11. Basin Information

(original calculations)

Undeveloped Conditions: Ex. 48" D.I.P. Under CSX Railroad

Subbasin	Ac	C	N
I	48.427	0.377	0.232
C	114.876	0.447	0.518
D	4.196	0.509	0.706
E	12.457	0.407	0.573
F	18.995	0.496	0.424
G	22.789	0.444	0.560
H	16.900	0.483	0.617
	238.64 ac	Wt C = 0.438	Wt N = 0.470

Time of Concentration:

Sheet Flow → L = 300'
n = 0.518 (Subbasin C)
H = 32'
S = 0.1067 ft/ft.

$$t_t = 0.827\left(\frac{LN}{S^{1/2}}\right)^{0.467}$$

$$= 0.827\left(\frac{(300)(0.518)}{(0.1067)^{1/2}}\right)^{0.46}$$

$$= \underline{14.72 \text{ min.}}$$

Shallow Flow → L = 2936'
H = 49'
S = 0.0166
v = 2.10 ft/s

$$t_t = \frac{L}{\frac{60\,sec}{1\,min} \cdot v}$$

$$= \frac{2936\,ft}{60\,(2.10\,ft/s)} = \underline{23.30\,min}$$

Undeveloped Conditions: Ex 48" DIP under CSX Railroad

Time of Concentration:

Open Channel → 2' Flat Bottom w/ 2:1 Side Slopes

L = 2340'

H = 18.2'

S = 0.0078 ft/ft

n = 0.040 (Natural Stream, Some Weeds)

R = 2.15'

v = 5.5 ft/sec

$$t_t = \frac{L}{\frac{1.49}{n} R^{2/3} S^{1/2}} = \frac{2340}{\left(\frac{1.49}{0.40}\right)(2.15)^{2/3}(0.0078)^{1/2}}$$

$$= 425.90 \text{ sec } (7.10 \text{ min.})$$

$$t_c = 14.72 + 23.30 + 7.10 = 45.12 \text{ min.}$$

$$I_{(10)} = 2.520 \text{ IN/Hr.}$$

$$Q_{(10)} = CiA = (0.438)(2.520)(238.64) = \underline{\underline{263.40 \text{ cfs}}}$$

Developed Conditions: Ex. 48" DIP under CSX Railroad

Subbasin	Ac	C	N
1	65.964	0.473	0.284
C	114.876	0.447	0.518
D	4.196	0.509	0.706
E	12.457	0.407	0.573
F	18.995	0.496	0.424
G	22.789	0.444	0.560
H	16.900	0.483	0.617
i	3.325	0.499	0.765
	259.502 ac	Wt C = 0.459	

t_c = 45.12 minutes

$I_{(25)}$ = 2.856 IN/Hr.

$Q_{(25)}$ = Cia = (0.459)(2.856)(259.502) = 340.18 cfs

$I_{(100)}$ = 3.628 IN/Hr

$Q_{(100)}$ = Cia = (0.459)(3.628)(259.502) = 432.14 cfs

03-5553-4B

Existing 48" Ductile Iron Pipe Under CSX Railroad
Friction Loss Calculations

Q= Flowrate (cfs)
Ke= Entrance Loss coefficient
Ko= Outlet Loss coefficient
g= Gravity (ft/sec^2)
h= Height of water above the centerline of the pipe (ft)
d= Diameter of the pipe (ft)
A= Area of the pipe (ft^2)
L= Length of pipe
n= Mannings roughness coefficient
IE=395.05 Upstream invert elevation of existing pipe
Tw=398.8 for 25 year storm event Locust Creek

Q= A * [h/ ((Ke+Ko)/2g) + ((2.87*n^2*L)/d^4/3)]^1/2

Q=	71.193	cubic feet per second
v=	5.665	feet per second
Ke=	0.20	see table
Ko=	1.0	assumed
g=	32.20	ft per second^2
h=	1.20	ft *
d=	4.000	ft
A=	12.57	ft^2 (48-inch Dia. Pipe)
L=	162.0	ft
n=	0.016	(Ductile Iron Pipe+CMP)

<u>**Q Avail < Q Req'd**</u> 71.193 cfs < 263.400 cfs Therefore Q allowable exceeds existing 48-inch pipe

* Water Elevation @ 400.0'

25yr. Water Elevation in Locust Creek = 398.8'

03-5553-4B

Existing 48" Ductile Iron Pipe Under CSX Railroad
Friction Loss Calculations

Q= Flowrate (cfs)
Ke= Entrance Loss coefficient
Ko= Outlet Loss coefficient
g= Gravity (ft/sec^2)
h= Height of water above the centerline of the pipe (ft)
d= Diameter of the pipe (ft)
A= Area of the pipe (ft^2)
L= Length of pipe
n= Mannings roughness coefficient
IE=395.05 Upstream invert elevation of existing pipe
Tw=398.8 for 25 year storm event Locust Creek

Q= A * [h/ ((Ke+Ko)/2g) + ((2.87*n^2*L)/d^4/3)]^1/2

Q=	75.231	cubic feet per second
v=	5.987	feet per second
Ke=	0.20	see table
Ko=	1.0	assumed
g=	32.20	ft per second^2
h=	1.34	ft *
d=	4.000	ft
A=	12.57	ft^2 (48-inch Dia. Pipe)
L=	162.0	ft
n=	0.016	(Ductile Iron Pipe+CMP)

<u>**Q Avail < Q Req'd**</u> 75.231 cfs < 263.400 cfs Therefore Q allowable exceeds existing 48-inch pipe

* Elevation = 400.14

Calculated 25 yr Storm Event Elevation w/
25 yr Storm Tailwater Elevation in Locust Creek (398.8)

03-5553-4B

Existing 48" Ductile Iron Pipe Under CSX Railroad

Friction Loss Calculations

Q= Flowrate (cfs)
Ke= Entrance Loss coefficient
Ko= Outlet Loss coefficient
g= Gravity (ft/sec^2)
h= Height of water above the centerline of the pipe (ft)
d= Diameter of the pipe (ft)
A= Area of the pipe (ft^2)
L= Length of pipe
n= Mannings roughness coefficient
IE=395.05 Upstream invert elevation of existing pipe
Tw=398.8 for 25 year storm event Locust Creek

$$Q= A * [h/ ((Ke+Ko)/2g) + ((2.87*n^2*L)/d^{4/3})]^{1/2}$$

Q=	88.157	cubic feet per second
v=	7.015	feet per second
Ke=	0.20	see table
Ko=	1.0	assumed
g=	32.20	ft per second^2
h=	1.84	ft *
d=	4.000	ft
A=	12.57	ft^2 (48-inch Dia. Pipe)
L=	162.0	ft
n=	0.016	(Ductile Iron Pipe+CMP)

<u>**Q Avail < Q Req'd**</u> 88.157 cfs < 263.400 cfs Therefore Q allowable exceeds existing 48-inch pipe

* Elevation = 400.64

Calculated 100yr Storm Event Elevation w/ 25 yr Storm Tailwater Elevation in Locust Creek (398.8)

03-5553-4B

Existing 48" Ductile Iron Pipe Under CSX Railroad

Friction Loss Calculations

Q= Flowrate (cfs)
Ke= Entrance Loss coefficient
Ko= Outlet Loss coefficient
g= Gravity (ft/sec^2)
h= Height of water above the centerline of the pipe (ft)
d= Diameter of the pipe (ft)
A= Area of the pipe (ft^2)
L= Length of pipe
n= Mannings roughness coefficient
IE=395.05 Upstream invert elevation of existing pipe
Tw=398.8 for 25 year storm event Locust Creek

Q= A * [h/ ((Ke+Ko)/2g) + ((2.87*n^2*L)/d^4/3)]^1/2

Q=	111.624	cubic feet per second
v=	8.883	feet per second
Ke=	0.20	see table
Ko=	1.0	assumed
g=	32.20	ft per second^2
h=	2.95	ft *
d=	4.000	ft
A=	12.57	ft^2 (48-inch Dia. Pipe)
L=	162.0	ft
n=	0.016	(Ductile Iron Pipe+CMP)

<u>**Q Avail < Q Req'd**</u> 111.624 cfs < 263.400 cfs Therefore Q allowable exceeds existing 48-inch pipe

* Without Tailwater
Water Elevation @ 400.0'

03-5553-4B

Proposed 48" Primary Spillway
Friction Loss Calculations

Q= Flowrate (cfs)
Ke= Entrance Loss coefficient
Ko= Outlet Loss coefficient
g= Gravity (ft/sec^2)
h= Height of water above the centerline of the pipe (ft)
d= Diameter of the pipe (ft)
A= Area of the pipe (ft^2)
L= Length of pipe
n= Mannings roughness coefficient
IE=395.05 Upstream invert elevation of existing pipe
Tw=398.8 for 25 year storm event Locust Creek

$$Q= A * [h/ ((Ke+Ko)/2g) + ((2.87*n^2*L)/d^{4/3})]^{1/2}$$

Q=	126.004	cubic feet per second
v=	10.027	feet per second
Ke=	0.20	see table
Ko=	1.0	assumed
g=	32.20	ft per second^2
h=	2.00	ft *
d=	4.000	ft
A=	12.57	ft^2 (48-inch Dia. Pipe)
L=	23.0	ft
n=	0.011	(Reinforced Concrete Pipe)

<u>Q Avail < Q Req'd</u> 126.004 cfs < 263.400 cfs Therefore Q allowable exceeds Primary Spillway

* Elevation = 400.00 w/o Tailwater Conditions in Locust Creek

03-5553-4B

Proposed 48" Primary Spillway
Friction Loss Calculations

Q= Flowrate (cfs)
Ke= Entrance Loss coefficient
Ko= Outlet Loss coefficient
g= Gravity (ft/sec^2)
h= Height of water above the centerline of the pipe (ft)
d= Diameter of the pipe (ft)
A= Area of the pipe (ft^2)
L= Length of pipe
n= Mannings roughness coefficient
IE=395.05 Upstream invert elevation of existing pipe
Tw=398.8 for 25 year storm event Locust Creek

Q= A * [h/ ((Ke+Ko)/2g) + ((2.87*n^2*L)/d^4/3)]^1/2

Q=	97.603	cubic feet per second
v=	7.767	feet per second
Ke=	0.20	see table
Ko=	1.0	assumed
g=	32.20	ft per second^2
h=	1.20	ft *
d=	4.000	ft
A=	12.57	ft^2 (48-inch Dia. Pipe)
L=	23.0	ft
n=	0.011	(Reinforced Concrete Pipe)

Q Avail < Q Req'd	97.603 cfs	<	263.400 cfs	Therefore Q allowable exceeds Primary Spillway

* Elevation = 400.00 with Tailwater Conditions in Locust Creek

03-5553-4B

Emergency Weir Spillway
Trapeziodal Weir Design Calculations

Q = Flowrate (cfs)
g = Gravity (ft/sec^2)
h = Height of water flowing over the weir (ft)
b = Width of weir (ft)
Cd = Discharge coefficient
O = Angle of triangle
A = Area of weir

Q = 2/3*Cd*(2g)^0.5*b*(h)^3/2 + 8/15*Cd*(2g)^0.5*tan(O/2)*(h)^5/2

Q =	58.48	cubic feet per second
v =	2.64	feet per second
head =	0.64	(Height of water flowing over the weir) ✱
g =	32.20	feet per second^2
b =	32.00	feet
side slope left =	4.00	ft/ft (left side)
side slope right =	4.00	ft/ft (right side)
Cd =	0.63	Rectangular coefficient
Cd =	0.58	Triangular coefficient
O=	151.93	Degrees
A =	22.12	square feet

✱ Elevation = 400.64

Calculated 100 yr Storm Event Elevation w/
25 yr. Storm Tailwater Elevation in Locust Creek (398.8)

03-5553-4B

Emergency Weir Spillway
Trapeziodal Weir Design Calculations

Q = Flowrate (cfs)
g = Gravity (ft/sec^2)
h = Height of water flowing over the weir (ft)
b = Width of weir (ft)
Cd = Discharge coefficient
O = Angle of triangle
A = Area of weir

Q = 2/3*Cd*(2g)^0.5*b*(h)^3/2 + 8/15*Cd*(2g)^0.5*tan(O/2)*(h)^5/2

Q =	5.72	cubic feet per second
v =	1.26	feet per second
head =	0.14	(Height of water flowing over the weir) *
g =	32.20	feet per second^2
b =	32.00	feet
side slope left =	4.00	ft/ft (left side)
side slope right =	4.00	ft/ft (right side)
Cd =	0.63	Rectangular coefficient
Cd =	0.58	Triangular coefficient
O=	151.93	Degrees
A =	4.56	square feet

* Elevation = 400.14
Calculated 25yr Storm Event Elevation w/
25yr Storm Tailwater Elevation in Locust Creek (398.8)

VANDERBURGH COUNTY DRAINAGE BOARD
FORM 800

PROJECT: **Spring Lake Valley** DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS

DESIGNER: Morley and Assoc. 5553-4B RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA:	68.539	ACRES
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED):	25.68	MINUTES
RAINFALL INTENSITY (Iu):	3.597	INCHES/HR
UNDEVELOPED RUNOFF COEFFICIENT (Cu):	0.351	
UNDEVELOPED RUNOFF RATE - Q=Cu*Iu*A	86.53	CFS
DEVELOPED RUNOFF COEFFICIENT (Cd):	0.516	

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	OUTFLOW RATE O (Cu*Iu*A) (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE Σ(Td)-O)*Td/12 (ACRE-FT)
0.08	7.208	254.92	86.53	168.39	1.169
0.17	5.925	209.54	86.53	123.01	1.708
0.25	5.033	178.00	86.53	91.46	1.905
0.33	4.571	161.64	86.53	75.11	2.086
0.42	4.108	145.29	86.53	58.76	2.040
0.50	3.646	128.94	86.53	42.41	1.767
0.58	3.385	119.70	86.53	33.17	1.612
0.67	3.123	110.46	86.53	23.93	1.329
0.75	2.862	101.22	86.53	14.68	0.918
0.83	2.601	91.97	86.53	5.44	0.378
0.92	2.339	82.72	86.53	-3.81	-0.291
1.00	2.078	73.49	86.53	-13.04	-1.087
1.25	1.909	67.50	86.53	-19.04	-1.983
1.50	1.739	61.50	86.53	-25.03	-3.129
1.75	1.570	55.51	86.53	-31.03	-4.525
2.00	1.400	49.51	86.53	-37.02	-6.170
2.50	1.210	42.78	86.53	-43.76	-9.116
3.00	1.019	36.04	86.53	-50.50	-12.624
4.00	0.836	29.57	86.53	-56.97	-18.989

PEAK STORAGE (ACRE/FT):	2.09
PEAK STORAGE (CUBIC FT):	90,884

VANDERBURGH COUNTY DRAINAGE BOARD
FORM 800

PROJECT: **Spring Lake Valley** DETENTION FACILITY DESIGN RETURN PERIOD: 100 YRS
DESIGNER: MORLEY & ASSOC. 5553-4B RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA:	68.539	ACRES
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED):	25.68	MINUTES
RAINFALL INTENSITY (Iu):	3.597	INCHES/HR
UNDEVELOPED RUNOFF COEFFICIENT (Cu):	0.351	
UNDEVELOPED RUNOFF RATE - Q=Cu*Iu*A	86.53	CFS
DEVELOPED RUNOFF COEFFICIENT (Cd):	0.516	

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	OUTFLOW RATE O (Cu*Iu*A) (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE (I(Td)-O)*Td/12 (ACRE-FT)
0.08	8.469	299.52	86.53	212.98	1.420
0.17	7.126	252.02	86.53	165.49	2.344
0.25	6.194	219.06	86.53	132.52	2.761
0.33	5.665	200.36	86.53	113.83	3.130
0.42	5.137	181.66	86.53	95.13	3.330
0.50	4.608	162.97	86.53	76.43	3.185
0.58	4.284	151.50	86.53	64.97	3.140
0.67	3.960	140.04	86.53	53.50	2.987
0.75	3.636	128.57	86.53	42.04	2.627
0.83	3.311	117.11	86.53	30.58	2.115
0.92	2.987	105.64	86.53	19.11	1.465
1.00	2.663	94.18	86.53	7.65	0.637
1.25	2.444	86.42	86.53	-0.12	-0.012
1.50	2.224	78.65	86.53	-7.88	-0.985
1.75	2.005	70.89	86.53	-15.64	-2.281
2.00	1.785	63.13	86.53	-23.41	-3.901
2.50	1.538	54.39	86.53	-32.14	-6.696
3.00	1.291	45.66	86.53	-40.88	-10.219
4.00	1.062	37.56	86.53	-48.97	-16.325

PEAK STORAGE (ACRE/FT):	3.33
PEAK STORAGE (CUBIC FT):	145,036

Retention Basin — Basin Area / Volume Cont

Q Available (cfs) w/ Tw = 398.8 (25yr. Elev. in Locust Creek)

Ex 48" D.I.P.		32' Weir		Q Avail. (cfs)	Storage (ft^3)
398.8 → 0	+	0	=	0	432,767
399.0 → 29.1	+	0	=	29.1	463,679
400.0 → 71.2	+	0	=	71.2	661,462
400.25 → 78.3	+	13.8	=	92.1	726,085
400.5 → 84.74	+	39.9	=	124.64	768,796
400.75 → 90.75	+	74.9	=	165.65	811,507
401.0 → 96.40	+	117.8	=	214.20	854,218

25 year Storm Event Discharge Elev = 400.74
w/ 25yr Event in Locust Creek

100 year Storm Event Discharge Elev = 400.64
w/ 25yr Event in Locust Creek

Retention Basin — Basin Area / Volume

Req'd Storage Volume (Form 800)

25-year Storage = 90,884 cu. ft.

100-year Storage = 145,036 cu. ft.

Primary Spillway Elevation = 397.00
Emergency Spillway Elevation = 401.00
Berm Elevation = 401.50

Elev.	Square Foot Area
396.00	143,967
397.00	154,498
398.00	165,152
399.00	175,908
400.00	186,764
401.00	197,720
401.50	203,236

O.K.

$$\text{Volume} = \frac{143{,}967 + 186{,}764}{2} = 165{,}365.5\ ft^2\,(4.0\ ft) = 661{,}462\ ft^3 > 90{,}884\ ft^3$$

$$\text{Add'l storage above } 400.0' = \frac{186{,}764 + 203{,}236}{2} = 195{,}000\ ft^2\,(1.5\ ft) = 292{,}500\ ft^3$$