LOCATION HYDRAULICS REPORT

Florida Department of Transportation

District 1

SR 544 PD&E Study

Limits of Project: From Martin Luther King Boulevard to SR 17

Polk County, Florida

Financial Management Number: 440273-1-22-01

ETDM Number: 5873

Date: October 2023

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated May 26, 2022 and executed by the Federal Highway Administration and FDOT.

PROFESSIONAL ENGINEER CERTIFICATION

LOCATION HYDRAULICS REPORT

Project: S.R. 544 PD&E Study

ETDM Number: 5873

Financial Project ID: 440273-1-22-01

This Location Hydraulics Report contains engineering information that fulfills the purpose and need for State Road 544 (Lucerne Park Road) Project Development & Environment Study from MLK Boulevard to SR 17 in Polk 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 Inwood Consulting Engineers, 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 Renato Chuw, PE on the date adjacent to the seal.

Renato E Chuw
2024.01.24 21:06:23 -05'00'

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

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Executive Summary

The State Road 544 (Lucerne Park Road) Project Development and Environment (PD&E) Study evaluated capacity, safety, and multi-modal improvements on Lucerne Park Road from MLK Boulevard to SR 17, a distance of approximately eight miles. This project involves the widening of SR 544 from two lanes to four lanes to meet future travel demands, improve safety and provide for bicycle and pedestrian features, such as sidewalks and a shared use path.

The purpose of this Location Hydraulics Report is to address base floodplain encroachments resulting from the roadway improvements evaluated in the PD&E Study. In accordance with Executive Order 11988 "Floodplain Management", U.S.DOT Order 5650.2, "Floodplain Management Protection", and Federal-Aid Policy Guide 23 CFR 650A, floodplains must be protected. The intent of these regulations is to avoid or minimize highway encroachments within the 100-year (base) floodplains and to avoid supporting land use development incompatible with floodplain values.

Floodplain encroachment areas resulting from the proposed SR 544 widening were quantified. It is determined that encroachments will occur to the floodplain associated with the proposed widening throughout the corridor.

According to the FEMA FIRMs, portions of the project are within Zone AE of the 100-year floodplain. These areas are associated with the various lakes in the region and have a 1% probability of flooding every year. Predicted flood water elevations range from 124.2 FT to 132.2 FT NAVD across the project limits, varying by lake. There are no Regulatory Floodways within the project limits.

It was concluded that the project will have encroachments of approximately 23.43 ac-ft of floodplain based on the proposed roadway alignment. These are minimal compared to the overall extent of the floodplain, therefore, it was determined that the floodplain encroachment is classified as "minimal". Minimal encroachments on a floodplain occur when there is a floodplain involvement, but the impacts on human life, transportation facilities, and natural and beneficial floodplain values are not significant and can be resolved with minimal efforts. Please refer to **Section 4.4** for additional information.

In conclusion, the following floodplain statement is a slightly modified version of statement Number 4 in the FDOT PD&E Manual (Part 2, Chapter 13 "Floodplains"), tailored for this project:

"The proposed cross drains and floodplain compensation areas will perform hydraulically in a manner equal to or greater than the existing condition, and backwater surface elevations are not expected to increase. As a result, there will be no significant change in flood risk, and there will not be a significant change in the potential for interruption or termination of emergency service or in emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant."

1.0 Project Overview

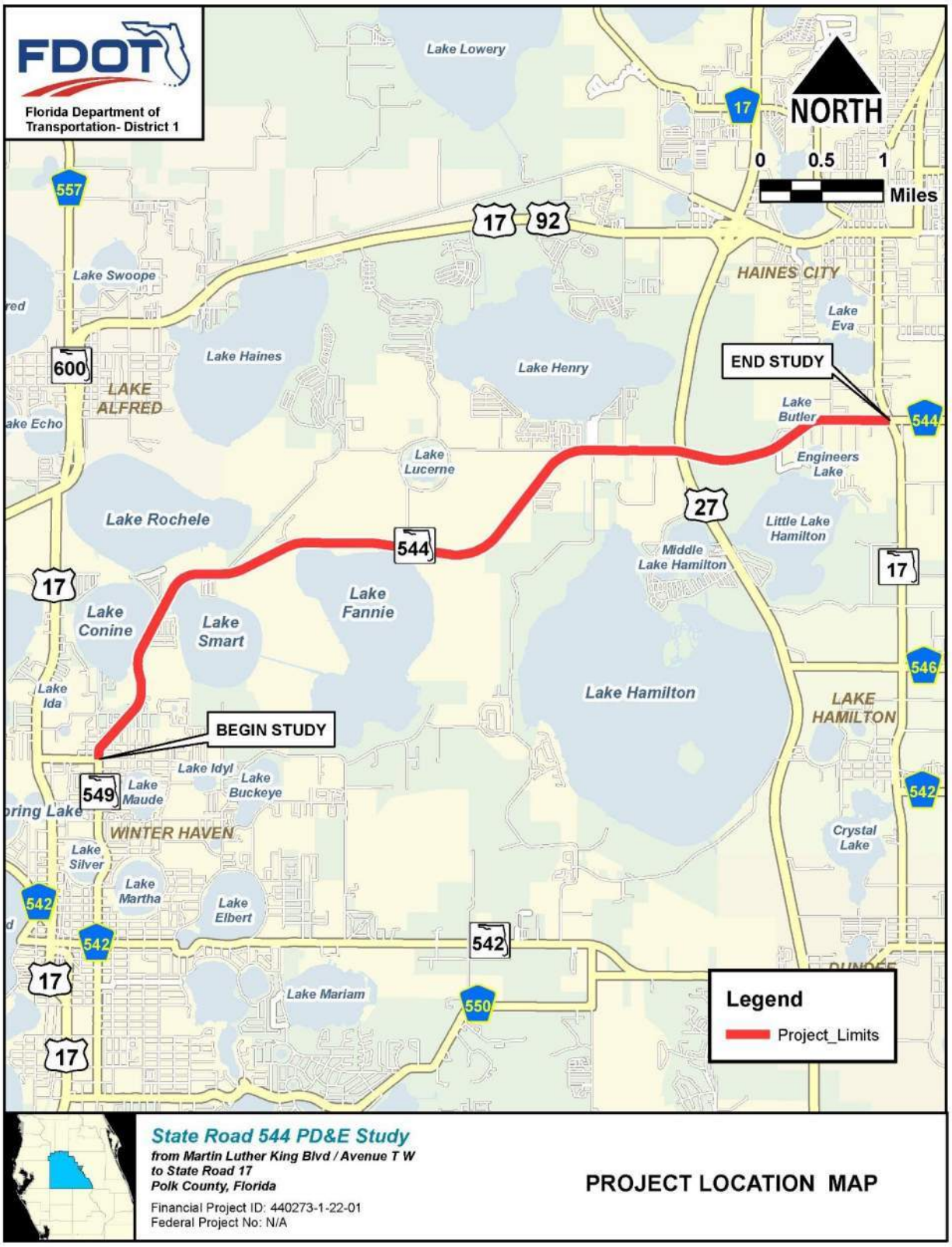
This project involves capacity and multi-modal improvements to SR 544 (Lucerne Park Road) from Martin Luther King Boulevard to SR 17 in Polk County, a length of 7.96 miles. The project location map is provided as **Figure 1-1**. The project corridor traverses three jurisdictions: the City of Winter Haven, Polk County, and Haines City. SR 544 (Lucerne Park Road) plays an important role in the regional network by providing east-west access for a growing area of east-central Polk County. It links two north-south principal arterials of Polk County (US 17 and US 27), US 27 being part of Florida's Strategic Intermodal System (SIS) and connects the cities of Winter Haven and Haines City, the second and third most populated cities within Polk County, respectively.

SR 544 (Lucerne Park Road) is classified as a two-lane urban minor arterial from Martin Luther King Boulevard to US 27 and as an urban collector from US 27 to SR 17. The roadway features two twelve-foot travel lanes with center and right turn lanes dispersed throughout the length of the corridor. The roadway also features an open drainage system; however, curbs and gutters exist from Martin Luther King Boulevard to Avenue Y and from La Vista Drive to SR 17 and in other areas where sidewalks are present.

Paved shoulders are present for the majority of the corridor and marked bicycle lanes exist on both sides of the roadway from 0.10 mile west of Brenton Manor Avenue to 0.2 mile east of US 27. The posted speed limit along the corridor ranges from 35 miles per hour to 55 miles per hour. Citrus Connection Route #60 (Winter Haven Northeast) operates along the eastern portion of the project corridor. Existing right-of-way along SR 544 (Lucerne Park Road) ranges from 50 feet to 85 feet from Martin Luther King Boulevard to Avenue Y, 90 feet to 170 feet from Avenue Y to US 27, and 60 feet to 140 feet from US 27 to SR 17.

In addition to widening from two to four lanes, the proposed improvements may include paved shoulders/marked bicycle lanes, sidewalks, and/or a shared-use path to provide safe bicycle and pedestrian mobility and meet objectives of the Polk Transportation Planning Organization (TPO) in transforming this corridor into a Complete Street. Additional right-of-way may be required depending on the proposed improvements and specific right-of-way requirements will be determined during this Project Development and Environment (PD&E) Study.

Figure 1-1: Project Location



1.1 Project Purpose and Need

The purpose of this project is to address roadway capacity deficiency along SR 544 (Lucerne Park Road) from Martin Luther King Boulevard to SR 17 in Polk County to accommodate future travel demand as a result of projected population and employment growth in the area. Other goals of the project include enhancing mobility options and multi-modal access as well as supporting local economic development initiatives. The need for the project is based on the following criteria:

1.1.1 Improve Operational Conditions and Accommodate Projected Travel Demand

This project is anticipated to improve traffic operations along SR 544 (Lucerne Park Road) by increasing operational capacity to meet the projected travel demand as a result of Polk County population and employment growth and increased regional travel in the corridor.

The project segment occurs within two of the eight Polk County planning areas [Central Planning Area and East Planning Area] as depicted in Momentum 2040 [the Polk Transportation Planning Organization's (TPO) Long Range Transportation Plan (LRTP)]. Of the eight planning areas, the East Planning Area is expected to experience the highest increase in population growth between 2010 and 2040 with a 29% increase in single-family dwelling units and a 34% increase in multi-family dwelling units. The Central Planning Area is anticipated to experience the second highest increase in single family dwelling units (25% increase) during the same time period. Accordingly, the Central Planning Area will experience the highest increase in employment growth between 2010 and 2040 with a 42% increase in industrial employment, 34% increase in commercial employment, and a 32% increase in service employment. Likewise, the East Planning Area will experience the second highest increase in commercial employment (26% increase) and the third highest increase in service employment (21% increase) during the same time period. Countywide employment is expected to increase by 79% between 2010 and 2040. Growth within the project area may be attributed to the numerous developments that have been approved and continue to be approved by the City of Haines City.

The greater SR 544 corridor serves commuters of the area as it provides access to regional transportation facilities [including US 92, US 17, US 27, and SR 17] as well as residential and commercial hubs within central Polk County. The project segment of SR 544 (Lucerne Park Road) specifically facilitates local commuter traffic between the population and employment centers of Winter Haven and Haines City. Identified as a Secondary Freight Network Highway Corridor by the Polk TPO, SR 544 additionally serves as a freight distribution route as it connects to a Strategic Intermodal System (SIS) Highway Corridor [US 27], Regional Freight Network Highway Corridors as designated by the Polk TPO [US 92, US 27, and SR 17], and another designated Polk TPO Secondary Freight Network Highway Corridor [US 17]. Truck traffic composes between 7.0% and 9.9 % of the total daily traffic present along the project segment of SR 544 (Lucerne Park Road). As such, this roadway plays an important role in facilitating truck traffic and the distribution of goods to both local and regional destinations.

While the roadway currently operates at an acceptable LOS, conditions are anticipated to deteriorate below established standards if no improvements occur by 2040 as the roadway lacks the capacity to accommodate the projected travel demand. With the proposed improvement, the corridor is expected to continue to operate at acceptable LOS or improved LOS.

1.1.2 Enhance Mobility Options and Multi-Modal Access

Notable pedestrian and bicycle traffic in the corridor was observed in the field despite the fact that sidewalks and bicycle lanes are intermittent and disconnected along the corridor. In addition, a large transit dependent population is present, composed primarily of minority and low-income populations as well as housing units with no vehicle available. Compared to the demographic characteristics for Polk County, the project analysis area [which consists of United States census block groups within a 500-foot buffer surrounding the project] contains a significantly higher minority population percentage [20.1% higher], a higher percentage of housing units with no vehicle available [1.2% higher], and a notably lower median family income [$11,246 less]. This indicates a population with a higher propensity to walk, bike, or take transit to access essential services. The need for multi-modal options within the corridor is critical as growth in the area has created a latent demand for increased bicycle and pedestrian activity.

It should be noted that a portion of the project segment [from Ave T to Old Lucerne Park Road] is identified by the Polk TPO as a Future Complete Streets Corridor. A Complete Street is defined as a corridor that is designed to provide safe access and travel for all users [pedestrians, bicyclists, motorists, and transit riders] of all ages and abilities. Some of the treatments proposed as part of the Future Complete Streets Corridor have been applied to a section immediately south/adjacent to the project corridor [from Ave T to Ave O] and to the westernmost/southernmost section of the project segment [Ave T to Ave Y]. These treatments included the reconstruction of driveways to meet Americans with Disabilities Act (ADA) standards, the addition of pedestrian street lighting, and the construction of crosswalks on intersecting minor streets. New or enhanced sidewalks, landscaping, enhanced bus stops, improved signage, as well as a shared use path [Old Dixie Trail - ETDM Project #14328] are some of the additional improvements being considered/evaluated along the project corridor.

Overall, the proposed project is anticipated to meet the mobility needs of the area by alleviating future congestion on the corridor, providing multimodal travel options, and improving east-west access within east-central Polk County. The proposed bicycle and pedestrian facilities are to enhance multi-modal access and connections between community points of interest and to the regional trail network.

1.1.3 Support Economic Development

One Florida Opportunity Zone [formerly titled Florida Enterprise Zone] borders the northern portion of the project corridor from Old Lucerne Park Road to US 27. This program provides tax incentives for investments in low-income communities. In addition, the easternmost/northernmost section of the project corridor occurs within the Haines City Community Redevelopment Area. Further, the westernmost/ southernmost section of the project [Ave T to Ware Ave] occurs within the Florence Villa Community Redevelopment Area; the Winter Haven Community Redevelopment Agency fosters and promotes community redevelopment activities within this designated district of the City of Winter Haven. Community Redevelopment Areas are recognized as special districts under Florida Statute created to encourage investment within the district through a series of strategic and timely public investments; activities that occur within them are detailed in customized redevelopment plans and include: infrastructure improvements, streetscaping or beautification treatments, affordable housing, recreation and park facility improvements, economic development/redevelopment strategies, transportation improvements, and neighborhood enhancement.

The enhanced roadway operational conditions resulting from the project along with the bicycle and pedestrian facilities proposed for the corridor are intended to provide infrastructure to support commerce and customers as well as modal options to serve the Florida Opportunity Zone and other communities along the corridor. It will also renew the aesthetic appeal of the surrounding area, thereby stimulating economic growth/revitalization and investment in the adjacent communities. As such, the project aligns with the economic development initiatives of the proximate, local communities.

1.2 Alternatives Analysis Summary

In order to meet the Purpose and Need for the project, four-lane roadway typical sections were developed and discussed with FDOT District One's Planning Studio. It was decided that due to the high speeds along SR 544, on-road bicycle lanes would not be considered. Therefore, a single 4-lane divided roadway typical section was developed for a majority of the project that includes 12-foot-wide outside travel lanes and 11-foot wide inside travel lanes separated by a 22-foot raised median. 10-foot shared use paths would be provided along both sides of the road. However due to constrained right-of-way conditions and potential impacts to existing residences and businesses, additional typical sections were considered at each end of the project corridor.

Below is a summary of the roadway improvements considered for each evaluation segment and the intersection improvements considered for the nine study intersections.

1.2.1 Segment 1 – Martin Luther King Boulevard to North of Avenue Y

Four alternative typical sections were considered through this historic minority neighborhood including a two-lane urban typical, a three-lane urban typical, a four-lane undivided rural typical and a five-lane urban typical section. Due to impacts to dozens of residences, churches and businesses associated with the four lane and five lane typical sections, they were eliminated from consideration and this section of SR 544 is considered constrained by the Polk Transportation Planning Organization. The two-lane and three-lane typicals that were considered, include 8-foot-wide sidewalks along both sides of the road and raised median refuge areas at the mid-block crosswalk locations. These options were presented to the Florence Villa community at two separate neighborhood meetings and there was support for both alternatives.

1.2.2 Segments 2 through 7 – North of Avenue Y to LaVista Drive

For a majority of the corridor, from Avenue Y to LaVista Drive, the four-lane divided typical section described earlier was considered. Additional right-of-way would be needed to accommodate this typical section in most areas, so alternatives included widening to the north side of the road and to the south side of the road. Items affecting the comparison of north side vs. south side widening include planned development, publicly owned parks and recreation areas and a proposed Duke Energy transmission line that will be constructed adjacent to the SR 544 right-of-way in a new easement that Duke Energy is in the process of acquiring.

1.2.3 Segment 8 – LaVista Drive to SR 17

The proposed four lane divided typical section was considered in Segment 8 and alignments evaluated widening to the north, to the south, and centered widening. However, due to the large number of residential relocations that would result with any of these three options, two additional alternatives were considered. The first one considered maintaining the existing four-lane undivided roadway and adding eight-foot sidewalks along each

side of the road. The other option considered a four-lane divided roadway with a reduced median width and eight-foot wide sidewalks located at the back of curb on both sides of the road.

Nine project intersections were evaluated using FDOT's Intersection Control Evaluation (ICE) process.

1.2.4 Martin Luther King Boulevard intersection

The proposed improvements at the Martin Luther King Boulevard intersection include maintaining the existing traffic signal but adding a new southbound right turn lane at the intersection.

1.2.5 Avenue Y intersection

Several alternatives were considered for the Avenue Y intersection including a traffic signal and several roundabouts, including two mini-roundabout alternatives.

1.2.6 Old Lucerne Park Road (west end)

Intersection improvement options at the Old Lucerne Park Road (west end) included a traffic signal and a roundabout. However, due to residential impacts and access issues to some residences in the northwest and northeast quadrants, a concept to realign Old Lucerne Park Road (west end) to align with Vista Del Lago Drive was considered. Both a traffic signal and roundabout were considered for this new intersection.

1.2.7 Lucerne Loop Road intersection

Both a traffic signal and a roundabout were considered for this intersection.

1.2.8 Old Lucerne Park Road (east end)

Several alternatives were considered for the intersection of Old Lucerne Park Road with SR 544. In addition to the skew of Old Lucerne Park Road at the intersection, new developments are planned on the south side of SR 544 across from the intersection and in the northwest quadrant of the intersection. Both a traffic signal and roundabout were evaluated at this intersection.

1.2.9 Lake Hamilton Drive intersection

Several alternatives were considered for this intersection, but a traffic signal was considered as the only viable alternative. This option includes realigning the two internal roads for the developments on the north side of SR 544 so that they would intersect SR 544 at a single location for the north leg of the intersection. Also, the ICE process identified the signalized thru-cut option as a viable alternative.

1.2.10 Brenton Manor Avenue intersection

Because of the proximity of this intersection to the US 27 intersection with SR 544 and the two options that were found to be viable at the US 27 intersection, the intersection type at Brenton Manor Avenue is tied to the concepts considered at US 27. Both a roundabout (paired with the single point urban interchange at US 27) and a traffic signal (paired with the northwest quadrant roadway concept at US 27) were evaluated.

1.2.11 US 27 intersection

Two concepts were found to be viable for consideration at the US 27 intersection with SR 544. These include a quadrant roadway in the northwest quadrant of the intersection that would include an intersection at Brenton Manor Avenue (traffic signal) and a new intersection at US 27. The other viable option is a single point urban interchange.

1.2.12 SR 17 intersection

The only concept identified for the SR 17 intersection was a traffic signal. Only improvements on the west leg of the intersection would be involved.

1.3 Description of Preferred Alternative

Below is a summary of the preferred alternative for each roadway segment and intersection.

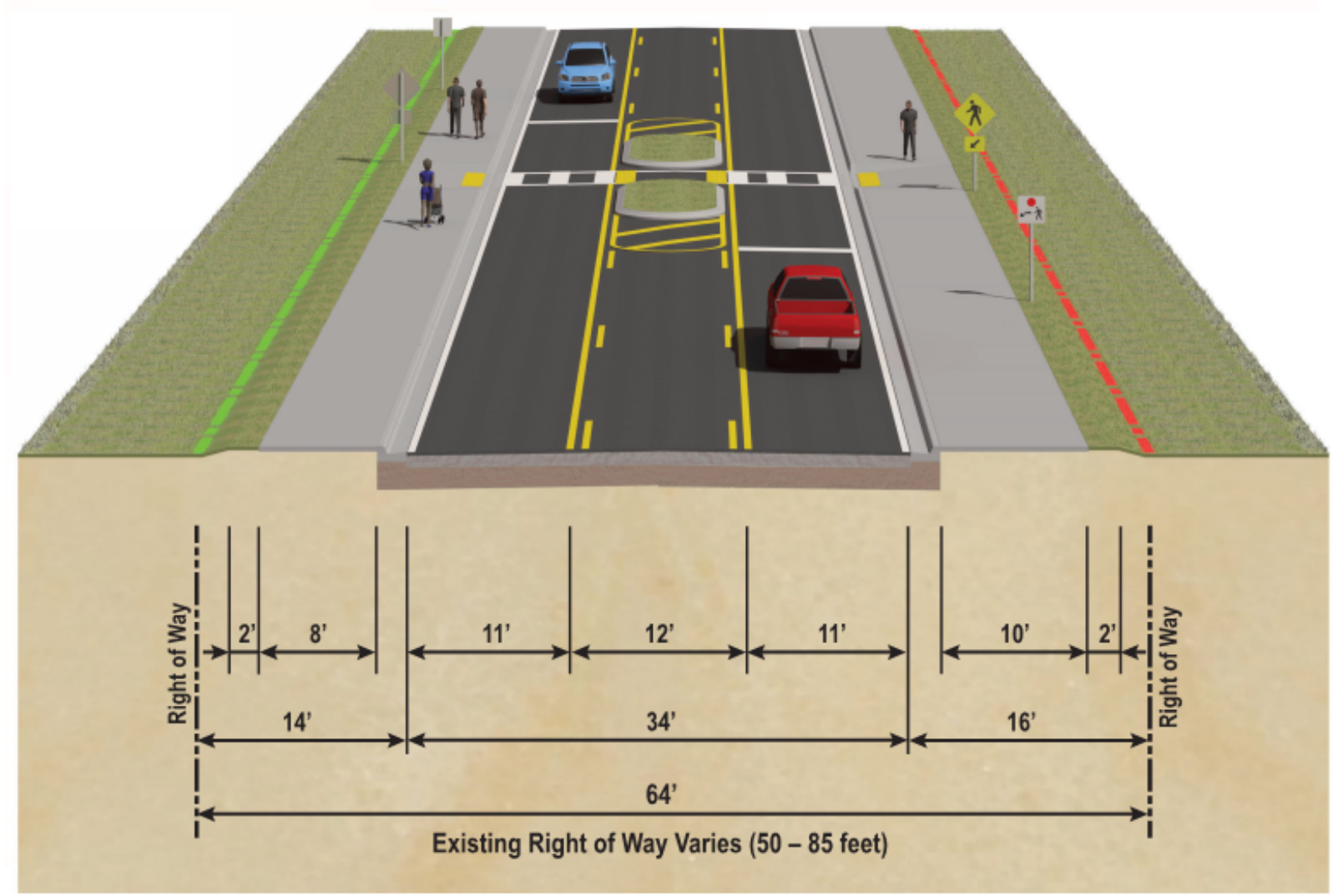
1.3.1 Segment 1 – Martin Luther King Boulevard to North of Avenue Y

The preferred typical section in Segment 1 is the three-lane typical section with a best fit alignment. It is slightly wider and will have minor right-of-way impacts (no residential relocations) than the two-lane alternative but will provide additional safety and capacity for turning vehicles with the center turn lane. Figure 1-2 illustrates this typical section.

The preferred improvement at the Martin Luther King Boulevard intersection is to maintain the existing traffic signal but add a new southbound right turn lane at the intersection. Improvements also include realigning the 1st Street NW intersection with SR 544 farther away from the Martin Luther King Boulevard intersection.

The mini-roundabout with the 90-foot inscribed diameter is recommended at Avenue Y. This concept will minimize impacts to the residences, businesses and church located at this intersection while providing an opportunity for an entrance feature to the historic Florence Villa neighborhood and speed control for vehicles entering the neighborhood.

Figure 1-2: Segment 1 Preferred Typical Section



1.3.2 Segment 2 – North of Avenue Y to East of Lake Conine Canal

The four-lane divided roadway is proposed with widening to the south side of the road. This alignment is recommended to avoid impacts to the Lake Conine Wetland Restoration Area and due to the proximity of the road to Lake Conine and wetlands along the lake. Figure 1-3 illustrates the proposed four-lane divided roadway typical section for Segments 2 through 7.

1.3.3 Segment 3 – East of Lake Conine Canal to East of Old Lucerne Park Road (west end)

The four-lane divided roadway is proposed with widening to the north side of the road. This alignment is recommended to avoid impacts to existing residential developments on the south side of SR 544 and due to the proximity of the road to Lake Smart and wetlands along the lake.

The preferred concept at the Old Lucerne Park Road (west end) intersection is to realign Old Lucerne Park Road (west end) to align with Vista Del Lago Drive and to provide a roundabout at the intersection. The roundabout will help with speed control along SR 544 and improve safety when compared to the traffic signal option.

1.3.4 Segment 4 – East of Old Lucerne Park Road (west end) to East of Lucerne Loop Road

The four-lane divided roadway is proposed with centered widening. The existing road right-of-way can accommodate the proposed four-lane divided roadway in this segment.

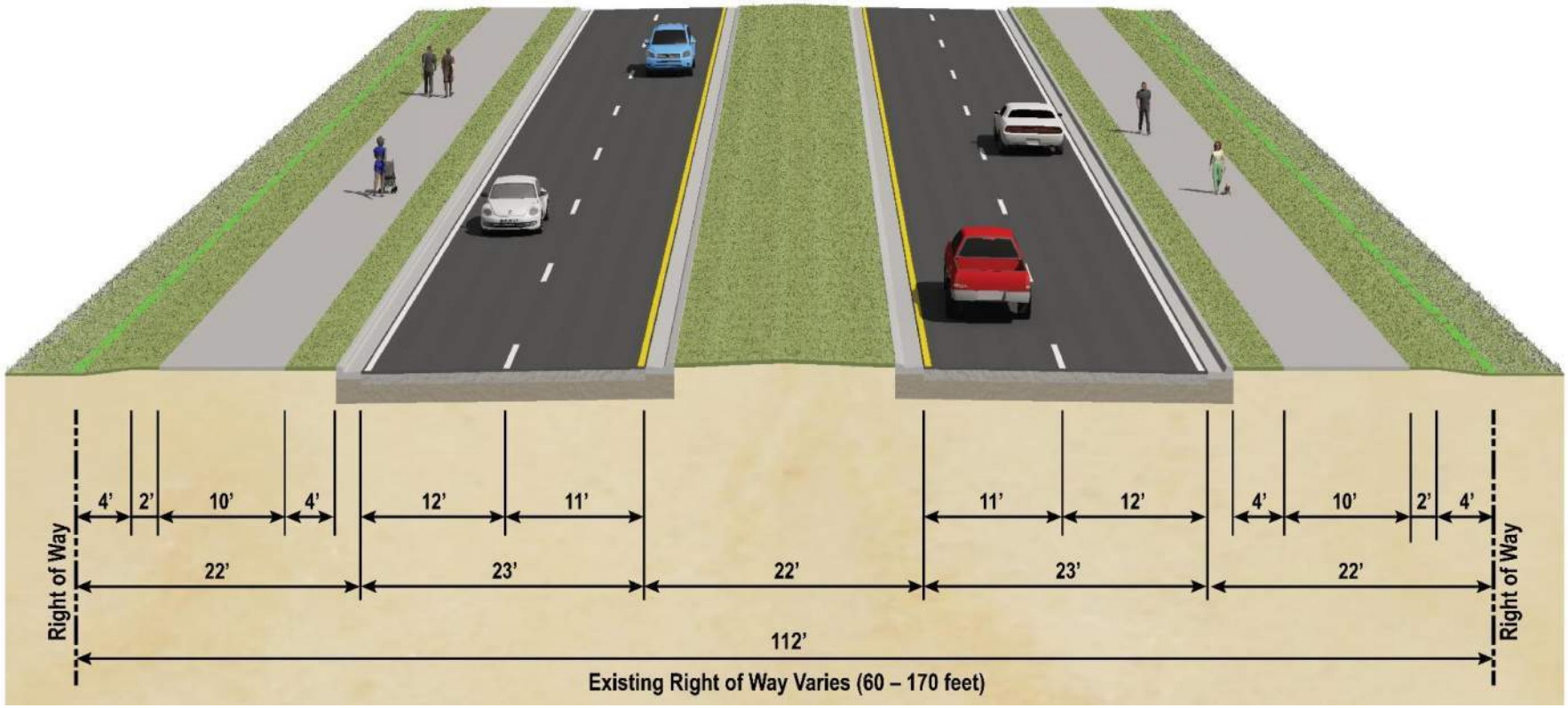
The preferred improvement at the Lucerne Loop Road intersection is the roundabout. It will help with speed control along SR 544 and improve safety when compared to the traffic signal option.

1.3.5 Segment 5 – East of Lucerne Loop Road to East of Lake Hamilton Canal

The four-lane divided roadway is proposed with widening to the north side of the road. This alignment is recommended to avoid impacts to the Lake Region Lakes Management District boat ramp on the south side of the road and also to avoid impacts to the proposed Duke Energy transmission easement/poles on the south side of the road.

The preferred improvement at the Old Lucerne Park Road (east end) intersection is the roundabout. It will help with speed control SR 544 and increase safety when compared to the traffic signal option at this skewed intersection.

Figure 1-3: Segment 2 through Segment 7 Preferred Typical Section



1.3.6 Segment 6 – East of Lake Hamilton Canal to West of Brenton Manor Avenue

The four-lane divided roadway is proposed with widening to the north side of the road. This alignment is recommended to avoid impacts to the Duke Energy transmission easement/poles and existing commercial development on the south side of the road.

The signalized thru-cut alternative is recommended at the Lake Hamilton Drive intersection. This option includes realigning the two internal roads for the developments on the north side of SR 544 so that they intersect SR 544 in a single location (north leg of the intersection).

1.3.7 Segment 7 – West of Brenton Manor Avenue to LaVista Drive

The four-lane divided roadway is proposed with widening to the north side of the road west of US 27 and to the south side of the road east of US 27. This alignment is recommended to avoid impacts to Duke Energy transmission easement/poles that switch from the south side of the road to the north side of the road through the US 27 intersection.

The preferred intersection improvement at Brenton Manor Avenue is the roundabout. This intersection concept is paired with the recommended single point urban interchange at US 27.

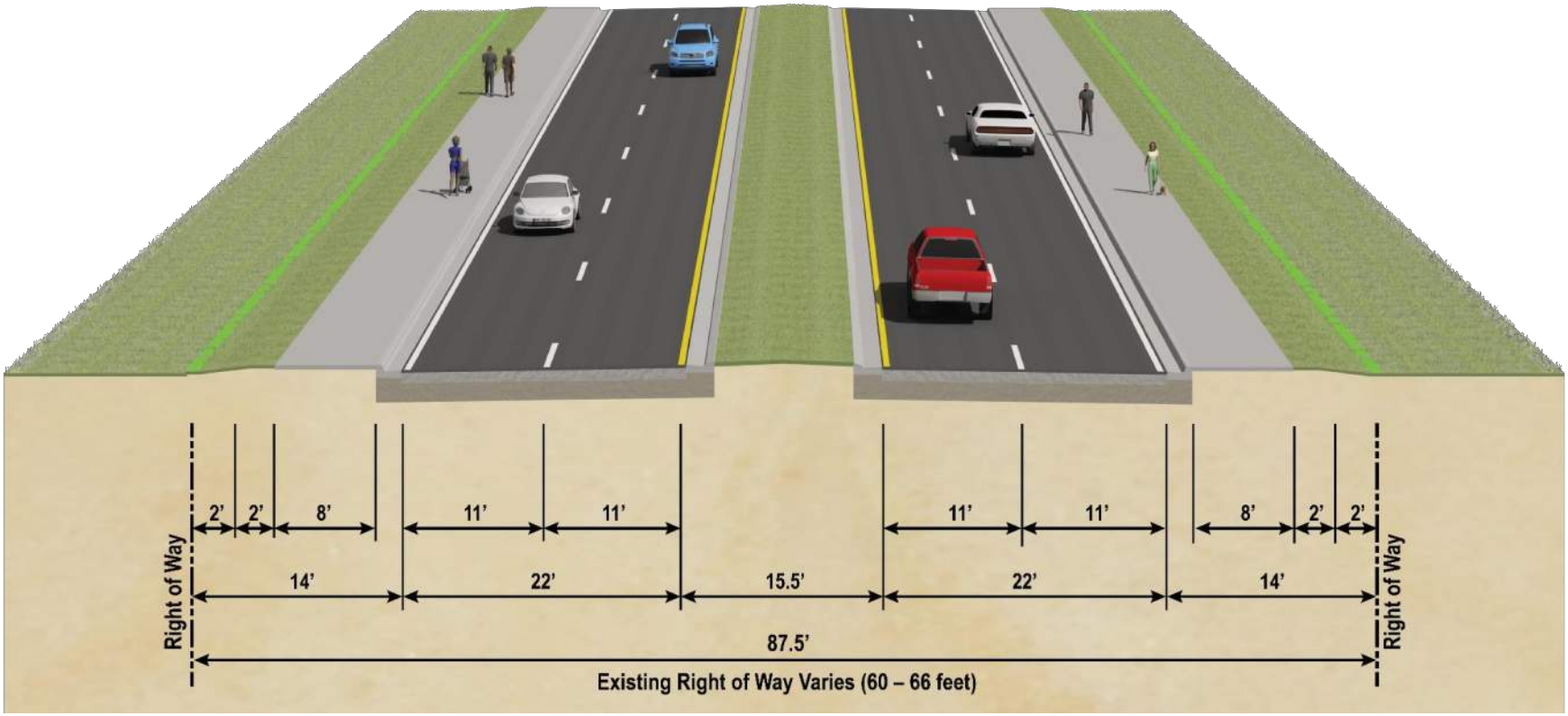
The single point urban interchange is the recommended improvement at the US 27 intersection due to the lower predicted life cycle crash costs with this concept compared to the northwest quadrant roadway with three signalized intersections.

1.3.8 Segment 8 – LaVista Drive to SR 17

The reduced four-lane divided roadway is proposed with centered widening through this segment. This alignment is recommended to minimize residential relocations through this segment of the project but providing access control with the raised median. Figure 1-4 illustrates this typical section.

The preferred concept for the SR 17 intersection is a traffic signal with only improvements to the west leg of the intersection.

Figure 1-4: Segment 8 Preferred Typical Section



2.0 Data Collection

The design team collected and reviewed data from the following sources:

- FDOT Drainage Manual, January 2023
- FDOT Drainage Design Guide, January 2023
- Polk County Land Development Code – Chapter 7, Section 740 (July 2023)
- Lake Region Lakes Management District (LRLRM) Permitting Policy
- SWFWMD Environmental Resource Permit Applicant's Handbook (Volume II)
- Florida Administrative Code (F.A.C.) Chapter 62-330
- Existing Permit Databases (SWFWMD)
- Field Reconnaissance (July 2020)
- United States Geological Survey (USGS) Quadrangle Maps
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel Nos. 12105C0365G, 12105C0355G, 12105C0358G, 12105C0359G, 12105C0380G, Effective Date 12/22/2016, in Polk County, Florida
- United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soils Survey of Polk County, Florida, 2020
- 1-ft LiDAR Data Source: Southwest Florida Water Management District (SWFWMD), Polk County, 2005

3.0 Existing Drainage Conditions

3.1 Topography & Hydrologic Features

Topography along the project is generally hilly with flat areas surrounding the water bodies. Existing ground elevations vary between 125 feet and 220 feet along the roadway corridor, with the highest elevations occurring at the beginning and end of the project limits. All elevations mentioned in this report are in reference to the North American Vertical Datum of 1988 (NAVD) unless otherwise stated. Where information was available only in the National Geodetic Vertical Datum of 1929 (NGVD), it was converted to NAVD using the conversion NAVD = NGVD – 0.88 feet. Please refer to the USGS Quadrangle Map, Figure 2 in **Appendix A**. There are seventeen (17) existing cross drains underneath SR 544 and one (1) bridge within the project limits allowing for conveyance of offsite and onsite runoff to flow beneath the road toward its historical path. The cross drains include two major conveyances – one 12'x12' concrete box culvert that is traversed by boat traffic and one 26' wide bridge culvert. The size and geometry of all cross drains and bridges have been estimated from the FDOT straight line diagram (dated 8/23/2021), 1-foot LiDAR contours, existing plans, and during field reconnaissance but should be verified during design. Please refer to **Table 3-1 for a Summary of Existing Cross Drains and Bridges.**

Table 3-1: Summary of Existing Cross Drains and Bridges

Structure No.	Station	Description	Remarks
CD-1	35+67	Single 36" RCP	
CD-2	46+53	Single 36" RCP	
CD-3	61+81	Single 30" RCP	
CD-4	70+74	Single 24" RCP	
CD-5	75+15	12' x 12' CBC	Canal connecting Lake Smart to Lake Conine
CD-6	86+68	Single 30" RCP	
CD-7	120+14	Double 30" RCP	
CD-8	133+61	Single 36" RCP	
CD-9	154+93	Single 54" RCP	
CD-10	183+65	Single 36" RCP	
CD-11	187+13	Single 48" RCP	
CD-12	233+56	Single 36" RCP	
CD-13	252+10	Triple 24" RCP	
Bridge	289+31	100' Bridge	Lake Henry Canal
CD-14	296+21	Single 30" RCP	
CD-15	348+10	26' Bridge Culvert	Lake Hamilton Creek
CD-16	365+13	Single 30" RCP	
CD-17	389+17	Single 15" RCP	

3.2 Soils Data and Geotechnical Investigations

The soil survey of Polk County, Florida (dated 2020) published by the USDA NRCS has been reviewed within the project vicinity. USDA Soil Survey Geographic database (SSURGO) data was also obtained from NRCS to create a soils map for the project limits using GIS ArcMap. The soil survey map for the project vicinity is illustrated in **Figure 3** of **Appendix A**.

Table 3-2: USDA NRCS Soil Survey Information for Polk County

Soil No.	USDA Soil Name	Seasonal High Ground Water		HSG	Soil Classification		
		Depth* (feet)	Duration (months)		Depth (inches)	Unified	AASHTO
3	Candler sand	>6.0	---	A	0-6	SP-SM, SP	A-3
					6-63	SP-SM, SP	A-2-3, A-3
					63-80	SP-SM	A-2-4, A-3
7	Pomona fine sand	0.5-1.5, 0.0-1.0	---	A/D	0-6	SP-SM, SP	A-2-4, A-3
					6-21	SP-SM, SP	A-2-4, A-3
					21-26	SP-SM, SM	A-2-4, A-3
					26-48	SP-SM, SP	A-2-4, A-3
					48-73	SC-SM, SC, SM	A-2, A-4, A-6
					73-80	SP-SM, SM	A-2-4, A-3
13	Samsula muck	+2.0-0.0	---	A/D	0-24	PT	A-8
					24-32	PT	A-8
					32-35	SP-SM, SM	A-2-4, A-3
					35-44	SP-SM, SM	A-2-4, A-3
					44-80	SP-SM, SM	A-2-4, A-3
14	Sparr sand	1.5-3.5	---	A/D	0-8	SP-SM, SM	A-2-4, A-3
					8-57	SP-SM, SM	A-2-4, A-3
					57-80	SC-SM, SC	A-2-4, A-2-6, A-7-6
15	Tavares fine sand	3.5-6.0	---	A	0-5	SP-SM, SP	A-2-4, A-3
					5-80	SP-SM, SP, SM	A-2-4, A-3
16	Urban land	---	---	---			
17	Smyrna and Myakka fine sands	0.5-1.5, 0.0-1.0	---	A/D	0-7	SP-SM, SP	A-3
					7-25	SP-SM, SP	A-3
					25-36	SP-SM, SM	A-2-4, A-3
					36-80	SP-SM, SP	A-3
21	Immokalee sand	0.5-1.5, 0.0-1.0	---	B/D	0-7	SP-SM, SP	A-3
					7-39	SP-SM, SP	A-3
					39-58	SP-SM, SM	A-2-4, A-3
					58-66	SP-SM, SP	A-3
					66-80	SP-SM, SM	A-2-4, A-3
23	Ona-Ona, wet, fine sand	0.5-1.5, 0.0-1.5	---	B/D	0-9	SP-SM, SP	A-3
					9-16	SP-SM, SM	A-2-4
					16-80	SP-SM, SM	A-2-4, A-3
25	Placid and Myakka fine sands	+2.0-0.0	---	A/D	0-18	SP-SM, SM, SP	A-2-4, A-3
					18-80	SP-SM, SM, SP	A-2-4, A-3
26	Lochloosa fine sand	2.5-5.0	---	C	0-6	SP-SM, SM	A-2-4, A-3
					6-36	SP-SM, SM	A-2-4, A-3
					36-65	SC-SM, SC	A-2-6, A-4, A-6
					65-80	SC-SM, SC	A-2-6 A-4, A-6

Soil No.	USDA Soil Name	Seasonal High Ground Water		HSG	Soil Classification		
		Depth* (feet)	Duration (months)		Depth (inches)	Unified	AASHTO
30	Pompano fine sand	0.0-0.5	---	A/D	0-15	SP-SM, SP	A-3
					15-80	SP-SM, SP	A-3
31	Adamsville fine sand	1.5-3.5	---	A/D	0-7	SP-SM, SM, SP	A-2-4, A-3
					7-20	SP-SM, SM, SP	A-2-4, A-3
					20-80	SP-SM, SM, SP	A-2-4, A-3
32	Kaliga muck	+2.0-0.0	---	C/D	0-25	PT	A-8
					25-35	SC, SM	A-2-4, A-4, A-7-6
					35-60	CL, SC-SM	A-4, A-6
					60-80	CL, SC, SM	A-4, A-6
35	Hontoon muck	+2.0-0.0	---	A/D	0-75	PT	A-8
					75-80	SC-SM, SC, SM	A-2-4, A-6
36	Basinger mucky fine sand	+2.0-0.0	---	A/D	0-7	SP-SM, SM	A-2-4, A-3
					7-19	SP-SM, SM	A-2-4, A-3
					19-39	SP-SM, SM	A-2-4, A-3
					39-80	SP-SM, SM	A-2-4, A-3
40	Wauchula fine sand	0.5-1.5, 0.0-1.0	---	C/D	0-7	SP-SM	A-2-4, A-3
					7-18	SP-SM	A-3, A-2-4
					18-26	SP-SM, SM	A-2-4, A-4
					26-33	SP-SM, SM	A-2-4, A-3
					33-70	SC-SM, SC, SM	A-2-4, A-2-6, A-4, A-6
					70-80	SC-SM, SC	A-2-4, A-2-6
42	Felda fine sand	0.0-1.0	---	A/D	0-5	SP-SM, SP	A-3
					5-22	SP-SM, SP	A-3
					22-50	SC-SM, SC, SM	A-2-4, A-2-6
					50-80	SP-SM, SP	A-2-4, A-2-6
47	Zolfo fine sand	1.5-3.5	---	A	0-5	SP-SM, SM	A-2-4, A-3
					5-59	SP-SM, SM	A-2-4, A-3
					59-80	SP-SM, SM	A-2-4, A-3
49	Adamsville-Urban Land complex	2.0-3.5	---	A	0-6	SP-SM	A-2-4, A-3
					6-80	SP-SM, SP	A-2-4, A-3
50	Candler-Urban Land complex	>6.0	---	A	0-6	SP-SM, SP	A-3
					6-63	SP-SM, SP	A-3
					63-80	SP-SM	A-2-4, A-3
59	Arents-Urban Land complex	1.5-3.0	---	A	0-80	SP-SM, SP	A-2-4, A-3
63	Tavares-Urban Land complex	3.5-6.0	---	A	0-8	SP-SM, SP	A-3
					8-80	SP-SM, SP	A-3
76	Millhopper fine sand	3.5-6.5	---	A	0-7	SP-SM, SM	A-2-4
					7-59	SC-SM, SP-SM, SM	A-2-4
					59-64	CL, SC	A-2-4, A-6
					64-80	CL, SC	A-7-6, A-6

The soils encountered along the project limits are within Hydrologic Soil Groups (HSG) A, A/D, B/D, C, and C/D. Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission. Group B soils have moderately low runoff potential when thoroughly wetted. They consist chiefly of sandy soils with

loam, silt, or sandy clay loam. Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission. If a soil is assigned to a dual HSG, the first letter is for drained areas and the second is for un-drained areas. Soils are only assigned a dual class if they are group D in their natural condition. According to the Soil Survey, there are 24 different soil types located along the project limits within Polk County. **Table 3-2: USDA NRCS Soil Survey Information for Polk County** summarizes and lists the soil types and relevant information. The ground water depth varies from +2 feet above the ground to >6 below the ground along the project per the NRCS Soil Survey information.

3.3 Existing Bridges

The existing bridge over Lake Henry Canal (identified in the Bridge Report as Lake Hamilton Canal) was constructed in 1964 and consists of three (3) concrete spans, each 29.9 feet in length. Information gathered from the National Bridge Inventory was used to provide some of the parameters as summarized in **Table 3-3**. Per the bridge inspection reports, there is no significant known scour at the bridge. The National Bridge Inventory Data can be found in **Appendix F**.

Table 3-3: Existing Bridge Data

Category	Bridge No. 160021
Year Constructed	1964
Structure Name	SR-544 over Lake Henry Canal
Facility Carried	SR-544
Approximate Location	0.8 Miles West of US-27
Owner/Maintenance Agency	State Highway Agency
Crossing/Waterway/ Canal ID	Lake Hamilton Canal
Bridge Length	89.9 ft
Number of Traffic Lanes	2
Number of Spans	3
Structure Type	Reinforced Concrete
Pile Type	
Deck Type	Concrete Cast-in-Place
Deck Condition	7 - Good
Superstructure Condition	7 - Good
Substructure Condition	7 - Good
Sufficiency Rating	91.6

The existing bridge culvert over Lake Hamilton Creek was constructed in 1965 and consists of two (2) culverts, each 9.8 feet in length. Information gathered from the National Bridge Inventory was used to provide some of the parameters as summarized in **Table 3-4**. Per the bridge inspection reports, there is no significant known scour at the bridge. The National Bridge Inventory Data can be found in **Appendix F**.

Table 3-4: Existing Bridge Data

Category	Bridge No. 160147
Year Constructed	1965
Structure Name	SR-544 over Lake Hamilton Creek
Facility Carried	SR-544
Approximate Location	0.2 Miles East of US-27
Owner/Maintenance Agency	State Highway Agency
Crossing/Waterway/ Canal ID	Lake Hamilton Creek
Bridge Length	21.0 ft
Number of Traffic Lanes	2
Number of Spans	2
Structure Type	Reinforced Concrete
Pile Type	N/A
Deck Type	N/A
Deck Condition	
Superstructure Condition	
Culvert Condition	6 - Fair
Sufficiency Rating	96.9

3.4 Environmental Characteristics

3.4.1 Land Use Data

The project corridor is predominately residential, commercial, and industrial with higher density urban areas located near the project beginning and end. Areas of undeveloped forest and wetland, agriculture, and open lakes are also present along the corridor. Several major trucking facilities existing along the corridor including a Walmart Distribution Center and the Century Commercial truck parking facility. Please see **Figures 4A and 4B** for the **Existing and Proposed Land Use Maps** in **Appendix A**. The widening of SR 544 does not alter the existing or future land uses in the area.

3.4.2 Natural and Biological Features

The proposed project has potential to involve several State and/or Federally listed protected wildlife species. These species and their anticipated involvement are identified in the Natural Resources Evaluation Report under a separate cover.

The project corridor was evaluated for the presence of potentially occurring protected species. A species-specific survey was conducted for the Audubon's crested caracara, during which no caracara were observed. The preferred alternative "may affect, but is not likely to adversely affect" the continued existence of the caracara. Due to the lack of suitable habitat or defined conservation measures for the species, the preferred alternative "may affect, but is not likely to adversely affect" the continued existence of the eastern black rail, eastern indigo snake, Everglade snail kite, wood stork, and federally protected plant species. Full acoustic and roost surveys

were conducted to determine Florida bonneted bat activity within the study corridor. No evidence of roosting or foraging was detected and the project is therefore anticipated to have "no effect" on the Florida bonneted bat. The project is also considered to have "no effect" on the Florida grasshopper sparrow and Florida scrub-jay. The project "may affect and is likely to adversely affect" the sand skink and blue-tailed mole skink until a species-specific survey has been completed. "No adverse effect is anticipated" for state listed species including the Florida burrowing owl, Florida pine snake, Florida sandhill crane, gopher tortoise, short-tailed snake, southeastern American kestrel, imperiled wading birds, and state listed plant species.

Wetlands and other surface waters with potential to be affected by the proposed project were identified within the study area. A wetland assessment was performed for these wetlands and other surface waters in accordance with the Uniform Mitigation Assessment Method (UMAM) as described in Chapter 62-345, FAC to determine the functional value provided by the wetlands and other surface waters. Other surface waters classified as upland cut ditches and permitted reservoirs were included in the assessment; however, mitigation will not be required for impacts to these other surface waters. Based on the wetland assessment, approximately 8.66 acres of direct impacts to wetlands are associated with the preferred alternative. Direct wetland impacts of 3.86 acres are associated with the preferred pond alternatives and floodplain compensation sites.

3.5 Floodplains/Floodways

According to the Federal Emergency Management Agency (FEMA), the relevant Flood Insurance Rate Map (FIRM) panel numbers are 12105C0365G, 12105C0355G, 12105C0358G, 1210C0359G, and 12105C380G, dated 12/22/2016.

According to the FEMA FIRMs, portions the project intersect Zone AE of the 100-year floodplain. These areas are associated with the various lakes in the region and have a 1% probability of flooding every year. Predicted flood water elevations range from 124.2 FT to 132.2 FT NAVD across the project limits, varying by lake. There are no federally regulated floodways within the project limits. Please refer to **Appendix A – Figure 5** for the **FEMA Floodplains Map**.

General comments relating to floodplains include the fact that any development within the 100-year floodplain has the potential for placing citizens and property at risk of flooding and producing changes in floodplain elevations and plan view extent. Development (such as roadways, housing developments, strip malls and other commercial facilities) within floodplains increases the potential for flooding by limiting flood storage capacity and exposing people and property to flood hazards. Development also reduces vegetated buffers that protect water quality and destroys important habitats for fish and wildlife. The area surrounding the proposed roadway widening project has and will continue to experience growth.

Any floodplain impacts are recommended to be mitigated for in offsite floodplain compensation sites on a cup for cup basis. From the available data, six (6) Floodplain Impact Areas (FIAs) have been determined based on areas in which the 100-year floodplain lies within the proposed right-of-way. **Figure 3-1** illustrates the location of the FIAs. **Table 3-5** summarizes the estimated floodplain impact volume for each FIA.

For five (5) of the FIAs identified, floodplain compensation sites were identified to provide cup for cup compensation. Calculations for these impacts are located in **Appendix C**. In the area of the remaining FIA, designated FIA "X", was determined that the floodplain shape is outdated and does not reflect real conditions.

The floodplain is a small, isolated shape and since the development of this map, the entire basin has been redeveloped including new stormwater ponds. It is recommended that during the design phase, a Letter of Map Revision (LOMR) be obtained or no-rise shown through floodplain modeling.

Floodplain impacts were quantified by identifying areas in which the floodplain will potentially be impacted by proposed roadway fill or pond berms. These areas were multiplied by an estimated average depth of impact to calculate an impact volume. The depth was calculated to be the lesser of either the difference between the floodplain elevation and the existing ground or the floodplain elevation and the Seasonal High Water Table (SHWT). It is estimated that the project will impact approximately 23.43 acre-feet of floodplain.

For the purpose of this study, a cup for cup approach was taken to provide the Department with right-of-way estimates for offsite floodplain compensation (FPC) sites for funding projections. Compensation volumes were calculated to be the available volume between the Seasonal High Water Table (SHWT) of the proposed compensation site and the 100-year flood elevation of the FIA. The Floodplain Compensation (FPC) sites are shown in **Figure 3-1**. Refer to the Pond Siting Report prepared for the study for further information. During the design phase, it is recommended that alternative approaches to traditional FPCs be considered. Alternative approaches include creating a floodplain model or coordinating with SWFWMD for new models that may become available within the project area.

Table 3-5: Summary of Floodplain Impacts and Compensation Areas

FIA	Estimated Impact Volume (ac-ft)	Estimated FPC Area Required (ac)
1	0.99	0.74
2	3.35	1.62
3	6.53	3.62
4	4.57	4.84
X	0.00	0.00
5	3.14	3.22

Figure 3-1: Floodplain Impact Area Map (FIA)

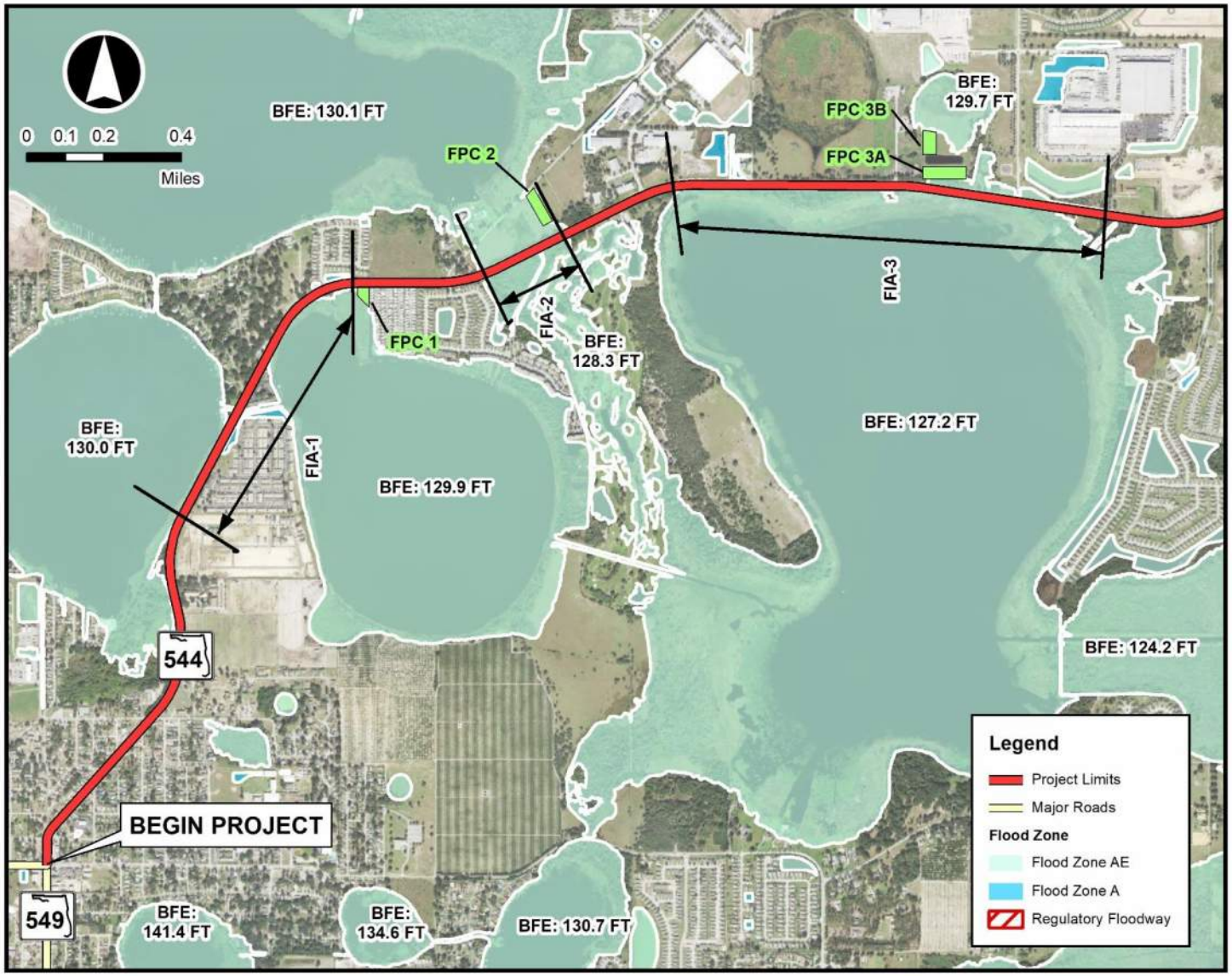
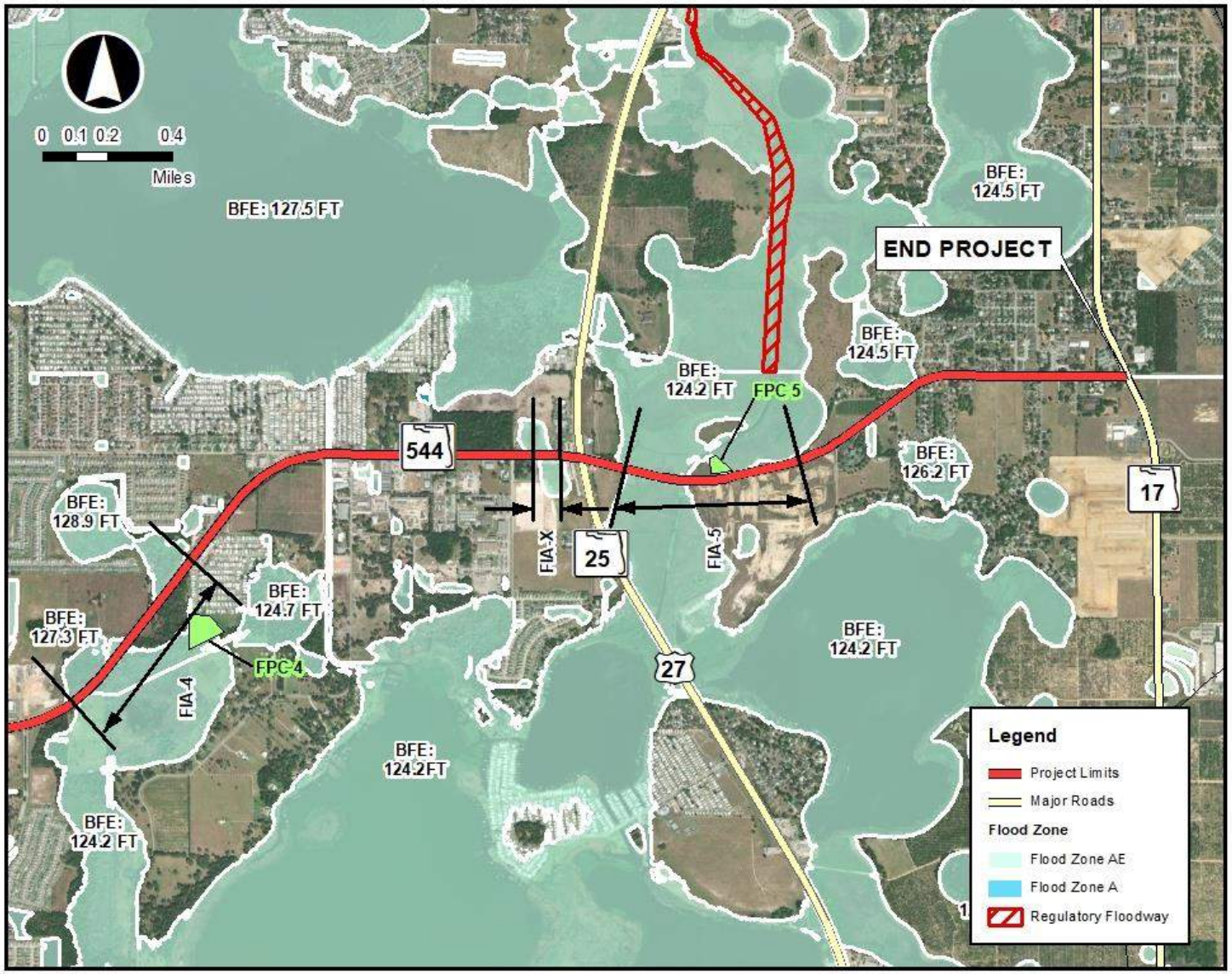


Figure 3-2: Floodplain Impact Area Map (FIA)



3.5.1 Flooding History and Maintenance Concern

A flooding complaint was identified by FDOT near SR 544, immediately east of the Lake Henry Canal. The complaint was logged by residents of the adjacent Lakeside Ranch Estates mobile home community who reported flooding issues on their properties. FDOT investigated the complaint and determined that the issues were a result of poor maintenance of the drainage along SR 544 and the associated outfall ditch. On the north side of SR 544, there is a depressional area that collects water from SR 544 via an open ditch system and a cross drain underneath SR 544 (CD-14). Note, this depressional area is not a permitted stormwater pond and is recommended to be utilized and expanded as the Pond 6 site. An outfall ditch exists between the depressional area and Lake Henry to the north and is intended to allow the depression to overflow into the lake when needed. However, FDOT determined that lack of maintenance through this area is preventing the outfall from performing and causing stormwater to instead stage up into adjacent properties. A resolution to this issue has not been documented. The original flooding investigation document is located in **Appendix G**.

4.0 Proposed Drainage Conditions

The stormwater runoff from the project limits will be collected and conveyed via curb and gutter to the proposed offsite detention ponds. The ponds will discharge at or near the same cross drains that carry the roadway runoff in the existing condition, or directly into canals or wetlands where appropriate. The proposed ponds have been sized to achieve the required water quality treatment and water quantity attenuation and serve as a budget tool for right-of-way estimation for the project to the Department. Please refer to the Pond Siting Report prepared for this study for more information.

4.1 Proposed Cross Drains

A preliminary analysis of the cross drains has been performed to determine whether the existing cross drains can be extended or would require a replacement. Replacement may be required due to an increase in headwater elevations caused by extension of the pipe, the need to relocate the pipe due to the proposed roadway configuration, existing damage to the cross drain that necessitates replacement, or the culvert nearing the end of its service life. Please note that the hydraulic analysis is based on providing adequate conveyance capacity. **Table 4-1** below provides a **Summary of Cross Drains**. The locations of the cross drains can be seen in the basin maps in **Appendix B.**

Table 4-1: Summary of Cross Drains

Structure No.	Station	Existing Condition				Proposed Condition				Remarks
		# of Barrels	Size	Type	Length (ft)	# of Barrels	Size	Type	Length (ft)	
CD-1	35+67	1	36”	RCP	81	1	42”	RCP	120	UPSIZE
CD-2	46+53	1	36”	RCP	72	1	42”	RCP	115	UPSIZE
CD-3	61+81	1	30”	RCP	72	1	30”	RCP	115	EXTEND
CD-4	70+74	1	24”	RCP	72	1	24”	RCP	112	EXTEND
CD-5	75+15	1	12’X12’	CBC	68	1	12”X12”	CBC	112	REPLACE*
CD-6	86+68	1	30”	RCP	72	1	30”	RCP	120	REPLACE**
CD-7	120+14	2	30”	RCP	82	2	30”	RCP	130	EXTEND
CD-8	133+61	1	36”	RCP	62	1	36”	RCP	130	EXTEND
CD-9	154+93	1	54”	RCP	84	1	54”	RCP	130	EXTEND
CD-10	183+65	1	36”	RCP	72	1	42”	RCP	130	UPSIZE
CD-11	187+13	1	48”	RCP	72	1	54”	RCP	130	UPSIZE
CD-12	233+56	1	36”	RCP	72	1	42”	RCP	135	UPSIZE
CD-13	252+10	3	24”	RCP	72	4	24”	RCP	115	ADD BARREL AND EXTEND
CD-14	296+21	1	30”	RCP	72	1	36”	RCP	116	UPSIZE
CD-15	348+10	2	8’X10’	CBC	68	2	8’X10’	CBC	118	REPLACE
CD-16	365+13	1	30”	RCP	72	1	36”	RCP	115	UPSIZE
CD-17	389+17	1	15”	RCP	80	1	15”	RCP	120	EXTEND

*The recommended alternative for CD-5 is to replace it with a bridge in order to provide better visibility and clearance for boaters. Please refer to correspondence with the Lake Region Lakes Management District. Hydraulic analysis has been performed to show that extending the box culvert is hydraulically feasible if this alternative is later pursued.

**While it is hydraulically feasible to extend CD-6, it will conflict with a proposed access road and is therefore recommended to be replaced.

The hydrologic analyses for the existing and proposed cross drains were based on the Rational Method (where adequate data was available to delineate drainage basins) for a 50-year, 100-year, and 500-year storm frequencies. For CD-5 and CD-15, which are both large culverts located within channels, the Velocity Method was used with an assumed velocity of 3 fps and an average flow depth of half of the culvert height, based on field observations. Recommended pipe sizes are based on certain assumptions for the hydraulic analyses such as roadway crest elevation and tailwater conditions. These assumptions were derived from the best available information at the time. Cross drain sizes and inverts were taken from the best available existing plans and verified during field reconnaissance. During the design phase, more accurate information regarding the tailwater conditions and roadway profile will be available to the designer. The cross drains were analyzed using the Federal Highway Administration HY-8 (v. 7.60) cross drain modeling software. For more information regarding the Cross Drain Analysis please refer to **Appendix D.**

4.2 Proposed Bridges

A Bridge Hydraulics Report (BHR) will be required during the design phase to evaluate the hydraulic impacts to Bridge #160021 over the Lake Henry Canal and #160147 over Lake Hamilton Creek. If CD-5 is converted to a bridge as recommended, a BHR will also be required for this culvert. Preliminary proposed bridge information, such as proposed length, width, number of spans, and vertical clearance, is discussed in the *Preliminary Engineering Report* prepared for this study. A scour evaluation should also be performed as part of the Bridge Hydraulics Report for the proposed bridges and bridge culvert. Potential bridge scour considerations include the long-term aggradation and degradation of the channel, contraction scour at the bridge and local scour at the piers and abutments.

Minimum vertical clearance required between the design flood stage (50-year storm) and the low member of the bridge is 2 feet. This clearance is necessary to allow the majority of debris to pass without causing damage to the structure. In addition, a minimum vertical clearance of 12 feet above the Mean High Water (MHW) is required for concrete superstructures classified as moderately aggressive due to chloride content. A minimum of 10 feet of horizontal clearance is required for crossings subject to boat traffic or consistent with debris conveyance needs and structure economy where no boat traffic is anticipated; however a minimum of 15 feet is requested by the LRLMD for the proposed bridge over the Conine-Smart Canal (existing CD-5). Additional clearances may be required by the LRLMD for CD-5 and SWFWMD for Bridge #160021 and should be further coordinated and documented in the BHR.

4.3 Longitudinal & Transverse Floodplain Impacts

The project will impact the 100-year floodplain in two (2) different ways;

1) Longitudinal encroachments resulting from filling the floodplain areas associated with proposed roadway widening within the project limits, isolated wetlands, wetland systems, and depressional areas.
2) Transverse impacts resulting from the extension and replacement of the existing cross drain culverts.

The longitudinal impacts cannot be avoided since the floodplains extend both north and south of SR 544 within the study limits. The floodplain impact area was quantified based on the FEMA FIRMs and established 100-year

base flood elevation, and the existing ground elevations were established from 1-foot LIDAR contours. To be conservative, it was assumed that any fill from the proposed roadway outside of the existing roadway was quantified as floodplain impacts.

The transverse impacts resulting from the extension or replacement of the culverts have not been analyzed in this report. To minimize upstream impacts, FDOT design criteria for conveyance systems (e.g. culverts) allow no significant rise in flood stages at the upstream end of the structures. During design, efforts should be made to show that proposed base headwater elevations will not surpass 0.1 feet of rise from the existing condition, and every necessary action should be taken to minimize upstream impacts. A preliminary hydraulic analysis of the cross drains has been performed as part of this study and included in this report.

4.4 Project Classification

The floodplain is located in a low density, non-urbanized area, and the encroachment area is classified as "minimal". Minimal encroachments on a floodplain occur when there is a floodplain involvement, but the impacts on human life, transportation facilities, and natural and beneficial floodplain values are not significant and can be resolved with minimal efforts. Normally, these minimal efforts to address the impacts will consist of applying the Department's drainage design standards and following the Water Management District's procedures to achieve results that will not increase or significantly change the flood elevations and/or limits.

4.5 Risk Evaluation

There is no change in flood "risk" associated with this project. The encroachments will not have a significant potential for interruption or termination of transportation facilities needed for emergency vehicles or used as an evacuation route. In addition, no significant adverse impacts on natural and beneficial floodplain values are anticipated and no significant impacts to highway users are expected.

4.6 PD&E Manual Requirements with Minimal Encroachment

Chapter 13 regarding Floodplains of the FDOT's PD&E Manual, Part 2 defines four categories of encroachments as they pertain to base floodplain involvement; significant, minimal, none and no involvement, and also lists the report criteria corresponding to these encroachment categories. The FDOT has different requirements based on the category of encroachment. The proposed SR 544 widening project was determined to have minimal encroachments and as a result, the requirements for this category are listed as follows:

a) **General description of the project including location, length, existing and proposed typical sections, drainage basins, and cross drains.**
See Sections 1.0 through 4.2 of this LHR for general project information and the Pond Siting Report for drainage basin descriptions.

b) **Determination of whether the proposed action is in the base floodplain.**
It has been determined that improvements associated with the widening of SR 544 will encroach on the Zone AE 100-year floodplain as established by the most recent FEMA maps dated 12/22/2016.

c) The history of flooding of the existing facilities and/or measures to minimize any impacts due to the proposed project improvements.

Flooding along SR 544 has not been recorded or reported by local agencies. One flooding complaint was identified within the project limits which involves flooding on private property that appears to be a result of a poorly maintained outfall for runoff from SR 544 (see Section 3.5.1 for more information). Floodplain Compensation Areas (FPCs) will be constructed to mitigate loss of storage in the floodplain throughout the corridor due to the project improvements. In addition, stormwater treatment areas are proposed to attenuate runoff. The project will have no adverse impact on the existing condition.

d) Determination of whether the encroachment is longitudinal or transverse, and if it is a longitudinal encroachment an evaluation and discussion of practicable avoidance alternatives.

With the increase in the number of travel lanes proposed, there will be longitudinal and transverse impacts to the floodplain. Longitudinal impacts will be minimized by utilizing the maximum allowable roadway embankment slope.

The transverse floodplain impacts from the project occur due to the lengthening of the existing cross drains. The impacts at these locations are not analyzed during this study and will need to be addressed during the design phase. A preliminary hydraulic analysis for the longer cross drains has been performed for this study and included in this report.

The existing roadway bisects the floodplain. There are no economically feasible avoidance alternatives.

e) The practicability of avoidance alternatives and/or measures to minimize impacts.

The project will take every effort to minimize floodplain impacts resulting from the roadway fill. The maximum allowable roadway embankment slope will be used within the floodplain area to minimize the floodplain impacts.

f) Impact of the project on emergency services and evacuation.

The proposed cross drains, bridges, and bridge culvert will perform hydraulically in a manner equal to or greater than the existing condition, and backwater elevations are not expected to increase. As a result, there will be no significant change in flood risk, and there will not be a significant change in the potential for interruption or termination of emergency service or in emergency evacuation routes.

g) Impacts of the project on the base flood, likelihood of flood risk, overtopping, location of overtopping, backwater.

The proposed cross drains, bridges, and bridge culvert will perform hydraulically in a manner equal to or greater than the existing condition. As a result, there will be no significant change in flood risk or overtopping.

h) Determination of the impact of the proposed improvements on regulatory floodways, if any, and documentation of coordination with FEMA and local agencies to determine the project's consistency with the regulatory floodway.

There is no involvement with regulatory floodways on this project.

i) The impacts on natural and beneficial floodplain values, and measures to restore and preserve these values (this information may also be addressed as part of the wetland impact evaluation and recommendations).

Floodplain impacts are proposed to be compensated in offsite floodplain compensation sites on a cup for cup basis, therefore, no impacts to beneficial floodplain values are anticipated. Wetland impacts are addressed as part of the Natural Resource Evaluation Report.

j) Consistency of the project with the local floodplain development plan or the land use elements in the Comprehensive Plan, and the potential impacts of encouraging development within the 100-year base floodplain.

The project will remain consistent with local floodplain development plans. The project will not support base floodplain development that is incompatible with existing floodplain management programs.

k) Measures to minimize floodplain impacts associated with the project, and measures to restore and preserve the natural and beneficial floodplain values impacted by the project.

The project will take every effort to minimize floodplain impacts resulting from the roadway fill. The maximum allowable roadway embankment slope will be used within the floodplain area to minimize the floodplain impacts and floodplain compensation will be provided as needed.

l) A map showing project, location and impacted floodplains. Copies of applicable maps should be included in the appendix.

*See Figure 5 in **Appendix A** and Figures 3-1 and 3-2.*

m) Results of any and all project risk assessments performed.

The proposed cross drains, bridges, and bridge culvert will perform hydraulically in a manner equal to or greater than the existing condition. As a result, there will be no significant change in flood risk.

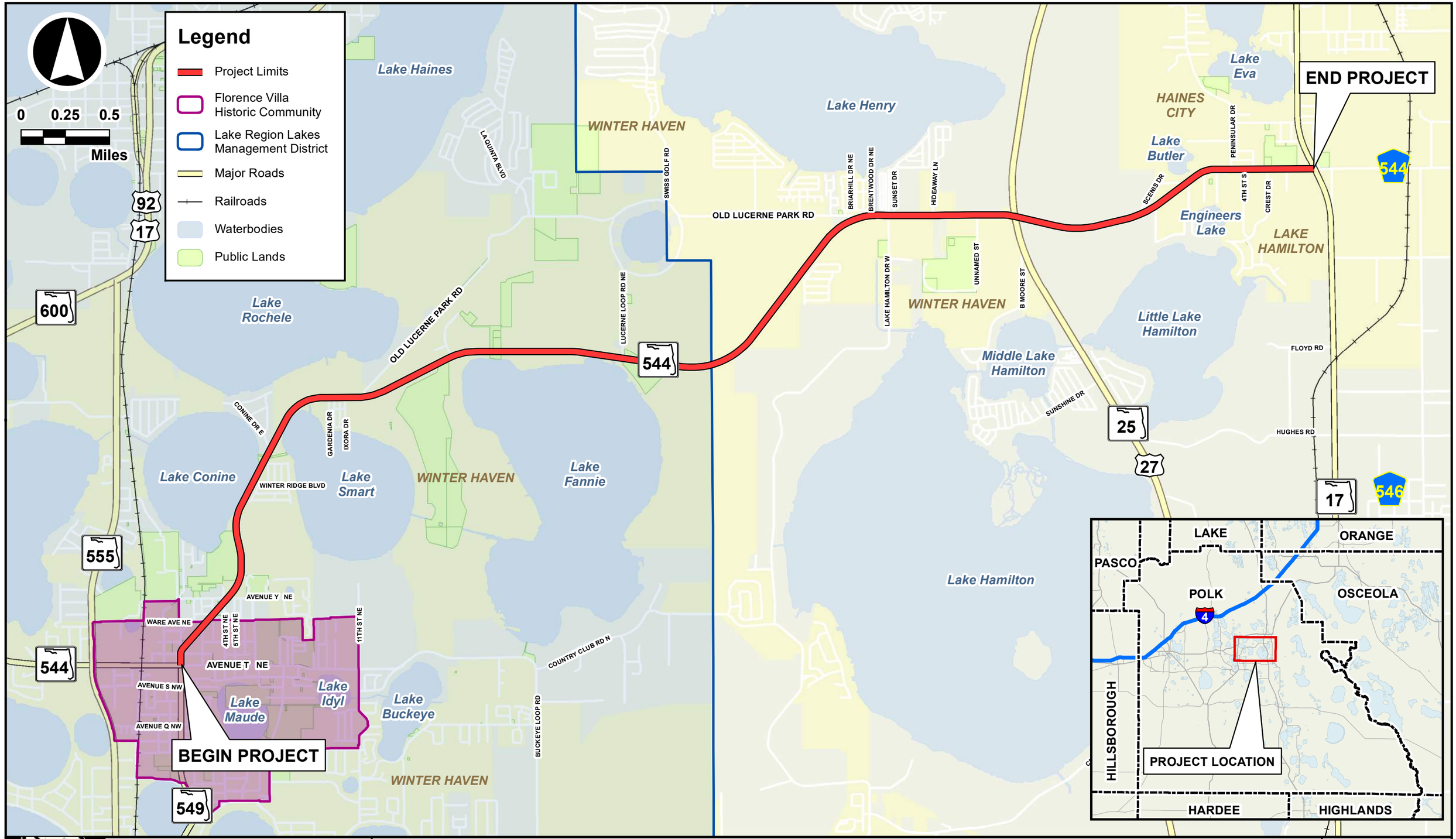
5.0 Conclusion and Recommendations

The modification to the drainage structures (cross drains, bridge and bridge culvert) included in the project will result in an insignificant change in their capacity to carry floodwater. This change will cause minimal increases in flood heights and flood limits. An alternative encroachment location is not considered in this category as it defeats the project purpose or is economically unfeasible. The proposed structures should be hydraulically equivalent to or greater than the existing structures, and backwater surface elevations are not expected to increase. As a result, the project will not affect existing flood heights or floodplain limits. This project will not result in any new or increased adverse environmental impacts. There will be no significant change in the potential for interruption or termination of emergency service or emergency evacuation routes. Therefore, it has been determined that these encroachments are not significant.

Although floodplain compensation sites have been conservatively sized for floodplain impact compensation for this project, it is recommended that additional alternatives be considered, such as a modeling approach or combining FPC sites. These alternatives should be further evaluated during the design phase.

APPENDIX A

Exhibits



Florida Department of Transportation
District 1

State Road 544 PD&E Study
from Martin Luther King Blvd / Avenue T W
to State Road 17
Polk County, Florida

Financial Project ID: 440273-1-22-01

PROJECT LOCATION MAP

Figure 1

Legend

- Project Limits
- Major Roads
- Railroads
- USGS Quadrangle
  Source: USGS 2018

0 0.25 0.5 Miles

END PROJECT

BEGIN PROJECT

WINTER HAVEN

DUNDEE

Florida Department of Transportation
District 1

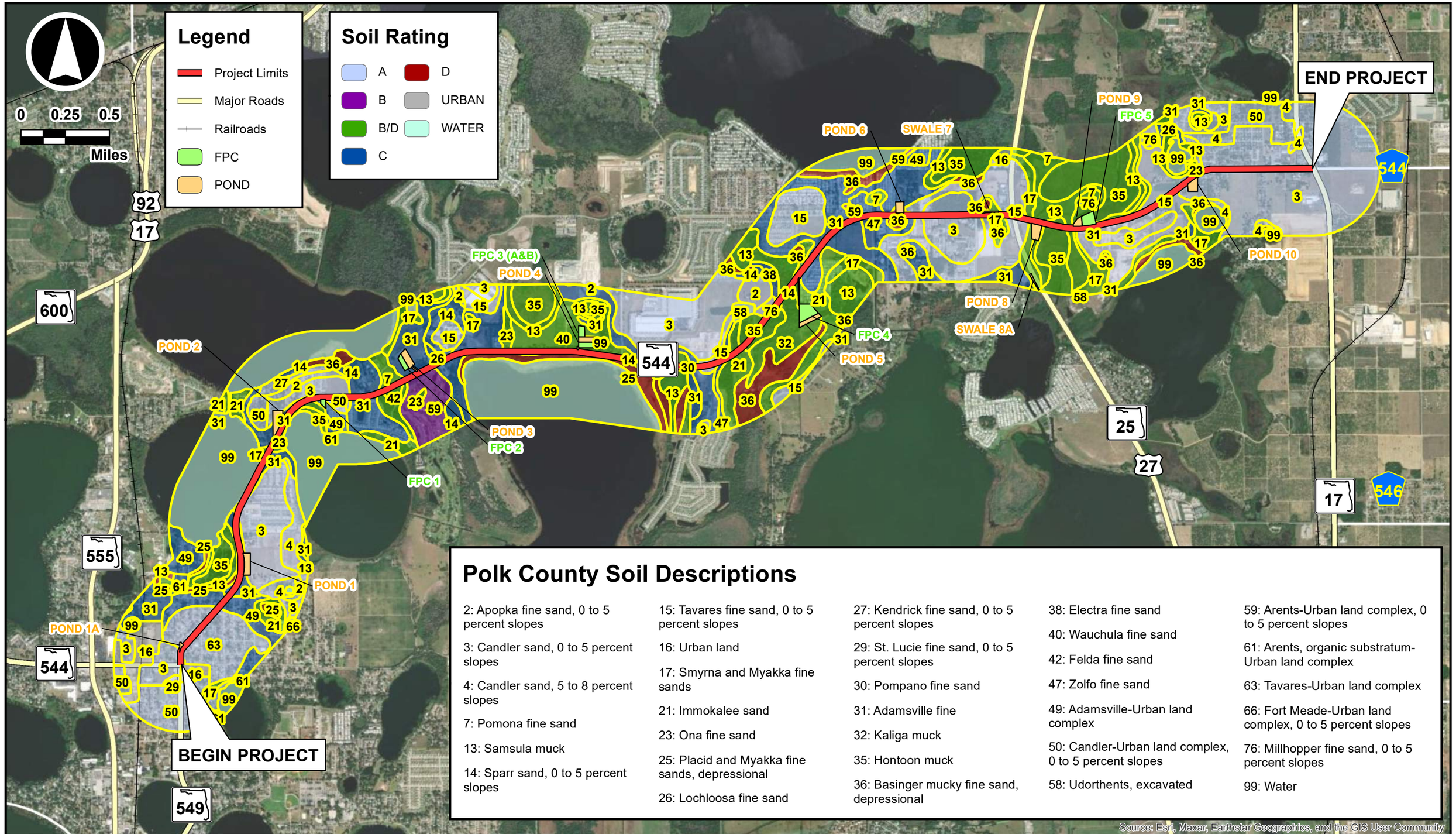
State Road 544 PD&E Study

from Martin Luther King Blvd / Avenue T W
to State Road 17
Polk County, Florida

Financial Project ID: 440273-1-22-01

USGS QUADRANGLE MAP

Figure
2



Polk County Soil Descriptions

2: Apopka fine sand, 0 to 5 percent slopes

3: Candler sand, 0 to 5 percent slopes

4: Candler sand, 5 to 8 percent slopes

7: Pomona fine sand

13: Samsula muck

14: Sparr sand, 0 to 5 percent slopes

15: Tavares fine sand, 0 to 5 percent slopes

16: Urban land

17: Smyrna and Myakka fine sands

21: Immokalee sand

23: Ona fine sand

25: Placid and Myakka fine sands, depressional

26: Lochloosa fine sand

27: Kendrick fine sand, 0 to 5 percent slopes

29: St. Lucie fine sand, 0 to 5 percent slopes

30: Pompano fine sand

31: Adamsville fine

32: Kaliga muck

35: Hontoon muck

36: Basinger mucky fine sand, depressional

38: Electra fine sand

40: Wauchula fine sand

42: Felda fine sand

47: Zolfo fine sand

49: Adamsville-Urban land complex

50: Candler-Urban land complex, 0 to 5 percent slopes

58: Udorthents, excavated

59: Arents-Urban land complex, 0 to 5 percent slopes

61: Arents, organic substratum-Urban land complex

63: Tavares-Urban land complex

66: Fort Meade-Urban land complex, 0 to 5 percent slopes

76: Millhopper fine sand, 0 to 5 percent slopes

99: Water

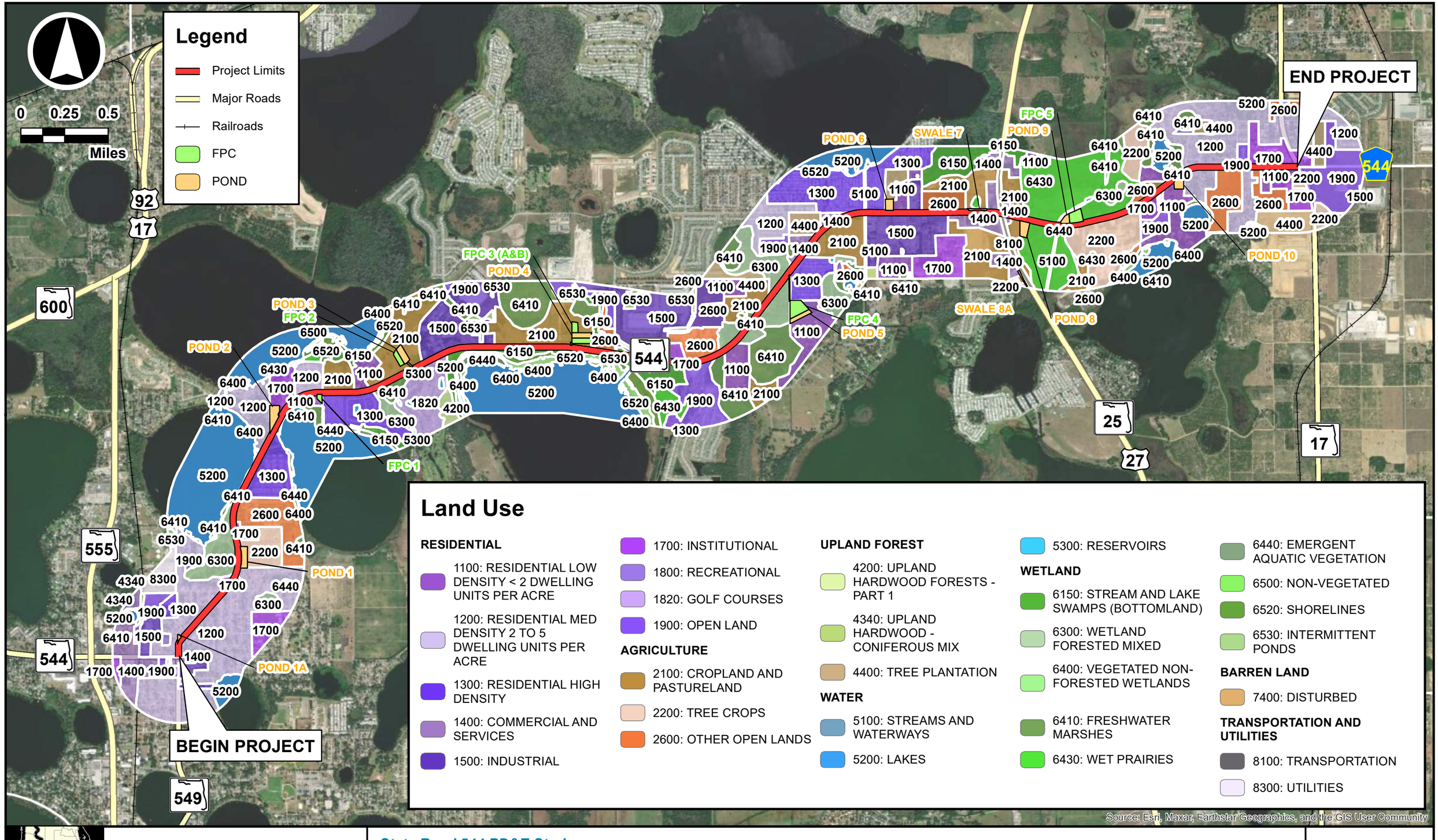
Florida Department of Transportation
District 1

State Road 544 PD&E Study
from Martin Luther King Blvd / Avenue T W
to State Road 17
Polk County, Florida

Financial Project ID: 440273-1-22-01

NRCS SOILS MAP

Figure
3



Land Use

RESIDENTIAL

- 1100: RESIDENTIAL LOW DENSITY < 2 DWELLING UNITS PER ACRE
- 1200: RESIDENTIAL MED DENSITY 2 TO 5 DWELLING UNITS PER ACRE
- 1300: RESIDENTIAL HIGH DENSITY
- 1400: COMMERCIAL AND SERVICES
- 1500: INDUSTRIAL
- 1700: INSTITUTIONAL
- 1800: RECREATIONAL
- 1820: GOLF COURSES
- 1900: OPEN LAND

AGRICULTURE

- 2100: CROPLAND AND PASTURELAND
- 2200: TREE CROPS
- 2600: OTHER OPEN LANDS

UPLAND FOREST

- 4200: UPLAND HARDWOOD FORESTS - PART 1
- 4340: UPLAND HARDWOOD - CONIFEROUS MIX
- 4400: TREE PLANTATION

WATER

- 5100: STREAMS AND WATERWAYS
- 5200: LAKES
- 5300: RESERVOIRS

WETLAND

- 6150: STREAM AND LAKE SWAMPS (BOTTOMLAND)
- 6300: WETLAND FORESTED MIXED
- 6400: VEGETATED NON-FORESTED WETLANDS
- 6410: FRESHWATER MARSHES
- 6430: WET PRAIRIES
- 6440: EMERGENT AQUATIC VEGETATION
- 6500: NON-VEGETATED
- 6520: SHORELINES
- 6530: INTERMITTENT PONDS

BARREN LAND

- 7400: DISTURBED

TRANSPORTATION AND UTILITIES

- 8100: TRANSPORTATION
- 8300: UTILITIES

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

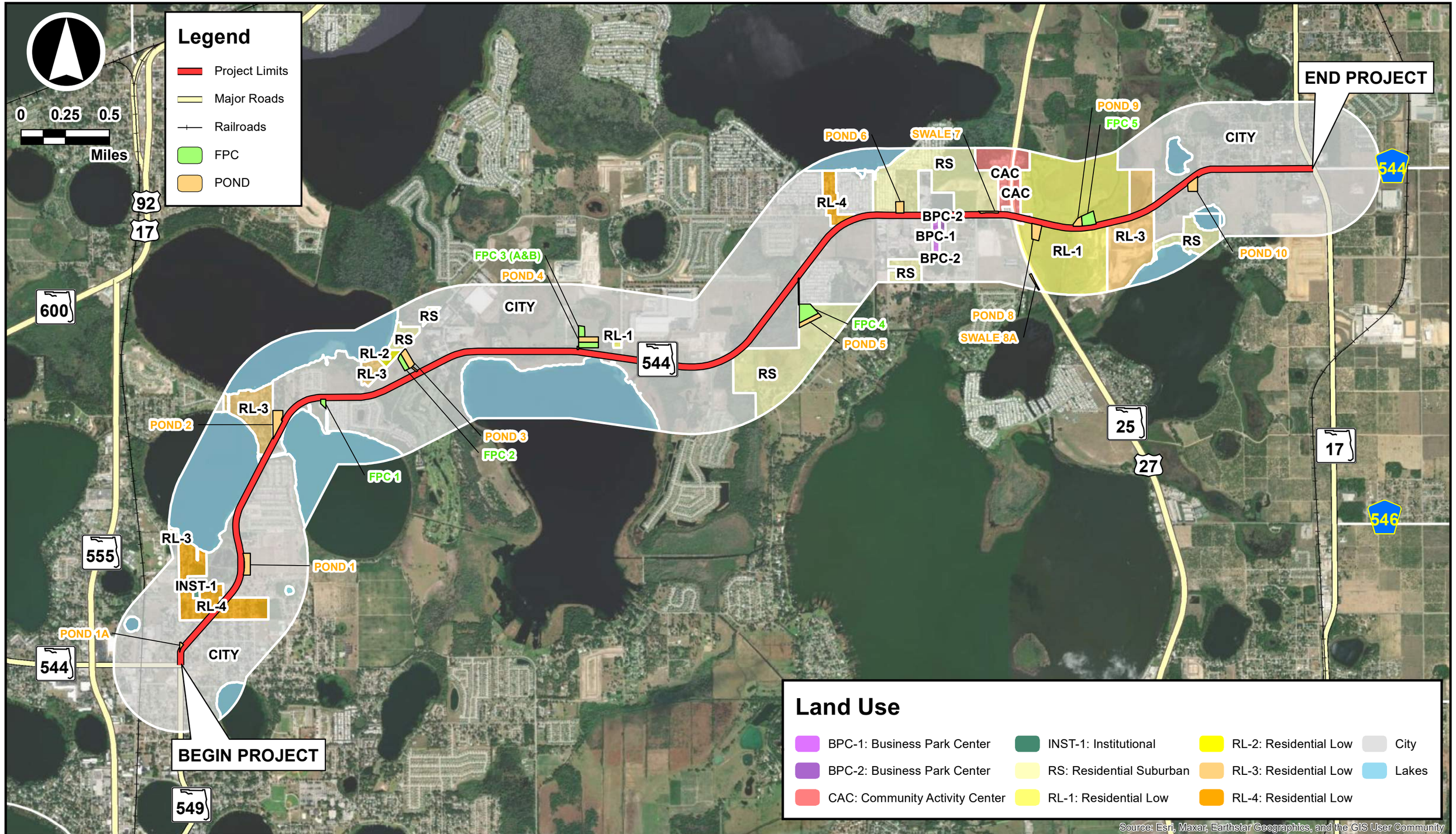
Florida Department of Transportation
District 1

State Road 544 PD&E Study
from Martin Luther King Blvd / Avenue T W
to State Road 17
Polk County, Florida

Financial Project ID: 440273-1-22-01

EXISTING LAND USE MAP (SWFWMD)

Figure
4A



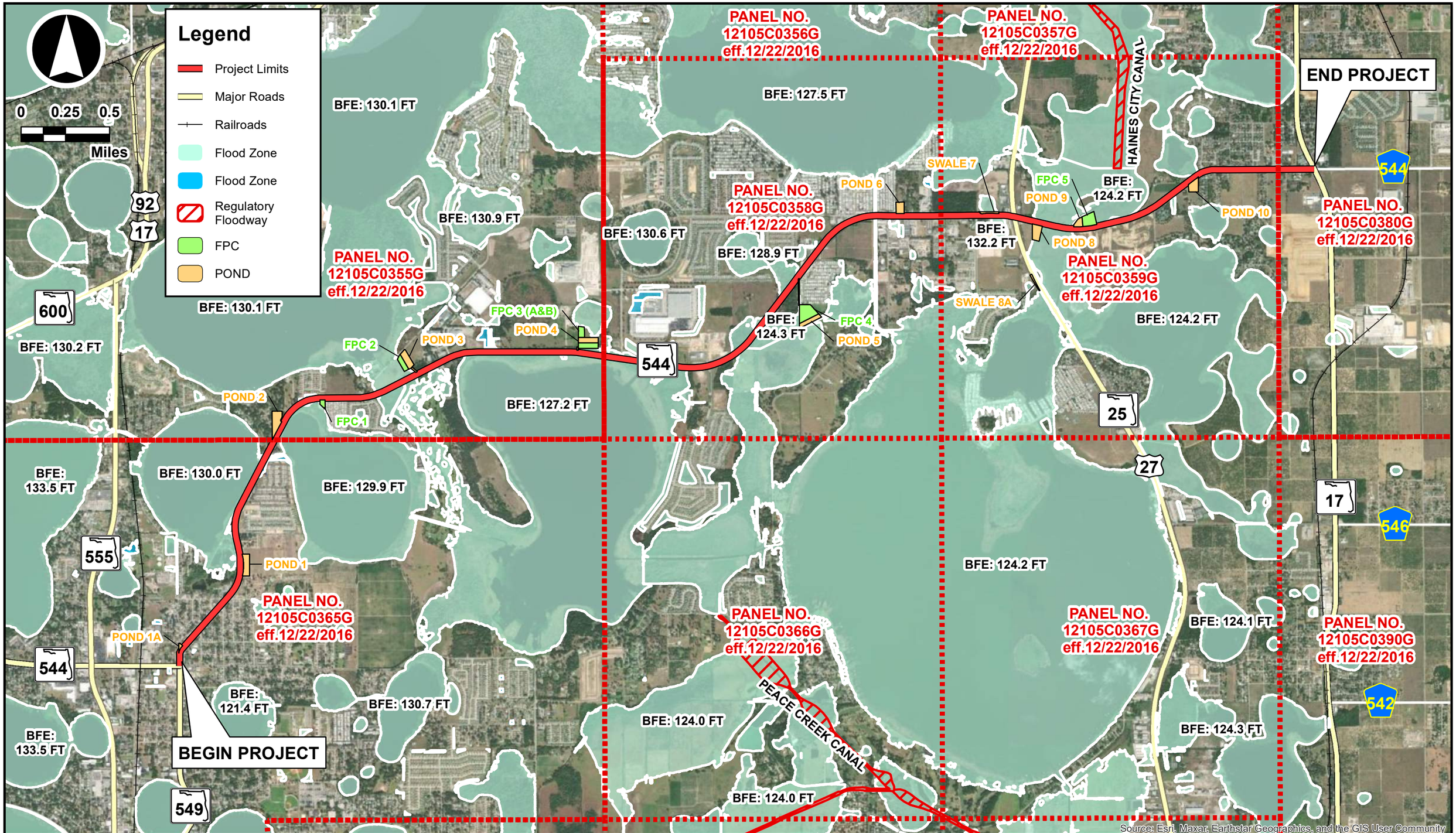
Florida Department of Transportation
District 1

State Road 544 PD&E Study
from Martin Luther King Blvd / Avenue T W
to State Road 17
Polk County, Florida

Financial Project ID: 440273-1-22-01

PROPOSED LAND USE MAP (POLK COUNTY)

Figure 4B



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

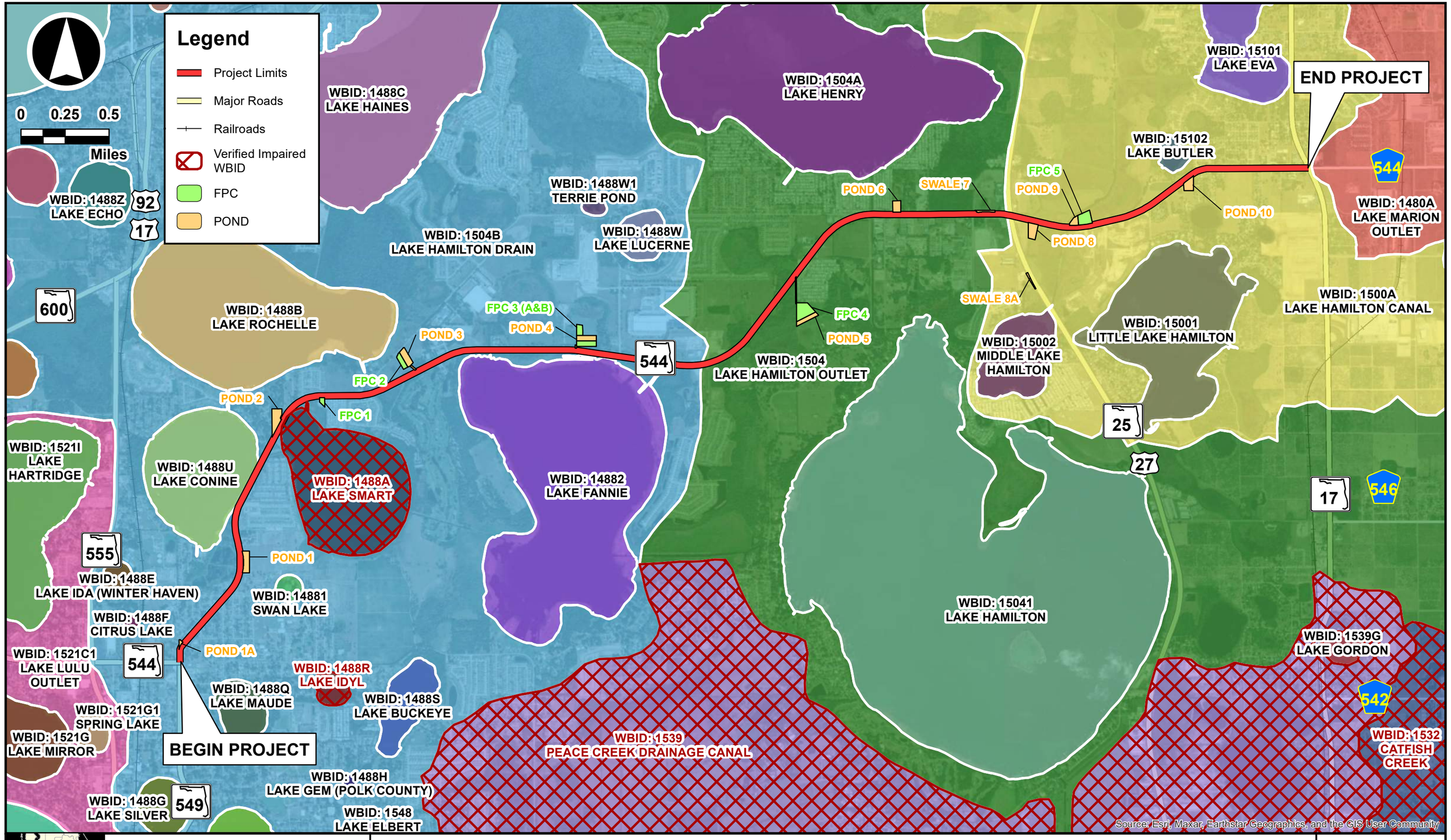
Florida Department of Transportation
District 1

State Road 544 PD&E Study
from Martin Luther King Blvd / Avenue T W to State Road 17
Polk County, Florida

Financial Project ID: 440273-1-22-01

FEMA FLOODPLAINS MAP

Figure 5



Florida Department of Transportation
District 1

State Road 544 PD&E Study
from Martin Luther King Blvd / Avenue T W
to State Road 17
Polk County, Florida

Financial Project ID: 440273-1-22-01

WBID MAP

Figure 6

APPENDIX B

Basin Maps

LAKE CITRUS

LAKE CONINE

0 100 400
Feet

ELEVATION CONTOURS
111-118
119-125
126-133
134-148
149-155
156-162
163-170
171-177
178-185
186-192
193-199
200-207
208-214
215-222

AVE T NW

AVE U NW

AVE V NW

AVE W NW

2ND ST NW

1ST ST N

MOTOR POOL RD

PALM DR NE

SUNSET SHORE DR

SUNSET DR E

544

POND 1A
0.37 AC

10

AVE W NE

2ND ST NE

3RD ST NE

ULRICH AVE

AVE Y NE

EUCLERVILLE PARK RD

15

20

25

544

4TH ST NE

AVE U NE

AVE V NE

STARS AVE NE

AVE T NE

CD-1
36" RCP

30

35

40

CD-2
36" RCP

45

50

55

POND 1
2.83 AC

LEGEND
BASIN 1A
BASIN 1
FLOOD ZONE A
FLOOD ZONE AE
WETLANDS
CROSS DRAIN
OFFSITE DRAINAGE AREA

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	440273-1-22-01

BASIN MAPS

SHEET NO.
1

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	440273-1-22-01

BASIN MAPS

SHEET NO. 2

LAKE ROCHELLE

POND 3
2.50 AC

POND 3 EASEMENT
0.23 AC

FPC 2
1.62 AC

CD-8
36" RCP

CD-9
54" RCP

CD-7
DBL. 30" RCP

OLD LUCERNE PARK RD

LUCERNE PARK RD

VALENTIA BLVD

VISTA DEL LAGO DR

ESTATE BLVD

544

120 125 130 135 140 145 150 155 160 165

N

0 100 400
Feet

LAKE FANNIE

ELEVATION CONTOURS

111-118	171-177
119-125	178-185
126-133	186-192
134-148	193-199
149-155	200-207
156-162	208-214
163-170	215-222

LEGEND

- BASIN 3
- BASIN 4
- FLOOD ZONE A
- FLOOD ZONE AE
- WETLANDS
- CROSS DRAIN
- OFFSITE DRAINAGE AREA

REVISIONS

DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	440273-1-22-01

BASIN MAPS

SHEET NO. 3

FPC 3B
1.33 AC

POND 4
EASEMENT
0.11 AC

POND 4
2.21 AC

FPC 3A
2.29 AC

CD-10
36" RCP

CD-11
48" RCP

LUCERNE PARK RD

544

LAKESIDE LANDING BLVD

LAKE FANNIE

N

0 100 400
Feet

175 180 185 190 195 200 205 210 215 220 225 230

ELEVATION CONTOURS

111-118	171-177
119-125	178-185
126-133	186-192
134-148	193-199
149-155	200-207
156-162	208-214
163-170	215-222

LEGEND

- BASIN 4
- BASIN 5
- FLOOD ZONE A
- FLOOD ZONE AE
- WETLANDS
- CROSS DRAIN
- OFFSITE DRAINAGE AREA

REVISIONS

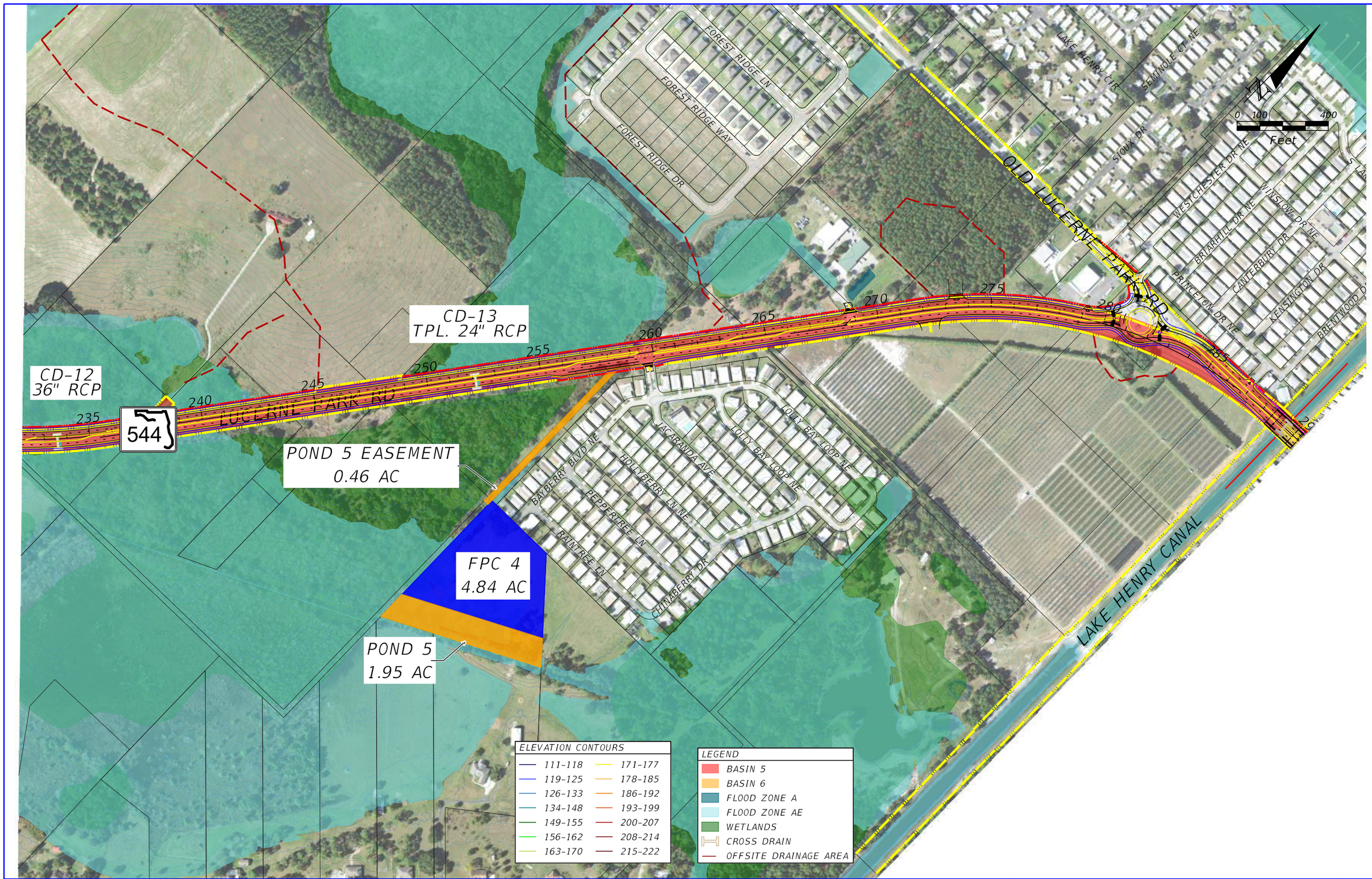
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	440273-1-22-01

BASIN MAPS

SHEET NO. 4



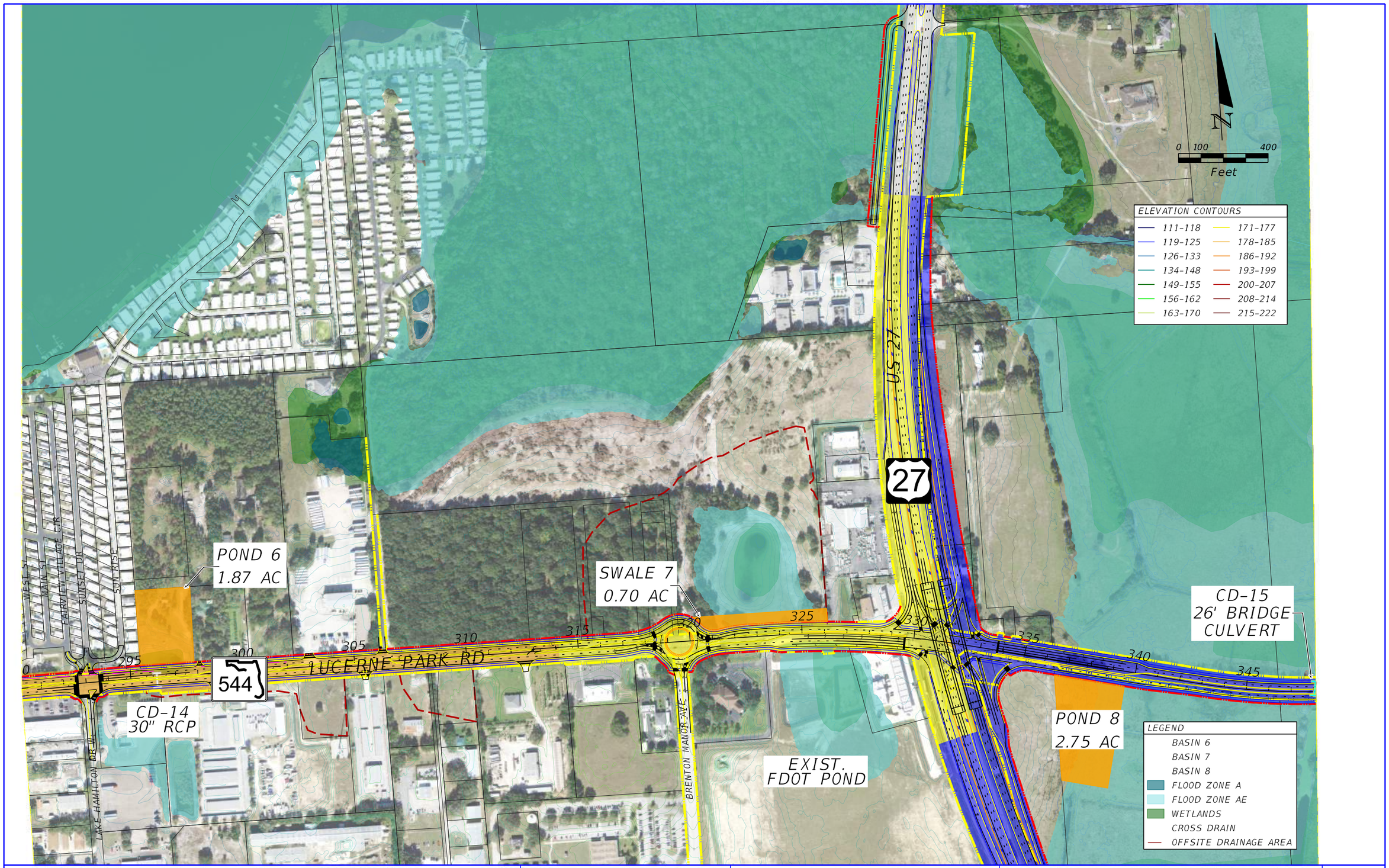
REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	440273-1-22-01

BASIN MAPS

SHEET NO. 5



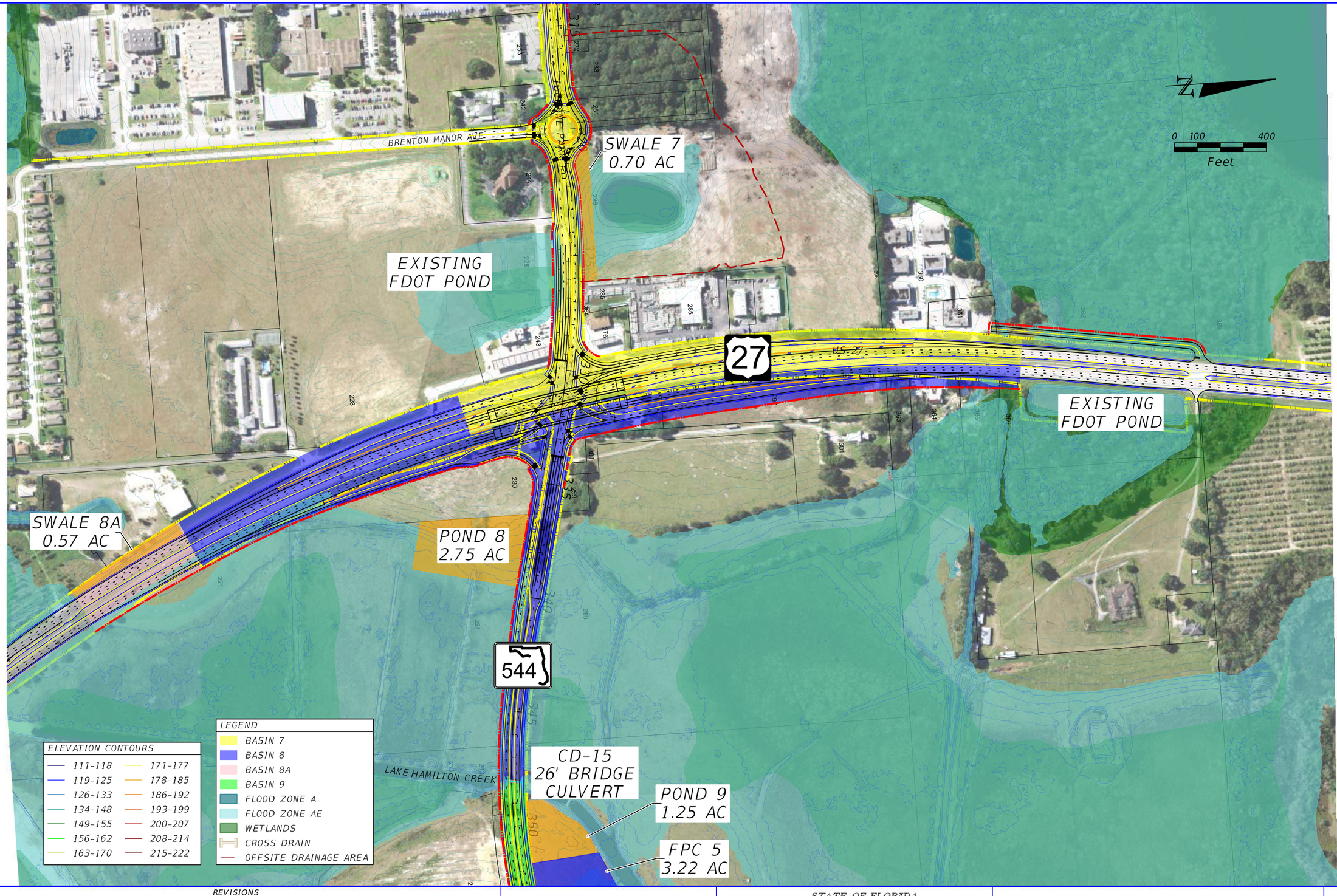
REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	440273-1-22-01

BASIN MAPS

SHEET NO. 6



REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	440273-1-22-01

BASIN MAPS

SHEET NO. 7

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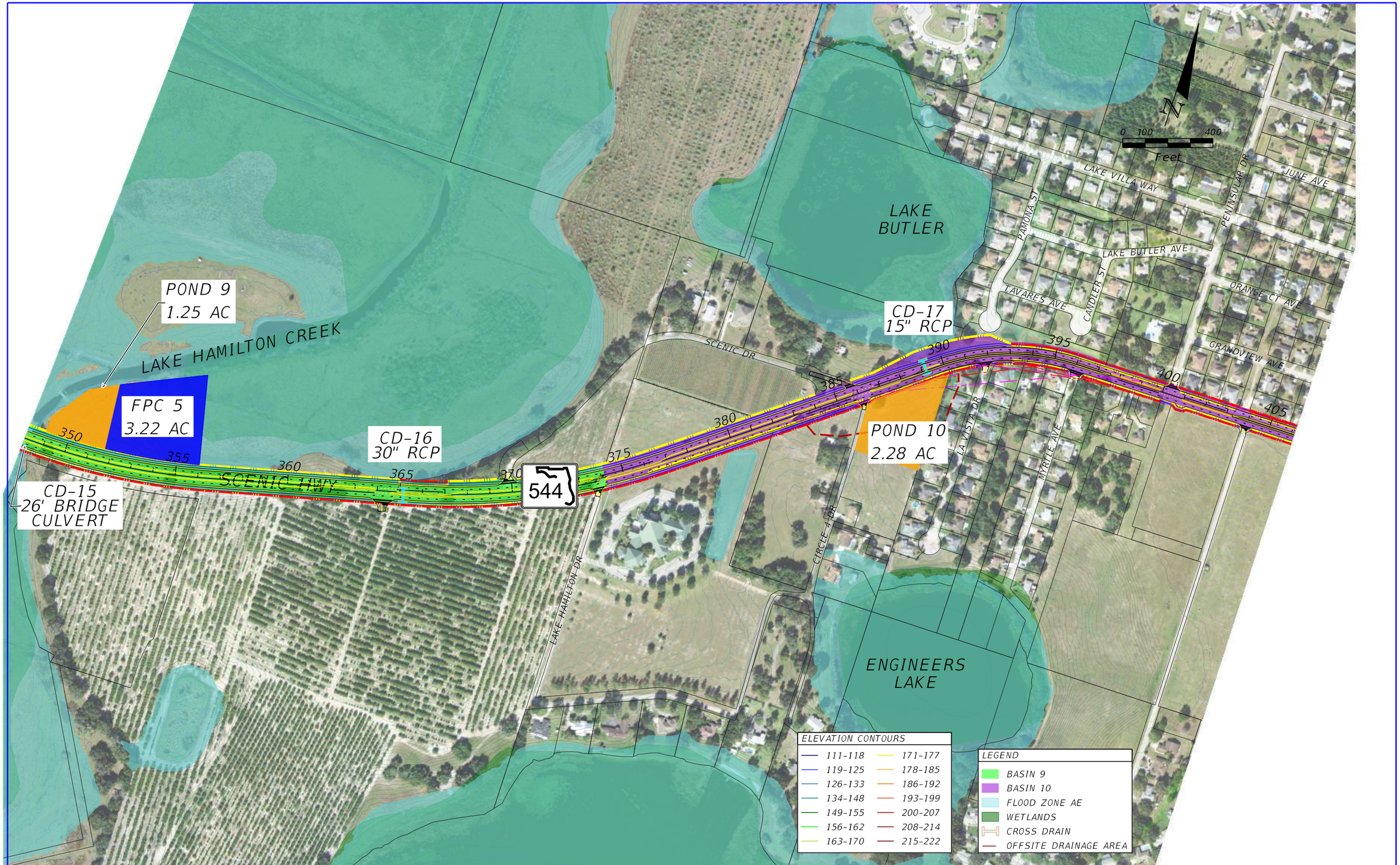

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	440273-1-22-01

BASIN MAPS

SHEET NO. 8

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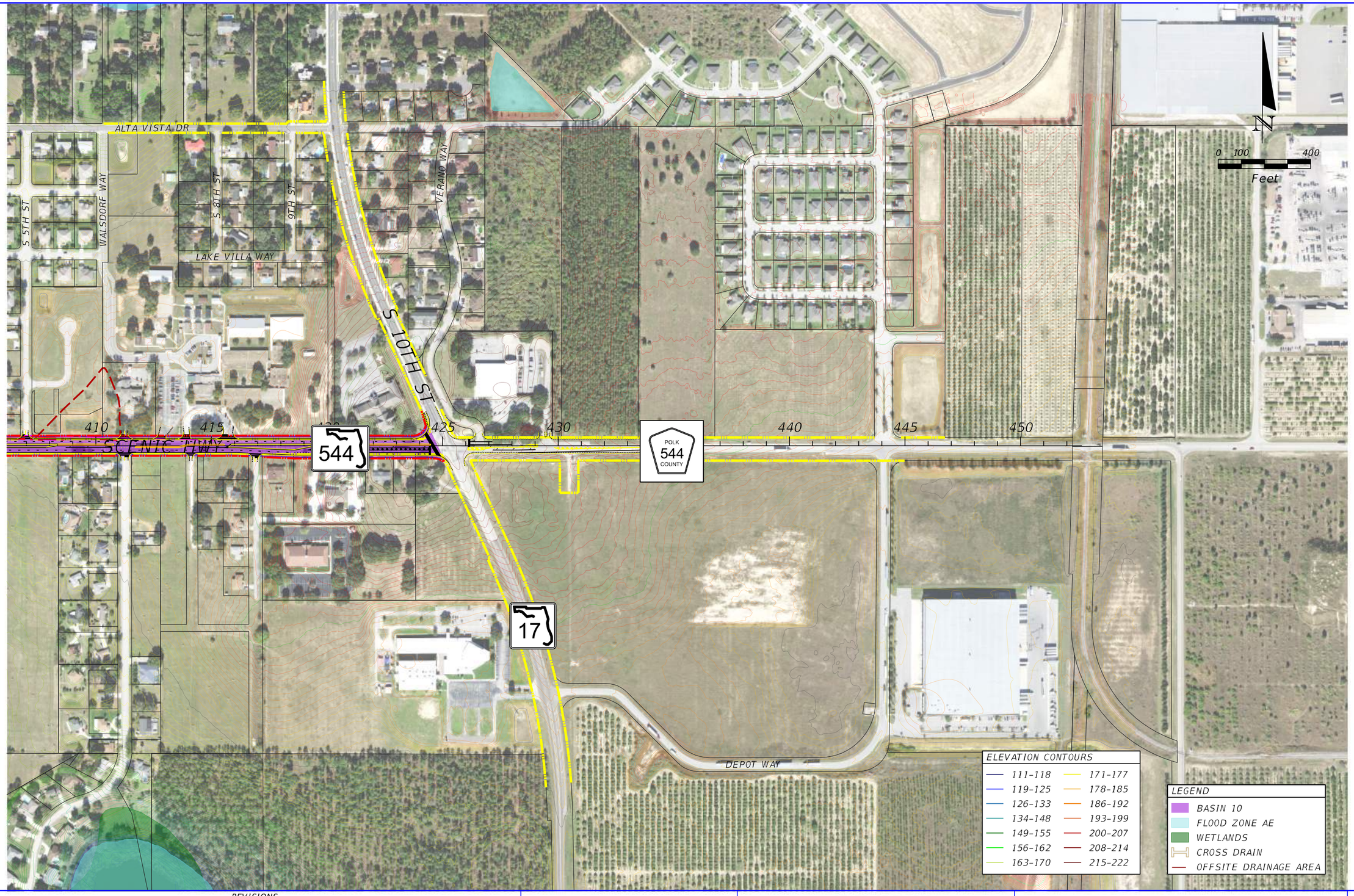

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 544	POLK	440273-1-22-01

BASIN MAPS

SHEET NO. 9

APPENDIX C

Floodplain Impact & Compensation Calculations

3000 Dovera Drive, Suite 200
Oviedo, FL 32765
407-971-8850

Made by: DLD
Ck. by: REC

Date: 8/7/2023
FPID#: 440273-1-22-01
Project Number: DT1-022-01

SR 544 PD&E STUDY

Floodplain Impact & Compensation Calculations

FIA 1 / FPC 1

Approximate Stations	Side	Area (ac)	Floodplain Elevation (ft)	Estimated Ground Elevation (ft)	Impact Volume (ac-ft)	Total Impact Volume for FIA (ac-ft)	Floodplain El. at FPC (ft)	Water Table El. at FPC (ft)	FPC Length (ft)	FPC Width (ft)	FPC Area (AC)	FPC Area Bottom (ac)	FPC Volume (ac-ft)	FPC Area + 20%
58+00 to 72+00	LT	0.40	130.0	129.0	0.40	0.99	129.9	128.0	180	150	0.62	0.51	1.07	0.74
75+00 to 94+00	RT	0.31	129.9	128.0	0.59									

FIA 2 / FPC 2

Approximate Stations	Side	Area (ac)	Floodplain Elevation (ft)	Estimated Ground Elevation (ft)	Impact Volume (ac-ft)	Total Impact Volume for FIA (ac-ft)	Floodplain El. at FPC (ft)	Water Table El. at FPC (ft)	FPC Length (ft)	FPC Width (ft)	FPC Area (AC)	FPC Area Bottom (ac)	FPC Volume (ac-ft)	FPC Area + 20%
118+00 to 131+00	LT	2.06	130.1	129.0	2.27	3.35	130.1	127.0	540	109	1.35	1.00	3.64	1.62
117+00 to 126+00	RT	0.77	129.8	128.5	1.00									
127+00 to 130+00	RT	0.26	128.3	128.0	0.08									

FIA 3 / FPC 3

Approximate Stations	Side	Area (ac)	Floodplain Elevation (ft)	Estimated Ground Elevation (ft)	Impact Volume (ac-ft)	Total Impact Volume for FIA (ac-ft)	Floodplain El. at FPC (ft)	Water Table El. at FPC (ft)	FPC Length (ft)	FPC Width (ft)	FPC Area (AC)	FPC Area Bottom (ac)	FPC Volume (ac-ft)	FPC Area + 20%
147+00 to 199+00	RT	4.32	127.2	126.75	1.94	6.53	128.3	126.0	625	210	3.01	2.67	6.53	3.62
147+00 to 157+00	LT	0.86	127.2	126.75	0.39									
181+00 to 193+00	LT	2.08	128.3	127.0	2.70									
193+00 to 206+00	LT	1.49	128.5	127.5	1.49									

FIA X

Approximate Stations	Side	Area (ac)	Floodplain Elevation (ft)	Estimated Ground Elevation (ft)	Impact Volume (ac-ft)	Total Impact Volume for FIA (ac-ft)	Floodplain El. at FPC (ft)	Water Table El. at FPC (ft)	FPC Length (ft)	FPC Width (ft)	FPC Area (AC)	FPC Area Bottom (ac)	FPC Volume (ac-ft)	FPC Area + 20%
322+00 to 326+00	LT	0.26	132.2	130.0	0.57	1.37	Floodplain boundaries do not accurately represent recent development in this basin. Recommendation is to apply for LOMR and/or show no-rise through floodplain modeling during design phase.							
324+00 to 327+00	RT	0.25	132.2	129.0	0.80									

FIA 4 / FPC 4

Approximate Stations	Side	Area (ac)	Floodplain Elevation (ft)	Estimated Ground Elevation (ft)	Impact Volume (ac-ft)	Total Impact Volume for FIA (ac-ft)	Floodplain El. at FPC (ft)	Water Table El. at FPC (ft)	FPC Length (ft)	FPC Width (ft)	FPC Area (AC)	FPC Area Bottom (ac)	FPC Volume (ac-ft)	FPC Area + 20%
Pond 5	RT	1.41	124.3	123.5	1.13	4.57	124.3	123.0	440	399	4.03	3.83	5.11	4.84
227+00 to 237+00	LT	0.85	127.3	127.0	0.25									
230+00 to 240+00	RT	0.16	124.3	123.5	0.13									
238+00 to 259+00	LT	1.61	128.9	127.0	3.06									

FIA 5 / FPC 5

Approximate Stations	Side	Area (ac)	Floodplain Elevation (ft)	Estimated Ground Elevation (ft)	Impact Volume (ac-ft)	Total Impact Volume for FIA (ac-ft)	Floodplain El. at FPC (ft)	Water Table El. at FPC (ft)	FPC Length (ft)	FPC Width (ft)	FPC Area (AC)*	FPC Area Bottom (ac)	FPC Volume (ac-ft)	FPC Area + 20%
Pond 8	RT	1.43	124.2	123.0	1.72	3.14	124.2	123.0	484	483	2.68	2.58	3.16	3.22
337+00 to 348+00	LT	0.33	124.2	123.0	0.40									
338+00 to 348+00	RT	0.81	124.2	123.0	0.97									
355+00 to 359+00	LT	0.07	124.2	123.5	0.05									
364+00 to 367+00	LT	0.01	124.2	123.5	0.01									

*FPC is Triangular

APPENDIX D

Cross Drain Analysis

REVISIONS					
DATE	DESCRIPTION	DATE	DESCRIPTION	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION	
				ROAD NO. / COUNTY / FINANCIAL PROJECT ID	CD-1 DRAINAGE AREAS
					SHEET NO. 1

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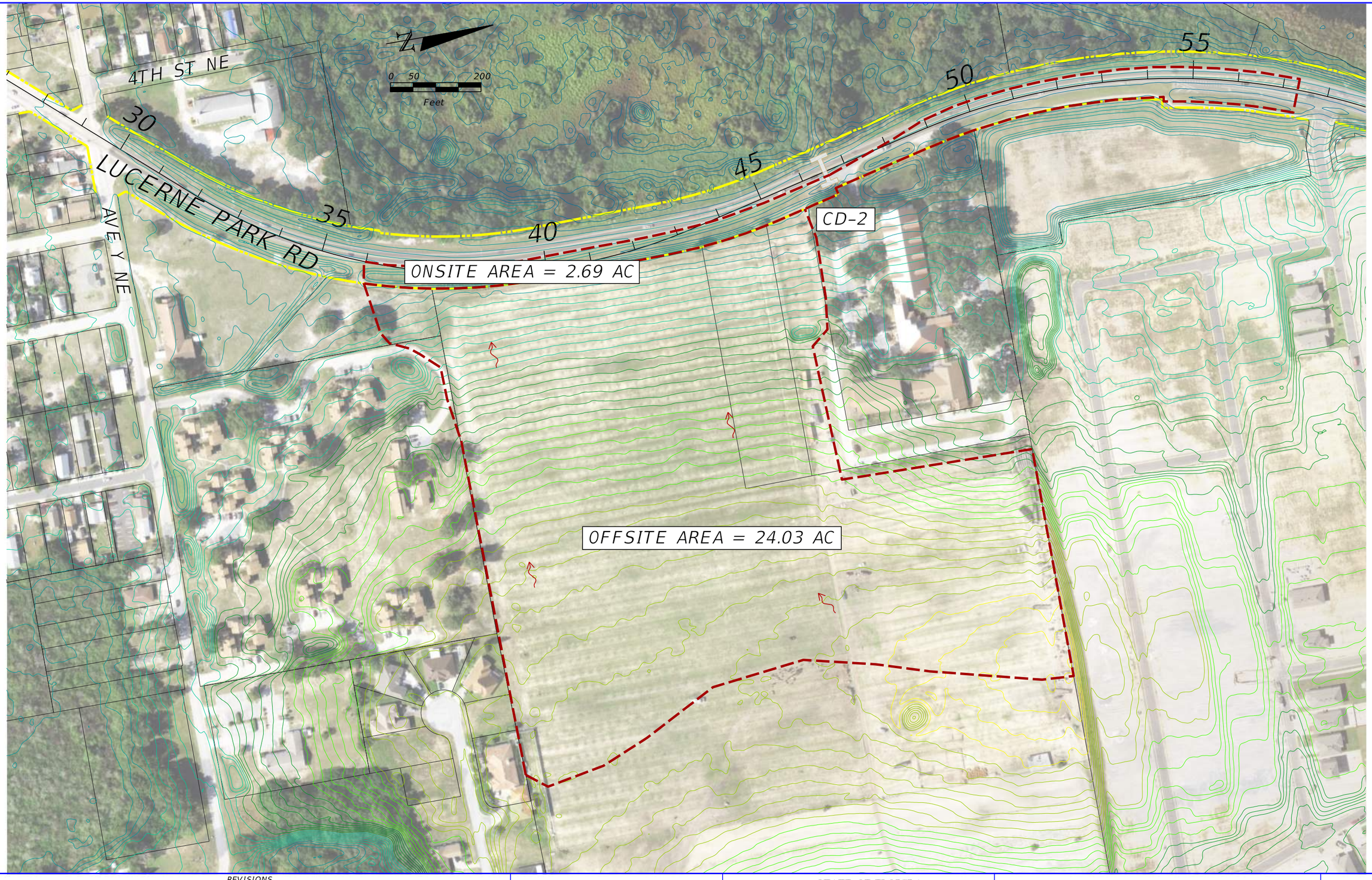


REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

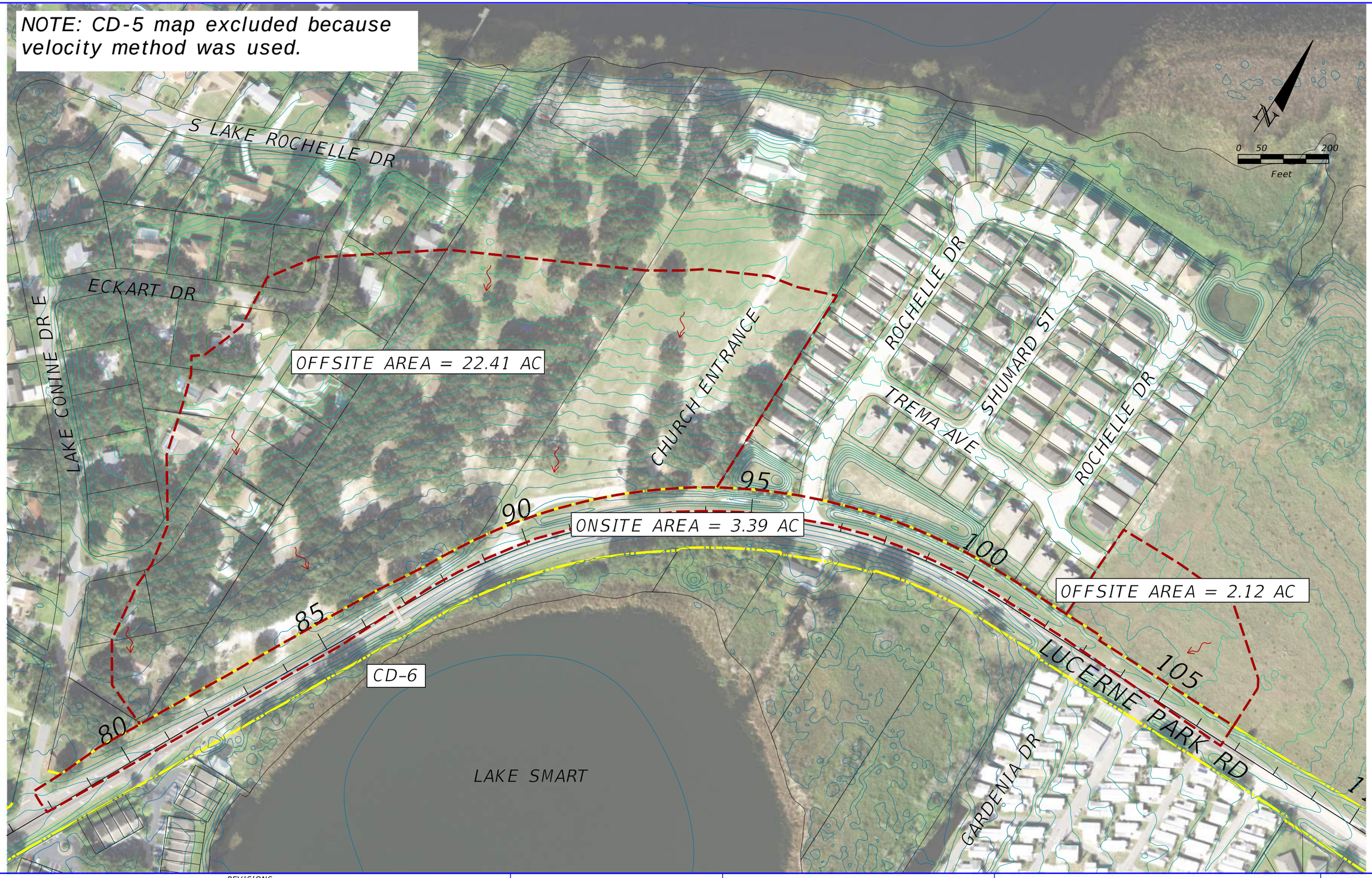
ROAD NO.	COUNTY	FINANCIAL PROJECT ID

CD-2 DRAINAGE AREAS

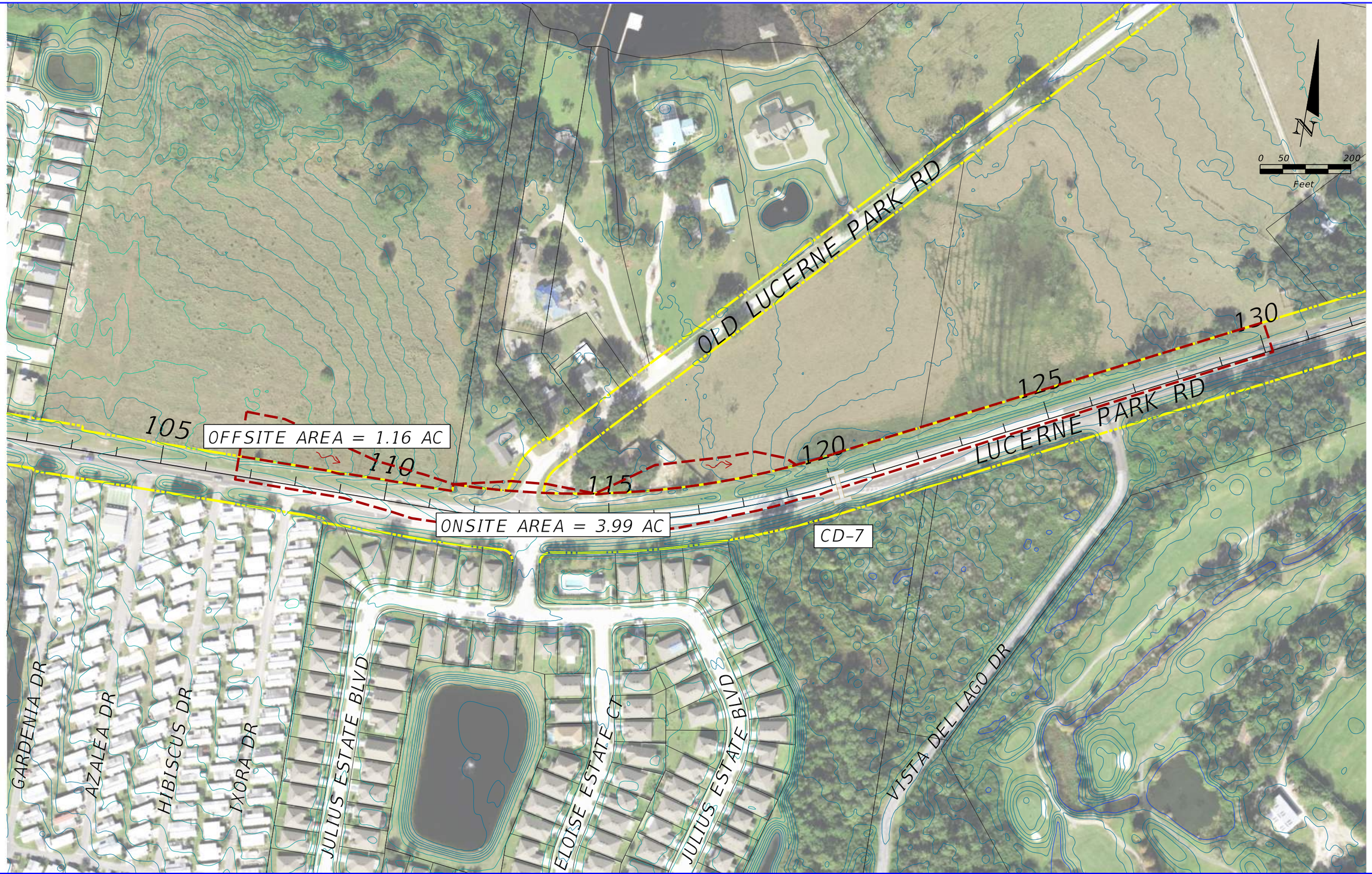
SHEET NO.
2

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			CD-3 AND CD-4 DRAINAGE AREAS	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		3

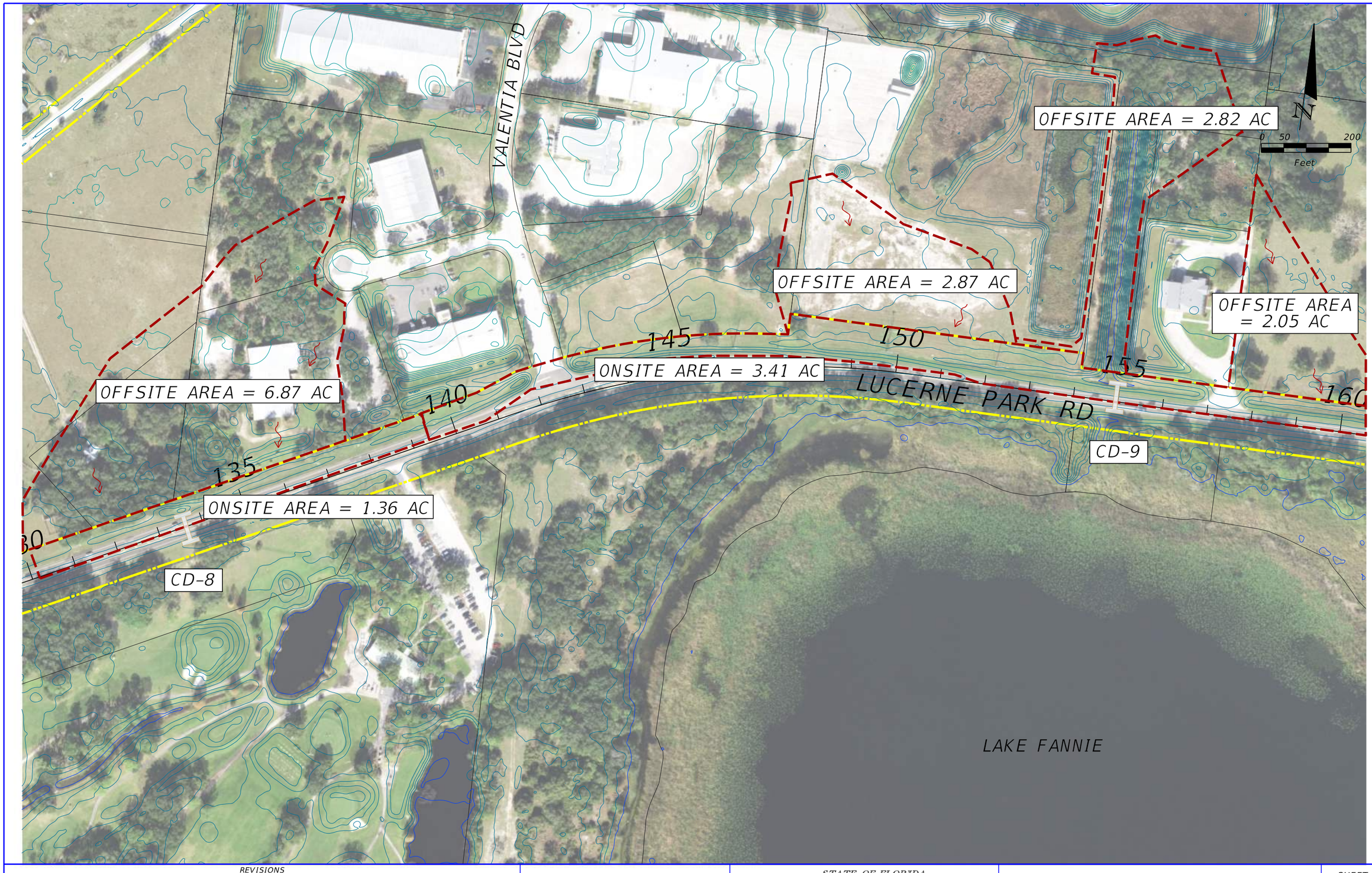
NOTE: CD-5 map excluded because velocity method was used.



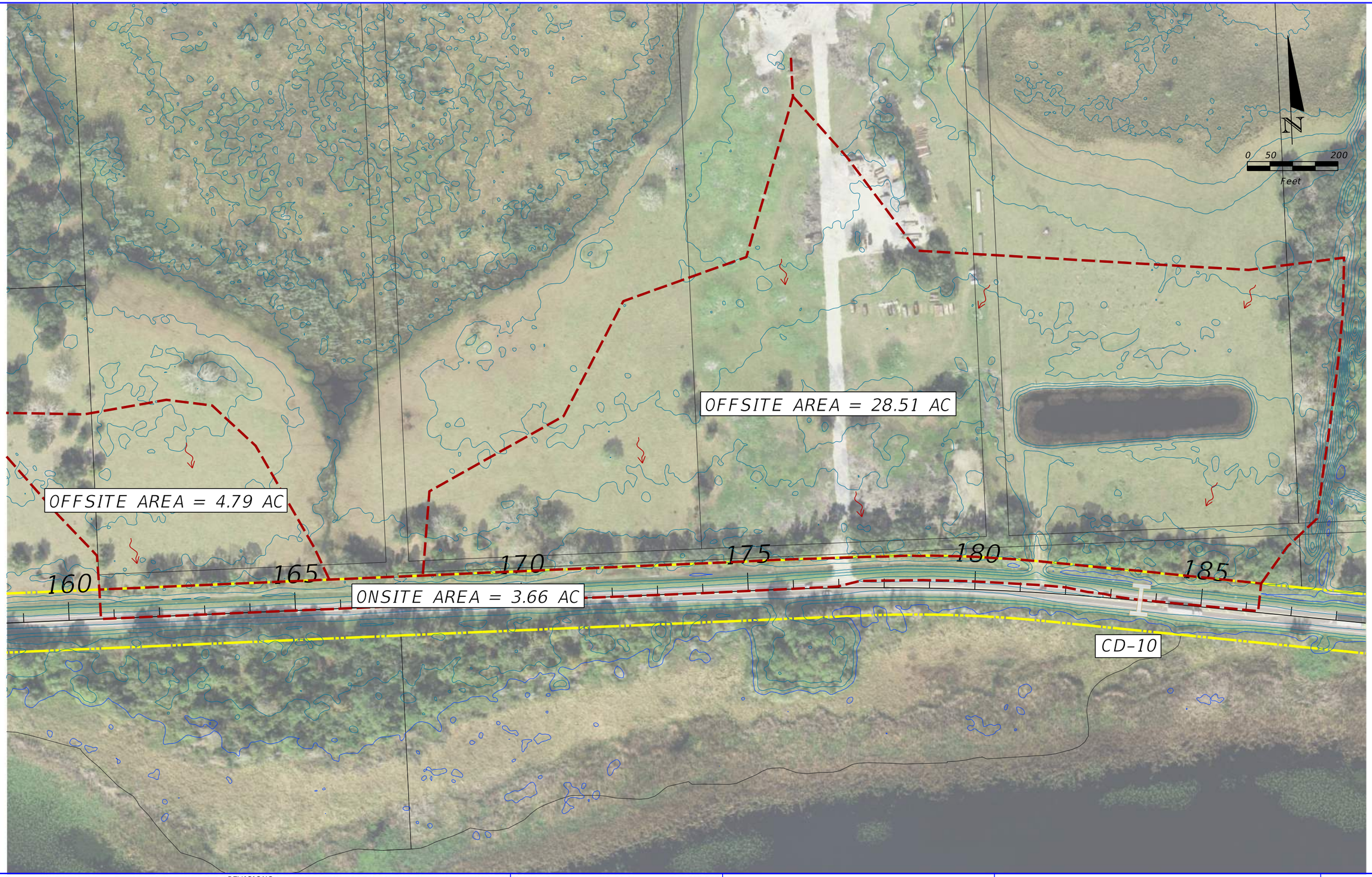
REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			CD-6 DRAINAGE AREAS	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		4



REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			CD-7 DRAINAGE AREAS	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		5



REVISIONS					STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION				SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID	CD-8 AND CD-9 DRAINAGE AREAS	6



REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			CD-10 DRAINAGE AREAS	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		7

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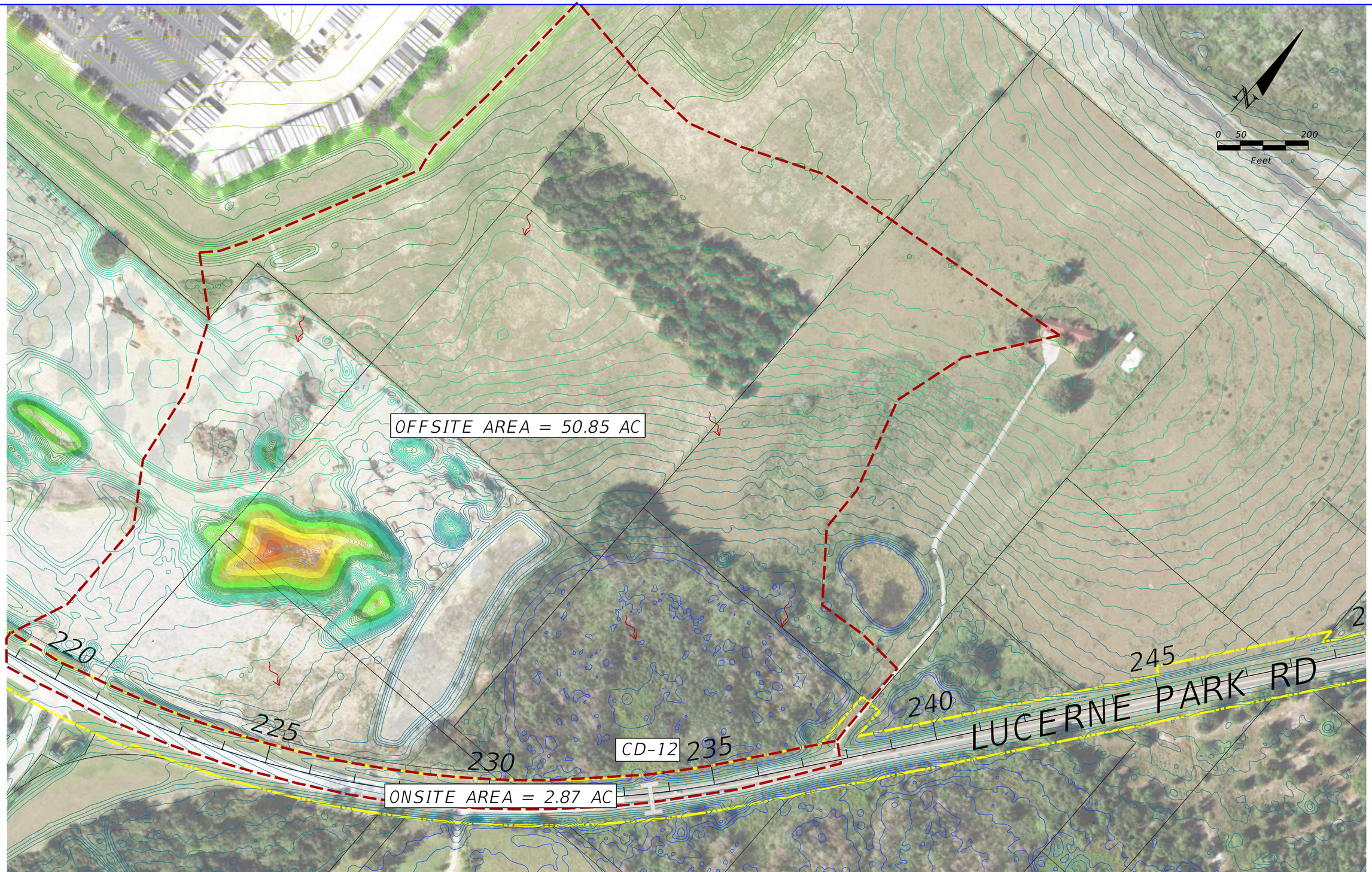
REVISIONS					
DATE	DESCRIPTION	DATE	DESCRIPTION	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION	
				ROAD NO. / COUNTY / FINANCIAL PROJECT ID	CD-11 DRAINAGE AREAS
					SHEET NO. 8



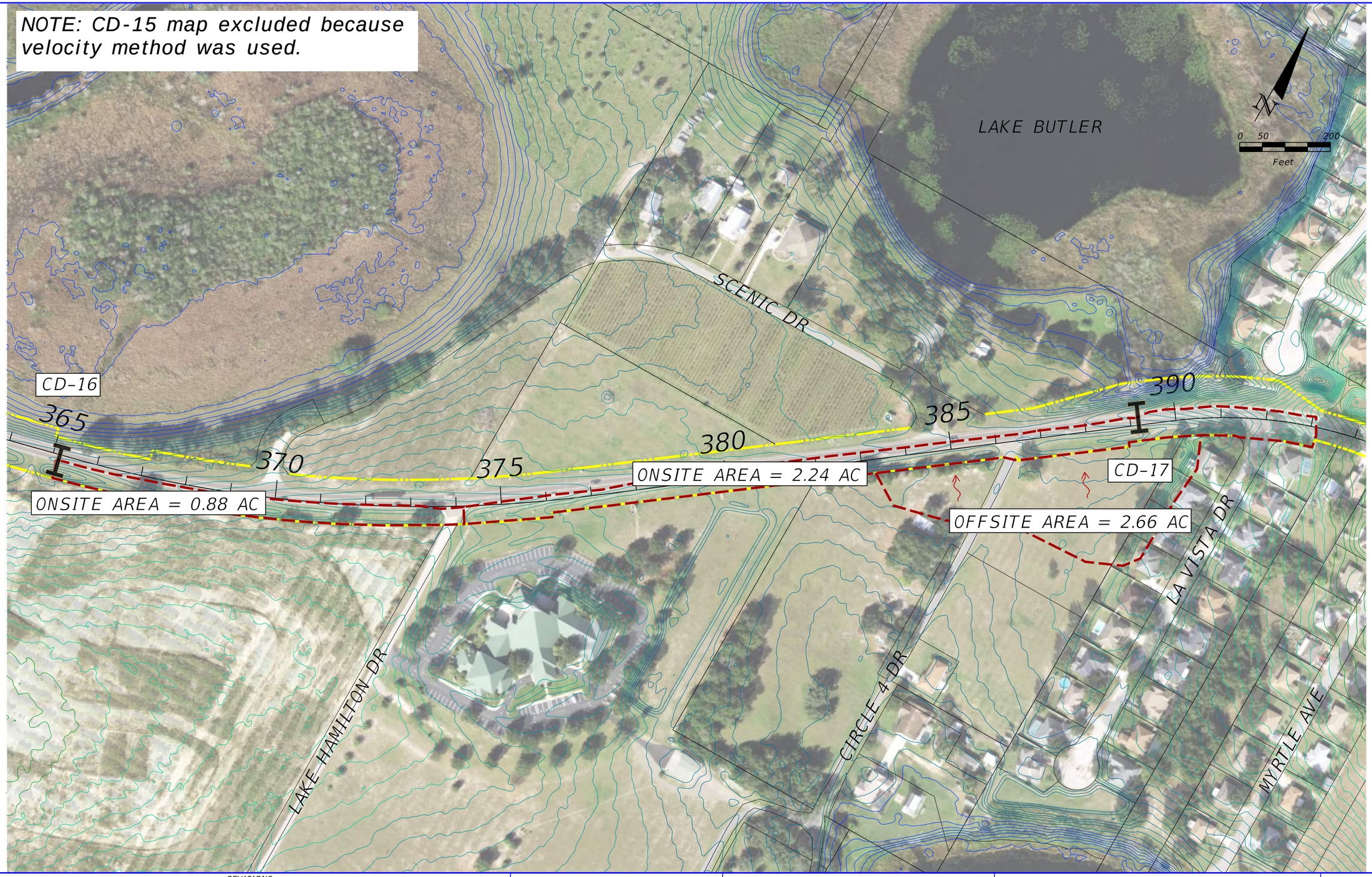
REVISIONS					STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			CD-12 DRAINAGE AREAS	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID		9

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION				SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID	
								10

CD-13 DRAINAGE AREAS

REVISIONS					STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION				SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID	CD-14 DRAINAGE AREAS	11

NOTE: CD-15 map excluded because velocity method was used.



REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID

CD-16 AND CD-17 DRAINAGE AREAS

SHEET NO. 12

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: DLD **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-1: 1 - 36" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

	Area (AC)	Runoff Coefficient C
Onsite:	4.23	0.9
Offsite:	24.30	0.3
Offsite:	10.95	0.2
Total:	39.48	

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.34
Intensity (I) = 6.30 IN/HR TC = 170.1 min
Total Area (A) = 39.48

Q_{25yr} =	1.0	**84 cfs**
Q_{50yr} =	$1.2Q_{25yr}$ =	**100 cfs**
Q_{100yr} =	$1.4Q_{25yr}$ =	**117 cfs**
Q_{500yr} =	$1.7Q_{100yr}$ =	**199 cfs**

Additional Discharges:
None

Tailwater elevation set at crown of pipe

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: DLD **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-2: 1 - 36" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.27
Intensity (I) = 5.70 IN/HR TC = 29.4 min
Total Area (A) = 26.72

	Area (AC)	Runoff Coefficient C
Onsite:	2.69	0.9
Offsite:	24.03	0.2
Total:	26.72	

Q_{25yr} = 1.0 **41 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **49 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **58 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **98 cfs**

Additional Discharges:
None

Tailwater elevation set at crown of pipe

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-3: 1 - 30" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.53
Intensity (I) = 7.00 IN/HR TC = 17.6 min
Total Area (A) = 2.78

	Area (AC)	Runoff Coefficient C
Onsite:	1.3	0.9
Offsite:	1.48	0.2
Total:	2.78	

Q_{25yr} = 1.0 **10 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **12 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **14 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **24 cfs**

Additional Discharges:
None

Tailwater elevation set at crown of pipe

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Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-4: 1 - 24" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.90
Intensity (I) = 8.40 IN/HR TC = 10.0 min
Total Area (A) = 0.99

	Area (AC)	Runoff Coefficient C
Onsite:	0.99	0.9
Offsite:	0	0.2
Total:	0.99	

Q_{25yr} = 1.0 **7 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **9 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **10 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **18 cfs**

Additional Discharges:
None

Tailwater elevation set at crown of pipe

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(407) 971-8850 phone (407) 971-8955 fax

Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-5: 12' x 12' CBC

HYDROLOGIC ANALYSIS

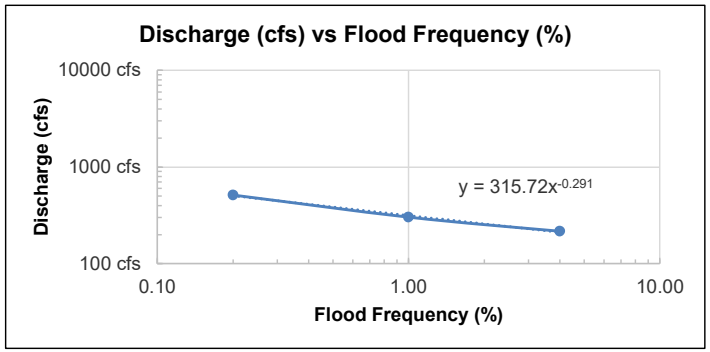
VELOCITY METHOD :

$Q = AV$

Q = Peak Runoff for Return Period T (cfs)
A = Existing Culvert Cross Section Area
V = 3 feet per second (maximum)

A_1 based on 12 ' x 12' CBC flowing half-full
A_1= 72.00 sq.ft.

$Q_{25yr} = A_1V =$ **216 cfs**
$Q_{50yr} = 631.44(2)^{-0.291} =$ **258 cfs**
$Q_{100yr} = 1.4Q_{25yr} =$ **302 cfs**
$Q_{500yr} = 1.7Q_{100yr} =$ **514 cfs**



Tailwater elevation based on average guage data for Lake Smart

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-6: 1 - 30" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.29
Intensity (I) = 4.60 IN/HR TC = 45.1 min
Total Area (A) = 25.8

	Area (AC)	Runoff Coefficient C
Onsite:	3.39	0.9
Offsite:	22.41	0.2
Total:	25.8	

Q_{25yr} = 1.0 **35 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **43 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **50 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **84 cfs**

Additional Discharges:
Lake Rochelle Estates Pond 1B 0.84 cfs
(25yr storm)

Tailwater elevation based on average guage data for Lake Smart

3000 Dovera Drive, Suite 200, Oviedo FL32765
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Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-7: 2 - 30" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.74
Intensity (I) = 6.00 IN/HR TC = 26.7 min
Total Area (A) = 5.15

	Area (AC)	Runoff Coefficient C
Onsite:	3.99	0.9
Offsite:	1.16	0.2
Total:	5.15	

Q_{25yr} = 1.0 **23 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **28 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **32 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **55 cfs**

Additional Discharges:
None

Tailwater elevation set at crown of pipe

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-8: 1 - 36" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

	Area (AC)	Runoff Coefficient C
Onsite:	1.36	0.9
Offsite:	6.87	0.2
Total:	8.23	

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.32
Intensity (I) = 5.90 IN/HR TC = 27.9 min
Total Area (A) = 8.23

Q_{25yr} = 1.0	**15 cfs**	**Additional Discharges:**
Q_{50yr} = $1.2Q_{25yr}$ =	**18 cfs**	None
Q_{100yr} = $1.4Q_{25yr}$ =	**21 cfs**	
Q_{500yr} = $1.7Q_{100yr}$ =	**36 cfs**	

Tailwater elevation set at crown of pipe

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-9: 1 - 54" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.41
Intensity (I) = 6.10 IN/HR TC = 24.6 min
Total Area (A) = 11.15

	Area (AC)	Runoff Coefficient C
Onsite:	3.41	0.9
Offsite:	7.74	0.2
Total:	11.15	

Q_{25yr} = 1.0 **28 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **34 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **39 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **67 cfs**

Additional Discharges:
None

Tailwater elevation based on average guage data for Lake Fannie

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-10: 1 - 36" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.27
Intensity (I) = 4.80 IN/HR TC = 40.4 min
Total Area (A) = 36.96

	Area (AC)	Runoff Coefficient C
Onsite:	3.66	0.9
Offsite:	33.3	0.2
Total:	36.96	

Q_{25yr} = 1.0 **48 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **57 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **67 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **114 cfs**

Additional Discharges:
None

Tailwater elevation based on average guage data for Lake Fannie

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by:	FJM	**DATE:**	August 7, 2023
Ch'd by:	REC	**PROJECT #:**	**DT1-022-01**

SR 544

CD-11: 1 - 48" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

			Area (AC)	Runoff Coefficient C
		Onsite:	4.92	0.9
Q =	Peak Runoff for Return Period T (cfs).	**Offsite:**	70.41	0.2
Composite C =	0.25	**Total:**	75.33	
Intensity (I) =	3.40 IN/HR	TC = 69.0 min		
Total Area (A) =	75.33			

Q_{25yr} =	1.0	**63 cfs**
$Q_{25Total}$ =		**69 cfs**
Q_{50yr} =	$1.2Q_{25yr}$ =	**82 cfs**
Q_{100yr} =	$1.4Q_{25yr}$ =	**96 cfs**
Q_{500yr} =	$1.7Q_{100yr}$ =	**163 cfs**

Additional Discharges:

Forterra Pipe Plant Pond	5.74 cfs
(25 year storm)	

Tailwater elevation based on average guage data for Lake Fannie

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by:	FJM	**DATE:**	August 7, 2023
Ch'd by:	REC	**PROJECT #:**	**DT1-022-01**

SR 544

CD-12: 1 - 36" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.24
Intensity (I) = 3.80 IN/HR TC = 61.1 min
Total Area (A) = 53.72

	Area (AC)	**Runoff Coefficient C**
Onsite:	2.87	0.9
Offsite:	50.85	0.2
Total:	53.72	

Q_{25yr} = 1.0 **48 cfs**
$Q_{25Total}$= **53 cfs**
Q_{50yr} = 1.2Q_{25yr} = **64 cfs**
Q_{100yr} = 1.4Q_{25yr} = **74 cfs**
Q_{500yr} = 1.7Q_{100yr} = **126 cfs**

Tailwater elevation set at crown of pipe

Additional Discharges:

Walmart Pond	4.56 cfs
(25 year storm)	

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Made by: FJM **DATE:** August 7, 2023
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SR 544

CD-13: 3 - 24" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.23
Intensity (I) = 2.20 IN/HR TC = 127.8 min
Total Area (A) = 145.11

	Area (AC)	Runoff Coefficient C
Onsite:	5.36	0.9
Offsite:	139.75	0.2
Total:	145.11	

Q_{25yr} = 1.0 **72 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **87 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **101 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **172 cfs**

Additional Discharges:
None

Tailwater elevation set at crown of pipe

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-14: 1 - 30" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

		Area (AC)	Runoff Coefficient C
Onsite:		2.38	0.9
Offsite:		2.91	0.2
Total:		5.29	

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.51
Intensity (I) = 8.40 IN/HR TC = 10 min
Total Area (A) = 5.29

Q_{25yr} =	1.0	**23 cfs**
$Q_{25Total}$ =		**25 cfs**
Q_{50yr} =	$1.2Q_{25yr}$ =	**30 cfs**
Q_{100yr} =	$1.4Q_{25yr}$ =	**35 cfs**
Q_{500yr} =	$1.7Q_{100yr}$ =	**59 cfs**

Additional Discharges:

Extra Space Storage	0.11 cfs
Safe Haven Storage	1.87 cfs
(25 year storm)	

Tailwater elevation set at crown of pipe

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-15: Bridge Culvert (Double 8' X 10' CBC)

HYDROLOGIC ANALYSIS

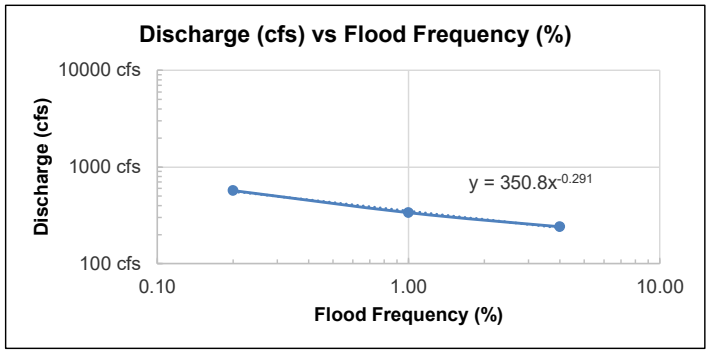
VELOCITY METHOD :

$Q = AV$

Q = Peak Runoff for Return Period T (cfs)
A = Existing Culvert Cross Section Area
V = 3 feet per second (maximum)

A_1 based on double 8' X 10' CBC flowing half-full
A_1 = 80.00 sq.ft.

$Q_{25yr} = A_1V =$ **240 cfs**
$Q_{50yr} = 631.44(2)^{-0.291} =$ **258 cfs**
$Q_{100yr} = 1.4Q_{25yr} =$ **336 cfs**
$Q_{500yr} = 1.7Q_{100yr} =$ **571 cfs**



Tailwater elevation based on average guage data for Lake Smart

3000 Dovera Drive, Suite 200, Oviedo FL32765
(407) 971-8850 phone (407) 971-8955 fax

Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-16: 1 - 30" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.90
Intensity (I) = 8.40 IN/HR TC = 10 min
Total Area (A) = 0.88

	Area (AC)	Runoff Coefficient C
Onsite:	0.88	0.9
Offsite:	0	0.2
Total:	0.88	

Q_{25yr} = 1.0 **7 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **8 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **9 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **16 cfs**

Additional Discharges:
None

Tailwater elevation set at crown of pipe
Previously, this CD collected offsite area, but the area is under development and will not longer outfall to this CD.

3000 Dovera Drive, Suite 200, Oviedo FL32765
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Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544

CD-17: 1 - 15" RCP (Existing)

HYDROLOGIC ANALYSIS

Discharge Calculations **Q = CIA**

Q = Peak Runoff for Return Period T (cfs).
Composite C = 0.52
Intensity (I) = 6.60 IN/HR TC = 21.2 min
Total Area (A) = 4.9

	Area (AC)	Runoff Coefficient C
Onsite:	2.24	0.9
Offsite:	2.66	0.2
Total:	4.9	

Q_{25yr} = 1.0 **17 cfs**
Q_{50yr} = $1.2Q_{25yr}$ = **20 cfs**
Q_{100yr} = $1.4Q_{25yr}$ = **24 cfs**
Q_{500yr} = $1.7Q_{100yr}$ = **40 cfs**

Additional Discharges:
None

Tailwater elevation set at crown of pipe

3000 Dovera Drive, Suite 200, Oviedo FL32765
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Made by: FJM **DATE:** August 7, 2023
Ch'd by: REC **PROJECT #:** DT1-022-01

SR 544 PD&E

CROSS DRAIN FLOOD DATA SHEET - EXISTING VS. PROPOSED

Structure Number	Approximate Location	Design Flood (50-yr Storm Event)					Base Flood (100-yr Storm Event)					Overtopping Flood				Greatest Flood (500-yr Storm Event)				
		Existing (A)		Proposed (B)		B-A	Existing (A)		Proposed (B)		B-A	Existing (A)		Proposed (B)		Existing (A)		Proposed (B)		B-A
		Discharge (cfs)	Stage (ft)	Discharge (cfs)	Stage (ft)	Stage (ft)	Discharge (cfs)	Stage (ft)	Discharge (cfs)	Stage (ft)	Stage (ft)	Discharge (cfs)	Stage (ft)	Discharge (cfs)	Stage (ft)	Discharge (cfs)	Stage (ft)	Discharge (cfs)	Stage (ft)	Stage (ft)
CD-1	Sta. 35+67	100	138.55	100	137.00	-1.55	117	138.61	117	138.51	-0.10	90.63	138.50	116.09	138.50	199	138.77	199	138.73	-0.04
CD-2	Sta. 46+53	49	132.68	49	132.21	-0.47	58	133.26	58	132.57	-0.69	67.66	134.00	84.70	134.00	98	134.07	98	134.04	-0.03
CD-3	Sta. 61+81	12	130.94	12	130.98	0.04	14	131.01	14	131.06	0.05	No Overtopping		No Overtopping		24	131.52	24	131.64	0.12
CD-4	Sta. 70+74	9	130.58	9	130.66	0.08	10	130.66	10	130.75	0.09	No Overtopping		No Overtopping		18	131.57	18	131.72	0.15
CD-5	Sta. 75+15	258	128.15	258	128.17	0.02	302	128.58	302	128.56	-0.02	No Overtopping		No Overtopping		514	130.57	514	130.53	-0.04
CD-6	Sta. 86+68	43	131.87	43	131.94	0.07	50	132.95	50	133.02	0.07	53.19	133.50	52.78	133.50	84	133.60	84	133.60	0.00
CD-7	Sta. 120+14	28	128.26	28	128.31	0.05	32	128.34	32	128.41	0.07	No Overtopping		No Overtopping		55	129.03	55	129.22	0.19
CD-8	Sta. 133+61	18	129.64	18	129.63	-0.01	21	129.66	21	129.71	0.05	No Overtopping		No Overtopping		36	130.16	36	130.33	0.17
CD-9	Sta. 154+93	34	124.14	34	124.15	0.01	39	124.18	39	124.20	0.02	No Overtopping		No Overtopping		67	124.54	67	124.58	0.04
CD-10	Sta. 183+65	57	126.07	57	125.45	-0.62	67	127.04	67	125.98	-1.06	83.26	129.00	107.89	129.00	114	129.09	114	129.03	-0.06
CD-11	Sta. 187+13	82	125.37	82	125.40	0.03	96	125.99	96	125.85	-0.14	139.33	128.50	162.40	128.50	163	128.57	163	128.50	-0.07
CD-12	Sta. 233+56	64	128.47	64	127.57	-0.90	74	129.44	74	128.10	-1.34	78.59	130.00	100.95	130.00	126	130.12	126	130.07	-0.05
CD-13	Sta. 252+10	87	129.03	87	128.04	-0.99	101	130.01	101	128.74	-1.27	98.56	130.00	122.21	130.00	172	130.15	172	130.12	-0.03
CD-14	Sta. 296+21	30	131.30	30	130.80	-0.50	35	131.73	35	131.04	-0.69	58.41	135.00	No Overtopping		59	135.00	59	132.69	-2.31
CD-15	Sta. 348+10	258	122.17	258	122.18	0.01	336	122.36	336	122.37	0.01	No Overtopping		No Overtopping		571	123.21	571	123.25	0.04
CD-16	Sta. 365+13	8	128.61	8	128.58	-0.03	9	128.63	9	128.59	-0.04	48.88	132.00	No Overtopping		16	128.87	16	128.75	-0.12
CD-17	Sta. 389+17	20	133.07	20	133.07	0.00	24	133.09	24	133.10	0.01	12.04	133.00	10.75	133.00	40	133.16	40	133.16	0.00

Upsize pipe to prevent base flood or increase in stage elevations.
Replace pipe with same size. Pipe to be replaced due to current condition or age.
Extend existing pipe.

Cross Drain Upsizing			
Structure Number	Existing Pipe Size	Proposed Pipe Size	Proposed Change
CD-1	Single 36" RCP	Single 42" RCP	UPSIZE
CD-2	Single 36" RCP	Single 42" RCP	UPSIZE
CD-3	Single 30" RCP	Single 30" RCP	EXTEND
CD-4	Single 24" RCP	Single 24" RCP	EXTEND
CD-5	Single 12' X12' CBC	Single 12' X 12' CBC	REPLACE*
CD-6	Single 30" RCP	Single 30" RCP	REPLACE**
CD-7	Double 30" RCP	Double 30" RCP	EXTEND
CD-8	Single 36" RCP	Single 36" RCP	EXTEND
CD-9	Single 54" RCP	Single 54" RCP	EXTEND

Cross Drain Upsizing			
Structure Number	Existing Pipe Size	Proposed Pipe Size	Proposed Change
CD-10	Single 36" RCP	Single 42" RCP	UPSIZE
CD-11	Single 48" RCP	Single 54" RCP	UPSIZE
CD-12	Single 36" RCP	Single 42" RCP	UPSIZE
CD-13	Triple 24" RCP	Quad 24" RCP	ADD BARREL
CD-14	Single 30" RCP	Single 36" RCP	UPSIZE
CD-15	Double 8' X 10' CBC	Double 8' X 10' CBC	REPLACE
CD-16	Single 30" RCP	Single 36" RCP	UPSIZE
CD-17	Single 15" RCP	Single 15" RCP	EXTEND

*The recommended alternative for CD-5 is to replace it with a bridge in order to provide better visibility and clearance for boaters. Please refer to correspondance with the Lake Region Lakes Management District. Hydraulic analysis has been performed to show that extending the box culvert is hydraulically feasible if this alternative is later pursued.

**While it is hydraulically feasible to extend CD-6, it will conflict with a proposed access road and is therefore recommended to be replaced.

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 100.00 cfs

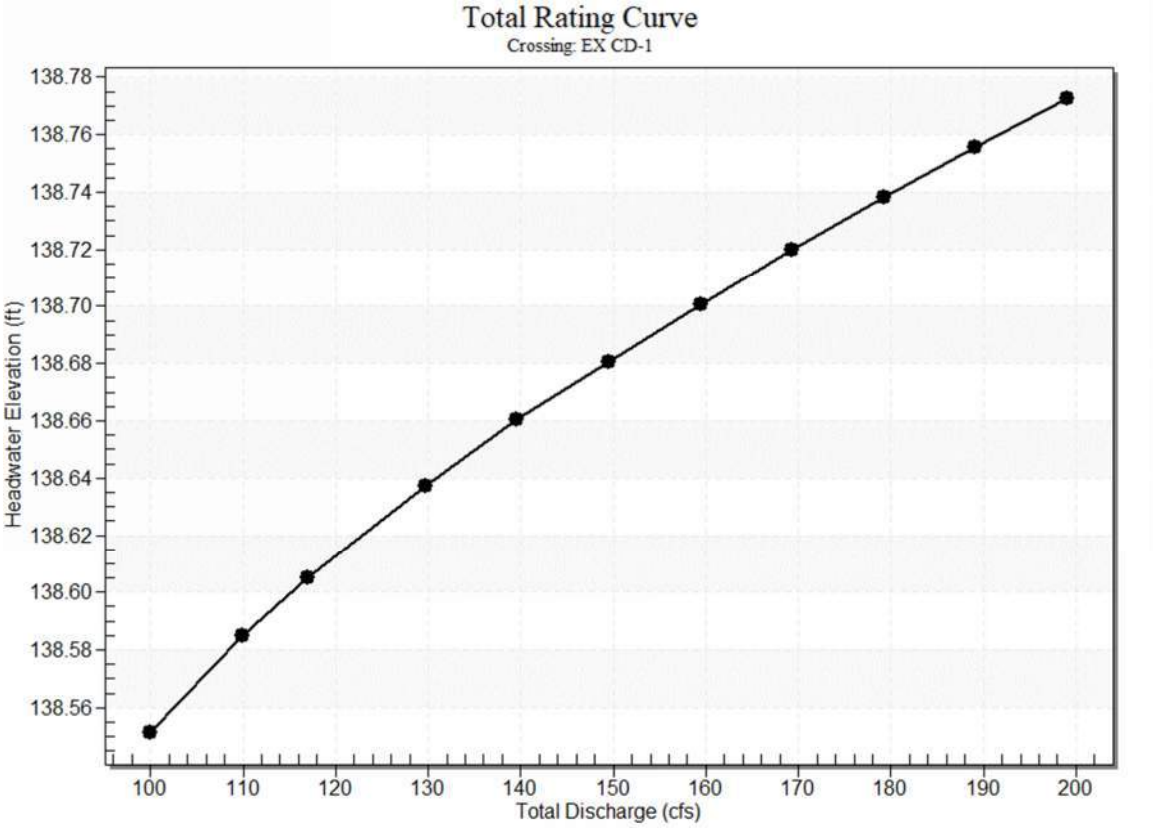
Design Flow: 117.00 cfs

Maximum Flow: 199.00 cfs

Table 1 - Summary of Culvert Flows at Crossing: EX CD-1

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
138.55	100.00	90.99	8.68	28
138.58	109.90	91.22	18.30	5
138.61	117.00	91.36	25.23	4
138.64	129.70	91.57	37.73	4
138.66	139.60	91.73	47.67	4
138.68	149.50	91.87	57.07	3
138.70	159.40	92.00	66.90	3
138.72	169.30	92.13	76.79	3
138.74	179.20	92.26	86.66	3
138.76	189.10	92.38	96.52	3
138.77	199.00	92.49	106.36	3
138.50	90.63	90.63	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-1



Culvert Data: EX CD-1

Table 2 - Culvert Summary Table: EX CD-1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
100.00 cfs	90.99 cfs	138.55	8.59	8.097	4-FFf	3.00	2.85	3.00	3.00	12.87	0.00
109.90 cfs	91.22 cfs	138.58	8.62	8.122	4-FFf	3.00	2.85	3.00	3.00	12.90	0.00
117.00 cfs	91.36 cfs	138.61	8.65	8.138	4-FFf	3.00	2.85	3.00	3.00	12.92	0.00
129.70 cfs	91.57 cfs	138.64	8.68	8.163	4-FFf	3.00	2.86	3.00	3.00	12.96	0.00
139.60 cfs	91.73 cfs	138.66	8.70	8.181	4-FFf	3.00	2.86	3.00	3.00	12.98	0.00
149.50 cfs	91.87 cfs	138.68	8.72	8.196	4-FFf	3.00	2.86	3.00	3.00	13.00	0.00
159.40 cfs	92.00 cfs	138.70	8.74	8.212	4-FFf	3.00	2.86	3.00	3.00	13.02	0.00
169.30 cfs	92.13 cfs	138.72	8.76	8.227	4-FFf	3.00	2.86	3.00	3.00	13.03	0.00
179.20 cfs	92.26 cfs	138.74	8.78	8.241	4-FFf	3.00	2.86	3.00	3.00	13.05	0.00
189.10 cfs	92.38 cfs	138.76	8.80	8.254	4-FFf	3.00	2.86	3.00	3.00	13.07	0.00
199.00 cfs	92.49 cfs	138.77	8.81	8.268	4-FFf	3.00	2.86	3.00	3.00	13.08	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

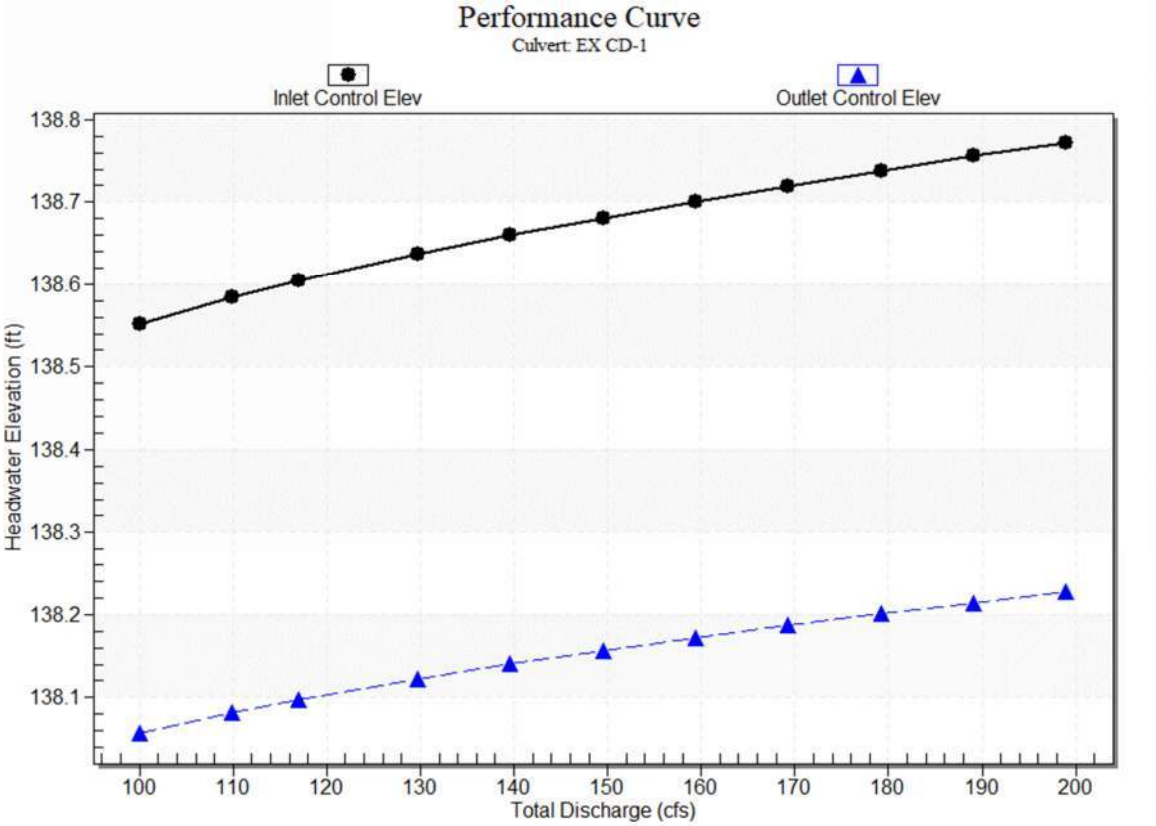
Inlet Elevation (invert): 129.96 ft,

Outlet Elevation (invert): 129.92 ft

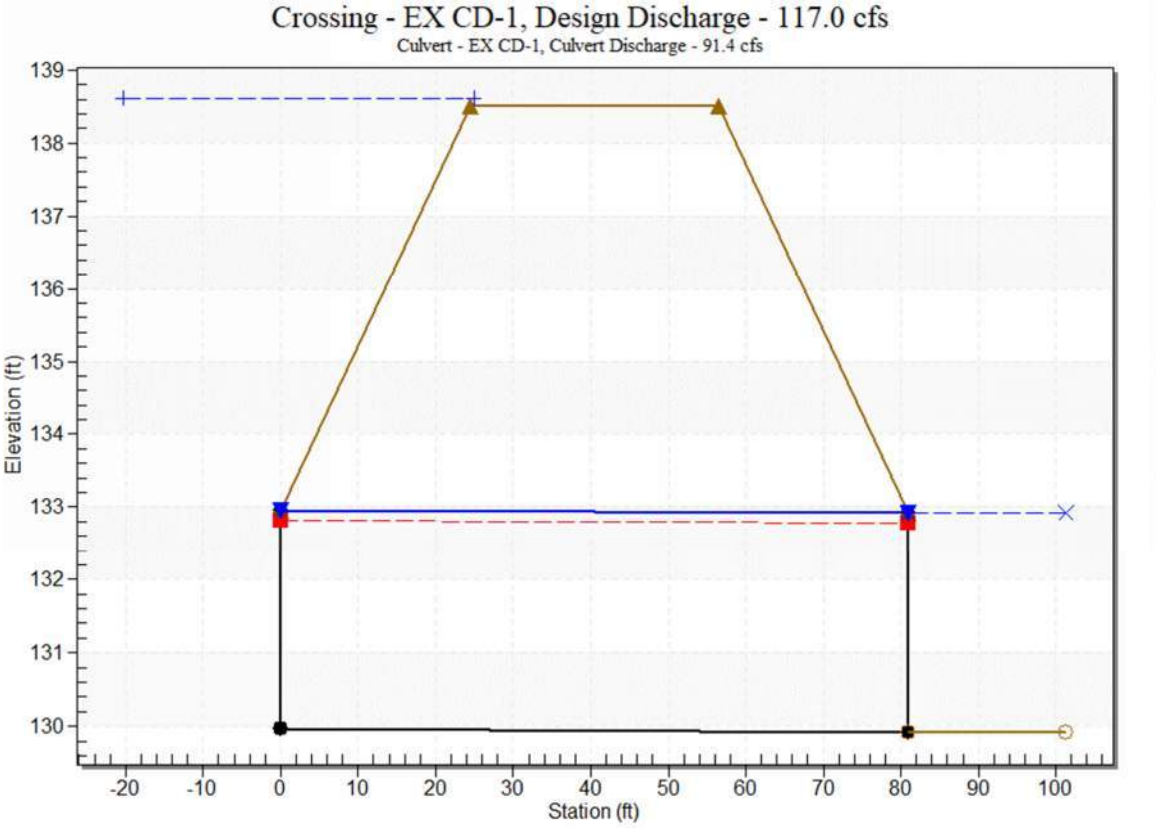
Culvert Length: 81.00 ft,

Culvert Slope: 0.0005

Culvert Performance Curve Plot: EX CD-1



Water Surface Profile Plot for Culvert: EX CD-1



Site Data - EX CD-1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 129.96 ft

Outlet Station: 81.00 ft

Outlet Elevation: 129.92 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-1

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-1

Table 3 - Downstream Channel Rating Curve (Crossing: EX CD-1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
100.00	132.92	3.00
109.90	132.92	3.00
117.00	132.92	3.00
129.70	132.92	3.00
139.60	132.92	3.00
149.50	132.92	3.00
159.40	132.92	3.00
169.30	132.92	3.00
179.20	132.92	3.00
189.10	132.92	3.00
199.00	132.92	3.00

Tailwater Channel Data - EX CD-1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 132.92 ft

Roadway Data for Crossing: EX CD-1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 250.00 ft

Crest Elevation: 138.50 ft

Roadway Surface: Paved

Roadway Top Width: 32.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 100.00 cfs

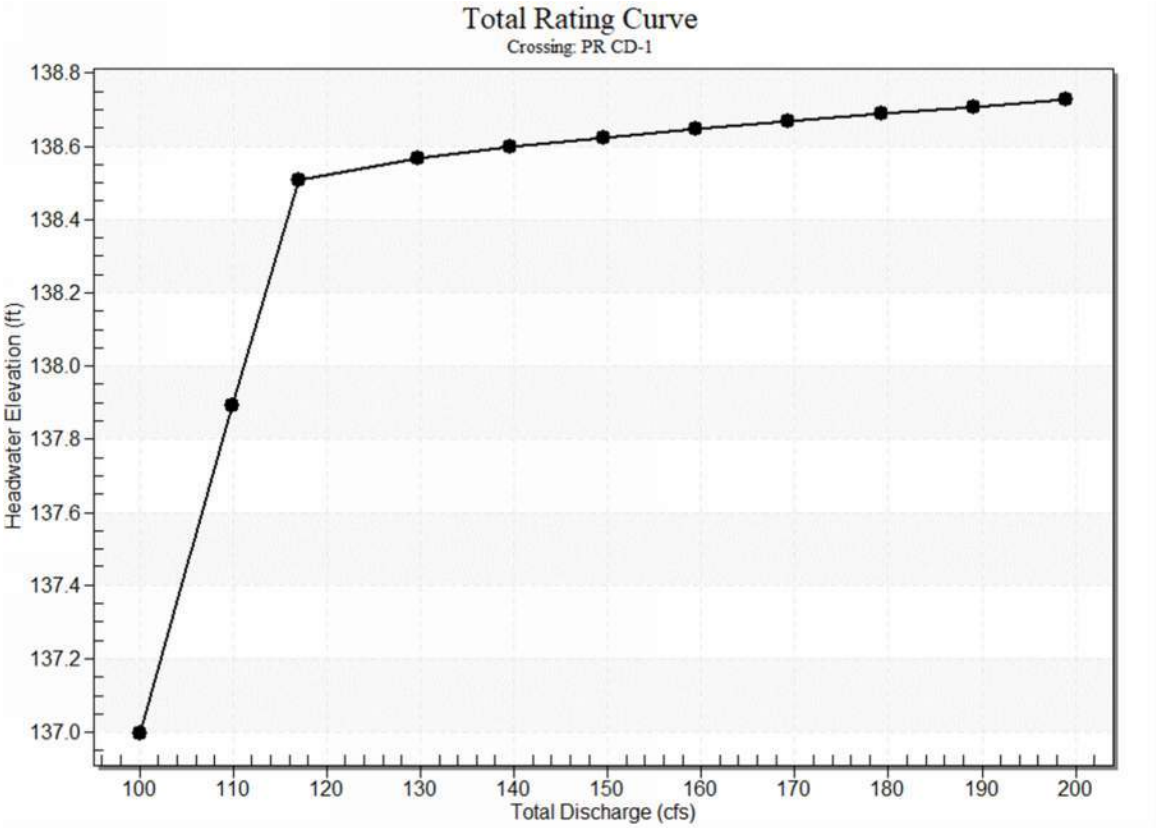
Design Flow: 117.00 cfs

Maximum Flow: 199.00 cfs

Table 4 - Summary of Culvert Flows at Crossing: PR CD-1

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
137.00	100.00	100.00	0.00	1
137.89	109.90	109.90	0.00	1
138.51	117.00	116.16	0.43	74
138.57	129.70	116.75	12.68	7
138.60	139.60	117.05	22.29	5
138.62	149.50	117.31	31.81	4
138.65	159.40	117.54	41.61	4
138.67	169.30	117.76	51.38	4
138.69	179.20	117.95	60.76	3
138.71	189.10	118.14	70.52	3
138.73	199.00	118.32	80.34	3
138.50	116.09	116.09	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-1



Culvert Data: PR CD-1

Table 5 - Culvert Summary Table: PR CD-1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
100.00 cfs	100.00 cfs	137.00	6.60	6.311	7-M2c	3.50	3.07	3.07	3.02	11.18	0.00
109.90 cfs	109.90 cfs	137.89	7.49	7.113	7-M2c	3.50	3.17	3.17	3.02	12.00	0.00
117.00 cfs	116.16 cfs	138.51	8.11	7.633	7-M2c	3.50	3.22	3.22	3.02	12.54	0.00
129.70 cfs	116.75 cfs	138.57	8.17	7.683	7-M2c	3.50	3.23	3.23	3.02	12.59	0.00
139.60 cfs	117.05 cfs	138.60	8.20	7.716	7-M2c	3.50	3.23	3.23	3.02	12.62	0.00
149.50 cfs	117.31 cfs	138.62	8.22	7.732	7-M2c	3.50	3.23	3.23	3.02	12.64	0.00
159.40 cfs	117.54 cfs	138.65	8.25	7.758	7-M2c	3.50	3.23	3.23	3.02	12.66	0.00
169.30 cfs	117.76 cfs	138.67	8.27	7.770	7-M2c	3.50	3.23	3.23	3.02	12.68	0.00
179.20 cfs	117.95 cfs	138.69	8.29	7.787	7-M2c	3.50	3.23	3.23	3.02	12.70	0.00
189.10 cfs	118.14 cfs	138.71	8.31	7.809	7-M2c	3.50	3.24	3.24	3.02	12.72	0.00
199.00 cfs	118.32 cfs	138.73	8.33	7.825	7-M2c	3.50	3.24	3.24	3.02	12.73	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

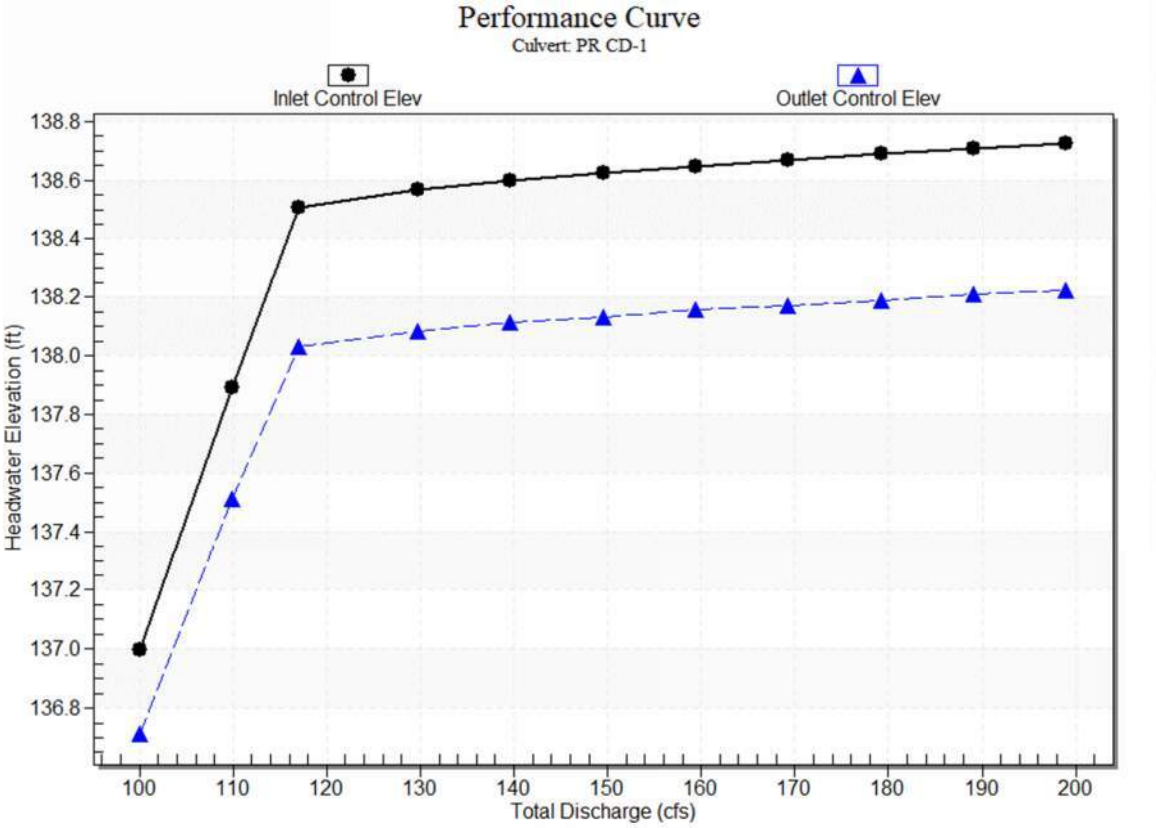
Inlet Elevation (invert): 130.40 ft,

Outlet Elevation (invert): 129.90 ft

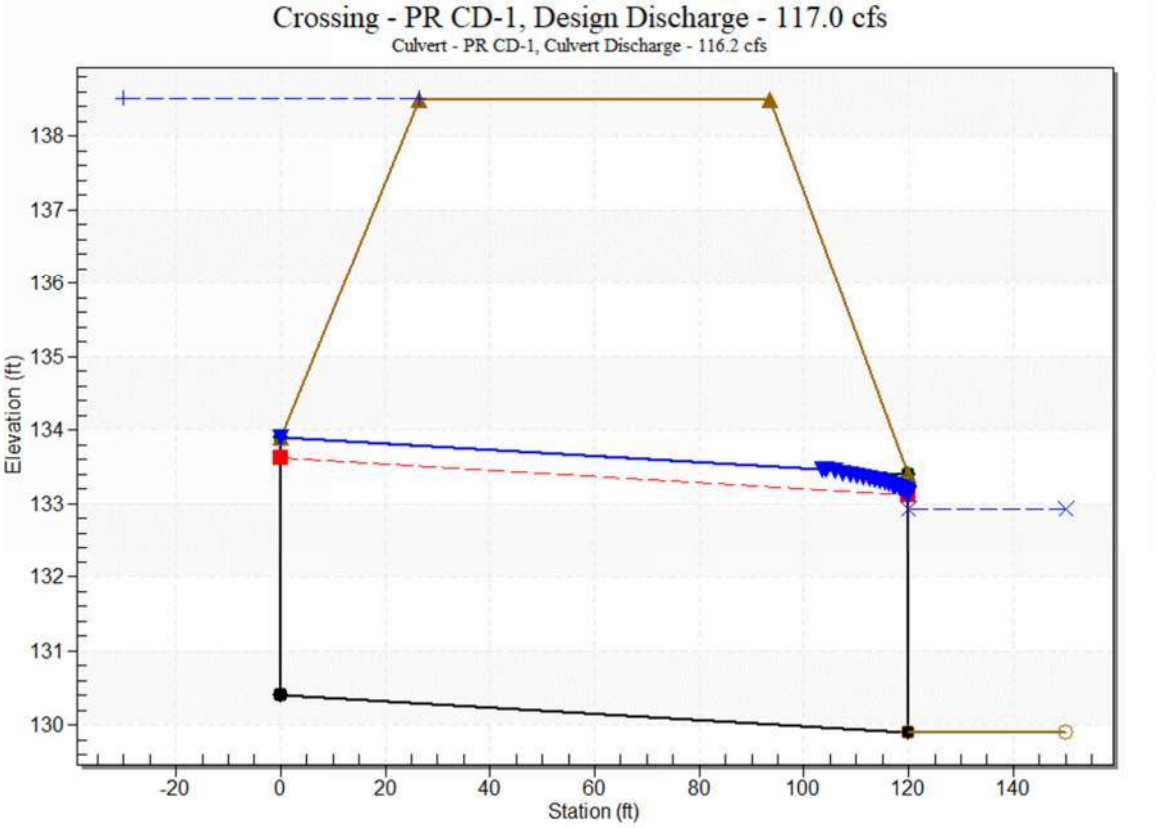
Culvert Length: 120.00 ft,

Culvert Slope: 0.0042

Culvert Performance Curve Plot: PR CD-1



Water Surface Profile Plot for Culvert: PR CD-1



Site Data - PR CD-1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 130.40 ft

Outlet Station: 120.00 ft

Outlet Elevation: 129.90 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-1

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-1

Table 6 - Downstream Channel Rating Curve (Crossing: PR CD-1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
100.00	132.92	3.02
109.90	132.92	3.02
117.00	132.92	3.02
129.70	132.92	3.02
139.60	132.92	3.02
149.50	132.92	3.02
159.40	132.92	3.02
169.30	132.92	3.02
179.20	132.92	3.02
189.10	132.92	3.02
199.00	132.92	3.02

Tailwater Channel Data - PR CD-1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 132.92 ft

Roadway Data for Crossing: PR CD-1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 250.00 ft

Crest Elevation: 138.50 ft

Roadway Surface: Paved

Roadway Top Width: 67.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 49.00 cfs

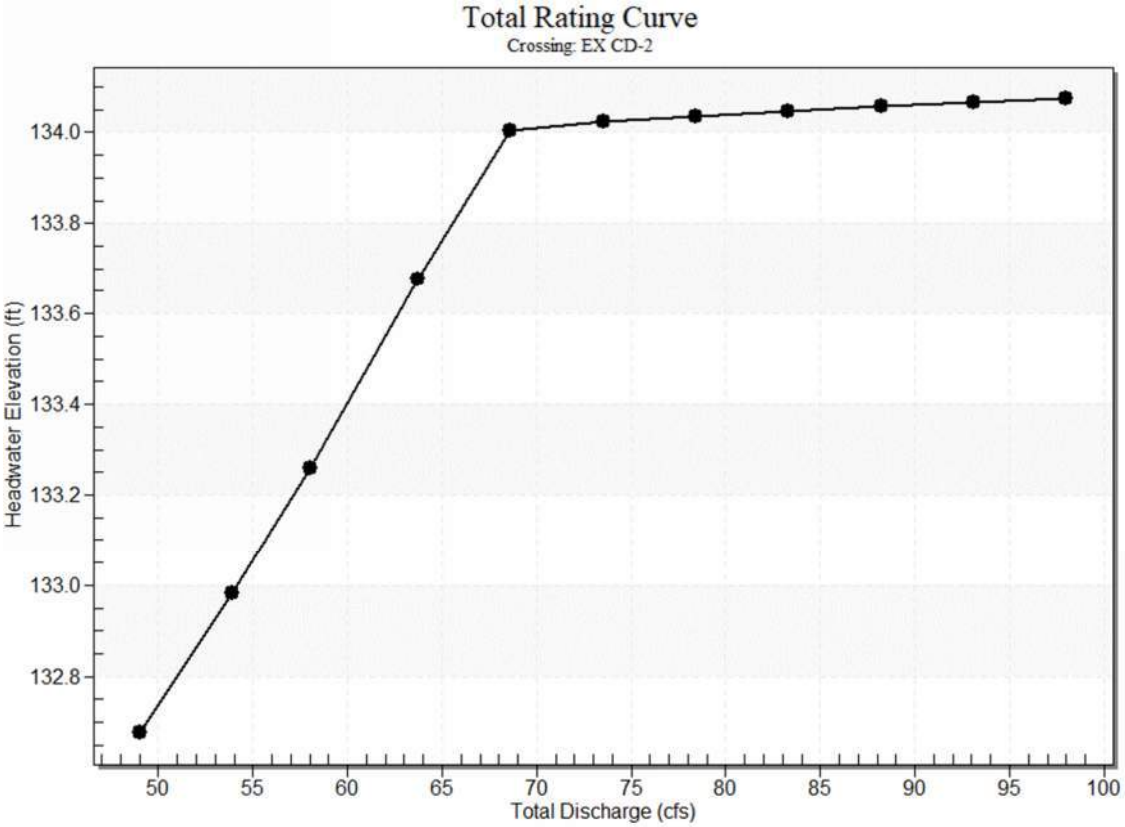
Design Flow: 58.00 cfs

Maximum Flow: 98.00 cfs

Table 7 - Summary of Culvert Flows at Crossing: EX CD-2

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
132.68	49.00	49.00	0.00	1
132.98	53.90	53.90	0.00	1
133.26	58.00	58.00	0.00	1
133.68	63.70	63.70	0.00	1
134.00	68.60	67.70	0.32	57
134.02	73.50	67.88	5.04	5
134.04	78.40	68.00	9.95	4
134.05	83.30	68.10	14.95	4
134.06	88.20	68.19	19.52	3
134.07	93.10	68.27	24.40	3
134.07	98.00	68.35	29.33	3
134.00	67.66	67.66	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-2



Culvert Data: EX CD-2

Table 8 - Culvert Summary Table: EX CD-2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
49.00 cfs	49.00 cfs	132.68	3.92	4.299	4-FFf	3.00	2.28	3.00	3.00	6.93	0.00
53.90 cfs	53.90 cfs	132.98	4.31	4.603	4-FFf	3.00	2.38	3.00	3.00	7.63	0.00
58.00 cfs	58.00 cfs	133.26	4.67	4.879	4-FFf	3.00	2.46	3.00	3.00	8.21	0.00
63.70 cfs	63.70 cfs	133.68	5.21	5.298	4-FFf	3.00	2.56	3.00	3.00	9.01	0.00
68.60 cfs	67.70 cfs	134.00	5.62	5.615	4-FFf	3.00	2.63	3.00	3.00	9.58	0.00
73.50 cfs	67.88 cfs	134.02	5.64	5.629	4-FFf	3.00	2.63	3.00	3.00	9.60	0.00
78.40 cfs	68.00 cfs	134.04	5.66	5.639	4-FFf	3.00	2.63	3.00	3.00	9.62	0.00
83.30 cfs	68.10 cfs	134.05	5.67	5.648	4-FFf	3.00	2.63	3.00	3.00	9.63	0.00
88.20 cfs	68.19 cfs	134.06	5.68	5.655	4-FFf	3.00	2.63	3.00	3.00	9.65	0.00
93.10 cfs	68.27 cfs	134.07	5.69	5.662	4-FFf	3.00	2.63	3.00	3.00	9.66	0.00
98.00 cfs	68.35 cfs	134.07	5.69	5.668	4-FFf	3.00	2.63	3.00	3.00	9.67	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

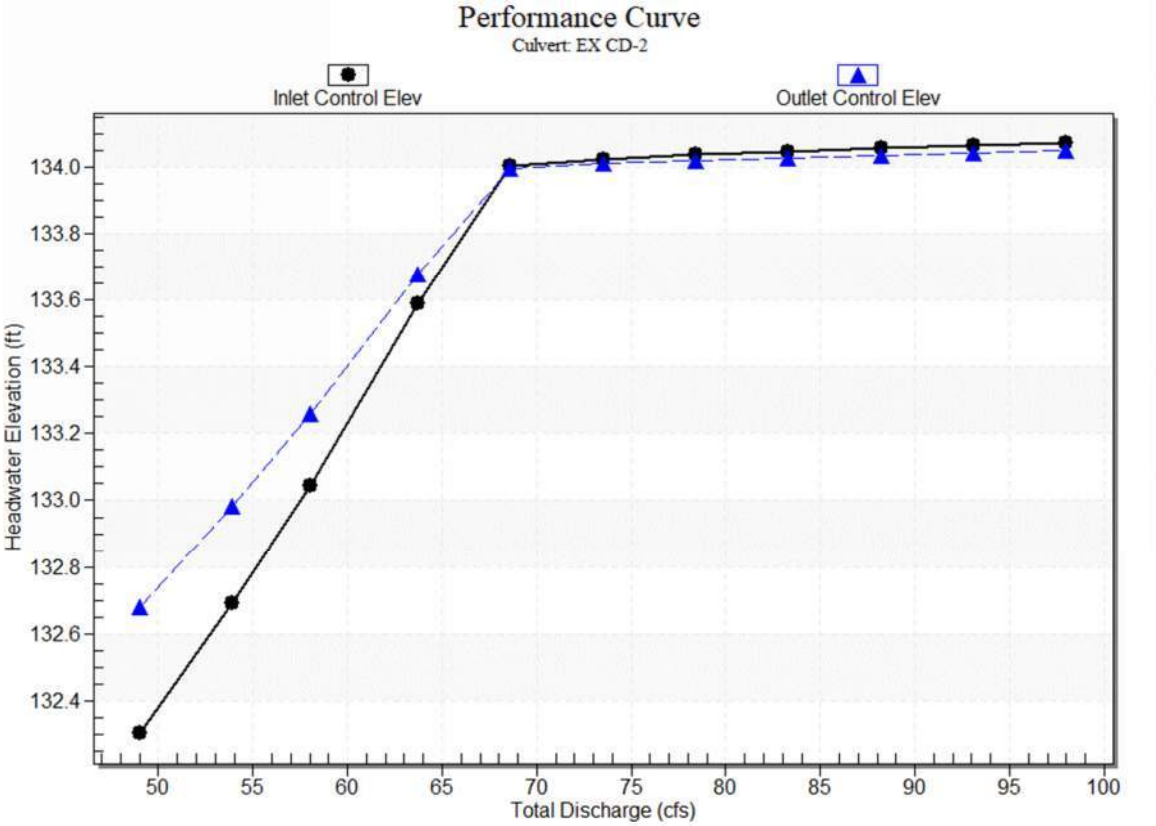
Inlet Elevation (invert): 128.38 ft,

Outlet Elevation (invert): 128.23 ft

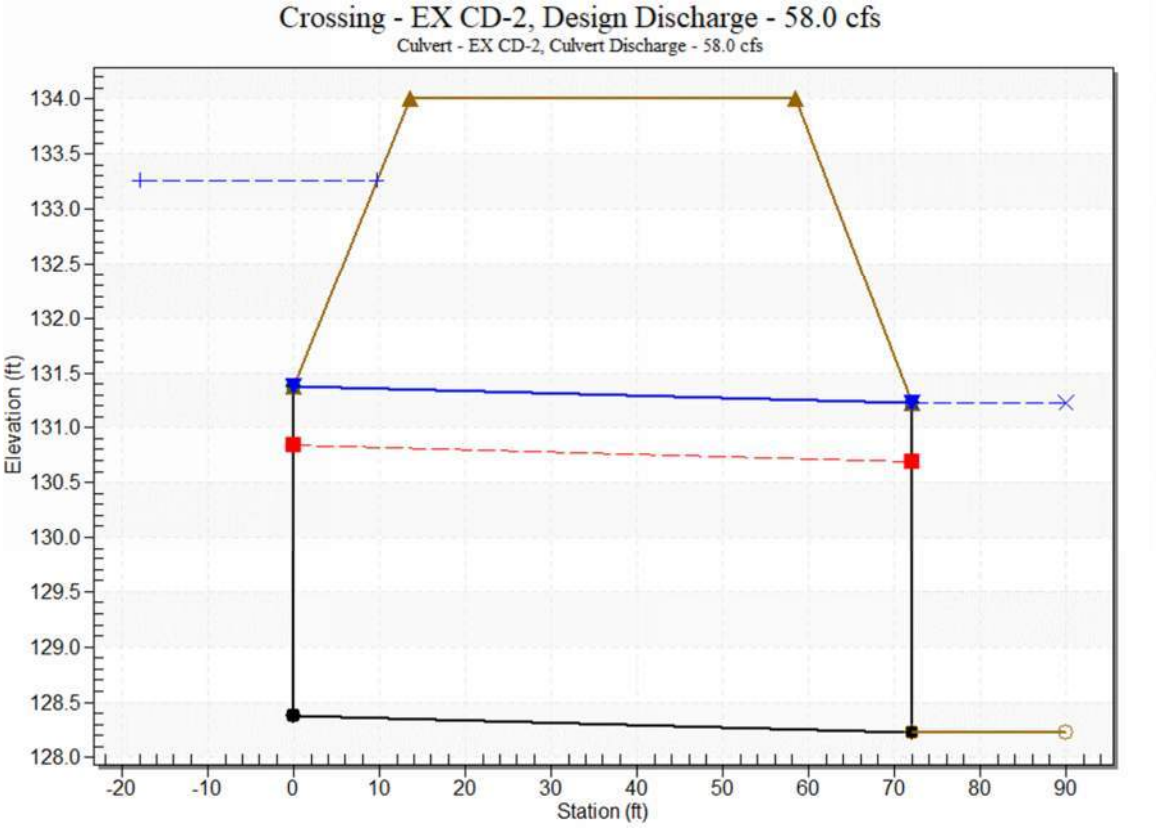
Culvert Length: 72.00 ft,

Culvert Slope: 0.0021

Culvert Performance Curve Plot: EX CD-2



Water Surface Profile Plot for Culvert: EX CD-2



Site Data - EX CD-2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 128.38 ft

Outlet Station: 72.00 ft

Outlet Elevation: 128.23 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-2

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-2

Table 9 - Downstream Channel Rating Curve (Crossing: EX CD-2)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
49.00	131.23	3.00
53.90	131.23	3.00
58.00	131.23	3.00
63.70	131.23	3.00
68.60	131.23	3.00
73.50	131.23	3.00
78.40	131.23	3.00
83.30	131.23	3.00
88.20	131.23	3.00
93.10	131.23	3.00
98.00	131.23	3.00

Tailwater Channel Data - EX CD-2

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 131.23 ft

Roadway Data for Crossing: EX CD-2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 500.00 ft

Crest Elevation: 134.00 ft

Roadway Surface: Paved

Roadway Top Width: 45.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 49.00 cfs

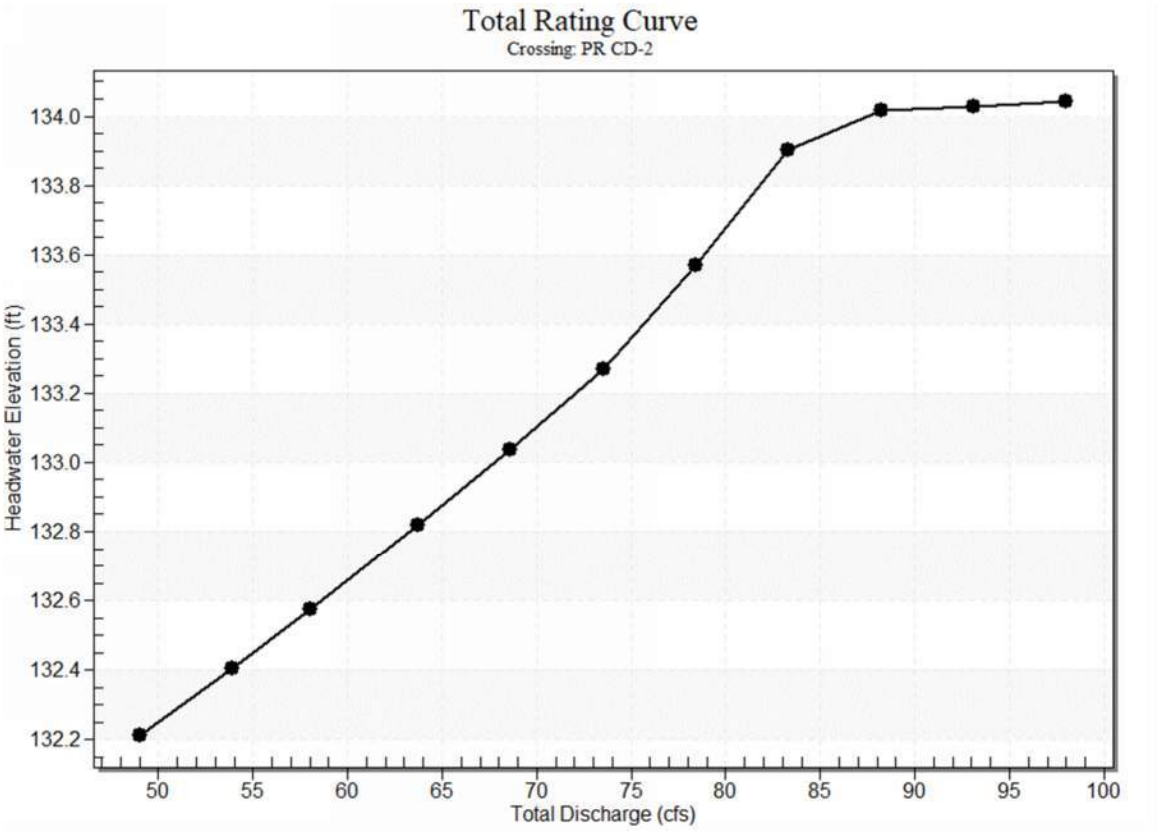
Design Flow: 58.00 cfs

Maximum Flow: 98.00 cfs

Table 10 - Summary of Culvert Flows at Crossing: PR CD-2

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
132.21	49.00	49.00	0.00	1
132.40	53.90	53.90	0.00	1
132.57	58.00	58.00	0.00	1
132.82	63.70	63.70	0.00	1
133.04	68.60	68.60	0.00	1
133.27	73.50	73.50	0.00	1
133.57	78.40	78.40	0.00	1
133.90	83.30	83.30	0.00	1
134.02	88.20	84.92	2.87	17
134.03	93.10	85.12	7.39	4
134.04	98.00	85.29	12.38	4
134.00	84.70	84.70	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-2



Culvert Data: PR CD-2

Table 11 - Culvert Summary Table: PR CD-2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
49.00 cfs	49.00 cfs	132.21	3.37	3.613	7-M1t	2.28	2.19	3.03	3.05	5.54	0.00
53.90 cfs	53.90 cfs	132.40	3.60	3.804	7-M1t	2.45	2.30	3.03	3.05	6.09	0.00
58.00 cfs	58.00 cfs	132.57	3.81	3.973	7-M1t	2.60	2.39	3.03	3.05	6.55	0.00
63.70 cfs	63.70 cfs	132.82	4.10	4.218	7-M1t	2.84	2.50	3.03	3.05	7.20	0.00
68.60 cfs	68.60 cfs	133.04	4.37	4.438	3-M2t	3.50	2.60	3.03	3.05	7.75	0.00
73.50 cfs	73.50 cfs	133.27	4.66	4.669	3-M2t	3.50	2.68	3.03	3.05	8.30	0.00
78.40 cfs	78.40 cfs	133.57	4.97	4.915	3-M2t	3.50	2.77	3.03	3.05	8.86	0.00
83.30 cfs	83.30 cfs	133.90	5.30	5.185	3-M2t	3.50	2.85	3.03	3.05	9.41	0.00
88.20 cfs	84.92 cfs	134.02	5.42	5.283	3-M2t	3.50	2.87	3.03	3.05	9.60	0.00
93.10 cfs	85.12 cfs	134.03	5.43	5.295	3-M2t	3.50	2.87	3.03	3.05	9.62	0.00
98.00 cfs	85.29 cfs	134.04	5.44	5.306	3-M2t	3.50	2.88	3.03	3.05	9.64	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

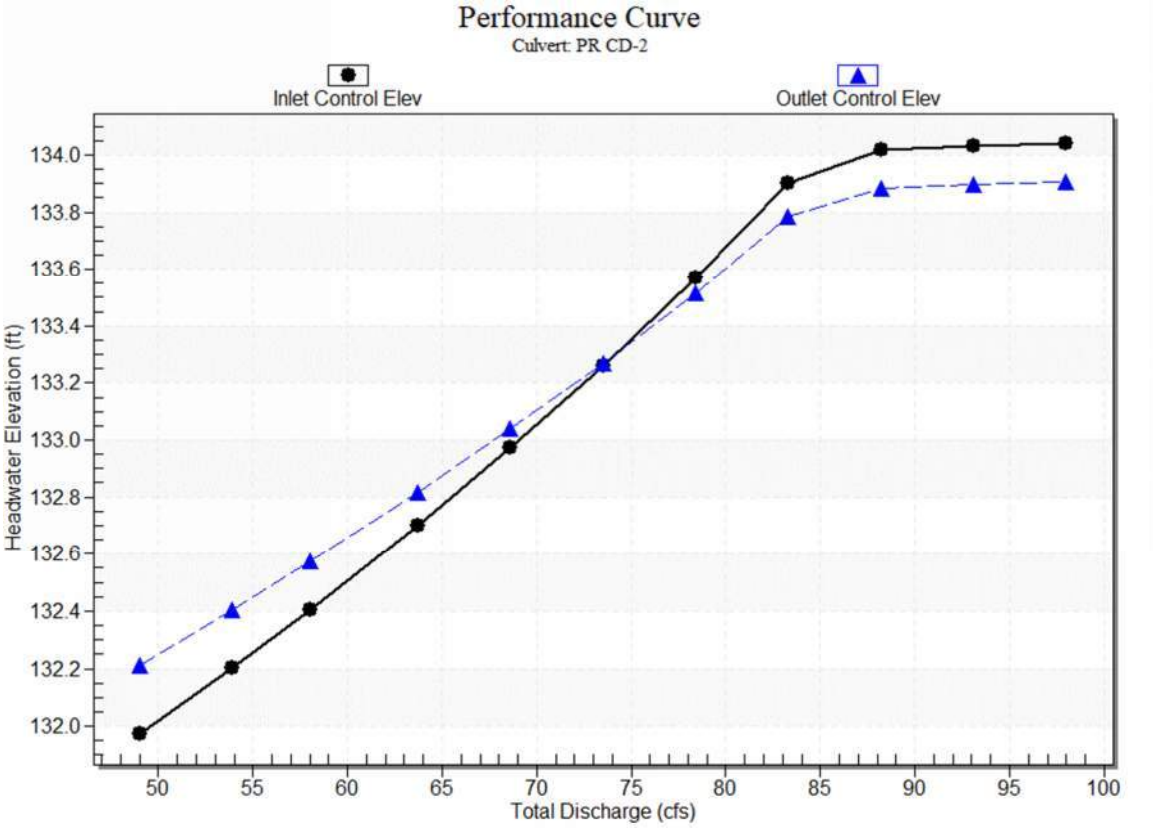
Inlet Elevation (invert): 128.60 ft,

Outlet Elevation (invert): 128.20 ft

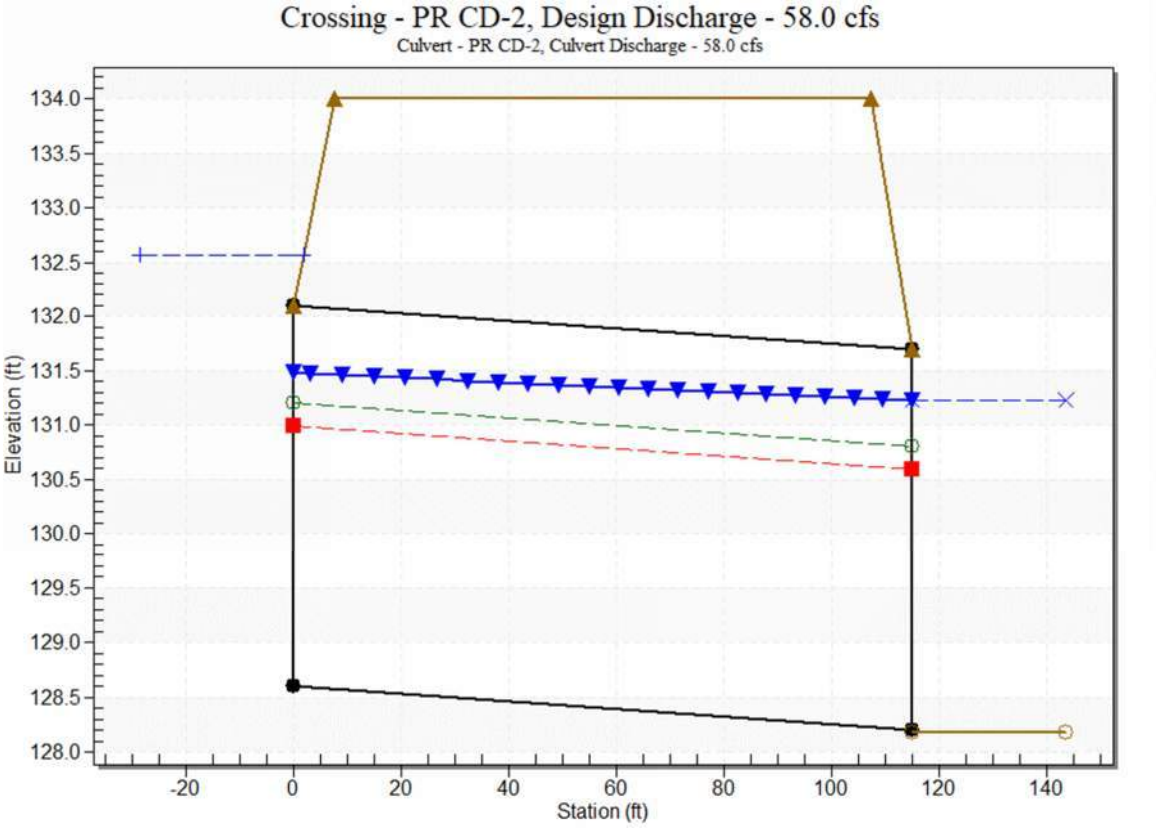
Culvert Length: 115.00 ft,

Culvert Slope: 0.0035

Culvert Performance Curve Plot: PR CD-2



Water Surface Profile Plot for Culvert: PR CD-2



Site Data - PR CD-2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 128.60 ft

Outlet Station: 115.00 ft

Outlet Elevation: 128.20 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-2

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-2

Table 12 - Downstream Channel Rating Curve (Crossing: PR CD-2)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
49.00	131.23	3.05
53.90	131.23	3.05
58.00	131.23	3.05
63.70	131.23	3.05
68.60	131.23	3.05
73.50	131.23	3.05
78.40	131.23	3.05
83.30	131.23	3.05
88.20	131.23	3.05
93.10	131.23	3.05
98.00	131.23	3.05

Tailwater Channel Data - PR CD-2

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 131.23 ft

Roadway Data for Crossing: PR CD-2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 500.00 ft

Crest Elevation: 134.00 ft

Roadway Surface: Paved

Roadway Top Width: 100.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 12.00 cfs

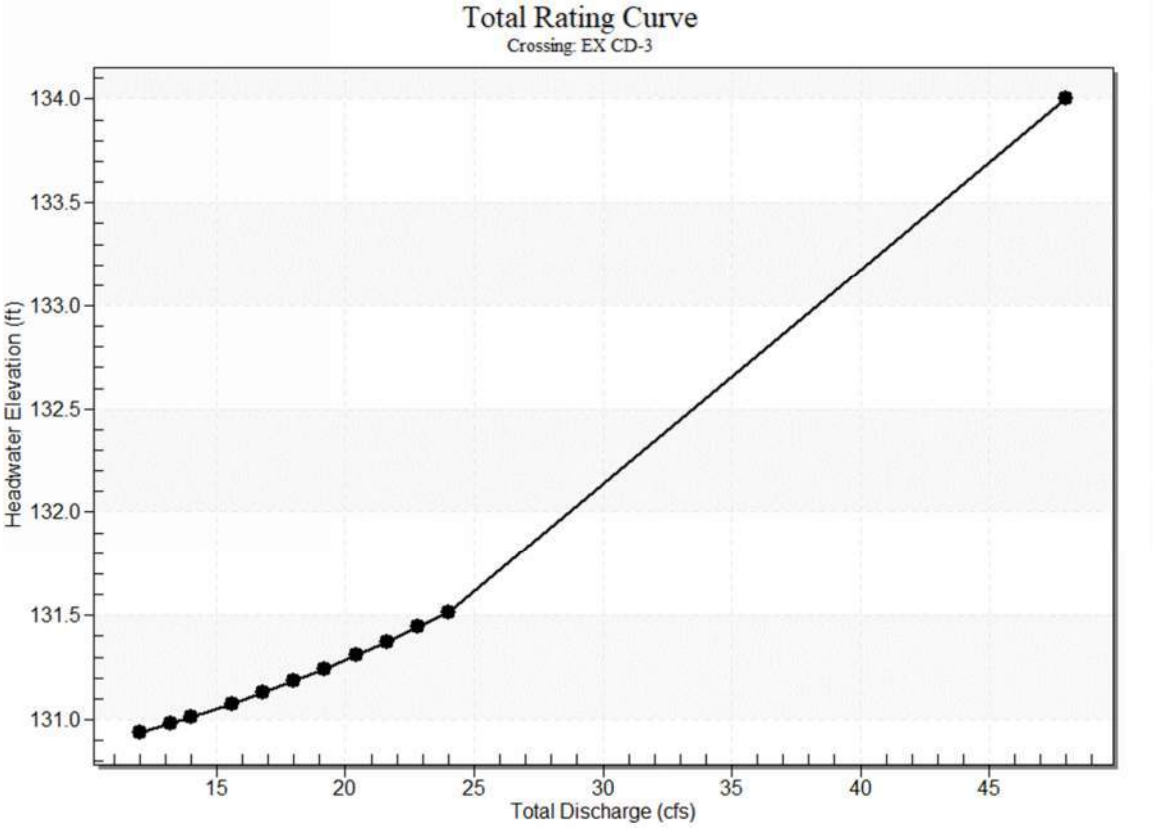
Design Flow: 14.00 cfs

Maximum Flow: 24.00 cfs

Table 13 - Summary of Culvert Flows at Crossing: EX CD-3

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
130.94	12.00	12.00	0.00	1
130.98	13.20	13.20	0.00	1
131.01	14.00	14.00	0.00	1
131.08	15.60	15.60	0.00	1
131.13	16.80	16.80	0.00	1
131.18	18.00	18.00	0.00	1
131.24	19.20	19.20	0.00	1
131.31	20.40	20.40	0.00	1
131.37	21.60	21.60	0.00	1
131.44	22.80	22.80	0.00	1
131.52	24.00	24.00	0.00	1
134.00	47.14	47.14	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-3



Culvert Data: EX CD-3

Table 14 - Culvert Summary Table: EX CD-3

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
12.00 cfs	12.00 cfs	130.94	1.69	2.249	1-S1f	1.01	1.16	2.50	2.50	2.44	0.00
13.20 cfs	13.20 cfs	130.98	1.79	2.291	1-S1f	1.06	1.22	2.50	2.50	2.69	0.00
14.00 cfs	14.00 cfs	131.01	1.85	2.321	1-S1f	1.10	1.26	2.50	2.50	2.85	0.00
15.60 cfs	15.60 cfs	131.08	1.98	2.385	1-S1f	1.17	1.33	2.50	2.50	3.18	0.00
16.80 cfs	16.80 cfs	131.13	2.07	2.438	1-S1f	1.22	1.39	2.50	2.50	3.42	0.00
18.00 cfs	18.00 cfs	131.18	2.17	2.494	1-S1f	1.27	1.44	2.50	2.50	3.67	0.00
19.20 cfs	19.20 cfs	131.24	2.26	2.554	1-S1f	1.32	1.49	2.50	2.50	3.91	0.00
20.40 cfs	20.40 cfs	131.31	2.35	2.617	1-S1f	1.37	1.53	2.50	2.50	4.16	0.00
21.60 cfs	21.60 cfs	131.37	2.44	2.684	1-S1f	1.42	1.58	2.50	2.50	4.40	0.00
22.80 cfs	22.80 cfs	131.44	2.54	2.753	1-S1f	1.46	1.62	2.50	2.50	4.64	0.00
24.00 cfs	24.00 cfs	131.52	2.63	2.826	1-S1f	1.51	1.67	2.50	2.50	4.89	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

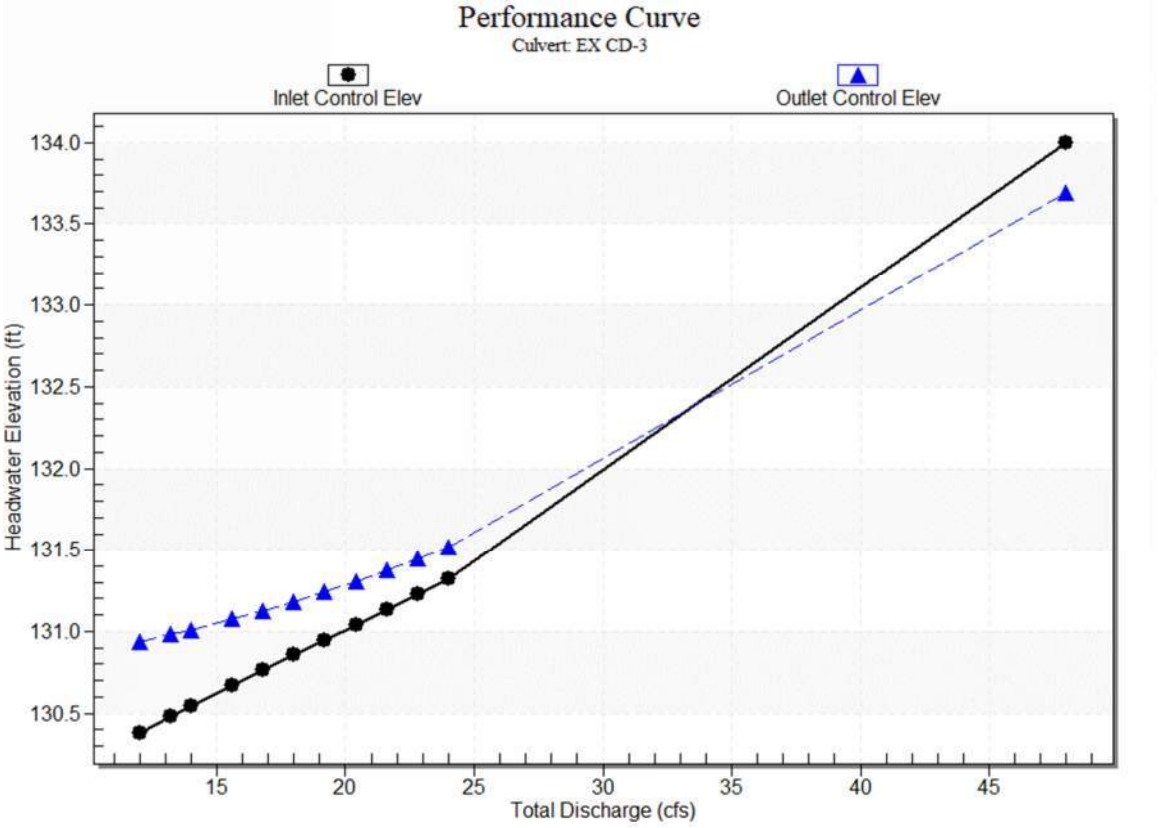
Inlet Elevation (invert): 128.69 ft,

Outlet Elevation (invert): 128.24 ft

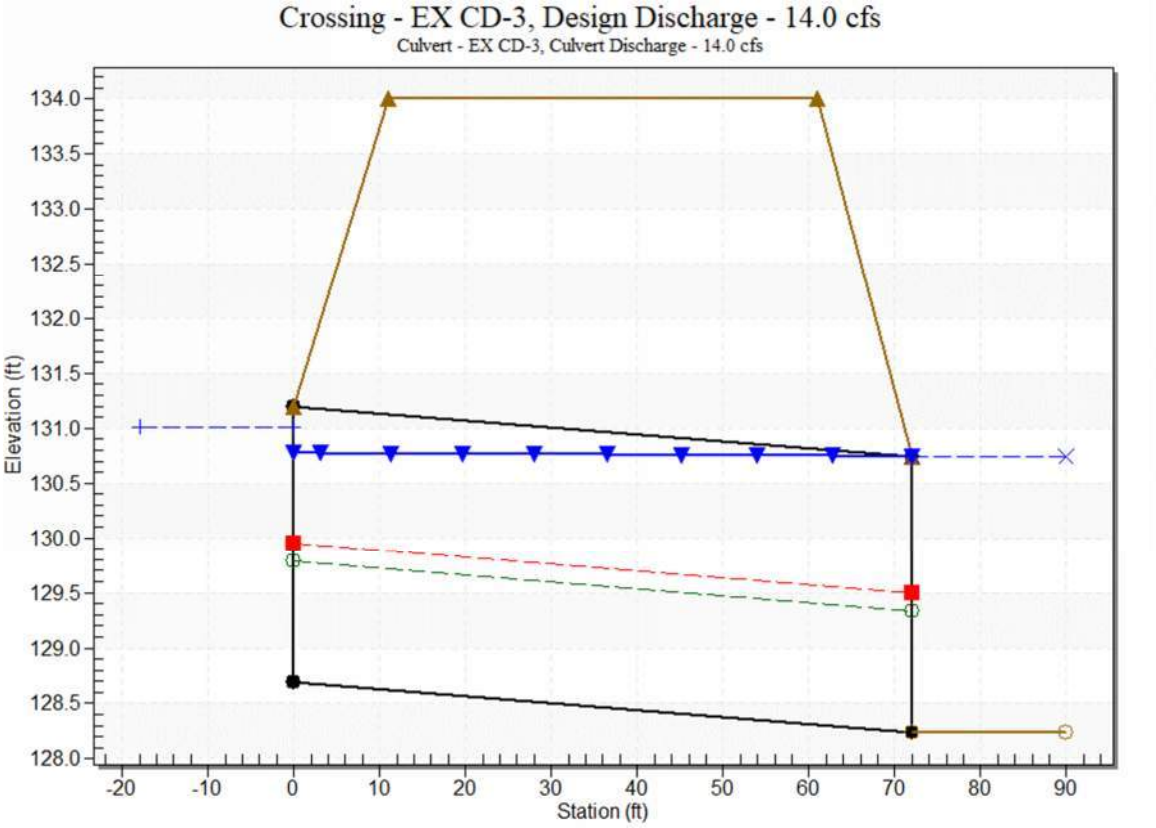
Culvert Length: 72.00 ft,

Culvert Slope: 0.0062

Culvert Performance Curve Plot: EX CD-3



Water Surface Profile Plot for Culvert: EX CD-3



Site Data - EX CD-3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 128.69 ft

Outlet Station: 72.00 ft

Outlet Elevation: 128.24 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-3

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-3

Table 15 - Downstream Channel Rating Curve (Crossing: EX CD-3)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
12.00	130.74	2.50
13.20	130.74	2.50
14.00	130.74	2.50
15.60	130.74	2.50
16.80	130.74	2.50
18.00	130.74	2.50
19.20	130.74	2.50
20.40	130.74	2.50
21.60	130.74	2.50
22.80	130.74	2.50
24.00	130.74	2.50

Tailwater Channel Data - EX CD-3

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 130.74 ft

Roadway Data for Crossing: EX CD-3

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1400.00 ft

Crest Elevation: 134.00 ft

Roadway Surface: Paved

Roadway Top Width: 50.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 12.00 cfs

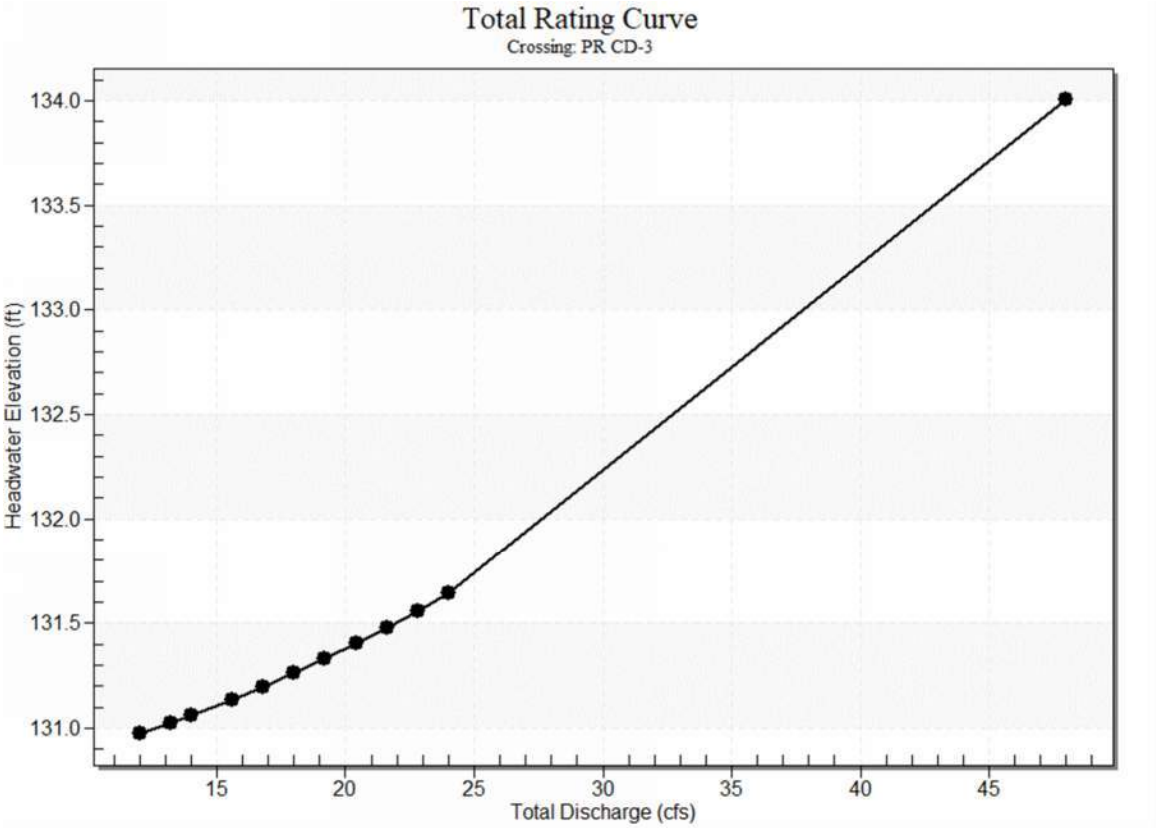
Design Flow: 14.00 cfs

Maximum Flow: 24.00 cfs

Table 16 - Summary of Culvert Flows at Crossing: PR CD-3

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
130.98	12.00	12.00	0.00	1
131.03	13.20	13.20	0.00	1
131.06	14.00	14.00	0.00	1
131.14	15.60	15.60	0.00	1
131.20	16.80	16.80	0.00	1
131.26	18.00	18.00	0.00	1
131.33	19.20	19.20	0.00	1
131.40	20.40	20.40	0.00	1
131.48	21.60	21.60	0.00	1
131.56	22.80	22.80	0.00	1
131.64	24.00	24.00	0.00	1
134.00	45.93	45.93	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-3



Culvert Data: PR CD-3

Table 17 - Culvert Summary Table: PR CD-3

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
12.00 cfs	12.00 cfs	130.98	1.69	2.158	1-S1f	1.01	1.16	2.50	2.63	2.44	0.00
13.20 cfs	13.20 cfs	131.03	1.79	2.206	1-S1f	1.06	1.22	2.50	2.63	2.69	0.00
14.00 cfs	14.00 cfs	131.06	1.85	2.241	1-S1f	1.10	1.26	2.50	2.63	2.85	0.00
15.60 cfs	15.60 cfs	131.14	1.98	2.317	1-S1f	1.17	1.33	2.50	2.63	3.18	0.00
16.80 cfs	16.80 cfs	131.20	2.07	2.378	1-S1f	1.22	1.39	2.50	2.63	3.42	0.00
18.00 cfs	18.00 cfs	131.26	2.17	2.443	1-S1f	1.27	1.44	2.50	2.63	3.67	0.00
19.20 cfs	19.20 cfs	131.33	2.26	2.512	1-S1f	1.32	1.49	2.50	2.63	3.91	0.00
20.40 cfs	20.40 cfs	131.40	2.35	2.585	1-S1f	1.37	1.53	2.50	2.63	4.16	0.00
21.60 cfs	21.60 cfs	131.48	2.44	2.661	1-S1f	1.42	1.58	2.50	2.63	4.40	0.00
22.80 cfs	22.80 cfs	131.56	2.54	2.740	1-S1f	1.47	1.62	2.50	2.63	4.64	0.00
24.00 cfs	24.00 cfs	131.64	2.63	2.822	1-S1f	1.52	1.67	2.50	2.63	4.89	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

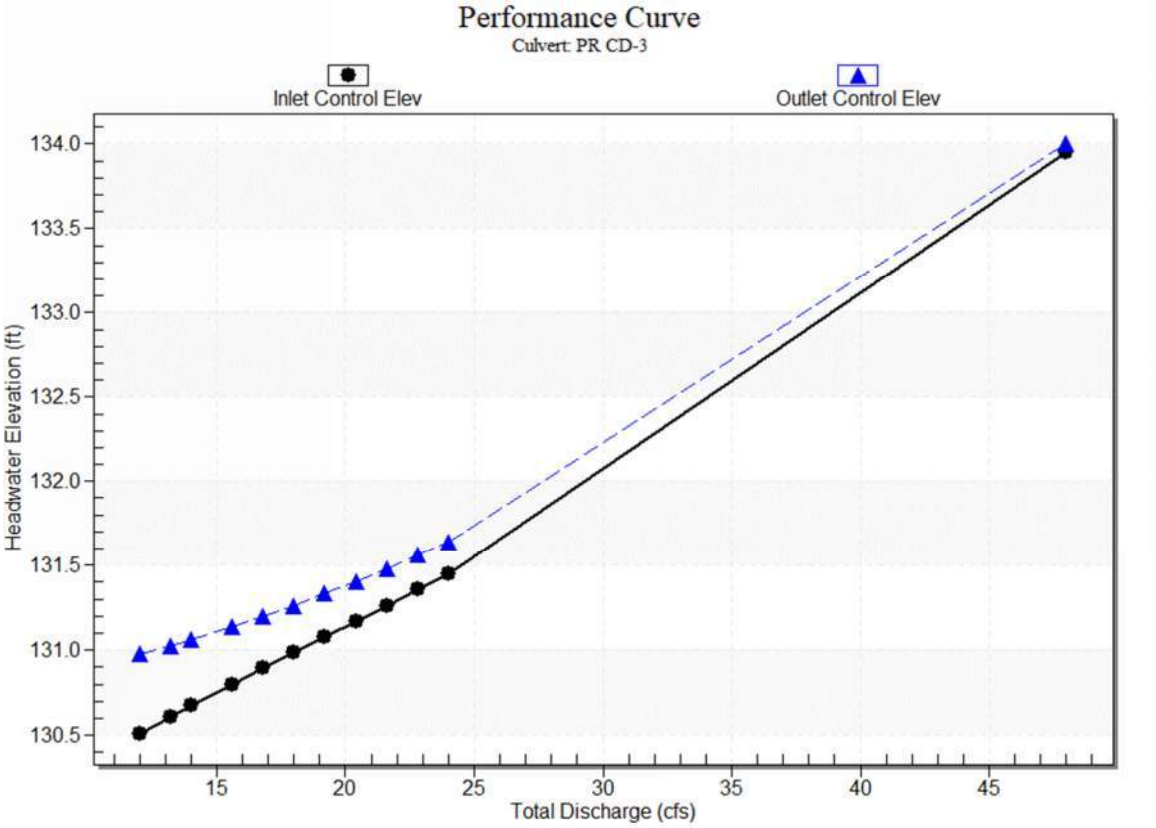
Inlet Elevation (invert): 128.82 ft,

Outlet Elevation (invert): 128.11 ft

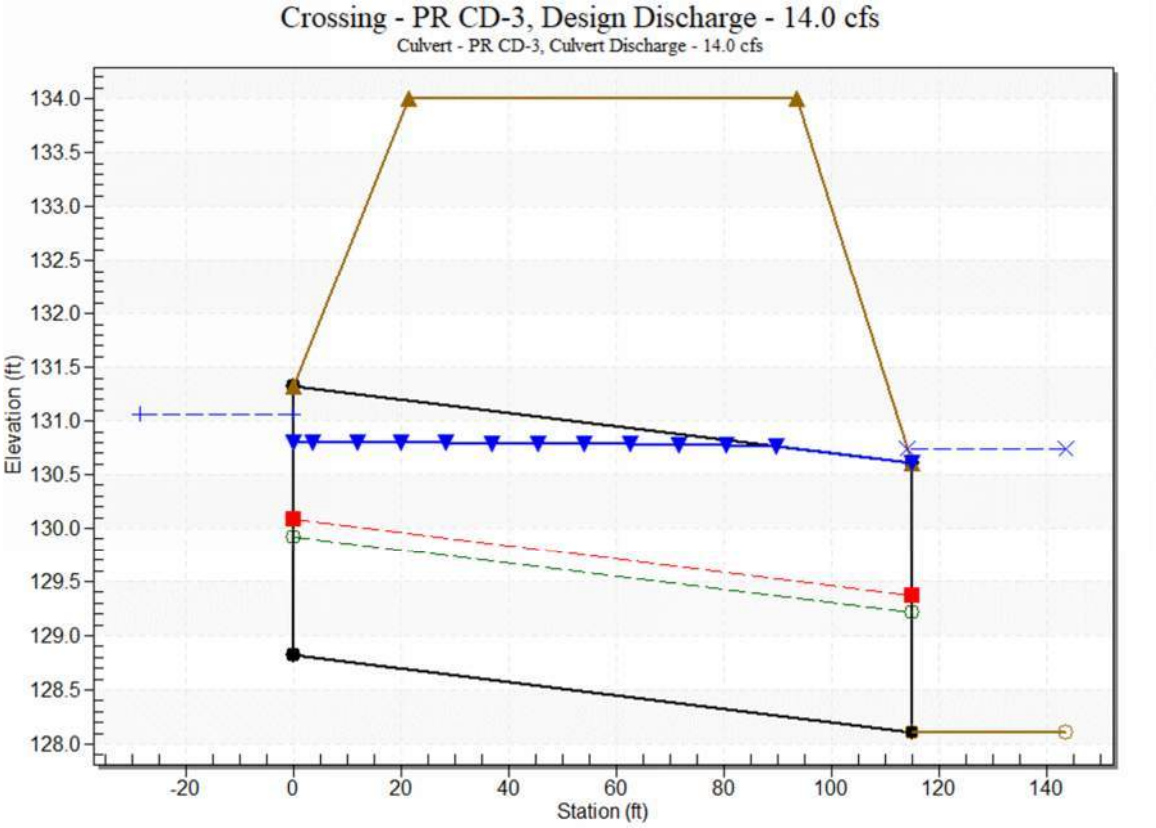
Culvert Length: 115.00 ft,

Culvert Slope: 0.0062

Culvert Performance Curve Plot: PR CD-3



Water Surface Profile Plot for Culvert: PR CD-3



Site Data - PR CD-3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 128.82 ft

Outlet Station: 115.00 ft

Outlet Elevation: 128.11 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-3

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-3

Table 18 - Downstream Channel Rating Curve (Crossing: PR CD-3)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
12.00	130.74	2.63
13.20	130.74	2.63
14.00	130.74	2.63
15.60	130.74	2.63
16.80	130.74	2.63
18.00	130.74	2.63
19.20	130.74	2.63
20.40	130.74	2.63
21.60	130.74	2.63
22.80	130.74	2.63
24.00	130.74	2.63

Tailwater Channel Data - PR CD-3

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 130.74 ft

Roadway Data for Crossing: PR CD-3

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1400.00 ft

Crest Elevation: 134.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 9.00 cfs

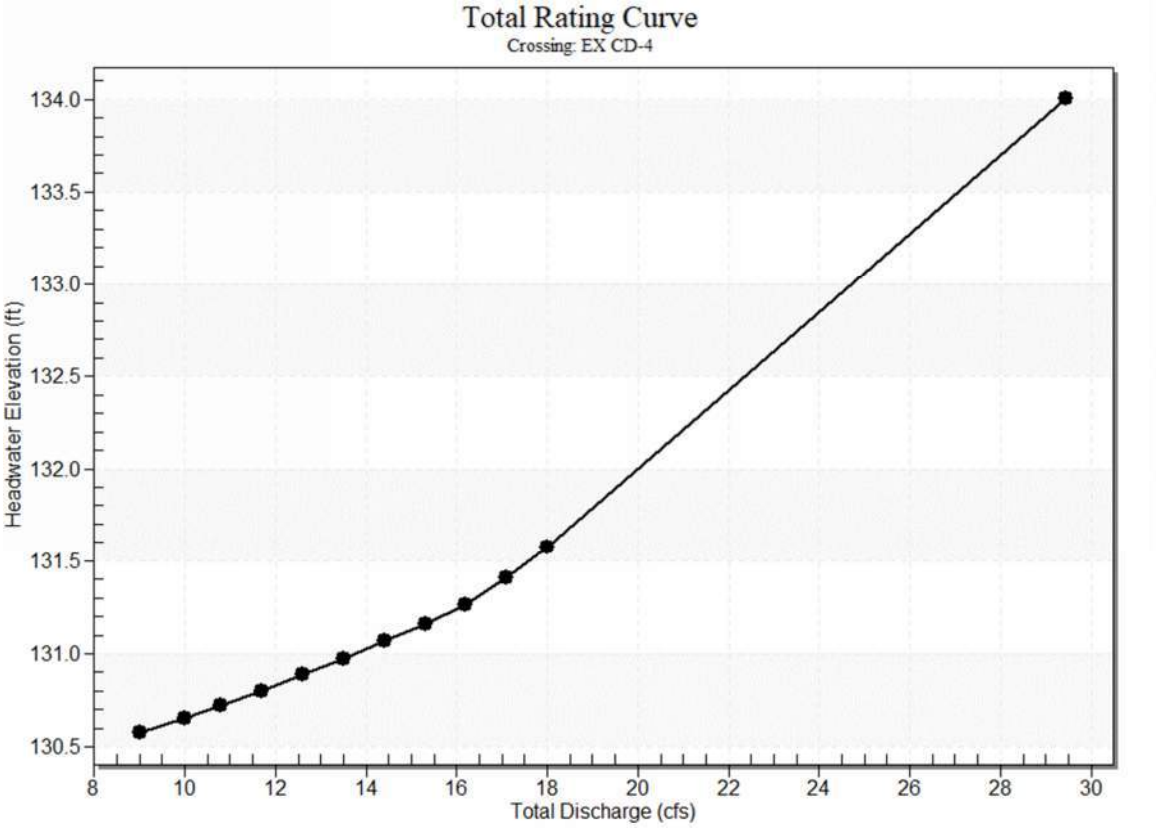
Design Flow: 10.00 cfs

Maximum Flow: 18.00 cfs

Table 19 - Summary of Culvert Flows at Crossing: EX CD-4

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-4 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
130.58	9.00	9.00	0.00	1
130.66	10.00	10.00	0.00	1
130.72	10.80	10.80	0.00	1
130.80	11.70	11.70	0.00	1
130.89	12.60	12.60	0.00	1
130.97	13.50	13.50	0.00	1
131.07	14.40	14.40	0.00	1
131.16	15.30	15.30	0.00	1
131.26	16.20	16.20	0.00	1
131.41	17.10	17.10	0.00	1
131.57	18.00	18.00	0.00	1
134.00	28.35	28.35	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-4



Culvert Data: EX CD-4

Table 20 - Culvert Summary Table: EX CD-4

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
9.00 cfs	9.00 cfs	130.58	1.61	1.890	1-S1f	0.96	1.07	2.00	2.00	2.86	0.00
10.00 cfs	10.00 cfs	130.66	1.72	1.966	1-S1f	1.02	1.13	2.00	2.00	3.18	0.00
10.80 cfs	10.80 cfs	130.72	1.81	2.033	1-S1f	1.07	1.18	2.00	2.00	3.44	0.00
11.70 cfs	11.70 cfs	130.80	1.92	2.112	1-S1f	1.12	1.23	2.00	2.00	3.72	0.00
12.60 cfs	12.60 cfs	130.89	2.03	2.196	1-S1f	1.17	1.28	2.00	2.00	4.01	0.00
13.50 cfs	13.50 cfs	130.97	2.15	2.284	1-S1f	1.23	1.32	2.00	2.00	4.30	0.00
14.40 cfs	14.40 cfs	131.07	2.28	2.377	1-S1f	1.28	1.37	2.00	2.00	4.58	0.00
15.30 cfs	15.30 cfs	131.16	2.42	2.472	1-S1f	1.34	1.41	2.00	2.00	4.87	0.00
16.20 cfs	16.20 cfs	131.26	2.57	2.572	1-S1f	1.40	1.45	2.00	2.00	5.16	0.00
17.10 cfs	17.10 cfs	131.41	2.72	2.676	5-S1f	1.46	1.49	2.00	2.00	5.44	0.00
18.00 cfs	18.00 cfs	131.57	2.88	2.787	5-S1f	1.52	1.53	2.00	2.00	5.73	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

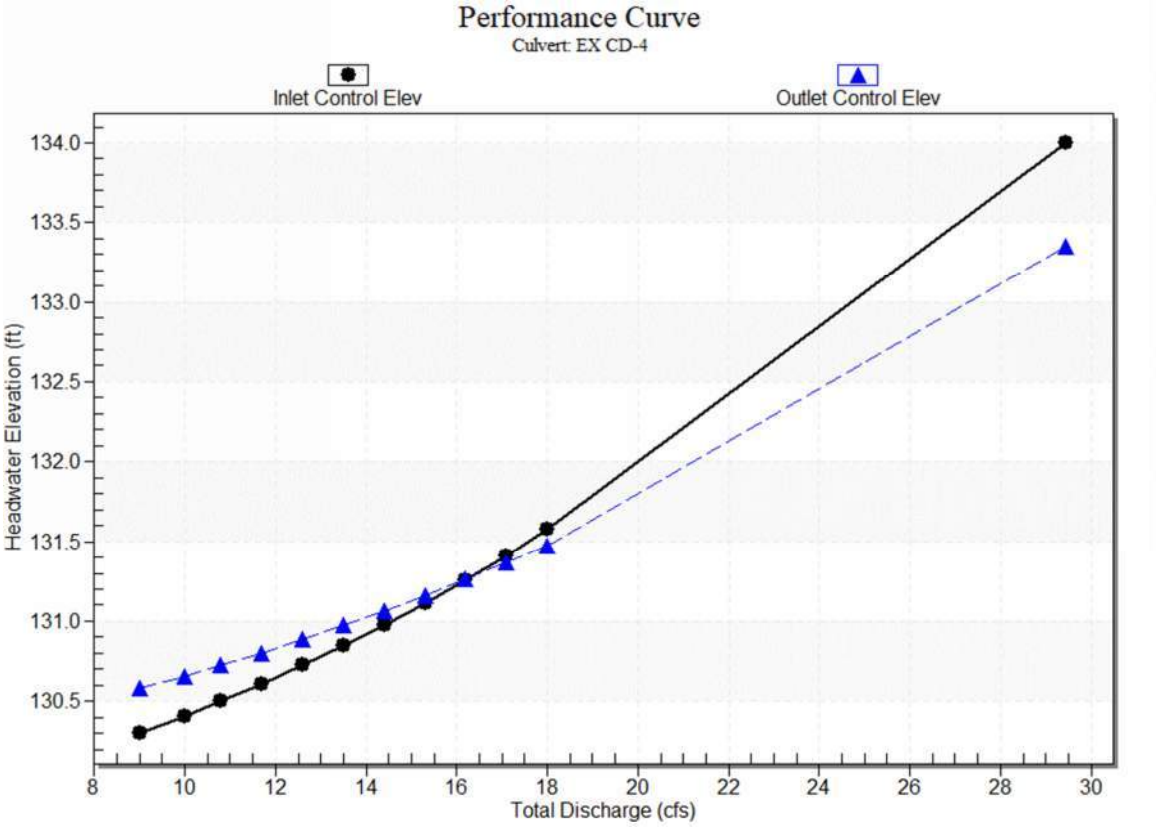
Inlet Elevation (invert): 128.69 ft,

Outlet Elevation (invert): 128.24 ft

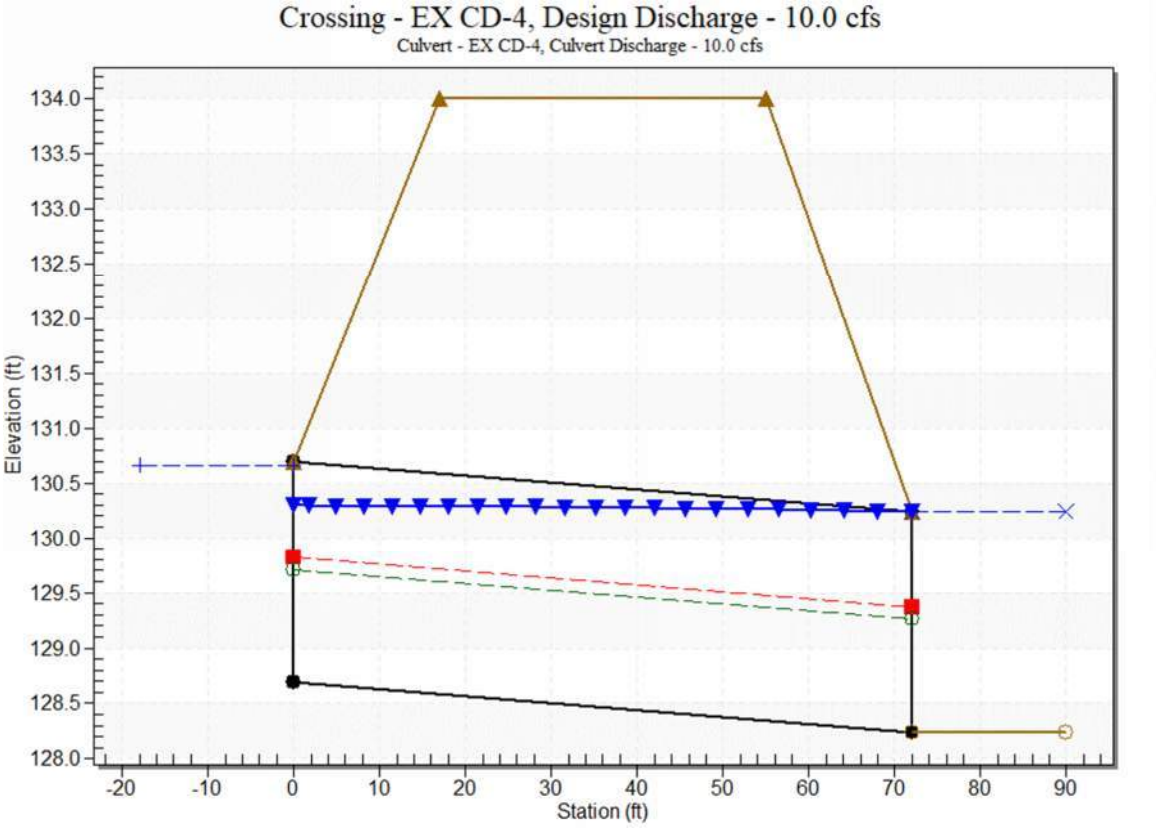
Culvert Length: 72.00 ft,

Culvert Slope: 0.0062

Culvert Performance Curve Plot: EX CD-4



Water Surface Profile Plot for Culvert: EX CD-4



Site Data - EX CD-4

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 128.69 ft

Outlet Station: 72.00 ft

Outlet Elevation: 128.24 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-4

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Tailwater Data for Crossing: EX CD-4

Table 21 - Downstream Channel Rating Curve (Crossing: EX CD-4)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
9.00	130.24	2.00
10.00	130.24	2.00
10.80	130.24	2.00
11.70	130.24	2.00
12.60	130.24	2.00
13.50	130.24	2.00
14.40	130.24	2.00
15.30	130.24	2.00
16.20	130.24	2.00
17.10	130.24	2.00
18.00	130.24	2.00

Tailwater Channel Data - EX CD-4

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 130.24 ft

Roadway Data for Crossing: EX CD-4

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1400.00 ft

Crest Elevation: 134.00 ft

Roadway Surface: Paved

Roadway Top Width: 38.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 9.00 cfs

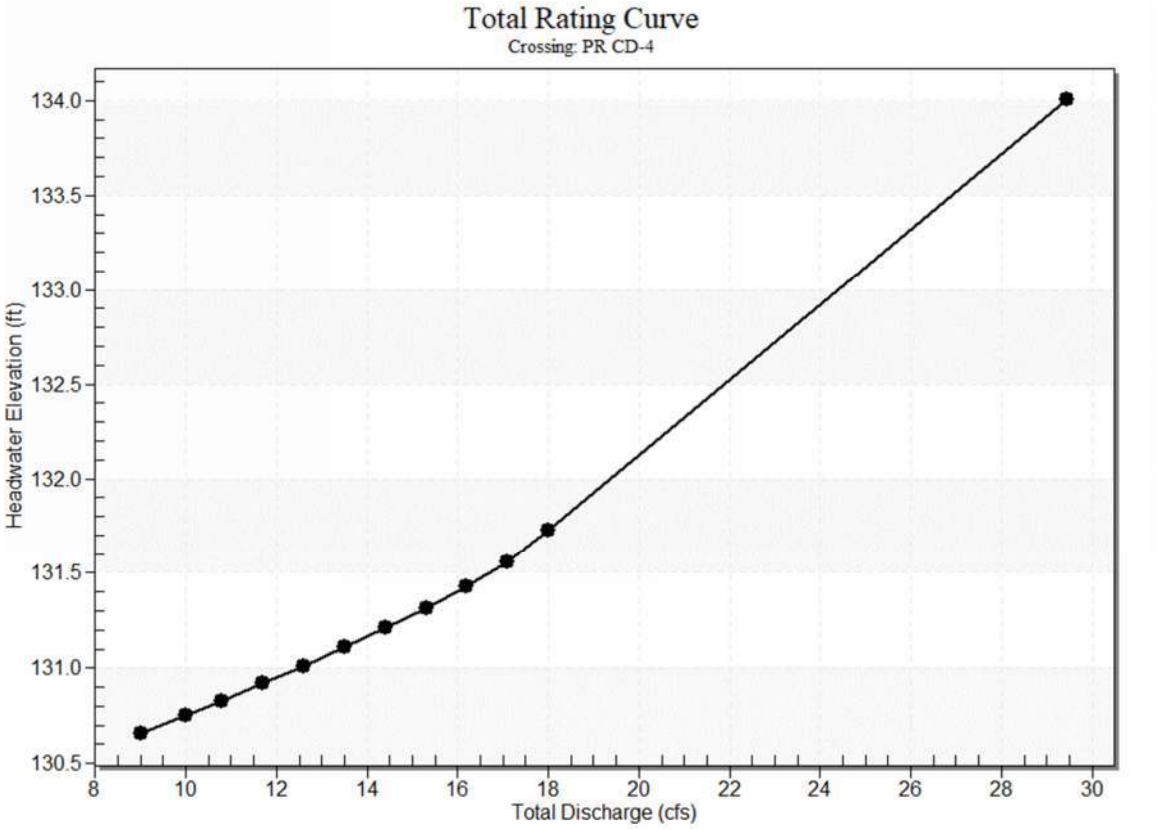
Design Flow: 10.00 cfs

Maximum Flow: 18.00 cfs

Table 100 - Summary of Culvert Flows at Crossing: PR CD-4

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-4 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
130.66	9.00	9.00	0.00	1
130.75	10.00	10.00	0.00	1
130.83	10.80	10.80	0.00	1
130.92	11.70	11.70	0.00	1
131.01	12.60	12.60	0.00	1
131.11	13.50	13.50	0.00	1
131.21	14.40	14.40	0.00	1
131.32	15.30	15.30	0.00	1
131.43	16.20	16.20	0.00	1
131.56	17.10	17.10	0.00	1
131.72	18.00	18.00	0.00	1
134.00	27.80	27.80	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-4



Culvert Data: PR CD-4

Table 101 - Culvert Summary Table: PR CD-4

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
9.00 cfs	9.00 cfs	130.66	1.61	1.819	1-S1f	0.96	1.07	2.00	2.10	2.86	0.00
10.00 cfs	10.00 cfs	130.75	1.72	1.910	1-S1f	1.02	1.13	2.00	2.10	3.18	0.00
10.80 cfs	10.80 cfs	130.83	1.81	1.987	1-S1f	1.07	1.18	2.00	2.10	3.44	0.00
11.70 cfs	11.70 cfs	130.92	1.92	2.078	1-S1f	1.12	1.23	2.00	2.10	3.72	0.00
12.60 cfs	12.60 cfs	131.01	2.03	2.172	1-S1f	1.17	1.28	2.00	2.10	4.01	0.00
13.50 cfs	13.50 cfs	131.11	2.15	2.270	1-S1f	1.23	1.32	2.00	2.10	4.30	0.00
14.40 cfs	14.40 cfs	131.21	2.28	2.370	1-S1f	1.28	1.37	2.00	2.10	4.58	0.00
15.30 cfs	15.30 cfs	131.32	2.42	2.476	1-S1f	1.34	1.41	2.00	2.10	4.87	0.00
16.20 cfs	16.20 cfs	131.43	2.57	2.590	1-S1f	1.40	1.45	2.00	2.10	5.16	0.00
17.10 cfs	17.10 cfs	131.56	2.72	2.720	1-S1f	1.46	1.49	2.00	2.10	5.44	0.00
18.00 cfs	18.00 cfs	131.72	2.88	2.867	4-FFf	1.52	1.53	2.00	2.10	5.73	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

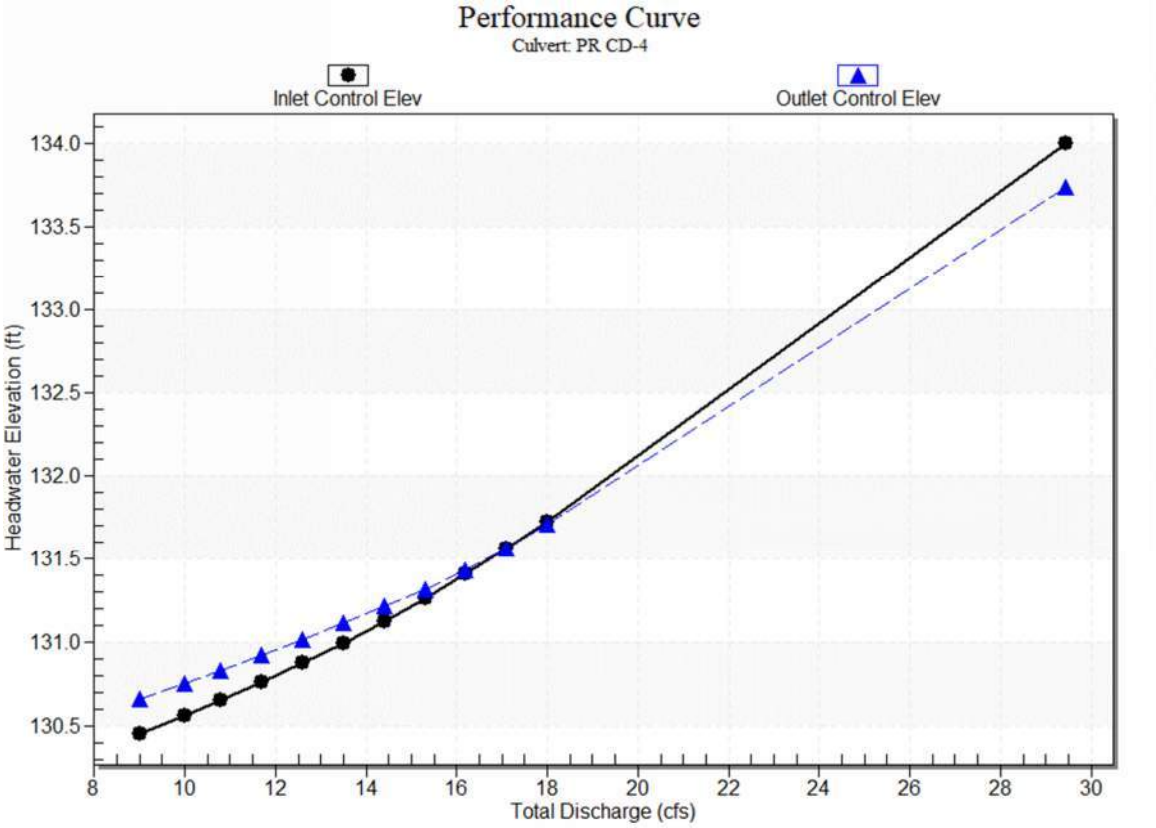
Inlet Elevation (invert): 128.84 ft,

Outlet Elevation (invert): 128.14 ft

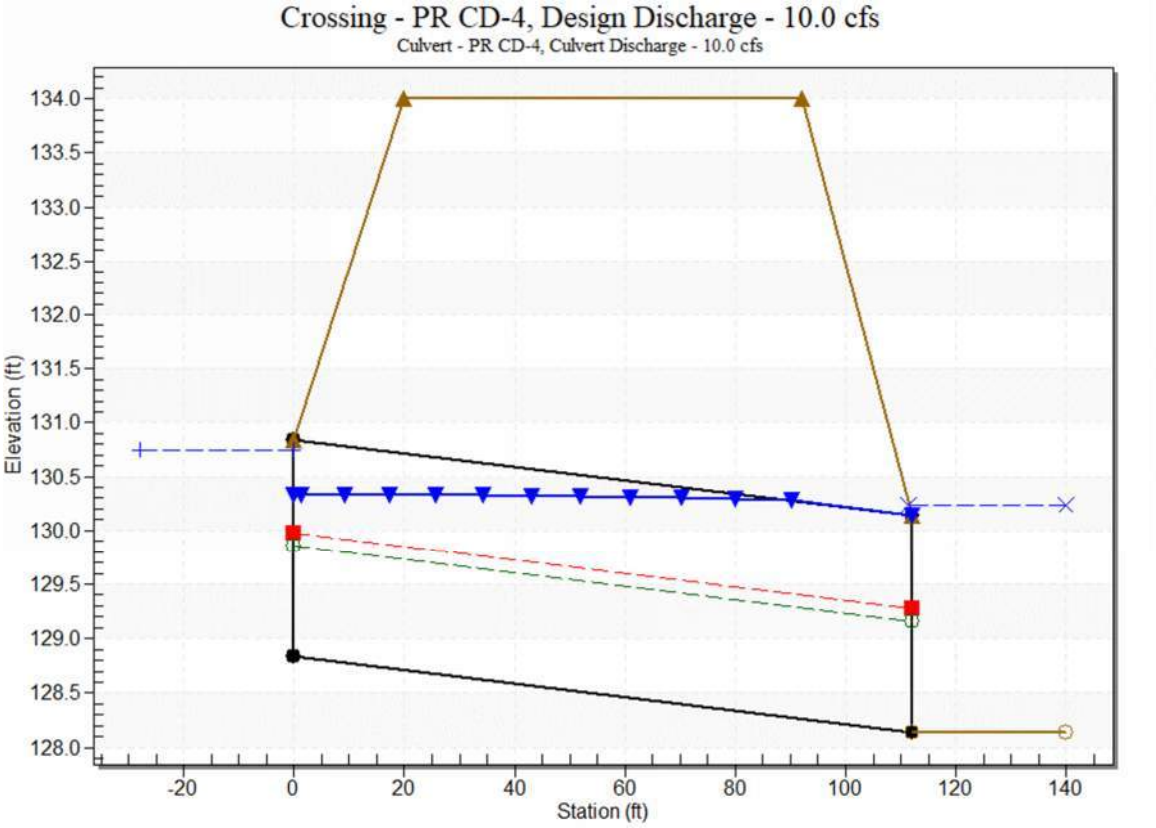
Culvert Length: 112.00 ft,

Culvert Slope: 0.0063

Culvert Performance Curve Plot: PR CD-4



Water Surface Profile Plot for Culvert: PR CD-4



Site Data - PR CD-4

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 128.84 ft

Outlet Station: 112.00 ft

Outlet Elevation: 128.14 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-4

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Tailwater Data for Crossing: PR CD-4

Table 102 - Downstream Channel Rating Curve (Crossing: PR CD-4)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
9.00	130.24	2.10
10.00	130.24	2.10
10.80	130.24	2.10
11.70	130.24	2.10
12.60	130.24	2.10
13.50	130.24	2.10
14.40	130.24	2.10
15.30	130.24	2.10
16.20	130.24	2.10
17.10	130.24	2.10
18.00	130.24	2.10

Tailwater Channel Data - PR CD-4

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 130.24 ft

Roadway Data for Crossing: PR CD-4

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1400.00 ft

Crest Elevation: 134.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 258.00 cfs

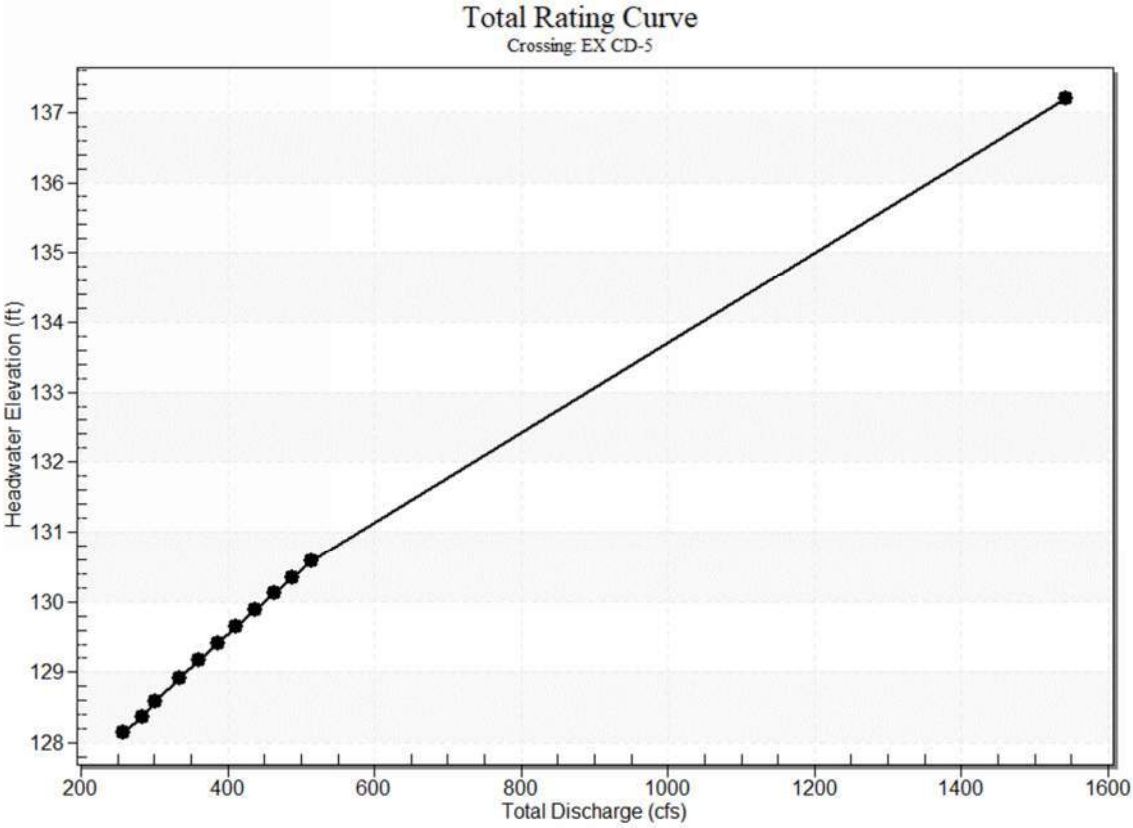
Design Flow: 302.00 cfs

Maximum Flow: 514.00 cfs

Table 22 - Summary of Culvert Flows at Crossing: EX CD-5

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-5 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
128.15	258.00	258.00	0.00	1
128.37	283.60	283.60	0.00	1
128.58	302.00	302.00	0.00	1
128.91	334.80	334.80	0.00	1
129.16	360.40	360.40	0.00	1
129.41	386.00	386.00	0.00	1
129.65	411.60	411.60	0.00	1
129.89	437.20	437.20	0.00	1
130.12	462.80	462.80	0.00	1
130.35	488.40	488.40	0.00	1
130.57	514.00	514.00	0.00	1
137.00	1413.67	1413.67	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-5



Culvert Data: EX CD-5

Table 23 - Culvert Summary Table: EX CD-5

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
258.00 cfs	258.00 cfs	128.15	4.06	4.232	7-H2t	0.00	2.43	5.38	5.38	4.00	0.00
283.60 cfs	283.60 cfs	128.37	4.33	4.448	7-H2t	0.00	2.59	5.38	5.38	4.39	0.00
302.00 cfs	302.00 cfs	128.58	4.51	4.659	7-H2c	0.00	2.70	5.38	5.38	4.68	0.00
334.80 cfs	334.80 cfs	128.91	4.83	4.992	7-H2c	0.00	2.89	5.38	5.38	5.19	0.00
360.40 cfs	360.40 cfs	129.16	5.08	5.244	7-H2c	0.00	3.04	5.38	5.38	5.58	0.00
386.00 cfs	386.00 cfs	129.41	5.31	5.491	7-H2c	0.00	3.18	5.38	5.38	5.98	0.00
411.60 cfs	411.60 cfs	129.65	5.55	5.732	7-H2c	0.00	3.32	5.38	5.38	6.38	0.00
437.20 cfs	437.20 cfs	129.89	5.77	5.968	7-H2c	0.00	3.45	5.38	5.38	6.77	0.00
462.80 cfs	462.80 cfs	130.12	6.00	6.199	7-H2c	0.00	3.59	2.28	5.38	16.94	0.00
488.40 cfs	488.40 cfs	130.35	6.22	6.427	7-H2c	0.00	3.59	2.38	5.38	17.13	0.00
514.00 cfs	514.00 cfs	130.57	6.43	6.650	7-H2c	0.00	3.59	2.47	5.38	17.32	0.00

Culvert Barrel Data

Culvert Barrel Type Double Broken-back Culvert

Inlet Elevation (invert): 123.92 ft,

Upper Break Elevation (invert): 123.92 ft,

Lower Break Elevation (invert): 122.12 ft,

Outlet Elevation (invert): 122.12 ft

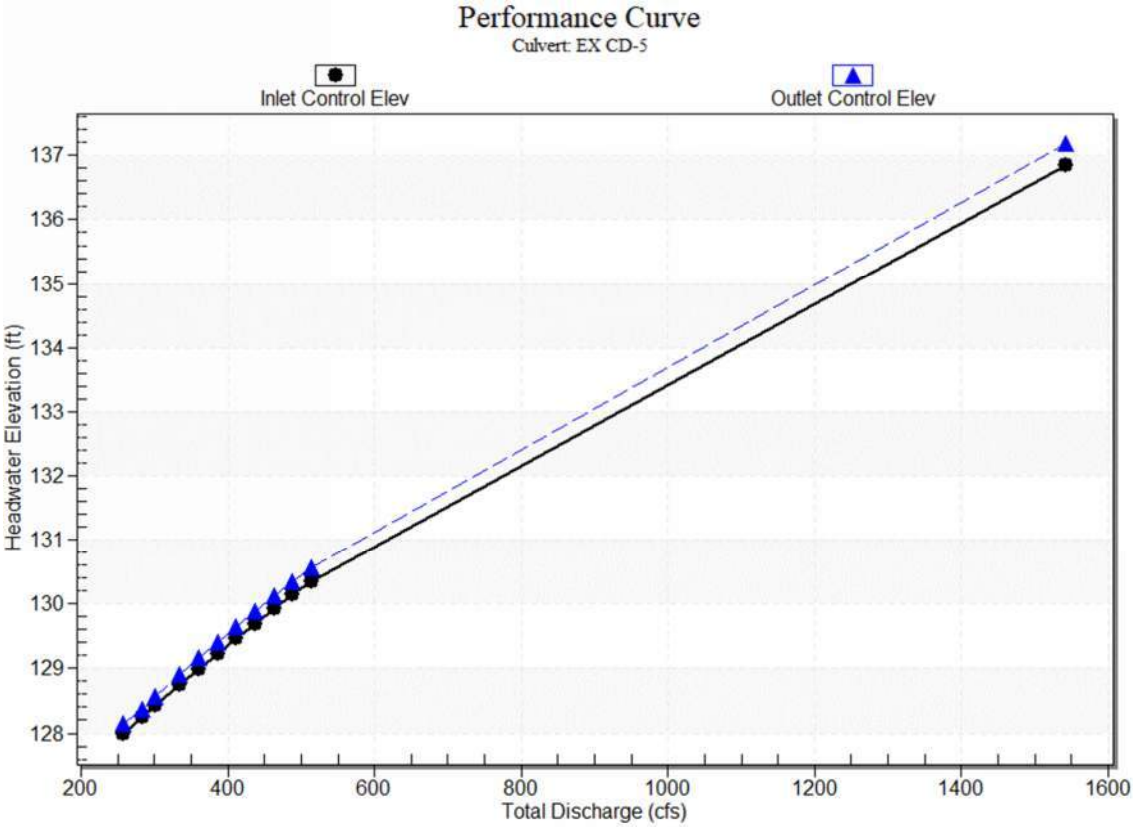
Culvert Length: 68.02 ft,

Upper Culvert Section Slope: 0.0000

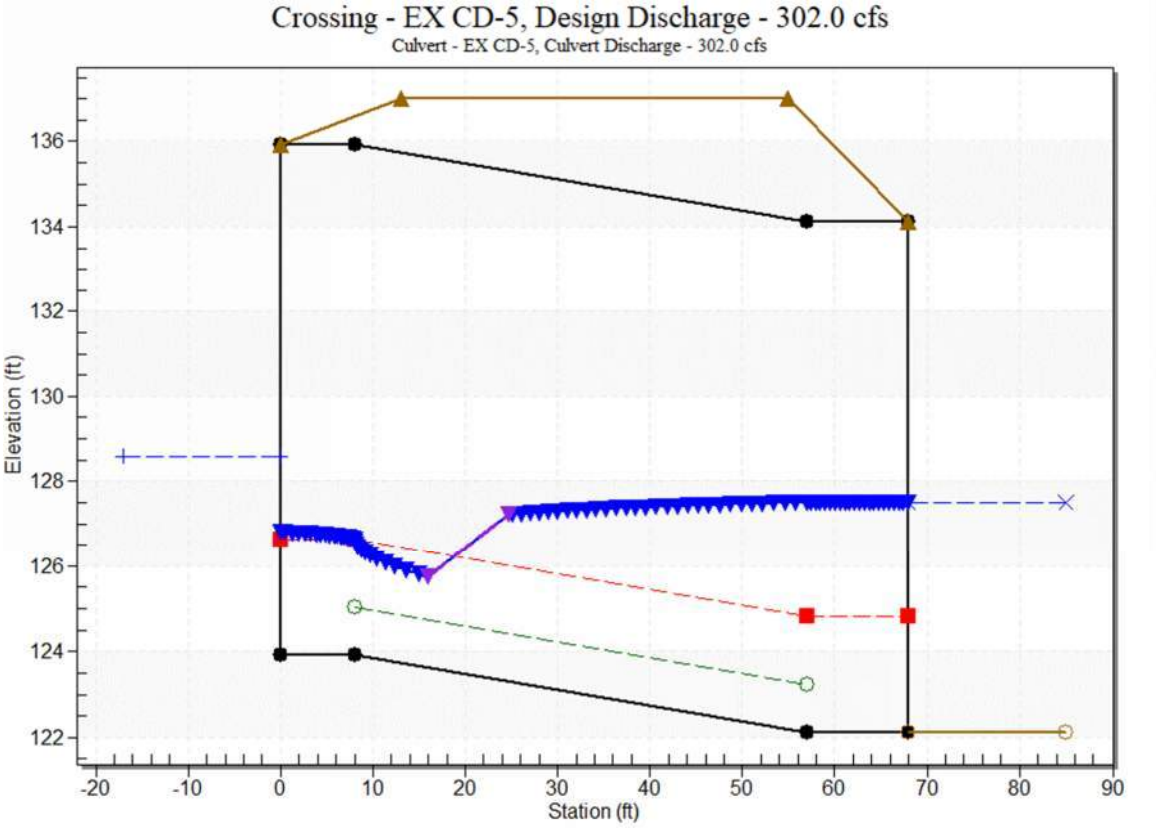
Steep Culvert Section Slope: 0.0367

Runout Culvert Section Slope: 0.0000

Culvert Performance Curve Plot: EX CD-5



Water Surface Profile Plot for Culvert: EX CD-5



Site Data - EX CD-5

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 123.92 ft

Upper Break Station: 8.00 ft

Upper Break Elevation: 123.92 ft

Lower Break Station: 57.00 ft

Lower Break Elevation: 122.12 ft

Outlet Station: 68.00 ft

Outlet Elevation: 122.12 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-5

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft

Barrel Rise: 12.00 ft

Upper & Middle Section Material: Concrete

Lower Section Material:

Embedment: 0.00 in

Upper & Middle Section Manning's n: 0.0120

Lower Section Manning's n: 0.0120

Culvert Type: Double Broken-back

Inlet Configuration: Square Edge (90º) Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-5

Table 24 - Downstream Channel Rating Curve (Crossing: EX CD-5)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
258.00	127.50	5.38
283.60	127.50	5.38
302.00	127.50	5.38
334.80	127.50	5.38
360.40	127.50	5.38
386.00	127.50	5.38
411.60	127.50	5.38
437.20	127.50	5.38
462.80	127.50	5.38
488.40	127.50	5.38
514.00	127.50	5.38

Tailwater Channel Data - EX CD-5

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 127.50 ft

Roadway Data for Crossing: EX CD-5

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 380.00 ft

Crest Elevation: 137.00 ft

Roadway Surface: Paved

Roadway Top Width: 42.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 258.00 cfs

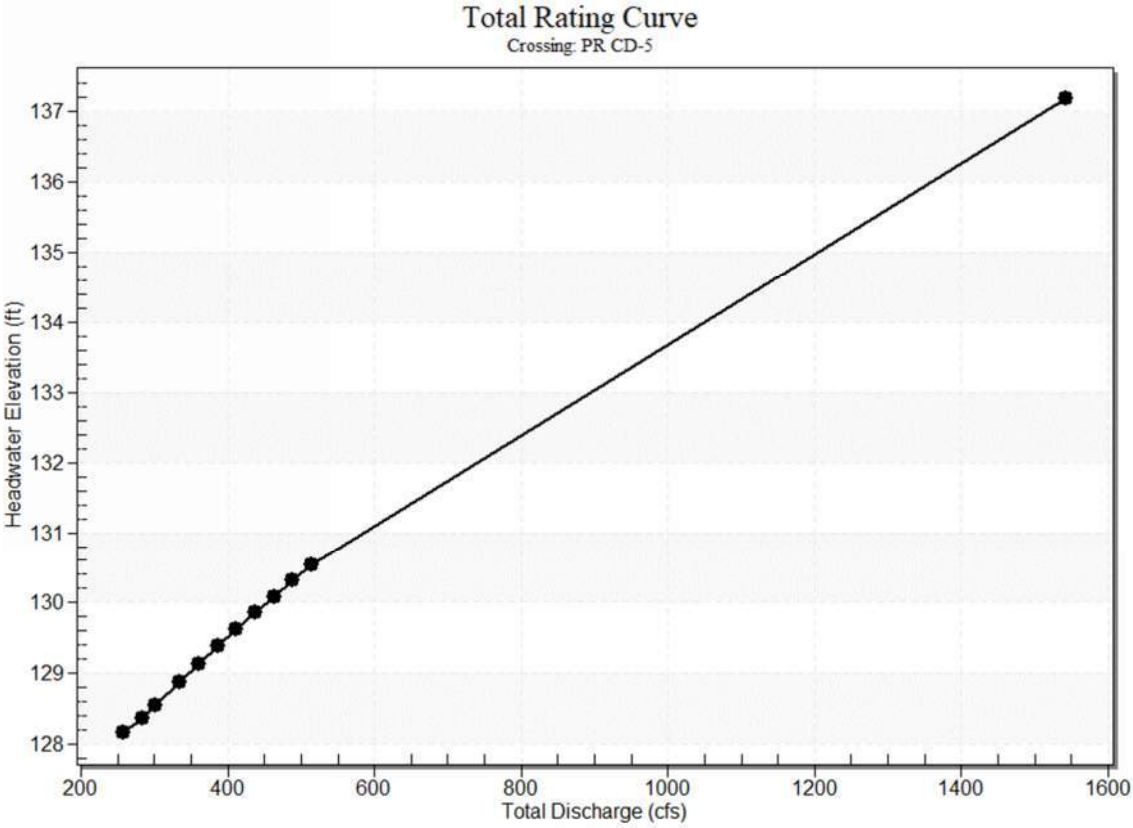
Design Flow: 302.00 cfs

Maximum Flow: 514.00 cfs

Table 25 - Summary of Culvert Flows at Crossing: PR CD-5

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-5 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
128.17	258.00	258.00	0.00	1
128.37	283.60	283.60	0.00	1
128.56	302.00	302.00	0.00	1
128.89	334.80	334.80	0.00	1
129.14	360.40	360.40	0.00	1
129.38	386.00	386.00	0.00	1
129.62	411.60	411.60	0.00	1
129.85	437.20	437.20	0.00	1
130.08	462.80	462.80	0.00	1
130.31	488.40	488.40	0.00	1
130.53	514.00	514.00	0.00	1
137.00	1427.72	1427.72	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-5



Culvert Data: PR CD-5

Table 26 - Culvert Summary Table: PR CD-5

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
258.00 cfs	258.00 cfs	128.17	4.11	4.253	7-H2t	0.00	2.43	5.38	5.38	4.00	0.00
283.60 cfs	283.60 cfs	128.37	4.37	4.450	7-H2t	0.00	2.59	5.38	5.38	4.39	0.00
302.00 cfs	302.00 cfs	128.56	4.56	4.636	7-H2t	0.00	2.70	5.38	5.38	4.68	0.00
334.80 cfs	334.80 cfs	128.89	4.88	4.966	7-H2t	0.00	2.89	5.38	5.38	5.19	0.00
360.40 cfs	360.40 cfs	129.14	5.13	5.216	7-H2t	0.00	3.04	5.38	5.38	5.58	0.00
386.00 cfs	386.00 cfs	129.38	5.37	5.461	7-H2c	0.00	3.18	5.38	5.38	5.98	0.00
411.60 cfs	411.60 cfs	129.62	5.61	5.700	7-H2c	0.00	3.32	5.38	5.38	6.38	0.00
437.20 cfs	437.20 cfs	129.85	5.84	5.934	7-H2c	0.00	3.45	5.38	5.38	6.77	0.00
462.80 cfs	462.80 cfs	130.08	6.06	6.164	7-H2c	0.00	3.45	5.38	5.38	7.17	0.00
488.40 cfs	488.40 cfs	130.31	6.28	6.389	7-H2c	0.00	3.45	2.43	5.38	16.78	0.00
514.00 cfs	514.00 cfs	130.53	6.49	6.611	7-H2c	0.00	3.45	2.52	5.38	16.98	0.00

Culvert Barrel Data

Culvert Barrel Type Double Broken-back Culvert

Inlet Elevation (invert): 123.92 ft,

Upper Break Elevation (invert): 123.92 ft,

Lower Break Elevation (invert): 122.12 ft,

Outlet Elevation (invert): 122.12 ft

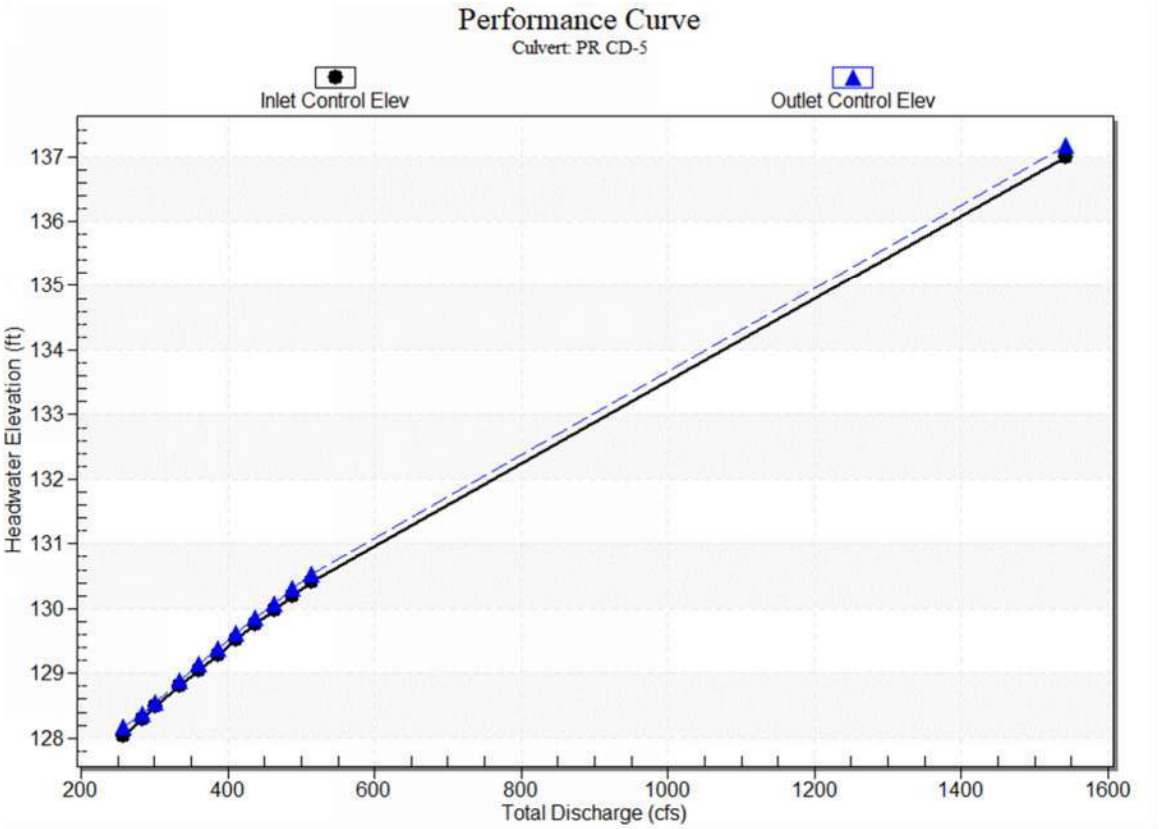
Culvert Length: 112.01 ft,

Upper Culvert Section Slope: 0.0000

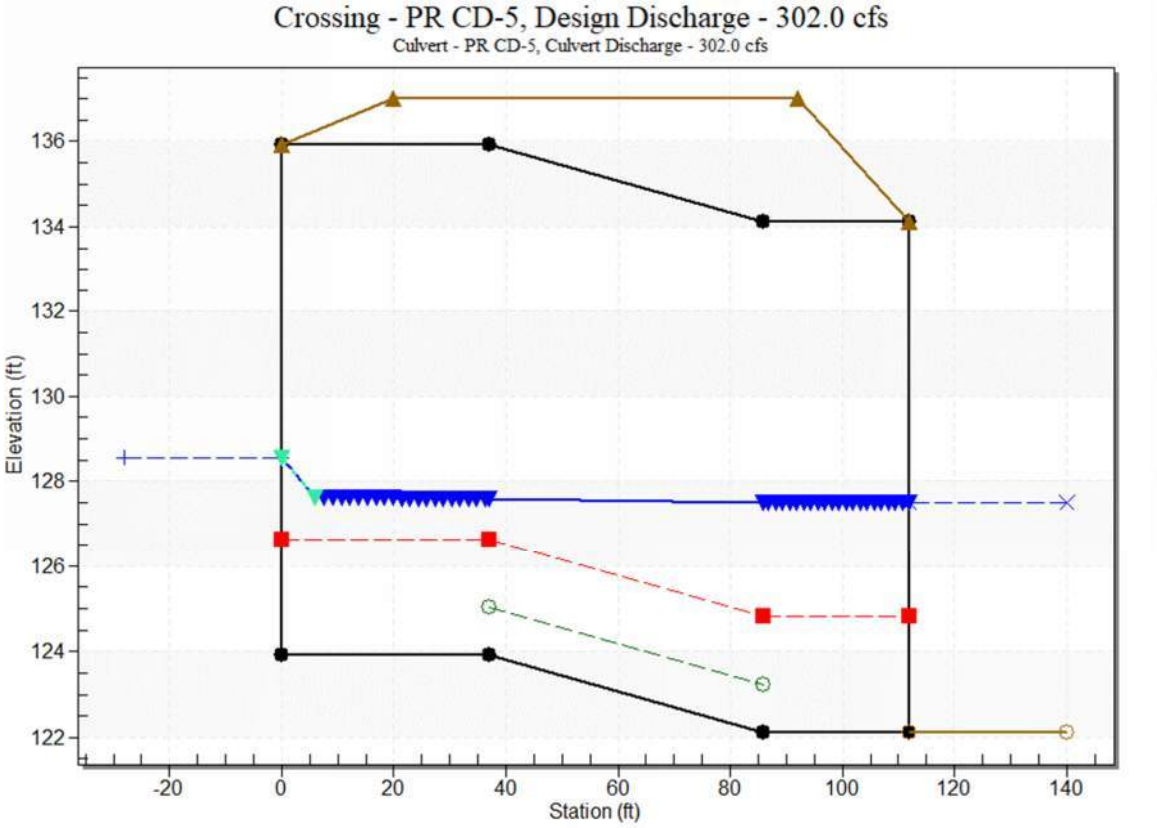
Steep Culvert Section Slope: 0.0367

Runout Culvert Section Slope: 0.0000

Culvert Performance Curve Plot: PR CD-5



Water Surface Profile Plot for Culvert: PR CD-5



Site Data - PR CD-5

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 123.92 ft

Upper Break Station: 37.00 ft

Upper Break Elevation: 123.92 ft

Lower Break Station: 86.00 ft

Lower Break Elevation: 122.12 ft

Outlet Station: 112.00 ft

Outlet Elevation: 122.12 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-5

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft

Barrel Rise: 12.00 ft

Upper & Middle Section Material: Concrete

Lower Section Material:

Embedment: 0.00 in

Upper & Middle Section Manning's n: 0.0120

Lower Section Manning's n: 0.0120

Culvert Type: Double Broken-back

Inlet Configuration: Square Edge (90º) Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-5

Table 27 - Downstream Channel Rating Curve (Crossing: PR CD-5)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
258.00	127.50	5.38
283.60	127.50	5.38
302.00	127.50	5.38
334.80	127.50	5.38
360.40	127.50	5.38
386.00	127.50	5.38
411.60	127.50	5.38
437.20	127.50	5.38
462.80	127.50	5.38
488.40	127.50	5.38
514.00	127.50	5.38

Tailwater Channel Data - PR CD-5

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 127.50 ft

Roadway Data for Crossing: PR CD-5

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 380.00 ft

Crest Elevation: 137.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 43.00 cfs

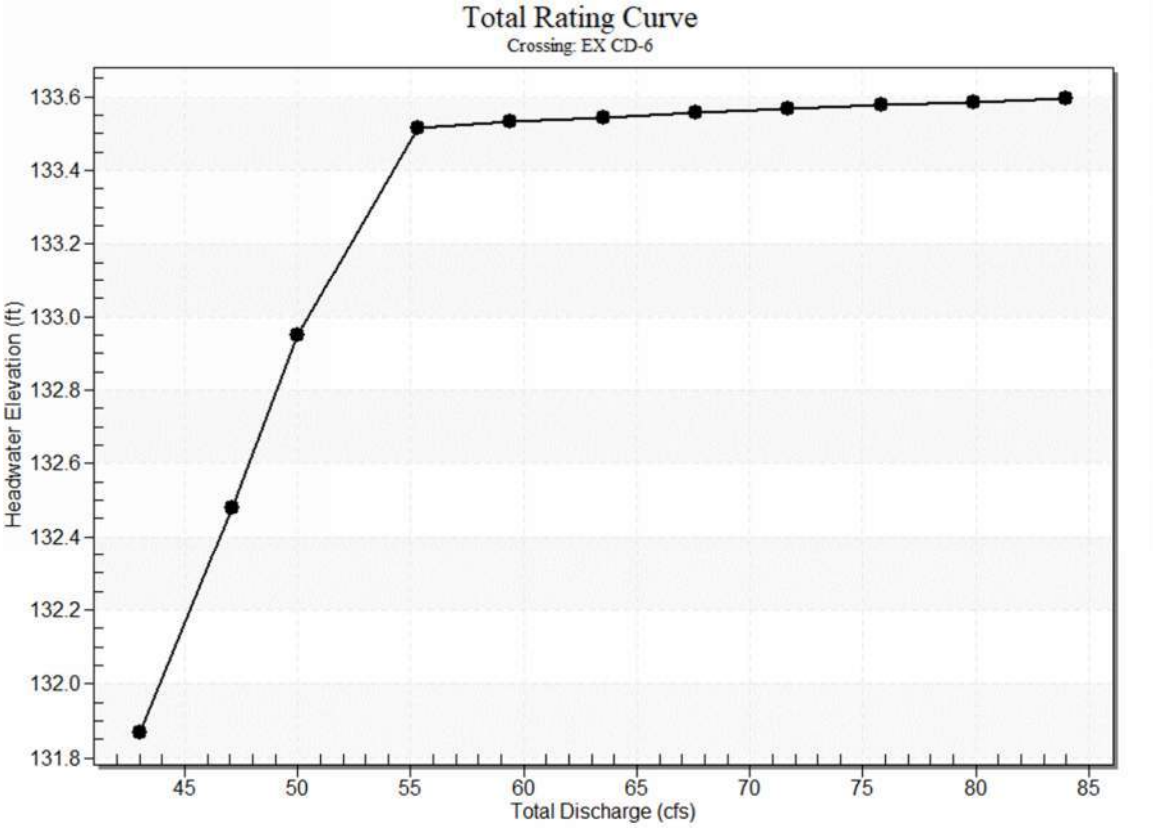
Design Flow: 50.00 cfs

Maximum Flow: 84.00 cfs

Table 7 - Summary of Culvert Flows at Crossing: EX CD-6

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
131.87	43.00	43.00	0.00	1
132.48	47.10	47.10	0.00	1
132.95	50.00	50.00	0.00	1
133.51	55.30	53.28	1.72	43
133.53	59.40	53.38	5.75	5
133.55	63.50	53.45	9.76	4
133.56	67.60	53.52	13.91	4
133.57	71.70	53.57	17.75	3
133.58	75.80	53.63	21.84	3
133.59	79.90	53.68	25.97	3
133.60	84.00	53.73	30.09	3
133.50	53.19	53.19	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-6



Culvert Data: EX CD-6

Table 8 - Culvert Summary Table: EX CD-6

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
43.00 cfs	43.00 cfs	131.87	4.69	4.123	5-S2n	2.04	2.19	2.05	1.00	9.96	0.00
47.10 cfs	47.10 cfs	132.48	5.30	4.604	7-M2c	2.50	2.26	2.26	1.00	10.09	0.00
50.00 cfs	50.00 cfs	132.95	5.77	5.028	7-M2c	2.50	2.30	2.30	1.00	10.58	0.00
55.30 cfs	53.28 cfs	133.51	6.33	5.515	7-M2c	2.50	2.34	2.34	1.00	11.16	0.00
59.40 cfs	53.38 cfs	133.53	6.35	5.530	7-M2c	2.50	2.34	2.34	1.00	11.18	0.00
63.50 cfs	53.45 cfs	133.55	6.37	5.541	7-M2c	2.50	2.34	2.34	1.00	11.19	0.00
67.60 cfs	53.52 cfs	133.56	6.38	5.551	7-M2c	2.50	2.34	2.34	1.00	11.21	0.00
71.70 cfs	53.57 cfs	133.57	6.39	5.560	7-M2c	2.50	2.34	2.34	1.00	11.22	0.00
75.80 cfs	53.63 cfs	133.58	6.40	5.572	7-M2c	2.50	2.34	2.34	1.00	11.23	0.00
79.90 cfs	53.68 cfs	133.59	6.41	5.579	7-M2c	2.50	2.34	2.34	1.00	11.23	0.00
84.00 cfs	53.73 cfs	133.60	6.42	5.587	7-M2c	2.50	2.34	2.34	1.00	11.24	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

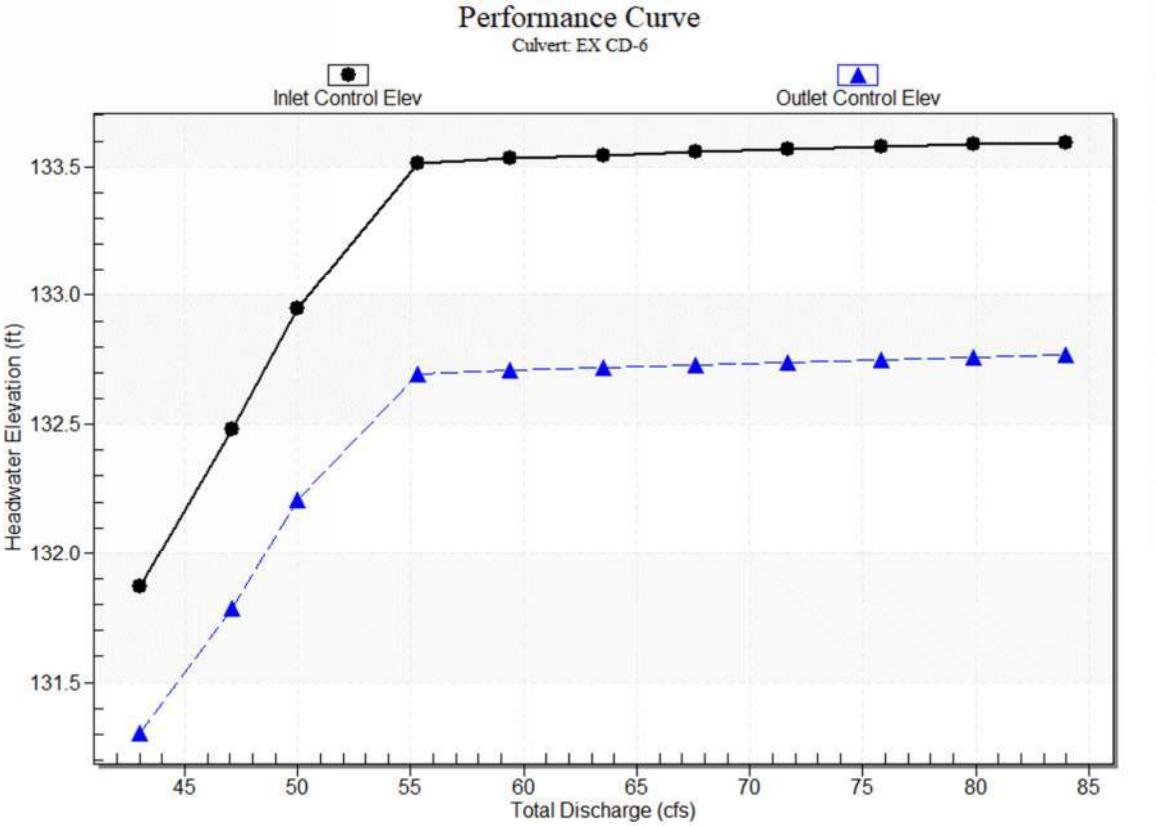
Inlet Elevation (invert): 127.18 ft,

Outlet Elevation (invert): 126.50 ft

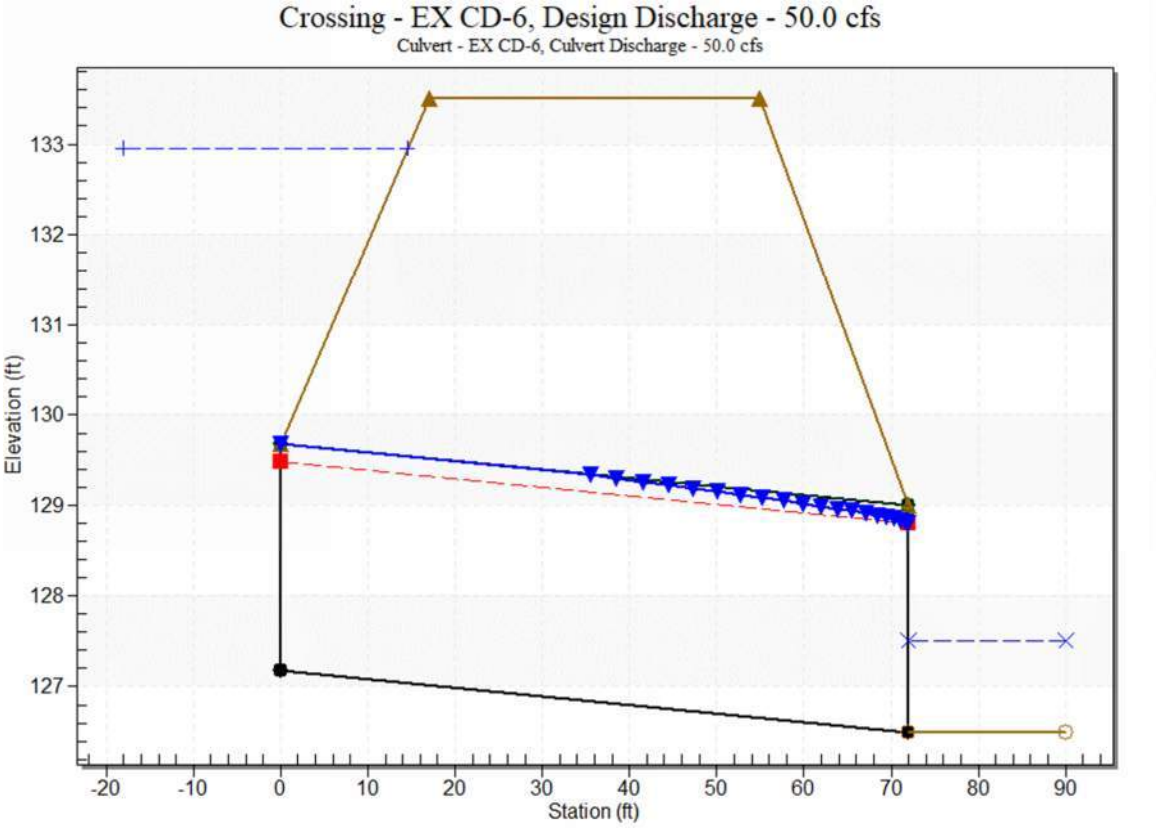
Culvert Length: 72.00 ft,

Culvert Slope: 0.0094

Culvert Performance Curve Plot: EX CD-6



Water Surface Profile Plot for Culvert: EX CD-6



Site Data - EX CD-6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 127.18 ft

Outlet Station: 72.00 ft

Outlet Elevation: 126.50 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-6

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-6

Table 9 - Downstream Channel Rating Curve (Crossing: EX CD-6)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
43.00	127.50	1.00
47.10	127.50	1.00
50.00	127.50	1.00
55.30	127.50	1.00
59.40	127.50	1.00
63.50	127.50	1.00
67.60	127.50	1.00
71.70	127.50	1.00
75.80	127.50	1.00
79.90	127.50	1.00
84.00	127.50	1.00

Tailwater Channel Data - EX CD-6

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 127.50 ft

Roadway Data for Crossing: EX CD-6

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 350.00 ft

Crest Elevation: 133.50 ft

Roadway Surface: Paved

Roadway Top Width: 38.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 43.00 cfs

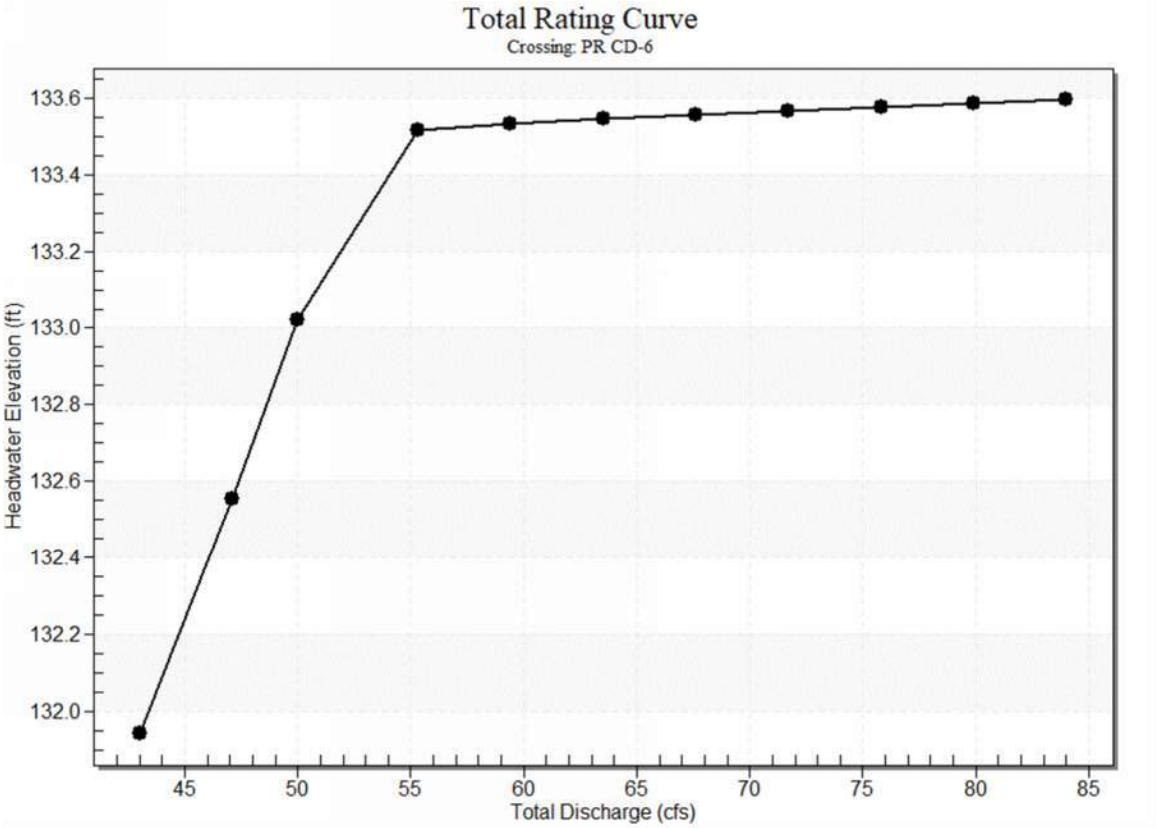
Design Flow: 50.00 cfs

Maximum Flow: 84.00 cfs

Table 10 - Summary of Culvert Flows at Crossing: PR CD-6

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
131.94	43.00	43.00	0.00	1
132.55	47.10	47.10	0.00	1
133.02	50.00	50.00	0.00	1
133.52	55.30	52.87	1.99	36
133.53	59.40	52.97	6.17	5
133.55	63.50	53.04	10.18	4
133.56	67.60	53.11	13.97	3
133.57	71.70	53.17	18.07	3
133.58	75.80	53.22	22.23	3
133.59	79.90	53.27	26.38	3
133.60	84.00	53.32	30.50	3
133.50	52.78	52.78	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-6



Culvert Data: PR CD-6

Table 11 - Culvert Summary Table: PR CD-6

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
43.00 cfs	43.00 cfs	131.94	4.69	4.420	7-M2c	2.50	2.19	2.19	1.05	9.43	0.00
47.10 cfs	47.10 cfs	132.55	5.30	5.067	7-M2c	2.50	2.26	2.26	1.05	10.09	0.00
50.00 cfs	50.00 cfs	133.02	5.77	5.542	7-M2c	2.50	2.30	2.30	1.05	10.58	0.00
55.30 cfs	52.87 cfs	133.52	6.27	6.024	7-M2c	2.50	2.33	2.33	1.05	11.09	0.00
59.40 cfs	52.97 cfs	133.53	6.28	6.038	7-M2c	2.50	2.33	2.33	1.05	11.11	0.00
63.50 cfs	53.04 cfs	133.55	6.30	6.054	7-M2c	2.50	2.33	2.33	1.05	11.12	0.00
67.60 cfs	53.11 cfs	133.56	6.31	6.065	7-M2c	2.50	2.34	2.34	1.05	11.13	0.00
71.70 cfs	53.17 cfs	133.57	6.32	6.071	7-M2c	2.50	2.34	2.34	1.05	11.14	0.00
75.80 cfs	53.22 cfs	133.58	6.33	6.085	7-M2c	2.50	2.34	2.34	1.05	11.15	0.00
79.90 cfs	53.27 cfs	133.59	6.34	6.090	7-M2c	2.50	2.34	2.34	1.05	11.16	0.00
84.00 cfs	53.32 cfs	133.60	6.35	6.102	7-M2c	2.50	2.34	2.34	1.05	11.17	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

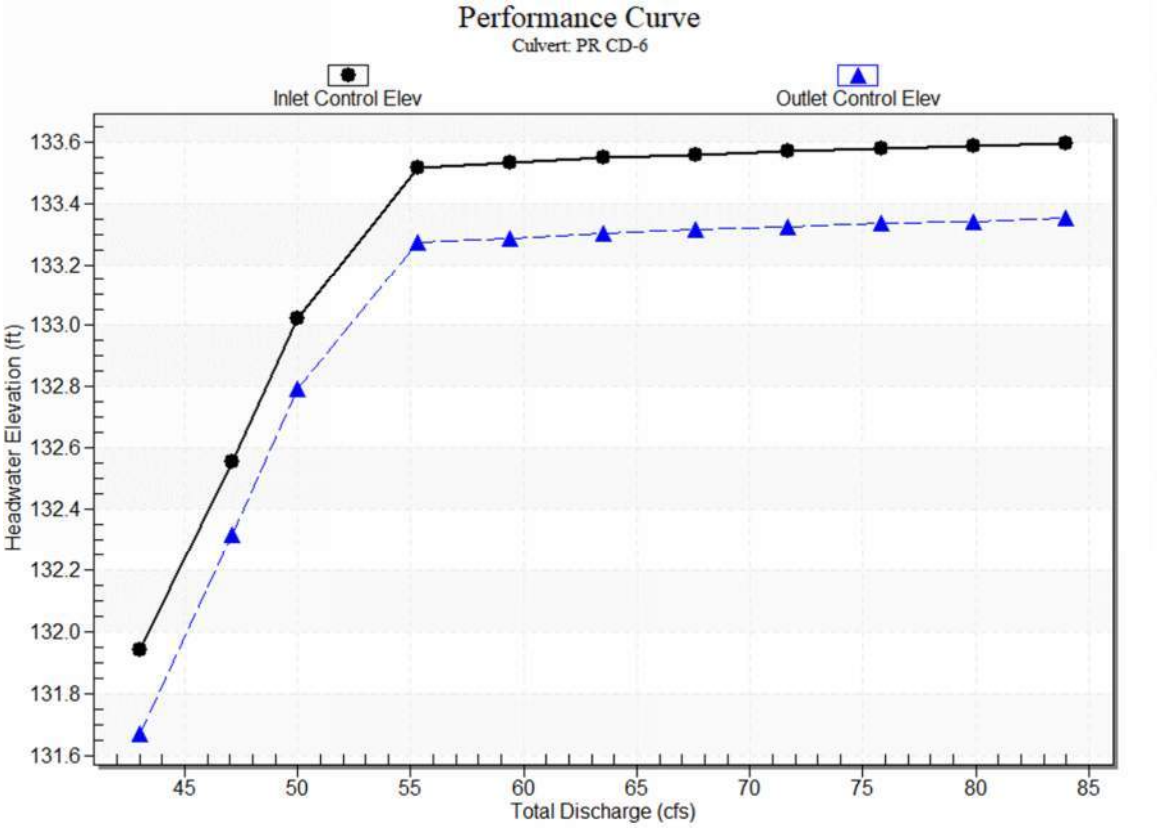
Inlet Elevation (invert): 127.25 ft,

Outlet Elevation (invert): 126.45 ft

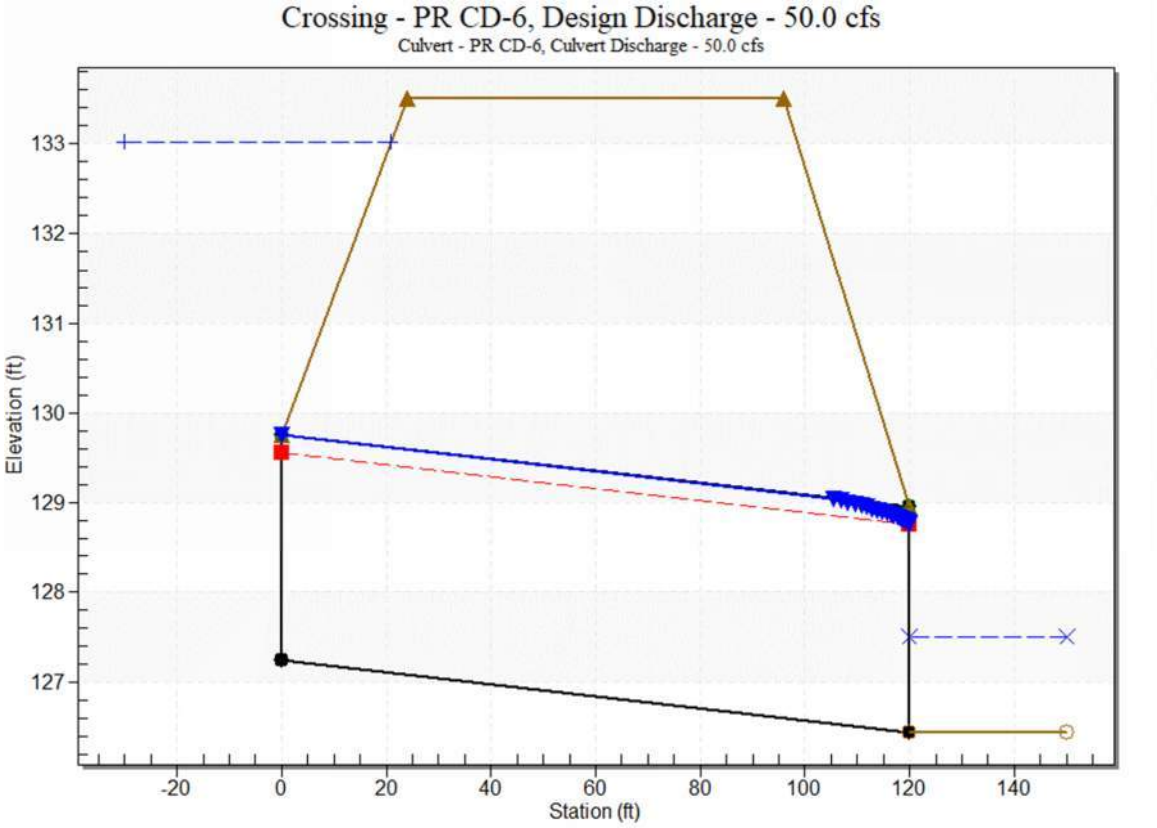
Culvert Length: 120.00 ft,

Culvert Slope: 0.0067

Culvert Performance Curve Plot: PR CD-6



Water Surface Profile Plot for Culvert: PR CD-6



Site Data - PR CD-6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 127.25 ft

Outlet Station: 120.00 ft

Outlet Elevation: 126.45 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-6

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-6

Table 12 - Downstream Channel Rating Curve (Crossing: PR CD-6)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
43.00	127.50	1.05
47.10	127.50	1.05
50.00	127.50	1.05
55.30	127.50	1.05
59.40	127.50	1.05
63.50	127.50	1.05
67.60	127.50	1.05
71.70	127.50	1.05
75.80	127.50	1.05
79.90	127.50	1.05
84.00	127.50	1.05

Tailwater Channel Data - PR CD-6

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 127.50 ft

Roadway Data for Crossing: PR CD-6

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 350.00 ft

Crest Elevation: 133.50 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 28.00 cfs

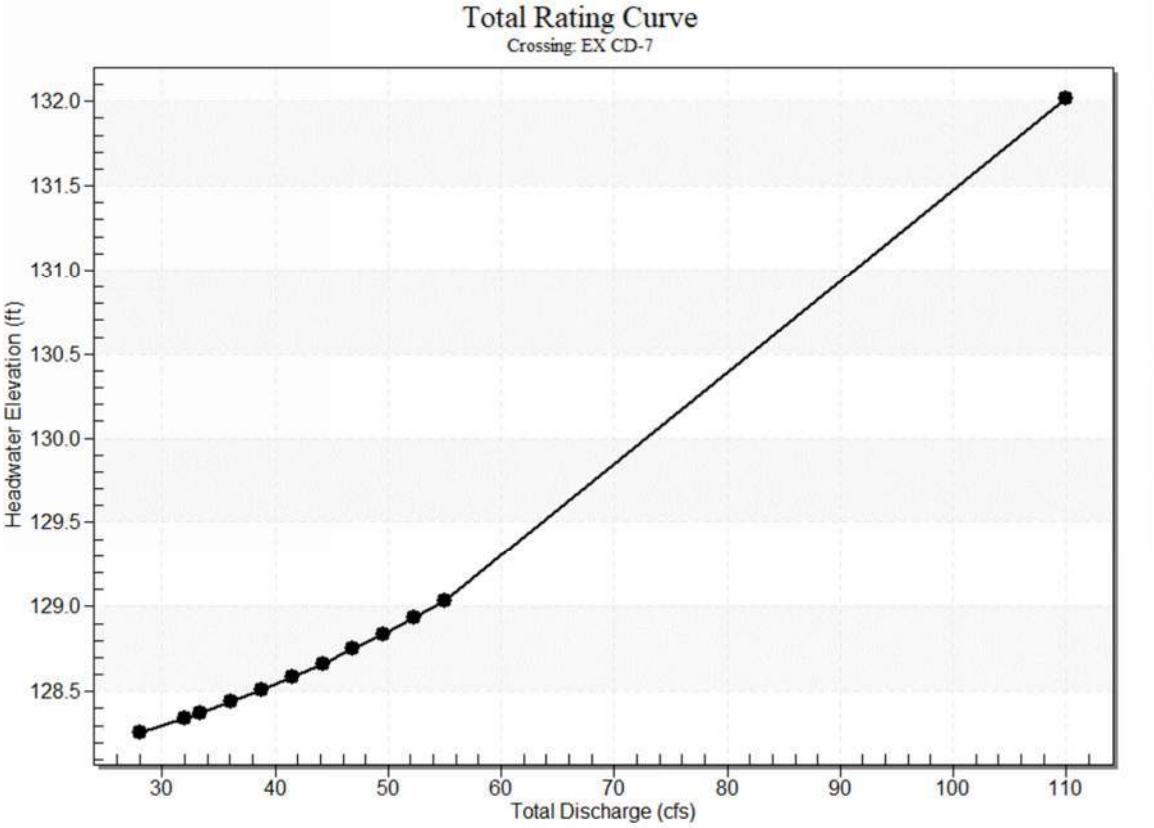
Design Flow: 32.00 cfs

Maximum Flow: 55.00 cfs

Table 34 - Summary of Culvert Flows at Crossing: EX CD-7

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-7 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
128.26	28.00	28.00	0.00	1
128.34	32.00	32.00	0.00	1
128.37	33.40	33.40	0.00	1
128.44	36.10	36.10	0.00	1
128.51	38.80	38.80	0.00	1
128.58	41.50	41.50	0.00	1
128.66	44.20	44.20	0.00	1
128.75	46.90	46.90	0.00	1
128.84	49.60	49.60	0.00	1
128.93	52.30	52.30	0.00	1
129.03	55.00	55.00	0.00	1
132.00	107.84	107.84	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-7



Culvert Data: EX CD-7

Table 35 - Culvert Summary Table: EX CD-7

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
28.00 cfs	28.00 cfs	128.26	1.86	2.720	4-FFf	2.50	1.26	2.50	2.50	2.85	0.00
32.00 cfs	32.00 cfs	128.34	2.02	2.803	4-FFf	2.50	1.35	2.50	2.50	3.26	0.00
33.40 cfs	33.40 cfs	128.37	2.07	2.835	4-FFf	2.50	1.38	2.50	2.50	3.40	0.00
36.10 cfs	36.10 cfs	128.44	2.18	2.899	4-FFf	2.50	1.44	2.50	2.50	3.68	0.00
38.80 cfs	38.80 cfs	128.51	2.28	2.969	4-FFf	2.50	1.49	2.50	2.50	3.95	0.00
41.50 cfs	41.50 cfs	128.58	2.38	3.044	4-FFf	2.50	1.55	2.50	2.50	4.23	0.00
44.20 cfs	44.20 cfs	128.66	2.49	3.124	4-FFf	2.50	1.60	2.50	2.50	4.50	0.00
46.90 cfs	46.90 cfs	128.75	2.59	3.209	4-FFf	2.50	1.65	2.50	2.50	4.78	0.00
49.60 cfs	49.60 cfs	128.84	2.70	3.299	4-FFf	2.50	1.70	2.50	2.50	5.05	0.00
52.30 cfs	52.30 cfs	128.93	2.82	3.393	4-FFf	2.50	1.74	2.50	2.50	5.33	0.00
55.00 cfs	55.00 cfs	129.03	2.94	3.493	4-FFf	2.50	1.79	2.50	2.50	5.60	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

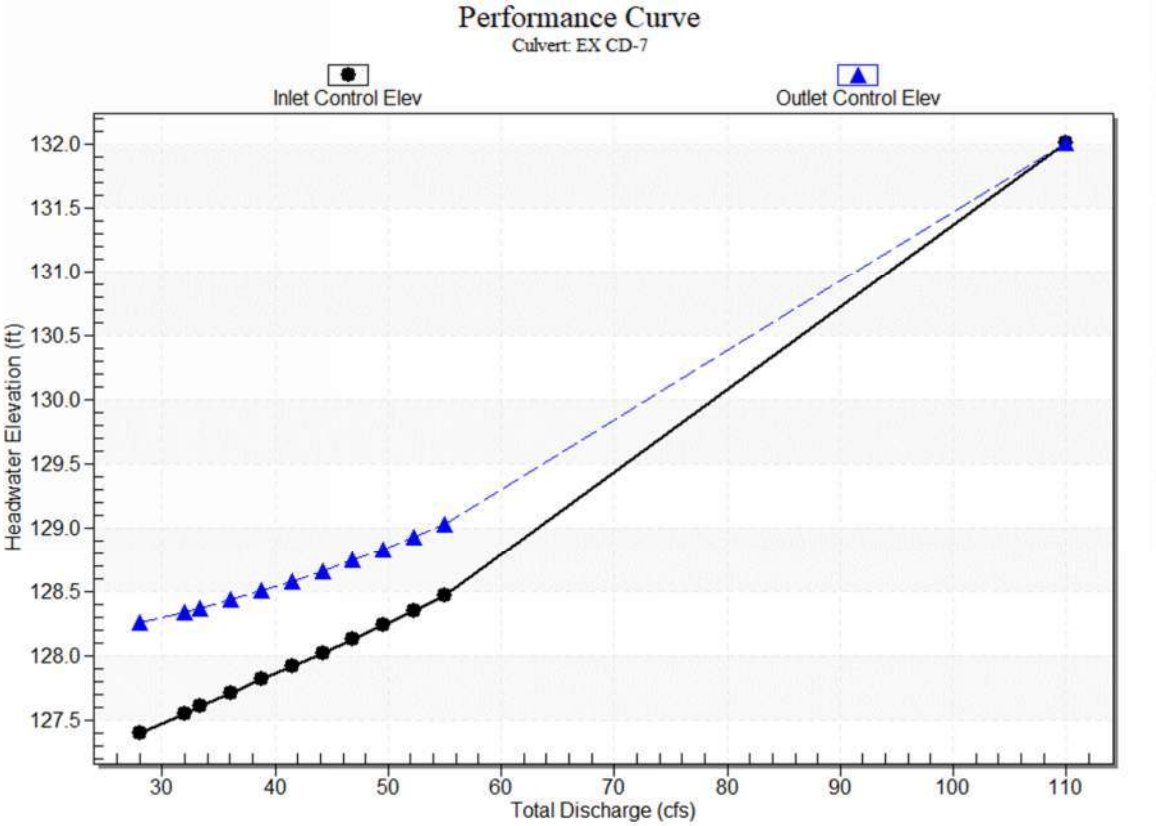
Inlet Elevation (invert): 125.54 ft,

Outlet Elevation (invert): 125.49 ft

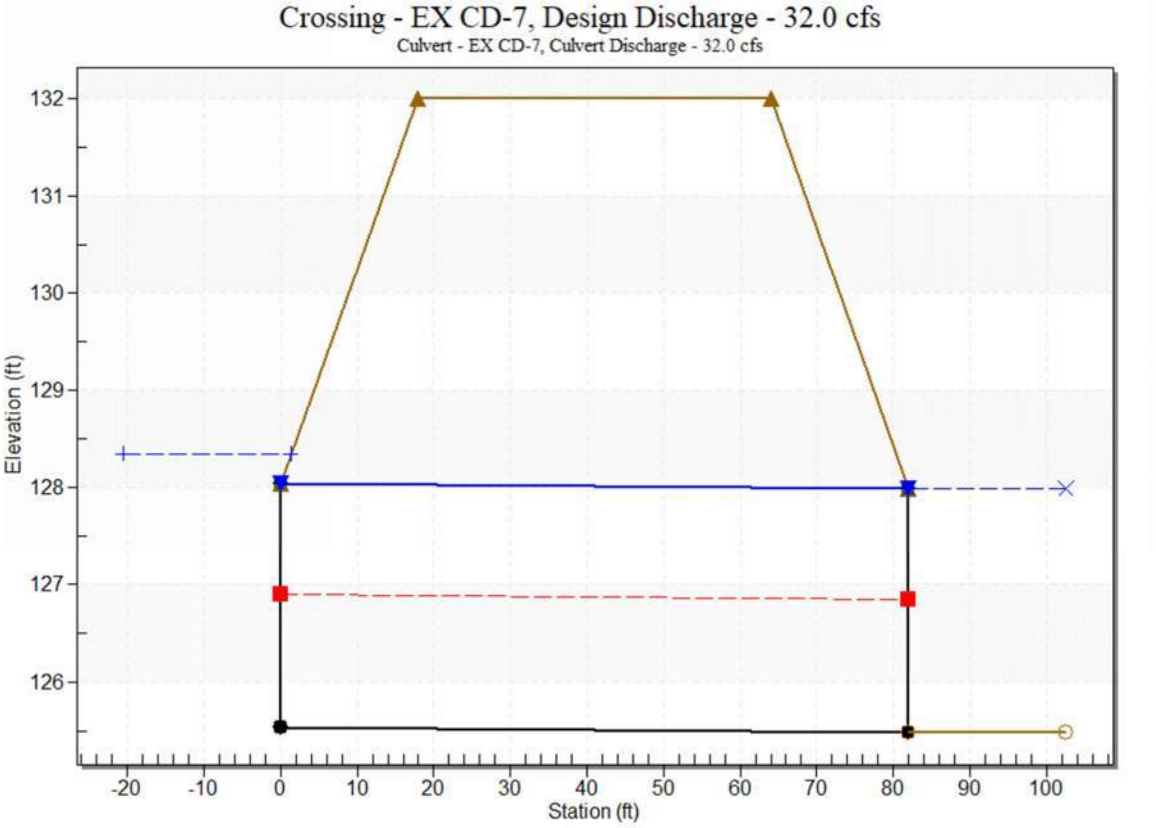
Culvert Length: 82.00 ft,

Culvert Slope: 0.0006

Culvert Performance Curve Plot: EX CD-7



Water Surface Profile Plot for Culvert: EX CD-7



Site Data - EX CD-7

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 125.54 ft

Outlet Station: 82.00 ft

Outlet Elevation: 125.49 ft

Number of Barrels: 2

Culvert Data Summary - EX CD-7

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-7

Table 36 - Downstream Channel Rating Curve (Crossing: EX CD-7)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
28.00	127.99	2.50
32.00	127.99	2.50
33.40	127.99	2.50
36.10	127.99	2.50
38.80	127.99	2.50
41.50	127.99	2.50
44.20	127.99	2.50
46.90	127.99	2.50
49.60	127.99	2.50
52.30	127.99	2.50
55.00	127.99	2.50

Tailwater Channel Data - EX CD-7

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 127.99 ft

Roadway Data for Crossing: EX CD-7

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 350.00 ft

Crest Elevation: 132.00 ft

Roadway Surface: Paved

Roadway Top Width: 46.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 28.00 cfs

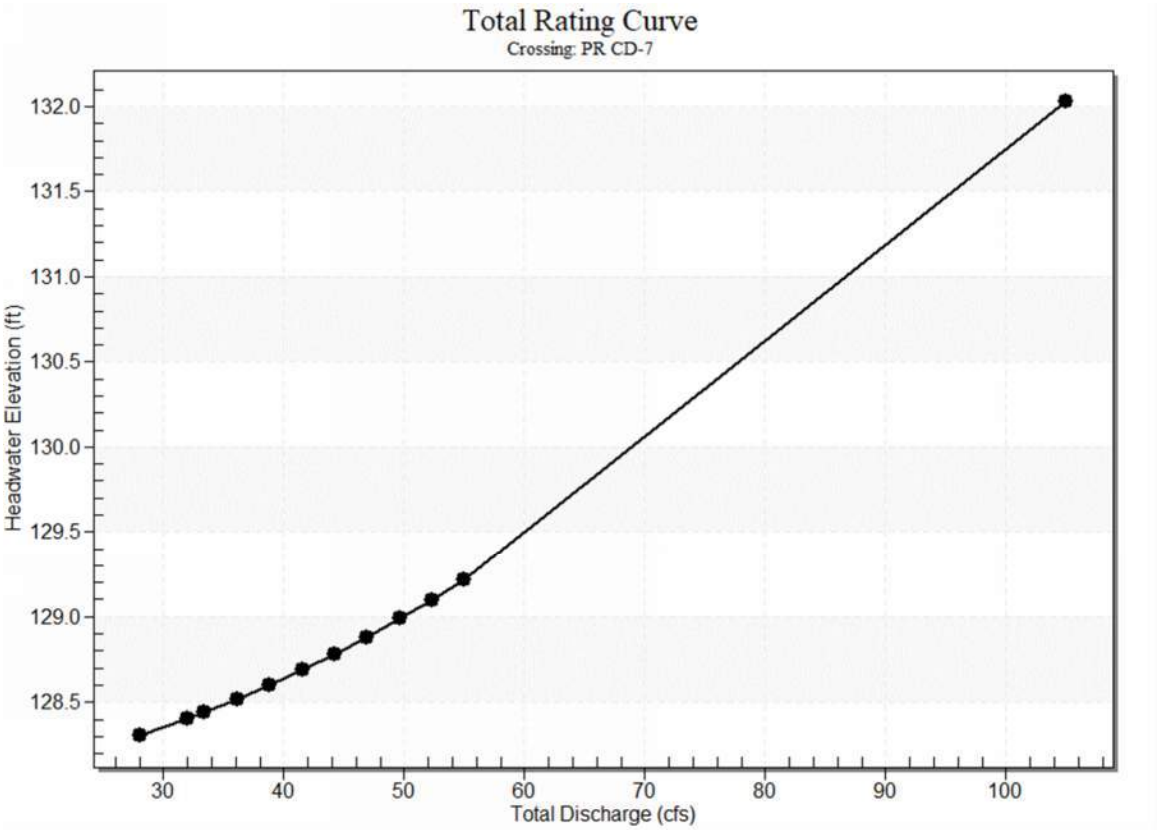
Design Flow: 32.00 cfs

Maximum Flow: 55.00 cfs

Table 37 - Summary of Culvert Flows at Crossing: PR CD-7

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-7 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
128.31	28.00	28.00	0.00	1
128.41	32.00	32.00	0.00	1
128.44	33.40	33.40	0.00	1
128.52	36.10	36.10	0.00	1
128.60	38.80	38.80	0.00	1
128.69	41.50	41.50	0.00	1
128.78	44.20	44.20	0.00	1
128.88	46.90	46.90	0.00	1
128.99	49.60	49.60	0.00	1
129.10	52.30	52.30	0.00	1
129.22	55.00	55.00	0.00	1
132.00	99.47	99.47	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-7



Culvert Data: PR CD-7

Table 38 - Culvert Summary Table: PR CD-7

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
28.00 cfs	28.00 cfs	128.31	1.86	2.748	4-FFf	2.50	1.26	2.50	2.51	2.85	0.00
32.00 cfs	32.00 cfs	128.41	2.02	2.845	4-FFf	2.50	1.35	2.50	2.51	3.26	0.00
33.40 cfs	33.40 cfs	128.44	2.07	2.882	4-FFf	2.50	1.38	2.50	2.51	3.40	0.00
36.10 cfs	36.10 cfs	128.52	2.18	2.958	4-FFf	2.50	1.44	2.50	2.51	3.68	0.00
38.80 cfs	38.80 cfs	128.60	2.28	3.040	4-FFf	2.50	1.49	2.50	2.51	3.95	0.00
41.50 cfs	41.50 cfs	128.69	2.38	3.128	4-FFf	2.50	1.55	2.50	2.51	4.23	0.00
44.20 cfs	44.20 cfs	128.78	2.49	3.222	4-FFf	2.50	1.60	2.50	2.51	4.50	0.00
46.90 cfs	46.90 cfs	128.88	2.59	3.322	4-FFf	2.50	1.65	2.50	2.51	4.78	0.00
49.60 cfs	49.60 cfs	128.99	2.70	3.427	4-FFf	2.50	1.70	2.50	2.51	5.05	0.00
52.30 cfs	52.30 cfs	129.10	2.82	3.539	4-FFf	2.50	1.74	2.50	2.51	5.33	0.00
55.00 cfs	55.00 cfs	129.22	2.94	3.656	4-FFf	2.50	1.79	2.50	2.51	5.60	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

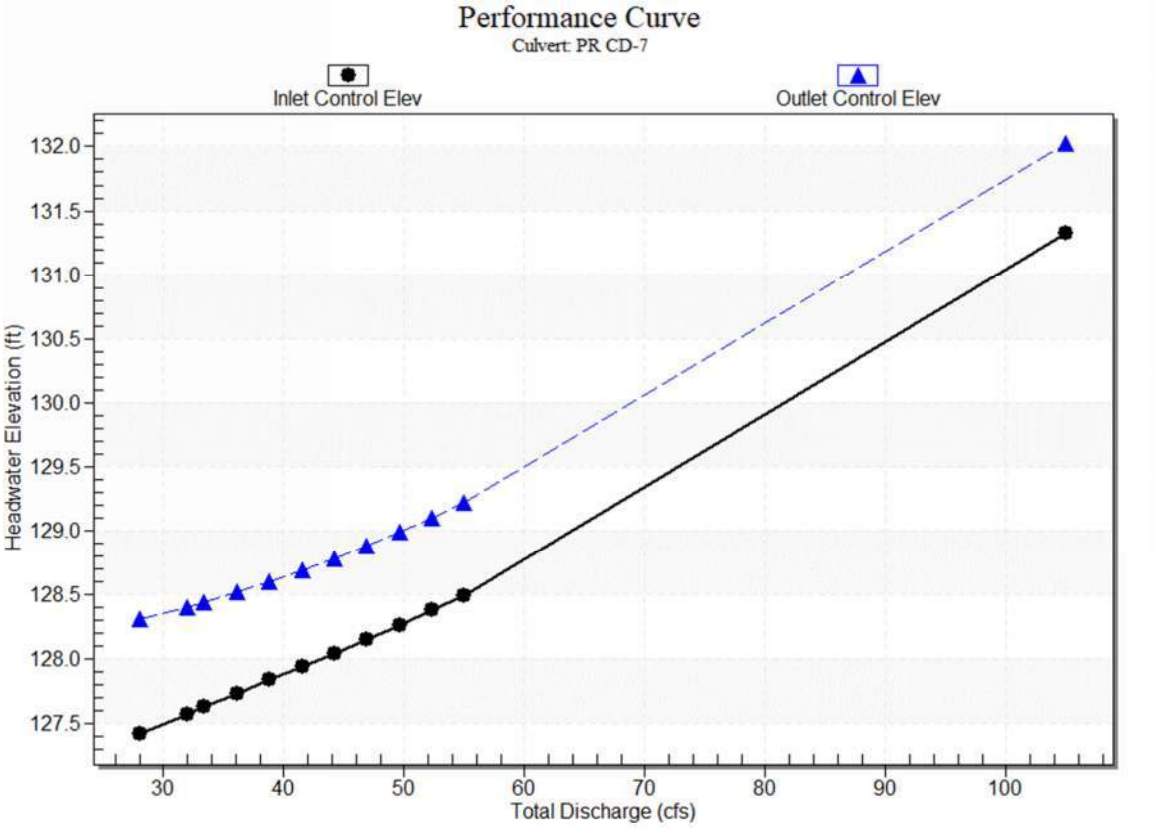
Inlet Elevation (invert): 125.56 ft,

Outlet Elevation (invert): 125.48 ft

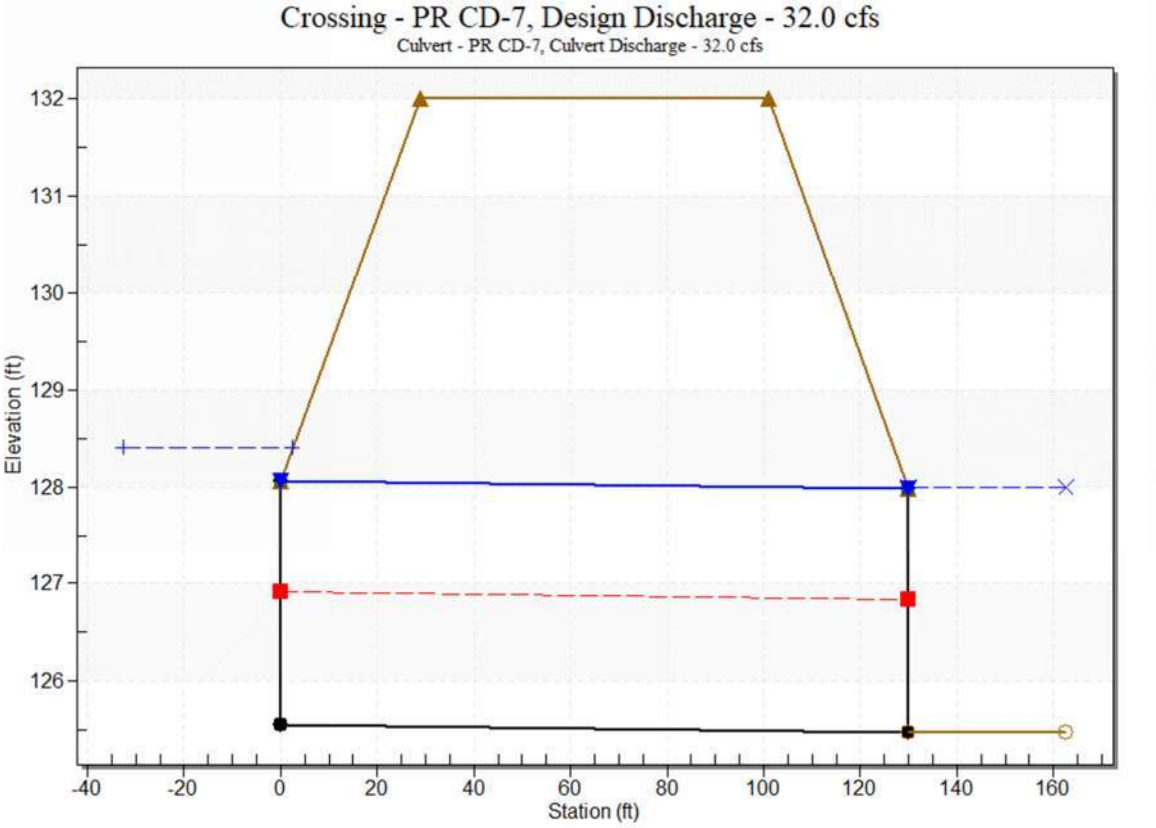
Culvert Length: 130.00 ft,

Culvert Slope: 0.0006

Culvert Performance Curve Plot: PR CD-7



Water Surface Profile Plot for Culvert: PR CD-7



Site Data - PR CD-7

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 125.56 ft

Outlet Station: 130.00 ft

Outlet Elevation: 125.48 ft

Number of Barrels: 2

Culvert Data Summary - PR CD-7

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-7

Table 39 - Downstream Channel Rating Curve (Crossing: PR CD-7)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
28.00	127.99	2.51
32.00	127.99	2.51
33.40	127.99	2.51
36.10	127.99	2.51
38.80	127.99	2.51
41.50	127.99	2.51
44.20	127.99	2.51
46.90	127.99	2.51
49.60	127.99	2.51
52.30	127.99	2.51
55.00	127.99	2.51

Tailwater Channel Data - PR CD-7

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 127.99 ft

Roadway Data for Crossing: PR CD-7

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 350.00 ft

Crest Elevation: 132.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 18.00 cfs

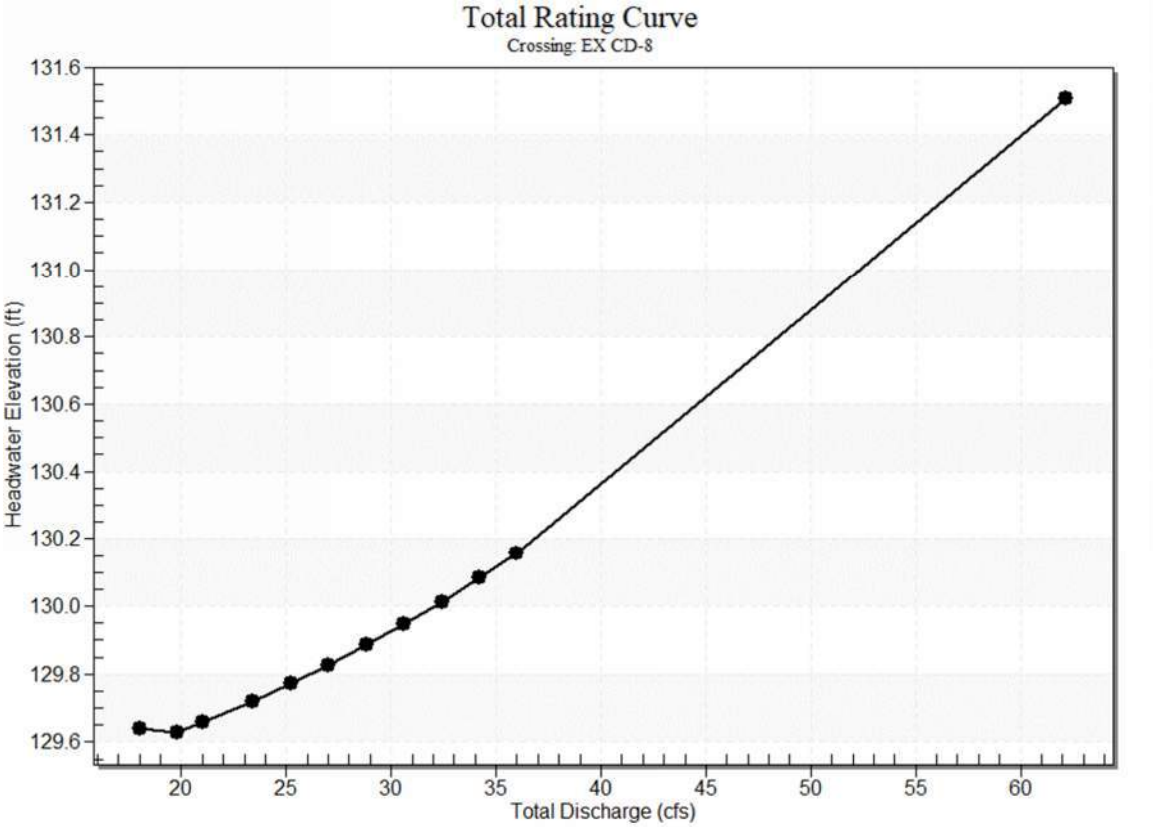
Design Flow: 21.00 cfs

Maximum Flow: 36.00 cfs

Table 40 - Summary of Culvert Flows at Crossing: EX CD-8

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-8 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
129.64	18.00	18.00	0.00	1
129.63	19.80	19.80	0.00	1
129.66	21.00	21.00	0.00	1
129.72	23.40	23.40	0.00	1
129.77	25.20	25.20	0.00	1
129.83	27.00	27.00	0.00	1
129.88	28.80	28.80	0.00	1
129.95	30.60	30.60	0.00	1
130.01	32.40	32.40	0.00	1
130.08	34.20	34.20	0.00	1
130.16	36.00	36.00	0.00	1
131.50	59.96	59.96	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-8



Culvert Data: EX CD-8

Table 41 - Culvert Summary Table: EX CD-8

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
18.00 cfs	18.00 cfs	129.64	1.97	3.138	3-M1f	1.71	1.36	3.00	3.00	2.55	0.00
19.80 cfs	19.80 cfs	129.63	2.09	3.129	4-FFf	1.82	1.43	3.00	3.00	2.80	0.00
21.00 cfs	21.00 cfs	129.66	2.16	3.158	4-FFf	1.89	1.47	3.00	3.00	2.97	0.00
23.40 cfs	23.40 cfs	129.72	2.31	3.220	4-FFf	2.04	1.56	3.00	3.00	3.31	0.00
25.20 cfs	25.20 cfs	129.77	2.42	3.271	4-FFf	2.16	1.62	3.00	3.00	3.57	0.00
27.00 cfs	27.00 cfs	129.83	2.52	3.326	4-FFf	2.29	1.68	3.00	3.00	3.82	0.00
28.80 cfs	28.80 cfs	129.88	2.63	3.385	4-FFf	2.43	1.74	3.00	3.00	4.07	0.00
30.60 cfs	30.60 cfs	129.95	2.73	3.447	4-FFf	2.63	1.79	3.00	3.00	4.33	0.00
32.40 cfs	32.40 cfs	130.01	2.84	3.513	4-FFf	3.00	1.85	3.00	3.00	4.58	0.00
34.20 cfs	34.20 cfs	130.08	2.94	3.583	4-FFf	3.00	1.90	3.00	3.00	4.84	0.00
36.00 cfs	36.00 cfs	130.16	3.05	3.657	4-FFf	3.00	1.95	3.00	3.00	5.09	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

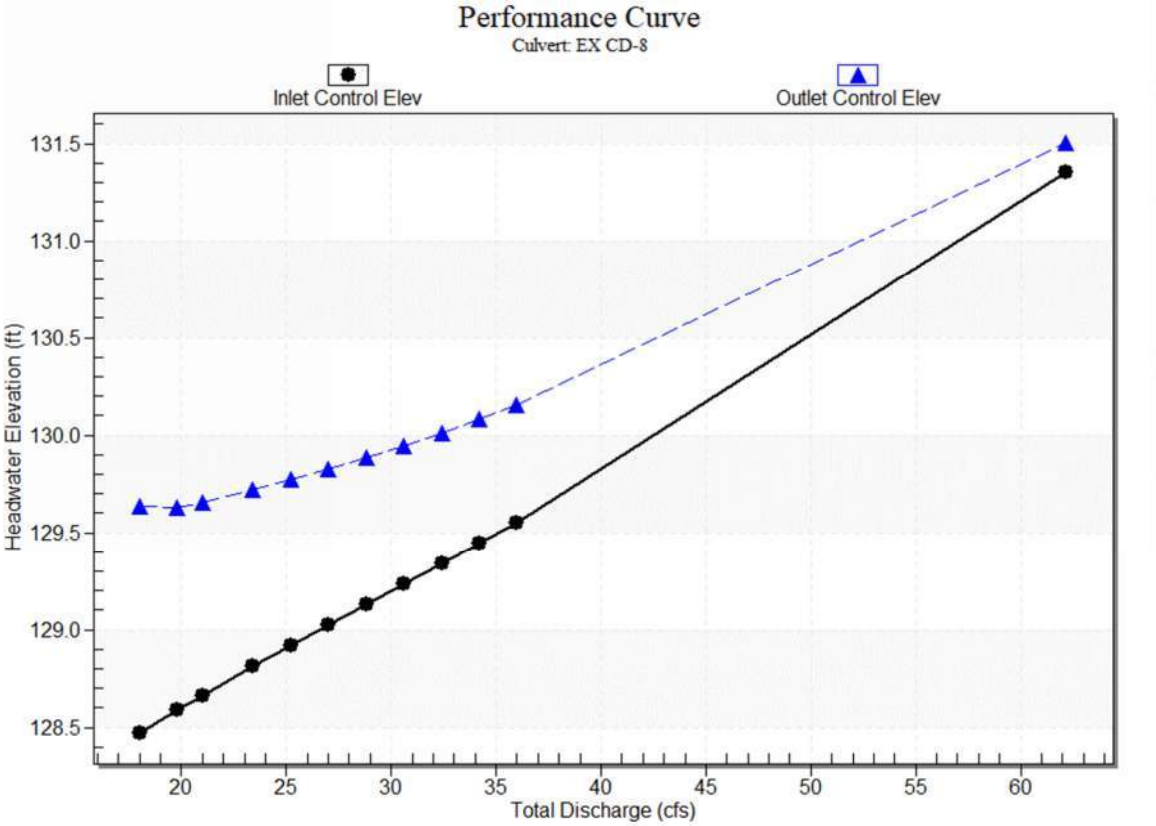
Inlet Elevation (invert): 126.50 ft,

Outlet Elevation (invert): 126.40 ft

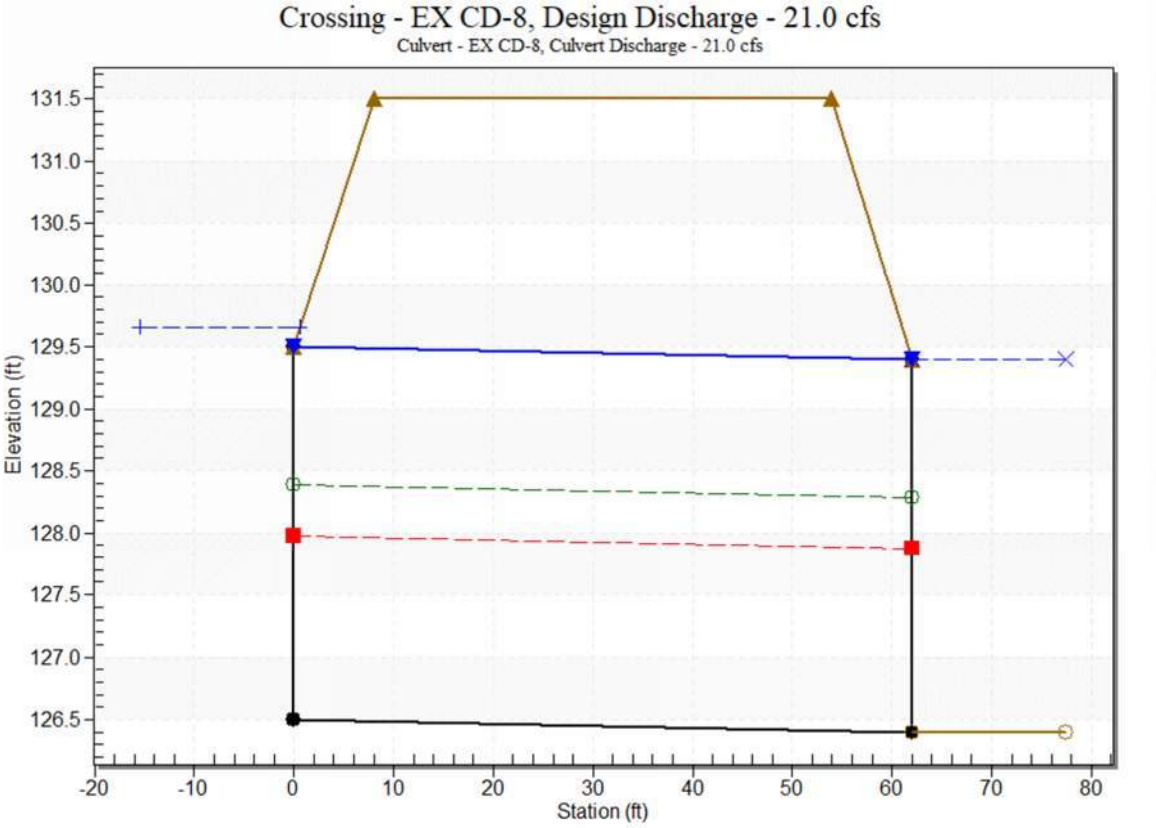
Culvert Length: 62.00 ft,

Culvert Slope: 0.0016

Culvert Performance Curve Plot: EX CD-8



Water Surface Profile Plot for Culvert: EX CD-8



Site Data - EX CD-8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 126.50 ft

Outlet Station: 62.00 ft

Outlet Elevation: 126.40 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-8

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-8

Table 42 - Downstream Channel Rating Curve (Crossing: EX CD-8)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
18.00	129.40	3.00
19.80	129.40	3.00
21.00	129.40	3.00
23.40	129.40	3.00
25.20	129.40	3.00
27.00	129.40	3.00
28.80	129.40	3.00
30.60	129.40	3.00
32.40	129.40	3.00
34.20	129.40	3.00
36.00	129.40	3.00

Tailwater Channel Data - EX CD-8

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 129.40 ft

Roadway Data for Crossing: EX CD-8

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1000.00 ft

Crest Elevation: 131.50 ft

Roadway Surface: Paved

Roadway Top Width: 46.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 18.00 cfs

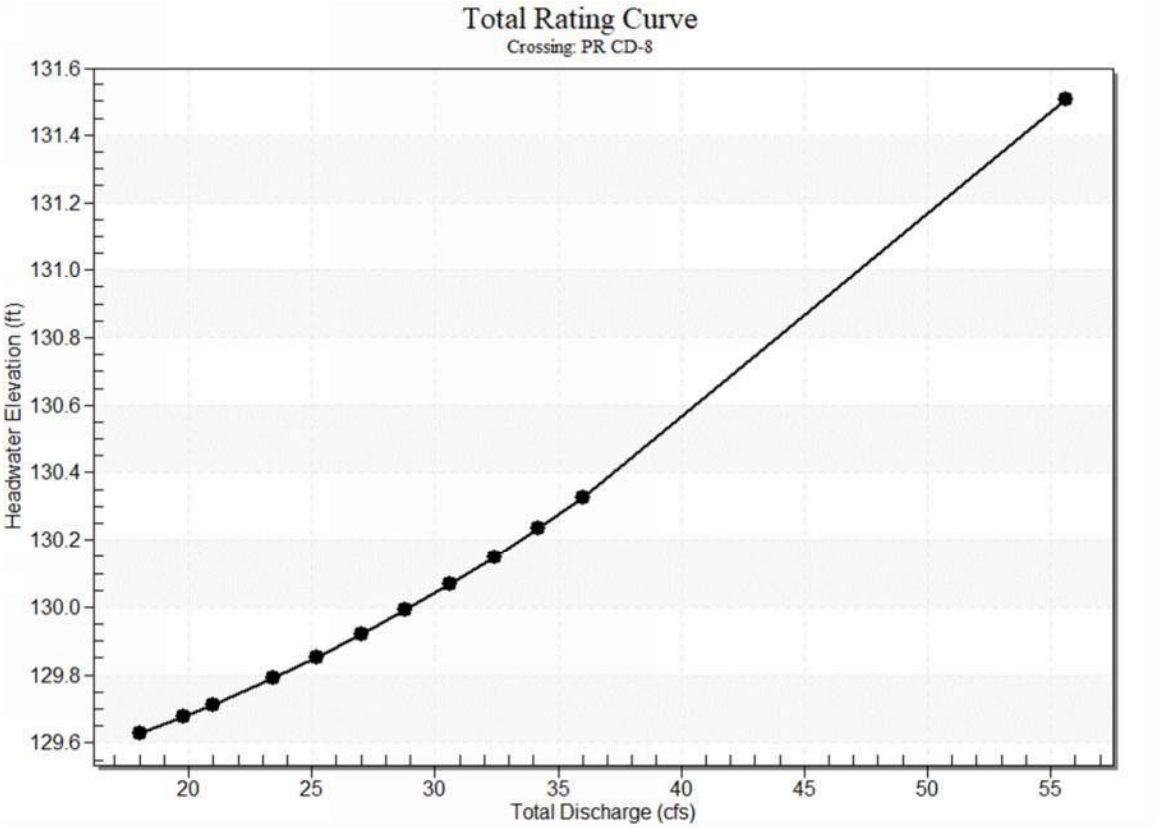
Design Flow: 21.00 cfs

Maximum Flow: 36.00 cfs

Table 43 - Summary of Culvert Flows at Crossing: PR CD-8

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-8 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
129.63	18.00	18.00	0.00	1
129.68	19.80	19.80	0.00	1
129.71	21.00	21.00	0.00	1
129.79	23.40	23.40	0.00	1
129.85	25.20	25.20	0.00	1
129.92	27.00	27.00	0.00	1
129.99	28.80	28.80	0.00	1
130.07	30.60	30.60	0.00	1
130.15	32.40	32.40	0.00	1
130.23	34.20	34.20	0.00	1
130.33	36.00	36.00	0.00	1
131.50	54.25	54.25	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-8



Culvert Data: PR CD-8

Table 44 - Culvert Summary Table: PR CD-8

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
18.00 cfs	18.00 cfs	129.63	1.97	3.079	3-M1f	1.73	1.36	3.00	3.05	2.55	0.00
19.80 cfs	19.80 cfs	129.68	2.09	3.128	3-M1f	1.84	1.43	3.00	3.05	2.80	0.00
21.00 cfs	21.00 cfs	129.71	2.16	3.163	3-M1f	1.92	1.47	3.00	3.05	2.97	0.00
23.40 cfs	23.40 cfs	129.79	2.31	3.241	3-M1f	2.07	1.56	3.00	3.05	3.31	0.00
25.20 cfs	25.20 cfs	129.85	2.42	3.303	4-FFf	2.20	1.62	3.00	3.05	3.57	0.00
27.00 cfs	27.00 cfs	129.92	2.52	3.370	4-FFf	2.34	1.68	3.00	3.05	3.82	0.00
28.80 cfs	28.80 cfs	129.99	2.63	3.442	4-FFf	2.50	1.74	3.00	3.05	4.07	0.00
30.60 cfs	30.60 cfs	130.07	2.73	3.518	4-FFf	3.00	1.79	3.00	3.05	4.33	0.00
32.40 cfs	32.40 cfs	130.15	2.84	3.599	4-FFf	3.00	1.85	3.00	3.05	4.58	0.00
34.20 cfs	34.20 cfs	130.23	2.94	3.685	4-FFf	3.00	1.90	3.00	3.05	4.84	0.00
36.00 cfs	36.00 cfs	130.33	3.05	3.775	4-FFf	3.00	1.95	3.00	3.05	5.09	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

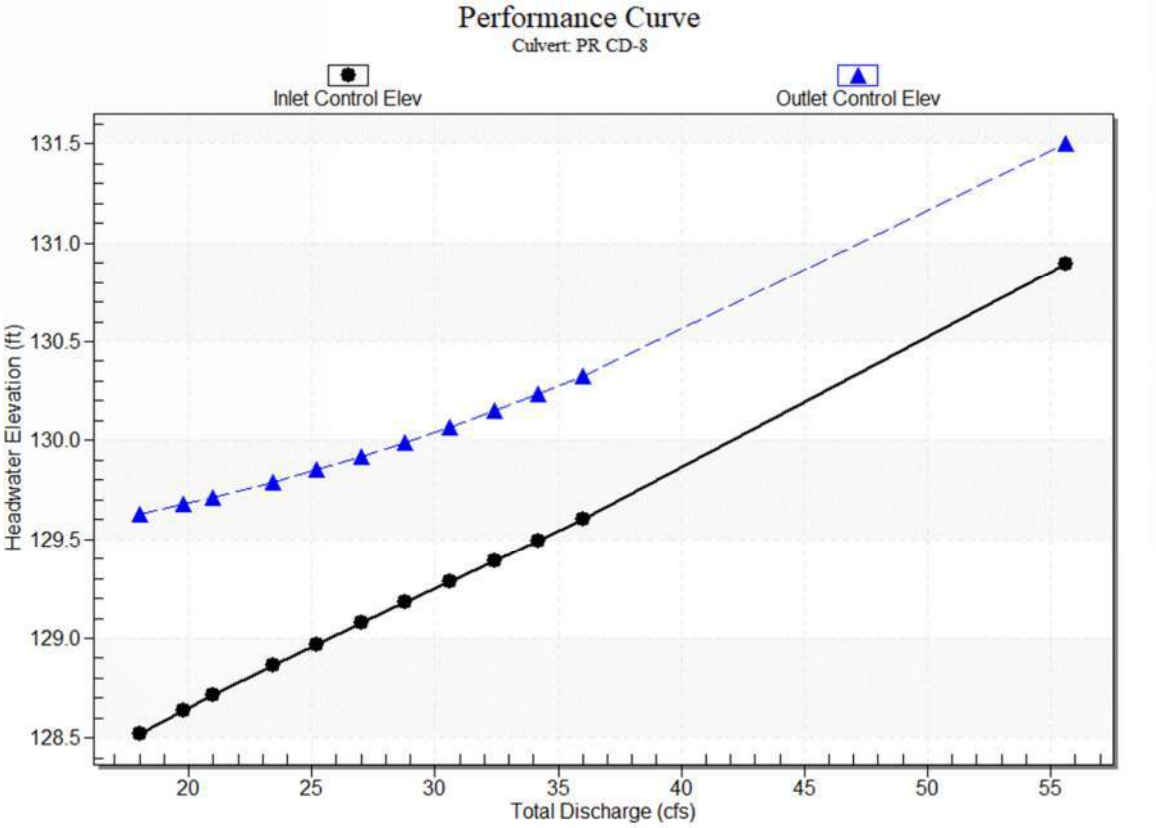
Inlet Elevation (invert): 126.55 ft,

Outlet Elevation (invert): 126.35 ft

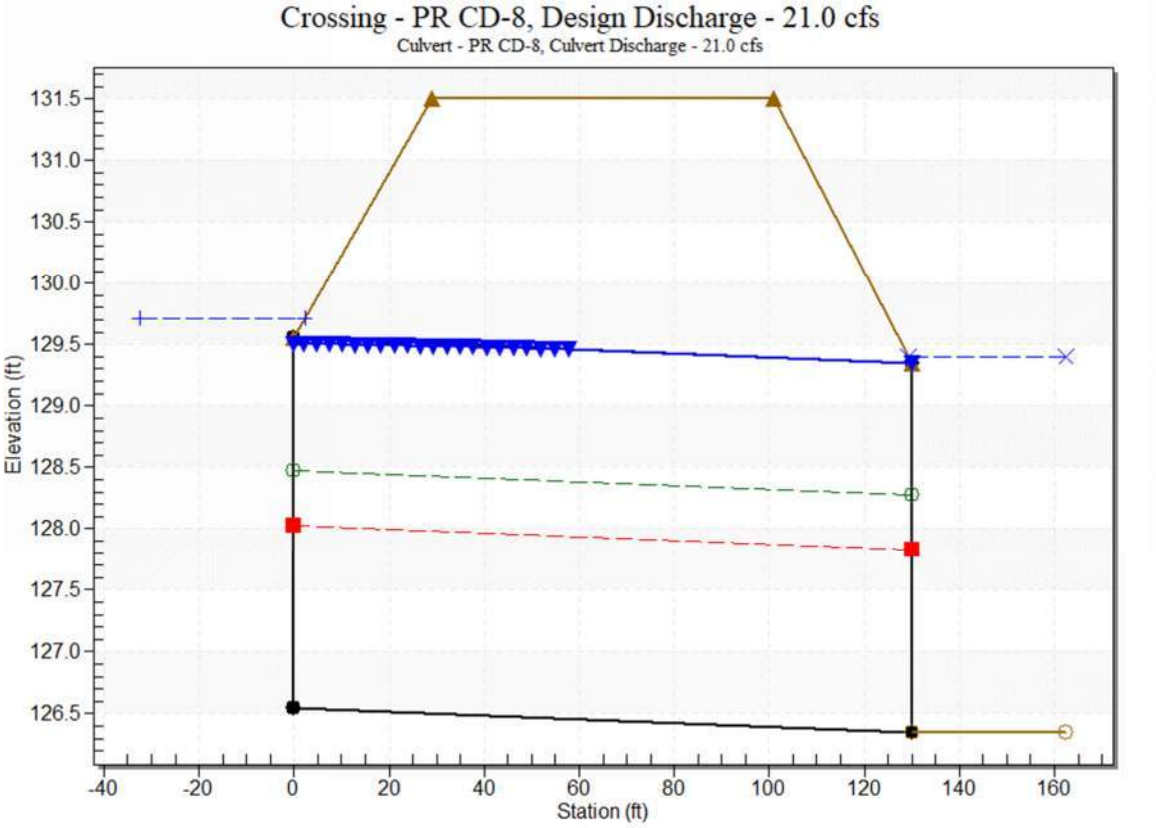
Culvert Length: 130.00 ft,

Culvert Slope: 0.0015

Culvert Performance Curve Plot: PR CD-8



Water Surface Profile Plot for Culvert: PR CD-8



Site Data - PR CD-8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 126.55 ft

Outlet Station: 130.00 ft

Outlet Elevation: 126.35 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-8

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-8

Table 45 - Downstream Channel Rating Curve (Crossing: PR CD-8)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
18.00	129.40	3.05
19.80	129.40	3.05
21.00	129.40	3.05
23.40	129.40	3.05
25.20	129.40	3.05
27.00	129.40	3.05
28.80	129.40	3.05
30.60	129.40	3.05
32.40	129.40	3.05
34.20	129.40	3.05
36.00	129.40	3.05

Tailwater Channel Data - PR CD-8

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 129.40 ft

Roadway Data for Crossing: PR CD-8

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1000.00 ft

Crest Elevation: 131.50 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 34.00 cfs

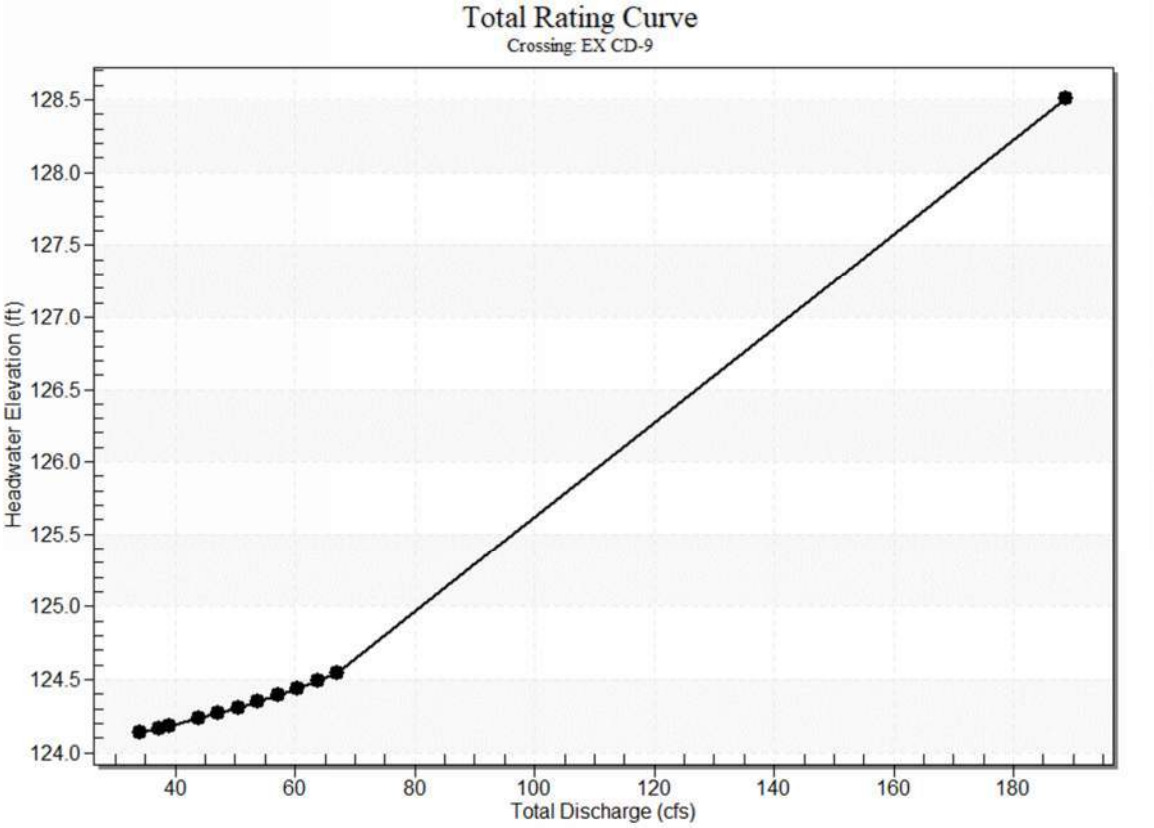
Design Flow: 39.00 cfs

Maximum Flow: 67.00 cfs

Table 46 - Summary of Culvert Flows at Crossing: EX CD-9

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-9 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
124.14	34.00	34.00	0.00	1
124.17	37.30	37.30	0.00	1
124.18	39.00	39.00	0.00	1
124.23	43.90	43.90	0.00	1
124.27	47.20	47.20	0.00	1
124.31	50.50	50.50	0.00	1
124.35	53.80	53.80	0.00	1
124.39	57.10	57.10	0.00	1
124.44	60.40	60.40	0.00	1
124.49	63.70	63.70	0.00	1
124.54	67.00	67.00	0.00	1
128.50	186.26	186.26	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-9



Culvert Data: EX CD-9

Table 47 - Culvert Summary Table: EX CD-9

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
34.00 cfs	34.00 cfs	124.14	2.33	4.060	3-M1t	2.15	1.67	4.02	4.02	2.27	0.00
37.30 cfs	37.30 cfs	124.17	2.47	4.089	3-M1t	2.27	1.76	4.02	4.02	2.49	0.00
39.00 cfs	39.00 cfs	124.18	2.54	4.104	3-M1t	2.33	1.80	4.02	4.02	2.60	0.00
43.90 cfs	43.90 cfs	124.23	2.74	4.154	3-M1t	2.50	1.91	4.02	4.02	2.93	0.00
47.20 cfs	47.20 cfs	124.27	2.87	4.190	3-M1t	2.62	1.98	4.02	4.02	3.15	0.00
50.50 cfs	50.50 cfs	124.31	2.99	4.229	3-M1t	2.74	2.06	4.02	4.02	3.37	0.00
53.80 cfs	53.80 cfs	124.35	3.11	4.270	3-M1t	2.86	2.13	4.02	4.02	3.59	0.00
57.10 cfs	57.10 cfs	124.39	3.22	4.314	3-M1t	2.98	2.19	4.02	4.02	3.81	0.00
60.40 cfs	60.40 cfs	124.44	3.33	4.361	3-M1t	3.10	2.26	4.02	4.02	4.03	0.00
63.70 cfs	63.70 cfs	124.49	3.44	4.410	3-M1t	3.23	2.32	4.02	4.02	4.25	0.00
67.00 cfs	67.00 cfs	124.54	3.55	4.461	3-M1t	3.37	2.38	4.02	4.02	4.47	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

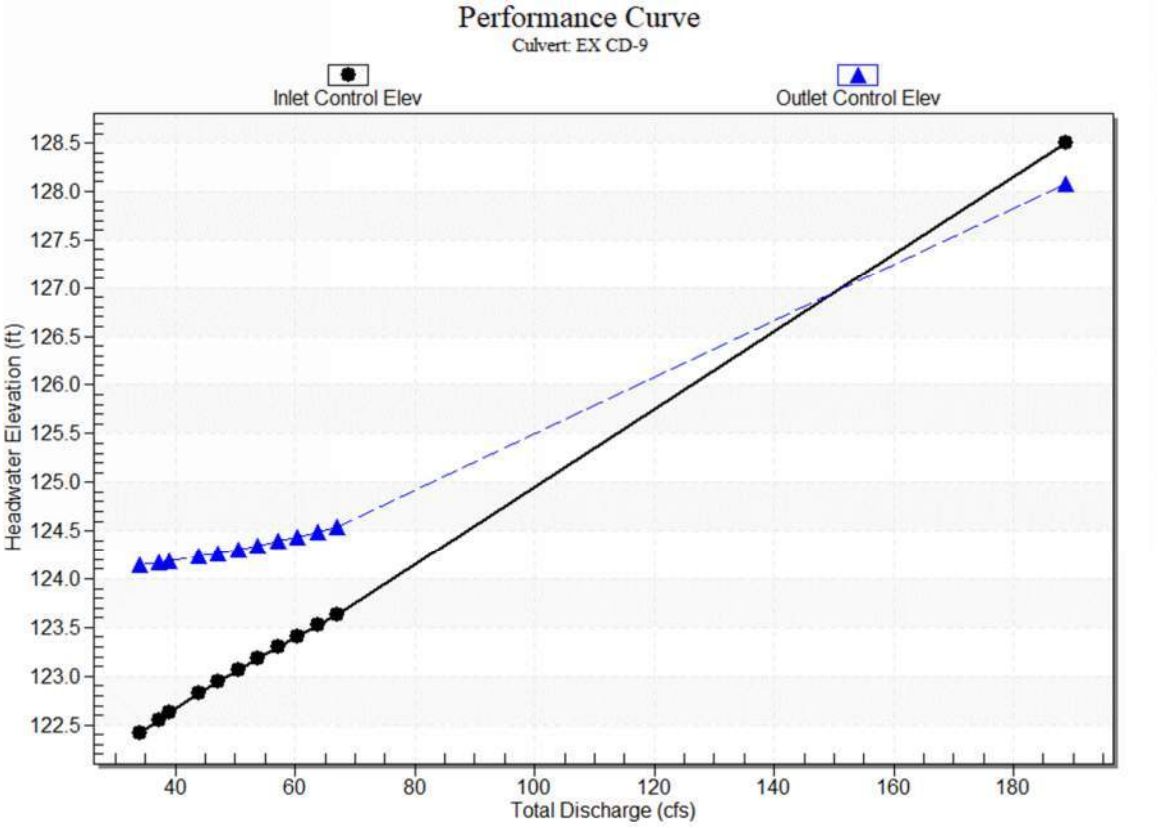
Inlet Elevation (invert): 120.08 ft,

Outlet Elevation (invert): 119.98 ft

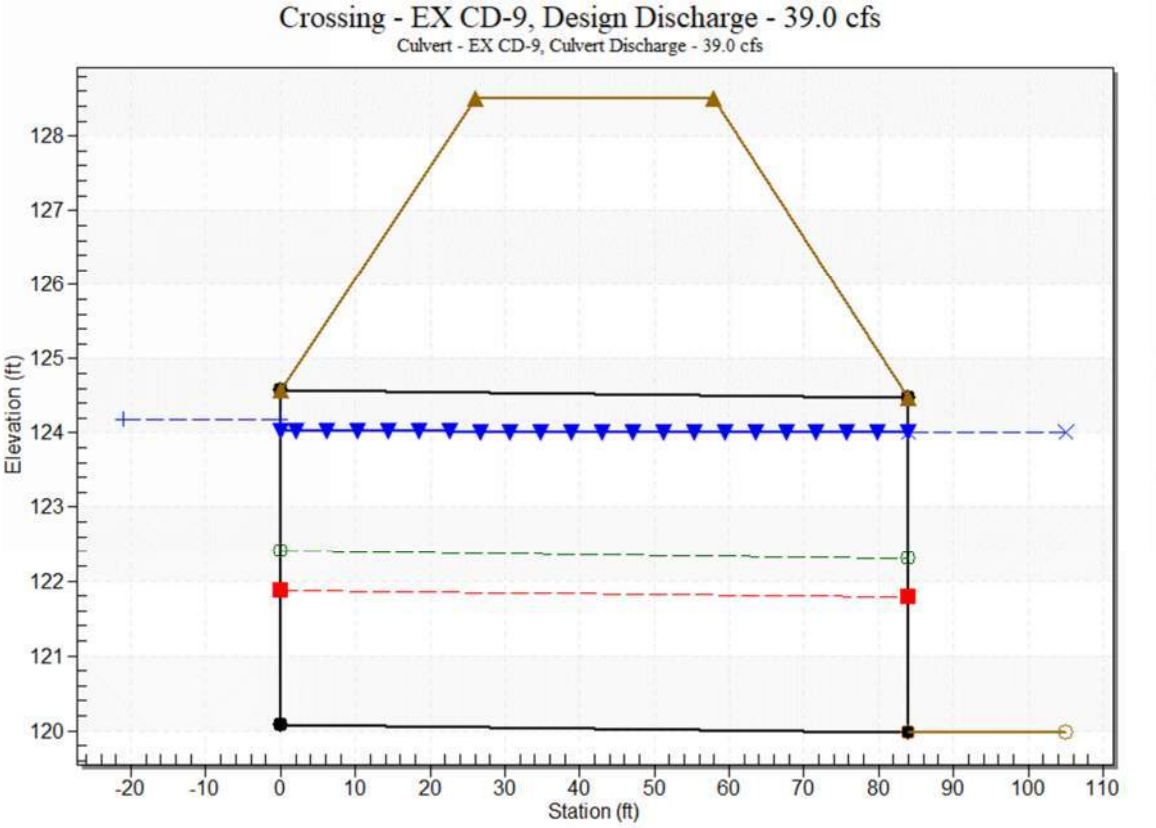
Culvert Length: 84.00 ft,

Culvert Slope: 0.0012

Culvert Performance Curve Plot: EX CD-9



Water Surface Profile Plot for Culvert: EX CD-9



Site Data - EX CD-9

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 120.08 ft

Outlet Station: 84.00 ft

Outlet Elevation: 119.98 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-9

Barrel Shape: Circular

Barrel Diameter: 4.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-9

Table 48 - Downstream Channel Rating Curve (Crossing: EX CD-9)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
34.00	124.00	4.02
37.30	124.00	4.02
39.00	124.00	4.02
43.90	124.00	4.02
47.20	124.00	4.02
50.50	124.00	4.02
53.80	124.00	4.02
57.10	124.00	4.02
60.40	124.00	4.02
63.70	124.00	4.02
67.00	124.00	4.02

Tailwater Channel Data - EX CD-9

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 124.00 ft

Roadway Data for Crossing: EX CD-9

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1000.00 ft

Crest Elevation: 128.50 ft

Roadway Surface: Paved

Roadway Top Width: 32.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 34.00 cfs

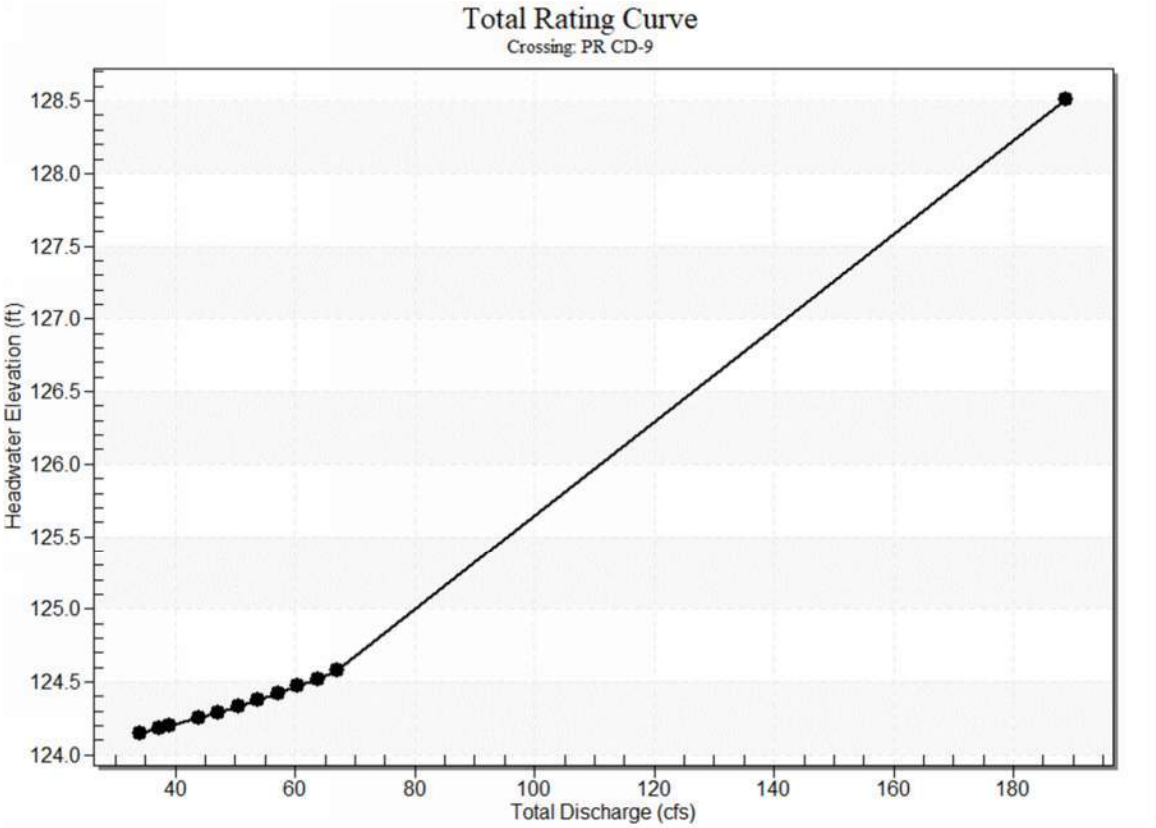
Design Flow: 39.00 cfs

Maximum Flow: 67.00 cfs

Table 49 - Summary of Culvert Flows at Crossing: PR CD-9

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-9 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
124.15	34.00	34.00	0.00	1
124.18	37.30	37.30	0.00	1
124.20	39.00	39.00	0.00	1
124.25	43.90	43.90	0.00	1
124.29	47.20	47.20	0.00	1
124.33	50.50	50.50	0.00	1
124.37	53.80	53.80	0.00	1
124.42	57.10	57.10	0.00	1
124.47	60.40	60.40	0.00	1
124.52	63.70	63.70	0.00	1
124.58	67.00	67.00	0.00	1
128.50	185.91	185.91	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-9



Culvert Data: PR CD-9

Table 50 - Culvert Summary Table: PR CD-9

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
34.00 cfs	34.00 cfs	124.15	2.33	4.050	3-M1t	2.17	1.67	4.05	4.05	2.26	0.00
37.30 cfs	37.30 cfs	124.18	2.47	4.080	3-M1t	2.29	1.76	4.05	4.05	2.47	0.00
39.00 cfs	39.00 cfs	124.20	2.54	4.097	3-M1t	2.35	1.80	4.05	4.05	2.59	0.00
43.90 cfs	43.90 cfs	124.25	2.74	4.150	3-M1t	2.53	1.91	4.05	4.05	2.91	0.00
47.20 cfs	47.20 cfs	124.29	2.87	4.188	3-M1t	2.65	1.98	4.05	4.05	3.13	0.00
50.50 cfs	50.50 cfs	124.33	2.99	4.230	3-M1t	2.76	2.06	4.05	4.05	3.35	0.00
53.80 cfs	53.80 cfs	124.37	3.11	4.274	3-M1t	2.89	2.13	4.05	4.05	3.57	0.00
57.10 cfs	57.10 cfs	124.42	3.22	4.320	3-M1t	3.01	2.19	4.05	4.05	3.79	0.00
60.40 cfs	60.40 cfs	124.47	3.33	4.370	3-M1t	3.14	2.26	4.05	4.05	4.01	0.00
63.70 cfs	63.70 cfs	124.52	3.44	4.422	3-M1t	3.27	2.32	4.05	4.05	4.23	0.00
67.00 cfs	67.00 cfs	124.58	3.55	4.476	3-M1t	3.42	2.38	4.05	4.05	4.44	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

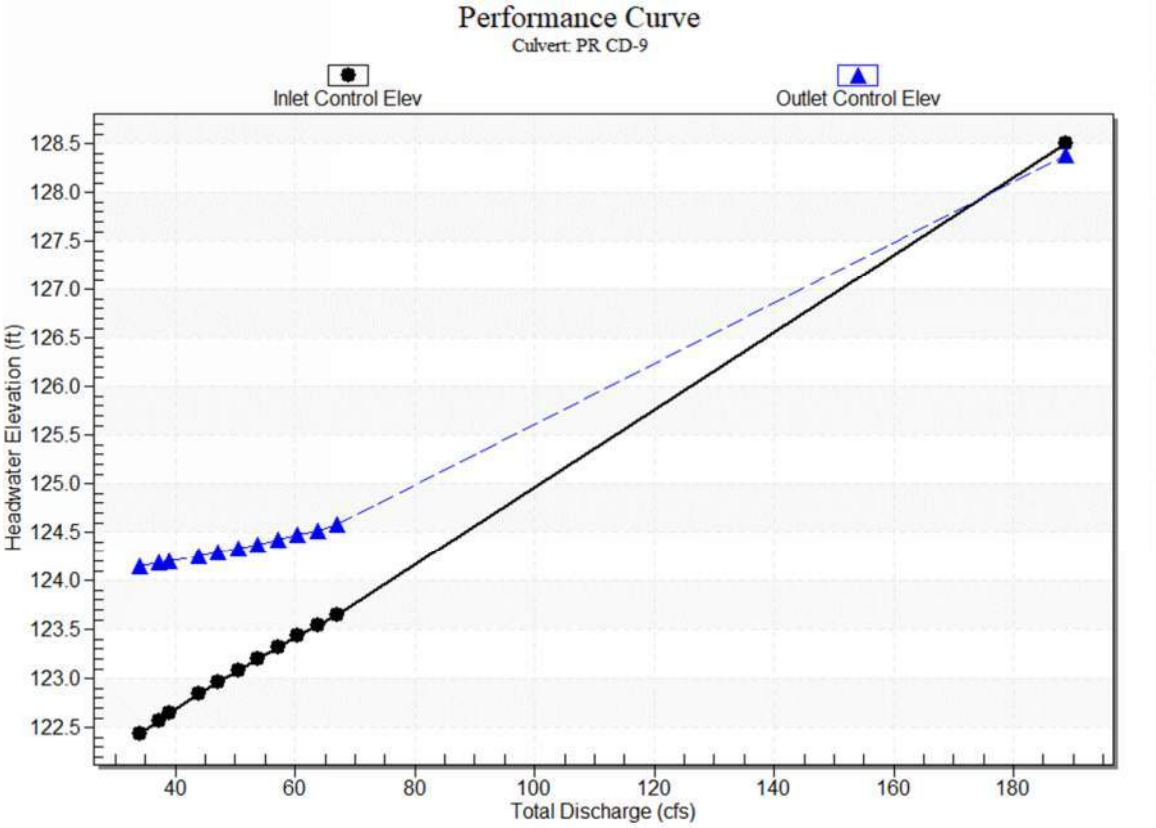
Inlet Elevation (invert): 120.10 ft,

Outlet Elevation (invert): 119.95 ft

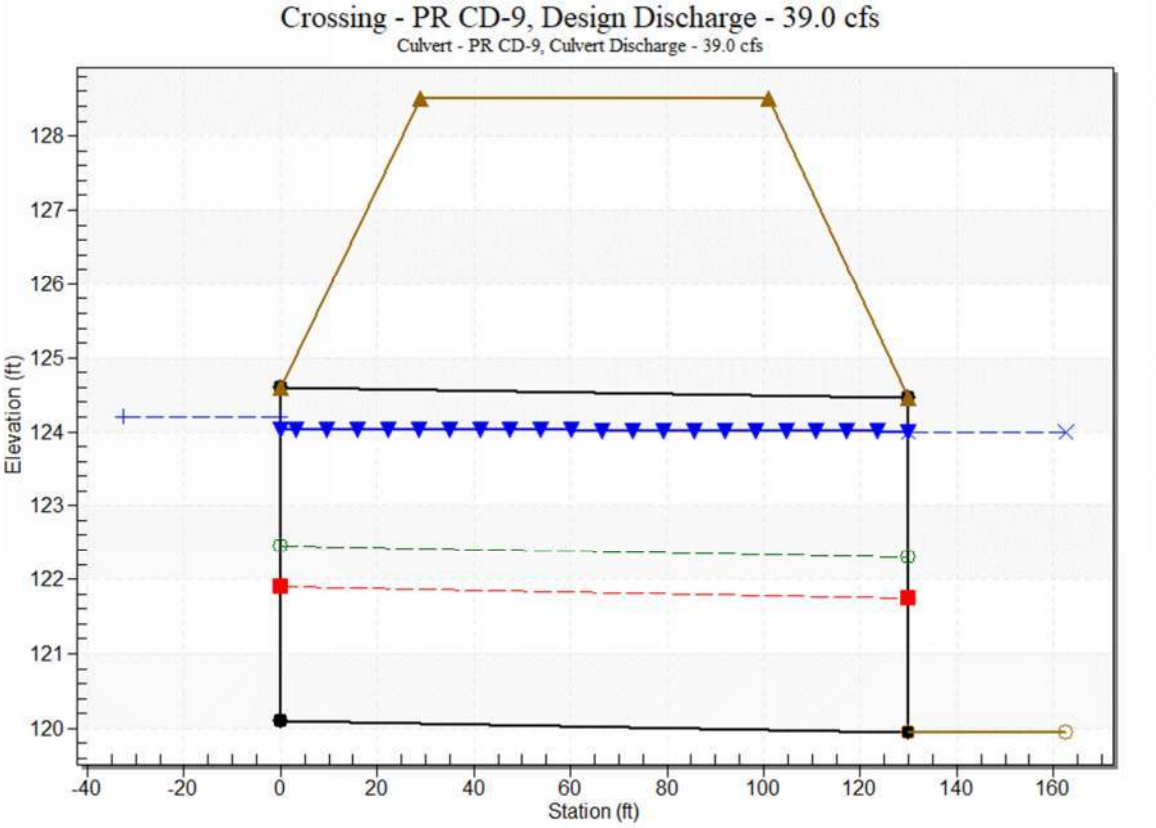
Culvert Length: 130.00 ft,

Culvert Slope: 0.0012

Culvert Performance Curve Plot: PR CD-9



Water Surface Profile Plot for Culvert: PR CD-9



Site Data - PR CD-9

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 120.10 ft

Outlet Station: 130.00 ft

Outlet Elevation: 119.95 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-9

Barrel Shape: Circular

Barrel Diameter: 4.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-9

Table 51 - Downstream Channel Rating Curve (Crossing: PR CD-9)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
34.00	124.00	4.05
37.30	124.00	4.05
39.00	124.00	4.05
43.90	124.00	4.05
47.20	124.00	4.05
50.50	124.00	4.05
53.80	124.00	4.05
57.10	124.00	4.05
60.40	124.00	4.05
63.70	124.00	4.05
67.00	124.00	4.05

Tailwater Channel Data - PR CD-9

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 124.00 ft

Roadway Data for Crossing: PR CD-9

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1000.00 ft

Crest Elevation: 128.50 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 57.00 cfs

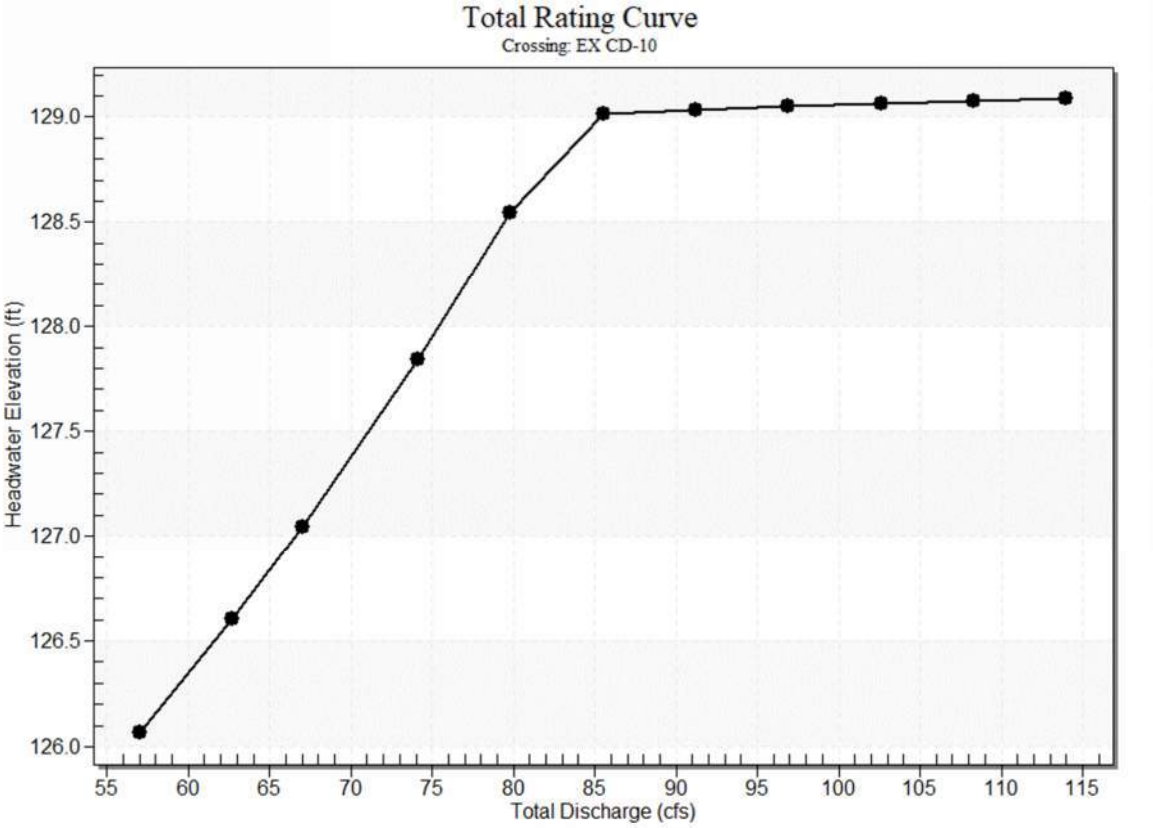
Design Flow: 67.00 cfs

Maximum Flow: 114.00 cfs

Table 52 - Summary of Culvert Flows at Crossing: EX CD-10

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-10 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
126.07	57.00	57.00	0.00	1
126.60	62.70	62.70	0.00	1
127.04	67.00	67.00	0.00	1
127.84	74.10	74.10	0.00	1
128.55	79.80	79.80	0.00	1
129.01	85.50	83.36	1.75	45
129.03	91.20	83.52	7.25	5
129.05	96.90	83.63	12.84	4
129.06	102.60	83.74	18.61	4
129.07	108.30	83.82	23.95	3
129.09	114.00	83.91	29.63	3
129.00	83.26	83.26	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-10



Culvert Data: EX CD-10

Table 53 - Culvert Summary Table: EX CD-10

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
57.00 cfs	57.00 cfs	126.07	4.57	4.438	5-S1f	2.32	2.45	3.00	3.00	8.06	0.00
62.70 cfs	62.70 cfs	126.60	5.10	4.872	4-FFf	2.58	2.55	3.00	3.00	8.87	0.00
67.00 cfs	67.00 cfs	127.04	5.54	5.208	4-FFf	3.00	2.62	3.00	3.00	9.48	0.00
74.10 cfs	74.10 cfs	127.84	6.34	5.813	4-FFf	3.00	2.71	3.00	3.00	10.48	0.00
79.80 cfs	79.80 cfs	128.55	7.05	6.342	4-FFf	3.00	2.77	3.00	3.00	11.29	0.00
85.50 cfs	83.36 cfs	129.01	7.51	6.692	4-FFf	3.00	2.80	3.00	3.00	11.79	0.00
91.20 cfs	83.52 cfs	129.03	7.53	6.708	4-FFf	3.00	2.80	3.00	3.00	11.82	0.00
96.90 cfs	83.63 cfs	129.05	7.55	6.720	4-FFf	3.00	2.80	3.00	3.00	11.83	0.00
102.60 cfs	83.74 cfs	129.06	7.56	6.730	4-FFf	3.00	2.80	3.00	3.00	11.85	0.00
108.30 cfs	83.82 cfs	129.07	7.57	6.739	4-FFf	3.00	2.80	3.00	3.00	11.86	0.00
114.00 cfs	83.91 cfs	129.09	7.59	6.747	4-FFf	3.00	2.80	3.00	3.00	11.87	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

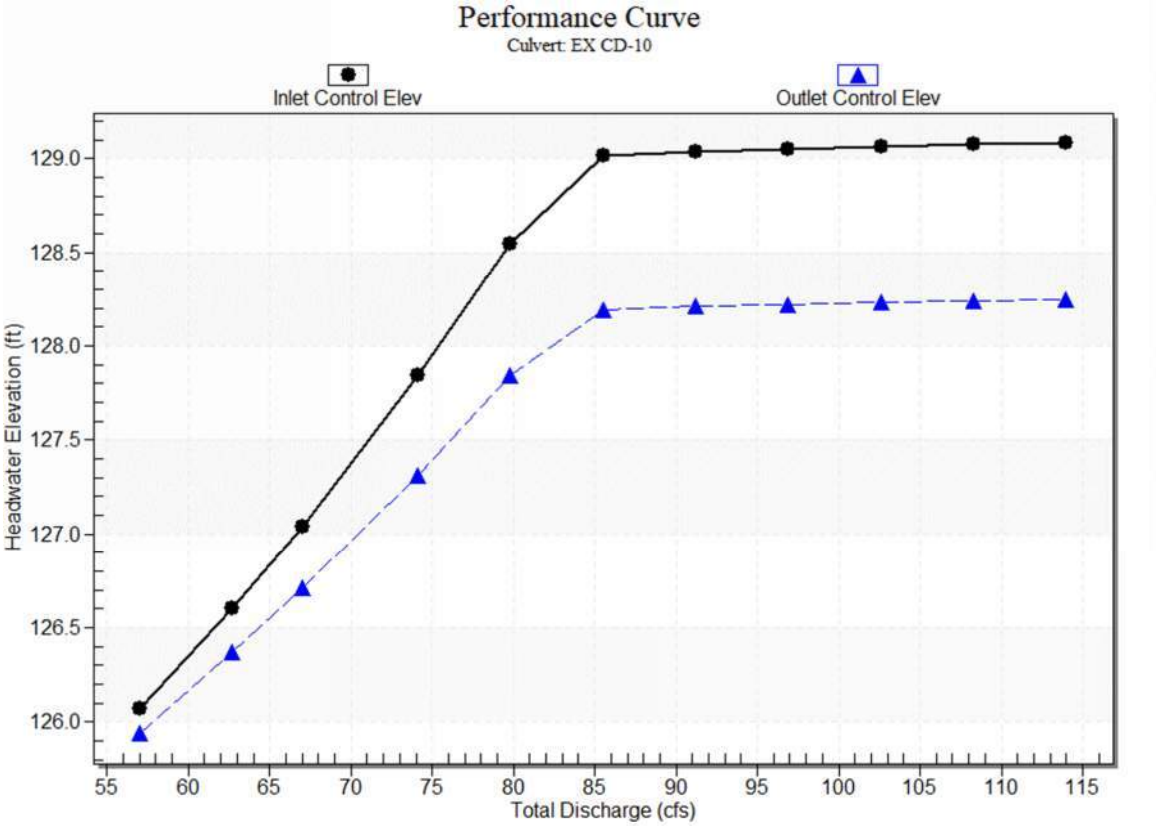
Inlet Elevation (invert): 121.50 ft,

Outlet Elevation (invert): 121.00 ft

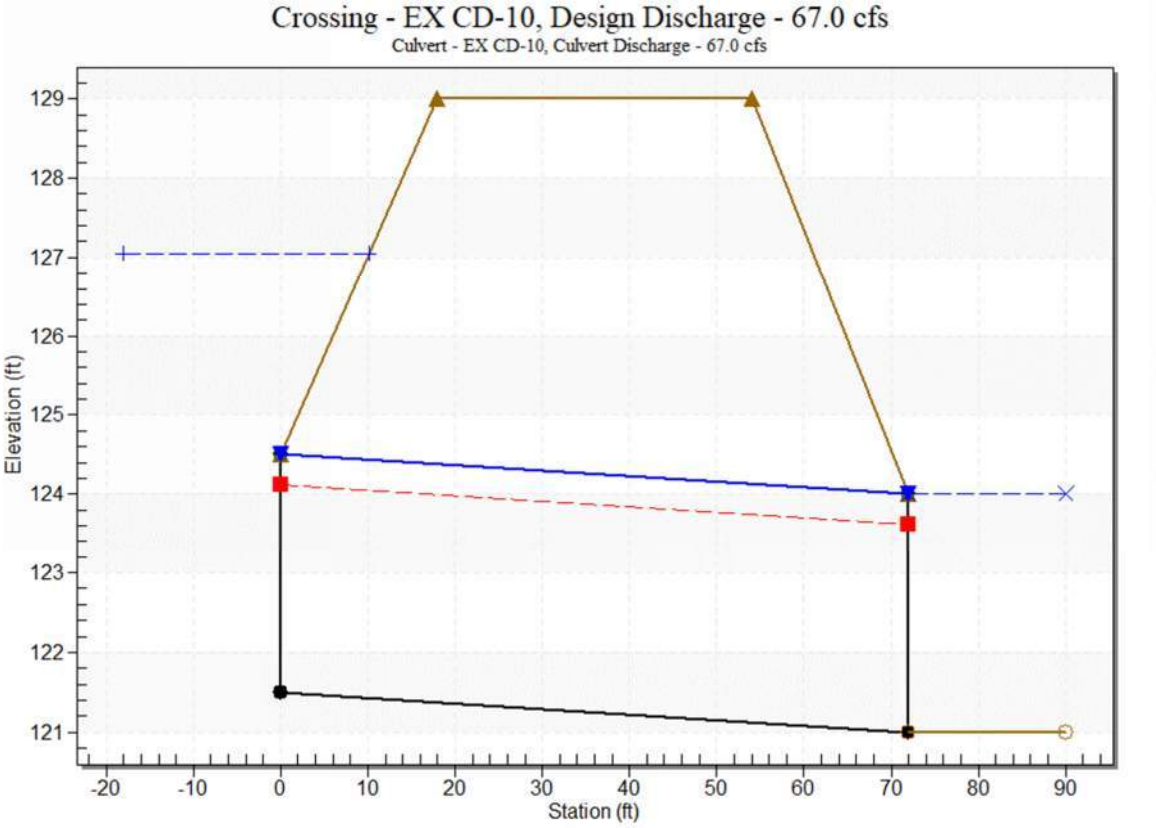
Culvert Length: 72.00 ft,

Culvert Slope: 0.0069

Culvert Performance Curve Plot: EX CD-10



Water Surface Profile Plot for Culvert: EX CD-10



Site Data - EX CD-10

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 121.50 ft

Outlet Station: 72.00 ft

Outlet Elevation: 121.00 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-10

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-10

Table 54 - Downstream Channel Rating Curve (Crossing: EX CD-10)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
57.00	124.00	3.00
62.70	124.00	3.00
67.00	124.00	3.00
74.10	124.00	3.00
79.80	124.00	3.00
85.50	124.00	3.00
91.20	124.00	3.00
96.90	124.00	3.00
102.60	124.00	3.00
108.30	124.00	3.00
114.00	124.00	3.00

Tailwater Channel Data - EX CD-10

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 124.00 ft

Roadway Data for Crossing: EX CD-10

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 400.00 ft

Crest Elevation: 129.00 ft

Roadway Surface: Paved

Roadway Top Width: 36.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 57.00 cfs

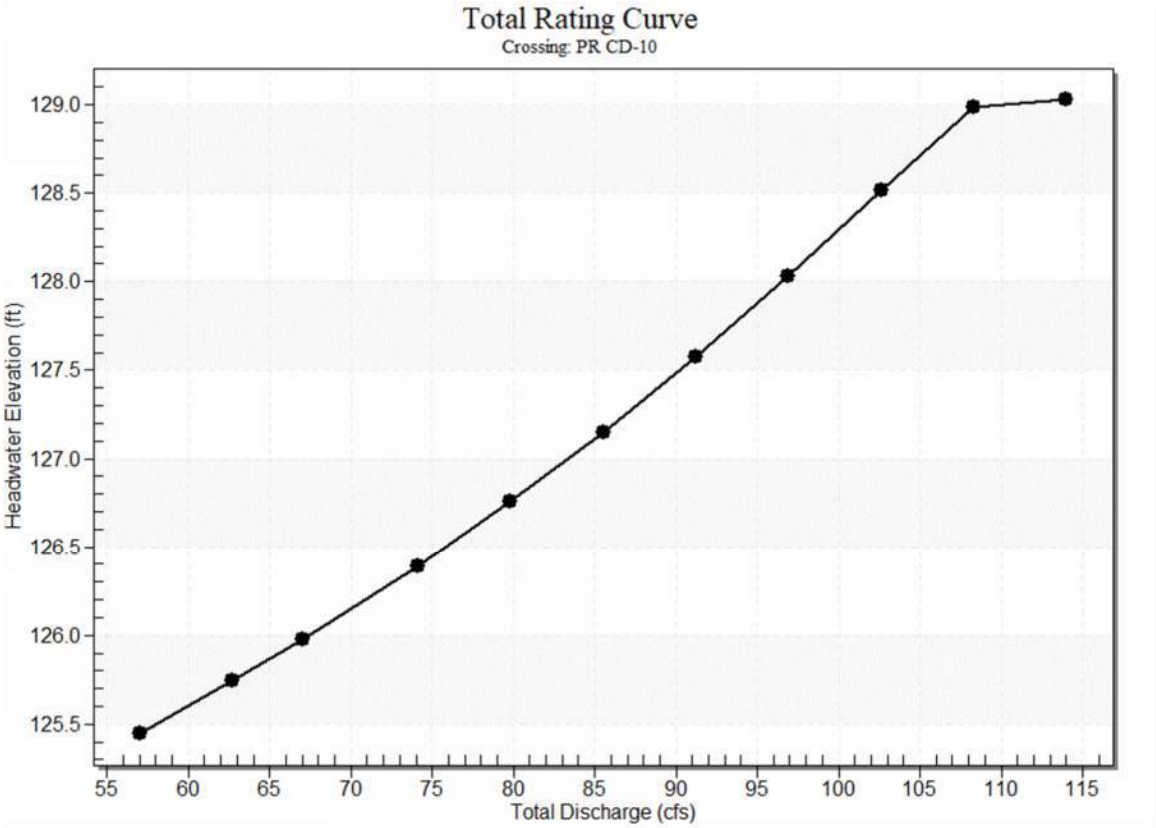
Design Flow: 67.00 cfs

Maximum Flow: 114.00 cfs

Table 55 - Summary of Culvert Flows at Crossing: PR CD-10

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-10 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
125.45	57.00	57.00	0.00	1
125.74	62.70	62.70	0.00	1
125.98	67.00	67.00	0.00	1
126.39	74.10	74.10	0.00	1
126.76	79.80	79.80	0.00	1
127.15	85.50	85.50	0.00	1
127.58	91.20	91.20	0.00	1
128.03	96.90	96.90	0.00	1
128.52	102.60	102.60	0.00	1
128.99	108.30	107.78	0.00	77
129.03	114.00	108.19	5.39	7
129.00	107.89	107.89	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-10



Culvert Data: PR CD-10

Table 56 - Culvert Summary Table: PR CD-10

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
57.00 cfs	57.00 cfs	125.45	3.75	3.471	5-JS1t	2.01	2.36	3.20	3.20	6.18	0.00
62.70 cfs	62.70 cfs	125.74	4.04	3.717	5-JS1t	2.14	2.48	3.20	3.20	6.80	0.00
67.00 cfs	67.00 cfs	125.98	4.28	3.918	5-JS1t	2.24	2.57	3.20	3.20	7.27	0.00
74.10 cfs	74.10 cfs	126.39	4.69	4.279	5-JS1t	2.40	2.69	3.20	3.20	8.04	0.00
79.80 cfs	79.80 cfs	126.76	5.06	4.595	5-JS1t	2.54	2.79	3.20	3.20	8.66	0.00
85.50 cfs	85.50 cfs	127.15	5.45	4.935	5-JS1t	2.70	2.88	3.20	3.20	9.27	0.00
91.20 cfs	91.20 cfs	127.58	5.88	5.298	5-JS1t	2.88	2.96	3.20	3.20	9.89	0.00
96.90 cfs	96.90 cfs	128.03	6.33	5.778	3-M2t	3.50	3.03	3.20	3.20	10.51	0.00
102.60 cfs	102.60 cfs	128.52	6.82	6.121	3-M2t	3.50	3.10	3.20	3.20	11.13	0.00
108.30 cfs	107.78 cfs	128.99	7.29	6.595	7-M2t	3.50	3.15	3.20	3.20	11.69	0.00
114.00 cfs	108.19 cfs	129.03	7.33	6.632	7-M2t	3.50	3.15	3.20	3.20	11.73	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

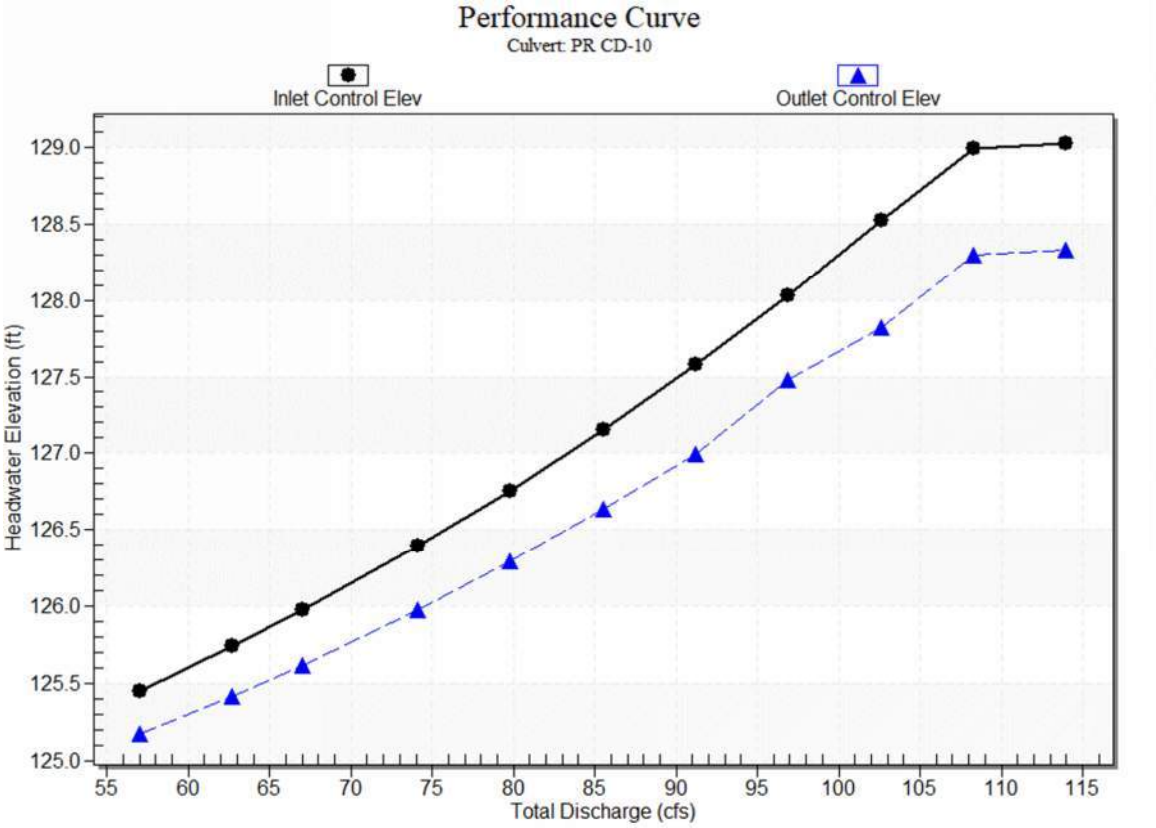
Inlet Elevation (invert): 121.70 ft,

Outlet Elevation (invert): 120.80 ft

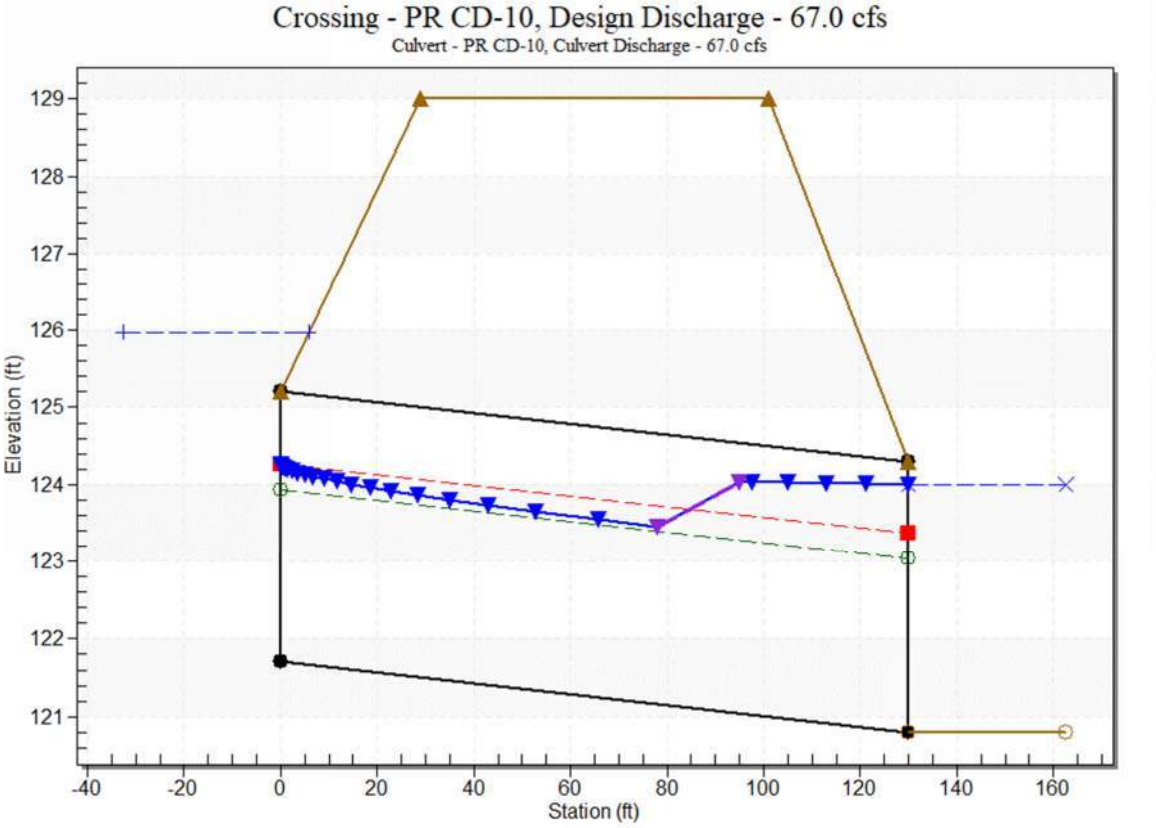
Culvert Length: 130.00 ft,

Culvert Slope: 0.0069

Culvert Performance Curve Plot: PR CD-10



Water Surface Profile Plot for Culvert: PR CD-10



Site Data - PR CD-10

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 121.70 ft

Outlet Station: 130.00 ft

Outlet Elevation: 120.80 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-10

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-10

Table 57 - Downstream Channel Rating Curve (Crossing: PR CD-10)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
57.00	124.00	3.20
62.70	124.00	3.20
67.00	124.00	3.20
74.10	124.00	3.20
79.80	124.00	3.20
85.50	124.00	3.20
91.20	124.00	3.20
96.90	124.00	3.20
102.60	124.00	3.20
108.30	124.00	3.20
114.00	124.00	3.20

Tailwater Channel Data - PR CD-10

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 124.00 ft

Roadway Data for Crossing: PR CD-10

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 400.00 ft

Crest Elevation: 129.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 82.00 cfs

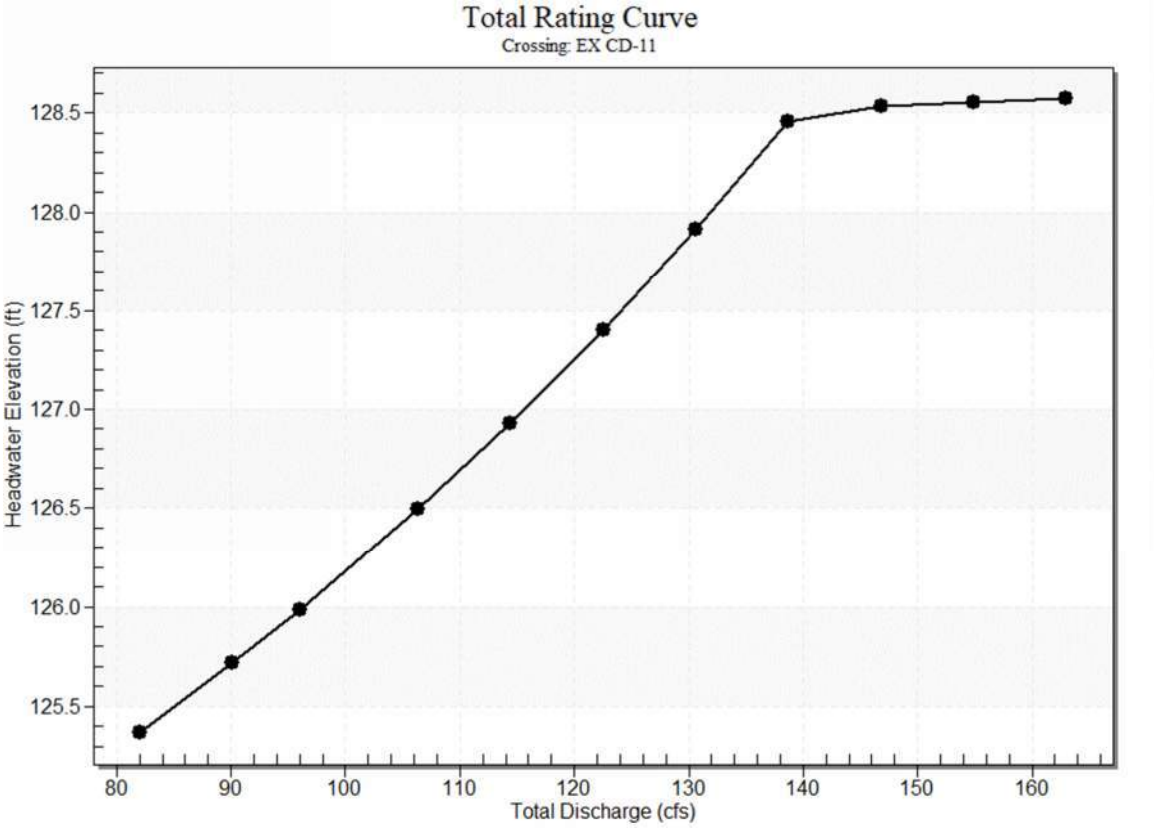
Design Flow: 96.00 cfs

Maximum Flow: 163.00 cfs

Table 58 - Summary of Culvert Flows at Crossing: EX CD-11

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-11 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
125.37	82.00	82.00	0.00	1
125.72	90.10	90.10	0.00	1
125.99	96.00	96.00	0.00	1
126.49	106.30	106.30	0.00	1
126.93	114.40	114.40	0.00	1
127.40	122.50	122.50	0.00	1
127.91	130.60	130.60	0.00	1
128.46	138.70	138.70	0.00	1
128.53	146.80	139.79	6.64	10
128.55	154.90	140.10	14.48	5
128.57	163.00	140.35	22.23	4
128.50	139.33	139.33	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-11



Culvert Data: EX CD-11

Table 59 - Culvert Summary Table: EX CD-11

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
82.00 cfs	82.00 cfs	125.37	4.37	4.190	5-JS1f	1.87	2.74	4.00	4.00	6.53	0.00
90.10 cfs	90.10 cfs	125.72	4.72	4.437	5-JS1f	1.98	2.88	4.00	4.00	7.17	0.00
96.00 cfs	96.00 cfs	125.99	4.99	4.632	5-JS1f	2.05	2.97	4.00	4.00	7.64	0.00
106.30 cfs	106.30 cfs	126.49	5.49	5.001	5-S2n	2.18	3.12	2.46	4.00	13.10	0.00
114.40 cfs	114.40 cfs	126.93	5.93	5.317	5-S2n	2.29	3.23	2.57	4.00	13.38	0.00
122.50 cfs	122.50 cfs	127.40	6.40	5.657	5-S2n	2.39	3.33	2.69	4.00	13.65	0.00
130.60 cfs	130.60 cfs	127.91	6.91	6.020	5-S2n	2.49	3.42	2.80	4.00	13.92	0.00
138.70 cfs	138.70 cfs	128.46	7.46	6.406	5-S2n	2.60	3.50	2.90	4.00	14.20	0.00
146.80 cfs	139.79 cfs	128.53	7.53	6.460	5-S2n	2.61	3.51	2.92	4.00	14.24	0.00
154.90 cfs	140.10 cfs	128.55	7.55	6.475	5-S2n	2.61	3.51	2.92	4.00	14.25	0.00
163.00 cfs	140.35 cfs	128.57	7.57	6.488	5-S2n	2.62	3.51	2.92	4.00	14.26	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

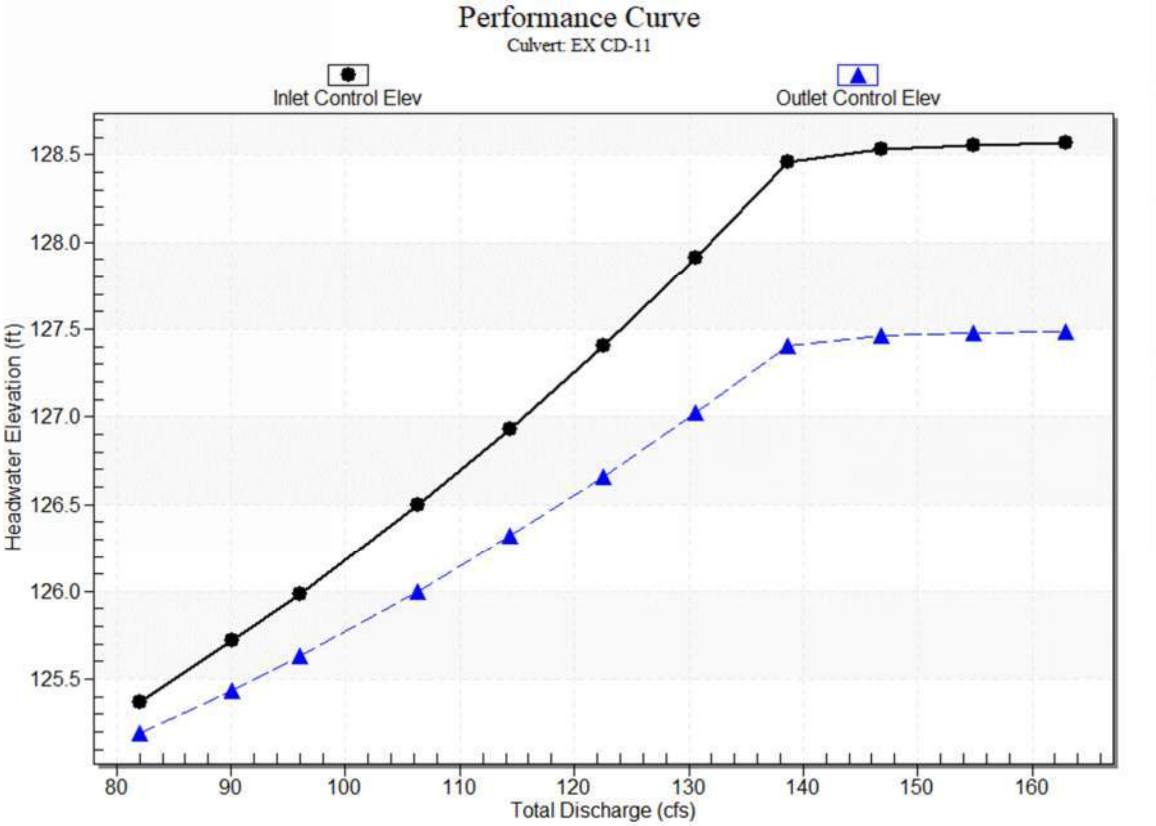
Inlet Elevation (invert): 121.00 ft,

Outlet Elevation (invert): 120.00 ft

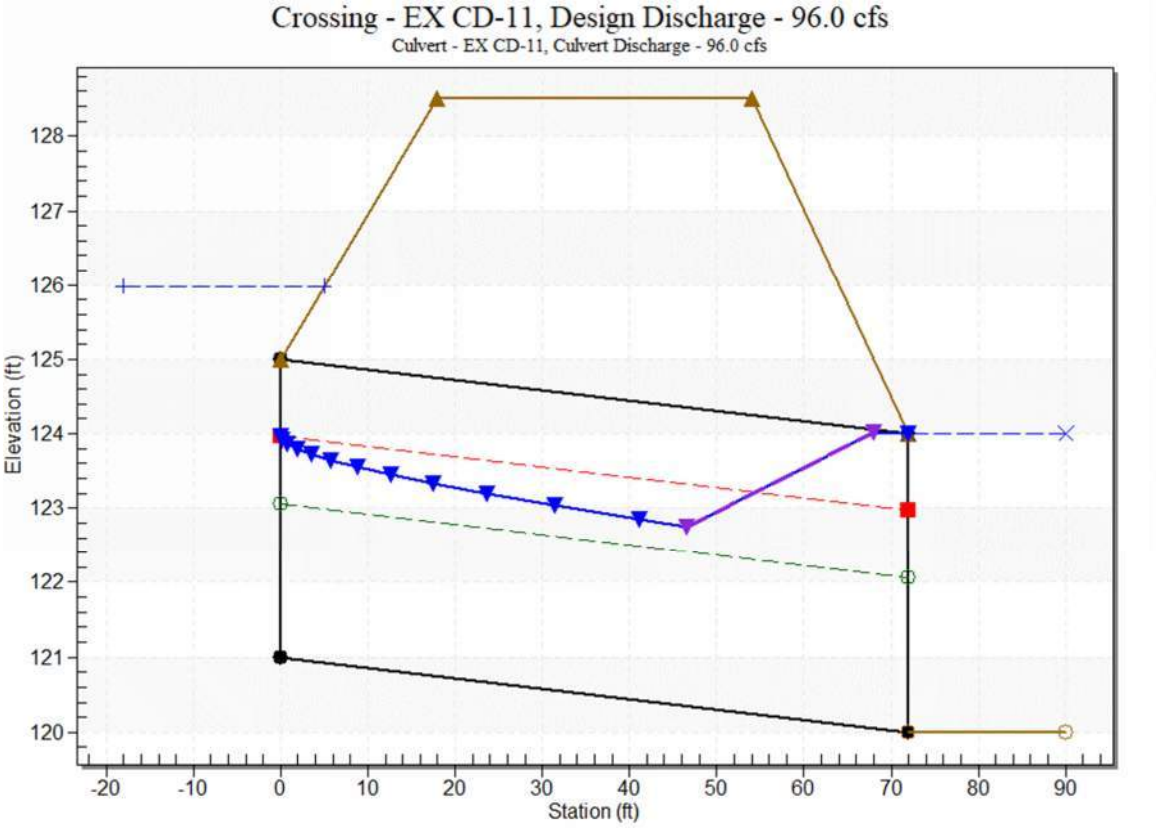
Culvert Length: 72.01 ft,

Culvert Slope: 0.0139

Culvert Performance Curve Plot: EX CD-11



Water Surface Profile Plot for Culvert: EX CD-11



Site Data - EX CD-11

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 121.00 ft

Outlet Station: 72.00 ft

Outlet Elevation: 120.00 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-11

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-11

Table 60 - Downstream Channel Rating Curve (Crossing: EX CD-11)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
82.00	124.00	4.00
90.10	124.00	4.00
96.00	124.00	4.00
106.30	124.00	4.00
114.40	124.00	4.00
122.50	124.00	4.00
130.60	124.00	4.00
138.70	124.00	4.00
146.80	124.00	4.00
154.90	124.00	4.00
163.00	124.00	4.00

Tailwater Channel Data - EX CD-11

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 124.00 ft

Roadway Data for Crossing: EX CD-11

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 400.00 ft

Crest Elevation: 128.50 ft

Roadway Surface: Paved

Roadway Top Width: 36.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 82.00 cfs

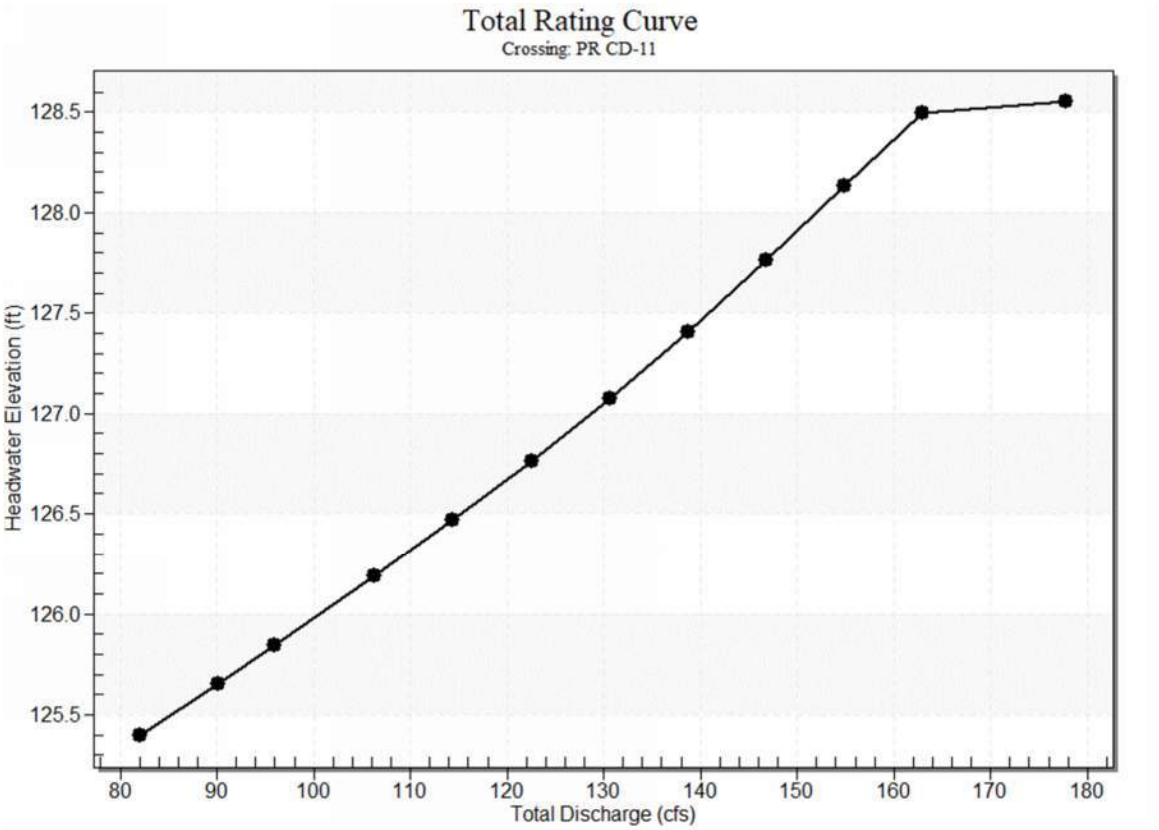
Design Flow: 96.00 cfs

Maximum Flow: 163.00 cfs

Table 61 - Summary of Culvert Flows at Crossing: PR CD-11

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-11 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
125.40	82.00	82.00	0.00	1
125.66	90.10	90.10	0.00	1
125.85	96.00	96.00	0.00	1
126.19	106.30	106.30	0.00	1
126.47	114.40	114.40	0.00	1
126.76	122.50	122.50	0.00	1
127.08	130.60	130.60	0.00	1
127.41	138.70	138.70	0.00	1
127.76	146.80	146.80	0.00	1
128.13	154.90	154.90	0.00	1
128.50	163.00	162.38	0.00	60
128.50	162.40	162.40	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-11



Culvert Data: PR CD-11

Table 62 - Culvert Summary Table: PR CD-11

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
82.00 cfs	82.00 cfs	125.40	4.00	3.411	1-JS1t	1.77	2.65	4.40	4.40	5.19	0.00
90.10 cfs	90.10 cfs	125.66	4.26	3.579	1-JS1t	1.86	2.78	4.40	4.40	5.70	0.00
96.00 cfs	96.00 cfs	125.85	4.45	3.711	1-JS1t	1.93	2.88	4.40	4.40	6.07	0.00
106.30 cfs	106.30 cfs	126.19	4.79	3.962	5-JS1t	2.04	3.03	4.40	4.40	6.72	0.00
114.40 cfs	114.40 cfs	126.47	5.07	4.178	5-S2n	2.13	3.15	2.32	4.40	13.87	0.00
122.50 cfs	122.50 cfs	126.76	5.36	4.409	5-S2n	2.22	3.26	2.41	4.40	14.10	0.00
130.60 cfs	130.60 cfs	127.08	5.68	4.656	5-S2n	2.30	3.36	2.51	4.40	14.32	0.00
138.70 cfs	138.70 cfs	127.41	6.01	4.919	5-S2n	2.39	3.46	2.61	4.40	14.53	0.00
146.80 cfs	146.80 cfs	127.76	6.36	5.198	5-S2n	2.47	3.56	2.70	4.40	14.74	0.00
154.90 cfs	154.90 cfs	128.13	6.73	5.493	5-S2n	2.56	3.65	2.79	4.40	14.94	0.00
163.00 cfs	162.38 cfs	128.50	7.10	5.779	5-S2n	2.63	3.72	2.88	4.40	15.12	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

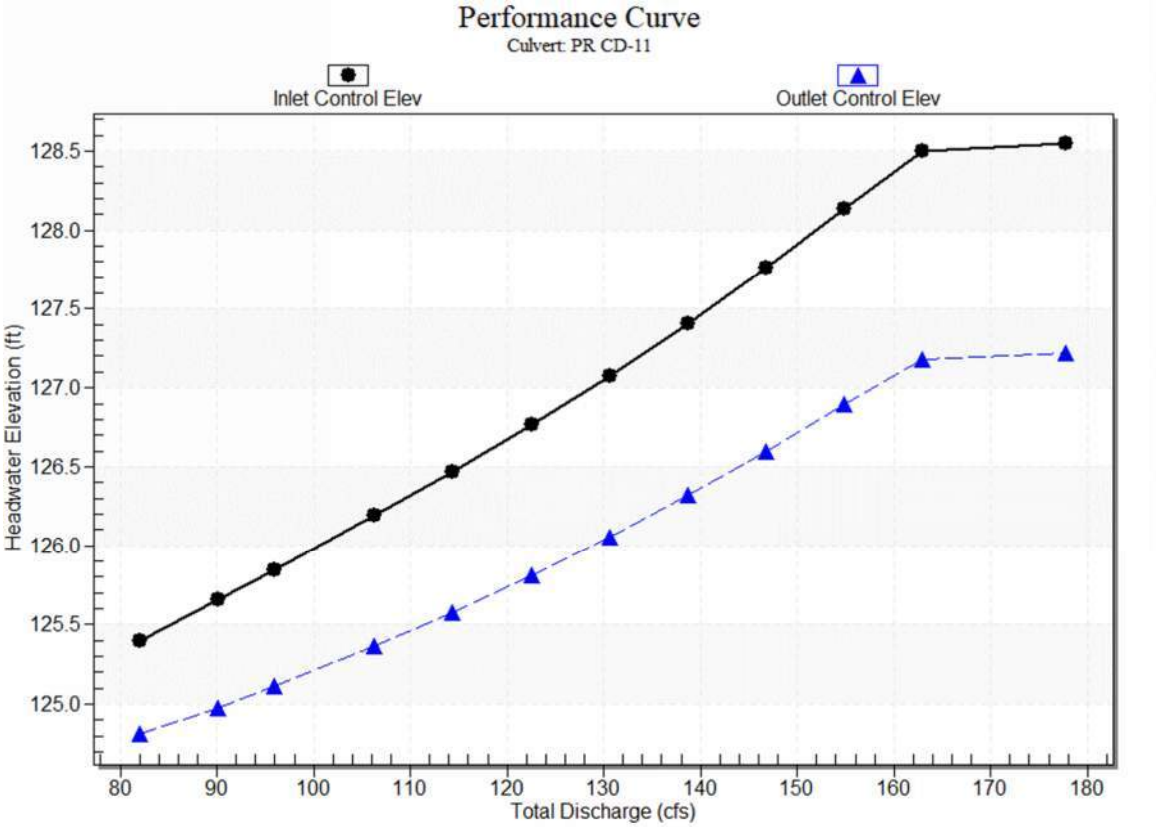
Inlet Elevation (invert): 121.40 ft,

Outlet Elevation (invert): 119.60 ft

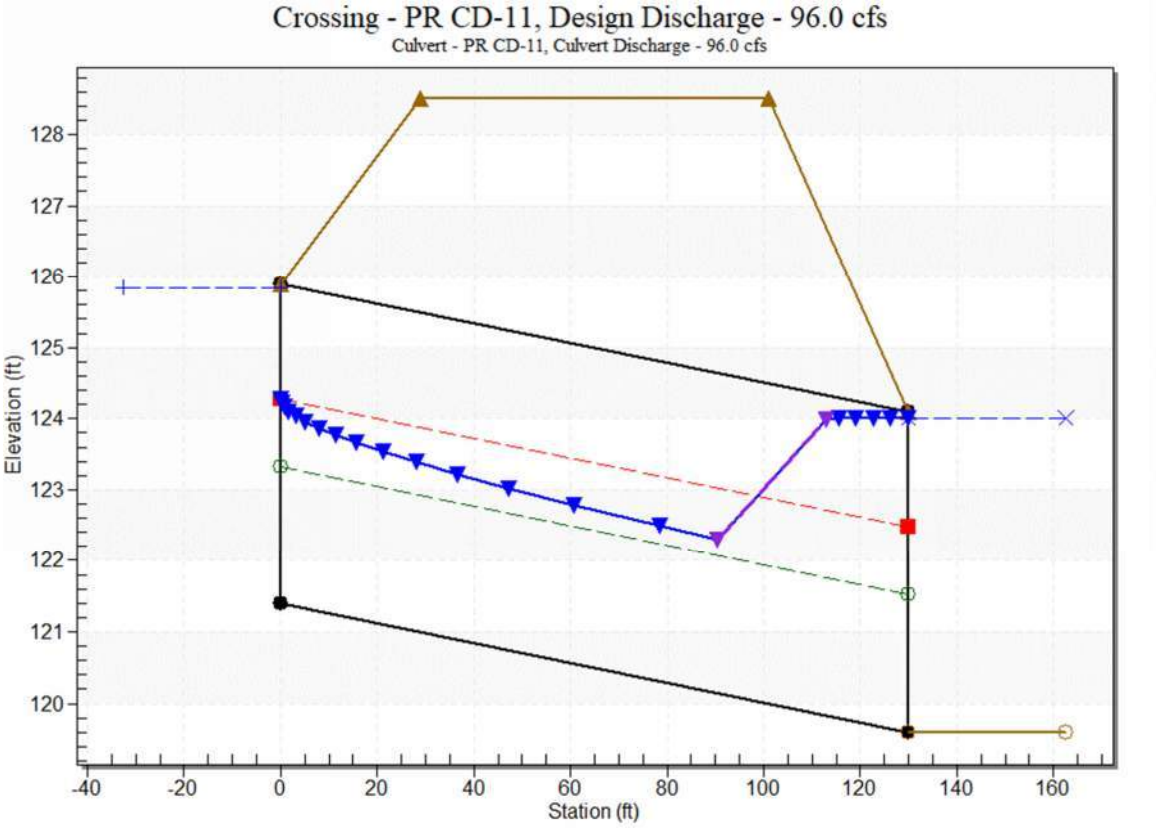
Culvert Length: 130.01 ft,

Culvert Slope: 0.0138

Culvert Performance Curve Plot: PR CD-11



Water Surface Profile Plot for Culvert: PR CD-11



Site Data - PR CD-11

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 121.40 ft

Outlet Station: 130.00 ft

Outlet Elevation: 119.60 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-11

Barrel Shape: Circular

Barrel Diameter: 4.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-11

Table 63 - Downstream Channel Rating Curve (Crossing: PR CD-11)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
82.00	124.00	4.40
90.10	124.00	4.40
96.00	124.00	4.40
106.30	124.00	4.40
114.40	124.00	4.40
122.50	124.00	4.40
130.60	124.00	4.40
138.70	124.00	4.40
146.80	124.00	4.40
154.90	124.00	4.40
163.00	124.00	4.40

Tailwater Channel Data - PR CD-11

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 124.00 ft

Roadway Data for Crossing: PR CD-11

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 400.00 ft

Crest Elevation: 128.50 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 64.00 cfs

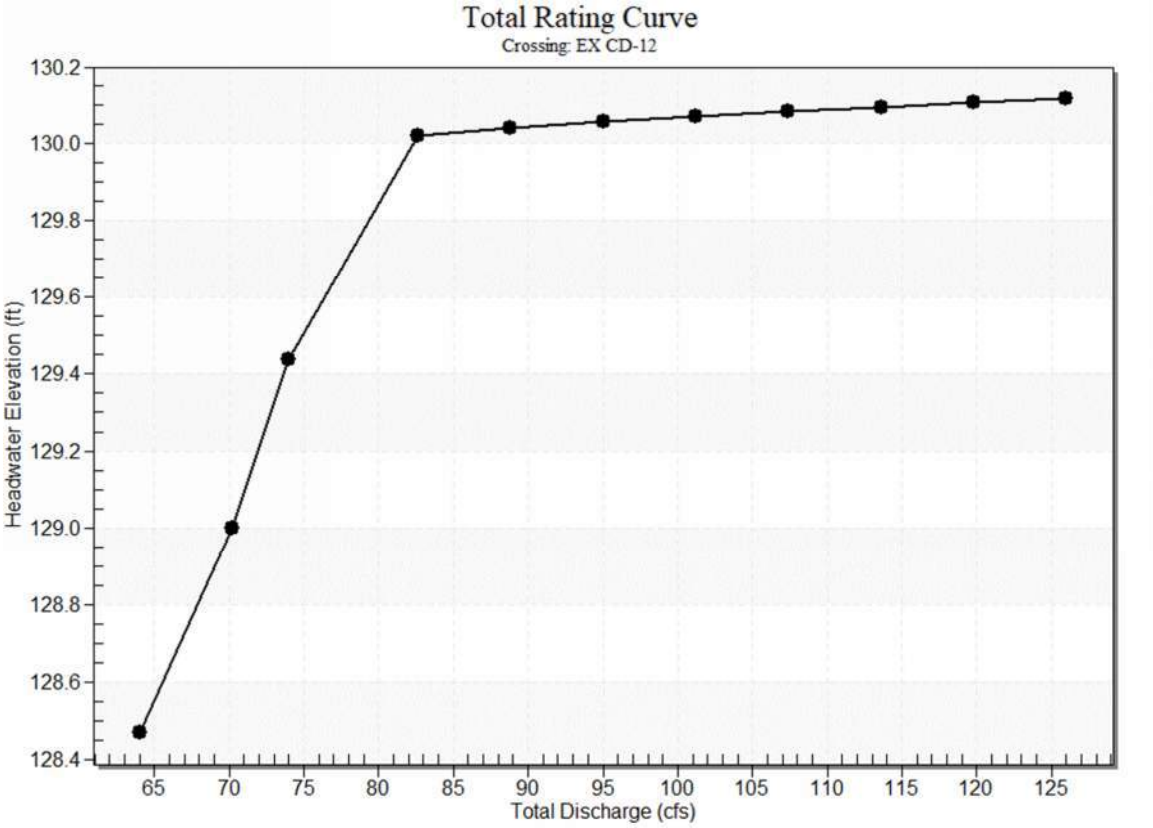
Design Flow: 74.00 cfs

Maximum Flow: 126.00 cfs

Table 64 - Summary of Culvert Flows at Crossing: EX CD-12

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-12 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
128.47	64.00	64.00	0.00	1
129.00	70.20	70.20	0.00	1
129.44	74.00	74.00	0.00	1
130.02	82.60	78.75	3.27	34
130.04	88.80	78.91	9.52	5
130.06	95.00	79.04	15.57	4
130.07	101.20	79.15	21.81	4
130.08	107.40	79.24	27.63	3
130.09	113.60	79.33	33.79	3
130.10	119.80	79.42	40.02	3
130.12	126.00	79.50	46.24	3
130.00	78.59	78.59	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-12



Culvert Data: EX CD-12

Table 65 - Culvert Summary Table: EX CD-12

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
64.00 cfs	64.00 cfs	128.47	5.24	5.371	4-FFf	3.00	2.57	3.00	3.00	9.05	0.00
70.20 cfs	70.20 cfs	129.00	5.90	5.873	4-FFf	3.00	2.66	3.00	3.00	9.93	0.00
74.00 cfs	74.00 cfs	129.44	6.34	6.204	4-FFf	3.00	2.71	3.00	3.00	10.47	0.00
82.60 cfs	78.75 cfs	130.02	6.92	6.641	4-FFf	3.00	2.76	3.00	3.00	11.14	0.00
88.80 cfs	78.91 cfs	130.04	6.94	6.657	4-FFf	3.00	2.76	3.00	3.00	11.16	0.00
95.00 cfs	79.04 cfs	130.06	6.96	6.669	4-FFf	3.00	2.76	3.00	3.00	11.18	0.00
101.20 cfs	79.15 cfs	130.07	6.97	6.679	4-FFf	3.00	2.76	3.00	3.00	11.20	0.00
107.40 cfs	79.24 cfs	130.08	6.98	6.688	4-FFf	3.00	2.76	3.00	3.00	11.21	0.00
113.60 cfs	79.33 cfs	130.09	6.99	6.697	4-FFf	3.00	2.76	3.00	3.00	11.22	0.00
119.80 cfs	79.42 cfs	130.10	7.00	6.705	4-FFf	3.00	2.76	3.00	3.00	11.24	0.00
126.00 cfs	79.50 cfs	130.12	7.02	6.713	4-FFf	3.00	2.77	3.00	3.00	11.25	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

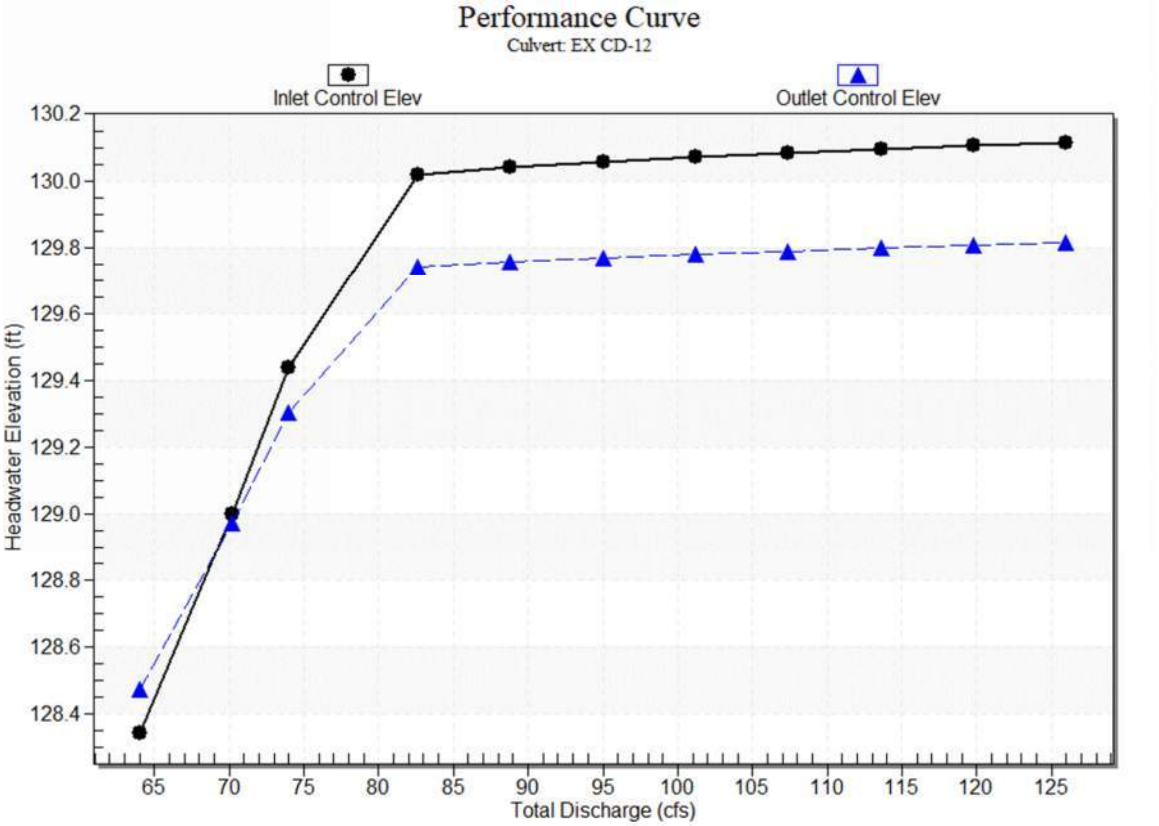
Inlet Elevation (invert): 123.10 ft,

Outlet Elevation (invert): 123.00 ft

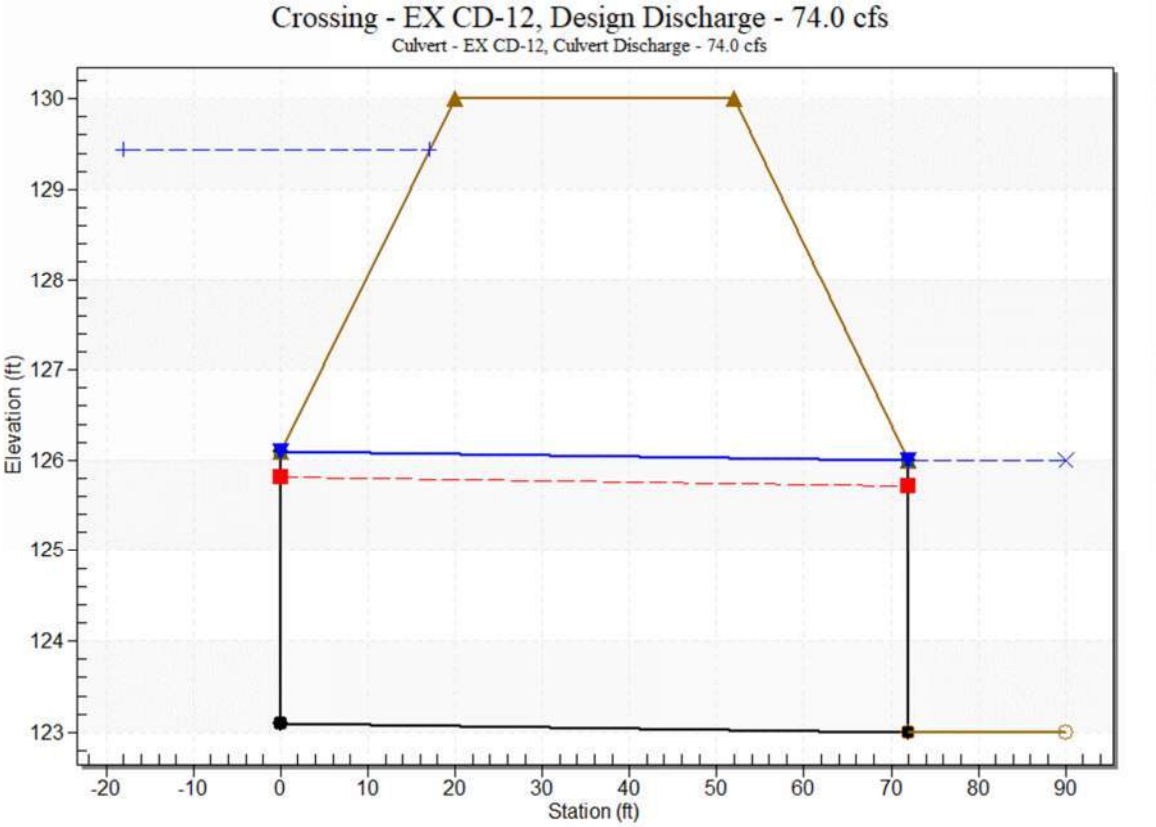
Culvert Length: 72.00 ft,

Culvert Slope: 0.0014

Culvert Performance Curve Plot: EX CD-12



Water Surface Profile Plot for Culvert: EX CD-12



Site Data - EX CD-12

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 123.10 ft

Outlet Station: 72.00 ft

Outlet Elevation: 123.00 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-12

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-12

Table 66 - Downstream Channel Rating Curve (Crossing: EX CD-12)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
64.00	126.00	3.00
70.20	126.00	3.00
74.00	126.00	3.00
82.60	126.00	3.00
88.80	126.00	3.00
95.00	126.00	3.00
101.20	126.00	3.00
107.40	126.00	3.00
113.60	126.00	3.00
119.80	126.00	3.00
126.00	126.00	3.00

Tailwater Channel Data - EX CD-12

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 126.00 ft

Roadway Data for Crossing: EX CD-12

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 400.00 ft

Crest Elevation: 130.00 ft

Roadway Surface: Paved

Roadway Top Width: 32.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 64.00 cfs

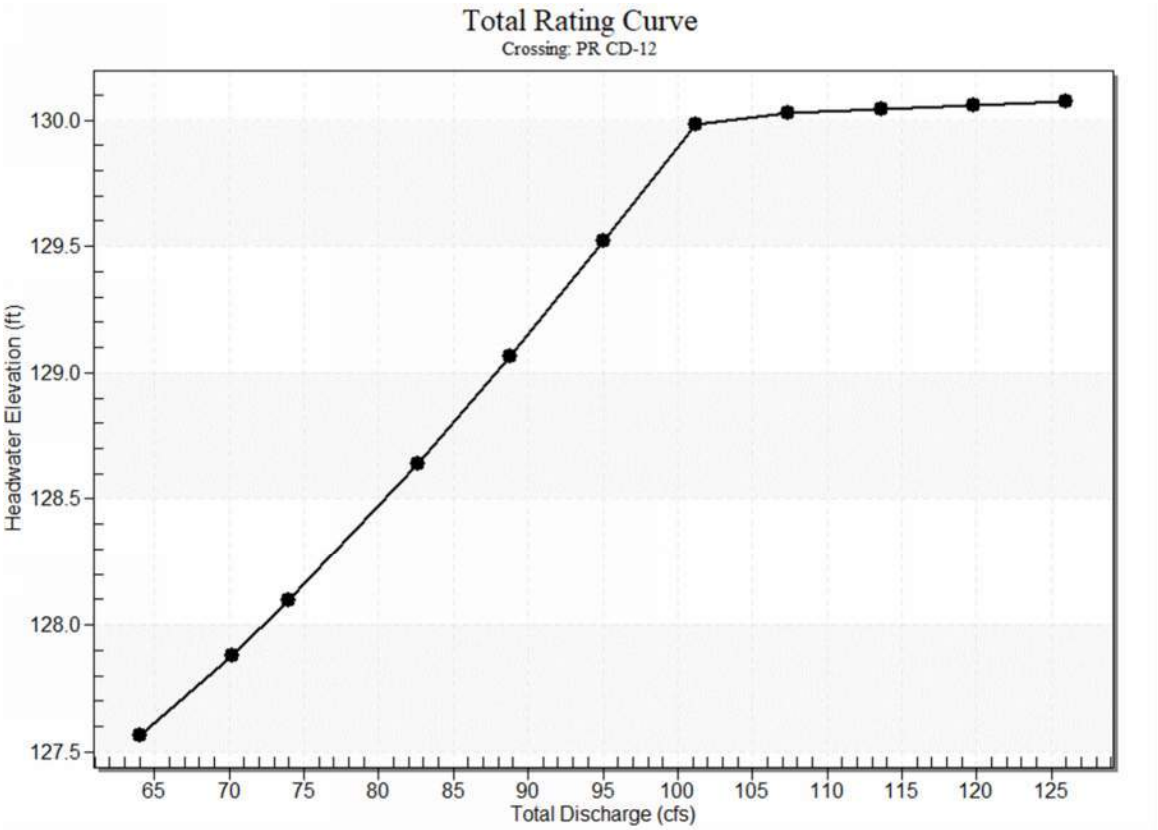
Design Flow: 74.00 cfs

Maximum Flow: 126.00 cfs

Table 67 - Summary of Culvert Flows at Crossing: PR CD-12

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-12 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
127.57	64.00	64.00	0.00	1
127.88	70.20	70.20	0.00	1
128.10	74.00	74.00	0.00	1
128.64	82.60	82.60	0.00	1
129.06	88.80	88.80	0.00	1
129.52	95.00	95.00	0.00	1
129.98	101.20	100.68	0.00	84
130.03	107.40	101.35	5.69	8
130.05	113.60	101.59	11.44	4
130.06	119.80	101.80	17.65	4
130.07	126.00	101.98	23.35	3
130.00	100.95	100.95	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-12



Culvert Data: PR CD-12

Table 68 - Culvert Summary Table: PR CD-12

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
64.00 cfs	64.00 cfs	127.57	4.12	4.415	3-M2t	3.50	2.51	3.05	3.05	7.19	0.00
70.20 cfs	70.20 cfs	127.88	4.47	4.727	3-M2t	3.50	2.63	3.05	3.05	7.89	0.00
74.00 cfs	74.00 cfs	128.10	4.70	4.947	7-M2t	3.50	2.69	3.05	3.05	8.32	0.00
82.60 cfs	82.60 cfs	128.64	5.26	5.489	7-M2t	3.50	2.84	3.05	3.05	9.28	0.00
88.80 cfs	88.80 cfs	129.06	5.70	5.914	7-M2t	3.50	2.93	3.05	3.05	9.98	0.00
95.00 cfs	95.00 cfs	129.52	6.19	6.369	7-M2t	3.50	3.01	3.05	3.05	10.68	0.00
101.20 cfs	100.68 cfs	129.98	6.66	6.831	7-M2c	3.50	3.08	3.08	3.05	11.24	0.00
107.40 cfs	101.35 cfs	130.03	6.72	6.879	7-M2c	3.50	3.08	3.08	3.05	11.29	0.00
113.60 cfs	101.59 cfs	130.05	6.74	6.896	7-M2c	3.50	3.09	3.09	3.05	11.31	0.00
119.80 cfs	101.80 cfs	130.06	6.76	6.911	7-M2c	3.50	3.09	3.09	3.05	11.33	0.00
126.00 cfs	101.98 cfs	130.07	6.77	6.923	7-M2c	3.50	3.09	3.09	3.05	11.34	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

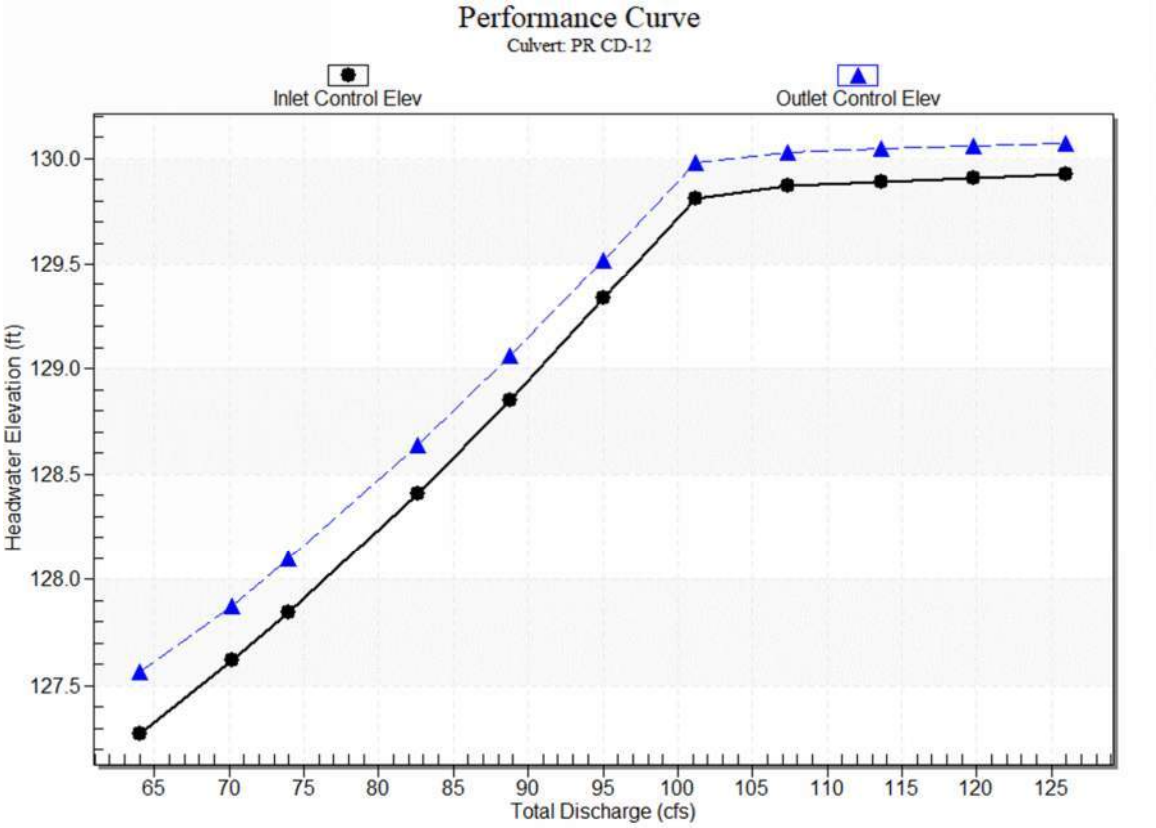
Inlet Elevation (invert): 123.15 ft,

Outlet Elevation (invert): 122.95 ft

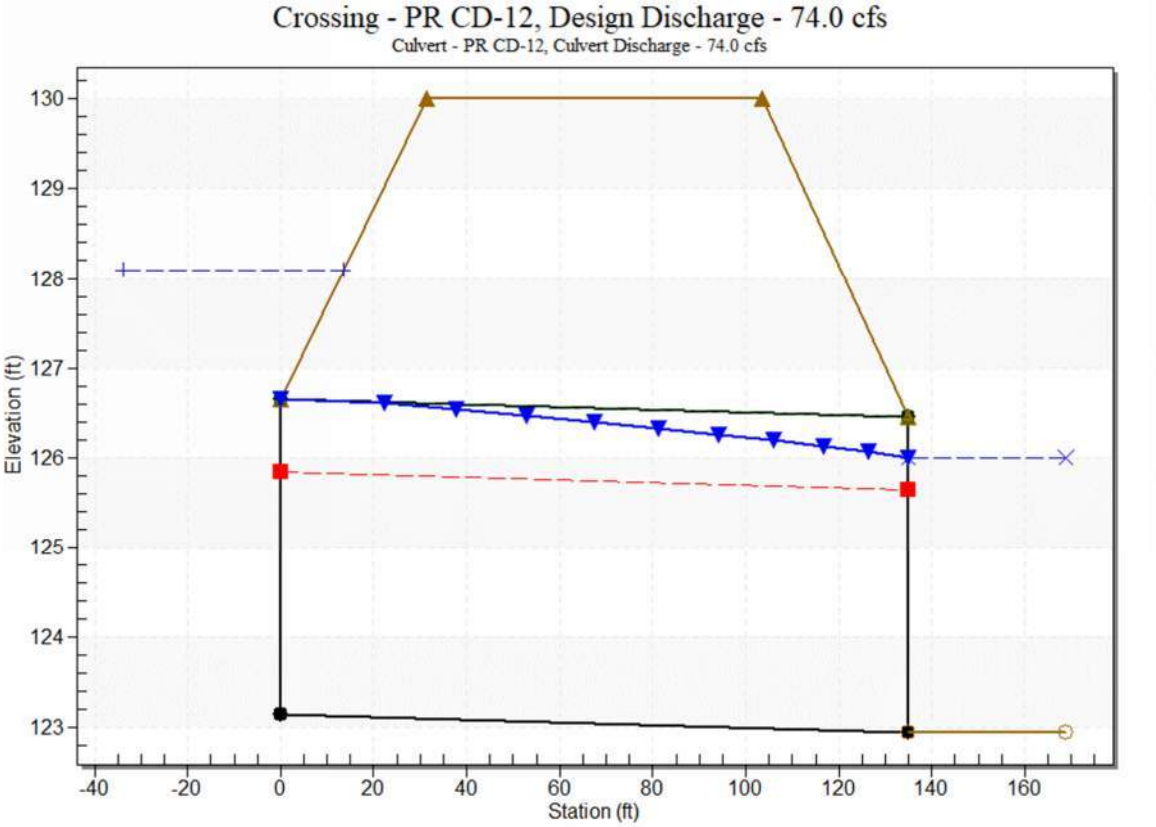
Culvert Length: 135.00 ft,

Culvert Slope: 0.0015

Culvert Performance Curve Plot: PR CD-12



Water Surface Profile Plot for Culvert: PR CD-12



Site Data - PR CD-12

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 123.15 ft

Outlet Station: 135.00 ft

Outlet Elevation: 122.95 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-12

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-12

Table 69 - Downstream Channel Rating Curve (Crossing: PR CD-12)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
64.00	126.00	3.05
70.20	126.00	3.05
74.00	126.00	3.05
82.60	126.00	3.05
88.80	126.00	3.05
95.00	126.00	3.05
101.20	126.00	3.05
107.40	126.00	3.05
113.60	126.00	3.05
119.80	126.00	3.05
126.00	126.00	3.05

Tailwater Channel Data - PR CD-12

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 126.00 ft

Roadway Data for Crossing: PR CD-12

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 400.00 ft

Crest Elevation: 130.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 87.00 cfs

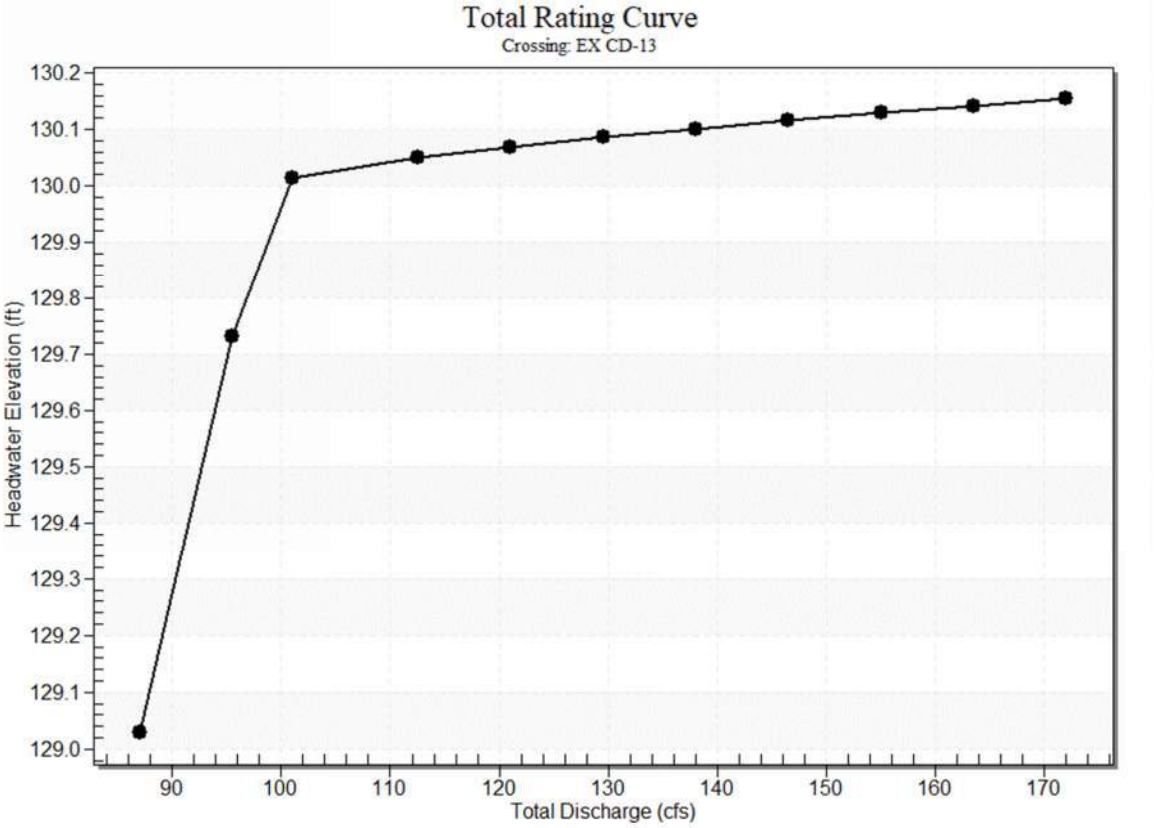
Design Flow: 101.00 cfs

Maximum Flow: 172.00 cfs

Table 13 - Summary of Culvert Flows at Crossing: EX CD-13

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-13 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
129.03	87.00	87.00	0.00	1
129.73	95.50	95.50	0.00	1
130.01	101.00	98.71	1.76	39
130.05	112.50	99.12	13.04	6
130.07	121.00	99.34	21.15	4
130.09	129.50	99.53	29.65	4
130.10	138.00	99.69	37.58	3
130.12	146.50	99.85	46.00	3
130.13	155.00	100.00	54.52	3
130.14	163.50	100.15	63.01	3
130.15	172.00	100.28	71.46	3
130.00	98.56	98.56	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-13



Culvert Data: EX CD-13

Table 14 - Culvert Summary Table: EX CD-13

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
87.00 cfs	87.00 cfs	129.03	4.71	4.687	4-FFf	2.00	1.85	2.00	2.00	9.23	0.00
95.50 cfs	95.50 cfs	129.73	5.41	5.299	4-FFf	2.00	1.89	2.00	2.00	10.13	0.00
101.00 cfs	98.71 cfs	130.01	5.69	5.546	4-FFf	2.00	1.90	2.00	2.00	10.47	0.00
112.50 cfs	99.12 cfs	130.05	5.73	5.578	4-FFf	2.00	1.90	2.00	2.00	10.52	0.00
121.00 cfs	99.34 cfs	130.07	5.75	5.594	4-FFf	2.00	1.90	2.00	2.00	10.54	0.00
129.50 cfs	99.53 cfs	130.09	5.77	5.610	4-FFf	2.00	1.90	2.00	2.00	10.56	0.00
138.00 cfs	99.69 cfs	130.10	5.78	5.622	4-FFf	2.00	1.90	2.00	2.00	10.58	0.00
146.50 cfs	99.85 cfs	130.12	5.80	5.635	4-FFf	2.00	1.90	2.00	2.00	10.59	0.00
155.00 cfs	100.00 cfs	130.13	5.81	5.647	4-FFf	2.00	1.90	2.00	2.00	10.61	0.00
163.50 cfs	100.15 cfs	130.14	5.82	5.658	4-FFf	2.00	1.91	2.00	2.00	10.63	0.00
172.00 cfs	100.28 cfs	130.15	5.83	5.669	4-FFf	2.00	1.91	2.00	2.00	10.64	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

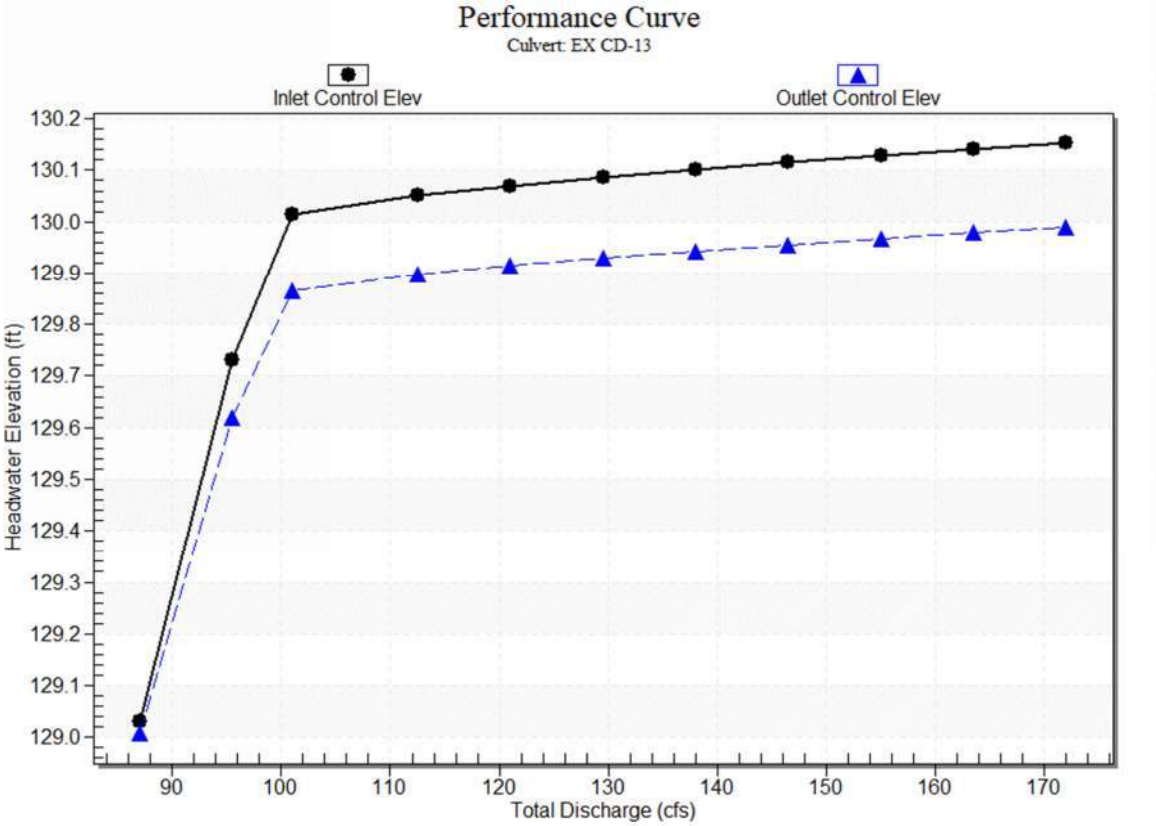
Inlet Elevation (invert): 124.32 ft,

Outlet Elevation (invert): 124.02 ft

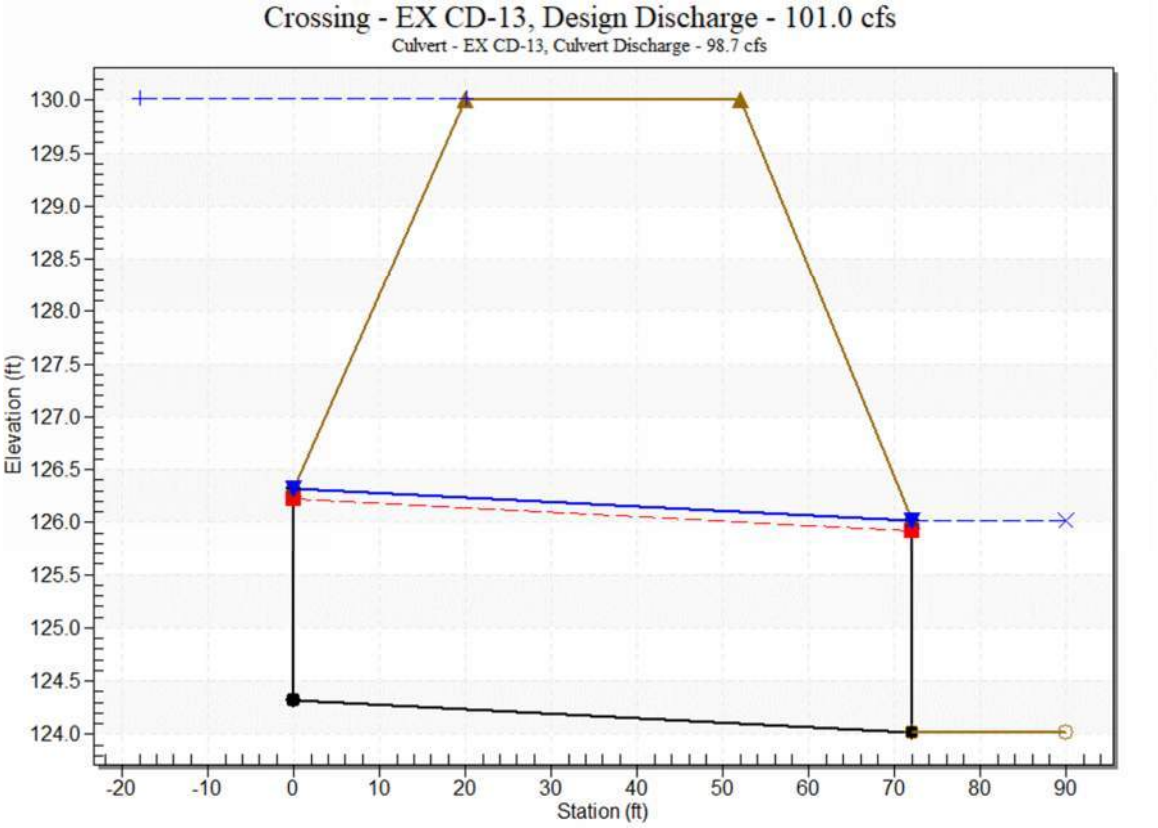
Culvert Length: 72.00 ft,

Culvert Slope: 0.0042

Culvert Performance Curve Plot: EX CD-13



Water Surface Profile Plot for Culvert: EX CD-13



Site Data - EX CD-13

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 124.32 ft

Outlet Station: 72.00 ft

Outlet Elevation: 124.02 ft

Number of Barrels: 3

Culvert Data Summary - EX CD-13

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-13

Table 15 - Downstream Channel Rating Curve (Crossing: EX CD-13)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
87.00	126.02	2.00
95.50	126.02	2.00
101.00	126.02	2.00
112.50	126.02	2.00
121.00	126.02	2.00
129.50	126.02	2.00
138.00	126.02	2.00
146.50	126.02	2.00
155.00	126.02	2.00
163.50	126.02	2.00
172.00	126.02	2.00

Tailwater Channel Data - EX CD-13

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 126.02 ft

Roadway Data for Crossing: EX CD-13

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 400.00 ft

Crest Elevation: 130.00 ft

Roadway Surface: Paved

Roadway Top Width: 32.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 87.00 cfs

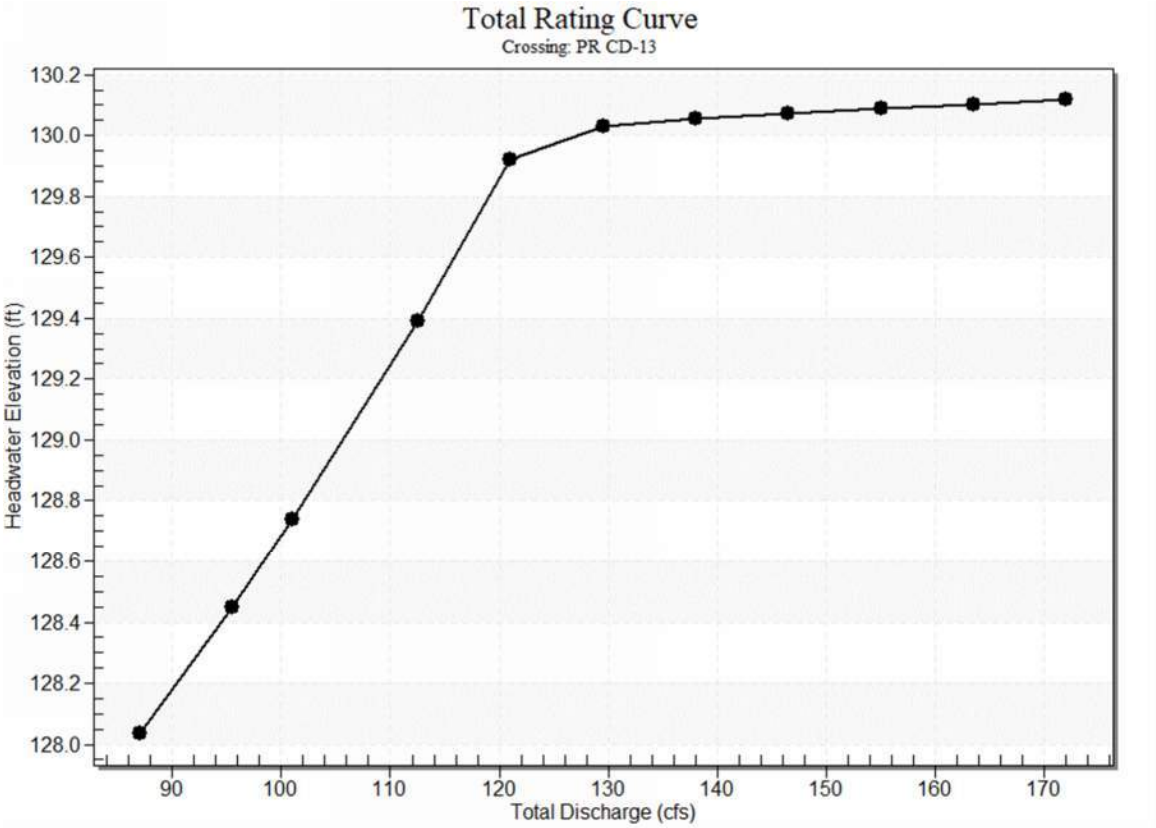
Design Flow: 101.00 cfs

Maximum Flow: 172.00 cfs

Table 16 - Summary of Culvert Flows at Crossing: PR CD-13

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-13 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
128.04	87.00	87.00	0.00	1
128.45	95.50	95.50	0.00	1
128.74	101.00	101.00	0.00	1
129.39	112.50	112.50	0.00	1
129.92	121.00	121.00	0.00	1
130.03	129.50	122.68	6.35	12
130.05	138.00	123.03	14.59	5
130.07	146.50	123.31	22.72	4
130.09	155.00	123.57	31.14	4
130.10	163.50	123.79	39.04	3
130.12	172.00	124.00	47.40	3
130.00	122.21	122.21	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-13



Culvert Data: PR CD-13

Table 17 - Culvert Summary Table: PR CD-13

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
87.00 cfs	87.00 cfs	128.04	3.23	3.567	4-FFf	2.00	1.67	2.00	2.00	6.92	0.00
95.50 cfs	95.50 cfs	128.45	3.61	3.980	4-FFf	2.00	1.73	2.00	2.00	7.60	0.00
101.00 cfs	101.00 cfs	128.74	3.88	4.268	4-FFf	2.00	1.77	2.00	2.00	8.04	0.00
112.50 cfs	112.50 cfs	129.39	4.51	4.923	4-FFf	2.00	1.83	2.00	2.00	8.95	0.00
121.00 cfs	121.00 cfs	129.92	5.01	5.452	4-FFf	2.00	1.87	2.00	2.00	9.63	0.00
129.50 cfs	122.68 cfs	130.03	5.12	5.561	4-FFf	2.00	1.87	2.00	2.00	9.76	0.00
138.00 cfs	123.03 cfs	130.05	5.14	5.584	4-FFf	2.00	1.87	2.00	2.00	9.79	0.00
146.50 cfs	123.31 cfs	130.07	5.16	5.602	4-FFf	2.00	1.87	2.00	2.00	9.81	0.00
155.00 cfs	123.57 cfs	130.09	5.17	5.619	4-FFf	2.00	1.88	2.00	2.00	9.83	0.00
163.50 cfs	123.79 cfs	130.10	5.18	5.633	4-FFf	2.00	1.88	2.00	2.00	9.85	0.00
172.00 cfs	124.00 cfs	130.12	5.20	5.648	4-FFf	2.00	1.88	2.00	2.00	9.87	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

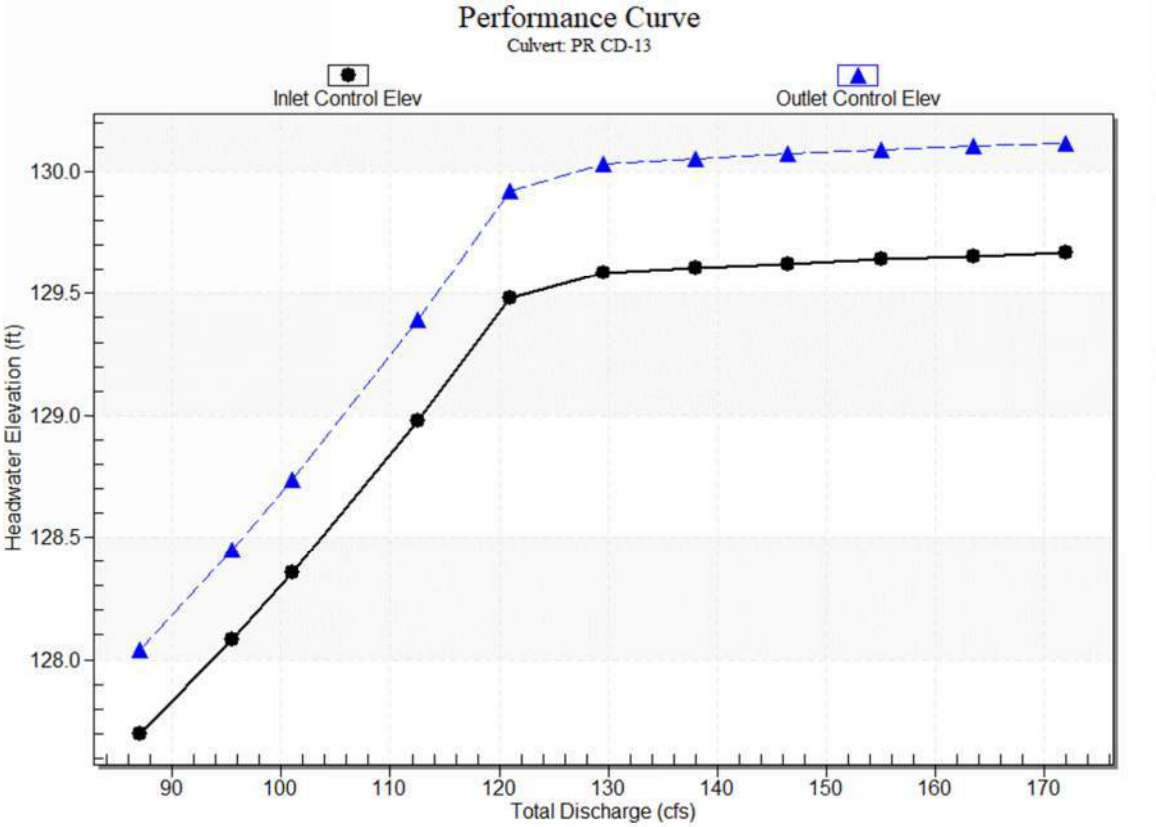
Inlet Elevation (invert): 124.47 ft,

Outlet Elevation (invert): 123.99 ft

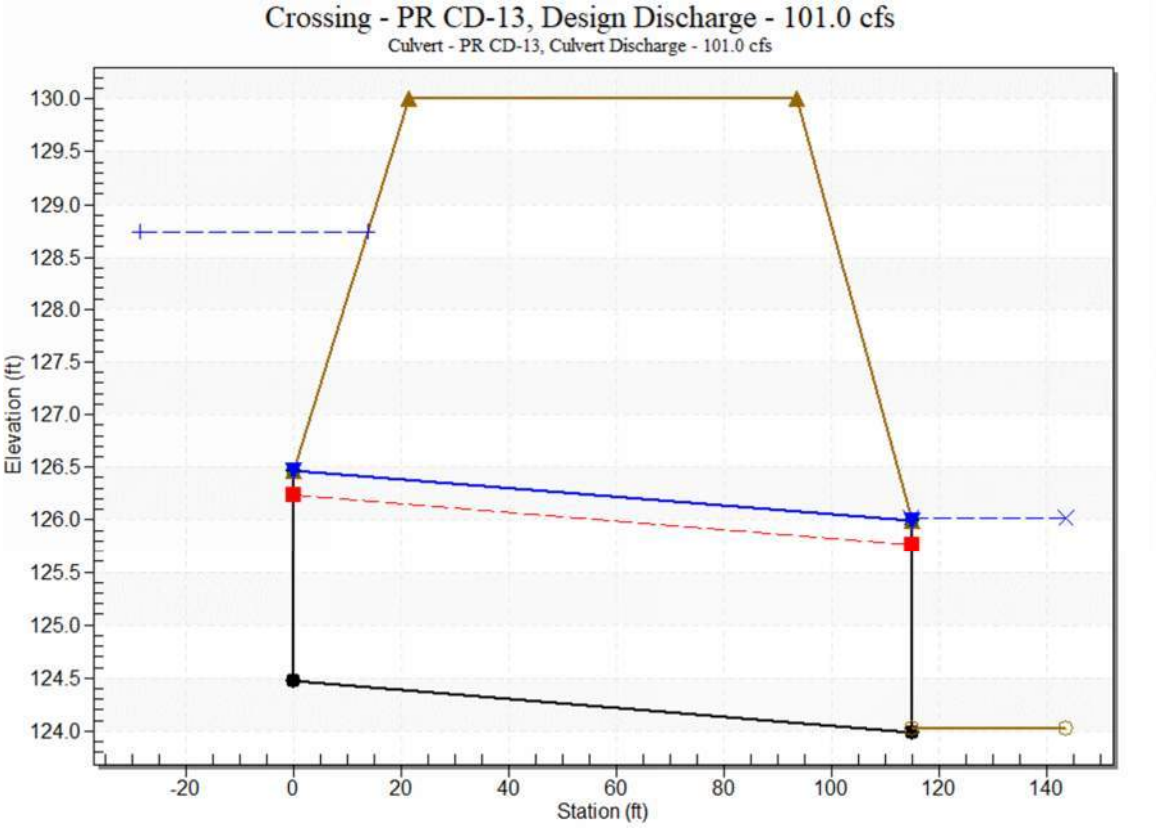
Culvert Length: 115.00 ft,

Culvert Slope: 0.0042

Culvert Performance Curve Plot: PR CD-13



Water Surface Profile Plot for Culvert: PR CD-13



Site Data - PR CD-13

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 124.47 ft

Outlet Station: 115.00 ft

Outlet Elevation: 123.99 ft

Number of Barrels: 4

Culvert Data Summary - PR CD-13

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-13

Table 18 - Downstream Channel Rating Curve (Crossing: PR CD-13)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
87.00	126.02	2.00
95.50	126.02	2.00
101.00	126.02	2.00
112.50	126.02	2.00
121.00	126.02	2.00
129.50	126.02	2.00
138.00	126.02	2.00
146.50	126.02	2.00
155.00	126.02	2.00
163.50	126.02	2.00
172.00	126.02	2.00

Tailwater Channel Data - PR CD-13

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 126.02 ft

Roadway Data for Crossing: PR CD-13

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 400.00 ft

Crest Elevation: 130.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 30.00 cfs

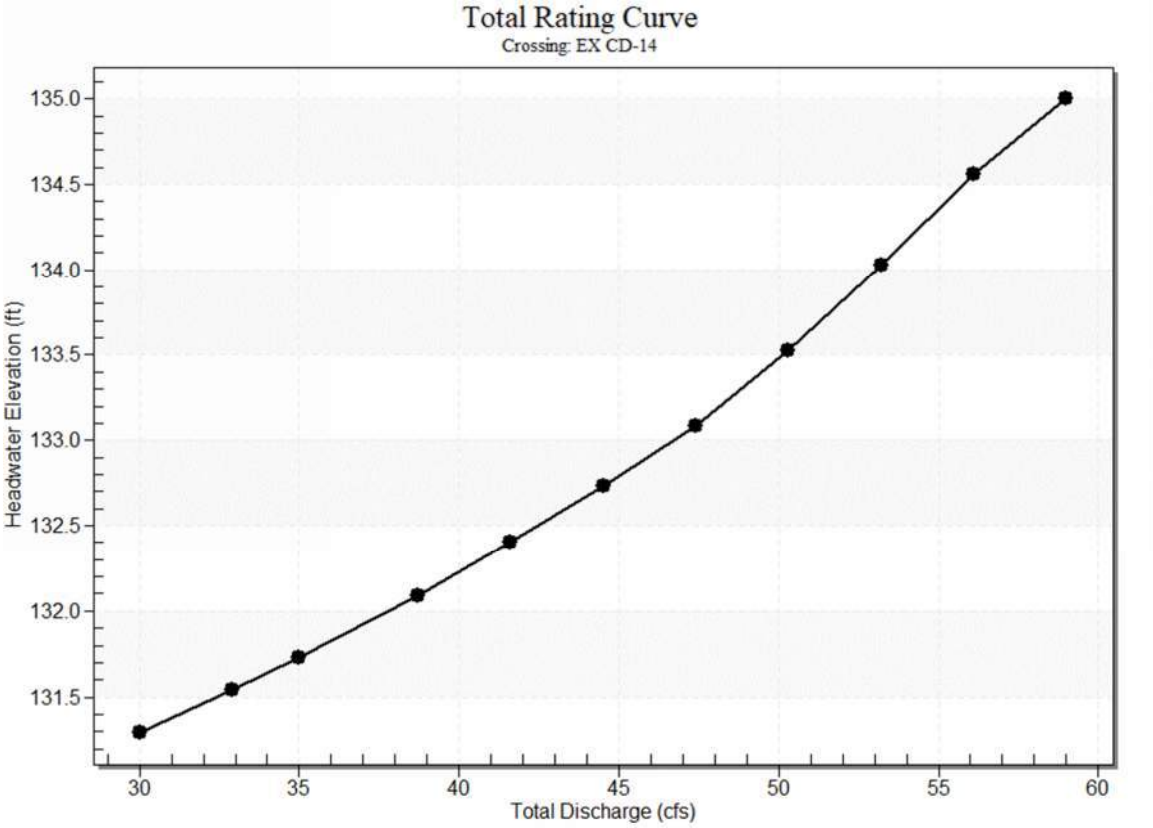
Design Flow: 35.00 cfs

Maximum Flow: 59.00 cfs

Table 76 - Summary of Culvert Flows at Crossing: EX CD-14

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-14 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
131.30	30.00	30.00	0.00	1
131.54	32.90	32.90	0.00	1
131.73	35.00	35.00	0.00	1
132.09	38.70	38.70	0.00	1
132.40	41.60	41.60	0.00	1
132.73	44.50	44.50	0.00	1
133.09	47.40	47.40	0.00	1
133.53	50.30	50.30	0.00	1
134.03	53.20	53.20	0.00	1
134.56	56.10	56.10	0.00	1
135.00	59.00	58.41	0.00	94
135.00	58.41	58.41	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-14



Culvert Data: EX CD-14

Table 77 - Culvert Summary Table: EX CD-14

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
30.00 cfs	30.00 cfs	131.30	3.17	3.596	4-FFf	2.50	1.87	2.50	2.50	6.11	0.00
32.90 cfs	32.90 cfs	131.54	3.46	3.839	4-FFf	2.50	1.95	2.50	2.50	6.70	0.00
35.00 cfs	35.00 cfs	131.73	3.68	4.028	4-FFf	2.50	2.01	2.50	2.50	7.13	0.00
38.70 cfs	38.70 cfs	132.09	4.12	4.391	4-FFf	2.50	2.10	2.50	2.50	7.88	0.00
41.60 cfs	41.60 cfs	132.40	4.50	4.700	4-FFf	2.50	2.16	2.50	2.50	8.47	0.00
44.50 cfs	44.50 cfs	132.73	4.92	5.032	4-FFf	2.50	2.22	2.50	2.50	9.07	0.00
47.40 cfs	47.40 cfs	133.09	5.36	5.386	4-FFf	2.50	2.26	2.50	2.50	9.66	0.00
50.30 cfs	50.30 cfs	133.53	5.83	5.763	4-FFf	2.50	2.30	2.50	2.50	10.25	0.00
53.20 cfs	53.20 cfs	134.03	6.33	6.162	4-FFf	2.50	2.34	2.50	2.50	10.84	0.00
56.10 cfs	56.10 cfs	134.56	6.86	6.583	4-FFf	2.50	2.36	2.50	2.50	11.43	0.00
59.00 cfs	58.41 cfs	135.00	7.30	6.935	4-FFf	2.50	2.38	2.50	2.50	11.90	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

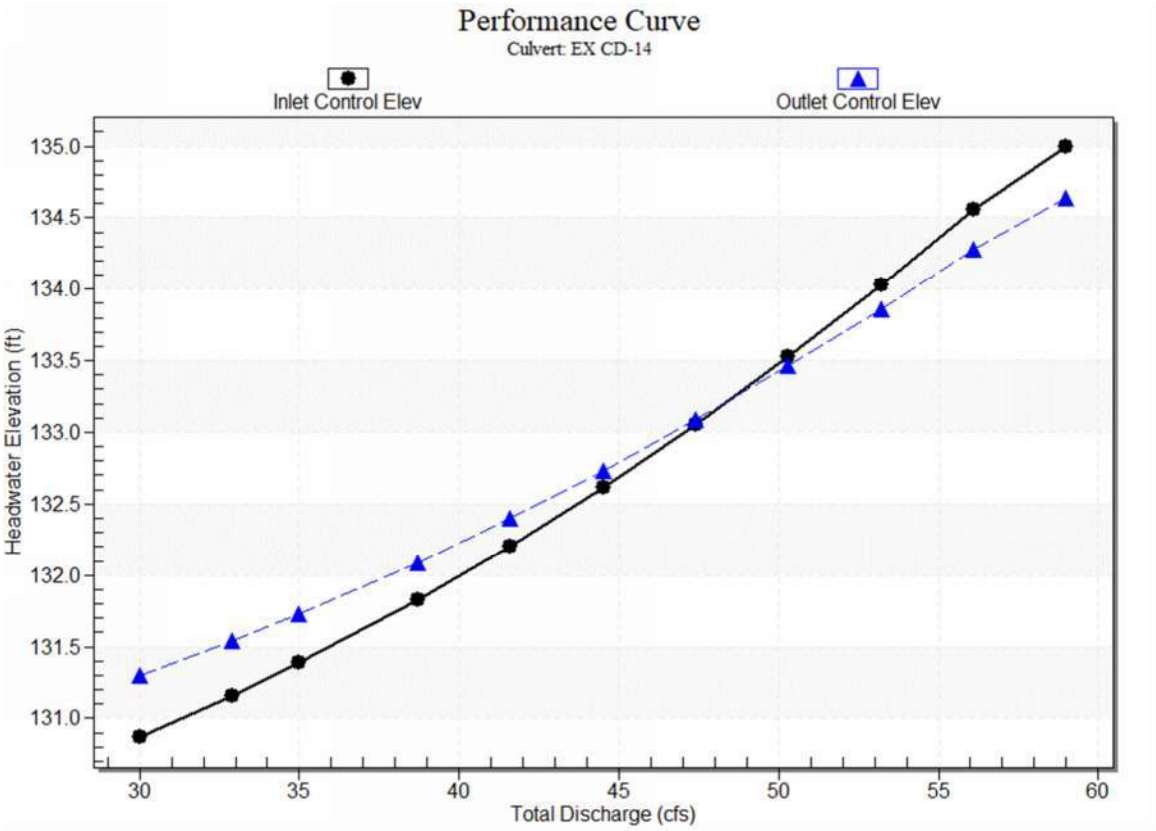
Inlet Elevation (invert): 127.70 ft,

Outlet Elevation (invert): 127.60 ft

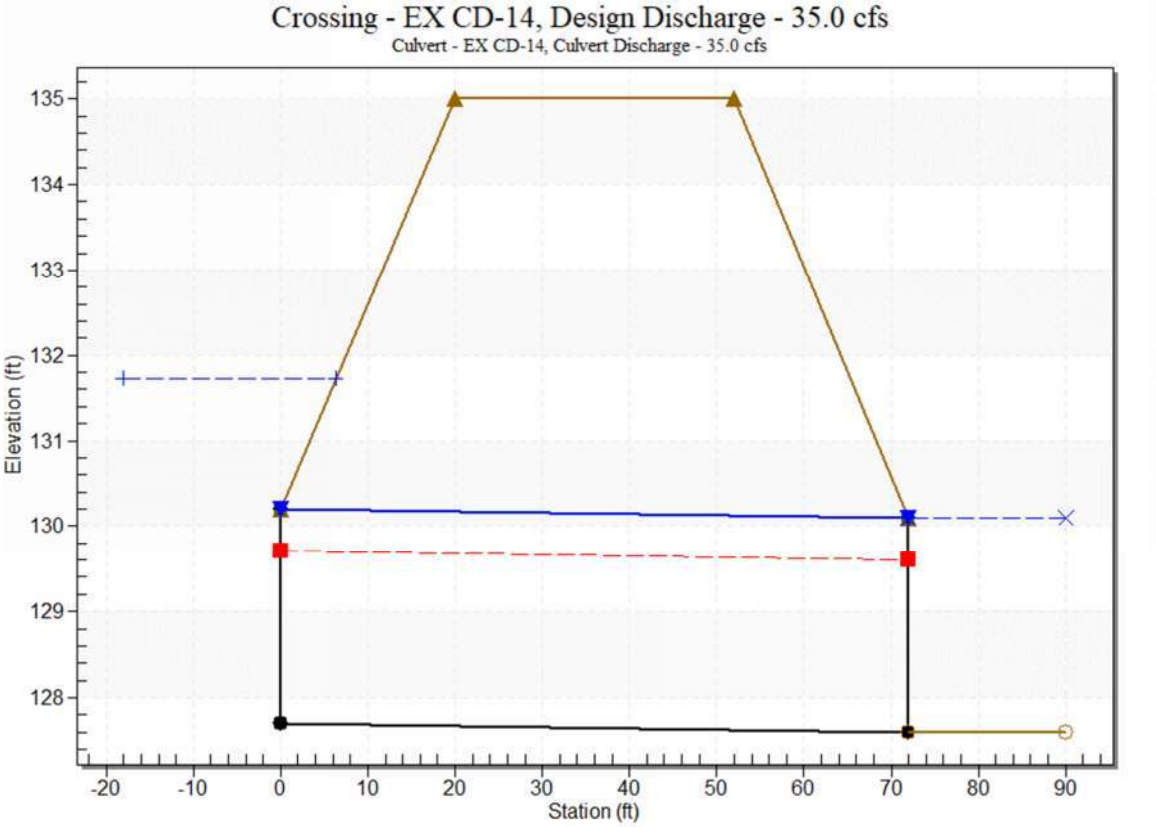
Culvert Length: 72.00 ft,

Culvert Slope: 0.0014

Culvert Performance Curve Plot: EX CD-14



Water Surface Profile Plot for Culvert: EX CD-14



Site Data - EX CD-14

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 127.70 ft

Outlet Station: 72.00 ft

Outlet Elevation: 127.60 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-14

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-14

Table 78 - Downstream Channel Rating Curve (Crossing: EX CD-14)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
30.00	130.10	2.50
32.90	130.10	2.50
35.00	130.10	2.50
38.70	130.10	2.50
41.60	130.10	2.50
44.50	130.10	2.50
47.40	130.10	2.50
50.30	130.10	2.50
53.20	130.10	2.50
56.10	130.10	2.50
59.00	130.10	2.50

Tailwater Channel Data - EX CD-14

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 130.10 ft

Roadway Data for Crossing: EX CD-14

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 800.00 ft

Crest Elevation: 135.00 ft

Roadway Surface: Paved

Roadway Top Width: 32.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 30.00 cfs

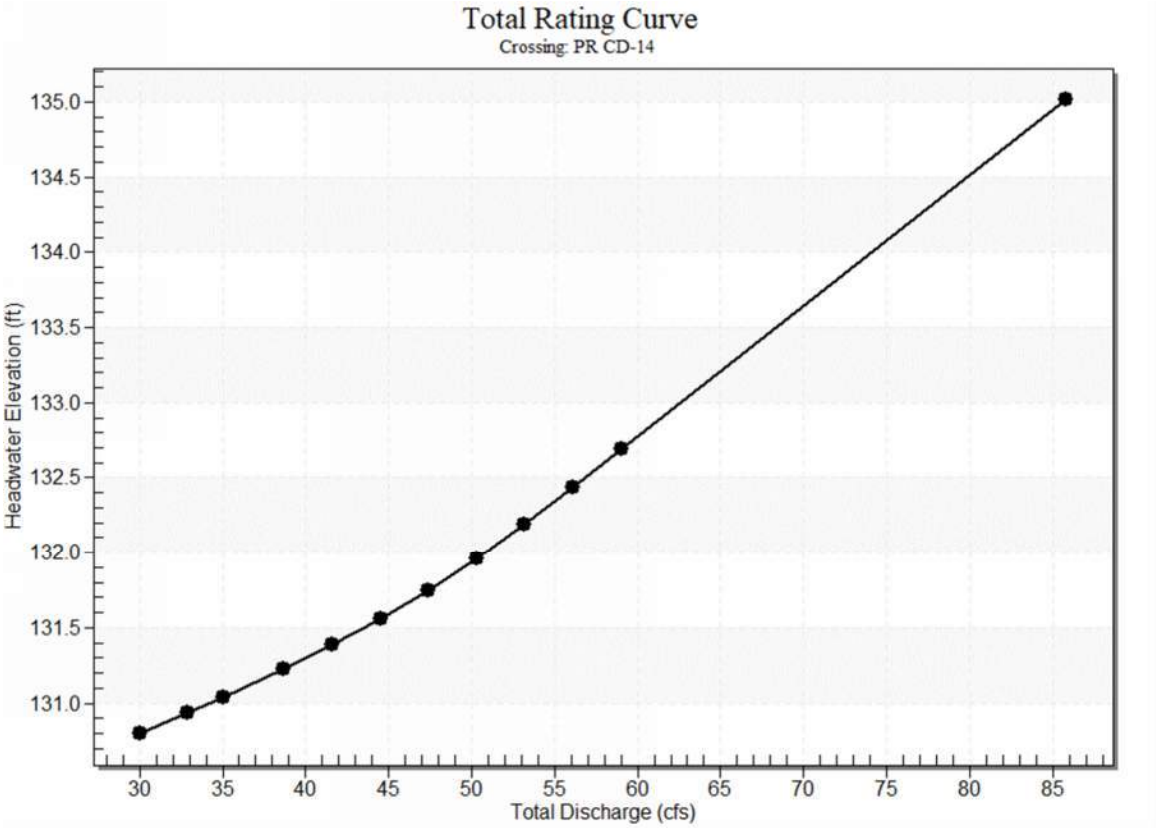
Design Flow: 35.00 cfs

Maximum Flow: 59.00 cfs

Table 79 - Summary of Culvert Flows at Crossing: PR CD-14

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-14 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
130.80	30.00	30.00	0.00	1
130.94	32.90	32.90	0.00	1
131.04	35.00	35.00	0.00	1
131.23	38.70	38.70	0.00	1
131.39	41.60	41.60	0.00	1
131.56	44.50	44.50	0.00	1
131.74	47.40	47.40	0.00	1
131.96	50.30	50.30	0.00	1
132.19	53.20	53.20	0.00	1
132.44	56.10	56.10	0.00	1
132.69	59.00	59.00	0.00	1
135.00	81.26	81.26	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-14



Culvert Data: PR CD-14

Table 80 - Culvert Summary Table: PR CD-14

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
30.00 cfs	30.00 cfs	130.80	2.70	3.052	7-M1t	2.45	1.77	2.55	2.53	4.68	0.00
32.90 cfs	32.90 cfs	130.94	2.87	3.185	3-M2t	3.00	1.86	2.55	2.53	5.14	0.00
35.00 cfs	35.00 cfs	131.04	2.99	3.287	3-M2t	3.00	1.92	2.55	2.53	5.47	0.00
38.70 cfs	38.70 cfs	131.23	3.22	3.478	3-M2t	3.00	2.02	2.55	2.53	6.04	0.00
41.60 cfs	41.60 cfs	131.39	3.40	3.638	3-M2t	3.00	2.10	2.55	2.53	6.50	0.00
44.50 cfs	44.50 cfs	131.56	3.60	3.809	3-M2t	3.00	2.17	2.55	2.53	6.95	0.00
47.40 cfs	47.40 cfs	131.74	3.80	3.995	3-M2t	3.00	2.24	2.55	2.53	7.40	0.00
50.30 cfs	50.30 cfs	131.96	4.02	4.208	7-M2t	3.00	2.31	2.55	2.53	7.85	0.00
53.20 cfs	53.20 cfs	132.19	4.25	4.441	7-M2t	3.00	2.37	2.55	2.53	8.31	0.00
56.10 cfs	56.10 cfs	132.44	4.50	4.687	7-M2t	3.00	2.43	2.55	2.53	8.76	0.00
59.00 cfs	59.00 cfs	132.69	4.76	4.944	7-M2t	3.00	2.48	2.55	2.53	9.21	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

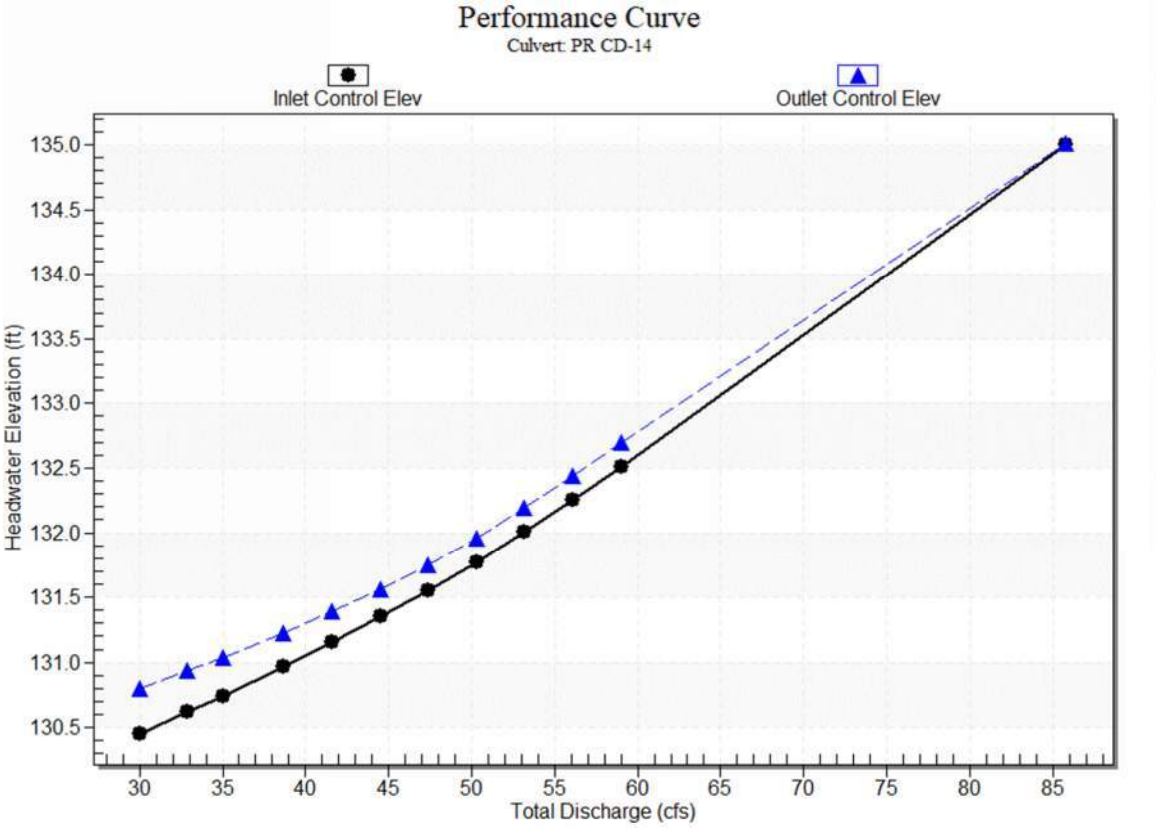
Inlet Elevation (invert): 127.75 ft,

Outlet Elevation (invert): 127.55 ft

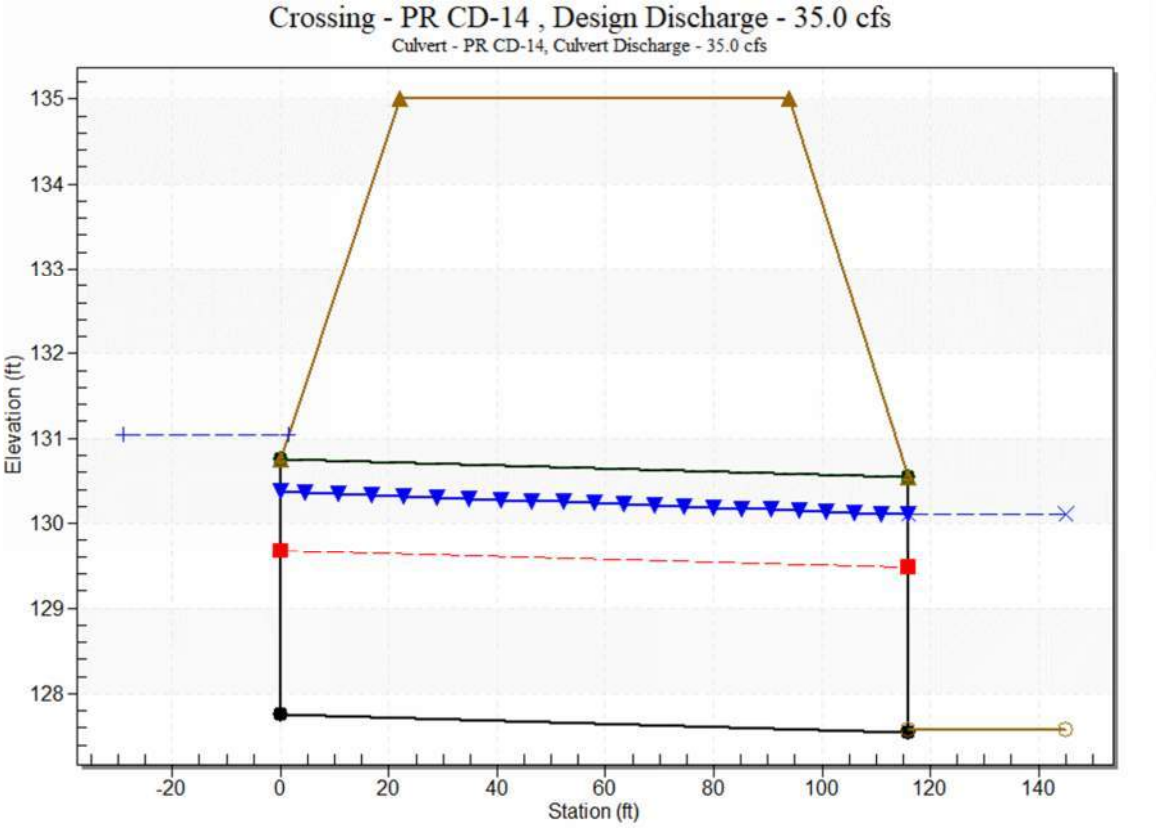
Culvert Length: 116.00 ft,

Culvert Slope: 0.0017

Culvert Performance Curve Plot: PR CD-14



Water Surface Profile Plot for Culvert: PR CD-14



Site Data - PR CD-14

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 127.75 ft

Outlet Station: 116.00 ft

Outlet Elevation: 127.55 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-14

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-14

Table 81 - Downstream Channel Rating Curve (Crossing: PR CD-14)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
30.00	130.10	2.53
32.90	130.10	2.53
35.00	130.10	2.53
38.70	130.10	2.53
41.60	130.10	2.53
44.50	130.10	2.53
47.40	130.10	2.53
50.30	130.10	2.53
53.20	130.10	2.53
56.10	130.10	2.53
59.00	130.10	2.53

Tailwater Channel Data - PR CD-14

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 130.10 ft

Roadway Data for Crossing: PR CD-14

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 800.00 ft

Crest Elevation: 135.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 258.00 cfs

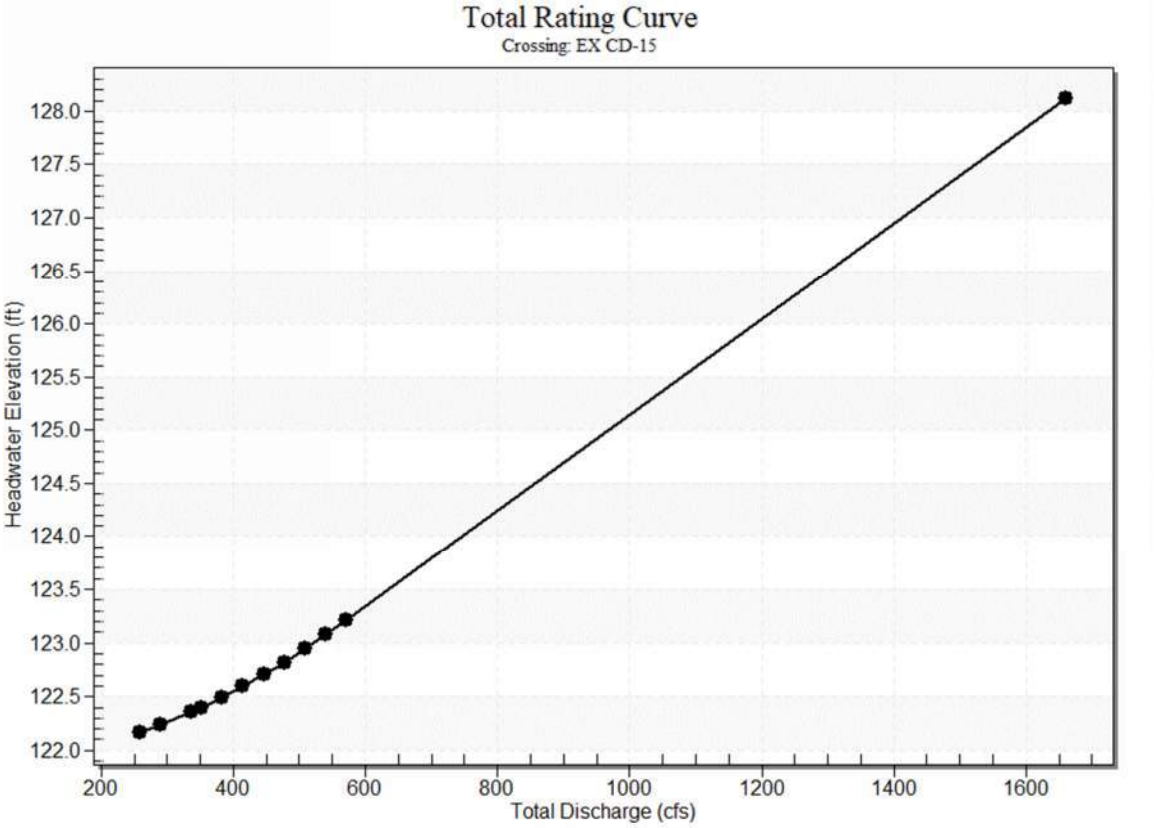
Design Flow: 336.00 cfs

Maximum Flow: 571.00 cfs

Table 82 - Summary of Culvert Flows at Crossing: EX CD-15

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-15 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
122.17	258.00	258.00	0.00	1
122.24	289.30	289.30	0.00	1
122.36	336.00	336.00	0.00	1
122.40	351.90	351.90	0.00	1
122.49	383.20	383.20	0.00	1
122.59	414.50	414.50	0.00	1
122.70	445.80	445.80	0.00	1
122.82	477.10	477.10	0.00	1
122.94	508.40	508.40	0.00	1
123.07	539.70	539.70	0.00	1
123.21	571.00	571.00	0.00	1
128.00	1544.06	1544.06	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-15



Culvert Data: EX CD-15

Table 83 - Culvert Summary Table: EX CD-15

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
258.00 cfs	258.00 cfs	122.17	2.96	4.068	1-S1t	1.66	1.73	4.00	4.00	3.23	0.00
289.30 cfs	289.30 cfs	122.24	3.20	4.137	1-S1t	1.79	1.87	4.00	4.00	3.62	0.00
336.00 cfs	336.00 cfs	122.36	3.53	4.255	1-S1t	1.98	2.06	4.00	4.00	4.20	0.00
351.90 cfs	351.90 cfs	122.40	3.64	4.299	1-S1t	2.04	2.13	4.00	4.00	4.40	0.00
383.20 cfs	383.20 cfs	122.49	3.85	4.392	1-S1t	2.16	2.25	4.00	4.00	4.79	0.00
414.50 cfs	414.50 cfs	122.59	4.06	4.493	1-S1t	2.28	2.37	4.00	4.00	5.18	0.00
445.80 cfs	445.80 cfs	122.70	4.25	4.601	1-S1t	2.40	2.49	4.00	4.00	5.57	0.00
477.10 cfs	477.10 cfs	122.82	4.44	4.718	1-S1t	2.51	2.60	4.00	4.00	5.96	0.00
508.40 cfs	508.40 cfs	122.94	4.63	4.842	1-S1t	2.63	2.72	4.00	4.00	6.35	0.00
539.70 cfs	539.70 cfs	123.07	4.81	4.974	1-S1t	2.74	2.83	4.00	4.00	6.75	0.00
571.00 cfs	571.00 cfs	123.21	4.99	5.115	1-S1t	2.85	2.94	4.00	4.00	7.14	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

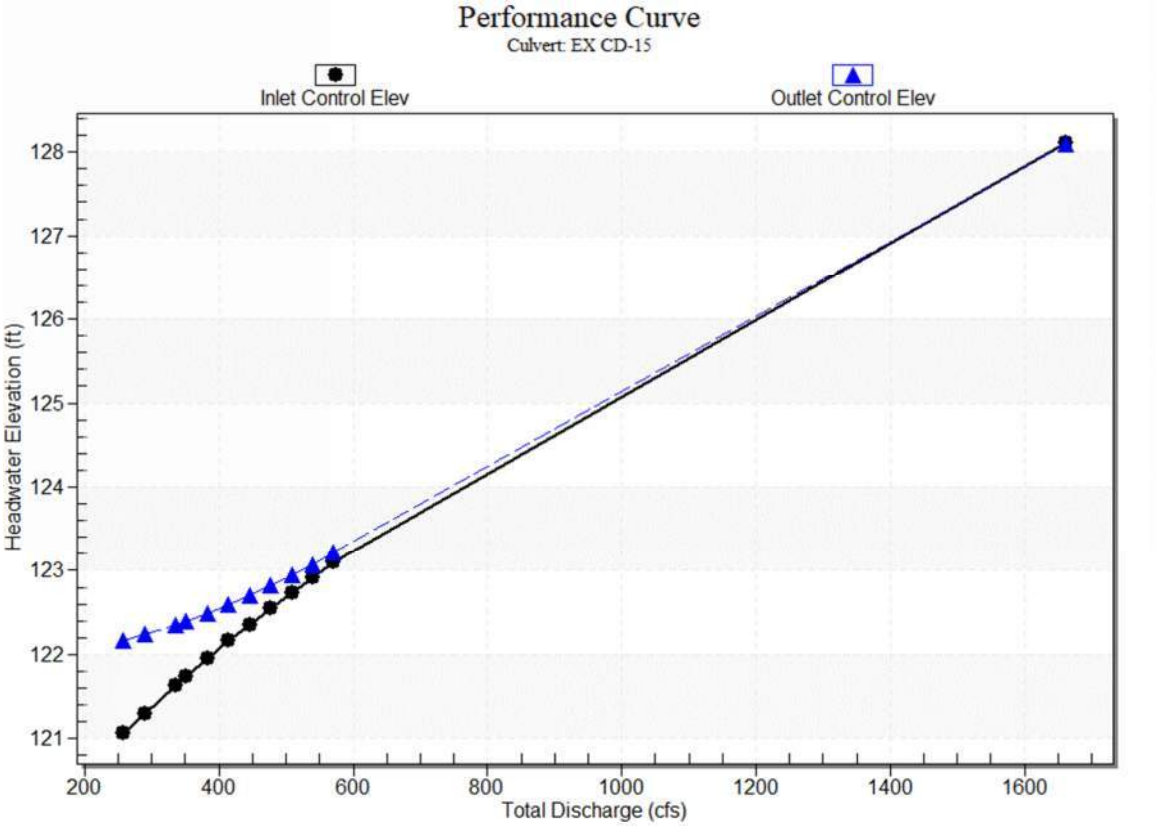
Inlet Elevation (invert): 118.10 ft,

Outlet Elevation (invert): 117.90 ft

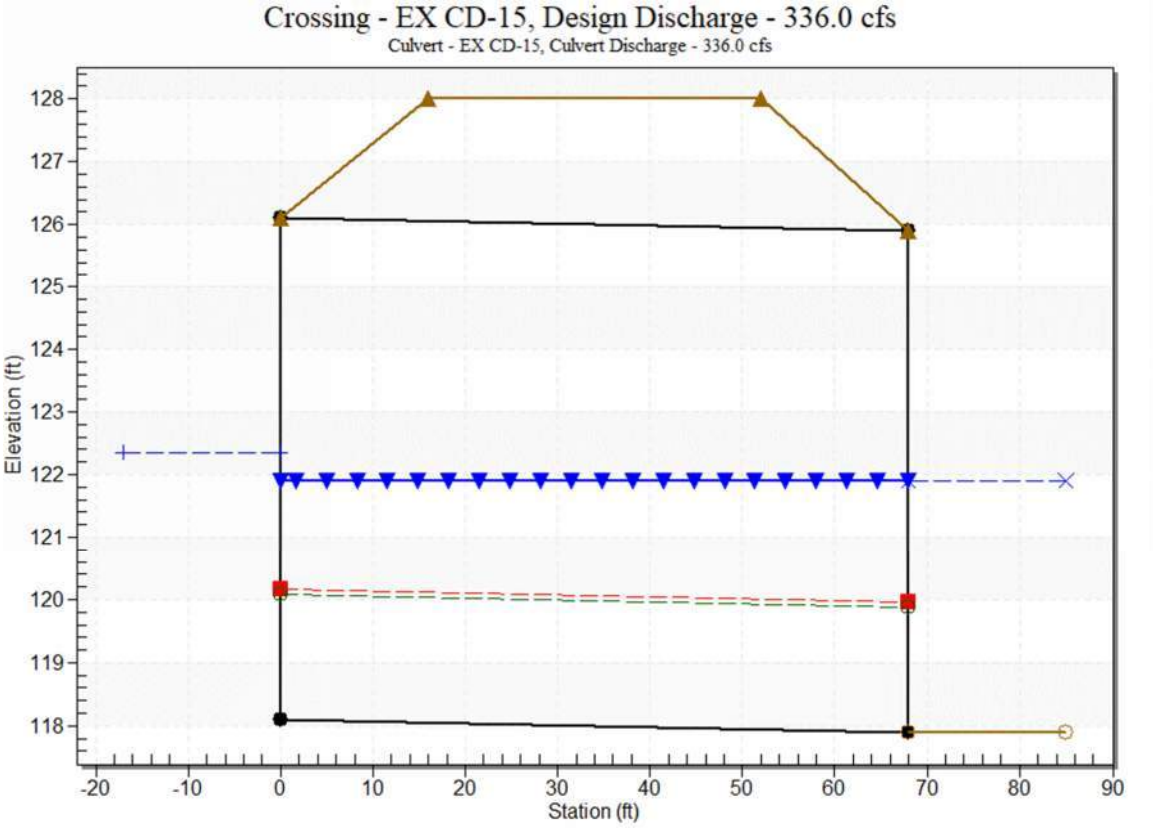
Culvert Length: 68.00 ft,

Culvert Slope: 0.0029

Culvert Performance Curve Plot: EX CD-15



Water Surface Profile Plot for Culvert: EX CD-15



Site Data - EX CD-15

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 118.10 ft

Outlet Station: 68.00 ft

Outlet Elevation: 117.90 ft

Number of Barrels: 2

Culvert Data Summary - EX CD-15

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft

Barrel Rise: 8.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90º) Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-15

Table 84 - Downstream Channel Rating Curve (Crossing: EX CD-15)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
258.00	121.90	4.00
289.30	121.90	4.00
336.00	121.90	4.00
351.90	121.90	4.00
383.20	121.90	4.00
414.50	121.90	4.00
445.80	121.90	4.00
477.10	121.90	4.00
508.40	121.90	4.00
539.70	121.90	4.00
571.00	121.90	4.00

Tailwater Channel Data - EX CD-15

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 121.90 ft

Roadway Data for Crossing: EX CD-15

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 800.00 ft

Crest Elevation: 128.00 ft

Roadway Surface: Paved

Roadway Top Width: 36.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 258.00 cfs

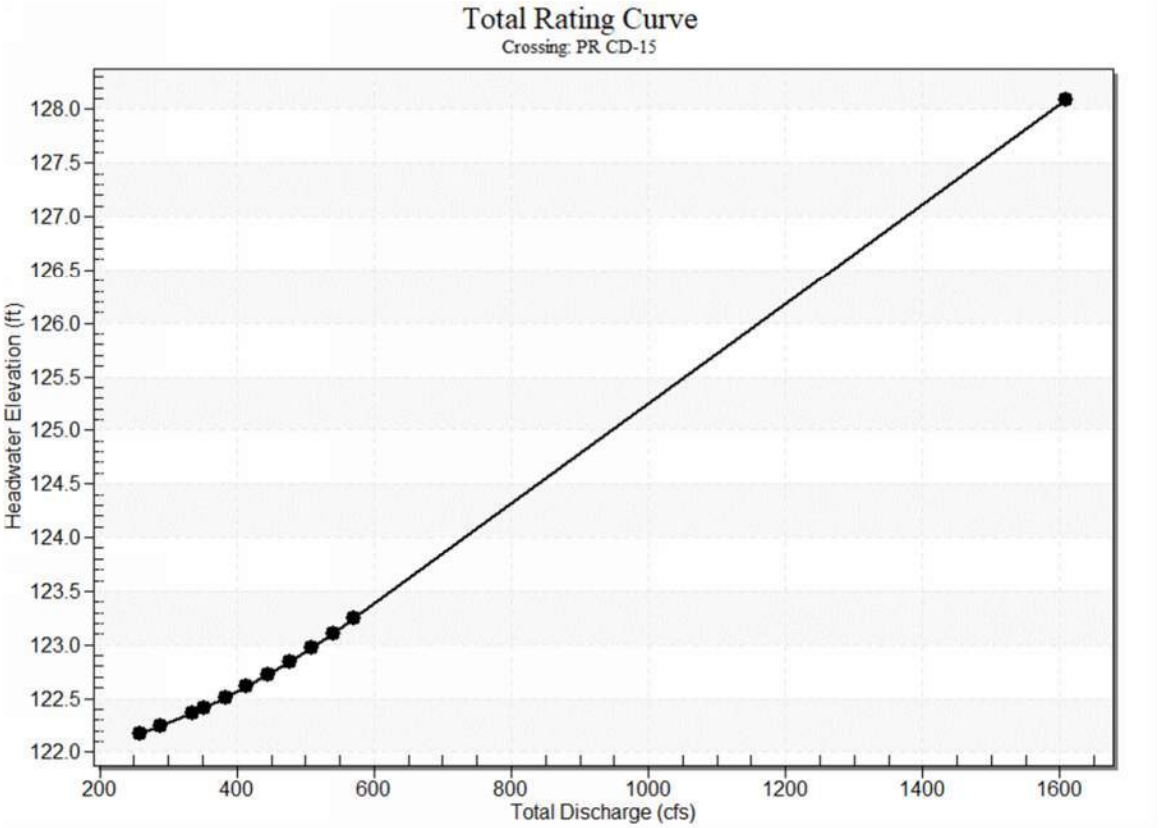
Design Flow: 336.00 cfs

Maximum Flow: 571.00 cfs

Table 85 - Summary of Culvert Flows at Crossing: PR CD-15

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-15 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
122.18	258.00	258.00	0.00	1
122.25	289.30	289.30	0.00	1
122.37	336.00	336.00	0.00	1
122.41	351.90	351.90	0.00	1
122.51	383.20	383.20	0.00	1
122.61	414.50	414.50	0.00	1
122.72	445.80	445.80	0.00	1
122.84	477.10	477.10	0.00	1
122.97	508.40	508.40	0.00	1
123.10	539.70	539.70	0.00	1
123.25	571.00	571.00	0.00	1
128.00	1532.61	1532.61	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-15



Culvert Data: PR CD-15

Table 86 - Culvert Summary Table: PR CD-15

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
258.00 cfs	258.00 cfs	122.18	2.96	4.025	1-S1t	1.65	1.73	4.10	4.10	3.15	0.00
289.30 cfs	289.30 cfs	122.25	3.20	4.096	1-S1t	1.78	1.87	4.10	4.10	3.53	0.00
336.00 cfs	336.00 cfs	122.37	3.53	4.217	1-S1t	1.97	2.06	4.10	4.10	4.10	0.00
351.90 cfs	351.90 cfs	122.41	3.64	4.262	1-S1t	2.04	2.13	4.10	4.10	4.29	0.00
383.20 cfs	383.20 cfs	122.51	3.85	4.357	1-S1t	2.16	2.25	4.10	4.10	4.67	0.00
414.50 cfs	414.50 cfs	122.61	4.06	4.460	1-S1t	2.28	2.37	4.10	4.10	5.05	0.00
445.80 cfs	445.80 cfs	122.72	4.25	4.572	1-S1t	2.39	2.49	4.10	4.10	5.44	0.00
477.10 cfs	477.10 cfs	122.84	4.44	4.691	1-S1t	2.51	2.60	4.10	4.10	5.82	0.00
508.40 cfs	508.40 cfs	122.97	4.63	4.819	1-S1t	2.62	2.72	4.10	4.10	6.20	0.00
539.70 cfs	539.70 cfs	123.10	4.81	4.955	1-S1t	2.73	2.83	4.10	4.10	6.58	0.00
571.00 cfs	571.00 cfs	123.25	4.99	5.099	1-S1t	2.84	2.94	4.10	4.10	6.96	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

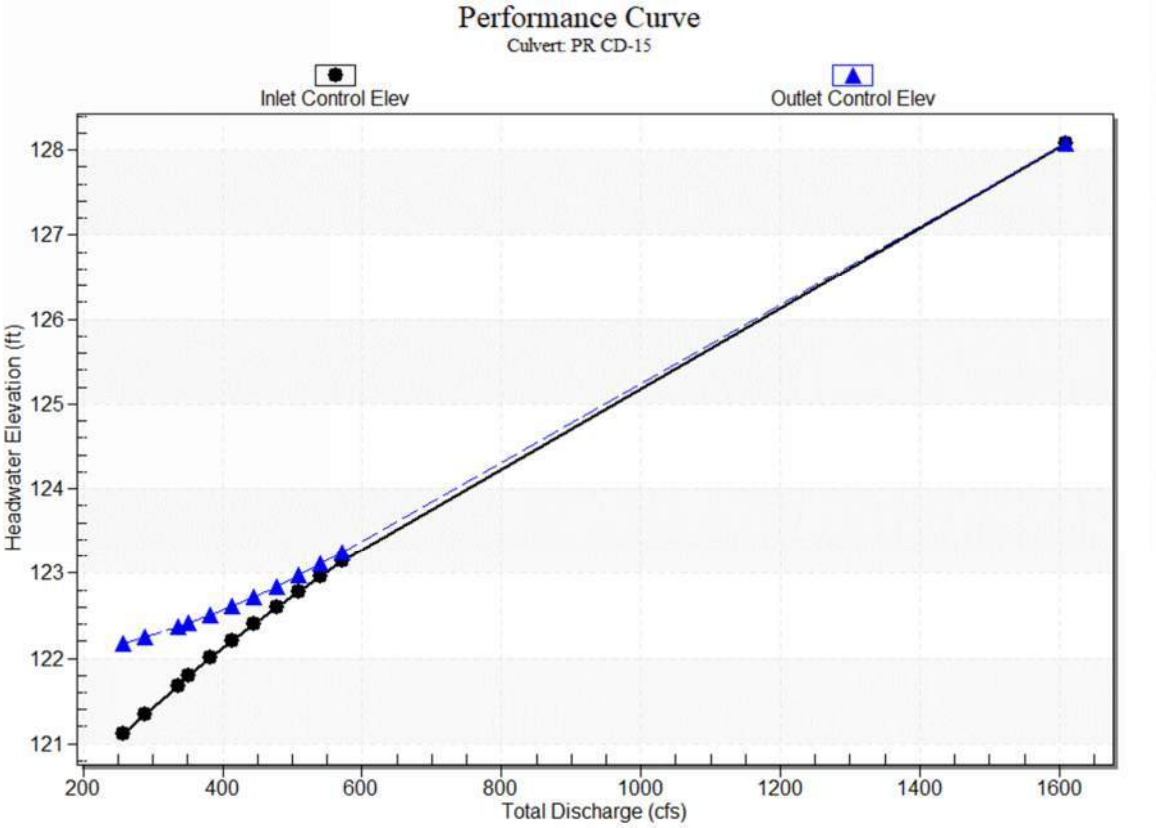
Inlet Elevation (invert): 118.15 ft,

Outlet Elevation (invert): 117.80 ft

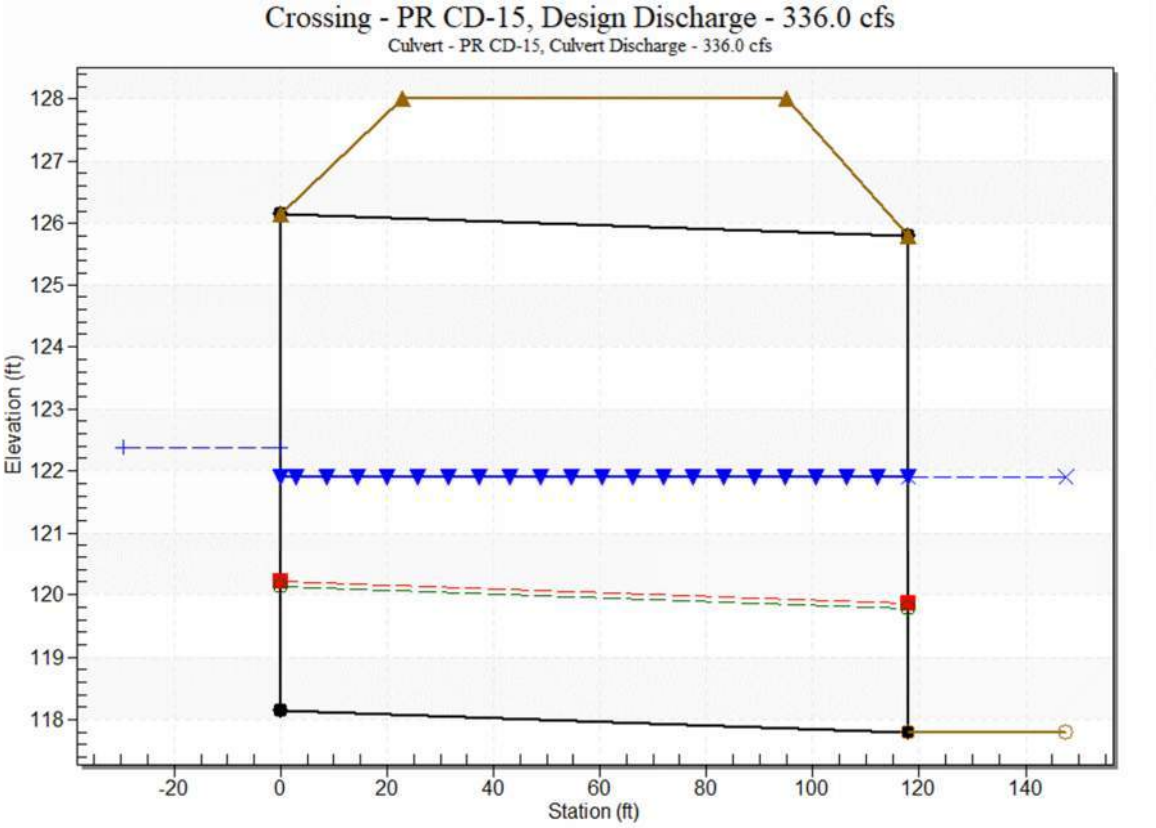
Culvert Length: 118.00 ft,

Culvert Slope: 0.0030

Culvert Performance Curve Plot: PR CD-15



Water Surface Profile Plot for Culvert: PR CD-15



Site Data - PR CD-15

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 118.15 ft

Outlet Station: 118.00 ft

Outlet Elevation: 117.80 ft

Number of Barrels: 2

Culvert Data Summary - PR CD-15

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft

Barrel Rise: 8.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90º) Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-15

Table 87 - Downstream Channel Rating Curve (Crossing: PR CD-15)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
258.00	121.90	4.10
289.30	121.90	4.10
336.00	121.90	4.10
351.90	121.90	4.10
383.20	121.90	4.10
414.50	121.90	4.10
445.80	121.90	4.10
477.10	121.90	4.10
508.40	121.90	4.10
539.70	121.90	4.10
571.00	121.90	4.10

Tailwater Channel Data - PR CD-15

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 121.90 ft

Roadway Data for Crossing: PR CD-15

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 800.00 ft

Crest Elevation: 128.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 8.00 cfs

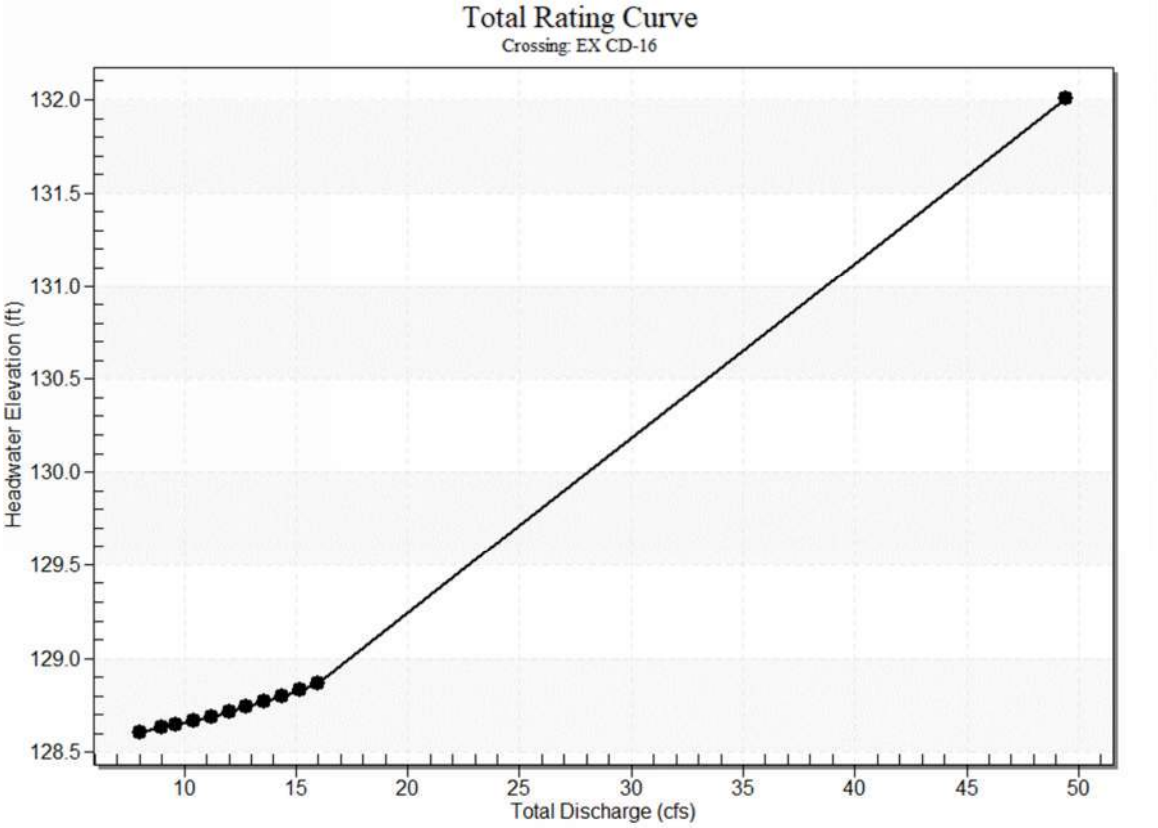
Design Flow: 9.00 cfs

Maximum Flow: 16.00 cfs

Table 88 - Summary of Culvert Flows at Crossing: EX CD-16

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-16 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
128.61	8.00	8.00	0.00	1
128.63	9.00	9.00	0.00	1
128.65	9.60	9.60	0.00	1
128.67	10.40	10.40	0.00	1
128.69	11.20	11.20	0.00	1
128.72	12.00	12.00	0.00	1
128.74	12.80	12.80	0.00	1
128.77	13.60	13.60	0.00	1
128.80	14.40	14.40	0.00	1
128.83	15.20	15.20	0.00	1
128.87	16.00	16.00	0.00	1
132.00	48.88	48.88	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-16



Culvert Data: EX CD-16

Table 89 - Culvert Summary Table: EX CD-16

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
8.00 cfs	8.00 cfs	128.61	1.31	2.197	1-S1f	0.84	0.94	2.50	2.50	1.63	0.00
9.00 cfs	9.00 cfs	128.63	1.41	2.220	1-S1f	0.90	1.00	2.50	2.50	1.83	0.00
9.60 cfs	9.60 cfs	128.65	1.47	2.236	1-S1f	0.93	1.03	2.50	2.50	1.96	0.00
10.40 cfs	10.40 cfs	128.67	1.54	2.257	1-S1f	0.97	1.08	2.50	2.50	2.12	0.00
11.20 cfs	11.20 cfs	128.69	1.62	2.281	1-S1f	1.01	1.12	2.50	2.50	2.28	0.00
12.00 cfs	12.00 cfs	128.72	1.69	2.306	1-S1f	1.05	1.16	2.50	2.50	2.44	0.00
12.80 cfs	12.80 cfs	128.74	1.76	2.333	1-S1f	1.08	1.20	2.50	2.50	2.61	0.00
13.60 cfs	13.60 cfs	128.77	1.82	2.361	1-S1f	1.12	1.24	2.50	2.50	2.77	0.00
14.40 cfs	14.40 cfs	128.80	1.89	2.391	1-S1f	1.16	1.28	2.50	2.50	2.93	0.00
15.20 cfs	15.20 cfs	128.83	1.95	2.422	1-S1f	1.20	1.31	2.50	2.50	3.10	0.00
16.00 cfs	16.00 cfs	128.87	2.01	2.456	1-S1f	1.23	1.35	2.50	2.50	3.26	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

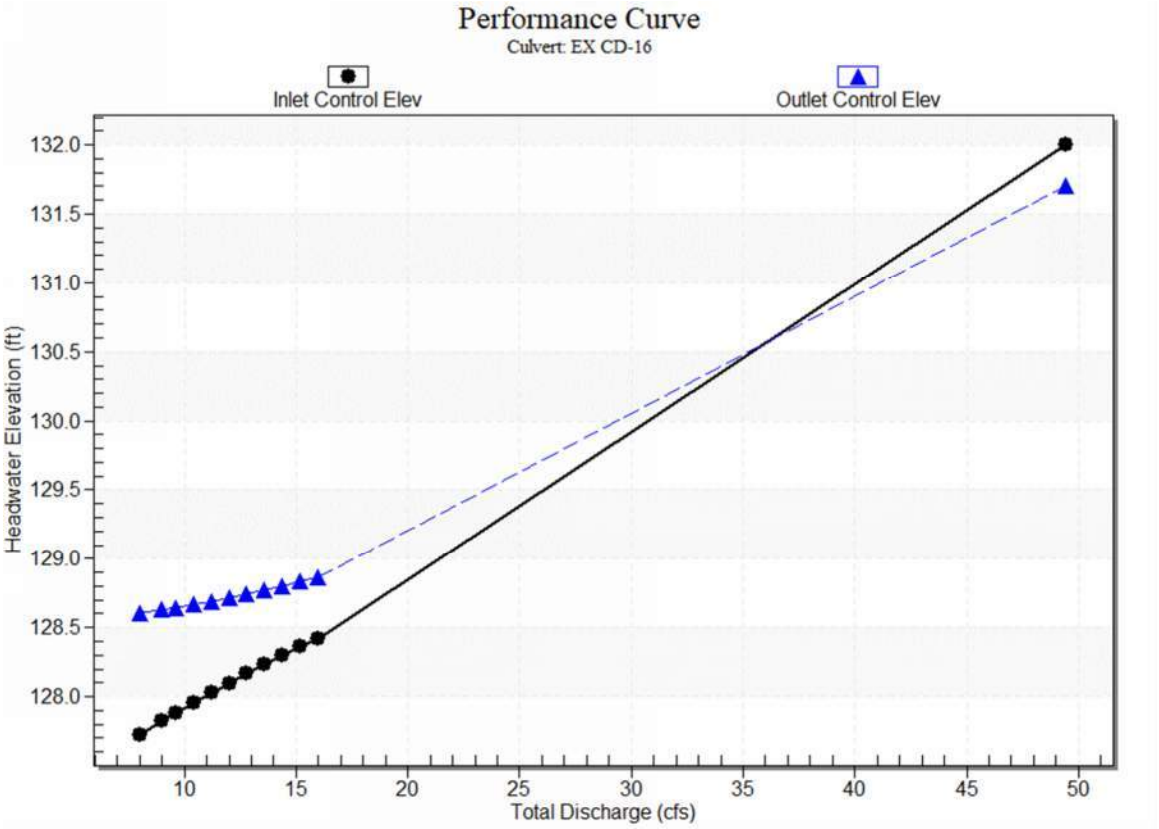
Inlet Elevation (invert): 126.41 ft,

Outlet Elevation (invert): 126.02 ft

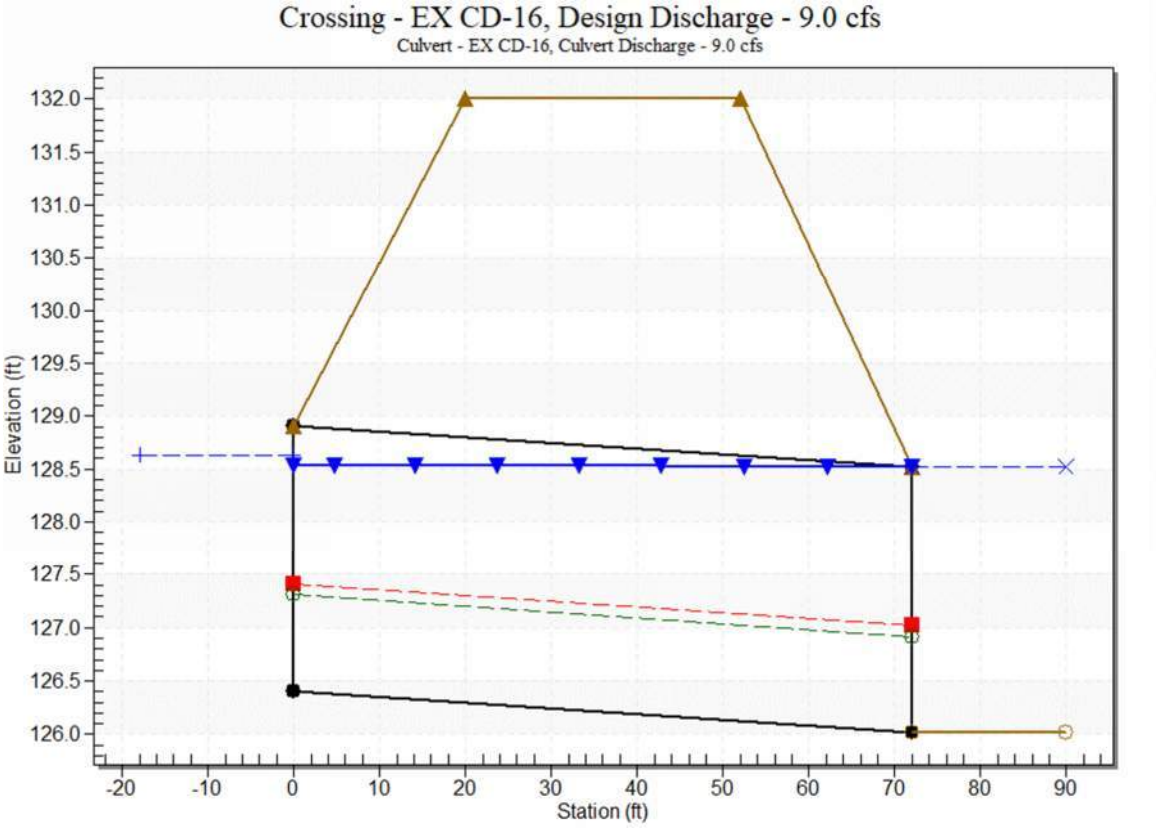
Culvert Length: 72.00 ft,

Culvert Slope: 0.0054

Culvert Performance Curve Plot: EX CD-16



Water Surface Profile Plot for Culvert: EX CD-16



Site Data - EX CD-16

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 126.41 ft

Outlet Station: 72.00 ft

Outlet Elevation: 126.02 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-16

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-16

Table 90 - Downstream Channel Rating Curve (Crossing: EX CD-16)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
8.00	128.52	2.50
9.00	128.52	2.50
9.60	128.52	2.50
10.40	128.52	2.50
11.20	128.52	2.50
12.00	128.52	2.50
12.80	128.52	2.50
13.60	128.52	2.50
14.40	128.52	2.50
15.20	128.52	2.50
16.00	128.52	2.50

Tailwater Channel Data - EX CD-16

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 128.52 ft

Roadway Data for Crossing: EX CD-16

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 132.00 ft

Roadway Surface: Paved

Roadway Top Width: 32.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 8.00 cfs

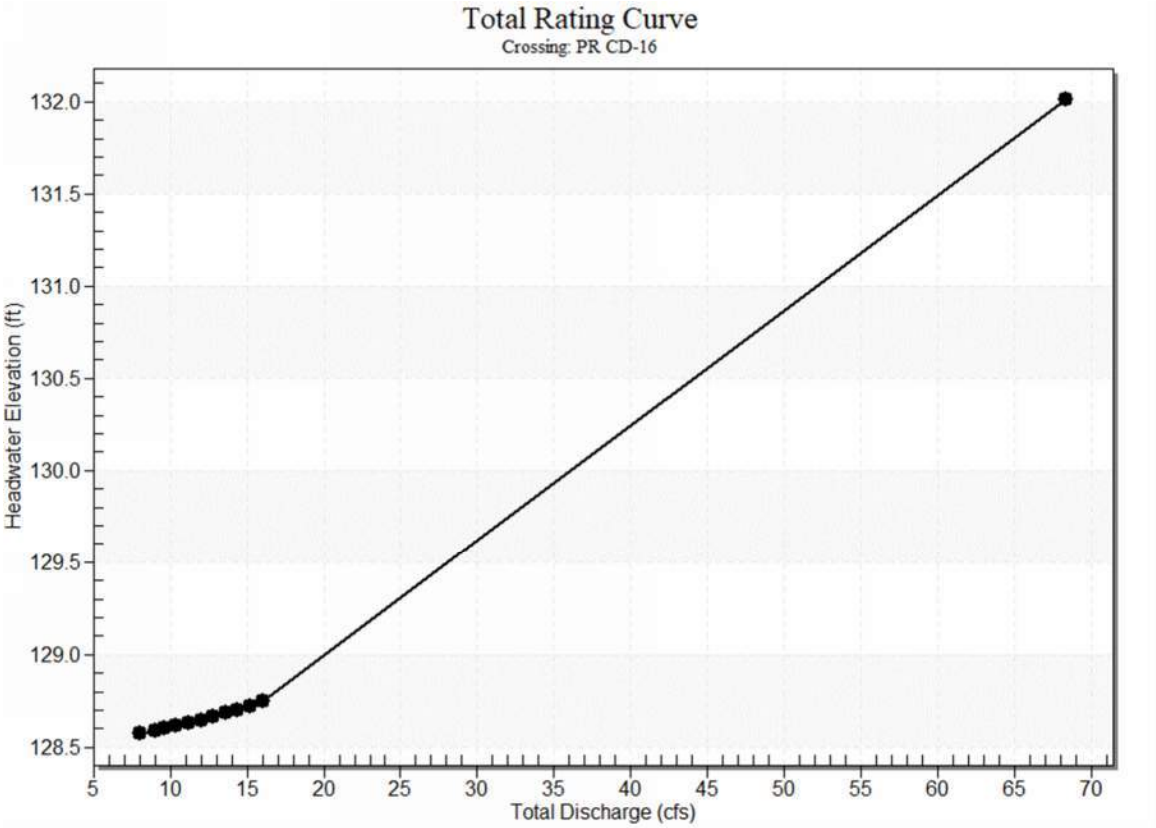
Design Flow: 9.00 cfs

Maximum Flow: 16.00 cfs

Table 91 - Summary of Culvert Flows at Crossing: PR CD-16

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-16 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
128.58	8.00	8.00	0.00	1
128.59	9.00	9.00	0.00	1
128.60	9.60	9.60	0.00	1
128.62	10.40	10.40	0.00	1
128.63	11.20	11.20	0.00	1
128.65	12.00	12.00	0.00	1
128.66	12.80	12.80	0.00	1
128.68	13.60	13.60	0.00	1
128.70	14.40	14.40	0.00	1
128.72	15.20	15.20	0.00	1
128.75	16.00	16.00	0.00	1
132.00	67.05	67.05	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-16



Culvert Data: PR CD-16

Table 92 - Culvert Summary Table: PR CD-16

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
8.00 cfs	8.00 cfs	128.58	1.22	2.126	1-S1t	0.79	0.89	2.67	2.67	1.20	0.00
9.00 cfs	9.00 cfs	128.59	1.30	2.141	1-S1t	0.84	0.95	2.67	2.67	1.35	0.00
9.60 cfs	9.60 cfs	128.60	1.35	2.151	1-S1t	0.87	0.98	2.67	2.67	1.44	0.00
10.40 cfs	10.40 cfs	128.62	1.40	2.165	1-S1t	0.91	1.02	2.67	2.67	1.57	0.00
11.20 cfs	11.20 cfs	128.63	1.46	2.181	1-S1t	0.94	1.06	2.67	2.67	1.69	0.00
12.00 cfs	12.00 cfs	128.65	1.52	2.197	1-S1t	0.98	1.10	2.67	2.67	1.81	0.00
12.80 cfs	12.80 cfs	128.66	1.58	2.214	1-S1t	1.01	1.14	2.67	2.67	1.93	0.00
13.60 cfs	13.60 cfs	128.68	1.65	2.233	1-S1t	1.04	1.17	2.67	2.67	2.05	0.00
14.40 cfs	14.40 cfs	128.70	1.71	2.253	1-S1t	1.08	1.21	2.67	2.67	2.17	0.00
15.20 cfs	15.20 cfs	128.72	1.77	2.273	1-S1t	1.11	1.24	2.67	2.67	2.29	0.00
16.00 cfs	16.00 cfs	128.75	1.82	2.295	1-S1t	1.14	1.28	2.67	2.67	2.41	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

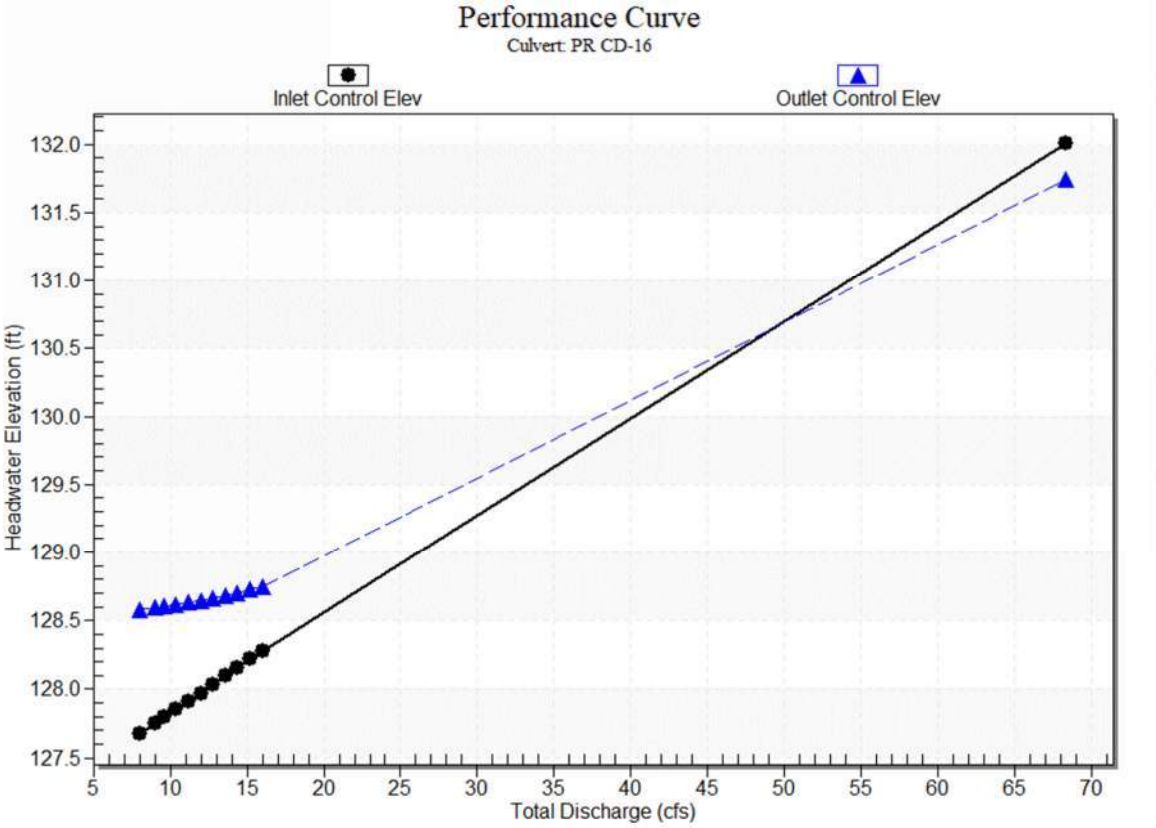
Inlet Elevation (invert): 126.45 ft,

Outlet Elevation (invert): 125.85 ft

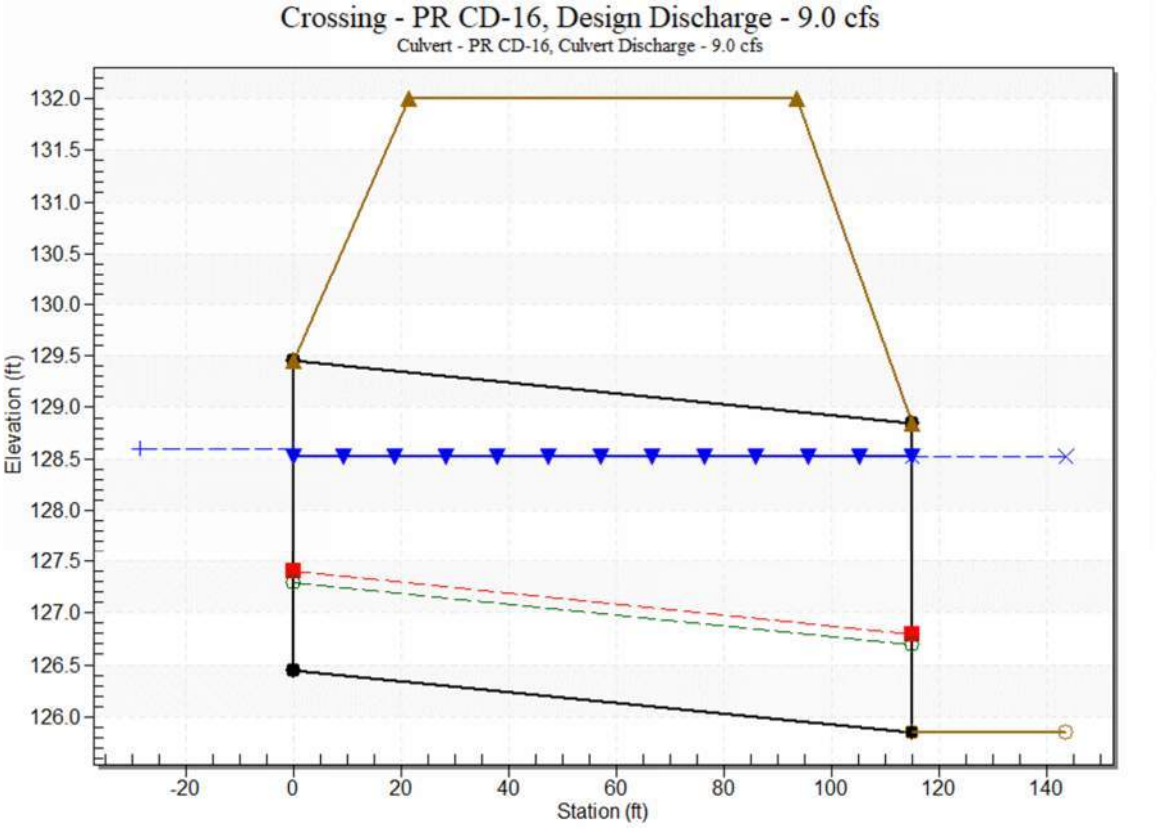
Culvert Length: 115.00 ft,

Culvert Slope: 0.0052

Culvert Performance Curve Plot: PR CD-16



Water Surface Profile Plot for Culvert: PR CD-16



Site Data - PR CD-16

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 126.45 ft

Outlet Station: 115.00 ft

Outlet Elevation: 125.85 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-16

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-16

Table 93 - Downstream Channel Rating Curve (Crossing: PR CD-16)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
8.00	128.52	2.67
9.00	128.52	2.67
9.60	128.52	2.67
10.40	128.52	2.67
11.20	128.52	2.67
12.00	128.52	2.67
12.80	128.52	2.67
13.60	128.52	2.67
14.40	128.52	2.67
15.20	128.52	2.67
16.00	128.52	2.67

Tailwater Channel Data - PR CD-16

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 128.52 ft

Roadway Data for Crossing: PR CD-16

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 132.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 20.00 cfs

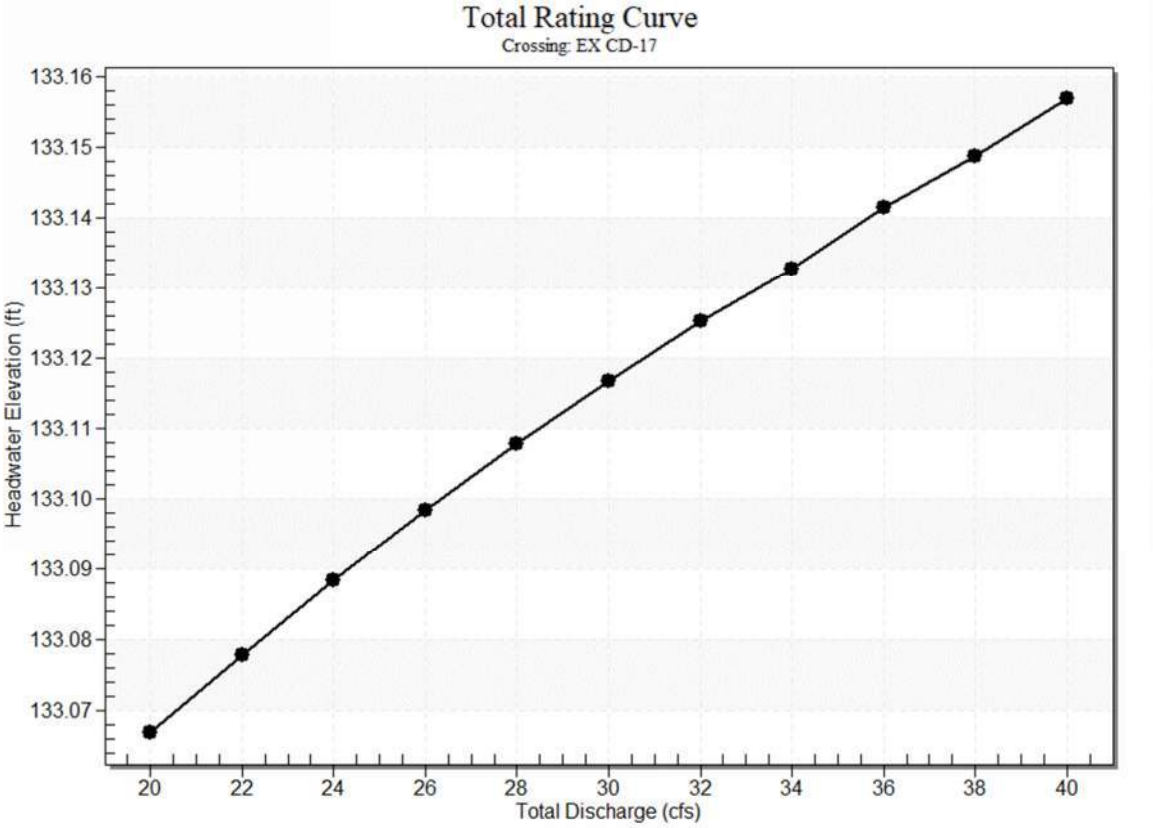
Design Flow: 24.00 cfs

Maximum Flow: 40.00 cfs

Table 94 - Summary of Culvert Flows at Crossing: EX CD-17

Headwater Elevation (ft)	Total Discharge (cfs)	EX CD-17 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
133.07	20.00	12.13	7.73	15
133.08	22.00	12.15	9.68	3
133.09	24.00	12.16	11.70	3
133.10	26.00	12.17	13.73	3
133.11	28.00	12.18	15.74	3
133.12	30.00	12.20	17.75	3
133.13	32.00	12.21	19.76	3
133.13	34.00	12.22	21.54	2
133.14	36.00	12.23	23.74	3
133.15	38.00	12.24	25.58	2
133.16	40.00	12.25	27.73	3
133.00	12.04	12.04	0.00	Overtopping

Rating Curve Plot for Crossing: EX CD-17



Culvert Data: EX CD-17

Table 95 - Culvert Summary Table: EX CD-17

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
20.00 cfs	12.13 cfs	133.07	4.79	5.967	4-FFf	1.25	1.25	1.25	1.50	9.89	0.00
22.00 cfs	12.15 cfs	133.08	4.80	5.978	4-FFf	1.25	1.25	1.25	1.50	9.90	0.00
24.00 cfs	12.16 cfs	133.09	4.81	5.988	4-FFf	1.25	1.25	1.25	1.50	9.91	0.00
26.00 cfs	12.17 cfs	133.10	4.82	5.998	4-FFf	1.25	1.25	1.25	1.50	9.92	0.00
28.00 cfs	12.18 cfs	133.11	4.82	6.008	4-FFf	1.25	1.25	1.25	1.50	9.93	0.00
30.00 cfs	12.20 cfs	133.12	4.83	6.017	4-FFf	1.25	1.25	1.25	1.50	9.94	0.00
32.00 cfs	12.21 cfs	133.13	4.84	6.025	4-FFf	1.25	1.25	1.25	1.50	9.95	0.00
34.00 cfs	12.22 cfs	133.13	4.85	6.033	4-FFf	1.25	1.25	1.25	1.50	9.96	0.00
36.00 cfs	12.23 cfs	133.14	4.85	6.041	4-FFf	1.25	1.25	1.25	1.50	9.96	0.00
38.00 cfs	12.24 cfs	133.15	4.86	6.049	4-FFf	1.25	1.25	1.25	1.50	9.97	0.00
40.00 cfs	12.25 cfs	133.16	4.87	6.057	4-FFf	1.25	1.25	1.25	1.50	9.98	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

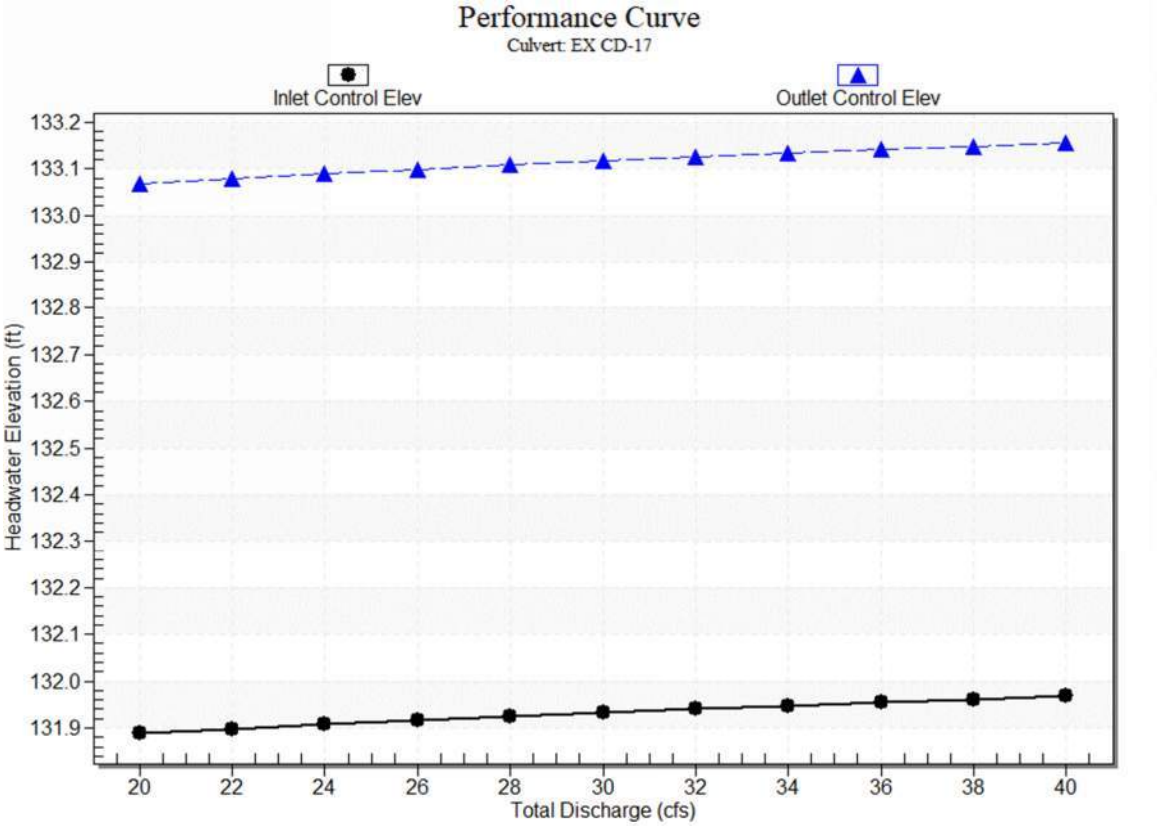
Inlet Elevation (invert): 127.10 ft,

Outlet Elevation (invert): 126.90 ft

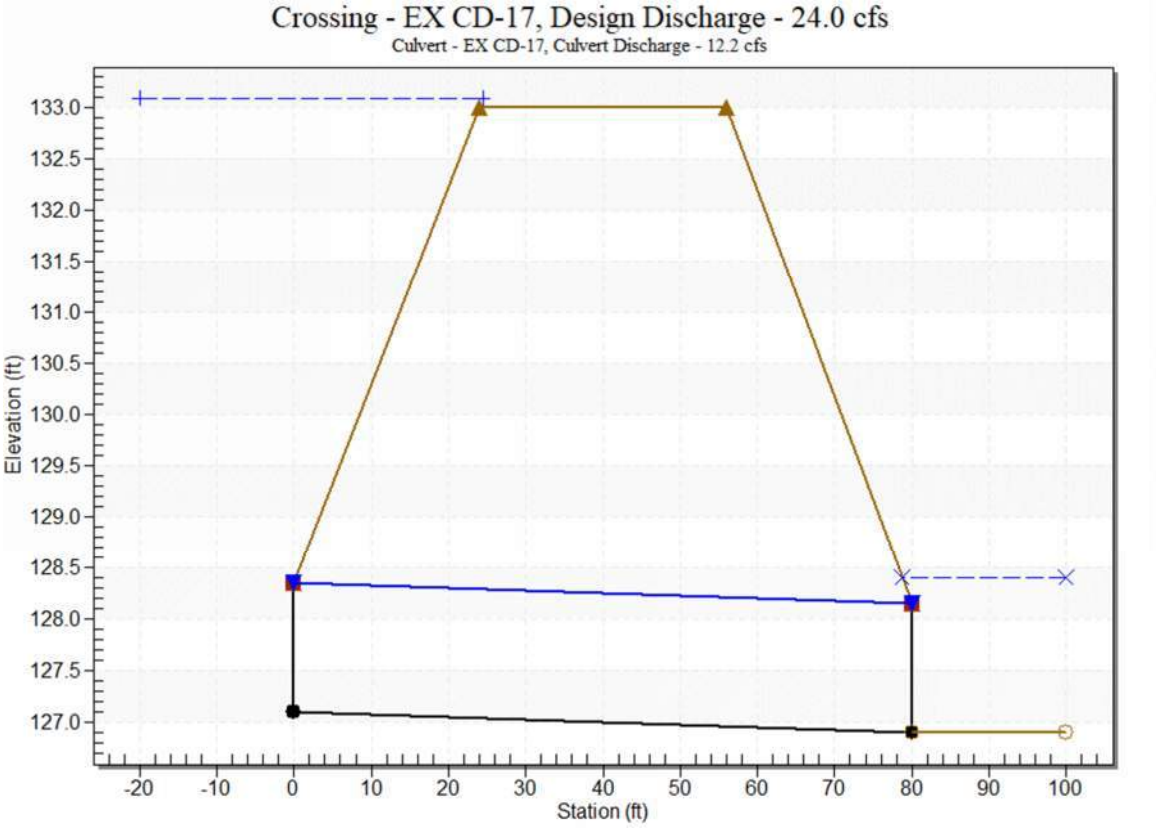
Culvert Length: 80.00 ft,

Culvert Slope: 0.0025

Culvert Performance Curve Plot: EX CD-17



Water Surface Profile Plot for Culvert: EX CD-17



Site Data - EX CD-17

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 127.10 ft

Outlet Station: 80.00 ft

Outlet Elevation: 126.90 ft

Number of Barrels: 1

Culvert Data Summary - EX CD-17

Barrel Shape: Circular

Barrel Diameter: 1.25 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: EX CD-17

Table 96 - Downstream Channel Rating Curve (Crossing: EX CD-17)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
20.00	128.40	1.50
22.00	128.40	1.50
24.00	128.40	1.50
26.00	128.40	1.50
28.00	128.40	1.50
30.00	128.40	1.50
32.00	128.40	1.50
34.00	128.40	1.50
36.00	128.40	1.50
38.00	128.40	1.50
40.00	128.40	1.50

Tailwater Channel Data - EX CD-17

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 128.40 ft

Roadway Data for Crossing: EX CD-17

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 150.00 ft

Crest Elevation: 133.00 ft

Roadway Surface: Paved

Roadway Top Width: 32.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 20.00 cfs

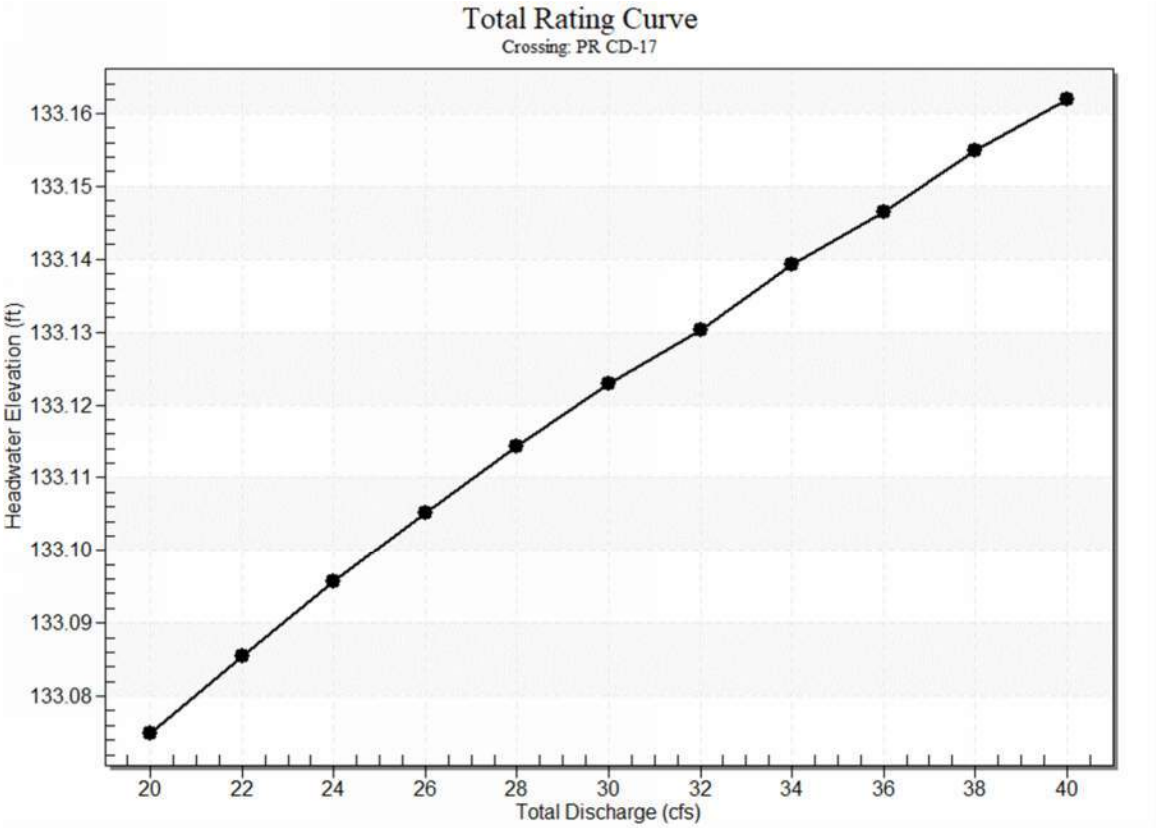
Design Flow: 24.00 cfs

Maximum Flow: 40.00 cfs

Table 97 - Summary of Culvert Flows at Crossing: PR CD-17

Headwater Elevation (ft)	Total Discharge (cfs)	PR CD-17 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
133.07	20.00	10.83	9.03	14
133.09	22.00	10.85	11.01	3
133.10	24.00	10.86	13.03	3
133.11	26.00	10.87	15.05	3
133.11	28.00	10.88	17.06	3
133.12	30.00	10.89	19.07	3
133.13	32.00	10.90	20.84	2
133.14	34.00	10.91	23.05	3
133.15	36.00	10.92	24.89	2
133.15	38.00	10.93	27.05	3
133.16	40.00	10.93	28.93	2
133.00	10.75	10.75	0.00	Overtopping

Rating Curve Plot for Crossing: PR CD-17



Culvert Data: PR CD-17

Table 98 - Culvert Summary Table: PR CD-17

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
20.00 cfs	10.83 cfs	133.07	3.94	5.875	4-FFf	1.25	1.15	1.25	1.50	8.83	0.00
22.00 cfs	10.85 cfs	133.09	3.95	5.885	4-FFf	1.25	1.15	1.25	1.50	8.84	0.00
24.00 cfs	10.86 cfs	133.10	3.96	5.896	4-FFf	1.25	1.15	1.25	1.50	8.85	0.00
26.00 cfs	10.87 cfs	133.11	3.97	5.905	4-FFf	1.25	1.15	1.25	1.50	8.86	0.00
28.00 cfs	10.88 cfs	133.11	3.97	5.914	4-FFf	1.25	1.15	1.25	1.50	8.87	0.00
30.00 cfs	10.89 cfs	133.12	3.98	5.923	4-FFf	1.25	1.15	1.25	1.50	8.87	0.00
32.00 cfs	10.90 cfs	133.13	3.98	5.930	4-FFf	1.25	1.14	1.25	1.50	8.88	0.00
34.00 cfs	10.91 cfs	133.14	3.99	5.939	4-FFf	1.25	1.14	1.25	1.50	8.89	0.00
36.00 cfs	10.92 cfs	133.15	4.00	5.947	4-FFf	1.25	1.14	1.25	1.50	8.90	0.00
38.00 cfs	10.93 cfs	133.15	4.00	5.955	4-FFf	1.25	1.14	1.25	1.50	8.90	0.00
40.00 cfs	10.93 cfs	133.16	4.01	5.962	4-FFf	1.25	1.14	1.25	1.50	8.91	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

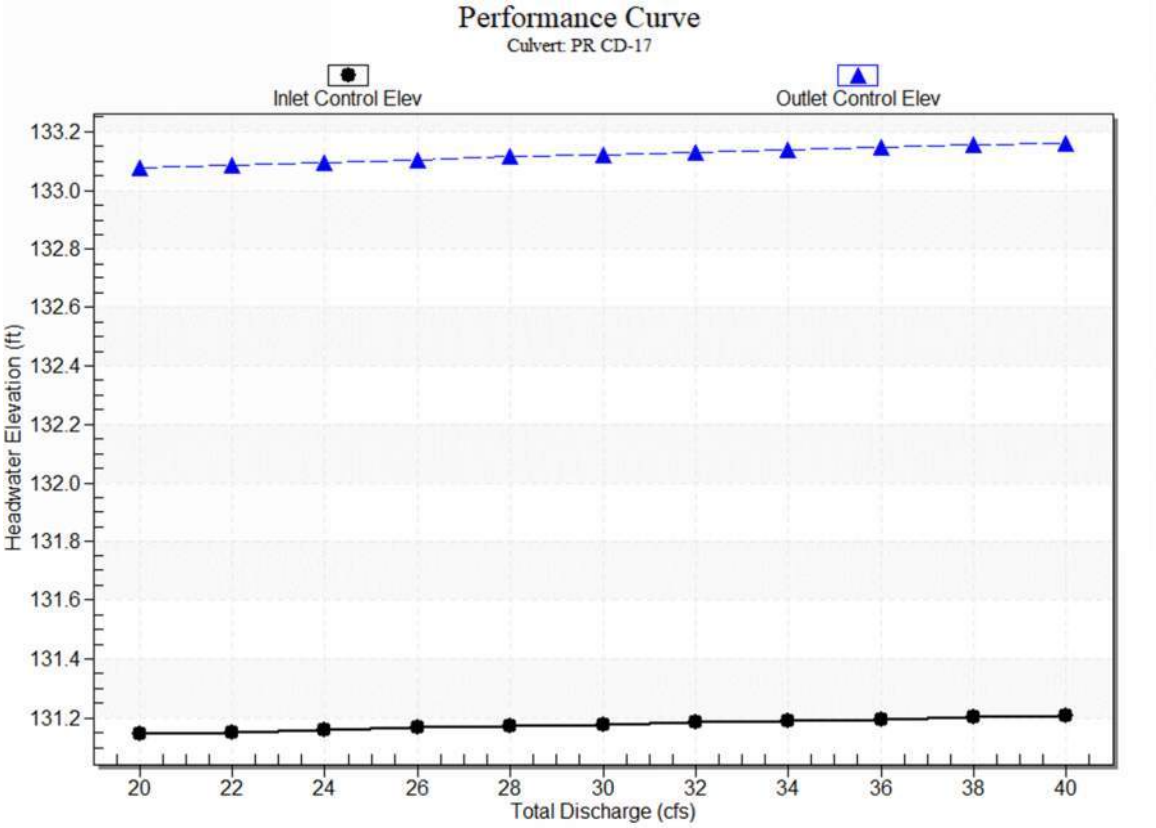
Inlet Elevation (invert): 127.20 ft,

Outlet Elevation (invert): 126.90 ft

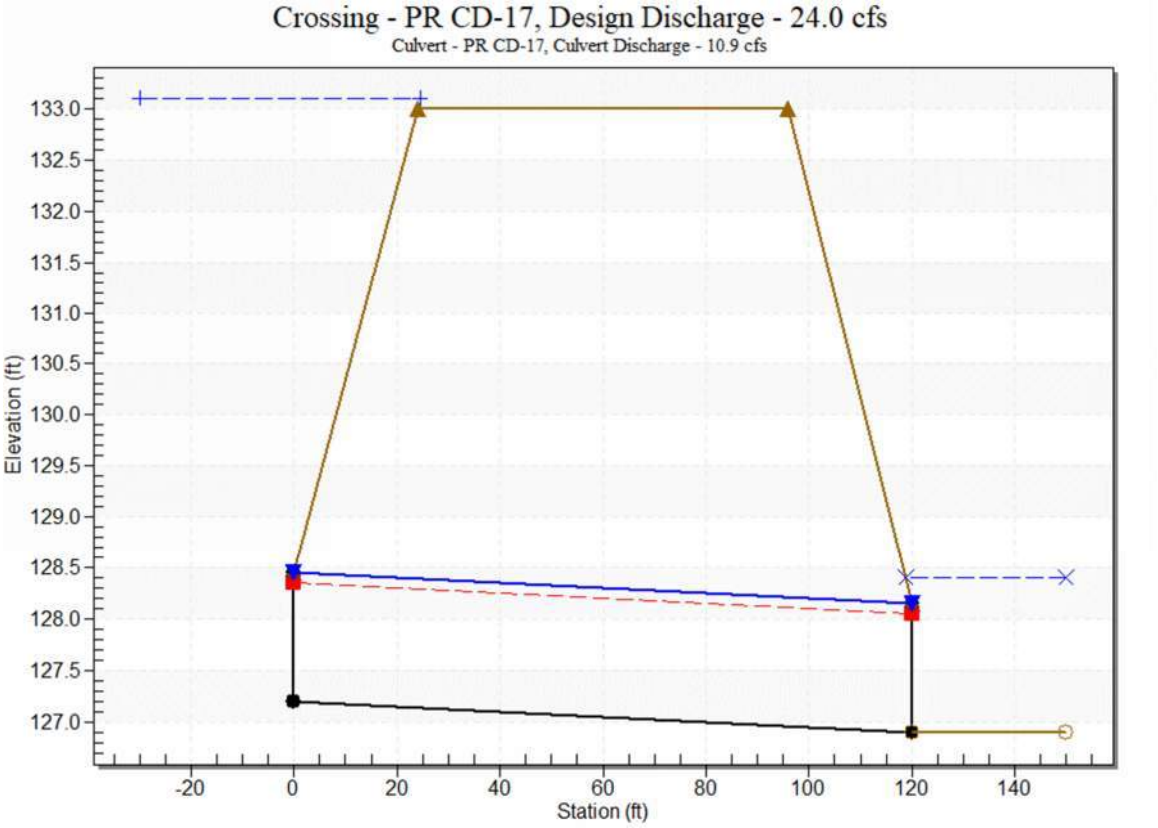
Culvert Length: 120.00 ft,

Culvert Slope: 0.0025

Culvert Performance Curve Plot: PR CD-17



Water Surface Profile Plot for Culvert: PR CD-17



Site Data - PR CD-17

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 127.20 ft

Outlet Station: 120.00 ft

Outlet Elevation: 126.90 ft

Number of Barrels: 1

Culvert Data Summary - PR CD-17

Barrel Shape: Circular

Barrel Diameter: 1.25 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: PR CD-17

Table 99 - Downstream Channel Rating Curve (Crossing: PR CD-17)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
20.00	128.40	1.50
22.00	128.40	1.50
24.00	128.40	1.50
26.00	128.40	1.50
28.00	128.40	1.50
30.00	128.40	1.50
32.00	128.40	1.50
34.00	128.40	1.50
36.00	128.40	1.50
38.00	128.40	1.50
40.00	128.40	1.50

Tailwater Channel Data - PR CD-17

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 128.40 ft

Roadway Data for Crossing: PR CD-17

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 150.00 ft

Crest Elevation: 133.00 ft

Roadway Surface: Paved

Roadway Top Width: 72.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 9.00 cfs

Design Flow: 10.00 cfs

Maximum Flow: 18.00 cfs

APPENDIX E

Cross Drain Pictures and Review Checklist

Review Checklist

CD-1

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 35+67 Size/Type 36" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: None

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation: Highly sedimented and vegetated

Misc. Comments:

West Headwall

East Headwall

Review Checklist

CD-2

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 46+53 Size/Type 36" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: None

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation: Yes

Misc. Comments:

West Headwall

East Headwall

Review Checklist

CD-3

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 61+81 Size/Type 30" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: None

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation: Yes

Misc. Comments:

West Headwall

East Catch Basin

Review Checklist

CD-4

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 70+74 Size/Type 24" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: None

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation: Yes

Misc. Comments:

West Headwall

East MES

Review Checklist

CD-5

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 75+15 Size/Type 12' x 12' CBC

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: N/A

Tailwater: *Ditch* *Piped outfall* *Overland flow* *Swamp*

Lake Conine-Lake Smart Canal

Erosion/Sedimentation:

Misc. Comments:

East End of Culvert

West End of Culvert

Review Checklist

CD-6

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 86+68 Size/Type 30" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: Approx. 4" from bottom of pipe

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation:

Misc. Comments:

West Headwall

(East Headwall could not be located)

Review Checklist

CD-7

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 120+14 Size/Type 2 - 30" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: Approx. 12" from bottom of pipe

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation:

Misc. Comments:

North Headwall

South Headwall

Review Checklist

CD-8

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 133+61 Size/Type 36" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: None

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation: Yes

Misc. Comments:

North Headwall

South Headwall

Review Checklist

CD-9

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 154+93 Size/Type 54" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: Approx 2" below crown of pipe

Tailwater: *Ditch* *Piped outfall* *Overland flow* (*Swamp*)

Erosion/Sedimentation:

Misc. Comments:

North Headwall

South Headwall

Review Checklist

CD-10

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 183+65 Size/Type 36" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: Approx. 4" from crown of pipe

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation:

Misc. Comments:

North Headwall

South Headwall

Review Checklist

CD-11

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 187+13 Size/Type 48" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: 4" from crown of pipe

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation:

Misc. Comments:

South Headwall

North Headwall

Review Checklist

CD-12

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 233+56 Size/Type 36" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: Approx. 12" from bottom

Tailwater: *Ditch* *Piped outfall* *Overland flow* (*Swamp*)

Erosion/Sedimentation:

Misc. Comments:

North Headwall

South Headwall

Review Checklist

CD-13

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 252+10 Size/Type 3 - 24" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: Approx. 12" from bottom of pipe

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation:

Misc. Comments:

South Headwall

North Headwall

Review Checklist

CD-14

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 296+21 Size/Type 30" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: None

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation: Yes

Misc. Comments:

South Headwall

North Headwall

Review Checklist

CD-15

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 348+10 Size/Type 26' BRIDGE CULVERT

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: N/A

Tailwater: *Ditch* *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation:

Misc. Comments: Bridge No. 160147

South Culvert

North Culvert

Review Checklist

CD-16

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 365+13 Size/Type 30" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: None

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation: Yes

Misc. Comments:

North Headwall

South Headwall

Review Checklist

CD-17

Date: 05/03/21

Project: State Road 544 (Lucerne Park Rd) Project Development and Environment (PD&E) Study from MLK Blvd to SR 17

Location: 389+17 Size/Type 15" RCP

Road surface/Leaking joints? No

Recent development in basin? Yes

Overtopping? *Roadway* *Basin divide* *In roadway ditch*

Concerns with culvert extension? *Limited right of way* *Wetlands*

Normal high water marks: None

Tailwater: (*Ditch*) *Piped outfall* *Overland flow* *Swamp*

Erosion/Sedimentation:

Misc. Comments:

South Headwall

APPENDIX F

National Bridge Inventory Data

- LandmarkHunter.com

Share:

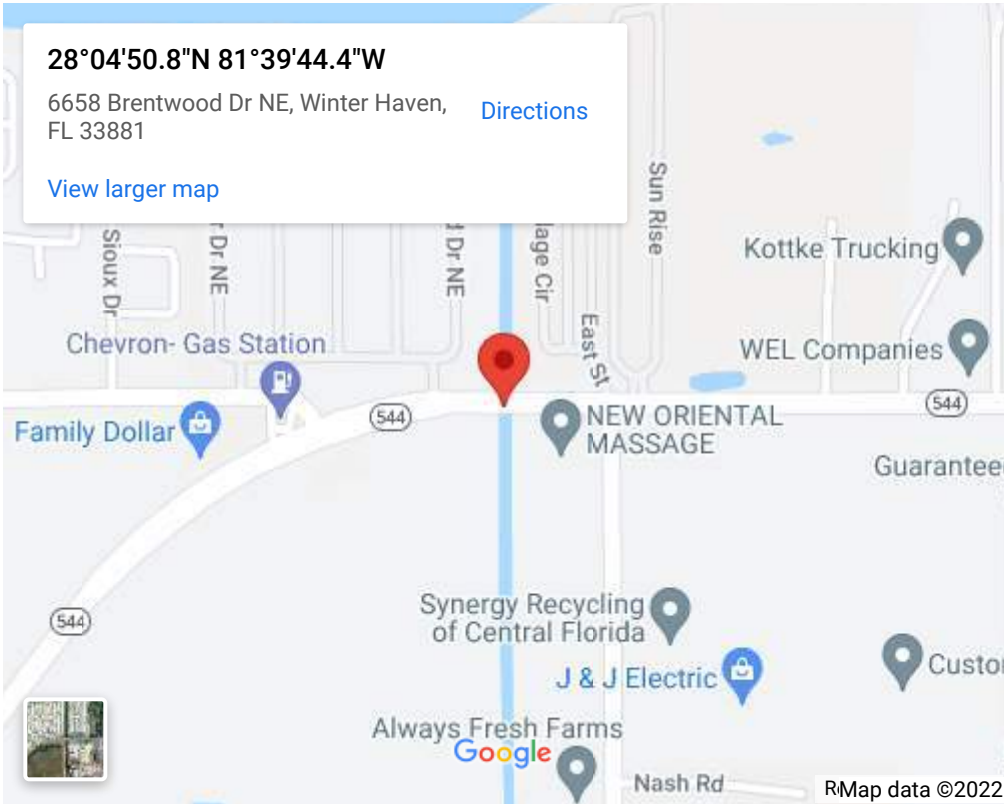
SR-544 over LAKE HAMILTON CANAL

Polk County, Florida

Map

- Google Maps
- Bing Maps
- OpenStreetMap
- MapQuest.com
- USGS National Map
- Geo URI (Android)

Coordinates:
+28.08078, -81.66233
28°04'51" N, 81°39'44" W



Facts

Source: National Bridge Inventory. Information not verified; use at your own risk.

Name:	SR-544 over LAKE HAMILTON CANAL
Structure number:	160021
Location:	0.8MI WEST OF US-27
Purpose:	Carries highway over waterway
Route classification:	Minor Arterial (Urban) *[16]*
Length of largest span:	29.9 ft. *[9.1 m]*
Total length:	89.9 ft. *[27.4 m]*
Roadway width between curbs:	43.3 ft. *[13.2 m]*
Deck width edge-to-edge:	46.3 ft. *[14.1 m]*
Owner:	State Highway Agency *[01]*
Year built:	1964
Year reconstructed:	2000
Historic significance:	Bridge is not eligible for the National Register of Historic Places *[5]*
Design load:	MS 18 / HS 20 *[5]*
Number of main spans:	3
Main spans material:	Concrete *[1]*
Main spans design:	Slab *[01]*
Deck type:	Concrete Cast-in-Place *[1]*

Latest Available Inspection: July 2018

Good/Fair/Poor Condition:	Good
Status:	Open, no restriction *[A]*
Average daily traffic:	19,500 *[as of 2017]*
Truck traffic:	9% of total traffic
Deck condition:	Good *[7 out of 9]*
Superstructure condition:	Good *[7 out of 9]*
Substructure condition:	Good *[7 out of 9]*
Structural appraisal:	Better than present minimum criteria *[7]*
Deck geometry appraisal:	Somewhat better than minimum adequacy to tolerate being left in place as is *[5]*
Water adequacy appraisal:	Equal to present desirable criteria *[8]*
Roadway alignment appraisal:	Equal to present desirable criteria *[8]*
Channel protection:	Bank protection is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and/or channel have minor amounts of drift. *[7]*
Scour condition:	Bridge foundations determined to be stable for assessed or calculated scour condition. *[5]*
Sufficiency rating:	91.6

Previous Inspections

Date	Condition	Deck	Superstructure	Substructure	ADT	Suff. Rating

July 2018	Good	Good	Good	Good	19500	91.6
July 2016	Good	Good	Good	Good	16100	92.9
July 2014	Good	Good	Good	Good	14800	93.4
July 2012	Good	Good	Good	Good	15900	93.0
November 2010	Good	Good	Good	Good	20375	90.3
December 2008	Good	Good	Good	Good	14800	92.4
December 2006	Good	Good	Good	Good	15600	92.1
December 2004	Good	Good	Good	Good	16100	92.9
January 2003	Good	Good	Good	Good	13900	93.7
January 2001	Good	Good	Good	Good	12800	94.1
January 1999	Good	Good	Good	Good	11200	74.6
December 1996	Good	Good	Good	Good	11500	74.4
May 1995	Good	Good	Good	Good	8500	75.9
June 1993	Good	-	Good	Good	8557	75.9
August 1991	Good	Good	Good	Very Good	8557	75.9

BridgeReports.com: National Bridge Inventory data
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- LandmarkHunter.com

- Go to:
- Map
- Facts
- Latest Inspection
- Previous Inspections

Share:

SR-544 over LAKE HAMILTON CREEK

Polk County, Florida

Map

- Google Maps
- Bing Maps
- OpenStreetMap
- MapQuest.com
- USGS National Map
- Geo URI (Android)

Coordinates:
+28.07968, -81.64421
28°04'47" N, 81°38'39" W

Facts

Source: National Bridge Inventory. Information not verified; use at your own risk.

Name:	SR-544 over LAKE HAMILTON CREEK
Structure number:	160147
Location:	0.2 MI EAST OF US-27
Purpose:	Carries highway over waterway
Route classification:	Collector (Urban) *[17]*
Length of largest span:	9.8 ft. *[3.0 m]*
Total length:	21.0 ft. *[6.4 m]*
Owner:	State Highway Agency *[01]*
Year built:	1965
Historic significance:	Bridge is not eligible for the National Register of Historic Places *[5]*
Design load:	MS 18+Mod / HS 20+Mod *[6]*
Number of main spans:	2
Main spans material:	Concrete *[1]*
Main spans design:	Culvert *[19]*
Deck type:	Not applicable *[N]*

Latest Available Inspection: July 2018

Good/Fair/Poor Condition:	Fair
Status:	Open, no restriction *[A]*
Average daily traffic:	9,100 *[as of 2017]*
Truck traffic:	13% of total traffic
Structural appraisal:	Equal to present minimum criteria *[6]*
Water adequacy appraisal:	Equal to present desirable criteria *[8]*
Roadway alignment appraisal:	Better than present minimum criteria *[7]*
Channel protection:	Bank protection is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and/or channel have minor amounts of drift. *[7]*
Culvert condition:	Deterioration or initial disintegration, minor chloride contamination, cracking with some leaching, or spalls on concrete or masonry walls and slabs. Local minor scouring at curtain walls, wingwalls or pipes. Metal culverts have a smooth curvature, non-symmetrical shape, significant corrosion or moderate pitting. *[6]*
Scour condition:	Bridge foundations determined to be stable for the assessed or calculated scour condition. *[8]*
Sufficiency rating:	96.9

Previous Inspections

Date	Condition	Culvert Condition	ADT	Suff. Rating
July 2018	Fair	6 out of 10	9100	96.9
July 2016	Good	7 out of 10	8500	97.0
July 2014	Good	7 out of 10	10375	96.6
July 2012	Good	7 out of 10	8400	97.0

November 2010	Good	7 out of 10	10500	97.5
December 2008	Good	7 out of 10	8000	98.1
December 2006	Good	7 out of 10	8400	98.0
December 2004	Good	7 out of 10	8500	98.0
January 2003	Good	7 out of 10	8000	98.1
January 2001	Good	7 out of 10	12800	97.0
January 1999	Good	7 out of 10	7800	98.2
January 1997	Good	8 out of 10	7800	97.2
April 1995	Good	8 out of 10	5000	97.9
June 1993	Good	8 out of 10	4502	99.0
August 1991	Good	8 out of 10	3976	98.1

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APPENDIX G

Correspondence

State Road 544
Project Development and Environment Study
From MLK Jr. Boulevard to SR 17
Polk County, Florida
Financial Project ID: 440273-1-22-01

FDOT Pond Site Coordination Meeting Summary – November 2, 2020, 3:00 pm

1. Attendees

FDOT: Richard Oujevolk, David Turley, Brent Setchell, Sergio Figueroa
Inwood: David Dangel, Jason Houck, Renato Chuw, Dayna Duffy

2. Discussion Items

a. The purpose of this meeting was to provide an overview of the preliminary pond locations for the SR 544 PD&E Study to the Department and receive feedback, in preparation to have the pond sites ready for Inwood's ecologists to conduct site specific species survey

b. An aerial display of the project along with the pond site locations was shared to all attendees and each basin description discussed with the preliminary pond site. Attached to these meeting minutes is a PDF of this display

c. It was discussed in the meeting that the scope for this study was to evaluate one pond site per basin so that the study can be environmentally cleared and demonstrated that it can be feasible. Evaluation of multiple pond sites per basin will be done during the design phase (when funded). Brent asked if site specific survey was necessary at this stage of the PD&E if only one pond site per basin was evaluated. Jason indicated that per new directives from EMO, it is required to get a Biological Opinion (BO).

d. The following items were discussed regarding each specific basin and pond site

   i. Basin 1 – two possible pond sites were explored to discuss with the Department. Pond 1A is a pond site adjacent to SR 544 and located within a parcel owned by the adjacent church. The pond site is in an old agricultural crop area but does not impact the church facility. The consensus was that it is acceptable to locate a pond site in this parcel. FDOT suggested to reshape this pond so that an access opening could be provided to the back end of the parcel. An alternative pond (1B) was also investigated and located adjacent to Lake Smart. This site is about 2000 feet away from SR 544 and not within a church property. However, the pipe easement from SR 544 would have to cross a high ridge line, making the inflow pipe at this location very deep. FDOT indicated that because of this, this pond site should not be evaluated. The direction was to proceed in evaluating Pond 1A.

   ii. Basin 2 – during the discussions, Inwood indicated that Basin 2 could be left untreated and compensating treatment provided in the pond site for Basin 1 (since they shared the same outfall). However, Brent suggested that because these lakes are impaired for nutrients, it is preferrable to have a dedicated pond site for Basin 2. Another option was to utilize the proposed floodplain compensation site to capture pollutants and provide some benefit to nutrient removal prior to discharging to the lake. Another potential pond location is on another church-owned parcel across from Lake Smart. This site will also be identified for the purpose of conducting the species survey.

iii. Basin 3 – the treatment and floodplain compensation sites are proposed to abut each other and located on a private parcel. FDOT agreed with the pond site location.

iv. Basin 4 – the treatment and floodplain compensation sites are proposed to abut each other and located on a private parcel. FDOT agreed with the pond site location.

v. Basin 5 and 6 – FDOT agreed with the proposed floodplain compensation site. For the treatment pond option, this was another basin that compensating treatment could be proposed (enlarging Pond 5 and not having a pond for Basin 6). However, due to the nutrient impairments of the lakes and to provide as much benefit to the environment, a dedicated pond site will be sited in Basin 6. FDOT mentioned that a floodplain complaint was logged for the adjacent mobile homes where the preliminary Pond 6 site is shown. The conclusion was that FDOT was not the cause of the flooding. There is an existing pond on this site that overtops the berm. One suggestion from David Turley was to evaluate if the pond can be located on the adjacent parcel to the north of the Pond 6 to avoid impacting the house within the property, or if the pond could utilize the existing pond in front of the house and be equalized with a second, new pond on the adjacent parcel. Inwood will investigate these options. FDOT agreed with the pond site for Basin 5.

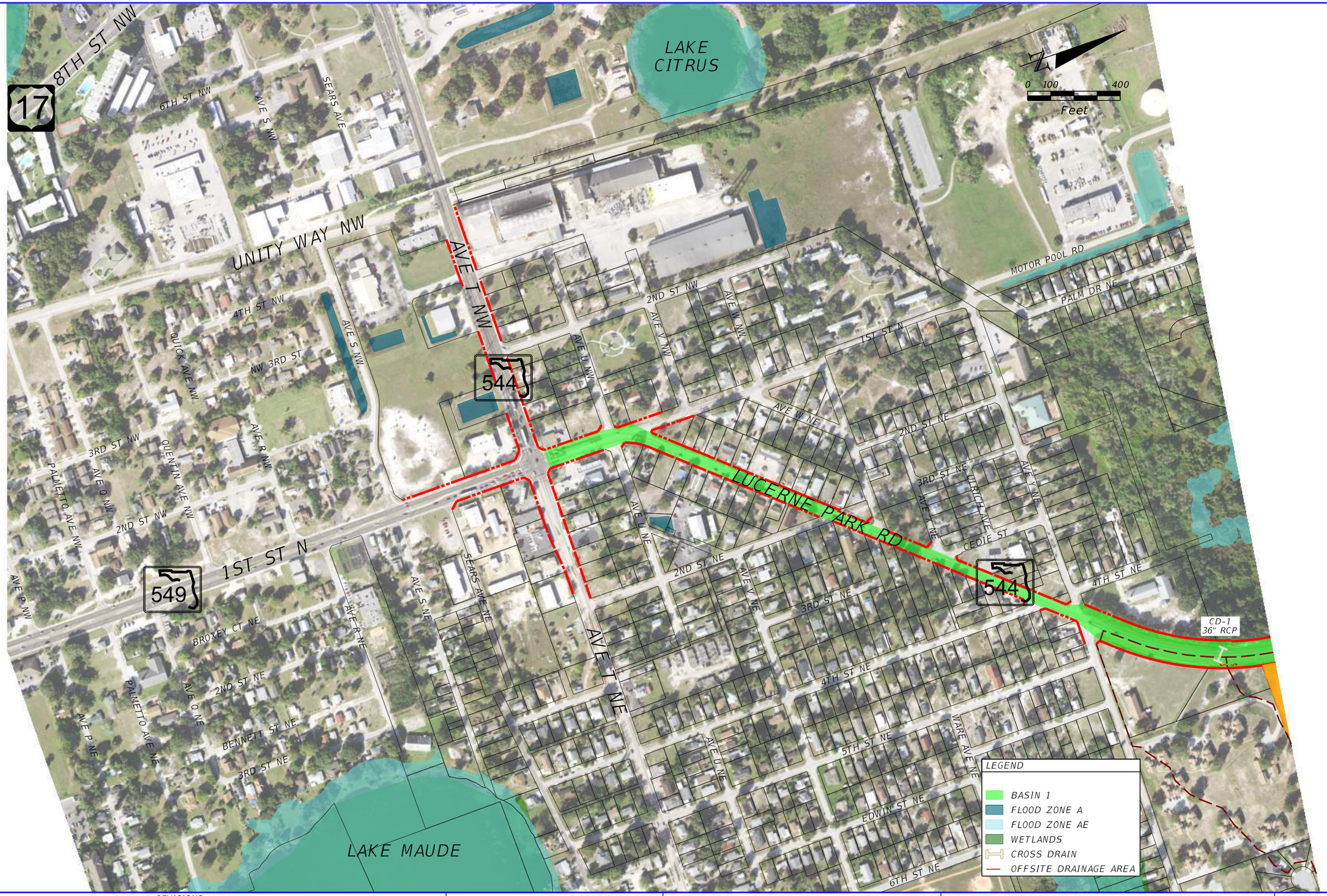
vi. Basin 7 – an existing FDOT pond was constructed that already treats portions of SR 544 and the turn lanes built under the existing development at the corner of SR 544 and US 27. FDOT agreed that this pond would be good to evaluate for this basin. Some expansion of the pond may be necessary to accommodate the proposed improvements of SR 544 for the study.

vii. Basin 8 and 9 – a single pond site is proposed adjacent to Lake Hamilton Creek with a compensating treatment approach. The site is outside of the floodplains with a direct outfall to the creek. A floodplain compensation site is proposed to abut the treatment site. Inwood mentioned that the compensating treatment approach made more sense in this area due the bridge culvert crossing and the large floodplain coverage within Basin 8. FDOT agreed with this pond site.

viii. Basin 10 – the pond site is on a private parcel, across from Lake Butler. There is an existing closed drainage system along SR 544 that drains to Lake Butler. The existing cross drain (CD-17, 15” pipe) collects and directs mostly the roadside runoff to the lake. This pond will be a dry retention pond but will also have an emergency outfall structure to discharge to Lake Butler. FDOT agreed with this pond site.

e. Sergio asked if we were scoped to evaluate Environmental Look Arounds/regional stormwater opportunities. Inwood mentioned that we will conduct meetings with the stakeholders including the Lakes Region Lake Water Management District (LRLWMD) to discuss any opportunities and document in the Pond Siting Report. Brent also suggested to contact the City of Winter Haven and ask about their stormwater master plan and see if there were any opportunities for their canal systems to provide a regional stormwater approach.

The meeting concluded at 4:00 pm



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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID

SHEET NO.
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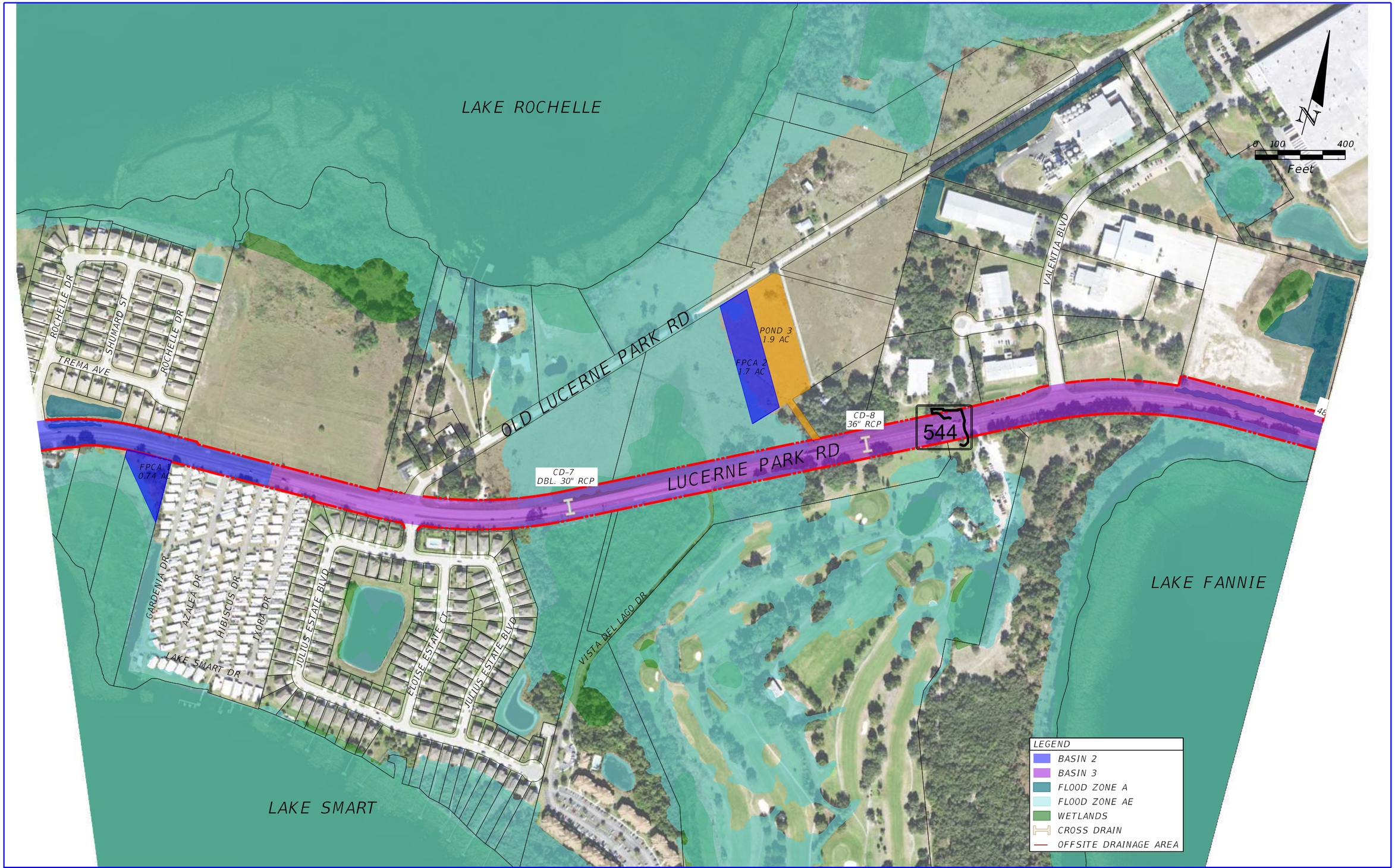

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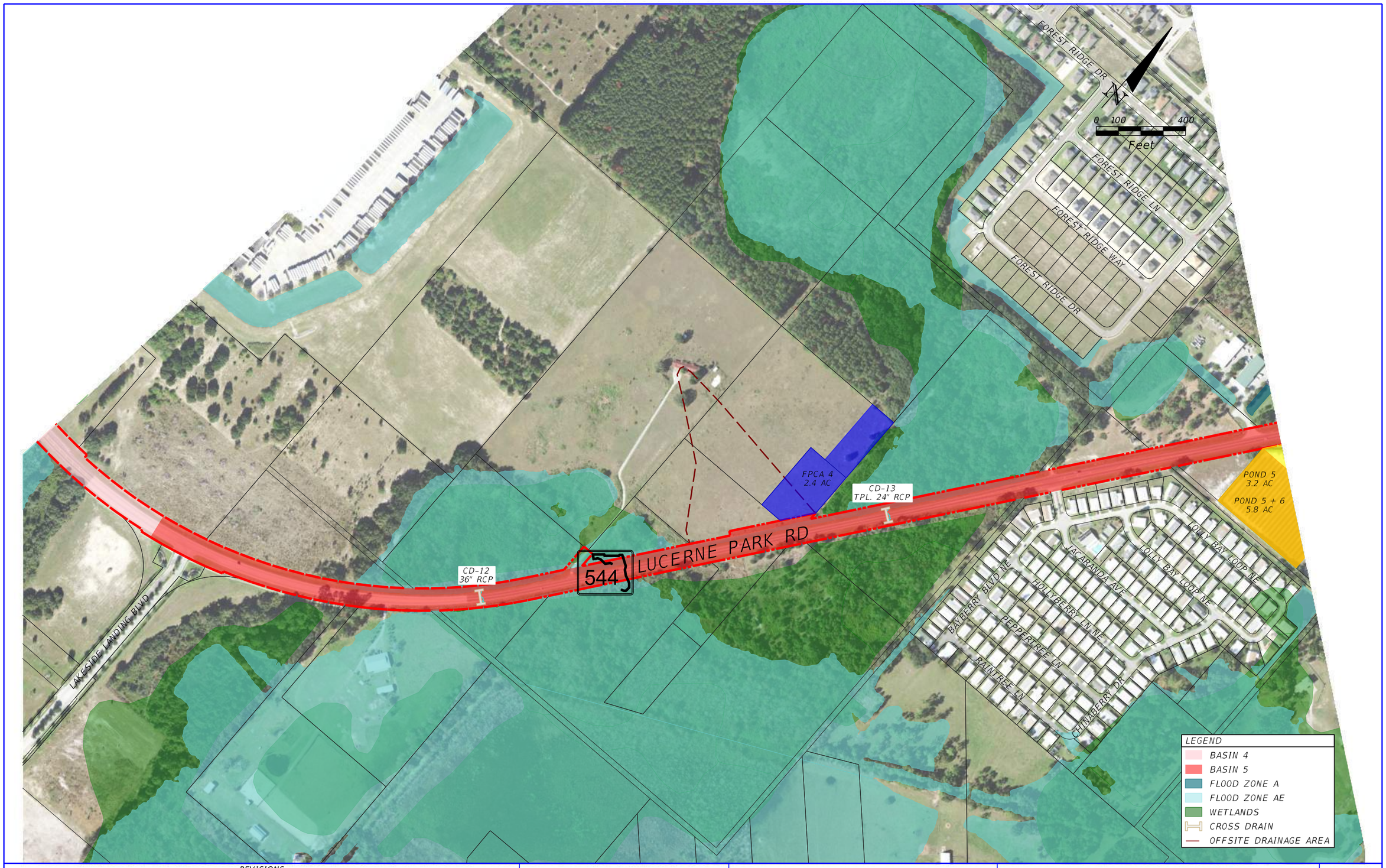

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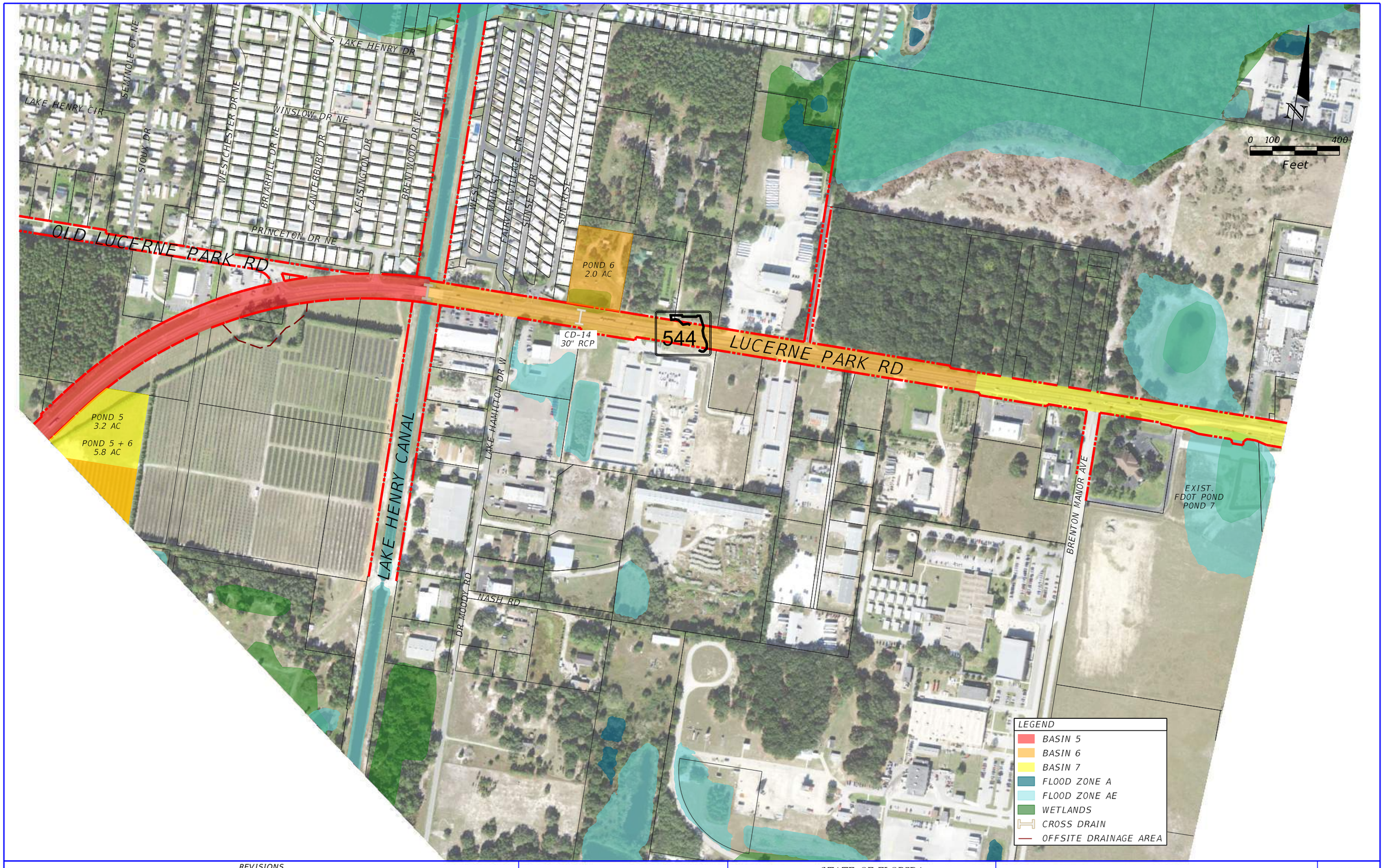

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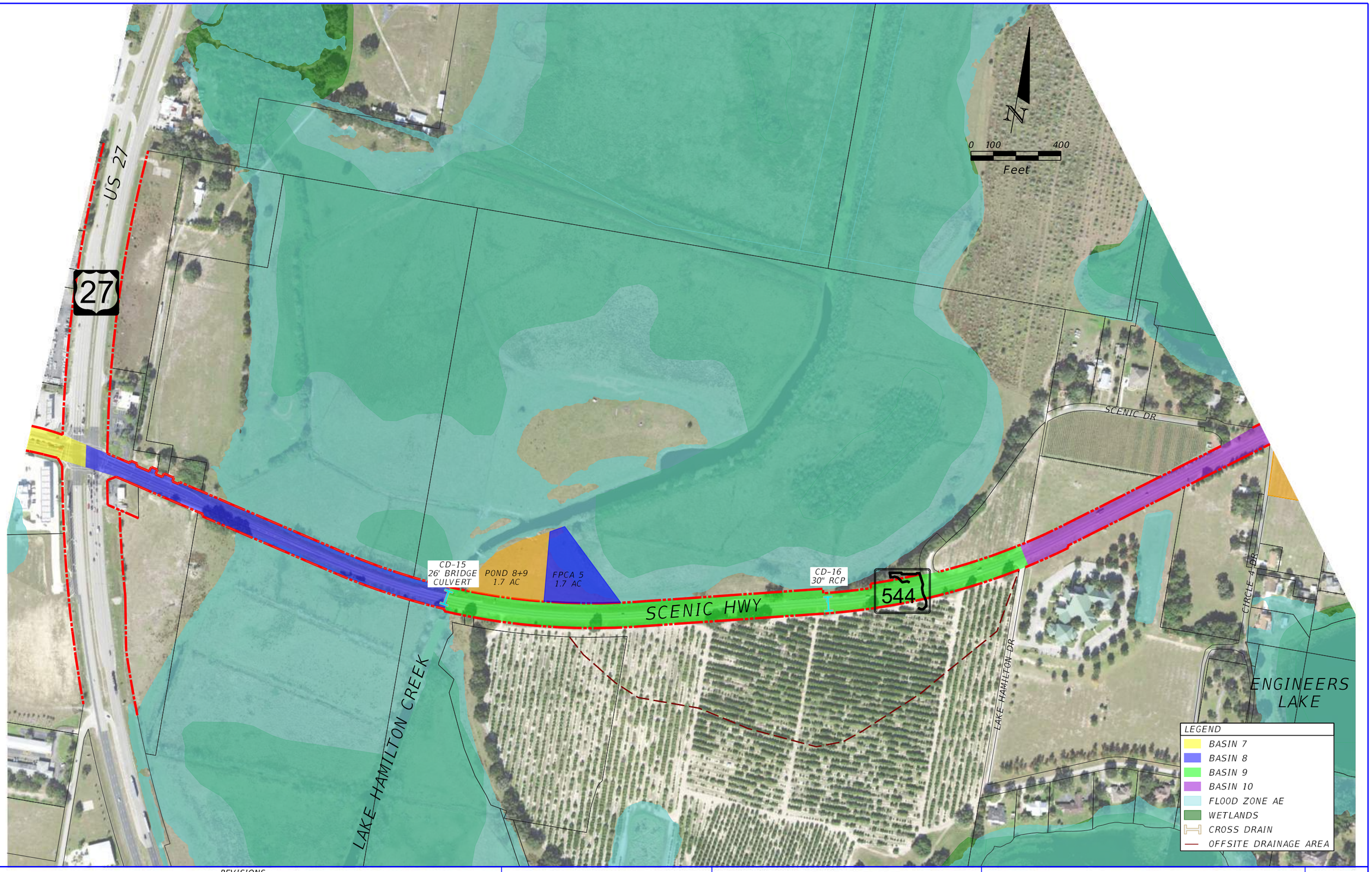

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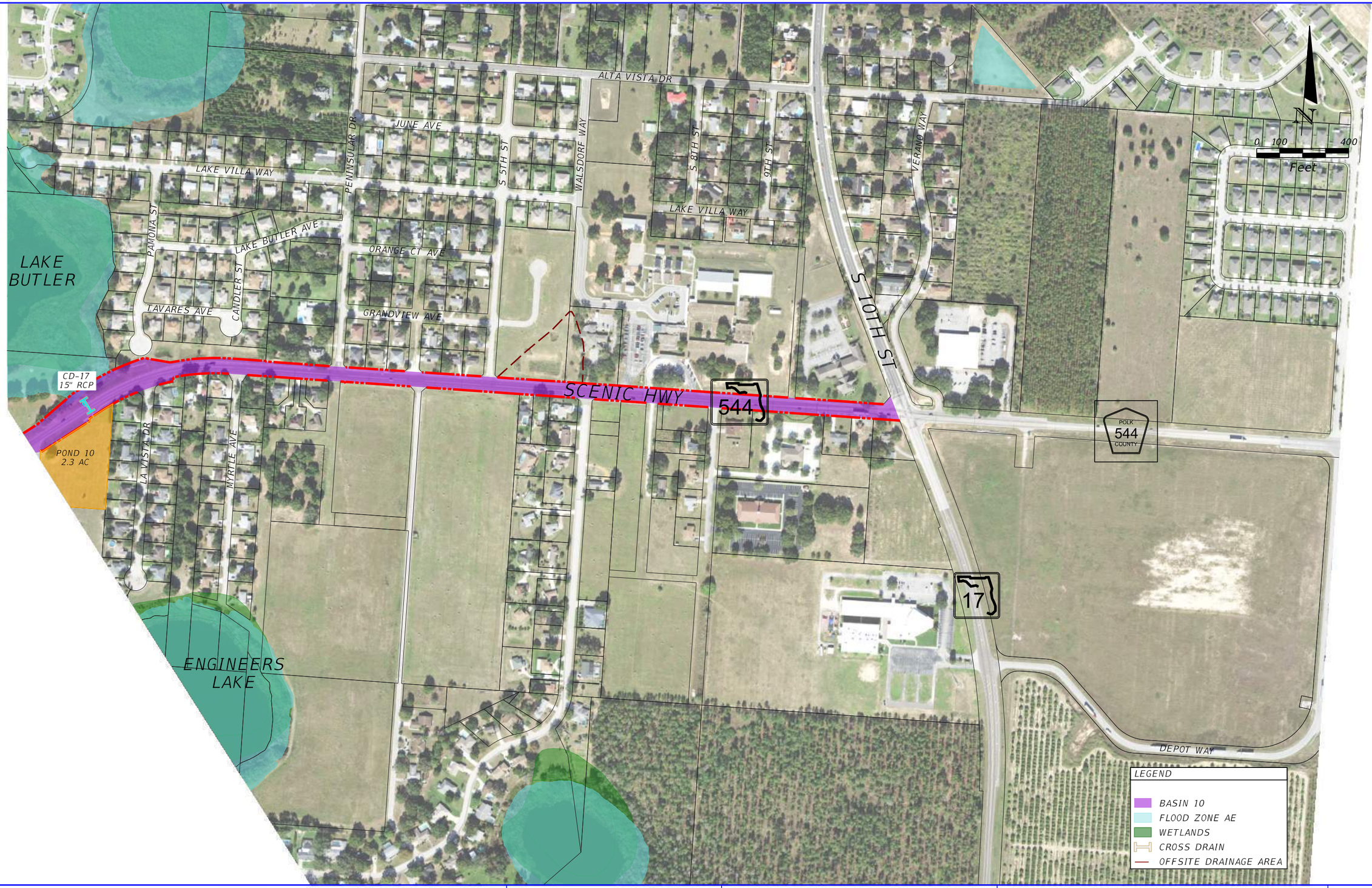

REVISIONS			
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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID

SHEET NO.
8

State Road 544
Project Development and Environment Study
From MLK Jr. Boulevard to SR 17
Polk County, Florida
Financial Project ID: 440273-1-22-01

FDOT Pond Site Coordination Meeting Summary – August 12, 2021 at 10 a.m.

1. Attendees

FDOT: Richard Oujevolk, David Turley, Brent Setchell, Sergio Figueroa
Inwood: David Dangel, Jason Houck, Jada Barhorst, Renato Chuw, Dayna Duffy

2. Discussion Items

- The purpose of the meeting was to provide FDOT with updated pond sites from the original sites shown back in November 2020. Since then, new developments and permit applications have been submitted that required some of the pond sites to be reshaped or relocated to different parcels.

- A separate basin (Basin 1A) was created with a dry pond (Pond 1A) north of the beginning of the project in the Florence Villa historic district. The dry pond will be located in a remnant area within FDOT R/W. This remnant area will be created by the realignment of the intersection of 1st St. N and SR 544. Brent concurred with the site.

- This new Basin and Pond 1A allowed for the previous Pond 1 to be smaller due to the reduced volume requirements. The existing ground rises rapidly east of Pond 1. Brent indicated that the site appears to have been an agricultural land and if so, there will be a benefit in accepting the offsite water into the pond due to the reduction in nutrient loadings.

    - David indicated that there are plans for a future road just south of the church and to discuss reshaping the pond to allow room for the future road. David will coordinate with drainage for the preliminary location of the road. The pond could be shortened on the north end and expanded to the east to make up the volume needed.

    - Pond 1 also has the option to provide compensating treatment for Basin 2, since these two basins share the same outfall to the lakes. David mentioned that the project is intended to be full reconstruction of the road. Brent stated that we will need to verify with SWFWMD regarding compensating treatment as they have applied it on hardship situations. Inwood will request for this project to be added in the agenda for the Sept. 1st monthly meeting with SWFWMD for the pre application meeting and will discuss the compensating treatment applicability.

    - Brent mentioned that if we can show a net benefit to the environment, SWFWMD may be more lenient on allowing compensating treatment.

- Pond 2 was shown as a standalone pond in Basin 2 in case the compensating treatment approach would not be applicable. Brent concurred with the site

- FPCA 1, FPCA 2 and Pond 3 did not change shape or locations from the November 2020 meeting. No comments from FDOT on these sites

- FPCA 3 and Pond 4 changed from the original locations due to recent development and permit on the parcel. The new Pond 4 occupies an existing borrow pit on the adjacent parcel to the east. FPCA 3 was divided into two separate sites (FPCA 3A and 3B), each abutting the north and south side of Pond 4. Brent asked if FPCA

3B (north side) could be reshaped to allow a better remnant to the parcel. However, after explaining that an access gap was provided on the east side of the parcel, Brent concurred with the site and shapes shown in the meeting.

- FPCA 4 and Pond 5 changed from the original locations due to a future residential development on the parcel for Pond 5 and a commercial development on the parcel for FPCA 4. The new locations are located on a privately owned parcel south of the project with an existing easement from SR 544. The new Pond 5 location encroaches into the floodplains and Brent suggested another option would be to place the pond on the adjacent parcel to the east. However, Brent indicated that his preference is to impact just one parcel. Inwood stated that as the roadway concept is refined more, a more accurate floodplain impact volume will be estimated and then it will be determined if the new Pond 5 location would be acceptable. The outfall for the new pond would be either to the existing ditch that runs along the south side of the parcel or to the adjacent wetlands.

- The previous Pond 5 location had the option for an expanded shape to provide compensating treatment, however, it was agreed to provide a dedicated pond for Basin 6. This site was previously shown in the November 2020 meeting. There is also a flooding complaint on the adjacent mobile home park. This would be another reason to site a pond for Basin 6 to see if it could provide relief for the existing flooding. Brent mentioned that FDOT has documentation regarding this flooding. Inwood mentioned that they will check back through their files for the documentation or request it from FDOT if needed.

- Inwood explained that the existing FDOT pond on the south side of SR 544 for Basin 7 is proposed to be relocated further south due to the new truck parking development on the parcel. Brent was aware of this project as FDOT had been coordinating with the property owner. Inwood stated that the existing permit and calculations were checked for the FDOT pond and that enough capacity is provided for the minor improvements to SR 544 in the basin. Most of the road has already been improved to four lanes at the intersection with US 27. Brent stated that he was hesitant on relying solely on the existing FDOT pond since the basin is a closed basin and FDOT had discussed with the property owner that the existing FDOT pond would be collecting the turn lanes on SR 544. Even if there was capacity for the rest of SR 544 improvements, Brent was concerned on adding more water to the pond and overloading it, giving reasons to the property owner for future issues.

    - David indicated that two concepts are currently being evaluated for the intersection at US 27, one of which is a quadrant roadway. Additional R/W for the roadway is anticipated along the north side of SR 544. Brent suggested that another option would be get more roadway right of way and provide linear swale treatment for Basin 7. Inwood will investigate the swale capacity required and add this to their concept.

    - For the quadrant roadway option, a separate pond was shown. The pond occupies the southern portion of the quadrant roadway and the size was based on accommodating the offsite runoff being as it is in a closed basin. An outfall will be provided to the NW to the existing wetlands and the size of the pond also accommodates the attenuation in the existing condition to the wetlands. Brent suggested to eliminate the access gap along the east side of the pond. Inwood will revise the shape accordingly.

    - Brent indicated that the existing cross drain in Basin 7 acts as a relief from the floodplains to the south with a bubble up structure.

- The pond in Basin 9 remained the same as the original location presented in November 2020. However, the pond also provides compensating treatment for Basin 8. Inwood mentioned that a pond site in Basin 8 was previously shown but taken out in favor of the compensating treatment approach. As mentioned before, FDOT had concerns regarding the compensating treatment applicability with SWFWMD, so it was agreed to provide a pond in Basin 8 for conservative measures. The compensating treatment would be acceptable if a

net improvement to the watershed can be demonstrated and will be verified with SWFWMD at the pre app meeting.

    - David mentioned that a Duke easement is proposed along the north side of SR 544 through this basin and that Inwood is currently coordinating with the utility agency and will need to verify that the pond shape will not conflict with the easement

- For Basin 10, Inwood explained that there is a permit exemption request from the property owner to have the ability to either develop houses or sell the property in the future. However, no development concept plans are available or prepared. Another site alternative was shown in the meeting west of this pond site and north of SR 544. Inwood asked if the Department had a preference on which site to move forward with. Brent indicated that because this is a PD&E study, it was OK to leave the original site for consideration. Furthermore, the outfall for the site is an existing cross drain in front of the pond site which made this site preferable. The pond location will also allow for the inflow pipe to discharge to the pond without having to cross the existing cross drain.

Action Items

1. Inwood to coordinate with Nicole Monies to include this project in the agenda for the pre app meeting with SWFWMD on Sept. 1st
2. Inwood to adjust Pond 1 shape to allow for the future access road south of the church
3. Investigate if Pond 1 can accept offsite runoff to the east to assist in the nutrient loading reductions
4. Investigate if Pond 5 can remain within the floodplain encroachments
5. Inwood to investigate if more roadway R/W can be acquired for a linear swale for assisted treatment in Basin 7
6. Inwood to revise shape of Pond 7 for the quadrant option to eliminate access gap on the east side
7. Inwood to locate pond in Basin 8 in case compensating treatment is not possible
8. Inwood to investigate Duke easement and potential impacts to Pond 9

The meeting concluded at 11:00 am

Meeting Minutes

3000 Dovera Drive, Suite 200, Oviedo, FL 32765 I P: 407-971-8850 I F: 407-971-8955 I www.inwoodinc.com

DATE: September 1, 2021

TO: **All Attendees / Project File**

FROM: Renato Chuw, PE

RE: SR 544 PD&E Study FPID 440273-1; SWFWMD Pre Application Meeting

CC: David Turley, Richard Oujevolk, Jonathon Bennett

A Pre-Application meeting was held for the SR 544 PD&E Study with Southwest Florida Water Management District (SWFWMD) on September 1st, 2021, at 2:00 PM. The meeting was held via a Teams meeting. In attendance were:

Dave Kramer (SWFWMD)
Al Gagne (SWFWMD)
Brent Setchell (FDOT)
Sergio Figueroa (FDOT)
Nicole Monies (FDOT)
Ben Shepherd (FDOT GEC)
David Dangel (Inwood)
Renato Chuw (Inwood)
Dayna Duffy (Inwood)
Jada Barhorst (Inwood)

The following is a summary of the items discussed in this meeting:

Project overview and description

- Renato shared his screen with Google Earth along with a KMZ of the project limits, drainage basins and preliminary pond site locations. An overview of the project was provided. The project begins at MLK Jr. Blvd/Avenue T in Winter Haven and extends to SR 17 in Haines City. The scope of the project is to evaluate widening SR 544 from two to four lanes. There are a total of 17 cross drains within the project, including 3 major (bridge culvert or bridge) crossings. These are located at the canal between Lake Conine and Lake Smart, at Lake Henry Canal, and at Lake Hamilton Creek.
- The project is within the Peace River Basin and has been divided into 10 drainage basins based on existing outfall locations and drainage patterns.
- Basin 7, located west of US 27, is a closed basin. Within this basin, there is an existing FDOT pond that will soon be relocated as part of a new development. Renato also pointed out that there is a potential quadrant roadway concept at this intersection and a separate pond site was located for this alternative.
- Renato mentioned that Inwood met with SWFWMD two years ago for a pre-application meeting while pursuing this project. At that time, SWFWMD stated that it would be acceptable to provide treatment only for net-new impervious if it could be physically separated from the existing runoff. However, at the time it was expected that the original lanes would remain throughout most of the project and two new lanes would be constructed. It is now anticipated that full reconstruction will be necessary due to right-of-way constraints.
    - Dave Kramer stated that while net new impervious is the minimum acceptable treatment, it would be preferable to SWFWMD to see treatment provided for all contributing DCIA in each basin.
    - Brent Setchell added that since right-of-way acquisition is needed anyway, FDOT would also prefer the most conservative approach of treating the total area of the reconstructed pavement.

- In Basins 1 and 2, one idea presented was to provide a larger pond in Basin 1 that would overtreat that basin and provide compensation for Basin 2 since at the time, it was thought that these two basins discharge to a common location (Lake Conine and Lake Smart which are connected by a canal crossing SR 544). Basin 2 would then discharge untreated.
    - FDOT had previously concurred with this idea and pointed out that the pond site for Basin 1 has a large offsite area of pasture that could be treated in the pond to balance the additional treatment for Basin 2 and show net benefit (nutrient reduction) to the basin.
    - SWFWMD indicated that although Basins 1 and 2 discharge to different lakes that are connected by a free-flowing canal, they are separate WBIDs and would recommend keeping them as separate basins and have one pond in each basin. Inwood had previously sited an alternative pond for Basin 2 so this will now be shown as the pond site for Basin 2.
- In Basins 8 and 9, a similar plan to use compensating treatment was proposed by Inwood. Both basins drain to Lake Hamilton Creek. Inwood mentioned that based on previous discussion with FDOT, they planned to show separate ponds for both basins moving forward.
    - SWFWMD mentioned that since these basins do drain to the same WBID, compensation might be more acceptable here.
    - Inwood will still locate a separate Basin 8 pond at the request of FDOT.
- Renato mentioned that the Lake Region Lakes Management District (LRLMD) is also a stakeholder on the project and will be contacted soon. Inwood met with them previously and obtained some information about local stormwater projects.
    - The Lake Conine Stormwater Park is located adjacent to the project but cannot be used for treatment of the roadway improvement since it was a cooperative project between LRLMD and SWFWMD with grant funding dedicated only for the scope of that project.
    - Inwood and SWFWMD are also aware of another LRLMD project, believed to be located near Lake Eloise. SWFWMD believed this project was too far from the SR 544 project to provide any potential credits.
- Renato mentioned that the first half of this project (from Avenue T until the Walmart Distribution Center) is funded for design in 2025 with the remainder of the project is unfunded. However, it is expected to be added to the 5-year work program soon.
- Renato also briefly discussed the floodplains on the project. There are multiple encroachments associated with various lakes and canals in the area. The floodplains are well defined and have established Zone AE 100-year elevations.
    - Inwood utilized a standard cup for cup compensation approach when sizing and siting the floodplain compensation sites.
    - Inwood is also aware of the Peace Creek Watershed study and will verify that the floodplains are consistent with those shown in FEMA maps.
- Jada provided an overview of the ecological and environmental permitting concerns on the project. Inwood's ecology team has completed several species surveys along the corridor. They are also investigating credits available in wetland mitigation banks to offset potential wetland impacts.
    - Albert Gagne mentioned that there could be Sovereign Submerged Lands (SSL) along the corridor and that this should be investigated if purchasing right-of-way adjacent to lakes.
    - Nicole Monies mentioned that she is aware the Peace River mitigation bank will not have forested credits available for several years.

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Action Items

- Inwood to revise all ponds to include treatment for all lanes of the corridor.
- Inwood to show separate ponds for each basin including Basins 2 and 8 which previously used a compensating approach.
- Inwood to arrange a meeting with LRLMD to discuss ELA opportunities.

These are the author's understanding of the discussions and decisions reached at this meeting. If there are comments or questions, please contact Renato Chuw at rchuw@inwoodinc.com or 407-971-8850.

Meeting Minutes

3000 Dovera Drive, Suite 200, Oviedo, FL 32765 I P: 407-971-8850 I F: 407-971-8955 I www.inwoodinc.com

DATE: November 30, 2021

TO: **All Attendees / Project File**

FROM: Renato Chuw, PE

RE: SR 544 PD&E Study FPID 440273-1; Lake Region Lakes Management District (LRLMD) Environmental Look Arounds (ELA) Meeting

CC: Sergio Figueroa, Richard Oujevolk, Jonathon Bennett

An Environmental Look Arounds (ELA) meeting was held for the SR 544 PD&E Study with the Lake Region Lakes Management District (LRLMD) on November 30th, 2021, at 2:00 PM. The meeting was held via a Teams meeting. In attendance were:

Roger Griffiths (LRLMD)	David Dangel (Inwood)
Brent Setchell (FDOT)	Renato Chuw (Inwood)
David Turley (FDOT)	Dayna Duffy (Inwood)
	Jada Barhorst (Inwood)

The purpose of this meeting was to discuss potential regional stormwater opportunities ("Environmental Look Arounds-ELA") with the Lake Region Lakes Management District (LRLMD). The following is a summary of the items discussed in this meeting:

- Renato shared his screen with Google Earth along with a KMZ of the project limits, drainage basins and preliminary pond site locations. Proposed stormwater treatment ponds and floodplain compensation ponds for each basin were shown. An overview of the project was provided. The project begins at MLK Jr. Blvd/Avenue T in Winter Haven and extends to SR 17 in Haines City. The scope of the project is to evaluate widening SR 544 from two to four lanes.

- Inwood had previously met with the LRLMD two years ago while pursuing this project and the objective of today's meeting was to revisit any potential opportunities for regional stormwater / ELA.

- It was confirmed in the meeting that using credits in the Lake Conine Wetland restoration project is not available for the purpose of the road improvement because of the funding mechanism specifically for the wetland restoration project. This was also stated by SWFWMD in the pre-application meeting held in September 2021.

- Previous discussion with LRLMD indicated the willingness to place pond sites on their parcels if they could include aesthetics and park-like features, specifically, the boat ramp parcel to Lake Fannie. However, the decision was to avoid placing pond sites in these Section 4(f) resources.

- LRLMD mentioned a new house built along Lake Smart, just north of the Winter Ridge Condos. Access to the house was discussed. Inwood indicated that this will be evaluated as the proposed roadway concepts are refined with the widening options.

- LRLMD expressed concern about access into and out of the boat ramp entrance to Lake Conine (west of SR 544) with acceleration and deceleration lanes on SR 544, which in the existing condition, is not provided. Inwood indicated that the four-lane improvement of SR 544 will accommodate this.

- LRLMD expressed their desire to realign the existing box culvert connecting Lake Conine and Lake Smart if improvements are proposed to this culvert resulting from the four-lane widening. Realigning the culvert will provide for better visibility to boaters. In addition, providing more vertical clearance inside the culvert would be desirable. LRLMD indicated that they are willing to realign portions of the canal as needed to accommodate the improvements.

- The segment of SR 544 from MLK Boulevard to the Walmart Distribution Center is funded for design in 2025. The segment from the Walmart Distribution Center to SR 17 is currently not funded but FDOT anticipates that it will be included in their 5-year work program.

- Inwood inquire if the LRLMD was aware of any potential regional stormwater opportunities in the area. LRLMD indicated that there is a property next to the Lake Fannie boat ramp that is vacant that may be suitable for a pond site. However, after looking at maps, this area appears to contain wetlands and is within the existing floodplain associated with Lake Fannie and more likely will present challenges to show avoidance and minimization of wetland impacts.

- A previous item discussed in 2019 was regarding the Lake Eloise treatment project. LRLMD indicated that this project would not work for any credits apply toward the SR 544 project.

- Nutrient loading analysis for the project will be evaluated as part of the SR 544 study with the proposed stormwater ponds. An option was discussed regarding possible conversion of some of the existing communities that are on septic to sewer, but this would involve cooperative efforts with the City.

- Inwood mentioned that a public meeting will be held in February 2022 to present initial roadway and typical section concepts. LRLMD expressed their desired to stay involved and informed on the study progression.

These are the author's understanding of the discussions and decisions reached at this meeting. If there are comments or questions, please contact Renato Chuw at rchuw@inwoodinc.com or 407-971-8850.

DRAINAGE COMPLAINT STUDY

SR 544 – POLK COUNTY

LAKESIDE RANCH ESTATES
SR 544 IN WINTER HAVEN

Prepared for:

FLORIDA DEPARTMENT OF TRANSPORTATION
District One
Bartow, FL

Prepared By:

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801 Broadway Ave
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1. INTRODUCTION

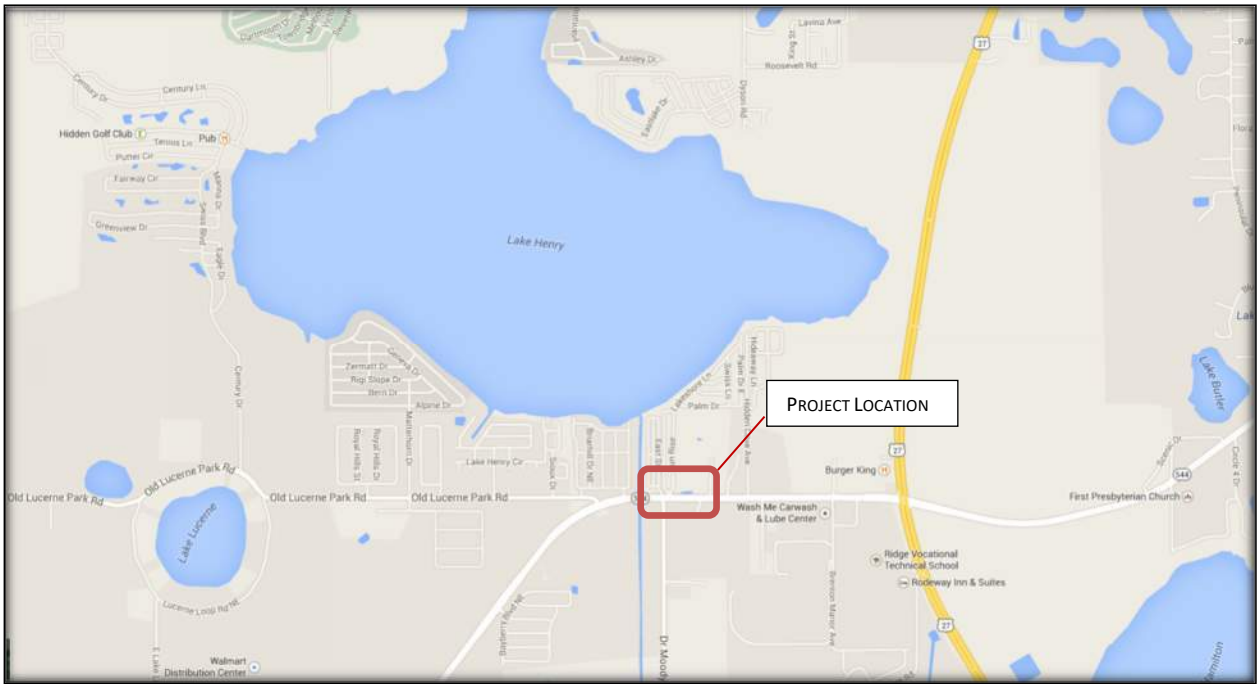

Figure 1: Project Location Map

2. DATA COLLECTION

Following is a list of data sources utilized in this investigation:

- On-site meeting with Residents March 24th, 2015
- Cook Surveying and Mapping, Inc. Survey (provided by residents)
- Polk County Property Appraiser
- Southwest Florida Water Management District permitting
- USGS
- FDOT straight line diagrams
- FDOT historical drainage maps (Section 16140-3501)
- FDOT construction plans for SR 544, 197429-1-52-01
- FDOT construction plans for SR 544, 197697-1-52-01

- FDOT Permits 2011-H-190-0179, C1605292, 2013-D-190-0003
- Field review April 27th, 2015

3. EXISTING CONDITIONS

SR 544 is an east west 2-lane urban facility with 12-foot travel lane and 5-foot paved shoulders. The road is in a normal crown section in this location. There is an existing 30-inch cross drain on SR 544, east of the Lakeside Estate entrance, which historically conveyed runoff from the south side of the roadway to an existing offsite pond located on the north side of SR 544. This runoff was then conveyed northward to Lake Henry via a system of drainage ditches and swales.

The majority of the runoff on the north side of the roadway from 1800-feet east of the cross drain, is conveyed westward to the historic 30-inch outfall via ditches and swales and through several driveway culverts. On the west side of the outfall, the runoff is collected from the Lake Hamilton Bridge and roadway areas and conveyed via ditch/swale through two existing driveway culverts and to the existing outfall.

The runoff on the south side of the roadway is conveyed via ditch/swale system from 1800-feet east of the outfall, through several driveway culverts to the historical 30-inch outfall. The runoff from the west side of the roadway and bridge section is also collected via ditch/swale and is directed to the outfall.

The flooding in this area appears to have be caused by a lack of maintenance of the existing outfall system on the north side of the roadway. The pond has become overgrown in recent years which has significantly reduced the capacity, whilst the existing outfall to Lake Henry has also become overgrown and can no longer convey runoff to the Lake. The conveyance ditches and swales previously used for conveyance have also been blocked by the addition of a private roadway/driveway entrance on private property which has been documented during FDOT staff site visits.

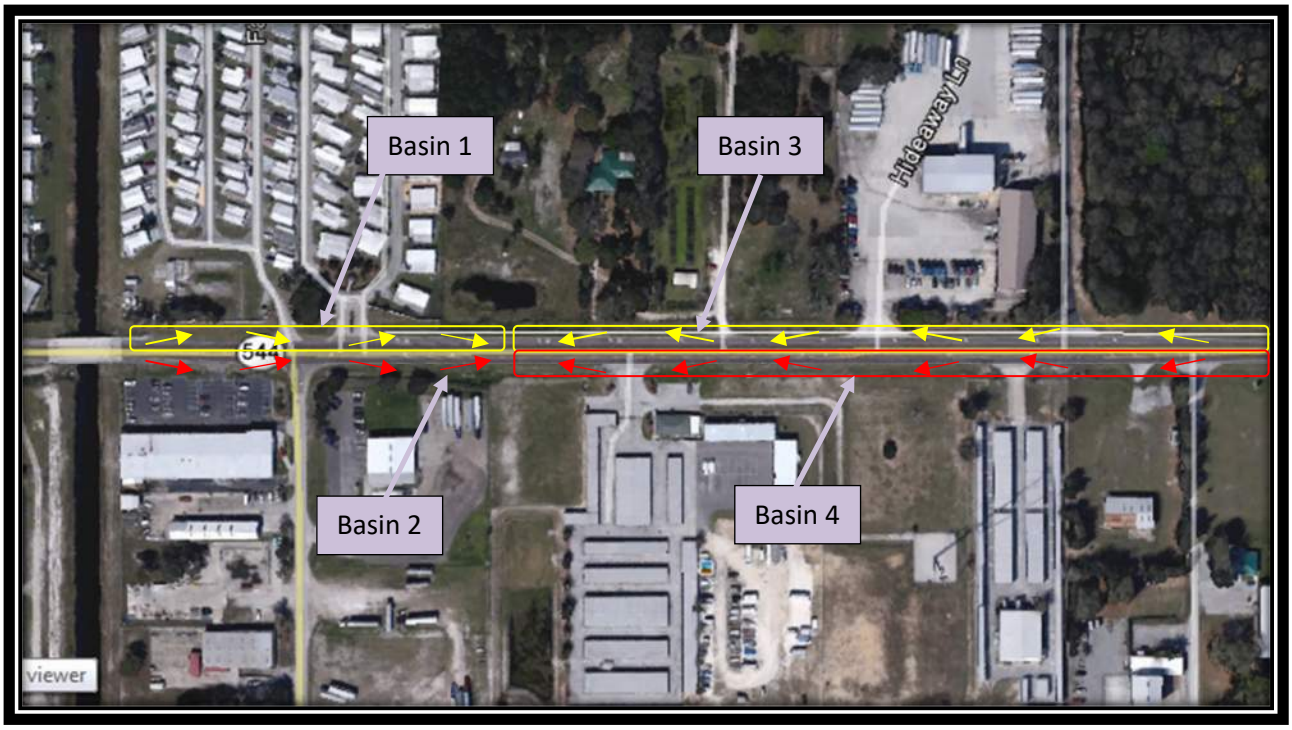

Figure 2: Project Existing Drainage Basin Map

BASIN 1:

The area included in the Basin 1 drainage boundary extends from the center of SR 544 roadway northward to the FDOT right of way line on the north side of the roadway. The area includes runoff from the bottom of the existing bridge to the location of the 30-inch cross-drain which discharges into the FDOT ditch from under SR 544.

Area & CN:

Basin Area	0.72 acres				
Impervious area:					
Roadway (CN 98)	0.39 acres	X	98	=	38.22
Pervious area:					
Ditches (CN 39)	0.33 acres	X	39	=	12.87
	0.72 acres				51.09
Weighted CN Calculation:	(0.39) X (98)	=	38.22		
	(0.33) X (39)	=	12.87		
	0.72 acres		51.09		**Weighted CN = 71.0**

BASIN 2:

The area included in the Basin 2 drainage boundary extends from the center of the roadway southward to the FDOT right of way line on the south side of the roadway. The area extends along the length of the SR 544 roadway from the existing bridge to the location of 30-inch cross-drain which conveys runoff from the southside of the road to the north. Basin 2 also includes additional offsite runoff from Lake Hamilton Dr. W., (south of SR 544), which drains from the south northward discharging into the SR 544 ditch. The runoff within this basin area then collectively drains eastwards towards the existing 30-inch cross drain under SR 544. Basin 4 also includes runoff from the offsite StoreRite development on the south side of the roadway. The permitted runoff from this site is documented in FDOT Drainage Application 2013-D-190-0003 and is included in the model using the maximum discharge rate during the peak storm event of 1.0-cfs.

Area & CN:

Basin Area 1.53 acres

Impervious area:						
Roadway	(CN 98)	0.70 acres	X	98	=	68.60
Offsite parking	(CN 98)	0.15 acres	X	98	=	14.70
Total Impervious		0.85 ac				83.3
Pervious area:						
Grassed area	(CN 39)	0.68 acres	X	39	=	26.52

Weighted CN Calculation:	(0.85) X (98)	=	83.3	
	(0.68) X (39)	=	26.52	
	1.53 ac		109.82	**Weighted CN = 71.8**

StoreRite

Offsite Drainage = 1.0 cfs

BASIN 3:

The area included in the Basin 3 drainage boundary extends from the center of the roadway northward to the right of way property line. The area extends from the center of the roadway at the location of the 30-inch crossdrain to for approximately 1400-feet eastward along SR 544 to the beginning of the roadway taper. The drainage basin is bordered by the right of way line on the northern side of the roadway.

Area & CN:

Basin Area 1.43 acres

Impervious area:						
Roadway	(CN 98)	0.90 acres	X	98	=	88.20
Pervious area:						
Grassed area	(CN 39)	0.53 acres	X	39	=	20.98

Weighted CN Calculation:	(0.90) X (98)	=	88.20	
	(0.53) X (39)	=	20.98	
	1.43 acres		109.18	**Weighted CN = 76.1**

BASIN 4:

The area included in the Basin 4 boundary extends from the centerline of SR 544 southward to the right of way line on the southside of the roadway. This area includes the runoff from the east side of the existing driveway for the Dollar General Store westward to the existing 30-inch crossdrain under SR 544.

Area & CN:

Basin Area 2.23 acres

Impervious area:

Roadway	(CN 98) 1.14 acres	X	98	=	111.72

Pervious area:

Grassed area	(CN 39) 1.09 acres	X	39	=	42.51

Weighted CN Calculation:	(1.14) X (98)	=	111.72	
	(1.09) X (39)	=	42.51	
	2.23 acres		154.23	**Weighted CN = 69.2**

The tailwater conditions utilized for the existing and proposed condition designs will be as described in the drainage manual Chapter Three for ponds and open ditches.

4. CONCEPTUAL DESIGN