

Final Bridge Technical Memorandum – Vertical Profile

Florida Department of Transportation

District 1

SR 789 (Ringling) Bridge

Limits of Project: from Bird Key to Sarasota Harbor West

Sarasota County, Florida

Financial Management Number(s): 436680-1-22-01 & 436680-1-32-01

ETDM Number: 14384

Date: July 2021

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by FDOT pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated December 14, 2016 and executed by FHWA and FDOT.

Authorized Signature

James W. Englert, PE

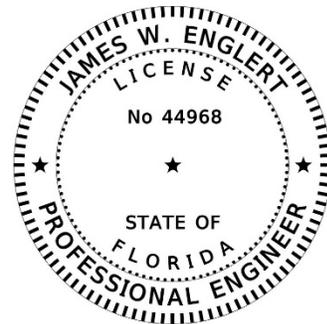
Print/Type Name

Professional Engineer No. 44668

Title

Hardesty & Hanover, LLC
5110 Eisenhower Boulevard, Suite 310
Tampa, FL 33634

Address



Final
Bridge Technical Memorandum – Vertical Profile

Florida Department of Transportation
District 1

SR 789 (Ringling) PD&E Study
from Bird Key Drive to Sarasota Harbor West
Sarasota County, Florida

Financial Project ID Numbers: FPID(S): 436680-1-22-01 & 436680-1-32-01

ETDM Number: 14384

Date: July 2021

PROFESSIONAL ENGINEER CERTIFICATION

BRIDGE TECHNICAL MEMORANDUM – VERTICAL PROFILE

Project: SR 789 (Ringling) Project Development & Environment Study from Bird Key Drive to Sarasota Harbor West

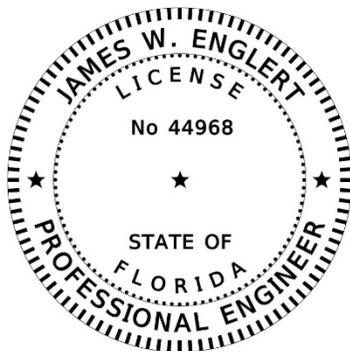
ETDM Number: 14384

Financial Project ID(s): 436680-1-22-01 & 436680-1-32-01

Federal Aid Project Number: TBD

This bridge technical memorandum contains detailed engineering information that fulfills the purpose and need for the SR 789 (Ringling) Project Development and Environment Study from Bird Key Drive to Sarasota Harbor West in Sarasota County, Florida. I acknowledge that the procedures and references used to develop the results contained in this report are standard to the professional practice of transportation engineering as applied through professional judgment and experience.

I hereby certify that I am a registered professional engineer in the State of Florida practicing with Hardesty & Hanover, LLC, and that I have prepared or approved the evaluation, findings, opinions, conclusions or technical advice for this project



THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY:

ON THE DATE ADJACENT TO THE SEAL

PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED AND THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES.

*HARDESTY & HANOVER, LLC
5110 EISENHOWER BOULEVARD
SUITE 310
TAMPA, FL 33634
JAMES W. ENGLERT, P.E. NO. 44968*

PROJECT SUMMARY

The intent of this document is to assist with the determination of the proposed profile prior to the preparation of the Bridge Development Report (BDR). Once the proposed profile is documented and approved, the BDR will consider various bridge types and configurations to determine the most appropriate structure for the project.

EXISTING CONDITIONS

This portion of SR 789 is classified as Urban Minor Arterial. It is a 4-lane divided facility with flush shoulders and a 40-foot wide median. East of the bridge, the posted speed is 40 mph. West of the bridge it is posted at 35 mph.

There are twin bridges over the Coon Key Channel spaced 100 feet center to center. Each bridge is 1008 feet long and 37'-5" wide out to out. There are 21 spans at 48 feet each consisting of 4 lines of precast prestressed AASHTO girders supported on pile bents. The roadway is 24 feet curb to curb with no shoulders. There are 5-foot sidewalks on each side of both bridges.

PHOTO 1 – EXISTING SOUTHBOUND BRIDGE #170951



The existing bridges are relatively low to the water with approximately 10 feet of clearance at the center and approximately 4 to 5 feet at the bridge ends. Existing bridge plans from 1956 show an 800-foot vertical curve centered on the bridges with grades of 1.65% leading into each end of the vertical curve. The elevation of the Causeway throughout the project limits varies from approximately 4 feet to 8 feet.

The main entrances to the Sarasota Yacht Club and the Sarasota Harbour East condominiums are located approximately 575 feet west of the west end of the existing bridge. A second auxiliary driveway from the Yacht Club is located approximately 280 feet west of the west end of the bridge.

DETERMINATION OF PROPOSED PROFILE

Current Criteria: The Florida Design Manual (FDM) lists several requirements for determination of the minimum vertical clearance of new bridges.

- Environmental: 12 feet minimum vertical clearance above Mean High Water (MHW) for concrete superstructures classified as moderately or extremely aggressive due to chloride content (FDM 260.8.1).
- Drainage: The minimum vertical clearance between the design flood stage and the low bridge member is 2 feet to allow the majority of debris to pass without damage to the bridge (FDM 260.8.1).
- Navigation: 6 feet minimum clearance above MHW for navigation (FDM 260.8.1).
- Coastal: A minimum vertical clearance of 1 foot above the 100-year design wave crest elevation including the storm surge elevation (FDM 260.8.1).

The hydraulic analysis yielded a design flood elevation (50-year) of +11.0 and a 100-year wave crest elevation of 18.8 feet above MHW. These values include 0.9 feet for additional sea level rise (SLR) above the current MHW elevation. Since that calculation, it was determined that an SLR of 2 feet should be used for this project. The MHW elevation was established at +0.15.

Using the criteria defined in the FDM, and the results of the hydraulic analysis, the following minimum required vertical clearances are obtained.

TABLE 1 – LOW MEMBER ELEVATIONS – DESIGN CRITERIA

Criteria	Minimum Vertical Clearance per Criteria (ft)	SLR (ft)	Freeboard (ft)	Low Member Elev ² (ft)
Environmental	12.0	2.0	0.0	14.15
Drainage	10.1 ¹	2.0	2.0	14.25
Navigation	6.0	2.0	0.0	8.15
Coastal	17.9 ¹	2.0	1.0	21.05

¹ Value subtracts the 0.9 feet of SLR that was included in the hydraulic analysis.

² Low member elevation includes 0.15 feet for MHW.

Exhibits 1 and 2 show the vertical profiles for the environmental and coastal criteria. The low member elevations do not match the tabulated values exactly since they were prepared before the value of SLR was set at 2 feet, but they provide an accurate enough depiction for discussion purposes. Both were assumed to be single bridge alternatives.

These alternatives have negative impacts on the second auxiliary driveway of the Sarasota Yacht Club. During an informational meeting with Yacht Club board members on February 3, 2021, they described the importance of maintaining the use of this auxiliary driveway. Due to the configuration of the main driveway and the location of the buildings on the property, the driveway is used by large delivery trucks and tractor trailers as a one-way route for deliveries. Once the trucks have completed their delivery, they use the auxiliary driveway to re-enter traffic on SR 789. The auxiliary driveway is necessary for the operation of the Yacht Club because of the lack of space within the property for these trucks to turn around.

Proposed Criteria: The configuration and location of the Yacht Club’s auxiliary driveway serve as a constraint on the maximum vertical profile that can be achieved. Attaining an elevation of 21.05 at the ends of the bridge would eliminate the Yacht Club’s auxiliary driveway, severely impacting their daily operations. There would also be minor impacts to the main entrance of the Yacht Club and to the entrance of the Sarasota Harbour East condominiums.

SDG 2.5 references Drainage Manual 4.9.5 when clearance above design wave crest cannot practically be met. When coastal bridges cannot be “elevated at least one foot above the design wave crest elevation, a qualified coastal engineer with experience in wave mechanics must address the requirements of the *AASHTO Guide Specifications for Bridges Vulnerable to Coastal Storms*.” INTERA is on the design team to determine the wave loads on the structure once alternatives are developed.

Where the low member cannot be located more than 12 feet above MHW, the bridge design requires strategies to mitigate for corrosion. These strategies might include the use of specific concrete classes with highly reactive pozzolans, CFRP or stainless steel prestressing strands and GFRP or stainless steel mild reinforcing steel, conventional carbon steel prestressing strands and carbon steel mild reinforcing together with calcium nitrite corrosion inhibiting concrete admixture, or design for zero net tension for prestressed concrete members to reduce the risk of concrete cracking. Coordination with the State Materials Office and the SDO for guidance on mix design, concrete cover and alternative reinforcing materials will be required for all superstructure components located within the splash zone. These special measures require prior approval from SDO.

We propose limiting the slope of the auxiliary driveway to 4%. This is the maximum slope for limited access highways or roadways with significant truck percentages. Delivery trucks leaving the Yacht Club will be entering the Causeway from a complete stop. A maximum grade of 4% for the auxiliary driveway is considered a safety measure.

Using the yacht club auxiliary driveway constraints, the vertical profile can provide 8 feet to 10 feet of vertical clearance at the ends of the bridge depending on the horizontal alignment of the new facility. The vertical clearance can be maximized by shifting the alignment to the north, which increases the roadway offset from the Yacht Club’s auxiliary driveway and increases the length of the 4% grade. A single bridge constructed in two phases, permits such an offset alignment to the north. Twin bridges centered on the existing alignment and constructed in three phases does not permit this offset, resulting in a lower maximum vertical clearance at the ends of the bridge.

TABLE 2 – LOW MEMBER ELEVATIONS – PROPOSED CRITERIA

Criteria	Maximum Vertical Clearance per Constraint (ft)	SLR (ft)	Freeboard (ft)	Low Member Elev ¹ (ft)
8 feet clear	8.0	2.0	0.0	10.15
10 feet clear	10.0	2.0	0.0	12.15

¹ Low member elevation includes 0.15 feet for MHW.

Exhibits 3 and 4 show the vertical profiles defined by the Yacht Club constraints for single bridge alternatives. Vertical clearances of both 8-feet and 10-feet can be achieved with a single bridge alternative. Exhibit 5 shows the 8-foot vertical profile defined by the Yacht Club constraints for a twin bridge alternative.

Structure Classification: The new structure should be considered Extremely Critical and be designed to resist wave forces at the Strength Limit State to the “Service Immediate” performance level [SDG 2.5]. The following data support that classification:

AADT: Significant volumes of traffic pass through the project limits every day. The 2018 AADT was 33,000. AADT is estimated to be 36,000 by 2040. Current traffic is 3.5% trucks.

Design Life: New bridge to be designed for 75 – 100-year design life. The new bridge will serve the residents of St. Armands Key, Lido Key and southern Longboat Key for many years. With today’s design tools and product innovations, bridges can be designed to touch down sooner with lower profiles. This strategy was used recently on the new Courtney Campbell Causeway Tide Relief Bridge (FPID 439206-1).

Evacuation Route: Even though evacuations typically take place before a storm event, following the event, it is important to have a link to send emergency response to the barrier islands and to allow business owners and residents back into the area as soon as it is safe to do so.

Limited access: If this bridge is not available due to a storm event, there is an alternative/detour route across the Cortez or Anna Maria Island Bridges, and the Longboat Key and New Pass Bridges. This detour is approximately 30 miles and adds significant travel time. However, the existing bridges on the detour route are currently not above the 100-year wave crest and are not designed to resist wave loading and thus may be damaged and not available for use. Eventually the bridges on the detour route will also be replaced with bridges designed to meet these requirements. The bridge also plays a critical role for emergency and essential services. Response times would be negatively impacted if the bridge is not in service. As Ringling Causeway is a

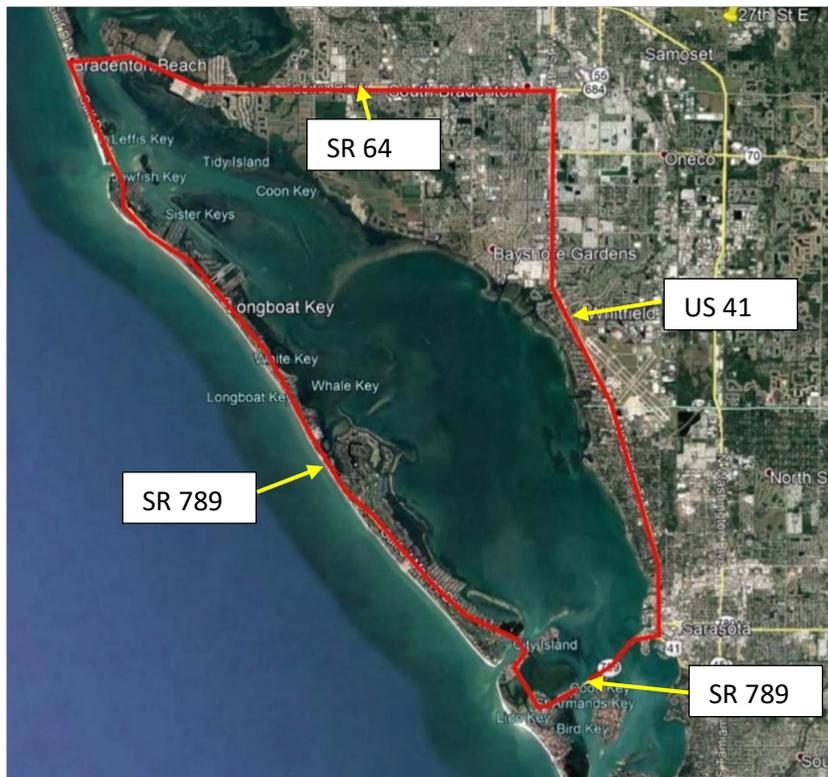
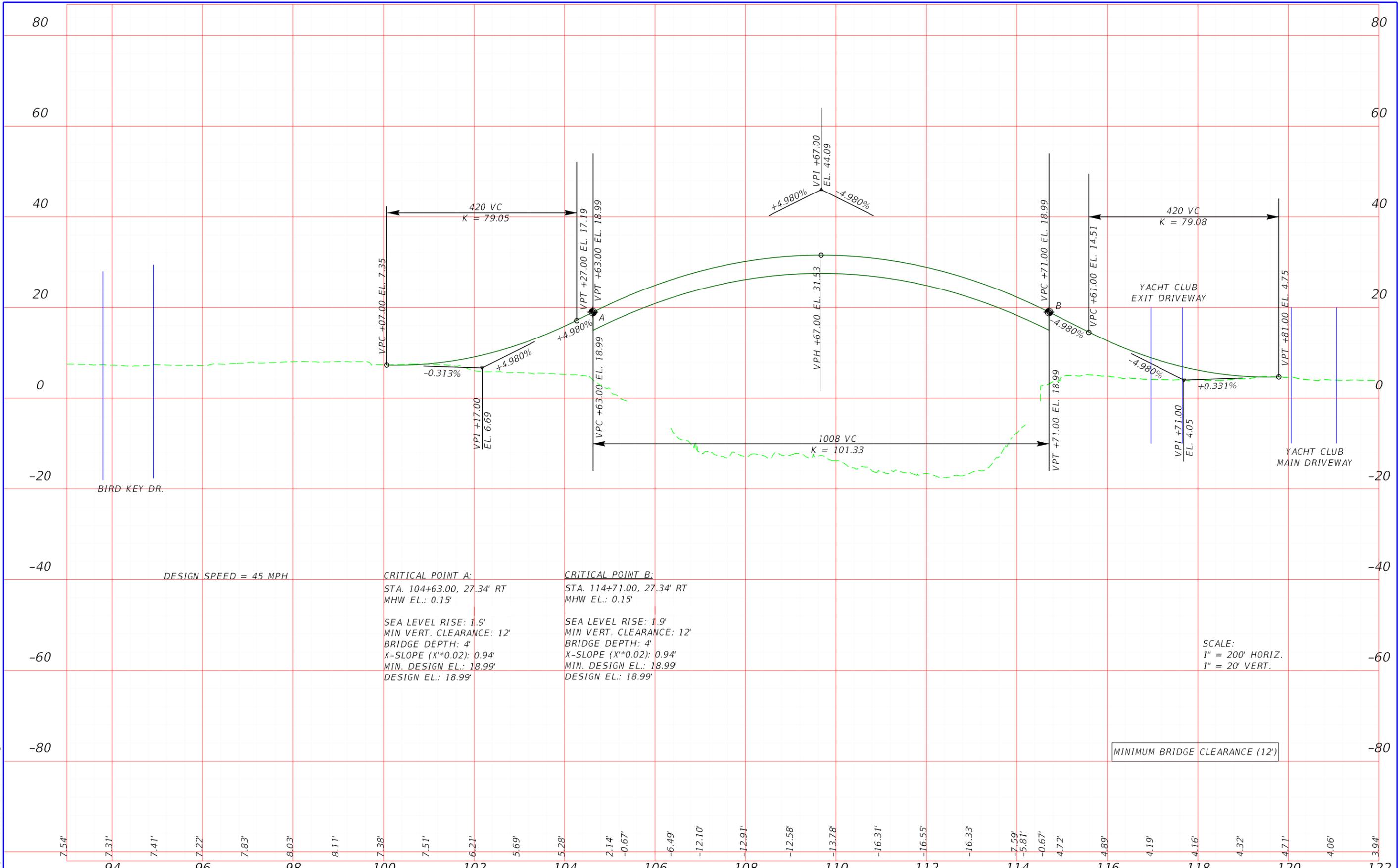


FIGURE 1 – DETOUR ROUTE FOR SR 789

much more direct route for the citizens of southern Longboat Key, Lido Key and St. Armands Key, it makes sense for this bridge to be classified as “Extremely Critical”.

Community Considerations: The auxiliary driveway of the Yacht Club presents a constraint on the design alternatives. This can be mitigated with lower profiles. Homeowners within the study area may voice opposition to a substantially higher profile.

Recommendations: Recommend moving into the BDR phase with 8 ‘and 10’ vertical clearance at the ends of the bridge. The final vertical clearance will depend on whether a single bridge or twin bridges are the preferred alternative. A variety of factors will be evaluated during the BDR phase to arrive at the appropriate solution.



DESIGN SPEED = 45 MPH

CRITICAL POINT A:

STA. 104+63.00, 27.34' RT
 MHW EL.: 0.15'

 SEA LEVEL RISE: 1.9'
 MIN VERT. CLEARANCE: 12'
 BRIDGE DEPTH: 4'
 X-SLOPE (X*0.02): 0.94'
 MIN. DESIGN EL.: 18.99'
 DESIGN EL.: 18.99'

CRITICAL POINT B:

STA. 114+71.00, 27.34' RT
 MHW EL.: 0.15'

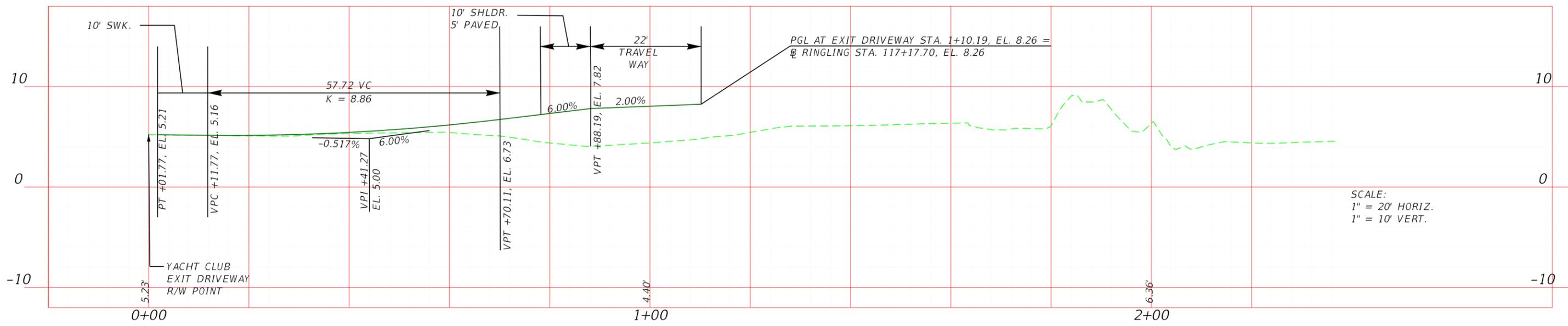
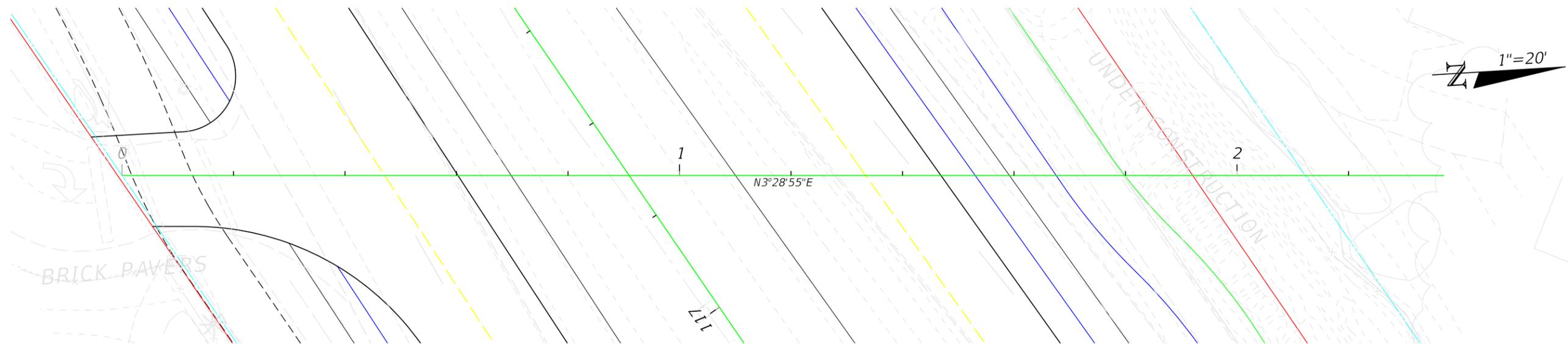
 SEA LEVEL RISE: 1.9'
 MIN VERT. CLEARANCE: 12'
 BRIDGE DEPTH: 4'
 X-SLOPE (X*0.02): 0.94'
 MIN. DESIGN EL.: 18.99'
 DESIGN EL.: 18.99'

SCALE:
 1" = 200' HORIZ.
 1" = 20' VERT.

MINIMUM BRIDGE CLEARANCE (12')

12/29/2020 4:28:19 PM zbermouna c:\users\zbermouna\hprprod\adms2318\ALGNRD00-ORD.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			EXHIBIT 1: ENVIRONMENTAL CRITERIA SDG 12 FEET CLEAR TO LOW MEMBER LOW MEMBER ELEVATION = 14.15	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		Exhibit
				789	SARASOTA	436680-1		1-1

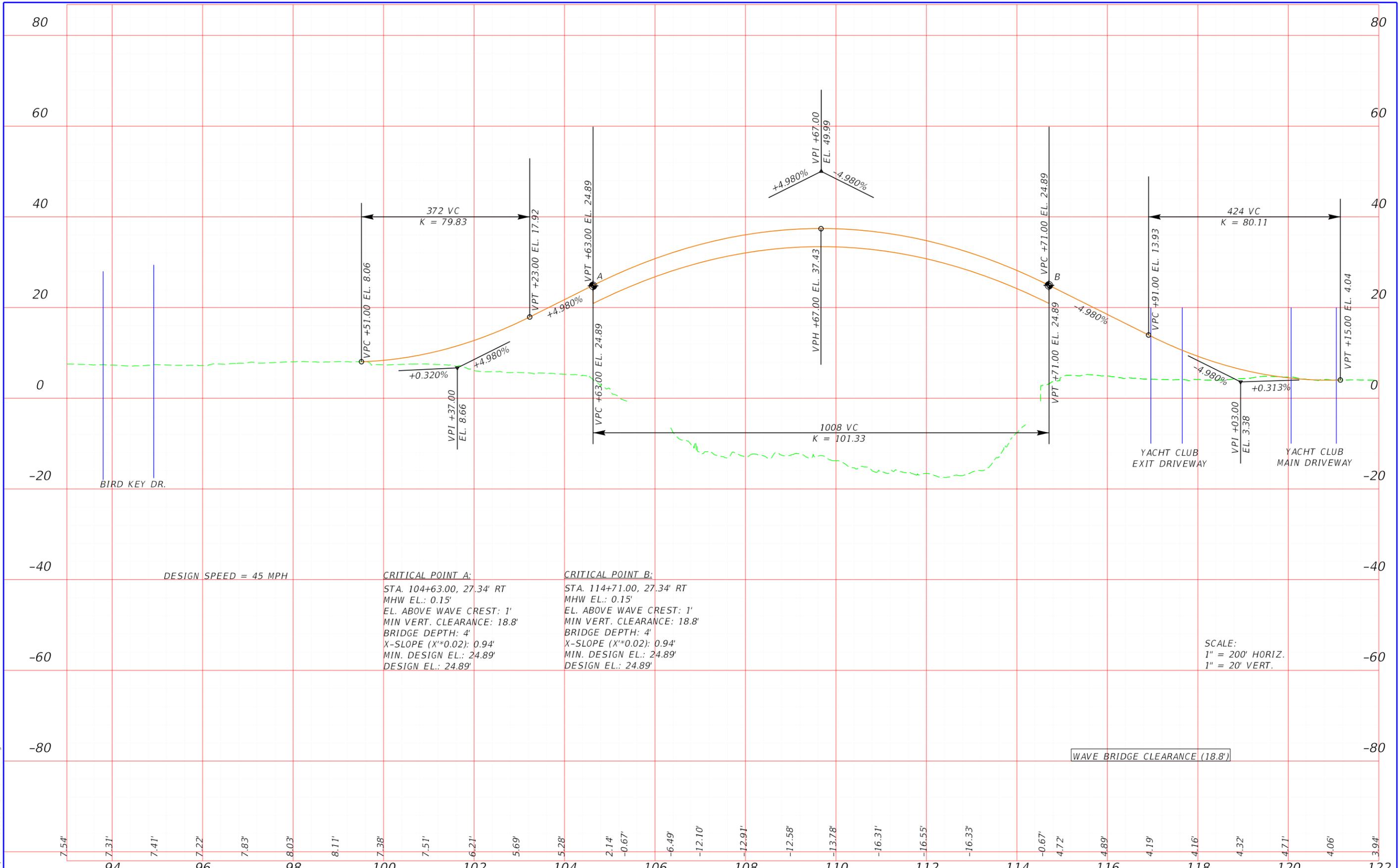


REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION		
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
789	SARASOTA	436680-1

EXHIBIT 1: ENVIRONMENTAL CRITERIA
SDG 12 FEET CLEAR TO LOW MEMBER
IMPACT TO YACHT CLUB AUXILIARY DRIVEWAY

SHEET NO.
 Exhibit
 1-2



DESIGN SPEED = 45 MPH

CRITICAL POINT A:

STA. 104+63.00, 27.34' RT
 MHW EL.: 0.15'
 EL. ABOVE WAVE CREST: 1'
 MIN VERT. CLEARANCE: 18.8'
 BRIDGE DEPTH: 4'
 X-SLOPE (X*0.02): 0.94'
 MIN. DESIGN EL.: 24.89'
 DESIGN EL.: 24.89'

CRITICAL POINT B:

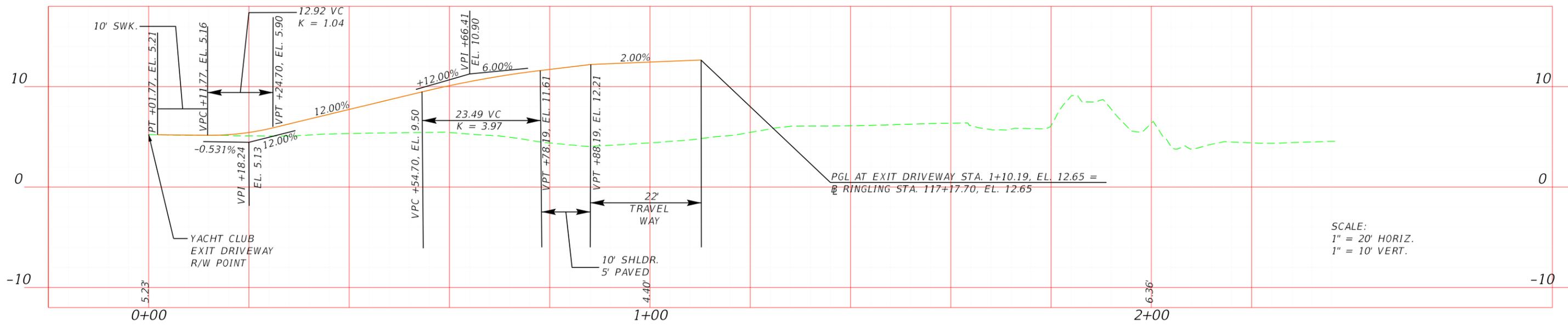
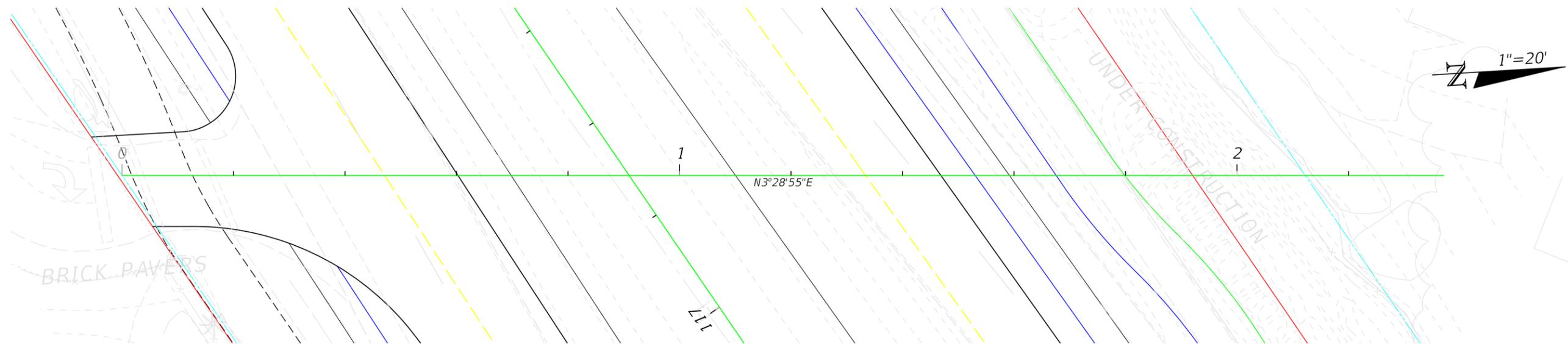
STA. 114+71.00, 27.34' RT
 MHW EL.: 0.15'
 EL. ABOVE WAVE CREST: 1'
 MIN VERT. CLEARANCE: 18.8'
 BRIDGE DEPTH: 4'
 X-SLOPE (X*0.02): 0.94'
 MIN. DESIGN EL.: 24.89'
 DESIGN EL.: 24.89'

SCALE:
 1" = 200' HORIZ.
 1" = 20' VERT.

WAVE BRIDGE CLEARANCE (18.8')

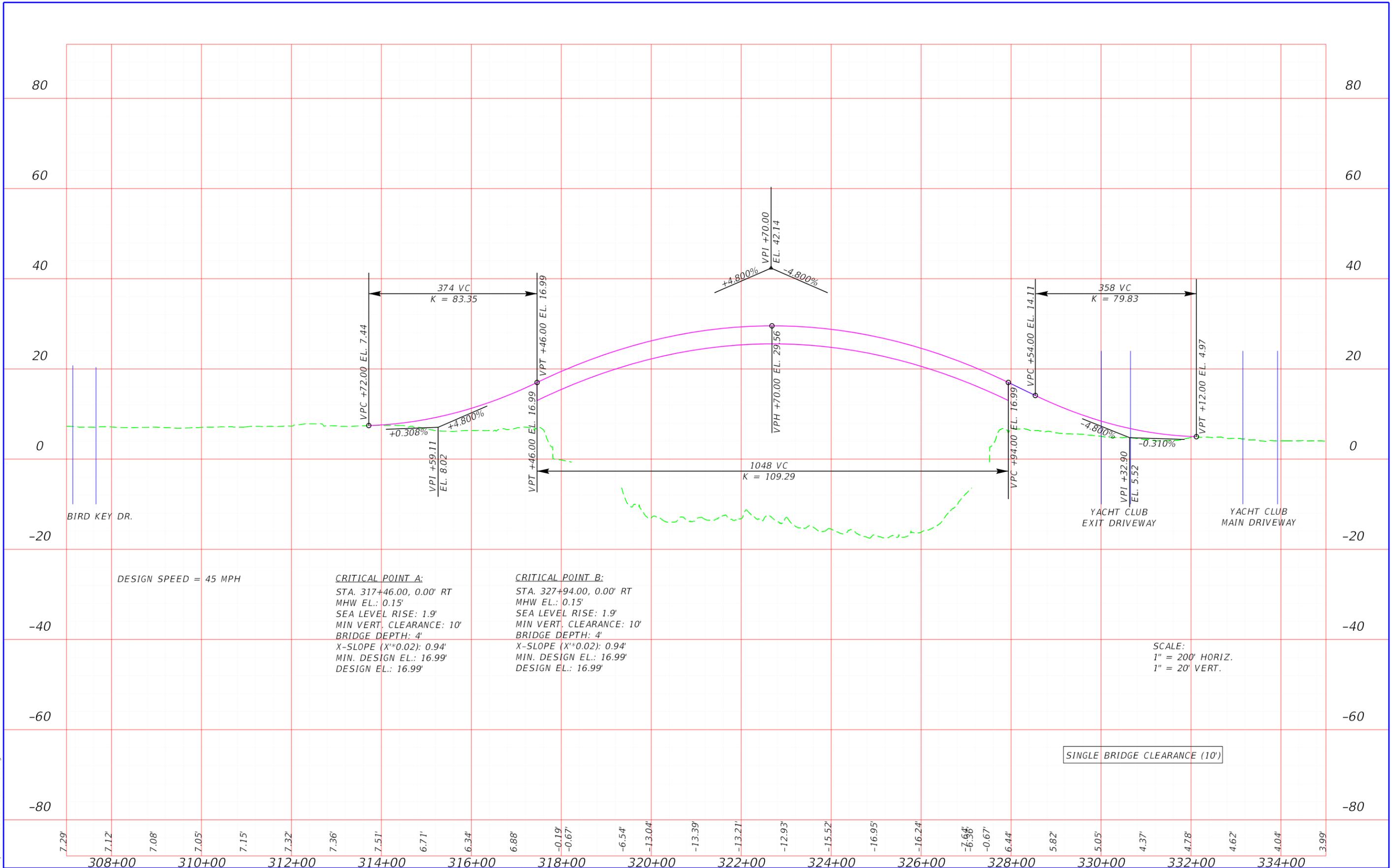
12/29/2020 3:57:15 PM zbermouna
 c:\users\zbermouna\hprprod\adms23318\ALGNRD00-ORD.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			EXHIBIT 2: COASTAL CRITERIA 1 FOOT ABOVE WAVE CREST ELEVATION LOW MEMBER ELEVATION = 21.05		SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID			
				789	SARASOTA	436680-1			Exhibit 2-1



REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			EXHIBIT 2: COASTAL CRITERIA 1 FOOT ABOVE WAVE CREST ELEVATION IMPACT TO YACHT CLUB AUXILIARY DRIVEWAY	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		Exhibit
				789	SARASOTA	436680-1		2-2

6/4/2021 11:36:48 AM zbermouna
 c:\users\zbermouna\hproj\prod\dms2318\DSRFRD01.dgn



DESIGN SPEED = 45 MPH

CRITICAL POINT A:
 STA. 317+46.00, 0.00' RT
 MHW EL.: 0.15'
 SEA LEVEL RISE: 1.9'
 MIN VERT. CLEARANCE: 10'
 BRIDGE DEPTH: 4'
 X-SLOPE (X*0.02): 0.94'
 MIN. DESIGN EL.: 16.99'
 DESIGN EL.: 16.99'

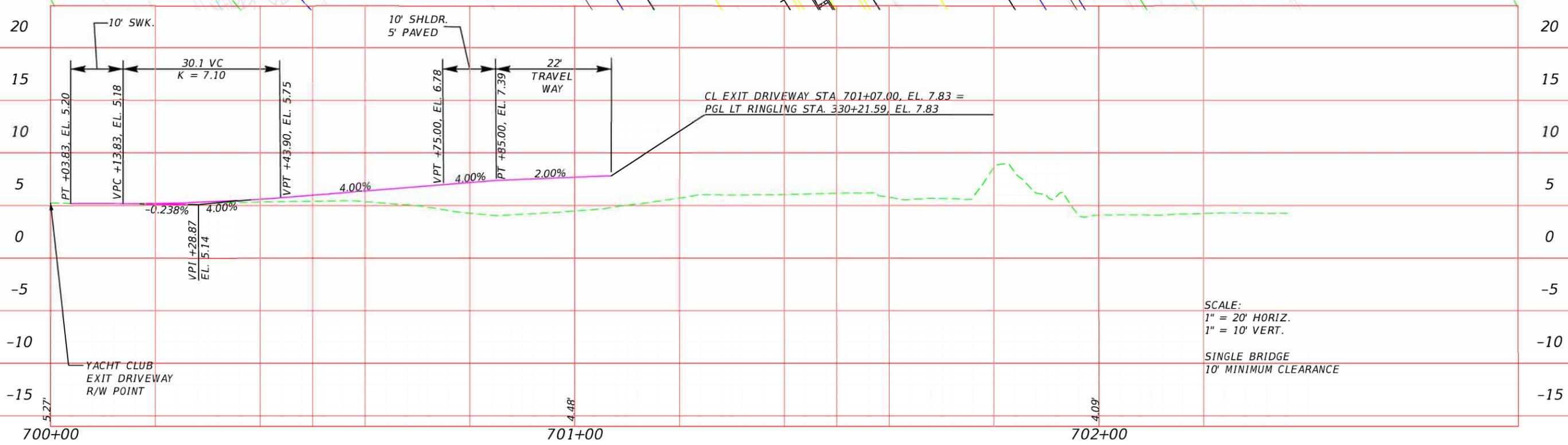
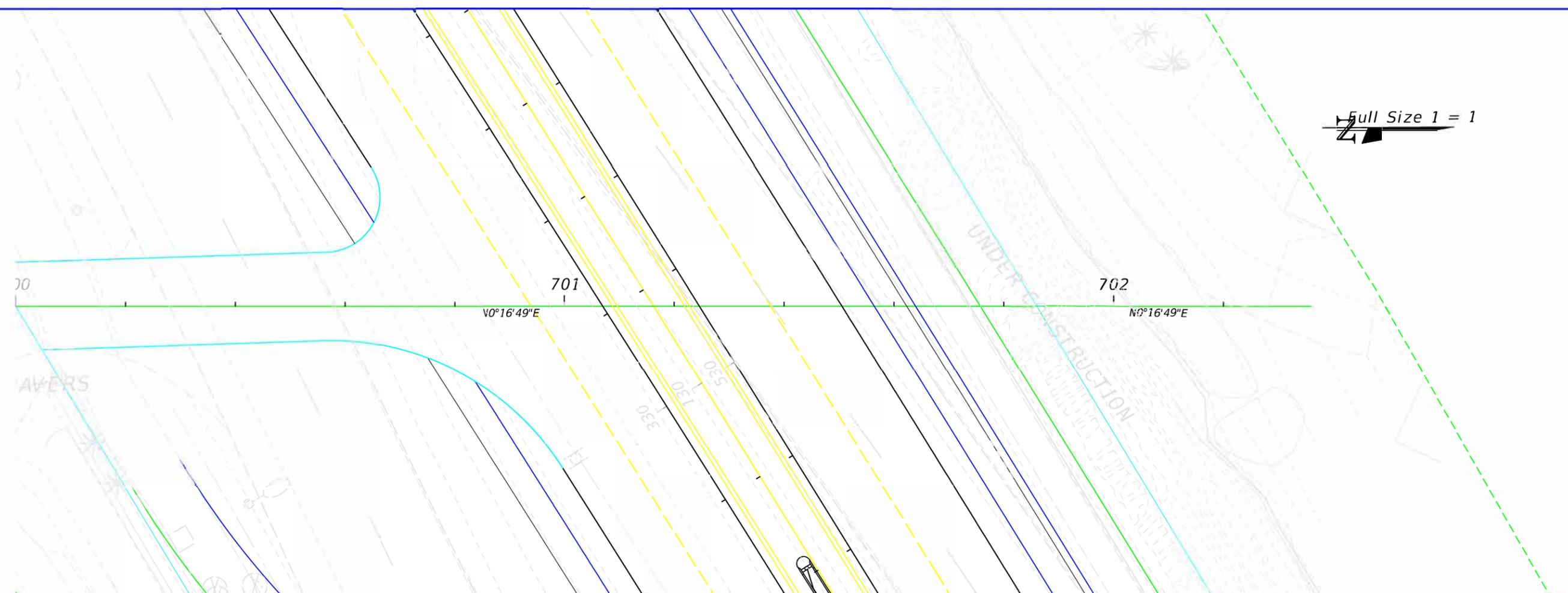
CRITICAL POINT B:
 STA. 327+94.00, 0.00' RT
 MHW EL.: 0.15'
 SEA LEVEL RISE: 1.9'
 MIN VERT. CLEARANCE: 10'
 BRIDGE DEPTH: 4'
 X-SLOPE (X*0.02): 0.94'
 MIN. DESIGN EL.: 16.99'
 DESIGN EL.: 16.99'

SCALE:
 1" = 200' HORIZ.
 1" = 20' VERT.

SINGLE BRIDGE CLEARANCE (10')

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			EXHIBIT 3: SINGLE BRIDGE 10 FEET OF VERTICAL CLEARANCE LOW MEMBER ELEVATION = 12.15	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		Exhibit
				789	SARASOTA	436680-1		3-1

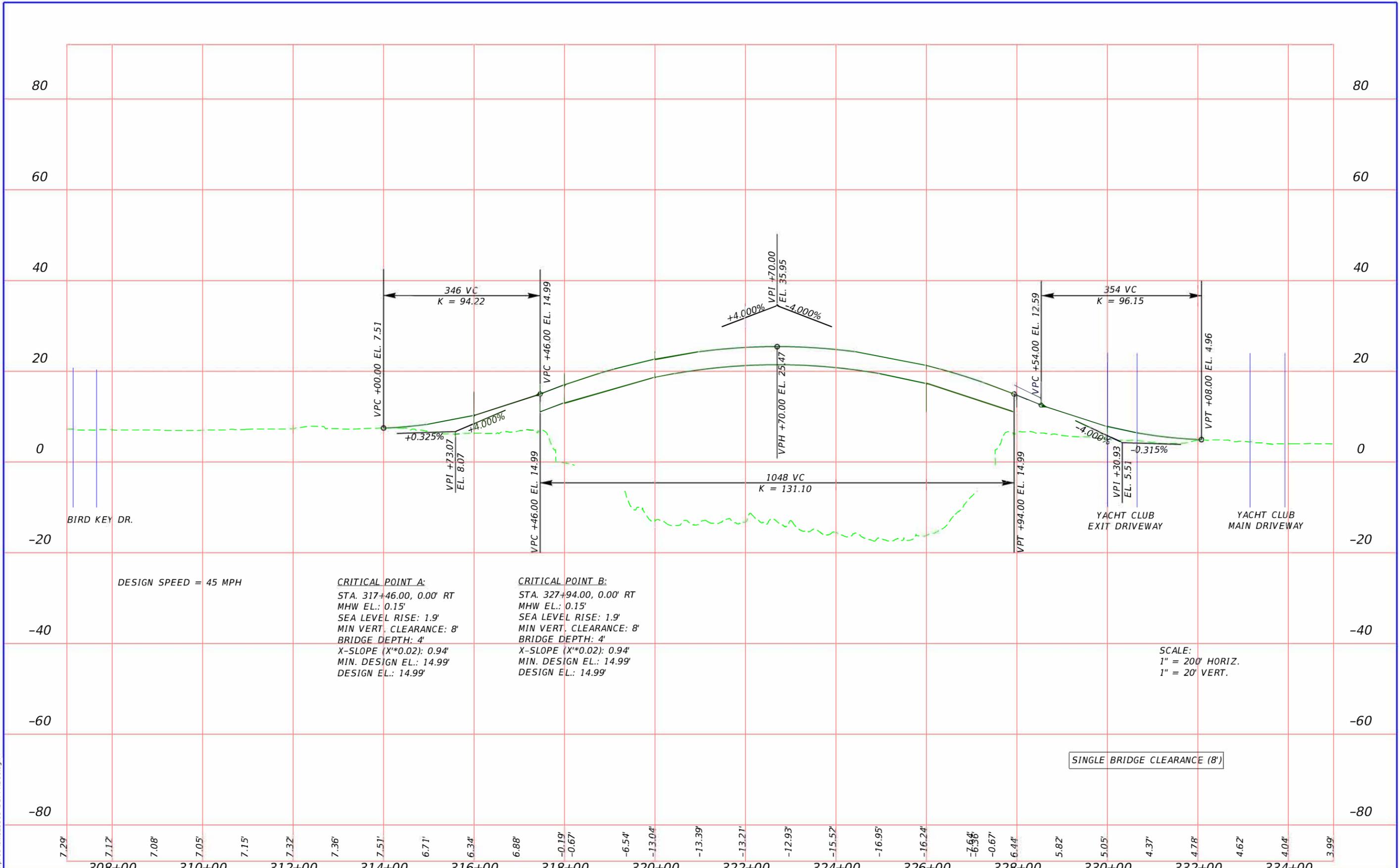
Full Size 1 = 1



SCALE:
 1" = 20' HORIZ.
 1" = 10' VERT.
 SINGLE BRIDGE
 10' MINIMUM CLEARANCE

4/6/2021 4:07:17 PM zbermoura c:\users\zbermoura\hpr\prod\dm\2318\DS\PRD01.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			EXHIBIT 3: SINGLE BRIDGE 10 FEET OF VERTICAL CLEARANCE YACHT CLUB AUXILIARY DRIVEWAY AT 4% MAX.	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		Exhibit
				789	SARASOTA	436680-1		3-2



DESIGN SPEED = 45 MPH

CRITICAL POINT A:
 STA. 317+46.00, 0.00' RT
 MHW EL.: 0.15'
 SEA LEVEL RISE: 1.9'
 MIN VERT. CLEARANCE: 8'
 BRIDGE DEPTH: 4'
 X-SLOPE (X*0.02): 0.94'
 MIN. DESIGN EL.: 14.99'
 DESIGN EL.: 14.99'

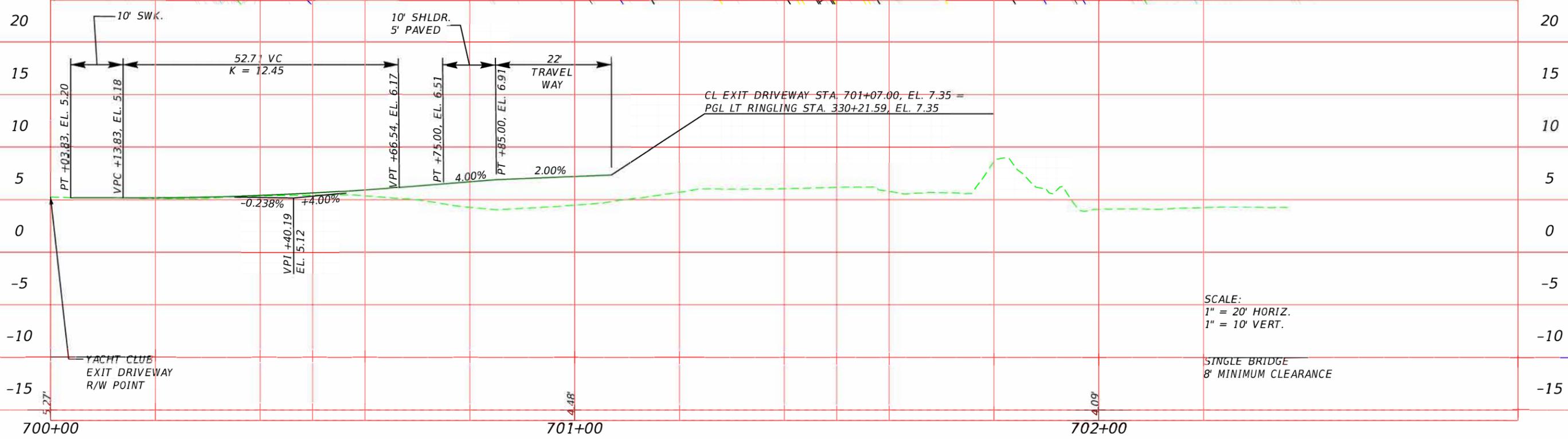
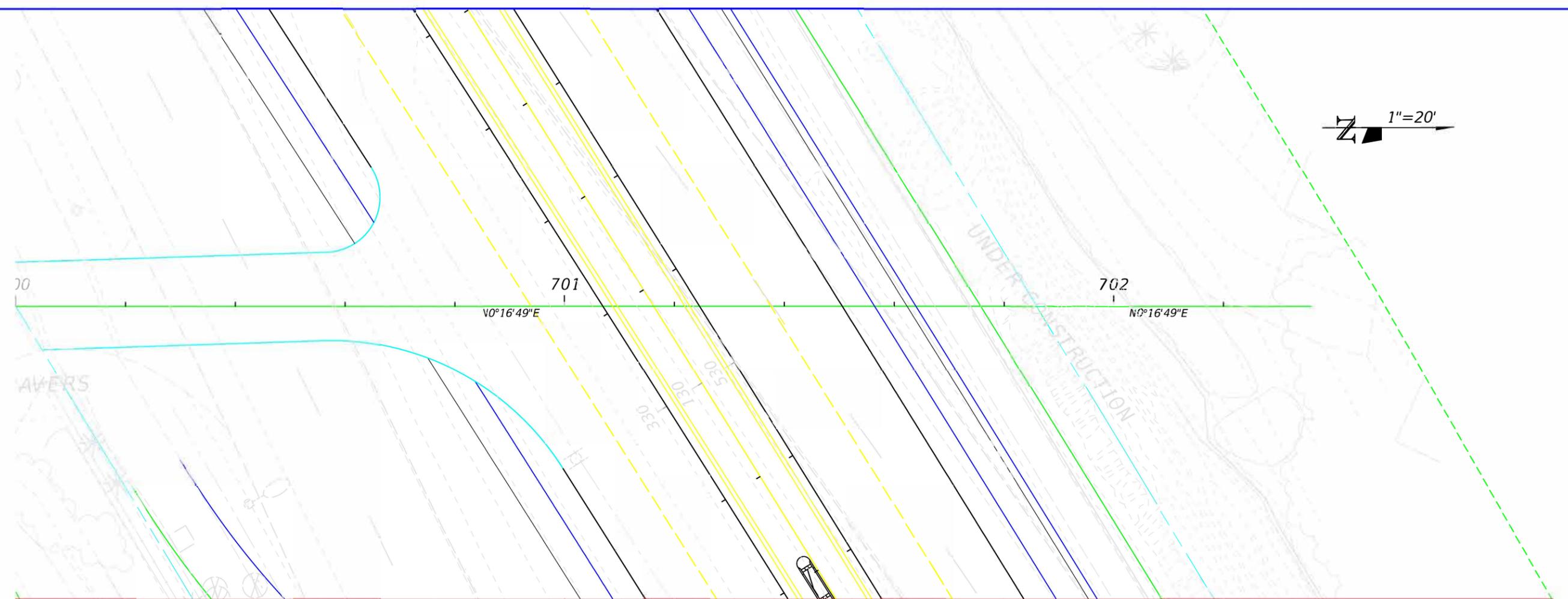
CRITICAL POINT B:
 STA. 327+94.00, 0.00' RT
 MHW EL.: 0.15'
 SEA LEVEL RISE: 1.9'
 MIN VERT. CLEARANCE: 8'
 BRIDGE DEPTH: 4'
 X-SLOPE (X*0.02): 0.94'
 MIN. DESIGN EL.: 14.99'
 DESIGN EL.: 14.99'

SCALE:
 1" = 200' HORIZ.
 1" = 20' VERT.

SINGLE BRIDGE CLEARANCE (8')

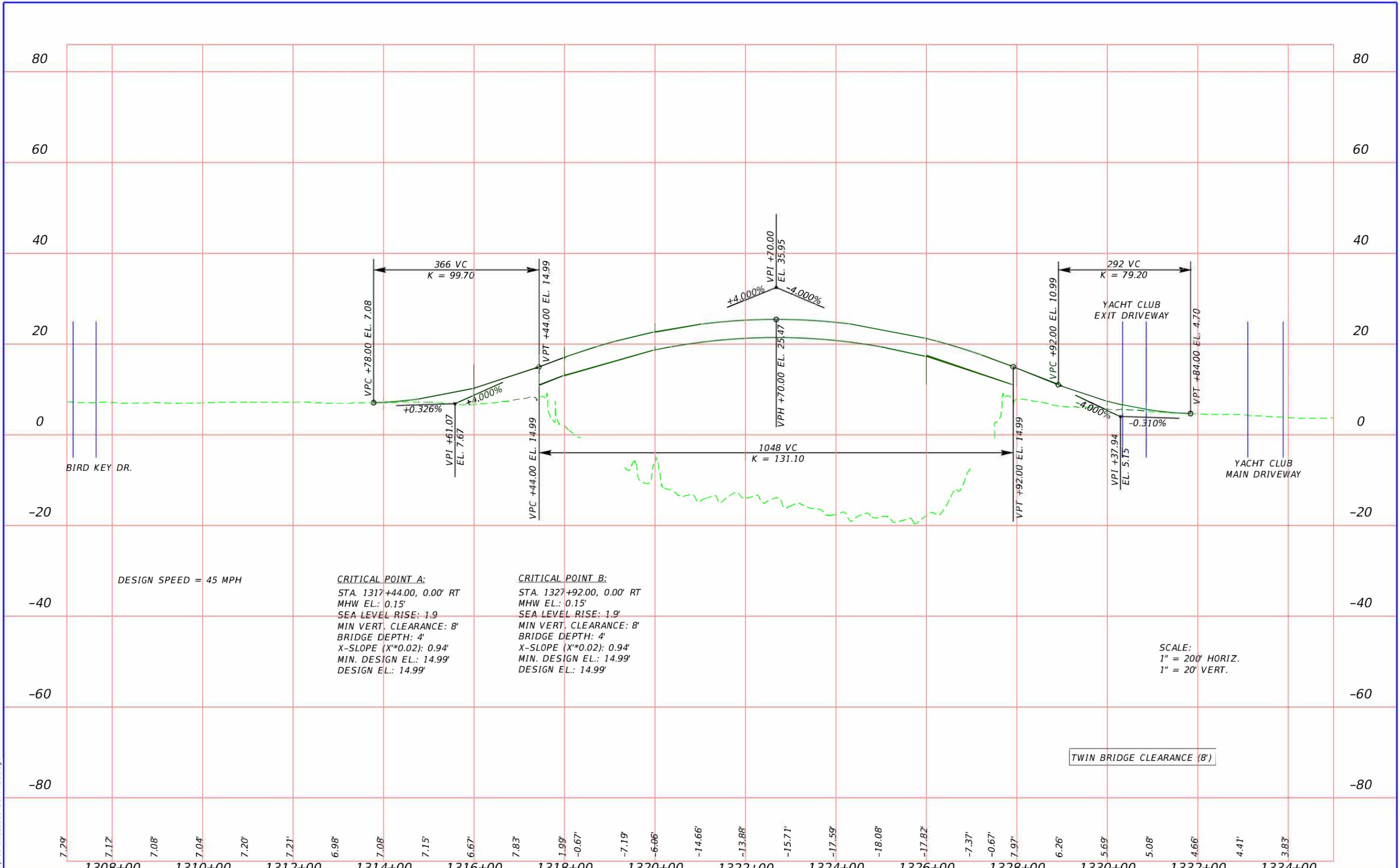
6/4/2021 11:39:07 AM zbenmoura c:\users\zbenmoura\hpro\p\dms2318\DSFPR001.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			EXHIBIT 4: SINGLE BRIDGE 8 FEET OF VERTICAL CLEARANCE LOW MEMBER ELEVATION = 10.15	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		Exhibit 4-1
				789	SARASOTA	436680-1		



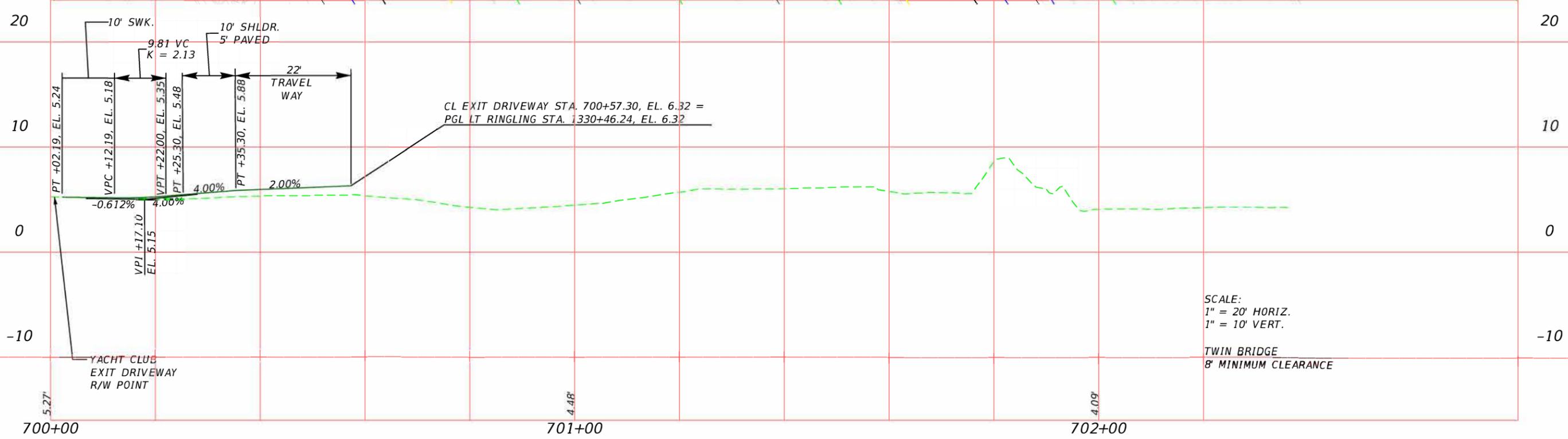
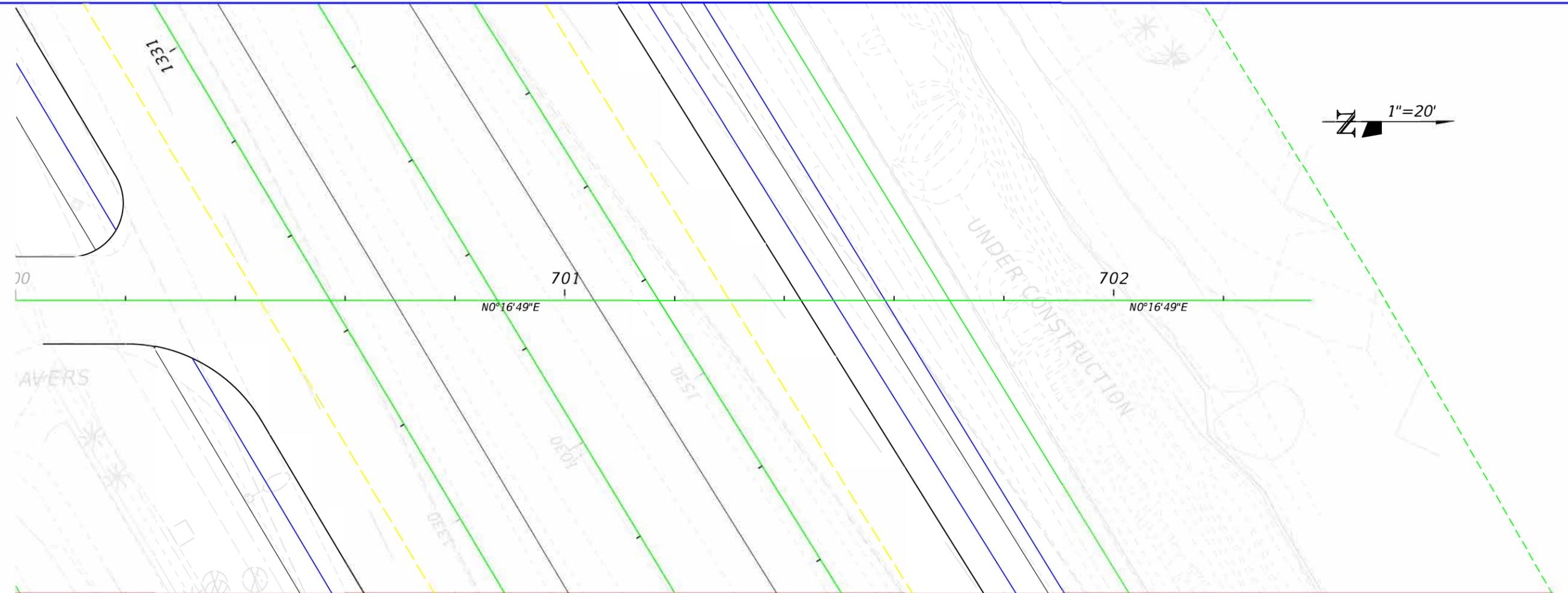
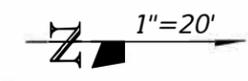
4/16/2021 3:58:39 PM zbermouira c:\users\zbermouira\appdata\local\temp\2318\DS\SPFR001.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			EXHIBIT 4: SINGLE BRIDGE 8 FEET OF VERTICAL CLEARANCE YACHT CLUB AUXILIARY DRIVEWAY AT 4% MAX.	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		Exhibit 4-2
				789	SARASOTA	436680-1		



6/4/2021 11:47:14 AM zbenmoura c:\users\zbenmoura\hprod\dms2318\DSRFD01.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			EXHIBIT 5: TWIN BRIDGES 8 FEET OF VERTICAL CLEARANCE LOW MEMBER ELEVATION = 10.15	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		Exhibit 5-1
				789	SARASOTA	436680-1		



4/6/2021 4:27:30 PM zbermoune
c:\users\zbermoune\appdata\local\temp\2318\DSRFR001.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			EXHIBIT 5: TWIN BRIDGES 8 FEET OF VERTICAL CLEARANCE YACHT CLUB AUXILIARY DRIVEWAY AT 4% MAX.		SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID			Exhibit 5-2
				789	SARASOTA	436680-1			