CLARK COUNTY, NEVADA

MEMO

☐ URGENT – REPLY IMMEDIATELY
☐ NO REPLY REQUIRED

FROM _____ OFFICE _____

DATE _____

SUBJECT _____

TO

MESSAGE

REPLY

CLARK COUNTY, NEVADA

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☐ NO REPLY REQUIRED

FROM _____ OFFICE _____

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SUBJECT _____

TO

MESSAGE

REPLY

Sahara Town Square

Offsite (Existing)

15.8 acres CN = 94

L_o = 1094 S = 5.6% V = 1.4 F/s t_c = .22 hr. Q_p = 775

Q_{10} = 26.8 t_{10} = 1.19
Q_{25} = 33.9 t_{25} = 1.77
Q_{100} = 45.0 t_{100} = 2.35

Onsite (Existing)

16.5 acres CN = 87

L = 1123 S = .8% V = .9 F/s t_c = .37 hr. Q_p = 570

Q_{10} = 14.0 t_{10} = .82
Q_{25} = 18.9 t_{25} = 1.24
Q_{100} = 26.3 t_{100} = 1.73

Onsite (Developed)

16.5 acres CN = 94

L = 1123 S = .8% V = 1.8 F/s t_c = .17 Q_p = 850

Q_{10} = 30.7 t_{10} = 1.40
Q_{25} = 38.9 t_{25} = 1.99
Q_{100} = 51.5 t_{100} = 2.35

Storm Drain Capacity

18" R = 1.77 E = .520 S = .20

Q = 5.6 cfs

CLARK COUNTY, NEVADA

HYDROLOGY STUDY

SAHARA TOWN SQUARE

SECTION 11, TOWNSHIP 21 SOUTH, RANGE 61 EAST, M.D.B.&M.

CLARK COUNTY, NEVADA

June 16, 1987

PREPARED FOR:

KITTRELL GARLOCK AND ASSOCIATES

PREPARED BY:

RAUGHMAN & TURNER, INC.
2325 WEST CHARLESTON BOULEVARD
LAS VEGAS NEVADA 89102
702/870-8771

NEVADA PROFESSIONAL ENGINEER — RICHARD BAUGHMAN — CIVIL — No. 2162

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PURPOSE AND INTENT

The purpose of this Hydrology Study is to explore the existence of potential flood hazards which might affect this site. This study intends to show what measures, if any, the developer of the site should take in order to protect his property against any flood damage.

Data and procedures used in the analysis of this Study was obtained from field observation and utilizing available topographic maps.

All runoff calculations for this Hydrology Study are based on the methods as outlined in the publication "Urban Hydrology for Small Watersheds (TR-55)" as published by the U.S. Soils Conservation Commission.

LOCATION & EXISTING TOPOGRAPHY

The subject site is described as a portion of the Northwest Quarter (NW 1/4) of the Northwest Quarter (NW 1/4) of Section 11, Township 21 South, Range 61 East, M.D.B.&M., Clark County. It is further described as Clark County Assessors Parcel No. 120-290-008, and is located at the Southeast corner of Sahara Avenue and Maryland Parkway.

The site is surrounded on all sides by fully developed lands: multifamily residential to the east, single family residential to the south and commercial to the west and north. The site slopes generally to the east at an approximate rate of .8%.

Upland area which could negatively impact the site lies to the west of Maryland Parkway. It consists of 15.8 acres of commercial development and has the potential to generate storm water runoffs of 32.3 c.f.s., under the conditions of a 25 year event.

The site itself contains 16.5 acres and could generate a runoff of 35 c.f.s. in its present condition, or 37.5 c.f.s. fully developed, for a 25 year event.

SUMMARY AND RECOMMENDATIONS

The runoff from Area "A" is diverted prior to reaching the subject site, even with a 100 year runoff (see Street Flow Calculations) by Maryland Parkway.

The site will be drained in two directions. Half will be surface drained toward Sahara Avenue and into its 60" RCP. The other half will be drained toward Karen Avenue, and flow east within the existing right-of-way. See Grading Plan for "on-site" drainage details.

DRAINAGE ANALYSIS

SAHARA TOWNE SQUARE

SECTION 11, TOWNSHIP 21 SOUTH, RANGE 61 EAST, M.D.B.&M.

CLARK COUNTY, NEVADA

JULY 13, 1987

PREPARED FOR:

KITTRELL GARLOCK AND ASSOCIATES

PREPARED BY:

RAUGHMAN & TURNER, INC.
2325 WEST CHARLESTON BOULEVARD
LAS VEGAS, NEVADA 89102
702/870-8771

NEVADA PROFESSIONAL ENGINEER — RICHARD BAUGHMAN — CIVIL — 7-13-87 — No. 2162

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CLARK COUNTY, NEVADA

MEMO

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NO REPLY REQUIRED

... Drainage Mgt ... 6/30/87

TO: Enwright & Thomas, Inc ... Sahara Towne ... 85-06-7-85

MESSAGE: The original drainage study is not approved. A contingency will be established to the storm drain will be required. Specifically, less than half the site drains to the Sahara storm drain. Submit specific flows to be outlet in Karen Ave. with water surface profiles for those flows. An agreement to participate in a storm drain to be constructed in Maryland Parkway ... will be required. In the future please include 10, 25, and 100 year flows for pre and post development with the associated calculations in your drainage studies.

REPLY

RECEIVED JUL 2 1987

Based on the Hydrology Study for Sahara Town Square dated June 16, 1987 and the Clark County Office of Storm Drainage Management Memo of June 30, 1987, the following analysis of the drainage pattern of the improved site has been prepared.

The site, after improvement, consists of seven sub-basins. Five of these basins (K-1, K-2, K-3, K-4 and K-5) will drain to Karen Avenue, while the remaining two basins (S-1 and S-2) drain to Sahara Avenue.

SUB-BASIN S-1 consists of 4.8 acres, including the roof drains from a portion of the proposed buildings, as shown on the drainage pattern map. It has the capability of generating runoffs of 8.5, 10.4 and 13.3 c.f.s. under the conditions of 10, 25 and 100 year event. The runoff from this area is concentrated at the Northeast corner of the site, and discharged into Sahara Avenue.

SUB-BASIN S-2 is a portion of the frontage along Sahara Avenue between Maryland Parkway and the center driveway of the project. It contains 0.6 acres, could generate runoffs of 1.2, 1.5 and 1.9 c.f.s. for the 10, 25 and 100 year storm. This runoff is concentrated at the center driveway and discharged into the Sahara Avenue curb line.

SUB-BASIN K-1 AND K-2 consist of 4.8 and 4.1 acres respectively. The potential runoff from these areas are 10.1, 12.4 and 15.8 c.f.s. each for the 10, 25 and 100 year events. These runoffs will be concentrated at the two "on-site" drop inlets shown on the improvement plans. Based on the unit hydrographs for these areas as compared to the flow rate of the 18" R.C.P. flowing to Karen Avenue (5.96 c.f.s.), ponding will be experienced during heavy rainfalls. Ponding in Area K-1 could reach an elevation of 1996.65 and 1996.75 during the 10 and 25 year event, as compared to a finish floor elevation of 1998.0 for the building. Area K-2 could pond to the elevation of 1996.8 and 1996.9 for the 10 and 25 year event. In the event of a 100 year storm, the ponding areas will overlap with a water surface elevation of 1997.25 feet. In the event of a malfunction of the 18" R.C.P. storm sewer, the center drive of the project fronting Sahara Avenue has been re-designed to drain from the 1997.0 elevation of the concrete valley to the center driveway on Sahara Avenue.

SUB-BASIN K-3 contains 0.3 acres and is located at the Karen Avenue/Maryland Parkway intersection. It has the potential to generate a runoff of 1.4, 1.7 and 2.2 c.f.s. under the conditions of the 10, 25 and 100 year storms. The runoff is concentrated at the most Westerly driveway on Karen Avenue and is discharged into Karen Avenue.

SUB-BASINS K-4 AND K-5 include 1.1 and 1.6 acres respectively and could generate identical runoffs of 3.7, 4.6 and 5.8 c.f.s. under the standard events. Area K-5 includes the roof drain not included in Area S-1. Both K-4 and K-5 discharge into Karen Avenue at the Southeast corner of the project.

SAHARA TOWNE SQUARE

STORM WATER RUNOFF (24 HR PRECIPITATION)
(IMPROVED - AFTER DEVELOPMENT)

DRAINAGE BASIN NO	AREA (acres)	CN	Tc (hr)	PEAK Q cfs/in	RUNOFF DEPTH (in) 10Yr	25Yr	100Yr	RUNOFF(cfs) 10Yr	25Yr	100Yr
K-1	4.8	98	.19	5.9	1.77	2.17	2.78	10.1	12.4	15.8
K-2	4.1	98	.14	5.7	1.77	2.17	2.78	10.1	12.4	15.8
K-3	0.3	98	.04	0.8	1.77	2.17	2.78	1.4	1.7	2.2
K-4	1.1	98	.05	2.1	1.77	2.17	2.78	1.7	4.6	5.8
K-5	1.6	98	.13	2.1	1.77	2.17	2.78	3.7	4.6	5.8
S-1	4.8	98	.18	4.8	1.77	2.17	2.78	8.5	10.4	13.3
S-2	0.6	98	.07	0.7	1.77	2.17	2.78	1.2	1.5	1.9

SAHARA TOWNE SQUARE

TIME OF CONCENTRATION

DRAINAGE BASIN NO.	HYD. LENGTH (feet)	SLOPE (%)	VELOCITY ft/sec	Tc Sec.	Tc Hrs.
K-1	536	0.62	0.77	697	0.19
K-2	487	1.07	0.99	491	0.14
K-3	101	1.06	0.72	140	0.04
K-4	221	2.36	1.27	175	0.05
K-5	277	0.51	0.61	453	0.13
S-1	480	0.60	0.76	668	0.18
S-2	154	0.69	0.63	245	0.07

SAHARA TOWNE SQUARE

AREA K-1 HYDROGRAPH

Tc=0.19 Q10=10.1 c.f.s. Q25=12.4 c.f.s. Q100= 15.8 c.f.s.

TIME	Q10	Q25	Q100
0.02	0.3	0.4	0.5
0.04	1.0	1.2	1.6
0.06	1.9	2.4	3.0
0.08	3.1	3.8	4.9
0.10	4.7	5.8	7.4
0.11	6.7	8.2	10.4
0.13	8.3	10.2	13.0
0.15	9.4	11.5	14.7
0.17	10.0	12.3	15.6
0.19	10.1	12.4	15.8
0.21	10.0	12.3	15.6
0.23	9.4	11.5	14.7
0.25	8.7	10.7	13.6
0.27	7.9	9.7	12.3
0.29	6.9	8.4	10.7
0.30	5.7	6.9	8.8
0.32	4.6	5.7	7.3
0.34	3.9	4.8	6.2
0.36	3.3	4.1	5.2
0.38	2.8	3.5	4.4
0.42	2.1	2.6	3.3
0.46	1.5	1.8	2.3
0.49	1.1	1.3	1.7
0.53	0.8	1.0	1.2
0.57	0.6	0.7	0.9
0.61	0.4	0.5	0.6
0.65	0.3	0.4	0.5
0.68	0.2	0.3	0.3
0.72	0.2	0.2	0.2
0.76	0.2	0.1	0.2
0.86	0.1	0.1	0.1
0.95	0	0	0

SAHARA TOWNE SQUARE

AREA K-2 HYDROGRAPH

Tc=0.14 Q10=10.1 c.f.s. Q25=12.4 c.f.s. Q100= 15.8 c.f.s.

TIME	Q10	Q25	Q100
0.01	0.1	0.4	0.5
0.03	1.0	1.2	1.6
0.04	1.9	2.4	3.0
0.06	3.1	3.8	4.9
0.07	4.7	5.8	7.4
0.08	6.7	8.2	10.4
0.10	8.3	10.2	13.0
0.11	9.4	11.5	14.7
0.13	10.0	12.3	15.6
0.14	10.1	12.4	15.8
0.15	10.0	12.3	15.6
0.17	9.4	11.5	14.7
0.18	8.7	10.7	13.6
0.20	7.9	9.7	12.3
0.21	6.9	8.4	10.7
0.22	5.7	6.9	8.8
0.24	4.6	5.7	7.3
0.25	3.9	4.8	6.2
0.27	3.3	4.1	5.2
0.28	2.8	3.5	4.4
0.31	2.1	2.6	3.3
0.34	1.5	1.8	2.3
0.36	1.1	1.3	1.7
0.39	0.8	1.0	1.2
0.42	0.6	0.7	0.9
0.45	0.4	0.5	0.6
0.48	0.3	0.4	0.5
0.50	0.2	0.3	0.3
0.53	0.2	0.2	0.2
0.56	0.1	0.1	0.2
0.63	0.1	0.1	0.1
0.70	0	0	0

SAHARA TOWNE SQUARE
DETENTION VOLUME COMPARISON
10-YEAR FREQUENCY

TIME	INFLOW: K-1 FLOW RATE	K-1 VOLUME	K-2 FLOW RATE	K-2 VOLUME	TOTAL VOLUME	OUTFLOW VOLUME @ 5.96 c.f.s.	DETAINED VOLUME
0	0		0				
		10.8		25.2	36.0	600.3	
.02	0.3		0.7				
		46.8		93.6	140.4	600.3	
.04	1.0		1.9				
		104.4		180.0	284.4	600.3	
.06	1.9		3.1				
		180		352.8	532.8	600.3	
.08	3.1		4.7				132.5
		280.8		540.0	820.8	600.3	
.10	4.7		6.3				553.0
		410.4		637.2	1047.6	600.3	
.11	6.7		8.4				1200.3
		540.0		698.4	1238.4	600.3	
.13	8.3		10.0				2038.4	
		637.2		720.0	1357.2	600.3	
.15	9.4		10.0				2795.3
		698.4		698.4	1396.8	600.3	
.17	10.0		9.4				3591.8
		723.6		637.2	1360.8	600.3	
.19	10.1		8.3				4957.3
		723.6		547.2	1270.8	600.3	
.21	10.0		6.9				5822.8
		698.4		435.6	1134.0	600.3	
.23	9.4		5.2				6556.5
		651.6		327.6	979.2	600.3	
.25	8.7		3.9				7135.4
		597.6		259.2	856.8	600.3	
.27	7.9		3.3				7501.9
		532.8		212.4	745.2	600.3	
.29	6.9		2.6				7936.8
		453.6		176.4	630.0	600.3	
.30	5.7		2.3				8166.5
		370.8		151.2	522.0	600.3	
.32	4.6		1.9				8288.2
		306.0		129.6	435.6	600.3	
.34	3.9		1.7				8322.5
		259.2		100.8	360.0	600.3	
.36	3.3		1.1				8283.2
		439.2		144.0	583.2	800.6	
.38	2.8		0.9				8065.8
		352.8		108.0	460.8	800.6	
.42	2.1		0.6				7726.0
		259.2		64.8	324.0	800.6	
.46	1.5		0.3				7249.4
		187.2		36.0	223.2	800.6	
.49	1.1		0.2				6672.0

NOT LEGIBLE FOR MICROFILMING

TIME	INFLOW K-1 FLOW RATE	INFLOW K-1 VOLUME	INFLOW K-2 FLOW RATE	INFLOW K-2 VOLUME	INFLOW TOTAL VOLUME	OUTFLOW VOLUME @ 0.08 c.f.s.	DETAINED VOLUME *
.49	1.1		0.2				4622.8
.53	0.8	136.8		28.8	165.6	800.6	4037.8
.57	0.6	100.8	0.2	21.6	122.4	800.6	3358.8
.61	0.4	72.0	0.1	7.2	79.2	800.6	2637.4
.65	0.3	50.4	0	0	50.4	800.6	1887.2
.68	0.2	36.0	0	0	36.0	800.6	1122.6
.72	0.2	28.8	0	0	28.8	800.6	350.8
.76	0.1	21.6	0	0	21.6	800.6	1571.8
.86	0.1	36.0	0	0	36.0	2001.6	0
.95	0	18.0	0	0	18.0	2001.6	0

TOTAL HOLDING TIME = 0.86 - 0.08 = 0.78 HRS

SAHARA TOWNE SQUARE
DETENTION VOLUME COMPARISON
25 YEAR FREQUENCY

TIME	INFLOW K-1 FLOW RATE	INFLOW K-1 VOLUME	INFLOW K-2 FLOW RATE	INFLOW K-2 VOLUME	INFLOW TOTAL VOLUME	OUTFLOW VOLUME @ 0.08 c.f.s.	DETAINED VOLUME *
0	0						
.02	0.4	14.4	0.2	25.2	39.6	800.6	
.04	1.2	57.6	0.2	111.6	169.2	800.6	
.06	2.4	129.6	0.4	223.2	352.8	800.6	
.08	3.8	223.2	0.8	432.0	655.2	800.6	254.6
.10	5.8	345.6	1.2	662.4	1008.0	800.6	862.6
.11	8.2	504.0	1.5	781.2	1285.2	800.6	1747.2
.13	10.2	662.4	1.8	856.8	1519.2	800.6	2866.8
.15	11.5	781.2	2.1	885.6	1666.8	800.6	4133.0
.17	12.3	856.8	2.3	856.8	1713.6	800.6	5446.2
.19	12.6	889.2	2.5	781.2	1670.4	800.6	6716.0
.21	12.3	885.6	2.6	684.6	1483.2	800.6	7398.7
.23	11.5	856.8	2.7	529.2	1386.0	800.6	8784.0
.25	10.7	799.2	2.8	399.6	1198.8	800.6	9583.4
.27	9.7	734.4	2.9	320.4	1054.8	800.6	10237.8
.29	8.4	651.6	3.0	262.8	914.4	800.6	10752.0
.30	6.9	550.8	3.1	219.6	770.4	800.6	11322.1
.32	5.7	453.6	3.2	187.2	640.8	800.6	11367.6
.34	4.8	378.0	3.3	147.6	525.6	800.6	11487.0
.36	4.1	320.4	3.4	111.6	432.0	800.6	11519.6
.38	3.5	547.2	3.5	172.8	720.0	800.6	11439.0
.42	2.6	439.2	3.6	129.6	568.8	800.6	11207.2
.46	1.8	316.8	3.7	86.4	403.2	800.6	10809.8
.49	1.3	223.2	3.8	64.8	288.0	800.6	10297.2

TIME	INFLOW K-1 FLOW RATE	INFLOW K-1 VOLUME	INFLOW K-2 FLOW RATE	INFLOW K-2 VOLUME	INFLOW TOTAL VOLUME	OUTFLOW VOLUME @ 0.08 c.f.s.	DETAINED VOLUME *
.49	1.3	165.6	0.4	43.2	208.8	800.6	10297.2
.53	1.0	122.4	0.2	21.6	144.0	800.6	9705.4
.57	0.7	86.4	0.1	14.4	100.8	800.6	9068.8
.61	0.5	64.8	0.1	7.2	72.0	800.6	8369.0
.65	0.4	50.4	0	0	50.4	800.6	7620.4
.68	0.3	36.0	0	0	36.0	800.6	6870.2
.72	0.2	21.6	0	0	21.6	800.6	6105.6
.76	0.1	36.0	0	0	36.0	2001.6	5326.4
.86	0.1	18.0	0	0	18.0	2001.6	4562.0
.95	0		0				3779.4

3779.4 ÷ 5.56 = 679.7" ÷ 3600 = 0.19 HRS

TOTAL HOLDING TIME = 0.95 - 0.08 + 0.19 = 1.06 HRS

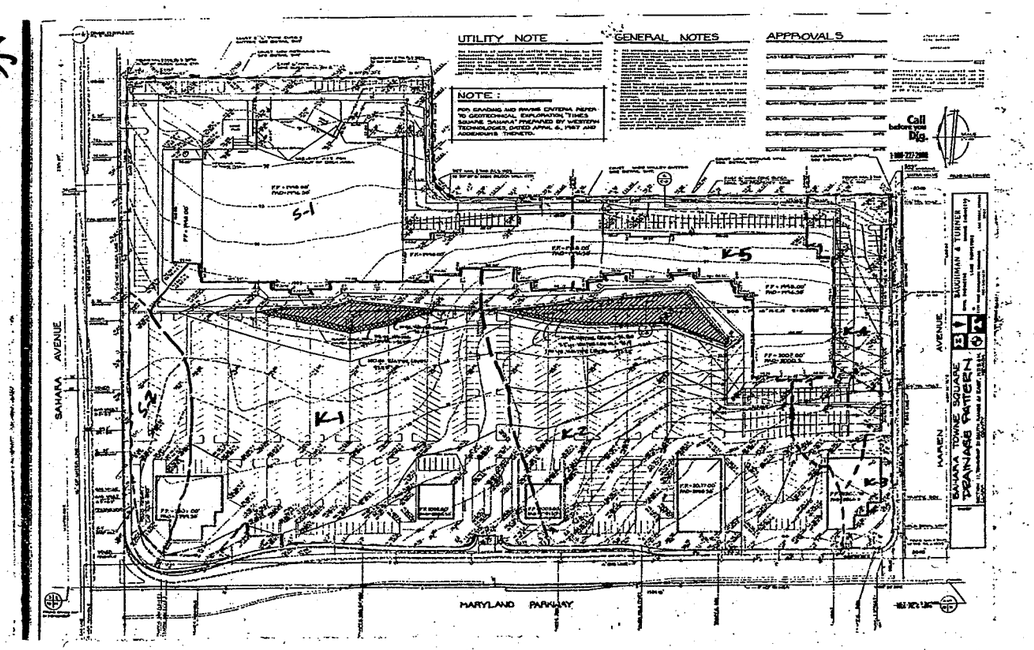
SAHARA TOWNE SQUARE
DETENTION VOLUME COMPARISON
100 YEAR FREQUENCY

TIME	INFLOW K-1 FLOW RATE	INFLOW K-1 VOLUME	INFLOW K-2 FLOW RATE	INFLOW K-2 VOLUME	INFLOW TOTAL VOLUME	OUTFLOW VOLUME @ 0.08 c.f.s.	DETAINED VOLUME *
0	0		0				
.02	0.5	18.0	1.1	39.6	57.6	800.3	
.04	1.6	75.6	3.0	147.6	223.2	800.3	49.7
.06	3.0	165.6	4.9	286.4	450.0	800.3	484.6
.08	4.9	284.4	10.6	550.8	835.2	800.3	1369.5
.10	7.4	462.8	13.0	842.4	1285.2	800.3	2607.2
.11	10.4	660.0	14.7	997.2	1638.0	800.3	4140.1
.13	13.0	842.4	15.6	1090.8	1933.2	800.3	5860.2
.15	14.7	997.2	15.6	1123.2	2120.4	800.3	7641.5
.17	15.6	1090.8	14.7	1090.8	2181.6	800.3	9368.8
.19	15.8	1130.4	13.0	997.2	2127.6	800.3	10952.1
.21	15.6	1130.4	10.7	853.2	1983.6	800.3	12339.4
.23	14.7	1090.8	8.1	676.8	1767.6	800.3	13452.7
.25	13.6	1018.8	6.7	516.8	1535.6	800.3	14395.2
.27	12.3	932.4	5.2	410.4	1342.8	800.3	15154.1
.29	10.7	828.0	4.0	331.2	1159.2	800.3	15733.0
.30	8.8	702.0	3.7	277.2	979.2	800.3	16153.5
.32	7.3	579.6	3.0	241.2	820.8	800.3	16430.0
.34	6.2	486.0	2.7	190.8	676.8	800.3	16586.1
.36	5.2	410.4	1.7	144.0	554.4	800.3	16697.9
.38	4.4	491.2	1.4	223.2	914.4	800.6	16617.3
.42	3.3	554.4	0.9	165.6	720.0	800.6	16327.9
.46	2.3	403.2	0.6	108.0	511.2	800.6	

TIME	INFLOW K-1 FLOW RATE	INFLOW K-1 VOLUME	INFLOW K-2 FLOW RATE	INFLOW K-2 VOLUME	INFLOW TOTAL VOLUME	OUTFLOW VOLUME @ 0.08 c.f.s.	DETAINED VOLUME *
.46	2.3		0.6				16327.9
.49	1.7	288.0	0.4	72.0	360.0	800.6	15887.3
.53	1.2	208.8	0.2	43.2	252.0	800.6	15338.7
.57	0.9	151.2	0.2	28.2	180.0	800.6	14718.1
.61	0.6	108.0	0.2	21.6	129.6	800.6	14047.1
.65	0.5	79.2	0.1	14.4	93.6	800.6	13340.1
.68	0.3	57.6	0.1	7.2	64.8	800.6	12604.3
.72	0.2	36.0	0	0	36.0	800.6	11839.7
.76	0.2	28.8	0	0	28.8	800.6	11067.9
.86	0.1	54.0	0	0	54.0	2001.6	9120.3
.95	0	18.0	0	0	18.0	2001.6	7136.7

7136.7 ÷ 5.56 = 1283.6" ÷ 3600 = 0.36 HRS

TOTAL HOLDING TIME = 0.95 - 0.08 + 0.36 = 1.23 HRS



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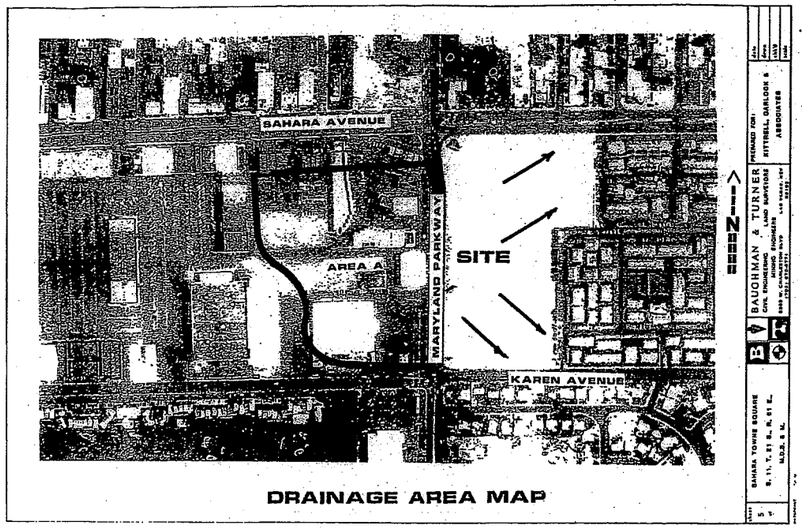
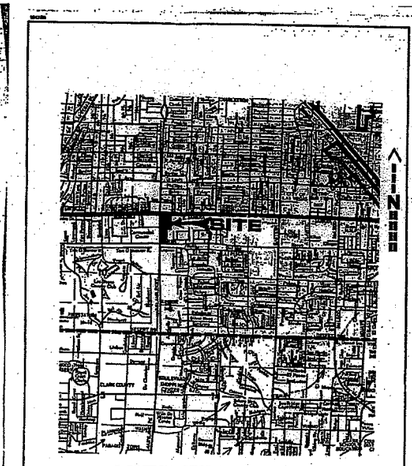


DRAINAGE AREA MAP

BAUGHMAN & TURNER
CIVIL ENGINEERS — LAND SURVEYORS — MINING ENGINEERS
PREPARED FOR: RITTENELL GARLOCK & ASSOCIATES
SAHARA TOWNE SQUARE
S. 11, T. 21 S., R. 61 E., M.D.B. & M.



VICINITY MAP

BAUGHMAN & TURNER
CIVIL ENGINEERS — LAND SURVEYORS — MINING ENGINEERS
PREPARED FOR: SAHARA TOWNE SQUARE
S. 11, T. 21 S., R. 61 E., M.D.B. & M.

ARNOLD-PACIFIC

STORM WATER RUNOFF (24 Hr PRECIPITATION)
(FUTURE DEVELOPMENT - AFTER DEVELOPMENT)

POINT OF CONCENTRATION	BASIN NO	AREA (acres)	Tc (hr)	I (in/hr)	RUNOFF COEFFICIENT 10YR	25YR	100YR	RUNOFF (cfs) 10YR	25YR	100YR
A		15.8	91	.38	14.9	1.77	2.17	2.77	26.4	32.3	41.5
PIPE		16.5	00	.41	17.2	1.77	2.17	2.77	30.4	37.3	47.6

ARNOLD-PACIFIC

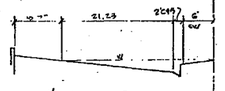
PIPE OR CONCENTRATION (AFTER DEVELOPMENT)

DRAINAGE PATH NO	PIPE LENGTH (feet)	SLOPE (S)	VELOCITY ft/sec	Tc sec	Tc hrs
A	1004	.5	.7	1367	.38
PIPE	1125	.4	1	1116	.31

ARNOLD-PACIFIC

PIPE OR CONCENTRATION (AFTER DEVELOPMENT)

DRAINAGE PATH NO	PIPE LENGTH (feet)	SLOPE (S)	VELOCITY ft/sec	Tc sec	Tc hrs
A	1004	.5	.7	1367	.38
PIPE	1125	.4	1	1116	.31



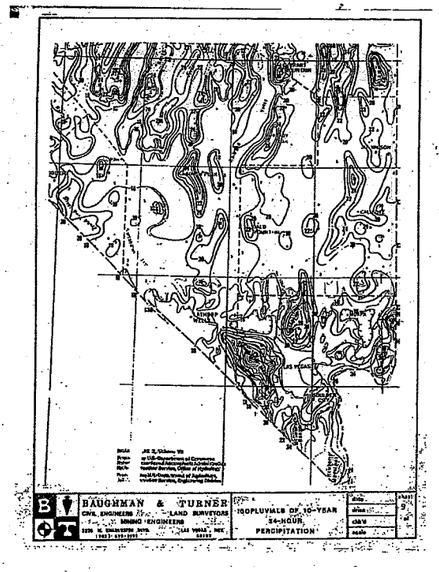
$A = 6.31$ s.f.
$P = 7.68$ LF
$r = 0.21$
$n = 0.020$
$s = 0.0160$

$V = \frac{1.486}{0.020} \times 0.21^{\frac{2}{3}} \times 0.016^{\frac{1}{2}} = 8.35$ ft/sec

$Q = 8.35 \times 6.31 = 21.12$ cfs $+ 2 = 42.25 > 41.3$ cfs

MARYLAND PARKWAY
STREET FLOW CALCULATIONS

APPENDIX



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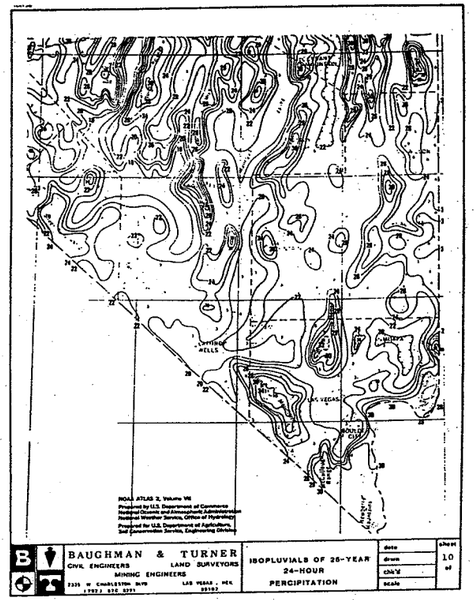
100-YEAR 24-HOUR PRECIPITATION



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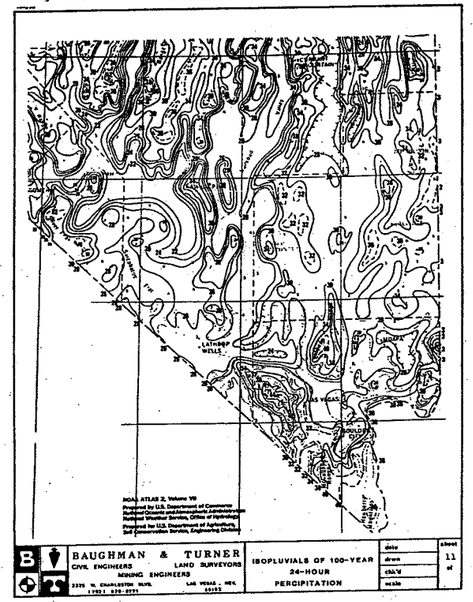
MINING ENGINEERS
3325 W. CHARLESTON BLVD. LAS VEGAS, NEV. 89102
(702) 870-8291

ISOPLUVIALS OF 25-YEAR 24-HOUR PERCIPITATION

date | drawn | ch'k'd | scale | sheet 10 of



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ISOPLUVIALS OF 100-YEAR 24-HOUR PERCIPITATION

date | drawn | ch'k'd | scale | sheet 11 of

Table 2-2.—Runoff curve numbers for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and I_a = 0.2S)

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP A	B	C	D
Cultivated land[1]: without conservation treatment	72	81	88	91
: with conservation treatment	62	71	78	81
Pasture or range land: poor condition	68	79	86	89
good condition	39	61	74	80
Meadow: good condition	30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch	45	66	77	83
good cover[2]	25	55	70	77
Open spaces, lawns, parks, golf courses, cemeteries, etc. good condition: grass cover on 75% or more of the area	39	61	74	80
fair condition: grass cover on 50% to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious).	81	88	91	93
Residential:[3]				
Average lot size — Average % impervious[4]				
1/8 acre or less — 65	77	85	90	92
1/4 acre — 38	61	75	83	87
1/3 acre — 30	57	72	81	86
1/2 acre — 25	54	70	80	85
1 acre — 20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5]	98	98	98	98
Streets and roads:				
paved with curbs and storm sewers[6]	98	98	98	98
gravel	76	85	89	91
dirt	72	82	87	89

[1] For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

[2] Good cover is protected from grazing and litter and brush cover soil.

[3] Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of road water directed to lawns where additional infiltration could occur.

[4] The remaining pervious areas (lawns) are considered to be in good pasture condition for these curve numbers.

[5] In some warmer climates of the country a curve number of 95 may be used.

then computed by dividing the total overland flow length by the average velocity.

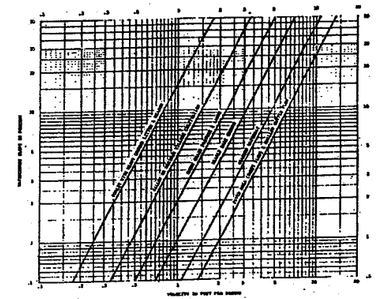


Figure 3-1.—Average velocities for estimating travel time for overland flow.

Storm sewer or road gutter flow

Travel time through the storm sewer or road gutter system to the main open channel is the sum of travel times in each individual component of the system between the uppermost inlet and the outlet. In most cases average velocities can be used without a significant loss of accuracy. During major storm events, the sewer system may be fully taxed and additional overland flow may occur, generally at a significantly lower velocity than the flow in the storm sewers. By using average conduit sizes and an average slope (excluding any vertical drops in the system), the average velocity can be estimated using Manning's formula.

Since the hydraulic radius of a pipe flowing half full is the same as when flowing full, the respective velocities are equal. Travel time may

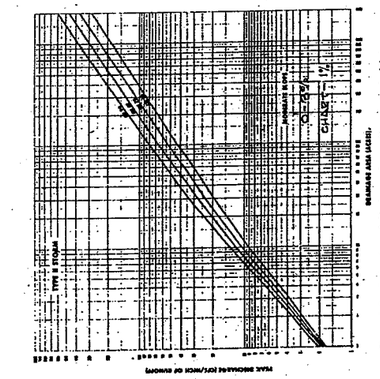


Figure 2-2.—Peak rates of discharge for small watersheds (24-hour, type-II storm distribution). Sheet 2 of 3

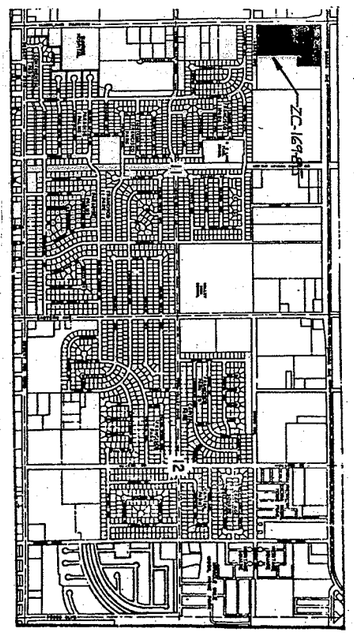
Table E-1.—Slope adjustment factors by drainage areas

Slope (percent)	10 acres	20 acres	50 acres	100 acres	200 acres	500 acres	1,000 acres	2,000 acres
FLAT SLOPES								
0.1	0.49	0.47	0.44	0.43	0.42	0.41	0.41	0.40
0.2	.61	.59	.56	.55	.54	.53	.53	.52
0.3	.69	.67	.65	.64	.63	.62	.62	.61
0.4	.76	.74	.72	.71	.70	.69	.69	.69
0.5	.82	.80	.78	.77	.77	.76	.76	.76
0.6	.90	.89	.88	.87	.87	.87	.87	.87
0.8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.0	1.13	1.14	1.14	1.15	1.16	1.17	1.17	1.17
1.5	1.21	1.24	1.26	1.28	1.29	1.30	1.31	1.31
MODERATE SLOPES								
3	.93	.92	.91	.90	.90	.90	.89	.89
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.04	1.05	1.07	1.08	1.08	1.08	1.09	1.09
6	1.07	1.10	1.12	1.14	1.15	1.16	1.17	1.17
7	1.09	1.13	1.18	1.21	1.22	1.23	1.23	1.24
STEEP SLOPES								
8	.92	.88	.84	.81	.80	.78	.78	.77
9	.94	.90	.86	.84	.83	.82	.81	.81
10	.96	.92	.88	.87	.86	.85	.84	.84
11	.96	.92	.91	.90	.89	.88	.87	.87
12	.97	.93	.93	.92	.91	.90	.90	.90
13	.97	.97	.95	.94	.93	.93	.93	.93
14	.98	.98	.97	.96	.96	.96	.95	.95
15	.99	.99	.99	.98	.98	.98	.98	.98
16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	1.03	1.04	1.03	1.06	1.07	1.08	1.09	1.10
20	1.06	1.08	1.12	1.14	1.15	1.16	1.17	1.19
22	1.09	1.11	1.14	1.17	1.20	1.22	1.23	1.24
24	1.12	1.16	1.20	1.24	1.28	1.31	1.33	1.33
26	1.17	1.21	1.25	1.29	1.34	1.37	1.40	1.43

Table 2-1.—Runoff depth in inches for selected CN's and rainfall amounts

Rainfall (inches)	Curve Number (CN) 80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
1.4	0.34	0.38	0.41	0.45	0.48	0.52	0.57	0.62	0.66	0.71	0.76	0.83	0.90	0.97	1.04	1.11	1.20	1.29	1.38
1.7	0.40					0.59					0.84					1.20			1.48
1.9	0.45					0.66					0.93					1.30			1.58
2.1	0.51					0.73					1.01					1.39			1.67
10yr																			
24hr																			
2.0	0.56	0.61	0.66	0.70	0.75	0.80	0.86	0.92	0.97	1.03	1.09	1.17	1.25	1.32	1.40	1.48	1.58	1.67	1.77
2.1	0.63					0.88					1.18					1.58			1.97
2.3	0.69					0.95					1.27					1.67			1.97
2.5	0.76					1.03					1.35					1.77			2.07
25yr																			
24hr																			
2.5	0.82	0.88	0.92	0.99	1.04	1.10	1.17	1.24	1.31	1.37	1.44	1.52	1.61	1.69	1.78	1.86	1.97	2.07	2.17
2.8	0.89					1.18					1.53					1.96			2.27
3.0	0.96					1.26					1.62					2.06			2.37
50yr																			
24hr																			
2.8	1.03	1.09	1.15	1.22	1.28	1.34	1.42	1.49	1.56	1.64	1.71	1.80	1.89	1.98	2.07	2.16	2.26	2.37	2.47
3.1	1.11					1.43					1.80					2.25			2.57
3.3	1.18					1.51					1.89					2.35			2.68
100yr																			
24hr																			
3.0	1.25	1.32	1.39	1.45	1.52	1.59	1.67	1.75	1.82	1.90	1.98	2.07	2.17	2.26	2.36	2.45	2.56	2.67	2.78

To obtain runoff depths for CN's and other rainfall amounts not shown in this table, use an arithmetic interpolation.



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