

S.R. 33 PD&E STUDY

From Old Combee Road to North of Tomkow Road

Polk County, Florida
Financial Project Number: 430185-1-22-01

CONCEPTUAL Location Hydraulic Report

Prepared For:



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Professional Engineer Certificate

I hereby certify that I am a registered professional engineer in the State of Florida practicing with Inwood Consulting Engineers, Inc., a corporation authorized to operate as an engineering business, FEID No. 59-3216593, by the State of Florida, Department of Professional Regulation, and Board of Professional Engineers. I have reviewed or approved the evaluation, findings, opinions and conclusions as reported in this Draft Location Hydraulic Report.

The Conceptual Location Hydraulic Report includes a summary of data collection efforts and floodplain analysis, and other possible secondary drainage system alternatives for the SR 33 PD&E Study. I acknowledge that the procedures and references used to develop the results contained in this report are standard to the professional practice of civil engineering as applied through design standards and criteria set forth by the federal, state, and local regulatory agencies as well as professional judgment and experience.

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EXECUTIVE SUMMARY

The SR 33 Project Development and Environment (PD&E) Study is being conducted by the Florida Department of Transportation (FDOT) to evaluate roadway and interchange improvement alternatives. The project limits of the SR 33 PD&E Study are from Old Combee Road to north of Tomkow Road in Polk County, a distance of approximately 4.33 miles. The existing roadway is generally a two-lane rural roadway that is a designated Emergency Evacuation Route.

SR 33 is currently classified by FDOT as an urban minor arterial through the study limits. Although a preferred roadway typical section and interchange alternative have not been determined yet, a four-lane divided roadway with four through lanes under I-4 is proposed. The existing SR 33 road right-of-way is 200 feet in width which should accommodate the proposed widening of SR 33. Improvements to the I-4 interchange will consist of ultimate interchange improvements that will involve replacing the I-4 bridges over SR 33. The roadway typical section used for the purposes of this report consists of the pavement savings roadway typical section; a four-lane divided roadway with a raised median, a 10-foot shared-use path, a 5-foot sidewalk, and roadside ditches for stormwater conveyance.

The project is located entirely within the Withlacoochee River sub-basin of the Orange Hammock River Watershed as defined by the Southwest Florida Water Management District (SWFWMD). Although the project lies entirely within the Withlacoochee River sub-basin, SR 33 currently outfalls to three different sub-basins within the project limits: Lake Deeson, Withlacoochee River, and Saddle Creek. The project site is within Sections 10, 11, 15, 21, 22, 28, and 29 of Township 27 South, Range 24 East.

The purpose of this Location Hydraulic 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", USDOT 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 roadway widening and proposed alternative stormwater ponds were quantified. It is determined that impacts will occur to the floodplain (Zone A – 100-year floodplain with no base flood elevations determined) associated with the proposed roadway northeast and within the SR 33 and I-4 interchange.

The 100-year flood stage within the project area varies and was estimated from 134.00 ft NAVD to 138.00 ft NAVD based on the FEMA flood maps and 1-ft LiDAR contours. It was concluded that the project will impact approximately 5.13 ac-ft of floodplain volume based on the ultimate SR 33 and I-4 interchange alternative and SR 33 roadway widening. 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 5.4](#) for discussion.

In conclusion, the following statement summarizes the results of our findings:

"The proposed cross drains 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."

SECTION 1 INTRODUCTION

The SR 33 Project Development and Environment (PD&E) Study is being conducted by the Florida Department of Transportation (FDOT) to evaluate roadway and interchange improvement alternatives. The project limits of the SR 33 PD&E Study are from Old Combee Road to north of Tomkow Road in Polk County, a distance of approximately 4.33 miles. The existing roadway is generally a two-lane rural roadway that is a designated Emergency Evacuation Route.

SR 33 is currently classified by FDOT as an urban minor arterial through the study limits. Although a preferred roadway typical section and bridge alternative have not been determined yet, a four-lane divided roadway with four through lanes under I-4 is proposed. The existing SR 33 road right-of-way is 200 feet in width which should accommodate the proposed widening of SR 33. Improvements to the I-4 interchange will consist of ultimate interchange improvements that will involve replacing the I-4 bridges over SR 33. The limits of the project are shown on the [Project Location Map](#) as shown in [Figure 1, Appendix 1](#).

The project is located entirely within the Withlacoochee River sub-basin of the Orange Hammock River Watershed as defined by SWFWMD. The project site is within Sections 10, 11, 15, 21, 22, 28, and 29 of Township 27 South, Range 24 East. Please refer to [Appendix 5](#) for the [SWFWMD Basin Map](#). A reproduction of the [United States Geological Survey \(USGS\) Quadrangle Maps](#) for the project vicinity is shown in [Figure 2](#).

The purpose of this Location Hydraulic Report is to address base floodplain encroachments resulting from the roadway improvements evaluated in the Project Development and Environment (PD&E) study. In accordance with Executive Order 11988 "Floodplain Management", USDOT 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. All figures for this report are included in [Appendix 1](#). For the ease of review, [Cross Drain Analyses](#) and [Floodplain Impact Analysis](#) are included in [Appendices 3](#) and [4](#), respectively. Other supporting information and data is included in the remaining appendices. Please note that the vertical datum used for this project is NAVD 88, unless otherwise specified.

SECTION 2 PROJECT DESCRIPTION

The existing roadway typical section for SR 33 within the project limits is a two-lane rural roadway constructed within a right-of-way that is 200 feet in width. It includes two twelve-foot lanes with five-foot paved shoulders along both sides of the road. Stormwater runoff is collected in roadside swales and drains towards different outfalls consisting of adjacent wetlands, an existing pond, and an existing canal. The posted speed limit along SR 33 ranges from 45 mph near the Old Combee Road intersection and increases to 50 and then 60 mph west of SR 659 heading northward. The existing roadway typical section is provided in [Figure 7, Appendix 1](#).

The proposed roadway typical section used for the purposes of this report consist of the pavement savings roadway typical section; a four-lane divided roadway with a raised median, a 10-foot shared-use path, a 5-foot sidewalk, and roadside ditches for stormwater conveyance. Please refer to **Figure 8, Appendix 1** for the proposed roadway typical section.

SECTION 3 DATA COLLECTION

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

- FDOT Drainage Manual, July 2013
- FDOT Drainage Handbook – Hydrology, February 2012
- SR 33 Plans – Final As-Built Plans, FPID 197152-5-52-01, M.P. 5.098 to M.P. 8.598, 2003
- SR 400 (I-4) Plans – Final Plans, FPID 201209-2-52-01, 2003
- SWFWMD Environmental Resource Permit Basis of Review, Part B, 2010
- Federal Emergency Management Agency (FEMA), Panel Nos. 12105C0310F and 12105C0175F, Polk County, Florida dated December 20, 2000.
- U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey of Polk County, Florida, 1990
- USDA NRCS Soil Survey Geographic (SSURGO) Database from SWFWMD, 2010
- United States Geological Survey (USGS) Quadrangle Maps
- 1-foot contours from Southwest Florida Water Management District LiDAR, 2007
- Polk County Property Appraiser’s Website (GIS parcel lines), 2012
- FDOT Straight Line Diagrams (SLD’s) of Road Inventory for SR 33
- Field Reconnaissance (January 2013)
- National Wetland Inventory (NWI) from U.S. Fish and Wildlife Service (USFWS), 2008 (GIS data)
- Interviews with FDOT Maintenance Staff
- SWFWMD Environmental Resource Permits: No. 2832 (SR 33 from I-4 to Old Combee Road), No. 7112 (East West Road), No. 21375 (Firstpark at Bridgewater), No. 40908 (Tomkow Road)
- Cultural Resource Assessment Survey (CRAS) End of Fieldwork Memo by Southeastern Archaeological Research Inc. (SEARCH), July 2013
- Pond Siting Report Wetland Assessment Memo by Inwood Consulting Engineers, Inc., 7/25/2013
- Protected Species Assessment by Scheda Ecological Services, Inc. , July 2013
- Geotechnical Memorandum by Tierra, Inc., July 2013
- Contamination Screening Evaluation Report by Tierra, Inc., July 2013

SECTION 4 EXISTING DRAINAGE CONDITIONS

4.1 Topography & Hydrologic Features

The topography of the project area is relatively flat with elevations ranging from a high of 160 feet to a low of 135 feet NAVD 88. Please refer to [USGS Quadrangle Map, Figure 2](#) in [Appendix 1](#). There are eight (8) existing cross drains and two (2) bridge culverts within the project limits allowing for conveyance of offsite and onsite runoff. The size and geometry of all cross drains and bridges have been verified from the FDOT SLD's, 1-foot LiDAR contours, SR 33 plans, as well as during field reconnaissance. Please refer to [Table 1](#) for a summary of existing cross drains and bridge culverts and [Appendix 2](#) for pictures and review checklists.

Table 1 – Summary of Existing Cross Drains and Bridges

| Structure Number | FDOT Milepost | Description |
|--------------------------|---------------|-----------------------------------|
| CD-1 | 5.309 | Single 30" RCP |
| CD-2 | 5.694 | Single 30" RCP |
| CD-3 (Bridge No. 160142) | 6.693 | Double 10'x3' Bridge Culvert |
| CD-4 | 6.996 | Single 36" RCP |
| CD-5 | 7.416 | Single 6'x2' Concrete Box Culvert |
| CD-6 (Bridge No. 160143) | 8.123 | Double 10'x3' Bridge Culvert |
| CD-7 | 8.275 | Double 48" RCP |
| CD-8 | 8.284 | Single 15" RCP |
| CD-9 | 8.656 | Single 4'x2' Concrete Box Culvert |
| CD-10 | 9.036 | Single 4'x2' Concrete Box Culvert |

4.2 Soils Data & Geotechnical Investigations

The Soil Survey of Polk County, Florida, published by the USDA NRCS (dated 1984) has been reviewed for the project vicinity. USDA SSURGO was also obtained from SWFWMD to create soils map in the project area using GIS ArcMap. SSURGO data was compared to Soil Survey by USDA NRCS and found no deviation. The soil survey map for the project vicinity is illustrated in [Figure 3](#) of [Appendix 1](#).

The soils encountered along the project limits consists of Hydrological Soil Group (HSG) A, B, B/D, C, and D soils. Type A soils have a high infiltration rate with a low water table. Type B soils have a moderate infiltration rate with a low water table. Type C soils are considered to have a slow infiltration rate with a moderate water table level. Type B/D and D soils are very poorly drained or poorly drained soils with high water tables. According to the Soil Survey, there are thirteen (13) different soil types located along the project limits. [Table 2 – USDA NRCS Soil Survey Information](#) summarizes and lists the soil types and relevant information. The ground water depth varies from >6' below - +2.0' above the existing ground throughout the project. According to the soil survey, there are some areas on SR 33 where the high water table is above the ground surface during certain months of the year.

A geotechnical evaluation study was performed by Tierra, Inc. along the proposed roadway improvements. A copy of the **Geotechnical Memorandum** is provided in **SR 33 PD&E Pond Siting Report - Appendix 10**, which includes on-site soil suitability and construction recommendations.

Table 2 – USDA NRCS Soil Survey Information

| Soil No. | Polk County USDA Soil Name | Seasonal High Ground Water | | HSG | Soil Classification | | |
|----------|---|----------------------------|-------------------|-----|---|--|--|
| | | Depth* (feet) | Duration (months) | | Depth (inches) | Unified | AASHTO |
| 3 | Candler sand, 0 to 5 percent slopes | >6.0 | N/A | A | 0-80 | SP, SP-SM | A-3 |
| 6 | Eaton mucky fine sand, depressional | +2-0 | Jun-Oct | D | 0-6 6-29 29-33 33-80 | SP-SM SM, SP-SM SC SC, CL, CH | A-3, A-2-4 A-2-4, A-3 A-7, A-4, A-6 A-7 |
| 7 | Pomona fine sand | 0-1.0 | June-Oct | B/D | 0-6 6-21 21-26 26-48 48-73 73-80 | SP, SP-SM SP, SP-SM SP-SM, SM SP, SP-SM, SM SC, SM-SC, SM N/A | A-3, A-2-4 A-3, A-2-4 A-3, A-2-4 A-3, A-2-4 A-2, A-4, A-6 N/A |
| 9 | Lynee sand | 0-1.0 | June-Oct | B/D | 0-5 5-21 21-28 28-33 33-80 | SP, SP-SM SP, SP-SM SP-SM, SM SP-SM SC, CH, CL | A-3 A-3 A-3, A-2-4 A-3, A-2-4 A-6, A-7 |
| 12 | Neilhurst sand, 1 to 5 percent slopes | >6.0 | N/A | A | 0-80 | SP, SP-SM | A-3, A-2-4 |
| 15 | Tavares fine sand, 0 to 5 percent slopes | 3.5-6.0 | June-Dec | A | 0-80 | SP, SP-SM | A-3 |
| 17 | Smyrna and Myakka fine sands | 0-1.0 | Jun-Oct | B/D | 0-12 12-25 25-42 42-48 48-80 | SP, SP-SM SM, SP-SM SP, SP-SM SM, SP-SM SP, SP-SM | A-3, A-2-4 A-3, A-2-4 A-3 A-3, A-2-4 A-3 |
| 22 | Pomello fine sand | 2.0-3.5 | Jul-Nov | C | 0-48 48-63 63-80 | SP, SP-SM SP-SM, SM SP, SP-SM | A-3 A-3, A-2-4 A-3 |
| 29 | St. Lucie fine sand, 0 to 5 percent sands | >6.0 | N/A | A | 0-80 | SP | A-3 |
| 35 | Hontoon muck | +2-0 | Jan-Dec | B/D | 0-75 75-80 | PT N/A | A-8 N/A |
| 51 | Pomona-Urban land complex | 0-1.0 | Jun-Oct | B/D | 0-6 6-21 21-26 26-48 48-73 73-80 | SP, SP-SM SP, SP-SM SP-SM, SM SP, SP-SM SC, SM-SC, SM N/A | A-3, A-2-4 A-3, A-2-4 A-3, A-2-4 A-3, A-2-4 A-2, A-4, A-6 N/A |
| 68 | Arents, 0 to 5 percent slopes | 4.0-6.0 | Jun-Oct | B | Not Available | Not Available | Not Available |
| 99 | Water | N/A | N/A | N/A | N/A | N/A | N/A |

4.3 Environmental Characteristics

4.3.1 Land Use Data

The project corridor is a mixture of residential, commercial, and industrial land uses interspersed with native wetland and upland habitat. Please refer to **Table 3** for a summary of the existing utilities located throughout the project corridor.

Table 3 – Summary of Existing Utilities

| Utility Company | Facility | Description |
|--------------------------------|--------------------------------------|--|
| Bright House Networks | Coax Cable and Fiber | Bright House maintains aerial cable and fiber on the City of Lakeland's pole line with buried service facilities throughout the project. |
| Verizon Florida | Communications | Verizon maintains buried communication facilities along the east side of SR 33 throughout the project. |
| City of Lakeland –Electric | Transmissions and Distribution Power | The City maintains transmission facilities along the west and east sides of SR 33 from Old Combee Road to just north of Spanish Oaks Boulevard where transmission continues along the east side of SR 33 to Tomkow Road. The City also has distribution facilities under built on the transmission poles located along the east side of SR 33 for the project limits. |
| City of Lakeland – Water/Sewer | Water/Sewer | The City maintains a 16-inch ductile iron water main along the east side of SR 33 from Old Combee Road to North Combee where it transitions to a 36-inch and travels along the west side of SR 33 to the I-4 Interchange. A 18-inch PVC force main enters the project just north of Spanish Oaks Boulevard and travels along the west side of SR 33 to approximately North Combee Road where it transitions to 12-inch and continues through the project limits. |
| City of Lakeland – Gas | Gas Main | The City of Lakeland has a 16-inch gas main that enters the project just north of Spanish Oaks Boulevard and continues along the west side of SR 33 to Tomkow Road. |
| Cox Cable | Coax Cable and Fiber | Cox Cable maintains aerial cable and fiber from Old Combee Road to Spanish Oaks Boulevard where it transitions to underground and terminates at Long Lake Circle. Cox cable also crosses SR 33 at the North Combee Road Intersection. |

The widening of SR 33 from Old Combee Road to north of Tomkow Road does not alter the existing or future land uses in the area. Future land uses adjacent to the project limits will include urban community, suburban, public facilities, and rural lands. Please see **Figures 4 and 5** for **Existing and Future Land Use Maps** in **Appendix 1**.

4.3.2 Cultural Features

Cultural features preserve and enhance the cultural nature of a community and include parks, schools, churches and other religious institutions. Also included are historic sites, archaeologically significant sites and neighborhood gathering places. Community services include facilities that provide necessary services such as fire stations, police stations, public and private schools, hospitals, cemeteries, public buildings, and civic facilities. All of these resources represent commonly occurring types of architecture for the locale, and available data did not indicate any significant historical associations.

A total of 82 shovel tests were excavated within the project Area of Potential Effect (APE), including 12 within the proposed pond areas. Three of the proposed ponds in the vicinity of the I-4/SR 33 interchange were not subjected to archaeological survey due to their very low archaeological potential (e.g., existing pavement, subsurface disturbance, standing water). None of the shovel tests within the project APE yielded cultural material. Additionally, SEARCH architectural historians documented 50 resources within the APE. These included 32 previously recorded above-ground resources, sixteen newly recorded above-ground resources, one previously recorded resource group, and one newly recorded resource group; none will be recommended eligible for National Register inclusion in the forthcoming technical report. No NRHP-eligible or listed resources were identified within the SR 33 project APE, and no further work is recommended. Thus, the construction of the pond sites will have no effect on any significant cultural resources.

Please refer to the CRAS prepared by Southeastern Archaeological Research (SEARCH) for the entire report. Please see [Appendix 6](#) of the [SR 33 Pond Siting Report](#) for a partial copy of the [CRAS End of Field Memo](#) pertaining to the pond sites.

4.3.3 Natural and Biological Features

Roadside swales exist along SR 33 to convey roadway and offsite runoff to the wetlands and cross drains. In addition, wetland systems, as well as isolated wetlands, are adjacent to the roadway. It is anticipated that the proposed roadway widening will result in minimal wetland impacts. Stormwater Treatment Pond alternative recommendations will be based on avoidance of wetland impacts whenever possible.

Based on the results of preliminary data collection and field reconnaissance, it has been determined that one of the SMF alternatives (Ponds 5A, 5B, and 5C) has the potential to result in adverse impacts to wetlands and other surface waters. These impacts will occur to the outer fringe of existing, roadside forested wetlands and other surface waters. A qualitative assessment of wetland/surface water impacts utilizing the Uniform Mitigation Assessment Methodology (UMAM) will be conducted as part of the ongoing PD&E Study. The UMAM analysis will provide estimates of the amount of mitigation that will be required to offset adverse impacts to wetlands and other surface waters resulting from the project. Please refer to the [SR 33 PD&E Pond Siting Report Wetland Evaluation Memo](#) included in the Pond Siting Report in [Appendix 7](#) for more information.

Several species have been observed within the project area or could potentially occur within the project area based on the literature and database review. Based on the protected species data

collection and field reviews, it was determined that pond sites 2 through 6 sites will have low impacts to protected species. Pond 1 was determined to have medium impacts; an indication of species where mitigation is reasonable and possible. At the Pond 1 site, two potentially occupied gopher tortoise burrows were observed; one within pond site 1 and one immediately west of the western boundary. Also, the state listed plant garberia (*Garberia heterophylla*) was located in the pond site.

No protected species were observed in pond sites 2 through 6. However, pond sites 2 and 3 could potentially support gopher tortoise, gopher frog, Florida mouse, burrowing owl, and crested caracara. Pond site 5C has the potential to support the gopher tortoise, indigo snake, wood stork and state-listed wading birds. Pond site 6 has the potential to support the wood stork and state-listed wading birds. A copy of the **Preliminary Protected Species Assessment** is included in the **SR 33 Pond Siting Report – Appendix 8**.

4.4 Floodplains/Floodways

The Federal Emergency Management Agency (FEMA) has developed a Flood Insurance Rate Map (FIRM) for the study area. The relevant FIRM panel numbers are 12105C0175F and 12105C0310F for Polk County, Florida dated December 20, 2000. The majority of the project and potential pond sites lies outside of the FEMA floodplain areas. A portion of the project area is located within six designated floodplain areas: FIA-1, FIA-2, FIA-3, FIA-4, FIA-5, and FIA-6 (Zone A - 100 year floodplain with no base flood elevations determined). The floodplain elevation was estimated based on overlaying the FEMA flood maps on top of 1-ft LiDAR contours. Based on this methodology, the 100-year flood stage was estimated to be at 134.0 ft NAVD for FIA-1, 138.0 ft NAVD for FIA-5, and 136.0 ft NAVD for FIA-6. For FIA-2, FIA-3, and FIA-4, the 100-year flood stage elevation of 134.0 ft NAVD is based on the Flood Data Sheet for the existing double 6'x4' concrete box culvert located in the 2003 I-4 roadway construction plans. Please refer to **Figure 6 – FEMA Floodplain Map** located in **Appendix 1**. Floodplain impacts are to be expected due to the SR 33 widening and the proposed I-4 and SR 33 interchange. In addition, the floodplain impacts and compensation for FIA-2, FIA-3, and FIA-4 are considered together as one floodplain since they are all connected to the same floodplain boundary. It should also be noted that per a telephone conversation with Scott Presson (Bartow Operation Maintenance Center Manager), SR 33 has no historical flooding issues within the project limits.

Furthermore, based on coordination with SWFWMD, the water management district is currently developing the Polk City Watershed Model; a model that depicts the existing drainage conditions for the 100-year storm event within Polk City, FL. SWFWMD indicated that the model drainage boundary is just outside the SR 33 project limits. It is expected that when the model is approved by next year (2014), new floodplain boundaries for the model drainage boundary and the surrounding area will be published. The floodplain boundaries in the surrounding area of the model drainage boundary would also be revised based on existing land use and soil data. Since the SR 33 project limits are located within the surrounding area of the model drainage boundary, the effective floodplain boundaries shown in this report may change in 2014. It is recommended that additional coordination with SWFWMD will be needed in order to ensure that the most current FEMA floodplain boundaries are used when calculating floodplain impacts during the design phase of the project.

4.4.1 Establishing Floodplain Impacts

In order to estimate the floodplain impacts throughout the project, the area (acres) of proposed impacts to the floodplain was first quantified between the existing shoulder and the proposed right-of-way. Based on the 1-ft LiDAR contours an average existing ground elevation could be determined and examined against the estimated 100-year flood stage and an approximate impact depth (ft) could be computed. By multiplying the approximate impact depth (ft) by the area of proposed floodplain impacts (acres), the result is an estimated impact volume (acre-ft). A slope reduction of 10% was then applied to this volume to account for roadway tie-down slopes.

It should be noted that for FIA-4 and FIA-5, the floodplain boundary shows that it covers the area of the existing SR 33 roadway. However, estimated floodplain elevations and 1-ft LiDAR contours indicate that the existing road is above the 100-year floodplain. Therefore, only those floodplain impacts that occur at or below the estimated floodplain elevations within the FEMA floodplain boundary were calculated for FIA-4 and FIA-5. For FIA-2, the estimated floodplain elevation and 1-ft LiDAR contours differ from the floodplain boundaries. Therefore, similar to FIA-4 and FIA-5, only those floodplain impacts that occur at or below the estimated floodplain elevation within the FEMA floodplain boundary were calculated for FIA-2 as well.

Floodplain compensation for impacts will be required; however, they will not require the acquisition of additional right-of-way. Floodplain compensation is expected to be achieved within the existing FDOT right-of-way along SR 33 and at the SR 33 and I-4 Interchange. Floodplain impact and compensation calculations can be found in [Appendix 4](#) of this report. Please refer to [Table 4](#) for Summary of Floodplain Impacts Areas.

Table 4 – Summary of Floodplain Impacts Areas

| Floodplain Impact Area (FIA) | Side | From Station | To Station | Estimated 100-yr Flood Stage (ft) |
|------------------------------|-------|--------------|------------|-----------------------------------|
| FIA-1 | RT | 435+30 | 442+00 | Zone A: EL 134.00 NAVD |
| FIA-2 | LT | 448+65 | 454+70 | Zone A: EL 134.00 NAVD |
| FIA-3 | LT | 436+50 | 438+90 | Zone A: EL 134.00 NAVD |
| FIA-4 | LT/RT | 453+00 | 465+00 | Zone A: EL 134.00 NAVD |
| FIA-5 | LT/RT | 471+20 | 478+00 | Zone A: EL 138.00 NAVD |
| FIA-6 | LT | 479+55 | 480+65 | Zone A: EL 136.00 NAVD |

SECTION 5 PROPOSED DRAINAGE CONDITIONS

The existing drainage boundaries and local drainage basins will be maintained in the future condition. The stormwater runoff from the project limits will be collected and conveyed in roadside ditches or closed drainage systems to the proposed pond alternatives: offsite wet detention ponds, joint-use, or dry linear retention swales along SR 33. The pond alternatives will discharge at or near the same cross drains that carry the roadway runoff in the existing condition. The water quality treatment and water quantity attenuation will be achieved through the construction of the recommended stormwater management alternative. For more

information regarding the proposed drainage conditions, please refer to the **SR 33 PD&E Pond Siting Report**.

5.1 Longitudinal & Transverse Floodplain Impacts

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

1. Longitudinal impacts resulting from filling the floodplain areas associated with 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 associated with the water bodies extend both north and south of the proposed alignment. The floodplain impact area was quantified based on the estimated FEMA 100-year flood stage and the existing ground elevation from 1-ft contours from LiDAR. To be conservative, it was assumed that any filling from the proposed roadway outside of the existing roadway was quantified as floodplain impacts. It is anticipated that the project will impact a total of 5.13 ac-ft. of the 100-year floodplain with the roadway improvements. Please refer to **Table 5** for a summary of floodplain impacts and compensation. During the final design phase of the project, every effort should be taken to minimize the floodplain impacts.

Table 5 – Summary of Floodplain Impacts and Compensation

| Floodplain Impact Area (FIA) | Floodplain Impacts (ac-ft) | Floodplain Compensation (ac-ft) |
|------------------------------|----------------------------|---------------------------------|
| FIA-1 | 0.80 | 0.97 |
| FIA-2 | 1.05 | 2.04 |
| FIA-3 | 0.29 | 0.10 |
| FIA-4 | 2.50 | 1.71 |
| Sub-Total | 3.84 | 3.85 |
| FIA-5 | 0.47 | 0.50 |
| FIA-6 | 0.02 | 0.02 |
| Total | 5.13 | 5.34 |

The transverse impacts resulting from the extension or replacement of the culverts are analyzed in the PD&E phase of the project. It is expected that impacts will occur to the existing floodplain associated with the extension of CD-9. CD-1 through CD-8 and CD-10 are proposed to be extended due to the roadway widening. No additional right-of-way is proposed in this area to compensate for the loss of storage created by the extension. It is possible to provide compensation within the existing right-of-way through excavated areas. However, during the final design phase of the project, every necessary action should be taken to minimize upstream

impacts. To minimize upstream impacts, FDOT design criteria for conveyance systems (e.g. culverts) allows no significant increase in flood stages at the upstream end of the structures.

The culvert extensions for seven (7) cross drains and two (2) bridge culverts were analyzed for existing and proposed conditions performances. It should be noted that CD-4 was not analyzed for existing and proposed condition performances because the existing pipe serves as an existing outfall structure west of SR 33 for the Bridgewater Management System (SWFWMD Permit No. 21375) and is not considered a cross drain that drains offsite runoff. It is proposed to match the existing pipe size for the extension.

The analysis at all the culvert extensions showed roadway overtopping (except CD-3 & CD-6) in the existing conditions during the 500-year (greatest flood) storm event. CD-1, CD-3 and CD-7 were found to have 0.10 ft, 0.01 ft and 0.07 ft increase in headwater respectively during the 50-year (design flood) storm event. Since the headwater increase is not more than 0.1 ft, it is proposed to match the existing pipe sizes.

Based on historical SR 33 drainage maps, CD-6 was originally constructed in an effort to connect existing wetlands from east to west of SR 33. However, the connection of these wetlands has been severed over time by the construction of Bridgewater commercial/industrial area (west of SR 33) and University Blvd. (east of SR 33). CD-6 currently only drains minimal offsite runoff and SR 33 onsite runoff to the east (existing canal) that ultimately outfalls to Saddle Creek. Therefore, in HY-8 inputs the inlet elevation is lower than the outlet elevation.

It is proposed to upsize three (3) cross drains which showed deficiency or higher headwater during the 100-year storm event with higher capacity structures to ensure no rise in headwater elevation to minimize any transverse impacts. Please refer to [Appendix 3](#) for cross drains analyses and HY-8 inputs and results. During the final design phase of the project, every necessary action should be taken to minimize upstream impacts.

It should be noted that these proposed cross drains were sized and analyzed based on best engineering judgments, assumptions, and limited available data. During the design phase, each cross drain should be analyzed for existing and proposed conditions with more defined data and designed to ensure no conflicts with the proposed roadway and no significant increase in headwater elevation. Also, a more detailed inspection of the cross drains will be necessary to verify their structural integrity and assess the need for complete reconstruction. Based on the cross drains analysis, it is concluded the transverse impacts resulting from the extension of the culverts are minimal.

5.2 Project Classification

The floodplain is located in a low density, non-urbanized area, and the encroachments 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.

5.3 Risk Evaluation

There is no change in flood "Risk" associated with this project. The proposed floodplain encroachments are classified as "minimal". 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.

5.4 PD&E Manual Requirements with Minimal Encroachment

Chapter 24 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 the encroachment. The proposed SR 33 widening project was determined to have minimal encroachments and as a result the requirements for this category are listed as follows:

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

Response: *According to the FDOT District 1 maintenance staff, SR 33 has no historical flooding issues within the project limits. Compensating areas will be constructed within the FDOT right-of-way to mitigate loss of storage in the floodplain due to the project improvements. The project will have no adverse impact on the existing condition.*

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

Response: *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 extension or replacement of the existing cross drains. These impacts have been analyzed during this study and will need to be addressed during the design phase.

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

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

Response: *This project will take every effort to minimize the 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. The floodplain impacts will be compensated by constructing floodplain mitigation areas.*

4. Impact of the proposed improvements on emergency services and evacuation.

Response: *The proposed cross drains 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.*

5. Impacts of the proposed improvement on the base flood, likelihood of flood risk, overtopping, location of overtopping, backwater, etc.

Response: *The proposed cross drains 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 or overtopping.*

6. 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.

Response: *The SR 33 roadway improvements do not encroach on regulated floodways within the project limits.*

7. 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).

Response: *See the SR 33 PD&E Study Pond Siting Report, Wetland Assessment Memo and Protected Species Assessment – Appendix 7 and 8.*

8. Consistency of the proposed improvements 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.

Response: *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.*

9. A map showing project, location and impacted floodplains. Provide copies of all applicable FIRM maps should be included within the final LHR report appendix.

Response: *See Figure 6 in Appendix 1.*

10. Results of any and all project risk assessments performed.

Response: *The proposed cross drains 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.*

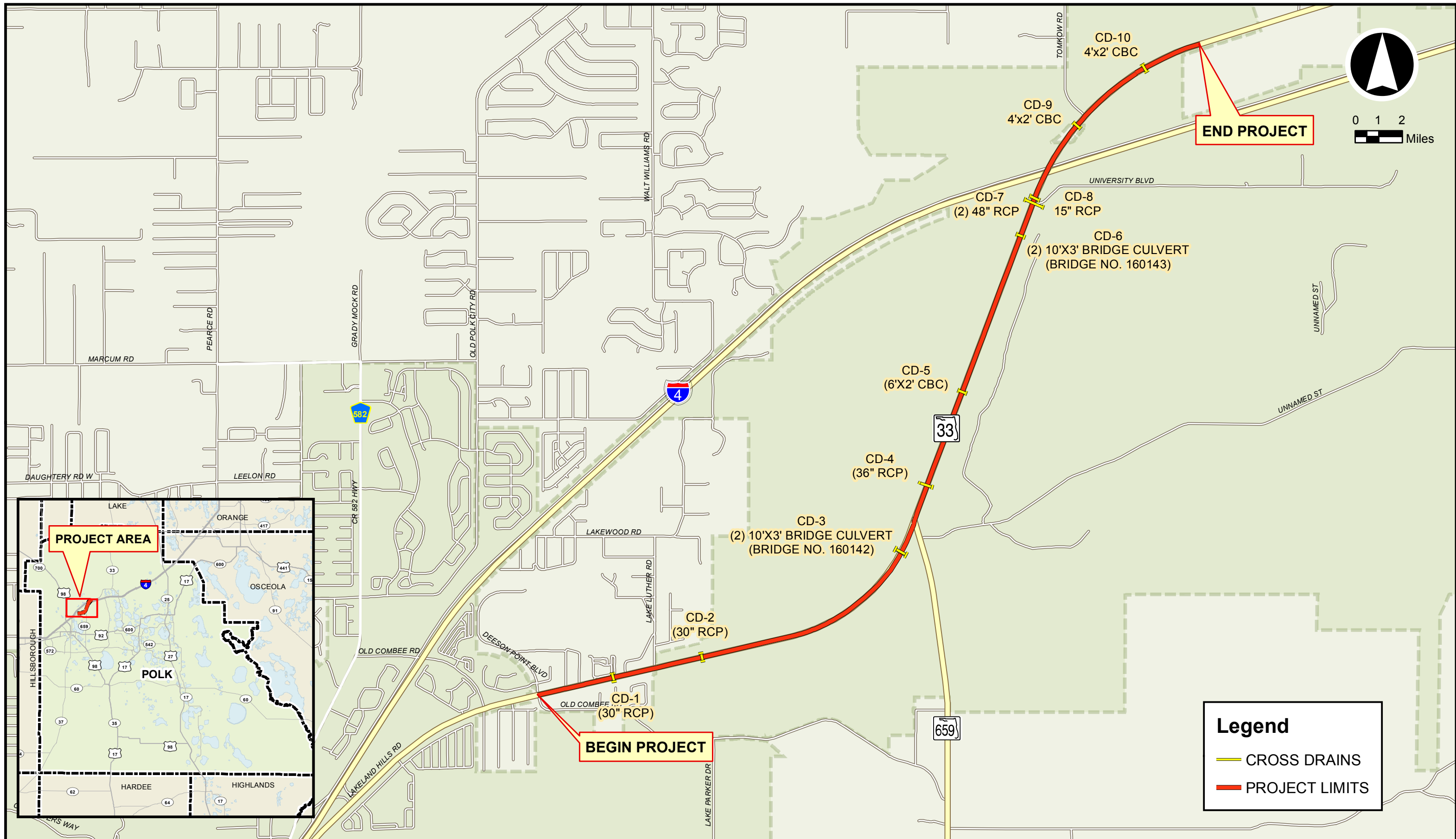
SECTION 6 CONCLUSIONS

During the final design, the modifications to drainage structures 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. The proposed structures will perform hydraulically in a manner equal to or greater than the existing structure and backwater surface elevations are not expected to increase. As a result, there will be no significant adverse impacts on the natural and beneficial floodplain values or any significant change in flood risks or damage. There will not be a significant change in potential for interruption or termination of emergency service or emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant.

Appendix 1

Figures

- Figure 1 – Project Location Map
- Figure 2 – USGS Quadrangle Map
- Figure 3 – SSURGO Soils Map
- Figure 4 – Existing Landuse Map
- Figure 5 – Future Landuse Map
- Figure 6 – FEMA Floodplain Map
- Figure 7 – Existing Typical Section
- Figure 8 – Proposed Typical Section



State Road 33 PD&E Study

from Old Combee Road
to North of Tomkow Road
Polk County, Florida

Financial Project ID: 430185-1-22-01
Federal Project No: N/A

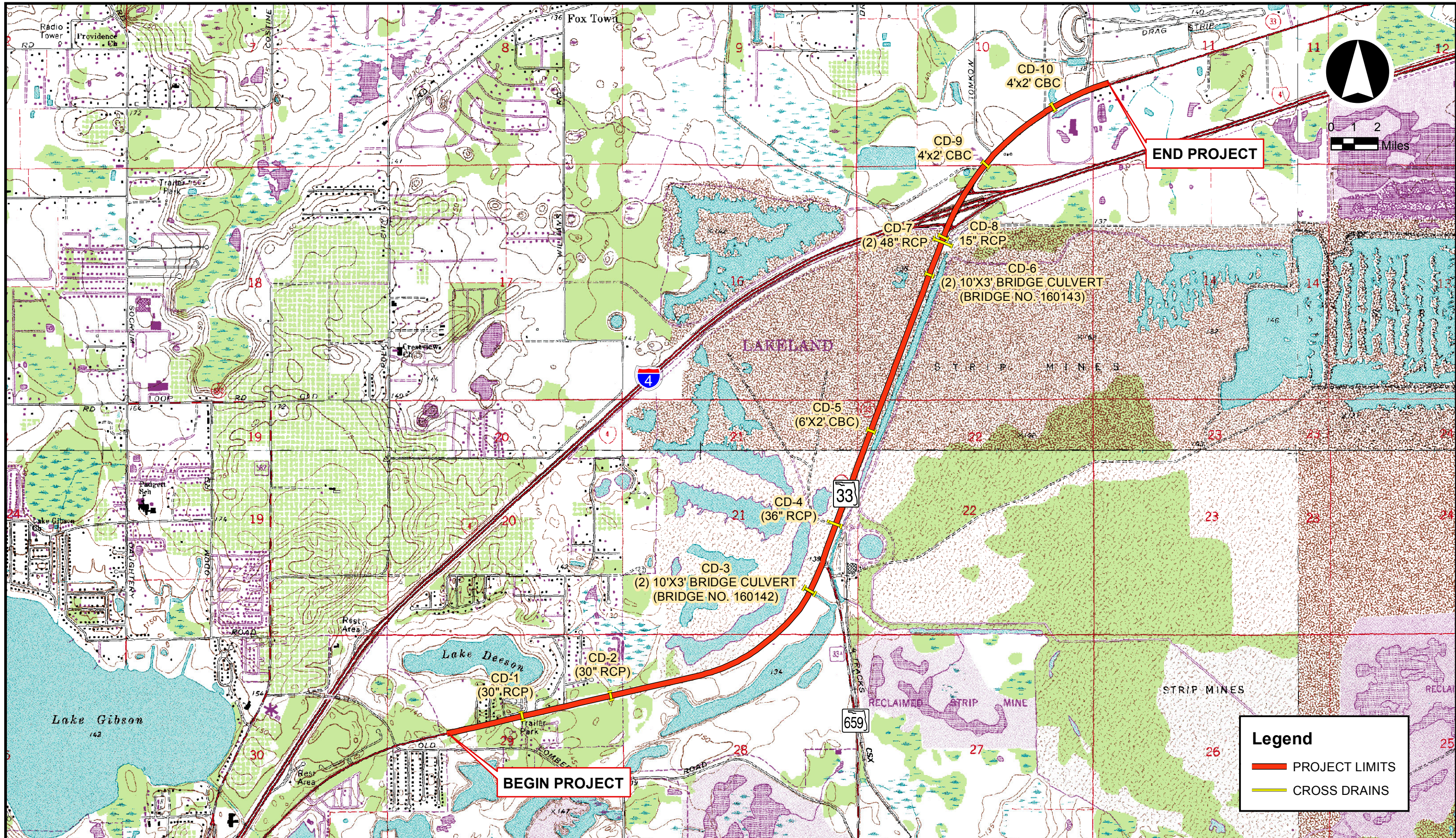
PROJECT LOCATION MAP

Figure

1



Florida Department
of Transportation
District 1



Legend

- PROJECT LIMITS
- CROSS DRAINS

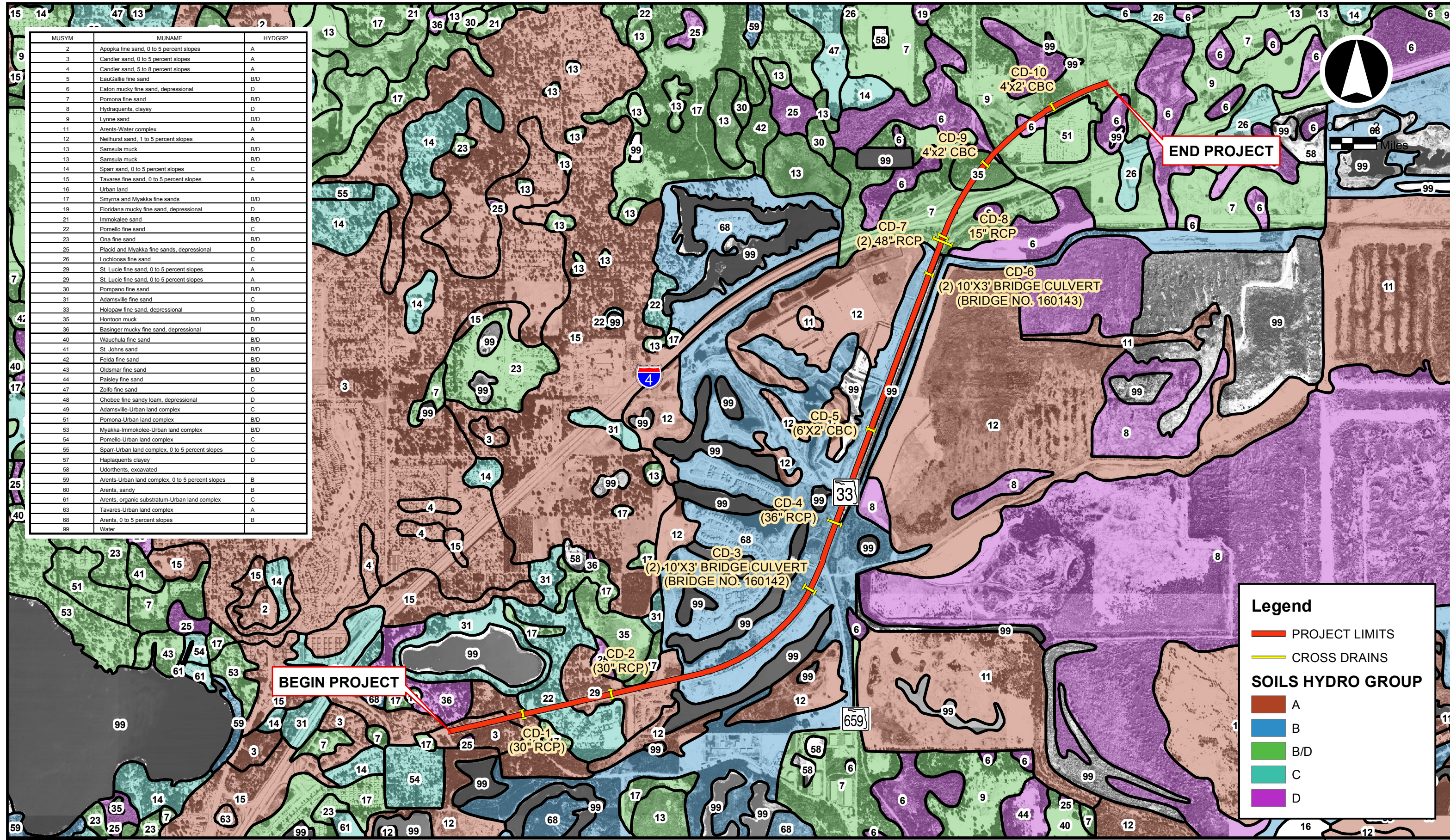


FDOT Florida Department of Transportation
District 1

State Road 33 PD&E Study
from Old Combee Road to North of Tomkow Road
Polk County, Florida
Financial Project ID: 430185-1-22-01
Federal Project No: N/A

USGS QUAD MAP

Figure 2



| MUSYM | MUNAME | HYDGRP |
|-------|--|--------|
| 2 | Apopka fine sand, 0 to 5 percent slopes | A |
| 3 | Candler sand, 0 to 5 percent slopes | A |
| 4 | Candler sand, 5 to 8 percent slopes | A |
| 5 | EauGalle fine sand | B/D |
| 6 | Eaton mucky fine sand, depressional | D |
| 7 | Pomona fine sand | B/D |
| 8 | Hydraquents, clayey | D |
| 9 | Lynne sand | B/D |
| 11 | Arents-Water complex | A |
| 12 | Neilhurst sand, 1 to 5 percent slopes | A |
| 13 | Samsula muck | B/D |
| 13 | Samsula muck | B/D |
| 14 | Sparr sand, 0 to 5 percent slopes | C |
| 15 | Tavares fine sand, 0 to 5 percent slopes | A |
| 16 | Urban land | |
| 17 | Smyrna and Myakka fine sands | B/D |
| 19 | Floridana mucky fine sand, depressional | D |
| 21 | Immokalee sand | B/D |
| 22 | Pomello fine sand | C |
| 23 | Ona fine sand | B/D |
| 25 | Placid and Myakka fine sands, depressional | D |
| 26 | Lochloosa fine sand | C |
| 29 | St. Lucie fine sand, 0 to 5 percent slopes | A |
| 29 | St. Lucie fine sand, 0 to 5 percent slopes | A |
| 30 | Pompano fine sand | B/D |
| 31 | Adamsville fine sand | C |
| 33 | Holopaw fine sand, depressional | D |
| 35 | Horton muck | B/D |
| 36 | Basinger mucky fine sand, depressional | D |
| 40 | Wauchula fine sand | B/D |
| 41 | St. Johns sand | B/D |
| 42 | Felda fine sand | B/D |
| 43 | Oldsmar fine sand | B/D |
| 44 | Paisley fine sand | D |
| 47 | Zolfo fine sand | C |
| 48 | Chobee fine sandy loam, depressional | D |
| 49 | Adamsville-Urban land complex | C |
| 51 | Pomona-Urban land complex | B/D |
| 53 | Myakka-Immokalee-Urban land complex | B/D |
| 54 | Pomello-Urban land complex | C |
| 55 | Sparr-Urban land complex, 0 to 5 percent slopes | C |
| 57 | Haplaquents clayey | D |
| 58 | Udortherns, excavated | |
| 59 | Arents-Urban land complex, 0 to 5 percent slopes | B |
| 60 | Arents, sandy | B |
| 61 | Arents, organic substratum-Urban land complex | C |
| 63 | Tavares-Urban land complex | A |
| 68 | Arents, 0 to 5 percent slopes | B |
| 99 | Water | |

Legend

- PROJECT LIMITS
- CROSS DRAINS

SOILS HYDRO GROUP

- A
- B
- B/D
- C
- D

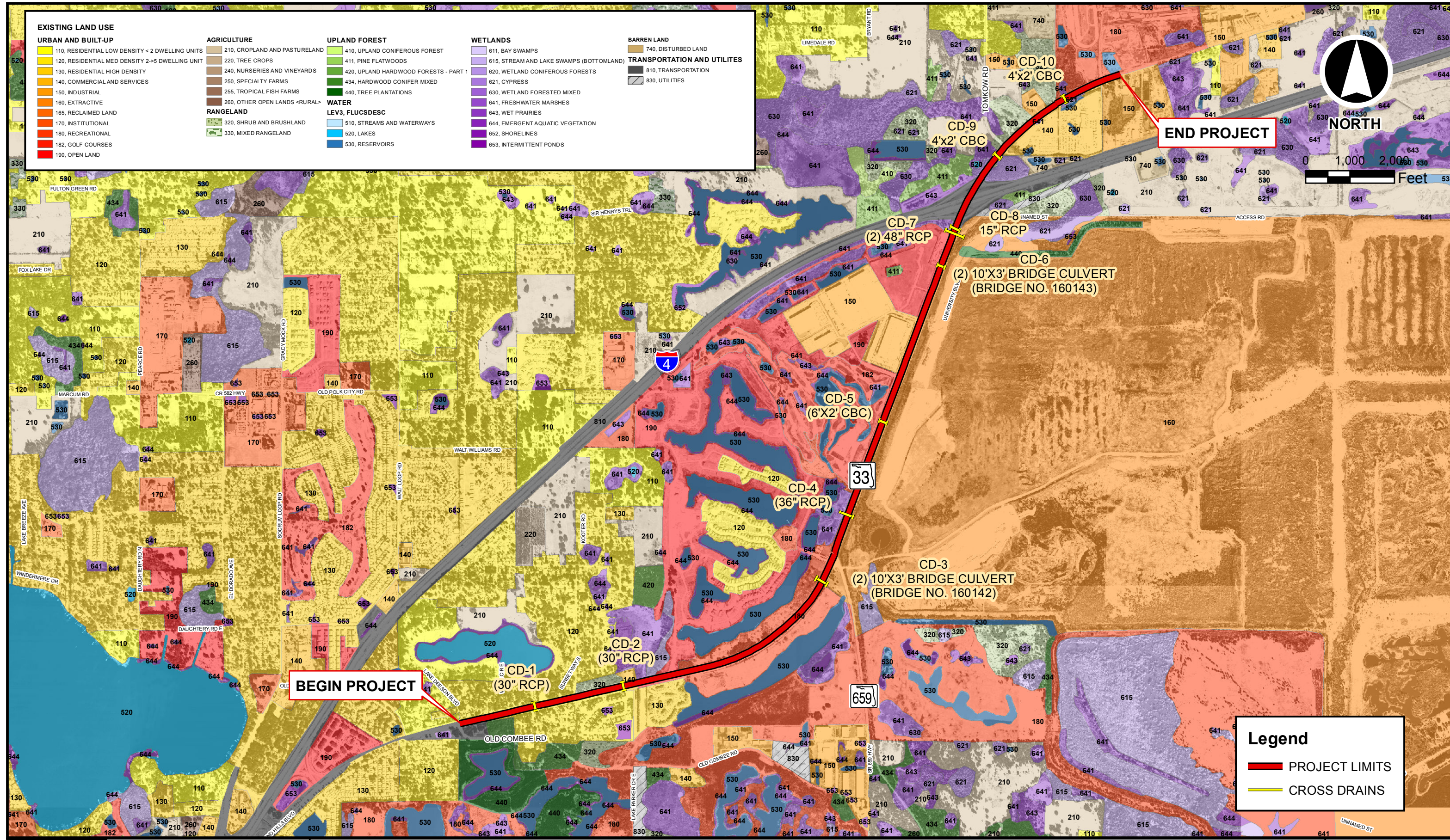
State Road 33 PD&E Study
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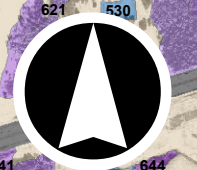
SSURGO SOILS TYPE MAP

Figure 3





| EXISTING LAND USE | | WETLANDS | | TRANSPORTATION AND UTILITIES | |
|---|-------------------------------|--|-------------------------------------|------------------------------|-------------------------------------|
| URBAN AND BUILT-UP | AGRICULTURE | WETLANDS | TRANSPORTATION AND UTILITIES | BARREN LAND | TRANSPORTATION AND UTILITIES |
| 110, RESIDENTIAL LOW DENSITY < 2 DWELLING UNITS | 210, CROPLAND AND PASTURELAND | 611, BAY SWAMPS | 740, DISTURBED LAND | 810, TRANSPORTATION | 830, UTILITIES |
| 120, RESIDENTIAL MED DENSITY 2->5 DWELLING UNIT | 220, TREE CROPS | 615, STREAM AND LAKE SWAMPS (BOTTOMLAND) | | | |
| 130, RESIDENTIAL HIGH DENSITY | 240, NURSERIES AND VINEYARDS | 620, WETLAND CONIFEROUS FORESTS | | | |
| 140, COMMERCIAL AND SERVICES | 250, SPECIALTY FARMS | 621, CYPRESS | | | |
| 150, INDUSTRIAL | 255, TROPICAL FISH FARMS | 630, WETLAND FORESTED MIXED | | | |
| 160, EXTRACTIVE | 260, OTHER OPEN LANDS <RURAL> | 641, FRESHWATER MARSHES | | | |
| 165, RECLAIMED LAND | | 643, WET PRAIRIES | | | |
| 170, INSTITUTIONAL | RANGELAND | 644, EMERGENT AQUATIC VEGETATION | | | |
| 180, RECREATIONAL | 320, SHRUB AND BRUSHLAND | 652, SHORELINES | | | |
| 182, GOLF COURSES | 330, MIXED RANGELAND | 653, INTERMITTENT PONDS | | | |
| 190, OPEN LAND | | | | | |
| | WATER | | | | |
| | LEV3, FLUCDESC | | | | |
| | 510, STREAMS AND WATERWAYS | | | | |
| | 520, LAKES | | | | |
| | 530, RESERVOIRS | | | | |



BEGIN PROJECT

END PROJECT

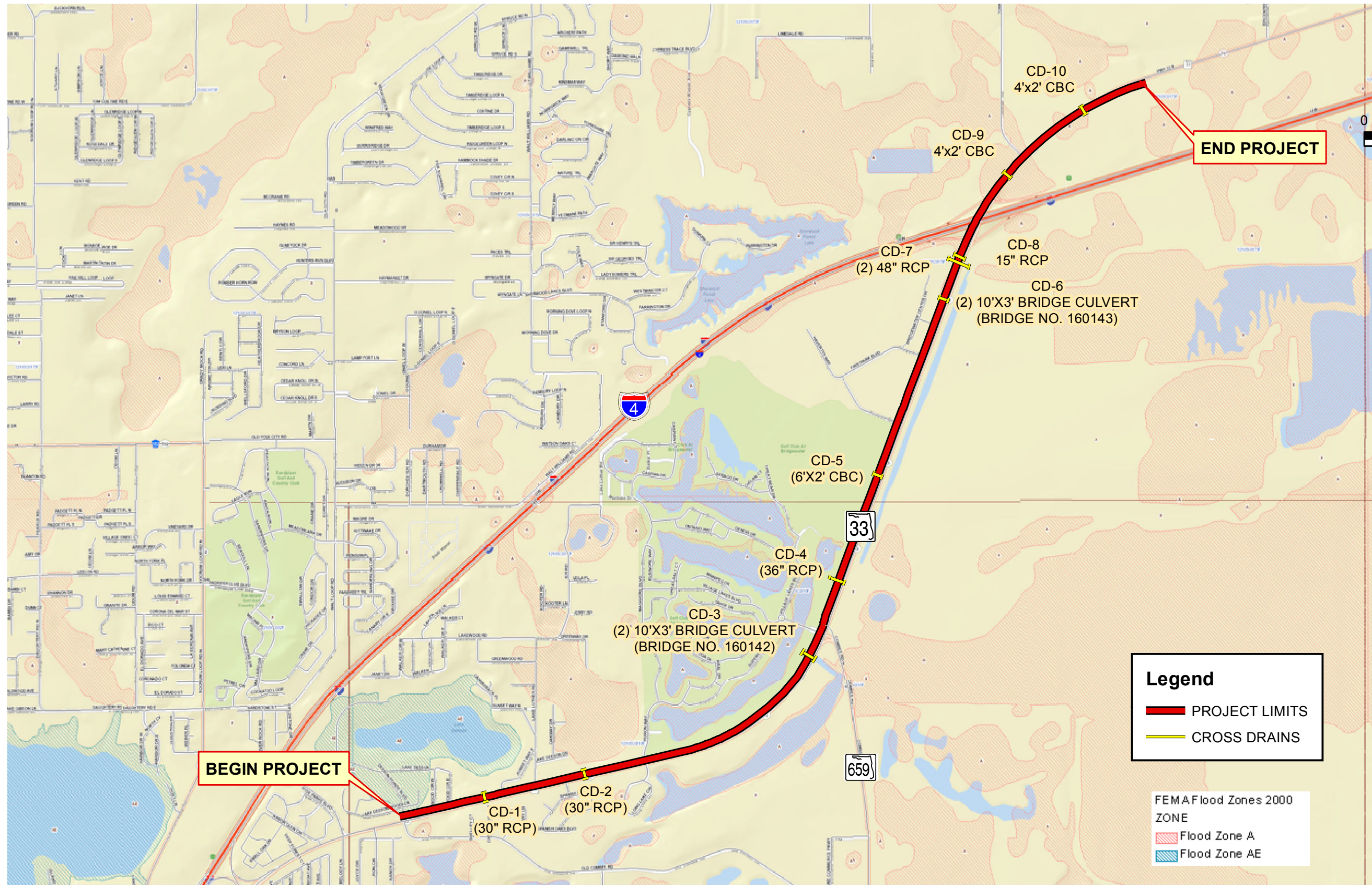
| Legend | |
|--------|----------------|
| | PROJECT LIMITS |
| | CROSS DRAINS |

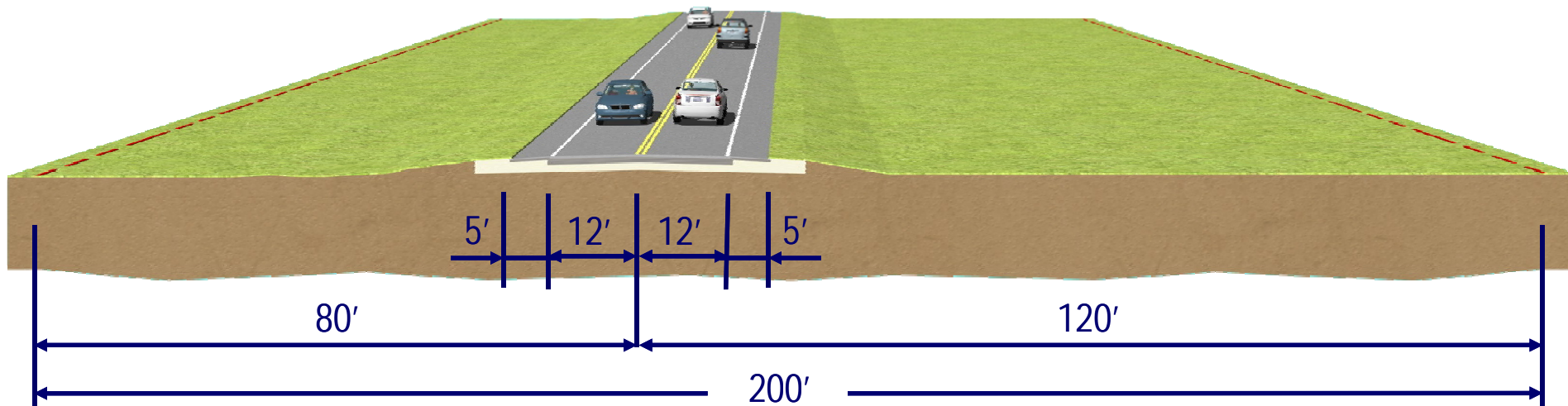


State Road 33 PD&E Study
 from Old Combee Road
 to North of Tomkow Road
 Polk County, Florida
 Financial Project ID: 430185-1-22-01
 Federal Project No: N/A

EXISTING LANDUSE MAP

Figure 4





Florida Department of
Transportation
District 1

State Road 33 PD&E Study

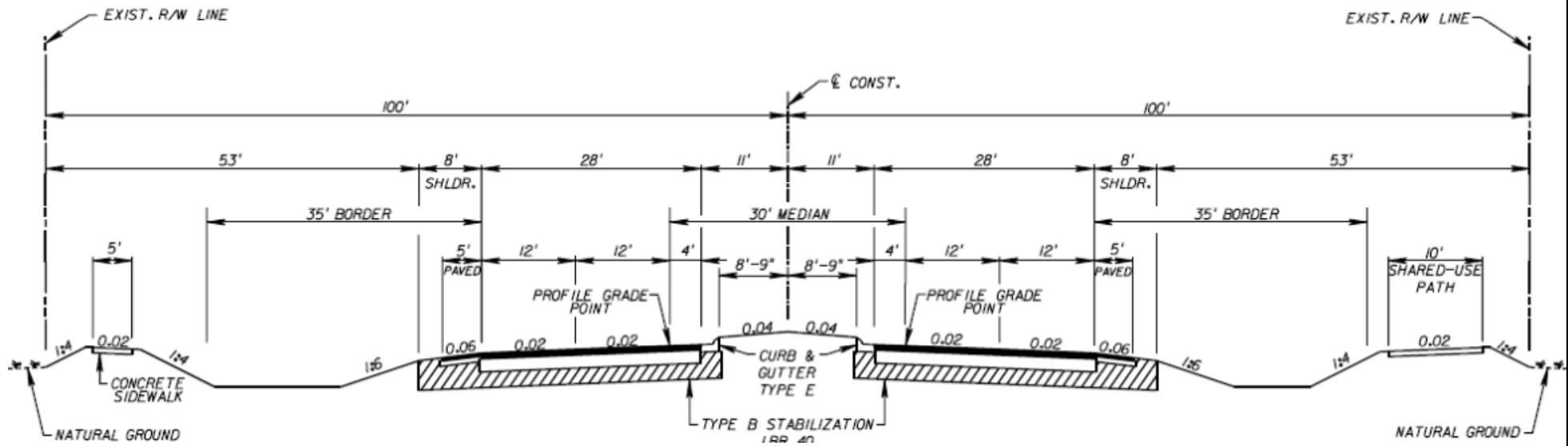
from Old Combee Road
to North Tomkow Road
Polk County, Florida

Financial Project ID: 430185-22-01
Federal Project No: N/A

EXISTING TYPICAL SECTION

Figure

7



Florida Department of
Transportation
District 1

State Road 33 PD&E Study

from Old Combee Road
to North Tomkow Road
Polk County, Florida

Financial Project ID: 430185-22-01
Federal Project No: N/A

PROPOSED TYPICAL SECTION

Figure
8

Appendix 2

Cross Drain Pictures and Review Checklist

Review Checklist

| | | | |
|----------------------------------|--|---------------|-------------------------|
| Date: | 1-16-2013 | | |
| Project: | SR 33 PD&E STUDY | | |
| Location: | 283+00 (CD-1) | Size / Type | 30" RCP |
| Road surface / Leaking joints? | NONE | | |
| Recent development in basin? | NONE | | |
| Overtopping? | Roadway | Basin Divide | <u>In roadway ditch</u> |
| | NONE | | |
| Concerns with culvert extension? | NO | Limited R/W | Wetlands |
| Normal high water marks: | Pipe is dry. NHW approximately 0.25' above downstream FL of pipe. | | |
| Tailwater: | <u>Ditch</u> | Piped outfall | Overland flow Swamp |
| | No apparent outfall for pipe. | | |
| Erosion / Sedimentation: | Minor sedimentation both upstream and downstream. | | |
| Misc. Comments: | Based on field investigation, Basin 1 is a closed basin. Runoff for Basin 1 flows to CD-1 and would need to stage up to R/W and then would outfall to Lake Deason. | | |

CD-1



Upstream



Downstream

Review Checklist

Date: 1-16-2013

Project: SR 33 PD&E STUDY

Location: 303+45 (CD-2) Size / Type 30" RCP

Road surface / Leaking joints? NONE

Recent development in basin? Yes. Landings at Long Lake development southeast of CD-2.

Overtopping? *Roadway* *Basin Divide* *In roadway ditch*
NONE

Concerns with culvert extension? *NO* *Limited R/W* *Wetlands*

Normal high water marks: Pipe is dry. No apparent stain line marks.

Tailwater: *Ditch* *Piped outfall* *Overland flow* *Swamp*
CD outfalls northeast via ditch to existing wetland north of SR 33.

Erosion / Sedimentation: Minor sedimentation and debri.

Misc. Comments: None.

CD-2



Upstream



Downstream

Review Checklist

| | |
|--------------------------------------|---|
| Date: | <u>1-16-2013</u> |
| Project: | <u>SR 33 PD&E STUDY</u> |
| Location: | <u>356+00 (CD-3)</u> Size / Type <u>(2) 10'x3' Bridge Culvert</u> |
| Road surface / Leaking joints? | <u>NONE</u> |
| Recent development in basin? | <u>Yes. Bridgwater Development North and South of CD.</u> |
| Overtopping? | <u>Roadway Basin Divide In roadway ditch</u> <u>NONE</u> |
| Concerns with culvert extension? Yes | <u>Limited R/W Wetlands</u> |
| Normal high water marks: | <u>Stain line is 15" above upstream FL.</u> |
| Tailwater: | <u>Ditch Piped outfall Overland flow Swamp</u> |
| | <u>CD outfalls south via ditch to existing Pond south of SR 33.</u> |
| Erosion / Sedimentation: | <u>Sedimentation and vegetation exists at DS end.</u> |
| Misc. Comments: | <u>Bridge number for Culvert is 160142. Bridge Culvert</u> <u>is in good condition. Field investigation confirms</u> <u>that SR 33 runoff is conveyed to CD-3 and outfalls</u> <u>to pond.</u> |

CD-3



Upstream



Downstream



Bridge Number



Upstream Ditch Looking North



Stain Line Measurement

Review Checklist

| | | | | |
|----------------------------------|--|----------------------|--------------------------------|--------------|
| Date: | <u>1-16-2013</u> | | | |
| Project: | <u>SR 33 PD&E STUDY</u> | | | |
| Location: | <u>372+00 (CD-4)</u> | Size / Type | <u>36" RCP</u> | |
| Road surface / Leaking joints? | <u>NONE</u> | | | |
| Recent development in basin? | <u>Yes. Bridgwater Development North of CD.</u> | | | |
| Overtopping? | <i>Roadway</i> | <i>Basin Divide</i> | <u><i>In roadway ditch</i></u> | |
| | <u>NONE</u> | | | |
| Concerns with culvert extension? | <i>Yes Limited R/W</i> | | <u><i>Wetlands</i></u> | |
| Normal high water marks: | <u>N/A</u> | | | |
| Tailwater: | <u><i>Ditch</i></u> | <i>Piped outfall</i> | <i>Overland flow</i> | <i>Swamp</i> |
| | <u>Pipe outfalls southeast via ditch to existing canal southeast of SR 33.</u> | | | |
| Erosion / Sedimentation: | <u>Sedimentation and vegetation exists at DS end.</u> | | | |
| Misc. Comments: | <u>Pipe underneath SR 33 is not a CD. It is an outfall</u> | | | |
| | <u>pipe connection from a control structure northwest</u> | | | |
| | <u>of SR 33. Pipe will need to be extended for proposed</u> | | | |
| | <u>roadway widening. Also, SLD diagram indicates a 24"</u> | | | |
| | <u>RCP whereas field measurements show 36" RCP.</u> | | | |

CD-4



Upstream Control Structure



Downstream



Downstream Ditch Looking Southeast

Review Checklist

Date: 1-16-2013

Project: SR 33 PD&E STUDY

Location: 394+50 (CD-5) Size / Type 6'x2' CBC

Road surface / Leaking joints? NONE

Recent development in basin? NONE

Overtopping? *Roadway* *Basin Divide* *In roadway ditch*
NONE

Concerns with culvert extension? Yes *Limited R/W* *Wetlands*

Normal high water marks: No apparent stain line marks.

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

Pipe outfalls southeast via ditch to existing canal southeast of SR 33.

Erosion / Sedimentation: Sedimentation and vegetation exists at DS end.

Misc. Comments: None

CD-5



Upstream



Downstream



Downstream Ditch Looking Southeast

Review Checklist

| | |
|----------------------------------|---|
| Date: | <u>1-16-2013</u> |
| Project: | <u>SR 33 PD&E STUDY</u> |
| Location: | <u>432+00 (CD-6) Size / Type (2)10'x3' Bridge Culvert</u> |
| Road surface / Leaking joints? | <u>NONE</u> |
| Recent development in basin? | <u>Yes. East West road southeast of SR 33 was recently constructed.</u> |
| Overtopping? | <u>Roadway Basin Divide In roadway ditch</u> <u>NONE</u> |
| Concerns with culvert extension? | <u>Yes Limited R/W Wetlands</u> |
| Normal high water marks: | <u>No apparent stain line marks.</u> |
| Tailwater: | <u>Ditch Piped outfall Overland flow Swamp</u> |
| Pipe outfalls | <u>southeast via ditch to existing canal southeast of SR 33.</u> |
| Erosion / Sedimentation: | <u>Sedimentation and vegetation exists at US and DS ends.</u> |
| Misc. Comments: | <u>Bridge Culvert bridge number was documented in the</u> <u>field to be 160143. Although survey FL elevations</u> <u>indicate flow to the north, field observation shows</u> <u>the runoff flowing south.</u> |

CD-6



Upstream



Downstream



Downstream Ditch Looking Southeast



Bridge Number

Review Checklist

| | |
|--------------------------------------|--|
| Date: | <u>1-16-2013</u> |
| Project: | <u>SR 33 PD&E STUDY</u> |
| Location: | <u>440+00 (CD-7) Size / Type (2) 48" RCP</u> |
| Road surface / Leaking joints? | <u>NONE</u> |
| Recent development in basin? | <u>Yes. East West road southeast of SR 33 was recently constructed.</u> |
| Overtopping? | <u>Roadway Basin Divide In roadway ditch</u> <u>NONE</u> |
| Concerns with culvert extension? Yes | <u>Limited R/W Wetlands</u> |
| Normal high water marks: | <u>Crown of pipe.</u> |
| Tailwater: | <u>Ditch Piped outfall Overland flow Swamp</u> <u>Pipe outfalls north via ditch to towards I-4 & SR 33 interchange.</u> |
| Erosion / Sedimentation: | <u>Major Sedimentation and vegetation exists at both ends of the CD.</u> |
| Misc. Comments: | <u>The upstream end of the culvert was not accessible</u> <u>due to major vegetation buildup near the culvert.</u> <u></u> <u></u> <u></u> |

CD-7



Upstream (Culvert not accessible due to vegetation)



Downstream Ditch Looking North

Review Checklist

| | |
|----------------------------------|--|
| Date: | <u>1-16-2013</u> |
| Project: | <u>SR 33 PD&E STUDY</u> |
| Location: | <u>441+00 (CD-8)</u> Size / Type <u>15" RCP</u> |
| Road surface / Leaking joints? | <u>NONE</u> |
| Recent development in basin? | <u>Yes. East West road southeast of SR 33 was recently constructed.</u> |
| Overtopping? | <i>Roadway</i> <i>Basin Divide</i> <u><i>In roadway ditch</i></u> <u>NONE</u> |
| Concerns with culvert extension? | <i>No</i> <i>Limited R/W</i> <i>Wetlands</i> |
| Normal high water marks: | <u>Crown of pipe.</u> |
| Tailwater: | <i>Ditch</i> <i>Piped outfall</i> <u><i>Overland flow</i></u> <i>Swamp</i> <u>Pipe outfalls north and sheet flows towards CD-7.</u> |
| Erosion / Sedimentation: | <u>NONE</u> |
| Misc. Comments: | <u>Only minor amount of SR 33 roadway runoff is</u> <u>conveyed to this cross drain based on field</u> <u>observation.</u> |

CD-8



Upstream



Upstream Overland Area



Downstream Overland Area

Review Checklist

| | | | |
|----------------------------------|--|----------------------|-------------------------|
| Date: | <u>1-16-2013</u> | | |
| Project: | <u>SR 33 PD&E STUDY</u> | | |
| Location: | <u>460+00 (CD-9)</u> | Size / Type | <u>2'x4' CBC</u> |
| Road surface / Leaking joints? | <u>NONE</u> | | |
| Recent development in basin? | <u>NONE</u> | | |
| Overtopping? | <i>Roadway</i> | <i>Basin Divide</i> | <i>In roadway ditch</i> |
| | <u>NONE</u> | | |
| Concerns with culvert extension? | <i>YES Limited R/W</i> | | <i>Wetlands</i> |
| Normal high water marks: | <u>Crown of pipe.</u> | | |
| Tailwater: | <i>Ditch</i> | <i>Piped outfall</i> | <i>Overland flow</i> |
| | | | <i>Swamp</i> |
| | <u>Pipe outfalls north and sheet flows towards wetlands.</u> | | |
| Erosion / Sedimentation: | <u>NONE</u> | | |
| Misc. Comments: | <u>NONE</u> | | |
| | <hr/> | | |
| | <hr/> | | |
| | <hr/> | | |

CD-9



Upstream



Downstream



Downstream Overland Area Looking North

Review Checklist

| | | | | |
|----------------------------------|--|----------------------|-------------------------|--------------|
| Date: | <u>7-23-2013</u> | | | |
| Project: | <u>SR 33 PD&E STUDY</u> | | | |
| Location: | <u>480+00 (CD-10)</u> | Size / Type | <u>2'x4' CBC</u> | |
| Road surface / Leaking joints? | <u>NONE</u> | | | |
| Recent development in basin? | <u>NONE</u> | | | |
| Overtopping? | <i>Roadway</i> | <i>Basin Divide</i> | <i>In roadway ditch</i> | |
| | <u>NONE</u> | | | |
| Concerns with culvert extension? | <i>YES</i> | <i>Limited R/W</i> | <i>Wetlands</i> | |
| Normal high water marks: | <u>Crown of pipe.</u> | | | |
| Tailwater: | <i>Ditch</i> | <i>Piped outfall</i> | <i>Overland flow</i> | <i>Swamp</i> |
| | <u>Pipe outfalls north and sheet flows towards wetlands.</u> | | | |
| Erosion / Sedimentation: | <u>NONE</u> | | | |
| Misc. Comments: | <u>NONE</u> | | | |
| | <u> </u> | | | |
| | <u> </u> | | | |
| | <u> </u> | | | |

CD-10



Upstream



Downstream



Upstream Overland Area Looking South



Downstream Overland Area Looking North

Appendix 3

Cross Drain Analyses

TABLE 3 - 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) | | B-A | 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) | Discharge (cfs) | Stage (ft) |
| CD-1 | Sta. 283+00 | 35.0 | 143.48 | 35.0 | 143.58 | 0.10 | 41.0 | 144.00 | 41.0 | 144.00 | 0.00 | 40.62 | 144.00 | 39.34 | 144.00 | | 70.0 | 144.04 | 70.0 | 144.04 | 0.00 |
| CD-2 | Sta. 303+45 | 35.0 | 142.48 | 35.0 | 141.80 | -0.68 | 41.0 | 143.04 | 41.0 | 142.11 | -0.93 | 49.76 | 144.00 | 67.61 | 144.00 | | 70.0 | 144.02 | 70.0 | 144.00 | -0.02 |
| CD-3 | Sta. 356+00 | 35.0 | 133.25 | 35.0 | 133.26 | 0.01 | 43.0 | 133.36 | 43.0 | 133.38 | 0.02 | | | | | | 73.0 | 133.74 | 73.0 | 133.75 | 0.01 |
| CD-4 | Sta. 372+00 | N/A | | | | | | | | | | | | | | | | | | | |
| CD-5 | Sta. 394+50 | 86.0 | 136.62 | 86.0 | 136.62 | 0.00 | 101.0 | 137.40 | 101.0 | 137.40 | 0.00 | 110.89 | 138.00 | 110.89 | 138.00 | | 171.0 | 138.03 | 171.0 | 138.03 | 0.00 |
| CD-6 | Sta. 432+00 | 53.0 | 133.44 | 53.0 | 133.43 | -0.01 | 58.0 | 133.45 | 58.0 | 133.43 | -0.02 | | | | | | 99.0 | 133.53 | 99.0 | 133.47 | -0.06 |
| CD-7 | Sta. 440+00 | 181.0 | 133.13 | 181.0 | 133.20 | 0.07 | 211.0 | 133.82 | 211.0 | 133.92 | 0.10 | 339.65 | 138.00 | 333.88 | 138.00 | | 359.0 | 138.03 | 359.0 | 138.04 | 0.01 |
| CD-8 | Sta. 441+00 | 9.0 | 138.00 | 9.0 | 136.91 | -1.09 | 10.0 | 138.01 | 10.0 | 137.30 | -0.71 | 9.01 | 138.00 | 11.59 | 138.00 | | 18.0 | 138.03 | 18.0 | 138.03 | 0.00 |
| CD-9 | Sta. 460+00 | 58.0 | 138.66 | 58.0 | 138.66 | 0.00 | 67.0 | 139.01 | 67.0 | 139.01 | 0.00 | 62.42 | 139.00 | 62.42 | 139.00 | | 114.0 | 139.04 | 114.0 | 139.04 | 0.00 |
| CD-10 | Sta. 480+00 | 58.0 | 139.66 | 58.0 | 139.17 | -0.49 | 67.0 | 140.38 | 67.0 | 139.53 | -0.85 | 68.43 | 140.50 | 88.29 | 140.50 | | 114.0 | 140.54 | 114.0 | 140.53 | -0.01 |

- Existing conditions show deficiency. Upsize pipe to prevent base flood in proposed conditions
- Upsize pipe to prevent base flood in proposed conditions. Cross drain does not show deficiency in existing conditions.
- Maintain same existing conditions inverts to prevent from getting high headwater levels

| Cross Drain Upsizing | | |
|----------------------|-----------------------------|-----------------------------|
| Structure Number | Existing Pipe Size | Proposed Pipe Size |
| CD-1 | 30" RCP (1) | 30" RCP (1) |
| CD-2 | 30" RCP (1) | 36" RCP (1) |
| CD-3 | 10' X 3' Bridge Culvert (2) | 10' X 3' Bridge Culvert (2) |
| CD-4 | 36" RCP (1) | 36" RCP (1) |
| CD-5 | 6' x 2' CBC (1) | 6' x 2' CBC (1) |
| CD-6 | 10' X 3' Bridge Culvert (2) | 10' X 3' Bridge Culvert (2) |
| CD-7 | 48" RCP (2) | 48" RCP (2) |
| CD-8 | 15" RCP (1) | 18" RCP (1) |
| CD-9 | 2' x 4' CBC (1) | 2' x 4' CBC (1) |
| CD-10 | 2' x 4' CBC (1) | 3' x 4' CBC (1) |

- same
- upsized
- same
- same
- same
- same
- same
- upsized
- same
- upsized

Please note that CD-4 is not a true cross drain that drains offsite area. The proposed cross drain will match the existing.

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Made by: JRC DATE: July 31, 2013
Ch'd by: REC PROJECT #: DT1-017-01

SR 33 PD&E STUDY
CD-1: 1 - 30" RCP (Sta. 283+00) (Existing)

HYDROLOGIC ANALYSIS

VELOCITY METHOD :

$$Q = AV$$

Q = Peak Runoff for Return Period T (cfs).
A = Existing Culvert Cross Section Area
V = 6 feet per second (maximum)

$$A_1 = 4.91 \text{ sq.ft.}$$

$$Q_{25yr} = A_1 V = \quad \mathbf{29 \text{ cfs}}$$

$$Q_{50yr} = 1.2Q_{25yr} = \quad \mathbf{35 \text{ cfs}}$$

$$Q_{100yr} = 1.4Q_{25yr} = \quad \mathbf{41 \text{ cfs}}$$

$$Q_{500yr} = 1.7Q_{100yr} = \quad \mathbf{70 \text{ cfs}}$$

Made by: JRC DATE: 7/31/2013
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SR 33 PD&E STUDY

Overtopping Frequency Determination for CD-1 (Proposed)

| Name | Approximate Location | Description | Barrel | Geometry | Pipe Size | | | Q ₍₅₀₎ | Q ₍₁₀₀₎ | Q _(OT) | Q ₍₅₀₀₎ |
|------|----------------------|-------------|--------|----------|-----------|-------|-----------------|-------------------|--------------------|-------------------|--------------------|
| | | | | | Height | Width | Total Area (sf) | | | | |
| CD-1 | 283+00 | 30" RCP | 1 | Round | 30" | 30" | 4.91 | 35.0 | 41.0 | 39.3 | 70.0 |

*OT = Overtopping

Sample Calculations:

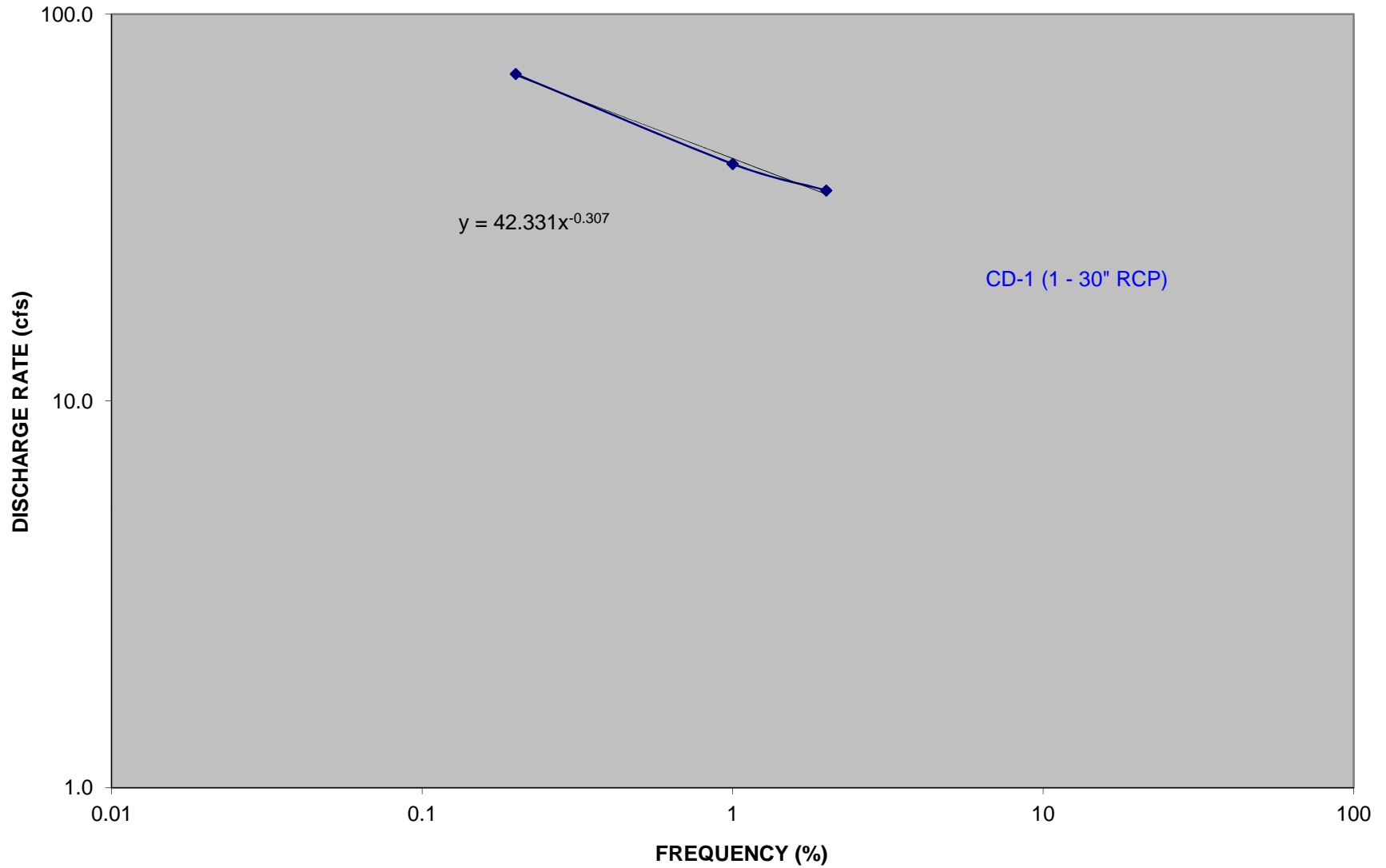
$$Q_{(OT)} = 42.331x^{0.3065} \quad (\text{see curve fitting equation from Chart 2})$$

x 1.27 %

Storm Event = 1/Storm Freq
 79-yr

| Storm Event | | | |
|---------------------|--------|-------|--------|
| 50-yr | 100-yr | 79-yr | 500-yr |
| Storm Frequency (%) | | | |
| 2 | 1 | 1.27 | 0.2 |

CHART 2: DETERMINATION OF OVERTOPPING FREQUENCY (%) USING DISCHARGE RATE AND STORM FREQUENCY for CD-1 (Proposed)



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SR 33 PD&E STUDY
CD-2: 1 - 30" RCP (Sta. 303+45) (Existing)

HYDROLOGIC ANALYSIS

VELOCITY METHOD :

$$Q = AV$$

Q = Peak Runoff for Return Period T (cfs).
A = Existing Culvert Cross Section Area
V = 6 feet per second (maximum)

$$A_1 = 4.91 \text{ sq.ft.}$$

$$Q_{25yr} = A_1 V = \quad \mathbf{29 \text{ cfs}}$$
$$Q_{50yr} = 1.2 Q_{25yr} = \quad \mathbf{35 \text{ cfs}}$$
$$Q_{100yr} = 1.4 Q_{25yr} = \quad \mathbf{41 \text{ cfs}}$$
$$Q_{500yr} = 1.7 Q_{100yr} = \quad \mathbf{70 \text{ cfs}}$$

Made by: JRC DATE: 7/31/2013
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SR 33 PD&E STUDY

Overtopping Frequency Determination for CD-2 (Proposed)

| Name | Approximate Location | Description | Barrel | Geometry | Pipe Size | | | Q ₍₅₀₎ | Q ₍₁₀₀₎ | Q _(OT) | Q ₍₅₀₀₎ |
|------|----------------------|-------------|--------|----------|-----------|-------|-----------------|-------------------|--------------------|-------------------|--------------------|
| | | | | | Height | Width | Total Area (sf) | | | | |
| CD-2 | 303+45 | 36" RCP | 1 | Round | 36" | 36" | 7.07 | 35.0 | 41.0 | 67.6 | 70.0 |

*OT = Overtopping

Sample Calculations:

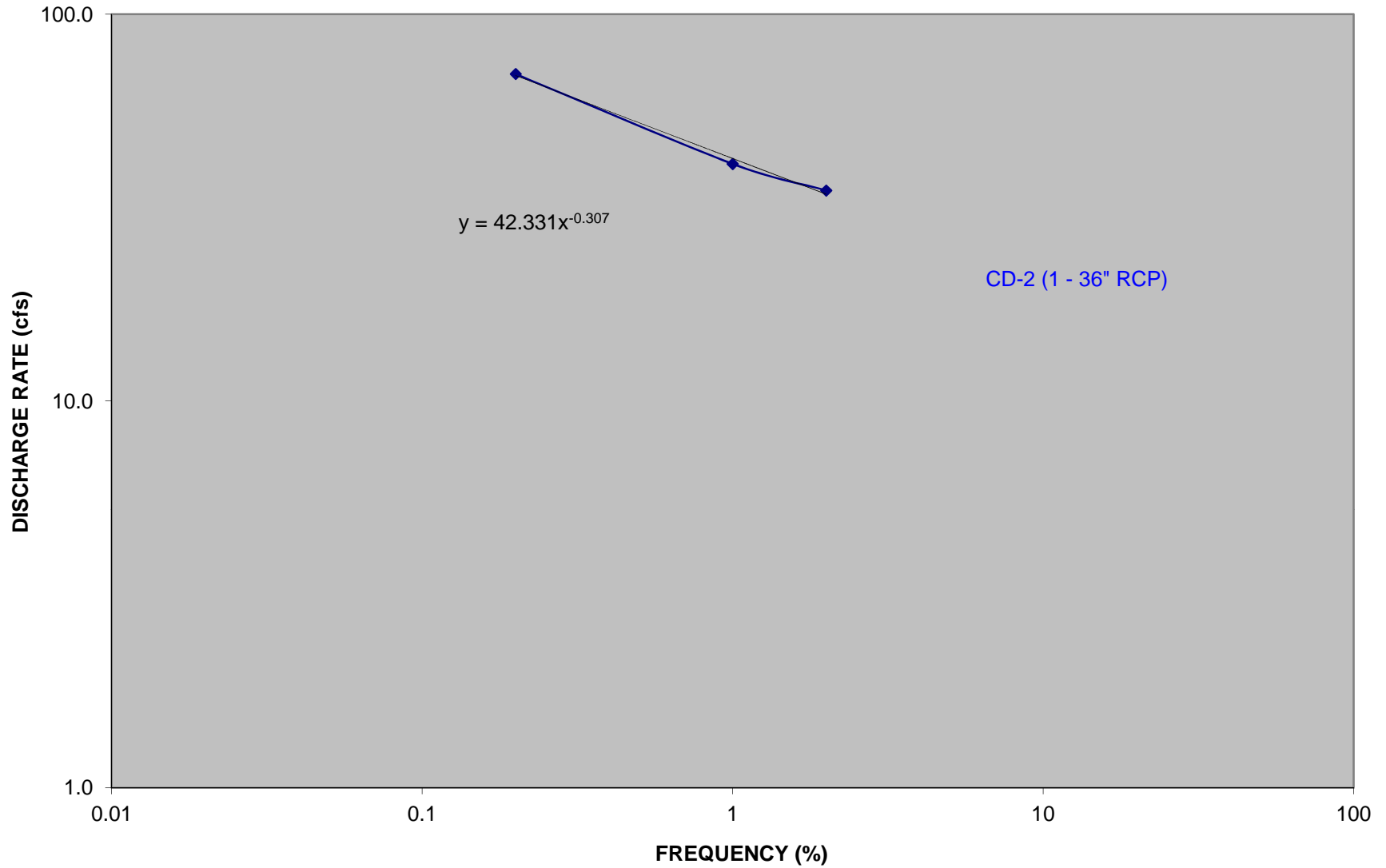
$$Q_{(OT)} = 42.331x^{0.3065} \quad (\text{see curve fitting equation from Chart 2})$$

x 0.22 %

Storm Event = 1/Storm Freq
 461-yr

| Storm Event | | | |
|---------------------|--------|--------|--------|
| 50-yr | 100-yr | 461-yr | 500-yr |
| Storm Frequency (%) | | | |
| 2 | 1 | 0.22 | 0.2 |

CHART 2: DETERMINATION OF OVERTOPPING FREQUENCY (%) USING DISCHARGE RATE AND STORM FREQUENCY for CD-2 (Proposed)



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SR 33 PD&E STUDY
CD-3: 2 - 10'X3' Bridge Culvert (Sta. 356+00) (Existing)

HYDROLOGIC ANALYSIS

RATIONAL METHOD : $Q = ciA$

Q = Peak Runoff for Return Period T (cfs).
c = Rational Method Runoff Coefficient = 0.40
i = Rainfall Intensity (inch/hr)
A = Drainage Area (ac) = 6.20 ac

From IDF Curve Developed by SWFWMD (Zone 8):
i₂₅ = 8.40 inch/hr (Recurrence Frequency 25 Year, TC 10 Minutes)
i₅₀ = 9.00 inch/hr (Recurrence Frequency 50 Year, TC 10 Minutes)
i₁₀₀ = 9.90 inch/hr (Recurrence Frequency 100 Year, TC 10 Minutes)

Total Discharge including Pond 1500:

$Q_{25yr} = ci_{25}A =$ **31 cfs**
 $Q_{50yr} = ci_{50}A =$ **35 cfs**
 $Q_{100yr} = ci_{100}A =$ **43 cfs**
 $Q_{500yr} = 1.7Q_{100yr} =$ **73 cfs**

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SR 33 PD&E STUDY
CD-5: 1 - 2' x 6' CBC (Sta. 394+50) (Existing)

HYDROLOGIC ANALYSIS

VELOCITY METHOD :

$$Q = AV$$

Q = Peak Runoff for Return Period T (cfs).
A = Existing Culvert Cross Section Area
V = 6 feet per second (maximum)

$$A_1 = 12.00 \text{ sq.ft.}$$

$$\begin{aligned} Q_{25yr} &= A_1 V = & \mathbf{72 \text{ cfs}} \\ Q_{50yr} &= 1.2 Q_{25yr} = & \mathbf{86 \text{ cfs}} \\ Q_{100yr} &= 1.4 Q_{25yr} = & \mathbf{101 \text{ cfs}} \\ Q_{500yr} &= 1.7 Q_{100yr} = & \mathbf{171 \text{ cfs}} \end{aligned}$$

Made by: JRC DATE: 7/31/2013
 Ch'd by: REC PROJECT #: DT1-017-01

SR 33 PD&E STUDY

Overtopping Frequency Determination for CD-5 (Proposed)

| Name | Approximate Location | Description | Barrel | Geometry | Pipe Size | | | Q ₍₅₀₎ | Q ₍₁₀₀₎ | Q _(OT) | Q ₍₅₀₀₎ |
|------|----------------------|-------------|--------|----------|-----------|-------|-----------------|-------------------|--------------------|-------------------|--------------------|
| | | | | | Height | Width | Total Area (sf) | | | | |
| CD-5 | 394+50 | 2' x 6' CBC | 1 | Box | 24" | 72" | 12.00 | 86.0 | 101.0 | 110.9 | 171.0 |

*OT = Overtopping

Sample Calculations:

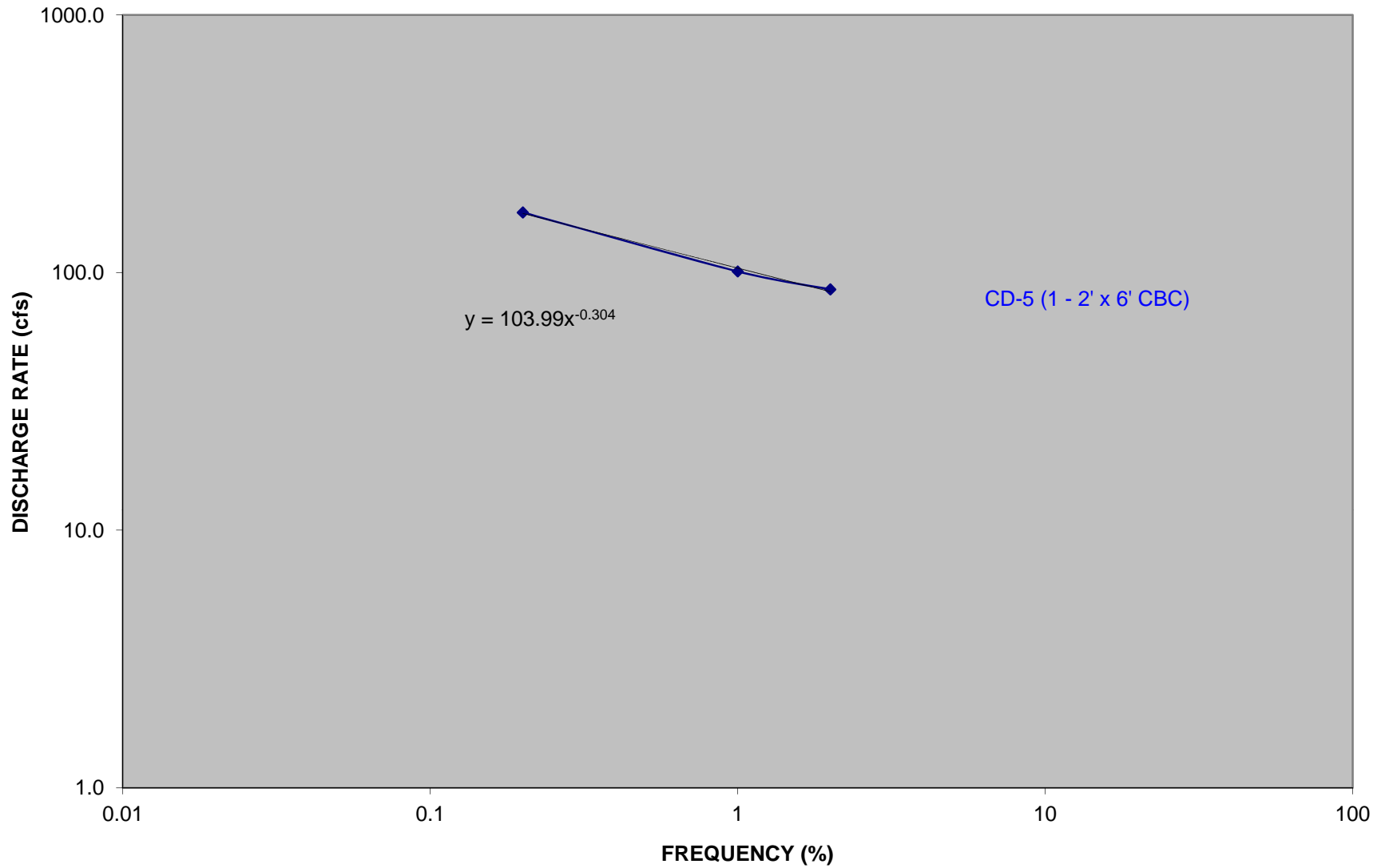
$$Q_{(OT)} = 103.99x^{0.3035} \quad (\text{see curve fitting equation from Chart 2})$$

x 0.81 %

Storm Event = 1/Storm Freq
 124-yr

| Storm Event | | | |
|---------------------|--------|--------|--------|
| 50-yr | 100-yr | 124-yr | 500-yr |
| Storm Frequency (%) | | | |
| 2 | 1 | 0.81 | 0.2 |

CHART 2: DETERMINATION OF OVERTOPPING FREQUENCY (%) USING DISCHARGE RATE AND STORM FREQUENCY for CD-5 (Proposed)



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SR 33 PD&E STUDY
CD-6: 2 - 10' X 3' Bridge Culvert" (Sta. 432+00) (Existing)

HYDROLOGIC ANALYSIS

RATIONAL METHOD : $Q = ciA$

Q = Peak Runoff for Return Period T (cfs).
c = Rational Method Runoff Coefficient = 0.40
i = Rainfall Intensity (inch/hr)
A = Drainage Area (ac) = 14.61 ac

From IDF Curve Developed by SWFWMD (Zone 8):
i₂₅ = 8.40 inch/hr (Recurrence Frequency 25 Year, TC 10 Minutes)
i₅₀ = 9.00 inch/hr (Recurrence Frequency 50 Year, TC 10 Minutes)
i₁₀₀ = 9.90 inch/hr (Recurrence Frequency 100 Year, TC 10 Minutes)

$Q_{25yr} = ci_{25}A =$ **49 cfs**
 $Q_{50yr} = ci_{50}A =$ **53 cfs**
 $Q_{100yr} = ci_{100}A =$ **58 cfs**
 $Q_{500yr} = 1.7Q_{100yr} =$ **99 cfs**

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SR 33 PD&E STUDY
CD-7: 2 - 48" RCP (Sta. 440+00) (Existing)

HYDROLOGIC ANALYSIS

VELOCITY METHOD :

$$Q = AV$$

Q = Peak Runoff for Return Period T (cfs).
A = Existing Culvert Cross Section Area
V = 6 feet per second (maximum)

$$A_1 = 25.13 \text{ sq.ft.}$$

$$Q_{25yr} = A_1 V = \quad \mathbf{151 \text{ cfs}}$$
$$Q_{50yr} = 1.2 Q_{25yr} = \quad \mathbf{181 \text{ cfs}}$$
$$Q_{100yr} = 1.4 Q_{25yr} = \quad \mathbf{211 \text{ cfs}}$$
$$Q_{500yr} = 1.7 Q_{100yr} = \quad \mathbf{359 \text{ cfs}}$$

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SR 33 PD&E STUDY

Overtopping Frequency Determination for CD-7 (Proposed)

| Name | Approximate Location | Description | Barrel | Geometry | Pipe Size | | | Q ₍₅₀₎ | Q ₍₁₀₀₎ | Q _(OT) | Q ₍₅₀₀₎ |
|------|----------------------|-------------|--------|----------|-----------|-------|-----------------|-------------------|--------------------|-------------------|--------------------|
| | | | | | Height | Width | Total Area (sf) | | | | |
| CD-7 | 440+00 | 48" RCP | 2 | Round | 48" | 48" | 25.13 | 181.0 | 211.0 | 333.9 | 359.0 |

*OT = Overtopping

Sample Calculations:

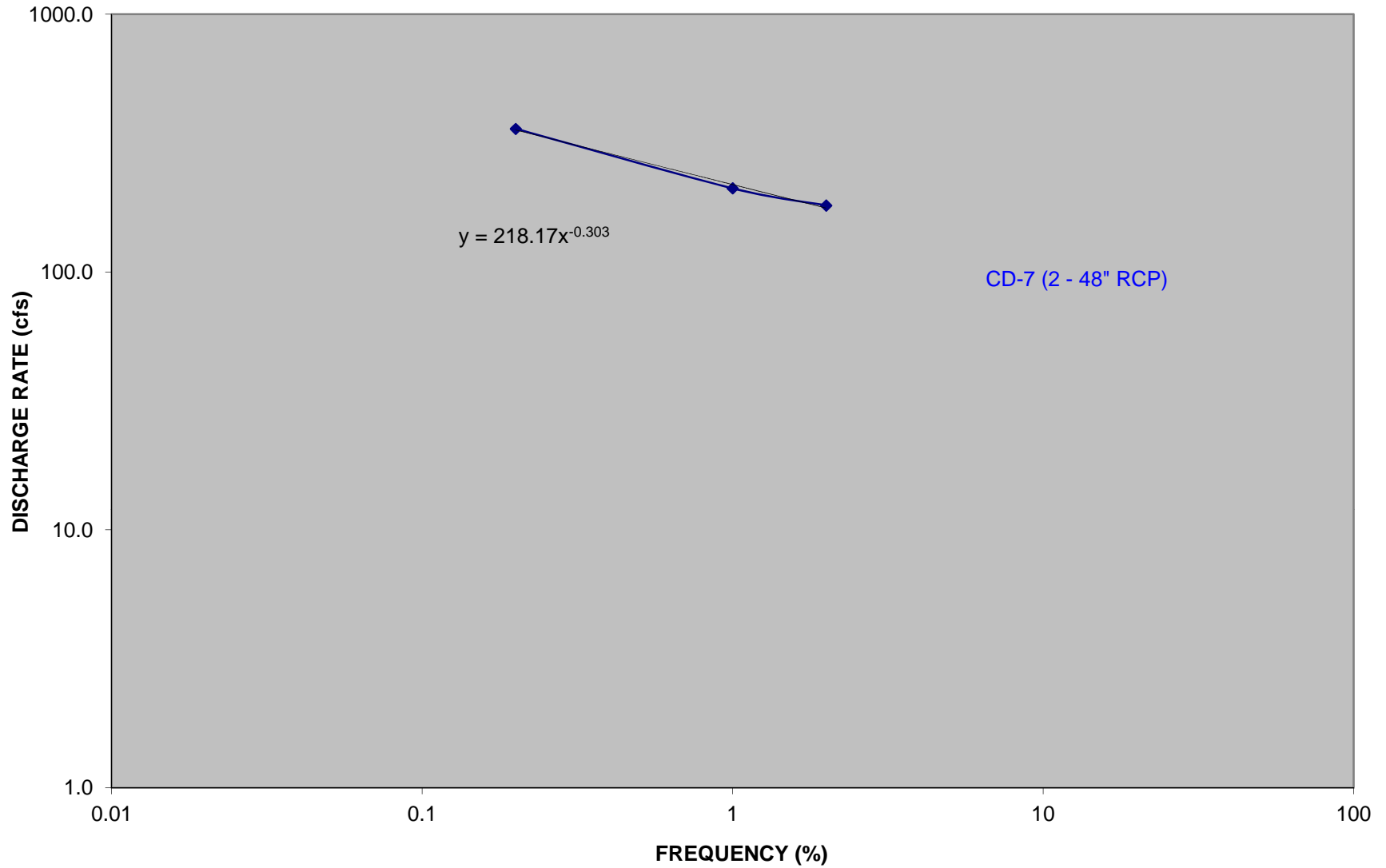
$$Q_{(OT)} = 218.17x^{0.3032} \quad (\text{see curve fitting equation from Chart 2})$$

x 0.25 %

Storm Event = 1/Storm Freq
 407-yr

| Storm Event | | | |
|---------------------|--------|--------|--------|
| 50-yr | 100-yr | 407-yr | 500-yr |
| Storm Frequency (%) | | | |
| 2 | 1 | 0.25 | 0.2 |

CHART 2: DETERMINATION OF OVERTOPPING FREQUENCY (%) USING DISCHARGE RATE AND STORM FREQUENCY for CD-7 (Proposed)



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SR 33 PD&E STUDY
CD-8: 1 - 15" RCP (Sta. 441+00) (Existing)

HYDROLOGIC ANALYSIS

VELOCITY METHOD :

$$Q = AV$$

Q = Peak Runoff for Return Period T (cfs).
A = Existing Culvert Cross Section Area
V = 6 feet per second (maximum)

$$A_1 = 1.23 \text{ sq.ft.}$$

$$\begin{aligned} Q_{25yr} &= A_1 V = && \mathbf{7 \text{ cfs}} \\ Q_{50yr} &= 1.2 Q_{25yr} = && \mathbf{9 \text{ cfs}} \\ Q_{100yr} &= 1.4 Q_{25yr} = && \mathbf{10 \text{ cfs}} \\ Q_{500yr} &= 1.7 Q_{100yr} = && \mathbf{18 \text{ cfs}} \end{aligned}$$

Made by: JRC DATE: 7/31/2013
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SR 33 PD&E STUDY

Overtopping Frequency Determination for CD-8 (Proposed)

| Name | Approximate Location | Description | Barrel | Geometry | Pipe Size | | | Q ₍₅₀₎ | Q ₍₁₀₀₎ | Q _(OT) | Q ₍₅₀₀₎ |
|------|----------------------|-------------|--------|----------|-----------|-------|-----------------|-------------------|--------------------|-------------------|--------------------|
| | | | | | Height | Width | Total Area (sf) | | | | |
| CD-8 | 441+00 | 18" RCP | 1 | Round | 18" | 18" | 1.77 | 9.0 | 10.0 | 11.6 | 18.0 |

*OT = Overtopping

Sample Calculations:

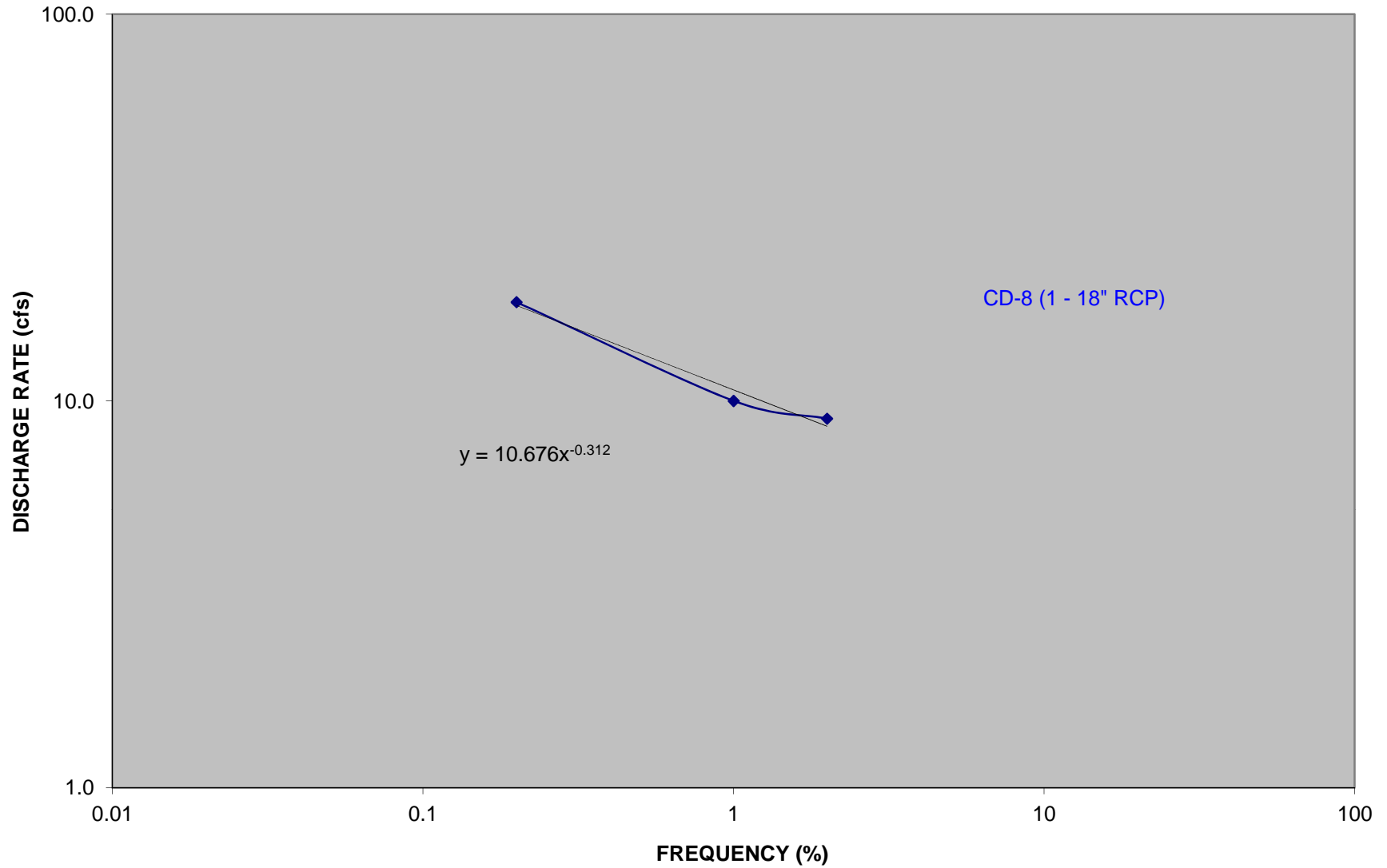
$$Q_{(OT)} = 10.676x^{-0.3123} \quad (\text{see curve fitting equation from Chart 2})$$

x 0.77 %

Storm Event = 1/Storm Freq
 130-yr

| Storm Event | | | |
|---------------------|--------|--------|--------|
| 50-yr | 100-yr | 130-yr | 500-yr |
| Storm Frequency (%) | | | |
| 2 | 1 | 0.77 | 0.2 |

CHART 2: DETERMINATION OF OVERTOPPING FREQUENCY (%) USING DISCHARGE RATE AND STORM FREQUENCY for CD-8 (Proposed)



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SR 33 PD&E STUDY
CD-9: 1 - 2' x 4' CBC (Sta.460+00) (Existing)

HYDROLOGIC ANALYSIS

VELOCITY METHOD :

$$Q = AV$$

Q = Peak Runoff for Return Period T (cfs).
A = Existing Culvert Cross Section Area
V = 6 feet per second (maximum)

$$A_1 = 8.00 \text{ sq.ft.}$$

$$\begin{aligned} Q_{25yr} &= A_1 V = && \mathbf{48 \text{ cfs}} \\ Q_{50yr} &= 1.2 Q_{25yr} = && \mathbf{58 \text{ cfs}} \\ Q_{100yr} &= 1.4 Q_{25yr} = && \mathbf{67 \text{ cfs}} \\ Q_{500yr} &= 1.7 Q_{100yr} = && \mathbf{114 \text{ cfs}} \end{aligned}$$

Made by: JRC DATE: 7/31/2013
 Ch'd by: REC PROJECT #: DT1-017-01

SR 33 PD&E STUDY

Overtopping Frequency Determination for CD-9 (Proposed)

| Name | Approximate Location | Description | Barrel | Geometry | Pipe Size | | | Q ₍₅₀₎ | Q ₍₁₀₀₎ | Q _(OT) | Q ₍₅₀₀₎ |
|------|----------------------|-------------|--------|----------|-----------|-------|-----------------|-------------------|--------------------|-------------------|--------------------|
| | | | | | Height | Width | Total Area (sf) | | | | |
| CD-9 | 460+00 | 2' x 4' CBC | 1 | Box | 24" | 48" | 8.00 | 58.0 | 67.0 | 62.4 | 114.0 |

*OT = Overtopping

Sample Calculations:

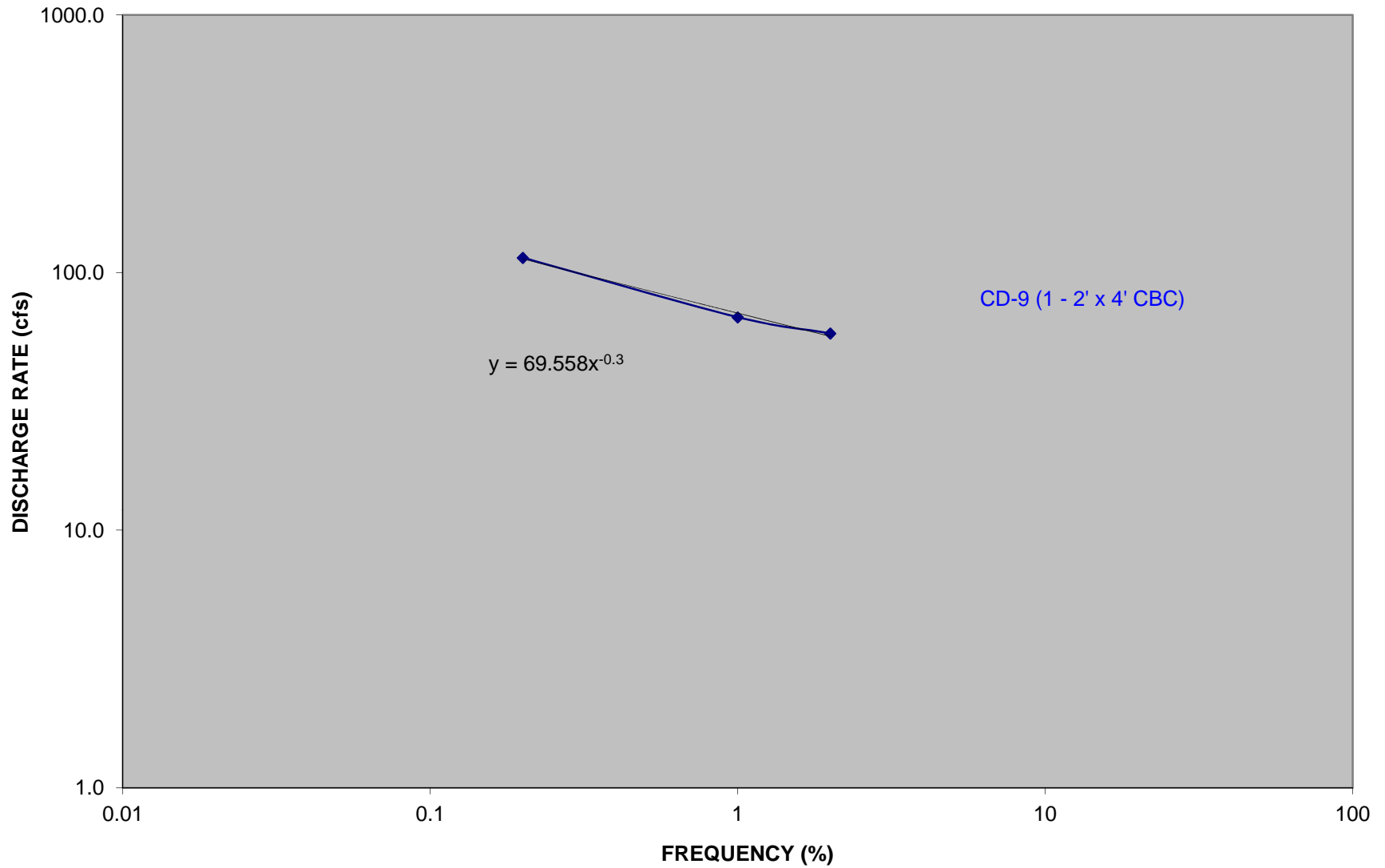
$$Q_{(OT)} = 69.558x^{0.3} \quad (\text{see curve fitting equation from Chart 2})$$

x 1.43 %

Storm Event = 1/Storm Freq
70-yr

| Storm Event | | | |
|---------------------|--------|-------|--------|
| 50-yr | 100-yr | 70-yr | 500-yr |
| Storm Frequency (%) | | | |
| 2 | 1 | 1.43 | 0.2 |

CHART 2: DETERMINATION OF OVERTOPPING FREQUENCY (%) USING DISCHARGE RATE AND STORM FREQUENCY for CD-9 (Proposed)



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SR 33 PD&E STUDY
CD-10: 1 - 2' x 4' CBC (Sta.480+00) (Existing)

HYDROLOGIC ANALYSIS

VELOCITY METHOD :

$$Q = AV$$

Q = Peak Runoff for Return Period T (cfs).
A = Existing Culvert Cross Section Area
V = 6 feet per second (maximum)

$$A_1 = 8.00 \text{ sq.ft.}$$

$$\begin{aligned} Q_{25yr} &= A_1 V = && \mathbf{48 \text{ cfs}} \\ Q_{50yr} &= 1.2 Q_{25yr} = && \mathbf{58 \text{ cfs}} \\ Q_{100yr} &= 1.4 Q_{25yr} = && \mathbf{67 \text{ cfs}} \\ Q_{500yr} &= 1.7 Q_{100yr} = && \mathbf{114 \text{ cfs}} \end{aligned}$$

Made by: JRC DATE: 7/31/2013
 Ch'd by: REC PROJECT #: DT1-017-01

SR 33 PD&E STUDY

Overtopping Frequency Determination for CD-10 (Proposed)

| Name | Approximate Location | Description | Barrel | Geometry | Pipe Size | | | Q ₍₅₀₎ | Q ₍₁₀₀₎ | Q _(OT) | Q ₍₅₀₀₎ |
|-------|----------------------|-------------|--------|----------|-----------|-------|-----------------|-------------------|--------------------|-------------------|--------------------|
| | | | | | Height | Width | Total Area (sf) | | | | |
| CD-10 | 480+00 | 2' x 4' CBC | 1 | Box | 36" | 48" | 12.00 | 58.0 | 67.0 | 88.3 | 114.0 |

*OT = Overtopping

Sample Calculations:

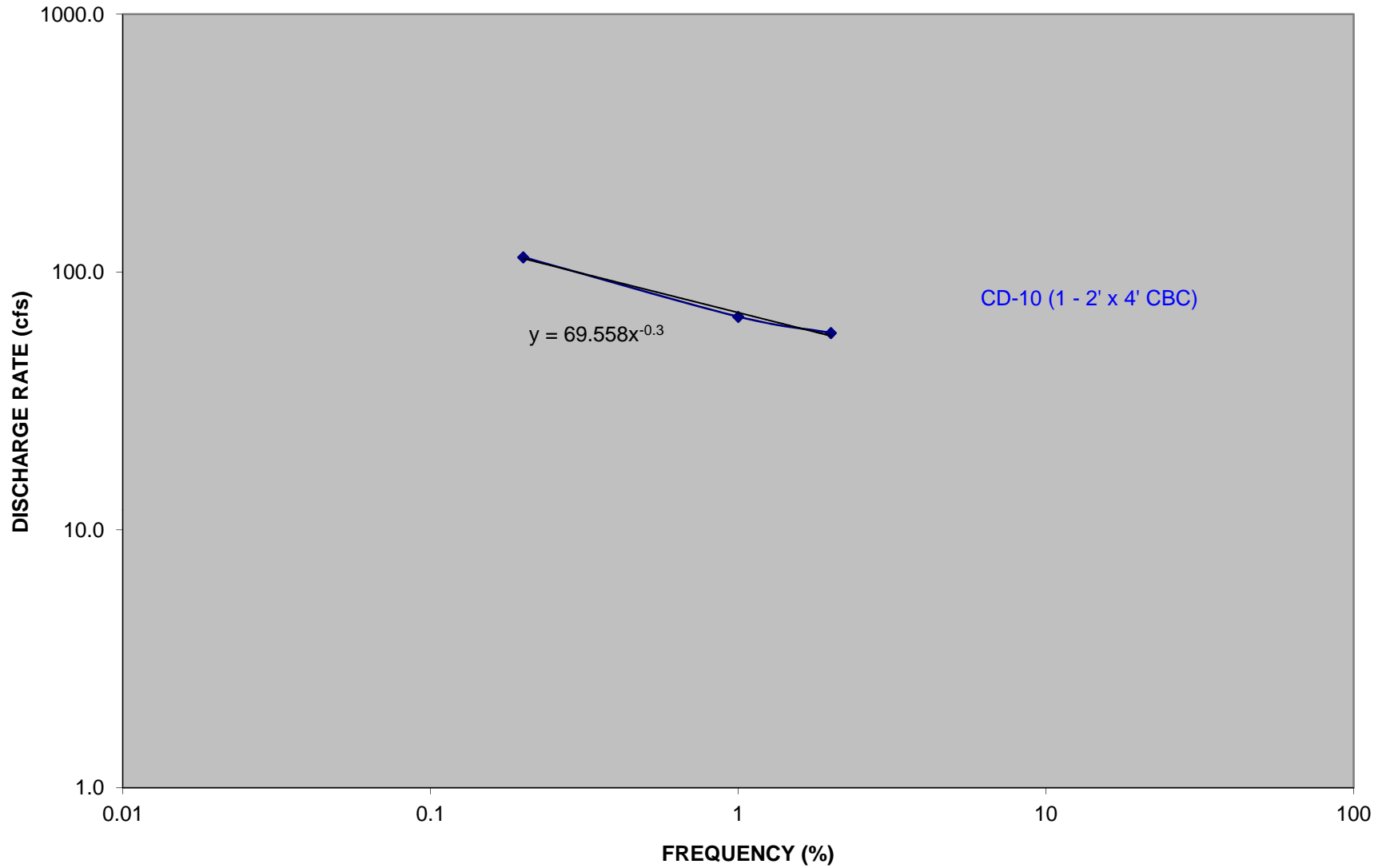
$$Q_{(OT)} = 69.558x^{0.3} \quad (\text{see curve fitting equation from Chart 2})$$

x 0.45 %

Storm Event = 1/Storm Freq
 221-yr

| Storm Event | | | |
|---------------------|--------|--------|--------|
| 50-yr | 100-yr | 221-yr | 500-yr |
| Storm Frequency (%) | | | |
| 2 | 1 | 0.45 | 0.2 |

CHART 2: DETERMINATION OF OVERTOPPING FREQUENCY (%) USING DISCHARGE RATE AND STORM FREQUENCY for CD-10 (Proposed)



HY-8 Culvert Analysis Report

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 |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 143.48 | 35.00 | 35.00 | 0.00 | 1 |
| 143.80 | 38.50 | 38.50 | 0.00 | 1 |
| 143.96 | 41.00 | 40.22 | 0.00 | 50 |
| 144.01 | 45.50 | 40.73 | 4.42 | 12 |
| 144.02 | 49.00 | 40.78 | 7.95 | 4 |
| 144.02 | 52.50 | 40.82 | 11.21 | 3 |
| 144.02 | 56.00 | 40.86 | 14.74 | 3 |
| 144.03 | 59.50 | 40.90 | 18.31 | 3 |
| 144.03 | 63.00 | 40.94 | 21.86 | 3 |
| 144.03 | 66.50 | 40.97 | 25.38 | 3 |
| 144.04 | 70.00 | 41.00 | 28.31 | 2 |
| 144.00 | 40.62 | 40.62 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Ex. CD-1

Total Rating Curve

Crossing: Ex. CD-1

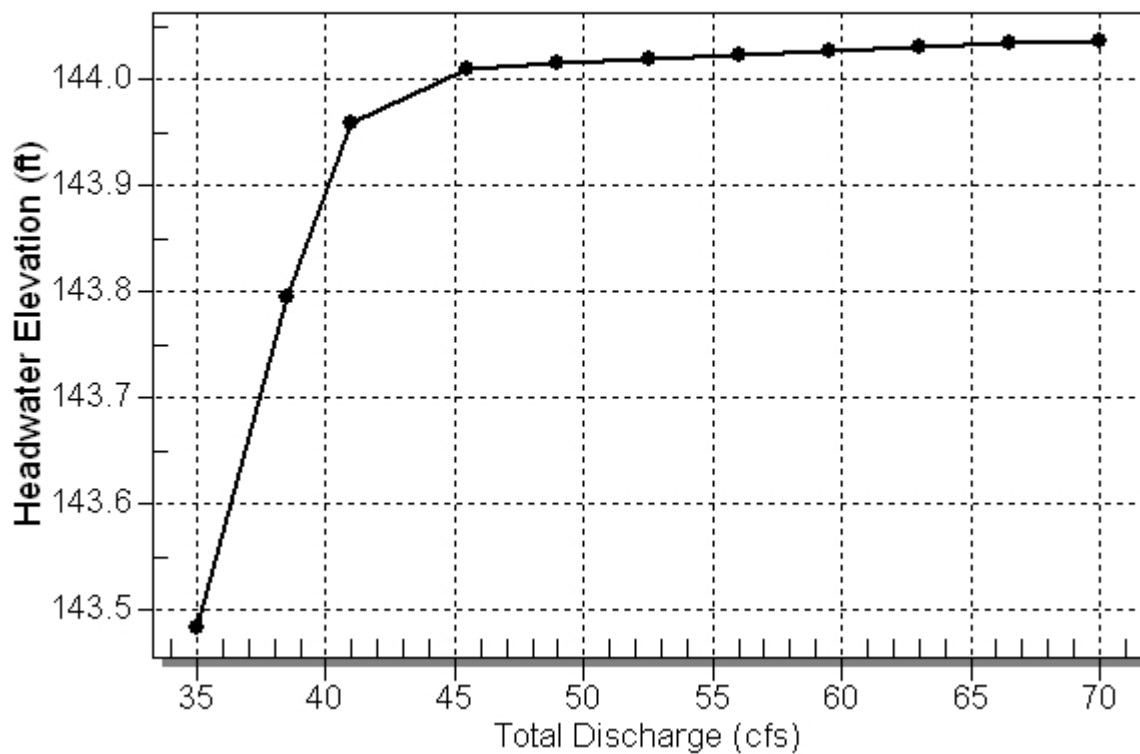


Table 2 - Culvert Summary Table: Ex. CD-1

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 35.00 | 35.00 | 143.48 | 3.291 | 3.484 | 4-FFf | 2.168 | 2.007 | 2.500 | 4.000 | 7.130 | 0.000 |
| 38.50 | 38.50 | 143.80 | 3.610 | 3.796 | 4-FFf | 2.500 | 2.081 | 2.500 | 4.000 | 7.843 | 0.000 |
| 41.00 | 40.22 | 143.96 | 3.777 | 3.959 | 4-FFf | 2.500 | 2.117 | 2.500 | 4.000 | 8.193 | 0.000 |
| 45.50 | 40.73 | 144.01 | 3.829 | 4.010 | 4-FFf | 2.500 | 2.128 | 2.500 | 4.000 | 8.298 | 0.000 |
| 49.00 | 40.78 | 144.02 | 3.834 | 4.015 | 4-FFf | 2.500 | 2.129 | 2.500 | 4.000 | 8.308 | 0.000 |
| 52.50 | 40.82 | 144.02 | 3.839 | 4.019 | 4-FFf | 2.500 | 2.130 | 2.500 | 4.000 | 8.317 | 0.000 |
| 56.00 | 40.86 | 144.02 | 3.843 | 4.023 | 4-FFf | 2.500 | 2.131 | 2.500 | 4.000 | 8.325 | 0.000 |
| 59.50 | 40.90 | 144.03 | 3.846 | 4.027 | 4-FFf | 2.500 | 2.132 | 2.500 | 4.000 | 8.333 | 0.000 |
| 63.00 | 40.94 | 144.03 | 3.850 | 4.030 | 4-FFf | 2.500 | 2.132 | 2.500 | 4.000 | 8.340 | 0.000 |
| 66.50 | 40.97 | 144.03 | 3.853 | 4.034 | 4-FFf | 2.500 | 2.133 | 2.500 | 4.000 | 8.346 | 0.000 |
| 70.00 | 41.00 | 144.04 | 3.856 | 4.036 | 4-FFf | 2.500 | 2.134 | 2.500 | 4.000 | 8.352 | 0.000 |

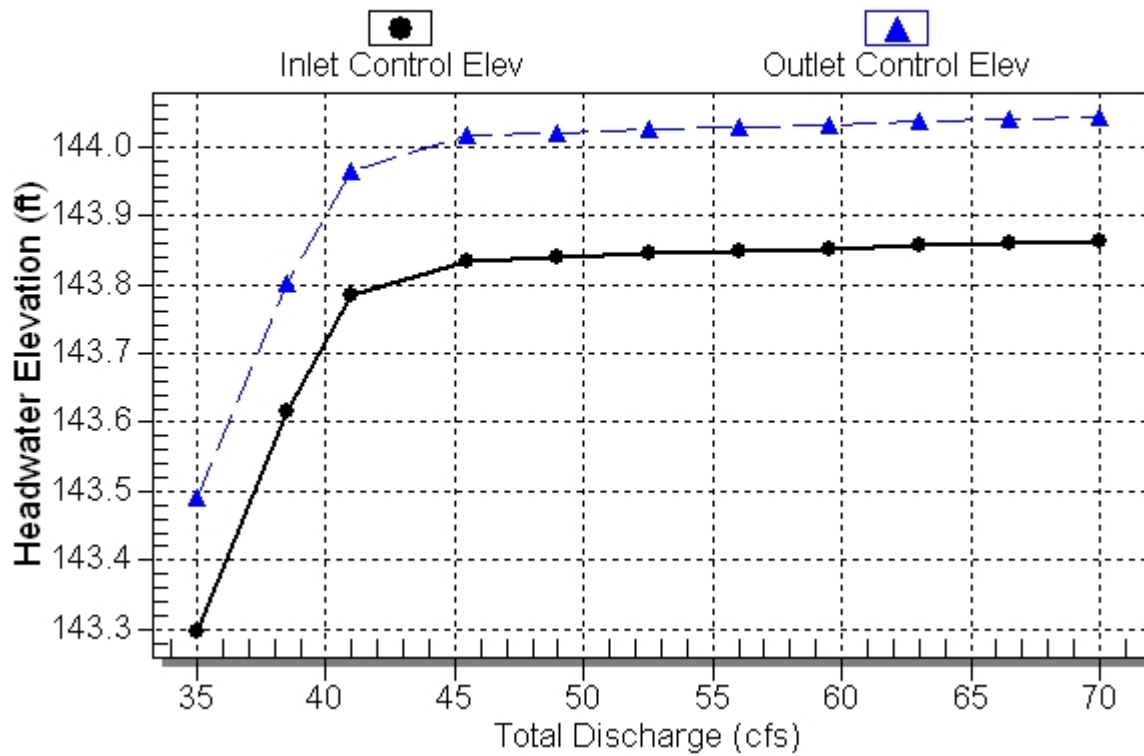
Inlet Elevation (invert): 140.00 ft, Outlet Elevation (invert): 139.50 ft

Culvert Length: 87.00 ft, Culvert Slope: 0.0057

Culvert Performance Curve Plot: Ex. CD-1

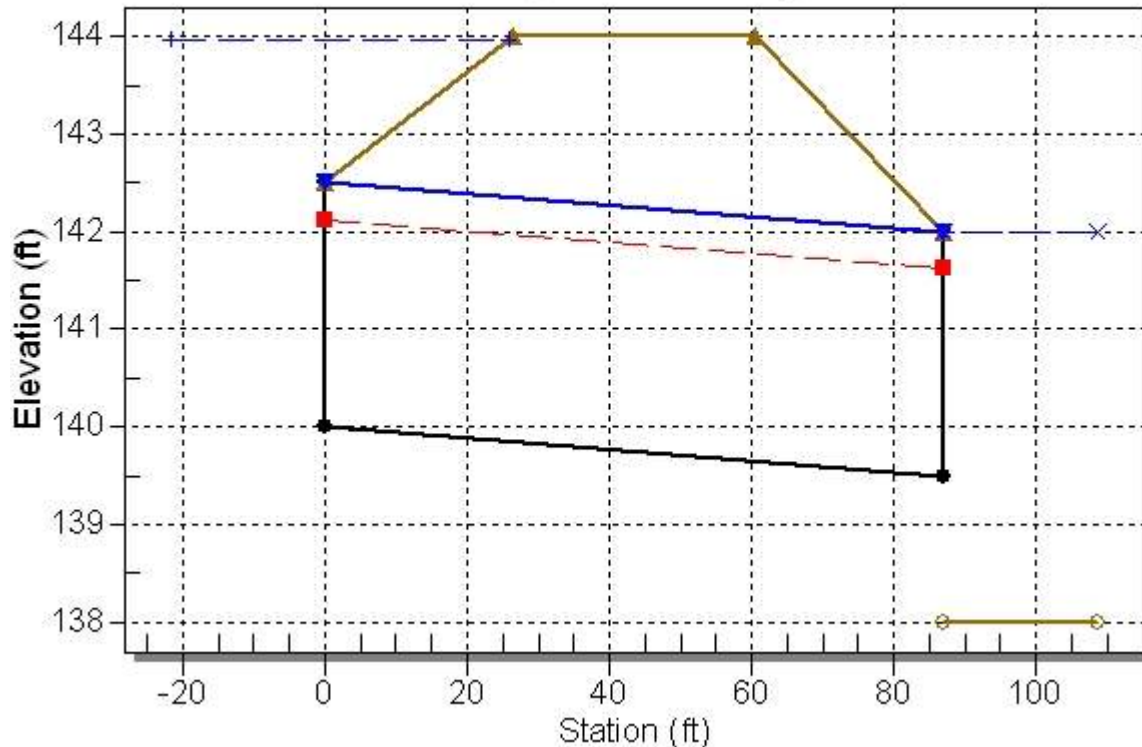
Performance Curve

Culvert: Ex. CD-1



Water Surface Profile Plot for Culvert: Ex. CD-1

Crossing - Ex. CD-1, Design Discharge - 41.0 cfs
Culvert - Ex. CD-1, Culvert Discharge - 40.2 cfs



Site Data - Ex. CD-1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 140.00 ft

Outlet Station: 87.00 ft

Outlet Elevation: 139.50 ft

Number of Barrels: 1

Culvert Data Summary - Ex. CD-1

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Grooved End in Headwall

Inlet Depression: None

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

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 35.00 | 142.00 | 4.00 |
| 38.50 | 142.00 | 4.00 |
| 41.00 | 142.00 | 4.00 |
| 45.50 | 142.00 | 4.00 |
| 49.00 | 142.00 | 4.00 |
| 52.50 | 142.00 | 4.00 |
| 56.00 | 142.00 | 4.00 |
| 59.50 | 142.00 | 4.00 |
| 63.00 | 142.00 | 4.00 |
| 66.50 | 142.00 | 4.00 |
| 70.00 | 142.00 | 4.00 |

Tailwater Channel Data - Ex. CD-1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 142.00 ft

Roadway Data for Crossing: Ex. CD-1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1423.00 ft

Crest Elevation: 144.00 ft

Roadway Surface: Paved

Roadway Top Width: 34.00 ft

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 |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 143.58 | 35.00 | 35.00 | 0.00 | 1 |
| 143.92 | 38.50 | 38.50 | 0.00 | 1 |
| 144.00 | 41.00 | 39.39 | 1.23 | 34 |
| 144.01 | 45.50 | 39.47 | 5.78 | 5 |
| 144.02 | 49.00 | 39.51 | 9.29 | 4 |
| 144.02 | 52.50 | 39.55 | 12.55 | 3 |
| 144.02 | 56.00 | 39.59 | 16.07 | 3 |
| 144.03 | 59.50 | 39.62 | 19.62 | 3 |
| 144.03 | 63.00 | 39.65 | 23.16 | 3 |
| 144.03 | 66.50 | 39.68 | 26.69 | 3 |
| 144.04 | 70.00 | 39.71 | 29.64 | 2 |
| 144.00 | 39.34 | 39.34 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Pr. CD-1

Total Rating Curve

Crossing: Pr. CD-1

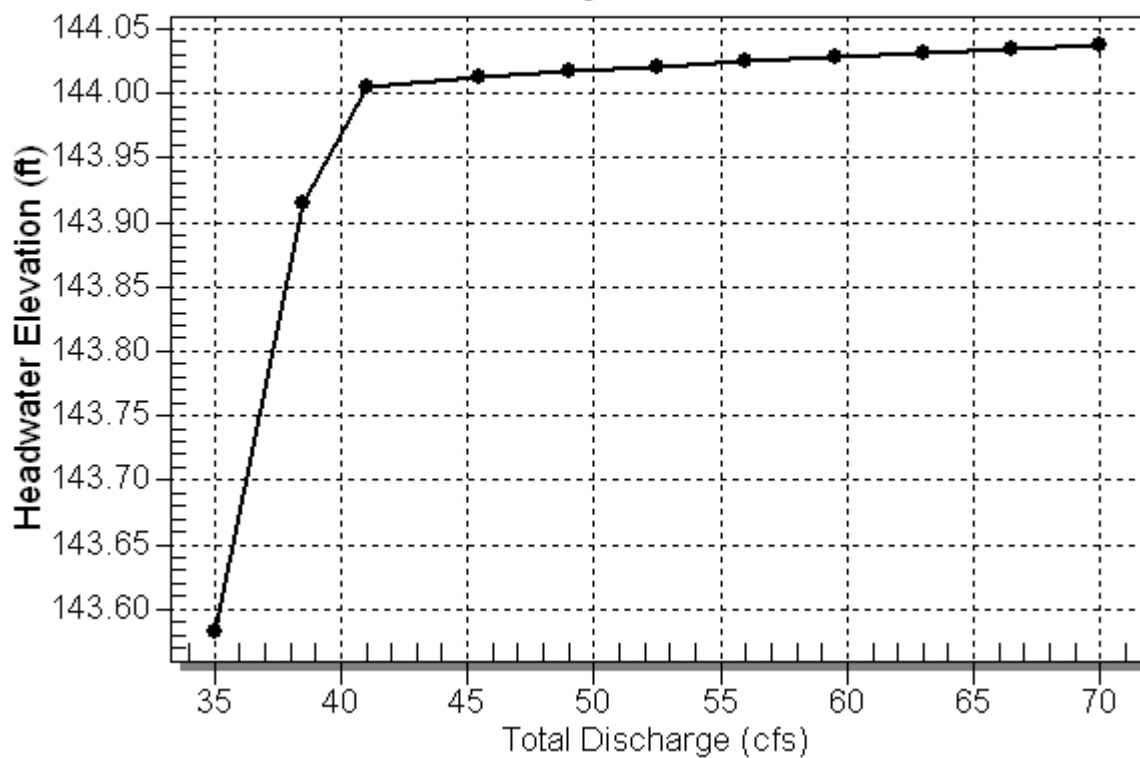


Table 5 - Culvert Summary Table: Pr. CD-1

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 35.00 | 35.00 | 143.58 | 3.291 | 3.583 | 4-FFf | 2.173 | 2.007 | 2.500 | 2.000 | 7.130 | 0.000 |
| 38.50 | 38.50 | 143.92 | 3.610 | 3.915 | 4-FFf | 2.500 | 2.081 | 2.500 | 2.000 | 7.843 | 0.000 |
| 41.00 | 39.39 | 144.00 | 3.696 | 4.004 | 4-FFf | 2.500 | 2.100 | 2.500 | 2.000 | 8.024 | 0.000 |
| 45.50 | 39.47 | 144.01 | 3.704 | 4.013 | 4-FFf | 2.500 | 2.101 | 2.500 | 2.000 | 8.040 | 0.000 |
| 49.00 | 39.51 | 144.02 | 3.708 | 4.017 | 4-FFf | 2.500 | 2.102 | 2.500 | 2.000 | 8.049 | 0.000 |
| 52.50 | 39.55 | 144.02 | 3.712 | 4.021 | 4-FFf | 2.500 | 2.103 | 2.500 | 2.000 | 8.057 | 0.000 |
| 56.00 | 39.59 | 144.02 | 3.715 | 4.025 | 4-FFf | 2.500 | 2.104 | 2.500 | 2.000 | 8.065 | 0.000 |
| 59.50 | 39.62 | 144.03 | 3.719 | 4.028 | 4-FFf | 2.500 | 2.105 | 2.500 | 2.000 | 8.072 | 0.000 |
| 63.00 | 39.65 | 144.03 | 3.722 | 4.032 | 4-FFf | 2.500 | 2.105 | 2.500 | 2.000 | 8.078 | 0.000 |
| 66.50 | 39.68 | 144.03 | 3.725 | 4.035 | 4-FFf | 2.500 | 2.106 | 2.500 | 2.000 | 8.084 | 0.000 |
| 70.00 | 39.71 | 144.04 | 3.727 | 4.037 | 4-FFf | 2.500 | 2.107 | 2.500 | 2.000 | 8.089 | 0.000 |

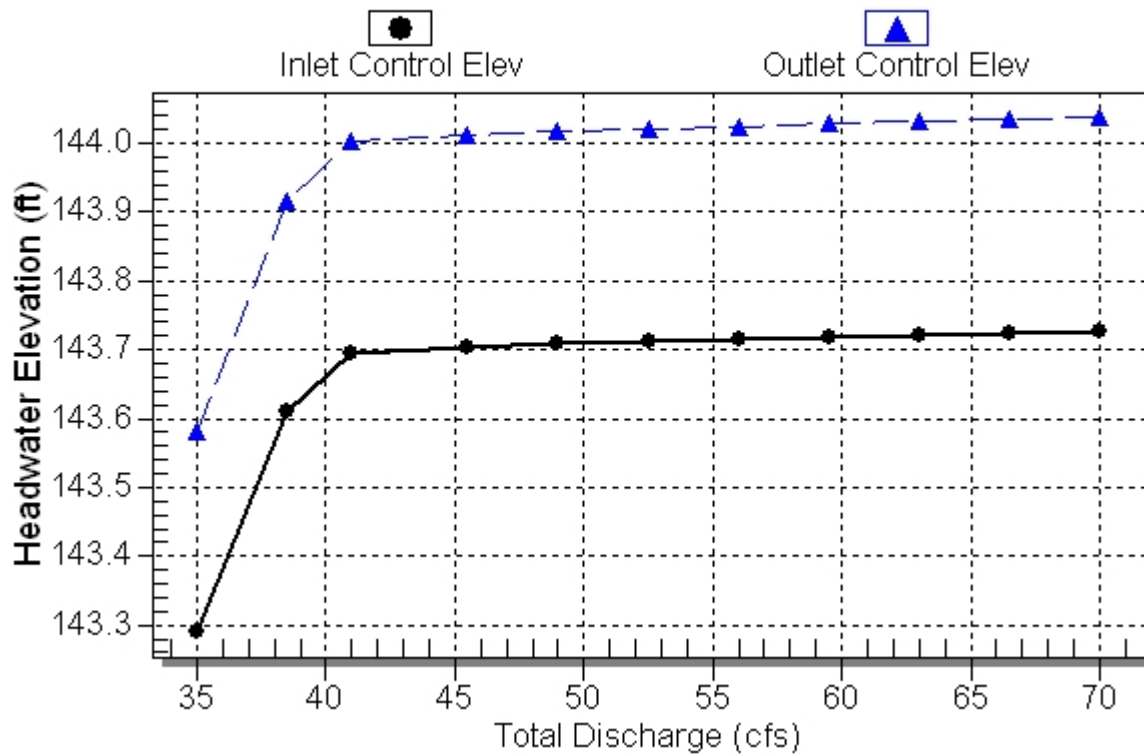
Inlet Elevation (invert): 140.00 ft, Outlet Elevation (invert): 139.41 ft

Culvert Length: 103.00 ft, Culvert Slope: 0.0057

Culvert Performance Curve Plot: Pr. CD-1

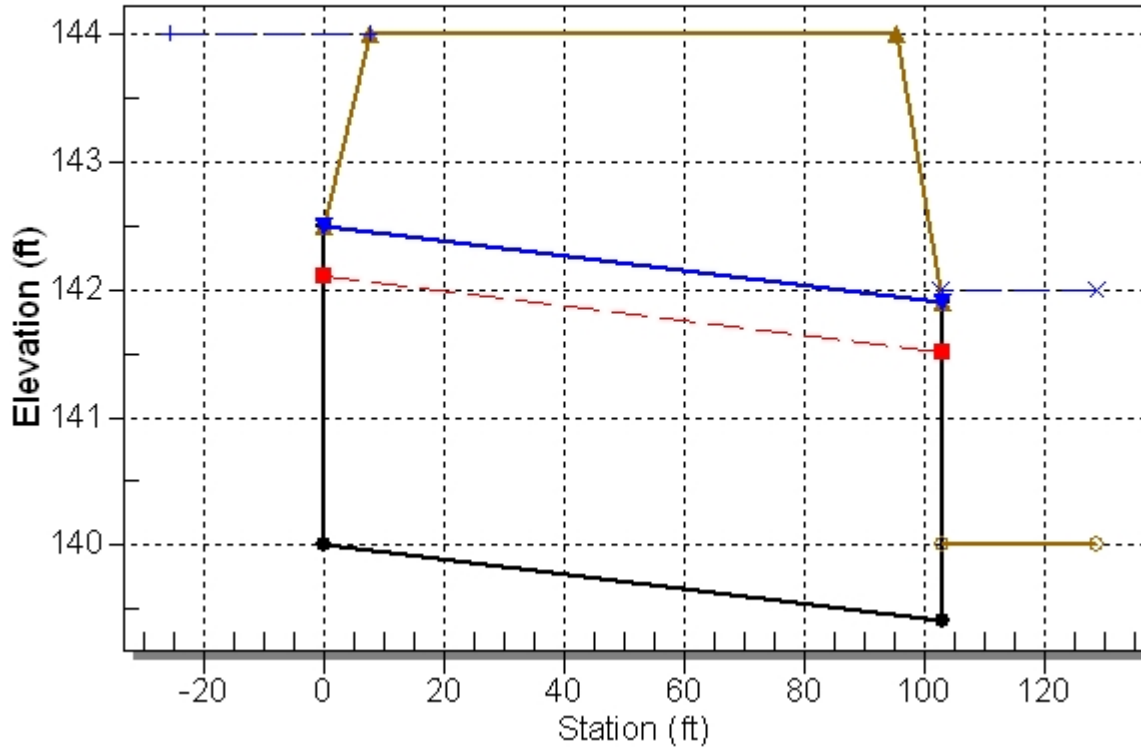
Performance Curve

Culvert: Pr. CD-1



Water Surface Profile Plot for Culvert: Pr. CD-1

Crossing - Pr. CD-1, Design Discharge - 41.0 cfs
Culvert - Pr. CD-1, Culvert Discharge - 39.4 cfs



Site Data - Pr. CD-1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 140.00 ft

Outlet Station: 103.00 ft

Outlet Elevation: 139.41 ft

Number of Barrels: 1

Culvert Data Summary - Pr. CD-1

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Grooved End in Headwall

Inlet Depression: None

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

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 35.00 | 142.00 | 2.00 |
| 38.50 | 142.00 | 2.00 |
| 41.00 | 142.00 | 2.00 |
| 45.50 | 142.00 | 2.00 |
| 49.00 | 142.00 | 2.00 |
| 52.50 | 142.00 | 2.00 |
| 56.00 | 142.00 | 2.00 |
| 59.50 | 142.00 | 2.00 |
| 63.00 | 142.00 | 2.00 |
| 66.50 | 142.00 | 2.00 |
| 70.00 | 142.00 | 2.00 |

Tailwater Channel Data - Pr. CD-1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 142.00 ft

Roadway Data for Crossing: Pr. CD-1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1423.00 ft

Crest Elevation: 144.00 ft

Roadway Surface: Paved

Roadway Top Width: 87.50 ft

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 |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 142.48 | 35.00 | 35.00 | 0.00 | 1 |
| 142.80 | 38.50 | 38.50 | 0.00 | 1 |
| 143.04 | 41.00 | 41.00 | 0.00 | 1 |
| 143.51 | 45.50 | 45.50 | 0.00 | 1 |
| 143.91 | 49.00 | 49.00 | 0.00 | 1 |
| 144.00 | 52.50 | 49.80 | 2.26 | 29 |
| 144.01 | 56.00 | 49.84 | 5.73 | 4 |
| 144.01 | 59.50 | 49.87 | 9.41 | 4 |
| 144.02 | 63.00 | 49.89 | 12.71 | 3 |
| 144.02 | 66.50 | 49.92 | 16.24 | 3 |
| 144.02 | 70.00 | 49.94 | 19.81 | 3 |
| 144.00 | 49.76 | 49.76 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Ex. CD-2

Total Rating Curve

Crossing: Ex. CD-2

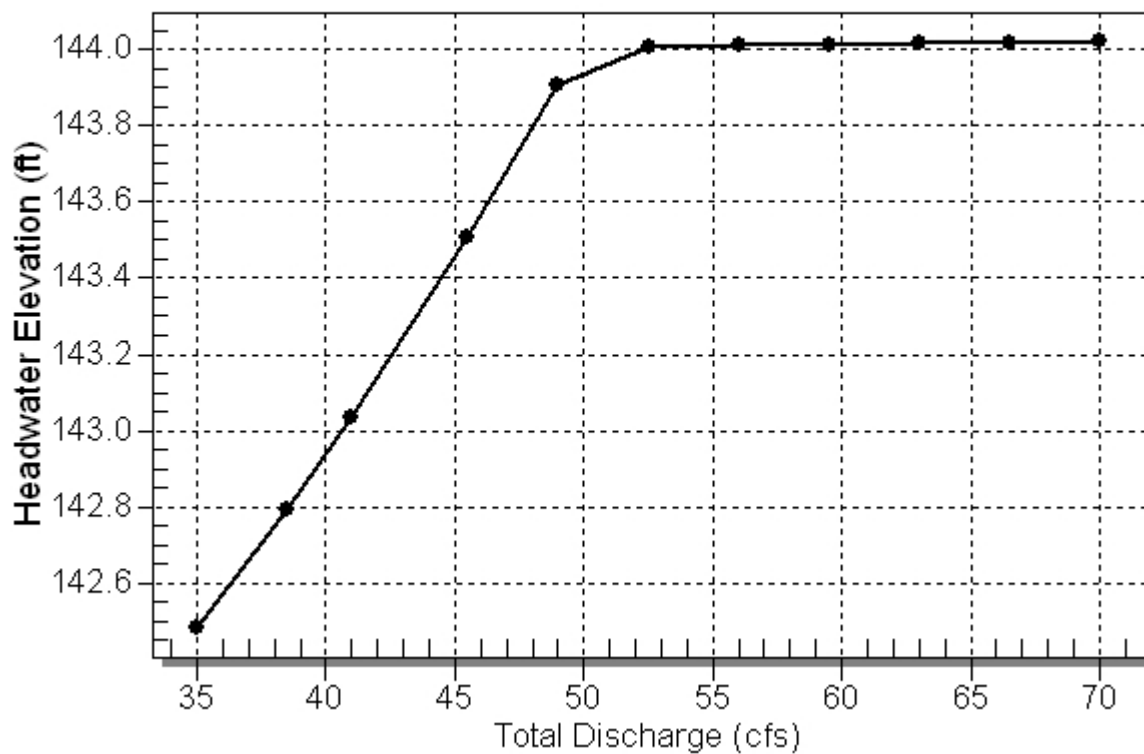


Table 8 - Culvert Summary Table: Ex. CD-2

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 35.00 | 35.00 | 142.48 | 3.291 | 3.484 | 4-FFf | 2.168 | 2.007 | 2.500 | 2.000 | 7.130 | 0.000 |
| 38.50 | 38.50 | 142.80 | 3.610 | 3.796 | 4-FFf | 2.500 | 2.081 | 2.500 | 2.000 | 7.843 | 0.000 |
| 41.00 | 41.00 | 143.04 | 3.856 | 4.036 | 4-FFf | 2.500 | 2.134 | 2.500 | 2.000 | 8.352 | 0.000 |
| 45.50 | 45.50 | 143.51 | 4.337 | 4.508 | 4-FFf | 2.500 | 2.229 | 2.500 | 2.000 | 9.269 | 0.000 |
| 49.00 | 49.00 | 143.91 | 4.743 | 4.909 | 4-FFf | 2.500 | 2.303 | 2.500 | 2.000 | 9.982 | 0.000 |
| 52.50 | 49.80 | 144.00 | 4.840 | 5.005 | 4-FFf | 2.500 | 2.320 | 2.500 | 2.000 | 10.146 | 0.000 |
| 56.00 | 49.84 | 144.01 | 4.844 | 5.009 | 4-FFf | 2.500 | 2.320 | 2.500 | 2.000 | 10.153 | 0.000 |
| 59.50 | 49.87 | 144.01 | 4.848 | 5.013 | 4-FFf | 2.500 | 2.321 | 2.500 | 2.000 | 10.159 | 0.000 |
| 63.00 | 49.89 | 144.02 | 4.851 | 5.016 | 4-FFf | 2.500 | 2.321 | 2.500 | 2.000 | 10.164 | 0.000 |
| 66.50 | 49.92 | 144.02 | 4.854 | 5.018 | 4-FFf | 2.500 | 2.322 | 2.500 | 2.000 | 10.169 | 0.000 |
| 70.00 | 49.94 | 144.02 | 4.856 | 5.021 | 4-FFf | 2.500 | 2.322 | 2.500 | 2.000 | 10.173 | 0.000 |

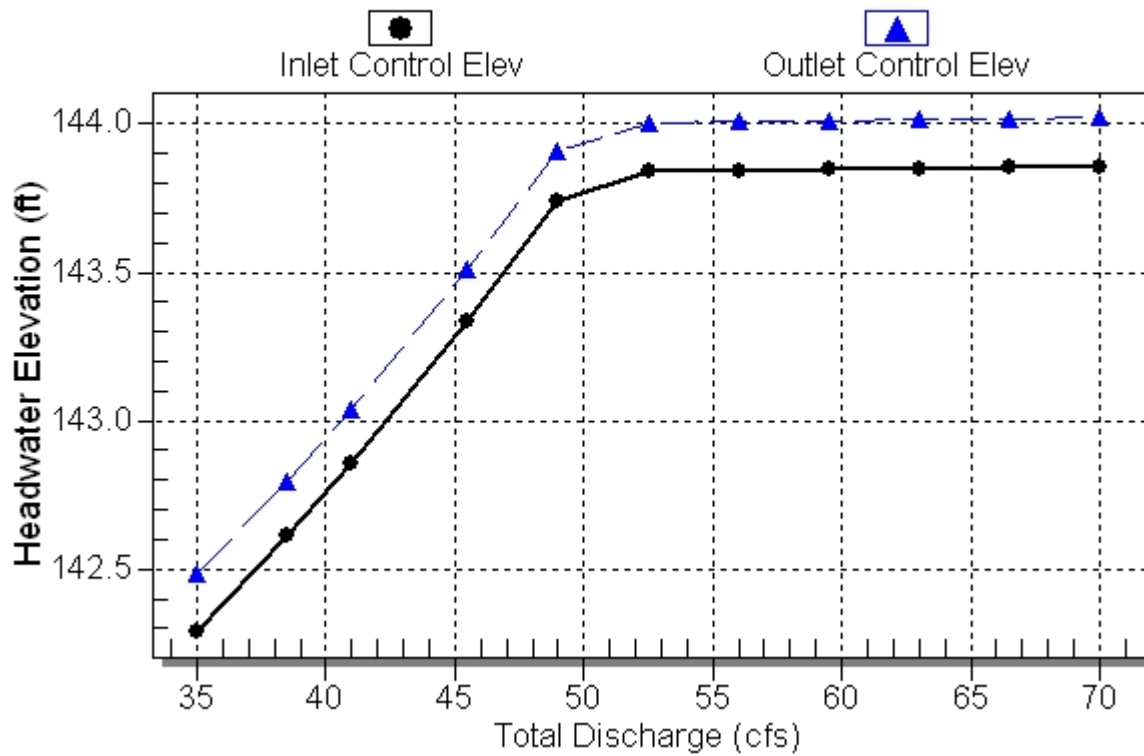
Inlet Elevation (invert): 139.00 ft, Outlet Elevation (invert): 138.50 ft

Culvert Length: 87.00 ft, Culvert Slope: 0.0057

Culvert Performance Curve Plot: Ex. CD-2

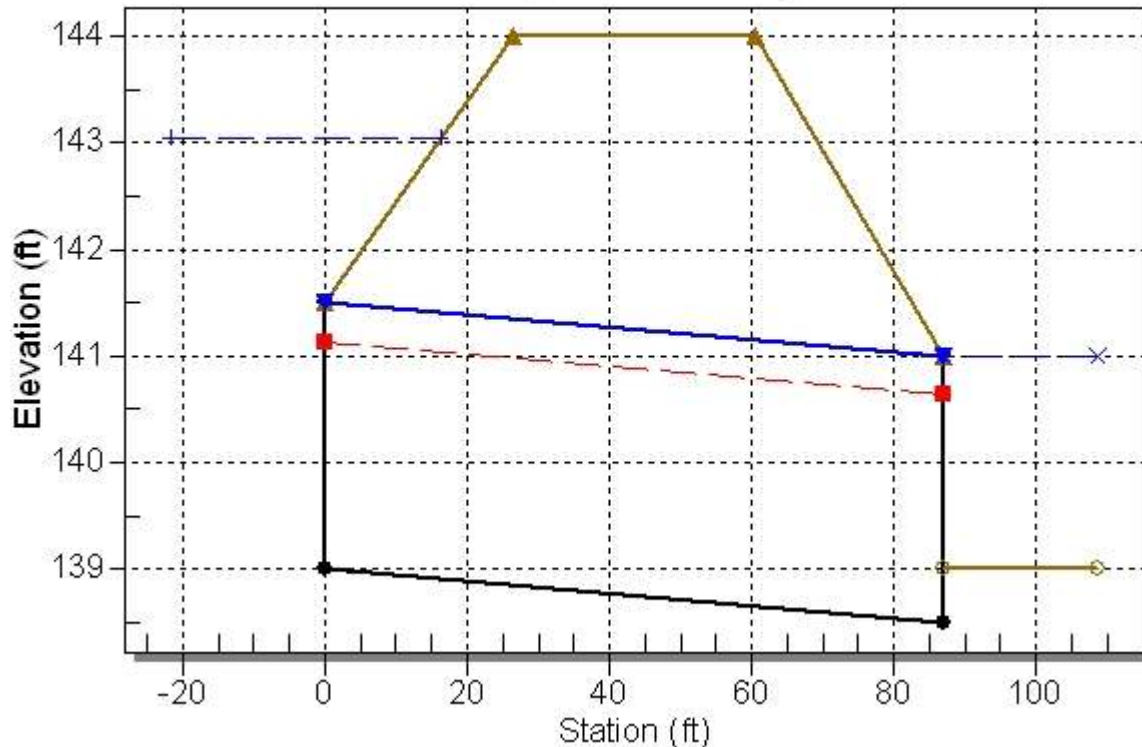
Performance Curve

Culvert: Ex. CD-2



Water Surface Profile Plot for Culvert: Ex. CD-2

Crossing - Ex. CD-2, Design Discharge - 41.0 cfs
Culvert - Ex. CD-2, Culvert Discharge - 41.0 cfs



Site Data - Ex. CD-2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 139.00 ft

Outlet Station: 87.00 ft

Outlet Elevation: 138.50 ft

Number of Barrels: 1

Culvert Data Summary - Ex. CD-2

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Grooved End in Headwall

Inlet Depression: None

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

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 35.00 | 141.00 | 2.00 |
| 38.50 | 141.00 | 2.00 |
| 41.00 | 141.00 | 2.00 |
| 45.50 | 141.00 | 2.00 |
| 49.00 | 141.00 | 2.00 |
| 52.50 | 141.00 | 2.00 |
| 56.00 | 141.00 | 2.00 |
| 59.50 | 141.00 | 2.00 |
| 63.00 | 141.00 | 2.00 |
| 66.50 | 141.00 | 2.00 |
| 70.00 | 141.00 | 2.00 |

Tailwater Channel Data - Ex. CD-2

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 141.00 ft

Roadway Data for Crossing: Ex. CD-2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 2235.00 ft

Crest Elevation: 144.00 ft

Roadway Surface: Paved

Roadway Top Width: 34.00 ft

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 |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 141.80 | 35.00 | 35.00 | 0.00 | 1 |
| 141.98 | 38.50 | 38.50 | 0.00 | 1 |
| 142.11 | 41.00 | 41.00 | 0.00 | 1 |
| 142.36 | 45.50 | 45.50 | 0.00 | 1 |
| 142.56 | 49.00 | 49.00 | 0.00 | 1 |
| 142.81 | 52.50 | 52.50 | 0.00 | 1 |
| 143.00 | 56.00 | 56.00 | 0.00 | 1 |
| 143.28 | 59.50 | 59.50 | 0.00 | 1 |
| 143.59 | 63.00 | 63.00 | 0.00 | 1 |
| 143.90 | 66.50 | 66.50 | 0.00 | 1 |
| 144.00 | 70.00 | 67.65 | 1.71 | 34 |
| 144.00 | 67.61 | 67.61 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Pr. CD-2

Total Rating Curve

Crossing: Pr. CD-2

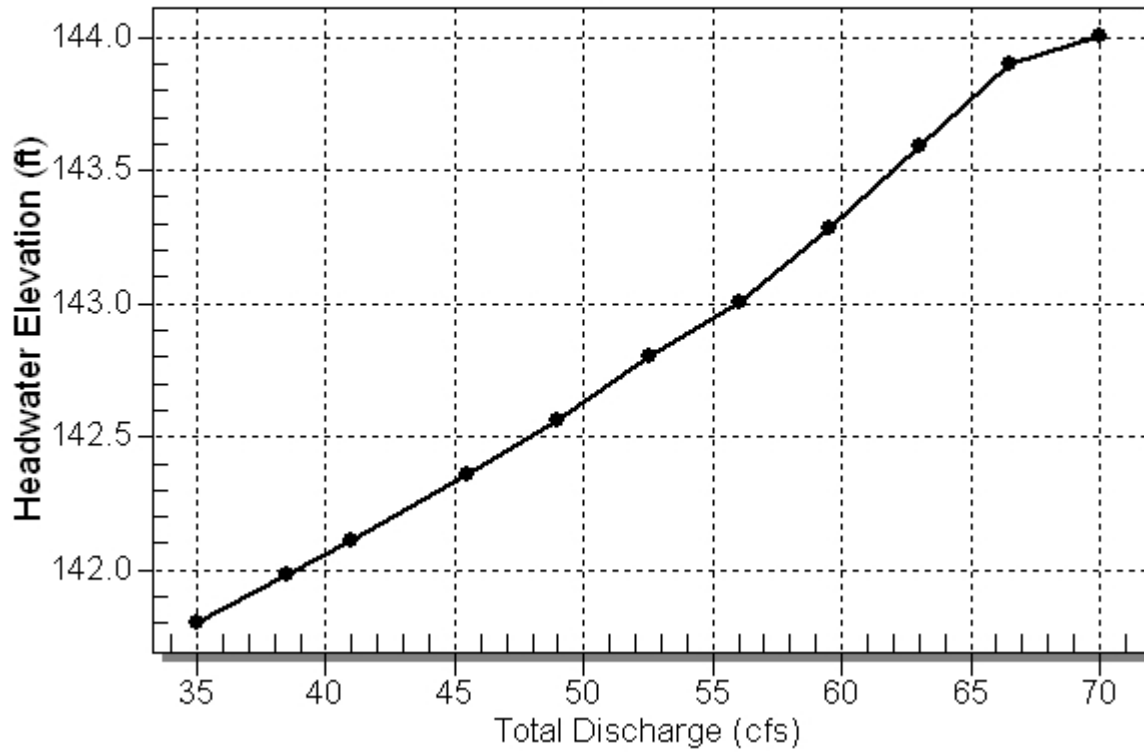


Table 11 - Culvert Summary Table: Pr. CD-2

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 35.00 | 35.00 | 141.80 | 2.804 | 2.804 | 1-S2n | 1.746 | 1.916 | 1.750 | 2.000 | 8.181 | 0.000 |
| 38.50 | 38.50 | 141.98 | 2.982 | 2.982 | 1-S2n | 1.860 | 2.014 | 1.863 | 2.000 | 8.355 | 0.000 |
| 41.00 | 41.00 | 142.11 | 3.112 | 3.112 | 5-S2n | 1.943 | 2.084 | 1.947 | 2.000 | 8.456 | 0.000 |
| 45.50 | 45.50 | 142.36 | 3.357 | 3.357 | 5-S2n | 2.092 | 2.190 | 2.094 | 2.000 | 8.638 | 0.000 |
| 49.00 | 49.00 | 142.56 | 3.560 | 3.560 | 5-S2n | 2.228 | 2.270 | 2.229 | 2.000 | 8.720 | 0.000 |
| 52.50 | 52.50 | 142.81 | 3.775 | 3.806 | 7-M1t | 2.365 | 2.350 | 2.780 | 2.000 | 7.722 | 0.000 |
| 56.00 | 56.00 | 143.00 | 4.002 | 4.001 | 7-M1t | 2.562 | 2.421 | 2.780 | 2.000 | 8.237 | 0.000 |
| 59.50 | 59.50 | 143.28 | 4.244 | 4.280 | 3-M2t | 3.000 | 2.477 | 2.780 | 2.000 | 8.752 | 0.000 |
| 63.00 | 63.00 | 143.59 | 4.500 | 4.589 | 7-M2t | 3.000 | 2.534 | 2.780 | 2.000 | 9.266 | 0.000 |
| 66.50 | 66.50 | 143.90 | 4.770 | 4.900 | 7-M2t | 3.000 | 2.590 | 2.780 | 2.000 | 9.781 | 0.000 |
| 70.00 | 67.65 | 144.00 | 4.862 | 5.004 | 7-M2t | 3.000 | 2.608 | 2.780 | 2.000 | 9.950 | 0.000 |

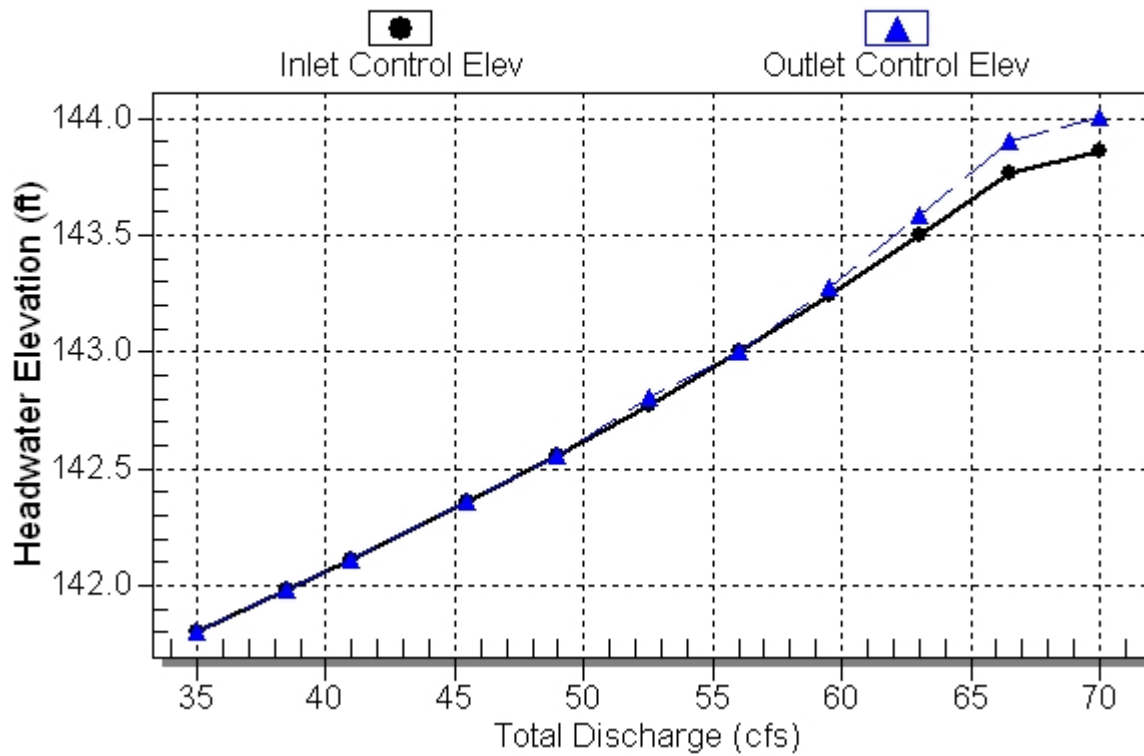
Inlet Elevation (invert): 139.00 ft, Outlet Elevation (invert): 138.22 ft

Culvert Length: 137.00 ft, Culvert Slope: 0.0057

Culvert Performance Curve Plot: Pr. CD-2

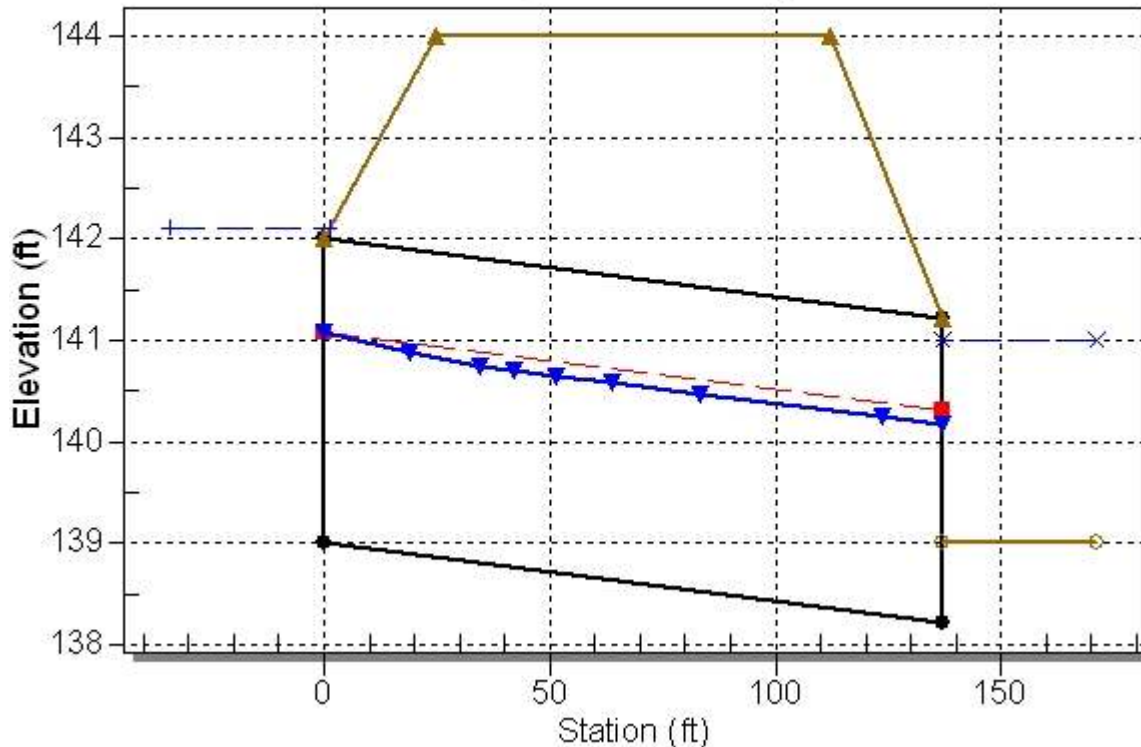
Performance Curve

Culvert: Pr. CD-2



Water Surface Profile Plot for Culvert: Pr. CD-2

Crossing - Pr. CD-2, Design Discharge - 41.0 cfs
Culvert - Pr. CD-2, Culvert Discharge - 41.0 cfs



Site Data - Pr. CD-2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 139.00 ft

Outlet Station: 137.00 ft

Outlet Elevation: 138.22 ft

Number of Barrels: 1

Culvert Data Summary - Pr. CD-2

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Grooved End in Headwall

Inlet Depression: None

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

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 35.00 | 141.00 | 2.00 |
| 38.50 | 141.00 | 2.00 |
| 41.00 | 141.00 | 2.00 |
| 45.50 | 141.00 | 2.00 |
| 49.00 | 141.00 | 2.00 |
| 52.50 | 141.00 | 2.00 |
| 56.00 | 141.00 | 2.00 |
| 59.50 | 141.00 | 2.00 |
| 63.00 | 141.00 | 2.00 |
| 66.50 | 141.00 | 2.00 |
| 70.00 | 141.00 | 2.00 |

Tailwater Channel Data - Pr. CD-2

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 141.00 ft

Roadway Data for Crossing: Pr. CD-2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 2735.00 ft

Crest Elevation: 144.00 ft

Roadway Surface: Paved

Roadway Top Width: 87.50 ft

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 |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 133.25 | 35.00 | 35.00 | 0.00 | 1 |
| 133.30 | 38.80 | 38.80 | 0.00 | 1 |
| 133.36 | 42.60 | 42.60 | 0.00 | 1 |
| 133.36 | 43.00 | 43.00 | 0.00 | 1 |
| 133.46 | 50.20 | 50.20 | 0.00 | 1 |
| 133.51 | 54.00 | 54.00 | 0.00 | 1 |
| 133.56 | 57.80 | 57.80 | 0.00 | 1 |
| 133.60 | 61.60 | 61.60 | 0.00 | 1 |
| 133.65 | 65.40 | 65.40 | 0.00 | 1 |
| 133.70 | 69.20 | 69.20 | 0.00 | 1 |
| 133.74 | 73.00 | 73.00 | 0.00 | 1 |
| 141.00 | 743.62 | 743.62 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Ex. CD-3

Total Rating Curve

Crossing: Ex. CD-3

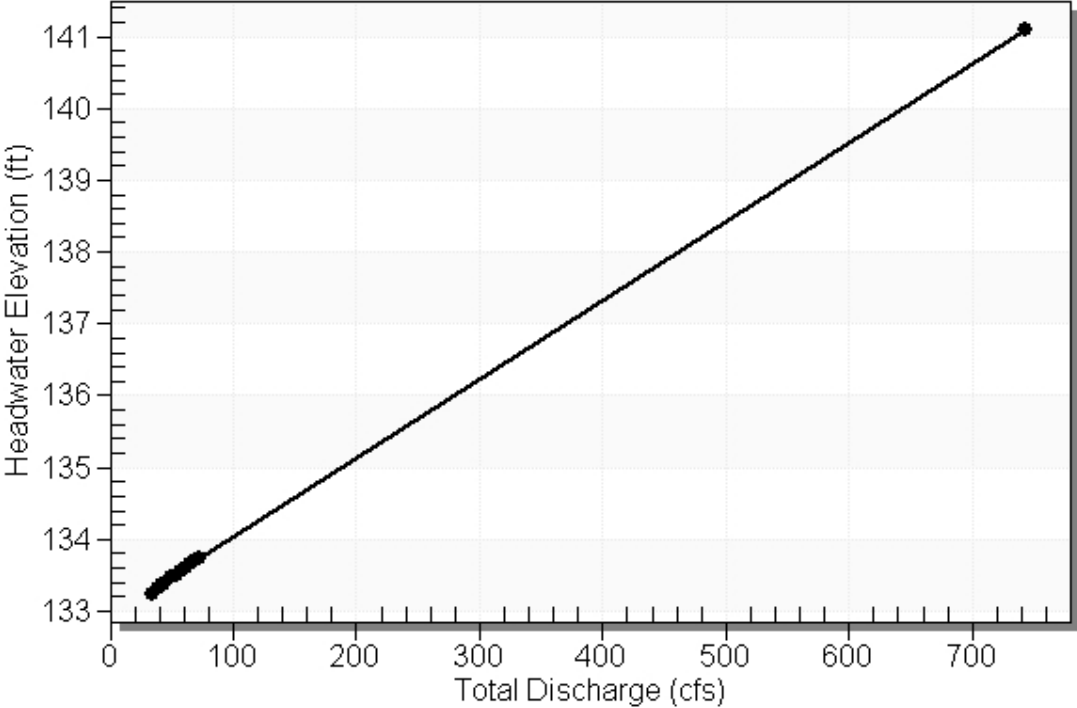


Table 14 - Culvert Summary Table: Ex. CD-3

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 35.00 | 35.00 | 133.25 | 0.783 | 0.817 | 2-M2c | 0.700 | 0.456 | 0.456 | 0.320 | 3.834 | 0.000 |
| 38.80 | 38.80 | 133.30 | 0.839 | 0.873 | 2-M2c | 0.750 | 0.489 | 0.489 | 0.320 | 3.968 | 0.000 |
| 42.60 | 42.60 | 133.36 | 0.893 | 0.927 | 2-M2c | 0.800 | 0.520 | 0.520 | 0.320 | 4.093 | 0.000 |
| 43.00 | 43.00 | 133.36 | 0.899 | 0.932 | 2-M2c | 0.805 | 0.524 | 0.524 | 0.320 | 4.106 | 0.000 |
| 50.20 | 50.20 | 133.46 | 0.996 | 1.029 | 2-M2c | 0.886 | 0.581 | 0.581 | 0.320 | 4.324 | 0.000 |
| 54.00 | 54.00 | 133.51 | 1.046 | 1.079 | 2-M2c | 0.927 | 0.609 | 0.609 | 0.320 | 4.430 | 0.000 |
| 57.80 | 57.80 | 133.56 | 1.095 | 1.127 | 2-M2c | 0.969 | 0.638 | 0.638 | 0.320 | 4.532 | 0.000 |
| 61.60 | 61.60 | 133.60 | 1.142 | 1.174 | 2-M2c | 1.010 | 0.665 | 0.665 | 0.320 | 4.629 | 0.000 |
| 65.40 | 65.40 | 133.65 | 1.189 | 1.220 | 2-M2c | 1.052 | 0.692 | 0.692 | 0.320 | 4.722 | 0.000 |
| 69.20 | 69.20 | 133.70 | 1.234 | 1.266 | 2-M2c | 1.093 | 0.719 | 0.719 | 0.320 | 4.812 | 0.000 |
| 73.00 | 73.00 | 133.74 | 1.279 | 1.310 | 2-M2c | 1.130 | 0.745 | 0.745 | 0.320 | 4.898 | 0.000 |

Straight Culvert

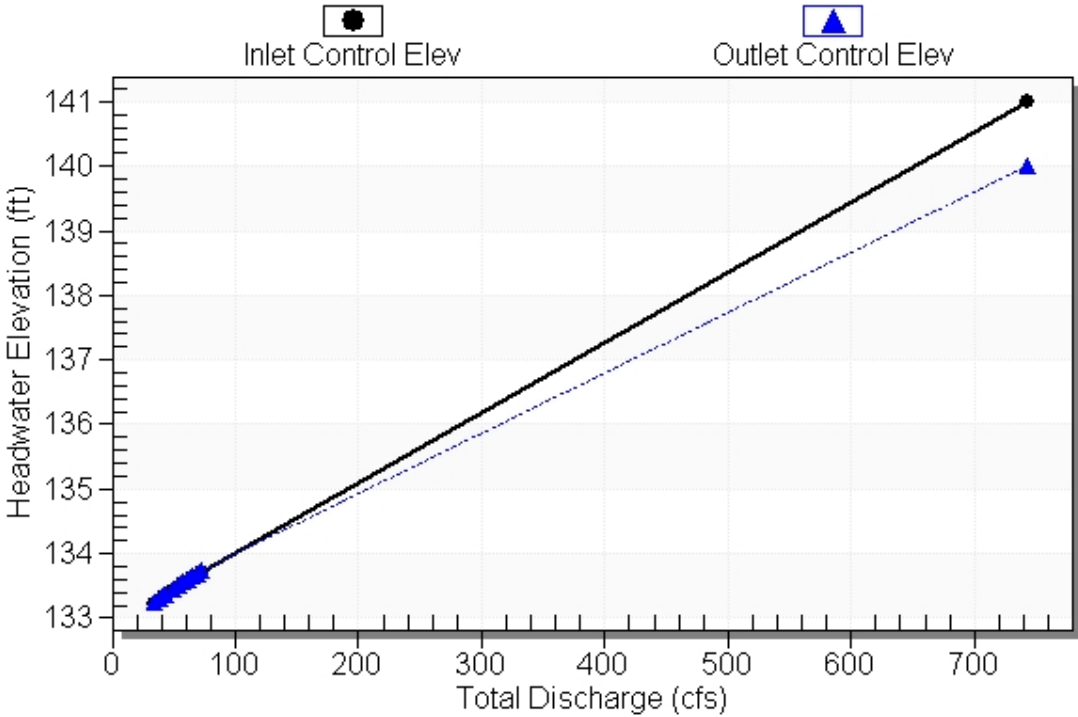
Inlet Elevation (invert): 132.43 ft, Outlet Elevation (invert): 132.33 ft

Culvert Length: 133.00 ft, Culvert Slope: 0.0008

Culvert Performance Curve Plot: Ex. CD-3

Performance Curve

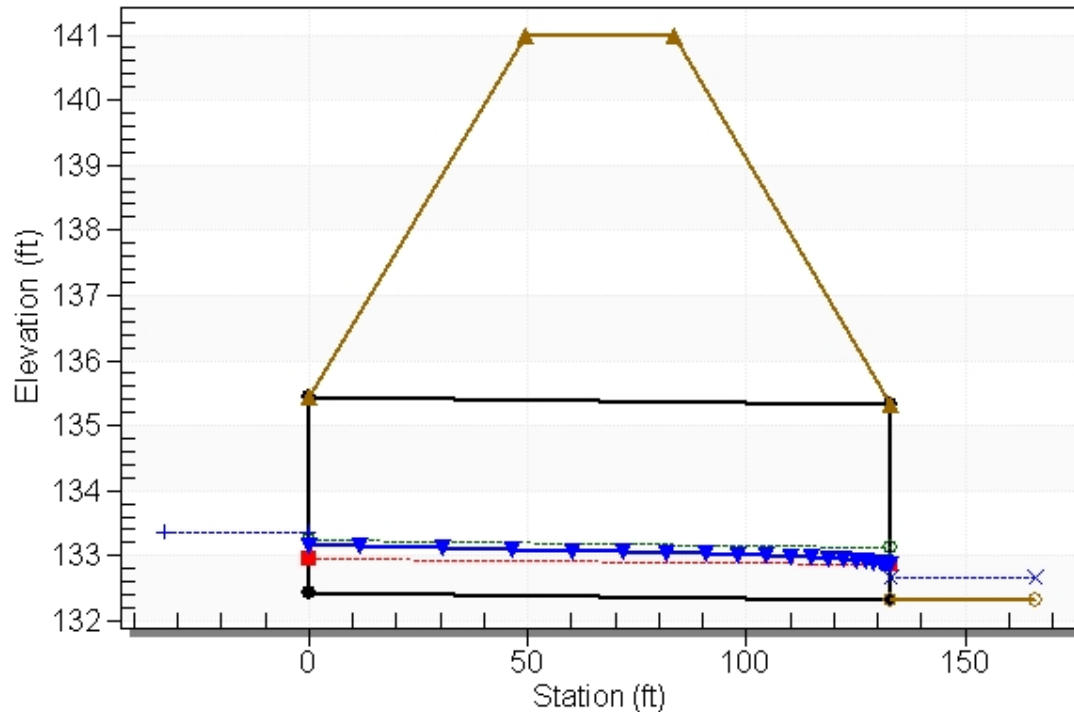
Culvert: Ex. CD-3



Water Surface Profile Plot for Culvert: Ex. CD-3

Crossing - Ex. CD-3, Design Discharge - 43.0 cfs

Culvert - Ex. CD-3, Culvert Discharge - 43.0 cfs



Site Data - Ex. CD-3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 132.43 ft

Outlet Station: 133.00 ft

Outlet Elevation: 132.33 ft

Number of Barrels: 2

Culvert Data Summary - Ex. CD-3

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft

Barrel Rise: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: NONE

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

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 35.00 | 132.65 | 0.32 |
| 38.80 | 132.65 | 0.32 |
| 42.60 | 132.65 | 0.32 |
| 43.00 | 132.65 | 0.32 |
| 50.20 | 132.65 | 0.32 |
| 54.00 | 132.65 | 0.32 |
| 57.80 | 132.65 | 0.32 |
| 61.60 | 132.65 | 0.32 |
| 65.40 | 132.65 | 0.32 |
| 69.20 | 132.65 | 0.32 |
| 73.00 | 132.65 | 0.32 |

Tailwater Channel Data - Ex. CD-3

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 132.65 ft

Roadway Data for Crossing: Ex. CD-3

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 5135.00 ft

Crest Elevation: 141.00 ft

Roadway Surface: Paved

Roadway Top Width: 34.00 ft

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 |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 133.26 | 35.00 | 35.00 | 0.00 | 1 |
| 133.32 | 38.80 | 38.80 | 0.00 | 1 |
| 133.37 | 42.60 | 42.60 | 0.00 | 1 |
| 133.38 | 43.00 | 43.00 | 0.00 | 1 |
| 133.47 | 50.20 | 50.20 | 0.00 | 1 |
| 133.52 | 54.00 | 54.00 | 0.00 | 1 |
| 133.57 | 57.80 | 57.80 | 0.00 | 1 |
| 133.62 | 61.60 | 61.60 | 0.00 | 1 |
| 133.66 | 65.40 | 65.40 | 0.00 | 1 |
| 133.71 | 69.20 | 69.20 | 0.00 | 1 |
| 133.75 | 73.00 | 73.00 | 0.00 | 1 |
| 141.00 | 743.60 | 743.60 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Pr. CD-3

Total Rating Curve

Crossing: Pr. CD-3

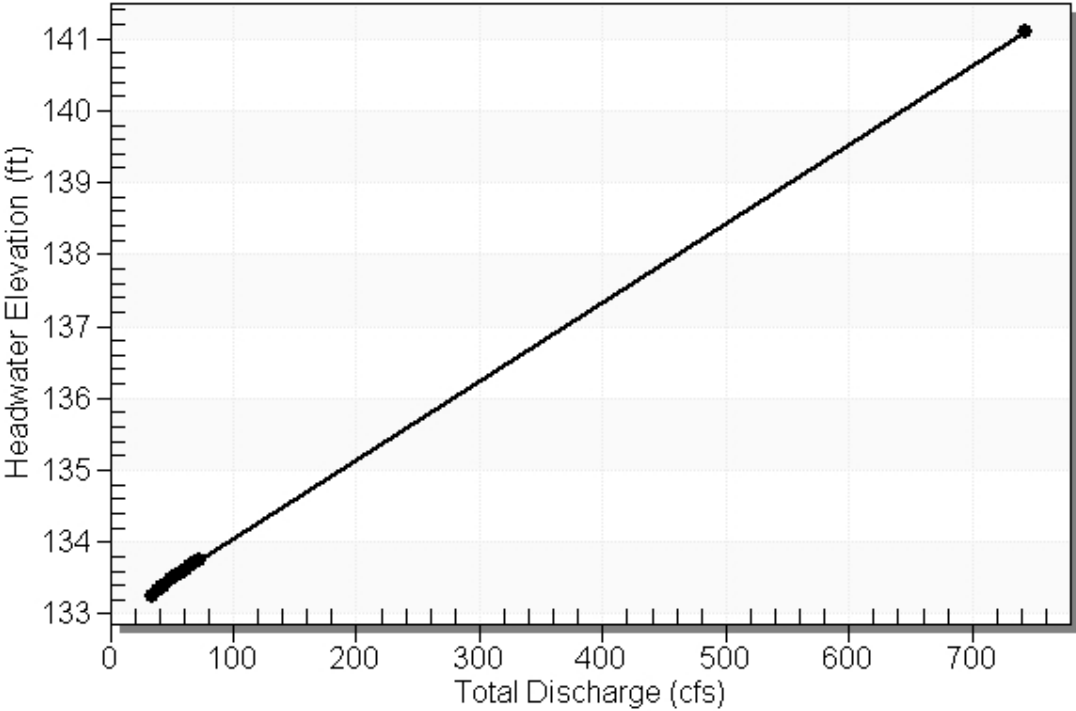


Table 17 - Culvert Summary Table: Pr. CD-3

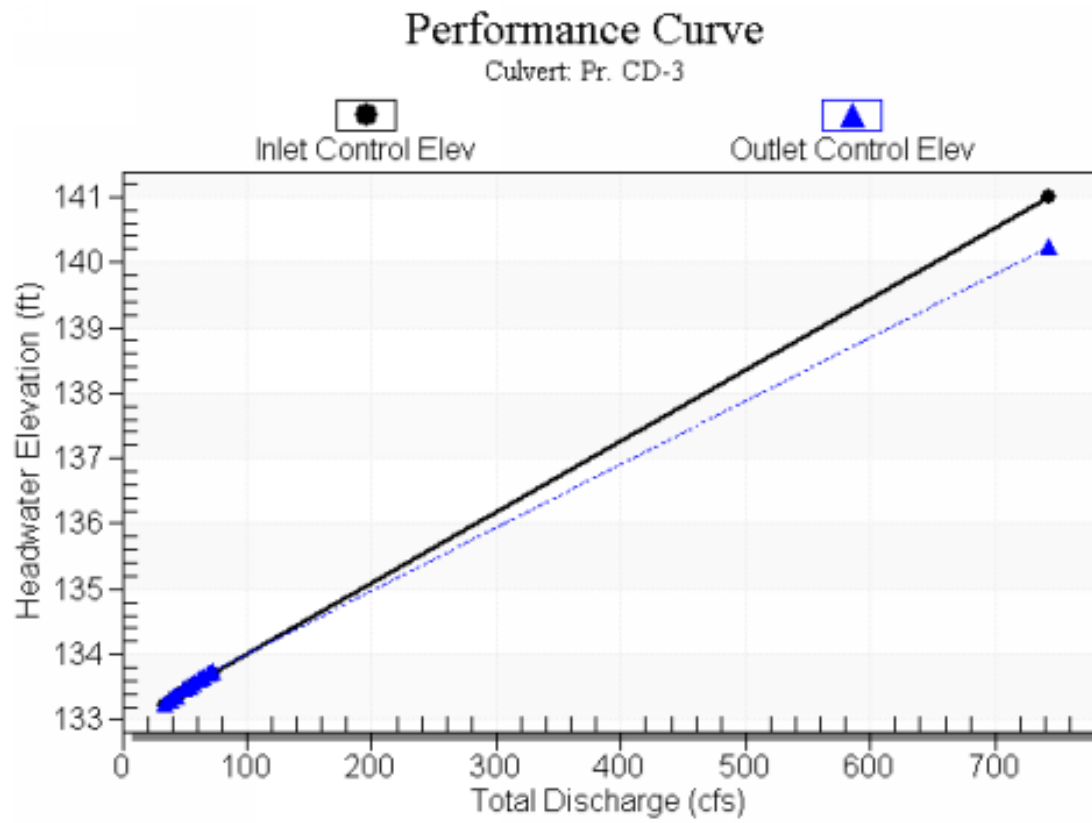
| Total Discharge (cfs) | Culvert Discharge (cfs) | Headwater Elevation (ft) | Inlet Control Depth (ft) | Outlet Control Depth (ft) | Flow Type | Normal Depth (ft) | Critical Depth (ft) | Outlet Depth (ft) | Tailwater Depth (ft) | Outlet Velocity (ft/s) | Tailwater Velocity (ft/s) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 35.00 | 35.00 | 133.26 | 0.784 | 0.831 | 2-M2c | 0.745 | 0.456 | 0.456 | 0.320 | 3.834 | 0.000 |
| 38.80 | 38.80 | 133.32 | 0.839 | 0.886 | 2-M2c | 0.799 | 0.489 | 0.489 | 0.320 | 3.968 | 0.000 |
| 42.60 | 42.60 | 133.37 | 0.893 | 0.940 | 2-M2c | 0.848 | 0.520 | 0.520 | 0.320 | 4.093 | 0.000 |
| 43.00 | 43.00 | 133.38 | 0.899 | 0.946 | 2-M2c | 0.853 | 0.524 | 0.524 | 0.320 | 4.106 | 0.000 |
| 50.20 | 50.20 | 133.47 | 0.997 | 1.043 | 2-M2c | 0.939 | 0.581 | 0.581 | 0.320 | 4.324 | 0.000 |
| 54.00 | 54.00 | 133.52 | 1.046 | 1.093 | 2-M2c | 0.984 | 0.609 | 0.609 | 0.320 | 4.430 | 0.000 |
| 57.80 | 57.80 | 133.57 | 1.095 | 1.141 | 2-M2c | 1.030 | 0.638 | 0.638 | 0.320 | 4.532 | 0.000 |
| 61.60 | 61.60 | 133.62 | 1.142 | 1.189 | 2-M2c | 1.076 | 0.665 | 0.665 | 0.320 | 4.629 | 0.000 |
| 65.40 | 65.40 | 133.66 | 1.189 | 1.235 | 2-M2c | 1.118 | 0.692 | 0.692 | 0.320 | 4.722 | 0.000 |
| 69.20 | 69.20 | 133.71 | 1.234 | 1.280 | 2-M2c | 1.158 | 0.719 | 0.719 | 0.320 | 4.812 | 0.000 |
| 73.00 | 73.00 | 133.75 | 1.279 | 1.325 | 2-M2c | 1.198 | 0.745 | 0.745 | 0.320 | 4.898 | 0.000 |

Straight Culvert

Inlet Elevation (invert): 132.43 ft, Outlet Elevation (invert): 132.33 ft

Culvert Length: 160.00 ft, Culvert Slope: 0.0006

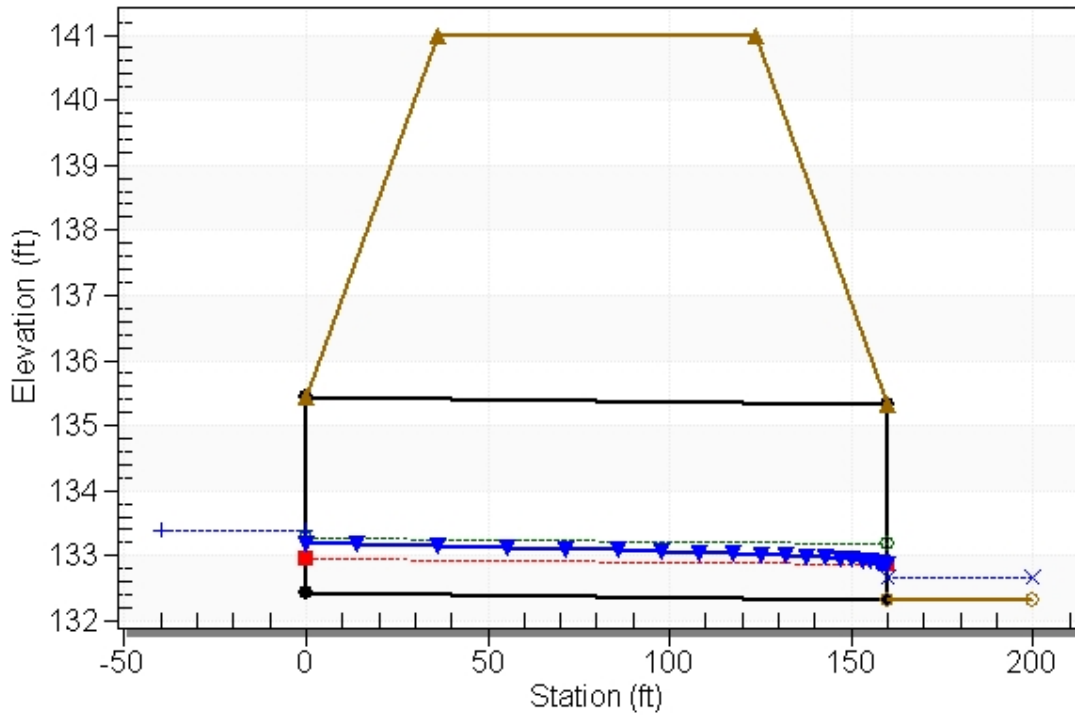
Culvert Performance Curve Plot: Pr. CD-3



Water Surface Profile Plot for Culvert: Pr. CD-3

Crossing - Pr. CD-3, Design Discharge - 43.0 cfs

Culvert - Pr. CD-3, Culvert Discharge - 43.0 cfs



Site Data - Pr. CD-3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 132.43 ft

Outlet Station: 160.00 ft

Outlet Elevation: 132.33 ft

Number of Barrels: 2

Culvert Data Summary - Pr. CD-3

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft

Barrel Rise: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: NONE

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

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 35.00 | 132.65 | 0.32 |
| 38.80 | 132.65 | 0.32 |
| 42.60 | 132.65 | 0.32 |
| 43.00 | 132.65 | 0.32 |
| 50.20 | 132.65 | 0.32 |
| 54.00 | 132.65 | 0.32 |
| 57.80 | 132.65 | 0.32 |
| 61.60 | 132.65 | 0.32 |
| 65.40 | 132.65 | 0.32 |
| 69.20 | 132.65 | 0.32 |
| 73.00 | 132.65 | 0.32 |

Tailwater Channel Data - Pr. CD-3

Tailwater Channel Option: Enter Constant Tailwater Elevation
Constant Tailwater Elevation: 132.65 ft

Roadway Data for Crossing: Pr. CD-3

Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 7455.00 ft
Crest Elevation: 141.00 ft
Roadway Surface: Paved
Roadway Top Width: 87.50 ft

Table 19 - Summary of Culvert Flows at Crossing: Ex. CD-5

| Headwater Elevation (ft) | Total Discharge (cfs) | Ex. CD-5 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 136.62 | 86.00 | 86.00 | 0.00 | 1 |
| 137.05 | 94.50 | 94.50 | 0.00 | 1 |
| 137.40 | 101.00 | 101.00 | 0.00 | 1 |
| 137.88 | 111.50 | 109.05 | 0.00 | 50 |
| 138.01 | 120.00 | 111.01 | 8.12 | 24 |
| 138.01 | 128.50 | 111.09 | 16.61 | 4 |
| 138.02 | 137.00 | 111.15 | 24.53 | 3 |
| 138.02 | 145.50 | 111.19 | 33.17 | 3 |
| 138.02 | 154.00 | 111.24 | 41.94 | 3 |
| 138.03 | 162.50 | 111.29 | 50.64 | 3 |
| 138.03 | 171.00 | 111.34 | 59.26 | 3 |
| 138.00 | 110.89 | 110.89 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Ex. CD-5

Total Rating Curve

Crossing: Ex. CD-5

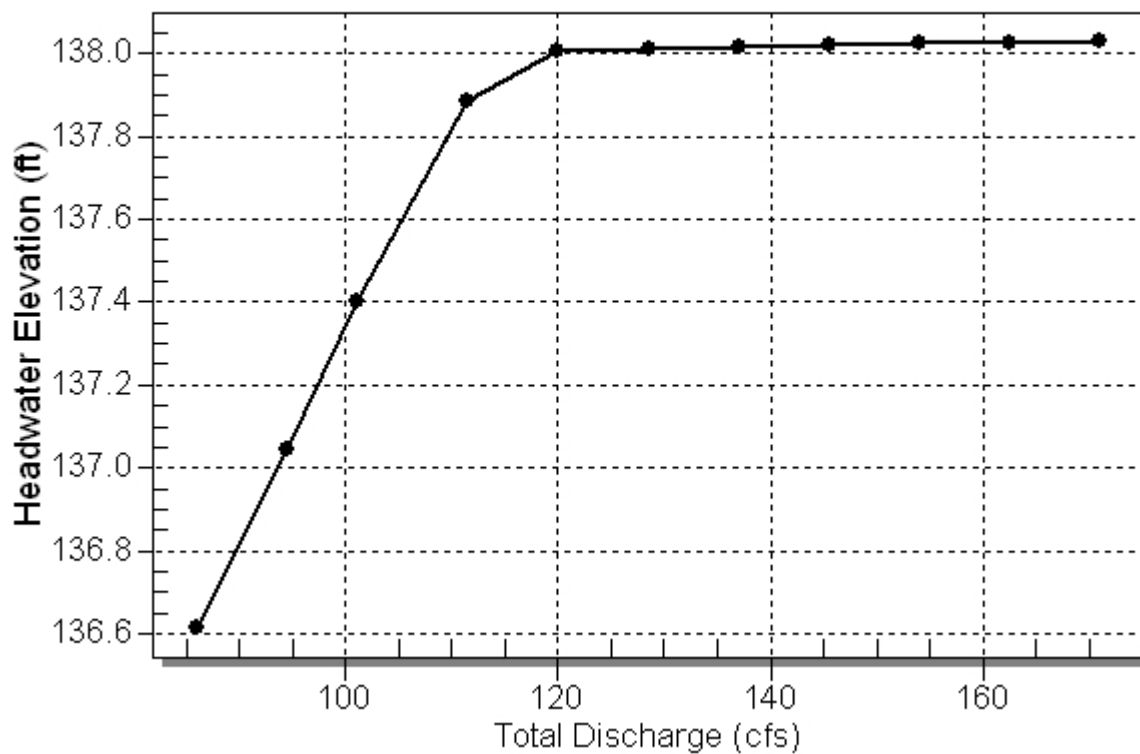


Table 20 - Culvert Summary Table: Ex. CD-5

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 86.00 | 86.00 | 136.62 | 3.615 | 0.000 | 5-S2n | 1.186 | 1.859 | 1.302 | 0.000 | 11.011 | 0.000 |
| 94.50 | 94.50 | 137.05 | 4.046 | 0.000 | 5-S2n | 1.264 | 1.979 | 1.396 | 0.000 | 11.280 | 0.000 |
| 101.00 | 101.00 | 137.40 | 4.404 | 3.223 | 5-S2n | 1.322 | 2.000 | 1.467 | 0.000 | 11.475 | 0.000 |
| 111.50 | 109.05 | 137.88 | 4.885 | 3.592 | 5-S2n | 1.395 | 2.000 | 1.550 | 0.000 | 11.726 | 0.000 |
| 120.00 | 111.01 | 138.01 | 5.008 | 3.686 | 5-S2n | 1.412 | 2.000 | 1.570 | 0.000 | 11.785 | 0.000 |
| 128.50 | 111.09 | 138.01 | 5.013 | 3.689 | 5-S2n | 1.413 | 2.000 | 1.570 | 0.000 | 11.793 | 0.000 |
| 137.00 | 111.15 | 138.02 | 5.016 | 3.692 | 5-S2n | 1.413 | 2.000 | 1.571 | 0.000 | 11.791 | 0.000 |
| 145.50 | 111.19 | 138.02 | 5.019 | 3.694 | 5-S2n | 1.414 | 2.000 | 1.572 | 0.000 | 11.788 | 0.000 |
| 154.00 | 111.24 | 138.02 | 5.022 | 3.697 | 5-S2n | 1.414 | 2.000 | 1.572 | 0.000 | 11.794 | 0.000 |
| 162.50 | 111.29 | 138.03 | 5.026 | 3.699 | 5-S2n | 1.415 | 2.000 | 1.573 | 0.000 | 11.792 | 0.000 |
| 171.00 | 111.34 | 138.03 | 5.029 | 3.702 | 5-S2n | 1.415 | 2.000 | 1.573 | 0.000 | 11.797 | 0.000 |

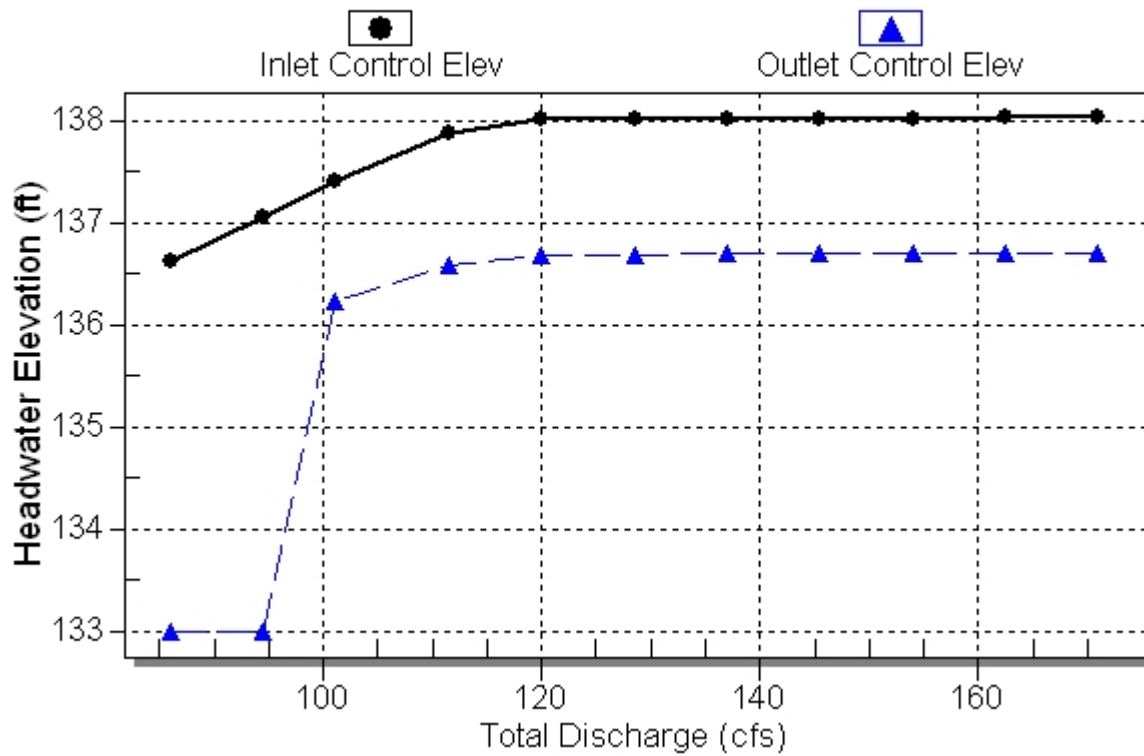
Inlet Elevation (invert): 133.00 ft, Outlet Elevation (invert): 132.00 ft

Culvert Length: 85.01 ft, Culvert Slope: 0.0118

Culvert Performance Curve Plot: Ex. CD-5

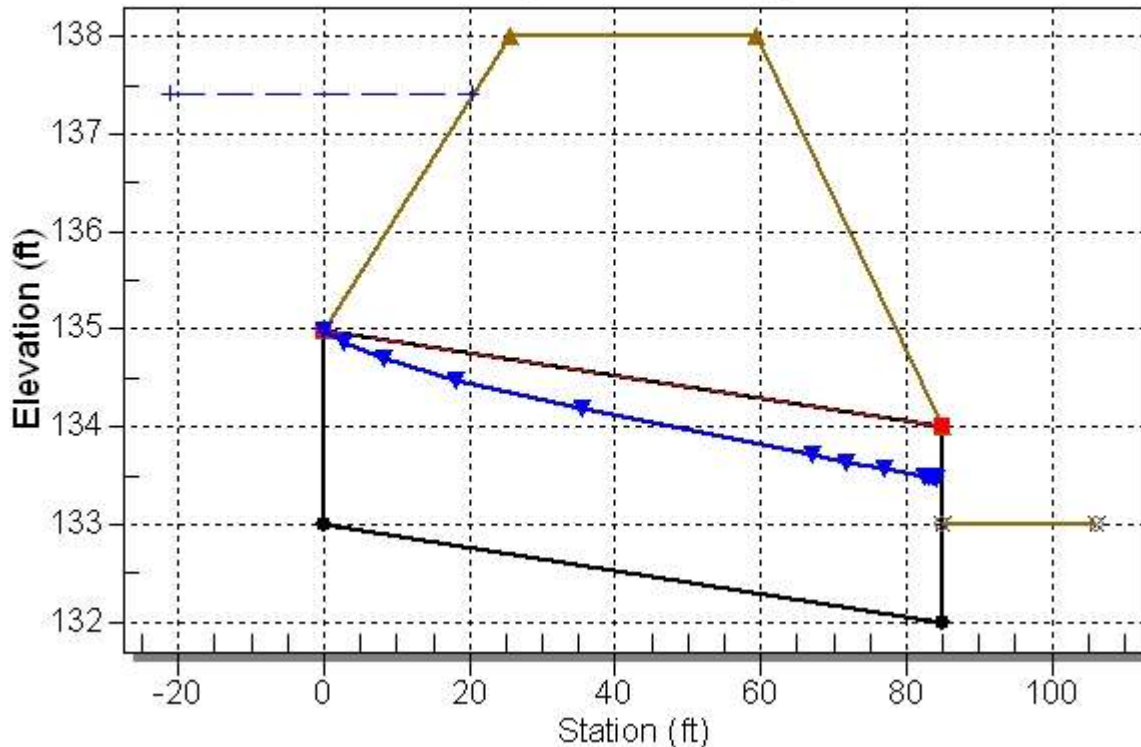
Performance Curve

Culvert: Ex. CD-5



Water Surface Profile Plot for Culvert: Ex. CD-5

Crossing - Ex. CD-5, Design Discharge - 101.0 cfs
Culvert - Ex. CD-5, Culvert Discharge - 101.0 cfs



Site Data - Ex. CD-5

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 133.00 ft

Outlet Station: 85.00 ft

Outlet Elevation: 132.00 ft

Number of Barrels: 1

Culvert Data Summary - Ex. CD-5

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft

Barrel Rise: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: None

Table 21 - Downstream Channel Rating Curve (Crossing: Ex. CD-5)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 86.00 | 133.00 | 0.00 |
| 94.50 | 133.00 | 0.00 |
| 101.00 | 133.00 | 0.00 |
| 111.50 | 133.00 | 0.00 |
| 120.00 | 133.00 | 0.00 |
| 128.50 | 133.00 | 0.00 |
| 137.00 | 133.00 | 0.00 |
| 145.50 | 133.00 | 0.00 |
| 154.00 | 133.00 | 0.00 |
| 162.50 | 133.00 | 0.00 |
| 171.00 | 133.00 | 0.00 |

Tailwater Channel Data - Ex. CD-5

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 133.00 ft

Roadway Data for Crossing: Ex. CD-5

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4115.00 ft

Crest Elevation: 138.00 ft

Roadway Surface: Paved

Roadway Top Width: 34.00 ft

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

| Headwater Elevation (ft) | Total Discharge (cfs) | Pr. CD-5 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 136.62 | 86.00 | 86.00 | 0.00 | 1 |
| 137.05 | 94.50 | 94.50 | 0.00 | 1 |
| 137.40 | 101.00 | 101.00 | 0.00 | 1 |
| 137.88 | 111.50 | 109.05 | 0.00 | 50 |
| 138.01 | 120.00 | 111.01 | 8.12 | 24 |
| 138.01 | 128.50 | 111.09 | 16.61 | 4 |
| 138.02 | 137.00 | 111.15 | 24.53 | 3 |
| 138.02 | 145.50 | 111.19 | 33.17 | 3 |
| 138.02 | 154.00 | 111.24 | 41.94 | 3 |
| 138.03 | 162.50 | 111.29 | 50.64 | 3 |
| 138.03 | 171.00 | 111.34 | 59.26 | 3 |
| 138.00 | 110.89 | 110.89 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Pr. CD-5

Total Rating Curve

Crossing: Pr. CD-5

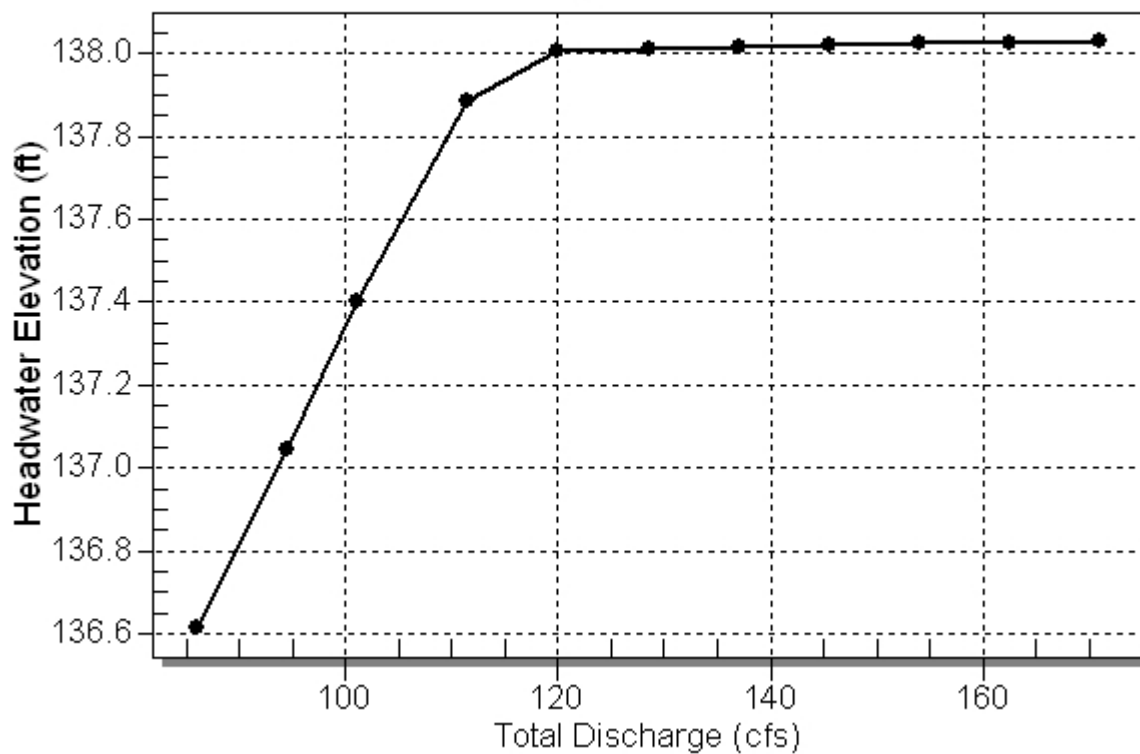


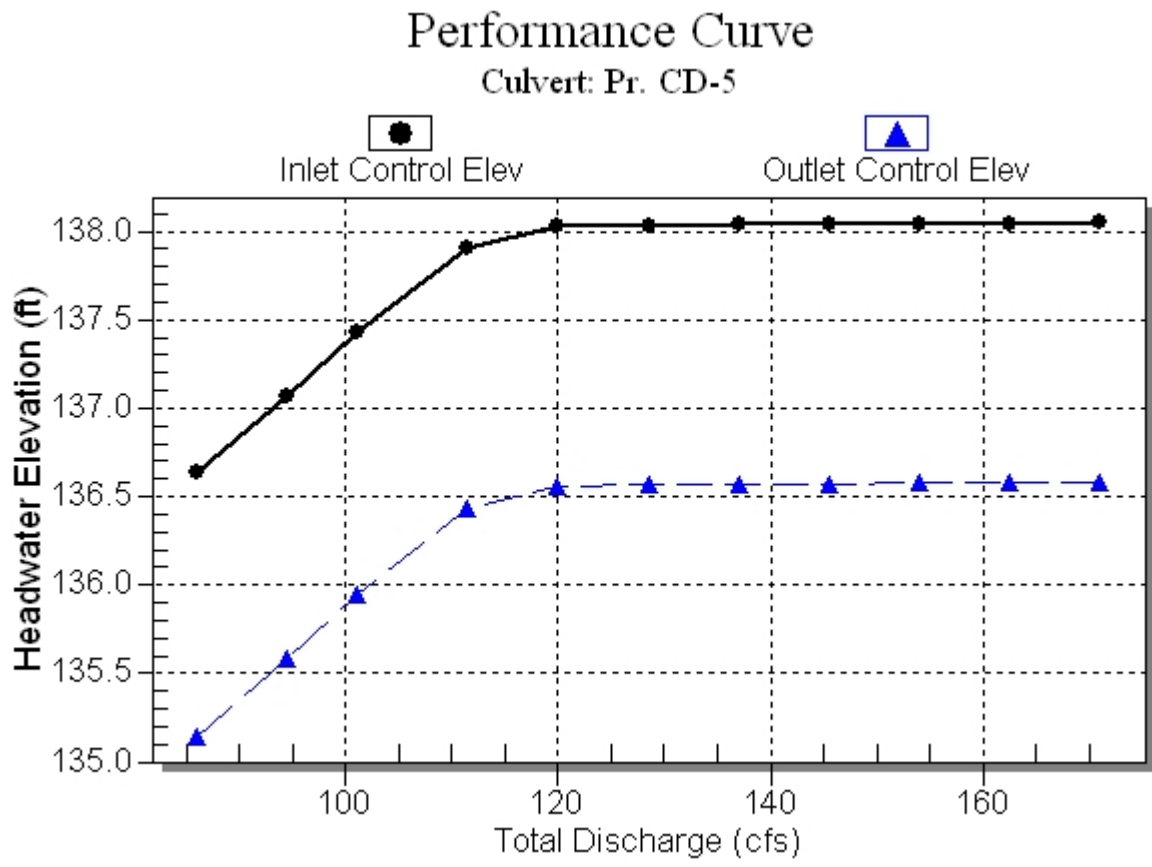
Table 23 - Culvert Summary Table: Pr. CD-5

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 86.00 | 86.00 | 136.62 | 3.615 | 2.125 | 4-FFf | 1.185 | 1.859 | 1.185 | 0.000 | 12.093 | 0.000 |
| 94.50 | 94.50 | 137.05 | 4.046 | 2.566 | 4-FFf | 1.263 | 1.979 | 1.263 | 0.000 | 12.472 | 0.000 |
| 101.00 | 101.00 | 137.40 | 4.404 | 2.931 | 5-S2n | 1.321 | 2.000 | 1.323 | 0.000 | 12.724 | 0.000 |
| 111.50 | 109.05 | 137.88 | 4.885 | 3.417 | 5-S2n | 1.394 | 2.000 | 1.447 | 0.000 | 12.561 | 0.000 |
| 120.00 | 111.01 | 138.01 | 5.008 | 3.541 | 5-S2n | 1.411 | 2.000 | 1.412 | 0.000 | 13.103 | 0.000 |
| 128.50 | 111.09 | 138.01 | 5.013 | 3.545 | 5-S2n | 1.412 | 2.000 | 1.413 | 0.000 | 13.103 | 0.000 |
| 137.00 | 111.15 | 138.02 | 5.016 | 3.549 | 5-S2n | 1.412 | 2.000 | 1.413 | 0.000 | 13.110 | 0.000 |
| 145.50 | 111.19 | 138.02 | 5.019 | 3.552 | 5-S2n | 1.413 | 2.000 | 1.414 | 0.000 | 13.102 | 0.000 |
| 154.00 | 111.24 | 138.02 | 5.022 | 3.555 | 5-S2n | 1.413 | 2.000 | 1.414 | 0.000 | 13.112 | 0.000 |
| 162.50 | 111.29 | 138.03 | 5.026 | 3.559 | 5-S2n | 1.414 | 2.000 | 1.415 | 0.000 | 13.106 | 0.000 |
| 171.00 | 111.34 | 138.03 | 5.029 | 3.562 | 5-S2n | 1.414 | 2.000 | 1.415 | 0.000 | 13.114 | 0.000 |

Inlet Elevation (invert): 133.00 ft, Outlet Elevation (invert): 130.76 ft

Culvert Length: 190.01 ft, Culvert Slope: 0.0118

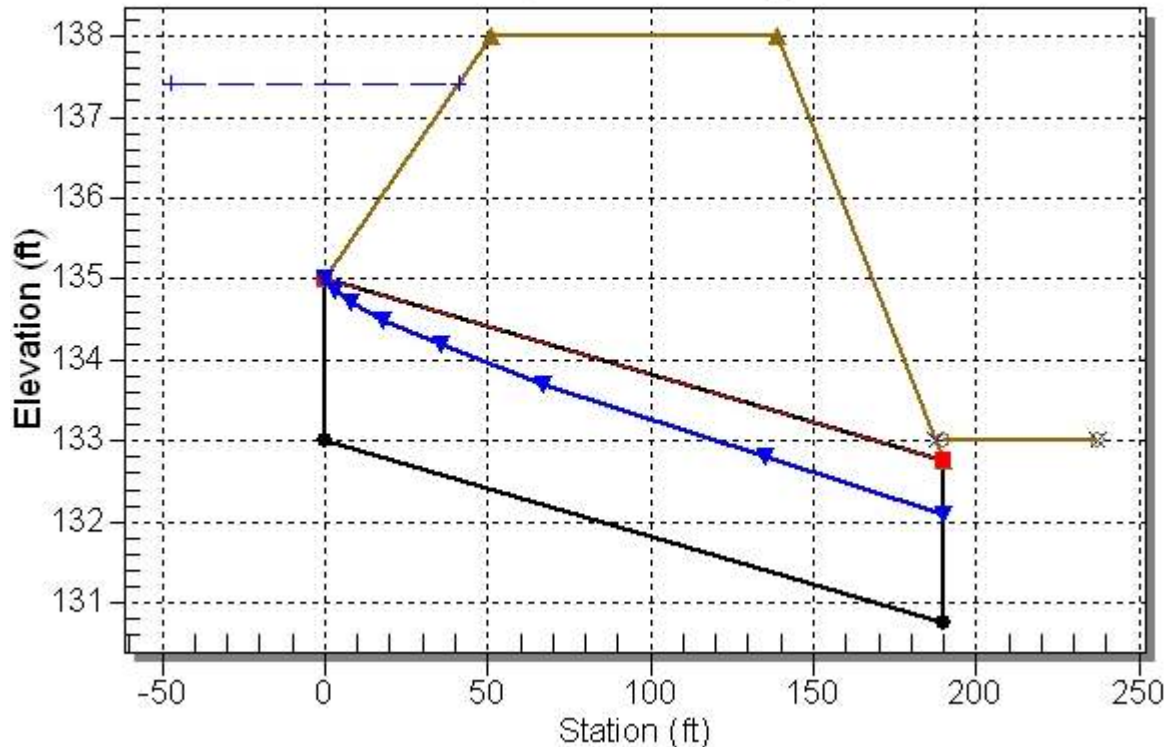
Culvert Performance Curve Plot: Pr. CD-5



Water Surface Profile Plot for Culvert: Pr. CD-5

Crossing - Pr. CD-5, Design Discharge - 101.0 cfs

Culvert - Pr. CD-5, Culvert Discharge - 101.0 cfs



Site Data - Pr. CD-5

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 133.00 ft

Outlet Station: 190.00 ft

Outlet Elevation: 130.76 ft

Number of Barrels: 1

Culvert Data Summary - Pr. CD-5

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft

Barrel Rise: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: None

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

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 86.00 | 133.00 | 0.00 |
| 94.50 | 133.00 | 0.00 |
| 101.00 | 133.00 | 0.00 |
| 111.50 | 133.00 | 0.00 |
| 120.00 | 133.00 | 0.00 |
| 128.50 | 133.00 | 0.00 |
| 137.00 | 133.00 | 0.00 |
| 145.50 | 133.00 | 0.00 |
| 154.00 | 133.00 | 0.00 |
| 162.50 | 133.00 | 0.00 |
| 171.00 | 133.00 | 0.00 |

Tailwater Channel Data - Pr. CD-5

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 133.00 ft

Roadway Data for Crossing: Pr. CD-5

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4115.00 ft

Crest Elevation: 138.00 ft

Roadway Surface: Paved

Roadway Top Width: 87.50 ft

Table 25 - Summary of Culvert Flows at Crossing: Ex. CD-6

| Headwater Elevation (ft) | Total Discharge (cfs) | Ex. CD-6 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 133.44 | 53.00 | 53.00 | 0.00 | 1 |
| 133.45 | 57.60 | 57.60 | 0.00 | 1 |
| 133.45 | 58.00 | 58.00 | 0.00 | 1 |
| 133.46 | 66.80 | 66.80 | 0.00 | 1 |
| 133.47 | 71.40 | 71.40 | 0.00 | 1 |
| 133.48 | 76.00 | 76.00 | 0.00 | 1 |
| 133.49 | 80.60 | 80.60 | 0.00 | 1 |
| 133.50 | 85.20 | 85.20 | 0.00 | 1 |
| 133.51 | 89.80 | 89.80 | 0.00 | 1 |
| 133.52 | 94.40 | 94.40 | 0.00 | 1 |
| 133.53 | 99.00 | 99.00 | 0.00 | 1 |
| 138.00 | 450.52 | 450.52 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Ex. CD-6

Total Rating Curve

Crossing: Ex. CD-6

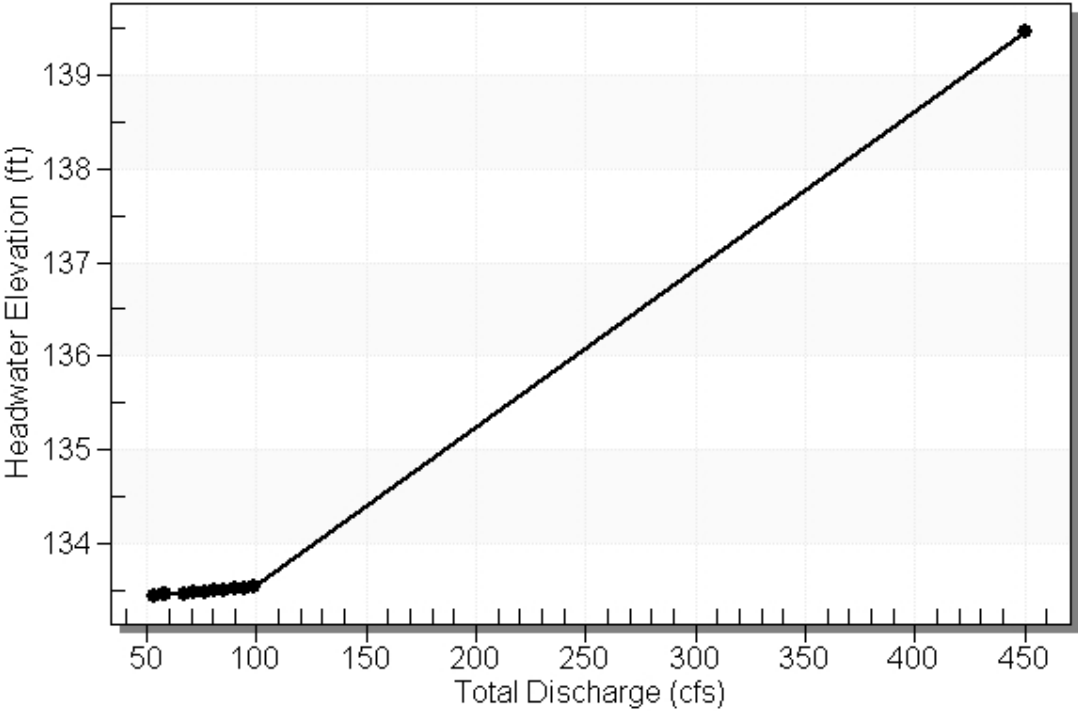


Table 26 - Culvert Summary Table: Ex. CD-6

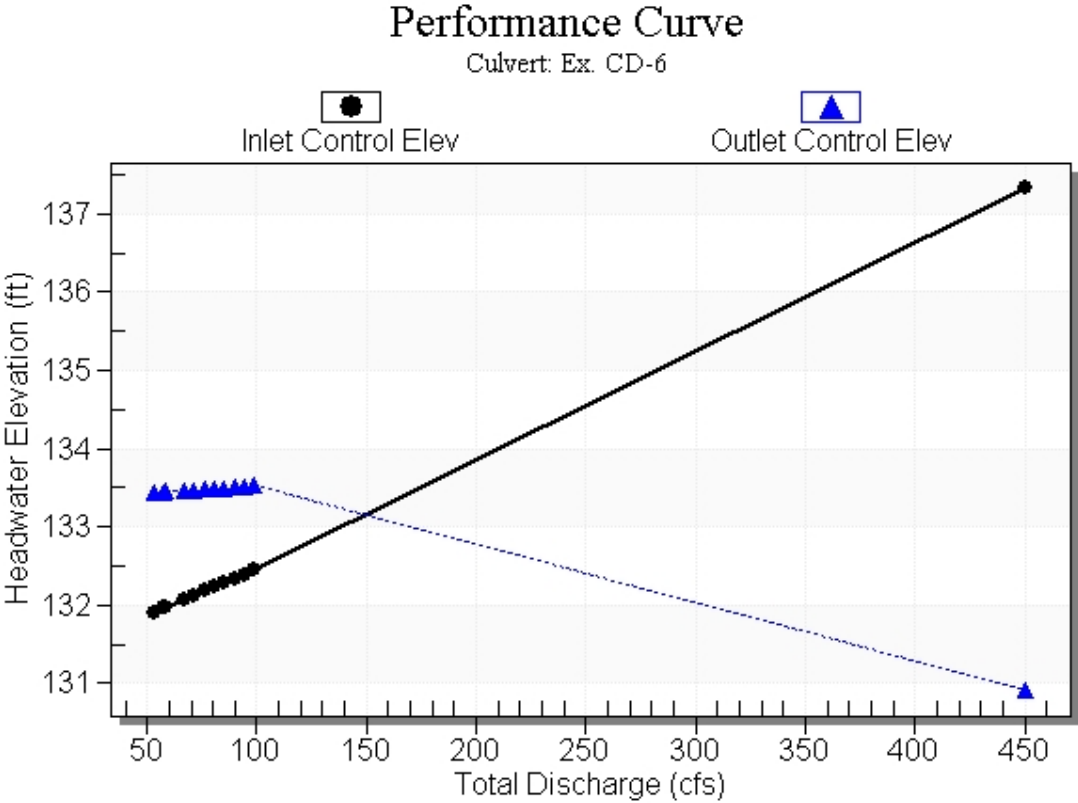
| Total Discharge (cfs) | Culvert Discharge (cfs) | Headwater Elevation (ft) | Inlet Control Depth (ft) | Outlet Control Depth (ft) | Flow Type | Normal Depth (ft) | Critical Depth (ft) | Outlet Depth (ft) | Tailwater Depth (ft) | Outlet Velocity (ft/s) | Tailwater Velocity (ft/s) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 53.00 | 53.00 | 133.44 | 0.996 | 2.533 | 9-A2t | -1.000 | 0.608 | 1.130 | 1.630 | 2.345 | 0.000 |
| 57.60 | 57.60 | 133.45 | 1.052 | 2.539 | 9-A2t | -1.000 | 0.643 | 1.130 | 1.630 | 2.549 | 0.000 |
| 58.00 | 58.00 | 133.45 | 1.057 | 2.540 | 9-A2t | -1.000 | 0.646 | 1.130 | 1.630 | 2.566 | 0.000 |
| 66.80 | 66.80 | 133.46 | 1.161 | 2.553 | 9-A2t | -1.000 | 0.711 | 1.130 | 1.630 | 2.956 | 0.000 |
| 71.40 | 71.40 | 133.47 | 1.215 | 2.560 | 9-A2t | -1.000 | 0.739 | 1.130 | 1.630 | 3.159 | 0.000 |
| 76.00 | 76.00 | 133.48 | 1.268 | 2.568 | 9-A2t | -1.000 | 0.771 | 1.130 | 1.630 | 3.363 | 0.000 |
| 80.60 | 80.60 | 133.49 | 1.320 | 2.577 | 9-A2t | -1.000 | 0.801 | 1.130 | 1.630 | 3.566 | 0.000 |
| 85.20 | 85.20 | 133.50 | 1.373 | 2.586 | 9-A2t | -1.000 | 0.832 | 1.130 | 1.630 | 3.770 | 0.000 |
| 89.80 | 89.80 | 133.51 | 1.426 | 2.595 | 9-A2t | -1.000 | 0.861 | 1.130 | 1.630 | 3.973 | 0.000 |
| 94.40 | 94.40 | 133.52 | 1.479 | 2.605 | 9-A2t | -1.000 | 0.890 | 1.130 | 1.630 | 4.177 | 0.000 |
| 99.00 | 99.00 | 133.53 | 1.532 | 2.616 | 9-A2t | -1.000 | 0.919 | 1.130 | 1.630 | 4.381 | 0.000 |

Straight Culvert

Inlet Elevation (invert): 130.91 ft, Outlet Elevation (invert): 132.28 ft

Culvert Length: 85.01 ft, Culvert Slope: -0.0161

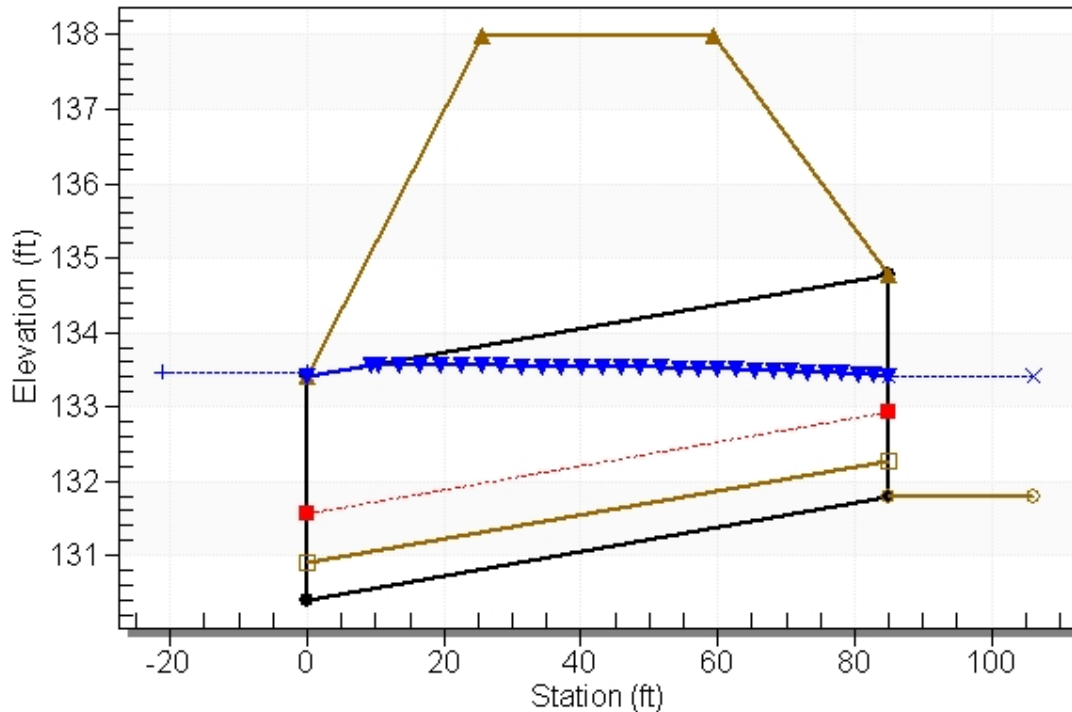
Culvert Performance Curve Plot: Ex. CD-6



Water Surface Profile Plot for Culvert: Ex. CD-6

Crossing - Ex. CD-6, Design Discharge - 58.0 cfs

Culvert - Ex. CD-6, Culvert Discharge - 58.0 cfs



Site Data - Ex. CD-6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 130.41 ft

Outlet Station: 85.00 ft

Outlet Elevation: 131.78 ft

Number of Barrels: 2

Culvert Data Summary - Ex. CD-6

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft

Barrel Rise: 3.00 ft

Barrel Material: Concrete

Embedment: 6.00 in

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: NONE

Table 27 - Downstream Channel Rating Curve (Crossing: Ex. CD-6)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 53.00 | 133.41 | 1.63 |
| 57.60 | 133.41 | 1.63 |
| 58.00 | 133.41 | 1.63 |
| 66.80 | 133.41 | 1.63 |
| 71.40 | 133.41 | 1.63 |
| 76.00 | 133.41 | 1.63 |
| 80.60 | 133.41 | 1.63 |
| 85.20 | 133.41 | 1.63 |
| 89.80 | 133.41 | 1.63 |
| 94.40 | 133.41 | 1.63 |
| 99.00 | 133.41 | 1.63 |

Tailwater Channel Data - Ex. CD-6

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 133.41 ft

Roadway Data for Crossing: Ex. CD-6

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 2550.00 ft

Crest Elevation: 138.00 ft

Roadway Surface: Paved

Roadway Top Width: 34.00 ft

Table 28 - Summary of Culvert Flows at Crossing: Pr. CD-6

| Headwater Elevation (ft) | Total Discharge (cfs) | Pr. CD-6 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 133.43 | 53.00 | 53.00 | 0.00 | 1 |
| 133.43 | 57.60 | 57.60 | 0.00 | 1 |
| 133.43 | 58.00 | 58.00 | 0.00 | 1 |
| 133.44 | 66.80 | 66.80 | 0.00 | 1 |
| 133.44 | 71.40 | 71.40 | 0.00 | 1 |
| 133.45 | 76.00 | 76.00 | 0.00 | 1 |
| 133.45 | 80.60 | 80.60 | 0.00 | 1 |
| 133.46 | 85.20 | 85.20 | 0.00 | 1 |
| 133.46 | 89.80 | 89.80 | 0.00 | 1 |
| 133.47 | 94.40 | 94.40 | 0.00 | 1 |
| 133.47 | 99.00 | 99.00 | 0.00 | 1 |
| 138.00 | 589.42 | 589.42 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Pr. CD-6

Total Rating Curve

Crossing: Pr. CD-6

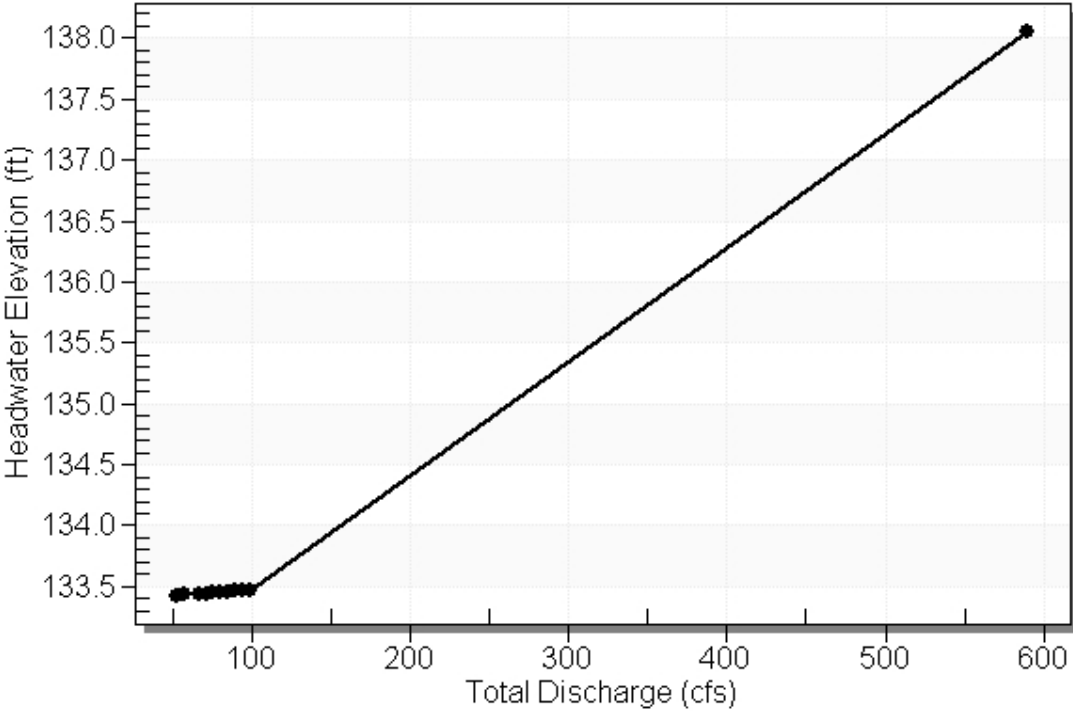


Table 29 - Culvert Summary Table: Pr. CD-6

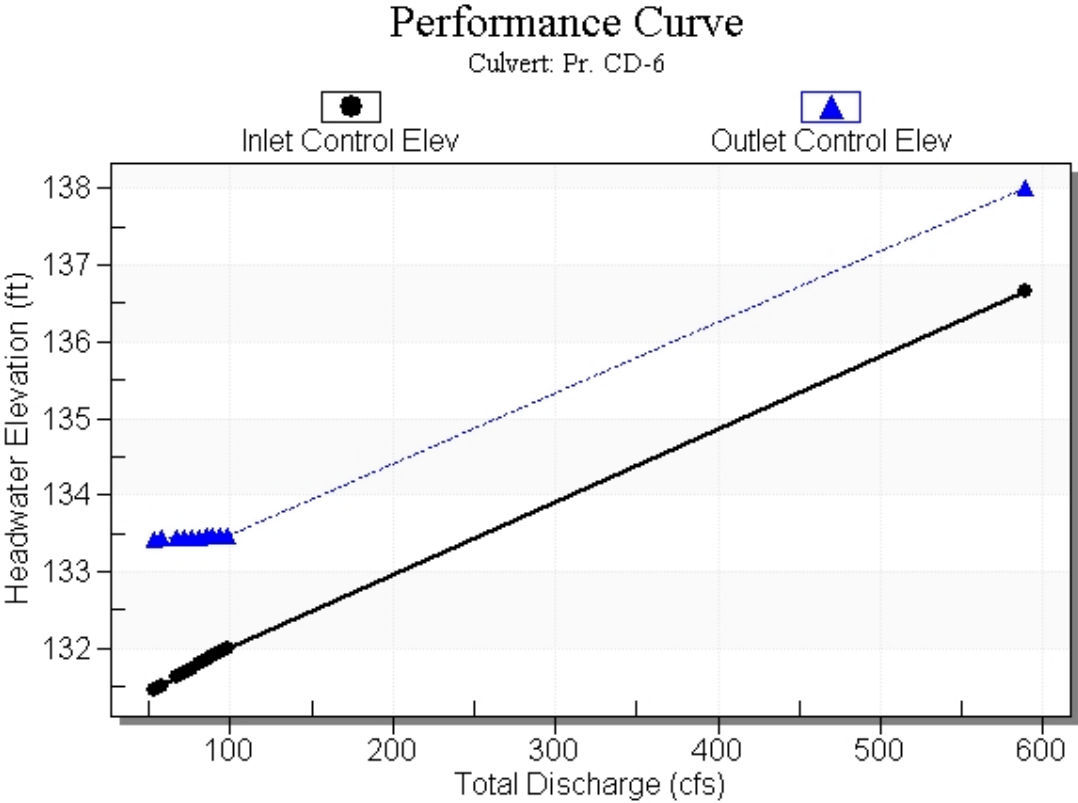
| Total Discharge (cfs) | Culvert Discharge (cfs) | Headwater Elevation (ft) | Inlet Control Depth (ft) | Outlet Control Depth (ft) | Flow Type | Normal Depth (ft) | Critical Depth (ft) | Outlet Depth (ft) | Tailwater Depth (ft) | Outlet Velocity (ft/s) | Tailwater Velocity (ft/s) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 53.00 | 53.00 | 133.43 | 1.042 | 3.018 | 9-A2t | -1.000 | 0.602 | 1.630 | 1.630 | 1.626 | 0.000 |
| 57.60 | 57.60 | 133.43 | 1.101 | 3.021 | 9-A2t | -1.000 | 0.636 | 1.630 | 1.630 | 1.767 | 0.000 |
| 58.00 | 58.00 | 133.43 | 1.106 | 3.022 | 9-A2t | -1.000 | 0.639 | 1.630 | 1.630 | 1.779 | 0.000 |
| 66.80 | 66.80 | 133.44 | 1.216 | 3.029 | 9-A2t | -1.000 | 0.702 | 1.630 | 1.630 | 2.049 | 0.000 |
| 71.40 | 71.40 | 133.44 | 1.271 | 3.033 | 9-A2t | -1.000 | 0.734 | 1.630 | 1.630 | 2.190 | 0.000 |
| 76.00 | 76.00 | 133.45 | 1.325 | 3.037 | 9-A2t | -1.000 | 0.765 | 1.630 | 1.630 | 2.331 | 0.000 |
| 80.60 | 80.60 | 133.45 | 1.378 | 3.042 | 9-A2t | -1.000 | 0.796 | 1.630 | 1.630 | 2.472 | 0.000 |
| 85.20 | 85.20 | 133.46 | 1.430 | 3.047 | 9-A2t | -1.000 | 0.826 | 1.630 | 1.630 | 2.613 | 0.000 |
| 89.80 | 89.80 | 133.46 | 1.481 | 3.052 | 9-A2t | -1.000 | 0.855 | 1.630 | 1.630 | 2.755 | 0.000 |
| 94.40 | 94.40 | 133.47 | 1.530 | 3.058 | 9-A2t | -1.000 | 0.884 | 1.630 | 1.630 | 2.896 | 0.000 |
| 99.00 | 99.00 | 133.47 | 1.577 | 3.063 | 9-A2t | -1.000 | 0.913 | 1.630 | 1.630 | 3.037 | 0.000 |

Straight Culvert

Inlet Elevation (invert): 130.41 ft, Outlet Elevation (invert): 131.78 ft

Culvert Length: 190.00 ft, Culvert Slope: -0.0072

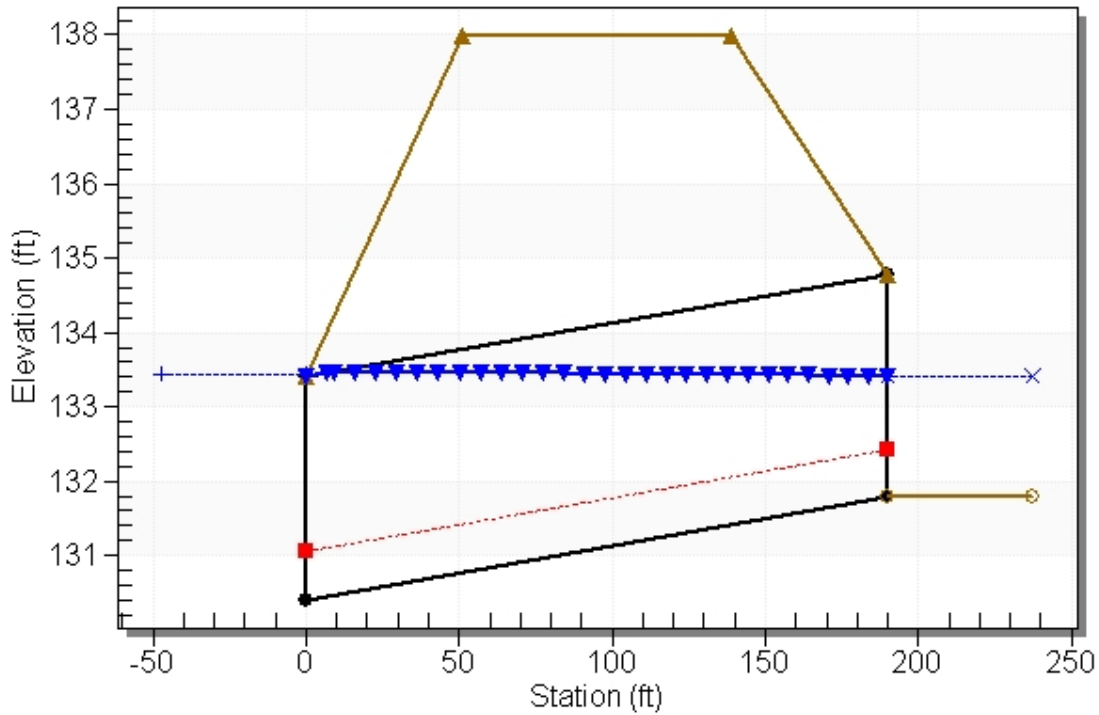
Culvert Performance Curve Plot: Pr. CD-6



Water Surface Profile Plot for Culvert: Pr. CD-6

Crossing - Pr. CD-6, Design Discharge - 58.0 cfs

Culvert - Pr. CD-6, Culvert Discharge - 58.0 cfs



Site Data - Pr. CD-6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 130.41 ft

Outlet Station: 190.00 ft

Outlet Elevation: 131.78 ft

Number of Barrels: 2

Culvert Data Summary - Pr. CD-6

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft

Barrel Rise: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: NONE

Table 30 - Downstream Channel Rating Curve (Crossing: Pr. CD-6)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 53.00 | 133.41 | 1.63 |
| 57.60 | 133.41 | 1.63 |
| 58.00 | 133.41 | 1.63 |
| 66.80 | 133.41 | 1.63 |
| 71.40 | 133.41 | 1.63 |
| 76.00 | 133.41 | 1.63 |
| 80.60 | 133.41 | 1.63 |
| 85.20 | 133.41 | 1.63 |
| 89.80 | 133.41 | 1.63 |
| 94.40 | 133.41 | 1.63 |
| 99.00 | 133.41 | 1.63 |

Tailwater Channel Data - Pr. CD-6

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 133.41 ft

Roadway Data for Crossing: Pr. CD-6

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 2550.00 ft

Crest Elevation: 138.00 ft

Roadway Surface: Paved

Roadway Top Width: 87.50 ft

Table 49 - Summary of Culvert Flows at Crossing: Ex. CD-7

| Headwater Elevation (ft) | Total Discharge (cfs) | Ex. CD-7 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 133.13 | 181.00 | 181.00 | 0.00 | 1 |
| 133.53 | 198.80 | 198.80 | 0.00 | 1 |
| 133.82 | 211.00 | 211.00 | 0.00 | 1 |
| 134.44 | 234.40 | 234.40 | 0.00 | 1 |
| 134.95 | 252.20 | 252.20 | 0.00 | 1 |
| 135.50 | 270.00 | 270.00 | 0.00 | 1 |
| 136.08 | 287.80 | 287.80 | 0.00 | 1 |
| 136.71 | 305.60 | 305.60 | 0.00 | 1 |
| 137.37 | 323.40 | 323.40 | 0.00 | 1 |
| 137.92 | 341.20 | 337.75 | 0.00 | 50 |
| 138.03 | 359.00 | 340.45 | 17.35 | 11 |
| 138.00 | 339.65 | 339.65 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Ex. CD-7

Total Rating Curve

Crossing: Ex. CD-7

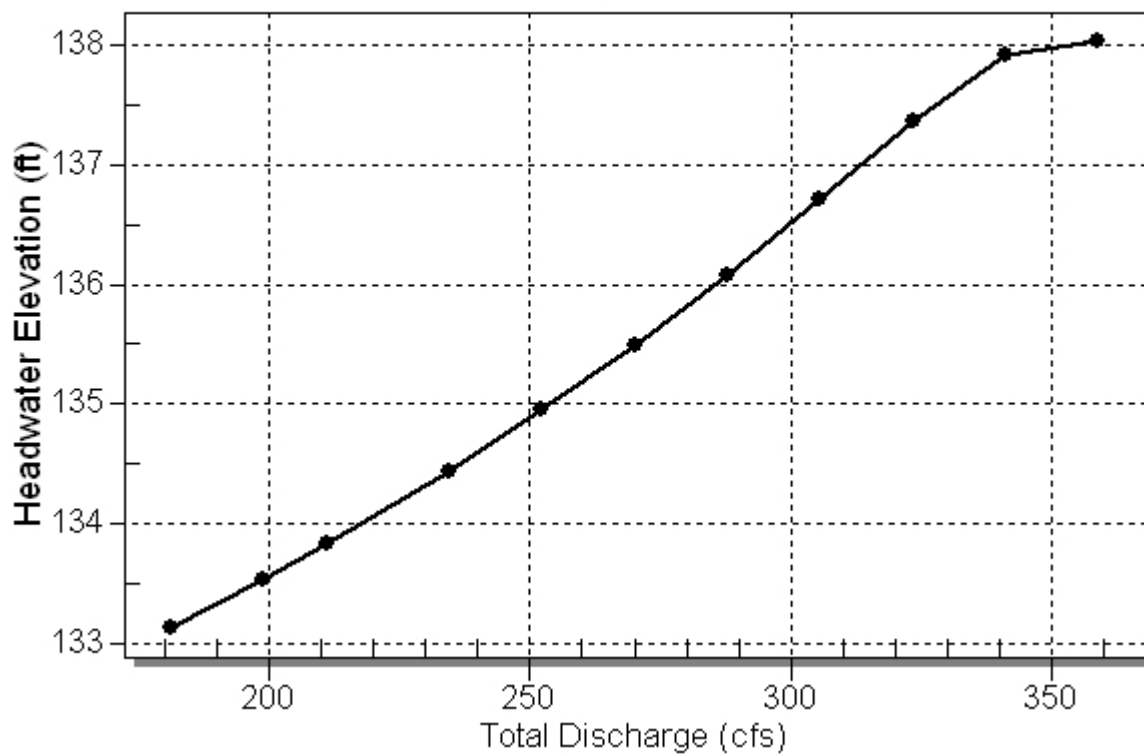


Table 50 - Culvert Summary Table: Ex. CD-7

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 181.00 | 181.00 | 133.13 | 4.761 | 9.071 | 4-FFf | 4.000 | 2.877 | 4.000 | 7.330 | 7.202 | 0.000 |
| 198.80 | 198.80 | 133.53 | 5.174 | 9.470 | 4-FFf | 4.000 | 3.009 | 4.000 | 7.330 | 7.910 | 0.000 |
| 211.00 | 211.00 | 133.82 | 5.478 | 9.764 | 4-FFf | 4.000 | 3.100 | 4.000 | 7.330 | 8.395 | 0.000 |
| 234.40 | 234.40 | 134.44 | 6.115 | 10.379 | 4-FFf | 4.000 | 3.252 | 4.000 | 7.330 | 9.326 | 0.000 |
| 252.20 | 252.20 | 134.95 | 6.649 | 10.889 | 4-FFf | 4.000 | 3.345 | 4.000 | 7.330 | 10.035 | 0.000 |
| 270.00 | 270.00 | 135.50 | 7.228 | 11.437 | 4-FFf | 4.000 | 3.437 | 4.000 | 7.330 | 10.743 | 0.000 |
| 287.80 | 287.80 | 136.08 | 7.852 | 12.022 | 4-FFf | 4.000 | 3.530 | 4.000 | 7.330 | 11.451 | 0.000 |
| 305.60 | 305.60 | 136.71 | 8.520 | 12.645 | 4-FFf | 4.000 | 3.623 | 4.000 | 7.330 | 12.159 | 0.000 |
| 323.40 | 323.40 | 137.37 | 9.231 | 13.305 | 4-FFf | 4.000 | 3.716 | 4.000 | 7.330 | 12.868 | 0.000 |
| 341.20 | 337.75 | 137.92 | 9.835 | 13.864 | 4-FFf | 4.000 | 3.791 | 4.000 | 7.330 | 13.439 | 0.000 |
| 359.00 | 340.45 | 138.03 | 9.951 | 13.972 | 4-FFf | 4.000 | 3.805 | 4.000 | 7.330 | 13.546 | 0.000 |

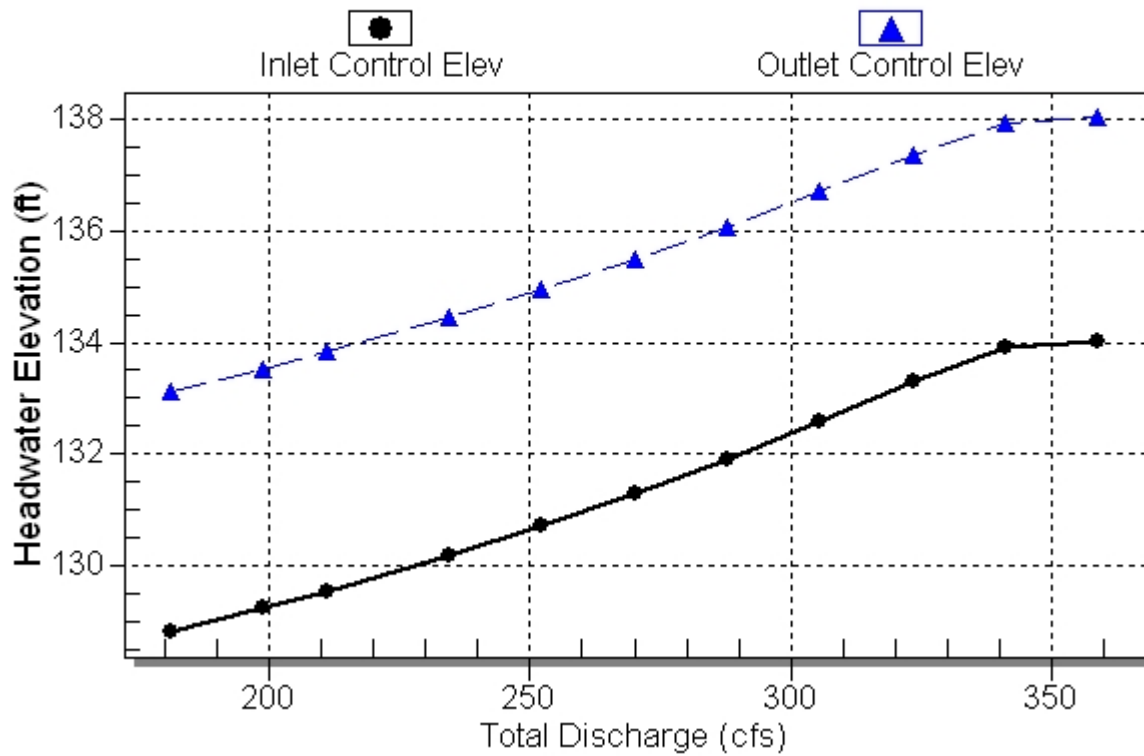
Inlet Elevation (invert): 124.06 ft, Outlet Elevation (invert): 123.87 ft

Culvert Length: 215.00 ft, Culvert Slope: 0.0009

Culvert Performance Curve Plot: Ex. CD-7

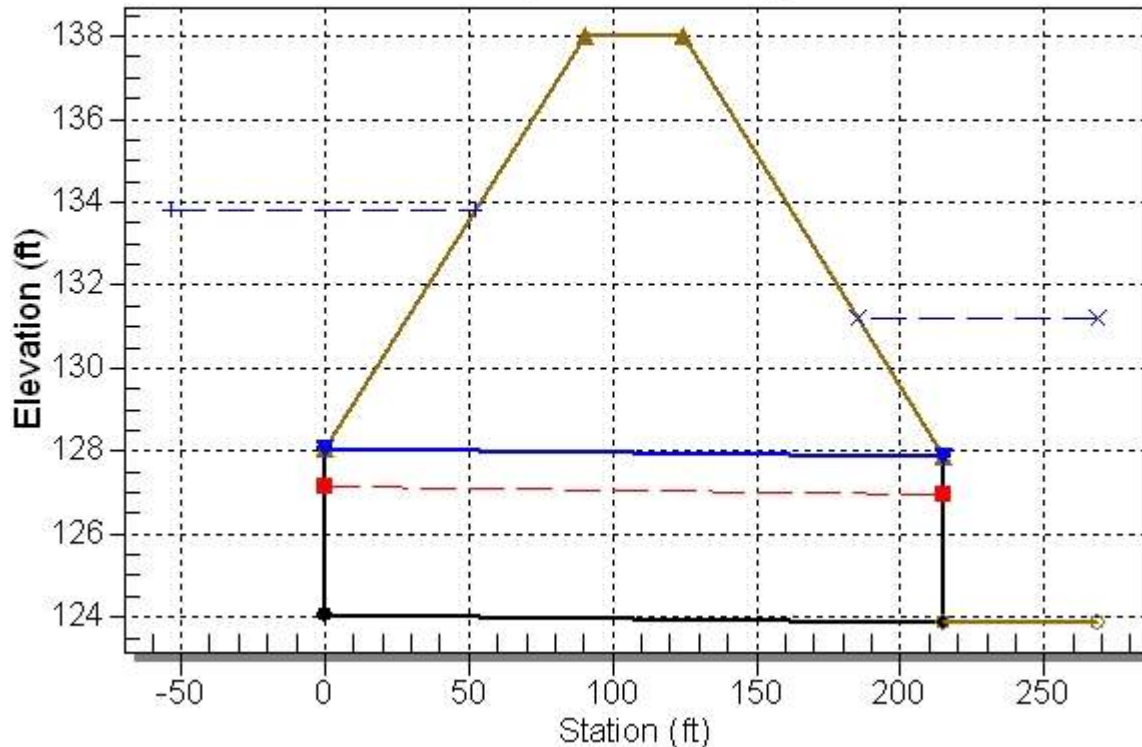
Performance Curve

Culvert: Ex. CD-7



Water Surface Profile Plot for Culvert: Ex. CD-7

Crossing - Ex. CD-7, Design Discharge - 211.0 cfs
Culvert - Ex. CD-7, Culvert Discharge - 211.0 cfs



Site Data - Ex. CD-7

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 124.06 ft

Outlet Station: 215.00 ft

Outlet Elevation: 123.87 ft

Number of Barrels: 2

Culvert Data Summary - Ex. CD-7

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Table 51 - Downstream Channel Rating Curve (Crossing: Ex. CD-7)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 181.00 | 131.20 | 7.33 |
| 198.80 | 131.20 | 7.33 |
| 211.00 | 131.20 | 7.33 |
| 234.40 | 131.20 | 7.33 |
| 252.20 | 131.20 | 7.33 |
| 270.00 | 131.20 | 7.33 |
| 287.80 | 131.20 | 7.33 |
| 305.60 | 131.20 | 7.33 |
| 323.40 | 131.20 | 7.33 |
| 341.20 | 131.20 | 7.33 |
| 359.00 | 131.20 | 7.33 |

Tailwater Channel Data - Ex. CD-7

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 131.20 ft

Roadway Data for Crossing: Ex. CD-7

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1000.00 ft

Crest Elevation: 138.00 ft

Roadway Surface: Paved

Roadway Top Width: 34.00 ft

Table 52 - Summary of Culvert Flows at Crossing: Pr. CD-7

| Headwater Elevation (ft) | Total Discharge (cfs) | Pr. CD-7 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 133.20 | 181.00 | 181.00 | 0.00 | 1 |
| 133.61 | 198.80 | 198.80 | 0.00 | 1 |
| 133.92 | 211.00 | 211.00 | 0.00 | 1 |
| 134.55 | 234.40 | 234.40 | 0.00 | 1 |
| 135.08 | 252.20 | 252.20 | 0.00 | 1 |
| 135.65 | 270.00 | 270.00 | 0.00 | 1 |
| 136.25 | 287.80 | 287.80 | 0.00 | 1 |
| 136.90 | 305.60 | 305.60 | 0.00 | 1 |
| 137.58 | 323.40 | 323.40 | 0.00 | 1 |
| 138.02 | 341.20 | 334.27 | 5.69 | 39 |
| 138.04 | 359.00 | 334.85 | 22.82 | 5 |
| 138.00 | 333.88 | 333.88 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Pr. CD-7

Total Rating Curve

Crossing: Pr. CD-7

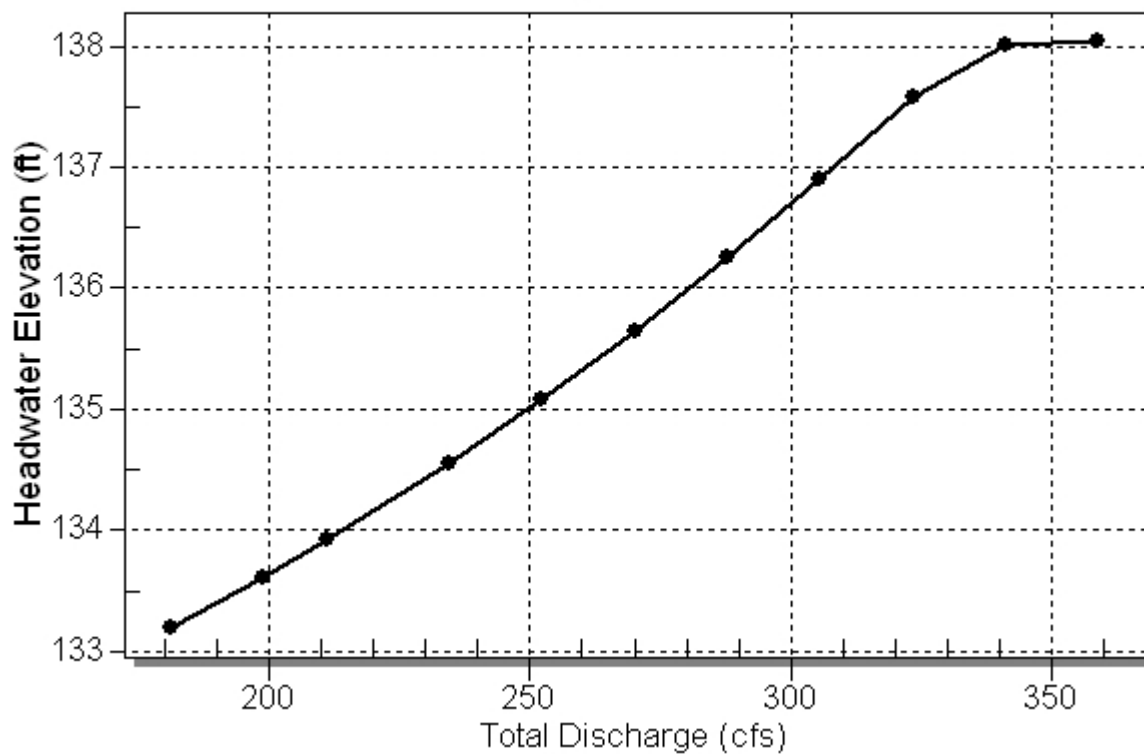


Table 53 - Culvert Summary Table: Pr. CD-7

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 181.00 | 181.00 | 133.20 | 4.761 | 9.138 | 4-FFf | 4.000 | 2.877 | 4.000 | 7.350 | 7.202 | 0.000 |
| 198.80 | 198.80 | 133.61 | 5.174 | 9.551 | 4-FFf | 4.000 | 3.009 | 4.000 | 7.350 | 7.910 | 0.000 |
| 211.00 | 211.00 | 133.92 | 5.478 | 9.856 | 4-FFf | 4.000 | 3.100 | 4.000 | 7.350 | 8.395 | 0.000 |
| 234.40 | 234.40 | 134.55 | 6.115 | 10.492 | 4-FFf | 4.000 | 3.252 | 4.000 | 7.350 | 9.326 | 0.000 |
| 252.20 | 252.20 | 135.08 | 6.649 | 11.020 | 4-FFf | 4.000 | 3.345 | 4.000 | 7.350 | 10.035 | 0.000 |
| 270.00 | 270.00 | 135.65 | 7.228 | 11.587 | 4-FFf | 4.000 | 3.437 | 4.000 | 7.350 | 10.743 | 0.000 |
| 287.80 | 287.80 | 136.25 | 7.852 | 12.192 | 4-FFf | 4.000 | 3.530 | 4.000 | 7.350 | 11.451 | 0.000 |
| 305.60 | 305.60 | 136.90 | 8.520 | 12.837 | 4-FFf | 4.000 | 3.623 | 4.000 | 7.350 | 12.159 | 0.000 |
| 323.40 | 323.40 | 137.58 | 9.231 | 13.520 | 4-FFf | 4.000 | 3.716 | 4.000 | 7.350 | 12.868 | 0.000 |
| 341.20 | 334.27 | 138.02 | 9.686 | 13.956 | 4-FFf | 4.000 | 3.772 | 4.000 | 7.350 | 13.300 | 0.000 |
| 359.00 | 334.85 | 138.04 | 9.711 | 13.980 | 4-FFf | 4.000 | 3.775 | 4.000 | 7.350 | 13.323 | 0.000 |

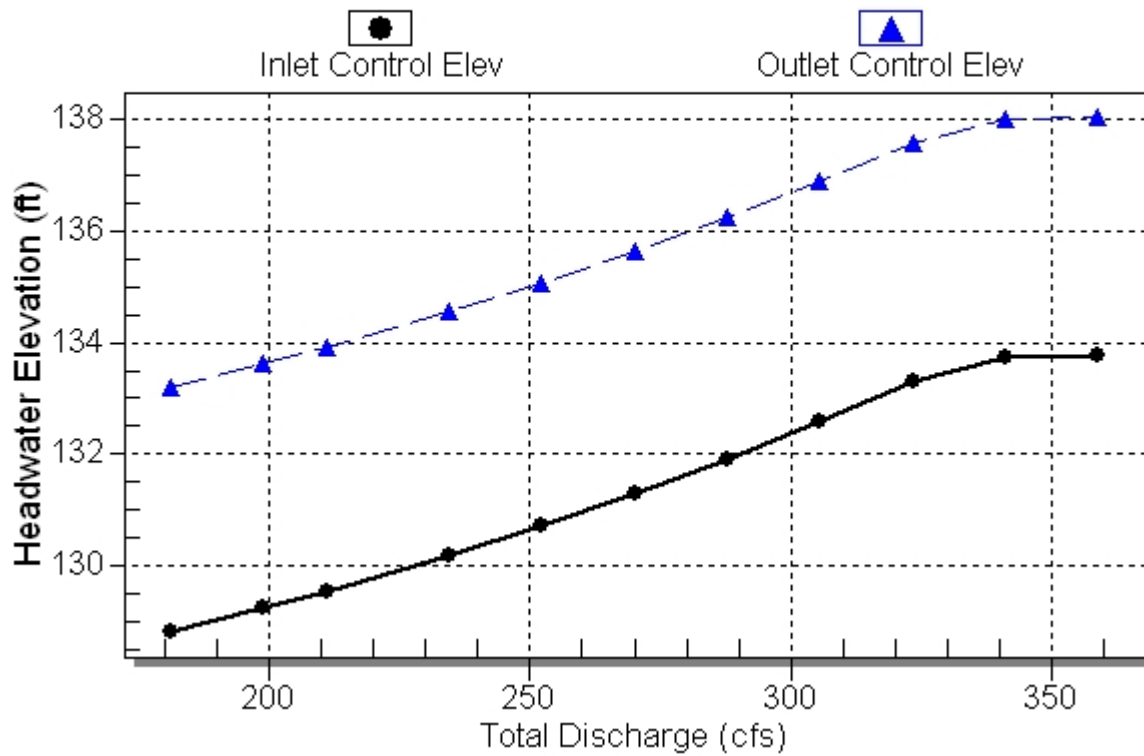
Inlet Elevation (invert): 124.06 ft, Outlet Elevation (invert): 123.85 ft

Culvert Length: 235.00 ft, Culvert Slope: 0.0009

Culvert Performance Curve Plot: Pr. CD-7

Performance Curve

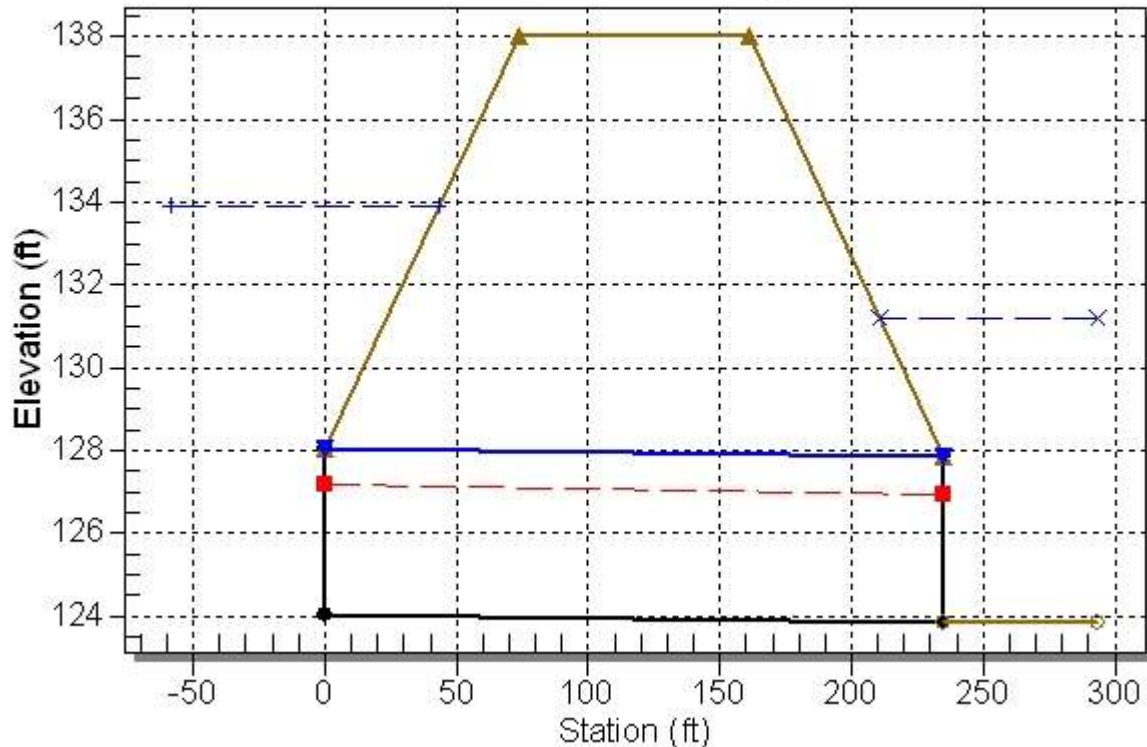
Culvert: Pr. CD-7



Water Surface Profile Plot for Culvert: Pr. CD-7

Crossing - Pr. CD-7, Design Discharge - 211.0 cfs

Culvert - Pr. CD-7, Culvert Discharge - 211.0 cfs



Site Data - Pr. CD-7

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 124.06 ft

Outlet Station: 235.00 ft

Outlet Elevation: 123.85 ft

Number of Barrels: 2

Culvert Data Summary - Pr. CD-7

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Table 54 - Downstream Channel Rating Curve (Crossing: Pr. CD-7)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 181.00 | 131.20 | 7.35 |
| 198.80 | 131.20 | 7.35 |
| 211.00 | 131.20 | 7.35 |
| 234.40 | 131.20 | 7.35 |
| 252.20 | 131.20 | 7.35 |
| 270.00 | 131.20 | 7.35 |
| 287.80 | 131.20 | 7.35 |
| 305.60 | 131.20 | 7.35 |
| 323.40 | 131.20 | 7.35 |
| 341.20 | 131.20 | 7.35 |
| 359.00 | 131.20 | 7.35 |

Tailwater Channel Data - Pr. CD-7

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 131.20 ft

Roadway Data for Crossing: Pr. CD-7

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1000.00 ft

Crest Elevation: 138.00 ft

Roadway Surface: Paved

Roadway Top Width: 87.50 ft

Table 31 - Summary of Culvert Flows at Crossing: Ex. CD-8

| Headwater Elevation (ft) | Total Discharge (cfs) | Ex. CD-8 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 138.00 | 9.00 | 9.00 | 0.00 | 1 |
| 138.01 | 9.90 | 9.02 | 0.79 | 7 |
| 138.01 | 10.00 | 9.02 | 0.91 | 3 |
| 138.01 | 11.70 | 9.03 | 2.57 | 4 |
| 138.02 | 12.60 | 9.04 | 3.46 | 3 |
| 138.02 | 13.50 | 9.04 | 4.37 | 3 |
| 138.02 | 14.40 | 9.05 | 5.29 | 3 |
| 138.03 | 15.30 | 9.05 | 6.21 | 3 |
| 138.03 | 16.20 | 9.05 | 7.11 | 3 |
| 138.03 | 17.10 | 9.06 | 7.88 | 2 |
| 138.03 | 18.00 | 9.06 | 8.91 | 3 |
| 138.00 | 9.01 | 9.01 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Ex. CD-8

Total Rating Curve

Crossing: Ex. CD-8

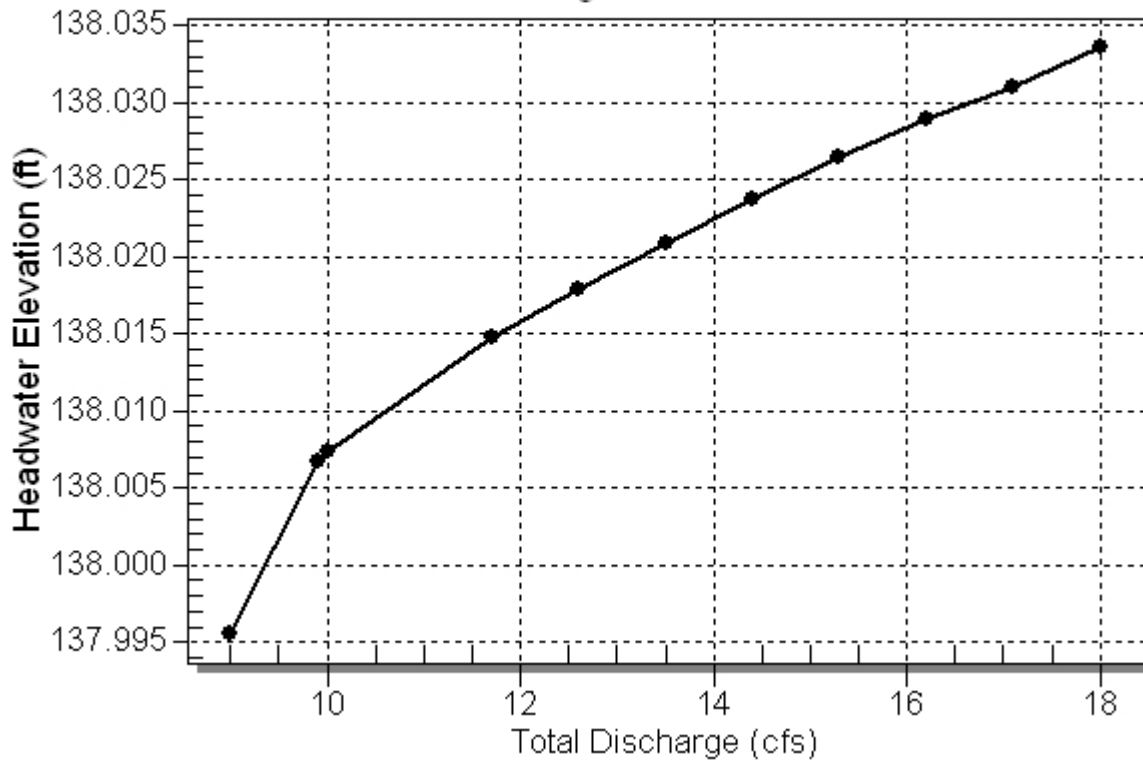


Table 32 - Culvert Summary Table: Ex. CD-8

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 9.00 | 9.00 | 138.00 | 2.486 | 2.996 | 4-FFf | 1.250 | 1.171 | 1.250 | 0.250 | 7.334 | 0.000 |
| 9.90 | 9.02 | 138.01 | 2.492 | 3.006 | 4-FFf | 1.250 | 1.173 | 1.250 | 0.250 | 7.348 | 0.000 |
| 10.00 | 9.02 | 138.01 | 2.492 | 3.007 | 4-FFf | 1.250 | 1.173 | 1.250 | 0.250 | 7.349 | 0.000 |
| 11.70 | 9.03 | 138.01 | 2.496 | 3.014 | 4-FFf | 1.250 | 1.173 | 1.250 | 0.250 | 7.358 | 0.000 |
| 12.60 | 9.04 | 138.02 | 2.499 | 3.018 | 4-FFf | 1.250 | 1.174 | 1.250 | 0.250 | 7.364 | 0.000 |
| 13.50 | 9.04 | 138.02 | 2.500 | 3.021 | 4-FFf | 1.250 | 1.174 | 1.250 | 0.250 | 7.368 | 0.000 |
| 14.40 | 9.05 | 138.02 | 2.502 | 3.024 | 4-FFf | 1.250 | 1.174 | 1.250 | 0.250 | 7.371 | 0.000 |
| 15.30 | 9.05 | 138.03 | 2.503 | 3.026 | 4-FFf | 1.250 | 1.174 | 1.250 | 0.250 | 7.375 | 0.000 |
| 16.20 | 9.05 | 138.03 | 2.505 | 3.029 | 4-FFf | 1.250 | 1.175 | 1.250 | 0.250 | 7.378 | 0.000 |
| 17.10 | 9.06 | 138.03 | 2.506 | 3.031 | 4-FFf | 1.250 | 1.175 | 1.250 | 0.250 | 7.381 | 0.000 |
| 18.00 | 9.06 | 138.03 | 2.508 | 3.033 | 4-FFf | 1.250 | 1.175 | 1.250 | 0.250 | 7.384 | 0.000 |

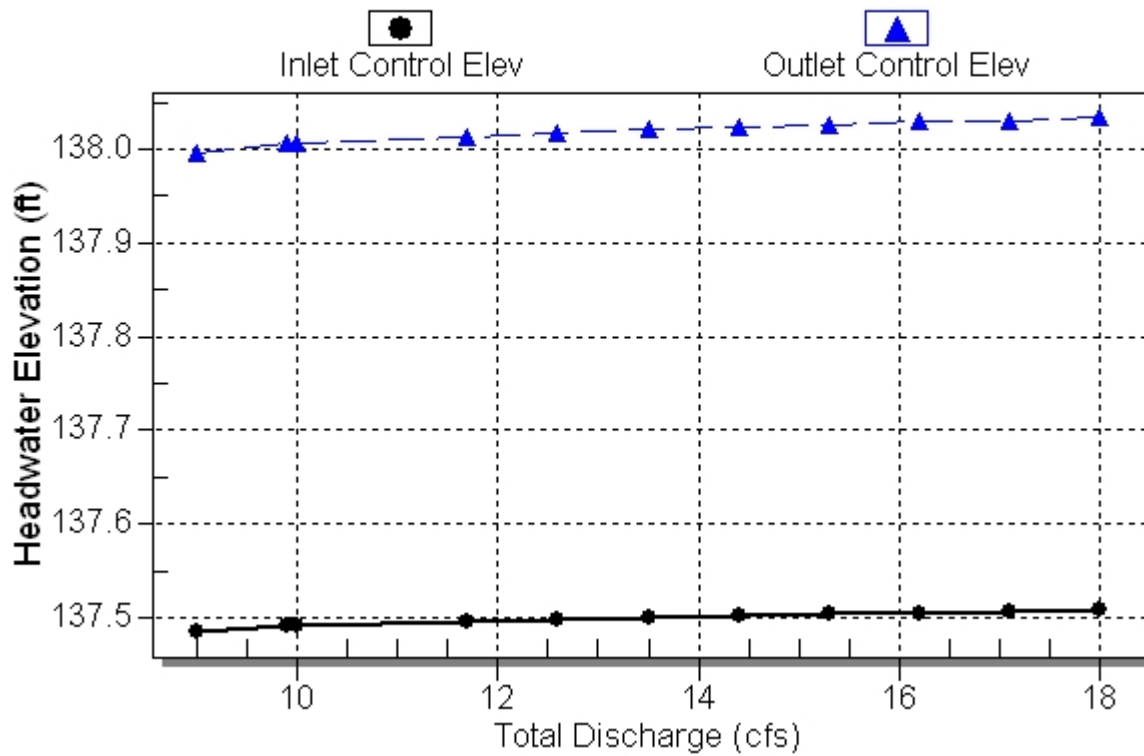
Inlet Elevation (invert): 135.00 ft, Outlet Elevation (invert): 134.00 ft

Culvert Length: 106.00 ft, Culvert Slope: 0.0094

Culvert Performance Curve Plot: Ex. CD-8

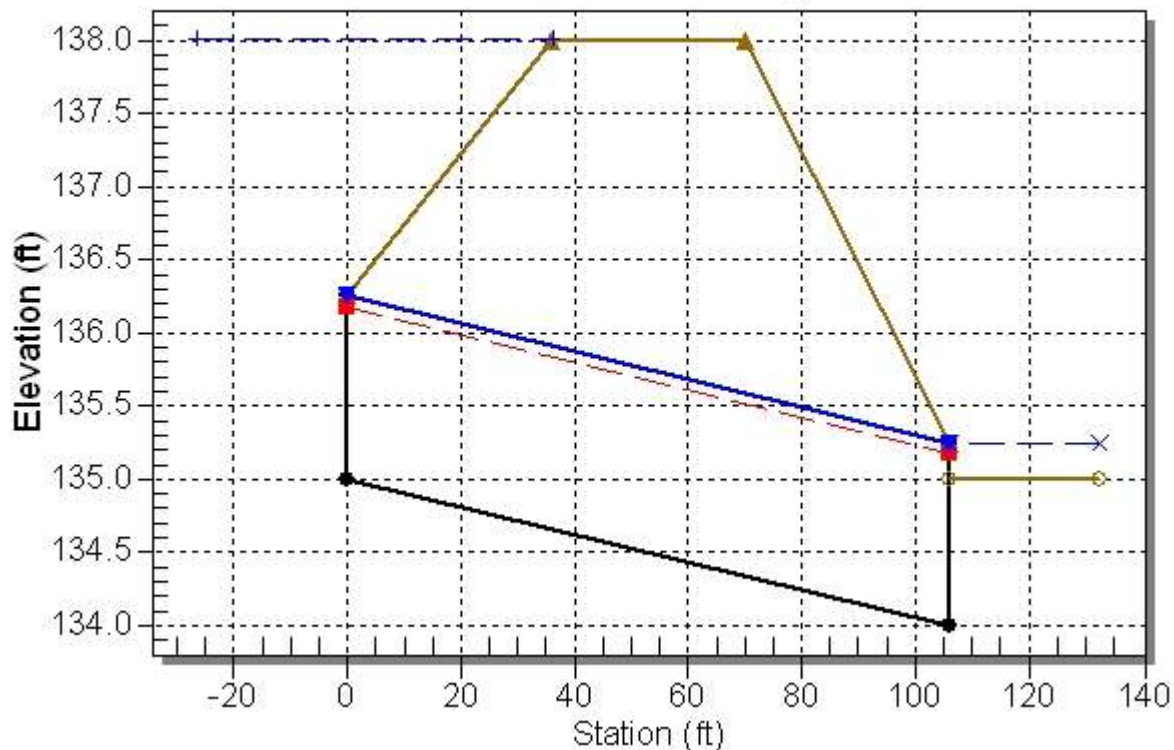
Performance Curve

Culvert: Ex. CD-8



Water Surface Profile Plot for Culvert: Ex. CD-8

Crossing - Ex. CD-8, Design Discharge - 10.0 cfs
Culvert - Ex. CD-8, Culvert Discharge - 9.0 cfs



Site Data - Ex. CD-8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 135.00 ft

Outlet Station: 106.00 ft

Outlet Elevation: 134.00 ft

Number of Barrels: 1

Culvert Data Summary - Ex. CD-8

Barrel Shape: Circular

Barrel Diameter: 1.25 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Grooved End in Headwall

Inlet Depression: None

Table 33 - Downstream Channel Rating Curve (Crossing: Ex. CD-8)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 9.00 | 135.25 | 0.25 |
| 9.90 | 135.25 | 0.25 |
| 10.00 | 135.25 | 0.25 |
| 11.70 | 135.25 | 0.25 |
| 12.60 | 135.25 | 0.25 |
| 13.50 | 135.25 | 0.25 |
| 14.40 | 135.25 | 0.25 |
| 15.30 | 135.25 | 0.25 |
| 16.20 | 135.25 | 0.25 |
| 17.10 | 135.25 | 0.25 |
| 18.00 | 135.25 | 0.25 |

Tailwater Channel Data - Ex. CD-8

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 135.25 ft

Roadway Data for Crossing: Ex. CD-8

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 500.00 ft

Crest Elevation: 138.00 ft

Roadway Surface: Paved

Roadway Top Width: 34.00 ft

Table 34 - Summary of Culvert Flows at Crossing: Pr. CD-8

| Headwater Elevation (ft) | Total Discharge (cfs) | Pr. CD-8 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 136.91 | 9.00 | 9.00 | 0.00 | 1 |
| 137.26 | 9.90 | 9.90 | 0.00 | 1 |
| 137.30 | 10.00 | 10.00 | 0.00 | 1 |
| 137.91 | 11.70 | 11.40 | 0.00 | 50 |
| 138.01 | 12.60 | 11.60 | 0.88 | 21 |
| 138.01 | 13.50 | 11.61 | 1.80 | 4 |
| 138.01 | 14.40 | 11.62 | 2.64 | 3 |
| 138.02 | 15.30 | 11.63 | 3.56 | 3 |
| 138.02 | 16.20 | 11.63 | 4.48 | 3 |
| 138.02 | 17.10 | 11.64 | 5.40 | 3 |
| 138.03 | 18.00 | 11.64 | 6.31 | 3 |
| 138.00 | 11.59 | 11.59 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Pr. CD-8

Total Rating Curve

Crossing: Pr. CD-8

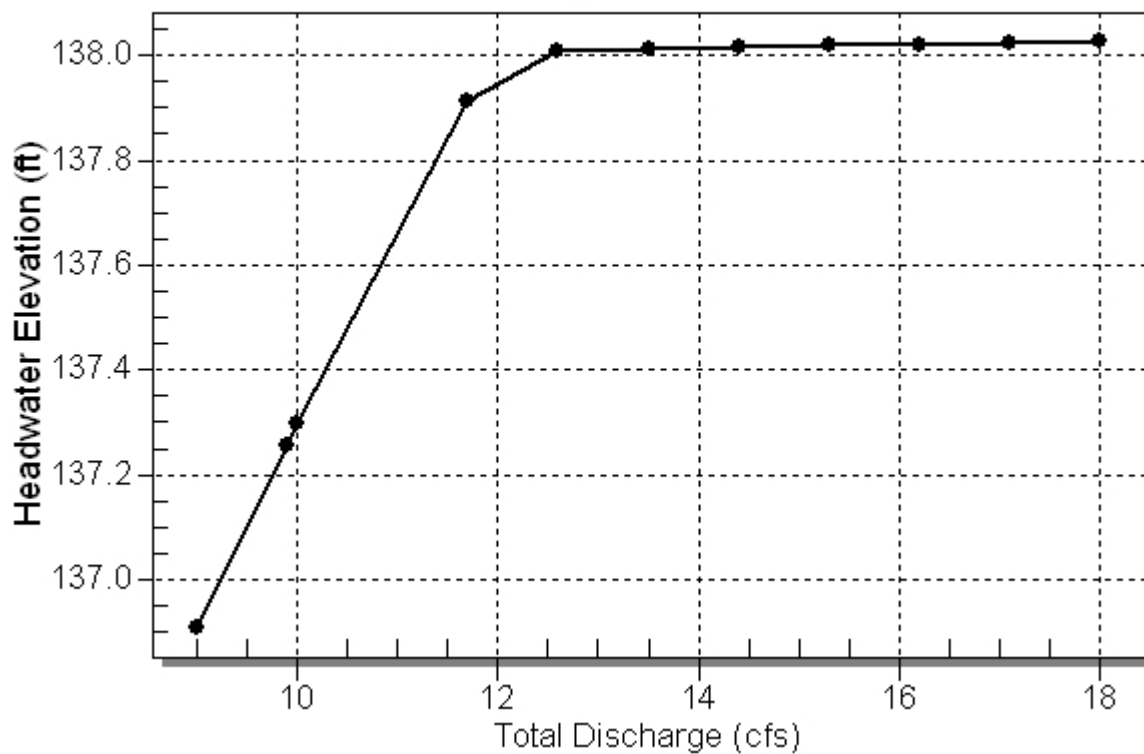


Table 35 - Culvert Summary Table: Pr. CD-8

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 9.00 | 9.00 | 136.91 | 1.835 | 1.909 | 4-FFf | 1.028 | 1.157 | 1.500 | 0.250 | 5.093 | 0.000 |
| 9.90 | 9.90 | 137.26 | 1.998 | 2.257 | 4-FFf | 1.111 | 1.211 | 1.500 | 0.250 | 5.602 | 0.000 |
| 10.00 | 10.00 | 137.30 | 2.018 | 2.298 | 4-FFf | 1.121 | 1.215 | 1.500 | 0.250 | 5.659 | 0.000 |
| 11.70 | 11.40 | 137.91 | 2.304 | 2.912 | 4-FFf | 1.290 | 1.279 | 1.500 | 0.250 | 6.452 | 0.000 |
| 12.60 | 11.60 | 138.01 | 2.348 | 3.007 | 4-FFf | 1.321 | 1.288 | 1.500 | 0.250 | 6.566 | 0.000 |
| 13.50 | 11.61 | 138.01 | 2.350 | 3.012 | 4-FFf | 1.322 | 1.288 | 1.500 | 0.250 | 6.571 | 0.000 |
| 14.40 | 11.62 | 138.01 | 2.352 | 3.015 | 4-FFf | 1.323 | 1.289 | 1.500 | 0.250 | 6.575 | 0.000 |
| 15.30 | 11.63 | 138.02 | 2.354 | 3.018 | 4-FFf | 1.324 | 1.289 | 1.500 | 0.250 | 6.579 | 0.000 |
| 16.20 | 11.63 | 138.02 | 2.355 | 3.021 | 4-FFf | 1.325 | 1.289 | 1.500 | 0.250 | 6.583 | 0.000 |
| 17.10 | 11.64 | 138.02 | 2.356 | 3.024 | 4-FFf | 1.326 | 1.290 | 1.500 | 0.250 | 6.586 | 0.000 |
| 18.00 | 11.64 | 138.03 | 2.357 | 3.027 | 4-FFf | 1.327 | 1.290 | 1.500 | 0.250 | 6.589 | 0.000 |

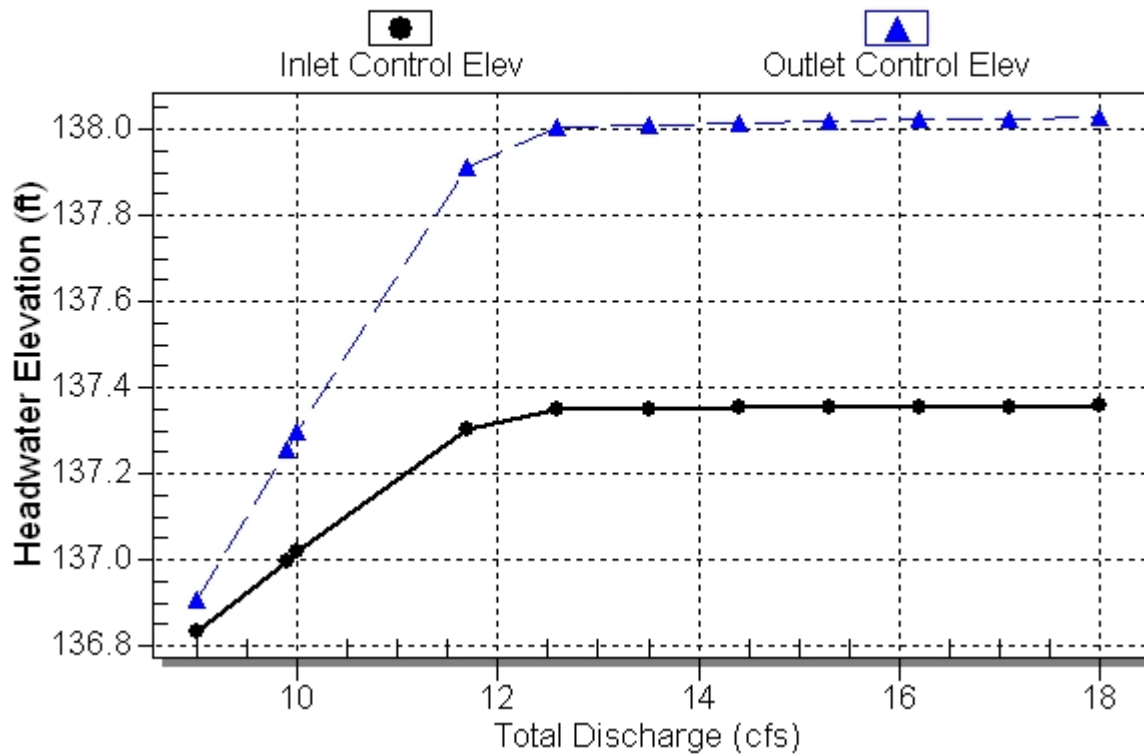
Inlet Elevation (invert): 135.00 ft, Outlet Elevation (invert): 133.22 ft

Culvert Length: 189.01 ft, Culvert Slope: 0.0094

Culvert Performance Curve Plot: Pr. CD-8

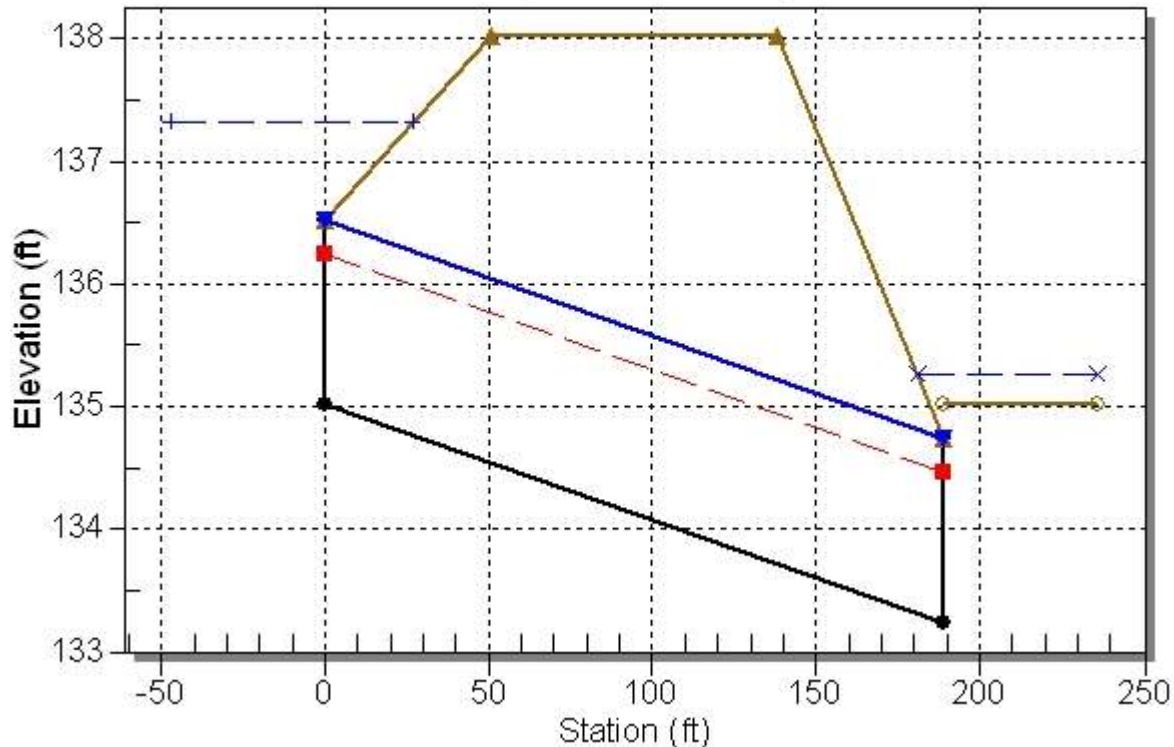
Performance Curve

Culvert: Pr. CD-8



Water Surface Profile Plot for Culvert: Pr. CD-8

Crossing - Pr. CD-8, Design Discharge - 10.0 cfs
Culvert - Pr. CD-8, Culvert Discharge - 10.0 cfs



Site Data - Pr. CD-8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 135.00 ft

Outlet Station: 189.00 ft

Outlet Elevation: 133.22 ft

Number of Barrels: 1

Culvert Data Summary - Pr. CD-8

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Grooved End in Headwall

Inlet Depression: None

Table 36 - Downstream Channel Rating Curve (Crossing: Pr. CD-8)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 9.00 | 135.25 | 0.25 |
| 9.90 | 135.25 | 0.25 |
| 10.00 | 135.25 | 0.25 |
| 11.70 | 135.25 | 0.25 |
| 12.60 | 135.25 | 0.25 |
| 13.50 | 135.25 | 0.25 |
| 14.40 | 135.25 | 0.25 |
| 15.30 | 135.25 | 0.25 |
| 16.20 | 135.25 | 0.25 |
| 17.10 | 135.25 | 0.25 |
| 18.00 | 135.25 | 0.25 |

Tailwater Channel Data - Pr. CD-8

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 135.25 ft

Roadway Data for Crossing: Pr. CD-8

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 500.00 ft

Crest Elevation: 138.00 ft

Roadway Surface: Paved

Roadway Top Width: 87.50 ft

Table 37 - Summary of Culvert Flows at Crossing: Ex. CD-9

| Headwater Elevation (ft) | Total Discharge (cfs) | Ex. CD-9 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 138.66 | 58.00 | 58.00 | 0.00 | 1 |
| 138.96 | 63.60 | 61.85 | 0.00 | 50 |
| 139.01 | 67.00 | 62.52 | 4.00 | 17 |
| 139.02 | 74.80 | 62.63 | 11.47 | 4 |
| 139.02 | 80.40 | 62.69 | 17.41 | 4 |
| 139.03 | 86.00 | 62.74 | 22.70 | 3 |
| 139.03 | 91.60 | 62.80 | 28.32 | 3 |
| 139.03 | 97.20 | 62.84 | 34.00 | 3 |
| 139.04 | 102.80 | 62.89 | 39.65 | 3 |
| 139.04 | 108.40 | 62.93 | 45.28 | 3 |
| 139.04 | 114.00 | 62.97 | 50.04 | 2 |
| 139.00 | 62.42 | 62.42 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Ex. CD-9

Total Rating Curve

Crossing: Ex. CD-9

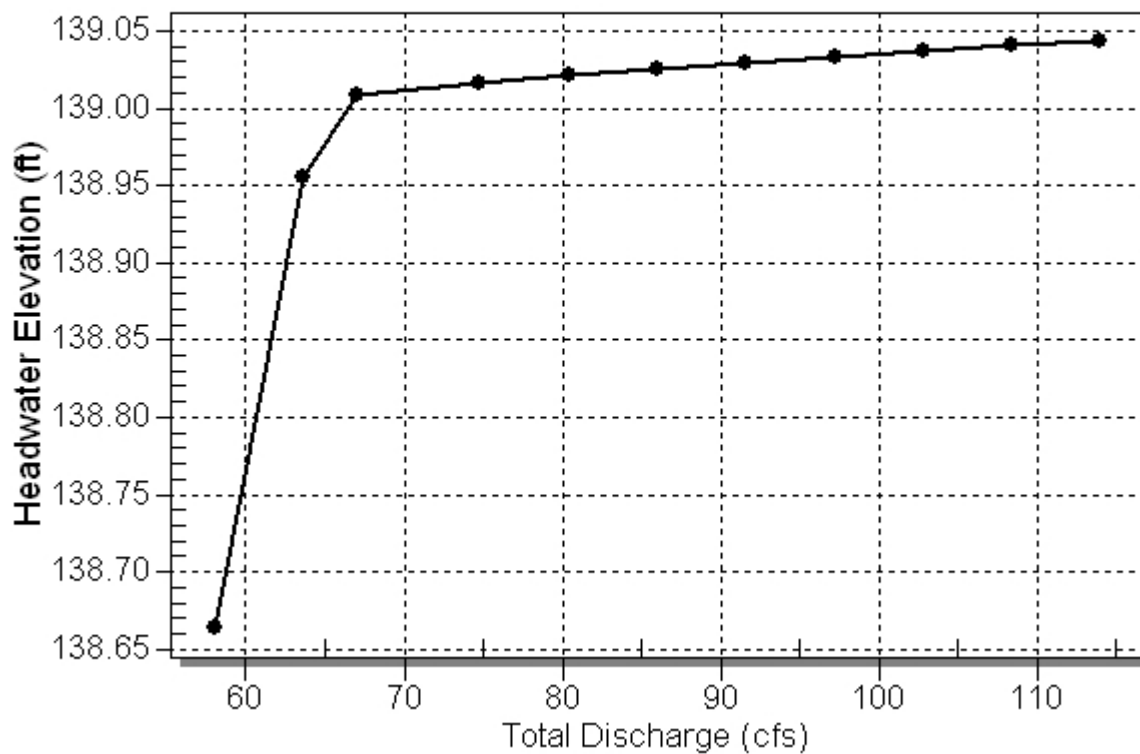


Table 38 - Culvert Summary Table: Ex. CD-9

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 58.00 | 58.00 | 138.66 | 3.664 | 2.733 | 4-FFf | 1.283 | 1.873 | 1.283 | 1.000 | 11.301 | 0.000 |
| 63.60 | 61.85 | 138.96 | 3.955 | 2.971 | 4-FFf | 1.344 | 1.955 | 1.344 | 1.000 | 11.510 | 0.000 |
| 67.00 | 62.52 | 139.01 | 4.008 | 3.014 | 4-FFf | 1.354 | 1.969 | 1.354 | 1.000 | 11.544 | 0.000 |
| 74.80 | 62.63 | 139.02 | 4.016 | 3.021 | 4-FFf | 1.356 | 1.971 | 1.356 | 1.000 | 11.549 | 0.000 |
| 80.40 | 62.69 | 139.02 | 4.021 | 3.025 | 4-FFf | 1.357 | 1.973 | 1.357 | 1.000 | 11.553 | 0.000 |
| 86.00 | 62.74 | 139.03 | 4.026 | 3.029 | 4-FFf | 1.357 | 1.974 | 1.357 | 1.000 | 11.555 | 0.000 |
| 91.60 | 62.80 | 139.03 | 4.030 | 3.032 | 4-FFf | 1.358 | 1.975 | 1.358 | 1.000 | 11.558 | 0.000 |
| 97.20 | 62.84 | 139.03 | 4.033 | 3.035 | 4-FFf | 1.359 | 1.976 | 1.359 | 1.000 | 11.560 | 0.000 |
| 102.80 | 62.89 | 139.04 | 4.037 | 3.038 | 4-FFf | 1.360 | 1.977 | 1.360 | 1.000 | 11.563 | 0.000 |
| 108.40 | 62.93 | 139.04 | 4.040 | 3.041 | 4-FFf | 1.360 | 1.978 | 1.360 | 1.000 | 11.565 | 0.000 |
| 114.00 | 62.97 | 139.04 | 4.043 | 3.043 | 4-FFf | 1.361 | 1.979 | 1.361 | 1.000 | 11.566 | 0.000 |

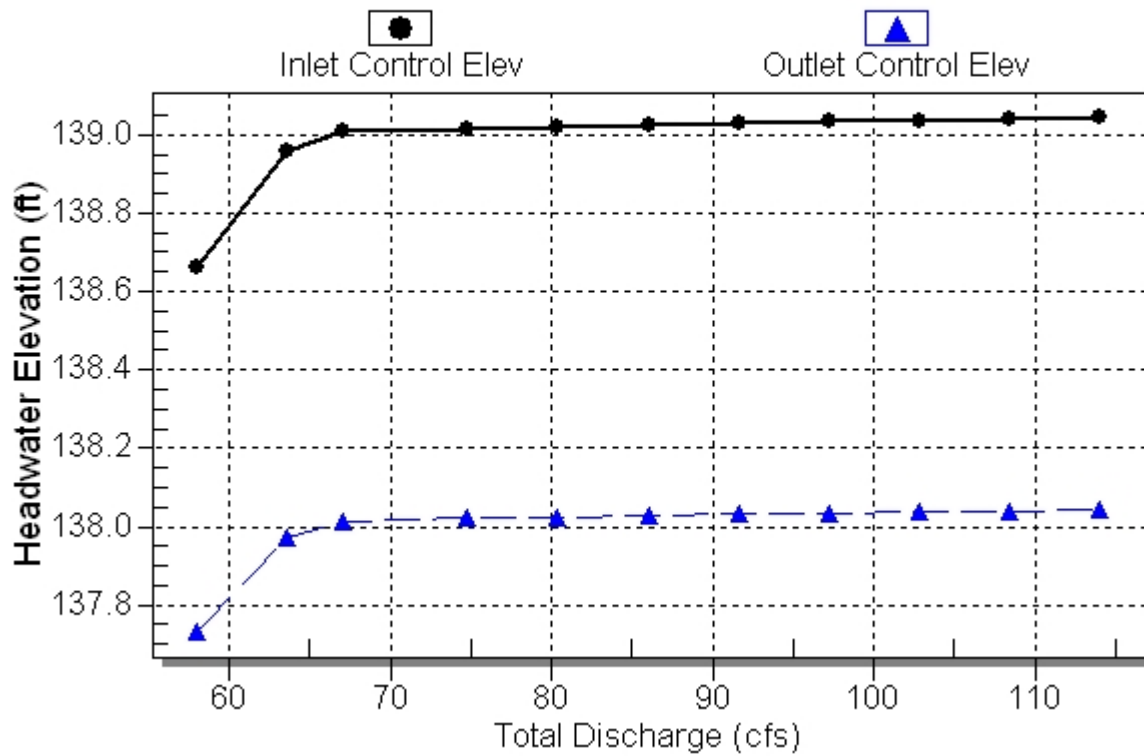
Inlet Elevation (invert): 135.00 ft, Outlet Elevation (invert): 134.00 ft

Culvert Length: 87.01 ft, Culvert Slope: 0.0115

Culvert Performance Curve Plot: Ex. CD-9

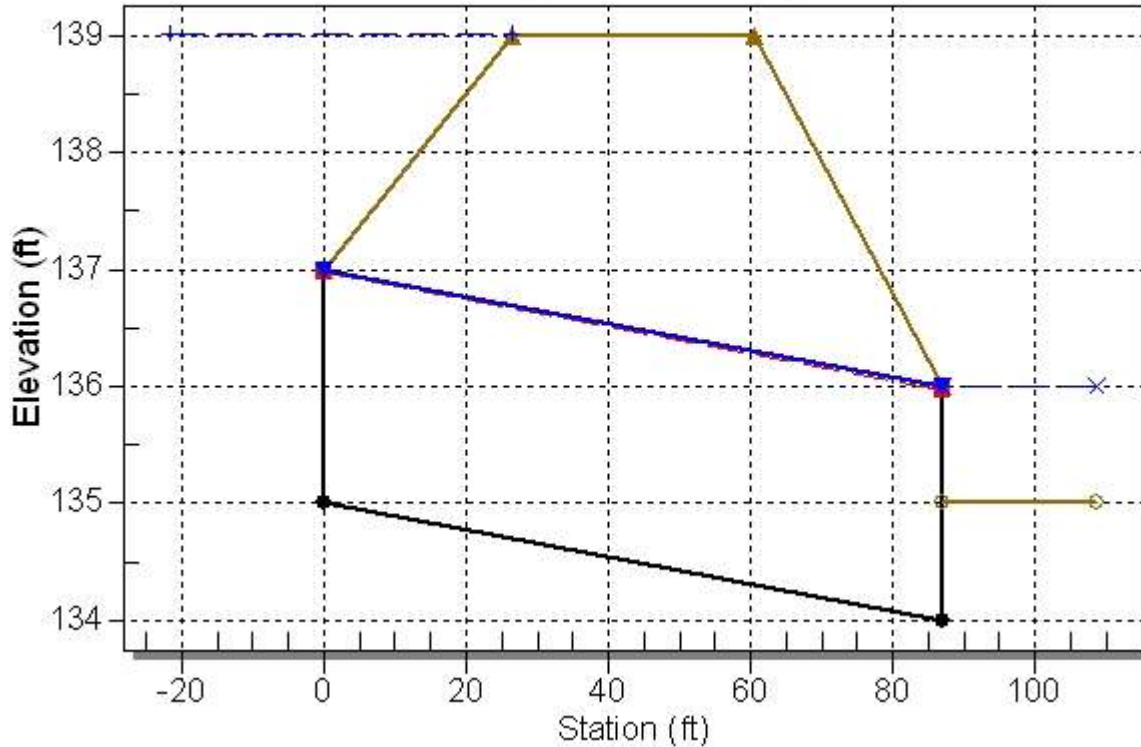
Performance Curve

Culvert: Ex. CD-9



Water Surface Profile Plot for Culvert: Ex. CD-9

Crossing - Ex. CD-9, Design Discharge - 67.0 cfs
Culvert - Ex. CD-9, Culvert Discharge - 62.5 cfs



Site Data - Ex. CD-9

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 135.00 ft

Outlet Station: 87.00 ft

Outlet Elevation: 134.00 ft

Number of Barrels: 1

Culvert Data Summary - Ex. CD-9

Barrel Shape: Concrete Box

Barrel Span: 4.00 ft

Barrel Rise: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: None

Table 39 - Downstream Channel Rating Curve (Crossing: Ex. CD-9)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 58.00 | 136.00 | 1.00 |
| 63.60 | 136.00 | 1.00 |
| 67.00 | 136.00 | 1.00 |
| 74.80 | 136.00 | 1.00 |
| 80.40 | 136.00 | 1.00 |
| 86.00 | 136.00 | 1.00 |
| 91.60 | 136.00 | 1.00 |
| 97.20 | 136.00 | 1.00 |
| 102.80 | 136.00 | 1.00 |
| 108.40 | 136.00 | 1.00 |
| 114.00 | 136.00 | 1.00 |

Tailwater Channel Data - Ex. CD-9

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 136.00 ft

Roadway Data for Crossing: Ex. CD-9

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1920.00 ft

Crest Elevation: 139.00 ft

Roadway Surface: Paved

Roadway Top Width: 34.00 ft

Table 40 - Summary of Culvert Flows at Crossing: Pr. CD-9

| Headwater Elevation (ft) | Total Discharge (cfs) | Pr. CD-9 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|--------------------------|-------------------------|-------------|
| 138.66 | 58.00 | 58.00 | 0.00 | 1 |
| 138.96 | 63.60 | 61.86 | 0.00 | 50 |
| 139.01 | 67.00 | 62.52 | 4.03 | 17 |
| 139.02 | 74.80 | 62.63 | 11.47 | 4 |
| 139.02 | 80.40 | 62.69 | 17.41 | 4 |
| 139.03 | 86.00 | 62.75 | 22.70 | 3 |
| 139.03 | 91.60 | 62.80 | 28.32 | 3 |
| 139.03 | 97.20 | 62.85 | 33.99 | 3 |
| 139.04 | 102.80 | 62.89 | 39.65 | 3 |
| 139.04 | 108.40 | 62.93 | 45.28 | 3 |
| 139.04 | 114.00 | 62.97 | 50.04 | 2 |
| 139.00 | 62.42 | 62.42 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Pr. CD-9

Total Rating Curve

Crossing: Pr. CD-9

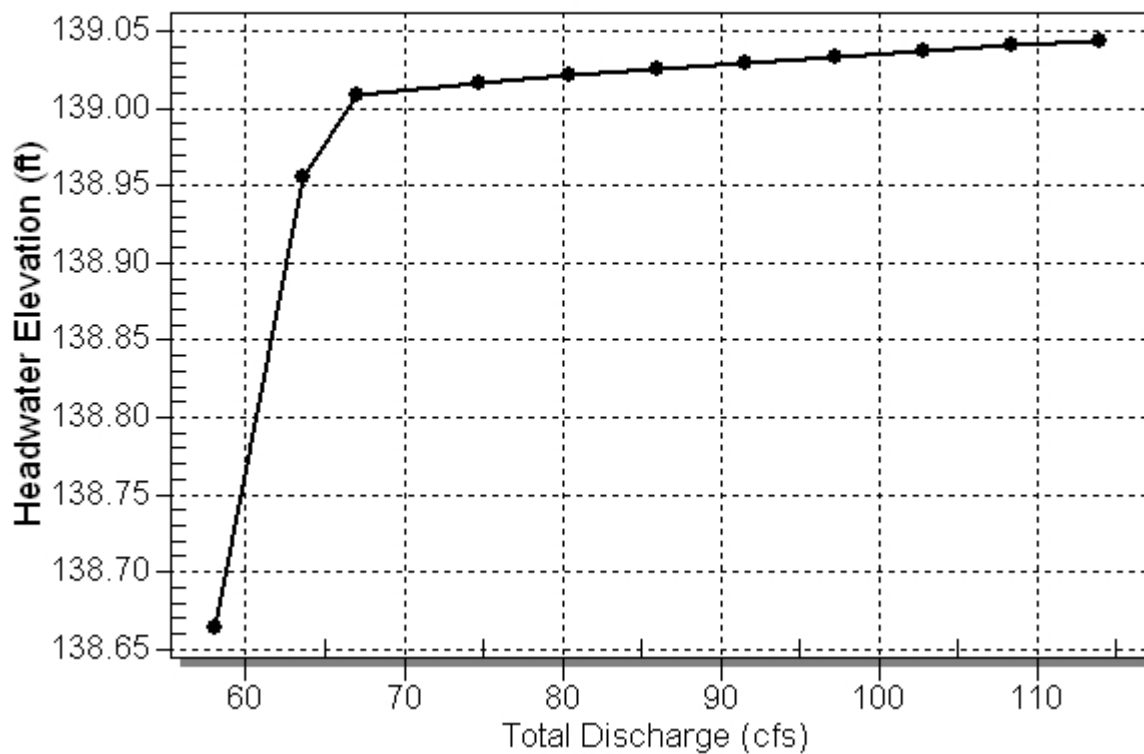


Table 41 - Culvert Summary Table: Pr. CD-9

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 58.00 | 58.00 | 138.66 | 3.664 | 3.330 | 4-FFf | 1.284 | 1.873 | 1.284 | 1.000 | 11.297 | 0.000 |
| 63.60 | 61.86 | 138.96 | 3.956 | 3.651 | 4-FFf | 1.344 | 1.955 | 1.344 | 1.000 | 11.505 | 0.000 |
| 67.00 | 62.52 | 139.01 | 4.008 | 3.708 | 4-FFf | 1.355 | 1.969 | 1.355 | 1.000 | 11.539 | 0.000 |
| 74.80 | 62.63 | 139.02 | 4.016 | 3.717 | 4-FFf | 1.356 | 1.971 | 1.356 | 1.000 | 11.545 | 0.000 |
| 80.40 | 62.69 | 139.02 | 4.022 | 3.723 | 4-FFf | 1.357 | 1.973 | 1.357 | 1.000 | 11.548 | 0.000 |
| 86.00 | 62.75 | 139.03 | 4.026 | 3.727 | 4-FFf | 1.358 | 1.974 | 1.358 | 1.000 | 11.551 | 0.000 |
| 91.60 | 62.80 | 139.03 | 4.030 | 3.732 | 4-FFf | 1.359 | 1.975 | 1.359 | 1.000 | 11.553 | 0.000 |
| 97.20 | 62.85 | 139.03 | 4.034 | 3.736 | 4-FFf | 1.360 | 1.976 | 1.360 | 1.000 | 11.556 | 0.000 |
| 102.80 | 62.89 | 139.04 | 4.037 | 3.740 | 4-FFf | 1.360 | 1.977 | 1.360 | 1.000 | 11.558 | 0.000 |
| 108.40 | 62.93 | 139.04 | 4.041 | 3.744 | 4-FFf | 1.361 | 1.978 | 1.361 | 1.000 | 11.560 | 0.000 |
| 114.00 | 62.97 | 139.04 | 4.044 | 3.747 | 4-FFf | 1.362 | 1.979 | 1.362 | 1.000 | 11.562 | 0.000 |

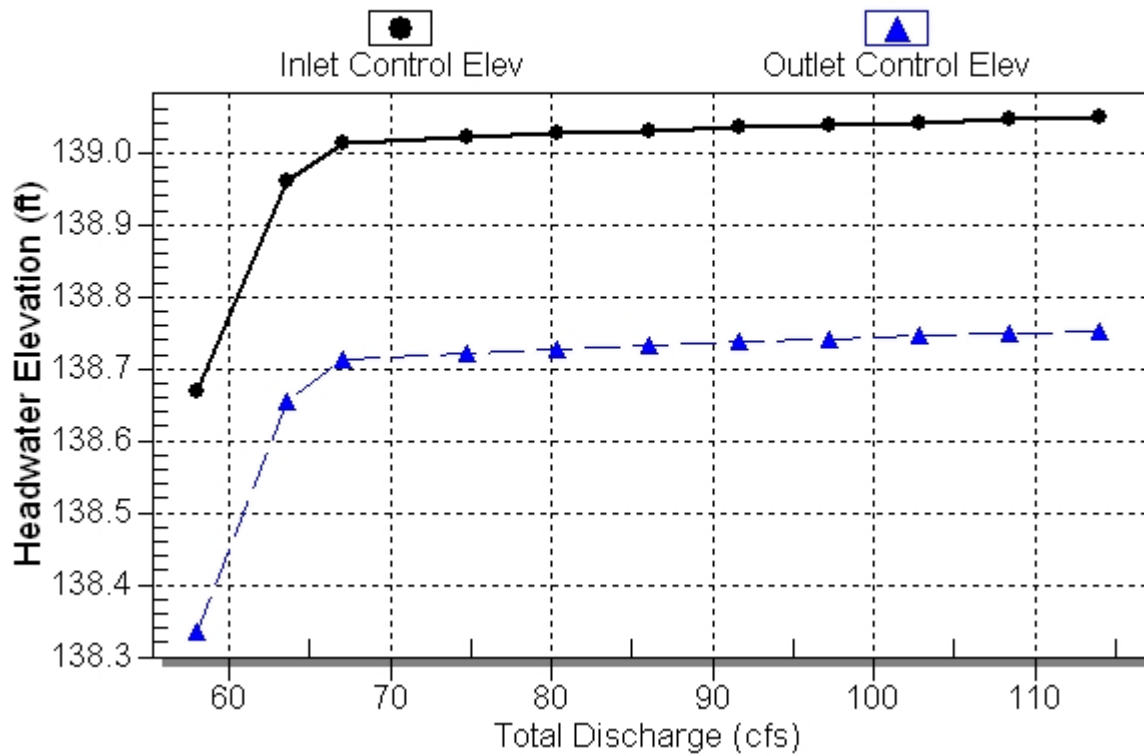
Inlet Elevation (invert): 135.00 ft, Outlet Elevation (invert): 132.83 ft

Culvert Length: 189.01 ft, Culvert Slope: 0.0115

Culvert Performance Curve Plot: Pr. CD-9

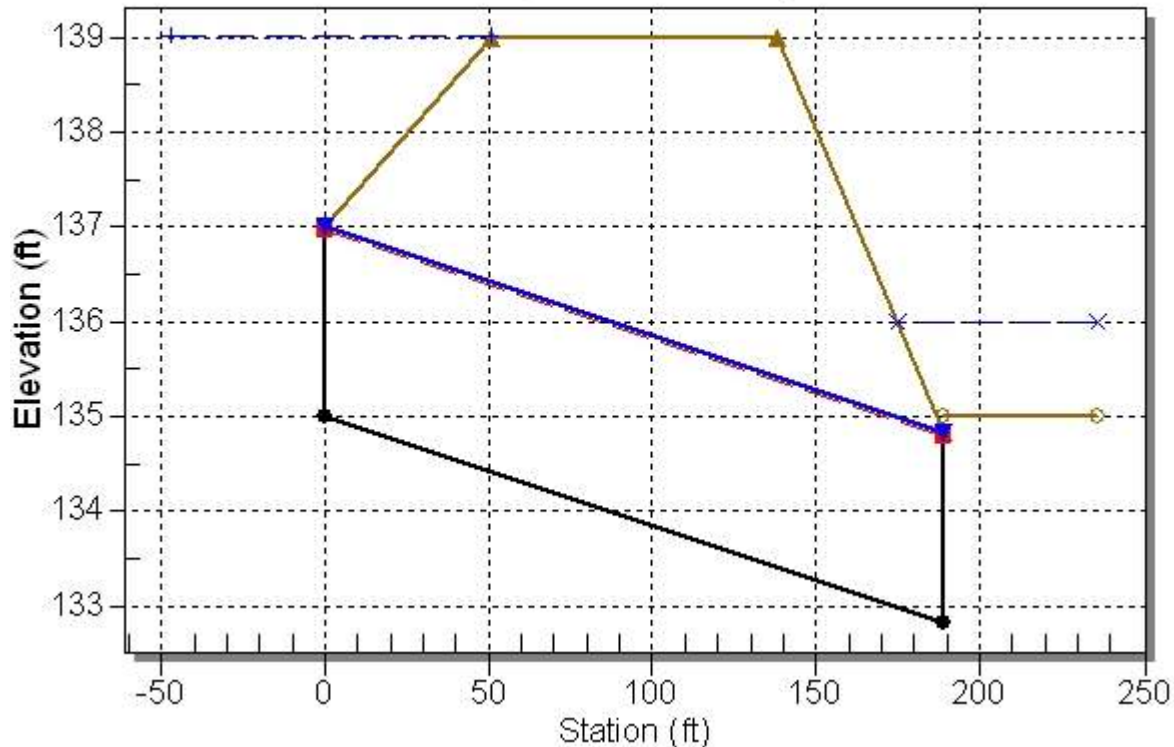
Performance Curve

Culvert: Pr. CD-9



Water Surface Profile Plot for Culvert: Pr. CD-9

Crossing - Pr. CD-9, Design Discharge - 67.0 cfs
Culvert - Pr. CD-9, Culvert Discharge - 62.5 cfs



Site Data - Pr. CD-9

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 135.00 ft

Outlet Station: 189.00 ft

Outlet Elevation: 132.83 ft

Number of Barrels: 1

Culvert Data Summary - Pr. CD-9

Barrel Shape: Concrete Box

Barrel Span: 4.00 ft

Barrel Rise: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: None

Table 42 - Downstream Channel Rating Curve (Crossing: Pr. CD-9)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 58.00 | 136.00 | 1.00 |
| 63.60 | 136.00 | 1.00 |
| 67.00 | 136.00 | 1.00 |
| 74.80 | 136.00 | 1.00 |
| 80.40 | 136.00 | 1.00 |
| 86.00 | 136.00 | 1.00 |
| 91.60 | 136.00 | 1.00 |
| 97.20 | 136.00 | 1.00 |
| 102.80 | 136.00 | 1.00 |
| 108.40 | 136.00 | 1.00 |
| 114.00 | 136.00 | 1.00 |

Tailwater Channel Data - Pr. CD-9

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 136.00 ft

Roadway Data for Crossing: Pr. CD-9

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1900.00 ft

Crest Elevation: 139.00 ft

Roadway Surface: Paved

Roadway Top Width: 87.50 ft

Table 43 - Summary of Culvert Flows at Crossing: Ex. CD-10

| Headwater Elevation (ft) | Total Discharge (cfs) | Ex. CD-10 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|---------------------------|-------------------------|-------------|
| 139.66 | 58.00 | 58.00 | 0.00 | 1 |
| 140.09 | 63.60 | 63.60 | 0.00 | 1 |
| 140.38 | 67.00 | 67.00 | 0.00 | 1 |
| 140.51 | 74.80 | 68.55 | 5.68 | 21 |
| 140.52 | 80.40 | 68.61 | 11.27 | 4 |
| 140.52 | 86.00 | 68.67 | 17.04 | 4 |
| 140.53 | 91.60 | 68.72 | 22.32 | 3 |
| 140.53 | 97.20 | 68.77 | 27.94 | 3 |
| 140.53 | 102.80 | 68.81 | 33.62 | 3 |
| 140.54 | 108.40 | 68.85 | 39.28 | 3 |
| 140.54 | 114.00 | 68.89 | 44.92 | 3 |
| 140.50 | 68.43 | 68.43 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Ex. CD-10

Total Rating Curve

Crossing: Ex. CD-10

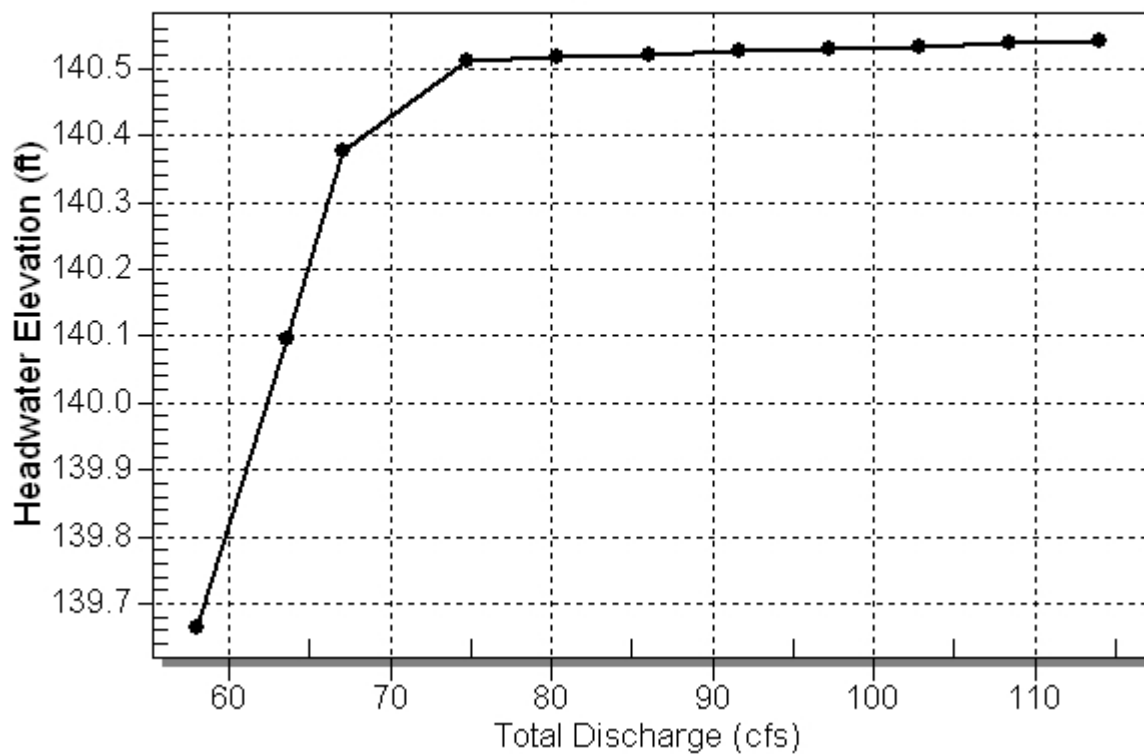


Table 44 - Culvert Summary Table: Ex. CD-10

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 58.00 | 58.00 | 139.66 | 3.665 | 2.757 | 4-FFf | 1.304 | 1.873 | 1.304 | 0.000 | 11.122 | 0.000 |
| 63.60 | 63.60 | 140.09 | 4.095 | 3.112 | 4-FFf | 1.394 | 1.992 | 1.394 | 0.000 | 11.409 | 0.000 |
| 67.00 | 67.00 | 140.38 | 4.376 | 3.344 | 5-S2n | 1.446 | 2.000 | 1.538 | 0.000 | 10.891 | 0.000 |
| 74.80 | 68.55 | 140.51 | 4.510 | 3.454 | 5-S2n | 1.470 | 2.000 | 1.563 | 0.000 | 10.964 | 0.000 |
| 80.40 | 68.61 | 140.52 | 4.516 | 3.459 | 5-S2n | 1.471 | 2.000 | 1.564 | 0.000 | 10.968 | 0.000 |
| 86.00 | 68.67 | 140.52 | 4.521 | 3.463 | 5-S2n | 1.472 | 2.000 | 1.565 | 0.000 | 10.970 | 0.000 |
| 91.60 | 68.72 | 140.53 | 4.525 | 3.466 | 5-S2n | 1.473 | 2.000 | 1.566 | 0.000 | 10.970 | 0.000 |
| 97.20 | 68.77 | 140.53 | 4.529 | 3.470 | 5-S2n | 1.474 | 2.000 | 1.567 | 0.000 | 10.971 | 0.000 |
| 102.80 | 68.81 | 140.53 | 4.533 | 3.473 | 5-S2n | 1.474 | 2.000 | 1.567 | 0.000 | 10.978 | 0.000 |
| 108.40 | 68.85 | 140.54 | 4.537 | 3.476 | 5-S2n | 1.475 | 2.000 | 1.568 | 0.000 | 10.978 | 0.000 |
| 114.00 | 68.89 | 140.54 | 4.540 | 3.479 | 5-S2n | 1.475 | 2.000 | 1.569 | 0.000 | 10.977 | 0.000 |

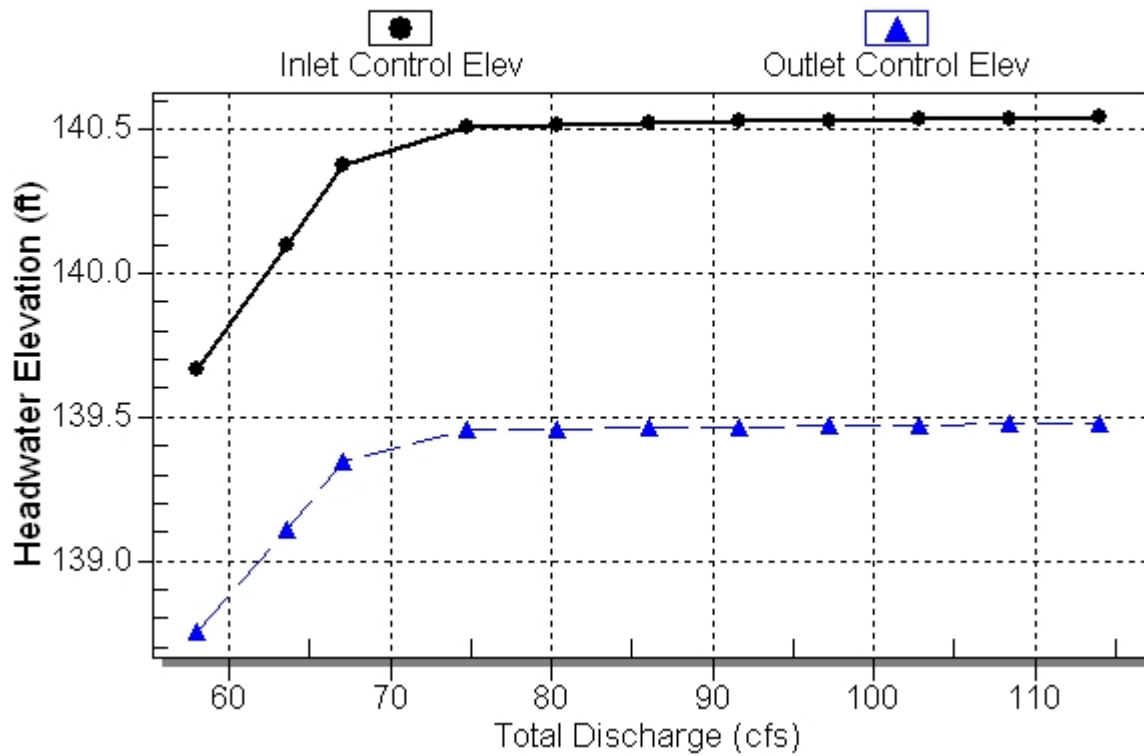
Inlet Elevation (invert): 136.00 ft, Outlet Elevation (invert): 135.00 ft

Culvert Length: 91.01 ft, Culvert Slope: 0.0110

Culvert Performance Curve Plot: Ex. CD-10

Performance Curve

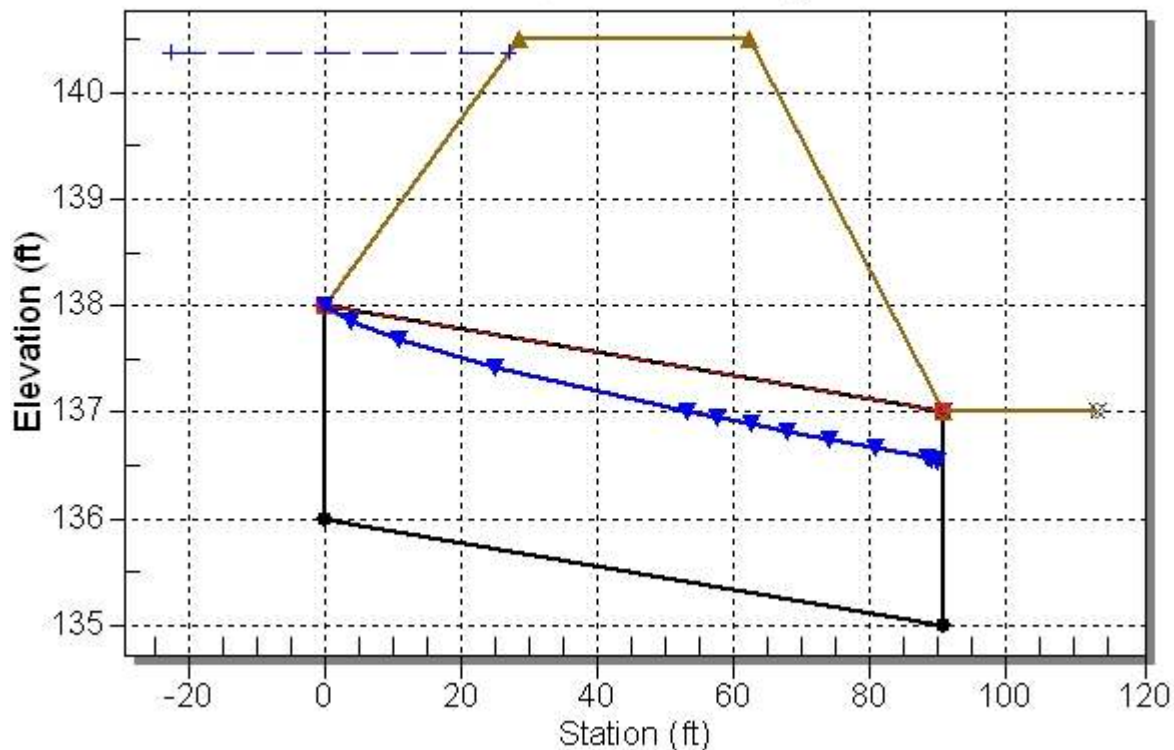
Culvert: Ex. CD-10



Water Surface Profile Plot for Culvert: Ex. CD-10

Crossing - Ex. CD-10, Design Discharge - 67.0 cfs

Culvert - Ex. CD-10, Culvert Discharge - 67.0 cfs



Site Data - Ex. CD-10

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 136.00 ft

Outlet Station: 91.00 ft

Outlet Elevation: 135.00 ft

Number of Barrels: 1

Culvert Data Summary - Ex. CD-10

Barrel Shape: Concrete Box

Barrel Span: 4.00 ft

Barrel Rise: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: None

Table 45 - Downstream Channel Rating Curve (Crossing: Ex. CD-10)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 58.00 | 137.00 | 0.00 |
| 63.60 | 137.00 | 0.00 |
| 67.00 | 137.00 | 0.00 |
| 74.80 | 137.00 | 0.00 |
| 80.40 | 137.00 | 0.00 |
| 86.00 | 137.00 | 0.00 |
| 91.60 | 137.00 | 0.00 |
| 97.20 | 137.00 | 0.00 |
| 102.80 | 137.00 | 0.00 |
| 108.40 | 137.00 | 0.00 |
| 114.00 | 137.00 | 0.00 |

Tailwater Channel Data - Ex. CD-10

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 137.00 ft

Roadway Data for Crossing: Ex. CD-10

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1900.00 ft

Crest Elevation: 140.50 ft

Roadway Surface: Paved

Roadway Top Width: 34.00 ft

Table 46 - Summary of Culvert Flows at Crossing: Pr. CD-10

| Headwater Elevation (ft) | Total Discharge (cfs) | Pr. CD-10 Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|--------------------------|-----------------------|---------------------------|-------------------------|-------------|
| 139.17 | 58.00 | 58.00 | 0.00 | 1 |
| 139.39 | 63.60 | 63.60 | 0.00 | 1 |
| 139.53 | 67.00 | 67.00 | 0.00 | 1 |
| 139.87 | 74.80 | 74.80 | 0.00 | 1 |
| 140.12 | 80.40 | 80.40 | 0.00 | 1 |
| 140.39 | 86.00 | 86.00 | 0.00 | 1 |
| 140.51 | 91.60 | 88.41 | 2.57 | 30 |
| 140.51 | 97.20 | 88.54 | 7.86 | 4 |
| 140.52 | 102.80 | 88.66 | 13.72 | 4 |
| 140.52 | 108.40 | 88.74 | 18.94 | 3 |
| 140.53 | 114.00 | 88.83 | 24.56 | 3 |
| 140.50 | 88.29 | 88.29 | 0.00 | Overtopping |

Rating Curve Plot for Crossing: Pr. CD-10

Total Rating Curve

Crossing: Pr. CD-10

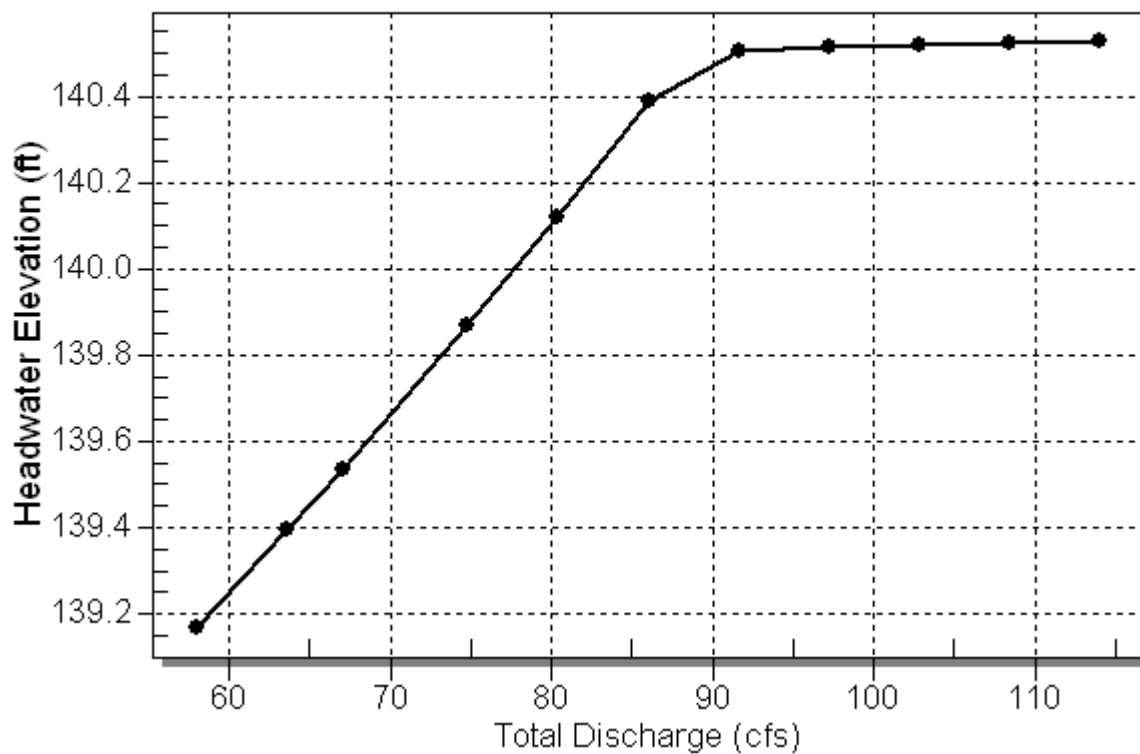


Table 47 - Culvert Summary Table: Pr. CD-10

| 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) |
|-----------------------|-------------------------|--------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|-------------------|----------------------|------------------------|---------------------------|
| 58.00 | 58.00 | 139.17 | 3.168 | 3.168 | 5-S1f | 1.298 | 1.873 | 1.873 | 0.000 | 7.741 | 0.000 |
| 63.60 | 63.60 | 139.39 | 3.394 | 3.394 | 5-S1f | 1.386 | 1.992 | 1.992 | 0.000 | 7.983 | 0.000 |
| 67.00 | 67.00 | 139.53 | 3.535 | 3.535 | 5-S1f | 1.440 | 2.062 | 2.062 | 0.000 | 8.123 | 0.000 |
| 74.80 | 74.80 | 139.87 | 3.869 | 3.869 | 5-S1f | 1.560 | 2.219 | 2.219 | 0.000 | 8.426 | 0.000 |
| 80.40 | 80.40 | 140.12 | 4.122 | 4.122 | 5-S1f | 1.644 | 2.329 | 2.329 | 0.000 | 8.632 | 0.000 |
| 86.00 | 86.00 | 140.39 | 4.387 | 4.387 | 5-S1f | 1.728 | 2.436 | 2.436 | 0.000 | 8.827 | 0.000 |
| 91.60 | 88.41 | 140.51 | 4.506 | 3.081 | 4-FFf | 1.764 | 2.481 | 1.764 | 0.000 | 12.532 | 0.000 |
| 97.20 | 88.54 | 140.51 | 4.513 | 3.087 | 4-FFf | 1.766 | 2.483 | 1.766 | 0.000 | 12.537 | 0.000 |
| 102.80 | 88.66 | 140.52 | 4.518 | 3.093 | 4-FFf | 1.767 | 2.485 | 1.767 | 0.000 | 12.541 | 0.000 |
| 108.40 | 88.74 | 140.52 | 4.523 | 3.097 | 4-FFf | 1.769 | 2.487 | 1.769 | 0.000 | 12.544 | 0.000 |
| 114.00 | 88.83 | 140.53 | 4.527 | 3.101 | 4-FFf | 1.770 | 2.489 | 1.770 | 0.000 | 12.547 | 0.000 |

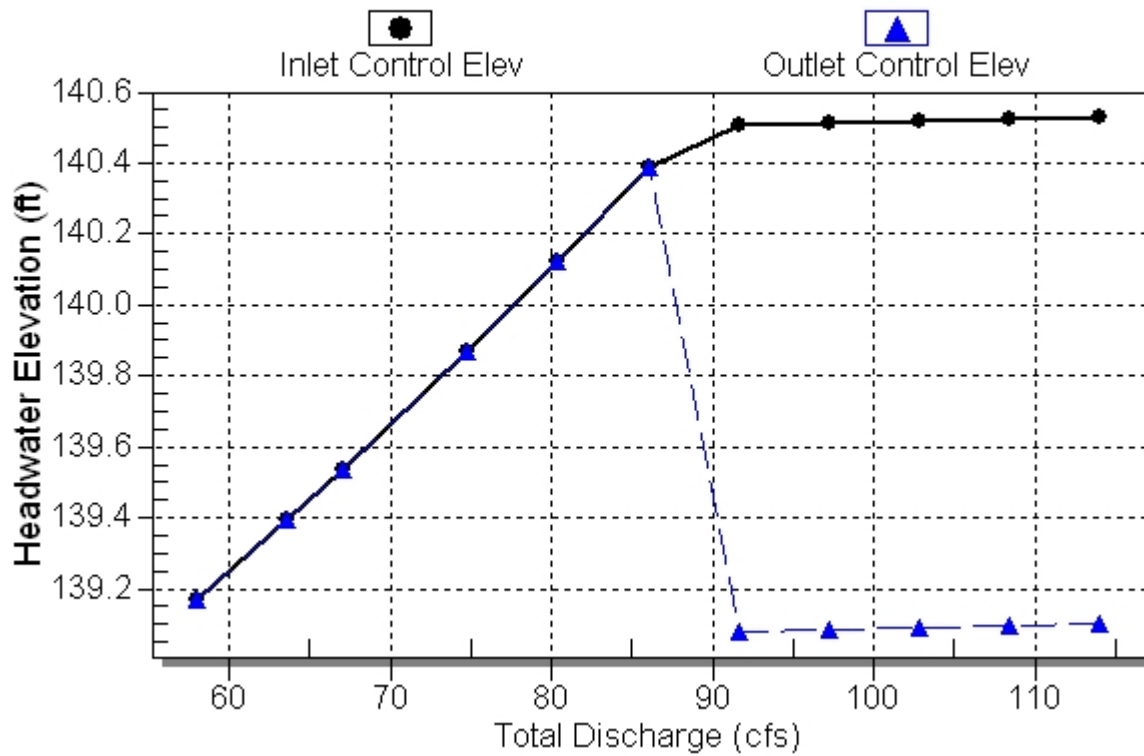
Inlet Elevation (invert): 136.00 ft, Outlet Elevation (invert): 133.90 ft

Culvert Length: 189.01 ft, Culvert Slope: 0.0111

Culvert Performance Curve Plot: Pr. CD-10

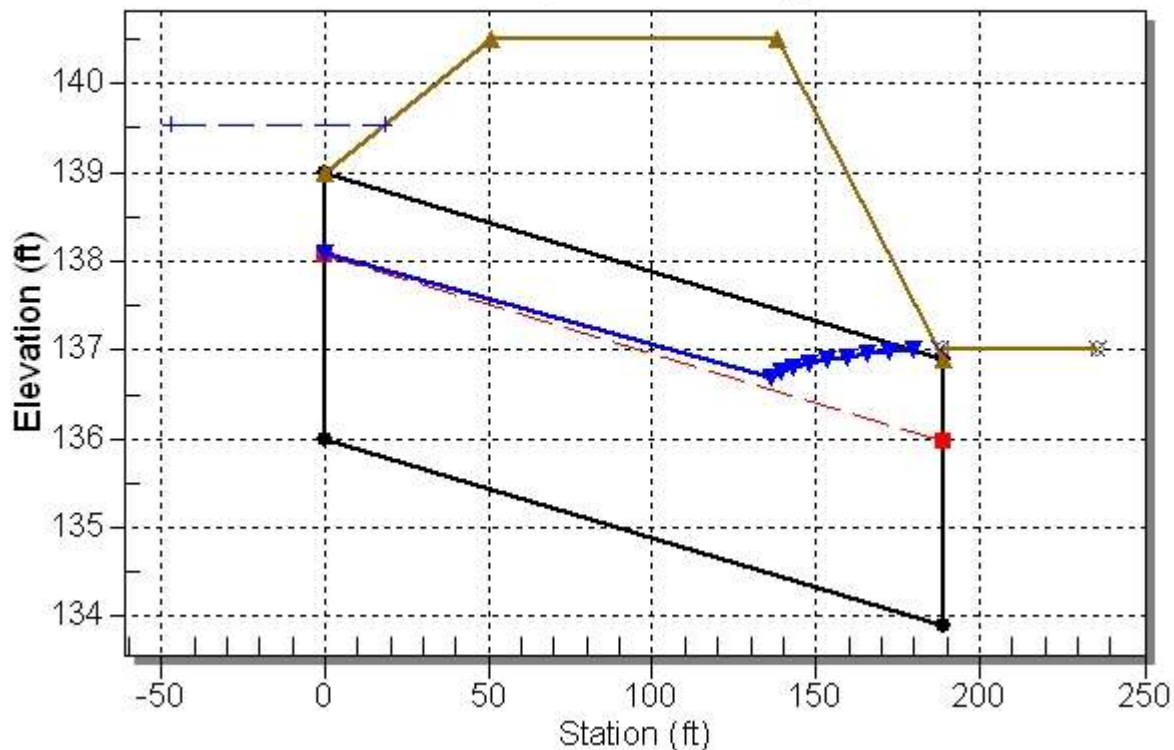
Performance Curve

Culvert: Pr. CD-10



Water Surface Profile Plot for Culvert: Pr. CD-10

Crossing - Pr. CD-10, Design Discharge - 67.0 cfs
Culvert - Pr. CD-10, Culvert Discharge - 67.0 cfs



Site Data - Pr. CD-10

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 136.00 ft

Outlet Station: 189.00 ft

Outlet Elevation: 133.90 ft

Number of Barrels: 1

Culvert Data Summary - Pr. CD-10

Barrel Shape: Concrete Box

Barrel Span: 4.00 ft

Barrel Rise: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: None

Table 48 - Downstream Channel Rating Curve (Crossing: Pr. CD-10)

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) |
|------------|-------------------------|------------|
| 58.00 | 137.00 | 0.00 |
| 63.60 | 137.00 | 0.00 |
| 67.00 | 137.00 | 0.00 |
| 74.80 | 137.00 | 0.00 |
| 80.40 | 137.00 | 0.00 |
| 86.00 | 137.00 | 0.00 |
| 91.60 | 137.00 | 0.00 |
| 97.20 | 137.00 | 0.00 |
| 102.80 | 137.00 | 0.00 |
| 108.40 | 137.00 | 0.00 |
| 114.00 | 137.00 | 0.00 |

Tailwater Channel Data - Pr. CD-10

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 137.00 ft

Roadway Data for Crossing: Pr. CD-10

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1900.00 ft

Crest Elevation: 140.50 ft

Roadway Surface: Paved

Roadway Top Width: 87.50 ft

Appendix 4

Floodplain Impact Analysis

Inwood Consulting Engineers, Inc.

3000 Dovera Drive, Suite 200
 Oviedo, FL 32765
 p. 407.971.8850 f. 407.971.8955

Made by: **SF**
 Ck. by: **REC**

Date: **08/01/13**
 Date: **08/01/13**
 Project Number: **DT1-017-01**

PROJECT: SR 33 PD&E Study - From Old Combee Road to North of Tomkow Road

| Floodplain Impact Calculations (Roadway) - FIA-1 | | | | | |
|--|------------------|-----------------------------|------------------------------------|-------------------------|-----------------------|
| Floodplain Elevation based upon FEMA FIRM, Panel Number: 12105C0175F & 12105C0310F - Polk County | | | | Elevation: 134.00 NAVD | |
| Basin | Area Filled (Ac) | FEMA 100-yr Flood Elevation | Average Existing Ground Elev. (ft) | Approx. Fill Depth (ft) | Impact Volume (Ac-Ft) |
| 5 | 1.78 | 134.00 | 133.50 | 0.50 | 0.89 |
| Slope Reduction % | | | | | 10% |
| Total Floodplain Impact (ac-ft) | | | | | 0.80 |

| Floodplain Impact Calculations (Roadway) - FIA-2 | | | | | |
|---|------------------|-----------------------------|------------------------------------|-------------------------|-----------------------|
| Floodplain Elevation based upon FEMA FIRM, Panel Number: 12105C0175F & 12105C0310F - Polk County & FDOT I-4 Roadway Plans | | | | Elevation: 134.00 NAVD | |
| Basin | Area Filled (Ac) | FEMA 100-yr Flood Elevation | Average Existing Ground Elev. (ft) | Approx. Fill Depth (ft) | Impact Volume (Ac-Ft) |
| 5 | 1.17 | 134.00 | 133.00 | 1.00 | 1.17 |
| Slope Reduction % | | | | | 10% |
| Total Floodplain Impact (ac-ft) | | | | | 1.05 |

| Floodplain Impact Calculations (Roadway) - FIA-3 | | | | | |
|---|------------------|-----------------------------|------------------------------------|-------------------------|-----------------------|
| Floodplain Elevation based upon FEMA FIRM, Panel Number: 12105C0175F & 12105C0310F - Polk County & FDOT I-4 Roadway Plans | | | | Elevation: 134.00 NAVD | |
| Basin | Area Filled (Ac) | FEMA 100-yr Flood Elevation | Average Existing Ground Elev. (ft) | Approx. Fill Depth (ft) | Impact Volume (Ac-Ft) |
| 5 | 0.32 | 134.00 | 133.00 | 1.00 | 0.32 |
| Slope Reduction % | | | | | 10% |
| Total Floodplain Impact (ac-ft) | | | | | 0.29 |

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Date: **08/01/13**
 Date: **08/01/13**
 Project Number: **DT1-017-01**

PROJECT: **SR 33 PD&E Study - From Old Combee Road to North of Tomkow Road**

| Floodplain Impact Calculations (Roadway) - FIA-4 | | | | | |
|---|------------------|-----------------------------|------------------------------------|-------------------------|-----------------------|
| Floodplain Elevation based upon FEMA FIRM, Panel Number: 12105C0175F & 12105C0310F - Polk County & FDOT I-4 Roadway Plans | | | | Elevation: 134.00 NAVD | |
| Basin | Area Filled (Ac) | FEMA 100-yr Flood Elevation | Average Existing Ground Elev. (ft) | Approx. Fill Depth (ft) | Impact Volume (Ac-Ft) |
| 5 | 2.40 | 134.00 | 133.00 | 1.00 | 2.40 |
| 6 | 0.21 | 134.00 | 133.00 | 1.00 | 0.21 |
| Pond 6 | 0.17 | 134.00 | 133.00 | 1.00 | 0.17 |
| Slope Reduction % | | | | | 10% |
| Total Floodplain Impact (ac-ft) | | | | | 2.50 |

| Floodplain Impact Calculations (Roadway) - FIA-5 | | | | | |
|--|------------------|-----------------------------|------------------------------------|-------------------------|-----------------------|
| Floodplain Elevation based upon FEMA FIRM, Panel Number: 12105C0175F & 12105C0310F - Polk County | | | | Elevation: 138.00 NAVD | |
| Basin | Area Filled (Ac) | FEMA 100-yr Flood Elevation | Average Existing Ground Elev. (ft) | Approx. Fill Depth (ft) | Impact Volume (Ac-Ft) |
| 6 | 1.05 | 138.00 | 137.50 | 0.50 | 0.53 |
| Slope Reduction % | | | | | 10% |
| Total Floodplain Impact (ac-ft) | | | | | 0.47 |

| Floodplain Impact Calculations (Roadway) - FIA-6 | | | | | |
|--|------------------|-----------------------------|------------------------------------|-------------------------|-----------------------|
| Floodplain Elevation based upon FEMA FIRM, Panel Number: 12105C0175F & 12105C0310F - Polk County | | | | Elevation: 136.00 NAVD | |
| Basin | Area Filled (Ac) | FEMA 100-yr Flood Elevation | Average Existing Ground Elev. (ft) | Approx. Fill Depth (ft) | Impact Volume (Ac-Ft) |
| 6 | 0.05 | 136.00 | 135.50 | 0.50 | 0.03 |
| Slope Reduction % | | | | | 10% |
| Total Floodplain Impact (ac-ft) | | | | | 0.02 |

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Date: **08/01/13**
 Date: **08/01/13**
 Project Number: **DT1-017-01**

PROJECT: **SR 33 PD&E Study - From Old Combee Road to North of Tomkow Road**

| Floodplain Compensation Area (FCA-1) | | | | |
|--------------------------------------|----------------|-----------|-------------------------|----------------|
| Description | Elevation (ft) | Area (ac) | Floodplain Compensation | |
| | | | Height (ft) | Volume (ac-ft) |
| Existing Ground | 135.00 | 1.09 | | |
| | | | N/A | N/A |
| 100-Yr Flood | 134.00 | 1.01 | | |
| | | | 1.00 | 0.97 |
| *Bottom | 133.00 | 0.94 | | |
| Total compensation volume | | | | 0.97 |

*Note: Bottom set by SHW of existing ground. SHW based on geotech soil boring SH-4 (SHW depth 2-feet below existing ground).

| Floodplain Compensation Area (FCA-2A & FCA-2B) | | | | |
|--|----------------|-----------|-------------------------|----------------|
| Description | Elevation (ft) | Area (ac) | Floodplain Compensation | |
| | | | Height (ft) | Volume (ac-ft) |
| Existing Ground | 135.00 | 0.52 | | |
| | | | N/A | N/A |
| 100-Yr Flood | 134.00 | 0.47 | | |
| | | | 1.00 | 0.44 |
| *Bottom | 133.00 | 0.42 | | |
| Total compensation volume | | | | 0.44 |

*Note: Bottom set by SHW of existing ground. SHW based on geotech soil boring AB-2 (SHW depth 2-feet below existing ground).

| Floodplain Compensation Area (FCA-2C) | | | | |
|---------------------------------------|----------------|-----------|-------------------------|----------------|
| Description | Elevation (ft) | Area (ac) | Floodplain Compensation | |
| | | | Height (ft) | Volume (ac-ft) |
| Existing Ground | 134.00 | 1.65 | | |
| | | | N/A | N/A |
| 100-Yr Flood | 134.00 | 1.65 | | |
| | | | 1.00 | 1.60 |
| *Bottom | 133.00 | 1.55 | | |
| Total compensation volume | | | | 1.60 |

*Note: Bottom set by SHW of existing ground. SHW based on NRCS Web soil survey (SHW depth 1-ft below existing ground).

| Floodplain Compensation Area (FCA-3) | | | | |
|--------------------------------------|----------------|-----------|-------------------------|----------------|
| Description | Elevation (ft) | Area (ac) | Floodplain Compensation | |
| | | | Height (ft) | Volume (ac-ft) |
| Existing Ground | 134.00 | 0.11 | | |
| | | | N/A | N/A |
| 100-Yr Flood | 134.00 | 0.11 | | |
| | | | 1.00 | 0.10 |
| *Bottom | 133.00 | 0.09 | | |
| Total compensation volume | | | | 0.10 |

*Note: Bottom set by SHW of existing ground. SHW based on NRCS Web soil survey (SHW depth 1-ft below existing ground).

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Made by: **SF**
 Ck. by: **REC**

Date: **08/01/13**
 Date: **08/01/13**
 Project Number: **DT1-017-01**

PROJECT: **SR 33 PD&E Study - From Old Combee Road to North of Tomkow Road**

| Floodplain Compensation Area (FCA-4A & 4B) | | | | |
|--|----------------|-----------|-------------------------|----------------|
| Description | Elevation (ft) | Area (ac) | Floodplain Compensation | |
| | | | Height (ft) | Volume (ac-ft) |
| Existing Ground | 135.00 | 1.24 | | |
| | | | N/A | N/A |
| 100-Yr Flood | 134.00 | 1.16 | | |
| | | | 1.00 | 1.12 |
| *Bottom | 133.00 | 1.08 | | |
| Total compensation volume | | | | 1.12 |

*Note: Bottom set by SHW of existing ground. SHW based on geotech soil boring AB-4 (SHW depth 2-feet below existing ground).

| Floodplain Compensation Area (FCA-4C) | | | | |
|---------------------------------------|----------------|-----------|-------------------------|----------------|
| Description | Elevation (ft) | Area (ac) | Floodplain Compensation | |
| | | | Height (ft) | Volume (ac-ft) |
| Existing Ground | 134.00 | 0.62 | | |
| | | | N/A | N/A |
| 100-Yr Flood | 134.00 | 0.62 | | |
| | | | 1.00 | 0.59 |
| *Bottom | 133.00 | 0.56 | | |
| Total compensation volume | | | | 0.59 |

*Note: Bottom set by SHW of existing ground. SHW based on NRCS Web soil survey (SHW depth 1-ft below existing ground).

| Floodplain Compensation Area (FCA-5A & FCA-5B) | | | | |
|--|----------------|-----------|-------------------------|----------------|
| Description | Elevation (ft) | Area (ac) | Floodplain Compensation | |
| | | | Height (ft) | Volume (ac-ft) |
| Existing Ground | 138.00 | 0.53 | | |
| | | | N/A | N/A |
| 100-Yr Flood | 138.00 | 0.53 | | |
| | | | 1.00 | 0.50 |
| *Bottom | 137.00 | 0.48 | | |
| Total compensation volume | | | | 0.50 |

*Note: Bottom set by Pond 6 Dry Linear Swale SHW elevation (137.00 feet).

| Floodplain Compensation Area (FCA-6) | | | | |
|--------------------------------------|----------------|-----------|-------------------------|----------------|
| Description | Elevation (ft) | Area (ac) | Floodplain Compensation | |
| | | | Height (ft) | Volume (ac-ft) |
| Existing Ground | 136.00 | 0.05 | | |
| | | | N/A | N/A |
| 100-Yr Flood | 136.00 | 0.05 | | |
| | | | 0.50 | 0.02 |
| *Bottom | 135.50 | 0.04 | | |
| Total compensation volume | | | | 0.02 |

*Note: Bottom set by SHW of existing ground. SHW based on NRCS Web soil survey (SHW depth 0.5-ft below existing ground).

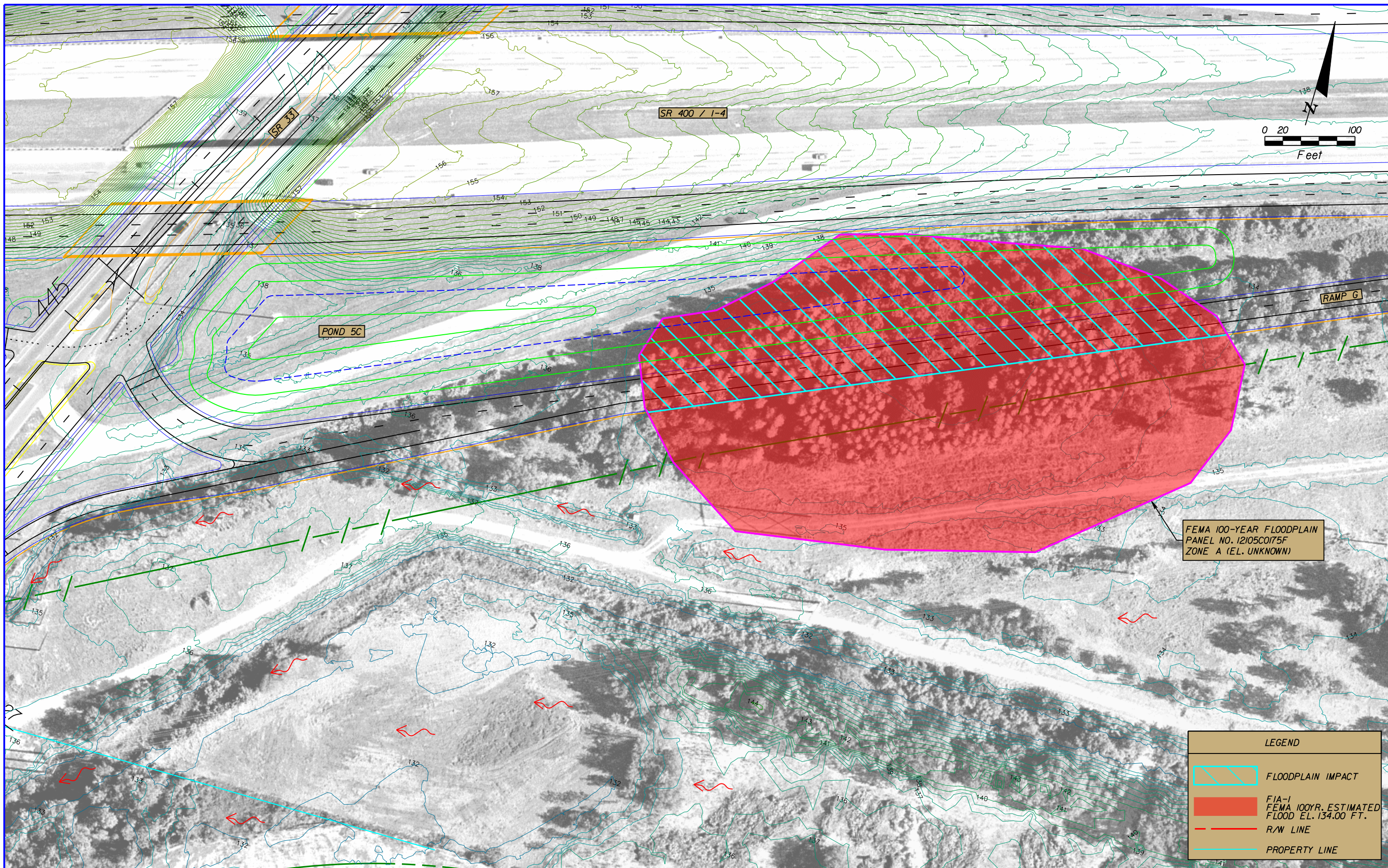
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Made by: **SF**
 Ck. by: **REC**

Date: **08/01/13**
 Date: **08/01/13**
 Project Number: **DT1-017-01**

PROJECT: **SR 33 PD&E Study - From Old Combee Road to North of Tomkow Road**

| Summary of Floodplain Impacts | | | |
|--------------------------------------|-----------------------------------|--|---------------------------|
| Floodplain Impact Area | Floodplain Impacts (ac-ft) | Floodplain Compensation (ac-ft) | Net Impact (ac-ft) |
| FIA-1 | 0.80 | 0.97 | -0.17 |
| FIA-2 | 1.05 | 2.04 | -0.99 |
| FIA-3 | 0.29 | 0.10 | 0.19 |
| FIA-4 | 2.50 | 1.71 | 0.79 |
| Total | 3.84 | 3.85 | -0.01 |
| FIA-5 | 0.47 | 0.50 | -0.03 |
| FIA-6 | 0.02 | 0.02 | 0.00 |



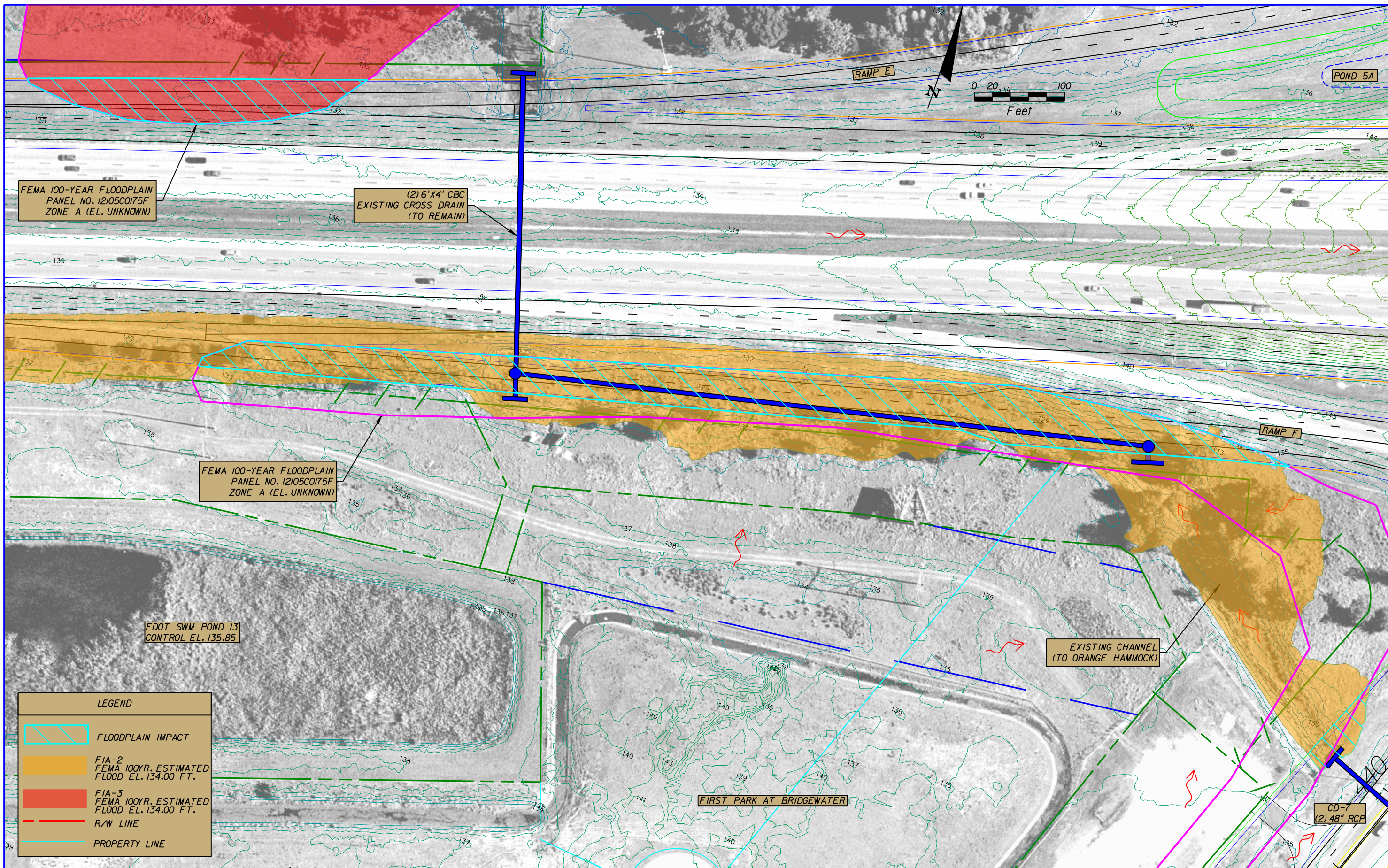
| REVISIONS | | | |
|-----------|-------------|------|-------------|
| DATE | DESCRIPTION | DATE | DESCRIPTION |
| | | | |

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| STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION | | |
|--|--------|----------------------|
| ROAD NO. | COUNTY | FINANCIAL PROJECT ID |
| 33 | POLK | 430185-1-22-01 |

FLOODPLAIN EXHIBIT
FIA-1

SHEET NO.



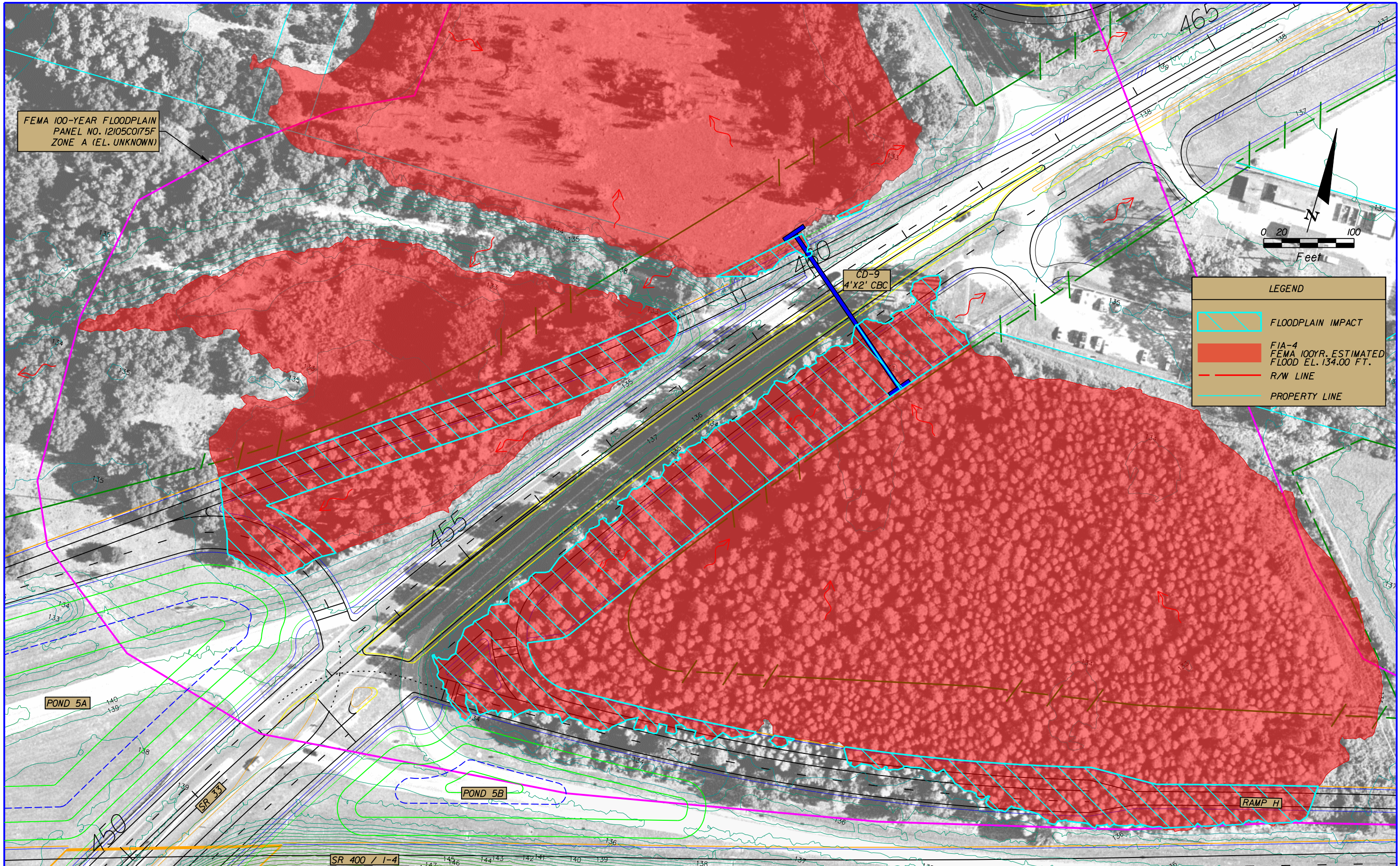
| REVISIONS | | | |
|-----------|-------------|------|-------------|
| DATE | DESCRIPTION | DATE | DESCRIPTION |
| | | | |

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| STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION | | |
|--|--------|----------------------|
| ROAD NO. | COUNTY | FINANCIAL PROJECT ID |
| 33 | POLK | 430185-1-22-01 |

FLOODPLAIN EXHIBIT
FIA-2 & FIA-3

SHEET NO.



FEMA 100-YEAR FLOODPLAIN
 PANEL NO. 12105C0175F
 ZONE A (EL. UNKNOWN)

LEGEND

- FLOODPLAIN IMPACT
- FIA-4 FEMA 100YR. ESTIMATED FLOOD EL. 134.00 FT.
- R/W LINE
- PROPERTY LINE

POND 5A

POND 5B

RAMP H

SR 400 / I-4

SR 331

CD-9
 4'x2' CBC

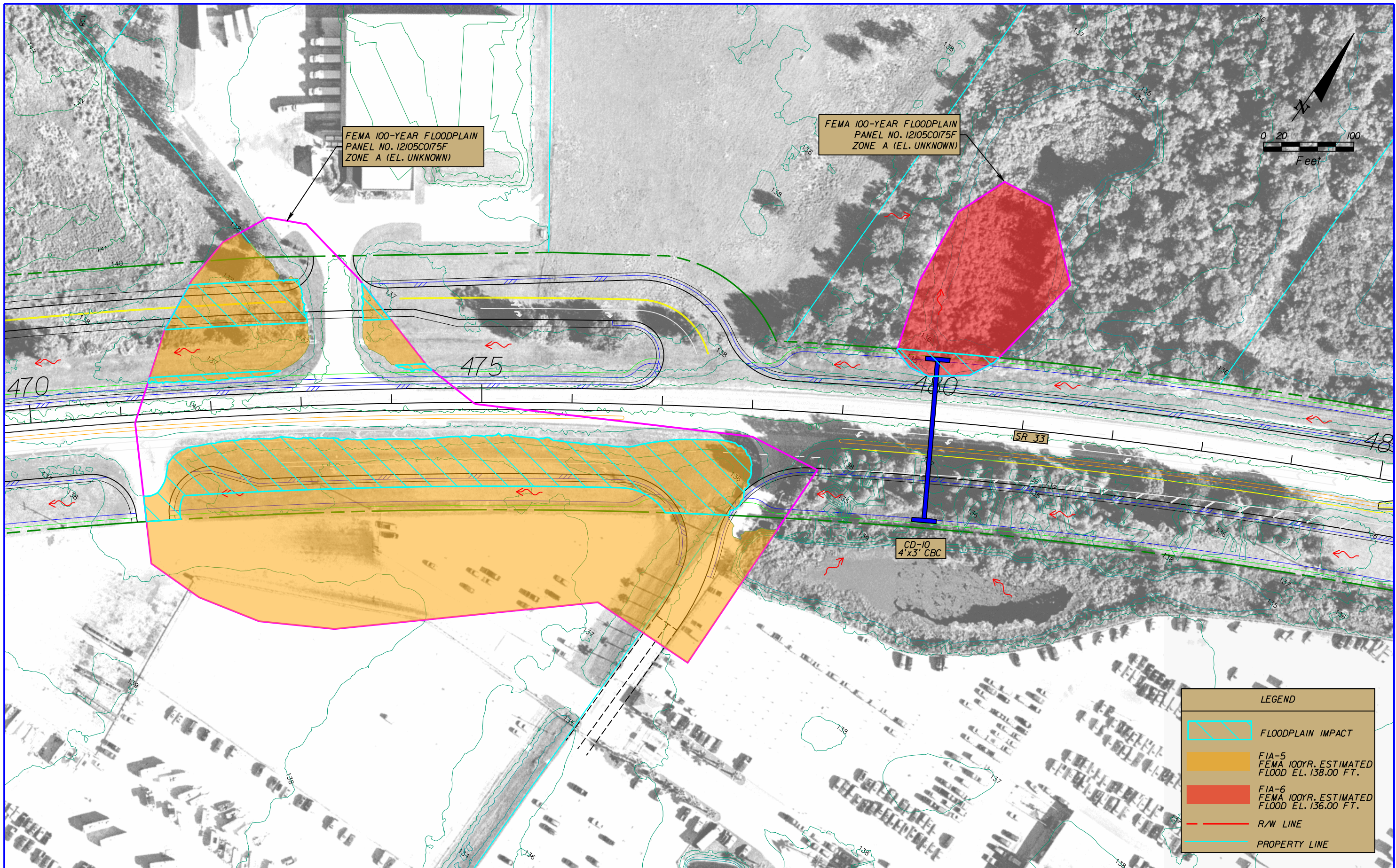
| REVISIONS | | | |
|-----------|-------------|------|-------------|
| DATE | DESCRIPTION | DATE | DESCRIPTION |
| | | | |

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 3000 Dovera Drive, Suite 200, Oviedo, Florida 32765
 P 407.971.8850

| STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION | | |
|--|--------|----------------------|
| ROAD NO. | COUNTY | FINANCIAL PROJECT ID |
| 33 | POLK | 430185-1-22-01 |

FLOODPLAIN EXHIBIT
FIA-4

SHEET NO.



FEMA 100-YEAR FLOODPLAIN
 PANEL NO. I2105C0175F
 ZONE A (EL. UNKNOWN)

FEMA 100-YEAR FLOODPLAIN
 PANEL NO. I2105C0175F
 ZONE A (EL. UNKNOWN)

CD-10
 4'x3' CBC

| LEGEND | |
|--------|--|
| | FLOODPLAIN IMPACT |
| | FIA-5 FEMA 100YR. ESTIMATED FLOOD EL. 138.00 FT. |
| | FIA-6 FEMA 100YR. ESTIMATED FLOOD EL. 136.00 FT. |
| | R/W LINE |
| | PROPERTY LINE |

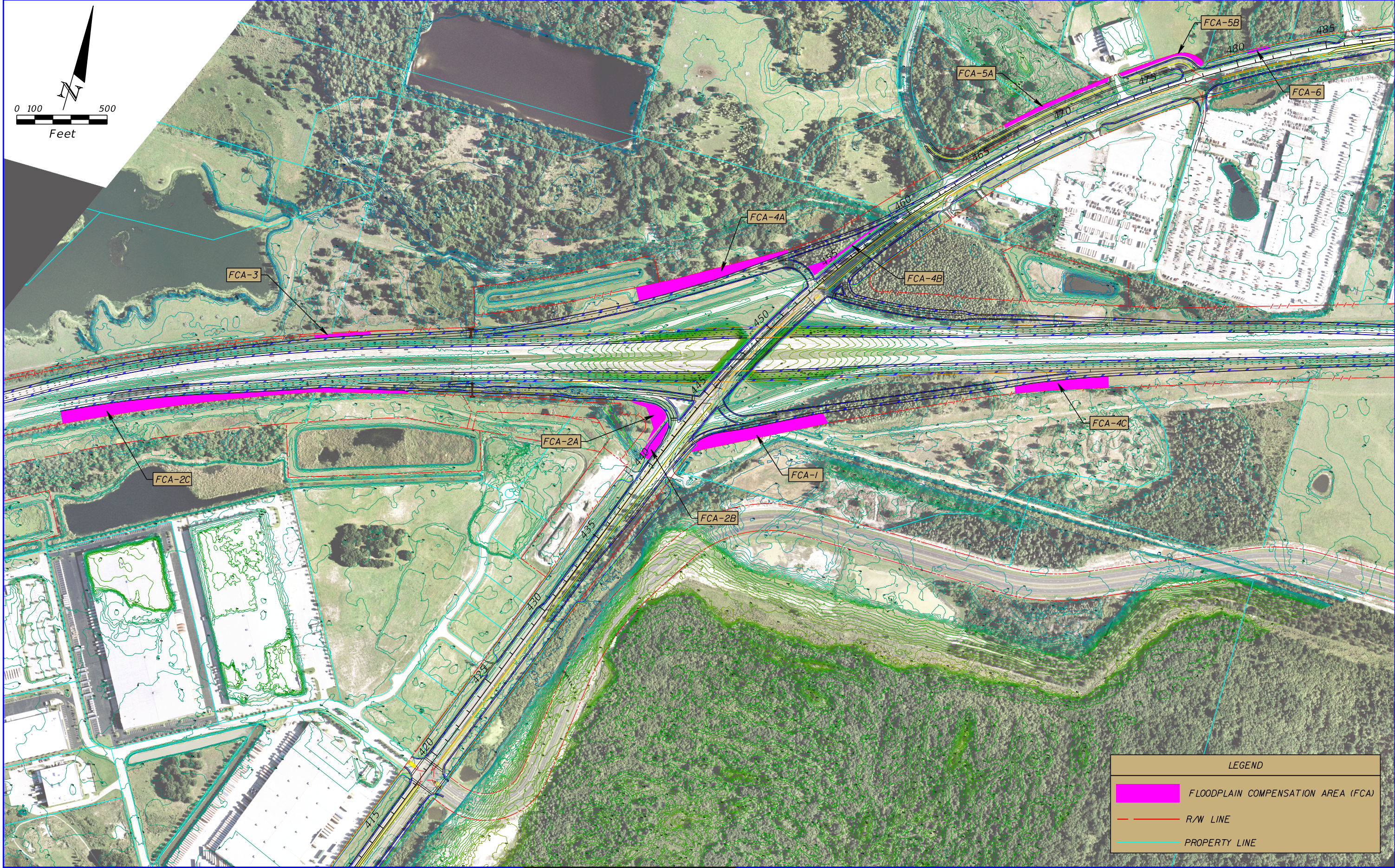
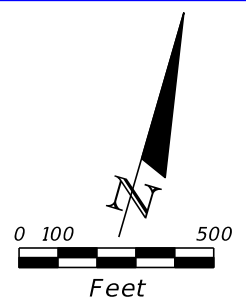
| REVISIONS | | | |
|-----------|-------------|------|-------------|
| DATE | DESCRIPTION | DATE | DESCRIPTION |
| | | | |

Inwood Consulting Engineers, Inc.
 3000 Dovera Drive, Suite 200, Oviedo, Florida 32765
 P 407.971.8850

| STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION | | |
|--|--------|----------------------|
| ROAD NO. | COUNTY | FINANCIAL PROJECT ID |
| 33 | POLK | 430185-1-22-01 |

FLOODPLAIN EXHIBIT
FIA-5 & FIA-6

SHEET
NO.



| LEGEND | |
|---|------------------------------------|
| | FLOODPLAIN COMPENSATION AREA (FCA) |
| | R/W LINE |
| | PROPERTY LINE |

| REVISIONS | | | |
|-----------|-------------|------|-------------|
| DATE | DESCRIPTION | DATE | DESCRIPTION |
| | | | |

Inwood Consulting Engineers, Inc.
 3000 Dovera Drive, Suite 200, Oviedo, Florida 32765
 P 407.971.8850

| STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION | | |
|--|--------|----------------------|
| ROAD NO. | COUNTY | FINANCIAL PROJECT ID |
| 33 | POLK | 430185-1-22-01 |

**FLOODPLAIN COMPENSATION
AREA (FCA)**

SHEET
NO.

Appendix 5

Correspondence

- Meeting Minutes
- Telephone Logs
- District Basin Maps
- Straight Line Diagram

Meeting Minutes

MEETING MINUTES

DATE: August 21, 2012

TO: Tony Sherrard – FDOT Project Manager

FROM: Sergio Figueroa, PE

RE: **Drainage Kickoff Meeting with FDOT** – FPID 430185-1-22-01 (SR 33 PD&E from Old Combee Road to north of Tomkow Road)

CC: All Attendees (via email), File

A meeting was held on August 21, 2012 at the FDOT District 1 office to discuss the drainage design approach for the SR 33 Project Development and Environment Study (PD&E). The purpose of the meeting was to discuss the requirements, procedures, and expectations from the Department on the drainage for the project. Attendees included the Inwood design team (David Dangel, Renato Chuw and Sergio Figueroa) and FDOT staff (Tony Sherrard, Jeffrey James, Carlton Spirio, Brent Setchell and Bill Hartmann).

The meeting began with an overview of the PD&E proposed improvements to SR 33. An aerial graphic was provided for visual clarity during the discussion. Listed below is a summary of topics discussed at the meeting.

Existing Drainage

- The project limits of the study is mostly located within the Orange Hammock local drainage basin and only partially located within the Lake Deeson basin (closed). These are part of the much larger Green Swamp Basin and Peace River Basin
 - Only Lake Deeson (WBID 1449A) is impaired for nutrients.
 - Inwood indicated that the WBID for the Orange Hammock Drain (WBID 1449) contained insufficient data for verification of impairment. It was agreed by both Inwood and FDOT that no pollutant loading analysis will be required within the Orange Hammock Basin.
- There are minimum floodplain impacts within the project study limits.
 - Only minor impacts are to be expected at the I-4 Interchange per the FEMA Floodplain Map.
 - The FEMA FIRM maps indicate that the majority of the project corridor is within Zone X.
 - Inwood is to verify with SWFWMD that there are no current floodplain studies within the project corridor.
- FDOT suggested looking at existing permits and coordinating with the landowners at the southwest corner of the SR 33 and I-4 interchange (FirstPark at Bridgewater). It was also mentioned that there are existing permits for the East West Road (University Boulevard) located at the southeast corner of the SR 33 and I-4 Interchange.
 - Inwood concurred and will research this area during the study.
 - FDOT indicated that the property owner at the southwest corner of the interchange approached the Department for potential development on this corner, including modifications to the existing FDOT pond.
 - Inwood is also to contact Leanna O'Reagan (PB – FDOT permit connection) for coordination with FirstPark at Bridgewater.
- Wetland Mitigation
 - FDOT suggested to look into the new wetland language for the PD&E reports that discusses the use of wetland mitigation bank as a preferred alternative and to only use senate billing as a last resort. Brent has forwarded this new language to Brooke Botterill.



Proposed Drainage Approach

- Based on existing topography and the cross drain locations, eight roadway drainage basins are anticipated within the project corridor.
 - As the PD&E study moves forward, Inwood indicated that they will look at these basins in more detail.
- Stormwater Management Options
 - Since the majority of the project corridor is within Type A Soils, dry treatment is proposed for both offsite ponds and linear swales for all the basins except for Basin 8.
 - FDOT confirmed to Inwood that in the Pond Siting Report (PSR), Inwood is to identify one offsite pond per basin and discuss the dry linear swale option in the report. The offsite pond option will be required to get clearances from FHWA and is the conservative approach.
 - Basin 4
 - Inwood is to verify that the current proposed offsite pond location will fit within the existing topographic area and have a positive outfall to the boundary condition. In addition, Inwood will check the existing pond at Bridgewater and compare to the proposed pond elevation.
 - Basin 5
 - Inwood explained to FDOT that there are limited options available to locate an offsite pond within this basin and that they will be looking at options for this basin such as compensating treatment.
 - Basin 7
 - The proposed approach will be to utilize the existing infield areas of the interchange for stormwater management. Inwood will also investigate the available capacity for the existing FDOT ponds for I-4.
 - Basin 8
 - FDOT informed Inwood that there is a driveway connection that is currently in the permitting phase on the west side of Tomkow Road. It was suggested to Inwood to move the current offsite pond location to the east side of Tomkow Road to avoid future conflicts with the driveway connection permit. Inwood concurred.
- FDOT recommended to commingle the offsite and the onsite runoff whenever possible to avoid having dual ditches for offsite bypass. Regarding no treatment of the offsite runoff and the new House Bill 599, FDOT suggested to discuss this with SWFWMD.
- Although FDOT critical duration is no longer applicable, FDOT suggested to still look at the 100-year storms with shorter durations to make sure there will be no adverse impacts.
- Brent provided a copy of the high speed rail plans through the I-4 and SR 33 Interchange. These plans did not propose any improvements to the SR 33 interchange.
- Initial traffic numbers indicated that there was no need for a four-lane facility; however, AIM will be investigating the traffic model and providing updated numbers. A six-lane facility is not anticipated to be justified.

Attachments: Meeting Agenda
Meeting Sign-in Sheet

Note: The above reflects the writer's understanding of the contents of the meeting. If any misinterpretations or inaccuracies are included, please contact Sergio Figueroa at (407) 971-8850 or sfigueroa@inwoodinc.com as soon as possible for resolution and revisions if necessary.

**State Road 33
Project Development and Environment Study
From Old Combee Road to north of Tomkow Road
Polk County, Florida
Financial Project ID: 430185-1-22-01**

FDOT Drainage Kickoff Meeting

1. Project Overview
 - a. Limits from Old Combee Road to North of Tomkow Road
 - b. Widening from two lane rural to four lane suburban or rural
 - i. Pavement savings are an option
2. Existing Drainage
 - a. Green Swamp and Peace River Basin
 - i. Orange Hammock local drainage basin
 - ii. Lake Deeson – closed basin
 - b. No formal water quality treatment
 - i. Exception is south of Old Combee Road and intersection with East-West Road
 - c. Nine existing cross drains
 - i. Evaluation as part of the LHR
 - ii. Two are bridge culverts (Pit Creek and Fork Creek)
 - d. Minimal floodplain impacts – majority within Zone X
 - i. Potential impacts within I-4 Interchange
 - e. WBID identification
 - i. Orange Hammock Drain (WBID 1449) – insufficient data
 - ii. Lake Deeson (WBID 1449A) – impaired for nutrients
3. Proposed Drainage Approach
 - a. Eight roadway drainage basins
 - b. Stormwater Management Options
 - i. Offsite ponds – dry (Basins 1 through 7), wet (Basin 8)
 - ii. Linear swales within right of way – Type A soils
 - c. Criteria for Pond Sizing
 - i. SWFWMD
 - o No OFW
 - o 1” of runoff over DCIA (Wet Detention)
 - o 0.5” of runoff over DCIA (Dry Retention)
 - o Pre vs Post Vol. Attenuation (25yr/24hr – open, 100yr/24hr – closed basin)
 - ii. FDOT
 - o Critical duration no longer applicable
 - o Offsite / Onsite areas commingling
 - d. I-4 Interchange drainage / infield areas for stormwater
4. Schedule

- a. Drainage data collection – Summer 2012
 - b. Draft LHR – May 2013
 - c. Draft PSR – August 2013
5. Other Items
- a. East West Road Project
 - b. Mine spoil soils – “slime”

Sergio Figueroa

From: David Ledgerwood
Sent: Wednesday, February 13, 2013 11:36 AM
To: Sergio Figueroa; Renato Chuw
Subject: FW: FPID:430185-1-22-01, Study of the Widening of SR 33
Attachments: SKMBT_C45213020712240.pdf
 FYI...

Sounds like OUC may or may not allow the ponds at this location. Let me know when we would like to meet with them to discuss.

David Ledgerwood, PE

INWOOD CONSULTING ENGINEERS

P: 407-971-8850 ext. 6609

From: Easterling, Chuck [mailto:CEasterling@ouc.com]
Sent: Wednesday, February 13, 2013 11:35 AM
To: David Ledgerwood
Cc: Parker, Rick; Spivey, Jason; Willis, Adonis T.; Easterling, Chuck; Ben Symons (B&V)
Subject: RE: FPID:430185-1-22-01, Study of the Widening of SR 33

David,
 OUC just went through that area with a project for access roads and pads for our facilities. We filled a portion of what you are requesting to dig out. We also permitted driveways off of SR33 for our access that must be maintained.
 Additionally, we just upgraded our wire and structures in this area.
 At a minimum, OUC will not allow for any ponds under the transmission lines, as we view them as structures that impede our ingress/egress to our facilities. We should probably find a time to sit down with your plans and our plans (possibly on-site to see our actual improvements) to see what we can live with...or not.
 Thanks,
 Chuck

Charles H. Easterling, PE
 Manager, Transmission Engineering & Construction, and System Maintenance
 Orlando Utilities Commission
 6003 Pershing Avenue
 Orlando, FL 32822

407-434-4123 office
 407-434-4356 fax

From: David Ledgerwood [mailto:dledgerwood@inwoodinc.com]
Sent: Wednesday, February 13, 2013 9:25 AM
To: Easterling, Chuck
Subject: FW: FPID:430185-1-22-01, Study of the Widening of SR 33

Chuck,

Please see the email string below. We are currently working on a PD&E study for SR 33 and trying to determine our proposed pond alternatives for the project. We are looking at a parcel owned by the City of Lakeland which has existing OUC Transmission lines on it. Two of our proposed pond alternatives are currently located under the existing OUC transmission lines, as shown in the attached graphic. These pond sites will not impact the existing poles or the access road for the transmission facilities. I wanted to see if OUC has any concerns or thoughts with the pond site at this location. Both pond are being designed to be dry ponds.

Any help is appreciated. Thanks.

David Ledgerwood, PE

INWOOD CONSULTING ENGINEERS

P: 407-971-8850 ext. 6609

From: Vann, Michael [mailto:Michael.Vann@lakelandelectric.com]
Sent: Monday, February 11, 2013 11:03 AM
To: David Ledgerwood
Cc: Fox, Richard; Hayes, Kris; Maxwell, Jeremy; Pennell, Matt
Subject: FPID:430185-1-22-01, Study of the Widening of SR 33

David,
 Please see attached mark-ups of the conceptual plan for the above project.

General relocation costs per mile:
 Overhead Transmission \$600k
 Overhead Transmission and Distribution on the same pole \$900k
 Overhead Distribution \$300k
 Underground Distribution \$1M

Please see attached pdf. The north/south transmission line shown on the east side of the pond is owned and maintained by Orlando Utilities Commission (OUC). Contact Chuck Easterling @ ceasterling@ouc.com or 407-434-4123 and he

can either assist you or point you in the right direction. The other line is owned by Lakeland Electric (LE). I do not foresee any issues with our transmission line and the pond as long as it does not impact the location or the access (as noted). Lakeland Electric will also be building a substation on the City of Lakeland parcel shown on the west side of Huron Way. Tentative in service date of summer 2014. I am also attaching a preliminary layout of the substation site and our right-of-way department has marked-up easement information.

Please continue to submit requests through Kris Hayes for Lakeland Electric, but Richard Fox will be the point of contact for Lakeland Electric's transmission and distribution facilities. Questions in reference to the future substation can be directed to Matt Pennell at matt.pennel@lakelandelectric.com or 863-834-6489.

Thanks,

Michael G. Vann

LAKELAND ELECTRIC
Transmission & Distribution Engineering Supervisor
863-834-6311
michael.vann@lakelandelectric.com

Markup Transmission Line Future Substation Easement Info

From: David Ledgerwood [<mailto:dledgerwood@inwoodinc.com>]
Sent: Monday, February 04, 2013 1:40 PM
To: Durbin, John
Cc: Lindsey, Ken; Kniss, Robert; Hayes, Kris; Sergio Figueroa
Subject: RE: FP ID:430185-1-22-01, Study of the Widening of SR 33

John,

Will you also be providing information regarding the electric facilities?

We have a proposed pond site we are looking at that is located on a parcel that is owned by the City and has existing transmission electric facilities on it. We currently have two adjacent basins with two separate ponds, but are looking at the option on combining the basins and having a single pond located on the City's property, which is just west of Huron Way. I have included a graphic showing the proposed pond site and pond expansion for combining the basins. The pond will be a dry pond and will be located under the existing transmission lines, but will not impact any existing transmission poles or the existing access road currently on the property. I wanted to see if the City has any concerns or thoughts with the pond site at this location. We have looked at placing the pond site on the east side of the property adjacent to Huron Way, but we will encounter substantial wetland impacts at this location.

If there is another person that I need to coordinate the pond site with, please forward me their contact information. Thanks in advance for your help.

David Ledgerwood, PE



INWOOD CONSULTING ENGINEERS
P: 407-971-8850 ext. 6609



From: David Ledgerwood
Sent: Monday, February 04, 2013 11:12 AM
To: 'Durbin, John'
Cc: Lindsey, Ken; Kniss, Robert; Hayes, Kris
Subject: RE: FP ID:430185-1-22-01, Study of the Widening of SR 33

John

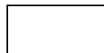
This project is in the PD&E Study phase and there is no current schedule for construction in the near future. At this point we are just studying alternative alignments and evaluating any right-of-way needs.

Feel free to contact me should you have any other questions. Thanks.

David Ledgerwood, PE



INWOOD CONSULTING ENGINEERS
P: 407-971-8850 ext. 6609



From: Durbin, John [<mailto:John.Durbin@lakelandelectric.com>]
Sent: Monday, February 04, 2013 8:31 AM
To: David Ledgerwood
Cc: Lindsey, Ken; Kniss, Robert; Hayes, Kris
Subject: FP ID:430185-1-22-01, Study of the Widening of SR 33



Mr. Ledgerwood;

We are preparing a response to your letter of January 30, 2013, for the CORRIDOR ANALYSIS OF EXISTING CONDITIONS.

The City of Lakeland, Lakeland Gas maintains a 16" high pressure gas line the runs from Tomkow Road to approx. 5000' North of Old Combee Road where it crosses under S.R. 33 and goes south to our power plant.

Could you please provide us with a project schedule, so that we can budget for the relocation of our gas line, if needed?

Thank you for time.

John E. Durbin
Engineering Technician
(863)834-8600



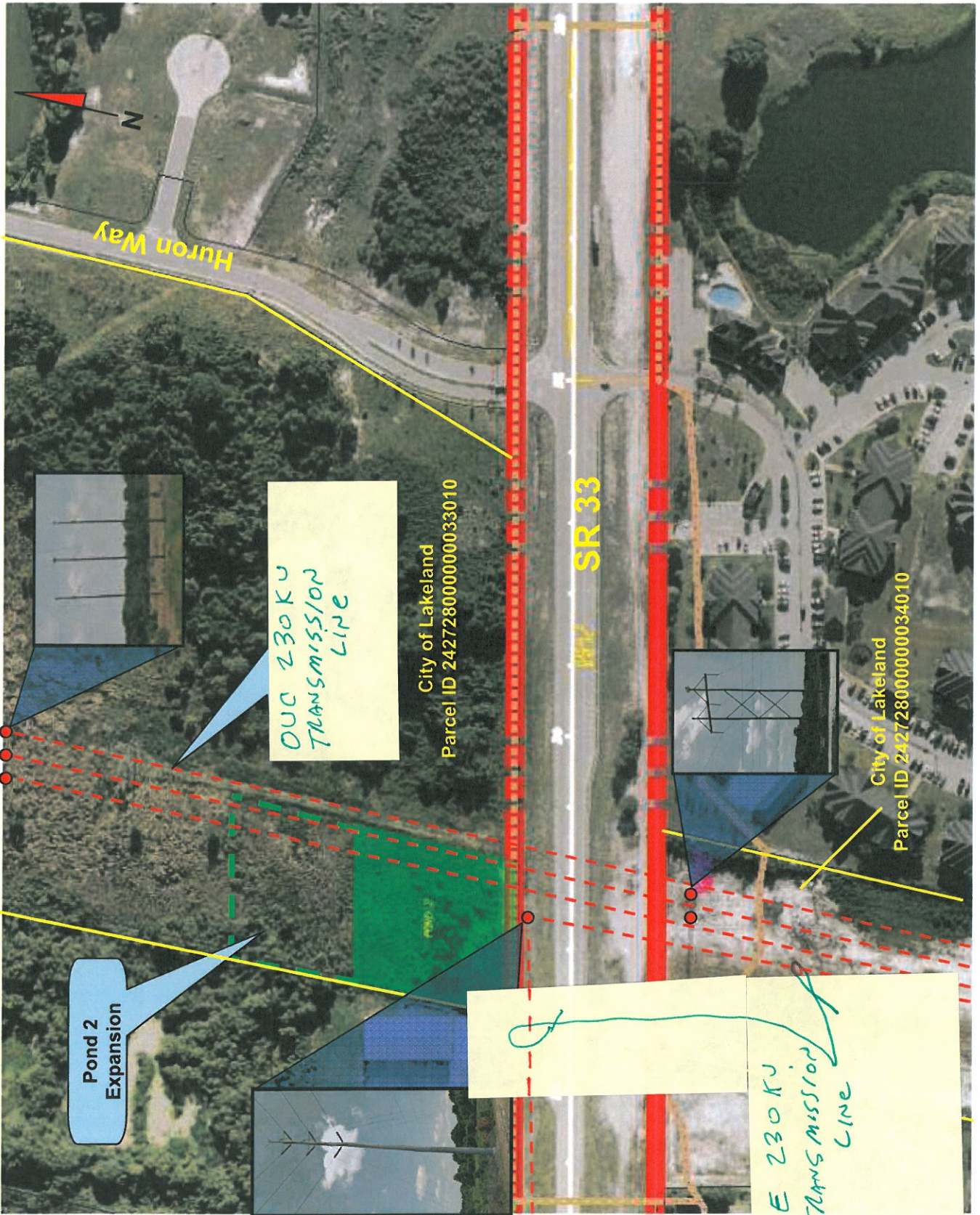
3030 E. Lake Parker Drive
Lakeland FL. 33805-9513

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Pond 2 Expansion

OUC 230KV
TRANSMISSION
LINE

City of Lakeland
Parcel ID 24272800000033010

City of Lakeland
Parcel ID 24272800000034010

LE 230KV
TRANSMISSION
LINE

SR 33

Huron Way

N

Telephone Logs



TELEPHONE LOG

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

DATE: 7/31/2013

CALL TO: Frank Ritchie (SWFWMD Staff Engineer – Tampa Office)

CALL FROM: Sergio Figueroa, P.E.

RE: FPID 430185-1-22-01 (SR 33 PD&E from Old Combee Road to north of Tomkow Road)

CC: File

Sergio Figueroa made a phone call to Frank Ritchie with Southwest Florida Water Management District (SWFWMD) on July 30, 2013 to discuss the SR 33 PD&E Study project from Old Combee Road to north of Tomkow Road. Mr. Figueroa asked Mr. Ritchie if there are any floodplain watershed models currently being developed that would include the drainage area within the SR 33 project limits. Mr. Ritchie stated that SWFWMD is currently developing the Polk City Watershed Model; however, the parameters of the model are just outside the SR 33 project limits. Mr. Ritchie also verified with Mr. Figueroa that the FEMA Floodplain boundary lines dated in December 20, 2000 within the SR 33 Project Limits are the most current effective FEMA Floodplain boundary lines at this time. Mr. Ritchie did mention further that when the Polk City Watershed Model is approved at some point next year, the FEMA floodplain lines within the SR 33 project limits may change slightly to more accurately reflect the 100 year floodplain based existing land use and soils data. Mr. Figueroa acknowledged the disclaimer and also stated that he appreciated Mr. Ritchie's discussion regarding the FEMA Floodplain boundaries within the SR 33 Project limits.

*****End of Telephone Log*****



TELEPHONE LOG

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

DATE: 2/6/2013

CALL TO: Scott Presson (Bartow Operations Center Manager)

CALL FROM: Sergio Figueroa, P.E.

RE: FPID 430185-1-22-01 (SR 33 PD&E from Old Combee Road to north of Tomkow Road)

CC: File

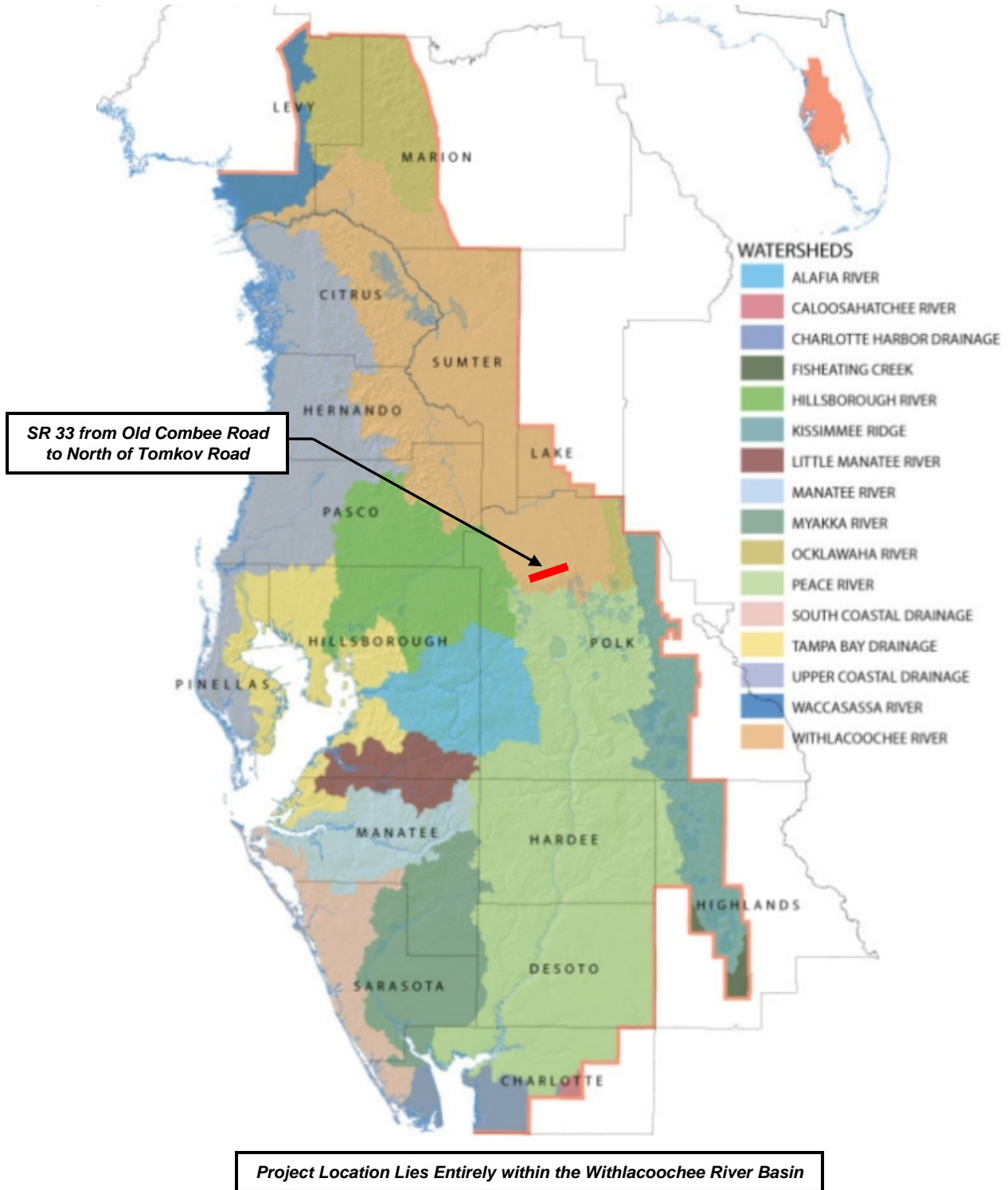
Scott Presson returned Sergio Figueroa's phone call on February 5, 2013 to discuss the SR 33 PD&E Study project from Old Combee Road to north of Tomkow Road. Mr. Presson stated that the Bartow maintenance office has no records of historical flooding issues within the SR 33 project limits. Mr. Figueroa asked Mr. Presson if the maintenance office had any knowledge of the FDOT owned land southwest of the SR 33 and I-4 Interchange and notified him that the apparent vacant space could be a potential pond site for the SR 33 widening. Mr. Presson informed Mr. Figueroa that the Bartow maintenance office uses that open space to store equipment and excess fill material for nearby FDOT projects. He also mentioned that the maintenance office would prefer the future pond site not to be at that location. Mr. Figueroa stated that he appreciated Mr. Presson's discussion regarding the flooding issues for SR 33 and comments regarding the potential pond site and that his comments will be taken under consideration during the SR 33 PD&E project.

*****End of Telephone Log*****

District Basin Maps:

- SWFWMD Watershed Basin Map
- FDEP WBID Map

SWFWMD Basin Map

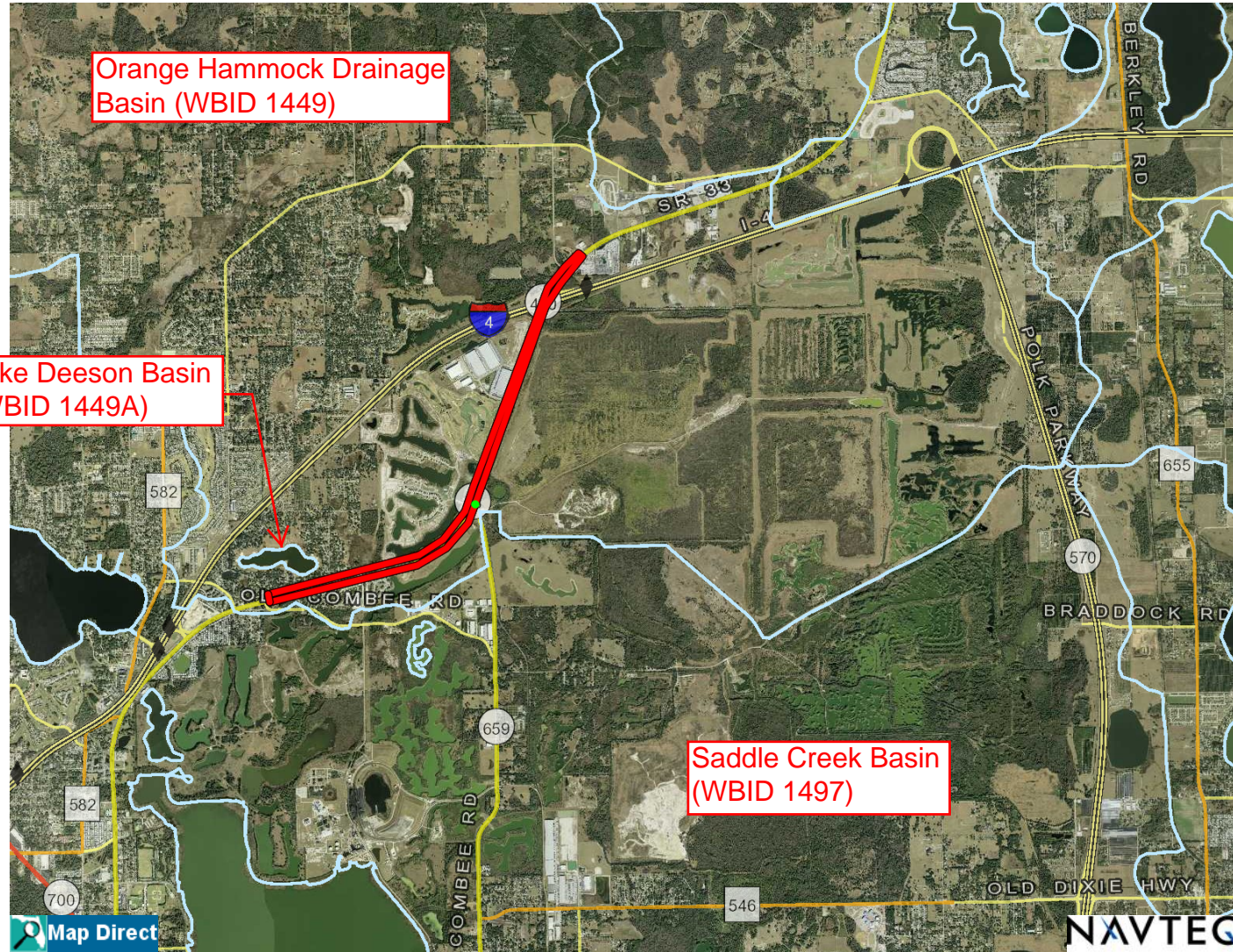




SR 33 from Old Combee Road to North of Tomkov Rd. WBID Map

28°10'26.5852", -81°57'52.7976"

28°10'18.2226", -81°48'39.5563"



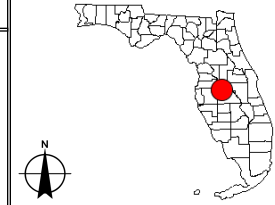
Orange Hammock Drainage Basin (WBID 1449)

Lake Deeson Basin (WBID 1449A)

Saddle Creek Basin (WBID 1497)

28°4'10.6972", -81°57'59.8224"

28°4'2.3425", -81°48'47.1114"



Scale 1:81,172

Aerial Imagery 2004-2009

Waterbody Ids (WBIDs)

Counties

Aerial Imagery Flight Dates 2004-2009

Florida Department of Environmental Protection Disclaimer: This map created in Map Direct on Thu, 15 Nov 2012 20:07:55 UTC is intended for display purposes only. It was created using data from different sources collected at different scales, with different levels of accuracy, and/or covering different periods of time. NAVTEQ road data is provided "AS IS" and without warranties of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, satisfactory quality and non-infringement. YOU SHOULD THEREFORE VERIFY ANY INFORMATION OBTAINED FROM THE SITE BEFORE ACTING ON IT.

Project outfalls to Orange Hammock, Saddle Creek, and Lake Deeson Basin. Only Saddle Creek and Lake Deeson Basin are verified for impaired nutrients.

Straight Line Diagram

| DATE | 5 YR INV | SLO REV | BMP | EMP | INTERIM REVISIONS | SLO REV |
|----------|----------|---------|-------|-------|-------------------|----------|
| BY | FTE | RWC | 0.000 | 0.747 | INV | 08/03/08 |
| 12/20/07 | | | 0.000 | 0.747 | 10/12/09 | 10/12/09 |

STRAIGHT LINE DIAGRAM OF ROAD INVENTORY

FLORIDA DEPARTMENT OF TRANSPORTATION DISTRICT ONE MAINTENANCE STATISTICS OFFICE

| INT. of US ROUTE NO | STATE ROAD NO. | COUNTY | DISTRICT | ROADWAY ID | SHEET NO. |
|---------------------|----------------|--------|----------|------------|-----------|
| | SR 33 | POLK | 1 | 16070000 | 1 of 4 |

| ROADWAY | FEATURES | ROADWAY COMPOSITION | HORIZONTAL | ALIGNMENT | STRUCTURE DESCRIPTION | DISTRICT USE | SIS | FUN CLASS |
|---------------------|---|---------------------|----------------------------------|---------------|-----------------------|--------------|-----|----------------------|
| MASSACHUSETTS AVE | INSIDE CITY & URBAN LAKELAND, LAKELAND SR 33 MASSACHUSETTS AVE | 28/FC-4 | PC-0.820 PI-0.846 PT-0.890 | B-N0° 25'00"W | | | | URBAN MINOR ARTERIAL |
| MEMORIAL BLVD | NOTE: TRANSFER TO THE CITY JULY 31, 2008 | 28/FC-4 | PC-0.890 PI-0.932 PT-0.990 | B-N0° 17'00"W | | | | URBAN COLLECTOR |
| PARK TRAMMELL BLVD | | 28/FC-4 | PC-2.698 PI-2.777 PT-2.761 | B-N0° 13'00"E | | | | URBAN MINOR ARTERIAL |
| TARAWA ST | | 28/FC-4 | PC-3.052 PI-3.279 PT-3.340 | | | | | URBAN MINOR ARTERIAL |
| VISTA PROF CTR ENT | | 28/FC-4 | PC-3.340 PI-3.652 PT-3.948 | | | | | URBAN MINOR ARTERIAL |
| LAKELAND CANAL CTR | | 28/FC-4 | PC-3.732 PI-3.828 PT-3.923 | | | | | URBAN MINOR ARTERIAL |
| LAKELAND HILLS BLVD | | 28/FC-4 | PC-3.755 PI-3.828 PT-3.923 | | | | | URBAN MINOR ARTERIAL |

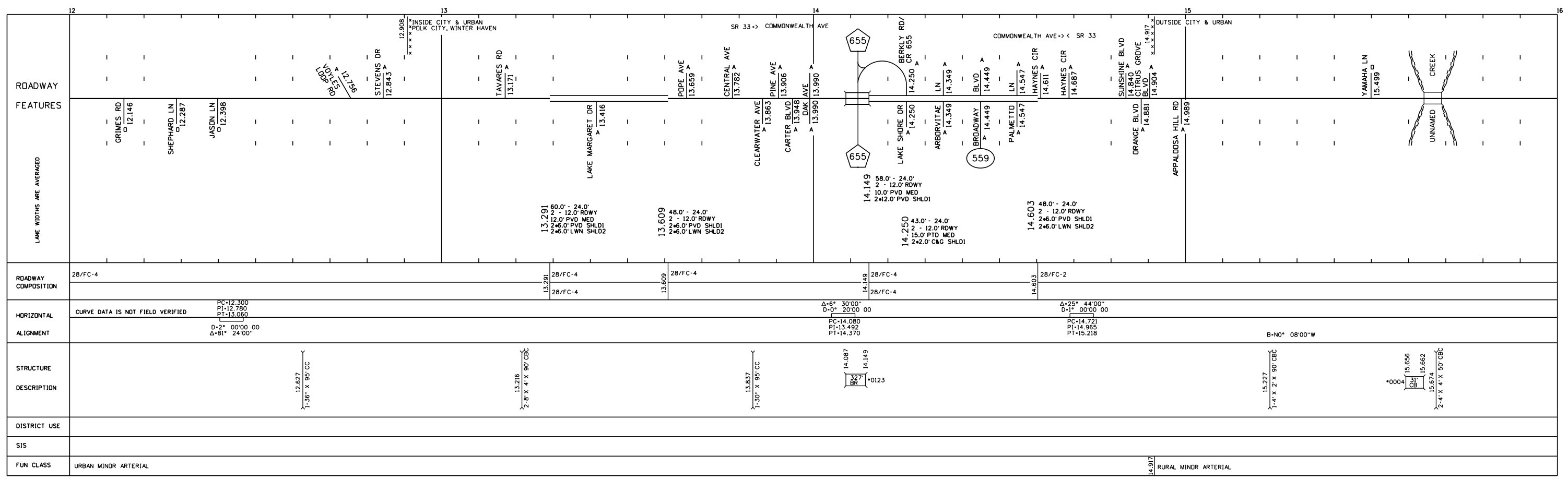
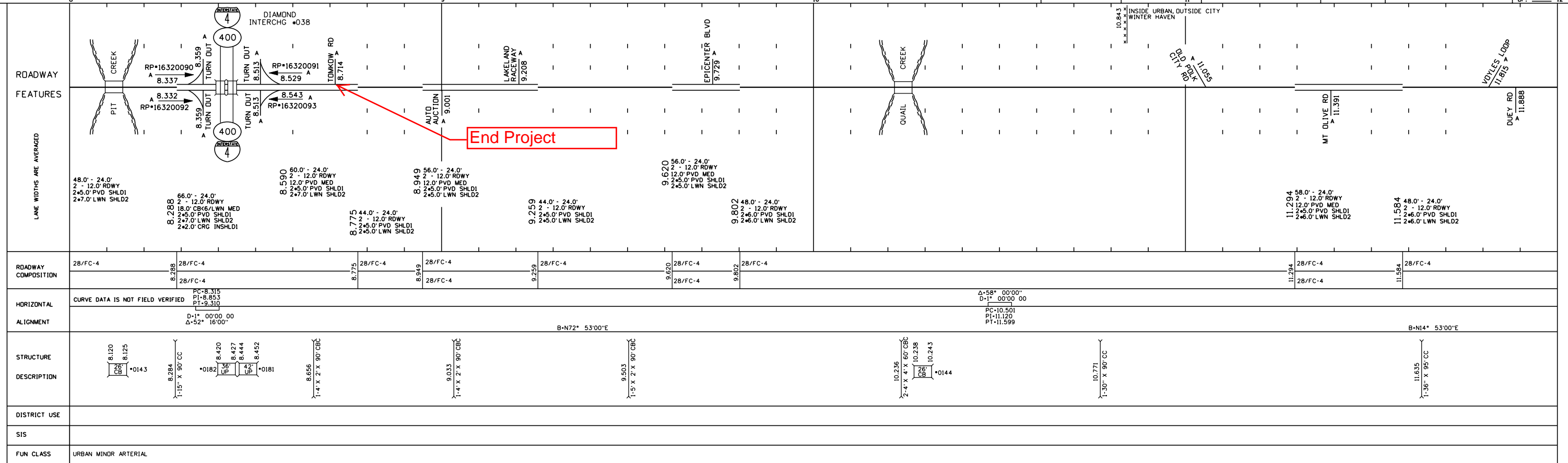
Begin Project

| ROADWAY | FEATURES | ROADWAY COMPOSITION | HORIZONTAL | ALIGNMENT | STRUCTURE DESCRIPTION | DISTRICT USE | SIS | FUN CLASS |
|---|--|---------------------|-----------------------------------|----------------|-----------------------|--------------|-----|----------------------|
| LK PARKER/GIBSON | UNDER CONSTRUCTION FROM 04.418 TO 04.750 | 28/FC-4 | PC-4.259 PI-4.563 PT-4.853 | B-N77° 07'00"E | | | | URBAN MINOR ARTERIAL |
| LAKELAND HAREDR | | 28/FC-4 | PC-5.106 PI-5.163 PT-5.228 | | | | | URBAN MINOR ARTERIAL |
| WOOD CIRCLE W | | 28/FC-4 | PC-5.701 PI-5.777 PT-5.870 | | | | | URBAN MINOR ARTERIAL |
| WOOD CIRCLE E | | 28/FC-4 | PC-6.119 PI-6.477 PT-6.870 | | | | | URBAN MINOR ARTERIAL |
| DAKRIIDGE MHP ENT | | 28/FC-4 | PC-6.472 PI-6.691 PT-6.995 | | | | | URBAN MINOR ARTERIAL |
| SUNSET WAY S | | 28/FC-4 | PC-7.211 PI-7.395 PT-7.995 | | | | | URBAN MINOR ARTERIAL |
| LK LUTHER RD | | 28/FC-4 | PC-7.416 PI-7.691 PT-8.012 | | | | | URBAN MINOR ARTERIAL |
| SPANISH LAKE BLVD | | 28/FC-4 | PC-7.995 PI-8.277 PT-8.570 | | | | | URBAN MINOR ARTERIAL |
| THE LANDINGS ENT | | 28/FC-4 | PC-8.012 PI-8.277 PT-8.570 | | | | | URBAN MINOR ARTERIAL |
| HURON WAY | | 28/FC-4 | PC-8.570 PI-8.828 PT-9.080 | | | | | URBAN MINOR ARTERIAL |
| INSIDE URBAN, OUTSIDE CITY LAKELAND | | 28/FC-4 | PC-9.080 PI-9.328 PT-9.570 | | | | | URBAN MINOR ARTERIAL |
| INSIDE CITY & URBAN LAKELAND, LAKELAND | | 28/FC-4 | PC-9.570 PI-9.828 PT-10.080 | | | | | URBAN MINOR ARTERIAL |

| | | | | | | |
|----------|----------|----------|-----|-----|-------------------|---------|
| DATE BY | 5 YR INV | SLD REV | BMP | EMP | INTERIM REVISIONS | SLD REV |
| 12/20/07 | FTE | 01/08/08 | | | INV | |

STRAIGHT LINE DIAGRAM OF ROAD INVENTORY
FLORIDA DEPARTMENT OF TRANSPORTATION DISTRICT ONE MAINTENANCE STATISTICS OFFICE

| | | | | | |
|---------------------|----------------|--------|----------|------------|-----------|
| INT. of US ROUTE NO | STATE ROAD NO. | COUNTY | DISTRICT | ROADWAY ID | SHEET NO. |
| | SR 33 | POLK | 1 | 16070000 | 2 |
| | | | | | OF 4 |



| | | | | | | |
|------|----------|----------|-----|-----|-------------------|---------|
| DATE | 5 YR INV | SLD REV | BMP | EMP | INTERIM REVISIONS | SLD REV |
| BY | FTE | RWC | | | INV | |
| | 12/20/07 | 07/08/08 | | | | |

STRAIGHT LINE DIAGRAM OF ROAD INVENTORY
 FLORIDA DEPARTMENT OF TRANSPORTATION DISTRICT ONE MAINTENANCE STATISTICS OFFICE

| | | | | | |
|---------------------|----------------|--------|----------|------------|-----------|
| INT. of US ROUTE NO | STATE ROAD NO. | COUNTY | DISTRICT | ROADWAY ID | SHEET NO. |
| | SR 33 | POLK | 1 | 16070000 | 3 |
| | | | | | OF 4 |

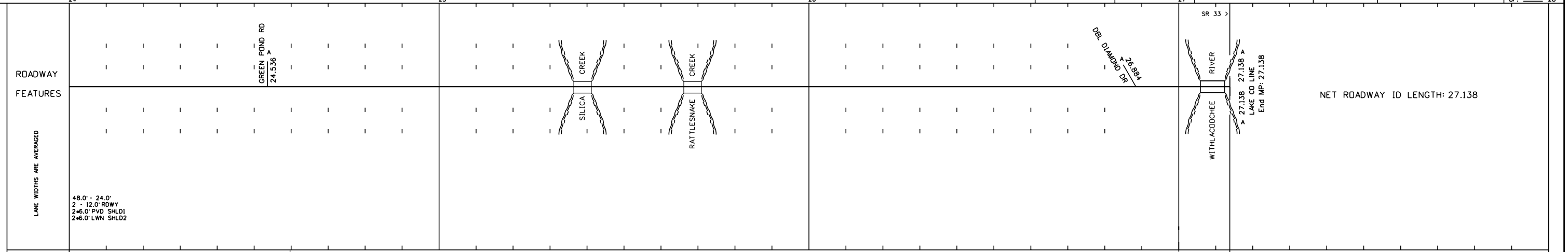
| | | | | | | | |
|--------------------------|--|--|----|----|----|----|--|
| ROADWAY FEATURES | ROADWAY | 16 | 17 | 18 | 19 | 20 | |
| | FEATURES | | | | | | |
| LANE WIDTHS ARE AVERAGED | | <p>48.0' - 24.0' 2 - 12.0' RDWY 2*6.0' PVD SHLD1 2*6.0' LWN SHLD2</p> | | | | | |
| ROADWAY COMPOSITION | 28/FC-2 | | | | | | |
| HORIZONTAL ALIGNMENT | CURVE DATA IS NOT FIELD VERIFIED | | | | | | |
| STRUCTURE DESCRIPTION | <p>B-N0° 53'00"W</p> <p>16.850 16.834 16.856 2-4' X 4' X 50' CBC *0145</p> <p>17.929 1-4' X 4' X 90' CBC</p> <p>18.362 18.367 *0005</p> <p>Δ-4° 22'00" D-0° 30'00 00 PC-18.371 PI-18.471 PT-18.612</p> <p>Δ-13° 15'00" D-0° 30'00 00 PC-19.051 PI-19.284 PT-19.543</p> <p>B-N18° 30'00"W</p> | | | | | | |
| DISTRICT USE | | | | | | | |
| SIS | | | | | | | |
| FUN CLASS | RURAL MINOR ARTERIAL | | | | | | |

| | | | | | | |
|--------------------------|---|----|----|----|----|----|
| ROADWAY FEATURES | ROADWAY | 20 | 21 | 22 | 23 | 24 |
| | FEATURES | | | | | |
| LANE WIDTHS ARE AVERAGED | <p>1-36" X 85' CM 20.547 20.556 20.563 36' CBC *0006</p> <p>20.954 1-3' X 2' X 90' CBC</p> <p>21.938 1-3' X 2' X 90' CBC</p> <p>Δ-27° 42'00" D-1° 00'00 00 PC-21.390 PI-21.652 PT-21.914</p> <p>Δ-22° 40' D-1° 00'00 00 PC-22.406 PI-22.737 PT-23.068</p> <p>Δ-2° 07'00" D-0° 10'00 00 PC-23.638 PI-23.758 PT-23.878</p> <p>B-N0° 09'00"W</p> <p>B-N27° 51'00"W</p> <p>B-N7° 08'00"E</p> <p>B-N5° 01'00"E</p> | | | | | |
| ROADWAY COMPOSITION | 28/FC-2 | | | | | |
| HORIZONTAL ALIGNMENT | CURVE DATA IS NOT FIELD VERIFIED | | | | | |
| STRUCTURE DESCRIPTION | | | | | | |
| DISTRICT USE | | | | | | |
| SIS | | | | | | |
| FUN CLASS | RURAL MINOR ARTERIAL | | | | | |

| 5 YR INV | | SLD REV | | INTERIM REVISIONS | |
|----------|-----|----------|-----|-------------------|---------|
| DATE | BY | DATE | BY | EMP | SLD REV |
| 12/20/07 | FTE | 07/08/08 | RWC | | |
| | | | | | |

STRAIGHT LINE DIAGRAM OF ROAD INVENTORY
 FLORIDA DEPARTMENT OF TRANSPORTATION DISTRICT ONE MAINTENANCE STATISTICS OFFICE

| | | | | | |
|---------------------|----------------|--------|----------|------------|-----------|
| INT. or US ROUTE NO | STATE ROAD NO. | COUNTY | DISTRICT | ROADWAY ID | SHEET NO. |
| | SR 33 | POLK | 1 | 16070000 | 4 |
| | | | | | OF 4 |



| | | | |
|------------------------------|----------------------------------|--|--|
| HORIZONTAL ALIGNMENT | CURVE DATA IS NOT FIELD VERIFIED | PC=24.967 PI=25.171 PT=25.171 D=1° 00'00.00 Δ=21° 30'00" | B=N26° 31'00"E |
| STRUCTURE DESCRIPTION | 24.394 1-30' X 95' CC | *0146 25.379 25.384 25.452 2-5' X 5' X 35' CBC | 25.680 25.705 *0209 |
| DISTRICT USE | | 26.152 1-3' X 2' X 45' CBC | 27.059 27.124 *0210 2-4' X 3' X 35' CBC |
| SIS | | | |
| FUN CLASS | RURAL MINOR ARTERIAL | | |