

Drainage Design and Post Construction Stormwater Management

Project Description:

This design build project includes minor widening and intersection improvements of State Route (SR) 435 between IR 71 and SR 729/Bluegrass Blvd. in Fayette County, Ohio inclusive of the interchange and intersection.

To address recent and future development in the area, a round-a-bout will replace the current temporarily signalized intersection of SR 729/Bluegrass Blvd and SR 435. Additionally, pavement will be added on the north side of SR 435 to provide two thru lanes for both eastbound and westbound. Auxiliary turn lanes are being added based on an interchange operation study performed under a separate contract.

Buildable Units for the project have been developed to facilitate an aggressive schedule. The roadway work is covered under two BU's; BU-4, SR 435 from I-71 to the bridge over US 35 and BU-5, from the bridge to just east of SR 729/Bluegrass Blvd. New right of way is required for the BU-5 improvements only.

The analysis of the drainage and BMPs has been separated to match the limits of BU-4 and BU-5.

BU-4

DRAINAGE

Pavement drainage throughout BU-4 is over the shoulder and roadside ditches. Open culverts are utilized under ramps, driveways and mall entrances. For the interchange ramps, the existing ditch lines will be shifted to accommodate the widened pavement. Along SR 435, widening will be completed along the existing northern edge of pavement. Open ditches are being maintained where feasible and existing conduit are being extended and connected with basins in other locations. No work is being performed along the south edge of pavement.

BMP Selection

Since BU-4 improvements are contained within existing RW and this area's drainage is independent from BU-5, BU-4 is being considered redevelopment per Location and Design Manual Volume 2, Section 1111.6.1 **Project EDA for BU-4** is estimated to be 3.32 Acres, treatment percentage of **20.0%** equates to a 0.66 **Acres treatment goal**. With the presence of over the shoulder open drainage, various vegetated means exist for BMP. A vegetated filter strip has been chosen.

The following has been identified as a suitable BMP:

I-71 Ramp D Station 18+25 to 22+75 Left: 25 FT Filter Strip; Treatment Credit: 0.66 Acres.

BU-5

BU-5 Drainage information will be added at a later date.

Storm sewer, ditch drainage, and BMP worksheets are included in appendices following this text. Drainage area maps and computations are included as appropriate.

**APPENDIX A – STORM SEWER DRAINAGE COMPUTATIONS AND
STORM SEWER DRAINAGE AREA MAP**



STORM SEWER SYSTEM

MALL ENTRANCE AND ALLEN RD

117955

PID : 17955 Date : 01/05/2024 Project : FAY-435-1.52

Location : SR 435 between 71 and Bluegrass Blvd

Description : West end between I-71 and SR 35

Designer : DcJ

Rainfall Area: C

Just Full Capacity Frequency (yrs.) : 10

Hydraulic Gradient Frequency (yrs.) : 25

Minimum Pipe Size : 12.00

Tailwater Elevation (ft.): 1051.00

this is an existing run at the beginning of the system. no work is being performed to change any of the drainage area to this point.

| From | To | From To | ΔAREA Σ AREA (acres) | ΔCA Σ CA | BEGIN TIME (min.) | RAINFALL INTENSITY (10 yrs.) (25 yrs.) | DISCHARGE (cfs.) (10 yrs.) (25 yrs.) | PIPE DIAM. (in.) | PIPE LENGTH (ft.) | SLOPE (ft./ft.) | F/L PIPE IN / OUT (ft.) | MEAN VEL (fps.) | JUST FULL CAPACITY (cfs.) | FRICT SLOPE (ft./ft.) | HYGR EL. (ft.) | COVER IN / OUT (ft.) | COVER MINUS HY GR | COVER MINUS CROWN | INLET MANNING'S 'n' | TYPE |
|-------------------------|----|----------------|----------------------------|--------------|-------------------------|--|--|------------------------|-------------------------|--------------------|-------------------------------|-----------------------|---------------------------------|-----------------------------|--------------------|----------------------------|-------------------------|-------------------------|---------------------------|-------|
| 10 | 15 | 59+20 begin | 1.16 1.16 | 0.88 0.88 | 15.00 | 4.47 4.73 | 3.9 4.2 | 15 | 30.0 | 0.0177 | 1055.37 1054.84 | 6.15 | 8.00 | 0.0055 | 1057.36 1057.19 | 1058.00 1058.00 | 0.64 | 1.38 | HW Half He | 0.015 |
| 15 | 20 | 58+80 58+10 | 0.33 1.49 | 0.30 1.18 | 15.08 | 4.46 4.73 | 5.3 5.6 | 15 | 72.0 | 0.0025 | 1054.84 1054.66 | 4.29 | 3.01 | 0.0099 | 1057.19 1056.48 | 1058.00 1058.00 | 0.81 | 1.91 | CB 3 | 0.015 |
| Warning | | | | | | | | | | | | | | | | | | | | |
| 20 | 25 | 58+10 57+75 | 0.24 1.73 | 0.21 1.39 | 15.36 | 4.42 4.73 | 6.2 6.6 | 18 | 130.0 | 0.0049 | 1054.66 1054.02 | 4.12 | 6.87 | 0.0052 | 1056.48 1055.80 | 1058.01 1058.00 | 1.53 | 1.85 | CB 3 | 0.015 |
| 25 | 30 | 56+75 54+90 | 0.91 2.64 | 0.72 2.11 | 15.89 | 4.35 4.73 | 9.2 10.0 | 24 | 175.0 | 0.0023 | 1053.80 1053.40 | 3.40 | 10.08 | 0.0026 | 1055.80 1055.28 | 1056.70 1056.00 | 0.90 | 0.90 | CB 2-2B | 0.015 |
| 30 | 35 | 54+90 54+00 | 0.40 3.04 | 0.28 2.39 | 16.75 | 4.24 4.73 | 10.1 11.3 | 24 | 100.0 | 0.0050 | 1053.45 1052.95 | 4.82 | 14.91 | 0.0033 | 1055.28 1054.95 | 1056.00 1055.70 | 0.72 | 0.55 | CB 2-4 | 0.015 |
| INCLUDE FLOW FROM 12" N | | | | | | | | | | | | | | | | | | | | |
| 35 | 40 | 54+00 52+70 | 0.38 3.42 | 0.29 2.68 | 17.09 | 4.20 4.73 | 11.3 12.7 | 24 | 125.0 | 0.0032 | 1052.95 1052.55 | 4.02 | 11.93 | 0.0042 | 1054.95 1054.19 | 1055.70 1055.00 | 0.75 | 0.75 | CB 2-4 | 0.015 |
| 40 | 45 | 52+70 51+72 | 0.39 3.81 | 0.30 2.98 | 17.61 | 4.14 4.69 | 12.3 14.0 | 24 | 100.0 | 0.0060 | 1052.55 1051.95 | 5.38 | 16.34 | 0.0051 | 1054.13 1053.62 | 1056.00 1056.00 | 1.87 | 1.45 | HW Half He | 0.015 |
| 50 | 45 | 50+75 begin | 1.26 5.07 | 1.07 4.05 | 15.00 | 4.47 4.66 | 4.8 5.0 | 18 | 125.0 | 0.0024 | 1051.80 1051.50 | 2.71 | 4.80 | 0.0030 | 1053.70 1053.32 | 1057.00 1057.00 | 3.30 | 3.70 | CB 2-2B | 0.015 |

49+95

EX. CB



STORM SEWER SYSTEM

| JUNCTION STATION | | ΔAREA | ΔCA | BEGIN | RAINFALL | DISCHARGE | | PIPE | | | F/L PIPE | MEAN | JUST FULL | FRICT | HYGR EL. | COVER | COVER | COVER | INLET TYPE | |
|------------------|-------|---------|------|--------|-----------|-----------|-----------|-------|--------|-----------|----------|---------|-----------|-----------|----------|----------|---------|-------|------------|------------|
| From | To | Σ AREA | Σ CA | TIME | INTENSITY | (cfs.) | (cfs.) | DIAM. | LENGTH | SLOPE | IN / OUT | VEL | CAPACITY | SLOPE | IN / OUT | IN / OUT | MINUS | MINUS | MANNING'S | |
| | | (acres) | | (min.) | (10 yrs.) | (25 yrs.) | (10 yrs.) | (in.) | (ft.) | (ft./ft.) | (ft.) | (fps.) | (cfs.) | (ft./ft.) | (ft.) | (ft.) | HY GR | CROWN | 'n' | |
| 45 | 55 | 0.38 | 0.30 | 17.92 | 4.10 | 4.66 | 17.8 | 20.3 | 36 | 80.0 | 0.0063 | 1051.50 | 6.06 | 49.16 | 0.0012 | 1053.32 | 1056.00 | 2.68 | 1.50 | HW Full He |
| final | 51+72 | 5.45 | 4.35 | | | | | | | | | 1051.00 | | | 1053.22 | 1056.00 | | | | 0.015 |

HALF HEIGHT HEADWALL IS AT 51+72

MISSING MH AT 51+95, PLUS ADD FLOW FROM 12" N

| SUB AREA 10 STA 59+20 LT | | |
|--------------------------|-------|------|
| C Computation | Ac | C |
| Drainage Area | 1.160 | 0.76 |
| Subarea - 1 | 32280 | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | 18250 | 0.50 |

| SUB AREA 15 STA 58+80 LT | | |
|--------------------------|-------|------|
| C Computation | Ac | C |
| Drainage Area | 0.330 | 0.90 |
| Subarea - 1 | 14200 | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | 175 | 0.50 |

| SUB AREA 20 STA 58+10 LT | | |
|--------------------------|-------|------|
| C Computation | Ac | C |
| Drainage Area | 0.240 | 0.89 |
| Subarea - 1 | 10300 | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | 150 | 0.50 |

| SUB AREA 25 STA 56+75 LT | | |
|--------------------------|-------|------|
| C Computation | Ac | C |
| Drainage Area | 0.910 | 0.79 |
| Subarea - 1 | 28630 | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | 10970 | 0.50 |

| SUB AREA 30 STA 54+90 LT | | |
|--------------------------|-------|------|
| C Computation | Ac | C |
| Drainage Area | 0.400 | 0.70 |
| Subarea - 1 | 8850 | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | 8705 | 0.50 |

| SUB AREA 35 STA 54+00 LT | | |
|--------------------------|-------|------|
| C Computation | Ac | C |
| Drainage Area | 0.380 | 0.77 |
| Subarea - 1 | 11050 | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | 5530 | 0.50 |

| SUB AREA 40 STA 52+70 LT | | |
|--------------------------|-------|------|
| C Computation | Ac | C |
| Drainage Area | 0.390 | 0.76 |
| Subarea - 1 | 10880 | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | 6110 | 0.50 |

| SUB AREA 45 STA 51+20 LT | | |
|--------------------------|-------|------|
| C Computation | Ac | C |
| Drainage Area | 0.380 | 0.78 |
| Subarea - 1 | 11717 | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | 4805 | 0.50 |

| SUB AREA 50 STA 50+00 LT | | |
|--------------------------|-------|------|
| C Computation | Ac | C |
| Drainage Area | 1.260 | 0.85 |
| Subarea - 1 | 47960 | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | 6815 | 0.50 |

| C Computation | Ac | C |
|---------------|-------|---------|
| Drainage Area | 0.000 | #DIV/0! |
| Subarea - 1 | | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | | 0.50 |

| C Computation | Ac | C |
|---------------|-------|---------|
| Drainage Area | 0.000 | #DIV/0! |
| Subarea - 1 | | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | | 0.50 |

| C Computation | Ac | C |
|---------------|-------|---------|
| Drainage Area | 0.000 | #DIV/0! |
| Subarea - 1 | | 0.90 |
| Subarea - 2 | | 0.50 |
| Subarea - 3 | | 0.30 |
| Subarea - 4 | | 0.70 |
| Subarea - 5 | | 0.50 |

CTY-RTE-SECTION

MODEL: DRAINAGE AREAS PAPER: 34x22 (in.) DATE: 1/12/2024 TIME: 10:04:03 AM USER: dennisj
pw:\pewjpw04_pavin.private.palmernet.com\Palmer_Engineering\Documents\Ohio\DOT\06\FY117955\400-Engineering\Drainage\Basemaps\117955_Drainage Areas.dgn



DRAINAGE AREAS

| |
|----------------------|
| DESIGN AGENCY |
| DESIGNER DCJ |
| REVIEWER 01-10-24 |
| PROJECT ID 117955 |
| SHEET TOTAL |

APPENDIX B – DITCH DRAINAGE COMPUTATIONS



DITCH ANALYSIS

PID : 117955 Date : 01/11/2024 Project : FAY-435

Location : FAYETTE COUNTY OHIO

Description : FAY 435 AT I-71, RAMP A upper gore, DITCH LINING ANALYSIS

Designer : DCJ

Rainfall Area : C

Allowable Shears

| | | | | | |
|-----------------------|------|-----------|------|----------------|------|
| Seed: | 0.40 | Jute Mat: | 0.45 | Temporary Mat: | 1.00 |
| Permanent Mat Type 1: | 2.00 | Type 2: | 3.00 | Type 3: | 5.00 |
| RCP Type B: | 6.00 | | | | |

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

| STATION BEGIN | STATION END | SIDE | LENGTH (ft.) | RADIUS (ft.) | IN SLOPE (ft./ft.) | BACK SLOPE (ft./ft.) | GRADE (ft./ft.) | AREA (acres) | AREA SUM (acres) | RUNOFF COEFF. | CA (Sum) | PROTECT TYPE | RAIN INT. (in./hr.) | STORM FREQ. (yrs.) | MANN. COEFF. | TIME FLOW (min.) | VEL. FLOW (fps.) | SHEAR (lbs./sq.ft.) | DESIGN FLOW (cfs.) | DEPTH FLOW (ft.) | WIDTH FLOW (ft.) |
|---------------|-------------|------|--------------|--------------|--------------------|----------------------|-----------------|--------------|------------------|---------------|----------|--------------|---------------------|--------------------|--------------|------------------|------------------|---------------------|--------------------|------------------|------------------|
| 18+00 | 22+00 | R | 400.00 | 4.00 | 4.00 | 4.00 | 0.0183 | 1.10 | 1.10 | 0.60 | 0.66 | Seed | 3.65 | 5 | 0.030 | 17.95 | 2.19 | 0.26 | 2.41 | 0.22 | 5.79 |
| | | | | | | | | | | | | Seed | 4.04 | 10 | 0.040 | 18.46 | 1.86 | 0.32 | 2.66 | 0.28 | 6.23 |

the Tc is high for the size of the drainage area

TYPICAL ALL DITCH CALCS:
THESE NUMBERS SHOULD MATCH SECTION 1102.3.1 OF L&D VOL 2



DITCH ANALYSIS

PID : 117955 **Date :** 01/11/2024 **Project :** FAY-435

Location : FAYETTE COUNTY OHIO

Description : FAY 435 AT I-71, RAMP A INFIELD, DITCH LINING ANALYSIS

Designer : DCJ

Rainfall Area : C

Allowable Shears

| | | | | | | |
|----------------------|----------------|------|------------------|------|-----------------------|------|
| | Seed: | 0.40 | Jute Mat: | 0.45 | Temporary Mat: | 1.00 |
| Permanent Mat | Type 1: | 2.00 | Type 2: | 3.00 | Type 3: | 5.00 |
| RCP | Type B: | 6.00 | | | | |

(*) Warning: Grade is steeper than allowable.

If value is parantheses, design parameters have been exceeded. - See user manual.

| STATION BEGIN | STATION END | SIDE | LENGTH (ft.) | RADIUS WIDTH (ft.) | IN SLOPE (ft./ft.) | BACK SLOPE (ft./ft.) | GRADE (ft./ft.) | AREA (acres) | AREA SUM (acres) | RUNOFF COEFF. | CA (Sum) | PROTECT TYPE | RAIN INT. (in./hr.) | STORM FREQ. (yrs.) | MANN. COEFF. | TIME FLOW (min.) | VEL. FLOW (fps.) | SHEAR (lbs./ sq.ft.) | DESIGN FLOW (cfs.) | DEPTH FLOW (ft.) | WIDTH FLOW (ft.) |
|------------------|----------------|------|-----------------|--------------------------|--------------------------|----------------------------|--------------------|-----------------|------------------------|------------------|-------------|-----------------|---------------------------|--------------------------|-----------------|------------------------|------------------------|----------------------------|--------------------------|------------------------|------------------------|
| 25+00 | 23+00 | R | 150.00 | 4.00 | 4.00 | 4.00 | 0.0190 | 2.00 | 2.00 | 0.65 | 1.30 | Seed | 3.89 | 5 | 0.030 | 15.88 | 2.82 | 0.40 | 5.06 | 0.34 | 6.69 |
| | | | | | | | | | | | | Seed | 4.33 | 10 | 0.040 | 16.04 | 2.38 | 0.50 | 5.63 | 0.42 | 7.34 |
| 23+00 | 22+00 | R | 100.00 | 4.00 | 4.00 | 4.00 | 0.0183 | 0.60 | 2.60 | 0.60 | 1.66 | Seed | 3.82 | 5 | 0.030 | 16.43 | 2.98 | 0.44 | 6.34 | 0.38 | 7.08 |
| | | | | | | | | | | | | Jute Mat | 3.81 | 5 | 0.040 | 16.56 | 2.43 | 0.51 | 6.32 | 0.45 | 7.59 |
| | | | | | | | | | | | | Temp. Mat | 3.81 | 5 | 0.040 | 16.56 | 2.43 | 0.51 | 6.32 | 0.45 | 7.59 |
| | | | | | | | | | | | | Temp. Mat | 4.25 | 10 | 0.040 | 16.70 | 2.51 | 0.54 | 7.05 | 0.48 | 7.80 |



DITCH ANALYSIS

PID : 117955 **Date :** 01/11/2024 **Project :** FAY-435

Location : FAYETTE COUNTY OHIO

Description : FAY 435 AT I-71, RAMP B INFIELD, DITCH LINING ANALYSIS

Designer : DCJ

Rainfall Area : C

Allowable Shears

| | | | | | | |
|----------------------|----------------|------|------------------|------|-----------------------|------|
| | Seed: | 0.40 | Jute Mat: | 0.45 | Temporary Mat: | 1.00 |
| Permanent Mat | Type 1: | 2.00 | Type 2: | 3.00 | Type 3: | 5.00 |
| RCP | Type B: | 6.00 | | | | |

(*) Warning: Grade is steeper than allowable.

If value is parantheses, design parameters have been exceeded. - See user manual.

| STATION BEGIN | STATION END | SIDE | LENGTH (ft.) | RADIUS WIDTH (ft.) | IN SLOPE (ft./ft.) | BACK SLOPE (ft./ft.) | GRADE (ft./ft.) | AREA (acres) | AREA SUM (acres) | RUNOFF COEFF. | CA (Sum) | PROTECT TYPE | RAIN INT. (in./hr.) | STORM FREQ. (yrs.) | MANN. COEFF. | TIME FLOW (min.) | VEL. FLOW (fps.) | SHEAR (lbs./ sq.ft.) | DESIGN FLOW (cfs.) | DEPTH FLOW (ft.) | WIDTH FLOW (ft.) |
|------------------|----------------|------|-----------------|--------------------------|--------------------------|----------------------------|--------------------|-----------------|------------------------|------------------|-------------|-----------------|---------------------------|--------------------------|-----------------|------------------------|------------------------|----------------------------|--------------------------|------------------------|------------------------|
| 11+50 | 6+00 | R | 550.00 | 4.00 | 4.00 | 4.00 | 0.0190 | 2.00 | 2.00 | 0.65 | 1.30 | Seed | 3.62 | 5 | 0.030 | 18.22 | 2.76 | 0.38 | 4.70 | 0.32 | 6.58 |
| | | | | | | | | | | | | Seed | 4.00 | 10 | 0.040 | 18.81 | 2.33 | 0.47 | 5.20 | 0.40 | 7.19 |
| 6+00 | 2+20 | R | 350.00 | 4.00 | 4.00 | 4.00 | 0.0129 | 1.50 | 3.50 | 0.65 | 2.28 | Seed | 3.41 | 5 | 0.030 | 20.27 | 2.80 | 0.38 | 7.76 | 0.47 | 7.77 |
| | | | | | | | | | | | | Seed | 3.75 | 10 | 0.040 | 21.25 | 2.35 | 0.46 | 8.52 | 0.58 | 8.60 |

the Tc is high for the size of the drainage area



DITCH ANALYSIS

PID : 117955 Date : 01/11/2024 Project : FAY-435

Location : FAYETTE COUNTY OHIO

Description : FAY 435 AT I-71, RAMP D infield, DITCH LINING ANALYSIS

Designer : DCJ

Rainfall Area : C

Allowable Shears

| | | | | | | |
|----------------------|----------------|------|------------------|------|-----------------------|------|
| | Seed: | 0.40 | Jute Mat: | 0.45 | Temporary Mat: | 1.00 |
| Permanent Mat | Type 1: | 2.00 | Type 2: | 3.00 | Type 3: | 5.00 |
| RCP | Type B: | 6.00 | | | | |

(*) Warning: Grade is steeper than allowable.

If value is parantheses, design parameters have been exceeded. - See user manual.

| STATION BEGIN | STATION END | SIDE | LENGTH (ft.) | RADIUS WIDTH (ft.) | IN SLOPE (ft./ft.) | BACK SLOPE (ft./ft.) | GRADE (ft./ft.) | AREA (acres) | AREA SUM (acres) | RUNOFF COEFF. | CA (Sum) | PROTECT TYPE | RAIN INT. (in./hr.) | STORM FREQ. (yrs.) | MANN. COEFF. | TIME FLOW (min.) | VEL. FLOW (fps.) | SHEAR (lbs./ sq.ft.) | DESIGN FLOW (cfs.) | DEPTH FLOW (ft.) | WIDTH FLOW (ft.) |
|------------------|----------------|------|-----------------|--------------------------|--------------------------|----------------------------|--------------------|-----------------|------------------------|------------------|-------------|-----------------|---------------------------|--------------------------|-----------------|------------------------|------------------------|----------------------------|--------------------------|------------------------|------------------------|
| 22+00 | 21+00 | R | 400.00 | 4.00 | 4.00 | 4.00 | 0.0183 | 1.80 | 1.80 | 0.60 | 1.08 | Seed | 3.20 | 5 | 0.030 | 22.64 | 2.47 | 0.31 | 3.46 | 0.27 | 6.20 |
| | | | | | | | | | | | | Seed | 3.58 | 10 | 0.040 | 23.11 | 2.10 | 0.39 | 3.86 | 0.34 | 6.74 |
| 21+00 | 18+00 | R | 300.00 | 4.00 | 4.00 | 4.00 | 0.0045 | 1.80 | 3.60 | 0.60 | 2.16 | Seed | 2.99 | 5 | 0.030 | 25.33 | 1.82 | 0.16 | 6.47 | 0.57 | 8.53 |
| | | | | | | | | | | | | Seed | 3.32 | 10 | 0.040 | 26.31 | 1.53 | 0.19 | 7.16 | 0.69 | 9.54 |

the Tc is high for the size of the drainage area

APPENDIX C – POST CONSTRUCTION STORMWATER BMP COMPUTATIONS



Ohio Department of Transportation - Office of Hydraulic Engineering
Post-Construction BMP Calculation Spreadsheet

Post Construction - Project Summary

Project Data

| | | Units |
|--|---------------|-------|
| Project EDA | 3.32 | acres |
| Is the Project Routine Maintenance per L&D Vol. 2, Sec. 1112.2 | No | |
| BMPs Required? | BMPs Required | NA |
| Ain (New Impervious Area in New Permanent R/W) | 0 | acres |
| Does Entire Site Drain to Large River (>100 sq. miles)? | No | |
| Water Quality Treatment Required | Yes | |
| Water Quantity Treatment Required | No | |

Treatment Percent and Treatment Requirement

| | | |
|--|--------------|-------|
| Aix (Project EDA that is inside the existing right-of-way) | 3.32 | acres |
| Ain (New Impervious Area in New Permanent R/W) | 0 | acres |
| T% (Treatment Percent) | 20.00 | % |
| Treatment Requirement | 0.66 | acres |

BMPs Provided

| BMP Name | BMP Type | Contributing Drainage Area (acres) | Contributing Drainage Area in ODOT R/W (acres) |
|----------|------------------------|------------------------------------|--|
| VFS1 | Vegetated Filter Strip | 0.66 | 0.66 |
| BMP2 | | | |
| BMP3 | | | |
| BMP4 | | | |
| BMP5 | | | |
| BMP6 | | | |
| BMP7 | | | |
| BMP8 | | | |
| BMP9 | | | |
| BMP10 | | | |

Treatment Provided

| | |
|---|--------------|
| Total Area with ODOT R/W Treated (acres) | 0.66 |
| Treatment Requirements (acres) | 0.66 |
| Treatment Check | Check Design |

BMP Submittal Requirements (Per L&D, Vol. 2, Sec. 1116.2)

| | | |
|---|-----|------|
| 1. Estimated Project Earth Disturbed Area | Yes | Good |
| 2. Treatment Percent Calculation | Yes | Good |
| 3. BMP Selected for use | Yes | Good |
| 4. Drainage area mapping for post-construction BMPs that show the total contributing drainage area and the amount of contributing area within ODOT right-of-way | Yes | Good |
| 5. Plan sheets showing locations of post-construction BMP | Yes | Good |
| 6. Calculations for each BMP | Yes | Good |
| 7. Explanation for any area that is not treated | Yes | Good |



Ohio Department of Transportation - Office of Hydraulic Engineering

Post-Construction BMP Calculation Spreadsheet

Vegetated Filter Strip

| Filter Strip | Route | Begin Station | End Station | Side | Pavement Width (FT) | Filter Strip Width (FT) | Filter Strip Slope (z:1) | Filter Strip Length (FT) | Drainage Area (acres) | Filter Strip Area (SF) | Item 659 Topsoil Volume (CY) | Item 670 Erosion Protection Area (SY) |
|------------------|-----------|---------------|-------------|------|---------------------|-------------------------|--------------------------|--------------------------|-----------------------|------------------------|------------------------------|---------------------------------------|
| Filter Strip #1 | 71 ramp D | 18+25 | 22+75 | LT | 39 | 25 | 6 | 450 | 0.66 | 11,250 | 138.9 | 1,250.0 |
| Filter Strip #2 | | | | | | | | 0 | | | 0.0 | 0.0 |
| Filter Strip #3 | | | | | | | | 0 | | | 0.0 | 0.0 |
| Filter Strip #4 | | | | | | | plans show 4:1 | 0 | | | 0.0 | 0.0 |
| Filter Strip #5 | | | | | | | | 0 | | | 0.0 | 0.0 |
| Filter Strip #6 | | | | | | | | 0 | | | 0.0 | 0.0 |
| Filter Strip #7 | | | | | | | | 0 | | | 0.0 | 0.0 |
| Filter Strip #8 | | | | | | | | 0 | | | 0.0 | 0.0 |
| Filter Strip #9 | | | | | | | | 0 | | | 0.0 | 0.0 |
| Filter Strip #10 | | | | | | | | 0 | | | 0.0 | 0.0 |

Total Treatment Credit Earned from Vegetated Filter Strips 0.66 acres

(Treatment is for quality only, not quantity)

1113-3

BMP Design Considerations

| | | Answer | Design Check |
|---|---|--------|--------------|
| 1 | Is the min. filter strip width 15-25 ft wide depending on L&D Table 1117-3? | Yes | Good |
| 2 | Is the slope 3:1 or flatter for 34 ft or narrower pavement drainage width | Yes | Good |
| 3 | Is the slope 6:1 or flatter for 35 - 48 ft pavement drainage width | NA | Good |
| 4 | Is the only contributing drainage to the filter strip from the road and shoulder? | Yes | Good |
| 5 | Does any concentrated flow or any outlets discharge to the filter strip? | No | Good |
| 6 | Is 4" of Item 659, Topsoil, included for the filter strip? | Yes | Good |
| 7 | Is Item 670, Slope Erosion Protection, included for the filter strip? | Yes | Good |

CTY-RTE-SECTION

MODEL: EDA PAPER SIZE: 34x22 (in.) DATE: 11/2/2024 TIME: 9:41:08 AM USER: demisj
pw:\pewipw04_pavin.private.palmernet.com\Palmer_Engineering\Documents\Ohio\DOT\06\FY117955\400-Engineering\Drainage\Basemap\117955_Drainage Areas.dgn



EARTH DISTURBED AREAS

DESIGN AGENCY

DESIGNER
DCJ

REVIEWER
01-10-24

PROJECT ID
117955

SHEET TOTAL

APPENDIX D-
EXISTING RAMP CULVERT COMPUTATIONS
AND
SR 435 -EXISTINTG 30" STORM (ST 44+50) COMPUTATIONS



CULVERT ANALYSIS

PID : 117955 **Date :** 01/15/2024 **Project :** fay-435-1.52

Location : SR 435 btween 71 and Bluegrass Blvd

Description : I-71 Ramp A 18" culvert

Designer : dcj

HEADWATER CONTROL CODES: INLET - Inlet Control.
 OUTLET - Outlet Control.
 OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
 OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
 N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 1 **Inlet Invert Elevation (ft.) :** 1044.16 **Outlet Invert Elevation (ft.) :** 1043.87
Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 120.00 **Culvert Slope (ft./ft.) :** 0.0024
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)
Pipe Size : 18 in.

Design Manning 'n' : (default) **Buried Manning 'n' :** N/A

Entrance Type : Headwall **Loss Coef. Ke :** 0.2500 **K :** 0.0083 **M :** 2.00 **Max. Q :** 3.30
CD : 0.6405 **c :** 0.0379 **Y :** 0.6900 **Min. Q :** 3.80

| FLOW (cfs.) | HEAD LOSS (ft.) | HWI (ft.) | HWO (ft.) | FLOW TYPE | VELOCITY (fps.) | DN (ft.) | DC (ft.) | MANNING N | HEADWATER CONTROL | BURIED DEPTH (ft.) | TAILWATER ELEVATION (ft.) |
|-------------|-----------------|-----------|-----------|-----------|-----------------|----------|----------|-----------|-------------------|--------------------|---------------------------|
| 9.70 | 4.32 | 1046.34 | 1049.54 | 2 - F | 6.39 | 1.50 | 1.20 | 0.0249 | OUTLET** | 0.00 | 1043.87 |
| 10.70 | 5.25 | 1046.58 | 1050.50 | 2 - F | 6.78 | 1.50 | 1.25 | 0.0249 | OUTLET** | 0.00 | 1044.34 |
| 11.70 | 6.28 | 1046.85 | 1051.55 | 2 - F | 7.18 | 1.50 | 1.30 | 0.0249 | OUTLET** | 0.00 | 1044.81 |
| 12.70 | 7.40 | 1047.15 | 1052.69 | 2 - F | 7.36 | 1.50 | 1.34 | 0.0249 | OUTLET** | 0.00 | 1045.28 |

Flow rate calculations are missing from the report. Provide information on how the flow rates used were determined

HOW WAS FLOW CALCULATED? I SEE NO SUPPORTING DOCUMENTATION



CULVERT ANALYSIS

PID : 117955 **Date :** 01/15/2024 **Project :** fay-435-1.52

Location : SR 435 btwn 71 and Bluegrass Blvd

Description : I-71 Ramp B 30" culvert

Designer : dcj

HEADWATER CONTROL CODES: INLET - Inlet Control.
 OUTLET - Outlet Control.
 OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
 OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
 N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 1 **Inlet Invert Elevation (ft.) :** 1046.55 **Outlet Invert Elevation (ft.) :** 1045.41
Pipe Quantity : 1
Culvert Type : Circular Smooth **Pipe Length (ft.) :** 95.00 **Culvert Slope (ft./ft.) :** 0.0120
Corrugation Type :
Pipe Size : 30 in.
Design Manning 'n' : (default) **Buried Manning 'n' :** N/A

1045.55 PER CULVERT DETAIL

Entrance Type : Square Edge with Headwall **Loss Coef. Ke :** 0.5000 **K :** 0.0098 **M :** 2.00 **Max. Q :** 3.30
CD : 0.6251 **c :** 0.0398 **Y :** 0.6700 **Min. Q :** 3.40

| FLOW (cfs.) | HEAD LOSS (ft.) | HWI (ft.) | HWO (ft.) | FLOW TYPE | VELOCITY (fps.) | DN (ft.) | DC (ft.) | MANNING N | HEADWATER CONTROL | BURIED DEPTH (ft.) | TAILWATER ELEVATION (ft.) |
|-------------|-----------------|-----------|-----------|-----------|-----------------|----------|----------|-----------|-------------------|--------------------|---------------------------|
| 21.10 | 1.50 | 1048.94 | N/A | 1 - C | 9.57 | 1.15 | 1.56 | 0.0120 | INLET | 0.00 | 1046.00 |
| 23.10 | 1.63 | 1049.10 | N/A | 1 - C | 9.78 | 1.21 | 1.64 | 0.0120 | INLET | 0.00 | 1046.88 |
| 25.10 | 1.51 | 1049.27 | 1048.67 | 1 - C | 10.00 | 1.27 | 1.71 | 0.0120 | INLET | 0.00 | 1047.76 |
| 27.10 | 1.06 | 1049.42 | 1049.70 | 2 - G | 5.52 | 1.33 | 1.77 | 0.0120 | OUTLET | 0.00 | 1048.64 |
| 29.10 | 1.22 | 1049.61 | 1050.74 | 2 - G | 5.93 | 1.39 | 1.84 | 0.0120 | OUTLET | 0.00 | 1049.52 |
| 31.10 | 1.40 | 1049.81 | 1051.79 | 2 - G | 6.34 | 1.45 | 1.90 | 0.0120 | OUTLET | 0.00 | 1050.40 |

SEE RAMP A CULVERT

ALLOWABLE HW IS 1050.53-1 = 1049.53

Flow rate calculations are missing from the report. Provide information on how the flow rates used were determined



STORM SEWER SYSTEM

PID : 17955 Date : 01/15/2024 Project : FAY-435-1.52

Location : SR 435 btween 71 and Bluegrass Blvd

Description : Mainline cross sewer Sta 44+50

Designer : DCJ

Rainfall Area: C

Just Full Capacity Frequency (yrs.) : 5

Hydraulic Gradient Frequency (yrs.) : 10

Minimum Pipe Size : 15.00

Tailwater Elevation (ft.): 1051.70

10

25

| JUNCTION | | STATION | ΔAREA | ΔCA | BEGIN | RAINFALL | | DISCHARGE | | PIPE | | | F/L PIPE | MEAN | JUST FULL | FRICT | HYGR EL. | COVER | COVER | COVER | INLET TYPE |
|----------|-------|---------|----------------|------|-------------|--------------------|-----------|-----------|-----------|-------------|--------------|-----------------|----------------|------------|-----------------|-----------------|----------------|----------------|-------------|-------------|---------------|
| From | To | From To | Σ AREA (acres) | Σ CA | TIME (min.) | INTENSITY (5 yrs.) | (10 yrs.) | (5 yrs.) | (10 yrs.) | DIAM. (in.) | LENGTH (ft.) | SLOPE (ft./ft.) | IN / OUT (ft.) | VEL (fps.) | CAPACITY (cfs.) | SLOPE (ft./ft.) | IN / OUT (ft.) | IN / OUT (ft.) | MINUS HY GR | MINUS CROWN | MANNING'S 'n' |
| 1 | 2 | 10+00 | 7.60 | 3.80 | 30.00 | 2.70 | 3.03 | 10.2 | 11.5 | 30 | 86.0 | 0.0012 | 1047.20 | 2.77 | 13.04 | 0.0010 | 1051.79 | 1051.80 | 0.01 | 2.10 | CB 5 |
| | begin | 10+86 | 7.60 | 3.80 | | | | | | | | | 1047.10 | | | | 1051.70 | 1051.78 | | | 0.015 |

provide calculation or support for the Tc used

INCLUDE MEDIAN CB AND REMAINDER OF 30" RCP TO SOUTH SIDE OF SR 435