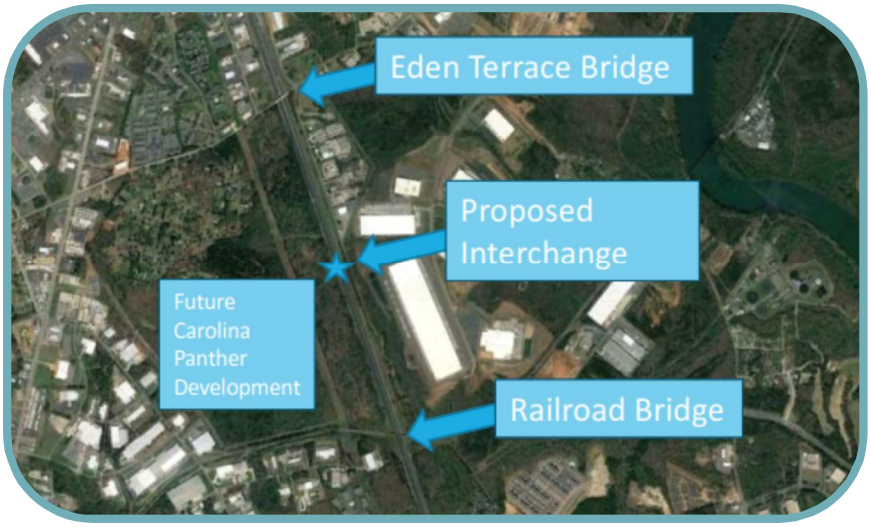
INTERSTATE 77
PANTHERS INTERCHANGE
YORK COUNTY, SOUTH CAROLINA

HYDROLOGY AND HYDRAULICS BASIS OF DESIGN



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BACKGROUND AND INTRODUCTION

The South Carolina Department of Transportation (SCDOT) proposes to construct a new interchange along Interstate 77 (I-77) in York County, South Carolina that will connect I-77 to the future Crossover Road (Paragon Way). In addition, the project will include the construction of a portion of Crossover Road, including the associated bridge over I-77 and resurfacing and cross slope correction of existing mainline I-77 within the project limits.

The new interchange shall provide access from I-77 to the new Crossover Road, which leads to Paragon Way to the east and to the proposed Carolina Panthers Facility to the west. The new interchange will be located along I-77 at approximate mile marker 81, which is approximately one mile south of US 21/Cherry Road (Exit 82) and approximately two miles north of S-122/Dave Lyle Boulevard (Exit 79). The project location map can be seen in Figure 1.

The new interchange will consist of directional ramps for all movements with two-lane loop ramps from Crossover Road to I-77 northbound and southbound, as well as, one-way exit ramps for I-77 northbound and southbound connecting to Connector Road.

This report serves as the hydrologic and hydraulic basis of design for the proposed interchange. This report provides a background of the existing drainage patterns and existing stormwater management infrastructure in the project vicinity. It will also serve to describe the preliminary/conceptual design of the stormwater management infrastructure improvements in the proposed interchange project vicinity. Additionally, this report includes a description of the existing and conceptually planned future stormwater management infrastructure improvements in the proposed interchange vicinity associated with the other development activities that may affect the proposed interchange stormwater management infrastructure final design. This report was conducted according to the criteria set forth in the SCDOT Requirements for Hydraulic Design Studies. Study information was obtained from roadway plans and surveys, USGS maps, Soil Conservation Service soil surveys, FEMA flood insurance maps, available LIDAR information and from field inspection.

This project is a design-build venture and the successful design build team will be responsible for coordination of its activities with work being completed by the developer constructing the Carolina Panthers Training Facility. It is assumed that the existing drainage patterns will be maintained after the addition of the new interchange and the Panthers Facility development. Coordination has occurred with the developer of the training facility to determine areas of newly developed impervious areas that will drain towards the interchange. The design of the Panthers Facility is being handled separately and is not documented in detail in this report. A conceptual site plan for the Panthers Training Facility can be seen in Appendix I. Any modifications to these facilities must provide comparable hydraulic capacities and operation.

WATERSHED AND RECEIVING STREAM

The proposed interchange is located within the Manchester Creek Watershed. Manchester Creek is a tributary to the Catawba River. The project site drains to an unnamed tributary of Manchester Creek. The project site is approximately 0.5 miles upstream of the confluence of the unnamed tributary with Manchester Creek. The confluence of Manchester Creek with the Catawba River is approximately 1.7 miles further downstream of the confluence with the unnamed tributary of Manchester Creek. Manchester Creek is located between the City of Rock Hill and the Catawba River in York County.

The existing land uses within the Manchester Creek Watershed consists of mostly developed areas. The development is a mix of high, medium, and low development and also includes developed open spaces. The land use also consists of some undeveloped, wooded areas primarily east of the US 21 bypass towards the Catawba River. The proposed interchange project site is one of those existing, undeveloped, wooded areas.

In the area of the proposed interchange, the unnamed tributary to Manchester Creek crosses I-77 in an existing 42" RCP. The inlet of the 42" RCP is located at the proposed location of the new Crossover Road bridge over I-77. The existing contributing area to the crossing is approximately 62 acres. The existing drainage area upstream of this 42" RCP crossing is mostly undeveloped woods with a small area of suburban residential homes.

Approximately 0.4 miles downstream of the project area along the unnamed tributary to Manchester Creek is the existing downstream crossing under the Southern Railroad. The existing structure size at this downstream crossing is a 2 @ 4' x 4.5' box culvert that has been extended on the end by 2@ 60" CMP's. This is the last crossing prior to the unnamed tributary to Manchester Creek's confluence with Manchester Creek. Information on this structure was obtained in the historic SCDOT construction plans as can be seen in Appendix F.

FEMA FLOOD HAZARD ZONES

The proposed interchange site does not cross or otherwise impact any flood hazard zones identified on the effective Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs). Figure 6 illustrates the FEMA flood hazards in the vicinity of the proposed interchange site. Downstream receiving streams Manchester Creek and the Catawba River are FEMA regulated streams. However, the unnamed tributary to Manchester Creek is not a FEMA regulated stream. The effective FEMA FIRM is map number 45091C0328F with an effective date of 5/16/2017 and can be seen in Appendix G.

SOILS INFORMATION

The proposed interchange project site is primarily located in the following soils groups: Brewback fine sandy loam (BbA), Mecklenburg-Wynott complex (MkC3 and MeB2), and Wynott-Wilkes complex (WwE2). These soils consist of sandy loams in the upper levels of the profile, with clay and clay loam mixed into lower levels of the profile. These soils are well drained and fall within the hydrologic soil groups of C and D. This soil information was obtained from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) web soil survey. For York County, South

Carolina the web soil survey is generated from official soil data. For more detailed information on the specific soil groups along the project reference the online web soil survey. A soil map of the project site is included in Appendix H.

EXISTING DRAINAGE

The existing drainage infrastructure in the project area along I-77 is illustrated in Figures 2 and 4. Figure 2 illustrates the existing drainage areas and Figure 4 illustrates the existing land uses. Existing conditions analysis was completed at two different sites. One is at the site of the existing 42" cross pipe under I-77 for the purpose of determining the efficiency of the existing pipe. The second is along the unnamed tributary to Manchester Creek at a downstream point of the crossing under Ramp 3. This site is downstream of the proposed interchange improvements and will be used for a point of comparison in the pre vs. post analysis. This site will be discussed more in depth in the pre vs. post analysis portion of this report. The site is labeled as Site 1 in the associated figures.

The existing I-77 corridor, within the project area, is an eight-lane facility (4 lanes in each of the north and south bound directions) separated by barrier in median. The existing I-77 stormwater infrastructure consists of roadside ditches on the outside, inlets and storm system along the median barrier and intermittent cross pipes, such as the previously discussed existing 42" RCP. In general, within the project area, the I-77 corridor drains from north to south and from west to east. The existing median storm drain system was not analyzed as part of this study. A conceptual storm drain layout has been provided in the Conceptual Drainage Plans in Appendix C. No added impervious area is anticipated to be drained to the existing median system. The existing roadside ditches will be impacted by the I-77 widening for the addition of the on and off ramps. The existing ditches were not analyzed as part of this study.

The area on the east side of I-77 is already developed with mostly industrial development. The area consists of large buildings and parking lots with a mix of grassed and wooded areas surrounding. The area on the west side of I-77 consists of mostly undeveloped woods with a small area of residential homes. This area drains to an existing 42" RCP under I-77. The area draining to the existing 42" RCP is approximately 61.2 acres as seen in Figure 2. The rational method was used to develop discharges and analyze the efficiency of the existing pipe. The composite C value was calculated as 0.28. This was calculated based on the existing land uses shown in Figure 4. The composite C value consisted of a C value of 0.9 for the impervious surfaces (pavement, roofs, etc.), a C value of 0.5 for the rolling suburban normal residential area, a C value of 0.15 for the rolling woodlands forest and a C value of 0.3 for the remaining grassed areas. Calculations for the composite C value can be seen in Appendix A. These runoff factors were determined using Table 4 in the SCDOT Requirements for Hydraulic Design Studies.

The time of concentration for the existing 42" RCP crossing was calculated as 30 minutes using the SCS method. Through preliminary coordination with the Panthers Facility design team, it was learned that a time of concentration of approximately 38 minutes was being used for the proposed crossing under the new offsite road that will connect proposed Crossover Road to S-284 (Eden Terrace). This crossing is immediately upstream of the Ramp 1 crossing. Therefore, the calculated 30 minute time of concentration for the existing 42" RCP crossing coincided and is also somewhat purposefully conservative. The main contributor to the time of concentration is an upstream sheet flow area through woods that is not planned to be disturbed by either the interchange project or the improvements from the Panthers Facility. Calculations for the time of concentration can be seen in Appendix A.

The discharges were calculated using the rational method and the appropriate correction factors were applied for the corresponding recurrence interval storms. The resulting discharges can be seen in Table 1 below. For additional information on discharge calculations see Appendix A.

Table 1. Existing Condition Discharge

NAME	TOTAL DRAINAGE AREA (AC.)	COMPOSITE C VALUE	TIME OF CONCENTRATION (MIN.)	10-YR DISCHARGE (CFS)	50-YR DISCHARGE (CFS)	100-YR DISCHARGE (CFS)
Existing 42" RCP Under I-77	61.2	0.28	30	63.3	93.2	104.5
Note: See Appendix A for additional Composite C, Time of Concentration and Discharge Calculations						

An HY-8 analysis was performed on the existing 42" RCP. Based on the results of this analysis it appears the existing 42" RCP is slightly undersized for the design year (50 year) storm event. The resulting HW/D for the 50-year event was 1.52. Per SCDOT guidelines the design head should be limited to 1.2 times the height of the culvert barrel. There is approximately 3.7' of freeboard from the 50-year headwater elevation to the I-77 shoulder point. However, prior to overtopping I-77, the headwater would spill into an adjacent roadside ditch and downstream to a different crossing under I-77. The overtopping point into this adjacent basin is approximately 5.5' higher than the invert in elevation of the 42" RCP. The 100-year event was also analyzed and determined that it did not overtop I-77 but does overtop into the adjacent basin. In the proposed condition, which will be discussed in further detail later in the report, the 42" RCP will no longer be utilized as an open end pipe to convey the water from the west to east side of I-77. Instead, the recommendation is to use the existing 42" to only convey the runoff from the directly connected storm drain systems along I-77. The 42" should be adequately sized to convey this runoff for the 10-year event. See Table 2 below for pipe analysis and Appendix B for additional HY-8 calculations.

Table 2. Existing Pipe Analysis

NAME	TOTAL DRAINAGE AREA (AC.)	50-YR DISCHARGE (CFS)	50-YR HEADWATER DEPTH (FT.)	50-YR HW/D	100-YR DISCHARGE (CFS)	100-YR HEADWATER DEPTH (FT.)
Existing 42" RCP Under I-77	61.2	93.2	5.33	1.52	104.5	5.76
Note: See Appendix B for additional HY-8 Pipe Analysis Calculations						

PROPOSED STORMWATER MANAGEMENT PLAN DESIGN

A conceptual, proposed drainage plan has been developed for the proposed interchange. Refer to Appendix C for an exhibit of the conceptual drainage plan referenced over the current roadway design plans. The conceptual drainage layout includes a general layout of proposed inlets and pipes, proposed ditch locations and proposed cross pipe locations. This layout was completed with the overall concept of maintaining existing drainage patterns to the maximum extent practicable. A detailed spread analysis

and pipe capacity analysis for the storm drains was not completed for the purposes of this report. It will be the responsibility of the design build team to design the proposed systems per SCDOT guidelines. However, a conceptual layout was needed to understand how the area would drain to the proposed cross pipe locations and for the purposes of analyzing and sizing the proposed cross pipes. Deviations from the conceptual layout will alter the cross pipe analysis and it will need to be re-analyzed accordingly.

As part of the conceptual storm drain layout design, connection of proposed storm systems to existing systems will be required in various locations, such as on the I-77 corridor at the existing 42" RCP crossing and also at the tie-in of proposed Crossover Road (Paragon Way) to existing Paragon Way (on the east side of I-77). The purpose of these tie-in's are to both utilize the existing systems to the extent possible and also to maintain existing drainage patterns. The design build team will be responsible for the final storm drain system layout including replacement of any existing damaged structures to be retained or the conversion of any older structures to be retained to current structure types.

The proposed ditches were analyzed preliminarily to obtain an understanding on the ditch geometry and depth needs (in relation to the proposed roadways). This was used to help establish the proposed right-of-way (ROW) and permission needs. Proposed ROW is shown on the drainage plans in Appendix C. The ROW on Tract 18 specifically will be determined by the design build team. Tract 18 will be acquired in its entirety due to access considerations. This tract will be available for the purposes of stormwater detention as necessary and the ROW will be established around the final footprint of the proposed detention facility. This will be discussed further in the Stormwater Control portion of the report.

This report focuses on the drainage flowing to the unnamed tributary to Manchester Creek through the main interchange site location. However, there is a small portion of the project area to the north of the interchange that flows towards an existing 36" RCP cross pipe under I-77. The additional impervious area from the interchange to this crossing is negligible. The proposed offsite Panthers facility improvements north of Crossover Road will be increasing the impervious area to this crossing, due to the proposed connector roadway improvements between Crossover Road and Eden Terrace. Based on preliminary Panthers facility plans, a stormwater control measure is being proposed upstream of the I-77 crossing to handle the increased impervious area.

Similarly, to the south of the proposed interchange, there is an outfall location that was not analyzed at an existing 42" cross pipe under I-77 (just north of the Southern Railroad crossing). The additional impervious area from the interchange that flows to this outfall due to the tie-out of the southbound on ramp is minimal. The majority of the proposed Panthers Training Facility drains towards this same cross pipe. Based on preliminary Panthers facility plans, stormwater control measures are also being proposed upstream of this crossing to handle the increased impervious area.

PROPOSED IMPACTS TO EXISTING INFRASTRUCTURE

The proposed project will create impacts to the existing infrastructure in the area. Some of the larger impacts are discussed in the sections below.

EXISTING STREAM CROSSING UNDER I-77

The proposed Crossover Road bridge over I-77 is located directly over the existing 42" RCP cross pipe under I-77. The proposed bridge intends to use vertical abutments. Due to this, the existing cross pipe being slightly undersized during existing conditions and the desire not to maintain a cross pipe under the

proposed bridge, the conceptual layout does not include the extension of the existing 42" RCP for purposes of conveying the stream crossing across I-77. Alternate layouts for the crossing under I-77 and Crossover Road were discussed with SCDOT. ROW needs limited the design alternative to the layout shown in the conceptual design plans.

The conceptual proposed layout for the crossing of the unnamed tributary to Manchester Creek under I-77 calls for a new pipe to be placed under proposed Crossover Road on the west side of I-77. This pipe could be installed through open cut construction. A junction box will be placed on the west side of I-77, south of the proposed Crossover Road bridge. This junction box will connect the proposed pipe under Crossover Road to a proposed pipe under I-77. The proposed pipe under I-77 would be installed using bore and jack construction to limit the impact to traffic control along heavily traveled I-77. A junction box will also be placed on the east side of I-77 at the downstream end of the bore and jack pipe. From this junction box, the downstream portion of the pipe can then be installed though open cut construction. This pipe will be diverted to outfall into a newly constructed channel away from the unnamed tributary to Manchester Creek. It is intended for this water to be directed to a proposed detention basin outside the interchange footprint to be located within Tract 18.

The construction of the new bore and jack cross pipe under I-77 can be phased so the existing 42" RCP can maintain the stream flow while the proposed bore and jack pipe under I-77 and the subsequent open cut pipes under proposed Crossover Road and on the downstream end are constructed. The conceptual layout calls to maintain the existing 42" RCP for use in draining the I-77 corridor. The existing 42" RCP will need to be extended on the downstream end due to the I-77 widening. During construction, a temporary diversion channel may be needed from the outlet of the existing 42" RCP around the bore pit of the new pipe under I-77 to provide stream flow. This temporary diversion would be located within the loop and within ROW.

The receiving pit on the west side of I-77 for the bore and jack pipe under I-77 has been accounted for with a combination of ROW and permissions. The placement of the open cut pipe under Crossover Road was determined by the need to avoid the proposed Crossover Road bridge vertical abutments and to stay within ROW in the southwest quadrant. See Figure 3 and Appendix C for these locations.

IMPACTS TO NEARBY DEVELOPMENT

The existing Exel – Energizer Distribution Center parcel will be impacted by the construction of Crossover Road's connection to existing Paragon Way and by the addition of the northbound I-77 off-ramp (Ramp 3) and the northbound I-77 on-loop (Ramp 2). These improvements will impact the parking lot connectivity and the existing storm drain systems on the north side of the parcel. In addition, the existing forebay and wet detention pond of the west side of the parcel (between the building and I-77) will be impacted. It is understood that the design of the revised parking lot connectivity, private storm drain system and detention pond will be handled by others and is therefore, not accounted for in this report. For the purposes of the conceptual drainage design and pre vs. post analysis, it is assumed that the drainage on this parcel will be directed to the re-established detention pond downstream of Ramp 3. The re-established private detention pond will stay on Tract 36 property and will not impact the unnamed tributary to Manchester Creek. See Figure 5 for locations of the impacts.

DOWNSTREAM SOUTHERN RAILROAD CROSSING

Downstream of the Ramp 3 outfall, along the unnamed tributary to Manchester Creek, there is only one additional crossing prior to the confluence with Manchester Creek. This crossing is under the Southern Railroad approximately 0.4 miles downstream of the Ramp 3 outfall. The existing structure under Southern Railroad is a 2 @ 4' x 4.5' box culvert that has been extended on the end by 2@ 60" CMP's. Information on this structure was obtained in the historic SCDOT construction plans as can be seen in Appendix F. There is a good amount of relief (25' to 30') from the stream elevations to the surrounding developments (I-77, Southern Railroad and Exel-Energizer Distribution Center). No analysis has been completed on the Southern Railroad structure. The outfall channel for unnamed tributary to Manchester Creek downstream from the proposed interchange was analyzed with the post condition flows, with no assumed detention, for both the 10 and 50 year events and it was found that the increased flows were contained within the existing stream banks. Additionally, there is planned detention downstream of the proposed interchange on tract 18 to help manage the increased runoff. No detention will be allowed within the functional footprint of the proposed interchange. Post-developed discharges and volumes shall be equal to or less than pre-developed discharges and volumes for all locations draining to or on Norfolk Southern's right of way. Post storm water control measures are discussed further in the report.

EXISTING UTILITIES

Existing utilities are present throughout the project area, including but not limited to, gas, fiber, water, sewer, power, telecommunications, and overhead transmission lines. Impacts from the conceptual drainage design were not able to account for potential utility impacts. During final design, care should be taken to avoid impacts to utilities if possible and/or coordinate with utilities about revised designs needed to avoid conflict with proposed drainage infrastructure.

DISCHARGE DETERMINATION AND CROSS PIPE ANALYSIS

Discharges were calculated at 9 different proposed cross pipe locations that were determined based on the conceptual drainage design. The proposed cross pipe locations and the corresponding drainage areas can be seen in Figure 3. The pipes are labeled 1 through 9 and will be referred to in this document as such. The discharges calculated were used to help analyze and size the proposed cross pipes.

Drainage areas were delineated using a combination of the supplied survey along with available LIDAR data. Drainage areas were confirmed during a site visit that occurred on 1/13/20. A photo map and the corresponding photos can be seen in Figure 7. The photos were taken using GPS to accurately track the location of the crossings up and downstream.

The composite C values were calculated for each cross pipe based on the proposed land uses shown in Figure 5. The composite C values consisted of a C value of 0.9 for the impervious surfaces (pavement, roofs, etc.), a C value of 0.5 for the rolling suburban normal residential area, a C value of 0.15 for the rolling woodlands forest and a C value of 0.3 for the remaining grassed areas. The land uses accounted for the additional impervious area due to the roadway improvements, as well as, areas of impervious due to offsite road and parking lot additions by the Carolina Panthers Facility. Calculations for the composite C value can be seen in Appendix A. These runoff factors were determined using Table 4 in the SCDOT Requirements for Hydraulic Design Studies.

The time of concentration for the cross pipes was calculated using the SCS method. For the cross pipes conveying the unnamed tributary to Manchester Creek across I-77 to the proposed detention facility downstream of Ramp 3 (pipes 1, 2, 5, 6 and 9) the time of concentration used was 30 minutes. This matched the time of concentration used in the existing conditions analysis of the existing 42" cross pipe under I-77. The main contributor to the time of concentration is an upstream sheet flow area through woods that is not planned to be disturbed by either the interchange project or the improvements from the Panthers Facility. The flow time from the inlet of Pipe 1 to the outlet of Pipe 9 is primarily pipe flow time. This flow time would cause minimal differences to the time of concentrations. Therefore, the more conservative 30-minute time of concentration was used for all these pipes calculations. The minimum time of concentration of 5 minutes was used for Pipes 3 and 4 to account for the proposed Panthers parking lot. Calculations for the time of concentration can be seen in Appendix A.

The discharges for all cross pipes were calculated using the rational method and the appropriate correction factors were applied for the corresponding recurrence interval storms. The resulting discharges can be seen in Table 3 below. For additional information on discharge calculations see Appendix A.

Table 3. Proposed Cross Pipe Discharges

NAME	TOTAL DRAINAGE AREA (AC.)	COMPOSITE C VALUE	TIME OF CONC. (MIN.)	10-YR DISCHARGE (CFS)	50-YR DISCHARGE (CFS)	100-YR DISCHARGE (CFS)
Pipe 1 Ramp 1 (Sta. 556+47)	43.2	0.39	30	62.1	91.4	102.4
Pipe 2 Ramp 4 (Sta. 553+37)	45.6	0.40	30	66.8	98.4	110.3
Pipe 3 Ramp 1 (Sta. 550+50)	6.9	0.65	5	34.2	49.0	54.2
Pipe 4 Ramp 4 (Sta. 556+41)	10.4	0.58	5	45.5	65.2	72.1
Pipe 5 Parwy/EL (Sta. 33+82 / 563+85)	69.0	0.46	30	115.2	169.6	190.1
Pipe 6 Ramp 2 (Sta. 566+26)	23.7	0.62	15	76.0	108.8	120.5
Pipe 7 Ramp 3 (Sta. 568+79)	27	0.60	15	83.9	120.1	132.9
Pipe 8 Parwy (Sta. 38+95)	7.8	0.60	15	24.0	34.4	38.1
Pipe 9 Ramp 3 (Sta. 570+88)	77.6	0.46	30	130.6	192.4	215.5
Note: See Appendix A for additional Composite C, Time of Concentration and Discharge Calculations						

The proposed pipes were analyzed in HY-8, using the principles given in FHWA's Hydraulic Design Series No. 5 and sized for the 50-year storm event. The pipes were sized to limit the design head to 1.2

times the height of the culvert barrel. See Table 4 below for pipe analysis and Appendix B for additional HY-8 calculations. The pipe inverts and lengths used for the analysis are approximate, based off the proposed roadway design and the available survey data. During final design, the inverts and lengths will need to be revised, with attention paid to freeboard and overtopping requirements.

Burying of the pipes for environmental purposes was not considered as part of this pipe sizing. If it is determined that the pipes need to be buried, then the pipe sizes will need to be increased accordingly to provide the opening area provided by the recommended pipe size at a minimum.

The pipes were sized with no consideration for detention or stormwater control measures. No detention will be allowed within the functional footprint of the interchange. There are options for potential detention downstream of the interchange that will be discussed further in the pre vs. post section of the report.

Table 4. Proposed Cross Pipe Analysis and Sizing

NAME	TOTAL DRAINAGE AREA (AC.)	50-YR DISCHARGE (CFS)	50-YR HEADWATER DEPTH (FT.)	50-YR HW/D	RECOMMENDED STRUCTURE SIZE
Pipe 1 Ramp 1 (Sta. 556+47)	43.2	91.4	4.37	1.09	48" RCP
Pipe 2 Ramp 4 (Sta. 553+37)	45.6	98.4	4.63	1.16	48" RCP
Pipe 3 Ramp 1 (Sta. 550+50)	6.9	49.0	3.54	1.18	36" RCP
Pipe 4 Ramp 4 (Sta. 556+41)	10.4	65.2	3.83	1.09	42" RCP
Pipe 5 Parwy/EL (Sta. 33+82 / 563+85)	69.0	169.6	5.72	1.14	60" RCP (Bore and Jack under I-77)
Pipe 6 Ramp 2 (Sta. 566+26)	23.7	108.8	4.50	1.00	54" RCP
Pipe 7 Ramp 3 (Sta. 568+79)	27	120.1	4.86	1.08	54" RCP
Pipe 8 Parwy (Sta. 38+95)	7.8	34.4	2.75	0.92	36" RCP
Pipe 9 Ramp 3 (Sta. 570+88)	77.6	192.4	5.82	1.06	66" RCP
Note: See Appendix B for additional HY-8 Pipe Analysis Calculations					

It should be noted that several of the fill heights of the roadways over the proposed cross pipes are at or exceed the maximum 30' allowable fill height limit per SCDOT Standard Drawings for RCP and Alternate pipes. For all installations beyond 30', embankment settlement may control design. In these situations, consultation will be needed with pipe manufacturers and geotechnical engineers to determine how the pipe should be designed to handle the deep fill heights. See SCDOT Standard Drawing 714-205-01.

PRE. VS. POST ANALYSIS AND STORMWATER CONTROL

An analysis was performed to compare the pre-development (existing conditions) and the post-development (proposed conditions) peak discharge rates prior to detention at the ultimate outfall of the proposed interchange, downstream of the proposed I-77 northbound off ramp (Ramp 3) on the unnamed tributary to Manchester Creek. The purpose of this comparison is the demonstrate the anticipated increases to flows due to the proposed interchange improvements and to help provide guidance on detention measures that will be required. The analysis point is labeled as Site 1 in the drainage area and land use maps (Figures 2 through 5). Table 7 below displays the comparison of the drainage areas, C values and discharges for the 10 and 100-year events.

The total drainage area in the post condition was raised by approximately 12.6 acres or 12%. This increase can be attributed to an area of approximately 4.7 acres on the west side of Connector Road near the intersection of an entrance to the Panthers Facility and the proposed road towards Eden Terrace. It can also be attributed to an additional area of 9.1 acres from the east side of Connector Road. The proposed Connector Road impacts an existing development (parking lot and detention basin) and will direct the water towards the interchange as opposed to the existing condition where the existing development captures this water and drains it to a private detention basin. There is a reduction in area of approximately 2 to 3 acres in the area of the Panther Practice Facility development. This area will instead be captured by the Panthers development and be drained to the proposed Panthers private detention basins further south within the development.

The C value increase is attributed to the additional impervious surfaces from the proposed roadways and development parking lots. The time of concentration remains the same for pre and post because, as discussed previously in the report, the main contributor to the time is an area of undeveloped woodlands that has no plan for development currently. The results of the pre vs. post discharge comparison can be seen in Table 7 below.

Table 7. Pre. Vs. Post Drainage Area and Discharge Comparison Prior to Detention

NAME	TOTAL DRAINAGE AREA (AC.)	COMPOSITE C VALUE	10-YR INTENSITY (IN/HR)	10-YR DISCHARGE (CFS)	100-YR INTENSITY (IN/HR)	100-YR DISCHARGE (CFS)
Site 1 Pre	105.9	0.31	3.64	120.2	4.81	198.4
Site 1 Post	118.5	0.50	3.64	214.3	4.81	353.6
Difference (%)	12%	59%	0%	78%	0%	78%
Note: See Appendix A for additional Pre vs Post Calculations						

As can be seen in the table above, the 10-year discharge increases by approximately 94 cfs or 78% and the 100-year discharge increases by 155 cfs or 78%. Due to these anticipated increases, detention will be required by the project. However, detention will not be allowed within functional footprint of the interchange. Instead, the design build team will need to design a stormwater control measure (detention/retention basin) south of Ramp 3 to be located on Tract 18. This tract will be acquired in its entirety for the use of the basin. Once the basin design has been finalized, the right of way needed around the basin will be established.

The proposed detention basin will be required to detain the necessary volume to account for the increased impervious area and resulting runoff due to the interchange improvements for the 100-year event. The post condition discharges within the unnamed tributary to Manchester Creek, downstream of the interchange and proposed detention basin, should be equal to the pre-condition discharges. The detention basin was not sized or designed as part of this preliminary report. A preliminary analysis was done to verify that Tract 18 would provide the needed area for the proposed detention basin. The design of the basin will be the responsibility of the design build team. The type of basin (wet or dry detention basin) needs to be coordinated with SCDOT. Multiple, interconnected basins may be required. The design of the basin should take into account the seasonally high groundwater table and provide space for a maintenance access road around the basin for cleanup and repair.

The conceptual, proposed drainage plan was configured to direct a large portion of the upstream drainage area to the proposed detention basin on Tract 18. See the proposed drainage layout in Appendix C and the proposed drainage area map in Figure 3. The drainage area from the west side of I-77, crossing under I-77 in Pipe 5, will be directed under Ramp 3 through Pipe 9 and to the proposed detention basin. The drainage area from the I-77 corridor will outfall separately through the existing 42" RCP, combine with most of the drainage area on the east side of the interchange, and pipe directly into the unnamed tributary to Manchester Creek through Pipe 7 under Ramp 3. This will allow for an uninterrupted drainage area that will flow to the creek. This results in the added impervious areas along I-77 corridor and most of the interchange on the east side of I-77 directly flowing into the creek without detention. Therefore, the proposed detention basin on Tract 18 will need to be sized to account for this un-detained portion of the increased impervious area, as well as, the contributing drainage area through Pipe 9, such that the resulting downstream discharges equals the pre-conditions.

The ultimate outfall channel (the unnamed tributary to Manchester Creek) will need to be analyzed with the 50-year post condition flows downstream of the proposed detention basin outfall to demonstrate that there is no anticipated property damage and that the channel is stable. The outfall channel (the unnamed tributary to Manchester Creek) was observed in the field as a 6' base channel with 1:1 side slopes and was approximately 4.5' in depth. It was observed as clean, winding stream with some pools, stones and vegetated banks. As a conservative point of comparison, the outfall channel was preliminarily analyzed with the 50-year post conditions flows with no detention and the results demonstrated that the flow will remain within the channel banks with approximately 0.5' of freeboard. As expected, the velocities in the channel were increased and the design build team should plan for additional protection measures on the stream to prevent erosion.

BRIDGE DECK DRAIN ANALYSIS

A bridge deck drain analysis has been completed for the conceptual Crossover Road (Paragon Way) overpass bridge over I-77. The analysis was completed based on the conceptual bridge plans as seen in Appendix D. The conceptual bridge layout has a total length of approximately 302'-6" from End Bent 1 to End Bent 4 with additional 20' approach slabs on each end of the bridge. It is a 3-span bridge with spans of 1 @ 80'-0", 1 @ 142'-6", and 1 @ 80'-0". The spread was analyzed using the proposed grade along the bridge of 0.5%.

Per the conceptual bridge typical section, the total width of the bridge will be approximately 126'-6", which will consist of 1' wide railings on each side, a 5'-7" sidewalk on the left side, a 15'-7" shared use path on the right side, 1'-6" offsets from face of curb to edge of travel lane on each side, 4 @ 12' wide lanes on

the left side of the bridge, 1 additional variable width left turn lane on the left side of the bridge, a variable width median, and 3 @ 12' wide lanes on the right side of the bridge. The total width draining towards the left side of the bridge is approximately 72'-3" and the total width draining to the right side of the bridge is approximately 54'-3". Due to the length of the bridge and the number of lanes, a cross slope break has been introduced beyond the first two lanes from the centerline on either side of the bridge. The cross slope changes from 2% to 2.5%, which should help to promote better drainage through the outside lanes of traffic.

The results of the deck drain analysis determined that bridge deck drains will be required with a recommended approximate spacing of 15' on center. A 10' spacing was accounted for from the outer bridge end bents.

The deck drains were analyzed for both 6" circular scuppers (with 30% blockage) and for 1' x 1' grate inlet scuppers. An allowable spread criteria of 6' was used for the analysis. This would allow for spread within 4'-6" of the outer 12' wide lanes. The outer lanes on each side of the bridge where the spread is being allowed to encroach are turn lanes, which have less overall spread concern due to cars slowing down to turn. The spread was analyzed using the 10-year storm event intensity for York County with a minimum time of concentration of 5 minutes. The results of the deck drain analysis can be seen in Appendix E.

The deck drains will require an underdrain system suspended from the bottom of the bridge. This will avoid runoff from the bridge passing through the deck drains and dropping water on the I-77 travel lanes below. The spacing provided assumes an underdrain system for the entire bridge.

The conceptual bridge proposes the use of 13 – Florida-I 72" prestressed concrete beams at 9'-10" centers. It should be noted that if the concrete I-beams shown in the conceptual typical bridge section are adjusted in location then they may conflict with the deck drains and deck drain system. In which case, the deck drains may require a special skewed design through the deck so as not to conflict with the I-beams. The deck drains should not be in conflict with the I-beams as currently shown in the typical section since the flow line at the face of curbs are not located directly over an I-beam.

FIGURE 1

LOCATION MAP

Unnamed Tributary to Manchester Creek

Manchester Creek

Southern Railroad existing crossing
2 @ 4' x 4.5' RCBC with 2 @ 60" CMP extensions on end

Legend

Project Boundary

0 2,000 4,000 Feet

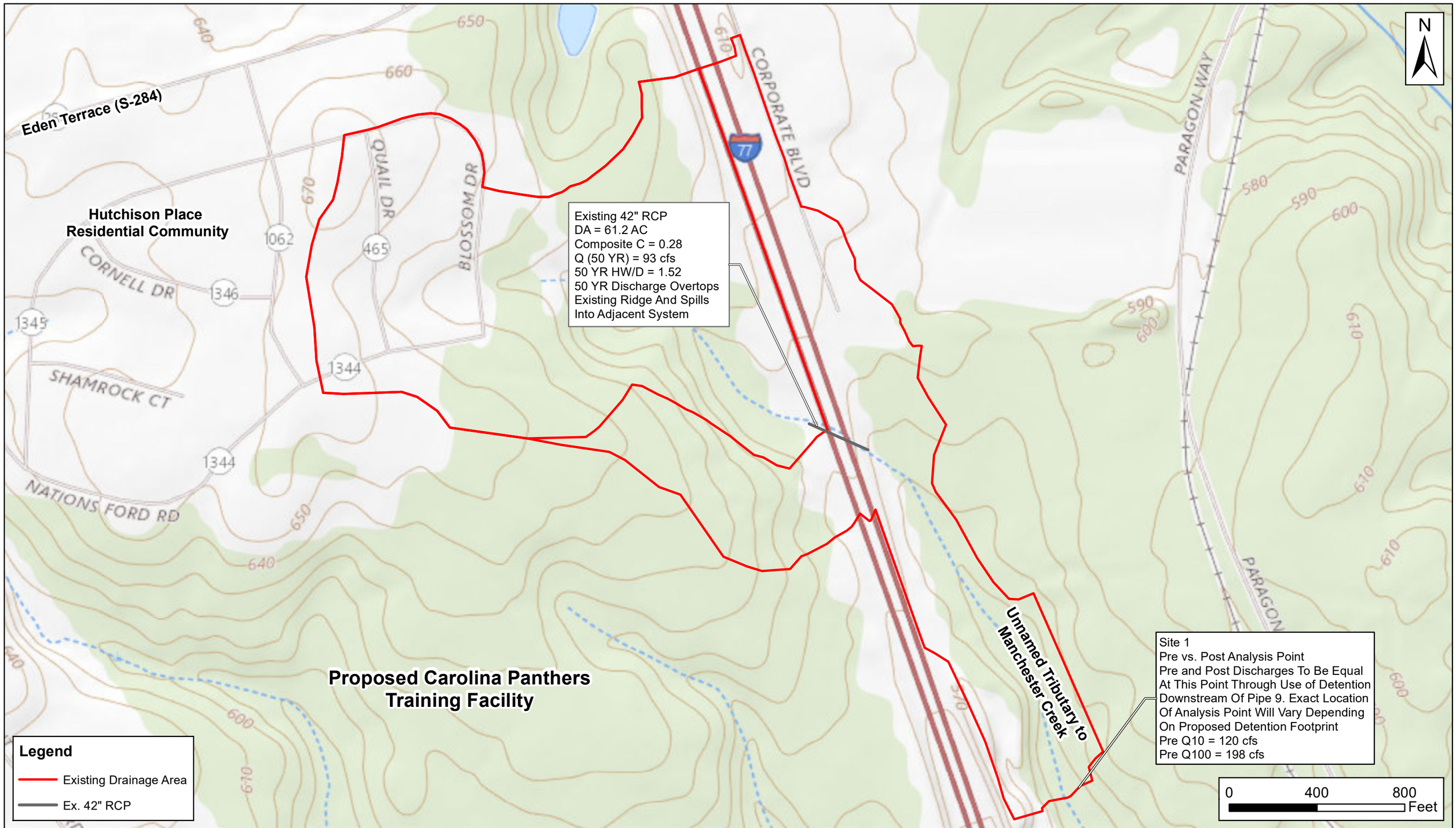
SCDOT Kimley»Horn

I-77 Panthers Interchange
Figure 1: Location Map

York County, SC
August 2020

FIGURE 2

EXISTING CONDITIONS DRAINAGE AREA MAP



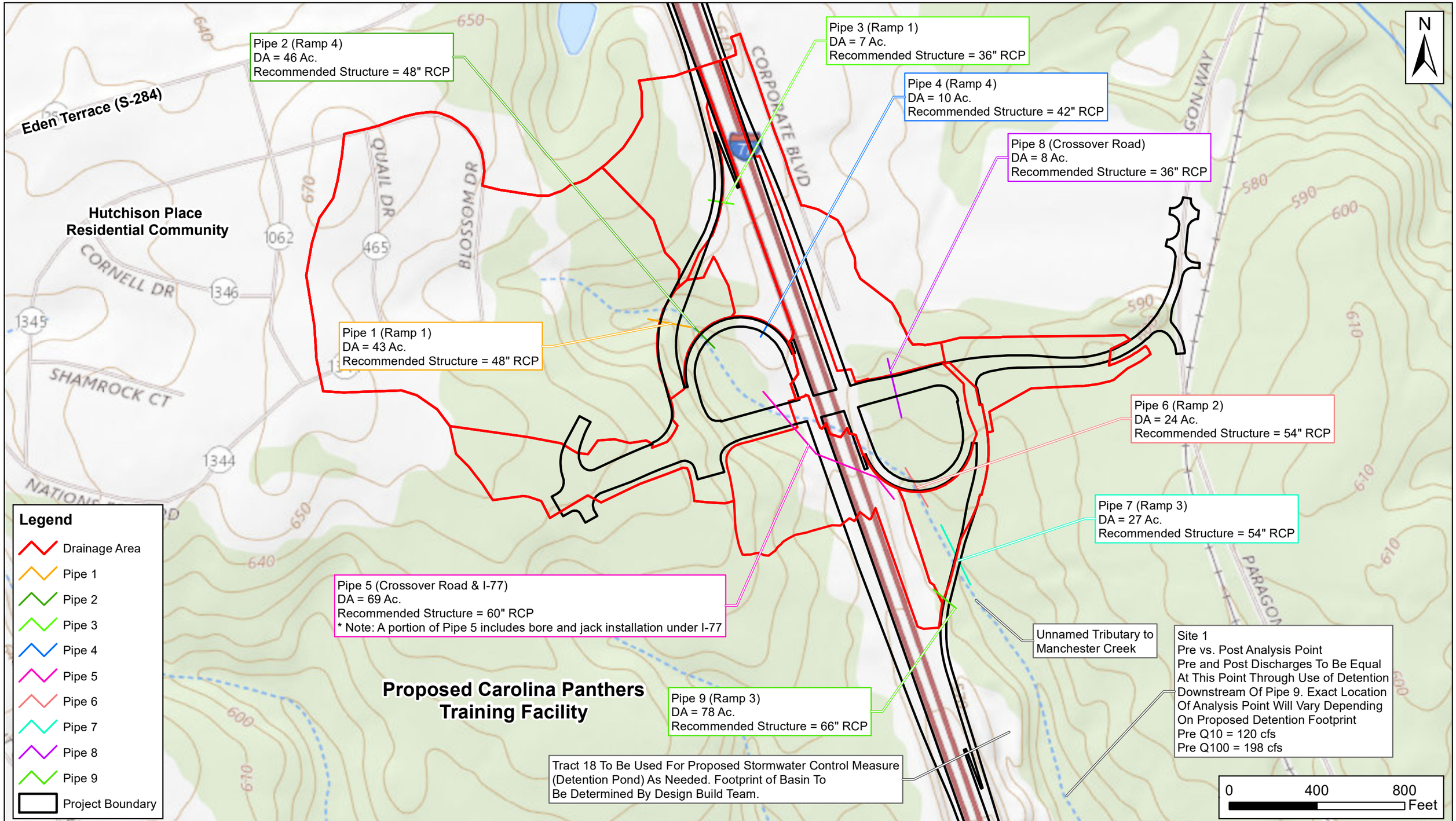
SCDOT Kimley»Horn

I-77 Panthers Interchange
Figure 2: Existing Conditions Drainage Area Map

York County, SC
August 2020

FIGURE 3

PROPOSED CONDITIONS DRAINAGE AREA MAP



I-77 Panthers Interchange
Figure 3: Proposed Conditions Drainage Area Map

SCDOT Kimley»Horn

York County, SC
August 2020

FIGURE 4

EXISTING CONDITIONS LAND USE MAP

SCDOT Kimley»Horn

I-77 Panthers Interchange
Figure 4: Existing Conditions Land Use Map

York County, SC
August 2020

FIGURE 5

PROPOSED CONDITIONS LAND USE MAP

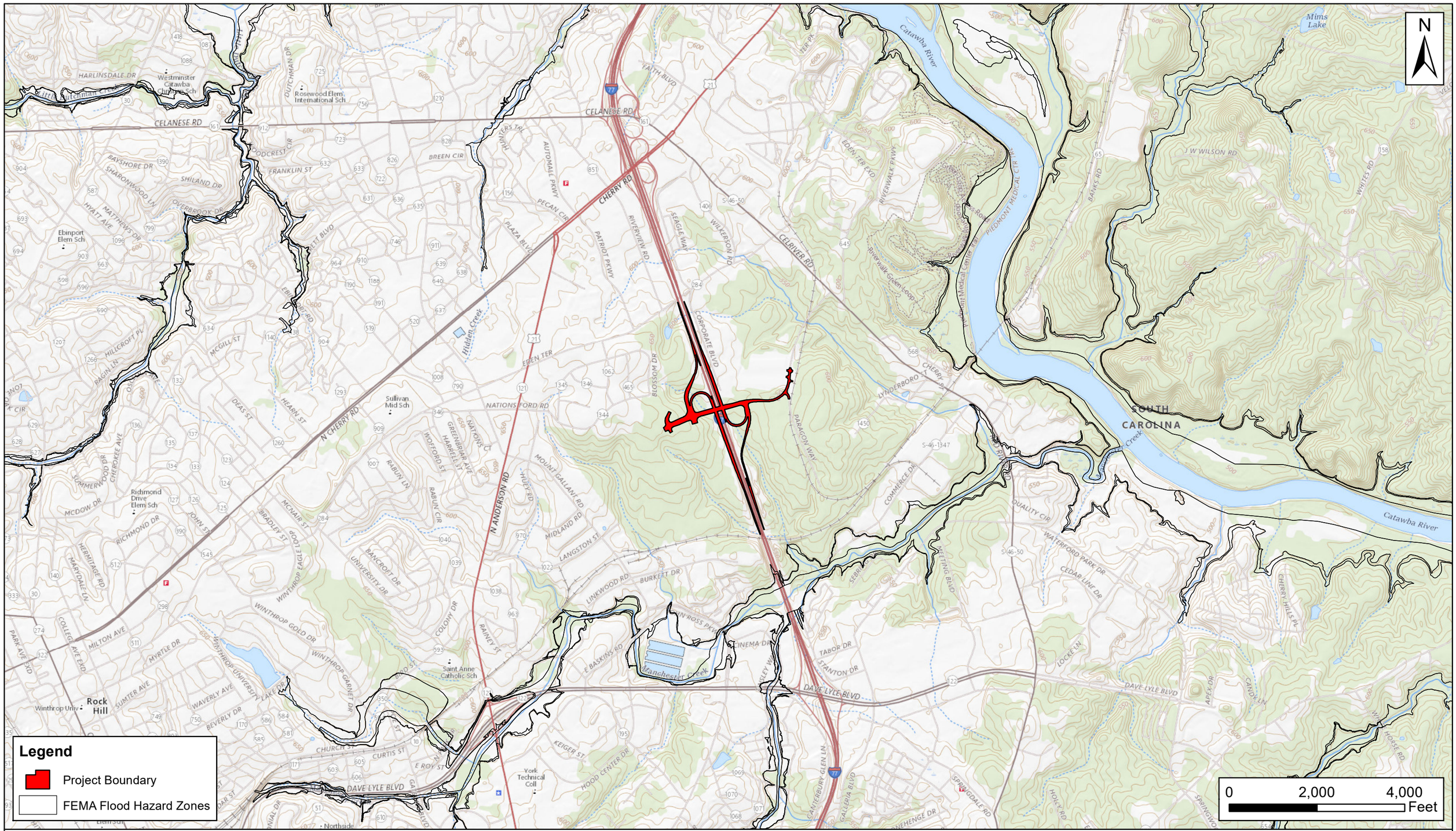
SCDOT Kimley»Horn

I-77 Panthers Interchange
Figure 5: Proposed Conditions Land Use Map

York County, SC
August 2020

FIGURE 6

FEMA FLOOD HAZARD MAP



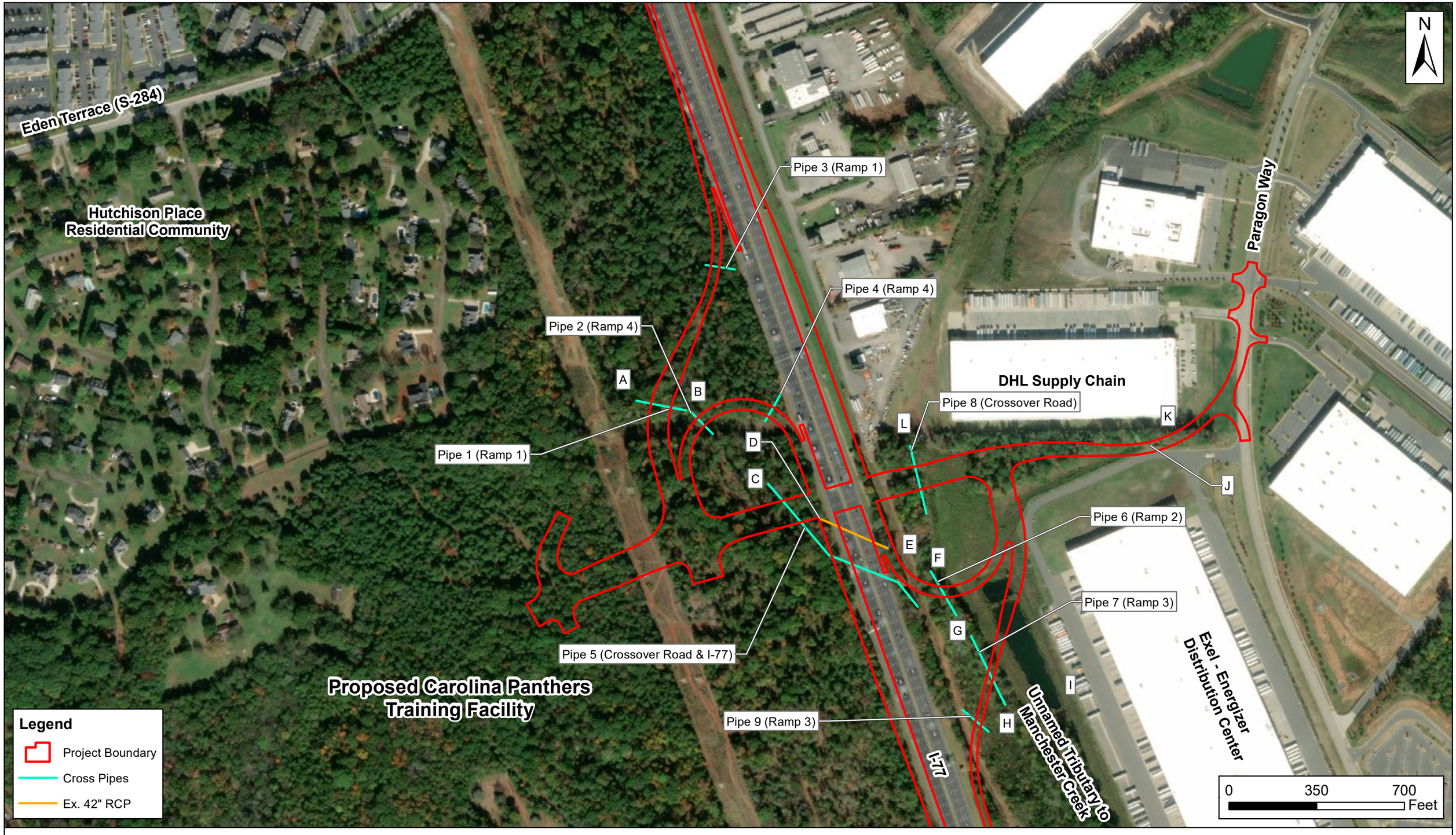
I-77 Panthers Interchange
Figure 6: FEMA Flood Hazard Map

SCDOT Kimley»Horn

York County, SC
August 2020

FIGURE 7

PHOTOS MAP AND SITE PHOTOS



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I-77 Panthers Interchange
Figure 7: Photos Map

York County, SC
August 2020

SITE A

Existing Stream near Pipe 1 looking Upstream

Existing Stream near Pipe 1 looking Downstream

Existing Swale near Pipe 1 outfall

SITE B

Existing Stream near Pipe 2 invert in, looking Upstream

Existing Stream near Pipe 2 invert in, looking Downstream

Existing Stream near Pipe 2 invert out, looking Upstream

Existing Stream near Pipe 2 invert out, looking downstream

SITE C

Existing Stream near Pipe 5
proposed invert in

Existing Stream near Pipe 5
proposed invert in

Existing Stream near Pipe 5
proposed invert in

Existing Stream near Pipe 5
proposed invert in

SITE D

Existing Swale coming towards Ex. 42” RCP

Existing stream from runoff parallel to I-77 coming to Ex. 42” RCP

Invert in of Ex. 42” RCP

Invert in of Ex. 42” RCP

SITE E

Existing outfall of Ex. 42” RCP

Existing outfall of Ex. 42” RCP

Existing outfall of Ex. 42” RCP

Headcut approx. 50’ downstream of Ex 42” RCP looking upstream towards outfall

SITE F

Existing Stream near Pipe 6

Existing Stream near inlet of Pipe 6

Existing Stream near Pipe 6

Existing Stream near outfall of Pipe 6

SITE G

Existing Stream near Pipe 7 proposed invert in

Existing Stream near Pipe 7 proposed invert in

Existing Stream near Pipe 7 proposed invert in

SITE H

Existing Stream near Pipe 7 proposed outfall

Existing Stream near Pipe 7 proposed outfall

Existing Stream near Pipe 7 proposed outfall

Existing Stream near Pipe 7 proposed outfall

SITE I

Existing outfall pipe from Detention Pond

Existing Detention Pond

Existing Detention Pond

SITE J

Existing private catch basin on offsite roadway to be relocated

Existing offsite roadway to be relocated

SITE K

Existing Swale

Existing Swale

SITE L

Existing swale near proposed invert in of Pipe 8

Existing swale near proposed invert in of Pipe 8

Proposed location of Pipe 8 under fill of proposed road

Proposed outfall of Pipe 8

APPENDIX A

DISCHARGE AND PRE VS. POST CALCULATIONS

Kimley»Horn

t_c Path Calculation

Ex. 42" RCP

Project Information

Project Name:	I-77 Panthers		
KHA Project #:	012827008		
Designed by:	SRG	Date:	8/20/2020
Reviewed by:		Date:	

Sheet Flow 1:

Surface description* =	Light Woods	
Roughness, n =	0.4	
Length, L =	200	ft
Average slope, s =	0.030	ft/ft
Two-year 24-hour rainfall, P_2 =	3.61	in

* See TR-55 Table 3-1

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}\, s^{0.4}}$$

T_1 = **0.498848** hr

Shallow Concentrated Flow 1:

Length, L =	112	ft
US Elevation =	650	ft
DS Elevation =	643	ft
Surface =	Unpaved	
Average slope, s =	0.063	ft/ft
Velocity** =	4.03	fps

** See TR-55 Figure 3-1

$T_t = L / 3600V$

T_2 = **0.00772** hr

Total Time $T_c = Tt_1 + Tt_2 + Tt_3 + \ldots.. + Tt_m$

T_c =	0.5066	hr
=	30.39	min
SAY=	**30**	**min**

Kimley»Horn

t_c Path Calculation

Pipes 1,2,5,9

Project Information

Project Name:	I-77 Panthers		
KHA Project #:	012827008		
Designed by:	SRG	Date:	8/20/2020
Reviewed by:		Date:	

Sheet Flow 1:

Surface description* =	Light Woods	
Roughness, n =	0.4	
Length, L =	200	ft
Average slope, s =	0.030	ft/ft
Two-year 24-hour rainfall, P_2 =	3.61	in

* See TR-55 Table 3-1

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}\, s^{0.4}}$$

T_1 = **0.498848** hr

Shallow Concentrated Flow 1:

Length, L =	112	ft
US Elevation =	650	ft
DS Elevation =	643	ft
Surface =	Unpaved	
Average slope, s =	0.063	ft/ft
Velocity** =	4.03	fps

** See TR-55 Figure 3-1

$T_t = L / 3600V$

T_2 = **0.00772** hr

Total Time

$T_c = Tt_1 + Tt_2 + Tt_3 + \ldots.. + Tt_m$

T_c =	0.5066	hr
=	30.39	min
SAY=	**30**	**min**

Kimley»Horn

t_c Path Calculation

Pipe 3 & 4

Project Information

Project Name:	I-77 Panthers		
KHA Project #:	012827008		
Designed by:	SRG	Date:	8/20/2020
Reviewed by:		Date:	

Sheet Flow 1:

Surface description* =	Paved	
Roughness, n =	0.011	
Length, L =	100	ft
Average slope, s =	0.043	ft/ft
Two-year 24-hour rainfall, P_2 =	3.61	in

* See TR-55 Table 3-1

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}\, s^{0.4}}$$

T_1 = ***0.013955*** ***hr***

Total Time $T_c = Tt_1 + Tt_2 + Tt_3 + \ldots.. + Tt_m$

T_c =	0.0140	hr
=	0.84	min
SAY=	**5**	**min***

*Minimum time of concentration used because of future Panthers development within most of drainage area

Kimley»Horn

t_c Path Calculation

Pipes 6,7,8

Project Information

Project Name:	I-77 Panthers		
KHA Project #:	012827008		
Designed by:	SRG	Date:	8/20/2020
Reviewed by:		Date:	

Sheet Flow 1:

Surface description* =	Managed Grass	
Roughness, n =	0.15	
Length, L =	196	ft
Average slope, s =	0.015	ft/ft
Two-year 24-hour rainfall, P_2 =	3.61	in

* See TR-55 Table 3-1

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}\, s^{0.4}}$$

T_1 = ***0.293141*** ***hr***

Total Time $T_c = Tt_1 + Tt_2 + Tt_3 + \ldots.. + Tt_m$

T_c =	0.2931	hr
=	17.59	min
SAY=	**15**	**min**

WEIGHTED C VALUES (POST DEVELOPMENT)								
NAME	LOCATION	STA. NO	TOTAL AREA (AC.)	PAVEMENTS AND ROOFS (C=0.9)	ROLLING SUBURBAN NORMAL RESIDENTIAL (C=0.5)	ROLLING WOODLANDS FOREST (C=0.15)	REMAINING AREA (C=0.3)	WEIGHTED C
PIPE 1	RAMP 1	556+47	43.2	2.95	19.22	10.28	10.75	0.39
PIPE 2	RAMP 4	553+37	45.6	3.93	19.22	10.28	12.17	0.40
PIPE 3	RAMP 1	550+50	6.9	4.07	0	0	2.83	0.65
PIPE 4	RAMP 4	556+41	10.4	4.8	0	0	5.6	0.58
PIPE 5	PARWY/EL	33+82/563+85	69	14.66	19.22	11.53	23.59	0.46
PIPE 6	RAMP 2	566+26	23.7	12.75	0	0	10.95	0.62
PIPE 7	RAMP 3	568+79	27.0	13.66	0	0	13.3	0.60
PIPE 8	PARWY	38+95	7.8	3.87	0	0	3.93	0.60
PIPE 9	RAMP 3	570+90	78	17.22	19.22	11.53	30.03	0.46

WEIGHTED C VALUES (PRE DEVELOPMENT)								
NAME	LOCATION	STA. NO	TOTAL AREA (AC.)	PAVEMENTS AND ROOFS (C=0.9)	ROLLING SUBURBAN NORMAL RESIDENTIAL (C=0.5)	ROLLING WOODLANDS FOREST (C=0.15)	REMAINING AREA (C=0.3)	WEIGHTED C
EX. 42" RCP	RAMP 4 (11' RT)	562+22	61.2	0.93	19.22	35.94	5.11	0.28

CALCULATED DISCHARGES (POST DEVELOPMENT)																		
				WEIGHTED C		TOC (MIN)	10-YR DISCHARGE CALCULATION			25-YR DISCHARGE CALCULATION			50-YR DISCHARGE CALCULATION			100-YR DISCHARGE CALCULATION		
NAME	LOCATION	STA. NO	TOTAL AREA (AC.)	SEE APPX. A	A*C	SEE APPX. A	I (in/hr)	Cf	Q10 (CFS)	I (in/hr)	Cf	Q25 (CFS)	I (in/hr)	Cf	Q50 (CFS)	I (in/hr)	Cf	Q100 (CFS)
PIPE 1	RAMP 1	556+47	43.2	0.39	17.0	30	3.64	1.00	62.1	4.12	1.10	77.2	4.47	1.20	91.4	4.81	1.25	102.4
PIPE 2	RAMP 4	553+37	45.6	0.40	18.3	30	3.64	1.00	66.8	4.12	1.10	83.1	4.47	1.20	98.4	4.81	1.25	110.3
PIPE 3	RAMP 1	550+50	6.9	0.65	4.5	5	7.58	1.00	34.2	8.45	1.10	41.9	9.05	1.20	49.0	9.62	1.25	54.2
PIPE 4	RAMP 4	556+41	10.4	0.58	6.0	5	7.58	1.00	45.5	8.45	1.10	55.8	9.05	1.20	65.2	9.62	1.25	72.1
PIPE 5	PARWY/EL	33+82/563+85	69	0.46	31.6	30	3.64	1.00	115.2	4.12	1.10	143.3	4.47	1.20	169.6	4.81	1.25	190.1
PIPE 6	RAMP 2	566+26	23.7	0.62	14.8	15	5.15	1.00	76.0	5.73	1.10	93.0	6.15	1.20	108.8	6.53	1.25	120.5
PIPE 7	RAMP 3	568+79	27.0	0.60	16.3	15	5.15	1.00	83.9	5.73	1.10	102.7	6.15	1.20	120.1	6.53	1.25	132.9
PIPE 8	PARWY	38+95	7.8	0.60	4.7	15	5.15	1.00	24.0	5.73	1.10	29.4	6.15	1.20	34.4	6.53	1.25	38.1
PIPE 9	RAMP 3	570+90	78	0.46	35.8	30	3.64	1.00	130.6	4.12	1.10	162.5	4.47	1.20	192.4	4.81	1.25	215.5

CALCULATED DISCHARGES (PRE DEVELOPMENT ANALYSIS AT EX 42" RCP CROSSING)																		
				WEIGHTED C		TOC (MIN)	10-YR DISCHARGE CALCULATION			25-YR DISCHARGE CALCULATION			50-YR DISCHARGE CALCULATION			100-YR DISCHARGE CALCULATION		
NAME	LOCATION	STA. NO	TOTAL AREA (AC.)	SEE APPX. A	A*C	SEE APPX. A	I (in/hr)	Cf	Q10 (CFS)	I (in/hr)	Cf	Q25 (CFS)	I (in/hr)	Cf	Q50 (CFS)	I (in/hr)	Cf	Q100 (CFS)
EX. 42" RCP	RAMP 4 (11' RT)	561+25	61.2	0.28	17.4	30	3.64	1.00	63.3	4.12	1.10	78.7	4.47	1.20	93.2	4.81	1.25	104.5

WEIGHTED C VALUES (PRE DEVELOPMENT)										
NAME	LOCATION	STA. NO	SIDE	TOTAL AREA (AC.)	PAVEMENTS AND ROOFS (C=0.9)	ROLLING SUBURBAN NORMAL RESIDENTIAL (C=0.5)	ROLLING WOODLANDS FOREST (C=0.15)	PROPOSED BASIN (C=1.0)	REMAINING AREA (C=0.3)	WEIGHTED C SEE APPX. A
SITE 1 PRE	RAMP 3	581+09	336' RT	105.86	9.74	19.22	56.35	0.00	20.55	0.31
SITE 1 POST	RAMP 3	581+09	336' RT	118.5	31.28	19.22	11.53	3.40	53.07	0.50

PRE-POST ANALYSIS AT ULTIMATE OUTFALL													
					WEIGHTED C SEE		TOC (MIN) SEE APPX. A	10-YR DISCHARGE CALCULATION			100-YR DISCHARGE CALCULATION		
NAME	LOCATION	STA. NO	SIDE	TOTAL AREA (AC.)	APPX. A	A*C		I (in/hr)	Cf	Q10 (CFS)	I (in/hr)	Cf	Q100 (CFS)
SITE 1 PRE	RAMP 3	581+09	336' RT	105.86	0.31	33.0	30	3.64	1.00	120.2	4.81	1.25	198.4
SITE 1 POST	RAMP 3	581+09	336' RT	118.5	0.50	58.8	30	3.64	1.00	214.3	4.81	1.25	353.6
			Difference (+/-)	13	0.18	26	0	0	0	94	0	0	155
			Difference (%)	12%	59%	78%	0%	0%	0%	78%	0%	0%	78%

APPENDIX B

HY-8 CROSS PIPE SIZING ANALYSIS

HY-8 Culvert Analysis Report

Culvert Data Summary - Pipe 1

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 1 - Culvert Summary Table: Pipe 1

Discharge Names	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)
50	91.40	91.40	598.37	4.370	0.070	5-S2n	1.736	2.898	1.832	2.158	16.286	5.094
100	102.40	102.40	598.78	4.783	1.131	5-S2n	1.852	3.065	1.960	2.279	16.718	5.249

****

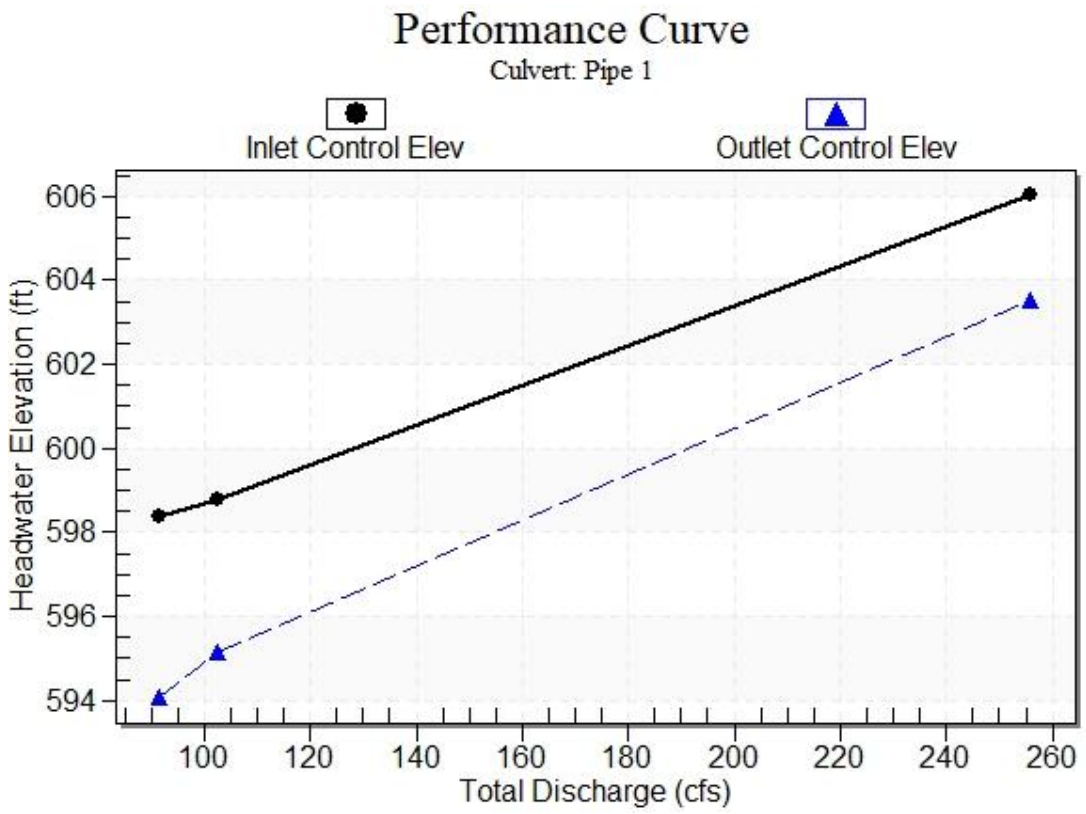
Straight Culvert

Inlet Elevation (invert): 594.00 ft, Outlet Elevation (invert): 589.50 ft

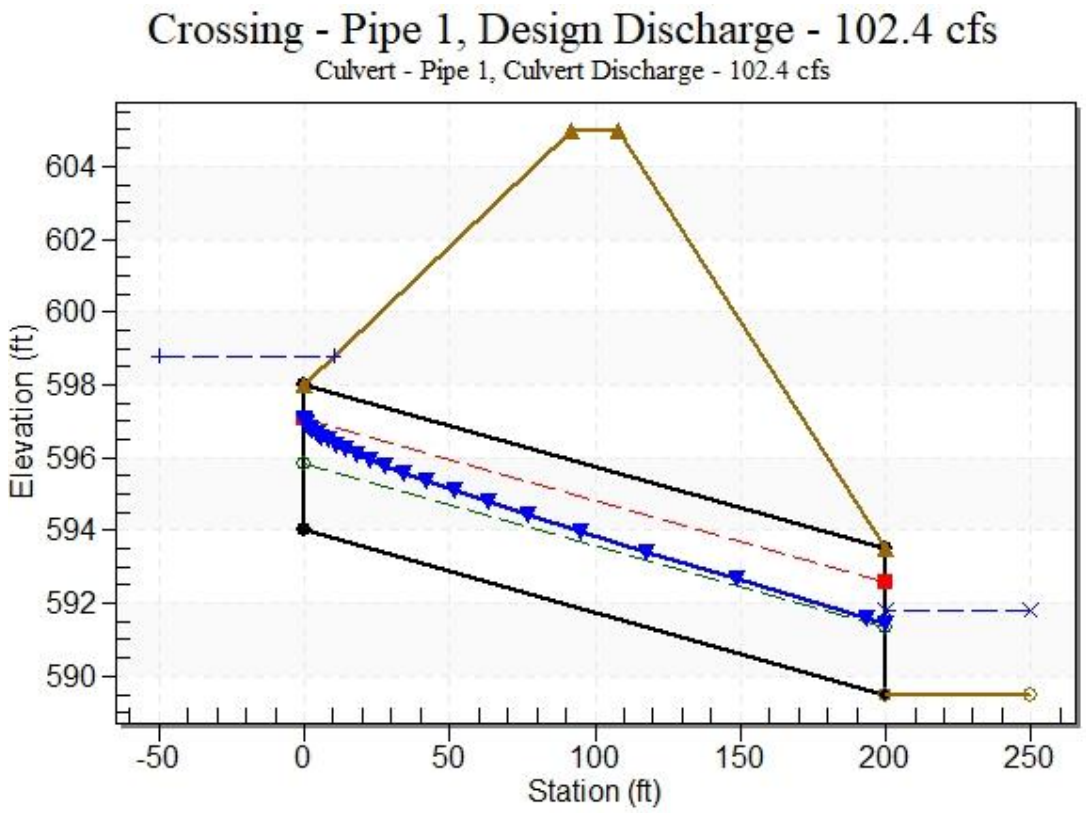
Culvert Length: 200.05 ft, Culvert Slope: 0.0225

****

Culvert Performance Curve Plot: Pipe 1



Water Surface Profile Plot for Culvert: Pipe 1



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 2 - Summary of Culvert Flows at Crossing: Pipe 1

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pipe 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
598.37	50	91.40	91.40	0.00	1
598.78	100	102.40	102.40	0.00	1
605.00	Overtopping	210.10	210.10	0.00	Overtopping

Rating Curve Plot for Crossing: Pipe 1

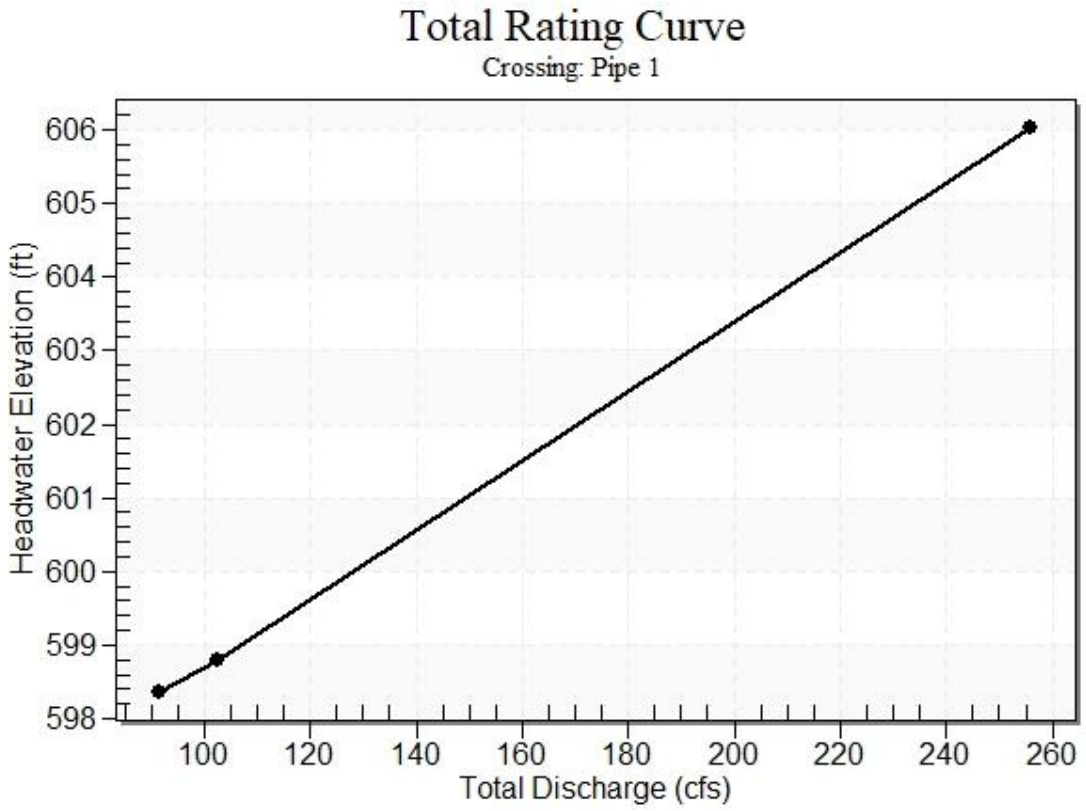


Table 3 - Downstream Channel Rating Curve (Crossing: Pipe 1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
91.40	591.66	2.16	5.09	1.35	0.75
102.40	591.78	2.28	5.25	1.42	0.76

Tailwater Channel Data - Pipe 1

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 4.00 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 589.50 ft

Culvert Data Summary - Pipe 2

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 4 - Culvert Summary Table: Pipe 2

Discharge Names	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)
50	98.40	98.40	593.13	4.630	2.186	5-S2n	1.820	3.006	1.995	2.236	15.709	5.194
100	110.30	110.30	593.60	5.105	2.702	5-S2n	1.944	3.174	2.141	2.362	16.108	5.352

****

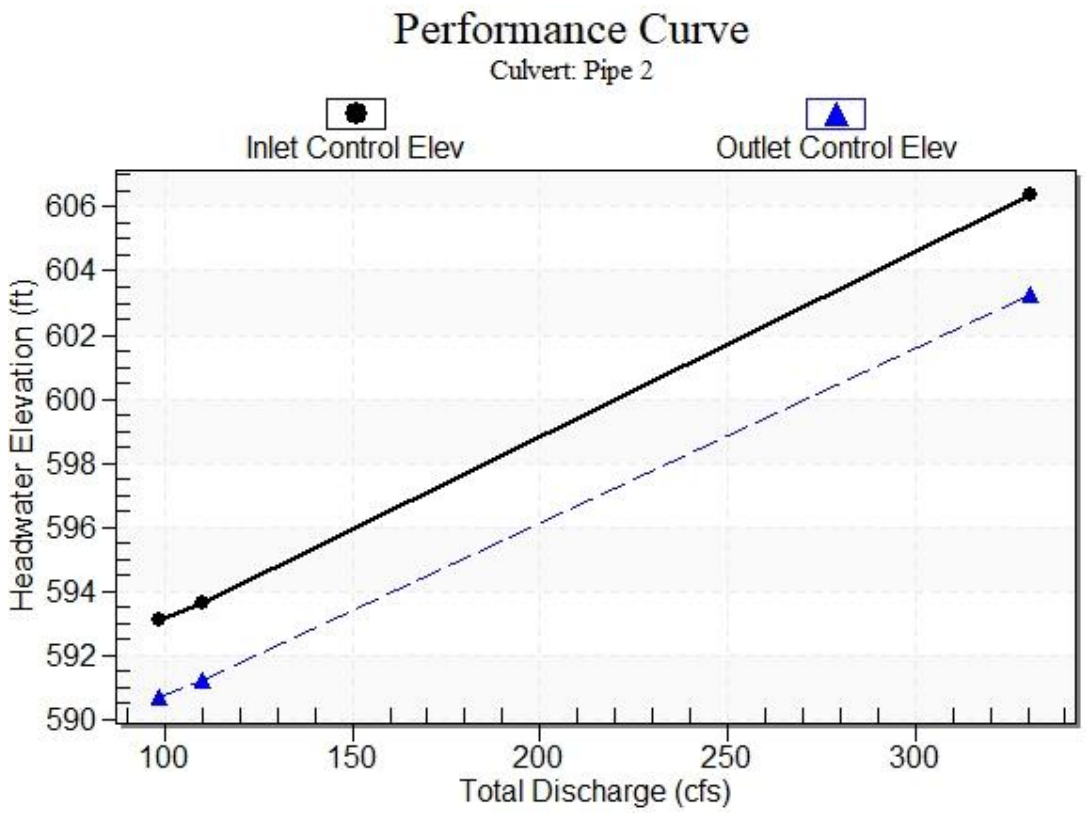
Straight Culvert

Inlet Elevation (invert): 588.50 ft, Outlet Elevation (invert): 585.50 ft

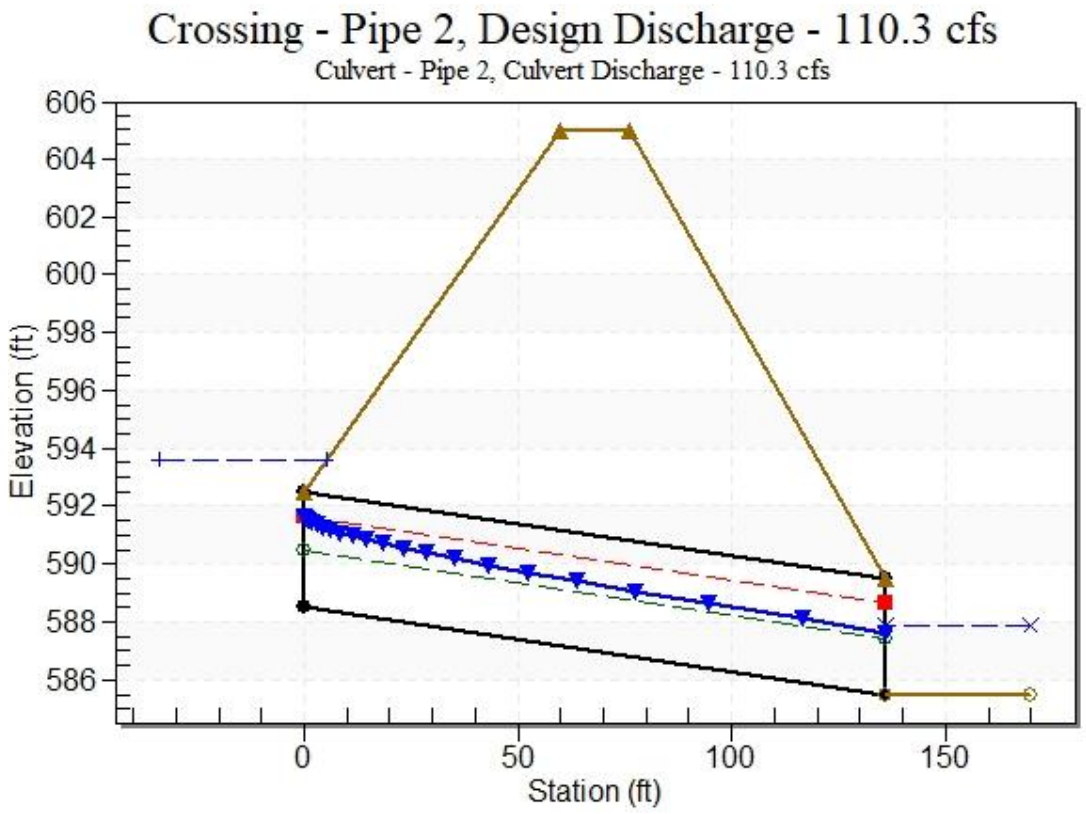
Culvert Length: 136.03 ft, Culvert Slope: 0.0221

****

Culvert Performance Curve Plot: Pipe 2



Water Surface Profile Plot for Culvert: Pipe 2



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 5 - Summary of Culvert Flows at Crossing: Pipe 2

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pipe 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
593.13	50	98.40	98.40	0.00	1
593.60	100	110.30	110.30	0.00	1
605.00	Overtopping	268.76	268.76	0.00	Overtopping

Rating Curve Plot for Crossing: Pipe 2

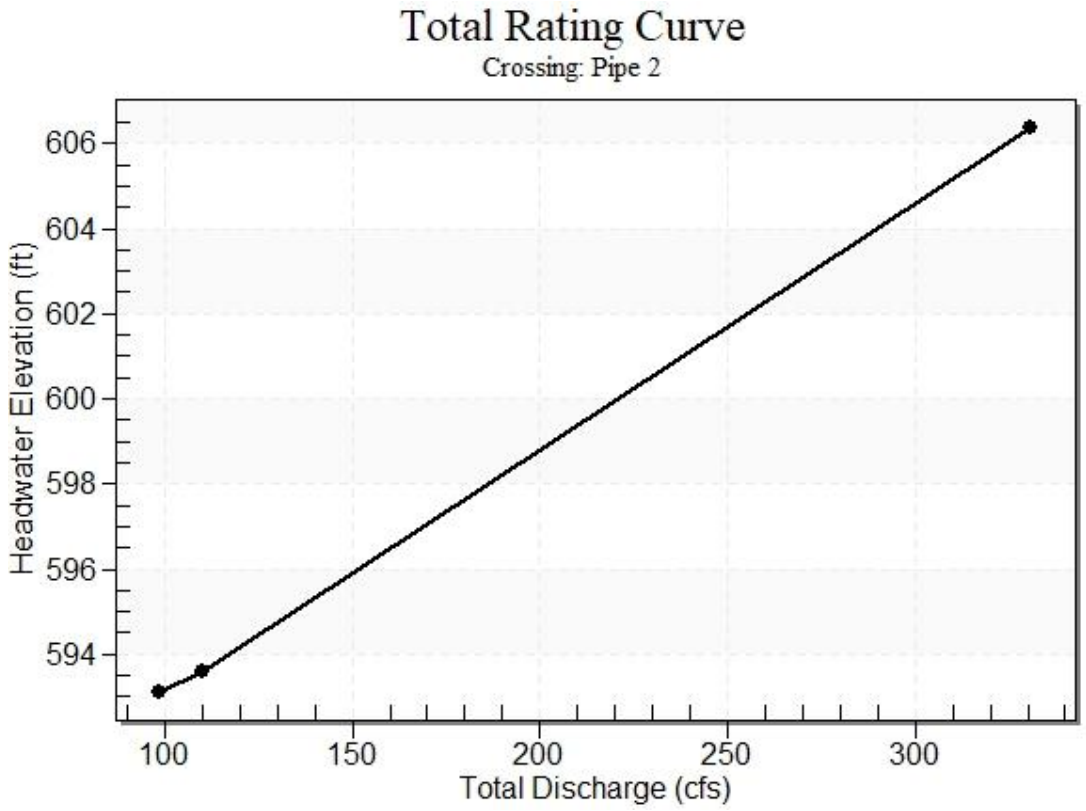


Table 6 - Downstream Channel Rating Curve (Crossing: Pipe 2)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
98.40	587.74	2.24	5.19	1.40	0.76
110.30	587.86	2.36	5.35	1.47	0.76

Tailwater Channel Data - Pipe 2

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 4.00 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 585.50 ft

Culvert Data Summary - Pipe 3

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 7 - Culvert Summary Table: Pipe 3

Discharge Names	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)
50	49.00	49.00	599.24	3.536	1.565	5-S2n	1.430	2.279	1.528	1.735	13.540	4.367
100	54.20	54.20	599.56	3.860	1.940	5-S2n	1.517	2.390	1.630	1.820	13.818	4.483

****

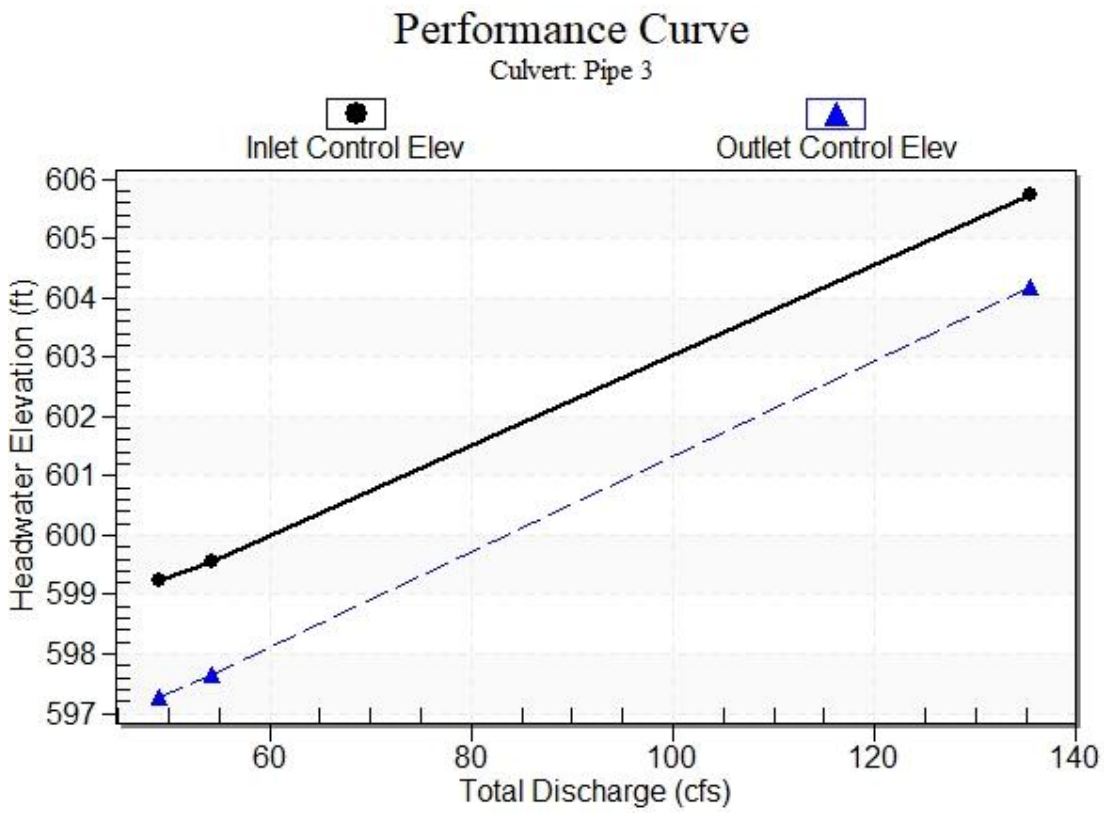
Straight Culvert

Inlet Elevation (invert): 595.70 ft, Outlet Elevation (invert): 593.20 ft

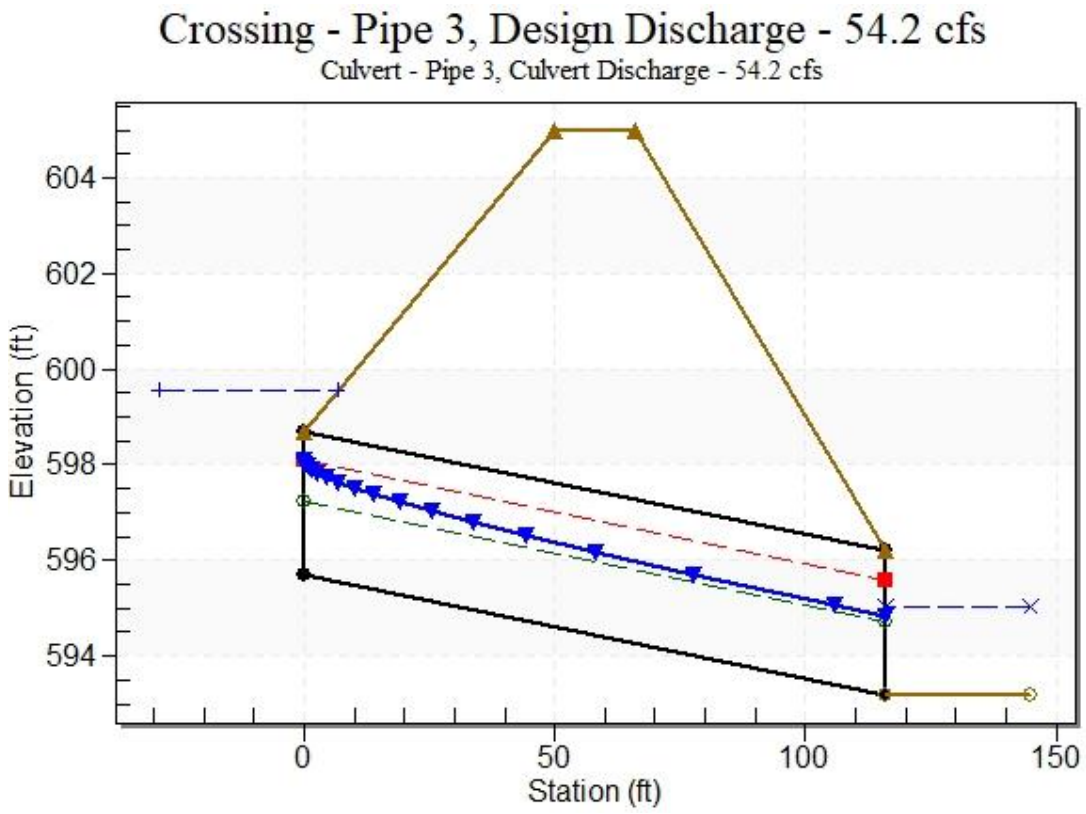
Culvert Length: 116.03 ft, Culvert Slope: 0.0216

****

Culvert Performance Curve Plot: Pipe 3



Water Surface Profile Plot for Culvert: Pipe 3



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 8 - Summary of Culvert Flows at Crossing: Pipe 3

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pipe 3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
599.24	50	49.00	49.00	0.00	1
599.56	100	54.20	54.20	0.00	1
605.00	Overtopping	110.88	110.88	0.00	Overtopping

Rating Curve Plot for Crossing: Pipe 3

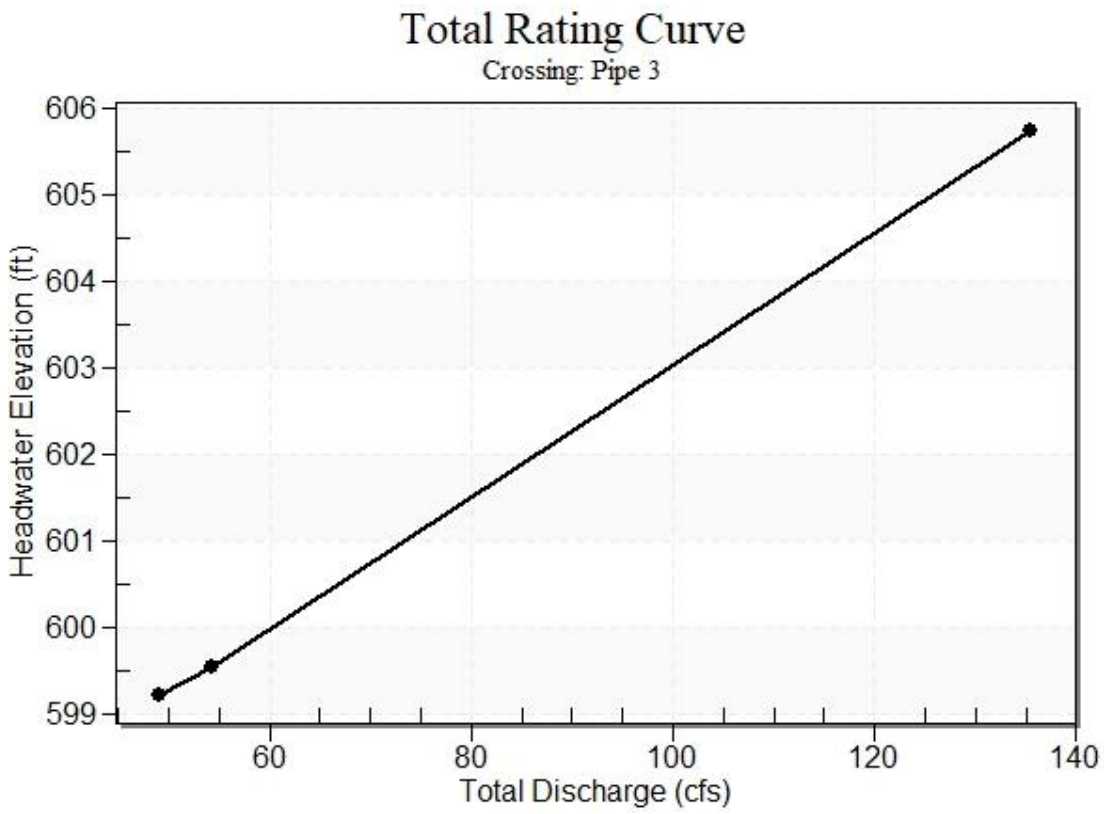


Table 9 - Downstream Channel Rating Curve (Crossing: Pipe 3)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
49.00	594.93	1.73	4.37	1.08	0.72
54.20	595.02	1.82	4.48	1.14	0.73

Tailwater Channel Data - Pipe 3

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 3.00 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 593.20 ft

Culvert Data Summary - Pipe 4

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 10 - Culvert Summary Table: Pipe 4

Discharge Names	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)
50	65.20	65.20	591.33	3.834	2.546	5-S2n	1.943	2.531	2.019	1.905	11.341	4.683
100	72.10	72.10	591.65	4.148	3.388	5-S2n	2.071	2.660	2.151	2.000	11.626	4.808

****

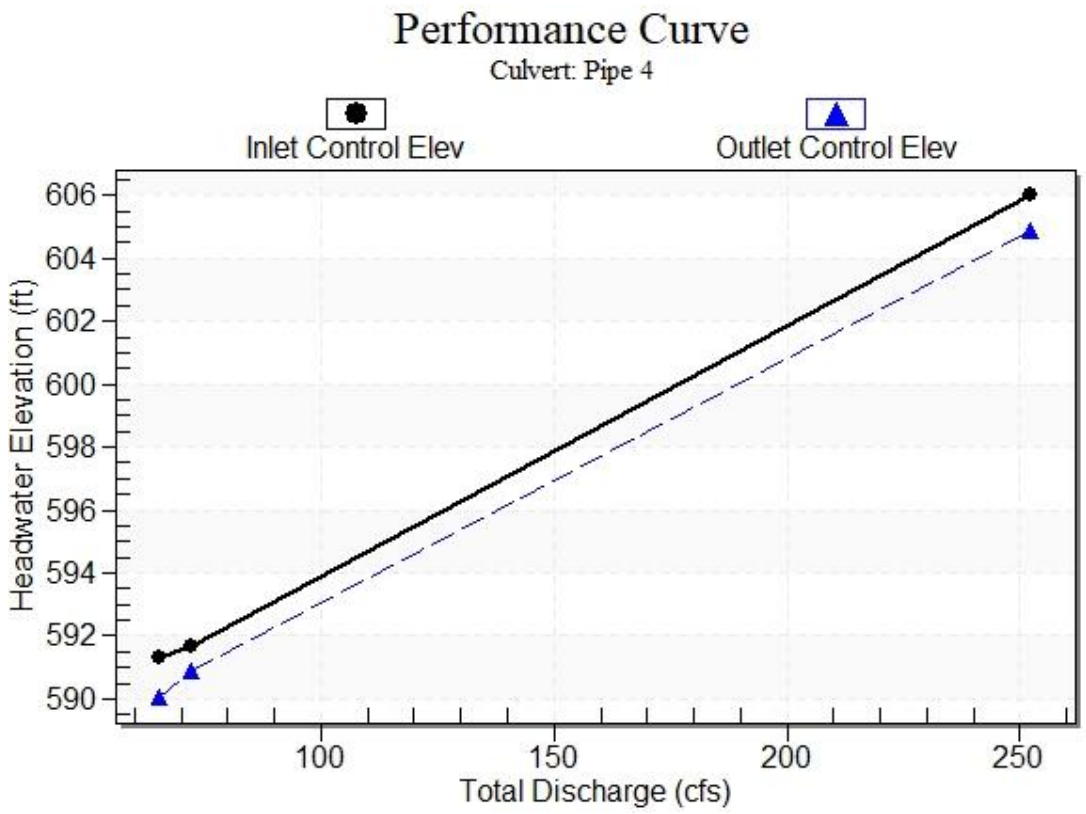
Straight Culvert

Inlet Elevation (invert): 587.50 ft, Outlet Elevation (invert): 586.20 ft

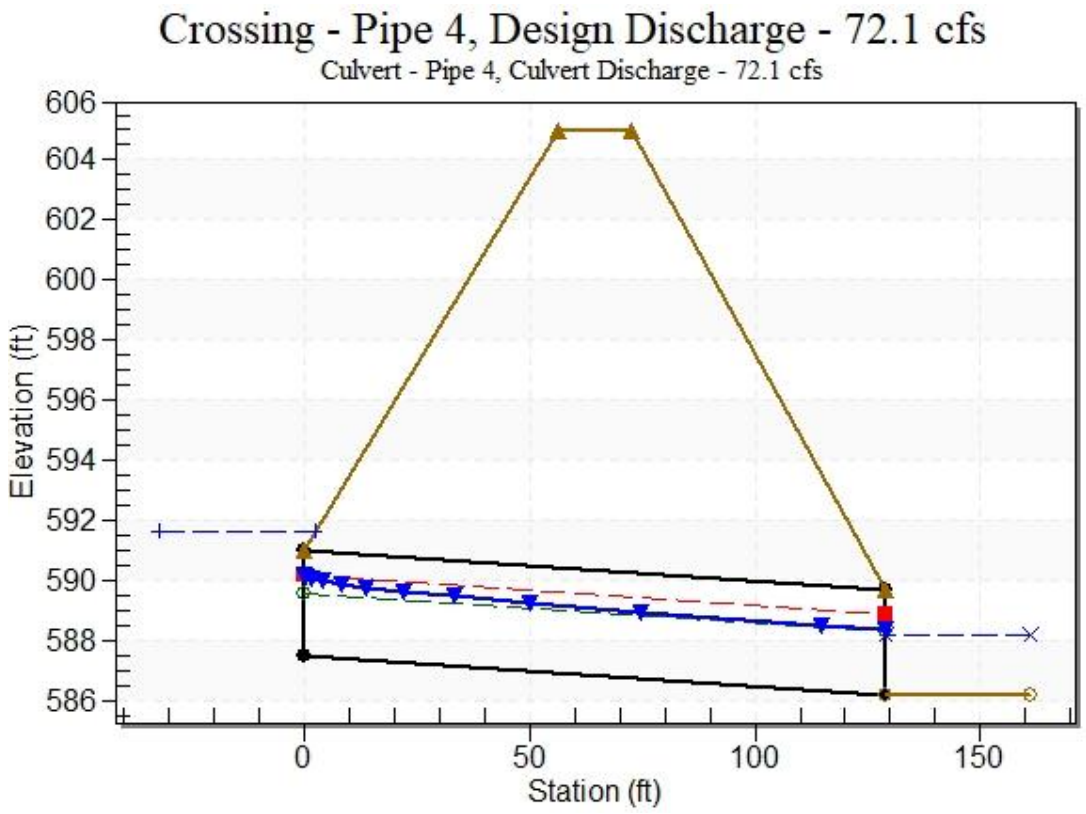
Culvert Length: 129.01 ft, Culvert Slope: 0.0101

****

Culvert Performance Curve Plot: Pipe 4



Water Surface Profile Plot for Culvert: Pipe 4



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 11 - Summary of Culvert Flows at Crossing: Pipe 4

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pipe 4 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
591.33	50	65.20	65.20	0.00	1
591.65	100	72.10	72.10	0.00	1
605.00	Overtopping	214.16	214.16	0.00	Overtopping

Rating Curve Plot for Crossing: Pipe 4

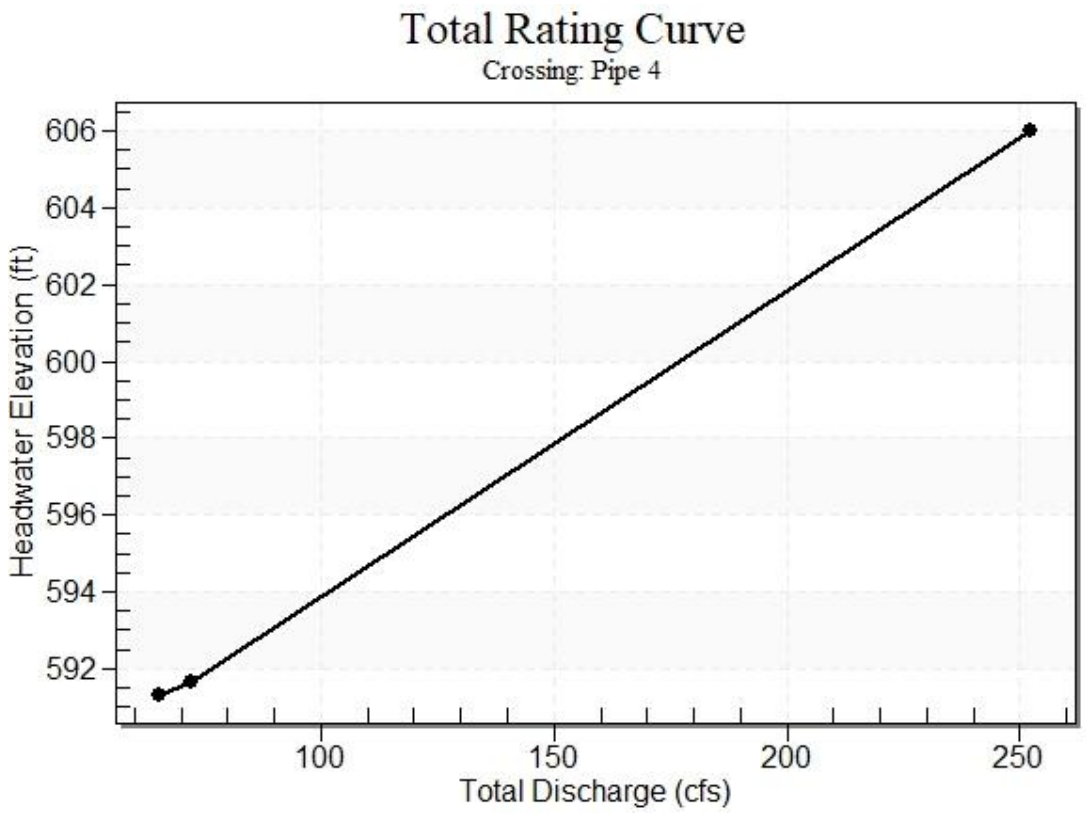


Table 12 - Downstream Channel Rating Curve (Crossing: Pipe 4)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
65.20	588.10	1.90	4.68	1.19	0.74
72.10	588.20	2.00	4.81	1.25	0.74

Tailwater Channel Data - Pipe 4

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 3.50 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 586.20 ft

Culvert Data Summary - Pipe 5

Barrel Shape: Circular

Barrel Diameter: 5.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 13 - Culvert Summary Table: Pipe 5

Discharge Names	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)
50	169.60	169.60	585.72	5.717	0.0*	5-S2n	2.127	3.733	2.127	2.727	21.303	5.948
100	190.10	190.10	586.30	6.296	0.0*	5-S2n	2.268	3.943	2.268	2.882	21.950	6.128

* Full Flow Headwater elevation is below inlet invert.

****

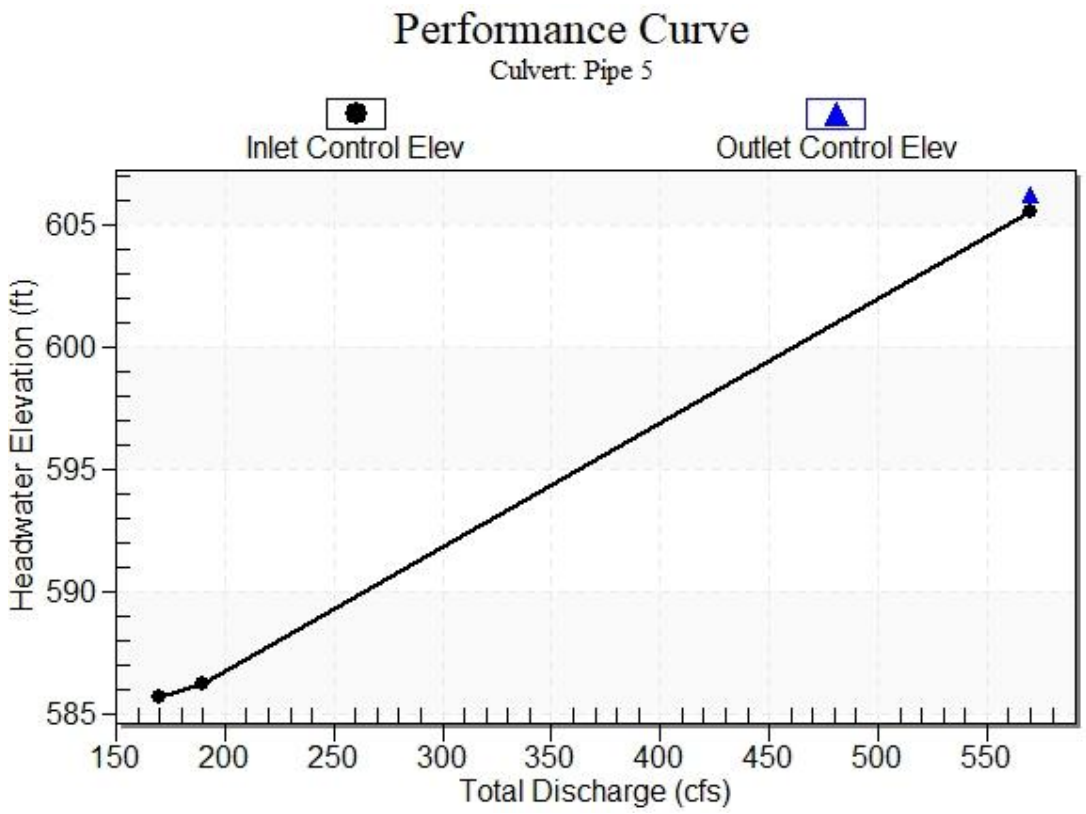
Straight Culvert

Inlet Elevation (invert): 580.00 ft, Outlet Elevation (invert): 559.90 ft

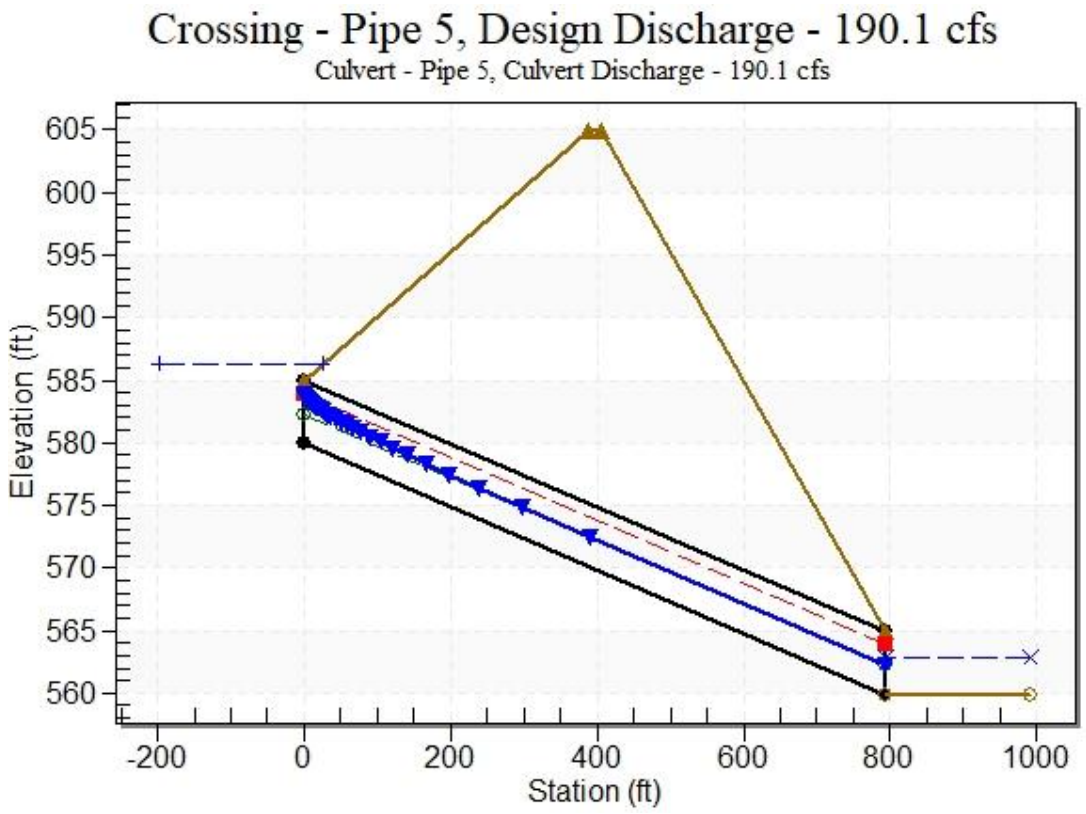
Culvert Length: 794.25 ft, Culvert Slope: 0.0253

****

Culvert Performance Curve Plot: Pipe 5



Water Surface Profile Plot for Culvert: Pipe 5



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 14 - Summary of Culvert Flows at Crossing: Pipe 5

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pipe 5 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
585.72	50	169.60	169.60	0.00	1
586.30	100	190.10	190.10	0.00	1
605.00	Overtopping	521.33	521.33	0.00	Overtopping

Rating Curve Plot for Crossing: Pipe 5

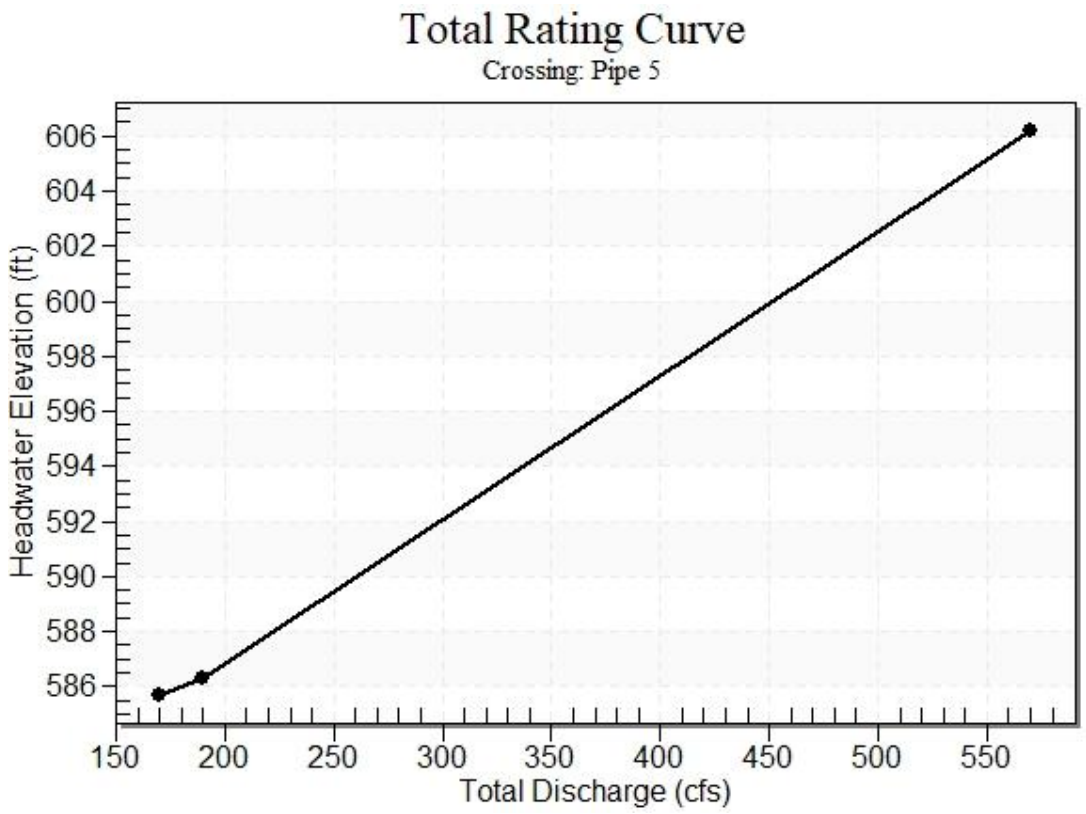


Table 15 - Downstream Channel Rating Curve (Crossing: Pipe 5)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
169.60	562.63	2.73	5.95	1.70	0.78
190.10	562.78	2.88	6.13	1.80	0.79

Tailwater Channel Data - Pipe 5

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 559.90 ft

Culvert Data Summary - Pipe 6

Barrel Shape: Circular

Barrel Diameter: 4.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 22 - Culvert Summary Table: Pipe 6

Discharge Names	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)
50	108.80	108.80	560.90	4.502	0.0*	5-S2n	1.730	3.068	1.842	2.267	17.761	5.311
100	120.50	120.50	561.24	4.841	0.0*	5-S2n	1.829	3.231	1.957	2.383	18.150	5.457

* Full Flow Headwater elevation is below inlet invert.

****

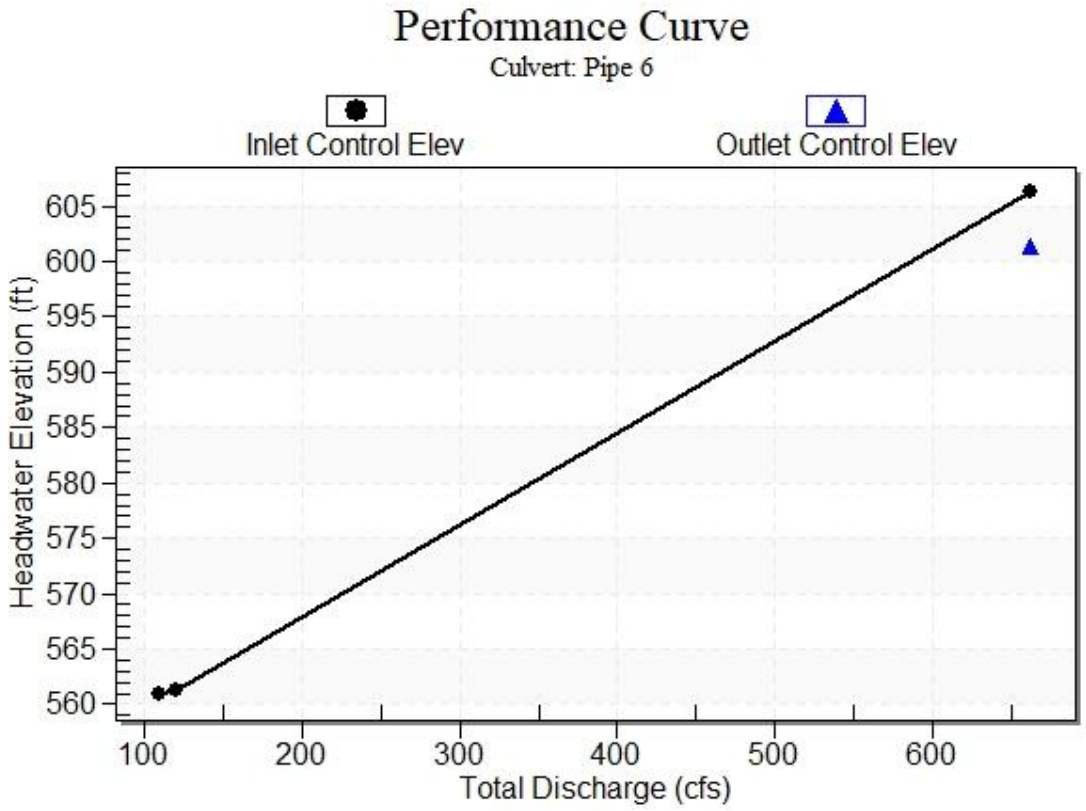
Straight Culvert

Inlet Elevation (invert): 556.40 ft, Outlet Elevation (invert): 551.00 ft

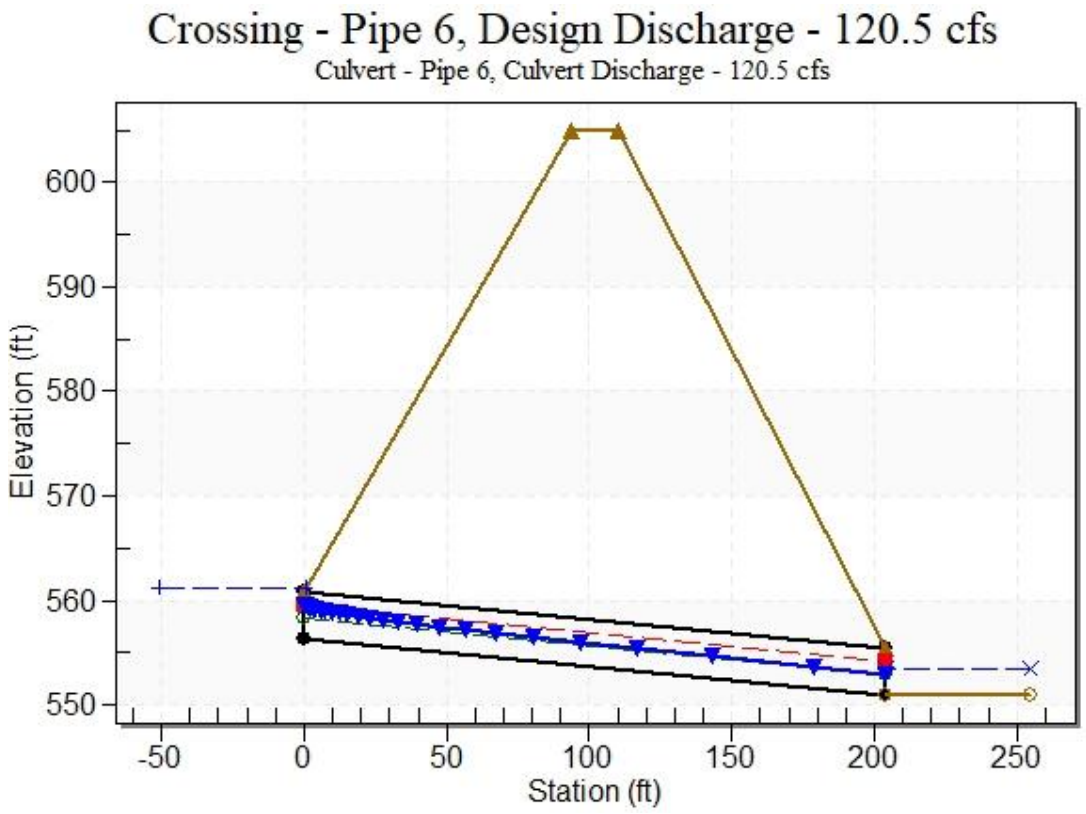
Culvert Length: 204.07 ft, Culvert Slope: 0.0265

****

Culvert Performance Curve Plot: Pipe 6



Water Surface Profile Plot for Culvert: Pipe 6



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 23 - Summary of Culvert Flows at Crossing: Pipe 6

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pipe 6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
560.90	50	108.80	108.80	0.00	1
561.24	100	120.50	120.50	0.00	1
605.00	Overtopping	608.46	608.46	0.00	Overtopping

Rating Curve Plot for Crossing: Pipe 6

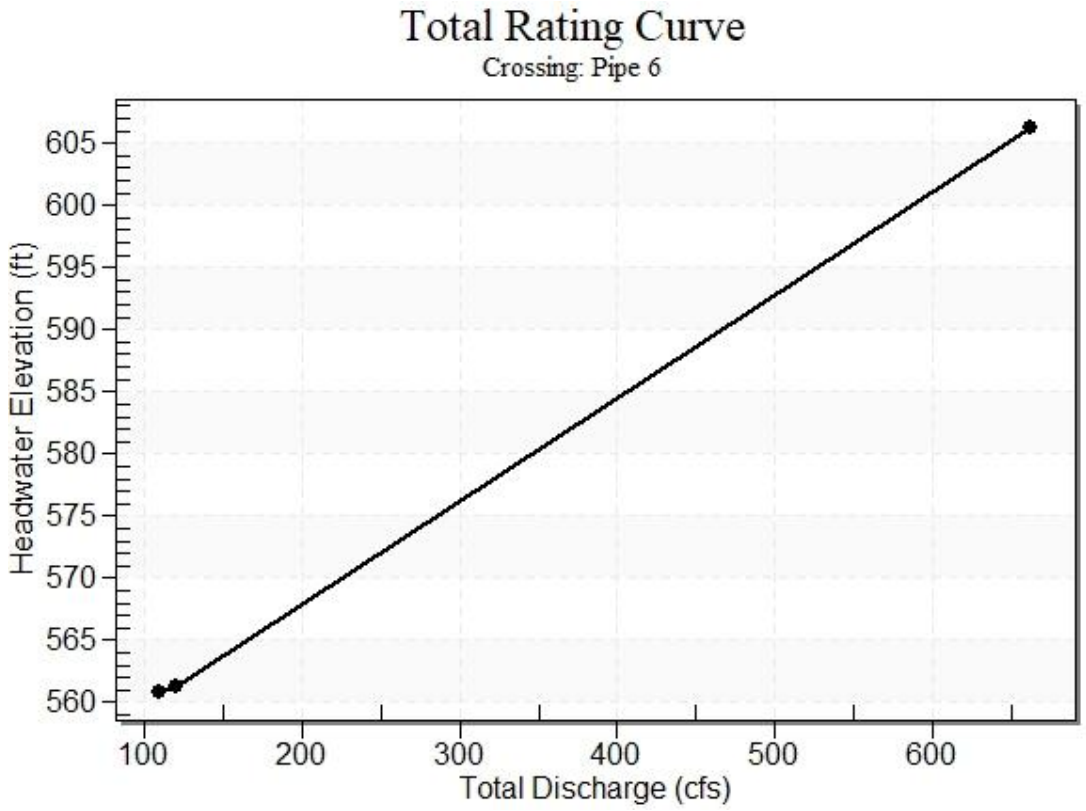


Table 24 - Downstream Channel Rating Curve (Crossing: Pipe 6)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
108.80	553.27	2.27	5.31	1.41	0.76
120.50	553.38	2.38	5.46	1.49	0.77

Tailwater Channel Data - Pipe 6

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 4.50 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 551.00 ft

Culvert Data Summary - Pipe 7

Barrel Shape: Circular

Barrel Diameter: 4.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 25 - Culvert Summary Table: Pipe 7

Discharge Names	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)
50	120.10	120.10	554.86	4.859	1.249	5-S2n	2.225	3.226	2.279	2.379	14.856	5.452
100	132.90	132.90	555.25	5.254	2.424	5-S2n	2.363	3.392	2.429	2.499	15.173	5.599

****

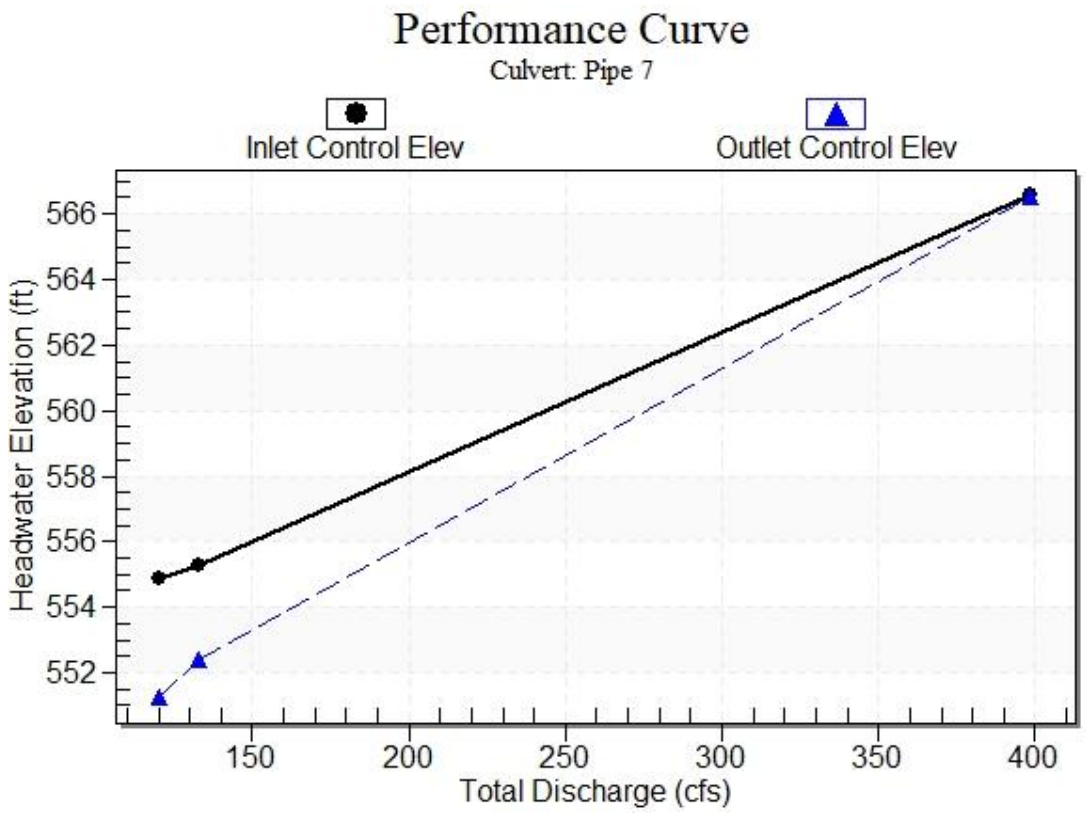
Straight Culvert

Inlet Elevation (invert): 550.00 ft, Outlet Elevation (invert): 546.00 ft

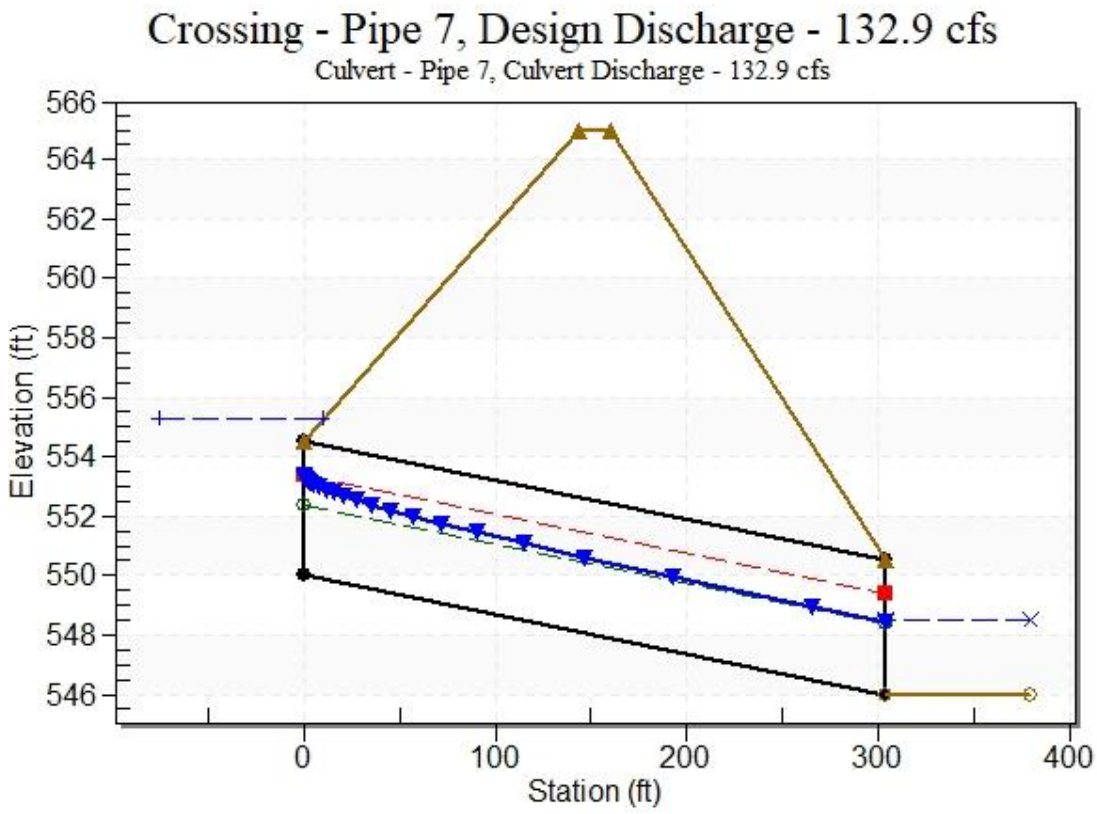
Culvert Length: 304.03 ft, Culvert Slope: 0.0132

****

Culvert Performance Curve Plot: Pipe 7



Water Surface Profile Plot for Culvert: Pipe 7



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 26 - Summary of Culvert Flows at Crossing: Pipe 7

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pipe 7 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
554.86	50	120.10	120.10	0.00	1
555.25	100	132.90	132.90	0.00	1
565.00	Overtopping	318.64	318.64	0.00	Overtopping

Rating Curve Plot for Crossing: Pipe 7

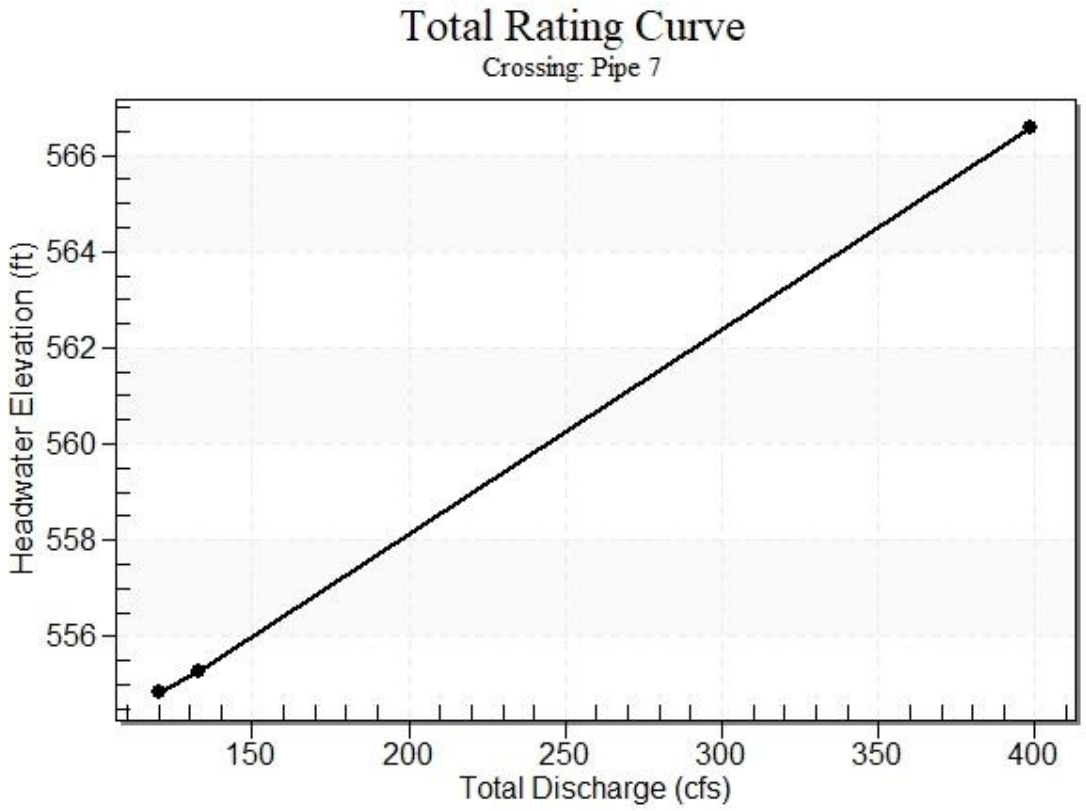


Table 27 - Downstream Channel Rating Curve (Crossing: Pipe 7)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
120.10	548.38	2.38	5.45	1.48	0.77
132.90	548.50	2.50	5.60	1.56	0.77

Tailwater Channel Data - Pipe 7

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 4.50 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 546.00 ft

Culvert Data Summary - Pipe 8

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 16 - Culvert Summary Table: Pipe 8

Discharge Names	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)
50	34.40	34.40	579.15	2.748	0.0*	1-S2n	1.153	1.905	1.156	1.460	13.695	3.979
100	38.10	38.10	579.34	2.935	0.0*	1-S2n	1.219	2.008	1.242	1.535	13.790	4.088

* Full Flow Headwater elevation is below inlet invert.

****

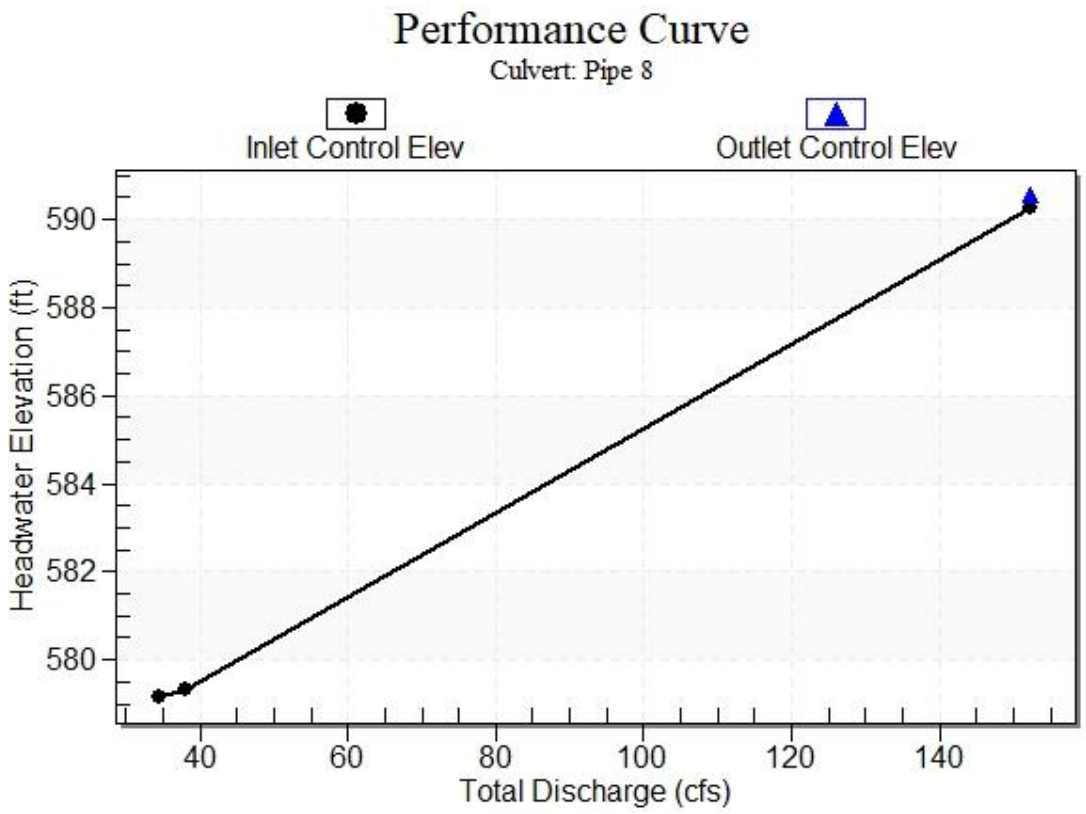
Straight Culvert

Inlet Elevation (invert): 576.40 ft, Outlet Elevation (invert): 570.00 ft

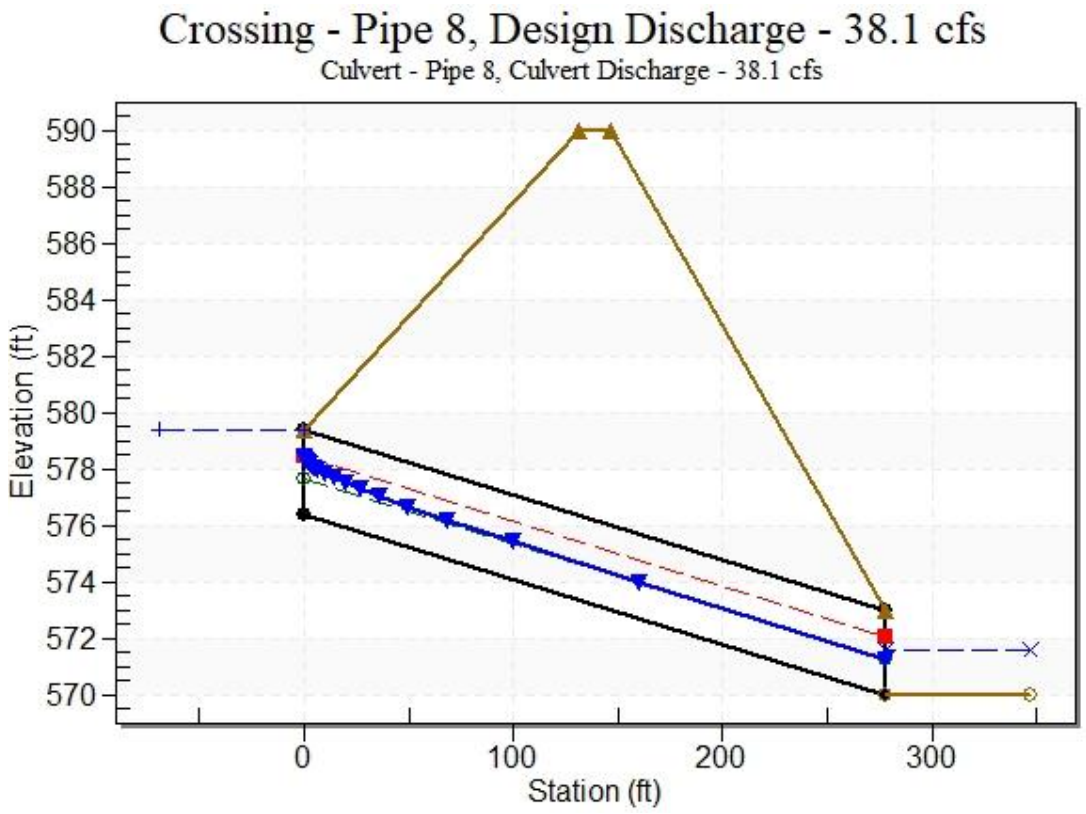
Culvert Length: 278.07 ft, Culvert Slope: 0.0230

****

Culvert Performance Curve Plot: Pipe 8



Water Surface Profile Plot for Culvert: Pipe 8



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 17 - Summary of Culvert Flows at Crossing: Pipe 8

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pipe 8 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
579.15	50	34.40	34.40	0.00	1
579.34	100	38.10	38.10	0.00	1
590.00	Overtopping	137.24	137.24	0.00	Overtopping

Rating Curve Plot for Crossing: Pipe 8

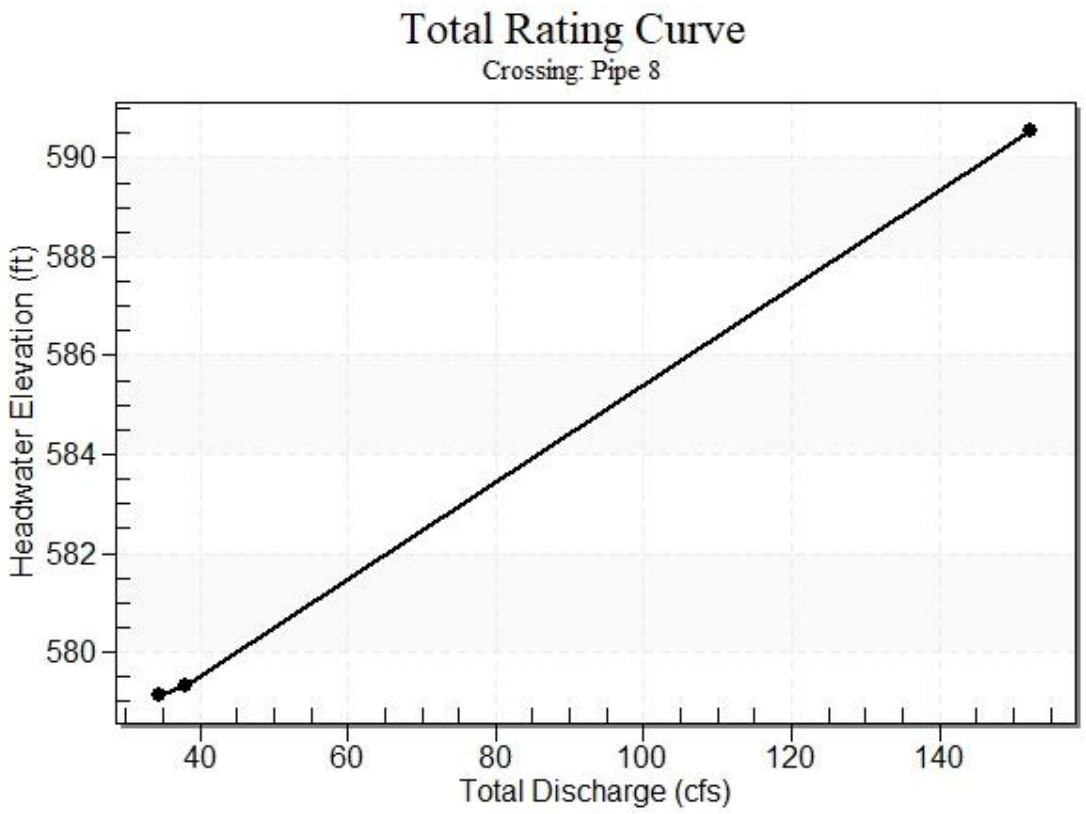


Table 18 - Downstream Channel Rating Curve (Crossing: Pipe 8)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
34.40	571.46	1.46	3.98	0.91	0.71
38.10	571.54	1.54	4.09	0.96	0.71

Tailwater Channel Data - Pipe 8

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 3.00 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 570.00 ft

Culvert Data Summary - Pipe 9

Barrel Shape: Circular

Barrel Diameter: 5.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End in Headwall

Inlet Depression: None

Table 28 - Culvert Summary Table: Pipe 9

Discharge Names	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)
50	192.40	192.40	558.32	5.819	4.180	5-S2n	2.872	3.883	3.104	2.819	13.923	6.128
100	215.50	215.50	558.84	6.338	4.813	5-S2n	3.078	4.109	3.327	2.979	14.340	6.314

****

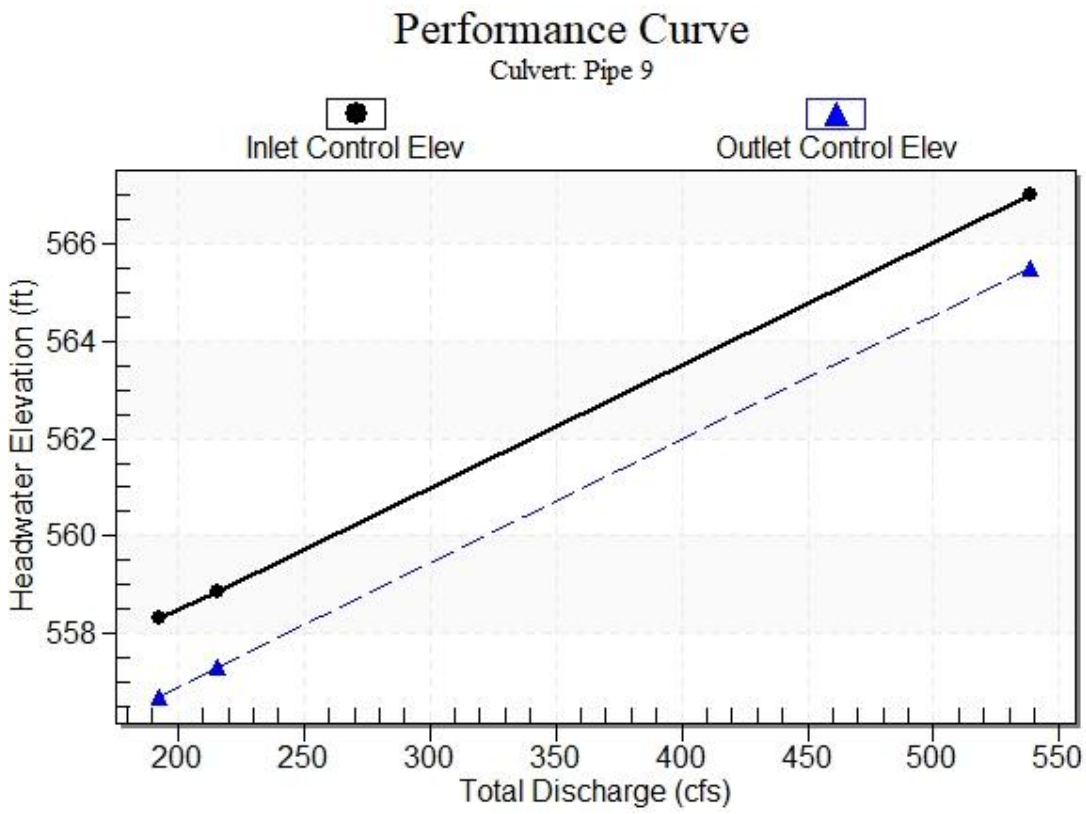
Straight Culvert

Inlet Elevation (invert): 552.50 ft, Outlet Elevation (invert): 551.20 ft

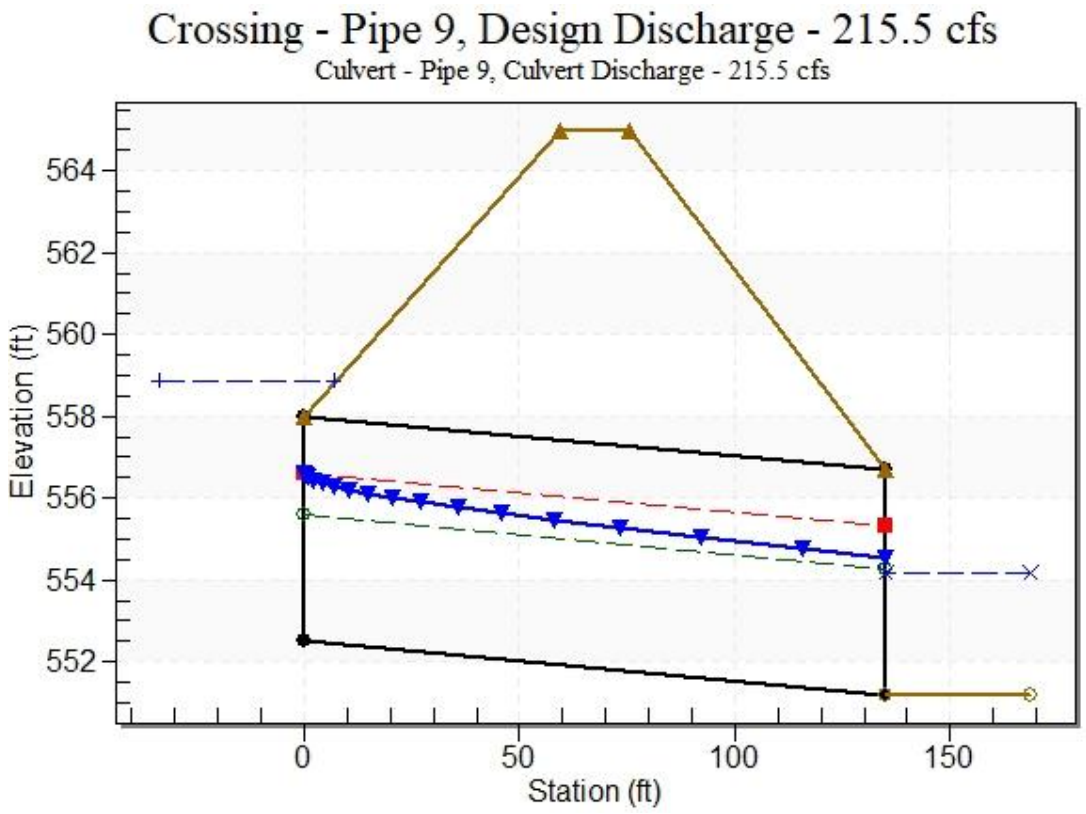
Culvert Length: 135.01 ft, Culvert Slope: 0.0096

****

Culvert Performance Curve Plot: Pipe 9



Water Surface Profile Plot for Culvert: Pipe 9



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 29 - Summary of Culvert Flows at Crossing: Pipe 9

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pipe 9 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
558.32	50	192.40	192.40	0.00	1
558.84	100	215.50	215.50	0.00	1
565.00	Overtopping	404.90	404.90	0.00	Overtopping

Rating Curve Plot for Crossing: Pipe 9

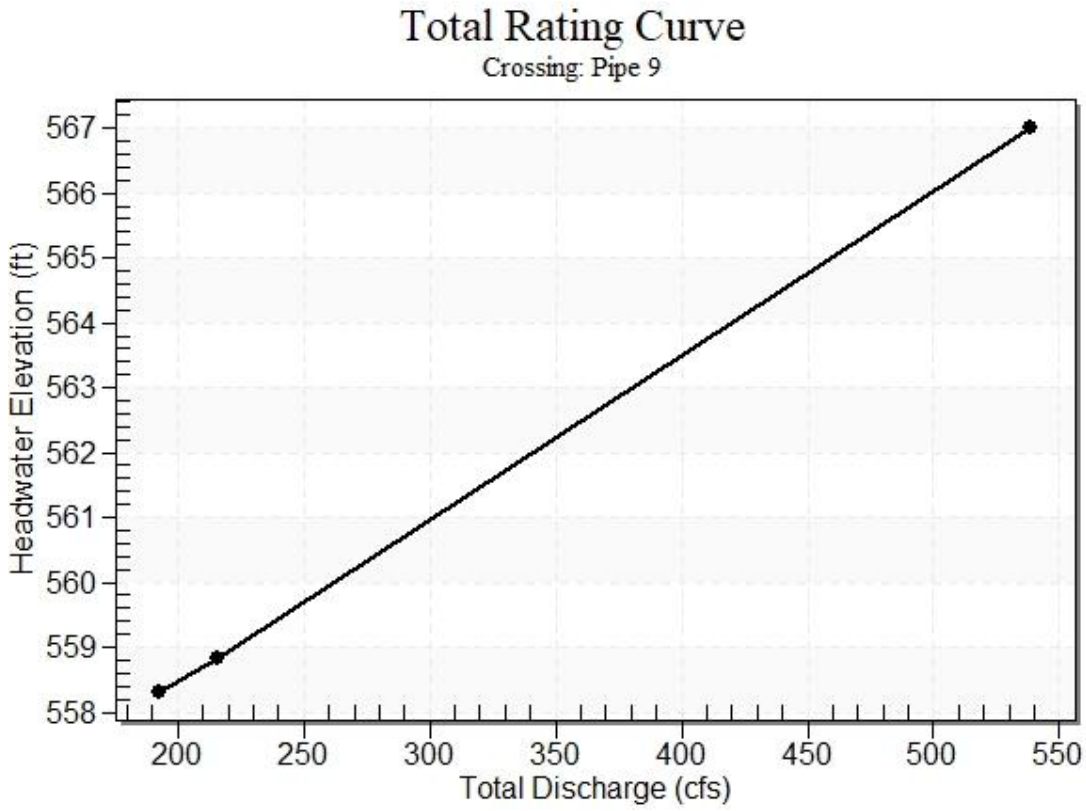


Table 30 - Downstream Channel Rating Curve (Crossing: Pipe 9)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
192.40	554.02	2.82	6.13	1.76	0.79
215.50	554.18	2.98	6.31	1.86	0.79

Tailwater Channel Data - Pipe 9

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.50 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 551.20 ft

Culvert Data Summary - EX 42

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End Projecting

Inlet Depression: None

Table 19 - Culvert Summary Table: EX 42

Discharge Names	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)
50	93.20	93.20	580.37	5.331	0.0*	5-S2n	1.808	2.986	1.859	1.616	17.946	10.065
100	104.50	99.64	580.80	5.756	0.073	5-S2n	1.882	3.064	1.939	1.705	18.215	10.367

* Full Flow Headwater elevation is below inlet invert.

****

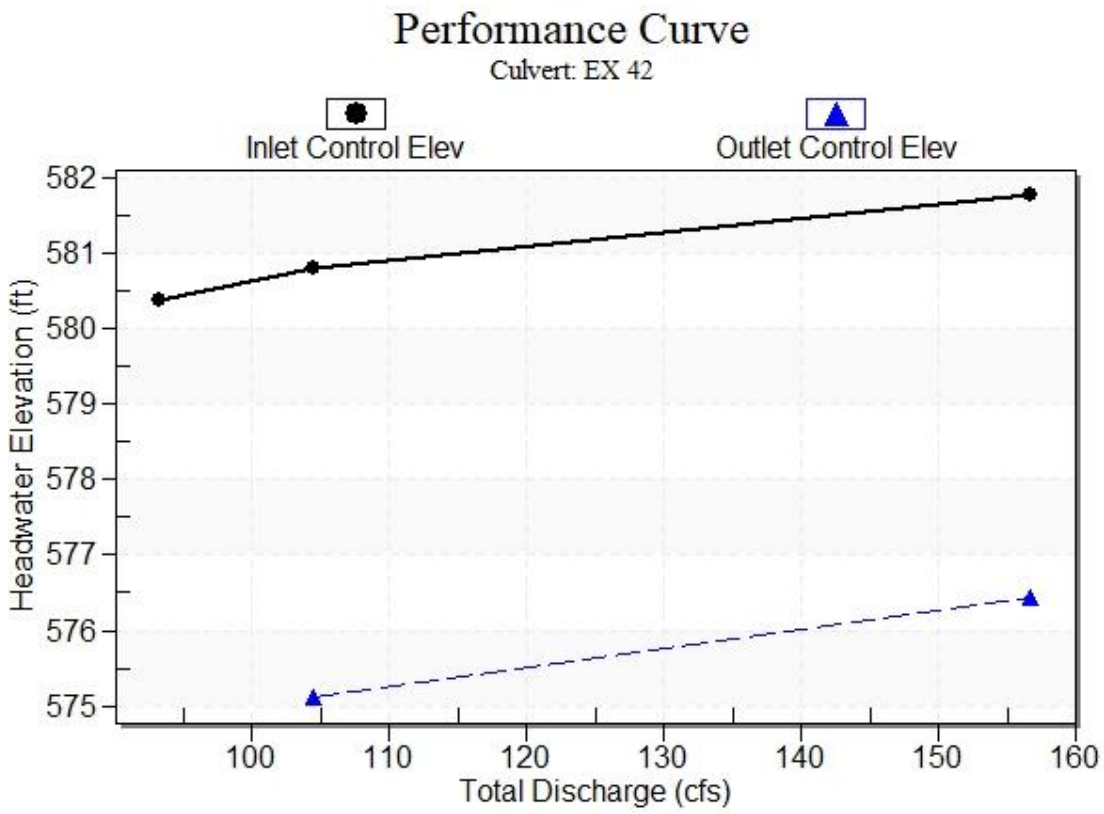
Straight Culvert

Inlet Elevation (invert): 575.04 ft, Outlet Elevation (invert): 567.40 ft

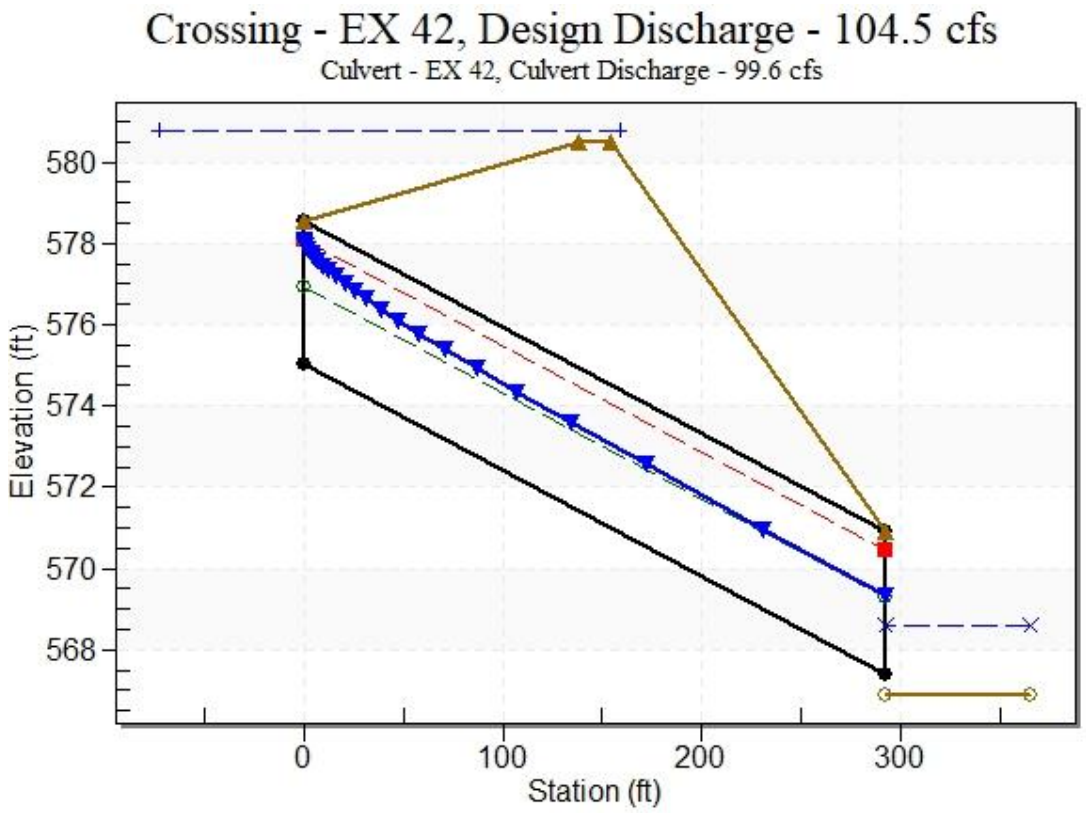
Culvert Length: 292.60 ft, Culvert Slope: 0.0261

****

Culvert Performance Curve Plot: EX 42



Water Surface Profile Plot for Culvert: EX 42



Crossing Discharge Data

Discharge Selection Method: User Defined

Table 20 - Summary of Culvert Flows at Crossing: EX 42

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	EX 42 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
580.37	50	93.20	93.20	0.00	1
580.80	100	104.50	99.64	4.82	5
580.50	Overtopping	95.21	95.21	0.00	Overtopping

Rating Curve Plot for Crossing: EX 42

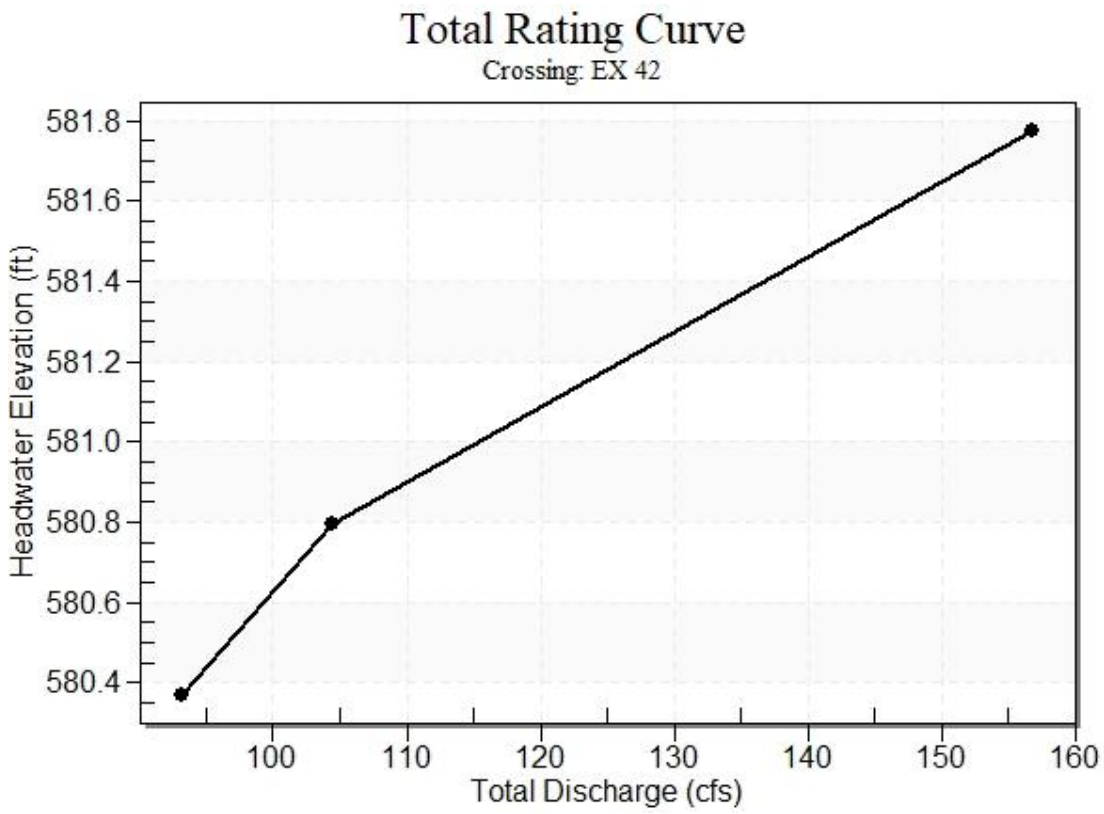


Table 21 - Downstream Channel Rating Curve (Crossing: EX 42)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
93.20	568.52	1.62	10.07	6.05	1.75
104.50	568.61	1.71	10.37	6.38	1.76

Tailwater Channel Data - EX 42

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 2.50 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0600

Channel Manning's n: 0.0350

Channel Invert Elevation: 566.90 ft

APPENDIX C

CONCEPTUAL DRAINAGE PLANS

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	YORK	P038652	I-77	7

MATCHLINE STA. 538+50.00
SEE SHEET NO. 6

MATCHLINE STA. 553+50.00
SEE SHEET NO. 8

MATCHLINE STA. 552+50.00
SEE SHEET NO. 11

I-77

RAMP 2

RAMP 1

PRIVATE POND BY OTHERS

PIPE 3 (RAMP 1)
DA = 7 AC.
RECOMMENDED
STRUCTURE = 36" RCP

10' R/W FOR DRAINAGE PB 67 PG 29 PB 410-PG 1

PRES.150' R/W FILE NO.46546J C.P.R.

NEW 175' R/W (I-77)

NEW 105' R/W
RAMP 1 = NEW TRANS. R/W (I-77)

NEW 110' R/W

BOUNDARY BASED OFF YORK COUNTY GIS DOES NOT CONSTITUTE AS A BOUNDARY SURVEY

STA. 540+53.77
BEGIN NEW C/A
TIE TO EXIST.

SCALE IN FEET
0 50 100 200

CONCEPTUAL DRAINAGE PLANS AND COMMENTS BY:
KIMLEY-HORN AND ASSOCIATES

THE PROPOSED STRUCTURES AND PIPES SHOWN ARE CONCEPTUAL AND ARE INCLUDED AS A GENERAL UNDERSTANDING OF STORMWATER ROUTING.

PLANS PREPARED BY:

NEEL-SCHAFFER
Solutions you can build upon

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			

TOPO. _____ DATE _____
DWG. _____ DATE _____ GROUP ____ - ____
R/W _____ DATE _____

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

I-77 INTERCHANGE AT EXIT 81
PLAN SHEET

SCALE 1"=50' RTE. I-77 DWG. NO. 7

$$user$$
$$$$$$path$$$$$$$$$filename$$$$$$$$
$$date$$$$

BORDER_50.DGN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	YORK	P038652	I-77	8

PIPE 6 (RAMP 2)
DA = 24 AC.
RECOMMENDED STRUCTURE = 54" RCP

CROSSOVER ROAD

PIPE 8 (CROSSOVER ROAD)
DA = 8 AC.
RECOMMENDED STRUCTURE = 36" RCP

MATCHLINE STA. 39+50.00
SEE SHEET NO. 12

EXTEND EXISTING 42"
RCP DUE TO WIDENING

MATCHLINE STA. 566+50.00
SEE SHEET NO. 12

PROPOSED BASE DITCH TO CONVEY WATER FROM OUTLET OF PIPE 5 TO PIPE 9 UNDER RAMP 3 AND ULTIMATELY TO PROPOSED STORMWATER CONTROL MEASURE. DITCH TO BE SIZED TO CONVEY 50 YEAR STORM EVENT AT A MINIMUM.

RAMP 2

PROPOSED JB AND END OF BORE AND JACK PIPE UNDER I-77

I-77

MATCHLINE STA. 553+50.00
SEE SHEET NO. 7

MATCHLINE STA. 568+50.00
SEE SHEET NO. 9

THE PROPOSED PIPE UNDER I-77 WOULD BE INSTALLED USING BORE AND JACK CONSTRUCTION TO LIMIT THE IMPACT TO TRAFFIC CONTROL ALONG HEAVILY TRAVELED I-77

PROPOSED JB AND BEGIN OF BORE AND JACK PIPE UNDER I-77

PERMISSION NEEDED FOR CONSTRUCTION OF PIPE 5

EXISTING 42" RCP CROSSPIPE TO BE RETAINED TO ONLY CONVEY RUNOFF FROM DIRECTLY CONNECTED STORM DRAIN SYSTEMS ALONG I-77

PIPE 5 (CROSSOVER ROAD & I-77)
DA = 69 AC.
RECOMMENDED STRUCTURE = 60" RCP

RAMP 4

PIPE 4 (RAMP 4)
DA = 10 AC.
RECOMMENDED STRUCTURE = 42" RCP

MATCHLINE STA. 554+50.00
SEE SHEET NO. 11

CROSSOVER ROAD

MATCHLINE STA. 32+50.00
SEE SHEET NO. 11

RAMP 4

SCALE IN FEET
0 50 100 200

$$user$$
$$$$$$path$$$$$$$$$$filename$$$$$$$$$
$$$$date$$$$

CONCEPTUAL DRAINAGE PLANS AND COMMENTS BY:
KIMLEY-HORN AND ASSOCIATES

THE PROPOSED STRUCTURES AND PIPES SHOWN ARE CONCEPTUAL AND ARE INCLUDED AS A GENERAL UNDERSTANDING OF STORMWATER ROUTING.

PLANS PREPARED BY:
NEEL-SCHAFFER
Solutions you can build upon

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			

TOPO. _____ DATE _____
DWG. _____ DATE _____ GROUP ____ - ____
R/W _____ DATE _____

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

I-77 INTERCHANGE AT EXIT 81
PLAN SHEET

SCALE 1"=50' RTE. I-77 DWG. NO. 8

BORDER_50.DGN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	YORK	P038652	I-77	9

PIPE 7 (RAMP 3)
DA = 27 AC.
RECOMMENDED STRUCTURE = 54" RCP

UNNAMED TRIBUTARY
TO MANCHESTER CREEK

SITE 1
PRE VS. POST ANALYSIS POINT
PRE AND POST DISCHARGES TO BE EQUAL AT THIS POINT THROUGH USE OF DETENTION DOWNSTREAM OF PIPE 9. EXACT LOCATION OF ANALYSIS POINT WILL VARY DEPENDING ON PROPOSED DETENTION FOOTPRINT
PRE Q10 = 120 CFS
PRE Q100 = 198 CFS

RAMP 3

PIPE 9 (RAMP 3)
DA = 78 AC.
RECOMMENDED STRUCTURE = 66" RCP

I-77

RAMP 4

PROPOSED STORMWATER CONTROL MEASURE (SCM) TO BE DESIGNED BY DESIGN BUILD TEAM. FOOTPRINT OF SCM TO BE DETERMINED BASED ON TYPE OF SCM, GRADING, AND DESIGN ELEVATIONS. RIGHT OF WAY TO BE ESTABLISHED BY THE DESIGN BUILD TEAM AFTER BASIN DESIGN FOOTPRINT HAS BEEN DETERMINED. TRACT 18 IN ITS ENTIRETY IS BEING ACQUIRED FOR THE USE OF THE PROPOSED SCM.
SCM DESIGN CONTROL MEASURES SHOULD ACCOUNT FOR MAINTENANCE ACCESS, MAINTAINING A BUFFER FROM UNNAMED TRIBUTARY TO MANCHESTER CREEK AND I-77.

MATCHLINE STA. 568+50.00
SEE SHEET NO. 12

MATCHLINE STA. 568+ 50.00
SEE SHEET NO. 8

MATCHLINE STA. 583+ 50.00
SEE SHEET NO. 10

BOUNDARY BASED OFF YORK COUNTY GIS
DOES NOT CONSTITUTE AS A BOUNDARY SURVEY

SCALE IN FEET
0 50 100 200

$$user$$
$$$$$$pathsssssssssfilenamesssssssss
$$$$date$$$$

CONCEPTUAL DRAINAGE PLANS AND COMMENTS BY:
KIMLEY-HORN AND ASSOCIATES

THE PROPOSED STRUCTURES AND PIPES SHOWN ARE CONCEPTUAL AND ARE INCLUDED AS A GENERAL UNDERSTANDING OF STORMWATER ROUTING.

PLANS PREPARED BY:
NEEL-SCHAFFER
Solutions you can build upon

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			

TOPO. _____ DATE _____
DWG. _____ DATE _____ GROUP ____ - ____
R/W _____ DATE _____

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

I-77 INTERCHANGE AT EXIT 81
PLAN SHEET

SCALE 1"=50' RTE. I-77 DWG. NO. 9

BORDER_50.DGN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	YORK	P038652	I-77	10

TRACT 18 WILL BE ACQUIRED IN ITS ENTIRETY FOR POTENTIAL USE OF THE STORMWATER CONTROL MEASURE. DESIGN BUILD TEAM TO DETERMINE REQUIRED FOOTPRINT OF SCM AND THE FINAL ROW AROUND THE SCM.

SOUTHERN RAILROAD EXISTING CROSSING
2 @ 4' x 4.5' RCBC WITH 2 @ 60" CMP EXTENSIONS ON END

EXISTING 42" CROSS PIPE

I-77

MATCHLINE STA. 583+50.00
SEE SHEET NO. 9

SCALE IN FEET
0 50 100 200

CONCEPTUAL DRAINAGE PLANS AND COMMENTS BY:
KIMLEY-HORN AND ASSOCIATES

THE PROPOSED STRUCTURES AND PIPES SHOWN ARE CONCEPTUAL AND ARE INCLUDED AS A GENERAL UNDERSTANDING OF STORMWATER ROUTING.

PLANS PREPARED BY:
NEEL-SCHAFFER
Solutions you can build upon

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			

TOPO. _____ DATE _____
DWG. _____ DATE _____ GROUP ____ - ____
R/W _____ DATE _____

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

I-77 INTERCHANGE AT EXIT 81
PLAN SHEET

SCALE 1"=50' RTE. I-77 DWG. NO. 10

$$user$$
$$$$$$path$$$$$$$$$$filename$$$$$$$$$
$$$$date$$$$

BORDER_50.DGN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	YORK	P038652	I-77	11

PIPE 2 (RAMP 4)
DA = 46 AC.
RECOMMENDED STRUCTURE = 48" RCP

RAMP 4

RAMP 1

CROSSOVER ROAD

MATCHLINE STA. 552+50.00
SEE SHEET NO. 7

MATCHLINE STA. 554+50.00
SEE SHEET NO. 8

MATCHLINE STA. 32+50.00
SEE SHEET NO. 8

PIPE 1 (RAMP 1)
DA = 43 AC.
RECOMMENDED STRUCTURE = 48" RCP

MATCHLINE STA. 26+50.00
SEE SHEET NO. 13

PROPOSED CAROLINA PANTHERS TRAINING FACILITY

PROPOSED UTILITY EASEMENTS

PROPOSED CONNECTOR ROAD BETWEEN CROSSOVER ROAD AND EDEN TERRACE FROM PANTHERS FACILITY

EXISTING UTILITY EASEMENTS

SCALE IN FEET
0 50 100 200

CONCEPTUAL DRAINAGE PLANS AND COMMENTS BY:
KIMLEY-HORN AND ASSOCIATES

THE PROPOSED STRUCTURES AND PIPES SHOWN ARE CONCEPTUAL AND ARE INCLUDED AS A GENERAL UNDERSTANDING OF STORMWATER ROUTING.

PLANS PREPARED BY:
NEEL-SCHAFFER
Solutions you can build upon

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			

TOPO. _____ DATE _____
DWG. _____ DATE _____ GROUP ____ - ____
R/W _____ DATE _____

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

I-77 INTERCHANGE AT EXIT 81
PLAN SHEET

SCALE 1"=50' RTE. I-77 DWG. NO. 11

$$user$$
$$$$$$pathsssssssssfilenamesssssssss
$$$$date$$$$

BORDER .50.DGN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	YORK	P038652	I-77	12

CROSSOVER ROAD

PARKING LOT CONNECTIVITY IMPACTED BY PROPOSED CROSSOVER ROAD

DHL SUPPLY CHAIN

EXEL-ENERGIZER DISTRIBUTION CENTER

RAMP 3

EXISTING PARCEL FOREBAY AND DETENTION POND IMPACTED BY PROPOSED INTERCHANGE. DESIGN OF THE REVISED STORM SYSTEM IN IMPACTED PARCEL 36 AND THE PARCELS NEW DETENTION POND WILL BE HANDLED BY OTHERS AND WILL STAY WITHIN THE PROPERTY LIMITS OF THE PARCEL.

RAMP 2

MATCHLINE STA. 46+50.00
SEE SHEET NO. 14

MATCHLINE STA. 39+50.00
SEE SHEET NO. 8

MATCHLINE STA. 566+50.00
SEE SHEET NO. 8

MATCHLINE STA. 568+50.00
SEE SHEET NO. 9

SCALE IN FEET
0 50 100 200

CONCEPTUAL DRAINAGE PLANS AND COMMENTS BY:
KIMLEY-HORN AND ASSOCIATES

THE PROPOSED STRUCTURES AND PIPES SHOWN ARE CONCEPTUAL AND ARE INCLUDED AS A GENERAL UNDERSTANDING OF STORMWATER ROUTING.

PLANS PREPARED BY:

NEEL-SCHAFFER
Solutions you can build upon

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			

TOPO. DATE
DWG. DATE GROUP ____ - ____
R/W DATE

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

I-77 INTERCHANGE AT EXIT 81
PLAN SHEET

SCALE 1"=50' RTE. I-77 DWG. NO. 12

RTE. NO.

BORDER_50.DGN

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$$$$$$pathss$$$$$$$$filenames$$$$$$$$
$$$$date$$$$

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	YORK	P038652	I-77	13

PROPOSED CONNECTOR ROAD BETWEEN CROSSOVER ROAD AND EDEN TERRACE FROM PANTHERS FACILITY

PROPOSED UTILITY EASEMENTS

ELECTRICAL & SEWER "T" LOCATION PER PRELIMINARY SITE PLAN PROVIDED BY PROPHOLIS IN SEPT. 2019

NEW IRANS. R/W

NEW 85' R/W

NEW TRANS. R/W

NEW 160' R/W

NEW 105' R/W

NEW 100' R/W

NEW 55' R/W

CROSSOVER ROAD

PROPOSED CAROLINA PANTHERS TRAINING FACILITY

MATCHLINE STA. 26+50.00
SEE SHEET NO. 11

SCALE IN FEET

0 50 100 200

CONCEPTUAL DRAINAGE PLANS AND COMMENTS BY:
KIMLEY-HORN AND ASSOCIATES

THE PROPOSED STRUCTURES AND PIPES SHOWN ARE CONCEPTUAL AND ARE INCLUDED AS A GENERAL UNDERSTANDING OF STORMWATER ROUTING.

PLANS PREPARED BY:

NEEL-SCHAFFER
Solutions you can build upon

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			

TOPO. DATE
DWG. DATE GROUP ____ - ____
R/W DATE

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

I-77 INTERCHANGE AT EXIT 81
PLAN SHEET

SCALE 1"=50' RTE. I-77 DWG. NO. 13

$$user$$
$$$$$$Path$$$$$$$$$$filename$$$$$$$$$
$$$$date$$$$$

BORDER_50.DGN

PROJ. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	YORK	P038652	I-77	M

CONCEPTUAL DRAINAGE LAYOUT SHOWN WITH A TIE IN TO THE EXISTING SYSTEM ALONG PARAGON WAY FOR THE PURPOSES OF MAINTAINING EXISTING DRAINAGE PATTERNS. DESIGN BUILD TEAM RESPONSIBLE FOR FINAL STORM DRAIN SYSTEM LAYOUT INCLUDING REPLACEMENT OF ANY EXISTING DAMAGED STRUCTURES TO BE RETAINED OR CONVERSION OF OLDER STRUCTURES TO CURRENT STRUCTURE TYPES.

DHL SUPPLY CHAIN

PARAGON WAY

CROSSOVER ROAD

EXEL-ENERGIZER DISTRIBUTION CENTER

MATCHLINE STA. 46+50.00
SEE SHEET NO. 12

SCALE IN FEET
0 50 100 200

CONCEPTUAL DRAINAGE PLANS AND COMMENTS BY:
KIMLEY-HORN AND ASSOCIATES

THE PROPOSED STRUCTURES AND PIPES SHOWN ARE CONCEPTUAL AND ARE INCLUDED AS A GENERAL UNDERSTANDING OF STORMWATER ROUTING.

PLANS PREPARED BY:
NEEL-SCHAFFER
Solutions you can build upon

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			

TOPO. _____ DATE _____
DWG. _____ DATE _____ GROUP ____ - ____
R/W _____ DATE _____

SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
ROAD DESIGN COLUMBIA, S.C.

I-77 INTERCHANGE AT EXIT 81
PLAN SHEET

SCALE 1"=50' RTE. I-77 DWG. NO. 14

$$user$$
$$$$$$paths$$$$$$$$filename$$$$$$$$
$$date$$$$

BORDER_50.DGN

APPENDIX D

CONCEPTUAL BRIDGE PLANS

b38652ts.dgn

PIN	SHEET NO.
P038652-B01	1

INDEX OF SHEETS

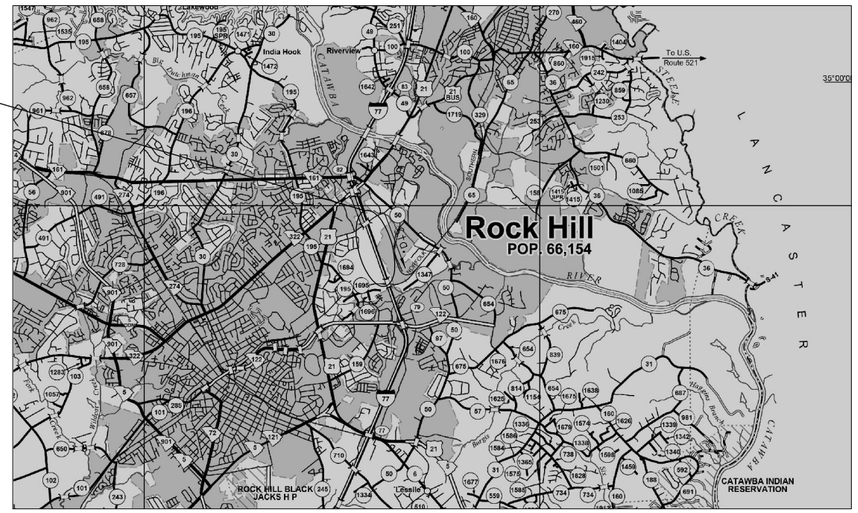
** Not Included In This Submittal

South Carolina Department of Transportation

PROPOSED PLANS FOR

YORK COUNTY
PROJECT ID P038652
I-77 INTERCHANGE NEAR EXIT 82
NEW BRIDGE OVER I-77 AT INTERCHANGE

SITE LOCATION



-N-

Approximate Location of Bridge is

Latitude	34° - 57' - 30" N
Longitude	80° - 58' - 49" W

LAYOUT

NET LENGTH OF ROADWAY	0.685	MILES
NET LENGTH OF BRIDGES	0.057	MILES
NET LENGTH OF PROJECT	0.703	MILES
LENGTH OF EXCEPTIONS	0.000	MILES
GROSS LENGTH OF PROJECT	3.814	MILES

TRAFFIC DATA

2023 ADT 13,800 V.P.D.

2043 ADT 30,900 V.P.D.

TRUCKS 2 %

NOTE: EXCEPT AS MAY OTHERWISE BE SPECIFIED ON THE PLANS OR IN THE SPECIAL PROVISIONS, ALL MATERIALS AND WORKMANSHIP ON THIS PROJECT SHALL CONFORM TO THE SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION (2007 EDITION) AND THE STANDARD DRAWINGS FOR ROAD CONSTRUCTION IN EFFECT AT THE TIME OF LETTING.

PLANS PREPARED BY:

RS&H

ENGINEER OF RECORD

CONCEPTUAL PLANS

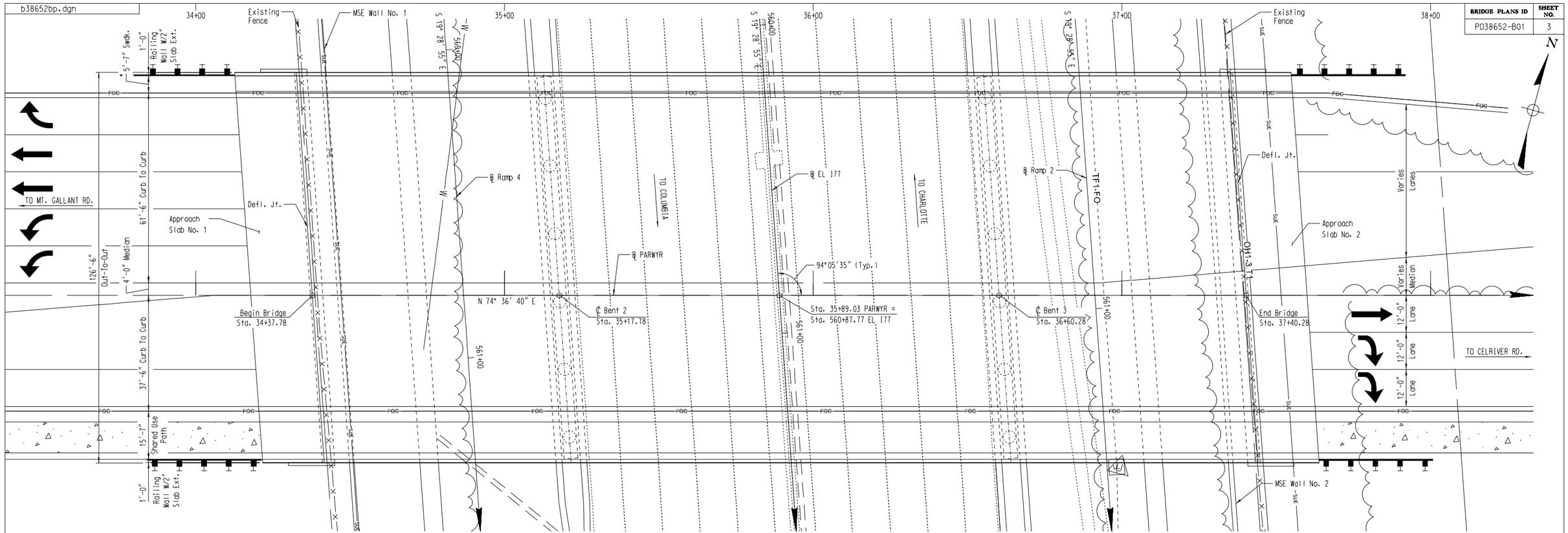
FOR CONSTRUCTION : _____ _____ DATE

REVIEWED	XXX	XX-XX	DATE
DR.	CLG	XXX	CHK
		BY	

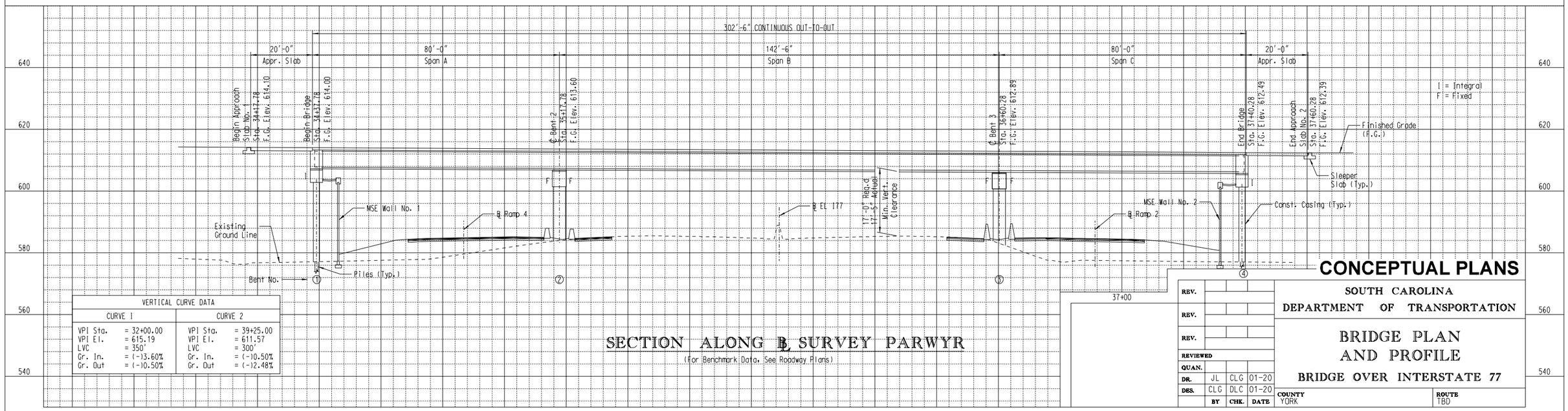
Guido
$Status$

b38652bp.dgn

BRIDGE PLANS ID	SHEET NO.
P038652-B01	3



PLAN



SECTION ALONG ℄ SURVEY PARWYR

(For Benchmark Data, See Roadway Plans)

VERTICAL CURVE DATA			
CURVE 1		CURVE 2	
VPI Sta.	= 32+00.00	VPI Sta.	= 39+25.00
VPI El.	= 615.19	VPI El.	= 611.57
LVC	= 350'	LVC	= 300'
Gr. In.	= (-)3.60%	Gr. In.	= (-)0.50%
Gr. Out	= (-)0.50%	Gr. Out	= (-)2.48%

CONCEPTUAL PLANS

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

BRIDGE PLAN AND PROFILE

BRIDGE OVER INTERSTATE 77

	BY	CHK.	DATE
REV.			
REV.			
REV.			
REVIEWED			
QUAN.			
DR.	JL	CLG	01-20
DES.	CLG	DLC	01-20

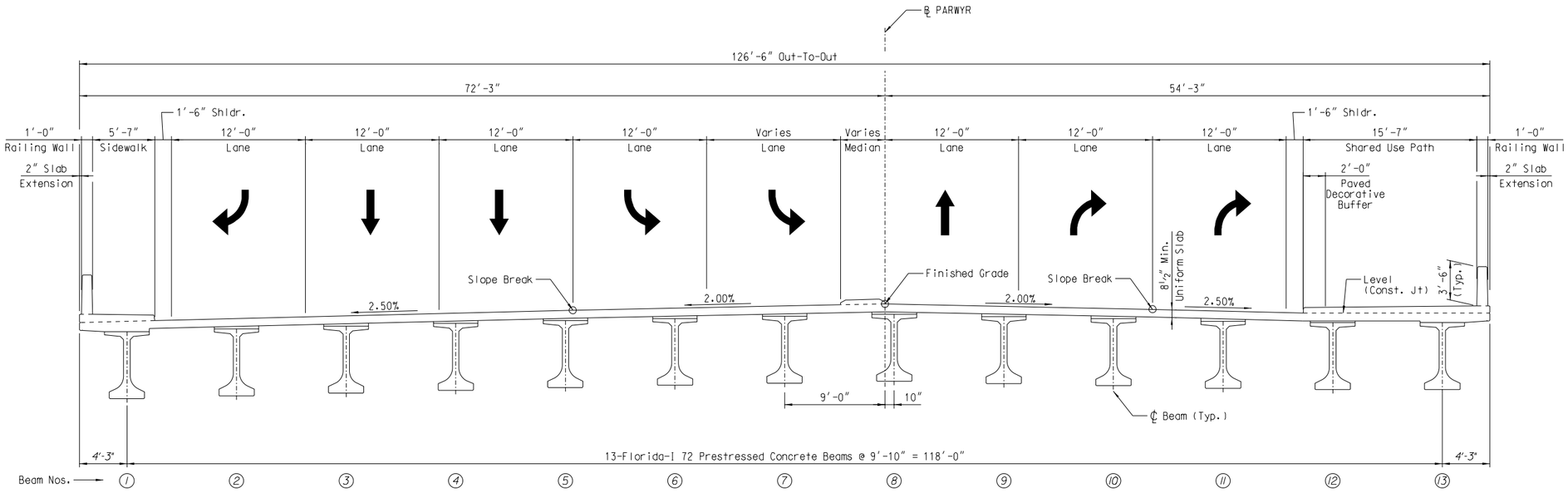
COUNTY: YORK

ROUTE: TBD

2/3/2020
Border Sheet 6/08

b38652ss.dgn

BRIDGE PLANS ID	SHEET NO.
P038652-B01	4



TYPICAL SECTION

(Looking In The Direction Of Stationing)

NOTE:

Diaphragm not shown.

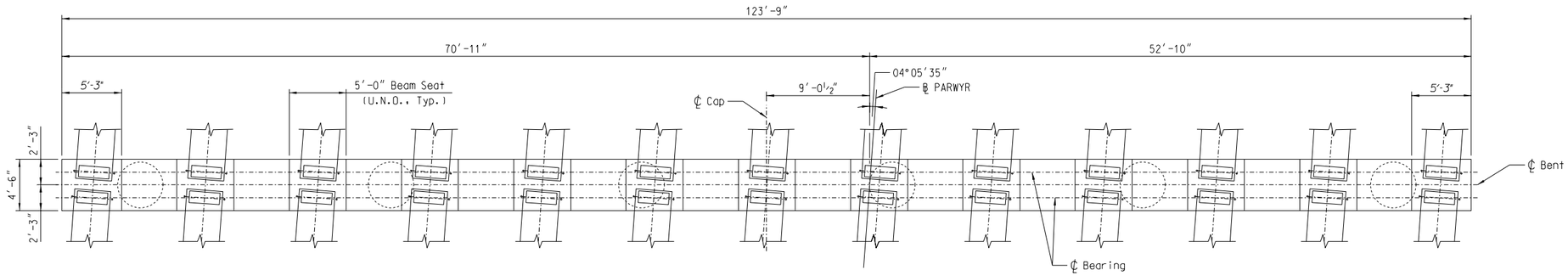
CONCEPTUAL PLANS

REV.				SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
REV.				
REV.				TYPICAL SECTION
REVIEWED				BRIDGE OVER INTERSTATE 77
QUAN.				
DR.	JL	CLG	01-20	
DES.	CLG	DLC	01-20	
	BY	CHK.	DATE	COUNTY: YORK — ROUTE: TBD

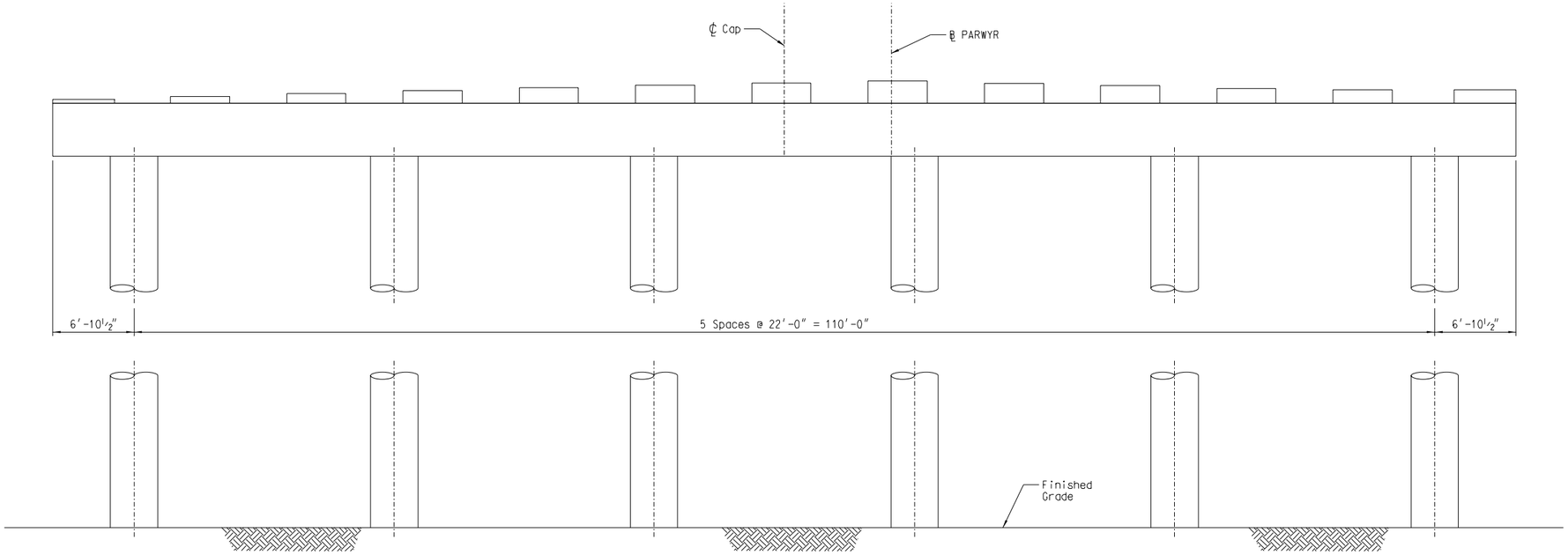
2/3/2020

b38652bt.dgn

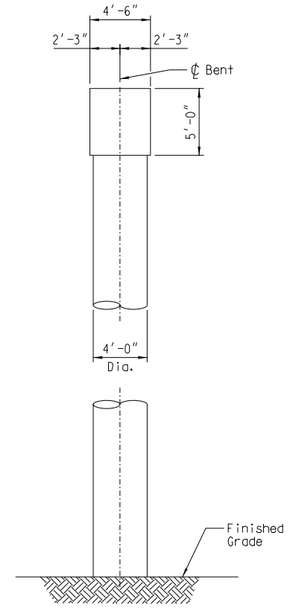
BRIDGE PLANS ID	SHEET NO.
P038652-B01	5



PLAN



ELEVATION



END ELEVATION

CONCEPTUAL PLANS

REV.				SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
REV.				INTERIOR BENT PLAN AND ELEVATION
REV.				BRIDGE OVER INTERSTATE 77
REVIEWED				
QUAN.				
DR.	JL	CLG	01-20	COUNTY: YORK
DES.	CLG	DLC	01-20	ROUTE: TBD
	BY	CHK.	DATE	

2/3/2020

APPENDIX E

BRIDGE DECK DRAIN CALCULATIONS

PROJECT: I-77 Panthers Interchange
DATE: 5/20/2020
DESIGNER: JCB

Reference HEC 21 May 93, pg 59
n=.016

15 ft spacing center to center

LEFT SIDE OF BRIDGE CALCULATIONS

Provide 30% Blockage
Note: 30% decrease of a 6" (.5' D) hole results in a .42' D hole.
USE "D"= 0.55 FT FOR A 6" DIAMETER DRAIN

Station	D. A. Width (feet)	D. A. Length (feet)	D.A. (Acres)	"C" Value	I (In/hr)	Q (cfs)	Q Bypass	Total Q (cfs)	Longitudinal Slope (ft/ft)	Cross Slope (ft/ft)	Spread (feet)	D/T	E (from HEC 21)	Q in (cfs)	Q bypass (cfs)
34+17.78	Approach														
34+37.78	Bent 1														
34+48.	72.25	30.22	0.050	0.9	7.57	0.34	0	0.341	0.005	0.025	4.78	0.11	0.40	0.137	0.205
34+63.	72.25	15	0.025	0.9	7.57	0.1695	0.205	0.3744	0.005	0.025	4.95	0.11	0.40	0.150	0.225
34+78.	72.25	15	0.025	0.9	7.57	0.17	0.225	0.3941	0.005	0.025	5.05	0.11	0.40	0.158	0.236
34+93.	72.25	15	0.025	0.9	7.57	0.17	0.236	0.4060	0.005	0.025	5.10	0.11	0.40	0.162	0.244
35+08.	72.25	15	0.025	0.9	7.57	0.17	0.244	0.4131	0.005	0.025	5.14	0.11	0.40	0.165	0.248
35+17.78	Bent 2														
35+27.	72.25	19	0.032	0.9	7.57	0.21	0.248	0.4626	0.005	0.025	5.36	0.10	0.40	0.185	0.278
35+42.	72.25	15	0.025	0.9	7.57	0.17	0.278	0.4470	0.005	0.025	5.29	0.10	0.40	0.179	0.268
35+57.	72.25	15	0.025	0.9	7.57	0.17	0.268	0.4377	0.005	0.025	5.25	0.10	0.40	0.175	0.263
35+72.	72.25	15	0.025	0.9	7.57	0.17	0.263	0.4321	0.005	0.025	5.23	0.11	0.40	0.173	0.259
35+87.	72.25	15	0.025	0.9	7.57	0.17	0.259	0.4288	0.005	0.025	5.21	0.11	0.40	0.172	0.257
36+02.	72.25	15	0.025	0.9	7.57	0.17	0.257	0.4268	0.005	0.025	5.20	0.11	0.40	0.171	0.256
36+17.	72.25	15	0.025	0.9	7.57	0.17	0.256	0.4256	0.005	0.025	5.20	0.11	0.40	0.170	0.255
36+32.	72.25	15	0.025	0.9	7.57	0.17	0.255	0.4248	0.005	0.025	5.19	0.11	0.40	0.170	0.255
36+47.	72.25	15	0.025	0.9	7.57	0.17	0.255	0.4244	0.005	0.025	5.19	0.11	0.40	0.170	0.255
36+60.28	Bent 3														
36+70.	72.25	23	0.038	0.9	7.57	0.26	0.255	0.5152	0.005	0.025	5.58	0.10	0.40	0.206	0.309
36+85.	72.25	15	0.025	0.9	7.57	0.17	0.309	0.4787	0.005	0.025	5.43	0.10	0.40	0.191	0.287
37+00.	72.25	15	0.025	0.9	7.57	0.17	0.287	0.4567	0.005	0.025	5.33	0.10	0.40	0.183	0.274
37+15.	72.25	15	0.025	0.9	7.57	0.17	0.274	0.4435	0.005	0.025	5.28	0.10	0.40	0.177	0.266
37+30.	72.25	15	0.025	0.9	7.57	0.17	0.266	0.4356	0.005	0.025	5.24	0.10	0.40	0.174	0.261
37+40.28	Bent 4														
37+60.28	Approach														

Deck Drains are located with a spacing of 15' center to center. All bypass flow for the deck drains will be picked up by the inlet downstream of the bridge. Spread at the end of the bridge is 5.0' at STA. 37+60

PROJECT: **I-77 Panthers Interchange**
DATE: 5/20/2020
DESIGNER: JCB

Reference HEC 21 May 93, pg 59
n=.016

15 ft spacing center to center

RIGHT SIDE OF BRIDGE CALCULATIONS

Provide 30% Blockage
Note: 30% decrease of a 6" (.5' D) hole results in a .42' D hole.
USE "D"= 0.42 FT FOR A 6" DIAMETER DRAIN

Station	D. A. Width (feet)	D. A. Length (feet)	D.A. (Acres)	"C" Value	I (In/hr)	Q (cfs)	Q Bypass	Total Q (cfs)	Longitudinal Slope (ft/ft)	Cross Slope (ft/ft)	Spread (feet)	D/T	E (from HEC 21)	Q in (cfs)	Q bypass (cfs)
34+17.78	Approach														
34+37.78	Bent 1														
34+48.	54.25	30.22	0.038	0.9	7.57	0.26	0	0.256	0.005	0.025	4.30	0.10	0.40	0.103	0.154
34+63.	54.25	15	0.019	0.9	7.57	0.1273	0.154	0.2811	0.005	0.025	4.45	0.09	0.40	0.112	0.169
34+78.	54.25	15	0.019	0.9	7.57	0.13	0.169	0.2959	0.005	0.025	4.53	0.09	0.40	0.118	0.178
34+93.	54.25	15	0.019	0.9	7.57	0.13	0.178	0.3048	0.005	0.025	4.59	0.09	0.40	0.122	0.183
35+08.	54.25	15	0.019	0.9	7.57	0.13	0.183	0.3102	0.005	0.025	4.62	0.09	0.40	0.124	0.186
35+17.78	Bent 2														
35+27.	54.25	19	0.024	0.9	7.57	0.16	0.186	0.3473	0.005	0.025	4.81	0.09	0.40	0.139	0.208
35+42.	54.25	15	0.019	0.9	7.57	0.13	0.208	0.3357	0.005	0.025	4.75	0.09	0.40	0.134	0.201
35+57.	54.25	15	0.019	0.9	7.57	0.13	0.201	0.3287	0.005	0.025	4.72	0.09	0.40	0.131	0.197
35+72.	54.25	15	0.019	0.9	7.57	0.13	0.197	0.3245	0.005	0.025	4.69	0.09	0.40	0.130	0.195
35+87.	54.25	15	0.019	0.9	7.57	0.13	0.195	0.3220	0.005	0.025	4.68	0.09	0.40	0.129	0.193
36+02.	54.25	15	0.019	0.9	7.57	0.13	0.193	0.3205	0.005	0.025	4.67	0.09	0.40	0.128	0.192
36+17.	54.25	15	0.019	0.9	7.57	0.13	0.192	0.3195	0.005	0.025	4.67	0.09	0.40	0.128	0.192
36+32.	54.25	15	0.019	0.9	7.57	0.13	0.192	0.3190	0.005	0.025	4.66	0.09	0.40	0.128	0.191
36+47.	54.25	15	0.019	0.9	7.57	0.13	0.191	0.3187	0.005	0.025	4.66	0.09	0.40	0.127	0.191
36+60.28	Bent 3														
36+70.	54.25	23	0.029	0.9	7.57	0.20	0.192	0.3869	0.005	0.025	5.01	0.08	0.40	0.155	0.232
36+85.	54.25	15	0.019	0.9	7.57	0.13	0.232	0.3594	0.005	0.025	4.88	0.09	0.40	0.144	0.216
37+00.	54.25	15	0.019	0.9	7.57	0.13	0.216	0.3429	0.005	0.025	4.79	0.09	0.40	0.137	0.206
37+15.	54.25	15	0.019	0.9	7.57	0.13	0.206	0.3330	0.005	0.025	4.74	0.09	0.40	0.133	0.200
37+30.	54.25	15	0.019	0.9	7.57	0.13	0.200	0.3271	0.005	0.025	4.71	0.09	0.40	0.131	0.196
37+40.28	Bent 4														
37+60.28	Approach														

Deck Drains are located with a spacing of 15' center to center. All bypass flow for the deck drains will be picked up by the inlet downstream of the bridge. Spread at the end of the bridge is 5.0' at STA. 37+60

I-77 Panthers Interchange		1
SCUPPER COMPUTATION SHEET	*Calc By*	JCB
1' x 1' GRATED INLET SCUPPERS (LEFT SIDE OF BRIDGE)	*Date*	5/20/2020

Design Guidelines
Limitations to ponding includes:
(1) The maximum spread is 6'-0"

Drainage design should be based on the 10-year storm.

A modified Manning's equation shall be used to simmulate gutter flow on the bridge deck.

$Q = 0.56 (Z/n) S^{1/2} d^{8/3}$

Where: Q = Discharge in cfs
Z = Reciprocal of cross slope
n = Manning's Coefficient = 0.016
S = Longitudinal slope at inlet

Solve for d
$d = (Qn / 0.56 Z S^{1/2})^{3/8}$

Use runoff coefficient, C = 0.9
Assume time of concentration to deck ends is 5 minutes. (minimum allowed by SCDOT)
i_{10} = 7.57 in/hr Based on IDF data from York county geopak file

The depth of gutter flow shall be determined using the pavement slope at the check point.
Slope at Inlet = $S = g_1 + X (g_2-g_1) / L$

Calculate the bypass flow:

Width of Inlet, W =	1 ft.
Length of Inlet, W =	1 ft.
Splashover Velocity, Vo =	3.8 fps (HEC 21 Chart 10)

Ration of Frontal Flow to Total Flow, Eo =	1-(1-W/T)^2.67 (HEC21 5.2 Eq. 8)
Fraction of frontal flow entering inlet, Rf =	1-0.09(V-Vo) (HEC 21 5.2 Eq. 9)
Interception Efficiency, E =	Eo x Rf
Flow entering Scupper, Qi =	E x Q
Bypass, Qbypass =	Q - Qi

References: HEC-21

Last inlet before bridge is at 34+10

Bypass on left side = 0 cfs

	Previous Inlet	Scupper Location	Scupper Spacing	Width	Area	Q_{10}	S	Z	d	Spread	Allow. Spread	Gutter Velocity							
			(ft.)	(ft)	(ac.)	(cfs)	(ft./ft.)	(ft./ft.)	(in)	(ft)	(ft)	(fps)	Status	Status	Eo	Rf	E	Qi	Qbypass
Bent 1	35+18																		
	34+18	34+48	30.22	72.00	0.0500	0.3403	-0.0050	40.00	1.430	4.77	6.000	1.269	OK	OK	0.4663	1	0.4663	0.1587	0.1816
	34+48	34+63	15	72.00	0.0248	0.3505	-0.0050	40.00	1.446	4.82	6.000	1.279	OK	OK	0.4621	1	0.4621	0.162	0.1885
	34+63	34+78	+15	72.00	0.0248	0.3575	-0.0050	40.00	1.456	4.85	6.000	1.285	OK	OK	0.4594	1	0.4594	0.16421	0.1932
	34+78	34+93	+15	72.00	0.0248	0.3622	-0.0050	40.00	1.464	4.88	6.000	1.289	OK	OK	0.4576	1	0.4576	0.16571	0.1964
	34+93	35+08	+15	72.00	0.0248	0.3654	-0.0050	40.00	1.468	4.89	6.000	1.292	OK	OK	0.4563	1	0.4563	0.16673	0.1986
Bent 2	35+18																		
	35+08	35+27	+19	72.00	0.0314	0.4126	-0.0050	40.00	1.537	5.12	6.000	1.332	OK	OK	0.4396	1	0.4396	0.18137	0.2312
	35+27	35+42	+15	72.00	0.0248	0.4001	-0.0050	40.00	1.519	5.06	6.000	1.322	OK	OK	0.4438	1	0.4438	0.17757	0.2226
	35+42	35+57	+15	72.00	0.0248	0.3915	-0.0050	40.00	1.507	5.02	6.000	1.315	OK	OK	0.4468	1	0.4468	0.1749	0.2166
	35+57	35+72	+15	72.00	0.0248	0.3855	-0.0050	40.00	1.498	4.99	6.000	1.310	OK	OK	0.4489	1	0.4489	0.17305	0.2125
	35+72	35+87	+15	72.00	0.0248	0.3814	-0.0050	40.00	1.492	4.97	6.000	1.306	OK	OK	0.4504	1	0.4504	0.17176	0.2096
	35+87	36+02	+15	72.00	0.0248	0.3785	-0.0050	40.00	1.488	4.96	6.000	1.304	OK	OK	0.4514	1	0.4514	0.17087	0.2077
	36+02	36+17	+15	72.00	0.0248	0.3766	-0.0050	40.00	1.485	4.95	6.000	1.302	OK	OK	0.4521	1	0.4521	0.17026	0.2063
	36+17	36+32	+15	72.00	0.0248	0.3752	-0.0050	40.00	1.483	4.94	6.000	1.301	OK	OK	0.4526	1	0.4526	0.16984	0.2054
	36+32	36+47	+15	72.00	0.0248	0.3743	-0.0050	40.00	1.482	4.94	6.000	1.300	OK	OK	0.4530	1	0.4530	0.16955	0.2048
Bent 3	36+60																		
	36+47	36+70	+23	72.00	0.0380	0.4638	-0.0050	40.00	1.606	5.35	6.000	1.372	OK	OK	0.4239	1	0.4239	0.19659	0.2672
	36+70	36+85	+15	72.00	0.0248	0.4361	-0.0050	40.00	1.569	5.23	6.000	1.351	OK	OK	0.4321	1	0.4321	0.18844	0.2476
	36+85	37+00	+15	72.00	0.0248	0.4166	-0.0050	40.00	1.542	5.14	6.000	1.336	OK	OK	0.4383	1	0.4383	0.18258	0.2340
	37+00	37+15	+15	72.00	0.0248	0.4029	-0.0050	40.00	1.523	5.08	6.000	1.324	OK	OK	0.4428	1	0.4428	0.17842	0.2245
	37+15	37+30	+15	72.00	0.0248	0.3934	-0.0050	40.00	1.510	5.03	6.000	1.316	OK	OK	0.4461	1	0.4461	0.1755	0.2179
Bent 4	36+60																		

I-77 Panthers Interchange		2
SCUPPER COMPUTATION SHEET	*Calc By*	JCB
1' x 1' GRATED INLET SCUPPERS (RIGHT SIDE OF BRIDGE)	*Date*	5/20/2020

Design Guidelines
Limitations to ponding includes:
(1) The maximum spread is 6'-0"

Drainage design should be based on the 10-year storm.

A modified Manning's equation shall be used to simmulate gutter flow on the bridge deck.

$Q = 0.56 (Z/n) S^{1/2} d^{8/3}$

Where: Q = Discharge in cfs
Z = Reciprocal of cross slope
n = Manning's Coefficient = 0.016
S = Longitudinal slope at inlet

Solve for d
$d = (Qn / 0.56 Z S^{1/2})^{3/8}$

Use runoff coefficient, C = 0.9
Assume time of concentration to deck ends is 5 minutes. (minimum allowed by SCDOT)
i_{10} = 7.57 in/hr Based on IDF data from York county geopak file

The depth of gutter flow shall be determined using the pavement slope at the check point.
Slope at Inlet = $S = g_1 + X (g_2-g_1) / L$

Calculate the bypass flow:

Width of Inlet, W =	1 ft.
Length of Inlet, W =	1 ft.
Splashover Velocity, Vo =	3.8 fps (HEC 21 Chart 10)

Ration of Frontal Flow to Total Flow, Eo =	1-(1-W/T)^2.67 (HEC21 5.2 Eq. 8)
Fraction of frontal flow entering inlet, Rf =	1-0.09(V-Vo) (HEC 21 5.2 Eq. 9)
Interception Efficiency, E =	Eo x Rf
Flow entering Scupper, Qi =	E x Q
Bypass, Qbypass =	Q - Qi

References: HEC-21

Last inlet before bridge is at 34+10

Bypass on right side = 0 cfs

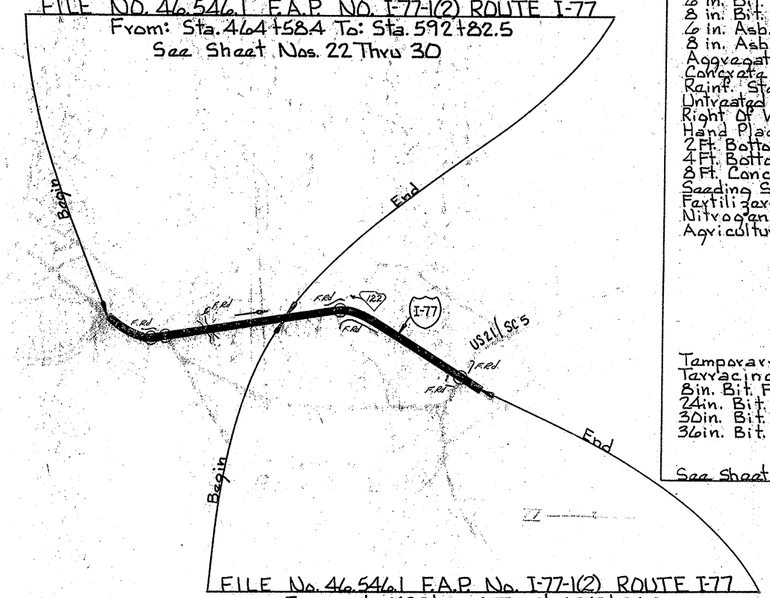
	Previous Inlet	Scupper Location	Scupper Spacing	Width	Area	Q_{10}	S	Z	d	Spread	Allow. Spread	Gutter Velocity							
			(ft.)	(ft)	(ac.)	(cfs)	(ft./ft.)	(ft./ft.)	(in)	(ft)	(ft)	(fps)	Status	Status	Eo	Rf	E	Qi	Qbypass
Bent 1	34+38																		
	34+18	34+48	30.22	54.00	0.0375	0.2552	-0.0050	40.00	1.284	4.28	6.000	1.181	OK	OK	0.5083	1	0.5083	0.12973	0.1255
	34+48	34+63	15	54.00	0.0186	0.2522	-0.0050	40.00	1.278	4.26	6.000	1.177	OK	OK	0.5101	1	0.5101	0.12864	0.1235
	34+63	34+78	+15	54.00	0.0186	0.2502	-0.0050	40.00	1.274	4.25	6.000	1.175	OK	OK	0.5113	1	0.5113	0.12794	0.1223
	34+78	34+93	+15	54.00	0.0186	0.2490	-0.0050	40.00	1.272	4.24	6.000	1.174	OK	OK	0.5120	1	0.5120	0.12749	0.1215
	34+93	35+08	+15	54.00	0.0186	0.2482	-0.0050	40.00	1.270	4.23	6.000	1.173	OK	OK	0.5125	1	0.5125	0.1272	0.1210
Bent 2	35+18																		
	35+08	35+27	+19	54.00	0.0236	0.2815	-0.0050	40.00	1.332	4.44	6.000	1.210	OK	OK	0.4938	1	0.4938	0.13897	0.1425
	35+27	35+42	+15	54.00	0.0186	0.2692	-0.0050	40.00	1.309	4.36	6.000	1.197	OK	OK	0.5004	1	0.5004	0.13468	0.1345
	35+42	35+57	+15	54.00	0.0186	0.2612	-0.0050	40.00	1.295	4.32	6.000	1.188	OK	OK	0.5049	1	0.5049	0.13186	0.1293
	35+57	35+72	+15	54.00	0.0186	0.2560	-0.0050	40.00	1.285	4.28	6.000	1.182	OK	OK	0.5078	1	0.5078	0.13001	0.1260
	35+72	35+87	+15	54.00	0.0186	0.2527	-0.0050	40.00	1.279	4.26	6.000	1.178	OK	OK	0.5098	1	0.5098	0.12882	0.1239
	35+87	36+02	+15	54.00	0.0186	0.2506	-0.0050	40.00	1.275	4.25	6.000	1.175	OK	OK	0.5111	1	0.5111	0.12805	0.1225
	36+02	36+17	+15	54.00	0.0186	0.2492	-0.0050	40.00	1.272	4.24	6.000	1.174	OK	OK	0.5119	1	0.5119	0.12756	0.1216
	36+17	36+32	+15	54.00	0.0186	0.2483	-0.0050	40.00	1.270	4.23	6.000	1.173	OK	OK	0.5124	1	0.5124	0.12724	0.1211
	36+32	36+47	+15	54.00	0.0186	0.2478	-0.0050	40.00	1.269	4.23	6.000	1.172	OK	OK	0.5128	1	0.5128	0.12704	0.1207
Bent 3	36+60																		
	36+47	36+70	+23	54.00	0.0285	0.3150	-0.0050	40.00	1.389	4.63	6.000	1.245	OK	OK	0.4774	1	0.4774	0.15036	0.1646
	36+70	36+85	+15	54.00	0.0186	0.2913	-0.0050	40.00	1.349	4.50	6.000	1.221	OK	OK	0.4887	1	0.4887	0.14236	0.1489
	36+85	37+00	+15	54.00	0.0186	0.2756	-0.0050	40.00	1.321	4.40	6.000	1.204	OK	OK	0.4969	1	0.4969	0.13694	0.1387
	37+00	37+15	+15	54.00	0.0186	0.2654	-0.0050	40.00	1.302	4.34	6.000	1.192	OK	OK	0.5025	1	0.5025	0.13334	0.1320
	37+15	37+30	+15	54.00	0.0186	0.2587	-0.0050	40.00	1.290	4.30	6.000	1.185	OK	OK	0.5063	1	0.5063	0.13098	0.1277
Bent 4	37+40																		

APPENDIX F

HISTORIC SCDOT PLANS FOR I-77

* 30-A - Plan & Profile Sheet for Rd at Southern Rail Road - 10-16-73

FILE NO. 46.546.1
F.A.P. NO. I-77-1(2)
YORK CO.
ROUTE NO. I-77
FROM: CATAWBA RIVER
TO: NEAR ROAD NO. S-710



FILE No. 46.546.1 F.A.P. No. I-77-1(2) ROUTE I-77
From: Sta. 464+58.4 To: Sta. 592+82.5
See Sheet Nos. 22 Thru 30

FILE No. 46.546.1 F.A.P. No. I-77-1(2) ROUTE I-77
From: Sta. 592+82.5 To: Sta. 753+25.0
See Sheet Nos. 30 Thru 42

I-77-1(2)	I-77-1(2)
2.342	2.982
—	0.005
2.342	2.987
0.080	0.051
2.422	3.038

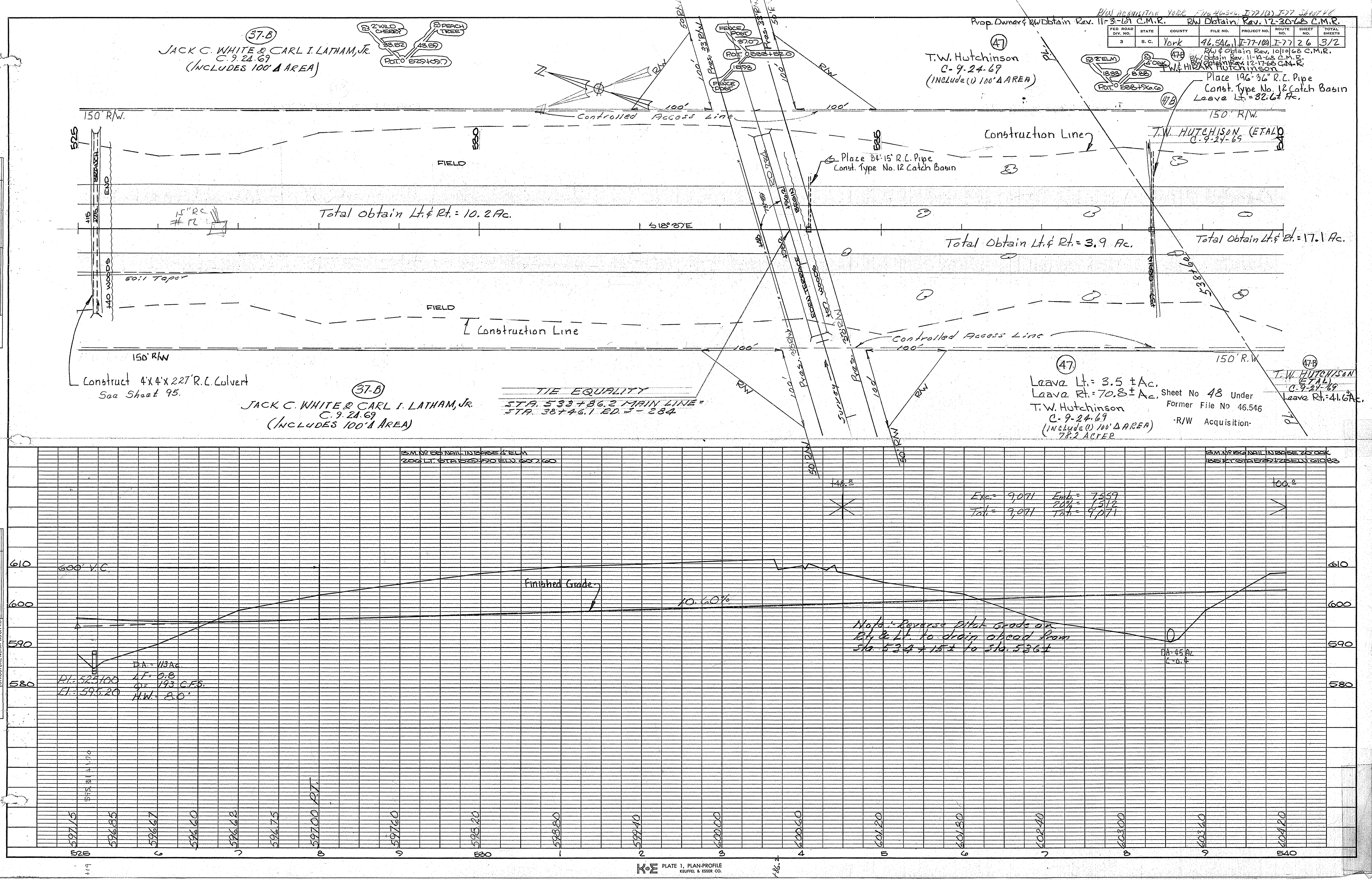
York 46.546.1 I-77-1(2) I-77 1 31

	I-77-1(2)	I-77-1(2)	Units
	Nac.	Nac.	L.S.
Clearing and Grubbing within Roadway	1.0	1.0	Acres
Clearing and Grubbing Borrow and Material Pits			
Unclassified Excavation	489,168	416,579	C.Y.
Overhaul	1,960	3,599	C.Y.
Selected Material For Shoulders	1,792	2,649	Tons
Asphaltic Concrete Surface Course Type I	107	158	Tons
Asphalt Cement In Paving Mixture	11,249	14,228	Tons
Stabilizer Aggregate No. 2 A Aggregate (With Prime)	874	2,252	L.F.
15 in. Reinf. Conc. Culvert Pipe (Class III)	692	1,234	L.F.
18 in. Reinf. Conc. Culvert Pipe (Class III)	1,596	304	L.F.
24 in. Reinf. Conc. Culvert Pipe (Class III)	196	380	L.F.
36 in. Reinf. Conc. Culvert Pipe (Class III)	524	—	L.F.
42 in. Reinf. Conc. Culvert Pipe (Class III)	—	244	L.F.
24 in. Reinf. Conc. Culvert Pipe (Class IV)	376	216	L.F.
30 in. Reinf. Conc. Culvert Pipe (Class IV)	500	640	L.F.
36 in. Reinf. Conc. Culvert Pipe (Class IV)	—	224	L.F.
42 in. Reinf. Conc. Culvert Pipe (Class IV)		160	L.F.
Alt. No. 1 - 15 in. Reinf. Conc. Culvert Pipe	140	160	L.F.
Alt. No. 2 - 15 in. Corrug. Metal Culvert Pipe (Gage 16) Type A	140	160	L.F.
Alt. No. 3 - 15 in. Corrug. Alum. Alloy Pipe (Gage 16) Type A	140	140	L.F.
Alt. No. 1 - 18 in. Reinf. Conc. Culvert Pipe	140	140	L.F.
Alt. No. 2 - 18 in. Corrug. Metal Culvert Pipe (Gage 16) Type A	140	140	L.F.
Alt. No. 3 - 18 in. Corrug. Alum. Alloy Pipe (Gage 16) Type A	60	40	L.F.
Alt. No. 1 - 24 in. Reinf. Conc. Culvert Pipe	60	40	L.F.
Alt. No. 2 - 24 in. Corrug. Metal Culvert Pipe (Gage 16) Type A	60	40	L.F.
Alt. No. 3 - 24 in. Corrug. Alum. Alloy Pipe (Gage 16) Type A	23	38	Each
Catch Basins Type No. 12	1	—	Each
Manholes	942	2,558	L.F.
Alt. No. 1 - 8 in. Corrug. Metal Pipe Slope Drain	942	2,558	L.F.
Alt. No. 2 - 8 in. Bit. Fibar Pipe Slope Drain	942	2,558	L.F.
Alt. No. 3 - 8 in. Asb. Cement Pipe Slope Drain	23	67	Each
Intake Spillway Assemblies	1,000	1,000	L.F.
6 in. Corrug. Metal Pipe Underdrain - Perforated	1,000	1,000	L.F.
8 in. Corrug. Metal Pipe Underdrain - Perforated	1,000	1,000	L.F.
6 in. Bit. Fibar Pipe Underdrain - Perforated	1,000	1,000	L.F.
8 in. Bit. Fibar Pipe Underdrain - Perforated	1,000	1,000	L.F.
6 in. Asb. Cement Pipe Underdrain - Perforated	1,000	1,000	L.F.
8 in. Asb. Cement Pipe Underdrain - Perforated	840	840	C.Y.
Aggregate No. 22 For Pipe Underdrain	231.3	1983.0	C.Y.
Concrete For Structures - Class A	36,284	319,317	Lbs.
Reinf. Steel For Structures	—	99	L.F.
Untreated Timber Cut-off Walls	46	51	Each
Right Of Way Markers	90	675	Tons
Hand Placed Rip Rap	750	—	L.F.
2 Ft. Bottom Concrete Gutter	475	—	L.F.
4 Ft. Bottom Concrete Gutter	541.3	1025.0	L.F.
8 Ft. Concrete Gutter	363,350	481,650	M.S.Y.
Seeding Shoulders and Slopes (Mulched)	42.2	56.2	Tons
Fertilizer (4-12-12)	3,603	4,776	Lbs.
Nitrogen (Actual)	150	200	Tons
Agricultural Lime			
Temporary Seeding (Mulched)	90,833	120,412	M.S.Y.
Terracing	234.3	298.3	L.F.
8 in. Bit. Fibar Pipe Slope Drain	468	596	L.F.
24 in. Bit. Fibar Sectional Drain 1/3 Section	234	298	L.F.
30 in. Bit. Fibar Sectional Drain 1/3 Section	234	298	L.F.
36 in. Bit. Fibar Sectional Drain 1/3 Section	234	298	L.F.

See Sheet No. 1-A For Moving Items and Fences

Bridges to be Constructed Under Separate Contract
Rte. I-77 From: Sta. 488+56.1 to: Sta. 490+76.1 220.0' R.C. Bridge
Rte. I-77 From: Sta. 501+41.6 to: Sta. 503+42.6 201.0' R.C. Bridge
Rte. I-77 From: Sta. 628+72.1 to: Sta. 631+42.1 270.0' R.C. Bridge
Rd. S-284 From: Sta. 37+10.1 to: Sta. 39+68.1 258.0' R.C. Bridge
Rte. 21 South From: Sta. 141+98.0 to: Sta. 17+42.0 273.0' R.C. Bridge

J. M. McMahon Jr. 5-14-71



York Co.
Rt.
Part 2

(12)

Sheet No 49 Under
Former File No 46.546

-R/W Acquisition-

R/W Acquisition File 46.546 Proj. I-77-1(2)

FED. ROAD DIV. NO.	STATE	COUNTY	FILE NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	York	46.546.1	I-77-1(2)	I-77	27	3/2

R/W obtain Rev. 10-10-68 C.M.R.
R/W Obtain Rev. 11-14-68 C.M.R.
R/W obtain Rev. 12-17-68 C.M.R.
R/W Obtain Rev. 12-30-68 C.M.R.
Prop. Owner & R/W Obtain Rev. 11-3-69 C.M.R.

PLAN
SURVEYED
PLOTTED
NOTE BOOK
NO.
ALIGNMENT CHECKED
RT. OF WAY CHECKED
BY
DATE
3/26/69

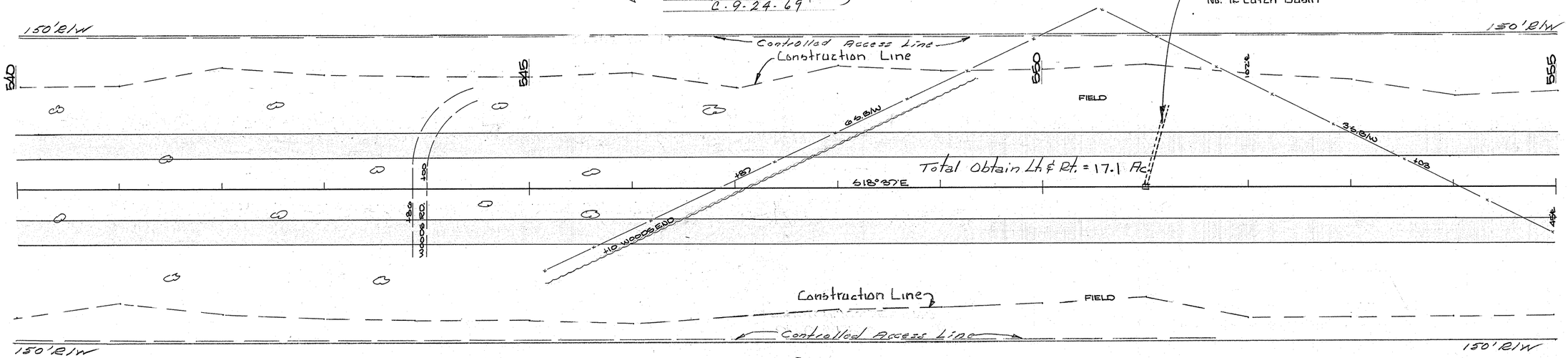
PROFILE
SURVEYED
PLOTTED
NOTE BOOK
NO.
GRADES CHECKED
BI. AS NOTED
STRUCTURE NOTATIONS CHKD.
BY MEH
DATE

York Co
RT
Part 2

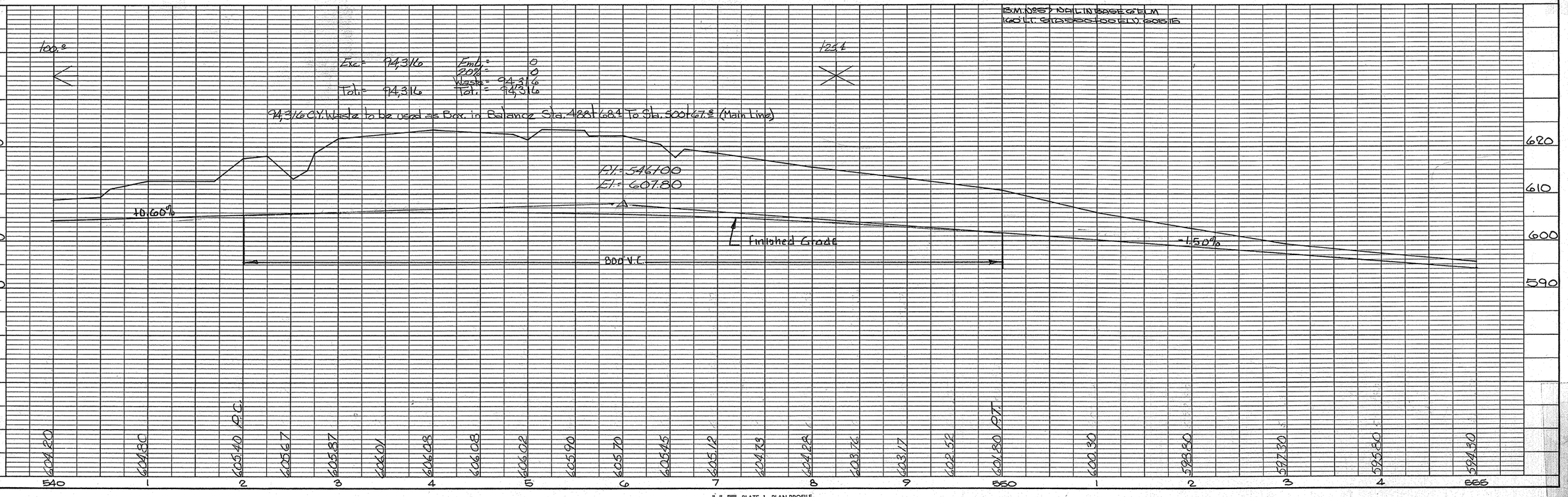
(13)

(47-B)
T.W. HUTCHISON (ETAL)
C-9-24-69

Place 88°15' R.C. Pipe on 15° Skew. Const. Type No. 12 Catch Basin



(47-B)
T.W. HUTCHISON (ETAL)
C-9-24-69



K&E PLATE 1, PLAN-PROFILE
KEUFFEL & ESSER CO.

Prop. Runway & R/W Obtain Rev. 11-3-78 C.M.R.

FED. ROAD DIV. NO.	STATE	COUNTY	FILE NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	York	A-46.546	I-77-1(12)	I-77	28	312

R/W Obtain Rev. 10-10-68 C.M.R.
R/W Obtain Rev. 11-14-68 C.M.R.
R/W Obtain Rev. 12-17-68 C.M.R.
R/W Obtain Rev. 12-30-68 C.M.R.

PLAN
SURVEYED
PLOTTED
NOTE BOOK
ALIGNMENT CHECKED
NO.
PT. OF VAL CHECKED
BY
DATE 9/6/67

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
NOTE BOOK
STRUCTURE NO. ATKINS CH KG
BY
DATE

T.W. HUTCHISON
C-9-24-69
(47B)

Place 88'-15" R.C. Pipe on 15° Skew. Const. Type No. 12 Catch Basin

33' R/W

(43A) CELANESE CORPORATION D-2.6.69

Leave 633± Ac.

POT. 0 Sta 1+08

12" ELM
Sta 0
Rt 28

12" POPLAR
Sta 0
Rt 28

POT. 0 Sta 1+58

12" CEDAR
Sta 0
Rt 28

40" OAK
Sta 0
Rt 28

T.W. HUTCHISON (ET-AL)
C-9-24-69
(47B)

Leave Lt. = 1.7± Ac.

HIRAM HUTCHISON ETAL
C-9-24-69
(48)

150' R/W

TOTAL OBTAINED = 0.7 Ac.

Controlled Access Line

Construction Line

Total Obtain Lt. & Rt. 1.2 Ac

Place 3 Intake Spillway Assemblies
Place 96'-8" Pipe Slope Drains

555
560
565
570

560+68

561+55

564+65

183'

183'

05°22'

185'

41'-42'

118'

TOTAL OBTAINED Lt. & Rt. = 17.1 Ac.

TOTAL OBTAINED LT. & RT. = 19.6 Ac

S 18° 35' E

100.05 BSLL

Sta 561+55

Sta 564+65

112' POWER LINE

Construction Line

Place 3 Intake Spillway Assemblies
Place 96'-8" Pipe Slope Drains

Controlled Access Line

150' R/W

T.W. HUTCHISON ETAL
C-9-24-69
(47B)

Place 252'-42" R.C. Pipe on 45° Skew.

Existing 42" RCP under I-77 at proposed location of Crossover Road bridge.

HIRAM HUTCHISON ETAL
C-9-24-69
(48)

Place 228'-24" R.C. Pipe on 15° Skew. Const. Type No. 12 Catch Basin

Leave Lt. = 18.3± Ac.
Leave Rt. = 121.1 ± Ac.

Sheet No 50 Under Former File No 46.546

-R/W Acquisition-

B.M. No 58 NAIL IN BASE 10" CEDAR 160' LT. STA 560+75 ELEV. 528.61

Exc. 49,891
Tot. 49,891

Emb 41,576
20% 8,315
Tot. 49,891

Finished Grade

-1.50%

DA: 10 Ac
C = 0.4

DA: 12 Ac
C = 0.4

590
580
570
560

555 | 6 | 7 | 8 | 9 | 560 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 570

594.30 | 591.80 | 591.30 | 589.80 | 588.30 | 586.80 | 585.30 | 583.80 | 582.30 | 580.80 | 579.30 | 577.80 | 576.30 | 574.80 | 573.312 P.C. | 572.30 | 572.53 | 571.74

York Co.
R/W
Part D
(1L)

K+E PLATE 1, PLAN-PROFILE
KEUFFEL & ESSER CO.

R/W Acquisition File 46.546 I-77(2) I-77

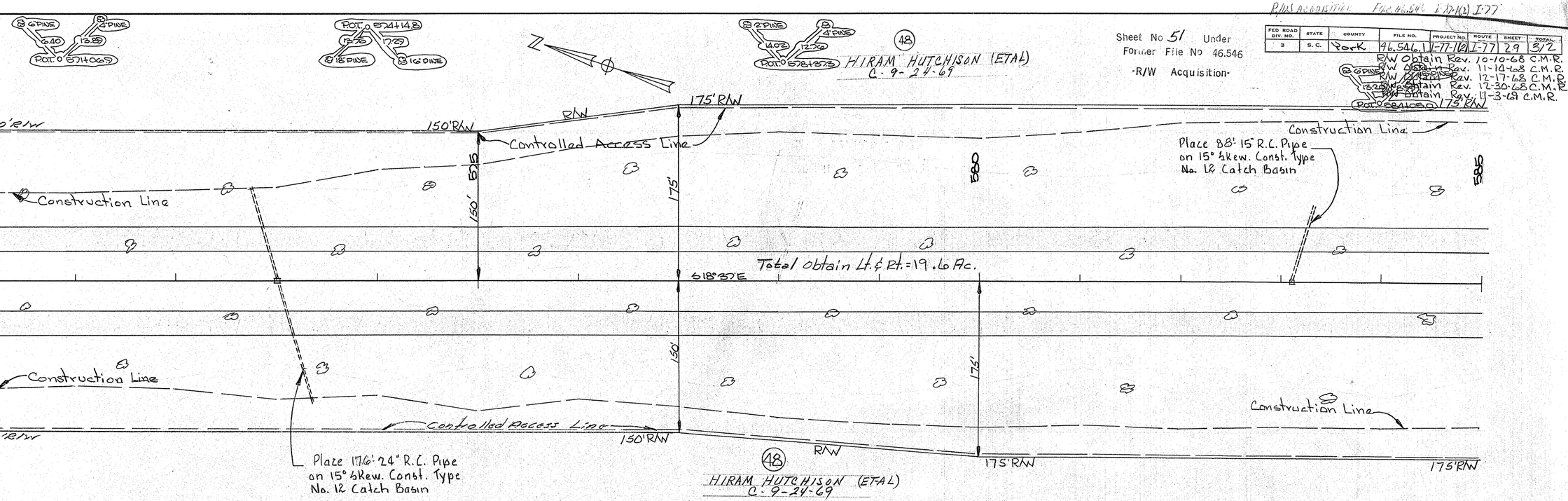
FED ROAD DIV. NO.	STATE	COUNTY	FILE NO.	PROJECT NO.	ROUTE	SHEET	TOTAL
3	S.C.	Pork	46.546	I-77-1(2)	I-77	29	32

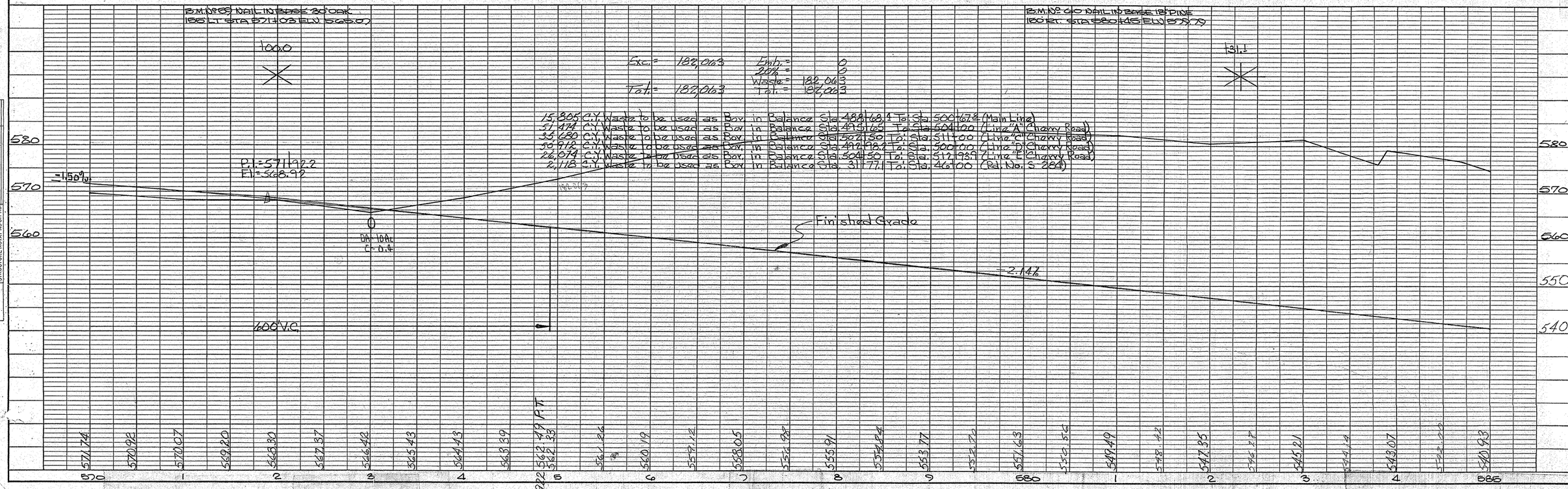
Sheet No 51 Under
Former File No 46.546
-R/W Acquisition-

R/W Obtain Rev. 10-10-68 C.M.R.
R/W Obtain Rev. 11-14-68 C.M.R.
R/W Obtain Rev. 12-17-68 C.M.R.
R/W Obtain Rev. 12-30-68 C.M.R.
R/W Obtain Rev. 1-3-69 C.M.R.

PLAN — SURVEYED, PLOTTED, NOTE BOOK, NO. — ALIGNMENT CHECKED, RT. OF WAY CHECKED, BY, DATE 5/16/67

PROFILE — SURVEYED, PLOTTED, NOTE BOOK, NO. — GRADES CHECKED, BASIS APPROVED, STRUCTURE NOTATIONS CHK'D, BY, DATE





PROFILE — SURVEYED, PLOTTED, NOTE BOOK, NO. — GRADES CHECKED, BASIS APPROVED, STRUCTURE NOTATIONS CHK'D, BY, DATE

York Co. ET Part 2

(15)

K+E PLATE 1, PLAN-PROFILE KEUFFEL & ESSER CO.

FED ROAD DIV. NO.	STATE	COUNTY	PROJECT NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	York	46.546 I-77	30	31 2

R/W Acquisition Plans

R/W Obtain Rev. 10-10-68 C.M.P.
R/W Obtain Rev. 11-14-68 C.M.P.
R/W Obtain Rev. 12-17-68 C.M.P.
R/W Obtain Rev. 12-30-68 C.M.P.
R/W Obtain Rev. 11-3-69 C.M.P.
Grades Rev - 2-10-71

(48) HIRAM HUTCHISON (ET-AL) C-9-24-69

See sheet No. 80-A for Right of Way on Southern Rail Road. (10-14-73)

R/W — Construction Line — 175' — 150' — Controlled Access Line — 150' R/W

Total obtain Lt. & Rt. = 19.6 Ac.

Existing 42" RCP under I-77 (north of Southern Railroad). Carolina Panthers Training Facility drains to this pipe.

Construction Line — 175' — cess Line — 150' R/W

(48) R/W

HIRAM HUTCHISON (ET-AL) C-9-24-69

Place 220'-42" R.C. Pipe
Construct Catch Basin
Type No 12

Res. 65' R.R. R/W

To Rock Hill

Southern Railroad

To Charlotte

Res. 65' R.R. R/W

MILE POST 109.22
2535.68

ROCK HILL INDUSTRIAL PARK
D. 5-7-71

Leave Rt = 10.7 Ac.

(1) See Below

Leave Lt 0.6 Ac.

Total Obtained Lt & Rt = 5.8 Ac

(2) CHARLES A. NEW C-4-13-71

Controlled Access Line — Construction Line

Place 88'-15" R.C. Pipe on 15° Skew
Construct Catch Basin Type No 12

Total Obtained = 35.4 Ac.

Sheet No 52 Under Former File No 46.546 -R/W Acquisition-

Construction Line — Controlled Access Line — R/W

(2) CHARLES A. NEW C-4-13-71

PLAN — SURVEYED — PLOTTED — GRADES CHECKED — ALIGNMENT CHECKED — RT. OF WAY CHECKED — NOTE BOOK — NO. — DATE — BY

PROFILE — SURVEYED — PLOTTED — GRADES CHECKED — R.R. CROSS. — STRUCTURE NO(S) & TYPE(S) — NOTE BOOK — NO. — DATE — BY MSH

B.M. No 61 NAIL IN BASE 8" HICKORY
165' LT. STA 550+00 ELV. 531.72

Exc.: 196,833 Emb.: 808
20%: 162
Waste: 195,863
Tot.: 196,833
Tot.: 196,833

17,039 C.Y. Waste to be used as Bor. in Bal. Sta. 311+77 To Sta. 440+00 (Rd. No. S-284)
178,824 C.Y. Waste to be used as Bor. in Bal. Sta. on Rte 122 - Sta 774+85.6 to 924+96.0

-2.14%

600' V.C.

P.I. 590+40.8
El. 529.36

D.A. = 85 Ac
C = 0.4

Exc.: 135,929 Emb.: 0
20%: 0
Waste: 135,929
Tot.: 135,929 Tot.: 135,929

12,400 C.Y. Waste to be used as Borrow on Frontage Rd Rt Sta 654+ to 666+

Note:- Grading at Railroad Site shall be Performed as directed by the Engineer. See note on Sheet No. 21

Finished Grade

-0.62%

B.M. No 62 NAIL IN BASE 12" PINE
155' RT. STA 553+00 ELV. 556.12

PLATE 1. PLAN-PROFILE
KELLER-BLESSER CO.

York Co
Rt
Part 2

15

PROPOSED TOP OF LOW RAIL ELEVATIONS AT PROPOSED STATIONS

564.70 563.90 563.10 562.71 562.32 561.94 561.58 561.22 560.87 560.54 560.21 559.89 559.58 559.29 559.00 558.43 557.86 557.29 556.72 556.16 555.59 555.02 554.45 553.88 553.32 552.75 552.18 551.61 551.04 550.48 549.91 549.34 548.77 548.20 547.64 547.07

-0.80 % → -0.568 % →

PROPOSED TOP OF LOW RAIL

EXISTING TOP OF LOW RAIL

℄ APPROX GROUND LINE ALONG ℄ PROP. MAIN TRACK

P.C.V.C. P.I.V.C. P.I.V.C. EL. 560.70 600' V.C. r=.004

℄ I-77 17'-1" CL. ℄ S.B. LANE ℄ N.B. LANE

This Sheet for Right of Way only at Southern Rail Road - 10-16-73 J.D.M.

EXISTING TOP OF LOW RAIL ELEVATIONS AT EXISTING STATIONS

565.36 564.69 563.87 563.02 562.20 561.45 560.69 560.09 559.48 558.88 558.45 557.88 557.34 556.67 556.02 555.28 554.57 553.92 553.02 551.78 550.76 550.00 549.67 549.55 549.35 549.28 548.95 548.59 548.16 547.64 547.17

560 550 540 530

3 4 5+00 6 7 8 9 10+00 11 12 13 14 15+00 16 17 18 19 20+00 21 22 23 24 25+00 26 27 28 29 30+00 31 32 33 34

PROFILE - MAIN TRACK

SCALE: 1"=100' H, 1"=10' V

B.M. Nº 61 - NAIL IN BASE 8" HICKORY
145' LT. STA. 590+00
EL. 531.72

Existing 42" RCP under I-77 (north of Southern Railroad). Carolina Panthers Training Facility drains to this pipe.

4B-A T.W. HUTCHINSON et al FEE DEED 6-7-73

4B-B CELANESE CORPORATION FEE DEED 9-6-73

4B-A (SEE LEFT)

TO CHARLOTTE HWY. R/W 150' ℄ I-77 150' 990' B.M. Nº 61

RIGHT OF WAY TO BE ACQUIRED AREA: 1.59 ± AC.

PROPOSED & RELOCATED SOU. RWY. MAIN TRACK APPROX. SLOPE STAKE LINE ℄ 160.34

O.H. POWER LINES

18" C.M.P. M.P. R-21.678 9+56.54

R.R. COMM. LINE (6W)

R.R. R/W LINE 65' 65'

M.P. R-22 AT STA. -7+42

TO COLUMBIA TO ROCK HILL R.R. R/W LINE

D = 3°-05.2' 5 10

R.R. SIGNAL LINE (7W)

SUB-STATION DUKE POWER CO.

SPIRAL

℄ EXIST. SOU. RWY. (C.C.B.A.) MAIN TRACK

C.S. 9+56.54 BEGIN REALIGNMENT

Δs = 2°-28.16' Ls = 160' L.T. = 106.68' S.T. = 53.34'

S.T. 11+16.54

P.O.T. 592+02.59 I-77
P.O.T. 17+62.15 SOU. RWY. RELOC.

P.O.T. 592+82.59 I-77
P.O.T. 18+00 SOU. RWY. EXIST.

℄ 24' RDWY. TO COLUMBIA 595' S 18°37' E ℄ 24' RDWY. N.B. LANE

ROCK HILL INDUSTRIAL PARK

B.M. Nº 61

Δs = 2°-24' Ls = 160' L.T. = 106.67' S.T. = 53.34'

T.S. 18+66.90 S.C. 20+26.90 D = 3°-00'

Δc = 16°-59.29' Dc = 3°-00' Rc = 1910.08' Tc = 285.25' Lc = 566.25' S.E. = 3" 50 M.P.H.

21+25 N 1°02' E 150'

S 5°45' E 150'

23+50 40' EXTENSION - 2-60" C.M.P.

APPROX. SLOPE STAKE LINE 234.90

PROP. R.R. R/W LINE

R=1845.08'

S 83°37' E 750.36'

59+30.87 135.06'

PROPOSED UNDERPASS 159.67'

94.77' R=1830.08' 215.60' R=1829.6'

65' 65' 80' 80' 65' 65'

20' GRADE TO DRAIN

D = 3°-00'

20 PROP. R.R. R/W LINE

EXISTING DBL. 4'x4.5' BOX CULV. 60" C.M.P. EXT. EA END

Existing 2 @ 4' x 4.5' RCBC with 2 @ 60 " CMP extensions under Southern Railroad. Downstream crossing on Unnamed Tributary to Manchester Creek.

Δc = 12°-18.08' Dc = 2°-00' Rc = 2864.93' Tc = 308.74' Lc = 615.07' S.E. = 12"

Δs = 2°-00' Ls = 80' S.T. = 37.33' L.T. = 42.69

C.S. 25+93.15

M.P. R-21.331 27+83.88

Δs = 1°-59.03' Ls = 80' L.T. = 42.61' S.T. = 37.41

C.S. 32+88.22

S.C. 33+68.22 END REALIGNMENT 33+89.98

TO CHARLOTTE

D = 2°-57.67' 65' 35' 65'

SPIRAL 77.74' R=2799.93' 12.15

R.R. COMM. LINE 7

R.R. R/W LINE 30' 30'

R.R. SIGNAL LINE 7

25 ℄ SIG. CASE

PLAN

SCALE: 1"=100'

℄ TRACK
TOP OF LOW RAIL S.E. 1'-0" 2
10" MIN. STONE BALLAST UNDER LOW RAIL

BALLAST SECTION - SUPERELEVATION TRACK

7'-0" MIN. 14'-0" 14'-0"
3'-0" 4'-0" TOP OF RAIL
1½" 2'-0" MIN. SUB-GRADE 2 1½" 2'-9"
10" STONE BALLAST (A.R.E.A. #4)
8" SUB-BALLAST (CRUSHED STONE)
CUT FILL

TYPICAL ROADBED SECTION - MAIN TRACK

℄ PROP. M/T ℄ EXIST. M/T
550 540 530 520
12'
1½
SHOULDER LINE
PIER I

SECTION AT STA 16+70
SCALE: 1"=20' H. & V.

ESTIMATED QUANTITIES — TRACKWORK

CLEARING & GRUBBING WITHIN RIGHT OF WAY	L.S.	—
UNCLASSIFIED EXCAVATION - (PLAN QUANTITY)	CU. YDS.	1,000
UNCLASSIFIED EXCAVATION (BORROW) (PLAN QUANTITY)	CU. YDS.	22,150
SUB-BALLAST - CRUSHED STONE - LIMESTONE	TONS	1,300
STONE BALLAST — AREA #4 (UNDERPASS INCLUDED)	TONS	1,630
RAILROAD TRACK TO BE CONSTRUCTED (132 LB. MATERIAL)	TK. FT.	1,412
RAILROAD TRACK TO BE LINED	TK. FT.	1,000
RAILROAD TRACK TO BE REMOVED	TK. FT.	1,434
GAGE RODS - INSULATED	EA.	70
RAIL ANCHORS	EA.	850
CROSS TIE REPLACEMENTS	EA.	210
SEEDING (MULCHED)	MSY.	6.20
FERTILIZER	TONS	0.64
LIME	TONS	1.28
NITROGEN (ACTUAL)	LB.	62
60" BIT. COATED CORR. METAL CULVERT PIPE, 8 GA., TYPE "C"	L.F.	80

REV.			
CHECKED			
TRACED			
MADE		BY	DATE

FAP 19-77-1(6)

S.C. STATE HIGHWAY DEPARTMENT
COLUMBIA, S.C.

SOUTHERN RAILWAY BRIDGE OVER I-77 YORK COUNTY, S.C. M.P. R-21.52

RELOCATED TRACK PLAN AND PROFILE

FILE NO.	COUNTY	ROUTE NO.	DATE
46.575	YORK	I-77	7-30-73

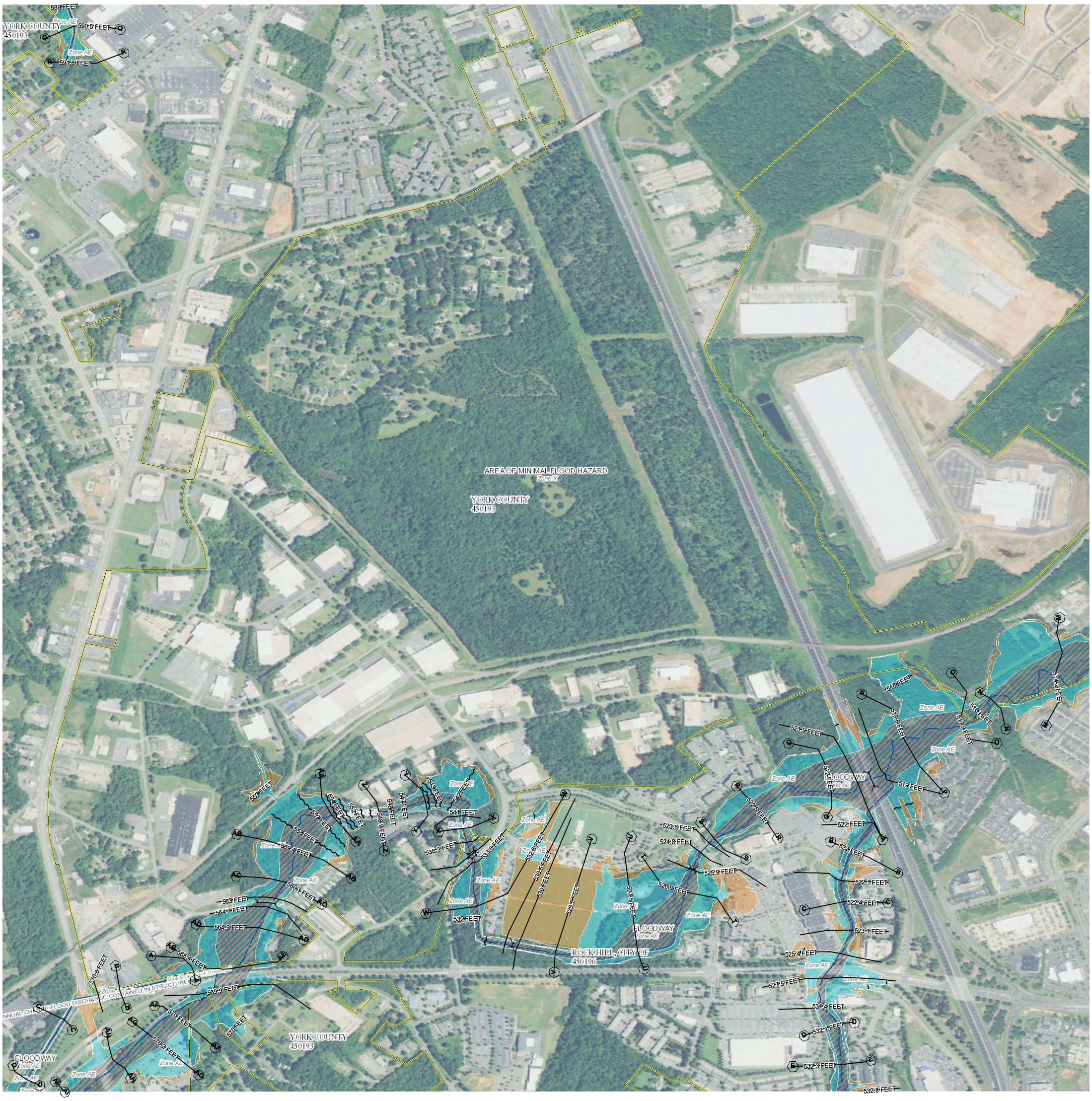
RALPH WHITEHEAD & ASSOCIATES CONSULTING ENGINEERS

SCALE: AS SHOWN

DWG. NO. D-1134.18

APPENDIX G

EFFECTIVE FEMA FIRM



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

34°56'8.39"N

80°59'7.20"W

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE)
	With BFE or Depth
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile
	Future Conditions 1% Annual Chance Flood Hazard
	Area with Reduced Flood Risk due to Levee See Notes.
	Area with Flood Risk due to Levee
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard
	Effective LOMRs
	Area of Undetermined Flood Hazard
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	20.2 Cross Sections with 1% Annual Chance
	17.5 Water Surface Elevation
	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can beordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

YORK COUNTY, SOUTH CAROLINA AND INCORPORATED AREAS

PANEL 328 OF 505

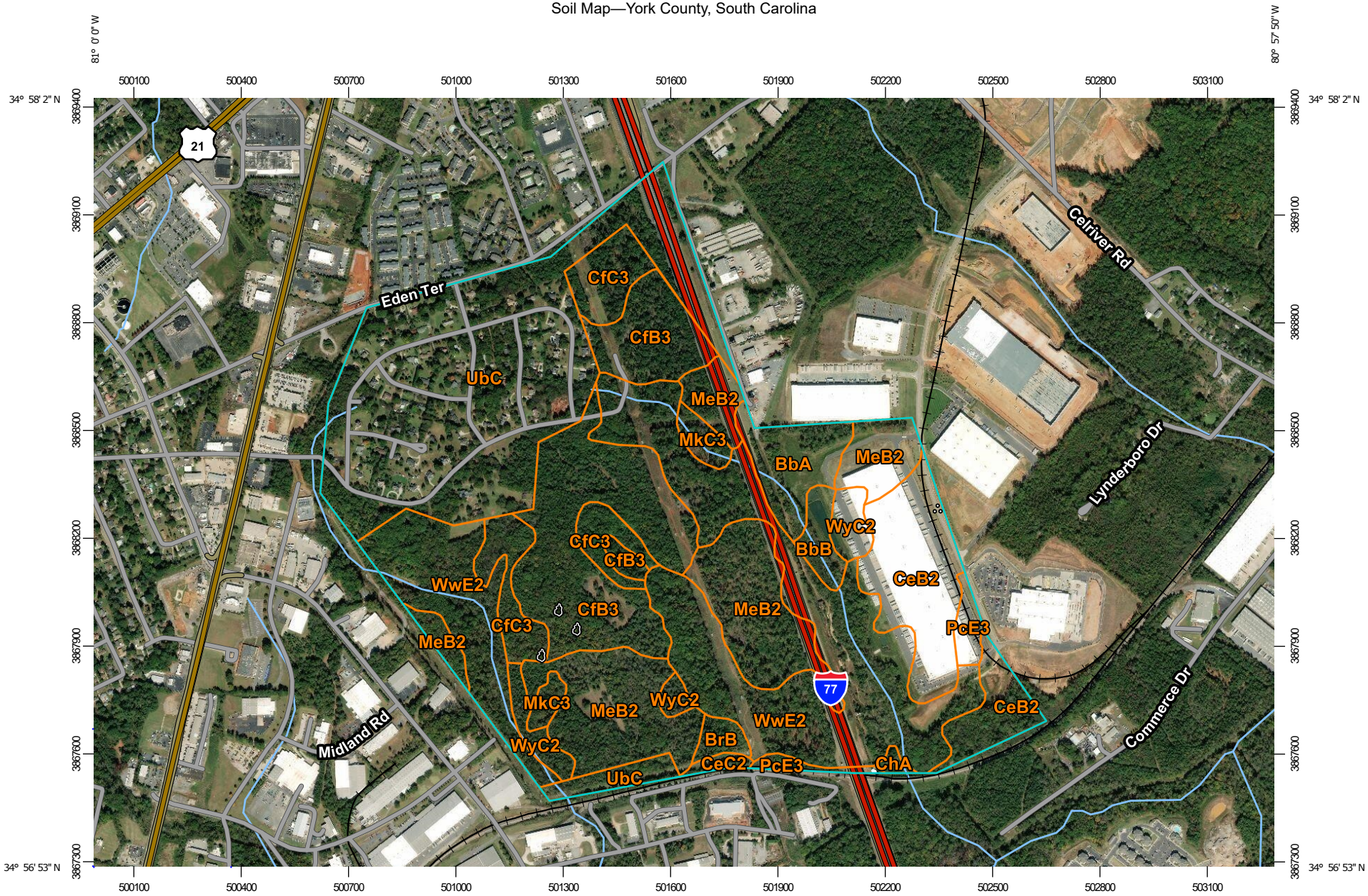
Panel Contains:

COMMUNITY	NUMBER	PANEL
YORK COUNTY SOUTH CAROLINA	450193	0328
ROCK HILL CITY OF SOUTH CAROLINA	450196	0328

MAP NUMBER
45091C0328F
EFFECTIVE DATE
05/16/2017

APPENDIX H

SOILS MAP AND INFORMATION


81° 0' 0" W
80° 57' 50" W
34° 58' 2" N
34° 56' 53" N
500100
500400
500700
501000
501300
501600
501900
502200
502500
502800
503100
3869400
3869100
3868800
3868500
3868200
3867900
3867600
3867300
21
77
Eden Ter
Celriver Rd
Lynderboro Dr
Commerce Dr
Midland Rd
CfC3
CfB3
UbC
MeB2
MkC3
BbA
WyC2
BbB
CeB2
PcE3
WwE2
BrB
CeC2
ChA
Map Scale: 1:15,100 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 200 400 800 1200
Feet
0 500 1000 2000 3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

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

Soil Survey Area: York County, South Carolina
Survey Area Data: Version 16, Sep 16, 2019

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

Date(s) aerial images were photographed: Apr 23, 2014—Nov 28, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BbA	Brewback fine sandy loam, 0 to 2 percent slopes	15.2	3.0%
BbB	Brewback fine sandy loam, 2 to 6 percent slopes	5.6	1.1%
BrB	Brewback very cobbly loam, 2 to 6 percent slopes	3.3	0.7%
CeB2	Cecil sandy clay loam, 2 to 6 percent slopes, moderately eroded	41.1	8.0%
CeC2	Cecil sandy clay loam, 6 to 10 percent slopes, moderately eroded	1.6	0.3%
CfB3	Cecil clay loam, 2 to 6 percent slopes, severely eroded	70.6	13.8%
CfC3	Cecil clay loam, 6 to 10 percent slopes, severely eroded	25.7	5.0%
ChA	Chewacla loam, 0 to 2 percent slopes, frequently flooded	1.1	0.2%
MeB2	Mecklenburg-Wynott complex, 2 to 6 percent slopes, moderately eroded	74.1	14.5%
MkC3	Mecklenburg-Wynott complex, 6 to 10 percent slopes, severely eroded	6.2	1.2%
PcE3	Pacolet clay loam, 15 to 25 percent slopes, severely eroded	5.7	1.1%
UbC	Urban land-Brewback complex, 0 to 10% slopes	128.1	25.0%
WwE2	Wynott-Wilkes complex, 15 to 25 percent slopes, moderately eroded	122.0	23.8%
WyC2	Wynott-Winnsboro complex, 6 to 10 percent slopes, moderately eroded	11.3	2.2%
Totals for Area of Interest		**511.6**	**100.0%**

APPENDIX I

CONCEPTUAL PANTHERS TRAINING FACILITY SITE PLAN

Unnamed Tributary to Manchester Creek

Southern Railroad existing crossing 2 @ 4' x 4.5' RCBC with 2 @ 60" CMP extensions on end

Manchester Creek

Legend

- Project Boundary
- Conceptual Panthers Site Plan

0 2,000 4,000 Feet

SCDOT Kimley»Horn

I-77 Panthers Interchange
Appendix I:Conceptual Panthers Training Facility Site Plan

York County, SC
August 2020