Post-Construction Stormwater Management Plan (For Kentuck, APCO 2, and TPP/101 Widening)

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Jordan Cove LNG

Post-Construction Stormwater Management Plan (For Kentuck, APCO 2, and TPP/101 Widening)

Prepared for

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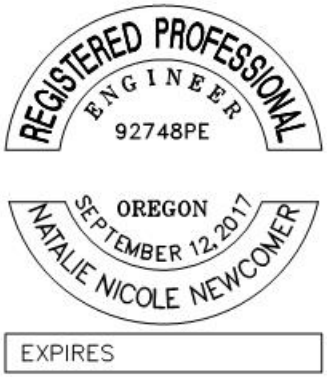

Prepared by

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2100 SW River Parkway

Portland, Oregon 97201

April 1, 2019

CERTIFICATION

This Stormwater Management Plan (SWMP or Plan) is a component of the facility operation and management documents. A copy of this Plan will be kept on site for use by affected or interested personnel. Updating of the Plan due to changes in facility operations that may affect stormwater quality is the responsibility of Jordan Cove Energy Project L.P. (JCLNG or Owner). In the case of significant operational changes, the SWMP will be amended.

JCLNG acknowledges that David Evans and Associates, Inc. (DEA) prepared this plan based on the current design and planned operations of the facility and related stormwater management controls and measures. In order to complete this Plan, the undersigned hereby certifies that, to the best of their knowledge, there is no unauthorized non-stormwater discharge at this facility that has not been identified in this SWMP.

In accordance with the State of Oregon, Department of Environmental Quality (ODEQ), National Pollutant Discharge Elimination System (NPDES), "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted, is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature _____

Name: Natalie Eades

Title: Manager, Environment & Regulatory

Representing: Jordan Cove LNG

Date: _____

Must be signed by owner as appropriate.

PURPOSE

This SWMP has been prepared to fulfill requirements for ODEQ's 401 Water Quality Certification. It is based on guidance described in ODEQ's March 2018 *Section 401 Water Quality Certification Post-Construction Stormwater Management Plan Submission Guidelines.* This SWMP, prepared by DEA, complements the strategy of a separate project LNG Terminal SWMP, prepared by the Kiewit/Black & Veatch Joint Venture (KBJ) which includes the main facilities LNG Terminal site. This SWMP covers the design and construction scope being managed by JCEP directly, including the TPP101, APCO 2, and Kentuck owners led facilities. This document is considered to be part of the facility operation and management documents, and a copy of it will be kept on each construction site for use by affected or interested personnel. Updating of the SWMP due to changes in facility operations that may affect stormwater quality is the responsibility of JCLNG. In the case of significant operational changes, the SWMP will be amended accordingly.

JCLNG acknowledges that DEA prepared this plan on behalf of JCLNG based on preliminary stormwater design of the facility.

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1. EXECUTIVE SUMMARY

This Stormwater Management Plan (SWMP or Plan) has been prepared to comply with ODEQ requirements for a Clean Water Act Section 401 Water Quality Certification. The Plan demonstrates how stormwater from impervious surfaces associated with the Jordan Cove Energy Project L.P. (LNG) Project (Project) (offsite from the main Terminal area) is being managed to remove pollutants prior to any discharge into waters of the State. Waters of the State include all manner of surface waters, including wetlands and subsurface waters. The three areas addressed in this Plan include the intersection at Trans Pacific Parkway (TPP) & US Highway 101 (US 101), the Kentuck Mitigation Site (Kentuck), and the APCO Bridge Site (APCO 2 Site).

The Plan describes the permanent best management practices (BMPs) to be employed at the Project to meet stormwater treatment requirements. Where space allows, ODEQ-preferred Low Impact Development (LID) BMPs are proposed. Where space is constrained, approved proprietary filter cartridge systems (Contech Stormwater Management StormFilter® cartridges) are proposed.

2. PROJECT INFORMATION

Jordan Cove LNG (JCLNG) is responsible for all work relating to the Jordan Cove Energy Project (Project) and all mitigation necessary for its construction. Primary contact information for the project is:

Jordan Cove LNG
111 SW 5th Avenue, Suite 1100
Portland, OR 97204
Contact Person: Natalie Eades
Phone Number: 971-940-7800

All work areas described in this Stormwater Management Plan (SWMP or Plan) are located in Coos County, Oregon. As previously mentioned, the features described in this Plan are located outside of the Liquefied Natural Gas (LNG) Terminal Area. They have been designed with similar stormwater management planning approaches and features developed by KBJ to meet like standards for the JCLNG Project area. See Appendix E (Figure 1) for the project vicinity and its relation to the LNG Project Area.

2.1 PROJECT DESCRIPTION

Project areas included in this plan are described as follows:

2.1.1 Trans Pacific Parkway and US 101

Trans Pacific Parkway (TPP) runs along the north side of the Project site (Appendix E: Figure 2). Its intersection with US 101 is located approximately 1.75 miles north-east of the LNG facility access road. The parkway is a county-owned two lane paved roadway with no curb or gutter on either side of the facility property boundaries. As a required Traffic Impact Analysis identified upgrade, the intersection will be widened to the northwest and a left turn lane will be added for travel from eastbound TPP onto northbound US 101 to minimize the Project's traffic impacts. The new roadway widening construction triggers water quality treatment requirements, but only from the crown of the road to the northwest edge of pavement. This defines the site contributing impervious area (CIA). The southeast (from the road crown) improvements include only grind and overlay paving. According to Oregon Department of Transportation (ODOT) standards, grind and overlay improvements that don't convey flow to or through CIA is not considered CIA. This southeast portion of the roadway will continue to sheet flow runoff to Coos Bay.

Due to the proximity of the intersection to receiving waters of Coos Bay, this project area is too space constrained to accommodate Low Impact Development (LID) treatment. Therefore, proprietary cartridge filter systems are proposed to provide stormwater treatment.

2.1.2 APCO 2 Site

The APCO 2 Site is a proposed dredged material disposal site located on the south shore of the bay at the south end of the US 101 Bridge (Appendix E: Figure 3). A new bridge between APCO Site 1 and APCO Site 2 is necessary for vehicular access to manage the dredged material. A single-span bridge that is 200 feet long and 19 feet 1 inch wide will span the tidal mudflat. The new bridge triggers water quality

treatment requirements for the new impervious surface as well as any contributing surface. The bridge approaches will be unmaintained gravel surfaces used by construction and maintenance vehicles.

2.1.3 Kentuck Mitigation Site

The Kentuck site is located approximately three miles directly east of the proposed LNG Terminal site (Appendix E: Figure 5). The Kentuck site will be composed of two main road improvement areas, a newly constructed levee, a gravel construction access and parking area, and a paved pedestrian trail. A 100-acre wetland mitigation area will be centrally located within the Kentuck site. The two main road improvement areas, East Bay Drive and Golf Course Lane, will be improved by elevating their grades and re-paving their surfaces.

Golf Course Lane approximates the southeast boundary of the mitigation site. It will be sloped away from the adjacent Mitigation Site along its whole length. For most of Golf Course Lane, runoff from the road will sheet flow into a parallel trapezoidal ditch running alongside the road (Appendix E: Figure 7). CIA water quality treatment LID bio-infiltration facilities will be built into the roadside ditch. Due to space constraints, runoff from two drainage basins will be captured in drainage curbs at the northeast end of Golf Course Lane. This will allow captured runoff to be conveyed to proprietary cartridge filter treatment systems for treatment prior to being discharged into Kentuck Slough.

East Bay Road approximates the southwest boundary of the mitigation site. It was built over water and is constrained by the fixed elevation of an adjacent existing bridge. It is also space constrained and will have drainage curbs installed along its new length to convey runoff to treatment facilities (Appendix E: Figure 6). Approved proprietary cartridge filter treatment systems will be utilized to provide water quality treatment. An LID roadside water quality filter strip is proposed along the northeast side of East Bay Road where there is insufficient vertical space to fit proprietary treatment inlets. The water quality filter strip will consist of an 8-inch layer of water quality soil placed above the highest measured tide (HMT) elevation of 10.26 ft (Note that the design wave height and design sea level were computed based on tides, wave setup, storm surge, wind data, fetch, and projected long-term sea level rise to determine the HMT. The nearest tide gage is located in Charleston, OR, near Coos Bay. National Oceanic and Atmospheric Administration (NOAA) recommends assuming a sea level rise value of 0.42 ft at the Charleston gage location. This HMT determination is further depicted in the original Kentuck Hydraulic Report completed in November, 2010 by West Consultants, Inc.). Due to space constraints and proximity to the HMT, proprietary treatment devices are proposed where insufficient space exists for LID treatment approaches. A portion of offsite runoff that drains across the proposed roadway improvements is considered CIA thereby triggering water quality requirements. This CIA will be treated within the water quality filter strip. There is an existing water quality treatment swale which treats the offsite CIA basins that consist of the intersection of East Bay Road and Kentuck Way Lane and the existing bridge over the Kentuck Slough. As a result of the Slough being connected to the bay, it will be tidally influenced. Since the existing swale also will be tidally influenced, it will be inundated with salt water and unable to treat the basins so it will be removed. A filter strip is proposed to treat the runoff from the CIA basins that used to be treated within the existing swale.

A new levee (Kentuck Levee) will be constructed along the inside of an existing levee near the northwest boundary of the mitigation area. The Kentuck Levee will be built for safety of the community and emergency workers. It will not be used post-construction for vehicle access except in emergency situations. Once construction is completed, the levee will not be paved or maintained. As a result, it will be considered a non-pollutant generating surface requiring no stormwater management facilities.

Kentuck Access Road will be constructed along the eastern edge of the old golf course for access between the Kentuck Trail and Golf Course Lane. A small parking lot serving 6 parking spots will be constructed at the end of the Kentuck Access Road prior to the trail for accessibility to the pedestrian trail. The Kentuck Access Road will be gravel and will drain to the east where the runoff will be captured and treated in a water quality swale prior to being discharged into the Mitigation Site.

The Kentuck Trail will be a paved surface used for pedestrian access and, periodically, for maintenance and emergency vehicles. The trail is considered a non-pollutant generating surface and not CIA. Therefore, no stormwater management is proposed.

2.2 CLIMATE

The climate of Coos County is greatly tempered by winds from the Pacific Ocean and has moderate summer and winter temperatures (USDA NRCS 1989). During summertime, rainfall is extremely light, while rains are frequent during the late fall and winter (USDA NRCS 1989). The rainy season begins in October and continues through May, and accounts for most of the annual precipitation. The project site receives an average of 63 inches of precipitation per year, with the highest monthly averages of approximately 10 inches/month occurring in November, December and January (ODOT 2011).

The average temperature in Coos County is approximately 46°F in the winter months and 59°F in the summer months (USDA NRCS 1989). The average daily minimum temperature occurs in the winter months and is 40°F, while the average daily maximum temperature occurs in the summer months and is approximately 65°F (USDA NRCS 1989).

2.3 SOIL INFORMATION

Soil information was obtained from the United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey (USDA NRCS 2019). The USDA NRCS collaborates with other federal agencies in order to update soils information periodically. For each of the sites within the project area, the soil type and drainage class are provided below.

2.3.1 Trans Pacific Parkway and US 101

This area includes a bridge and causeway that have been built up with soil and rock fill material. There are no surfaces in the area other than water, pavement, and shoulder rock. For the sake of analysis, the contributing areas at the TPP – US 101 intersection are considered 100% impervious. The custom soils report for the TPP site (USDA NRCS 2019) can be found in Appendix A.

2.3.2 APCO 2 Site

Soils at the APCO 2 Site are classified as Udorthents and water. Udorthents are poorly draining soils on flat surfaces of 0 to 1 percent grade. The Udorthents, level category of soil does not have a hydraulic soil group identified by NRCS. The custom soils report for the APCO 2 Site (USDA NRCS 2019) can be found in Appendix A.

A geotechnical report and investigation that was conducted on the APCO 2 site (GRI, 2018) shows the soils within the boring test by the bridge abutments consists of fill material on top of sand and silty sand.

2.3.3 Kentuck Mitigation Site

Soils at Kentuck are classified as Chetco silty clay loam, Coquille silt loam, Nestucca silt loam, Salander silt loam (50- to 75-percent slopes), Templeton silt loam (7- to 30-percent slopes), Templeton silt loam (30- to 50-percent slopes), and water. On the Slough side of the project, the majority of the soils in this project area are members of the Hydrologic Soil Group C/D. However, in work areas along Golf Course Lane where water quality infiltration treatment will occur, well-draining clean fill is proposed. The hillside draining to Golf Course Lane is comprised of mainly well-draining soils, including Templeton silt soil and Geisel silt loam. Where space allows, LIDs will be constructed on clean fill material. The custom soils report for the Kentuck area (USDA NRCS 2019) can be found in Appendix A.

2.4 LAND USE

The land use in the vicinity of TPP is roadway right-of-way and water. The APCO land use primarily consists of water and storage areas for dredge materials. The Kentuck site was previously a golf course and is surrounded by residential properties and agricultural lands (i.e., pasture).

2.5 TRAFFIC VOLUME AND DESIGN SPEED

TPP has an average daily traffic (ADT) of 1,500, with a posted speed limit of 55 miles per hour (mph). At the intersection of TPP & US 101, US 101's existing ADT is 13,300, and the speed limit on US 101 is 55 mph.

No traffic studies nor signal installation analysis were completed for the APCO 2 Site as traffic will be limited to maintenance vehicles for the dredged material disposal site.

No traffic studies nor signal installation analysis were completed for the Kentuck area, as no major roadway improvements are being made.

2.6 STATUS OF RECEIVING WATERS

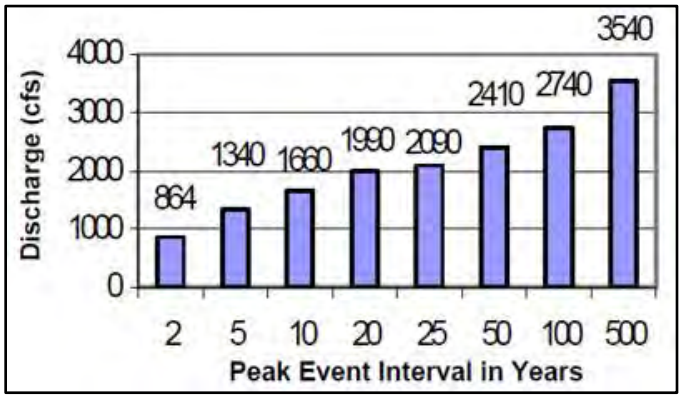
Under Section 303(d) of the Clean Water Act (CWA), the Environmental Protection Agency (EPA) or its state delegates are required to develop a list of surface waters in each state that do not meet water quality criteria. These criteria are developed by each of the states to protect "beneficial uses" and are approved by the EPA. The Oregon Environmental Quality Commission (OEQC) has adopted numeric and narrative water quality standards to protect designated beneficial uses and specific beneficial uses for the Coos Bay have been determined by the Oregon Administrative Rules (OAR 340-041-0271, Table

300A, November 2003). A segment of the Coos River, beginning at its mouth as it enters Coos Bay, has been designated as a "salmon and steelhead migration corridor."

Coos Bay is the second largest estuary in Oregon, accounting for about 27 percent of the state's estuarine resources (ODEQ 2004). The surface area of the bay is 10,973 acres at high tide and 5,810 acres at low tide, with tidelands covering approximately 4,569 acres (2,738 acres of tidal marsh and 1,400 acres of eelgrass beds). Coos Bay and Coos River Basin are located within Oregon's South Coast Basin. The ODEQ Designated Beneficial Uses of the South Coast Basin include industrial water supply, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, and commercial navigation and transportation.

Kentuck Slough contributes freshwater from the Coos River Basin to the Coos Bay estuary and is part of the Kentuck sub-basin, a drainage area of approximately 16.62 square miles (NOAA and SSNERR 2005, CWA 2005). Upstream of the Kentuck Slough are Mettman Creek and Kentuck Creek (CWA 2005). Annual peak stream flow was obtained using the Peak Flow Estimation Program, which uses hydrologic prediction equations and physical watershed characteristics to estimate peak flows (OWRD 2005). Figure 1 (below) shows the estimated discharge at the mouth of Kentuck creek for storm events for two to five hundred year recurrence intervals. The bankfull flow event is estimated to be 864 cubic feet per second (cfs), while a maximum discharge of 3,540 cfs is estimated for a 500-year storm event in Kentuck Creek.

Figure 1: 2005 Kentuck Creek Discharge



The Kentuck Inlet is a marsh located at the mouth of Coos River and is in the slough system (ODFW 1979). Most of the marsh area of the Kentuck Inlet has been lost through diking (Hoffnagle and Olsen 1974). Original diking along the upper portion of the Kentuck Inlet was extended, and a bridge and tide gate were installed (ODFW 1979).

The 303(d) listed water bodies are based upon the best available data, and in most cases, the list must be revised every two years. An impaired water body must have a Total Maximum Daily Load (TMDL) developed for each applicable pollutant. Coos Bay has numerous sloughs and bays and is fed by over thirty tributaries (the major ones being the Coos River and Tenmile Watershed), which together comprise the Coos Subbasin. Based on review of the ODEQ's Water Quality Assessment database (ODEQ

2012), sampling of Coos Bay in the vicinity of Jordan Cove has shown elevated concentrations of fecal coliform year round, which warrant placing this segment of Coos Bay on the 303(d) list of impaired waters for shellfish growing. In addition, concentrations of chromium, copper, nickel, tributyltin, and zinc raise potential concerns for drinking water, resident fish and aquatic life, as well as anadromous fish passage (ODEQ, 2012). An EPA-approved TMDL was issued for the Tenmile Watershed on May 31, 2007; however, a TMDL has not been developed for the Coos River, which is presently undergoing the initial scoping and data collection phase required to develop the TMDL. Since the pollutants listed above could impair beneficial uses of Coos Bay, the Project is required to work toward minimization of the potential discharge of these pollutants to the Bay.

2.7 GROUNDWATER WELLS

2.7.1 Trans Pacific Parkway and Highway 101

No groundwater wells are located within 0.25 miles of the TPP site (Oregon Water Resources Department 2014).

2.7.2 APCO 2 Site

No groundwater wells are located within 0.25 miles of the APCO site (Oregon Water Resources Department 2019).

2.7.3 Kentuck Mitigation Site

Five groundwater wells are located within 0.25 miles of the Kentuck area with four of these located in the southern portion of Kentuck (Oregon Water Resources Department 2014). Four wells have a permit number G 1389 (Dunes Aquifer) and are designated to be residential sources. The other well is under permit S 30540 for residential use. Disposition of these wells is being addressed with the landowners. The wells will be protected or re-drilled in order to provide safe drinking water for residents. See Appendix B for the well permits.

2.8 POLLUTANTS OF CONCERN

Post construction activities at the TPP Intersection, APCO, and Kentuck areas have the potential to be the source of a variety of stormwater pollutants. Trucks and vehicles can disturb sediment or debris that has accumulated on the paved road surfaces. Other potential pollutants that may affect stormwater runoff quality include those typical of roadways: particulates from tires, exhaust gases, and vehicle brakes, and potential release of fuels (gasoline and diesel), oil, grease, polycyclic aromatic hydrocarbons (PAH), and total and dissolved metals such as chromium, copper, nickel, zinc and lead. Section 6 provides an overview of the BMPs that will be used in roadway areas to provide stormwater runoff water quality treatment.

The pollutants on the TMDL list include common pollutants associated with roadway pollution including chromium, copper, nickel, and zinc. Tributyltin and fecal coliform are also on the TMDL list for Coos Bay, however they are not a typical pollutant associated with roadway runoff. Tributyltin is a compound historically used in paint for the bottoms of ocean vessels, it has since been banned and would not be a typical pollutant for concern on roadways.

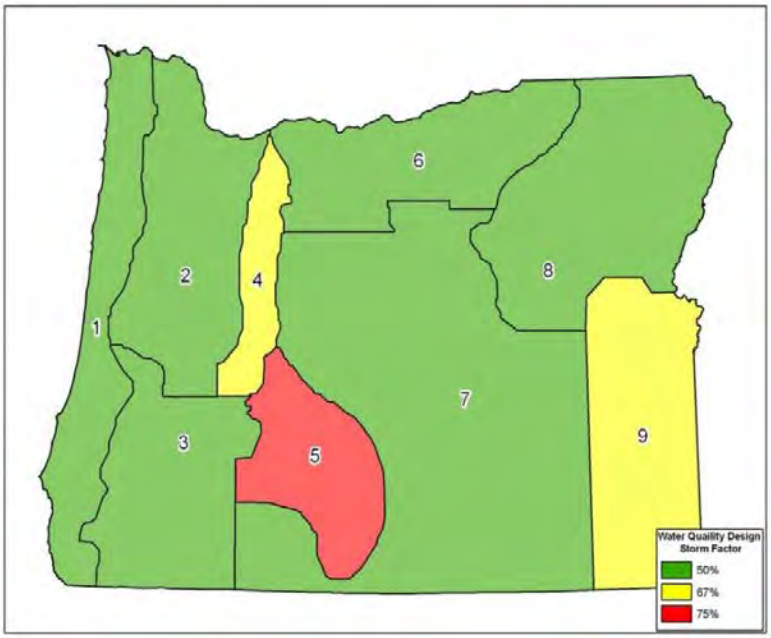
Soil testing was completed at Kentuck at the southeastern corner of the site at the existing pond. The pond will be removed, and the existing stream will be re-aligned to the interior of Kentuck. Soil testing found higher than allowable levels of mercury in the pond sediment. This contaminated material will be removed and disposed of properly before tidal influence is allowed to reach the pond. See GRI report in Appendix A for further information.

3. REGULATIONS

3.1 WATER QUALITY

Conservatively, JCLNG will be providing water quality treatment for flows up to the 2-year, 24-hour event. For context, this is double the ODOT treatment requirement. In Coos County, ODOT only requires the treatment of 50% of the 2-year 24-hour event (ODOT 2014). Figure 2 shows statewide ODOT water quality design storm factors for stormwater treatment.

Figure 2: ODOT Water Quality Design Storm (ODOT 2014)



3.2 GROUNDWATER MANAGEMENT ZONES

The project will not conduct any activities that could cause an adverse impact on existing or potential beneficial uses of groundwater management zones. All stormwater must be managed in a manner that will prevent a violation of the Groundwater Quality Protection Rules (OAR Chapter 340, Division 40). There are no groundwater concerns associated at the TPP Intersection, APCO Site 2, or Kentuck areas, provided the structural integrity of the stormwater infrastructure is maintained.

3.3 WELLHEAD PROTECTION ZONES

The completed project will have saltwater intrusion impacts to two of the existing wells at Kentuck. Analysis of the existing wells has been performed, and full mitigation of the wells will be completed. All stormwater must be managed in a manner that will prevent a violation of the Oregon Wellhead Protection Rules (OAR Chapter 340, Division 40, 0140). There are no groundwater concerns associated at the TPP or APCO 2 Site Project areas, provided the structural integrity of the stormwater infrastructure is maintained.

4. HYDROLOGY

Hydrologic calculations were performed for water quality treatment facility sizing purposes. Hydrologic calculations for water quality were performed using a Type 1A distribution using the Santa Barbara Unit Hydrograph (SBUH) method in HydroCAD® modeling software. The rainfall depths used in HydroCAD® are documented in Appendix D. Rainfall (precipitation) depths were gathered using data from ODOT (ODOT, 2014). Runoff curve numbers (CN) for each drainage area vary and are based on weighted averages considering impervious surface in each basin, land use types, and site geotechnical investigations, and professional judgment. HydroCAD® output consisting of peak discharge rates and total flow volume of a storm are summarized in Table 1. Full calculation sheets of each basin area are also attached in Appendix D.

Table 1: Summary of Project Site Hydrology

Trans Pacific Parkway – US-Hwy 101 Intersection					
(Drainage Area = 0.62 Acres, CN = 98)					
Storm Frequency	**2-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
24-Hr Rainfall (in)	3.5	4.7	5.5	6.1	6.75
Peak Discharge (cfs)	0.50	0.69	0.80	0.89	0.98
Total Volume (cf)	7,301	9,977	11,763	13,101	14,554
APCO 2 Site					
(Drainage Area = 0.10 Acres, CN = 98)					
Storm Frequency	**2-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
24-Hr Rainfall (in)	3.6	4.9	5.7	6.3	6.9
Peak Discharge (cfs)	0.08	0.10	0.12	0.14	0.14
Total Volume (cf)	1,102	1,528	1,788	1,986	2,182
Kentuck Mitigation – East Bay Road					
(Drainage Area = 0.92 Acres, CN = 98)					
Storm Frequency	**2-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
24-Hr Rainfall (in)	3.6	4.9	5.7	6.3	6.9
Peak Discharge (cfs)	0.76	1.07	1.25	1.35	1.50
Total Volume (cf)	11,179	15,488	18,142	20,131	22,125

Kentuck Mitigation – Golf Course Lane					
(Drainage Area = 0.78 Acres, CN = 98)					
Storm Frequency	**2-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
24-Hr Rainfall (in)	3.6	4.9	5.7	6.3	6.9
Peak Discharge (cfs)	0.66	0.90	1.06	1.16	1.27
Total Volume (cf)	9,531	13,203	15,465	17,163	18,860
Kentuck Mitigation – Kentuck Trail					
(Drainage Area = 0.70 Acres, CN = 98)					
Storm Frequency	**2-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
24-Hr Rainfall (in)	3.6	4.9	5.7	6.3	6.9
Peak Discharge (cfs)	0.59	0.81	0.94	1.05	1.15
Total Volume (cf)	8,553	11,850	13,879	15,402	16,926
Kentuck Mitigation – Kentuck Levee					
(Drainage Area = 1.70 Acres, CN = 90)					
Storm Frequency	**2-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
24-Hr Rainfall (in)	3.6	4.9	5.7	6.3	6.9
Peak Discharge (cfs)	1.11	1.66	2.00	2.26	2.52
Total Volume (cf)	15,685	23,326	28,103	31,709	35,330
Kentuck Mitigation – Kentuck Access Road and Parking					
(Drainage Area = 0.22 Acres, CN = 90)					
Storm Frequency	**2-YR**	**10-YR**	**25-YR**	**50-YR**	**100-YR**
24-Hr Rainfall (in)	3.6	4.9	5.7	6.3	6.9
Peak Discharge (cfs)	0.14	0.22	0.26	0.29	0.32
Total Volume (cf)	2,030	3,019	3,637	4,104	4,572

5. *PROPOSED SYSTEM DRAINAGE PATTERNS*

5.1 TRANS PACIFIC PARKWAY AND US 101

Historically, stormwater runoff at TPP has sheet flowed from the crown of the road into Coos Bay. However, the TPP and US 101 intersection is being widened to the northwest, triggering water quality treatment requirements on that side of the intersection. Drainage curbs will be added near the edge of pavement to collect and convey flow from the road crown to water quality treatment facilities. The grind and overlay improvement area on the southeast side of the improvement area does not require stormwater treatment. The road has a standard centerline 2% crown which will sheet flow runoff to curbs at the edge of the roadway on the northwest side. Once along the curb, water will flow toward the low point of each of the basins. At these low points Contech Stormwater Management StormFilter® inlet cartridge water quality treatment BMPs will be installed. The cartridges will treat water quality and bypass higher design flows before discharging the runoff via 12-inch ductile iron pipe onto rip-rap road

base adjacent to the receiving waters. The bottom of the outfall pipes will be at a minimum elevation of 10.3 ft. to stay above the permitted Highest Measured Tide (HMT) elevation of 10.26 ft, which delineates the regulated resource boundary. See Appendix E (Figure 2) for drainage patterns and treatment locations. Appendix F shows roadway plans with drainage features, as well as the proposed plan and profile of the roadway.

5.2 APCO 2 SITE

The APCO Bridge will be crowned to drain from West to East along the curb and gutter on the bridge. The flow will be captured within inlets on the north and south side of the bridge. The inlets will then discharge the flow to their respective treatment facilities along the north and south side of the bridge.

The APCO 2 Site soils are mostly fill material with sand below the fill. The design focuses on dispersing the flow with a flow dispersion trench to avoid any concentrated outfalls to the steep banks of the erosive soils. The treatment facilities will outfall the captured flow into a 30-foot long by 2-foot wide drain rock trench that will disperse flow over the trench area to reduce the erosive velocities. The flow will then evenly travel over the flow spreader which consists of a concrete weir to a rock splash pad 6-inches wide that will transition to a 6.5-foot wide vegetated strip with 8-inches of water quality soil to provide water quality treatment. See Appendix E (Figure 4) for drainage patterns and treatment locations. Appendix F shows roadway plans with drainage features, as well as the proposed plan and profile of the roadway.

5.3 KENTUCK MITIGATION SITE

Improvements at East Bay Road consist of re-paving the road, constructing a new bridge, installing guardrail and drainage curb along the road. The road has sections of standard centerline 2% crown as well as sections of superelevation with 2% cross slope which will sheet flow runoff to roadside drainage curbs. Once along the curb, water will flow toward the low point of the roadway. Contech Stormwater Management StormFilter® inlet cartridge water quality treatment BMPs will be installed to capture and treat runoff. The cartridges will treat water quality and bypass higher design flows before discharging the runoff via 12-inch ductile iron pipe onto rip-rap road base adjacent to the receiving waters. The outfall pipes downstream of the cartridge filter water quality systems will discharge at a minimum elevation of 10.3 ft. to stay above the permitted HMT elevation of 10.26 ft. Portions of the roadway that drain to a water quality filter strip do not have drainage curb, here the flow continues to sheet flow to the water quality facility. See Appendix E (Figure 6) for drainage patterns and treatment locations. Appendix F shows preliminary roadway plans with drainage features, as well as the plan and profile of the roadway.

Road improvements at Golf Course Lane include raising the elevation of the roadway and re-paving. The roadway will be in full superelevation at a 2% slope draining away from the mitigation site. For most of Golf Course Lane a 4-ft.-wide trapezoidal ditch/bio-infiltration facility running parallel to the road will capture sheet flow runoff and provide water treatment and conveyance. The water quality swale will include a water quality compost soil where a native water quality seed mix will be planted (see Appendix F for ditch details) to treat the water as it flows to the low points in the road. Water quality and low flows in the ditch will infiltrate through water quality vegetation and water quality mix. Higher flows will

be conveyed in the ditch to 12-inch diameter roadway pipe crossings which will discharge into the mitigation area. Along the east end of the Golf Course Lane, the project passes a wetland that is not to be impacted, and also crosses a proposed culvert. Along this section, drainage curb will collect runoff and convey it to Contech StormFilters. The bottom of the outfall pipe will be at a minimum elevation of 10.3 ft. to stay above the HMT. See Appendix E (Figure 7) for drainage patterns and treatment locations.

The Kentuck Access Road consists of a new gravel roadway providing access to the new Kentuck Trail. The roadway will be in full superelevation at a 2% slope draining away from the mitigation site. The runoff will sheet flow to a 4-ft-wide trapezoidal water quality swale running parallel to the road. The water quality swale will include a water quality compost soil planted with a native water quality seed mix (see Appendix F for ditch details) to treat the water as it flows to the low points in the road. Water quality and low flows in the ditch will infiltrate through water quality vegetation and water quality mix. Higher flows will be conveyed in the ditch to 12-inch diameter roadway pipe crossings which will discharge into the mitigation area. The parking area will also have a gravel surface that sheet flows to the water quality swale for treatment along with the roadway.

As previously discussed, Kentuck Levee will not be paved or used for any vehicular access except for infrequent emergencies. The Kentuck Trail will have a paved surface that will be used for pedestrian access and, on infrequent occasion, emergency vehicles. These surfaces are non-pollutant generating and are not CIA therefore no stormwater management is proposed. Appendix F shows preliminary roadway plans with drainage features, as well as the proposed plan and profile of the roadway.

6. WATER QUALITY TREATMENT

Conservatively, water quality facilities are designed to treat a 2-year, 24-hour rainfall event per direction from KBJ and the JCLNG facility. Note that these treatment volumes are twice that of typical design standard requirements (e.g., ODOT standards require 50% treatment of a 2-year storm).

All CIA is proposed to be treated for water quality with biofiltration swales, filter strips, and Contech StormFilters. See Table 2 below for summaries of the treatment types for each basin. Figures 1-7 show the location of each drainage basin.

Table 2: Summary of CIA Treatment

Trans Pacific Parkway – US-Hwy 101 Intersection			
Water Quality Treatment			
Basin	**Area (acres)**	**2-YR (cfs)**	**Treatment**
TPP-1	0.08	0.06	Contech StormFilter
TPP-2	0.23	0.19	Contech StormFilter
TPP-3	0.31	0.25	Contech StormFilter

APCO Site 2			
Water Quality Treatment			
Basin	**Area (acres)**	**2-YR (cfs)**	**Treatment**
APCO-BR-1	0.05	0.04	Filter Strip
APCO-BR-2	0.05	0.04	Filter Strip

Kentuck-East Bay Drive			
Water Quality Treatment			
Basin	**Area (acres)**	**2-YR (cfs)**	**Treatment**
EBD-1	0.06	0.05	Filter Strip
EBD-2	0.13	0.11	Filter Strip
EBD-3	0.26	0.22	Filter Strip
EBD-4	0.05	0.04	Contech StormFilter
EBD-5	0.05	0.04	Contech StormFilter
EBD-6	0.05	0.04	Contech StormFilter
EBD-7	0.13	0.11	Contech StormFilter
EBD-8	0.07	0.05	Contech StormFilter
EBD-9	0.12	0.10	Contech StormFilter

Kentuck – Golf Course Lane			
Water Quality Treatment			
Basin	**Area (acres)**	**2-YR (cfs)**	**Treatment**
GCL-1	0.21	0.18	Biofiltration Swale
GCL-2	0.11	0.09	Biofiltration Swale
GCL-3	0.16	0.13	Biofiltration Swale
GCL-4	0.08	0.07	Contech StormFilter
GCL-5	0.22	0.19	Contech StormFilter

Kentuck – Access Road and Parking			
Water Quality Treatment			
Basin	**Area (acres)**	**2-YR (cfs)**	**Treatment**
KA-1	0.03	0.02	Biofiltration Swale
KA-2	0.19	0.12	Biofiltration Swale

6.1 BIOFILTRATION SWALES

Biofiltration swales are proposed at the Golf Course Lane portion of the Kentuck Project. Biofiltration swales are designed with mild slopes, flat bottoms, shallow flows, and vegetation to additionally slow the flows. The contact with soil and vegetation increases pollutant removal through sedimentation; a minimum residence time of 9 minutes is required by ODOT to provide the necessary time for treatment. The swales are designed to meet the ODOT residence time as well as the minimum 4-foot flat bottom width, and 18-inches of water quality soil. For cross section details of facilities, see the design drawings in Appendix F.

6.2 FILTER STRIPS

Filter strips are proposed at the APCO 2 Site as well as the East Bay Drive portion of the Kentuck Project. Filter strips treat stormwater through dispersion of flow across a vegetated surface with water quality soil. The filter strip at East Bay Drive maintains the sheet flow from the adjacent roadway across the 12-foot wide filter strip width. The offsite CIA basin EBR-1 and EBR-2 will be concentrated flow from the existing curb and gutter. The concentrated flow will be dispersed through a flow dispersion trench prior to the vegetated filter strip. The strip was sized to infiltrate the water quality event in the water quality soil prior to the discharge to the Slough. The bottom of the 8-inches of water quality soil in the filter strip is above the HMT.

The filter strips at the APCO 2 Site do not have sheet flow to the filter strip. The flow drains to the gutter along the bridge and is captured in a grate inlet that conveys the concentrated flow to a flow dispersion trench which disperses the flow prior to the vegetated filter strip. The strip was sized to infiltrate the water quality event in the water quality soil prior to the discharge to the Slough. For cross section details of facilities, see the design drawings in Appendix F.

6.3 CONTECH STORMFILTERS

Contech StormFilters are proposed at the TPP and Kentuck sites. The Contech StormFilters are an approved proprietary cartridge filter treatment method per ODOT. The StormFilters are underground devices that consist of an inlet to capture the flows and media-filled cartridges to treat for water quality. The devices use rechargeable, media-filled cartridges to absorb and retain pollutants from the stormwater runoff. ZPG™ media will be utilized in the StormFilter units. The ZPG™ media is a proprietary blend of zeolite, perlite, and granular activated carbon that targets organics, soluble metals, total suspended solids, and other pollutants. For cross section details of facilities, see the design drawings in Appendix F.

6.4 ENERGY DISSIPATION

When stormwater runoff becomes concentrated to a point discharge, energy dissipation is often needed to reduce the erosive forces at the outfall. Class 50 riprap is proposed at these locations where the outfalls area concentrated. The pipe outfalls along the bay side of East Bay Road, discharge to the riprap revetment slope which dissipates the energy and protect the roadway from wave action. For details, see the design drawings in Appendix F.

7. WATER QUANTITY CONTROL

Project stormwater discharges do not qualify for quantity control due to their proximity to the ocean and tidally influenced major bodies of water.

7.1 OPERATIONS AND MAINTENANCE MEASURES

Upon completion of the project, maintenance of the water quality stormwater systems will be critical to the overall functionality of the systems. Operations and maintenance (O&M) procedures and practices used in facility operations will continue to minimize the generation and discharge of potential pollutants in areas where they may intermix with stormwater runoff. Example operations and maintenance manuals from ODOT and Contech are included in Appendix C. A detailed O&M plan for each structural control will be provided with the final submittal of this document prior to operations. The O&M Plan will include the name and contact information for the legally Responsible Party following the plan. Some critical O&M BMPs used to minimize or eliminate stormwater contact with potential pollutants include:

1. Regular inspection and collection of litter and debris from drainage courses and cleaning catch basins of accumulated solids or oils at least annually;
2. Regular inspection for accumulated fine sediment in infiltration trenches and basins;
3. Regular inspection of filtration cartridges and replacement as recommended by the manufacturer;
4. Where appropriate, inspecting and sweeping paved roads to effectively remove sand and other particulate pollutants prior to reaching treatment facilities and adjacent receiving waters; and
5. Prohibit driving over water quality swales and filter strips to avoid compaction of the water quality soil.

8. CONCLUSION

The permanent best management practices (BMPs) described in this Stormwater Management Plan will achieve pollutant removal to the "maximum extent practicable" for project Contributing Impervious Area. Opportunistically, utilizing permanent Low Impact Development water quality BMPs will help achieve this goal by mimicking natural hydrology and minimizing the amount of infrastructure needed to manage runoff. Preventative maintenance is a key component to the continuation of water quality treatment. Stormwater treatment BMPs will be routinely inspected according to the Operations and Maintenance Manual and all manufacturer recommendations. Specifics of the analysis and design will be added to this Plan as design progresses.

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10. APPENDICES

APPENDIX A: UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL RESOURCES CONSERVATION SERVICE (USDA NRCS) SOILS REPORTS

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Coos County, Oregon

Trans Pacific Parkway and Hwy 101



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.


124° 13' 39" W
124° 13' 11" W
43° 26' 40" N
43° 26' 27" N
400680
400740
400800
400860
400920
400980
401040
401100
401160
401220
401280
4810890
4810830
4810770
4810710
4810650
4810590
4810530
W
Jordan Cove Rd
101
Map Scale: 1:2,830 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0
40
80
160
240
Feet
0
100
200
400
600
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Coos County, Oregon
Survey Area Data: Version 9, Sep 17, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 6, 2010—Jul 13, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Coos County, Oregon (OR011)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
W	Water	4.1	100.0%
Totals for Area of Interest		**4.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Coos County, Oregon

W—Water

Map Unit Composition

Water: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

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A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Coos County, Oregon

APCO Site



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.


124° 13' 46" W
124° 13' 40" W
43° 25' 24" N
43° 25' 21" N
400460
400470
400480
400490
400500
400510
400520
400530
400540
400550
400560
400570
400580
400590
400600
4808560
4808550
4808540
4808530
4808520
4808510
4808500
4808490
4808480
4808470
57
W
57
Soil Map may not be valid at this scale.
Map Scale: 1:647 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 5 10 20 30
Feet
0 30 60 120 180
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Coos County, Oregon
Survey Area Data: Version 13, Sep 17, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Sep 15, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
57	Udorthents, level	0.6	63.0%
W	Water	0.4	37.0%
Totals for Area of Interest		**1.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

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Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Coos County, Oregon

57—Udorthents, level

Map Unit Composition

Udorthents and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Landform: Flood plains, tidal flats, marshes
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium, dredging spoil, dune sand, and wood chips

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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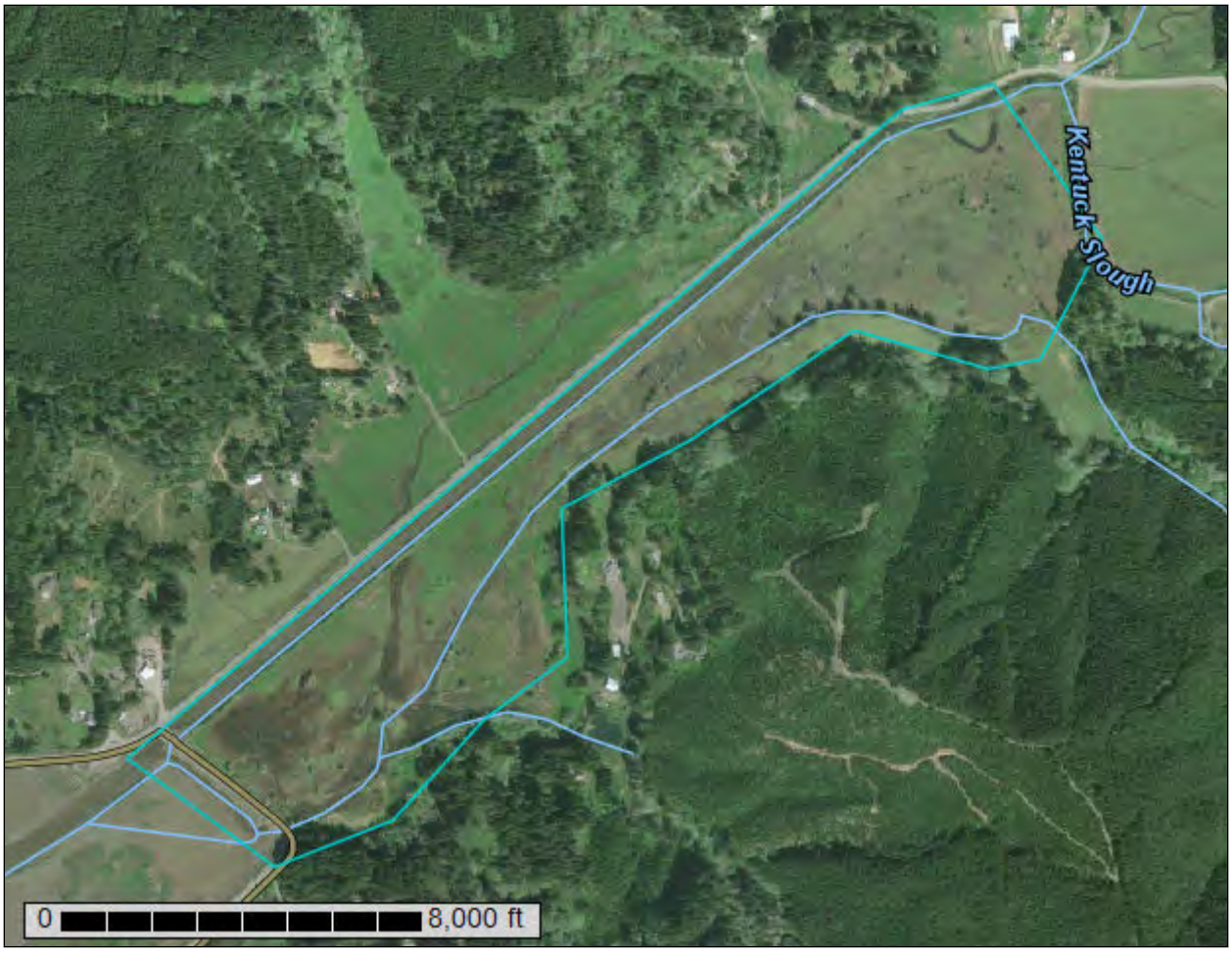
Custom Soil Resource Report for Coos County, Oregon

Kentuck Mitigation Site



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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

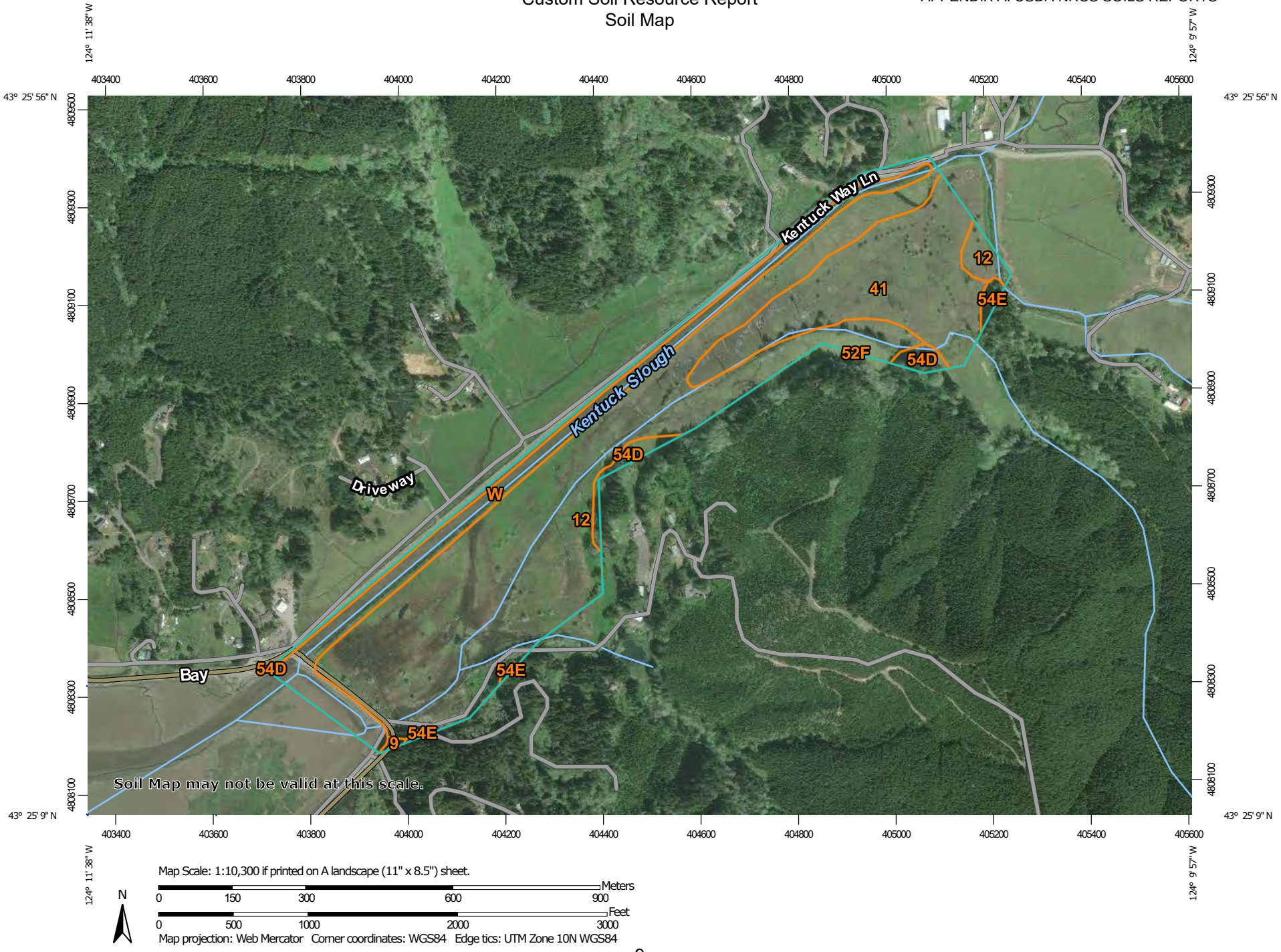
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.


124° 11' 38" W
124° 9' 57" W
43° 25' 56" N
43° 25' 9" N
403400
403600
403800
404000
404200
404400
404600
404800
405000
405200
405400
405600
4809500
4809300
4809100
4808900
4808700
4808500
4808300
4808100
Kentuck Way Ln
Kentuck Slough
Driveway
Bay
12
41
54E
52F
54D
W
9
Soil Map may not be valid at this scale.
Map Scale: 1:10,300 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 150 300 600 900
Feet
0 500 1000 2000 3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Coos County, Oregon
Survey Area Data: Version 13, Sep 17, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Sep 15, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9	Chetco silty clay loam	0.2	0.2%
12	Coquille silt loam	71.3	62.1%
41	Nestucca silt loam	24.2	21.1%
52F	Salander silt loam, 50 to 75 percent slopes	0.0	0.0%
54D	Templeton silt loam, 7 to 30 percent slopes	2.6	2.3%
54E	Templeton silt loam, 30 to 50 percent slopes	0.9	0.8%
W	Water	15.6	13.6%
Totals for Area of Interest		**114.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it

was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Coos County, Oregon

9—Chetco silty clay loam

Map Unit Setting

National map unit symbol: 21rh
Elevation: 0 to 750 feet
Mean annual precipitation: 50 to 100 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 160 to 300 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chetco and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chetco

Setting

Landform: Flood plains, deltas
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 10 inches: silty clay loam
H2 - 10 to 24 inches: silty clay
H3 - 24 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Forage suitability group: Very Poorly Drained (G004AY019OR)
Hydric soil rating: Yes

Minor Components

Coquille

Percent of map unit: 9 percent
Landform: Flood plains

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Nestucca

Percent of map unit: 8 percent
Hydric soil rating: No

Langlois

Percent of map unit: 8 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

12—Coquille silt loam

Map Unit Setting

National map unit symbol: 21m5
Elevation: 0 to 750 feet
Mean annual precipitation: 50 to 100 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 160 to 300 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Coquille and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coquille

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 36 inches: silty clay loam
H3 - 36 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Available water storage in profile: High (about 11.0 inches)

Interpretive groups
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Forage suitability group: Very Poorly Drained (G004AY019OR)
Hydric soil rating: Yes

Minor Components

Langlois
Percent of map unit: 7 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Chetco
Percent of map unit: 6 percent
Landform: Flood plains, deltas
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Clatsop
Percent of map unit: 6 percent
Landform: Tidal flats
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Nestucca
Percent of map unit: 6 percent
Hydric soil rating: No

41—Nestucca silt loam

Map Unit Setting
National map unit symbol: 21p1
Elevation: 0 to 750 feet

Mean annual precipitation: 50 to 100 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 160 to 300 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Nestucca and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nestucca

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 40 inches: silty clay loam
H3 - 40 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.57 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 11.2 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Forage suitability group: Somewhat Poorly Drained (G004AY017OR)
Hydric soil rating: No

Minor Components

Nestucca dark surf

Percent of map unit: 4 percent
Hydric soil rating: No

Nehalem

Percent of map unit: 4 percent
Hydric soil rating: No

Chetco

Percent of map unit: 4 percent
Landform: Flood plains, deltas
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Hydric soil rating: Yes

Coquille

Percent of map unit: 4 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Langlois

Percent of map unit: 4 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

52F—Salander silt loam, 50 to 75 percent slopes

Map Unit Setting

National map unit symbol: 21pw
Elevation: 50 to 1,600 feet
Mean annual precipitation: 60 to 100 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 100 to 270 days
Farmland classification: Not prime farmland

Map Unit Composition

Salander and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salander

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from sedimentary rock

Typical profile

H1 - 0 to 26 inches: silt loam
H2 - 26 to 65 inches: silty clay loam

Properties and qualities

Slope: 50 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 22.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Millicoma

Percent of map unit: 20 percent
Hydric soil rating: No

54D—Templeton silt loam, 7 to 30 percent slopes

Map Unit Setting

National map unit symbol: 21q0
Elevation: 50 to 1,400 feet
Mean annual precipitation: 60 to 100 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Templeton and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Templeton

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum weathered from sedimentary rock

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 42 inches: silt loam
H3 - 42 to 52 inches: weathered bedrock

Properties and qualities

Slope: 7 to 30 percent

Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Forage suitability group: Well Drained >15% Slopes (G004AY013OR)
Hydric soil rating: No

Minor Components

Salander

Percent of map unit: 25 percent
Hydric soil rating: No

54E—Templeton silt loam, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: 21q1
Elevation: 20 to 800 feet
Mean annual precipitation: 55 to 80 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Templeton and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Templeton

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Colluvium and residuum weathered from sedimentary rock

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 42 inches: silt loam
H3 - 42 to 52 inches: weathered bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Geisel

Percent of map unit: 13 percent
Hydric soil rating: No

Deep gravelly loam

Percent of map unit: 12 percent
Hydric soil rating: No

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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APCO Site 2 Geotechnical Design Report

A	11/01/18	Issued for Review	GRI	M&N	DEA	

REV	DATE	DESCRIPTION	BY	CHKD	APPVD	COMPANY APPROVAL

IP SECURITY	☐ Confidential	Total amount of pages including coversheet:	162
FOR CONTRACTOR DOCUMENTS	Contract No.	Contractor Document No.	Contractor Rev.
	DEA-041, SO 1230	276	0

JCL DOCUMENT NUMBER	Proj. Code	Unit / Location	Discipline	Doc. Type	Orig. Code	Sequence No.	Sheet No.
	J1	650	GEO	RPT	DEA	00002	00

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1. INTRODUCTION

Jordan Cove LNG (JCLNG), LLC, is seeking authorization from the Federal Energy Regulatory Commission (FERC) under Section 3 of the Natural Gas Act (NGA) to site, construct, and operate a natural-gas liquefaction and liquefied natural gas (LNG) export facility (LNG Terminal) located on the bay side of the North Spit of Coos Bay, Oregon. The LNG Terminal, related facilities, temporary construction sites, and other sites/actions associated with LNG Terminal construction are collectively referred to as the Jordan Cove Energy Project (JCEP). Four individual projects, collectively known as the Owner's Scope Projects (OSP), are being completed by JCLNG in support of the larger JCEP. The Navigation Reliability Improvements (NRI) Project is included in the OSP. This report has been prepared to specifically address geotechnical considerations related to the dredge disposal at APCO 2 Site, which is described further below.

1.1 PROJECT DESCRIPTION

The purpose of the NRI project is to modify the Coos Bay, Oregon, Federal Navigational Channel (FNC) at four discrete locations between the Coos Bay inlet and the JCEP site. The general location of the project site is shown on the Vicinity Map, Figure 1. All elevations reference the North American Vertical Datum of 1988 (NAVD 88) unless otherwise noted. The features of the NRI Project, as they relate to this report, include the following:

- Navigation Reliability Improvements – Dredging at four locations along the FNC to improve navigational reliability and efficiency.

- APCO Site 2 – Improvements to the site to allow for the disposal of dredge material, including construction of a dredged material disposal area and an access bridge.

Dredging means and methods, dredge material type and behavior during handling, containment of dredged material, sequence and method of dredge material disposal, and potential impacts of the improvements to adjacent infrastructure are important geotechnical considerations for the project. Based on our review of preliminary project plans prepared by Moffatt & Nichol (M&N), the four dredge locations are between River Mile (RM) 2 and 2.8, RM 4 and 4.7, RM 5.8 and 6.1, and RM 6.5 and 6.9. Based on these preliminary plans and our understanding of sediment and rock conditions within the Coos Bay channel, the predominant dredge materials from the four locations consist of sand, sandstone, and siltstone. Table 1.1.1 lists the anticipated material types at the four dredging locations. Estimated quantities of dredged-material volume at each location are being refined by M&N.

Table 1.1.1. Estimated NRI Dredge Material Types

Dredge Location	Predominant Dredge Materials
1	Sandstone and Sand
2	Siltstone and Sand
3	Sandstone and Sand
4	Sand

We understand a cutter-head suction dredge will be utilized to complete the majority of dredging; however, alternative methods may be used in areas where harder rock is encountered. Based on conceptual plans prepared by M&N, we understand dredge materials will be transported and hydraulically placed by pumping into a disposal area at APCO Site 2.

Access to APCO Site 2 from the mainland will be provided by a new single-lane, single-span bridge over a wetland between APCO Sites 1 and 2 that will measure approximately 200 ft long and 20 ft wide. The bridge will be used primarily by construction and heavy equipment traffic and not be open to the public.

1.2 PREVIOUS STUDIES

GRI completed a geotechnical data report for the APCO Site 2. The results of the investigation were provided in our July 19, 2017, report titled "Geotechnical Data Report, APCO Site Pre-Purchase Evaluation, Channel Safety Enhancement Project, Coos Bay Pilots Association, Coos County, Oregon." A discussion regarding dredging considerations was provided in a July 25, 2017, memorandum by GRI titled "Preliminary Geotechnical Considerations for Dredge Material Placement to Support APCO Site Pre-Purchase Evaluation, Coos County, Oregon."

1.3 PROJECT CONSIDERATIONS AND ASSUMPTIONS

Based on discussions with the project design team, we understand a containment dike will be constructed around the perimeter of APCO Site 2 to facilitate the disposal of dredge material from the FNC. Figure 2 shows the location of the proposed containment dike and disposal area. This report assumes the containment dike be constructed in three stages in a vertically overlapping dike configuration. Based on preliminary grading plans developed by M&N, we understand the center of the disposal area will be initially regraded to about elevation 26 ft. The initial dike stage, shown on Figure 2, will be constructed with on-site material placed to a crest elevation of about 44 ft with 3H:1V (Horizontal to Vertical) inside side slopes and 4H:1V outside side slopes. The width of the crest of the dike will be about 12 ft. Subsequent dike stages will allow for placement of dredged material within the disposal area to an approximate elevation of 68 ft. Figures 4.1A through 4.4B show the existing and proposed conditions following construction of the initial dike stage along four cross-sections designated A-A' through D-D' as shown on Figure 2. Cross section locations were selected based on available subsurface information, specific project features and existing infrastructure, and existing topography.

One of the key assumptions in this report is related to the behavior of varying dredge materials during handling and placement within the disposal area. The previously mentioned memorandum by GRI titled "Preliminary Geotechnical Considerations for Dredge Material Placement to Support APCO Site Pre-Purchase Evaluation, Coos County, Oregon," provides a more detailed description of the dredged material and the potential range of material during handling and placement within the disposal area. In summary, the sand and sandstone dredged material from Locations 1 through 4 is anticipated to be pumped into the disposal area as predominantly sand slurry. The siltstone dredged material from Location 2 is anticipated to be pumped into the disposal area as predominantly silty and clayey slurry that will be more challenging to manage.

The feasibility of constructing the disposal area with vertically overlapping containment dikes is dependent on the assumptions that the dredged material within the disposal area can be dewatered, be suitable for use as containment dike fill in accordance with Section 4.2, and provide adequate support for subsequent containment dike stages. In this regard, the dredged-sand sediment from Locations 1 through 4 and the sandstone from Locations 1 and 3 have the greatest potential for use as fill and providing adequate support, as we anticipate this material will dewater and consolidate more quickly after being pumped into the disposal area. The siltstone material dredged from Location 2 has the potential for a significant percentage of silt- and clay-sized particles that will likely remain saturated and unconsolidated for extended periods of time following placement within the disposal area. Therefore, the siltstone dredged-rock material will likely not be suitable for use as fill or to provide adequate support for subsequent lifts of dredge fill within the assumed schedule for this project. Consequently, this report assumes the following general construction sequence: following the construction of the initial dike stage using the on-site sand fills, predominantly sandy material from NRI dredge Locations 1, 3, and/or 4 should be pumped into the disposal area. Fill for subsequent dike stages will be constructed from the dredged material as it dewaters and consolidates. Following construction of the final dike stage, siltstone and predominantly fine-grained material dredged from NRI Location 2 should be pumped into the disposal area.

It should be noted that there is potential for portions of the sandstone dredged-rock material from Locations 1 and 3 to have enough silt content to behave similar to the fine-grained material dredged from NRI Location 2. If encountered, this material may need to be isolated within the disposal area and located away from the zones where necessary to support the next lift of containment dikes.

2. SITE DESCRIPTION

2.1 SITE CONDITIONS

2.1.1 Topography and Surface Conditions

The APCO Site 2 is located in the northern portion of North Bend, Oregon. The APCO Site 2 is a largely unimproved island mantled primarily with sand fill and light to dense scrub vegetation. The site is bordered by the FNC to the north, Pony Slough to the west and south, and a tidally influenced wetland to the east. Coos Bay Rail Link is located along on the western edge of the site. East of the wetland is APCO 1 Site, formerly the site of the Al Pierce Lumber Company. The APCO 1 Site can be accessed

directly from Chappell Parkway to the east of the site. The existing ground surface elevation at the site ranges from about 24 to 45 ft. In general, the site is surrounded by relatively steep slopes dipping towards Coos Bay to the north, Pony Slough to the west, and an unnamed wetland to the east and south.

2.2 GEOLOGY

On a regional scale, the APCO Site 2 is located within the Cascadia Subduction Zone (CSZ), the active convergent plate boundary along which remnants of the Farallon Plate (the Gorda, Juan de Fuca, and Explorer plates) are being subducted beneath the western edge of the overriding North American Plate. The subduction zone is a broad, eastward-dipping zone of contact between the upper portion of the subducting slabs of the Gorda, Juan de Fuca, and Explorer plates and the overriding North American Plate (Wells et al., 2000; Goldfinger et al., 2012). Sediments deposited in an open embayment of the Pacific Ocean during the Eocene time 56 to 34 million years ago became lithified into the bedrock units including the marine interbedded siltstones and sandstones of the Coaledo Formation below the site (Allen and Baldwin, 1944; Baldwin and Beaulieu, 1973). Major folding and uplift at Coos Bay occurred during Oligocene (23 to 34 million years ago) to Pliocene time (3 to 5 million years ago) and caused the initial faulting and folding now observed in the area (Dott, 1966).

Locally, the area has been folded into a series of primarily north-northeast-trending anticlines and synclines, which are commonly associated with drag on adjacent faults. Faults are generally either north-south-trending reverse faults or west-northwest and east-northeast thrust or oblique strike-slip faults. Geologic mapping at the site suggests the site is located within a synclinal trough that trends north-south through the site through Pony Slough (Black and Madin, 1995). Historical information indicates the U.S. Army Corps of Engineers (USACE) placed sand fill on the site in the 1980s. The sand fill is underlain by Quaternary alluvial deposits. The local geologic conditions are shown on Figure 3.

3. SUBSURFACE CONDITIONS

3.1 GENERAL

Geotechnical field exploration programs were completed for two geotechnical investigation phases for APCO Sites 1 and 2. The first mobilization occurred between August 28 and September 10, 2013, and the second occurred between June 12 and 22, 2017. A third geotechnical field exploration program, originally intended to be completed in advance of this report, has not yet been authorized.

The combined geotechnical investigations included six mud-rotary borings, designated B-1 through B-6, six CPT explorations, designated CPT-1 through CPT-6, and 10 direct-push probes, designated DP-1 through DP-10. The borings were advanced to depths ranging between 100 and 136.5 ft, the CPT explorations to depths ranging between approximately 39 and 62 ft, and the direct-push probes to depths ranging between 18 and 30 ft. The locations of the borings, direct-push probes, and CPT explorations completed at APCO Site 2 are shown on Figure 2. Additional details regarding the field explorations and laboratory testing programs completed for the 2013 and 2017 geotechnical investigation phases are provided in the Geotechnical Data Report for the project (Appendix A).

3.2 SOIL AND ROCK

For the purpose of discussion, the soil and rock disclosed by the explorations have been grouped into the following categories based on their physical characteristics and engineering properties. The sand fill, as described below, is differentiated into Fill or Possible Fill on the boring logs. The Possible Fill could potentially be related to historical shoaling of sand at the APCO Sites 1 and 2 before placement of fill; however, this material exhibits characteristics and properties similar to the sand fill.

1. **SAND (Fill or Possible Fill)**
2. **Recent Alluvium**
3. **Older Alluvium**
4. **SILTSTONE**

3.2.1 SAND (Fill or Possible Fill)

The boring and CPT explorations completed at the APCO Site 2 encountered sand fill from the ground surface to a maximum depth between approximately 22 and 30 ft (between elevations 0 and 6 ft). The direct-push probes encountered sand fill from the ground surface to the maximum depth explored of about 30 ft. The sand fill is typically brown to gray, fine to medium grained, and contains trace to some silt. Zones containing scattered wood debris and shell fragments are present locally in the sand fill. The relative density of the sand fill varies considerably from very loose to very dense based on Standard Penetration Test (SPT) N-values ranging from 4 to 58 blows/ft and CPT tip-resistance values ranging from 3 to 442 tsf. However, the relative density of the sand fill typically ranges from medium dense to dense based on SPT N-values and CPT tip-resistance values ranging from about 10 to 34 blows/ft and 46 to 206 tsf, respectively. Boring B-5 encountered a layer of soft to medium-stiff sandy silt within the possible sand fill at depths between approximately 22.5 and 25 ft (between elevations 10.7 and 8.2 ft). CPT-4 also encountered possible lenses of very soft to soft silt within the sand fill between about elevations 19 and 11 ft. The natural moisture content of the sand fill ranges from about 5 to 72%. The lower CPT tip-resistance values and higher moisture contents of the fill are typically associated with higher fines contents.

3.2.2 Recent Alluvium

The boring and CPT explorations completed at the APCO Site 2 encountered recent alluvial deposits of sand with silt beneath the sand fill to a maximum depth between approximately 34 and 38 ft (between elevations -6 and -12.2 ft). The recent alluvium is typically gray, fine grained, and silty. Zones containing scattered wood debris and shell fragments are present locally. Based on the CPT explorations, the recent alluvium may be interbedded with relatively thick lenses of very soft to soft silt. The relative density of the recent alluvium typically ranges from very loose to loose based on SPT N-values ranging from 0 to 6 blows/ft and CPT tip-resistance values ranging from 6 to 30 tsf. The natural moisture content of the recent alluvium ranges from about 24 to 54%.

3.2.3 Older Alluvium

The boring and CPT explorations completed at the APCO Site 2 encountered older alluvial deposits of sand with variable amounts of silt beneath the recent alluvium and to the maximum depth explored. An exception was boring B-1, where older alluvial deposits were encountered beneath the recent alluvium to a maximum depth of approximately 132.5 ft (elevation -104.5 ft). The older alluvium is typically gray, fine grained, and contains a trace of silt to silty. Zones containing scattered wood debris and shell fragments are present locally. The relative density of the older alluvium typically ranges from medium dense to very dense based on SPT N-values ranging from 24 blows/ft to practical refusal (defined as more than 50 blows for 6 in. of sampler penetration) and CPT tip-resistance values ranging from about 100 to 350 tsf. Within the older alluvium, borings B-1, B-2, and B-5 encountered 3- to 5-ft-thick interbedded layers of very loose to loose silty sand, and boring B-6 encountered a 3-ft-thick interbedded layer of very soft silt with a blow count of 0 blows/ft. The natural moisture content of the older alluvium ranges from about 19 to 103%.

3.2.4 SILTSTONE

Boring B-1 encountered decomposed siltstone beneath the older alluvium and to the maximum depth explored of about 136.5 ft (elevation -108.5 ft). The silt is gray and contains variable amounts of sand and a trace of clay. The relative consistency of the silt is hard based on an SPT N-value of 38 blows/ft. The natural moisture content of the siltstone is about 38%.

3.3 GROUNDWATER

The borings were advanced using mud-rotary drilling techniques, which do not allow the direct measurement of groundwater levels. The CPT explorations indicated groundwater at a depth between approximately 20 and 33 ft (between elevations -1 and 1 ft). The groundwater level at the site is anticipated to be near the water level observed in the adjacent Coos Bay and Pony Slough and fluctuates in response to tides.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL

The following sections discuss the important geotechnical considerations and present our preliminary design recommendations for construction of the proposed project features at the APCO Site 2. The important geotechnical considerations are:

- The subsurface investigations indicate the majority of the site is mantled by sand fill with varying amounts of silt. Several explorations encountered relatively thick lenses of very soft to soft silt within the sand fill. These silty lenses will significantly decrease the estimated factor of safety against slope stability without mitigation and will be a wet weather earthwork consideration if encountered.

- All explorations encountered recent alluvial deposits of very loose to loose sand with silt beneath the sand fill and beginning at about elevation 0 ft. The explorations indicate the thickness of this

deposit ranges from about 5 to 15 ft. Based on the results of the CPT explorations, these deposits were interpreted to contain layers of very soft to soft silt. These silty layers will significantly decrease the estimated factor of safety against slope stability without mitigation and will increase the settlement of the proposed containment dike during construction. The proximity of the proposed dike system to the top of relatively steep existing slopes is also a significant geotechnical consideration.

- Placement of the dredge slurry will create large hydraulic head differentials. Seepage through the sand containment dikes due to the placement of dredge material may be significant and uncontrolled seepage without mitigation may result in containment dike instability.

- The suitability of the dredged material for use as fill or to provide adequate support is an important design consideration. Dredge material containing significant amounts of the silt will not be suitable for use as fill to construct the proposed containment dikes or provide support for subsequent lifts. Therefore, the sequence in which dredge material is placed in the disposal area, and the ability of the dredge material to support subsequent dikes, are important considerations. Dredged material containing significant amounts of silt will need to be isolated within the disposal area and/or disposed of during the final stage of the project.

In general, the results of our analyses indicate containment dike and dredge material can be placed at the site with adequate factors of safety provided the following recommendations for the construction of the project are adopted:

- Pre-fabricated vertical drains (wick drains) should be installed beneath the footprint of the initial containment dike to accelerate consolidation settlement and soil strength increases following fill placement.

- Ground improvement, such as vibro-replacement stone columns, should be installed beneath the initial containment dike stage in the vicinity of the southern portions of cross-section A-A’, where more significant soft silts were encountered. Locations along the dike alignment with similar topographic and subsurface conditions should also be reinforced with stone columns. We anticipate additional locations similar to cross section A-A' will be identified following the final design field exploration and lab testing program.

- Steep slopes located near the outer toe of the containment dike system should be flattened to reduce the risk of surficial slope failures.

- A drainage system should be installed within the containment dike to draw the slurry-induced water table down below the outer slope of the dike containment system to increase the factor of safety.

A more detailed discussion regarding the analyses and our recommendations is provided below.

4.2 ANALYSIS AND RESULTS

4.2.1 Preliminary Design Parameters

Preliminary design parameters for soil strength, compressibility, and permeability were estimated based on a limited bridge design exploration program and pre-purchase site investigation completed in 2013 and 2017, respectively. As discussed previously, we recommend completing an additional design phase field exploration and lab testing program prior to final design to help refine the preliminary soil design parameters presented below. The following sections present a more detailed discussion of the preliminary design parameters and the analyses methods and results.

4.2.2 Design and Staging Assumptions

Construction of the proposed containment dike system and dredged material disposal area was evaluated at cross-sections A-A' through D-D' in general accordance with the USACE, Dredging and Dredged Material Management, EM 1110-2-5025. The locations of the cross-sections used in the evaluations are shown on Figure 2. Our geotechnical analyses were completed based on preliminary plans developed by M&N and the construction sequence outlined below. In general, a vertically overlapping dike system, similar to that presented in Diagram A, will be used to construct the dredge disposal area at the APCO Site 2. Construction of the containment dikes will occur in three stages. Following the construction of each dike, dredge material will be placed in the disposal area. Subsequent dike stages will be constructed after the dredge material is sufficiently dewatered and compacted. As currently planned, the construction sequence is:

- The grades inside the initial containment dike (Stage 1) will be graded to elevation 26 ft.
- The initial containment dike (Stage 1) will be constructed using existing on-site, near-surface sand fill to an elevation of 44 ft with 3H:1V inside side slopes and 4H:1V outside side slopes. Dredged material from NRI Locations 1, 3, and/or 4 will then be pumped into the disposal area to a maximum elevation of 40 ft.
- A second containment dike will be constructed upon and with dewatered dredged material (Stage 2) to an elevation of 58 ft. Dredged material from NRI Locations 1, 3, and/or 4 will then be pumped into the disposal area to a maximum elevation of 54 ft.
- A third and final containment dike will be constructed (Stage 3) upon and with dewatered dredged material to a final grade elevation of 72 ft. Dredged material from NRI Location 2 will then be pumped into the disposal area to a maximum elevation of 68 ft.

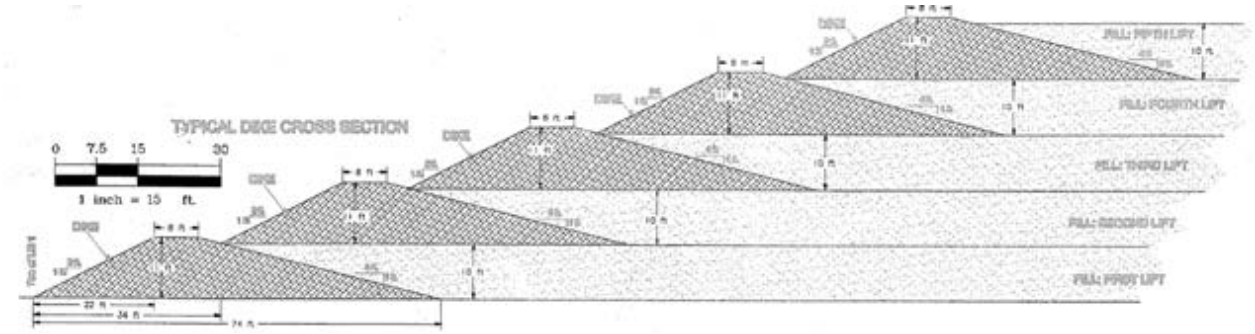

Diagram A. Schematic Example of Overlapping Dikes

Based on discussions with the project design team, our analyses targeted a four-year schedule for construction of the containment dike system and placement of dredged material:

- Year 1 (Q4) through Year 2 (Q3): Initial grading installation of pre-fabricated vertical (wick) drains, and construction of the first containment dike (Stage 1) and temporary work area.
- Year 2 (Q4) through Year 3 (Q1): Dredging and placement of dredged material within the disposal area.
- Year 3 (Q2 through Q3): Construction of the second containment dike (Stage 2).
- Year 3 (Q4) through Year 4 (Q1): Dredging and placement of dredged material within the disposal area.
- Year 4 (Q2 through Q3): Construction of third and final containment dike (Stage 3).
- Year 4 (Q4) through Year 5 (Q1): Dredging and placement of dredged material within the disposal area.

4.2.3 Settlement

Settlement of the foundation soils as a result of loading imposed by the containment dike system and dredged material disposal area has two components: 1) immediate (elastic) settlement of predominantly coarse-grained foundation soils during construction; and 2) primary consolidation of predominantly fine-grained foundation soils during and following construction. Additionally, the risk for long-term secondary compression settlements (soil creep) of the foundation soils can be further evaluated after the proposed final design field exploration and lab testing program is completed. However, it is acknowledged that long-term settlement of dredge spoils may be a more significant consideration. We also understand structural improvements are not planned for the site and reducing long-term settlement of the site after completion of the dredge fills is not a project goal.

The program Settle3D by Rocscience, Inc., was used to estimate total and time-rate settlement of the foundation soils under loads from the containment dike system and material placed in the dredge disposal area. To estimate settlement, the materials disclosed by the subsurface explorations were grouped into predominantly coarse-grained and predominantly fine-grained soil layers for each cross section (Figures 4.1A through 4.4B). Settlement analyses were completed for each end of the cross sections where the proposed containment dikes will be located. Settlement analyses were also completed at the Coos Bay Rail Link and the proposed temporary work area located at the west and east ends of cross section D-D', respectively. The thickness of each soil layer for the cross sections is shown in Table 4.2.1. It should be noted that the table sums the interbedded layers within the units shown separately on the cross sections.

Table 4.2.1. Estimated Cumulative Layer Thicknesses for Cross Sections A-A' Through D-D'

	Layer Thickness for Each Cross Section, ft							
	A-A'		B-B'		C-C'		D-D'	
Soil Description	North	South	North	South	East	West	East	West
Existing Sandy Fill	29	25.5	36	37	36	16	31	16
Existing Silty Fill/Older Silty Alluvium	3.0	7.5	4.0	8.0	25	16	23	12
Recent Alluvium	5.0	5.0	6.0	6.0	7.0	4.0	9.0	6.0
Older Sandy Alluvium	90	90	95	95	72	90	73	90
Siltstone	10	10	10	10	5.0	10	10	10

Settlement in the coarse-grained layers was assumed to occur simultaneously as the containment dike system is constructed. The predominantly coarse-grained materials in the foundation soils were assigned an elastic modulus based on correlations with SPT and CPT measurements (Ohya et al., 1982; Meyerhof and Fellenius, 1985; Mayne and Frost, 1988; Kulhawy and Mayne, 1990; Robertson, 2009). Silty layers interbedded in the sand fill and older alluvium were assigned conventional bilinear compressibility parameters based on our experience with similar materials in the area. In the absence of laboratory consolidation tests, settlement of the recent alluvium was estimated using a tangent modulus approach (Janbu, 1963, 1965, 1967). Constrained moduli estimated from correlations with CPT cone tip resistance (Robertson, 2009) were used to determine to Janbu settlement parameters. The resulting values were compared to typical values found in literature (CFEM, 1992) and used to estimate settlement in predominantly fine-grained soil layers. Time-dependent settlement properties for the predominantly fine-grained soils at the site were estimated based on our experience with similar soils in the area and values presented in literature. The design settlement parameters used in our analyses are provided in Table 4.2.2.

Table 4.2.2. Estimated Settlement Parameters for Cross Sections A-A' Through D-D'

Soil Description	Total Unit Weight (pcf)	$C_{c\varepsilon}$	$C_{r\varepsilon}$	C_v (ft^2/yr)	C_{vr} (ft^2/yr)	Janbu Modulus Number, *m*	Janbu Exponent, *a*	Elastic Modulus, *E* (psf)
Existing Sandy Fill	110	-	-	-	-	-	-	1,000,000
Existing Silty Fill/Older Silty Alluvium	100	0.25	0.025	100	500	-	-	-
Recent Alluvium	110	-	-	100	500	50	0.5	-
Older Sandy Alluvium	120	-	-	-	-	-	-	1,400,000
Siltstone	120	-	-	-	-	-	-	2,000,000

Settlement of the foundation soils was estimated for cross sections A-A' through D-D' at the conclusion of each construction stage based on the anticipated schedule discussed in Section 4.2.2. Our analyses assumed the proposed containment dike system will be constructed with fine-grained sand obtained from near-surface material at the APCO Site 2 and from dredged sand and sandstone material removed from NRI Locations 1 through 4, and will be placed in accordance with the recommendations in Section 4.3 of this report.

Our settlement models assume wick drains will be installed beneath the footprint of the initial containment dike (Stage 2) prior to the placement of fill. Wick drains also allow for the use of greater soil strength when assessing global stability by accelerating consolidation settlement. Our assumptions regarding changes in shear strength due to consolidation settlement during construction of the project are discussed in greater detail in Section 4.2.5 of this report. Our specific recommendations regarding wick drains are presented in Section 4.2.5.1 of this report.

The results of our settlement analyses are shown in Table 4.2.3. The table provides estimates of total cumulative settlement under the center of each dike as the containment dike system is constructed and dredged material is placed in the disposal area.

Table 4.2.3. Estimated Total Foundation Soil Settlements for Cross Sections A-A' Through D-D'

Construction Stage	Location	Applied Load	Total Settlement, in.							
			A-A'		B-B'		C-C'		D-D'	
			North	South	North	South	East	West	East	West
1	Underneath Dike 1	Dike Load	1.5	1.5	1.0	1.0	1.0	2.5	0.5	3.0
		Dredge Fill Load	2.0	2.0	1.0	1.5	1.0	3.0	1.0	3.0
2	Underneath Dike 1	Dike Load	2.5	2.5	1.5	2.0	1.0	3.5	1.5	4.5
		Dredge Fill Load	2.5	3.0	2.0	2.0	1.5	4.0	1.5	4.5
	Underneath Dike 2	Dike Load	3.0	4.0	3.5	4.0	3.0	5.5	3.0	5.5
		Dredge Fill Load	4.0	5.0	4.0	4.5	3.0	6.0	3.5	6.0
3	Underneath Dike 1	Dike Load	2.5	3.0	1.5	2.5	1.5	4.0	1.5	5.0
		Dredge Fill Load	2.5	3.0	2.0	2.5	1.5	4.0	1.5	5.0
	Underneath Dike 2	Dike Load	4.5	5.5	4.5	5.5	4.0	6.5	4.0	7.0
		Dredge Fill Load	4.5	5.5	5.0	5.5	4.0	6.5	4.0	7.0
	Underneath Dike 3	Dike Load	5.5	6.0	5.5	6.0	4.5	7.5	5.0	8.0
		Dredge Fill Load	5.5	6.5	6.0	6.5	5.0	8.0	5.5	8.5

In general, the results of our settlement analyses indicate cumulative settlement of the foundation soils beneath the initial containment dike constructed in Stage 1 may range between about 0.5 to 3 in. at the end of Stage 1, about 1 to 4.5 in. at the end of Stage 2, and about 1.5 to 5 in. at the end of Stage 3. Cumulative settlement under the containment dike constructed during Stage 2 may range between about 3 to 6 in. at the end of Stage 2, and about 4 to 7 in. at the end of Stage 3. Cumulative settlement under the containment dike constructed during Stage 3 may range from about 4.5 to 8.5 in. underneath the center of the dike following construction of Stage 3. It is noted that the estimates of cumulative settlement for containment dikes constructed in Stages 2 and 3 include settlements due to dikes constructed during previous stages of construction.

As shown on Figures 2 and 4.4B, we understand a temporary work area will be constructed on the east side of the containment dike at about the same time of the initial containment dike construction. The

estimated settlements under the center of the proposed temporary work area may range from about 0.5 to 2 in. Our analyses indicated a low risk of significant settlements beneath the Coos Bay Rail Link as a result of the fill placement.

The results of our time-rate settlement analyses indicate approximately 90% consolidation can be achieved in silty layers where wick drains have been installed following the construction of each containment dike and placement of dredge material. Layers of thicker, fine-grained foundation soils located in areas of the site not improved with wick drains, such as the inner regions of the dredge disposal area, may continue to exhibit some settlement over the course of several years following construction of the project. Actual time-rate settlements of the foundation soils underlying the center of the disposal area will depend on several factors, including the presence and specific layering of fine-grained soils, timing and placement of dredge material, and drainage and dewatering system installed in the dredge disposal area.

As discussed in Section 4.1, relatively clean sand and sandstone dredge material should be placed in the disposal area first. Soils containing significant fines, including the siltstone at NRI Location 2, are not suitable foundation materials for subsequent dike lifts and should be placed in the disposal area last. Settlement or reconsolidation of slurry with significant fine-grained material placed within the last lift of the disposal area is challenging to estimate and outside our scope of work. The degree of reconsolidation of this material will vary significantly, depending on predominant material type and particle size distribution, initial water content and unit weight, degree of handling and behavior during dredging, and efficacy of the dewatering and drainage system.

4.2.4 Seepage

Seepage through the dikes will be a significant geotechnical consideration because the containment dikes will be constructed with fine-grained sand obtained from near-surface material at APCO Site 2 and from dredged sand and sandstone material removed from NRI Locations 1 through 4. Additionally, we anticipate large volumes of dredged material will be pumped into the disposal area as a slurry of water and soil over relatively short periods of time. The time required to dewater the dredge material is not known at this time and may vary significantly depending on the type of dredge material placed within the disposal area, the permeability characteristics of the underlying foundation soils, and the discharge weir and dewatering system installed at the site. As a result, we assumed significant head differentials will develop across the containment dikes. For our stability analysis, we assumed a drainage system will need to be installed within the containment dike to draw down the water from the outer slope of the containment dike system. A more detailed discussion regarding the location of the temporary phreatic surface assumed in our analyses is provided in the following section.

4.2.5 Slope Stability

Global stability of the proposed containment dike system was assessed for cross sections A-A’ through D-D’ using the slope stability program SLIDE 2018 and Spencer’s Method for limit equilibrium. The critical slip surface with the lowest factor of safety was determined using a grid-and-radius search routine with factors of safety calculated for multiple circular-slip surfaces. A minimum failure surface depth of

about 2 ft was set as a limiting parameter in the model to so surficial failures would be excluded from the analysis.

Global stability was assessed for the following scenarios based on the construction and schedule considerations outlined in Section 4.2.2 of this report:

- After construction of each containment dike in Stages 1, 2, and 3 to crest elevations of 44, 58, and 72 ft, respectively. Short-term conditions were evaluated by using undrained shear strengths for predominantly fine-grained soils and drained friction angles for predominantly coarse-grained soils. A detailed discussion of the soil strengths used in our analyses is provided below. The static groundwater level is assumed to be located well below the proposed fills near elevation 0 ft.

- After placement of dredge material in the disposal area behind the containment dikes constructed in Stages 1, 2, and 3. Based on a minimum freeboard height of 4 ft, we assumed dredge material in Stages 1, 2, and 3 will be placed to maximum elevations of 40, 54, and 68 ft, respectively. Short-term conditions were evaluated by using undrained shear strengths for predominantly fine-grained soils and drained friction angles for predominantly coarse-grained soils. The groundwater table in the center of the disposal area was assumed to be located at the top of the dredge material. Groundwater near the edge of the disposal area was modeled under steady state conditions assuming a drainage system will be installed. We assumed measures will be implemented to limit water infiltration into the existing slope below the toe of the initial containment dike.

The strength parameters used in our analyses are provided in Table 4.2.4. The parameters were selected based on correlations with in-situ tests conducted at the site (Schmertmann, 1975; Kulhawy and Mayne, 1990; Sabatini et al., 2002; Robertson, 2009; Mayne, 2016, 2017), engineering judgement, our experience with similar soils in the vicinity of the project site, and observed variability. The strength of the predominantly fine-grained foundation soils was described with stress-normalized strength (SHANSEP) parameters, where undrained shear strength is a function of the effective overburden stress, σ'_v:

$$S_u = A + \sigma'_v \cdot S$$

where A is a lower-bound shear strength and S is a constant equal to the ratio of undrained shear strength to effective overburden stress. In the absence of consolidation test data, all predominantly fine-grained soils at the site were assumed to be normally consolidated. The strength of predominantly coarse-grained foundation soils was described using the drained friction angles shown in Table 4.2.4. The strength of these layers was conservatively assumed to remain constant throughout construction.

Table 4.2.4. Estimated Strength Parameters for Cross Sections A-A' Through D-D'

Soil Description	Total Unit Weight, psf	Undrained Shear Strength, S_u, psf	Friction Angle, ˚	SHANSEP Strength Parameters	
				A, psf	S
Dredge Material (Short-Term Conditions)	85	-	-	-	-
Sandy Dredge Material (Long-Term Conditions)	100	-	28	-	-
Silty Dredge Material (Long-Term Conditions)	100	300	-	-	-
Proposed Dike Sand Fill	105	-	36	-	-
Existing Sand Fill	110	-	34	-	-
Silt (Existing Silt Fill/Older Silty Alluvium)	100	-	-	75	0.25
Recent Alluvium	110	-	-	0	0.25
Older Sandy Alluvium	120	-	38	-	-
Older Silty Sand Alluvium	100	-	24	-	-
Siltstone	120	1,200	-	-	-

The global stability analyses assume wick drains are installed beneath the footprint of the Stage 1 containment dike and the underlying fine-grained soils achieve about 90% consolidation following construction of the containment dike and placement of dredge material in each construction stage. The increase in undrained shear strength due to consolidation is directly dependent on the increase in effective overburden stress that occurs as excess pore water pressures generated by loads applied at the ground surface dissipate over time. The rate of pore water pressure dissipation is dependent of the permeability of the soil and proximity to drainage layers such as wick drains or more permeable, coarse-grained soils. The dissipation of excess pore water pressure can be represented as a percentage of the total applied stress, $\Delta\sigma$, by the degree of consolidation, U. As a result, the increase in undrained shear strength, ΔS_u, can be evaluated as:

$$\Delta S_u = \Delta\sigma'_v \cdot S = (U \cdot \Delta\sigma) \cdot S$$

where U is expressed in decimal form, equal to 0 immediately after the load is applied, and equal to 1 after all consolidation settlement has occurred. The equation shown above was used to estimate increases in undrained shear strengths of the predominantly fine-grained foundation soils in our global stability models during construction of the project.

The dredge material slurry was assumed to have no strength immediately following placement into the disposal area. The long-term strength of the dredged sand and sandstone, and siltstone after the material has been dewatered was estimated using a drained friction angle and undrained shear strength, respectively.

The results of the global stability analysis are presented in Table 4.2.5 and on Figures 1B through 56B in Appendix B. In most locations, the proposed containment dike system with wick drains and the assumed drainage features meet or exceed the USACE-recommended factor of safety against failure as described in the USACE Dredging and Dredged Material Management, EM 1110-2-5025, for the majority of the cross sections analyzed. However, at the south side of cross section A-A', the global factors of safety are slightly lower than the recommended minimum value of 1.3 due to a thick layer of near-surface silt and relatively steep existing slopes below the outer toe of the containment dike.

Table 4.2.5. Global Stability Factors of Safety for Cross Sections A-A' Through D-D'

		Stage 1		Stage 2		Stage 3		
Cross Section	Side Analyzed	Initial Excav. and Dike Const.	Dredge Fill Placement	Dike Const.	Dredge Fill Placement	Dike Const.	Dredge Fill Placement	Long Term
A-A'	North	2.2	1.7	2.2	1.7	2.2	1.6	2.2
	South	1.3	1.3	1.2	1.2	1.3	1.3	1.3
B-B'	North	2.1	1.4	2.3	1.4	2.4	1.4	2.4
	South	>2.5	>2.5	>2.5	>2.5	>2.5	2.2	>2.5
C-C'	East	2.3	2.0	2.3	1.8	2.3	1.7	2.3
	West	2.4	1.8	2.3	1.5	2.3	1.4	2.3
D-D'	East	1.8	2.1	2.1	2.1	2.2	2.2	2.2
	West	2.1	2.2	2.1	2.1	2.2	2.1	2.1

The anticipated construction schedule for the project likely precludes surcharging to allow for soil strength increases in the fine-grained soil layer. As a result, additional global stability analyses were completed for the south end of cross section A-A' to evaluate the benefit of ground improvement to increase the estimated factor of safety. Subsequent modeling was completed, including a 60-ft-wide zone of stone columns centered beneath the outer toe of the initial containment dike constructed in Stage 1. We assumed the stone columns will be installed prior to construction of the dike and extend from about elevation 30 ft to elevation -5 ft. The size and spacing of the stone columns were selected based on a minimum area replacement ratio of 17%. Our analyses were completed assuming the stone column ground improvement will be installed on a 7-ft, equilateral, triangular spacing with a diameter of about 3 ft. Stone columns were modeled as discrete elements with a drained friction angle equal to 42° and unit weight equal to 125 pcf. We assumed the sandy soils will be improved through densification and the

friction angles of predominantly coarse-grained soils located in the zone of stone columns will increase by 4°. We assumed soils with higher silt contents, such as the recent alluvium, will not densify during stone column installation. Additional discussion regarding ground improvement is provided in Section 4.2.5.2 of this report.

The ground improvement configuration included in our model improves global stability of the proposed containment dike at the south end of cross section A-A' and results in factors of safety that meet or exceed the USACE-recommended value of 1.3. However, relatively shallow potential failure surfaces with factors of safety of less than 1.3 exist in locations outside the zone of improved ground and along relatively steep slopes near the perimeter of the site. Although these potential failure surfaces do not intersect the proposed containment dike system, they have the potential to cause progressive undermining of the dike. Because the location and extents where ground improvement can be installed is limited by relatively steep existing slopes near the perimeter of the site and project constraints related to reducing impacts on the adjacent wetland, flattening existing slopes where shallow failures may occur is an option to increase the factor of safety. Based on the available topographic information, the slope angle below the proposed containment dike system at the southern portion of cross section A-A' is about 2H:1V. To evaluate the benefit of flattened slopes to increase the global factor of safety, the slope near the toe of the initial containment dike outside the zone of ground improvement was flattened to about 3.5H:1V. Slopes below the Highest Measured Tide (HMT) at elevation 10.26 ft were not modified. The results of our global stability analyses with stone columns and flattened slopes are shown in Table 4.2.6. The output from the slope stability model is shown on Figures 57B through 63B. In addition to slope modifications, placement of a blanket of well-graded crushed rock fill over this portion of the slope could also increase the factor of safety.

Table 4.2.6. Global Stability Factors of Safety for the South End of Cross Section A-A' with Ground Improvement and Flattened Slopes

Stage 1		Stage 2		Stage 3		
Initial Excav. and Dike Const.	Dredge Fill Placement	Dike Const.	Dredge Fill Placement	Dike Const.	Dredge Fill Placement	Long Term
1.6	1.5	1.7	1.4	1.6	1.4	1.7

It should be emphasized that additional stability models showed significantly lower global factors of safety with uncontrolled seepage through the containment dike system and the additional drainage improvements to pull down the groundwater table from the outer portions of the containment dikes. In addition, we assumed water exiting the disposal area will be controlled and piped to a discharge location and not allowed to infiltrate and saturate the existing slopes located below the outer toe of the initial containment dike.

This report recommends an additional field exploration and lab testing program, including undisturbed sampling and laboratory strength testing, be completed prior to final design. Following this work, our global stability models should be updated using the refined estimates of soil shear strength.

4.2.5.1 Wick Drains

Wick drains are commonly used to accelerate consolidation settlements by significantly shortening drainage paths within the foundation soils. For this project, wick drains would allow the fine-grained soils to consolidate faster as load is applied and increase the undrained shear strengths of these soils.

We assumed wick drains be installed beneath the footprint of the initial dike constructed in Stage 1. Iterative time-rate settlement analyses were completed to estimate the required wick-drain spacing and installation depth such that the foundation soils achieve about 90% of their total estimated consolidation settlements. Drain spacing of about 6 ft (triangular pattern) will be required to achieve about 90% consolidation in the interbedded silt layers and recent alluvium following construction of each containment dike and subsequent placement of dredge material in accordance with the anticipated project schedule outlined in Section 4.2.2 of this report. Based on the current available subsurface information, we recommend wick drains be installed to the bottom of the recent alluvium located between elevations -4 and -7 ft.

Each wick drain should be provided with an anchor plate at the bottom to anchor the wick-drain bottom at the required depth. A horizontal drainage layer consisting of either a granular blanket or horizontal wick drains should be installed to outlet water from beneath the containment dike fill. A cut-off wall or other seepage impediment may need to be installed to mitigate the development of a preferential seepage pathway from the disposal area through a granular blanket and to the outer toe of the containment dike. The granular blanket or horizontal wick drains should be placed after installation of the wick drains and before placement of the containment dike fill. If encountered, dense layers of surficial foundation soils could require pre-drilling of the wick drains. This will increase the drain cost and time of installation.

4.2.5.2 Ground Improvement

Preliminary global stability models completed for this report indicate a ground improvement program can be designed to mitigate risks associated with static slope stability. Although not included in the scope of this report, ground improvement also has the benefit of mitigating the risk of seismic-induced settlement and lateral spreading, provided the elements are installed deep enough. Due to sandy and interbedded soils present at the site, the most effective ground improvement will likely consist of vibro-compaction or vibro-replacement (stone columns) using the bottom-feed method. Vibro-compaction is a ground improvement technique that densifies granular soils, such as relatively clean sand, using a vibratory probe. The probe is vibrated and jetted into the ground until reaching the bottom of the improvement zone. The soils are densified by the vibratory process as the probe is removed. Stone columns are similar to vibro-compaction, except stone aggregate is added to the void created by the probe. The aggregate is densified by lowering the probe into the aggregate in small lifts until reaching the ground surface, creating columns of aggregate. Due to the presence of significant silt content in zones of the sand, we recommend the ground improvement method consist of vibro-replacement with stone columns using the

bottom-feed method. Based on the current available subsurface information, we recommend stone columns be installed to the bottom of the recent alluvium located between elevations -4 and -7 ft. Depending on the density of the near-surface soils, pre-drilling may be required to install stone columns. We anticipate silty soil layers such as the recent alluvium near elevation 0 ft will not densify in a similar manner during stone column installation.

Vibro-replacement stone columns are typically installed with a combination of air and water to advance the probe. Depending on the final ground improvement configuration, temporary sheet pile walls for containment may be necessary in order to reduce the risk of potential impacts from spoils or other disturbances impacting the adjacent waterways. Details of the ground improvement design will be coordinated with DEA and M&N in future work.

4.2.5.3 Instrumentation

The staged-fill design assumes engineering estimates of several variables, including groundwater level, time-rate of consolidation, and shear-strength gain from soil consolidation based on the currently available geotechnical data. The use of instrumentation will be essential to evaluate the actual rate of pore-pressure dissipation and assumed strength increases in the foundation soils during construction. This instrumentation should also include slope inclinometers to evaluate the potential for horizontal ground movement beneath the staged fills. These data will allow assessment of the staged-fill construction and assist in evaluating the need to modify the rate of staged-fill placement assumed in this report.

Staged-fill settlement should be obtained from settlement plates surveyed for elevation. Pore-pressure dissipation in the foundation soils should be monitored with vibrating-wire piezometers installed prior to placing the staged fill. Slope inclinometers should be installed along the toe of the staged fill after the Stage 1 fill layer has been placed. Details of the staged-fill instrumentation can be developed as plans are finalized.

4.3 SITE PREPARATION AND EARTHWORK

The ground surface within all areas that will receive fill including the disposal area, the containment dike footprint, and the temporary work area should be stripped of vegetation, surface organics, and loose surface soils. The lateral limits of stripping and grubbing should extend at least 3 ft beyond areas that will receive fill. For planning purposes, a stripping depth of approximately 6 to 12 in. may be required to remove the organic sod and root layer; however, stripping depths should be based on field observations at the time of construction. Grubbing and deeper excavations will be required to remove shrubs and rooted zones, if encountered. Where present, roots larger than ½ in. in diameter should be excavated. Stripped and grubbed material, including the vegetation and underlying organic surface soils, should be transported off site for disposal or stockpiled on site for use in non-structural areas if suitable.

Following stripping and grubbing, the areas to receive fill should be cut (rough grading) to establish planned subgrade elevations. Subgrades should be evaluated by a qualified geotechnical engineer to

identify loose, soft, or disturbed areas that may require over excavation. Proof rolling with a fully loaded dump truck or other heavy, rubber-tired vehicle may be part of the evaluation.

A 6- to 12-in.-thick granular work surface will likely be sufficient to provide a suitable working surface for construction equipment on the relatively sandy subgrade. If siltier zones of the sand are encountered, this granular work surface may need to be increased to about 18 in. during wet weather conditions. Any subgrade soils disturbed by construction activity should be overexcavated to firm soil and backfilled with structural fill. The performance of haul roads can usually be improved by placing a geotextile fabric over the fine-grained subgrade soils prior to placing the rock.

Temporary excavations will be required for the project to complete site earthwork, including the initial site grading to elevation 26 ft. Excavated slopes should only be used where they can be safely constructed and remain safe throughout construction. The slopes should be analyzed by the contractor's design team, including soil materials, water levels, and permanent and construction surcharges that will impact the slopes. For preliminary estimating purposes, it is our opinion temporary slopes that have no seepage and no surcharges can be excavated to heights of up to 10 ft at a safe slope angle of 1H:1V. Temporary slopes greater than 10 ft high should be sloped no steeper than 1.5H:1V. Flatter slopes may be necessary based on actual conditions. Excavations should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations. In our opinion, the contractor will be in the best position to observe subsurface conditions continuously throughout the construction process and respond to the soil and groundwater conditions. Construction site safety is generally the sole responsibility of the contractor, who is also solely responsible for the means, methods, and sequencing of the construction operations and choices regarding temporary excavations, shoring, and dewatering. We are providing this information only as a service to our client. Under no circumstances should the information provided below be interpreted to mean GRI is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred. We anticipate excavations can be made using conventional equipment. It should be expected that unsupported cut slopes would experience some sloughing and raveling if exposed to surface water and the contractor should assume measures to mitigate erosion during wet weather.

We recommend the fill material used for the containment dike be organic-free and compacted at moisture contents within about 5% of the optimum moisture content, as determined by ASTM International (ASTM) D698. Fill material not near the optimum moisture content should be moisture-conditioned prior to compaction. Fill and backfill material should be placed in uniform, horizontal lifts and compacted with appropriate equipment. The appropriate lift thickness will vary depending on the material and compaction equipment used. Fill material should be compacted to a minimum of 90% of ASTM D698. It is the contractor's responsibility to select appropriate compaction equipment and place the material in lifts thin enough to meet these criteria.

We understand the on-site sand fills will be used to create the initial lifts of containment dikes. In general, the existing sand fill is fine- to medium-grained and contains trace to some silt (less than 12% silt). However, layers containing more than 12% silt should be anticipated in the sandy fill. The sand fill is suitable for reuse as structural fill for containment dike provided the soil can be compacted as described

above and is free of debris and organics. It should be noted that as silt content in the sand fill increases, the material will require more effort to aerate and dry if wetter than optimum. Additionally, siltier sand fill material will be more difficult to compact during wet weather, and silt layers may need to be isolated within the disposal area if they cannot be suitably compacted. The anticipated dredged-sand sediment from NRI Locations 1 through 4 and sandstone from NRI Locations 1 and 3 can be used as structural fill for the containment dike, provided they can be compacted as described above. However, the use of sandstone will depend on the gradation after it has been slurried into the site and how the material breaks down as it is moved and placed on site. As noted in the Introduction of this report, there is potential for portions of the sandstone dredged-rock material from NRI Locations 1 and 3 to have significant silt content and behave similar to the fine-grained material dredged from NRI Location 2. If encountered, this material may need to be isolated within the disposal area and away from potential support zones for the containment dikes.

4.4 RECOMMENDATIONS FOR ADDITIONAL WORK

We recommend an additional geotechnical field exploration program and engineering analyses be completed to support advancement of the design phase of the project. Supplemental subsurface explorations consisting of CPT explorations and borings are recommended to further characterize the recent alluvium. Specifically, we recommend CPT explorations be completed to further delineate the thickness and help evaluate the permeability of the recent alluvium throughout the APCO Site 2. In addition to CPT explorations, borings should be completed to obtain relatively undisturbed samples of potential silt layers within the recent alluvium. Following completion of the supplemental subsurface explorations, laboratory testing should be completed, including shear strength testing of the recent alluvium, and consolidation testing of potential silt layers within the recent alluvium.

The considerations presented in this report are preliminary. Updates to the settlement and stability analyses will be required following collection and analysis of the additional geotechnical information.

5. LIMITATIONS

This report has been prepared to aid the engineering team in the design of this project. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the earthwork and foundations. In the event any changes in the design and location of the improvements as outlined in this report are planned, we should be given the opportunity to review the changes and modify or reaffirm the conclusions and recommendations of this report in writing.

The conclusions and recommendations submitted in this report are based on the data obtained from the explorations shown on the site plans and other sources of information discussed in this report. In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is acknowledged variations in soil conditions may exist between exploration locations. This report does not reflect any variations that may occur between these explorations. The nature and extent of variation may not become evident until construction. If, during construction, subsurface conditions differ from those encountered in the explorations, we should be advised at once so we can observe and review these conditions and reconsider our recommendations where necessary.

6. PREPARERS AND CONTRIBUTORS

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This document has been submitted electronically.

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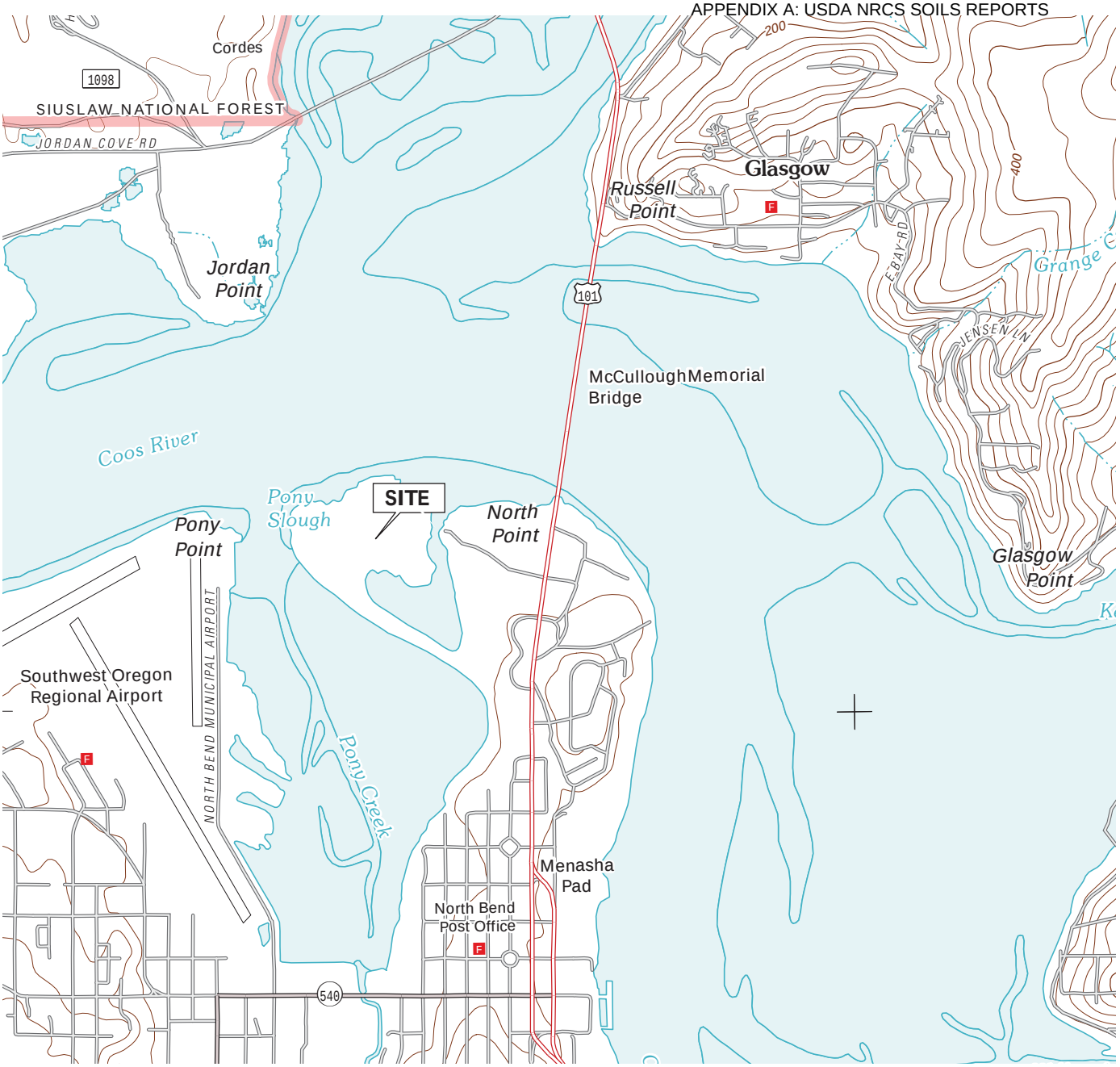


USGS TOPOGRAPHIC MAP
NORTH BEND, OREG. (2011)

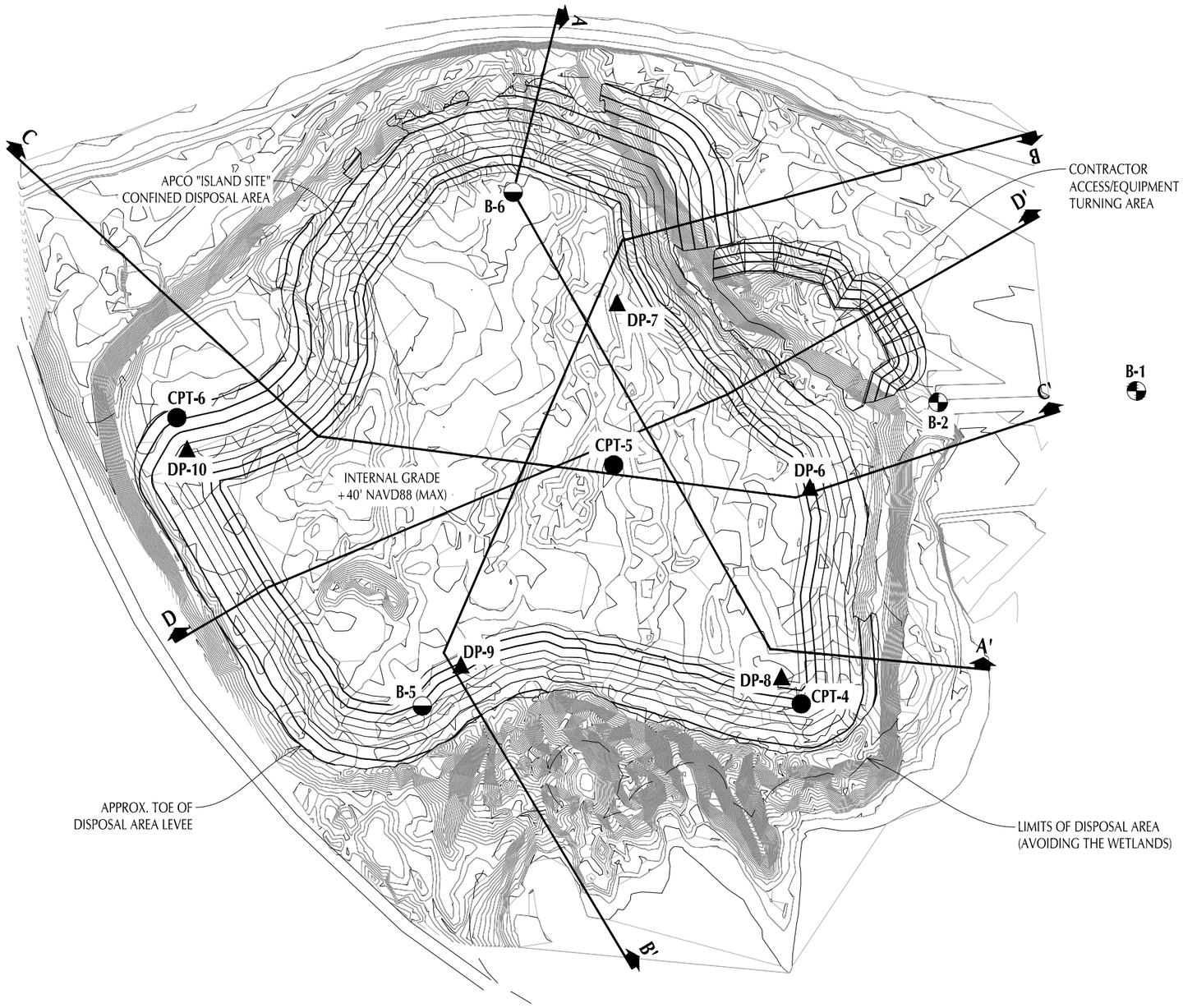
North

0 1/2 1 MILE

GRI DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE
APCO SITE 2

VICINITY MAP

NOV. 2018 JOB NO. 6099-B FIG. 1



NOTES:

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BORING COMPLETED BY GRI
(AUGUST - SEPTEMBER 2013)

DIRECT-PUSH PROBE COMPLETED BY GRI
(JUNE 12 - 22, 2017)

CONE PENETRATION TEST COMPLETED BY GRI
(JUNE 12 - 22, 2017)

BORING COMPLETED BY GRI
(JUNE 12 - 22, 2017)

SITE PLAN FROM FILE BY DAVID EVANS AND ASSOCIATES, INC.
DATED APRIL 5, 2018

North

0 200 400 FT

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GRI

Jordan Cove LNG SM

JORDAN COVE ENERGY PROJECT
APCO SITE 2

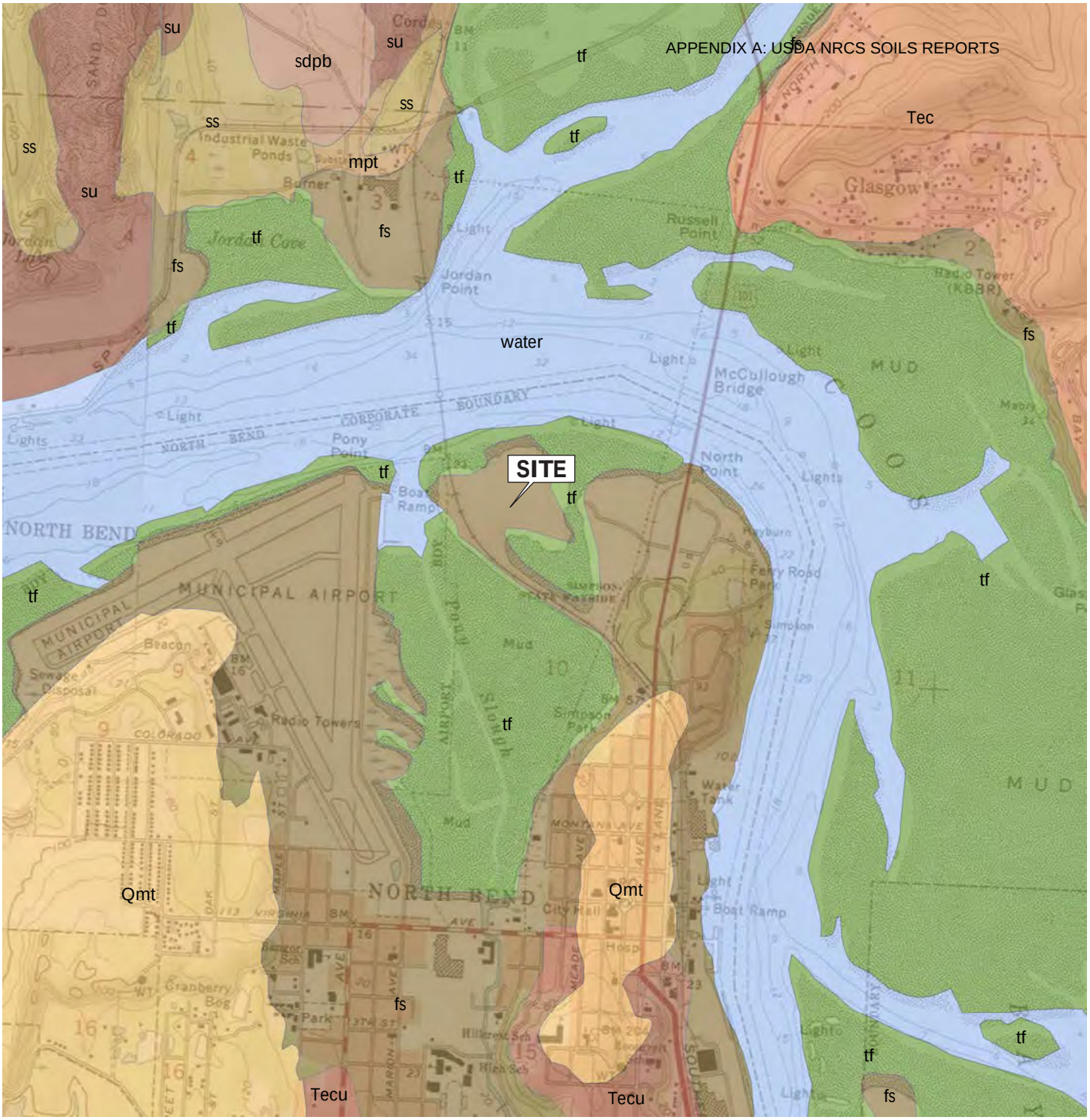
COOS COUNTY

Designer: SCR Review: KWW

Drafter: WMF Checker: KWW

SITE PLAN

SHEET NO.
FIG. 2



GEOLOGIC FORMATIONS

- Beach deposits, sdpb
- Coaledo Formation, Tec
- Coaledo Formation, Tecu
- Coastal terrace deposits, Qmt
- Eolian deposits, ss
- Eolian deposits, su
- Estuarine deposits, tf
- Man-made fill deposits, fs
- Marsh deposits, mpt
- Water

North

0 2,000 4,000 FT

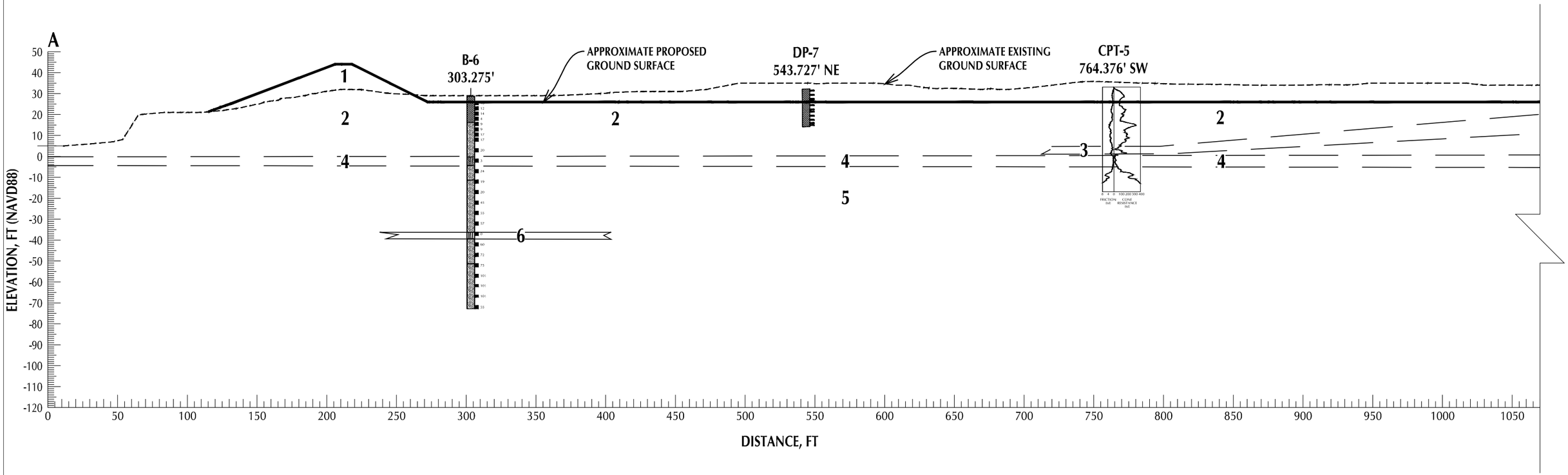
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LOCAL GEOLOGIC MAP

MODIFIED FROM: OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES DIGITAL DATA SERIES OGDC-6

NOV. 2018 JOB NO. 6099-B FIG. 3



LEGEND

- ■16 SPT SAMPLE AND N VALUE
- ■32* 3-IN. SAMPLE AND N* VALUE
- ☐U UNDISTURBED SAMPLE
- ☐ ROCK CORE
- ☐ GRAB SAMPLE

BORING LEGEND

- FILL
- SAND
- SILTY SAND
- SILT
- SANDY SILT

STRATIGRAPHY INTERPRETATION KEY:

1) CONTAINMENT DIKE FILL
2) EXISTING SANDY FILL
3) EXISTING SILTY FILL
4) RECENT ALLUVIUM
5) OLDER SANDY ALLUVIUM
6) OLDER SILTY ALLUVIUM
7) SILTSTONE

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COOS COUNTY

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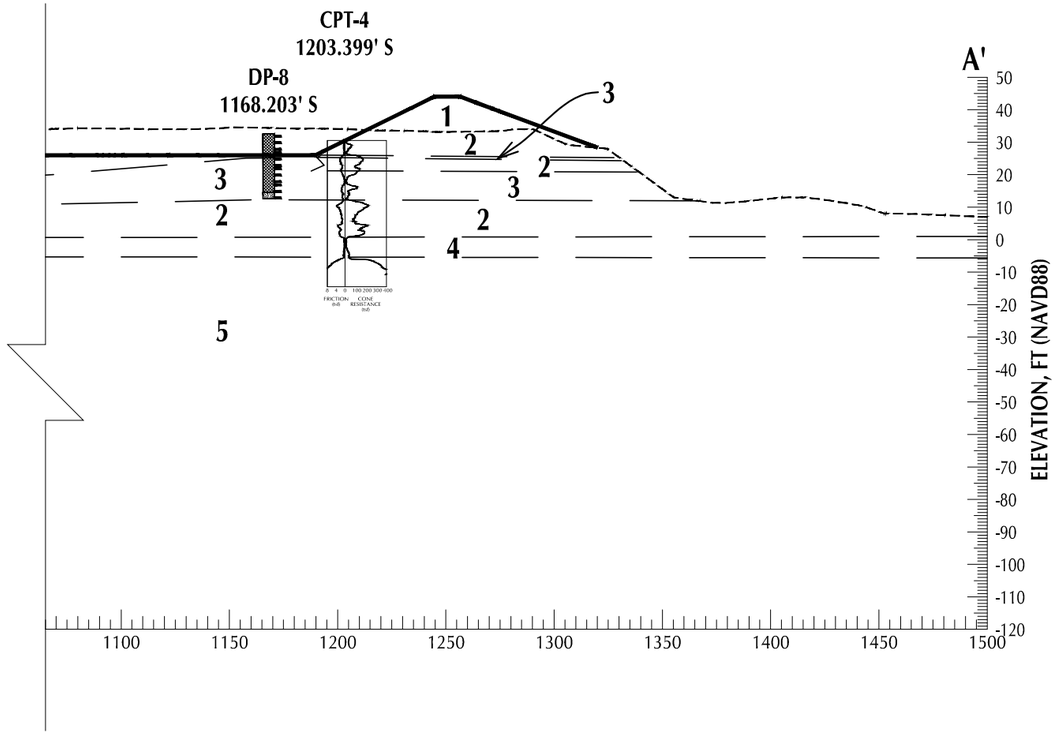
CROSS SECTION A-A' (NORTH)

SHEET NO.
FIG. 4.1A



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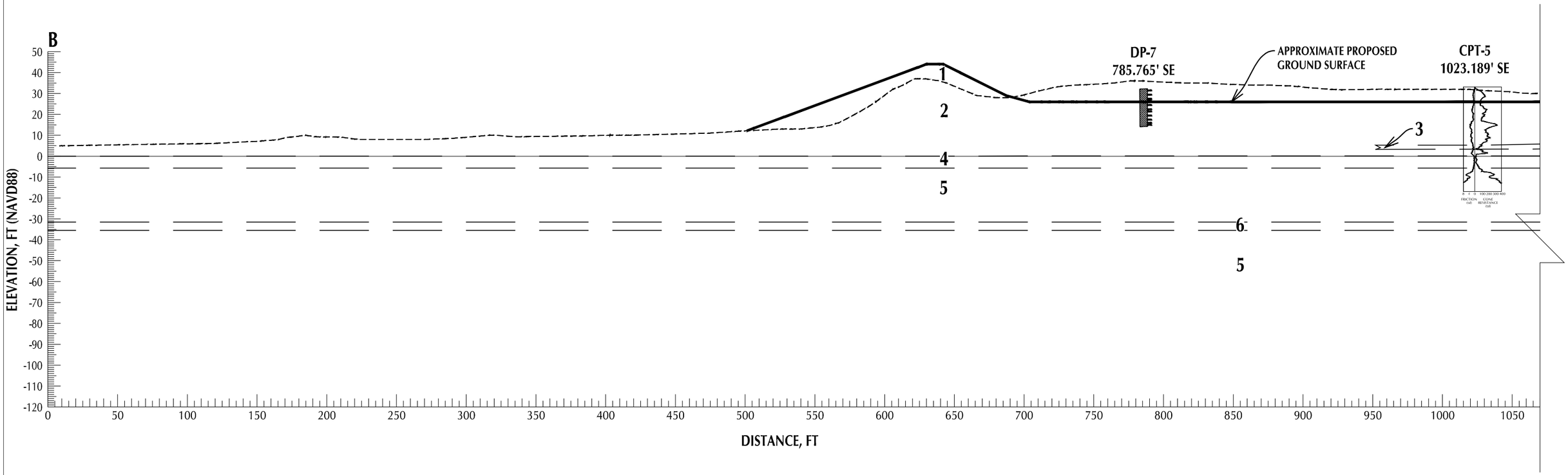
CROSS SECTION A-A' (SOUTH)

SHEET NO.
FIG. 4.1B



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APCO SITE 2

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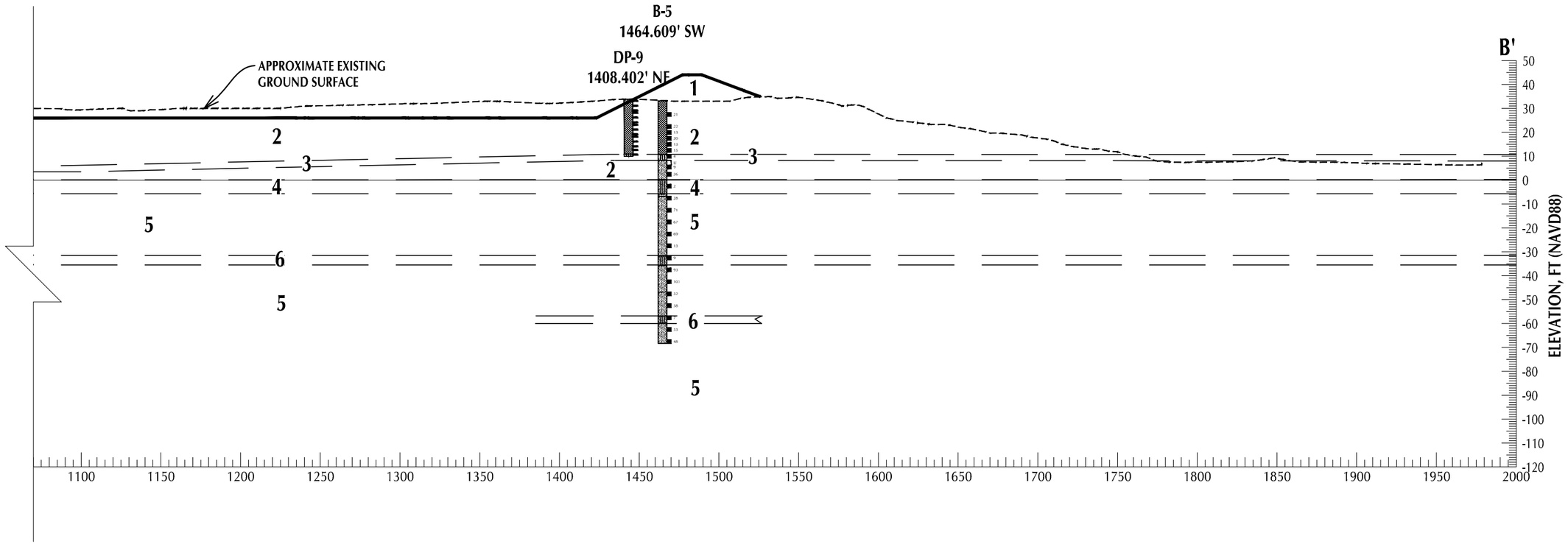
CROSS SECTION B-B' (NORTH)

SHEET NO.
FIG. 4.2A



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JORDAN COVE ENERGY PROJECT
APCO SITE 2

COOS COUNTY

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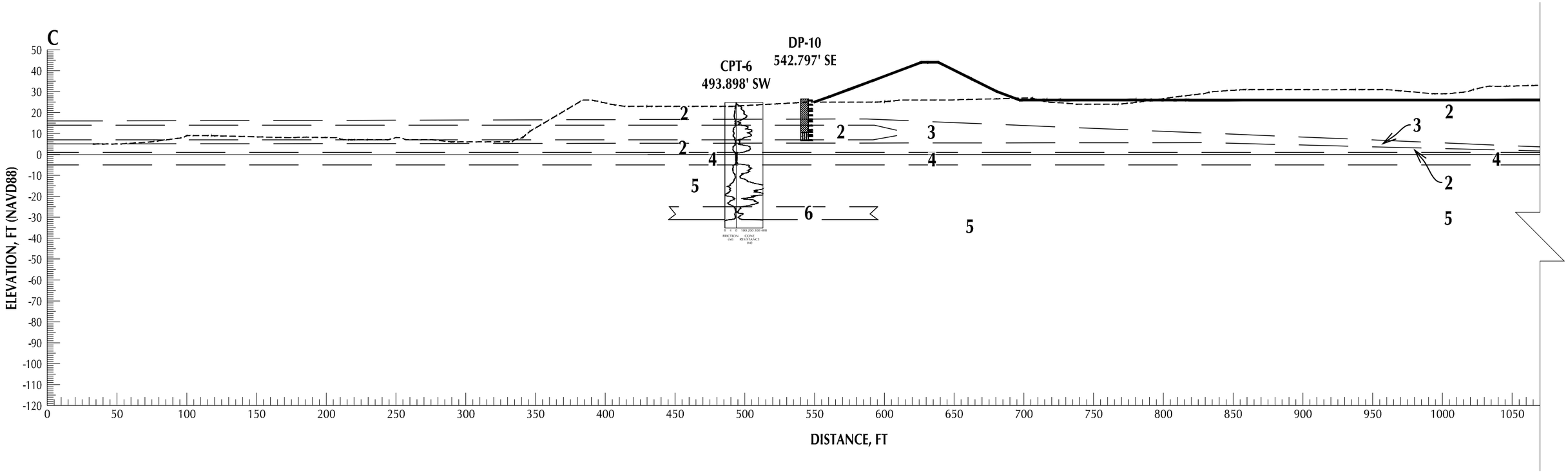
CROSS SECTION B-B' (SOUTH)

SHEET NO.
FIG. 4.2B



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JORDAN COVE ENERGY PROJECT
APCO SITE 2

COOS COUNTY

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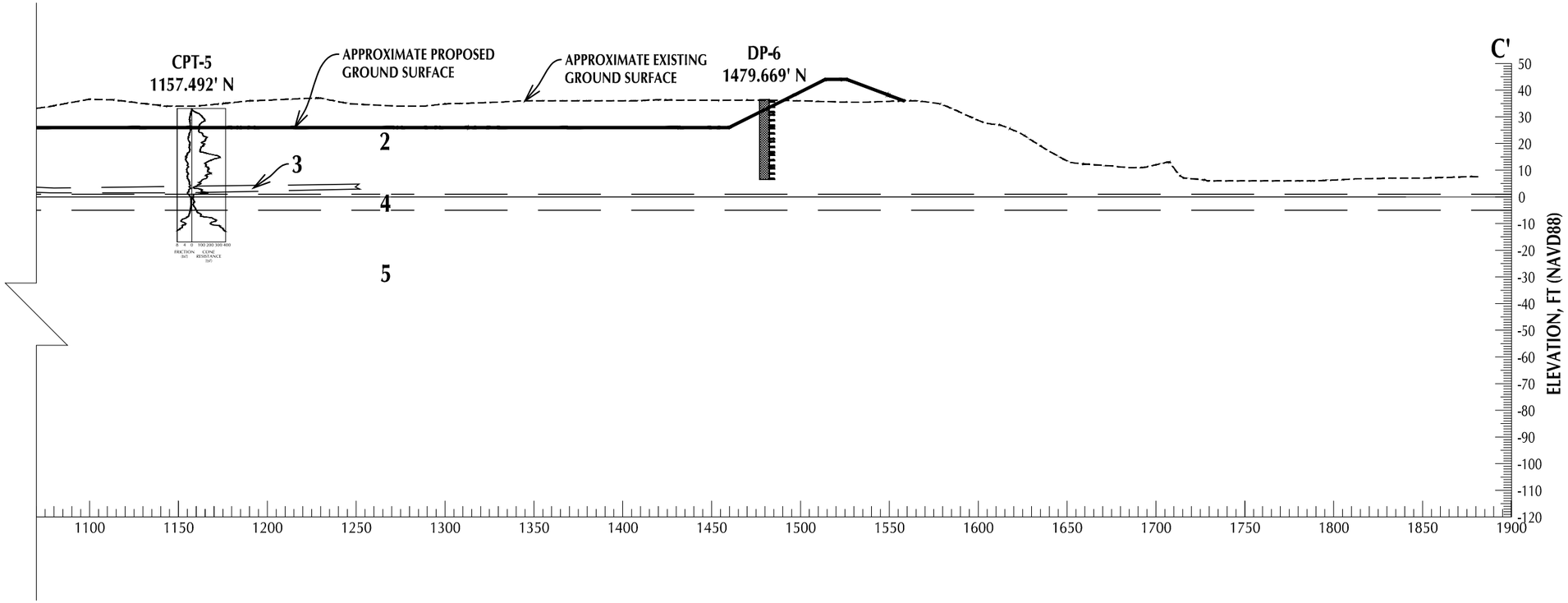
Drafter: WMF Checker: KWW

CROSS SECTION C-C' (EAST)

SHEET NO. FIG. 4.3A



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APCO SITE 2

COOS COUNTY

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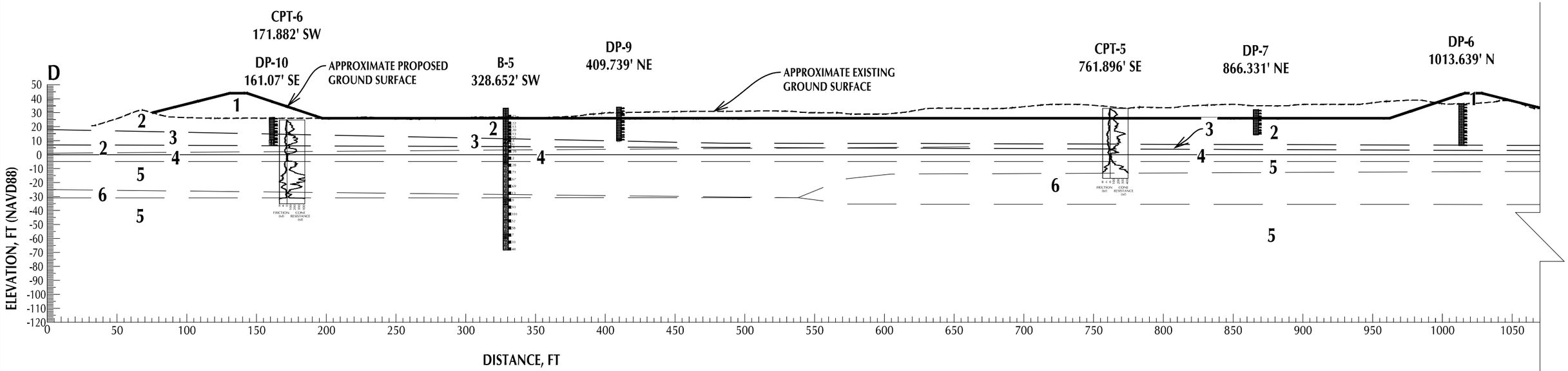
CROSS SECTION C-C' (WEST)

SHEET NO.
FIG. 4.3B



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JORDAN COVE ENERGY PROJECT
APCO SITE 2

COOS COUNTY

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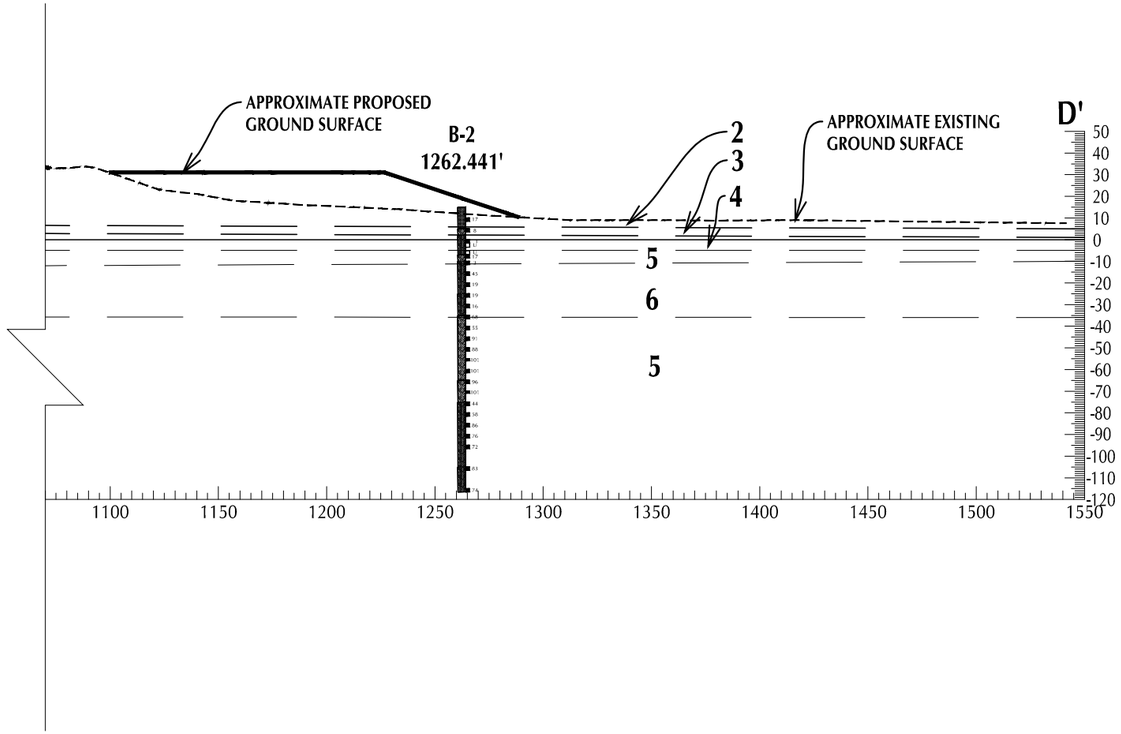
CROSS SECTION D-D' (WEST)

SHEET NO. FIG. 4.4A



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Jordan Cove LNG℠

JORDAN COVE ENERGY PROJECT
APCO SITE 2

COOS COUNTY

Designer: SCR Review: KWW
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CROSS SECTION D-D' (EAST)

SHEET NO.
FIG. 4.4B

APPENDIX A: GEOTECHNICAL DATA REPORT, JORDAN COVE ENERGY PROJECT, APCO SITE 2

APCO Geotechnical Data Report

A	07-19-2017	Issued for Information	K. Wolfe	S. Schlechter	S. Schlechter	

REV	DATE	DESCRIPTION	BY	CHKD	APPVD	COMPANY APPROVAL

IP SECURITY	☐ Confidential	Total amount of pages including coversheet:	298
FOR CONTRACTOR DOCUMENTS	Contract No.	Contractor Document No.	Contractor Rev.
	GRI-020	5764 SO 1165	For Information

JCL DOCUMENT NUMBER	Proj. Code	Unit / Location	Discipline	Doc. Type	Orig. Code	Sequence No.	Sheet No.
	J1	000	GEO	RPT	GRI	00051	00

Revision Modification Log

Document Title :		Rev. :	
Document No. :		Rev. Date :	

Page No.	Section	Change Description

9750 SW Nimbus Avenue
Beaverton, OR 97008-7172
p | 503-641-3478 f | 503-644-8034

July 19, 2017

5764 – SO1165 APCO GEOTECHNICAL DATA RPT

Jordan Cove LNG, LLC
5615 Kirby Drive, Suite 500
Houston, TX 77005

Attention: Mick Rowlands

SUBJECT: **Geotechnical Data Report**
APCO Site Pre-Purchase Evaluation
Channel Safety Enhancement Project
Coos Bay Pilots Association
Coos County, Oregon

At your request, GRI completed a geotechnical investigation program for the APCO East and West Sites in North Bend, Oregon. The general location of the sites are shown on the Vicinity Map in Figure 1. The purpose of this report is to support a pre-purchase evaluation of APCO site. Additionally, the findings from this exploration program will be used to support a preliminary dredge material placement consultation coordinated with Moffatt & Nichol (M&N) and David Evans and Associates, Inc. (DEA). During this work, an environmental sampling program was also carried out to evaluate dredge sand deposited on the site for potential contamination in order to support a Phase II Environmental Site Assessment (ESA), the details and results of which are provided in a separate report. This data report summarizes the subsurface explorations and laboratory testing completed at the site, which include the following two primary phases: a 2013 phase that included two borings, laboratory testing, and preparation of a draft geotechnical data report; and a 2017 phase of work that included four borings, six cone penetration tests (CPTs), 10 direct-push probes, laboratory testing, and preparation of this geotechnical data report that combines the results of the 2013 and 2017 geotechnical investigation phases. This geotechnical data report (GDR) describes the work accomplished, provides a summary of subsurface conditions at the project site, and presents geotechnical data and information related to the investigations.

PROJECT DESCRIPTION

The APCO Mainland (APCO East Site) and Island (APCO West Site) sites in North Bend, Oregon, are being considered for confined disposal of dredge materials. The location of the project site is shown in Figure 2. Our understanding of the project is based on our review of conceptual plans prepared for the APCO sites by M&N and a kickoff meeting conference call with the team on May 12, 2017. In general, the project proposes dredging material from four separate locations within the Coos Bay channel and transporting the dredged material to the site via a system of dredge pipes and booster pumps.

The conceptual plans show dredge material placement within confined disposal areas to maximum internal grades of 37 and 51 ft (North American Vertical Datum of 1988 [NAVD 88]) for the East and West Sites, respectively. Existing grades vary between approximately 20 to 30 ft at the APCO East Site and 25 to 40 ft at the APCO West Site. All elevations within this report refer to NAVD88. The dredged material will be

confined by levees constructed of dredged sand fill. The preliminary dredge plans show slope angles of 5H:1V (Horizontal to Vertical) but these will likely be adjusted as the design proceeds. Several discharge outfall weirs will aid in removing water from the disposal areas. A temporary, pile-supported access bridge will connect the APCO East and West Sites.

We understand the APCO West Site will likely not be used for development but that it is preferable that the APCO East Site will readily support future development.

SITE DESCRIPTION

Topography/Surface Conditions

The APCO Site (East and West Sites) is located in the northern portion of North Bend, Oregon. The site is bordered by Chappell Parkway and Hwy 101 to the east and the Coos Bay Rail Link to the south and west. The site is accessed by Chappell Parkway from the east. A tidally influenced channel and wetland trend south to north through the center of the site and separates the East and West Sites. The channel and tidal wetland varies in elevation between approximately 4 and 10 ft. The East Site is relatively flat and varies in elevation between approximately 20 and 30 ft. Remnants of gravel roads from the former Al Pierce Lumber Company are visible at the ground surface at the East Site. The West Site has more variable topography when compared to the East Site and varies in elevation between approximately 25 and 40 ft. Sparse, low-lying vegetation, including grasses and shrubs, cover areas beyond the limits of the gravel roads within the East Site. The West Site is characterized by low lying vegetation, including grasses and shrubs, and scattered groups of trees.

Geology

On a regional scale, the APCO Site is located within the Cascadia Subduction Zone (CSZ), the active convergent plate boundary along which remnants of the Farallon Plate (the Gorda, Juan de Fuca, and Explorer tectonic plates) are being subducted beneath the western edge of the overriding North American plate. The subduction zone is a broad, eastward-dipping zone of contact between the upper portion of the subducting slabs of the Gorda, Juan de Fuca, and Explorer plates and the over-riding North American Plate (Wells et al., 2000; Goldfinger et al., 2012). Sediments deposited in an open embayment of the Pacific Ocean during the Eocene time 56 to 34 million years ago became lithified into the bedrock units including the marine interbedded siltstones and sandstones of the Coaledo Formation below the site (Baldwin et al., 1973; Allen and Baldwin, 1944). Major folding and uplift at Coos Bay occurred during Oligocene (23 to 34 million years ago) to Pliocene time (3 to 5 million years ago) and caused the initial faulting and folding now observed in the area (Dott, 1966).

Locally, the area has been folded into a series of primarily north-northeast-trending anticlines and synclines, which are commonly associated with drag on adjacent faults. Faults are generally either north-south-trending reverse faults or west-northwest and east-northeast thrust or oblique strike-slip faults. Geologic mapping at the site suggests the site is located within a synclinal trough that trends north-south through the site through Pony Slough (Madin et al., 1995). Historical information indicates the U.S. Army Corps of Engineers placed sand fill on the site in the 1980s. The sand fill is underlain by Quaternary alluvial deposits.

SUBSURFACE CONDITIONS

General

The geotechnical investigations completed on site were completed during two separate mobilizations. The first mobilization was completed as part of a previous task order and occurred between August 28 and September 10, 2013, and the second occurred between June 12 and June 22, 2017, as part of this scope of work.

The geotechnical investigations included six mud-rotary borings, designated B-1 through B-6, six CPT explorations, designated CPT-1 through CPT-6, and 10 direct-push probes, designated DP-1 through DP-10. Borings B-1 through B-2 were completed as part of the 2013 exploration program and the boring numbers for this exploration program were labeled sequentially from the previous program starting with B-3. The borings were advanced to depths ranging between 100 and 136.5 ft, the CPT explorations to depths ranging between approximately 39 and 62 ft, and the direct-push probes to depths ranging between 18 and 30 ft. It should be noted that very dense sand layers or very stiff decomposed siltstone resulted in refusal of the CPT explorations at shallower depths than initially planned. Probe CPT-2 was attempted several times near the planned location due to initial refusal at depths less than 20 ft. The locations of the borings, CPT explorations, and direct-push probes are shown on Figure 2.

The field exploration and laboratory testing programs completed for this investigation are described in Appendix A. Logs of the borings, B-1 through B-6, are provided on Figures 1A through 6A. Logs of the CPT explorations, CPT-1 through CPT-6, are provided on Figures 7A through 12A. Logs of the direct-push probes, DP-1 through DP-10, are provided on Figures 13A through 22A. The terms used to describe the soils encountered in the explorations are defined in Tables 1A and 2A.

The results of our geotechnical investigation program indicate medium dense to very sand fill was encountered at the ground surface over much of the East and West Sites. The sand fill is estimated to vary in thickness between approximately 22 and 30 ft at the East Site, and 13 and 29 ft at the West Site. Very loose to loose sand (upper sand) was encountered beneath the sand fill and varies in thickness between approximately 7 to 17 feet at the East Site, and 4 to 9 feet at the West Site. The transition between native and fill materials was difficult to estimate in some of the explorations and the discussion below further describes this uncertainty. Medium dense to very dense sand (lower sand) was encountered beneath the very loose to loose sand and varies in thickness between approximately 98.5 ft at boring B-1, approximately 9.5 ft at CPT-3, and 12 ft at boring B-4. Borings B-2, B-3, B-5 and B-6, and CPT explorations CPT-1, CPT-2, and CPT-4 through CPT-6 encountered the lower sand beneath the upper sand to the maximum depth explored. Borings B-1 and B-4, and CPT-3 encountered decomposed siltstone beneath the lower sand to the maximum depth explored.

It should be noted that the correlations between borings and adjacent CPT explorations indicate the CPT classifications shown on the logs are likely over estimating the fines content of the soils on site. A more detailed discussion of the materials disclosed by the explorations is provided below.

Soils

For the purpose of discussion, the soil and rock disclosed by the borings have been grouped into the following categories based on their physical characteristics and engineering properties. The sand fill, as described below, is differentiated into Fill and Possible Fill on the borings logs. The Possible Fill could

potentially be related to historical shoaling of sand at the APCO East and West site before placement of fill; however, this material exhibits characteristics and properties that are similar to the sand fill.

1. **SAND (Fill or Possible Fill)**
2. **UPPER SAND (Recent Alluvium)**
3. **LOWER SAND (Older Alluvium)**
4. **SILTSTONE**

1. SAND (Fill or Possible Fill). Borings B-1 through B-6 and CPT explorations CPT-1 through CPT-6 encountered sand fill from the ground surface to a maximum depth between approximately 22 and 30 ft (elevation between 0 and 6 ft) at the East Site, and from the ground surface to a maximum depth between approximately 13 and 29 ft (elevation between 0 and 2 feet) at the West Site. Direct-push probes DP-1 through DP-10 encountered sand fill from the ground surface to the maximum depth explored. The sand fill is typically brown to gray, fine to medium grained, and contains trace to some silt. Zones containing scattered wood debris and shell fragments are present locally in the sand fill. The relative density of the sand fill varies considerably from very loose to very dense based on Standard Penetration Test (SPT) N-values ranging from 4 to 58 blows/ft, and CPT tip resistance values ranging from 3 to 442 tsf. However, the relative density of the sand fill typically ranges from medium dense to dense based on SPT N-values and CPT tip resistance values ranging from about 10 to 34 and 46 to 206 tsf, respectively. Boring B-5 encountered a layer of soft to medium stiff sandy silt within the possible fill at depths between approximately 22.5 and 25 ft (elevation between 10.7 and 8.2 ft). The natural moisture content of the sand fill ranges from about 5 to 72%. The lower CPT tip resistances and higher moisture contents of the fill are typically associated with higher fines contents.

2. UPPER SAND (Recent Alluvium). Borings B-1 through B-6 and CPT explorations CPT-1 through CPT-6 encountered the upper sand beneath the sand fill to a maximum depth between approximately 34 and 38 ft (elevation between -6 and -12.2 ft) at the East Site, and beneath the sand fill to a maximum depth between approximately 22 to 39 ft (elevation between -4.3 and -7 ft) at the West Site. The upper sand is typically gray, fine grained, and silty. Zones containing scattered wood debris and shell fragments are present locally in the upper sand. Based on the CPT explorations, the upper sand may be interbedded with lenses of very soft to soft silt. The relative density of the upper sand typically ranges from very loose to loose based upon SPT N-values ranging from 0 to 6 blows/ft, and CPT tip resistance values ranging from 6 to 30 tsf. The natural moisture content of the upper sand ranges from about 24 to 54%.

3. LOWER SAND (Older Alluvium). Borings B-2, B-3, B-5 and B-6, and CPT explorations CPT-1, CPT-2, and CPT-4 through CPT-6 encountered the lower sand beneath the upper sand and to the maximum depth explored. Borings B-1 and B-4, and CPT exploration CPT-3 encountered the lower sand beneath the upper sand and to a maximum depth of approximately 132.5 ft (elevation 104.5 ft) at boring B-1, 50 ft (elevation -24.2 ft) at boring B-4, and 46 ft (elevation -25 ft) at CPT exploration CPT-3. The lower sand is typically gray, fine grained, and contains a trace of silt to silty. Zones containing scattered wood debris and shell fragments are present locally in the lower sand. The relative density of the sand fill varies considerably from very loose to very dense based on SPT N-values ranging from 0 to blows/ft to practical refusal, which is defined as more than 50 blows for 6 in. of sampler penetration, and CPT tip resistance values ranging from 13 to 514 tsf. However, the relative density of the sand fill typically ranges from medium dense to very dense based upon N-values and CPT tip resistance values ranging from 24 to practical refusal and 101

to 349 tsf, respectively. Borings B-1, B-2, B-4 and B-5 encountered 3- to 5-ft-thick interbedded layers of very loose to loose silty sand. Boring B-6 encountered a 3-ft-thick interbedded layer of very soft silt. The natural moisture content of the lower sand ranges from about 19 to 103%.

4. SILTSTONE. Borings B-1 and B-4, and CPT exploration CPT-3 encountered decomposed siltstone consisting of silt beneath the lower sand and to the maximum depth explored. The silt is gray and contains varying amount of sand and a trace of clay. The relative consistency of the silt is hard based on SPT N-values of 38 blows/ft to practical refusal and CPT sleeve friction values ranging from 2 to 7 tsf. The natural moisture content of the siltstone ranges from about 17 to 28%.

Groundwater

The borings were advanced using mud-rotary drilling techniques, which do not allow the direct measurement of groundwater levels. The CPT explorations indicated groundwater at a depth between approximately 20 and 33 ft (elevation between -1 and 1 ft). CPT-2 indicated groundwater at a depth of approximately 17.5 ft (elevation 9 ft); however, this groundwater measurement appears to be erroneous and therefore was not included in our approximation of groundwater levels at the site. The groundwater level at the site is anticipated to be near the water level observed in the adjacent Coos Bay and Pony Slough and fluctuates in response to tides.

LIMITATIONS

This geotechnical data report summarizes the results of subsurface explorations and laboratory testing completed for this phase of the geotechnical exploration program. The scope of this report is limited to the specific project and location described herein, and our description of the project represents our current understanding of the significant aspects of the project The data provided in this report were obtained from the subsurface explorations made at the locations indicated on the Exploration Site Plan and from other sources of information as discussed in this report. In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is acknowledged that variations in soil or rock conditions may exist between exploration locations, and this report does not necessarily reflect these potential variations.

Submitted for GRI,

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USGS TOPOGRAPHIC MAP
NORTH BEND, OREG. (2014)

North

0 1/2 1 MILE

GRI

JORDAN COVE LNG
APCO SITE PRE-PURCHASE EVALUATION

VICINITY MAP

JULY 2017 JOB NO. 5764-SO 1165 FIG. 1



GRI

JORDAN COVE LNG
APCO SITE PRE-PURCHASE EVALUATION

EXPLORATION SITE PLAN

JULY 2017 JOB NO. 5764-SO 1165 FIG. 2

APPENDIX A

Field Explorations and Laboratory Testing

APPENDIX A

FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATIONS

General

The geotechnical investigations on site were completed during two separate mobilizations. The first mobilization occurred between August 28 and September 10, 2013, the second occurred between June 12 and June 22, 2017.

The geotechnical investigation for this phase of work included four mud-rotary borings, designated B-3 through B-6, six CPT explorations, designated CPT-1 through CPT-6, and 10 direct-push probes, designated DP-1 through DP-10. The locations of the borings, CPT explorations, and direct-push probes are shown on Figure 2. Before mobilizing to the site, a work and safety plan was completed by GRI and submitted to Jordan Cove for approval. The work and safety plan described the planned work at the site, summarized required tribal notifications and permitting, and provided specifics regarding our health and safety program for the project. Our work was completed in general accordance with the approved work and safety plan.

The field work was directed by an experienced geotechnical engineer from GRI, who maintained a detailed log of the materials disclosed during the course of the work and obtained soil samples from the borings. All explorations were backfilled in accordance with the Oregon Water Resources Department (OWRD) requirements.

Borings

Boring B-1 was advanced to a depth of 136.5 ft on September 9 and 10, 2013, with a CME75 truck-mounted drill rig. Boring B-2 was advanced to a depth of 131.5 ft on August 28 and 29, 2013, with a WS 45 track-mounted drill rig. Borings B-3 through B-6 were advanced to depths ranging between 100.3 and 101.5 ft on June 19 through June 22, 2017, with a CME55 track-mounted drill rig. The borings were drilled using mud-rotary drilling techniques. The drill rigs were provided and operated by Western States Soil Conservation, Inc. of Hubbard, Oregon. Disturbed and undisturbed samples were typically obtained at 2.5- to 10-ft intervals of depth. Disturbed samples were obtained using a standard split-spoon sampler. At the time of sampling, the Standard Penetration Test was conducted. This test consists of driving a standard split-spoon sampler into the soil a distance of 18 in. using a 140-lb hammer dropped 30 in. The number of blows required to drive the sampler the last 12 in. is known as the standard penetration resistance, or SPT N-value. The SPT N-values provide a measure of the relative density of granular soils, such as sand, and the relative consistency, or stiffness, of cohesive soils such as clay or silt. The split-spoon samples were carefully examined in the field, and representative portions were saved in airtight jars for further examination and physical testing in our laboratory.

Relatively undisturbed samples of soils were obtained by pushing 3-in.-outside-diameter (O.D.) Shelby tubes into the undisturbed soil a maximum distance of 24 in. using the hydraulic ram of the drill rig. The soil exposed in the ends of the Shelby tubes were examined and classified in the field. After classification, the ends of the tubes were sealed with rubber caps and tape to preserve the natural moisture content of the soils. All samples were returned to our laboratory for further examination and physical testing.

Logs of the borings are provided on Figures 1A through 6A. Each log presents a descriptive summary of the various types of material encountered in the boring and notes the depth where the materials and/or characteristics of the materials change. To the right of the descriptive summary, the numbers and types of samples taken during the drilling operation are indicated. Farther to the right, N-values are shown graphically along with the results of laboratory testing performed on the soils. The terms and symbols used to describe the materials encountered in the borings are defined in Tables 1A and 2A and the attached legend.

Cone Penetration Tests

CPT-1 through CPT-6 were advanced to depths ranging between approximately 39 and 62 ft on June 12 and 13, 2017, using a with a Geoprobe 6622CPT track-mounted rig provided and operated by Oregon Geotechnical Explorations, Inc. of Keizer, Oregon. During a CPT, a steel cone is forced vertically into the soil at a constant rate of penetration. The force required to cause penetration at a constant rate can be related to the bearing capacity of the soil immediately surrounding the point of the penetrometer cone. This force is measured and recorded every 4 in. In addition to the cone measurements, measurements are obtained of the magnitude of force required to force a friction sleeve, attached above the cone, through the soil. The force required to move the friction sleeve can be related to the undrained shear strength of fine-grained soils. The dimensionless ratio of sleeve friction to point bearing capacity provides an indicator of the type of soil penetrated. The cone penetration resistance and sleeve friction can be used to evaluate the relative consistency of cohesionless and cohesive soils, respectively. In addition, a piezometer fitted between the cone and the sleeve measures changes in water pressures as the probe is advanced and can also be used to measure the depth of the top of the groundwater surface. The CPT logs are provided on Figures 7A through 12A. An interpretation of the soil types encountered by the probe is shown graphically on the logs. Guidelines for the classification of soils in the CPT probe are provided in Table 2A.

Direct-Push Probes

DP-1 through DP-10, were advanced to depths ranging between 18 and 30 ft on June 13 through June 15, 2017. The push-probes were completed using a track-mounted direct-push probe operated by Oregon Geotechnical Explorations, Inc. of Keizer, Oregon. Logs of the borings are presented in Appendix A and shown on Figures 13A through 22A. The terms and symbols used to describe the soils encountered in the borings are defined in Table 1A and the attached legend. The exploration details and results from the direct-push probes were used to support a Phase II ESA completed for the project and are provided in a separate report.

Soil core were collected continuously using a 5-ft-long, 1.5-in.-inside-diameter, Macro-Core sampler (manufactured by Geoprobe®). The sampler contains a clear plastic liner that holds soil cores. The liners were cut open in the field to expose the soil cores. The soil in the sample cores was visually examined for indications of contamination (staining, noticeable odors). The borings were advanced in 5-ft intervals. Soil samples were placed into a laboratory supplied, airtight, glass containers.

GEOTECHICAL LABORATORY TESTING

General

The samples obtained from the borings were examined in our laboratory, where the physical characteristics of the samples were noted and the field classifications were modified where necessary. At the time of

classification, the natural moisture content of each sample was determined. Due to the granular nature of the soils, additional geotechnical laboratory testing was limited to grain size analyses.

Natural Moisture Content

Natural moisture contents were determined in conformance with ASTM D 2216. The results are summarized on Figures 1A through 6A and Table 3A

Grain Size (Washed Sieve)

To assist in classification of the soils, samples of known dry weight were washed over a No. 200 sieve. The material retained on the No. 200 sieve is oven dried and re-weighed, and the percentage of material (by weight) that passed the No. 200 sieve is calculated. The test results are shown on Figures 1A through 6A and Table 3A

Table 1A: GUIDELINES FOR CLASSIFICATION OF SOIL

Description of Relative Density for Granular Soil

Relative Density	Standard Penetration Resistance (N-values) blows per foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	over 50

Description of Consistency for Fine-Grained (Cohesive) Soils

Consistency	Standard Penetration Resistance (N-values) blows per foot	Torvane or Undrained Shear Strength, tsf
Very Soft	0 - 2	less than 0.125
Soft	2 - 4	0.125 - 0.25
Medium Stiff	4 - 8	0.25 - 0.50
Stiff	8 - 15	0.50 - 1.0
Very Stiff	15 - 30	1.0 - 2.0
Hard	over 30	over 2.0

Grain-Size Classification	Modifier for Subclassification		
Boulders: > 12 in.		Primary Constituent SAND or GRAVEL	Primary Constituent SILT or CLAY
Cobbles: 3 - 12 in.	Adjective	Percentage of Other Material (by weight)	
Gravel:	trace:	5 - 15 (sand, gravel)	5 - 15 (sand, gravel)
1/4 - 3/4 in. (fine)	some:	15 - 30 (sand, gravel)	15 - 30 (sand, gravel)
3/4 - 3 in. (coarse)	sandy, gravelly:	30 - 50 (sand, gravel)	30 - 50 (sand, gravel)
Sand:	trace:	< 5 (silt, clay)	*Relationship of clay and silt determined by plasticity index test*
No. 200 - No. 40 sieve (fine)	some:	5 - 12 (silt, clay)	
No. 40 - No. 10 sieve (medium)	silty, clayey:	12 - 50 (silt, clay)	
No. 10 - No. 4 sieve (coarse)			
Silt/Clay: pass No. 200 sieve			

Table 2A: SOIL CLASSIFICATION BASED ON CONE PENETRATION TEST

Friction Ratio (Percent)	Soil Classification
0 to 2	Clean sand or slightly silty sand
2 to 5	Silty sand, clayey sand, or silt
> 5	Clayey silt, silty clay, or clay

COHESIVE SOILS

Sleeve Friction, tsf	Relative Consistency
<0.12	Very Soft
0.12 to 0.25	Soft
0.25 to 0.50	Medium Stiff
0.50 to 1.00	Stiff
1.00 to 2.00	Very Stiff
>2.00	Hard

COHESIONLESS SOILS

	Soil Type*			
	ML, SM	SM, SP, SW	SP, SW, GW	SW, GP
Relative Density	**Cone Penetration Resistance, tsf**			
Very Loose	0 - 8	0 - 14	0 - 20	0 - 24
Loose	8 - 20	14 - 35	20 - 50	24 - 60
Med. Dense	20 - 60	35 - 105	50 - 150	60 - 180
Dense	60 - 100	105 - 175	150 - 250	180 - 300
Very Dense	> 100	> 175	> 250	> 300

* Unified Soil Classification System

Friction ratio is equal to sleeve friction (tsf) divided by cone penetration (tsf) expressed as a percent.

Table 3A

SUMMARY OF LABORATORY RESULTS

Sample Information						Atterberg Limits			
Location	Sample	Depth, ft	Elevation, ft	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Fines Content, %	Soil Type
B-1	S-1	5.0	23.0	19	--	--	--	--	FILL
	S-2	10.0	18.0	16	--	--	--	--	FILL
	S-3	15.0	13.0	21	--	--	--	7	FILL
	S-4	20.0	8.0	19	--	--	--	--	FILL
	S-5	25.0	3.0	34	--	--	--	10	SAND
	S-7	32.0	-4.0	32	--	--	--	12	SAND
	S-9	36.0	-8.0	23	--	--	--	5	SAND
	S-10	40.0	-12.0	23	--	--	--	--	SAND
	S-11	45.0	-17.0	31	--	--	--	14	SAND
	S-12	50.0	-22.0	24	--	--	--	--	SAND
	S-13	55.0	-27.0	23	--	--	--	--	SAND
	S-14	60.0	-32.0	33	--	--	--	28	Silty SAND
	S-15	65.0	-37.0	23	--	--	--	--	SAND
	S-16	70.0	-42.0	21	--	--	--	--	SAND
	S-17	75.0	-47.0	23	--	--	--	--	SAND
	S-18	80.0	-52.0	21	--	--	--	--	SAND
	S-19	85.0	-57.0	22	--	--	--	--	SAND
	S-20	90.0	-62.0	20	--	--	--	--	SAND
	S-21	95.0	-67.0	21	--	--	--	--	SAND
	S-22	100.0	-72.0	23	--	--	--	--	SAND
	S-23	105.0	-77.0	28	--	--	--	22	Silty SAND
	S-24	110.0	-82.0	22	--	--	--	13	Silty SAND
	S-25	120.0	-92.0	21	--	--	--	8	SAND
	S-26	130.0	-102.0	103	--	--	--	49	Silty SAND
	S-27	135.0	-107.0	28	--	--	--	75	SILT
B-2	S-1	5.0	10.0	5	--	--	--	--	FILL
	S-2	10.0	5.0	24	--	--	--	--	SAND
	S-3	15.0	0.0	38	--	--	--	28	Silty SAND
	S-6	22.0	-7.0	27	--	--	--	6	SAND
	S-7	25.0	-10.0	39	--	--	--	27	Silty SAND
	S-8	30.0	-15.0	22	--	--	--	--	Silty SAND
	S-9	35.0	-20.0	28	--	--	--	16	Silty SAND
	S-10	40.0	-25.0	27	--	--	--	13	Silty SAND
	S-11	45.0	-30.0	29	--	--	--	21	Silty SAND
	S-12	50.0	-35.0	24	--	--	--	7	SAND
	S-13	55.0	-40.0	26	--	--	--	--	SAND
	S-14	60.0	-45.0	22	--	--	--	--	SAND
	S-15	65.0	-50.0	23	--	--	--	--	SAND
	S-16	70.0	-55.0	21	--	--	--	--	SAND
	S-17	75.0	-60.0	20	--	--	--	--	SAND

Table 3A

SUMMARY OF LABORATORY RESULTS

Sample Information						Atterberg Limits			
Location	Sample	Depth, ft	Elevation, ft	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Fines Content, %	Soil Type
B-2	S-18	80.0	-65.0	23	--	--	--	--	SAND
	S-19	85.0	-70.0	21	--	--	--	--	SAND
	S-20	90.0	-75.0	20	--	--	--	14	Silty SAND
	S-21	95.0	-80.0	20	--	--	--	16	Silty SAND
	S-22	100.0	-85.0	19	--	--	--	--	Silty SAND
	S-23	105.0	-90.0	19	--	--	--	12	Silty SAND
	S-24	110.0	-95.0	22	--	--	--	12	Silty SAND
	S-25	120.0	-105.0	20	--	--	--	--	Silty SAND
	S-26	130.0	-115.0	22	--	--	--	--	Silty SAND
B-3	S-1	2.5	27.5	9	--	--	--	--	FILL
	S-2	5.0	25.0	10	--	--	--	--	FILL
	S-3	7.5	22.5	10	--	--	--	5	FILL
	S-4	10.0	20.0	11	--	--	--	--	FILL
	S-5	12.5	17.5	9	--	--	--	--	FILL
	S-6	15.0	15.0	13	--	--	--	--	FILL
	S-7	20.0	10.0	17	--	--	--	9	FILL
	S-8	22.5	7.5	20	--	--	--	--	FILL
	S-9	25.0	5.0	27	--	--	--	8	SAND
	S-10	27.5	2.5	29	--	--	--	--	SAND
	S-11	30.0	0.0	39	--	--	--	23	Silty SAND
	S-12	35.0	-5.0	35	--	--	--	--	Silty SAND
	S-13	40.0	-10.0	25	--	--	--	--	SAND
	S-14	45.0	-15.0	26	--	--	--	7	SAND
	S-15	50.0	-20.0	30	--	--	--	--	SAND
	S-16	55.0	-25.0	25	--	--	--	--	SAND
	S-17	60.0	-30.0	24	--	--	--	5	SAND
	S-18	65.0	-35.0	24	--	--	--	--	SAND
	S-19	70.0	-40.0	25	--	--	--	--	SAND
	S-20	75.0	-45.0	24	--	--	--	--	SAND
	S-21	80.0	-50.0	21	--	--	--	--	SAND
	S-22	85.0	-55.0	23	--	--	--	--	SAND
	S-23	90.0	-60.0	21	--	--	--	--	SAND
	S-24	95.0	-65.0	22	--	--	--	--	SAND
	S-25	100.0	-70.0	29	--	--	--	--	SAND
B-4	S-1	2.5	23.3	16	--	--	--	--	FILL
	S-2	5.0	20.8	12	--	--	--	--	FILL
	S-3	7.5	18.3	10	--	--	--	--	FILL
	S-4	10.0	15.8	14	--	--	--	6	FILL
	S-5	12.5	13.3	27	--	--	--	--	FILL
	S-6	15.0	10.8	21	--	--	--	7	FILL

Table 3A

SUMMARY OF LABORATORY RESULTS

Sample Information						Atterberg Limits			
Location	Sample	Depth, ft	Elevation, ft	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Fines Content, %	Soil Type
B-4	S-7	20.0	5.8	25	--	--	--	5	SAND
	S-8	25.0	0.8	54	--	--	--	--	Silty SAND
	S-9	30.0	-4.2	42	--	--	--	33	Silty SAND
	S-10	35.0	-9.2	32	--	--	--	--	Silty SAND
	S-11	40.0	-14.2	25	--	--	--	--	SAND
	S-12	45.0	-19.2	42	--	--	--	12	SAND
	S-13	50.0	-24.2	22	--	--	--	--	Sandy SILT
	S-14	55.0	-29.2	25	--	--	--	--	Sandy SILT
	S-15	60.0	-34.2	26	--	--	--	--	Sandy SILT
	S-16	65.0	-39.2	17	--	--	--	52	Sandy SILT
	S-17	70.0	-44.2	18	--	--	--	--	Sandy SILT
	S-18	75.0	-49.2	23	--	--	--	--	Sandy SILT
	S-19	80.0	-54.2	17	--	--	--	66	Sandy SILT
	S-20	85.0	-59.2	17	--	--	--	--	Sandy SILT
	S-21	90.0	-64.2	17	--	--	--	--	Sandy SILT
	S-22	95.0	-69.2	25	--	--	--	--	Sandy SILT
	S-23	100.0	-74.2	19	--	--	--	--	Sandy SILT
B-5	S-1	5.0	28.2	14	--	--	--	6	FILL
	S-2	10.0	23.2	11	--	--	--	--	FILL
	S-3	12.5	20.7	21	--	--	--	--	FILL
	S-4	15.0	18.2	14	--	--	--	3	FILL
	S-5	17.5	15.7	15	--	--	--	--	FILL
	S-6	20.0	13.2	22	--	--	--	--	FILL
	S-7	22.5	10.7	72	--	--	--	53	Sandy SILT
	S-8	25.6	7.6	19	97	--	--	2	SAND
	S-9	27.0	6.2	22	--	--	--	--	SAND
	S-10	30.0	3.2	24	--	--	--	--	SAND
	S-11	35.0	-1.8	32	--	--	--	25	Silty SAND
	S-12	40.0	-6.8	25	--	--	--	--	SAND
	S-13	45.0	-11.8	21	--	--	--	--	SAND
	S-14	50.0	-16.8	22	--	--	--	--	SAND
	S-15	55.0	-21.8	21	--	--	--	--	SAND
	S-16	60.0	-26.8	29	--	--	--	--	SAND
	S-17	65.0	-31.8	31	--	--	--	31	Silty SAND
	S-18	70.0	-36.8	22	--	--	--	--	SAND
	S-19	75.0	-41.8	21	--	--	--	--	SAND
	S-20	80.0	-46.8	26	--	--	--	--	SAND
	S-21	85.0	-51.8	21	--	--	--	--	SAND
	S-22	90.0	-56.8	30	--	--	--	18	Silty SAND
	S-23	95.0	-61.8	23	--	--	--	--	SAND

Table 3A

SUMMARY OF LABORATORY RESULTS

Sample Information						Atterberg Limits			
Location	Sample	Depth, ft	Elevation, ft	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Fines Content, %	Soil Type
B-5	S-24	100.0	-66.8	24	--	--	--	--	SAND
B-6	S-1	2.5	26.2	13	--	--	--	--	FILL
	S-2	5.0	23.7	18	--	--	--	2	FILL
	S-3	7.5	21.2	18	--	--	--	--	FILL
	S-4	10.0	18.7	26	--	--	--	--	FILL
	S-5	12.5	16.2	15	--	--	--	--	SAND
	S-6	15.0	13.7	20	--	--	--	--	SAND
	S-7	17.5	11.2	14	--	--	--	--	SAND
	S-8	20.0	8.7	20	--	--	--	8	SAND
	S-9	25.0	3.7	20	--	--	--	--	SAND
	S-10	30.0	-1.3	35	--	--	--	29	Silty SAND
	S-11	35.0	-6.3	25	--	--	--	--	SAND
	S-12	40.0	-11.3	26	--	--	--	--	SAND
	S-13	45.0	-16.3	21	--	--	--	--	SAND
	S-14	50.0	-21.3	22	--	--	--	9	SAND
	S-15	55.0	-26.3	24	--	--	--	--	SAND
	S-16	60.0	-31.3	23	--	--	--	--	SAND
	S-17	65.0	-36.3	69	--	--	--	79	SILT
	S-18	70.0	-41.3	24	--	--	--	--	SAND
	S-19	75.0	-46.3	20	--	--	--	--	SAND
	S-20	80.0	-51.3	23	--	--	--	--	SAND
	S-21	85.0	-56.3	19	--	--	--	--	SAND
	S-22	90.0	-61.3	19	--	--	--	--	SAND
	S-23	95.0	-66.3	21	--	--	--	--	SAND
	S-24	100.0	-71.3	22	--	--	--	--	SAND

BORING AND TEST PIT LOG LEGEND

SOIL SYMBOLS

Symbol	Typical Description
	LANDSCAPE MATERIALS
	FILL
	GRAVEL; clean to some silt, clay, and sand
	Sandy GRAVEL; clean to some silt and clay
	Silty GRAVEL; up to some clay and sand
	Clayey GRAVEL; up to some silt and sand
	SAND; clean to some silt, clay, and gravel
	Gravelly SAND; clean to some silt and clay
	Silty SAND; up to some clay and gravel
	Clayey SAND; up to some silt and gravel
	SILT; up to some clay, sand, and gravel
	Gravelly SILT; up to some clay and sand
	Sandy SILT; up to some clay and gravel
	Clayey SILT; up to some sand and gravel
	CLAY; up to some silt, sand, and gravel
	Gravelly CLAY; up to some silt and sand
	Sandy CLAY; up to some silt and gravel
	Silty CLAY; up to some sand and gravel
	PEAT

BEDROCK SYMBOLS

Symbol	Typical Description
	BASALT
	MUDSTONE
	SILTSTONE
	SANDSTONE

SURFACE MATERIAL SYMBOLS

Symbol	Typical Description
	Asphalt concrete PAVEMENT
	Portland cement concrete PAVEMENT
	Crushed rock BASE COURSE

SAMPLER SYMBOLS

Symbol	Sampler Description
	2.0-in. O.D. split-spoon sampler and Standard Penetration Test with recovery (ASTM D1586)
	Shelby tube sampler with recovery (ASTM D1587)
	3.0-in. O.D. split-spoon sampler with recovery (ASTM D3550)
	Grab Sample
	Rock core sample interval
	Sonic core sample interval
	Geoprobe sample interval

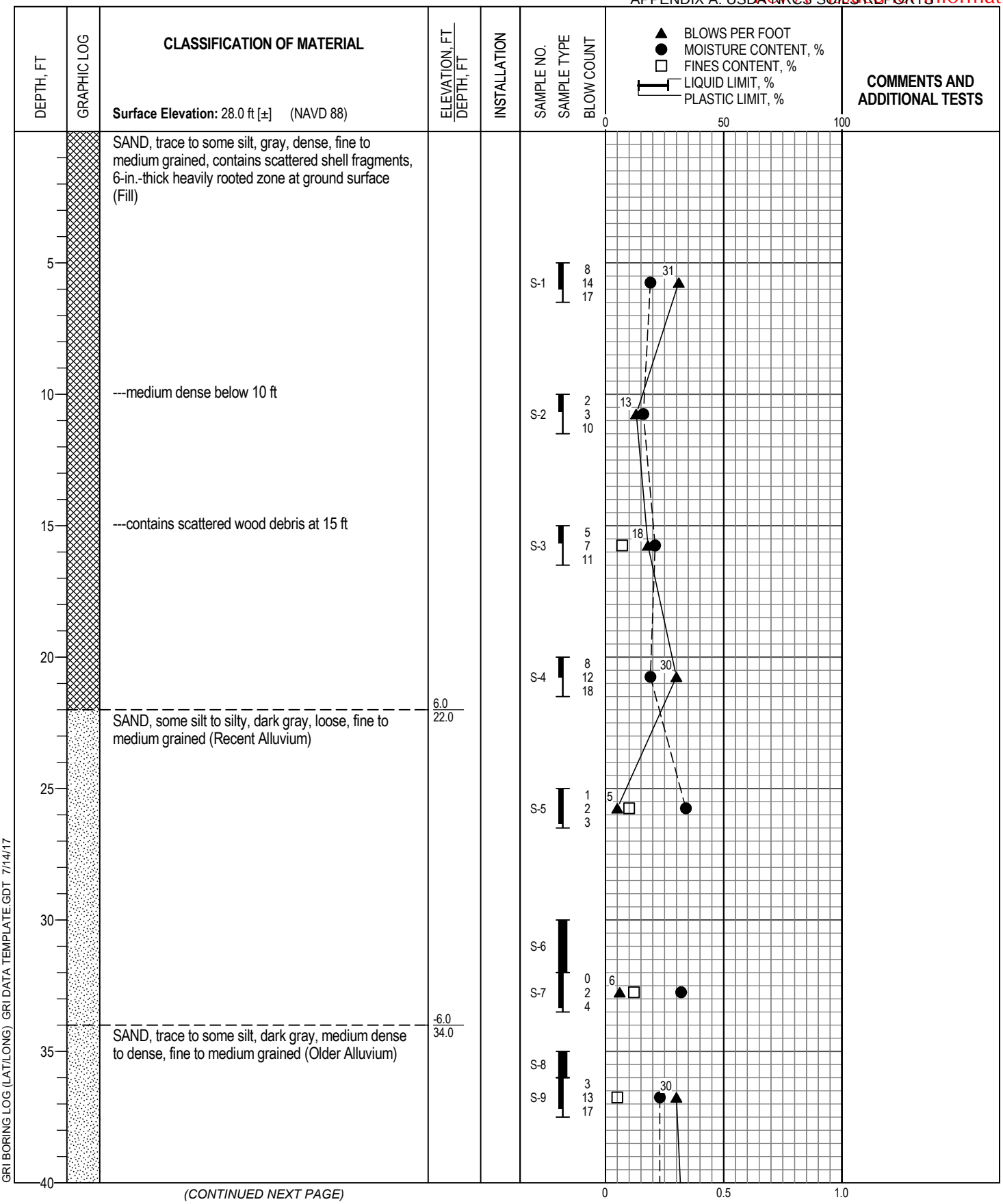
INSTALLATION SYMBOLS

Symbol	Symbol Description
	Flush-mount monument set in concrete
	Concrete, well casing shown where applicable
	Bentonite seal, well casing shown where applicable
	Filter pack, machine-slotted well casing shown where applicable
	Grout, vibrating-wire transducer cable shown where applicable
	Vibrating-wire pressure transducer
	1-in.-diameter solid PVC
	1-in.-diameter hand-slotted PVC
	Grout, inclinometer casing shown where applicable

FIELD MEASUREMENTS

Symbol	Typical Description
	Groundwater level during drilling and date measured
	Groundwater level after drilling and date measured
	Rock core recovery (%)
	Rock quality designation (RQD, %)

BORING AND TEST PIT LOG LEGEND GRI DATA TEMPLATE.GDT 6/30/17



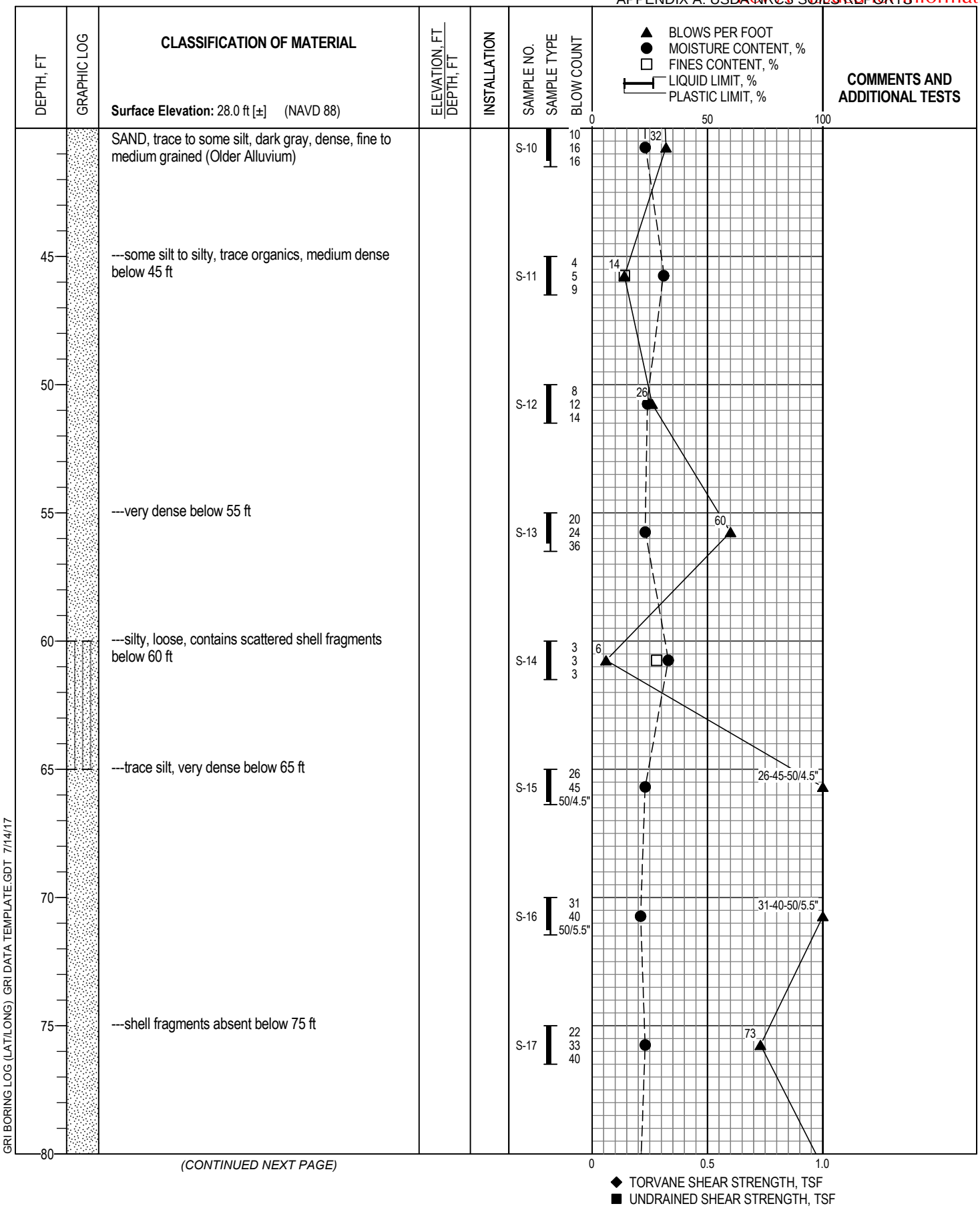
(CONTINUED NEXT PAGE)

GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: T. Gayne	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 9/9/13	**Coordinates:** Not Available
Drilling Method: Mud Rotary **Equipment:** CME 75 HT Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 85%
Note: See Legend for Explanation of Symbols	

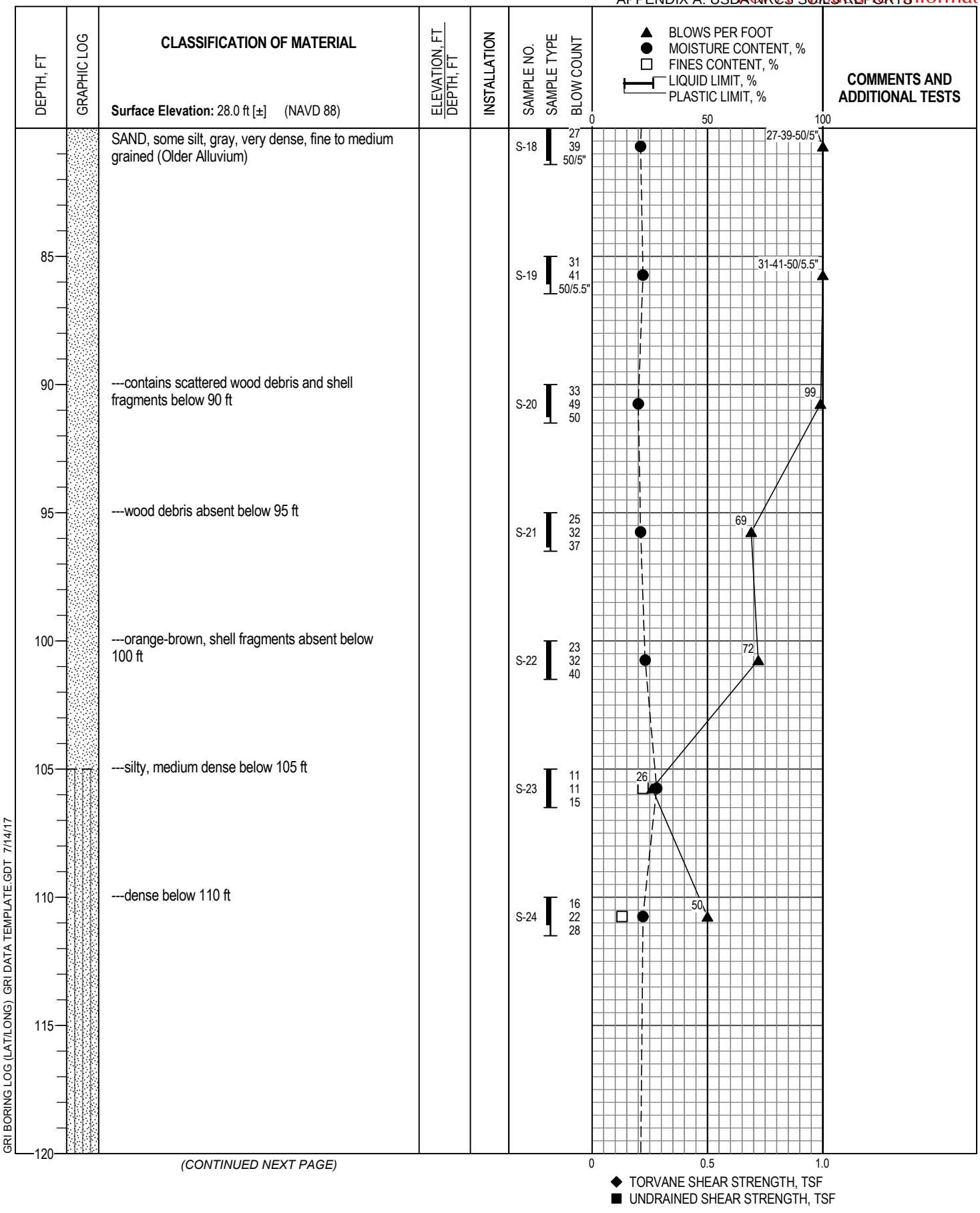
BORING B-1

JULY 2017 JOB NO. 5764 1165 FIG. 1A



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-1

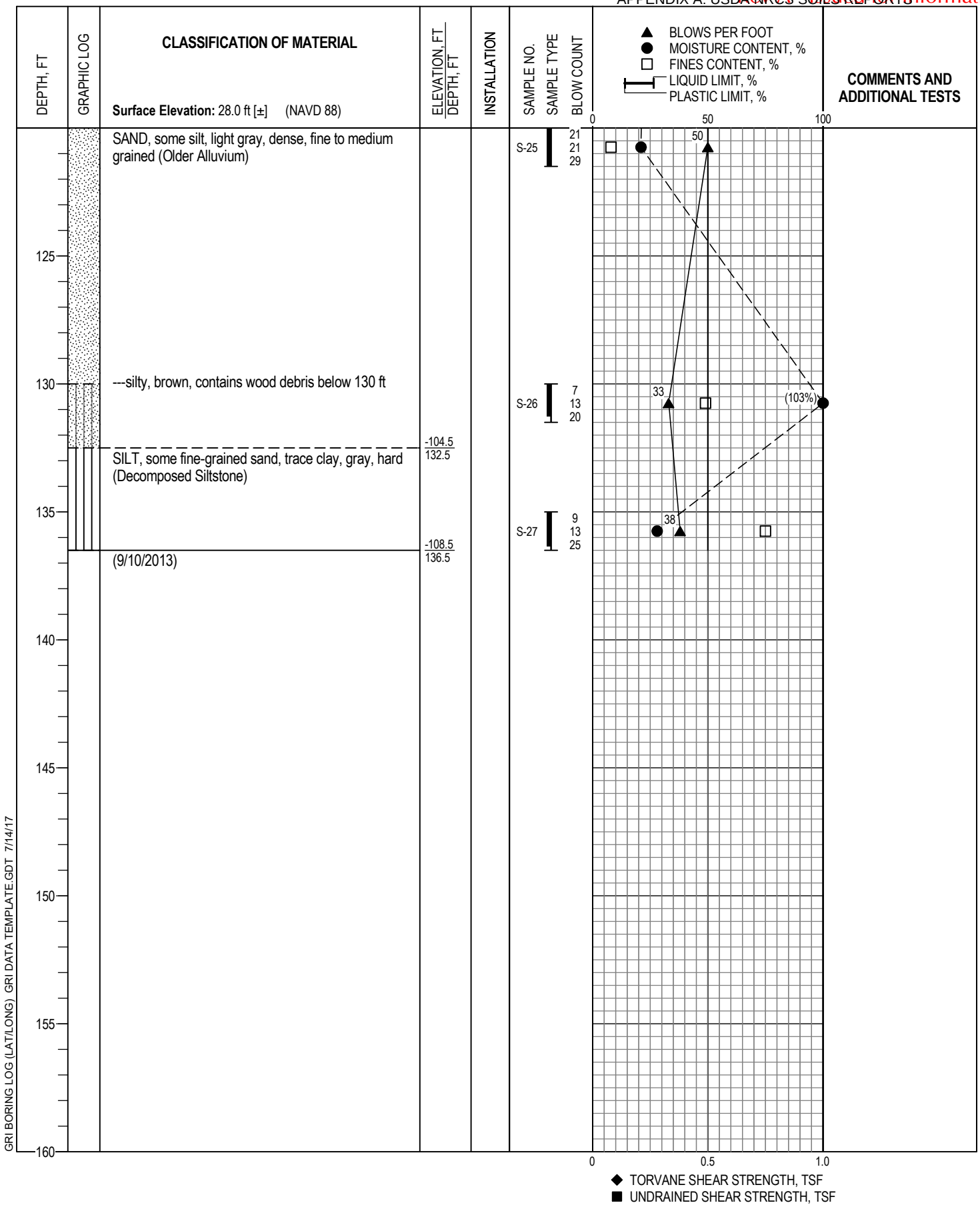


(CONTINUED NEXT PAGE)

GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-1

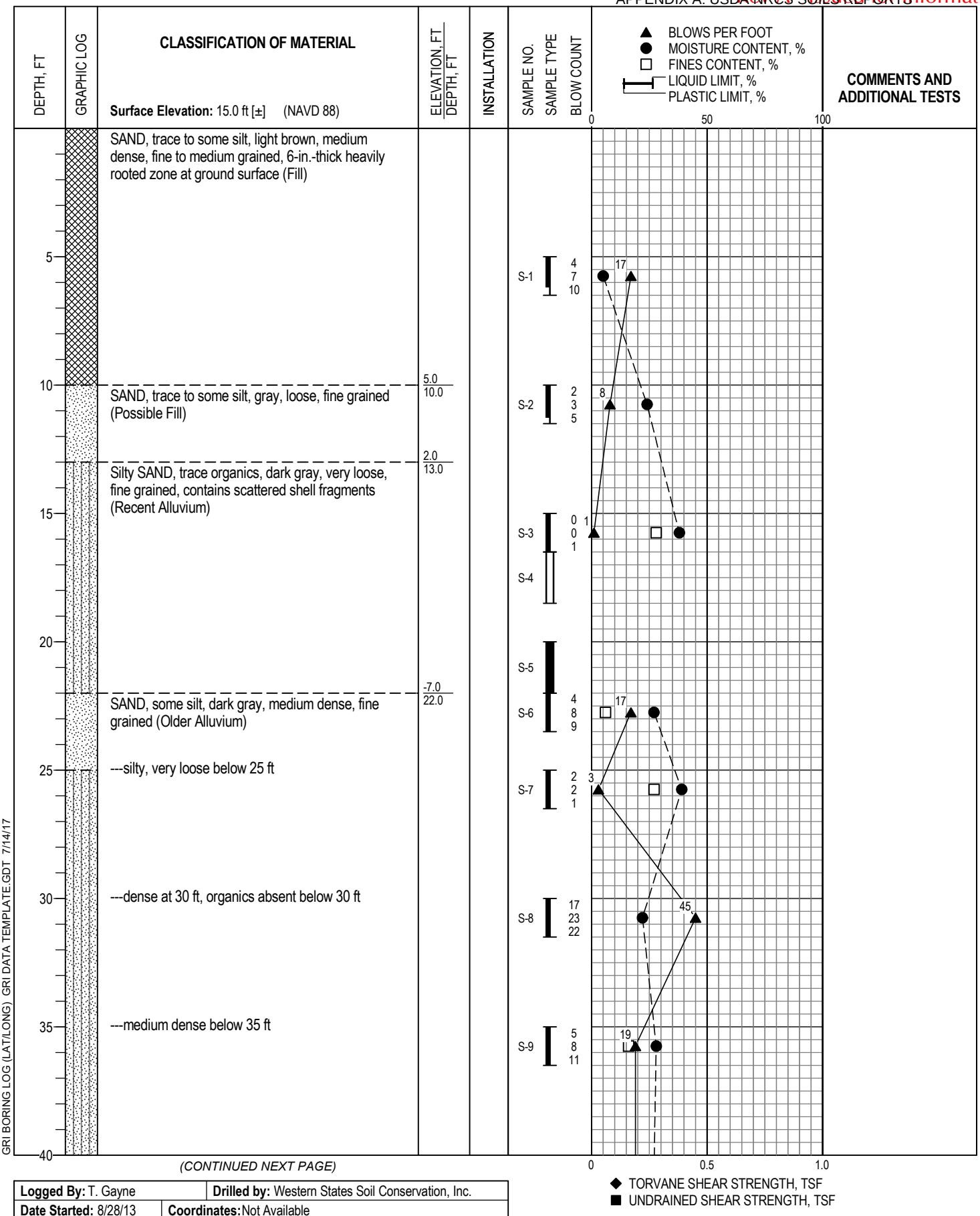
JULY 2017 JOB NO. 5764 1165 FIG. 1A



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-1

JULY 2017 JOB NO. 5764 1165 FIG. 1A



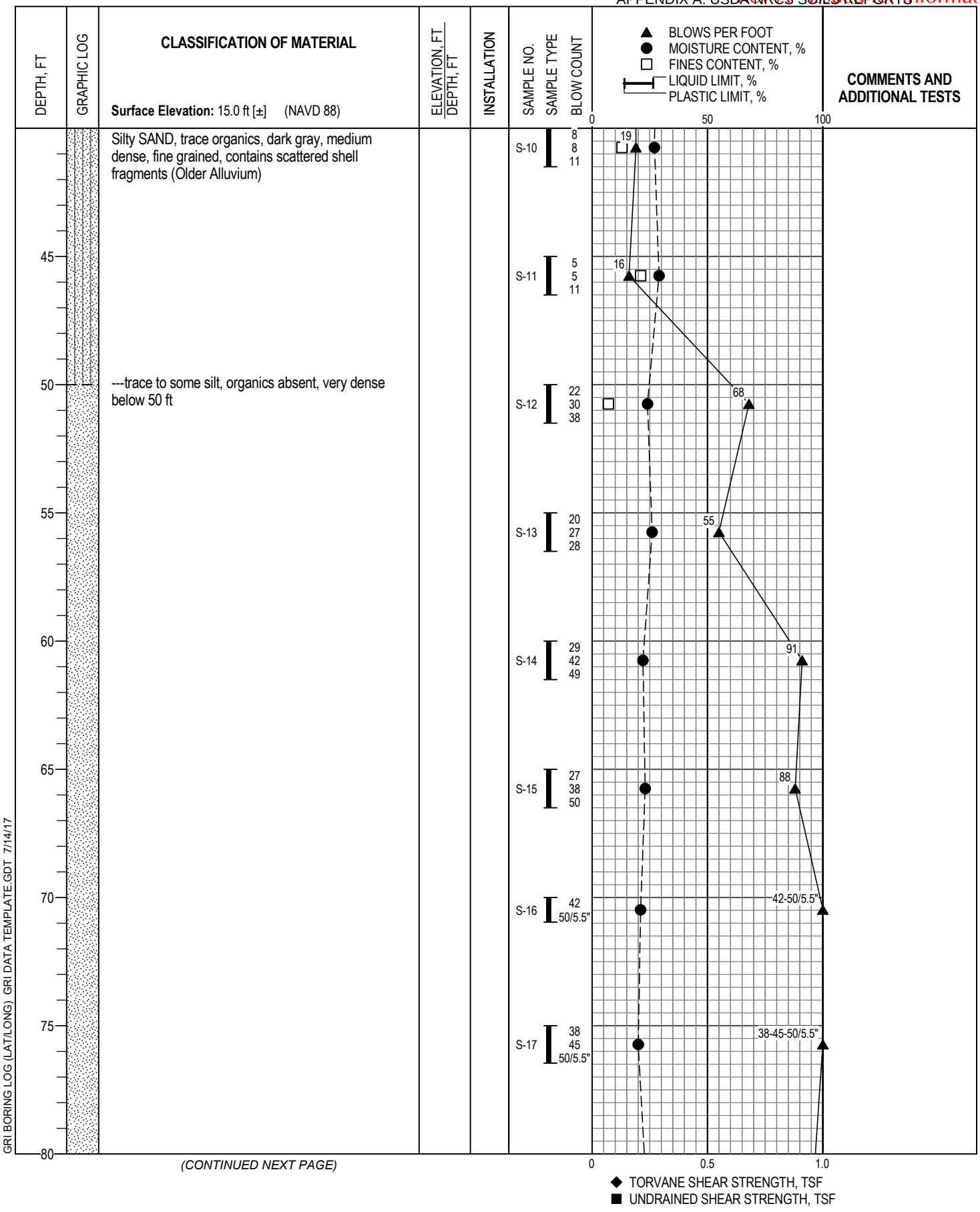
(CONTINUED NEXT PAGE)

GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: T. Gayne	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 8/28/13	**Coordinates:** Not Available
Drilling Method: Mud Rotary **Equipment:** WS 45 Track-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 75%
Note: See Legend for Explanation of Symbols	

BORING B-2

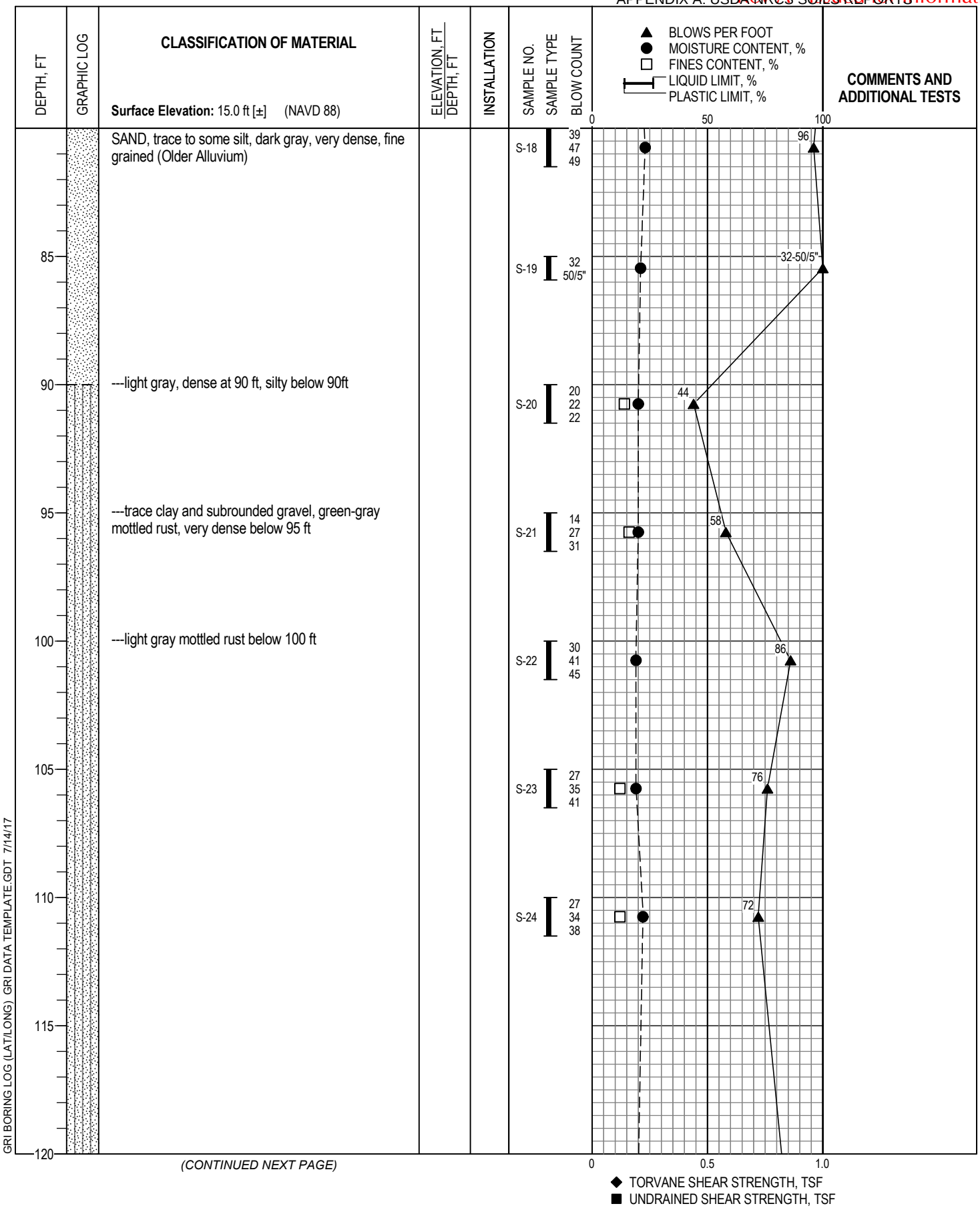
JULY 2017 JOB NO. 5764 1165 FIG. 2A



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-2

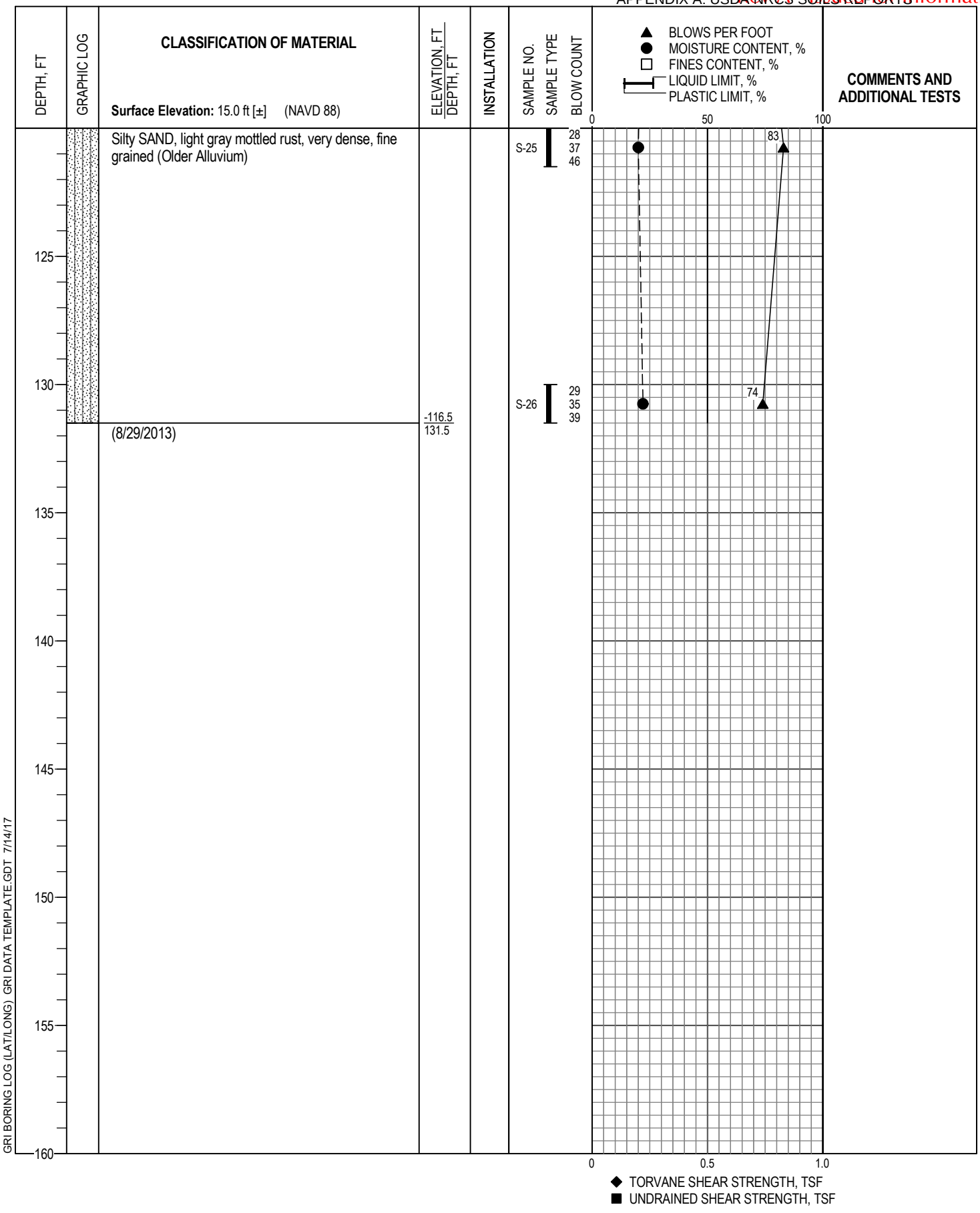
JULY 2017 JOB NO. 5764 1165 FIG. 2A



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-2

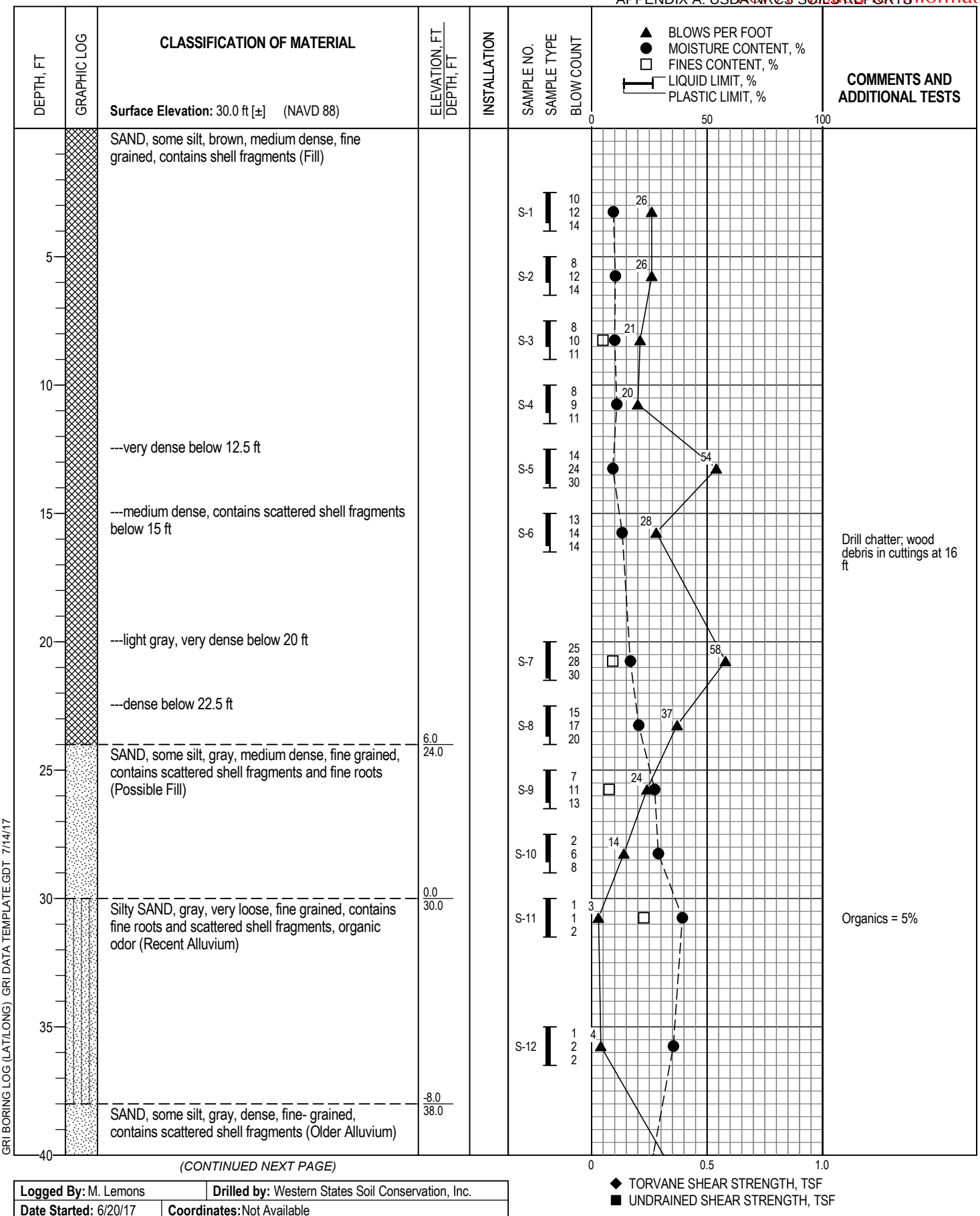
JULY 2017 JOB NO. 5764 1165 FIG. 2A



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

GRI

BORING B-2



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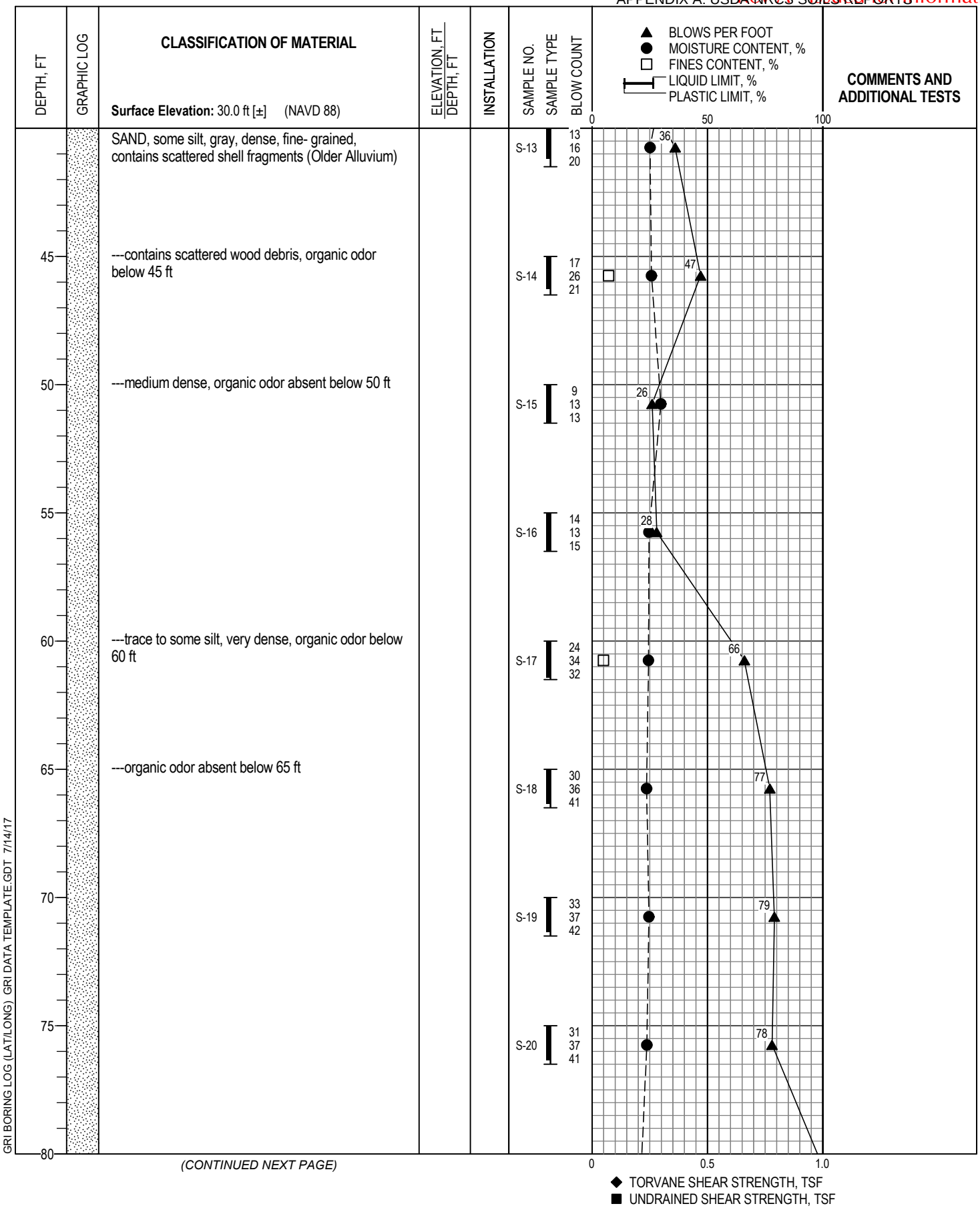
GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: M. Lemons	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 6/20/17	**Coordinates:** Not Available
Drilling Method: Mud Rotary **Equipment:** CME 55 HT Track-Mounted Drill Rig **Hole Diameter:** 4 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 76%
Note: See Legend for Explanation of Symbols	

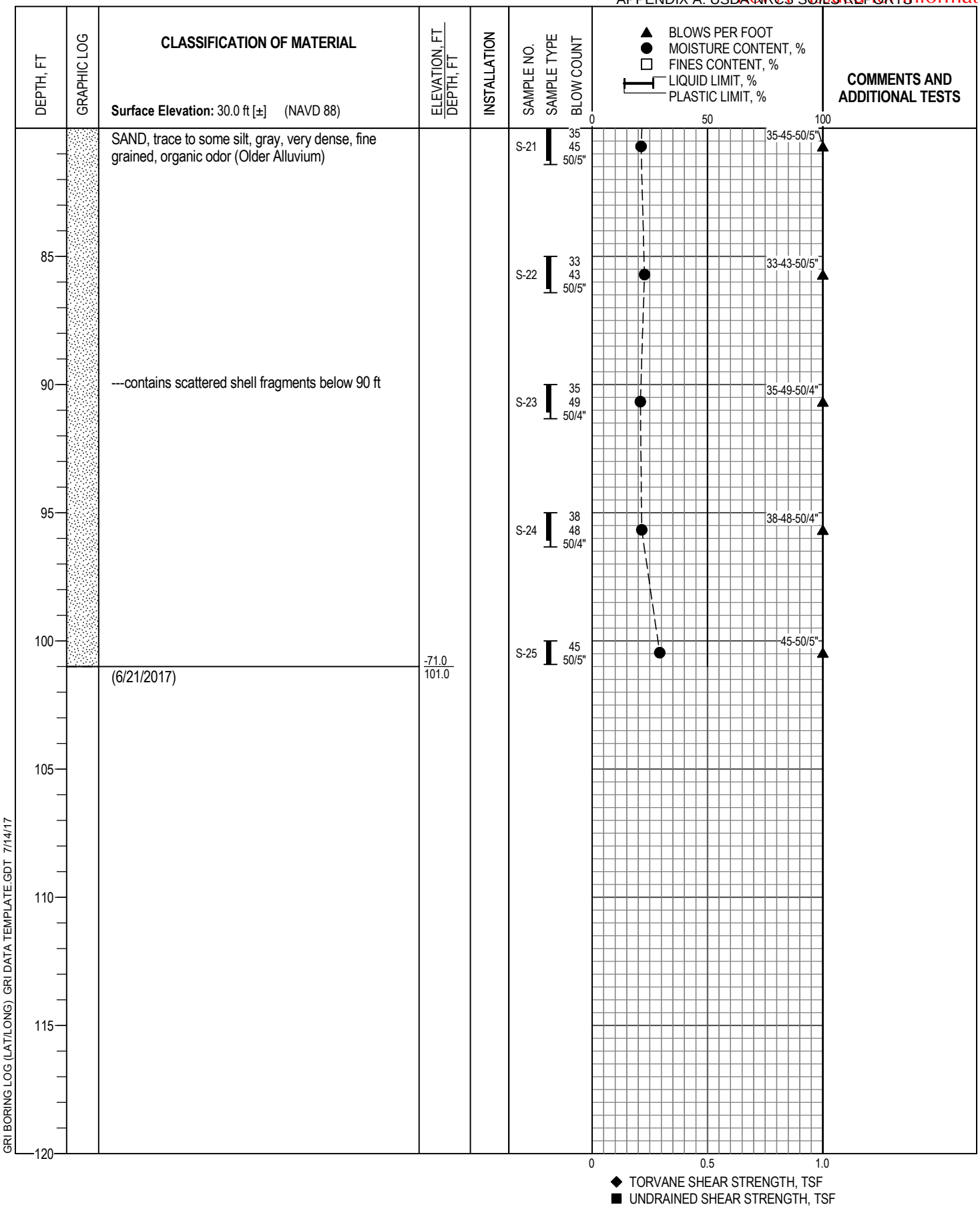
BORING B-3

JULY 2017 JOB NO. 5764 1165 FIG. 3A



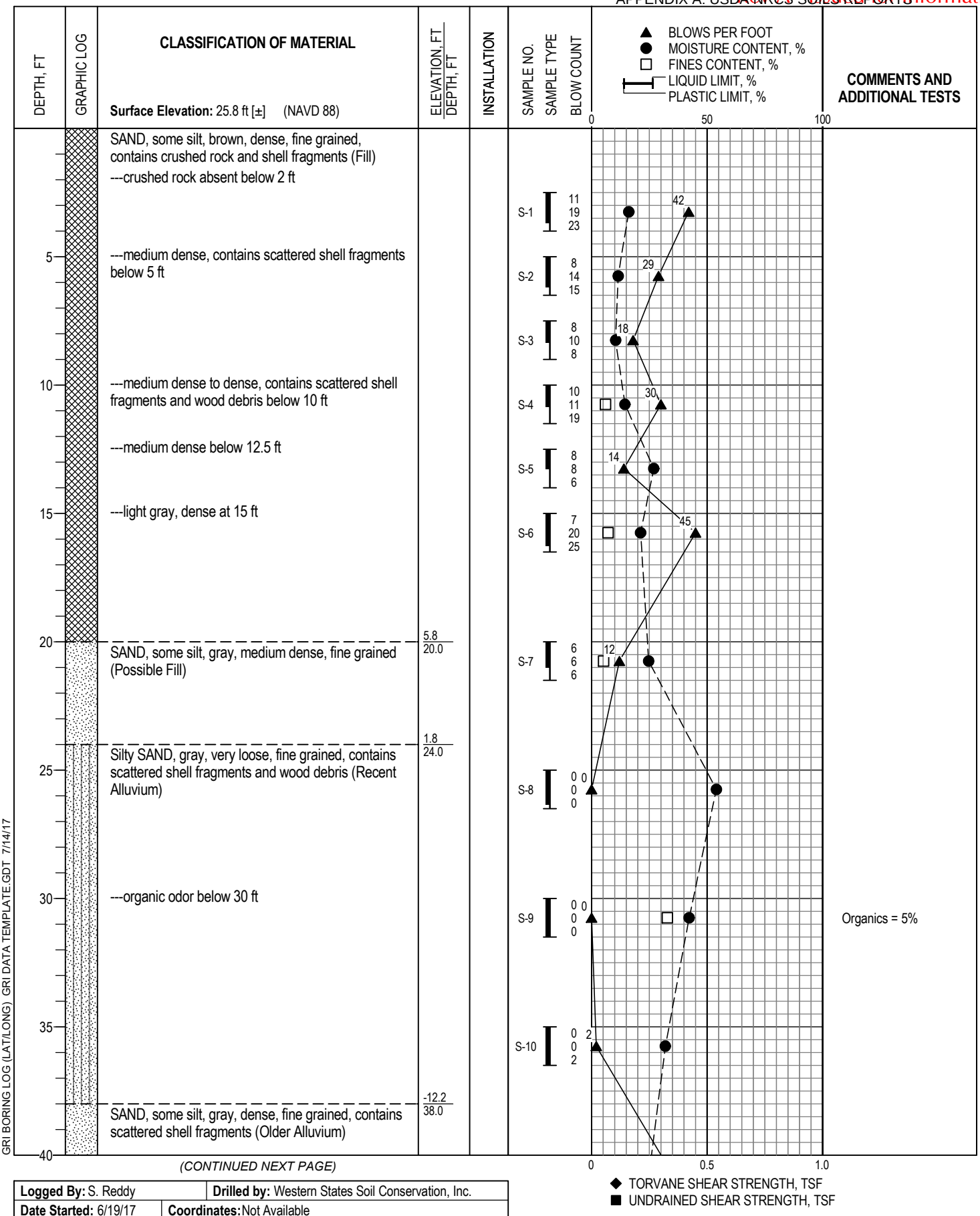
GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-3



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-3



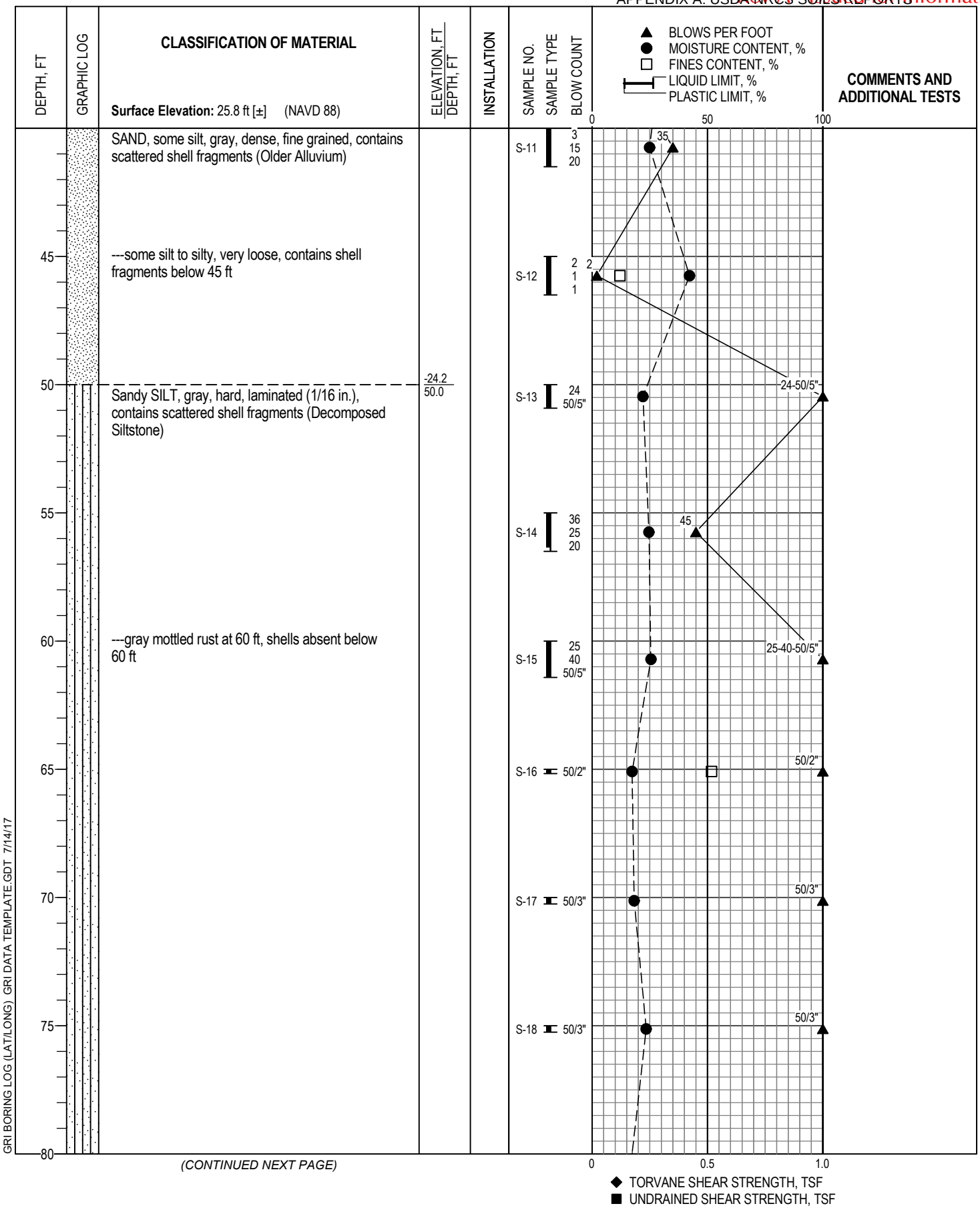
GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 6/19/17	**Coordinates:** Not Available
Drilling Method: Mud Rotary **Equipment:** CME 55 HT Track-Mounted Drill Rig **Hole Diameter:** 4 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 76%
Note: See Legend for Explanation of Symbols	

GRI

BORING B-4

JULY 2017 JOB NO. 5764 1165 FIG. 4A

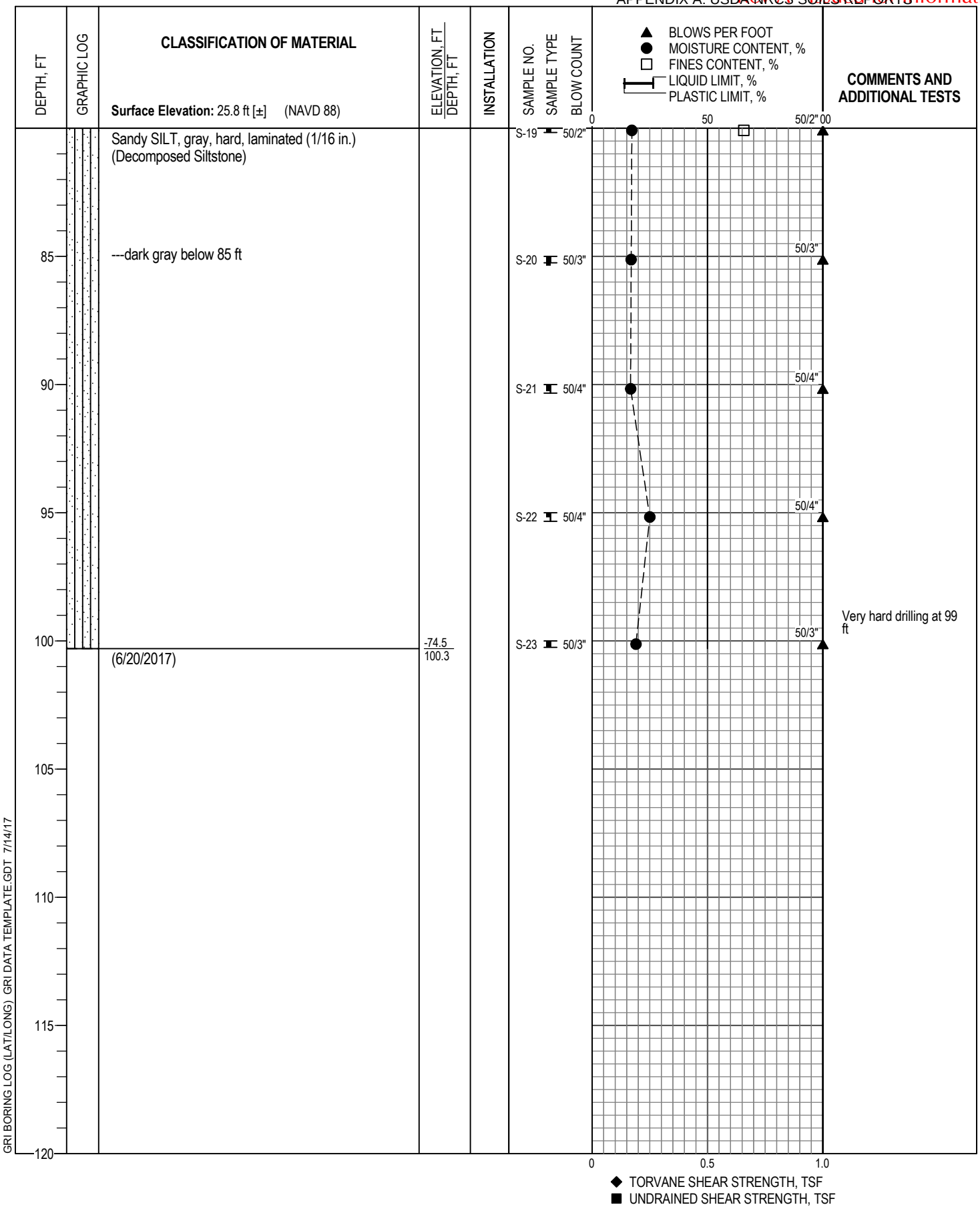


GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

GRI

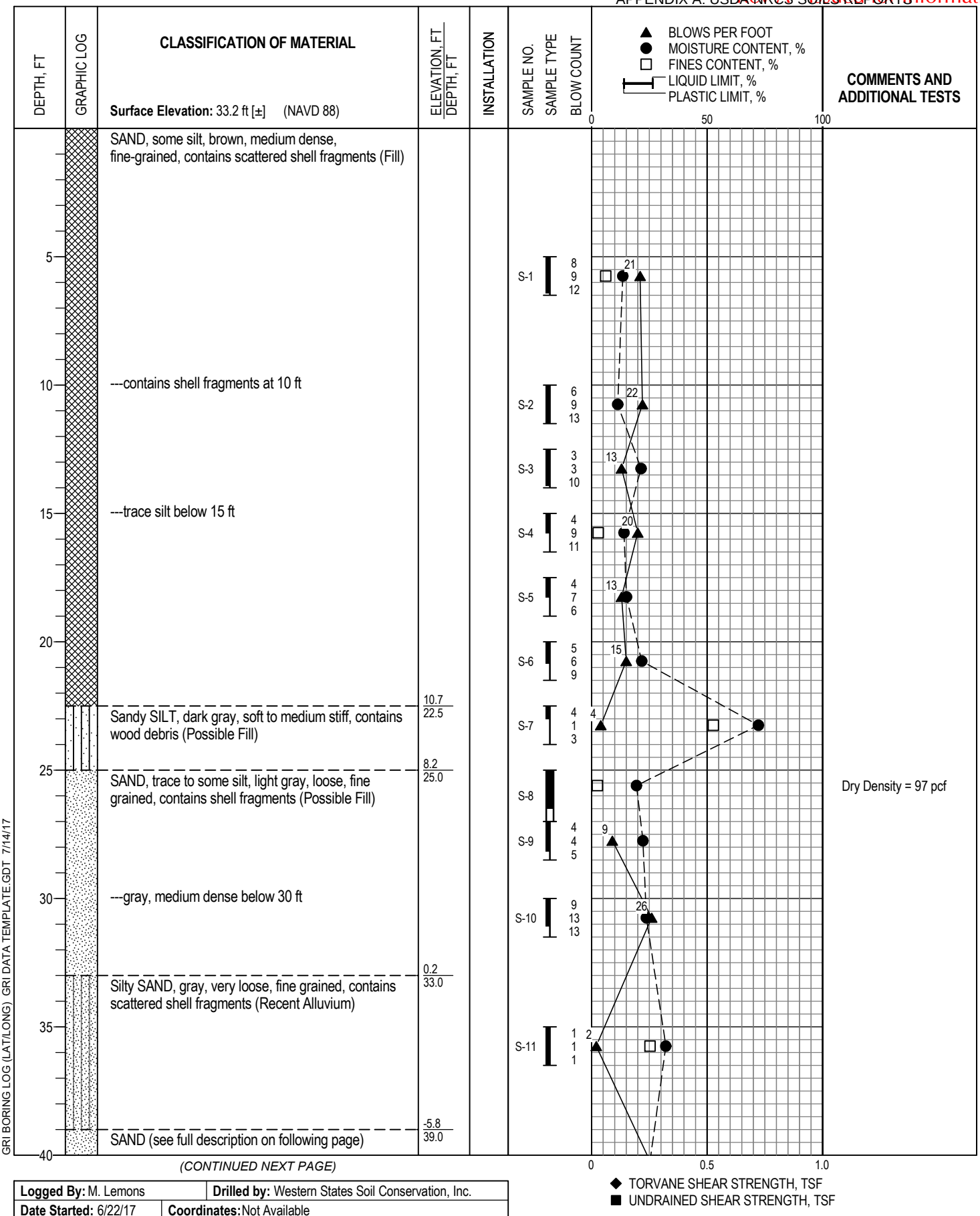
BORING B-4

JULY 2017 JOB NO. 5764 1165 FIG. 4A



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-4

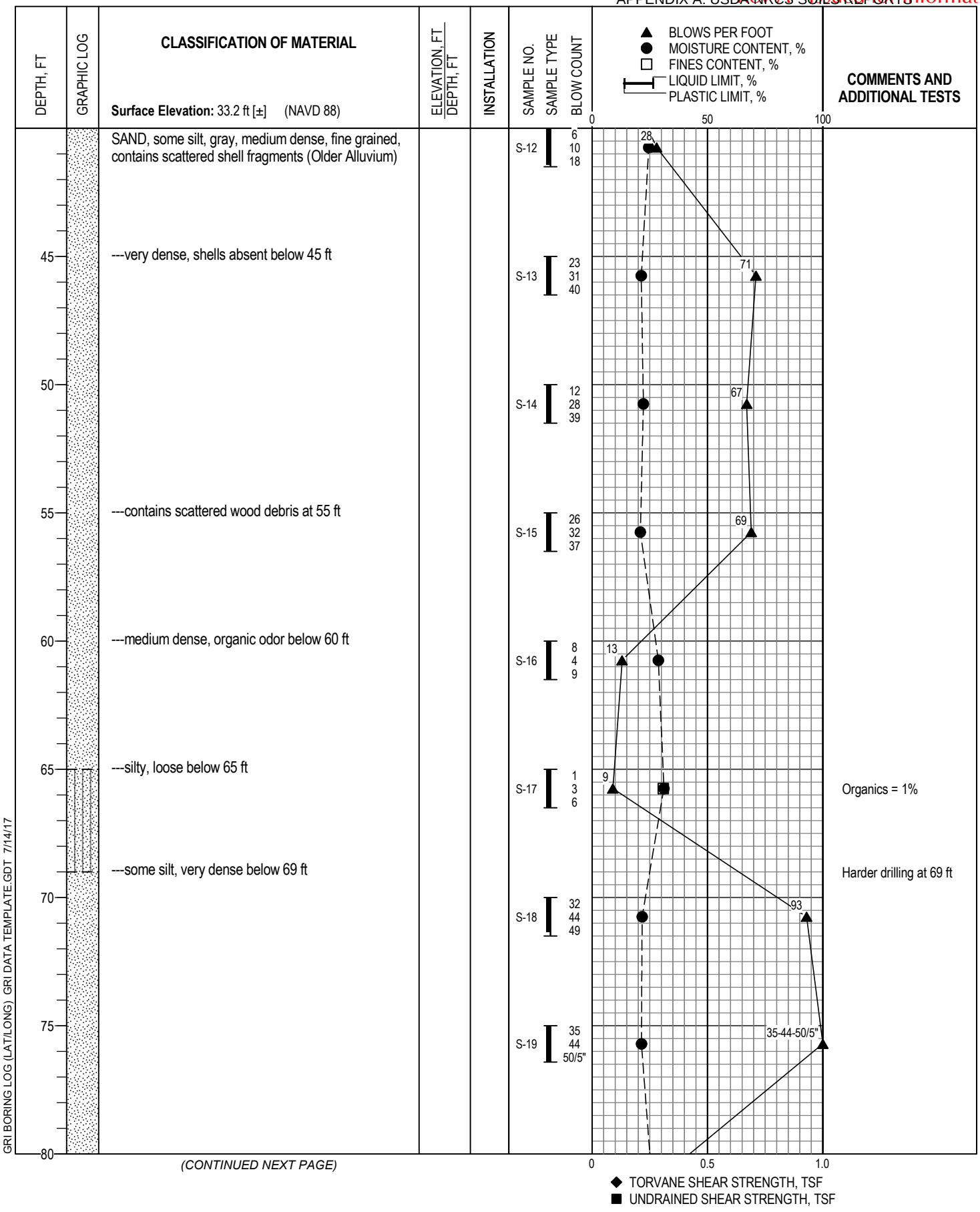


(CONTINUED NEXT PAGE)

GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: M. Lemons	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 6/22/17	**Coordinates:** Not Available
Drilling Method: Mud Rotary **Equipment:** CME 55 HT Track-Mounted Drill Rig **Hole Diameter:** 4 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 76%
Note: See Legend for Explanation of Symbols	

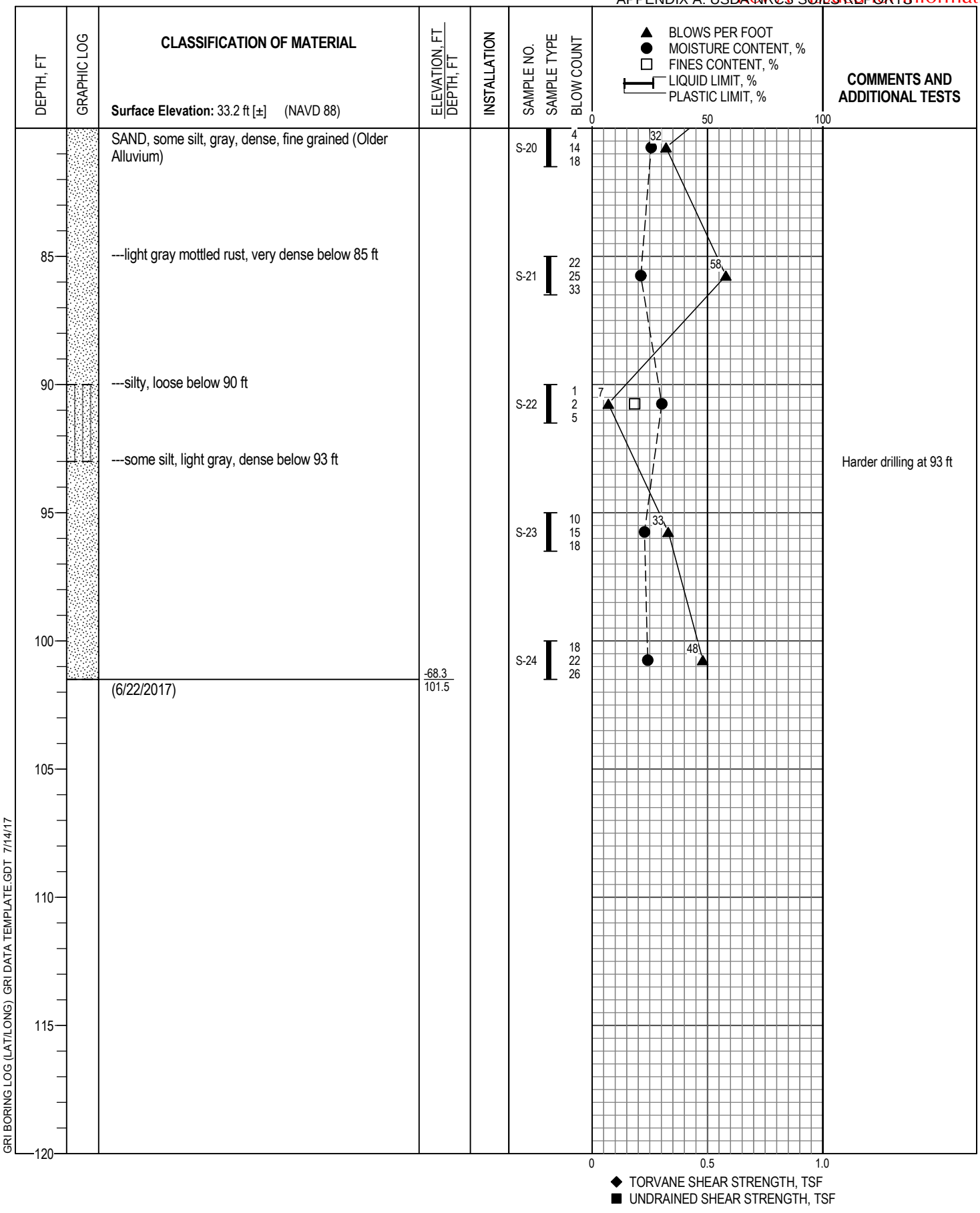
BORING B-5



(CONTINUED NEXT PAGE)

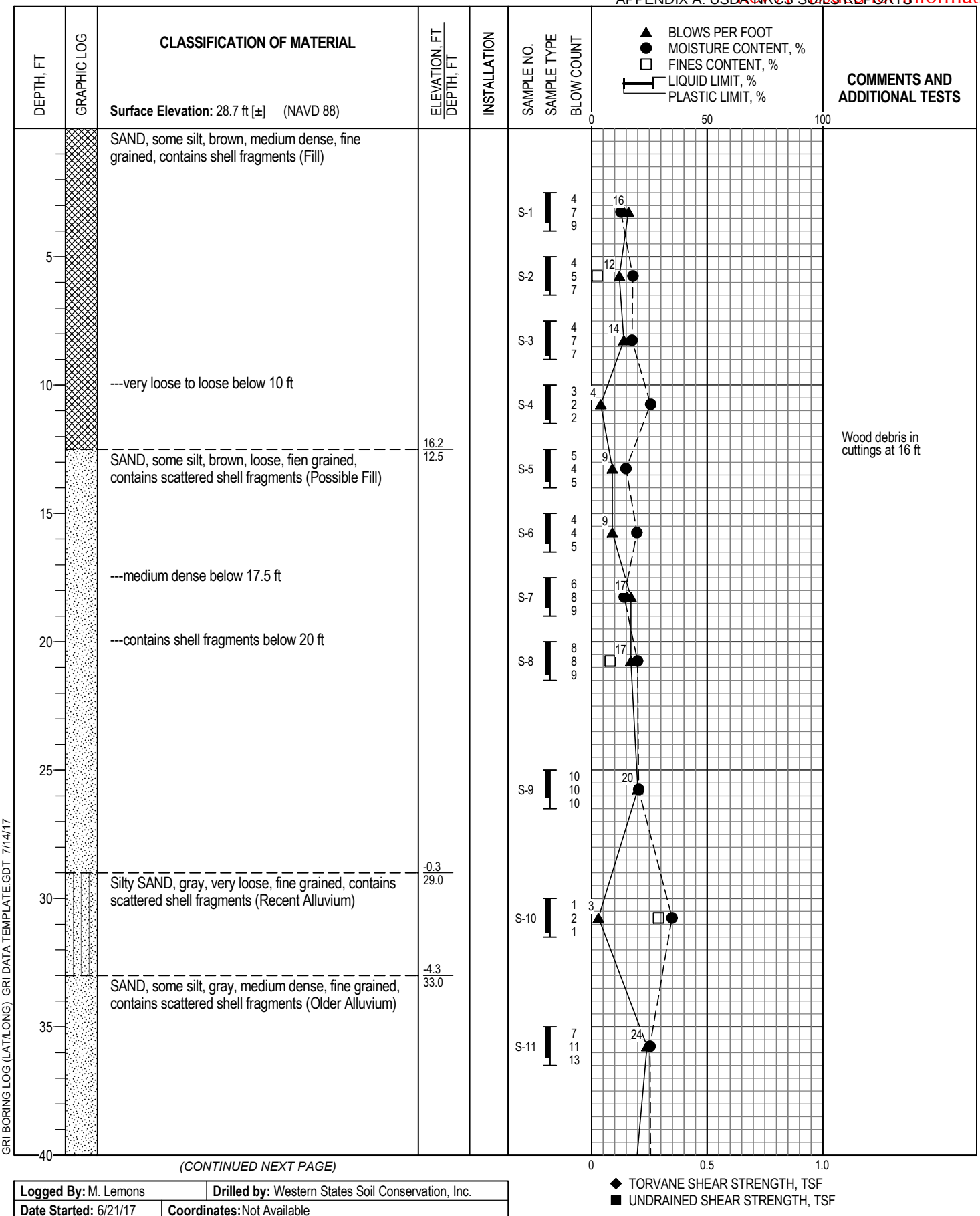
GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-5



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-5



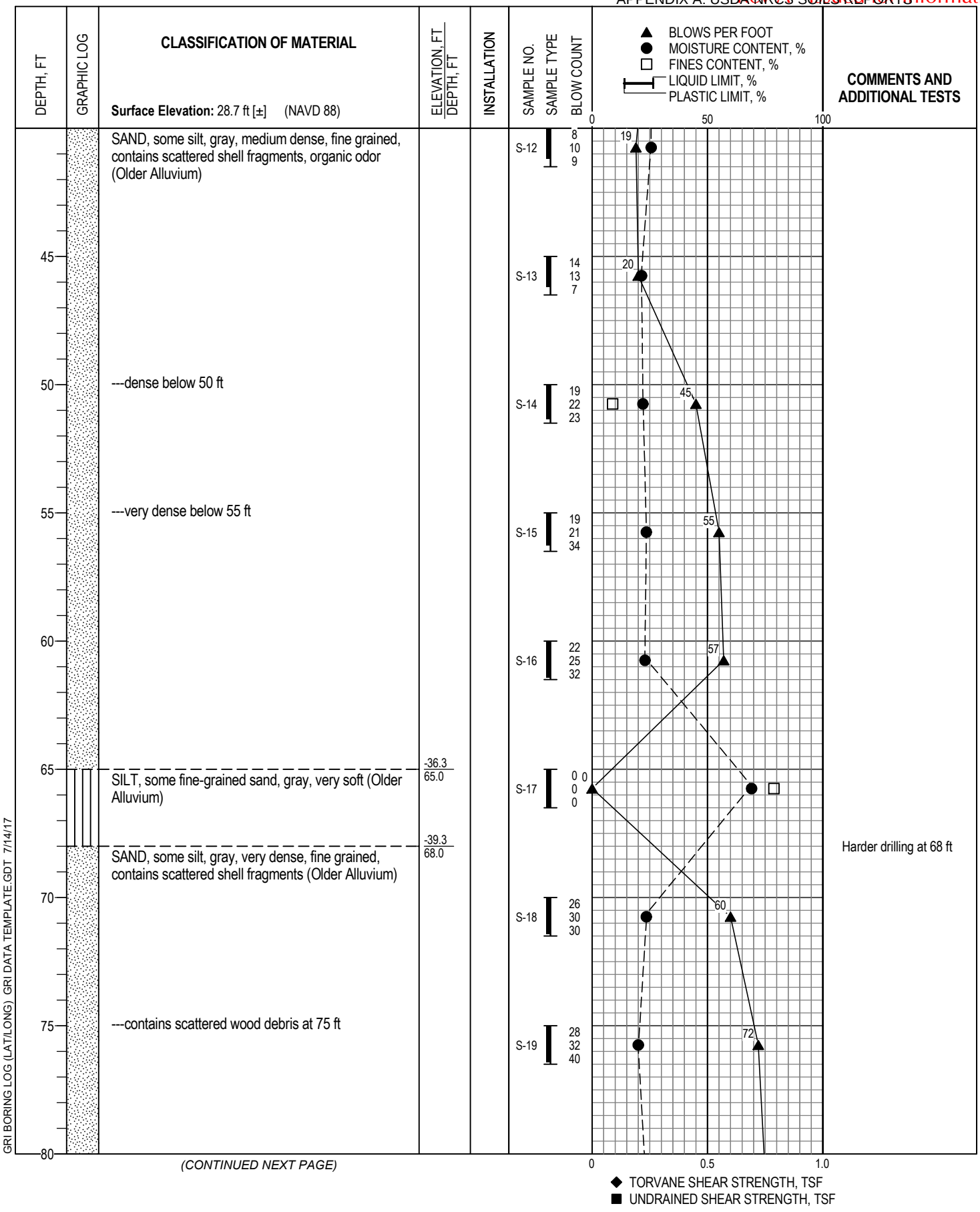
(CONTINUED NEXT PAGE)

GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: M. Lemons	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 6/21/17	**Coordinates:** Not Available
Drilling Method: Mud Rotary **Equipment:** CME 55 HT Track-Mounted Drill Rig **Hole Diameter:** 4 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 76%
Note: See Legend for Explanation of Symbols	

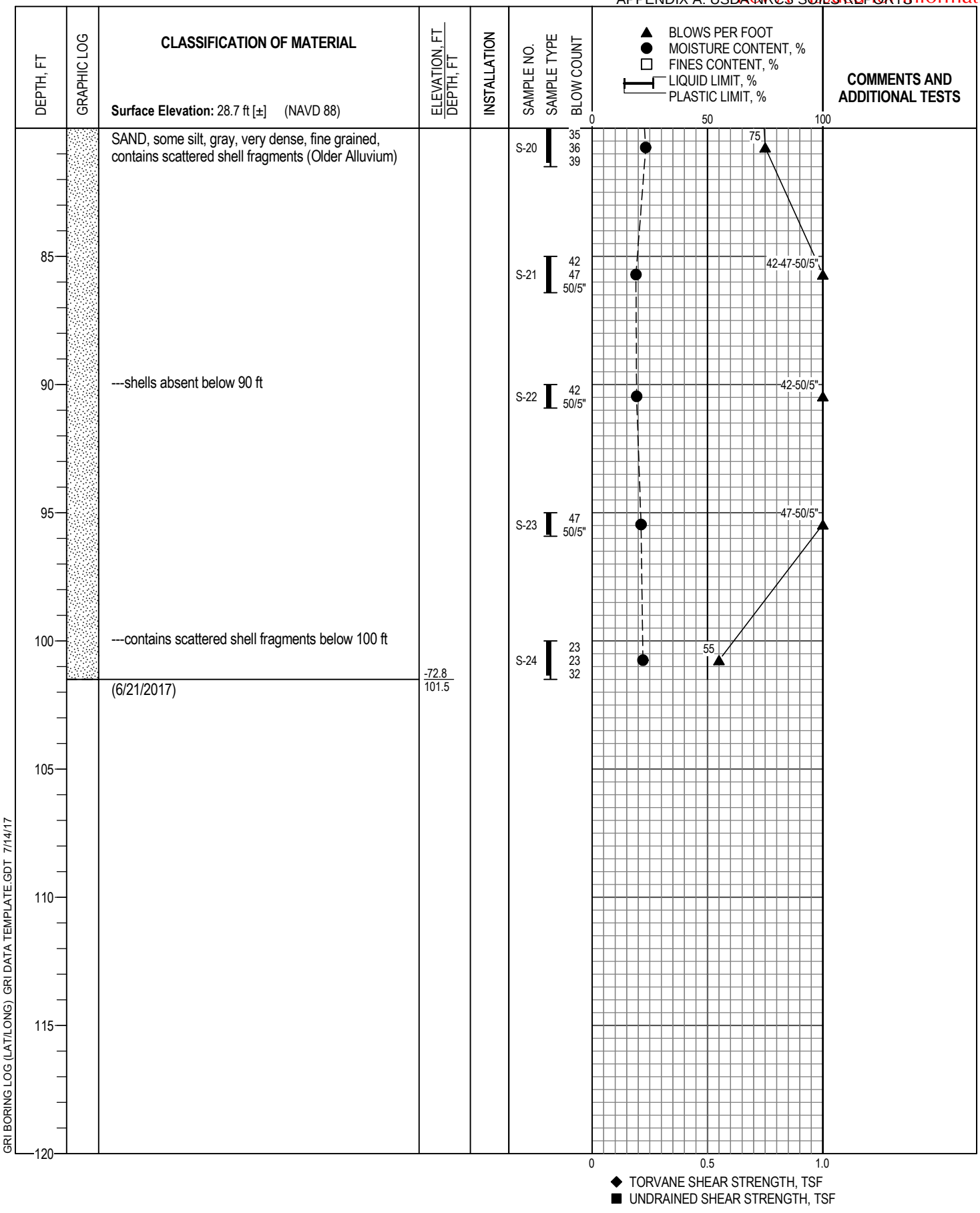
BORING B-6

JULY 2017 JOB NO. 5764 1165 FIG. 6A



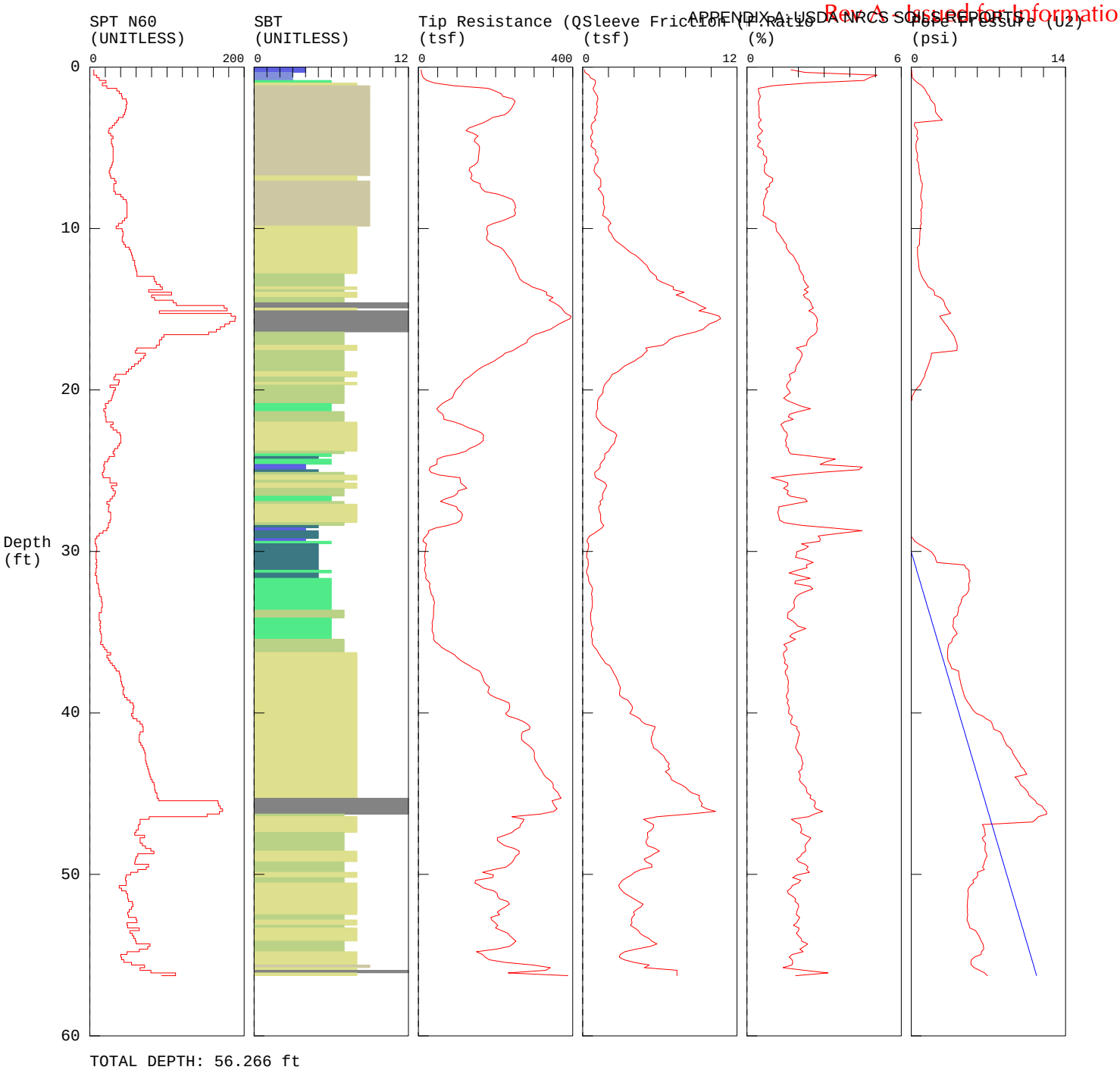
GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-6



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

BORING B-6

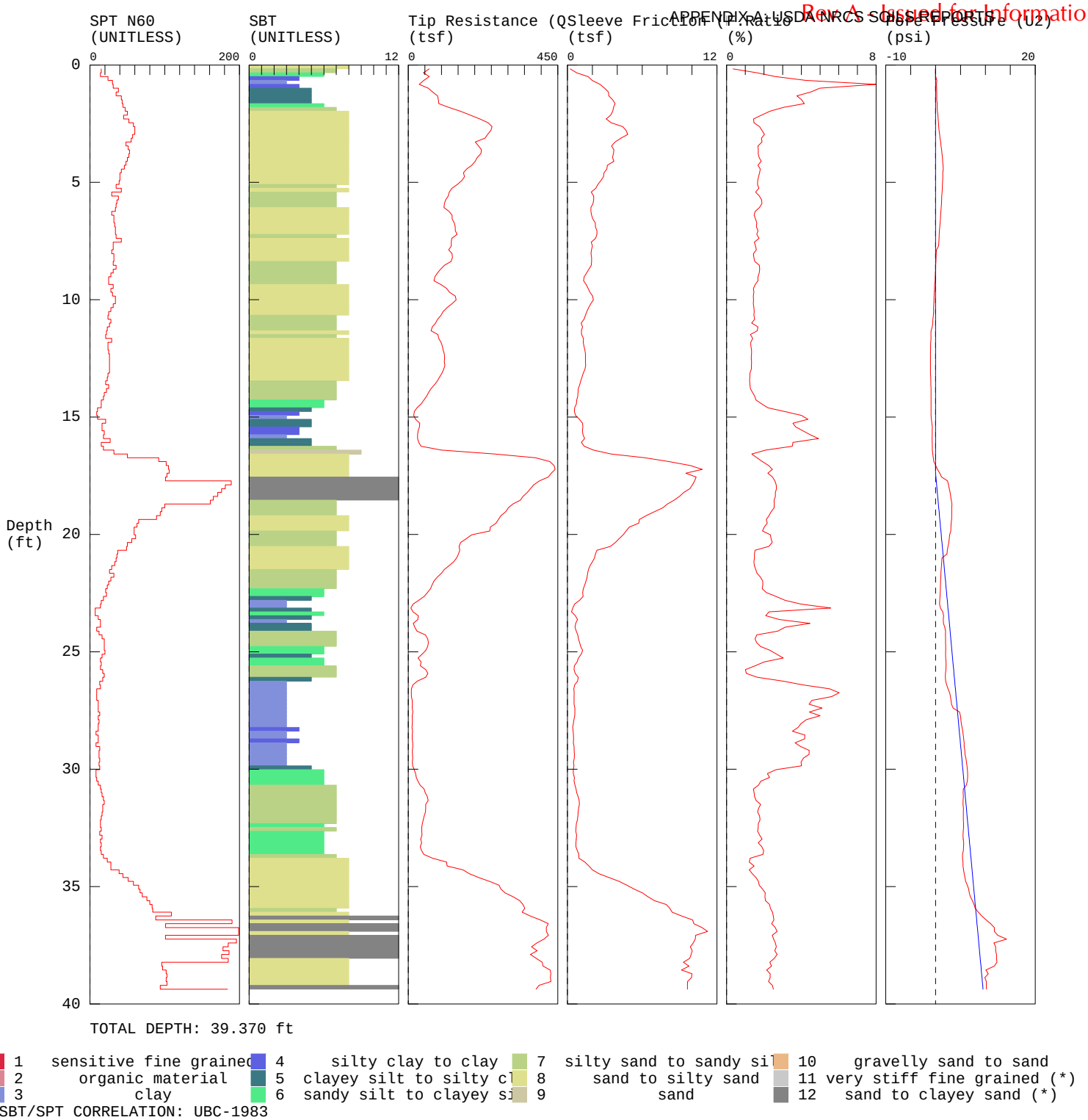


Observed By: M. Lemons	Advanced By: Oregon Geotechnical Explorations, Inc.
Date Started: 06/12/17	Ground Surface Elevation: 29.2 ft (NAVD 88)
Coordinates: Not Available	

GRI

CONE PENETRATION TEST CPT-1

JULY 2017 JOB NO. 5764 1165 FIG. 7A

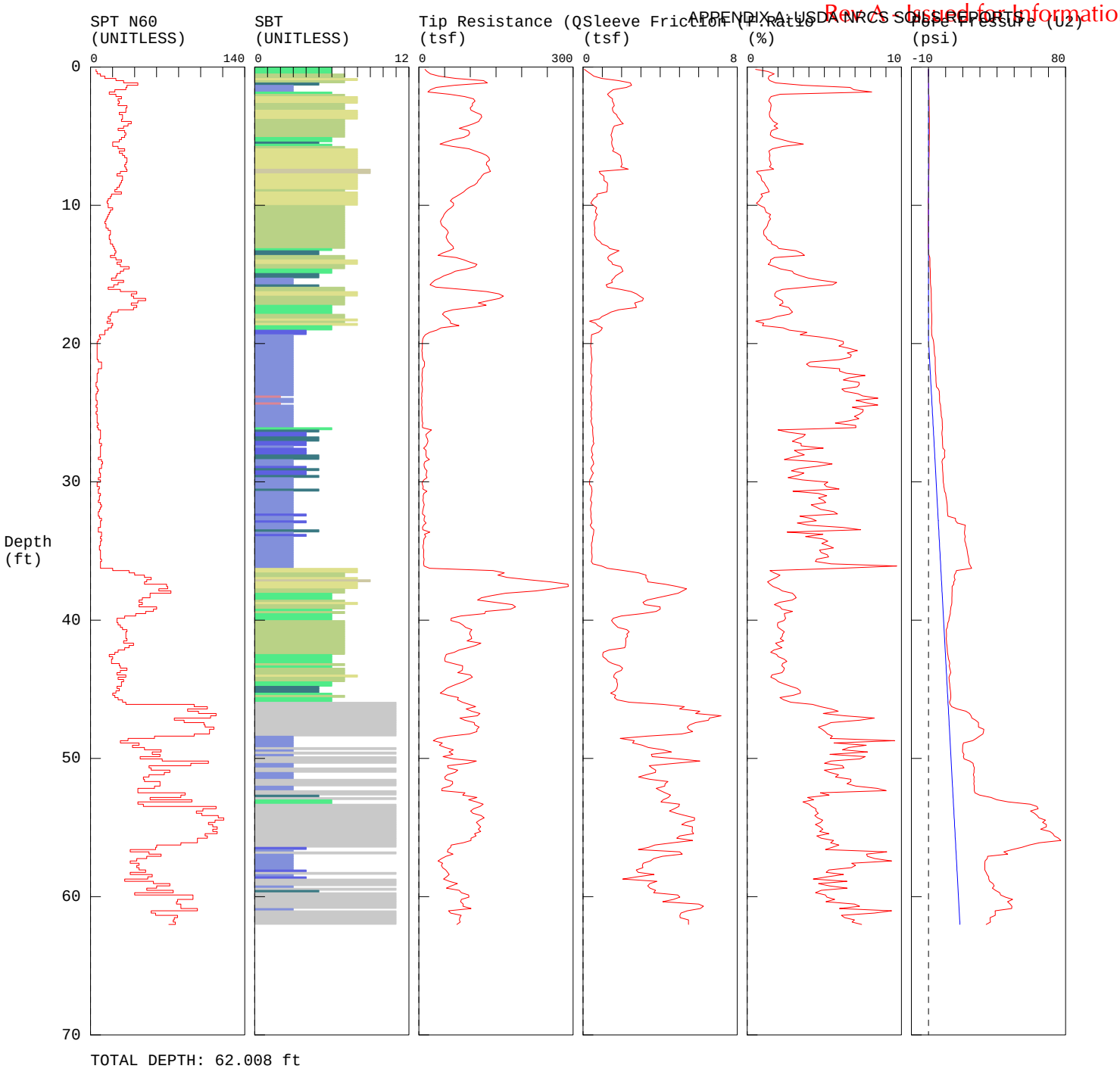


Observed By: M. Lemons	Advanced By: Oregon Geotechnical Explorations, Inc.
Date Started: 06/12/17	Ground Surface Elevation: 26.7 ft (NAVD 88)
Coordinates: Not Available	

GRI

CONE PENETRATION TEST CPT-2

JULY 2017 JOB NO. 5764 1165 FIG. 8A

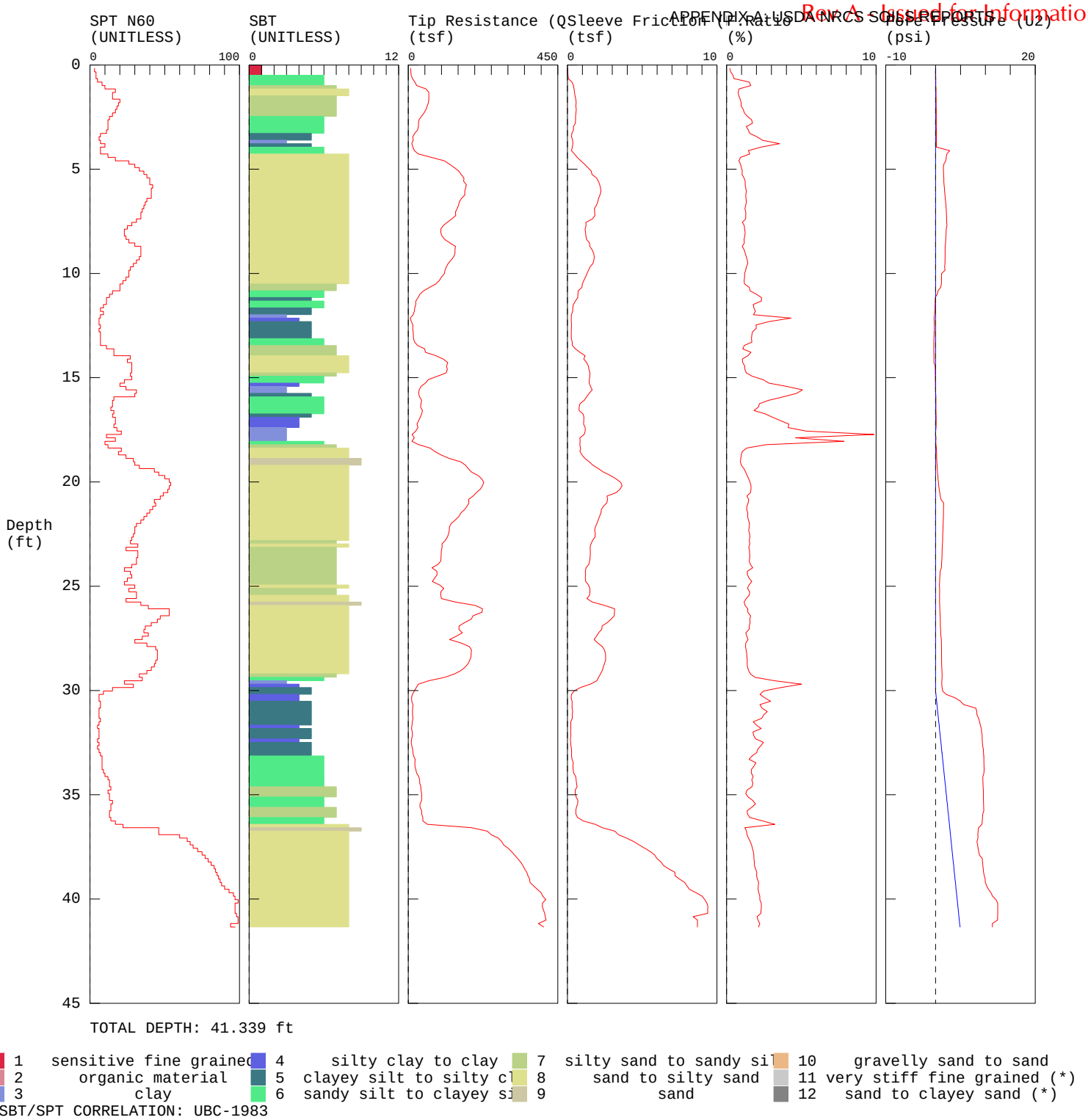


Observed By: M. Lemons	Advanced By: Oregon Geotechnical Explorations, Inc.
Date Started: 06/12/17	Ground Surface Elevation: 21.2 ft (NAVD 88)
Coordinates: Not Available	

GRI

CONE PENETRATION TEST CPT-3

JULY 2017 JOB NO. 5764 1165 FIG. 9A

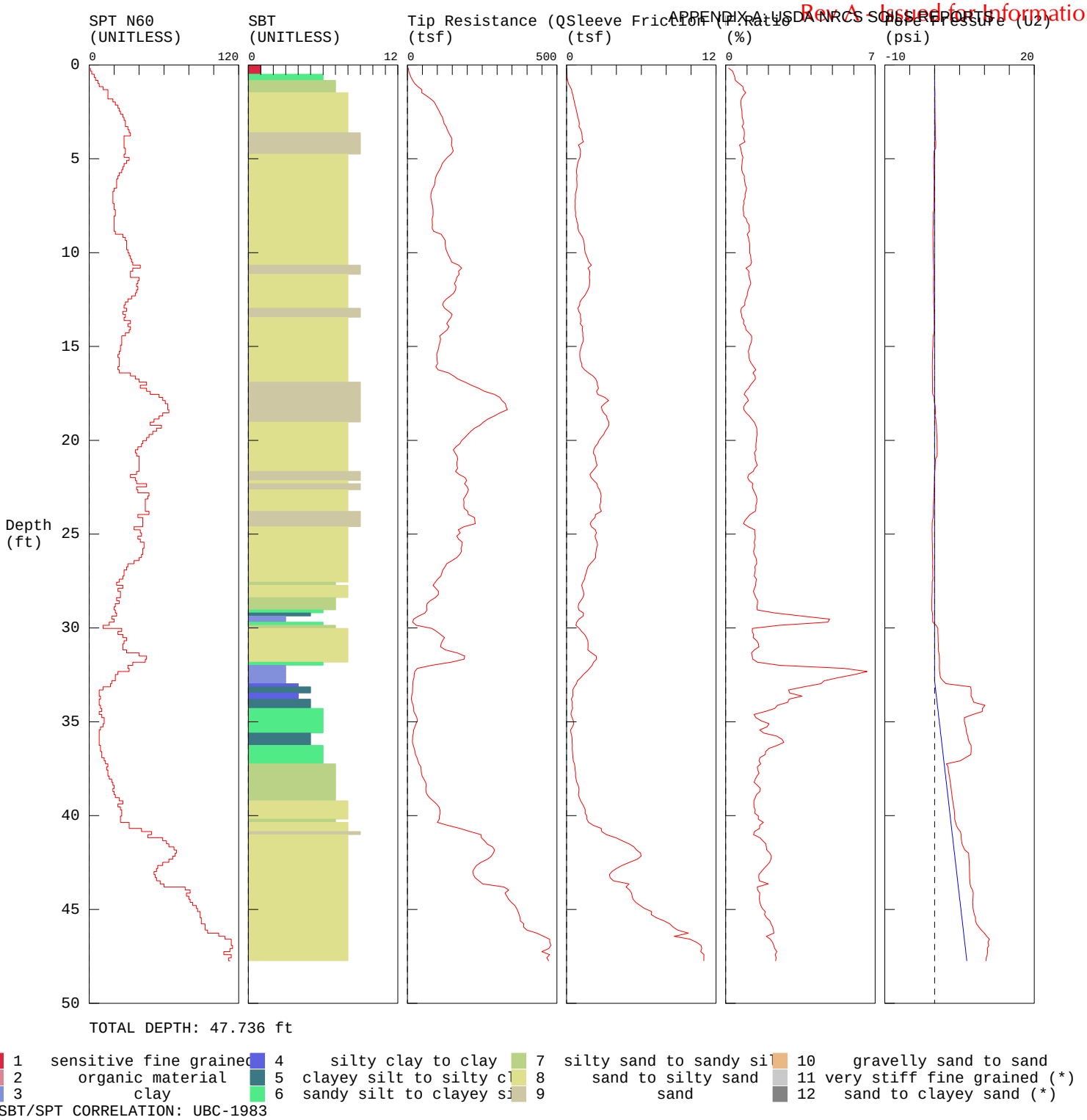


Observed By: M. Lemons	Advanced By: Oregon Geotechnical Explorations, Inc.
Date Started: 06/13/17	Ground Surface Elevation: 30.5 ft (NAVD 88)
Coordinates: Not Available	

GRI

CONE PENETRATION TEST CPT-4

JULY 2017 JOB NO. 5764 1165 FIG. 10A

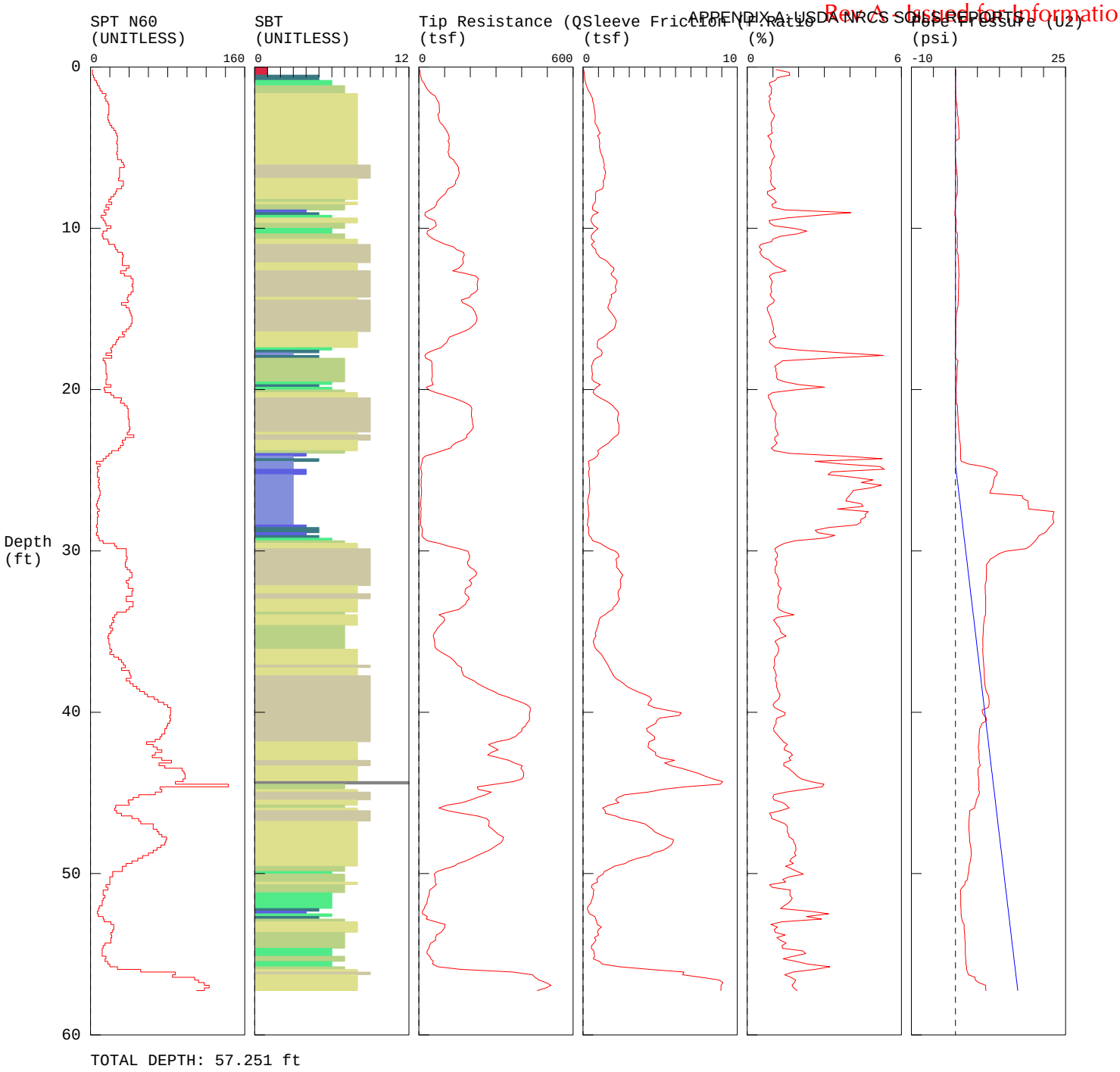


Observed By: M. Lemons	Advanced By: Oregon Geotechnical Explorations, Inc.
Date Started: 06/13/17	Ground Surface Elevation: 33.1 ft (NAVD 88)
Coordinates: Not Available	

GRI

CONE PENETRATION TEST CPT-5

JULY 2017 JOB NO. 5764 1165 FIG. 11A

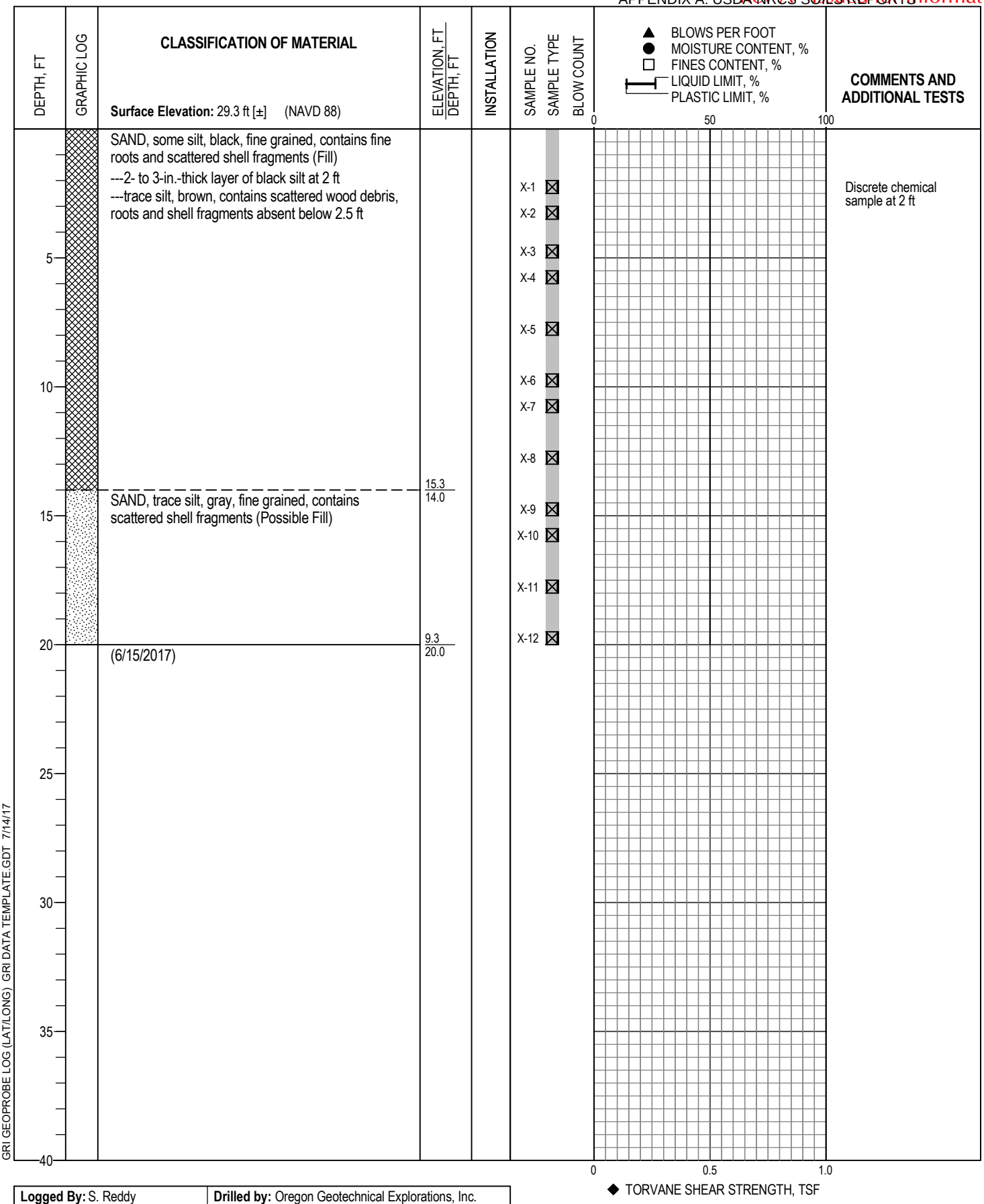


Observed By: M. Lemons	Advanced By: Oregon Geotechnical Explorations, Inc.
Date Started: 06/13/17	Ground Surface Elevation: 24.8 ft (NAVD 88)
Coordinates: Not Available	

GRI

CONE PENETRATION TEST CPT-6

JULY 2017 JOB NO. 5764 1165 FIG. 12A

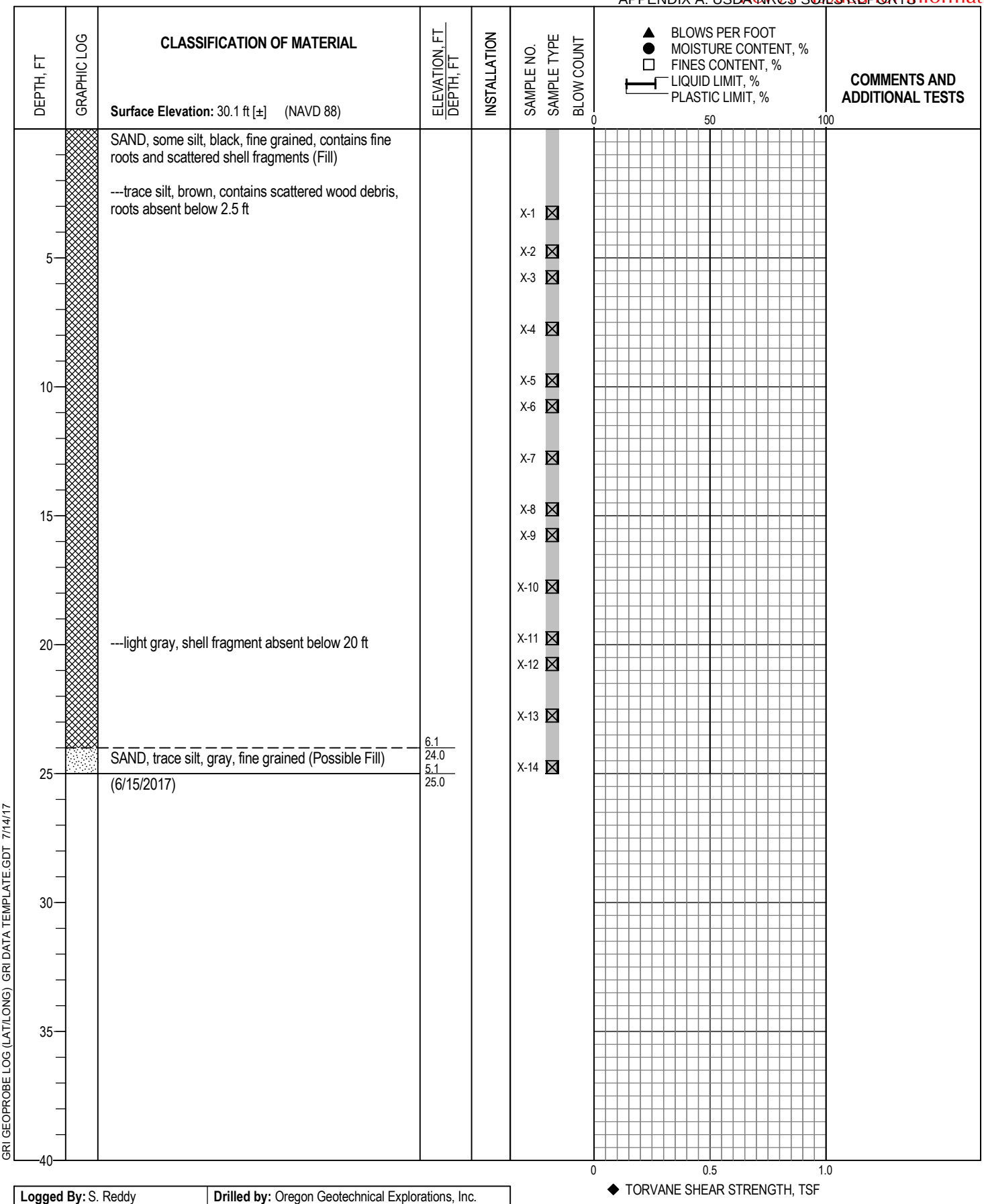


GRI GEOPROBE LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/15/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-1

JULY 2017 JOB NO. 5764 1165 FIG. 13A

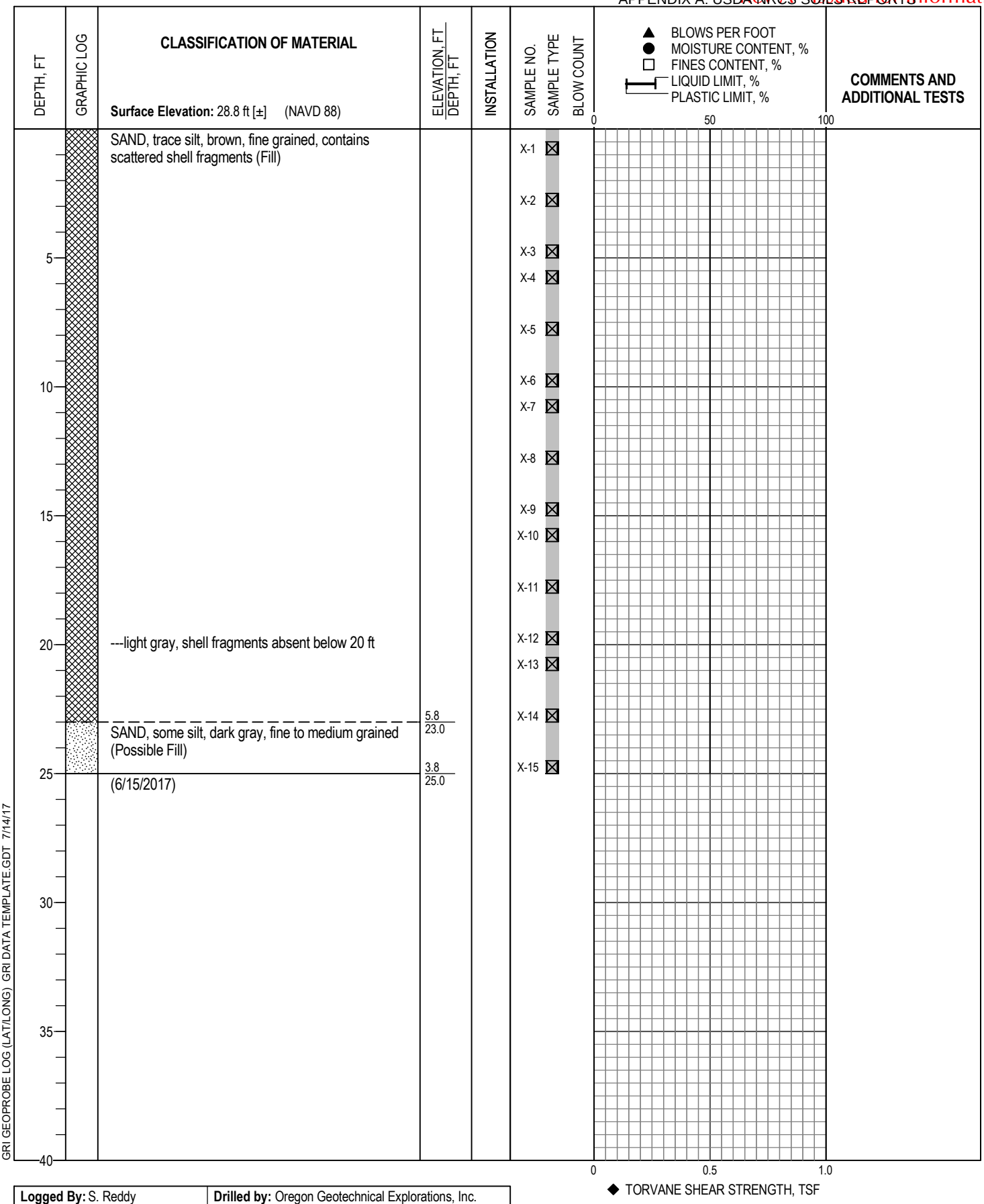


GRI GEOPROBE LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/15/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-2

JULY 2017 JOB NO. 5764 1165 FIG. 14A

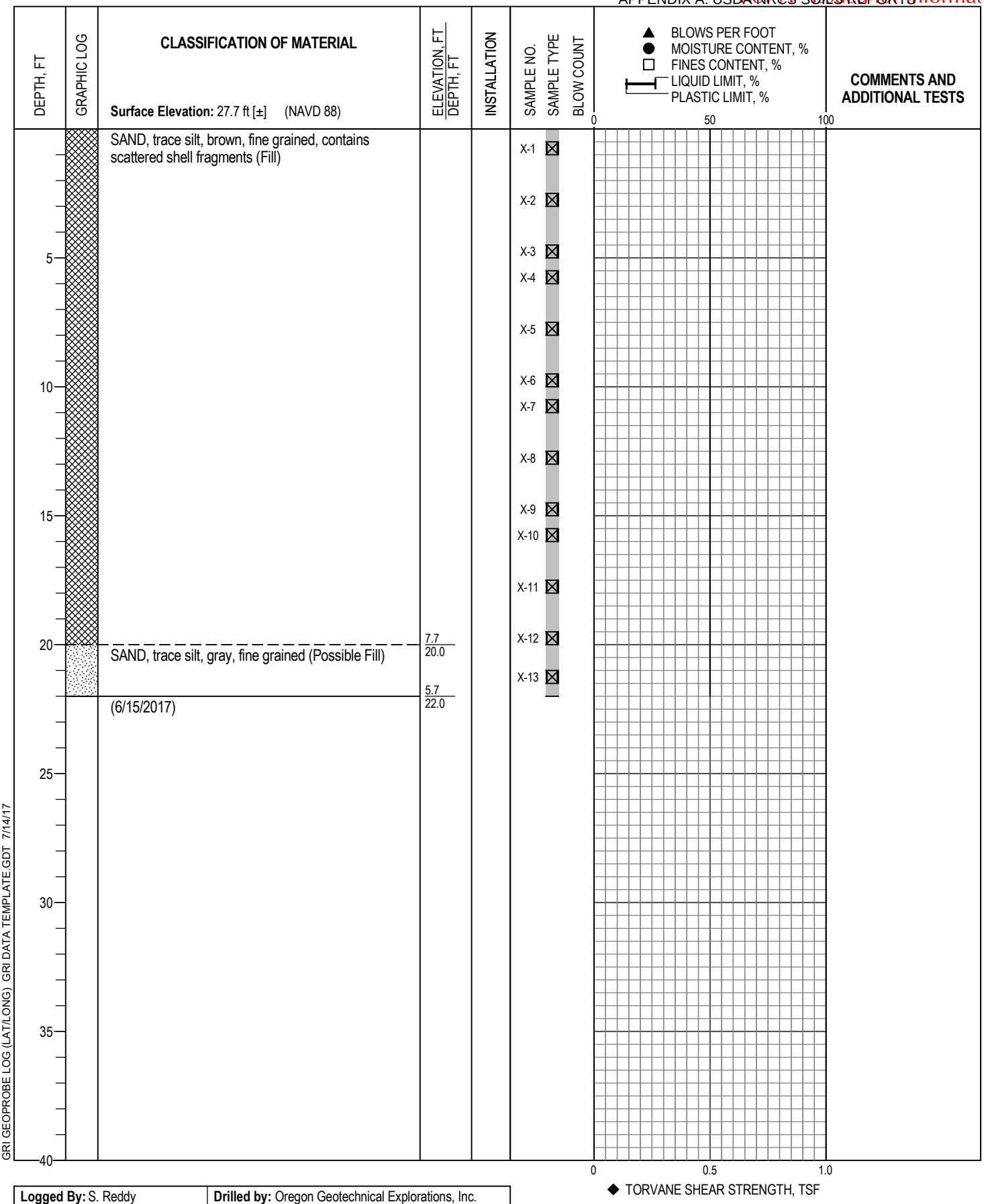


GRI GEOPROBE LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/15/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-3

JULY 2017 JOB NO. 5764 1165 FIG. 15A

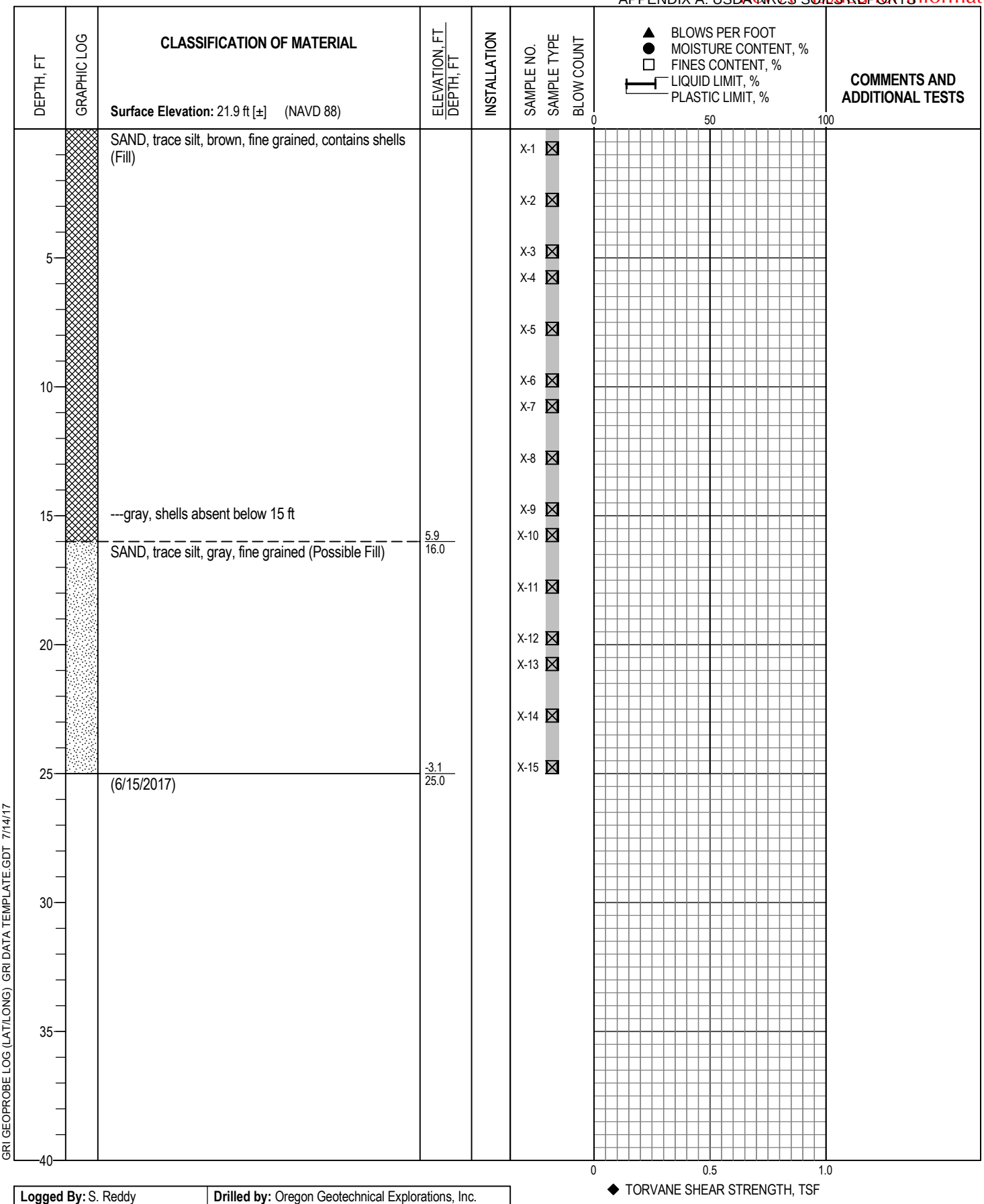


GRI GEOPROBE LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/15/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-4

JULY 2017 JOB NO. 5764 1165 FIG. 16A

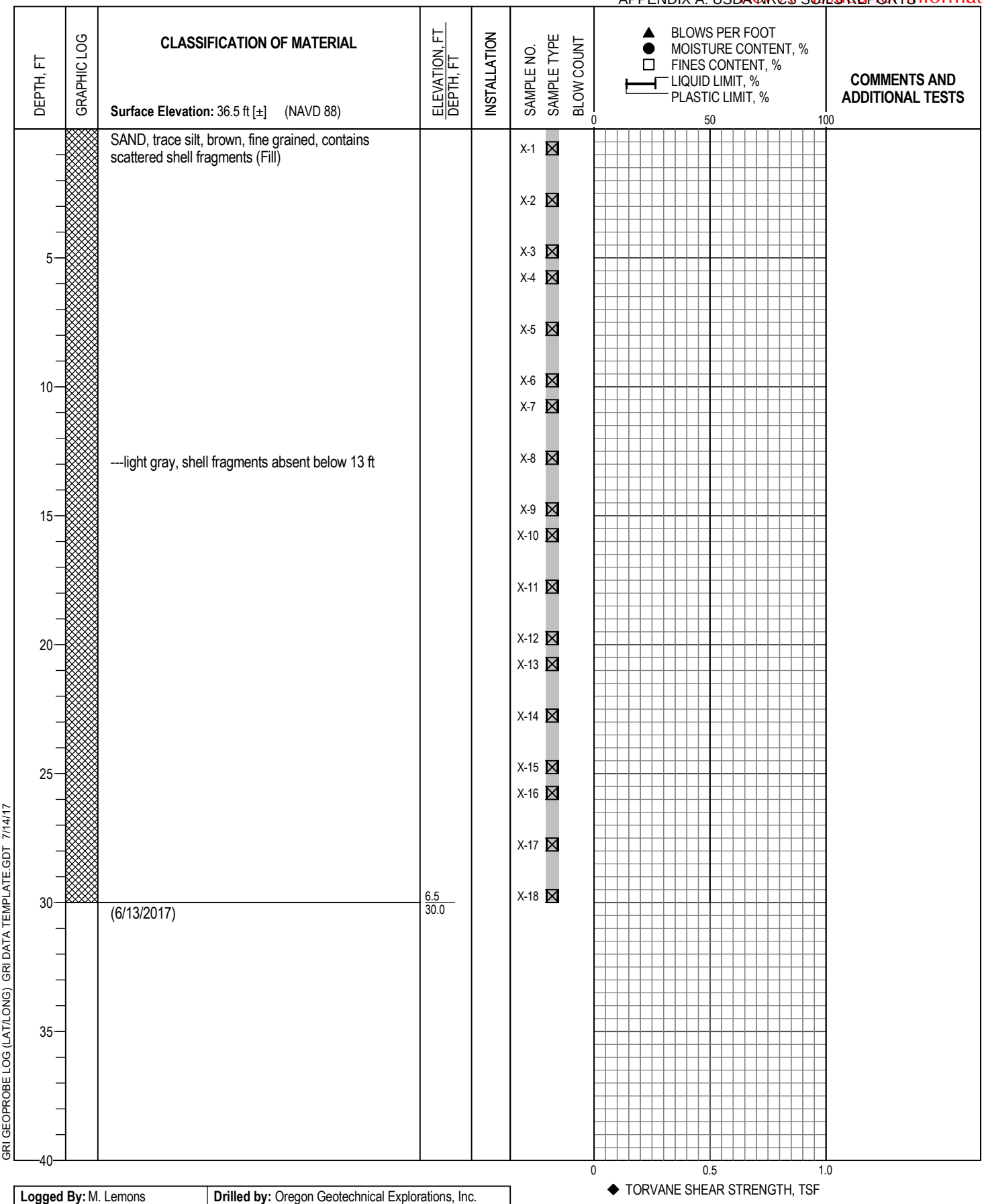


GRI GEOPROBE LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/15/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-5

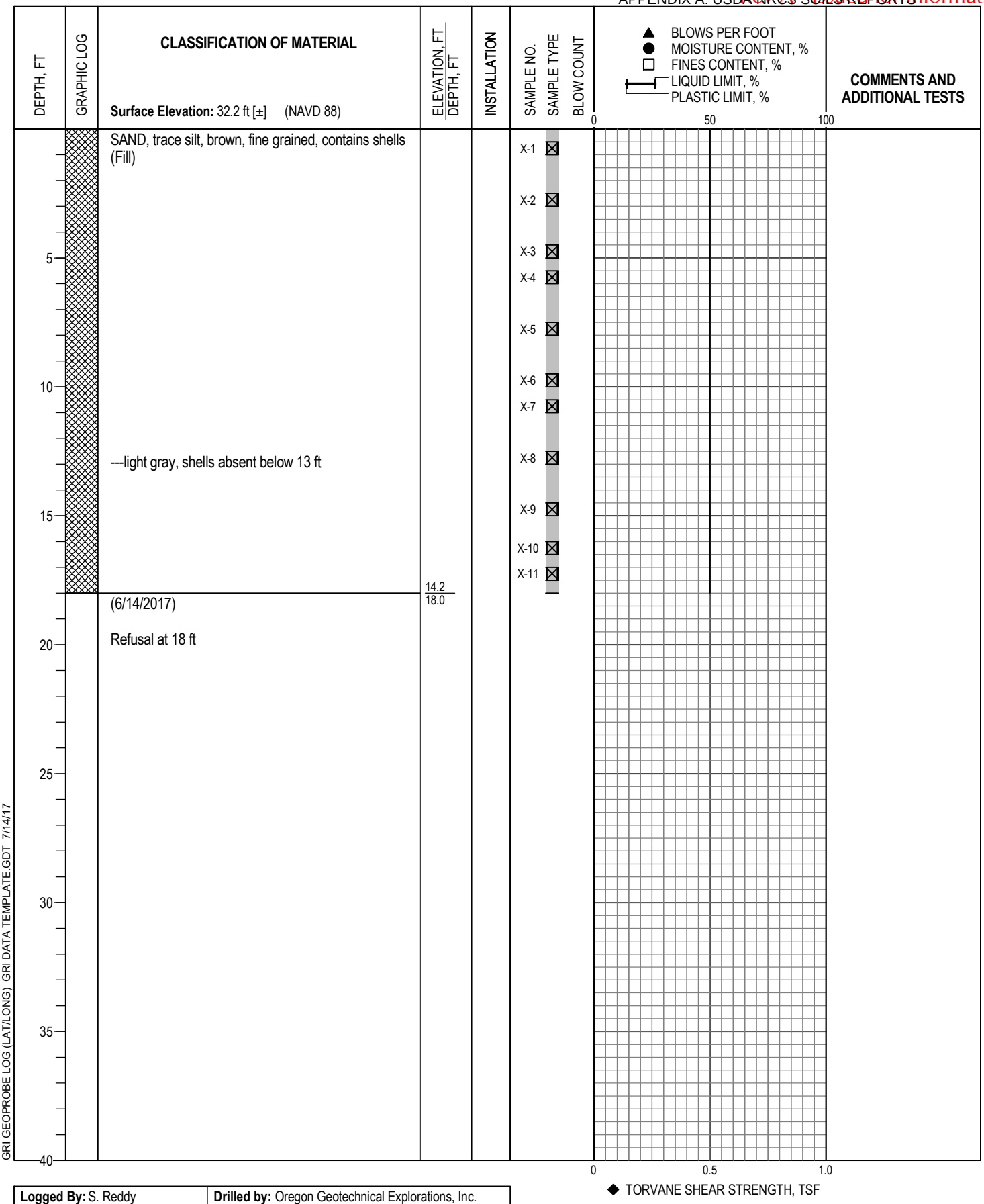
JULY 2017 JOB NO. 5764 1165 FIG. 17A



Logged By: M. Lemons	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/13/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-6

JULY 2017 JOB NO. 5764 1165 FIG. 18A

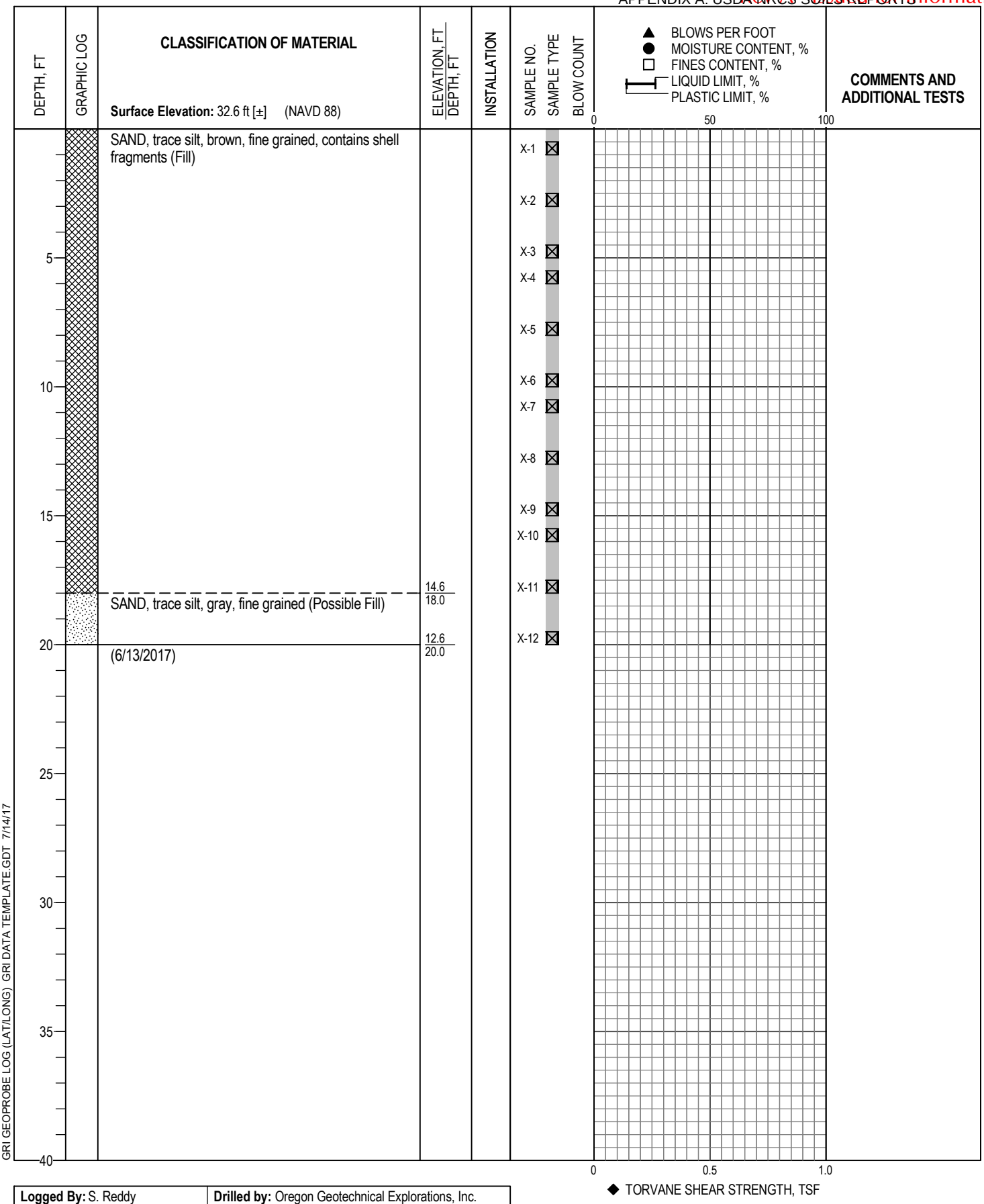


GRI GEOPROBE LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/14/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-7

JULY 2017 JOB NO. 5764 1165 FIG. 19A

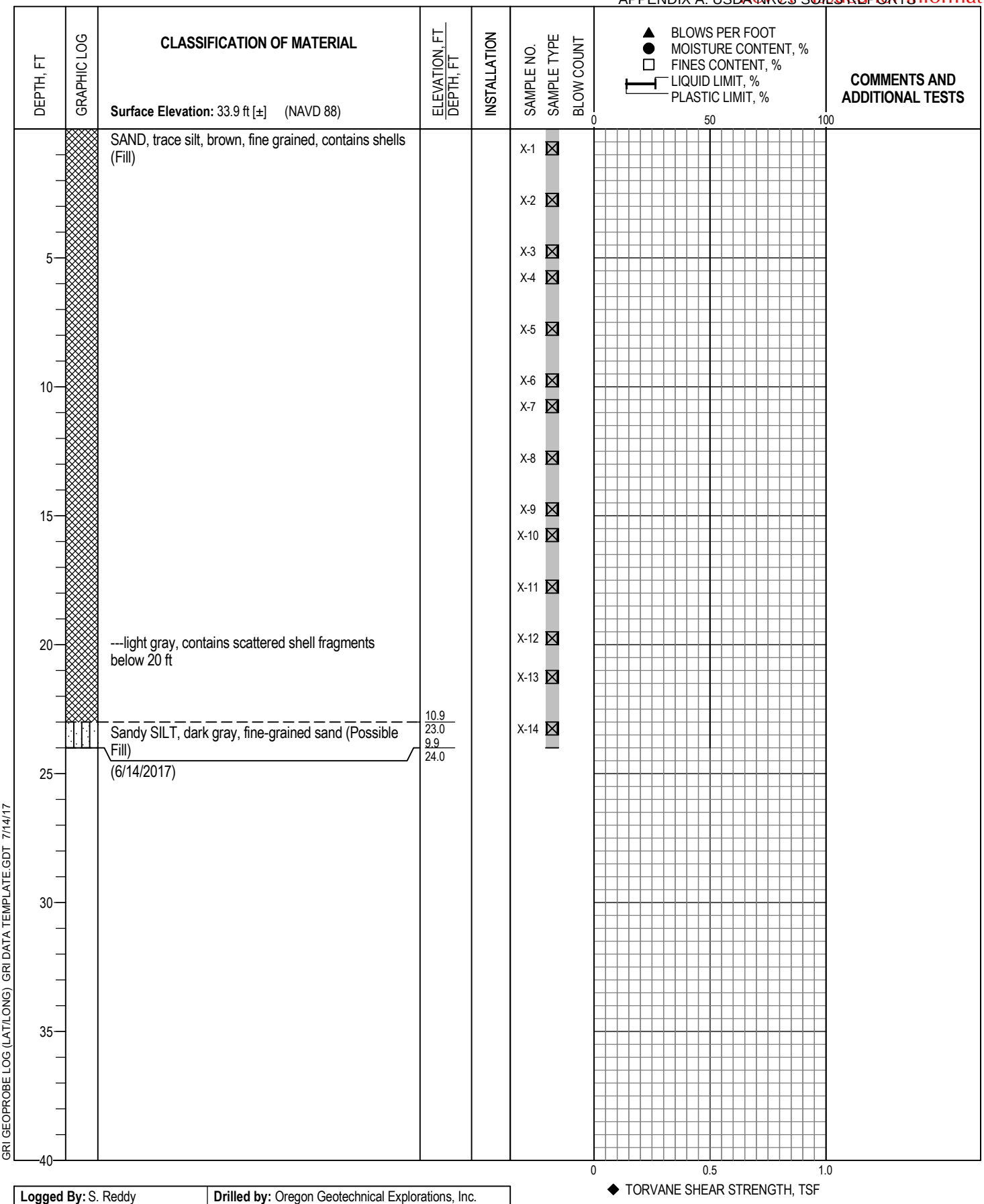


GRI GEOPROBE LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/13/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-8

JULY 2017 JOB NO. 5764 1165 FIG. 20A

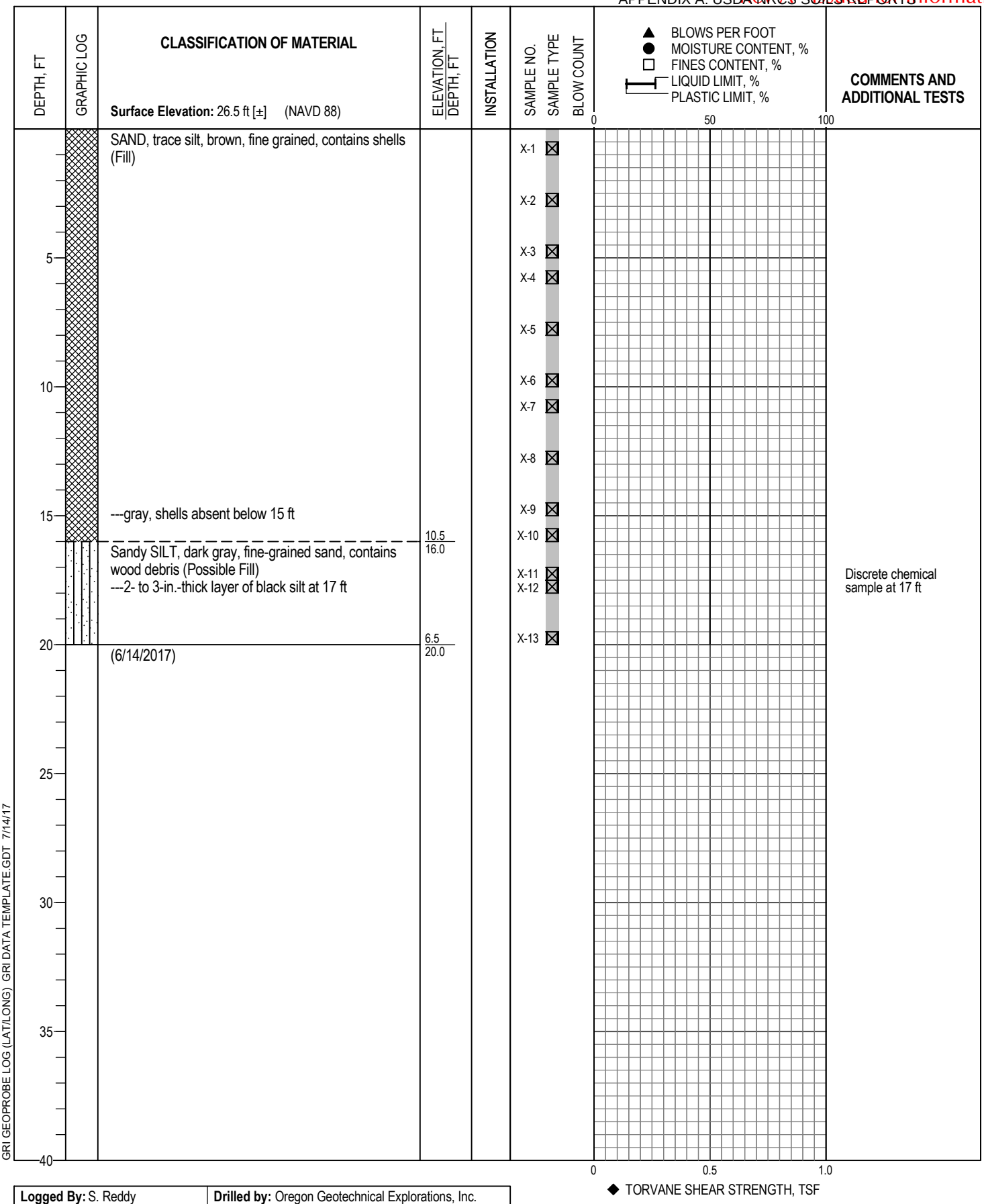


GRI GEOPROBE LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/14/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-9

JULY 2017 JOB NO. 5764 1165 FIG. 21A



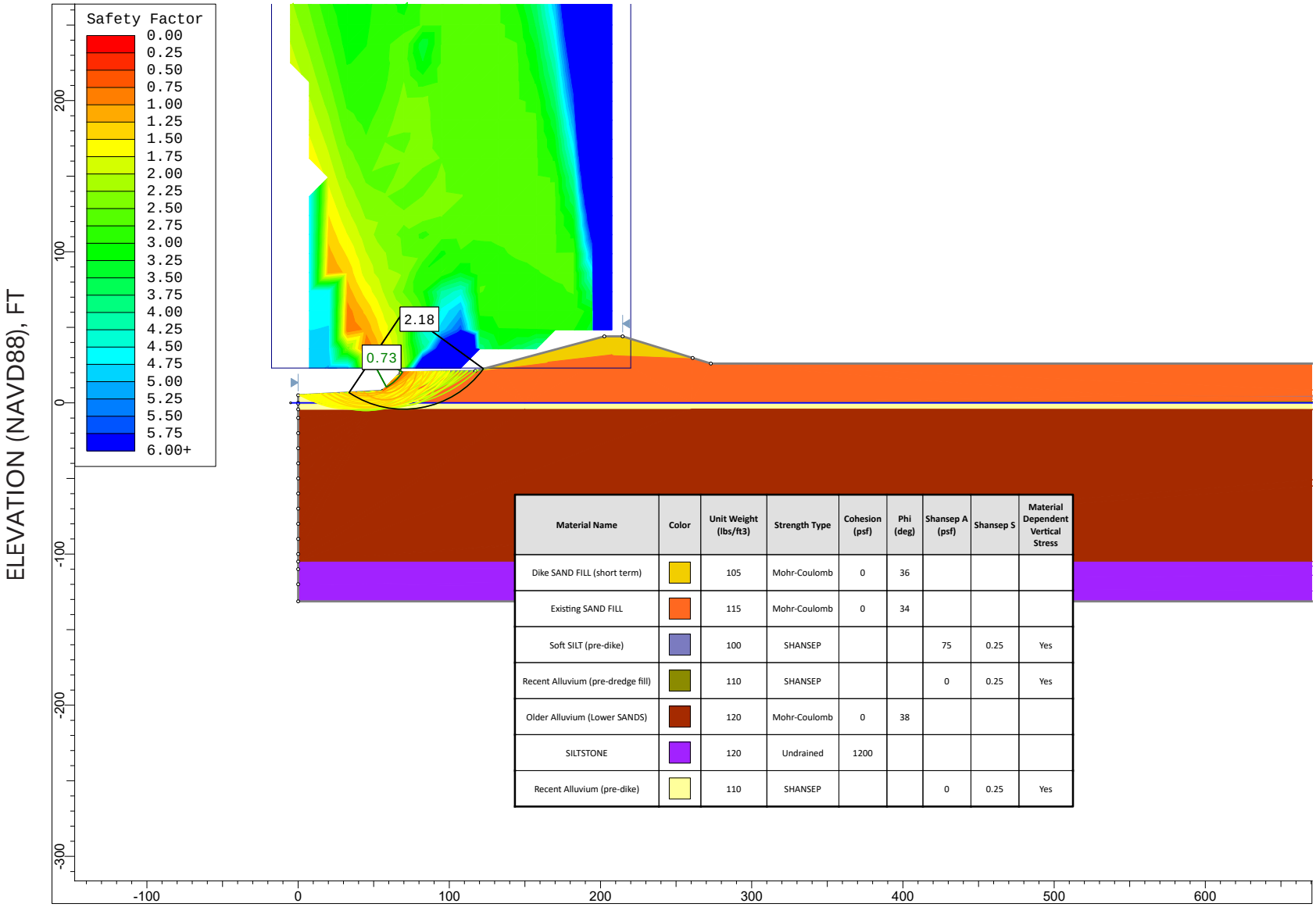
GRI GEOPROBE LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 7/14/17

Logged By: S. Reddy	**Drilled by:** Oregon Geotechnical Explorations, Inc.
Date Started: 6/14/17	**Coordinates:** Not Available
Drilling Method: Direct Push Probe **Equipment:** Geoprobe 6622CPT **Hole Diameter:** 3 in.	**Hammer Type:** Not Used **Weight:** Not Used **Drop:** **Energy Ratio:**
Note: See Legend for Explanation of Symbols	

GEOPROBE DP-10

JULY 2017 JOB NO. 5764 1165 FIG. 22A

APPENDIX B: SLOPE STABILITY MODEL OUTPUTS



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dike SAND FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes

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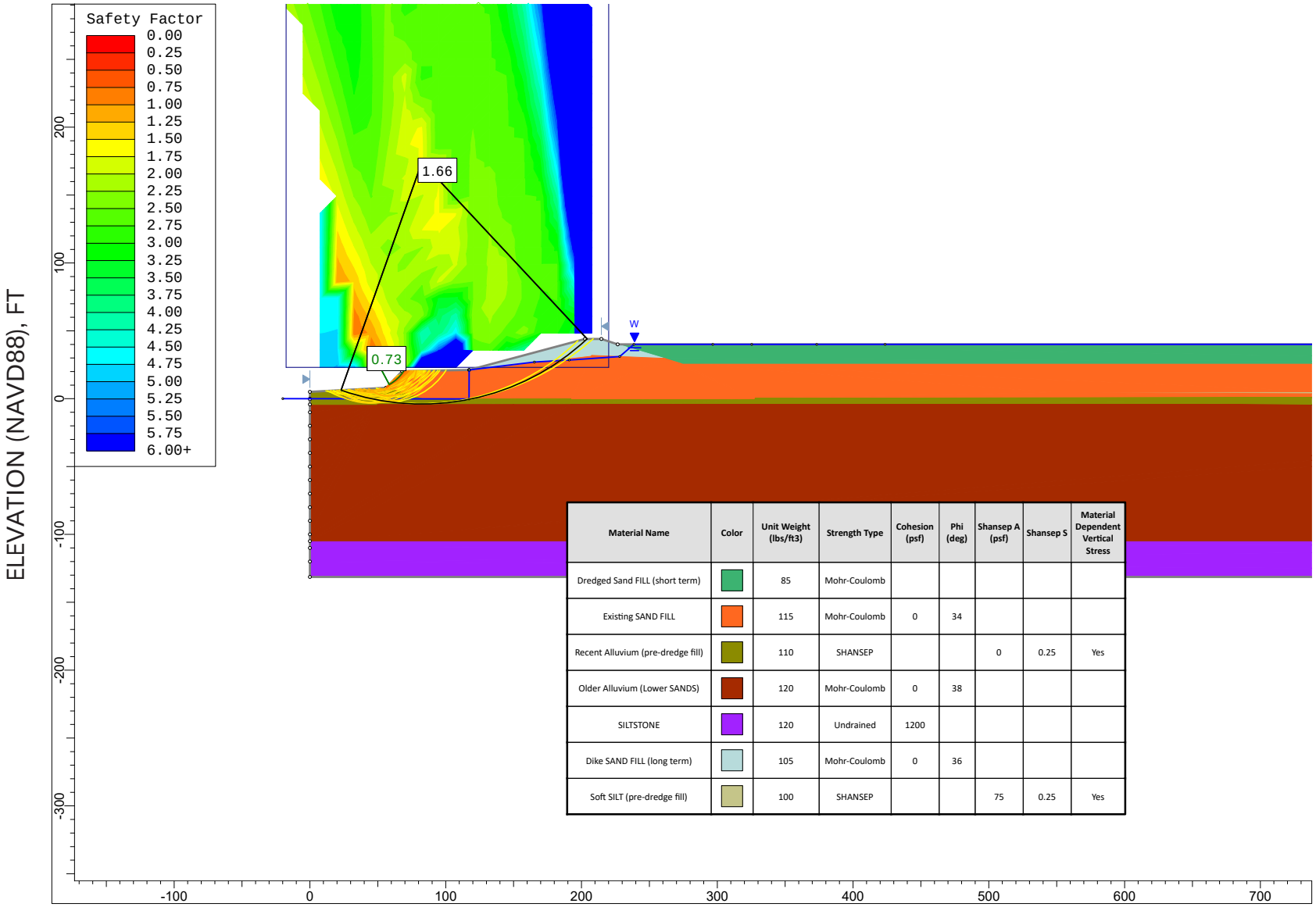
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DIKE CONSTRUCTION

CROSS SECTION A-A' (NORTH)

NOV. 2018 JOB NO. 6099-B FIG. 1B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dredged Sand FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes

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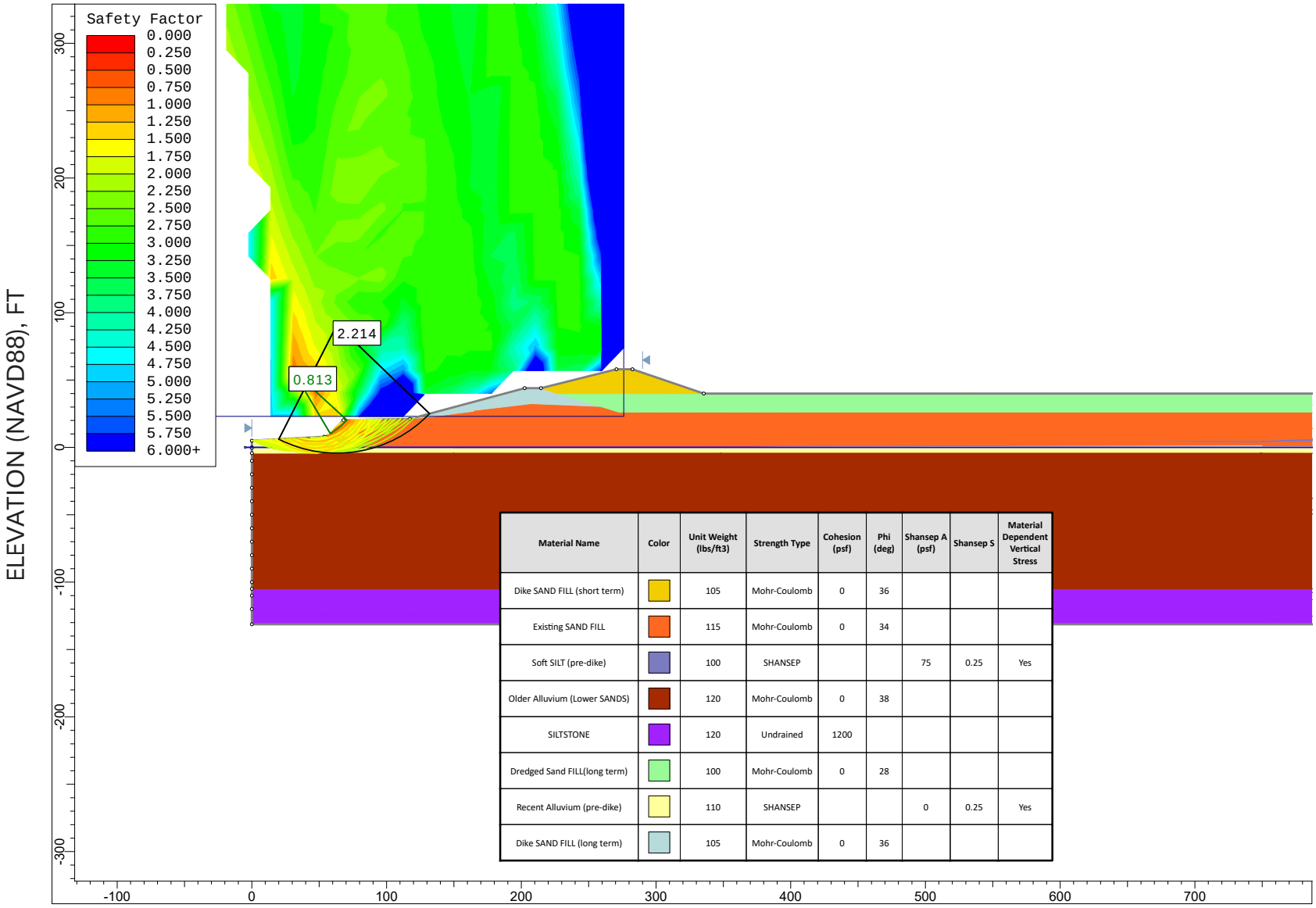
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DREDGE FILL PLACEMENT

CROSS SECTION A-A' (NORTH)

NOV. 2018 JOB NO. 6099-B FIG. 2B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dike SAND FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			

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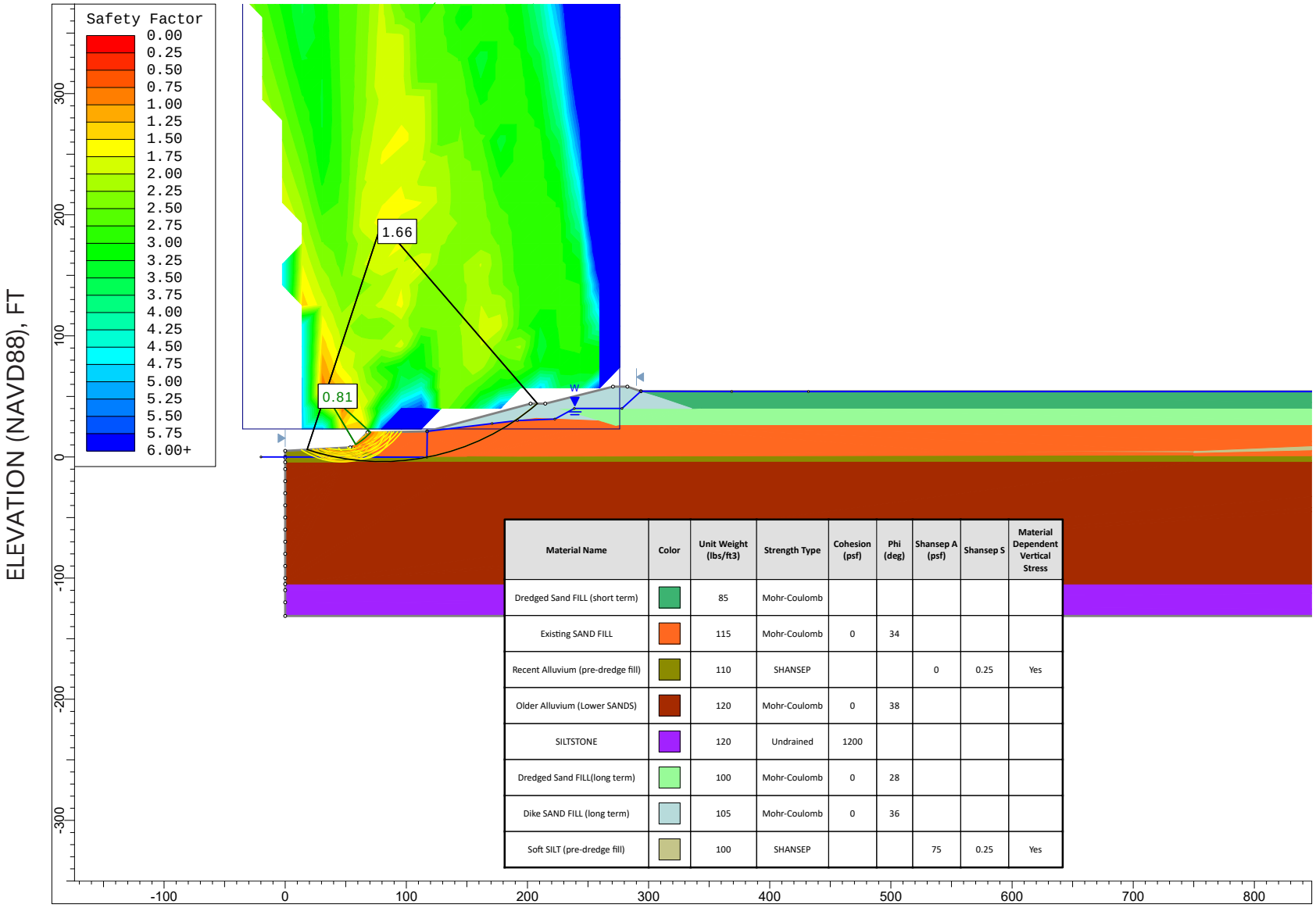
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DIKE CONSTRUCTION

CROSS SECTION A-A' (NORTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dredged Sand FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes

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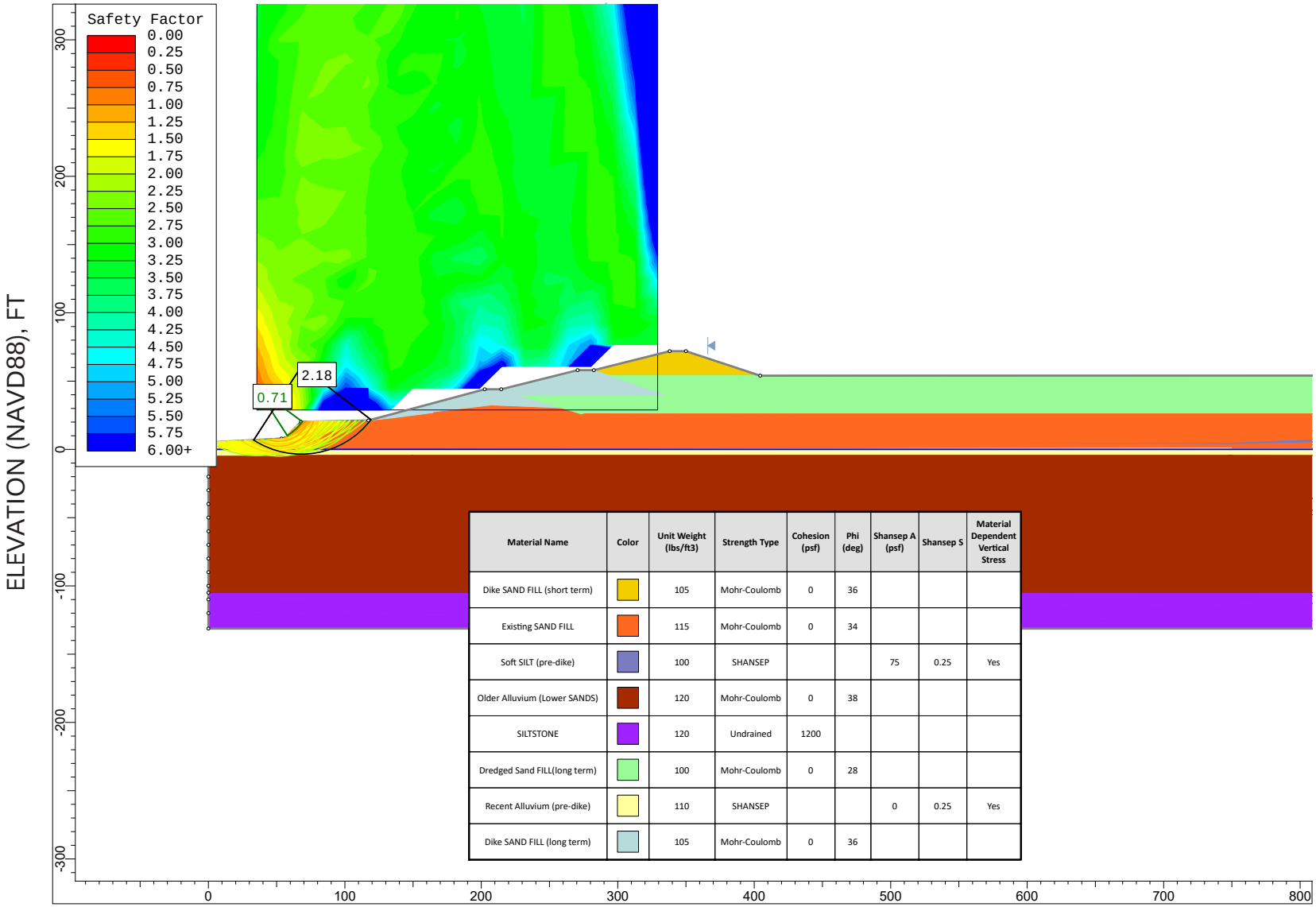
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DREDGE FILL PLACEMENT

CROSS SECTION A-A' (NORTH)

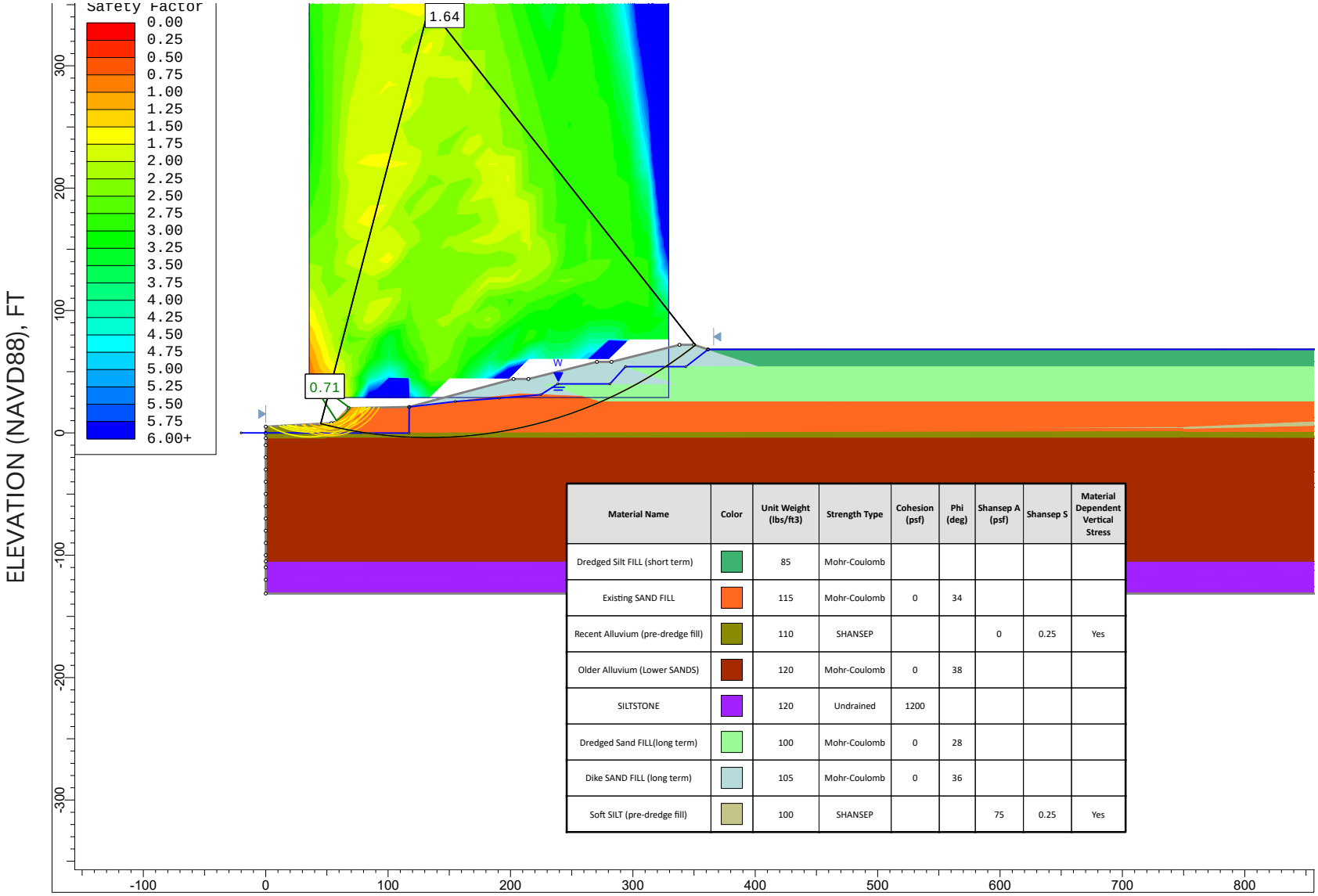


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dike SAND FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DIKE CONSTRUCTION

CROSS SECTION A-A' (NORTH)

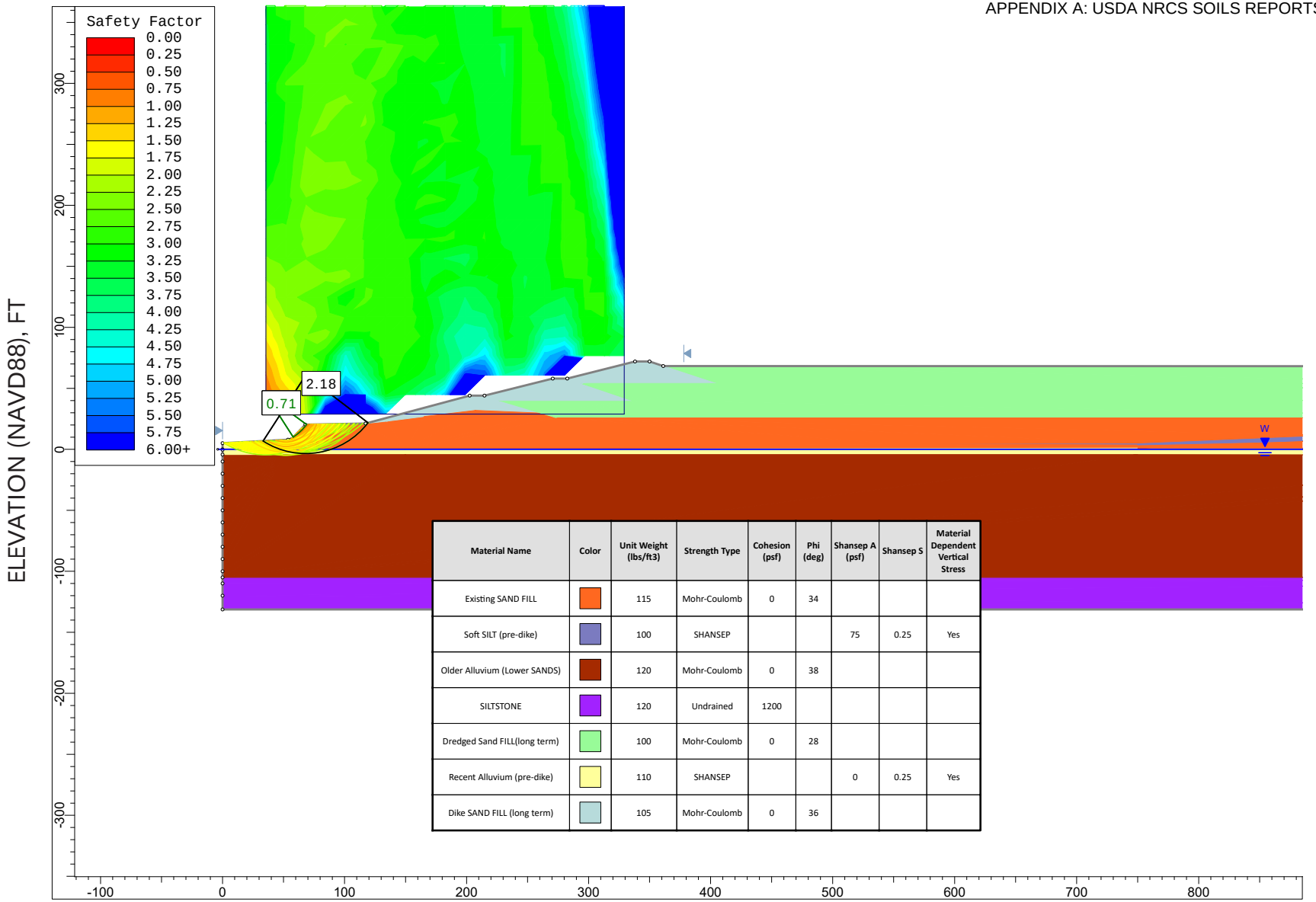


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dredged Silt FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DREDGE FILL PLACEMENT

CROSS SECTION A-A' (NORTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			

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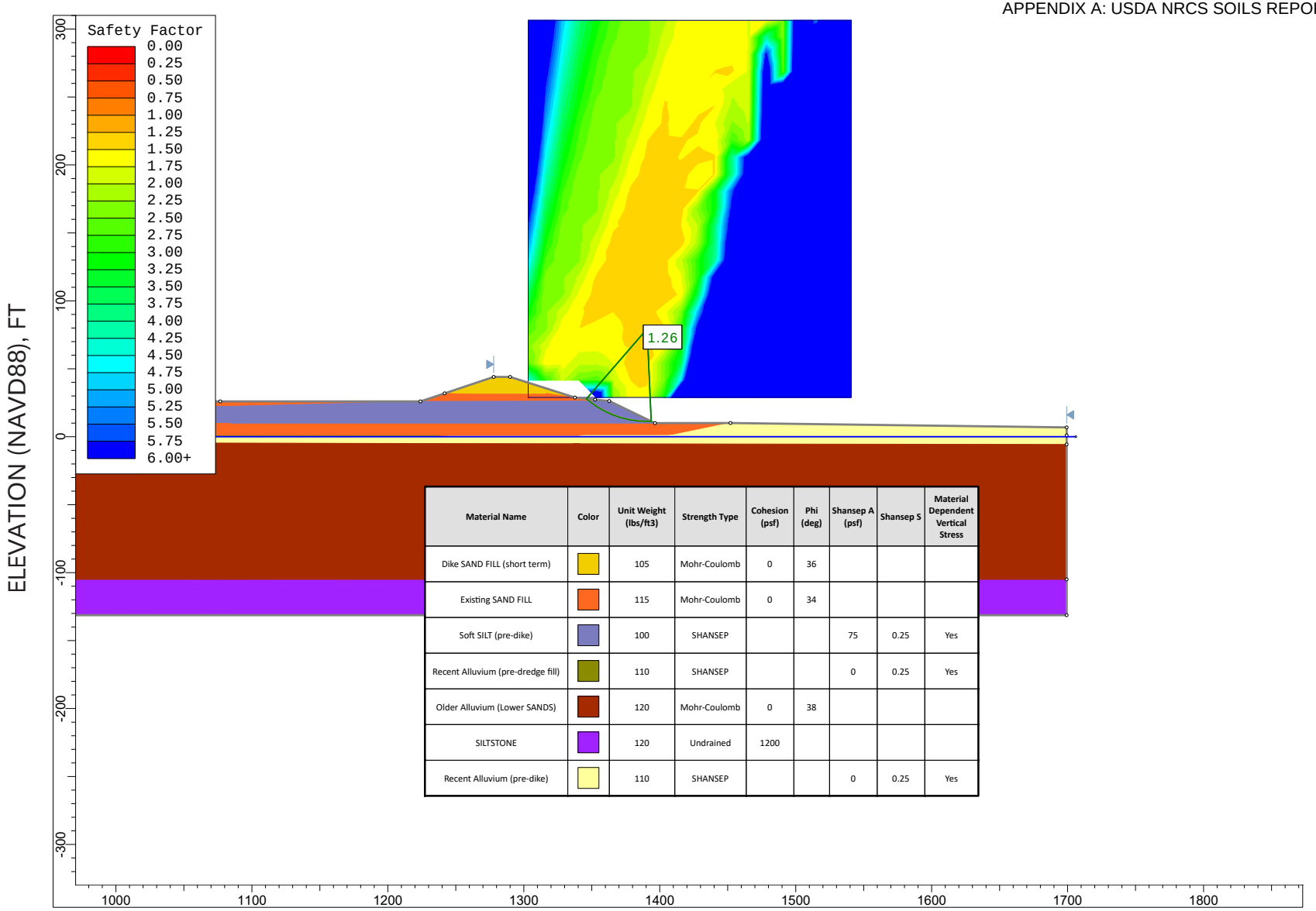
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LONG TERM

CROSS SECTION A-A' (NORTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dike SAND FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes

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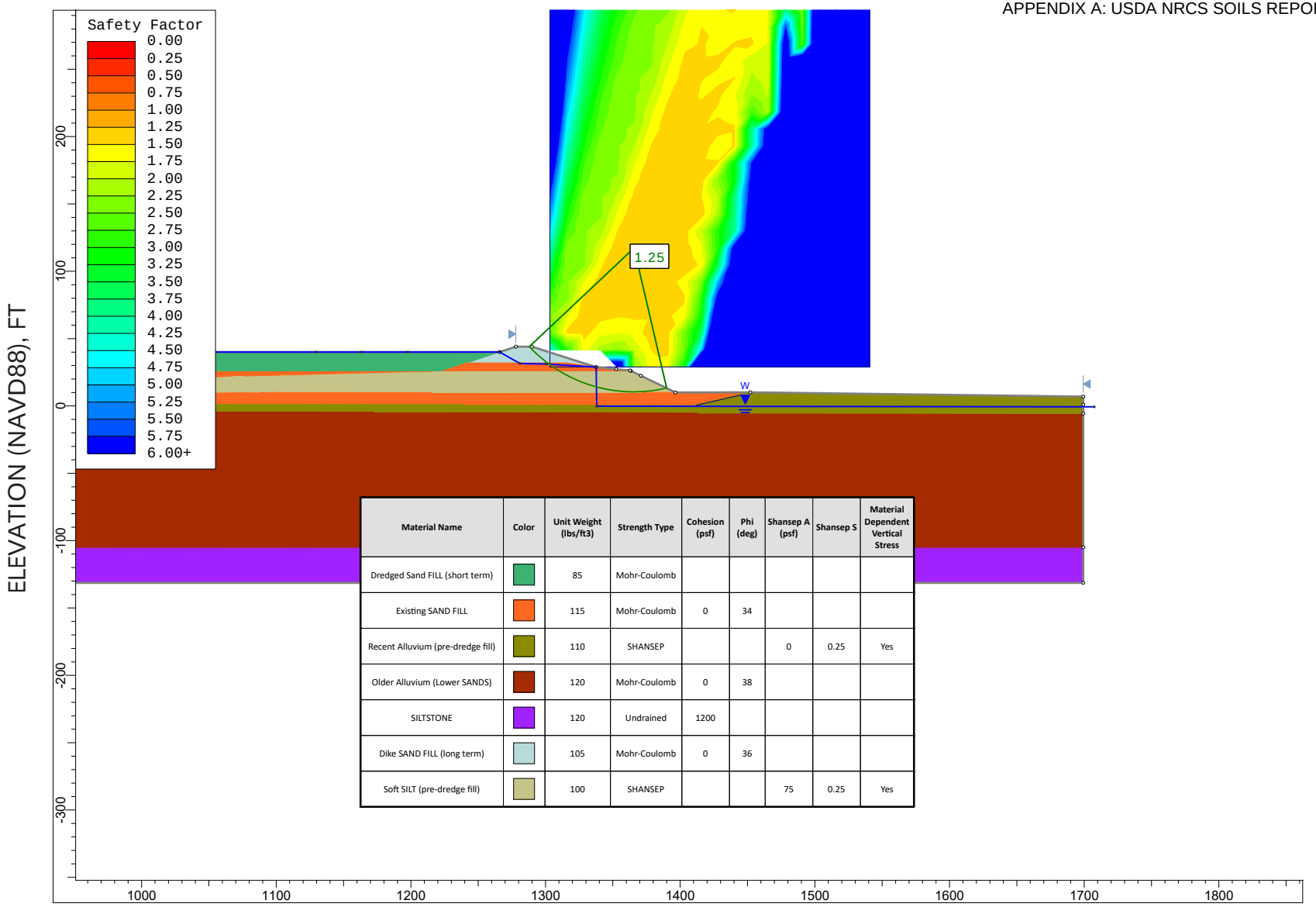
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DIKE CONSTRUCTION

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 8B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dredged Sand FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes

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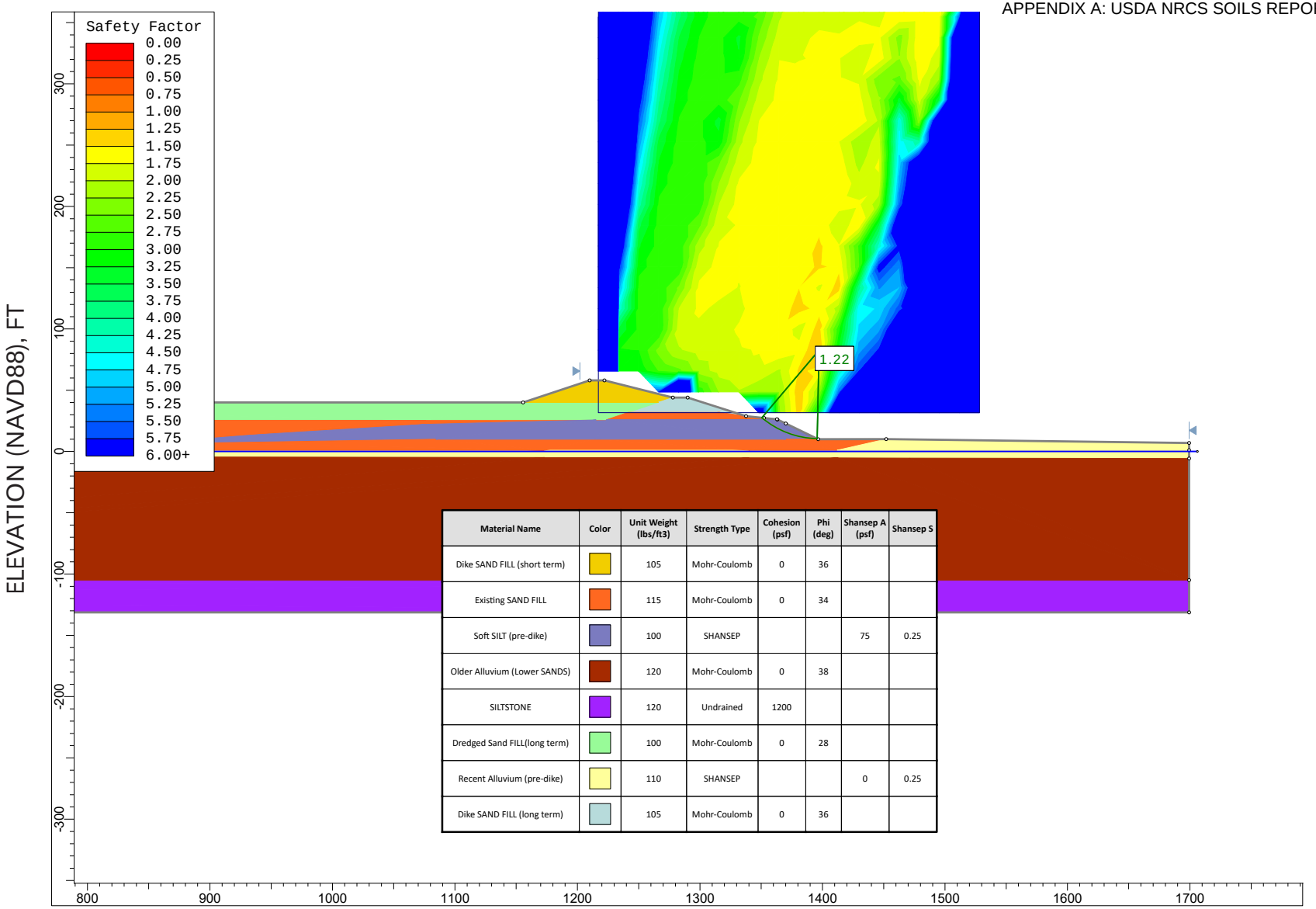
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DREDGE FILL PLACEMENT

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 9B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S
Dike SAND FILL (short term)		105	Mohr-Coulomb	0	36		
Existing SAND FILL		115	Mohr-Coulomb	0	34		
Soft SILT (pre-dike)		100	SHANSEP			75	0.25
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38		
SILTSTONE		120	Undrained	1200			
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28		
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36		

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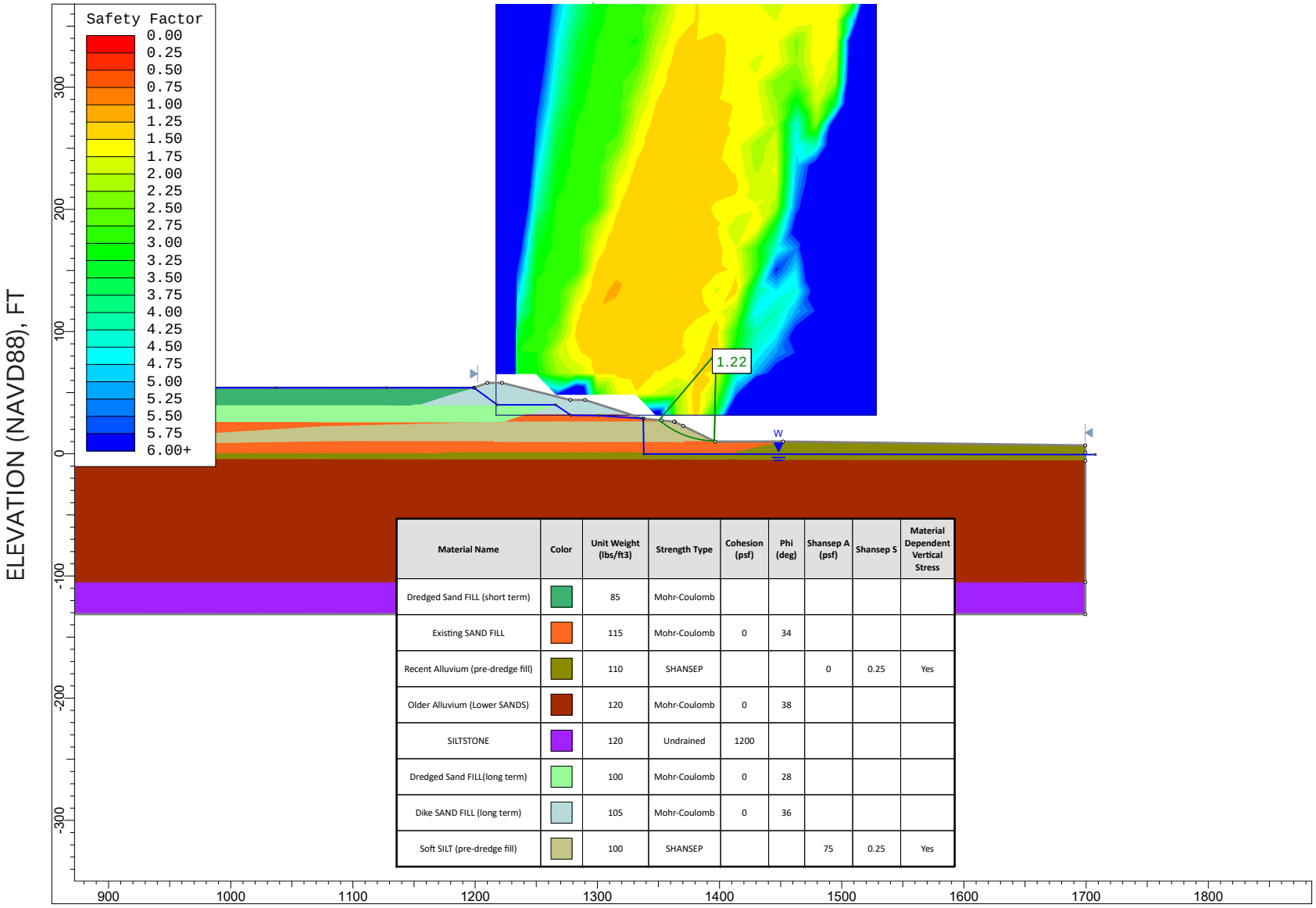
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DIKE CONSTRUCTION

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 10B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dredged Sand FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes

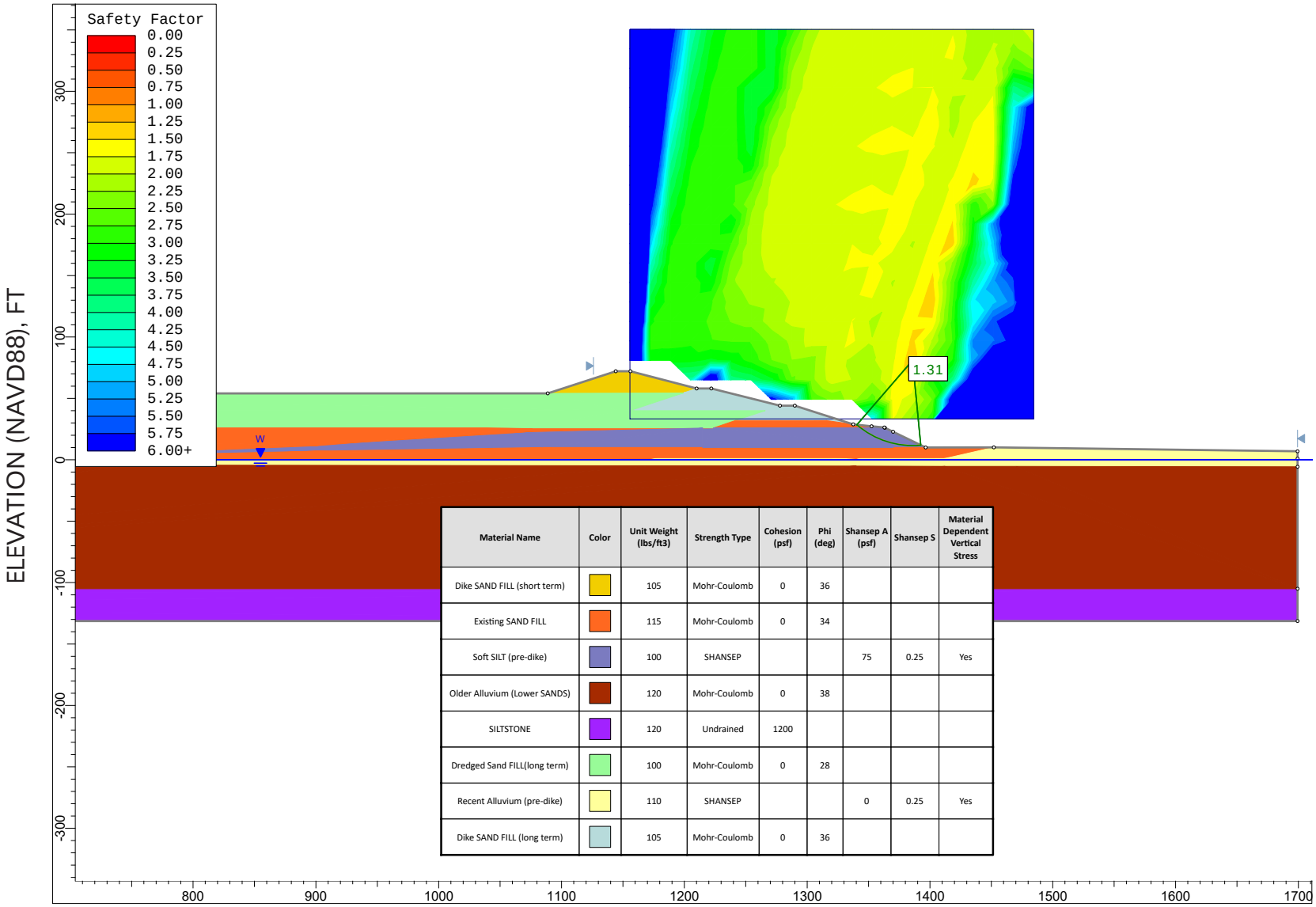
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DREDGE FILL PLACEMENT

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 11B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dike SAND FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			

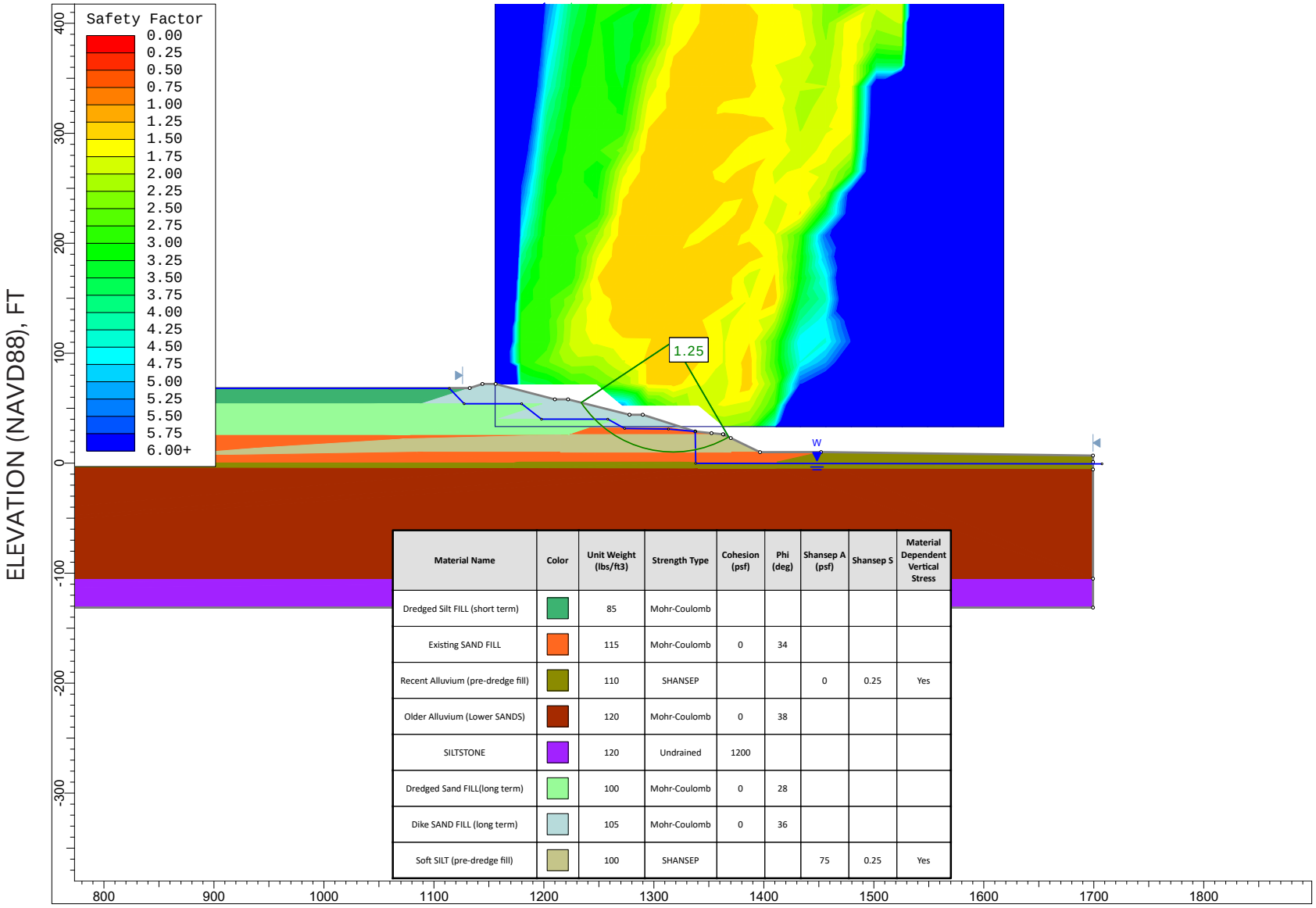
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DIKE CONSTRUCTION

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 12B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dredged Silt FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes

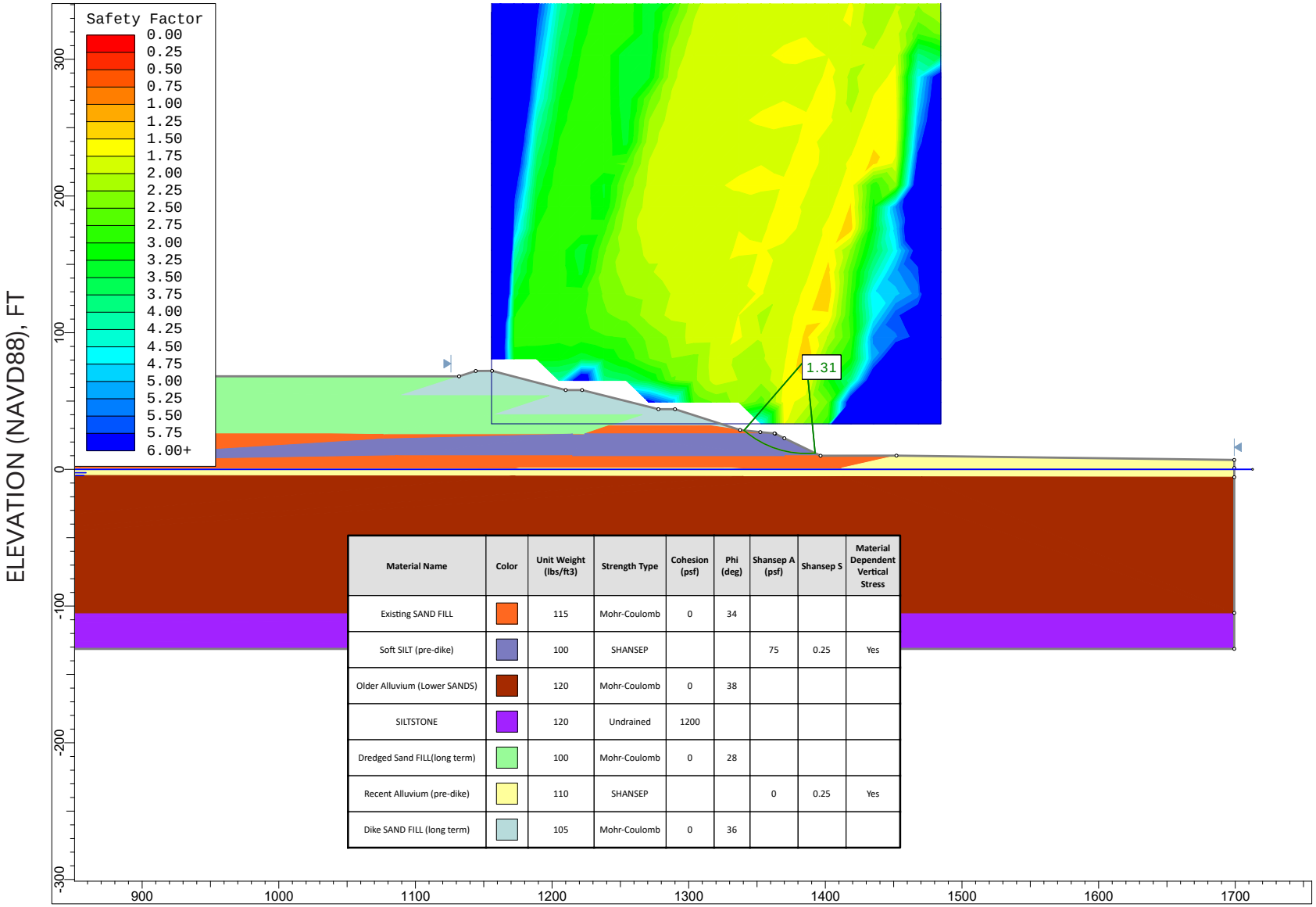
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DREDGE FILL PLACEMENT

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 13B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			

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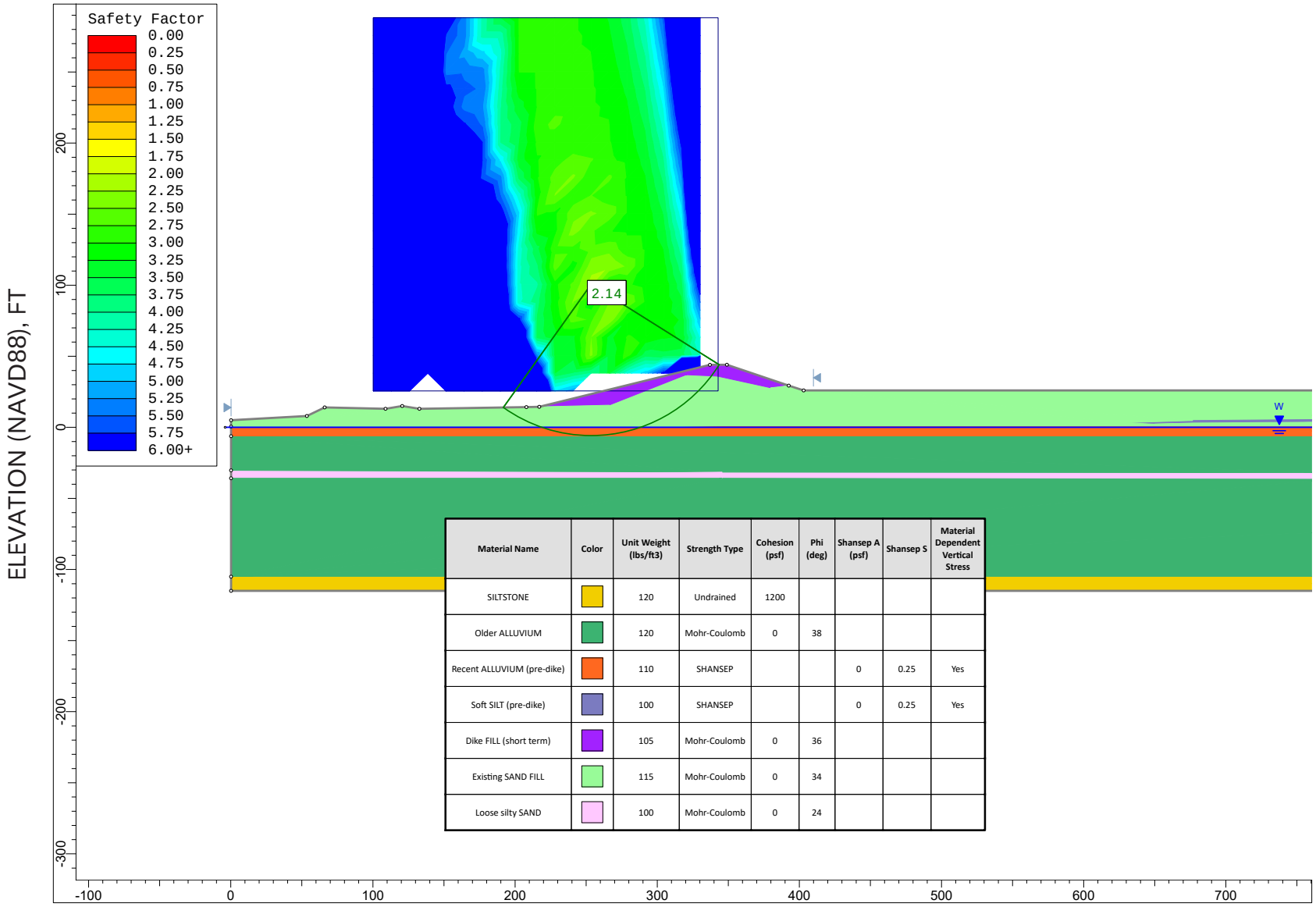
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LONG TERM

CROSS SECTION A-A' (SOUTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Recent ALLUVIUM (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			

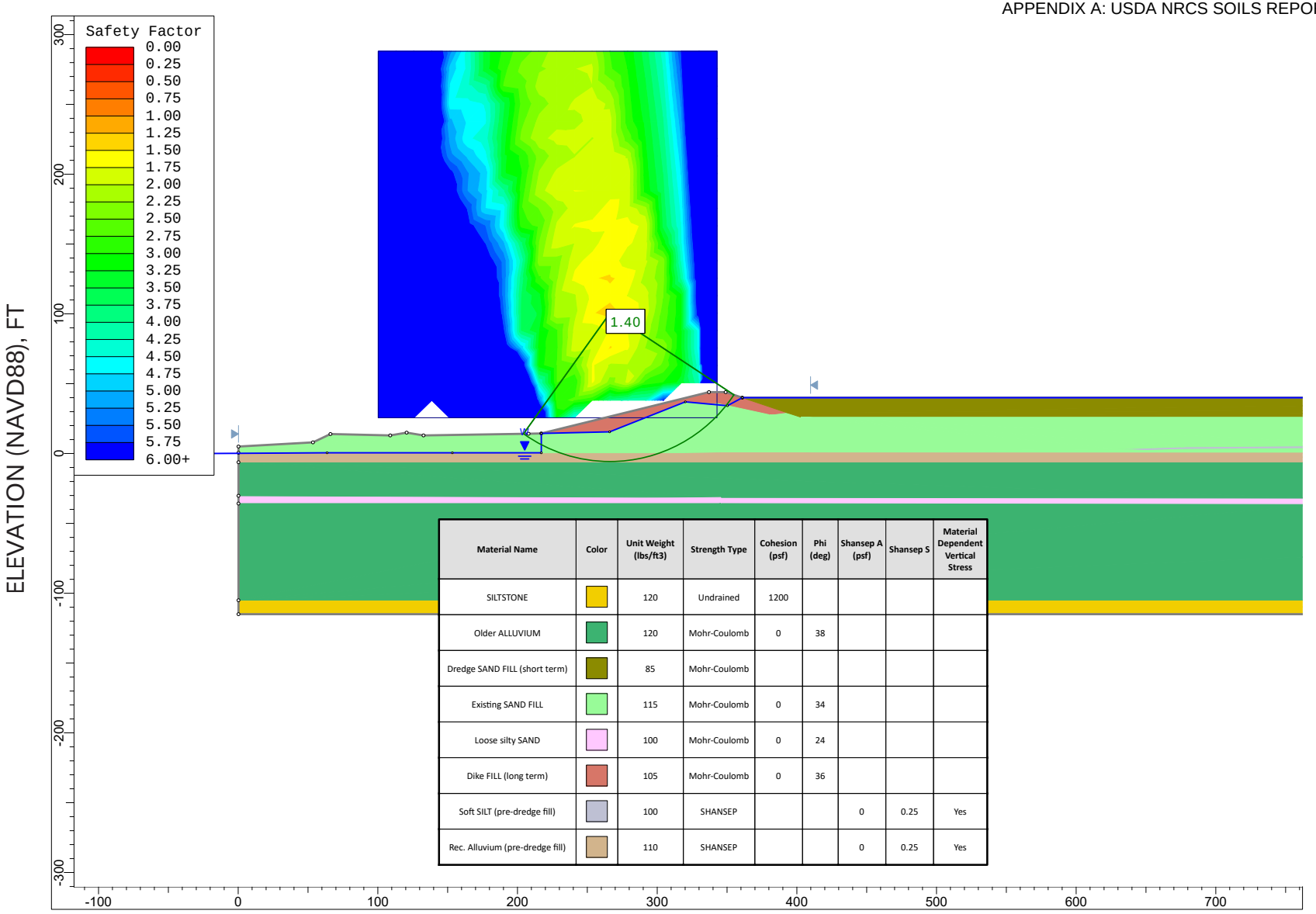
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DIKE CONSTRUCTION

CROSS SECTION B-B' (NORTH)

NOV. 2018 JOB NO. 6099-B FIG. 15B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes

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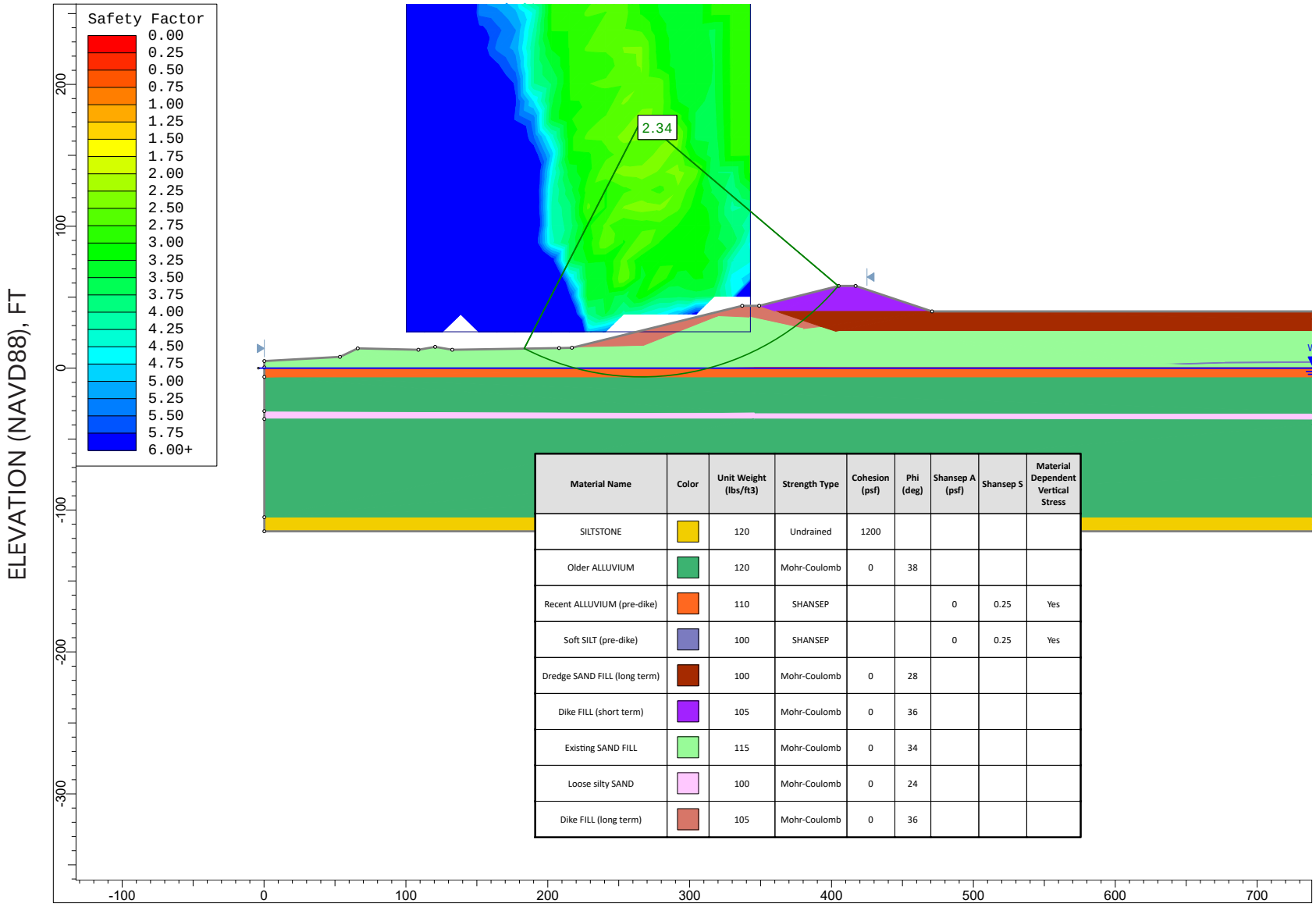
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DREDGE FILL PLACEMENT

CROSS SECTION B-B' (NORTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Recent ALLUVIUM (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			

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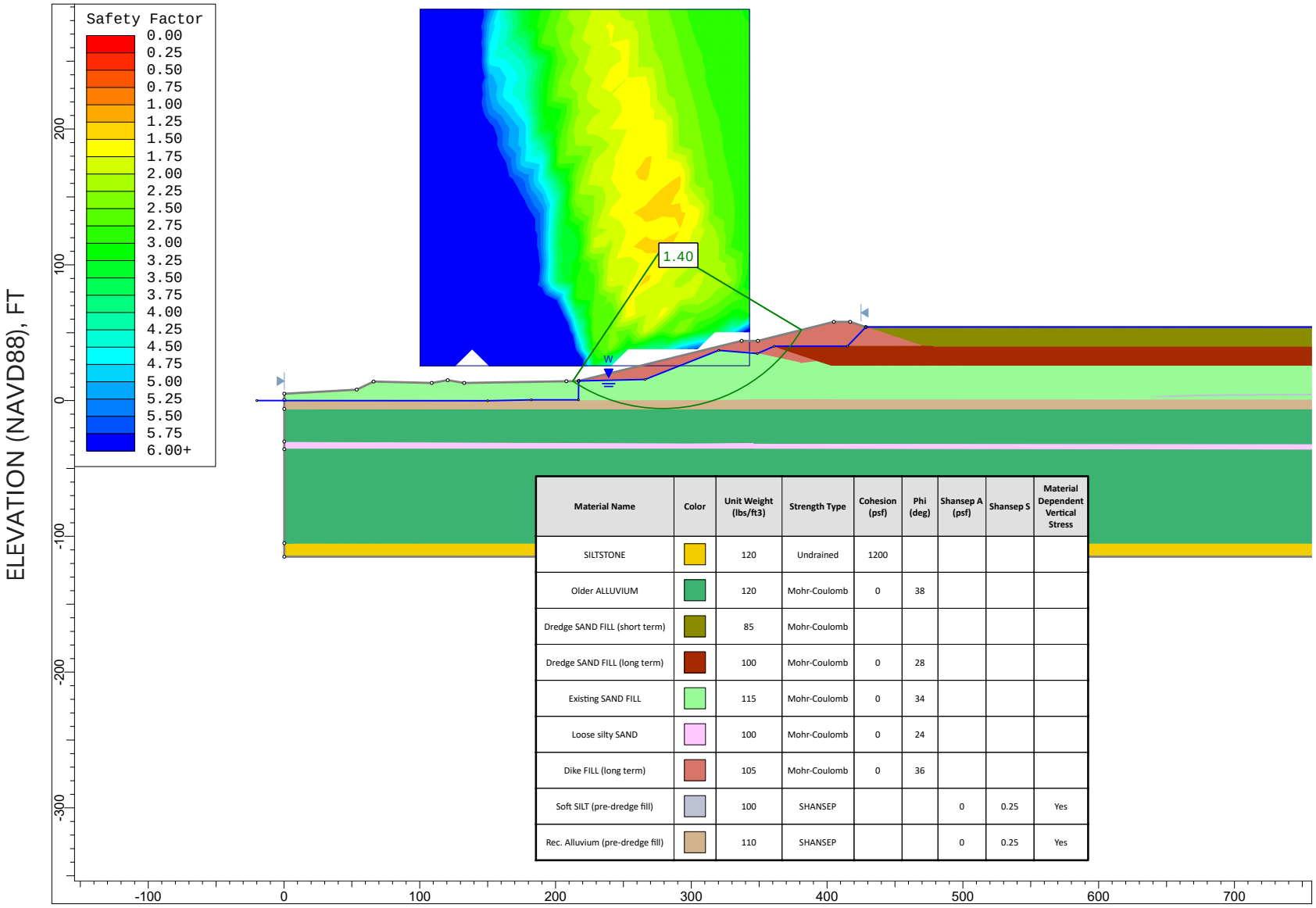
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DIKE CONSTRUCTION

CROSS SECTION B-B' (NORTH)

NOV. 2018 JOB NO. 6099-B FIG. 17B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes

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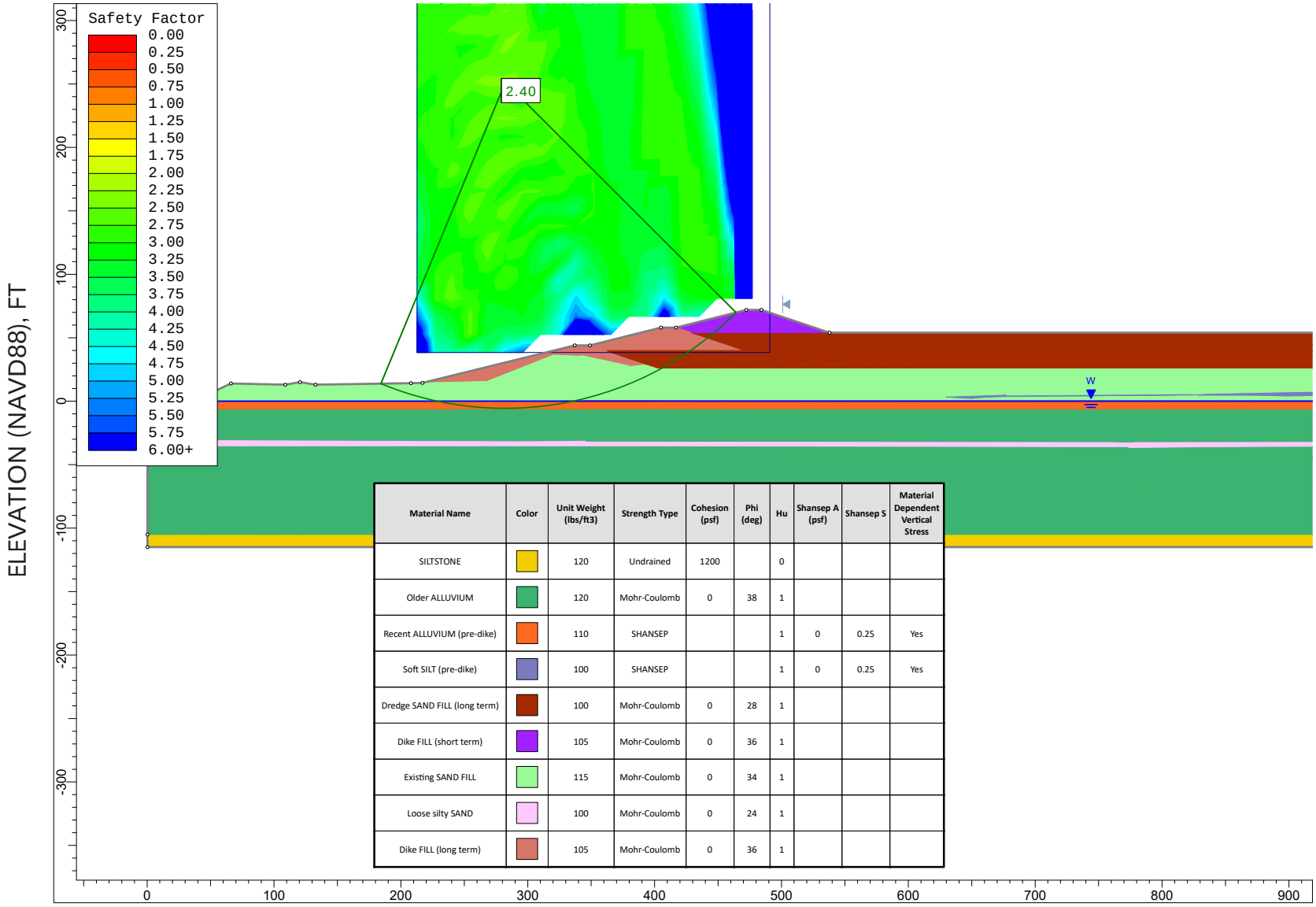
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DREDGE FILL PLACEMENT

CROSS SECTION B-B' (NORTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Hu	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200		0			
Older ALLUVIUM		120	Mohr-Coulomb	0	38	1			
Recent ALLUVIUM (pre-dike)		110	SHANSEP			1	0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			1	0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28	1			
Dike FILL (short term)		105	Mohr-Coulomb	0	36	1			
Existing SAND FILL		115	Mohr-Coulomb	0	34	1			
Loose silty SAND		100	Mohr-Coulomb	0	24	1			
Dike FILL (long term)		105	Mohr-Coulomb	0	36	1			

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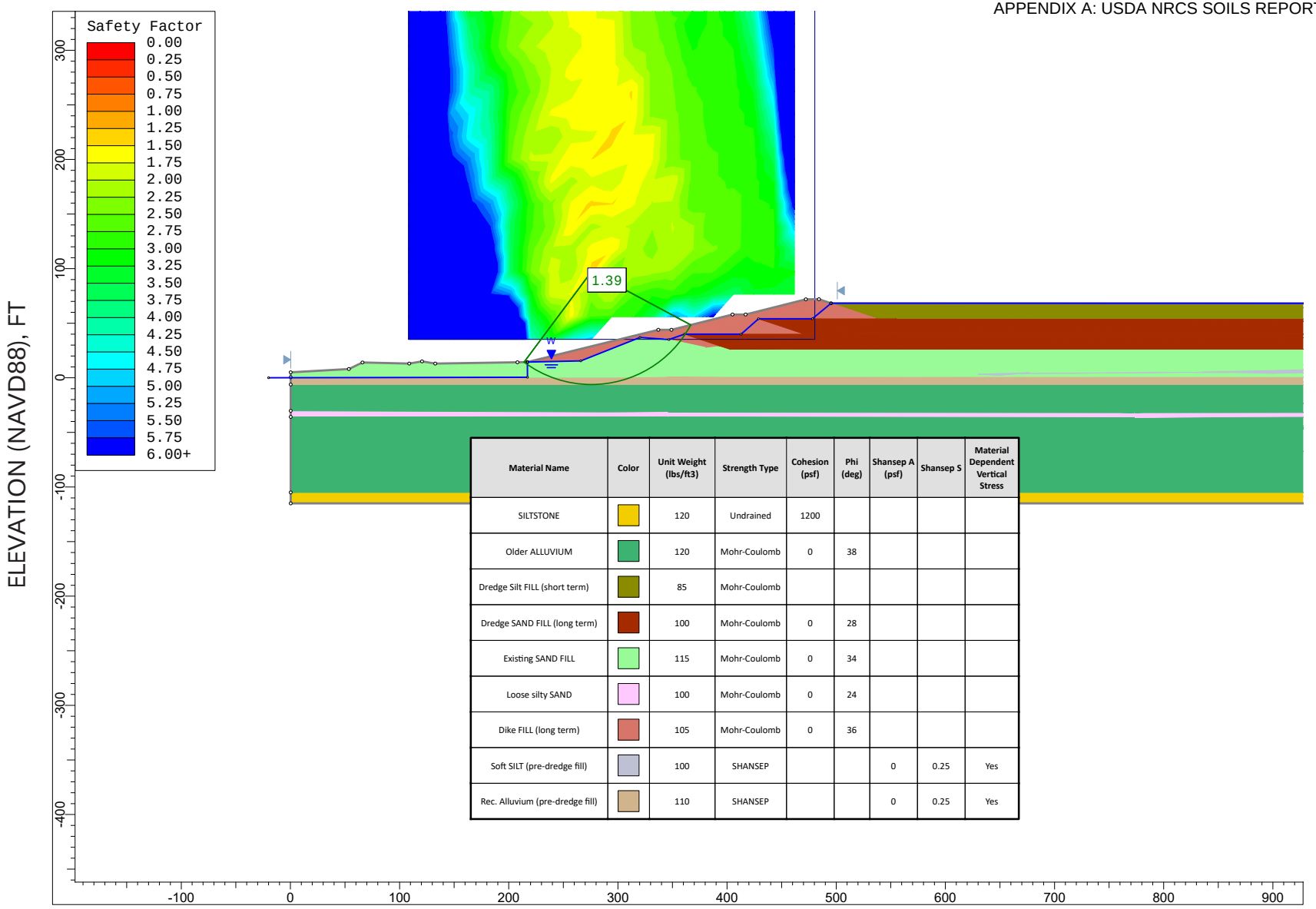
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DIKE CONSTRUCTION

CROSS SECTION B-B' (NORTH)

NOV. 2018 JOB NO. 6099-B FIG. 19B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Dredge Silt FILL (short term)		85	Mohr-Coulomb					
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes

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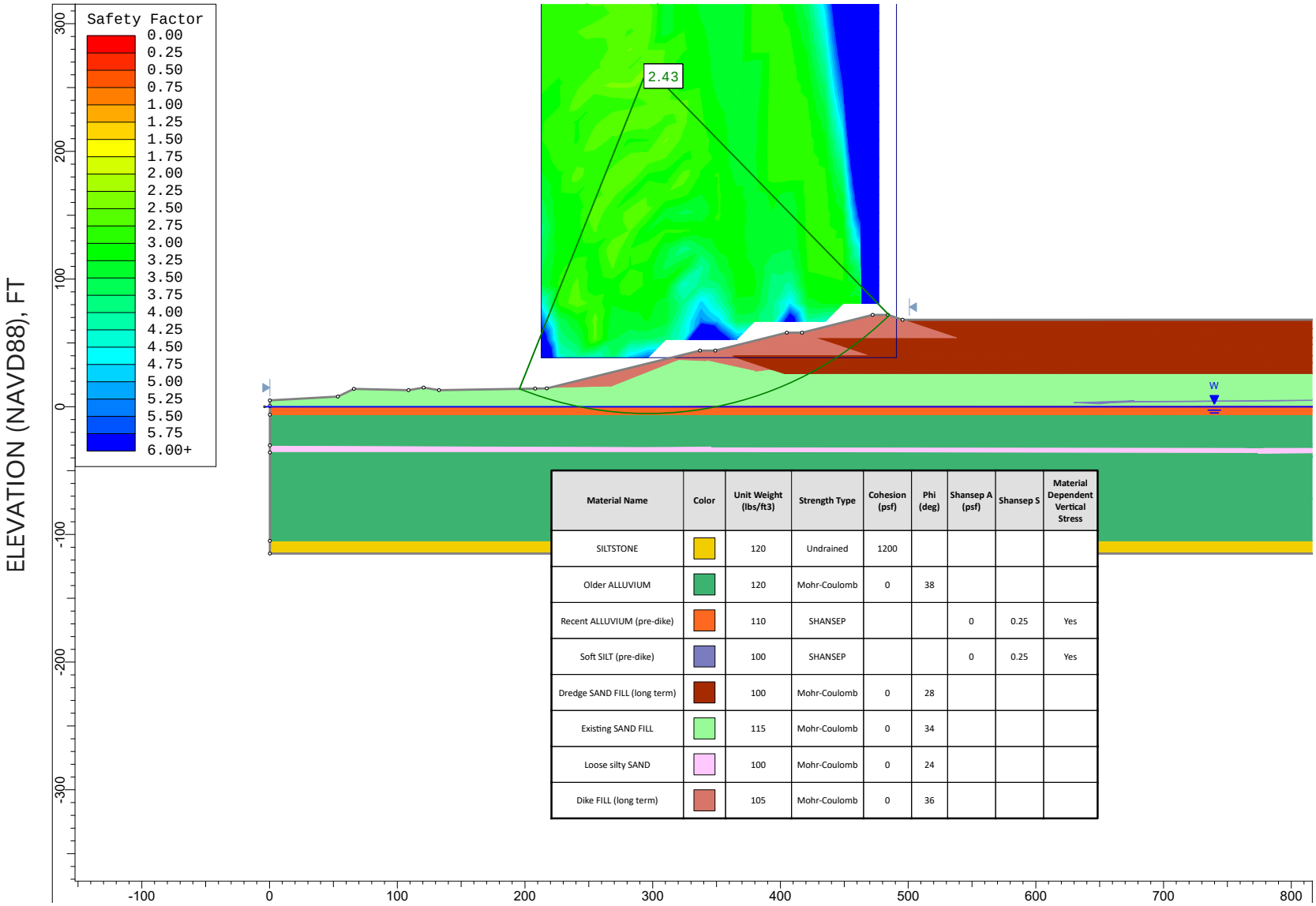
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DREDGE FILL PLACEMENT

CROSS SECTION B-B' (NORTH)

NOV. 2018 JOB NO. 6099-B FIG. 20B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Recent ALLUVIUM (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			

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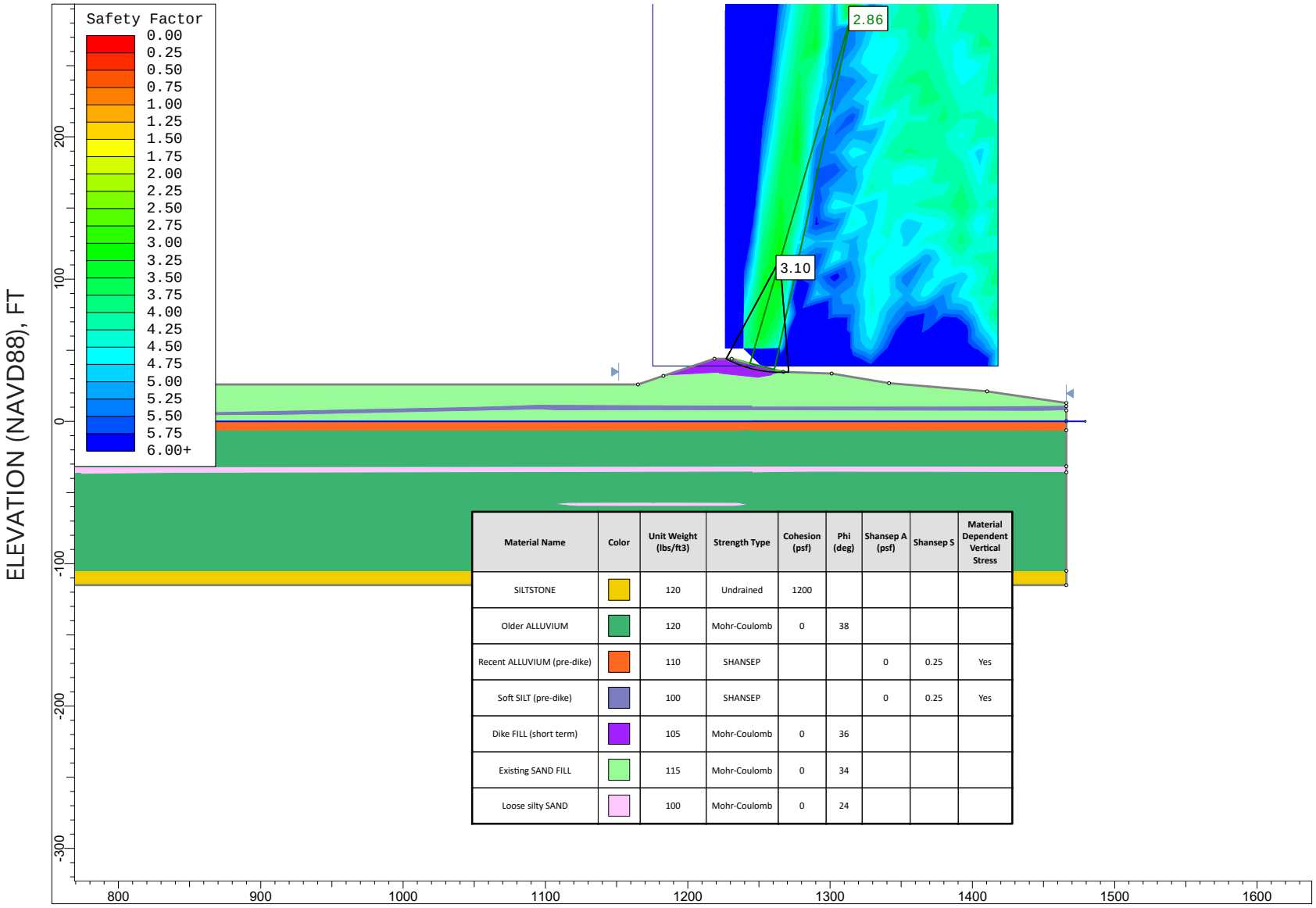
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LONG TERM

CROSS SECTION B-B' (NORTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Recent ALLUVIUM (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			

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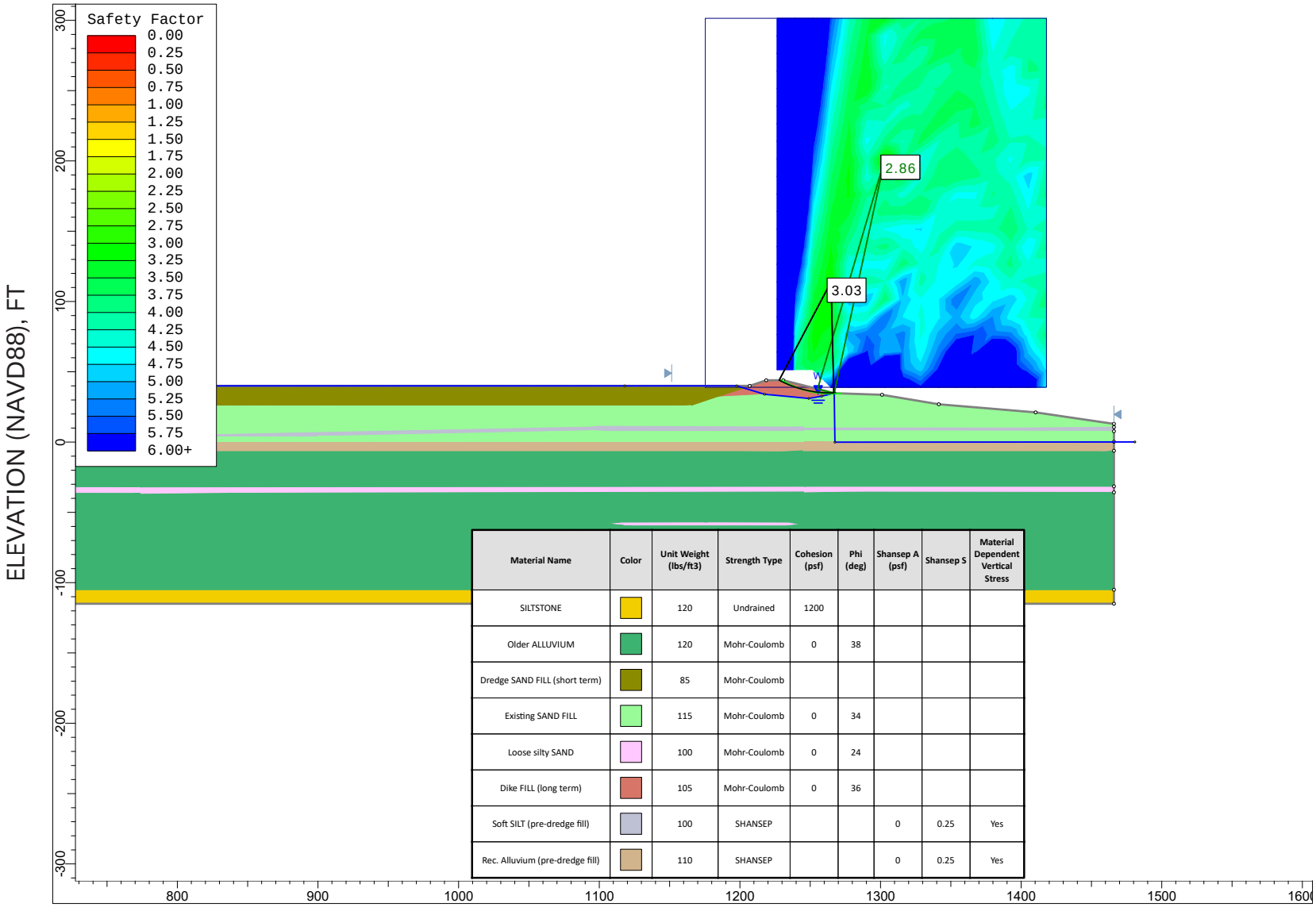
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DIKE CONSTRUCTION

CROSS SECTION B-B' (SOUTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes

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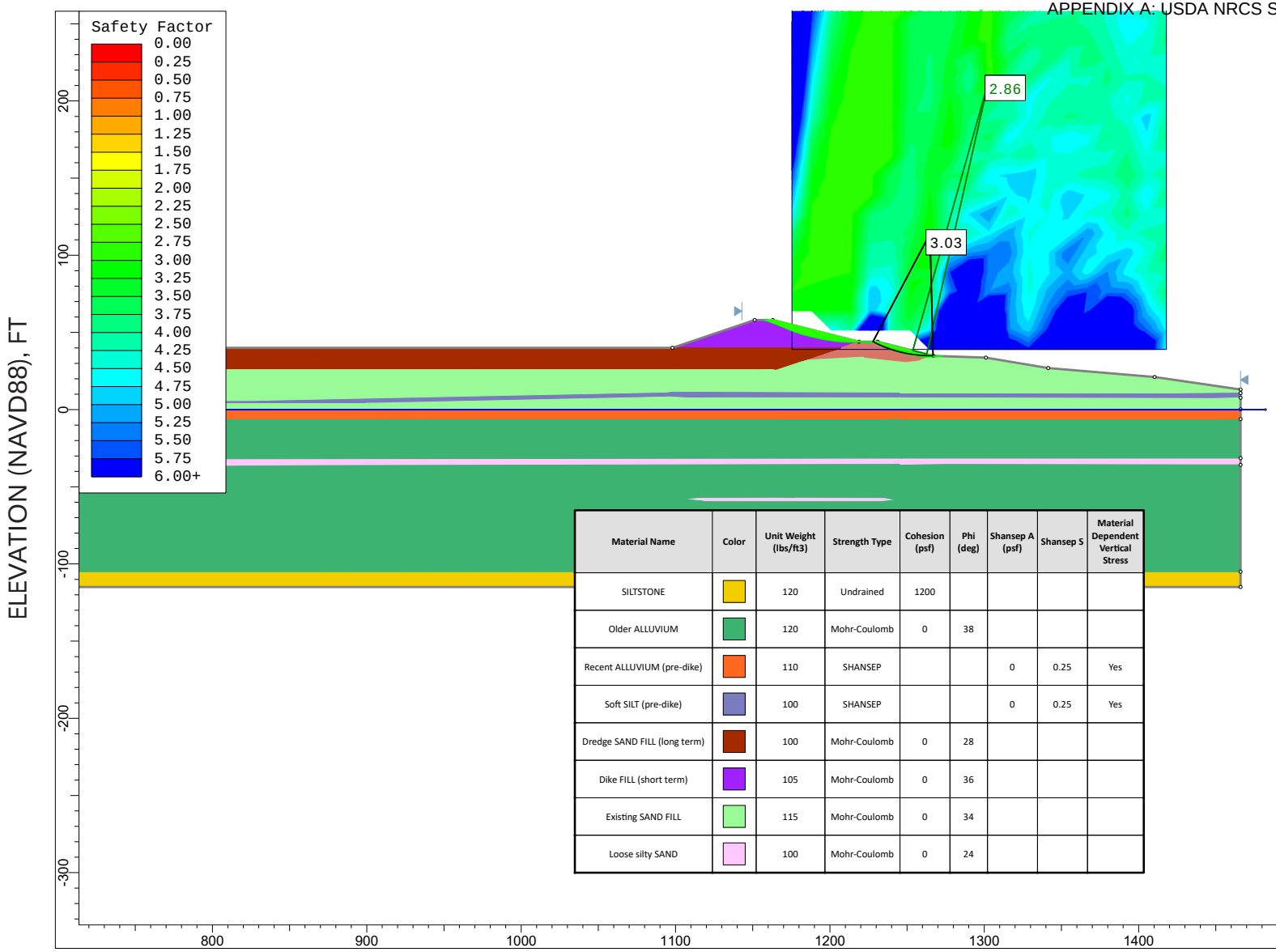
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DREDGE FILL PLACEMENT

CROSS SECTION B-B' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 23B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Recent ALLUVIUM (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			

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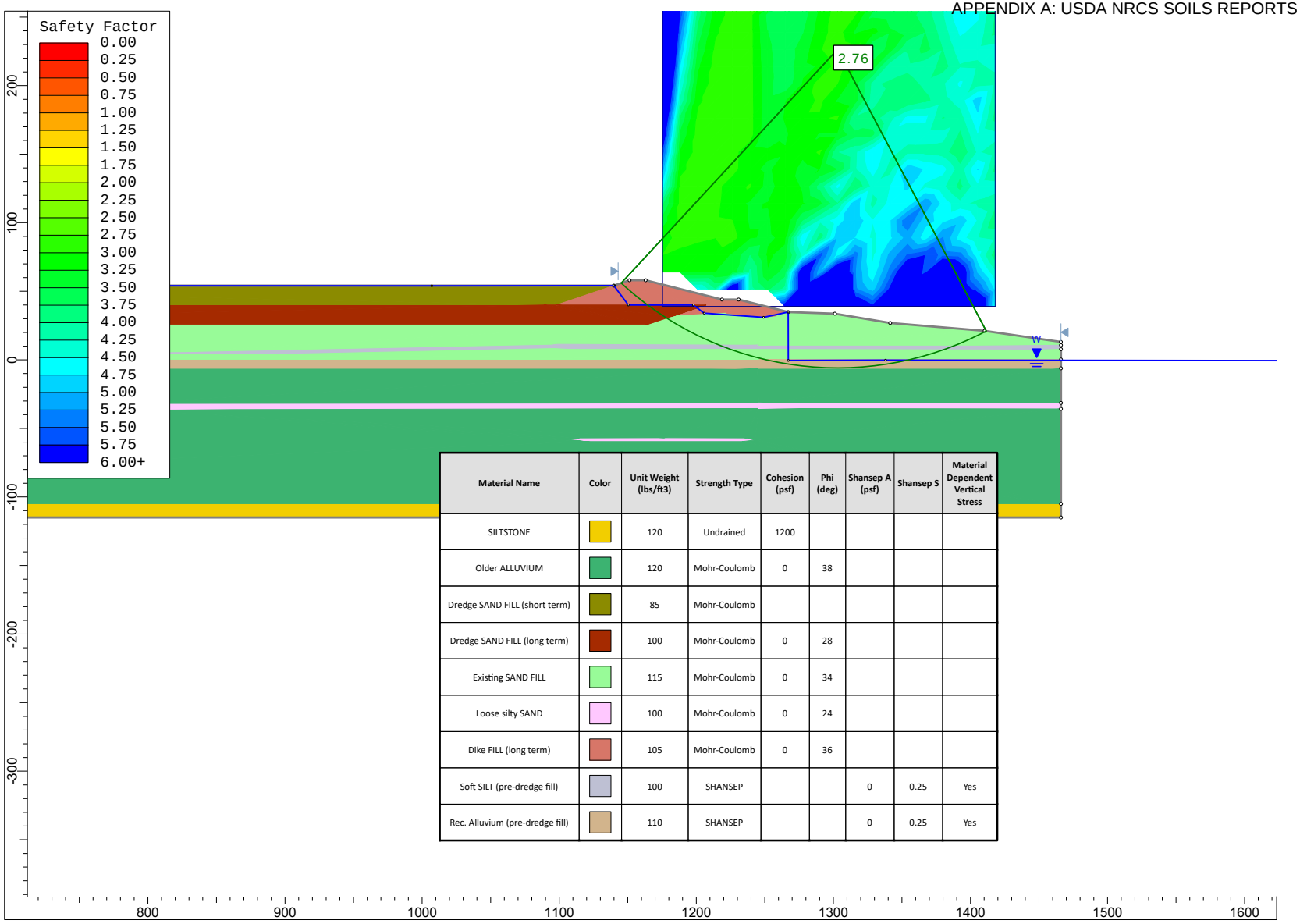
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DIKE CONSTRUCTION

CROSS SECTION B-B' (SOUTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes

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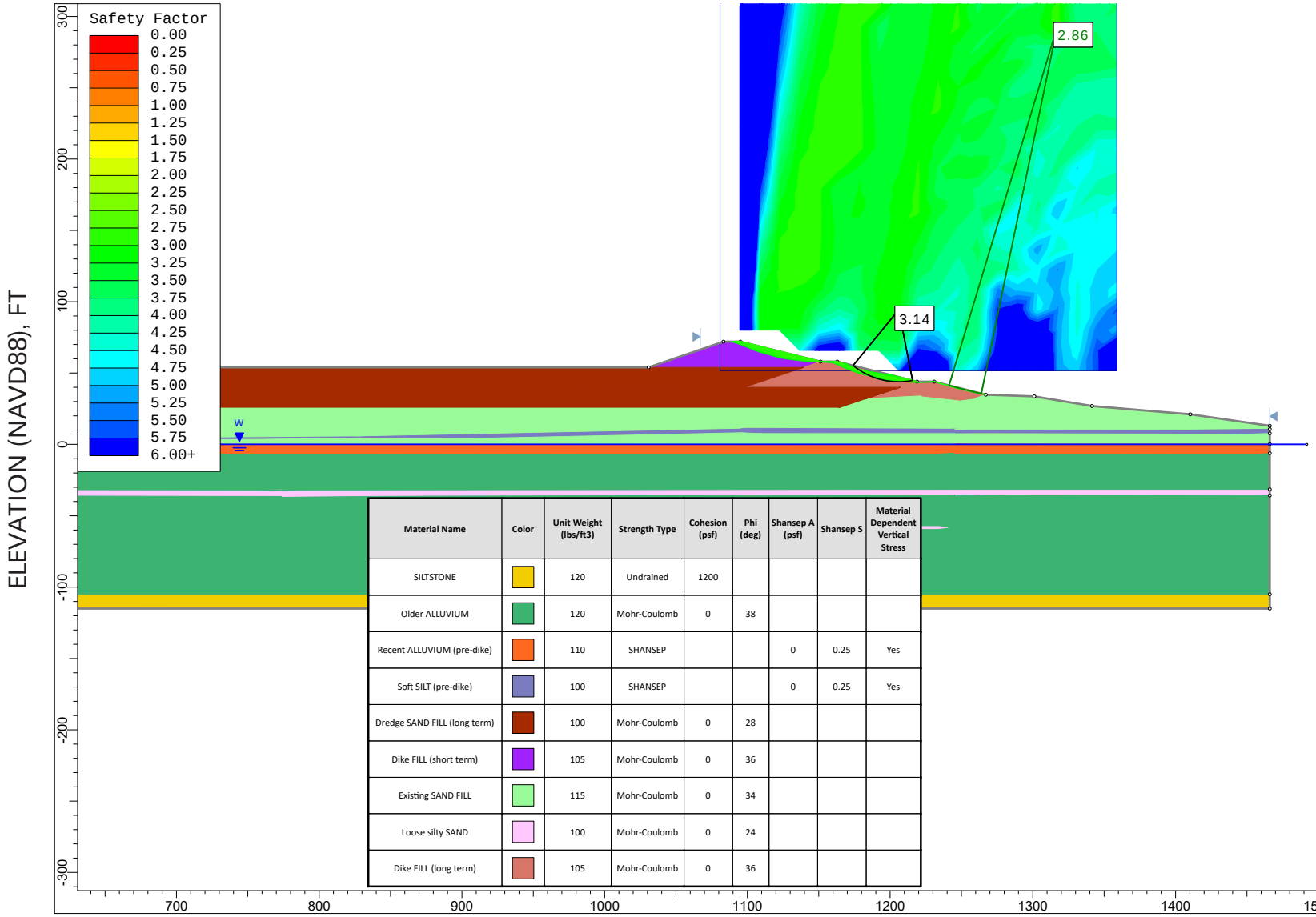
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DREDGE FILL PLACEMENT

CROSS SECTION B-B' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 25B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Recent ALLUVIUM (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			

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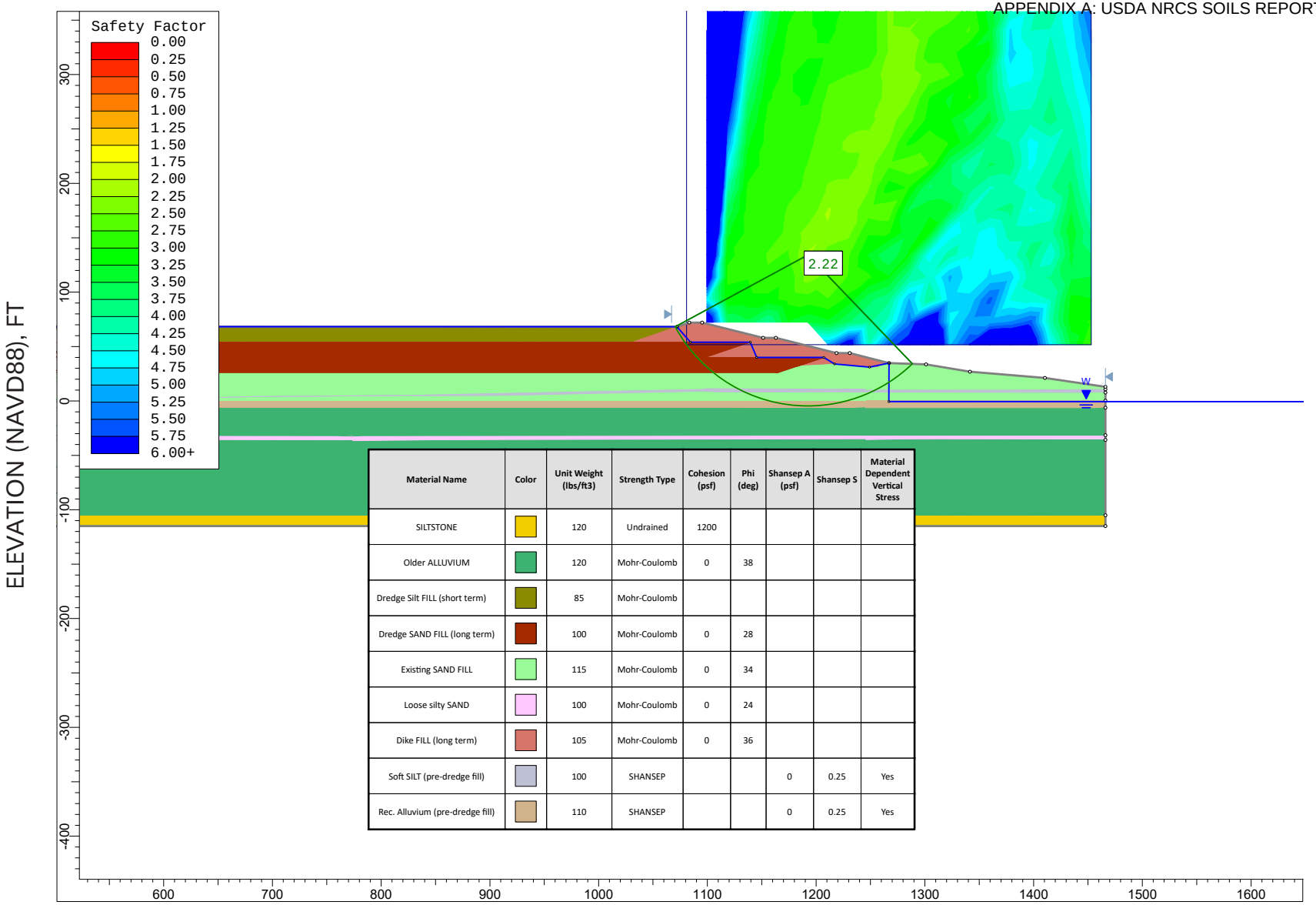
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DIKE CONSTRUCTION

CROSS SECTION B-B' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 26B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Dredge Silt FILL (short term)		85	Mohr-Coulomb					
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes

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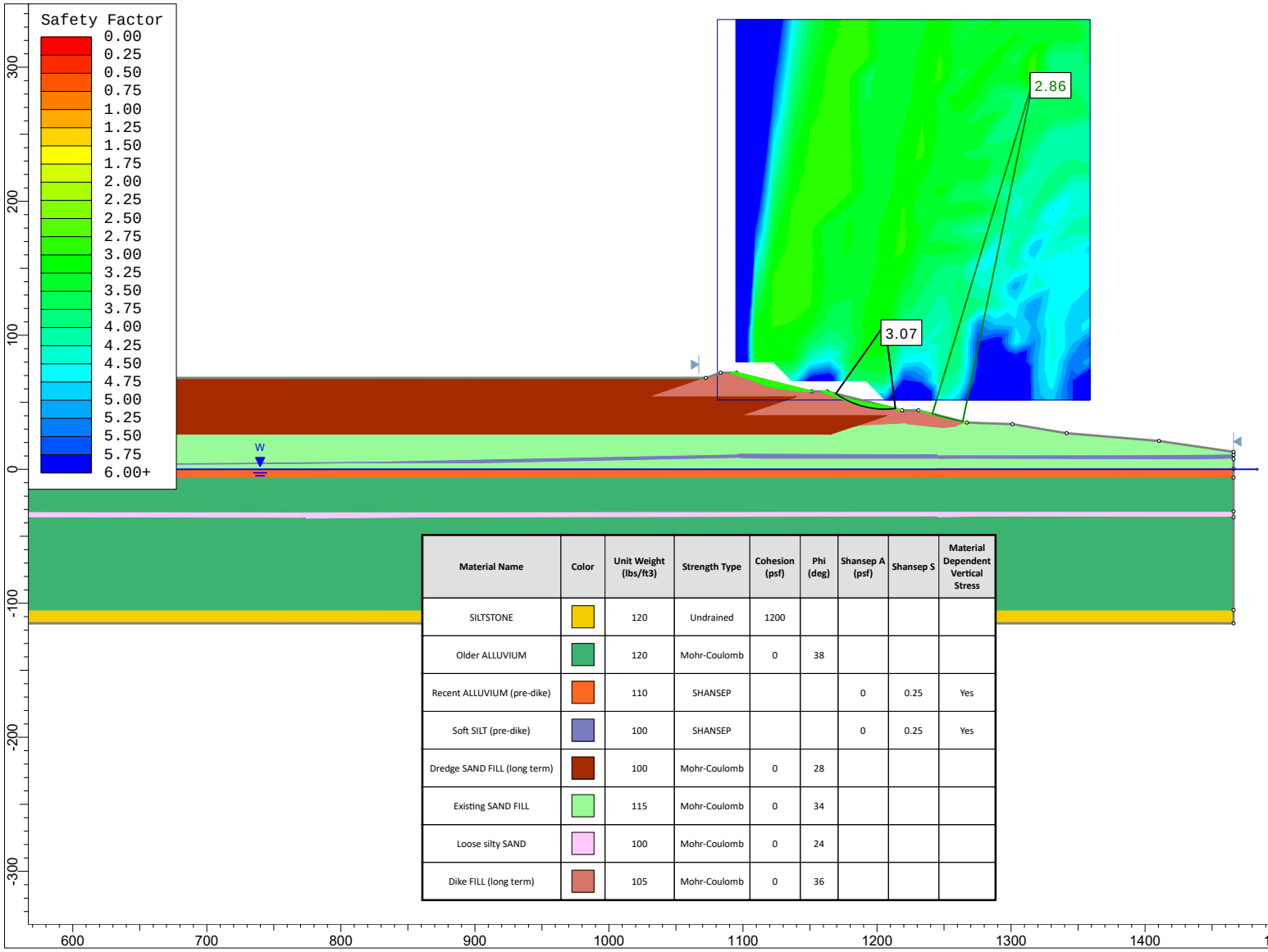
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DREDGE FILL PLACEMENT

CROSS SECTION B-B' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 27B



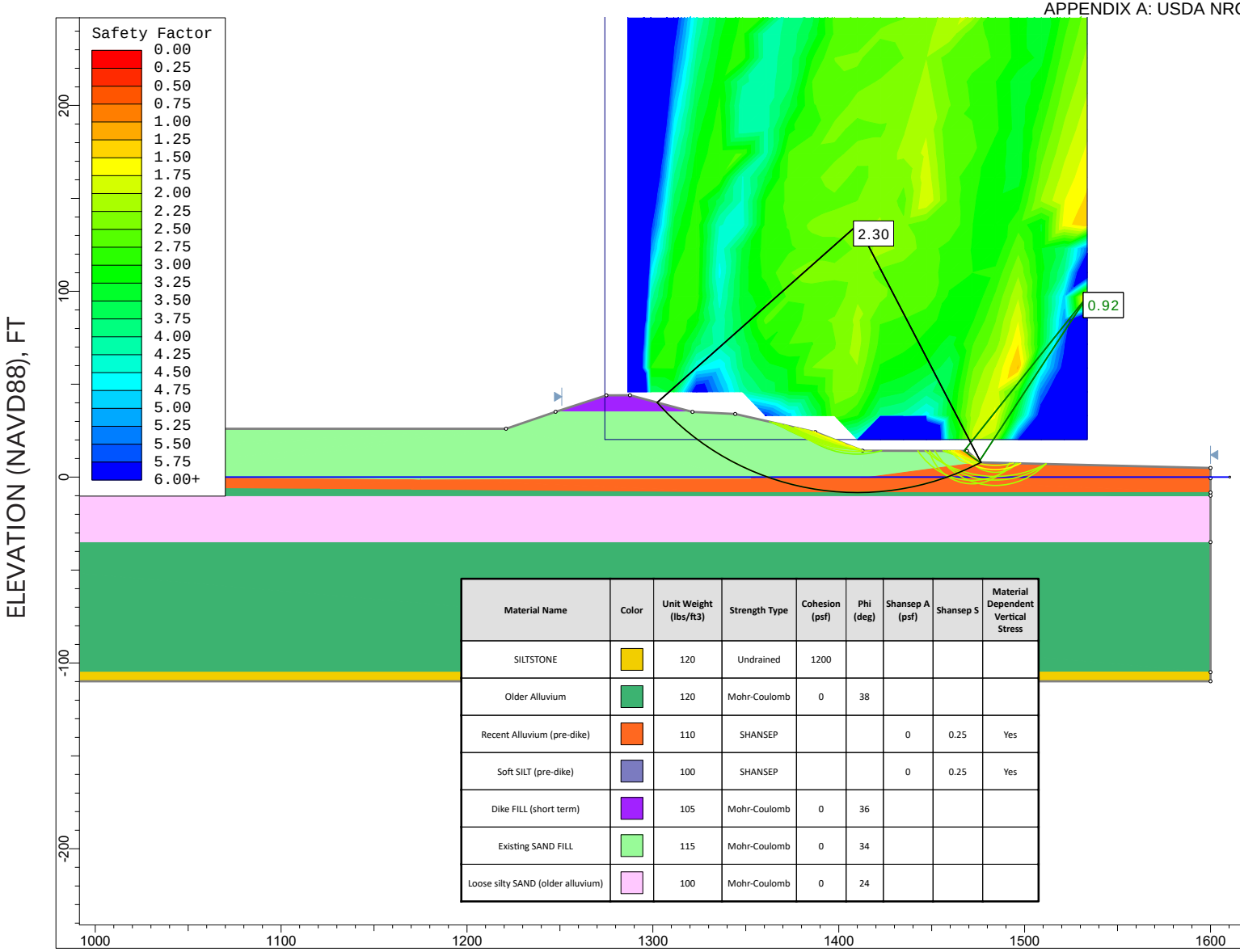
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older ALLUVIUM		120	Mohr-Coulomb	0	38			
Recent ALLUVIUM (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	0	36			

GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LONG TERM

CROSS SECTION B-B' (SOUTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			

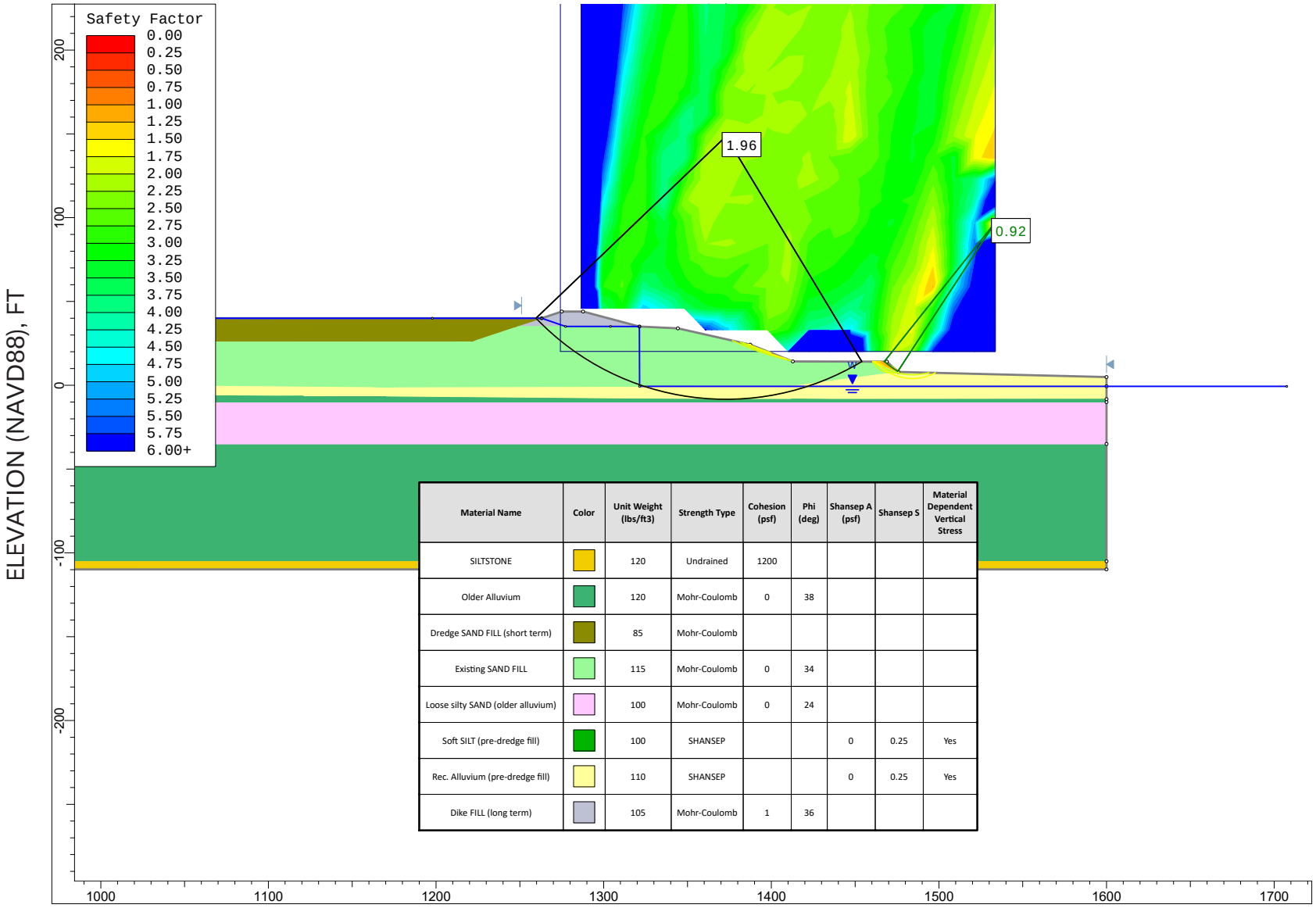
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DIKE CONSTRUCTION

CROSS SECTION C-C' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 29B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

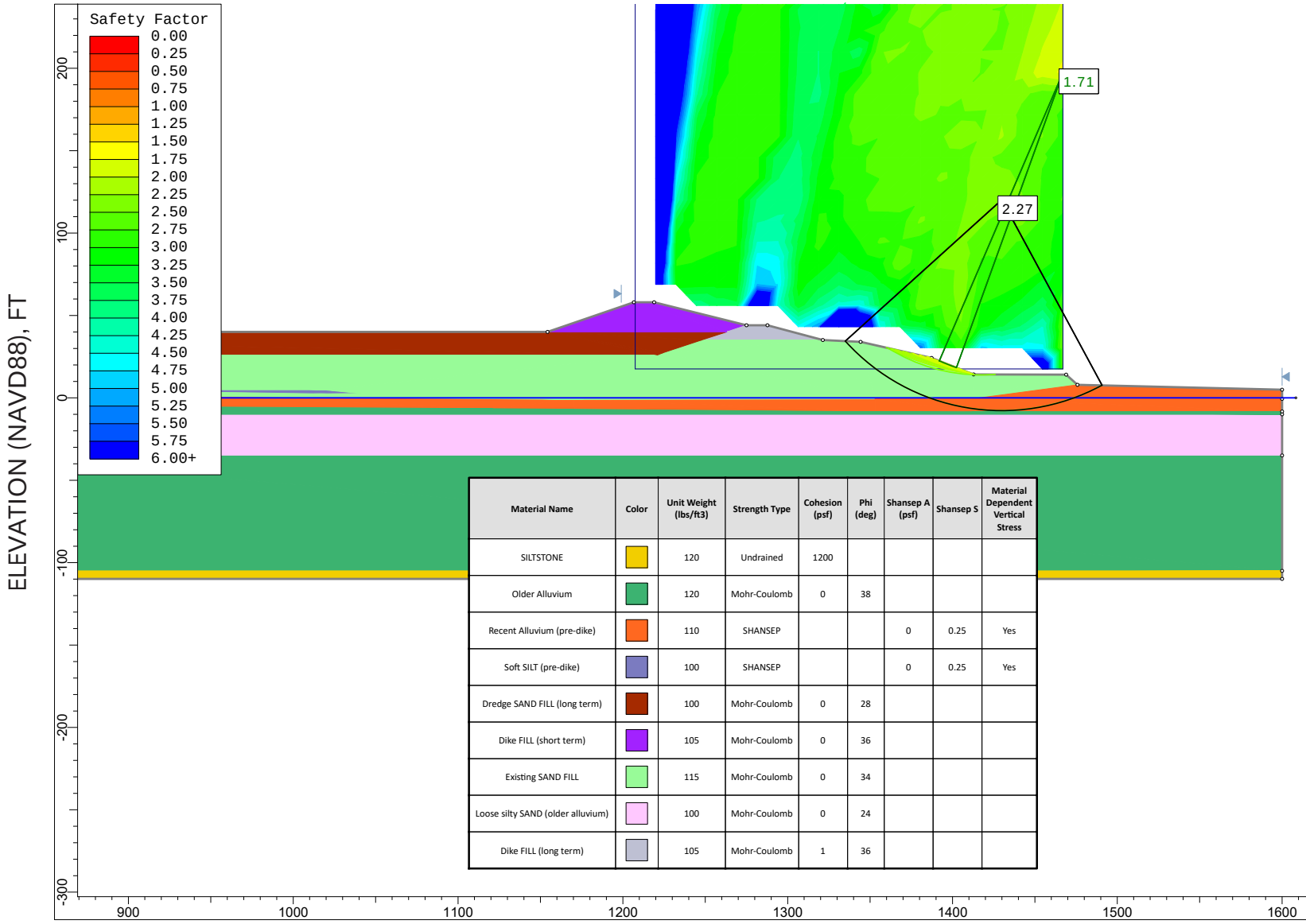
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DREDGE FILL PLACEMENT

CROSS SECTION C-C' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 30B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

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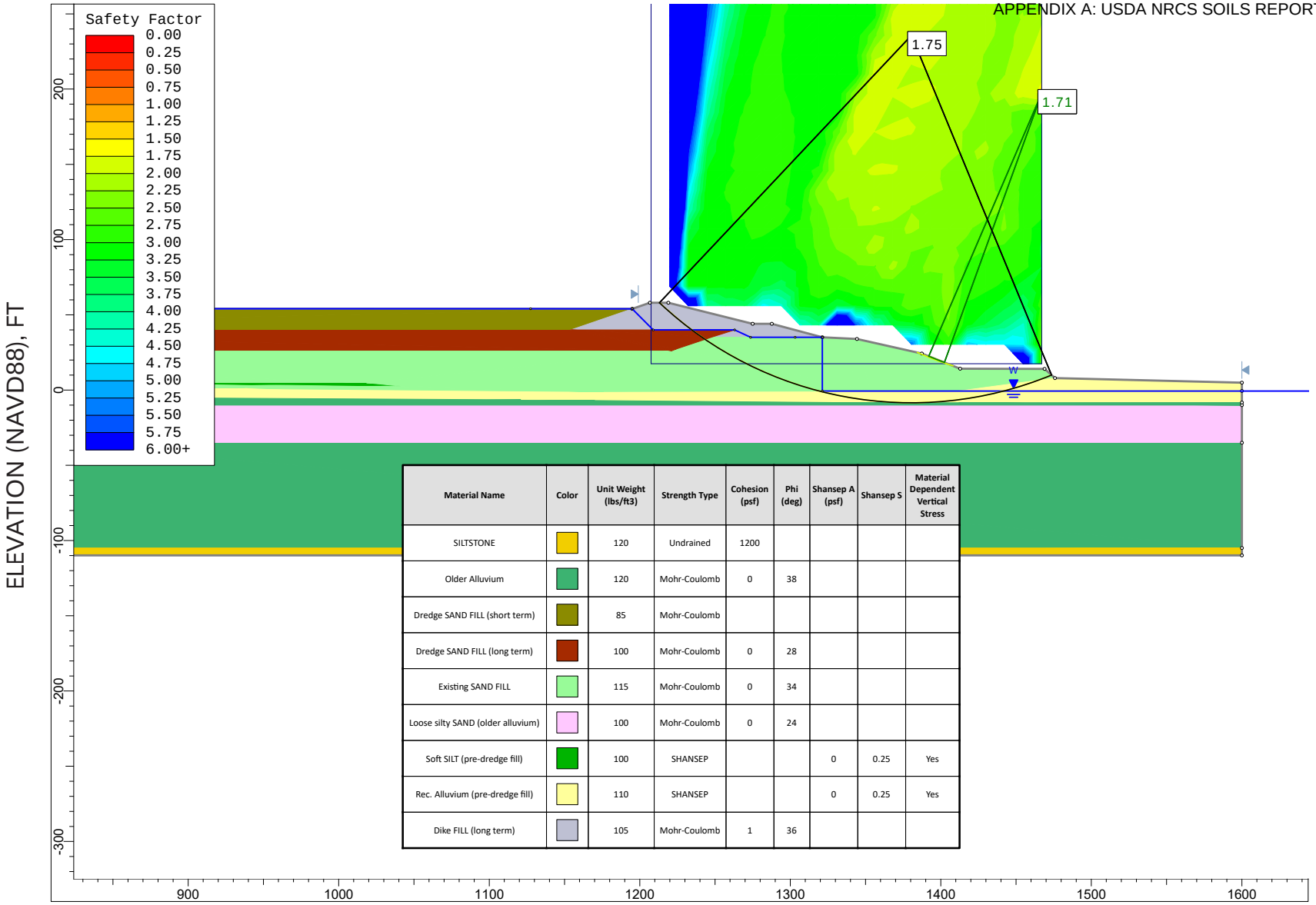
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DIKE CONSTRUCTION

CROSS SECTION C-C' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 31B



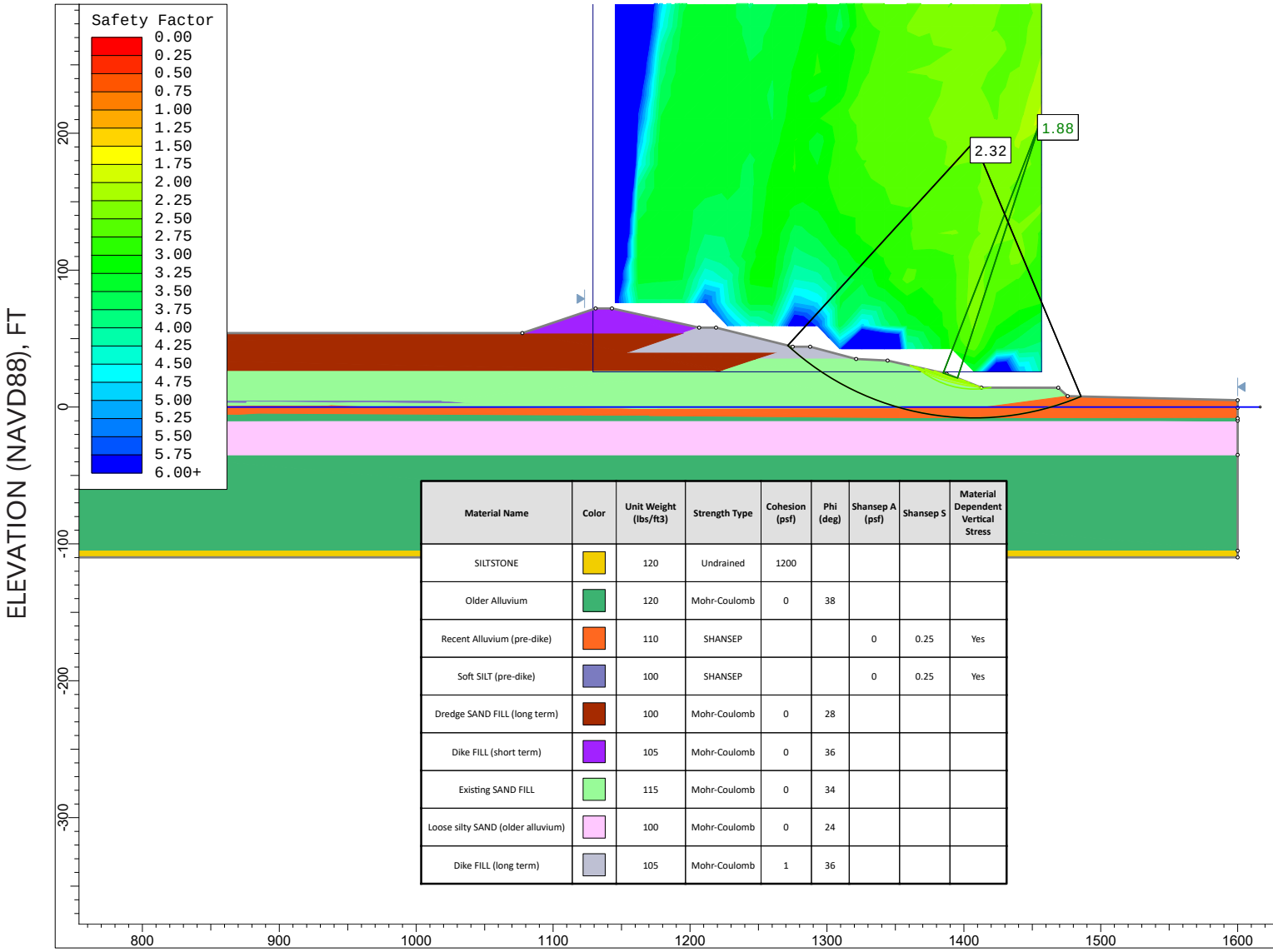
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DREDGE FILL PLACEMENT

CROSS SECTION C-C' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 32B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

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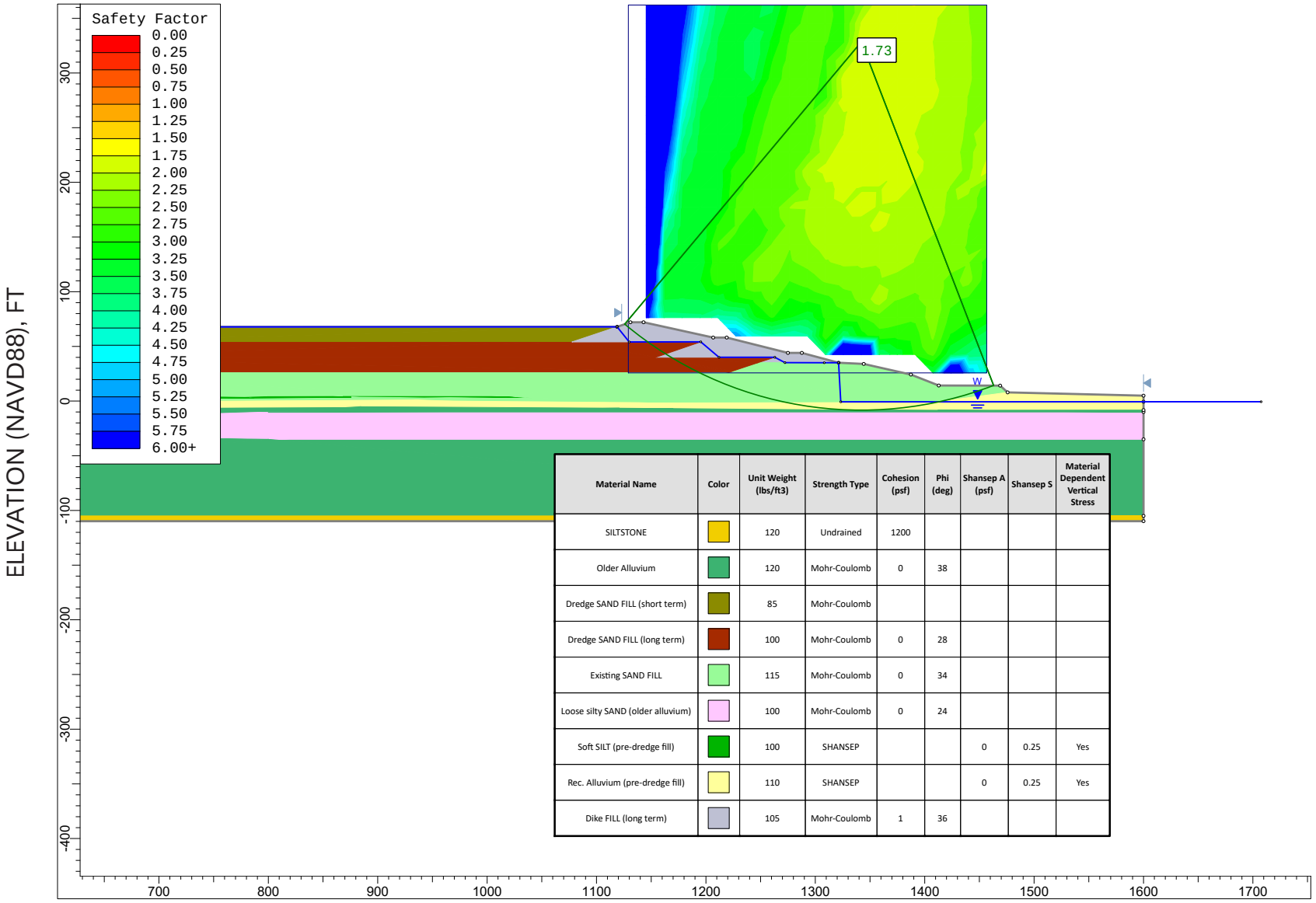
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DIKE CONSTRUCTION

CROSS SECTION C-C' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 33B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

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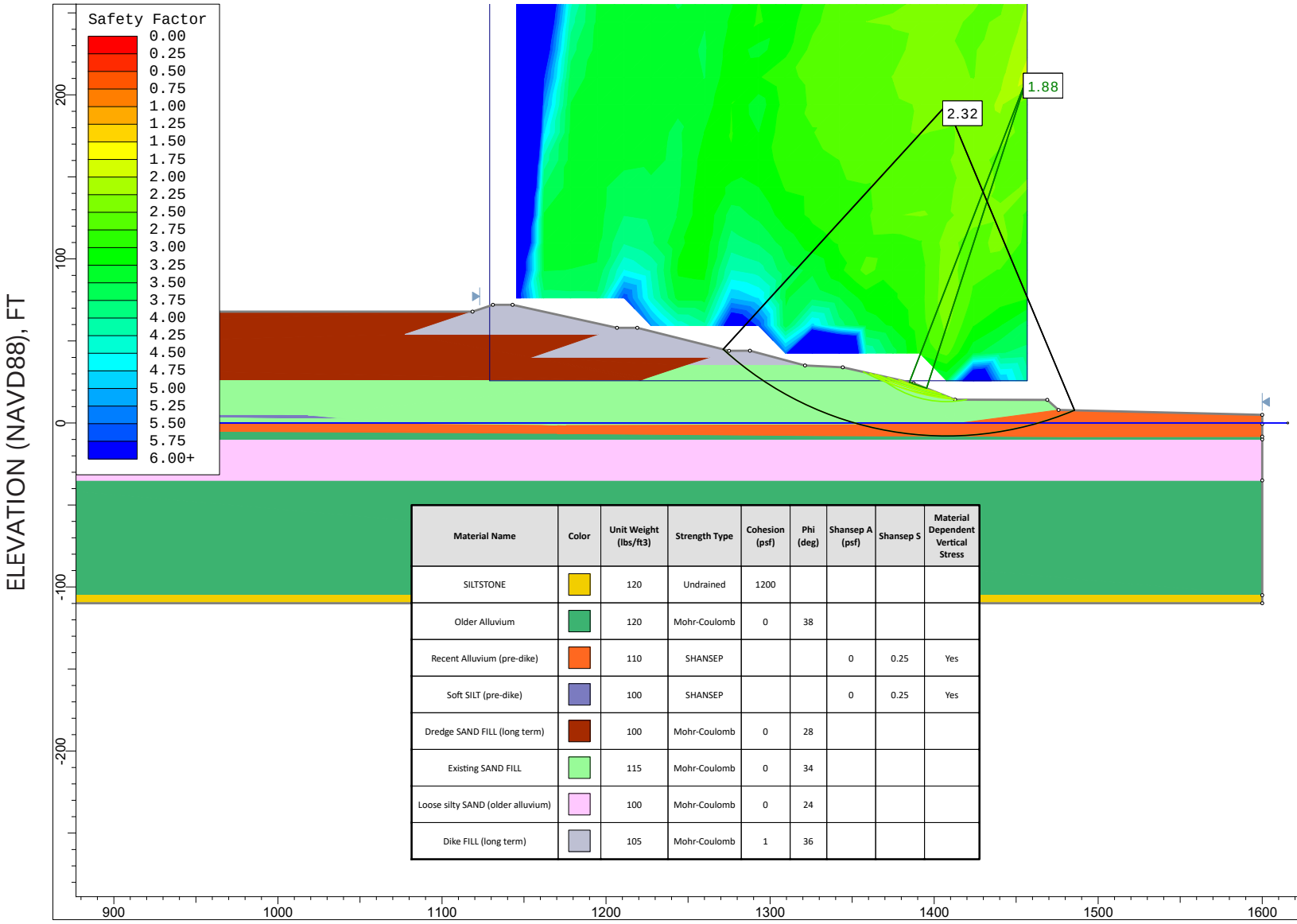
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DREDGE FILL PLACEMENT

CROSS SECTION C-C' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 34B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

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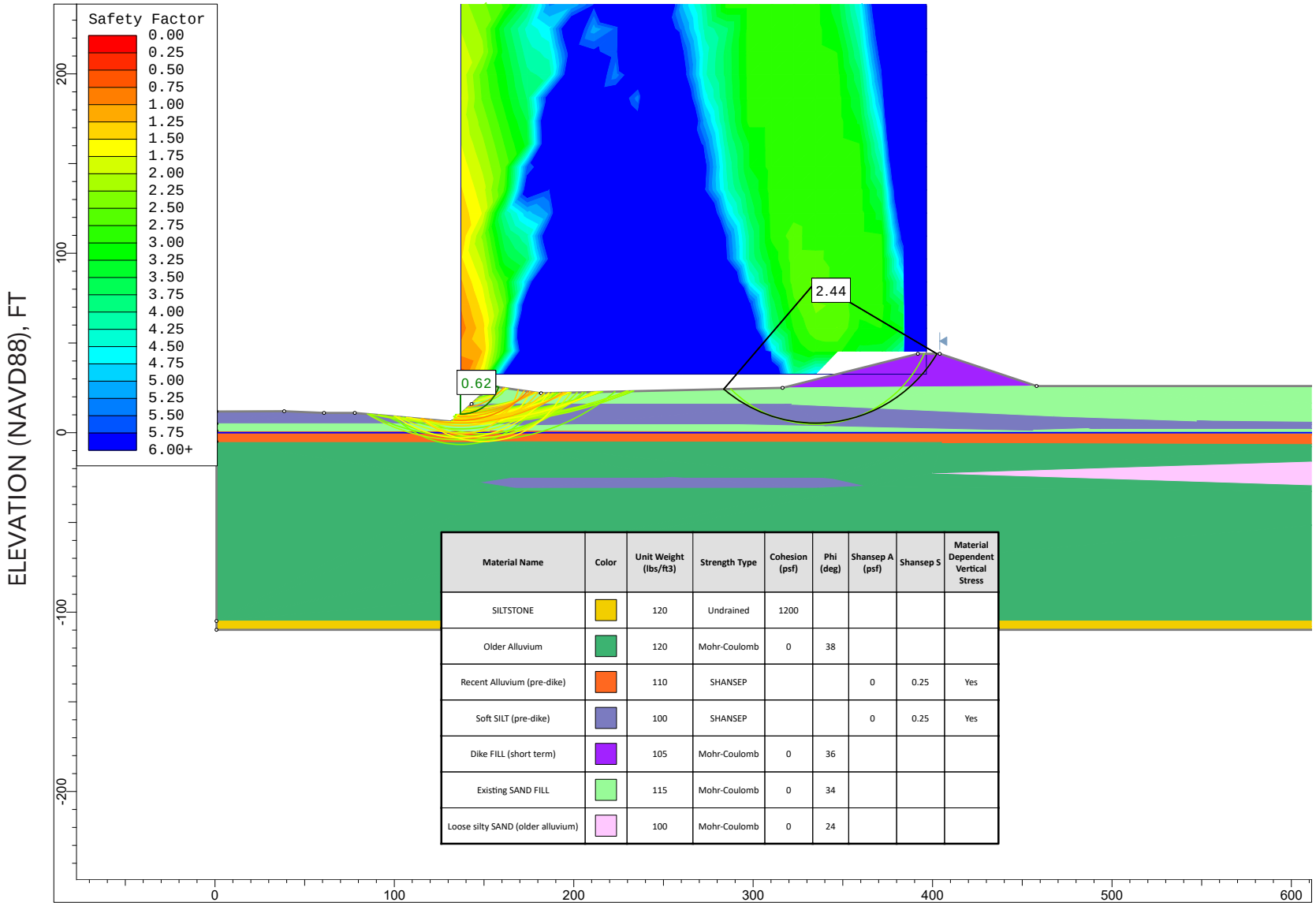
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LONG TERM

CROSS SECTION C-C' (EAST)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			

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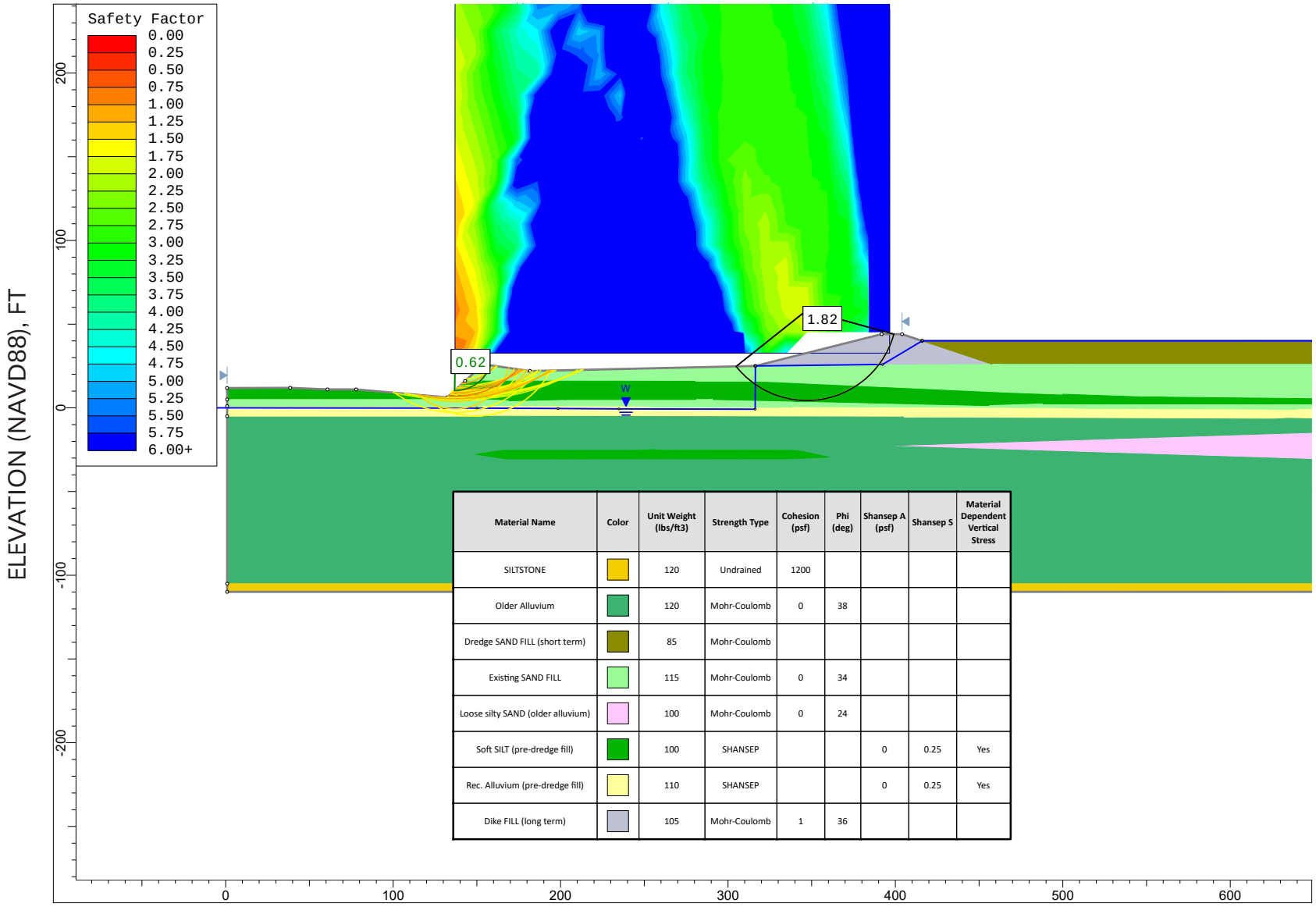
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DIKE CONSTRUCTION

CROSS SECTION C-C' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 36B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

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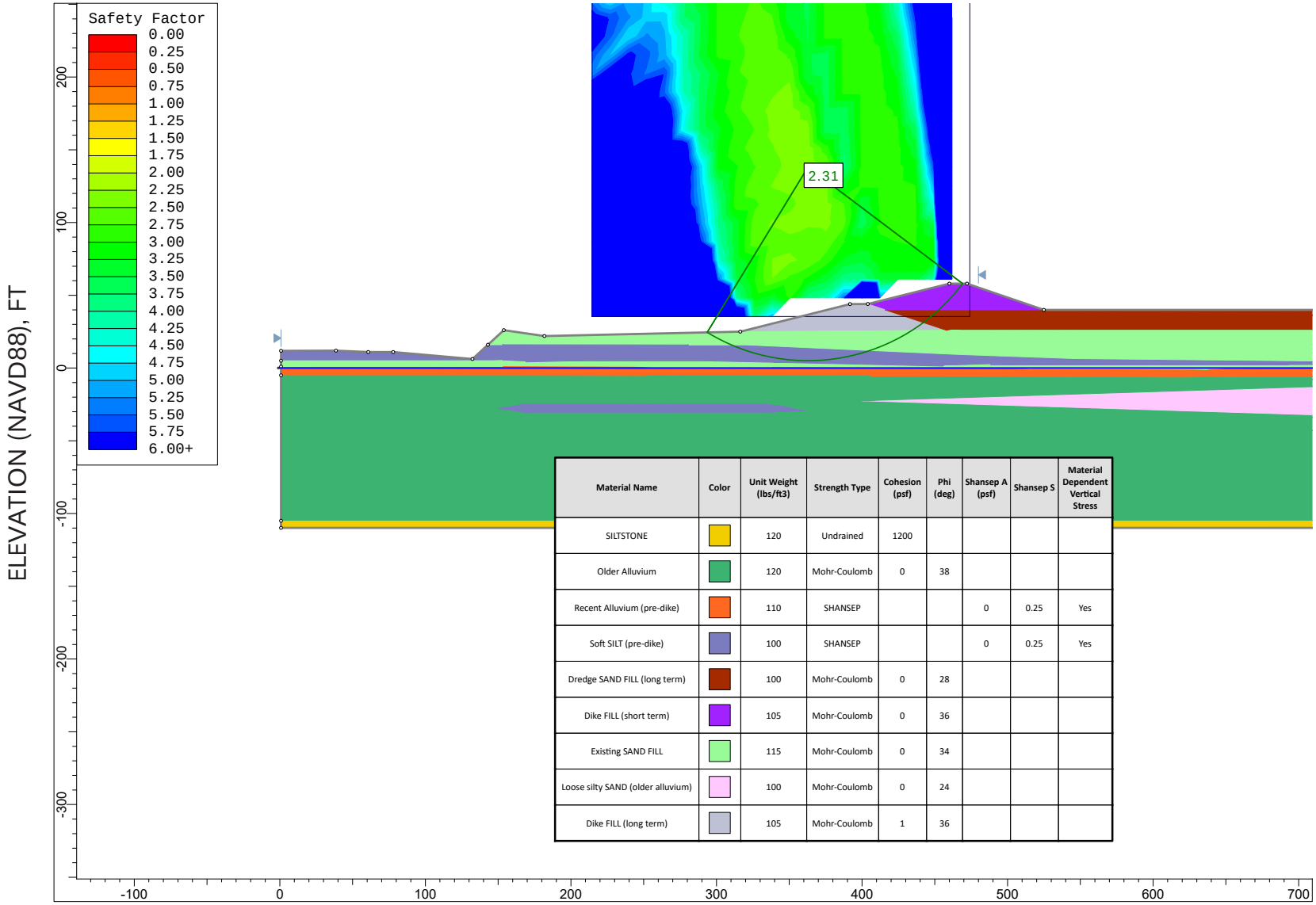
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DREDGE FILL PLACEMENT

CROSS SECTION C-C' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 37B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

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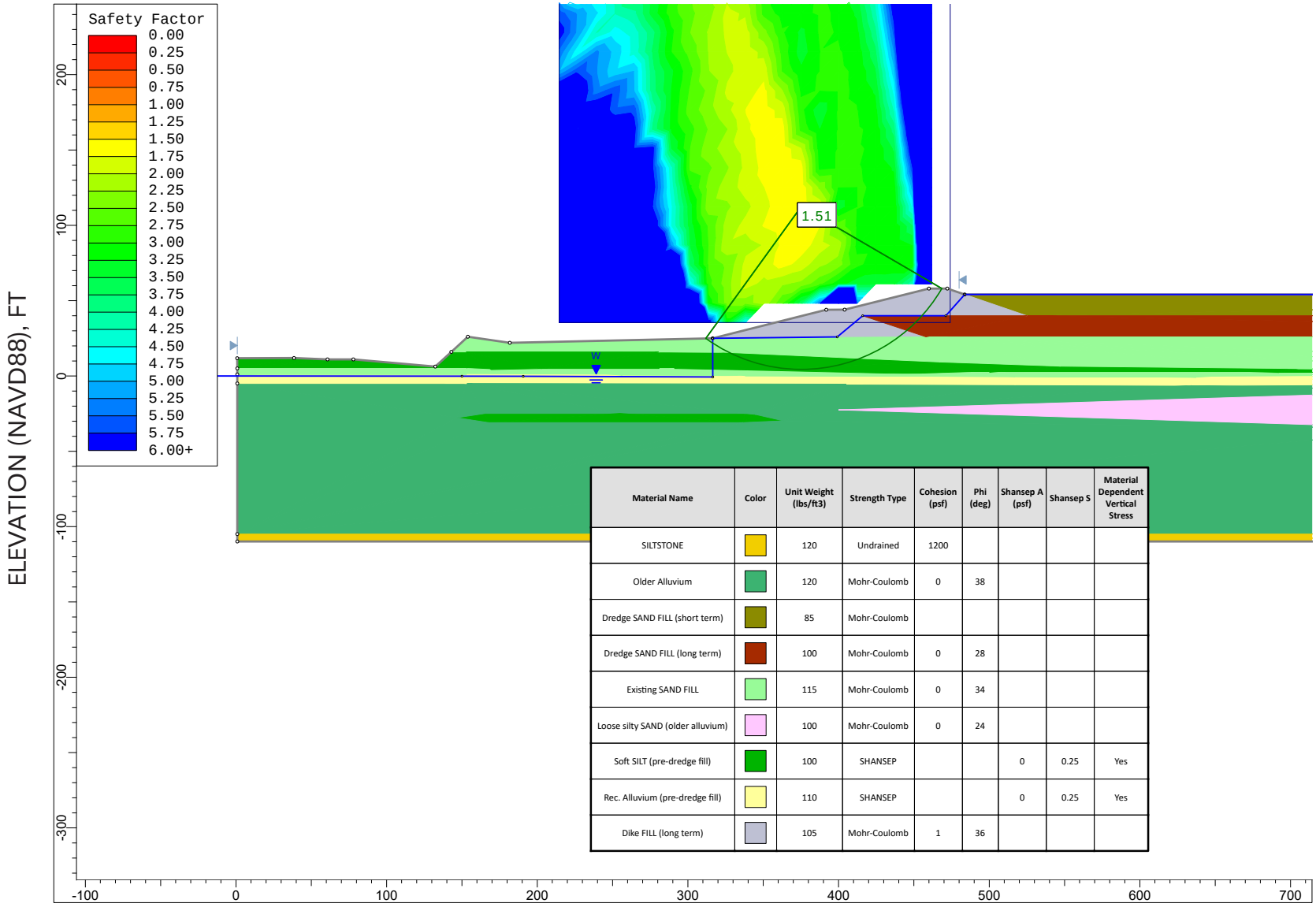
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DIKE CONSTRUCTION

CROSS SECTION C-C' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 38B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

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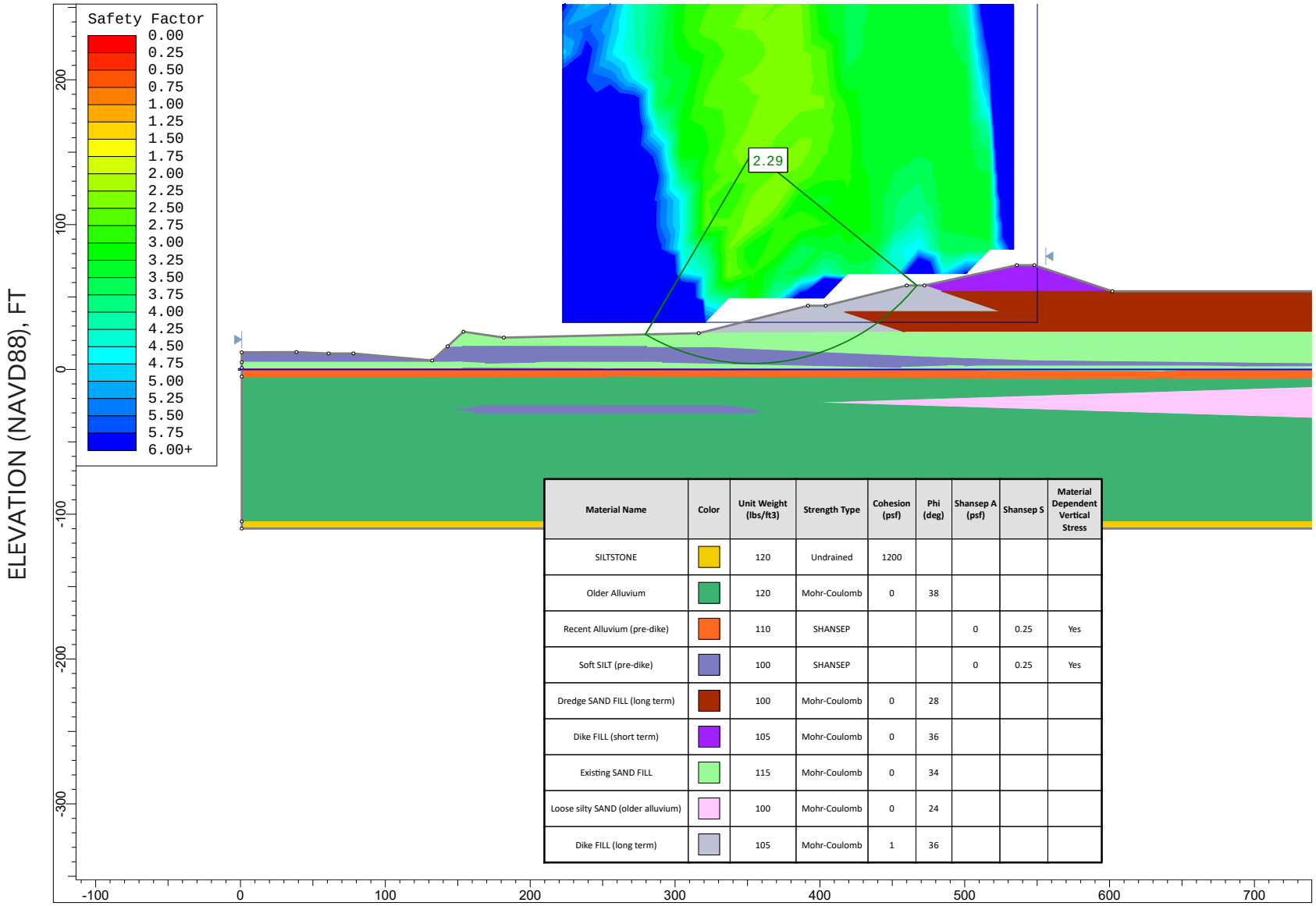
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DREDGE FILL PLACEMENT

CROSS SECTION C-C' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 39B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Dike FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

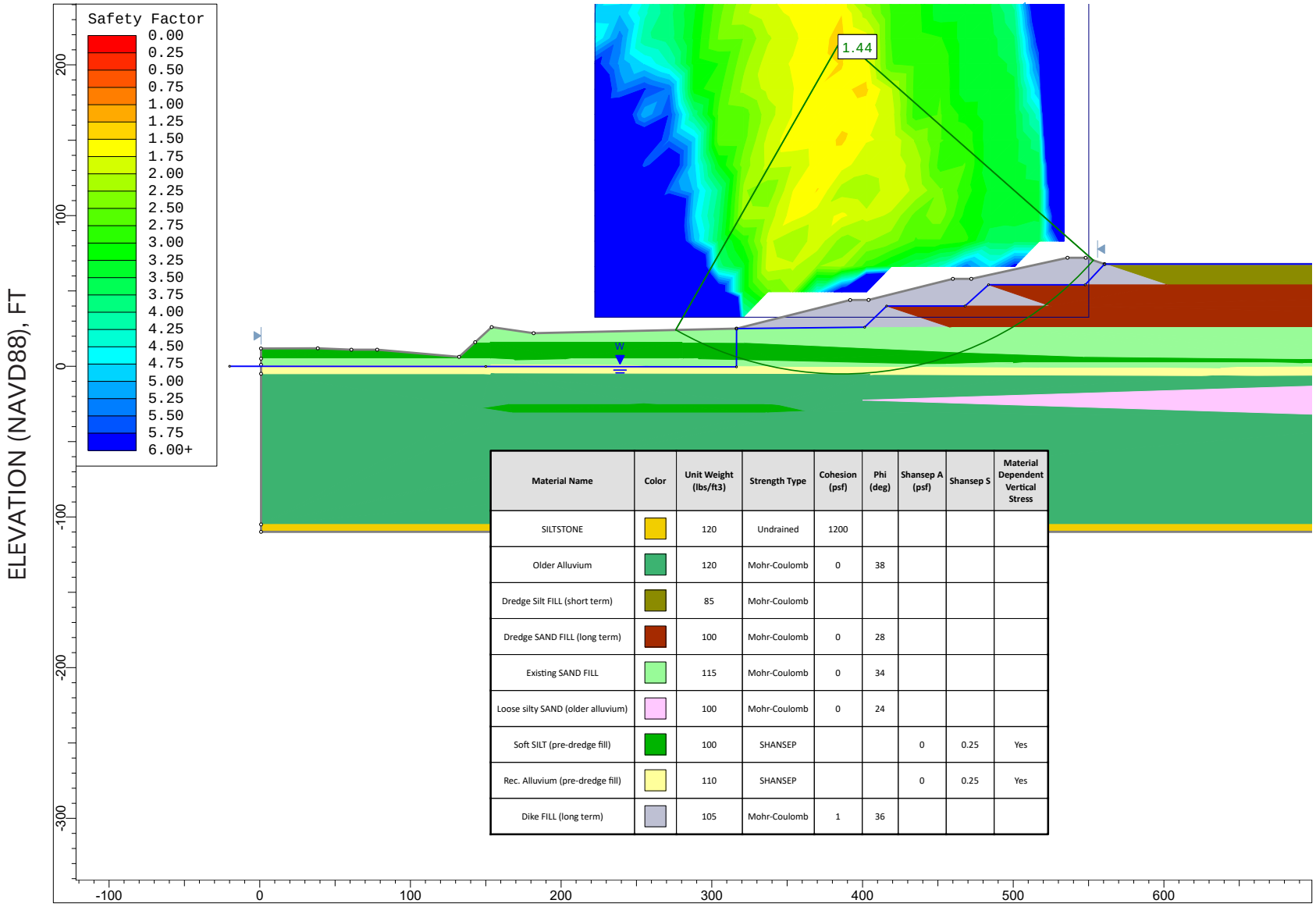
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DIKE CONSTRUCTION

CROSS SECTION C-C' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 40B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Dredge Silt FILL (short term)		85	Mohr-Coulomb					
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Soft SILT (pre-dredge fill)		100	SHANSEP			0	0.25	Yes
Rec. Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

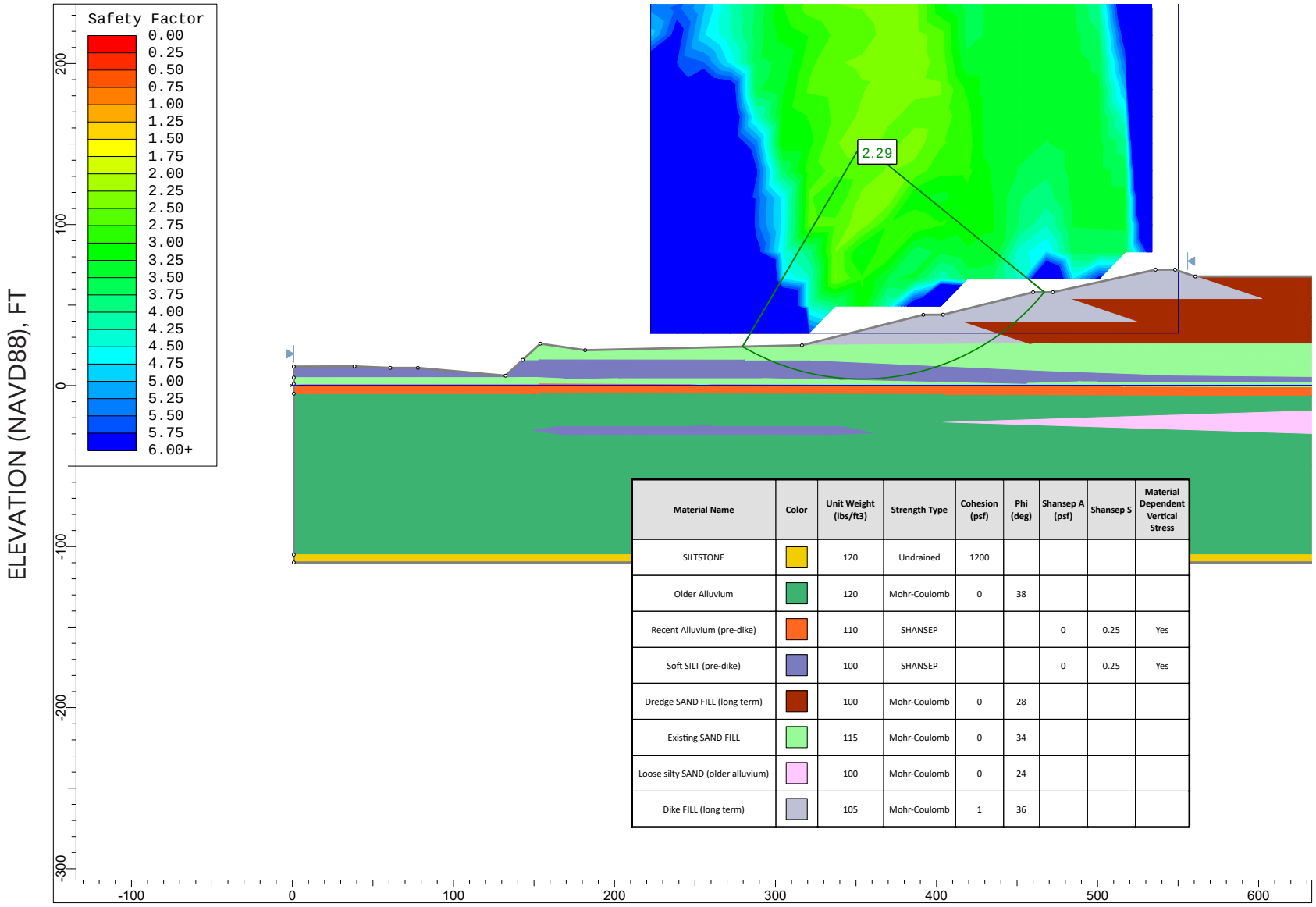
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DREDGE FILL PLACEMENT

CROSS SECTION C-C' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 41B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			0	0.25	Yes
Dredge SAND FILL (long term)		100	Mohr-Coulomb	0	28			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty SAND (older alluvium)		100	Mohr-Coulomb	0	24			
Dike FILL (long term)		105	Mohr-Coulomb	1	36			

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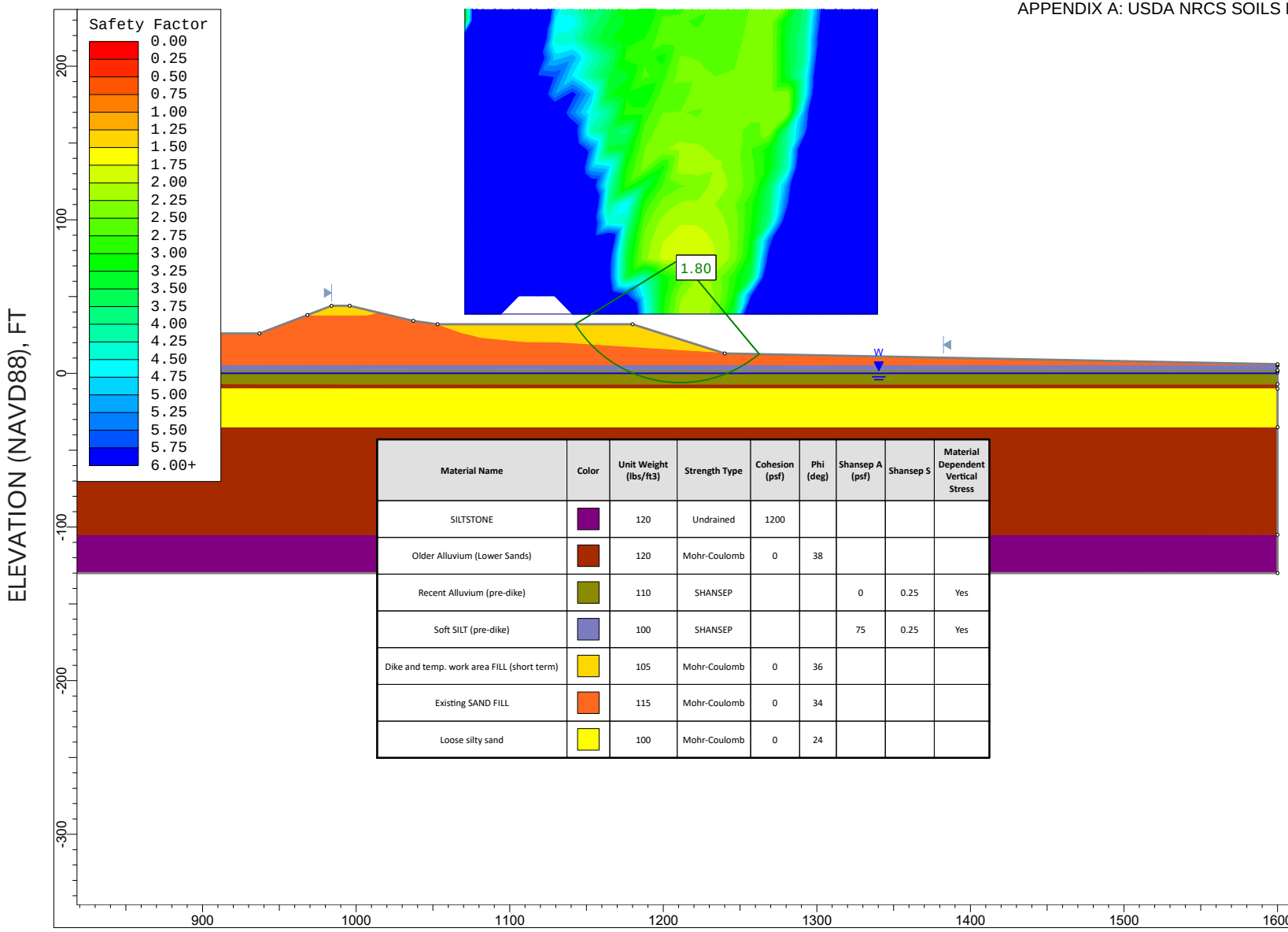
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LONG TERM

CROSS SECTION C-C' (WEST)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Dike and temp. work area FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			

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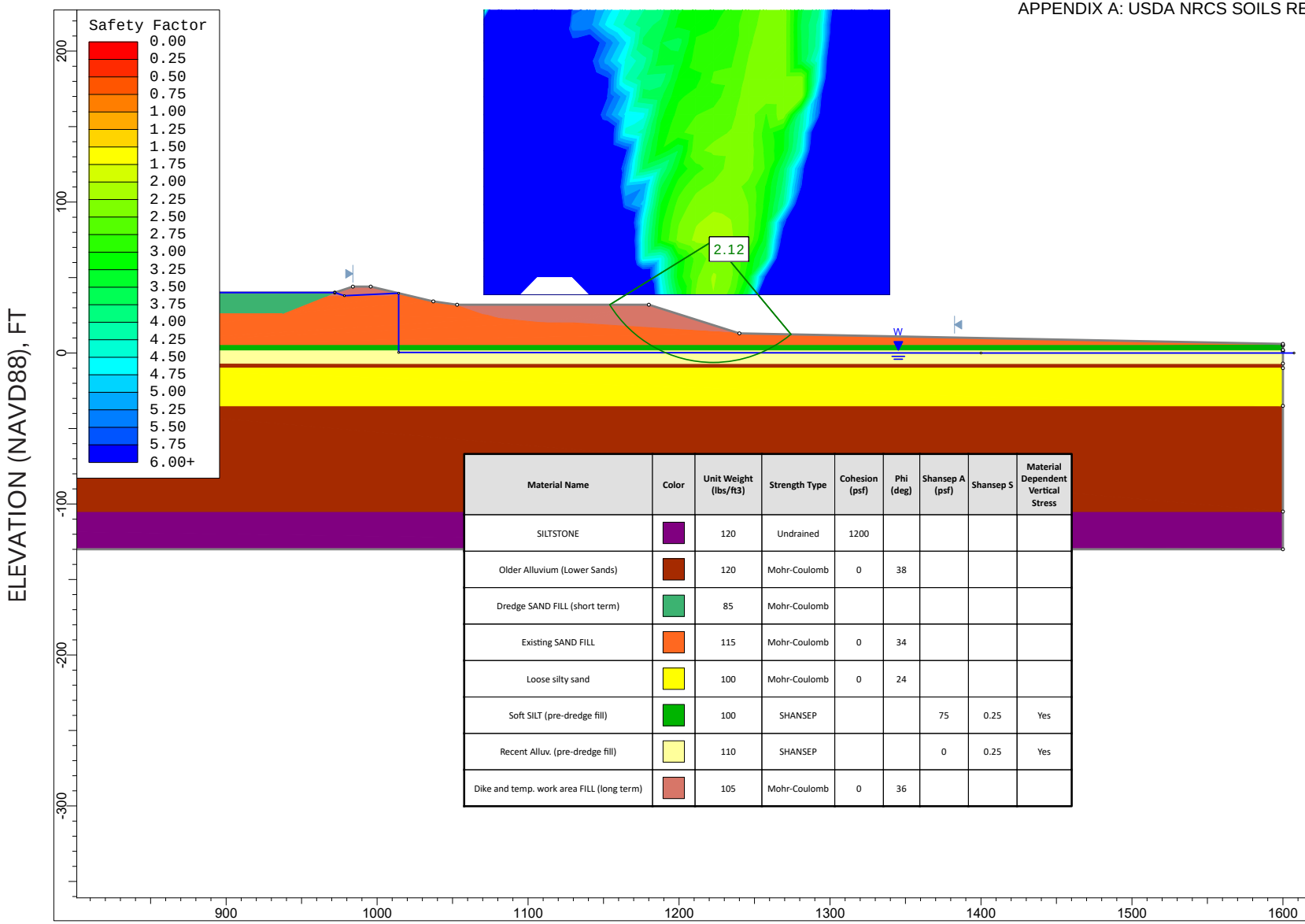
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DIKE CONSTRUCTION

CROSS SECTION D-D' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 43B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes
Recent Alluv. (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

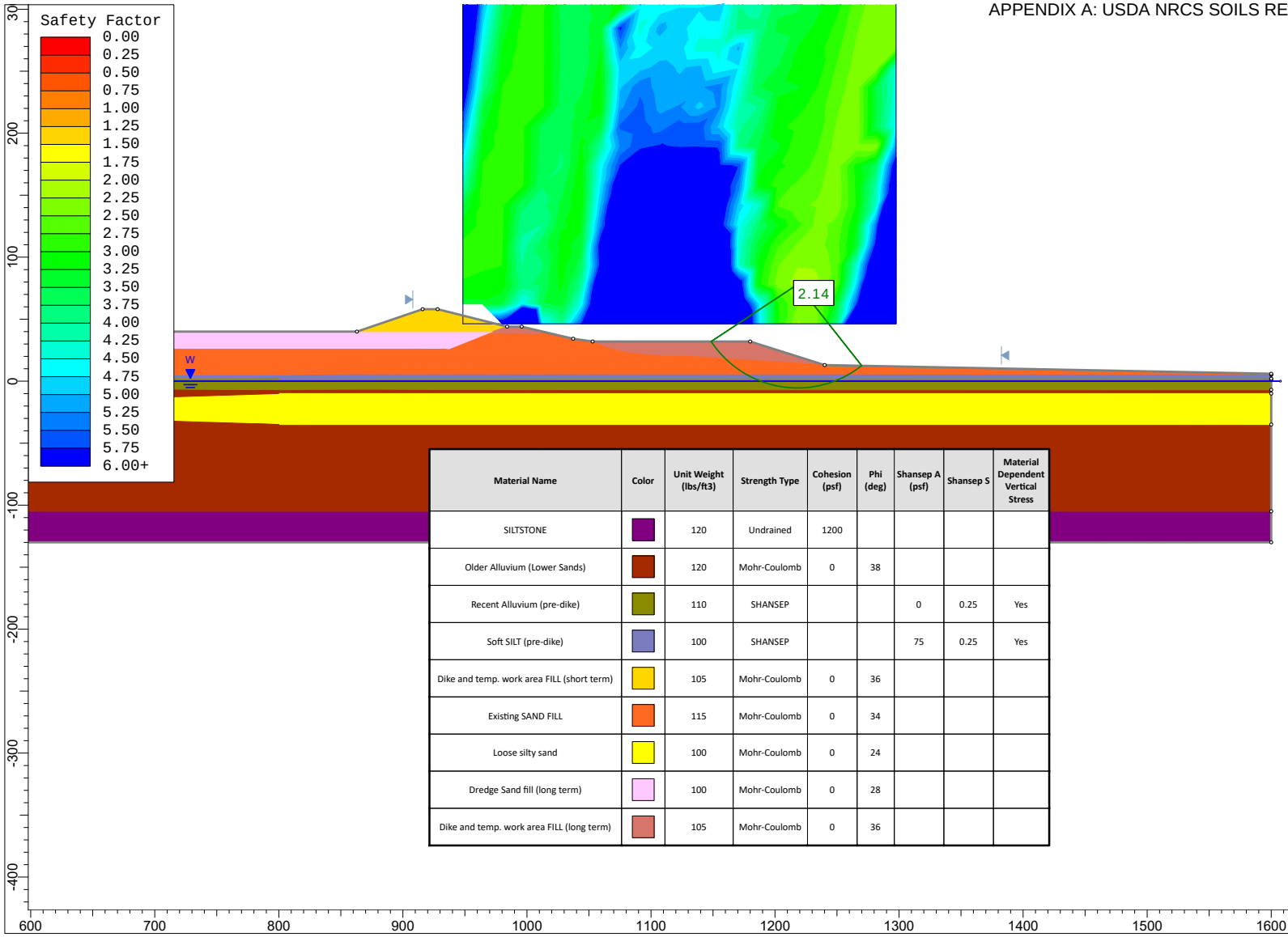
GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DREDGE FILL PLACEMENT

CROSS SECTION D-D' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 44B



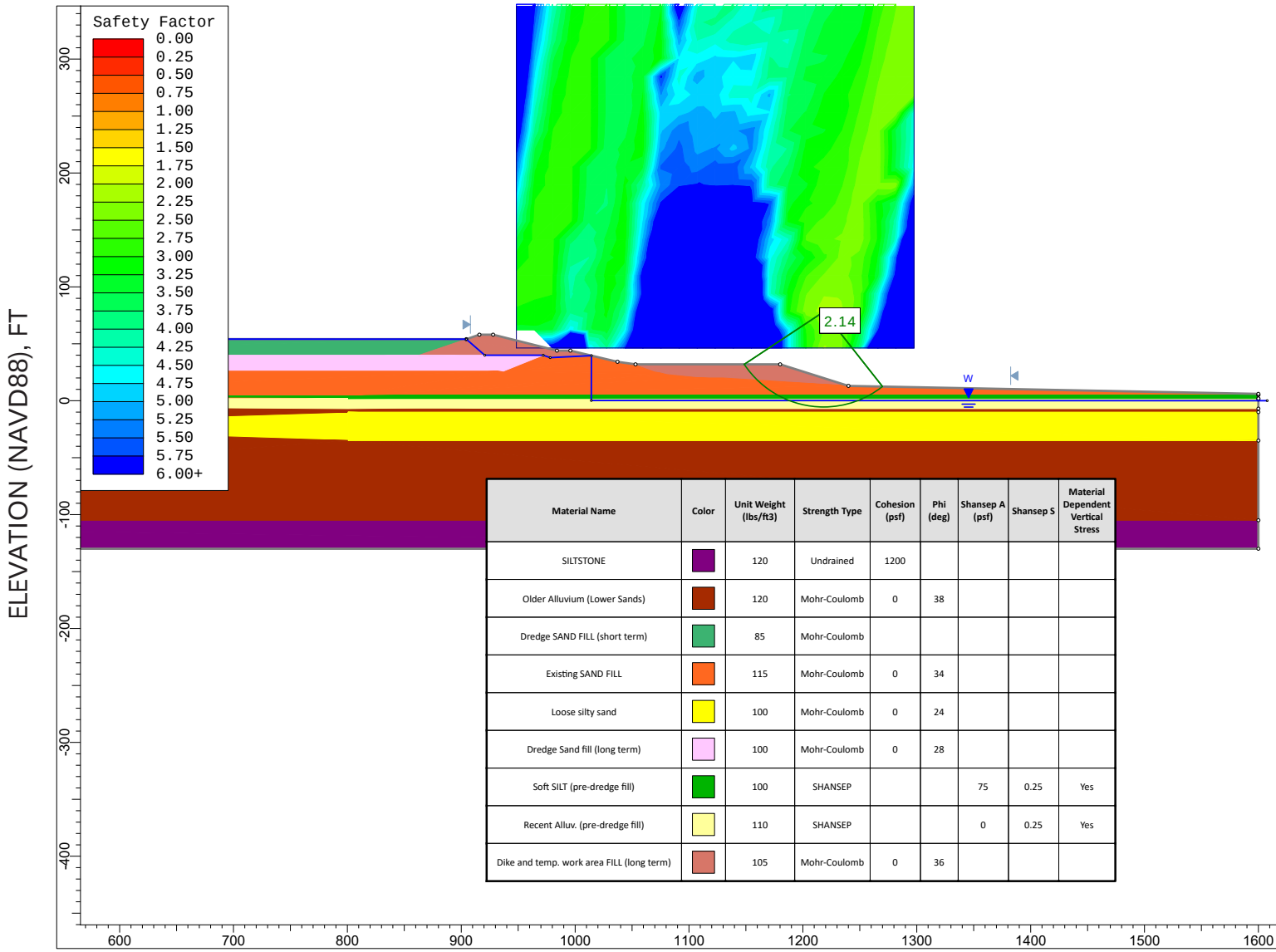
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Dike and temp. work area FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DIKE CONSTRUCTION

CROSS SECTION D-D' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 45B



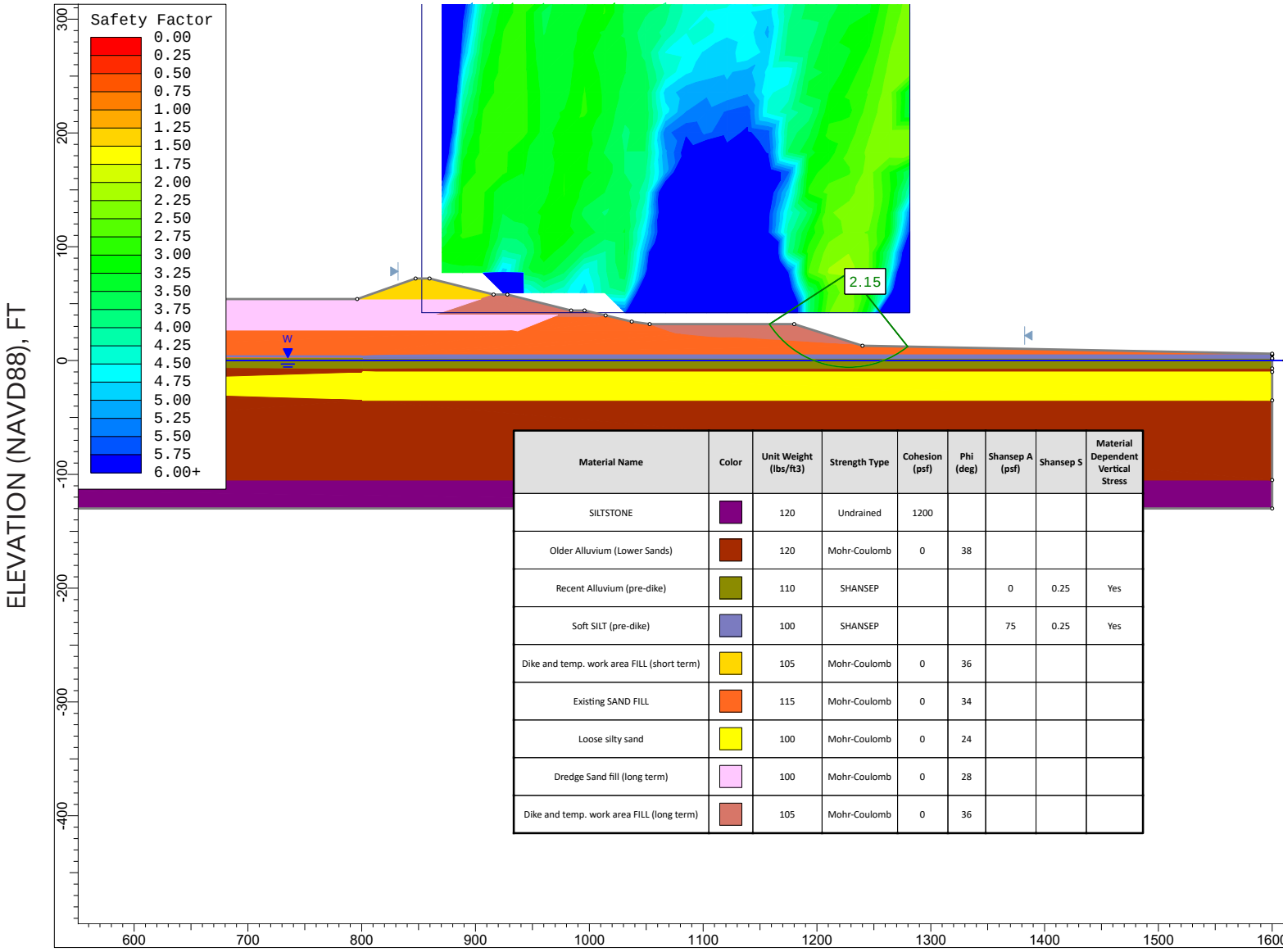
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes
Recent Alluv. (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DREDGE FILL PLACEMENT

CROSS SECTION D-D' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 46B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Dike and temp. work area FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

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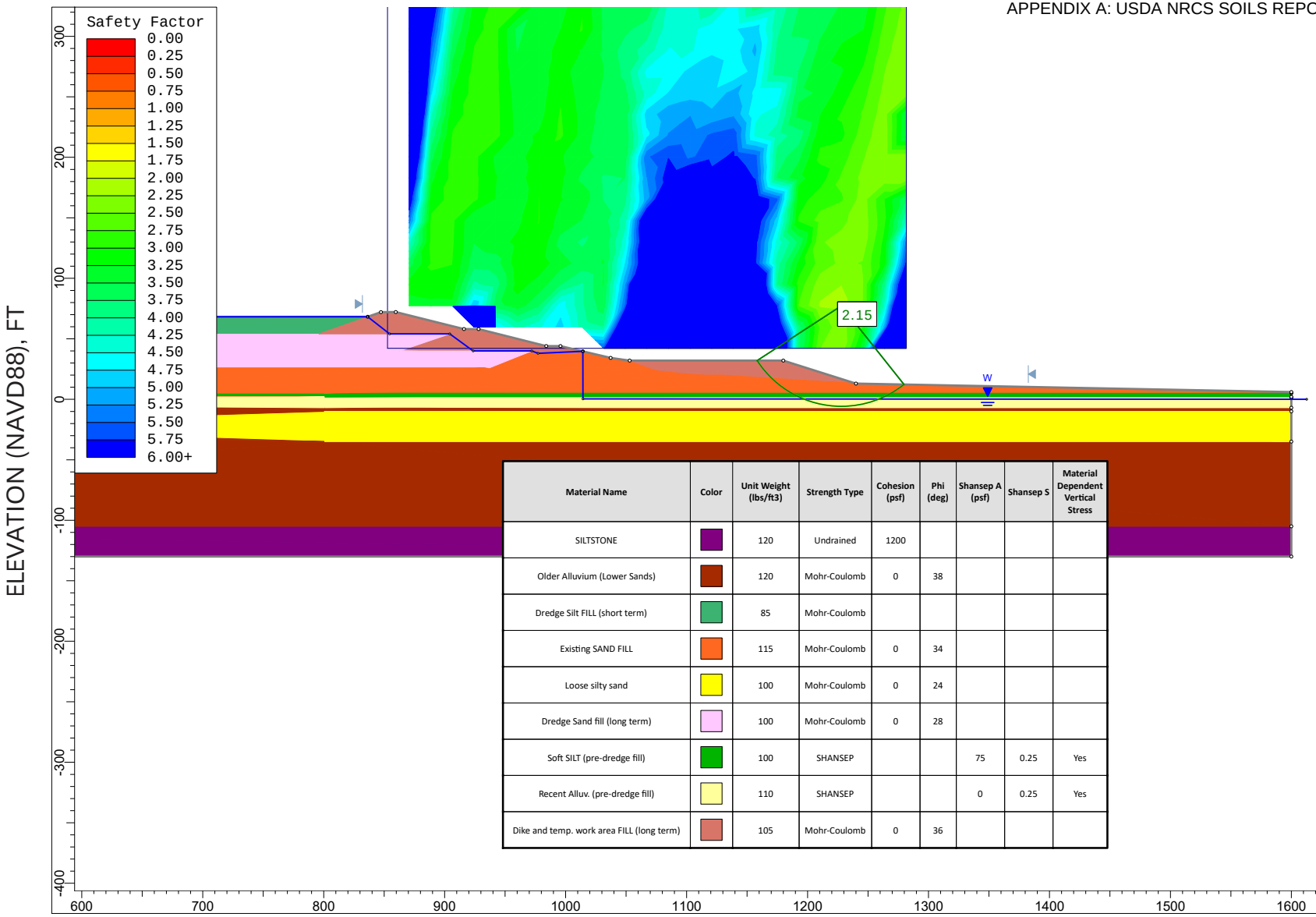
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DIKE CONSTRUCTION

CROSS SECTION D-D' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 47B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Dredge Silt FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes
Recent Alluv. (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

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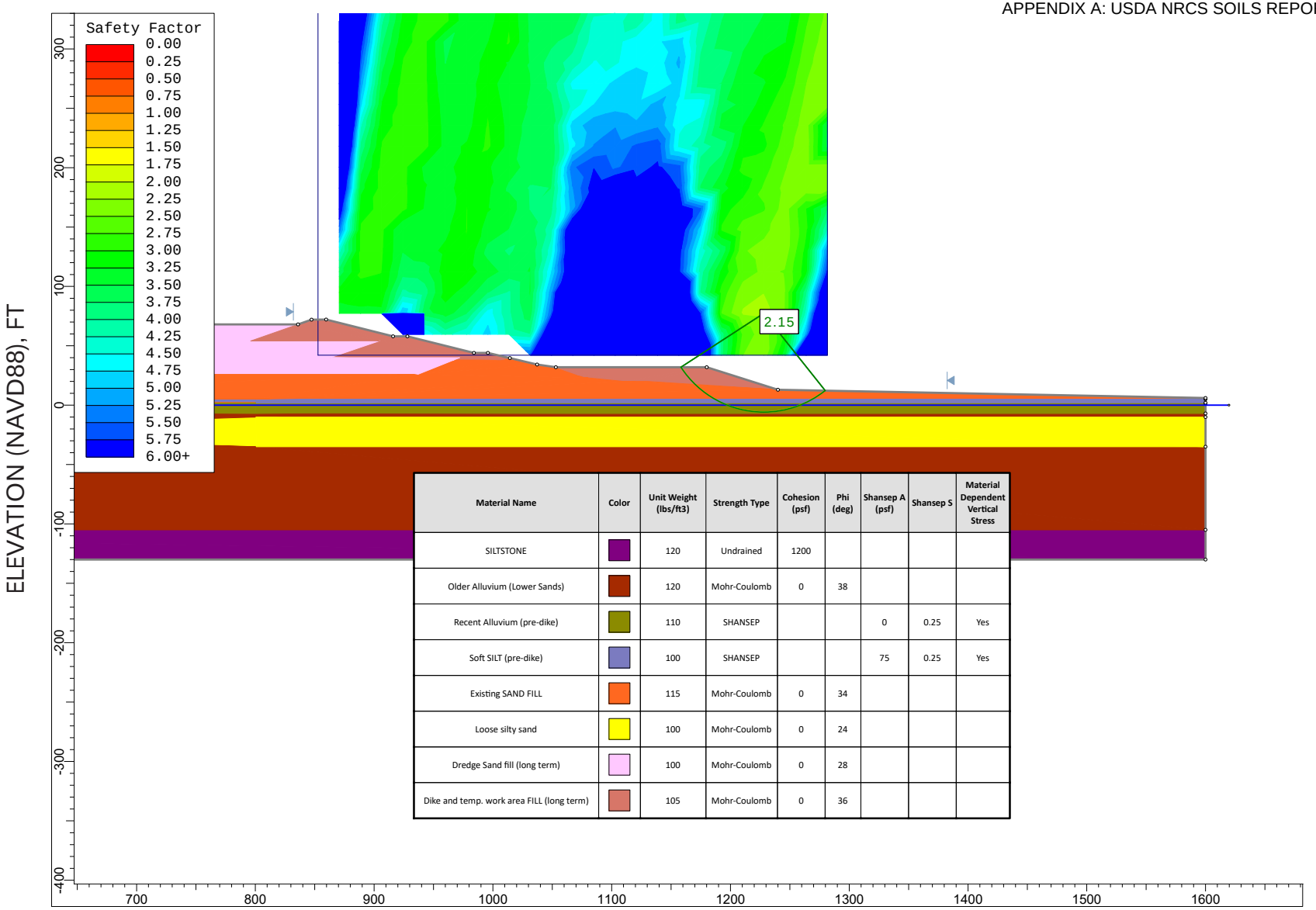
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DREDGE FILL PLACEMENT

CROSS SECTION D-D' (EAST)

NOV. 2018 JOB NO. 6099-B FIG. 48B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

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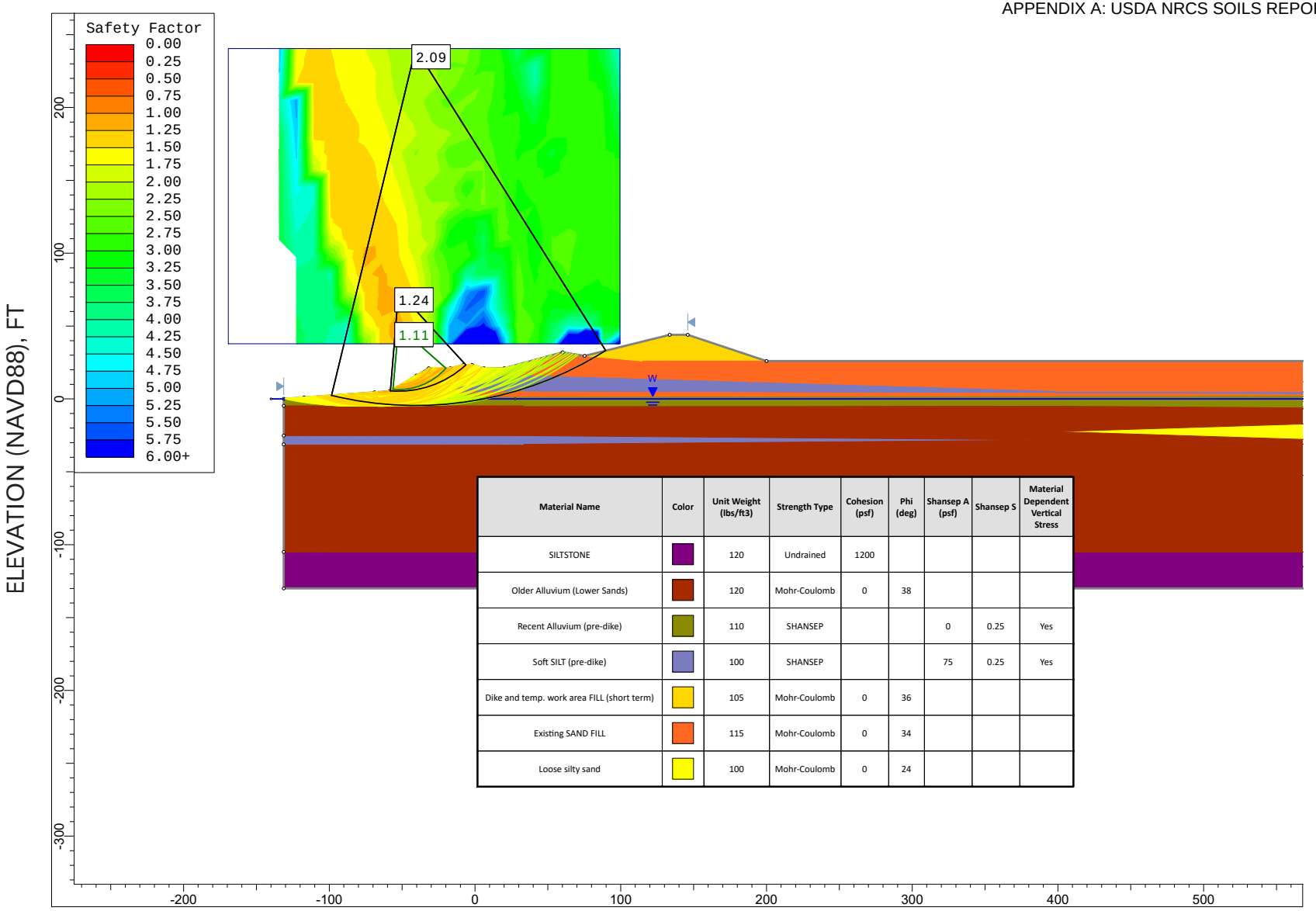
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LONG TERM

CROSS SECTION D-D' (EAST)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Dike and temp. work area FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			

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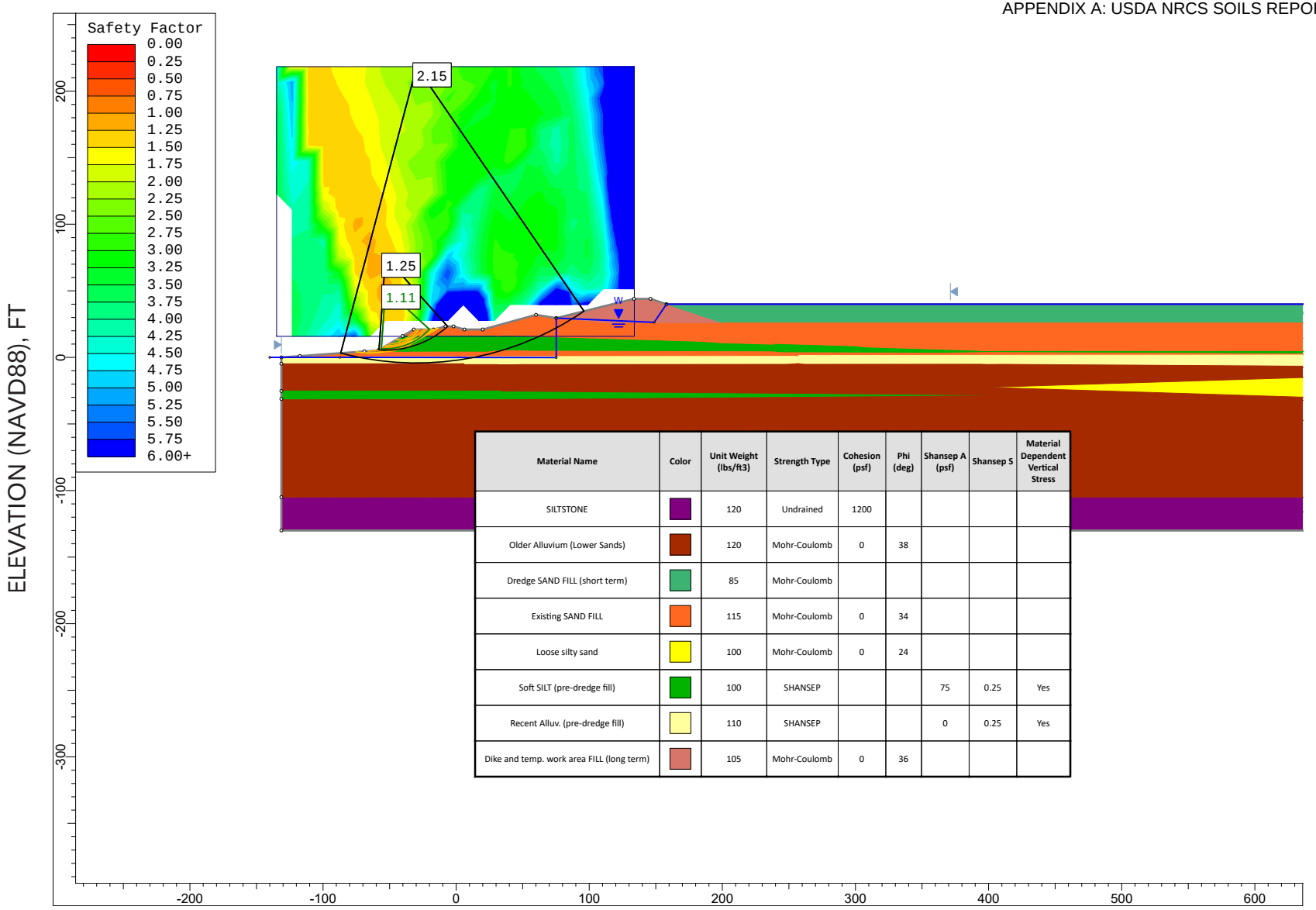
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DIKE CONSTRUCTION

CROSS SECTION D-D' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 50B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes
Recent Alluv. (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

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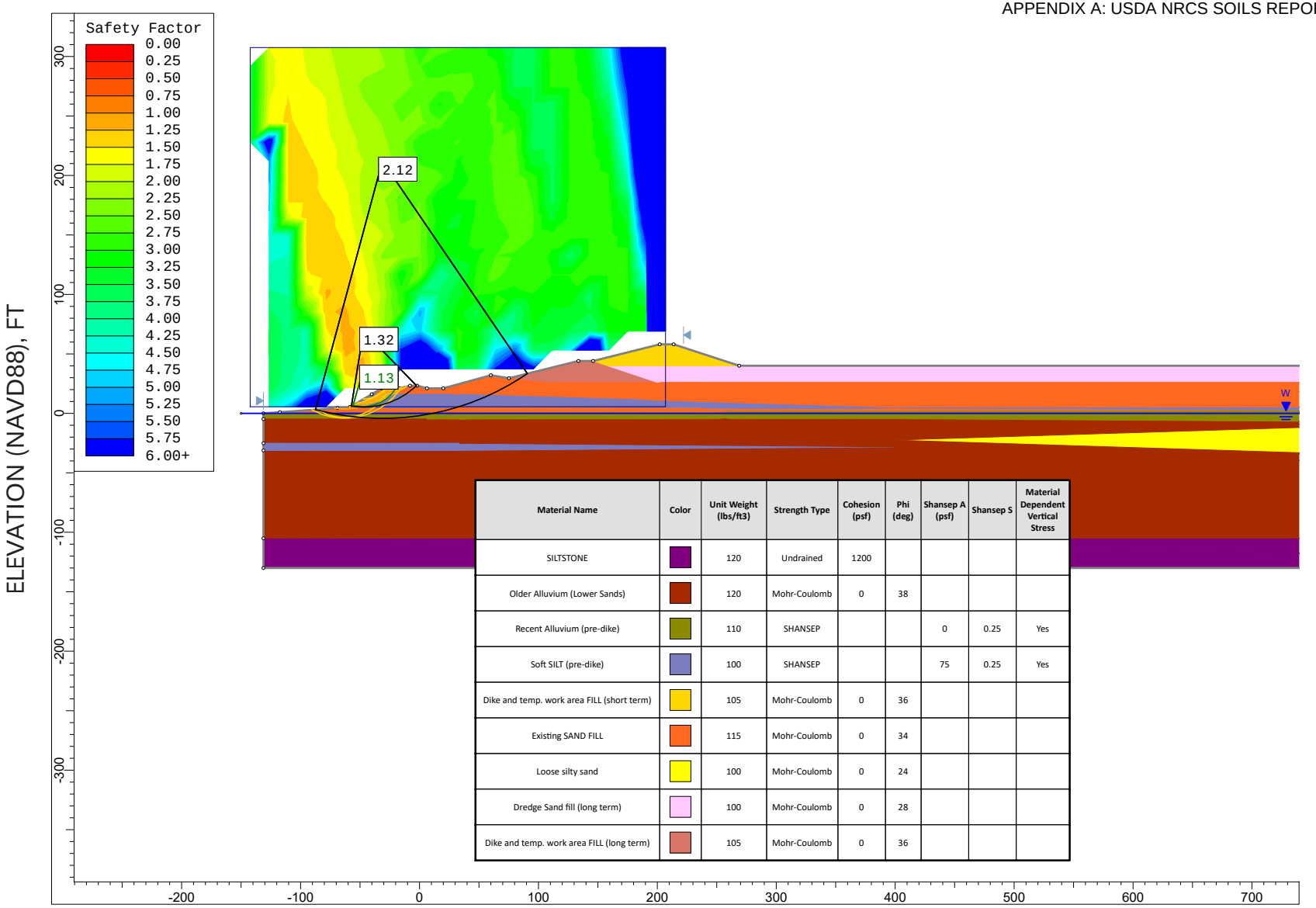
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DREDGE FILL PLACEMENT

CROSS SECTION D-D' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 51B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Dike and temp. work area FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

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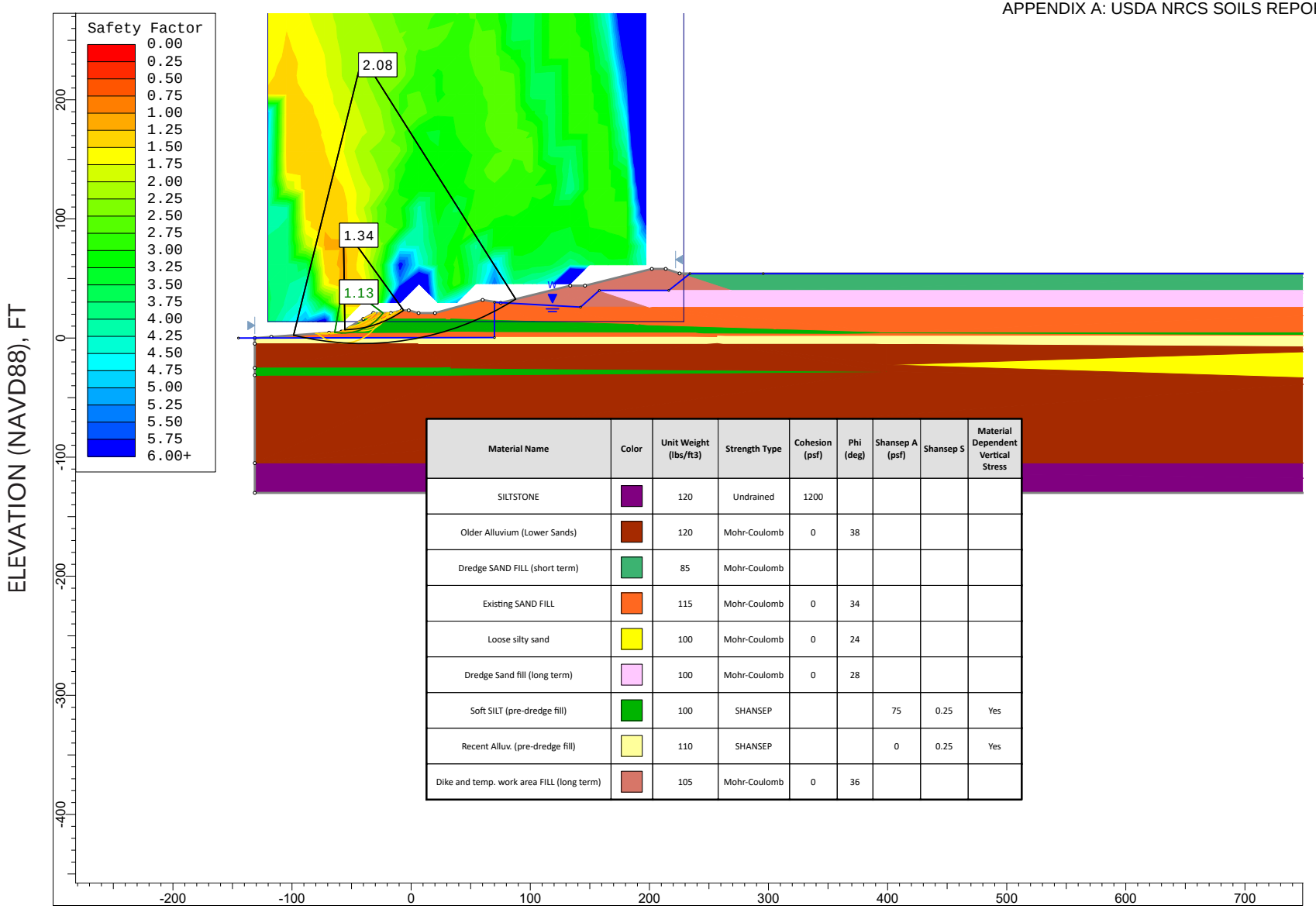
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DIKE CONSTRUCTION

CROSS SECTION D-D' (WEST)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Dredge SAND FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes
Recent Alluv. (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

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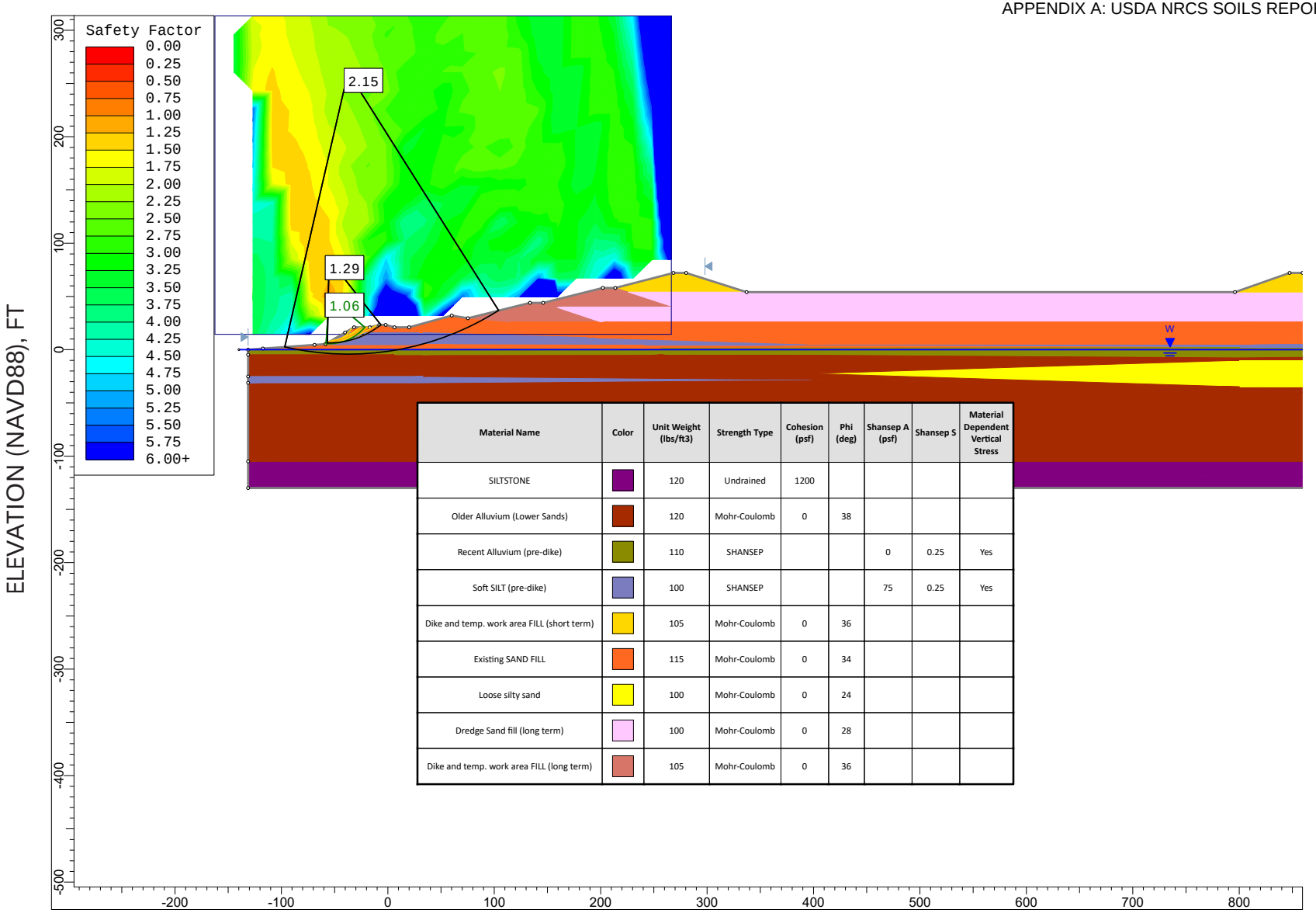
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DREDGE FILL PLACEMENT

CROSS SECTION D-D' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 53B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Dike and temp. work area FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

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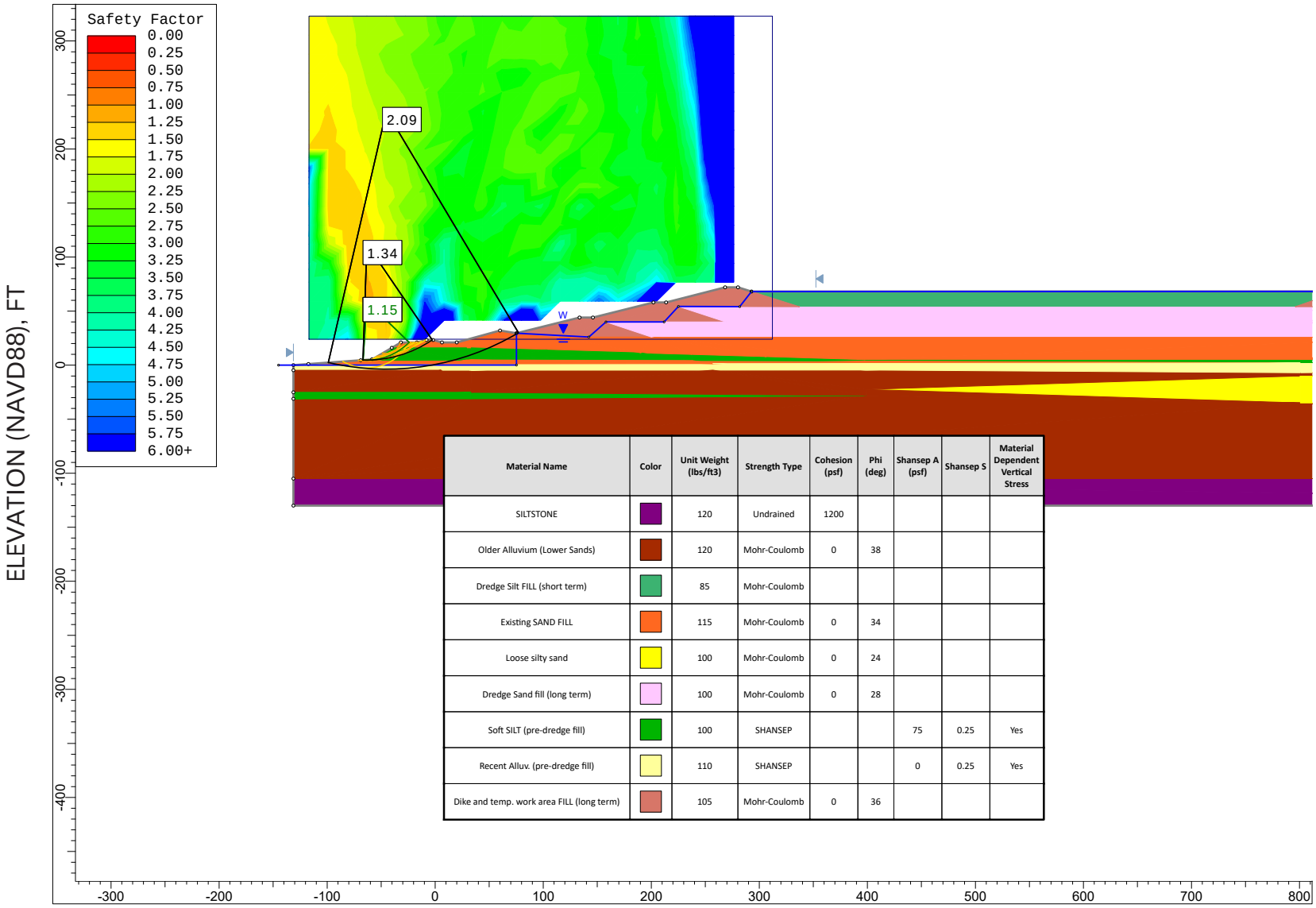
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DIKE CONSTRUCTION

CROSS SECTION D-D' (WEST)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Dredge Silt FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes
Recent Alluv. (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

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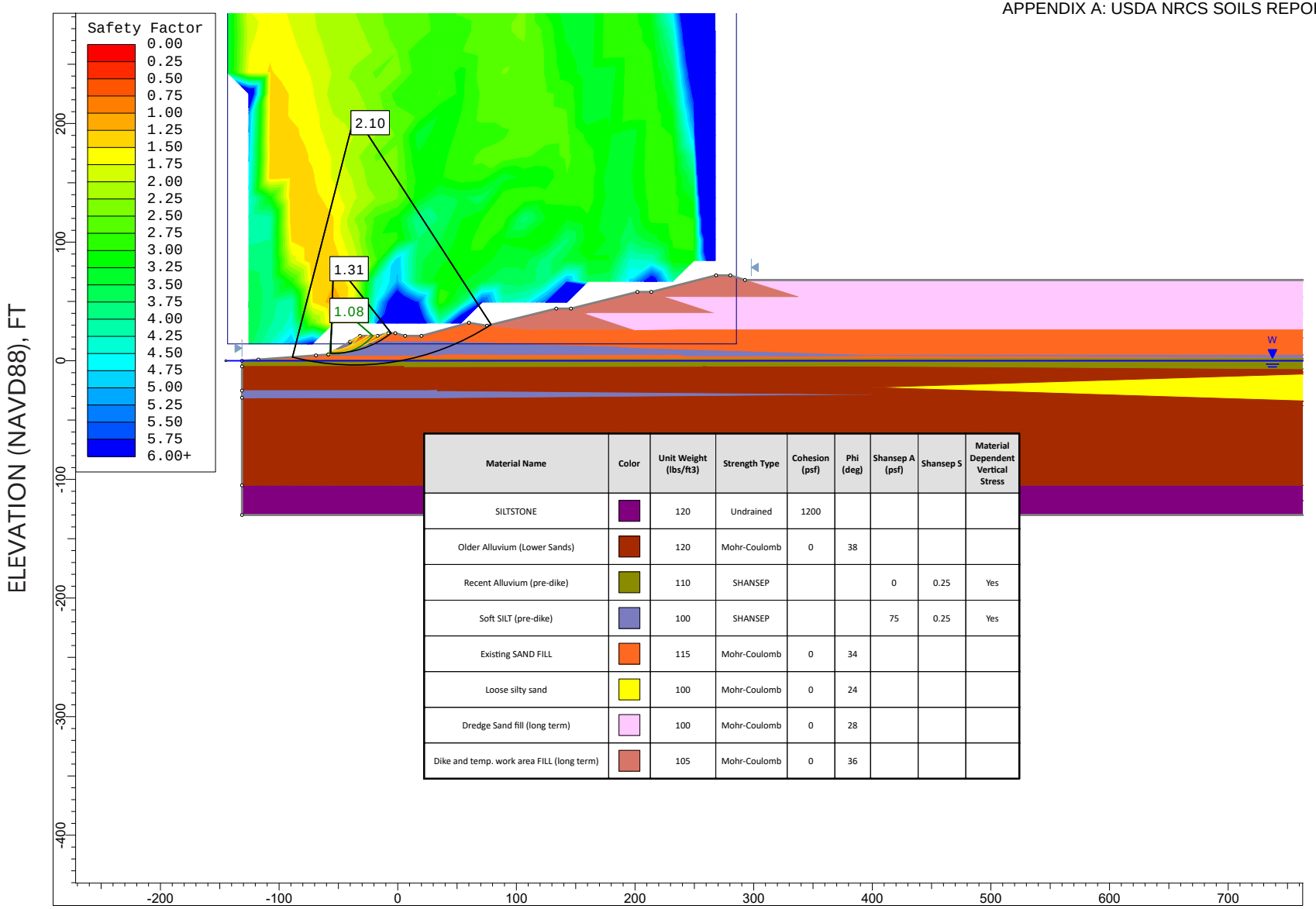
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DREDGE FILL PLACEMENT

CROSS SECTION D-D' (WEST)

NOV. 2018 JOB NO. 6099-B FIG. 55B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
SILTSTONE		120	Undrained	1200				
Older Alluvium (Lower Sands)		120	Mohr-Coulomb	0	38			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Loose silty sand		100	Mohr-Coulomb	0	24			
Dredge Sand fill (long term)		100	Mohr-Coulomb	0	28			
Dike and temp. work area FILL (long term)		105	Mohr-Coulomb	0	36			

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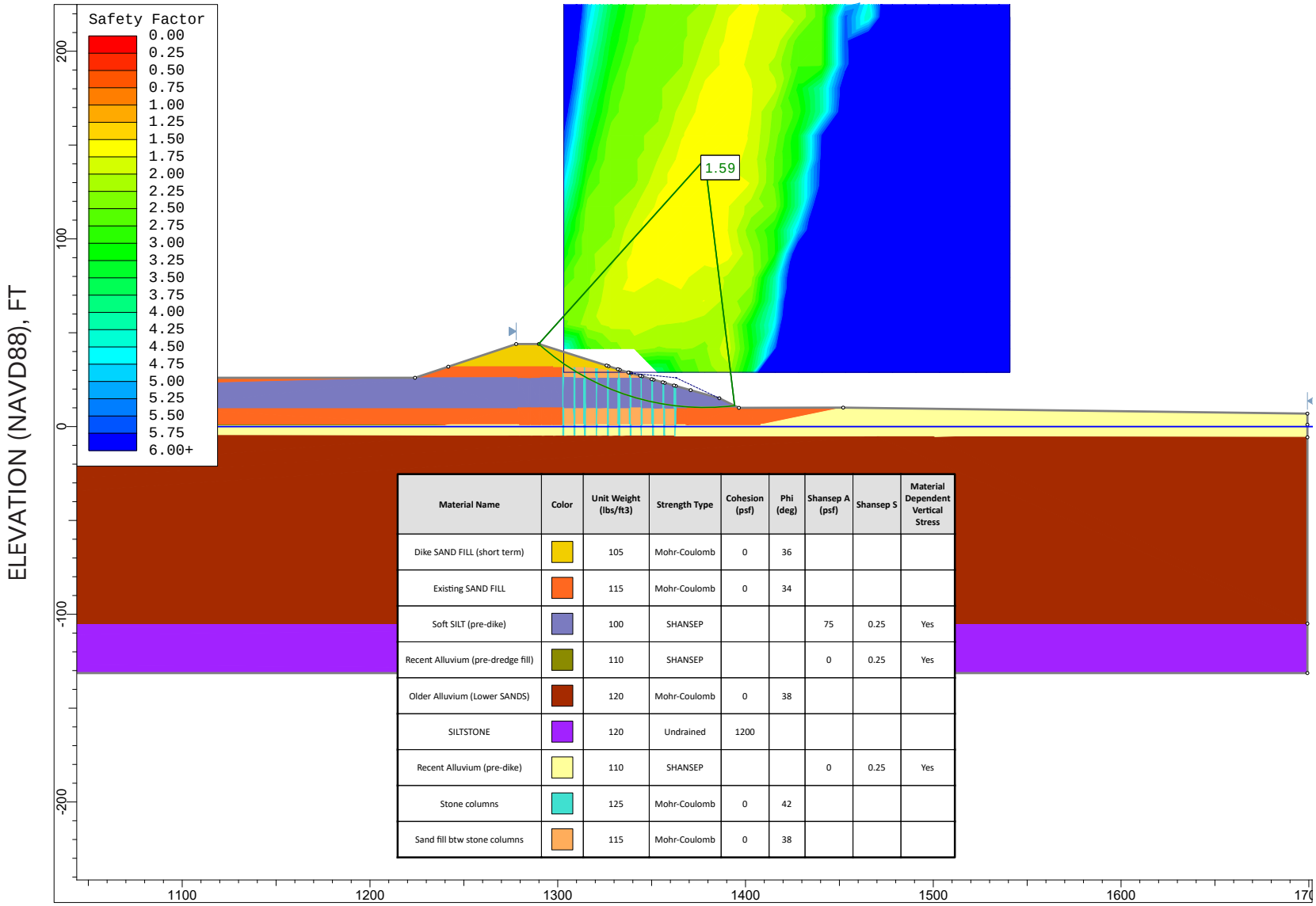
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LONG TERM

CROSS SECTION D-D' (WEST)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dike SAND FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Stone columns		125	Mohr-Coulomb	0	42			
Sand fill btw stone columns		115	Mohr-Coulomb	0	38			

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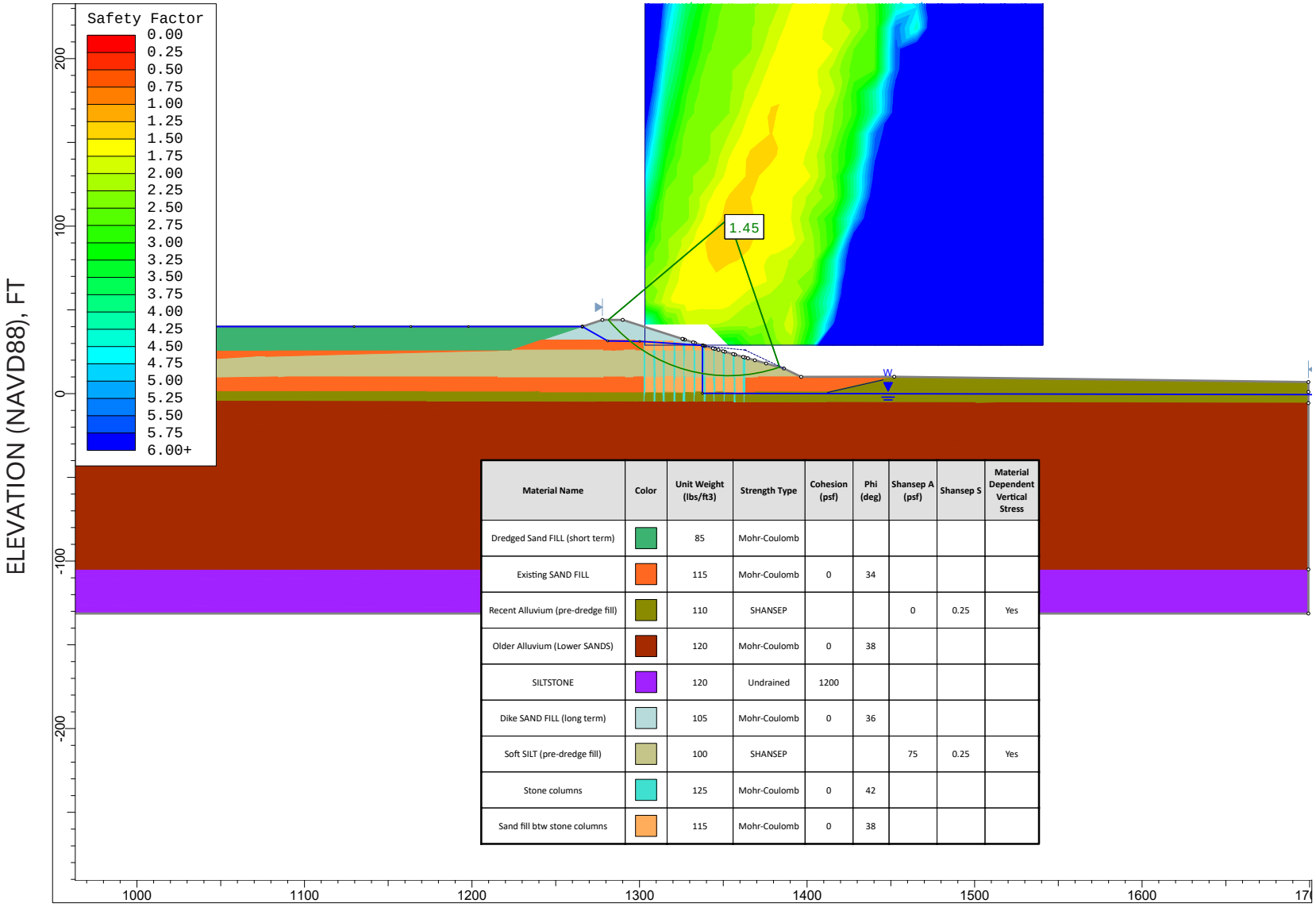
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DIKE CONSTRUCTION WITH GROUND IMPROVEMENT AND FLATTENED SLOPES

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 57B



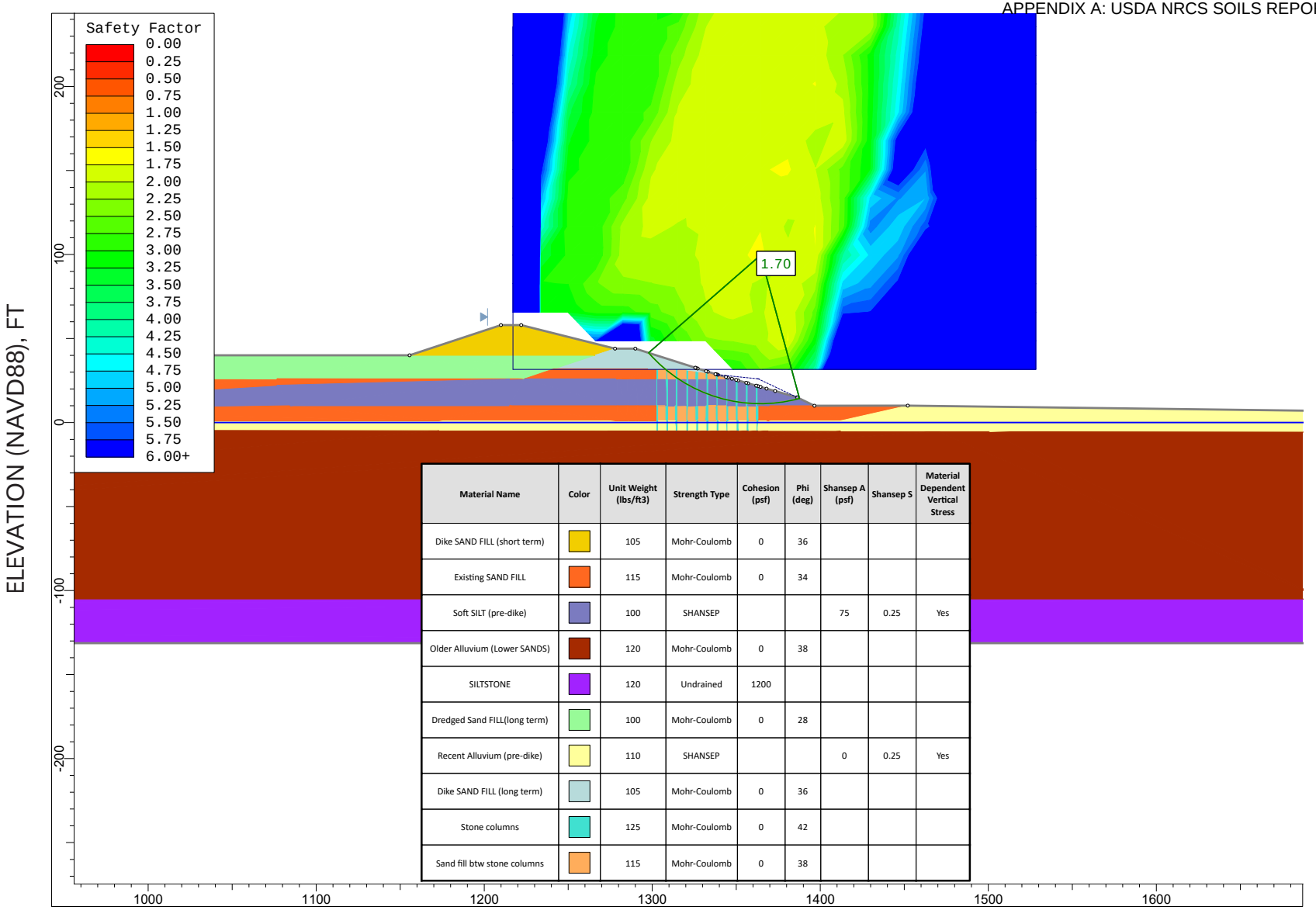
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dredged Sand FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes
Stone columns		125	Mohr-Coulomb	0	42			
Sand fill btw stone columns		115	Mohr-Coulomb	0	38			

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 1 DREDGE FILL PLACEMENT WITH GROUND IMPROVEMENT AND FLATTENED SLOPES

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 58B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dike SAND FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Stone columns		125	Mohr-Coulomb	0	42			
Sand fill btw stone columns		115	Mohr-Coulomb	0	38			

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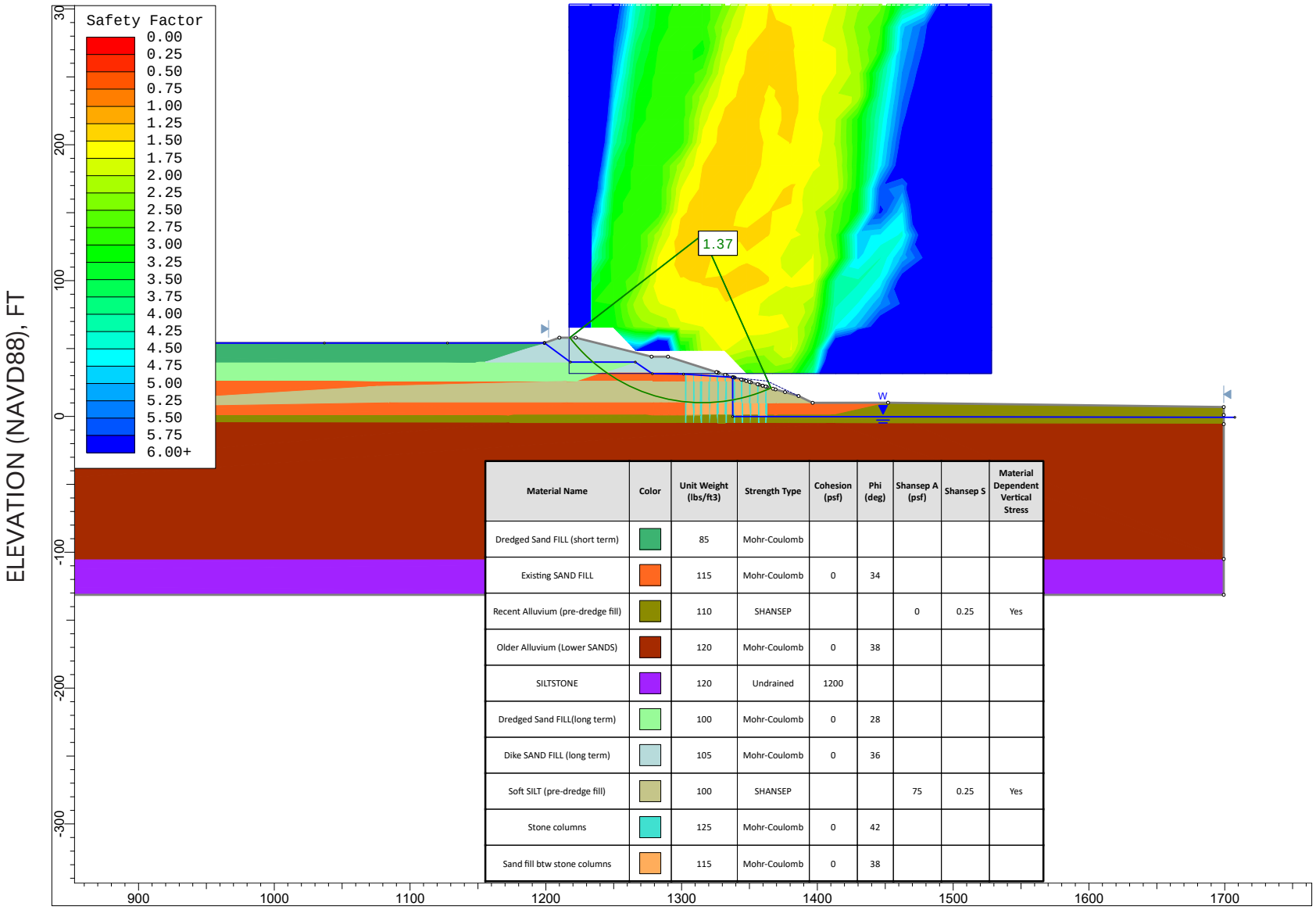
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DIKE CONSTRUCTION WITH GROUND IMPROVEMENT AND FLATTENED SLOPES

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 59B



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dredged Sand FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes
Stone columns		125	Mohr-Coulomb	0	42			
Sand fill btw stone columns		115	Mohr-Coulomb	0	38			

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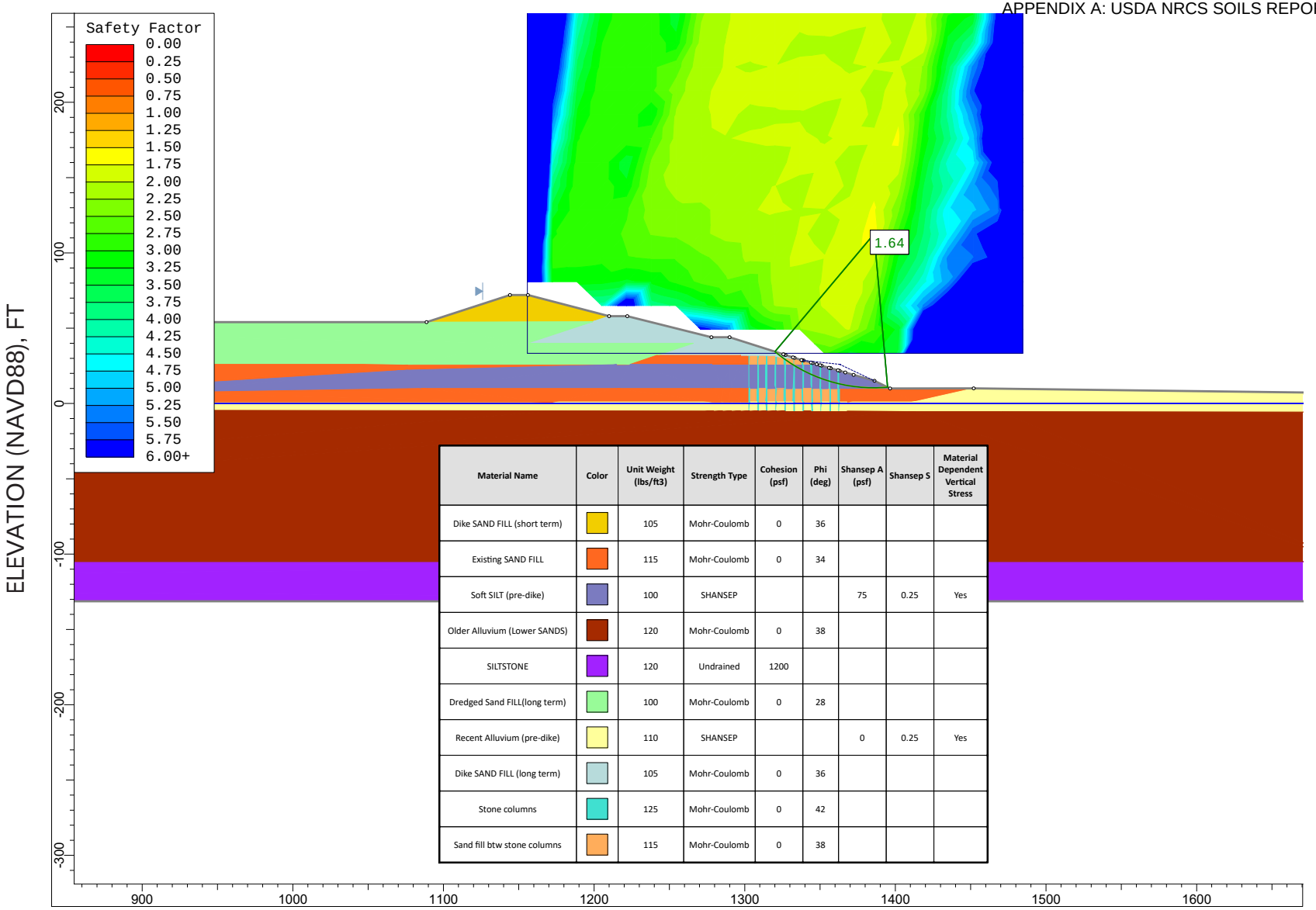
DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 2 DREDGE FILL PLACEMENT WITH GROUND IMPROVEMENT AND FLATTENED SLOPES

CROSS SECTION A-A' (SOUTH)

NOV. 2018 JOB NO. 6099-B FIG. 60B



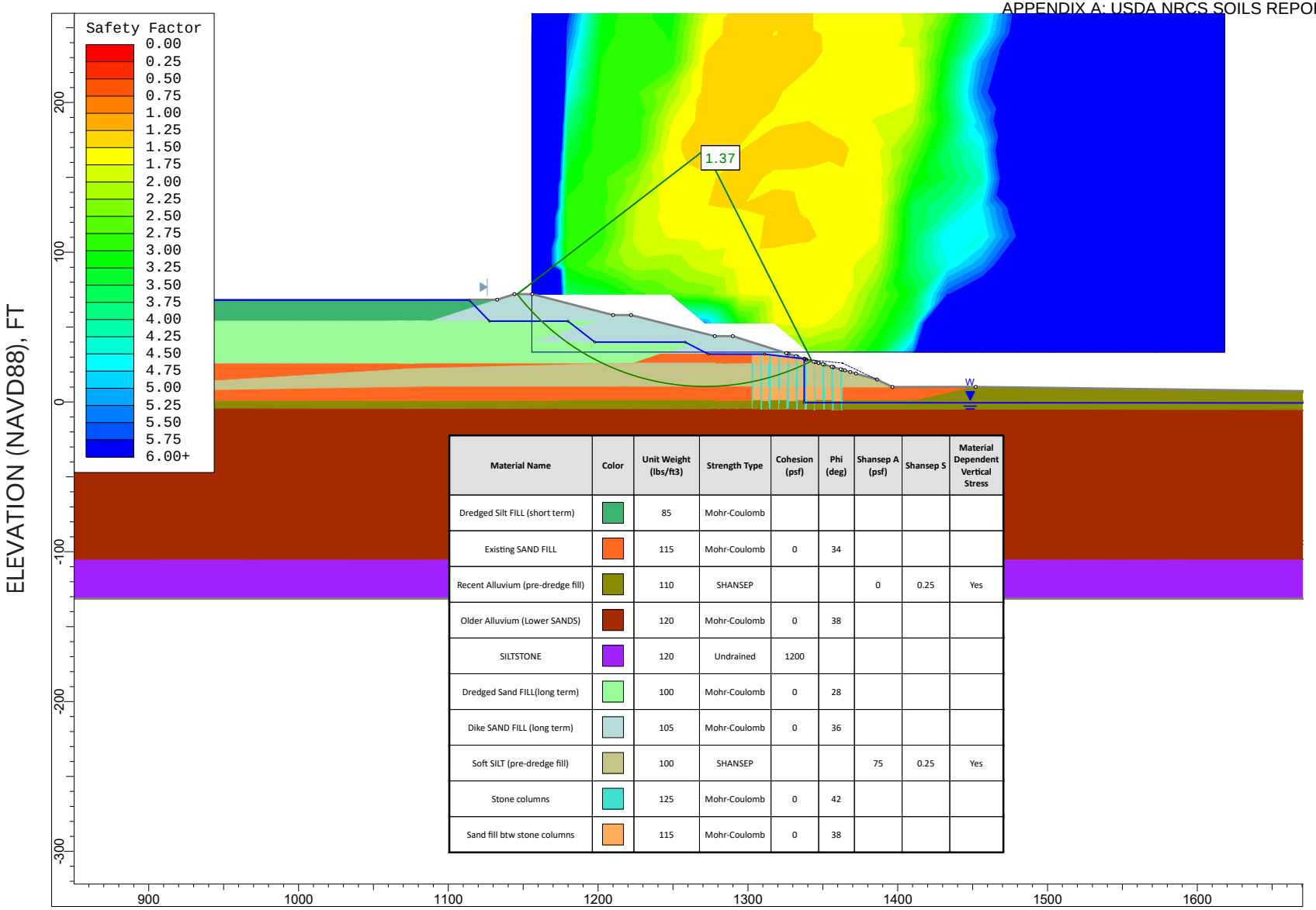
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dike SAND FILL (short term)		105	Mohr-Coulomb	0	36			
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Stone columns		125	Mohr-Coulomb	0	42			
Sand fill btw stone columns		115	Mohr-Coulomb	0	38			

GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DIKE CONSTRUCTION WITH GROUND IMPROVEMENT AND FLATTENED SLOPES

CROSS SECTION A-A' (SOUTH)



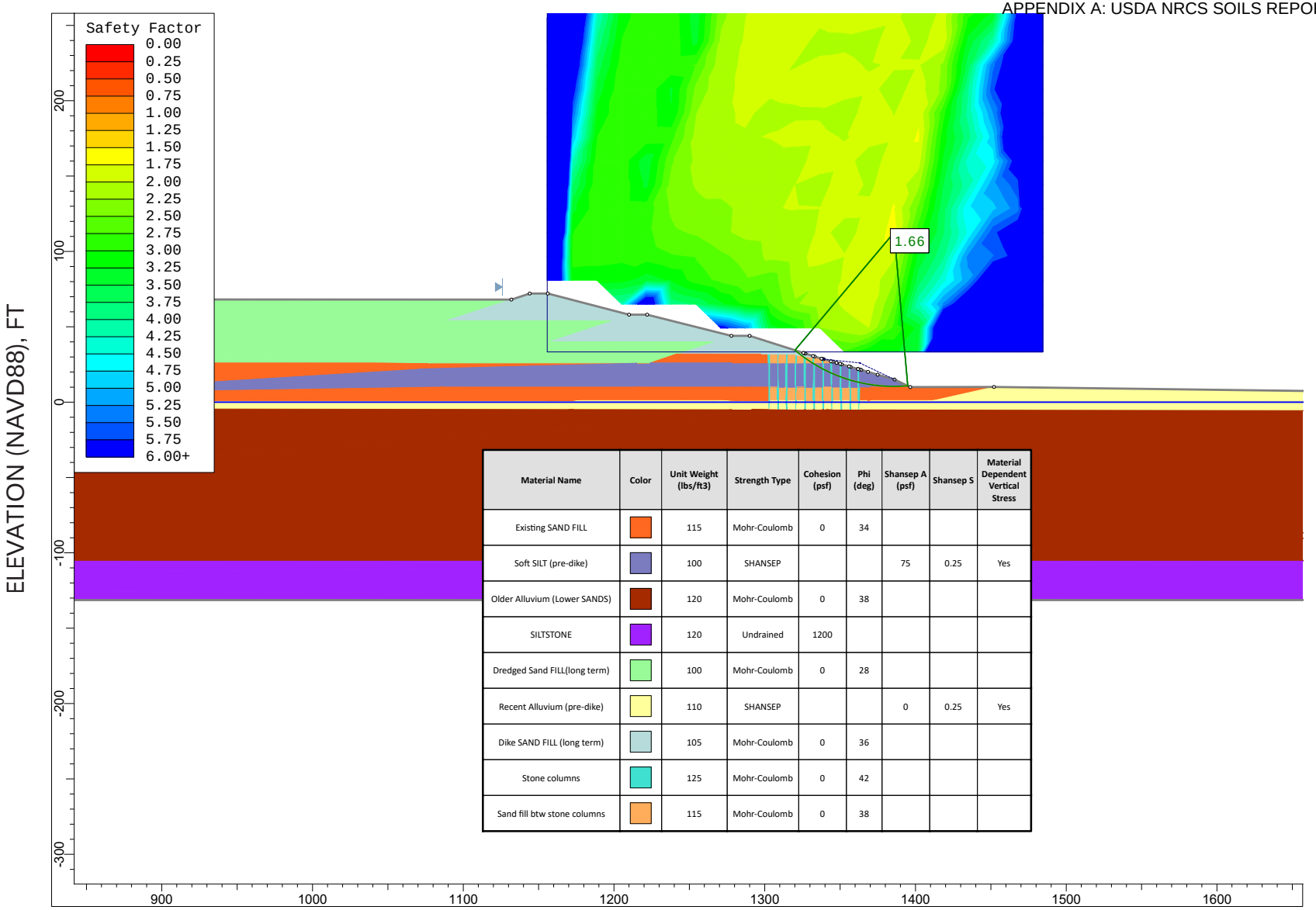
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Dredged Silt FILL (short term)		85	Mohr-Coulomb					
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Recent Alluvium (pre-dredge fill)		110	SHANSEP			0	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Soft SILT (pre-dredge fill)		100	SHANSEP			75	0.25	Yes
Stone columns		125	Mohr-Coulomb	0	42			
Sand fill btw stone columns		115	Mohr-Coulomb	0	38			

GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

STAGE 3 DREDGE FILL PLACEMENT WITH GROUND IMPROVEMENT AND FLATTENED SLOPES

CROSS SECTION A-A' (SOUTH)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shansep A (psf)	Shansep S	Material Dependent Vertical Stress
Existing SAND FILL		115	Mohr-Coulomb	0	34			
Soft SILT (pre-dike)		100	SHANSEP			75	0.25	Yes
Older Alluvium (Lower SANDS)		120	Mohr-Coulomb	0	38			
SILTSTONE		120	Undrained	1200				
Dredged Sand FILL(long term)		100	Mohr-Coulomb	0	28			
Recent Alluvium (pre-dike)		110	SHANSEP			0	0.25	Yes
Dike SAND FILL (long term)		105	Mohr-Coulomb	0	36			
Stone columns		125	Mohr-Coulomb	0	42			
Sand fill btw stone columns		115	Mohr-Coulomb	0	38			

GRI

DAVID EVANS AND ASSOCIATES, INC.
JORDAN COVE OWNER'S SCOPE PROJECTS
APCO SITE 2

LONG TERM WITH GROUND IMPROVEMENT AND FLATTENED SLOPES

CROSS SECTION A-A' (SOUTH)

APPENDIX B: WELL PERMITS

Permit No. G- 1389

APPLICATION FOR A PERMIT

To Appropriate the Ground Waters of the State of Oregon

I, PACIFIC POWER & LIGHT COMPANY
(Name of applicant)

of Public Service Bldg., Portland 4, Oregon, county of Multnomah,
(Postoffice Address)

state of Oregon, do hereby make application for a permit to appropriate the following described ground waters of the state of Oregon, SUBJECT TO EXISTING RIGHTS:

If the applicant is a corporation, give date and place of incorporation

Applicant was incorporated under laws of State of Maine on June 16, 1910

1. *Give name of nearest stream to which the well, tunnel or other source of water development is situated* North Slough, a tributary of Coos Bay; and Tenmile Creek
(Name of stream)

tributary of the Pacific Ocean

2. *The amount of water which the applicant intends to apply to beneficial use is* approx. 46 *cubic feet per second or* 20,800 *gallons per minute.*

3. *The use to which the water is to be applied is* industrial uses including the manufacture of pulp and paper

4. *The well or other source is located* - *ft.* - *(N. or S.) and* - *ft.* - *(E. or W.) from the* - *corner of* Refer to Attachment No. 1 hereto and General Plan Map attached hereto
(Section or subdivision)

(If preferable, give distance and bearing to section corner)

(If there is more than one well, each must be described. Use separate sheet if necessary)

being within the - *of Sec.* -, *Twp.* -, *R.* -, *W. M., in the county of* Coos

5. *The* pipelines *to be* 16 or more *miles in length, terminating in the* within the area outlined on the General Area Map attached hereto and more fully described in reply to No. 12 below. *of Sec.* ..., *Twp.* ..., *R.* ..., *W. M., the proposed location being shown throughout on the accompanying map.*
(Canal or pipe line)
(Smallest legal subdivision)

6. *The name of the well or other works is* Coos Bay Sand Dunes Water Supply

DESCRIPTION OF WORKS

7. *If the flow to be utilized is artesian, the works to be used for the control and conservation of the supply when not in use must be described.*

Flow is not artesian

8. *The development will consist of* 64 wells *having a diameter of* 10 *inches and an estimated depth of* 130 *feet. It is estimated that* 130 commercial well screen *feet of the well will require* and steel *casing. Depth to water table is estimated* to be less than 10 feet at the well locations.
(Give number of wells, tunnels, etc.)
(Kind)
(Feet)

G1— —3.5M

CANAL SYSTEM OR PIPE LINE—

9. (a) Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line) Not Applicable feet; width on bottom ..... feet; depth of water ..... feet; grade ..... feet fall per one thousand feet.

(b) At ..... miles from headgate: width on top (at water line) Not Applicable ..... feet; width on bottom ..... feet; depth of water ..... feet; grade ..... feet fall per one thousand feet.

(c) Length of pipe, approx. 83,000 ft.; size at ~~intake~~ wells, 6 in.; in size at See accompanying General Plan Map ~~place of use~~ ..... in.; size at place of use 30 and 24 in.; difference in elevation between intake and place of use, approx. 25 ft. Is grade uniform? No Estimated capacity, approx. 50 sec. ft.

10. If pumps are to be used, give size and type 64 vertical turbine pumps; 3, 4, 5, 6 and 7 stage units to be used; 18-8" units and 46-10" units.

Give horsepower and type of motor or engine to be used Three-phase electric motors; 7 @ 10 hp, 16 @ 15 hp, 20 @ 20 hp, 11 @ 25 hp, and 10 @ 30 hp

11. If the location of the well, tunnel, or other development work is less than one-fourth mile from a natural stream or stream channel, give the distance to the nearest point on each of such channels and the difference in elevation between the stream bed and the ground surface at the source of development

Wells are more than one-fourth mile from Tenmile Creek and North Slough

12. Location of area to be irrigated, or place of use as outlined on attached General Area Map

Township N. or S.	Range E. or W. of Willamette Meridian	Section	~~Tract~~	Number Acres To Be Irrigated
Water will be used at as yet undetermined locations within the following described sections:				
T 23 S	R 12 W	18,19,30,31		Water not to be used
T 23 S	R 13 W	13,14,15,22,23,24,25,26,27,33, 34,35,36		for irrigation
T 24 S	R 12 W	6,7,18,19,30,31		
T 24 S	R 13 W	1,2,3,4,9,10,11,12,13,14,15,16,17, 20,21,22,23,24,25,26,27,28,29,31,32,33,34,35,36		
T 25 S	R 12 W	6,7,18,19,30,31		
T 25 S	R 13 W	All of Township		
T 26 S	R 12 W	6		
T 26 S	R 13 W	1,2,3,4,5,6		
T 25 S	R 14 W	12,13,23,24,25,26		
T 26 S	R 14 W	1,2,3,4		

(If more space required, attach separate sheet)

Character of soil Water is not to be used for irrigation

Kind of crops raised " " " " " " " "

MUNICIPAL SUPPLY—

13. *To supply the city of* Not Applicable

in ..... *county, having a present population of* .....

and an estimated population of ..... *in 19*.....

ANSWER QUESTIONS 14, 15, 16, 17 AND 18 IN ALL CASES

14. *Estimated cost of proposed works, $* Approx. $2,500,000 (Including approx. $800,000 already expended on exploratory work)

15. *Construction work will begin on or before* Started

16. *Construction work will be completed on or before* See Remarks Below

17. *The water will be completely applied to the proposed use on or before* See Remarks Below

18. *If the ground water supply is supplemental to an existing water supply, identify any application for permit, permit, certificate or adjudicated right to appropriate water, made or held by the applicant.* Not Applicable

PACIFIC POWER & LIGHT COMPANY

By: [signature] President
(Signature of applicant)

Remarks: The project for which a permit is requested will provide suitable fresh water for industrial purposes in the Coos Bay area where fresh water is not now economically available in large quantity. This project is the result of exploratory work to find a source of such water carried out by the applicant since 1954 following the determination in conference with leaders of the Coos Bay communities that the development of an industrial water supply was a critical need of the area. More than $800,000 has been expended in this exploratory work, including the construction of five pilot wells and an experimental gallery which are producing more than 2 million gallons per day. It is expected that one of the primary uses of this water will be a large expansion of pulp and paper manufacturing using the large raw material resources of the forest industries and the timber reserves of the Coos Bay area.

The facilities described in this application are those needed to develop fully the water supply of the sand dune area between Coos Bay and Tenmile Creek. It is essential to the effective development of this water potential, and for control of salt water intrusion, that the works be built and operated in an orderly manner in accordance with a carefully designed and integrated program as described in this application.

The applicant contemplates that the water extraction facilities will be installed progressively as industry locates in the area and calls for water. The timing of construction will thus depend on the rapidity of industrial growth and may extend over a number of years. The applicant has been actively working for more than five years to bring industries to the area and will continue to do so. As stated above the applicant has already begun construction of the proposed project and will complete construction of the project as rapidly as the demands of industry may require so as ultimately to attain the full development and utilization of this water resource.

The investigatory work completed by applicant and a description of the water supply and features necessary to its development are summarized in the attached memorandum.

STATE OF OREGON,
County of Marion, } *ss.*

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for .....

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before ....., *19*.....

WITNESS my hand this ..... *day of* ....., *19*.....

.....
STATE ENGINEER

By .....
ASSISTANT

STATE OF OREGON, } ss.
County of Marion, }

PERMIT

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 46.0 cubic feet per second measured at the point of diversion from the well or source of appropriation, or its equivalent in case of rotation with other water users, from 64 wells.

The use to which this water is to be applied is industrial uses including the manufacture of pulp and paper.

If for irrigation, this appropriation shall be limited to - - - of one cubic foot per second or its equivalent for each acre irrigated and shall be further limited to a diversion of not to exceed ..... acre feet per acre for each acre irrigated during the irrigation season of each year; .....

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The well shall be cased as necessary in accordance with good practice and if the flow is artesian the works shall include proper capping and control valve to prevent the waste of ground water.

The works constructed shall include an air line and pressure gauge or an access port for measuring line, adequate to determine water level elevation in the well at all times.

The permittee shall install and maintain a weir, meter, or other suitable measuring device, and shall keep a complete record of the amount of ground water withdrawn.

The priority date of this permit is January 3, 1956

Actual construction work shall begin on or before August 10, 1960 and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 1960

Complete application of the water to the proposed use shall be made on or before October 1, 1961

WITNESS my hand this 10th day of August, 1959

Lewis A. Stanley
STATE ENGINEER

Application No. G-200 pe

Permit No. G-1389

PERMIT

TO APPROPRIATE THE GROUND WATERS OF THE STATE OF OREGON

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the 3rd day of January, 1956, at 8:00 o'clock A. M.

Returned to applicant:

Approved:

August 10, 1959

Recorded in book No. 6 of Ground Water Permits on page 1389

LEWIS A. STANLEY
STATE ENGINEER

Drainage Basin No. 17 page 23

State Printing $110.00

11-600-CIV-LN-DEA-00001-00 Rev. 0

1389

ATTACHMENT NO. 1

Application for a Permit
To Appropriate the Ground Waters of the State of Oregon
Section 4 - Location of Wells

(1)

Well No.	Distance Ft.	Bearing	Bearing From	Well Location
1	3180	S 70 E	NW Cor. Sec. 23	NE NE 1/4 Sec. 23
2	2620	S 60 E	NW Cor. Sec. 23	SE NW 1/4 Sec. 23
3	2420	S 43 E	NW Cor. Sec. 23	SE NW 1/4 Sec. 23
4	2870	S 30 E	NW Cor. Sec. 23	SE NW 1/4 Sec. 23
5	2570	N 35 W	S 1/4 Cor. Sec. 23	NW SW 1/4 Sec. 23
6	2390	N 52 W	S 1/4 Cor. Sec. 23	NW SW 1/4 Sec. 23
7	2320	N 71 W	S 1/4 Cor. Sec. 23	SW SW 1/4 Sec. 23
8	120	N 72 E	SW Cor. Sec. 23	SW SW 1/4 Sec. 23
9	690	S 3 W	SW Cor. Sec. 23	NE NE 1/4 Sec. 27
10	1250	N 14 W	E 1/4 Cor. Sec. 27	SE NE 1/4 Sec. 27
11	820	N 48 W	E 1/4 Cor. Sec. 27	SE NE 1/4 Sec. 27
12	880	S 78 W	E 1/4 Cor. Sec. 27	NE SE 1/4 Sec. 27
13	2040	N 32 W	SE Cor. Sec. 27	NE SE 1/4 Sec. 27
14	1650	N 50 W	SE Cor. Sec. 27	SE SE 1/4 Sec. 27
15	1480	N 78 W	SE Cor. Sec. 27	SW SE 1/4 Sec. 27
16	1660	S 75 W	SE Cor. Sec. 27	NW NE 1/4 Sec. 34
17	2100	S 56 W	SE Cor. Sec. 27	NW NE 1/4 Sec. 34
18	1930	N 68 W	E 1/4 Cor. Sec. 34	SW NE 1/4 Sec. 34
19	2050	N 89 W	E 1/4 Cor. Sec. 34	SW NE 1/4 Sec. 34
20	2400	S 74 W	E 1/4 Cor. Sec. 34	NW SE 1/4 Sec. 34
21	2930	S 61 W	E 1/4 Cor. Sec. 34	SW SE 1/4 Sec. 34
22	550	N 26 W	N 1/4 Cor. Sec. 3	SE SW 1/4 Sec. 34
23	530	S 63 W	N 1/4 Cor. Sec. 3	NE NW 1/4 Sec. 3
24	1200	S 37 W	N 1/4 Cor. Sec. 3	NE NW 1/4 Sec. 3
25	2380	S 45 E	NW Cor. Sec. 3	SE NW 1/4 Sec. 3
26	2970	S 35 E	NW Cor. Sec. 3	SE NW 1/4 Sec. 3
27	2140	N 34 E	SW Cor. Sec. 3	NE SW 1/4 Sec. 3
28	1510	N 50 E	SW Cor. Sec. 3	SW SW 1/4 Sec. 3
29	1060	N 78 E	SW Cor. Sec. 3	SW SW 1/4 Sec. 3
30	1000	S 61 E	SW Cor. Sec. 3	NW NW 1/4 Sec. 10
31	1390	S 29 E	SW Cor. Sec. 3	NW NW 1/4 Sec. 10
32	790	N 26 E	W 1/4 Cor. Sec. 10	SW NW 1/4 Sec. 10
33	160	N 85 E	W 1/4 Cor. Sec. 10	SW NW 1/4 Sec. 10
34	720	S 5 E	W 1/4 Cor. Sec. 10	NW SW 1/4 Sec. 10
35	650	N 29 W	SE Cor. Sec. 9	SE SE 1/4 Sec. 9
36	1310	N 22 W	E 1/4 Cor. Sec. 16	SE NE 1/4 Sec. 16
37	970	S 37 W	E 1/4 Cor. Sec. 16	NE SE 1/4 Sec. 16
38	1590	S 89 W	NE Cor. Sec. 21	NW NE 1/4 Sec. 21
39	2830	N 71 E	W 1/4 Cor. Sec. 21	SW NE 1/4 Sec. 21
40	2420	S 65 E	W 1/4 Cor. Sec. 21	NE SW 1/4 Sec. 21
41	1690	S 78 E	NW Cor. Sec. 28	NE NW 1/4 Sec. 28
42	580	N 42 E	W 1/4 Cor. Sec. 28	SW NW 1/4 Sec. 28
43	1200	N 26 W	NE Cor. Sec. 32	SE SE 1/4 Sec. 29
44	1600	S 68 W	NE Cor. Sec. 32	NW NE 1/4 Sec. 32
45	2380	N 84 W	E 1/4 Cor. Sec. 32	SW NE 1/4 Sec. 32
46	2920	S 56 W	E 1/4 Cor. Sec. 32	SW SE 1/4 Sec. 32
47	2590	N 89 W	E 1/4 Cor. Sec. 33	SW NE 1/4 Sec. 33

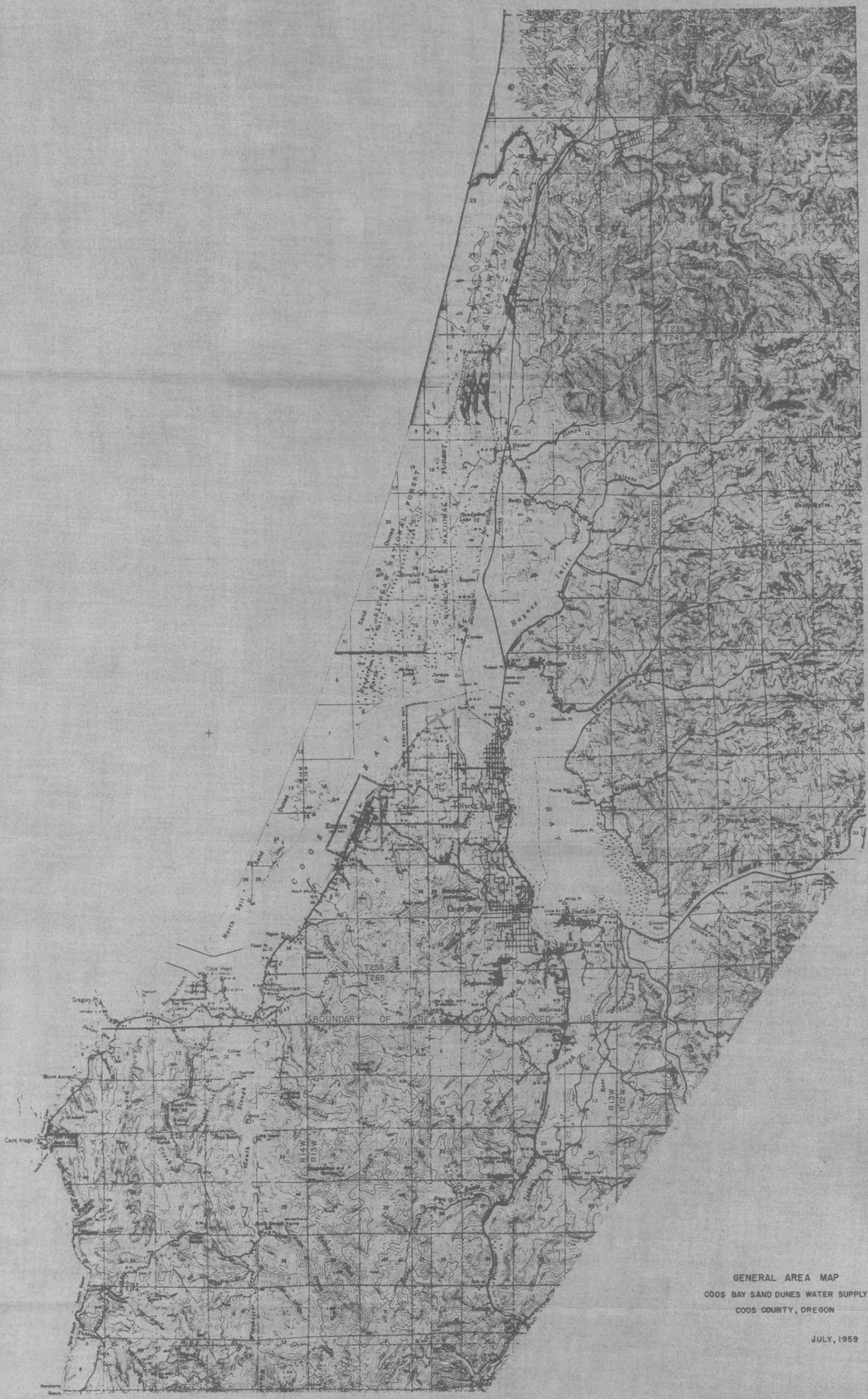
1389

Well No.	Distance Ft.	Bearing	Bearing From	Well Location
48	2130	S 71 W	E 1/4 Cor. Sec. 33	NW SE 1/4 Sec. 33
49	1600	N 84 W	E 1/4 Cor. Sec. 33	SW NE 1/4 Sec. 33
50	1670	N 41 W	E 1/4 Cor. Sec. 33	SE NE 1/4 Sec. 33
51	780	S 72 W	NE Cor. Sec. 33	NE NE 1/4 Sec. 33
52	1070	N 29 W	NE Cor. Sec. 33	SE SE 1/4 Sec. 28
53	400	S 23 W	E 1/4 Cor. Sec. 28	NE SE 1/4 Sec. 28
54	810	N 35 E	E 1/4 Cor. Sec. 28	SW NW 1/4 Sec. 27
55	4490	S 82 W	NE Cor. Sec. 27	NW NW 1/4 Sec. 27
56	4240	N 83 W	NE Cor. Sec. 27	SW SW 1/4 Sec. 22
57	3700	S 76 W	E 1/4 Cor. Sec. 22	NE SW 1/4 Sec. 22
58	3600	N 84 W	E 1/4 Cor. Sec. 22	SE NW 1/4 Sec. 22
59	2330	S 65 E	NW Cor. Sec. 22	NE NW 1/4 Sec. 22
60	2230	N 86 E	NW Cor. Sec. 22	SE SW 1/4 Sec. 15
61	2820	S 62 E	W 1/4 Cor. Sec. 15	SE SW 1/4 Sec. 15
62	2420	S 85 W	E 1/4 Cor. Sec. 15	NE SE 1/4 Sec. 15
63	2170	N 65 W	E 1/4 Cor. Sec. 15	SW NE 1/4 Sec. 15
64	1700	S 70 W	NE Corner Sec. 15	NW NE 1/4 Sec. 15

(1) Wells 1-22 incl. located in T23S, R13W, W.M.

Wells 23-64 incl. located in T24S, R13W, W.M.

All wells in Coos County, Oregon


R13W
R12W
T23S
T24S
T24S
T25S
T25S
T26S
R14W
R13W
R13W
R12W
PROPOSED USE
AREA OF
BOUNDARY
BOUNDARY OF AREA OF PROPOSED USE
COOS BAY
COOS BAY
SIUSLAW NATIONAL FOREST
NATIONAL FOREST
Haynes Inlet
North Spit
Sand Dunes
Sand Dunes
Empire
North Bend
Coos Bay
Eastside
Coos Head
Barview
Gregory Pt.
Cape Arago
Merchants Beach
Jordan Cove
Hauser
Palouse
Slough
Creek
Millington
Glasgow
Russell Pt.
Fossil Pt.
Crawford Pt.
Coaledo
Bay Park
Bunker Hill
Shore Acres
Sunset Lake
Woodland Lake
Horsfall's Lake
Horsfall Lake
Jordan Pt.
Gunckle Pt.
Pierce Pt.
Collier Pt.
Yoakam Pt.
Gregory Pt.
Fossil Pt.
Crawford Pt.
White Pt.
Graveyard Point
Catching Slough
Millington
Coaledo
Coos Bay
Eastside
Bunker Hill
Empire
North Bend
Hauser
Palouse
Glasgow
Russell Pt.
Jordan Cove
Coos Head
Barview
Gregory Pt.
Cape Arago
Merchants Beach
Shore Acres
Sunset Lake
Woodland Lake
Horsfall's Lake
Horsfall Lake
Sand Dunes
Sand Dunes
North Spit
Haynes Inlet
Slough
Creek
Slough
Slough
Slough

RECEIVED
MAY 28 1965
STATE ENGINEER
SALEM, OREGON

CERTIFICATE NO. 52387 Permit No. 30540

*APPLICATION FOR PERMIT

To Appropriate the Public Waters of the State of Oregon

I, Sydney Thomas Roberts (Name of applicant)

of R#2, Box 541A North Bend (Mailing address),

State of Oregon, do hereby make application for a permit to appropriate the following described public waters of the State of Oregon, SUBJECT TO EXISTING RIGHTS:

If the applicant is a corporation, give date and place of incorporation .....

1. The source of the proposed appropriation is Two name (Name of stream) Spring, a tributary of Coos Bay

2. The amount of water which the applicant intends to apply to beneficial use is .01 cubic feet per second. (If water is to be used from more than one source, give quantity from each)

**3. The use to which the water is to be applied is Domestic (Irrigation, power, mining, manufacturing, domestic supplies, etc.)

4. The point of diversion is located ~~750~~ ft. ~~N. 01° 11' W~~ (N. or S.) and ~~630~~ ft. ~~N. 68° 11' W~~ (E. or W.) from the ~~E~~ corner of ~~the same Sec. 12~~ (Section or subdivision)

Well located N 58° 27' W, 1139 feet from E 1/4 Corner Sec 12, T 25 S, R 13 W (If preferable, give distance and bearing to section corner)

(If there is more than one point of diversion, each must be described. Use separate sheet if necessary)

being within the SE 1/4 NE 1/4 (Give smallest legal subdivision) of Sec. 12, Tp. 25 S (N. or S.), R. 13 W (E. or W.), W. M., in the county of Coos

5. The ..... (Main ditch, canal or pipe line) to be ..... (Miles or feet) in length, terminating in the ..... (Smallest legal subdivision) of Sec. ....., Tp. ..... (N. or S.), R. ..... (E. or W.), W. M., the proposed location being shown throughout on the accompanying map.

DESCRIPTION OF WORKS

Diversion Works—

6. (a) Height of dam ..... feet, length on top ..... feet, length at bottom ..... feet; material to be used and character of construction ..... (Loose rock, concrete, masonry, rock and brush, timber crib, etc., wasteway over or around dam)

(b) Description of headgate ..... (Timber, concrete, etc., number and size of openings)

(c) If water is to be pumped give general description ..... (Size and type of pump)

..... (Size and type of engine or motor to be used, total head water is to be lifted, etc.)

*A different form of application is provided where storage works are contemplated.

**Application for permits to appropriate water for the generation of electricity, with the exception of municipalities, must be made to the Hydroelectric Commission. Either of the above forms may be secured, without cost, together with instructions by addressing the State Engineer, Salem, Oregon.

Canal System or Pipe Line—

7. (a) Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line) ..... feet; width on bottom ..... feet; depth of water ..... feet; grade ..... feet fall per one thousand feet.

(b) At ..... miles from headgate: width on top (at water line) ..... feet; width on bottom ..... feet; depth of water ..... feet; grade ....feet fall per one thousand feet.

(c) Length of pipe, ... ft.; size at intake, ... in.; size at ..... ft. from intake ..... in.; size at place of use ..... in.; difference in elevation between intake and place of use, ... ft. Is grade uniform? ..... Estimated capacity, ... sec. ft.

8. Location of area to be irrigated, or place of use .....

Township North or South	Range E. or W. of Willamette Meridian	Section	Forty-acre Tract	Number Acres To Be Irrigated
25S	13W	12	SE¼NE¼	Domestic and garden

(If more space required, attach separate sheet)

(a) Character of soil .....

(b) Kind of crops raised .....

Power or Mining Purposes—

9. (a) Total amount of power to be developed ..... theoretical horsepower.

(b) Quantity of water to be used for power ..... sec. ft.

(c) Total fall to be utilized ..... (Head) feet.

(d) The nature of the works by means of which the power is to be developed .....

.....

(e) Such works to be located in ..... (Legal subdivision) of Sec. ....., Tp. ..... (No. N. or S.), R. ..... (No. E. or W.), W. M.

(f) Is water to be returned to any stream? ..... (Yes or No)

(g) If so, name stream and locate point of return .....

....., Sec. ....., Tp. ..... (No. N. or S.), R. ..... (No. E. or W.), W. M.

(h) The use to which power is to be applied is .....

(i) The nature of the mines to be served .....

Municipal or Domestic Supply—

10. (a) To supply the city of .....

..... County, having a present population of .....
(Name of)

and an estimated population of, ... in 19.....

(b) If for domestic use state number of families to be supplied ..... One .....

(Answer questions 11, 12, 13, and 14 in all cases)

11. Estimated cost of proposed works, $..... 250 .....

12. Construction work will begin on or before ..... Feb 1965 .....

13. Construction work will be completed on or before ..... Aug 30/65 .....

14. The water will be completely applied to the proposed use on or before ..... Aug 30/65 .....

..... Sydney J. Roberts .....
(Signature of applicant)

.....

Remarks: .....

I misunderstood the information I got from the surveyors office in Coquille, and installed two 42" dia. well casings in the spring where it originates on my property. This was for construction purposes, and with your approval, I may have to deepen it another two feet.

STATE OF OREGON, }
County of Marion, } ss.

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for .....

.....

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before ....., 19.....

WITNESS my hand this ..... day of ....., 19.....

.....
STATE ENGINEER

By .....
ASSISTANT

PERMIT

STATE OF OREGON,
County of Marion, } *ss.*

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 0.01 *cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from* a spring

The use to which this water is to be applied is domestic use of one family including the irrigation of not to exceed one-half acre lawn and garden.

If for irrigation, this appropriation shall be limited to - - - - - - - - - *of one cubic foot per second or its equivalent for each acre irrigated*

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is May 28, 1965

Actual construction work shall begin on or before October 22, 1966 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 19*67

*Complete application of the water to the proposed use shall be made on or before October 1, 19*68.

WITNESS my hand this 22nd *day of* October, *19*65.

STATE ENGINEER

pe

Application No. 40941

Permit No. 30540

PERMIT
TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the 28th *day of* May, 1965, *at* 8:00 *o'clock* A *M.*

Returned to applicant:

Approved:
October 22, 1965

Recorded in book No. ..... *of Permits on page* 30540

CHRIS L. WHEELER
STATE ENGINEER

Drainage Basin No. 17 *page* 10H

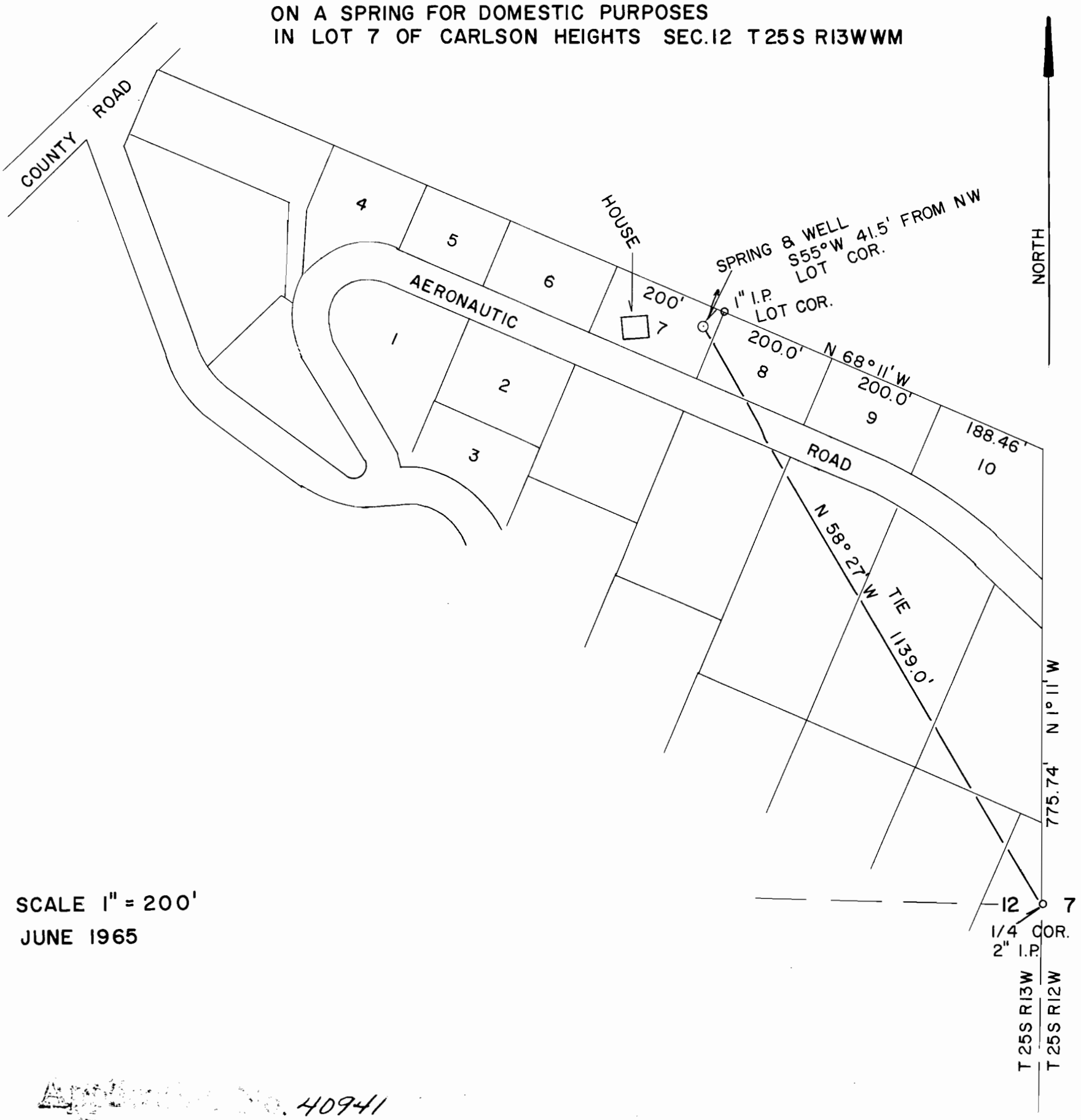
Fees $20.00

State Printing 9137

J1-600-CIK-PLN-DEA-00001-00 Rev. 0

SURVEY MAP FOR WATER RIGHTS FOR SYDNEY T. ROBERTS

ON A SPRING FOR DOMESTIC PURPOSES
IN LOT 7 OF CARLSON HEIGHTS SEC.12 T25S R13WWM



SCALE 1" = 200'
JUNE 1965

Application No. 40941
Permit No. 30540

REGISTERED
OREGON
LAND SURVEYOR
Ronald L Durham
JULY 12, 1963
RONALD L. DURHAM
606

F.L.L.

LEWD CONSULTANTS & SURVEYORS
1.12w 65

APPENDIX C: OPERATIONS AND MAINTENANCE PLAN

Table 1: General Maintenance			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
Annual Visual Inspection and Maintenance	Routine inspection	**Facilities should be inspected annually prior to fall rains**. If appropriate, also inspect the facility after the first significant rain event following dry spell (e.g. the first 24-hour rainfall greater then 0.5 inches after summer)	Identify existing and potential operational problems. Repair damaged components that are critical to the operation of the feature (e.g. flow control valves, liners, underdrains, and pipes) as soon as practical. Schedule routine maintenance such as mowing, sump cleanout, lube moving parts, repairs, etc. If the facility is problematic, schedule additional inspections or maintenance. Repair or replace facility field markers according to Technical Bulletin GE10-01(B). A marked facility has an O&M Plan.
	Maintenance of ancillary structures, if present Examples include • Flow splitter manhole • Diversion manhole • Catch basin • Shut-off valve assembly • Pretreatment or primary treatment manhole • Large detention pipe • Vault • Outfall	Damage or problems are observed or anticipated during the annual inspection.	Grease moving parts to ensure proper operation. Remove sediment from sumps, vaults, catch basins, and structures to prevent the release of oil or sediment. Annual cleaning is recommended. The use of a Vactor® truck is allowed unless prohibited in the facility's O&M manual Repair or replace damaged orifice assembly/riser pipe. Restore to design standards. Be aware of possible confined space requirements. Repair or replace damaged gates, locks, chains, etc that are used to secure valves and access points to prevent vandalism
General	Temporary erosion control hampers maintenance	Erosion control remains from project construction (contractor did not remove)	Contact contractor to complete work OR remove temporary erosion control that is not specified in the O&M Plan.

Table 1: General Maintenance			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
General	Spilled material has entered the pond or structures	Oil, fuel, or other pollutants are evident following a spill event or accident.	Utilize valves or other features, if present, to contain the spilled material. Remove and properly manage spilled material and contaminated soil. Contact Region HazMat or spill response company for spill cleanup assistance where appropriate. Contact a Region Hydraulic Engineer for technical assistance with pond restoration, if necessary.
	Litter (trash and debris)	Trash poses a hazard, inhibits function, or is aesthetically unacceptable (e.g. evidence of dumping).	Remove problematic trash and debris as soon as practical. There should be no evidence of dumping. Remove non-problematic trash in accordance with District litter practices.
	Insects	Insects interfere with maintenance activities.	Implement vector control in accordance with County Health and District practices.
	Vegetation growth (mowing and brushing)	Vegetation growth restricts access, limits sight distance, obstructs water flow, or interferes with maintenance activity.	Mow access, berms, bottom, and side-slopes of the facility as noted in the District Integrated Vegetation Management (IVM) Plan. Remove vegetation in or around grates that obstruct (or could obstruct) flow. Avoid mowing or removing vegetation that does not need to be controlled. Avoid removing vegetation too low to the ground. NOTE: Removing vegetation too near to the ground may result in scalping of the soil, unwanted damaged to vegetation, or growth of unwanted plant species. Heavy equipment is allowed within aboveground water quality and detention facilities unless access restrictions are listed in the O&M Manual.

Table 1: General Maintenance			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
	Noxious weed growth	Control of noxious weeds is required by law or prescribed in the District IVM Plan	Remove noxious weeds in accordance with the District IVM Plan. Follow Environmental Protection Agency (EPA) label and ODOT policies on herbicide usage.
General	Hazard trees	Trees are found to be weakened, unsound, undermined, leaning, or exposed and may fall across the highway	Remove hazard trees as soon as practical. Where appropriate, consult an ODOT Forester for help identifying or removing hazard trees.
	Tree growth	Tree growth restricts access, obstructs function, jeopardizes infrastructure, or interferes with maintenance actions.	Prune or remove as needed to maintain access, function, and tree health. Manage potentially problematic woody material before the trees reach 6 inches diameter at breast height (DBH). Consult an ODOT Forester for the removal or management of trees greater than 6 inches DBH. Obtain permits where appropriate. Refer to the District IVM Plan for the management of smaller trees. Avoid removing trees that will not interfere with the operation or maintenance of the facility.

Table 3: Maintenance of Water Quality or Biofiltration Swales

Swales should provide even sheet flow that moves water from the inlet to the outlet.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Follow applicable Guidance from Table 1 AND applicable guidance from this table.		
	Vegetation growth (mowing and brushing)	Vegetation growth restricts access, limits sight distance, obstructs water flow, or interferes with maintenance activity. **Swales should be mowed annually.**	Mow access, berms, swale, and side-slopes as noted in the District Integrated Vegetation Management (IVM) Plan. The use of heavy equipment is allowed unless access restrictions are listed in the O&M Manual.
Swale Components	Sediment accumulation in pre-treatment areas or ancillary structures (e.g. manholes)	Sediment affects flow. Sediment jeopardizes infrastructure.	Remove sediment that prevents adequate drainage into swale. Use methods that minimize disturbance to surrounding vegetation. The use of heavy equipment is allowed unless access restrictions are listed in the O&M Manual. Sediment may contain oil and other pollutants, especially in areas with high ADT. Refer to the ODOT Maintenance Environmental Management System (EMS) Manual for the disposal of contaminated sediment. Note: Pollutant concentrations may increase if sediment is not routinely removed.
	Sediment accumulation along swale bottom	Sediment inhibits the flow of water through the grass (e.g. water is ponding or cutting a channel).	Remove sediment from grassy areas. The use of a Vactor® truck is allowed unless access restrictions are listed in the O&M Manual. Restore slope and geometry to design standards, if necessary. Reseed grass cover where needed. Stormwater should infiltrate or flow toward outlet once inflow has ceased.

Table 3: Maintenance of Water Quality or Biofiltration Swales

Swales should provide even sheet flow that moves water from the inlet to the outlet.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Swale Components	Erosion	Side slopes show evidence of erosion greater than 2 inches deep and the potential for continued erosion is evident.	Promptly address erosion that causes immediate problems (e.g. damage to highway or highway structure) Schedule non-urgent repairs with routine work. Stabilize slope using appropriate erosion control and repair methods. Repair the cause of the erosion where possible. If necessary, contact the ODOT Erosion Control Coordinator to evaluate the condition.
	Poor vegetation coverage	Vegetation (grass) is sparse or eroded patches occur in more than 10 percent of swale. NOTE: A single incident (e.g. vehicle accident) typically effects less than 10 percent of the area and is unlikely to trigger a repair.	Repair and reseed as appropriate to restore coverage. Install erosion control measures as needed. Trim overhanging limbs and remove brushy vegetation that limit grass growth (provide too much shade).
	Missing or eroded amended soil mix	Bare soil is observed over 10 percent of the amended area.	Identify and resolve erosion problem Add amended soil. Contact a Region Hydraulics Engineer for required material specifications.
	Amended soil mix along swale bottom is clogged	Standing water is observed for seven (7) consecutive days or longer from May through October.	Remove and replace amended soil mix. Contact a Region Hydraulics Engineer for required material specifications. Replace or repair damaged underlying drainage geotextile, impermeable liner, drain piping, and granular drain backfill material when applicable.
	Granular drain backfill material for underdrain pipe plugged	Amended soil mix has been replaced and standing water is still observed for seven (7) consecutive days or longer from May through October.	Remove and replace granular drain backfill material. Contact a Region Hydraulics Engineer for required material specifications. Install new drainage geotextile over new granular drain backfill material. Replace amended soil mix.

Table 3: Maintenance of Water Quality or Biofiltration Swales

Swales should provide even sheet flow that moves water from the inlet to the outlet.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Swale Components	Impermeable liner damage NOTE: Liners may not be visible. If present, liners are typically below the grass surface along the bottom of the swale Fabric wrapped around underdrains is not a liner.	Liner is damaged (e.g. during sediment removal or by motoring public). Liner is damaged when condition allows potential contamination to be released to the subsurface.	Repair or replace the liner with similar material. Replace top soil and grass as appropriate. Features with liners, typically have maintenance option limitations; check the O&M Manual. If necessary, contact a Region Hydraulics Engineer for technical assistance.
	Obstruction or blockage of pipes	Water does not flow in, through, or out of the swale.	Remove obstructions to restore flow (e.g. remove trash, debris, sediment, or vegetation as necessary). Jet rodders may be used to clean piping unless specifically prohibited in the O&M plan.
	Flow spreader is uneven or clogged	Water does not flow evenly across the structure	Clean sump or forebay as needed to maintain capacity. Clean or repair spreader as needed to provide a uniform flow and prevent erosion. Level portions of the flow spreader that have settled.

Table 4: Filter Strips

Filter strips should provide even sheet flow that moves water from edge of pavement toward a downslope conveyance.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Follow applicable Guidance from Table 1 AND applicable guidance from this table.		
	Vegetation growth (mowing and brushing)	Vegetation growth restricts access, limits sight distance, obstructs water flow, or interferes with maintenance activity. **Filter strips should be mowed annually.**	Mow as noted in the District Integrated Vegetation Management (IVM) Plan. The use of heavy equipment is allowed unless access restrictions are listed in the O&M Manual.
Filter Strip Components	Sediment accumulation	Sediment inhibits the flow of water through the grass (e.g. water is ponding or cutting a channel).	Remove sediment from grassy areas. The use of a Vactor® truck is allowed unless access restrictions are listed in the O&M Manual. Restore slope and geometry to design standards, if necessary. Reseed grass cover where needed.
	Missing or eroded amended soil mix	Bare soil is observed over 10 percent of the amended area.	Identify and resolve erosion problem Add amended soil. Contact a Region Hydraulics Engineer for required material specifications.
	Amended soil mix is clogged	Standing water is observed for seven (7) consecutive days or longer from May through October.	Remove and replace amended soil mix. Contact a Region Hydraulics Engineer for required material specifications. Replace or repair damaged underlying drainage geotextile, impermeable liner, drain piping, and granular drain backfill material when applicable.
	Flow spreader is uneven or clogged	Water does not flow evenly across the structure	Clean or repair spreader as needed to provide a uniform flow and prevent erosion. Level portions of the flow spreader that have settled.
	Erosion or rutting	Areas have eroded or channelized due to high flows or vehicular damage	Repair, regrade, and reseed (as needed) to restore uniform flow across grass.
	Poor vegetation coverage	Vegetation (grass) is sparse or eroded patches occur in more than 10% of the strip. NOTE: A single incident is unlikely to trigger a repair.	Repair and reseed as appropriate to restore coverage. Install erosion control measures as needed.

CONTECH®
ENGINEERED SOLUTIONS

StormFilter Inspection and Maintenance Procedures



The Stormwater Management StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. **Inspection**
   - Inspection of the vault interior to determine the need for maintenance.
2. **Maintenance**
   - Cartridge replacement
   - Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.



In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..



Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to weather or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)

1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
   a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.



Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

   Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.



Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood and float.

D. At location under structure access, tip the cartridge on its side.

E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

F. Set the empty, used cartridge aside or load onto the hauling truck.

G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.







Inspection Report

Date: Personnel:

Location: System Size:

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: Date:

Sediment Depth on Vault Floor:

Structural Damage:

Estimated Flow from Drainage Pipes (if available):

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water:

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal:

☐ Minor Structural Repairs:

☐ Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source:

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source:

Erosion of Landscaped Areas: Yes ☐ No ☐ Source:

Items Needing Further Work:

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Months in Service:

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

RECYCLED PAPER

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ENGINEERED SOLUTIONS

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OPERATION AND MAINTENANCE

CatchBasin StormFilter™

Important: These guidelines should be used as a part of your site stormwater plan.

Overview

The CatchBasin StormFilter™ (CBSF) consists of a multi-chamber steel, concrete, or plastic catch basin unit that can contain up to four StormFilter cartridges. The steel CBSF is offered both as a standard and as a deep unit.

The CBSF is installed flush with the finished grade and is applicable for both constrained lot and retrofit applications. It can also be fitted with an inlet pipe for roof leaders or similar applications.

The CBSF unit treats peak water quality design flows up to 0.13 cfs, coupled with an internal weir overflow capacity of 1.0 cfs for the standard unit, and 1.8 cfs for the deep steel and concrete units. Plastic units have an internal weir overflow capacity of 0.5 cfs.

Design Operation

The CBSF is installed as the primary receiver of runoff, similar to a standard, grated catch basin. The steel and concrete CBSF units have an H-20 rated, traffic bearing lid that allows the filter to be installed in parking lots, and for all practical purposes, takes up no land area. Plastic units can be used in landscaped areas and for other non-traffic-bearing applications.

The CBSF consists of a sumped inlet chamber and a cartridge chamber(s). Runoff enters the sumped inlet chamber either by sheet flow from a paved surface or from an inlet pipe discharging directly to the unit vault. The inlet chamber is equipped with an internal baffle, which traps debris and floating oil and grease, and an overflow weir. While in the inlet chamber, heavier solids are allowed to settle into the deep sump, while lighter solids and soluble pollutants are directed under the baffle and into the cartridge chamber through a port between the baffle and the overflow weir.

Once in the cartridge chamber, polluted water ponds and percolates horizontally through the media in the filter cartridges. Treated water collects in the cartridge's center tube from where it is directed by an under-drain manifold to the outlet pipe on the downstream side of the overflow weir and discharged.

When flows into the CBSF exceed the water quality design value, excess water spills over the overflow weir, bypassing the cartridge bay, and discharges to the outlet pipe.

Applications

The CBSF is particularly useful where small flows are being treated or for sites that are flat and have little available hydraulic head to spare. The unit is ideal for applications in which standard catch basins are to be used. Both water quality and catchment issues can be resolved with the use of the CBSF.

Retro-Fit

The retrofit market has many possible applications for the CBSF. The CBSF can be installed by replacing an existing catch basin without having to "chase the grade," thus reducing the high cost of re piping the storm system.

© 2013 Contech Engineered Solutions

CatchBasin StormFilter™

Maintenance Guidelines

Maintenance procedures for typical catch basins can be applied to the CatchBasin StormFilter (CBSF). The filter cartridges contained in the CBSF are easily removed and replaced during maintenance activities according to the following guidelines.

1. Establish a safe working area as per typical catch basin service activity.
2. Remove steel grate and diamond plate cover (weight 100 lbs. each).
3. Turn cartridge(s) counter-clockwise to disconnect from pipe manifold.
4. Remove 4” center cap from cartridge and replace with lifting cap.
5. Remove cartridge(s) from catch basin by hand or with vactor truck boom.
6. Remove accumulated sediment via vactor truck (min. clearance 13” x 24”).
7. Remove accumulated sediment from cartridge bay. (min. clearance 9.25” x 11”).
8. Rinse interior of both bays and vactor remaining water and sediment.
9. Install fresh cartridge(s) threading clockwise to pipe manifold.
10. Replace cover and grate.
11. Return original cartridges to Contech for cleaning.

Media may be removed from the filter cartridges using the vactor truck before the cartridges are removed from the catch basin structure. Empty cartridges can be easily removed from the catch basin structure by hand. Empty cartridges should be reassembled and returned to Contech as appropriate.

Materials required include a lifting cap, vactor truck and fresh filter cartridges. Contact Contech for specifications and availability of the lifting cap. The vactor truck must be equipped with a hose capable of reaching areas of restricted clearance. the owner may refresh spent cartridges. Refreshed cartridges are also available from Contech on an exchange basis. Contact the maintenance department of Contech at 503-258-3157 for more information.

Maintenance is estimated at 26 minutes of site time. For units with more than one cartridge, add approximately 5 minutes for each additional cartridge. Add travel time as required.

Mosquito Abatement

In certain areas of the United States, mosquito abatement is desirable to reduce the incidence of vectors.

In BMPs with standing water, which could provide mosquito breeding habitat, certain abatement measures can be taken.

1. Periodic observation of the standing water to determine if the facility is harboring mosquito larvae.
2. Regular catch basin maintenance.
3. Use of larvicides containing Bacillus thuringiensis israelensis (BTI). BTI is a bacterium toxic to mosquito and black fly larvae.

In some cases, the presence of petroleum hydrocarbons may interrupt the mosquito growth cycle.

Using Larvicides in the CatchBasin StormFilter

Larvicides should be used according to manufacturer’s recommendations.

Two widely available products are Mosquito Dunks and Summit B.t.i. Briquets. For more information, visit http://www.summitchemical.com/mos_ctrl/d efault.htm.

The larvicide must be in contact with the permanent pool. The larvicide should also be fastened to the CatchBasin StormFilter by string or wire to prevent displacement by high flows. A magnet can be used with a steel catch basin.

For more information on mosquito abatement in stormwater BMPs, refer to the following: http://www.ucmrp.ucdavis.edu/publications/managingmosquitoesstormwater8125.pdf

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APPENDIX D: WATER QUALITY CALCULATIONS

Project: Jordan Cove Energy Project - Trans Pacific Parkway
Stormwater Management Plan **By:** NNP
Water Quality Facility Calculations **Date:** 2/28/2019

Design Storm:

2-Year Storm Event = WQ (3.5 in)
10-Year Storm Event (4.7 in)
25-Year Storm Event (5.5 in)
50-Year Storm Event (6.1 in)
100-Year Storm Event (6.75 in)

Basin Information

Basin	HP to HP	Drainage Area (ft^2)	Drainage Area (acres)	Surfacing	Weighted CN	Time of Concentration (min)
TPP - 1	TPP Sta.291+89 to Sta.293+56	3,345	0.08	Paved w/ curb	98	5
TPP - 2	TPP Sta.293+56 to Sta.296+85	10,044	0.23	Paved w/ curb	98	5
TPP - 3	TPP Sta.296+85 to Sta.299+95	13,424	0.31	Paved w/ curb	98	5
Total		**26,813**	**0.62**			

HydroCAD Analysis Output for Design Events:

Basin	W.Q. Discharge (cfs)	W.Q. Discharge (gpm)	W.Q. Volume (cf)	10-year Discharge (cfs)	25-Year Discharge (cfs)	50-Year Discharge (cfs)	100-Year Discharge (cfs)
TPP - 1	**0.06**	27	913	0.09	0.10	0.11	0.12
TPP - 2	**0.19**	85	2,734	0.26	0.30	0.33	0.37
TPP - 3	**0.25**	112	3,654	0.34	0.40	0.45	0.49
Total	**0.50**	**224**	**7,301**	**0.69**	**0.80**	**0.89**	**0.98**

Cartridge Flow Rates - Contech StormFilter

Type	Hydraulic Drop (ft)	Treatment Capcity (gpm)	
		2 gpm/ft^2	1 gpm/ft^2
27"	3.05	22.5	11.3
18"	2.3	15.0	7.5

Cartridge Size Requirements - Per Basin

Basin	27" - 2gpm Capacity	27" - 1gpm Capacity	18"- 2gpm Capacity	18"- 1gpm Capacity
TPP - 1	2	2	2	4
TPP - 2	4	8	6	12
TPP - 3	5	10	8	15

Manning Pipe Flow Calculations - Outfall Sizing

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad n = 0.013 \qquad A = \pi\left(\frac{D}{2}\right)^2 \qquad R = \frac{A}{P} = \frac{\pi\left(\frac{D}{2}\right)^2}{2\pi\left(\frac{D}{2}\right)} \qquad S = 2.9\left(\frac{3n}{D^{2/3}}\right)^2$$

Pipe Size	A (ft^2)	R (ft)	S (min)	Q (cfs)
12" Dia.	0.79	0.25	0.0044	2.37

Project: Jordan Cove Energy Project -APCO Site 2
Stormwater Management Plan
Water Quality Facility Calculations

By: NNP
Date: 2/28/2019

Design Storm:

2-Year Storm Event = WQ (3.6 in)
10-Year Storm Event (4.9 in)
25-Year Storm Event (5.7 in)
50-Year Storm Event (6.3 in)
100-Year Storm Event (6.9 in)

Basin Information

Basin	HP to HP	Drainage Area (ft^2)	Drainage Area (acres)	Surfacing	Weighted CN	Time of Concentration (min)
APCO-BR-1	Bridge Span North side	1965.00	0.05	Paved	98	5
APCO-BR-2	Bridge Span South side	1965.00	0.05	Paved	98	5
Total		**3,930**	**0.10**			

HydroCAD Analysis Output for Design Events:

Basin	W.Q. Peak Discharge (cfs)	W.Q. Peak Discharge (gpm)	W.Q. Total Volume (cf)	10-year Discharge (cfs)	25-year Discharge (cfs)	50-year Discharge (cfs)	100-year Discharge (cfs)
APCO-BR-1	0.04	18	551	0.05	0.06	0.07	0.07
APCO-BR-2	0.04	18	551	0.05	0.06	0.07	0.07
Total	**0.08**	**36**	**1,102**	**0.10**	**0.12**	**0.14**	**0.14**

Water Quality Design

Infiltrate water quality event in the amended soil strip
Infiltration rate of amended soil is from ODOT at 9in/hr

Basin	Amended Soil Length (ft)	Amended Soil Width (ft)	Amended Soil Area (sqft)	Infiltration of Amended Soil (in/hr)	Infiltration of Amended Soil (ft/s)	W.Q. Peak Discharge (cfs)	Required Amended Soil Area (sqft)
APCO-BR-1	30	6.5	195	9	0.00021	0.04	192
APCO-BR-2	30	6.5	195	9	0.00021	0.04	192

100-year Velocity Check with Broad Crest Wier Equation

Check 100-year event for errosive velocities

Basin	Length (ft)	Discharge (cfs)	H (Depth) (ft)	q (cfs/ft)	Velocity (fps)
APCO-BR-1	30	0.07	0.01	0.002	0.24
APCO-BR-2	30	0.07	0.01	0.002	0.24

$$q = 2.4H^{3/2}$$

Where:
q= Volumetric flow rate per unit length, cfs/ft
H= Depth of flow over weir

Soils are silty sand, assuming average particle size of 0.05mm the permissible velocity is 0.65fps
Chow, 1959, Open Channel Hydraulics

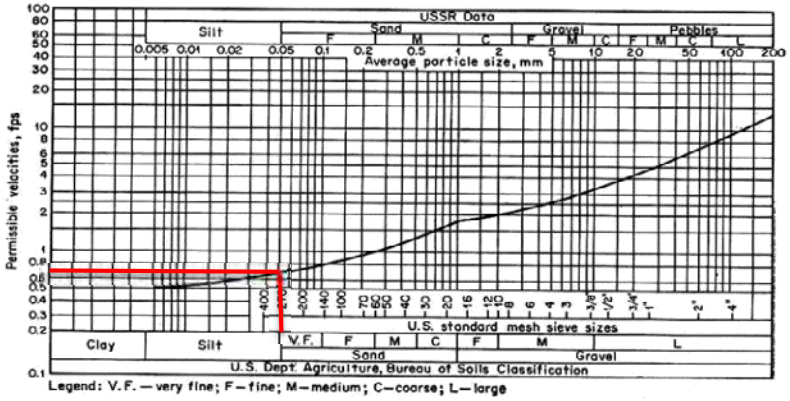


FIG. 7-3. U.S. and U.S.S.R. data on permissible velocities for noncohesive soils.

Project: Jordan Cove Energy Project - Kentuck East Bay Road
Stormwater Management Plan **By:** NNP
Water Quality Facility Calculations **Date:** 2/28/2019

Design Storm:

2-Year Storm Event = WQ (3.6 in)
10-Year Storm Event (4.9 in)
25-Year Storm Event (5.7 in)
50-Year Storm Event (6.3 in)
100-Year Storm Event (6.9 in)

Basin Information

Basin	HP to HP	Drainage Area (ft^2)	Drainage Area (acres)	Surfacing	Weighted CN	Time of Concentration (min)	Treatment
EBR-1	EB Sta.10+03 to Sta.11+14	2,642	0.06	Paved w/ curb	98	5	Filter Strip
EBR-2	EB Sta.9+52 to Sta.10+69	5,693	0.13	Paved w/ curb	98	5	Filter Strip
EBR-3	EB Sta.10+69 to Sta.13+91	11,334	0.26	Paved w/o curb	98	5	Filter Strip
EBR-4	EB Sta.13+91 to Sta.15+19	2,024	0.05	Paved w/ curb	98	5	Contech StormFilter
EBR-5	EB Sta.13+91 to Sta.15+19	2,080	0.05	Paved w/ curb	98	5	Contech StormFilter
EBR-6	EB Sta.15+19 to Sta.16+23	1,970	0.05	Paved w/ curb	98	5	Contech StormFilter
EBR-7	EB Sta.15+19 to Sta.17+46	5,708	0.13	Paved w/ curb	98	5	Contech StormFilter
EBR-8	EB Sta.17+46 to Sta.18+38	2,838	0.07	Paved w/ curb	98	5	Contech StormFilter
EBR-9	EB Sta.18+38 to Sta.19+67	5,397	0.12	Paved w/ curb	98	5	Contech StormFilter
Total		**39,686**	**0.92**				

HydroCAD Analysis Output for Design Events:

Basin	W.Q. Discharge (cfs)	W.Q. Discharge (gpm)	W.Q. Volume (cf)	10-year Discharge (cfs)	25-Year Discharge (cfs)	50-Year Discharge (cfs)	100-Year Discharge (cfs)
EBR-1	0.05	22	733	0.07	0.08	0.09	0.10
EBR-2	0.11	49	1,588	0.15	0.18	0.19	0.21
EBR-3	0.22	99	3,177	0.30	0.35	0.39	0.43
EBR-4	0.04	18	611	0.06	0.07	0.07	0.08
EBR-5	0.04	18	611	0.06	0.07	0.07	0.08
EBR-6	0.04	18	611	0.06	0.07	0.07	0.08
EBR-7	0.11	49	1,588	0.15	0.18	0.19	0.21
EBR-8	0.05	22	794	0.08	0.09	0.10	0.11
EBR-9	0.10	45	1,466	0.14	0.16	0.18	0.20
Total	**0.76**	**341**	**11,179**	**1.07**	**1.25**	**1.35**	**1.50**

Project: Jordan Cove Energy Project - Kentuck East Bay Road
Stormwater Management Plan
Water Quality Facility Calculations

By: NNP
Date: 2/28/2019

Cartridge Flow Rates - Contech StormFilter

Type	Hydraulic Drop (ft)	Treatment Capcity (gpm)	
		2 gpm/ft^2	1 gpm/ft^2
27"	3.05	22.5	11.3
18"	2.3	15.0	7.5

Cartridge Size Requirements - Per Basin

Basin	Facility ID	27" - 2gpm Capacity	27" - 1gpm Capacity	18"- 2gpm Capacity	18"- 1gpm Capacity
EBR-4&5	**"EB" 13+92**	2	4	3	5
EBR-6	**"EB" 15+21 Lt.**	1	2	2	3
EBR-7	**"EB" 15+21 Rt.**	3	5	4	7
EBR-8	**"EB" 18+41**	1	2	2	3
EBR-9	**"EB" 19+65**	2	4	3	6

Manning Pipe Flow Calculations - Outfall Sizing

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad n = 0.013 \qquad A = \pi\left(\frac{D}{2}\right)^2 \qquad R = \frac{A}{P} = \frac{\pi\left(\frac{D}{2}\right)^2}{2\pi\left(\frac{D}{2}\right)} \qquad S = 2.9\left(\frac{3n}{D^{2/3}}\right)^2$$

Pipe Size	A (ft^2)	R (ft)	S (min)	Q (cfs)
12" Dia.	0.79	0.25	0.0044	2.37

Project: Jordan Cove Energy Project - Kentuck East Bay Road
Stormwater Management Plan
Water Quality Facility Calculations

By: NNP
Date: 2/28/2019

Water Quality Design

Infiltrate water quality event in the amended soil strip
Infiltration rate of amended soil is from ODOT at 9in/hr

Basin	Amended Soil Length (ft)	Amended Soil Width (ft)	Amended Soil Area (sqft)	Infiltration of Amended Soil (in/hr)	Infiltration of Amended Soil (ft/s)	W.Q. Peak Discharge (cfs)	Required Amended Soil Area (sqft)
EBR-1 EBR-2 EBR-3	215	12	2580	6	0.00014	0.38	2736

100-year Velocity Check with Broad Crest Wier Equation

Check 100-year event for errosive velocities

Basin	Length (ft)	Discharge (cfs)	H (Depth) (ft)	q (cfs/ft)	Velocity (fps)
EBR-1 EBR-2 EBR-3	215	0.74	0.01	0.003	0.27

$$q = 2.4H^{3/2}$$

Where:
q= Volumetric flow rate per unit length, cfs/ft
H= Depth of flow over weir

Soils are fill sand, with fine to medium grain with a permissible velocity is 1.0fps
Chow, 1959, Open Channel Hydraulics

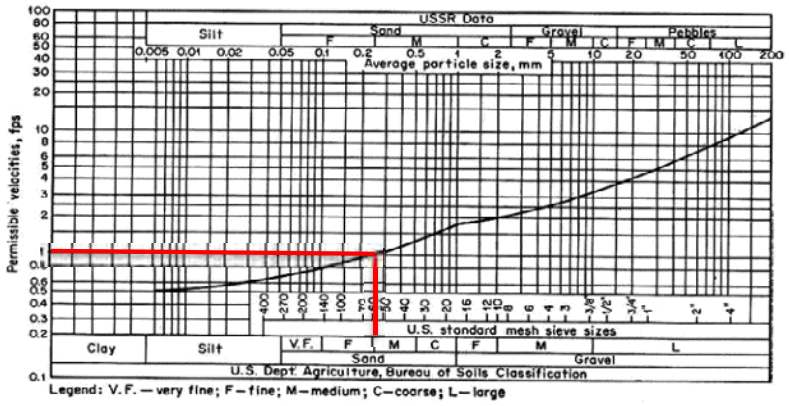


FIG. 7-3. U.S. and U.S.S.R. data on permissible velocities for noncohesive soils.

Project: Jordan Cove Energy Project - Kentuck Golf Course Lane
Stormwater Management Plan **By:** NNP
Water Quality Facility Calculations **Date:** 2/28/2019

Design Storm:

2-Year Storm Event = WQ (3.6 in)
10-Year Storm Event (4.9 in)
25-Year Storm Event (5.7 in)
50-Year Storm Event (6.3 in)
100-Year Storm Event (6.9 in)

Basin Information

Basin	HP to HP	Drainage Area (ft^2)	Drainage Area (acres)	Surfacing	Weighted CN	Time of Concentration (min)	Treatment
GCL-1	GC Sta.20+63 to Sta.25+79	8,980	0.21	Paved w/ curb	98	5	Swale
GCL-2	GC Sta.25+79 to Sta.28+76	4,755	0.11	Paved w/ curb	98	5	Swale
GCL-3	GC Sta.28+76 to Sta.33+11	6,967	0.16	Paved w/ curb	98	5	Swale
GCL-4	GC Sta.33+11 to Sta.35+22	3,365	0.08	Paved w/ curb	98	5	Contech StormFilters
GCL-5	GC Sta.35+22 to Sta.40+89	9,489	0.22	Paved w/ curb	98	5	Contech StormFilters
Total		**33,556**	**0.78**				

HydroCAD Analysis Output for Design Events:

Basin	W.Q. Discharge (cfs)	W.Q. Discharge (gpm)	W.Q. Volume (cf)	10-year Discharge (cfs)	25-Year Discharge (cfs)	50-Year Discharge (cfs)	100-Year Discharge (cfs)
GCL-1	**0.18**	81	2,566	0.24	0.28	0.31	0.34
GCL-2	**0.09**	40	1,344	0.13	0.15	0.16	0.18
GCL-3	**0.13**	58	1,955	0.19	0.22	0.24	0.26
GCL-4	**0.07**	31	978	0.09	0.11	0.12	0.13
GCL-5	**0.19**	85	2688	0.25	0.30	0.33	0.36
Total	**0.66**	**180**	**9,531**	**0.90**	**1.06**	**1.16**	**1.27**

Cartridge Flow Rates - Contech StormFilter

Type	Hydraulic Drop (ft)	Treatment Capcity (gpm)	
		2 gpm/ft^2	1 gpm/ft^2
27"	3.05	22.5	11.3
18"	2.3	15.0	7.5

Cartridge Size Requirements - Per Basin

Basin	Facility ID	27" - 2gpm Capacity	27" - 1gpm Capacity	18"- 2gpm Capacity	18"- 1gpm Capacity
GCL-4	**"GC" 35+20**	2	3	3	5
GCL-5	**"GC" 35+63**	4	8	6	12

Water Quality Swale Design

Basin	W.Q. Discharge (cfs)	Swale Bottom Width (ft)	Swale Length (ft)	Swale Slope (%)	Velocity (ft/s)	Residence Time (min)	Depth (ft)
GCL-1	0.18	4	320	0.53%	0.16	33	0.25
GCL-2	0.09	4	247	0.74%	0.14	29	0.15
GCL-3	0.13	4	209	0.50%	0.14	25	0.21

Minimum residence time of 9min and a max WQ depth of 0.50ft

Project: Jordan Cove Energy Project - Kentuck Golf Course Lane
Stormwater Management Plan
Water Quality Facility Calculations

By: NNP
Date: 2/28/2019

Manning Pipe Flow Calculations - Outfall Sizing

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad n = 0.013 \qquad A = \pi \left(\frac{D}{2}\right)^2 \qquad R = \frac{A}{P} = \frac{\pi \left(\frac{D}{2}\right)^2}{2\pi \left(\frac{D}{2}\right)} \qquad S = 2.9 \left(\frac{3n}{D^{2/3}}\right)^2$$

Pipe Size	A (ft^2)	R (ft)	S (min)	Q (cfs)
12" Dia.	0.79	0.25	0.0044	2.37

Project: Jordan Cove Energy Project - Kentuck Access, Trail and Levee
Stormwater Management Plan **By:** NNP
Water Quality Facility Calculations **Date:** 2/28/2019

Design Storm:

2-Year Storm Event = WQ (3.6 in)
10-Year Storm Event (4.9 in)
25-Year Storm Event (5.7 in)
50-Year Storm Event (6.3 in)
100-Year Storm Event (6.9 in)

Basin Information

Basin	Segment	Drainage Area (ft^2)	Drainage Area (acres)	Surfacing	Weighted CN	Time of Concentration (min)	Treatment
KT-1	Kentuck Trail	30,592	0.70	Paved w/o curb	98	5	No Treatment
KL-1	Kentuck Levee	73,906	1.70	Gravel w/o curb	90	5	No Treatment
KA-1	Kentuck Access and Parking	1,216	0.03	Gravel w/o curb	90	5	Swale
KA-2	Kentuck Access and Parking	8,279	0.19	Gravel w/o curb	90	5	Swale

HydroCAD Analysis Output for Design Events:

Basin	W.Q. Discharge (cfs)	W.Q. Discharge (gpm)	W.Q. Volume (cf)	10-year Discharge (cfs)	25-Year Discharge (cfs)	50-Year Discharge (cfs)	100-Year Discharge (cfs)
KT-1	**0.59**	265	8,553	0.81	0.94	1.05	1.15
KL-1	**1.11**	498	15,685	1.66	2.00	2.26	2.52
KA-1	**0.02**	9	277	0.03	0.04	0.04	0.04
KA-2	**0.12**	54	1,753	0.19	0.22	0.25	0.28
KA Total	**0.14**	63	2,030	0.22	0.26	0.29	0.32

Water Quality Swale Design

Basin	W.Q. Discharge (cfs)	Swale Bottom Width (ft)	Swale Length (ft)	Swale Slope (%)	Velocity (ft/s)	Residence Time (min)	Depth (ft)
KA-1	0.02	4	100	2.50%	0.12	14	0.04
KA-2	0.12	4	145	2.00%	0.22	11	0.13

Minimum residence time of 9min and a max WQ depth of 0.50ft

Worksheet for GCL-1 Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.240	
Channel Slope	0.53000	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	0.18	ft³/s

Results

Normal Depth	0.25	ft
Flow Area	1.11	ft²
Wetted Perimeter	5.10	ft
Hydraulic Radius	0.22	ft
Top Width	4.99	ft
Critical Depth	0.04	ft
Critical Slope	2.49829	ft/ft
Velocity	0.16	ft/s
Velocity Head	0.00	ft
Specific Energy	0.25	ft
Froude Number	0.06	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.04	ft
Channel Slope	0.53000	%

Worksheet for GCL-1 Swale

GVF Output Data

Critical Slope	2.49829	ft/ft

Worksheet for GCL-2 Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.240	
Channel Slope	0.74000	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	0.09	ft³/s

Results

Normal Depth	0.15	ft
Flow Area	0.64	ft²
Wetted Perimeter	4.66	ft
Hydraulic Radius	0.14	ft
Top Width	4.59	ft
Critical Depth	0.02	ft
Critical Slope	2.89838	ft/ft
Velocity	0.14	ft/s
Velocity Head	0.00	ft
Specific Energy	0.15	ft
Froude Number	0.07	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.15	ft
Critical Depth	0.02	ft
Channel Slope	0.74000	%

Worksheet for GCL-2 Swale

GVF Output Data

Critical Slope	2.89838	ft/ft

Worksheet for GCL-3 Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.240	
Channel Slope	0.50000	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	0.13	ft³/s

Results

Normal Depth	0.21	ft
Flow Area	0.91	ft²
Wetted Perimeter	4.93	ft
Hydraulic Radius	0.19	ft
Top Width	4.83	ft
Critical Depth	0.03	ft
Critical Slope	2.67005	ft/ft
Velocity	0.14	ft/s
Velocity Head	0.00	ft
Specific Energy	0.21	ft
Froude Number	0.06	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.03	ft
Channel Slope	0.50000	%

Worksheet for GCL-3 Swale

GVF Output Data

Critical Slope	2.67005	ft/ft

Worksheet for KA-1 Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.240	
Channel Slope	2.50000	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	0.02	ft^3/s

Results

Normal Depth	0.04	ft
Flow Area	0.17	ft^2
Wetted Perimeter	4.19	ft
Hydraulic Radius	0.04	ft
Top Width	4.17	ft
Critical Depth	0.01	ft
Critical Slope	3.99044	ft/ft
Velocity	0.12	ft/s
Velocity Head	0.00	ft
Specific Energy	0.04	ft
Froude Number	0.10	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.04	ft
Critical Depth	0.01	ft
Channel Slope	2.50000	%

Worksheet for KA-1 Swale

GVF Output Data

Critical Slope	3.99044	ft/ft

Worksheet for KA-2 Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.240	
Channel Slope	2.00000	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	0.12	ft³/s

Results

Normal Depth	0.13	ft
Flow Area	0.56	ft²
Wetted Perimeter	4.59	ft
Hydraulic Radius	0.12	ft
Top Width	4.52	ft
Critical Depth	0.03	ft
Critical Slope	2.72706	ft/ft
Velocity	0.22	ft/s
Velocity Head	0.00	ft
Specific Energy	0.13	ft
Froude Number	0.11	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.13	ft
Critical Depth	0.03	ft
Channel Slope	2.00000	%

Worksheet for KA-2 Swale

GVF Output Data

Critical Slope	2.72706	ft/ft

Summary for Subcatchment 5S: TPP-1

[49] Hint: Tc<2dt may require smaller dt

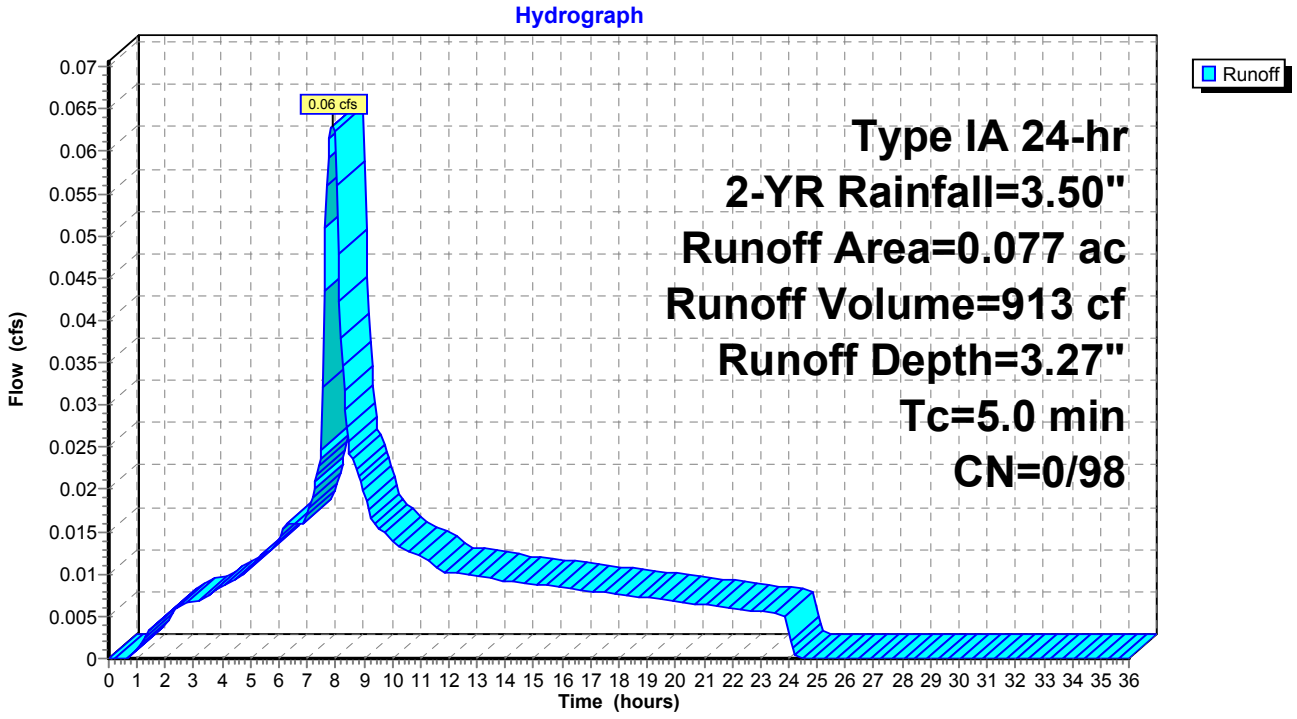
Runoff = 0.06 cfs @ 7.90 hrs, Volume= 913 cf, Depth= 3.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.50"

	Area (ac)	CN	Description
*	0.077	98	
	0.077	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: TPP-1



Summary for Subcatchment 6S: TPP-2

[49] Hint: Tc<2dt may require smaller dt

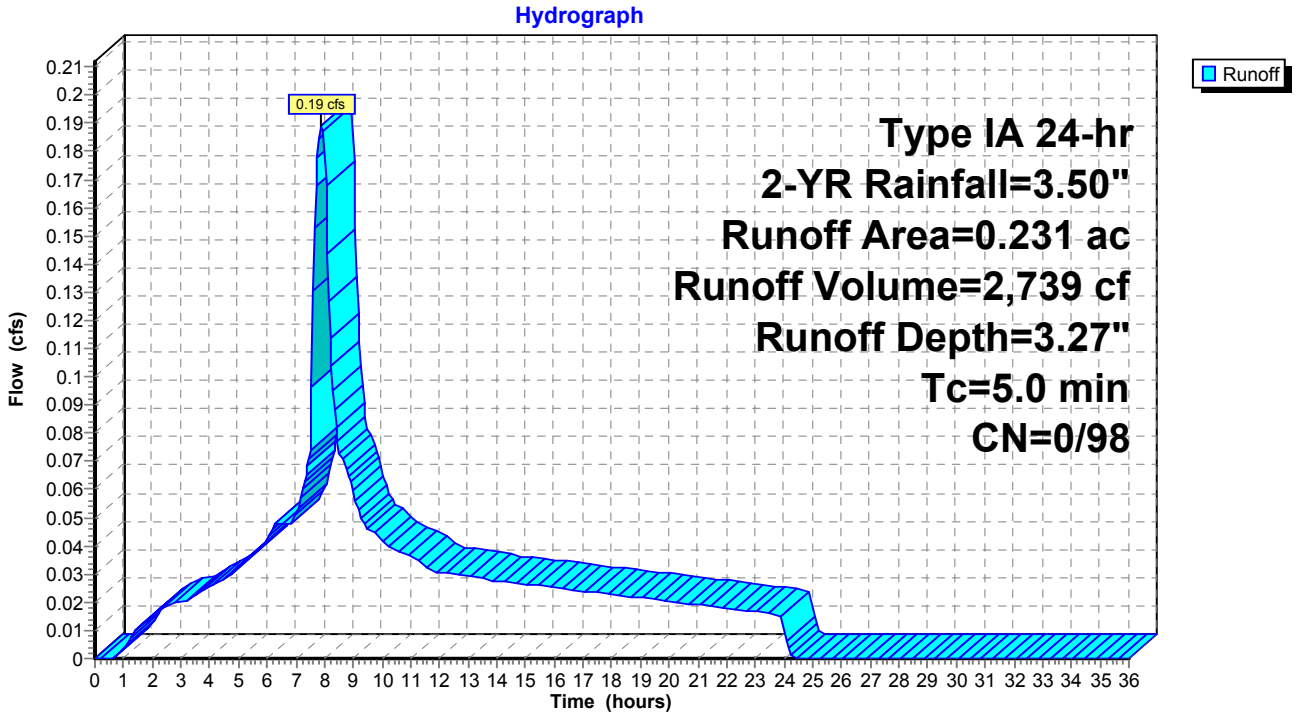
Runoff = 0.19 cfs @ 7.90 hrs, Volume= 2,739 cf, Depth= 3.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.50"

	Area (ac)	CN	Description
*	0.231	98	
	0.231	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: TPP-2



Summary for Subcatchment 7S: TPP-3

[49] Hint: Tc<2dt may require smaller dt

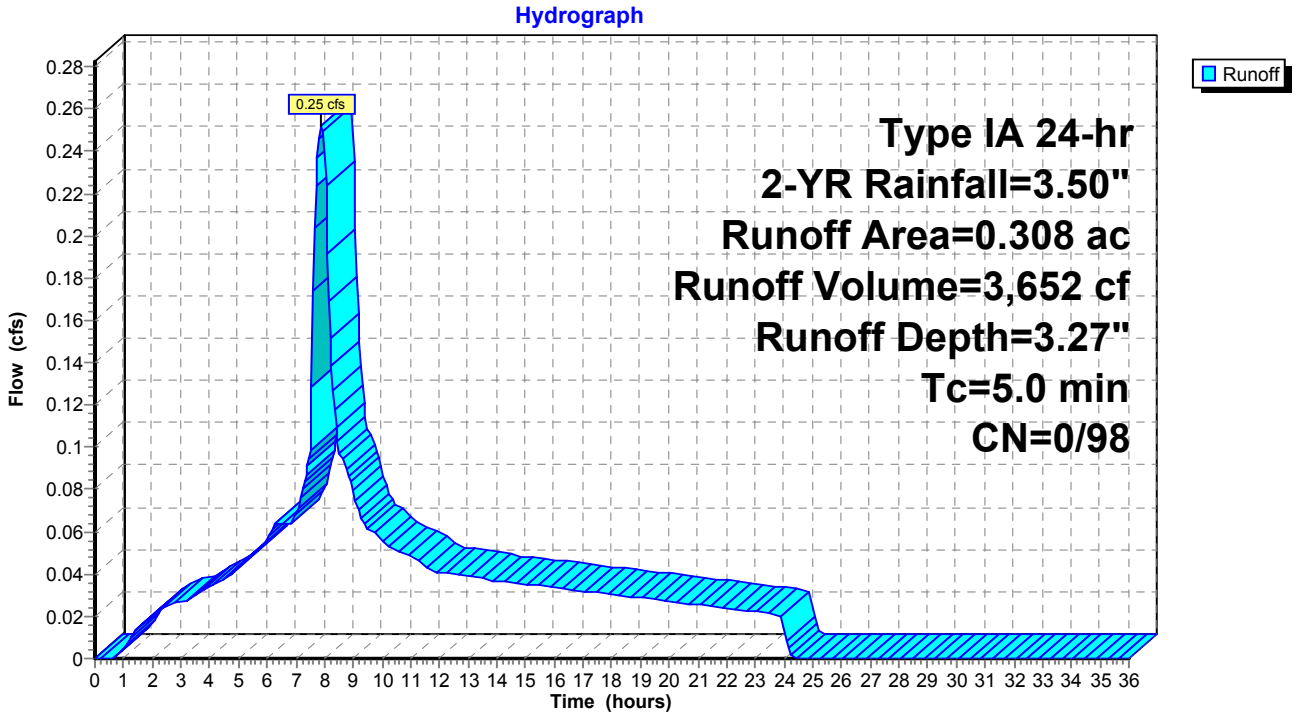
Runoff = 0.25 cfs @ 7.90 hrs, Volume= 3,652 cf, Depth= 3.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.50"

	Area (ac)	CN	Description
*	0.308	98	
	0.308	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7S: TPP-3



Summary for Subcatchment 5S: TPP-1

[49] Hint: Tc<2dt may require smaller dt

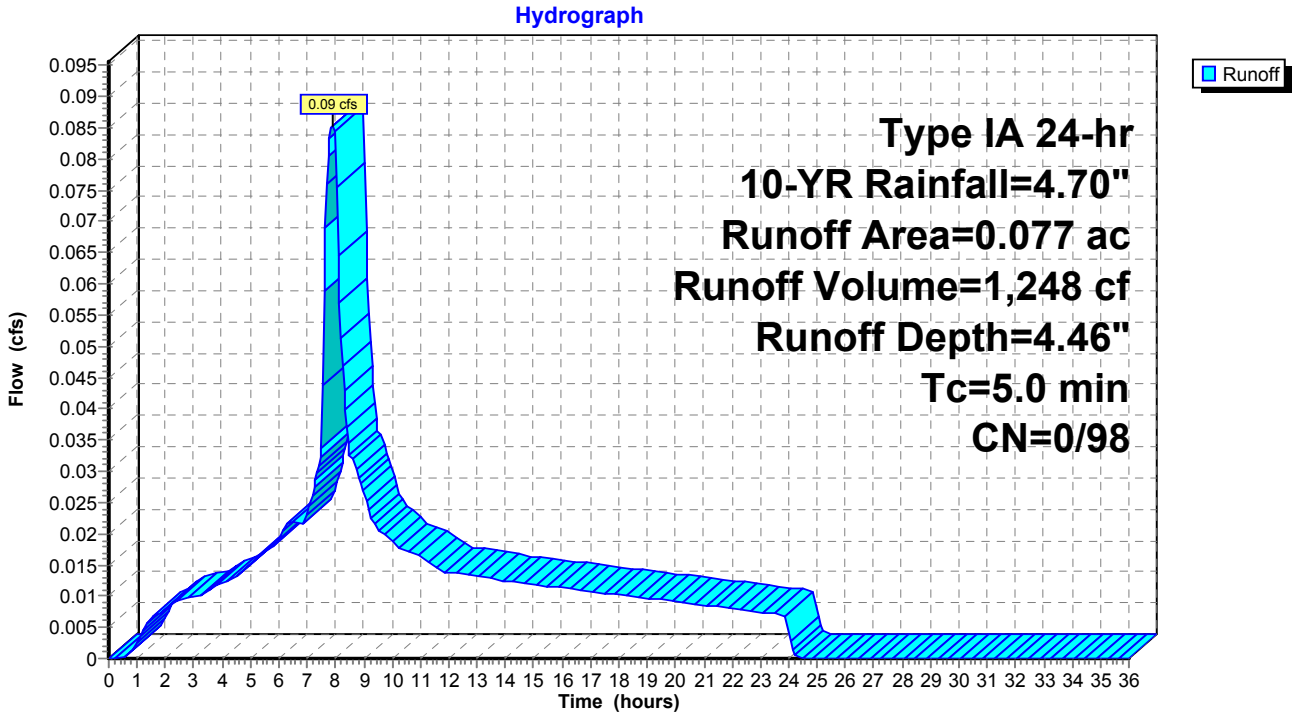
Runoff = 0.09 cfs @ 7.90 hrs, Volume= 1,248 cf, Depth= 4.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.70"

	Area (ac)	CN	Description
*	0.077	98	
	0.077	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: TPP-1



Summary for Subcatchment 6S: TPP-2

[49] Hint: Tc<2dt may require smaller dt

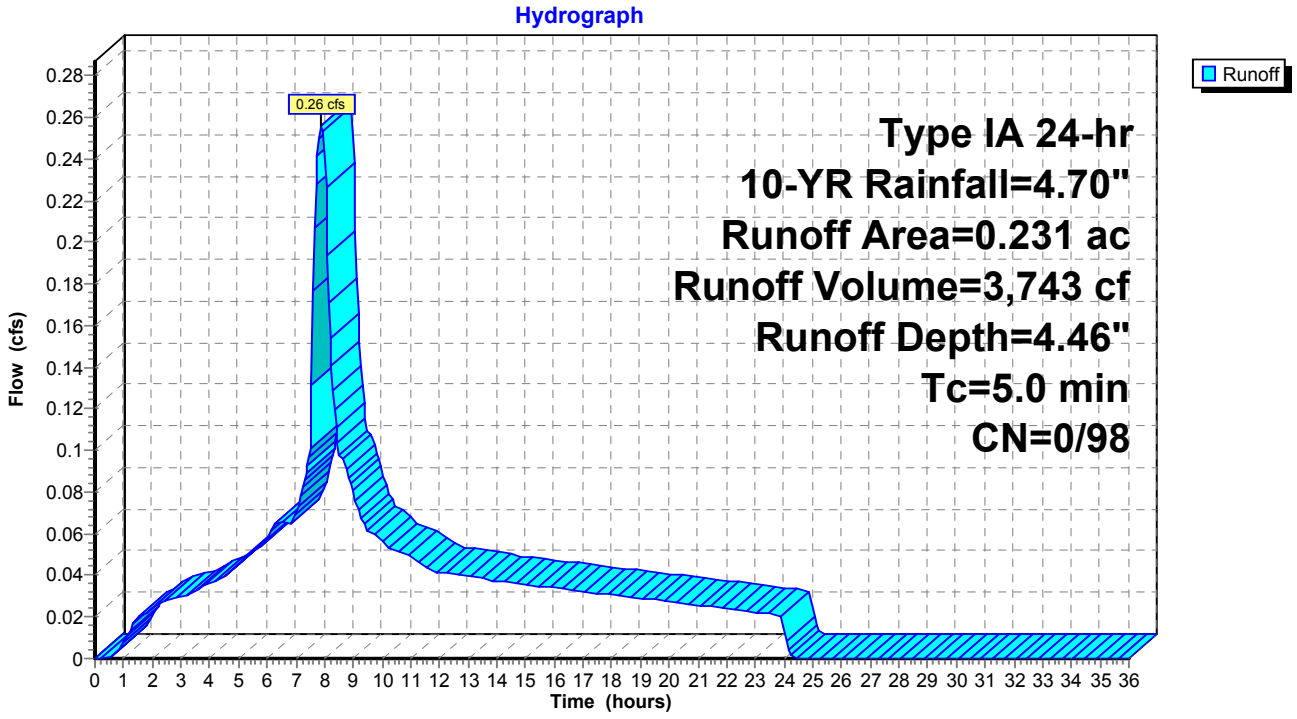
Runoff = 0.26 cfs @ 7.90 hrs, Volume= 3,743 cf, Depth= 4.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.70"

	Area (ac)	CN	Description
*	0.231	98	
	0.231	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: TPP-2



Summary for Subcatchment 7S: TPP-3

[49] Hint: Tc<2dt may require smaller dt

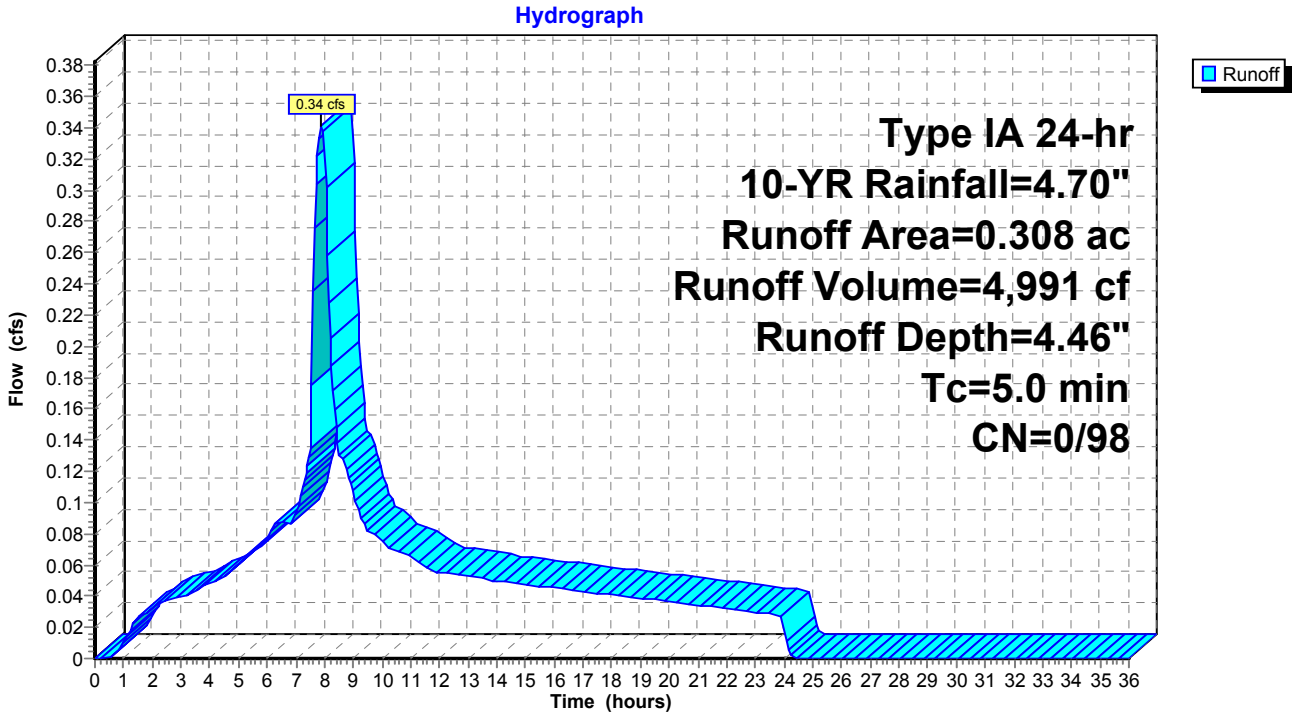
Runoff = 0.34 cfs @ 7.90 hrs, Volume= 4,991 cf, Depth= 4.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.70"

	Area (ac)	CN	Description
*	0.308	98	
	0.308	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7S: TPP-3



Summary for Subcatchment 5S: TPP-1

[49] Hint: Tc<2dt may require smaller dt

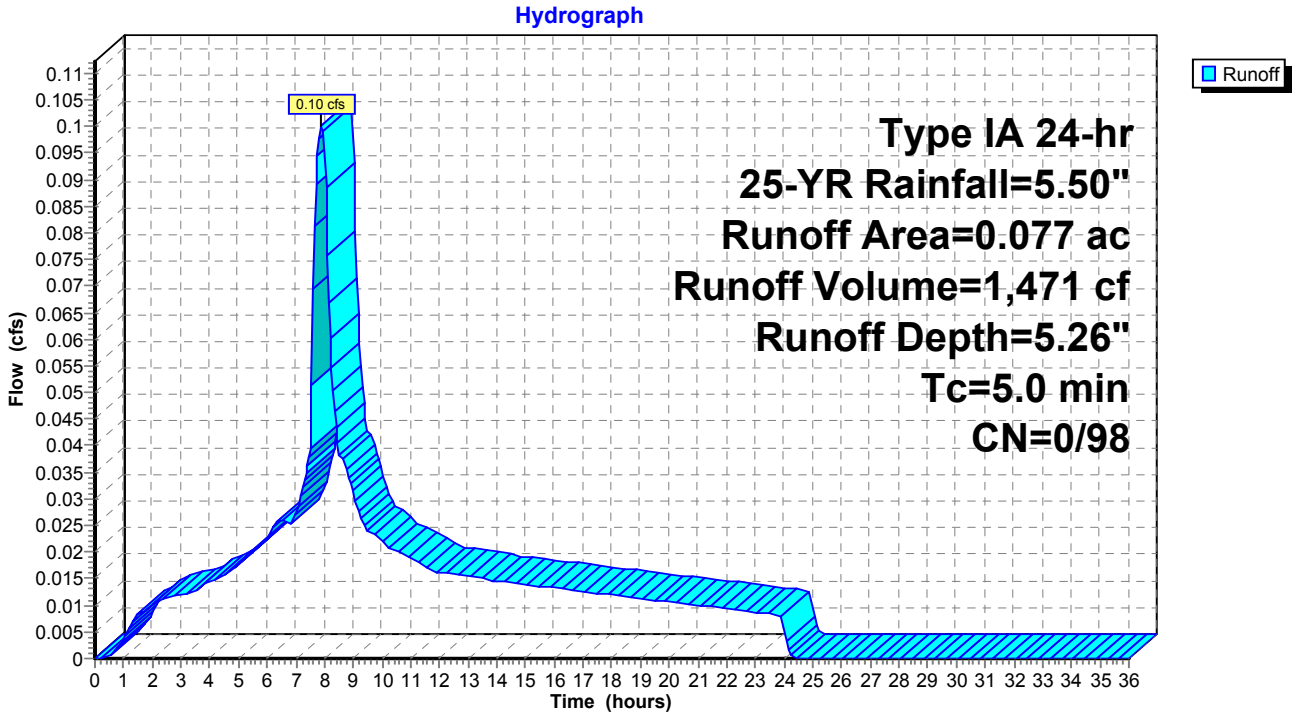
Runoff = 0.10 cfs @ 7.89 hrs, Volume= 1,471 cf, Depth= 5.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.50"

	Area (ac)	CN	Description
*	0.077	98	
	0.077	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: TPP-1



Summary for Subcatchment 6S: TPP-2

[49] Hint: Tc<2dt may require smaller dt

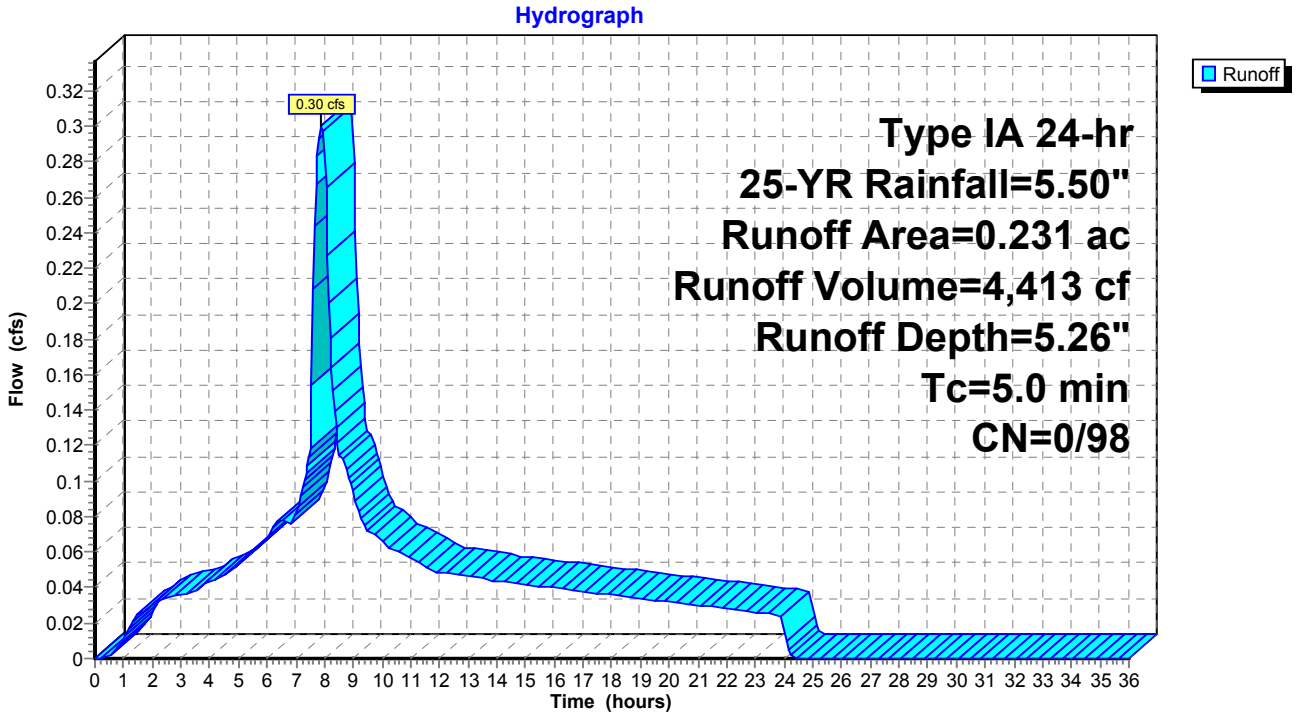
Runoff = 0.30 cfs @ 7.89 hrs, Volume= 4,413 cf, Depth= 5.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.50"

	Area (ac)	CN	Description
*	0.231	98	
	0.231	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: TPP-2



Summary for Subcatchment 7S: TPP-3

[49] Hint: Tc<2dt may require smaller dt

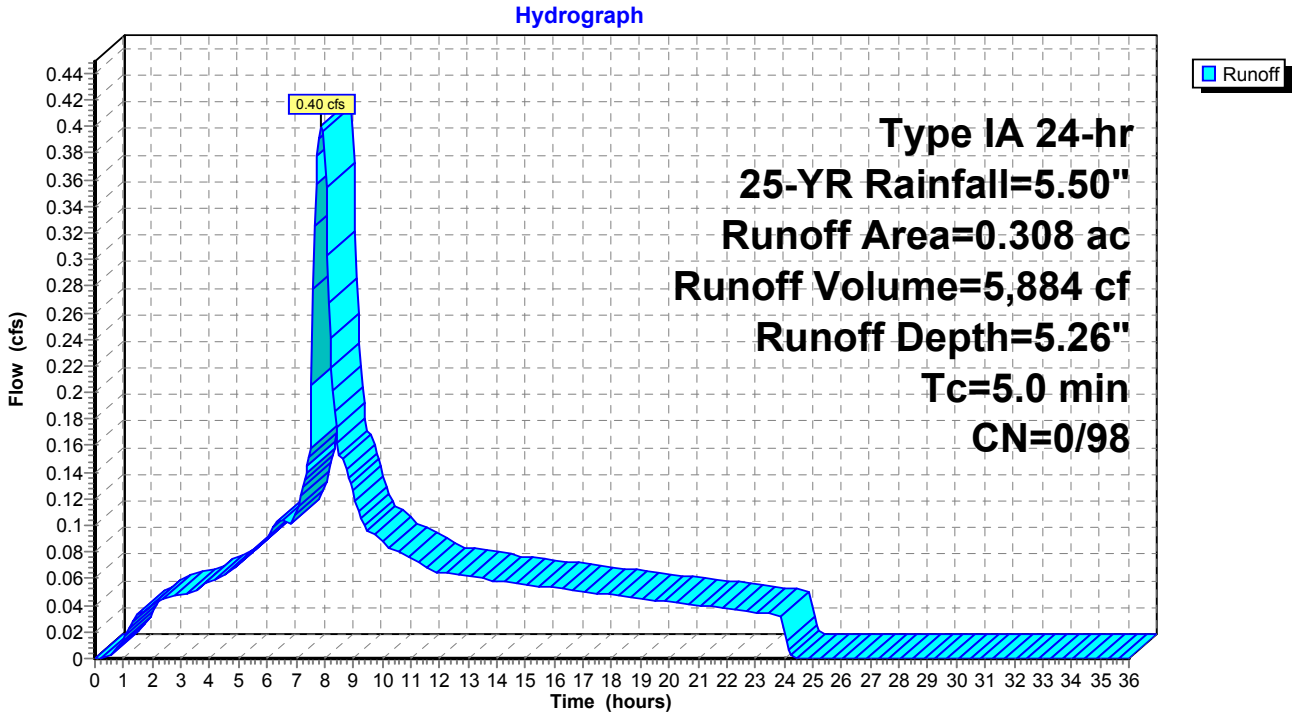
Runoff = 0.40 cfs @ 7.89 hrs, Volume= 5,884 cf, Depth= 5.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.50"

	Area (ac)	CN	Description
*	0.308	98	
	0.308	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7S: TPP-3



Summary for Subcatchment 5S: TPP-1

[49] Hint: Tc<2dt may require smaller dt

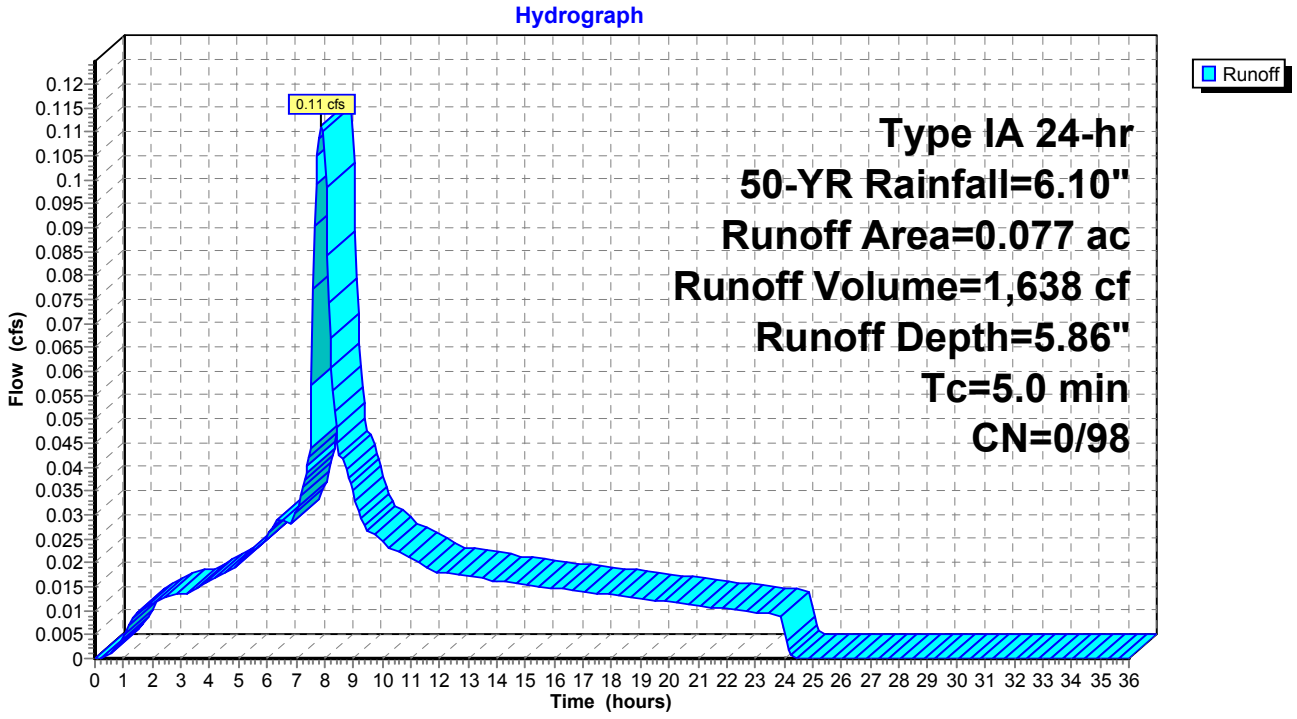
Runoff = 0.11 cfs @ 7.89 hrs, Volume= 1,638 cf, Depth= 5.86"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.10"

	Area (ac)	CN	Description
*	0.077	98	
	0.077	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: TPP-1



Summary for Subcatchment 6S: TPP-2

[49] Hint: Tc<2dt may require smaller dt

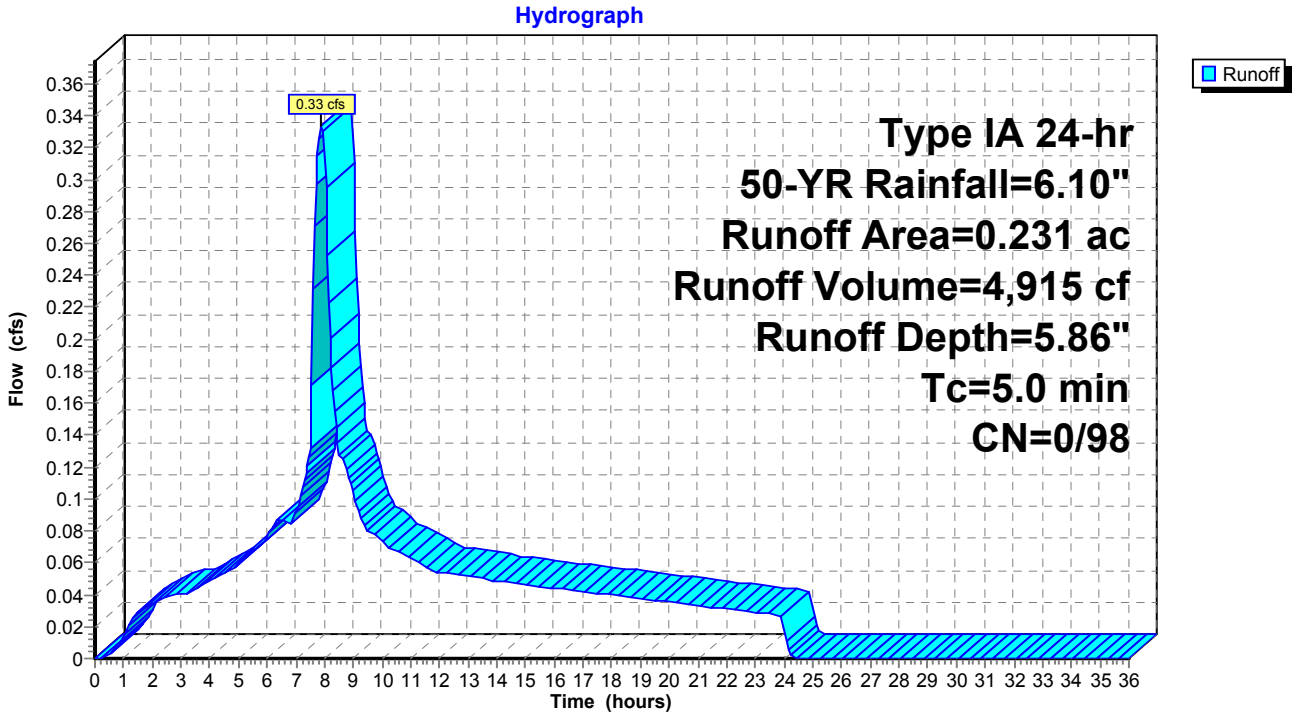
Runoff = 0.33 cfs @ 7.89 hrs, Volume= 4,915 cf, Depth= 5.86"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.10"

	Area (ac)	CN	Description
*	0.231	98	
	0.231	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: TPP-2



Summary for Subcatchment 7S: TPP-3

[49] Hint: Tc<2dt may require smaller dt

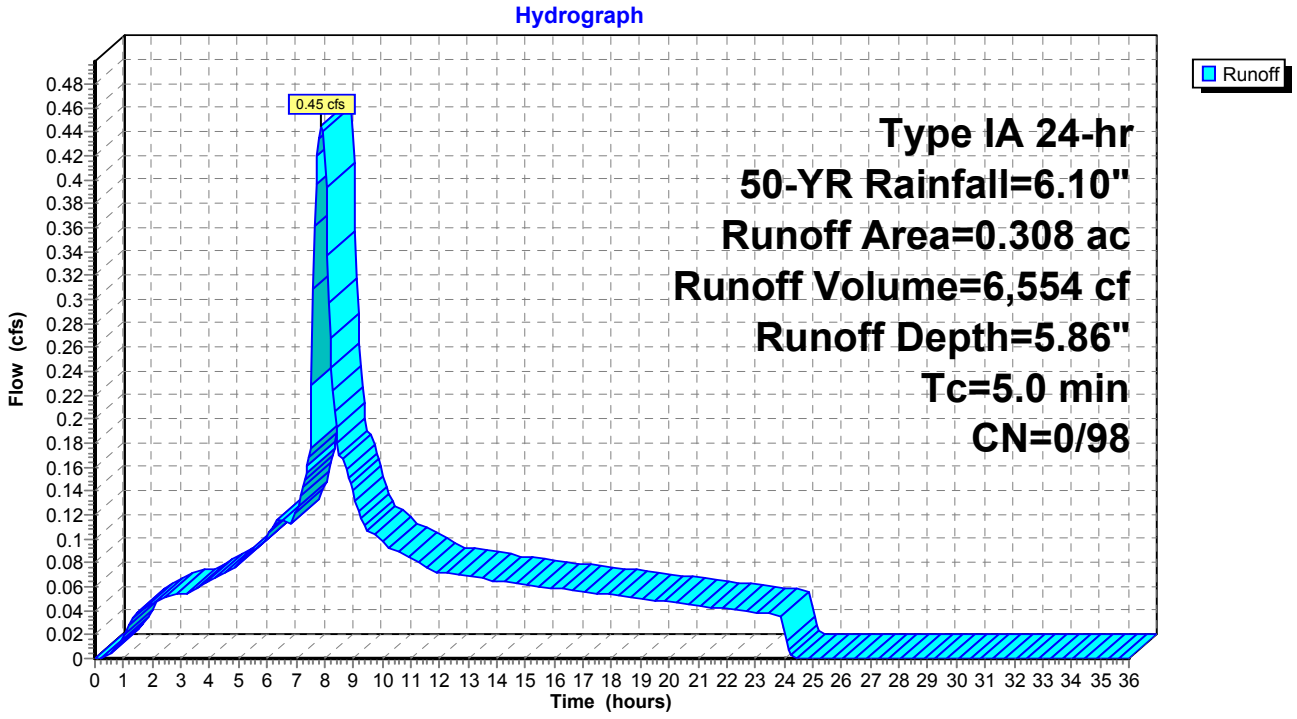
Runoff = 0.45 cfs @ 7.89 hrs, Volume= 6,554 cf, Depth= 5.86"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.10"

	Area (ac)	CN	Description
*	0.308	98	
	0.308	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7S: TPP-3



Summary for Subcatchment 5S: TPP-1

[49] Hint: Tc<2dt may require smaller dt

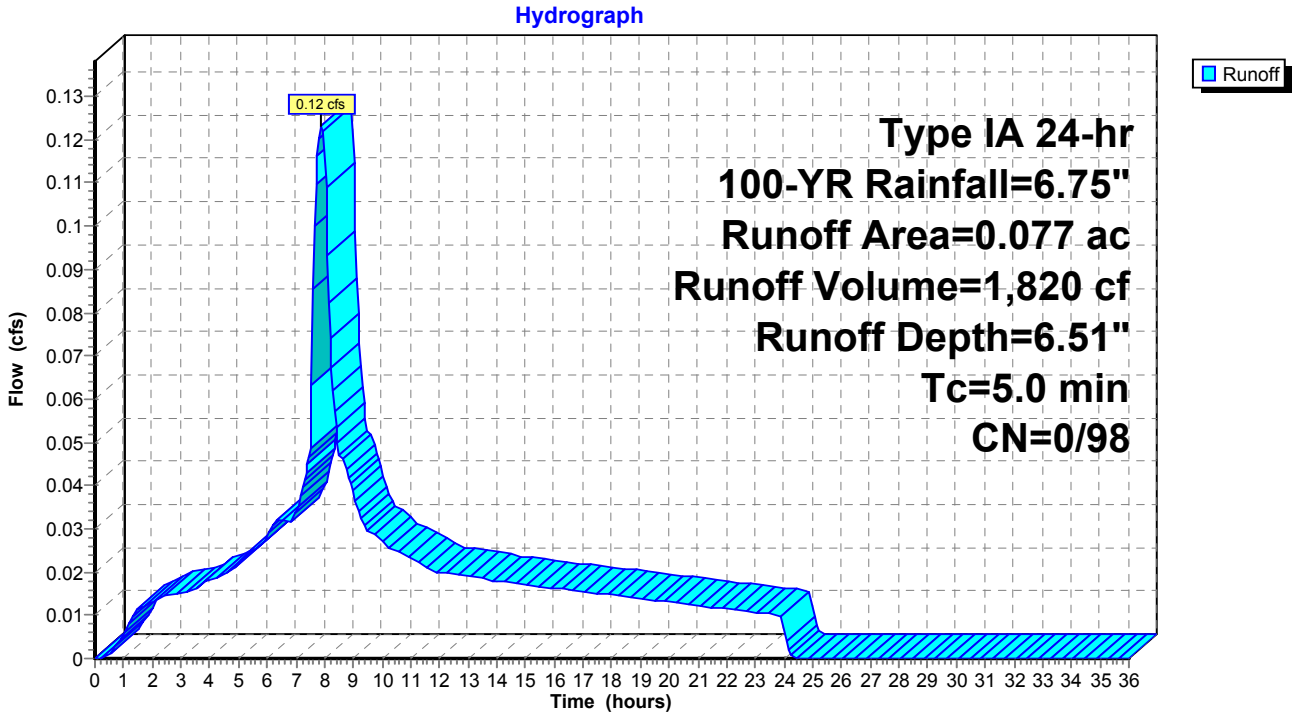
Runoff = 0.12 cfs @ 7.89 hrs, Volume= 1,820 cf, Depth= 6.51"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.75"

	Area (ac)	CN	Description
*	0.077	98	
	0.077	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: TPP-1



Summary for Subcatchment 6S: TPP-2

[49] Hint: Tc<2dt may require smaller dt

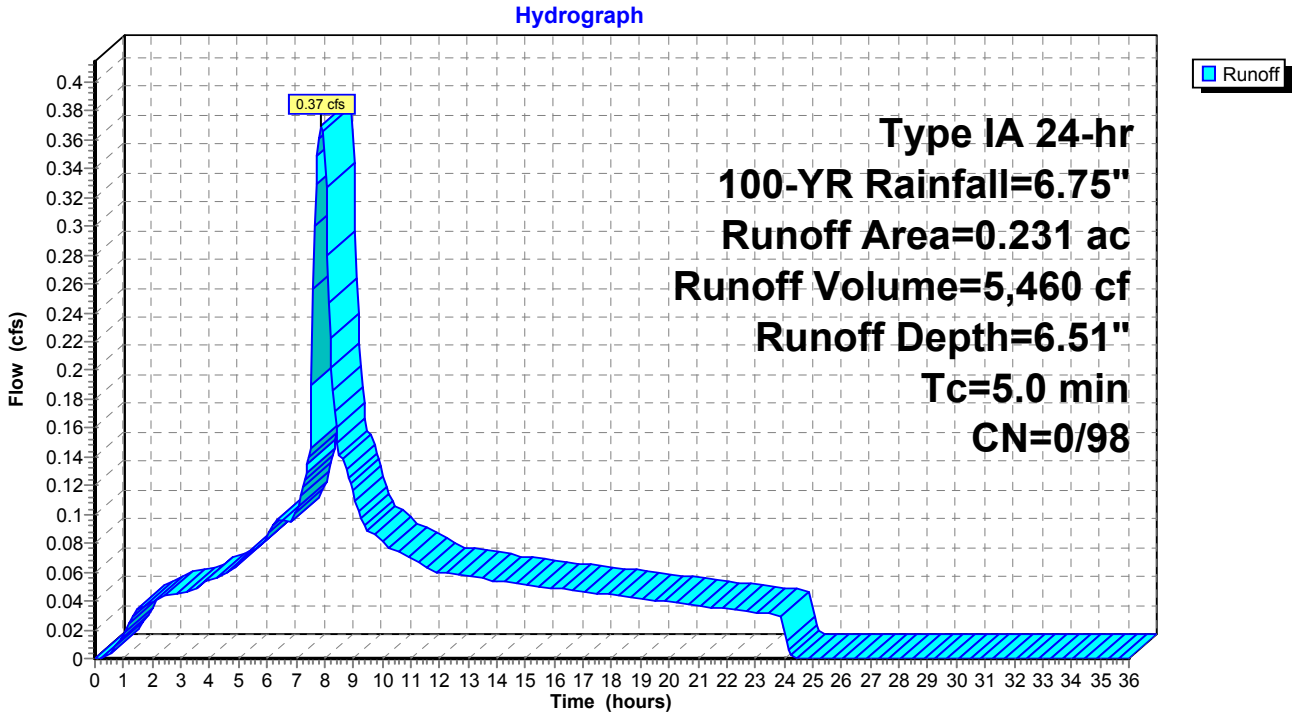
Runoff = 0.37 cfs @ 7.89 hrs, Volume= 5,460 cf, Depth= 6.51"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.75"

	Area (ac)	CN	Description
*	0.231	98	
	0.231	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: TPP-2



Summary for Subcatchment 7S: TPP-3

[49] Hint: Tc<2dt may require smaller dt

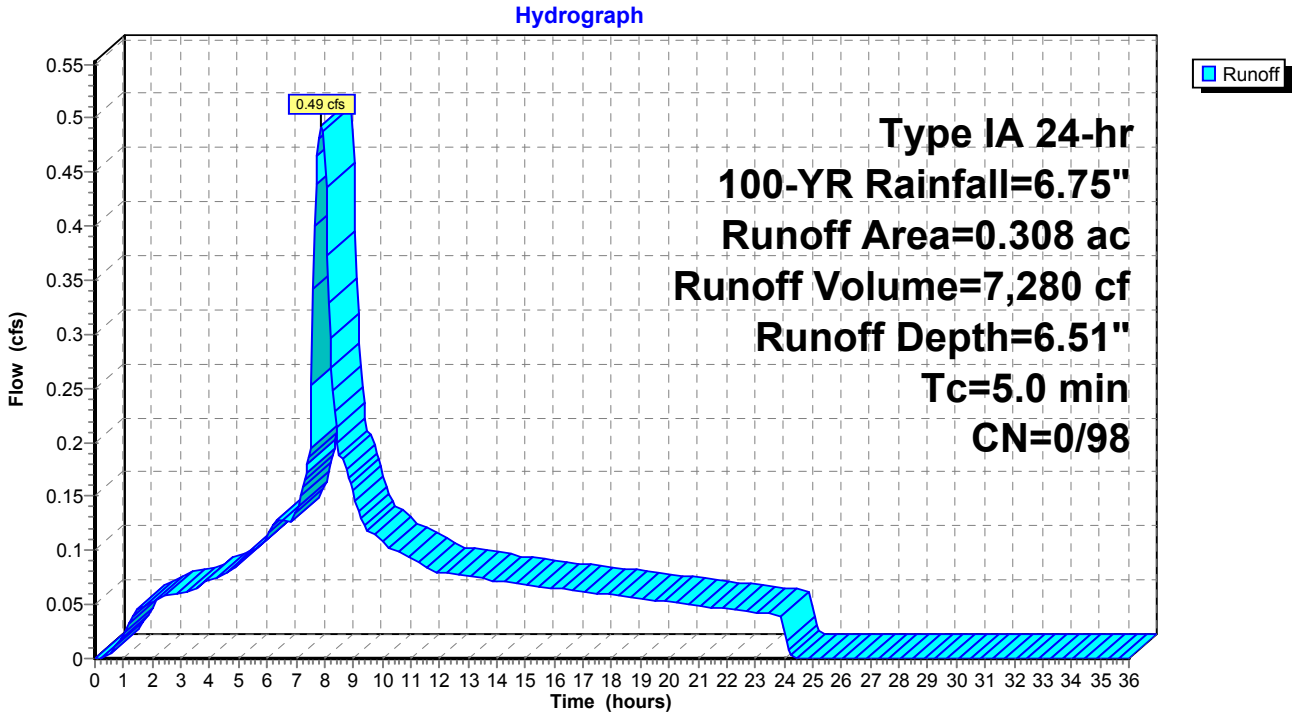
Runoff = 0.49 cfs @ 7.89 hrs, Volume= 7,280 cf, Depth= 6.51"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.75"

	Area (ac)	CN	Description
*	0.308	98	
	0.308	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7S: TPP-3



Summary for Subcatchment 5S: APCO Bridge -1

[49] Hint: Tc<2dt may require smaller dt

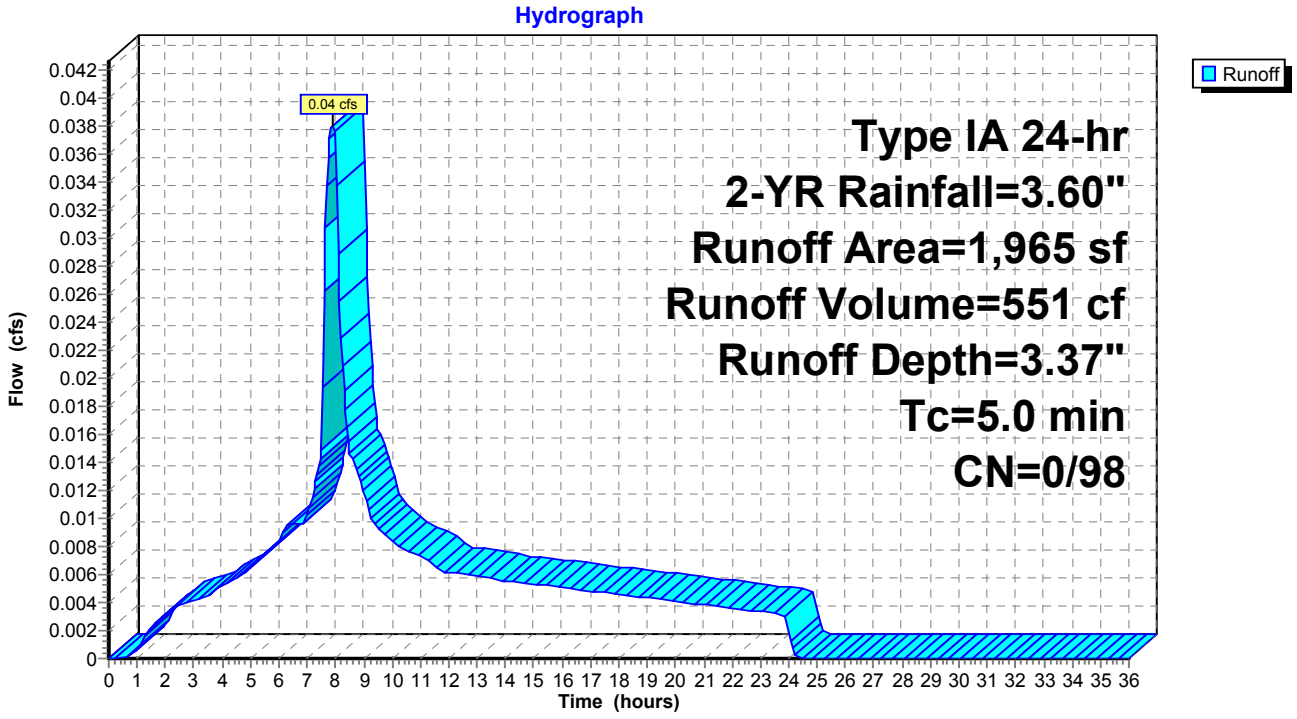
Runoff = 0.04 cfs @ 7.90 hrs, Volume= 551 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: APCO Bridge -1



Summary for Subcatchment 6S: APCO Bridge -2

[49] Hint: Tc<2dt may require smaller dt

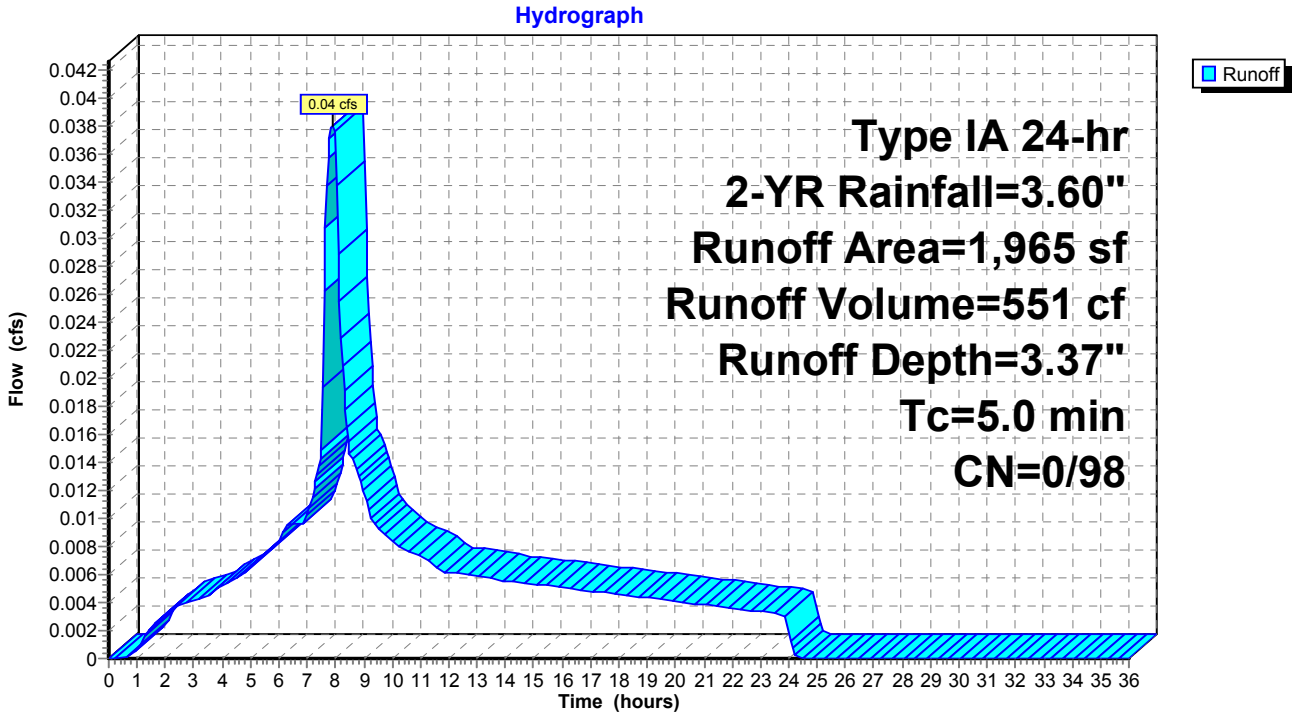
Runoff = 0.04 cfs @ 7.90 hrs, Volume= 551 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: APCO Bridge -2



Summary for Subcatchment 5S: APCO Bridge -1

[49] Hint: Tc<2dt may require smaller dt

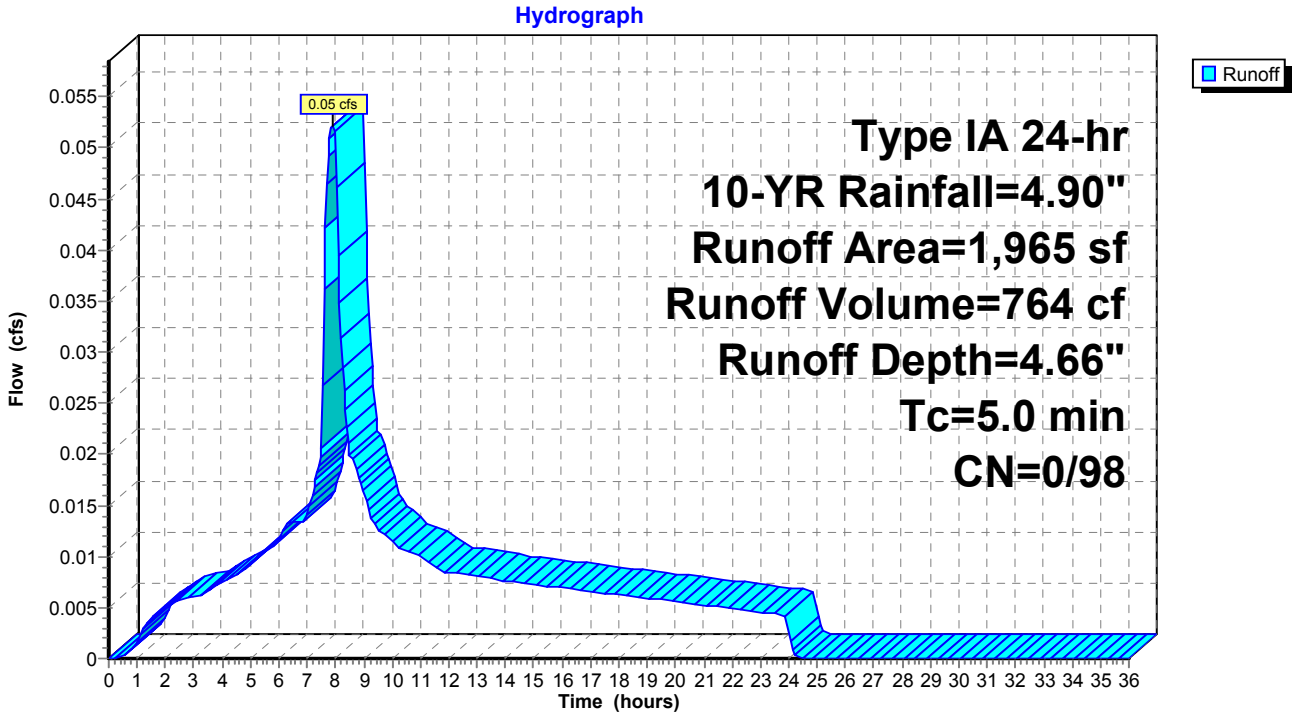
Runoff = 0.05 cfs @ 7.90 hrs, Volume= 764 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: APCO Bridge -1



Summary for Subcatchment 6S: APCO Bridge -2

[49] Hint: Tc<2dt may require smaller dt

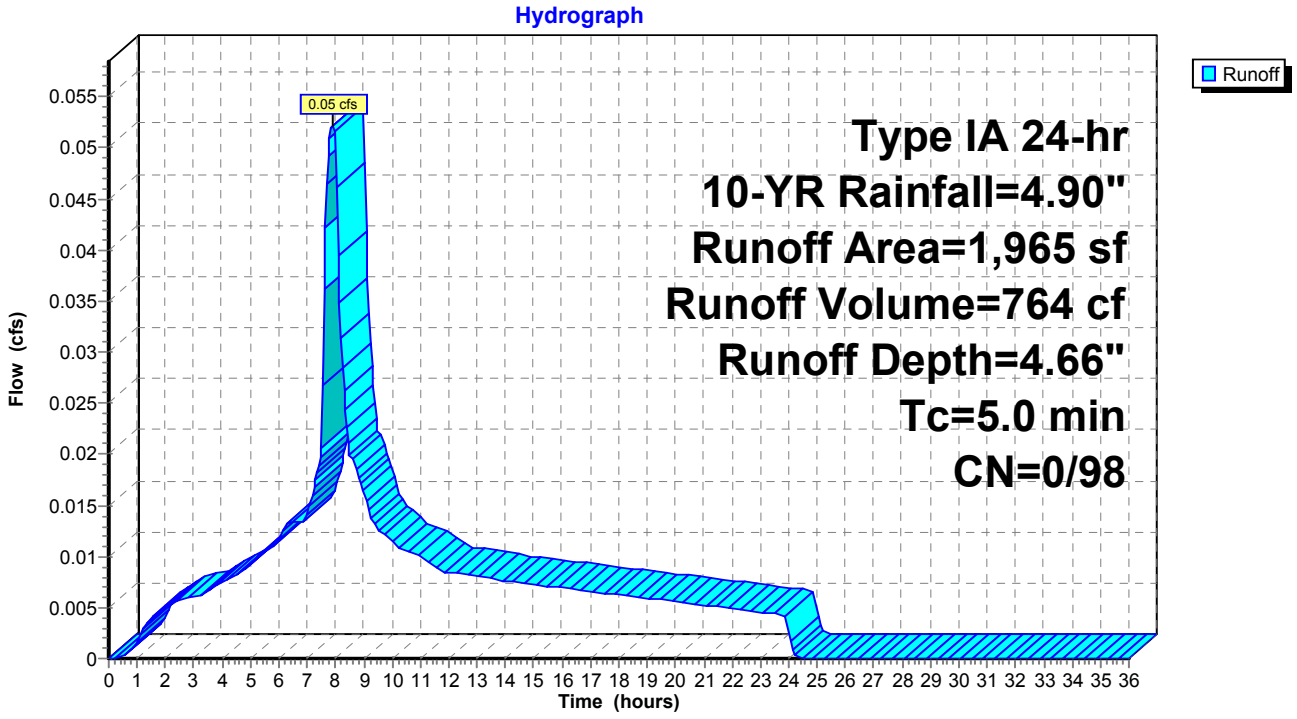
Runoff = 0.05 cfs @ 7.90 hrs, Volume= 764 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: APCO Bridge -2



Summary for Subcatchment 5S: APCO Bridge -1

[49] Hint: Tc<2dt may require smaller dt

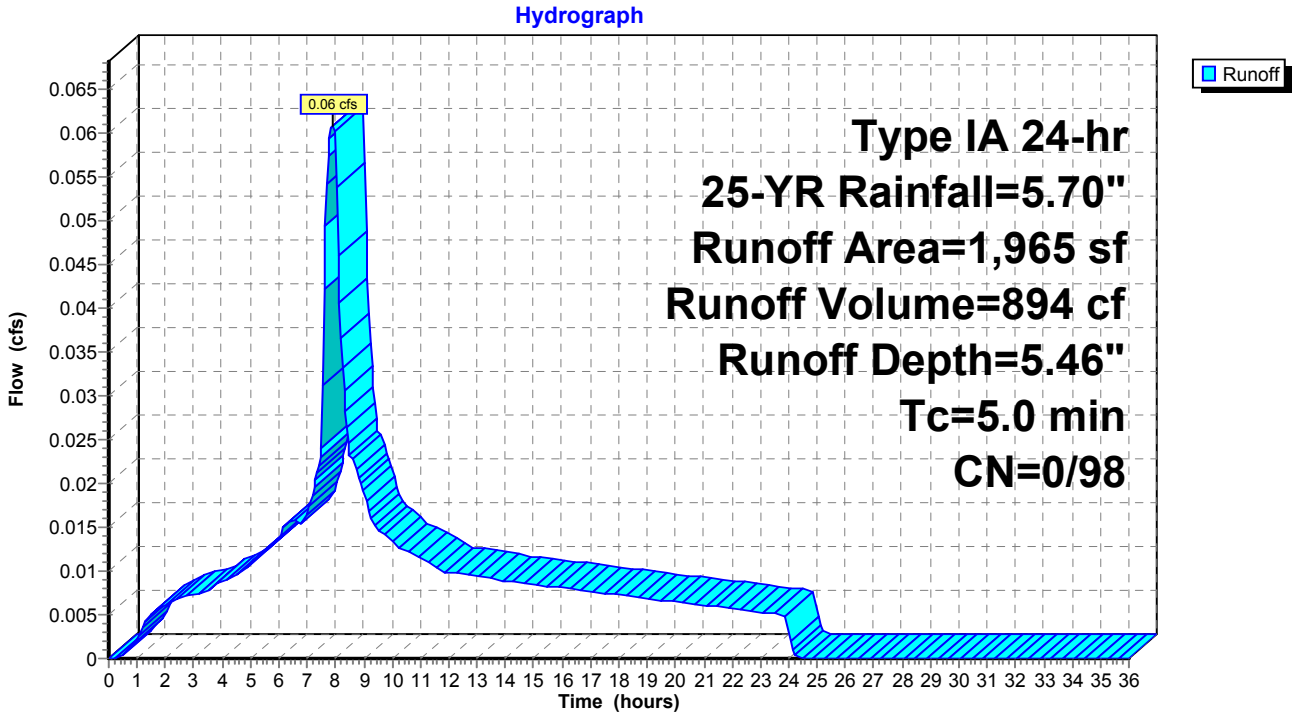
Runoff = 0.06 cfs @ 7.89 hrs, Volume= 894 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: APCO Bridge -1



Summary for Subcatchment 6S: APCO Bridge -2

[49] Hint: Tc<2dt may require smaller dt

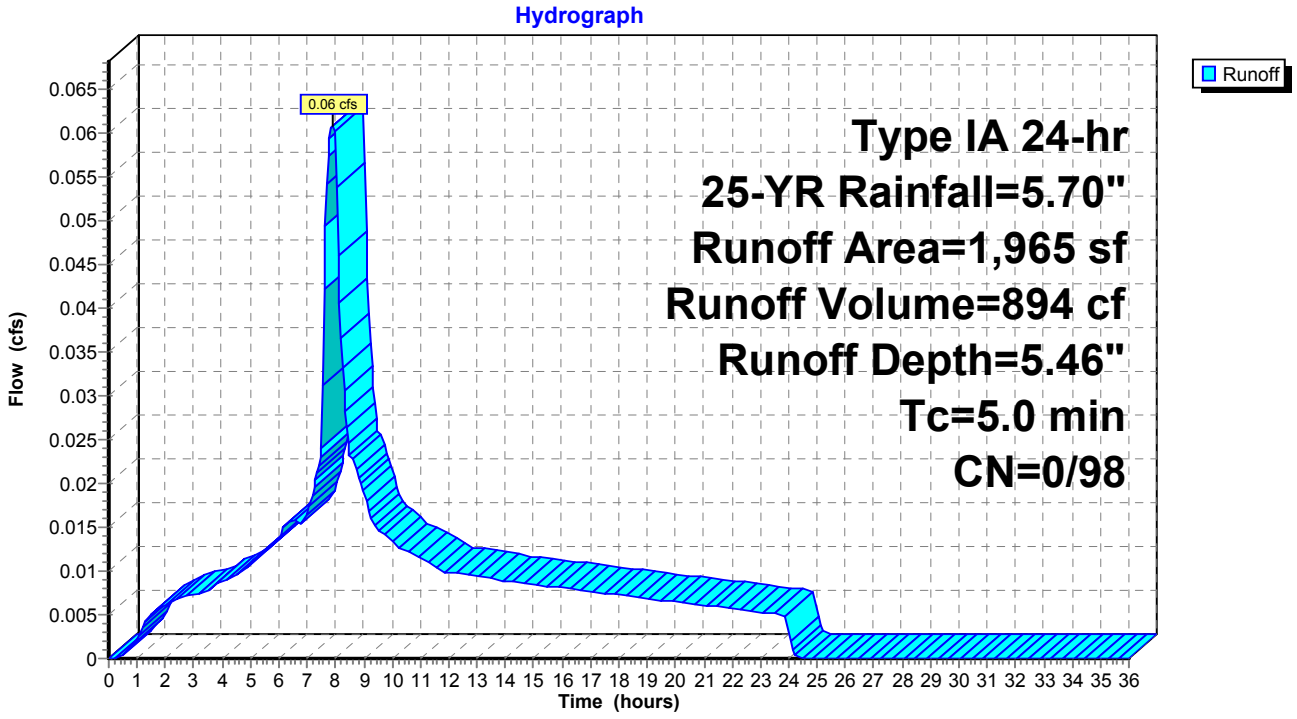
Runoff = 0.06 cfs @ 7.89 hrs, Volume= 894 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: APCO Bridge -2



Summary for Subcatchment 5S: APCO Bridge -1

[49] Hint: Tc<2dt may require smaller dt

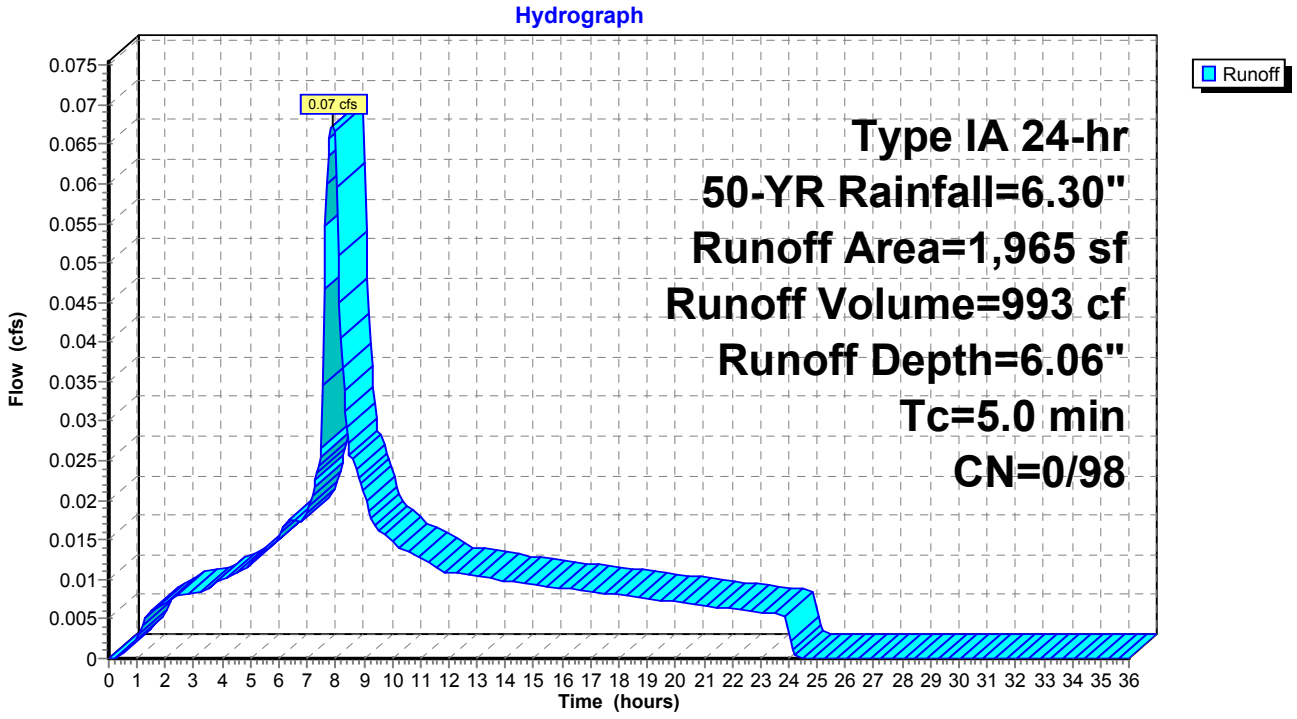
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 993 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: APCO Bridge -1



Summary for Subcatchment 6S: APCO Bridge -2

[49] Hint: Tc<2dt may require smaller dt

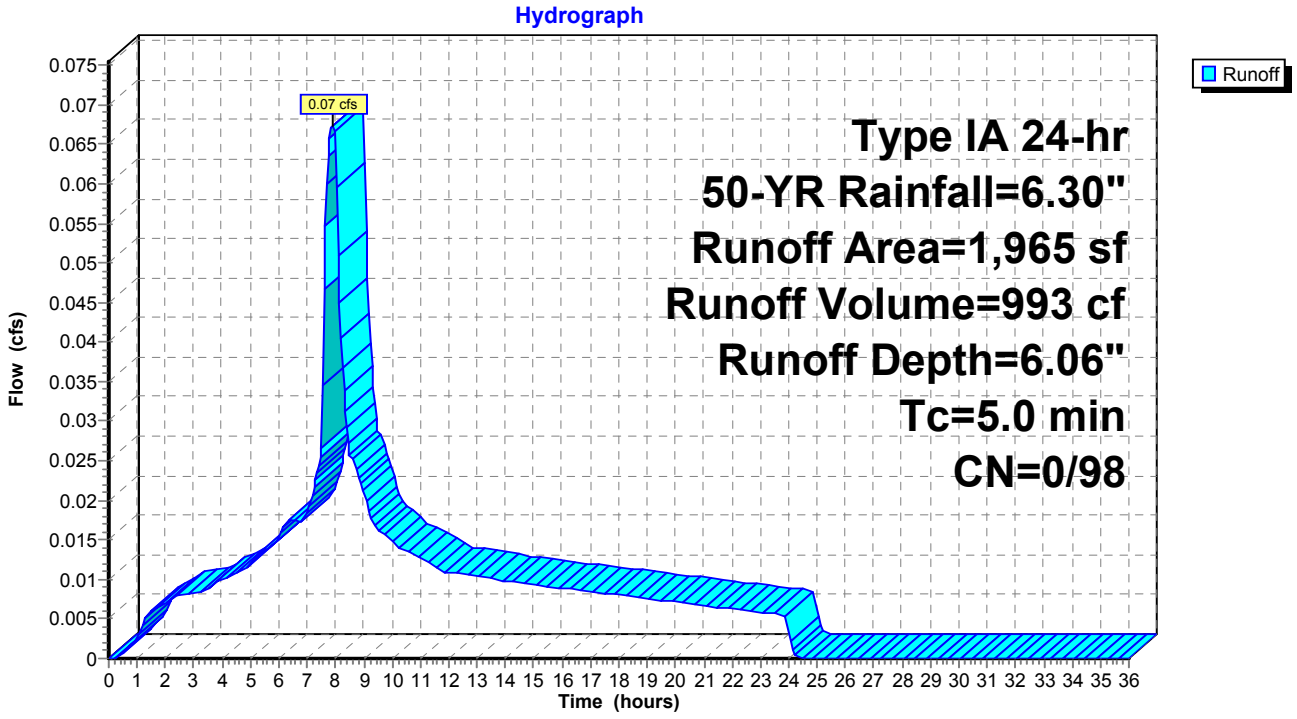
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 993 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: APCO Bridge -2



Summary for Subcatchment 5S: APCO Bridge -1

[49] Hint: Tc<2dt may require smaller dt

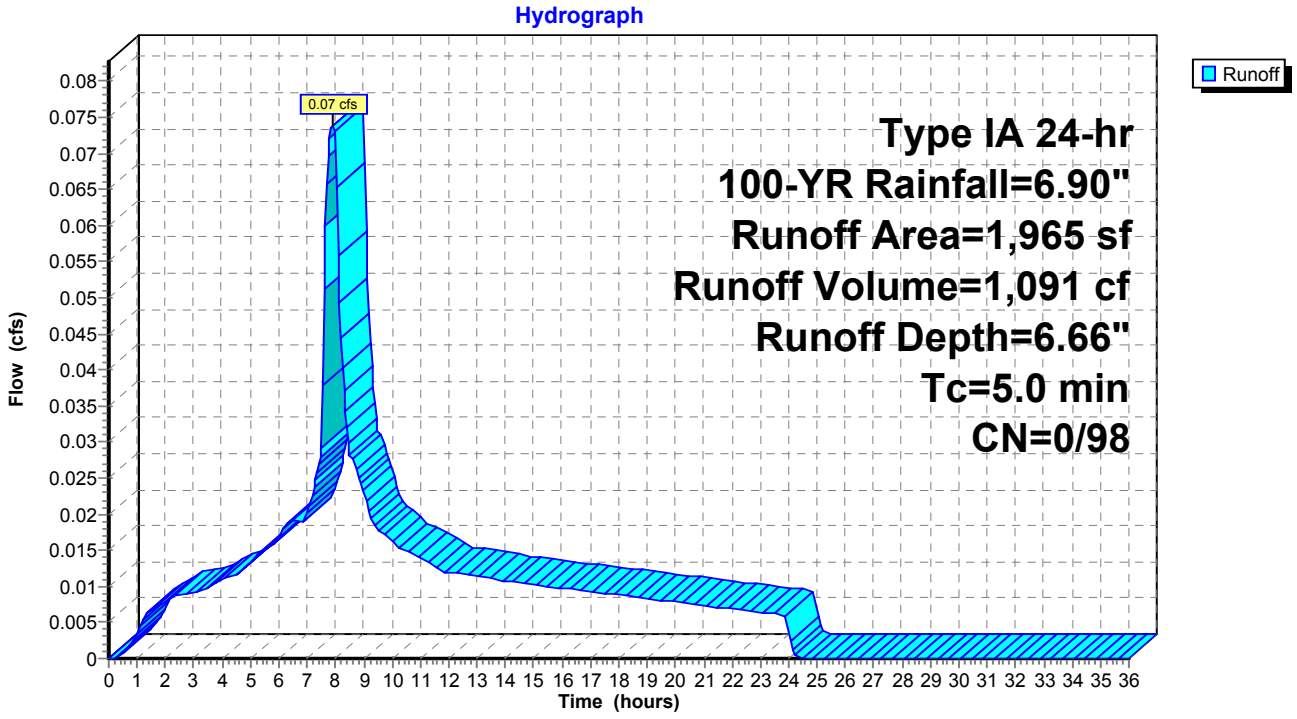
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 1,091 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: APCO Bridge -1



Summary for Subcatchment 6S: APCO Bridge -2

[49] Hint: Tc<2dt may require smaller dt

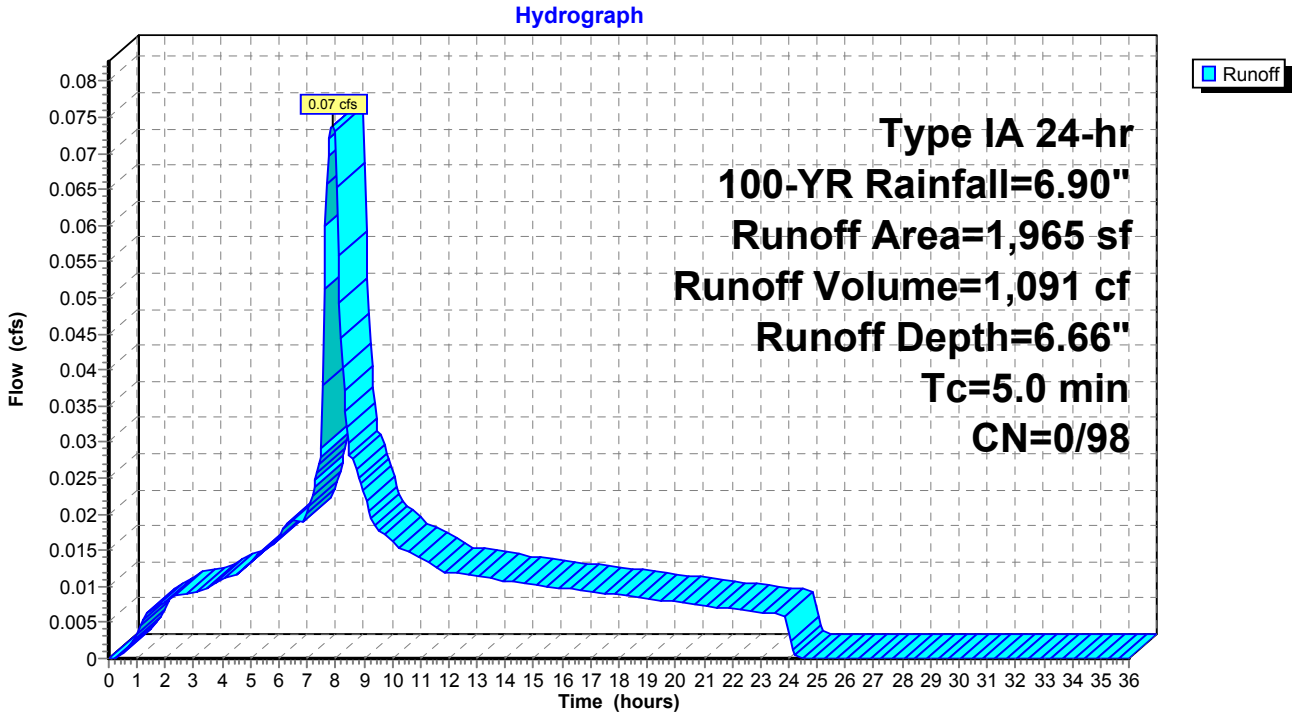
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 1,091 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (sf)	CN	Description
*	1,965	98	
	1,965	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: APCO Bridge -2



Summary for Subcatchment 5S: EBD-1

[49] Hint: Tc<2dt may require smaller dt

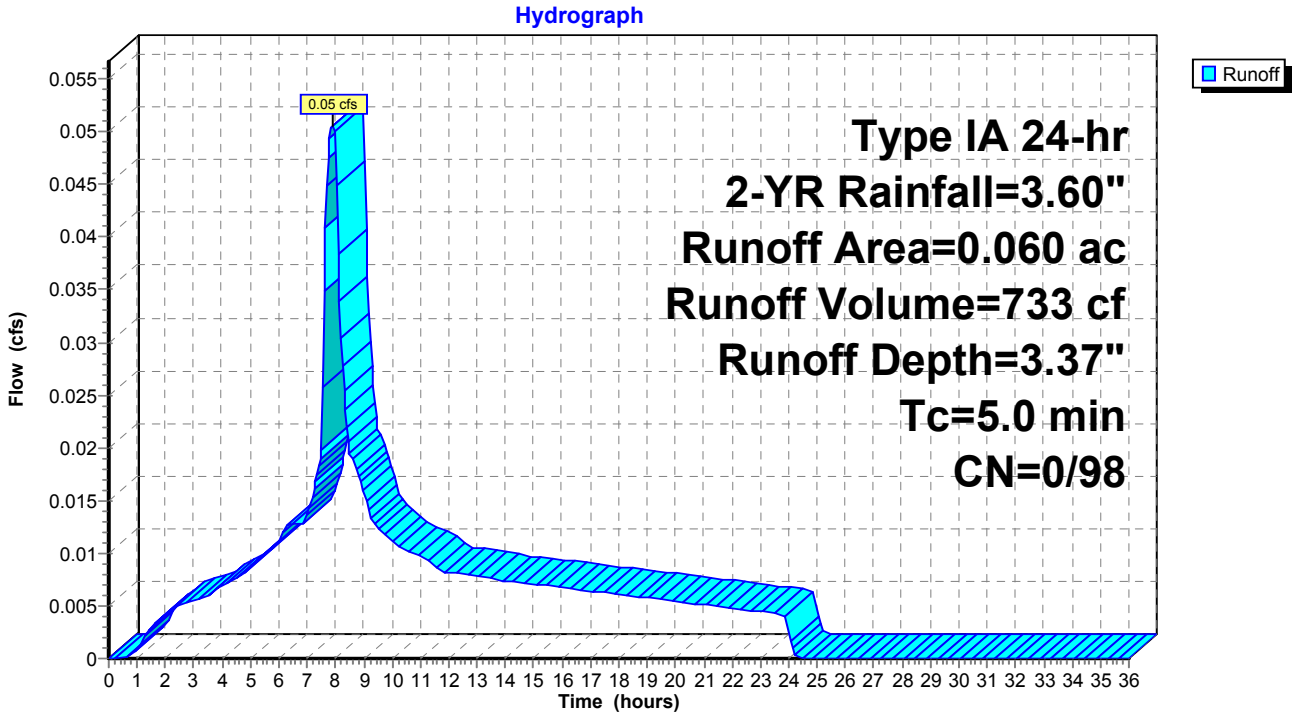
Runoff = 0.05 cfs @ 7.90 hrs, Volume= 733 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.060	98	
	0.060	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: EBD-1



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Summary for Subcatchment 6S: EBD-2

[49] Hint: Tc<2dt may require smaller dt

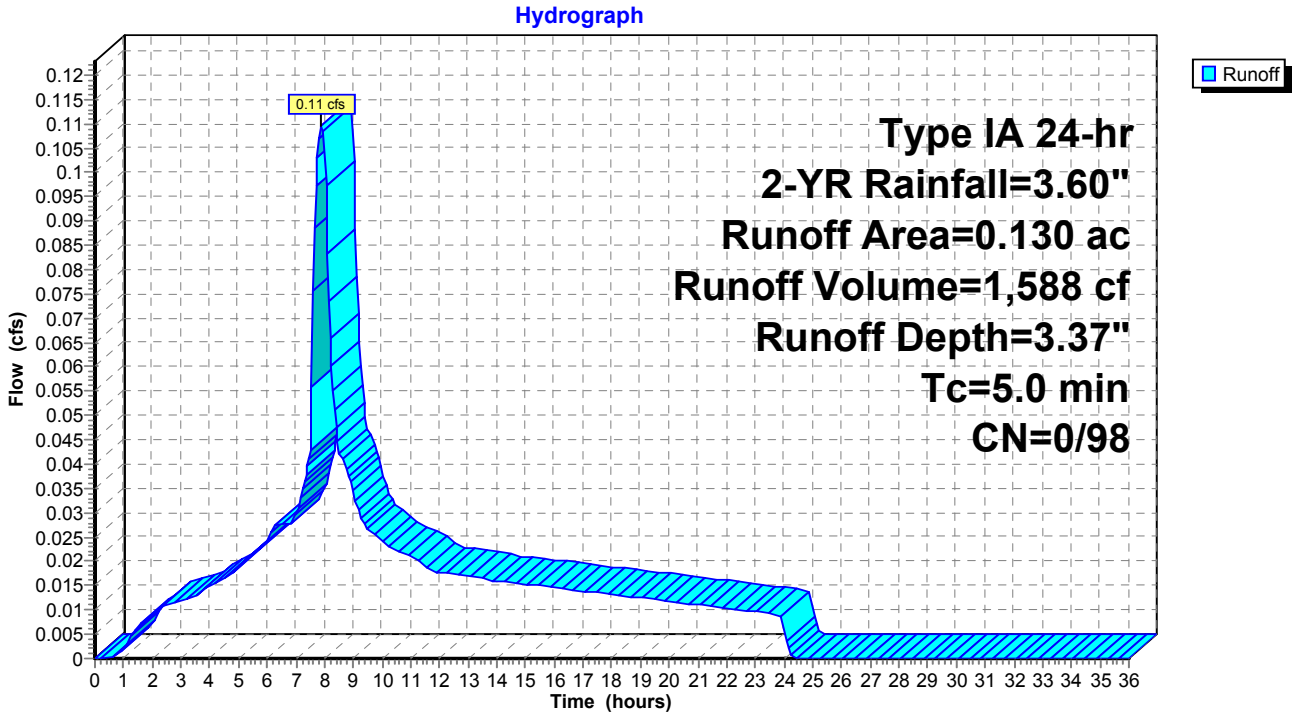
Runoff = 0.11 cfs @ 7.90 hrs, Volume= 1,588 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: EBD-2



Summary for Subcatchment 9S: EBD-3

[49] Hint: Tc<2dt may require smaller dt

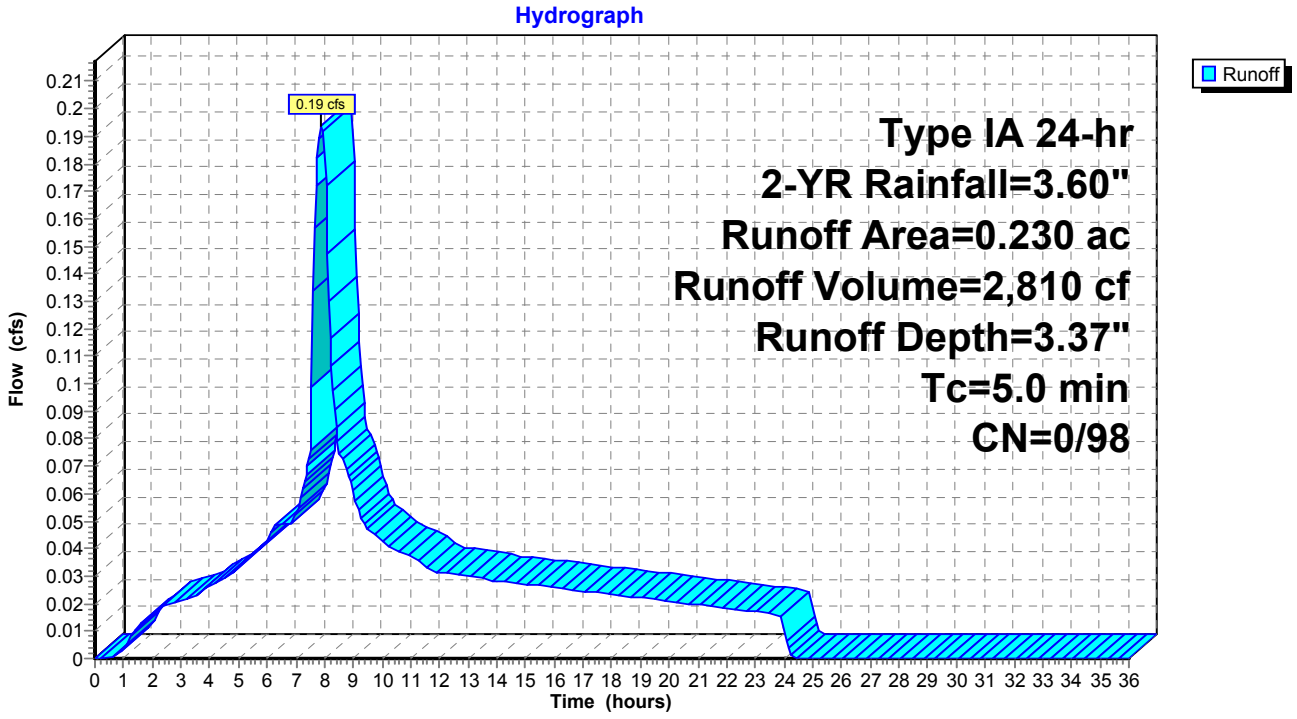
Runoff = 0.19 cfs @ 7.90 hrs, Volume= 2,810 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.230	98	
	0.230	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: EBD-3



Summary for Subcatchment 10S: EBD-4

[49] Hint: Tc<2dt may require smaller dt

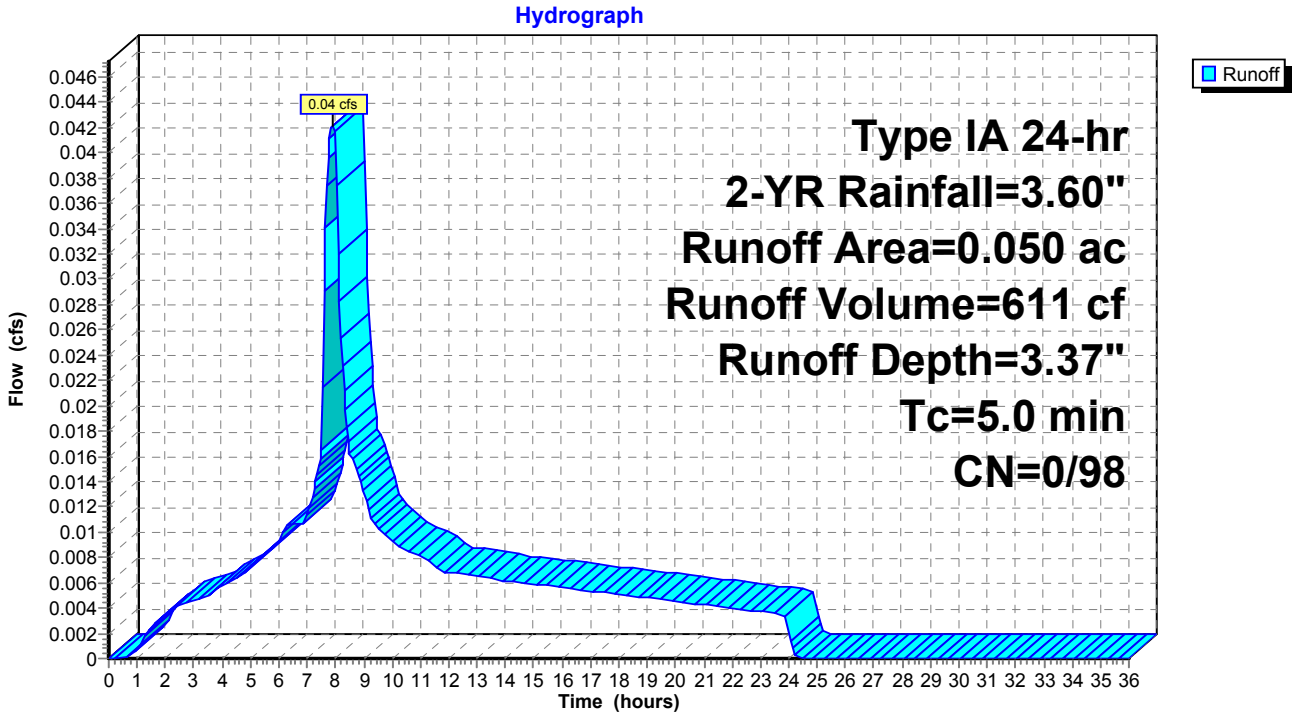
Runoff = 0.04 cfs @ 7.90 hrs, Volume= 611 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: EBD-4



Summary for Subcatchment 11S: EBD-5

[49] Hint: Tc<2dt may require smaller dt

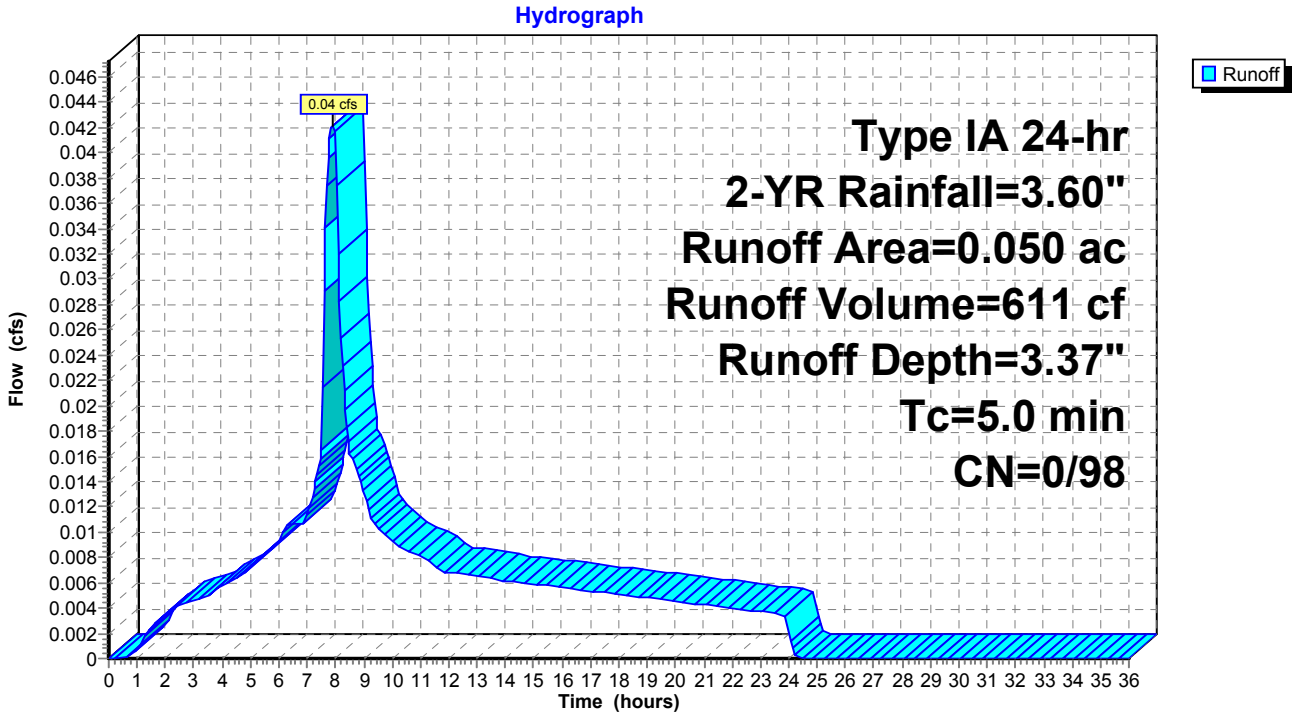
Runoff = 0.04 cfs @ 7.90 hrs, Volume= 611 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: EBD-5



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Summary for Subcatchment 12S: EBD-6

[49] Hint: Tc<2dt may require smaller dt

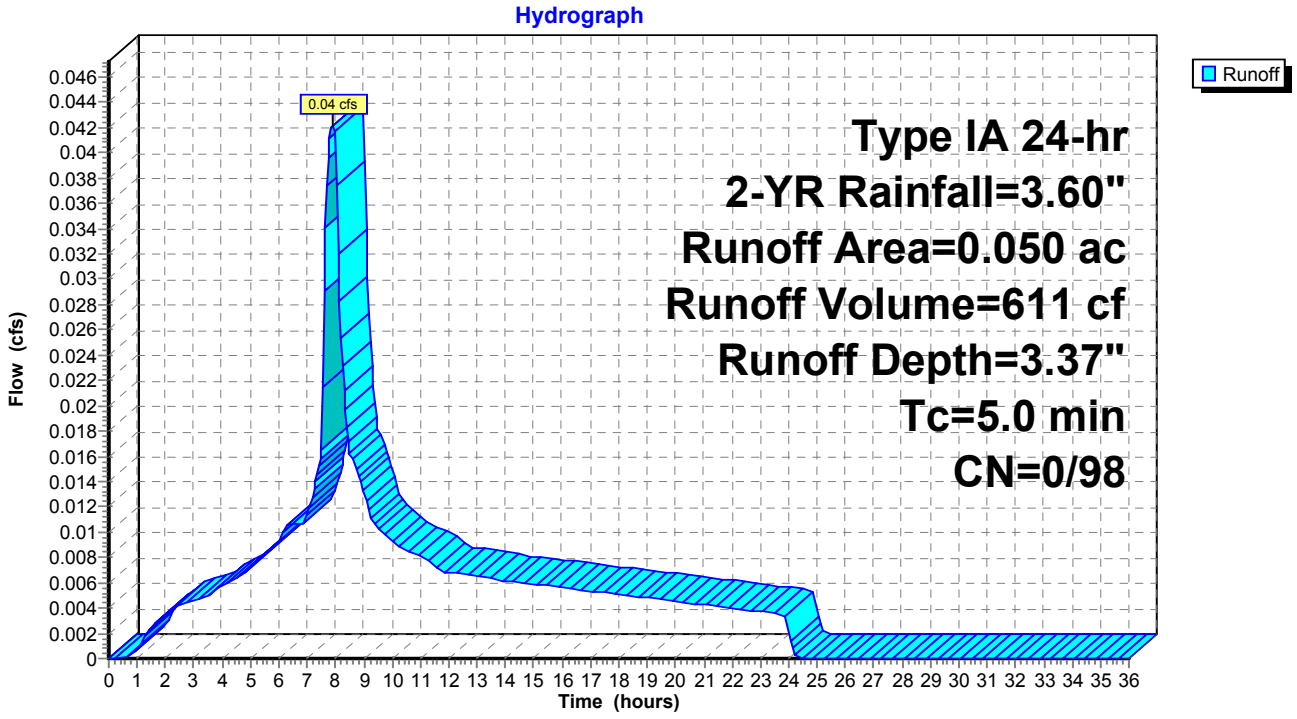
Runoff = 0.04 cfs @ 7.90 hrs, Volume= 611 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 12S: EBD-6



Summary for Subcatchment 13S: EBD-7

[49] Hint: Tc<2dt may require smaller dt

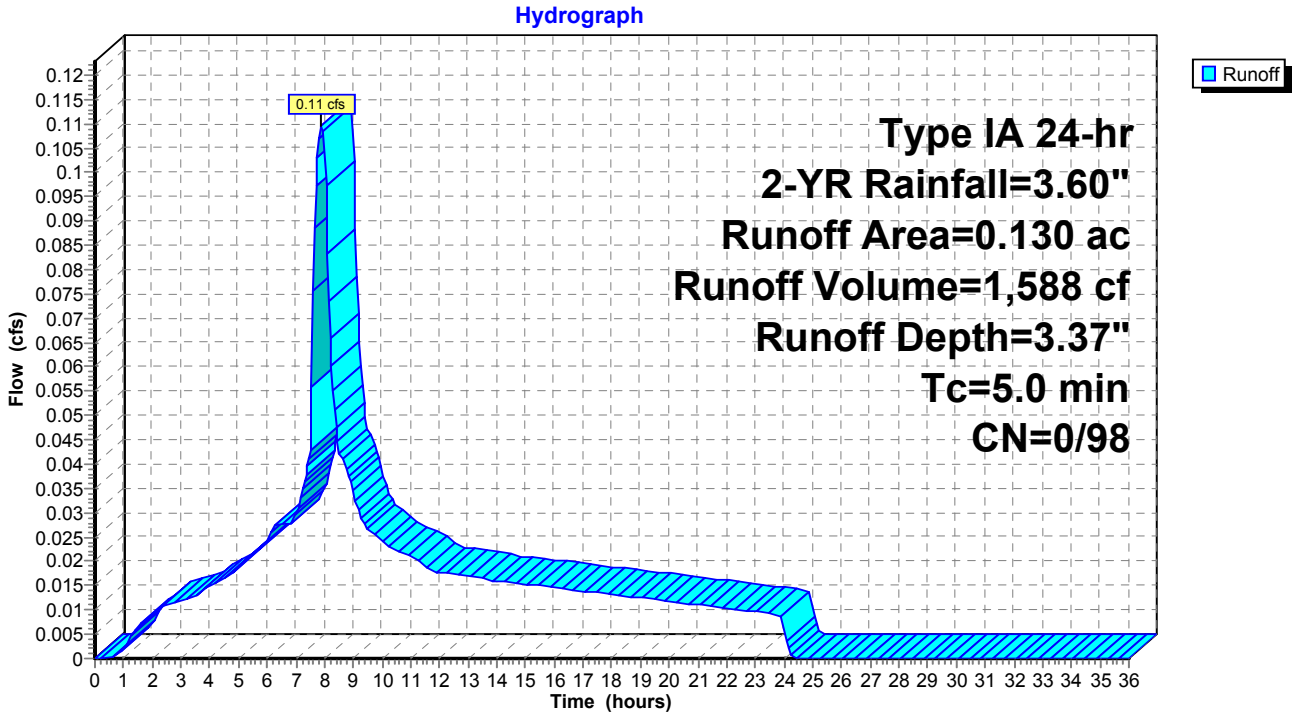
Runoff = 0.11 cfs @ 7.90 hrs, Volume= 1,588 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 13S: EBD-7



Summary for Subcatchment 14S: EBD-8

[49] Hint: Tc<2dt may require smaller dt

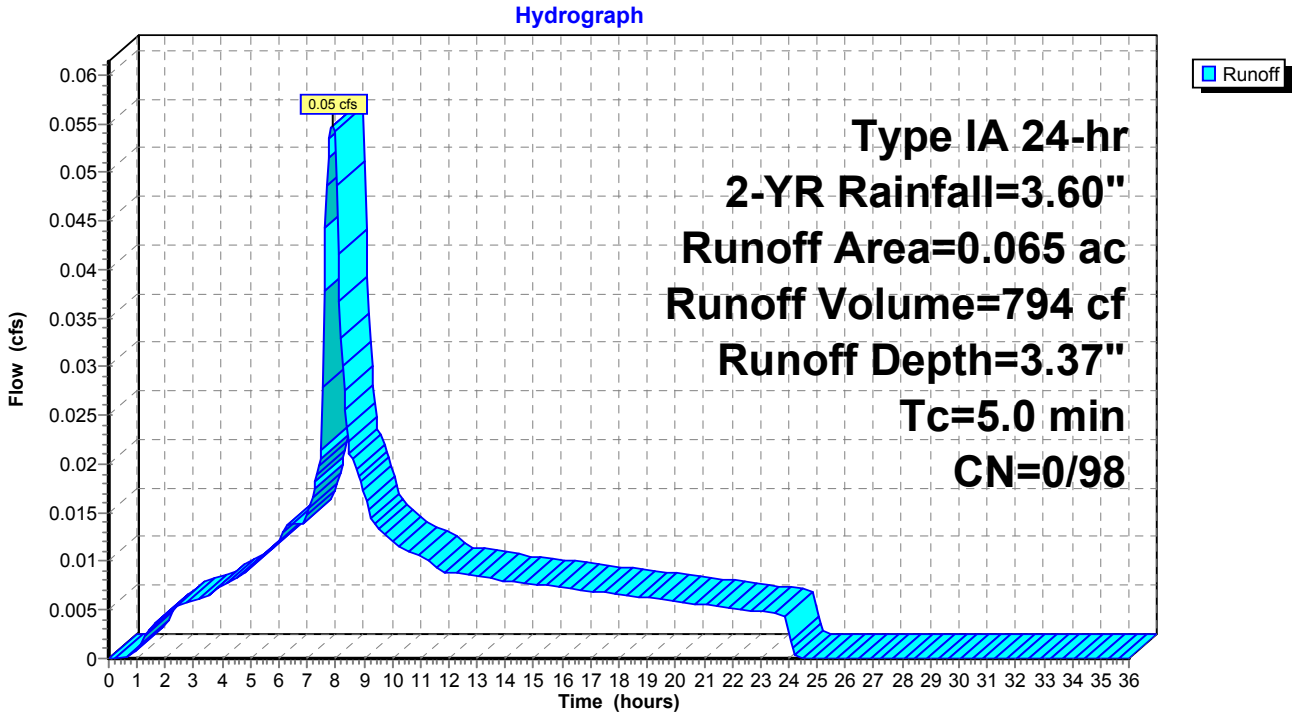
Runoff = 0.05 cfs @ 7.90 hrs, Volume= 794 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.065	98	
	0.065	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 14S: EBD-8



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Summary for Subcatchment 15S: EBD-9

[49] Hint: Tc<2dt may require smaller dt

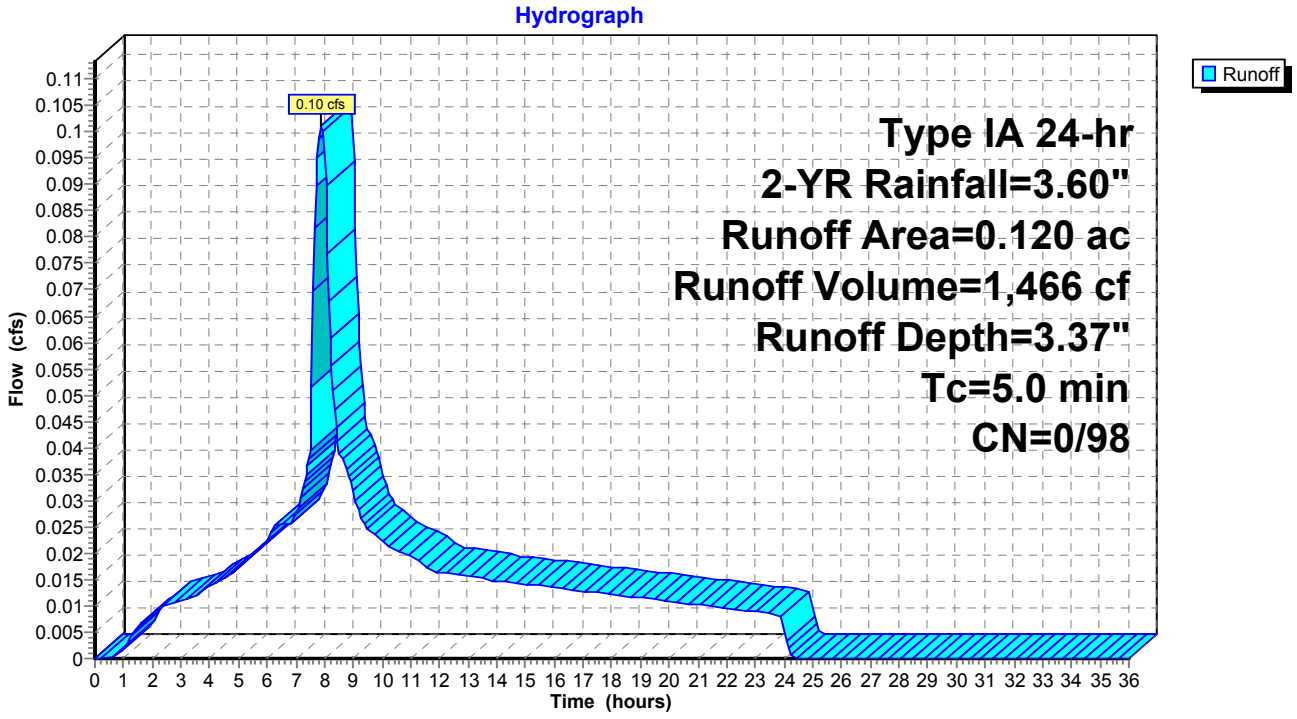
Runoff = 0.10 cfs @ 7.90 hrs, Volume= 1,466 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.120	98	
	0.120	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 15S: EBD-9



Summary for Subcatchment 16S: EBD-10

[49] Hint: Tc<2dt may require smaller dt

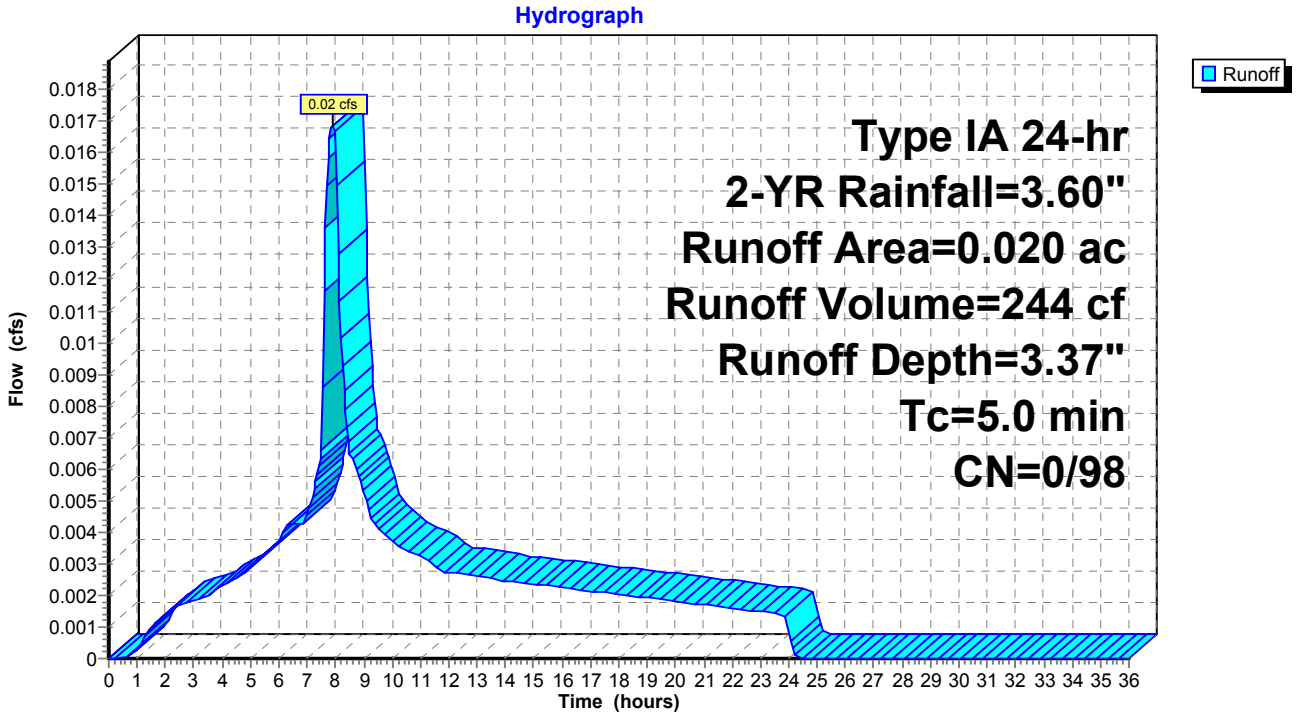
Runoff = 0.02 cfs @ 7.90 hrs, Volume= 244 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.020	98	
	0.020	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 16S: EBD-10



Summary for Subcatchment 5S: EBD-1

[49] Hint: Tc<2dt may require smaller dt

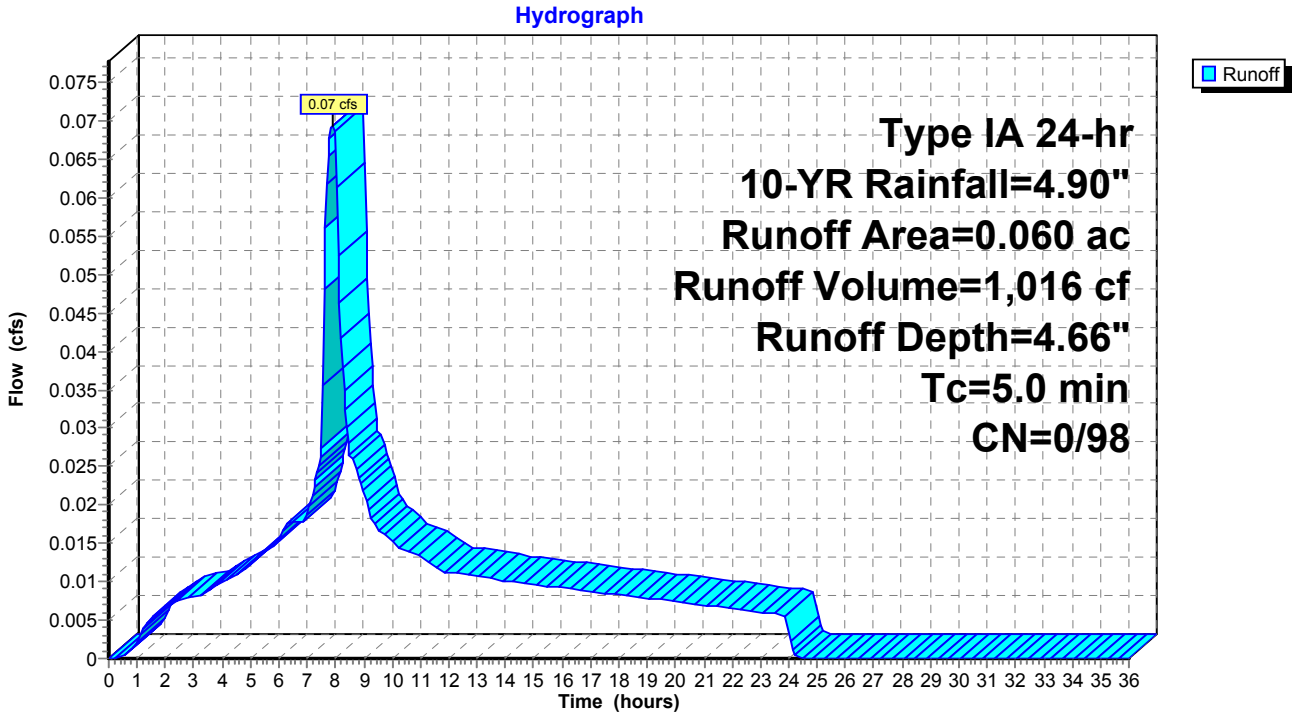
Runoff = 0.07 cfs @ 7.90 hrs, Volume= 1,016 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.060	98	
	0.060	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: EBD-1



Summary for Subcatchment 6S: EBD-2

[49] Hint: Tc<2dt may require smaller dt

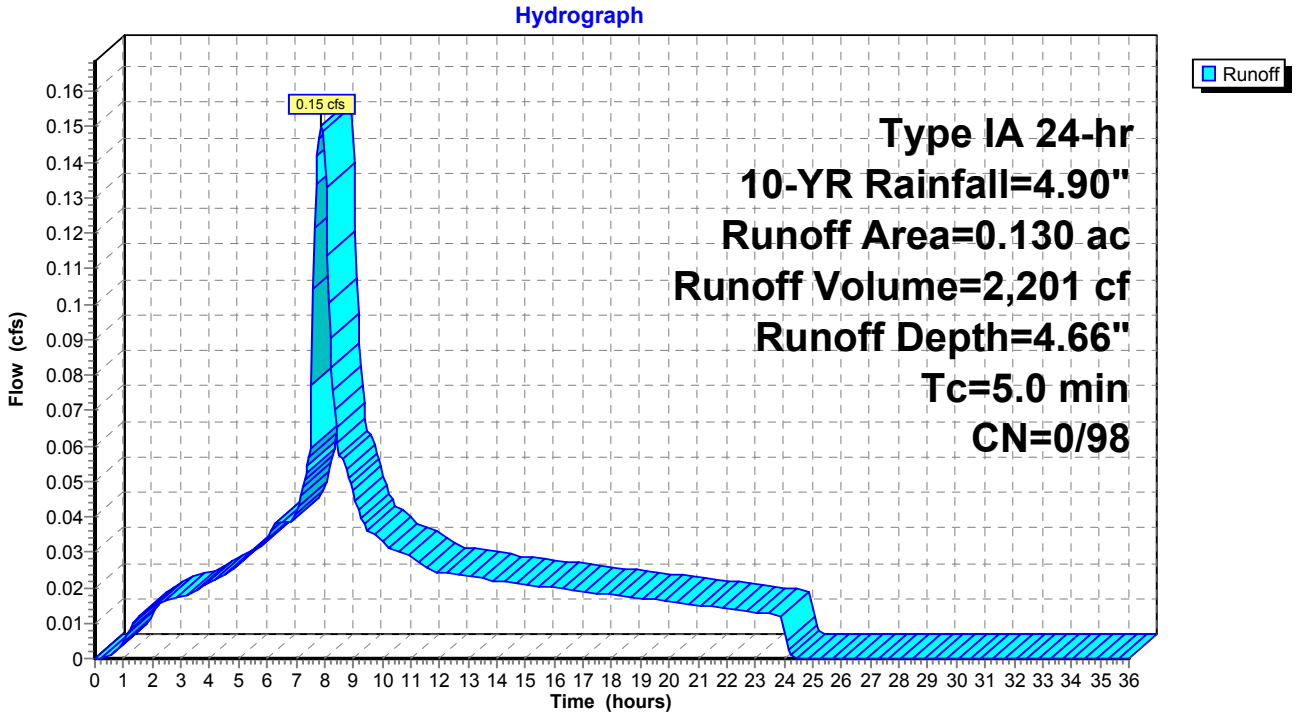
Runoff = 0.15 cfs @ 7.90 hrs, Volume= 2,201 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: EBD-2



Summary for Subcatchment 9S: EBD-3

[49] Hint: Tc<2dt may require smaller dt

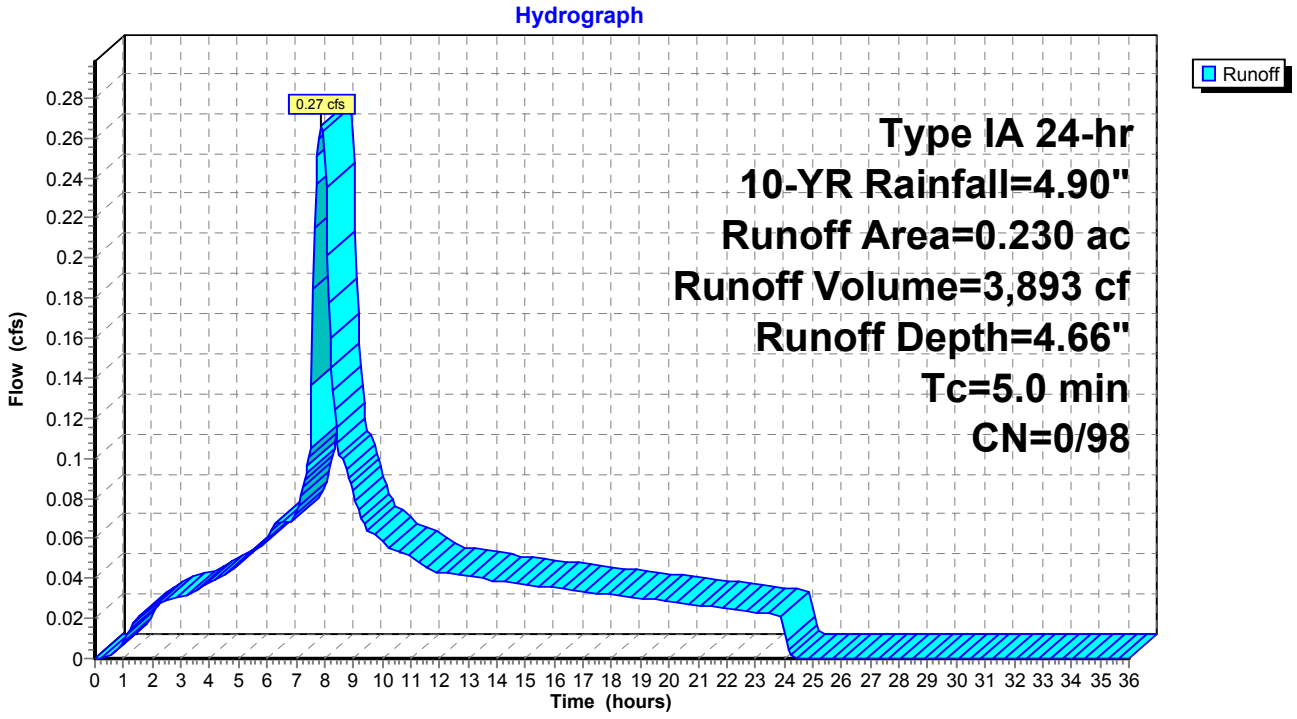
Runoff = 0.27 cfs @ 7.90 hrs, Volume= 3,893 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.230	98	
	0.230	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: EBD-3



Summary for Subcatchment 10S: EBD-4

[49] Hint: Tc<2dt may require smaller dt

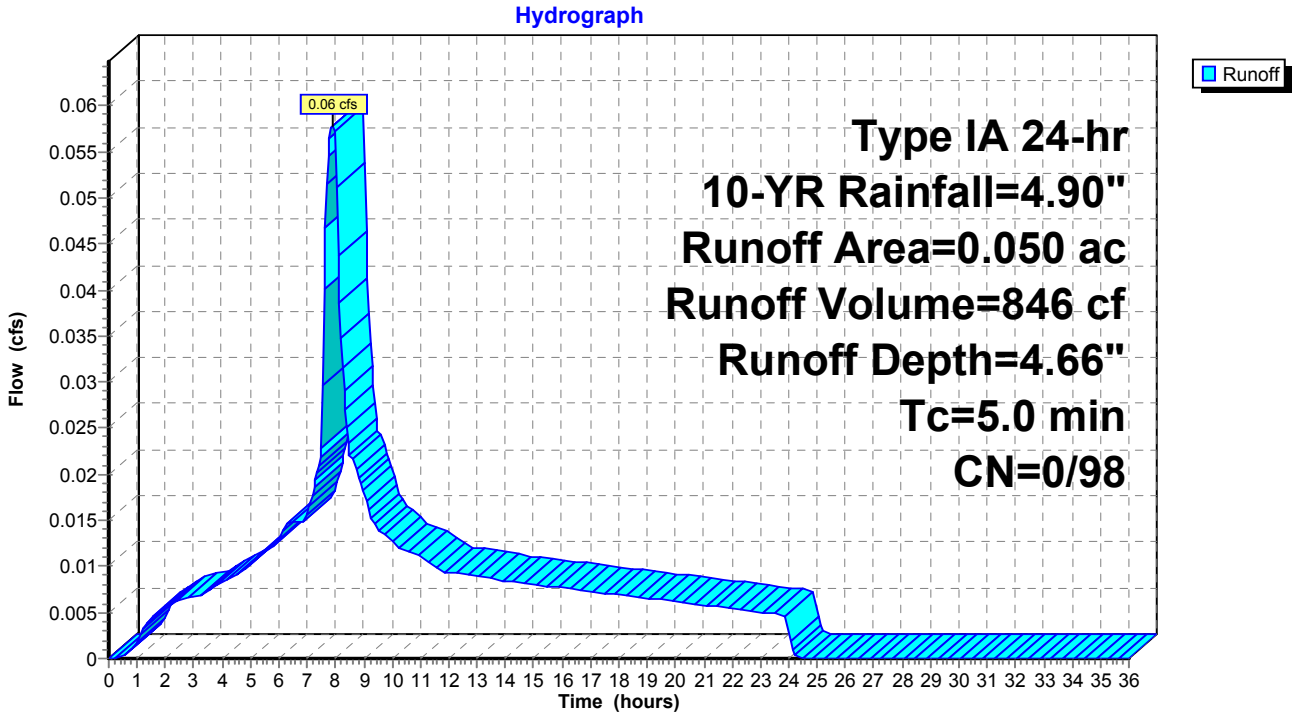
Runoff = 0.06 cfs @ 7.90 hrs, Volume= 846 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: EBD-4



Summary for Subcatchment 11S: EBD-5

[49] Hint: Tc<2dt may require smaller dt

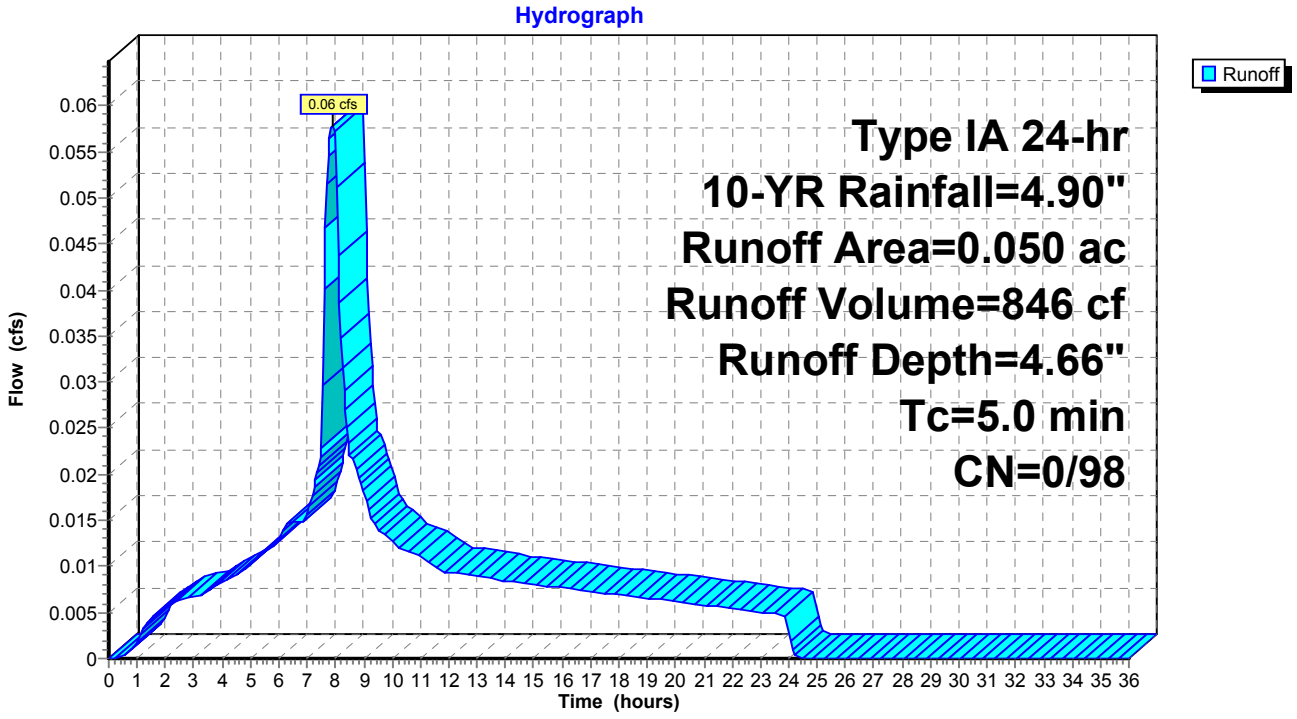
Runoff = 0.06 cfs @ 7.90 hrs, Volume= 846 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: EBD-5



Summary for Subcatchment 12S: EBD-6

[49] Hint: Tc<2dt may require smaller dt

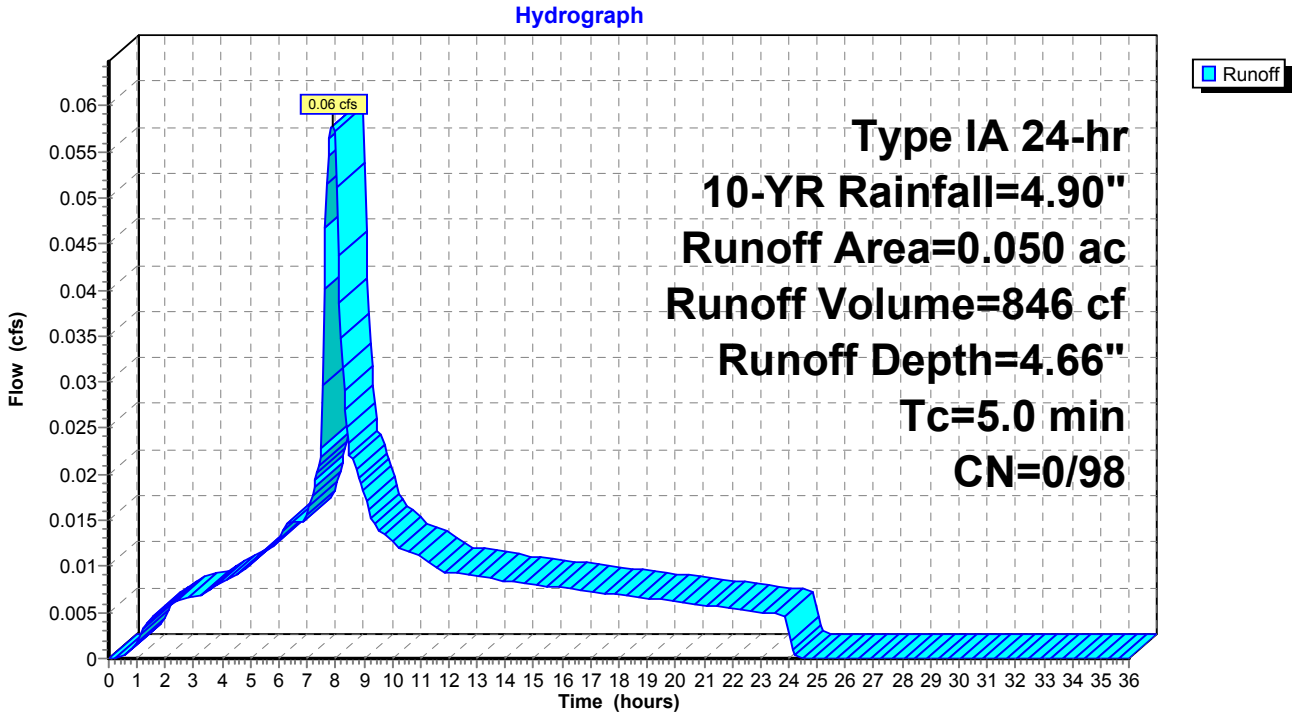
Runoff = 0.06 cfs @ 7.90 hrs, Volume= 846 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 12S: EBD-6



Summary for Subcatchment 13S: EBD-7

[49] Hint: Tc<2dt may require smaller dt

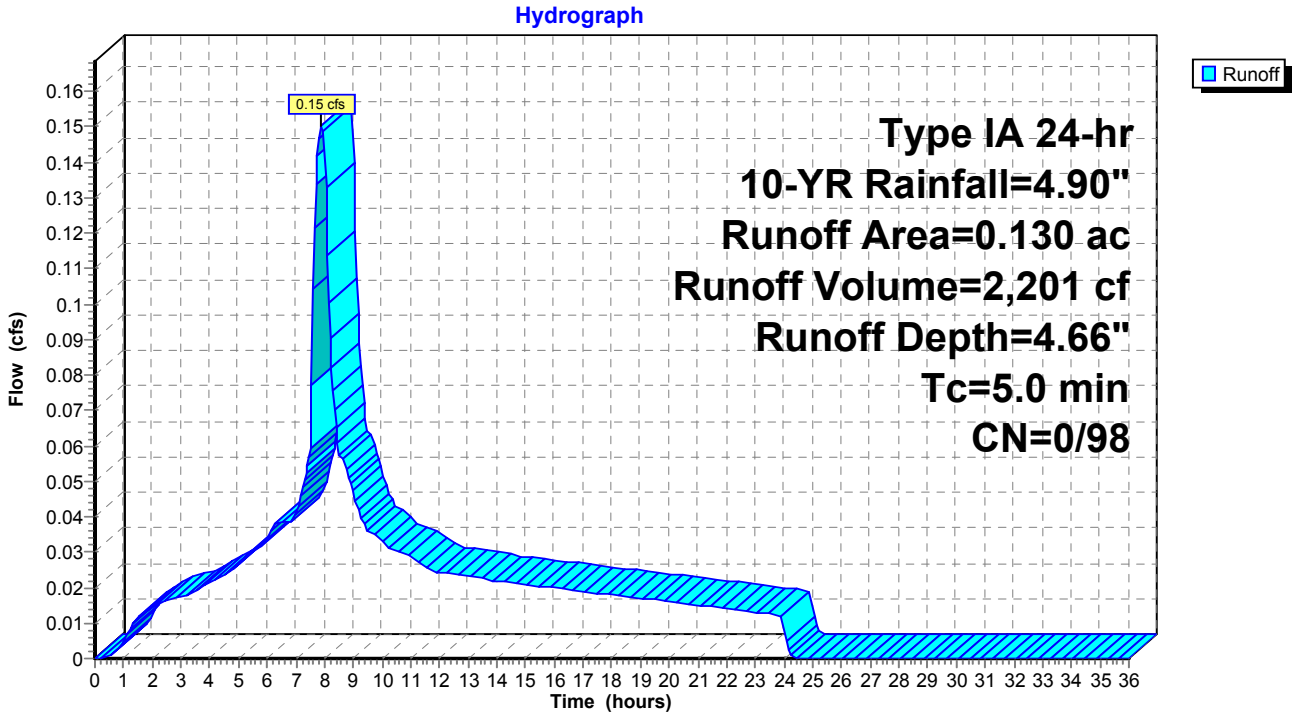
Runoff = 0.15 cfs @ 7.90 hrs, Volume= 2,201 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 13S: EBD-7



Summary for Subcatchment 14S: EBD-8

[49] Hint: Tc<2dt may require smaller dt

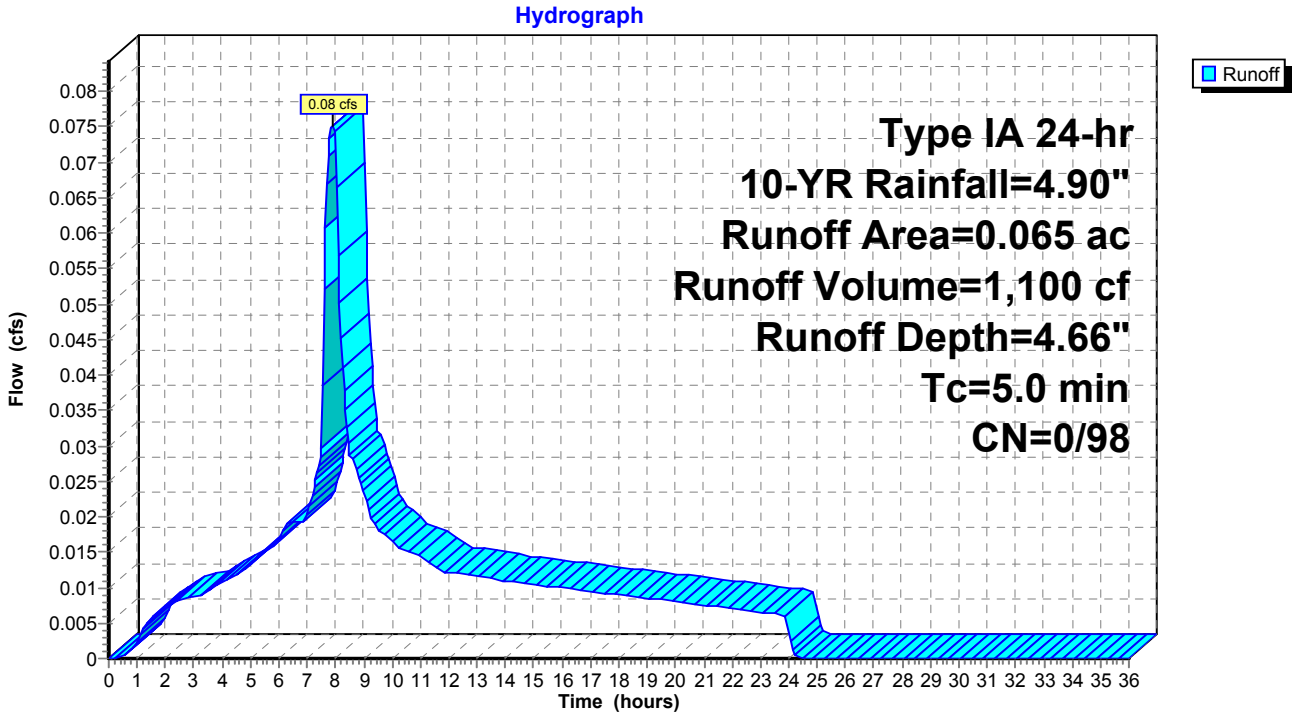
Runoff = 0.08 cfs @ 7.90 hrs, Volume= 1,100 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.065	98	
	0.065	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 14S: EBD-8



Summary for Subcatchment 15S: EBD-9

[49] Hint: Tc<2dt may require smaller dt

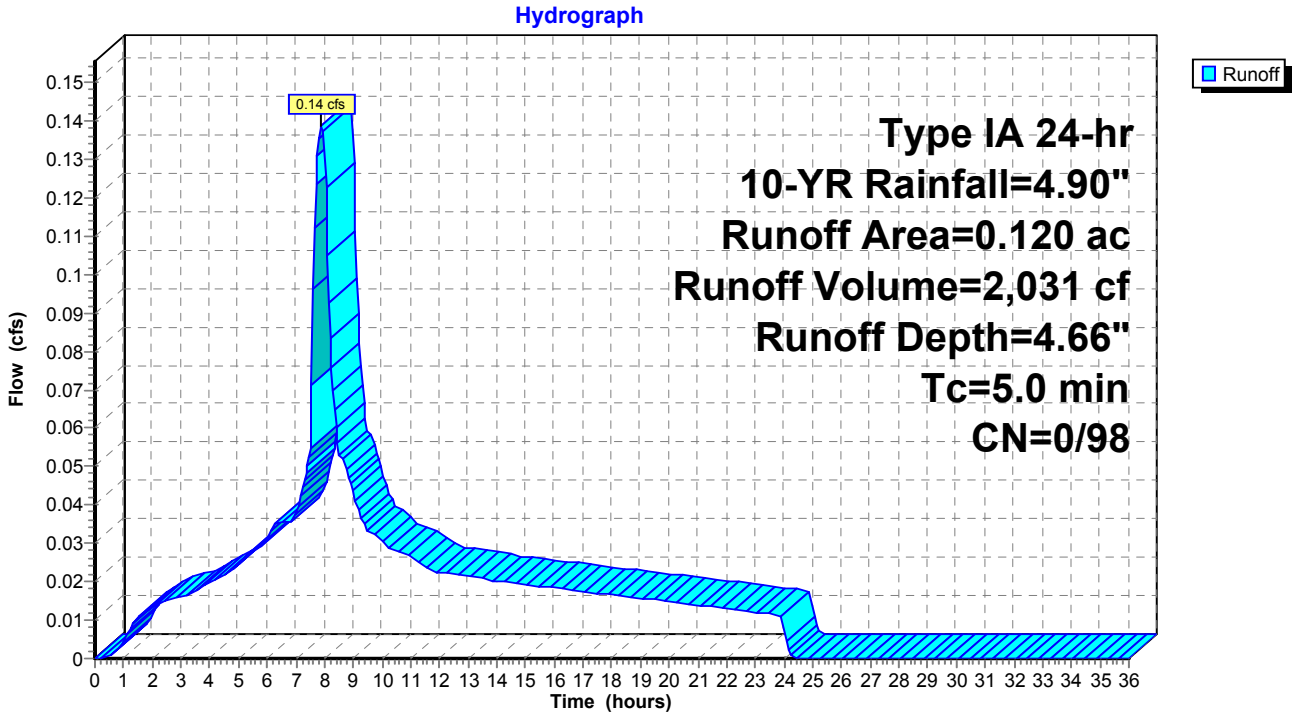
Runoff = 0.14 cfs @ 7.90 hrs, Volume= 2,031 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.120	98	
	0.120	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 15S: EBD-9



Summary for Subcatchment 16S: EBD-10

[49] Hint: Tc<2dt may require smaller dt

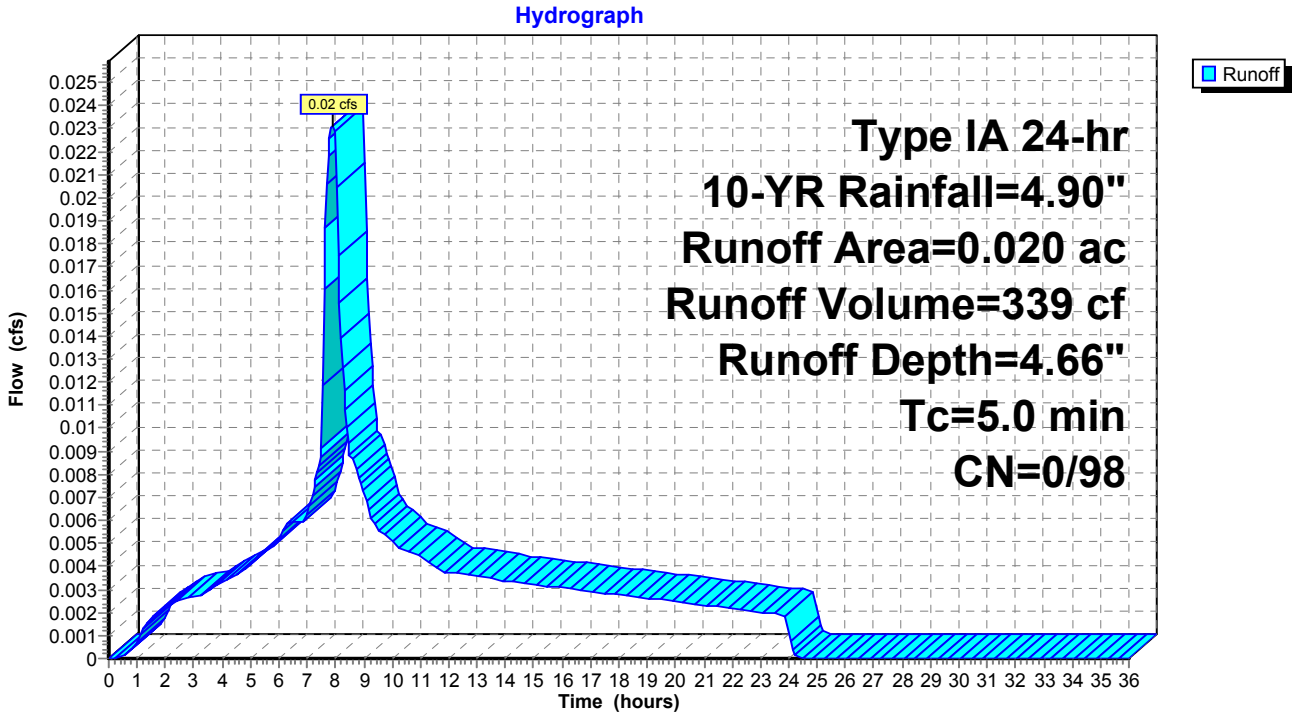
Runoff = 0.02 cfs @ 7.90 hrs, Volume= 339 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.020	98	
	0.020	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 16S: EBD-10



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Summary for Subcatchment 5S: EBD-1

[49] Hint: Tc<2dt may require smaller dt

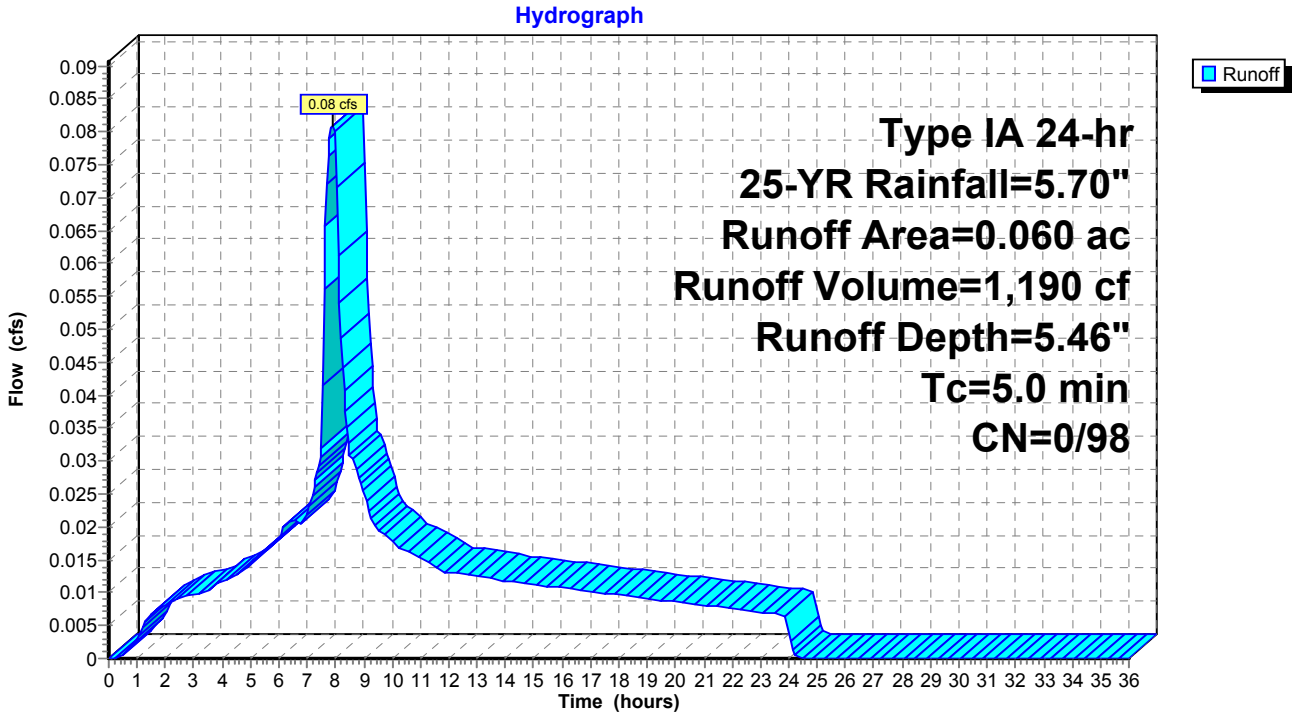
Runoff = 0.08 cfs @ 7.89 hrs, Volume= 1,190 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.060	98	
	0.060	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: EBD-1



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Summary for Subcatchment 6S: EBD-2

[49] Hint: Tc<2dt may require smaller dt

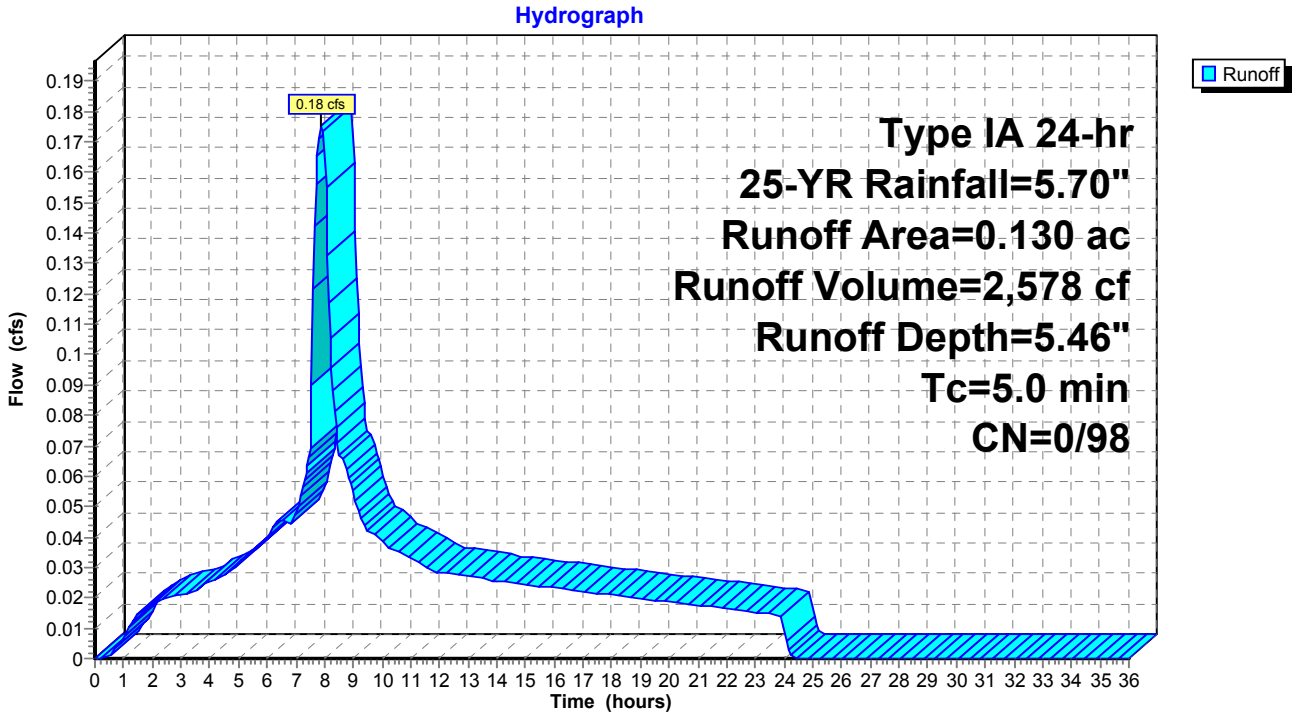
Runoff = 0.18 cfs @ 7.89 hrs, Volume= 2,578 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: EBD-2



Summary for Subcatchment 9S: EBD-3

[49] Hint: Tc<2dt may require smaller dt

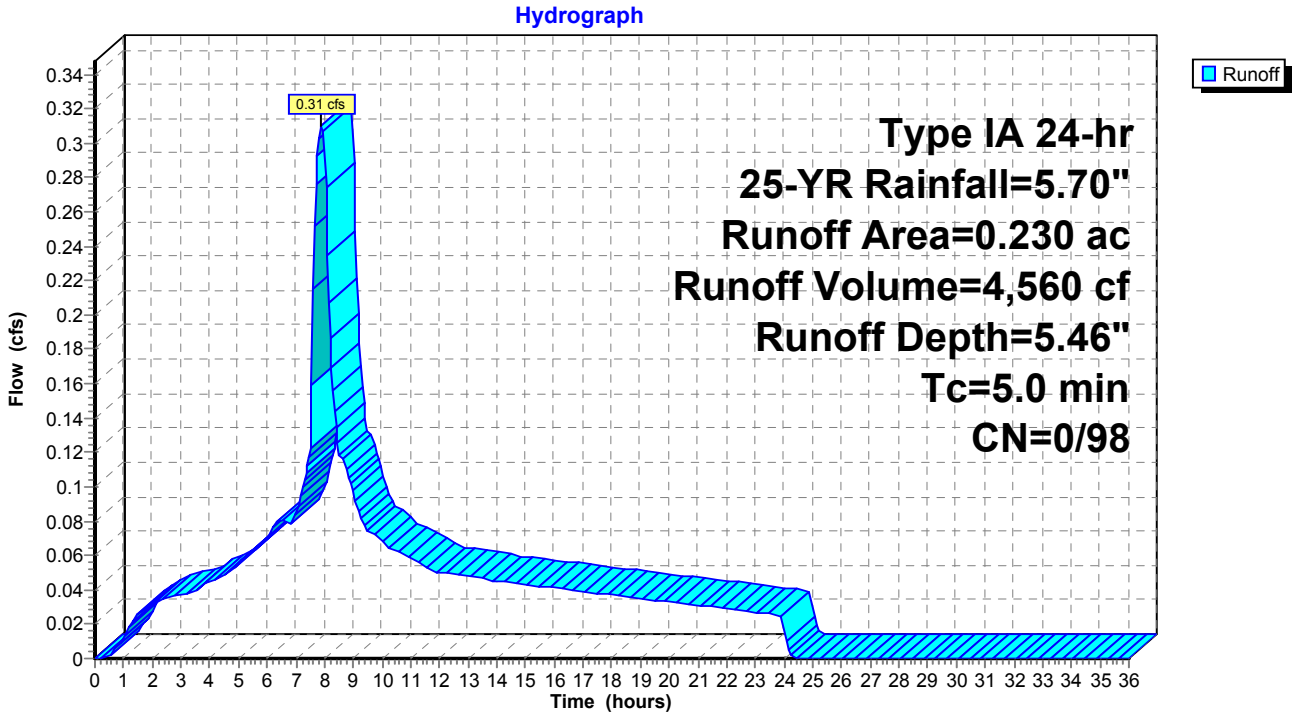
Runoff = 0.31 cfs @ 7.89 hrs, Volume= 4,560 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.230	98	
	0.230	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: EBD-3



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Summary for Subcatchment 10S: EBD-4

[49] Hint: Tc<2dt may require smaller dt

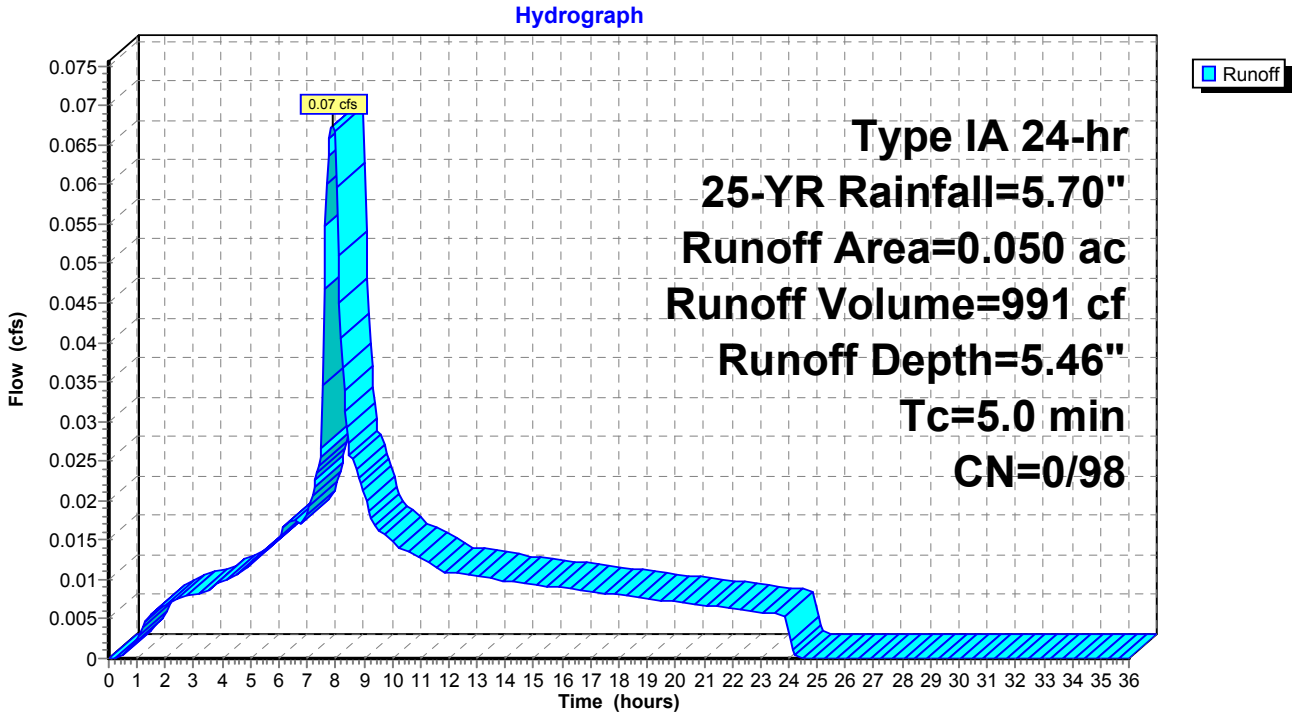
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 991 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: EBD-4



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Summary for Subcatchment 11S: EBD-5

[49] Hint: Tc<2dt may require smaller dt

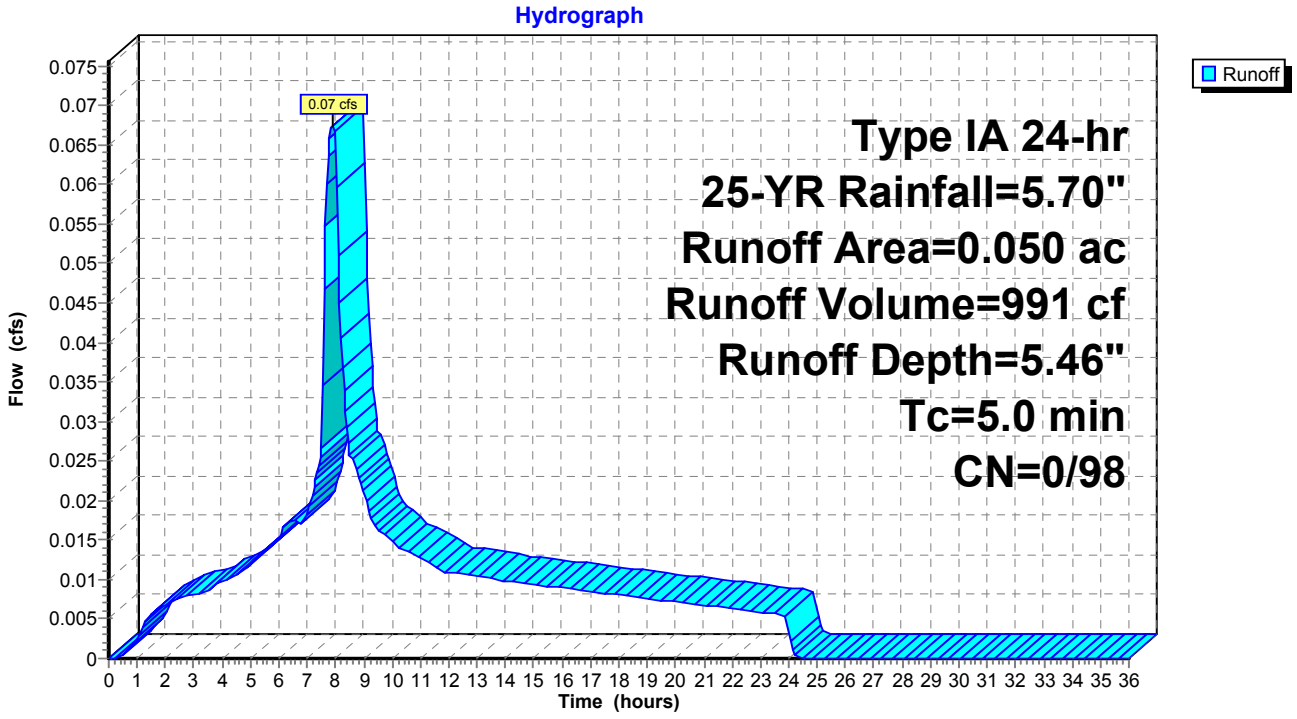
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 991 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: EBD-5



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Summary for Subcatchment 12S: EBD-6

[49] Hint: Tc<2dt may require smaller dt

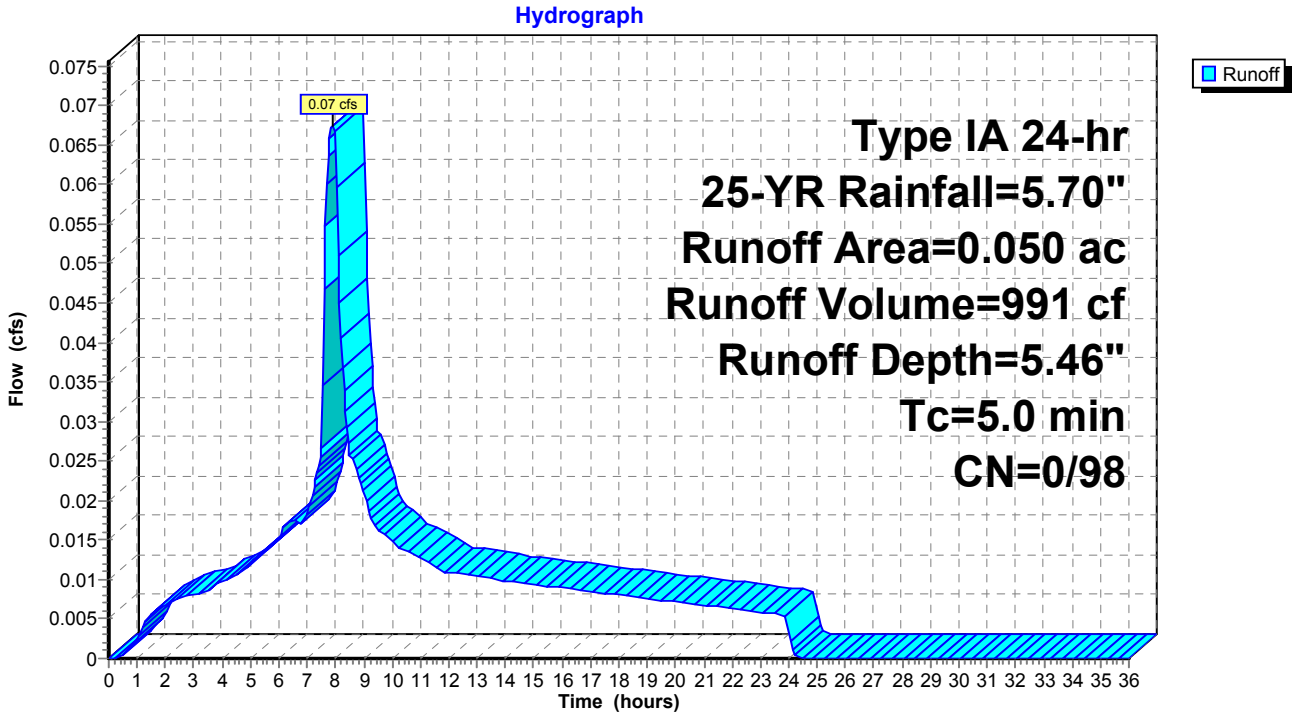
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 991 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 12S: EBD-6



Summary for Subcatchment 13S: EBD-7

[49] Hint: Tc<2dt may require smaller dt

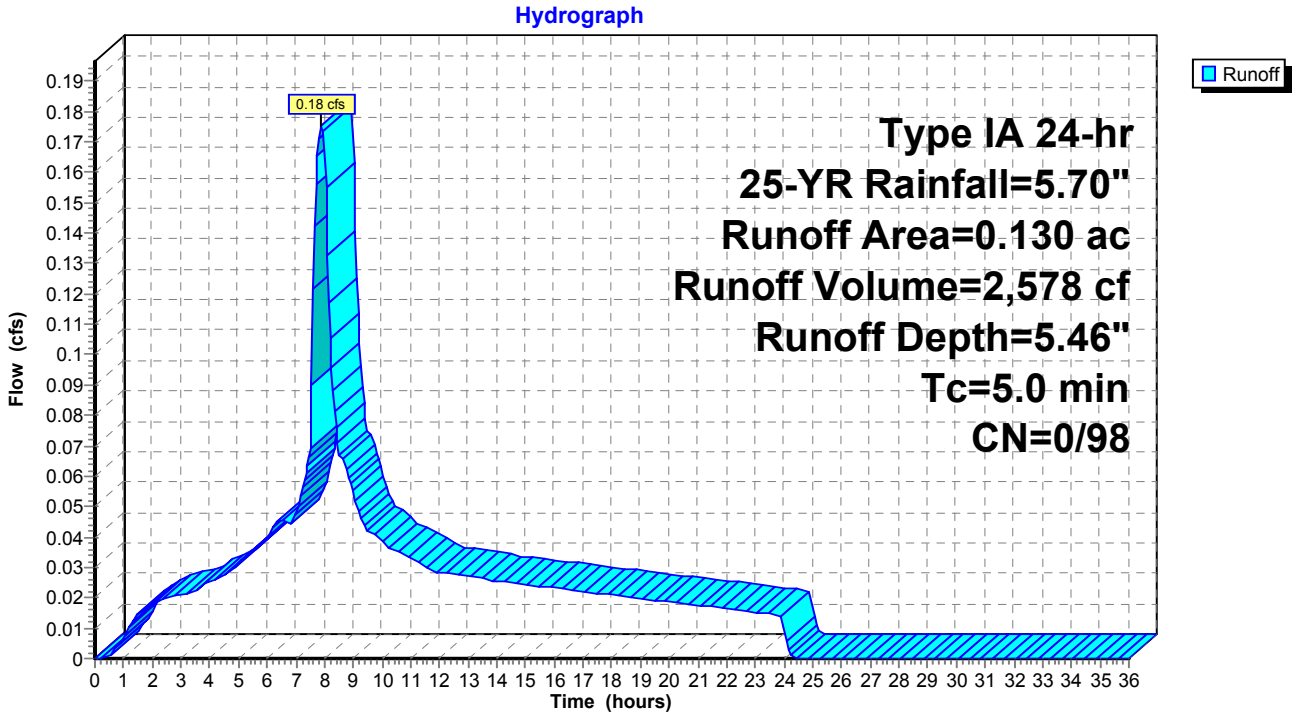
Runoff = 0.18 cfs @ 7.89 hrs, Volume= 2,578 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 13S: EBD-7



Summary for Subcatchment 14S: EBD-8

[49] Hint: Tc<2dt may require smaller dt

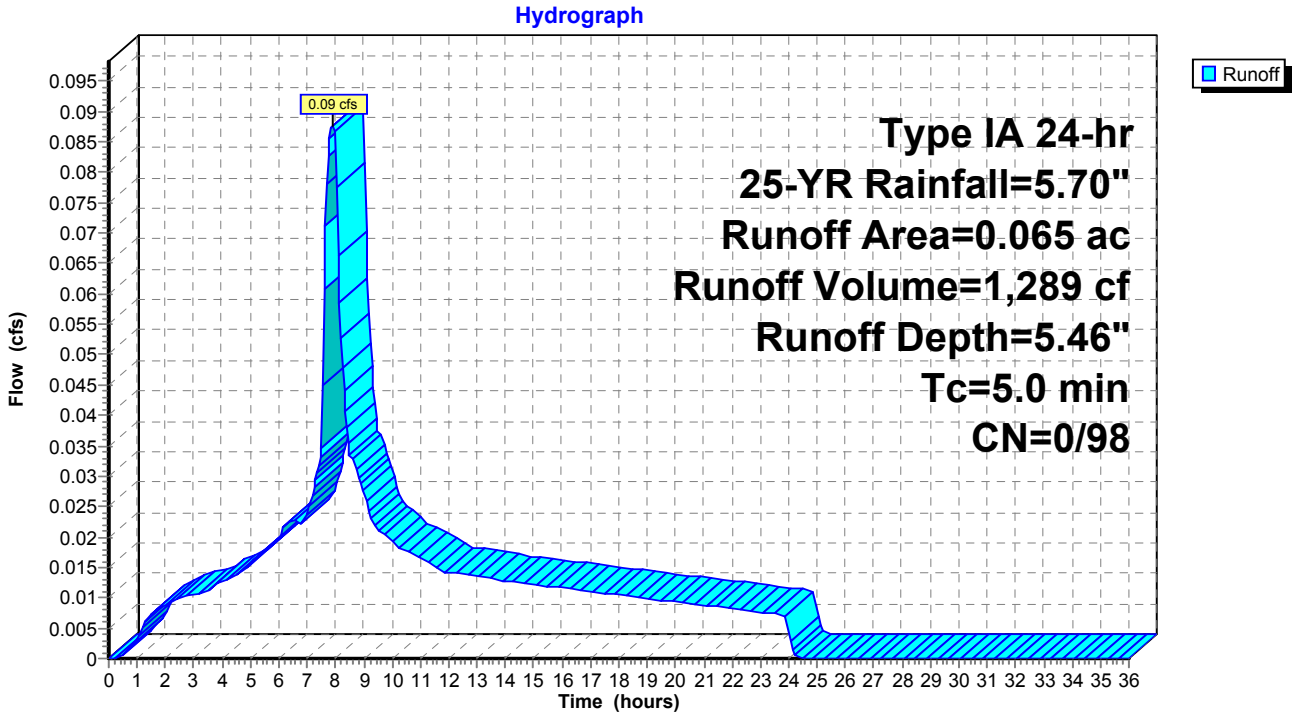
Runoff = 0.09 cfs @ 7.89 hrs, Volume= 1,289 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.065	98	
	0.065	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 14S: EBD-8



Summary for Subcatchment 15S: EBD-9

[49] Hint: Tc<2dt may require smaller dt

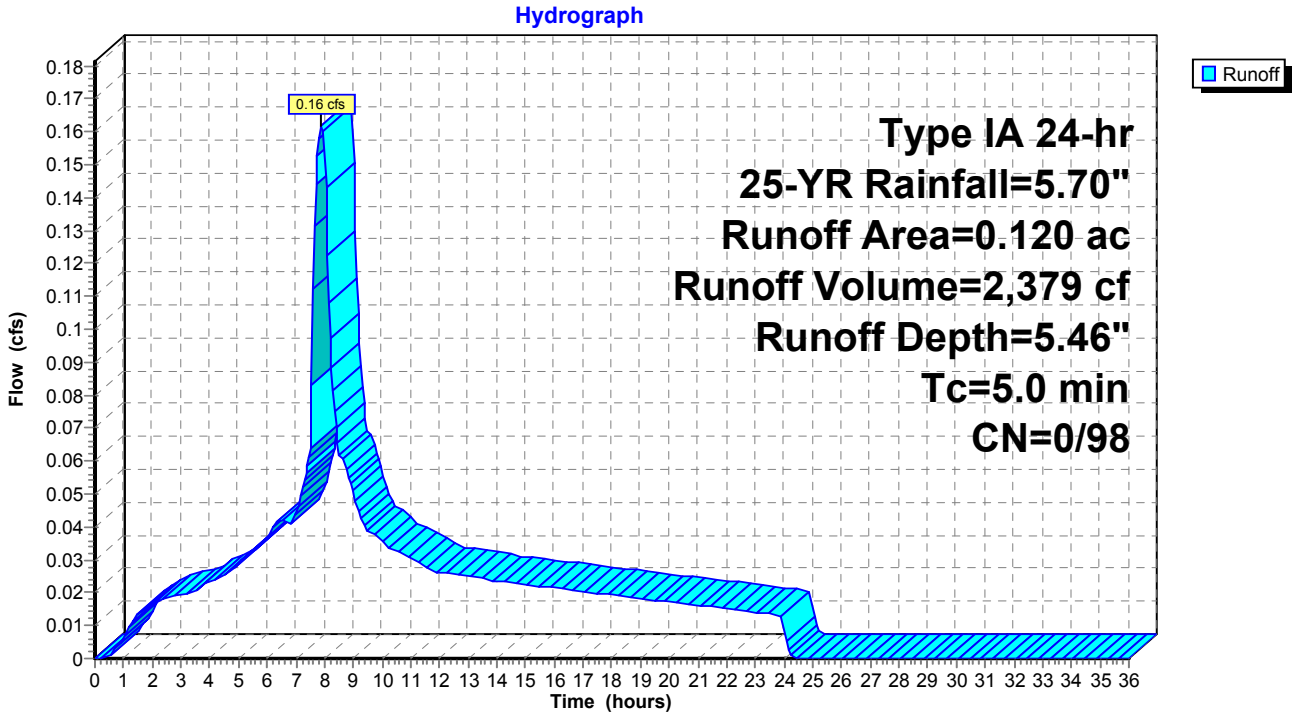
Runoff = 0.16 cfs @ 7.89 hrs, Volume= 2,379 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.120	98	
	0.120	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 15S: EBD-9



Summary for Subcatchment 16S: EBD-10

[49] Hint: Tc<2dt may require smaller dt

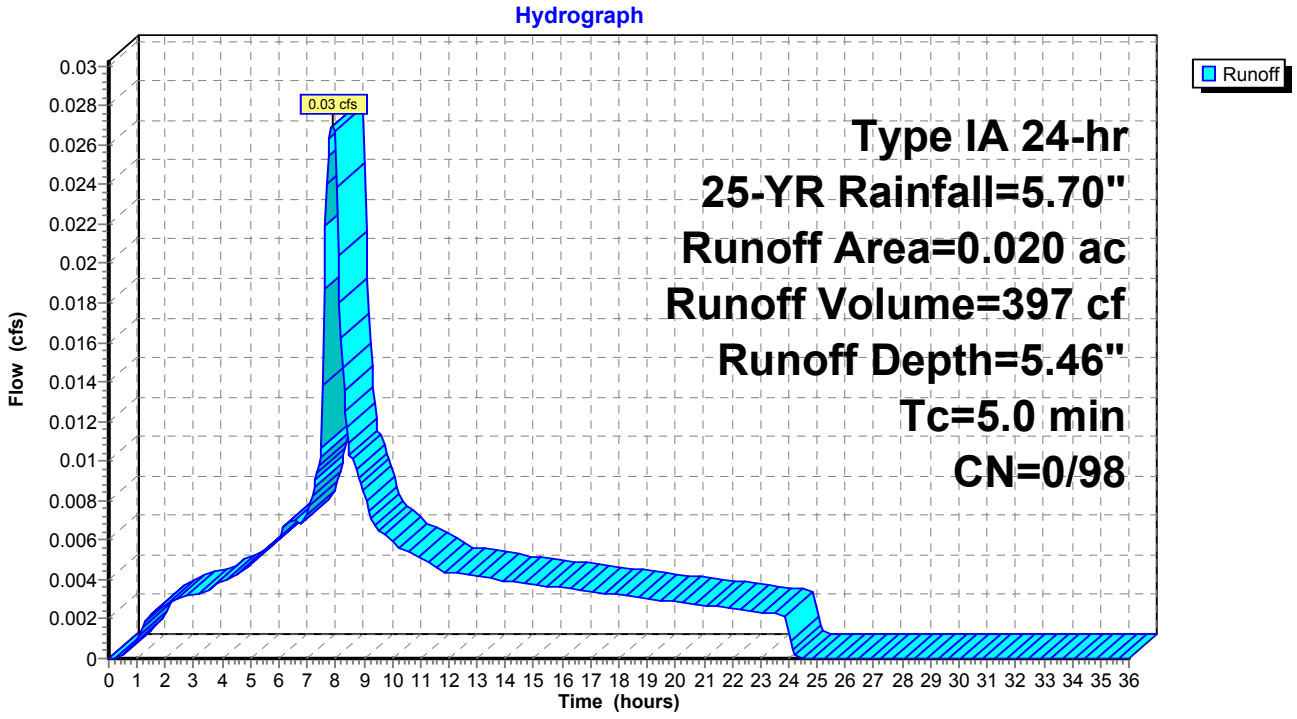
Runoff = 0.03 cfs @ 7.89 hrs, Volume= 397 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.020	98	
	0.020	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 16S: EBD-10



Summary for Subcatchment 5S: EBD-1

[49] Hint: Tc<2dt may require smaller dt

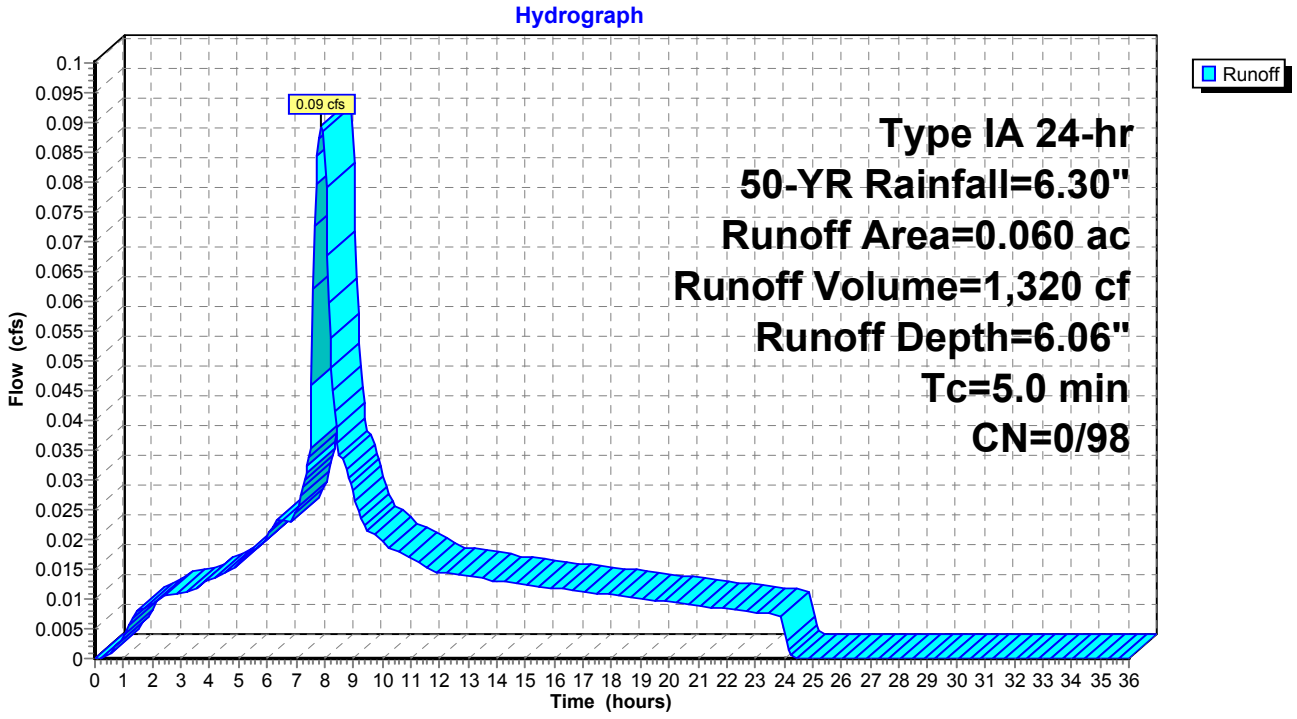
Runoff = 0.09 cfs @ 7.89 hrs, Volume= 1,320 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.060	98	
	0.060	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: EBD-1



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Summary for Subcatchment 6S: EBD-2

[49] Hint: Tc<2dt may require smaller dt

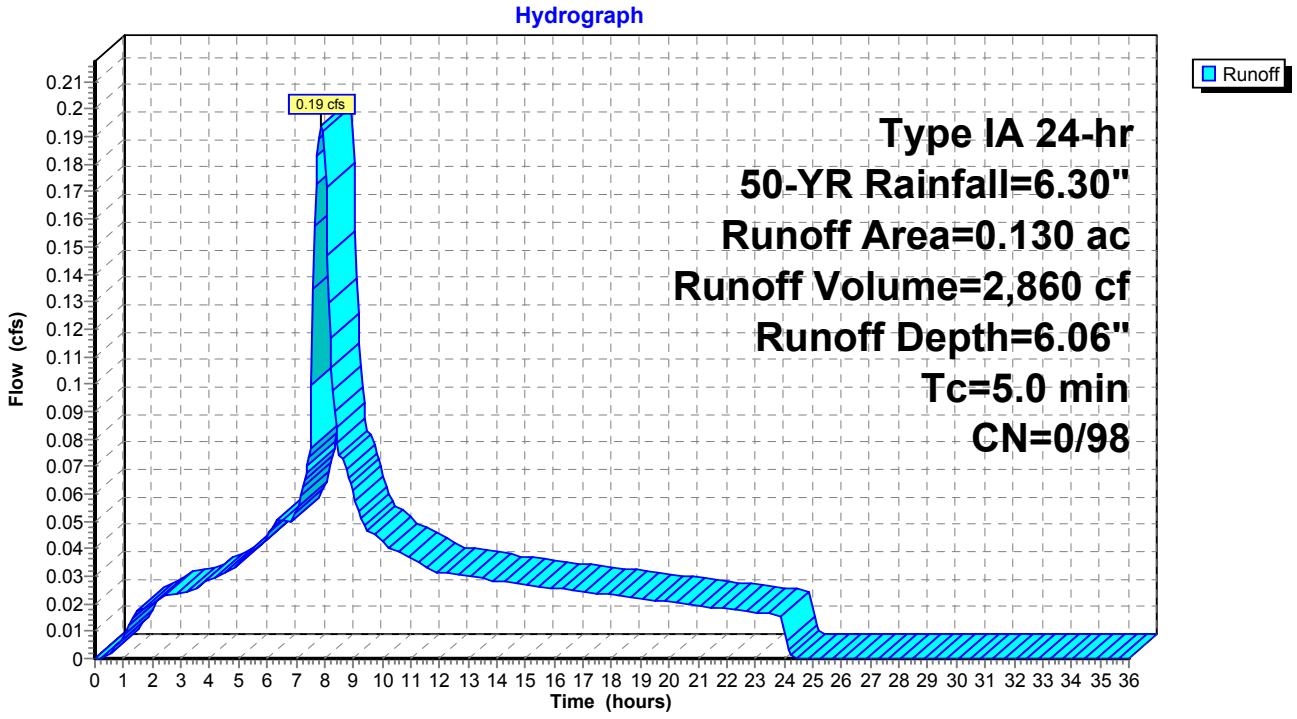
Runoff = 0.19 cfs @ 7.89 hrs, Volume= 2,860 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: EBD-2



Summary for Subcatchment 9S: EBD-3

[49] Hint: Tc<2dt may require smaller dt

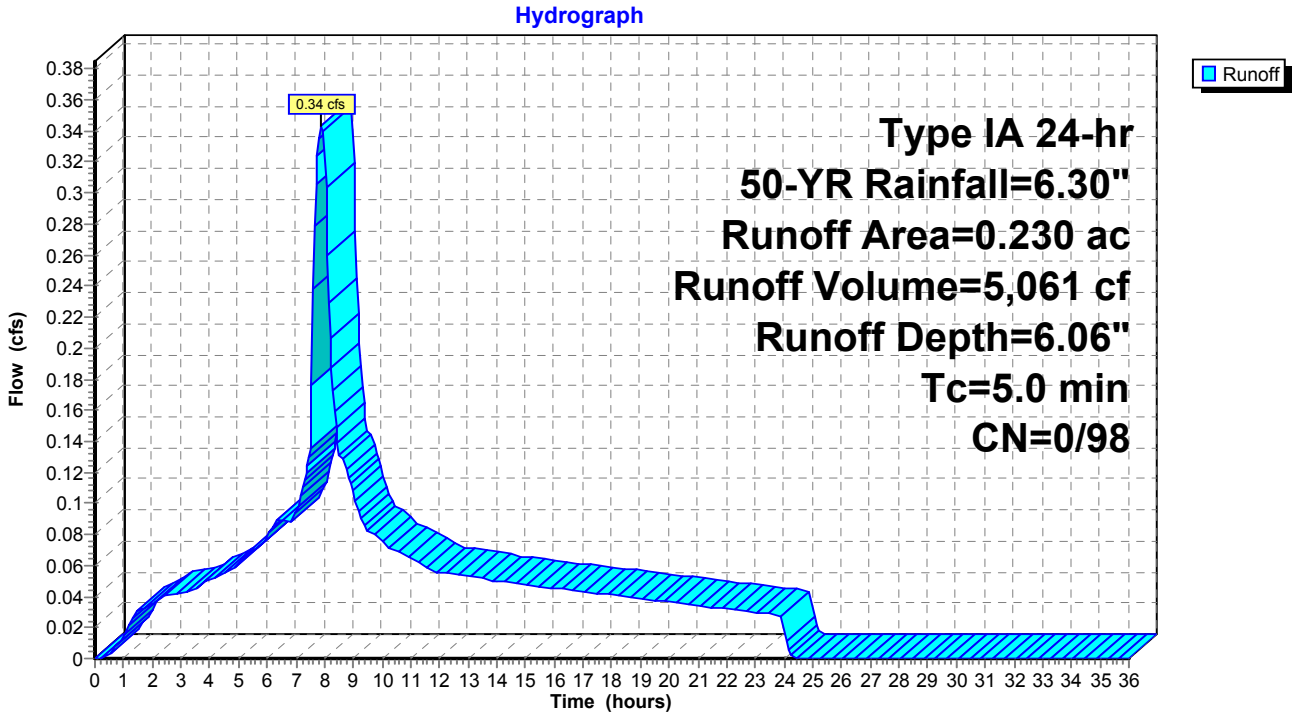
Runoff = 0.34 cfs @ 7.89 hrs, Volume= 5,061 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.230	98	
	0.230	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: EBD-3



Summary for Subcatchment 10S: EBD-4

[49] Hint: Tc<2dt may require smaller dt

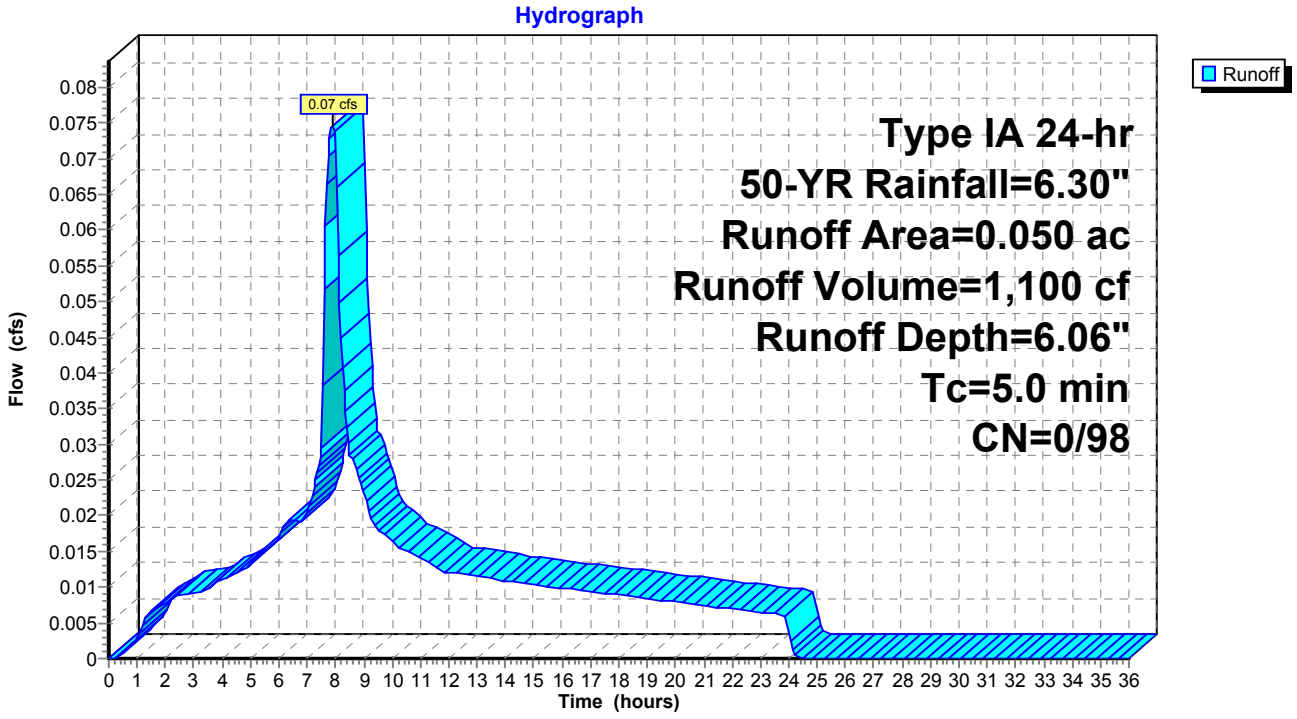
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 1,100 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: EBD-4



Summary for Subcatchment 11S: EBD-5

[49] Hint: Tc<2dt may require smaller dt

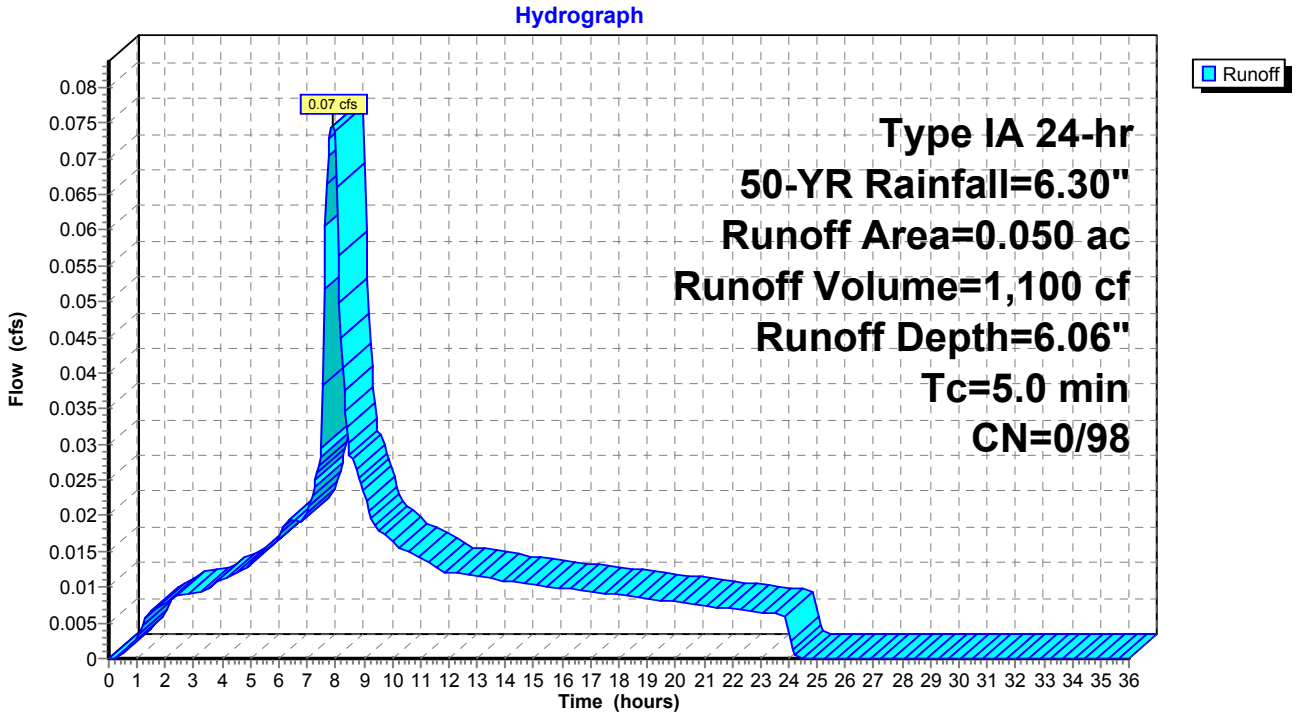
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 1,100 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: EBD-5



Summary for Subcatchment 12S: EBD-6

[49] Hint: Tc<2dt may require smaller dt

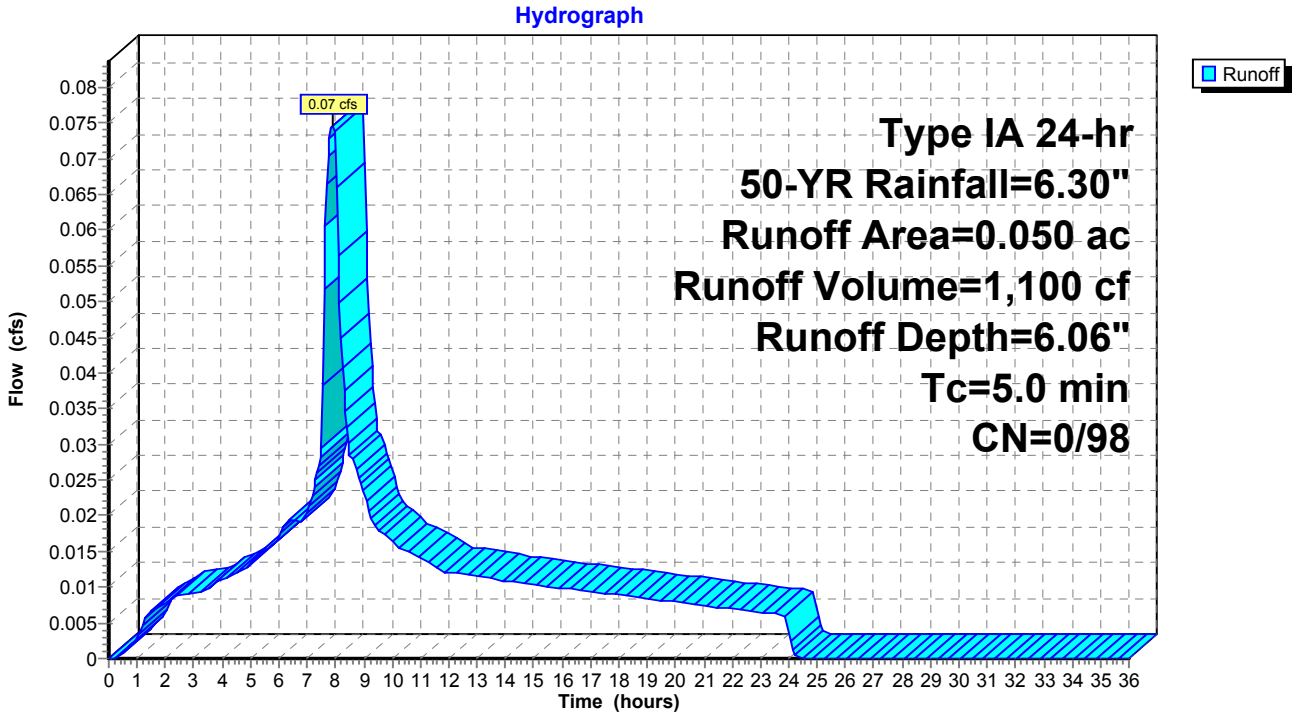
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 1,100 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 12S: EBD-6



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Summary for Subcatchment 13S: EBD-7

[49] Hint: Tc<2dt may require smaller dt

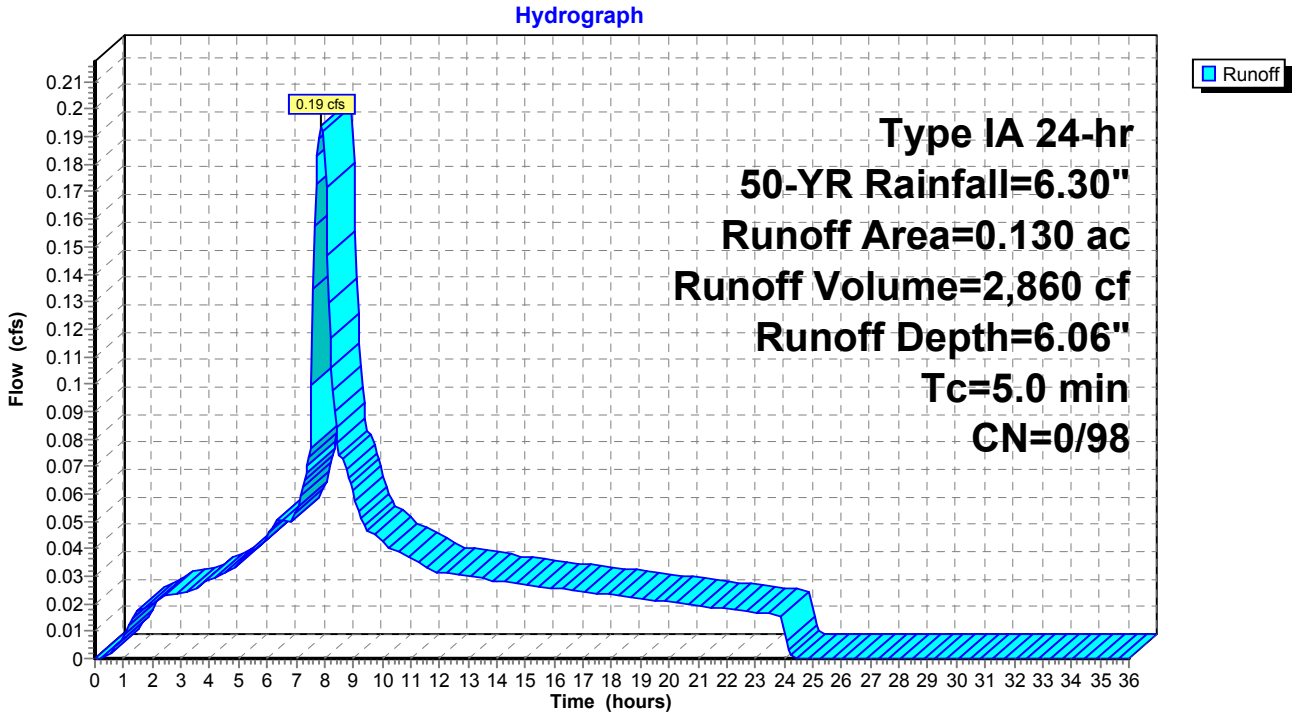
Runoff = 0.19 cfs @ 7.89 hrs, Volume= 2,860 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 13S: EBD-7



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Summary for Subcatchment 14S: EBD-8

[49] Hint: Tc<2dt may require smaller dt

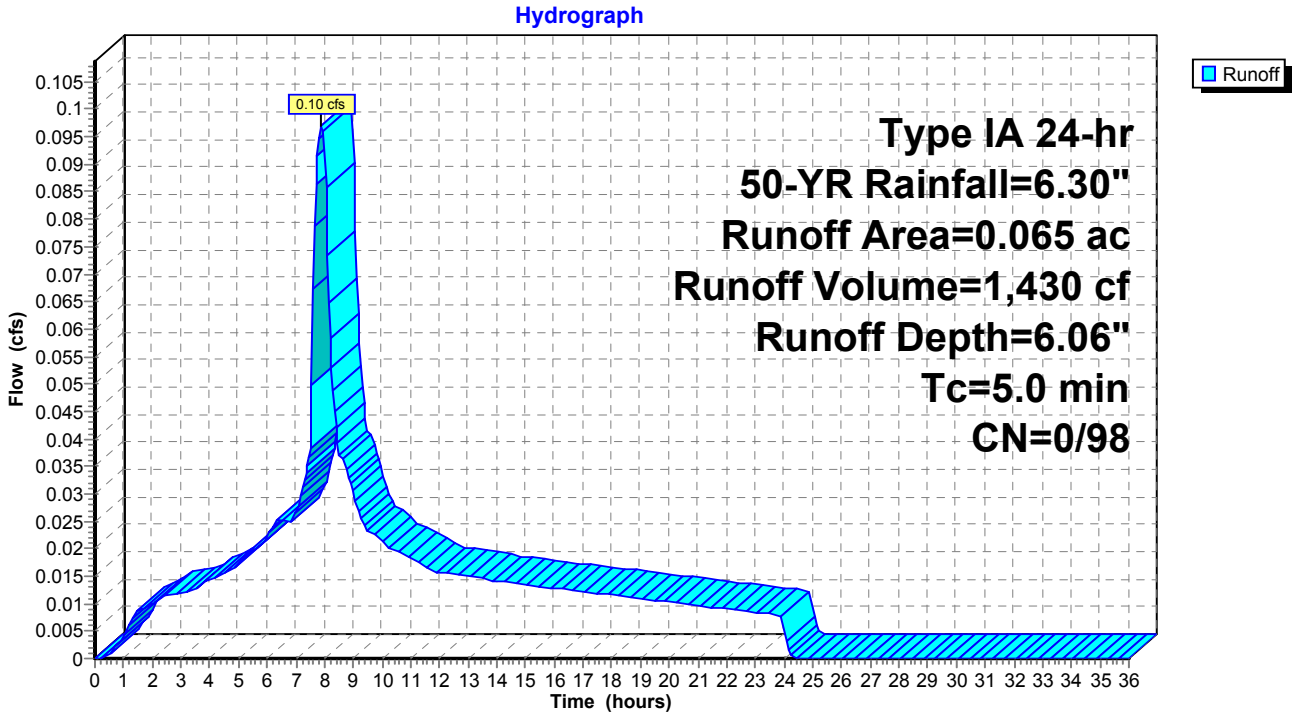
Runoff = 0.10 cfs @ 7.89 hrs, Volume= 1,430 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.065	98	
	0.065	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 14S: EBD-8



Summary for Subcatchment 15S: EBD-9

[49] Hint: Tc<2dt may require smaller dt

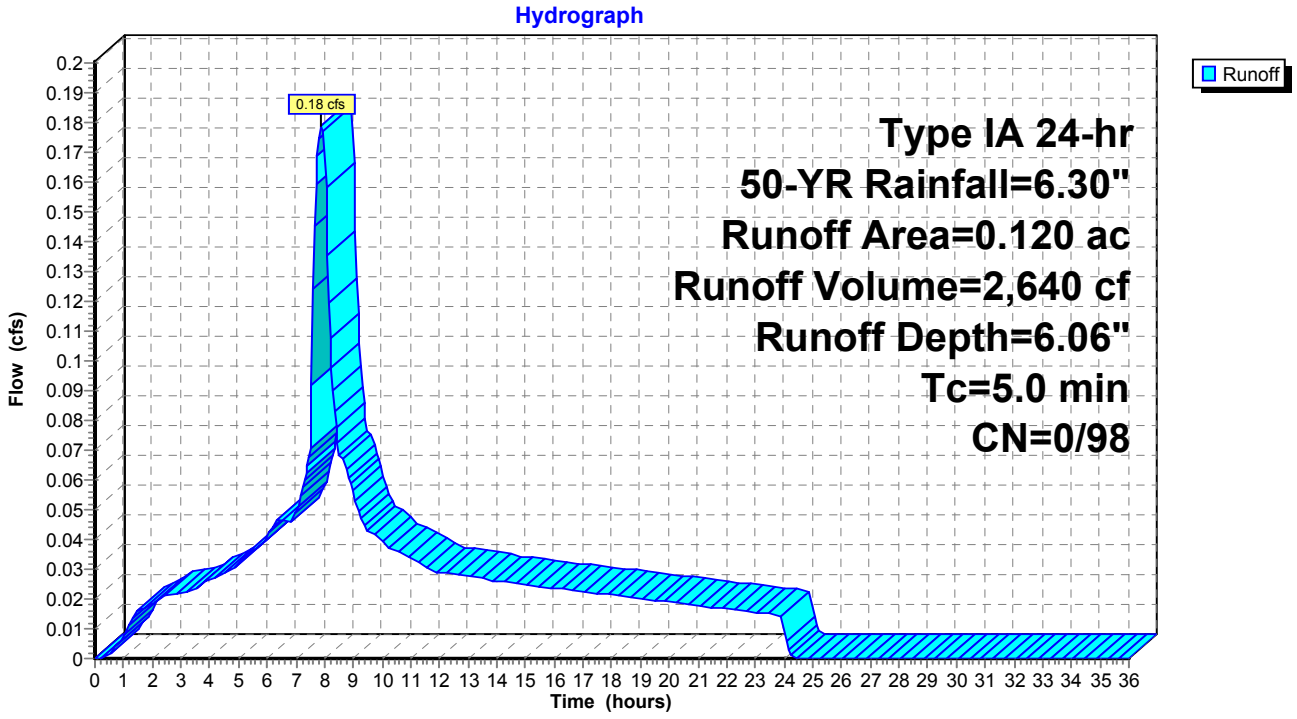
Runoff = 0.18 cfs @ 7.89 hrs, Volume= 2,640 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.120	98	
	0.120	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 15S: EBD-9



Summary for Subcatchment 16S: EBD-10

[49] Hint: Tc<2dt may require smaller dt

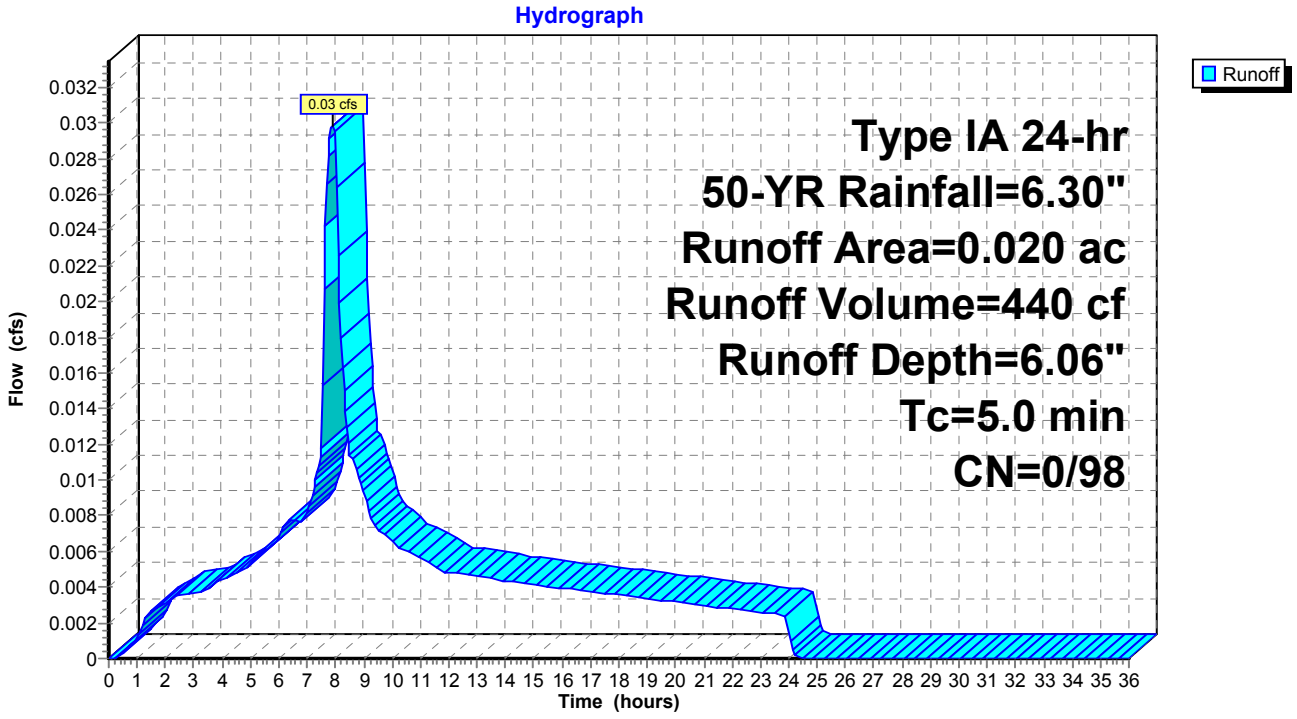
Runoff = 0.03 cfs @ 7.89 hrs, Volume= 440 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.020	98	
	0.020	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 16S: EBD-10



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Summary for Subcatchment 5S: EBD-1

[49] Hint: Tc<2dt may require smaller dt

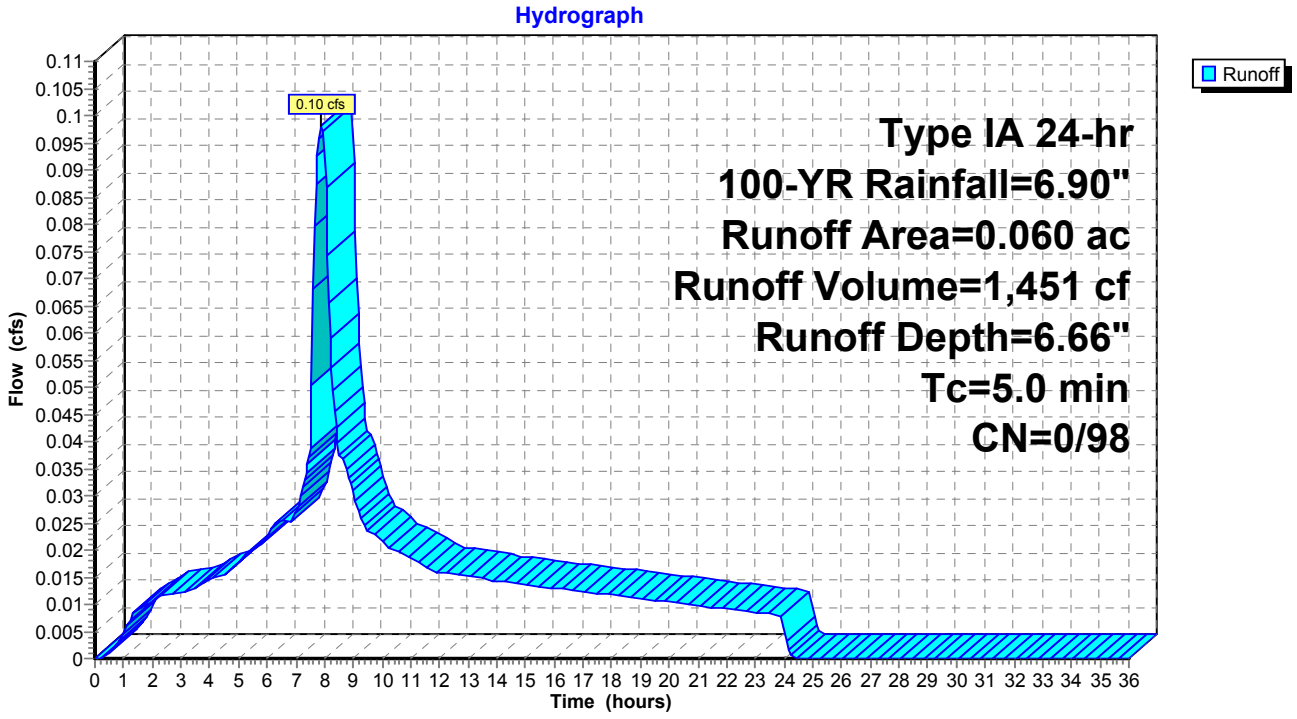
Runoff = 0.10 cfs @ 7.89 hrs, Volume= 1,451 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.060	98	
	0.060	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: EBD-1



Summary for Subcatchment 6S: EBD-2

[49] Hint: Tc<2dt may require smaller dt

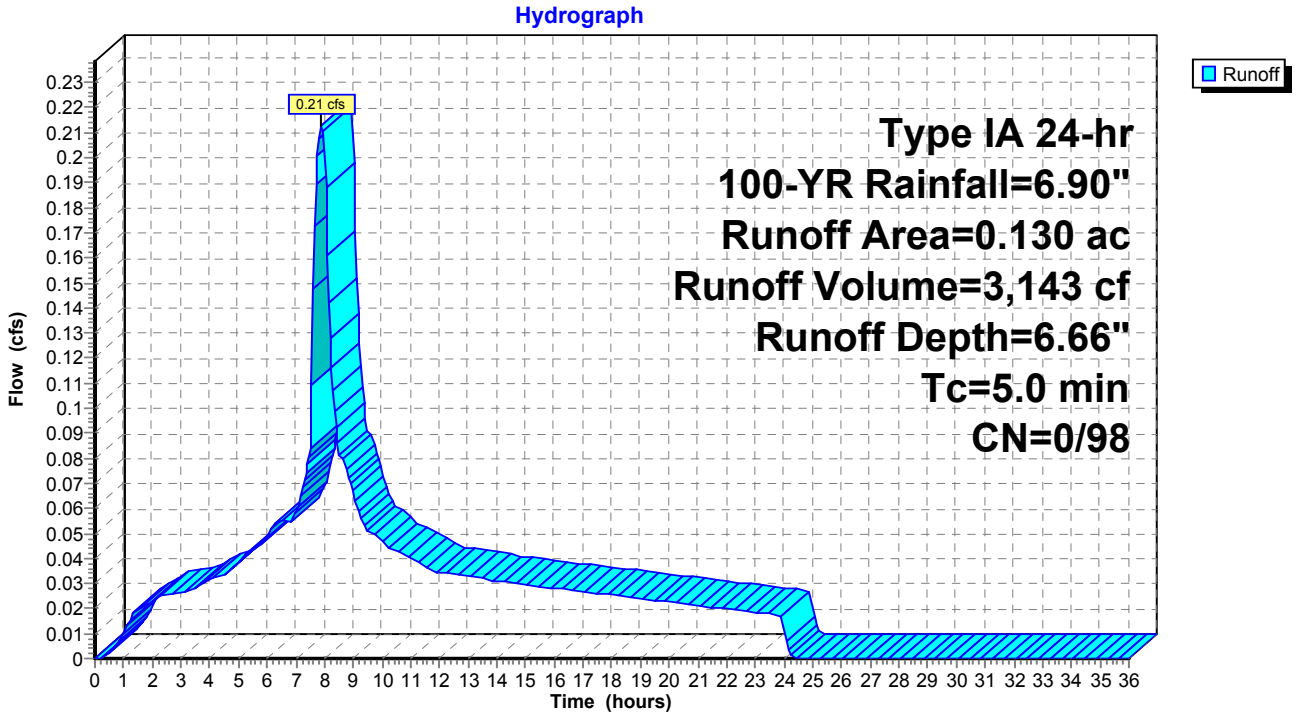
Runoff = 0.21 cfs @ 7.89 hrs, Volume= 3,143 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: EBD-2



Summary for Subcatchment 9S: EBD-3

[49] Hint: Tc<2dt may require smaller dt

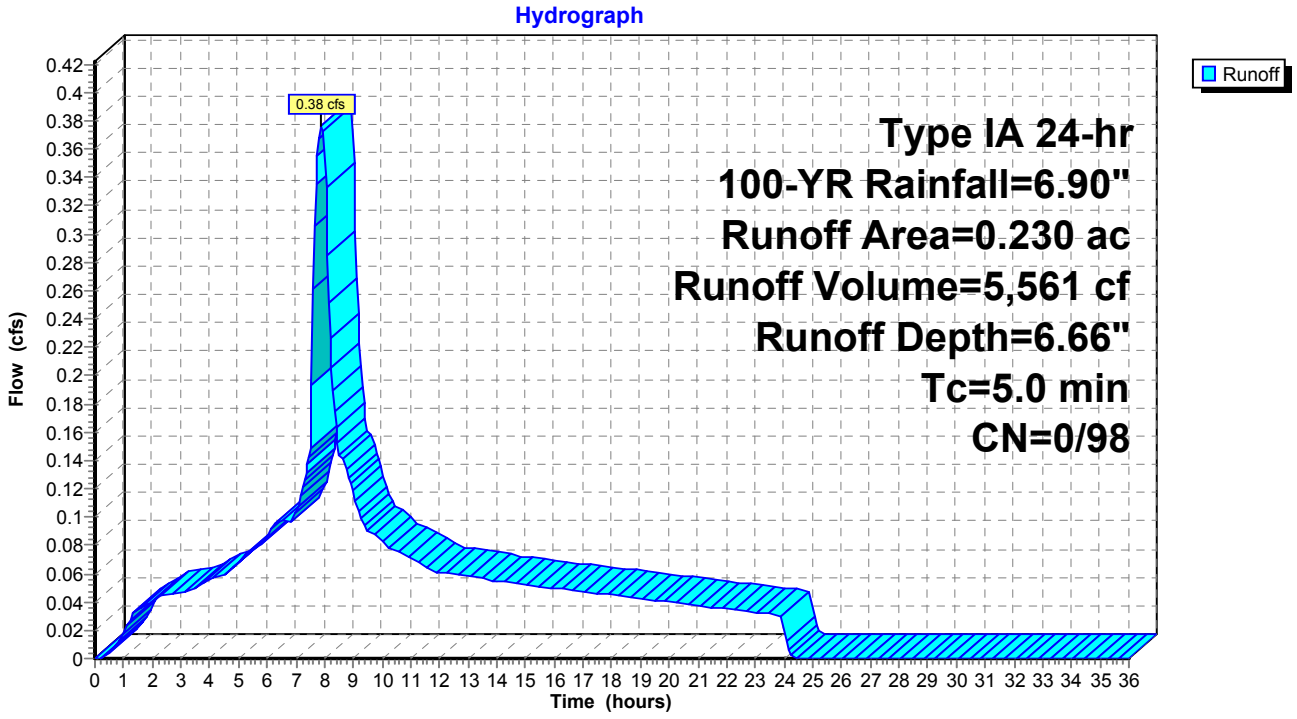
Runoff = 0.38 cfs @ 7.89 hrs, Volume= 5,561 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.230	98	
	0.230	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: EBD-3



Summary for Subcatchment 10S: EBD-4

[49] Hint: Tc<2dt may require smaller dt

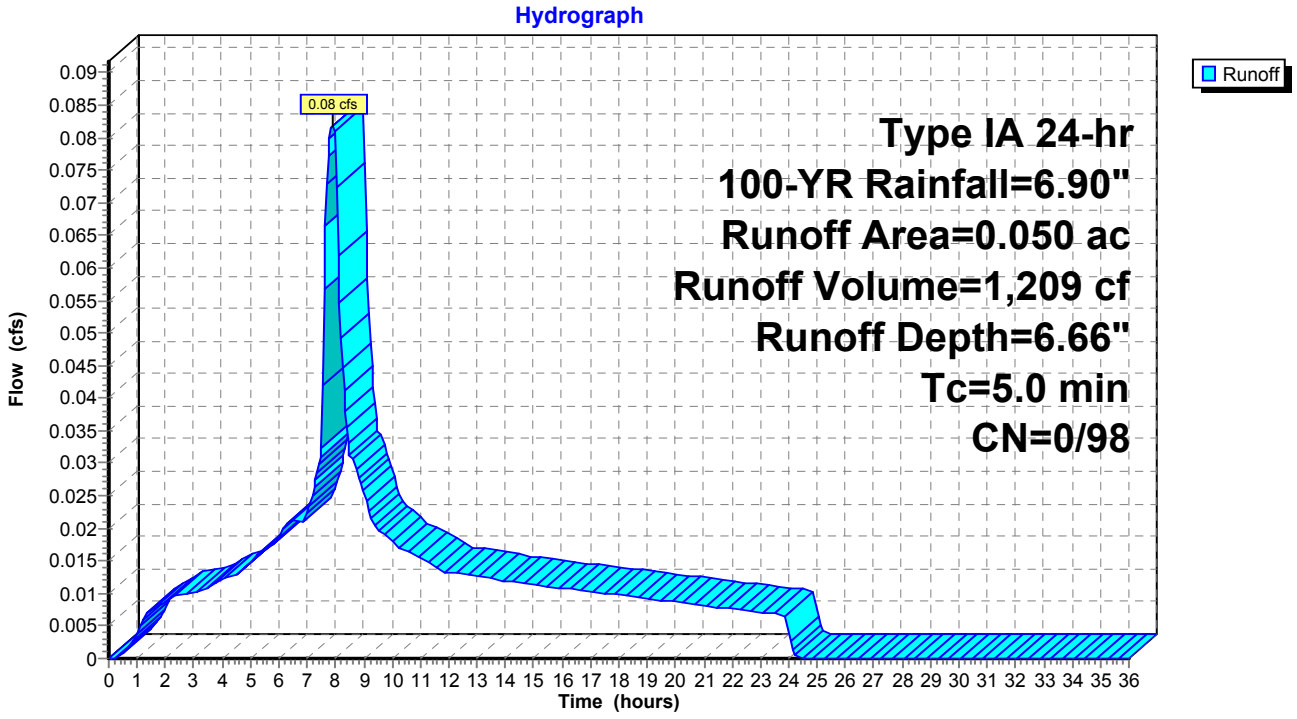
Runoff = 0.08 cfs @ 7.89 hrs, Volume= 1,209 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: EBD-4



Kentuck EBD
Prepared by David Evans and Associates, Inc.
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Summary for Subcatchment 11S: EBD-5

[49] Hint: Tc<2dt may require smaller dt

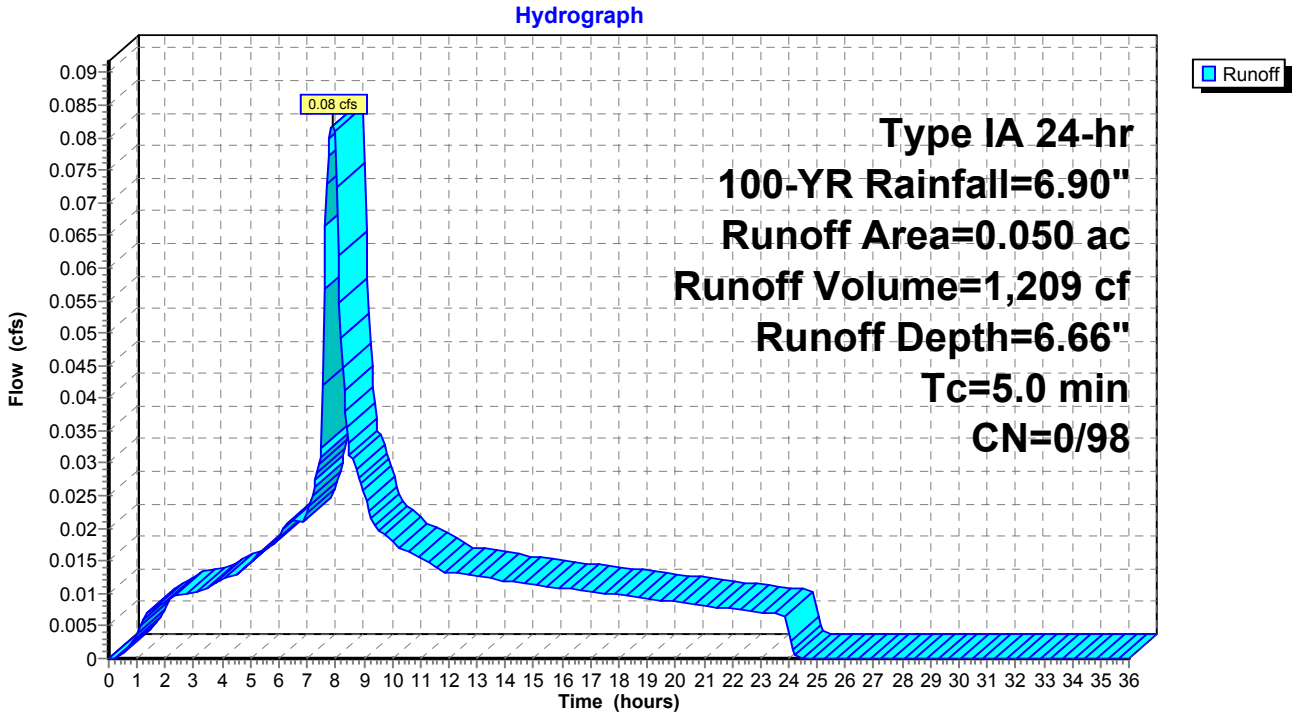
Runoff = 0.08 cfs @ 7.89 hrs, Volume= 1,209 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: EBD-5



Summary for Subcatchment 12S: EBD-6

[49] Hint: Tc<2dt may require smaller dt

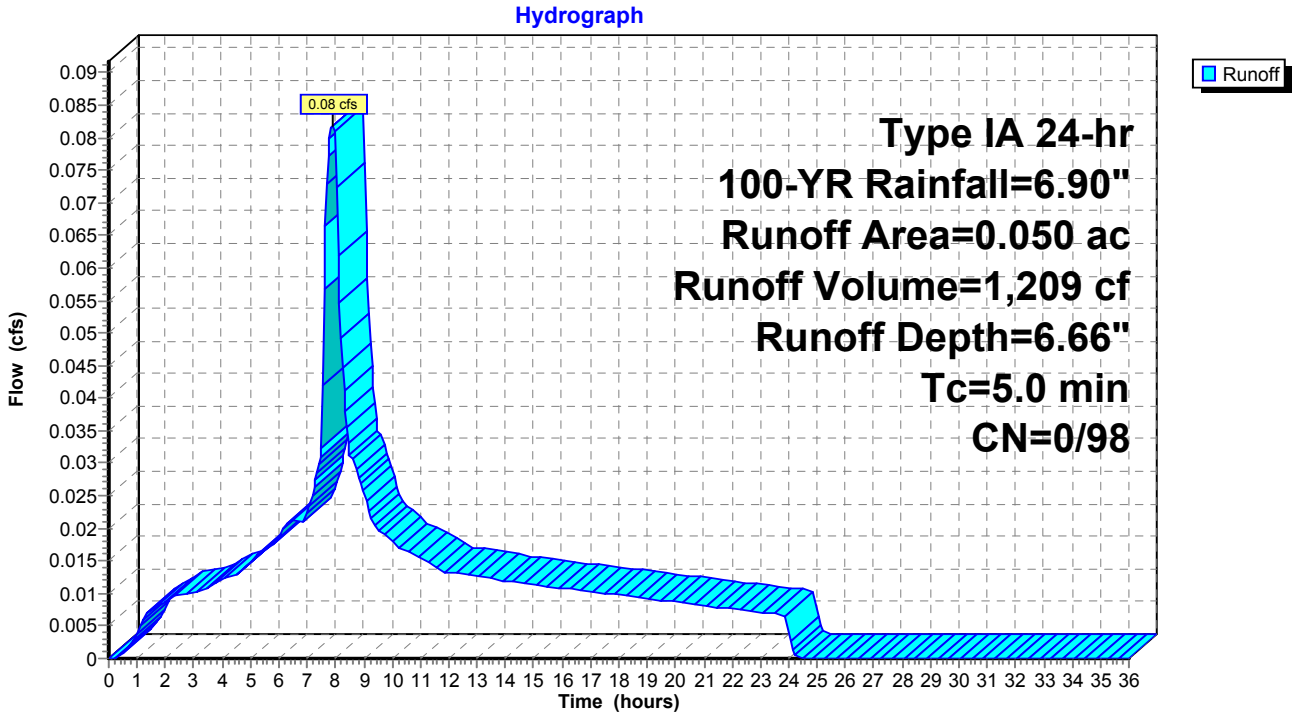
Runoff = 0.08 cfs @ 7.89 hrs, Volume= 1,209 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.050	98	
	0.050	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 12S: EBD-6



Summary for Subcatchment 13S: EBD-7

[49] Hint: Tc<2dt may require smaller dt

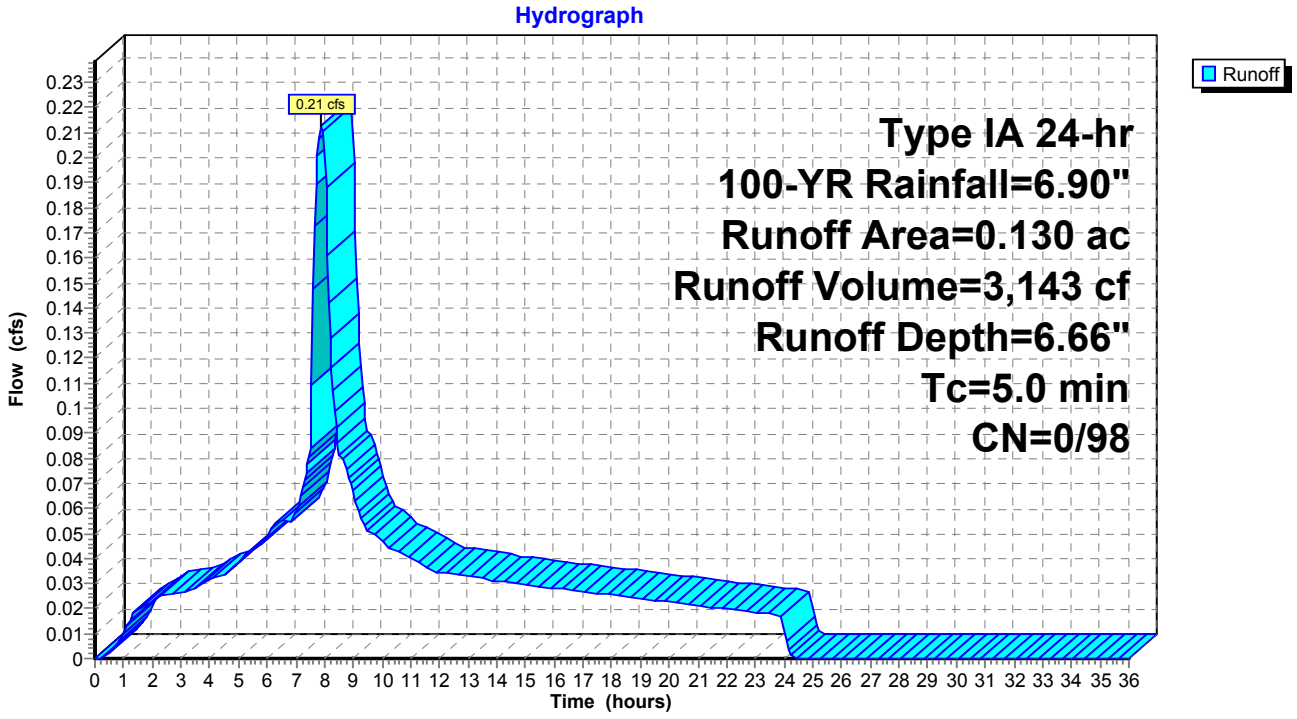
Runoff = 0.21 cfs @ 7.89 hrs, Volume= 3,143 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.130	98	
	0.130	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 13S: EBD-7



Summary for Subcatchment 14S: EBD-8

[49] Hint: Tc<2dt may require smaller dt

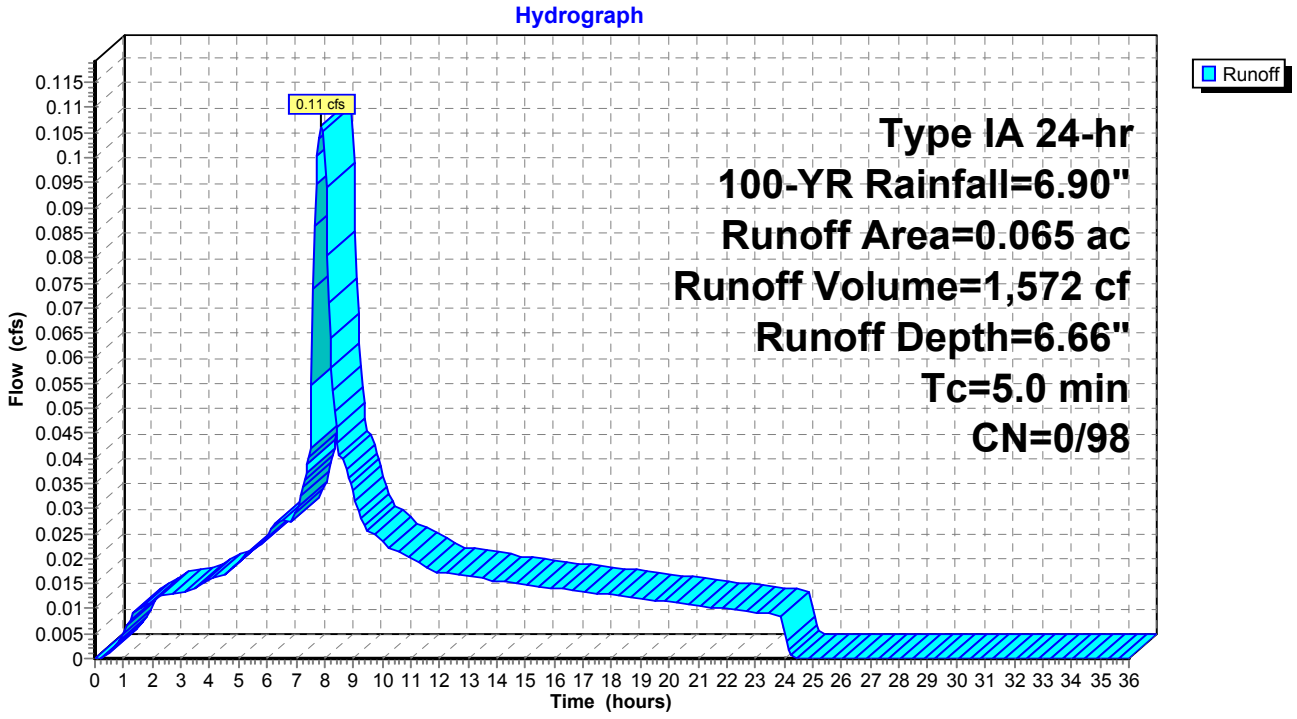
Runoff = 0.11 cfs @ 7.89 hrs, Volume= 1,572 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.065	98	
	0.065	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 14S: EBD-8



Summary for Subcatchment 15S: EBD-9

[49] Hint: Tc<2dt may require smaller dt

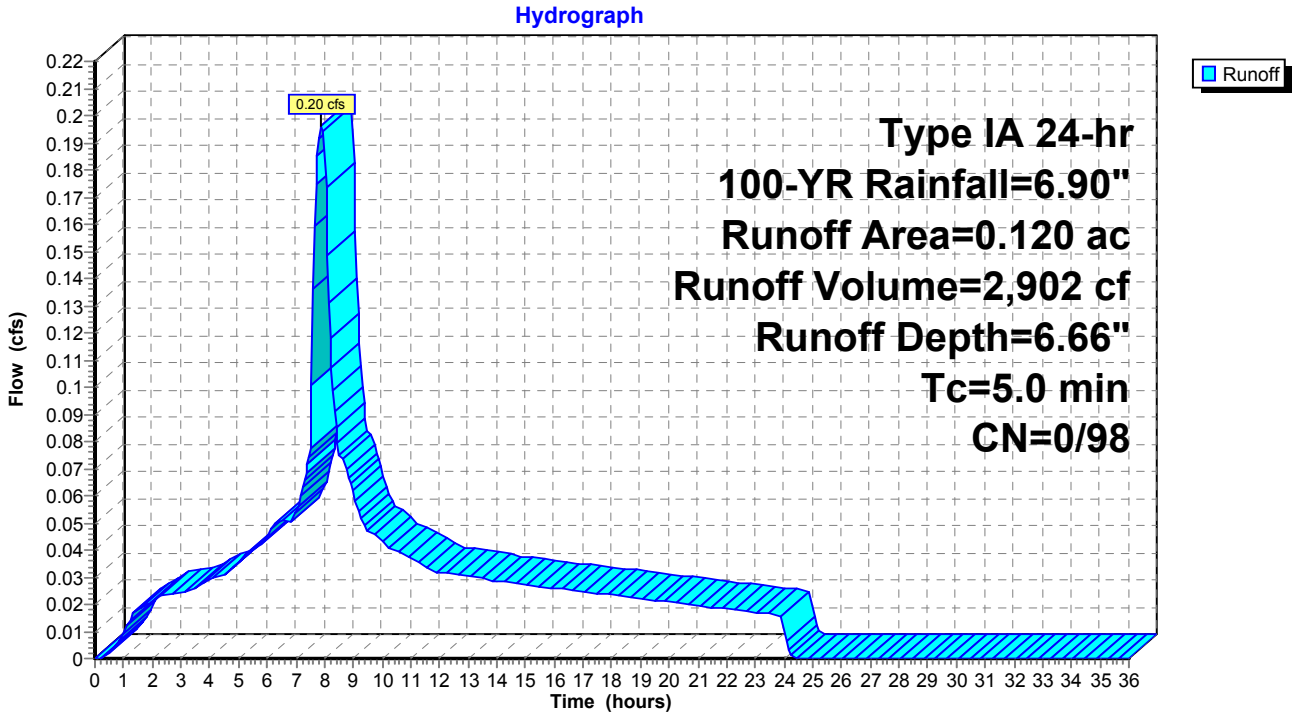
Runoff = 0.20 cfs @ 7.89 hrs, Volume= 2,902 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.120	98	
	0.120	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 15S: EBD-9



Summary for Subcatchment 16S: EBD-10

[49] Hint: Tc<2dt may require smaller dt

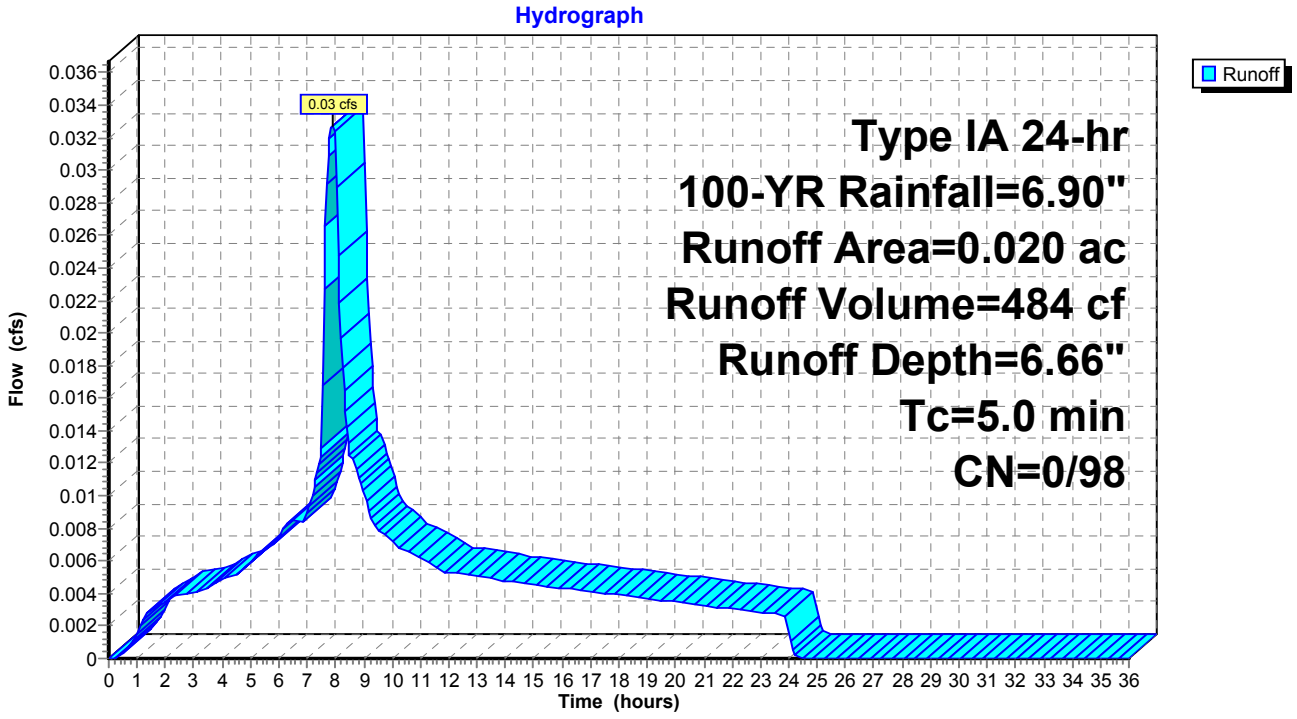
Runoff = 0.03 cfs @ 7.89 hrs, Volume= 484 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.020	98	
	0.020	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 16S: EBD-10



Summary for Subcatchment 5S: GCL-1

[49] Hint: Tc<2dt may require smaller dt

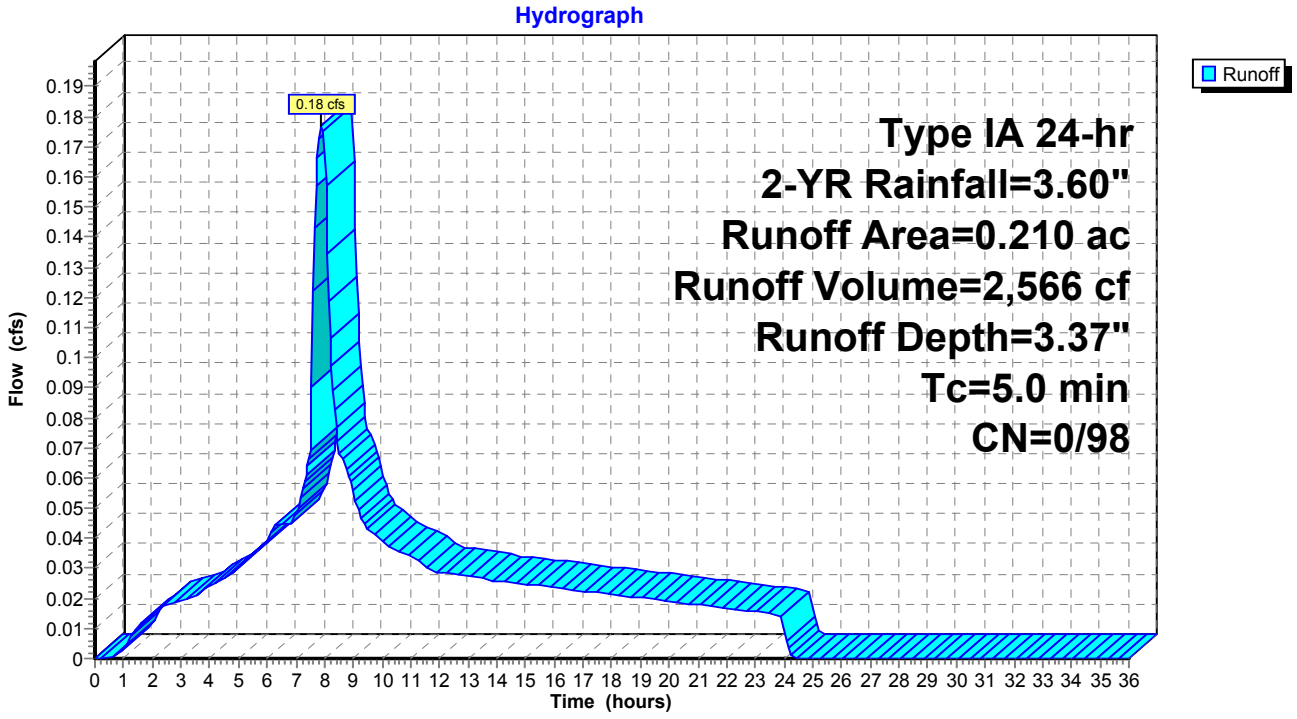
Runoff = 0.18 cfs @ 7.90 hrs, Volume= 2,566 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.210	98	
	0.210	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: GCL-1



Summary for Subcatchment 6S: GCL-2

[49] Hint: Tc<2dt may require smaller dt

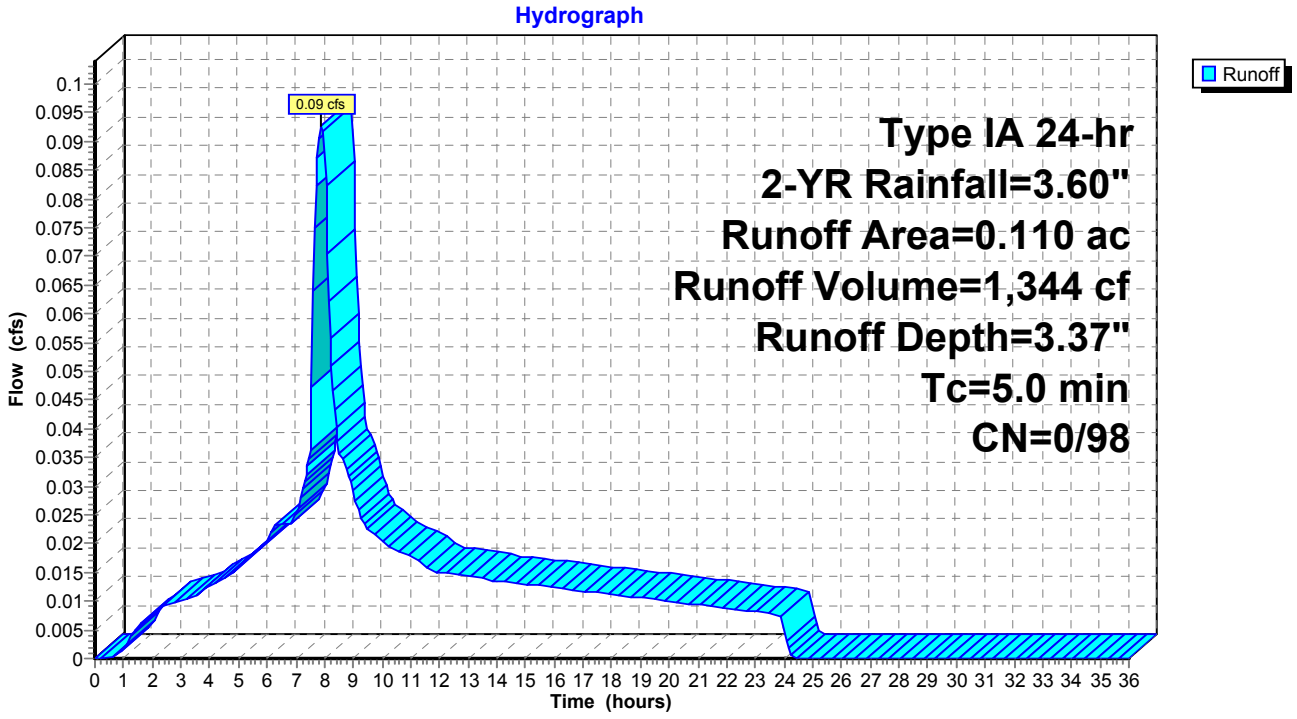
Runoff = 0.09 cfs @ 7.90 hrs, Volume= 1,344 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.110	98	
	0.110	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: GCL-2



Summary for Subcatchment 9S: GCL-3

[49] Hint: Tc<2dt may require smaller dt

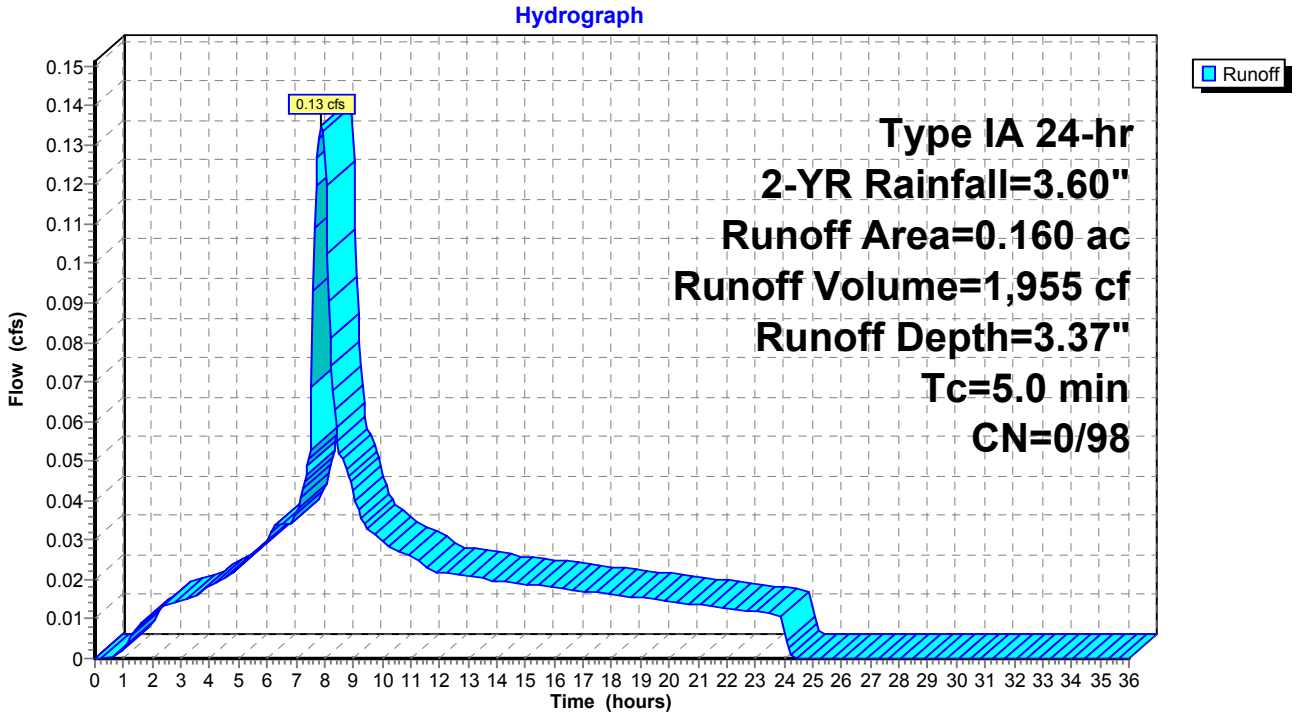
Runoff = 0.13 cfs @ 7.90 hrs, Volume= 1,955 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.160	98	
	0.160	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: GCL-3



Summary for Subcatchment 10S: GCL-4

[49] Hint: Tc<2dt may require smaller dt

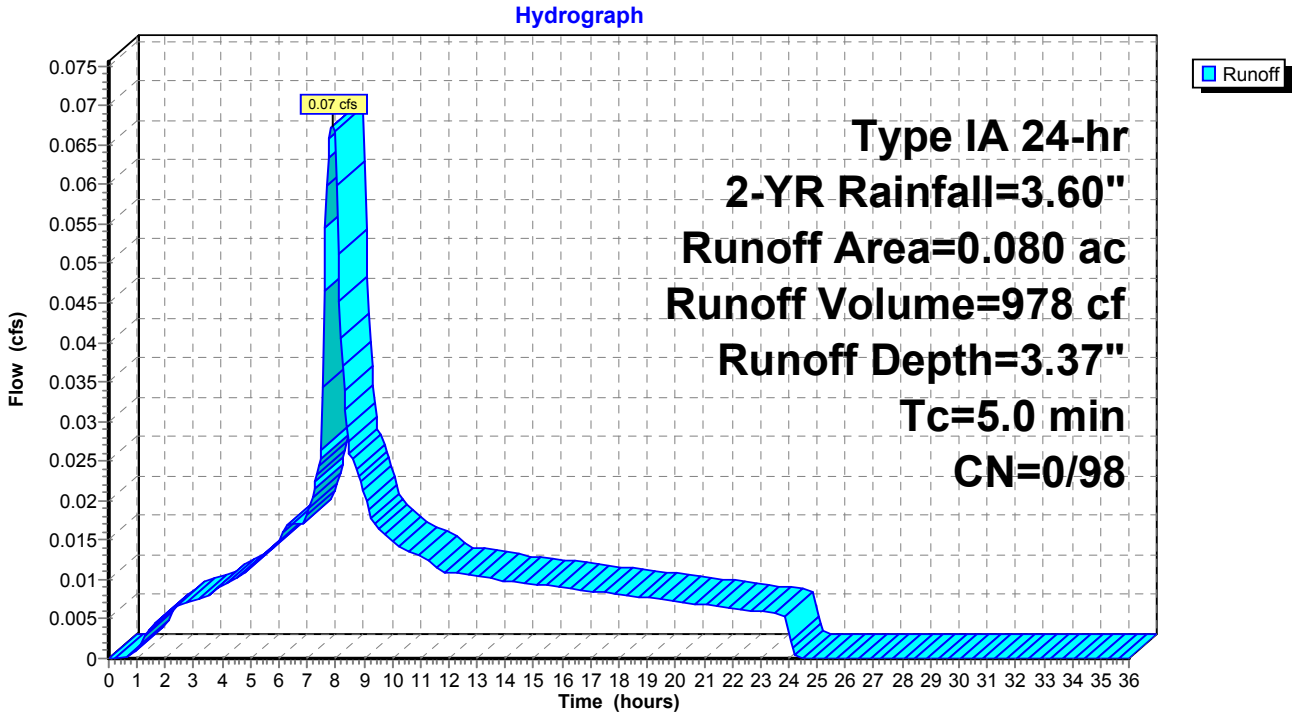
Runoff = 0.07 cfs @ 7.90 hrs, Volume= 978 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.080	98	
	0.080	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: GCL-4



Summary for Subcatchment 11S: GCL-5

[49] Hint: Tc<2dt may require smaller dt

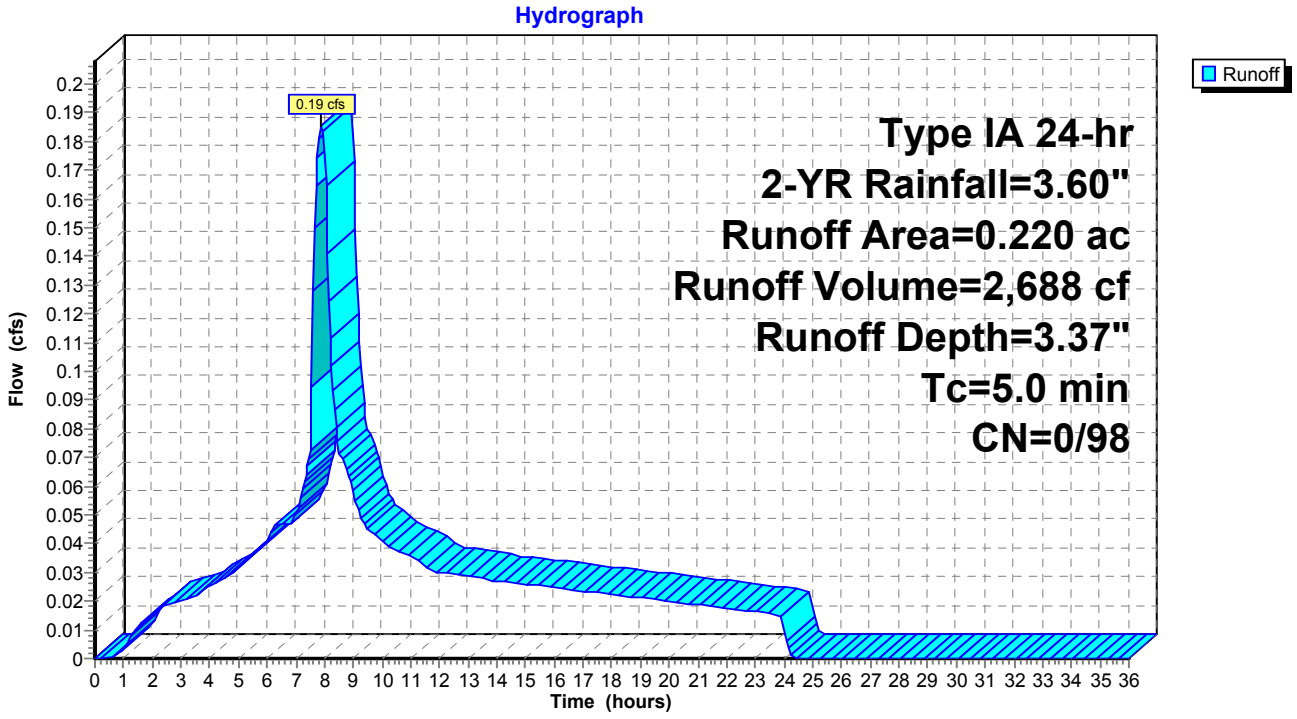
Runoff = 0.19 cfs @ 7.90 hrs, Volume= 2,688 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.220	98	
	0.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: GCL-5



Summary for Subcatchment 5S: GCL-1

[49] Hint: Tc<2dt may require smaller dt

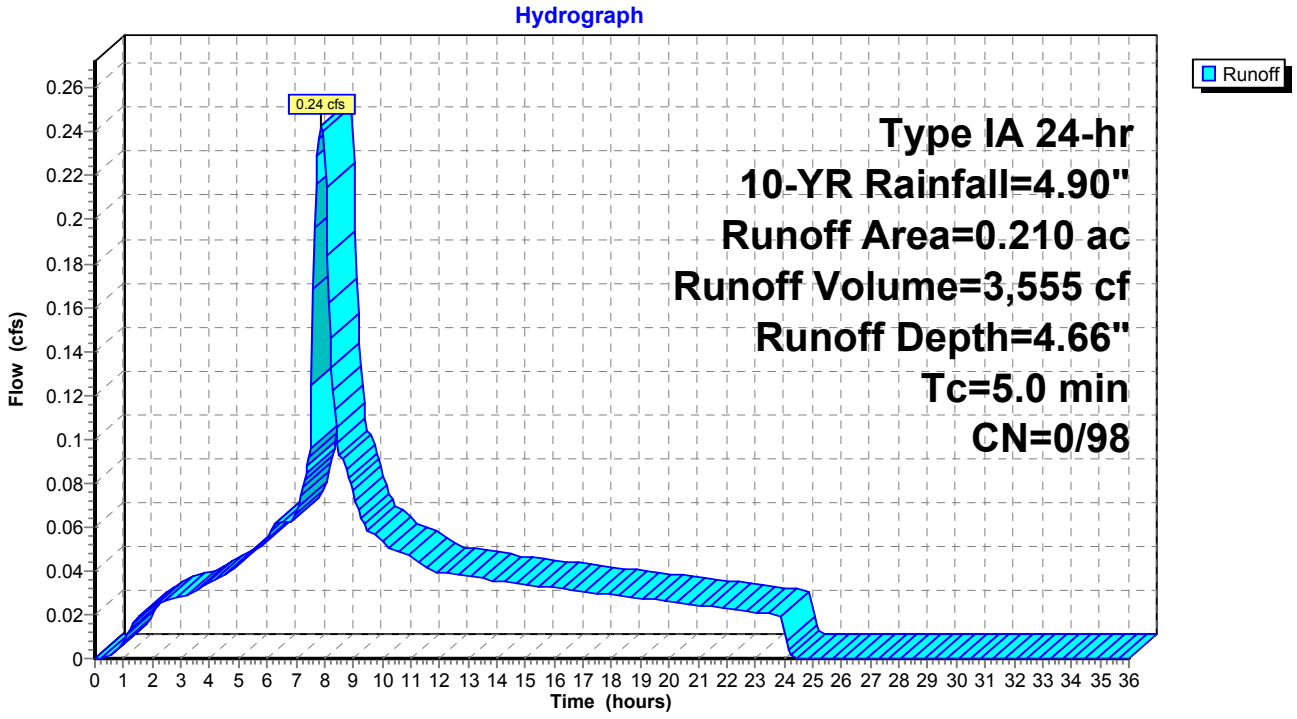
Runoff = 0.24 cfs @ 7.90 hrs, Volume= 3,555 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.210	98	
	0.210	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: GCL-1



Summary for Subcatchment 6S: GCL-2

[49] Hint: Tc<2dt may require smaller dt

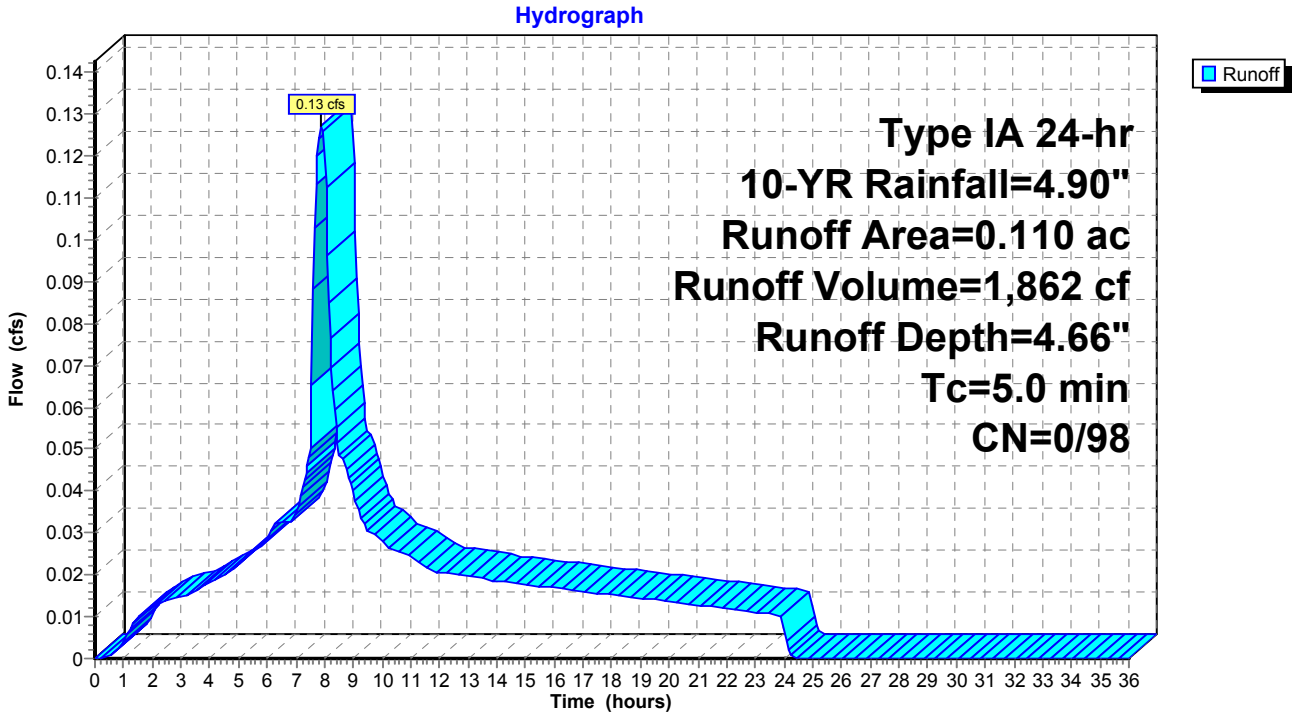
Runoff = 0.13 cfs @ 7.90 hrs, Volume= 1,862 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.110	98	
	0.110	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: GCL-2



Summary for Subcatchment 9S: GCL-3

[49] Hint: Tc<2dt may require smaller dt

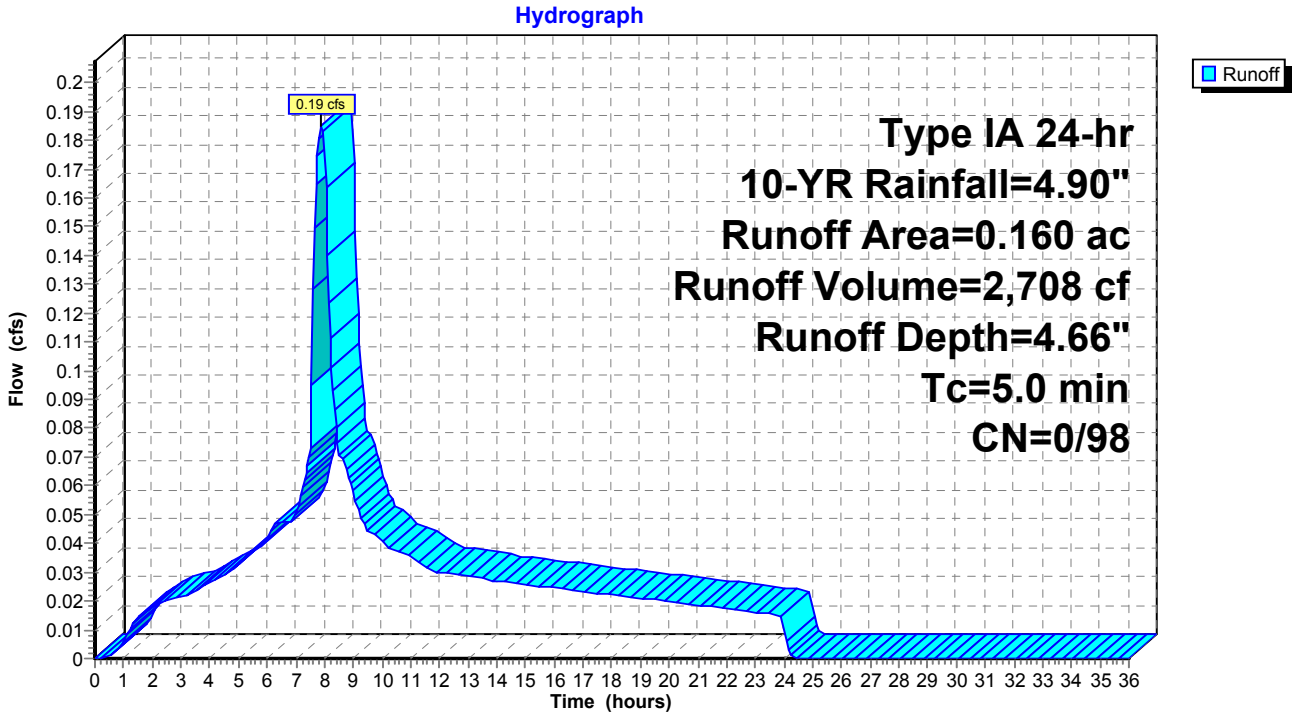
Runoff = 0.19 cfs @ 7.90 hrs, Volume= 2,708 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.160	98	
	0.160	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: GCL-3



Summary for Subcatchment 10S: GCL-4

[49] Hint: Tc<2dt may require smaller dt

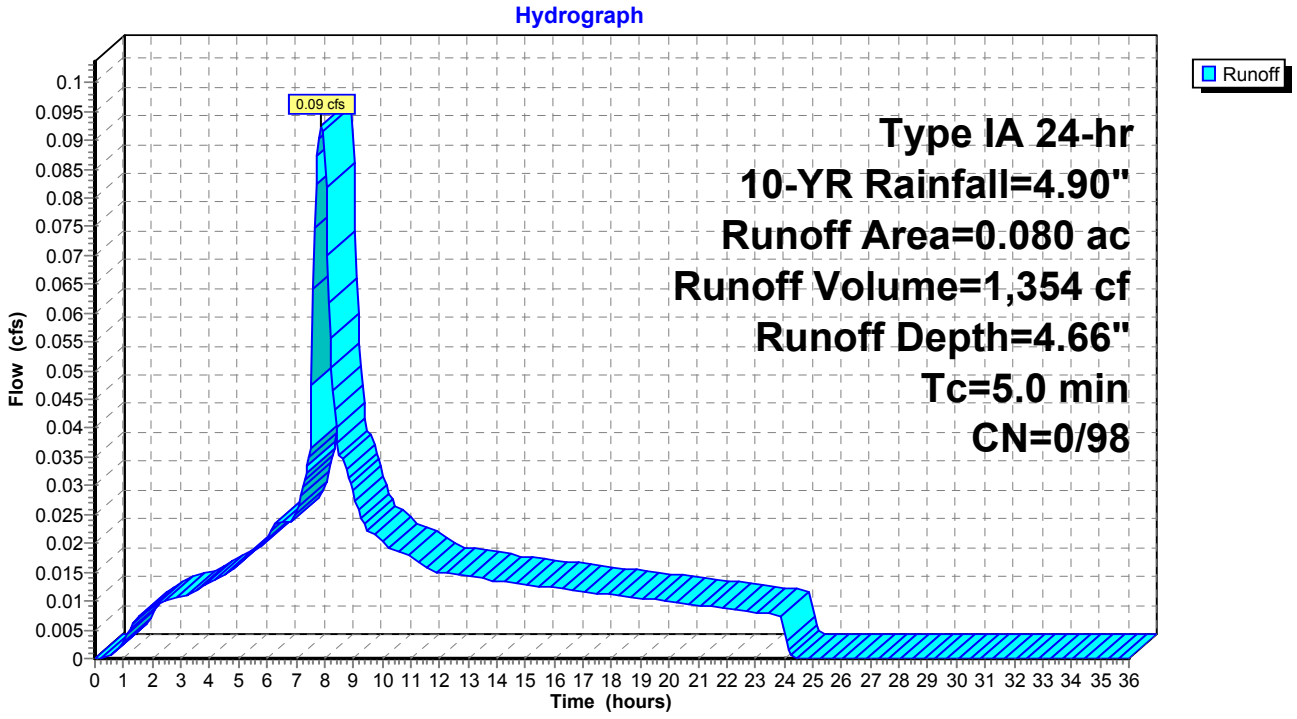
Runoff = 0.09 cfs @ 7.90 hrs, Volume= 1,354 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.080	98	
	0.080	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: GCL-4



Summary for Subcatchment 11S: GCL-5

[49] Hint: Tc<2dt may require smaller dt

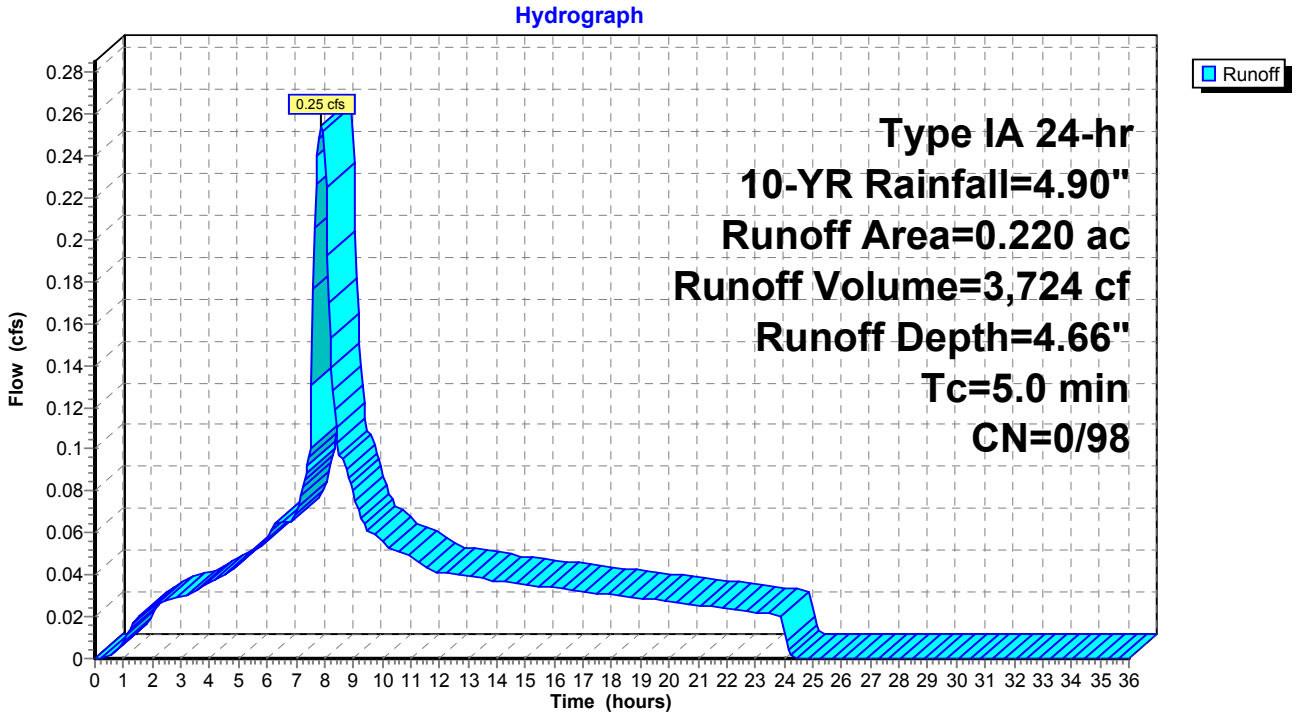
Runoff = 0.25 cfs @ 7.90 hrs, Volume= 3,724 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.220	98	
	0.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: GCL-5



Summary for Subcatchment 5S: GCL-1

[49] Hint: Tc<2dt may require smaller dt

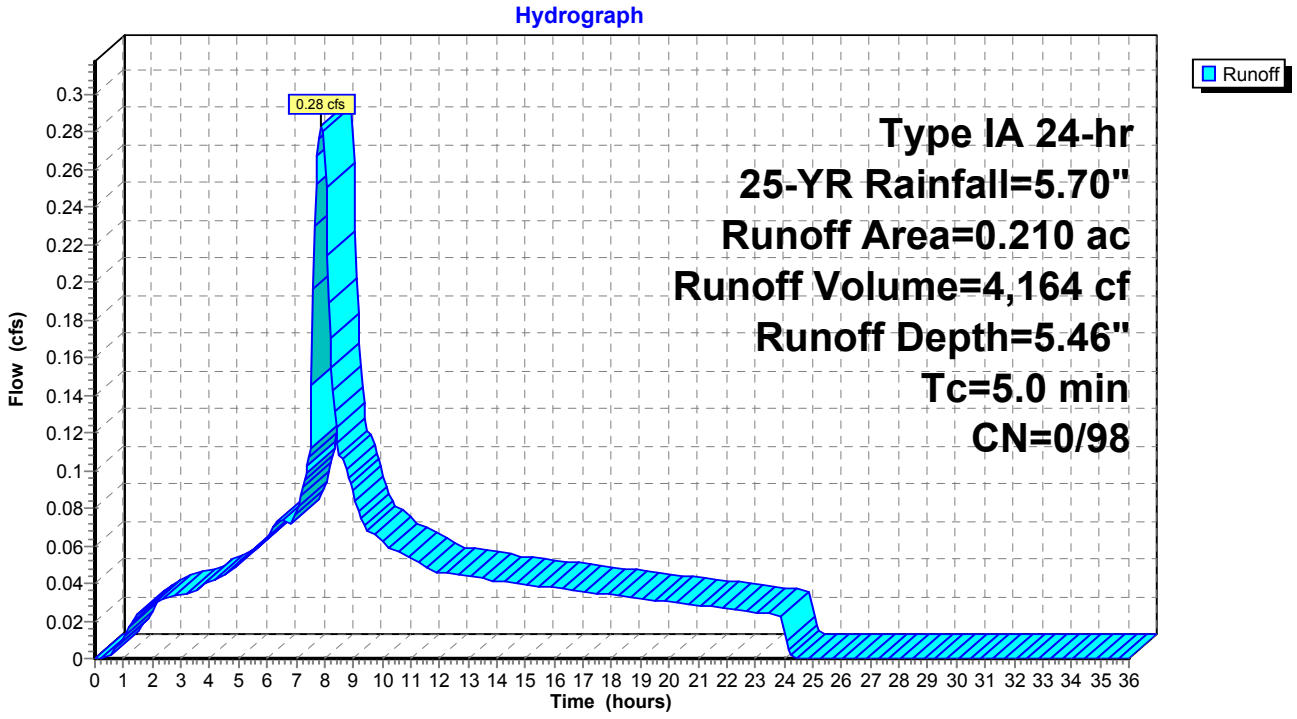
Runoff = 0.28 cfs @ 7.89 hrs, Volume= 4,164 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.210	98	
	0.210	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: GCL-1



Summary for Subcatchment 6S: GCL-2

[49] Hint: Tc<2dt may require smaller dt

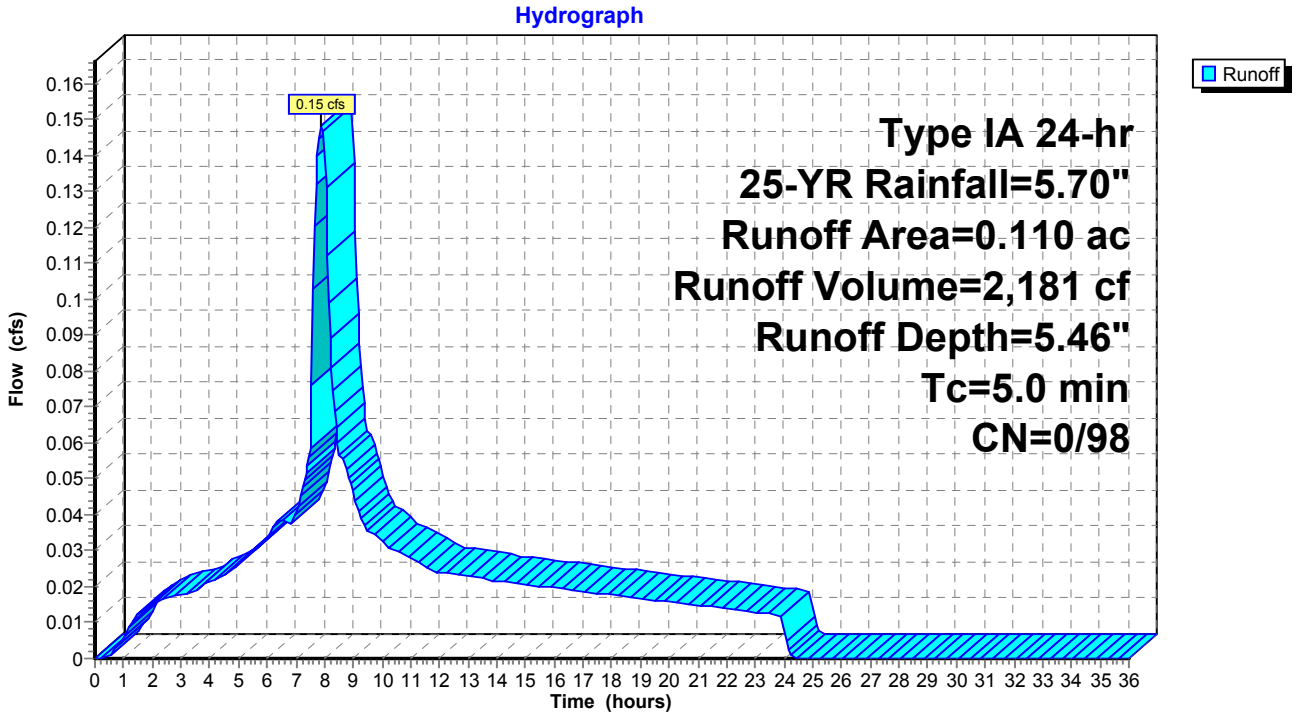
Runoff = 0.15 cfs @ 7.89 hrs, Volume= 2,181 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.110	98	
	0.110	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: GCL-2



Summary for Subcatchment 9S: GCL-3

[49] Hint: Tc<2dt may require smaller dt

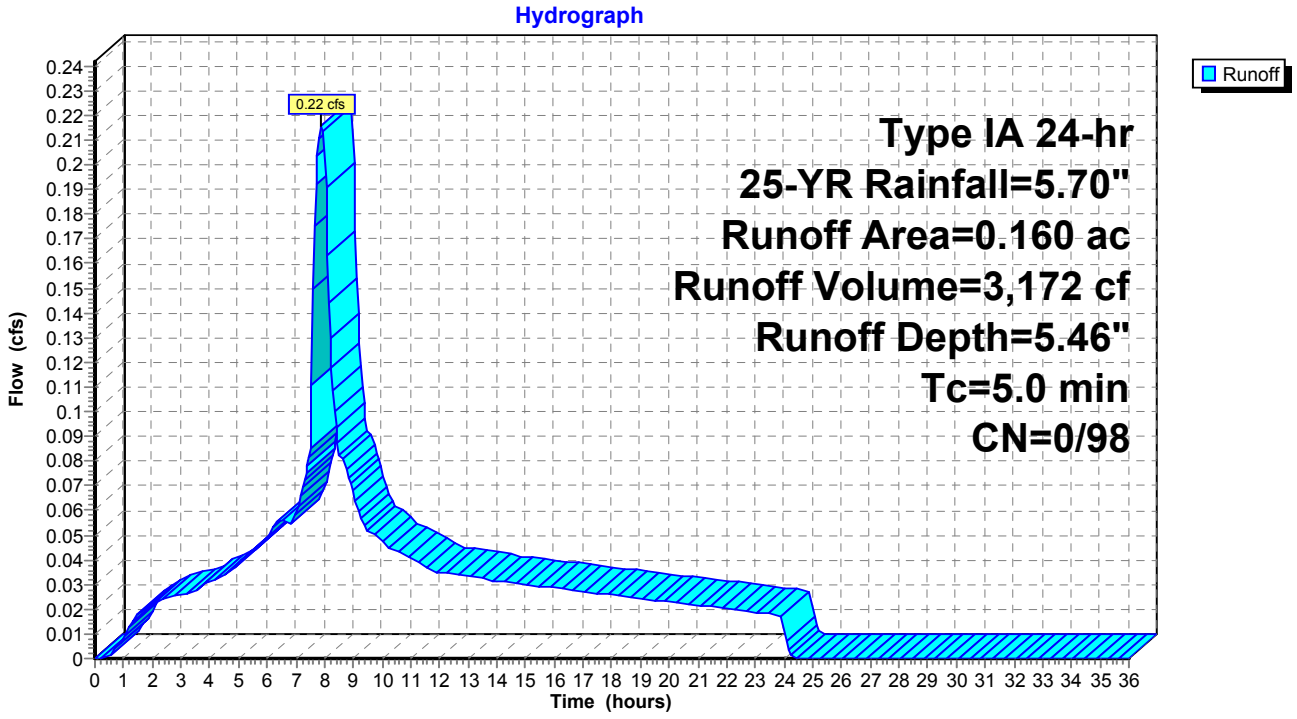
Runoff = 0.22 cfs @ 7.89 hrs, Volume= 3,172 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.160	98	
	0.160	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: GCL-3



Summary for Subcatchment 10S: GCL-4

[49] Hint: Tc<2dt may require smaller dt

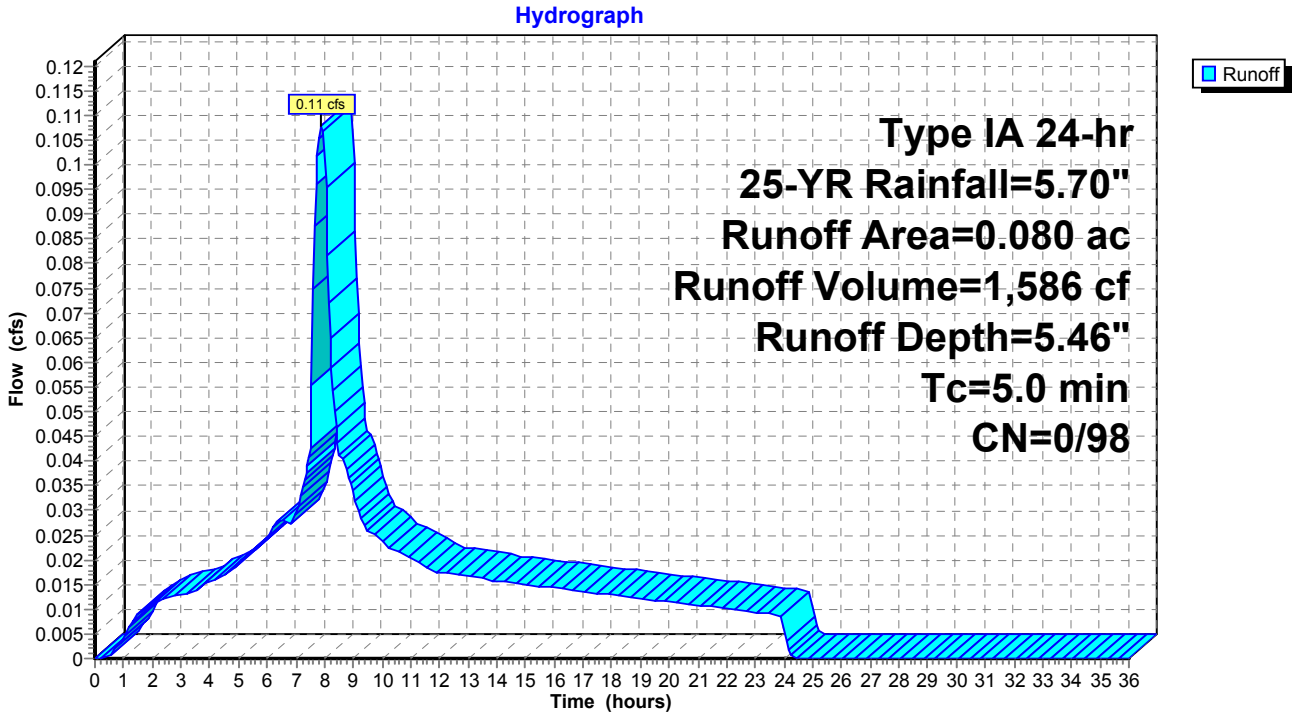
Runoff = 0.11 cfs @ 7.89 hrs, Volume= 1,586 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.080	98	
	0.080	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: GCL-4



Summary for Subcatchment 11S: GCL-5

[49] Hint: Tc<2dt may require smaller dt

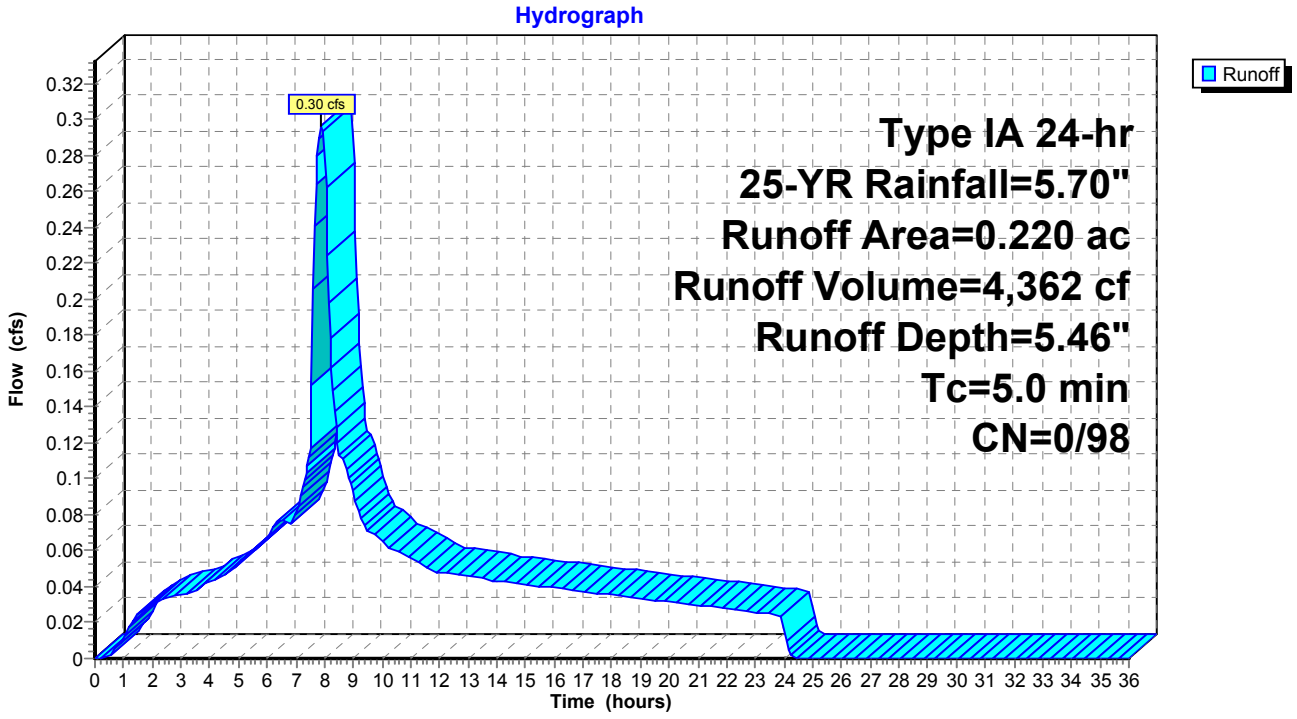
Runoff = 0.30 cfs @ 7.89 hrs, Volume= 4,362 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.220	98	
	0.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: GCL-5



Summary for Subcatchment 5S: GCL-1

[49] Hint: Tc<2dt may require smaller dt

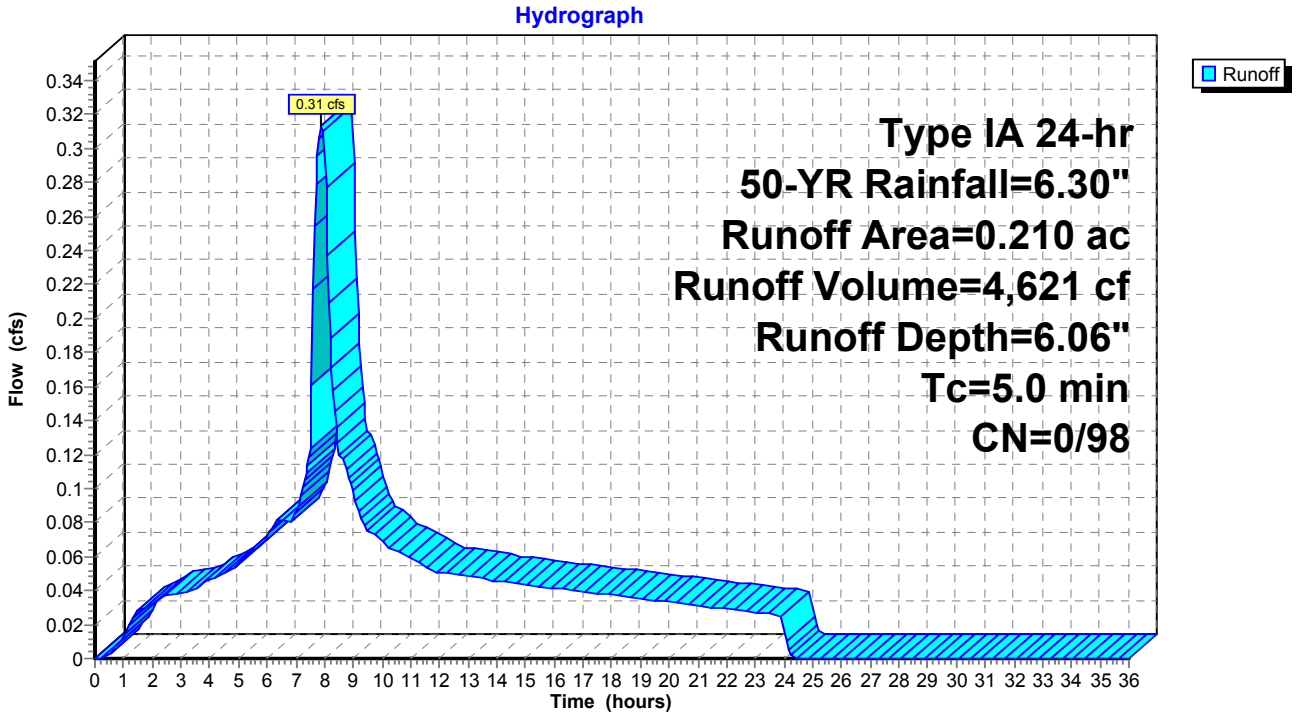
Runoff = 0.31 cfs @ 7.89 hrs, Volume= 4,621 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.210	98	
	0.210	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: GCL-1



Summary for Subcatchment 6S: GCL-2

[49] Hint: Tc<2dt may require smaller dt

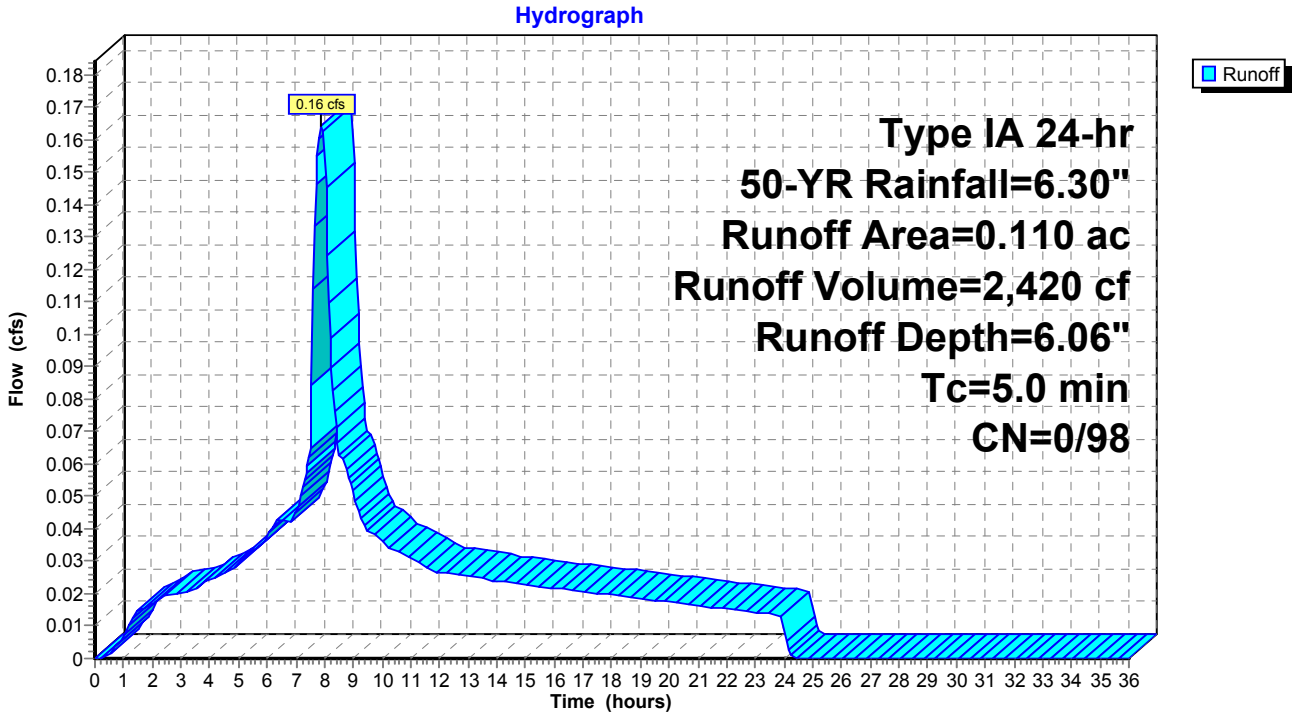
Runoff = 0.16 cfs @ 7.89 hrs, Volume= 2,420 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.110	98	
	0.110	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: GCL-2



Summary for Subcatchment 9S: GCL-3

[49] Hint: Tc<2dt may require smaller dt

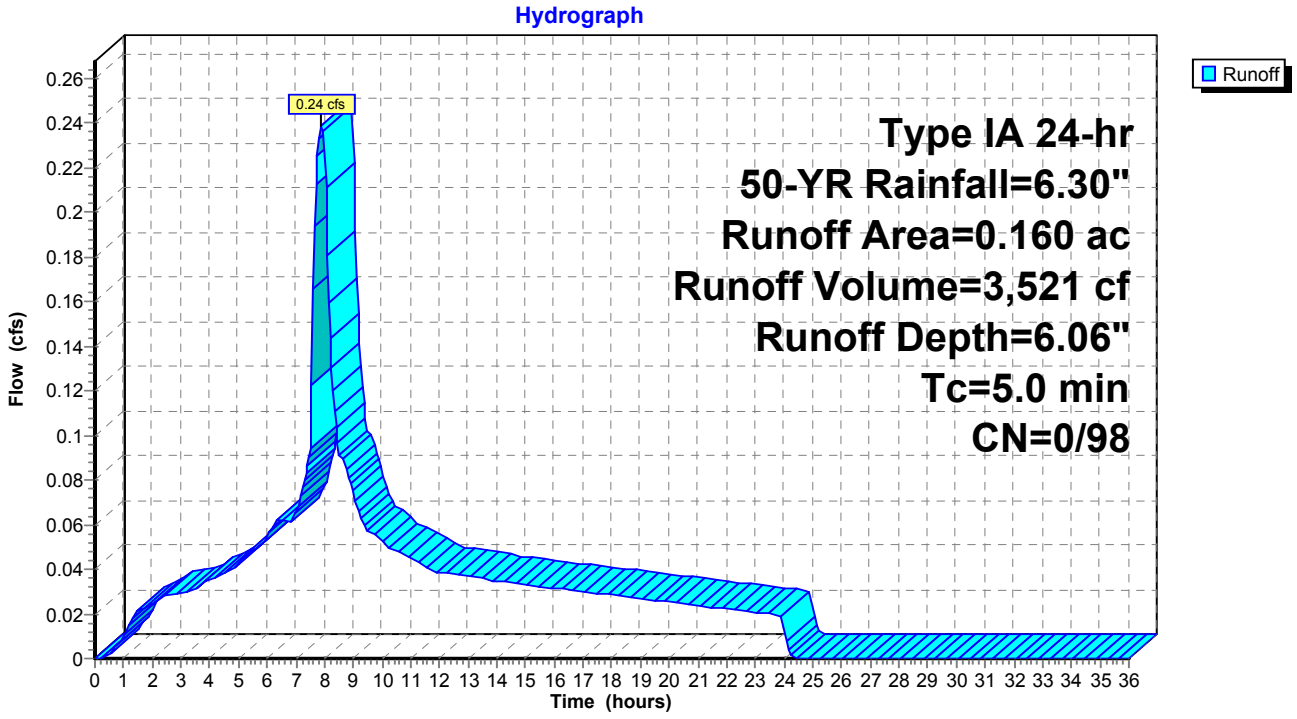
Runoff = 0.24 cfs @ 7.89 hrs, Volume= 3,521 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.160	98	
	0.160	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: GCL-3



Summary for Subcatchment 10S: GCL-4

[49] Hint: Tc<2dt may require smaller dt

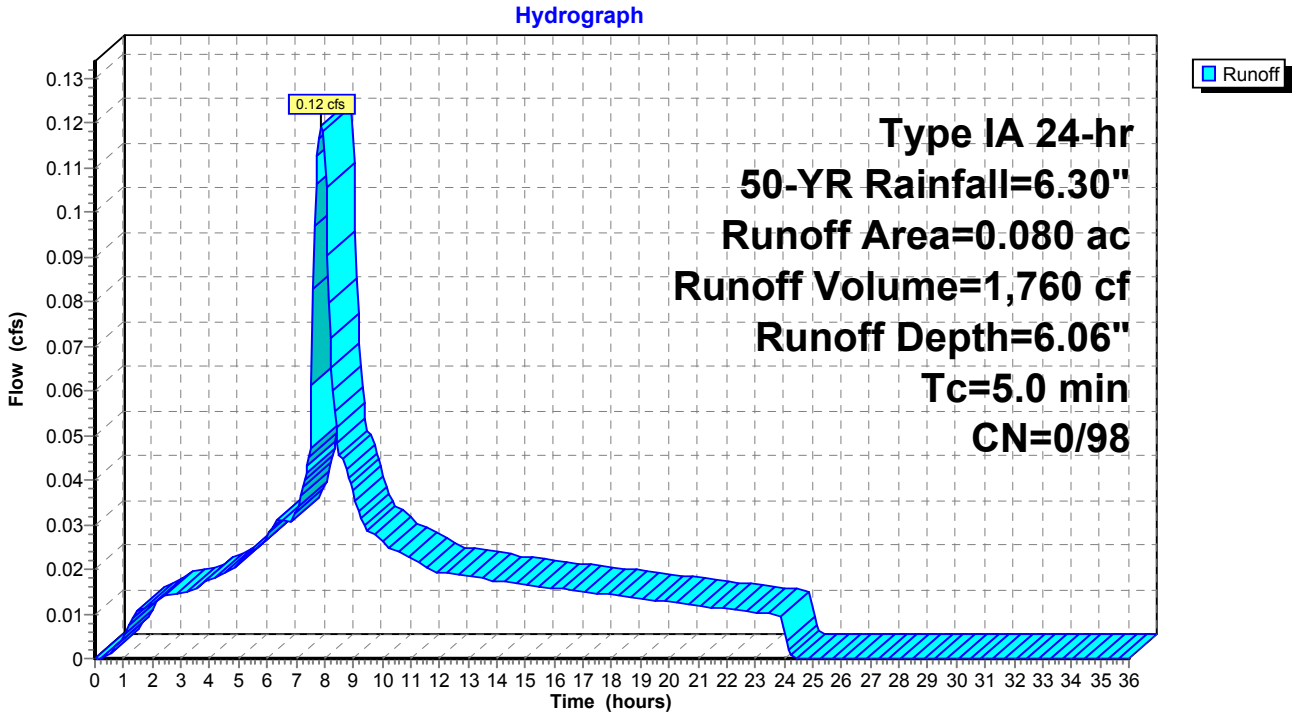
Runoff = 0.12 cfs @ 7.89 hrs, Volume= 1,760 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.080	98	
	0.080	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: GCL-4



Summary for Subcatchment 11S: GCL-5

[49] Hint: Tc<2dt may require smaller dt

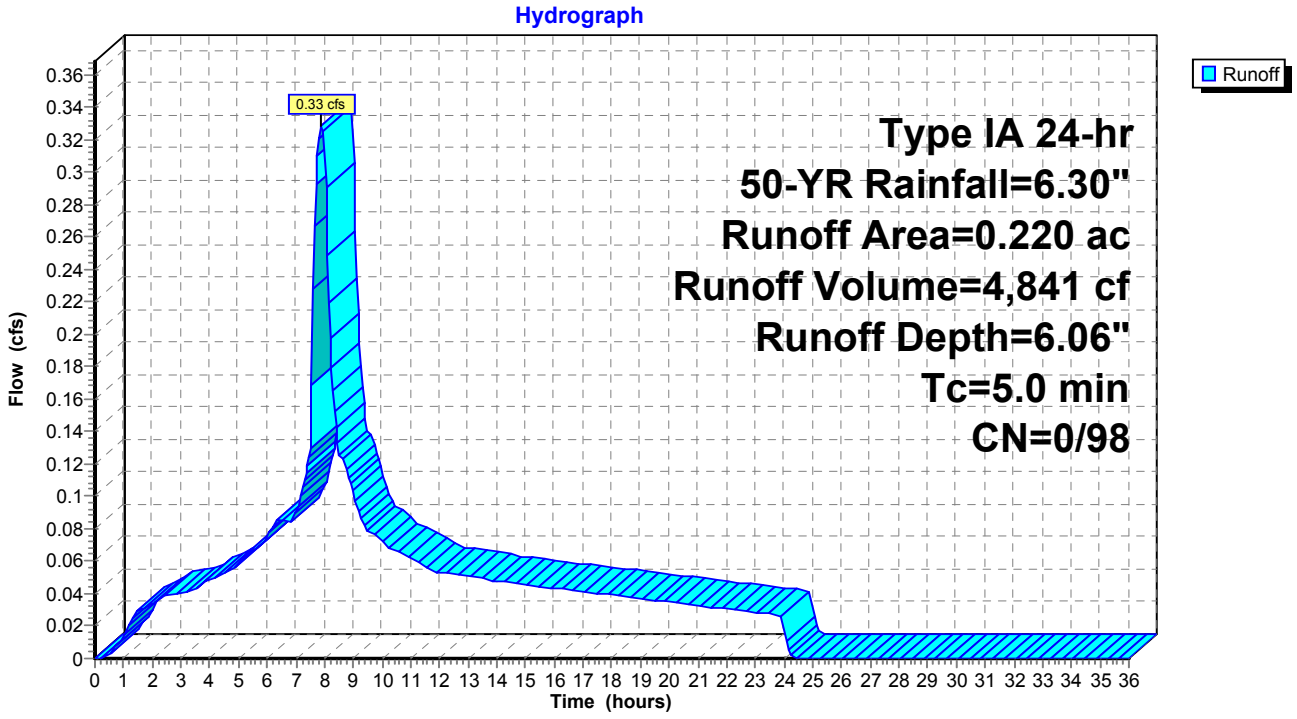
Runoff = 0.33 cfs @ 7.89 hrs, Volume= 4,841 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.220	98	
	0.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: GCL-5



Summary for Subcatchment 5S: GCL-1

[49] Hint: Tc<2dt may require smaller dt

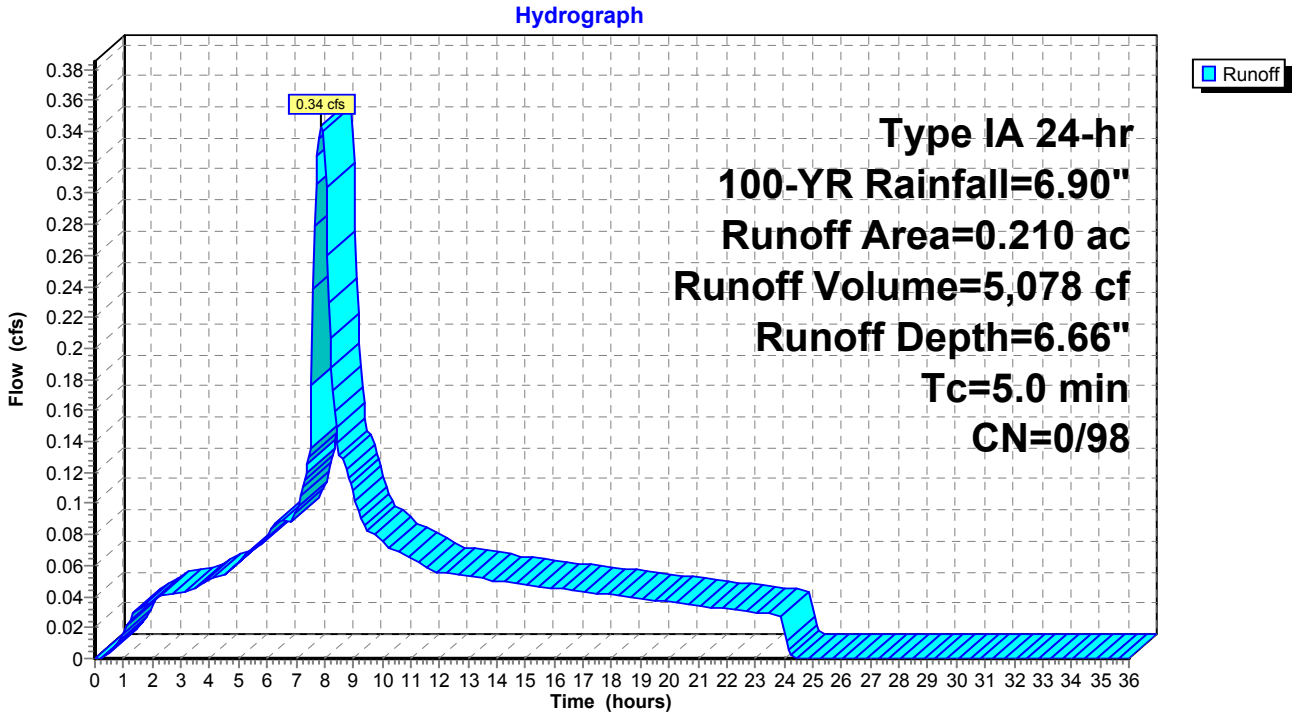
Runoff = 0.34 cfs @ 7.89 hrs, Volume= 5,078 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.210	98	
	0.210	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: GCL-1



Summary for Subcatchment 6S: GCL-2

[49] Hint: Tc<2dt may require smaller dt

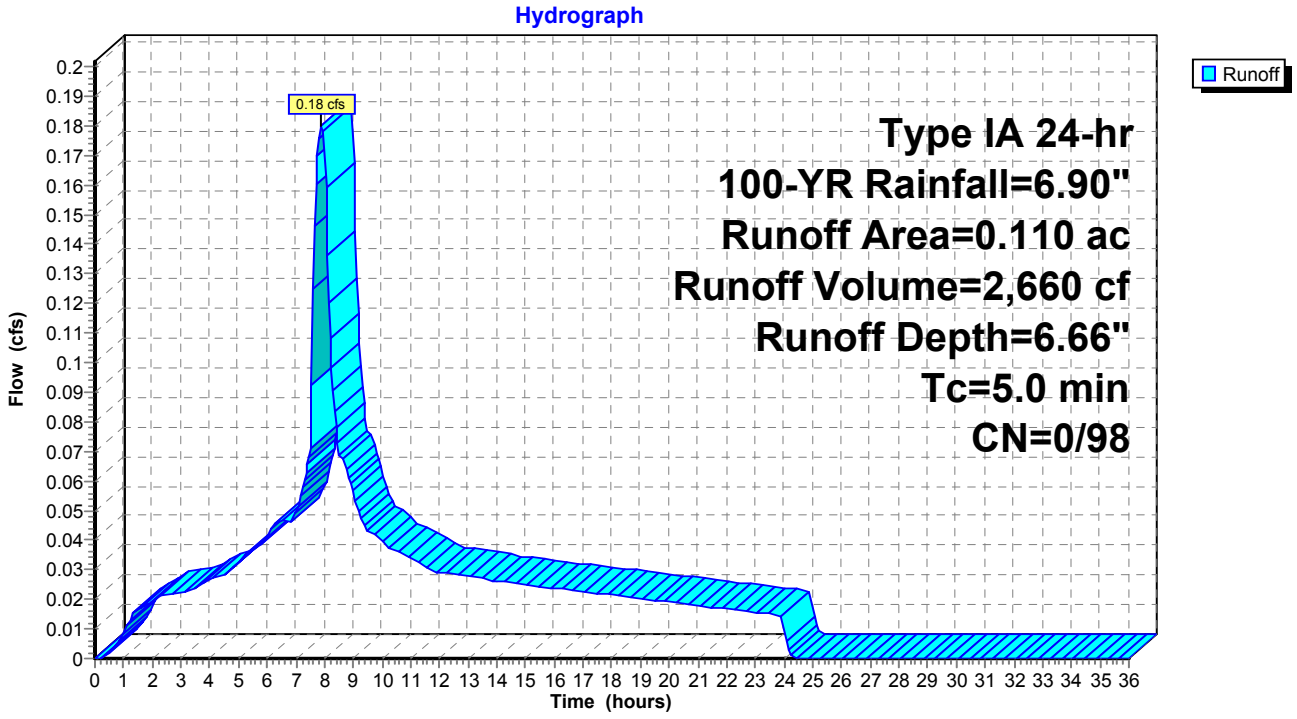
Runoff = 0.18 cfs @ 7.89 hrs, Volume= 2,660 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.110	98	
	0.110	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: GCL-2



Summary for Subcatchment 9S: GCL-3

[49] Hint: Tc<2dt may require smaller dt

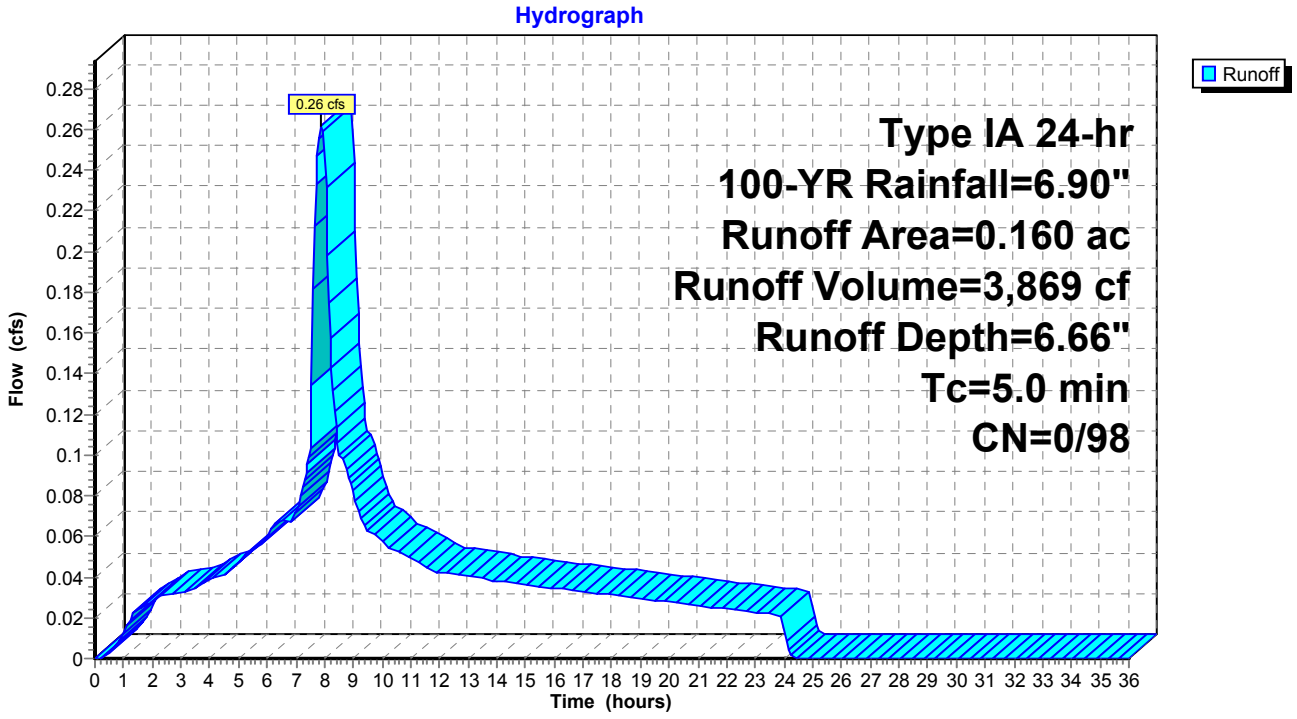
Runoff = 0.26 cfs @ 7.89 hrs, Volume= 3,869 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.160	98	
	0.160	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: GCL-3



Summary for Subcatchment 10S: GCL-4

[49] Hint: Tc<2dt may require smaller dt

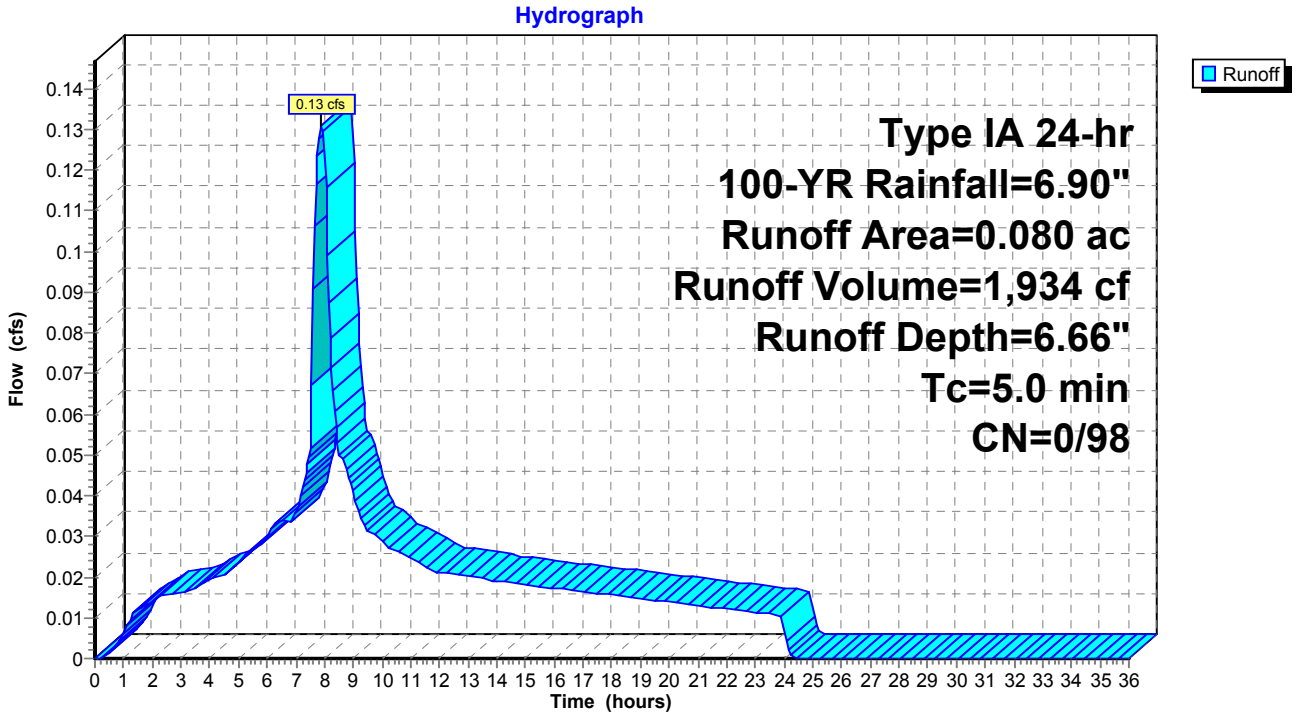
Runoff = 0.13 cfs @ 7.89 hrs, Volume= 1,934 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.080	98	
	0.080	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: GCL-4



Summary for Subcatchment 11S: GCL-5

[49] Hint: Tc<2dt may require smaller dt

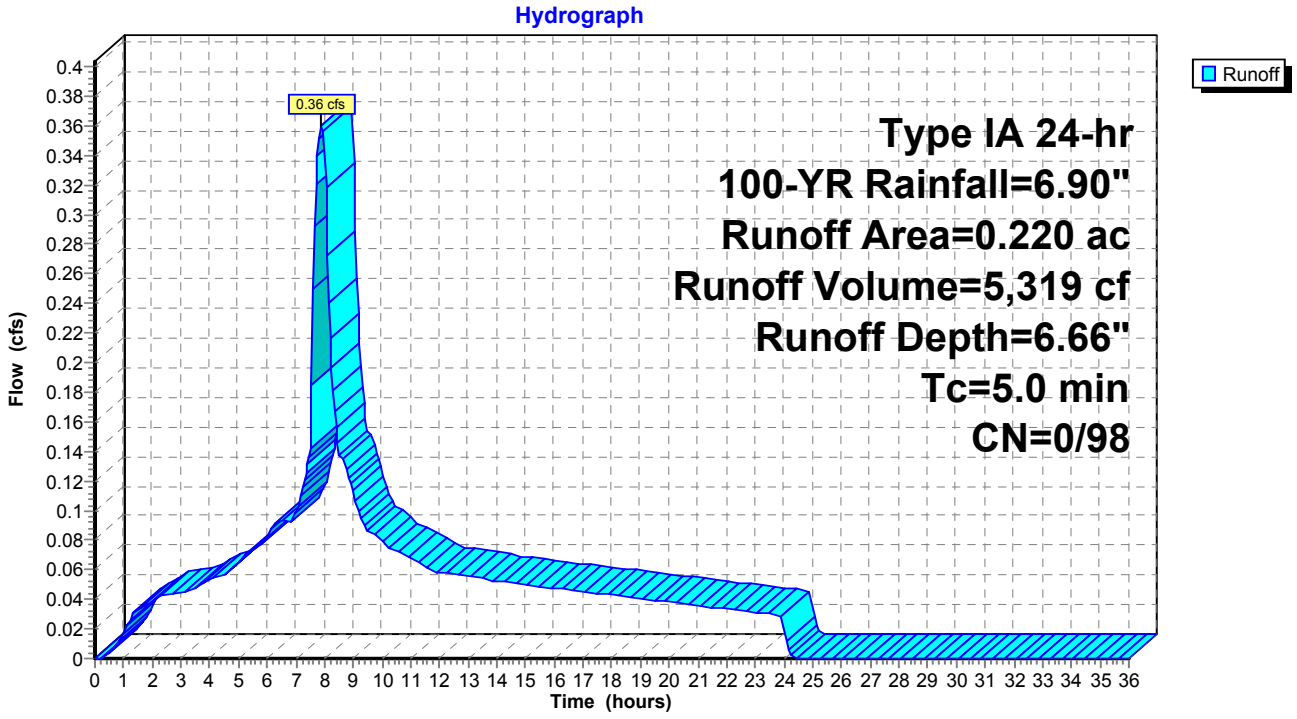
Runoff = 0.36 cfs @ 7.89 hrs, Volume= 5,319 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.220	98	
	0.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: GCL-5



Summary for Subcatchment 5S: KT-1

[49] Hint: Tc<2dt may require smaller dt

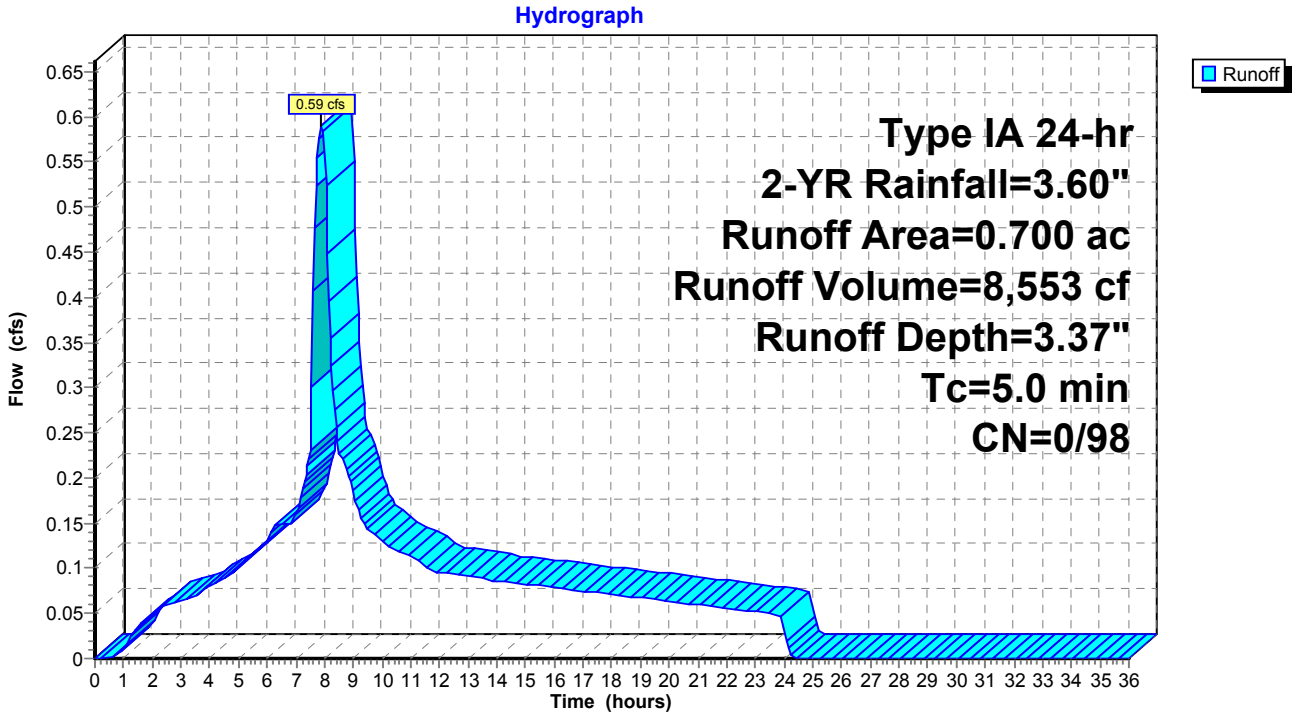
Runoff = 0.59 cfs @ 7.90 hrs, Volume= 8,553 cf, Depth= 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.700	98	
	0.700	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: KT-1



Summary for Subcatchment 6S: KL-1

[49] Hint: Tc<2dt may require smaller dt

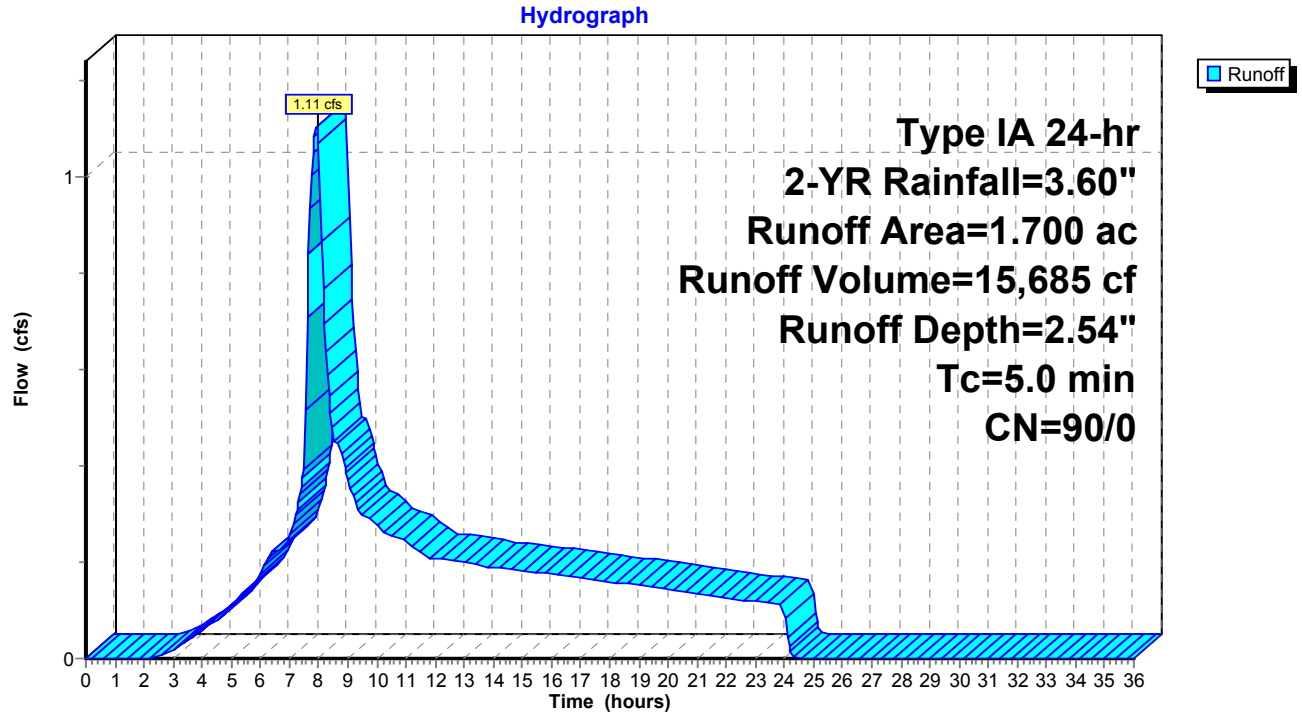
Runoff = 1.11 cfs @ 7.94 hrs, Volume= 15,685 cf, Depth= 2.54"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	1.700	90	
	1.700	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: KL-1



Summary for Subcatchment 9S: KA-1

[49] Hint: Tc<2dt may require smaller dt

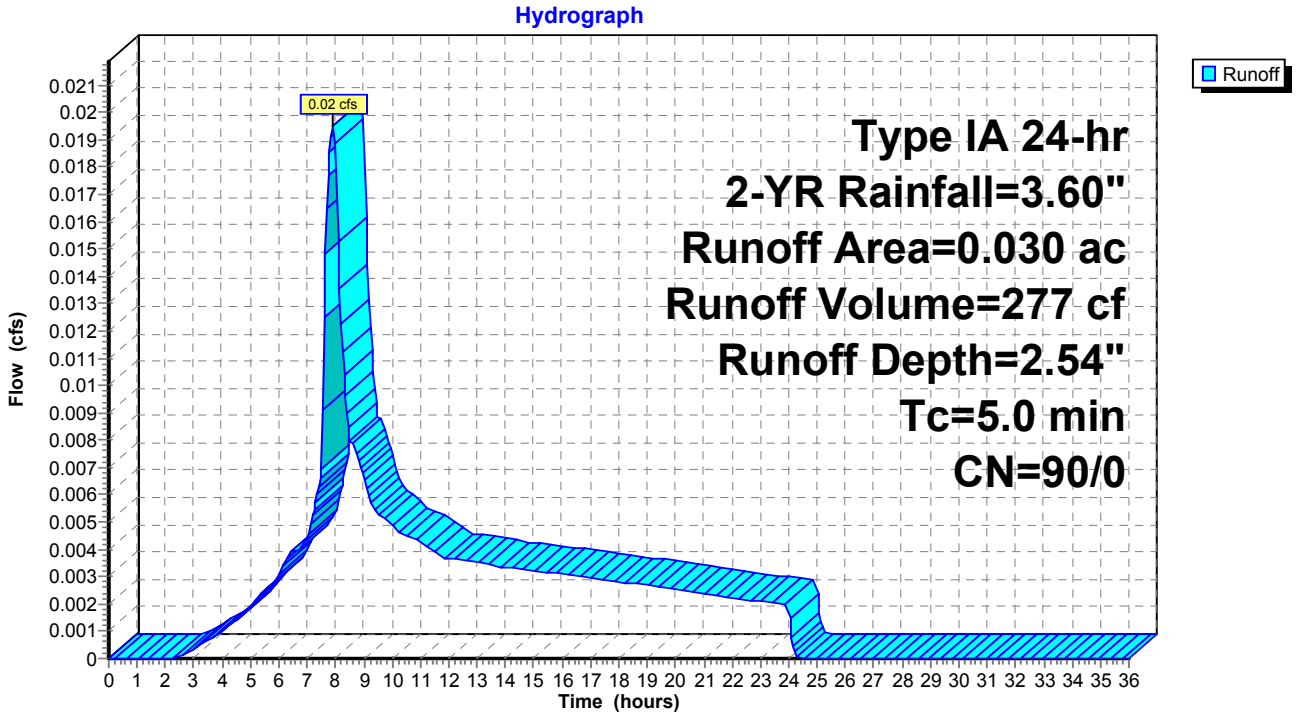
Runoff = 0.02 cfs @ 7.94 hrs, Volume= 277 cf, Depth= 2.54"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.030	90	
	0.030	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: KA-1



Summary for Subcatchment 10S: KA-2

[49] Hint: Tc<2dt may require smaller dt

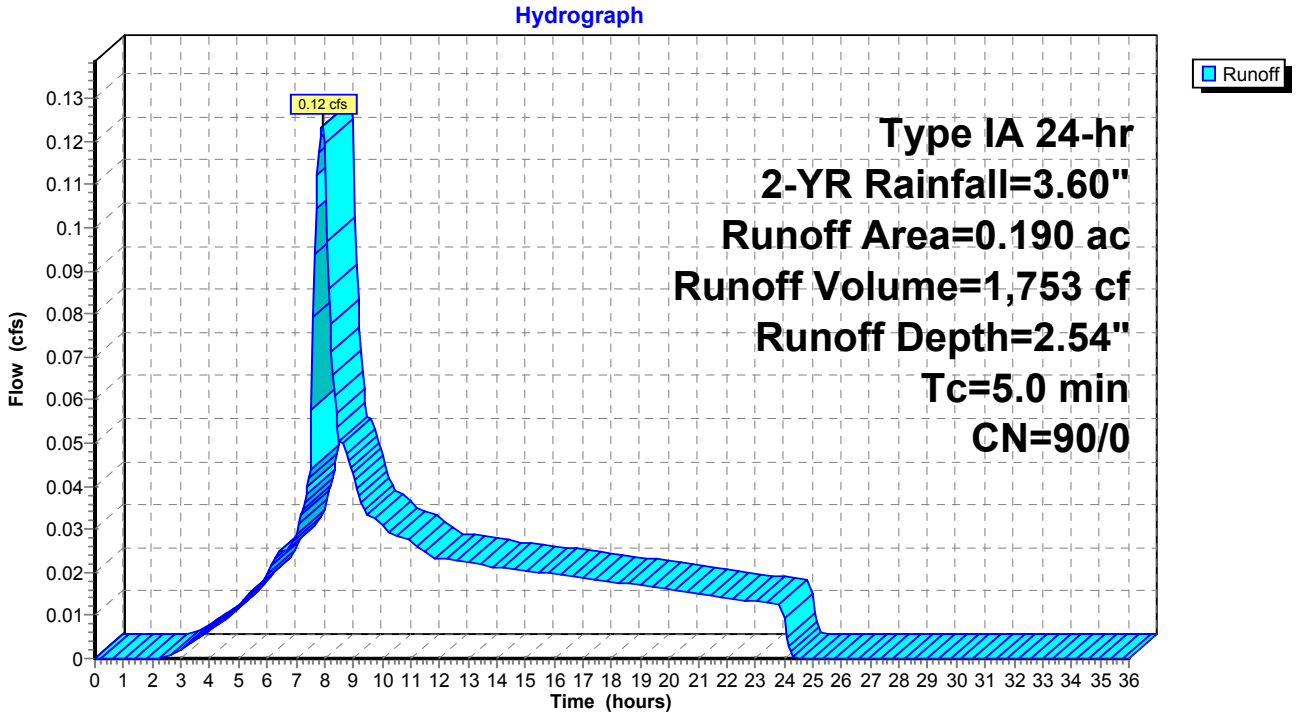
Runoff = 0.12 cfs @ 7.94 hrs, Volume= 1,753 cf, Depth= 2.54"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YR Rainfall=3.60"

	Area (ac)	CN	Description
*	0.190	90	
	0.190	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: KA-2



Summary for Subcatchment 5S: KT-1

[49] Hint: Tc<2dt may require smaller dt

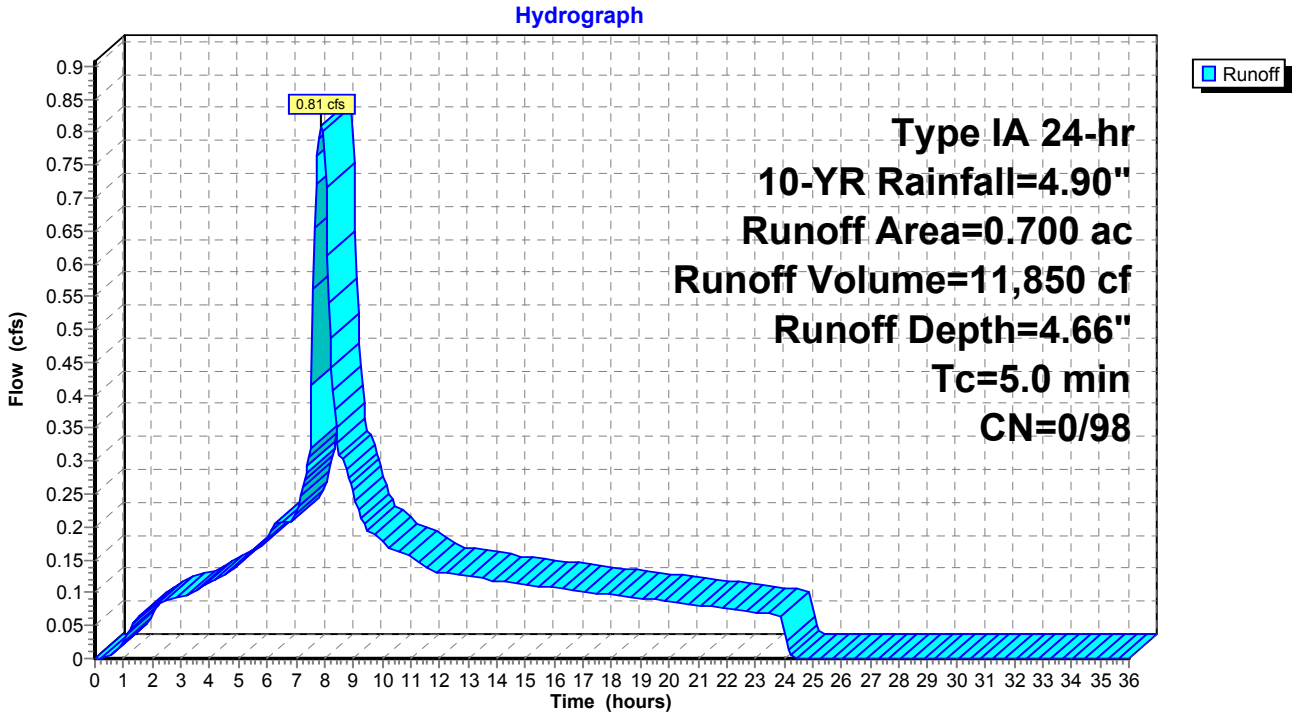
Runoff = 0.81 cfs @ 7.90 hrs, Volume= 11,850 cf, Depth= 4.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.700	98	
	0.700	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: KT-1



Summary for Subcatchment 6S: KL-1

[49] Hint: Tc<2dt may require smaller dt

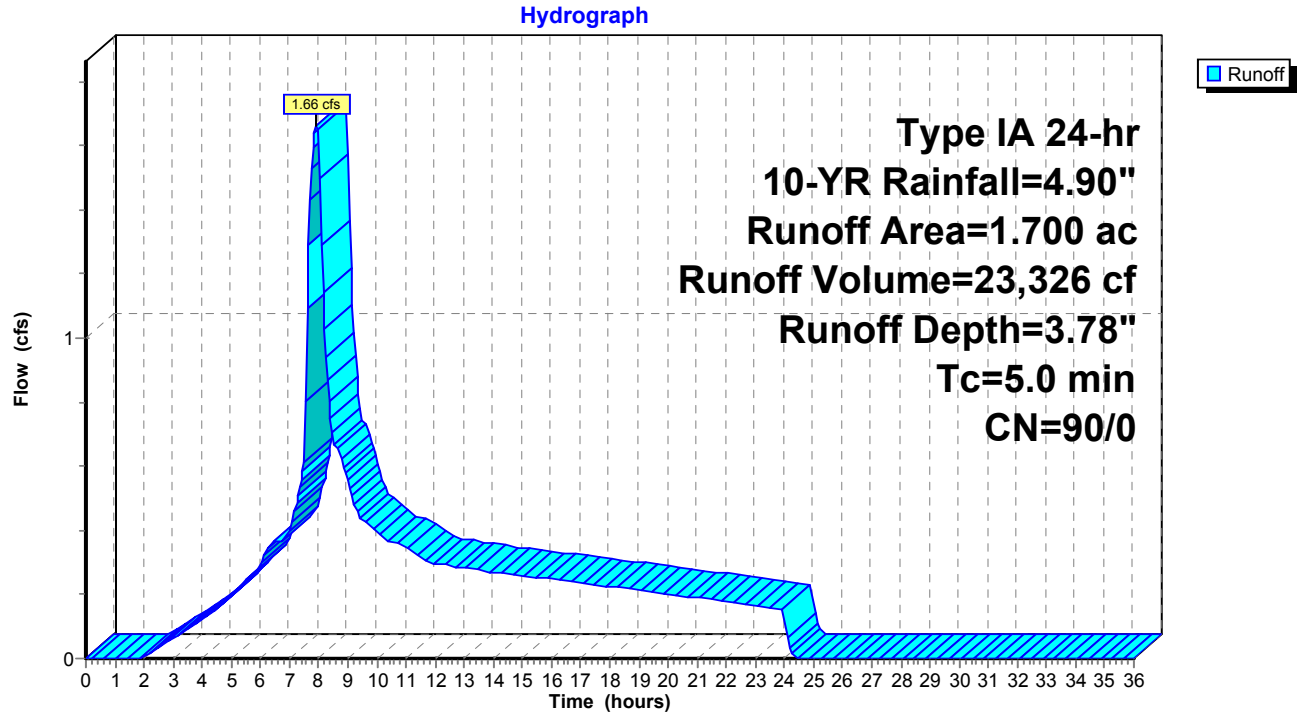
Runoff = 1.66 cfs @ 7.92 hrs, Volume= 23,326 cf, Depth= 3.78"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	1.700	90	
	1.700	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: KL-1



Summary for Subcatchment 9S: KA-1

[49] Hint: Tc<2dt may require smaller dt

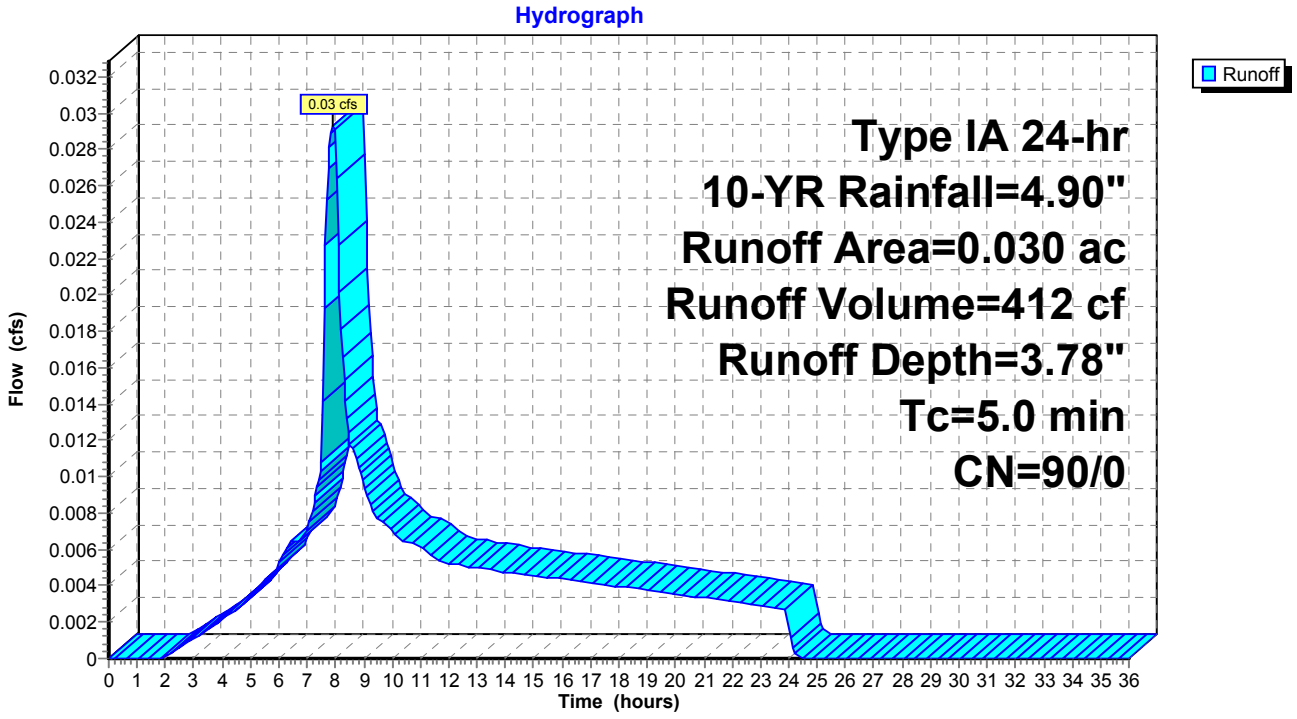
Runoff = 0.03 cfs @ 7.92 hrs, Volume= 412 cf, Depth= 3.78"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.030	90	
	0.030	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: KA-1



Summary for Subcatchment 10S: KA-2

[49] Hint: Tc<2dt may require smaller dt

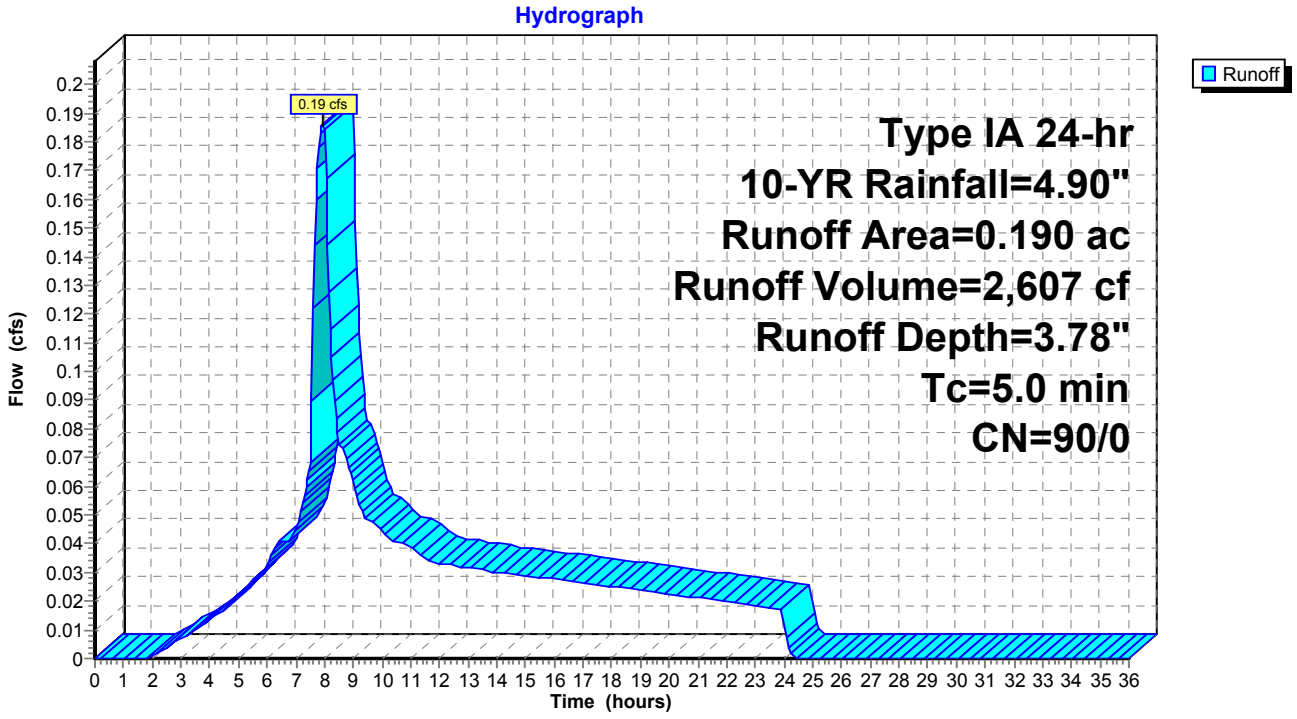
Runoff = 0.19 cfs @ 7.92 hrs, Volume= 2,607 cf, Depth= 3.78"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=4.90"

	Area (ac)	CN	Description
*	0.190	90	
	0.190	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: KA-2



Summary for Subcatchment 5S: KT-1

[49] Hint: Tc<2dt may require smaller dt

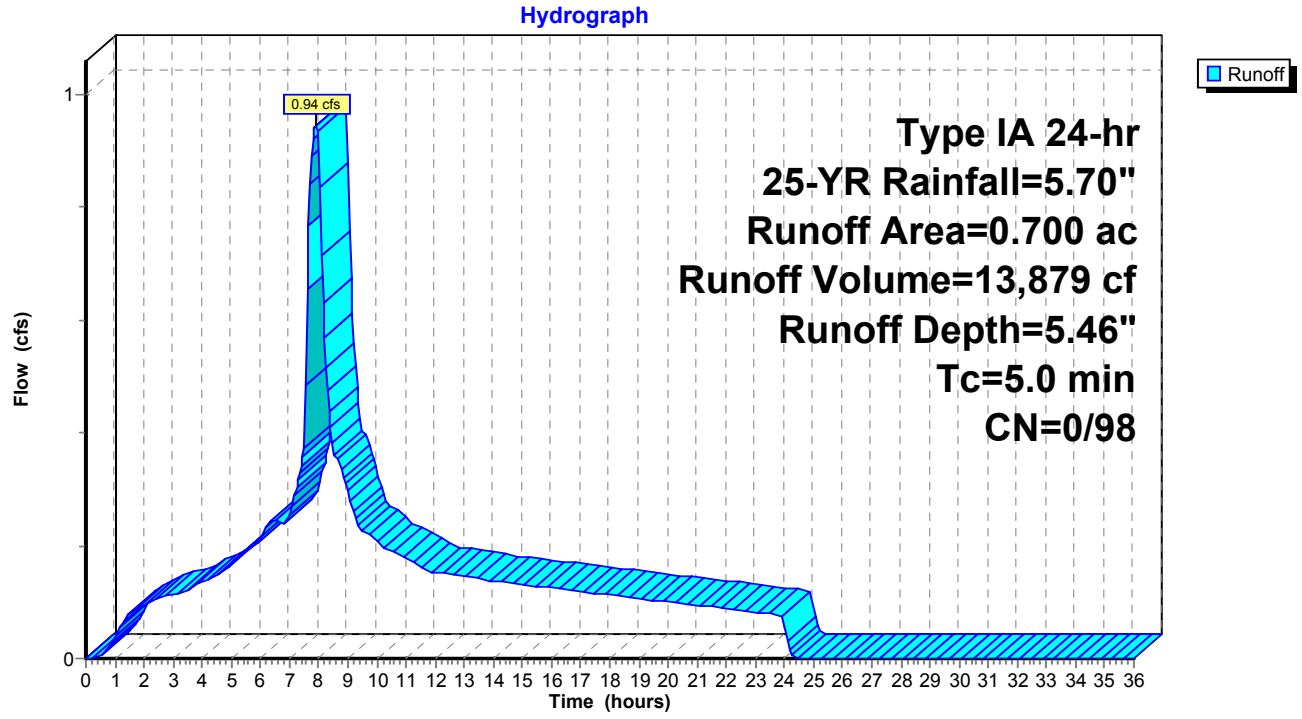
Runoff = 0.94 cfs @ 7.89 hrs, Volume= 13,879 cf, Depth= 5.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.700	98	
	0.700	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: KT-1



Summary for Subcatchment 6S: KL-1

[49] Hint: Tc<2dt may require smaller dt

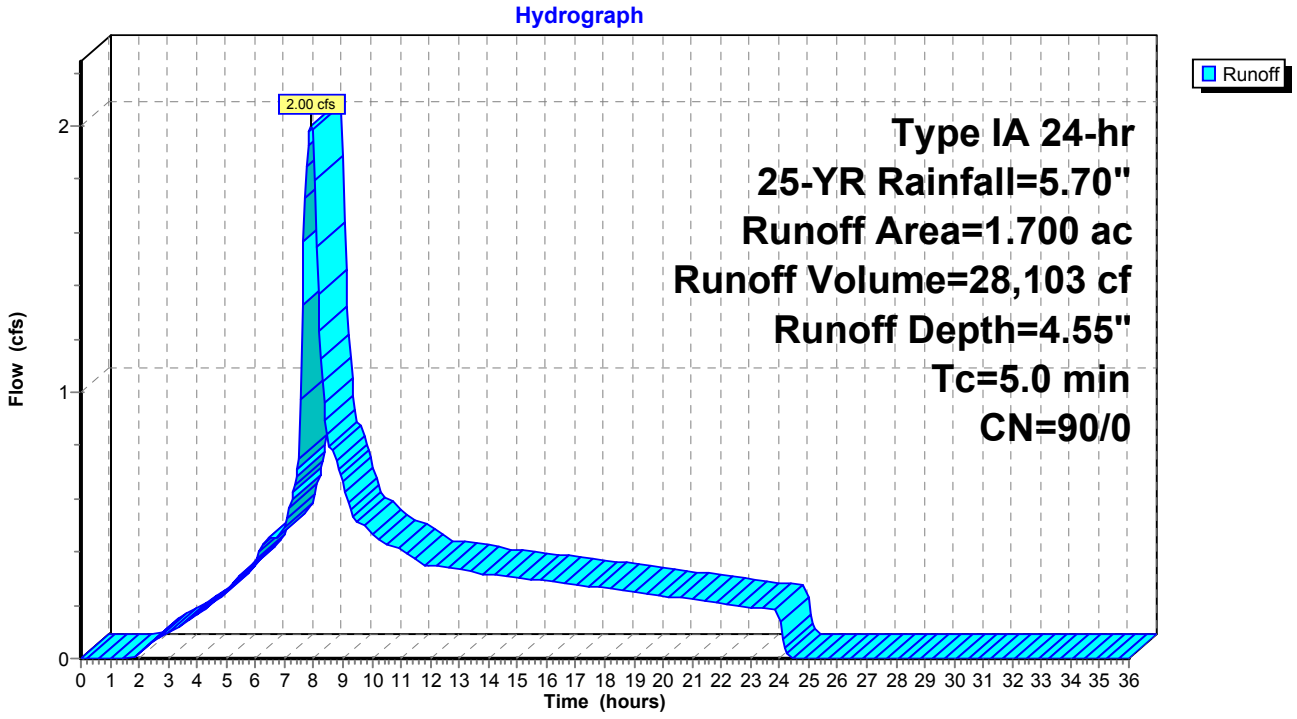
Runoff = 2.00 cfs @ 7.92 hrs, Volume= 28,103 cf, Depth= 4.55"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	1.700	90	
	1.700	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: KL-1



Summary for Subcatchment 9S: KA-1

[49] Hint: Tc<2dt may require smaller dt

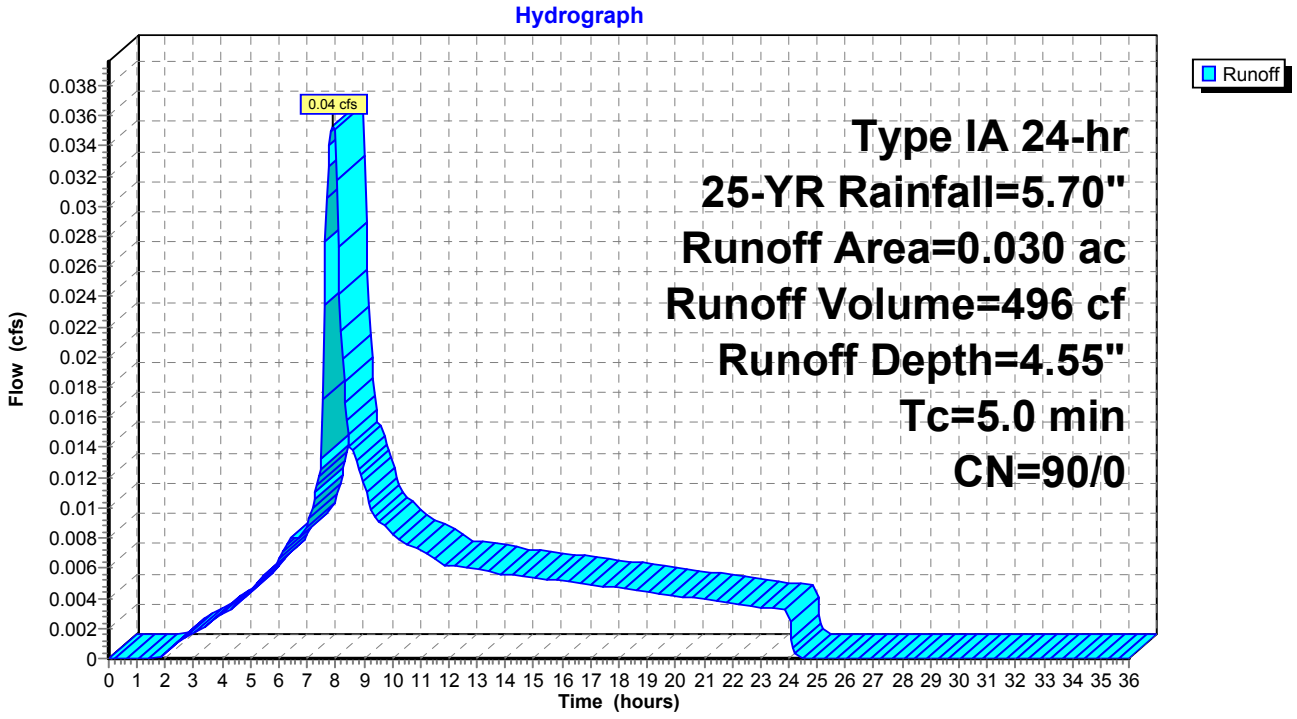
Runoff = 0.04 cfs @ 7.92 hrs, Volume= 496 cf, Depth= 4.55"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.030	90	
	0.030	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: KA-1



Summary for Subcatchment 10S: KA-2

[49] Hint: Tc<2dt may require smaller dt

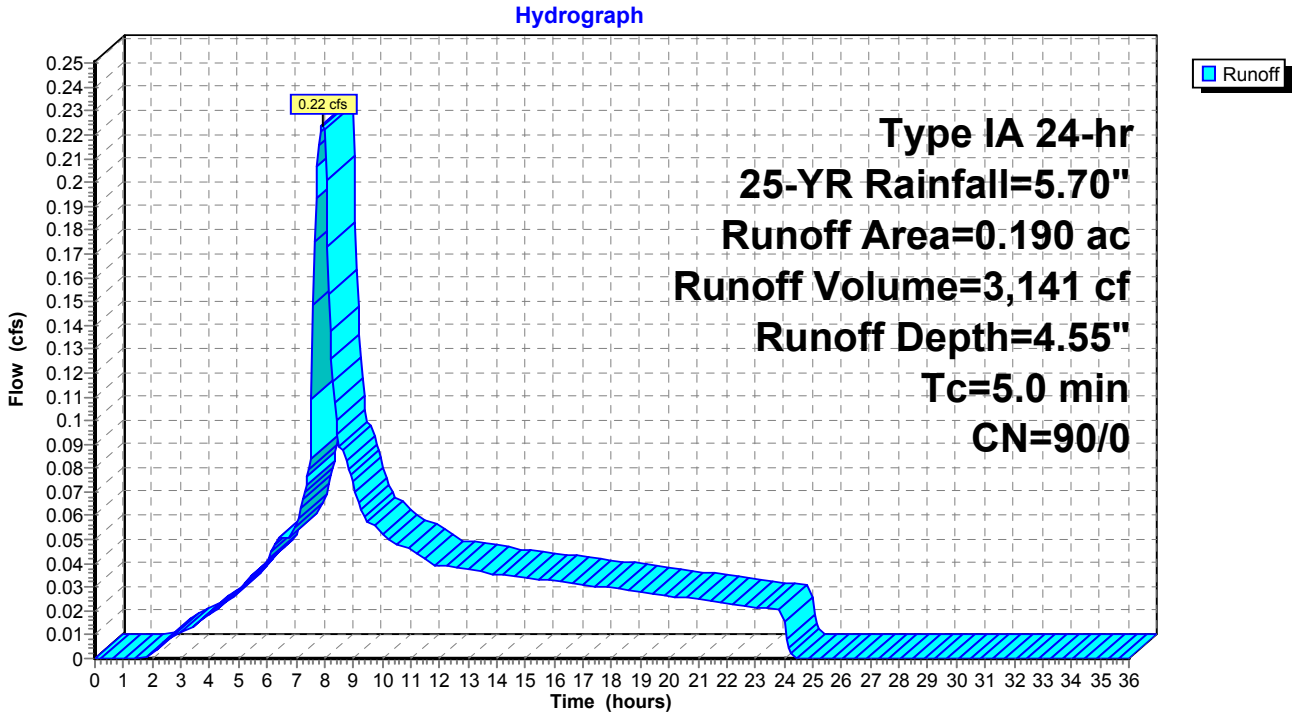
Runoff = 0.22 cfs @ 7.92 hrs, Volume= 3,141 cf, Depth= 4.55"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YR Rainfall=5.70"

	Area (ac)	CN	Description
*	0.190	90	
	0.190	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: KA-2



Summary for Subcatchment 5S: KT-1

[49] Hint: Tc<2dt may require smaller dt

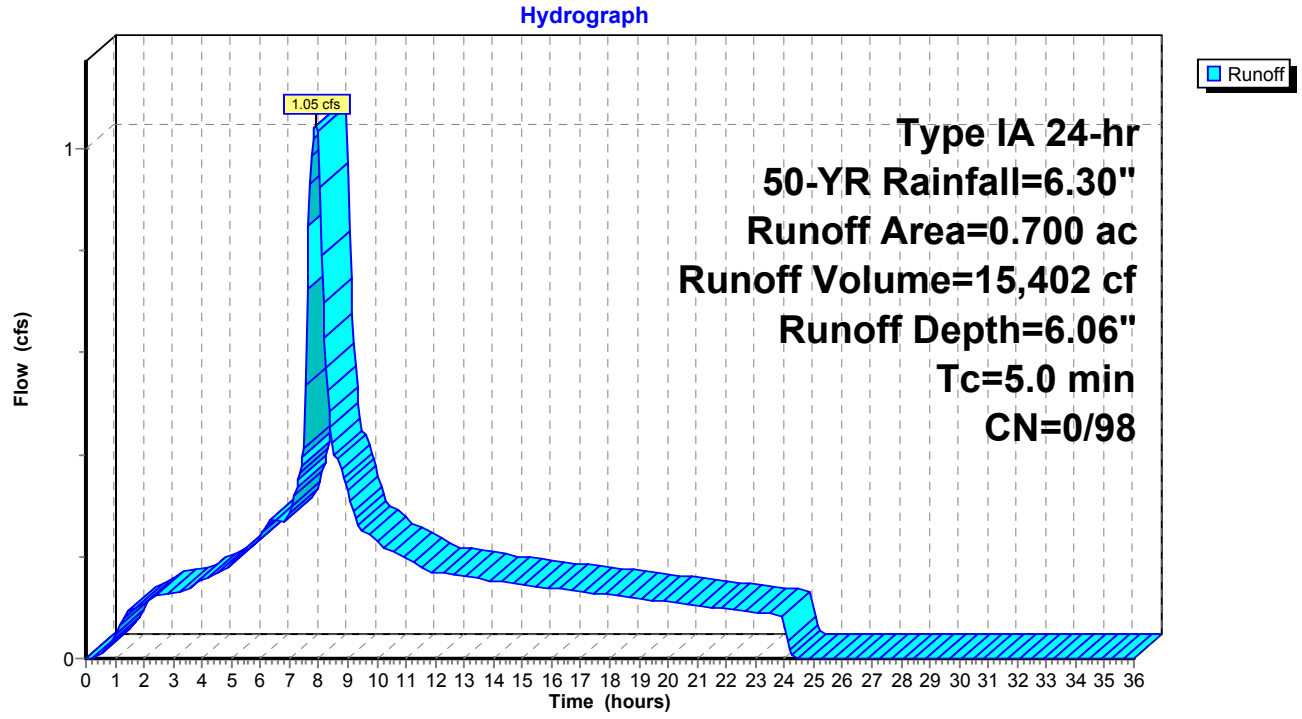
Runoff = 1.05 cfs @ 7.89 hrs, Volume= 15,402 cf, Depth= 6.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.700	98	
	0.700	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: KT-1



Summary for Subcatchment 6S: KL-1

[49] Hint: Tc<2dt may require smaller dt

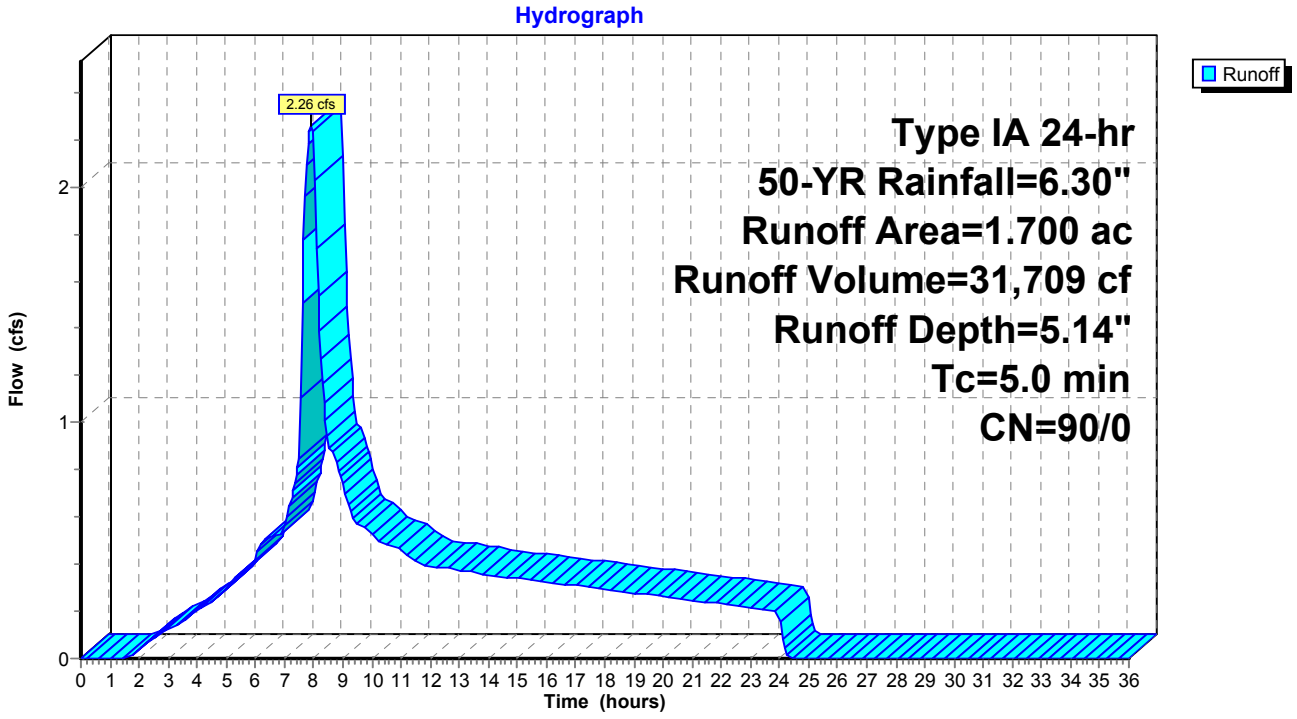
Runoff = 2.26 cfs @ 7.92 hrs, Volume= 31,709 cf, Depth= 5.14"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	1.700	90	
	1.700	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: KL-1



Summary for Subcatchment 9S: KA-1

[49] Hint: Tc<2dt may require smaller dt

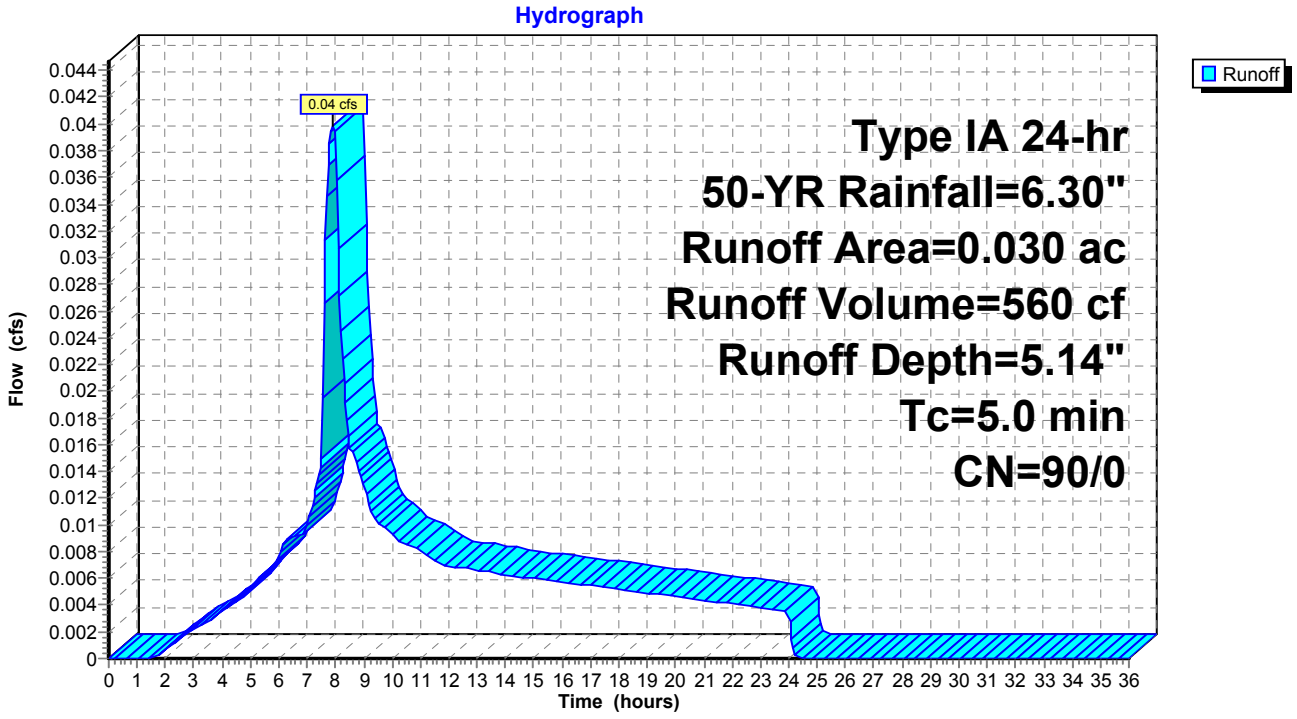
Runoff = 0.04 cfs @ 7.92 hrs, Volume= 560 cf, Depth= 5.14"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.030	90	
	0.030	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: KA-1



Summary for Subcatchment 10S: KA-2

[49] Hint: Tc<2dt may require smaller dt

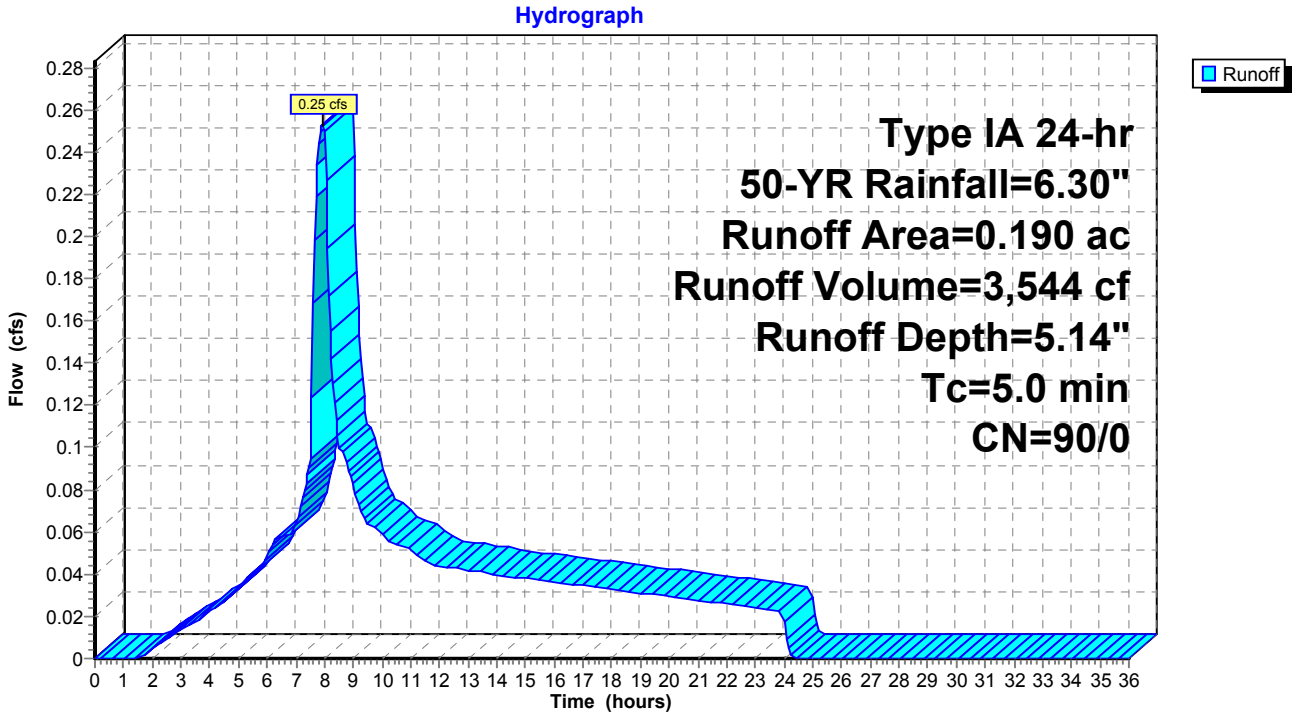
Runoff = 0.25 cfs @ 7.92 hrs, Volume= 3,544 cf, Depth= 5.14"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 50-YR Rainfall=6.30"

	Area (ac)	CN	Description
*	0.190	90	
	0.190	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: KA-2



Summary for Subcatchment 5S: KT-1

[49] Hint: Tc<2dt may require smaller dt

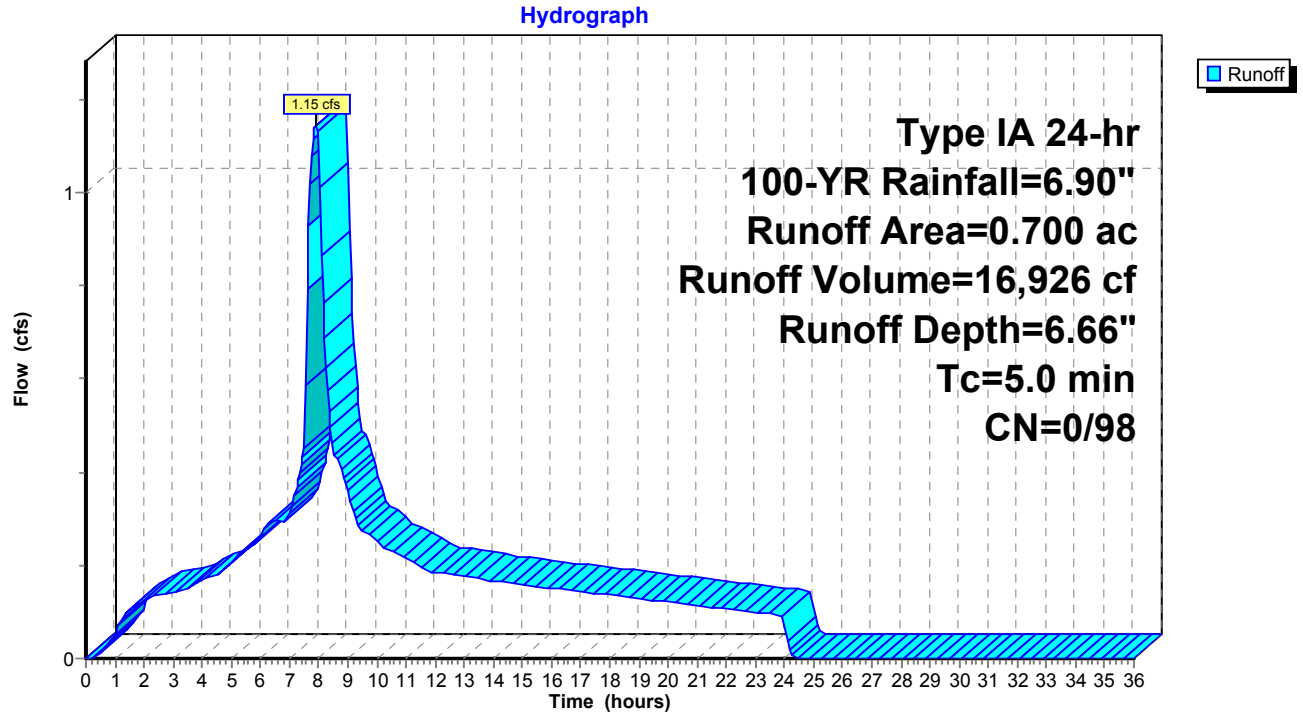
Runoff = 1.15 cfs @ 7.89 hrs, Volume= 16,926 cf, Depth= 6.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.700	98	
	0.700	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: KT-1



Summary for Subcatchment 6S: KL-1

[49] Hint: Tc<2dt may require smaller dt

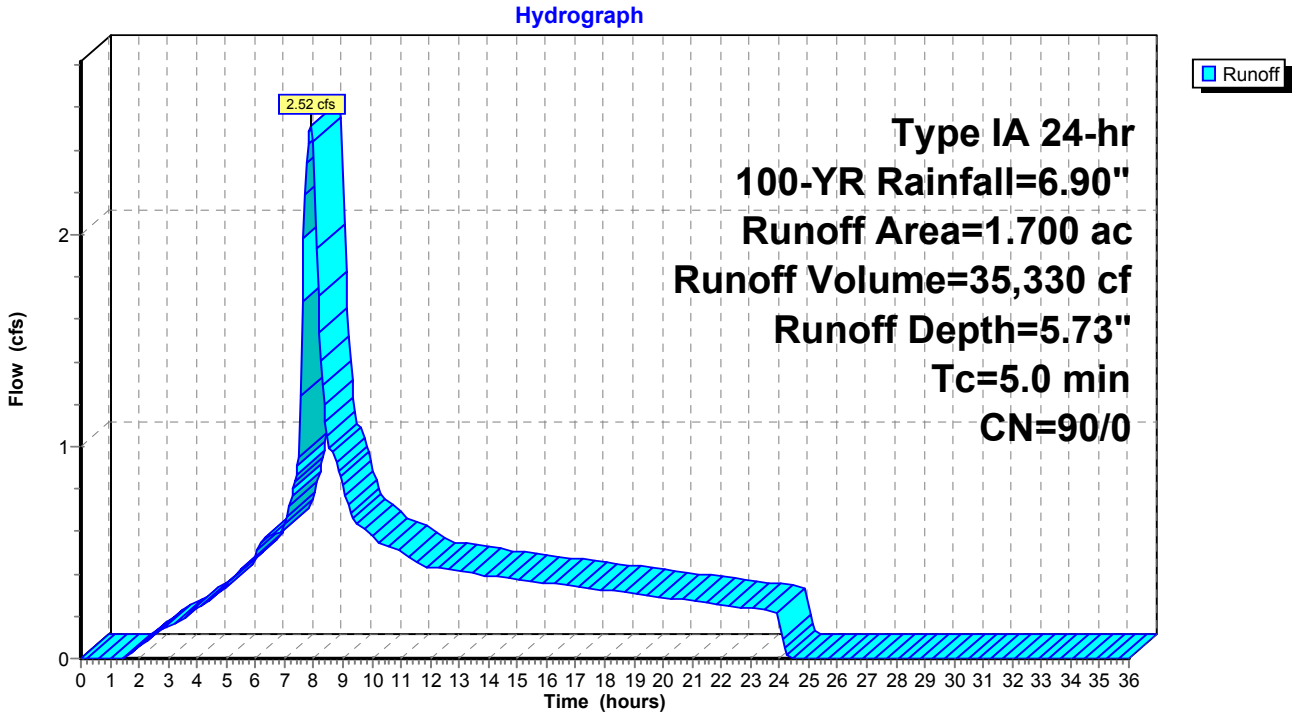
Runoff = 2.52 cfs @ 7.91 hrs, Volume= 35,330 cf, Depth= 5.73"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	1.700	90	
	1.700	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: KL-1



Summary for Subcatchment 9S: KA-1

[49] Hint: Tc<2dt may require smaller dt

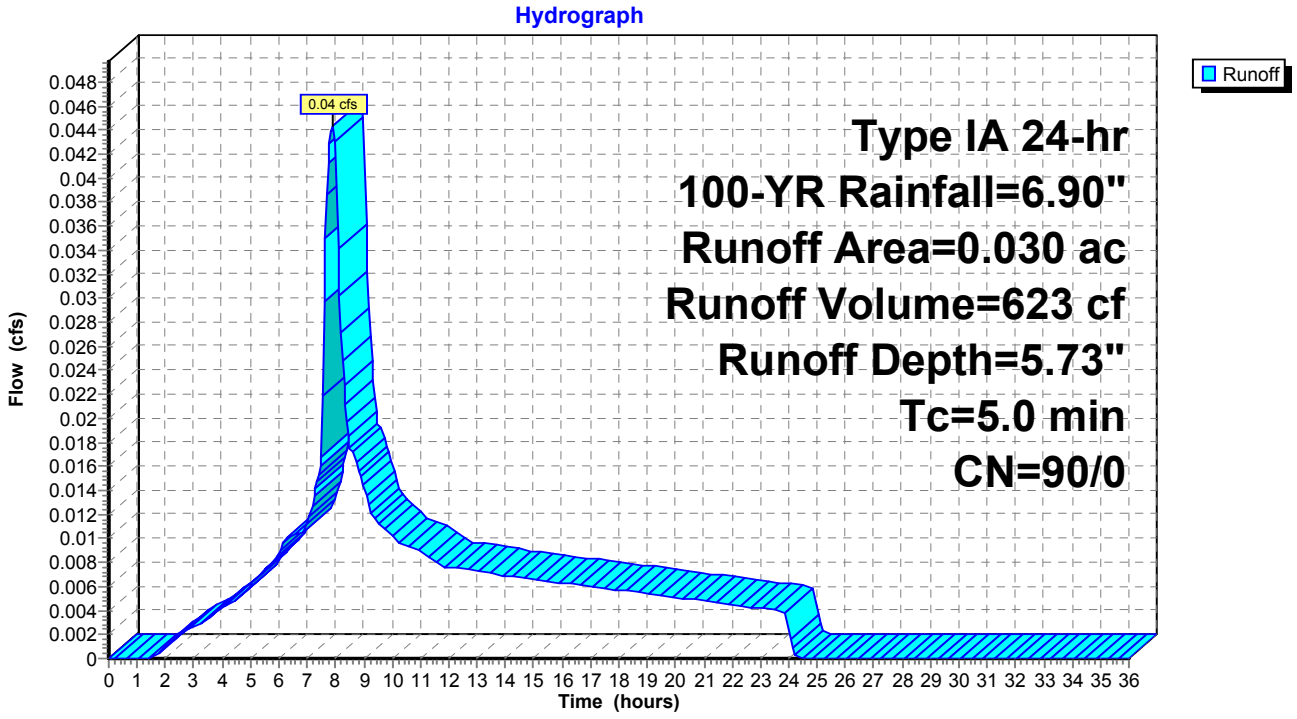
Runoff = 0.04 cfs @ 7.91 hrs, Volume= 623 cf, Depth= 5.73"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.030	90	
	0.030	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: KA-1



Summary for Subcatchment 10S: KA-2

[49] Hint: Tc<2dt may require smaller dt

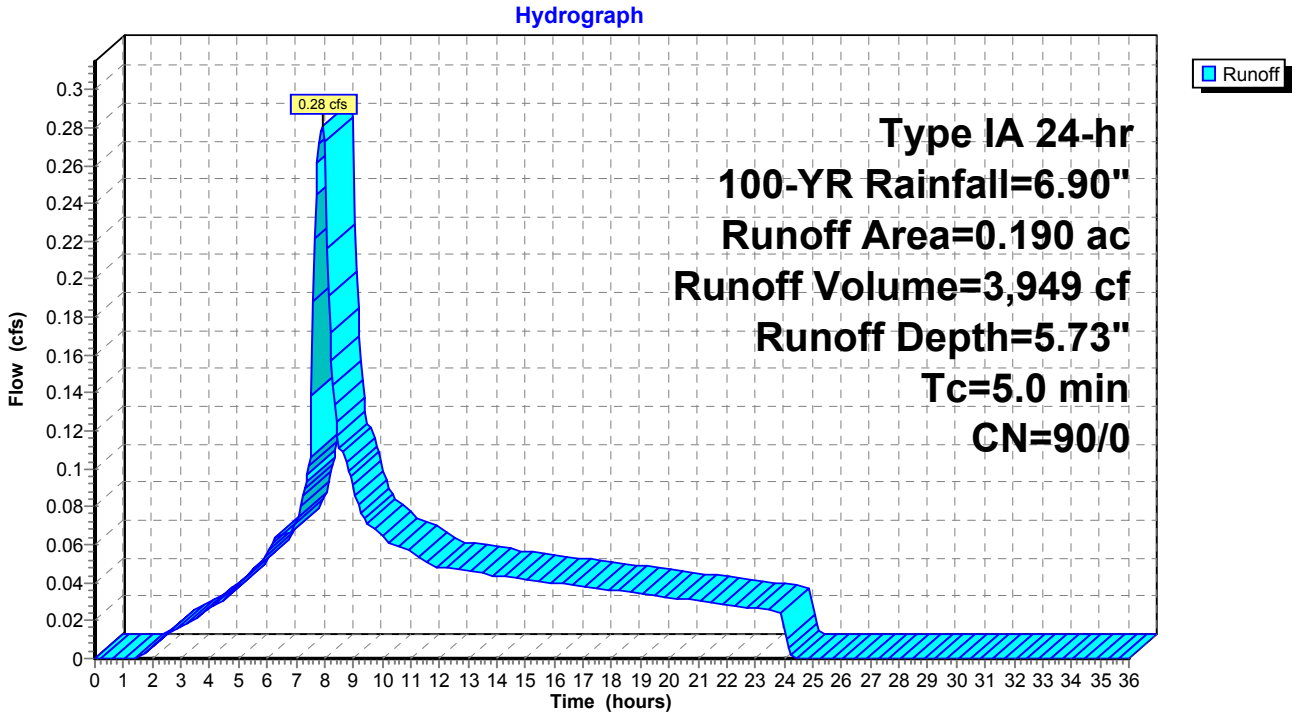
Runoff = 0.28 cfs @ 7.91 hrs, Volume= 3,949 cf, Depth= 5.73"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-YR Rainfall=6.90"

	Area (ac)	CN	Description
*	0.190	90	
	0.190	90	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: KA-2



APPENDIX E: STORMWATER INFRASTRUCTURE FIGURES

Trans Pacific Parkway and US-101 Intersection
See Figure 2

Jordan Cove LNG Project Area

APCO Site Layout
See Figure 3

APCO Bridge
See Figure 4

Kentuck Mitigation Site Proposed Site Layout
See Figure 5

East Bay Road
See Figure 6

Kentuck Access Road
See Figure 8

Golf Course Lane
See Figure 7

Southwest Oregon Regional Airport

North Bend

Project Location
OREGON

0 0.2 0.4 0.6 0.8 1 Mile

Jordan Cove Energy Project

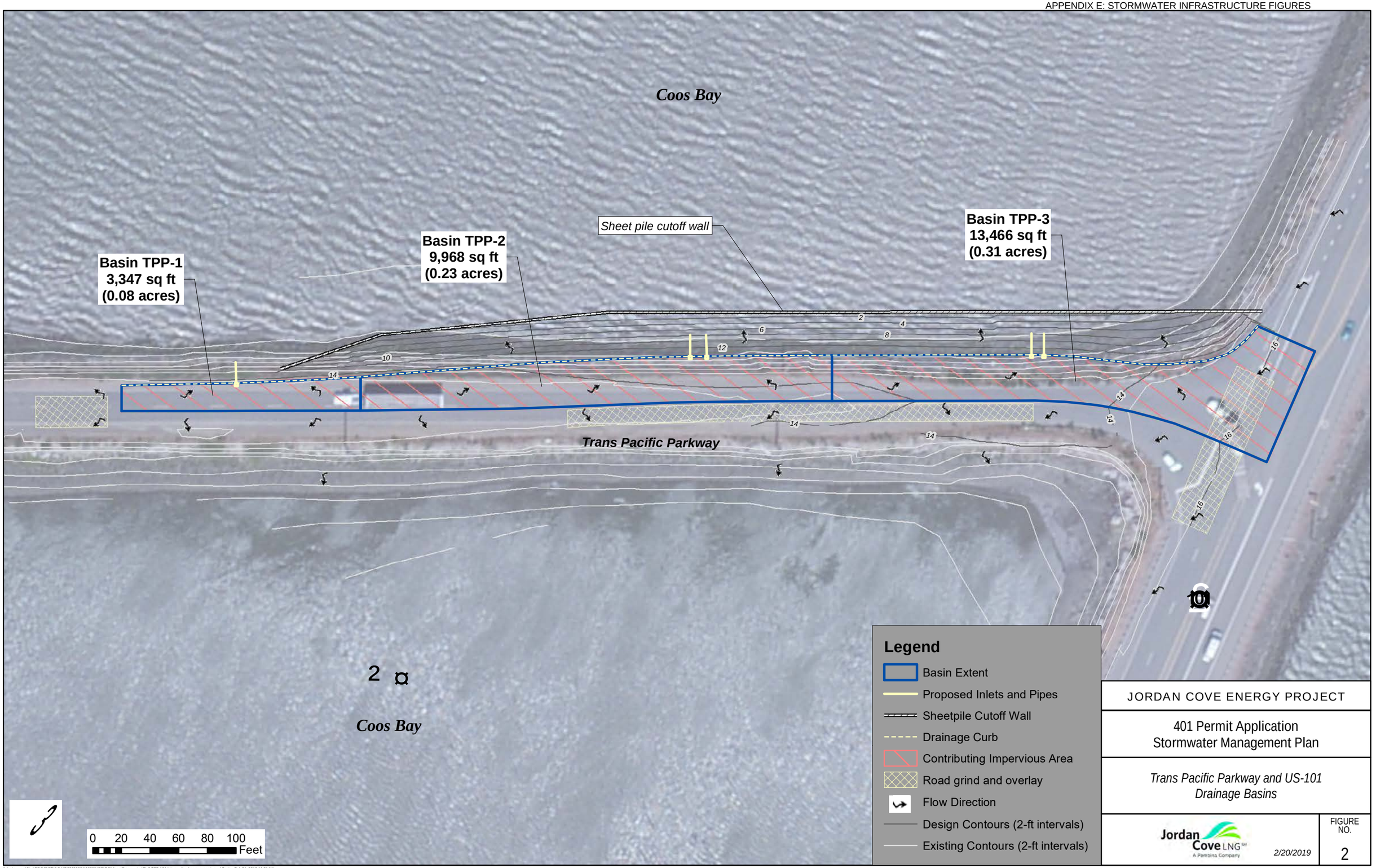
401 Permit Application
Stormwater Management Plan

Vicinity Map

Jordan Cove LNG
A Pembina Company

2/28/2019

FIGURE NO. 1



JORDAN COVE ENERGY PROJECT

401 Permit Application
Stormwater Management Plan

Trans Pacific Parkway and US-101 Drainage Basins

Jordan Cove LNG
A Pembina Company

2/20/2019

FIGURE NO. 2

Soil Unit	Soil Type	Drainage
57	Udorthents, level	Poorly drained

Coos Bay

Wetland APC-G

Wetland APC-A3

Wetland APC-F

Wetland APC-E

APCO Bridge

57

APCO SITE 2

APCO SITE 1

57

Wetland APC-C2

Wetland APC-A2

Wetland APC-D

Chappell Pkwy

Wetland APC-A1

Wetland APC-C1

rail

Wetland APC-B1

Wetland APC-B2

Wetland APC-A4

Chappell Pkwy

Pony Slough

Legend

- JCEP Project Area
- Delineated Wetland
- NRCS Soil Unit
- Existing Contours (2-ft intervals)

3

0 100 200 300 400 500 Feet

Jordan Cove Energy Project

401 Permit Application
Stormwater Management Plan

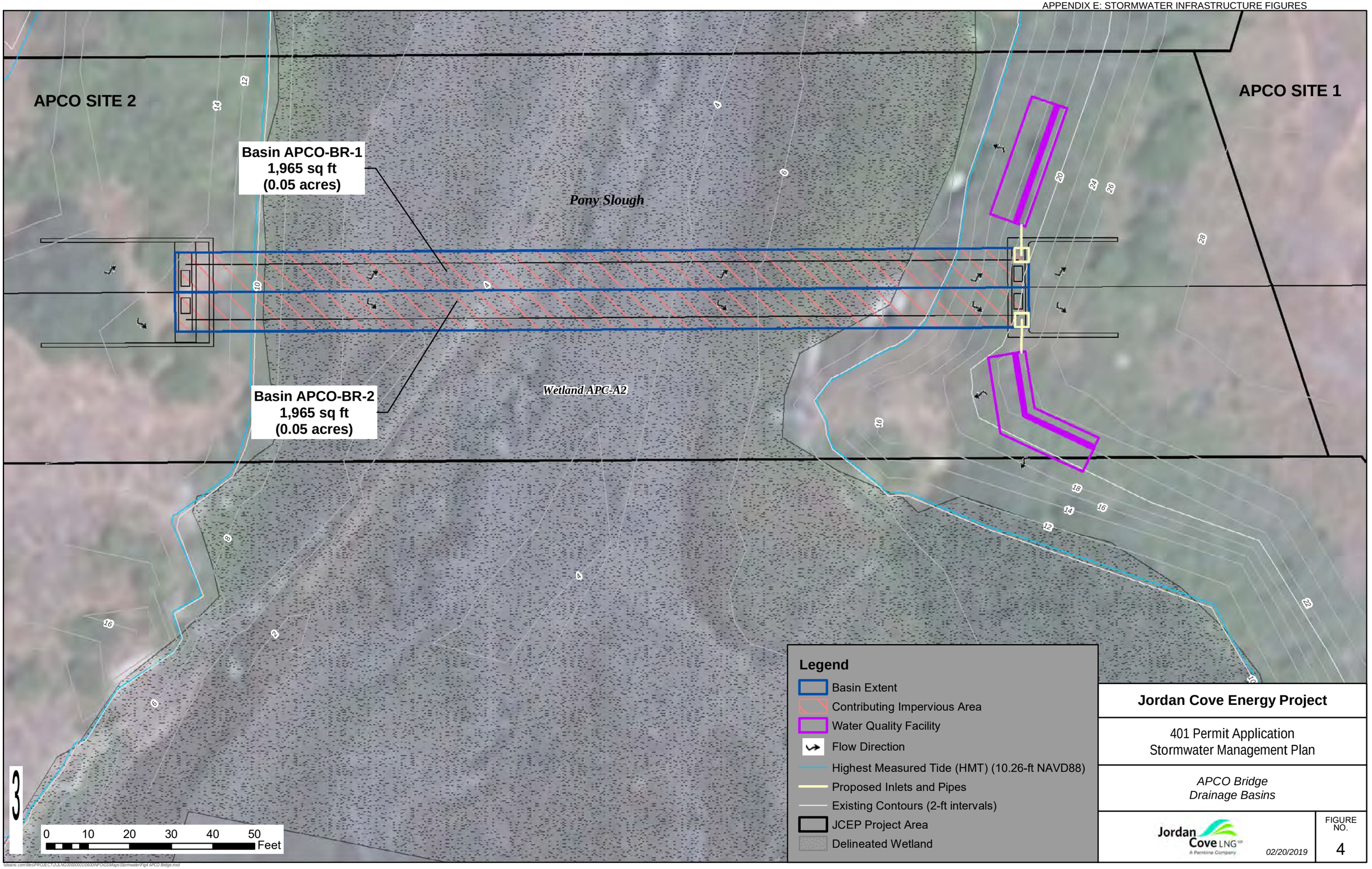
APCO Site Layout

Jordan Cove LNG
A Pembina Company

02/20/2019

FIGURE NO. 3

\\deainc.com\files\PROJECTUJLNG\000000010600INFO\GIS\Maps\Stormwater\Fig3 APCO Site Layout.mxd



Jordan Cove Energy Project

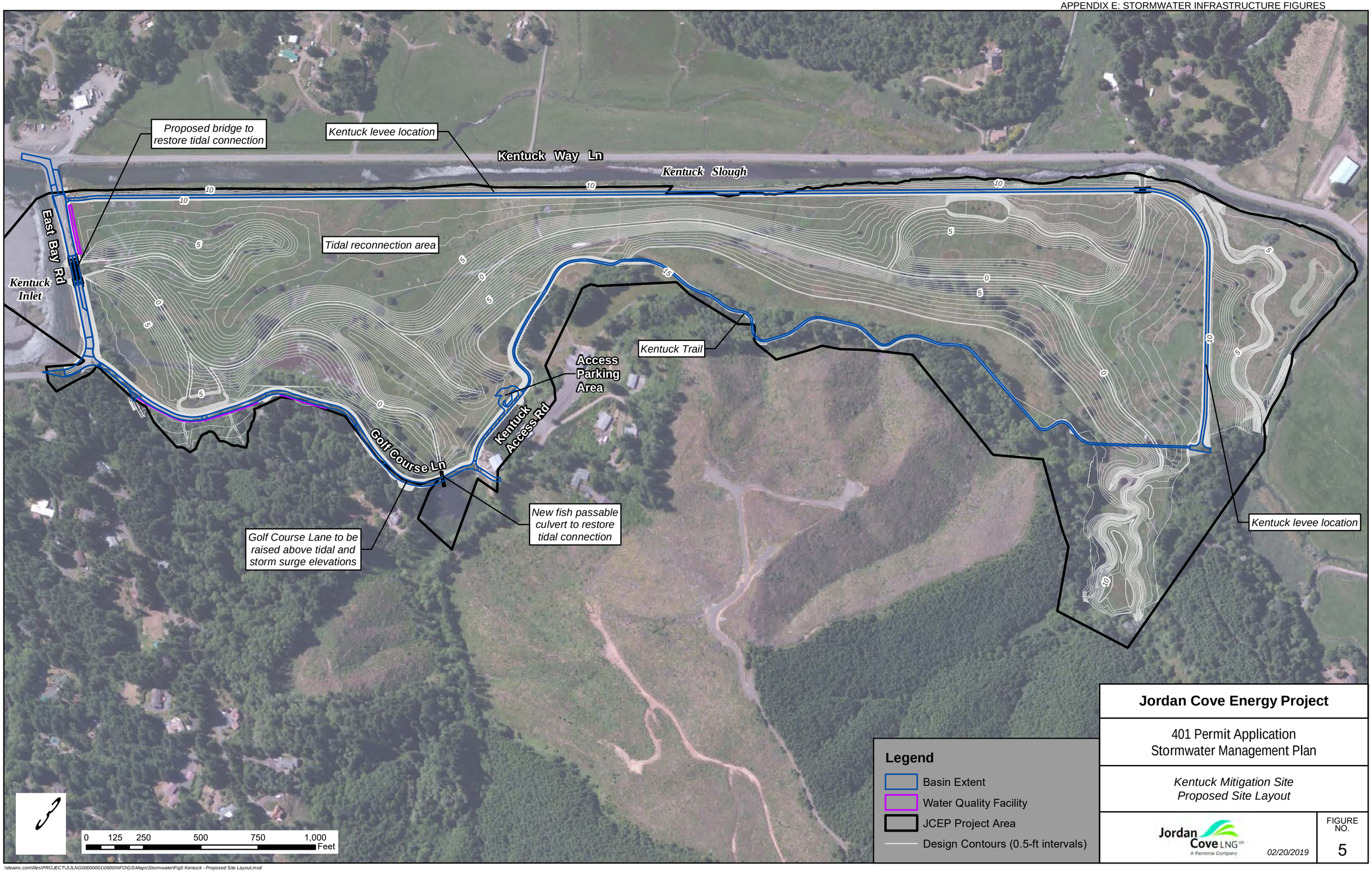
401 Permit Application
Stormwater Management Plan

APCO Bridge
Drainage Basins

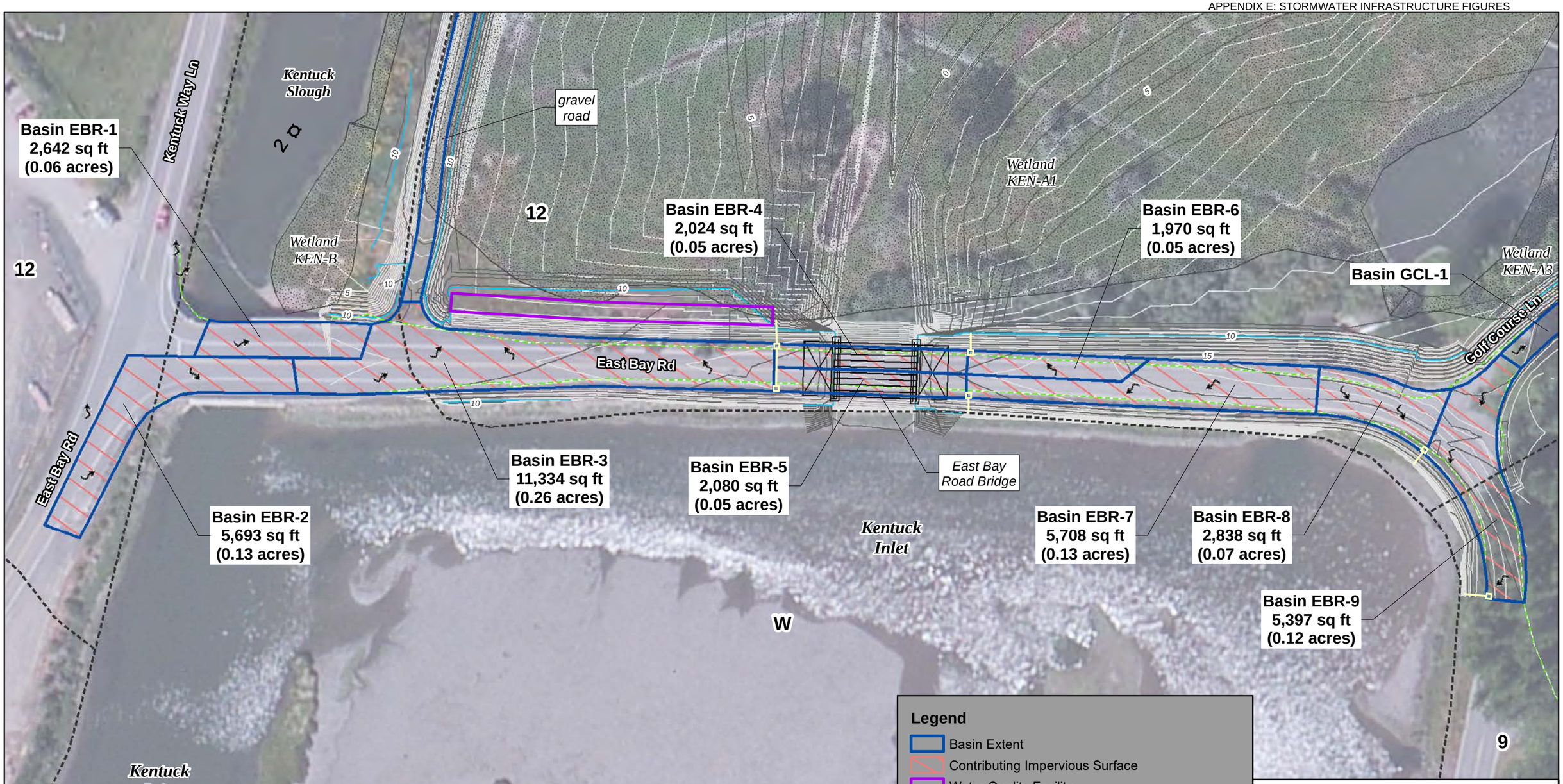
Jordan Cove LNG
A Pembina Company

02/20/2019

FIGURE NO. 4



\\deainc.com\files\PROJECT\JJLNG00000001\0600\INFO\GIS\Maps\Stormwater\Fig5 Kentuck - Proposed Site Layout.mxd



Soil Unit	Soil Type	Drainage
9	Chetco silty clay loam	Very poorly drained
12	Coquille silt loam	Very poorly drained
W	Water	n/a

Legend

- Basin Extent
- Contributing Impervious Surface
- Water Quality Facility
- Proposed Inlets and Pipes
- Flow Direction
- Existing Impervious Boundary
- Highest Measured Tide (HMT) (10.26-ft NAVD88)
- Design Contours (1-ft intervals)
- Existing Contours (0.5-ft intervals)
- NRCS Soil Unit
- Delineated Wetland

Jordan Cove Energy Project

401 Permit Application
Stormwater Management Plan

Kentuck Mitigation Site - East Bay Road Drainage Basins

Jordan Cove LNG
A Pembina Company

2/28/2019

FIGURE NO. 6

\\deainc.com\files\PROJECTU\JLNG\00000001\0600\INFO\GIS\Maps\Stormwater\Fig6 Kentuck - East Bay Drive - Drainage Basins.mxd

Soil Unit	Soil Type	Drainage
12	Coquille silt loam	Very poorly drained
54E	Templeton silt loam, 30 to 50 percent slopes	Well drained
W	Water	n/a

Levee
gravel road
Kentuck Access Road
Basin KA-1
54E
Wetland KEN-A2
Basin GCL-5
9,489 sq ft
(0.22 acres)
Fish Passage Culvert
Pond
W
Golf Course Ln
Wetland KEN-A7
12
Wetland KEN-A5
Wetland KEN-A1
Basin GCL-3
6,967 sq ft
(0.16 acres)
Basin GCL-4
3,365 sq ft
(0.08 acres)
54E
Wetland KEN-A3
Basin GCL-2
4,755 sq ft
(0.11 acres)
Wetland KEN-A4
Basin EBR-7
Basin EBR-8
Golf Course Ln
East Bay Rd
Basin GCL-1
8,980 sq ft
(0.21 acres)
Basin EBR-9
3
0 40 80 120 160 200 Feet

Legend

- Basin Extent
- Contributing Impervious Surface
- Water Quality Facility
- Proposed Inlets and Pipes
- Flow Direction
- Existing Impervious Boundary
- Highest Measured Tide (HMT) (10.26-ft NAVD88)
- Design Contours (1-ft intervals)
- Existing Contours (0.5-ft intervals)
- NRCS Soil Unit
- Delineated Wetland

JORDAN COVE ENERGY PROJECT

401 Permit Application
Stormwater Management Plan

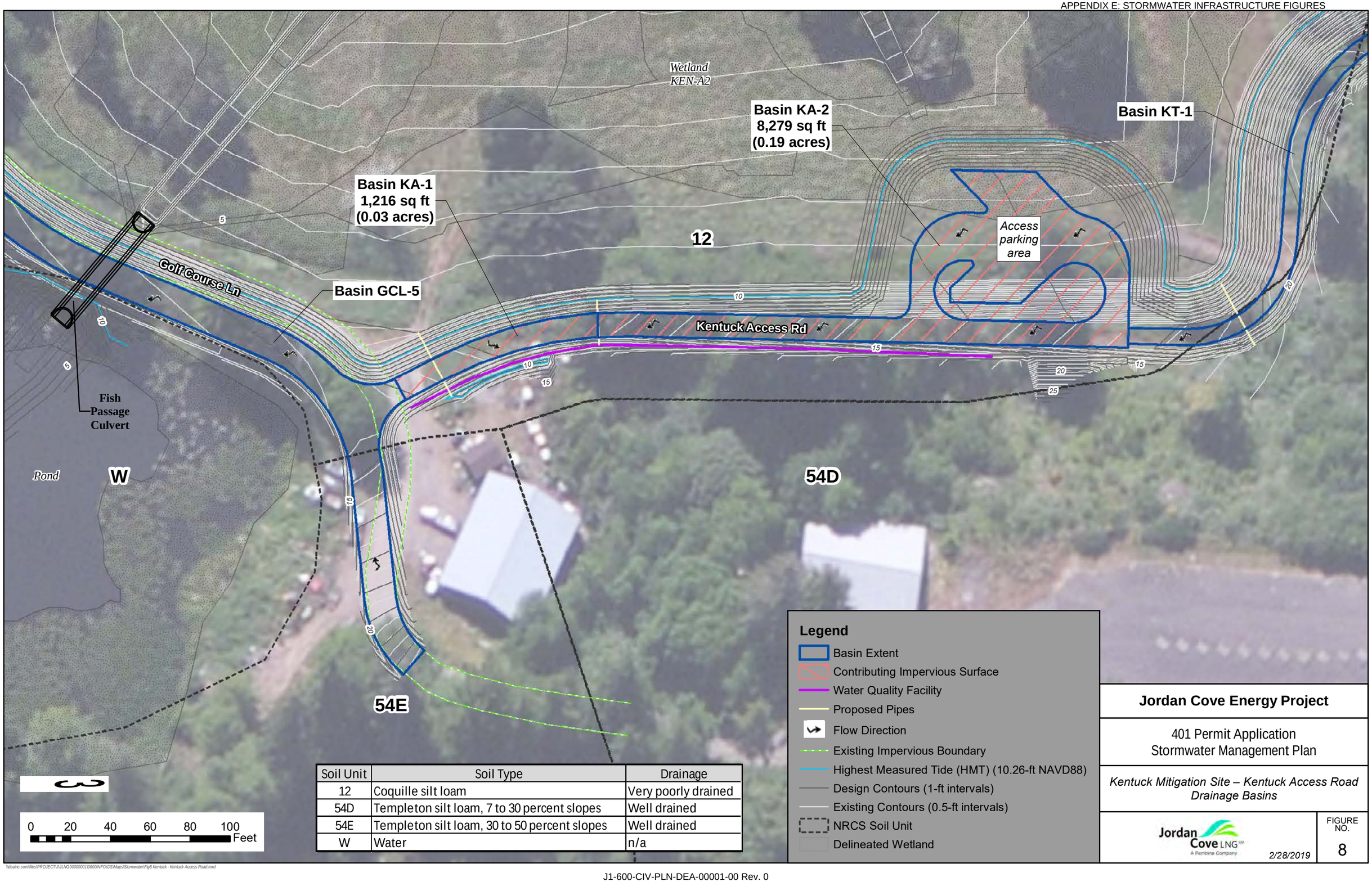
Kentuck Mitigation Site - Golf Course Lane Drainage Basins

Jordan Cove LNG
A Pambina Company

2/27/2019

FIGURE NO. 7

\\deainc.com\files\PROJECTJJLNG\00000001\0600\INFO\GIS\Maps\Stormwater\Fig7 Kentuck - Golf Course Rd - Drainage Basins.mxd



Soil Unit	Soil Type	Drainage
12	Coquille silt loam	Very poorly drained
54D	Templeton silt loam, 7 to 30 percent slopes	Well drained
54E	Templeton silt loam, 30 to 50 percent slopes	Well drained
W	Water	n/a

Legend

- Basin Extent
- Contributing Impervious Surface
- Water Quality Facility
- Proposed Pipes
- Flow Direction
- Existing Impervious Boundary
- Highest Measured Tide (HMT) (10.26-ft NAVD88)
- Design Contours (1-ft intervals)
- Existing Contours (0.5-ft intervals)
- NRCS Soil Unit
- Delineated Wetland

Jordan Cove Energy Project

401 Permit Application
Stormwater Management Plan

Kentuck Mitigation Site – Kentuck Access Road Drainage Basins

Jordan Cove LNG
A Pembina Company

2/28/2019

FIGURE NO. 8

\\deainc.com\files\PROJECTU\JLNG\00000001\0600\INFO\GIS\Maps\Stormwater\Fig8 Kentuck - Kentuck Access Road.mxd

APPENDIX F: ROADWAY & STORMWATER DESIGN DRAWINGS

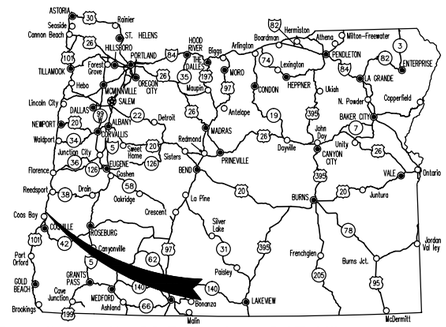
JORDAN COVE ENERGY PROJECT

PLANS FOR PROPOSED PROJECT

GRADING, DRAINAGE, STRUCTURES, PAVING, & SIGNING

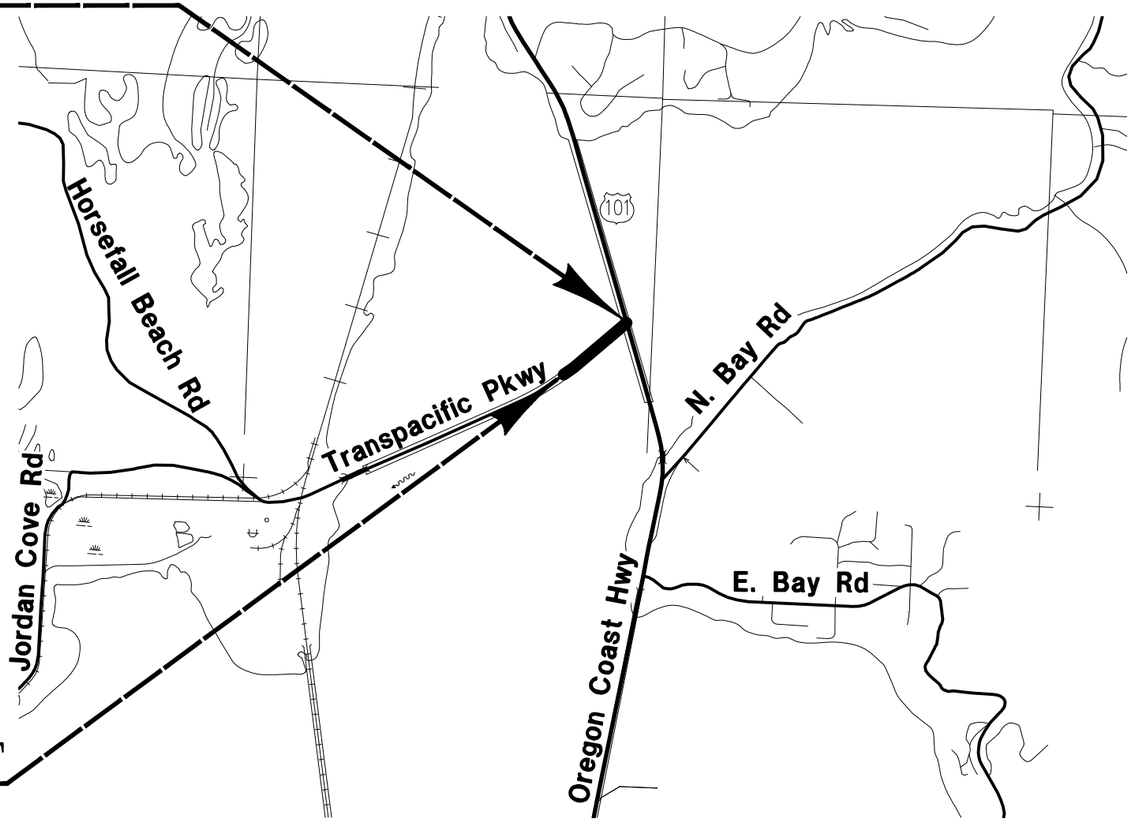
TRANS PACIFIC PKWY/US101 INTERSECTION

COOS COUNTY
SEPTEMBER 2016



Overall Length Of Project – 0.17 Miles

END OF PROJECT
STA. "TPP" 300+00



BEGINNING OF PROJECT
STA. "TPP" 291+29

T. 24 S., R. 13 W., Sec. 34 W.M.

N

ATTENTION:
Oregon Law Requires You To Follow Rules Adopted By The Oregon Utility Notification Center. Those Rules Are Set Forth In OAR 952-001-0010 Through OAR 952-001-0090. You May Obtain Copies Of The Rules By Calling The Center. (Note: The Telephone Number For The Oregon Utility Center Is (503) 232-1987.)

LET'S ALL WORK TOGETHER TO MAKE THIS JOB SAFE

DAVID EVANS AND ASSOCIATES, INC.
2100 Southwest River Parkway
Portland Oregon 97201 Ph: 503.223.6663

JORDAN COVE ENERGY PROJECT
TRANS PACIFIC PKWY INTERSECTION MODS.

COOS COUNTY

Reviewed By – G. Oien
Designed By – D. Iliyn
Drafted By – D. Iliyn

TITLE SHEET

SHEET NO. 1

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INDEX OF SHEETS CONT.

SHEET NO.	DESCRIPTION
1	Title Sheet
1A	Index Of Sheets
2	Typical Sections
2B	Intersection Detail
2B–2	Water Quality Inlet Details
2B–3	Water Quality Inlet Details
2B–4	Water Quality Inlet Details
2C	Embankment Construction Stage 1–Phase 1A
2C–2	Embankment Construction Stage 1–Phase 1B
2C–3	Embankment Construction Details
2C–4	Traffic Control Plan Stage I, Phase 1A
2C–5	Traffic Control Plan Stage I, Phase 1B
2C–6	Traffic Control Plan Stage II, Phase 1
2C–7	Traffic Control Plan Stage II, Phase 2
3	Plan and Profile
3A	Plan and Profile
TRAFFIC	
SG	Signal Plan and Detector Plan Legend
SG–2	Temporary Signal Plan
SG–3	Detector Plan
SG–4	Signal Plan Details
SG–5	Signal Plan Details
SG–6	Signal Plan Details

Standard Drg. Nos.

RD400 – Guardrail And Metal Median Barrier
RD405 – Guardrail And Metal Median Barrier Parts
RD410 – Guardrail Parts (Thrie Beam)
RD415 – Guardrail And Metal Median Barrier Parts
RD420 – Energy Absorbing Terminal

RD701 – Drainage Curbs
RD705 – Islands
RD710 – Accessible Route Islands

TM450 – Mast Arm Pole Details
TM452 – Strain Pole Details
TM455 – Temporary Signal Pole Details
TM460 – Vehicle Signal Details
TM463 – Spanwire Mounting Details
TM465 – Overhead Sign, Fire Preemption And Photoelectric Control Details
TM467 – Pedestrian Signal And Pedestrian Push Button Details
TM470 – Color Code Charts
TM475 – Loop Details
TM480 – Loop Entrance Details
TM488 – Terminal Cabinet Detail
TM490 – Crosswalk Closure Detail

TM500 – Pavement Marking Standard Detail Blocks
TM501 – Pavement Marking Standard Detail Blocks
TM503 – Pavement Marking Standard Detail Blocks
TM530 – Intersection Pavement Markings (Crosswalk, Stop Bar & Bike Lane Stencil)
TM531 – Turn Arrow Marking Details

TM741 – Square Tube Sign Supports

TM800 – Tables, Abrupt Edge And PCMS Details
TM820 – Temporary Barricades
TM821 – Temporary Sign Supports
TM850 – 2–Lane, 2–Way Roadways

DAVID EVANS AND ASSOCIATES, INC.
2100 Southwest River Parkway
Portland Oregon 97201 Ph: 503.223.6663

JORDAN COVE ENERGY PROJECT
TRANS PACIFIC PKWY INTERSECTION MODS.

COOS COUNTY

Reviewed By – G. Oien
Designed By – D. Iliyn
Drafted By – D. Iliyn

INDEX SHEET

SHEET NO. 1A

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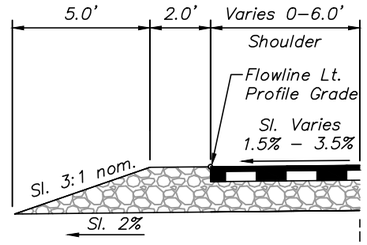

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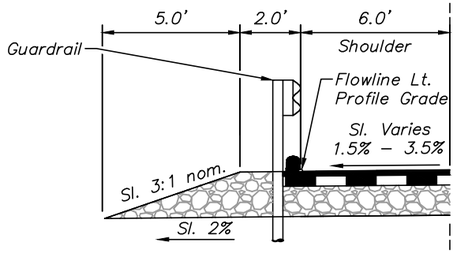

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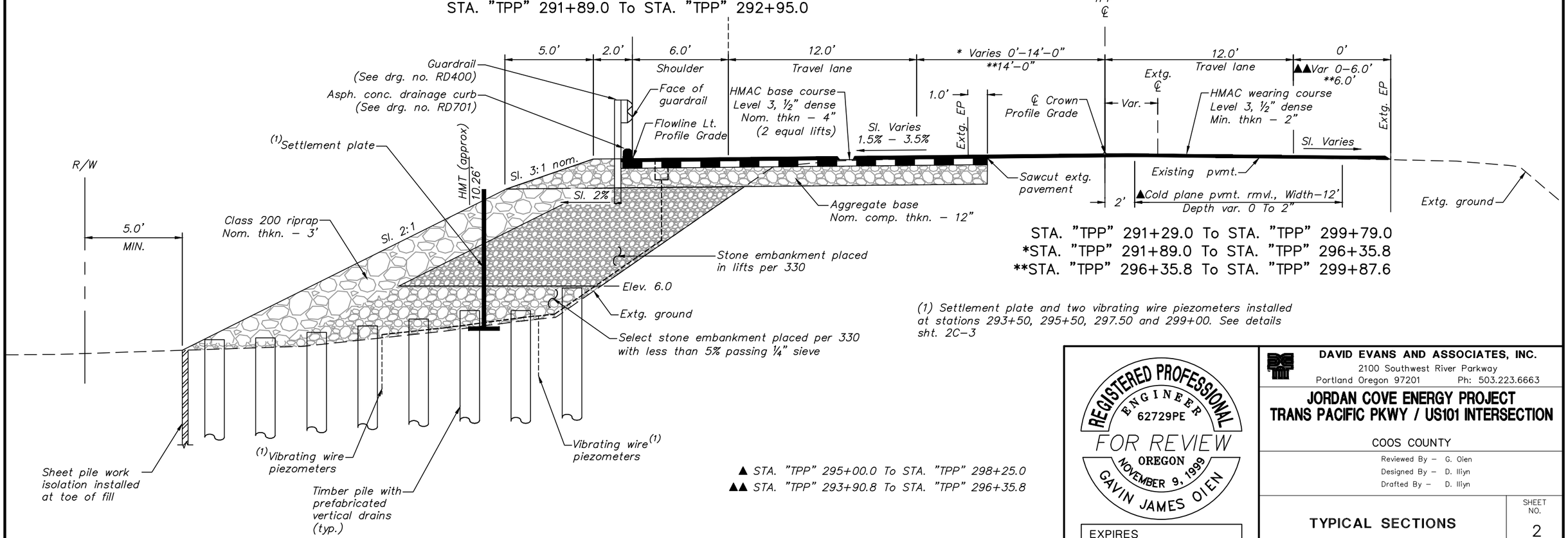

STA. "TPP" 291+29.0 To STA. "TPP" 299+79.0
*STA. "TPP" 291+89.0 To STA. "TPP" 296+35.8
**STA. "TPP" 296+35.8 To STA. "TPP" 299+87.6

▲ STA. "TPP" 295+00.0 To STA. "TPP" 298+25.0
▲▲ STA. "TPP" 293+90.8 To STA. "TPP" 296+35.8

(1) Settlement plate and two vibrating wire piezometers installed at stations 293+50, 295+50, 297.50 and 299+00. See details sht. 2C–3

REGISTERED PROFESSIONAL ENGINEER
62729PE
FOR REVIEW
OREGON
NOVEMBER 9, 1999
GAVIN JAMES OIEN
EXPIRES

DAVID EVANS AND ASSOCIATES, INC.
2100 Southwest River Parkway
Portland Oregon 97201 Ph: 503.223.6663

JORDAN COVE ENERGY PROJECT
TRANS PACIFIC PKWY / US101 INTERSECTION

COOS COUNTY

Reviewed By – G. Oien
Designed By – D. Iliyn
Drafted By – D. Iliyn

TYPICAL SECTIONS

SHEET NO. 2

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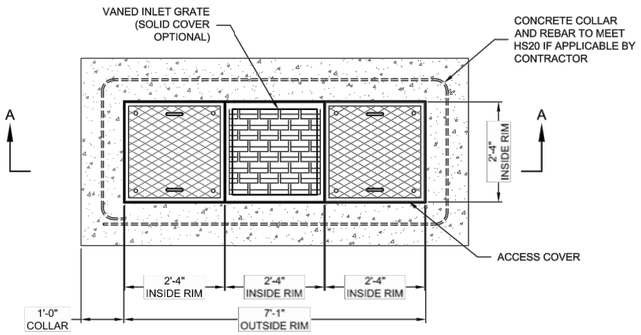
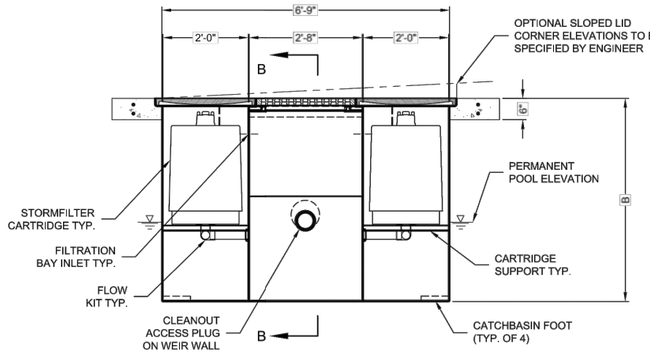
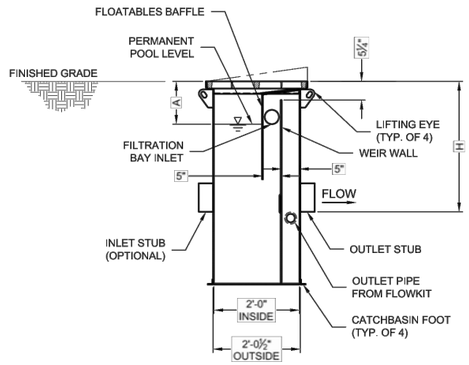


PLAN VIEW



SECTION A-A



SECTION B-B

STORMFILTER CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 2 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF TWO CARTRIDGES. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"		18"		18" DEEP	
MINIMUM HYDRAULIC DROP (H)	3.05'		2.3'		3.3'	
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	15	7.5	15	7.5
PEAK HYDRAULIC CAPACITY	1.0		1.0		1.8	
INLET PERMANENT POOL LEVEL (A)	1'-0"		1'-0"		2'-0"	
OVERALL STRUCTURE HEIGHT (B)	4'-9"		3'-9"		4'-9"	

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
6. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH QUANTITY (2) #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
7. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 37 SECONDS.
8. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

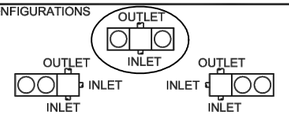
INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

2-CARTRIDGE DEEP CATCHBASIN STORMFILTER DATA

STRUCTURE ID	TPP1
WATER QUALITY FLOW RATE (cfs)	0.06 CFS
PEAK FLOW RATE (<1.8 cfs)	0.10 CFS
RETURN PERIOD OF PEAK FLOW (yrs)	25–YEAR
CARTRIDGE FLOW RATE (gpm)	15 GPM
MEDIA TYPE (CSF, PERLITE, ZPG, GAC, PHS)	PERLITE
RIM ELEVATION	14.12'

PIPE DATA:	I.E.	DIAMETER
INLET STUB	N/A	N/A
OUTLET STUB	10.59'	12"

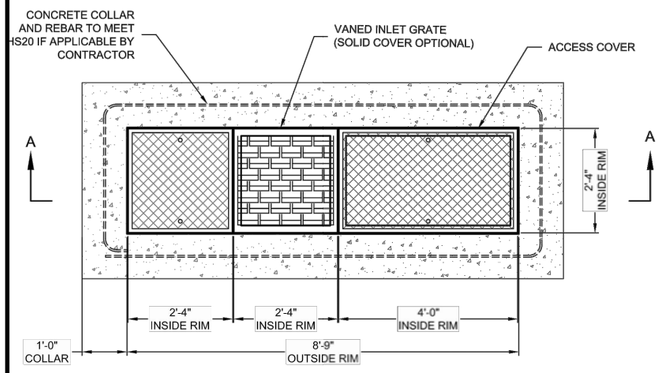
CONFIGURATIONS



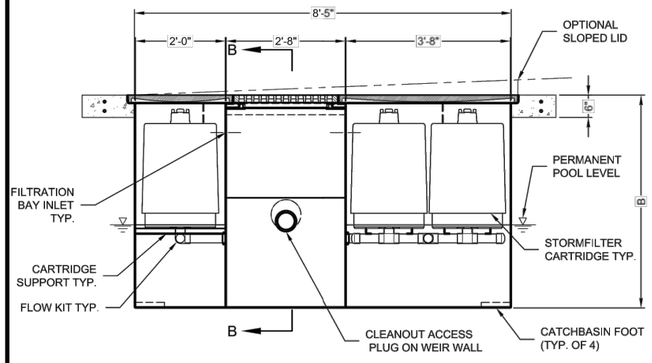
SLOPED LID	YES (NO)
SOLID COVER	YES (NO)
NOTES/SPECIAL REQUIREMENTS:	

The Stormwater Management StormFilter®

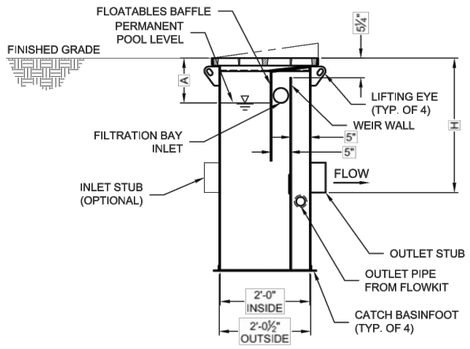
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 6,641,720; 6,810,576; 6,946,067; 6,953,097; 6,972,085; 7,186,333; 7,296,692; 7,297,266; 7,513,708; 7,566,394; 7,686,959; 7,896,586; 8,431,016; 8,470,173; 8,500,990; 8,512,561; 8,607,979; 8,622,223; 8,622,225; 8,673,151; 8,790,515; 8,858,792; 8,961,787; 9,039,897; 9,095,792; 9,199,184; 9,266,039; 9,352,263; 9,352,264; 9,358,484; 9,358,485; 9,375,660; 9,375,661; 9,427,684; 9,427,685; 9,433,878; 9,440,170; 9,440,171; 9,440,172; 9,440,173; 9,440,174; 9,440,175; 9,440,176; 9,440,177; 9,440,178; 9,440,179; 9,440,180; 9,440,181; 9,440,182; 9,440,183; 9,440,184; 9,440,185; 9,440,186; 9,440,187; 9,440,188; 9,440,189; 9,440,190; 9,440,191; 9,440,192; 9,440,193; 9,440,194; 9,440,195; 9,440,196; 9,440,197; 9,440,198; 9,440,199; 9,440,200; 9,440,201; 9,440,202; 9,440,203; 9,440,204; 9,440,205; 9,440,206; 9,440,207; 9,440,208; 9,440,209;



PLAN VIEW



SECTION A-A



SECTION B-B

STORMFILTER CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 3 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF THREE CARTRIDGES. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"		(18")		18" DEEP	
MINIMUM HYDRAULIC DROP (H)	3.05'		(2.3)		3.3'	
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/ft²	1 gpm/ft²	(2 gpm/ft²)	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	(15)	7.5	15	7.5
PEAK HYDRAULIC CAPACITY	1.0		1.0		1.8	
INLET PERMANENT POOL LEVEL (A)	1'-0"		1'-0"		2'-0"	
OVERALL STRUCTURE HEIGHT (B)	4'-9"		3'-9"		4'-9"	

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ANGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
6. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH QUANTITY (2) #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
7. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 37 SECONDS.
8. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

3-CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID		TPP2
WATER QUALITY FLOW RATE (cfs)		0.19 CFS
PEAK FLOW RATE (<1 cfs)		0.30 CFS
RETURN PERIOD OF PEAK FLOW (yrs)		25-YEAR
CARTRIDGE FLOW RATE (gpm)		15 gpm
MEDIA TYPE (CSF, PERLITE, ZPG, GAC, PHS)		PERLITE
RIM ELEVATION (STA. 295+87.00)		13.33'
RIM ELEVATION (STA. 295+98.00)		13.32'
PIPE DATA:	I.E.	DIAMETER
OUTLET STUB (STA. 295+87.00)	10.86'	12"
OUTLET STUB (STA. 295+98.00)	10.86'	12"

CONFIGURATION



SLOPED LID	YES (NO)
SOLID COVER	YES (NO)

NOTES/SPECIAL REQUIREMENTS:
THE DESIGN FLOWS SHOWN ARE THE COMBINED FLOWS FOR BOTH THE 3 CARTRIDGE CATCH BASINS.

The Stormwater Management StormFilter®

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,631; 5,624,576; 5,707,521; 5,893,971; 6,027,639; 6,284,137; 6,498,934; AND RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

CONTECH® ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

3 CARTRIDGE CATCHBASIN STORMFILTER STANDARD DETAIL

REGISTERED PROFESSIONAL ENGINEER
44930
FOR REVIEW
OREGON
JULY 13, 1999
DOUGLAS B. GATES
EXPIRES

DAVID EVANS AND ASSOCIATES, INC.
2100 Southwest River Parkway
Portland Oregon 97201 Ph: 503.223.6663

JORDAN COVE ENERGY PROJECT
TRANS PACIFIC PKWY / US101 INTERSECTION

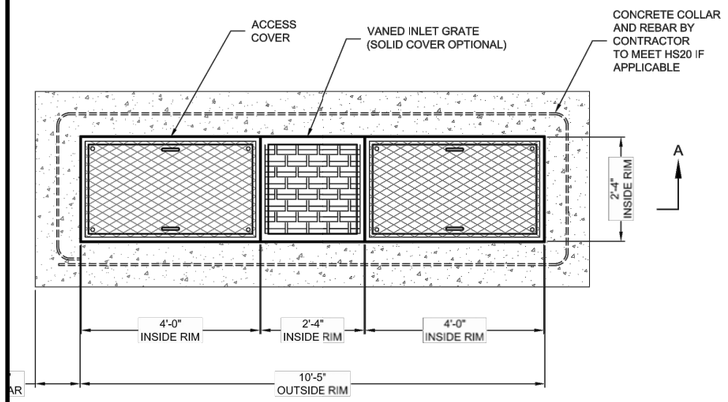
COOS COUNTY

Reviewed By – D. Gates
Designed By – N. Pittenger
Drafted By – K. Chiodo

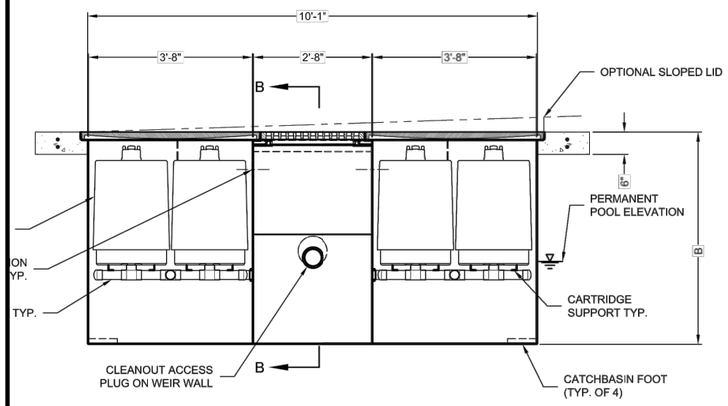
WATER QUALITY INLET DETAILS

SHEET NO. 2B-3

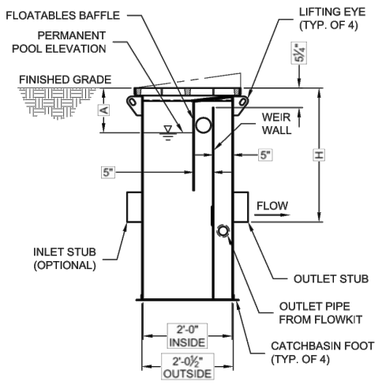
C:\pw_work\jordan_cove_lng\kxch\dms00428\ECDT002BJCEP0004-2B & 2B-2.dwg kxch Sep 28, 2016 6:02pm



PLAN VIEW
27" CARTRIDGES



SECTION A-A



SECTION C-C

STORMFILTER CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 4 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF FOUR CARTRIDGES. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"		(18")		18" DEEP	
MINIMUM HYDRAULIC DROP (H)	3.05'		(2.3)		3.3'	
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/ft²	1 gpm/ft²	(2 gpm/ft²)	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	(15)	7.5	15	7.5
PEAK HYDRAULIC CAPACITY	1.0		1.0		1.8	
INLET PERMANENT POOL LEVEL (A)	1'-0"		1'-0"		2'-0"	
OVERALL STRUCTURE HEIGHT (B)	4'-9"		3'-9"		4'-9"	

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
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5. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
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7. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 37 SECONDS.
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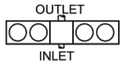
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

4-CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID			TPP3
WATER QUALITY FLOW RATE (cfs)			0.26 CFS
PEAK FLOW RATE (<1 cfs)			0.35 CFS
RETURN PERIOD OF PEAK FLOW (yrs)			25–YEAR
CARTRIDGE FLOW RATE (gpm)			15 GPM
MEDIA TYPE (CSF, PERLITE, ZPG, GAC, PHS)			PERLITE
RIM ELEVATION	(STA. 298+20)		12.90'
RIM ELEVATION	(STA. 298+33)		12.89'
PIPE DATA:		I.E.	DIAMETER
OUTLET STUB	(STA. 298+20)	10.59	12"
OUTLET STUB	(STA. 298+33)	10.59	12"

CONFIGURATION



SLOPED LID	YES (NO)
SOLID COVER	YES (NO)

NOTES/SPECIAL REQUIREMENTS:
THE DESIGN FLOWS SHOWN ARE THE COMBINED FLOWS FOR BOTH OF THE 4 CARTRIDGE CATCH BASINS.

The Stormwater Management StormFilter®
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,631; 5,324,070; 5,707,531; 5,725,760; 5,783,065; 5,817,232; 5,849,188; 6,027,643; 6,045,698; RELATED FOREIGN PATENTS; OR OTHER PATENTS PENDING.

CONTECH® ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

4 CARTRIDGE CATCHBASIN
STORMFILTER
STANDARD DETAIL

REGISTERED PROFESSIONAL ENGINEER
44930
FOR REVIEW
OREGON
JULY 13, 1999
DOUGLAS B. GATES
EXPIRES

DAVID EVANS AND ASSOCIATES, INC.
2100 Southwest River Parkway
Portland Oregon 97201 Ph: 503.223.6663

JORDAN COVE ENERGY PROJECT
TRANS PACIFIC PKWY / US101 INTERSECTION

COOS COUNTY

Reviewed By – D. Gates
Designed By – N. Pittenger
Drafted By – K. Chiodo

WATER QUALITY INLET DETAILS

SHEET NO. 2B–4

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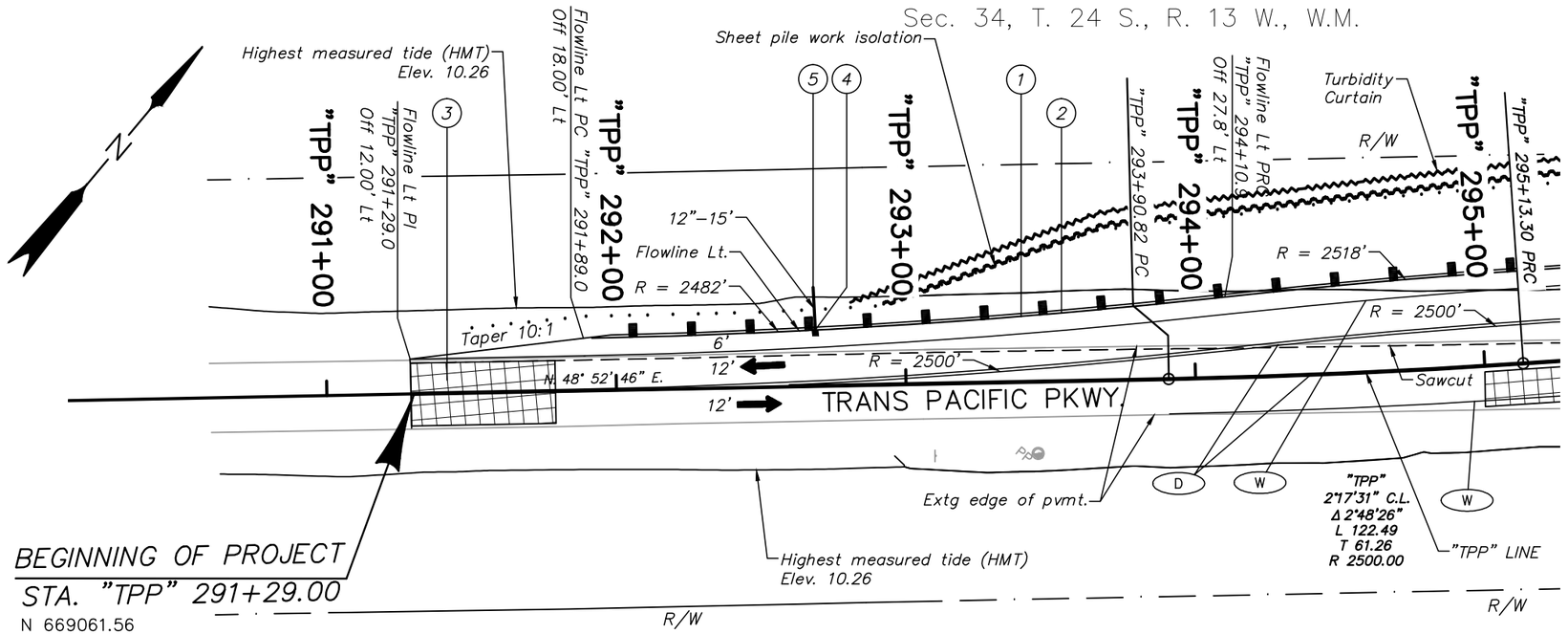
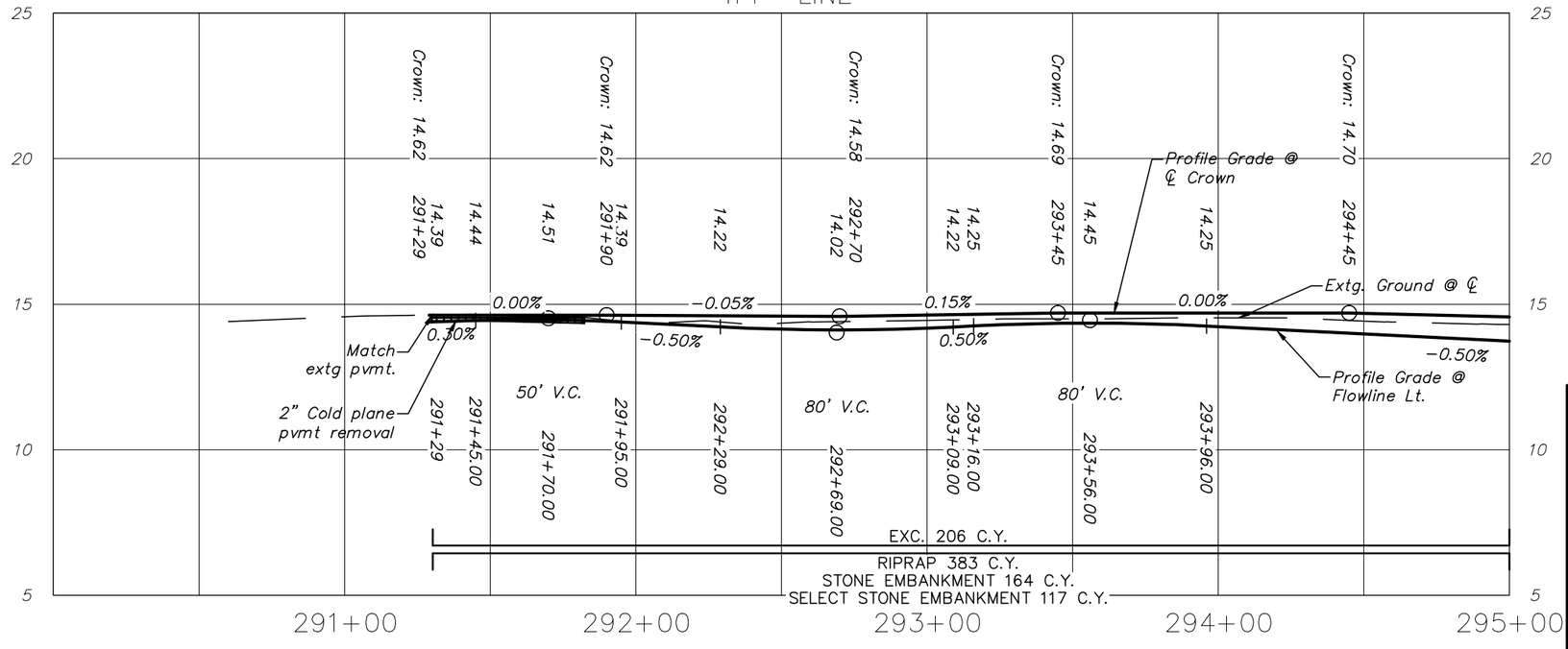
Sec. 34, T. 24 S., R. 13 W., W.M.



1. Sta. "TPP" 291+82 to Sta. "TPP" 299+65, Lt.
   Const. guardrail – 800' (Type 2A)
   Const. guardrail terminal, non–flared (L=37.5')
   Test Level – 3
   W=1, E=0
   (See drg. nos. RD400, RD405, RD410, RD415, and RD420)
2. Const. asph. conc. drainage curb
   (See drg. no. RD701)
3. 2" Cold plane pvmt. removal = 69 Sq.yd.
4. Sta. "TPP" 292+69, Lt.
   Const. water quality inlet (TPP1)
   (For details, see sht. 2B–2)
5. Sta. "TPP" 292+69, Lt.
   Const. outfall
   Inst. 12" sewer pipe – 15'
   Slope = 1.0%

"TPP" LINE



0' 25' 50' 100'

STRIPING LEGEND

- (D) Inst. double no–pass
- (W) Inst. 4" white line

LEGEND

- Fill slope line . . . . . .
- 2" Cold Plane Pavement Removal

REGISTERED PROFESSIONAL ENGINEER
62729PE
FOR REVIEW
OREGON
NOVEMBER 9, 1999
GAVIN JAMES OIEN
EXPIRES

DAVID EVANS AND ASSOCIATES, INC.
2100 Southwest River Parkway
Portland Oregon 97201 Ph: 503.223.6663

JORDAN COVE ENERGY PROJECT
TRANS PACIFIC PKWY / US101 INTERSECTION

COOS COUNTY

Reviewed By – G. Oien
Designed By – D. Iliyn
Drafted By – D. Iliyn

PLAN AND PROFILE

SHEET NO. 3

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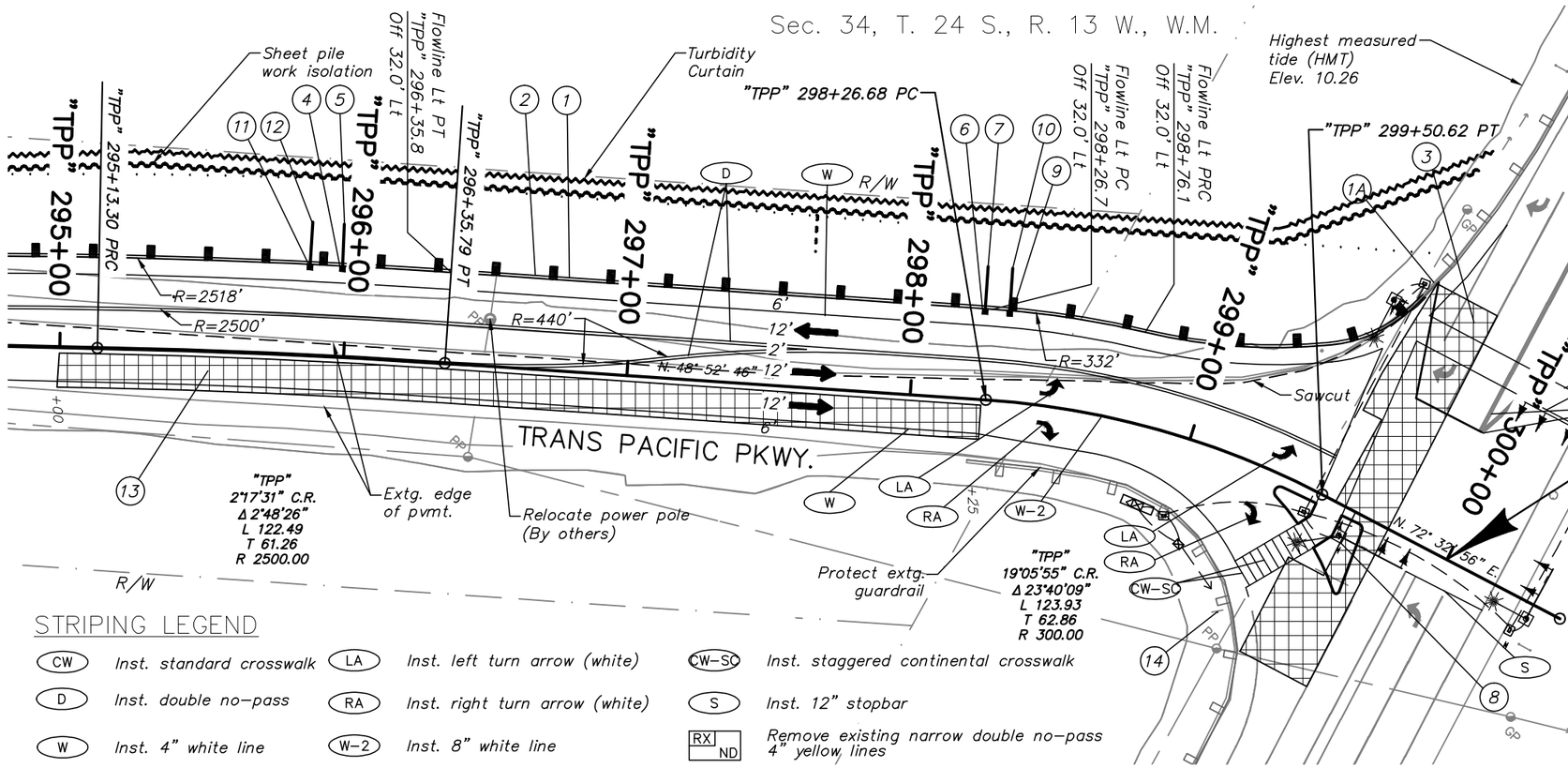
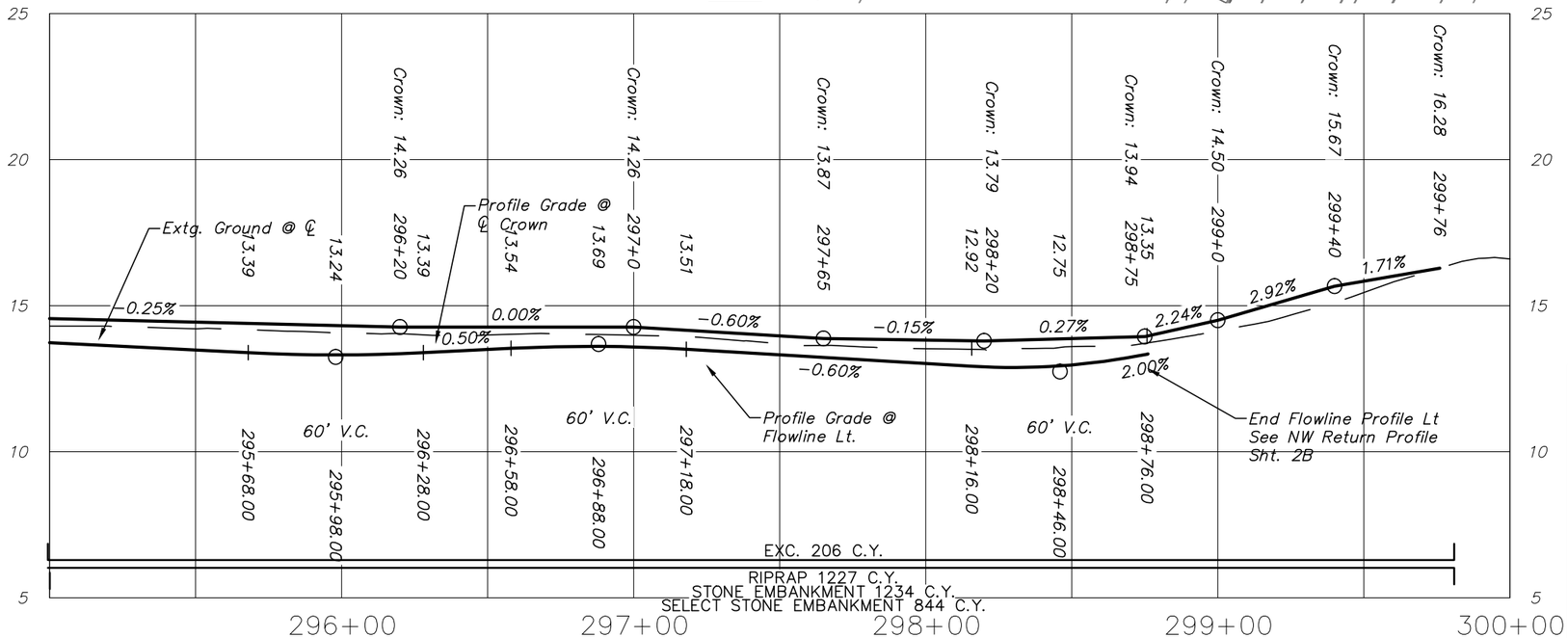
Sec. 34, T. 24 S., R. 13 W., W.M.



STRIPING LEGEND

CW	Inst. standard crosswalk	LA	Inst. left turn arrow (white)	CW-SC	Inst. staggered continental crosswalk
D	Inst. double no-pass	RA	Inst. right turn arrow (white)	S	Inst. 12" stopbar
W	Inst. 4" white line	W-2	Inst. 8" white line	RX ND	Remove existing narrow double no-pass 4" yellow lines



(1) See sht. 3, note 1
Remove extg. guardrail – 184'
(1A) Connect to extg. guardrail

(2) Const. asph. conc. drainage curb

(3) 2" Cold plane pvmt removal = 367 Sq. yd.

(4) Sta. "TPP" 295+98, Lt.
Const. water quality inlet (TPP2A)
(For details, see sht. 2B-3)

(5) Sta. "TPP" 295+98, Lt.
Const. outfall
Inst. 12" sew. pipe – 15'
Slope = 1.0%

(6) Sta. "TPP" 298+20, Lt.
Const. water quality inlet (TPP3A)
(For details, see sht. 2B-4)

(7) Sta. "TPP" 298+20, Lt.
Const. outfall
Inst. 12" sew. pipe – 15'
Slope = 1.0%

(8) Const. conc. island (Non-mountable, type C, cut through)
(For details, see sht. 2B and ODOT std. drg. no. RD 705 and RD710)

(9) Sta. "TPP" 298+33, Lt.
Const. water quality inlet (TPP3B)
(For details, see sht. 2B-4)

(10) Sta. "TPP" 298+33, Lt.
Const. outfall
Inst. 12" sew. pipe – 15'
Slope = 1.0%

(11) Sta. "TPP" 295+87, Lt.
Const. water quality inlet (TPP2B)
(For details, see sht. 2B-3)

(12) Sta. "TPP" 295+87, Lt.
Const. outfall
Inst. 12" sew. pipe – 15'
Slope = 1.0%

(13) 2" Cold plane pvmt removal = 433 Sq. yd.

(14) Remove extg. sign and support

LEGEND

Fill slope line . . . . . .

2" Cold Plane Pavement Removal

0' 25' 50' 100'

REGISTERED PROFESSIONAL ENGINEER
62729PE
FOR REVIEW
OREGON
NOVEMBER 9, 1999
GAVIN JAMES OIEN
EXPIRES

DAVID EVANS AND ASSOCIATES, INC.
2100 Southwest River Parkway
Portland Oregon 97201 Ph: 503.223.6663

JORDAN COVE ENERGY PROJECT
TRANS PACIFIC PKWY / US101 INTERSECTION

COOS COUNTY

Reviewed By – G. Oien
Designed By – D. Iliyn
Drafted By – D. Iliyn

PLAN AND PROFILE

SHEET NO. 3A

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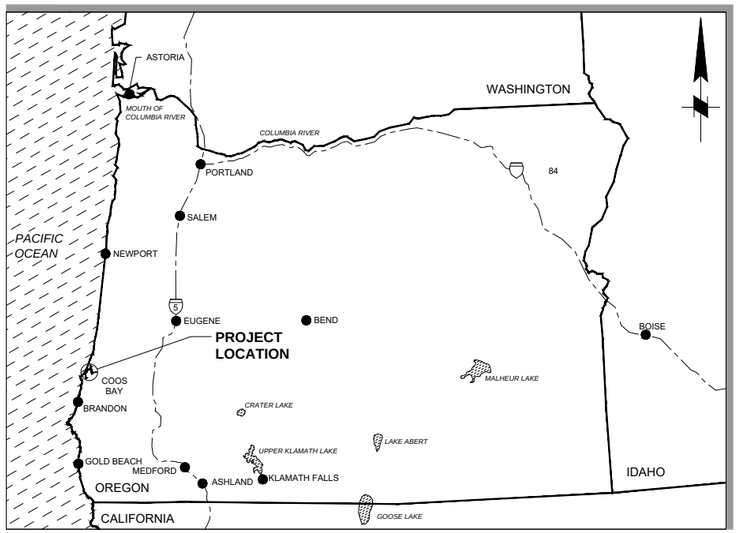
COOS BAY, OR
JORDAN COVE LNG
APCO 2 SITE DESIGN



VICINITY MAP
SCALE: NTS



LOCATION MAP
SCALE: NTS

NO.	DATE	BY / CHK.	APPD.	REVISION AND RECORD OF ISSUE
A	12/07/18	MK/RD	WG	ISSUED FOR REVIEW

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moffatt & nichol

Jordan Cove LNG LP
A Pembina Company

JORDAN COVE ENERGY PROJECT
APCO 2 SITE DESIGN

COOS COUNTY

Designer: W GERKIN
Drafter: D CORCORAN
Review: Reviewed_by
Checker: Checked_by

COVER SHEET

SHEET NO.
G-001

Q:\HO\9929-06 JCLNG Navigation Reliability Improvement\CADD_Active_NRI-SheetSet\992906-G-001 12/11/2018 10:03 AM Corcorran, Darwin

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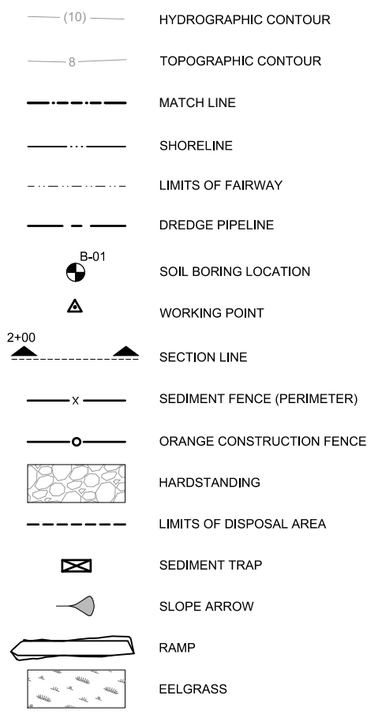
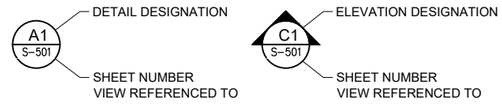
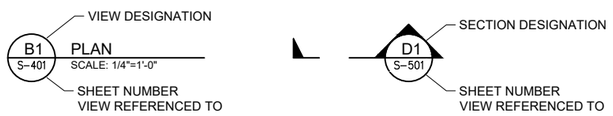
LEGEND





DETAIL CALLOUT ELEVATION VIEW



VIEW TITLE SECTION CUT

ABBREVIATIONS

APPROX	APPROXIMATE
ATON	AID-TO-NAVIGATION
CONC	CONCRETE
CONST	CONSTRUCTION
CTS	CENTERS
CY	CUBIC YARDS
EL	ELEVATION
ELEV	ELEVATION
ESC	EROSION AND SEDIMENT CONTROL
EXIST	EXISTING
FT	FEET
GRND	GROUND
HORIZ	HORIZONTAL
LT	LONG TON OR LEFT
MAX	MAXIMUM
MH	MANHOLE
MHHW	MEAN HIGHER HIGH WATER
MHW	MEAN HIGH WATER
MIL	1000TH OF AN INCH
MIN	MINIMUM
MISC	MISCELLANEOUS
MLW	MEAN LOW WATER
MLLW	MEAN LOWER LOW WATER
MPH	MILES PER HOUR
MSL	MEAN SEA LEVEL
N	NORTH
NAVD	NORTH AMERICAN VERTICAL DATUM
NGVD	NATIONAL GEODETIC VERTICAL DATUM
NO.	A NUMBER
NTS	NOT TO SCALE
PD	PROJECT DATUM
QTY	QUANTITY
R	RADIUS
RT	RIGHT
S	SOUTH
SCH	SCHEDULE
SHT	SHEET
STA	STATION
STD	STANDARD
T	TON
TBM	TEMPORARY BENCHMARK
TBR	TO BE REMOVED
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
USACE	UNITED STATES ARMY CORPS OF ENGINEERS
W	WEST
W/	WITH
"	SECONDS OR INCH
'	MINUTES OR FEET
*	ASTERISK
□	SQUARE
#	NUMBER OR POUNDS
&	AND
@	AT
℄	CENTERLINE
Ø	DIAMETER OR PHASE
°	DEGREES
₹	PLATE
∠	ANGLE

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moffatt & nichol

Jordan Cove LNG
A Pembina Company

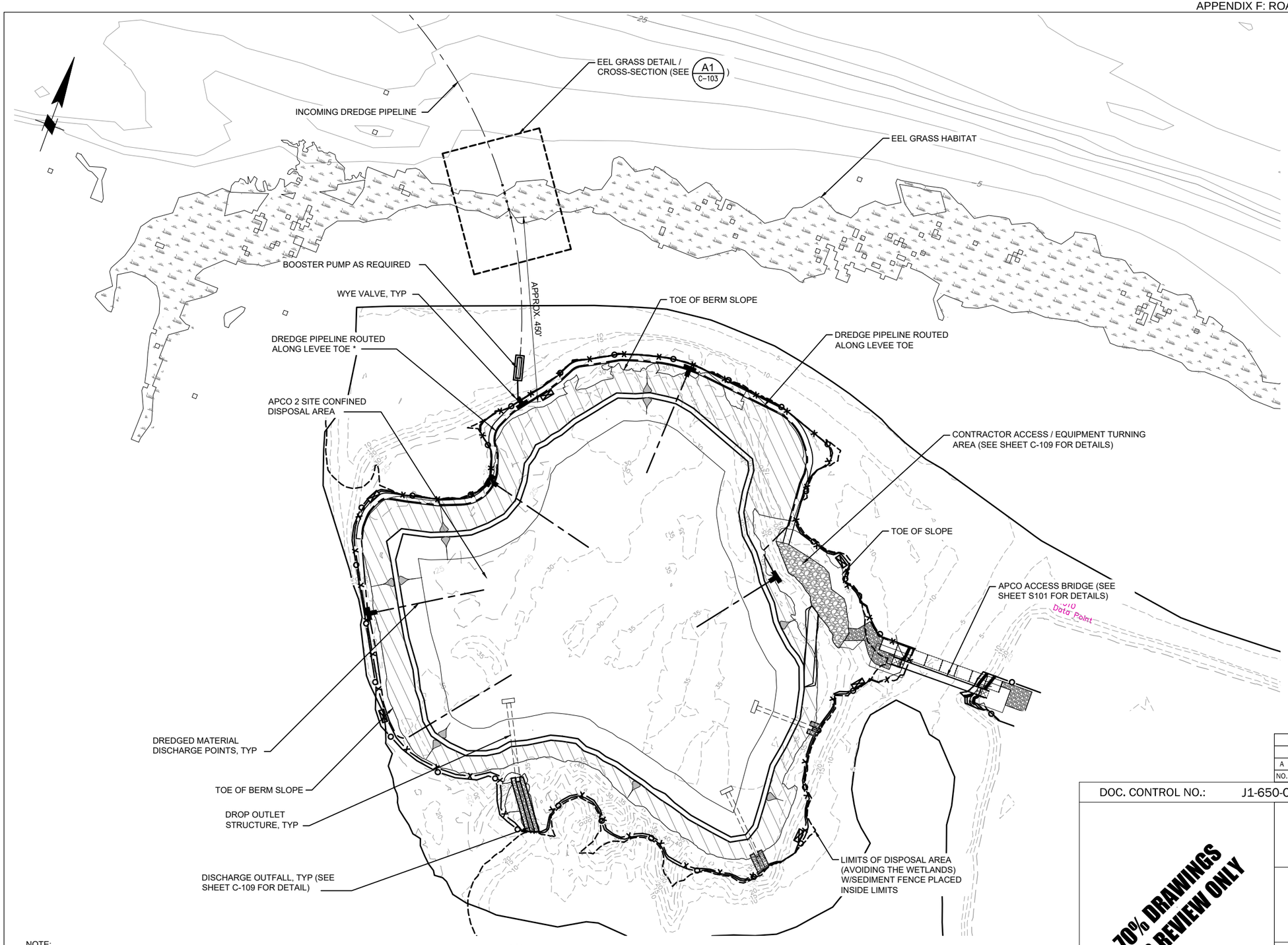
JORDAN COVE ENERGY PROJECT
APCO 2 SITE DESIGN

COOS COUNTY

Designer: W GERKIN Review: Reviewed_by

Drafter: D CORCORRAN Checker: Checked_by

SHEET INDEX, LEGEND & ABBREVIATIONS SHEET NO. G-002



A1 C-102 EELGRASS CROSSING VICINITY PLAN
SCALE: 1" = 120'

NOTES:

1. THE PIPELINE STRING WILL BE LAID ON THE COOS BAY NAVIGATION CHANNEL BOTTOM, ALONG A CORRIDOR APPROXIMATELY 50 FEET WIDE ALONG THE EASTERN TOE OF THE CHANNEL. CHANNEL CROSSING WILL REQUIRE NAVIGATION MARKERS TO PROVIDE WARNING OF THE REDUCED UNDERKEEL CLEARANCE ON THE CHANNEL BOTTOM.

NOTE:

* THE OUTSIDE TOE OF THE BERM SLOPES SHALL INCLUDE A PIPELINE DISCHARGE CORRIDOR OF MINIMUM OF 15 FEET WIDE. THE PIPELINE CORRIDOR SHALL BE WIDE ENOUGH TO ALLOW VEHICULAR ACCESS TO MAINTAIN SITE FENCING AND THE DREDGE DISCHARGE PIPELINES.

120' 0' 120' 240'
SCALE: 1"=120'

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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A Pembina Company

JORDAN COVE ENERGY PROJECT
APCO 2 SITE DESIGN

COOS COUNTY

Designer: W GERKIN Review: Reviewed_by
Drafter: D CORCORRAN Checker: Checked_by

EELGRASS CROSSING VICINITY PLAN

SHEET NO. C-102

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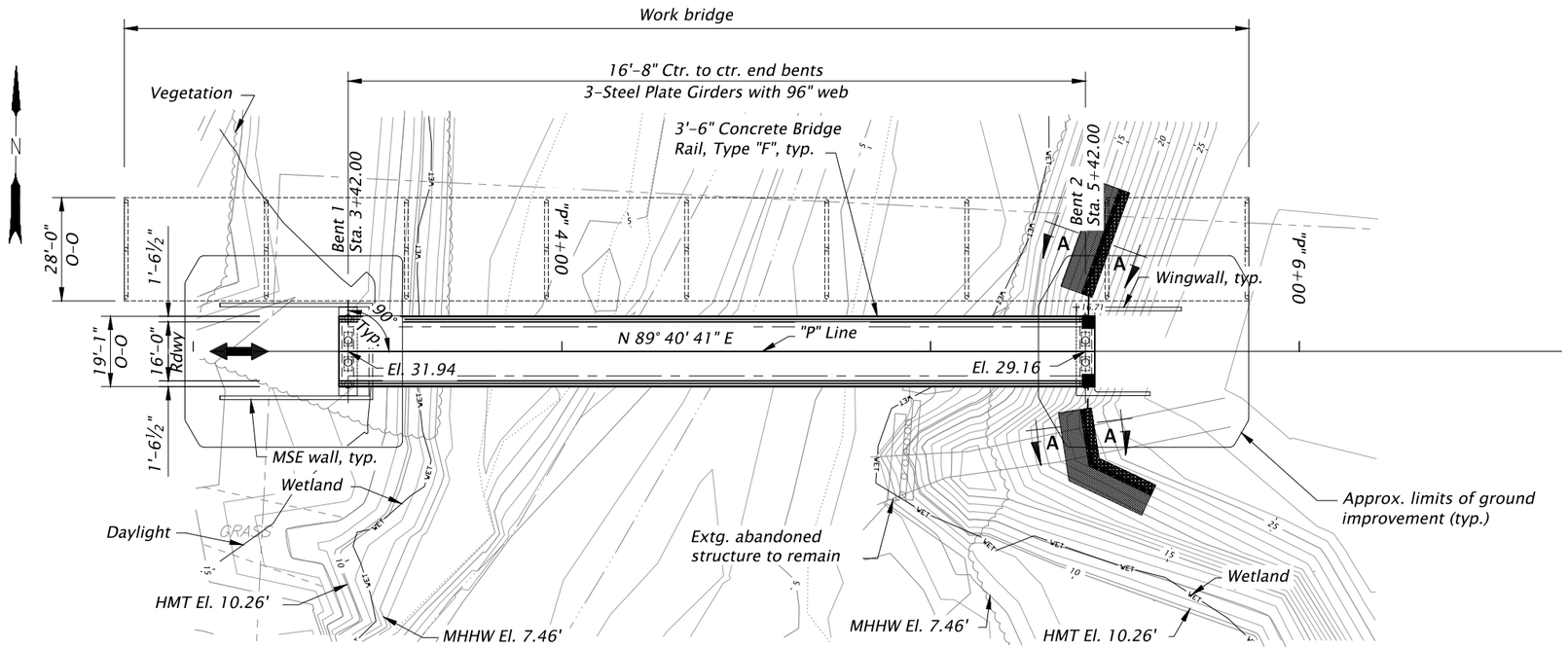
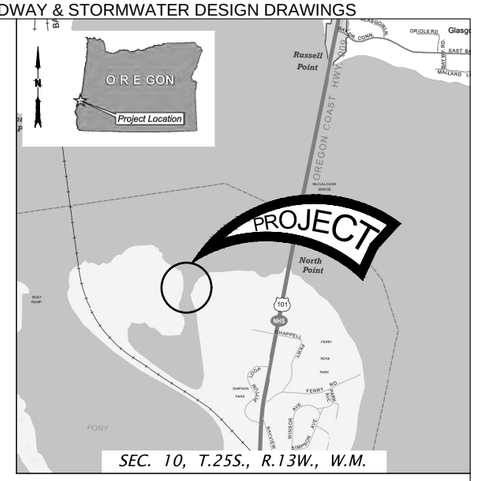


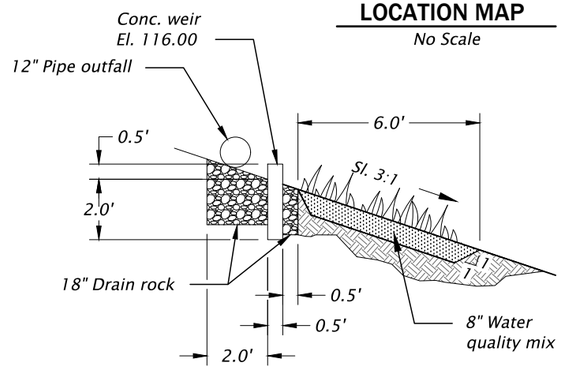
PLAN

Scale: 1" = 20'-0"



LOCATION MAP

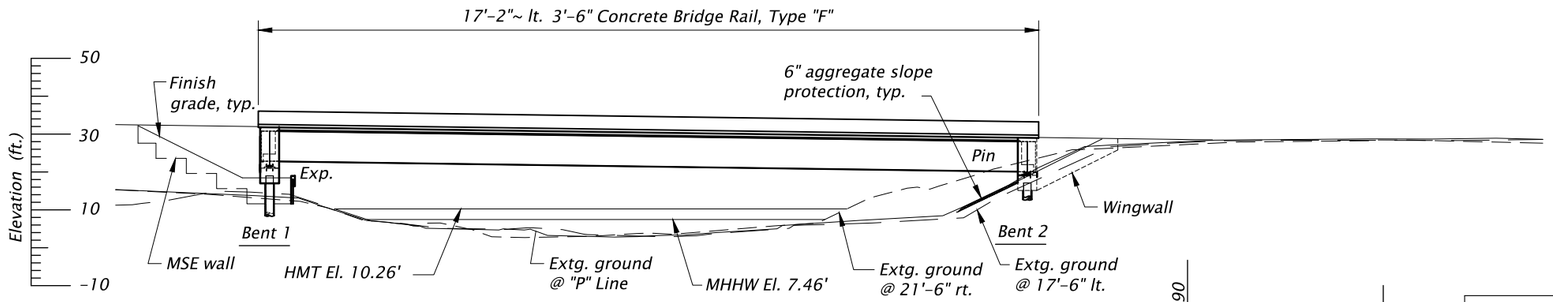
No Scale



WATER QUALITY FILTER STRIP

SECTION A-A

No Scale

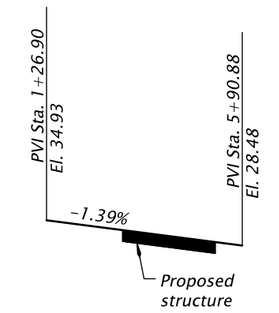


ELEVATION

Scale: 1" = 20'-0"

Notes:
Elevations are based on North American Vertical Datum 1988 (NAVD88).

MHHW = Mean Higher High Water.
MSE = Mechanically Stabilized Earth.
HMT = Highest Measured Tide.



GRADELINE DIAGRAM

No Scale

Note: This drawing is superseded by J1-650-CIV-PLN-DEA-00002-01 Rev B

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
4	3/01/19	JC		TS	REV D: ISSUED FOR REVIEW
3	12/07/18	JC		TS	REV C: ISSUED FOR REVIEW
2	10-01-18	JC		TS	REV B: ISSUED FOR REVIEW
1	08-08-18	JC		TS	REV A: ISSUED FOR REVIEW

DOC. CONTROL NO.: J1-650-STR-PLN-DEA-00009-01 REV D - ISSUED FOR REVIEW

DRAFT PLANS FOR REVIEW ONLY

DAVID EVANS AND ASSOCIATES INC.
2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
NAVIGATION RELIABILITY IMPROVEMENTS
APCO BRIDGE SITE
COOS COUNTY

Designer: Andrew Walker | Review: Terry Stones
Drafter: Jim Culpepper | Checker: Anthony Calcagno

PLAN AND ELEVATION

SHEET NO. S101

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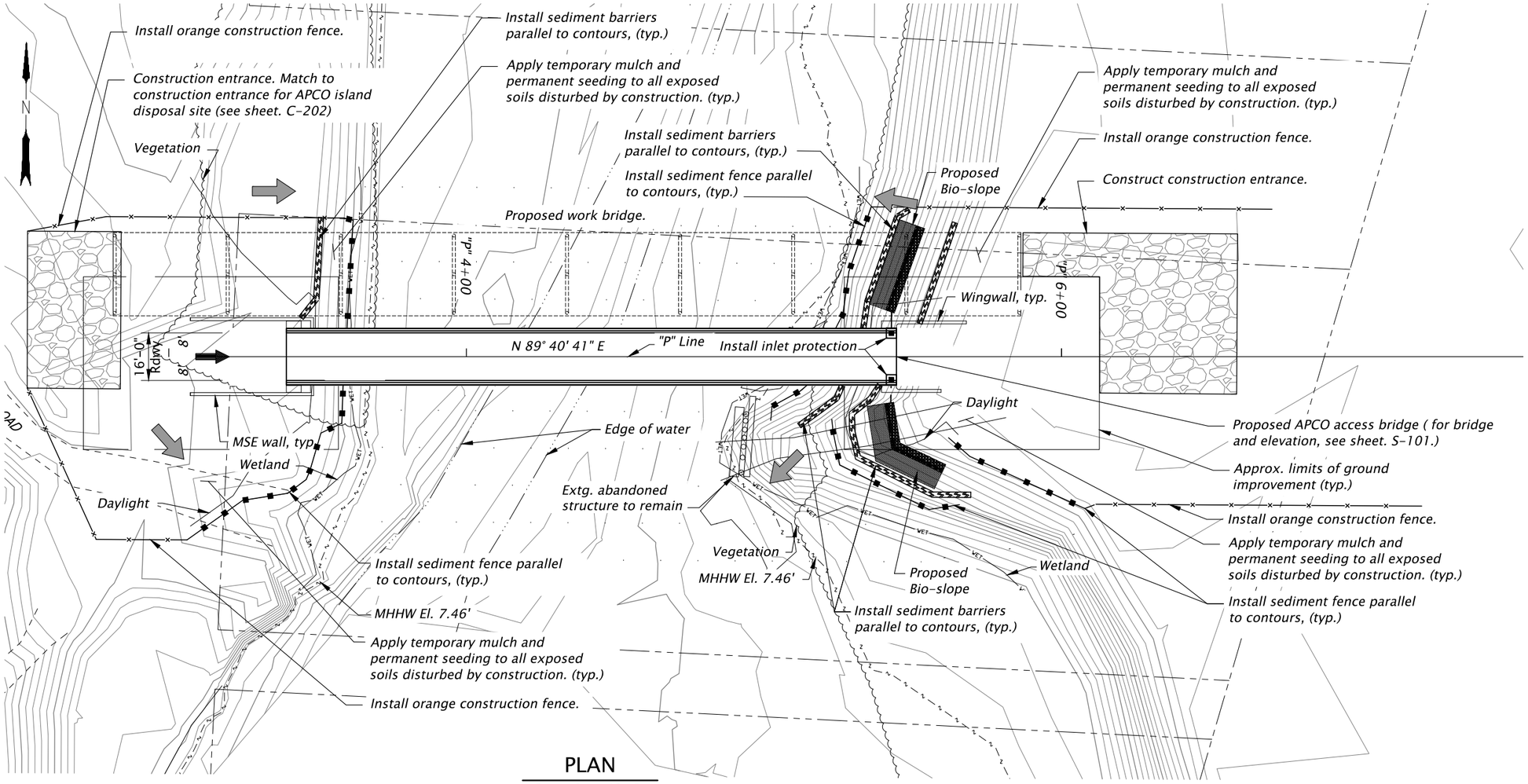


PLAN

Scale: 1" = 40'-0"

LEGEND:

- EXISTING GROUND CONTOUR (2 FT)
- 10 EXISTING GROUND CONTOUR (10 FT)
- SEDIMENT FENCE (PERIMETER)
- SEDIMENT BARRIER (INTERIOR)
- ORANGE CONSTRUCTION FENCE
- CONSTRUCTION ENTRANCE
- INLET PROTECTION
- DRAINAGE FLOW DIRECTION

NOTE:
FOR PERMANENT SEEDING, USE SUNMARK NATIVE SALT TOLERANT MIX. (SEE SHT. C-202 FOR SEED MIX)

Notes:

Elevations are based on North American Vertical Datum 1988 (NAVD88).

MHHW = Mean Higher High Water.

0 40' 80' 120'

SCALE: 1"=40'-0"

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
3	12/7/18	BH		TS	REV. C: Issued for Review
2	09/26/18	BH		TS	REV. B: Issued for Review
1	08/08/18	BH		TS	REV. A: Issued for Review

DOC. CONTROL NO.: J1-650-CIV-PLN-DEA-00001-01 Rev C - ISSUED FOR REVIEW

FOR REVIEW ONLY

DAVID EVANS AND ASSOCIATES INC.
2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG
A Pembina Company

JORDAN COVE ENERGY PROJECT
NAVIGATION RELIABILITY IMPORVEMENTS

COOS COUNTY

Designer: B. Henri | Review: Jim Culpepper
Drafter: CJ Chavez | Checker: Terry Stones

EROSION AND SEDIMENT CONTROL PLAN | SHEET NO. C204

C:\pw_work\dea\jim Culpepper\dms04978\EC101_APC_PE01 2/14/2019 11:39 AM Jim Culpepper

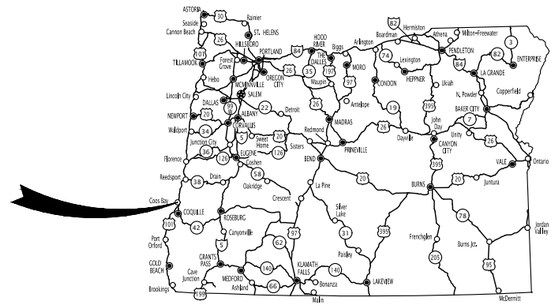
PLANS FOR PROPOSED PROJECT

Grading, Drainage, Paving, Structures, Signals, Signing, & Striping

JORDAN COVE LNG

KENTUCK PROJECT SITE

COOS COUNTY
DECEMBER 2018



VICINITY MAP
NOT TO SCALE

T.25S, R.12W, Sec. 6, 7;
T.25S, R.13W, Sec. 1, 12 W.M.

PROJECT LOCATION:

Located east of North Bend, Oregon (Township 25 South, Range 12 West, Sections 6 and 7; Township 25 South, Range 13 West, Sections 1 and 12, Willamette Meridian).

Latitude: 43.426073
Longitude: -124.180924

PROPERTY DESCRIPTION:

The Kentuck Project site is located east of North Bend, Oregon (Township 25 South, Range 12 West, Sections 6 and 7; Township 25 South, Range 13 West, Sections 1 and 12, Willamette Meridian). Tax maps and lots are: 25s12w06c lot 100, 25s13w12a lot 100, and 25s13w1d lot 400.

ATTENTION EXCAVATORS:

Oregon law requires you to follow rules adopted by the Oregon Utility Notification Center. Those rules are set forth in OAR 952-001-0010 through OAR 952-001-0090. You may obtain copies of these rules from the center by calling 503-232-1987. If you have any questions about the rules, you may contact the center. You must notify the center at least two business days, before commencing an excavation. Call 503-246-6699.

The permittee is required to meet all the conditions of the 1200C permit. This ESCP and general conditions have been developed to facilitate compliance with the 1200C permit requirements. In cases of discrepancies or omissions, the 1200C permit requirements supercede requirements in this plan.

OWNER/DEVELOPER

Jordan Cove LNG
111 SW 5th Ave., Suite 1100
Portland, Oregon 97204
(971) 940-7814
Contact: Derik Vowels, Lead Environmental Advisor
Email: Dvowels@pembina.com

CIVIL ENGINEER

David Evans And Associates, Inc.
2100 SW River Parkway
Portland, Oregon 97201
(503) 499-0470
Contact: Brady Berry, PE
Email: brady.berry@deainc.com



SITE MAP
NOT TO SCALE

SAFETY FIRST
LET'S ALL
WORK TOGETHER
TO MAKE THIS
JOB SAFE

ATTENTION:
Oregon Law Requires You To Follow Rules Adopted By The Oregon Utility Notification Center. Those Rules Are Set Forth In OAR 952-001-0010 Through OAR 952-001-0090. You May Obtain Copies Of The Rules By Calling The Center. (Note: The Telephone Number For The Oregon Utility Center Is (503) 232-1987.)

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-TEC-KEY-DEA-00001-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

Designer: S. Moriarty | Review: B. Berry
Drafter: K. Roper | Checker: -

COVER SHEET

SHEET NO.
G001

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S205 – KENTUCK MTR BRIDGE BENT 2 PLAN AND ELEVATION
S206 – KENTUCK MTR BRIDGE PRESTRESSED SLAB DETAILS
S207 – KENTUCK MTR BRIDGE SHEET PILE WALL LAYOUT
S208 – KENTUCK MTR BRIDGE TIDE GATE FRAME
S301 – GOLF COURSE LANE CULVERT PLAN AND ELEVATION
S302 – GOLF COURSE LANE CULVERT TYPICAL SECTION
S303 – GOLF COURSE LANE CULVERT HEADWALL DETAILS

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-TEC-LST-DEA-00001-01 Rev A - ISSUED FOR REVIEW

70% PLANS FOR REVIEW ONLY

DAVID EVANS AND ASSOCIATES INC.
2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

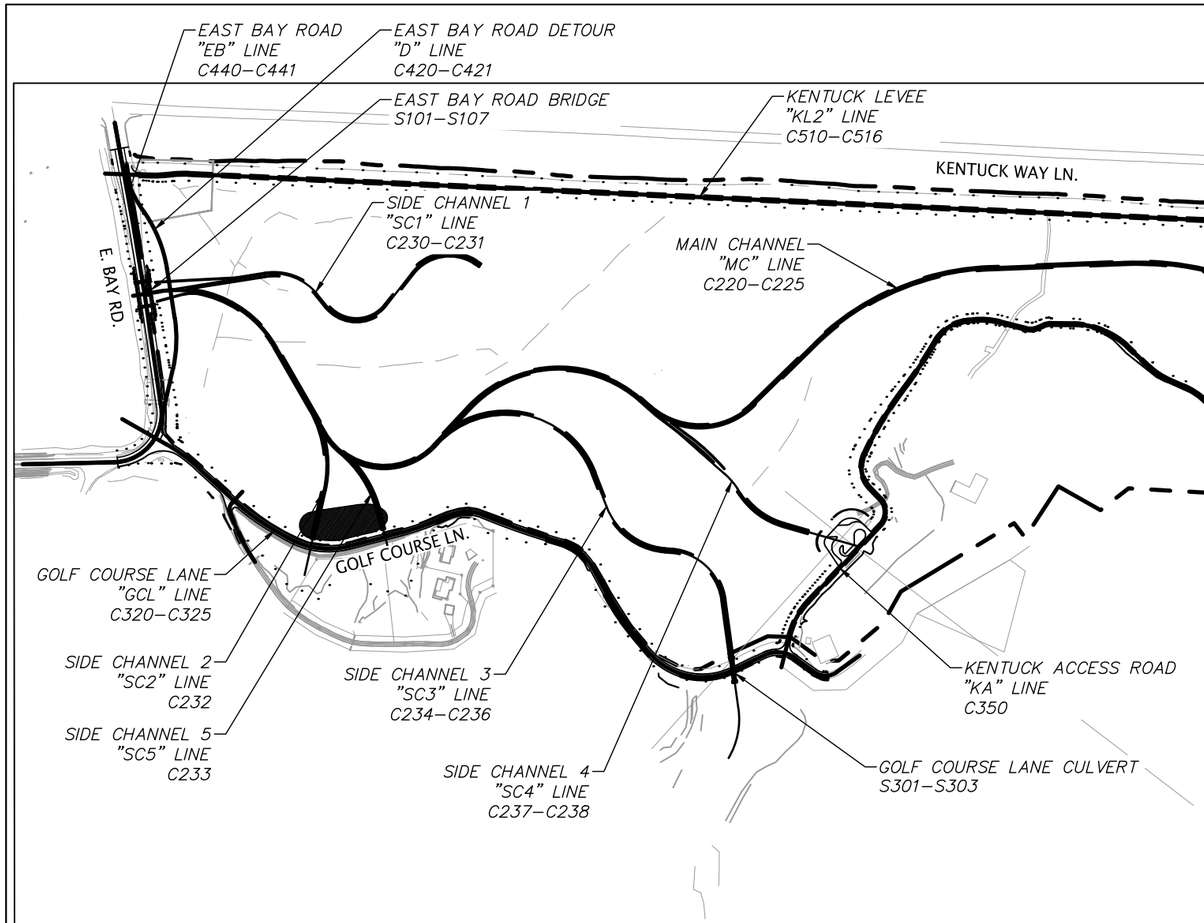
Jordan Cove LNG℠

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

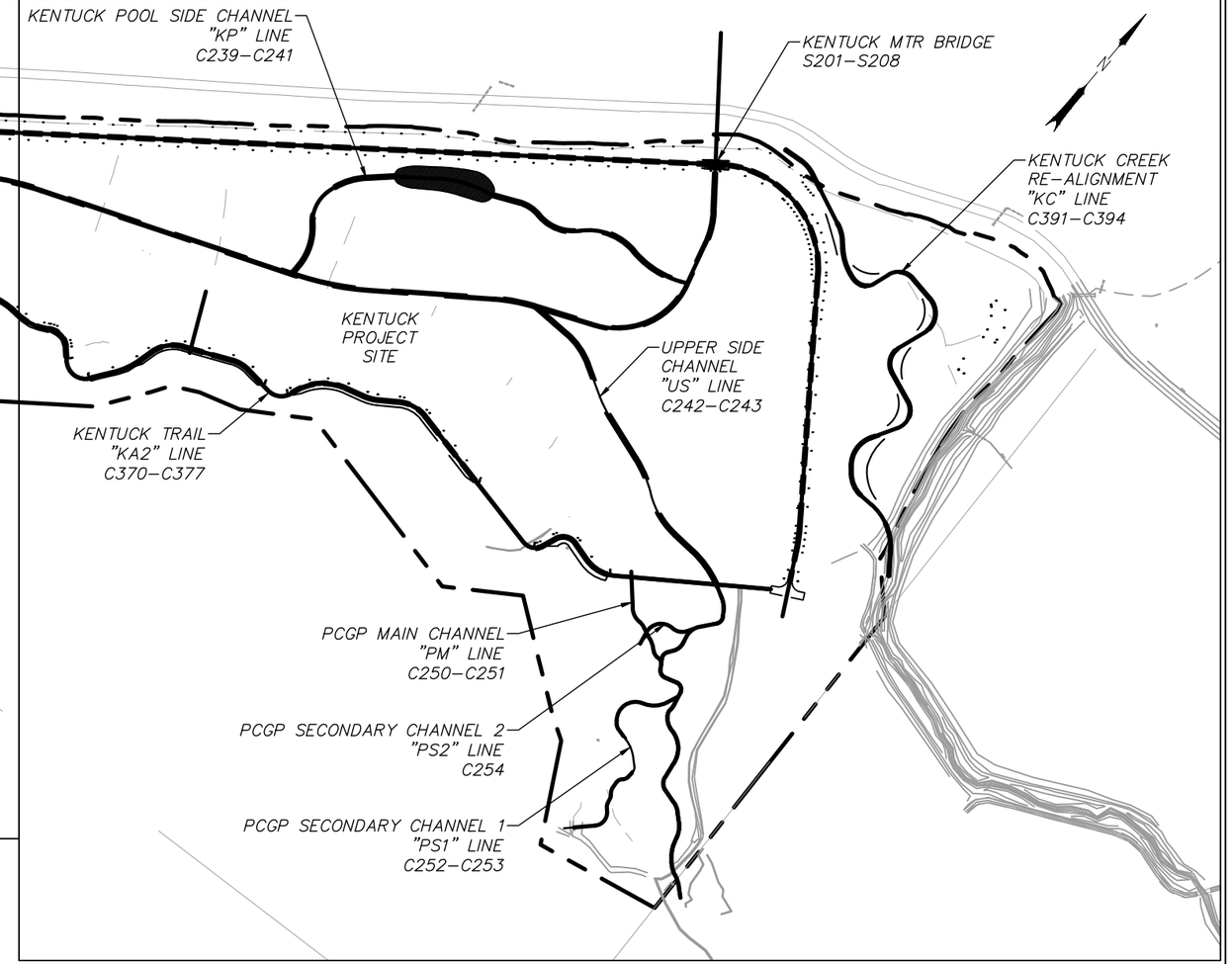
COOS COUNTY

Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

SHEET INDEX SHEET NO. G002



WEST SIDE



EAST SIDE

NO.	DATE	BY / CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB	TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-TEC-PLN-DEA-00001-01 Rev A - ISSUED FOR REVIEW

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Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

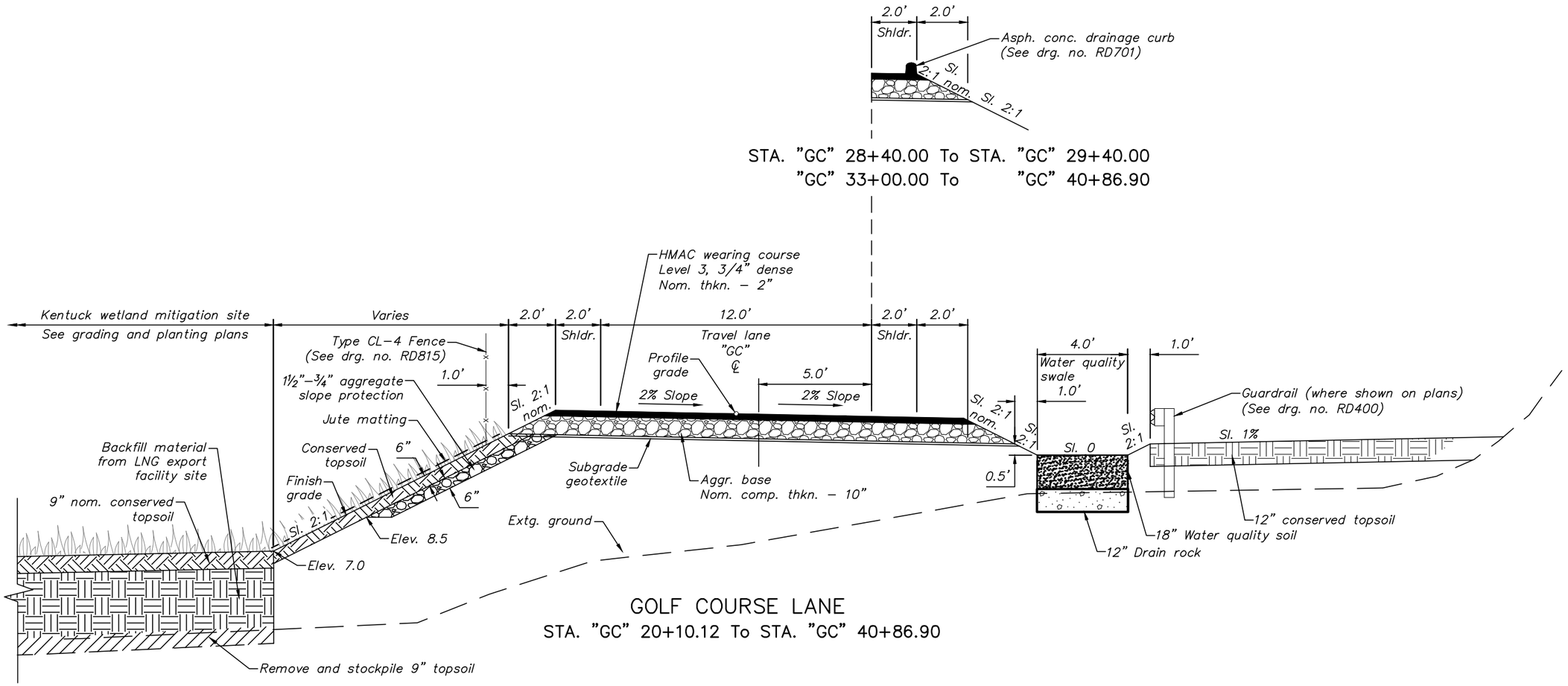
COOS COUNTY

Designer: S. Moriarty
Drafter: K. Roper
Review: B. Berry
Checker: -

SITE PLAN SHEET LAYOUT

SHEET NO.
G003

C:\pw_work\dea\kelley Roper\dms04977\G001_KPS_CV01 12/9/2018 5:38 PM Kelly Roper



GOLF COURSE LANE

STA. "GC" 20+10.12 To STA. "GC" 40+86.90

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
2	03/01/19	BB		TS	Rev B - Issued for Reivew
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-SCT-DEA-00003-01 REV B - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG
A Pembina Company

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

Designer: S. Moriarty Review: B. Berry

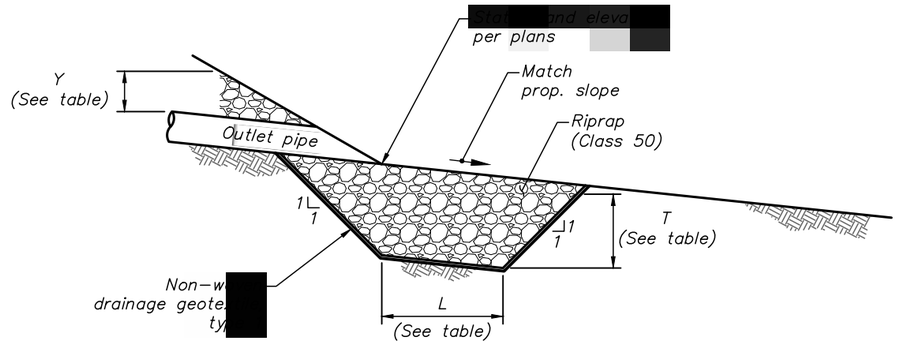
Drafter: S. Moriarty Checker: -

GOLF COURSE LANE TYPICAL SECTION

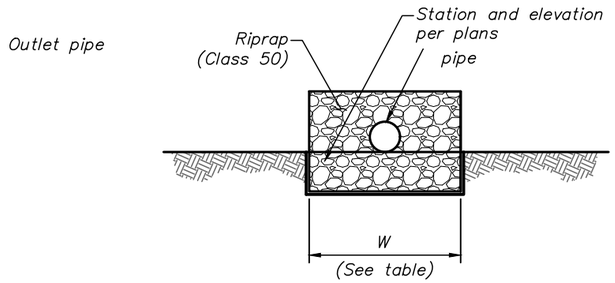
SHEET NO. C300

C:\pw_work\dea\jim Culpepper\dms04977\C300_KPS_TY01_GC LANE 2/28/2019 2:23 PM Jim Culpepper

| SHEET NUMBER | NOTE NO. ON PLANS | ① DESIGN HEIGHT OF COVER (FEET) | PIPE: CIRCULAR OR ELLIPTICAL — SIZE IN (Inches) 10 | 12 | 15 | 18 | 24 | 30 | 36 | 72 — LENGTH IN FEET | PIPE: PIPE-ARCH HELICAL — EQUIV. RND SIZE (In.) | PIPE: PIPE-ARCH CROSS-SECTIONAL DIMENSIONS ② — SPAN (Ft.-In.) | RISE | CORNER RADII (In.) | USE / INSTALLATION CRITERIA: DRAIN (PERFORATED) | CULVERT (ROAD APPROACH) | CULVERT (CONDUIT) | CULVERT | IRRIGATION | SIPHON | STORM SEWER | SANITARY SEWER | OTHERS (SEE REMARKS) | WATERTIGHT JOINTS | SLOPE ANCHORS | WATERLINE | PH | RESISTIVITY (HUNDREDS) | TERMINAL TREATMENT: LT / RT SLOPED ENDS | SKEW NUMBER | PAVED END SLOPES No. | RIGID: PRE-CAST CONCRETE PLAIN ③ 1 | 2 | 3 | REINF. III | IV | V | SPECIAL: DUCTILE IRON, CL. 51 | AWWA C900 or C905 | HDPE | POLYPROPYLENE | APPURTENANCES: MANHOLES DEPTH, TOP OF COVER TO INVERT (Feet) | DIAMETER OF LARGEST PIPE IN BASE (In.) | CONC. PRECAST | CLEANOUT | WATER QUALITY | SHALLOW | FLAT TOP | INLETS TYPE: BEEHIVE INLET | G-2 | WQ Inlet | Area Drain, Type III | Ditch Inlet | OG-48 Manhole — Number Required | EXTENSION LEFT (Feet) | RIGHT (Feet) | ④ EXTG. PIPE MATERIAL | REMARKS |
|---|---|---



ELEVATION VIEW



ENDVIEW

RIPRAP DESIGN TABLE				
Location	L	W	T	Y
Sta. "GC" 25+00, Lt.	4'	5'	2.3'	1'
Sta. "GC" 27+00, Lt.	4'	5'	2.3'	1'
Sta. "GC" 30+50, Lt.	4'	5'	2.3'	1'
Sta. "GC" 33+66, Lt.	4'	5'	2.3'	1'
Sta. "GC" 35+20, Lt.	4'	5'	2.3'	1'
Sta. "GC" 35+63, Lt.	4'	5'	2.3'	1'
Sta. "GC" 35+85, Lt.	4'	5'	2.3'	1'
Sta. "KA" 10+50, Lt.	4'	5'	2.3'	1'
Sta. "KA" 11+34, Lt.	4'	5'	2.3'	1'
Sta. "KA" 14+60, Lt.	4'	5'	2.3'	1'
Sta. "KA" 18+19, Lt.	4'	5'	2.3'	1'
Sta. "KA" 20+13, Lt.	4'	5'	2.3'	1'
Sta. "KA" 23+84, Lt.	4'	5'	2.3'	1'

RIPRAP PADS

N.T.S.

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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DOC. CONTROL NO.: J1-600-CIV-DTL-DEA-00014-01 REV A - ISSUED FOR REVIEW

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Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

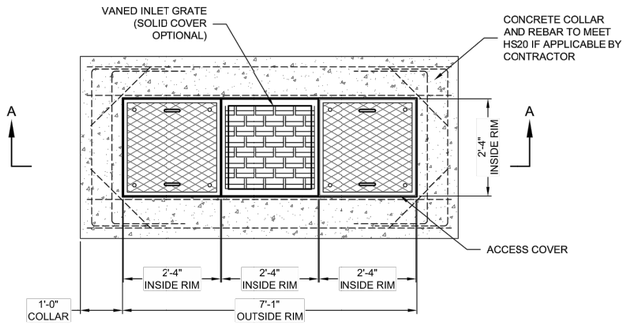
COOS COUNTY

Designer: M. Rice Review: A. Raskin

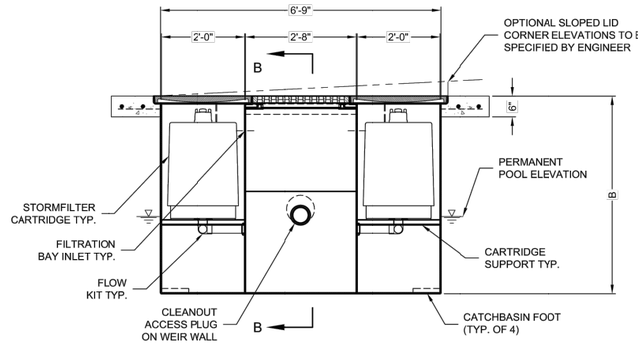
Drafter: E. Boguslawski Checker: A. Raskin

GOLF COURSE LANE DETAILS

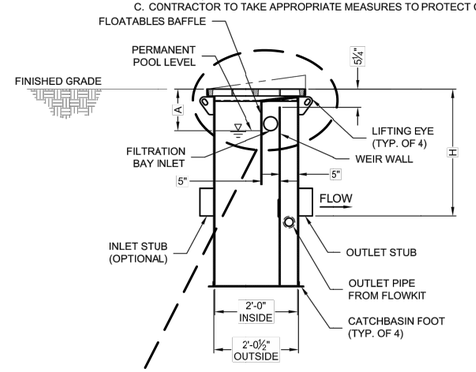
SHEET NO. C311



PLAN VIEW



SECTION A-A



SECTION B-B

STORMFILTER STEEL CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 2 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF TWO CARTRIDGES. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			18" DEEP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			3.3'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	15	12.53	7.5
PEAK HYDRAULIC CAPACITY	1.0			1.0			1.8		
INLET PERMANENT POOL LEVEL (A)	1'-0"			1'-0"			2'-0"		
OVERALL STRUCTURE HEIGHT (B)	4'-9"			3'-9"			4'-9"		

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB© (PSORB) MEDIA ONLY

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. WWW.CONTECHES.COM
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. MANUFACTURER TO APPLY A SURFACE BEAD WELD IN THE SHAPE OF THE LETTER "O" ABOVE THE OUTLET PIPE STUB ON THE EXTERIOR SURFACE OF THE STEEL SFCB.
6. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
7. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
8. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
9. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

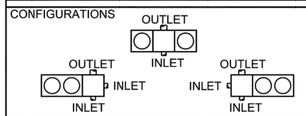
INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

2-CARTRIDGE DEEP CATCHBASIN STORMFILTER DATA

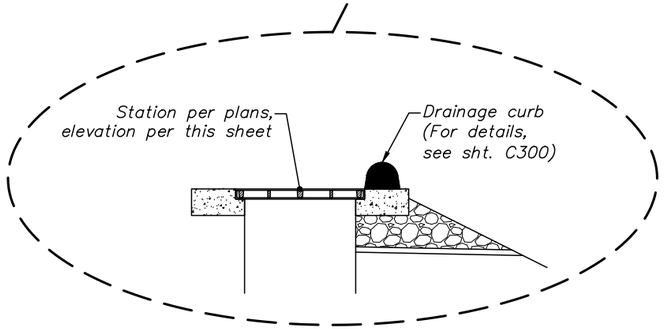
STRUCTURE ID	"GC" Sta. 35+20, Rt.
WATER QUALITY FLOW RATE (cfs)	0.07
PEAK FLOW RATE (<1.8 cfs)	0.12
RETURN PERIOD OF PEAK FLOW (yrs)	50
CARTRIDGE FLOW RATE (gpm)	22.5
MEDIA TYPE (PERLITE, ZPG, PSORB)	ZPG
RIM ELEVATION	13.74

PIPE DATA:	I.E.	DIAMETER
INLET STUB	N/A	N/A
OUTLET STUB	10.51	12"

CONFIGURATIONS



SLOPED LID	NO
SOLID COVER	NO
NOTES/SPECIAL REQUIREMENTS:	



The Stormwater Management StormFilter®
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,629; 5,707,517; 5,769,962; 6,027,639; 6,649,048; 6,991,114; 7,186,058; AUSTRALIA, RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING

CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-526-3999 513-645-7000 513-645-7993 FAX

2 CARTRIDGE CATCHBASIN
STORMFILTER
STANDARD DETAIL

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-DTL-DEA-00015-01 REV A - ISSUED FOR REVIEW

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Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

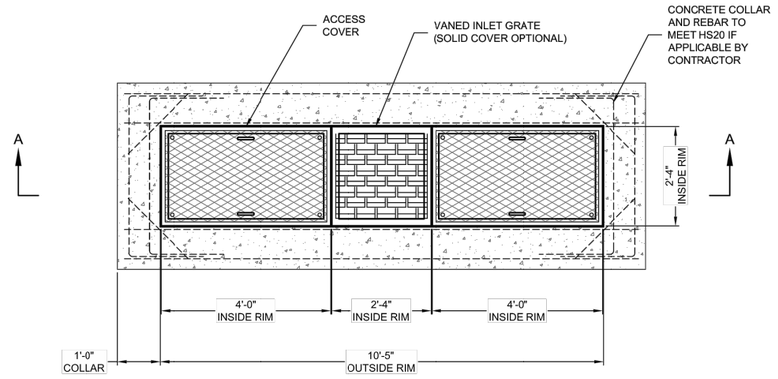
COOS COUNTY

Designer: M. Rice Review: A. Raskin
Drafter: E. Boguslawski Checker: A. Raskin

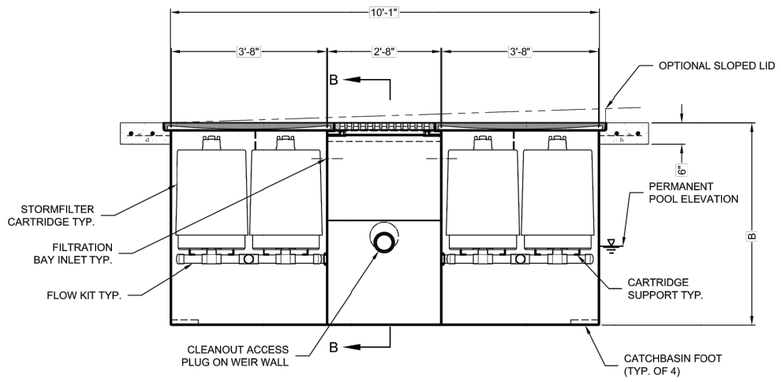
GOLF COURSE LANE DETAILS

SHEET NO. C312

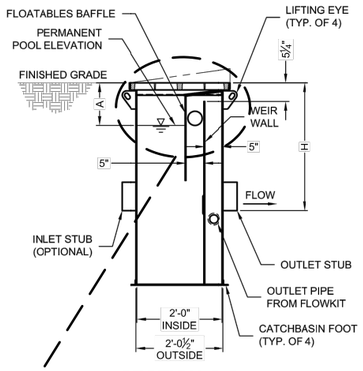
C:\pw_work\dea\jim Culpepper\dms04977\C310_KPS_DT01_GC LANE 12/6/2018 7:16 PM Jim Culpepper



PLAN VIEW
27" CARTRIDGES



SECTION A-A



SECTION C-C

STORMFILTER STEEL CATCHBASIN DESIGN NOTES

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PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			18" DEEP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			3.3'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	15	12.53	7.5
PEAK HYDRAULIC CAPACITY	1.0			1.0			1.8		
INLET PERMANENT POOL LEVEL (A)	1'-0"			1'-0"			2'-0"		
OVERALL STRUCTURE HEIGHT (B)	4'-9"			3'-9"			4'-9"		

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY

GENERAL NOTES
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2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
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B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

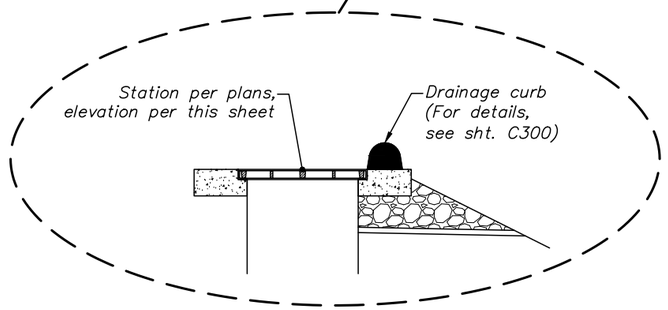
4-CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID	"GC" Sta. 35+63, Rt.
WATER QUALITY FLOW RATE (cfs)	0.07
PEAK FLOW RATE (<1 cfs)	0.19
RETURN PERIOD OF PEAK FLOW (yrs)	50
CARTRIDGE FLOW RATE (gpm)	22.5
MEDIA TYPE (PERLITE, ZPG, PSORB)	ZPG
RIM ELEVATION	13.56

PIPE DATA:	I.E.	DIAMETER
INLET STUB	N/A	N/A
OUTLET STUB	10.49	12"

CONFIGURATION
OUTLET
INLET

SLOPED LID	NO
SOLID COVER	NO
NOTES/SPECIAL REQUIREMENTS:	
*PER ENGINEER OF RECORD	



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9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-526-3999 513-645-7000 513-645-7993 FAX

4 CARTRIDGE CATCHBASIN
STORMFILTER
STANDARD DETAIL

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Jordan Cove LNG℠

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE
COOS COUNTY

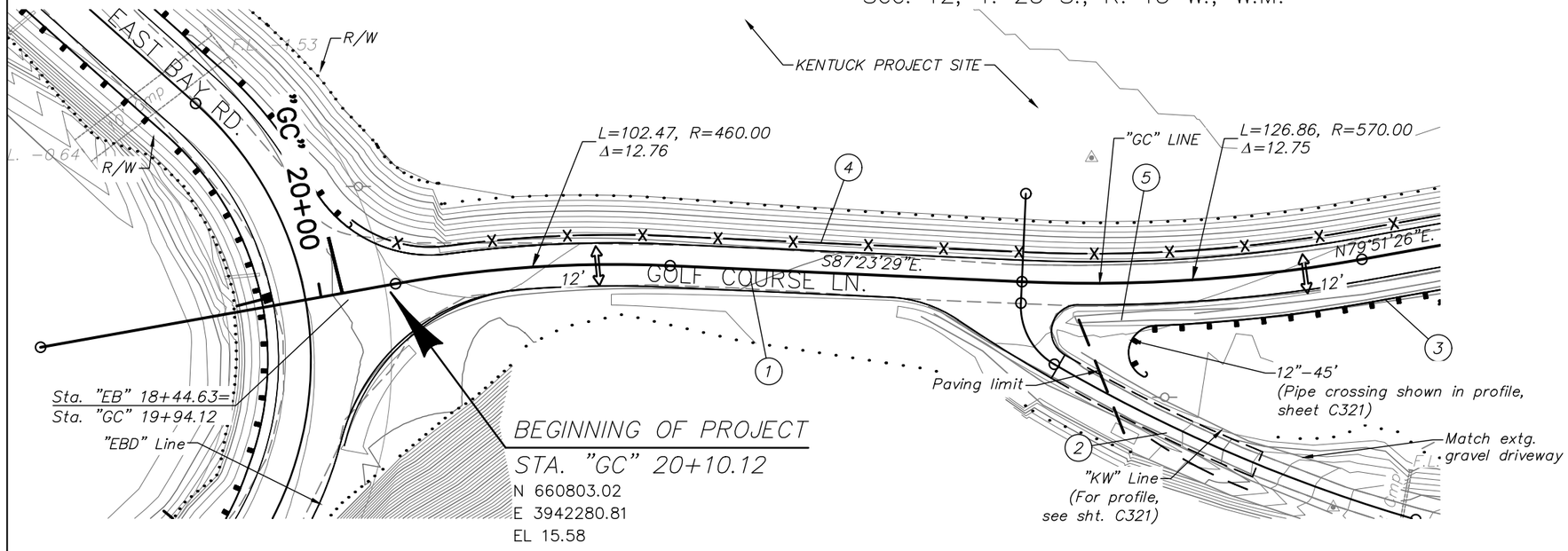
Designer: M. Rice Review: A. Raskin
Drafter: E. Boguslawski Checker: A. Raskin

GOLF COURSE LANE DETAILS

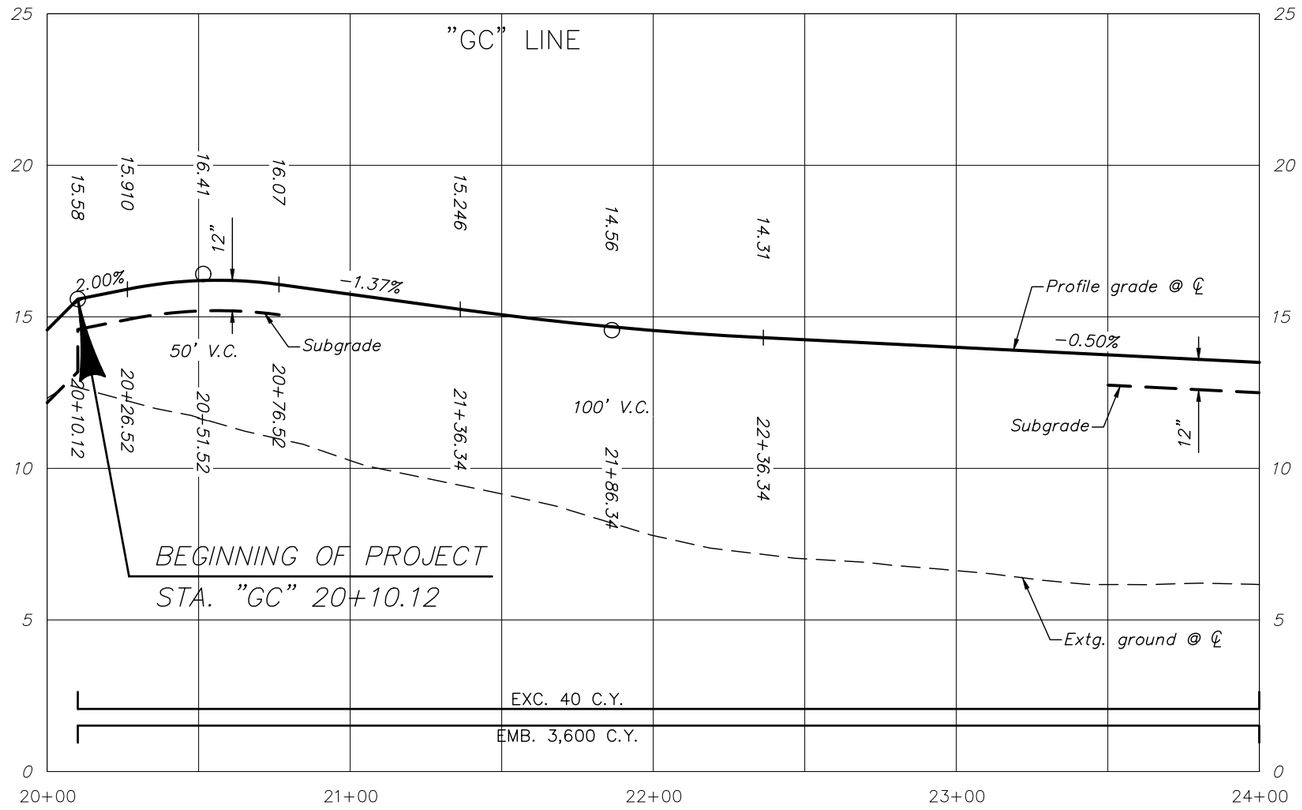
SHEET NO. C313

C:\pw_work\dea\jim Culpepper\dms04977\C310_KPS_DT01_GC LANE 12/6/2018 7:16 PM Jim Culpepper

Sec. 12, T. 25 S., R. 13 W., W.M.



1. Const. Golf Course Lane
   (For details, see sheet C300)
2. Sta. "KW" 10+69.85, 10.05', Rt.
   I.E. in 11.67
3. Sta. "GC" 23+10 to Sta. "GC" 28+25, Rt.
   Const. guardrail – 566' (Type 2A)
   Inst. end piece (Type B)
   (See drg. nos. RD405, RD410, RD415, & RD480)
4. Const. type CL–4 fence
   (See drg. no. RD815)
5. Sta. "GC" 22+82.74, 13.65' Rt.
   Install 12" culv. pipe – 45', Sl.=0.73%
   5' depth
   I.E. out 11.67



LEGEND
Cut slope line — — —
Fill slope line · · · · · · · ·

NO.	DATE	BY / CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB	TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00042-01 Rev A - ISSUED FOR REVIEW

70% PLANS FOR REVIEW ONLY

DAVID EVANS AND ASSOCIATES INC.
2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

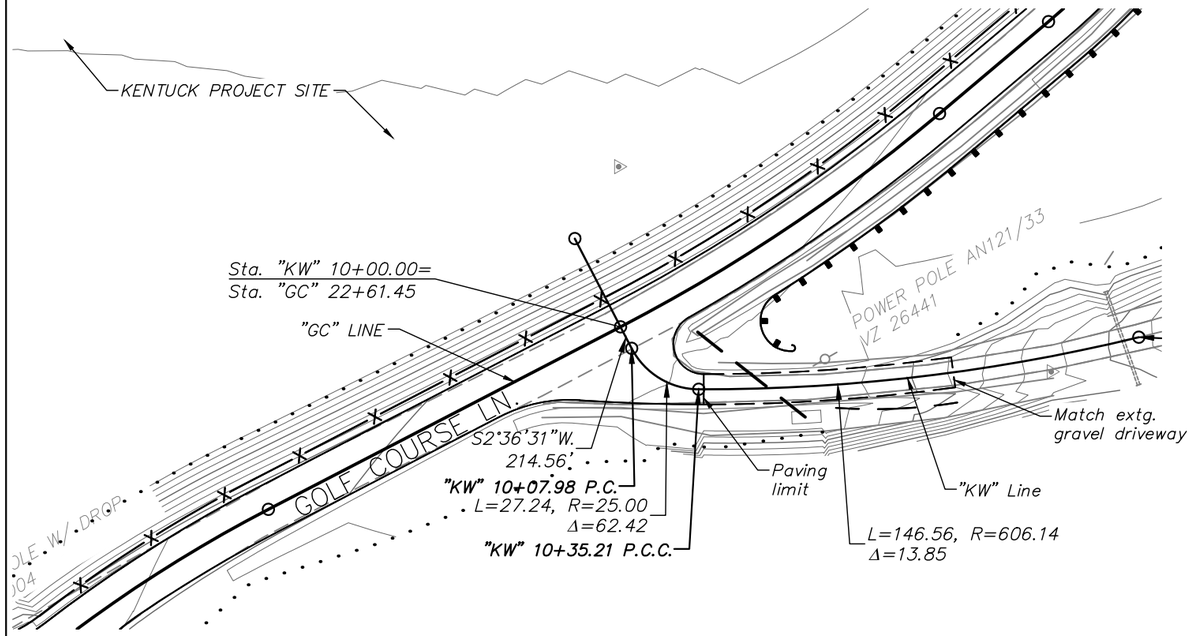
JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

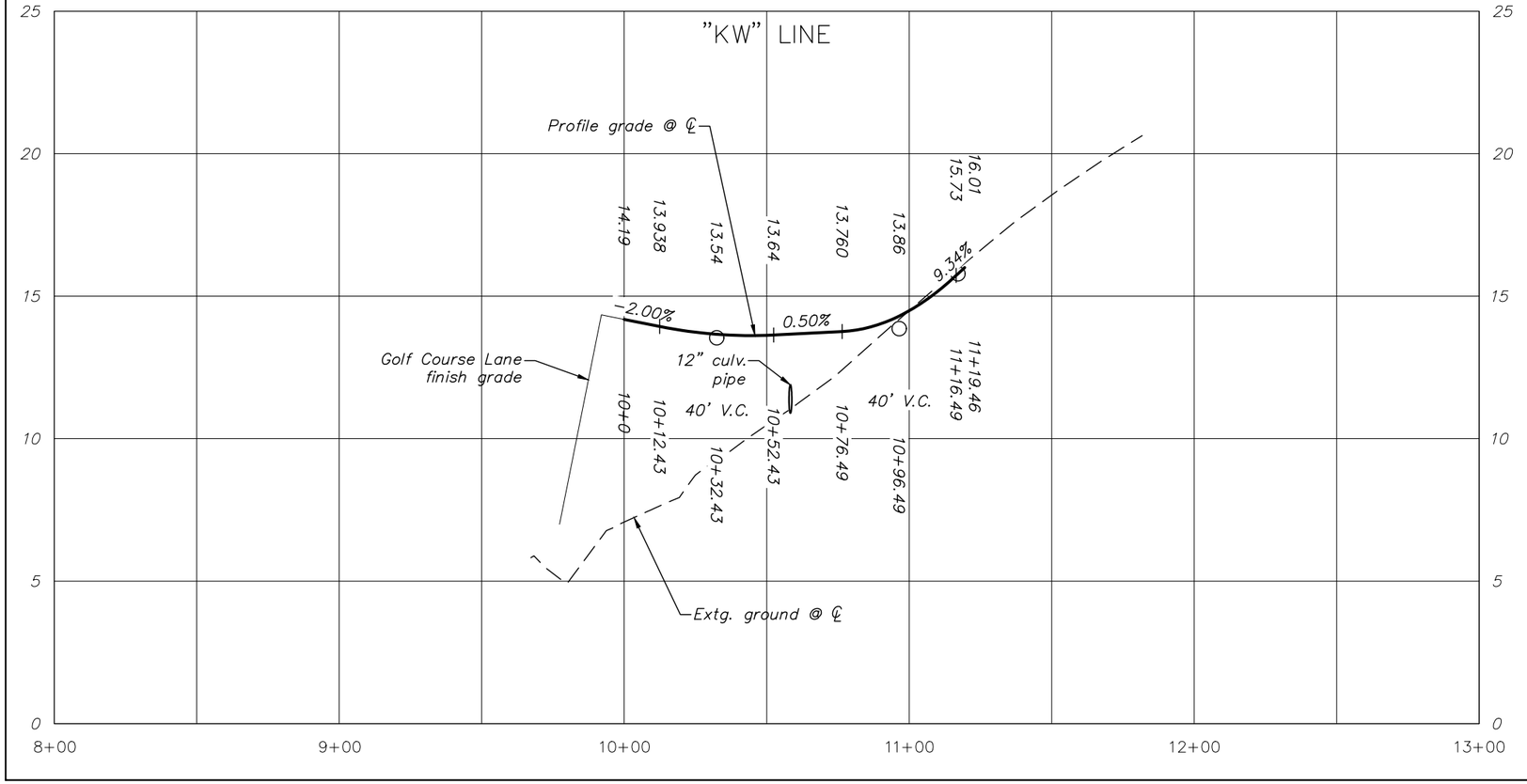
COOS COUNTY

Designer: S. Moriarty | Review: B. Berry
Drafter: K. Roper | Checker: -

GOLF COURSE LANE PLAN AND PROFILE

SHEET NO. C320





LEGEND

Cut slope line — — —

Fill slope line · · · · · · · ·

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00043-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
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Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

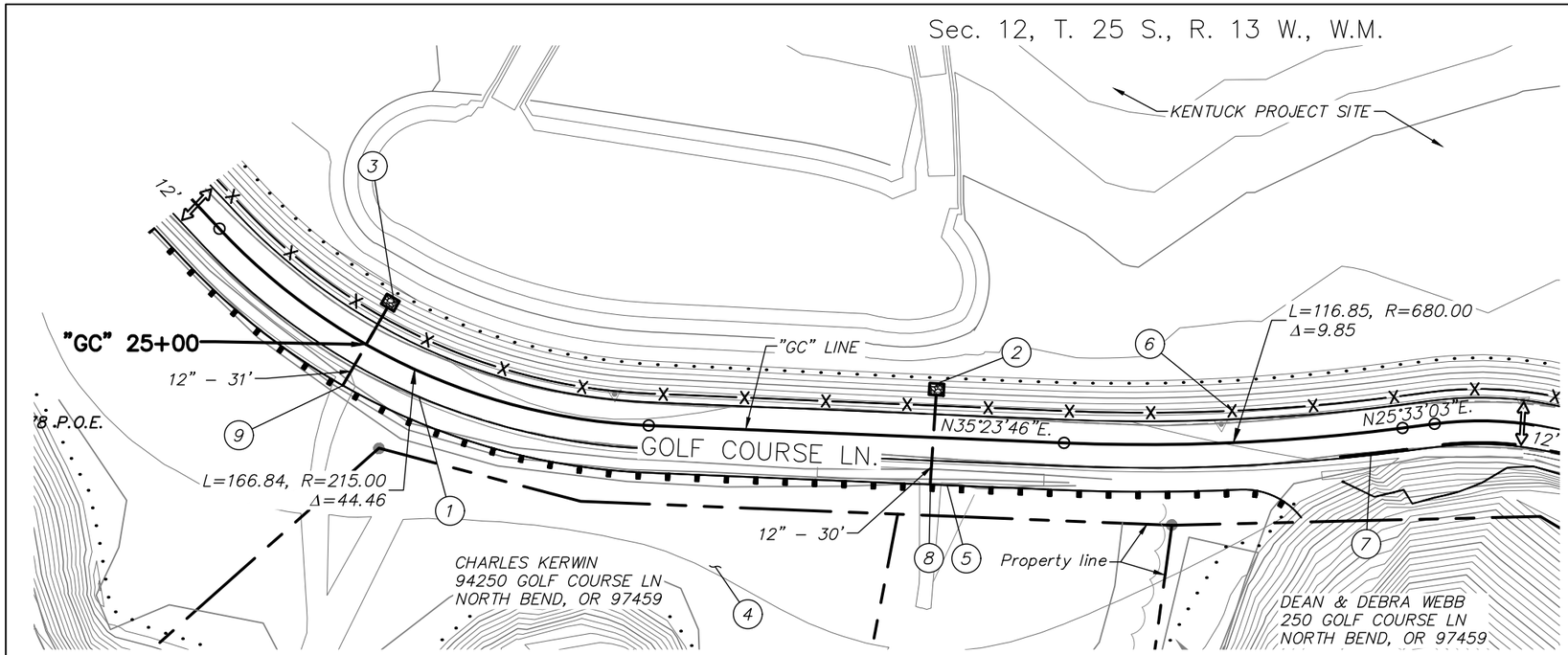
COOS COUNTY

Designer: S. Moriarty
Drafter: K. Roper
Review: B. Berry
Checker: -

KERWIN & WEBB PLAN AND PROFILE

SHEET NO. C321

C:\pw_work\dea\kelley Roper\dms04977\C320_KPS_PP01_GC LANE 12/9/2018 9:38 PM Kelly Roper



(1) Const. Golf Course Lane
(For details, see sheet C300)

(2) Sta. "GC" 27+00.73, 14.60' Lt.
Inst. 12" culv. pipe – 30', Sl.=3.14%
5' depth
I.E. out 10.48
Const. loose riprap (class 50) – 2.6 C.Y.
(For details, see sht. C311)

(3) Sta. "GC" 25+00.00, 14.67' Lt.
Inst. 12" culv. pipe – 31', Sl.=2.91%
5' depth
I.E. out 10.54
Const. loose riprap (class 50) – 2.6 C.Y.
(For details, see sht. C311)

(4) Const. septic and drain field, drainage ditches, and grading
(For details, see sht. X)

(5) See sht. 3 note 3
Const. guardrail (Type 2A)
Const anchor – 1 (Type 1)
Bury end in slope
(See drg. nos. RD435, RD450)

(6) Const. type CL–4 fence

(7) Const. asph. conc. drainage curb – 100'

(8) Sta. "GC" 27+00.00, 15.63' Rt.
I.E. in 11.43

(9) Sta. "GC" 25+00.00, 16.26' Rt.
I.E. in 11.44

LEGEND
Cut slope line
Fill slope line

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00044-01 Rev A - ISSUED FOR REVIEW

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Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

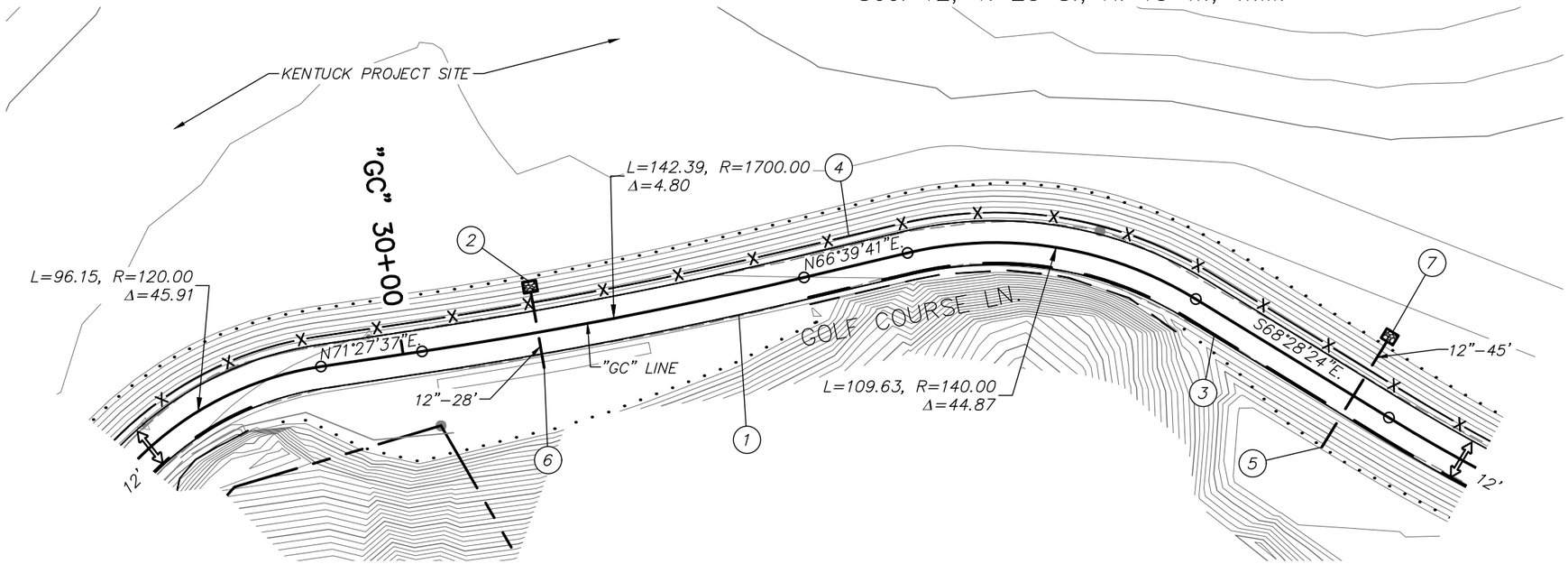
COOS COUNTY

Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

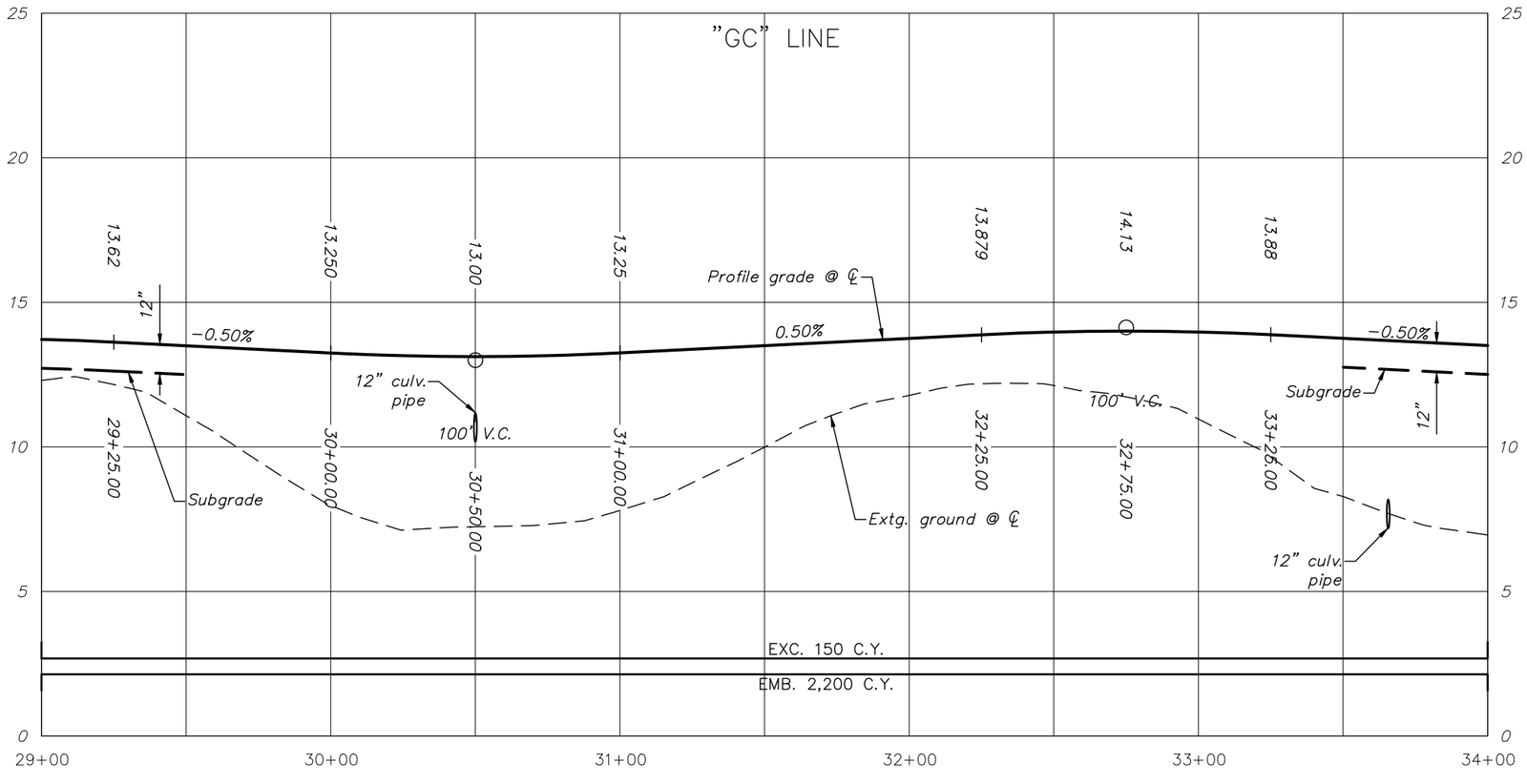
GOLF COURSE LANE PLAN AND PROFILE

SHEET NO. C322

Sec. 12, T. 25 S., R. 13 W., W.M.



1. Const. Golf Course Lane
   (For details, see sheet C300)
2. Sta. "GC" 30+50.00, 14.95' Lt.
   Inst. 12" culv. pipe – 28', Sl.=5.74%
   5' depth
   I.E. out 10.31
   Const. loose riprap (class 50) – 2.6 C.Y.
   (For details, see sheet C311)
3. Const. asph. conc. drainage curb – 950'
4. Const. type CL–4 fence
5. Sta. 33+65.56, 22.03' Rt.
   I.E. in 7.35
6. Sta. 30+50.00, 13.10' Rt.
   I.E. in 11.92
7. Sta. "GC" 33+65.66, 23.30' Lt.
   Inst. 12" culv. pipe – 45', Sl.=0.77%
   10' depth
   I.E. out 7.00
   Const. loose riprap (class 50) – 2.6 C.Y.
   (For details, see sheet C311)



LEGEND
Cut slope line — — —
Fill slope line . . . . . .

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00045-01 Rev A - ISSUED FOR REVIEW

70% PLANS
FOR REVIEW ONLY

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

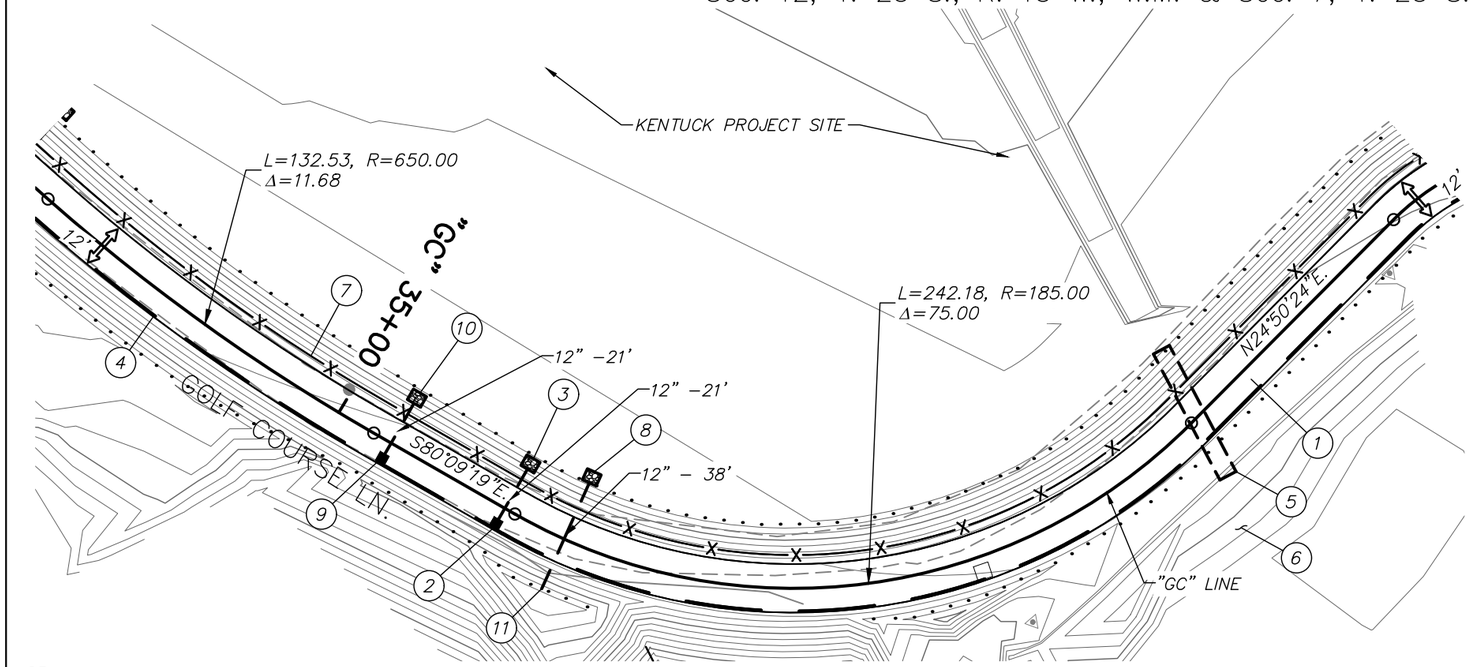
JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE
COOS COUNTY

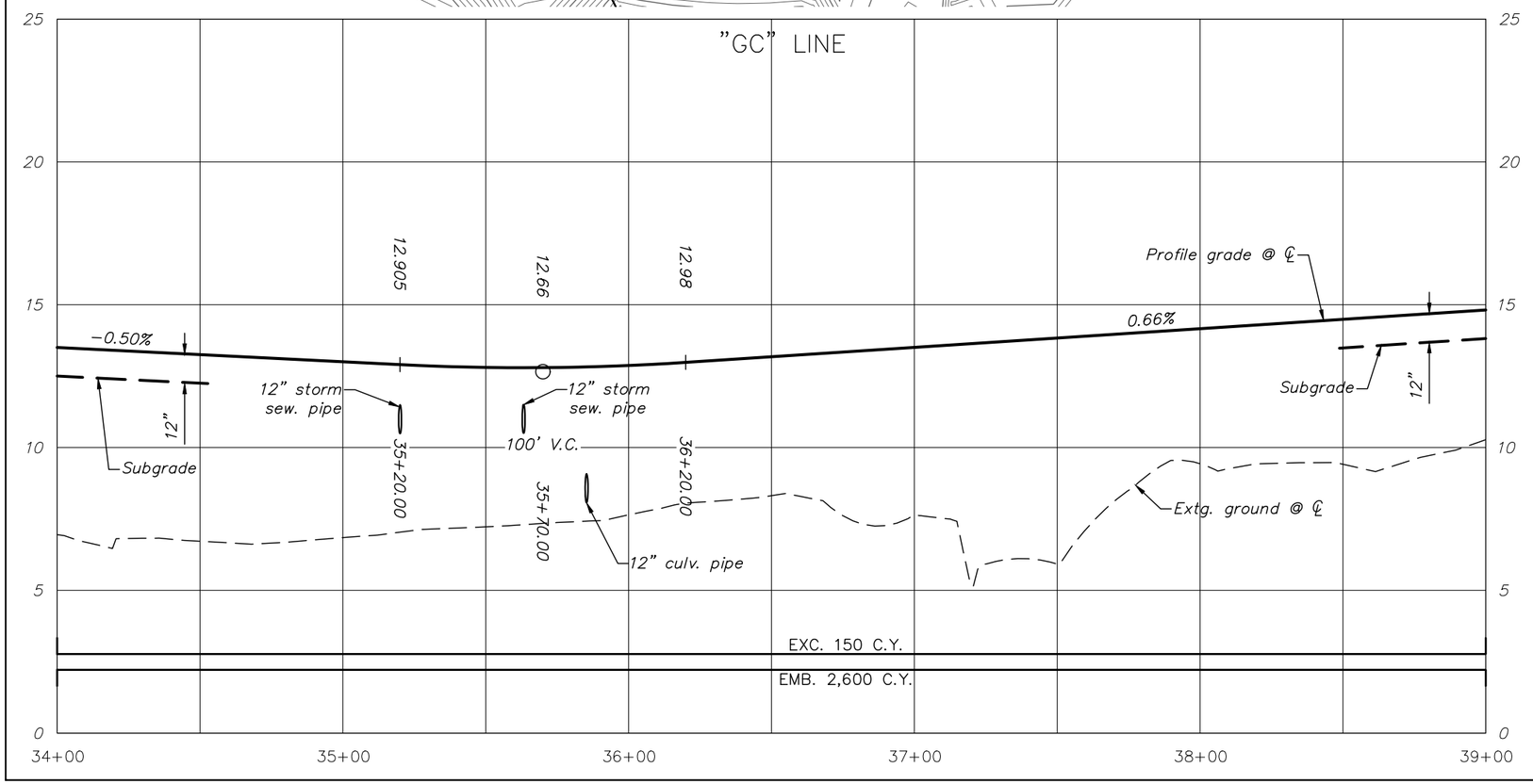
Designer: S. Moriarty
Drafter: K. Roper
Review: B. Berry
Checker: -

GOLF COURSE LANE PLAN AND PROFILE

SHEET NO.
C323

Sec. 12, T. 25 S., R. 13 W., W.M. & Sec. 7, T. 25 S., R. 12 W., W.M.





(1) Const. Golf Course Lane
(For details, see sheet C300)

(2) Sta. "GC" 35+63.25, Rt.
Const. water quality inlet
(For details, see sheet C313)

(3) Sta. "GC" 35+63.29, 14.91' Lt.
Inst. 12" storm sew. pipe – 21', Sl.=0.44%
5' depth
I.E. out 10.40
Const. loose riprap (class 50) – 2.6 C.Y.
(For details, see sheet C311)

(4) Const. asph. conc. drainage curb

(5) Arch culvert
(For details, see sheets S301 & S303)

(6) Remove top 18" from
drained irrigation pond site – 845 C.Y.

(7) Const. type CL–4 fence

(8) Sta. "GC" 35+85.29, 20.35' Rt.
Inst. 12" culv. pipe – 38', Sl.=2.11%
10' depth
I.E. out 7.64
Const. loose riprap (class 50) – 2.6 C.Y.
(For details, see sht. C311)

(9) Sta. "GC" 35+20.01, Rt.
Const. water quality inlet
(For details, see sht. C312)

(10) Sta. "GC" 35+20.02, 15.12' Lt.
Inst. 12" storm sew. pipe – 21', Sl.=0.45%
5' depth
I.E. out 10.42
Const. loose riprap (class 50) – 2.6 C.Y.
(For details, see sht. C311)

(11) Sta. "GC" 35+85.29, 17.95' Rt.
I.E. in 8.45

LEGEND

Cut slope line — — —

Fill slope line . . . . . .

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1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00046-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG℠

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

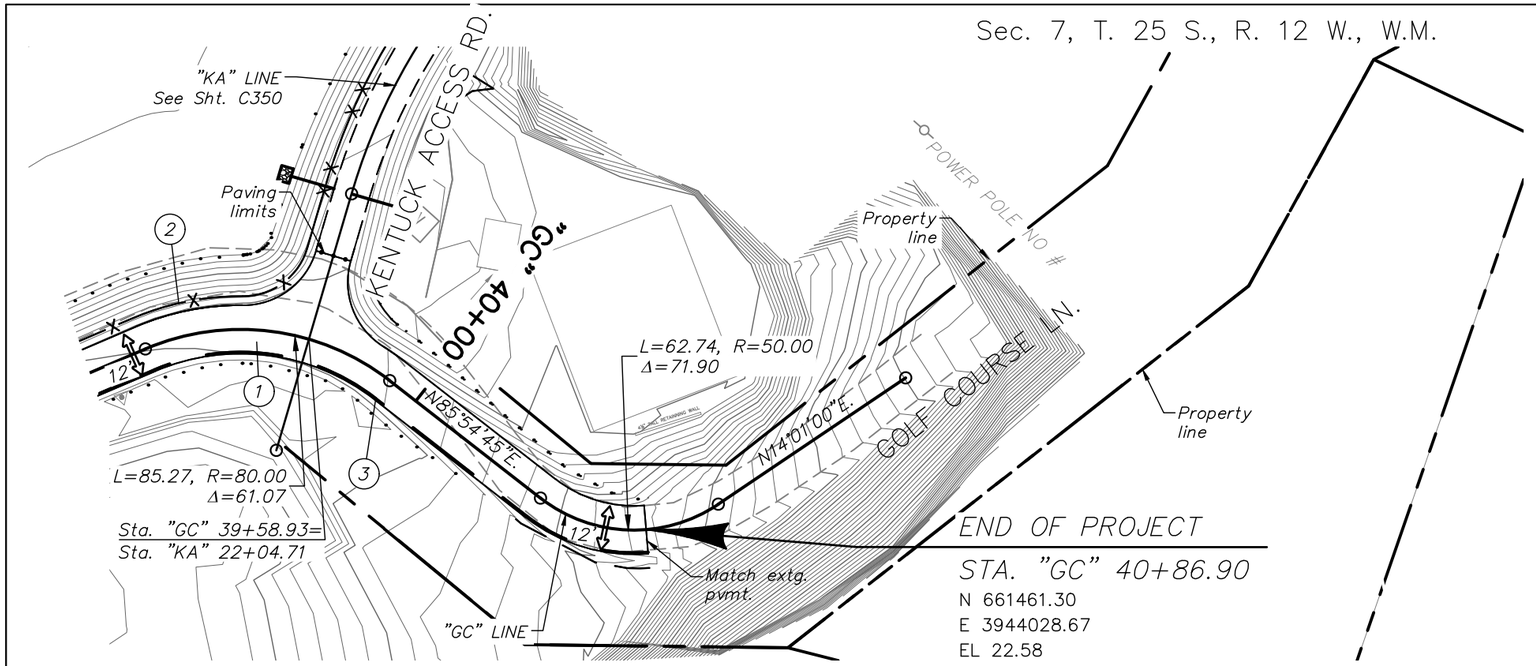
Designer: S. Moriarty Review: B. Berry

Drafter: K. Roper Checker: -

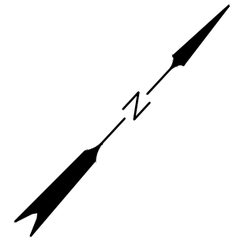
GOLF COURSE LANE PLAN AND PROFILE

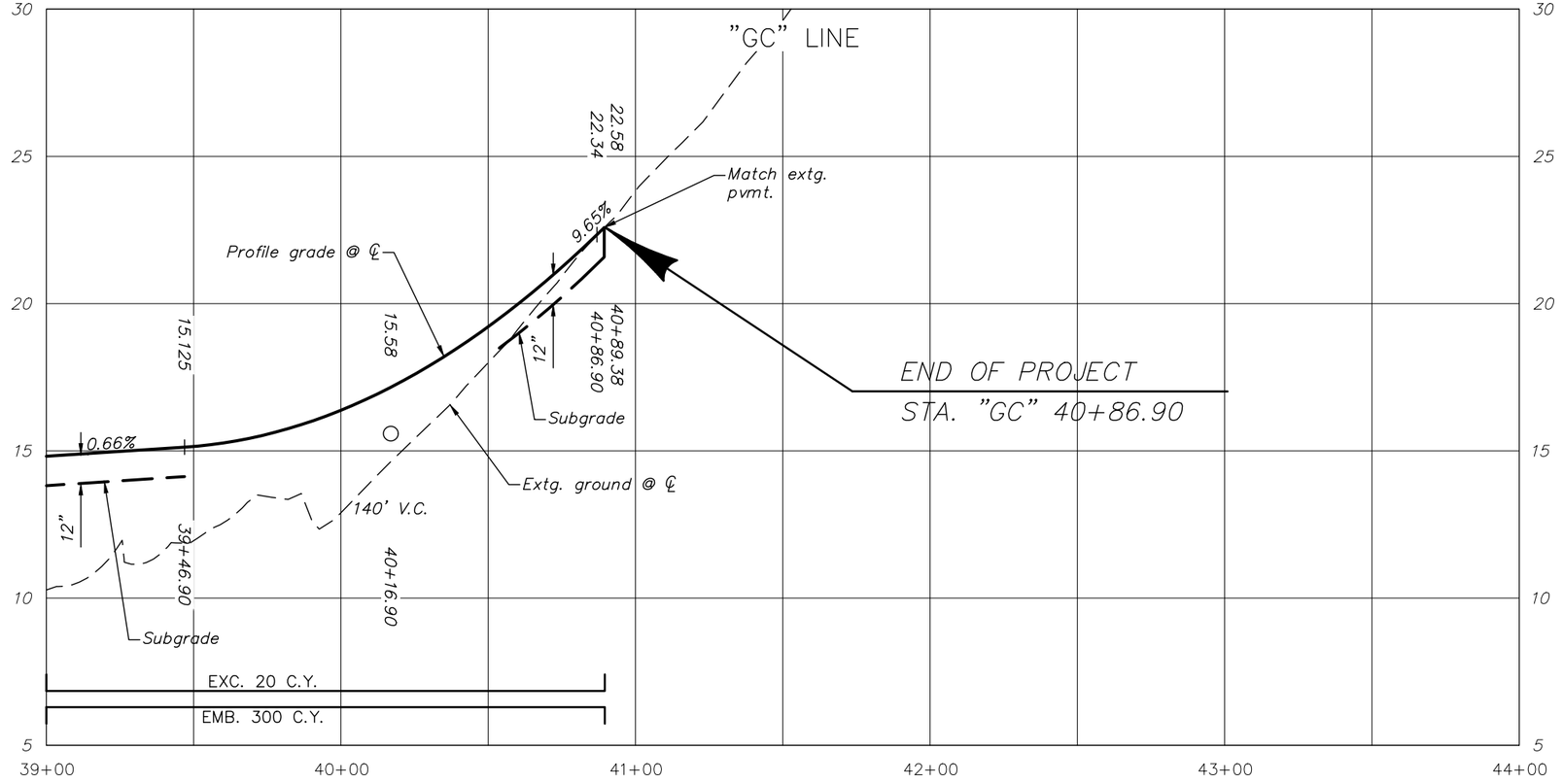
SHEET NO. C324

C:\pw_work\dea\kelley Roper\dms04977\C320_KPS_PP01_GC LANE 12/9/2018 9:38 PM Kelly Roper



1. Const. Golf Course Lane (For details, see sheet C300)
2. Const. type CL-4 fence
3. Const. asph. conc. drainage curb





LEGEND

Cut slope line — — —

Fill slope line · · · · · · · · ·

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00047-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG℠

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

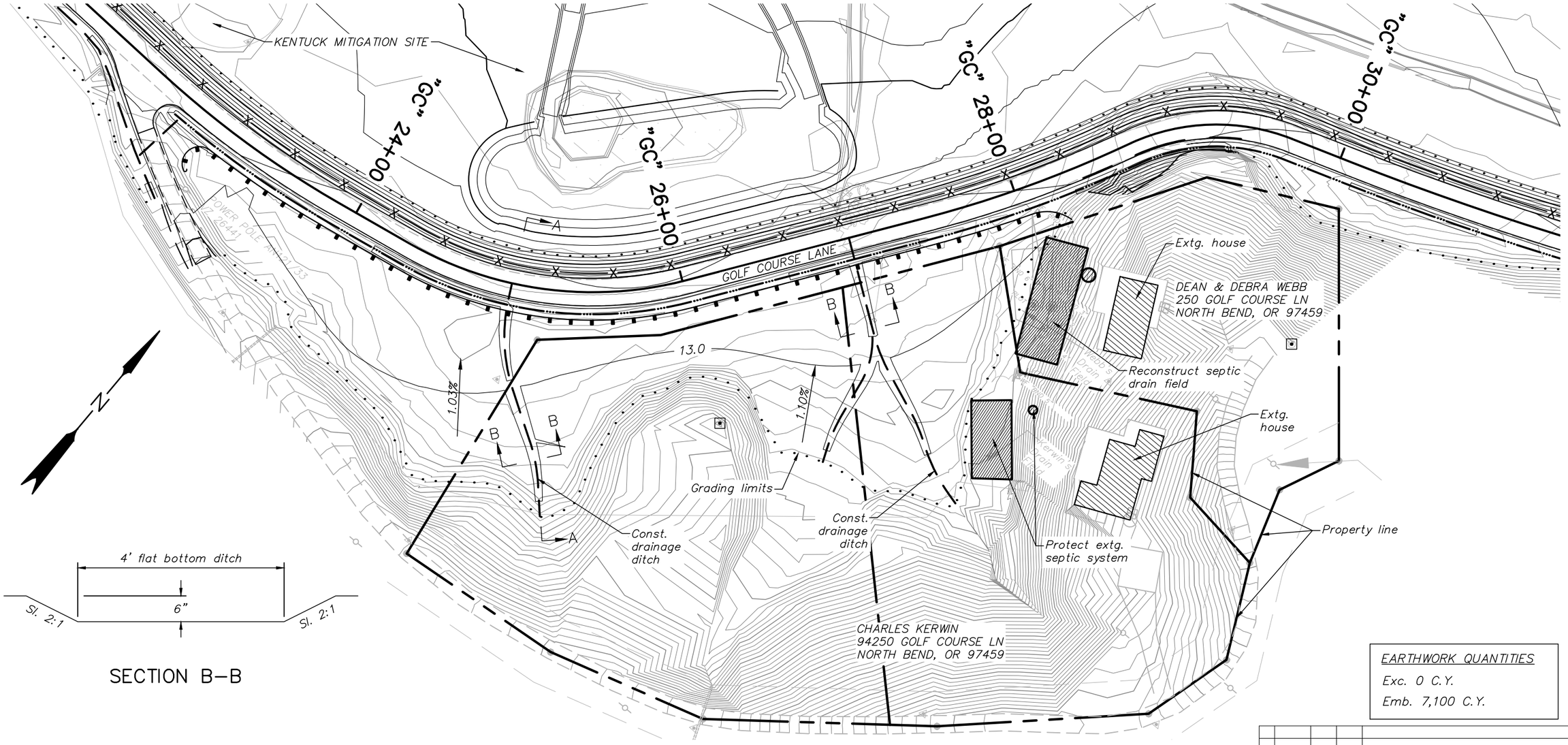
Designer: S. Moriarty Review: B. Berry

Drafter: K. Roper Checker: -

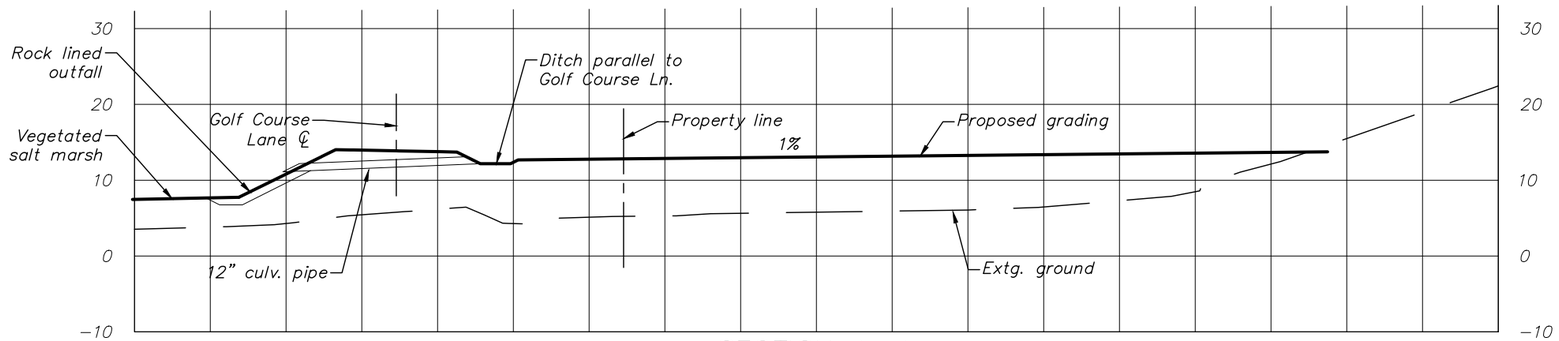
GOLF COURSE LANE PLAN AND PROFILE

SHEET NO. C325

C:\pw_work\dea\kelley Roper\dms04977\C320_KPS_PP01_GC LANE 12/9/2018 9:39 PM Kelly Roper



SECTION B–B



SECTION A–A

EARTHWORK QUANTITIES
Exc. 0 C.Y.
Emb. 7,100 C.Y.

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-GRD-DEA-00002-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
GOLF COURSE LANE

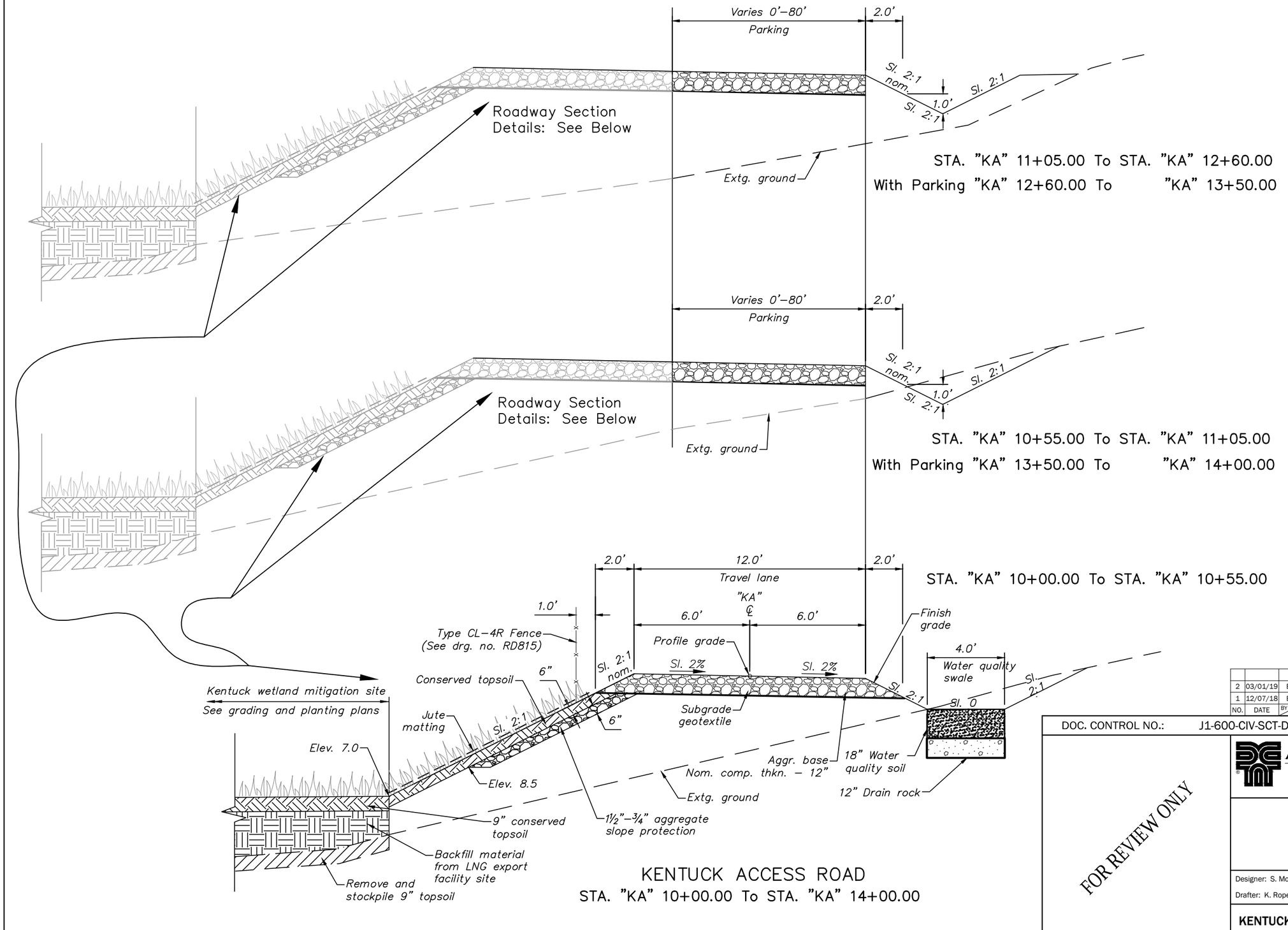
COOS COUNTY

Designer: B. Henri | Review: B. Guthrie
Drafter: T. Danisch | Checker: -

KERWIN & WEBB GRADING PLAN

SHEET NO. C326

C:\pw_work\dea\kelley Roper\dms04977\C321_KPS_PP02_GC LANE_KW 12/9/2018 9:39 PM Kelly Roper



KENTUCK ACCESS ROAD
STA. "KA" 10+00.00 To STA. "KA" 14+00.00

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
2	03/01/19	BB		TS	Rev B - Issued for Reivew
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-SCT-DEA-00004-01 REV B - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG
A Pembina Company

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

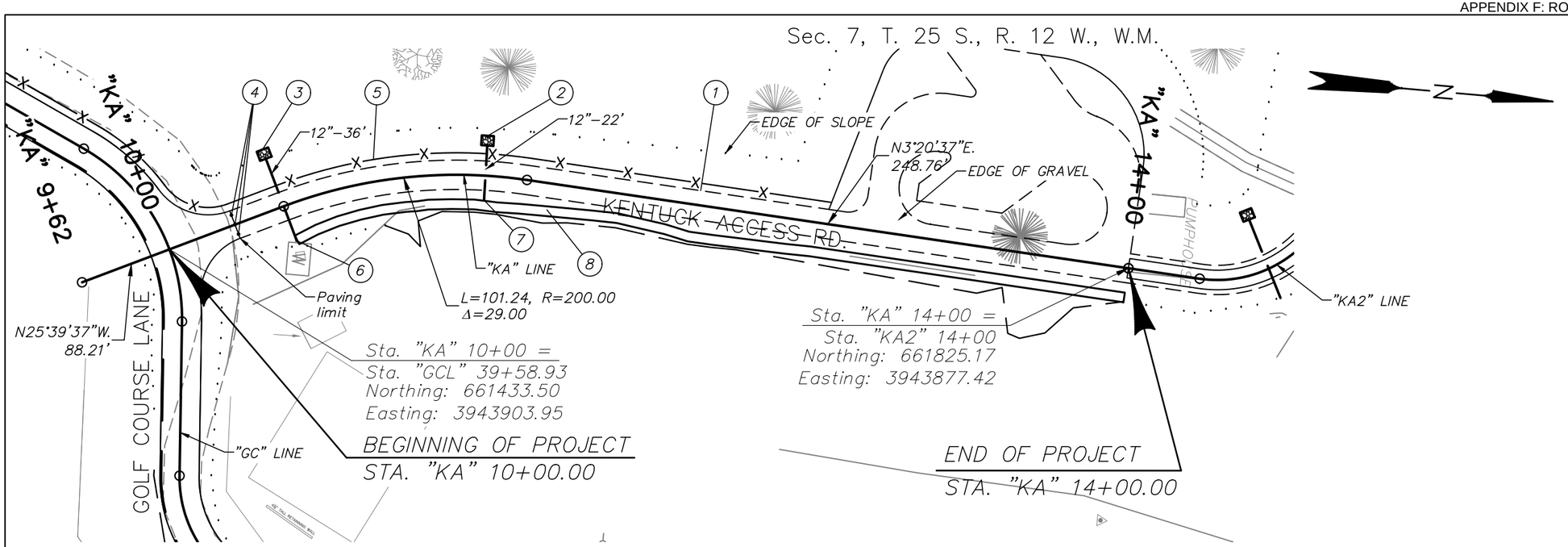
COOS COUNTY

Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

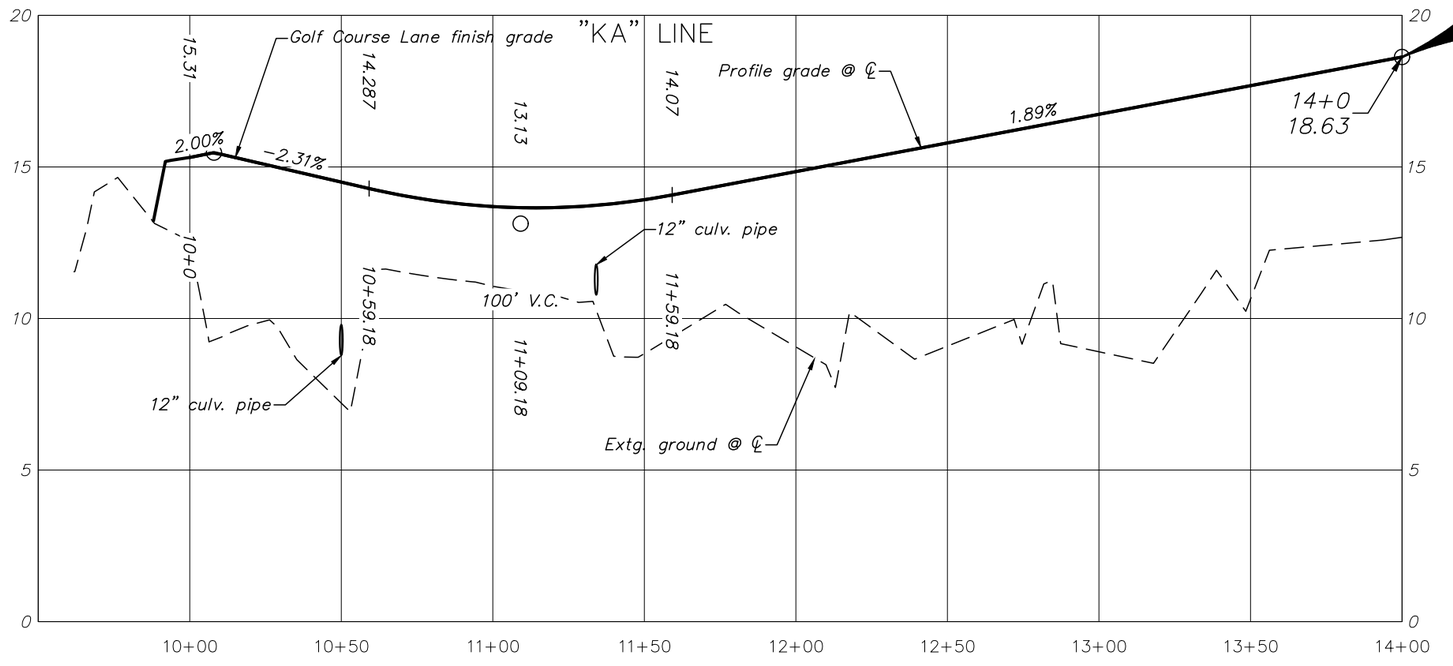
KENTUCK ACCESS ROAD TYPICAL SECTION

SHEET NO. C330

C:\pw_work\dea\dusty Altenburg\dms04977\C330_KPS_TY01_KENTUCK ACCESS 2/28/2019 3:56 PM Dustin Altenburg



1. Const. 12' Access Road
   (For details, see sheet C330)
2. Sta. "KA" 11+34.10, 12.35' Lt.
   Inst. 12" culv. pipe – 22', Sl.=11.09%
   5' depth
   I.E. out 9.41
   Const. loose riprap (class 50) – 2.6 C.Y.
   (For details, see sheet C311)
3. Sta. "KA" 10+50.00, 20.76' Lt.
   Inst. 12" culv. pipe – 36', Sl.=8.63%
   10' depth
   I.E. out 7.00
   Const. loose riprap (class 50) – 2.6 C.Y.
   (For details, see sheet C311)
4. Inst. removable bollard – 3
   (For details, see sheet C340)
5. Const. type CL–4R fence
   (See drg. no. RD815)
6. Sta. "KA" 10+50.00, 15.06' Rt.
   I.E. in 10.09
7. Sta. "KA" 11+34.10, 10.00' Rt.
   I.E. in 11.89
8. Const. Water Quality Swale



END OF PROJECT
STA. "KA" 14+00.00

LEGEND
Cut slope line — — —
Fill slope line ·····

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
2	03/01/19	BB		TS	Rev B Issued for Review
1	8/10/18	BH		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00048-01 Rev B - Issued for Review

FOR REVIEW ONLY

DAVID EVANS AND ASSOCIATES INC.
2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG
A Pembina Company

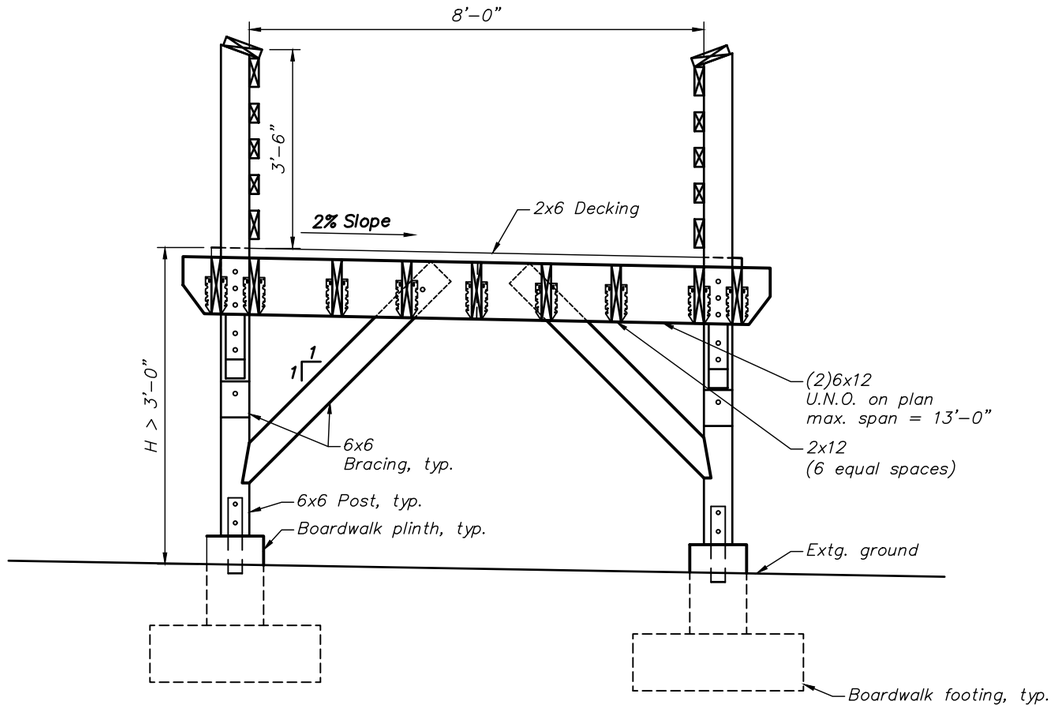
JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

Designer: B. Henri | Review: B. Guthrie
Drafter: T. Danisch | Checker: -

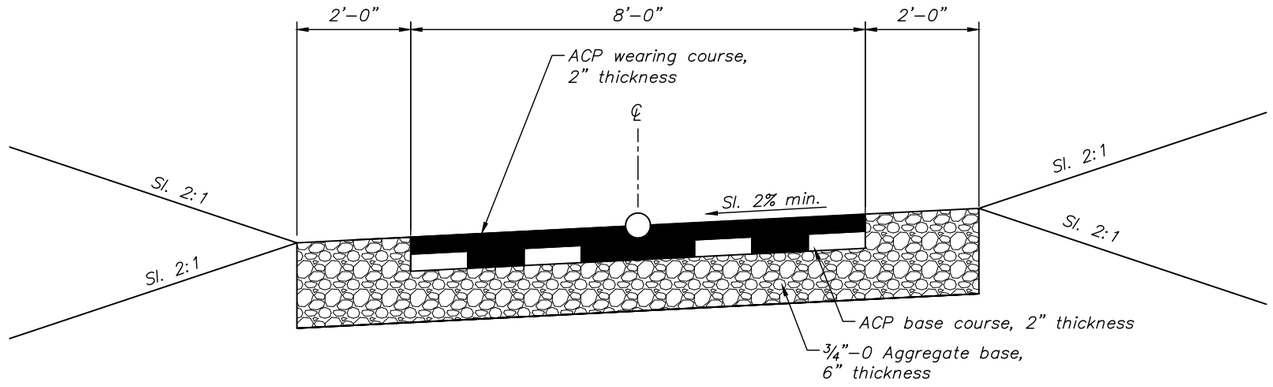
KENTUCK ACCESS ROAD PLAN AND PROFILE

SHEET NO. C350



TYPICAL SECTION AT BOARDWALK

Scale : 3/8" = 1'-0"



TYPICAL TRAIL SECTION

Scale : 3/8" = 1'-0"

NO.	DATE	BY / CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB	TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-SCT-DEA-00005-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG℠

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

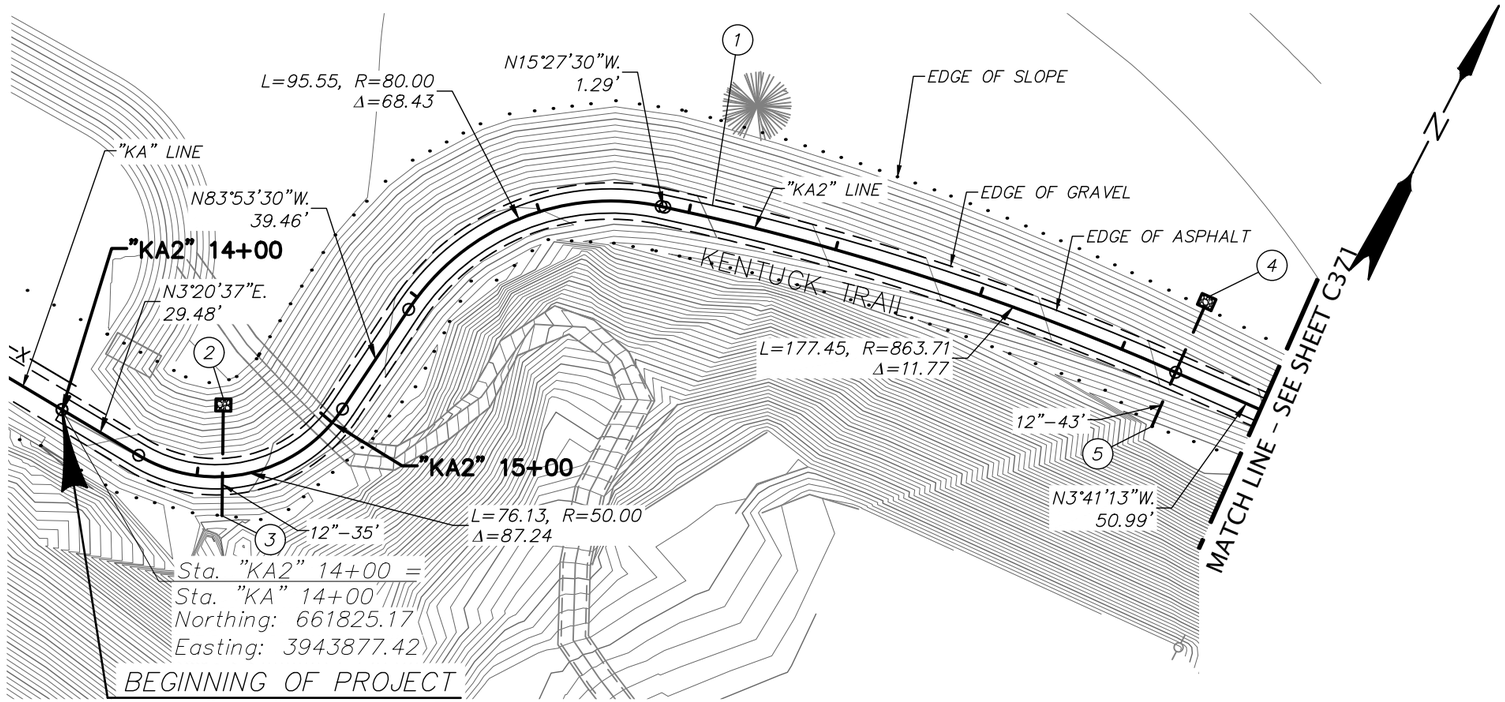
Designer: S. Moriarty | Review: B. Berry
Drafter: K. Roper | Checker: -

KENTUCK TRAIL TYPICAL SECTION

SHEET NO. C360

C:\pw_work\dea\kelley Roper\dms04977\C360_KPS_DT01_MULTI-USE PATH 12/9/2018 8:23 PM Kelly Roper

Sec. 1, T. 25 S., R. 13 W., W.M.



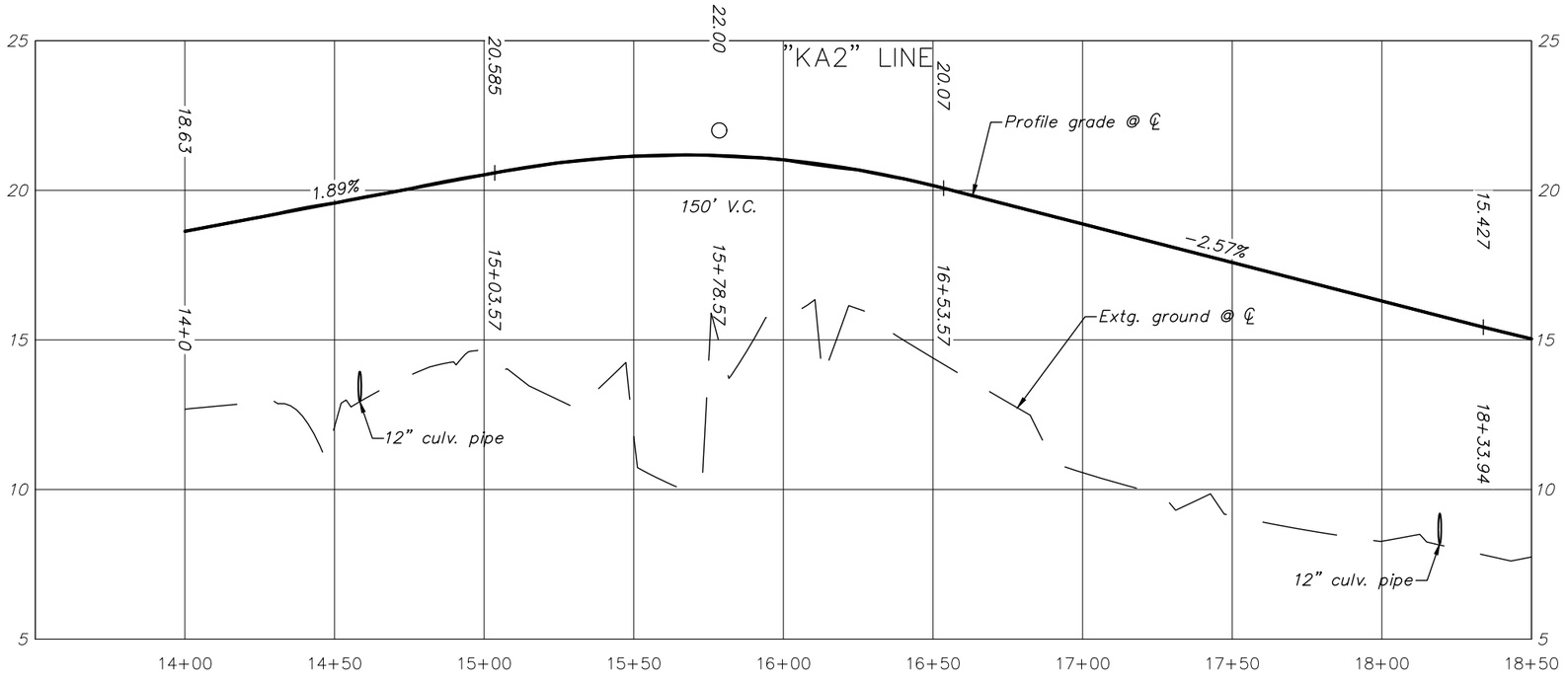
1. Const. 8' Asphalt Path
   (For details, see sheet C360)

2. Sta. "KA" 14+60.49, 21.59' Lt.
   Inst. 12" culv. pipe – 35', Sl.=4.34%
   10' depth
   I.E. out 12.00
   Const. loose riprap (class 50) – 2.6 C.Y.
   (For details, see sheet C311)

3. Sta. "KA" 14+57.90, 12.88' Rt.
   I.E. in 13.50

4. Sta. "KA" 18+19.36, 23.36' Lt.
   Inst. 12" culv. pipe – 43', Sl.=5.09%
   10' depth
   I.E. out 7.00
   Const. loose riprap (class 50) – 2.6 C.Y.
   (For details, see sheet C311)

5. Sta. "KA" 18+19.36, 19.50' Rt.
   I.E. in 9.18



LEGEND
Cut slope line — — —
Fill slope line ·····

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00049-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

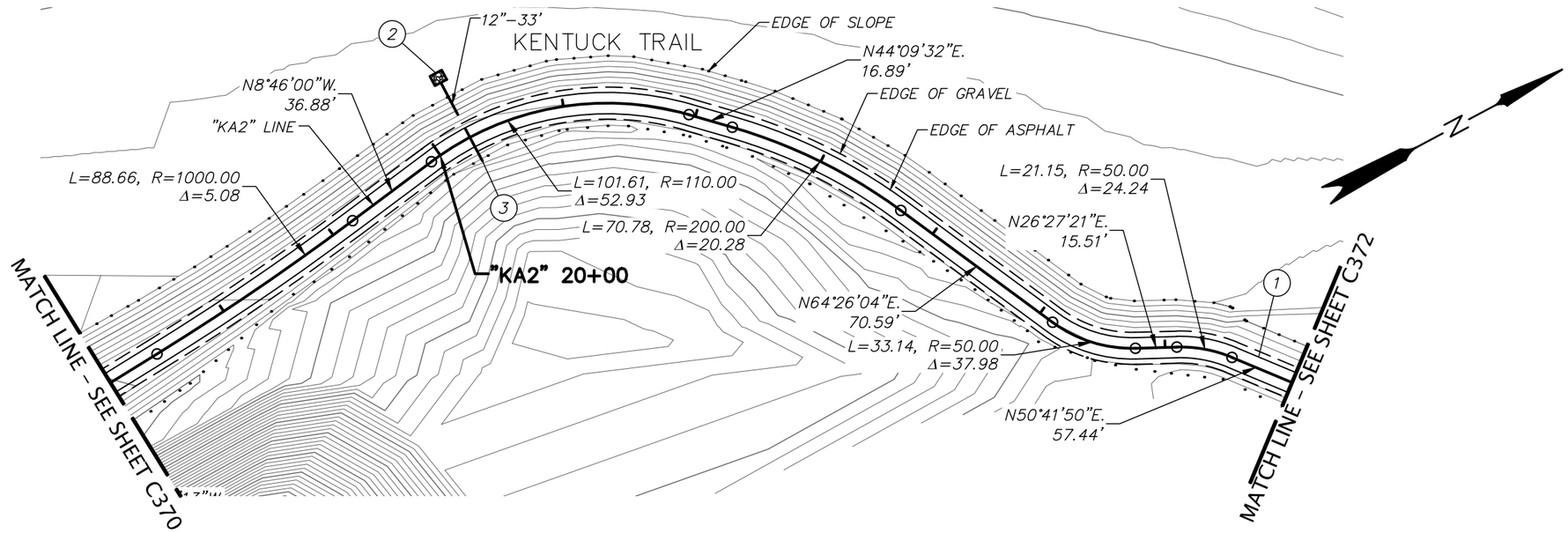
Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

KENTUCK TRAIL
KENTUCK TRAIL PLAN AND PROFILE

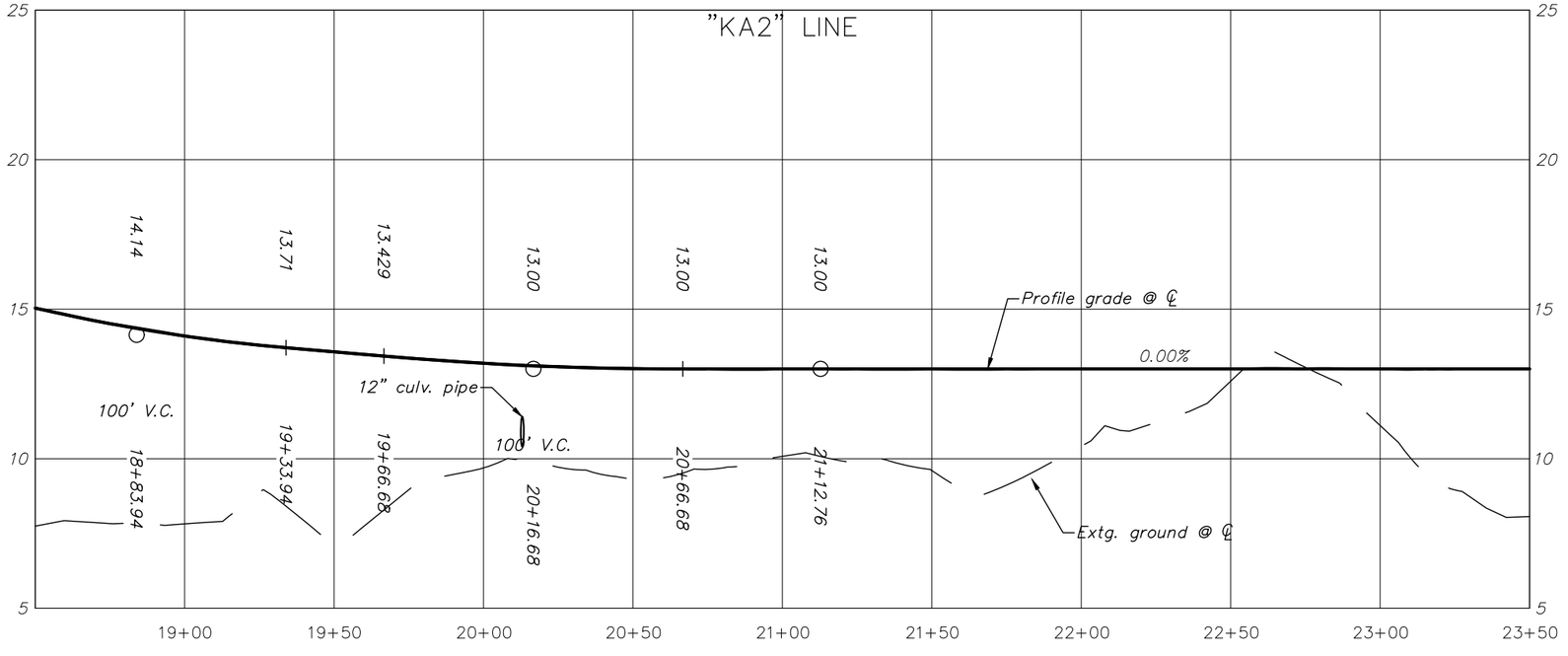
SHEET NO. C370

C:\pw_work\dea\kelley Roper\dms04977\C370_KPS_PP01_KENTUCK TRAIL 12/9/2018 8:24 PM Kelly Roper

Sec. 1, T. 25 S., R. 13 W., W.M.



1. Const. 8' Asphalt Path
   (For details, see sheet C360)
2. Sta. "KA" 20+13.00, 23.20' Lt.
   Inst. 12" culv. pipe – 33', Sl.=15.60%
   5' depth
   I.E. out 6.78
   Const. loose riprap (class 50) – 2.6 C.Y.
   (For details, see sheet C311)
3. Sta. "KA" 20+13.00, 10.00' Rt.
   I.E. in 11.96



LEGEND
Cut slope line
Fill slope line

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

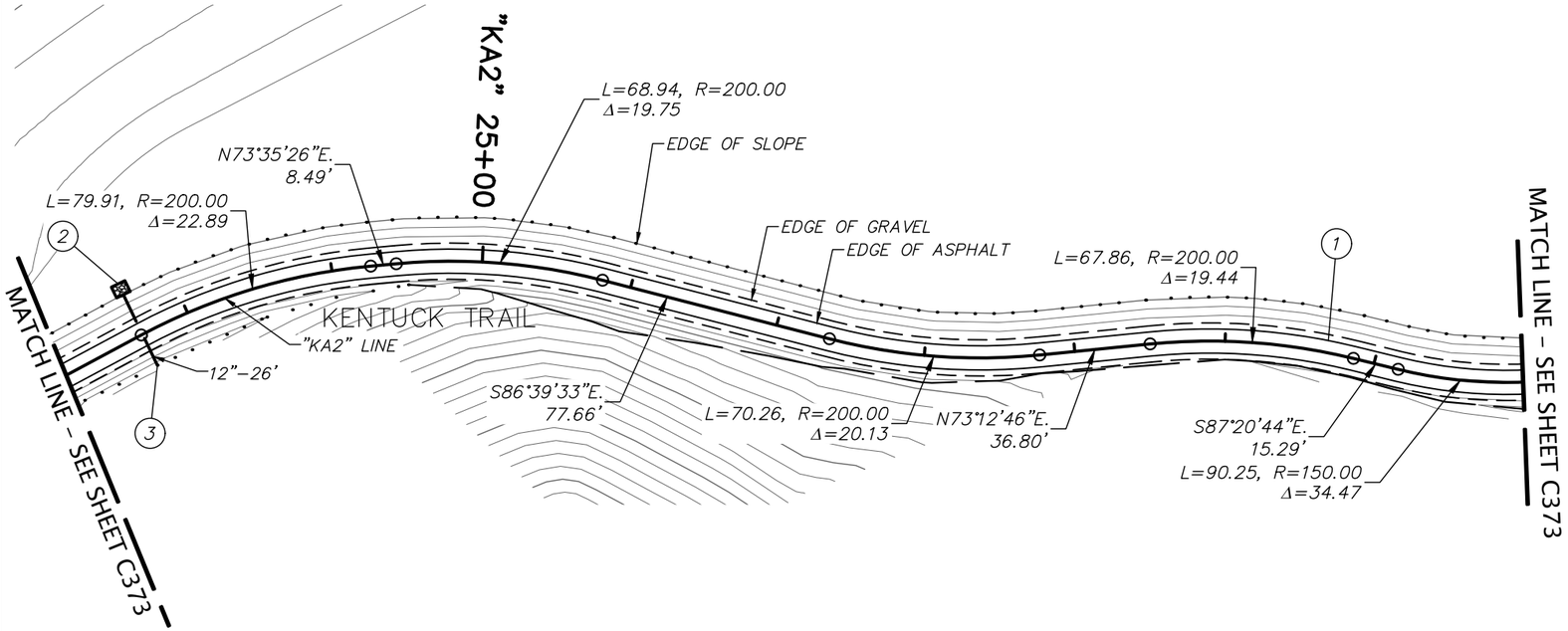
COOS COUNTY

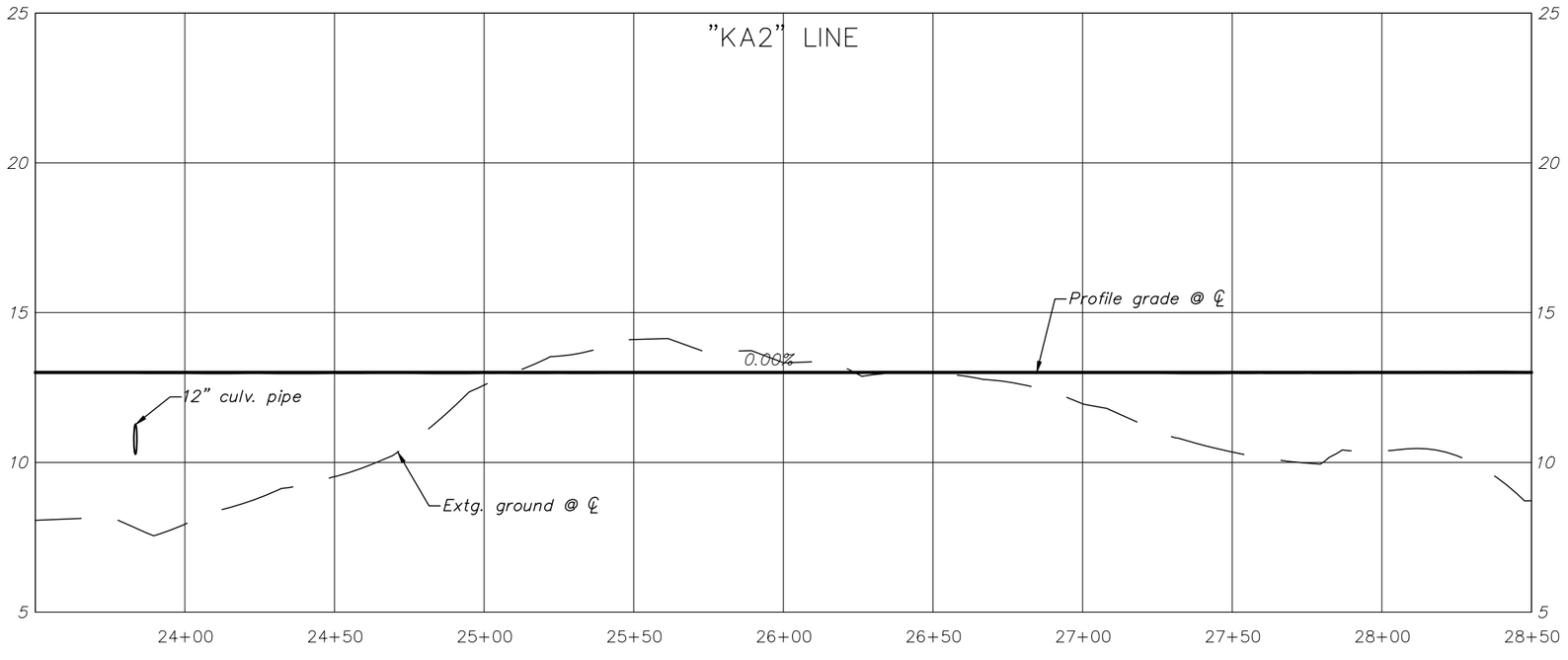
Designer: S. Moriarty | Review: B. Berry
Drafter: K. Roper | Checker: -

KENTUCK TRAIL
KENTUCK TRAIL PLAN AND PROFILE

SHEET NO. C371

Sec. 1, T. 25 S., R. 13 W., W.M.





N

1. Const. 8' Asphalt Path
   (For details, see sheet C360)

2. Sta. "KA" 23+84.02, 14.60' Lt.
   Inst. 12" culv. pipe – 26', Sl.=1.81%
   5' depth
   I.E. out 10.00
   Const. loose riprap (class 50) – 2.6 C.Y.
   (For details, see sheet C311)

3. Sta. "KA" 23+83.00, 11.31' Rt.
   I.E. in 10.47

LEGEND
Cut slope line
Fill slope line

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KENTUCK TRAIL
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SHEET NO. C372

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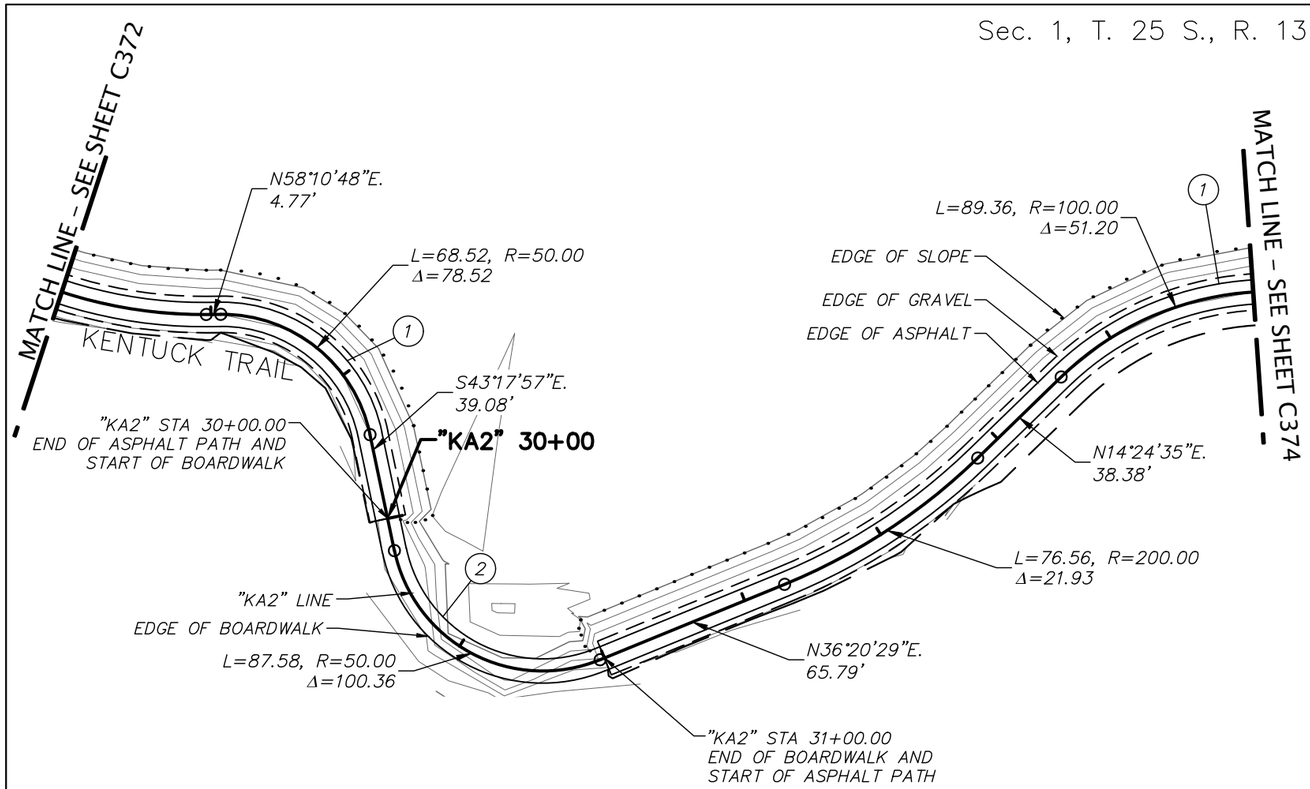
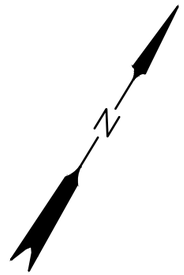
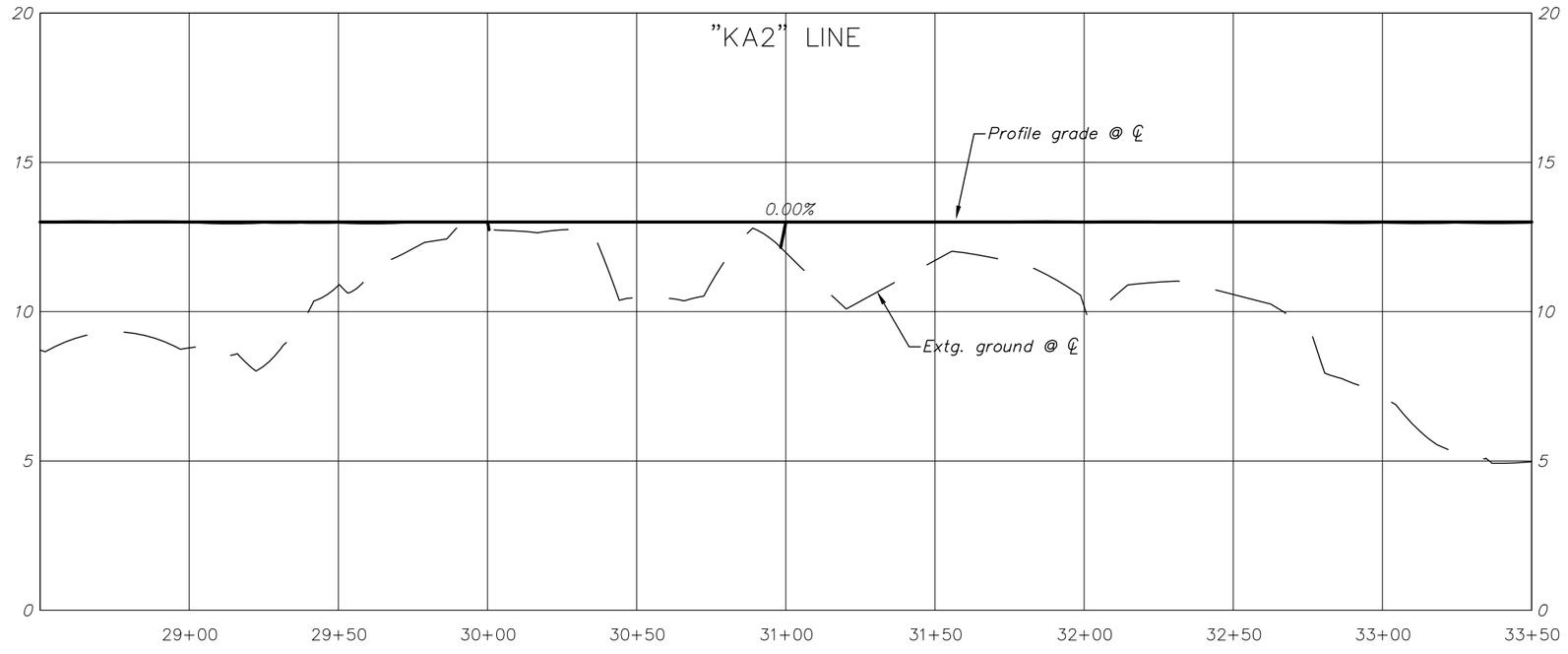




1. Const. 8' Asphalt Path
(For details, see sheet C360)
2. Const. 8' Boardwalk Path
(For details, see sheet C360)



LEGEND
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Fill slope line ·····

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Drafter: K. Roper Checker: -

KENTUCK TRAIL
KENTUCK TRAIL PLAN AND PROFILE

SHEET NO. C373

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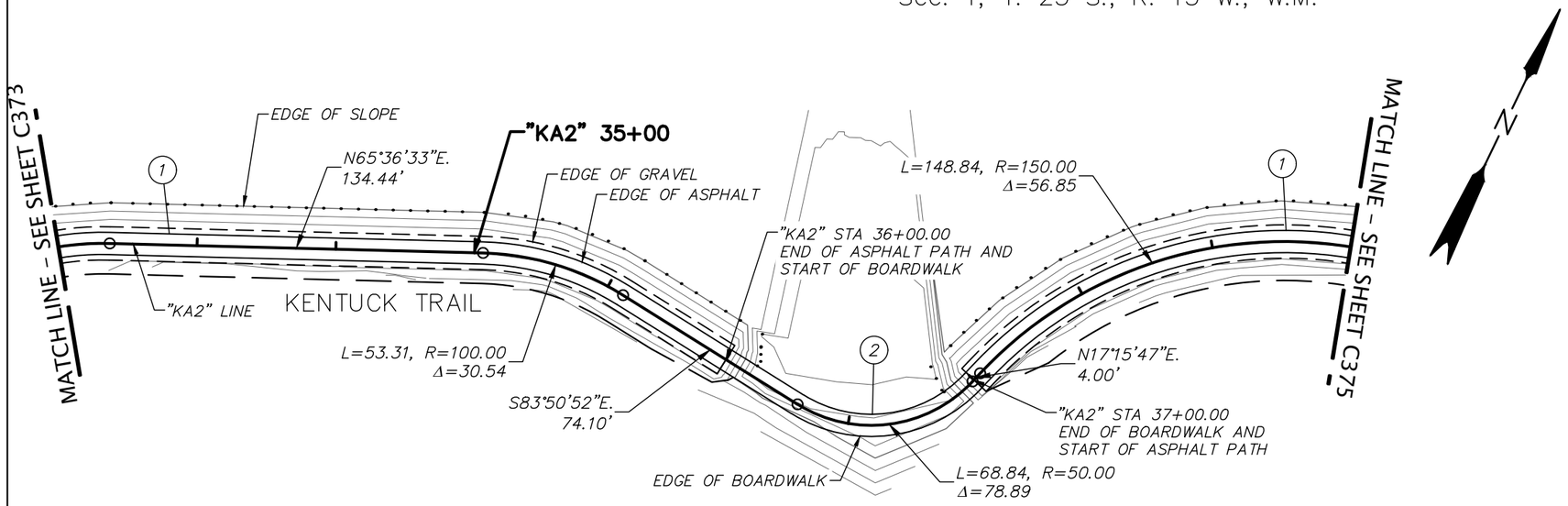
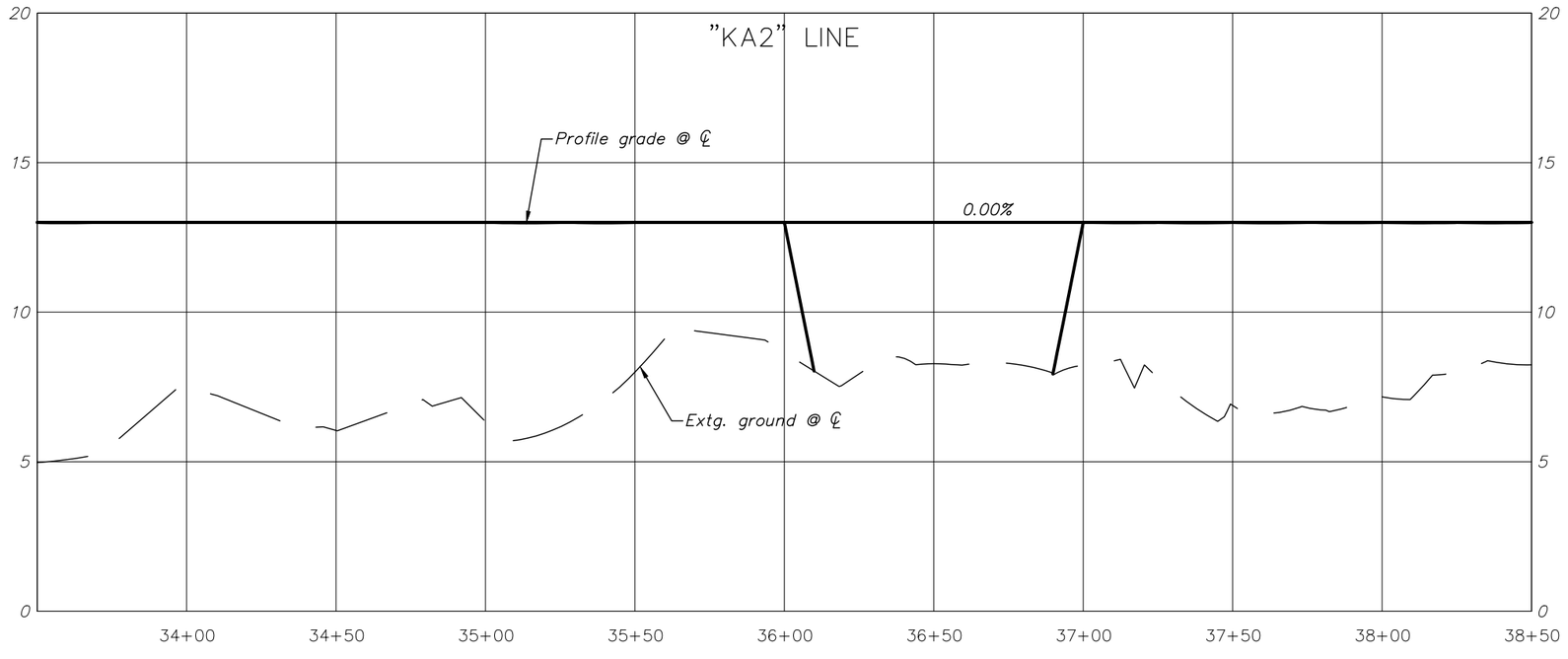


1. Const. 8' Asphalt Path (For details, see sheet C360)
2. Const. 8' Boardwalk Path (For details, see sheet C360)



LEGEND
Cut slope line — — —
Fill slope line ·····

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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KENTUCK PROJECT SITE

COOS COUNTY

Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

KENTUCK TRAIL
KENTUCK TRAIL PLAN AND PROFILE

SHEET NO. C374

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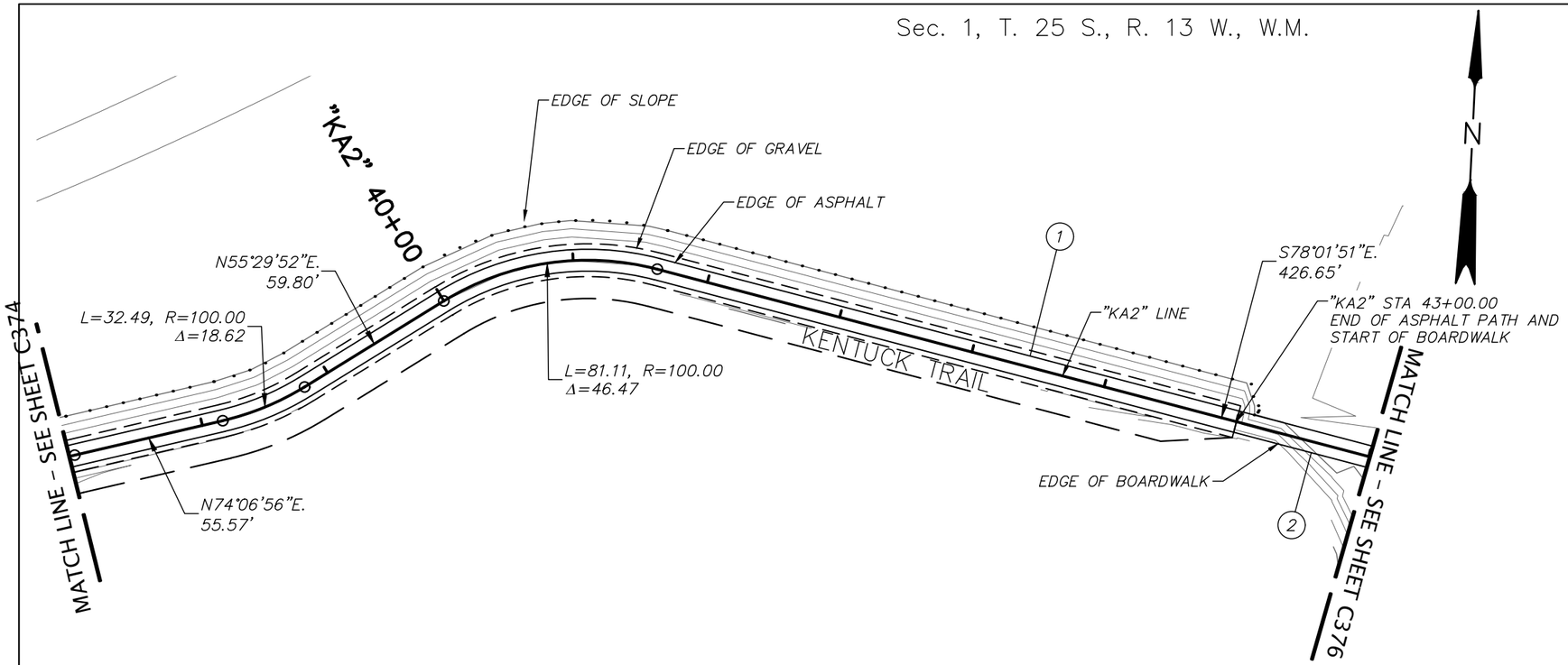

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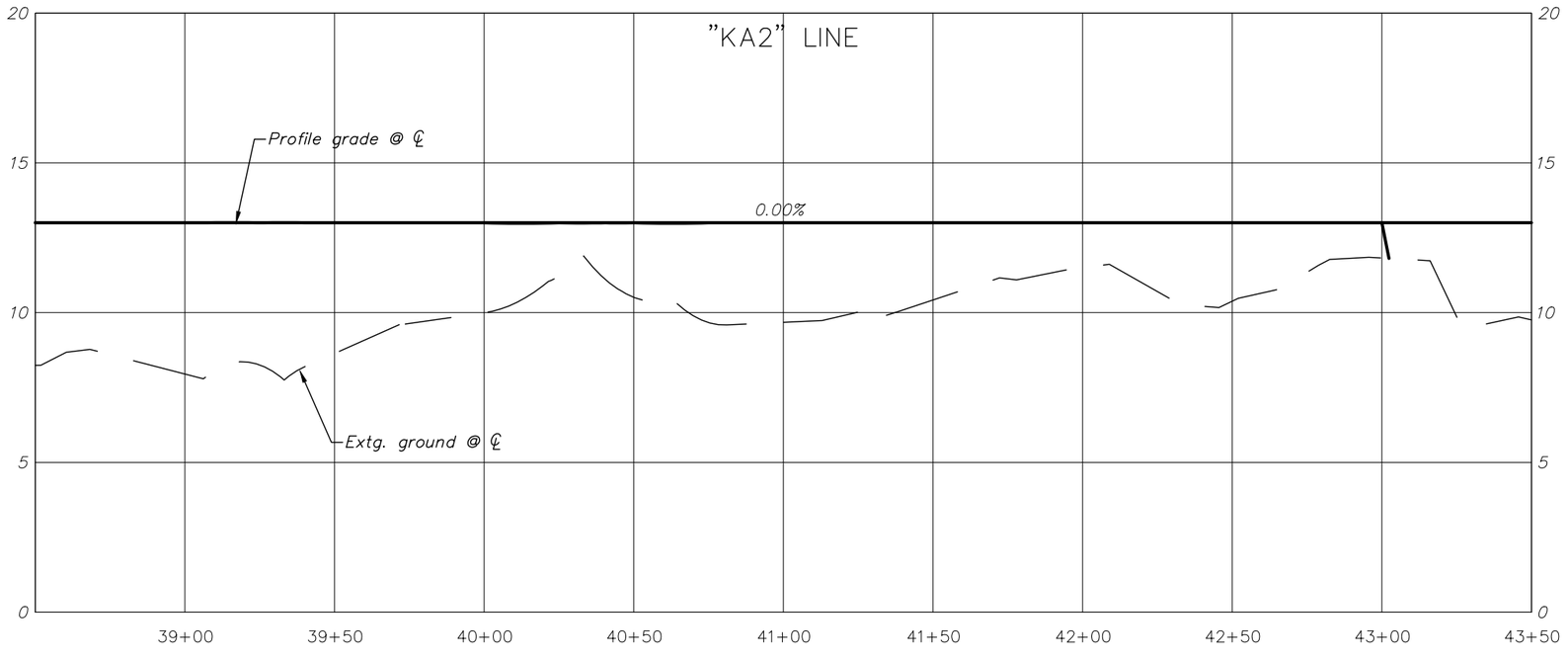
2. Const. 8' Boardwalk Path (For details, see sheet C360)



LEGEND
Cut slope line — — —
Fill slope line ·····

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KENTUCK PROJECT SITE

COOS COUNTY

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Drafter: K. Roper Checker: -

KENTUCK TRAIL
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SHEET NO. C375

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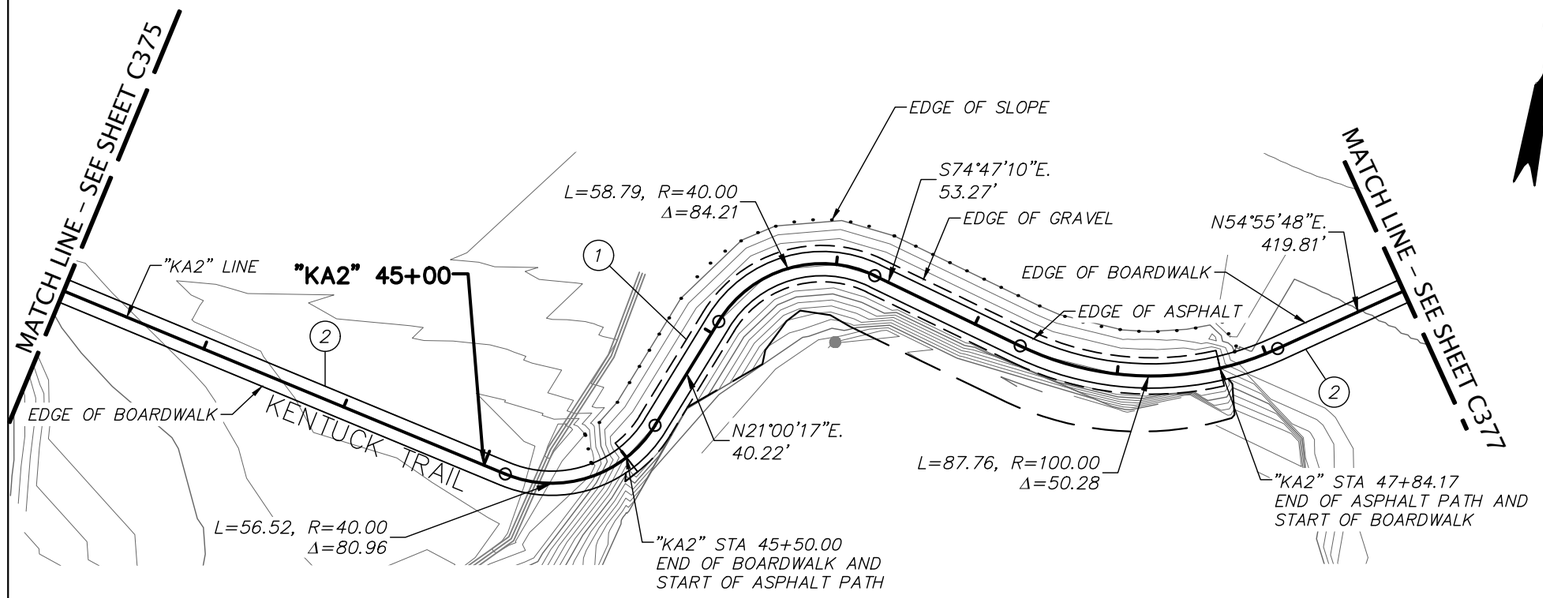

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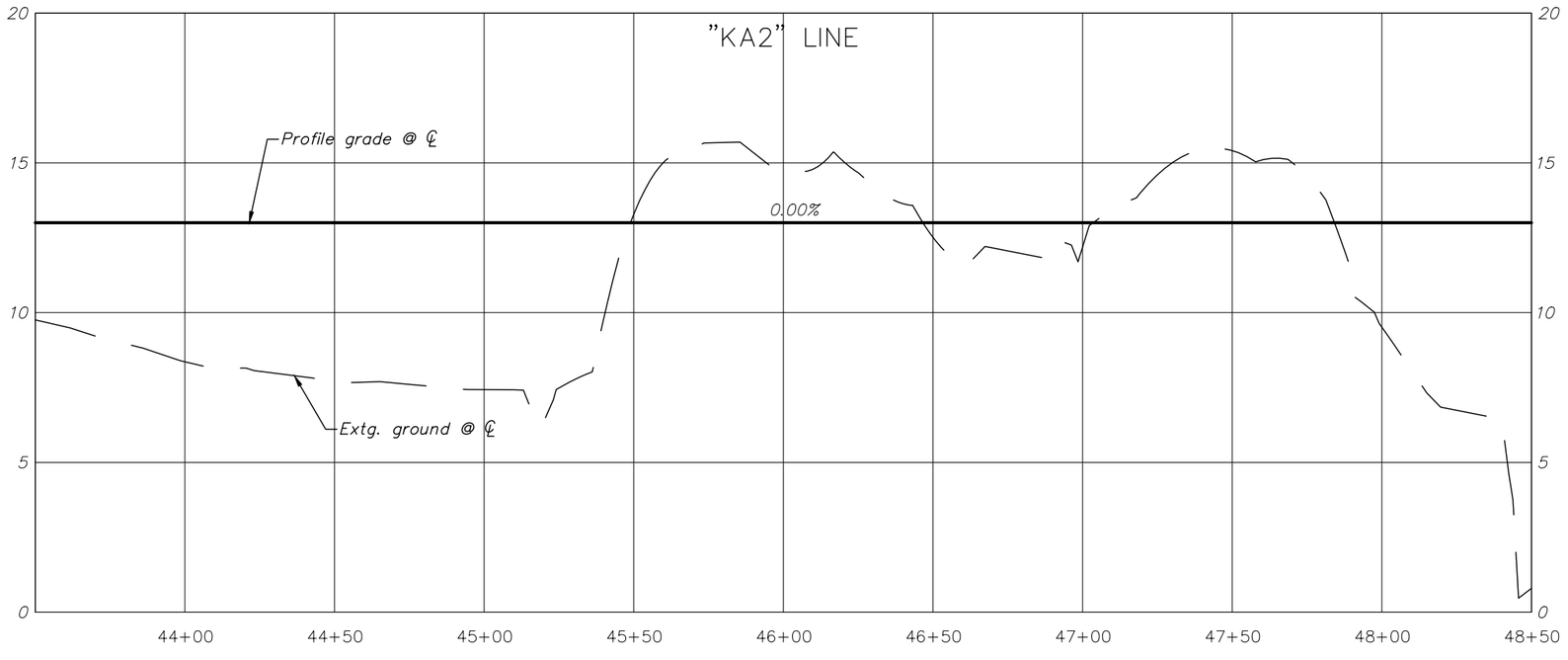
2. Const. 8' Boardwalk Path (For details, see sheet C360)



LEGEND
Cut slope line — — —
Fill slope line ·····

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KENTUCK PROJECT SITE

COOS COUNTY

Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

KENTUCK TRAIL
KENTUCK TRAIL PLAN AND PROFILE

SHEET NO. C376

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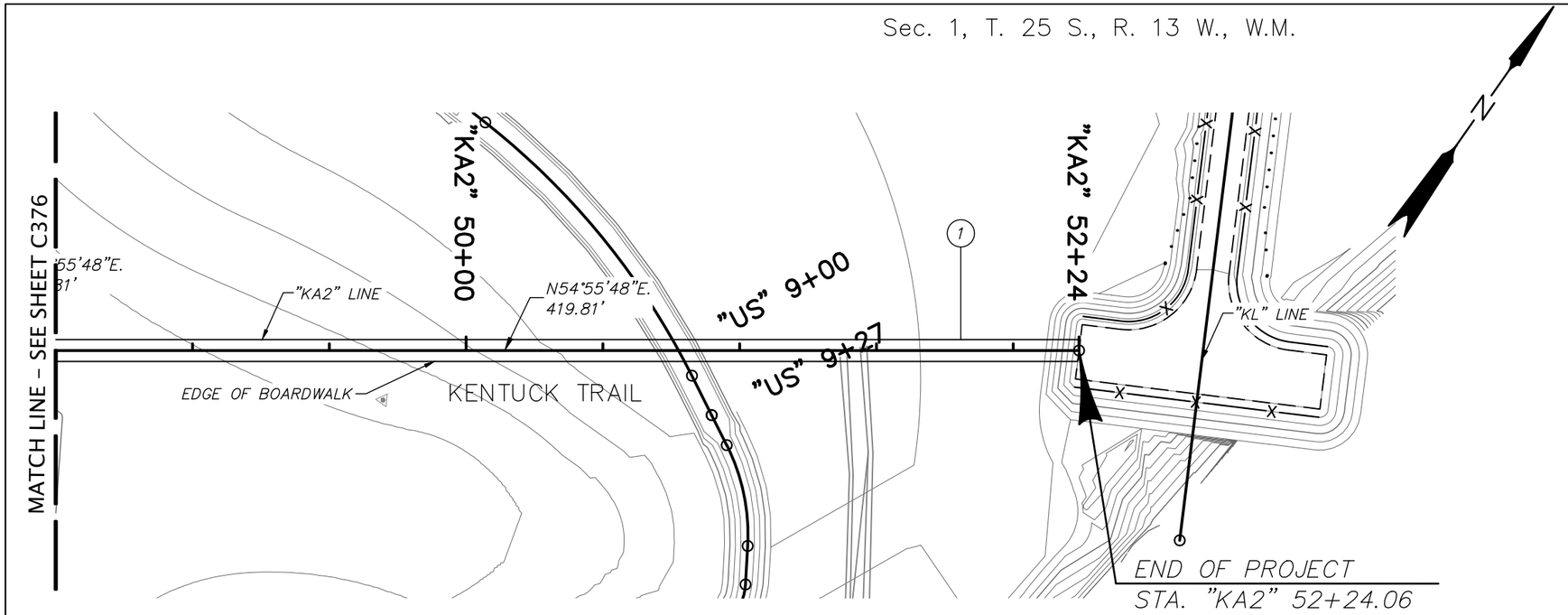
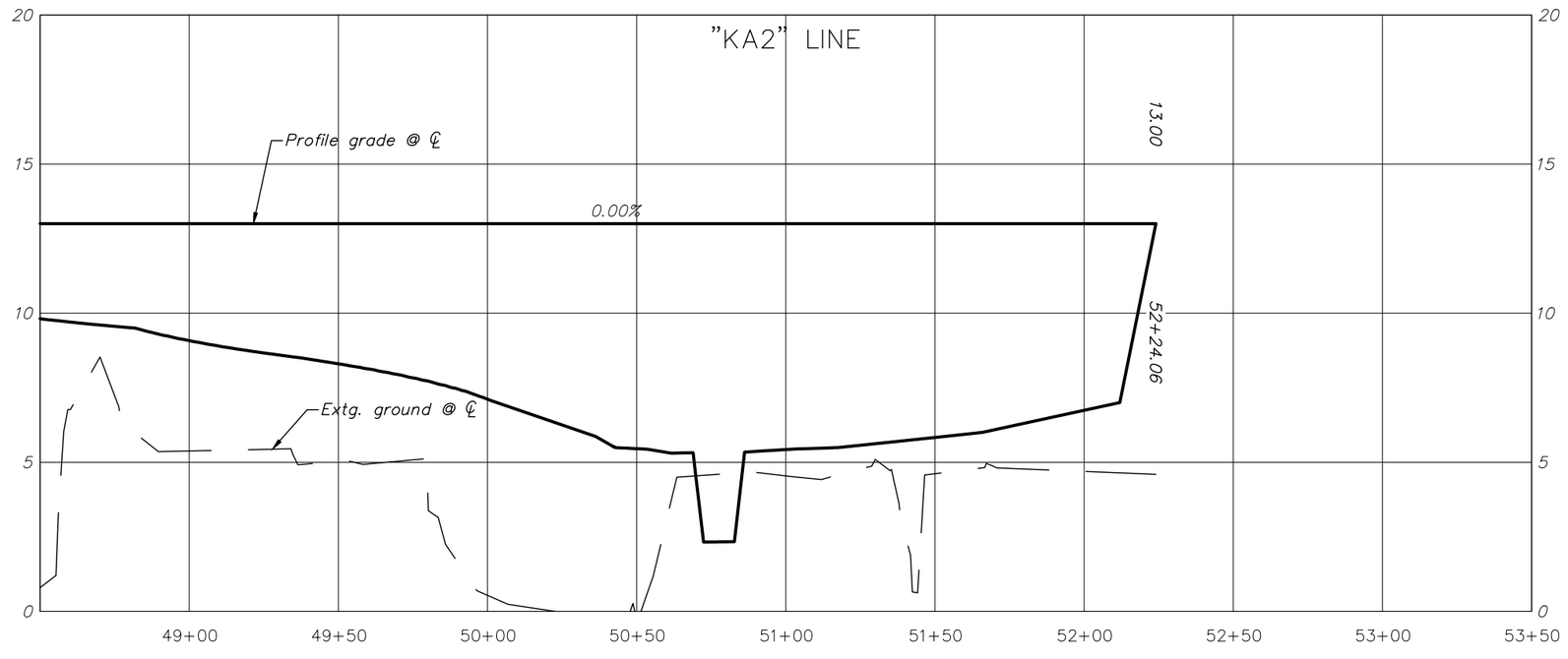


1 Const. 8' Boardwalk Path
(For details, see sheet C360)



LEGEND
Cut slope line
Fill slope line

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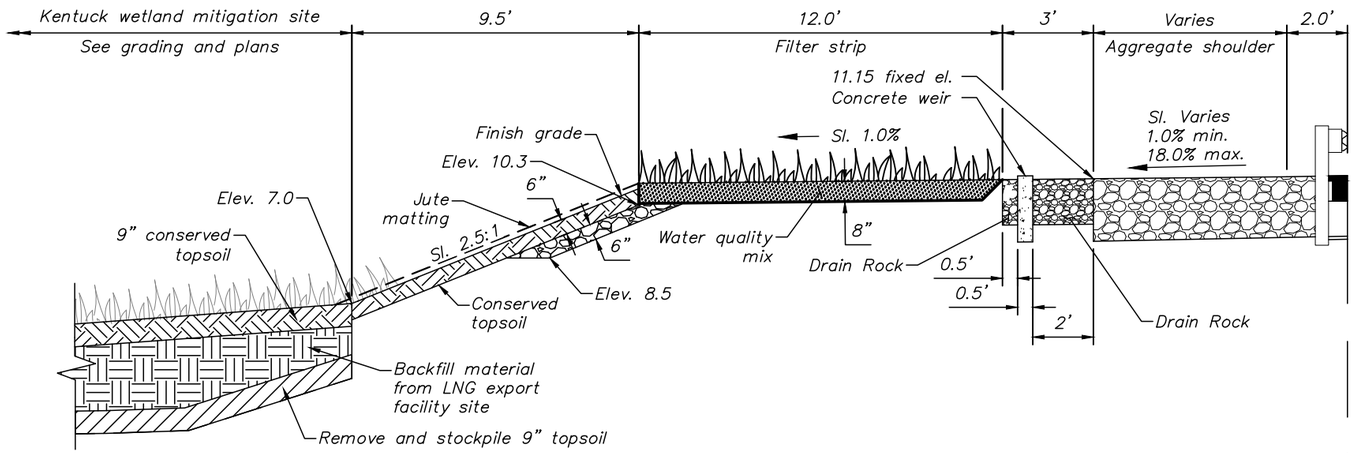
COOS COUNTY

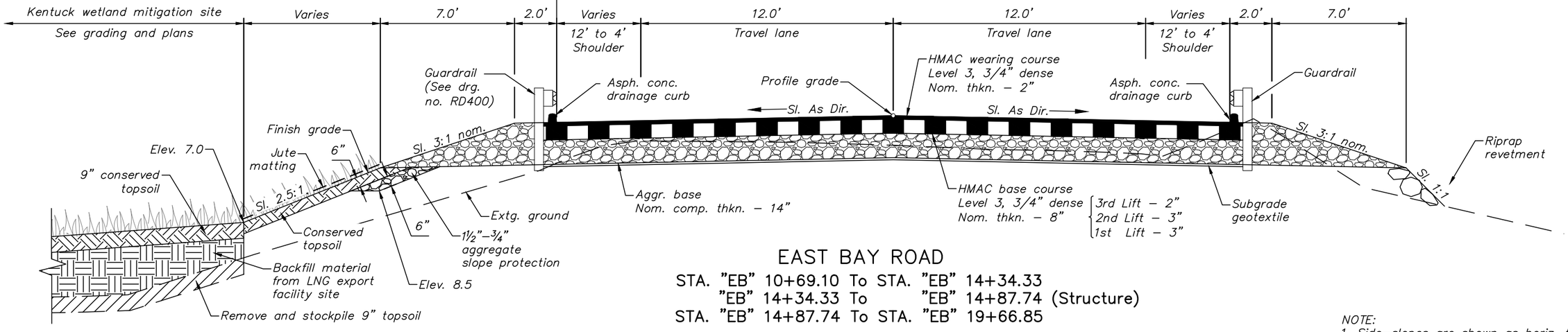
Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

KENTUCK TRAIL
KENTUCK TRAIL PLAN AND PROFILE

SHEET NO.
C377

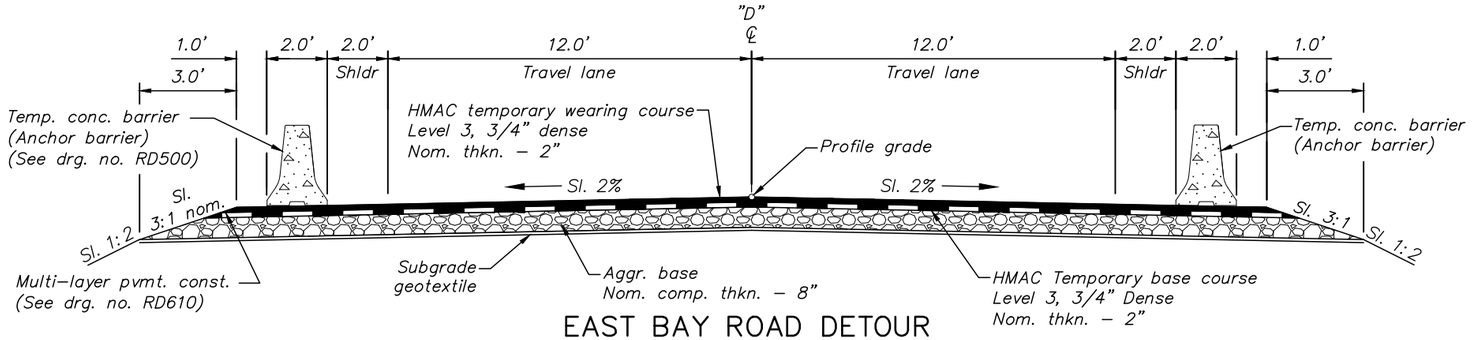


STA. "EB" 10+69.10 To STA. "EB" 14+34.33



EAST BAY ROAD

STA. "EB" 10+69.10 To STA. "EB" 14+34.33
"EB" 14+34.33 To "EB" 14+87.74 (Structure)
STA. "EB" 14+87.74 To STA. "EB" 19+66.85



EAST BAY ROAD DETOUR

STA. "11+91.12" To STA. "D" 17+94.55

NOTE:
1. Side–slopes are shown as horiz. to vert.

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JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

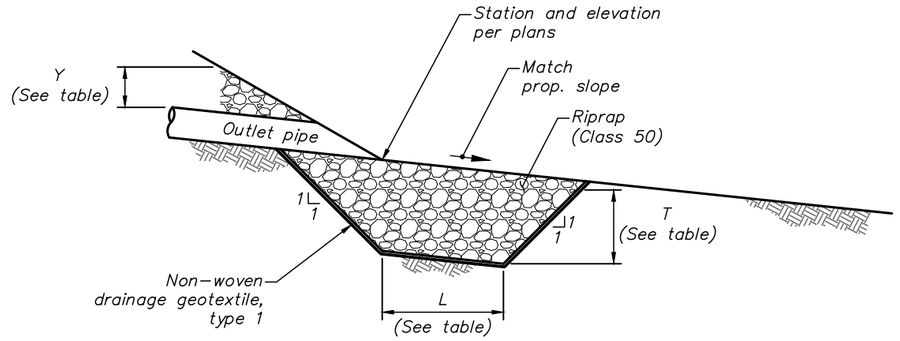
COOS COUNTY

Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

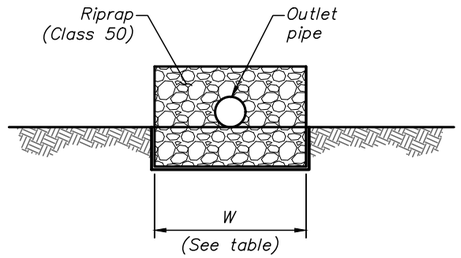
EAST BAY ROAD TYPICAL SECTION

SHEET NO. C400

| SHEET NUMBER | NOTE NO. ON PLANS | ① DESIGN HEIGHT OF COVER (FEET) | PIPE: CIRCULAR OR ELLIPTICAL — SIZE IN (Inches) 10 | 12 | 15 | 18 | 24 | 30 | 36 | 72 — LENGTH IN FEET | PIPE - ARCH: HELICAL / RIVETED WELDED OR LOCK SEAM — EQUIV. RND SIZE (In.) | LENGTH (Ft.) | CROSS - SECTIONAL DIMENSIONS ② SPAN (Ft.-In.) | RISE (Ft.-In.) | CORNER RADII (In.) | USE / INSTALLATION CRITERIA: DRAIN (PERFORATED) | CULVERT (ROAD APPROACH) | CULVERT (CONDUIT) | CULVERT | IRRIGATION | SIPHON | STORM SEWER | SANTARY SEWER | OTHERS (SEE REMARKS) | WATERTIGHT JOINTS | SLOPE ANCHORS | WATERLINE | PH | RESISTIVITY (HUNDREDS) | TERMINAL TREATMENT: LT / RT SLOPED ENDS (Not for Conc. Pipe Over 60" Dia.) | SKEW NUMBER | PAVED END SLOPES No. | RIGID: PRE-CAST CONCRETE PLAIN ③ 1 | 2 | 3 | REINF. III | IV | V | SPECIAL: DUCTILE IRON, CL. 51 | AWWA C300 or C905 | HDPE | POLYPROPYLENE | APPURTENANCES: MANHOLES DEPTH, TOP OF COVER TO INVERT (Feet) | DIAMETER OF LARGEST PIPE IN BASE (In.) | CONC. PRECAST | CLEANOUT | WATER QUALITY | SHALLOW | FLAT TOP | INLETS TYPE: BEEHVE INLET | G-2 | WQ Inlet | Area Drain, Type II | Ditch Inlet | CG-48 Manhole — Number Required | EXTENSION: LEFT (Feet) | RIGHT (Feet) | ④ EXTG. PIPE MATERIAL | REMARKS |
|---|---|---



ELEVATION VIEW

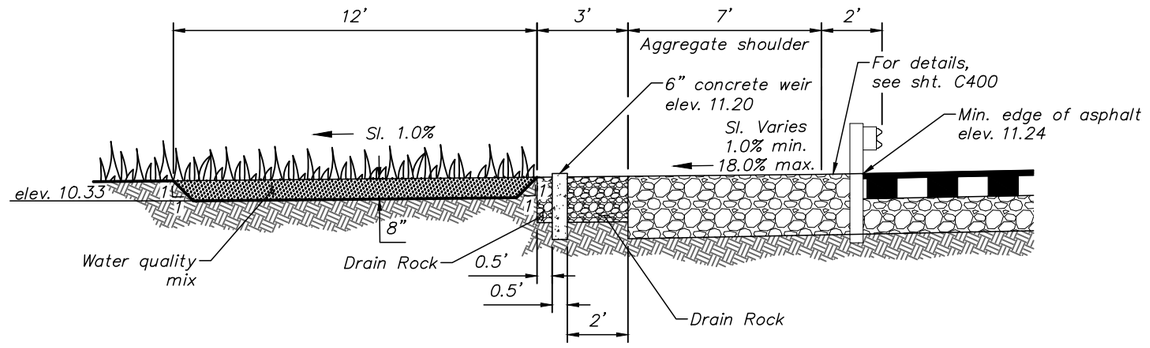


ENDVIEW

RIPRAP DESIGN TABLE				
Location	*L*	*W*	*T*	*Y*
Sta. "EB" 13+91, Lt.	*4'*	*5'*	*2.3'*	*1'*
Sta. "EB" 15+21, Lt.	*4'*	*5'*	*2.3'*	*1'*
Sta. "EB" 20+62, Lt.	*4'*	*5'*	*2.3'*	*1'*

RIPRAP PADS

N.T.S.



WATER QUALITY FILTER STRIP

(STA. "EB" 11+73.88, 32.64' LT. TO STA. "EB" 13+88.68, 28.00' LT.)

N.T.S.

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A Pembina Company

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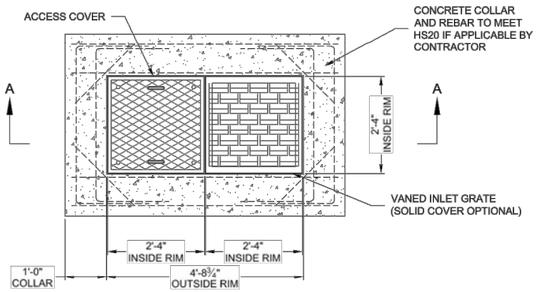
KENTUCK PROJECT SITE

COOS COUNTY

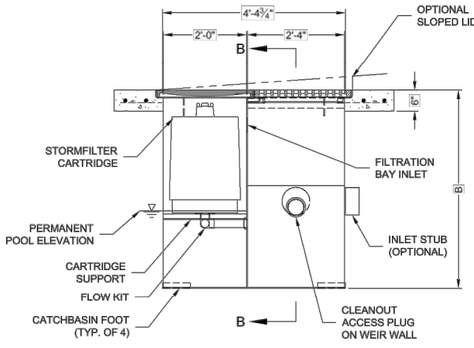
Designer: S. Moriarty | Review: B. Berry
Drafter: K. Roper | Checker: -

EAST BAY ROAD DETAILS

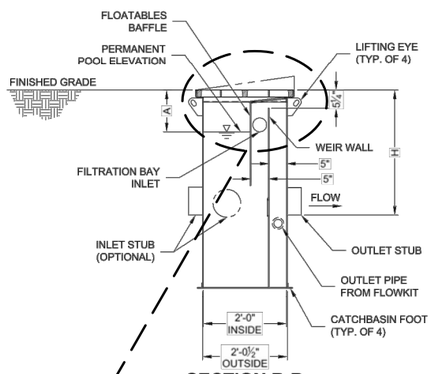
SHEET NO. C413



PLAN VIEW



SECTION A-A



SECTION B-B

STORMFILTER STEEL CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 1 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF ONE CARTRIDGE. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			18" DEEP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			3.3'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	15	12.53	7.5
PEAK HYDRAULIC CAPACITY	1.0			1.0			1.8		
INLET PERMANENT POOL LEVEL (A)	1'-0"			1'-0"			2'-0"		
OVERALL STRUCTURE HEIGHT (B)	4'-9"			3'-9"			4'-9"		

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. MANUFACTURER TO APPLY A SURFACE BEAD WELD IN THE SHAPE OF THE LETTER "O" ABOVE THE OUTLET PIPE STUB ON THE EXTERIOR SURFACE OF THE STEEL SFCB.
6. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
7. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
8. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
9. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

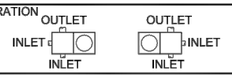
INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

1-CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID	"EB" Sta. 18+41, Rt.
WATER QUALITY FLOW RATE (cfs)	0.05
PEAK FLOW RATE (<1 cfs)	0.09
RETURN PERIOD OF PEAK FLOW (yrs)	25
CARTRIDGE HEIGHT (27", 18", 18" DEEP)	22.5
CARTRIDGE FLOW RATE (gpm)	ZPG
MEDIA TYPE (PERLITE, ZPG, PSORB)	13.72
RIM ELEVATION	

PIPE DATA:	I.E.	DIAMETER
INLET STUB	N/A	N/A
OUTLET STUB	10.67	12"

CONFIGURATION



SLOPED LID	NO
SOLID COVER	NO
NOTES/SPECIAL REQUIREMENTS:	

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CONTECH ENGINEERED SOLUTIONS LLC
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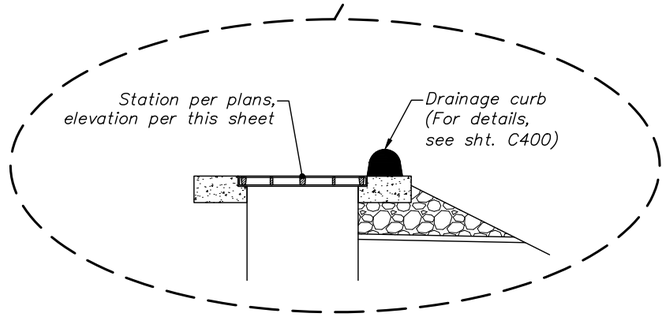
1 CARTRIDGE CATCHBASIN STORMFILTER STANDARD DETAIL



NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-DTL-DEA-00021-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG℠

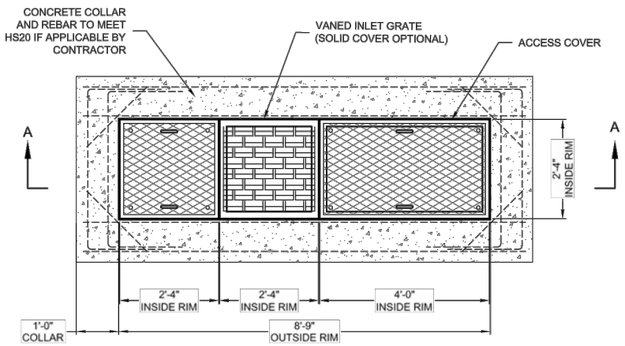
JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

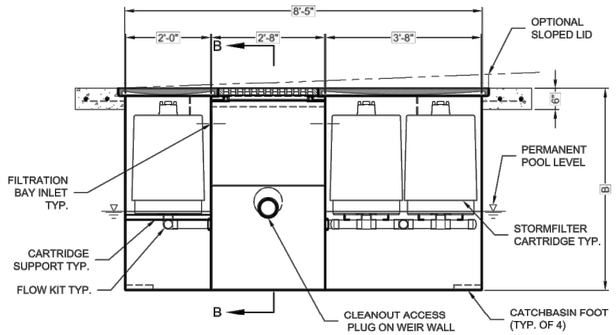
Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

EAST BAY ROAD DETAILS

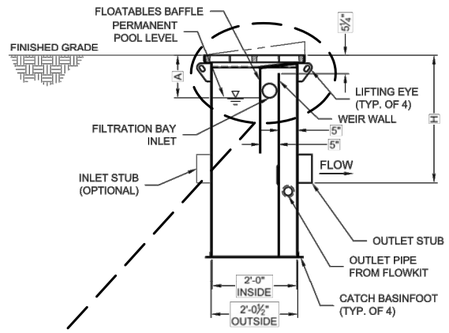
SHEET NO. C414



PLAN VIEW



SECTION A-A



SECTION B-B

STORMFILTER STEEL CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 3 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF THREE CARTRIDGES. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			18" DEEP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			3.3'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	15	12.53	7.5
PEAK HYDRAULIC CAPACITY	1.0			1.0			1.8		
INLET PERMANENT POOL LEVEL (A)	1'-0"			1'-0"			2'-0"		
OVERALL STRUCTURE HEIGHT (B)	4'-9"			3'-9"			4'-9"		

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB ® (PSORB) MEDIA ONLY

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ANGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contecheS.com
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. MANUFACTURER TO APPLY A SURFACE BEAD WELD IN THE SHAPE OF THE LETTER "O" ABOVE THE OUTLET PIPE STUB ON THE EXTERIOR SURFACE OF THE STEEL SFCB.
6. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
7. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
8. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
9. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

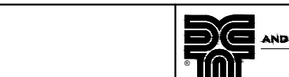
INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

4 -CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID	"EB" Sta. 15+21, Rt.
WATER QUALITY FLOW RATE (cfs)	0.11
PEAK FLOW RATE (<1 cfs)	0.18
RETURN PERIOD OF PEAK FLOW (yrs)	25
CARTRIDGE FLOW RATE (gpm)	15
MEDIA TYPE (PERLITE, ZPG, PSORB)	ZPG
RIM ELEVATION	13.81

PIPE DATA:	I.E.	DIAMETER
INLET STUB	N/A	N/A
OUTLET STUB	10.61	12"

CONFIGURATION



SLOPED LID	NO
SOLID COVER	NO
NOTES/SPECIAL REQUIREMENTS:	

2 -CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID	"EB" Sta. 15+21, Lt.
WATER QUALITY FLOW RATE (cfs)	0.04
PEAK FLOW RATE (<1 cfs)	0.07
RETURN PERIOD OF PEAK FLOW (yrs)	25
CARTRIDGE FLOW RATE (gpm)	15
MEDIA TYPE (PERLITE, ZPG, PSORB)	ZPG
RIM ELEVATION	13.80

PIPE DATA:	I.E.	DIAMETER
INLET STUB	N/A	N/A
OUTLET STUB	10.59	12"

CONFIGURATION



SLOPED LID	NO
SOLID COVER	NO
NOTES/SPECIAL REQUIREMENTS:	

3-CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID	"EB" Sta. 13+92, Lt.
WATER QUALITY FLOW RATE (cfs)	0.08
PEAK FLOW RATE (<1 cfs)	0.14
RETURN PERIOD OF PEAK FLOW (yrs)	25
CARTRIDGE FLOW RATE (gpm)	15
MEDIA TYPE (PERLITE, ZPG, PSORB)	ZPG
RIM ELEVATION	12.84

PIPE DATA:	I.E.	DIAMETER
INLET STUB	10.38	12"
OUTLET STUB	10.38	12"

CONFIGURATION



SLOPED LID	NO
SOLID COVER	NO
NOTES/SPECIAL REQUIREMENTS:	

3-CARTRIDGE CATCHBASIN STORMFILTER DATA

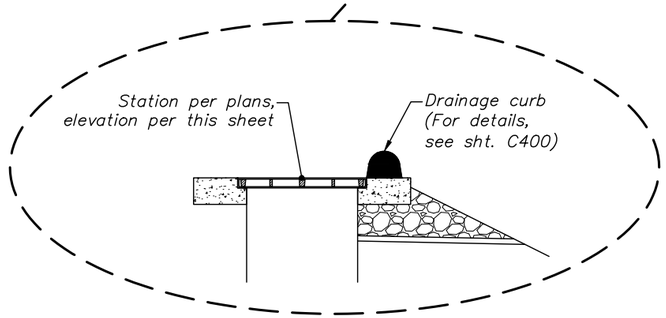
STRUCTURE ID	"EB" Sta. 19+65 , Rt.
WATER QUALITY FLOW RATE (cfs)	0.10
PEAK FLOW RATE (<1 cfs)	0.16
RETURN PERIOD OF PEAK FLOW (yrs)	25
CARTRIDGE FLOW RATE (gpm)	15
MEDIA TYPE (PERLITE, ZPG, PSORB)	ZPG
RIM ELEVATION	12.78

PIPE DATA:	I.E.	DIAMETER
INLET STUB	N/A	N/A
OUTLET STUB	10.46	12"

CONFIGURATION



SLOPED LID	NO
SOLID COVER	NO
NOTES/SPECIAL REQUIREMENTS:	



The Stormwater Management StormFilter

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3 CARTRIDGE CATCHBASIN STORMFILTER STANDARD DETAIL

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

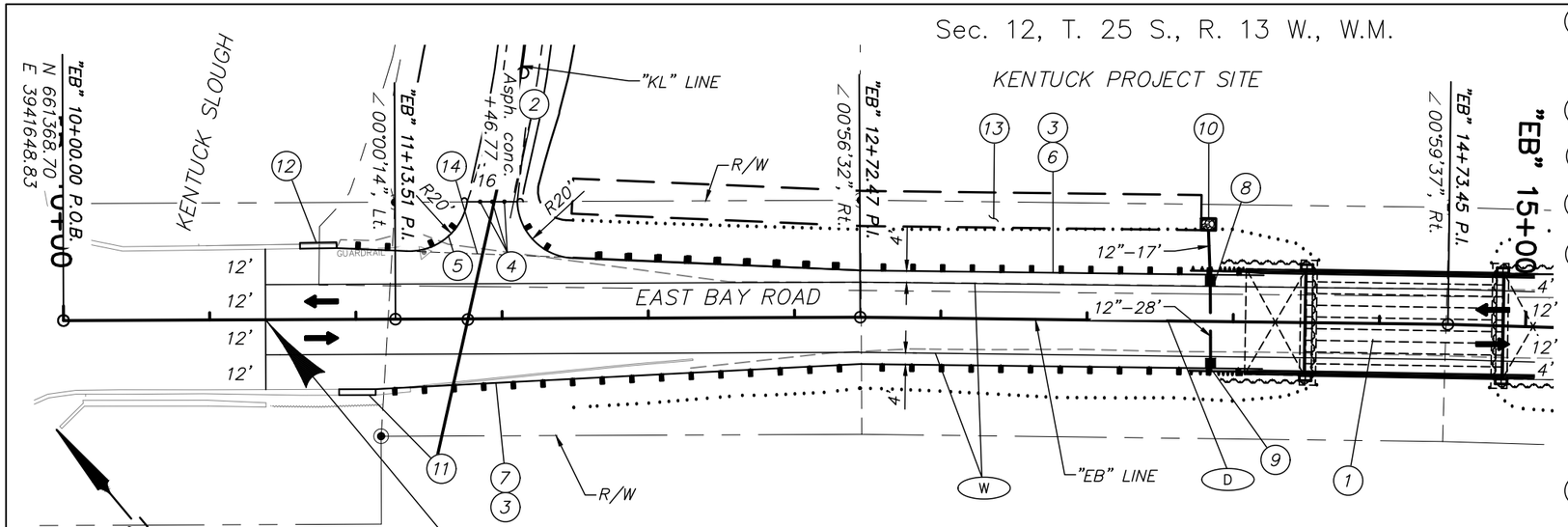
Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

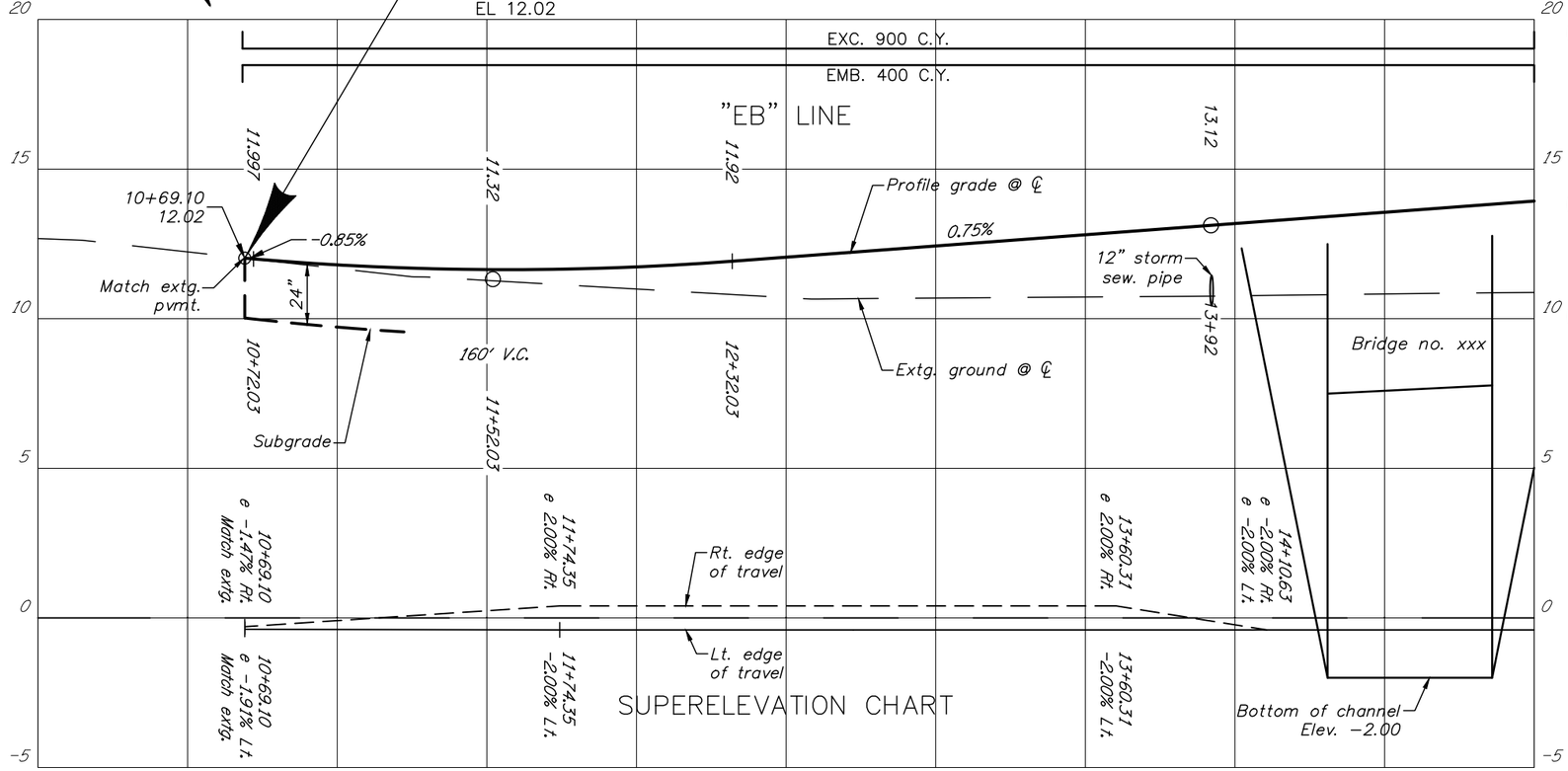
EAST BAY ROAD DETAILS

SHEET NO. C416

C:\pw_work\dea\kelley Roper\dms04977\C410_KPS_DT01_EAST BAY RD 12/7/2018 2:55 PM Kelly Roper

Sec. 12, T. 25 S., R. 13 W., W.M.





(1) *Structure no. xxx*
Const. structure – 55'
Rdwy. width – 32'
(For drg. nos., see sht. __)

(2) *Const. appr.*
(See drg. no. RD715)

(3) *Const. asp. conc. drainage curb*
(See drg. no. RD701)

(4) *Inst. removable bollard – 3*
(For details, see sht. C410)

(5) *Sta. "EB" 10+94 to Sta. "EB" 11+38, Lt.*
Const. guardrail – 37.50'
(Type 4) 31"
Const. guardrail transition
Const anchor – 2 (Type 1 modified)
Inst. end piece (Type B) – Thrie beam
Const. guardrail to conc. barrier transition
W=0, E=0
(For details, see sht. C411)
(See drg. nos. RD405, RD410, RD415, RD450, RD480, and RD530)

(6) *Sta. "EB" 11+55 to Sta. "EB" 14+10, Lt.*
Const. guardrail – 253.5' (Type 2A) 31"
Const. guardrail – 12.5' (Type 3) 31"
Const. guardrail transition
Const anchor – 2 (Type 1 modified)
Inst. end piece (Type B)
W=0, E=0
Const. Type "F" bridge rail to guardrail transition
(See drg. nos. RD440 & BR291)

(7) *Sta. "EB" 11+07 to Sta. "EB" 14+10, Rt.*
Const. guardrail – 278.5' (Type 2A)
Const. guardrail – 25' (Type 3)
Const. guardrail transition – 2
Const. guardrail to conc. barrier transition
W=0, E=0
Const. Type "F" bridge rail to guardrail transition

(8) *Sta. "EB" 13+92.02, Lt.*
Const. water quality inlet
Inst. 12" storm sew. pipe – 28', Sl.=0.44%
5' depth
(For details, see sht. C416)

(9) *Sta. "EB" 13+92.44, Rt.*
Const. type "G–2" inlet
Rim elev. 13.05
I.E. out 10.50
(See drg. nos. RD364 & RD365)

(10) *Sta. "EB" 13+91.18, 31.19' Rt.*
Const. outfall, I.E. 10.30 out
Inst. 12" sew. pipe – 17', Sl.=0.44%
5' depth
Const. loose riprap (class 50)– 2.6 C.Y.
(For details, see sht. C413)

(11) *Sta. "EB" 10+94 to Sta. "EB" 11+07, Rt.*
Remove extg. conc. shldr. barrier
Const. conc. shldr. barrier – 12.5'
Anchor barrier
E=0
(See drg. nos. RD500, RD516, RD530)

(12) *Sta. "EB" 10+81 to Sta. "EB" 10+93, Lt.*
Remove extg. conc. shldr. barrier
Const. conc. shldr. barrier – 12.5'
Anchor barrier
E=0

(13) *Sta. "EB" 11+73.88, 32.64' Lt. to Sta. "EB" 13+88.68, 28.00' Lt.*
Const. water quality filter strip
(For details, see sht. C413)

(14) *Const. valley gutter*

STRIPING LEGEND

(D) *Inst. double no–pass*

(S) *Inst. 12" white stop bar*

(W) *Inst. 4" white line*

LEGEND
Cut slope line — — —
Fill slope line ·····

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
2	03/01/19	BB		TS	Rev B Issued for Review
1	12/07/18	BB		TS	Rev A - Issued for Review

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG
A Pembina Company

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

EAST BAY ROAD PLAN AND PROFILE

SHEET NO. C440

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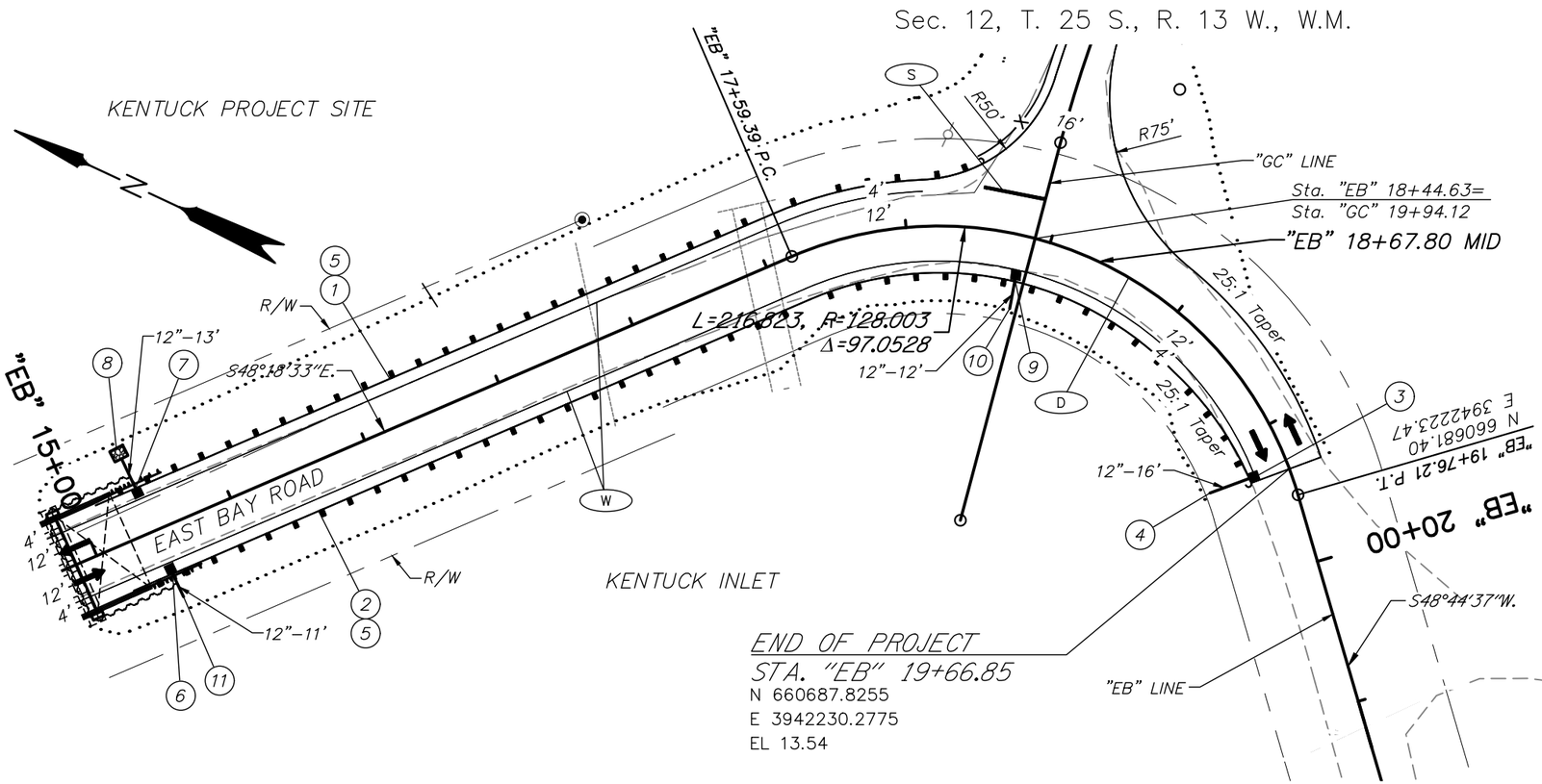

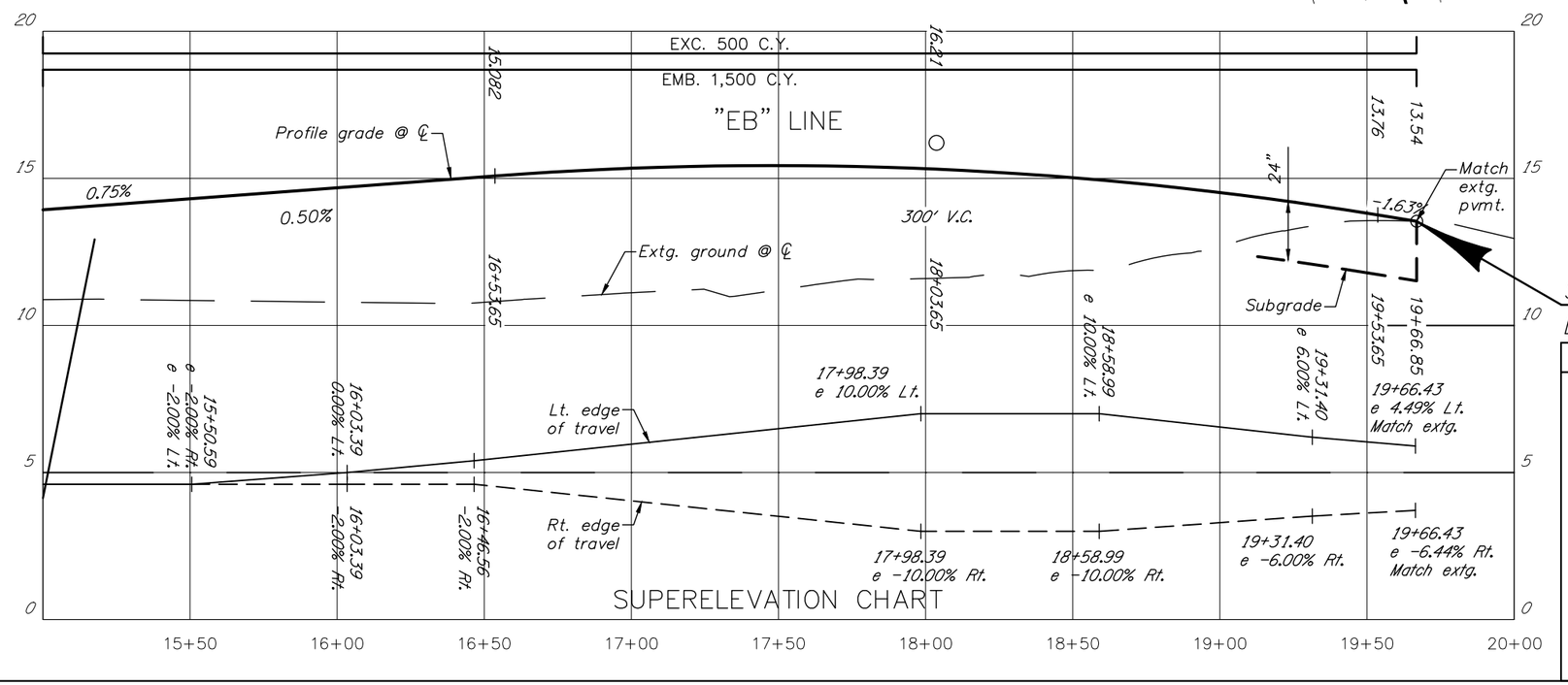

(1) Sta. "EB" 15+07 to Sta. "EB" 18+24, Lt.
Const. guardrail – 275' (Type 2A) 31"
Const. guardrail – 12.5' (Type 3) 31"
Const guardrail terminal, non–flared
Test level – 3
W=1', E=0
Const. Type "F" bridge rail to guardrail transition

(2) Sta. "EB" 15+07 to Sta. "EB" 19+66, Rt.
Const. guardrail – 287.5' (Type 2A) 31"
Const. guardrail – 12.5' (Type 3) 31"
Const. guardrail terminal, non–flared
Test level – 3
W=1', E=0
Const. Type "F" bridge rail to guardrail tr

(3) Sta. "EB" 19+64.97, Rt.
Const. water quality inlet
(For details, see sheet C416)

(4) Sta. "EB" 19+64.61, 28.30' Rt.
Inst. 12" storm sew. pipe – 16', Sl.=0.44%
5' depth
I.E. out 10.39

(5) Const. asph. conc. drainage curb

(6) Sta. "EB" 15+21.39, Rt.
Const. water quality inlet
(For details, see sht. C416)

(7) Sta. "EB" 15+21.42, Lt.
Const. water quality inlet
(For details, see sht. C416)

(8) Sta. "EB" 15+20.95, 27.24' Lt.
Inst. 12" storm sew. pipe – 13', Sl.=1.01%
5' depth
I.E. out 10.46
Const. loose riprap (class 50) – 2.6 cu.yd.
(For details, see sht. C413)

(9) Sta. "EB" 18+41.09, Rt.
Const. water quality inlet
(For details, see sht. C414)

(10) Sta. "EB" 18+41.79', 25.45' Rt.
Inst. 12" storm sew. pipe – 9', Sl.=0.56%, 5' depth
I.E. out 10.57
Const. loose riprap (class 50) 2.6 cu.yd.
(For details, see sht. C413)

(11) Sta. "EB" 15+21.75, 24.68' Rt.
Inst. 12" storm sew. pipe – 11', Sl.=1.07%, 5' depth
I.E. out 10.50

STRIPING LEGEND

(D) Inst. double no–pass

(S) Inst. 12" white stop bar

(W) Inst. 4" white line

LEGEND

Cut slope line — — —

Fill slope line ·····

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE
COOS COUNTY

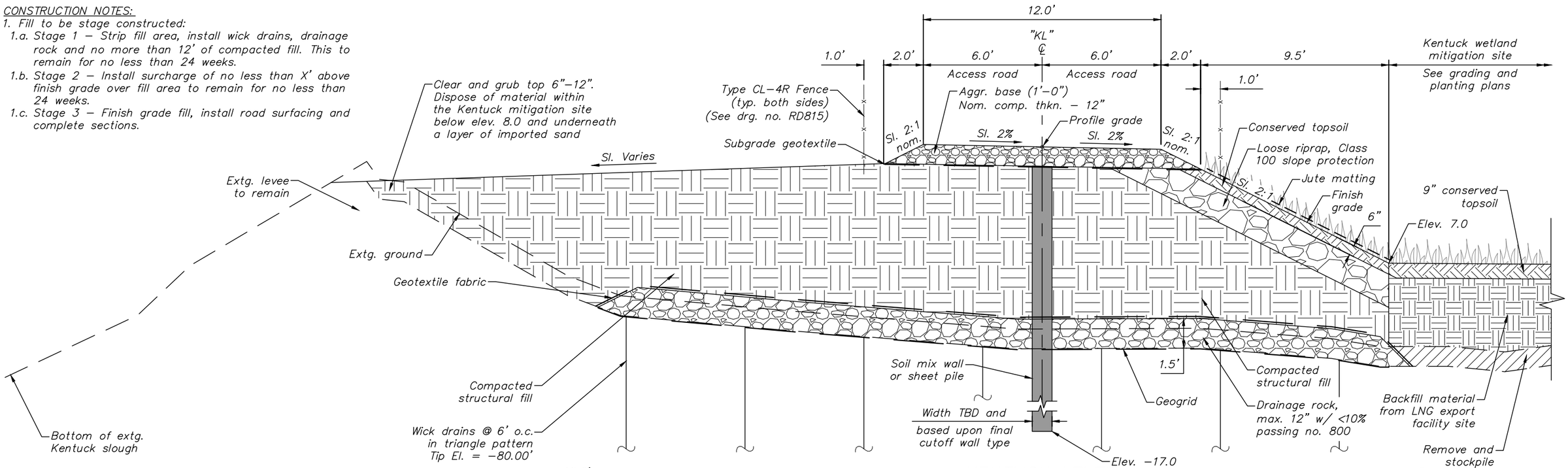
Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

EAST BAY ROAD PLAN AND PROFILE

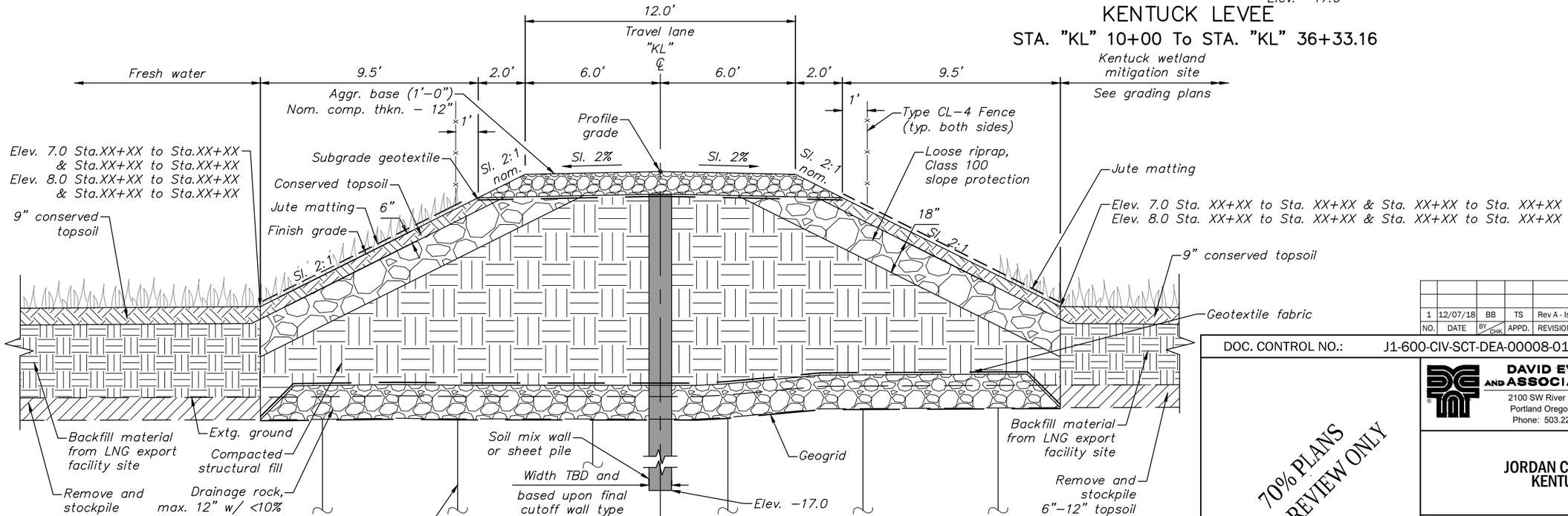
SHEET NO. C441

C:\pw_work\dea\kelley Roper\dms04977\C440_KPS_PP01_EAST BAY RD 12/9/2018 7:32 PM Kelly Roper

CONSTRUCTION NOTES:
1. Fill to be stage constructed:
   1.a. Stage 1 – Strip fill area, install wick drains, drainage rock and no more than 12' of compacted fill. This to remain for no less than 24 weeks.
   1.b. Stage 2 – Install surcharge of no less than X' above finish grade over fill area to remain for no less than 24 weeks.
   1.c. Stage 3 – Finish grade fill, install road surfacing and complete sections.



KENTUCK LEVEE
STA. "KL" 10+00 To STA. "KL" 36+33.16



CROSS LEVEE
STA. "KL" 36+33.16 To STA. "KL" 39+00.27
"LC" 10+00.00 To STA. "LC" 11+17.12

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

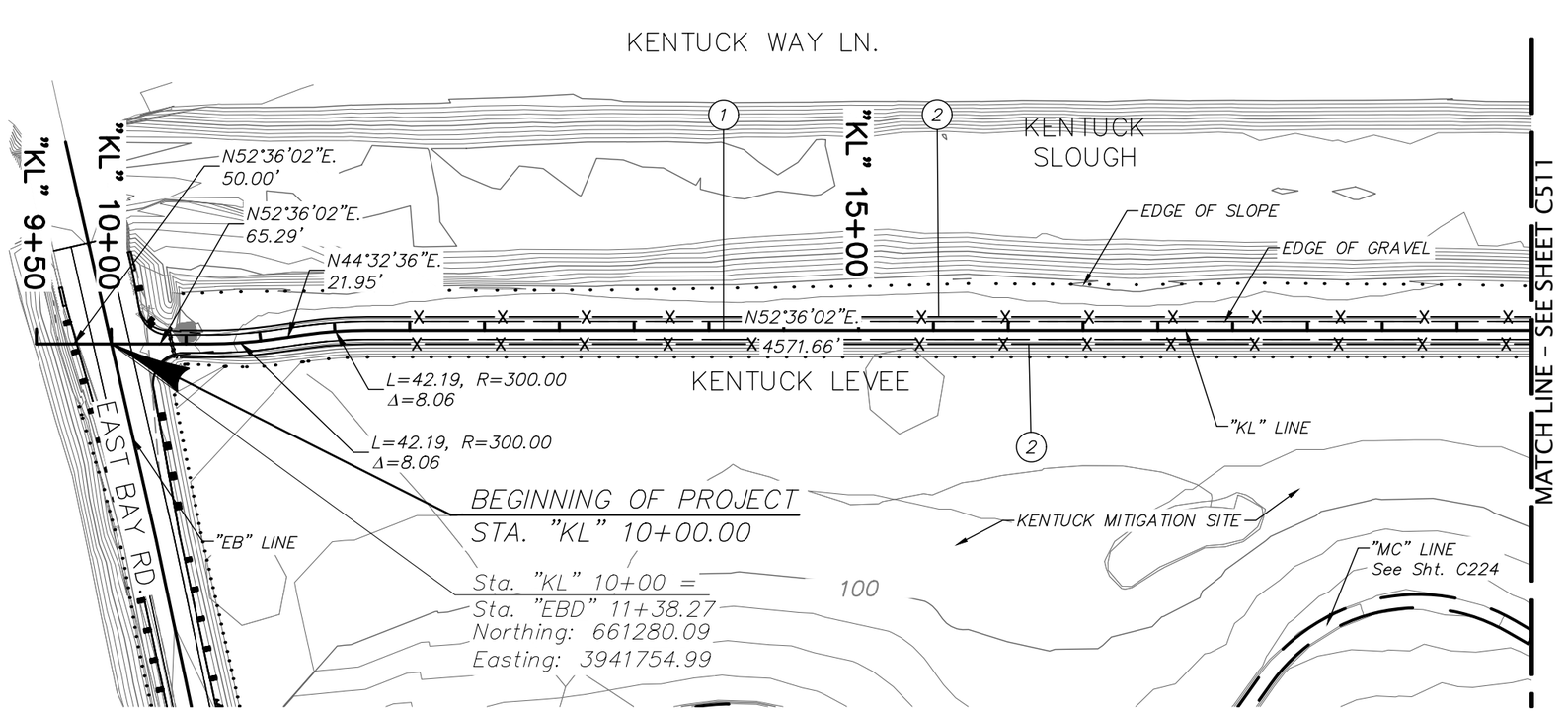
COOS COUNTY

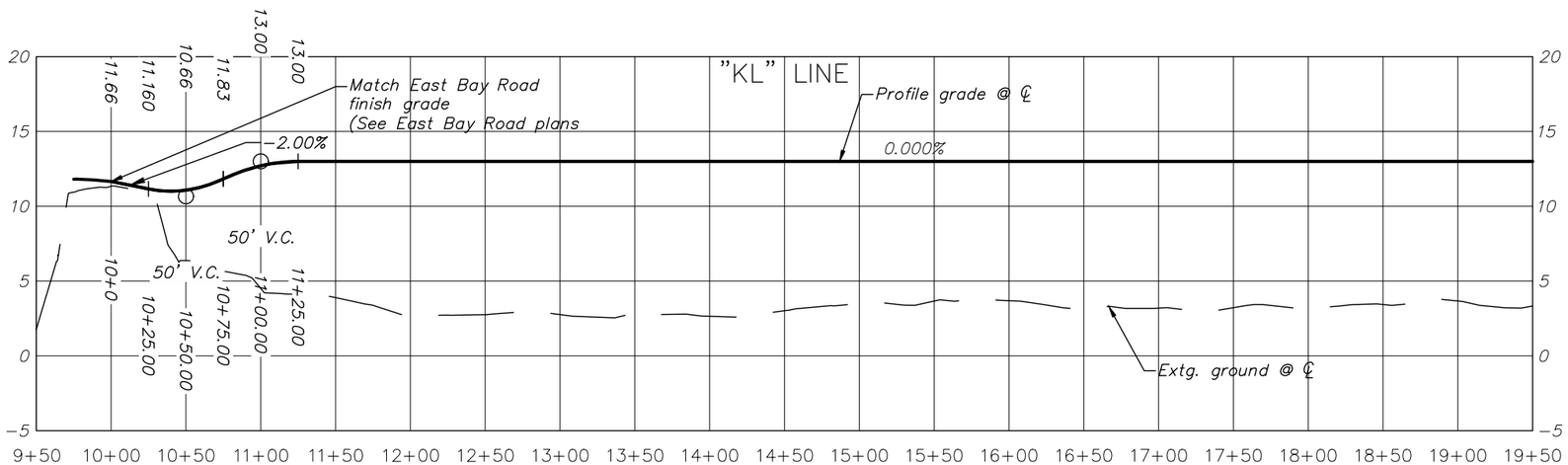
Designer: S. Moriarty | Review: B. Berry
Drafter: K. Roper | Checker: -

LEVEE TYPICAL SECTION

SHEET NO. C500

Secs. 12 & 1, T. 25 S., R. 13 W., W.M.





LEGEND
Cut slope line
Fill slope line

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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COOS COUNTY

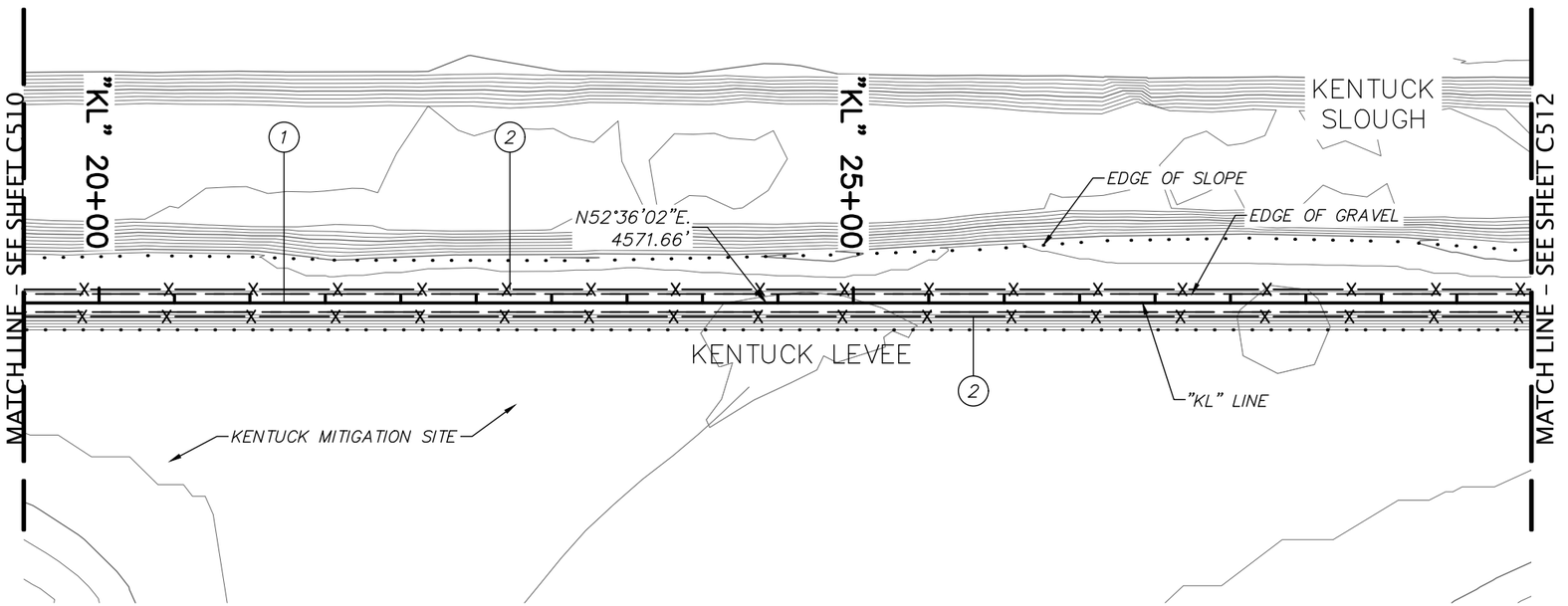
Designer: S. Moriarty | Review: B. Berry
Drafter: K. Roper | Checker: -

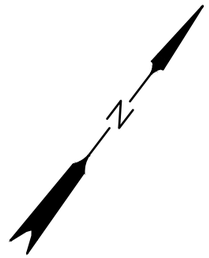
LEVEE PLAN AND PROFILE

SHEET NO. C510

C:\pw_work\dea\kelley Roper\dms04977\C510_KPS_PP01_KENTUCK LEVEE 12/9/2018 6:52 PM Kelly Roper

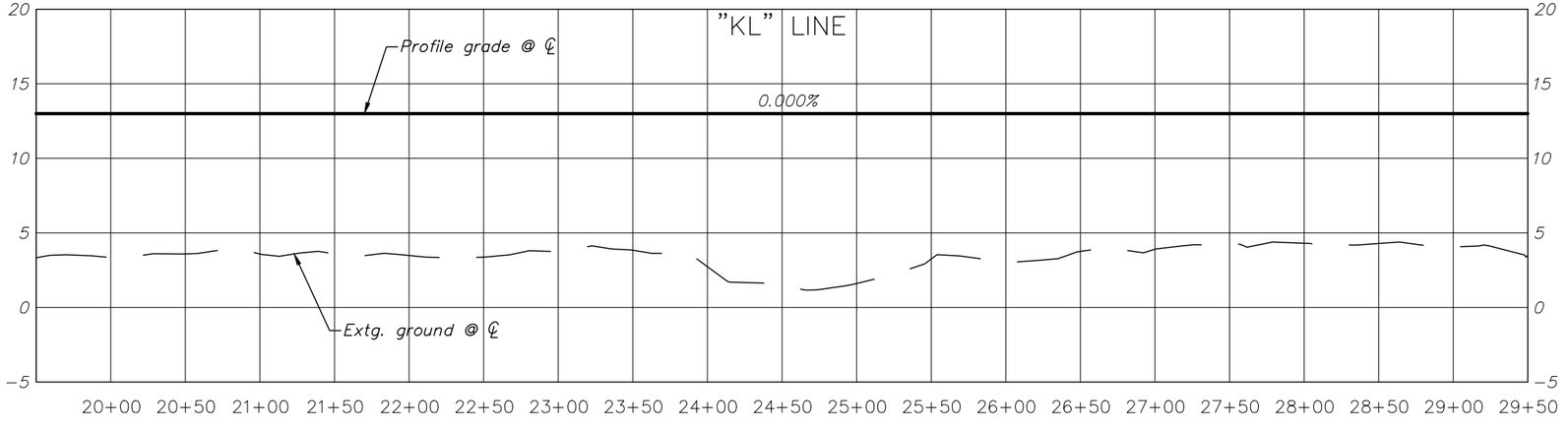
Sec. 1, T. 25 S., R. 13 W., W.M.





1 Const. levee and 12' access road (For details, see sheet C500)

2 Const. type CL–4 fence



LEGEND

Cut slope line ——— ——— ———

Fill slope line · · · · · · · · ·

NO.	DATE	BY / CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB	TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00067-01 Rev A - ISSUED FOR REVIEW

70% PLANS FOR REVIEW ONLY

DAVID EVANS AND ASSOCIATES INC.
2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

Designer: S. Moriarty Review: B. Berry

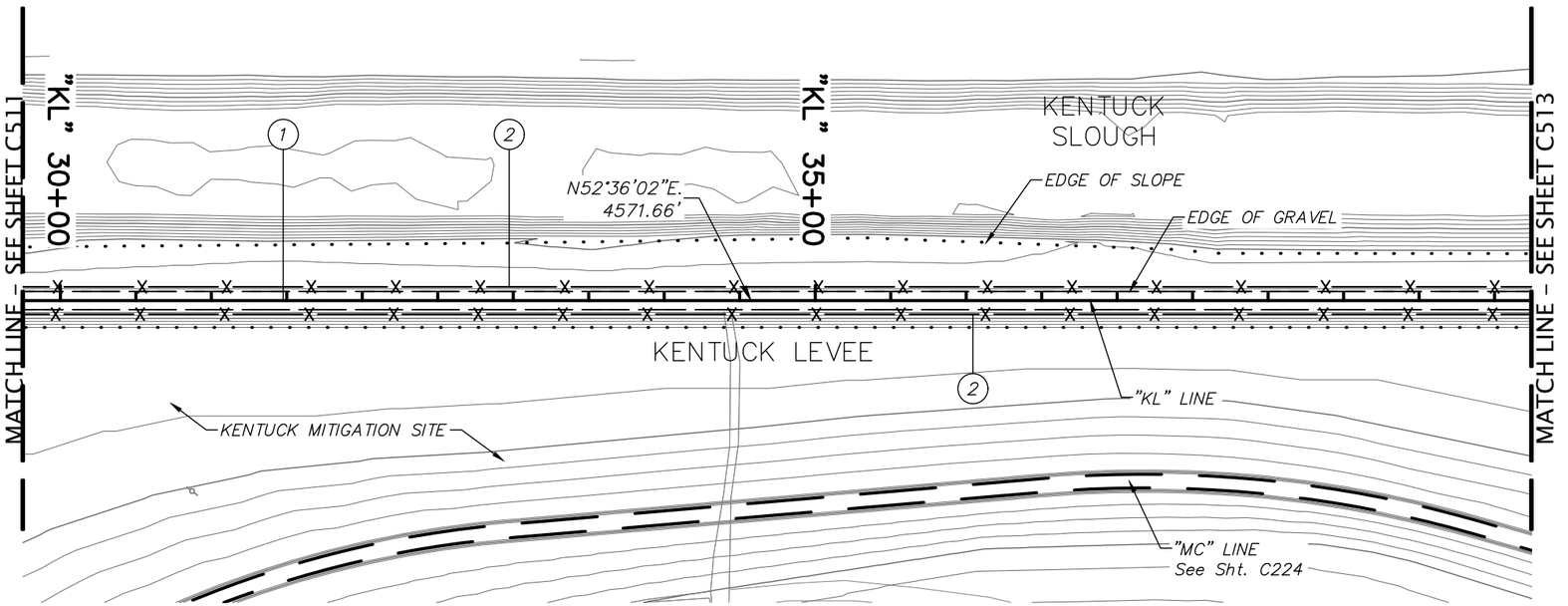
Drafter: K. Roper Checker: -

LEVEE PLAN AND PROFILE

SHEET NO. C511

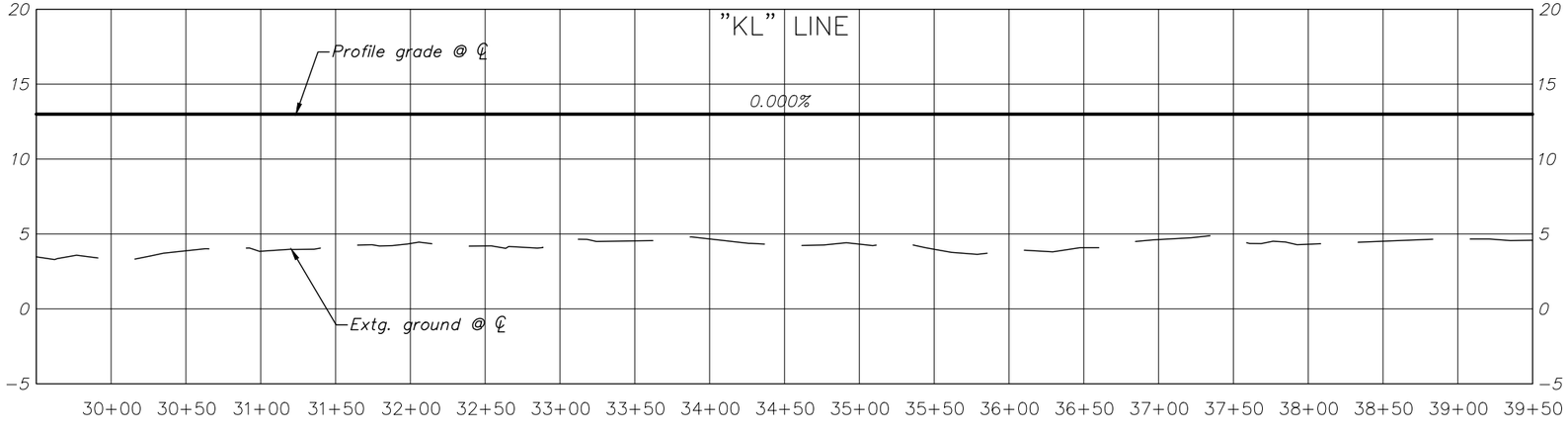
C:\pw_work\dea\kelley Roper\dms04977\C510_KPS_PP01_KENTUCK LEVEE 12/9/2018 6:52 PM Kelly Roper

Sec. 1, T. 25 S., R. 13 W., W.M.



1 Const. levee and 12' access road (For details, see sheet C500)

2 Const. type CL–4 fence



LEGEND

Cut slope line ——— ——— ———

Fill slope line · · · · · · · · ·

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

Designer: S. Moriarty Review: B. Berry

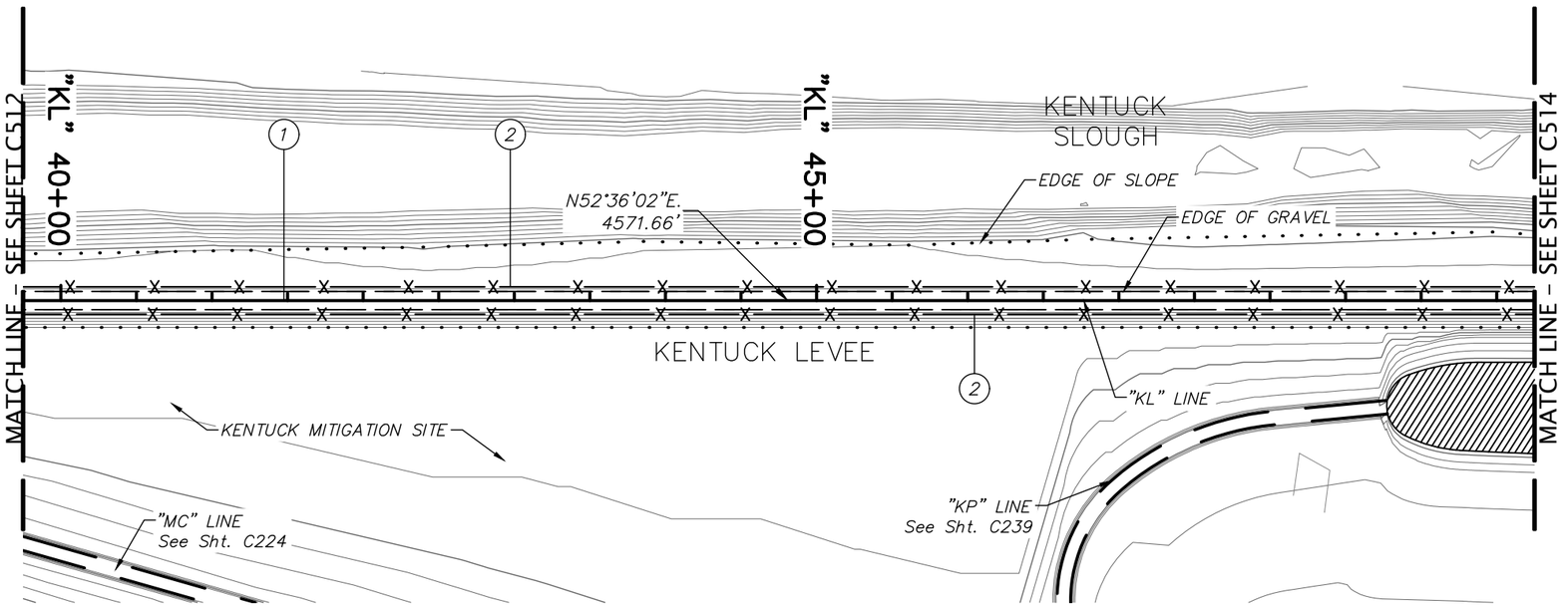
Drafter: K. Roper Checker: -

LEVEE PLAN AND PROFILE

SHEET NO. C512

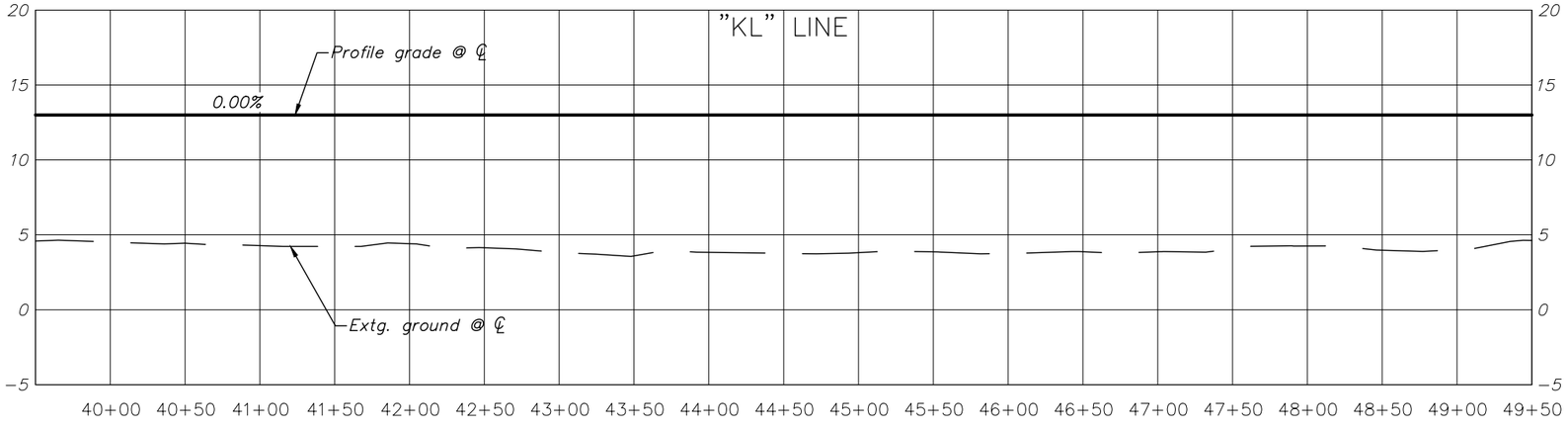
C:\pw_work\dea\kelley Roper\dms04977\C510_KPS_PP01_KENTUCK LEVEE 12/9/2018 6:52 PM Kelly Roper

Sec. 1, T. 25 S., R. 13 W., W.M.



1 Const. levee and 12' access road (For details, see sheet C500)

2 Const. type CL–4 fence



LEGEND

Cut slope line

Fill slope line

NO.	DATE	BY/CHK	APPD.	REVISION AND RECORD OF ISSUE
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Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

Designer: S. Moriarty Review: B. Berry

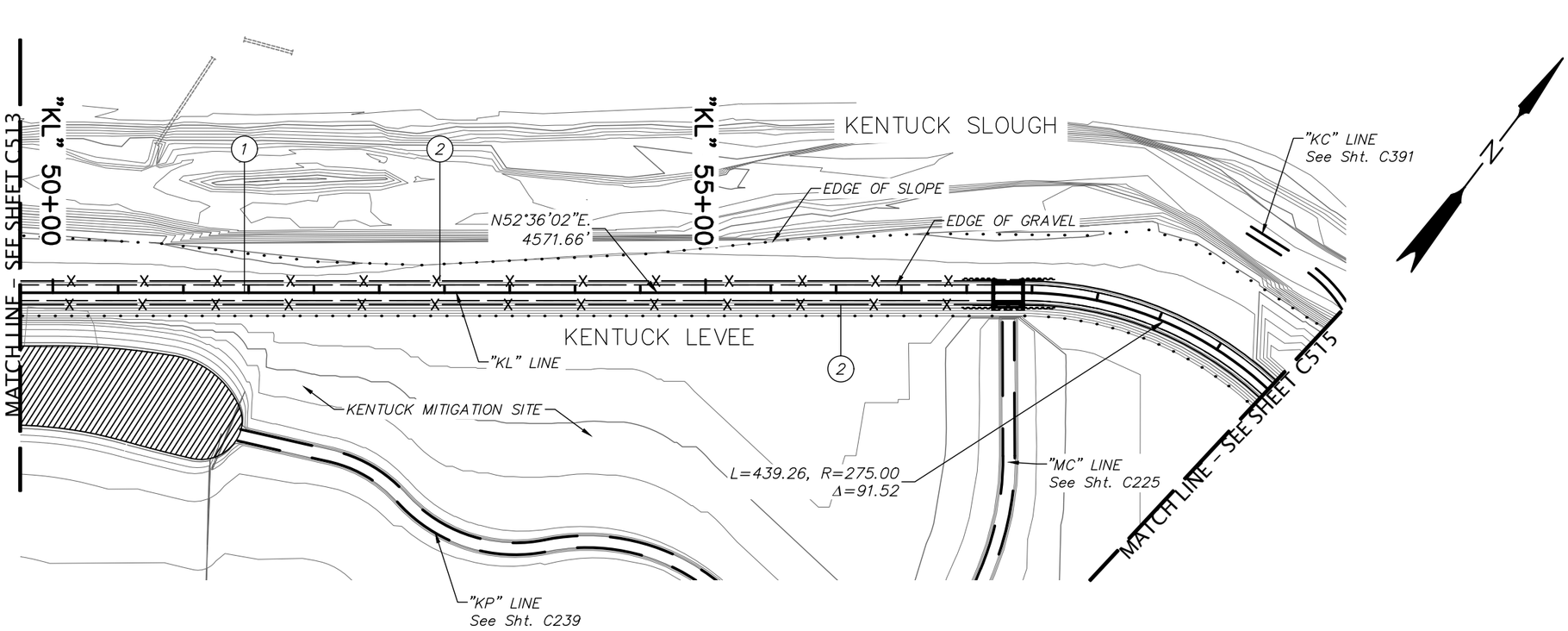
Drafter: K. Roper Checker: -

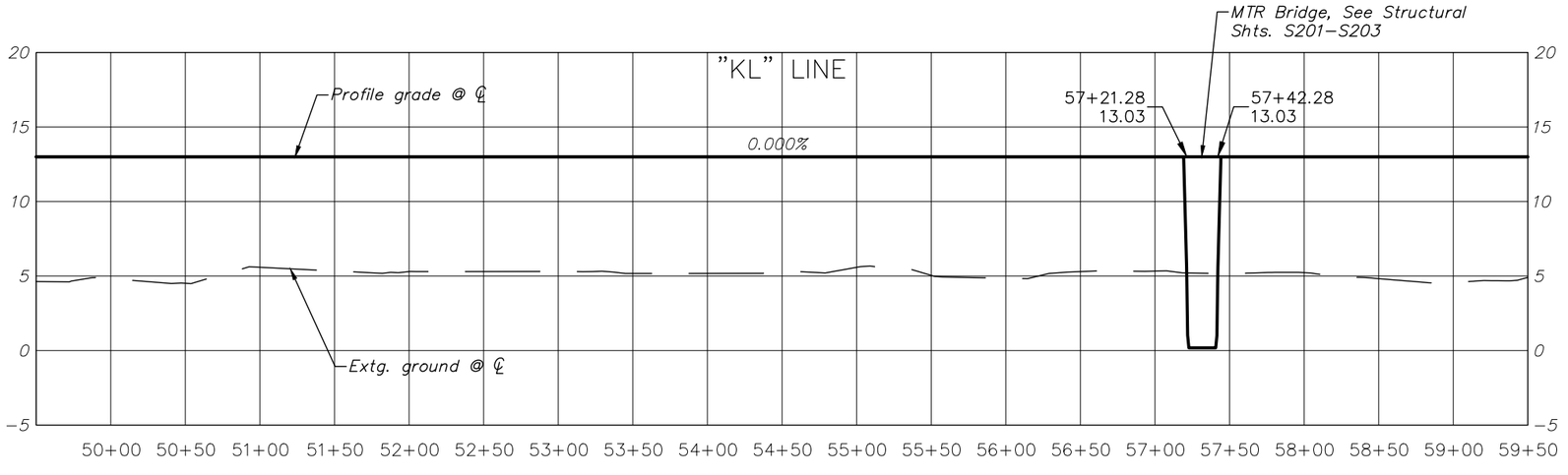
LEVEE PLAN AND PROFILE

SHEET NO. C513

C:\pw_work\dea\kelley Roper\dms04977\C510_KPS_PP01_KENTUCK LEVEE 12/9/2018 6:52 PM Kelly Roper

Sec. 1, T. 25 S., R. 13 W., W.M.





LEGEND
Cut slope line
Fill slope line

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

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Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

Designer: S. Moriarty Review: B. Berry
Drafter: K. Roper Checker: -

LEVEE PLAN AND PROFILE

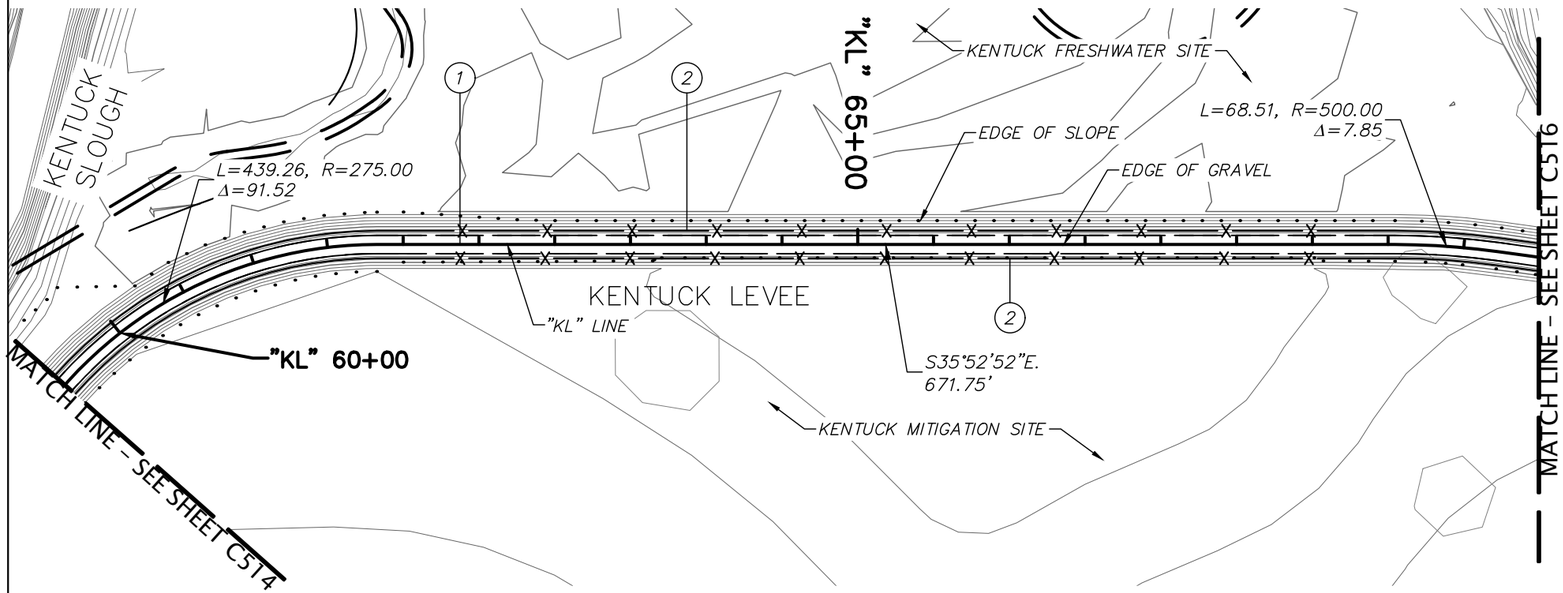
SHEET NO. C514

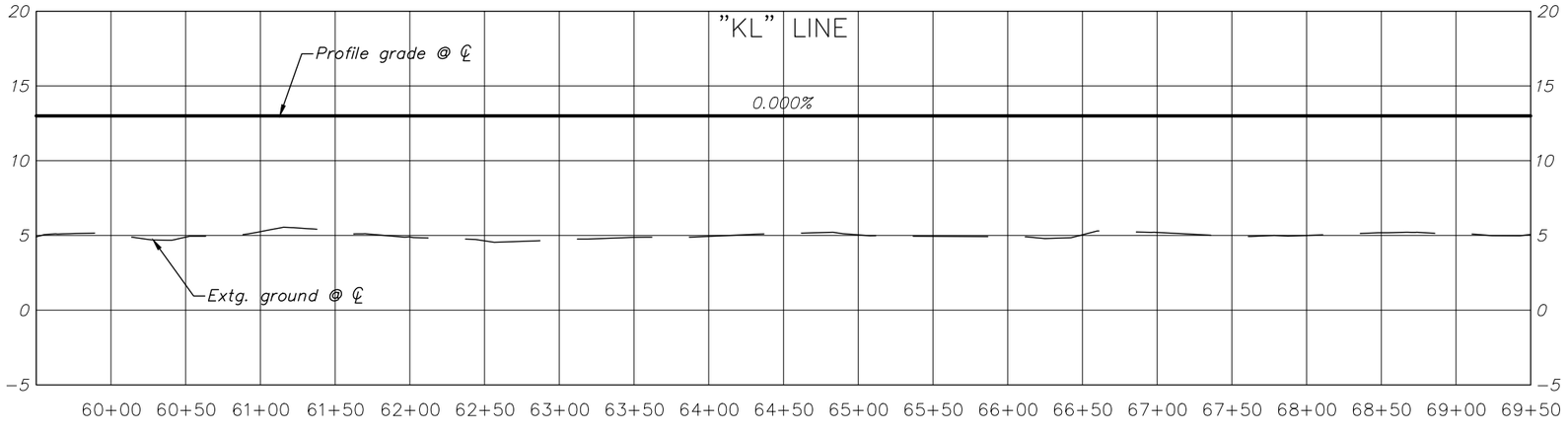
KENTUCK WAY LN.

Sec. 1, T. 25 S., R. 13 W., W.M.

1 Const. levee and 12' access road (For details, see sheet C500)

2 Const. type CL-4 fence





LEGEND

Cut slope line — — —

Fill slope line · · · · · · · · ·

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

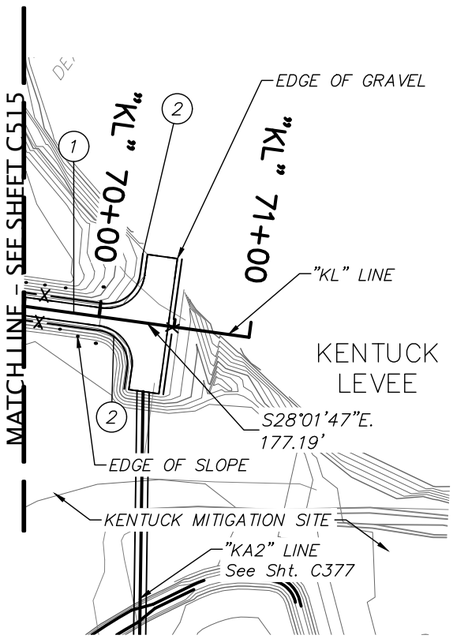
Designer: S. Moriarty Review: B. Berry

Drafter: K. Roper Checker: -

LEVEE PLAN AND PROFILE

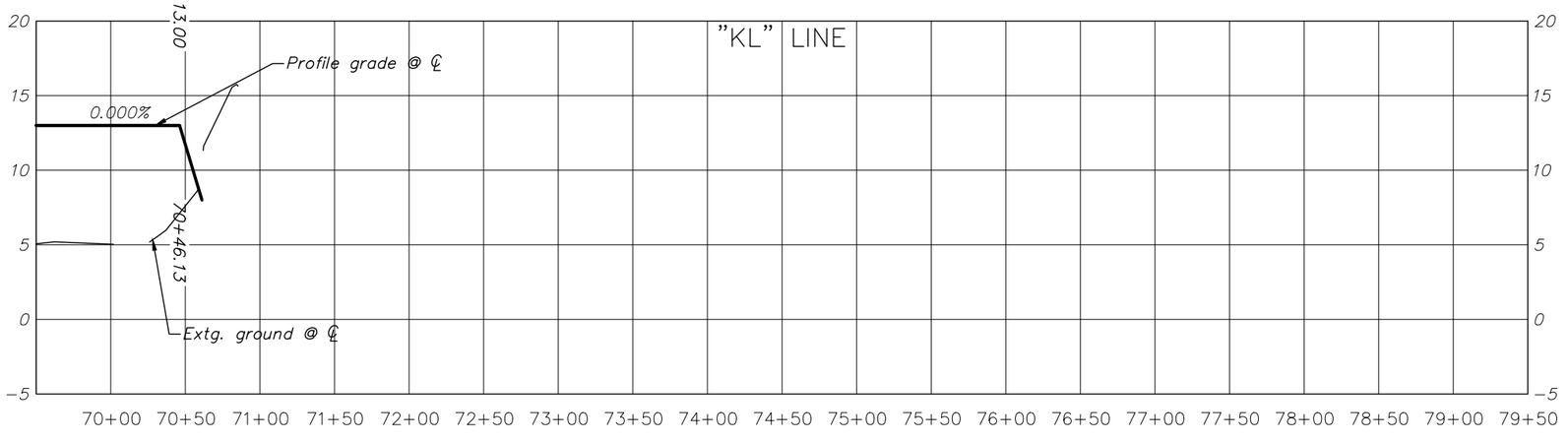
SHEET NO. C515

Sec. 1, T. 25 S., R. 13 W., W.M.



1 Const. levee and 12' access road (For details, see sheet C500)

2 Const. type CL-4 fence



LEGEND

Cut slope line — — —

Fill slope line . . . . . .

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	BB		TS	Rev A - Issued for Review

DOC. CONTROL NO.: J1-600-CIV-PLN-DEA-00072-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE

COOS COUNTY

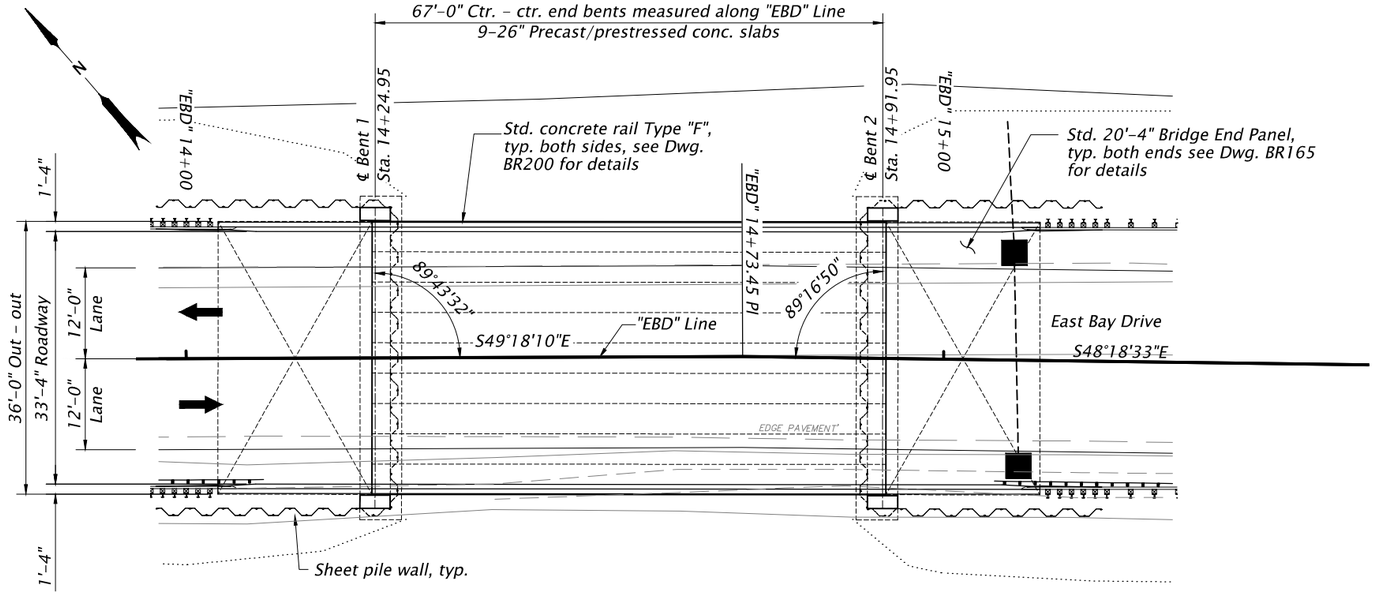
Designer: S. Moriarty Review: B. Berry

Drafter: K. Roper Checker: -

LEVEE PLAN AND PROFILE

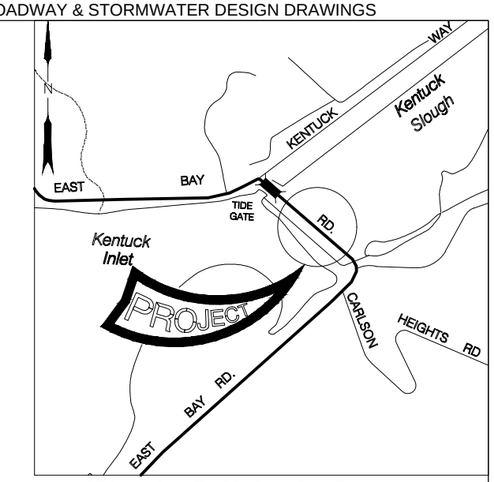
SHEET NO. C516

C:\pw_work\dea\kelley Roper\dms04977\C510_KPS_PP01_KENTUCK LEVEE 12/9/2018 6:52 PM Kelly Roper



PLAN

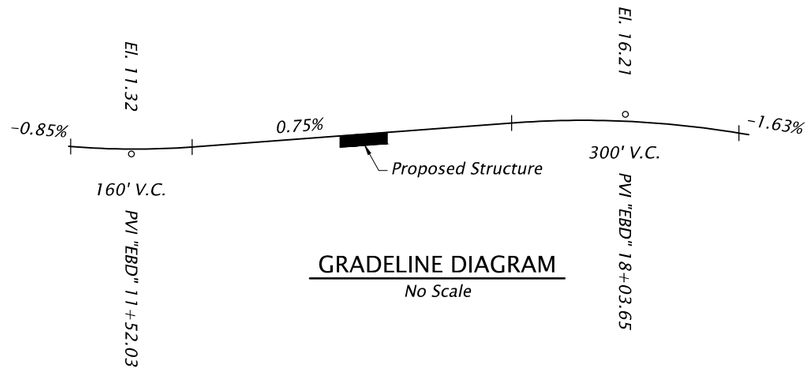
Scale: 1" = 10'-0"



SEC. 12, T. 25 S., R. 13 W., W.M.

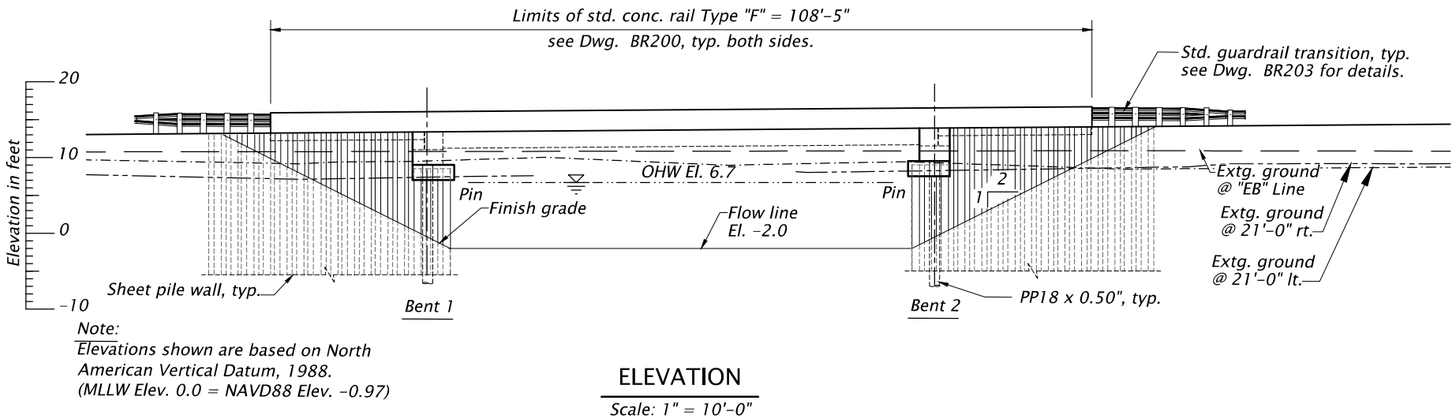
LOCATION MAP

No Scale



GRADELINE DIAGRAM

No Scale



Note:
Elevations shown are based on North American Vertical Datum, 1988.
(MLLW Elev. 0.0 = NAVD88 Elev. -0.97)

ELEVATION

Scale: 1" = 10'-0"

NO.	DATE	BY	CHK	APPD.	REVISION AND RECORD OF ISSUE
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Portland Oregon 97201
Phone: 503.223.6663

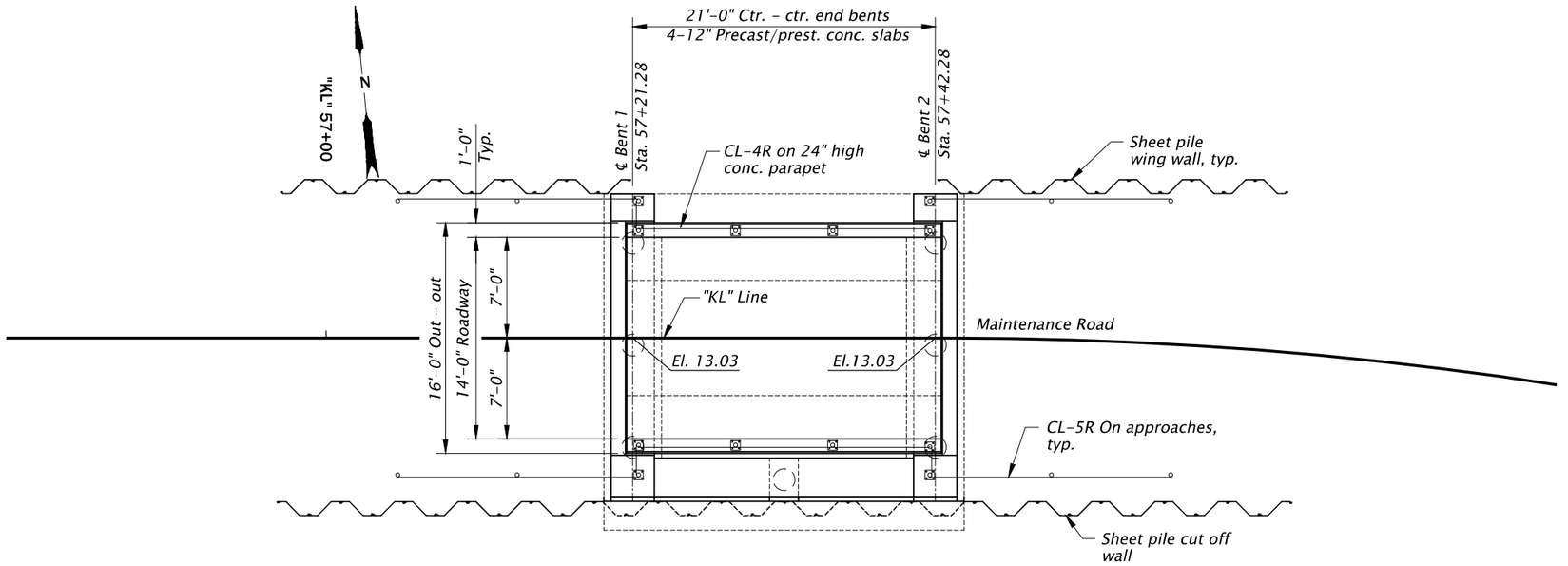
Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE
EAST BAY ROAD BRIDGE
COOS COUNTY

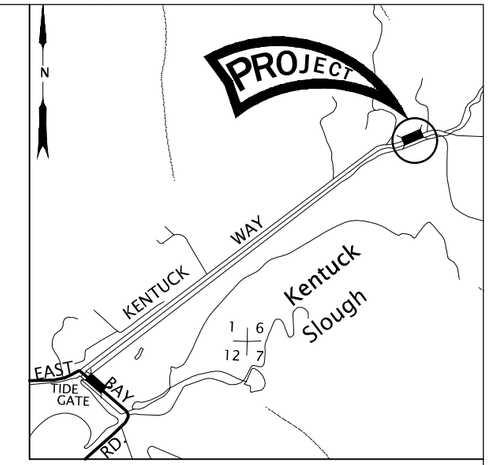
Designer: Anthony Calcagno
Drafter: Jim Culpepper
Review:
Checker: Terry Stones

PLAN AND ELEVATION

SHEET NO. S101

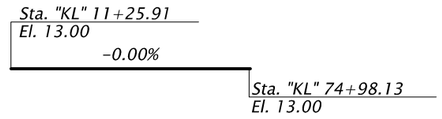


PLAN
Scale: 1" = 10'-0"



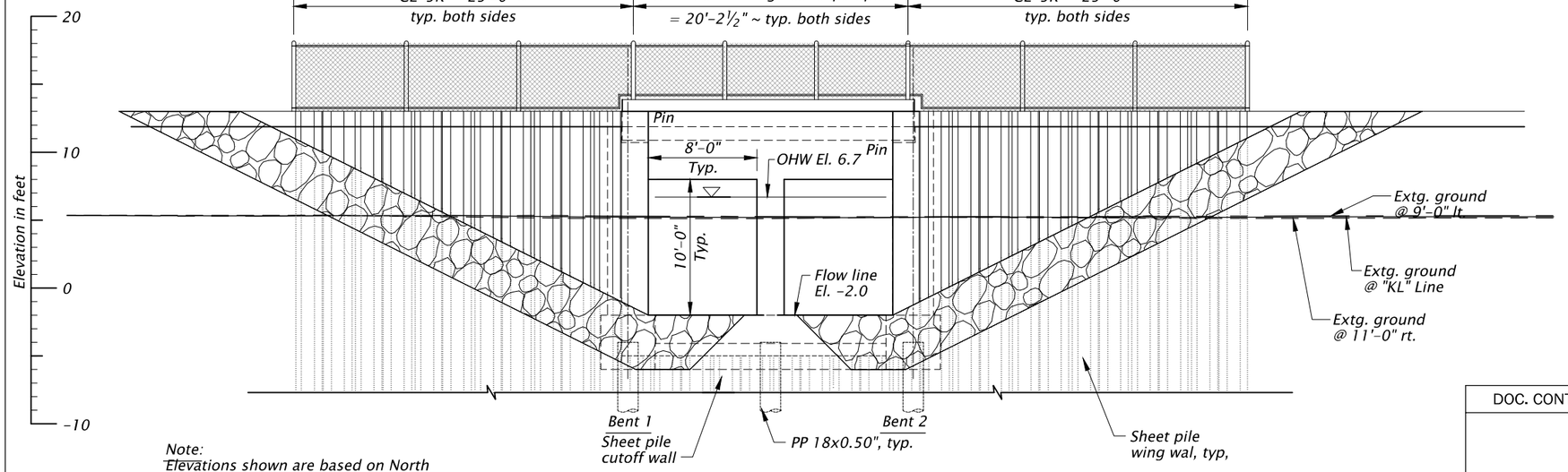
SEC. 1, T. 25 S., R. 13 W., W.M.

LOCATION MAP
No Scale



Note:
Gradeline is top of aggregate wearing surface at centerline maintenance road.

GRADELINE DIAGRAM
No Scale



Note:
Elevations shown are based on North American Vertical Datum, 1988. To convert to MLLW Datum add 0.97 ft.

ELEVATION
Scale: 1" = 10'-0"

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	JC		TS	REV A: ISSUED FOR REVIEW

DOC. CONTROL NO.: J1-600-STR-PLN-DEA-00006-01 REV A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

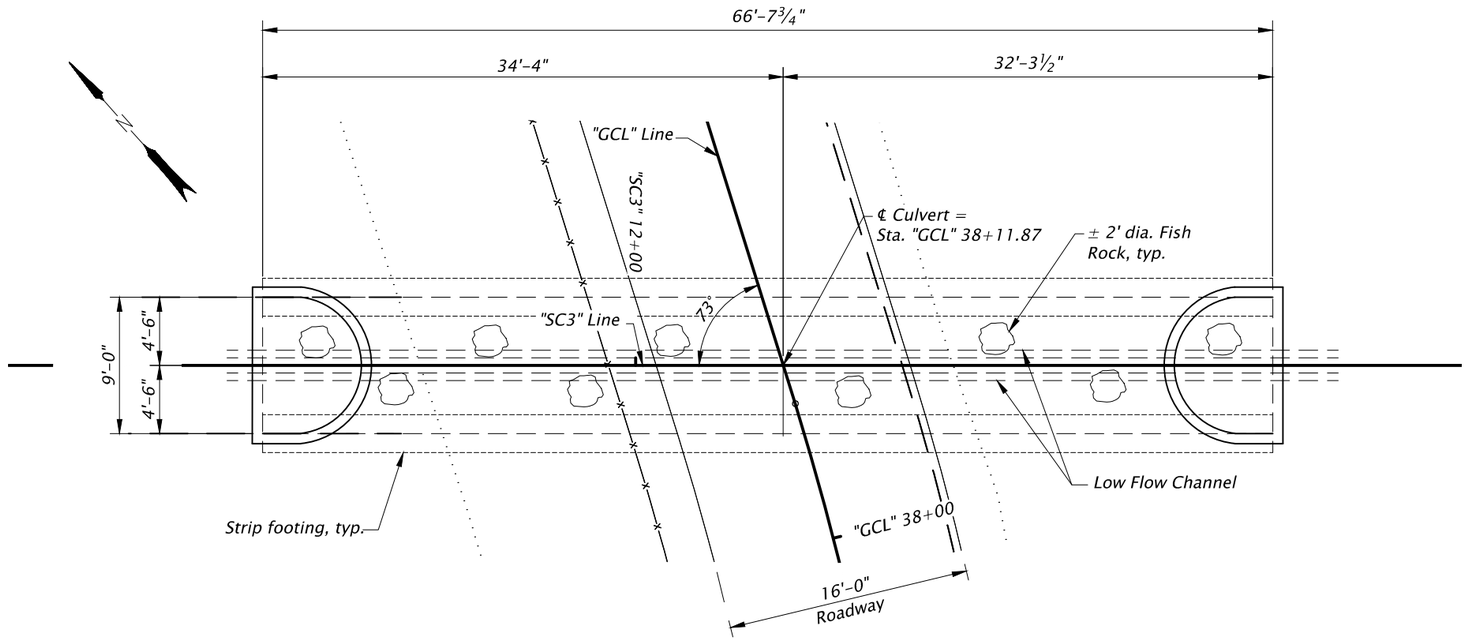
JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE
KENTUCK MTR BRIDGE
COOS COUNTY

Designer: Anthony Calcagno | Review:
Drafter: Jim Culpepper | Checker: -

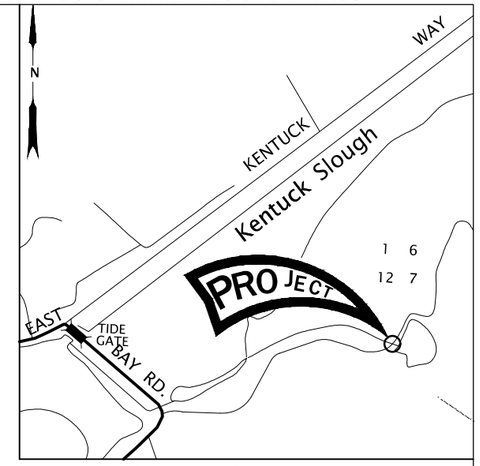
PLAN AND ELEVATION

SHEET NO. S201

C:\pw_work\dea\dusty Altenburg\dms04977\EB201_KPS_PE01 12/7/2018 11:46 AM Dustin Altenburg

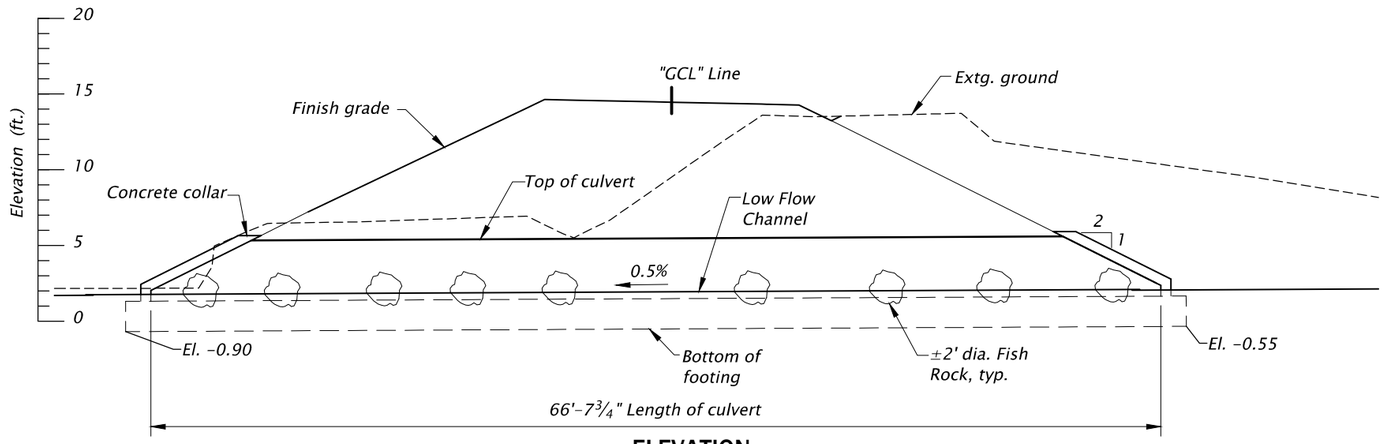


PLAN
Scale: 1" = 10'-0"



SEC. 1, T. 25 S., R. 13 W., W.M.

LOCATION MAP
No Scale



ELEVATION
Scale: 1" = 10'-0"

Note:
Elevations shown are based on North American Vertical Datum, 1988. (MLLW Elev. 0.0 = NAVD88 Elev. -0.97)

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	JC		TS	REV A: ISSUED FOR REVIEW

DOC. CONTROL NO.: J1-600-STR-PLN-DEA-00012-01 REV A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

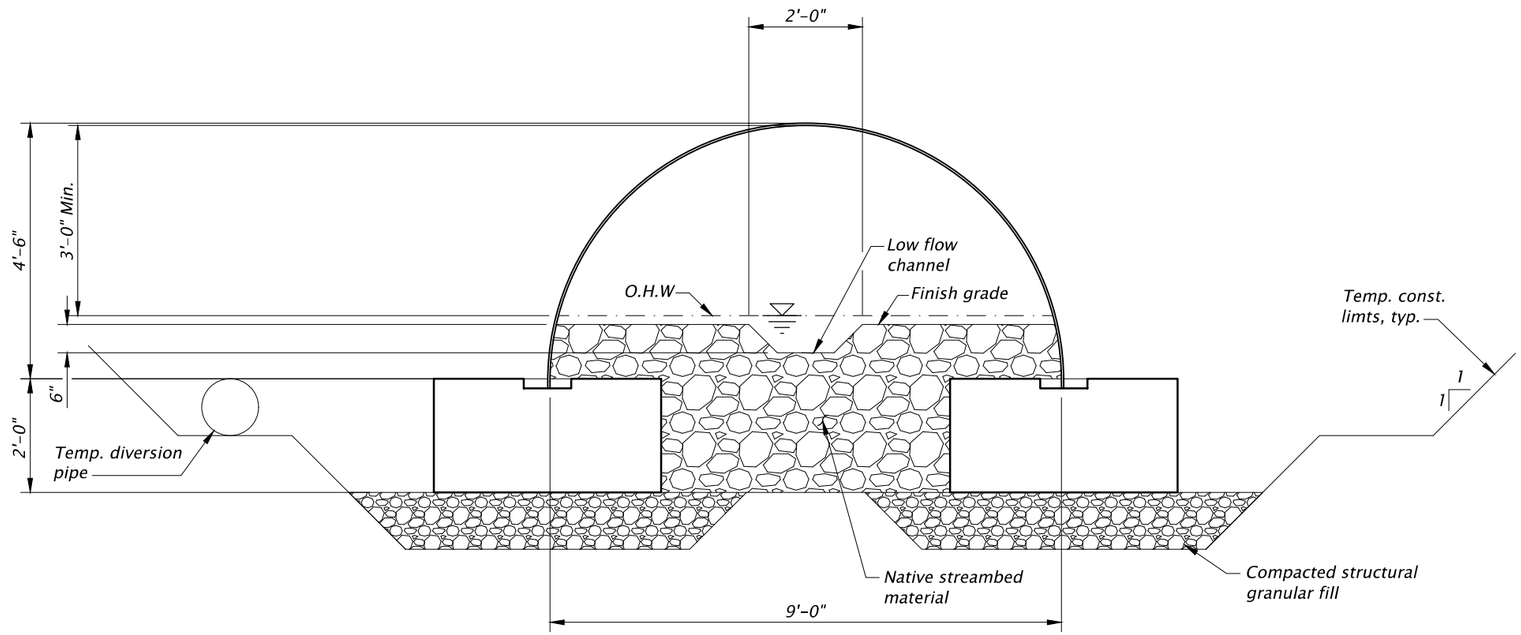
Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE
GOLF COURSE LANE CULVERT
COOS COUNTY

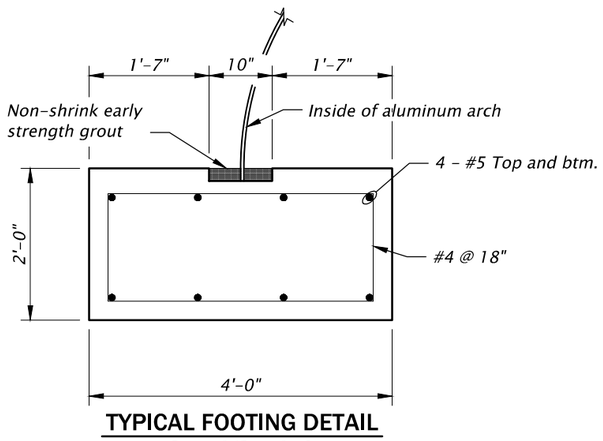
Designer: Anthony Calcagno Review: Terry Stones
Drafter: Jim Culpepper Checker: -

PLAN AND ELEVATION

SHEET NO.
S301



TYPICAL SECTION
Scale: 3/8" = 1'-0"



TYPICAL FOOTING DETAIL
Scale: 1/2" = 1'-0"

GENERAL NOTES

Provide all materials and perform all work according to the 2018 Oregon Standard Specifications for Construction.

Design culvert in accordance with the 2017 AASHTO LRFD Bridge Design Specifications (including interim revisions) and the 2018 ODOT Bridge Design Manual (BDM).

During construction contractor is responsible for the safety of the structure.

Provide all reinforcing steel according to ASTM Specification A706, or AASHTO 31 (ASTM A615) Grade 60. Provide field bent stirrups according to ASTM Specification A706. Use the following splice lengths (unless shown otherwise).

Reinforcing Splice Lengths (Class B) Grade 60 f'c = 3.3 ksi											
Bar Size	#3	#4	#5	#6	#7	#8	#9	#10	#11	#14	#18
Uncoated	1'-4"	1'-7"	2'-0"	2'-5"	2'-9"	3'-2"	3'-7"	4'-0"	4'-5"	Not Permitted	

Increase all splice lengths 30% for horizontal or nearly horizontal bars so placed that more than 12" of fresh concrete is cast below the bar.

Splice reinforcing steel at alternate bars, staggered at least one splice length or as far as possible,
unless shown otherwise.

All reinforcing shall have 2" of concrete cover unless shown otherwise.

All reinforcing spacing is intended to be maximum unless shown otherwise.

Provide a ¾" chamfer on all exposed concrete edges unless noted otherwise.

Provide all aluminum according to AASHTO M-219.

Provide Class 3000 - 1½", 1", or ¾" concrete for all other concrete.

All Grout shall be non-shrink high early strength grout (non-ferous) with a minimum strength of 5000 psi.

Low flow channel to have 1:1 side slopes.

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

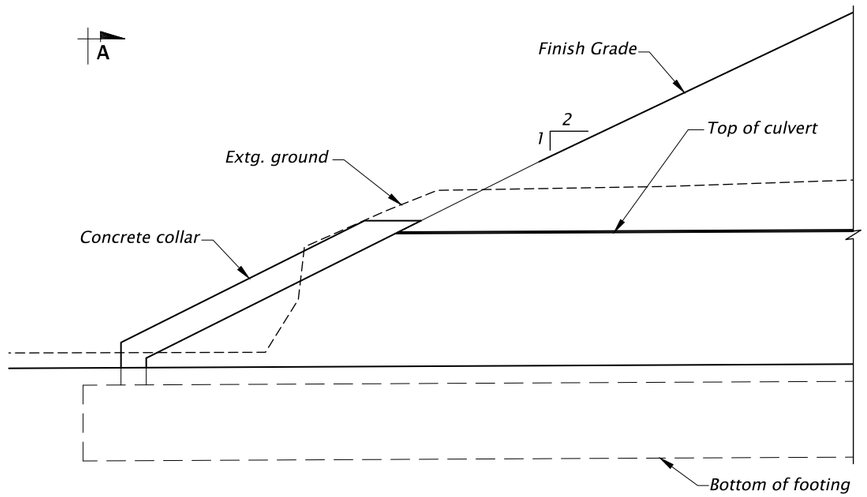
Jordan Cove LNG℠

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE
GOLF COURSE LANE CULVERT
COOS COUNTY

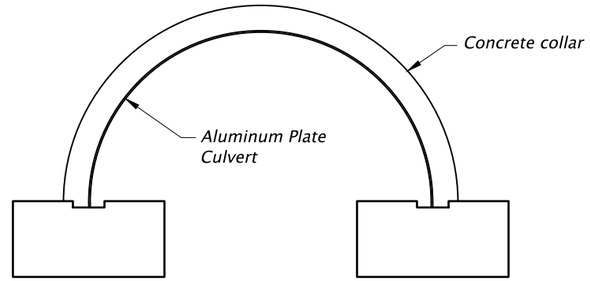
Designer: Anthony Calcagno | Review: Terry Stones
Drafter: | Checker: -

TYPICAL SECTION

SHEET NO. S302



CULVERT END DETAIL
Scale: 1/4" = 1'-0"



VIEW A-A
Scale: 1/4" = 1'-0"

A

NO.	DATE	BY	CHK.	APPD.	REVISION AND RECORD OF ISSUE
1	12/07/18	JC		TS	REV A: ISSUED FOR REVIEW

DOC. CONTROL NO.: J1-600-STR-DTL-DEA-00003-01 Rev A - ISSUED FOR REVIEW

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2100 SW River Parkway
Portland Oregon 97201
Phone: 503.223.6663

Jordan Cove LNG

JORDAN COVE ENERGY PROJECT
KENTUCK PROJECT SITE
GOLF COURSE LANE
COOS COUNTY

Designer: Anthony Calcagno
Drafter: Dusty Altenburg
Review: Terry Stones
Checker: -

HEADWALL DETAILS

SHEET NO.
S303

C:\pw_work\dea\dusty Altenburg\dms04977\EB303_KPS_HW01 12/7/2018 11:55 AM Dustin Altenburg