



Hansen and Associates, Inc.
Consulting Engineers & Land Surveyors

May 4, 2016

Thomas Katers
Raasch Engineers / Architects
400 AMS Ct.
Green Bay, WI 54313

Re: Kimberly Clark – Weber County, Utah – Drainage

Dear Tom,

Hansen & Associates, Inc (HAI) performed a review of drainage informative relative to the Kimberly Clark expansion project. Our understanding is that the proposed project consists of parking lot improvements that will encompass 9,121 SF of new impervious surfaces. A future patio, building addition and trail could contribute 13,577 SF of new impervious surfaces. This is a relatively minor increase for the 87-acre site. The purpose of this report is to evaluate whether the existing drainage pond is sufficient for this minor increase.

Previous Reports

A global drainage report was prepared by JBR Environmental Consultants dated August 18, 2010. HAI checked the report parameters. The 87-acre drainage basin area was accepted. We determined the site to have 44.54 acres impervious areas ($C = 0.95$) and 42.64 acres pervious areas ($C = 0.15$) for a weighted coefficient of $C = 0.56$. JBR utilized an analysis using CN numbers.

HAI performed a site survey of the existing drainage pond and found the storage area to coincide with JBR's 6.1 AF.

For the hydrologic analysis, we utilized local rainfall data as published by NOAA (attached). Runoff was calculated by a hydrograph method utilizing a runoff rate of 0.1 cfs/acre. County standards involve evaluation of the 10-year storm event, which yields a peak volume requirement of 123,872 cubic feet (2.84 AF). The peak event coincided with the 1-hour time period which also coincided well with JBR's time of concentration determination of 56 minutes. JBR had determined the 10-year, 6-hour event to be 3.7 AF of storage.

As for a peak runoff rate, JBR had calculated the flowrate to be 45.95 cfs. Our calculations utilizing the Rational Method (area = 87 acres, $C = 0.56$, $T_c = 56$ minutes, $I-10 = 0.95$ in/hr) yields a flow of 46.28 cfs, closely aligning with JBR's data.

The existing drainage pond is very well developed with manicured and well maintained grass. The 6.1 acre pond (approximate 5-foot depth) easily has capacity for the required 2.84 AF of storage.

Outflow

Attached is a picture of the existing outflow structure consisting of a flared concrete inlet with a bolted plate that acts as an orifice device, which covers the outbound 30-inch RCP pipe. This was installed per JBR's report with the plate being 7 inches above invert elevation. JBR calculated the outflow through the orifice opening to be 6.8 cfs at a water depth of 3.61 feet – our calculations yield 7.7 cfs. The flow through the orifice opening at full water depth of 5 feet equals 9.2 cfs, which closely approximates the allowable release rate of 8.7 cfs. Our conclusion is that the orifice is reasonably well designed.

The outbound 30-inch RCP pipe is 51 feet to the municipal storm line at a slope of 0.82% - this pipe has a flowing full capacity of 37.1 cfs, which reasonably approximates the peak flow rate of 46 cfs as mentioned earlier. There strangely isn't an overflow grate on the west side of the orifice plate – in other words, flow is forever limited by the bolted orifice – the 30-inch pipe capacity is rendered irrelevant. It is suggested that a grated overflow box be placed west of the bolted orifice. A staff member at Kimberly Clark commented that he has seen flows actually back-drain into the Kimberly Clark pond. Investigating downstream flows was outside the scope of this report.

New Improvements

The new impervious surfaces (proposed and future) amount to 22,698 SF. Drainage calculations (attached) for the 10-year, 24-hour storm with no release amounts to 3,795 cubic feet (.08 AF) – such is relatively insignificant in regards to the ample capacity.

Conclusions

The existing Kimberly Clark drainage pond has ample capacity for the proposed and contemplated improvements.

Should you have any questions, please do not hesitate to call.

Respectfully;
Hansen and Associates, Inc.



Jim Flint, PE / PLS



NOAA Atlas 14, Volume 1, Version 5
Location name: Ogden, Utah, US*
Latitude: 41.2972°, Longitude: -112.0277°
Elevation: 4258 ft*
 * source: Google Maps



FARR WEST

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin,
 Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao,
 Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.57 (1.37-1.81)	1.97 (1.74-2.28)	2.69 (2.36-3.11)	3.37 (2.93-3.90)	4.46 (3.79-5.21)	5.48 (4.51-6.47)	6.71 (5.34-7.99)	8.16 (6.25-9.92)	10.5 (7.60-13.2)	12.7 (8.72-16.3)
10-min	1.19 (1.04-1.37)	1.50 (1.33-1.73)	2.05 (1.80-2.36)	2.56 (2.23-2.96)	3.40 (2.89-3.96)	4.18 (3.44-4.92)	5.11 (4.06-6.08)	6.21 (4.76-7.55)	7.99 (5.78-10.0)	9.65 (6.64-12.4)
15-min	0.988 (0.860-1.14)	1.24 (1.10-1.44)	1.69 (1.48-1.96)	2.12 (1.84-2.45)	2.81 (2.38-3.27)	3.45 (2.84-4.06)	4.22 (3.36-5.03)	5.13 (3.93-6.24)	6.61 (4.78-8.28)	7.98 (5.49-10.2)
30-min	0.664 (0.580-0.766)	0.836 (0.738-0.966)	1.14 (1.00-1.32)	1.43 (1.24-1.65)	1.89 (1.61-2.20)	2.32 (1.91-2.74)	2.84 (2.26-3.38)	3.45 (2.65-4.20)	4.45 (3.21-5.58)	5.37 (3.70-6.89)
60-min	0.411 (0.358-0.474)	0.517 (0.457-0.598)	0.705 (0.619-0.815)	0.883 (0.767-1.02)	1.17 (0.994-1.36)	1.44 (1.18-1.69)	1.76 (1.40-2.09)	2.14 (1.64-2.60)	2.75 (1.99-3.45)	3.32 (2.29-4.27)
2-hr	0.261 (0.232-0.297)	0.326 (0.290-0.372)	0.422 (0.372-0.480)	0.513 (0.448-0.585)	0.664 (0.567-0.766)	0.804 (0.670-0.936)	0.969 (0.782-1.15)	1.17 (0.906-1.41)	1.48 (1.08-1.85)	1.78 (1.24-2.27)
3-hr	0.202 (0.182-0.226)	0.249 (0.224-0.280)	0.311 (0.279-0.350)	0.370 (0.329-0.417)	0.464 (0.406-0.527)	0.552 (0.473-0.635)	0.661 (0.551-0.773)	0.791 (0.638-0.943)	1.00 (0.768-1.24)	1.20 (0.879-1.52)
6-hr	0.137 (0.126-0.151)	0.167 (0.153-0.185)	0.202 (0.184-0.223)	0.234 (0.211-0.259)	0.283 (0.252-0.315)	0.323 (0.284-0.363)	0.369 (0.319-0.421)	0.421 (0.355-0.487)	0.527 (0.430-0.630)	0.623 (0.493-0.773)
12-hr	0.087 (0.080-0.095)	0.106 (0.098-0.116)	0.128 (0.118-0.141)	0.147 (0.134-0.162)	0.176 (0.159-0.195)	0.200 (0.178-0.223)	0.226 (0.197-0.255)	0.253 (0.216-0.290)	0.295 (0.245-0.347)	0.330 (0.267-0.395)
24-hr	0.053 (0.048-0.058)	0.065 (0.059-0.071)	0.077 (0.071-0.085)	0.088 (0.081-0.096)	0.102 (0.093-0.111)	0.113 (0.103-0.123)	0.124 (0.113-0.136)	0.136 (0.122-0.148)	0.151 (0.135-0.176)	0.167 (0.145-0.201)
2-day	0.031 (0.028-0.034)	0.038 (0.035-0.041)	0.045 (0.041-0.049)	0.051 (0.047-0.055)	0.058 (0.054-0.063)	0.064 (0.059-0.070)	0.070 (0.064-0.076)	0.076 (0.069-0.083)	0.083 (0.075-0.091)	0.089 (0.080-0.101)
3-day	0.022 (0.021-0.024)	0.027 (0.025-0.030)	0.033 (0.030-0.035)	0.037 (0.034-0.040)	0.043 (0.039-0.046)	0.047 (0.043-0.051)	0.051 (0.047-0.056)	0.056 (0.051-0.061)	0.062 (0.056-0.067)	0.066 (0.059-0.074)
4-day	0.018 (0.017-0.020)	0.022 (0.020-0.024)	0.026 (0.024-0.029)	0.030 (0.028-0.033)	0.035 (0.032-0.038)	0.038 (0.035-0.042)	0.042 (0.038-0.046)	0.046 (0.041-0.050)	0.051 (0.046-0.056)	0.054 (0.049-0.060)
7-day	0.012 (0.011-0.014)	0.015 (0.014-0.017)	0.018 (0.017-0.020)	0.020 (0.019-0.022)	0.023 (0.021-0.025)	0.026 (0.024-0.028)	0.028 (0.026-0.031)	0.030 (0.028-0.033)	0.033 (0.030-0.037)	0.036 (0.032-0.039)
10-day	0.010 (0.009-0.011)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.015-0.017)	0.018 (0.017-0.020)	0.020 (0.018-0.022)	0.021 (0.020-0.023)	0.023 (0.021-0.025)	0.025 (0.023-0.027)	0.026 (0.024-0.029)
20-day	0.006 (0.006-0.007)	0.008 (0.007-0.008)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.012 (0.011-0.013)	0.013 (0.012-0.014)	0.013 (0.012-0.015)	0.014 (0.013-0.015)	0.015 (0.014-0.017)	0.016 (0.015-0.017)
30-day	0.005 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.011)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.013 (0.011-0.014)
45-day	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.006)	0.007 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.007-0.009)	0.009 (0.008-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.010)	0.010 (0.009-0.011)
60-day	0.004 (0.003-0.004)	0.005 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.005-0.006)	0.007 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.007-0.008)	0.008 (0.007-0.009)	0.009 (0.008-0.009)	0.009 (0.008-0.009)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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KIMBERLY CLARK

Drainage Calculations - 10 YEAR - Detention

May 4, 2016

BASIN

RAINFALL: 10-YR, 1-HOUR	0.883	INCHES	STORAGE REQUIREMENT FROM ENTITY
BASIN AREA (SF):	3,797,561	SF	
BASIN AREA (AC):	87.18	AC	
100% IMPERVIOUSNESS	1.00		
BASIN WEIGHTED 'C':	0.56		
RAINFALL ON BASIN (100%):	279,437	CF	100% RAINFALL FOR STORAGE EVENT
RUNOFF FROM BASIN (PER 'C')	156,485	CF	100% RUNOFF FOR STORAGE EVENT
RAINFALL PER IDF:			
INTENSITY AT 24 HRS:	0.088	IN/HR	24-HR RATE FOR CHOSEN EVENT
100% RAINFALL ON SITE	668,371	CF	RAINFALL - 100%
VOLUME = I*(T=24 HRS)*A*C	374,288	CF	24-HR RUNOFF - MIGHT NOT BE APPLIC.
PREC. VS. IDF COMPARSON	-217803	CF	ONLY APPLIC. IF COMPARING 24-HR. EVENT
BASIN A (AREA):	3,797,561	SF	
SUMP ROCK PERIMETER (LF)	0	LF	
SUMP ROCK HEIGHT	0	LF	
SUMP PERC SF	0	SF	
PERCOLATION RATE (IN/HR)	0.00	IN/HR	
PERCOLATION (CFS)	0.0000	CFS	
PERCOLATION PER 5 MINUTES	0.0	CF	
NUMBER OF SUMPS	0		

Duration	Storm Intensity	Weighted "C"	Subbasin Area	Stormwater Flow	Accumulated inflow	MH / Rock Storage	Metered Outflow Rate	Total Outflow	Metered Outflow	Other Outflow	Required Storage	Available Storage
(min)	(in/hr)		(sq.ft.)	(cfs)	(cf)	(cf)	(cfs)	(cf)	(cfs)	(cf)	(cf)	(cf)
5	3.37	0.56	3,797,561	164.53	49,358	-	8.7000	2,610	0.000	-	46,748	-
10	2.56	0.56	3,797,561	124.98	74,989	-	8.7000	5,220	0.000	-	69,769	-
15	2.12	0.56	3,797,561	103.50	93,150	-	8.7000	7,830	0.000	-	85,320	-
30	1.43	0.56	3,797,561	69.81	125,665	-	8.7000	15,660	0.000	-	110,005	-
60	0.88	0.56	3,797,561	43.11	155,192	-	8.7000	31,320	0.000	-	123,872	-
120	0.51	0.56	3,797,561	25.05	180,325	-	8.7000	62,640	0.000	-	117,685	-
180	0.37	0.56	3,797,561	18.06	195,088	-	8.7000	93,960	0.000	-	101,128	-
360	0.23	0.56	3,797,561	11.42	246,760	-	8.7000	187,920	0.000	-	58,840	-
720	0.15	0.56	3,797,561	7.18	310,032	-	8.7000	375,840	0.000	-	(65,808)	-
1440	0.088	0.56	3,797,561	4.296	374,288	-	8.7000	751,680	0.000	-	(377,392)	-

KIMBERLY CLARK

Drainage Calculations - 10 YEAR - New Areas

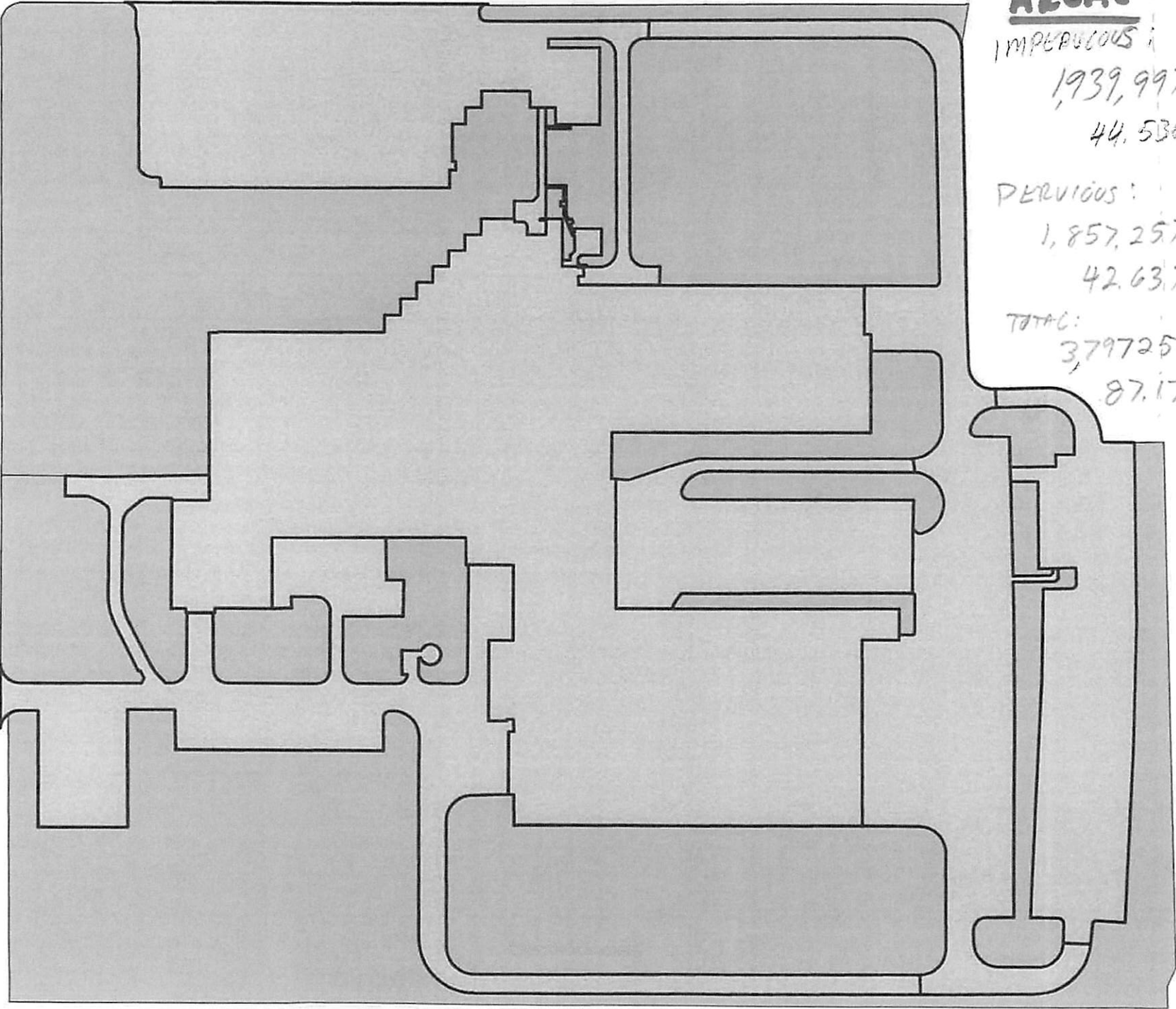
May 4, 2016

BASIN

RAINFALL: 10-YR, 1-HOUR	0.883	INCHES	STORAGE REQUIREMENT FROM ENTITY
BASIN AREA (SF):	22,698	SF	
BASIN AREA (AC):	0.52	AC	
100% IMPERVIOUSNESS	1.00		
BASIN WEIGHTED 'C':	0.95		
RAINFALL ON BASIN (100%):	1,670	CF	100% RAINFALL FOR STORAGE EVENT
RUNOFF FROM BASIN (PER 'C')	1,587	CF	100% RUNOFF FOR STORAGE EVENT
RAINFALL PER IDF:			
INTENSITY AT 24 HRS:	0.088	IN/HR	24-HR RATE FOR CHOSEN EVENT
100% RAINFALL ON SITE	3,995	CF	RAINFALL - 100%
VOLUME = I*(T=24 HRS)*A*C	3,795	CF	24-HR RUNOFF - MIGHT NOT BE APPLIC.
PREC. VS. IDF COMPARSON	-2208	CF	ONLY APPLIC. IF COMPARING 24-HR. EVENT
BASIN A (AREA):	22,698	SF	
SUMP ROCK PERJIMETER (LF)	0	LF	
SUMP ROCK HEIGHT	0	LF	
SUMP PERC SF	0	SF	
PERCOLATION RATE (IN/HR)	0.00	IN/HR	
PERCOLATION (CFS)	0.0000	CFS	
PERCOLATION PER 5 MINUTES	0.0	CF	
NUMBER OF SUMPS	0		

Duration	Storm Intensity	Weighted "C"	Subbasin Area	Stormwater Flow	Accumulated inflow	MH / Rock Storage	Metered Outflow Rate	Total Outflow	Metered Outflow	Other Outflow	Required Storage	Available Storage
(min)	(in/hr)		(sq.ft.)	(cfs)	(cf)	(cf)	(cfs)	(cf)	(cfs)	(cf)	(cf)	(cf)
5	3.37	0.95	22,698	1.67	500	-	0.0000	-	0.000	-	500	-
10	2.56	0.95	22,698	1.27	760	-	0.0000	-	0.000	-	760	-
15	2.12	0.95	22,698	1.05	944	-	0.0000	-	0.000	-	944	-
30	1.43	0.95	22,698	0.71	1,274	-	0.0000	-	0.000	-	1,274	-
60	0.88	0.95	22,698	0.44	1,574	-	0.0000	-	0.000	-	1,574	-
120	0.51	0.95	22,698	0.25	1,828	-	0.0000	-	0.000	-	1,828	-
180	0.37	0.95	22,698	0.18	1,978	-	0.0000	-	0.000	-	1,978	-
360	0.23	0.95	22,698	0.12	2,502	-	0.0000	-	0.000	-	2,502	-
720	0.15	0.95	22,698	0.07	3,144	-	0.0000	-	0.000	-	3,144	-
1440	0.088	0.95	22,698	0.044	3,795	-	0.0000	-	0.000	-	3,795	-

N →



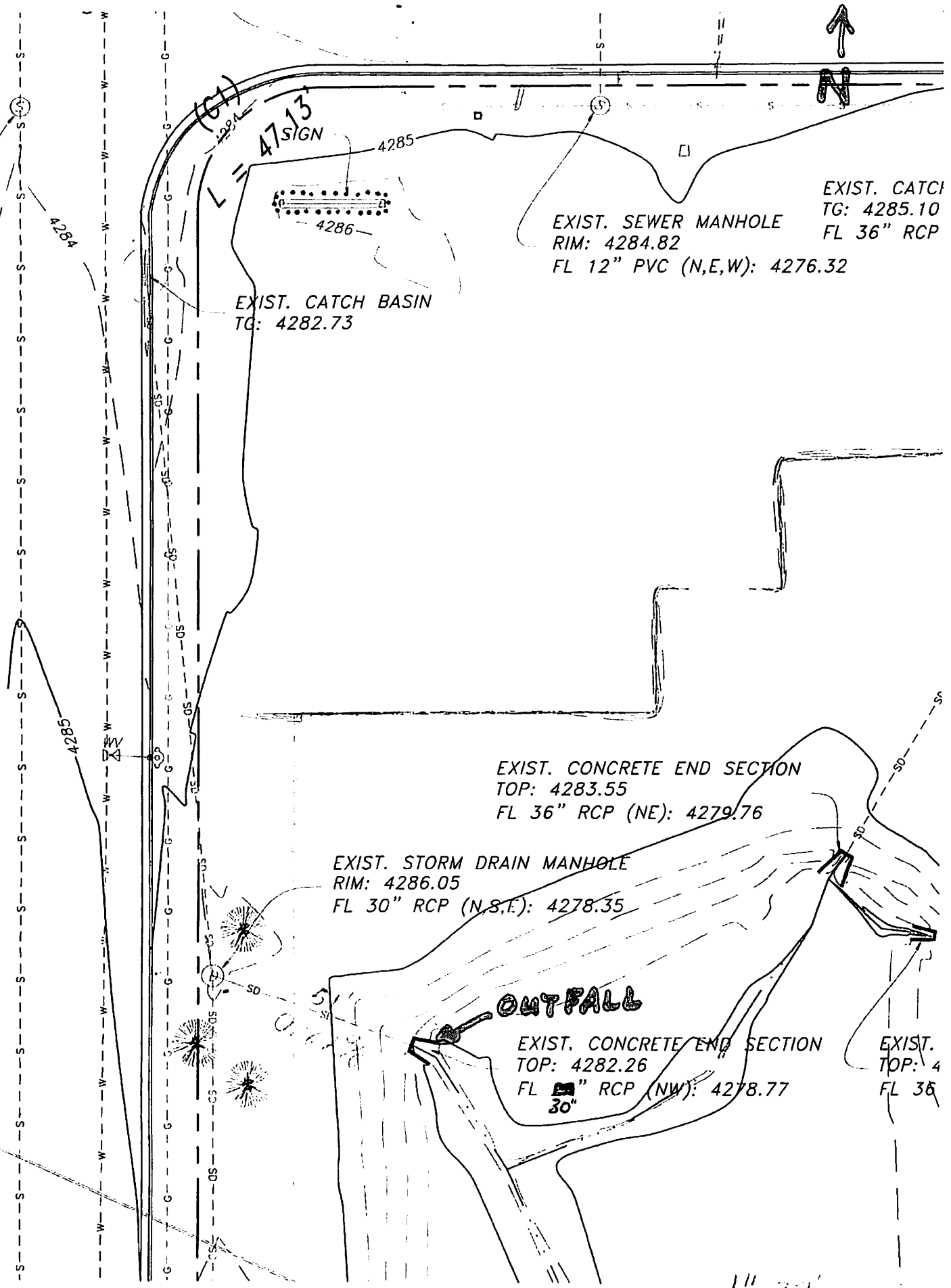
AREAS

IMPERVIOUS:
1,939,997 SF
44.536 ACRES

PERVIOUS:
1,857,257 SF
42.637 ACRES

TOTAL:
3,797,254 SF
87.173 ACRES

N:\2016\16-3-23 Kimberly Clark\drawings\16-3-23 Kimberly Clark.dwg, 4/29/2016 11:15:58 AM, oce 4520 Downstairs



EXIST. CATCH BASIN
TG: 4282.73

EXIST. SEWER MANHOLE
RIM: 4284.82
FL 12" PVC (N,E,W): 4276.32
EXIST. CATCH
TG: 4285.10
FL 36" RCP

EXIST. CONCRETE END SECTION
TOP: 4283.55
FL 36" RCP (NE): 4279.76

EXIST. STORM DRAIN MANHOLE
RIM: 4286.05
FL 30" RCP (N,S,E): 4278.35

OUTFALL

EXIST. CONCRETE END SECTION
TOP: 4282.26
FL 30" RCP (NW): 4278.77

EXIST. TOP: 4
FL 36"

11' 30'





KC

Orifice Calculations

April 29, 2016

Allowable release rate @ 0.15 cfs/acre: 0.16

$$Q = C_d * A * (2 * g * h)^{.5}$$

	<u>SIZE (IN-DIA.)</u>	<u>AREA (SF)</u>
A (inches diameter - round):	0.580	0.86340
A (square - using inches):	2.000	0.02778
Cd	0.62	
g	32.2	
<u>CIRCULAR:</u>		
TOP WATER ELEVATION: (FT)	103.61	PLUG-IN
BOTTOM OF ORIFICE: (FT)	100.00	PLUG-IN
CENTROID OF ORIFICE: (FT)	0.35	
CENTROID ELEVATION:	100.35	
EFFECTIVE 'h' (FEET):	3.26	
		<u>GPM</u>
Q (cfs):	7.7563	3481.03
<u>SQUARE</u>		
TOP ELEVATION: (FT)	103.61	PLUG-IN
BOTTOM OF ORIFICE: (FT)	100.00	PLUG-IN
CENTROID OF ORIFICE: (FT)	0.08	
CENTROID ELEVATION:	100.08	
EFFECTIVE 'h' (FEET):	3.53	
		<u>GPM</u>
Q (cfs):	0.2595	116.48

KC

Orifice Calculations

April 29, 2016

Allowable release rate @ 0.15 cfs/acre: 0.16

$$Q = C_d * A * (2 * g * h)^{.5}$$

	<u>SIZE (IN-DIA.)</u>	<u>AREA (SF)</u>
A (inches diameter - round):	0.580	0.86340
A (square - using inches):	2.000	0.02778

Cd 0.62

g 32.2

CIRCULAR:

TOP WATER ELEVATION: (FT) 105.00 PLUG-IN

BOTTOM OF ORIFICE: (FT) 100.00 PLUG-IN

CENTROID OF ORIFICE: (FT) 0.35

CENTROID ELEVATION: 100.35

EFFECTIVE 'h' (FEET): 4.65

Q (cfs): 9.2635 GPM 4157.44

SQUARE

TOP ELEVATION: (FT) 105.00 PLUG-IN

BOTTOM OF ORIFICE: (FT) 100.00 PLUG-IN

CENTROID OF ORIFICE: (FT) 0.08

CENTROID ELEVATION: 100.08

EFFECTIVE 'h' (FEET): 4.92

Q (cfs): 0.3065 GPM 137.54