, TX.
Willoughby, David A. (2005). "Horizontal Directional Drilling Utility and Pipeline Applications.", New York, NY.

Calculation By:	SL	Client	J-C Engineering		
Checked By	TD/RS	Project Number	Pending	Print Date:	5/6/2024
Calculation Date	4/19/2024	Project Name	Rio Dell Feeder	User:	Steven Linton
Program Version	Beta 1.6 (Rev. 11/08/23)	Project Address	, Rio Dell, California		
File Location:	X:\01 Project Folders\J-C Engineering\Rio Dell\04 ENG\4.08 Geotech Reports\Calcs\[Eel River HDD-East Calc v.B.1.7.xlsm]Summary (Plastic)				

X:\01 Project Folders\J-C Engineering\Rio Dell\04 ENG\4.08 Geotech Reports\Drawings\Rio Dell Drawing\HDD Drawing Rio Dell 20240506.dwg

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REGISTERED PROFESSIONAL ENGINEER
ROMEO SHIPLEE
No. 81127
Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION
0	05/01/24	ISSUED FOR REVIEW SET

	NAME	DATE
DESIGN BY	ARR	4/29/24
DRAWN BY	ESB	4/29/24
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING
J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

SITE NAME

N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE

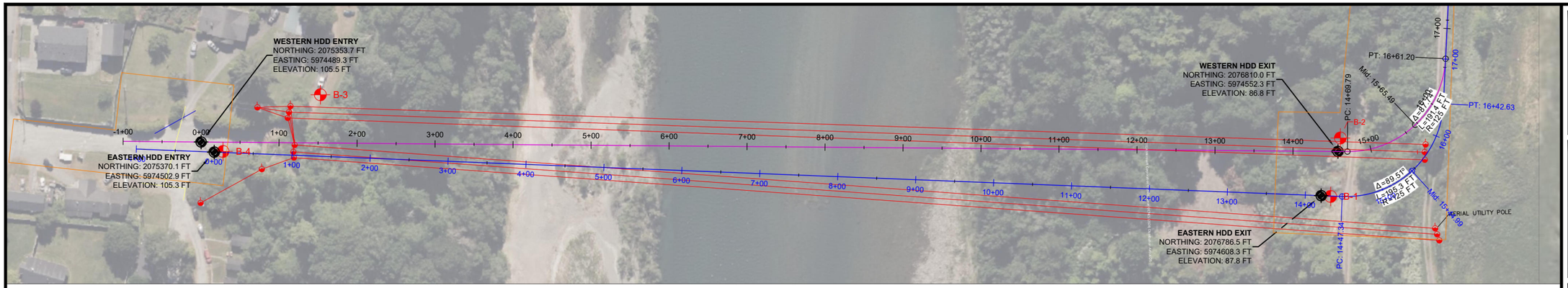
ISSUED FOR REVIEW SET

DRAWING TITLE

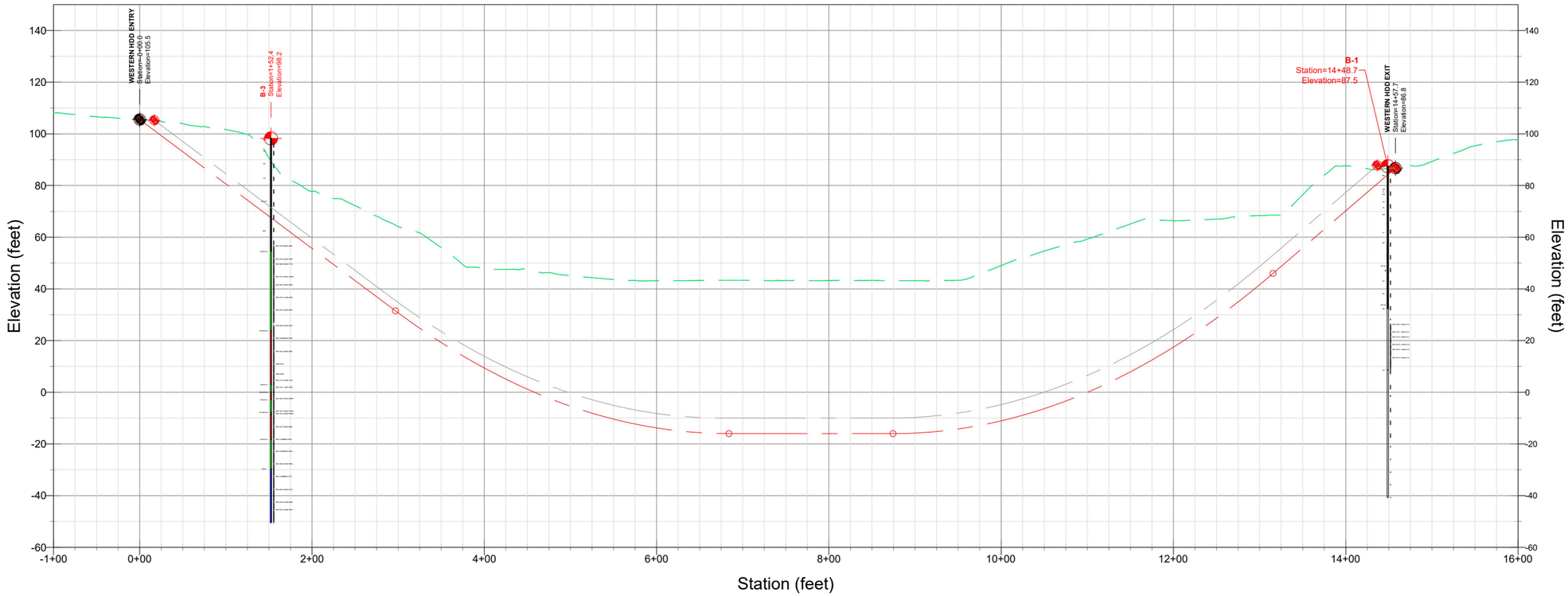
CALCULATIONS (EAST)

DRAWING NO.

HDD-5



PLAN VIEW
SCALE: 1" = 70'



PROFILE VIEW
HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1"= 100'

NOTE: Stratification lines and subsurface material descriptions shown on this drawing have been simplified for presentation purposes. Refer to the project getoechnical boring logs and report for more detailed subsurface information.

Soil boring logs shown on the profile drawing represent approximate subsurface stratification. Copies of the soil boring logs from the borings shown on this profile are included in Drawing GEO-2 to GEO-5.

CAMPOS EPC
1401 Blake Street, Denver, CO 80202
(303) 623-3345

REGISTERED PROFESSIONAL ENGINEER
ROMEO SHIPLEE
No. 81127
Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION
0	05/01/24	ISSUED FOR REVIEW SET

0 70 140 210
SCALE: 1" = 70' SCALE IN FEET
ORIGINAL DRAWING SIZE IS 22 X 34

	NAME	DATE
DESIGN BY	ARR	4/29/24
DRAWN BY	ESB	4/29/24
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING
J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

SITE NAME
N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE
ISSUED FOR REVIEW SET

DRAWING TITLE
GEOTECHNICAL PROFILE

DRAWING NO.
GEO-1

X:\01 Project Folders\J-C Engineering\Rio Dell\04 ENG\4.08 Geotech Reports\Drawings\Rio Dell Drawing\HDD Drawing Rio Dell 20240506.dwg

BSK Associates
691 N. Laverne Avenue, Suite 101
Fresno, CA 93727
Telephone: 559-497-2880

Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popenoe

Boring: **B-1**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1								GP	**Poorly Graded GRAVEL with Sand** - brown-dark brown, moist, medium, fine grained sand, fine to coarse grained gravel, subrounded gravel	
6			7	101.1	18.9			ML	**Sandy SILT** - dark bluish brown, moist, low plasticity, fine grained sand, fine grained gravel (subrounded)	
10								SM	**Silty SAND** - dark bluish brown, moist, fine grained sand, very loose	
11			4					CL	**CLAY** - dark bluish brown, medium plasticity, soft, trace silt	
12								SM	**Silty SAND** - dark bluish brown, moist, fine grained sand	
15								SP	**Poorly Graded SAND** - brown, moist, very loose, fine to medium grained sand, pourous	
16			4					CL	**Sandy Lean CLAY** - grayish brown, moist, fine grained sand, weakly cemented	
20								SM	**Silty SAND** - grayish brown, moist, loose, fine grained sand, weakly cemented	
21			10	80.4	22.3					
26			4					CL	**Sandy Lean CLAY** - grayish brown, moist, medium plasticity, firm, fine grained sand, oxidation staining	
30								GP	**Poorly Graded GRAVEL with Sand** - blush gray-grayish brown, moist, medium dense, fine to coarse grained gravel (subangular-angular), medium grained sand	
31			30							
36			82	119.2	5.7				... very dense, medium to coarse grained sand	
39								GP-GC		

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 11/28/23
Date Completed: 11/28/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: 41 Feet
Completion Depth: 131.5 Feet
Borehole Diameter: 8"

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Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popenoe

Boring: **B-1**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
41			58			16			**Poorly Graded GRAVEL with Clay and Sand** - brown-grayish brown, moist, dense, fine grained sand, wet, angular gravel, lense of clay matrix=low plasticity *(continued)*	▽
46			50	109.4	6.2			GP	**Poorly Graded GRAVEL with Sand** - bluish gray, wet, dense, fine to coarse grained gravel, subrounded-rounded gravel, fine to medium grained sand	
51			64			7		GC	**Clayey GRAVEL with Sand** - bluish gray, wet, dense, medium grained sand, subangular-subrounded gravel, pourous, moderately cemented, clay matrix=low plasticity, fine grained gravel	
55								GP-GC	**Poorly Graded GRAVEL with Clay and Sand** - medium sand, wet, very dense, round-subround gravel	
56			96	128.0	8.8			GP	**Poorly Graded GRAVEL with Sand** - bluish gray, wet, fine grained sand, dense, sandstone pieces	
60			50/ 4							
62								GP	**Poorly Graded GRAVEL** - bluish gray, wet, angular-subangular, fine to coarse grained gravel, sandstone pieces	Run 1: Recevery=10", RQD=0
										Run 2: Recevery=0", RQD=0
									... reddish brown	Run 3: Recevery=11", RQD=0
									... bluish, sand matrix	Run 4: Recevery=15", RQD=0
										Run 5: Recevery=7", RQD=0
										Run 6: Recevery=22", RQD=0

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 11/28/23
Date Completed: 11/28/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: 41 Feet
Completion Depth: 131.5 Feet
Borehole Diameter: 8"

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Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popenoe

Boring: **B-1**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
81			76					SP	**Poorly Graded SAND with Gravel** - bluish gray, wet, rounded fine grained gravel, fine grained sand	
86			62							
91			50/ 5			13			... low plasticity clay matrix	
96			95							
101			50		16.4			SP	**Poorly Graded SAND** - bluish gray, dense, wet, fine grained sand	
106			50		17.4			SP	**Poorly Graded SAND with Gravel** - bluish gray, wet, dense, fine grained sand, cobbles- coarse grained gravel	
110			50/ 3.5					SP	**Poorly Graded SAND** - bluish gray, wet, dense, fine grained sand	
115			50/ 2						... medium to coarse grained sand (sandstone)	

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 11/28/23
Date Completed: 11/28/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: 41 Feet
Completion Depth: 131.5 Feet
Borehole Diameter: 8"

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Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popenoe

Boring: **B-1**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
121			50/ 3.5					SP	**Poorly Graded SAND** - bluish gray, wet, dense, fine grained sand, pourous (sandstone)	
125			50/ 2							
130			50/ 1.5						Boring terminated at approximately 130 feet bgs. Groundwater Encountered at approximately 41 feet bgs. Boring backfilled with neat cement and soil cuttings.	

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 11/28/23
Date Completed: 11/28/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: 41 Feet
Completion Depth: 131.5 Feet
Borehole Diameter: 8"

CAMPOS EPC
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REGISTERED PROFESSIONAL ENGINEER
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Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION

NOT TO SCALE

ORIGINAL DRAWING SIZE IS 22 X 34

	NAME	DATE
DESIGN BY		
DRAWN BY		
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING
J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

SITE NAME
N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE
ISSUED FOR CONSTRUCTION

DRAWING TITLE
GEOTECHNICAL BORINGS

DRAWING NO.
GEO-2

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BSK ASSOCIATES

BSK Associates
691 N. Laverne Avenue, Suite 101
Fresno, CA 93727
Telephone: 559-497-2880

Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popence

Page 1 of 1

Boring: **B-2**

Depth (Feet)	Samples	Blow Counts	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
0									6" AC	
1–5								GP-GM	**Poorly Graded GRAVEL with Silt and Sand** - dark brown, moist, fine grained sand, coarse grained gravel	
6–10	X		5					CL	**Sandy Lean CLAY** - bluish gray-dark bluish gray, moist, medium plasticity, soft, fine grained sand	
11–15	X		6							
16–20	X		3					SM	**Silty SAND** - dark bluish gray, moist, fine grained sand, soft	
								CL	**Sandy Lean CLAY** - dark bluish gray, moist, medium plasticity, soft	
								SM	**Silty SAND** - dark bluish gray, moist, medium plasticity, soft, fine grained sand	
21	X		5						Boring terminated at approximately 21.5 feet bgs. No groundwater encountered. Boring backfilled with neat cement and soil cuttings.	
22–39										

GEO_BORING LOGS.GPJ_BSK.GDT_12/18/23

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 12/1/23
Date Completed: 12/1/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: Not Encountered
Completion Depth: 21.5 Feet
Borehole Diameter: 8"

* See key sheet for symbols and abbreviations used above.

CAMPOS EPC
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(303) 623-3345

REGISTERED PROFESSIONAL ENGINEER
ROMEO SHIPLEE
No. 81127
Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION

NOT TO SCALE

ORIGINAL DRAWING SIZE IS 22 X 34

	NAME	DATE
DESIGN BY		
DRAWN BY		
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING

J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

SITE NAME

N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE

ISSUED FOR CONSTRUCTION

DRAWING TITLE

GEOTECHNICAL BORINGS

DRAWING NO.

GEO-3

BSK Associates
691 N. Laverne Avenue, Suite 101
Fresno, CA 93727
Telephone: 559-497-2880

Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popenoe

Boring: **B-3**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1-6			24					SM	**Silty SAND** - dark brown, moist, medium dense, fine grained sand, fine grained gravel	
7-9			22					CL	**Sandy CLAY** - brown, moist, medium plasticity, fine grained sand	
10-11			22	126.8	9.7			GC	**Clayey GRAVEL with Sand** - greenish black, wet, medium dense, angular-subangular, fine coarse gravel	
12-15			13	106.0	22.3			CH	**Fat CLAY** - bluish gray, medium plasticity, moist, firm ... cuttings lean clay, brown-bluish gray, medium-high plasticity	
16-21			12							
22-26			41					GP-GC	**Poorly Graded GRAVEL with Clay and Sand** - brown to dark brown, wet, dense, medium grained sand, fine gravel, angular gravel (clay matrix) ... subangular gravel	
27-31			44							
32-36			52					MH	**Elastic SILT with Sand** - bluish gray, moist, medium plasticity, firm to hard	

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 10/3/23
Date Completed: 10/3/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: Not Encountered
Completion Depth: 150 Feet
Borehole Diameter: 8"

* See key sheet for symbols and abbreviations used above.

BSK Associates
691 N. Laverne Avenue, Suite 101
Fresno, CA 93727
Telephone: 559-497-2880

Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popenoe

Boring: **B-3**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
41-43			97					MH	**Elastic SILT** - bluish gray, moist, hard	
44-45					8.9			Sltstn	**SILTSTONE** bluish gray, slightly unweathered, weakly cemented, unfractured, no filling	Run 1: Recovery=26", RQD=48%
46-48					12.2				... siltstone, blush gray, slightly weathered, fractured, weakly cemented, no filling	Run 2: Recovery=7", RQD=30%
49-52					13.9					Run 3: Recovery=41", RQD=76%
53-56					12.4				siltstone, bluish gray, unweathered, tight aperture, no fill, fine grained sand, Joint 55 degrees VRC=4-6	Run 4: Recovery=32", RQD=100%
57-64									Joint=55, fine gravel, fine bedding from 56' - 56.5', weak	Run 5: Recovery=49", RQD=98% Run 6: Recovery=58", RQD=98% Run 7: Recovery=51", RQD=85%
65-67								Sltstn	**Sandy SILTSTONE** - bluish gray, unweathered tight aperture, no fill, very fine grained sand,weak	
68-74										Run 8: Recovery=59", RQD=93%
75-77								Sndstn	**Clayey SANDSTONE** - bluish gray, fine grained sand, Jointed=50° @ 75.2ft bgs, weak, tight aperture, JRC=4-6	Run 9: Recovery=61", RQD=93%

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 10/3/23
Date Completed: 10/3/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: Not Encountered
Completion Depth: 150 Feet
Borehole Diameter: 8"

* See key sheet for symbols and abbreviations used above.

BSK Associates
691 N. Laverne Avenue, Suite 101
Fresno, CA 93727
Telephone: 559-497-2880

Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popenoe

Boring: **B-3**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
81-95									**Clayey SANDSTONE** - bluish gray, fine grained sand, Jointed=50° @ 75.2ft bgs, weak, tight aperture, JRC=4-6 *(continued)* jointed =50° @ 80' bgs and 40 degrees @ 82.9' bgs ... weak ... very weak	Run 10: Recovery=55", RQD=90% Run 11: RQD=35% Run 12 and 13 samples disturbed, Total recovery=58" Run 12: RQD=30%
96-98								Sltstn	**Clayey SILTSTONE** - bluish gray, fine, unweathered, weak, no infilling	Run 13: Recovery=22", RQD=71%
99-101								Sndstn	**Clayey SANDSTONE** - bluish gray, fine sand, unweathered, weak, no infilling	Run 14: Recovery=58", RQD=50%
102-108								Sltstn	**SILTSTONE** - bluish gray, unweathered, Silt & Clay, weak, no infilling, moderately fractured, JRC=4-6, Joint 50 degress @ 103.5' bgs ... laminated foliation	Run 15: Recovery=59", RQD=100% Run 16: Recovery=6", RQD=100%
109-117					7.4			Sndstn	**Clayey SANDSTONE** - bluish gray, unweathered, weak, no filling, slightly unfracture, JRC=2-4 Silt bedding, laminated, fine grained sand Joint 60 @ 112' bgs	Run 17: Recovery=58", RQD=100% Run 18: Recovery=55", RQD=98%
118-119								Sltstn	**SILTSTONE** - clayey sandstone, bluish gray, unweathered, weak, no filling, slightly fractured, very fine grained sand, JRC=2-4, no visible bedding	

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 10/3/23
Date Completed: 10/3/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: Not Encountered
Completion Depth: 150 Feet
Borehole Diameter: 8"

* See key sheet for symbols and abbreviations used above.

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Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popenoe

Boring: **B-3**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
121-129								Sltstn	**SILTSTONE** - clayey sandstone, bluish gray, unweathered, weak, no filling, slightly fractured, very fine grained sand, JRC=2-4, no visible bedding *(continued)* **SILTSTONE** - bluish gray, very fine grained sand, unweathered, weak, slightly fractured, tight aperture, JRC= 2-4, no infilling **SHALE** - bluish gray, fine very fine grained, unweathered, slightly fractured, tight aperture, JRC=2-4, no infilling	Run 19: Recovery=61", RQD=87% Run 20: Recovery=62, RQD=95% Run 21: Recovery=54, RQD=98%
130-137					11.3				Joint=50 @ 135.3', 135.5', 136', 136.5'	Run 22: Recovery=60", RQD=77%
138-146									... Shale, bluish gray, fine very fine grained, unweathered, weak, slightly fractured, tight aperture, JRC = 2-4, no infilling	Run 23: Recovery=50", RQD=81% Run 24: Recovery=34", RQD=88% Run 25: Recovery=56, RQD=91%
147-159									Boring terminated at approximately 150 feet bgs. No groundwater encountered. Boring backfilled with neat cement and soil cuttings.	

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 10/3/23
Date Completed: 10/3/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: Not Encountered
Completion Depth: 150 Feet
Borehole Diameter: 8"

* See key sheet for symbols and abbreviations used above.

CAMPOS EPC
1401 Blake Street, Denver, CO 80202
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REGISTERED PROFESSIONAL ENGINEER
ROMEO SHIPLEE
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Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

ROMEO SHIPLEE LIC. NO: 22007394

REVISIONS

REV #	DATE	DESCRIPTION

NOT TO SCALE

ORIGINAL DRAWING SIZE IS 22 X 34

	NAME	DATE
DESIGN BY		
DRAWN BY		
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING
J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

SITE NAME
N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE
ISSUED FOR CONSTRUCTION

DRAWING TITLE
GEOTECHNICAL BORINGS

DRAWING NO.
GEO-4

X:\01 Project Folders\J-C Engineering\Rio Dell\04 ENG\4.08 Geotech Reports\Drawings\Rio Dell Drawing\HDD Drawing Rio Dell 20240506.dwg

BSK ASSOCIATES

BSK Associates
691 N. Laverne Avenue, Suite 101
Fresno, CA 93727
Telephone: 559-497-2880

Project: Rio Dell HDD Pipeline
Location: Rio Dell, California
Project No.: G00-001-255
Logged By: K. Yang
Checked By: N. Popenoe

Page 1 of 1

Boring: B-4

Depth (Feet)	Samples	Bulk Sample	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1–4			23					GP	**Poorly Graded GRAVEL with Sand** - moist, coarse gravel, medium dense (fill)	
5–10			7					CL	**Sandy Lean CLAY** - brown, moist, medium plasticity, soft-firm, trace fine gravel, fine grained sand	
11–12			11						... cuttings; sandy clay (CL)	no recovery
13–16			7					SP-SC	**Poorly Graded SAND with Clay** - brown, low plasticity, moist, loose, fine grained sand	
17–21			14					CL	**Sandy Lean CLAY** - brown, medium plasticity, moist, soft	
22–26			15					SC	**Clayey SAND** - brown, moist, loose, non-plastic, fine grained sand	
27–30			50/ 5.5					GP-GC	**Poorly Graded GRAVEL with Clay and Sand** - brown with yellowish red staining, wet, dense, fine coarse gravel, coarse sand	
31–36			50						... fine gravel	
37–39									Boring terminated at approximately 36.5 feet bgs. No groundwater encountered. Boring backfilled with neat cement and soil cuttings.	

GEO_BORING LOGS.GPJ_BSK.GDT_12/18/23

Drilling Contractor: Taber
Drilling Method: Hollow Stem Auger
Drilling Equipment: CME 55
Date Started: 10/3/23
Date Completed: 10/3/23

Surface Elevation: 0.0
Sample Method: 2.5" Modified Cal & 1.5" I.D. SPT Split Spoon
Groundwater Depth: Not Encountered
Completion Depth: 36.5 Feet
Borehole Diameter: 8"

* See key sheet for symbols and abbreviations used above.

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REVISIONS

REV #	DATE	DESCRIPTION

NOT TO SCALE

ORIGINAL DRAWING SIZE IS 22 X 34

	NAME	DATE
DESIGN BY		
DRAWN BY		
CHECKED BY		
APPROVED BY		

J-C GENERAL ENGINEERING INC.
HORIZONTAL DIRECTIONAL DRILLING

J-C ENGINEERING INC.
1102 BLACK DIAMOND WAY
LODI, CALIFORNIA 95240

SITE NAME

N PACIFIC AVE
2 16" HDPE
UPSIZE
CITY OF CALIFORNIA
HUMBOLDT COUNTY
RIO DELL, CALIFORNIA

DRAWING STAGE

ISSUED FOR CONSTRUCTION

DRAWING TITLE

GEOTECHNICAL BORINGS

DRAWING NO.

GEO-5