

# DEER CREEK SUBDIVISION

## STORMWATER DRAINAGE ANALYSIS

### PREPARED FOR:

Village of Sleepy Hollow  
1 Thorobred Lane  
Sleepy Hollow, Illinois 60118

### REVISED:

NOVEMBER 22, 2000

## INTRODUCTION

The Deer Creek Subdivision is located in the Village of Sleepy Hollow, Kane County Illinois. Periodic flooding occurs within the subdivision due to insufficient culvert and overland flow path capacities. Our previous analysis dated October 1999 focused only on the Wispark Development in Elgin and recommended an allowable release rate. It did not evaluate the affect of runoff from land within the Village on ditch and culvert capacity. The purpose of this study is to evaluate the effects of intervening drainage area and discharge on available culvert capacity and to recommend improvements to the drainage facilities within the Deer Creek Subdivision. The recommendations will include culvert replacement and minor grading changes to promote more efficient conveyance of stormwater runoff.

## HYDROLOGIC ANALYSIS

The upstream tributary area of the Deer Creek Subdivision consists of approximately 200 acres west of Randall Road (subwatershed 1). Within the subdivision, approximately 6 acres drain to the culvert beneath Jamestowne Court at Jamestowne Road (subwatershed 4), and 11 acres drain to the culvert at Belmont Parkway and Jamestowne Road (subwatershed 3). The drainage area to the twin 30" culverts (originally planned as a single 42" pipe per the record drawings) beneath Jamestowne Road consists of approximately 70 acres (subwatersheds 2, 3, and 4) within the subdivision in addition to the 200 acres within the City of Elgin. A second culvert crossing beneath Randall Road also drains through the Saddle Club subdivision to these twin 30" culverts. Based on a review of the aerial contour mapping, there appears to be little area tributary to this culvert. However, a local resident reports that significant flow emanates from this culvert. The tributary subwatersheds are depicted on Exhibit 1. Drainage in this area of the Saddle Club Subdivision will be discussed separately.

The Illinois Department of Transportation (IDOT) Drainage Manual recommends using the Rational Method to determine the 30- and 50-year recurrence interval runoff amounts for culvert design. However, because intensity-duration-frequency information is not available for the 30-year event, the 25-year event and the 50-year events were evaluated.

25-year and 50-year flow rates were calculated for three locations within the Deer Creek Subdivision: the culvert under Jamestowne Court (subwatershed 4), the culvert under Belmont Parkway (subwatershed 3 and 4) and the twin 30" culverts beneath Jamestowne Road (subwatersheds 1, 2, 3, and 4).

In accordance with accepted IDOT methodology as outlined in their Drainage Manual, flow rates were computed using the Rational Method by multiplying the runoff coefficient (C), rainfall intensity (i) and drainage area (A). The land cover of the subject watershed determines the runoff coefficient. Based on aerial orthophotographic information provided by the Kane County Development Department, land uses and subwatershed boundaries were determined. The IDOT Drainage Manual recommends using a C of between 0.35 and 0.55 for urban residential areas. The rainfall intensity was taken from the intensity duration frequency curves for Northwestern Illinois as published in the IDOT Drainage Manual. The Rational Method requires that the rainfall intensity (i) has a duration equal to the time of concentration (Tc) of the watershed. Table 1 lists the value of each rational method parameter for each location analyzed.

**TABLE 1. RATIONAL METHOD PARAMETERS**

Subwatershed	Tc (min)	C	i (in/hr)		Subwatershed Area (acres)	Watershed Area for Rational Method (acres)	Total Tributary Area (acres)
			25-Year	50-Year			
1	-	-	-	-	200	-	200
2	75	0.40	2.25	2.7	53	70	270
3	68	0.40	2.4	2.8	11	17	217
4	65	0.40	2.5	2.95	6	6	6

It was assumed that the drainage area west of Randall Road (Subwatershed 1) is tributary to two proposed stormwater detention facilities located upstream of Randall Road in the Wispark Development. Based on the report entitled Final Engineering Calculations for Northwest Corporate Park – Phase III prepared by Cowhey Gudmundson Leder, Ltd.(CGL) dated January 7, 2000 and revised January 28, 2000, the 50-year recurrence interval release rate is 24 cfs. For the purpose of this analysis, Hey and Associates has modified the TR-20 model used by CGL to determine the 25-year recurrence interval release rate of 21 cfs for proposed conditions. The proposed release rates for Subwatershed 1 were added to the Rational Method flow rates calculated for Jamestowne Road to determine the total amount of flow to the twin 30" culverts. Table 2 shows the results of the hydrologic analysis described above. Appendix A includes the background information used in the hydrologic analysis.

**TABLE 2. HYDROLOGIC ANALYSIS RESULTS SUMMARY**

SUBWATERSHED	LOCATION	FLOW RATE (CFS)	
		25-YEAR	50-YEAR
1	Randall Road <sup>1</sup>	21	24
2	Jamestowne Road <sup>2</sup>	84	100
3	Belmont Parkway <sup>2</sup>	37	43
4	Jamestowne Court <sup>3</sup>	6	7

1.Flow rates from CGL report.

2.Flow rates calculated from Rational Method plus flow rate from Randall Road

3.Flow rate calculated from Rational Method.

## HYDRAULIC ANALYSIS

The results of the hydrologic analysis described above were used to determine both existing and proposed water surface elevations within the Deer Creek Subdivision for the 25- and 50- year recurrence interval. The proposed conditions hydraulic analysis consists of recommended improvements to the existing drainage facilities. The existing and proposed hydraulic analyses are described below.

### EXISTING CONDITIONS HYDRAULIC ANALYSIS

The stage-outflow information generated in the previous analysis completed October 1999 by Hey and Associates, Inc. along with the results of the hydrologic analysis described in this report were used to determine existing water surface elevations for the 25- and 50-year recurrence interval storm events. The existing conditions hydraulic analysis evaluates ten (10) culverts and four (4) ditch cross sections along Jamestowne Road.

The existing conditions hydraulic analysis was performed using the Federal Highway Administration HY-8 culvert analysis program for the culverts and conventional open-channel flow calculations using Manning's equation for the ditches. Detailed pipe invert, size and material information and cross section information provided by Gerald L. Heinz & Associates was used and was supplemented by aerial orthophotographic information provided by the Kane County Development Department and record drawings of the project prepared by Joseph A. Schudt & Associates. The location of the culverts and ditch cross sections evaluated are included on Exhibit 2. The results of the existing conditions hydraulic analysis are shown in Table 3.

**TABLE 3. 25-YEAR AND 50-YEAR EXISTING CONDITIONS WATER SURFACE ELEVATIONS.**

LOCATION	25-YEAR		50-YEAR		ROAD/DRIVE OVERTOP ELEVATION
	FLOW (CFS)	ELEV	FLOW (CFS)	ELEV	
XS 0 <sup>(1)</sup>	21	100.50	24	100.84	101.42
SLP 79	21	100.50	24	100.84	101.10
SLP 78	21	100.16	24	100.36	100.94
SLP 77	21	97.92	24	98.25	98.79
SLP 76	21	97.45	24	97.74	98.55
XS 3 <sup>(1)</sup>	21	96.97	24	97.21	97.41
SLP 75	21	96.97	24	<b>97.21</b>	97.11
JMSTWN (Jamestowne Ct)	6	96.59	7	<b>96.74</b>	96.72
XS 2 <sup>(1)</sup>	6	<b>94.59</b>	7	<b>96.74</b>	95.45
SLP 74	37	<b>94.40</b>	43	<b>94.43</b>	94.30
BLMTPKY (Belmont Parkway)	37	<b>93.68</b>	43	<b>93.78</b>	93.44
XS 1 <sup>(1)</sup>	37	<b>93.68</b>	43	<b>93.71</b>	93.35
SLP 72	84	<b>93.68</b>	100	<b>93.71</b>	93.50
SLP230 (Jamestowne Rd)	84	<b>93.06</b>	100	<b>93.17</b>	92.79

<sup>(1)</sup> Water surface elevations determined by backwater conditions.

Assumes that Wispark stormwater detention is in place and functioning as designed.

Numbers in bold indicate overtopping.

## PROPOSED CONDITIONS HYDRAULIC ANALYSIS

The purpose of the proposed conditions hydraulic analysis is to document the reduction in water surface elevations resulting from implementation of the recommended improvements. The existing conditions HY-8 runs were modified to reflect the proposed changes in culvert sizes, the addition of culverts, and the change in pipe materials at all locations from corrugated metal to reinforced concrete. The results of the proposed conditions analysis are presented in Tables 4 and 5. Ditch cross section geometry was not changed from the existing conditions analysis except as noted below because the ditches were generally found to have sufficient capacity. Based on the cross section information provided by Gerald L. Heinz & Associates, a separate normal depth analysis was performed that accounted for the fact that the ditches are at higher elevations relative to the culvert inverts. The results of the analysis indicate that the ditches are able to convey the design flow and that, except as noted, culvert capacity remains the limiting factor for conveyance. Ditch information used and results of this analysis are included in Appendix A.

## RECOMMENDED IMPROVEMENTS

The Illinois Department of Transportation recommends that roadway culverts be designed with a level of service of between 30 and 50 years. Based on the results of the existing conditions hydraulic analysis, it appears that the existing culverts at locations SLP74, BLMTPKY, SLP72, and SLP230 (Jamestowne Rd)



begin to overtop the existing roadway elevation during the 25-year recurrence interval storm event, followed by SLP75 and JMSTWN (Jamestowne Ct.) that begin to overtop the existing roadway elevation during the 50-year recurrence interval storm event. The remaining culverts exhibit sufficient conveyance for up to the 50-year event.

There are several improvements that could allow for increased stormwater conveyance within the Deer Creek Subdivision including changes in culvert material, size and placement and some minor ditch regrading. A table of existing and proposed culvert number and sizes is included in Appendix A.

#### Culvert Replacement

- The existing corrugated metal pipe (CMP) culverts should be replaced with precast reinforced concrete pipes (RCP) with flared end sections. The need for galvanized grates will need to be evaluated by the Village. RCP was chosen because it has a roughness coefficient roughly half that of CMP and has a correspondingly greater capacity for a given pipe size. As shown in Table 3 the culverts at SLP76, SLP77, SLP78, and SLP79 do not overtop even in a 50-year storm event indicating that these culverts already have sufficient capacity and do not have to be replaced. However, replacing them with RCP would further increase the runoff capacity for the subdivision.
- The single 36-inch CMP culvert under Belmont Parkway should be replaced with two 30-inch RCP culverts.
- The single 30-inch CMP culvert that stretches under the driveways at 732 and 733 Jamestown Road should be replaced with three 33-inch RCP culverts.
- The two 30-inch CMP culverts under Jamestowne Road (SLP 230) should be replaced with three 30-inch RCP culverts. If possible, the culverts should be skewed so the culverts flow from the southwest under Jamestowne Road to the northeast in order to reduce entrance losses into the culverts and improve culvert performance.

TABLE 4. 25-YEAR EXISTING AND PROPOSED CONDITIONS WATER SURFACE ELEVATIONS.

LOCATION	FLOW (CFS)	EXISTING 25-YEAR ELEV. (FT)	PROPOSED 25-YEAR ELEV. (FT)	CHANGE IN ELEV. (FT)	ROAD/DRIVE OVERTOP ELEVATION
XS 0 <sup>(1)</sup>	21	100.50	100.13	0.37	101.42
SLP 79	21	100.50	100.13	0.37	101.10
SLP 78	21	100.16	99.84	0.32	100.94
SLP 77	21	97.92	97.45	0.47	98.79
SLP 76	21	97.45	96.87	0.58	98.55
XS 3 <sup>(1)</sup>	21	96.97	96.45	0.52	97.41
SLP 75	21	96.97	96.48	0.49	97.11
JMSTWN (Jamestowne Ct)	6	96.59	96.19	0.40	96.72
XS 2 <sup>(1)</sup>	6	<b>96.59</b>	94.52	2.07	95.45
SLP 74	37	<b>94.40</b>	93.90	0.50	94.30
BLMTPKY (Belmont Pkwy)	37	<b>93.68</b>	93.02	0.66	93.44
XS 1 <sup>(1)</sup>	37	<b>93.68</b>	92.67	0.82	93.35
SLP 72	84	<b>93.68</b>	92.85	0.83	93.50
SLP 230 (Jamestowne Rd)	84	<b>93.06</b>	92.00	1.06	92.79

<sup>(1)</sup>Water surface elevations determined by backwater conditions.

- Assumes that Wispark stormwater detention is in place and functioning as desired.
- Numbers in bold indicate overtopping.
- XS2 has sufficient capacity when considered with current improvements.

TABLE 5. 50-YEAR EXISTING AND PROPOSED CONDITIONS WATER SURFACE ELEVATIONS.

LOCATION	FLOW (CFS)	EXISTING 50-YEAR ELEV. (FT)	PROPOSED 50-YEAR ELEV. (FT)	CHANGE IN ELEV. (FT)	ROAD/DRIVE OVERTOP ELEVATION
XS 0 <sup>(1)</sup>	24	100.84	100.35	0.49	101.42
SLP 79	24	100.84	100.35	0.49	101.10
SLP 78	24	100.36	100.01	0.35	100.94
SLP 77	24	98.25	97.56	0.69	98.79
SLP 76	24	97.74	97.07	0.67	98.55
XS 3 <sup>(1)</sup>	24	97.21	96.55	0.66	97.41
SLP 75	24	<b>97.21</b>	96.82	0.39	97.11
JMSTWN (Jamestowne Ct)	7	<b>96.74</b>	96.53	0.21	96.72
XS 2 <sup>(1)</sup>	7	<b>96.74</b>	94.54	2.20	95.45
SLP 74	43	<b>94.43</b>	94.25	0.16	94.30
BLMTPKY (Belmont Pkwy)	43	<b>93.78</b>	93.25	0.46	93.44
XS 1 <sup>(1)</sup>	43	<b>93.71</b>	92.78	0.73	93.35
SLP 72	100	<b>93.71</b>	93.27	0.44	93.50
SLP 230 (Jamestowne Rd)	100	<b>93.17</b>	92.41	0.76	92.79

<sup>(1)</sup>Water surface elevations determined by backwater conditions.

- Assumes that Wispark stormwater detention is in place and functioning as desired.
- Numbers in bold indicate overtopping.
- XS2 has sufficient capacity when considered with current improvements

### Ditch Regrading

- The ditch that runs parallel with Randall Road behind 238 Jamestowne Court should be regraded. At present it has a capacity of only approximately 5 cfs. It should be regraded from the inverts of the twin culverts beneath Randall Road to the adjacent ditch at a slope of at least 0.0024 ft/ft. The ditch should be triangular in cross section, have 2:1 to 3:1 side slopes and a minimum depth of approximately 2 feet so that it has a capacity of at least 31 cfs.
- Ditch between Belmont Parkway and the SLP 72 should be dug 1 foot deeper to a depth of 90.51 feet. The current side slopes of 5:1 should be retained.

### PROJECT COST ESTIMATES

The total estimated project cost for completion of the proposed drainage improvements is \$67,700 for a 25-Year level of service as shown in Table 6. Prices include complete material and installation costs for precast reinforced concrete pipes with flared end sections and galvanized flared end grates based on quotes from Welch Bros., Inc. Cost calculations are included in Appendix A.

**TABLE 6. PRELIMINARY COST ESTIMATE FOR PROPOSED CULVERT REPLACEMENTS.**

LOCATION	MATERIAL	DIAMETER (IN)	LENGTH (FT)	NUMBER	TOTAL COST
XS 0 (regrading for 31 cfs )	NA	NA	NA	NA	\$1,200
SLP 79	RCP	36	30	1	\$6,500
SLP 78	RCP	36	30	1	\$6,500
SLP 77	RCP	36	30	1	\$6,500
SLP 76	RCP	36	30	1	\$6,500
XS 3	NA	NA	NA	NA	NA
SLP 75	RCP	36	30	1	\$6,500
JMSTWN (Jamestowne Ct)	RCP	15	50	1	\$3,000
XS 2	NA	NA	NA	NA	NA
SLP 74	RCP	36	30	1	\$6,500
BLMTPKY (Belmont Parkway)	RCP	30	50	2	\$12,000
XS 1 (regrading)	NA	NA	NA	NA	\$2000
SLP 72	RCP	33	70	3	\$28,000
SLP 230 (Jamestowne Rd)	RCP	30	50	3	\$18,000
<b>25-YEAR LEVEL OF SERVICE</b>					<b>\$67,700</b>
<b>50-YEAR LEVEL OF SERVICE</b>					<b>\$77,200</b>
<b>TOTAL REPLACEMENT</b>					<b>\$103,200</b>

Calculations are included in Appendix A.

Not all culverts require replacement, reference text and Tables 4 and 5

25-Year Level of Service accounts for SLP230, SLP72, XS1, BLMTPKY, SLP74, XS0

50-Year Level of Service accounts for SLP230, SLP72, XS1, BLMTPKY, SLP74, XS0, JMSTWN, SLP75



## SADDLE CLUB DRAINAGE

The drainage problems in the Saddle Club subdivision appear to result from two sources, overland runoff and subsurface drainage. Although many residents complained of overflowing swales and inadequate storm water conveyance, residents have noticed a reduction in those problems post construction of the detention facilities upstream of Randall Road.

High groundwater resulting from inadequate subsurface drainage or an abandoned tile line, appears to contribute to the cause of localized basement flooding. Long-time residents claim that portions of the subdivision were constructed over a creek bed. Prior to formulation of a solution of the existing drainage problems in the Saddle Club Subdivision, information on the historical and existing drainage must be collected. Contour information prior to construction of the existing subdivision may give clues to the natural pre-construction drainage of the area and suggest areas to focus on when collecting data on the existing drainage system. Village Hall files were investigated for the Saddle Club Subdivision plans; however, nothing was found in the files. We recommend researching County records to determine the subdivision engineer and attempting obtain plans through them.

We suggest that the following be performed to assist in determining the nature of the flooding problems and to aid in determining a solution.

- Soil survey: a soil survey is necessary to determine the hydraulic capacities of the soils in the subdivision. Certain soil groups allow water to infiltrate while others do not. Information on the natural drainage capacity of the soils is necessary to formulate a solution that will allow for natural infiltration where possible and additional subsurface drainage where necessary.
- Tile Investigation: a tile investigation is necessary to describe the existing subsurface drainage that exists in the subdivision. An inadequately abandoned tile line can transport and discharge subsurface water to areas that have inadequate capacity and may contribute to the basement flooding or standing water in the drainage swales.
- Groundwater Level Measurements: a network of shallow groundwater monitoring wells (piezometers) is necessary to establish an understanding of the groundwater levels within the subdivision. Groundwater levels in conjunction with the tile investigation will provide the necessary information to understand the influence of subsurface drainage within the subdivision and to formulate a comprehensive solution.

- Culvert/Swale Capacity Analysis: A culvert and swale capacity analysis would be helpful to determine whether culvert diameters or swale cross sections have sufficient capacity or need to be enlarged to increase stormwater conveyance capacities throughout the subdivision.

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## List of Exhibits, Tables and Appendices

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Exhibit 2	Culvert and Cross Section Locations on Aerial Photograph
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Table 2	Hydrologic Analysis Results Summary
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EXHIBIT 1



DEER CREEK  
SUBDIVISION



DELINEATED  
SUBWATERSHEDS  
ON AERIAL  
PHOTOGRAPH



SCALE:  
**Not to Scale**

