

JEF-43-18.85

PID # 120662

DRAINAGE CALCS

Flood Information:

- Per L&D Vol. 2 1004.2
 - Design Storm: 10 year (10% AEP)
 - Check Storm: 100 year (1% AEP)
- Stream Stats:
 - $Q(10) = 42.6$ cfs
 - $Q(100) = 93.3$ cfs
 - Drainage Area: 0.0694 Sq. Mi. (44.42 Acre), Verified by LiDAR

Existing Drainage Calcs:

Ex. 36" CMP

The last 24' of the existing pipe was separated and was not included in the analysis.

Project is not located within a floodplain.

Survey Shots:

- Inlet (SV5004): FL = 1139.72
- Outlet (SV1375): FL = 1119.62 (pipe separation)
- Outlet (SV1372): FL = 1118.46 (not used for analysis, but actual outlet)

Surveyed Length = 366.545'; round to 367'

Slope = 0.0548

The existing 36" CMP was modelled in CDSS and output the following values:

Existing 36" CMP Hydraulic Data				
	Q (cfs) (Stream Stats)	Head Water Control Elev. (Inlet)	Head Water Control Elev. (Outlet)	Velocity at Outlet (fps)
Q_{10} (10% AEP)	42.6	1143.63		11.94
Q_{100} (1% AEP)	93.3		1152.23	13.41

The existing culvert meets 1006.2.1 A through 1006.2.1 C. 1006.2.1 D is not applicable. This culvert is in a deep ravine but does not exceed the check for flat terrain. For 1006.2.2, the culvert does not meet B, as the headwater is 6.5 feet above the limit. The remainder of in 1006.2.2 is not applicable.

Proposed Drainage Calcs:

The proposed design is to put a cure in place plastic (CIPP) liner through the pipe. This required a few modifications to the pipe as described below.

Design/Analysis:

On the inlet side, the first 5 feet of the pipe will be and replaced with 10 feet of 36" CMP to provide a clean end for the proposed liner and headwall. The slope was kept the same for the extended length of the pipe.

On the outlet side, 34 feet of the pipe will be removed and replaced with 10 feet of 36" CMP. The rest of the treatment is similar to the inlet.

This resulted in a total length of 377', with the same slope as the existing culvert.

Analysis:

Since CDSS does not have a setting for a CIPP liner, it was treated as a smooth pipe for calculation purposes. A Manning's N value of 0.012 was used for the analysis to be conservative for velocity.

Proposed 36" CMP With CIPP Liner Hydraulic Data			
CIPP (added L)	Q (cfs) (Stream Stats)	Head Water Elev. (Inlet)	Velocity at Outlet (fps)
Q ₁₀ (10% AEP)	42.6	1143.65	19.94
Q ₁₀₀ (1% AEP)	93.3	1150.28	24.50

For 1006.2.1, the proposed design meets checks A through C, and D does not apply. For 1006.2.2, the proposed design meets checks C & D, with A and E being not applicable. The proposed design does not meet check B, but does improve the existing conditions by 2.22'.

Due to the velocity of the outlet, 17' of RCP will be added to the end of the culvert.

Ditch Near Outlet Modification:

The pipe had been damaged because of a ditch that forms near the outlet end of the pipe. This ditch has eroded an area south of the outlet and will be regraded and armored to mitigate future scour.

Due to the steep (~32%) slope of this ditch, and the constructability concerns of a concrete channel or culverting the flow, grouted rock will be used to armor the channel bed as well as the foreslopes and backslopes.

StreamStats Report - JEF-43-18.89, PID 120662 (06/24/2024)

Region ID: OH
Workspace ID: OH20240624111328079000
Clicked Point (Latitude, Longitude): 40.44799, -80.89388
Time: 2024-06-24 07:13:48 -0400



+ Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CSL1085LFP	Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 2D grid	374	feet per mi
DRNAREA	Area that drains to a point on a stream	0.0694	square miles
FOREST	Percentage of area covered by forest	11.1	percent
LAT_CENT	Latitude of Basin Centroid	40.449	decimal degrees
LC92STOR	Percentage of water bodies and wetlands determined from the NLCD	0	percent
OHREGA	Ohio Region A Indicator	0	dimensionless
OHREGC	Ohio Region C Indicator	0	dimensionless
PRECIPCENT	Mean Annual Precip at Basin Centroid	37.5	inches
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.52	dimensionless

44.416 acre

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Flow Full Model Reg B SIR2019 5018]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0694	square miles	0.04	6309

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
OHREGC	Ohio Region C Indicator 1 if in C else 0	0	dimensionless	0	1
OHREGA	Ohio Region A Indicator 1 if in A else 0	0	dimensionless	0	1
CSL1085LFP	Stream Slope 10 and 85 Longest Flow Path	374	feet per mi	1.21	457
LC92STOR	Percent Storage from NLCD1992	0	percent	0	7.1

Peak-Flow Statistics Flow Report [Peak Flow Full Model Reg B SIR2019 5018]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	15.2	ft ³ /s	7.85	29.4	40.1
20-percent AEP flood	30	ft ³ /s	16.2	55.6	37.2
10-percent AEP flood	42.6	ft ³ /s	22.8	79.5	37.6
4-percent AEP flood	61.1	ft ³ /s	32.4	115	38.1
2-percent AEP flood	76.6	ft ³ /s	40.1	146	37.8
1-percent AEP flood	93.3	ft ³ /s	48.2	181	39.6
0.2-percent AEP flood	136	ft ³ /s	69.2	267	40.3

Peak-Flow Statistics Citations

Koltun, G.F.,2019, Flood-frequency estimates for Ohio streamgages based on data through water year 2015 and techniques for estimating flood-frequency characteristics of rural, unregulated Ohio streams: U.S. Geological Survey Scientific Investigations Report 2019–5018, 25 p. (<https://dx.doi.org/10.3133/sir20195018>)

➤ Monthly Flow Statistics

Monthly Flow Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0694	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	0	percent	0	19
PRECIPCENT	Mean Annual Precip at Basin Centroid	37.5	inches	34	43.2
FOREST	Percent Forest	11.1	percent	0	99.1
LAT_CENT	Latitude of Basin Centroid	40.449	decimal degrees	38.68	41.2
STREAM_VARG	Streamflow Variability Index from Grid	0.52	dimensionless	0.25	1.13

Monthly Flow Statistics Disclaimers [Low Flow LatLE 41.2 wri02 4068]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Monthly Flow Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

Statistic	Value	Unit
January Mean Flow	0.0887	ft ³ /s
February Mean Flow	0.128	ft ³ /s
March Mean Flow	0.133	ft ³ /s
April Mean Flow	0.133	ft ³ /s
May Mean Flow	0.0757	ft ³ /s
June Mean Flow	0.0506	ft ³ /s

Statistic	Value	Unit
July Mean Flow	0.0318	ft ³ /s
August Mean Flow	0.0218	ft ³ /s
September Mean Flow	0.0122	ft ³ /s
October Mean Flow	0.0129	ft ³ /s
November Mean Flow	0.0283	ft ³ /s
December Mean Flow	0.0648	ft ³ /s
<i>Monthly Flow Statistics Citations</i>		
Koltun, G. F., and Whitehead, M. T.,2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (https://pubs.er.usgs.gov/publication/wri024068)		

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

USGS Software Disclaimer: This software has been approved for release by the U.S. Geological Survey (USGS). Although the software has been subjected to rigorous review, the USGS reserves the right to update the software as needed pursuant to further analysis and review. No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the software and related material nor shall the fact of release constitute any such warranty. Furthermore, the software is released on condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use.

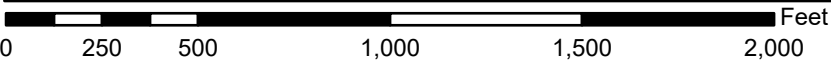
USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.20.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

National Flood Hazard Layer FIRMMette



80°53'58"W 40°27'7"N



1:6,000

80°53'21"W 40°26'40"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		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 Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/23/2024 at 8:34 AM 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.

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. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



CULVERT ANALYSIS

PID : 120662 Date : 06/24/2024 Project : JEF-43-18.89

Location : Beneath S.R. 43

Description : Ex. 36" CMP

Designer : LNW

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 : 0 Inlet Invert Elevation (ft.) : 1139.72 Outlet Invert Elevation (ft.) : 1119.62
Pipe Quantity : 1
Culvert Type : Circular Corrugated Pipe Length (ft.) : 367.00 Culvert Slope (ft./ft.) : 0.0548
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)
Pipe Size : 36 in.
Design Manning 'n' : (default)
Entrance Type : No Headwall Loss Coef. Ke : 0.9000

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.)
42.60	21.45	1143.63	1128.37	2 - E	11.94	1.51	2.13	0.0241	INLET	0.00	1119.62
93.30	29.68	1151.25	1152.23	2 - F	13.41	3.00	2.86	0.0241	OUTLET**	0.00	1119.62

CRS:	JEF-43-18.85	BY:	LNW
PID:	120662	DATE:	6/6/2025

PIPE INFO:	Ex. 36" CMP
------------	-------------

Pipe	
Inlet Invert	1139.72'
Inlet Diameter	3.0 FT
Inlet Crown	1142.72'
Deep?	YES
Flat?	NO
EX?	YES

Roadway	
Near Low EOP	1160.00'
ADT	2600
Type	Other Highway
Drainage Area	0.07 Sq. Mi.
DRAIN (ACRE)	44.42 ACRES
Overtop Elev	1160.00'

CDSS Headwater	Control	
10%	1143.63'	INLET
1%	1152.23'	OUTLET

Nearby Objects	
Building Nearby?	NO
Bike Path Near?	NO

Design Storm Controls:	
HW(10)	1143.63'

Check Storm Controls:	
HW(100)	1152.23'

A:	1159.00'	OKAY	A:	NO VALUE	N/A
B:	1144.72'	N/A	B:	1145.72'	DOES NOT MEET
C:	1146.72'	OKAY	C:	1160.00'	N/A
D:	N/A	N/A	D:	N/A	
			E:	N/A	

1006.2.1 Design Storm Controls

Headwater depth for all culverts (Type A Conduits) must not exceed any of the following controls for the design storm:

- A. 2 feet below the near, low edge of the pavement for drainage areas 1000 acres or greater and 1 foot below for culverts draining less than 1000 acres.
- B. 2 feet above the inlet crown of the culvert or above a tailwater elevation that submerges the inlet crown in flat terrain.
- C. 4 feet above the inlet crown of a culvert in a deep ravine.
- D. 1 foot below the near edge of pavement for bicycle pathways.

1006.2.2 Check Storm Controls

Headwater depth for all culverts (Type A Conduits) must not exceed any of the following controls for the applicable check storm.

- A. 2 feet below the lowest ground elevation adjacent to an occupied building for a 50-year storm. This is not intended to lower existing high-water elevations around buildings.
- B. Limit the maximum 100-year storm headwater depth to twice the diameter or rise of the culvert.
- C. Size a replacement structure to prevent overtopping by the 100-year storm where overtopping would not occur with the existing structure.
- D. Size a replacement structure so that flooding of upstream land is not increased for the 100-year storm when compared to the existing structure. Before implementing this criteria consider the type of upstream property and land use.
- E. Controls Specific to an FIS. See section 1006.4.

Design Storm Controls:

HW(10) = 1143.63'

A. Drainage area = 44.416 Acres

Near Low Edge of Pavement = 1160' - 1 = 1159'

HW(10) < 1159' **OKAY**

B. N/A

C. 1142.72' + 4' = 1146.72'

HW(10) < 1146.72' **OKAY**

D. N/A

Check Storm Controls:

HW(100) = 1152.23'

A. N/A

B. 1139.72' + 2 x 3' = 1145.72'

HW(100) > 1145.72' **DOES NOT MEET**

C. Existing overtopping?: NO, as per Hugh Sutherin, 04/03/2025

D. N/A for Existing Analysis

E. N/A, Not in Floodplain



CULVERT ANALYSIS

PID : 120662 **Date :** 06/24/2024 **Project :** JEF-43-18.89

Location : Beneath S.R. 43

Description : Prop. 36" CIPP Liner

Designer : LNW

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 :** 0 **Inlet Invert Elevation (ft.) :** 1139.99 **Outlet Invert Elevation (ft.) :** 1119.35
Pipe Quantity : 1
Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 377.00 **Culvert Slope (ft./ft.) :** 0.0548
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)
Pipe Size : 36 in.
Design Manning 'n' : 0.0120
Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

	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.)
	42.60	21.74	1143.65	1124.28	2 - E	19.94	1.03	2.13	0.0120	INLET	0.00	1119.35
	93.30	28.00	1150.28	1133.67	2 - E	24.50	1.59	2.86	0.0120	INLET	0.00	1119.35

CRS:	JEF-43-18.85	BY:	LNW
PID:	120662	DATE:	6/6/2025

PIPE INFO:	Prop. 36" CMP (CIPP Liner)
------------	----------------------------

Pipe	
Inlet Invert	1139.72'
Inlet Diameter	3.0 FT
Inlet Crown	1142.72'
Deep?	YES
Flat?	NO
EX?	NO

Roadway	
Near Low EOP	1160.00'
ADT	2600
Type	Other Highway
Drainage Area	0.07 Sq. Mi.
DRAIN (ACRE)	44.42 ACRES
Overtop Elev	1160.00'

CDSS Headwater	Control	
10%	1143.65'	INLET
1%	1150.28'	INLET

Nearby Objects	
Building Nearby?	NO
Bike Path Near?	NO

Design Storm Controls:	
HW(10)	1143.65'

Check Storm Controls:	
HW(100)	1150.28'

A:	1159.00'	OKAY	A:	NO VALUE	N/A
B:	1144.72'	N/A	B:	1145.72'	DOES NOT MEET
C:	1146.72'	OKAY	C:	1160.00'	OKAY
D:	N/A	N/A	D:	OKAY	
			E:	N/A	

1006.2.1 Design Storm Controls

Headwater depth for all culverts (Type A Conduits) must not exceed any of the following controls for the design storm:

- A. 2 feet below the near, low edge of the pavement for drainage areas 1000 acres or greater and 1 foot below for culverts draining less than 1000 acres.
- B. 2 feet above the inlet crown of the culvert or above a tailwater elevation that submerges the inlet crown in flat terrain.
- C. 4 feet above the inlet crown of a culvert in a deep ravine.
- D. 1 foot below the near edge of pavement for bicycle pathways.

1006.2.2 Check Storm Controls

Headwater depth for all culverts (Type A Conduits) must not exceed any of the following controls for the applicable check storm.

- A. 2 feet below the lowest ground elevation adjacent to an occupied building for a 50-year storm. This is not intended to lower existing high-water elevations around buildings.
- B. Limit the maximum 100-year storm headwater depth to twice the diameter or rise of the culvert.
- C. Size a replacement structure to prevent overtopping by the 100-year storm where overtopping would not occur with the existing structure.
- D. Size a replacement structure so that flooding of upstream land is not increased for the 100-year storm when compared to the existing structure. Before implementing this criteria consider the type of upstream property and land use.
- E. Controls Specific to an FIS. See section 1006.4.

Design Storm Controls:

HW(10) = 1143.65'

A. Drainage area = 44.416 Acres

Near Low Edge of Pavement = 1160' - 1 = 1159'

HW(10) < 1159' **OKAY**

B. N/A

C. 1142.72' + 4' = 1146.72'

HW(10) < 1146.72' **OKAY**

D. N/A

Check Storm Controls:

HW(100) = 1150.28'

A. N/A

B. 1139.72' + 2 x 3' = 1145.72'

HW(100) > 1145.72' **DOES NOT MEET**

C. Overtop Elev: 1160'

1150.28' < 1160' **OKAY**

D. 1150.28' < 1152.23'

HW(100) **OKAY**

E. N/A, Not in Floodplain

1002-4
REFERENCE SECTION
1002.2.3

1002-4





DITCH ANALYSIS

PID : 120662 **Date :** 07/12/2024 **Project :** JEF-43-18.89

Location : DITCH SOUTHEAST OF CULVERT

Description : DRAINAGE AREA TO SOUTHEAST OF CULVERT

Designer : LNW

Rainfall Area : A

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 (ft.)	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.)
0+00			94.81	2.00	1.00	1.00	3.5000	18.98	18.98	0.40	7.59		2.20	5	0.030	35.05	31.51		16.68	0.24	2.47