

REVIEWED
↑ 4-26-94
BAX ENGINEERING
LOOKS OK



Project: PINEWOOD PLACE
Date: JAN. 1994 Project No: 93-4757B
Designed: _____ Checked: _____
Rev. April 13, 1994

STORMWATER DETENTION ANALYSIS

GENERAL SITE DATA & RUNOFF CALCULATIONS

- 1.) The tract of land shall be known as "PINEWOOD PLACE" in the City of O'fallon MO. The development shall consist of apartments on 6.506 acres and single family residences on 8.726 acres. It is proposed that a "wet" stormwater detention basin be constructed near the east property line near the central area of the project site. The storage volume and outflow rates shall be proportioned to insure that the peak rate of runoff leaving the sub-watershed of the site under post developed conditions is less than or equal to the peak rate of runoff leaving the sub-watershed of the site under pre-developed conditions for the design 25 year frequency-20 minute duration storm (as required by the City of O'fallon). A 100 year-20 minute design storm shall also be checked for safe passage (no detention required) through the detention basin.

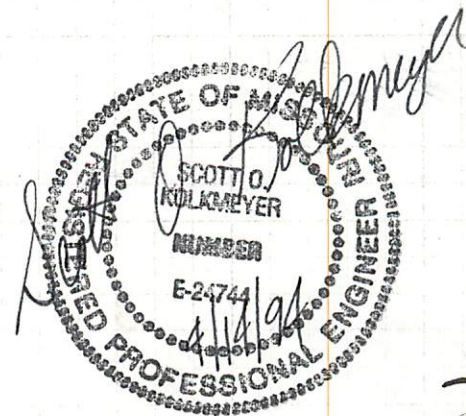
- 2.) The pre-developed P.I. factors to be used for the analysis are:

25 year-20 minute storm : 2.31 c.f.s./A[±]. (undeveloped, assumed 0%-5% impervious)
100 year-20 minute storm : 2.95 c.f.s./A[±]

- 3.) The post-developed P.I. factors to be used for the analysis are:

single family residential:
25 year-20 minute storm : 3.26 c.f.s./A[±]
100 year-20 minute storm : 4.17 c.f.s./A[±]

apartments, multi-family
25 year-20 minute storm : 4.07 c.f.s./A[±]
100 year-20 minute storm : 5.21 c.f.s./A[±]



3



Project: _____

Date: _____ Project No: _____

Designed: _____ Checked: _____

4.) From the drainage area map of the project, the 25 year-20 minute storm inflow to the basin is found as:

ONSITE:

$$8.49 A^E \times 3.26 \text{ c.f.s./}A^E = 27.68 \text{ c.f.s.}$$

$$1.25 A^E \times 4.07 \text{ c.f.s./}A^E = 5.09 \text{ c.f.s.}$$

$$\text{Sub Total} = 32.77 \text{ c.f.s.}$$

OFFSITE:

$$10.72 A^E \times 2.31 \text{ c.f.s./}A^E = 24.76 \text{ c.f.s. (area north of project not included with Havenview subdivision discharge, see sheet 10)}$$

$$\text{Havenview subdivision} = 35.34 \text{ c.f.s. (see below)*}$$

$$\text{Sub Total} = 60.10 \text{ c.f.s.}$$

$$\text{TOTAL FLOW, } Q_{25/20} \text{ TO DETENTION BASIN} = 92.87 \text{ c.f.s.}$$

* From the drainage area map and detention calculations by Colton/Lester for Havenview Subdivision obtained from the City of O'Fallon, the discharge from the detention basin and subdivision is estimated as:

Area to Basin:**

$$0.82 A^E$$

$$0.50 A^E$$

$$1.24 A^E$$

$$1.36 A^E$$

$$0.56 A^E$$

$$1.24 A^E$$

$$0.44 A^E$$

$$0.70 A^E$$

$$1.52 A^E$$

$$1.29 A^E$$

$$1.50 A^E$$

$$0.40 A^E$$

$$1.03 A^E \text{ (sheet flow estimated)}$$

$$12.60 A^E \text{ (Per detention calcs @ Havenview)}$$

The 25 year discharge from the basin is estimated as (the 25 year inflow) - (the detention provided per calcs) - per City of O'Fallon

$$\therefore Q_{25 \text{ out}} = 12.60 A^E \times 3.26 \text{ c.f.s./}A^E - 8.90 \text{ c.f.s.} = 41.08 \text{ c.f.s.} - 8.90 \text{ c.f.s.} = 32.18 \text{ c.f.s.}$$

There is also 0.97 A^E estimated as sheet flow from the subdivision which does not pass thru the detention basin.

Therefore, total flow from Havenview =

$$32.18 \text{ c.f.s.} + (0.97 A^E \times 3.26 \text{ c.f.s./}A^E) =$$

$$32.18 \text{ c.f.s.} + 3.16 \text{ c.f.s.} = 35.34 \text{ c.f.s.}$$

**NOTE: THERE IS A SLIGHT DIFFERENCE IN WHAT ACTUALLY FLOWS TO THE HAVENVIEW DETENTION BASIN AND WHAT THE REPORT SAYS. IN ANY CASE THE FLOW WILL STILL GO TO THE PINWOOD DETENTION BASIN. ACTUAL DETENTION SHALL REMAIN AT 8.90 C.F.S. AT HAVENVIEW AS DISCUSSED WITH THE CITY OF O'FALLON.



Project: _____

Date: _____ Project No: _____

Designed: _____ Checked: _____

5.) The required attenuation due to development is estimated at:

$$\begin{aligned}
 & 8.73A^e \times (3.26 \text{ c.f.s./}A^e - 2.31 \text{ c.f.s./}A^e) + 6.51A^e \times (4.07 \text{ c.f.s./}A^e - 2.31 \text{ c.f.s./}A^e) \\
 = \text{required attenuation} &= 8.29 \text{ c.f.s.} + 11.46 \text{ c.f.s.} \\
 &= 19.75 \text{ c.f.s.}
 \end{aligned}$$

16.03 c.f.s. is the required attenuation of the detention basin to meet City of O'Fallon requirements for detention to the subwatershed. However, because at the point of discharge of the detention basin, the area being discharged may increase, the detention basin shall be analyzed so that the discharge after development is less than or equal to the discharge before development at that point, when considering a 25 year-20 minute design storm. It is estimated that 2.2A^e may be discharged a short distance further upstream than it was prior to the proposed development. Therefore the attenuation of the basin shall be increased to provide for this. The increased attenuation is estimated at:

Pre-developed onsite discharge at property line near detention basin discharge point:

$$Q_{25/20} = 11.60A^e \times 2.31 \text{ c.f.s./}A^e = 26.80 \text{ c.f.s.}$$

Post-developed onsite discharge at property line near detention basin discharge point:

$$\begin{aligned}
 Q_{25/20} &= 8.73A^e \times 3.26 \text{ c.f.s./}A^e = 28.46 \text{ c.f.s.} \\
 &+ 9.93A^e \times 4.07 \text{ c.f.s./}A^e = 20.07 \text{ c.f.s.} \\
 &+ 0.22A^e \times 2.31 \text{ c.f.s./}A^e = 0.51 \text{ c.f.s.} * \\
 &\hline
 &49.04 \text{ c.f.s.}
 \end{aligned}$$

* This area is offsite area which may be diverted to discharge with referenced onsite area. Presently zoned A-1 agricultural St. Charles County.

6.) The attenuation which shall be provided is $49.04 \text{ c.f.s.} - 26.80 \text{ c.f.s.} = 22.24 \text{ c.f.s.}$



Project: _____

Date: _____ Project No: _____

Designed: _____ Checked: _____

6.) Of the flows that will inflow to the proposed detention basin, the most remote point of origination lies offsite approximately 300 feet west of the west property line of the project site near the northwest corner of the project. (This point being just northwest of the northwest corner of the adjacent Havenview subdivision.) The flow shall travel through the Havenview detention basin prior to discharging onto the Pinewood Place development. After discussing the project with the City of O'Fallon, it was determined that the time of concentration T_c to be used shall be 20 minutes. This is due to that when the Havenview detention basin is functioning, the peak release rate will be detained to approximately 20 minutes. The time of concentration could possibly be further reduced when considering the travel time from the Havenview detention basin to the Pinewood Place detention basin however, this would result in a time of concentration greater than 20 minutes resulting in a peak inflow to the basin which is considered less than the peak discharge required by the City of O'Fallon for calculating stormwater runoff of the project. Therefore, the time of concentration shall be 20 minutes.

FRANK
GODWIN

7.) The permitted release rate of the basin for the 25 year-20 minute design storm is found by subtracting the required attenuation from the peak inflow to the basin:

$$\text{permitted release rate of detention basin} = 92.87 \text{ c.f.s.} - 22.24 \text{ c.f.s.} = 70.63 \text{ c.f.s.}$$



Project: _____

Date: _____ Project No: _____

Designed: _____ Checked: _____

STORM ROUTING CALCULATIONS & RESULTS

- 1.) A computer program was used in routing the 25 year-20 minute design storm through the basin. As found in the routing calculations (sheet 6-8), the peak outflow is 3.66 c.f.s. The peak elevation is 503.36. This results in the actual detention provided by the basin as 89.21 c.f.s. which is approximately 401% of the required detention for the project.

DATA REPORT

DATE: 04-13-1994

PROJECT NAME ..: PINWOOD PLACE
PROJECT NUMBER : 93-4757B
CALCULATED BY .: S.O.K.

THE STORM FREQUENCY: 25 YEAR STORM

THE STORM DURATION: 20 MINUTES

TOTAL TIME OF CONCENTRATION: 20 MINUTE(S)

MANUAL ENTRY METHOD FOR Tc
Tc = 20

Q (C.F.S.) ENTERING THE BASIN ...: 92.87 C.F.S.

ELEVATION : 502.00 AREA: 74384

ELEVATION : 504.00 AREA: 80810

ELEVATION : 506.00 AREA: 87489

ELEVATION : 507.00 AREA: 93440

LOWFLOW PIPE INFORMATION

LOWFLOW PIPE NUMBER: 1
THE DIAMETER: 12 INCHES
THE UPPER FLOWLINE ELEVATION: 502.00
THE LOWER FLOWLINE ELEVATION: 500.00
THE LOWFLOW PIPE LENGTH: 153 FEET
THE MANNINGS (n) COEFFICIENT: 0.013
THE ENTRANCE LOSS COEFFICIENT (Ke) : 0.150

DBASIN VERSION 1.2B
DETENTION BASIN CALCULATIONS

PROJECT: PINWOOD PLACE
PROJECT NO.: 93-4757B
DATE: 04-13-1994
BY: S.O.K.

| ELEVATION | AREA | INCREMENTAL VOLUME | ACTUAL ACCUM. VOLUME |
|-----------|-------|--------------------|----------------------|
| 502.00 | 74384 | 0 | 0 |
| 504.00 | 80810 | 155194 | 155194 |
| 506.00 | 87489 | 168299 | 323493 |
| 507.00 | 93440 | 90465 | 413958 |

| TIME (MIN) | INFLOW (C.F.S.) | INCR. VOL. (CU.FT.) | OUTFLOW (C.F.S.) | NET. DET. (CU.FT.) | ELEV. |
|------------|-----------------|---------------------|------------------|--------------------|--------|
| 0 | 0.00 | 0 | 0.00 | 0 | 502.00 |
| 1 | 4.64 | 279 | 0.01 | 278 | 502.01 |
| 2 | 9.29 | 836 | 0.01 | 835 | 502.02 |
| 3 | 13.93 | 1671 | 0.02 | 1669 | 502.03 |
| 4 | 18.57 | 2784 | 0.03 | 2782 | 502.04 |
| 5 | 23.22 | 4175 | 0.06 | 4171 | 502.06 |
| 6 | 27.86 | 5843 | 0.11 | 5837 | 502.08 |
| 7 | 32.50 | 7787 | 0.17 | 7777 | 502.11 |
| 8 | 37.15 | 10006 | 0.22 | 9992 | 502.13 |
| 9 | 41.79 | 12500 | 0.33 | 12480 | 502.17 |
| 10 | 46.44 | 15266 | 0.44 | 15240 | 502.20 |
| 11 | 51.08 | 18304 | 0.58 | 18269 | 502.24 |
| 12 | 55.72 | 21613 | 0.79 | 21565 | 502.28 |
| 13 | 60.37 | 25187 | 1.05 | 25124 | 502.33 |
| 14 | 65.01 | 29025 | 1.34 | 28945 | 502.38 |
| 15 | 69.65 | 33124 | 1.70 | 33022 | 502.43 |
| 16 | 74.30 | 37480 | 2.17 | 37350 | 502.49 |
| 17 | 78.94 | 42086 | 2.75 | 41921 | 502.55 |
| 18 | 83.58 | 46936 | 3.66 | 46716 | 502.61 |
| 19 | 88.23 | 52010 | 1.63 | 51912 | 502.66 |
| 20 | 92.87 | 57484 | 1.92 | 57369 | 502.73 |
| 21 | 88.23 | 62662 | 2.14 | 62534 | 502.79 |
| 22 | 83.58 | 67549 | 2.37 | 67407 | 502.86 |
| 23 | 78.94 | 72143 | 2.52 | 71992 | 502.91 |
| 24 | 74.30 | 76450 | 2.69 | 76288 | 502.97 |
| 25 | 69.65 | 80467 | 2.83 | 80298 | 503.02 |
| 26 | 65.01 | 84198 | 2.95 | 84021 | 503.07 |
| 27 | 60.37 | 87643 | 3.05 | 87460 | 503.11 |
| 28 | 55.72 | 90803 | 3.17 | 90613 | 503.16 |
| 29 | 51.08 | 93678 | 3.24 | 93483 | 503.19 |
| 30 | 46.43 | 96270 | 3.33 | 96070 | 503.23 |

| TIME (MIN) | INFLOW (C.F.S.) | INCR. VOL. (CU.FT.) | OUTFLOW (C.F.S.) | NET. DET. (CU.FT.) | ELEV. |
|---------------|--------------------|------------------------|---------------------|-----------------------|--------|
| 31 | 41.79 | 98577 | 3.40 | 98374 | 503.26 |
| 32 | 37.15 | 100602 | 3.44 | 100396 | 503.28 |
| 33 | 32.50 | 102346 | 3.48 | 102137 | 503.30 |
| 34 | 27.86 | 103809 | 3.52 | 103598 | 503.32 |
| 35 | 23.22 | 104991 | 3.57 | 104777 | 503.34 |
| 36 | 18.57 | 105891 | 3.59 | 105676 | 503.35 |
| 37 | 13.93 | 106512 | 3.61 | 106296 | 503.36 |
| 38 | 9.29 | 106853 | 3.61 | 106636 | 503.36 |
| 39 | 4.64 | 106915 | 3.61 | 106699 | 503.36 |
| 40 | 0.00 | 106699 | 3.61 | 106482 | 503.36 |
| 41 | 0.00 | 106482 | 3.61 | 106266 | 503.36 |
| 42 | 0.00 | 106266 | 3.59 | 106051 | 503.35 |
| 43 | 0.00 | 106051 | 3.59 | 105835 | 503.35 |
| 44 | 0.00 | 105835 | 3.59 | 105620 | 503.35 |
| 45 | 0.00 | 105620 | 3.59 | 105405 | 503.35 |

ADDITIONAL INFORMATION

PEAK OUTFLOW = 3.66 C.F.S. AT 18 MINUTES AT HIGH WATER ELEVATION 502.61
 REQUIRED DETENTION = 22.24 C.F.S. MINIMUM.

PEAK₂₅ HIGH WATER = 503.36

PERMITTED RELEASE RATE₂₅ OF BASIN = 70.63 C.F.S.



Project: _____

Date: _____ Project No: _____

Designed: _____ Checked: _____

2.) A 100 year - 20 minute design storm shall be checked for safe passage through the detention facility. When considering this storm, it will be assumed that all areas upstream are fully developed. The 100 year - 20 minute discharge is estimated as:

$Q_{100/20} =$ (see sheet 2)

$$\begin{aligned} \text{onsite: } Q_{25/20} \times 1.28 &= Q_{100/20} \\ &= 32.77 \times 1.28 = 41.95 \text{ c.f.s.} \end{aligned}$$

offsite:

$$\begin{aligned} 10.72A^2 \times 4.17 \text{ c.f.s./}A^2 &= 44.70 \text{ c.f.s. (assumed fully developed residential area)} \\ 35.39 \times 1.28 &= 45.29 \text{ c.f.s.} \end{aligned}$$

$$\text{TOTAL } Q_{100/20} = 131.89 \text{ c.f.s.}$$

As found in the following routing calculations (sheets 10-12), the peak outflow is 4.66 c.f.s. at elevation 503.95. This results in an actual detention of 127.23 c.f.s. for the 100 year - 20 minute storm or approximately 96% of the entire storm even though detention is not required for this storm for the project.

=====
DATA REPORT
=====

DATE: 04-13-1994

PROJECT NAME ..: PINWOOD PLACE
PROJECT NUMBER : 93-4757B
CALCULATED BY .: S.O.K.

THE STORM FREQUENCY: 100 YEAR STORM

THE STORM DURATION: 20 MINUTES

TOTAL TIME OF CONCENTRATION: 20 MINUTE(S)

MANUAL ENTRY METHOD FOR Tc
Tc = 20

Q (C.F.S.) ENTERING THE BASIN: 131.89 C.F.S.

ELEVATION : 502.00 AREA: 74384
ELEVATION : 504.00 AREA: 80810
ELEVATION : 506.00 AREA: 87489
ELEVATION : 507.00 AREA: 93440

LOWFLOW PIPE INFORMATION

LOWFLOW PIPE NUMBER: 1
THE DIAMETER: 12 INCHES
THE UPPER FLOWLINE ELEVATION: 502.00
THE LOWER FLOWLINE ELEVATION: 500.00
THE LOWFLOW PIPE LENGTH: 153 FEET
THE MANNINGS (n) COEFFICIENT: 0.013
THE ENTRANCE LOSS COEFFICIENT (Ke) : 0.150

=====

DBASIN VERSION 1.2B
DETENTION BASIN CALCULATIONS

PROJECT: PINWOOD PLACE
PROJECT NO.: 93-4757B
DATE: 04-13-1994
BY: S.O.K.

| ELEVATION | AREA | INCREMENTAL VOLUME | ACTUAL ACCUM. VOLUME |
|-----------|-------|--------------------|----------------------|
| 502.00 | 74384 | 0 | 0 |
| 504.00 | 80810 | 155194 | 155194 |
| 506.00 | 87489 | 168299 | 323493 |
| 507.00 | 93440 | 90465 | 413958 |

| TIME (MIN) | INFLOW (C.F.S.) | INCR. VOL. (CU.FT.) | OUTFLOW (C.F.S.) | NET. DET. (CU.FT.) | ELEV. |
|------------|-----------------|---------------------|------------------|--------------------|--------|
| 0 | 0.00 | 0 | 0.00 | 0 | 502.00 |
| 1 | 6.59 | 396 | 0.01 | 395 | 502.01 |
| 2 | 13.19 | 1187 | 0.01 | 1186 | 502.02 |
| 3 | 19.78 | 2373 | 0.03 | 2371 | 502.04 |
| 4 | 26.38 | 3954 | 0.06 | 3950 | 502.06 |
| 5 | 32.97 | 5929 | 0.11 | 5922 | 502.08 |
| 6 | 39.57 | 8296 | 0.17 | 8286 | 502.11 |
| 7 | 46.16 | 11056 | 0.27 | 11040 | 502.15 |
| 8 | 52.76 | 14205 | 0.41 | 14181 | 502.19 |
| 9 | 59.35 | 17742 | 0.55 | 17709 | 502.23 |
| 10 | 65.95 | 21665 | 0.79 | 21618 | 502.28 |
| 11 | 72.54 | 25971 | 1.09 | 25905 | 502.34 |
| 12 | 79.13 | 30653 | 1.47 | 30565 | 502.40 |
| 13 | 85.73 | 35709 | 1.98 | 35590 | 502.47 |
| 14 | 92.32 | 41129 | 2.66 | 40970 | 502.54 |
| 15 | 98.92 | 46905 | 3.66 | 46686 | 502.61 |
| 16 | 105.51 | 53016 | 1.68 | 52916 | 502.67 |
| 17 | 112.11 | 59642 | 2.00 | 59522 | 502.75 |
| 18 | 118.70 | 66644 | 2.31 | 66506 | 502.84 |
| 19 | 125.30 | 74024 | 2.61 | 73867 | 502.94 |
| 20 | 131.89 | 81781 | 2.88 | 81608 | 503.04 |
| 21 | 125.30 | 89126 | 3.10 | 88940 | 503.13 |
| 22 | 118.70 | 96062 | 3.31 | 95863 | 503.22 |
| 23 | 112.11 | 102590 | 3.50 | 102380 | 503.31 |
| 24 | 105.51 | 108710 | 3.67 | 108490 | 503.39 |
| 25 | 98.92 | 114425 | 3.81 | 114197 | 503.46 |
| 26 | 92.32 | 119736 | 3.94 | 119500 | 503.53 |
| 27 | 85.73 | 124644 | 4.05 | 124401 | 503.59 |
| 28 | 79.13 | 129149 | 4.16 | 128899 | 503.65 |
| 29 | 72.54 | 133252 | 4.25 | 132997 | 503.70 |
| 30 | 65.94 | 136954 | 4.33 | 136694 | 503.75 |

| TIME (MIN) | INFLOW (C.F.S.) | INCR. VOL. (CU.FT.) | OUTFLOW (C.F.S.) | NET. DET. (CU.FT.) | ELEV. |
|---------------|--------------------|------------------------|---------------------|-----------------------|--------|
| 31 | 59.35 | 140255 | 4.40 | 139991 | 503.79 |
| 32 | 52.76 | 143156 | 4.47 | 142888 | 503.83 |
| 33 | 46.16 | 145658 | 4.52 | 145387 | 503.86 |
| 34 | 39.57 | 147761 | 4.57 | 147487 | 503.89 |
| 35 | 32.97 | 149465 | 4.60 | 149189 | 503.91 |
| 36 | 26.38 | 150772 | 4.63 | 150494 | 503.93 |
| 37 | 19.78 | 151681 | 4.65 | 151402 | 503.94 |
| 38 | 13.19 | 152194 | 4.66 | 151914 | 503.95 |
| 39 | 6.59 | 152310 | 4.66 | 152030 | 503.95 |
| 40 | 0.00 | 152030 | 4.65 | 151751 | 503.94 |
| 41 | 0.00 | 151751 | 4.65 | 151473 | 503.94 |
| 42 | 0.00 | 151473 | 4.65 | 151194 | 503.94 |
| 43 | 0.00 | 151194 | 4.63 | 150916 | 503.93 |
| 44 | 0.00 | 150916 | 4.63 | 150638 | 503.93 |
| 45 | 0.00 | 150638 | 4.63 | 150360 | 503.93 |

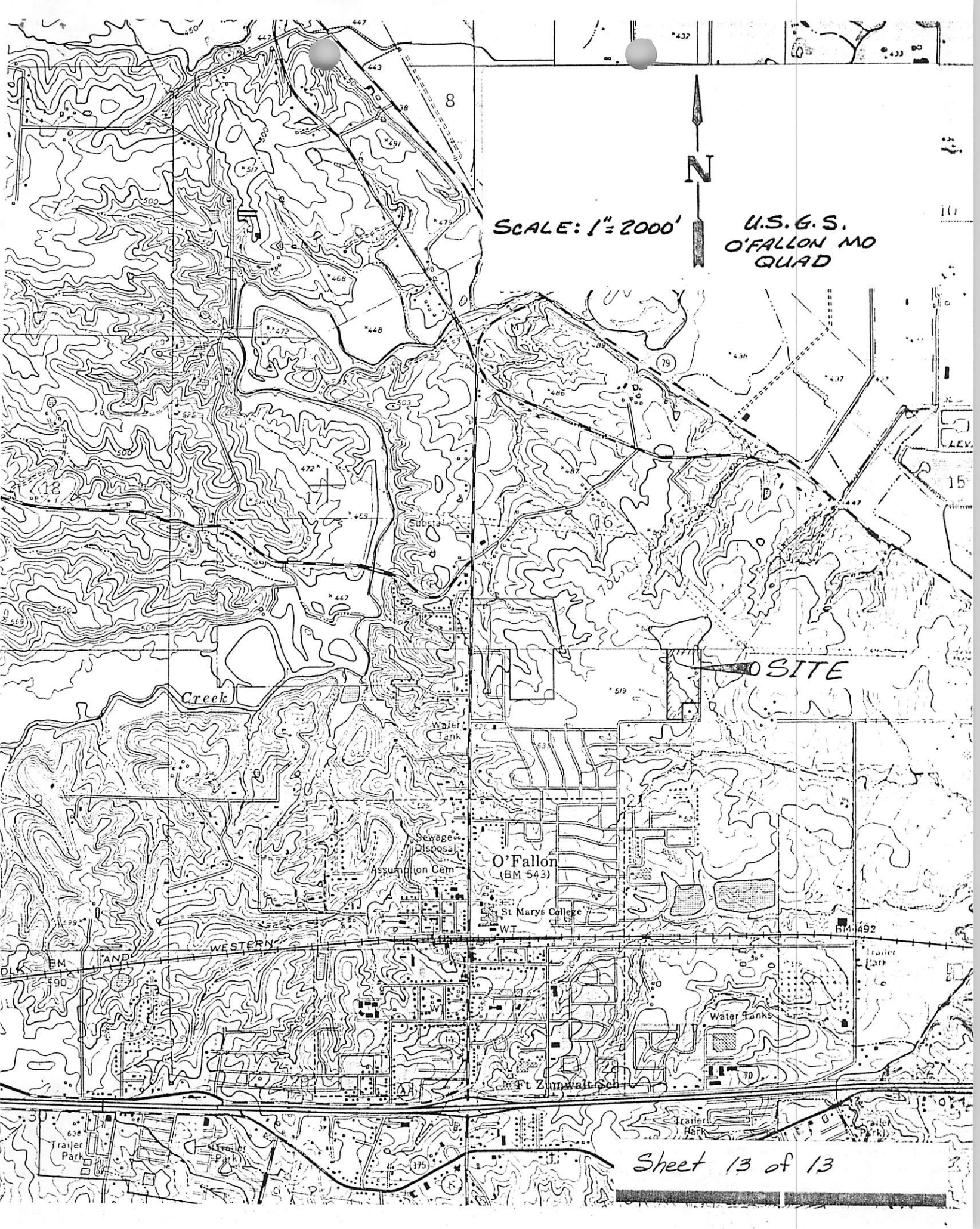
=====

ADDITIONAL INFORMATION

=====

PEAK OUTFLOW = 4.66 C.F.S. AT 38 MINUTES AT HIGH WATER ELEVATION 503.95

REQUIRED DETENTION = N/A C.F.S. MINIMUM.



SCALE: 1" = 2000'

U.S.G.S.
O'FALLON MO
QUAD

SITE

Creek

Water Tank

Sewage Disposal

Assumption Cem

O'Fallon
(BM 543)

St Marys College

WT

Water Tanks

Ft Zimwalt Sch

Trailer Park

Trailer Park

Trailer Park

Trailer Park

Sheet 13 of 13