DRAFT FINAL DRAINAGE REPORT
FOR
STATE ROUTE 51
THUNDERBIRD ROAD
TO
BELL ROAD

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Volume 2 of 2
Appendixes

March, 1996

CONTRACT 95-50
TRACS No. H 4047 01C

PREPARED FOR:
ARIZONA DEPARTMENT OF TRANSPORTATION

PREPARED BY:

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
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LARRY STEVEN
MILLER
Date Signed 3-4-96
ARIZONA, U.S.A.

VOLUME 2
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Appendix D - On-site Hydraulics
- On-Site Storm Drain Trunkline Hydraulic Analysis (StormCAD)

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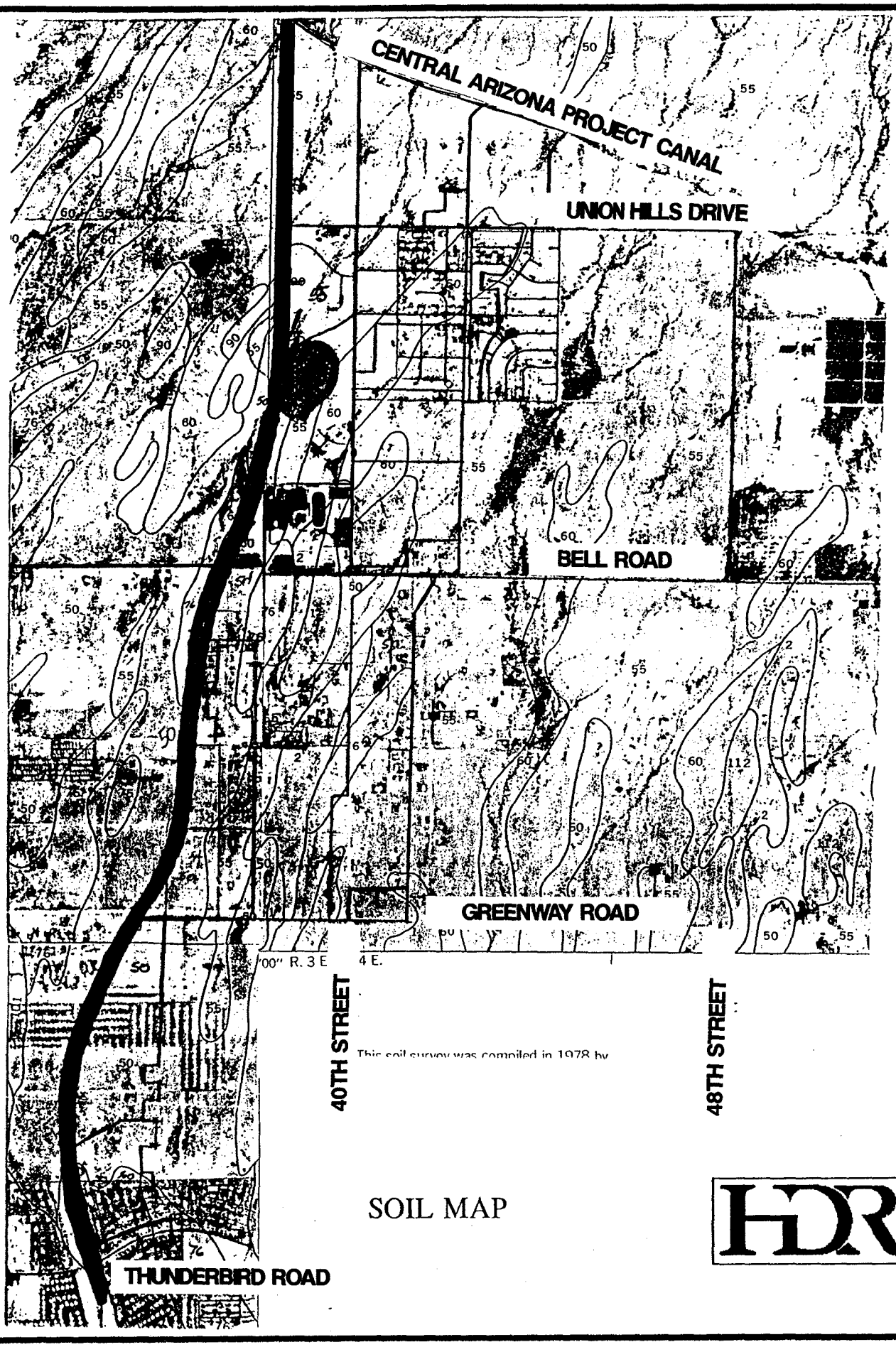
APPENDIX A

SOIL OF THE AGUILA-CAREFREE AREA SOIL SURVEY, Issued April, 1986

Map Symbol	Soil Name	USDA Texture	Unified Soil Class
1	Antho - Noncalcareous	Sandy Loam	SM
2	Antho - Noncalcareous	Gravelly Sandy Loam	SM
50	Estrella - Calcareous	Loam	CL-ML
55	Gilman - Noncalcareous	Loam	CL
60	Glenbar - Noncalcareous	Loam	ML,CL-ML
76	Mohall -	Clay Loam	CL



This soil survey was compiled in 1978 by

SOIL MAP

HDR

SQUAW PEAK
OFF-SITE DRAINAGE
Summary Table of Modeling Parameters for LG Record.

SUBBASIN ID	AREA (acres)	LAND USE								IA (in.)	DTHETA	PSIF (in.)	XKSAT (in/hr)	Percent Cover	Ck	XKSAT (Adjusted)	RTIMP	Retention Volume
		SF-(1/4)	SF-(1/3)	SF-(1/2)	SF-(1)	SF-(2)	MF	COMM	IND									
SR51UH	61.1	61.1								0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.30	10 ac-ft
UH40NE	79.1	63.3					15.8			0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.35	8.7 ac-ft
UN42NE	52.6	5.3					47.3			0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.52	10.0 ac-ft
SR51NP	38.2	0.0								0.35 **	0.25	3.5	0.25	<10%	1.00	0.25	0.00	
SR51SP	58.1									0.35 **	0.25 *	5.0 *	0.25 *	<10%	1.00	0.25	0.00	2.5 ac-ft
REL40E	61.0	48.8						12.2		0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.41	
CBD40E	108.9	92.6								0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.26	
SR51BN	11.0							11.0		0.05	0.25	3.5	0.25	<10%	1.00	0.25	0.85	2.0 ac-ft
BRPVHS	43.4							21.7		0.20	0.25 *	4.2 *	0.40 *	<10%	1.00	0.40	0.43	
BR40NE	53.7	18.8					26.9	8.1		0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.50	8.0 ac-ft
BLR40E	13.2							13.2		0.05	0.25	3.5	0.25	<10%	1.00	0.25	0.85	3.0 ac-ft
SR51BS	18.1							8.2		0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.38	2.0 ac-ft
SR51PR	5.6	5.6								0.35	0.25	3.5	0.25	<10%	1.00	0.25	0.30	
PDLN38	87.3	45.8					4.8	13.1		0.20	.26 *	3.8 *	0.60 *	<10%	1.00	0.54	0.31	8 ac-ft
BUEN37	52.6	25.2	27.3							0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.26	
GRWY36	37.8	1.9	35.9							0.35	0.25	4.95	0.26 *	<10%	1.00	0.26	0.22	
GRWY38	77.8	38.9	19.5							0.20	0.27 *	3.1 *	0.79 *	<10%	1.00	0.79	0.21	2.0 ac-ft
GWR40	20.4	5.1	5.1					10.2		0.20	0.25 *	4.9 *	0.29 *	<10%	1.00	0.27	0.56	4.0 ac-ft
GWR40N	104.6		99.3					5.2		0.35	0.25 *	4.8 *	0.28 *	<10%	1.00	0.28	0.25	
SR51NR	16.5	16.5								0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.3	
SR51GD	52.5	52.5								0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.3	
SR51LD	35.8	35.8								0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.3	
SR51TR	10.1	10.1								0.20	0.25	3.5	0.25	<10%	1.00	0.25	0.3	

* = Composite Value - See Subbasin Calculation Sheet.
** Park area - no connected impervious area

Retention Volumes

Subbasin ID	
SR51UH	Currently being developed
UH40NE	1/3 built out prior to 1988
UN42NE	
SR51SP	COP Parks & Rec Center built after 1988 (1/3 of area)
SR51BN	
BR40NE	80% built after 1988
BLR40E	
SR51BS	1/2 are flows to depressed areas with dry wells
PDLN38	
GRWY38	1/4 is park (COP) and new development
GWR40	

CALCULATE UNIT HYDROLGRAPH PARAMETERS FOR CLARK METHODOLOGY

SUBBASIN ID	AREA ac	AREA mi^2	L ft	Lca ft	ELEV U/S	ELEV D/S	SLOPE ft/ft	RTIMP %	Tc hr	R hr
SR51UH	61.1	0.095	4400	2200	1525	1502	0.00523	30%	0.36	0.39
UH40NE	79.1	0.124	3400	2000	1521	1505.5	0.00456	35%	0.33	0.25
UN42NE	52.6	0.082	2100	1400	1520	1504	0.00762	52%	0.20	0.13
SR51NP	38.2	0.060	2200	1000	1503	1478	0.01136	0%	0.42	0.35
SR51SP	58.1	0.091	3150	1400	1490	1470	0.00635	0%	0.59	0.53
REL40E	61.0	0.095	3700	2400	1506.5	1490	0.00446	41%	0.32	0.30
CBD40E	108.9	0.170	6200	3400	1509	1478.94	0.00485	26%	0.49	0.53
SR51BN	11.0	0.017	2450	1100	1475	1462.3	0.00518	85%	0.15	0.25
BRPVHS	43.4	0.068	2600	1950	1475	1463	0.00462	43%	0.26	0.22
BR40NE	53.7	0.084	3600	1750	1476	1465	0.00306	50%	0.28	0.28
BLR40E	13.2	0.021	1900	600	1470	1465	0.00263	85%	0.14	0.16
SR51BS	18.1	0.028	1650	880	1462	1454.5	0.00455	38%	0.18	0.17
SR51PR	5.6	0.009	1175	725	1452.7	1446	0.0057	30%	0.15	0.21
PDLN38	87.3	0.136	2000	1100	1466	1451	0.0075	31%	0.24	0.11
BUEN37	52.6	0.082	3600	1800	1455	1436.4	0.00517	26%	0.34	0.34
GRWY36	37.8	0.059	2700	1500	1438	1430.5	0.00278	22%	0.33	0.32
GRWY38	77.8	0.122	3200	950	1449	1433.34	0.00489	21%	0.32	0.23
GWR40	20.4	0.032	5900	3100	1469	1440.5	0.00483	56%	0.31	0.77
GWR40N	104.6	0.163	1300	600	1441	1439.5	0.00115	25%	0.27	0.08
SR51NR	16.5	0.026	1650	775	1430.1	1423.7	0.00388	30%	0.20	0.19
SR51GD	52.5	0.082	3100	1650	1428.5	1414	0.00468	30%	0.31	0.27
SR51LD	35.8	0.056	2750	1500	1415	1407.7	0.00265	30%	0.30	0.30
SR51TR	10.1	0.016	800	400	1409	1405	0.005	30%	0.13	0.09

ESTIMATE PEAK DISCHARGE BY RATIONAL METHOD

C	Kb	i	Tc hr	Tc min	Q cfs
0.65	0.025	6.09	0.18475	11.0852	65.43
0.65	0.025	5.25	0.25282	15.1694	179.16
0.65	0.025	4.9	0.29138	17.4826	113.90
0.65	0.040	6.25	0.15034	9.02036	41.03

'ARAMETERS FOR SR-51 HEC-1 MODELING

2-YEAR	Value	5-YEAR	Value	10-YEAR	Value	25-YEAR	Value	50-YEAR	Value	100-YEAR	Value
5-min	0.37	5-min	0.46	5-min	0.52	5-min	0.60	5-min	0.67	5-min	0.74
10-min	0.56	10-min	0.69	10-min	0.79	10-min	0.92	10-min	1.03	10-min	1.13
15-min	0.68	15-min	0.86	15-min	0.99	15-min	1.17	15-min	1.31	15-min	1.45
30-min	0.90	30-min	1.16	30-min	1.33	30-min	1.58	30-min	1.78	30-min	1.97
1-hr	1.10	1-hr	1.43	1-hr	1.65	1-hr	1.97	1-hr	2.22	1-hr	2.47
2-hr	1.16	2-hr	1.53	2-hr	1.79	2-hr	2.14	2-hr	2.42	2-hr	2.70
3-hr	1.20	3-hr	1.60	3-hr	1.88	3-hr	2.26	3-hr	2.56	3-hr	2.85
6-hr	1.27	6-hr	1.73	6-hr	2.04	6-hr	2.48	6-hr	2.82	6-hr	3.15
12-hr	1.32	12-hr	1.86	12-hr	2.21	12-hr	2.71	12-hr	3.09	12-hr	3.48
24-hr	1.37	24-hr	1.98	24-hr	2.39	24-hr	2.94	24-hr	3.37	24-hr	3.80

INPUT VALUE FROM NOAA ATLAS

HEC-1 Precipitation Input Card

	5-min	15-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
50-year								
PH	0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37
100-year								
PH	0.74	1.45	2.47	2.70	2.85	3.15	3.48	3.80

SR-51 SQUAW PEAK								
Routing Parameter Derivation								
Route from	Route to	Length	Elevation	Elevation	Slope	Type of routing		
			U/S	D/S				
Union Hills Dr & 40th St	SR-51 @ middle of Park	2200	1503.00	1478.00	0.0114	Channel		
SR-51 @ middle of Park	SR-51 @ Bell Road	3550	1478.00	1462.30	0.0044	Storm Drain		
NW corner of PVHS	SW corner of PVHS (Bell Rd)	1300	1470.00	1463.00	0.0054	Street Flow		
Robert E. Lee & 40th St.	Campo Bello & 40th St.	1100	1490.00	1478.94	0.0055	Street Flow *		
Union Hills & 42nd St.	Campo Bello & 40th St.	5500	1504.00	1478.94	0.0046	Street Flow - Inverted Crown		
Campo Bello & 40th St.	NW corner of PVHS	1400	1478.94	1470.00	0.0064	Shallow Wash Flow		
Bell Road & 40th St.	Bell Road & 38th St.	1350	1466.12	1462.80	0.0025	Street Flow		
Bell Road & 38th St.	SR-51 @ Bell Road	500	1462.80	1462.30	0.0010	Street Flow		
SR-51 @ Bell Road	SR-51 @ Phelps Rd.	1100	1462.30	1458.69	0.0033	Storm Drain		
SR-51 @ Phelps Rd.	SR-51 @ Paradise Lane	1600	1458.69	1453.45	0.0033	Storm Drain		
SR-51 @ Paradise Lane	SR-51 @ Tierra Buena	1300	1453.45	1449.19	0.0033	Storm Drain		
SR-51 @ Tierra Buena	SR-51 @ Greenway Rd.	1350	1449.19	1444.76	0.0033	Storm Drain		
Bell Road & 40th St.	Greenway & 40th St.	5300	1465.50	1440.60	0.0047	Street Flow		
Bell Road & 38th St.	Paradise Ln & 38th St.	2640	1463.00	1446.00	0.0064	Street Flow		
Paradise Ln & 40th St.	Greenway Rd. & 40th St.	2640	1446.00	1440.50	0.0021	Street Flow		
Greenway Rd. & 40th St.	Greenway Rd. & 38th St.	1350	1440.50	1433.40	0.0053	Street Flow		
Greenway Rd. & 38th St.	Greenway Rd. & 36th St.	1300	1433.40	1430.75	0.0020	Street Flow		
SR-51 @ Greenway Rd.	SR-51 @ Blanche Dr.	1250	1444.76	1440.66	0.0033	Storm Drain		
SR-51 @ Blanche Dr.	SR-51 @ Gelding Dr.	2275	1440.66	1433.20	0.0033	Storm Drain		
SR-51 @ Gelding Dr.	SR-51 @ Ludlow Dr.	1600	1433.20	1427.95	0.0033	Storm Drain		
36th St South of Bell Rd	SR51 So of Paradise Ln	3250	1459	1442.5	0.0051	Storm Drain - Use Ground Slope		
* Slope based on length of 2000 ft.								

Job No.	00173-118-044	No.

Computation

HDR

Project	SR – 51 Squaw Peak Highway	Computed LSM		Date	Aug. 8, '95
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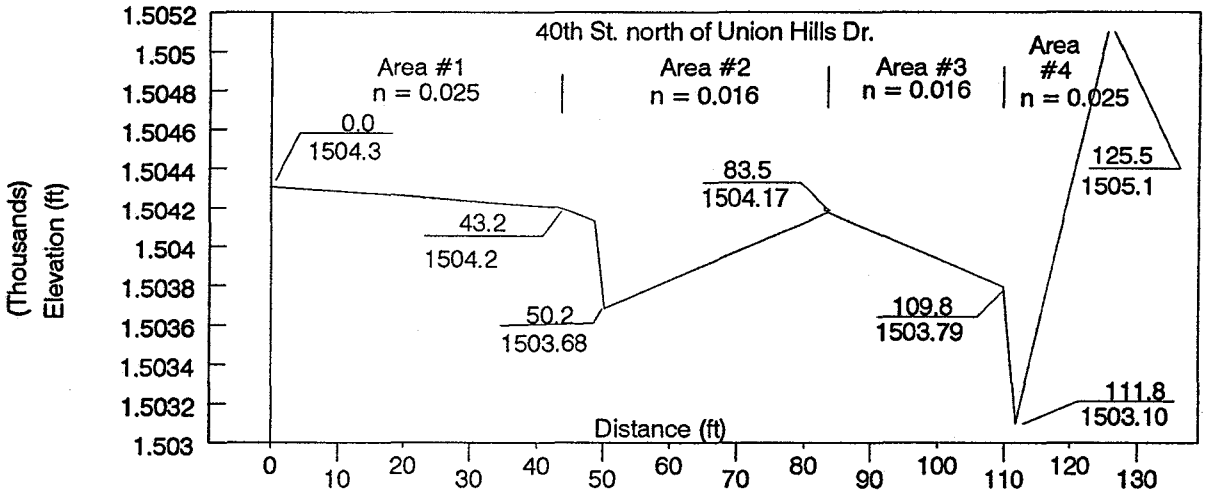
40th Street North of Union Hills
Surveyed Topographic Data

Point #	Distance	Elevation	Note
15	0	1504.3	NG
16	43.2	1504.2	S/W
17	48.7	1504.13	T/C
18	50.2	1503.68	G
19	83.5	1504.17	E/P
20	109.8	1503.79	E/P
21	111.8	1503.1	NG
22	125.5	1505.1	NG @ P/L



Area #4 Graphic ID: UH40N.PIC

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1503.10	0.00	0.00	0.025	0.00	0.00	0.0088	0.00	0
1503.68	5.65	1.64	0.025	5.65	0.29	0.0088	4.01	2.44
1503.79	6.73	2.32	0.025	6.73	0.35	0.0088	6.37	2.74
1504.13	9.06	5.00	0.025	9.06	0.55	0.0088	18.79	3.75
1504.17	9.33	5.37	0.025	9.33	0.58	0.0088	20.73	3.86
1504.20	9.54	5.65	0.025	9.54	0.59	0.0088	22.25	3.94
1504.30	10.22	6.64	0.025	10.22	0.65	0.0088	27.79	4.18
1505.10	15.70	17.01	0.025	15.70	1.08	0.0088	100.05	5.88

Area #3

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1503.10	0.00	0.00	0.016	0.00	0.00	0.0088	0.00	0
1503.68	0.00	0.00	0.016	0.00	0.00	0.0088	0.00	0.00
1503.79	0.00	0.00	0.016	0.00	0.00	0.0088	0.00	0.00
1504.13	23.53	4.00	0.016	23.53	0.17	0.0088	10.70	2.67
1504.17	26.30	5.00	0.016	26.30	0.19	0.0088	14.39	2.88
1504.20	26.30	5.79	0.016	26.30	0.22	0.0088	18.37	3.18
1504.30	26.30	8.42	0.016	26.30	0.32	0.0088	34.30	4.08
1505.10	26.30	29.46	0.016	26.30	1.12	0.0088	276.77	9.40

* Slope based on USGS topographic data

Computation

HDR

Project	SR – 51 Squaw Peak Highway	Computed LSM		Date	Aug. 8, '95
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Task	Intersection Evaluation – Union Hills & 40th Street	Sheet	2	Of	5

40th Street North of Union Hills

Area #2

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1503.10	0.00	0.00	0.016	0.00	0.00	0.0088	0.00	0
1503.68	0.00	0.00	0.016	0.00	0.00	0.0088	0.00	0.00
1503.79	7.84	0.43	0.016	7.84	0.05	0.0088	0.54	1.26
1504.13	32.08	7.22	0.016	32.08	0.23	0.0088	23.26	3.22
1504.17	35.02	8.56	0.016	35.02	0.24	0.0088	29.16	3.41
1504.20	35.18	9.61	0.016	35.18	0.27	0.0088	35.27	3.67
1504.30	35.18	13.13	0.016	35.18	0.37	0.0088	59.31	4.52
1505.10	35.18	41.28	0.016	35.18	1.17	0.0088	400.07	9.69

Area #1

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1503.10	0.00	0.00	0.025	0.00	0.00	0.0088	0.00	0
1503.68	0.00	0.00	0.025	0.00	0.00	0.0088	0.00	0.00
1503.79	0.00	0.00	0.025	0.00	0.00	0.0088	0.00	0.00
1504.13	0.00	0.00	0.025	0.00	0.00	0.0088	0.00	0.00
1504.17	0.00	0.00	0.025	0.00	0.00	0.0088	0.00	0.00
1504.20	0.00	0.00	0.025	0.00	0.00	0.0088	0.00	0.00
1504.30	43.20	2.16	0.025	43.20	0.05	0.0088	1.63	0.76
1505.10	43.20	36.72	0.025	43.20	0.85	0.0088	183.73	5.00

* Slope based on USGS topographic data

RATING CURVE FOR 40th STREET NORTH OF UNION HILLS DRIVE

Elev.	Q	Area	V
1503.10	0.00	0.00	0.00
1503.68	4.01	1.64	2.44
1503.79	6.91	2.75	2.51
1504.13	52.75	16.22	3.25
1504.17	64.27	18.93	3.40
1504.20	75.89	21.05	3.60
1504.30	123.04	30.35	4.05
1505.10	960.62	124.47	7.72

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Computation

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Project	SR – 51 Squaw Peak Highway	Computed LSM		Date	Aug. 8, '95
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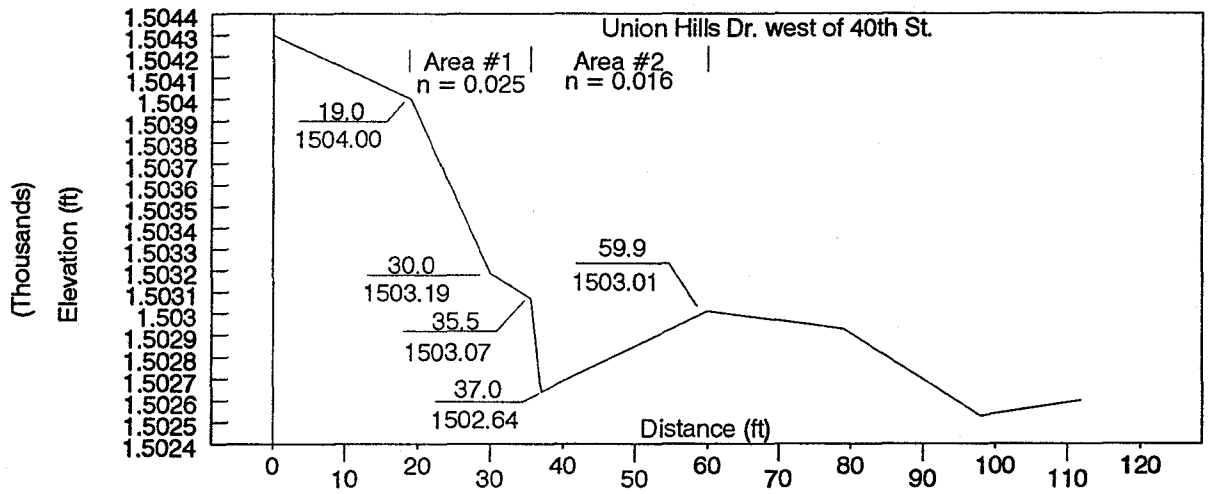
Union Hills Drive West of 40th Street
Surveyed Topographic Data

Point #	Distance	Elevation	Note
15	0	1504.3	NG
14	19	1504	NG
13	30	1503.19	S/W
12	35.5	1503.07	T/C
11	37	1502.64	G
10	59.9	1503.01	E/P
9	78.9	1502.93	C/L
8	97.9	1502.53	E/P
7	111.9	1502.6	NG



Area #2 Graphic ID: UH40W.PIC

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1502.64	0.00	0.00	0.016	0.00	0.00	0.0032	0.00	0
1503.01	24.19	4.48	0.016	24.19	0.18	0.0032	7.63	1.71
1503.07	24.40	5.25	0.016	24.40	0.21	0.0032	9.89	1.89
1503.19	29.90	8.22	0.016	29.90	0.27	0.0032	18.27	2.22

* Slope based on USGS topographic data

NOTE: At elevations greater than 1503.01, storm water overtops Union Hills Drive and flows to the south. Area #2 is the ditch along the north side of Union Hills Drive. This intersection is presently under construction.

Job No.	00173-118-044	No.

Computation

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Project	SR – 51 Squaw Peak Highway	Computed LSM		Date	Aug. 8, '95
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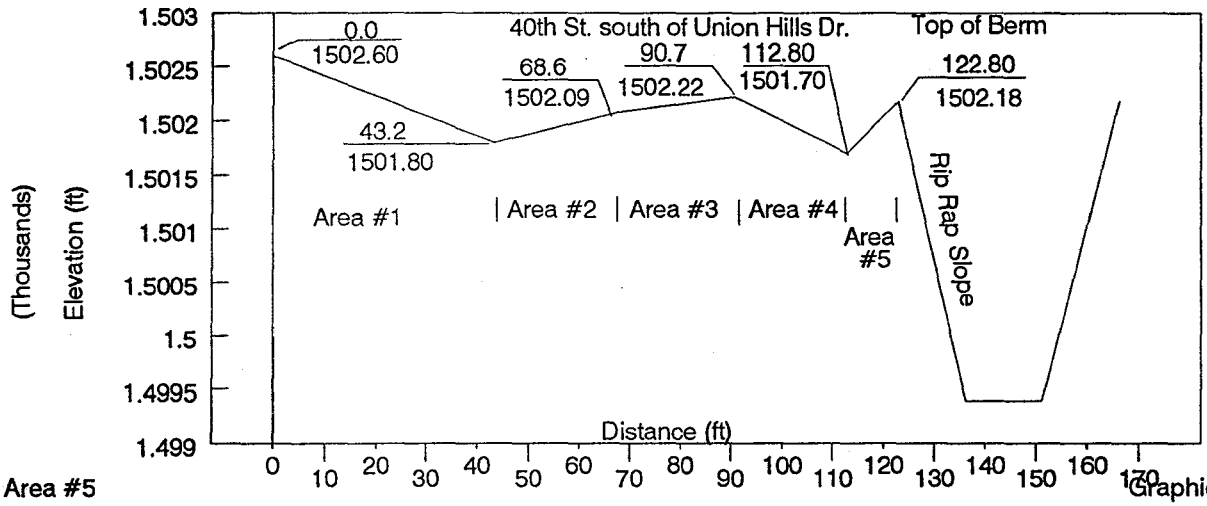
40th Street South of Union Hills
Surveyed Topographic Data

Point #	Distance	Elevation	Note
7	0	1502.6	NG
6	43.2	1501.8	NG
5	68.6	1502.09	E/P
4	90.7	1502.22	C/L
3	112.8	1501.7	E/P
2	122.8	1502.18	Berm Top
1	136.1	1499.38	Toe of Rip Rap Bank
**	151.1	1499.38	Estimated point
**	166.1	1502.18	Estimated point

** For pictorial purposes only



Graphic ID :UH40S.PIC

Area #5

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1501.70	0.00	0.00	0.025	0.00	0.00	0.0111	0.00	0
1501.80	2.08	0.10	0.025	2.08	0.05	0.0111	0.09	0.85
1502.09	8.12	1.58	0.025	8.12	0.19	0.0111	3.34	2.11
1502.18	10.00	2.40	0.025	10.00	0.24	0.0111	5.80	2.42
1502.22	10.00	2.80	0.025	10.00	0.28	0.0111	7.50	2.68
1502.60	10.00	7.00	0.025	10.00	0.70	0.0111	34.56	4.94

Area #4

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1501.70	0.00	0.00	0.016	0.00	0.00	0.0111	0.00	0
1501.80	4.25	0.21	0.016	4.25	0.00	0.0111	0.00	0.00
1502.09	16.57	3.23	0.016	16.57	0.00	0.0111	0.00	0.00
1502.18	20.40	4.90	0.016	20.40	0.24	0.0111	18.50	3.78
1502.22	22.10	5.75	0.016	22.10	0.26	0.0111	22.90	3.99
1502.60	22.10	14.14	0.016	22.10	0.64	0.0111	102.78	7.27

* Slope based on USGS topographic data

Job No. 00173-118-044

Computation

HDR

Project	SR – 51 Squaw Peak Highway	Computed LSM		Date	Aug. 8, '95
Subject	Hydrology Modeling	Checked		Date	
Task	Intersection Evaluation – Union Hills & 40th Street	Sheet	5	Of	5

40th Street South of Union Hills

Area #3

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1501.70	0.00	0.00	0.016	0.00	0.00	0.0111	0.00	0
1501.80	0.00	0.00	0.016	0.00	0.00	0.0111	0.00	0.00
1502.09	0.00	0.00	0.016	0.00	0.00	0.0111	0.00	0.00
1502.18	15.30	0.69	0.016	15.30	0.05	0.0111	0.85	1.24
1502.22	22.10	1.44	0.016	22.10	0.07	0.0111	2.27	1.58
1502.60	22.10	9.83	0.016	22.10	0.44	0.0111	56.09	5.70

Area #2

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1501.70	0.00	0.00	0.025	0.00	0.00	0.0111	0.00	0
1501.80	0.00	0.00	0.025	0.00	0.00	0.0111	0.00	0.00
1502.09	25.40	3.68	0.025	25.40	0.00	0.0111	0.00	0.00
1502.18	25.40	5.97	0.025	25.40	0.24	0.0111	14.23	2.38
1502.22	25.40	9.27	0.025	25.40	0.37	0.0111	29.65	3.20
1502.60	25.40	22.23	0.025	25.40	0.88	0.0111	127.33	5.73

Area #1

Elev.	Top Width	Area	n	WP	R	s*	Q	V
1501.70	0.00	0.00	0.025	0.00	0.00	0.0111	0.00	0
1501.80	0.00	0.00	0.025	0.00	0.00	0.0111	0.00	0.00
1502.09	15.66	2.27	0.025	15.66	0.00	0.0111	0.00	0.00
1502.18	20.52	3.90	0.025	20.52	0.19	0.0111	8.07	2.07
1502.22	22.68	4.76	0.025	22.68	0.21	0.0111	10.54	2.21
1502.60	43.20	17.28	0.025	43.20	0.40	0.0111	58.75	3.40

* Slope based on USGS topographic data

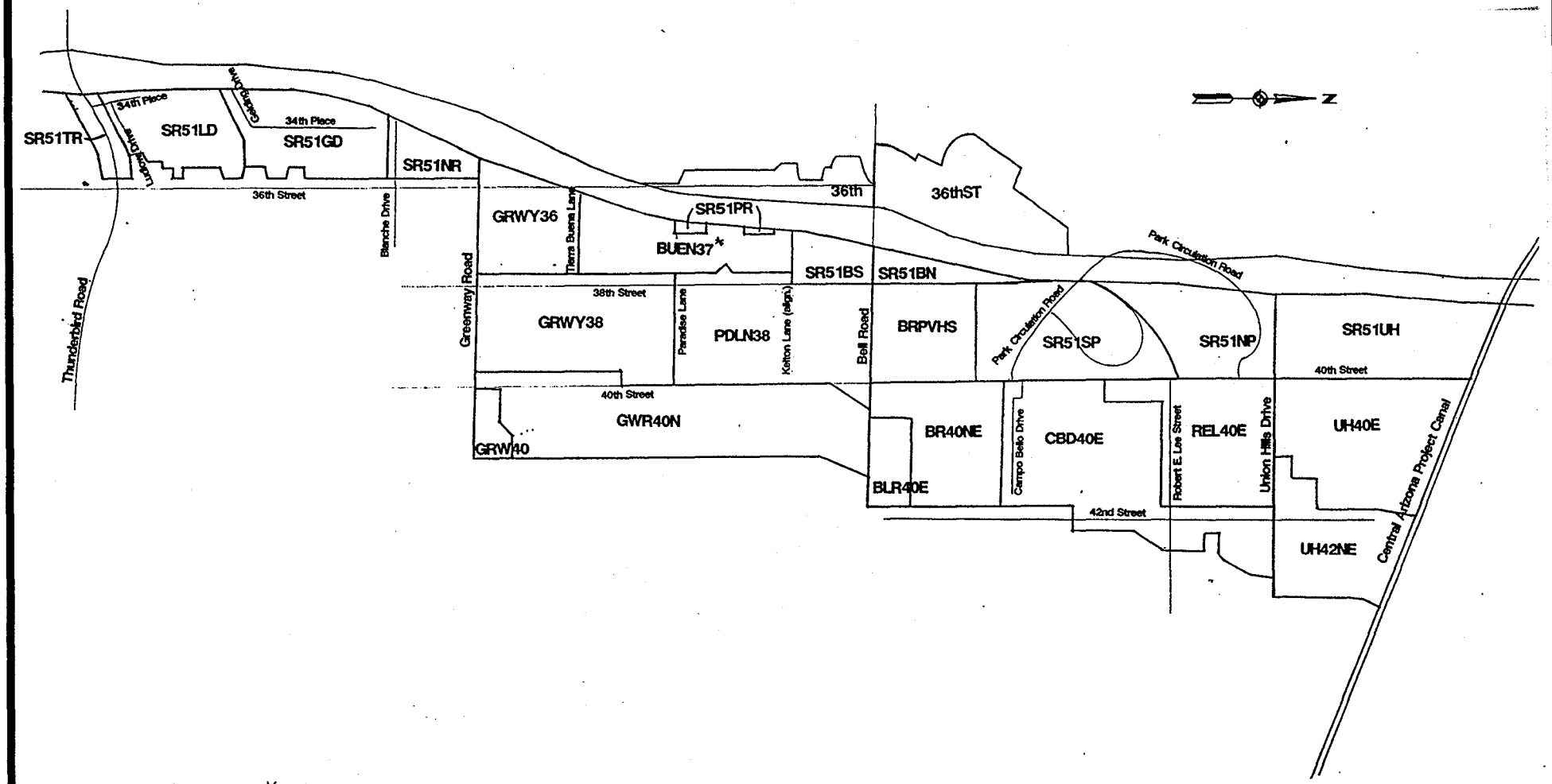
RATING CURVE FOR 40th STREET SOUTH OF UNION HILLS DRIVE

Elev.	Q	Area	V
1501.70	0.00	0.00	0.00
1501.80	0.09	0.32	0.28
1502.09	3.34	10.77	0.31
1502.18	47.46	17.85	2.66
1502.22	72.87	24.02	3.03
1502.60	379.51	70.48	5.38

FLOW SPLIT AT 40th STREET & UNION HILLS DRIVE:

Qin	Qw	Qs	% to the South
0.00	0.00	0.00	0.00%
5.00	5.00	0.00	0.00%
10.00	7.00	3.00	30.00%
25.00	10.00	15.00	60.00%
50.00	15.00	35.00	70.00%
85.00	20.00	65.00	76.47%
100.00	17.00	83.00	83.00%
125.00	17.00	108.00	86.40%

Flow Split Based On Rating Curves



* BUEN37 Flows into 36th Street Storm Drain at Tierra Buena

SUBAREA DELINEATION MAP

HDR

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE   1/17/1996  TIME   8:23    *
*                                      *
****************************************
```

```
****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*      DAVIS, CALIFORNIA 95616         *
*          (916) 551-1748              *
*                                      *
****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                    HEC-1 INPUT                                    PAGE  1

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID        State Route 51 - Squaw Peak Highway                    SR-5150.DAT
  2           ID        Off-site Hydrology - Thunderbird to Central Arizona Project
  3           ID        50-year 24-hour analysis
  4           ID        ADOT 1993 Procedures
  5           IT       2                    2000
  6           IO       3
              *DIAGRAM
              *

  7           KK  UH40NE
  8           KM        Runoff from subdivision NE quad. of 40th Street & Union Hills
  9           PH                    0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37
 10           BA   0.124
 11           LG    0.20    0.25     3.5    0.25    35.0
 12           UC    0.33    0.25
              *

 13           KK  DETBAS
 14           KM        Route outflow hydrograph through imaginary basin to account for
 15           KM        City of Phoenix 100-year 2-hour retention policy
 16           DT    RET1     8.7
```

```
 17          DI       0     100     200     300
 18          DQ       0     100     200     300
             *

 19          KK   SPLIT
 20          KM        Split flows @ 40th St. & Union Hills Dr. to South and west
 21          DT   UH40S
 22          DI     0.0     5.0    10.0    25.0    50.0    85.0   100.0   200.0
 23          DQ     0.0     0.0     3.0    15.0    35.0    65.0    83.0   183.0
             *

 24          KK  RUH40NE
 25          KM        Route hydrograph from Union Hills & 40th St. to SR51UH @ 38th St.
 26          RS       1    FLOW     0.0
 27          RC   0.016   0.016   0.016     500  0.0032
 28          RX    19.0    30.0    35.5    37.0    59.9    60.0    65.0    70.0
 29          RY     4.0    3.19    3.07    2.64    3.01    4.00     4.0     4.0
             *

 30          KK  SR51UH
 31          KM        Runoff from new subdivision NW quad. of 40th Street & Union Hills
 32          BA   0.095
 33          LG    0.20    0.25     3.5    0.25    30.0
 34          UC    0.36    0.39
             *

 35          KK  DETBAS
 36          KM        Route outflow hydrograph through imaginary basin to account for
 37          KM        City of Phoenix 100-year 2-hour retention policy
 38          DT    RET2    10.0
 39          DI       0     100     200     300
 40          DQ       0     100     200     300
             *
1                                    HEC-1 INPUT                                    PAGE  2

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 41          KK   COMB1
 42          KM        Combine flows at 38th St. & Union Hills Drive
 43          HC       2
             *

 44          KK  RSR51UH
 45          KM        Route hydrograph from Union Hills & 38th Street to SR-51 at SR51NP
 46          RS       5    FLOW     0.0
 47          RC   0.025   0.030   0.025    2200  0.0109
 48          RX     0.0    55.0    60.0    69.0    74.0    83.0    88.0   143.0
 49          RY     5.0     4.0     4.0     1.0     1.0     4.0     4.0     5.0
             *

 50          KK  RETHYD
 51          KM        Retrieve diverted hydrograph from 40th St. & Union Hills Drive
 52          DR   UH40S
             *

 53          KK  RUH40S
 54          KM        Route diverted flows to SR-51 in channel
 55          RS       5    FLOW     0.0
 56          RC   0.025   0.030   0.025    2200  0.0114
```

```
 57          RX     0.0    55.0    60.0    69.0    74.0    83.0    88.0   143.0
 58          RY     5.0     4.0     4.0     1.0     1.0     4.0     4.0     5.0
             *

 59          KK  SR51NP
 60          KM        Runoff from north half of Paridise Valley Park
 61          BA   0.060
 62          LG    0.35    0.25     3.5    0.25
 63          UC    0.42    0.35
             *

 64          KK   COMB2
 65          KM        Combine flows at SR-51 and circulation road in Paradise Valley Park
 66          HC       3
             *

 67          KK  RSR51NP
 68          KM        Route flows from COMB2 @ SR-51 to Bell Road & SR-51 - PIPE FLOW
 69          RK    3550  0.0068   0.012            CIRC     5.0                      3
             *

 70          KK  SR51SP
 71          KM        Runoff from south half of Paradise Valley Park
 72          BA   0.091
 73          LG    0.35    0.25     5.0    0.25
 74          UC    0.59    0.53
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 75          KK  DETBAS
 76          KM        Route outflow hydrograph through imaginary basin to account for
 77          KM        City of Phoenix 100-year 2-hour retention policy for Parks & Rec Center
 78          DT    RET3     2.5
 79          DI       0     100     200     300
 80          DQ       0     100     200     300
             *

 81          KK  REL40E
 82          KM        Runoff from subdivision SE quad. of 40th Street & Union Hills
 83          BA   0.095
 84          LG    0.20    0.25     3.5    0.25    41.0
 85          UC    0.32    0.30
             *

 86          KK  RREL40E
 87          KM        Route hydrograph from 40th St. & Robert E. Lee St. to Campo Bello Dr.
 88          KM         at CBD40E in 40th Street.
 89          RS       2    FLOW     0.0
 90          RC   0.016   0.016   0.016    1100  0.0056
 91          RX     0.0     3.0    24.0    24.5    62.5    63.0    74.0    96.0
 92          RY     3.0     0.5     1.5     1.0     1.0     1.5     2.0     3.0
             *

 93          KK  UH42NE
 94          KM        Runoff from subdivision NE quad. of 42nd Street & Union Hills
 95          BA   0.082
 96          LG    0.20    0.25     3.5    0.25    52.0
```

```
 97          UC    0.30    0.13
             *

 98          KK  DETBAS
 99          KM        Route outflow hydrograph through imaginary basin to account for
100          KM        City of Phoenix 100-year 2-hour retention policy
101          DT    RET4    10.0
102          DI       0     100     200     300
103          DQ       0     100     200     300
             *

104          KK  RUH42NE
105          KM        Route hydrograph from 42nd St. and Union Hills to 40th & Campo Bello Dr.
106          KM        Route through street network.
107          RS      11    FLOW     0.0
108          RC   0.016   0.016   0.016    5500  0.0046
109          RX     0.0     3.0    24.0    24.5    62.5    63.0    74.0    96.0
110          RY     3.0     0.5     1.5     1.0     1.0     1.5     2.0     3.0
             *

111          KK  CBD40E
112          KM        Runoff from subdivision east side of 40th Street & Campo Bello
113          BA   0.170
114          LG    0.20    0.25     3.5    0.25    26.0
115          UC    0.49    0.53
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

116          KK   COMB3
117          KM        Combine hydrographs at 40th St. & Campo Bello Dr.
118          HC       3
             *

119          KK  RCBD40E
120          KM        Route combine flows from 40th St. and Campo Bello Drive to northwest
121          KM        corner of Paradise Valley High School, through the City of Phoenix
122          KM        Parks and Rec. Center.  Channel is shallow flow across desert.
123          RS       3    FLOW     0.0
124          RC   0.025   0.025   0.025    1450  0.0064
125          RX     0.0    24.0    32.0    40.0    50.0    58.0    64.0    88.0
126          RY     4.0     2.5     2.0     0.5     0.5     2.0     2.5     4.0
             *

127          KK   COMB4
128          KM        Combine flows at NW corner of Paradise Valley High School
129          HC       2
             *

130          KK  RSR51SP
131          KM        Route flows Paradise Valley Park through PV HS using
132          KM        maintenance road along west side of school to Bell Road
133          RS       3    FLOW     0.0
134          RC   0.016   0.016   0.016    1300  0.0054
135          RX     0.0    13.0    18.5    19.0    49.0    49.5    51.0    51.1
136          RY     3.0     1.5     1.5     1.0     1.0     1.5     1.5     3.0
             *
```

```
137        KK  BRPVHS
138        KM       Runoff from Paradise Valley High School 40th Street & Bell Road
139        BA   0.068
140        LG    0.20    0.25     4.2    0.40    43.0
141        UC    0.26    0.22
           *

142        KK   SPLIT
143        KM       Split 2/3 of runoff to south across Bell Road in 2 dip sections
144        DT  PVH40S
145        DI     0.0     3.0     6.0    24.0    54.0    96.0   150.0   210.0
146        DQ     0.0     2.0     4.0    16.0    36.0    64.0   100.0   140.0
           *

147        KK   COMB5
148        KM       Combine flows at 38th Street & Bell Road
149        HC       2
           *

150        KK   SPLIT
151        KM       Split flows @ 38th St. & Bell Road to South and west
152        DT   BR38S
153        DI     0.0     3.0    10.0    25.0    55.0    90.0   140.0   300.0   400.0
154        DQ     0.0     1.0     5.0    14.0    20.0    55.0   105.0   265.0   365.0
           *
```



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LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

155        KK  RBRPVHS
156        KM       Route flows from 38th St. & Bell Rd. to SR-51 & Bell Road
157        RS       1    FLOW     0.0
158        RC   0.016   0.016   0.016     500  0.0010
159        RX    90.0   100.0   104.9   105.0   132.9   133.0   134.0   144.0
160        RY    67.0    63.4    63.3    62.8    62.8    63.3    64.0    67.0
           *

161        KK  SR51BN
162        KM       Runoff from mini-storage lot north of Bell Road, west of 38th Street
163        KM       Assume retention basins are removed by right turn lane onto SR-51
164        BA   0.017
165        LG    0.05    0.25     3.5    0.25    85.0
166        UC    0.15    0.25
           *
           *      KKDETBAS
           *      KM      Route outflow hydrograph through imaginary basin to account for
           *      KM      City of Phoenix 100-year 2-hour retention policy
           *      DT  RET6     2.0
           *      DI     0     100     200     300
           *      DQ     0     100     200     300
           *

167        KK   COMB6
168        KM       Combine flow in Bell Road at SR-51
169        HC       2
           *

170        KK   COMB7
171        KM       Combine flow in SR-51 at Bell Road
```

```
172          HC       2
             *

173          KK  RSR51BN
174          KM        Route flows from COMB7 @ SR-51 and Bell Road to nr Phelps Rd. & SR-51
175          KM        - PIPE FLOW
176          RK    1100  0.0033   0.012            CIRC     6.0                      1
             *

177          KK  SR51BS
178          KM        Runoff from SW quad. of 38th Street & Bell Road
179          BA   0.028
180          LG    0.20    0.25     3.5    0.25    38.0
181          UC    0.18    0.17
             *

182          KK  DETBAS
183          KM        Route outflow hydrograph through imaginary basin to account for
184          KM        City of Phoenix 100-year 2-hour retention policy
185          DT    RET7     3.0
186          DI       0     100     200     300
187          DQ       0     100     200     300
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

188          KK   COMB8
189          KM        Combine flow in SR-51 at Phelps Road
190          HC       2
             *

191          KK  RSR51BS
192          KM        Route flows from COMB8 @ SR-51 and Phelps Road to Paradise Lane & SR-51
193          KM        - PIPE FLOW
194          RK    1600  0.0033   0.012            CIRC     6.0                      2
             *

195          KK  SR51PR
196          KM        Runoff from NE quad. of SR-51 & Paradise Lane
197          BA   0.009
198          LG    0.20    0.35     3.5    0.25    30.0
199          UC    0.15    0.21
             *

200          KK   COMB9
201          KM        Combine flow in SR-51 at Paradise Lane
202          HC       2
             *

203          KK  RSR51PR
204          KM        Route flows from COMB9 @ SR-51 and Paradise Lane to 36th Street Storm Dr
205          KM        - PIPE FLOW
206          RK     650  0.0033   0.012            CIRC     6.0                      1
             *

207          KK  36thST
208          KM        Runoff from subdivision north of Bell Road in 36th ST.
209          KM        Concentration point south of Bell Road at proposed inlet on east side
```

```
210        KM        2-yr 24-hour flow to memic COP storm drain capacity
211        PH                   0.37    0.68    1.10    1.16    1.20    1.27    1.32    1.37
212        BA   0.072
213        LG    0.23    0.25     3.5    0.25    26.9
214        UC    0.33    0.34
           *

215        KK  R36thST
216        KM        Route flows from 36th Street south of Bell to SR-51 south of Paradise La
217        KM        - PIPE FLOW
218        RK    3250  0.0051   0.012           CIRC     3.5                      1
           *
           *

219        KK    36th
220        KM        Runoff from 36th Street from Bell to north of Tierra Buena.
221        KM        50-year flow analysis
222        PH                   0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37
223        BA  0.0228
224        LG    0.15    0.25     3.5    0.25    40.0
225        UC   0.269   0.551
           *
                                HEC-1 INPUT                                          PAGE  7

LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


226        KK  COMB9B
227        KM        Combine flows in 36th Street, west of SR-51
228        HC       2
           *

229        KK  COMB9C
230        KM        Combine flows in SR-51 off-site storm drain south of Paradise Ln.
231        HC       2
           *

232        KK  RSR51PR
233        KM        Route flows from COMB9B @ SR-51 and Paradise Lane to Tierra Buena & SR-5
234        KM        - PIPE FLOW
235        RK     800  0.0033   0.012           CIRC     6.0                      1
           *

236        KK  BUEN37
237        KM        Runoff from NE quad. of SR-51 & Tierra Buena
238        PH                   0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37
239        BA   0.082
240        LG    0.20    0.25     3.5    0.25    26.0
241        UC    0.34    0.34
           *

242        KK  DIVBUEN37
243        KM        Divert Tierra Buia Flows into existing 36th Street Storm Drain
244        DT  36thSD
245        DI       0     100     200     300
246        DQ       0     100     200     300
           *

247        KK  COMB10
248        KM        Combine flow in SR-51 at Tierra Buena
```

```
249          HC       2
             *

250          KK  RBUEN37
251          KM        Route flows from COMB10 @ SR-51 and Tierra Buena to Greenway & SR-51
252          KM        - PIPE FLOW
253          RK    1350  0.0033   0.012            CIRC     6.5                        1
             *

254          KK  BR40NE
255          KM        Runoff from development east of 40th Street, north of Bell Road
256          BA   0.084
257          LG    0.20    0.25     3.5    0.25    50.0
258          UC    0.28    0.28
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

259          KK  DETBAS
260          KM        Route outflow hydrograph through imaginary basin to account for
261          KM        City of Phoenix 100-year 2-hour retention policy
262          DT    RET5     8.0
263          DI       0     100     200     300
264          DQ       0     100     200     300
             *

265          KK   SPLIT
266          KM        Split flows @ 40th St. & Bell Road to South and west
267          DT   BR40S
268          DI     0.0     5.0    10.0    25.0    40.0    85.0   150.0   200.0
269          DQ     0.0     0.0     5.0    10.0    15.0    28.0    45.0    60.0
             *

270          KK  RBR40NE
271          KM        Route flow from 40th St. & Bell to 38th & Bell Road
272          RS       3    FLOW     0.0
273          RC   0.016   0.016   0.016    1350  0.0025
274          RX    99.0    99.5   100.0   125.0   202.7   203.2   221.2   239.2
275          RY   66.87   66.77   66.27   65.83   66.37   66.87   66.87   66.87
             *

276          KK  RETHYD
277          KM        Retrieve diverted hydrograph from Paradise Valley High School @ Bell Rd
278          DR  PVH40S
             *

279          KK  COMB11
280          KM        Combine flows at Bell Road and 38th Street, south side of Bell Road
281          HC       2
             *

282          KK  RETHYD
283          KM        Retrieve diverted hydrograph from 38th St. & Bell Road
284          DR   BR38S
             *

285          KK  COMB12
286          KM        Combine flows in 38th Street, south of Bell Road
```

```
287          HC       2
             *

288          KK  RBR38S
289          KM        Route diverted hydrograph BR38S south in 38th Street to Paradise Lane
290          KM        Adjust depth by increasing end point elevations to allow for high
291          KM        peak flow in 38th Street.  Increase from 46.63, 0.0; 46.38, 15.0 to
292          KM        50.0, 0.0; 46.6, 1.0 and 46.29,57.0; 46.55, 67.0; to 46.5, 66.0, 50.0
293          RS       5    FLOW     0.0
294          RC   0.016   0.016   0.016    2640  0.0064
295          RX     0.0     1.0    19.5    20.0    52.0    52.5    66.0    67.0
296          RY    50.0    46.6   46.23   45.80   45.77   46.26    46.5    50.0
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

297          KK  PDLN38
298          KM        Runoff from NE quad. of 38th Street & Paradise Lane
299          BA   0.136
300          LG    0.20    0.26     3.8    0.54    31.0
301          UC    0.24    0.11
             *

302          KK  DETBAS
303          KM        Route outflow hydrograph through imaginary basin to account for
304          KM        City of Phoenix 100-year 2-hour retention policy
305          DT    RET8     8.0
306          DI       0     100     200     300
307          DQ       0     100     200     300
             *

308          KK  COMB13
309          KM        Combine flows at Paradise Lane and 38th Street
310          HC       2
             *

311          KK  RPDLN38
312          KM        Route combined hydrograph PDLN38 south in 38th Street to Greenway Road
313          KM        Adjust depth by increasing end point elevations to allow for high
314          KM        peak flow in 38th Street.  Increase from 46.63, 0.0; 46.38, 15.0 to
315          KM        50.0, 0.0; 46.6, 1.0 and 46.29,57.0; 46.55, 67.0; to 46.5, 66.0, 50.0
316          RS       5    FLOW     0.0
317          RC   0.016   0.016   0.016    2640  0.0048
318          RX     0.0     1.0    19.5    20.0    52.0    52.5    66.0    67.0
319          RY    50.0    46.6   46.23   45.80   45.77   46.26    46.5    50.0
             *

320          KK  GRWY38
321          KM        Runoff from NE quad. of 38th Street & Greenway Road
322          BA   0.122
323          LG    0.20    0.27     3.1    0.79    21.0
324          UC    0.32    0.23
             *

325          KK  DETBAS
326          KM        Route outflow hydrograph through imaginary basin to account for
327          KM        City of Phoenix 100-year 2-hour retention policy
328          DT    RET9     2.0
```

```
329          DI       0     100     200     300
330          DQ       0     100     200     300
             *

331          KK  COMB14
332          KM        Combine flows at Greenway Road and 38th Street
333          HC       2
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

334          KK  RETHYD
335          KM        Retrieve diverted hydrograph from 40th St. & Bell Road
336          DR   BR40S
             *

337          KK  BLR40E
338          KM        Runoff from east of 40th Street & north of Bell Road
339          BA   0.021
340          LG    0.05    0.25     3.5    0.25    85.0
341          UC    0.14    0.16
             *

342          KK  DETBAS
343          KM        Route outflow hydrograph through imaginary basin to account for
344          KM        City of Phoenix 100-year 2-hour retention policy
345          DT   RET10     3.0
346          DI       0     100     200     300
347          DQ       0     100     200     300
             *

348          KK  COMB15
349          KM        Combine flows at Bell Road and 40th Street
350          HC       2
             *

351          KK  RBLR40E
352          KM        Route flows from 40th St. & Bell Rd. to 40th St. & Greenway Road
353          RS      11    FLOW     0.0
354          RC   0.016   0.016   0.016    5300  0.0047
355          RX     0.0    29.5    35.0    36.5   101.3   102.8   108.3   126.3
356          RY   66.72   65.21   65.12   64.81   64.70   64.99   65.04   66.72
             *

357          KK  GRW40N
358          KM        Runoff from NE quad. of 40th Street & Greenway Road
359          BA   0.163
360          LG    0.35    0.25     4.8    0.28    25.0
361          UC    0.27    0.08
             *

362          KK   GWR40
363          KM        Runoff from NE quad. of 40th Street & Greenway Road
364          BA   0.032
365          LG    0.20    0.25     4.9    0.27    56.0
366          UC    0.31    0.77
             *
```

```
367          KK  DETBAS
368          KM        Route outflow hydrograph through imaginary basin to account for
369          KM        City of Phoenix 100-year 2-hour retention policy
370          DT   RET11     4.0
371          DI       0     100     200     300
372          DQ       0     100     200     300
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

373          KK  COMB16
374          KM        Combine flows at Greenway Road and 40th Street
375          HC       3
             *

376          KK   SPLIT
377          KM        Split flows at Greenway Road & 40th Street
378          KM        ASSUME 50% to south and 50% to west after first 25 cfs to west
379          KM        No topographic data available to refine deversion
380          DT  GRW40S
381          DI     0.0    15.0    25.0    27.0   125.0   775.0
382          DQ     0.0     0.0     0.0     1.0    50.0   375.0
             *

383          KK  RGRW40N
384          KM        Route flows from 40th St. & Greenway Rd. to 38th St. & Greenway Road
385          RS       3    FLOW     0.0
386          RC   0.016   0.016   0.016    1350  0.0053
387          RX     0.0    28.5    34.0    34.5    89.0    89.5    95.0   121.0
388          RY   50.05   48.67   48.56   48.11   48.01   48.50   48.64   49.45
             *

389          KK  COMB17
390          KM        Combine flows at Greenway Road and 38th Street
391          HC       2
             *

392          KK   SPLIT
393          KM        Split flows along Greenway Road south at 38th Street and west
394          DT  GRW38S
395          DI     0.0    15.0    25.0   125.0   765.0
396          DQ     0.0     0.0     0.0    30.0   435.0
             *

397          KK  RGRW40N
398          KM        Route flows from 38th St. & Greenway Rd. to 36th St. & Greenway Road
399          RS       3    FLOW     0.0
400          RC   0.016   0.016   0.016    1300  0.0020
401          RX     0.0    28.5    34.0    34.5    89.0    89.5    95.0   121.0
402          RY   50.05   48.67   48.56   48.11   48.01   48.50   48.64   49.45
             *

403          KK  GRWY36
404          KM        Runoff from NE quad. of 36th Street & Greenway Road
405          BA   0.059
406          LG    0.20    0.25    4.95    0.26    22.0
407          UC    0.33    0.32
             *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 408          KK  COMB18
 409          KM        Combine flows at Greenway Road and 36th Street
 410          HC       2
              *

 411          KK   SPLIT
 412          KM        Split flows @ 36th St. & Greenway Road to South and west
 413          DT  GWY36S
 414          DI     0.0    10.0    30.0    37.0   100.0   200.0   250.0   625.0  1000.0
 415          DQ     0.0     7.0    20.0    25.0    65.0   140.0   175.0   475.0   775.0
              *

 416          KK  COMB19
 417          KM        Combine flows at Greenway Road and SR-51
 418          HC       2
              *

 419          KK  RGRWY36
 420          KM        Route flows from COMB16 @ SR-51 and Greenway Road to Blanche Dr. & SR-51
 421          KM        - PIPE FLOW
 422          RK    1250  0.0033   0.012            CIRC     7.0                      1
              *

 423          KK  SR51NR
 424          KM        Runoff from NE quad. of SR-51 & Nisbet Road
 425          BA   0.026
 426          LG    0.20    0.25     3.5   0.25    30.0
 427          UC    0.20    0.19
              *

 428          KK  COMB20
 429          KM        Combine flows at Blanche Dr. and SR-51
 430          HC       2
              *

 431          KK  RSR51NR
 432          KM        Route flows from COMB17 @ SR-51 and Blanche Dr. to Gelding & SR-51
 433          KM        - PIPE FLOW
 434          RK    2275  0.0033   0.012            CIRC     7.5                      2
              *

 435          KK  SR51GD
 436          KM        Runoff from NE quad. of SR-51 & Gelding Drive
 437          BA   0.082
 438          LG    0.20    0.25     3.5   0.25    30.0
 439          UC    0.31    0.27
              *

 440          KK   SPLIT
 441          KM        Split flows @ Gelding and 35th Street to the south
 442          DT  35GLDG
 443          DI     0.0     3.5    11.0    25.0    45.0    65.0    86.0   115.0   155.0   200.0
 444          DQ     0.0     0.0     3.5    10.0    25.0    35.0    47.0    65.0    90.0   120.0
              *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

445           KK  COMB21
446           KM        Combine flows at Gelding and SR-51
447           HC       2
              *

448           KK  RSR51GD
449           KM        Route flows from COMB18 @ SR-51 and Gelding to Ludlow & SR-51
450           KM        - PIPE FLOW
451           RK    1500  0.0033   0.012            TRAP     8.0   0.001                1
              *

452           KK  SR51LD
453           KM        Runoff from NE quad. of SR-51 & Ludlow Drive
454           BA   0.056
455           LG    0.20    0.25     3.5   0.25    30.0
456           UC    0.30    0.30
              *

457           KK  RETGLDG
458           KM        Retrieve diverted hydrograph at 35th Street and Gelding
459           DR  35GLDG
              *

460           KK  Comb21B
461           KM         Combine flows at Ludlow Drive and 34th Place
462           HC       2
              *

463           KK   SPLIT
464           KM        Split flows @ 34th Pl. & Ludlow Drive to Thunderbird (south)
465           DT   TB-LD
466           DI     0.0     9.0    16.0    25.0    50.0    81.0    98.0   116.0
467           DQ     0.0     0.0     2.0     6.0    19.0    35.0    44.0    54.0
              *

468           KK  COMB22
469           KM        Combine flows at Ludlow and SR-51
470           HC       2
              *

471           KK  RETHYD
472           KM        Retrieve diverted hydrograph from 34th Pl. & Ludlow Drive
473           DR   TB-LD
              *

474           KK  SR51TR
475           KM        Runoff from NE quad. of SR-51 & Thunderbird Road
476           BA   0.016
477           LG    0.20    0.25     3.5   0.25    30.0
478           UC    0.13    0.09
              *
```


LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

```
479          KK  COMB23
480          KM        Combine flows at Thunderbird and SR-51
481          HC       2
             *
482          ZZ
1
             SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   7      UH40NE
               .
               .
  16           .------->    RET1
  13      DETBAS
               .
               .
  21           .------->   UH40S
  19       SPLIT
               V
               V
  24      RUH40N
               .
               .
  30           .      SR51UH
               .           .
               .           .
  38           .           .------->    RET2
  35           .      DETBAS
               .           .
               .           .
  41       COMB1............
               V
               V
  44      RSR51U
               .
               .
  52           .           .<-------   UH40S
  50           .      RETHYD
               .           V
               .           V
  53           .      RUH40S
               .           .
               .           .
  59           .           .      SR51NP
               .           .           .
               .           .           .
  64       COMB2........................
               V
               V
  67      RSR51N
               .
               .
  70           .      SR51SP
               .           .
               .           .
  78           .           .------->    RET3
  75           .      DETBAS
```

```
                .          .
                .          .
 81             .          .     REL40E
                .          .         V
                .          .         V
 86             .          .     RREL40
                .          .         .
                .          .         .
 93             .          .         .     UH42NE
                .          .         .          .
                .          .         .          .
101             .          .         .          .-------->    RET4
 98             .          .         .     DETBAS
                .          .         .          V
                .          .         .          V
104             .          .         .     RUH42N
                .          .         .          .
                .          .         .          .
111             .          .         .          .     CBD40E
                .          .         .          .          .
                .          .         .          .          .
116             .          .      COMB3.......................
                .          .         V
                .          .         V
119             .          .     RCBD40
                .          .         .
                .          .         .
127             .       COMB4............
                .          V
                .          V
130             .      RSR51S
                .          .
                .          .
137             .          .     BRPVHS
                .          .         .
                .          .         .
144             .          .         .-------> PVH40S
142             .          .      SPLIT
                .          .         .
                .          .         .
147             .       COMB5............
                .          .
                .          .
152             .          .-------> BR38S
150             .       SPLIT
                .          V
                .          V
155             .      RBRPVH
                .          .
                .          .
161             .          .     SR51BN
                .          .         .
                .          .         .
167             .       COMB6............
                .          .
                .          .
170          COMB7............
                V
                V
173          RSR51B
```

```
            .
            .
177         .      SR51BS
            .           .
            .           .
185         .           .-------->    RET7
182         .      DETBAS
            .           .
            .           .
188      COMB8............
            V
            V
191     RSR51B
            .
            .
195         .      SR51PR
            .           .
            .           .
200      COMB9............
            V
            V
203     RSR51P
            .
            .
207         .      36thST
            .           V
            .           V
215         .      R36thS
            .           .
            .           .
219         .           .        36th
            .           .           .
            .           .           .
226         .      COMB9B............
            .           .
            .           .
229     COMB9C............
            V
            V
232     RSR51P
            .
            .
236         .      BUEN37
            .           .
            .           .
244         .           .-------->  36thSD
242         .      DIVBUE
            .           .
            .           .
247     COMB10............
            V
            V
250     RBUEN3
            .
            .
254         .      BR4ONE
            .           .
            .           .
262         .           .-------->    RET5
259         .      DETBAS
```

```
                .         .
                .         .
267             .         .-------> BR40S
265             .    SPLIT
                .         V
                .         V
270             .    RBR40N
                .         .
                .         .
278             .         .         .<------- PVH40S
276             .         .    RETHYD
                .         .         .
                .         .         .
279             .    COMB11............
                .         .
                .         .
284             .         .         .<-------  BR38S
282             .         .    RETHYD
                .         .         .
                .         .         .
285             .    COMB12............
                .         V
                .         V
288             .    RBR38S
                .         .
                .         .
297             .         .    PDLN38
                .         .         .
                .         .         .
305             .         .         .-------> RET8
302             .         .    DETBAS
                .         .         .
                .         .         .
308             .    COMB13............
                .         V
                .         V
311             .    RPDLN3
                .         .
                .         .
320             .         .    GRWY38
                .         .         .
                .         .         .
328             .         .         .-------> RET9
325             .         .    DETBAS
                .         .         .
                .         .         .
331             .    COMB14............
                .         .
                .         .
336             .         .         .<-------  BR40S
334             .         .    RETHYD
                .         .         .
                .         .         .
337             .         .         .    BLR40E
                .         .         .         .
                .         .         .         .
345             .         .         .         .-------> RET10
342             .         .         .    DETBAS
                .         .         .         .
                .         .         .         .
```

```
348          .           .      COMB15............
             .           .           V
             .           .           V
351          .           .      RBLR40
             .           .           .
             .           .           .
357          .           .           .      GRW40N
             .           .           .           .
             .           .           .           .
362          .           .           .           .      GWR40
             .           .           .           .           .
             .           .           .           .           .
370          .           .           .           .           .-------->   RET11 '
367          .           .           .           .      DETBAS
             .           .           .           .           .
             .           .           .           .           .
373          .           .      COMB16........................
             .           .           .
             .           .           .
380          .           .           .-------->  GRW40S
376          .           .       SPLIT
             .           .           V
             .           .           V
383          .           .      RGRW40
             .           .           .
             .           .           .
389          .      COMB17............
             .           .
             .           .
394          .           .-------->  GRW38S
392          .       SPLIT
             .           V
             .           V
397          .      RGRW40
             .           .
             .           .
403          .           .      GRWY36
             .           .           .
             .           .           .
408          .      COMB18............
             .           .
             .           .
413          .           .-------->  GWY36S
411          .       SPLIT
             .           .
             .           .
416     COMB19............
             V
             V
419     RGRWY3
             .
             .
423          .      SR51NR
             .           .
             .           .
428     COMB20............
             V
             V
431     RSR51N
             .
```

```
                .
435             .      SR51GD
                .          .
                .          .
442             .          .-------> 35GLDG
440             .       SPLIT
                .          .
                .          .
445        COMB21............
               V
               V
448        RSR51G
                .
                .
452             .      SR51LD
                .          .
                .          .
459             .          .          .<-------  35GLDG
457             .          .     RETGLD
                .          .          .
                .          .          .
460             .      Comb21............
                .          .
                .          .
465             .          .------->   TB-LD
463             .       SPLIT
                .          .
                .          .
468        COMB22............
                .
                .
473             .          .<-------   TB-LD
471             .      RETHYD
                .          .
                .          .
474             .          .     SR51TR
                .          .          .
                .          .          .
479             .      COMB23............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE   1/17/1996  TIME   8:23   *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

State Route 51 - Squaw Peak Highway SR-5150.DAT
Off-site Hydrology - Thunderbird to Central Arizona Project
50-year 24-hour analysis
ADOT 1993 Procedures

```
 6 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          3  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                   NMIN          2  MINUTES IN COMPUTATION INTERVAL
                  IDATE      1   0  STARTING DATE
                  ITIME       0000  STARTING TIME
                     NQ       2000  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE      3   0  ENDING DATE
                 NDTIME       1838  ENDING TIME
                  ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.03 HOURS
                 TOTAL TIME BASE   66.63 HOURS

       ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 7 KK     *   UH40NE   *
          *            *
          **************
                              Runoff from subdivision NE quad. of 40th Street & Union Hills

           SUBBASIN RUNOFF DATA

10 BA        SUBBASIN CHARACTERISTICS
                  TAREA        0.12  SUBBASIN AREA

             PRECIPITATION DATA

 9 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
             ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
             5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
              0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                STORM AREA =    0.12

11 LG        GREEN AND AMPT LOSS RATE
                  STRTL        0.20  STARTING LOSS
                    DTH        0.25  MOISTURE DEFICIT
                   PSIF        3.50  WETTING FRONT SUCTION
                  XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                  RTIMP       35.00  PERCENT IMPERVIOUS AREA

12 UC        CLARK UNITGRAPH
```

```
                    TC        0.33  TIME OF CONCENTRATION
                    R         0.25  STORAGE COEFFICIENT

          SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=  0.33 HR,      R=  0.25 HR
                                  SNYDER   TP=  0.29 HR,     CP=  0.65

                                          UNIT HYDROGRAPH
                                     46 END-OF-PERIOD ORDINATES
            7.      25.      51.      80.     110.     140.     162.     177.     182.     178.
          161.     141.     123.     108.      94.      83.      72.      63.      55.      48.
           42.      37.      32.      28.      25.      22.      19.      17.      15.      13.
           11.      10.       9.       7.       7.       6.       5.       4.       4.       3.
            3.       3.       2.       2.       2.       2.

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   UH4ONE

  TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.13, TOTAL EXCESS =    2.24

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                            (CFS)
+   241.      12.30                 27.         7.          3.          3.
                          (INCHES)  2.038      2.229       2.230       2.230
                           (AC-FT)  13.        15.         15.         15.

                          CUMULATIVE AREA =    0.12 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 13 KK    *   DETBAS   *
          *            *
          **************
                                Route outflow hydrograph through imaginary basin to account for
                                City of Phoenix 100-year 2-hour retention policy

   DT          DIVERSION
                     ISTAD        RET1  DIVERSION HYDROGRAPH IDENTIFICATION
                    DSTRMX        8.70  MAXIMUM VOLUME TO BE DIVERTED

   DI            INFLOW        0.00    100.00    200.00    300.00

   DQ      DIVERTED FLOW       0.00    100.00    200.00    300.00

                                                   ***

   ***            ***            ***            ***            ***
```

DIVERSION HYDROGRAPH RET1

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 241.	12.30		17.	4.	2.	2.
		(INCHES)	1.266	1.316	1.316	1.316
		(AC-FT)	8.	9.	9.	9.

CUMULATIVE AREA = 0.12 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DETBAS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 171.	12.50		12.	3.	1.	1.
		(INCHES)	0.866	0.915	0.915	0.915
		(AC-FT)	6.	6.	6.	6.

CUMULATIVE AREA = 0.12 SQ MI

*** ***

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              **************
              *            *
   19 KK      *     SPLIT  *
              *            *
              **************
```

Split flows @ 40th St. & Union Hills Dr. to South and west

DT	DIVERSION ISTAD	UH40S DIVERSION HYDROGRAPH IDENTIFICATION							
DI	INFLOW	0.00	5.00	10.00	25.00	50.00	85.00	100.00	200.00
DQ	DIVERTED FLOW	0.00	0.00	3.00	15.00	35.00	65.00	83.00	183.00

***

*** *** *** *** ***

DIVERSION HYDROGRAPH UH40S

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 154.	12.50		8.	2.	1.	1.
		(INCHES)	0.584	0.584	0.584	0.584

```
                    (AC-FT)        4.         4.         4.         4.

                    CUMULATIVE AREA =    0.12 SQ MI


     ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION    SPLIT

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR      72-HR     66.63-HR
+  (CFS)       (HR)
                      (CFS)
+     20.     12.73                 4.         1.         0.         0.
                    (INCHES)     0.282      0.331      0.331      0.331
                    (AC-FT)        2.         2.         2.         2.

                    CUMULATIVE AREA =    0.12 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 24 KK    *   RUH40N   *     E
          *            *
          **************
                                Route hydrograph from Union Hills & 40th St. to SR51UH @ 38th St.

            HYDROGRAPH ROUTING DATA

 26 RS        STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       FLOW  TYPE OF INITIAL CONDITION
                   RSVRIC       0.00  INITIAL CONDITION
                        X       0.00 WORKING R AND D COEFFICIENT

 27 RC        NORMAL DEPTH CHANNEL
                      ANL      0.016  LEFT OVERBANK N-VALUE
                     ANCH      0.016  MAIN CHANNEL N-VALUE
                      ANR      0.016  RIGHT OVERBANK N-VALUE
                    RLNTH       500.  REACH LENGTH
                      SEL     0.0032  ENERGY SLOPE
                    ELMAX        0.0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                     CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 29 RY       ELEVATION     4.00       3.19       3.07       2.64       3.01       4.00       4.00       4.00
 28 RX       DISTANCE     19.00      30.00      35.50      37.00      59.90      60.00      65.00      70.00

                                                  ***

                                     COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE      0.00       0.00       0.01       0.02       0.03       0.05       0.07       0.09       0.11       0.14
          OUTFLOW      0.00       0.10       0.61       1.79       3.86       6.99      12.09      18.64      26.54      35.85
        ELEVATION      2.64       2.71       2.78       2.85       2.93       3.00       3.07       3.14       3.21       3.28
```

STORAGE	0.16	0.19	0.22	0.25	0.28	0.31	0.34	0.37	0.40	0.44
OUTFLOW	46.45	58.29	71.36	85.64	101.12	117.81	135.69	154.77	175.06	196.55
ELEVATION	3.36	3.43	3.50	3.57	3.64	3.71	3.79	3.86	3.93	4.00

*** *** *** *** ***

HYDROGRAPH AT STATION RUH40N

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 19.	12.77		4.	1.	0.	0.
		(INCHES)	0.281	0.331	0.331	0.331
		(AC-FT)	2.	2.	2.	2.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (AC-FT)	(HR)				
0.	12.77	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (FEET)	(HR)				
3.14	12.77	2.89	2.74	2.68	2.68

CUMULATIVE AREA = 0.12 SQ MI

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**************
*            *
30 KK   *   SR51UH  *
*            *
**************
```

Runoff from new subdivision NW quad. of 40th Street & Union Hills

SUBBASIN RUNOFF DATA

32 BA SUBBASIN CHARACTERISTICS

TAREA 0.09 SUBBASIN AREA

PRECIPITATION DATA

9 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.09

33 LG GREEN AND AMPT LOSS RATE

STRTL 0.20 STARTING LOSS

DTH 0.25 MOISTURE DEFICIT

```
                    PSIF        3.50  WETTING FRONT SUCTION
                   XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                   RTIMP       30.00  PERCENT IMPERVIOUS AREA

34 UC          CLARK UNITGRAPH
                      TC        0.36  TIME OF CONCENTRATION
                       R        0.39  STORAGE COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                   ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=  0.36 HR,      R=  0.39 HR
                                  SNYDER   TP=  0.34 HR,     CP=  0.55

                                          UNIT HYDROGRAPH
                                     68 END-OF-PERIOD ORDINATES
            3.      11.      23.      37.      52.      67.      81.      92.      99.     103.
          102.      96.      88.      81.      74.      68.      62.      57.      53.      48.
           44.      41.      37.      34.      32.      29.      27.      24.      22.      21.
           19.      17.      16.      15.      13.      12.      11.      10.      10.       9.
            8.       7.       7.       6.       6.       5.       5.       4.       4.       4.
            3.       3.       3.       3.       2.       2.       2.       2.       2.       2.
            1.       1.       1.       1.       1.       1.       1.       1.

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SR51UH

  TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.22, TOTAL EXCESS =    2.15

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
  (CFS)       (HR)
                          (CFS)
   144.     12.37                    20.         5.          2.          2.
                         (INCHES)   1.978       2.142       2.143       2.143
                         (AC-FT)     10.         11.         11.         11.

                    CUMULATIVE AREA =    0.09 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          ***************
          *             *
35 KK     *   DETBAS    *
          *             *
          ***************
                         Route outflow hydrograph through imaginary basin to account for
                         City of Phoenix 100-year 2-hour retention policy

  DT          DIVERSION
                   ISTAD        RET2  DIVERSION HYDROGRAPH IDENTIFICATION
                  DSTRMX       10.00  MAXIMUM VOLUME TO BE DIVERTED
```

```
     DI            INFLOW        0.00    100.00    200.00    300.00

     DQ      DIVERTED FLOW       0.00    100.00    200.00    300.00

                                                                 ***

      ***            ***            ***            ***            ***

                        DIVERSION HYDROGRAPH     RET2

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     144.     12.37                 20.          5.          2.          2.
                        (INCHES)    1.919       1.974       1.974       1.974
                         (AC-FT)     10.         10.         10.         10.

                        CUMULATIVE AREA =    0.09 SQ MI


      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   DETBAS

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+       9.     13.73                  1.          0.          0.          0.
                        (INCHES)    0.137       0.169       0.169       0.169
                         (AC-FT)      1.          1.          1.          1.

                        CUMULATIVE AREA =    0.09 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   41 KK    *     COMB1  *
            *            *
            **************
                          Combine flows at 38th St. & Union Hills Drive

   43 HC          HYDROGRAPH COMBINATION
                        ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                 ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    COMB1

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
```

```
                    (CFS)
+     19.     12.77                 5.        2.        1.        1.
                  (INCHES)     0.214     0.261     0.261     0.261
                   (AC-FT)        2.        3.        3.        3.

                  CUMULATIVE AREA =    0.22 SQ MI
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*** ***

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          **************
          *            *
 44 KK    *   RSR51U   *     H
          *            *
          **************
                          Route hydrograph from Union Hills & 38th Street to SR-51 at SR51NP

            HYDROGRAPH ROUTING DATA

 46 RS        STORAGE ROUTING
                    NSTPS          5  NUMBER OF SUBREACHES
                     ITYP       FLOW  TYPE OF INITIAL CONDITION
                   RSVRIC       0.00  INITIAL CONDITION
                        X       0.00 WORKING R AND D COEFFICIENT

 47 RC        NORMAL DEPTH CHANNEL
                      ANL      0.025  LEFT OVERBANK N-VALUE
                     ANCH      0.030  MAIN CHANNEL N-VALUE
                      ANR      0.025  RIGHT OVERBANK N-VALUE
                    RLNTH      2200.  REACH LENGTH
                      SEL     0.0109  ENERGY SLOPE
                    ELMAX        0.0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                  CROSS-SECTION DATA
                      --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 49 RY      ELEVATION    5.00     4.00     4.00     1.00     1.00     4.00     4.00     5.00
 48 RX      DISTANCE     0.00    55.00    60.00    69.00    74.00    83.00    88.00   143.00

                                                  ***

                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

        STORAGE      0.00     0.06     0.13     0.22     0.32     0.43     0.56     0.70     0.86     1.02
        OUTFLOW      0.00     2.01     6.72    13.92    23.74    36.32    51.85    70.52    92.51   118.01
      ELEVATION      1.00     1.21     1.42     1.63     1.84     2.05     2.26     2.47     2.68     2.89

        STORAGE      1.20     1.40     1.60     1.83     2.06     2.45     3.11     4.02     5.17     6.57
        OUTFLOW    147.20   180.25   217.35   258.66   304.37   367.57   455.26   572.64   726.79   924.09
      ELEVATION      3.11     3.32     3.53     3.74     3.95     4.16     4.37     4.58     4.79     5.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      93. TO      368.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

    ***          ***          ***          ***          ***
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HYDROGRAPH AT STATION RSR51U

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 18.	12.90		5.	2.	1.	1.
		(INCHES)	0.211	0.261	0.261	0.261
		(AC-FT)	2.	3.	3.	3.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (AC-FT)	(HR)				
0.	12.90	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (FEET)	(HR)				
1.72	12.90	1.32	1.11	1.04	1.04

CUMULATIVE AREA = 0.22 SQ MI

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              **************
              *            *
  50 KK       *   RETHYD   *
              *            *
              **************
```

Retrieve diverted hydrograph from 40th St. & Union Hills Drive

52 DR RETRIEVE DIVERSION HYDROGRAPH

ISTAD UH40S DIVERSION HYDROGRAPH IDENTIFICATION

***

*** *** *** *** ***

HYDROGRAPH AT STATION RETHYD

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 154.	12.50		8.	2.	1.	1.
		(INCHES)	0.331	0.331	0.331	0.331
		(AC-FT)	4.	4.	4.	4.

CUMULATIVE AREA = 0.00 SQ MI

*** ***

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              **************
              *            *
 53 KK        *   RUH40S   *
              *            *
              **************
```

Route diverted flows to SR-51 in channel

HYDROGRAPH ROUTING DATA

```
55 RS          STORAGE ROUTING
                    NSTPS          5  NUMBER OF SUBREACHES
                     ITYP       FLOW  TYPE OF INITIAL CONDITION
                   RSVRIC       0.00  INITIAL CONDITION
                        X       0.00 WORKING R AND D COEFFICIENT

56 RC          NORMAL DEPTH CHANNEL
                      ANL      0.025  LEFT OVERBANK N-VALUE
                     ANCH      0.030  MAIN CHANNEL N-VALUE
                      ANR      0.025  RIGHT OVERBANK N-VALUE
                    RLNTH      2200.  REACH LENGTH
                      SEL     0.0114  ENERGY SLOPE
                    ELMAX        0.0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION
```

CROSS-SECTION DATA

		--- LEFT OVERBANK ---		+ ------ MAIN CHANNEL		------- +	--- RIGHT OVERBANK ---		
58 RY	ELEVATION	5.00	4.00	4.00	1.00	1.00	4.00	4.00	5.00
57 RX	DISTANCE	0.00	55.00	60.00	69.00	74.00	83.00	88.00	143.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.06	0.13	0.22	0.32	0.43	0.56	0.70	0.86	1.02
OUTFLOW	0.00	2.06	6.87	14.24	24.27	37.14	53.03	72.12	94.61	120.69
ELEVATION	1.00	1.21	1.42	1.63	1.84	2.05	2.26	2.47	2.68	2.89
STORAGE	1.20	1.40	1.60	1.83	2.06	2.45	3.11	4.02	5.17	6.57
OUTFLOW	150.53	184.34	222.28	264.53	311.27	375.90	465.59	585.63	743.27	945.04
ELEVATION	3.11	3.32	3.53	3.74	3.95	4.16	4.37	4.58	4.79	5.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 72. TO 376.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RUH40S

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
134.	12.60		8.	2.	1.	1.
		(INCHES)	0.000	0.000	0.000	0.000
		(AC-FT)	4.	4.	4.	4.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (AC-FT)	(HR)				

```
      0.     12.60                  0.         0.         0.         0.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR      72-HR     66.63-HR
+   (FEET)      (HR)
     2.99      12.60                 1.19       1.05       1.02       1.02

                        CUMULATIVE AREA =    0.00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  59 KK     *   SR51NP   *
            *            *
            **************
                                Runoff from north half of Paridise Valley Park

              SUBBASIN RUNOFF DATA

  61 BA         SUBBASIN CHARACTERISTICS
                      TAREA        0.06  SUBBASIN AREA

                PRECIPITATION DATA

   9 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                   STORM AREA =    0.06

  62 LG         GREEN AND AMPT LOSS RATE
                      STRTL        0.35  STARTING LOSS
                        DTH        0.25  MOISTURE DEFICIT
                       PSIF        3.50  WETTING FRONT SUCTION
                      XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                      RTIMP        0.00  PERCENT IMPERVIOUS AREA

  63 UC         CLARK UNITGRAPH
                         TC        0.42  TIME OF CONCENTRATION
                          R        0.35  STORAGE COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                   ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=  0.42 HR,       R=  0.35 HR
                                  SNYDER   TP=  0.38 HR,      CP=  0.63

                                          UNIT HYDROGRAPH
                                     63 END-OF-PERIOD ORDINATES
                     2.      6.     13.     20.     28.     37.     46.     53.     59.     63.
                    65.     66.     63.     58.     53.     48.     44.     40.     36.     33.
                    30.     27.     25.     22.     20.     19.     17.     15.     14.     13.
```

```
          12.      10.      10.      9.       8.       7.       6.       6.       5.       5.
           4.       4.       4.      3.       3.       3.       3.       2.       2.       2.
           2.       2.       1.      1.       1.       1.       1.       1.       1.       1.
           1.       1.       1.

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SR51NP

  TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.80, TOTAL EXCESS =    1.57

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
  (CFS)       (HR)
                          (CFS)
    85.      12.40                   10.         3.          1.          1.
                         (INCHES)   1.562       1.562       1.562       1.562
                          (AC-FT)     5.          5.          5.          5.

                         CUMULATIVE AREA =    0.06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 64 KK    *     COMB2  *
          *            *
          **************
                         Combine flows at SR-51 and circulation road in Paradise Valley Park

 66 HC          HYDROGRAPH COMBINATION
                      ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

   ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION    COMB2

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
  (CFS)       (HR)
                          (CFS)
   198.      12.60                   23.         6.          2.          2.
                         (INCHES)   0.754       0.800       0.800       0.800
                          (AC-FT)    11.         12.         12.         12.

                         CUMULATIVE AREA =    0.28 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *           *
 67 KK    *   RSR51N  *     P
          *           *
          **************
```

Route flows from COMB2 @ SR-51 to Bell Road & SR-51 - PIPE FLOW

HYDROGRAPH ROUTING DATA

69 RK KINEMATIC WAVE STREAM ROUTING

L	3550.	CHANNEL LENGTH
S	0.0068	SLOPE
N	0.012	CHANNEL ROUGHNESS COEFFICIENT
CA	0.00	CONTRIBUTING AREA
SHAPE	CIRC	CHANNEL SHAPE
WD	5.00	BOTTOM WIDTH OR DIAMETER
Z	0.00	SIDE SLOPE
NDXMIN	3	MINIMUM NUMBER OF DX INTERVALS

***

COMPUTED KINEMATIC PARAMETERS
VARIABLE TIME STEP
(DT SHOWN IS A MINIMUM)

ELEMENT	ALPHA	M	DT (MIN)	DX (FT)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	MAXIMUM CELERITY (FPS)
MAIN	7.22	1.25	1.19	1183.33	196.12	758.95	0.80	17.51

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1191E+02 EXCESS=0.0000E+00 OUTFLOW=0.1191E+02 BASIN STORAGE=0.3209E-10 PERCENT ERROR= 0.0

INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

MAIN	7.22	1.25	2.00	192.66	760.00	0.80

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HYDROGRAPH AT STATION RSR51N

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 193.	12.67		23.	6.	2.	2.
		(INCHES)	0.754	0.800	0.800	0.800
		(AC-FT)	11.	12.	12.	12.

CUMULATIVE AREA = 0.28 SQ MI

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70 KK     *    SR51SP  *
          *            *
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Runoff from south half of Paradise Valley Park

SUBBASIN RUNOFF DATA

72 BA SUBBASIN CHARACTERISTICS

TAREA	0.09	SUBBASIN AREA

PRECIPITATION DATA

9 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

HYDRO-35			TP-40					TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.09

73 LG GREEN AND AMPT LOSS RATE

STRTL	0.35	STARTING LOSS
DTH	0.25	MOISTURE DEFICIT
PSIF	5.00	WETTING FRONT SUCTION
XKSAT	0.25	HYDRAULIC CONDUCTIVITY
RTIMP	0.00	PERCENT IMPERVIOUS AREA

74 UC CLARK UNITGRAPH

TC	0.59	TIME OF CONCENTRATION
R	0.53	STORAGE COEFFICIENT

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= 0.59 HR, R= 0.53 HR

SNYDER TP= 0.55 HR, CP= 0.61

UNIT HYDROGRAPH

94 END-OF-PERIOD ORDINATES

1.	4.	8.	13.	18.	24.	30.	36.	43.	49.
54.	59.	63.	65.	67.	68.	68.	66.	63.	59.
55.	52.	49.	46.	43.	40.	38.	36.	33.	31.
29.	28.	26.	24.	23.	21.	20.	19.	18.	17.
16.	15.	14.	13.	12.	11.	11.	10.	9.	9.
8.	8.	7.	7.	7.	6.	6.	5.	5.	5.
4.	4.	4.	4.	3.	3.	3.	3.	3.	3.
2.	2.	2.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.						

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HYDROGRAPH AT STATION SR51SP

TOTAL RAINFALL = 3.37, TOTAL LOSS = 1.90, TOTAL EXCESS = 1.47

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	66.63-HR
(CFS)	(HR)				

```
                        (CFS)
+     91.     12.53                14.         4.         1.         1.
                      (INCHES)    1.465      1.465      1.465      1.465
                       (AC-FT)      7.         7.         7.         7.

                      CUMULATIVE AREA =    0.09 SQ MI
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          *            *
  75 KK   *   DETBAS   *
          *            *
          **************
                                Route outflow hydrograph through imaginary basin to account for
                                City of Phoenix 100-year 2-hour retention policy for Parks & Rec Center

    DT          DIVERSION
                     ISTAD        RET3  DIVERSION HYDROGRAPH IDENTIFICATION
                    DSTRMX        2.50  MAXIMUM VOLUME TO BE DIVERTED

    DI             INFLOW        0.00    100.00    200.00    300.00

    DQ       DIVERTED FLOW       0.00    100.00    200.00    300.00

                                                              ***

     ***            ***            ***            ***            ***

                      DIVERSION HYDROGRAPH     RET3

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR     66.63-HR
+   (CFS)       (HR)
                        (CFS)
+     91.     12.53                5.         1.         0.         0.
                      (INCHES)    0.515      0.515      0.515      0.515
                       (AC-FT)      2.         2.         2.         2.

                      CUMULATIVE AREA =    0.09 SQ MI

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION   DETBAS

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR     66.63-HR
+   (CFS)       (HR)
                        (CFS)
+     89.     12.60                9.         2.         1.         1.
                      (INCHES)    0.949      0.949      0.949      0.949
                       (AC-FT)      5.         5.         5.         5.

                      CUMULATIVE AREA =    0.09 SQ MI
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          *            *
81 KK     *   REL40E   *
          *            *
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Runoff from subdivision SE quad. of 40th Street & Union Hills

SUBBASIN RUNOFF DATA

83 BA SUBBASIN CHARACTERISTICS

TAREA	0.09	SUBBASIN AREA

PRECIPITATION DATA

9 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.09

84 LG GREEN AND AMPT LOSS RATE

STRTL	0.20	STARTING LOSS
DTH	0.25	MOISTURE DEFICIT
PSIF	3.50	WETTING FRONT SUCTION
XKSAT	0.25	HYDRAULIC CONDUCTIVITY
RTIMP	41.00	PERCENT IMPERVIOUS AREA

85 UC CLARK UNITGRAPH

TC	0.32	TIME OF CONCENTRATION
R	0.30	STORAGE COEFFICIENT

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= 0.32 HR, R= 0.30 HR

SNYDER TP= 0.29 HR, CP= 0.59

UNIT HYDROGRAPH

53 END-OF-PERIOD ORDINATES

5.	17.	35.	55.	77.	97.	113.	123.	127.	123.
112.	101.	90.	81.	72.	64.	58.	52.	46.	41.
37.	33.	30.	26.	24.	21.	19.	17.	15.	14.
12.	11.	10.	9.	8.	7.	6.	6.	5.	4.
4.	4.	3.	3.	3.	2.	2.	2.	2.	1.
1.	1.	1.							

*** *** *** *** ***

HYDROGRAPH AT STATION REL40E

TOTAL RAINFALL = 3.37, TOTAL LOSS = 1.02, TOTAL EXCESS = 2.34

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 172.	12.30		22.	6.	2.	2.
		(INCHES)	2.108	2.332	2.333	2.333
		(AC-FT)	11.	12.	12.	12.

CUMULATIVE AREA = 0.09 SQ MI

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          *            *
 86 KK    *   RREL40   *     E
          *            *
          **************
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Route hydrograph from 40th St. & Robert E. Lee St. to Campo Bello Dr.
at CBD40E in 40th Street.

HYDROGRAPH ROUTING DATA

89 RS	STORAGE ROUTING		
	NSTPS	2	NUMBER OF SUBREACHES
	ITYP	FLOW	TYPE OF INITIAL CONDITION
	RSVRIC	0.00	INITIAL CONDITION
	X	0.00	WORKING R AND D COEFFICIENT
90 RC	NORMAL DEPTH CHANNEL		
	ANL	0.016	LEFT OVERBANK N-VALUE
	ANCH	0.016	MAIN CHANNEL N-VALUE
	ANR	0.016	RIGHT OVERBANK N-VALUE
	RLNTH	1100.	REACH LENGTH
	SEL	0.0056	ENERGY SLOPE
	ELMAX	0.0	MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

CROSS-SECTION DATA

		--- LEFT OVERBANK ---			+ ------ MAIN CHANNEL -------			+ --- RIGHT OVERBANK ---	
92 RY	ELEVATION	3.00	0.50	1.50	1.00	1.00	1.50	2.00	3.00
91 RX	DISTANCE	0.00	3.00	24.00	24.50	62.50	63.00	74.00	96.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.00	0.02	0.04	0.10	0.27	0.45	0.65	0.85	1.06
OUTFLOW	0.00	0.22	1.37	4.04	9.32	27.98	59.14	101.19	155.31	222.43
ELEVATION	0.50	0.63	0.76	0.89	1.03	1.16	1.29	1.42	1.55	1.68
STORAGE	1.28	1.52	1.76	2.01	2.28	2.55	2.83	3.13	3.43	3.74
OUTFLOW	299.91	387.75	486.00	594.71	713.96	843.87	984.53	1136.09	1298.67	1472.42
ELEVATION	1.82	1.95	2.08	2.21	2.34	2.47	2.61	2.74	2.87	3.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 300. TO 1472.

THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

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HYDROGRAPH AT STATION RREL40

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
+ 170.	12.37		22.	6.	2.	2.
		(INCHES)	2.108	2.331	2.333	2.333
		(AC-FT)	11.	12.	12.	12.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	66.63-HR
0.	12.33	0.	0.	0.	0.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	66.63-HR
1.58	12.37	0.96	0.76	0.60	0.60

CUMULATIVE AREA = 0.09 SQ MI

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          *            *
93 KK     *   UH42NE   *
          *            *
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Runoff from subdivision NE quad. of 42nd Street & Union Hills

SUBBASIN RUNOFF DATA

95 BA SUBBASIN CHARACTERISTICS

TAREA 0.08 SUBBASIN AREA

PRECIPITATION DATA

9 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.08

96 LG GREEN AND AMPT LOSS RATE

STRTL	0.20	STARTING LOSS
DTH	0.25	MOISTURE DEFICIT
PSIF	3.50	WETTING FRONT SUCTION
XKSAT	0.25	HYDRAULIC CONDUCTIVITY
RTIMP	52.00	PERCENT IMPERVIOUS AREA

```
97 UC          CLARK UNITGRAPH
                        TC        0.30  TIME OF CONCENTRATION
                         R        0.13  STORAGE COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=  0.30 HR,       R=  0.13 HR
                                        SNYDER   TP=  0.24 HR,      CP=  0.76

                                                   UNIT HYDROGRAPH
                                             26 END-OF-PERIOD ORDINATES
                 9.      34.      66.     100.     133.     158.     171.     172.     160.     133.
               103.      79.      61.      47.      37.      28.      22.      17.      13.      10.
                 8.       6.       5.       4.       3.       2.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   UH42NE

    TOTAL RAINFALL =    3.37, TOTAL LOSS =    0.83, TOTAL EXCESS =    2.54

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     212.      12.23                   20.         6.          2.          2.
                         (INCHES)     2.239       2.523       2.524       2.524
                         (AC-FT)       10.         11.         11.         11.

                         CUMULATIVE AREA =    0.08 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
98 KK       *   DETBAS   *
            *            *
            **************
                                Route outflow hydrograph through imaginary basin to account for
                                City of Phoenix 100-year 2-hour retention policy

    DT          DIVERSION
                     ISTAD        RET4  DIVERSION HYDROGRAPH IDENTIFICATION
                    DSTRMX       10.00  MAXIMUM VOLUME TO BE DIVERTED

    DI             INFLOW        0.00    100.00    200.00    300.00

    DQ       DIVERTED FLOW       0.00    100.00    200.00    300.00

                                                          ***

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DIVERSION HYDROGRAPH RET4

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
212.	12.23		19.	5.	2.	2.
		(INCHES)	2.192	2.287	2.287	2.287
		(AC-FT)	10.	10.	10.	10.

CUMULATIVE AREA = 0.08 SQ MI

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HYDROGRAPH AT STATION DETBAS

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
4.	13.43		2.	1.	0.	0.
		(INCHES)	0.182	0.238	0.238	0.238
		(AC-FT)	1.	1.	1.	1.

CUMULATIVE AREA = 0.08 SQ MI

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              *            *
104 KK        *   RUH42N   *     E
              *            *
              **************
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Route hydrograph from 42nd St. and Union Hills to 40th & Campo Bello Dr.
Route through street network.

HYDROGRAPH ROUTING DATA

107 RS STORAGE ROUTING

NSTPS	11	NUMBER OF SUBREACHES
ITYP	FLOW	TYPE OF INITIAL CONDITION
RSVRIC	0.00	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

108 RC NORMAL DEPTH CHANNEL

ANL	0.016	LEFT OVERBANK N-VALUE
ANCH	0.016	MAIN CHANNEL N-VALUE
ANR	0.016	RIGHT OVERBANK N-VALUE
RLNTH	5500.	REACH LENGTH
SEL	0.0046	ENERGY SLOPE
ELMAX	0.0	MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

CROSS-SECTION DATA

--- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---

110 RY	ELEVATION	3.00	0.50	1.50	1.00	1.00	1.50	2.00	3.00
109 RX	DISTANCE	0.00	3.00	24.00	24.50	62.50	63.00	74.00	96.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.02	0.10	0.22	0.51	1.37	2.27	3.23	4.24	5.31
OUTFLOW	0.00	0.20	1.24	3.66	8.44	25.36	53.60	91.71	140.77	201.59
ELEVATION	0.50	0.63	0.76	0.89	1.03	1.16	1.29	1.42	1.55	1.68
STORAGE	6.42	7.58	8.80	10.06	11.38	12.74	14.16	15.63	17.15	18.72
OUTFLOW	271.81	351.43	440.48	539.00	647.09	764.82	892.31	1029.67	1177.02	1334.49
ELEVATION	1.82	1.95	2.08	2.21	2.34	2.47	2.61	2.74	2.87	3.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 272. TO 1334.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

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HYDROGRAPH AT STATION RUH42N

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 3.	14.37		2.	1.	0.	0.
		(INCHES)	0.175	0.238	0.238	0.238
		(AC-FT)	1.	1.	1.	1.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (AC-FT)	(HR)				
0.	14.23	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (FEET)	(HR)				
0.87	14.37	0.77	0.61	0.54	0.54

CUMULATIVE AREA = 0.08 SQ MI

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              **************
              *            *
111 KK        *   CBD40E   *
              *            *
              **************
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Runoff from subdivision east side of 40th Street & Campo Bello

SUBBASIN RUNOFF DATA

113 BA SUBBASIN CHARACTERISTICS

TAREA 0.17 SUBBASIN AREA

PRECIPITATION DATA

9 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

HYDRO-35			TP-40					TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.17

114 LG GREEN AND AMPT LOSS RATE

STRTL	0.20	STARTING LOSS
DTH	0.25	MOISTURE DEFICIT
PSIF	3.50	WETTING FRONT SUCTION
XKSAT	0.25	HYDRAULIC CONDUCTIVITY
RTIMP	26.00	PERCENT IMPERVIOUS AREA

115 UC CLARK UNITGRAPH

TC	0.49	TIME OF CONCENTRATION
R	0.53	STORAGE COEFFICIENT

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= 0.49 HR, R= 0.53 HR

SNYDER TP= 0.45 HR, CP= 0.55

UNIT HYDROGRAPH

92 END-OF-PERIOD ORDINATES

3.	9.	19.	31.	44.	59.	74.	89.	103.	114.
124.	131.	135.	137.	134.	127.	119.	112.	105.	99.
93.	87.	82.	77.	72.	68.	64.	60.	56.	53.
49.	46.	44.	41.	38.	36.	34.	32.	30.	28.
26.	25.	23.	22.	21.	19.	18.	17.	16.	15.
14.	13.	12.	12.	11.	10.	10.	9.	9.	8.
7.	7.	7.	6.	6.	5.	5.	5.	5.	4.
4.	4.	4.	3.	3.	3.	3.	3.	2.	2.
2.	2.	2.	2.	2.	2.	1.	1.	1.	1.
1.	1.								

*** *** *** *** ***

HYDROGRAPH AT STATION CBD40E

TOTAL RAINFALL = 3.37, TOTAL LOSS = 1.29, TOTAL EXCESS = 2.08

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
205.	12.47		35.	9.	3.	3.
		(INCHES)	1.929	2.071	2.073	2.073
		(AC-FT)	17.	19.	19.	19.

CUMULATIVE AREA = 0.17 SQ MI

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** **

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          *            *
116 KK    *     COMB3  *
          *            *
          **************
                                Combine hydrographs at 40th St. & Campo Bello Dr.

118 HC          HYDROGRAPH COMBINATION
                     ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION    COMB3

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)      (HR)
                          (CFS)
+    362.     12.40                   58.        16.         6.          6.
                        (INCHES)    1.543      1.708       1.711       1.711
                         (AC-FT)      29.        32.         32.         32.

                        CUMULATIVE AREA =    0.35 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** **

          **************
          *            *
119 KK    *    RCBD40  *     E
          *            *
          **************
                                Route combine flows from 40th St. and Campo Bello Drive to northwest
                                corner of Paradise Valley High School, through the City of Phoenix
                                Parks and Rec. Center.  Channel is shallow flow across desert.

             HYDROGRAPH ROUTING DATA

123 RS          STORAGE ROUTING
                     NSTPS           3  NUMBER OF SUBREACHES
                      ITYP        FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC        0.00  INITIAL CONDITION
                         X        0.00 WORKING R AND D COEFFICIENT

124 RC          NORMAL DEPTH CHANNEL
                       ANL       0.025  LEFT OVERBANK N-VALUE
                      ANCH       0.025  MAIN CHANNEL N-VALUE
                       ANR       0.025  RIGHT OVERBANK N-VALUE
                     RLNTH       1450.  REACH LENGTH
                       SEL      0.0064  ENERGY SLOPE
```

ELMAX 0.0 MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

CROSS-SECTION DATA

		--- LEFT OVERBANK ---			+ ------ MAIN CHANNEL		------- + --- RIGHT OVERBANK ---		
126 RY	ELEVATION	4.00	2.50	2.00	0.50	0.50	2.00	2.50	4.00
125 RX	DISTANCE	0.00	24.00	32.00	40.00	50.00	58.00	64.00	88.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.07	0.15	0.24	0.34	0.46	0.58	0.72	0.88	1.05
OUTFLOW	0.00	2.94	9.73	19.95	33.66	50.98	72.11	97.23	126.54	166.26
ELEVATION	0.50	0.68	0.87	1.05	1.24	1.42	1.61	1.79	1.97	2.16
STORAGE	1.25	1.48	1.75	2.06	2.40	2.77	3.19	3.64	4.12	4.64
OUTFLOW	213.10	267.15	329.28	400.66	482.15	574.56	678.63	795.12	924.71	1068.09
ELEVATION	2.34	2.53	2.71	2.89	3.08	3.26	3.45	3.63	3.82	4.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 482. TO 1068.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RCBD40

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
360.	12.47		58.	16.	6.	6.
		(INCHES)	1.543	1.708	1.711	1.711
		(AC-FT)	29.	32.	32.	32.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	66.63-HR
1.	12.47	0.	0.	0.	0.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	66.63-HR
2.79	12.47	1.21	0.77	0.60	0.60

CUMULATIVE AREA = 0.35 SQ MI

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*            *
127 KK  *  COMB4  *
*            *
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Combine flows at NW corner of Paradise Valley High School

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129 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION    COMB4

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
+   (CFS)      (HR)
                         (CFS)
+    416.     12.60                67.         18.          7.          7.
                      (INCHES)   1.420       1.550       1.552       1.552
                       (AC-FT)     33.         36.         36.         36.

                      CUMULATIVE AREA =    0.44 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** **


          **************
          *            *
130 KK    *    RSR51S  *     P
          *            *
          **************
                           Route flows Paradise Valley Park through PV HS using
                           maintenance road along west side of school to Bell Road

            HYDROGRAPH ROUTING DATA

133 RS          STORAGE ROUTING
                     NSTPS          3  NUMBER OF SUBREACHES
                      ITYP       FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC       0.00  INITIAL CONDITION
                         X       0.00 WORKING R AND D COEFFICIENT

134 RC          NORMAL DEPTH CHANNEL
                       ANL      0.016  LEFT OVERBANK N-VALUE
                      ANCH      0.016  MAIN CHANNEL N-VALUE
                       ANR      0.016  RIGHT OVERBANK N-VALUE
                     RLNTH      1300.  REACH LENGTH
                       SEL     0.0054  ENERGY SLOPE
                     ELMAX        0.0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
136 RY       ELEVATION    3.00     1.50     1.50     1.00     1.00     1.50     1.50     3.00
135 RX       DISTANCE     0.00    13.00    18.50    19.00    49.00    49.50    51.00    51.10

                                                          ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE      0.00     0.09     0.19     0.29     0.38     0.49     0.61     0.73     0.86     0.99
```

OUTFLOW	0.00	4.81	15.27	30.00	48.43	70.42	97.35	128.62	163.93	203.12
ELEVATION	1.00	1.11	1.21	1.32	1.42	1.53	1.63	1.74	1.84	1.95
STORAGE	1.12	1.26	1.40	1.54	1.68	1.83	1.98	2.13	2.29	2.45
OUTFLOW	246.10	292.80	343.17	397.18	454.81	516.06	580.91	649.36	721.41	797.08
ELEVATION	2.05	2.16	2.26	2.37	2.47	2.58	2.68	2.79	2.89	3.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 97. TO 797.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RSR51S

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
404.	12.63		67.	18.	7.	7.
		(INCHES)	1.420	1.550	1.552	1.552
		(AC-FT)	33.	36.	36.	36.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	66.63-HR
1.	12.63	0.	0.	0.	0.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	66.63-HR
2.38	12.63	1.38	1.13	1.05	1.05

CUMULATIVE AREA = 0.44 SQ MI

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*            *
*   BRPVHS   *
*            *
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137 KK

Runoff from Paradise Valley High School 40th Street & Bell Road

SUBBASIN RUNOFF DATA

139 BA

SUBBASIN CHARACTERISTICS

TAREA 0.07 SUBBASIN AREA

PRECIPITATION DATA

9 PH

DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

```
                                        STORM AREA =    0.07

140 LG          GREEN AND AMPT LOSS RATE
                      STRTL       0.20  STARTING LOSS
                        DTH       0.25  MOISTURE DEFICIT
                       PSIF       4.20  WETTING FRONT SUCTION
                      XKSAT       0.40  HYDRAULIC CONDUCTIVITY
                      RTIMP      43.00  PERCENT IMPERVIOUS AREA

141 UC          CLARK UNITGRAPH
                         TC       0.26  TIME OF CONCENTRATION
                          R       0.22  STORAGE COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=  0.26 HR,      R=  0.22 HR
                                  SNYDER   TP=  0.23 HR,     CP=  0.62

                                          UNIT HYDROGRAPH
                                     40 END-OF-PERIOD ORDINATES
              6.      22.      44.      69.      93.     110.     118.     116.     104.      89.
             77.      66.      57.      49.      42.      36.      31.      27.      23.      20.
             17.      14.      12.      11.       9.       8.       7.       6.       5.       4.
              4.       3.       3.       2.       2.       2.       1.       1.       1.       1.

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   BRPVHS

    TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.15, TOTAL EXCESS =    2.21

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                            (CFS)
+     140.     12.27                14.         4.          1.          1.
                          (INCHES)  1.969       2.204       2.205       2.205
                           (AC-FT)   7.          8.          8.          8.

                          CUMULATIVE AREA =    0.07 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
142 KK    *     SPLIT  *
          *            *
          **************
                         Split 2/3 of runoff to south across Bell Road in 2 dip sections

    DT          DIVERSION
                     ISTAD      PVH40S  DIVERSION HYDROGRAPH IDENTIFICATION
```

```
   DI            INFLOW        0.00      3.00      6.00     24.00     54.00     96.00    150.00    210.00

   DQ      DIVERTED FLOW       0.00      2.00      4.00     16.00     36.00     64.00    100.00    140.00

                                                                  ***

    ***            ***            ***            ***            ***

                      DIVERSION HYDROGRAPH   PVH40S

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                          (CFS)
+    93.      12.27                  10.          3.          1.          1.
                         (INCHES)   1.313       1.469       1.470       1.470
                          (AC-FT)     5.          5.          5.          5.

                         CUMULATIVE AREA =    0.07 SQ MI


    ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION    SPLIT

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                          (CFS)
+    47.      12.27                   5.          1.          0.          0.
                         (INCHES)   0.656       0.735       0.735       0.735
                          (AC-FT)     2.          3.          3.          3.

                         CUMULATIVE AREA =    0.07 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 147 KK   *     COMB5  *
          *            *
          **************
                          Combine flows at 38th Street & Bell Road

 149 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

    ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION    COMB5

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
```

```
+   (CFS)       (HR)
                          (CFS)
+     420.      12.63                72.         20.         7.          7.
                        (INCHES)    1.317       1.440       1.443       1.443
                         (AC-FT)     36.         39.         39.         39.

                        CUMULATIVE AREA =    0.51 SQ MI
```

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            **************
            *            *
 150 KK     *     SPLIT  *
            *            *
            **************
                                Split flows @ 38th St. & Bell Road to South and West

     DT          DIVERSION
                      ISTAD       BR38S  DIVERSION HYDROGRAPH IDENTIFICATION

     DI             INFLOW       0.00      3.00      10.00     25.00     55.00     90.00     140.00    300.00    400.00

     DQ       DIVERTED FLOW      0.00      1.00      5.00      14.00     20.00     55.00     105.00    265.00    365.00

                                                                  ***

      ***            ***            ***            ***            ***

                        DIVERSION HYDROGRAPH    BR38S

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     385.      12.63                57.         15.         5.          5.
                        (INCHES)    1.039       1.082       1.083       1.083
                         (AC-FT)     28.         29.         29.         29.

                        CUMULATIVE AREA =    0.51 SQ MI


      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    SPLIT

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+      35.      12.10                15.         5.          2.          2.
                        (INCHES)    0.278       0.358       0.359       0.359
                         (AC-FT)      7.         10.         10.         10.

                        CUMULATIVE AREA =    0.51 SQ MI
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          **************
          *            *
155 KK    *   RBRPVH   *     S
          *            *
          **************
```

Route flows from 38th St. & Bell Rd. to SR-51 & Bell Road

HYDROGRAPH ROUTING DATA

157 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	FLOW	TYPE OF INITIAL CONDITION
RSVRIC	0.00	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

158 RC NORMAL DEPTH CHANNEL

ANL	0.016	LEFT OVERBANK N-VALUE
ANCH	0.016	MAIN CHANNEL N-VALUE
ANR	0.016	RIGHT OVERBANK N-VALUE
RLNTH	500.	REACH LENGTH
SEL	0.0010	ENERGY SLOPE
ELMAX	0.0	MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

CROSS-SECTION DATA

		--- LEFT OVERBANK ---			+ ------ MAIN CHANNEL -------			+ --- RIGHT OVERBANK ---	
160 RY	ELEVATION	67.00	63.40	63.30	62.80	62.80	63.30	64.00	67.00
159 RX	DISTANCE	90.00	100.00	104.90	105.00	132.90	133.00	134.00	144.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.07	0.14	0.22	0.31	0.39	0.49	0.58	0.68	0.78
OUTFLOW	0.00	6.59	20.75	41.14	68.33	101.52	140.32	184.62	234.39	289.60
ELEVATION	62.80	63.02	63.24	63.46	63.68	63.91	64.13	64.35	64.57	64.79
STORAGE	0.88	0.99	1.10	1.22	1.33	1.46	1.58	1.71	1.84	1.98
OUTFLOW	350.23	416.30	487.83	564.85	647.40	735.52	829.26	928.68	1033.82	1144.76
ELEVATION	65.01	65.23	65.45	65.67	65.89	66.12	66.34	66.56	66.78	67.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 736. TO 1145.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RBRPVH

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
(CFS)	(HR)					
		(CFS)				
+ 35.	12.50		15.	5.	2.	2.
		(INCHES)	0.277	0.358	0.359	0.359

```
                    (AC-FT)        7.        10.        10.        10.

 PEAK STORAGE   TIME                      MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR      72-HR     66.63-HR
+  (AC-FT)      (HR)
      0.       12.30                0.         0.         0.         0.

  PEAK STAGE    TIME                      MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR      72-HR     66.63-HR
+   (FEET)      (HR)
    63.40      12.70               63.11      62.91      62.84      62.84

                    CUMULATIVE AREA =    0.51 SQ MI
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          **************
          *            *
 161 KK   *   SR51BN   *
          *            *
          **************
                         Runoff from mini-storage lot north of Bell Road, west of 38th Street
                         Assume retention basins are removed by right turn lane onto SR-51

            SUBBASIN RUNOFF DATA

 164 BA       SUBBASIN CHARACTERISTICS
                   TAREA        0.02  SUBBASIN AREA

              PRECIPITATION DATA

  9 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                  STORM AREA =    0.02

 165 LG       GREEN AND AMPT LOSS RATE
                   STRTL        0.05  STARTING LOSS
                     DTH        0.25  MOISTURE DEFICIT
                    PSIF        3.50  WETTING FRONT SUCTION
                   XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                   RTIMP       85.00  PERCENT IMPERVIOUS AREA

 166 UC       CLARK UNITGRAPH
                      TC        0.15  TIME OF CONCENTRATION
                       R        0.25  STORAGE COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=  0.15 HR,       R=  0.25 HR
                                    SNYDER   TP=  0.14 HR,      CP=  0.42
```

UNIT HYDROGRAPH
43 END-OF-PERIOD ORDINATES

3.	11.	22.	30.	32.	29.	25.	22.	19.	17.
15.	13.	11.	10.	9.	8.	7.	6.	5.	4.
4.	3.	3.	3.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	0.	0.	0.	0.
0.	0.	0.							

*** *** *** *** ***

HYDROGRAPH AT STATION SR51BN

TOTAL RAINFALL = 3.37, TOTAL LOSS = 0.25, TOTAL EXCESS = 3.12

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
39.	12.20		5.	1.	1.	1.
		(INCHES)	2.637	3.101	3.104	3.104
		(AC-FT)	2.	3.	3.	3.

CUMULATIVE AREA = 0.02 SQ MI

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          **************
          *            *
167 KK    *     COMB6  *
          *            *
          **************
```

Combine flow in Bell Road at SR-51

169 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

***

*** *** *** *** ***

HYDROGRAPH AT STATION COMB6

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
73.	12.20		20.	6.	2.	2.
		(INCHES)	0.353	0.446	0.449	0.449
		(AC-FT)	10.	12.	13.	13.

CUMULATIVE AREA = 0.52 SQ MI

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
170 KK      *     COMB7  *
            *            *
            **************
                                Combine flow in SR-51 at Bell Road

172 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION    COMB7

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                        (CFS)
+    241.     12.67                42.         12.          4.          4.
                      (INCHES)    0.488       0.569       0.571       0.571
                       (AC-FT)     21.         24.         24.         24.

                      CUMULATIVE AREA =    0.80 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
173 KK      *   RSR51B   *     N
            *            *
            **************
                                Route flows from COMB7 @ SR-51 and Bell Road to nr Phelps Rd. & SR-51
                                - PIPE FLOW

              HYDROGRAPH ROUTING DATA

176 RK          KINEMATIC WAVE STREAM ROUTING
                          L      1100.  CHANNEL LENGTH
                          S     0.0033  SLOPE
                          N      0.012  CHANNEL ROUGHNESS COEFFICIENT
                         CA       0.00  CONTRIBUTING AREA
                      SHAPE       CIRC  CHANNEL SHAPE
                         WD       6.00  BOTTOM WIDTH OR DIAMETER
                          Z       0.00  SIDE SLOPE
                     NDXMIN          2  MINIMUM NUMBER OF DX INTERVALS

                                                          ***

        *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1
```

COMPUTED KINEMATIC PARAMETERS
VARIABLE TIME STEP
(DT SHOWN IS A MINIMUM)

ELEMENT	ALPHA	M	DT (MIN)	DX (FT)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	MAXIMUM CELERITY (FPS)
MAIN	5.19	1.25	0.45	366.67	240.61	760.90	0.57	13.97

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2442E+02 EXCESS=0.0000E+00 OUTFLOW=0.2442E+02 BASIN STORAGE=0.4279E-10 PERCENT ERROR= 0.0

INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

MAIN	5.19	1.25	2.00	239.95	760.00	0.57

*** *** *** *** ***

HYDROGRAPH AT STATION RSR51B

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
240.	12.67		42.	12.	4.	4.
		(INCHES)	0.489	0.569	0.571	0.571
		(AC-FT)	21.	24.	24.	24.

CUMULATIVE AREA = 0.80 SQ MI

*** ***

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              **************
              *            *
177 KK        *   SR51BS   *
              *            *
              **************
```

Runoff from SW quad. of 38th Street & Bell Road

SUBBASIN RUNOFF DATA

179 BA SUBBASIN CHARACTERISTICS
TAREA 0.03 SUBBASIN AREA

PRECIPITATION DATA

9 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.03

```
180 LG          GREEN AND AMPT LOSS RATE
                      STRTL        0.20  STARTING LOSS
                        DTH        0.25  MOISTURE DEFICIT
                       PSIF        3.50  WETTING FRONT SUCTION
                      XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                      RTIMP       38.00  PERCENT IMPERVIOUS AREA

181 UC          CLARK UNITGRAPH
                         TC        0.18  TIME OF CONCENTRATION
                          R        0.17  STORAGE COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                    ***

                                              UNIT HYDROGRAPH PARAMETERS
                                       CLARK   TC=  0.18 HR,      R=  0.17 HR
                                      SNYDER   TP=  0.16 HR,     CP=  0.58

                                              UNIT HYDROGRAPH
                                         30 END-OF-PERIOD ORDINATES
              5.      20.      39.      56.      65.      62.      53.      43.      35.      29.
             24.      20.      16.      13.      11.       9.       7.       6.       5.       4.
              3.       3.       2.       2.       2.       1.       1.       1.       1.       1.

     ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   SR51BS

    TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.08, TOTAL EXCESS =    2.29

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+      71.      12.20                 6.          2.          1.          1.
                        (INCHES)   2.074       2.281       2.282       2.282
                         (AC-FT)      3.          3.          3.          3.

                        CUMULATIVE AREA =    0.03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
182 KK      *   DETBAS   *
            *            *
            **************
                                Route outflow hydrograph through imaginary basin to account for
                                City of Phoenix 100-year 2-hour retention policy

    DT          DIVERSION
                      ISTAD       RET7  DIVERSION HYDROGRAPH IDENTIFICATION
                     DSTRMX       3.00  MAXIMUM VOLUME TO BE DIVERTED
```

```
    DI            INFLOW        0.00    100.00    200.00    300.00

    DQ      DIVERTED FLOW       0.00    100.00    200.00    300.00

                                                                 ***

     ***            ***            ***            ***            ***

                        DIVERSION HYDROGRAPH     RET7

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                            (CFS)
+     71.     12.20                   6.          2.          1.          1.
                          (INCHES)  1.949       2.009       2.009       2.009
                           (AC-FT)    3.          3.          3.          3.

                          CUMULATIVE AREA =    0.03 SQ MI


     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   DETBAS

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                            (CFS)
+      7.     12.80                   1.          0.          0.          0.
                          (INCHES)  0.226       0.273       0.273       0.273
                           (AC-FT)    0.          0.          0.          0.

                          CUMULATIVE AREA =    0.03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
188 KK    *     COMB8  *
          *            *
          **************
                          Combine flow in SR-51 at Phelps Road

190 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                 ***

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    COMB8

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
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```
                    (CFS)
+    240.    12.67                43.        12.        5.         5.
                  (INCHES)      0.479      0.559      0.561      0.561
                   (AC-FT)       21.        25.        25.        25.

                  CUMULATIVE AREA =    0.83 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** **


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          *            *
 191 KK   *    RSR51B  *     S
          *            *
          **************
                         Route flows from COMB8 @ SR-51 and Phelps Road to Paradise Lane & SR-51
                         - PIPE FLOW

            HYDROGRAPH ROUTING DATA

 194 RK       KINEMATIC WAVE STREAM ROUTING
                      L      1600.  CHANNEL LENGTH
                      S     0.0033  SLOPE
                      N      0.012  CHANNEL ROUGHNESS COEFFICIENT
                     CA       0.00  CONTRIBUTING AREA
                  SHAPE       CIRC  CHANNEL SHAPE
                     WD       6.00  BOTTOM WIDTH OR DIAMETER
                      Z       0.00  SIDE SLOPE
                 NDXMIN          2  MINIMUM NUMBER OF DX INTERVALS

                                                  ***
                          COMPUTED KINEMATIC PARAMETERS
                               VARIABLE TIME STEP
                            (DT SHOWN IS A MINIMUM)

              ELEMENT    ALPHA      M        DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                          PEAK                  CELERITY
                                             (MIN)      (FT)     (CFS)    (MIN)       (IN)      (FPS)

              MAIN         5.19     1.25      0.78    533.33    238.14   761.40      0.56      13.96


CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2483E+02  EXCESS=0.0000E+00 OUTFLOW=0.2483E+02 BASIN STORAGE=0.1171E-09 PERCENT ERROR=   0.0


                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


              MAIN         5.19     1.25      2.00              237.17   762.00      0.56

     ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   RSR51B

 PEAK FLOW     TIME                      MAXIMUM AVERAGE FLOW
                              6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
```

```
                    (CFS)
+    237.    12.70                43.        12.        5.         5.
                  (INCHES)      0.479      0.560      0.561      0.561
                  (AC-FT)        21.        25.        25.        25.

                  CUMULATIVE AREA =    0.83 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
195 KK    *   SR51PR   *
          *            *
          **************
                         Runoff from NE quad. of SR-51 & Paradise Lane

            SUBBASIN RUNOFF DATA

197 BA        SUBBASIN CHARACTERISTICS
                    TAREA        0.01  SUBBASIN AREA

              PRECIPITATION DATA

 9 PH                            DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                          STORM AREA =    0.01

198 LG        GREEN AND AMPT LOSS RATE
                    STRTL        0.20  STARTING LOSS
                      DTH        0.35  MOISTURE DEFICIT
                     PSIF        3.50  WETTING FRONT SUCTION
                    XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                    RTIMP       30.00  PERCENT IMPERVIOUS AREA

199 UC        CLARK UNITGRAPH
                       TC        0.15  TIME OF CONCENTRATION
                        R        0.21  STORAGE COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                          ***

                                   UNIT HYDROGRAPH PARAMETERS
                             CLARK   TC=  0.15 HR,      R=  0.21 HR
                            SNYDER   TP=  0.14 HR,     CP=  0.46

                                   UNIT HYDROGRAPH
                              36 END-OF-PERIOD ORDINATES
            2.      7.     13.     18.     19.     17.     14.     12.     10.      9.
            8.      6.      6.      5.      4.      3.      3.      3.      2.      2.
            2.      1.      1.      1.      1.      1.      1.      1.      0.      0.
            0.      0.      0.      0.      0.      0.
```

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     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   SR51PR

   TOTAL RAINFALL =   3.37, TOTAL LOSS =   1.28, TOTAL EXCESS =   2.09

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     20.      12.17                 2.          1.          0.          0.
                        (INCHES)   1.916       2.079       2.080       2.080
                         (AC-FT)     1.          1.          1.          1.

                        CUMULATIVE AREA =   0.01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** **


          **************
          *            *
  200 KK  *     COMB9  *
          *            *
          **************
                         Combine flow in SR-51 at Paradise Lane

  202 HC          HYDROGRAPH COMBINATION
                       ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION    COMB9

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+    241.      12.70                45.         13.          5.          5.
                        (INCHES)   0.494       0.576       0.577       0.577
                         (AC-FT)    22.         26.         26.         26.

                        CUMULATIVE AREA =   0.84 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  203 KK  *   RSR51P   *     R
          *            *
          **************
                         Route flows from COMB9 @ SR-51 and Paradise Lane to 36th Street Storm Dr
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- PIPE FLOW

HYDROGRAPH ROUTING DATA

206 RK KINEMATIC WAVE STREAM ROUTING

L	650.	CHANNEL LENGTH
S	0.0033	SLOPE
N	0.012	CHANNEL ROUGHNESS COEFFICIENT
CA	0.00	CONTRIBUTING AREA
SHAPE	CIRC	CHANNEL SHAPE
WD	6.00	BOTTOM WIDTH OR DIAMETER
Z	0.00	SIDE SLOPE
NDXMIN	2	MINIMUM NUMBER OF DX INTERVALS

***

COMPUTED KINEMATIC PARAMETERS
VARIABLE TIME STEP
(DT SHOWN IS A MINIMUM)

ELEMENT	ALPHA	M	DT (MIN)	DX (FT)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	MAXIMUM CELERITY (FPS)
MAIN	5.19	1.25	0.39	216.67	240.09	762.52	0.58	13.98

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2583E+02 EXCESS=0.0000E+00 OUTFLOW=0.2583E+02 BASIN STORAGE=0.6493E-10 PERCENT ERROR= 0.0

INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

MAIN	5.19	1.25	2.00	238.80	762.00	0.58

*** *** *** *** ***

HYDROGRAPH AT STATION RSR51P

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
239.	12.70	(CFS)	45.	13.	5.	5.
		(INCHES)	0.494	0.576	0.577	0.577
		(AC-FT)	22.	26.	26.	26.

CUMULATIVE AREA = 0.84 SQ MI

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**************
*            *
*   36thST   *
*            *
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207 KK

Runoff from subdivision north of Bell Road in 36th ST.

Concentration point south of Bell Road at proposed inlet on east side
2-yr 24-hour flow to memic COP storm drain capacity

SUBBASIN RUNOFF DATA

212 BA SUBBASIN CHARACTERISTICS

TAREA	0.07	SUBBASIN AREA

PRECIPITATION DATA

211 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

HYDRO-35			TP-40					TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.37	0.68	1.10	1.16	1.20	1.27	1.32	1.37	0.00	0.00	0.00	0.00

STORM AREA = 0.07

213 LG GREEN AND AMPT LOSS RATE

STRTL	0.23	STARTING LOSS
DTH	0.25	MOISTURE DEFICIT
PSIF	3.50	WETTING FRONT SUCTION
XKSAT	0.25	HYDRAULIC CONDUCTIVITY
RTIMP	26.90	PERCENT IMPERVIOUS AREA

214 UC CLARK UNITGRAPH

TC	0.33	TIME OF CONCENTRATION
R	0.34	STORAGE COEFFICIENT

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= 0.33 HR, R= 0.34 HR
SNYDER TP= 0.30 HR, CP= 0.56

UNIT HYDROGRAPH
60 END-OF-PERIOD ORDINATES

3.	11.	22.	36.	50.	64.	76.	83.	88.	87.
82.	74.	67.	61.	55.	50.	45.	41.	37.	34.
31.	28.	25.	23.	21.	19.	17.	15.	14.	13.
11.	10.	9.	9.	8.	7.	6.	6.	5.	5.
4.	4.	4.	3.	3.	3.	2.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.

*** *** *** *** ***

HYDROGRAPH AT STATION 36thST

TOTAL RAINFALL = 1.37, TOTAL LOSS = 0.70, TOTAL EXCESS = 0.67

	PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
+	(CFS)	(HR)					
			(CFS)				
+	44.	12.33		5.	1.	0.	0.
			(INCHES)	0.640	0.667	0.667	0.667
			(AC-FT)	2.	3.	3.	3.

CUMULATIVE AREA = 0.07 SQ MI

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
215 KK    *   R36thS   *     T
          *            *
          **************
                                Route flows from 36th Street south of Bell to SR-51 south of Paradise La
                                - PIPE FLOW

            HYDROGRAPH ROUTING DATA

218 RK        KINEMATIC WAVE STREAM ROUTING
                        L      3250.  CHANNEL LENGTH
                        S     0.0051  SLOPE
                        N      0.012  CHANNEL ROUGHNESS COEFFICIENT
                       CA       0.00  CONTRIBUTING AREA
                    SHAPE       CIRC  CHANNEL SHAPE
                       WD       3.50  BOTTOM WIDTH OR DIAMETER
                        Z       0.00  SIDE SLOPE
                   NDXMIN          2  MINIMUM NUMBER OF DX INTERVALS

                                                  ***
                                COMPUTED KINEMATIC PARAMETERS
                                     VARIABLE TIME STEP
                                  (DT SHOWN IS A MINIMUM)

                ELEMENT    ALPHA      M        DT       DX      PEAK    TIME TO     VOLUME    MAXIMUM
                                                                          PEAK                  CELERITY
                                                (MIN)     (FT)    (CFS)    (MIN)      (IN)      (FPS)

                MAIN         5.90     1.25      1.64   1083.33    43.60   742.43      0.67     11.00

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2562E+01  EXCESS=0.0000E+00 OUTFLOW=0.2564E+01 BASIN STORAGE=0.4013E-10 PERCENT ERROR=  -0.1

                                INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                MAIN         5.90     1.25      2.00              43.44   742.00      0.67

    ***          ***          ***          ***          ***

                   HYDROGRAPH AT STATION   R36thS

PEAK FLOW     TIME                      MAXIMUM AVERAGE FLOW
                                   6-HR      24-HR      72-HR    66.63-HR
  (CFS)       (HR)
                        (CFS)
+    43.     12.37                  5.         1.         0.         0.
                      (INCHES)   0.640      0.667      0.668      0.668
                       (AC-FT)      2.         3.         3.         3.

                      CUMULATIVE AREA =    0.07 SQ MI
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          **************
          *            *
219 KK    *     36th   *
          *            *
          **************
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Runoff from 36th Street from Bell to north of Tierra Buena.
50-year flow analysis

SUBBASIN RUNOFF DATA

223 BA SUBBASIN CHARACTERISTICS

TAREA	0.02	SUBBASIN AREA

PRECIPITATION DATA

222 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.02

224 LG GREEN AND AMPT LOSS RATE

STRTL	0.15	STARTING LOSS
DTH	0.25	MOISTURE DEFICIT
PSIF	3.50	WETTING FRONT SUCTION
XKSAT	0.25	HYDRAULIC CONDUCTIVITY
RTIMP	40.00	PERCENT IMPERVIOUS AREA

225 UC CLARK UNITGRAPH

TC	0.27	TIME OF CONCENTRATION
R	0.55	STORAGE COEFFICIENT

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= 0.27 HR, R= 0.55 HR
SNYDER TP= 0.27 HR, CP= 0.37

UNIT HYDROGRAPH
92 END-OF-PERIOD ORDINATES

1.	3.	6.	10.	14.	17.	20.	21.	21.	19.
18.	17.	16.	15.	14.	13.	13.	12.	11.	11.
10.	9.	9.	8.	8.	7.	7.	7.	6.	6.
5.	5.	5.	5.	4.	4.	4.	4.	3.	3.
3.	3.	3.	2.	2.	2.	2.	2.	2.	2.
2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.								

```
    ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION     36th

   TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.03, TOTAL EXCESS =    2.34

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
  (CFS)       (HR)
                         (CFS)
     30.     12.30                    5.          1.          1.          1.
                        (INCHES)    2.106       2.325       2.328       2.328
                         (AC-FT)      3.          3.          3.          3.

                        CUMULATIVE AREA =    0.02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
226 KK    *    COMB9B  *
          *            *
          **************
                          Combine flows in 36th Street, west of SR-51

228 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

    ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   COMB9B

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
  (CFS)       (HR)
                         (CFS)
     73.     12.37                   10.          3.          1.          1.
                        (INCHES)    0.993       1.066       1.067       1.067
                         (AC-FT)      5.          5.          5.          5.

                        CUMULATIVE AREA =    0.09 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
229 KK    *    COMB9C  *
          *            *
          **************
```

Combine flows in SR-51 off-site storm drain south of Paradise Ln.

```
231 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   COMB9C

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                         (CFS)
+     282.     12.70                 55.         16.          6.          6.
                       (INCHES)    0.544       0.625       0.627       0.627
                        (AC-FT)     27.         31.         31.         31.

                       CUMULATIVE AREA =    0.93 SQ MI
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          **************
          *            *
232 KK    *    RSR51P  *     R
          *            *
          **************
```

Route flows from COMB9B @ SR-51 and Paradise Lane to Tierra Buena & SR-5
- PIPE FLOW

```
            HYDROGRAPH ROUTING DATA

235 RK          KINEMATIC WAVE STREAM ROUTING
                         L        800.  CHANNEL LENGTH
                         S      0.0033  SLOPE
                         N       0.012  CHANNEL ROUGHNESS COEFFICIENT
                        CA        0.00  CONTRIBUTING AREA
                     SHAPE        CIRC  CHANNEL SHAPE
                        WD        6.00  BOTTOM WIDTH OR DIAMETER
                         Z        0.00  SIDE SLOPE
                    NDXMIN           2  MINIMUM NUMBER OF DX INTERVALS

                                                        ***

        *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

                                   COMPUTED KINEMATIC PARAMETERS
                                        VARIABLE TIME STEP
                                     (DT SHOWN IS A MINIMUM)

                ELEMENT    ALPHA       M        DT        DX      PEAK   TIME TO    VOLUME   MAXIMUM
                                                                          PEAK               CELERITY
                                                (MIN)      (FT)    (CFS)   (MIN)      (IN)     (FPS)
```

```
                MAIN          5.19      1.25       0.43    266.67    280.71    762.77      0.63      14.42

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3123E+02  EXCESS=0.0000E+00 OUTFLOW=0.3123E+02 BASIN STORAGE=0.1128E-09 PERCENT ERROR=   0.0

                                    INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                MAIN          5.19      1.25       2.00              277.76    762.00      0.63

    ***           ***           ***           ***           ***

                      HYDROGRAPH AT STATION   RSR51P

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
  (CFS)        (HR)
                          (CFS)
   278.      12.70                 55.         16.          6.          6.
                         (INCHES)  0.544      0.625       0.627       0.627
                          (AC-FT)   27.         31.         31.         31.

                         CUMULATIVE AREA =    0.93 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
236 KK    *   BUEN37   *
          *            *
          **************
                            Runoff from NE quad. of SR-51 & Tierra Buena

            SUBBASIN RUNOFF DATA

239 BA        SUBBASIN CHARACTERISTICS
                    TAREA        0.08  SUBBASIN AREA

              PRECIPITATION DATA

238 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                STORM AREA =    0.08

240 LG        GREEN AND AMPT LOSS RATE
                    STRTL        0.20  STARTING LOSS
                      DTH        0.25  MOISTURE DEFICIT
                     PSIF        3.50  WETTING FRONT SUCTION
                    XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                    RTIMP       26.00  PERCENT IMPERVIOUS AREA

241 UC        CLARK UNITGRAPH
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```
TC        0.34  TIME OF CONCENTRATION
 R        0.34  STORAGE COEFFICIENT

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                   ***

                          UNIT HYDROGRAPH PARAMETERS
                   CLARK   TC=  0.34 HR,      R=  0.34 HR
                  SNYDER   TP=  0.31 HR,     CP=  0.57

                          UNIT HYDROGRAPH
                     60 END-OF-PERIOD ORDINATES
     3.     12.     24.     39.     54.     70.     83.     93.     98.     99.
    94.     86.     78.     70.     64.     58.     52.     48.     43.     39.
    35.     32.     29.     26.     24.     22.     20.     18.     16.     15.
    13.     12.     11.     10.      9.      8.      7.      7.      6.      5.
     5.      5.      4.      4.      3.      3.      3.      3.      2.      2.
     2.      2.      2.      1.      1.      1.      1.      1.      1.      1.

  ***         ***         ***         ***         ***

              HYDROGRAPH AT STATION   BUEN37

  TOTAL RAINFALL =   3.37, TOTAL LOSS =   1.29, TOTAL EXCESS =   2.08

 PEAK FLOW    TIME                    MAXIMUM AVERAGE FLOW
                                 6-HR      24-HR      72-HR    66.63-HR
+  (CFS)      (HR)
                        (CFS)
+    134.    12.33                17.         5.         2.         2.
                      (INCHES)  1.931     2.073      2.074      2.074
                       (AC-FT)     8.         9.         9.         9.

                      CUMULATIVE AREA =   0.08 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 242 KK   *   DIVBUE   *    N37
          *            *
          **************
                        Divert Tierra Buia Flows into existing 36th Street Storm Drain

   DT        DIVERSION
                  ISTAD     36thSD  DIVERSION HYDROGRAPH IDENTIFICATION

   DI           INFLOW      0.00    100.00    200.00    300.00

   DQ     DIVERTED FLOW     0.00    100.00    200.00    300.00

                                                  ***

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DIVERSION HYDROGRAPH 36thSD

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
+ 134.	12.33		17.	5.	2.	2.
		(INCHES)	1.931	2.073	2.074	2.074
		(AC-FT)	8.	9.	9.	9.

CUMULATIVE AREA = 0.08 SQ MI

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HYDROGRAPH AT STATION DIVBUE

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
+ 0.	0.03		0.	0.	0.	0.
		(INCHES)	0.000	0.000	0.000	0.000
		(AC-FT)	0.	0.	0.	0.

CUMULATIVE AREA = 0.08 SQ MI

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          *            *
247 KK    *    COMB10  *
          *            *
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Combine flow in SR-51 at Tierra Buena

249 HC HYDROGRAPH COMBINATION

ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION COMB10

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
+ 278.	12.70		55.	16.	6.	6.
		(INCHES)	0.500	0.575	0.576	0.576
		(AC-FT)	27.	31.	31.	31.

CUMULATIVE AREA = 1.02 SQ MI

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
250 KK    *   RBUEN3   *     7
          *            *
          **************
                                Route flows from COMB10 @ SR-51 and Tierra Buena to Greenway & SR-51
                                - PIPE FLOW

             HYDROGRAPH ROUTING DATA

253 RK          KINEMATIC WAVE STREAM ROUTING
                          L       1350.  CHANNEL LENGTH
                          S      0.0033  SLOPE
                          N       0.012  CHANNEL ROUGHNESS COEFFICIENT
                         CA        0.00  CONTRIBUTING AREA
                      SHAPE        CIRC  CHANNEL SHAPE
                         WD        6.50  BOTTOM WIDTH OR DIAMETER
                          Z        0.00  SIDE SLOPE
                     NDXMIN           2  MINIMUM NUMBER OF DX INTERVALS

                                                  ***
                                COMPUTED KINEMATIC PARAMETERS
                                     VARIABLE TIME STEP
                                  (DT SHOWN IS A MINIMUM)

                  ELEMENT    ALPHA       M        DT       DX      PEAK    TIME TO     VOLUME    MAXIMUM
                                                                             PEAK                  CELERITY
                                                  (MIN)     (FT)    (CFS)    (MIN)      (IN)      (FPS)

                  MAIN         5.26     1.25      0.65   450.00   277.43   763.61      0.58      14.53

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3123E+02  EXCESS=0.0000E+00 OUTFLOW=0.3123E+02 BASIN STORAGE=0.2207E-09 PERCENT ERROR=   0.0

                                INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN         5.26     1.25      2.00            277.18   764.00      0.58

     ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   RBUEN3

 PEAK FLOW     TIME                      MAXIMUM AVERAGE FLOW
                                   6-HR      24-HR      72-HR    66.63-HR
+  (CFS)       (HR)
                          (CFS)
+    277.     12.73                55.        16.        6.         6.
                        (INCHES)  0.500     0.575     0.576      0.576
                         (AC-FT)    27.        31.        31.        31.

                        CUMULATIVE AREA =    1.02 SQ MI
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          *            *
254 KK    *   BR40NE   *
          *            *
          **************
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Runoff from development east of 40th Street, north of Bell Road

SUBBASIN RUNOFF DATA

256 BA SUBBASIN CHARACTERISTICS

TAREA 0.08 SUBBASIN AREA

PRECIPITATION DATA

238 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.08

257 LG GREEN AND AMPT LOSS RATE

STRTL	0.20	STARTING LOSS
DTH	0.25	MOISTURE DEFICIT
PSIF	3.50	WETTING FRONT SUCTION
XKSAT	0.25	HYDRAULIC CONDUCTIVITY
RTIMP	50.00	PERCENT IMPERVIOUS AREA

258 UC CLARK UNITGRAPH

TC	0.28	TIME OF CONCENTRATION
R	0.28	STORAGE COEFFICIENT

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= 0.28 HR, R= 0.28 HR

SNYDER TP= 0.25 HR, CP= 0.57

UNIT HYDROGRAPH

49 END-OF-PERIOD ORDINATES

5.	20.	40.	63.	86.	106.	118.	123.	118.	106.
94.	84.	74.	66.	59.	52.	46.	41.	36.	32.
29.	25.	23.	20.	18.	16.	14.	12.	11.	10.
9.	8.	7.	6.	5.	5.	4.	4.	3.	3.
3.	2.	2.	2.	2.	1.	1.	1.	1.	

*** *** *** *** ***

HYDROGRAPH AT STATION BR40NE

TOTAL RAINFALL = 3.37, TOTAL LOSS = 0.87, TOTAL EXCESS = 2.50

PEAK FLOW TIME MAXIMUM AVERAGE FLOW

			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 163.	12.27		20.	6.	2.	2.
		(INCHES)	2.214	2.487	2.489	2.489
		(AC-FT)	10.	11.	11.	11.

CUMULATIVE AREA = 0.08 SQ MI

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              **************
              *            *
 259 KK       *   DETBAS   *
              *            *
              **************
```

Route outflow hydrograph through imaginary basin to account for
City of Phoenix 100-year 2-hour retention policy

DT	DIVERSION					
		ISTAD	RET5	DIVERSION HYDROGRAPH IDENTIFICATION		
		DSTRMX	8.00	MAXIMUM VOLUME TO BE DIVERTED		
DI		INFLOW	0.00	100.00	200.00	300.00
DQ		DIVERTED FLOW	0.00	100.00	200.00	300.00

***

*** *** *** *** ***

DIVERSION HYDROGRAPH RET5

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 163.	12.27		15.	4.	1.	1.
		(INCHES)	1.712	1.786	1.786	1.786
		(AC-FT)	8.	8.	8.	8.

CUMULATIVE AREA = 0.08 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DETBAS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 74.	12.67		6.	2.	1.	1.
		(INCHES)	0.636	0.703	0.703	0.703
		(AC-FT)	3.	3.	3.	3.

CUMULATIVE AREA = 0.08 SQ MI

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          **************
          *            *
265 KK    *    SPLIT   *
          *            *
          **************
```

Split flows @ 40th St. & Bell Road to South and west

DT	DIVERSION ISTAD	BR40S	DIVERSION HYDROGRAPH IDENTIFICATION						
DI	INFLOW	0.00	5.00	10.00	25.00	40.00	85.00	150.00	200.00
DQ	DIVERTED FLOW	0.00	0.00	5.00	10.00	15.00	28.00	45.00	60.00

***

*** *** *** *** ***

DIVERSION HYDROGRAPH BR40S

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
25.	12.67		2.	0.	0.	0.
		(INCHES)	0.180	0.180	0.180	0.180
		(AC-FT)	1.	1.	1.	1.

CUMULATIVE AREA = 0.08 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION SPLIT

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
49.	12.67		4.	1.	0.	0.
		(INCHES)	0.456	0.523	0.523	0.523
		(AC-FT)	2.	2.	2.	2.

CUMULATIVE AREA = 0.08 SQ MI

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          *           *
270 KK    *   RBR40N  *     E
          *           *
          **************
```

Route flow from 40th St. & Bell to 38th & Bell Road

HYDROGRAPH ROUTING DATA

```
272 RS        STORAGE ROUTING
                   NSTPS          3  NUMBER OF SUBREACHES
                    ITYP       FLOW  TYPE OF INITIAL CONDITION
                  RSVRIC       0.00  INITIAL CONDITION
                       X       0.00 WORKING R AND D COEFFICIENT

273 RC        NORMAL DEPTH CHANNEL
                     ANL      0.016  LEFT OVERBANK N-VALUE
                    ANCH      0.016  MAIN CHANNEL N-VALUE
                     ANR      0.016  RIGHT OVERBANK N-VALUE
                   RLNTH      1350.  REACH LENGTH
                     SEL     0.0025  ENERGY SLOPE
                   ELMAX        0.0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION
```

CROSS-SECTION DATA

		--- LEFT OVERBANK ---			+ ------ MAIN CHANNEL -------			+ --- RIGHT OVERBANK ---	
275 RY	ELEVATION	66.87	66.77	66.27	65.83	66.37	66.87	66.87	66.87
274 RX	DISTANCE	99.00	99.50	100.00	125.00	202.70	203.20	221.20	239.20

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.01	0.04	0.08	0.15	0.23	0.34	0.46	0.60	0.75
OUTFLOW	0.00	0.13	0.81	2.38	5.13	9.29	15.11	22.79	32.54	45.23
ELEVATION	65.83	65.88	65.94	65.99	66.05	66.10	66.16	66.21	66.27	66.32
STORAGE	0.92	1.10	1.27	1.45	1.62	1.80	1.97	2.15	2.32	2.50
OUTFLOW	60.58	80.82	103.33	128.00	154.74	183.47	214.14	246.67	281.00	317.12
ELEVATION	66.38	66.43	66.49	66.54	66.60	66.65	66.71	66.76	66.82	66.87

*** *** *** *** ***

HYDROGRAPH AT STATION RBR40N

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 28.	12.93		4.	1.	0.	0.
		(INCHES)	0.449	0.523	0.523	0.523
		(AC-FT)	2.	2.	2.	2.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (AC-FT)	(HR)				
0.	12.93	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (FEET)	(HR)				

```
   66.24     12.93                 66.00       65.90       65.85       65.85

                      CUMULATIVE AREA =    0.08 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
276 KK    *    RETHYD  *
          *            *
          **************
                         Retrieve diverted hydrograph from Paradise Valley High School @ Bell Rd

278 DR          RETRIEVE DIVERSION HYDROGRAPH
                      ISTAD      PVH40S  DIVERSION HYDROGRAPH IDENTIFICATION

                                                          ***

    ***             ***             ***             ***             ***

                       HYDROGRAPH AT STATION   RETHYD

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
  (CFS)       (HR)
                        (CFS)
    93.      12.27                10.          3.          1.          1.
                      (INCHES)    1.063       1.190       1.190       1.190
                       (AC-FT)      5.          5.          5.          5.

                      CUMULATIVE AREA =    0.00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
279 KK    *    COMB11  *
          *            *
          **************
                         Combine flows at Bell Road and 38th Street, south side of Bell Road

281 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

    ***             ***             ***             ***             ***

                       HYDROGRAPH AT STATION   COMB11

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
```

```
+   (CFS)       (HR)
                          (CFS)
+      93.      12.27                13.         4.         1.         1.
                        (INCHES)    1.463      1.708      1.713      1.713
                         (AC-FT)       7.         8.         8.         8.

                         CUMULATIVE AREA =    0.08 SQ MI
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            **************
            *            *
 282 KK     *    RETHYD  *
            *            *
            **************
                                Retrieve diverted hydrograph from 38th St. & Bell Road

 284 DR          RETRIEVE DIVERSION HYDROGRAPH
                       ISTAD       BR38S  DIVERSION HYDROGRAPH IDENTIFICATION

                                                                  ***

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION   RETHYD

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     385.      12.63                57.        15.         5.         5.
                        (INCHES)    6.259      6.521      6.525      6.525
                         (AC-FT)      28.        29.        29.        29.

                         CUMULATIVE AREA =    0.00 SQ MI
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            **************
            *            *
 285 KK     *    COMB12  *
            *            *
            **************
                                Combine flows in 38th Street, south of Bell Road

 287 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

      ***             ***             ***             ***             ***
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HYDROGRAPH AT STATION COMB12

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
418.	12.63		70.	19.	7.	7.
		(INCHES)	7.720	8.229	8.239	8.239
		(AC-FT)	35.	37.	37.	37.

CUMULATIVE AREA = 0.08 SQ MI

*** ***

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              **************
              *            *
288 KK        *    RBR38S  *
              *            *
              **************
```

Route diverted hydrograph BR38S south in 38th Street to Paradise Lane
Adjust depth by increasing end point elevations to allow for high
peak flow in 38th Street. Increase from 46.63, 0.0; 46.38, 15.0 to
50.0, 0.0; 46.6, 1.0 and 46.29,57.0; 46.55, 67.0; to 46.5, 66.0, 50.0

HYDROGRAPH ROUTING DATA

293 RS STORAGE ROUTING

NSTPS	5	NUMBER OF SUBREACHES
ITYP	FLOW	TYPE OF INITIAL CONDITION
RSVRIC	0.00	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

294 RC NORMAL DEPTH CHANNEL

ANL	0.016	LEFT OVERBANK N-VALUE
ANCH	0.016	MAIN CHANNEL N-VALUE
ANR	0.016	RIGHT OVERBANK N-VALUE
RLNTH	2640.	REACH LENGTH
SEL	0.0064	ENERGY SLOPE
ELMAX	0.0	MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

CROSS-SECTION DATA

		--- LEFT OVERBANK ---			+ ------ MAIN CHANNEL -------		+ --- RIGHT OVERBANK ---		
296 RY	ELEVATION	50.00	46.60	46.23	45.80	45.77	46.26	46.50	50.00
295 RX	DISTANCE	0.00	1.00	19.50	20.00	52.00	52.50	66.00	67.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.41	0.85	1.41	2.24	3.12	4.00	4.88	5.77	6.65
OUTFLOW	0.00	17.34	58.36	120.91	218.24	352.43	515.74	705.09	918.34	1153.89
ELEVATION	45.77	45.99	46.22	46.44	46.66	46.88	47.11	47.33	47.55	47.77
STORAGE	7.54	8.43	9.32	10.21	11.11	12.00	12.90	13.80	14.70	15.61
OUTFLOW	1410.43	1686.91	1982.40	2296.13	2627.39	2975.58	3340.15	3720.59	4116.47	4527.37
ELEVATION	48.00	48.22	48.44	48.66	48.89	49.11	49.33	49.55	49.78	50.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 218. TO 4527.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RBR38S

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 408.	12.70		70.	19.	7.	7.
		(INCHES)	7.720	8.229	8.239	8.239
		(AC-FT)	35.	37.	37.	37.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (AC-FT)	(HR)				
1.	12.70	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (FEET)	(HR)				
46.96	12.70	46.10	45.87	45.81	45.81

CUMULATIVE AREA = 0.08 SQ MI

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          **************
          *            *
297 KK    *    PDLN38  *
          *            *
          **************
```

Runoff from NE quad. of 38th Street & Paradise Lane

SUBBASIN RUNOFF DATA

299 BA SUBBASIN CHARACTERISTICS

TAREA 0.14 SUBBASIN AREA

PRECIPITATION DATA

238 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.14

300 LG GREEN AND AMPT LOSS RATE

STRTL 0.20 STARTING LOSS

DTH 0.26 MOISTURE DEFICIT

```
                    PSIF        3.80  WETTING FRONT SUCTION
                   XKSAT        0.54  HYDRAULIC CONDUCTIVITY
                   RTIMP       31.00  PERCENT IMPERVIOUS AREA

301 UC         CLARK UNITGRAPH
                      TC        0.24  TIME OF CONCENTRATION
                       R        0.11  STORAGE COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                   ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=  0.24 HR,      R=  0.11 HR
                                  SNYDER   TP=  0.19 HR,     CP=  0.77

                                          UNIT HYDROGRAPH
                                     22 END-OF-PERIOD ORDINATES
            25.      90.     173.     257.     321.     349.     337.     282.     210.     155.
           114.      84.      62.      46.      34.      25.      18.      13.      10.       7.
             5.       4.

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   PDLN38

   TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.50, TOTAL EXCESS =    1.87

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
   (CFS)       (HR)
                           (CFS)
    347.     12.20                    25.         7.          2.          2.
                          (INCHES)  1.689       1.859       1.859       1.859
                          (AC-FT)     12.         13.         13.         13.

                         CUMULATIVE AREA =    0.14 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
302 KK    *   DETBAS   *
          *            *
          **************
                                Route outflow hydrograph through imaginary basin to account for
                                City of Phoenix 100-year 2-hour retention policy

   DT          DIVERSION
                     ISTAD       RET8  DIVERSION HYDROGRAPH IDENTIFICATION
                    DSTRMX       8.00  MAXIMUM VOLUME TO BE DIVERTED

   DI             INFLOW       0.00    100.00    200.00    300.00

   DQ      DIVERTED FLOW       0.00    100.00    200.00    300.00
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     ***            ***            ***            ***            ***

                        DIVERSION HYDROGRAPH     RET8

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     347.     12.20                 15.         4.          1.          1.
                         (INCHES)   1.059       1.103       1.103       1.103
                          (AC-FT)    8.          8.          8.          8.

                         CUMULATIVE AREA =    0.14 SQ MI


     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   DETBAS

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     270.     12.30                 10.         3.          1.          1.
                         (INCHES)   0.713       0.756       0.756       0.756
                          (AC-FT)    5.          5.          5.          5.

                         CUMULATIVE AREA =    0.14 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 308 KK     *    COMB13  *
            *            *
            **************
                                Combine flows at Paradise Lane and 38th Street

 310 HC          HYDROGRAPH COMBINATION
                      ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                    ***

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   COMB13

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     511.     12.43                 80.        21.          8.          8.
                         (INCHES)   3.381       3.609       3.613       3.613
                          (AC-FT)   40.         42.         42.         42.
```

CUMULATIVE AREA = 0.22 SQ MI

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          **************
          *            *
311 KK    *    RPDLN3  *     8
          *            *
          **************
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Route combined hydrograph PDLN38 south in 38th Street to Greenway Road
Adjust depth by increasing end point elevations to allow for high
peak flow in 38th Street. Increase from 46.63, 0.0; 46.38, 15.0 to
50.0, 0.0; 46.6, 1.0 and 46.29,57.0; 46.55, 67.0; to 46.5, 66.0, 50.0

HYDROGRAPH ROUTING DATA

316 RS STORAGE ROUTING

NSTPS	5	NUMBER OF SUBREACHES
ITYP	FLOW	TYPE OF INITIAL CONDITION
RSVRIC	0.00	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

317 RC NORMAL DEPTH CHANNEL

ANL	0.016	LEFT OVERBANK N-VALUE
ANCH	0.016	MAIN CHANNEL N-VALUE
ANR	0.016	RIGHT OVERBANK N-VALUE
RLNTH	2640.	REACH LENGTH
SEL	0.0048	ENERGY SLOPE
ELMAX	0.0	MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

CROSS-SECTION DATA

		--- LEFT OVERBANK ---			+ ------ MAIN CHANNEL		------- + --- RIGHT OVERBANK ---		
319 RY	ELEVATION	50.00	46.60	46.23	45.80	45.77	46.26	46.50	50.00
318 RX	DISTANCE	0.00	1.00	19.50	20.00	52.00	52.50	66.00	67.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.41	0.85	1.41	2.24	3.12	4.00	4.88	5.77	6.65
OUTFLOW	0.00	15.02	50.54	104.71	189.00	305.22	446.65	610.62	795.31	999.30
ELEVATION	45.77	45.99	46.22	46.44	46.66	46.88	47.11	47.33	47.55	47.77
STORAGE	7.54	8.43	9.32	10.21	11.11	12.00	12.90	13.80	14.70	15.61
OUTFLOW	1221.47	1460.91	1716.81	1988.50	2275.39	2576.93	2892.65	3222.13	3564.97	3920.82
ELEVATION	48.00	48.22	48.44	48.66	48.89	49.11	49.33	49.55	49.78	50.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 305. TO 3921.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RPDLN3

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 513.	12.43		80.	21.	8.	8.
		(INCHES)	3.381	3.609	3.613	3.613
		(AC-FT)	40.	42.	42.	42.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (AC-FT)	(HR)				
1.	12.43	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	66.63-HR
+ (FEET)	(HR)				
47.20	12.43	46.15	45.89	45.81	45.81

CUMULATIVE AREA = 0.22 SQ MI

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              *            *
320 KK        *    GRWY38  *
              *            *
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Runoff from NE quad. of 38th Street & Greenway Road

SUBBASIN RUNOFF DATA

322 BA SUBBASIN CHARACTERISTICS

TAREA	0.12	SUBBASIN AREA

PRECIPITATION DATA

238 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.12

323 LG GREEN AND AMPT LOSS RATE

STRTL	0.20	STARTING LOSS
DTH	0.27	MOISTURE DEFICIT
PSIF	3.10	WETTING FRONT SUCTION
XKSAT	0.79	HYDRAULIC CONDUCTIVITY
RTIMP	21.00	PERCENT IMPERVIOUS AREA

324 UC CLARK UNITGRAPH

TC	0.32	TIME OF CONCENTRATION
R	0.23	STORAGE COEFFICIENT

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

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                                                    ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=  0.32 HR,       R=  0.23 HR
                                  SNYDER   TP=  0.28 HR,      CP=  0.66

                                          UNIT HYDROGRAPH
                                     42 END-OF-PERIOD ORDINATES
              8.      28.      56.      88.     121.     152.     174.     187.     190.     180.
            159.     138.     119.     103.      89.      77.      67.      58.      50.      43.
             37.      32.      28.      24.      21.      18.      16.      13.      12.      10.
              9.       8.       7.       6.       5.       4.       4.       3.       3.       2.
              2.       2.

    ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION   GRWY38

   TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.85, TOTAL EXCESS =    1.52

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     66.63-HR
   (CFS)       (HR)
                            (CFS)
+    194.     12.30                     18.         5.          2.          2.
                         (INCHES)     1.393       1.508       1.508       1.508
                          (AC-FT)       9.         10.         10.         10.

                         CUMULATIVE AREA =    0.12 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
325 KK    *   DETBAS   *
          *            *
          **************
                                Route outflow hydrograph through imaginary basin to account for
                                City of Phoenix 100-year 2-hour retention policy

   DT          DIVERSION
                     ISTAD        RET9  DIVERSION HYDROGRAPH IDENTIFICATION
                    DSTRMX        2.00  MAXIMUM VOLUME TO BE DIVERTED

   DI             INFLOW        0.00    100.00    200.00    300.00

   DQ       DIVERTED FLOW       0.00    100.00    200.00    300.00

                                                    ***

    ***            ***            ***            ***            ***

                         DIVERSION HYDROGRAPH     RET9

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
```

			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 112.	12.13		4.	1.	0.	0.
		(INCHES)	0.279	0.307	0.307	0.307
		(AC-FT)	2.	2.	2.	2.

CUMULATIVE AREA = 0.12 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DETBAS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 194.	12.30		15.	4.	1.	1.
		(INCHES)	1.170	1.201	1.201	1.201
		(AC-FT)	8.	8.	8.	8.

CUMULATIVE AREA = 0.12 SQ MI

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              *            *
331 KK        *    COMB14  *
              *            *
              **************
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Combine flows at Greenway Road and 38th Street

333 HC HYDROGRAPH COMBINATION

ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

***

*** *** *** *** ***

HYDROGRAPH AT STATION COMB14

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 658.	12.43		95.	25.	9.	9.
		(INCHES)	2.591	2.750	2.753	2.753
		(AC-FT)	47.	50.	50.	50.

CUMULATIVE AREA = 0.34 SQ MI

*** ***

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              **************
              *            *
334 KK        *   RETHYD   *
              *            *
              **************
                                  Retrieve diverted hydrograph from 40th St. & Bell Road

336 DR            RETRIEVE DIVERSION HYDROGRAPH
                       ISTAD       BR40S  DIVERSION HYDROGRAPH IDENTIFICATION

                                                                  ***

     ***              ***              ***              ***              ***

                         HYDROGRAPH AT STATION   RETHYD

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
   (CFS)       (HR)
                           (CFS)
      25.      12.67                   2.          0.          0.          0.
                         (INCHES)    0.044       0.044       0.044       0.044
                          (AC-FT)       1.          1.          1.          1.

                          CUMULATIVE AREA =    0.00 SQ MI


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              **************
              *            *
337 KK        *   BLR40E   *
              *            *
              **************
                                  Runoff from east of 40th Street & north of Bell Road

                SUBBASIN RUNOFF DATA

339 BA            SUBBASIN CHARACTERISTICS
                       TAREA        0.02  SUBBASIN AREA

                  PRECIPITATION DATA

238 PH                                  DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                   STORM AREA =    0.02

340 LG            GREEN AND AMPT LOSS RATE
                       STRTL        0.05  STARTING LOSS
                         DTH        0.25  MOISTURE DEFICIT
                        PSIF        3.50  WETTING FRONT SUCTION
                       XKSAT        0.25  HYDRAULIC CONDUCTIVITY
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                    RTIMP       85.00  PERCENT IMPERVIOUS AREA

341 UC          CLARK UNITGRAPH
                         TC       0.14  TIME OF CONCENTRATION
                          R       0.16  STORAGE COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                        ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=  0.14 HR,       R=  0.16 HR
                                         SNYDER   TP=  0.13 HR,      CP=  0.52

                                                   UNIT HYDROGRAPH
                                             28 END-OF-PERIOD ORDINATES
                 6.      23.      42.      54.      52.      43.      35.      28.      23.      19.
                15.      12.      10.       8.       7.       5.       4.       4.       3.       2.
                 2.       2.       1.       1.       1.       1.       1.       0.

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   BLR40E

    TOTAL RAINFALL =    3.37, TOTAL LOSS =    0.25, TOTAL EXCESS =    3.12

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+      60.     12.17                     6.          2.          1.          1.
                        (INCHES)     2.637       3.102       3.103       3.103
                         (AC-FT)        3.          3.          3.          3.

                       CUMULATIVE AREA =    0.02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
342 KK      *    DETBAS  *
            *            *
            **************
                                Route outflow hydrograph through imaginary basin to account for
                                City of Phoenix 100-year 2-hour retention policy

    DT          DIVERSION
                      ISTAD      RET10  DIVERSION HYDROGRAPH IDENTIFICATION
                     DSTRMX       3.00  MAXIMUM VOLUME TO BE DIVERTED

    DI             INFLOW       0.00    100.00    200.00    300.00

    DQ      DIVERTED FLOW       0.00    100.00    200.00    300.00

                                                        ***
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    ***          ***          ***          ***          ***

                    DIVERSION HYDROGRAPH    RET10

 PEAK FLOW     TIME                      MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                        (CFS)
+     60.     12.17                6.          2.          1.          1.
                      (INCHES)   2.532       2.679       2.679       2.679
                       (AC-FT)     3.          3.          3.          3.

                      CUMULATIVE AREA =    0.02 SQ MI


    ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   DETBAS

 PEAK FLOW     TIME                      MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                        (CFS)
+      2.     13.13                1.          0.          0.          0.
                      (INCHES)   0.328       0.425       0.425       0.425
                       (AC-FT)     0.          0.          0.          0.

                      CUMULATIVE AREA =    0.02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
348 KK    *    COMB15  *
          *            *
          **************
                          Combine flows at Bell Road and 40th Street

350 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

    ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   COMB15

 PEAK FLOW     TIME                      MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                        (CFS)
+     25.     12.67                2.          1.          0.          0.
                      (INCHES)   1.036       1.145       1.145       1.145
                       (AC-FT)     1.          1.          1.          1.

                      CUMULATIVE AREA =    0.02 SQ MI
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          *            *
351 KK    *   RBLR40   *     E
          *            *
          **************
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Route flows from 40th St. & Bell Rd. to 40th St. & Greenway Road

HYDROGRAPH ROUTING DATA

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353 RS        STORAGE ROUTING
                   NSTPS        11  NUMBER OF SUBREACHES
                    ITYP      FLOW  TYPE OF INITIAL CONDITION
                  RSVRIC      0.00  INITIAL CONDITION
                       X      0.00 WORKING R AND D COEFFICIENT

354 RC        NORMAL DEPTH CHANNEL
                     ANL     0.016  LEFT OVERBANK N-VALUE
                    ANCH     0.016  MAIN CHANNEL N-VALUE
                     ANR     0.016  RIGHT OVERBANK N-VALUE
                   RLNTH     5300.  REACH LENGTH
                     SEL    0.0047  ENERGY SLOPE
                   ELMAX       0.0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION
```

CROSS-SECTION DATA

		--- LEFT OVERBANK ---		+ ------ MAIN CHANNEL		------- +	--- RIGHT OVERBANK ---		
356 RY	ELEVATION	66.72	65.21	65.12	64.81	64.70	64.99	65.04	66.72
355 RX	DISTANCE	0.00	29.50	35.00	36.50	101.30	102.80	108.30	126.30

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.41	1.26	2.13	3.08	4.09	5.16	6.28	7.43	8.63
OUTFLOW	0.00	3.03	19.15	45.38	81.03	126.12	180.36	243.35	314.91	394.97
ELEVATION	64.70	64.81	64.91	65.02	65.13	65.23	65.34	65.44	65.55	65.66
STORAGE	9.87	11.15	12.47	13.83	15.24	16.68	18.17	19.70	21.27	22.89
OUTFLOW	483.48	580.47	685.95	799.97	922.59	1053.87	1193.89	1342.73	1500.48	1667.22
ELEVATION	65.76	65.87	65.98	66.08	66.19	66.29	66.40	66.51	66.61	66.72

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 315. TO 1667.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RBLR40

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)				
		(CFS)			

```
+    11.     13.57                    2.         1.         0.         0.
                          (INCHES)   1.004      1.145      1.145      1.145
                           (AC-FT)   1.         1.         1.         1.

PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR       24-HR      72-HR     66.63-HR
+ (AC-FT)      (HR)
     0.      13.53                    0.         0.         0.         0.

PEAK STAGE     TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR       24-HR      72-HR     66.63-HR
+  (FEET)      (HR)
   64.86     13.57                   64.76      64.72      64.71      64.71

                          CUMULATIVE AREA =    0.02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
357 KK    *    GRW40N  *
          *            *
          **************
                                Runoff from NE quad. of 40th Street & Greenway Road

            SUBBASIN RUNOFF DATA

359 BA        SUBBASIN CHARACTERISTICS
                    TAREA        0.16  SUBBASIN AREA

              PRECIPITATION DATA

238 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                STORM AREA =    0.16

360 LG        GREEN AND AMPT LOSS RATE
                    STRTL        0.35  STARTING LOSS
                      DTH        0.25  MOISTURE DEFICIT
                     PSIF        4.80  WETTING FRONT SUCTION
                    XKSAT        0.28  HYDRAULIC CONDUCTIVITY
                    RTIMP       25.00  PERCENT IMPERVIOUS AREA

361 UC        CLARK UNITGRAPH
                       TC        0.27  TIME OF CONCENTRATION
                        R        0.08  STORAGE COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                  ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=  0.27 HR,       R=  0.08 HR
```

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                                        SNYDER   TP=  0.20 HR,      CP=  0.81

                                                    UNIT HYDROGRAPH
                                                 18 END-OF-PERIOD ORDINATES
              33.      116.      216.      314.      394.      434.      428.      381.      288.      190.
             124.       81.       53.       35.       23.       15.       10.        6.

     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   GRW40N

    TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.45, TOTAL EXCESS =    1.91

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     455.     12.20                 31.         8.          3.          3.
                        (INCHES)    1.770       1.907       1.907       1.907
                         (AC-FT)     15.         17.         17.         17.

                        CUMULATIVE AREA =    0.16 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** **


          **************
          *            *
362 KK    *     GWR40  *
          *            *
          **************
                                Runoff from NE quad. of 40th Street & Greenway Road

             SUBBASIN RUNOFF DATA

364 BA          SUBBASIN CHARACTERISTICS
                      TAREA        0.03  SUBBASIN AREA

                PRECIPITATION DATA

238 PH                                  DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                   STORM AREA =    0.03

365 LG          GREEN AND AMPT LOSS RATE
                      STRTL        0.20  STARTING LOSS
                        DTH        0.25  MOISTURE DEFICIT
                       PSIF        4.90  WETTING FRONT SUCTION
                      XKSAT        0.27  HYDRAULIC CONDUCTIVITY
                      RTIMP       56.00  PERCENT IMPERVIOUS AREA

366 UC          CLARK UNITGRAPH
                         TC        0.31  TIME OF CONCENTRATION
                          R        0.77  STORAGE COEFFICIENT
```

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= 0.31 HR, R= 0.77 HR

SNYDER TP= 0.31 HR, CP= 0.32

UNIT HYDROGRAPH

128 END-OF-PERIOD ORDINATES

1.	2.	5.	8.	12.	15.	18.	20.	22.	22.
21.	20.	19.	18.	18.	17.	16.	15.	15.	14.
14.	13.	12.	12.	11.	11.	10.	10.	10.	9.
9.	8.	8.	8.	7.	7.	7.	7.	6.	6.
6.	5.	5.	5.	5.	5.	4.	4.	4.	4.
4.	4.	3.	3.	3.	3.	3.	3.	3.	3.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.		

*** *** *** *** ***

HYDROGRAPH AT STATION GWR40

TOTAL RAINFALL = 3.37, TOTAL LOSS = 0.82, TOTAL EXCESS = 2.55

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
34.	12.37		8.	2.	1.	1.
		(INCHES)	2.221	2.531	2.537	2.537
		(AC-FT)	4.	4.	4.	4.

CUMULATIVE AREA = 0.03 SQ MI

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          **************
          *            *
367 KK    *   DETBAS   *
          *            *
          **************
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Route outflow hydrograph through imaginary basin to account for
City of Phoenix 100-year 2-hour retention policy

DT	DIVERSION					
		ISTAD	RET11	DIVERSION HYDROGRAPH IDENTIFICATION		
		DSTRMX	4.00	MAXIMUM VOLUME TO BE DIVERTED		
DI		INFLOW	0.00	100.00	200.00	300.00

```
     DQ      DIVERTED FLOW        0.00    100.00    200.00    300.00

                                                                 ***

      ***            ***            ***            ***            ***

                        DIVERSION HYDROGRAPH    RET11

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+      34.     12.37                  8.          2.          1.          1.
                        (INCHES)    2.202       2.344       2.344       2.344
                         (AC-FT)       4.          4.          4.          4.

                        CUMULATIVE AREA =    0.03 SQ MI


      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   DETBAS

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+       2.     15.50                  1.          0.          0.          0.
                        (INCHES)    0.153       0.193       0.193       0.193
                         (AC-FT)       0.          0.          0.          0.

                        CUMULATIVE AREA =    0.03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 373 KK     *    COMB16  *
            *            *
            **************
                              Combine flows at Greenway Road and 40th Street

 375 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                 ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   COMB16

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
```

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+    455.     12.20                  33.         9.         3.         3.
                          (INCHES)  1.423      1.575      1.579      1.579
                           (AC-FT)   16.        18.        18.        18.

                          CUMULATIVE AREA =    0.22 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 376 KK     *     SPLIT  *
            *            *
            **************
                                 Split flows at Greenway Road & 40th Street
                                 ASSUME 50% to south and 50% to west after first 25 cfs to west
                                 No topographic data available to refine deversion

    DT          DIVERSION
                      ISTAD      GRW40S  DIVERSION HYDROGRAPH IDENTIFICATION

    DI             INFLOW        0.00     15.00     25.00     27.00    125.00    775.00

    DQ       DIVERTED FLOW       0.00      0.00      0.00      1.00     50.00    375.00

                                                                ***

     ***            ***            ***            ***            ***

                        DIVERSION HYDROGRAPH   GRW40S

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR      72-HR     66.63-HR
+  (CFS)       (HR)
                          (CFS)
+    215.     12.20                  12.         3.         1.         1.
                          (INCHES)  0.517      0.517      0.517      0.517
                           (AC-FT)    6.         6.         6.         6.

                          CUMULATIVE AREA =    0.22 SQ MI


     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    SPLIT

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR      72-HR     66.63-HR
+  (CFS)       (HR)
                          (CFS)
+    240.     12.20                  21.         6.         2.         2.
                          (INCHES)  0.906      1.058      1.062      1.062
                           (AC-FT)   10.        12.        12.        12.

                          CUMULATIVE AREA =    0.22 SQ MI
```

*** **

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          **************
          *            *
383 KK    *   RGRW40   *     N
          *            *
          **************
```

Route flows from 40th St. & Greenway Rd. to 38th St. & Greenway Road

HYDROGRAPH ROUTING DATA

385 RS STORAGE ROUTING

NSTPS	3	NUMBER OF SUBREACHES
ITYP	FLOW	TYPE OF INITIAL CONDITION
RSVRIC	0.00	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

386 RC NORMAL DEPTH CHANNEL

ANL	0.016	LEFT OVERBANK N-VALUE
ANCH	0.016	MAIN CHANNEL N-VALUE
ANR	0.016	RIGHT OVERBANK N-VALUE
RLNTH	1350.	REACH LENGTH
SEL	0.0053	ENERGY SLOPE
ELMAX	0.0	MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

CROSS-SECTION DATA

		--- LEFT OVERBANK ---			+ ------ MAIN CHANNEL -------			+ --- RIGHT OVERBANK ---	
388 RY	ELEVATION	50.05	48.67	48.56	48.11	48.01	48.50	48.64	49.45
387 RX	DISTANCE	0.00	28.50	34.00	34.50	89.00	89.50	95.00	121.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.10	0.28	0.46	0.65	0.83	1.04	1.27	1.52	1.79
OUTFLOW	0.00	3.16	18.29	42.19	73.42	111.28	156.23	209.22	270.44	340.13
ELEVATION	48.01	48.12	48.22	48.33	48.44	48.55	48.65	48.76	48.87	48.98
STORAGE	2.07	2.38	2.71	3.05	3.41	3.78	4.16	4.54	4.93	5.33
OUTFLOW	418.59	506.12	603.03	709.63	828.96	960.23	1101.38	1252.29	1412.90	1583.17
ELEVATION	49.08	49.19	49.30	49.41	49.51	49.62	49.73	49.84	49.94	50.05

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 209. TO 1583.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RGRW40

	PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
				6-HR	24-HR	72-HR	66.63-HR
+	(CFS)	(HR)					
			(CFS)				
+	235.	12.27		21.	6.	2.	2.
			(INCHES)	0.906	1.058	1.062	1.062

```
                    (AC-FT)      10.        12.        12.        12.

PEAK STORAGE   TIME                      MAXIMUM AVERAGE STORAGE
                                  6-HR       24-HR      72-HR     66.63-HR
+ (AC-FT)      (HR)
     0.      12.27                 0.         0.         0.         0.

 PEAK STAGE    TIME                      MAXIMUM AVERAGE STAGE
                                  6-HR       24-HR      72-HR     66.63-HR
  (FEET)       (HR)
  48.81      12.27               48.19      48.09      48.04      48.04

                    CUMULATIVE AREA =    0.22 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
389 KK    *    COMB17  *
          *            *
          **************
                         Combine flows at Greenway Road and 38th Street

391 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

    ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION   COMB17

PEAK FLOW      TIME                      MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR      72-HR     66.63-HR
+  (CFS)       (HR)
                      (CFS)
   785.       12.43                116.        31.        11.        11.
                     (INCHES)     1.936      2.095      2.098      2.098
                     (AC-FT)       58.        62.        62.        62.

                    CUMULATIVE AREA =    0.56 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
392 KK    *     SPLIT  *
          *            *
          **************
                         Split flows along Greenway Road south at 38th Street and west

   DT          DIVERSION
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                    ISTAD      GRW38S  DIVERSION HYDROGRAPH IDENTIFICATION

     DI            INFLOW       0.00     15.00     25.00    125.00    765.00

     DQ      DIVERTED FLOW      0.00      0.00      0.00     30.00    435.00

                                                                 ***

      ***            ***            ***            ***            ***

                      DIVERSION HYDROGRAPH   GRW38S

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     448.     12.43                 51.         13.          5.          5.
                        (INCHES)    0.853       0.853       0.853       0.853
                         (AC-FT)     25.         25.         25.         25.

                        CUMULATIVE AREA =    0.56 SQ MI


      ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION    SPLIT

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     337.     12.43                 65.         19.          7.          7.
                        (INCHES)    1.083       1.241       1.245       1.245
                         (AC-FT)     32.         37.         37.         37.

                        CUMULATIVE AREA =    0.56 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** **


          **************
          *            *
397 KK    *    RGRW40  *     N
          *            *
          **************
                                Route flows from 38th St. & Greenway Rd. to 36th St. & Greenway Road

             HYDROGRAPH ROUTING DATA

399 RS          STORAGE ROUTING
                     NSTPS          3  NUMBER OF SUBREACHES
                      ITYP       FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC       0.00  INITIAL CONDITION
                         X       0.00 WORKING R AND D COEFFICIENT

400 RC          NORMAL DEPTH CHANNEL
                       ANL      0.016  LEFT OVERBANK N-VALUE
```

ANCH	0.016	MAIN CHANNEL N-VALUE
ANR	0.016	RIGHT OVERBANK N-VALUE
RLNTH	1300.	REACH LENGTH
SEL	0.0020	ENERGY SLOPE
ELMAX	0.0	MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

CROSS-SECTION DATA

		--- LEFT OVERBANK ---		+ ------ MAIN CHANNEL		------- +	--- RIGHT OVERBANK ---		
402 RY	ELEVATION	50.05	48.67	48.56	48.11	48.01	48.50	48.64	49.45
401 RX	DISTANCE	0.00	28.50	34.00	34.50	89.00	89.50	95.00	121.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.09	0.27	0.44	0.62	0.80	1.00	1.22	1.46	1.72
OUTFLOW	0.00	1.94	11.24	25.92	45.10	68.36	95.97	128.53	166.13	208.94
ELEVATION	48.01	48.12	48.22	48.33	48.44	48.55	48.65	48.76	48.87	48.98
STORAGE	2.00	2.29	2.61	2.94	3.28	3.64	4.00	4.37	4.75	5.13
OUTFLOW	257.13	310.91	370.44	435.92	509.23	589.87	676.57	769.28	867.94	972.54
ELEVATION	49.08	49.19	49.30	49.41	49.51	49.62	49.73	49.84	49.94	50.05

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 677. TO 973.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION RGRW40

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
325.	12.50		65.	19.	7.	7.
		(INCHES)	1.083	1.241	1.245	1.245
		(AC-FT)	32.	37.	37.	37.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	66.63-HR
1.	12.50	0.	0.	0.	0.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	66.63-HR
49.22	12.50	48.45	48.20	48.08	48.08

CUMULATIVE AREA = 0.56 SQ MI

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403 KK     *    GRWY36  *
           *            *
           **************
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Runoff from NE quad. of 36th Street & Greenway Road

SUBBASIN RUNOFF DATA

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405 BA        SUBBASIN CHARACTERISTICS
                   TAREA        0.06  SUBBASIN AREA

              PRECIPITATION DATA

238 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
            ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
            5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
             0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                STORM AREA =    0.06

406 LG        GREEN AND AMPT LOSS RATE
                   STRTL        0.20  STARTING LOSS
                     DTH        0.25  MOISTURE DEFICIT
                    PSIF        4.95  WETTING FRONT SUCTION
                   XKSAT        0.26  HYDRAULIC CONDUCTIVITY
                   RTIMP       22.00  PERCENT IMPERVIOUS AREA

407 UC        CLARK UNITGRAPH
                      TC        0.33  TIME OF CONCENTRATION
                       R        0.32  STORAGE COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=  0.33 HR,      R=  0.32 HR
                                    SNYDER   TP=  0.30 HR,     CP=  0.58

                                          UNIT HYDROGRAPH
                                     57 END-OF-PERIOD ORDINATES
              3.      10.      19.      31.      43.      55.      65.      71.      75.      74.
             69.      62.      56.      50.      45.      41.      37.      33.      30.      27.
             24.      22.      20.      18.      16.      14.      13.      12.      11.      10.
              9.       8.       7.       6.       6.       5.       5.       4.       4.       3.
              3.       3.       2.       2.       2.       2.       2.       1.       1.       1.
              1.       1.       1.       1.       1.       1.       1.

    ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   GRWY36

   TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.44, TOTAL EXCESS =    1.93

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                           (CFS)
+     96.      12.33                    11.         3.          1.          1.
                           (INCHES)   1.797       1.917       1.918       1.918
                           (AC-FT)      6.          6.          6.          6.
```

CUMULATIVE AREA = 0.06 SQ MI

*** ***

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              **************
              *            *
408 KK        *    COMB18  *
              *            *
              **************
```

Combine flows at Greenway Road and 36th Street

410 HC HYDROGRAPH COMBINATION

ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

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*** *** *** *** ***

HYDROGRAPH AT STATION COMB18

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
399.	12.50		76.	22.	8.	8.
		(INCHES)	1.149	1.305	1.309	1.309
		(AC-FT)	38.	43.	43.	43.

CUMULATIVE AREA = 0.62 SQ MI

*** ***

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              **************
              *            *
411 KK        *     SPLIT  *
              *            *
              **************
```

Split flows @ 36th St. & Greenway Road to South and west

DT DIVERSION

ISTAD GWY36S DIVERSION HYDROGRAPH IDENTIFICATION

DI	INFLOW	0.00	10.00	30.00	37.00	100.00	200.00	250.00	625.00	1000.00
DQ	DIVERTED FLOW	0.00	7.00	20.00	25.00	65.00	140.00	175.00	475.00	775.00

***

*** *** *** *** ***

DIVERSION HYDROGRAPH GWY36S

```
  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     295.     12.50                    53.         15.          5.          5.
                        (INCHES)     0.803       0.912       0.915       0.915
                        (AC-FT)       26.         30.         30.         30.

                        CUMULATIVE AREA =    0.62 SQ MI


      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    SPLIT

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     105.     12.50                    23.          7.          2.          2.
                        (INCHES)     0.346       0.393       0.394       0.394
                        (AC-FT)       11.         13.         13.         13.

                        CUMULATIVE AREA =    0.62 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** **


            **************
            *            *
  416 KK    *    COMB19  *
            *            *
            **************
                                Combine flows at Greenway Road and SR-51

  418 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   COMB19

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                          (CFS)
+     361.     12.73                    78.         22.          8.          8.
                        (INCHES)     0.442       0.506       0.508       0.508
                        (AC-FT)       38.         44.         44.         44.

                        CUMULATIVE AREA =    1.63 SQ MI
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              **************
              *            *
419 KK        *   RGRWY3   *     6
              *            *
              **************
```

Route flows from COMB16 @ SR-51 and Greenway Road to Blanche Dr. & SR-51
- PIPE FLOW

HYDROGRAPH ROUTING DATA

422 RK KINEMATIC WAVE STREAM ROUTING

L	1250.	CHANNEL LENGTH
S	0.0033	SLOPE
N	0.012	CHANNEL ROUGHNESS COEFFICIENT
CA	0.00	CONTRIBUTING AREA
SHAPE	CIRC	CHANNEL SHAPE
WD	7.00	BOTTOM WIDTH OR DIAMETER
Z	0.00	SIDE SLOPE
NDXMIN	2	MINIMUM NUMBER OF DX INTERVALS

***

COMPUTED KINEMATIC PARAMETERS
VARIABLE TIME STEP
(DT SHOWN IS A MINIMUM)

ELEMENT	ALPHA	M	DT (MIN)	DX (FT)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	MAXIMUM CELERITY (FPS)
MAIN	5.32	1.25	0.49	416.67	360.72	764.98	0.51	15.47

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4420E+02 EXCESS=0.0000E+00 OUTFLOW=0.4420E+02 BASIN STORAGE=0.1770E-09 PERCENT ERROR= 0.0

INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

MAIN	5.32	1.25	2.00	358.04	764.00	0.51

*** *** *** *** ***

HYDROGRAPH AT STATION RGRWY3

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
358.	12.73		78.	22.	8.	8.
		(INCHES)	0.442	0.506	0.508	0.508
		(AC-FT)	38.	44.	44.	44.

CUMULATIVE AREA = 1.63 SQ MI

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
423 KK    *    SR51NR  *
          *            *
          **************
                          Runoff from NE quad. of SR-51 & Nisbet Road

             SUBBASIN RUNOFF DATA

425 BA          SUBBASIN CHARACTERISTICS
                      TAREA        0.03  SUBBASIN AREA

                PRECIPITATION DATA

238 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                STORM AREA =    0.03

426 LG          GREEN AND AMPT LOSS RATE
                      STRTL        0.20  STARTING LOSS
                        DTH        0.25  MOISTURE DEFICIT
                       PSIF        3.50  WETTING FRONT SUCTION
                      XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                      RTIMP       30.00  PERCENT IMPERVIOUS AREA

427 UC          CLARK UNITGRAPH
                         TC        0.20  TIME OF CONCENTRATION
                          R        0.19  STORAGE COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                     ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=  0.20 HR,       R=  0.19 HR
                                       SNYDER   TP=  0.18 HR,      CP=  0.57

                                                UNIT HYDROGRAPH
                                           34 END-OF-PERIOD ORDINATES
                  4.      14.      28.      42.      52.      55.      50.      42.      35.      29.
                 25.      21.      17.      15.      12.      10.       9.       7.       6.       5.
                  4.       4.       3.       2.       2.       2.       1.       1.       1.       1.
                  1.       1.       1.       0.

     ***          ***          ***          ***          ***

                     HYDROGRAPH AT STATION   SR51NR

    TOTAL RAINFALL =    3.37, TOTAL LOSS =    1.22, TOTAL EXCESS =    2.15

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
```

```
                        (CFS)
+     61.     12.20                 6.         1.         1.         1.
                      (INCHES)    1.980      2.144      2.145      2.145
                       (AC-FT)      3.         3.         3.         3.

                      CUMULATIVE AREA =    0.03 SQ MI
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          **************
          *            *
 428 KK   *    COMB20  *
          *            *
          **************
                          Combine flows at Blanche Dr. and SR-51

 430 HC         HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   COMB20

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR     66.63-HR
+  (CFS)       (HR)
                        (CFS)
+    368.     12.73                 83.         24.         9.         9.
                      (INCHES)    0.465      0.532      0.533      0.533
                       (AC-FT)      41.         47.        47.        47.

                      CUMULATIVE AREA =    1.66 SQ MI
```

*** ***

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          **************
          *            *
 431 KK   *    RSR51N  *     R
          *            *
          **************
                          Route flows from COMB17 @ SR-51 and Blanche Dr. to Gelding & SR-51
                          - PIPE FLOW

            HYDROGRAPH ROUTING DATA

 434 RK         KINEMATIC WAVE STREAM ROUTING
                         L       2275.  CHANNEL LENGTH
                         S      0.0033  SLOPE
                         N       0.012  CHANNEL ROUGHNESS COEFFICIENT
                        CA        0.00  CONTRIBUTING AREA
```

```
SHAPE        CIRC  CHANNEL SHAPE
  WD         7.50  BOTTOM WIDTH OR DIAMETER
   Z         0.00  SIDE SLOPE
NDXMIN          2  MINIMUM NUMBER OF DX INTERVALS

                                        ***
                    COMPUTED KINEMATIC PARAMETERS
                         VARIABLE TIME STEP
                       (DT SHOWN IS A MINIMUM)

ELEMENT    ALPHA      M        DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                           PEAK                  CELERITY
                             (MIN)      (FT)     (CFS)    (MIN)       (IN)      (FPS)

MAIN        5.38      1.25      0.85    758.33    367.65   766.05      0.53      15.67

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4717E+02  EXCESS=0.0000E+00 OUTFLOW=0.4718E+02 BASIN STORAGE=0.5270E-09 PERCENT ERROR=   0.0

                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

MAIN        5.38      1.25      2.00              367.52   766.00      0.53

   ***         ***         ***         ***         ***

                  HYDROGRAPH AT STATION   RSR51N

 PEAK FLOW    TIME                    MAXIMUM AVERAGE FLOW
                                 6-HR       24-HR      72-HR     66.63-HR
+  (CFS)      (HR)
                        (CFS)
+    368.     12.77                83.        24.        9.         9.
                      (INCHES)   0.465      0.532      0.533      0.533
                       (AC-FT)    41.        47.        47.        47.

                     CUMULATIVE AREA =    1.66 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
435 KK    *   SR51GD   *
          *            *
          **************
                        Runoff from NE quad. of SR-51 & Gelding Drive

            SUBBASIN RUNOFF DATA

437 BA        SUBBASIN CHARACTERISTICS
                   TAREA        0.08  SUBBASIN AREA

              PRECIPITATION DATA

238 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
```

..... HYDRO-35			..... TP-40					..... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
0.67	1.31	2.22	2.42	2.56	2.82	3.09	3.37	0.00	0.00	0.00	0.00

STORM AREA = 0.08

438 LG GREEN AND AMPT LOSS RATE

STRTL	0.20	STARTING LOSS
DTH	0.25	MOISTURE DEFICIT
PSIF	3.50	WETTING FRONT SUCTION
XKSAT	0.25	HYDRAULIC CONDUCTIVITY
RTIMP	30.00	PERCENT IMPERVIOUS AREA

439 UC CLARK UNITGRAPH

TC	0.31	TIME OF CONCENTRATION
R	0.27	STORAGE COEFFICIENT

SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= 0.31 HR, R= 0.27 HR

SNYDER TP= 0.28 HR, CP= 0.61

UNIT HYDROGRAPH

48 END-OF-PERIOD ORDINATES

5.	17.	34.	54.	75.	94.	108.	117.	118.	111.
99.	88.	77.	68.	60.	53.	47.	42.	37.	33.
29.	25.	23.	20.	18.	16.	14.	12.	11.	9.
8.	7.	7.	6.	5.	5.	4.	4.	3.	3.
2.	2.	2.	2.	1.	1.	1.	1.		

*** *** *** *** ***

HYDROGRAPH AT STATION SR51GD

TOTAL RAINFALL = 3.37, TOTAL LOSS = 1.22, TOTAL EXCESS = 2.15

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
154.	12.30		17.	5.	2.	2.
		(INCHES)	1.978	2.142	2.143	2.143
		(AC-FT)	9.	9.	9.	9.

CUMULATIVE AREA = 0.08 SQ MI

*** ***

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              **************
              *            *
440 KK        *    SPLIT   *
              *            *
              **************
```

Split flows @ Gelding and 35th Street to the south

```
DT          DIVERSION
                 ISTAD      35GLDG  DIVERSION HYDROGRAPH IDENTIFICATION

DI            INFLOW        0.00     3.50    11.00    25.00    45.00    65.00    86.00   115.00   155.00   200.00

DQ      DIVERTED FLOW       0.00     0.00     3.50    10.00    25.00    35.00    47.00    65.00    90.00   120.00

                                                          ***

 ***          ***            ***            ***            ***

                    DIVERSION HYDROGRAPH   35GLDG

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                         (CFS)
+      89.     12.30                 9.          2.          1.          1.
                       (INCHES)    0.984       0.984       0.984       0.984
                        (AC-FT)      4.          4.          4.          4.

                    CUMULATIVE AREA =    0.08 SQ MI


 ***          ***            ***            ***            ***

                    HYDROGRAPH AT STATION    SPLIT

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+   (CFS)       (HR)
                         (CFS)
+      65.     12.30                 9.          3.          1.          1.
                       (INCHES)    0.994       1.158       1.159       1.159
                        (AC-FT)      4.          5.          5.          5.

                    CUMULATIVE AREA =    0.08 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
445 KK    *    COMB21  *
          *            *
          **************
                    Combine flows at Gelding and SR-51

447 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***
```

```
   ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   COMB21

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
  (CFS)        (HR)
                          (CFS)
+   409.      12.43                   92.         26.          9.          9.
                        (INCHES)    0.489       0.561       0.563       0.563
                         (AC-FT)       45.         52.         52.         52.

                       CUMULATIVE AREA =    1.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
448 KK    *   RSR51G   *     D
          *            *
          **************
                            Route flows from COMB18 @ SR-51 and Gelding to Ludlow & SR-51
                            - PIPE FLOW

            HYDROGRAPH ROUTING DATA

451 RK         KINEMATIC WAVE STREAM ROUTING
                         L       1500.  CHANNEL LENGTH
                         S      0.0033  SLOPE
                         N       0.012  CHANNEL ROUGHNESS COEFFICIENT
                        CA        0.00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD        8.00  BOTTOM WIDTH OR DIAMETER
                         Z        0.00  SIDE SLOPE
                    NDXMIN           2  MINIMUM NUMBER OF DX INTERVALS

                                                  ***
                                  COMPUTED KINEMATIC PARAMETERS
                                       VARIABLE TIME STEP
                                    (DT SHOWN IS A MINIMUM)

                 ELEMENT    ALPHA       M        DT       DX      PEAK    TIME TO     VOLUME    MAXIMUM
                                                                            PEAK                  CELERITY
                                                (MIN)     (FT)    (CFS)    (MIN)       (IN)      (FPS)

                 MAIN         2.18    1.47      0.58   500.00   408.50   747.26       0.56      16.85

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5225E+02  EXCESS=0.0000E+00 OUTFLOW=0.5226E+02 BASIN STORAGE=0.1437E-06 PERCENT ERROR=   0.0

                                  INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN         2.18    1.47      2.00            408.24   748.00       0.56
```

```
***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION   RSR51G

 PEAK FLOW    TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
+  (CFS)      (HR)
                         (CFS)
+    408.     12.47                92.         26.          9.          9.
                       (INCHES)   0.489       0.561       0.563       0.563
                        (AC-FT)     45.         52.         52.         52.

                       CUMULATIVE AREA =    1.74 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
452 KK    *   SR51LD   *
          *            *
          **************
                         Runoff from NE quad. of SR-51 & Ludlow Drive

            SUBBASIN RUNOFF DATA

454 BA        SUBBASIN CHARACTERISTICS
                    TAREA        0.06  SUBBASIN AREA

              PRECIPITATION DATA

238 PH                            DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 .....  ............... TP-40 ...............  ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN   2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               0.67    1.31    2.22   2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                              STORM AREA =    0.06

455 LG        GREEN AND AMPT LOSS RATE
                    STRTL        0.20  STARTING LOSS
                      DTH        0.25  MOISTURE DEFICIT
                     PSIF        3.50  WETTING FRONT SUCTION
                    XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                    RTIMP       30.00  PERCENT IMPERVIOUS AREA

456 UC        CLARK UNITGRAPH
                      TC        0.30  TIME OF CONCENTRATION
                       R        0.30  STORAGE COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                          ***

                                UNIT HYDROGRAPH PARAMETERS
                          CLARK   TC=  0.30 HR,       R=  0.30 HR
                         SNYDER   TP=  0.27 HR,      CP=  0.57
```

UNIT HYDROGRAPH
53 END-OF-PERIOD ORDINATES

3.	11.	22.	36.	49.	62.	71.	76.	76.	71.
64.	57.	51.	46.	41.	37.	33.	29.	26.	23.
21.	19.	17.	15.	13.	12.	11.	10.	9.	8.
7.	6.	6.	5.	4.	4.	4.	3.	3.	3.
2.	2.	2.	2.	1.	1.	1.	1.	1.	1.
1.	1.	1.							

*** *** *** *** ***

HYDROGRAPH AT STATION SR51LD

TOTAL RAINFALL = 3.37, TOTAL LOSS = 1.22, TOTAL EXCESS = 2.15

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
100.	12.30		12.	3.	1.	1.
		(INCHES)	1.979	2.143	2.144	2.144
		(AC-FT)	6.	6.	6.	6.

CUMULATIVE AREA = 0.06 SQ MI

*** ***

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          **************
          *            *
457 KK    *   RETGLD   *     G
          *            *
          **************
```

Retrieve diverted hydrograph at 35th Street and Gelding

459 DR RETRIEVE DIVERSION HYDROGRAPH
ISTAD 35GLDG DIVERSION HYDROGRAPH IDENTIFICATION

***

*** *** *** *** ***

HYDROGRAPH AT STATION RETGLD

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
+ 89.	12.30		9.	2.	1.	1.
		(INCHES)	1.442	1.442	1.442	1.442
		(AC-FT)	4.	4.	4.	4.

CUMULATIVE AREA = 0.00 SQ MI

*** ***

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              **************
              *            *
460 KK        *   Comb21   *     B
              *            *
              **************
```

Combine flows at Ludlow Drive and 34th Place

```
462 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

     ***            ***            ***            ***            ***
```

HYDROGRAPH AT STATION Comb21

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 190.	12.30		21.	5.	2.	2.
		(INCHES)	3.420	3.584	3.585	3.585
		(AC-FT)	10.	11.	11.	11.

CUMULATIVE AREA = 0.06 SQ MI

*** ***

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              **************
              *            *
463 KK        *    SPLIT   *
              *            *
              **************
```

Split flows @ 34th Pl. & Ludlow Drive to Thunderbird (south)

```
DT          DIVERSION
                 ISTAD      TB-LD  DIVERSION HYDROGRAPH IDENTIFICATION

DI             INFLOW       0.00      9.00     16.00     25.00     50.00     81.00     98.00    116.00

DQ       DIVERTED FLOW      0.00      0.00      2.00      6.00     19.00     35.00     44.00     54.00

                                                        ***

     ***            ***            ***            ***            ***
```

DIVERSION HYDROGRAPH TB-LD

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	66.63-HR
+ (CFS)	(HR)					
		(CFS)				
+ 95.	12.30		9.	2.	1.	1.

```
                    (INCHES)     1.415       1.415       1.415       1.415
                     (AC-FT)       4.          4.          4.          4.

                    CUMULATIVE AREA =    0.06 SQ MI


    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION    SPLIT

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                        (CFS)
+     95.     12.30                  12.          3.          1.          1.
                    (INCHES)     2.005       2.169       2.170       2.170
                     (AC-FT)       6.          6.          6.          6.

                    CUMULATIVE AREA =    0.06 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 468 KK   *    COMB22  *
          *            *
          **************
                          Combine flows at Ludlow and SR-51

 470 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   COMB22

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     66.63-HR
+  (CFS)       (HR)
                        (CFS)
+    490.     12.40                 104.         30.         11.         11.
                    (INCHES)     0.536       0.611       0.613       0.613
                     (AC-FT)      51.         59.         59.         59.

                    CUMULATIVE AREA =    1.80 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
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```
471 KK     *    RETHYD  *
           *            *
           **************
```

Retrieve diverted hydrograph from 34th Pl. & Ludlow Drive

```
473 DR          RETRIEVE DIVERSION HYDROGRAPH
                     ISTAD       TB-LD  DIVERSION HYDROGRAPH IDENTIFICATION

                                                          ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   RETHYD

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     66.63-HR
+   (CFS)      (HR)
                         (CFS)
+      95.     12.30                 9.          2.          1.          1.
                       (INCHES)    0.044       0.044       0.044       0.044
                        (AC-FT)      4.          4.          4.          4.

                       CUMULATIVE AREA =    0.00 SQ MI
```

*** ***

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           **************
           *            *
474 KK     *    SR51TR  *
           *            *
           **************
```

Runoff from NE quad. of SR-51 & Thunderbird Road

```
              SUBBASIN RUNOFF DATA

476 BA          SUBBASIN CHARACTERISTICS
                     TAREA        0.02  SUBBASIN AREA

                PRECIPITATION DATA

238 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37    0.00    0.00    0.00    0.00

                                                STORM AREA =    0.02

477 LG          GREEN AND AMPT LOSS RATE
                     STRTL        0.20  STARTING LOSS
                       DTH        0.25  MOISTURE DEFICIT
                      PSIF        3.50  WETTING FRONT SUCTION
                     XKSAT        0.25  HYDRAULIC CONDUCTIVITY
                     RTIMP       30.00  PERCENT IMPERVIOUS AREA

478 UC          CLARK UNITGRAPH
                        TC        0.13  TIME OF CONCENTRATION
```

```
                    R        0.09  STORAGE COEFFICIENT

          SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                  ***

                                        UNIT HYDROGRAPH PARAMETERS
                                  CLARK   TC=  0.13 HR,      R=  0.09 HR
                                 SNYDER   TP=  0.11 HR,     CP=  0.64

                                          UNIT HYDROGRAPH
                                     17 END-OF-PERIOD ORDINATES
          9.      31.      53.      60.      49.      34.      23.      16.      11.       7.
          5.       4.       2.       2.       1.       1.       1.

   ***          ***          ***          ***          ***

                   HYDROGRAPH AT STATION   SR51TR

  TOTAL RAINFALL =   3.37, TOTAL LOSS =   1.22, TOTAL EXCESS =   2.15

PEAK FLOW    TIME                      MAXIMUM AVERAGE FLOW
                                  6-HR      24-HR      72-HR     66.63-HR
  (CFS)      (HR)
                        (CFS)
    53.     12.13                  3.         1.         0.         0.
                       (INCHES)  1.981      2.146      2.146      2.146
                        (AC-FT)     2.         2.         2.         2.

                       CUMULATIVE AREA =   0.02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
479 KK    *   COMB23   *
          *            *
          **************
                        Combine flows at Thunderbird and SR-51

481 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

   ***          ***          ***          ***          ***

                   HYDROGRAPH AT STATION   COMB23

PEAK FLOW    TIME                      MAXIMUM AVERAGE FLOW
                                  6-HR      24-HR      72-HR     66.63-HR
  (CFS)      (HR)
                        (CFS)
   125.     12.23                 12.         3.         1.         1.
                       (INCHES)  6.934      7.098      7.099      7.099
                        (AC-FT)     6.         6.         6.         6.
```

CUMULATIVE AREA = 0.02 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	UH40NE	241.	12.30	27.	7.	3.	0.12		
+	DIVERSION TO	RET1	241.	12.50	17.	4.	2.	0.12		
+	HYDROGRAPH AT	DETBAS	171.	12.50	12.	3.	1.	0.12		
+	DIVERSION TO	UH40S	154.	12.73	8.	2.	1.	0.12		
+	HYDROGRAPH AT	SPLIT	20.	12.73	4.	1.	0.	0.12		
+	ROUTED TO	RUH40N	19.	12.77	4.	1.	0.	0.12		
+									3.14	12.77
+	HYDROGRAPH AT	SR51UH	144.	12.37	20.	5.	2.	0.09		
+	DIVERSION TO	RET2	144.	13.73	20.	5.	2.	0.09		
+	HYDROGRAPH AT	DETBAS	9.	13.73	1.	0.	0.	0.09		
+	2 COMBINED AT	COMB1	19.	12.77	5.	2.	1.	0.22		
+	ROUTED TO	RSR51U	18.	12.90	5.	2.	1.	0.22		
+									1.72	12.90
+	HYDROGRAPH AT	RETHYD	154.	12.50	8.	2.	1.	0.00		
+	ROUTED TO	RUH40S	134.	12.60	8.	2.	1.	0.00		
+									2.99	12.60
+	HYDROGRAPH AT	SR51NP	85.	12.40	10.	3.	1.	0.06		
+	3 COMBINED AT	COMB2	198.	12.60	23.	6.	2.	0.28		

ROUTED TO									
+	RSR51N	193.	12.67	23.	6.	2.	0.28		
HYDROGRAPH AT									
+	SR51SP	91.	12.53	14.	4.	1.	0.09		
DIVERSION TO									
+	RET3	91.	12.60	5.	1.	0.	0.09		
HYDROGRAPH AT									
+	DETBAS	89.	12.60	9.	2.	1.	0.09		
HYDROGRAPH AT									
+	REL40E	172.	12.30	22.	6.	2.	0.09		
ROUTED TO									
+	RREL40	170.	12.37	22.	6.	2.	0.09		
+								1.58	12.37
HYDROGRAPH AT									
+	UH42NE	212.	12.23	20.	6.	2.	0.08		
DIVERSION TO									
+	RET4	212.	13.43	19.	5.	2.	0.08		
HYDROGRAPH AT									
+	DETBAS	4.	13.43	2.	1.	0.	0.08		
ROUTED TO									
+	RUH42N	3.	14.37	2.	1.	0.	0.08		
+								0.87	14.37
HYDROGRAPH AT									
+	CBD40E	205.	12.47	35.	9.	3.	0.17		
3 COMBINED AT									
+	COMB3	362.	12.40	58.	16.	6.	0.35		
ROUTED TO									
+	RCBD40	360.	12.47	58.	16.	6.	0.35		
+								2.79	12.47
2 COMBINED AT									
+	COMB4	416.	12.60	67.	18.	7.	0.44		
ROUTED TO									
+	RSR51S	404.	12.63	67.	18.	7.	0.44		
+								2.38	12.63
HYDROGRAPH AT									
+	BRPVHS	140.	12.27	14.	4.	1.	0.07		
DIVERSION TO									
+	PVH40S	93.	12.27	10.	3.	1.	0.07		
HYDROGRAPH AT									
+	SPLIT	47.	12.27	5.	1.	0.	0.07		
2 COMBINED AT									
+	COMB5	420.	12.63	72.	20.	7.	0.51		

	DIVERSION TO								
+		BR38S	385.	12.10	57.	15.	5.	0.51	
	HYDROGRAPH AT								
+		SPLIT	35.	12.10	15.	5.	2.	0.51	
	ROUTED TO								
+		RBRPVH	35.	12.50	15.	5.	2.	0.51	
+									63.40 12.70
	HYDROGRAPH AT								
+		SR51BN	39.	12.20	5.	1.	1.	0.02	
	2 COMBINED AT								
+		COMB6	73.	12.20	20.	6.	2.	0.52	
	2 COMBINED AT								
+		COMB7	241.	12.67	42.	12.	4.	0.80	
	ROUTED TO								
+		RSR51B	240.	12.67	42.	12.	4.	0.80	
	HYDROGRAPH AT								
+		SR51BS	71.	12.20	6.	2.	1.	0.03	
	DIVERSION TO								
+		RET7	71.	12.80	6.	2.	1.	0.03	
	HYDROGRAPH AT								
+		DETBAS	7.	12.80	1.	0.	0.	0.03	
	2 COMBINED AT								
+		COMB8	240.	12.67	43.	12.	5.	0.83	
	ROUTED TO								
+		RSR51B	237.	12.70	43.	12.	5.	0.83	
	HYDROGRAPH AT								
+		SR51PR	20.	12.17	2.	1.	0.	0.01	
	2 COMBINED AT								
+		COMB9	241.	12.70	45.	13.	5.	0.84	
	ROUTED TO								
+		RSR51P	239.	12.70	45.	13.	5.	0.84	
	HYDROGRAPH AT								
+		36thST	44.	12.33	5.	1.	0.	0.07	
	ROUTED TO								
+		R36thS	43.	12.37	5.	1.	0.	0.07	
	HYDROGRAPH AT								
+		36th	30.	12.30	5.	1.	1.	0.02	
	2 COMBINED AT								
+		COMB9B	73.	12.37	10.	3.	1.	0.09	
	2 COMBINED AT								

	COMB9C	282.	12.70	55.	16.	6.	0.93		
ROUTED TO									
	RSR51P	278.	12.70	55.	16.	6.	0.93		
HYDROGRAPH AT									
	BUEN37	134.	12.33	17.	5.	2.	0.08		
DIVERSION TO									
	36thSD	134.	0.03	17.	5.	2.	0.08		
HYDROGRAPH AT									
	DIVBUE	0.	0.03	0.	0.	0.	0.08		
2 COMBINED AT									
	COMB10	278.	12.70	55.	16.	6.	1.02		
ROUTED TO									
	RBUEN3	277.	12.73	55.	16.	6.	1.02		
HYDROGRAPH AT									
	BR40NE	163.	12.27	20.	6.	2.	0.08		
DIVERSION TO									
	RET5	163.	12.67	15.	4.	1.	0.08		
HYDROGRAPH AT									
	DETBAS	74.	12.67	6.	2.	1.	0.08		
DIVERSION TO									
	BR40S	25.	12.67	2.	0.	0.	0.08		
HYDROGRAPH AT									
	SPLIT	49.	12.67	4.	1.	0.	0.08		
ROUTED TO									
	RBR40N	28.	12.93	4.	1.	0.	0.08		
								66.24	12.93
HYDROGRAPH AT									
	RETHYD	93.	12.27	10.	3.	1.	0.00		
2 COMBINED AT									
	COMB11	93.	12.27	13.	4.	1.	0.08		
HYDROGRAPH AT									
	RETHYD	385.	12.63	57.	15.	5.	0.00		
2 COMBINED AT									
	COMB12	418.	12.63	70.	19.	7.	0.08		
ROUTED TO									
	RBR38S	408.	12.70	70.	19.	7.	0.08		
								46.96	12.70
HYDROGRAPH AT									
	PDLN38	347.	12.20	25.	7.	2.	0.14		
DIVERSION TO									
	RET8	347.	12.30	15.	4.	1.	0.14		

	HYDROGRAPH AT								
+		DETBAS	270.	12.30	10.	3.	1.	0.14	
	2 COMBINED AT								
+		COMB13	511.	12.43	80.	21.	8.	0.22	
	ROUTED TO								
+		RPDLN3	513.	12.43	80.	21.	8.	0.22	
+									47.20 12.43
	HYDROGRAPH AT								
+		GRWY38	194.	12.30	18.	5.	2.	0.12	
	DIVERSION TO								
+		RET9	112.	12.30	4.	1.	0.	0.12	
	HYDROGRAPH AT								
+		DETBAS	194.	12.30	15.	4.	1.	0.12	
	2 COMBINED AT								
+		COMB14	658.	12.43	95.	25.	9.	0.34	
	HYDROGRAPH AT								
+		RETHYD	25.	12.67	2.	0.	0.	0.00	
	HYDROGRAPH AT								
+		BLR40E	60.	12.17	6.	2.	1.	0.02	
	DIVERSION TO								
+		RET10	60.	13.13	6.	2.	1.	0.02	
	HYDROGRAPH AT								
+		DETBAS	2.	13.13	1.	0.	0.	0.02	
	2 COMBINED AT								
+		COMB15	25.	12.67	2.	1.	0.	0.02	
	ROUTED TO								
+		RBLR40	11.	13.57	2.	1.	0.	0.02	
+									64.86 13.57
	HYDROGRAPH AT								
+		GRW40N	455.	12.20	31.	8.	3.	0.16	
	HYDROGRAPH AT								
+		GWR40	34.	12.37	8.	2.	1.	0.03	
	DIVERSION TO								
+		RET11	34.	15.50	8.	2.	1.	0.03	
	HYDROGRAPH AT								
+		DETBAS	2.	15.50	1.	0.	0.	0.03	
	3 COMBINED AT								
+		COMB16	455.	12.20	33.	9.	3.	0.22	
	DIVERSION TO								
+		GRW40S	215.	12.20	12.	3.	1.	0.22	

HYDROGRAPH AT									
	SPLIT	240.	12.20	21.	6.	2.	0.22		
ROUTED TO									
	RGRW40	235.	12.27	21.	6.	2.	0.22		
								48.81	12.27
2 COMBINED AT									
	COMB17	785.	12.43	116.	31.	11.	0.56		
DIVERSION TO									
	GRW38S	448.	12.43	51.	13.	5.	0.56		
HYDROGRAPH AT									
	SPLIT	337.	12.43	65.	19.	7.	0.56		
ROUTED TO									
	RGRW40	325.	12.50	65.	19.	7.	0.56		
								49.22	12.50
HYDROGRAPH AT									
	GRWY36	96.	12.33	11.	3.	1.	0.06		
2 COMBINED AT									
	COMB18	399.	12.50	76.	22.	8.	0.62		
DIVERSION TO									
	GWY36S	295.	12.50	53.	15.	5.	0.62		
HYDROGRAPH AT									
	SPLIT	105.	12.50	23.	7.	2.	0.62		
2 COMBINED AT									
	COMB19	361.	12.73	78.	22.	8.	1.63		
ROUTED TO									
	RGRWY3	358.	12.73	78.	22.	8.	1.63		
HYDROGRAPH AT									
	SR51NR	61.	12.20	6.	1.	1.	0.03		
2 COMBINED AT									
	COMB20	368.	12.73	83.	24.	9.	1.66		
ROUTED TO									
	RSR51N	368.	12.77	83.	24.	9.	1.66		
HYDROGRAPH AT									
	SR51GD	154.	12.30	17.	5.	2.	0.08		
DIVERSION TO									
	35GLDG	89.	12.30	9.	2.	1.	0.08		
HYDROGRAPH AT									
	SPLIT	65.	12.30	9.	3.	1.	0.08		
2 COMBINED AT									
	COMB21	409.	12.43	92.	26.	9.	1.74		
ROUTED TO									

```
+                    RSR51G      408.   12.47        92.        26.        9.      1.74

        HYDROGRAPH AT
+                    SR51LD      100.   12.30        12.         3.        1.      0.06

        HYDROGRAPH AT
+                    RETGLD       89.   12.30         9.         2.        1.      0.00

        2 COMBINED AT
+                    Comb21      190.   12.30        21.         5.        2.      0.06

        DIVERSION TO
+                     TB-LD       95.   12.30         9.         2.        1.      0.06

        HYDROGRAPH AT
+                     SPLIT       95.   12.30        12.         3.        1.      0.06

        2 COMBINED AT
+                    COMB22      490.   12.40       104.        30.       11.      1.80

        HYDROGRAPH AT
+                    RETHYD       95.   12.30         9.         2.        1.      0.00

        HYDROGRAPH AT
+                    SR51TR       53.   12.13         3.         1.        0.      0.02

        2 COMBINED AT
+                    COMB23      125.   12.23        12.         3.        1.      0.02
1
                                   SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                       (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                          INTERPOLATED TO
                                                                     COMPUTATION INTERVAL
          ISTAQ    ELEMENT      DT       PEAK    TIME TO    VOLUME      DT       PEAK    TIME TO    VOLUME
                                                   PEAK                                    PEAK

                              (MIN)     (CFS)     (MIN)     (IN)    (MIN)     (CFS)    (MIN)      (IN)

          RSR51N   MANE        1.19    196.12    758.95     0.80     2.00    192.66   760.00      0.80

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1191E+02 EXCESS=0.0000E+00 OUTFLOW=0.1191E+02 BASIN STORAGE=0.3209E-10 PERCENT ERROR=   0.0

          RSR51B   MANE        0.45    240.61    760.90     0.57     2.00    239.95   760.00      0.57

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2442E+02 EXCESS=0.0000E+00 OUTFLOW=0.2442E+02 BASIN STORAGE=0.4279E-10 PERCENT ERROR=   0.0

          RSR51B   MANE        0.78    238.14    761.40     0.56     2.00    237.17   762.00      0.56

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2483E+02 EXCESS=0.0000E+00 OUTFLOW=0.2483E+02 BASIN STORAGE=0.1171E-09 PERCENT ERROR=   0.0

          RSR51P   MANE        0.39    240.09    762.52     0.58     2.00    238.80   762.00      0.58

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2583E+02 EXCESS=0.0000E+00 OUTFLOW=0.2583E+02 BASIN STORAGE=0.6493E-10 PERCENT ERROR=   0.0
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```
          R36thS  MANE        1.64     43.60    742.43      0.67      2.00     43.44    742.00       0.67

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2562E+01 EXCESS=0.0000E+00 OUTFLOW=0.2564E+01 BASIN STORAGE=0.4013E-10 PERCENT ERROR=  -0.1

          RSR51P  MANE        0.43    280.71    762.77      0.63      2.00    277.76    762.00       0.63

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3123E+02 EXCESS=0.0000E+00 OUTFLOW=0.3123E+02 BASIN STORAGE=0.1128E-09 PERCENT ERROR=   0.0

          RBUEN3  MANE        0.65    277.43    763.61      0.58      2.00    277.18    764.00       0.58

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3123E+02 EXCESS=0.0000E+00 OUTFLOW=0.3123E+02 BASIN STORAGE=0.2207E-09 PERCENT ERROR=   0.0

          RGRWY3  MANE        0.49    360.72    764.98      0.51      2.00    358.04    764.00       0.51

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4420E+02 EXCESS=0.0000E+00 OUTFLOW=0.4420E+02 BASIN STORAGE=0.1770E-09 PERCENT ERROR=   0.0

          RSR51N  MANE        0.85    367.65    766.05      0.53      2.00    367.52    766.00       0.53

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4717E+02 EXCESS=0.0000E+00 OUTFLOW=0.4718E+02 BASIN STORAGE=0.5270E-09 PERCENT ERROR=   0.0

          RSR51G  MANE        0.58    408.50    747.26      0.56      2.00    408.24    748.00       0.56

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5225E+02 EXCESS=0.0000E+00 OUTFLOW=0.5226E+02 BASIN STORAGE=0.1437E-06 PERCENT ERROR=   0.0


*** NORMAL END OF HEC-1 ***
```

To Ray Jordan, P.E.
Jim Romero, P.E.

From L. Steve Miller, P.E.

Date August 28, 1995

HDR

Memorandum

Subject SR-51 Squaw Peak Off-site Hydrology

I have completed the modeling of the SR-51 watershed between the Central Arizona Project Canal and Thunderbird Road. The watershed was analyzed using data from the USGS quadrangle mapping, ADOT provided mapping along the roadway alignment, intersection surveys provided by HDR's survey subconsultant, and field trips to identify watershed characteristics. The results of the HEC-1 modeling effort are based on the ADOT 1993 Highway Drainage Design Manual procedures which include the Green & Ampt infiltration loss procedure and the Clark Unit Hydrograph procedure. Past experience with these procedures have shown shorter times of concentration and higher peak discharges results from their application. A comparison of the Final Hydrology Report (November, 1988) discharges along the SR-51 and the results of HDR's analysis are provided in the following table.

LOCATION	Final Hydrology Report			HDR Analysis		
	DA	Q50	Q100	DA	Q50	Q100
SR-51 & Bell Road	0.32	237	295	0.80	252	295
SR-51 & Greenway Road	0.63	389	516	1.54	411	506
SR-51 U/S Thunderbird Road	0.83	433	601	1.70	614	692
Thunderbird Road @ SR-51 (east side)				0.06	82	94

As can be seen in the preceding table, the Final Hydrology Report, produced by Baker Engineers, does not account for the entire watershed contributing to SR-51 within this reach. The original purpose of the hydrologic model shown in the Final Hydrology Report was to establish discharges within the roadway corridor during the routing study. The initial modeling performed by AN West for Gruen & Associates based subarea delineations on the topographic data from the USGS quadrangle mapping (1981-1982). The GEC (Baker Engineers) remodeled the area south of Thunderbird using HEC-1 prior to the final design contract. The report indicates the model for the area north of Thunderbird Road (TR-20) was adjusted to account for the selected route but the watershed boundaries does not appear to have been revisited as was done for the area to the south. The adjusted route study hydrology was more general in nature and the HDR modeling is very specific and detailed and is appropriate for use for final design of the drainage facilities.

Large overflows to the south along the mile streets divert much of the watershed runoff along 40th, 39th and 36th Streets, thus reducing the peak runoff getting to the SR-51 alignment. Therefore, despite the larger drainage area in the HDR model, the predicted peak discharges along the SR-51 alignment north of Greenway Road by the two models are very consistent. The only physical constraint assumption used in the HDR modeling which effects the modeling results

was that the flow being deverted to the SR-51 alignment at Greenway Road was limited 35 cfs because of the sag condition in Greenway Road immediately east of the alignment. This sag will probably back storm water into the intersection at 38th Street during high flows which will force most of the flow in excess of the design discharge to the south. The largest difference in the results of the two models occurs between Greenway & Thunderbird Roads. The Final Hydrology Report used the TR-20 model while HDR used the HEC-1 model. These two simulation models are not consistent in their routing, hydrograph peaking routines, unit hydrograph and loss rate functions. The other factor which greatly impacts the modeling results were the curve numbers used in the Final Hydrology Report were between 74.9 and 83.4. They were selected to account for the City of Phoenix retention policy under which the area was developed. These curve numbers result in low runoff predictions. For the area between Greenway and Thunderbird Roads, the CN's used account for some retention within the residential development. No retention was observed during site visits to this area.

The HDR model is based on the current analysis procedures adopted by ADOT. For the areas developed since 1988, the 100-year 2-hour runoff volume (City of Phoenix retention requirement) was modeled and the modeling event (50-yr. or 100-yr.) runoff hydrographs were routed through modeling retention basins which reduced the runoff hydrograph by this retention volume. Where site visits indicated that no retention was provided, HDR's model does not account for this reduction in flow. The storm water collected along SR-51 was routed as pipe and culvert flow with no losses and short travel times which represents the roadway off-site drainage concept. This caused the timing of the peak flow in the pipe to be nearly coincident with the off-site flow from the small adjacent drainage areas south of Greenway Road. The result of this modeling is the dramatic increase in peak flow along the SR-51 alignment between Greenway and Thunderbird Roads. This condition was not experienced in the previous modeling effort by AN West and Baker Engineering because the storm analyzed previously was a 9-hour duration storm rather than the 24-hour storm and the routing and hydrograph methods used previously offset the peaks enough to only increase the resultant hydrograph by 44 cfs and 85 cfs between Greenway and Thunderbird Roads for the 50-year and 100-year events. The peak flow rate entering the SR-51 alignment between these two roads from the previous model was 221 and 267 cfs for these two events. The computation interval for the TR-20 model was set at 6 minutes while the HDR model was run with a 2 minute time step due to much smaller subbasin areas. This accounts for some of the peak flow rate differences.

The existing storm drains in 40th Street, 36th Street, and in Greenway Road were not modeled because the storm water runoff which they collect has been accounted for. When the storm water inlets for these areas are being design, these flows will have to be separated. Neither HDR nor the AN West/Baker modeling accounted for the Pump Station input at Greenway Road. This peak discharge has not been established for the current mainline profile but has been estimated to be as much as 80-90 cfs. The previous study by Baker indicated that the pump station capacity would be in the 40-50 cfs range.

To Jim Romero, P.E.
Ray Jordan, P.E.

From L. Steve Miller, P.E.

Date August 29, 1995

HDR

Memorandum

Subject SR-51 Squaw Peak Off-site Hydrology - Review Comments

Because of his upcoming extended vacation, Ray called me this morning and discussed the August 28, 1995 Memo which explained the results of the hydrologic modeling of the SR-51 watershed. He had the following three comments:

1. The HDR model shows a very large increase in drainage area and very small increases in storm water runoff along SR-51. Both the watershed and the hydrologic model should be review independently to insure the results are reasonable. Ray did not question the results but does want this quality control activity to occur.
2. The modeling time step was set at 2 minutes while the ADOT design manual suggests that a 5 minute time step be used for 24-hour storms. HDR needs to justify the smaller time step being used.
3. Was the watershed over sub-divided? The philosophy of the ADOT design manual is to minimize the number of subbasins.

Ray agreed that this modeling effort was most likely necessary to determine design inflows. The previous modeling effort was general in nature and did not provide the required design discharges necessary for final design.

While these comments were addressed over the phone to his satisfaction, Ray asked me to document the conversation and HDR's responses for you in this memo. The following are HDR's explanation of the three concerns.

1. An independent watershed site visit will be conducted to verify flow splits and reasonableness of model. This will be done by Jerry Zovne, P.E., Ph.D., to insure that the watershed has been appropriately modeled.
2. The modeling time step used in the model was a consequence of two small watersheds between Greenway and Thunderbird Roads. The model requires a time step that allows three time periods on the rising limb of the hydrograph, therefore the 2 minute time step is necessary.
3. The 1.70 square mile drainage area was divided into 23 subbareas. This would usually be considered excessive however, because there are 11 inflow locations along the SR-51 alignment and 7 flow splits in the watershed, the drainage area size appears to be reasonable.

Concluding the review conversation with Ray, he indicated that the flows from the HDR analysis were to be used for the design of the storm drain and also that the Indian Bend Wash peak flows should not be changed, that the discharges being used by BRW are still appropriate.

To File

From L. Steve Miller, P.E.

Date September 5, 1995

HDR

Memorandum

Subject SR-51 Off-site Hydrologic Modeling - QC review by J. Zovne, 9-1-95 JZovne

I asked Dr. Jerry Zovne to field verify the flow splits and the drainage boundaries used in the hydrologic analysis of the SR-51 Squaw Peak project. Dr. Zovne spent several hours in the field on September 1, 1995 and felt that there was a possibility that the area between 44th Street and 42nd Place, between Hartford Avenue and Union Hills Drive and also the area between Union Hills Drive and the CAP between 45th Place and 43rd Street could be adding to the area modeled in the SR-51 analysis. A detention basin exists at 42nd Place and Hartford which could overflow and pond in the intersection. There is a ~~very~~ small ~~unimproved~~ channel between two houses on Hartford Avenue, north of the basin overflow location. These flows are collected in Danbury Road and are conveyed to the west in Danbury Road and possibly to the south in 42nd Street. The flows in 42nd Street are collected in the detention basin at 41st Street and Anderson Drive. The flows in Danbury are routed to 40th Street and are routed to Bell in 40th Street. There is some possibility that these flows could be combining with the Campo Bello Drive flows and get to the SW corner of Paradise Valley Park.

For model simplicity and to model the most severe possible condition as far as the SR-51 off-site collection system is concerned, the area in question was modeled using the Green & Ampt soil parameters from the adjacent subarea (CBD40E), and combining these flows at 40th Street and Campo Bello Drive. This route only travels through three flow splits and has the propensity to collect these flows as far to the north (upstream) as possible. The other route would increase the number of splits by 2 and route the hydrograph through an additional basin.

The impact of adding the questioned contribution area to the model is an increased discharge at SR-51 and Greenway Road and also at SR-51 and Blanche Drive. The 50-year peak flow rate increase by 15 and 11 cfs at these two locations. This amounts to about a two percent increase in flow rate. Because of the minimal impact to the design capacity of the off-site drainage facilities the area east of 42nd Place will not be added to the hydrologic analysis for SR-51.

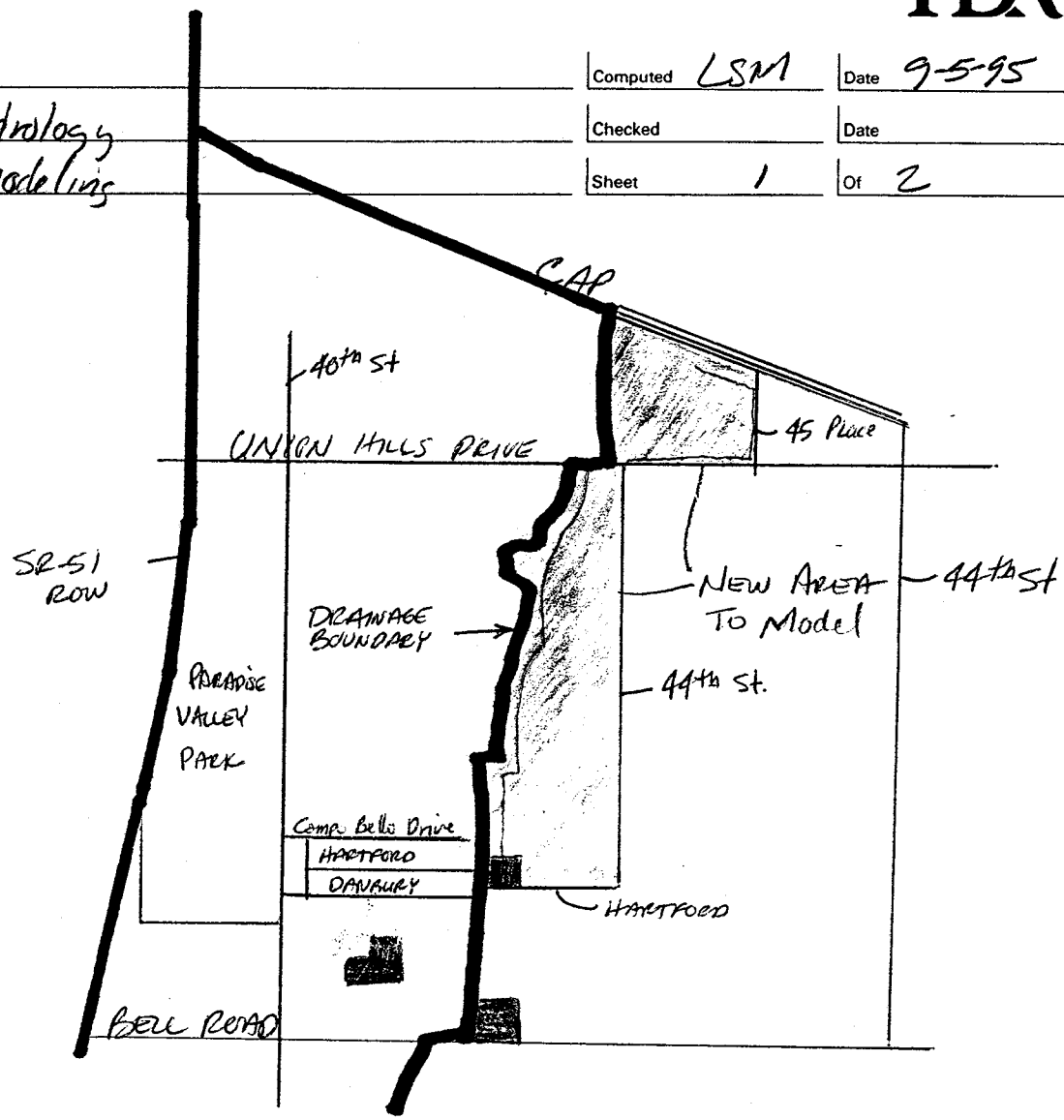
Dr. Zovne did not have a problem with the flow splits used in the modeling effort.

Job No. | No.

HDR Engineering, Inc.

HDR

Project SR-51		Computed LSM	Date 9-5-95
Subject Offsite Hydrology		Checked	Date
Task QC Review modeling		Sheet 1	Of 2



CALC D.A.

0.25 mi X 0.20 mi = 0.05
0.69 mi X 0.17 mi = 0.117
Σ 0.167 mi²

BASIN CALC.

Mea. from 1200' photo
300' X 175' = 1.2 Ac
260' X 135' = 0.81 Ac

Assume 4:1 side slopes & d=5' ∴ Vol = $\left(\frac{1.2+0.8}{2}\right)$ 5 = 5 Ac-ft.

TEST RUN TO IDENTIFY IMPACT OF AREA EAST OF 42ND CONTRIBUTING TO 40TH ST. N of Bell Road.

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             MAY   1991                *
*          VERSION 4.0.1E               *
*                                       *
* RUN DATE   9/05/1995  TIME  10:52     *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 551-1748               *
*                                       *
*****************************************
```

NET IMPACT -
15cfs increase along SR-51
So of Greenway out of 563cfs ∴ Neglect
Possible contribution of Area E. of 42ND -

```
X     X  XXXXXXX   XXXXX          X
X     X  X       X     X        XX
X     X  X       X              X
XXXXXXX  XXXX    X       XXXXX  X
X     X  X       X              X
X     X  X       X     X        X
X     X  XXXXXXX   XXXXX        XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID        State Route 51 - Squaw Peak Highway                    TEST ~~SR-5150~~.DAT
  2           ID        Off-site Hydrology - Thunderbird to Central Arizona Project
  3           ID        50-year 24-hour analysis
  4           ID        ADOT 1993 Procedures
  5           IT       2                    2000
  6           IO       3
              *DIAGRAM
              *

  7           KK  UH40NE
  8           KM        Runoff from subdivision NE quad. of 40th Street & Union Hills
  9           PH                    0.67    1.31    2.22    2.42    2.56    2.82    3.09    3.37
 10           BA   0.124
 11           LG    0.20    0.25     3.5    0.25    35.0
 12           UC    0.33    0.25
              *

 13           KK  DETBAS
 14           KM        Route outflow hydrograph through imaginary basin to account for
 15           KM        City of Phoenix 100-year 2-hour retention policy
 16           DT    RET1     8.7
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17          DI       0     100     200     300
18          DQ       0     100     200     300
            *

19          KK   SPLIT
20          KM        Split flows @ 40th St. & Union Hills Dr. to South and west
21          DT   UH40S
22          DI     0.0     5.0    10.0    25.0    50.0    85.0   100.0   200.0
23          DQ     0.0     0.0     3.0    15.0    35.0    65.0    83.0   183.0
            *

24          KK  RUH40NE
25          KM        Route hydrograph from Union Hills & 40th St. to SR51UH @ 38th St.
26          RS       1    FLOW     0.0
27          RC   0.016   0.016   0.016     500  0.0032
28          RX    19.0    30.0    35.5    37.0    59.9    60.0    65.0    70.0
29          RY     4.0    3.19    3.07    2.64    3.01    4.00     4.0     4.0
            *

30          KK  SR51UH
31          KM        Runoff from new subdivision NW quad. of 40th Street & Union Hills
32          BA   0.095
33          LG    0.20    0.25     3.5    0.25    30.0
34          UC    0.36    0.39
            *

35          KK  DETBAS
36          KM        Route outflow hydrograph through imaginary basin to account for
37          KM        City of Phoenix 100-year 2-hour retention policy
38          DT    RET2    10.0
39          DI       0     100     200     300
40          DQ       0     100     200     300
            *
```



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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

41          KK   COMB1
42          KM        Combine flows at 38th St. & Union Hills Drive
43          HC       2
            *

44          KK  RSR51UH
45          KM        Route hydrograph from Union Hills & 38th Street to SR-51 at SR51NP
46          RS       5    FLOW     0.0
47          RC   0.025   0.030   0.025    2200  0.0109
48          RX     0.0    55.0    60.0    69.0    74.0    83.0    88.0   143.0
49          RY     5.0     4.0     4.0     1.0     1.0     4.0     4.0     5.0
            *

50          KK  RETHYD
51          KM        Retrieve diverted hydrograph from 40th St. & Union Hills Drive
52          DR   UH40S
            *

53          KK  RUH40S
54          KM        Route diverted flows to SR-51 in channel
55          RS       5    FLOW     0.0
56          RC   0.025   0.030   0.025    2200  0.0114
```

```
 57          RX     0.0    55.0    60.0    69.0    74.0    83.0    88.0   143.0
 58          RY     5.0     4.0     4.0     1.0     1.0     4.0     4.0     5.0
             *

 59          KK  SR51NP
 60          KM        Runoff from north half of Paridise Valley Park
 61          BA   0.060
 62          LG    0.35    0.25     3.5   0.25
 63          UC    0.42    0.35
             *

 64          KK   COMB2
 65          KM        Combine flows at SR-51 and circulation road in Paradise Valley Park
 66          HC       3
             *

 67          KK  RSR51NP
 68          KM        Route flows from COMB2 @ SR-51 to Bell Road & SR-51 - PIPE FLOW
 69          RK    3550  0.0068   0.012            CIRC     5.0                     3
             *

 70          KK  SR51SP
 71          KM        Runoff from south half of Paradise Valley Park
 72          BA   0.091
 73          LG    0.35    0.25     5.0   0.25
 74          UC    0.59    0.53
             *
                                   HEC-1 INPUT                                    PAGE  3

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 75          KK  DETBAS
 76          KM        Route outflow hydrograph through imaginary basin to account for
 77          KM        City of Phoenix 100-year 2-hour retention policy for Parks & Rec Center
 78          DT    RET3     2.5
 79          DI       0     100     200     300
 80          DQ       0     100     200     300
             *

 81          KK  REL40E
 82          KM        Runoff from subdivision SE quad. of 40th Street & Union Hills
 83          BA   0.095
 84          LG    0.20    0.25     3.5    0.25    41.0
 85          UC    0.32    0.30
             *

 86          KK  RREL40E
 87          KM        Route hydrograph from 40th St. & Robert E. Lee St. to Campo Bello Dr.
 88          KM         at CBD40E in 40th Street.
 89          RS       2    FLOW     0.0
 90          RC   0.016   0.016   0.016    1100  0.0056
 91          RX     0.0     3.0    24.0    24.5    62.5    63.0    74.0    96.0
 92          RY     3.0     0.5     1.5     1.0     1.0     1.5     2.0     3.0
             *

 93          KK  UH42NE
 94          KM        Runoff from subdivision NE quad. of 42nd Street & Union Hills
 95          BA   0.082
 96          LG    0.20    0.25     3.5    0.25    52.0
```

```
 97          UC    0.30    0.13
             *

 98          KK  DETBAS
 99          KM        Route outflow hydrograph through imaginary basin to account for
100          KM        City of Phoenix 100-year 2-hour retention policy
101          DT    RET4    10.0
102          DI       0     100     200     300
103          DQ       0     100     200     300
             *

104          KK  RUH42NE
105          KM        Route hydrograph from 42nd St. and Union Hills to 40th & Campo Bello Dr.
106          KM        Route through street network.
107          RS      11    FLOW     0.0
108          RC   0.016   0.016   0.016    5500  0.0046
109          RX     0.0     3.0    24.0    24.5    62.5    63.0    74.0    96.0
110          RY     3.0     0.5     1.5     1.0     1.0     1.5     2.0     3.0
             *

111          KK  HART42
112          KM        Runoff from area east of 42 and north of Harford
113          BA   0.170
114          LG    0.20    0.25     3.5    0.25    26.0
115          UC   0.458   0.477
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

116          KK  DETBAS
117          KM        Route outflow hydrograph through imaginary basin to account for
118          KM        City of Phoenix 100-year 2-hour retention policy
119          DT    RET4     5.0
120          DI       0     100     200     300
121          DQ       0     100     200     300
             *

122          KK  CBD40E
123          KM        Runoff from subdivision east side of 40th Street & Campo Bello
124          BA   0.170
125          LG    0.20    0.25     3.5    0.25    26.0
126          UC    0.49    0.53
             *

127          KK   COMB3
128          KM        Combine hydrographs at 40th St. & Campo Bello Dr.
129          HC       4
             *

130          KK  RCBD40E
131          KM        Route combine flows from 40th St. and Campo Bello Drive to northwest
132          KM        corner of Paradise Valley High School, through the City of Phoenix
133          KM        Parks and Rec. Center.  Channel is shallow flow across desert.
134          RS       3    FLOW     0.0
135          RC   0.025   0.025   0.025    1450  0.0064
136          RX     0.0    24.0    32.0    40.0    50.0    58.0    64.0    88.0
137          RY     4.0     2.5     2.0     0.5     0.5     2.0     2.5     4.0
             *
```

```
138          KK   COMB4
139          KM        Combine flows at NW corner of Paradise Valley High School
140          HC       2
             *

141          KK  RSR51SP
142          KM        Route flows Paradise Valley Park through PV HS using
143          KM        maintenance road along west side of school to Bell Road
144          RS       3    FLOW     0.0
145          RC   0.016   0.016   0.016    1300  0.0054
146          RX     0.0    13.0    18.5    19.0    49.0    49.5    51.0    51.1
147          RY     3.0     1.5     1.5     1.0     1.0     1.5     1.5     3.0
             *

148          KK  BRPVHS
149          KM        Runoff from Paradise Valley High School 40th Street & Bell Road
150          BA   0.068
151          LG    0.20    0.25     4.2    0.40    43.0
152          UC    0.26    0.22
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

153          KK   SPLIT
154          KM        Split 2/3 of runoff to south across Bell Road in 2 dip sections
155          DT  PVH40S
156          DI     0.0     3.0     6.0    24.0    54.0    96.0   150.0   210.0
157          DQ     0.0     2.0     4.0    16.0    36.0    64.0   100.0   140.0
             *

158          KK   COMB5
159          KM        Combine flows at 38th Street & Bell Road
160          HC       2
             *

161          KK   SPLIT
162          KM        Split flows @ 38th St. & Bell Road to South and west
163          DT   BR38S
164          DI     0.0     3.0    10.0    25.0    55.0    90.0   140.0   300.0   400.0
165          DQ     0.0     1.0     5.0    14.0    20.0    55.0   105.0   265.0   365.0
             *

166          KK  RBRPVHS
167          KM        Route flows from 38th St. & Bell Rd. to SR-51 & Bell Road
168          RS       1    FLOW     0.0
169          RC   0.016   0.016   0.016     500  0.0010
170          RX    90.0   100.0   104.9   105.0   132.9   133.0   134.0   144.0
171          RY    67.0    63.4    63.3    62.8    62.8    63.3    64.0    67.0
             *

172          KK  SR51BN
173          KM        Runoff from mini-storage lot north of Bell Road, west of 38th Street
174          BA   0.017
175          LG    0.05    0.25     3.5    0.25    85.0
176          UC    0.15    0.25
             *
```

```
177          KK  DETBAS
178          KM        Route outflow hydrograph through imaginary basin to account for
179          KM        City of Phoenix 100-year 2-hour retention policy
180          DT    RET6     2.0
181          DI       0     100     200     300
182          DQ       0     100     200     300
             *

183          KK   COMB6
184          KM        Combine flow in Bell Road at SR-51
185          HC       2
             *

186          KK   COMB7
187          KM        Combine flow in SR-51 at Bell Road
188          HC       2
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

189          KK  RSR51BN
190          KM        Route flows from COMB7 @ SR-51 and Bell Road to nr Phelps Rd. & SR-51
191          KM        - PIPE FLOW
192          RK    1100  0.0033   0.012            CIRC     6.0                        1
             *

193          KK  SR51BS
194          KM        Runoff from SW quad. of 38th Street & Bell Road
195          BA   0.028
196          LG    0.20    0.25     3.5    0.25    38.0
197          UC    0.18    0.17
             *

198          KK  DETBAS
199          KM        Route outflow hydrograph through imaginary basin to account for
200          KM        City of Phoenix 100-year 2-hour retention policy
201          DT    RET7     3.0
202          DI       0     100     200     300
203          DQ       0     100     200     300
             *

204          KK   COMB8
205          KM        Combine flow in SR-51 at Phelps Road
206          HC       2
             *

207          KK  RSR51BS
208          KM        Route flows from COMB8 @ SR-51 and Phelps Road to Paradise Lane & SR-51
209          KM        - PIPE FLOW
210          RK    1600  0.0033   0.012            CIRC     6.0                        2
             *

211          KK  SR51PR
212          KM        Runoff from NE quad. of SR-51 & Paradise Lane
213          BA   0.009
214          LG    0.20    0.35     3.5    0.25    30.0
215          UC    0.15    0.21
             *
```

```
216          KK   COMB9
217          KM        Combine flow in SR-51 at Paradise Lane
218          HC       2
             *

219          KK  RSR51PR
220          KM        Route flows from COMB9 @ SR-51 and Paradise Lane to Tierra Buena & SR-51
221          KM        - PIPE FLOW
222          RK    1300  0.0033   0.012            CIRC     6.0                      1
             *
1                                          HEC-1 INPUT                                          PAGE  7

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

223          KK  BUEN37
224          KM        Runoff from NE quad. of SR-51 & Tierra Buena
225          BA   0.082
226          LG    0.20    0.25     3.5    0.25    26.0
227          UC    0.34    0.34
             *

228          KK  COMB10
229          KM        Combine flow in SR-51 at Tierra Buena
230          HC       2
             *

231          KK  RBUEN37
232          KM        Route flows from COMB10 @ SR-51 and Tierra Beuna to Greenway & SR-51
233          KM        - PIPE FLOW
234          RK    1350  0.0033   0.012            CIRC     6.5                      1
             *

235          KK  BR40NE
236          KM        Runoff from development east of 40th Street, north of Bell Road
237          BA   0.084
238          LG    0.20    0.25     3.5    0.25    50.0
239          UC    0.28    0.28
             *

240          KK  DETBAS
241          KM        Route outflow hydrograph through imaginary basin to account for
242          KM        City of Phoenix 100-year 2-hour retention policy
243          DT    RET5     8.0
244          DI       0     100     200     300
245          DQ       0     100     200     300
             *

246          KK   SPLIT
247          KM        Split flows @ 40th St. & Bell Road to South and west
248          DT   BR40S
249          DI     0.0     5.0    10.0    25.0    40.0    85.0   150.0   200.0
250          DQ     0.0     0.0     5.0    10.0    15.0    28.0    45.0    60.0
             *

251          KK  RBR40NE
252          KM        Route flow from 40th St. & Bell to 38th & Bell Road
253          RS       3    FLOW     0.0
254          RC   0.016   0.016   0.016    1350  0.0025
```

```
255          RX    99.0    99.5   100.0   125.0   202.7   203.2   221.2   239.2
256          RY   66.87   66.77   66.27   65.83   66.37   66.87   66.87   66.87
             *

257          KK  RETHYD
258          KM        Retrieve diverted hydrograph from Paradise Valley High School @ Bell Rd
259          DR  PVH40S
             *
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

260          KK  COMB11
261          KM        Combine flows at Bell Road and 38th Street, south side of Bell Road
262          HC       2
             *

263          KK  RETHYD
264          KM        Retrieve diverted hydrograph from 38th St. & Bell Road
265          DR   BR38S
             *

266          KK  COMB12
267          KM        Combine flows in 38th Street, south of Bell Road
268          HC       2
             *

269          KK  RBR38S
270          KM        Route diverted hydrograph BR38S south in 38th Street to Paradise Lane
271          KM        Adjust depth by increasing end point elevations to allow for high
272          KM        peak flow in 38th Street.  Increase from 46.63, 0.0; 46.38, 15.0 to
273          KM        50.0, 0.0; 46.6, 1.0 and 46.29,57.0; 46.55, 67.0; to 46.5, 66.0, 50.0
274          RS       5    FLOW     0.0
275          RC   0.016   0.016   0.016    2640  0.0064
276          RX     0.0     1.0    19.5    20.0    52.0    52.5    66.0    67.0
277          RY    50.0    46.6   46.23   45.80   45.77   46.26    46.5    50.0
             *

278          KK  PDLN38
279          KM        Runoff from NE quad. of 38th Street & Paradise Lane
280          BA   0.136
281          LG    0.20    0.26     3.8    0.54    31.0
282          UC    0.24    0.11
             *

283          KK  DETBAS
284          KM        Route outflow hydrograph through imaginary basin to account for
285          KM        City of Phoenix 100-year 2-hour retention policy
286          DT    RET8     8.0
287          DI       0     100     200     300
288          DQ       0     100     200     300
             *

289          KK  COMB13
290          KM        Combine flows at Paradise Lane and 38th Street
291          HC       2
             *

292          KK  RPDLN38
```

```
293          KM        Route combined hydrograph PDLN38 south in 38th Street to Greenway Road
294          KM        Adjust depth by increasing end point elevations to allow for high
295          KM        peak flow in 38th Street.  Increase from 46.63, 0.0; 46.38, 15.0 to
296          KM        50.0, 0.0; 46.6, 1.0 and 46.29,57.0; 46.55, 67.0; to 46.5, 66.0, 50.0
297          RS       5    FLOW     0.0
298          RC   0.016   0.016   0.016    2640  0.0048
299          RX     0.0     1.0    19.5    20.0    52.0    52.5    66.0    67.0
1                                          HEC-1 INPUT                                          PAGE  9

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

300          RY    50.0    46.6   46.23   45.80   45.77   46.26    46.5    50.0
             *

301          KK  GRWY38
302          KM        Runoff from NE quad. of 38th Street & Greenway Road
303          BA   0.122
304          LG    0.20    0.27     3.1    0.79    21.0
305          UC    0.32    0.23
             *

306          KK  DETBAS
307          KM        Route outflow hydrograph through imaginary basin to account for
308          KM        City of Phoenix 100-year 2-hour retention policy
309          DT    RET9     2.0
310          DI       0     100     200     300
311          DQ       0     100     200     300
             *

312          KK  COMB14
313          KM        Combine flows at Greenway Road and 38th Street
314          HC       2
             *

315          KK  RETHYD
316          KM        Retrieve diverted hydrograph from 40th St. & Bell Road
317          DR   BR40S
             *

318          KK  BLR40E
319          KM        Runoff from east of 40th Street & north of Bell Road
320          BA   0.021
321          LG    0.05    0.25     3.5    0.25    85.0
322          UC    0.14    0.16
             *

323          KK  DETBAS
324          KM        Route outflow hydrograph through imaginary basin to account for
325          KM        City of Phoenix 100-year 2-hour retention policy
326          DT   RET10     3.0
327          DI       0     100     200     300
328          DQ       0     100     200     300
             *

329          KK  COMB15
330          KM        Combine flows at Bell Road and 40th Street
331          HC       2
             *

332          KK  RBLR40E
```

```
333          KM        Route flows from 40th St. & Bell Rd. to 40th St. & Greenway Road
334          RS      11    FLOW     0.0
335          RC   0.016   0.016   0.016    5300  0.0047
336          RX     0.0    29.5    35.0    36.5   101.3   102.8   108.3   126.3
337          RY   66.72   65.21   65.12   64.81   64.70   64.99   65.04   66.72
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


338          KK  GRW40N
339          KM        Runoff from NE quad. of 40th Street & Greenway Road
340          BA   0.163
341          LG    0.35    0.25     4.8    0.28    25.0
342          UC    0.27    0.08
             *

343          KK   GWR40
344          KM        Runoff from NE quad. of 40th Street & Greenway Road
345          BA   0.032
346          LG    0.20    0.25     4.9    0.27    56.0
347          UC    0.31    0.77
             *

348          KK  DETBAS
349          KM        Route outflow hydrograph through imaginary basin to account for
350          KM        City of Phoenix 100-year 2-hour retention policy
351          DT   RET11     4.0
352          DI       0     100     200     300
353          DQ       0     100     200     300
             *

354          KK  COMB16
355          KM        Combine flows at Greenway Road and 40th Street
356          HC       3
             *

357          KK   SPLIT
358          KM        Split flows at Greenway Road & 40th Street
359          KM        ASSUME 50% to south and 50% to west after first 25 cfs to west
360          KM        No topographic data available to refine deversion
361          DT  GRW40S
362          DI     0.0    15.0    25.0    27.0   125.0   775.0
363          DQ     0.0     0.0     0.0     1.0    50.0   375.0
             *

364          KK  RGRW40N
365          KM        Route flows from 40th St. & Greenway Rd. to 38th St. & Greenway Road
366          RS       3    FLOW     0.0
367          RC   0.016   0.016   0.016    1350  0.0053
368          RX     0.0    28.5    34.0    34.5    89.0    89.5    95.0   121.0
369          RY   50.05   48.67   48.56   48.11   48.01   48.50   48.64   49.45
             *

370          KK  COMB17
371          KM        Combine flows at Greenway Road and 38th Street
372          HC       2
             *
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 373          KK   SPLIT
 374          KM        Split flows along Greenway Road south at 38th Street and west
 375          DT  GRW38S
 376          DI     0.0     15.0     25.0    125.0    765.0
 377          DQ     0.0      0.0      0.0     30.0    435.0
              *

 378          KK  RGRW40N
 379          KM        Route flows from 38th St. & Greenway Rd. to 36th St. & Greenway Road
 380          RS       3    FLOW     0.0
 381          RC   0.016   0.016   0.016     1300  0.0020
 382          RX     0.0    28.5    34.0     34.5    89.0    89.5    95.0   121.0
 383          RY   50.05   48.67   48.56    48.11   48.01   48.50   48.64   49.45
              *

 384          KK  GRWY36
 385          KM        Runoff from NE quad. of 36th Street & Greenway Road
 386          BA   0.059
 387          LG    0.20    0.25    4.95    0.26    22.0
 388          UC    0.33    0.32
              *

 389          KK  COMB18
 390          KM        Combine flows at Greenway Road and 36th Street
 391          HC       2
              *

 392          KK   SPLIT
 393          KM        Split flows @ 36th St. & Greenway Road to South and west
 394          DT  GWY36S
 395          DI     0.0     10.0     30.0     37.0    100.0    200.0    250.0    625.0   1000.0
 396          DQ     0.0      7.0     20.0     25.0     65.0    140.0    175.0    475.0    775.0
              *

 397          KK  COMB19
 398          KM        Combine flows at Greenway Road and SR-51
 399          HC       2
              *

 400          KK  RGRWY36
 401          KM        Route flows from COMB16 @ SR-51 and Greenway Road to Blanche Dr. & SR-51
 402          KM        - PIPE FLOW
 403          RK    1250  0.0033   0.012            CIRC     7.0                        1
              *

 404          KK  SR51NR
 405          KM        Runoff from NE quad. of SR-51 & Nisbet Road
 406          BA   0.026
 407          LG    0.20    0.25     3.5    0.25    30.0
 408          UC    0.20    0.19
              *
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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

```
409          KK  COMB20
410          KM        Combine flows at Blanche Dr. and SR-51
411          HC       2
             *

412          KK  RSR51NR
413          KM        Route flows from COMB17 @ SR-51 and Blanche Dr. to Gelding & SR-51
414          KM        - PIPE FLOW
415          RK    2275  0.0033   0.012            CIRC     7.5                      2
             *

416          KK  SR51GD
417          KM        Runoff from NE quad. of SR-51 & Gelding Drive
418          BA   0.082
419          LG    0.20    0.25     3.5   0.25    30.0
420          UC    0.31    0.27
             *

421          KK  COMB21
422          KM        Combine flows at Gelding and SR-51
423          HC       2
             *

424          KK  RSR51GD
425          KM        Route flows from COMB18 @ SR-51 and Gelding to Ludlow & SR-51
426          KM        - PIPE FLOW
427          RK    1500  0.0033   0.012            TRAP     8.0   0.001              1
             *

428          KK  SR51LD
429          KM        Runoff from NE quad. of SR-51 & Ludlow Drive
430          BA   0.056
431          LG    0.20    0.25     3.5   0.25    30.0
432          UC    0.30    0.30
             *

433          KK   SPLIT
434          KM        Split flows @ 34th Pl. & Ludlow Drive to Thunderbird (south)
435          DT   TB-LD
436          DI     0.0     9.0    16.0    25.0    50.0    81.0    98.0   116.0
437          DQ     0.0     0.0     2.0     6.0    19.0    35.0    44.0    54.0
             *

438          KK  COMB22
439          KM        Combine flows at Ludlow and SR-51
440          HC       2
             *

441          KK  RETHYD
442          KM        Retrieve diverted hydrograph from 34th Pl. & Ludlow Drive
443          DR   TB-LD
             *
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```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

444          KK  SR51TR
445          KM        Runoff from NE quad. of SR-51 & Thunderbird Road
446          BA   0.016
```

```
447          LG    0.20    0.25     3.5   0.25    30.0
448          UC    0.13    0.09
             *

449          KK  COMB23
450          KM        Combine flows at Thunderbird and SR-51
451          HC       2
             *
452          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

 NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  7      UH40NE
              .
              .
 16           .------->    RET1
 13      DETBAS
              .
              .
 21           .------->   UH40S
 19       SPLIT
             V
             V
 24      RUH40N
              .
              .
 30           .      SR51UH
              .           .
              .           .
 38           .           .------->    RET2
 35           .      DETBAS
              .           .
              .           .
 41       COMB1............
             V
             V
 44      RSR51U
              .
              .
 52           .           .<-------   UH40S
 50           .      RETHYD
              .           V
              .           V
 53           .      RUH40S
              .           .
              .           .
 59           .           .      SR51NP
              .           .           .
              .           .           .
 64       COMB2........................
             V
             V
 67      RSR51N
              .
              .
 70           .      SR51SP
```

```
          .          .
          .          .
 78       .          .-------->    RET3
 75       .     DETBAS
          .          .
          .          .
 81       .          .     REL40E
          .          .          V
          .          .          V
 86       .          .     RREL40
          .          .          .
          .          .          .
 93       .          .          .     UH42NE
          .          .          .          .
          .          .          .          .
101       .          .          .          .-------->    RET4
 98       .          .          .     DETBAS
          .          .          .          V
          .          .          .          V
104       .          .          .     RUH42N
          .          .          .          .
          .          .          .          .
111       .          .          .          .     HART42
          .          .          .          .          .
          .          .          .          .          .
119       .          .          .          .          .-------->    RET4
116       .          .          .          .     DETBAS
          .          .          .          .          .
          .          .          .          .          .
122       .          .          .          .          .     CBD40E
          .          .          .          .          .          .
          .          .          .          .          .          .
127       .          .      COMB3.................................
          .          .          V
          .          .          V
130       .          .     RCBD40
          .          .          .
          .          .          .
138       .      COMB4............
          .          V
          .          V
141       .     RSR51S
          .          .
          .          .
148       .          .     BRPVHS
          .          .          .
          .          .          .
155       .          .          .-------->  PVH40S
153       .          .      SPLIT
          .          .          .
          .          .          .
158       .      COMB5............
          .          .
          .          .
163       .          .-------->  BR38S
161       .      SPLIT
          .          V
          .          V
166       .     RBRPVH
          .          .
```

```
                .           .
172             .           .       SR51BN
                .           .           .
                .           .           .
180             .           .           .-------->    RET6
177             .           .       DETBAS
                .           .           .
                .           .           .
183             .        COMB6............
                .           .
                .           .
186        COMB7............
               V
               V
189       RSR51B
                .
                .
193             .       SR51BS
                .           .
                .           .
201             .           .-------->    RET7
198             .       DETBAS
                .           .
                .           .
204        COMB8............
               V
               V
207       RSR51B
                .
                .
211             .       SR51PR
                .           .
                .           .
216        COMB9............
               V
               V
219       RSR51P
                .
                .
223             .       BUEN37
                .           .
                .           .
228       COMB10............
               V
               V
231       RBUEN3
                .
                .
235             .       BR40NE
                .           .
                .           .
243             .           .-------->    RET5
240             .       DETBAS
                .           .
                .           .
248             .           .-------->   BR40S
246             .        SPLIT
                .           V
                .           V
251             .       RBR40N
```

```
                .          .
                .          .
259             .          .          .<-------  PVH40S
257             .          .     RETHYD
                .          .          .
                .          .          .
260             .     COMB11............
                .          .
                .          .
265             .          .          .<-------   BR38S
263             .          .     RETHYD
                .          .          .
                .          .          .
266             .     COMB12............
                .          V
                .          V
269             .     RBR38S
                .          .
                .          .
278             .          .     PDLN38
                .          .          .
                .          .          .
286             .          .          .------->    RET8
283             .          .     DETBAS
                .          .          .
                .          .          .
289             .     COMB13............
                .          V
                .          V
292             .     RPDLN3
                .          .
                .          .
301             .          .     GRWY38
                .          .          .
                .          .          .
309             .          .          .------->    RET9
306             .          .     DETBAS
                .          .          .
                .          .          .
312             .     COMB14............
                .          .
                .          .
317             .          .          .<-------   BR40S
315             .          .     RETHYD
                .          .          .
                .          .          .
318             .          .          .     BLR40E
                .          .          .          .
                .          .          .          .
326             .          .          .          .------->   RET10
323             .          .          .     DETBAS
                .          .          .          .
                .          .          .          .
329             .          .     COMB15............
                .          .          V
                .          .          V
332             .          .     RBLR40
                .          .          .
                .          .          .
338             .          .          .     GRW40N
```

```
                .          .          .          .
                .          .          .          .
343             .          .          .          .      GWR40
                .          .          .          .          .
                .          .          .          .          .
351             .          .          .          .          .-------->   RET11
348             .          .          .          .     DETBAS
                .          .          .          .          .
                .          .          .          .          .
354             .          .     COMB16.......................
                .          .          .
                .          .          .
361             .          .          .-------->  GRW40S
357             .          .      SPLIT
                .          .          V
                .          .          V
364             .          .     RGRW40
                .          .          .
                .          .          .
370             .     COMB17............
                .          .
                .          .
375             .          .-------->  GRW38S
373             .      SPLIT
                .          V
                .          V
378             .     RGRW40
                .          .
                .          .
384             .          .     GRWY36
                .          .          .
                .          .          .
389             .     COMB18............
                .          .
                .          .
394             .          .-------->  GWY36S
392             .      SPLIT
                .          .
                .          .
397        COMB19............
                V
                V
400        RGRWY3
                .
                .
404             .     SR51NR
                .          .
                .          .
409        COMB20............
                V
                V
412        RSR51N
                .
                .
416             .     SR51GD
                .          .
                .          .
421        COMB21............
                V
                V
```

```
424      RSR51G
              .
              .
428           .      SR51LD
              .           .
              .           .
435           .           .-------->   TB-LD
433           .       SPLIT
              .           .
              .           .
438      COMB22............
              .
              .
443           .           .<--------   TB-LD
441           .      RETHYD
              .           .
              .           .
444           .           .      SR51TR
              .           .           .
              .           .           .
449           .      COMB23............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE   9/05/1995  TIME  10:52   *
*                                      *
****************************************
```

```
****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*      DAVIS, CALIFORNIA 95616         *
*          (916) 551-1748              *
*                                      *
****************************************
```

State Route 51 - Squaw Peak Highway SR-5150.DAT
Off-site Hydrology - Thunderbird to Central Arizona Project
50-year 24-hour analysis
ADOT 1993 Procedures

```
6 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                     NMIN          2  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ       2000  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      3   0  ENDING DATE
                   NDTIME       1838  ENDING TIME
                    ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL    0.03 HOURS
                   TOTAL TIME BASE   66.63 HOURS

        ENGLISH UNITS
```

```
              **************
              *            *
449 KK        *    COMB23  *
              *            *
              **************
```

Combine flows at Thunderbird and SR-51

```
451 HC          HYDROGRAPH COMBINATION
                      ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

    ***             ***             ***             ***             ***
```

HYDROGRAPH AT STATION COMB23

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	66.63-HR
		(CFS)				
+ 82.	12.17		7.	2.	1.	1.
		(INCHES)	4.292	4.456	4.457	4.457
		(AC-FT)	4.	4.	4.	4.

CUMULATIVE AREA = 0.02 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	UH4ONE	241.	12.30	27.	7.	3.	0.12		
DIVERSION TO	RET1	241.	12.50	17.	4.	2.	0.12		
HYDROGRAPH AT	DETBAS	171.	12.50	12.	3.	1.	0.12		
DIVERSION TO	UH4OS	154.	12.73	8.	2.	1.	0.12		
HYDROGRAPH AT	SPLIT	20.	12.73	4.	1.	0.	0.12		
ROUTED TO	RUH4ON	19.	12.77	4.	1.	0.	0.12	3.14	12.77
HYDROGRAPH AT	SR51UH	144.	12.37	20.	5.	2.	0.09		
DIVERSION TO	RET2	144.	13.73	20.	5.	2.	0.09		

	HYDROGRAPH AT								
+		DETBAS	9.	13.73	1.	0.	0.	0.09	
	2 COMBINED AT								
+		COMB1	19.	12.77	5.	2.	1.	0.22	
	ROUTED TO								
+		RSR51U	18.	12.90	5.	2.	1.	0.22	
+									1.72 12.90
	HYDROGRAPH AT								
+		RETHYD	154.	12.50	8.	2.	1.	0.00	
	ROUTED TO								
+		RUH40S	134.	12.60	8.	2.	1.	0.00	
+									2.99 12.60
	HYDROGRAPH AT								
+		SR51NP	85.	12.40	10.	3.	1.	0.06	
	3 COMBINED AT								
+		COMB2	198.	12.60	23.	6.	2.	0.28	
	ROUTED TO								
+		RSR51N	193.	12.67	23.	6.	2.	0.28	
	HYDROGRAPH AT								
+		SR51SP	91.	12.53	14.	4.	1.	0.09	
	DIVERSION TO								
+		RET3	91.	12.60	5.	1.	0.	0.09	
	HYDROGRAPH AT								
+		DETBAS	89.	12.60	9.	2.	1.	0.09	
	HYDROGRAPH AT								
+		REL40E	172.	12.30	22.	6.	2.	0.09	
	ROUTED TO								
+		RREL40	170.	12.37	22.	6.	2.	0.09	
+									1.58 12.37
	HYDROGRAPH AT								
+		UH42NE	212.	12.23	20.	6.	2.	0.08	
	DIVERSION TO								
+		RET4	212.	13.43	19.	5.	2.	0.08	
	HYDROGRAPH AT								
+		DETBAS	4.	13.43	2.	1.	0.	0.08	
	ROUTED TO								
+		RUH42N	3.	14.37	2.	1.	0.	0.08	
									0.87 14.37
	HYDROGRAPH AT								
+		HART42	220.	12.43	35.	9.	3.	0.17	
	DIVERSION TO								

	RET4	199.	12.43	9.	3.	1.	0.17		
HYDROGRAPH AT	DETBAS	220.	12.43	27.	7.	3.	0.17		
HYDROGRAPH AT	CBD40E	205.	12.47	35.	9.	3.	0.17		
4 COMBINED AT	COMB3	581.	12.43	84.	23.	8.	0.52		
ROUTED TO	RCBD40	576.	12.50	84.	23.	8.	0.52	3.27	12.50
2 COMBINED AT	COMB4	620.	12.60	94.	25.	9.	0.61		
ROUTED TO	RSR51S	609.	12.63	94.	25.	9.	0.61	2.73	12.63
HYDROGRAPH AT	BRPVHS	140.	12.27	14.	4.	1.	0.07		
DIVERSION TO	PVH40S	93.	12.27	10.	3.	1.	0.07		
HYDROGRAPH AT	SPLIT	47.	12.27	5.	1.	0.	0.07		
2 COMBINED AT	COMB5	625.	12.63	98.	27.	10.	0.68		
DIVERSION TO	BR38S	590.	12.10	82.	21.	8.	0.68		
HYDROGRAPH AT	SPLIT	35.	12.10	17.	5.	2.	0.68		
ROUTED TO	RBRPVH	35.	12.50	17.	5.	2.	0.68	63.40	12.70
HYDROGRAPH AT	SR51BN	39.	12.20	5.	1.	1.	0.02		
DIVERSION TO	RET6	39.	12.60	4.	1.	0.	0.02		
HYDROGRAPH AT	DETBAS	16.	12.60	1.	0.	0.	0.02		
2 COMBINED AT	COMB6	51.	12.60	18.	6.	2.	0.69		
2 COMBINED AT	COMB7	241.	12.67	40.	12.	4.	0.97		
ROUTED TO									

+		RSR51B	240.	12.67	40.	12.	4.	0.97	
	HYDROGRAPH AT	SR51BS	71.	12.20	6.	2.	1.	0.03	
	DIVERSION TO								
+		RET7	71.	12.80	6.	2.	1.	0.03	
	HYDROGRAPH AT								
+		DETBAS	7.	12.80	1.	0.	0.	0.03	
	2 COMBINED AT								
+		COMB8	240.	12.67	41.	12.	4.	1.00	
	ROUTED TO								
+		RSR51B	237.	12.70	41.	12.	4.	1.00	
	HYDROGRAPH AT								
+		SR51PR	20.	12.17	2.	1.	0.	0.01	
	2 COMBINED AT								
+		COMB9	241.	12.70	43.	13.	5.	1.01	
	ROUTED TO								
+		RSR51P	237.	12.70	43.	13.	5.	1.01	
	HYDROGRAPH AT								
+		BUEN37	134.	12.33	17.	5.	2.	0.08	
	2 COMBINED AT								
		COMB10	307.	12.70	60.	17.	6.	1.09	
	ROUTED TO								
+		RBUEN3	304.	12.73	60.	17.	6.	1.09	
	HYDROGRAPH AT								
+		BR40NE	163.	12.27	20.	6.	2.	0.08	
	DIVERSION TO								
+		RET5	163.	12.67	15.	4.	1.	0.08	
	HYDROGRAPH AT								
+		DETBAS	74.	12.67	6.	2.	1.	0.08	
	DIVERSION TO								
+		BR40S	25.	12.67	2.	0.	0.	0.08	
	HYDROGRAPH AT								
+		SPLIT	49.	12.67	4.	1.	0.	0.08	
	ROUTED TO								
+		RBR40N	28.	12.93	4.	1.	0.	0.08	
+									66.24 12.93
	HYDROGRAPH AT								
		RETHYD	93.	12.27	10.	3.	1.	0.00	
	2 COMBINED AT								
+		COMB11	93.	12.27	13.	4.	1.	0.08	

HYDROGRAPH AT									
+	RETHYD	590.	12.63	82.	21.	8.	0.00		
2 COMBINED AT									
	COMB12	623.	12.63	95.	25.	9.	0.08		
ROUTED TO									
+	RBR38S	611.	12.67	95.	25.	9.	0.08		
+								47.22	12.67
HYDROGRAPH AT									
+	PDLN38	347.	12.20	25.	7.	2.	0.14		
DIVERSION TO									
+	RET8	347.	12.30	15.	4.	1.	0.14		
HYDROGRAPH AT									
+	DETBAS	270.	12.30	10.	3.	1.	0.14		
2 COMBINED AT									
	COMB13	666.	12.57	105.	28.	10.	0.22		
ROUTED TO									
	RPDLN3	660.	12.63	105.	28.	10.	0.22		
+								47.39	12.63
HYDROGRAPH AT									
	GRWY38	194.	12.30	18.	5.	2.	0.12		
DIVERSION TO									
	RET9	112.	12.30	4.	1.	0.	0.12		
HYDROGRAPH AT									
	DETBAS	194.	12.30	15.	4.	1.	0.12		
2 COMBINED AT									
	COMB14	731.	12.63	121.	32.	11.	0.34		
HYDROGRAPH AT									
	RETHYD	25.	12.67	2.	0.	0.	0.00		
HYDROGRAPH AT									
+	BLR40E	60.	12.17	6.	2.	1.	0.02		
DIVERSION TO									
+	RET10	60.	13.13	6.	2.	1.	0.02		
HYDROGRAPH AT									
+	DETBAS	2.	13.13	1.	0.	0.	0.02		
2 COMBINED AT									
+	COMB15	25.	12.67	2.	1.	0.	0.02		
ROUTED TO									
	RBLR40	11.	13.57	2.	1.	0.	0.02		
								64.86	13.57
HYDROGRAPH AT									
+	GRW40N	455.	12.20	31.	8.	3.	0.16		

	HYDROGRAPH AT								
+		GWR40	34.	12.37	8.	2.	1.	0.03	
	DIVERSION TO								
		RET11	34.	15.50	8.	2.	1.	0.03	
	HYDROGRAPH AT								
+		DETBAS	2.	15.50	1.	0.	0.	0.03	
	3 COMBINED AT								
+		COMB16	455.	12.20	33.	9.	3.	0.22	
	DIVERSION TO								
+		GRW40S	215.	12.20	12.	3.	1.	0.22	
	HYDROGRAPH AT								
+		SPLIT	240.	12.20	21.	6.	2.	0.22	
	ROUTED TO								
+		RGRW40	235.	12.27	21.	6.	2.	0.22	
+									48.81 12.27
	2 COMBINED AT								
+		COMB17	786.	12.43	141.	38.	14.	0.56	
	DIVERSION TO								
+		GRW38S	449.	12.43	66.	16.	6.	0.56	
	HYDROGRAPH AT								
		SPLIT	338.	12.43	76.	21.	8.	0.56	
	ROUTED TO								
+		RGRW40	331.	12.67	76.	21.	8.	0.56	
+									49.23 12.67
	HYDROGRAPH AT								
+		GRWY36	96.	12.33	11.	3.	1.	0.06	
	2 COMBINED AT								
+		COMB18	401.	12.50	87.	24.	9.	0.62	
	DIVERSION TO								
+		GWY36S	296.	12.50	61.	17.	6.	0.62	
	HYDROGRAPH AT								
+		SPLIT	105.	12.50	26.	7.	3.	0.62	
	2 COMBINED AT								
+		COMB19	403.	12.73	85.	24.	9.	1.71	
	ROUTED TO								
+		RGRWY3	401.	12.73	85.	24.	9.	1.71	
	HYDROGRAPH AT								
		SR51NR	61.	12.20	6.	1.	1.	0.03	
	2 COMBINED AT								
+		COMB20	411.	12.73	91.	26.	9.	1.73	
	ROUTED TO								

	RSR51N	409.	12.77	91.	26.	9.	1.73
HYDROGRAPH AT							
	SR51GD	154.	12.30	17.	5.	2.	0.08
2 COMBINED AT							
	COMB21	513.	12.37	108.	31.	11.	1.82
ROUTED TO							
	RSR51G	513.	12.40	108.	31.	11.	1.82
HYDROGRAPH AT							
	SR51LD	100.	12.30	12.	3.	1.	0.06
DIVERSION TO							
+	TB-LD	45.	12.30	4.	1.	0.	0.06
HYDROGRAPH AT							
+	SPLIT	55.	12.30	8.	2.	1.	0.06
2 COMBINED AT							
+	COMB22	563.	12.40	116.	33.	12.	1.87
HYDROGRAPH AT							
+	RETHYD	45.	12.30	4.	1.	0.	0.00
HYDROGRAPH AT							
	SR51TR	53.	12.13	3.	1.	0.	0.02
2 COMBINED AT							
	COMB23	82.	12.17	7.	2.	1.	0.02

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
RSR51N	MANE	1.19	196.12	758.95	0.80	2.00	192.66	760.00	0.80

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1191E+02 EXCESS=0.0000E+00 OUTFLOW=0.1191E+02 BASIN STORAGE=0.3209E-10 PERCENT ERROR= 0.0

RSR51B	MANE	0.50	240.18	760.69	0.45	2.00	239.94	760.00	0.45

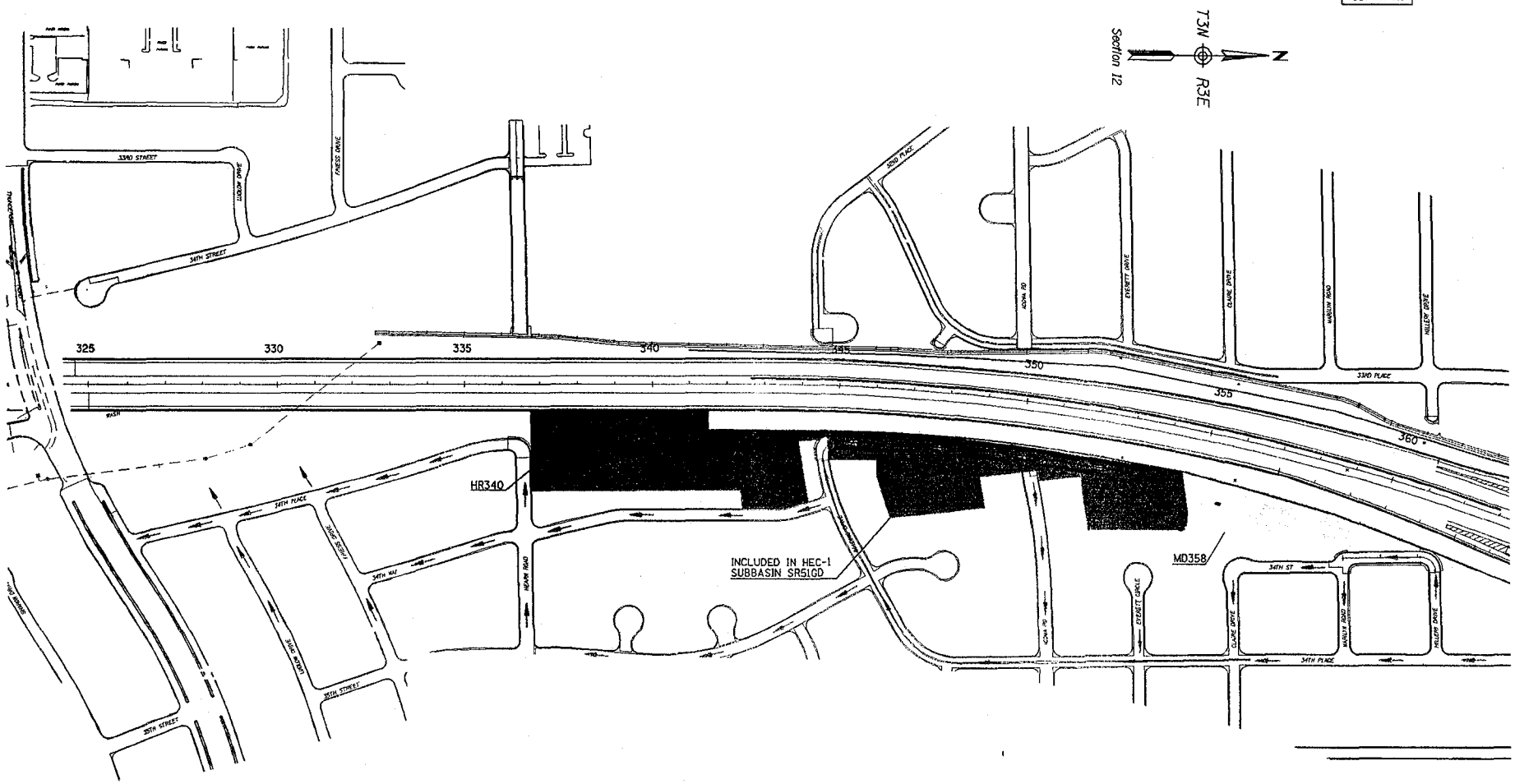
CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2347E+02 EXCESS=0.0000E+00 OUTFLOW=0.2347E+02 BASIN STORAGE=0.4278E-10 PERCENT ERROR= 0.0

RSR51B	MANE	0.77	238.44	761.42	0.45	2.00	237.23	762.00	0.45

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2388E+02 EXCESS=0.0000E+00 OUTFLOW=0.2388E+02 BASIN STORAGE=0.1191E-09 PERCENT ERROR= 0.0

RSR51P	MANE	0.63	239.66	762.90	0.46	2.00	236.72	762.00	0.46

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			
		051-MA-011			



FILE: C:\sR51\rPsr-5101.dgn
DATE: 01-Mar-96 08:20

SURVEY NO.	TRACING PLANS	REVISIONS	LOCATION	DATE

60% SUBMITTAL

	NAME	DATE
DESIGN	SM	2-96
DRAWN	KJ	2-96
CHECKED		

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SR 51
PAVEMENT DRAINAGE SUBBASINS
Sta. 322+00 to 360+50

ROUTE: SR 51
LOCATION: THUNDERBIRD ROAD TO BELL ROAD

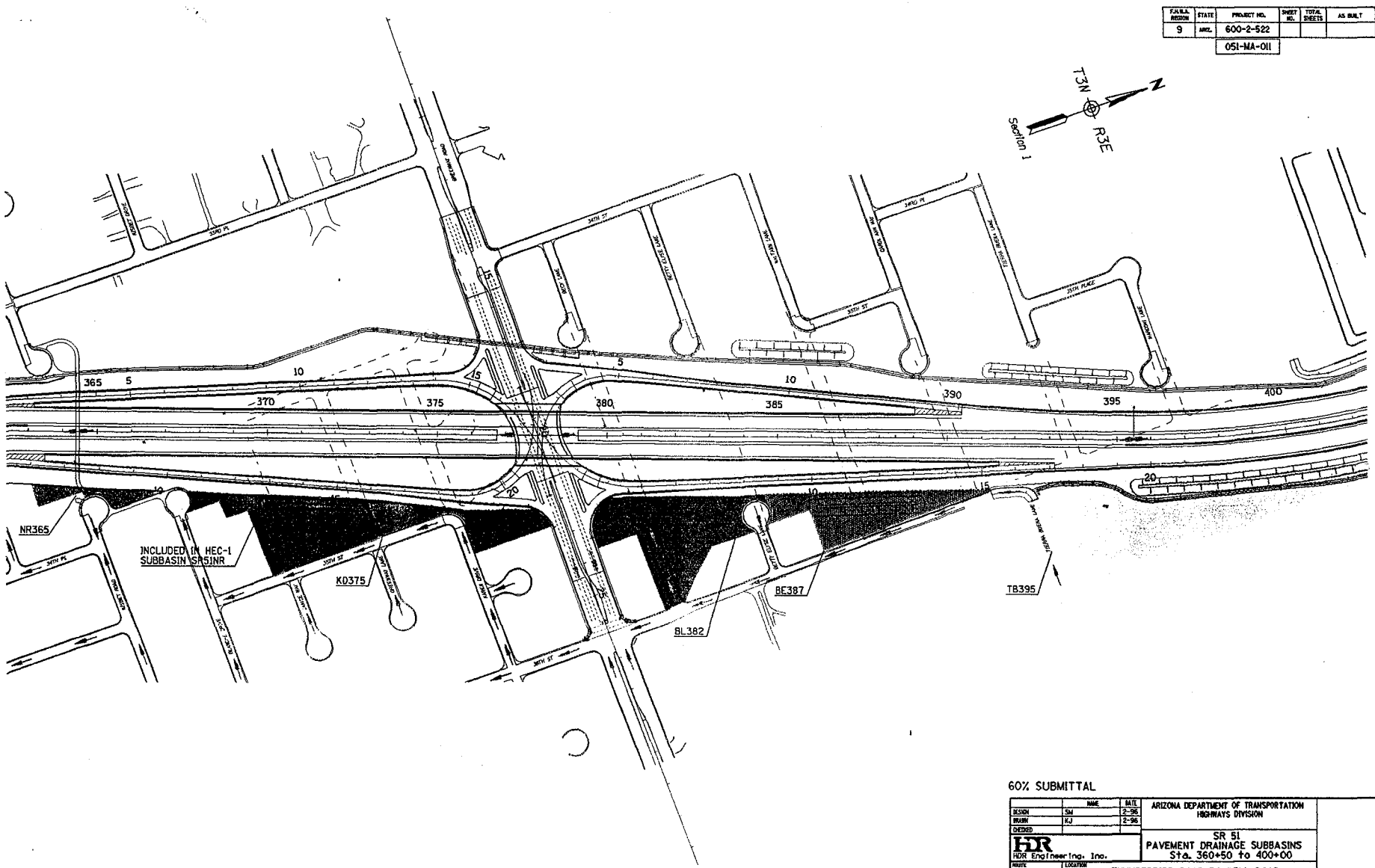
PRELIMINARY
NOT FOR
CONSTRUCTION
OR
RECORDING

SHEET D- OF

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

CONSTRUCTION DISPLAY ON

F.A.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			
		051-MA-011			



60% SUBMITTAL

	NAME	DATE
DESIGN	SM	2-96
DRAWN	KJ	2-96
CHECKED		

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SR 51
PAVEMENT DRAINAGE SUBBASINS
Sta. 360+50 to 400+00

ROUTE: SR 51 LOCATION: THUNDERBIRD ROAD TO BELL ROAD

SHEET D- OF

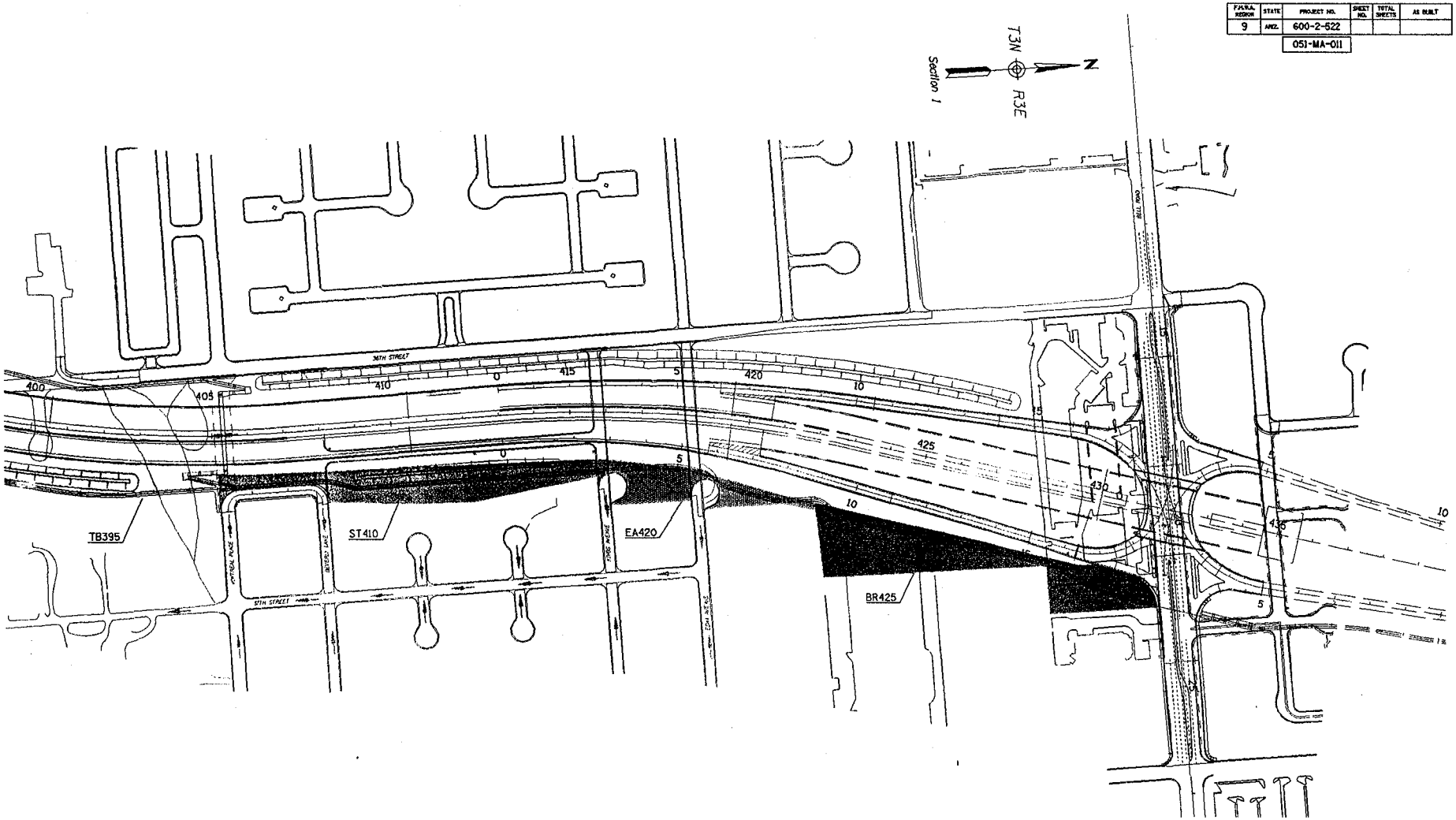
TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

FILE: C:\sr51\rpsr5102.dgn
DATE: 01-Mar-96 11:15

SURVEY NO.	FINISHED PLANS	BOUNDARY	LOCATION	DATE

*****CONSTRUCTION SPECIFICATION*****
*****STATIONING*****

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			
		051-MA-011			



60% SUBMITTAL

	NAME	DATE
DESIGN	SM	2-96
DRAWN	KJ	2-96
CHECKED		

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SR 51
PAVEMENT DRAINAGE SUBBASINS
Sta 400+00 to 438+00

ROUTE: SR 51
LOCATION: THUNDERBIRD ROAD TO BELL ROAD

PRELIMINARY
NOT FOR
CONSTRUCTION
OR
RECORDING

SHEET D- OF

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

FILE: C:\sr51\rpsr5103.dgn
DATE: 1-Mar-96 11:25

SURVY NO.	PROBING PLANS	RECORDING	LOCATION	DATE

CONSTRUCTION DISPLAY ON

Job No. | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 12/22/95
Subject Q CALCULATION FOR AREA INLET OFF	Checked	Date
Task HEARN RD.	Sheet	Of

AREA CALCULATED USING AREA CALCULATION COMMAND WITHIN MICROSTATION CAD FILE.

DRAINAGE AREA FOR THIS AREA INLET = 139,581 ft² = 3.2 ACRES

$$Q = CiA$$

$C = 0.695$
$A = 3.2$ ACRES
$i = 6.45$ BASED ON THE FOLLOWING

$$T_C = 11.4\, L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

L = LONGEST FLOW LENGTH IN MILES = 0.14 miles
$K_b = 0.04$ TABLE 2-1 PG 2-8 ADOT '93 HWY DRAIN. DESIGN MANUAL
$S = 15.9 - 11.7 = 4.2/690' = 0.0061$ ft/ft — $0.0061 \times 5280 = 32.21$ ft/mi

$$\therefore T_C = 11.4(0.14)^{0.5}(0.04)^{0.52}(32.21)^{-0.31}(6.45)^{-0.38}$$
$$= 11.4(0.37)(0.19)(0.34)(0.49)$$
$$= .13 \text{ hrs} = 8 \text{ min.}$$

since $8 < 10$ $i = 6.45$

THEREFORE

$$Q = (0.695)(3.2)(6.45)$$
$$Q = 14.3 \text{ CFS}$$

```
PAVEMENT DRAINAGE PROGRAM - HEC-12                                          Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : sr51
-------------------------------------------------------------------------------------
Sta 337+00                                   INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd    = 14.3    Slope1= 0.0500 Gutter= 2.00 Area  = 1.99
CB ID  = ai1  C2=0.00  A2= 0.00 Qrunoff= 14.3     Slope2= 0.0000 a     = 0.00 Perim =10.60
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 3.33
.....................................................................................
                                             OUTPUT
Flowby=  0.0 Qtotal= 14.3 Qint= 14.3 Flowby dn=  0.0 Depth=1.80 Spread= 37.92 Veloc= 0.00
-------------------------------------------------------------------------------------
                                           CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.014  Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
-------------------------------------------------------------------------------------
Prepared by:          Date:01/05/96    Time:14:56:18     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
=====================================================================================
```

AREA TABLE:

139,581 ♯ = 3.2 ACRES

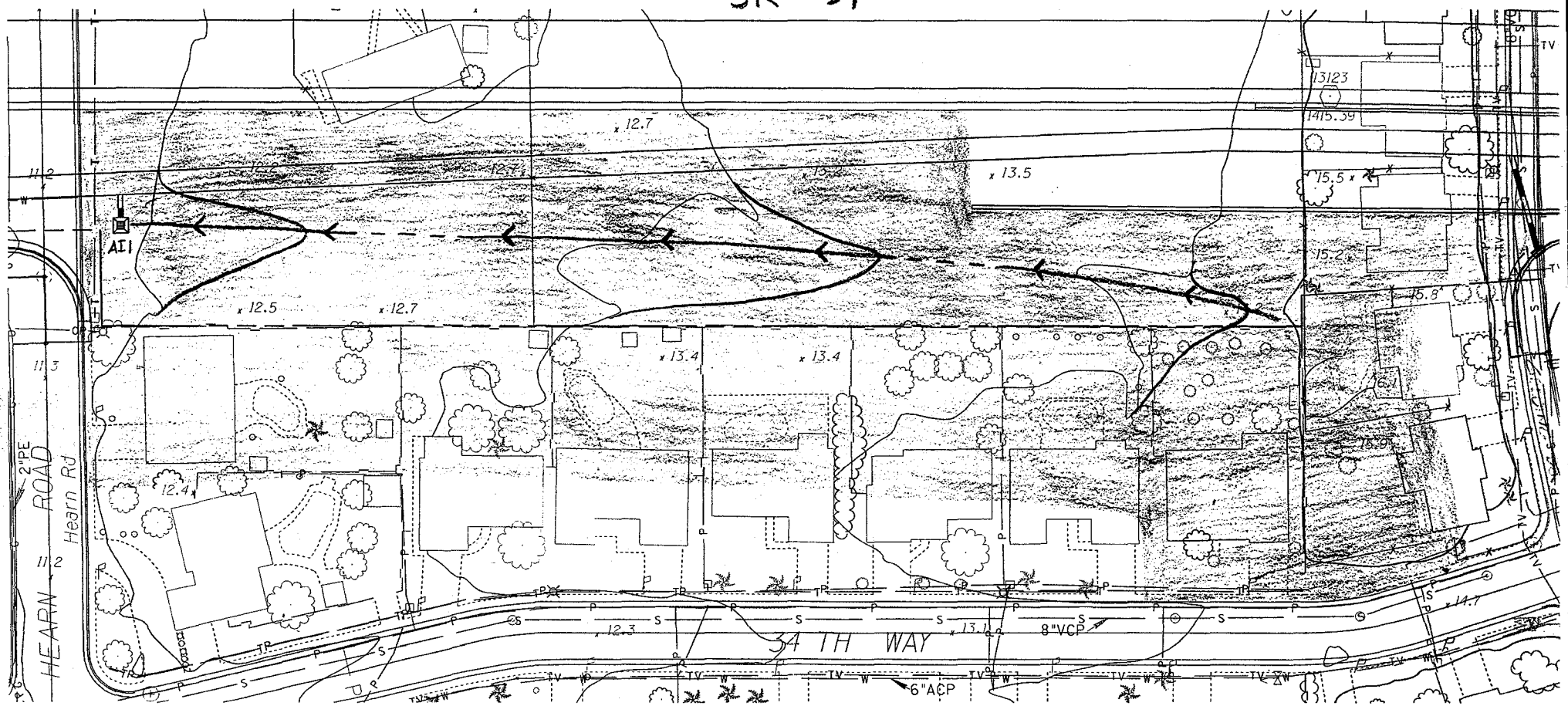
PROPOSED CONTOUR

PROPOSED FLOWLINE

Q = 14.3 CFS

N

1" = 50'



Job No. | No.

HDR Engineering, Inc.

HDR

Project	Computed KAJ	Date 12/18/95
Subject	Checked	Date
Task	Sheet 4	Of

ACCORDING TO FIGURE 2-2 PG 2-6 IN ADOT HGWY MANUAL USING 2.2 FOR A RAINFALL DURATION AT 10 MINUTES A VALUE OF 6.45 IS DETERMINED. IF $T_C = 10$ BY USING 6.45 FOR i IN PRECEDING FORMULA THEN 6.45 CAN BE USED IN $Q = CiA$.

E OF ℄ $\quad T_C = 11.4\, L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$

L = LENGTH OF LONGEST FLOW PATH IN MILES = 1080' = .21 miles

K_b = 0.025 TABLE 2-1, PG 2-8 ADOT HWY MANUAL

S = 20.4 FURTHEST NORTH IN CUL-DE-SAC - 15.5 SOUTH OF ALOMA IN COLLECTOR = 4.9

4.9/1080 = 0.0045 - 0.0045 × 5280 = 23.76 ′/MILE

$$T_C = 11.4\,(.21)^{0.5}\,(.025)^{0.52}\,(23.76)^{-0.31}\,(6.45)^{-0.38}$$

$$T_C = 11.4\,(.46)(.15)(.37)(.49)$$

= .14 hrs. = 8.56 min.

since 8.56 < 10 and is not on the table 2-2, 6.45 = i

∴ $Q = CiA$

$= (0.74651)(6.45)(2.52)$

$\boxed{Q = 12.13 \text{ CFS EAST OF ℄}}$

W OF ℄ $\quad T_C = 11.4\, L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$

L = 960' = .18 miles

K_b = 0.04

S = 0.005 $\quad$ 4.9/960' = 0.0051 - 0.0051 × 5280 = 26.95

i = 6.45

∴

$$T_C = 11.4\,(.18)^{0.5}\,(0.04)^{0.52}\,(26.95)^{-0.31}\,(6.45)^{-0.38}$$

$= 11.4\,(.42)(.19)(.36)(.49)$

= .16 hrs = 9.62 min.

∴ $Q = (0.80669)(6.45)(0.64)$

∴ $\boxed{Q = 3.33 \text{ CFS WEST OF ℄}}$

Job No. | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 2/24/96
Subject REVISED CURB OPENING/INLET FOR GELDING	Checked	Date
Task	Sheet	Of

BASED ON A Q OF 66 CFS, I CALCULATED A CURB OPENING OF 17' 2-7'S AND 1-3' TO HANDLE A PORTION OF THIS RUNOFF. (20 CFS) THE AREA INLET OFF GELDING WOULD HANDLE THE BALANCE (46 CFS) I DETERMINED THROUGH HEC-12 THAT 4 GRATES ARE NECESSARY TO HANDLE THIS CAPACITY.

BY UTILIZING A COMBINATION GRATE/CURB OPENING ON GELDING IN ACTUALITY, WE SHOULD BE ABLE TO ACCOMODATE MORE THAN THE 20 CFS PREVIOUSLY EXPLAINED.

Licensed to: HDR Engineering, Phoenix, AZ 85016
Project : sr51

Sta 344+58

INPUT

Intens.= 0.00 C1=0.00 A1= 0.00 Qadd = 20.0 Slope1=99.0000 Gutter= 2.00 Area = 0.00
CB ID = col C2=0.00 A2= 0.00 Qrunoff= 20.0 Slope2= 0.0420 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 2.00 Length=17.00

.....

OUTPUT

Flowby= 0.0 Qtotal= 20.0 Qint= 20.0 Flowby dn= 0.0 Depth=0.50 Spread= 14.52 Veloc= 0.00

CRITERIA

Runoff computed by Rational Method Manning's n Gutter=0.014 Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90

Prepared by: Date:02/24/96 Time:07:25:58 Checked by: Date:
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PAVEMENT DRAINAGE PROGRAM - HEC-12                                                    Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : sr51
-----------------------------------------------------------------------------------------
Sta 344+58o                                   INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd   = 46.0    Slope1= 0.0500 Gutter= 2.00 Area  = 7.94
CB ID  = ai   C2=0.00  A2= 0.00 Qrunoff= 46.0    Slope2= 0.0000 a     = 0.00 Perim =57.22
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0500 W     = 0.00 Length=26.64
.........................................................................................
                                              OUTPUT
Flowby=  0.0 Qtotal= 46.0 Qint= 46.0 Flowby dn=  0.0 Depth=0.66 Spread= 15.20 Veloc= 0.00
-----------------------------------------------------------------------------------------
                                            CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.014  Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
-----------------------------------------------------------------------------------------
Prepared by:          Date:02/24/96    Time:07:47:55     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
=========================================================================================
```

* CALCULATIONS BASED ON 6" VERTICAL CURB & GUTTER FOR NEW CONNECTOR ROAD.

80 SCALE

N

THIS LINE REPRESENTS AN APPROX. LOCATION OF A HIGH POINT INDICATING A DRAINAGE TRANSITION.

800'
SLOPE = 0.00475

18.8 - 15.0 = 3.8/800' = 0.00475%

EVERETT DR.

WATCH STREET NO.

CB1

CB2

CB3

ATL (8 GRATES)

Hilly Dr. 166 Cr.

34th WAY

35 TH ST.

88 CFS

CL OHIO

15th ST.

ACOMA

10' VCP

AREA TABLE

	87,413.60 ☐' (2.01 ACRES)
	22,288.74 ☐' (0.51 ACRES)
	15,557.58 ☐' (0.36 ACRES)
	12,190.21 ☐' (0.28 ACRES)

TOTAL = 3.16 ACRES

Job No. | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 12/22/95
Subject Q CALCULATION FOR AREA INLET @ STA 355+00	Checked	Date
Task	Sheet	Of

$Q = CiA$

$A = 1.6$ ACRES $\therefore Q = (0.695)(6.45)(1.6)$

$C = 0.695$ $\boxed{= 7.2 \text{ CFS}}$

$i = 6.45$

$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$

$L =$ LONGEST FLOW PATH $= 795' = 0.15$ miles

$K_b = 0.04$

$S = 23.6 - 20.3 = 3.3 / 735'$ [735' DISTANCE BETWEEN TWO ELEVS.]

$= 0.0045 \therefore 0.0045 \times 5280' = 23.71$ '/MILE

$\therefore T_c = 11.4(0.15)^{.95}(0.04)^{0.52}(23.71)^{-0.31}(6.45)^{-0.38}$

$= (0.39)11.4(0.19)(0.37)(0.49)$

$= 0.15$ hrs. $= 9.19$ hours $\quad 9.19 < 10$ so $6.45 = i$

```
==========================================================================================
PAVEMENT DRAINAGE PROGRAM - HEC-12                                                Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : sr51
------------------------------------------------------------------------------------------
Sta 355+00                                   INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd    =  7.2    Slope1= 0.0500 Gutter= 2.00 Area  = 1.99
CB ID  = ai3  C2=0.00  A2= 0.00 Qrunoff=  7.2    Slope2= 0.0500 a     = 0.00 Perim =10.60
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade   =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 3.33
..........................................................................................
                                             OUTPUT
Flowby=  0.0 Qtotal=  7.2 Qint=  7.2 Flowby dn=  0.0 Depth=0.59 Spread= 11.79 Veloc= 0.00
------------------------------------------------------------------------------------------
                                            CRITERIA
Runoff computed by Rational Method   Manning`s n Gutter=0.014  Manning`s n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
------------------------------------------------------------------------------------------
Prepared by:          Date:01/02/96    Time:10:25:39     Checked by:        Date:
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==========================================================================================
```

AREA TABLE:

68,640 ϕ = 1.6 ACRES

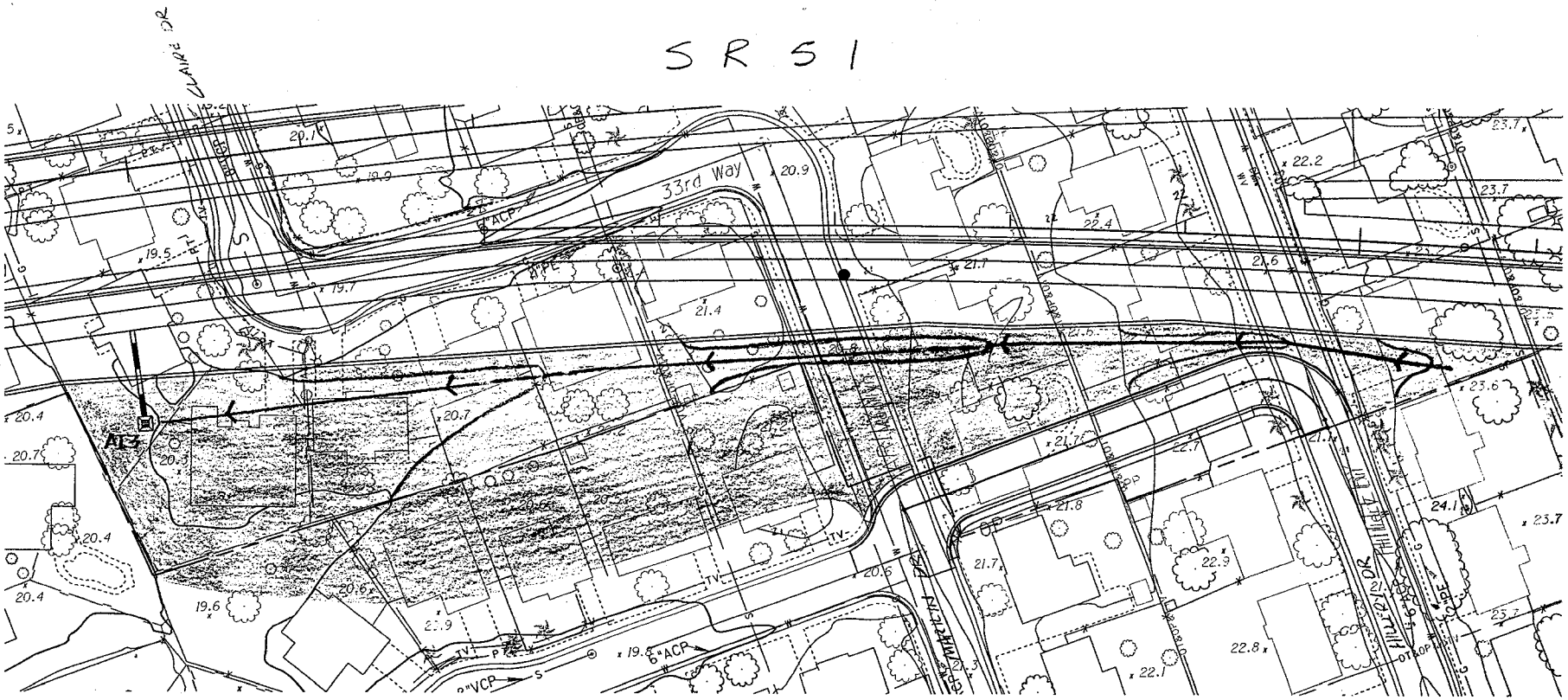
Q = 7.2 CFS

PROPOSED CONTOUR

PROPOSED FLOWLINE

→ Z

1" = 60'



Job No. A14 | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 1/4/96
Subject Q CALCULATION FOR AREA INLET @ STA 363+00	Checked	Date
Task	Sheet	Of

$Q = CiA$

$A = 13,376^{\phi} = 0.3$ ACRES

$C = 0.695$

$i = 6.45$

$\therefore \quad Q = (0.3)(0.695)(6.45)$

$= 1.3$ CFS

$\boxed{Q = 1.3 \text{ CFS}}$

```
PAVEMENT DRAINAGE PROGRAM - HEC-12                                          Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : sr51
-------------------------------------------------------------------------------------
Sta 363+00                                  INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd   =  1.3    Slope1= 0.0500 Gutter= 2.00 Area  = 1.99
CB ID  = AI4  C2=0.00  A2= 0.00 Qrunoff=  1.3    Slope2= 0.0500 a     = 0.00 Perim =10.60
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 3.33
.....................................................................................
                                            OUTPUT
Flowby=  0.0 Qtotal=  1.3 Qint=  1.3 Flowby dn=  0.0 Depth=0.19 Spread=  3.77 Veloc= 0.00
-------------------------------------------------------------------------------------
                                           CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.014  Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
-------------------------------------------------------------------------------------
Prepared by:          Date:01/04/96    Time:15:13:44     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
=====================================================================================
```

AREA TABLE:

= 13,376 ϕ = 0.3 ACRES

Q = 1.3 CFS

PROPOSED FLOWLINE

→ N

1" = 50'

Job No. A1S | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 1/3/96
Subject Q CALCULATION FOR AREA INLET @ STA 367+00	Checked	Date
Task	Sheet	Of

$Q = CiA$

$A = 0.3$ ACRES
$C = 0.695$
$i = 6.45$

$T_c = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i^{-0.38}$

$L = 535' = 0.10$ MILES
$K_b = 0.04$
$S = 2.06'/535' = 0.0039\% \times 5280 = 20.33$ '/MILE
$i =$ TRY 6.45

$T_c = 11.4(0.31)(0.04)^{0.52}(20.3)^{-0.31}(6.45)^{-0.38}$
$= 11.4(0.31)(0.19)(0.39)(0.49)$
$= 0.13$ hrs. $= 7.70$ hours $7.7 < 10$ therefore $6.45 = i$

THEREFORE

$Q = (0.695)(6.45)(0.3)$
$\boxed{= 1.3 \text{ CFS}}$

+

61 CFS FROM BLANCHE DRIVE

$\boxed{62.3 \text{ CFS}}$

Licensed to: HDR Engineering, Phoenix, AZ 85016
Project : SR51

Sta 367+00

INPUT

Intens.= 0.00 C1=0.00 A1= 0.00 Qadd = 62.3 Slope1= 0.0500 Gutter= 2.00 Area =11.91
CB ID = AI5 C2=0.00 A2= 0.00 Qrunoff= 62.3 Slope2= 0.0500 a = 0.00 Perim =25.14
Grt P-1-7/8-4 C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0500 W = 0.00 Length= 6.66

.....

OUTPUT

Flowby= 0.0 Qtotal= 62.3 Qint= 62.3 Flowby dn= 0.0 Depth=0.95 Spread= 18.94 Veloc= 0.00

CRITERIA

Runoff computed by Rational Method Manning's n Gutter=0.014 Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90

Prepared by: Date:01/08/96 Time:15:09:17 Checked by: Date:
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==========

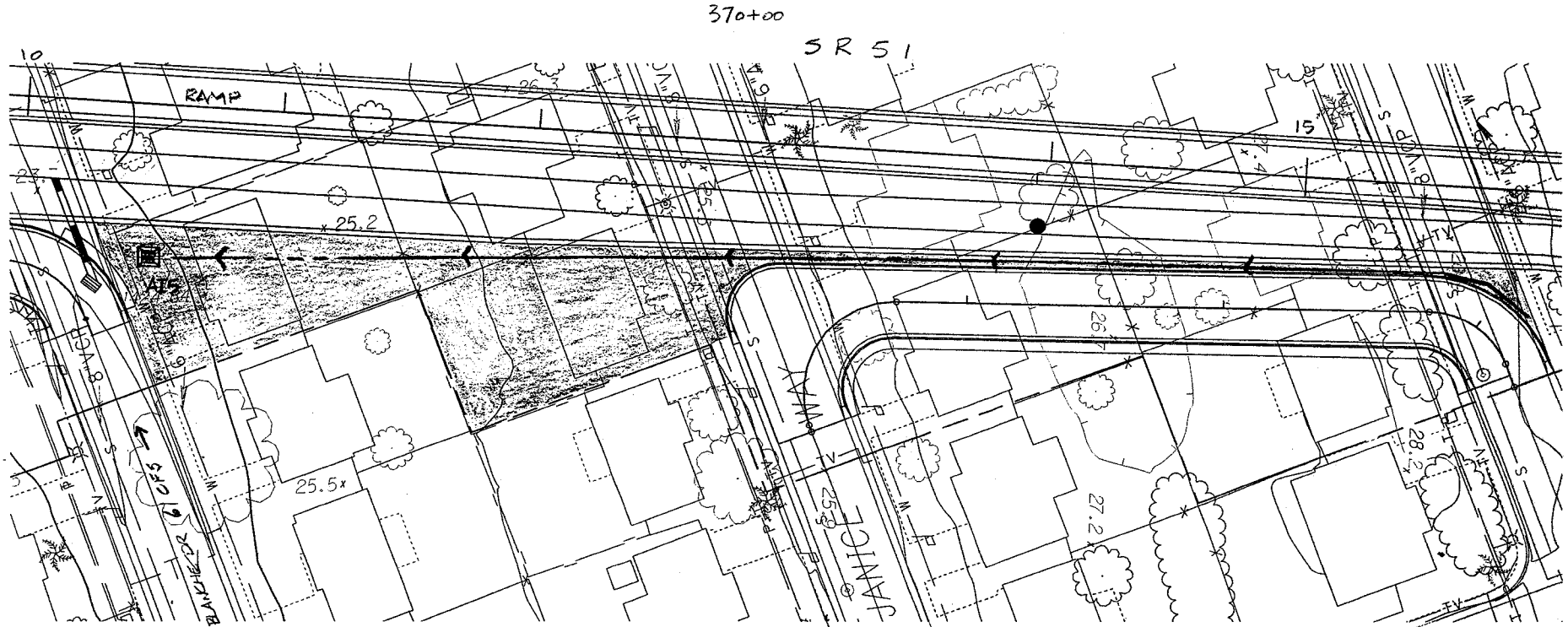
AREA TABLE:

= 0.3 ACRES

Q = 1.3 CFS OFFSITE
61.0 ON BLANCHE

PROPOSED FLOWLINE

→ N
1" = 40'



JANICE WAY Q

$A_T = 297 \times 176 = 1.193\ Ac.$
$A_R = 229 \times 140 = 0.736\ Ac$
$A_{PART} =$
0.457

$\bar{C} = \frac{.736(.60)+(.457)(.9)}{1.193} = 0.71$

$Q = CiA$
$= .071\ (1.193)(1.0) = 1.5$

Job No. A16 | No.

HDR Engineering, Inc.

HDR

Project SRSI	Computed KAJ	Date 1/3/96
Subject Q CALCULATION FOR AREA INLET @ STA 373+00	Checked	Date
Task	Sheet	Of

$Q = CiA$

$C = 0.695$
$i = 6.45$
$A = 32{,}751.4\,\text{ft}^2 = 0.75$ ACRE

$Q = (0.695)(6.45)(0.75)$

$\boxed{Q = 3.4 \text{ CFS}}$

```
==========================================================================================
PAVEMENT DRAINAGE PROGRAM - HEC-12                                                  Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : SR51
------------------------------------------------------------------------------------------
Sta 373+00                                  INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd   =  3.4    Slope1= 0.0500 Gutter= 2.00 Area  = 1.99
CB ID  = AI6  C2=0.00  A2= 0.00 Qrunoff=  3.4    Slope2= 0.0500 a     = 0.00 Perim =10.60
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 3.33
..........................................................................................
                                            OUTPUT
Flowby=  0.0 Qtotal=  3.4 Qint=  3.4 Flowby dn=  0.0 Depth=0.36 Spread=  7.15 Veloc= 0.00
------------------------------------------------------------------------------------------
                                          CRITERIA
Runoff computed by Rational Method   Manning`s n Gutter=0.014  Manning`s n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
------------------------------------------------------------------------------------------
Prepared by:          Date:01/03/96    Time:10:06:12     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
==========================================================================================
```

AREA TABLE:

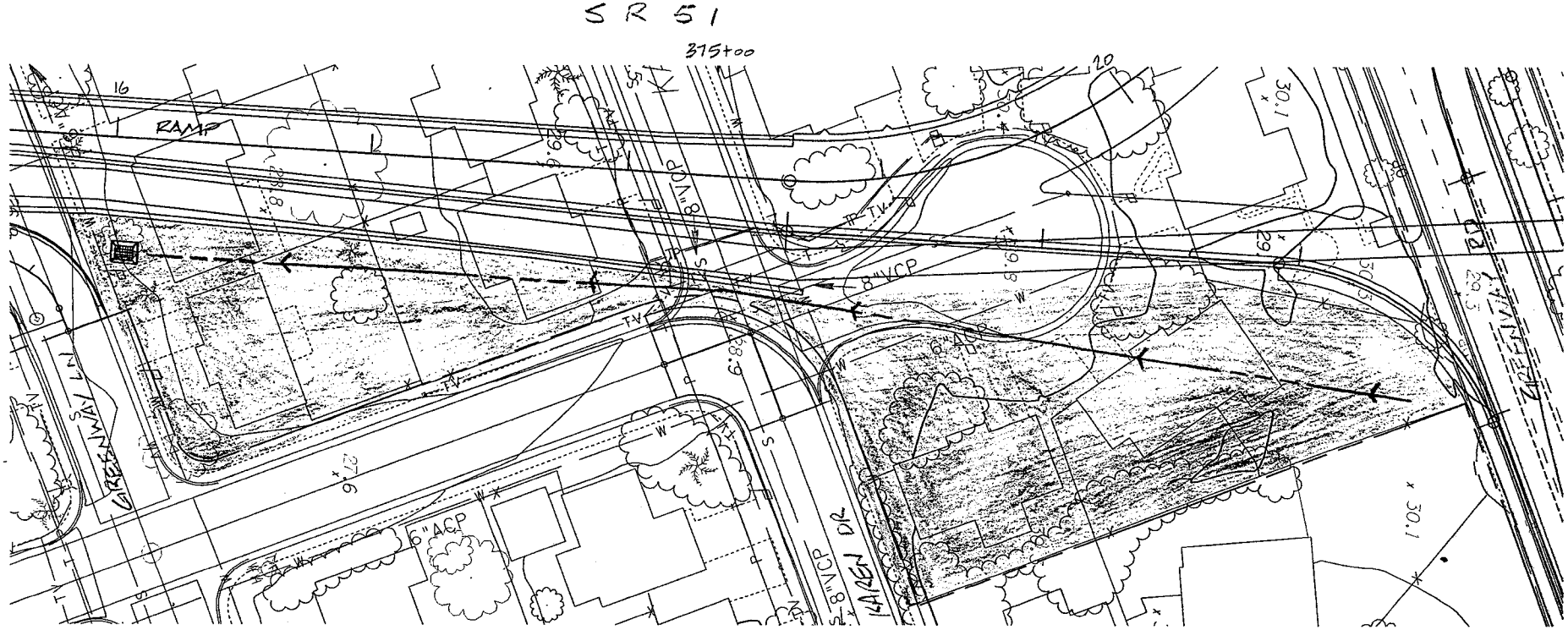
= 32,751.4 ⌀ = 0.75 ACRES

Q = 3.4 CFS

PROPOSED FLOWLINE

→ N

1" = 40'



Job No. A1 1 | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 1/3/96
Subject Q CALCULATION FOR AREA INLET @ STA 380+00	Checked	Date
Task	Sheet	Of

OFFSITE DRAINAGE AREA

$Q = CiA$

$C = 0.695$
$i = 6.45$
$A = 0.92$

$= (0.92)(0.695)(6.45)$
$= 4.1$ CFS

$\boxed{Q = 4.1 \text{ CFS}}$

BECK

$Q = 1.53$ CFS

BETTY ELYSE

$Q = 1.04$ CFS

$\boxed{\text{TOTAL} = 6.67 \text{ CFS}}$

Job No. | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 1/9/96
Subject Q CALCULATION FOR BOTH BECK AND BETTY ELYSE	Checked	Date
Task	Sheet	Of

$Q = CiA$

BECK LN

$C = 0.95$ BASED ON TABLE 2-3 PG 2-16 OF NDOT HWY MANUAL $P_1 = 2.2$

$i = 6.45$

$A = 0.25$ ACRES

$\therefore Q = 1.53$ CFS FOR BECK LN.

BETTY ELYSE

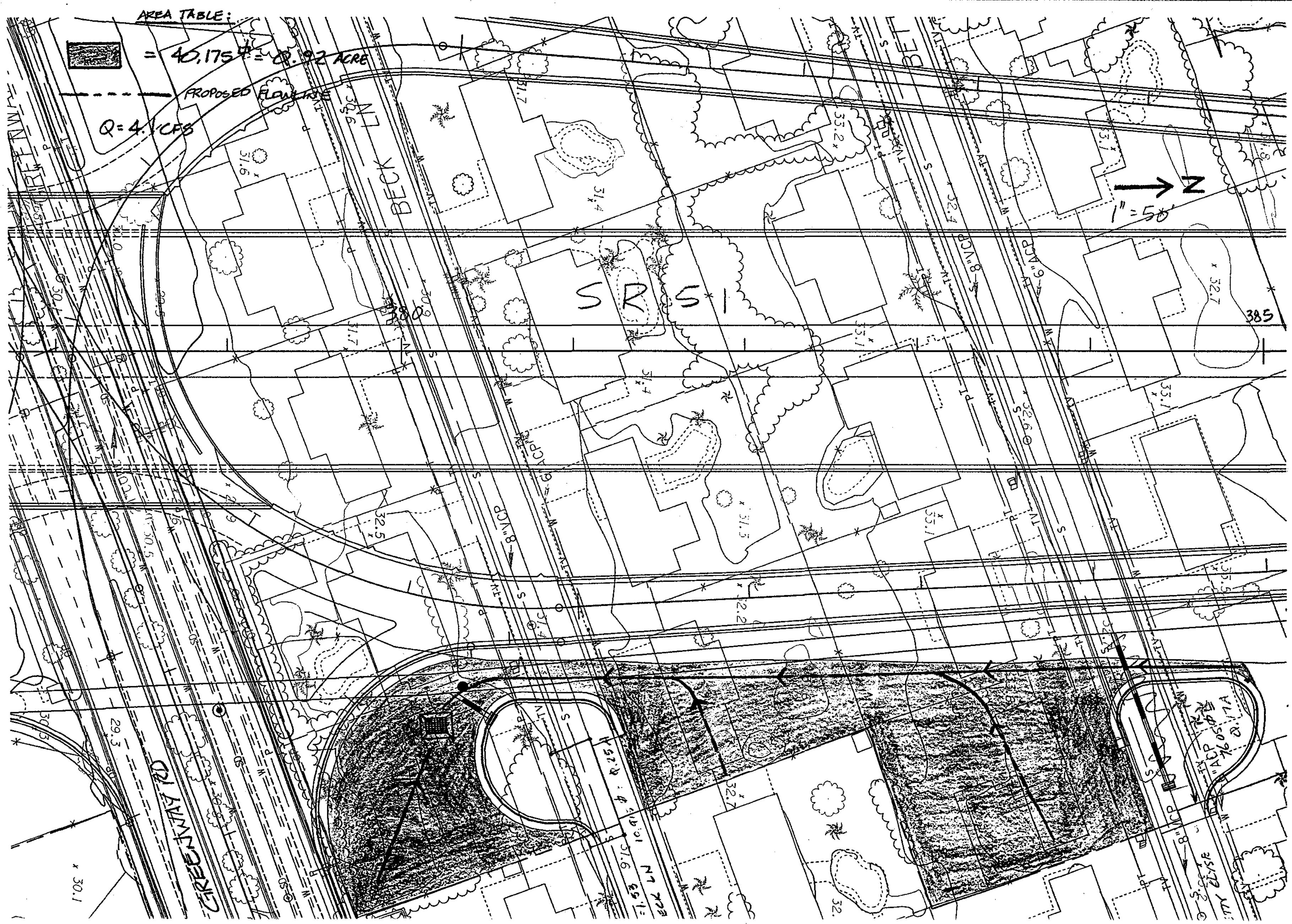
$C = 0.95$

$i = 6.45$

$A = 0.17$ ACRES

$\therefore Q = 1.04$ CFS FOR BETTY ELYSE

```
==========================================================================================
PAVEMENT DRAINAGE PROGRAM - HEC-12                                                  Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : sr51
------------------------------------------------------------------------------------------
Sta 380+00                                   INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd    =  6.7    Slope1= 0.0500 Gutter= 2.00 Area  = 1.99
CB ID  = AI7  C2=0.00  A2= 0.00 Qrunoff=  6.7    Slope2= 0.0500 a     = 0.00 Perim =10.60
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade   =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 3.33
..........................................................................................
                                             OUTPUT
Flowby=  0.0 Qtotal=  6.7 Qint=  6.7 Flowby dn=  0.0 Depth=0.56 Spread= 11.21 Veloc= 0.00
------------------------------------------------------------------------------------------
                                           CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.014  Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.09 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
------------------------------------------------------------------------------------------
Prepared by:          Date:01/09/96    Time:11:05:10     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
==========================================================================================
```


AREA TABLE:
= 40,175 ± = 0.92 ACRE
PROPOSED FLOWLINE
Q = 4.1 CFS
BECK LN
GREENWAY RD
SRS1
N
1" = 50'
380
385
8" VCP
6" ACP

Job No. AI8 | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 1/3/96
Subject Q CALCULATION FOR AREA INLET @ STA 385+00	Checked	Date
Task	Sheet	Of

$Q = CiA$

$A = 40{,}713.6^{\phi} = 0.93$ ACRES

$i = 6.45$

$C = 0.695$

$= (0.93)(6.45)(0.695)$

$= 4.2$ CFS

$$\boxed{Q = 4.2 \text{ CFS}}$$

```
==========================================================================================
PAVEMENT DRAINAGE PROGRAM - HEC-12                                                Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : SR51
------------------------------------------------------------------------------------------
Sta 385+00                                   INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd    =  4.2    Slope1= 0.0500 Gutter= 2.00 Area  = 1.99
CB ID  = AI8  C2=0.00  A2= 0.00 Qrunoff=  4.2    Slope2= 0.0500 a     = 0.00 Perim =10.60
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade   =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 3.33
..........................................................................................
                                             OUTPUT
Flowby=  0.0 Qtotal=  4.2 Qint=  4.2 Flowby dn=  0.0 Depth=0.41 Spread=  8.23 Veloc= 0.00
------------------------------------------------------------------------------------------
                                           CRITERIA
Runoff computed by Rational Method   Manning`s n Gutter=0.014  Manning`s n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
------------------------------------------------------------------------------------------
Prepared by:          Date:01/03/96    Time:15:36:09     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
==========================================================================================
```

AREA TABLE:

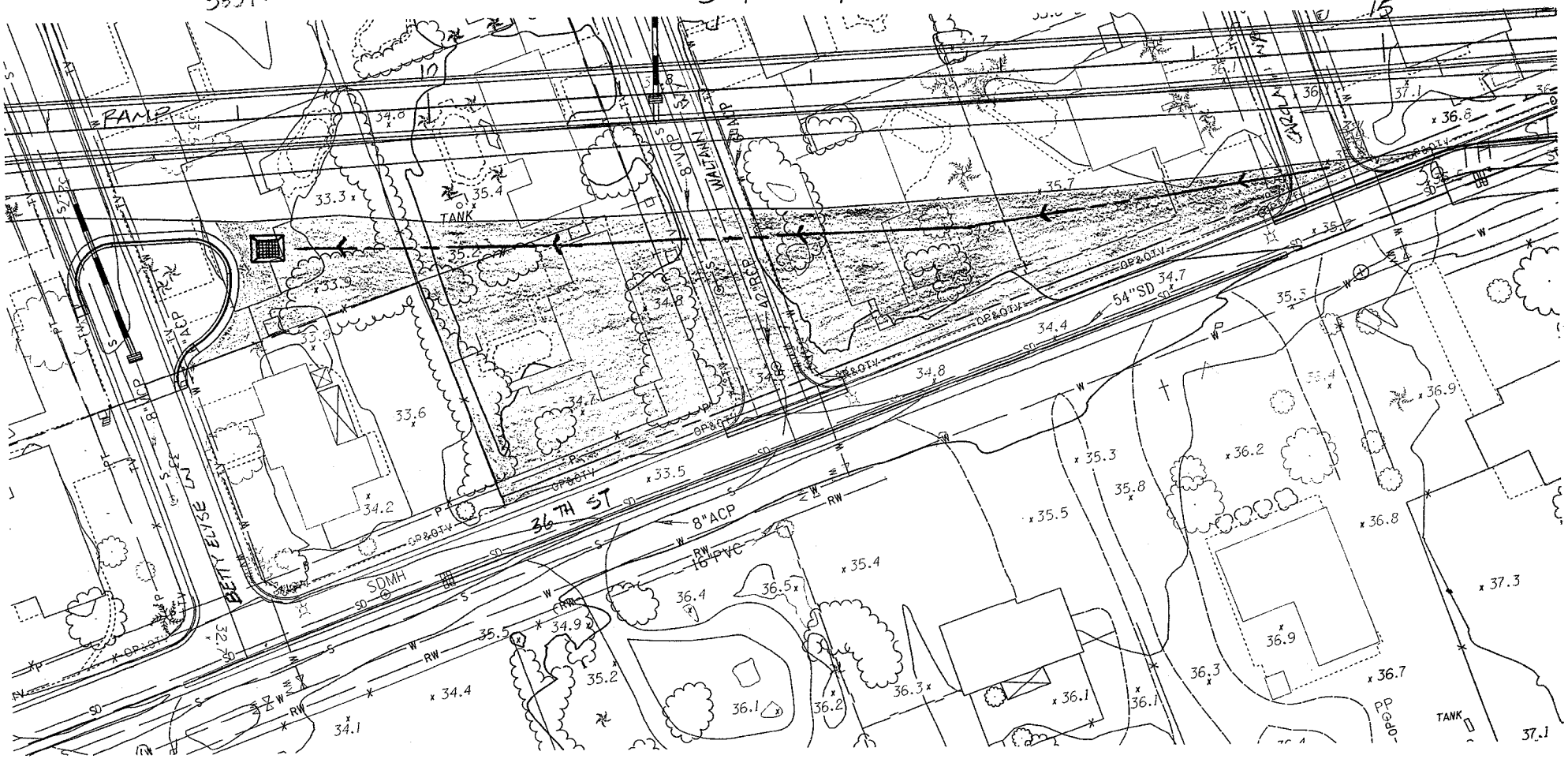
= 40,713.6 ϕ = 0.93 ACRES

Q = 4.2 CFS

PROJECTED FLOWLINE

→ Z

1" = 50'



Job No. AI9 | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 1/4/96
Subject Q CALCULATION FOR AREA INLET @ STA 393+00	Checked	Date
Task	Sheet	Of

$Q = CiA$

$A = 206{,}409^{\square\square} = 4.7$ ACRES
$i = 6.45$
$C = 0.695$

$\therefore Q = (4.7)(6.45)(0.695)$

$\therefore \boxed{Q = 21.1 \text{ CFS}}$

$T_c = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i^{-0.38}$

44.5
38.2
6.3

$L = 1000' \div 5280 = 0.19$ MILES
$K_b = 0.04$
$S = 6.3'/1000' = 0.0063 \times 5280 = 33.3'/\text{MILE}$

$\therefore = 11.4(0.19)^{0.5}(0.04)^{0.52}(33.3)^{-0.31}(6.45)^{-0.38}$
$= (11.4)(0.44)(0.19)(0.34)(0.49)$
$= 0.16$ hrs $= 9.62$ min.

134 CFS TIERRA BUENA EAST
155.1 CFS

$\boxed{\text{TOTAL } Q = 155.1 \text{ CFS}}$

```
==========================================================================================
PAVEMENT DRAINAGE PROGRAM - HEC-12                                                Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : sr51
------------------------------------------------------------------------------------------
Sta 393+00                                   INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd    = 21.1    Slope1= 0.0500 Gutter= 2.00 Area  = 3.97
CB ID  = AI9  C2=0.00  A2= 0.00 Qrunoff= 21.1     Slope2= 0.0500 a     = 0.00 Perim =19.40
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade   =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 6.66
..........................................................................................
                                             OUTPUT
Flowby=  0.0 Qtotal= 21.1 Qint= 21.1 Flowby dn=  0.0 Depth=0.98 Spread= 19.56 Veloc= 0.00
------------------------------------------------------------------------------------------
                                            CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.014  Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
------------------------------------------------------------------------------------------
Prepared by:          Date:01/05/96    Time:07:47:17     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
==========================================================================================
```

AREA TABLE:

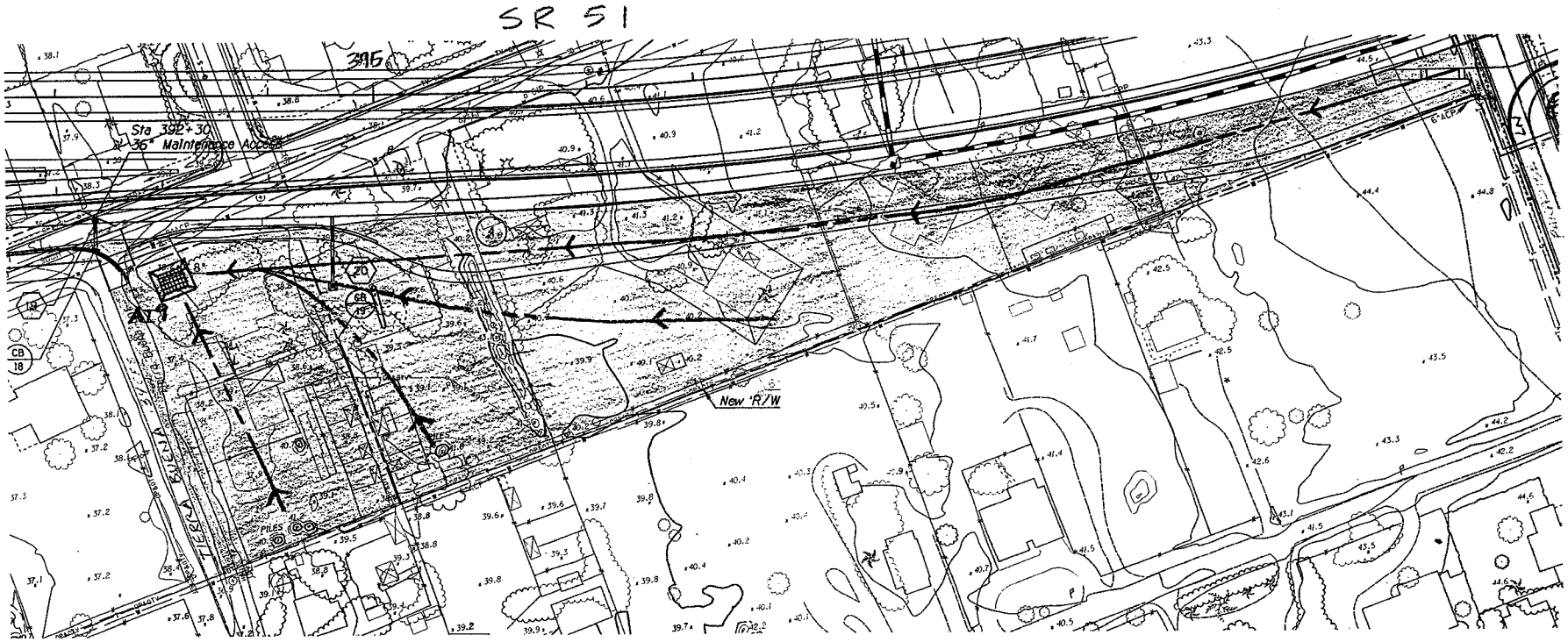
= 206,409 ϕ = 4.7 ACRES

Q = 21.1 CFS

PROPOSED FLOWLINE

N

1" = 100'



Job No. AI 11 | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 1/5/96
Subject Q CALCULATION FOR AREA INLET @ STA 416+00	Checked	Date
Task	Sheet	Of

$Q = CiA$

$C = 0.695$
$i = 6.45$
$A = 35{,}126^{\#} = 0.8$ ACRES

$\therefore (0.695)(6.45)(0.8)$
$= 3.6$

$\boxed{Q = 3.6 \text{ CFS}}$

```
==========================================================================================
PAVEMENT DRAINAGE PROGRAM - HEC-12                                                  Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : sr51
------------------------------------------------------------------------------------------
Sta 416+00                                  INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd   =  3.6    Slope1= 0.0500 Gutter= 2.00 Area  = 1.99
CB ID  = A11  C2=0.00  A2= 0.00 Qrunoff=  3.6    Slope2= 0.0500 a     = 0.00 Perim =10.60
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 3.33
..........................................................................................
                                            OUTPUT
Flowby=  0.0 Qtotal=  3.6 Qint=  3.6 Flowby dn=  0.0 Depth=0.37 Spread=  7.43 Veloc= 0.00
------------------------------------------------------------------------------------------
                                          CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.014  Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
------------------------------------------------------------------------------------------
Prepared by:          Date:01/05/96    Time:13:32:07     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
==========================================================================================
```

AREA TABLE:

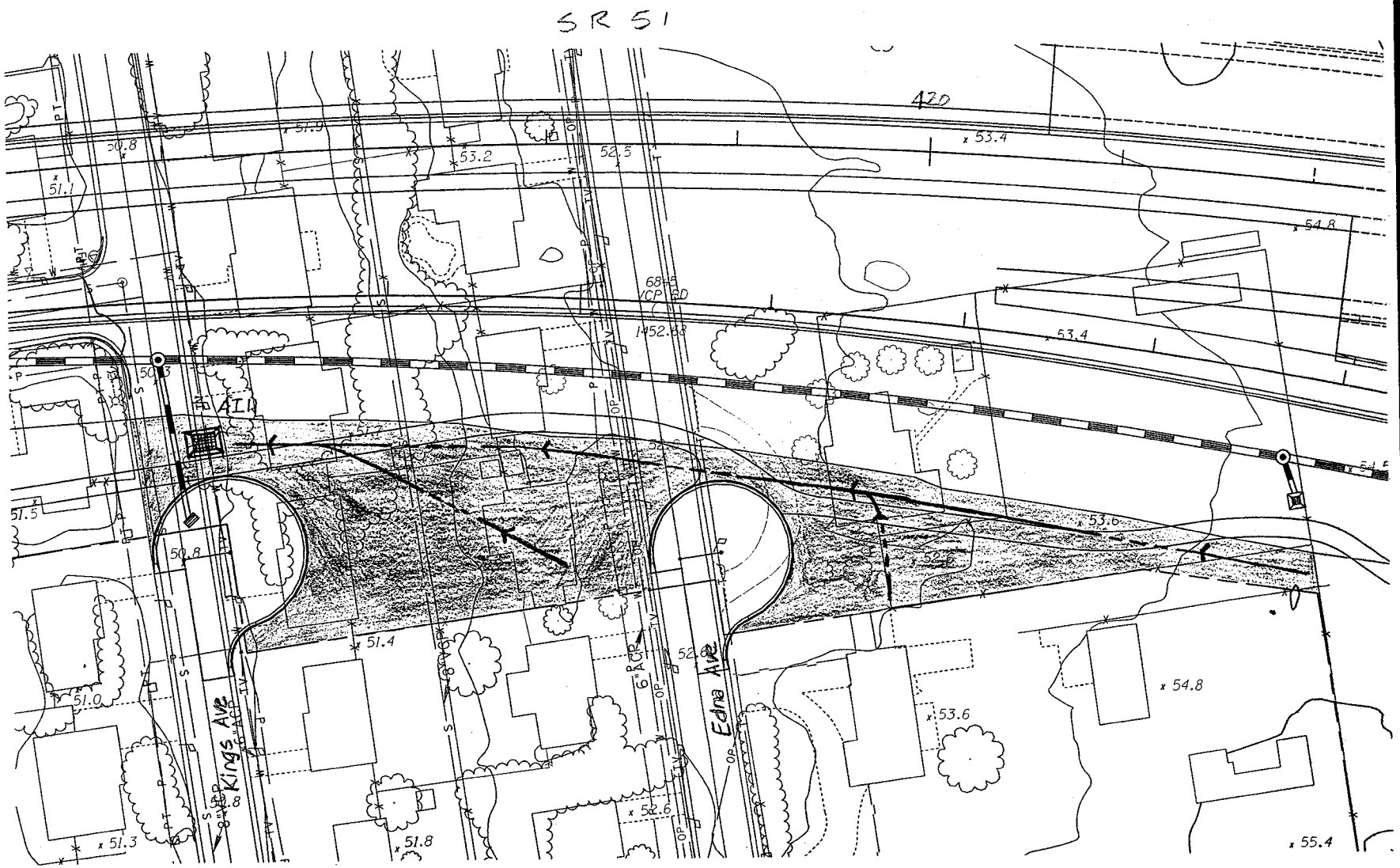
[redacted] = 35,126 ft² = 0.8 ACRES

Q =

PROPOSED FLOWLINE

→ N

1" = 50'



Job No. AI10 | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 1/5/96
Subject Q CALCULATION FOR AREA INLET @ STA 406+00	Checked	Date
Task	Sheet	Of

$Q = CiA$

$C = 0.695$
$i = 6.45$
$A = 1.9$ ACRES

$Q = (0.695)(6.45)(1.9)$
$= 8.5$ CFS

$$\boxed{Q = 8.5 \text{ CFS}}$$

$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$

$L = 950'/5280' = 0.18$ MILE
$K_b = 0.025$
$S = 51 - 45.4 = 5.6/950 = 0.0059 \times 5280 = 31.1$ '/MILE

$T_c = (11.4)(0.18)^{0.5}(0.025)^{0.52}(31.1)^{-0.31}(6.45)^{-0.38}$
$= (11.4)(0.42)(0.15)(0.34)(0.49)$
$= 0.12$ MILES $= 7.2$ MINS.

```
==========================================================================================
PAVEMENT DRAINAGE PROGRAM - HEC-12                                                Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : SR51
------------------------------------------------------------------------------------------
Sta 406+00                                      INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd    =  8.5    Slope1= 0.0500 Gutter= 2.00 Area  = 1.99
CB ID  = AI1  C2=0.00  A2= 0.00 Qrunoff=  8.5    Slope2= 0.0500 a     = 0.00 Perim =10.60
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade   =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 3.33
..........................................................................................
                                                OUTPUT
Flowby=  0.0 Qtotal=  8.5 Qint=  8.5 Flowby dn=  0.0 Depth=0.66 Spread= 13.17 Veloc= 0.00
------------------------------------------------------------------------------------------
                                              CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.014  Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
------------------------------------------------------------------------------------------
Prepared by:          Date:01/05/96    Time:10:22:37     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
==========================================================================================
```

AREA TABLE:

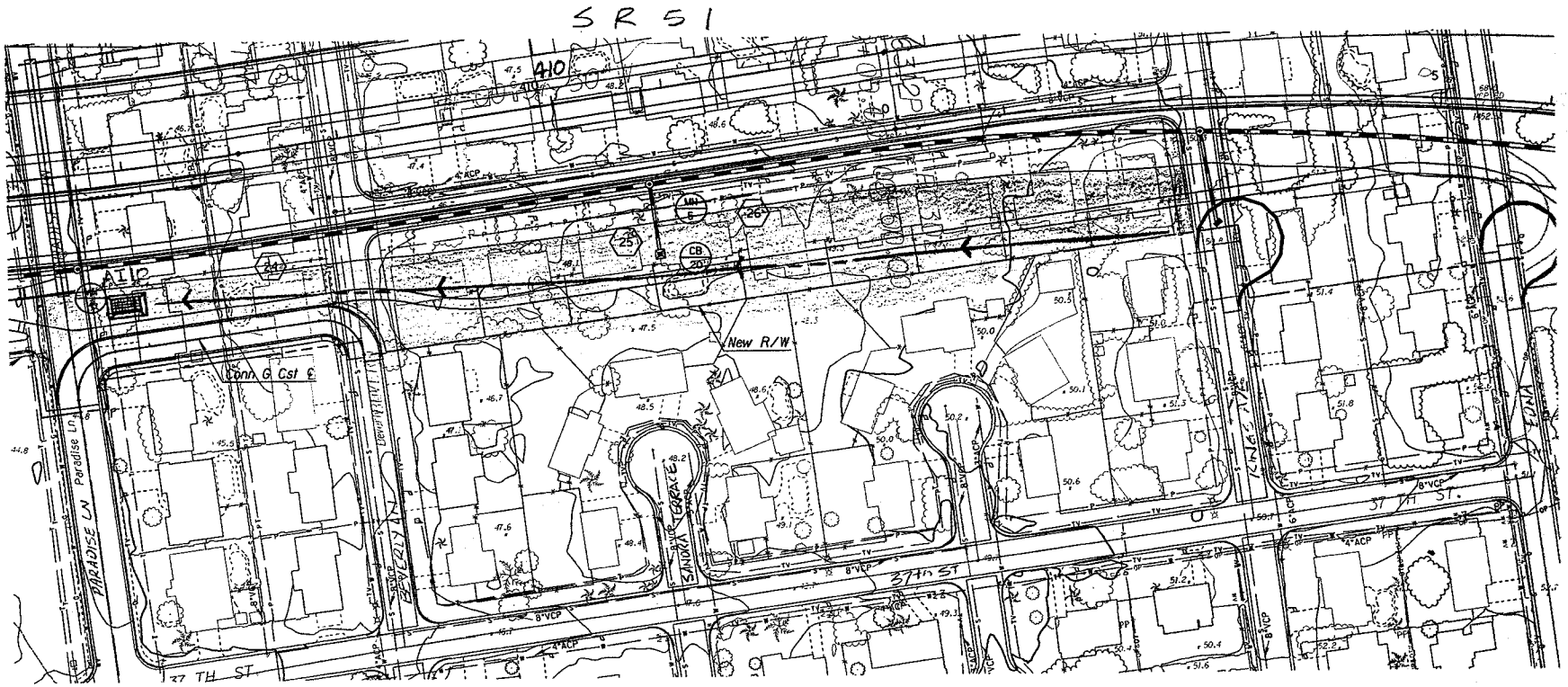
= 81,968 # = 1.9 ACRES

Q = 8.5 CFS

PROPOSED FLOWLINE

N

1" = 100'



Job No. AI12 | No.

HDR Engineering, Inc.

HDR

Project SR51	Computed KAJ	Date 1/5/96
Subject Q CALCULATION FOR AREA INLET @ STA 423+00	Checked	Date
Task	Sheet	Of

$Q = CiA$

$C = 0.695$
$i = 6.45$
$A = 109{,}100^{\phi} = 2.5$ ACRES

$\therefore \; Q = (0.695)(6.45)(2.5)$

$\boxed{Q = 11.2 \text{ CFS}}$

```
==========================================================================================
PAVEMENT DRAINAGE PROGRAM - HEC-12                                                Page   1
Licensed to: HDR Engineering, Phoenix, AZ 85016
Project     : SR51
------------------------------------------------------------------------------------------
Sta 423+00                                   INPUT
Intens.= 0.00 C1=0.00  A1= 0.00 Qadd   = 11.2    Slope1= 0.0500 Gutter= 2.00 Area  = 1.99
CB ID  = A12  C2=0.00  A2= 0.00 Qrunoff= 11.2    Slope2= 0.0500 a     = 0.00 Perim =10.60
Grt P-1-7/8-4 C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0500 W     = 0.00 Length= 3.33
..........................................................................................
                                             OUTPUT
Flowby=  0.0 Qtotal= 11.2 Qint= 11.2 Flowby dn=  0.0 Depth=0.79 Spread= 15.83 Veloc= 0.00
------------------------------------------------------------------------------------------
                                            CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.014  Manning's n Pavement=0.018
Clogging Factors in Sag Location:
----- Curb Opening= 1.00 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.00 Comb-Grate=99.90
Clogging Factors on Continuous Grade:
----- Curb Opening= 2.00 Grate= 2.00 Slotted Drain= 1.25 Comb-Curb= 1.00 Comb-Grate=99.90
------------------------------------------------------------------------------------------
Prepared by:          Date:01/05/96    Time:14:54:55     Checked by:        Date:
Pavement Drainage Program (C), 1991 Copyright by SMF Engineering Corporation, Phoenix, AZ
==========================================================================================
```

AREA TABLE:

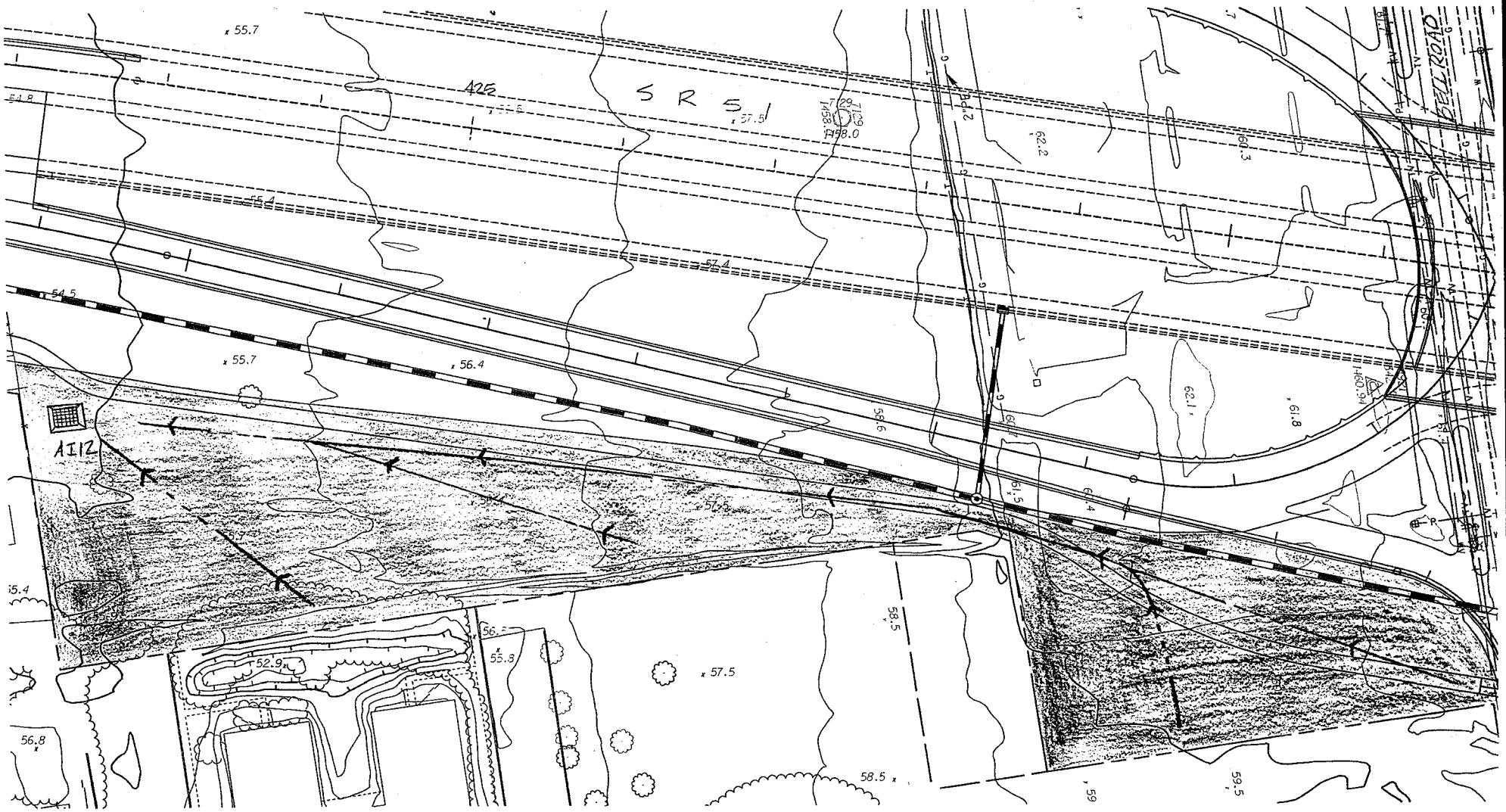
=

Q =

PROPOSED FLOWLINE

N

1" = 60'



APPENDIX B

HDR Engineering, Inc.

Project	SR-51, Squaw Peak	Computed	LSM	Date	2/22/95
Subject	Off-Site Drainage	Checked		Date	
Task	Hydraulic Analysis	Sheet	1	Of	19

PIPE NO. 1 End of Project to 8" Sanitary Crossing

Station = 995.12 1850

Downstream Conditions:

Energy Grade Line Elevation: 1402.46 ft.
Hydraulic Grade Line Elevation: 1402.14 ft.
Vo = 10.49 ft/sec
Station = 995.12 Length = 854.88 ft
Inv. Elev. = 1397.065 ft Slope = 0.0030 ft/ft Top of Box 1403.065

USE: 10 x 6 RCB

Culvert Data B	D	n	Area ft^2	WP ft	R ft	Q cfs	Vd fps	Vd^2/2g ft	So ft/ft
10	3.9	0.013	39	17.8	2.191011	409	10.49	1.71	0.0030

NOTE: Flow is Open Channel.

Unstream Conditions:

Station = 1850
Inv. Elev. = 1399.63 ft

Energy Grade Line Elevation: 1405.237 ft.
Hydraulic Grade Line Elevation: 1403.530 ft. Check Top of Pipe Elev = 1405.63

NOTE: HGL is below the storm drain soffit and therefore is open channel flow.

JUNCTION LOSSES: Ref: DESIGN OF URBAN HIGHWAY DRAINAGE - THE STATE-OF-THE-ART FHWA, August 1979

Junction Conditions:

Energy Grade Line Elevation: 1405.237 ft.
Hydraulic Grade LIne Elevation: 1403.530 ft.
Station = 1850
Inv. Elev. = 1399.63 ft.

Losses @ 12" SS Sleave

	Outlet	@ S.S.	
Q =	409	409	cfs
V =	10.49	14.10	fps
V^2/64.4 =	1.71	3.09	
AREA =	39.00	29.00	ft^2
QV =	4289.26	5768.31	

Expansion Loss for 8x6 to 10x6 RCB's

	@ S.S.	Upstream	
Q =	409	409	cfs
V =	14.10	10.54	fps
V^2/64.4 =	3.09	1.73	

Ht = 0.2 (V1^2/64.4 - v2^2/64.4)

Hj = y + Hvu - Hvo (5-17)
Y = (QoVo-QuVu-Q3V3*cos(angle))/(0.5*(Ao+Au)*g)

Y = -1.351 ft
Hj = 0.030 ft

Ht = 0.273 ft

HDR Engineering, Inc.

Project	SR-51, Squaw Peak	Computed	LSM	Date	2/22/95
Subject	Off-Site Drainage	Checked		Date	
Task	Hydraulic Analysis	Sheet	2	Of	19

PIPE NO. 2 8" Sanitary Crossing to Gelding Drive

Station = 1850 2612

Downstream Conditions:

Energy Grade Line Elevation: 1405.54 ft.
Hydraulic Grade Line Elevation: 1403.81 ft.
Vo = 10.54 ft/sec
Station = 1850 Length = 762 ft
Inv. Elev. = 1399.63 ft Slope = 0.0030 ft/ft Top of Box 1405.63

USE: 8 x 6 RCB

Culvert Data B	D	n	Area ft^2	WP ft	R ft	Q cfs	Vd fps	Vd^2/2g ft	So ft/ft
8	4.85	0.013	38.8	17.7	2.19209	409	10.54	1.73	0.0030

NOTE: Flow is Open Channel.

Unstream Conditions:

Station = 2612
Inv. Elev. = 1401.916 ft

Energy Grade Line Elevation: 1408.491 ft.
Hydraulic Grade Line Elevation: 1406.766 ft. Check Top of Pipe Elev = 1407.916

NOTE: HGL is below the storm drain soffit and therefore is open channel flow.

JUNCTION LOSSES: Ref: DESIGN OF URBAN HIGHWAY DRAINAGE - THE STATE-OF-THE-ART FHWA, August 1979

Junction Conditions:

Energy Grade Line Elevation: 1408.491 ft.
Hydraulic Grade LIne Elevation: 1406.766 ft.
Station = 2612
Inv. Elev. = 1401.916 ft.

	Outlet	Upstream	Lateral
Laterial Dia =			4 ft
Lateral Angle =			90 degrees
Q =	409	368	41 cfs
V =	10.54	10.30	3.26 fps
V^2/64.4 =	1.73	1.65	0.17
AREA =	38.80	35.72	12.57 ft^2
QV =	4311.37	3791.27	133.77

Hj = y + Hvu - Hvo (5-17)
Y = (QoVo-QuVu-Q3V3*cos(angle))/(0.5*(Ao+Au)*g)

Y = 0.433 ft
Hj = 0.356 ft

HDR Engineering, Inc.

Project	SR-51, Squaw Peak	Computed	LSM	Date	2/22/95
Subject	Off-Site Drainage	Checked		Date	
Task	Hydraulic Analysis	Sheet	3	Of	19

PIPE NO. 3 Gelding Drive to Blanche Drive

Station = 2612 4944

Downstream Conditions:

Energy Grade Line Elevation: 1408.847 ft.
Hydraulic Grade Line Elevation: 1407.199 ft.
Vo = 10.30 ft/sec
Station = 2612 Length = 2332 ft
Inv. Elev. = 1401.916 ft Slope = 0.00300 ft/ft Top of Box 1407.916

Use 8 x 6 RCB

Culvert Data B	D	n	Area ft^2	WP ft	R ft	Q cfs	Vd fps	Vd^2/2g ft	So ft/ft
8	4.465	0.013	35.72	16.93	2.109864	368	10.30	1.65	0.00300

NOTE: *HGL is below the storm drain soffit and therefore is open channel.*

Station = 4944
Inv. Elev. = 1408.912 ft

Energy Grade Line Elevation: 1415.06 ft.
Hydraulic Grade Line Elevation: 1413.410 ft. Check Top of Pipe Elev = 1414.912

JUNCTIONS LOSSES:

Ref: DESIGN OF URBAN HIGHWAY DRAINAGE - THE STATE-OF-THE-ART
FHWA, August 1979 Junction Loss Equations (5-17 & 5-18)

Station = 4944
Inv. Elev. = 1408.912

	Outlet	@ S.S.	Lateral
Laterial Dia =			4 ft
Lateral Angle =			90 degrees
Q =	368	361	7 cfs
V =	10.30	10.26	0.56 fps
V^2/64.4 =	1.65	1.63	0.00
AREA =	35.72	35.20	12.57 ft^2
QV =	3791.27	3702.30	3.90

Hj = y + Hvu - Hvo (5-17)
Y = (QoVo-QuVu-Q3V3*cos(angle))/(0.5*(Ao+Au)*g)

Y = 0.078 ft
Hj = 0.063 ft

BEND LOSSES
Angle = 3
each 2
Kb = 0.01
Hb= 0.033

Bend Losses Degrees	Kb
0-3	0.00
3-11	0.01
11-19	0.02
19-27	0.030
27-39	0.040

HDR Engineering, Inc.

Project	SR-51, Squaw Peak	Computed	LSM	Date	2/22/95
Subject	Off-Site Drainage	Checked		Date	
Task	Hydraulic Analysis	Sheet	4	Of	19

PIPE NO. 4 Blanche Drive to Greenway Road

Station = 4944 6042

Downstream Conditions:

Energy Grade Line Elevation: 1415.121 ft.
Hydraulic Grade Line Elevation: 1413.488 ft.
Vo = 10.26 ft/sec
Station = 4944 Length = 1098 ft
Inv. Elev. = 1408.912 ft Slope = 0.00300 ft/ft Top of Box 1414.912

Use 8 x 6 RCB

Open Channel Flow Analysis

Culvert Data B	D	n	Area ft^2	WP ft	R ft	Q cfs	Vd fps	Vd^2/2g ft	So ft/ft
8	4.4	0.013	35.2	16.8	2.095238	361	10.26	1.63	0.00300

NOTE: HGL is below the storm drain soffit and therefore is open channel flow.

Upstream Conditions:

Energy Grade Line Elevation: 1418.26 ft.
Hydraulic Grade Line Elevation: 1416.62 ft.
Station = 6042
Inv. Elev. = 1412.206 ft
Top of Pipe= 1418.206 ft

JUNCTIONS LOSSES: Ref: DESIGN OF URBAN HIGHWAY DRAINAGE - THE STATE-OF-THE-ART FHWA, August 1979

	Outlet	@ S.S.	Lateral	
Laterial Dia =			3	ft
Lateral Angle =			90	degrees
Q =	361	282	79	cfs
V =	10.26	9.19	11.18	fps
V^2/64.4 =	1.63	1.31	1.94	
AREA =	35.20	30.68	7.07	ft^2
QV =	3702.30	2592.05	882.92	

Hj = y + Hvu- Hvo (5-17)
Y = (QoVo-QuVu-Q3V3*cos(angle))/(0.5*(Ao+Au)*g)

Y= 1.047 ft
Hj = 0.725 ft

BEND LOSSES
Angle = 7
each 1
Kb = 0.01
Hb= 0.0163

Bend Losses Degrees	Kb
0-3	0.00
3-11	0.01
11-19	0.02
19-27	0.030
27-39	0.040

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PIPE NO. 5 Greenway Road to 36th Street Storm Drain Connection

Station = 6042 8304

Downstream Conditions:

Energy Grade Line Elevation: 1418.981 ft.

Hydraulic Grade Line Elevation: 1417.669 ft.

Vo = 9.19 ft/sec ADD 0.81' @ Manhole to miss 42" sanitary sewer

Station = 6042 Length = 2262 ft

Inv. Elev. = 1413.016 ft Slope = 0.00264 ft/ft Top of Box 1419.016

Change slope to miss 42" sanitary sewer

Use 8 x 6 RCB

Open Channel Flow Analysis

Culvert Data B	D	n	Area ft^2	WP ft	R ft	Q cfs	Vd fps	Vd^2/2g ft	So ft/ft
8	3.835	0.013	30.68	15.67	1.957881	282	9.19	1.31	0.00264

Upstream Conditions:

Energy Grade Line Elevation: 1424.13 ft.

Hydraulic Grade Line Elevation: 1422.822 ft.

Station = 8304

Inv. Elev. = 1418.987 ft Top of Pipe= 1424.987 ft

JUNCTIONS LOSSES: Ref: DESIGN OF URBAN HIGHWAY DRAINAGE - THE STATE-OF-THE-ART FHWA, August 1979

	Outlet	@ S.S.	Lateral
Laterial Dia =			4 ft
Lateral Angle =			90 degrees
Q =	282	241	41 cfs
V =	9.19	10.10	3.26 fps
V^2/64.4 =	1.31	1.58	0.17
AREA =	30.68	23.86	12.57 ft^2
QV =	2592.05	2434.35	133.77

Hj = y + Hvu - Hvo (5-17)

Y = (QoVo-QuVu-Q3V3*cos(angle))/(0.5*(Ao+Au)*g)

Y= 0.180 ft

Hj = 0.452 ft

BEND LOSSES	Bend Losses Degrees	Kb
Angle = 0	0-3	0.00
each 0	3-11	0.01
Kb = 0.00	11-19	0.02
Hb= 0.0000	19-27	0.030
	27-39	0.040

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HDR Engineering, Inc.

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PIPE NO. 6 36th Street Storm Drain Connection to Angle Point

Station = 8304 8500

Downstream Conditions:

Energy Grade Line Elevation: 1424.586 ft.
Hydraulic Grade Line Elevation: 1423.002 ft.
Vo = 10.10 ft/sec
Station = 8304 Length = 196 ft
Inv. Elev. = 1418.987 ft Slope = 0.00310 ft/ft Pipe Top 1424.987

Use 6 foot diameter RCP

Top of Pipe = 1424.987 ft
Distance HGL is below Pipe = 1.985 ft

Calculate partial full pipe parameters

Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

Open Channel Flow Analysis

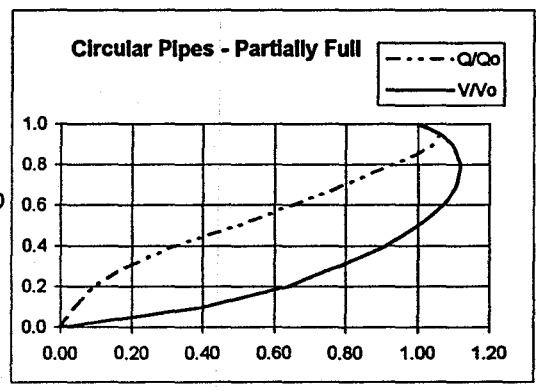
	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.000	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1426.07 ft.
Hydraulic Grade Line Elevation: 1424.49 ft.
Station = 8500
Inv. Elev. = 1419.595 ft
Top of Pipe= 1425.595 ft

Calculate Manhole Losses

Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss = 0.079 ft



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 12.5	0-3	0.00
each 1	3-11	0.01
Kb = 0.02	11-19	0.02
Hb= 0.0317	19-27	0.030
	27-39	0.040

HDR Engineering, Inc.

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PIPE NO. 7

	Angle Point to	Angle Point
Station =	8500	8570

Downstream Conditions:

Energy Grade Line Elevation: 1426.150 ft.
Hydraulic Grade Line Elevation: 1424.566 ft.
Vo = 1.58 ft/sec
Station = 8500 Length = 70 ft
Inv. Elev. = 1419.595 ft Slope = 0.00310 ft/ft Pipe Top 1425.595

Use 6 foot diameter RCP

Top of Pipe = 1425.595 ft
Distance HGL is below Pipe = 1.029 ft

Calculate partial full pipe parameters
Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

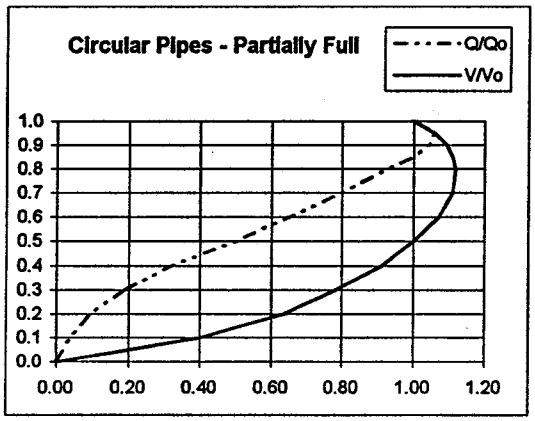
Open Channel Flow Analysis

	Pipe Data Dia	D	n	Area ft^2	WP ft	R ft	Q cfs	Vf fps	Vf^2/2g ft	S ft/ft
Full Flow	6	6.000	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1426.30 ft.
Hydraulic Grade Line Elevation: 1424.72 ft.
Station = 8570
Inv. Elev. = 1419.812 ft
Top of Pipe= 1425.812 ft

Calculate Manhole Losses
Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss = 0.079 ft



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 25.5	0-3	0.00
each 1	3-11	0.01
Kb = 0.03	11-19	0.02
Hb= 0.0475	19-27	0.030
	27-39	0.040

HDR Engineering, Inc.

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PIPE NO. 8 Angle Point to Paradise Lane

Station = 8570 8762

Downstream Conditions:

Energy Grade Line Elevation: 1426.383 ft.
Hydraulic Grade Line Elevation: 1424.799 ft.
Vo = 10.10 ft/sec
Station = 8500 Length = 192 ft
Inv. Elev. = 1419.812 ft Slope = 0.00310 ft/ft

Use 6 foot diameter RCP

Top of Pipe = 1425.812 ft
Distance HGL is below Pipe = 1.013 ft

Calculate partial full pipe parameters

Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

Open Channel Flow Analysis

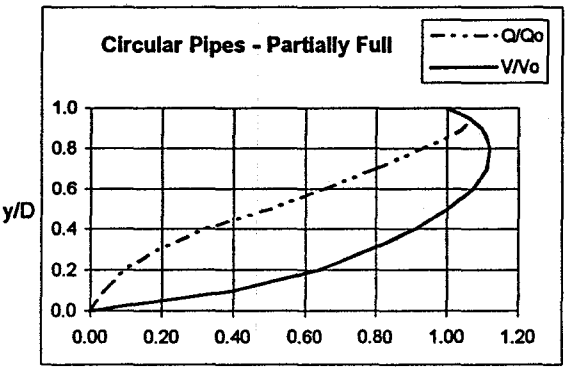
	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.000	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1426.87 ft.
Hydraulic Grade Line Elevation: 1425.28 ft.
Station = 8692
Inv. Elev. = 1420.407 ft
Top of Pipe= 1426.407 ft

Calculate Manhole Losses

Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss = 0.079 ft



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 3	0-3	0.00
each 1	3-11	0.01
Kb = 0.01	11-19	0.02
Hb= 0.0158	19-27	0.030
	27-39	0.040

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PIPE NO. 9 Paradise Lane to Local Off-Site

Station = 8762 9200

Downstream Conditions:

Energy Grade Line Elevation: 1426.947 ft.

Hydraulic Grade Line Elevation: 1425.362 ft.

Vo = 10.10 ft/sec

Station = 8692 Length = 438 ft

Inv. Elev. = 1420.407 ft Slope = 0.0031 ft/ft

Use 6 foot diameter RCP

Top of Pipe = 1426.407 ft

Distance HGL is below Pipe = 1.045 ft

Calculate partial full pipe parameters

Qd/Qf = 0.95

d/Dia = 0.81

V/Vf = 1.12

Open Channel Flow Analysis

	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.000	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1428.23 ft.

Hydraulic Grade Line Elevation: 1426.64 ft.

Station = 9130

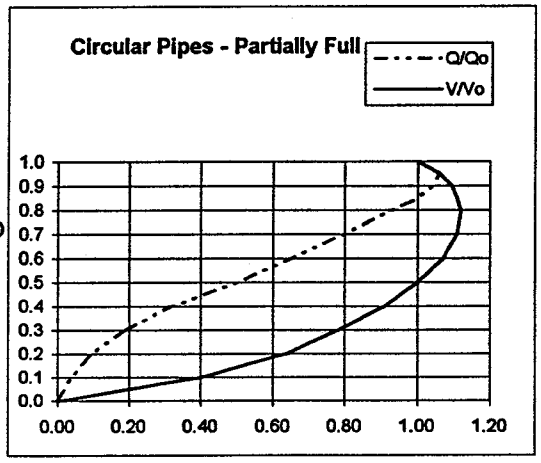
Inv. Elev. = 1421.765 ft

Top of Pipe= 1427.765 ft

Calculate Manhole Losses

Manhole Loss = 0.05 * Vo^2/64.4

Manhole Loss = 0.079 ft



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 4	0-3	0.00
each 1	3-11	0.01
Kb = 0.01	11-19	0.02
Hb= 0.0158	19-27	0.030
	27-39	0.040

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HDR Engineering, Inc.

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PIPE NO. 10 Local Off-Site to On-Site Flows

Station = 9200 9500

Downstream Conditions:

Energy Grade Line Elevation: 1428.304 ft.
Hydraulic Grade Line Elevation: 1426.720 ft.
Vo = 10.10 ft/sec
Station = 9130 Length = 300 ft
Inv. Elev. = 1421.765 ft Slope = 0.0031 ft/ft

Use 6 foot diameter RCP

Top of Pipe = 1427.765 ft
Distance HGL is below Pipe = 1.045 ft

Calculate partial full pipe parameters

Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

Open Channel Flow Analysis

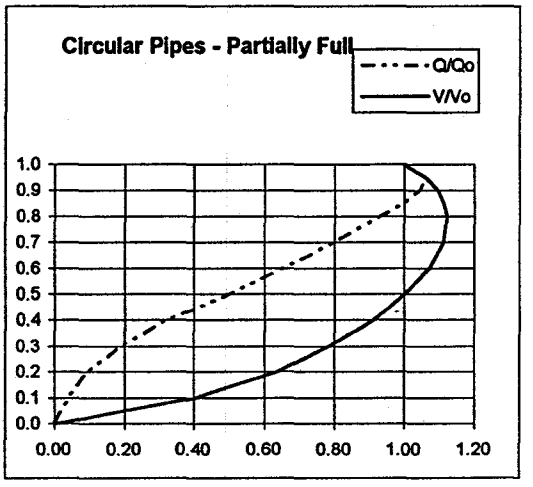
	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.000	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1429.16 ft.
Hydraulic Grade Line Elevation: 1427.57 ft.
Station = 9430
Inv. Elev. = 1422.695 ft
Top of Pipe= 1428.695 ft

Calculate Manhole Losses

Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss = 0.079 ft



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 3	0-3	0.00
each 1	3-11	0.01
Kb = 0.01	11-19	0.02
Hb= 0.0158	19-27	0.030
	27-39	0.040

HDR Engineering, Inc.

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PIPE NO. 11 On-Site Flows to Kings Avenue

Station = 9500 9741

Downstream Conditions:

Energy Grade Line Elevation: 1429.234 ft.
Hydraulic Grade Line Elevation: 1427.650 ft.
Vo = 10.10 ft/sec
Station = 9500 Length = 241 ft
Inv. Elev. = 1422.695 ft Slope = 0.00310 ft/ft

Top of Pipe = 1428.695 ft
Distance HGL is below Pipe = 1.045 ft

Use 6 foot diameter RCP

Calculate partial full pipe parameters

Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

Open Channel Flow Analysis

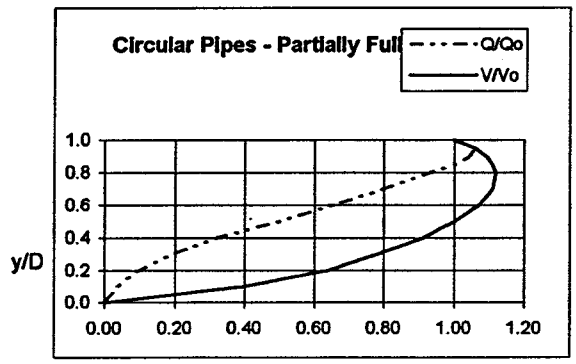
	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.000	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1429.89 ft.
Hydraulic Grade Line Elevation: 1428.30 ft.
Station = 9741
Inv. Elev. = 1423.442 ft
Top of Pipe= 1429.442 ft

Calculate Manhole Losses

Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss = 0.079 ft



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 0.5	0-3	0.00
each 1	3-11	0.01
Kb = 0.00	11-19	0.02
Hb= 0.0000	19-27	0.030
	27-39	0.040

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HDR Engineering, Inc.

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PIPE NO. 12 Kings Avenue to On-Site Flows

Station = 9741 9996

Downstream Conditions:

Energy Grade Line Elevation: 1429.966 ft.
Hydraulic Grade Line Elevation: 1428.381 ft.
Vo = ft/sec
Station = 9741 Length = 255 ft
Inv. Elev. = 1423.442 ft Slope = 0.00310 ft/ft

Top of Pipe = 1429.442 ft
Distance HGL is below Pipe = 1.061 ft

Use 6 foot diameter RCP

Calculate partial full pipe parameters

Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

Open Channel Flow Analysis

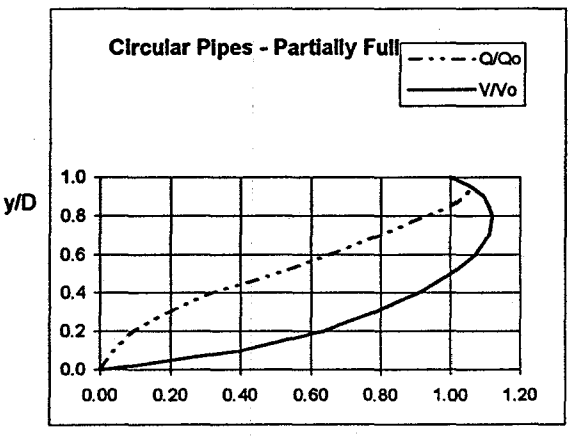
	Pipe Data Dia	D	n	Area ft^2	WP ft	R ft	Q cfs	Vf fps	Vf^2/2g ft	S ft/ft
Full Flow	6	6.000	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1430.69 ft.
Hydraulic Grade Line Elevation: 1429.11 ft.
Station = 9996
Inv. Elev. = 1424.233 ft
Top of Pipe= 1430.233 ft

Calculate Manhole Losses

Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss = 0.079 ft



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 10	0-3	0.00
each 1	3-11	0.01
Kb = 0.01	11-19	0.02
Hb= 0.0158	19-27	0.030
	27-39	0.040

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PIPE NO. 13 On-Site Flows to On-Site Flows

Station = 9996 10180

Downstream Conditions:

Energy Grade Line Elevation: 1430.772 ft.
Hydraulic Grade Line Elevation: 1429.188 ft.
Vo = 10.10 ft/sec
Station = 9996 Length = 184 ft
Inv. Elev. = 1424.233 ft Slope = 0.00310 ft/ft

Use 6 foot diameter RCP

Top of Pipe = 1430.233 ft
Distance HGL is below Pipe = 1.045 ft
Calculate partial full pipe parameters
Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

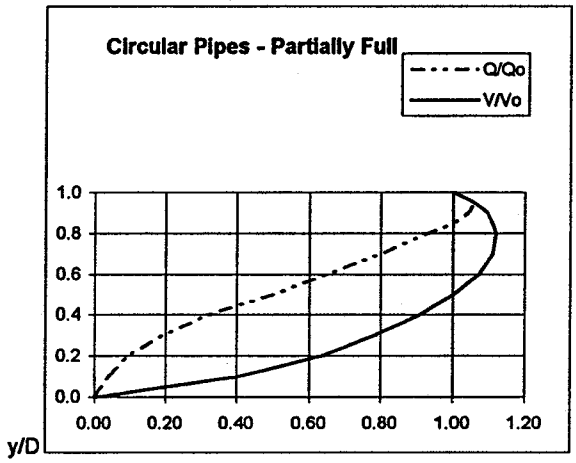
Open Channel Flow Analysis

	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.000	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1431.26 ft.
Hydraulic Grade Line Elevation: 1429.68 ft.
Station = 10180
Inv. Elev. = 1424.803 ft
Top of Pipe= 1430.803 ft

Calculate Manhole Losses
Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss (5) = 0.396 ft



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 7.5	0-3	0.00
each 1	3-11	0.01
Kb = 0.01	11-19	0.02
Hb= 0.0158	19-27	0.030
	27-39	0.040

HDR Engineering, Inc.

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PIPE NO. 14 On-Site Flows to On-Site & Off-Site Flows

Station = 10180 10395

Downstream Conditions:

Energy Grade Line Elevation: 1431.659 ft.
Hydraulic Grade Line Elevation: 1430.075 ft.
Vo = ft/sec
Station = 10180 Length = 215 ft
Inv. Elev. = 1424.803 ft Slope = 0.00310 ft/ft

Top of Pipe = 1430.803 ft
Distance HGL is below Pipe = 0.728 ft

Use 6 foot diameter RCP

Calculate partial full pipe parameters
Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

Open Channel Flow Analysis

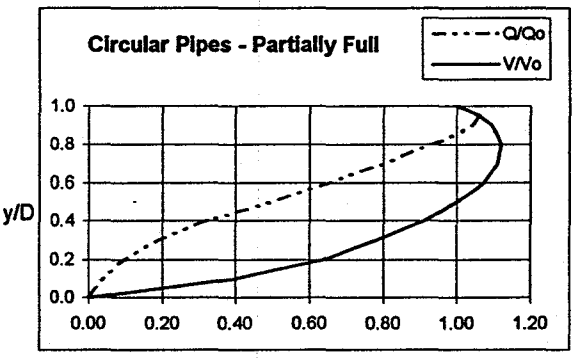
	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.00	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1431.91 ft.
Hydraulic Grade Line Elevation: 1430.33 ft.
Station = 10395
Inv. Elev. = 1425.469 ft
Top of Pipe= 1431.469 ft

Calculate Manhole Losses
Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss (4)= 0.317 ft

Estimated Mainline Profile Elevation is : 1470 ft.



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 0	0-3	0.00
each 1	3-11	0.01
Kb = 0.00	11-19	0.02
Hb= 0.0000	19-27	0.030
	27-39	0.040

HDR Engineering, Inc.

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PIPE NO. 15 On-Site & Off-Site Flows to On-Site & Off-Site Flows

Station = 10395 10444

Downstream Conditions:

Energy Grade Line Elevation: 1432.231 ft.
Hydraulic Grade Line Elevation: 1430.646 ft.
Vo = 10.10 ft/sec
Station = 10395 Length = 49 ft
Inv. Elev. = 1425.469 ft Slope = 0.00310 ft/ft

Top of Pipe = 1431.469 ft
Distance HGL is below Pipe = 0.823 ft

Use 6 foot diameter RCP

Calculate partial full pipe parameters

Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

Open Channel Flow Analysis

	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.00	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

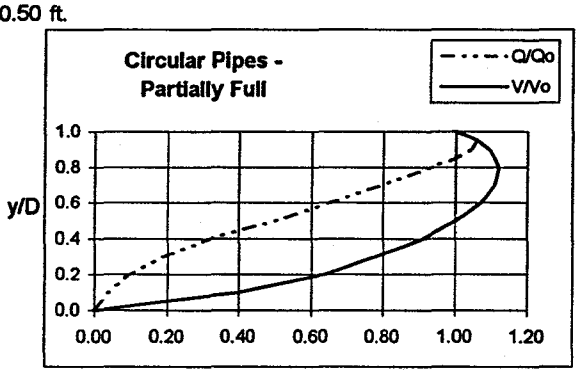
Upstream Conditions:

Energy Grade Line Elevation: 1432.08 ft.
Hydraulic Grade Line Elevation: 1430.50 ft.
Station = 10444
Inv. Elev. = 1425.621 ft
Top of Pipe= 1431.621 ft

Calculate Manhole Losses

Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss (4)= 0.317 ft

Estimated Mainline Profile Elevation is : 1470 ft.



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 3	0-3	0.00
each 1	3-11	0.01
Kb = 0.01	11-19	0.02
Hb= 0.0158	19-27	0.030
	27-39	0.040

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HDR Engineering, Inc.

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Subject	Off-Site Drainage	Checked		Date	
Task	Hydraulic Analysis	Sheet	16	Of	19

PIPE NO. 16 On-Site & Off-Site Flows to On-Site - Bell Road Low Point

Station = 10444 10879

Downstream Conditions:

Energy Grade Line Elevation: 1432.398 ft.
Hydraulic Grade Line Elevation: 1430.814 ft.
Vo = 10.10 ft/sec
Station = 10395 Length = 435 ft
Inv. Elev. = 1425.621 ft Slope = 0.00310 ft/ft

Use 6 foot diameter RCP

Top of Pipe = 1431.621 ft
Distance HGL is below Pipe = 0.807 ft
Calculate partial full pipe parameters
Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

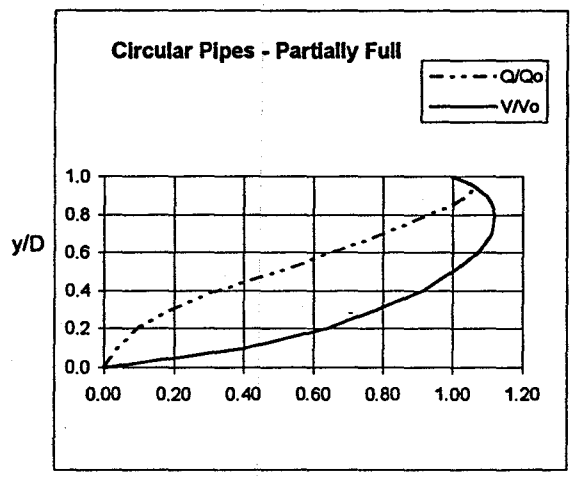
Open Channel Flow Analysis

	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.000	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1433.43 ft.
Hydraulic Grade Line Elevation: 1431.85 ft.
Station = 10830
Inv. Elev. = 1426.97 ft
Top of Pipe= 1432.97 ft

Calculate Manhole Losses
Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss (5) = 0.396 ft



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 6.5	0-3	0.00
each 1	3-11	0.01
Kb = 0.01	11-19	0.02
Hb= 0.0158	19-27	0.030
	27-39	0.040

HDR Engineering, Inc.

Project	SR-51, Squaw Peak	Computed	LSM	Date	2/22/95
Subject	Off-Site Drainage	Checked		Date	
Task	Hydraulic Analysis	Sheet	17	Of	19

PIPE NO. 17 On-Site - Bell Road Low Point to Bell Road

Station = 10879 11430

Downstream Conditions:

Energy Grade Line Elevation: 1433.826 ft.
Hydraulic Grade Line Elevation: 1432.242 ft.
Vo = 10.10 ft/sec
Station = 10830 Length = 551 ft
Inv. Elev. = 1426.97 ft Slope = 0.00310 ft/ft

Use 6 foot diameter RCP

Top of Pipe = 1432.97 ft
Distance HGL is below Pipe = 0.728 ft

Calculate partial full pipe parameters

Qd/Qf = 0.95
d/Dia = 0.81
V/Vf = 1.12

Open Channel Flow Analysis

	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.00	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.86	0.012	23.86			241	10.10	1.58	0.00310

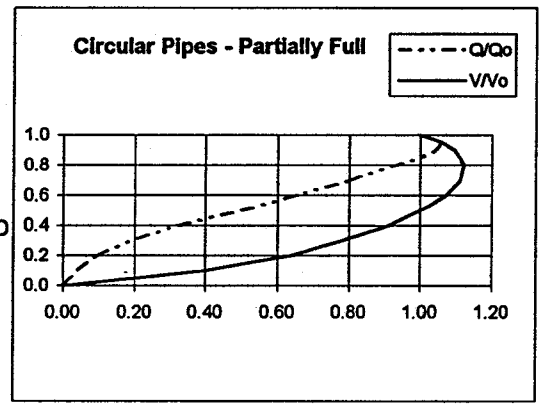
Upstream Conditions:

Energy Grade Line Elevation: 1435.12 ft.
Hydraulic Grade Line Elevation: 1433.54 ft.
Station = 11381
Inv. Elev. = 1428.678 ft
Top of Pipe= 1434.678 ft

Calculate Manhole Losses

Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss (4)= 0.317 ft

Estimated Mainline Profile Elevation is : 1470 ft.



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 0	0-3	0.00
each 0	3-11	0.01
Kb = 0.00	11-19	0.02
Hb= 0.0000	19-27	0.030
	27-39	0.040

HDR Engineering, Inc.

Project	SR-51, Squaw Peak	Computed	LSM	Date	2/22/95
Subject	Off-Site Drainage	Checked		Date	
Task	Hydraulic Analysis	Sheet	18	Of	19

PIPE NO. 18 Bell Road to End of Pavement

Station = 11430 11660

Downstream Conditions:

Energy Grade Line Elevation: 1435.439 ft.

Hydraulic Grade Line Elevation: 1433.911 ft.

Vo = 9.92 ft/sec

Station = 11381 Length = 230 ft

Inv. Elev. = 1428.678 ft Slope = 0.00310 ft/ft

Use 6 foot diameter RCP

Top of Pipe = 1434.678 ft

Distance HGL is below Pipe = 0.767 ft

Calculate partial full pipe parameters

Qd/Qf = 0.78

d/Dia = 0.68

V/Vf = 1.1

Open Channel Flow Analysis

	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.00	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.08	0.012	19.96			198	9.92	1.53	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1435.03 ft.

Hydraulic Grade Line Elevation: 1433.50 ft.

Station = 11611

Inv. Elev. = 1429.391 ft

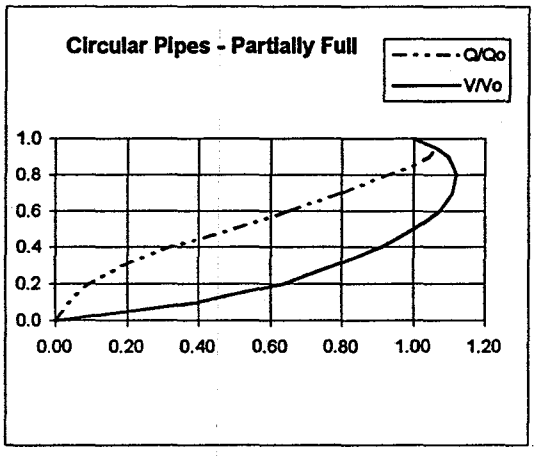
Top of Pipe= 1435.391 ft

Calculate Manhole Losses

Manhole Loss = 0.05 * Vo^2/64.4

Manhole Loss (4)= 0.306 ft

Estimated Mainline Profile Elevation is : 1470 ft.



BEND LOSSES	Bend Losses Degrees	Kb
Angle = 11	0-3	0.00
each 1	3-11	0.01
Kb = 0.02	11-19	0.02
Hb= 0.0306	19-27	0.030
	27-39	0.040

Job No.	0173-118-044	No.

HDR Engineering, Inc.

Project	SR-51, Squaw Peak	Computed	LSM	Date	2/22/95
Subject	Off-Site Drainage	Checked		Date	
Task	Hydraulic Analysis	Sheet	19	Of	19

PIPE NO. 19 End of Pavement to Danbury Road

Station = 11660 11735

Downstream Conditions:

Energy Grade Line Elevation: 1435.335 ft.
Hydraulic Grade Line Elevation: 1433.807 ft.
Vo = 9.92 ft/sec
Station = 11660 Length = 75 ft
Inv. Elev. = 1429.391 ft Slope = 0.00310 ft/ft

Use 6 foot diameter RCP

Top of Pipe = 1435.391 ft
Distance HGL is below Pipe = 1.584 ft

Calculate partial full pipe parameters
Qd/Qf = 0.78
d/Dia = 0.68
V/Vf = 1.1

Open Channel Flow Analysis

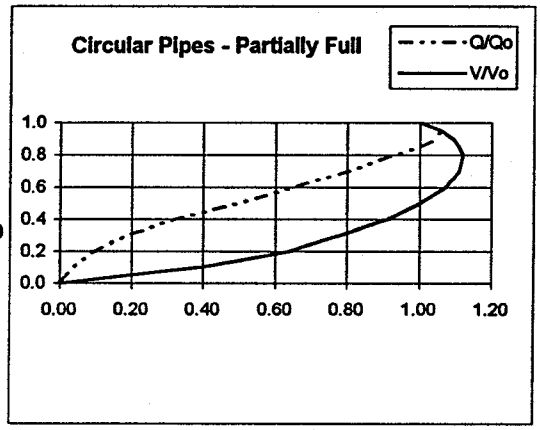
	Pipe Data		n	Area	WP	R	Q	Vf	Vf^2/2g	S
	Dia	D		ft^2	ft	ft	cfs	fps	ft	ft/ft
Full Flow	6	6.00	0.012	28.27	18.85	1.5	255	9.02	1.26	0.00309
Design	6	4.08	0.012	19.96			198	9.92	1.53	0.00310

Upstream Conditions:

Energy Grade Line Elevation: 1435.23 ft.
Hydraulic Grade Line Elevation: 1433.70 ft.
Station = 11735
Inv. Elev. = 1429.623 ft
Top of Pipe= 1435.623 ft

Calculate Manhole Losses
Manhole Loss = 0.05 * Vo^2/64.4
Manhole Loss (4)= 0.306 ft

Estimated Mainline Profile Elevation is : 1470 ft.



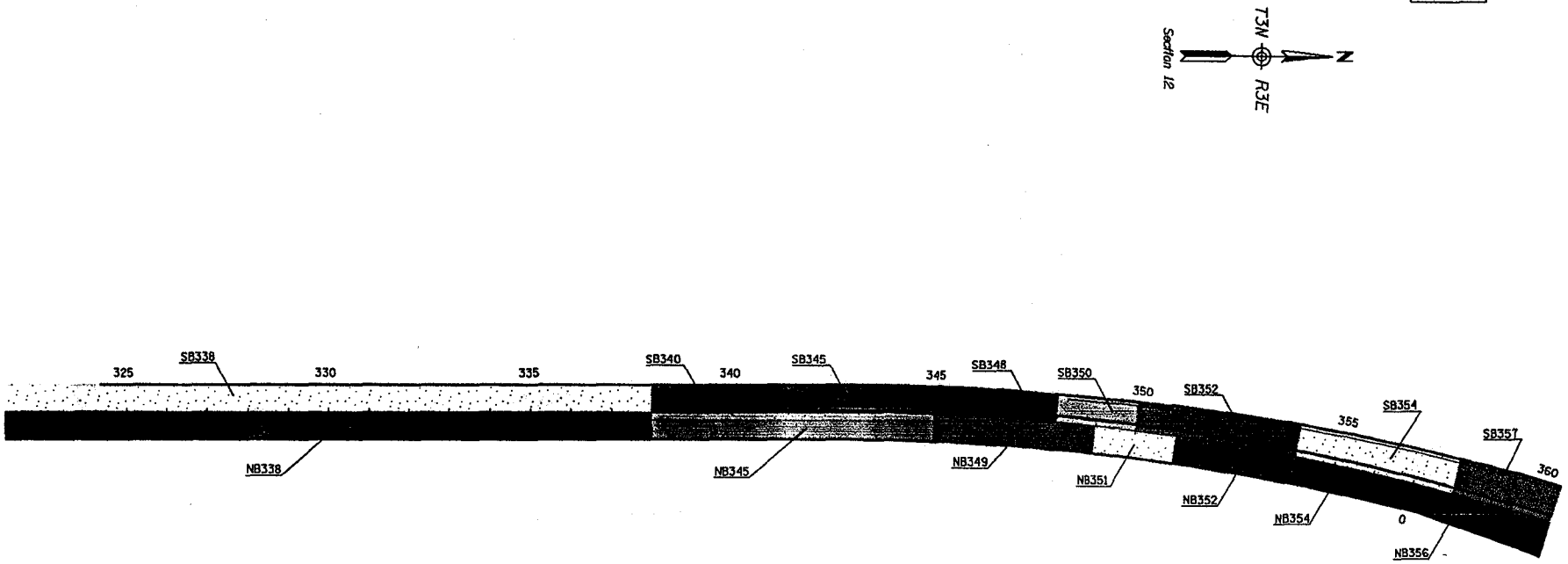
PROJECT ENDING CONDITIONS:
Energy Grade Line Elevation: 1435.54 ft.
Hydraulic Grade Line Elevation: 1434.01 ft.
Station = 11735
Inv. Elev. = 1429.723

BEND LOSSES
Angle = 0
each 0
Kb = 0.00
Hb= 0.0000

Bend Losses Degrees	Kb
0-3	0.00
3-11	0.01
11-19	0.02
19-27	0.030
27-39	0.040

APPENDIX C

F.A.R.S. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			
		051-MA-011			



60% SUBMITTAL

	NAME	DATE	
DESIGN	JJJ		ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION
DRAWN	WH		
CHECKED			SR 51 PAVEMENT DRAINAGE SUBBASINS Sta. 322+00 to 360+50
HDR Engineering, Inc.			
ROUTE SR 51	LOCATION THUNDERBIRD ROAD TO BELL ROAD		

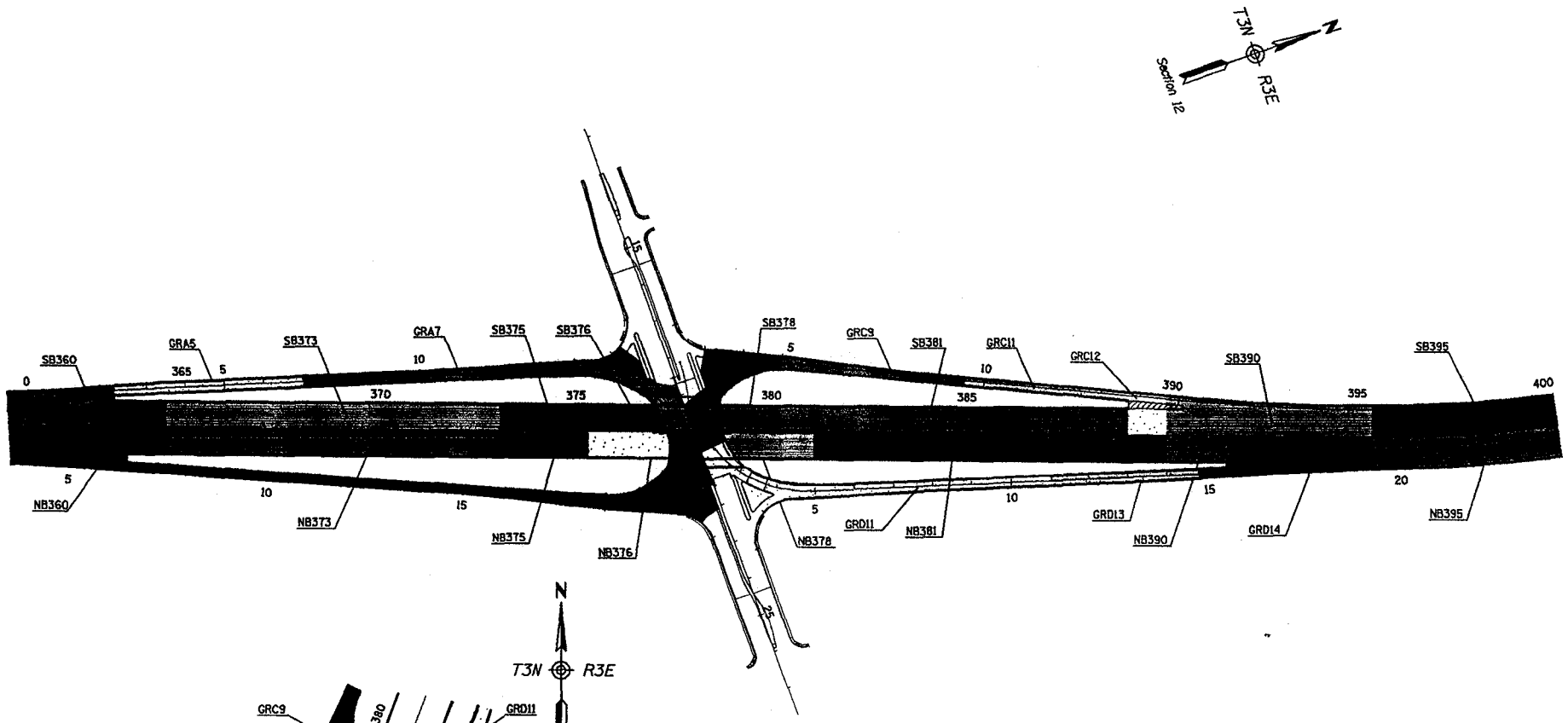
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

SHEET 0- OF

FILE: d:\sapeak\drs-5109.dgn
DATE: 1-Mar-96 12:50

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

F.A.P.N. NUMBER	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			
		051-MA-011			



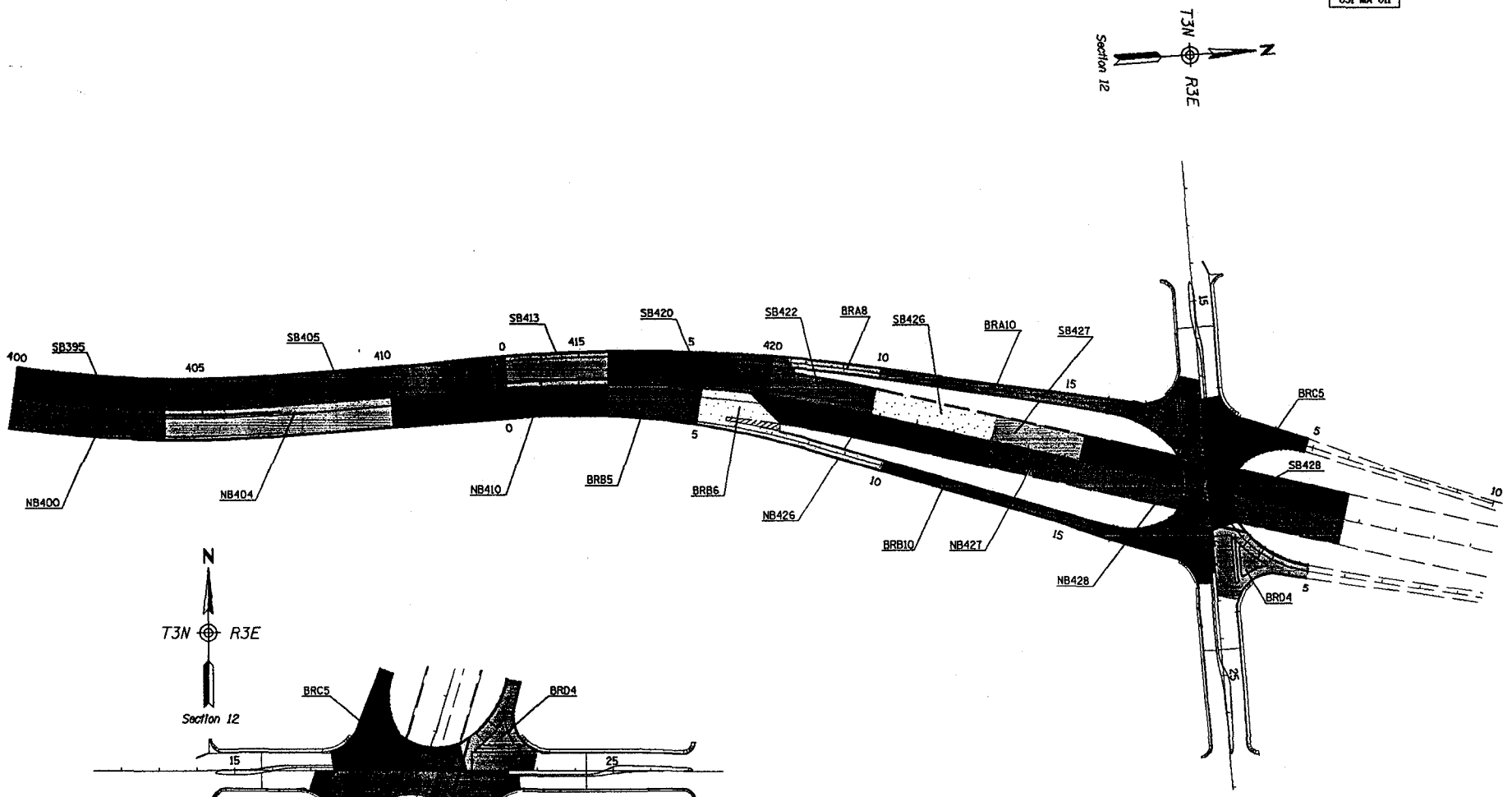
FILE: dl\sapeek\dr-sr6110.dgn
DATE: 1-Mar-96 12:51

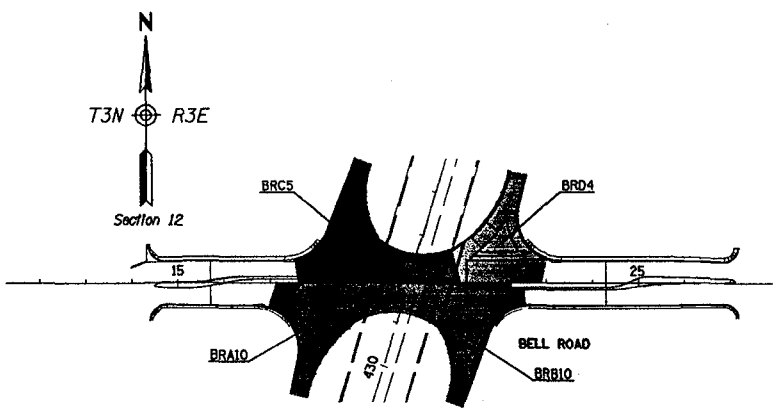
60% SUBMITTAL

	NAME	DATE	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION	PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING
DESIGN	JJ			
DRAWN	RH			
CHECKED				
HDR Hoff Engineering, Inc.			SR 51 PAVEMENT DRAINAGE SUBBASINS Sta. 360+50 to 400+00	
ROUTE SR 51	LOCATION THUNDERBIRD ROAD TO BELL ROAD			SHEET D- OF

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

F.A.R.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			
		051-MA-011			





60% SUBMITTAL

	NAME	DATE	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION	PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING
DESIGN	JJ		SR 51 PAVEMENT DRAINAGE SUBBASINS Sta 400+00 to 438+00	
DRAWN	WH			
CHECKED				
HDR Engineering, Inc.				
ROUTE: SR 51	LOCATION: THUNDERBIRD ROAD TO BELL ROAD			SHEET 9 OF

FILE: dh\sapeek\drsr5111.dgn
DATE: 1-Mar-96 12:51

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

SR-51
Summary Table
Pavement Inlets - Southbound M

Preliminary
1/30/96

Area Desig.	*Inlet Station*	*Offset*	*Interin*	*by*	*Grate Elev.*	Notes
SB338	338+00	69' LT.	11.7		1416.08	Begin Project - 320+00
SB340	340+00	69' LT.	1.5		1410.67	Super Changes D/S of Inlet
SB345	345+00	15' LT.	3.8		1411.88	
SB348	348+00	15' LT.	2.3		1410.52	
SB350	350+00	15' LT.	1.6		1410.00	
SB352	352+42.06	15' LT.	3.4		1409.78	Inlet at Sag Location
SB354	354+00	15' LT.	3.0		1409.87	
SB357	357+00	15' LT.	3.7		1410.58	
SB360	360+50	15' LT.	3.9		1412.17	
SB373	373+00	69' LT.	6.3		1408.53	
SB375	375+25	69' LT.	1.6		1407.43	
SB376	376+60.73	69' LT.	1.6		1407.24	Inlet at Sag Location
SB378	378+00	69' LT.	1.7		1407.43	
SB381	381+00	69' LT.	6.0		1409.19	
GRA5	5+51.80 Ramp A	14' LT.	2.0		1413.60	Inlet at Sag Location
GRA7	7+00 Ramp A	14' LT.	5.7		1414.36	
GRC9	9+50 Ramp C	8.0' LT.	5.4		1419.86	
GRC11	11+41.86 Ramp C	8.0' LT.	1.1		1418.69	Inlet at Sag Location
GRC12	12+50 Ramp C	8.0' LT.	1.6		1419.06	
SB390	390+00	103' LT	4.9		1421.94	
SB395	395+25	81' LT.	7.8		1427.66	
SB404	404+00	81' LT.	8.1		1432.05	
SB413	413+10	15' LT.	2.7		1438.86	Super Changes D/S of Inlet
SB420	420+00	15' LT.	4.3		1438.25	
SB422	422+80	15' LT.	2.6		1437.24	Super Changes D/S of Inlet
SB426	426+00	69' LT.	2.3		1435.38	
SB427	427+09.09	69' LT.	1.3		1435.27	Inlet at Sag Location
SB428	428+40	69' LT.	4.2		1435.43	
BRA8	8+46.33 Ramp A	14' RT.	0.9		1440.53	Inlet at Sag Location
BRA10	10+00 Ramp A	14' RT.	8.1		1441.60	
BRC5	5+00 Ramp C	20' LT.	5.2		1458.60	

Filename: Squaw6/Sheet8(2)

Notes

a. Design Q shown incl
b. Inlet spacing has bee
It is assumed that inl
paved. Spread criter
c. Minimum diameter fo
d. GRC11 = Greenway
e. BRA10 = Bell Road, I
e. Spread Criteria Used
1. Allow
2. 10-Ye
3. 50-Ye
4. Ramp

on.

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/26/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB338	**Sheet**	1	of 2

Sub-basin Data:

Begin. Sta. = 322+00 S. Bound - Begin Project
End Sta. = 338+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 1671 = 0.3164 mi.
Shldr. x-slope= 2.0 %
Ave. Slope, S = 0.72 % = 38.02 ft./mi.
Slope at Inlet = 0.72 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	1600	112,800	2.5895

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.17
0.167	4.7	0.15
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 11.0

Spread, T (ft) = 17.4 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder +1/2 lane).

50 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.15
0.167	6.4	0.13
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 14.9
Spread, T (ft) = 19.7 See Note 1
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane).

Inlet location determined by spread criteria for 10 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 14.9**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 3.1% Composite Ave.
Sx = 2.9%
Spread (ft) = 17

Pavement Spread, Ts (ft) = 13.5
Shoulder x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 4.4 See Note 7
Gutter Flow, Qw (cfs) = 10.5
Eo = Qw/Q = 0.70

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB338	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf =	1.0	See Note 5
Velocity (ft/sec) =	3.5	See Note 1.
Rs at 50% Efficiency =	0.035	See Note 6. With 50% clogging, grate length = 1.5'.
Eo =	0.70	
Qi at 50% Efficiency (cfs) =	7.5	Calculated - Approx.
Qi at 50% Efficiency (cfs) =	7.6	SMF Program - Use
Inlet Bypass (cfs) =	7.3	

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8

Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) =	3		
W (ft.)=	2.5	Length for total interception, Lt (ft) =	15.9
Sx (%) =	2.0	Lt at 67% Efficiency (ft) =	23.7
Sw (%) =	10	Length of Slotted Drain used (ft) =	20
Se (%) =	9.0	L/Lt =	0.84
Se (ft/ft) =	0.090	Slotted Drain Intercept. (cfs) =	6.1
n =	0.016	Slotted Drain Bypass (cfs) =	1.2

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB338
     Catch Basin ID                   : 338
     Type of Inlet                    :  2.2        Grated Inlet
     Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          : 11.0
     Longitudinal Grade (ft/ft)       :  0.0072
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff= 11.0 cfs   Qtotal= 11.0 cfs  Flowby dn=  4.7 cfs
Qint  =  6.3 cfs   Depth  =  0.47 ft   Spread= 17.41 ft  Velocity =  3.14 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB338
     Catch Basin ID                   : 338
     Type of Inlet                    :  2.2        Grated Inlet
     Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          : 14.9
     Longitudinal Grade (ft/ft)       :  0.0072
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff= 14.9 cfs   Qtotal= 14.9 cfs  Flowby dn=  7.3 cfs
Qint  =  7.6 cfs   Depth  =  0.51 ft   Spread= 19.71 ft  Velocity =  3.37 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB340	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 338+00 S. Bound
End Sta. = 340+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 271 = 0.0512 mi.
Shldr. x-slope= 2.0 %
Ave. Slope, S = 0.72 % = 38.02 ft./mi.
Slope at Inlet = 0.72 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	200	14,100	0.3237

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.07
0.167	4.7	0.06
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.4
Q10 w/carry-over (cfs) = 1.4
Spread, T (ft) = 6.5 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder +1/2 lane).

50 Year Event:

Carry over from upstream inlet (cfs) = 1.2

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.06
0.167	6.4	0.05
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 1.9
Q50 w/carry-over (cfs) = 3.1
Spread, T (ft) = 9.9 See Note 1
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane).

Inlet location determined by spread criteria for 10 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.1**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.3% Composite Ave.
Sx = 4.7%
Spread (ft) = 7

Pavement Spread, Ts (ft) = 3.5
Shoulder x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.1 See Note 7
Gutter Flow, Qw (cfs) = 3.0
Eo = Qw/Q = 0.97

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HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB340	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf =	1.0	See Note 5
Velocity (ft/sec) =	2.4	See Note 1.
Rs at 50% Efficiency =	0.07	See Note 6. With 50% clogging, grate length = 1.5'.
Eo =	0.97	
Qi at 50% Efficiency (cfs) =	2.9	Calculated - Approx.
Qi at 50% Efficiency (cfs) =	2.6	SMF Program - Use
Inlet Bypass (cfs) =	0.5	

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8

Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) =	3		
W (ft.)=	2.5	Length for total interception, Lt (ft) =	4.4
Sx (%) =	2.0	Lt at 67% Efficiency (ft) =	6.6
Sw (%) =	10	Length of Slotted Drain used (ft) =	10
Se (%) =	11.7	Slotted Drain Intercept. (cfs) =	0.5
Se (ft/ft) =	0.117	Slotted Drain Bypass (cfs) =	0.0
n =	0.016		

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: SB340	
Catch Basin ID	: 340	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.32	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0072	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 1.4 cfs Qtotal= 1.4 cfs Flowby dn= 0.0 cfs
Qint = 1.4 cfs Depth = 0.25 ft Spread= 6.46 ft Velocity = 2.11 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB340	
Catch Basin ID	: 340	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.32	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 1.2	
Longitudinal Grade (ft/ft)	: 0.0072	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.1 cfs Qtotal= 3.1 cfs Flowby dn= 0.5 cfs
Qint = 2.6 cfs Depth = 0.32 ft Spread= 9.91 ft Velocity = 2.41 ft/s

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HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. SB345	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 340+00 S. Bound
End Sta. = 345+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 557 = 0.1055 mi.
Pvmnt. x-slope= 2.9 %
Ave. Slope, S = 0.7 % = 36.96 ft./mi.
Slope at Inlet = 0.65 %

Area			
Width	Length	Area (sf)	Area (ac)
57.0	500	28,500	0.6543

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.8

Spread, T (ft) = 7.8 SMF Program. See Note 1.
Allowable Spread (ft) = 9.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.8
Spread, T (ft) = 9.0 See Note 1
Allowable Spread (ft) = 9.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.8**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 4.8% Composite Ave.
Sx = 4.3%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 2.9
Pavement Flow, Qs (cfs) = 0.4 See Note 7
Gutter Flow, Qw (cfs) = 3.4
Eo = Qw/Q = 0.89

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB345	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo))	See Note 4
Rf = 1.0	See Note 5
Rs at 50% Efficiency = 0.04	With 50% Clogging, Grate Length = 1.5'. See Note 6.
Eo = 0.89	
Qi at 50% Efficiency (cfs) = 3.0	Calculated
Qi at 50% Efficiency (cfs) = 3.2	SMF Program - Use
Inlet Bypass (cfs) = 0.6	

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: SB345	
Catch Basin ID	: 345	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.65	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0065	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.8 cfs Qtotal= 2.8 cfs Flowby dn= 0.3 cfs
Qint = 2.5 cfs Depth = 0.32 ft Spread= 7.78 ft Velocity = 2.43 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB345	
Catch Basin ID	: 345	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.65	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0065	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.8 cfs Qtotal= 3.8 cfs Flowby dn= 0.6 cfs
Qint = 3.2 cfs Depth = 0.35 ft Spread= 8.96 ft Velocity = 2.59 ft/s

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HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. SB348	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 345+00 S. Bound
End Sta. = 348+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 357 = 0.0676 mi.
Pvmnt. x-slope= 2.9 %
Ave. Slope, S = 0.40 % = 21.12 ft./mi.
Slope at Inlet = 0.29 %

Area

Width	Length	Area (sf)	Area (ac)
57.0	300	17,100	0.3926

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event: Carry over from upstream inlet (cfs) = 0.3

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.09
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.7
Q10 w/carry-over (cfs) = 2.0
Spread, T (ft) = 8.0 SMF Program. See Note 1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlet (cfs) = 0.6

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
0.167	6.4	0.07
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.3
Q50 w/ carry-over (cfs) = 2.9
Spread, T (ft) = 9.5 See Note 1
Allowable Spread (ft) = 10.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 2.9**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.4% Composite Ave.
Sx = 4.7%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 2.9
Pavement Flow, Qs (cfs) = 0.3 See Note 7
Gutter Flow, Qw (cfs) = 2.6
Eo = Qw/Q = 0.90

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HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB348	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo))	See Note 4
Rf = 1.0	See Note 5
Rs at 50% Efficiency = 0.18	With 50% Clogging, Grate Length = 1.5'. See Note 6.
Eo = 0.90	
Qi at 50% Efficiency (cfs) = 2.4	Calculated
Qi at 50% Efficiency (cfs) = 2.4	SMF Program - Use
Inlet Bypass (cfs) = 0.5	

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: SB348	
Catch Basin ID	: 348	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.39	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 0.3	
Longitudinal Grade (ft/ft)	: 0.0029	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.0 cfs Qtotal= 2.0 cfs Flowby dn= 0.2 cfs
Qint = 1.8 cfs Depth = 0.33 ft Spread= 7.99 ft Velocity = 1.64 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB348	
Catch Basin ID	: 348	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.39	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 0.6	
Longitudinal Grade (ft/ft)	: 0.0029	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.9 cfs Qtotal= 2.9 cfs Flowby dn= 0.5 cfs
Qint = 2.4 cfs Depth = 0.37 ft Spread= 9.47 ft Velocity = 1.77 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. SB350	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 348+00 S. Bound
End Sta. = 350+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 259 = 0.0491 mi.
Pvmnt. x-slope= 2.9 %
Ave. Slope, S = 0.30 % = 15.84 ft./mi.
Slope at Inlet = 0.24 %

Area

Width	Length	Area (sf)	Area (ac)
59.0	200	11,800	0.2709

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event: Carry over from upstream inlet (cfs) = 0.2

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.09
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.1
Q10 w/carry-over (cfs) = 1.3
Spread, T (ft) = 7.7 SMF Program. See Note 1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlet (cfs) = 0.5

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
0.167	6.4	0.07
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 1.6
Q50 w/ carry-over (cfs) = 2.1
Spread, T (ft) = 8.5 SMF Program.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 2.1**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.6% Composite Ave.
Sx = 4.9%
Spread (ft) = 7.5

Pavement Spread, Ts (ft) = 4.0
Pavement x-slope (%) = 2.9
Pavement Flow, Qs (cfs) = 0.10 See Note 7
Gutter Flow, Qw (cfs) = 2.0
Eo = Qw/Q = 0.95

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB350	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf =	1.0	See Note 5
Rs at 50% Efficiency =	0.20	With 50% Clogging, Grate Length = 1.5'. See Note 6.
Eo =	0.95	
Qi at 50% Efficiency (cfs) =	1.9	Calculated
Qi at 50% Efficiency (cfs) =	1.8	SMF Program - Use
Inlet Bypass (cfs) =	0.3	

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8

Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) =	3		
W (ft.)=	2.5	Length for total interception, Lt (ft) =	1.8
Sx (%) =	2.9	Lt at 67% Efficiency (ft) =	2.7
Sw (%) =	10	Length of Slotted Drain used (ft) =	5
Se (%) =	22.9	Slotted Drain Intercept. (cfs) =	0.3
Se (ft/ft) =	0.229	Slotted Drain Bypass (cfs) =	0.0
n =	0.016		

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: SB350	
Catch Basin ID	: 350	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.27	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 0.2	
Longitudinal Grade (ft/ft)	: 0.0024	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 1.4 cfs Qtotal= 1.4 cfs Flowby dn= 0.1 cfs
Qint = 1.3 cfs Depth = 0.30 ft Spread= 6.99 ft Velocity = 1.41 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB350	
Catch Basin ID	: 350	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.27	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 0.5	
Longitudinal Grade (ft/ft)	: 0.0024	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.1 cfs Qtotal= 2.1 cfs Flowby dn= 0.3 cfs
Qint = 1.8 cfs Depth = 0.34 ft Spread= 8.54 ft Velocity = 1.53 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. SB352	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 350+00 S. Bound
End Sta. = 354+00 S. Bound
Inlet Condition = Sag Location - 352+42
Kb = 0.02
C = 0.90
Length, L (ft) = 250 = 0.0473 mi.
Pvmnt. x-slope= 2.9 %
Ave. Slope, S = 0.1 % = 5.28 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
65.0	400	26,000	0.5969

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlets (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.12
0.167	4.7	0.11
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.5

Spread, T (ft) = 8.0 SMF Program. See Note 1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlets (cfs) = 0.1

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.11
0.167	6.4	0.10
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.4
Q50 w/carry over (cfs) = 3.5
Spread, T (ft) = 10.8 SMF Program.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.5**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 6.2% Composite Ave.
Sx = 5.3%
Spread (ft) = 9.5

Pavement Spread, Ts (ft) = 6.0
Pavement x-slope (%) = 2.9
Pavement Flow, Qs (cfs) = 0.35 See Note 7
Gutter Flow, Qw (cfs) = 3.2
Eo = Qw/Q = 0.90

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HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB352	**Sheet**	2	of 2

Grate Interception: Sag Location

Qi = Cw*P*d^1.5 — See Note 4

Cw = 3

Qi max. at 100% Efficiency (cfs) = 7.45 — P (ft) = 9 — Disregard curb side.

Calc. d (ft) = 0.42

Qi at 50% Efficiency (cfs) = 3.5 — SMF Program - Use.

Inlet Bypass (cfs) = 0.0

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5 — See Note 5

Qi = 0.94*L*d^.5 — See Note 6

Slotted Drain Length, L (ft) = 0

Approx. Depth, d (ft) = 0.42

Qi at 100% Efficiency (cfs) = 0.00

Qi at 50% Efficiency (cfs) = 0.00

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoeniz, AZ..
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb for 10- yr. event.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 23, page 80.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: SB352	
Catch Basin ID	: 352	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.5	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.5 cfs Qtotal= 2.5 cfs Flowby dn= 0.0 cfs
Qint = 2.5 cfs Depth = 0.32 ft Spread= 7.95 ft Velocity = 0.00 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB352	
Catch Basin ID	: 352	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 3.5	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.5 cfs Qtotal= 3.5 cfs Flowby dn= 0.0 cfs
Qint = 3.5 cfs Depth = 0.41 ft Spread= 10.77 ft Velocity = 0.00 ft/s

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HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/26/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB354	**Sheet**	1	of 2

Sub-basin Data:

Begin. Sta. = 357+00 S. Bound
End Sta. = 354+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 375 = 0.0710 mi.
Pvmnt. x-slope= 2.9 %
Ave. Slope, S = 0.30 % = 15.84 ft./mi.
Slope at Inlet = 0.15 %

Area

Width	Length	Area (sf)	Area (ac)
75.0	300	22,500	0.5165

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.2

Spread, T (ft) = 9.7 SMF Program. See Note 1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlet (cfs) = 0.2

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.0
Q50 w/ carry over (cfs) = 3.2
Spread, T (ft) = 11.4 SMF Program. Spread at inlet reduced by slotted drain
Allowable Spread (ft) = 10.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.2**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 4.4% Composite Ave.
Sx = 4.0%
Spread (ft) = 10

Pavement Spread, Ts (ft) = 6.5
Pavement x-slope (%) = 2.9
Pavement Flow, Qs (cfs) = 0.50 See Note 7
Gutter Flow, Qw (cfs) = 2.7
Eo = Qw/Q = 0.84

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB354	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.0 — See Note 5
Velocity (ft/sec) = 1.4
Rs at 50% Efficiency = 0.25 — With 50% Clogging, Grate Length = 1.5'. See Note 6.
Eo = 0.84
Qi at 50% Efficiency (cfs) = 2.4 — Calculated
Qi at 50% Efficiency (cfs) = 2.4 — SMF Program - Use
Inlet Bypass (cfs) = 0.8

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.9
Sw (%) = 10
Se (%) = 2.9
Se (ft/ft) = 0.029
n = 0.016

Length for total interception, Lt (ft) = 7.8
Lt at 67% Efficiency (ft) = 11.6
Length of Slotted Drain used (ft) = 10
L/Lt = 0.86
Slotted Drain Intercept. (cfs) = 0.7
Slotted Drain Bypass (cfs) = 0.1

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: SB354	
Catch Basin ID	: 354	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.2	
Longitudinal Grade (ft/ft)	: 0.0015	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.2 cfs Qtotal= 2.2 cfs Flowby dn= 0.4 cfs
Qint = 1.8 cfs Depth = 0.38 ft Spread= 9.72 ft Velocity = 1.30 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB354	
Catch Basin ID	: 354	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 3.2	
Longitudinal Grade (ft/ft)	: 0.0015	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.2 cfs Qtotal= 3.2 cfs Flowby dn= 0.8 cfs
Qint = 2.4 cfs Depth = 0.43 ft Spread= 11.41 ft Velocity = 1.41 ft/s

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HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/26/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB357	**Sheet**	1	of 2

Sub-basin Data:

Begin. Sta. = 360+50 S. Bound
End Sta. = 357+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 430 = 0.0814 mi.
Pvmnt. x-slope= 2.9 %
Ave. Slope, S = 0.37 % = 19.54 ft./mi.
Slope at Inlet = 0.35 %

Area

Width	Length	Area (sf)	Area (ac)
80.0	350	28,000	0.6428

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)
Q10 (cfs) = CiA = 2.7
Q10 w/carry-over (cfs) = 2.7

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Spread, T (ft) = 8.9 SMF Program. See Note 1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlet (cfs) = 0.2

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.7
Q50 w/ carry over (cfs) = 3.9
Spread, T (ft) = 10.4 SMF Program.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.9**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.2% Composite Ave.
Sx = 4.6%
Spread (ft) = 8.8

Pavement Spread, Ts (ft) = 5.3
Pavement x-slope (%) = 2.9
Pavement Flow, Qs (cfs) = 0.48 See Note 7
Gutter Flow, Qw (cfs) = 3.4
Eo = Qw/Q = 0.88

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HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB357	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.0 — See Note 5
Velocity (ft/sec) =
Rs at 50% Efficiency = 0.12 — With 50% Clogging, Grate Length = 1.5'. See Note 6.
Eo = 0.88
Qi at 50% Efficiency (cfs) = 3.0 — Calculated
Qi at 50% Efficiency (cfs) = 3.0 — SMF Program - Use
Inlet Bypass (cfs) = 0.9

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.9
Sw (%) = 10
Se (%) = 11.7
Se (ft/ft) = 0.117
n = 0.016

Length for total interception, Lt (ft) = 4.6
Lt at 67% Efficiency (ft) = 6.8
Length of Slotted Drain used (ft) = 5
L/Lt = 0.73
Slotted Drain Intercept. (cfs) = 0.7
Slotted Drain Bypass (cfs) = 0.2

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: SB357	
Catch Basin ID	: 357	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.64	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0035	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.7 cfs Qtotal= 2.7 cfs Flowby dn= 0.4 cfs
Qint = 2.3 cfs Depth = 0.35 ft Spread= 8.89 ft Velocity = 1.89 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB357	
Catch Basin ID	: 357	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.64	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 0.2	
Longitudinal Grade (ft/ft)	: 0.0035	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.9 cfs Qtotal= 3.9 cfs Flowby dn= 0.9 cfs
Qint = 3.0 cfs Depth = 0.40 ft Spread= 10.41 ft Velocity = 2.05 ft/s

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HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. SB360	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 364+44 S. Bound
End Sta. = 360+50 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 450 = 0.0852 mi.
Pvmnt. x-slope= 2.9 %
Ave. Slope, S = 0.26 % = 13.73 ft./mi.
Slope at Inlet = 0.5029 %

Area			
Width	Length	Area (sf)	Area (ac)
n/a	n/a	29,165	0.6695

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)
Q10 (cfs) = CiA = 2.8

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.12
0.167	4.7	0.11
Use minimum Tc of 10 min. i = 4.7		

Spread, T (ft) = 8.3 SMF Program. See Note 1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.11
0.167	6.4	0.10
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.9
Spread, T (ft) = 9.6 See Note1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.9**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.4% Composite Ave.
Sx = 4.7%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 2.9
Pavement Flow, Qs (cfs) = 0.35 See Note 7
Gutter Flow, Qw (cfs) = 3.6
Eo = Qw/Q = 0.91

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB360	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.0 — See Note 5
Velocity (ft/sec) = 2.4
Rs at 50% Efficiency = 0.10 — With 50% Clogging, Grate Length = 1.5'. See Note 6.
Eo = 0.91
Qi at 50% Efficiency (cfs) = 3.3 — Calculated
Qi at 50% Efficiency (cfs) = 3.1 — SMF Program - Use
Inlet Bypass (cfs) = 0.8

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.9
Sw (%) = 10
Se (%) = 12.0
Se (ft/ft) = 0.120
n = 0.016

Length for total interception, Lt (ft) = 4.8
Lt at 67% Efficiency (ft) = 7.1
Length of Slotted Drain used (ft) = 5
L/Lt = 0.70
Slotted Drain Intercept. (cfs) = 0.6
Slotted Drain Bypass (cfs) = 0.2

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB360
     Catch Basin ID                   : 360
     Type of Inlet                    :  2.2        Grated Inlet
     Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
     Drainage Area-1 (acres)          :  0.67
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  0.0
     Longitudinal Grade (ft/ft)       :  0.0050
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0290
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.9 cfs   Qtotal=  2.9 cfs  Flowby dn=  0.4 cfs
Qint  =  2.5 cfs   Depth  =  0.34 ft   Spread=  8.34 ft  Velocity =  2.21 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB360
     Catch Basin ID                   : 360
     Type of Inlet                    :  2.2        Grated Inlet
     Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
     Drainage Area-1 (acres)          :  0.67
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  0.0
     Longitudinal Grade (ft/ft)       :  0.0050
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0290
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  3.9 cfs   Qtotal=  3.9 cfs  Flowby dn=  0.8 cfs
Qint  =  3.1 cfs   Depth  =  0.37 ft   Spread=  9.58 ft  Velocity =  2.35 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB373	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 364+44 S. Bound
End Sta. = 373+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 927 = 0.1755 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.42 % = 22.18 ft./mi.
Slope at Inlet = 0.629 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	856	60,348	1.3854

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.15
0.167	4.7	0.13
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 5.9
Q10 w/carry-over (cfs) = 5.9
Velocity (ft/sec) = 3.0
Spread, T (ft) = 9.0 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.13
0.167	6.4	0.12
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 8.0
Q50 w/carry-over (cfs) = 8.0
Velocity (ft/sec) = 3.2
Spread, T (ft) = 10.2 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 8.0**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB 373	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.7% Composite Ave.
Sx = 5.0%
Spread (ft) = 10

Pavement Spread, Ts (ft) = 6.5
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 1.9 See Note 7
Gutter Flow, Qw (cfs) = 6.1
Eo = Qw/Q = 0.76

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.00 See Note 5
Rs at 50% Efficiency = 0.07 See Note 6. With 50% clogging, grate length = 1.5'.
Eo = 0.76
Qi at 50% Efficiency (cfs) = 4.8 Calculated
Qi at 50% Efficiency (cfs) = 5.9 SMF Program - Use
Inlet Bypass (cfs) = 2.1

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb for 10- yr. event.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: SB373	
Catch Basin ID	: 373	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 1.39	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0063	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 5.9 cfs Qtotal= 5.9 cfs Flowby dn= 1.3 cfs
Qint = 4.6 cfs Depth = 0.43 ft Spread= 9.01 ft Velocity = 2.98 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB373	
Catch Basin ID	: 373	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 1.39	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0063	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 8.0 cfs Qtotal= 8.0 cfs Flowby dn= 2.2 cfs
Qint = 5.9 cfs Depth = 0.48 ft Spread= 10.21 ft Velocity = 3.21 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB375	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 373+00 S. Bound
End Sta. = 375+25 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 296 = 0.0560 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.09 % = 4.75 ft./mi.
Slope at Inlet = 0.25 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	225	15,863	0.3642

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 1.3

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.14
0.167	4.7	0.12
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.5
Q10 w/carry-over (cfs) = 2.8
Velocity (ft/sec) = 1.8
Spread, T (ft) = 8.0 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 2.1

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.12
0.167	6.4	0.11
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.1
Q50 w/carry-over (cfs) = 4.2
Velocity (ft/sec) = 1.9
Spread, T (ft) = 9.5 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 4.2**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB 375	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.9% Composite Ave.
Sx = 5.1%
Spread (ft) = 9

Pavement Spread, Ts (ft) = 5.5
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 0.8 See Note 7
Gutter Flow, Qw (cfs) = 3.4
Eo = Qw/Q = 0.81

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.00 See Note 5
Rs at 50% Efficiency = 0.17 See Note 1.
Eo = 0.81 See Note 6. With 50% clogging, grate length = 1.5'.
Qi at 50% Efficiency (cfs) = 2.9 Calculated
Qi at 50% Efficiency (cfs) = 3.3 SMF Program - Use
Inlet Bypass (cfs) = 0.9

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb for 10- yr. event.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: SB375	
Catch Basin ID	: 375	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.36	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 1.3	
Longitudinal Grade (ft/ft)	: 0.0025	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.9 cfs Qtotal= 2.9 cfs Flowby dn= 0.4 cfs
Qint = 2.4 cfs Depth = 0.39 ft Spread= 8.06 ft Velocity = 1.77 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB375	
Catch Basin ID	: 375	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.36	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 2.1	
Longitudinal Grade (ft/ft)	: 0.0025	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 4.2 cfs Qtotal= 4.2 cfs Flowby dn= 0.9 cfs
Qint = 3.3 cfs Depth = 0.45 ft Spread= 9.48 ft Velocity = 1.93 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB376	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 375+25 S. Bound
End Sta. = 378+00 S. Bound
Inlet Condition = Sag Location 376+60
Kb = 0.02
C = 0.90
Length, L (ft) = 175 = 0.0331 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.1 % = 5.28 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	n/a	15,015	0.3447

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlets (cfs) = 0.9

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.5
Q10 w/carryover (cfs) = 2.4
Spread, T (ft) = 6.2 SMF Program. See Note 1
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlets (cfs) = 1.7

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.0
Q50 w/carry-over (cfs) = 3.7
Spread, T (ft) = 8.9
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by sag location.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.7**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB376	**Sheet**	2	of 2

Grate Interception: Sag Location

Qi = Cw*P*d^1.5 — See Note 3

Cw = 3

Qi max. at 100% Efficiency (cfs) = 7.3 — Calc. P (ft) = 9 — Disregard curb side.

Calc. d (ft) = 0.42

Qi at 50% Efficiency (cfs) = 3.7 — SMF Program - Use.

Inlet Bypass (cfs) = 0.0

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5 — See Note 4

Qi = 0.94*L*d^.5 — See Note 5

Slotted Drain Length, L (ft) = 0.0

Approx. Depth, d (ft) = 0.42

Qi at 100% Efficiency (cfs) = 0.0

Qi at 50% Efficiency (cfs) = 0.0

Notes

1. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 23, page 80.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.

Output Screen ********** PgUp PgDn Esc

Station	: SB376	
Catch Basin ID	: 376	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.4	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.4 cfs Qtotal= 2.4 cfs Flowby dn= 0.0 cfs
Qint = 2.4 cfs Depth = 0.32 ft Spread= 6.24 ft Velocity = 0.00 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB376	
Catch Basin ID	: 376	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 3.7	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.7 cfs Qtotal= 3.7 cfs Flowby dn= 0.0 cfs
Qint = 3.7 cfs Depth = 0.42 ft Spread= 8.88 ft Velocity = 0.00 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB378	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 378+00 S. Bound
End Sta. = 381+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 372 = 0.0705 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.5 % = 27.98 ft./mi.
Slope at Inlet = 0.3 %

Area			
Width	Length	Area (sf)	Area (ac)
71.5	n/a	17,518	0.4022

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 1.0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.09
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.7
Q10 w/carry-over (cfs) = 2.7
Velocity (ft/sec) = 1.9
Spread, T (ft) = 7.6 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 1.8

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
0.167	6.4	0.07
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.3
Q50 w/carry-over (cfs) = 4.1
Velocity (ft/sec) = 2.1
Spread, T (ft) = 9.0 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 4.1**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB378	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 6.1% Composite Ave.
Sx = 5.3%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 0.5 See Note 7
Gutter Flow, Qw (cfs) = 3.6
Eo = Qw/Q = 0.88

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.14 Grate Length = 1.5'. See Note 6.
Eo = 0.88
Qi at 50% Efficiency (cfs) = 3.2 Calculated
Qi at 50% Efficiency (cfs) = 3.3 SMF Program - Use
Inlet Bypass (cfs) = 0.8

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: SB378	
Catch Basin ID	: 378	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.7	
Longitudinal Grade (ft/ft)	: 0.0030	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.7 cfs Qtotal= 2.7 cfs Flowby dn= 0.4 cfs
Qint = 2.3 cfs Depth = 0.37 ft Spread= 7.58 ft Velocity = 1.88 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB378	
Catch Basin ID	: 378	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 4.1	
Longitudinal Grade (ft/ft)	: 0.0030	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 4.1 cfs Qtotal= 4.1 cfs Flowby dn= 0.8 cfs
Qint = 3.3 cfs Depth = 0.43 ft Spread= 9.03 ft Velocity = 2.06 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB381	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 381+00 N. Bound
End Sta. = 389+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 872 = 0.1651 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 1.1 % = 58.08 ft./mi.
Slope at Inlet = 0.96 %

Width	Length	Area (sf)	Area (ac)
71.5	800	57,200	1.3131

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.10
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 5.6
Velocity (ft/sec) = 3.5
Spread, T (ft) = 8.1 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 7.6
Q50 w/carry-over (cfs) = 7.6
Velocity (ft/sec) = 3.7
Spread, T (ft) = 9.2 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 7.6**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB381	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 6.0% Composite Ave.
Sx = 5.2%
Spread (ft) = 8.5

Pavement Spread, Ts (ft) = 5.0
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 1.1 See Note 7
Gutter Flow, Qw (cfs) = 6.5
Eo = Qw/Q = 0.86

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.06 Grate Length = 1.5'. See Note 6.
Eo = 0.86
Qi at 50% Efficiency (cfs) = 5.6 Calculated
Qi at 50% Efficiency (cfs) = 5.8 SMF Program - Use
Inlet Bypass (cfs) = 1.8

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: SB381	
Catch Basin ID	: 381	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 1.31	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0096	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 5.6 cfs Qtotal= 5.6 cfs Flowby dn= 1.0 cfs
Qint = 4.6 cfs Depth = 0.39 ft Spread= 8.08 ft Velocity = 3.46 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB381	
Catch Basin ID	: 381	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 1.31	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0096	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 7.6 cfs Qtotal= 7.6 cfs Flowby dn= 1.8 cfs
Qint = 5.8 cfs Depth = 0.43 ft Spread= 9.18 ft Velocity = 3.72 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. GRA5	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 2+16.68 Greenway Ramp A
End Sta. = 7+00 Greenway Ramp A
Inlet Condition = Sag Location - 5+51.80
Kb = 0.02
C = 0.90
Length, L (ft) = 350 = 0.066 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 0.28 % = 14.78 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
31	483	14,973	0.3437

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0.1

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.5
Q10 w/carry-over (cfs) = 1.6
Spread, T (ft) = 6.2 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 0.6

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.0
Q50 w/carry-over (cfs) = 2.6
Spread, T (ft) = 10.8 SMF Program.
Allowable Spread (ft) = 10

Inlet location determined by spread criteria for 50-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 2.6**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. GRA5	**Sheet**	2	of 2

Grate Interception:

Qi = Cw*P*d^1.5	See Note 3		
		Cw = 3	
Qi max. at 100% Efficiency (cfs) = 5.1	Calc.	P (ft) = 9	Disregard curb side.
		d (ft) = 0.33	
Qi at 50% Efficiency (cfs) = 2.6	SMF Program - Use.		
Inlet Bypass (cfs) = 0.0			

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5	See Note 5
Qi = 0.94*L*d^.5	See Note 6
Slotted Drain Length, L (ft) = 0.0	Calculated
Slotted Drain Length, L (ft) = 0	Use
Approx. Depth, d (ft) = 0.5	
Qi at 100% Efficiency (cfs) = 0.0	
Qi at 50% Efficiency (cfs) = 0.0	

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. n/a
3. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
4. n/a
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 23, page 80.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.

Output Screen ********** PgUp PgDn Esc

Station	: GRA5	
Catch Basin ID	: 5	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 1.6	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 1.6 cfs Qtotal= 1.6 cfs Flowby dn= 0.0 cfs
Qint = 1.6 cfs Depth = 0.24 ft Spread= 6.23 ft Velocity = 0.00 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: GRA5	
Catch Basin ID	: 5	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 2.6	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.6 cfs Qtotal= 2.6 cfs Flowby dn= 0.0 cfs
Qint = 2.6 cfs Depth = 0.33 ft Spread= 10.84 ft Velocity = 0.00 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. GRA7	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 7+00 Ramp A
End Sta. = 14+25 Ramp A
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 1100 = 0.208 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 1.4 % = 73.92 ft./mi.
Slope at Inlet = 1.1 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	1100	42,800	0.983

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.10
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 4.2
Spread, T (ft) = 10.4 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.09
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 5.7
Q50 w/carry-over 5.7
Spread, T (ft) = 12.0 SMF Program. Spread reduced at inlet by slotted drain.
Allowable Spread (ft) = 10

Inlet location determined by spread criteria for 50-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 5.7**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 4.7% Composite Ave.
Sx = 4.2%
Spread (ft) = 8.5

Pavement Spread, Ts (ft) = 5.0
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.5 See Note 7
Gutter Flow, Qw (cfs) = 5.3
Eo = Qw/Q = 0.92

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. GRA7	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.0 — See Note 5
Velocity (ft/sec) = 3.2
Rs at 50% Efficiency = 0.04 — See Note 6. At 50% efficiency, grate length = 1.5 ft.
Eo = 0.92
Qi at 50% Efficiency (cfs) = 4.9 — Calculated
Qi at 50% Efficiency (cfs) = 4.3 — SMF Program - Use
Inlet Bypass (cfs) = 1.4

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 2.0
Se (ft/ft) = 0.020
n = 0.016

Length for total interception, Lt (ft) = 22.3
Lt at 67% Efficiency (ft) = 33.3
Length of Slotted Drain used (ft) = 20
L/Lt = 0.60
Slotted Drain Intercept. (cfs) = 0.8
Slotted Drain Bypass (cfs) = 0.6

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. n/a
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : GRA7
     Catch Basin ID                   : 7
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  4.2
     Longitudinal Grade (ft/ft)       :  0.0110
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  4.2 cfs   Qtotal=  4.2 cfs  Flowby dn=  0.7 cfs
Qint  =  3.5 cfs   Depth  =  0.33 ft   Spread= 10.41 ft  Velocity =  3.02 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : GRA7
     Catch Basin ID                   : 7
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  5.7
     Longitudinal Grade (ft/ft)       :  0.0110
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  5.7 cfs   Qtotal=  5.7 cfs  Flowby dn=  1.4 cfs
Qint  =  4.3 cfs   Depth  =  0.36 ft   Spread= 11.96 ft  Velocity =  3.23 ft/s
```

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51		**Computed**	JPJ	12/26/95
Subject	Pavement Drainage		**Checked**	LSM	
Task	Ultimate Design Sub-basin No. GRC9		**Sheet**	1	of 2

Sub-basin Data:

Begin. Sta. = Greenway Bridge Deck
End Sta. = 9+50 Ramp C
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 750 = 0.142 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 1.4 % = 73.92 ft./mi.
Slope at Inlet = 1.36 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	n/a	40,500	0.930

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.09
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 3.9
Spread, T (ft) = 9.5 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
0.167	6.4	0.07
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 5.4
Q50 w/carry-over 5.4
Spread, T (ft) = 11.1 SMF Program. Spread at inlet reduced by inlet depression.
Allowable Spread (ft) = 10

Inlet location determined by spread criteria for 50 yr. event.
Inlet size Use 50-yr. Design Storm: **Q (cfs) = 5.4**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 4.9% Composite Ave.
Sx = 4.4%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.3 See Note 7
Gutter Flow, Qw (cfs) = 5.1
Eo = Qw/Q = 0.94

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95	
Subject	Pavement Drainage	**Checked**	LSM		
Task	Ultimate Design Sub-basin No. GRC9	**Sheet**	2	of	2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo))	See Note 4
Rf = 1.00	See Note 5
Velocity (ft/sec) = 3.50	
Rs at 50% Efficiency = 0.04	Grate Length = 1.5'. See Note 6.
Eo = 0.94	
Qi at 50% Efficiency (cfs) = 4.8	Calculated
Qi at 50% Efficiency (cfs) = 4.2	SMF Program (See Note 7 and attached printout) - Use
Inlet Bypass (cfs) = 1.2	

Slotted Drain Calculations:

Slotted Drain not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : GRC9
     Catch Basin ID                   : 9
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  3.9
     Longitudinal Grade (ft/ft)       :  0.0136
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  3.9 cfs   Qtotal=  3.9 cfs  Flowby dn=  0.5 cfs
Qint  =  3.4 cfs   Depth  =  0.31 ft   Spread=  9.51 ft  Velocity =  3.27 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : GRC9
     Catch Basin ID                   : 9
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  5.4
     Longitudinal Grade (ft/ft)       :  0.0136
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  5.4 cfs   Qtotal=  5.4 cfs  Flowby dn=  1.2 cfs
Qint  =  4.2 cfs   Depth  =  0.34 ft   Spread= 11.11 ft  Velocity =  3.48 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. GRC11	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 9+50 Ramp C
End Sta. = 12+50 Ramp C
Inlet Condition = Sag Location - 11+42.86
Kb = 0.02
C = 0.90
Length, L (ft) = 200 = 0.038 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 0.1 % = 5.28 ft./mi.
Slope at Inlet = 0 %

Area			
Width	Length	Area (sf)	Area (ac)
28	300	8,400	0.1928

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0.5

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.10
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 0.8
Q10 (cfs) w/carry-over = 1.3
Spread, T (ft) = 4.7 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 1.3

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.09
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 1.1
Q50 w/carry-over 2.4
Spread, T (ft) = 10.0 SMF Program
Allowable Spread (ft) = 10

Inlet location determined by sag location.
Inlet size Use 50-yr. Design Storm: **Q (cfs) = 2.4**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. GRC11	**Sheet**	2	of 2

Grate Interception: Sag Location

Qi = Cw*P*d^1.5 — See Note 3

Cw = 3

Qi max. at 100% Efficiency (cfs) = 4.9 — Calc. P (ft) = 9 — Disregard curb side.

Qi at 100% Efficiency (cfs) = 2.4 — Calc. d (ft) = 0.32

Qi at 50% Efficiency (cfs) = 2.4 — SMF Program - Use

Inlet Bypass (cfs) = 0.0

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5 — See Note 5

Qi = 0.94*L*d^.5 — See Note 6

Slotted Drain Length, L (ft) = 0.0

Approx. Depth, d (ft) = 0.32

Qi at 100% Efficiency (cfs) = 0.0

Qi at 50% Efficiency (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix, AZ.
2. n/a.
3. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
4. n/a
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 23, page 80.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : GRC11
      Catch Basin ID                   : 11
      Type of Inlet                    :  2.2        Grated Inlet
      Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          :  1.3
      Longitudinal Grade (ft/ft)       :  0.0000
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0200
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  1.3 cfs   Qtotal=  1.3 cfs  Flowby dn=  0.0 cfs
Qint  =  1.3 cfs   Depth  =  0.21 ft   Spread=  4.67 ft  Velocity =  0.00 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : GRC11
      Catch Basin ID                   : 11
      Type of Inlet                    :  2.2        Grated Inlet
      Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          :  2.4
      Longitudinal Grade (ft/ft)       :  0.0000
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0200
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.4 cfs   Qtotal=  2.4 cfs  Flowby dn=  0.0 cfs
Qint  =  2.4 cfs   Depth  =  0.32 ft   Spread=  9.97 ft  Velocity =  0.00 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. GRC12	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 12+50 Ramp C
End Sta. = 390+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 425 = 0.080 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 1.0 % = 52.80 ft./mi.
Slope at Inlet = 0.8 %

Area

Width	Length	Area (sf)	Area (ac)
n/a	n/a	13,625	0.3128

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.08
0.167	4.7	0.07
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.3
Spread, T (ft) = 6.0 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 0.3

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.07
0.167	6.4	0.06
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 1.8
Q50 w/carry-over 2.1
Spread, T (ft) = 8 SMF Program.
Allowable Spread (ft) = 10

Inlet location determined by spread criteria for 50 yr. event.
Inlet size Use 50-yr. Design Storm: **Q (cfs) = 2.1**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 1
Sx2 = 6.4% Composite Ave.
Sx = 5.5%
Spread (ft) = 5.5

Pavement Spread, Ts (ft) = 2.0
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.1 See Note 1
Gutter Flow, Qw (cfs) = 2.0
Eo = Qw/Q = 0.95

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95	
Subject	Pavement Drainage	**Checked**	LSM		
Task	Ultimate Design Sub-basin No. GRC12	**Sheet**	2	of	2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.00 — See Note 5
Velocity (ft/sec) = 2.40
Rs at 50% Efficiency = 0.07 — Grate Length = 1.5'. See Note 6.
Eo = 0.95
Qi at 50% Efficiency (cfs) = 1.9 — Calculated
Qi at 50% Efficiency (cfs) = 2.0 — SMF Program (See Note 7 and attached printout) - Use
Inlet Bypass (cfs) = 0.1

Slotted Drain Calculations:

Slotted Drain not Used.

Notes

1. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : GRC12
      Catch Basin ID                   : 12
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          :  1.3
      Longitudinal Grade (ft/ft)       :  0.0080
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0200
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  1.3 cfs   Qtotal=  1.3 cfs  Flowby dn=  0.0 cfs
Qint  =  1.3 cfs   Depth  =  0.24 ft   Spread=  6.01 ft  Velocity =  2.20 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : GRC12
      Catch Basin ID                   : 12
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          :  2.1
      Longitudinal Grade (ft/ft)       :  0.0080
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0200
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.1 cfs   Qtotal=  2.1 cfs  Flowby dn=  0.1 cfs
Qint  =  2.0 cfs   Depth  =  0.28 ft   Spread=  7.96 ft  Velocity =  2.35 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB390	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 390+00 S. Bound
End Sta. = 395+25 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 550 = 0.1042 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 1.10 % = 58.08 ft./mi.
Slope at Inlet = 1.66 %

Area			
Width	Length	Area (sf)	Area (ac)
n/a	n/a	44,625	1.0244

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.09
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 4.3

Spread, T (ft) = 9.5 SMF Program. See Note 1.
Allowable Spread (ft) = 12 (gutter + shoulder +).

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
0.167	6.4	0.07
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 5.9
Q50 w/carry-over 5.9
Spread, T (ft) = 11.1 See Note 1
Allowable Spread (ft) = 12 (gutter + shoulder +).

Use 50-yr. Design Storm: **Q (cfs) = 5.9**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 4.9% Composite Ave.
Sx = 4.4%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.37 See Note 7
Gutter Flow, Qw (cfs) = 5.5
Eo = Qw/Q = 0.94

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB390	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 0.9 — See Note 5
Velocity (ft/sec) = 3.8
Rs at 50% Efficiency = 0.03 — Grate Length = 1.5'. See Note 6.
Eo = 0.94
Qi at 50% Efficiency (cfs) = 4.7 — Calculated
Qi at 50% Efficiency (cfs) = 4.5 — SMF Program - Use
Inlet Bypass (cfs) = 1.4

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 11.4
Se (ft/ft) = 0.114
n = 0.016

Length for total interception, Lt (ft) = 8.9
Lt at 67% Efficiency (ft) = 13.3
Length of Slotted Drain used (ft) = 10
L/Lt = 0.75
Slotted Drain Intercept. (cfs) = 1.1
Slotted Drain Bypass (cfs) = 0.3

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB390
     Catch Basin ID                   : 390
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  4.3
     Longitudinal Grade (ft/ft)       :  0.0166
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  4.3 cfs   Qtotal=  4.3 cfs  Flowby dn=  0.7 cfs
Qint  =  3.6 cfs   Depth  =  0.31 ft   Spread=  9.51 ft  Velocity =  3.61 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB390
     Catch Basin ID                   : 390
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  5.9
     Longitudinal Grade (ft/ft)       :  0.0166
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  5.9 cfs   Qtotal=  5.9 cfs  Flowby dn=  1.4 cfs
Qint  =  4.5 cfs   Depth  =  0.34 ft   Spread= 11.06 ft  Velocity =  3.83 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB395	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 395+25 S. Bound
End Sta. = 404+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 958 = 0.1813 mi.
Pvmnt. x-slope= 3.0 %
Ave. Slope, S = 0.55 % = 29.04 ft./mi.
Slope at Inlet = 0.55 %

Area

Width	Length	Area (sf)	Area (ac)
82.5	875	72,188	1.6572

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.14
0.167	4.7	0.12
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 7.0
Q10 w/ carry over (cfs) = 7.0
Spread, T (ft) = 11.8 SMF Program. See Note 1.
Allowable Spread (ft) = 13.5 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.12
0.167	6.4	0.11
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 9.5
Spread, T (ft) = 13.4 SMF Program.
Allowable Spread (ft) = 13.5 See Note 3.

Inlet location determined by spread criteria for 50-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 9.5**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 4.5% Composite Ave.
Sx = 4.0%
Spread (ft) = 13

Pavement Spread, Ts (ft) = 9.5
Pavement x-slope (%) = 3.0
Pavement Flow, Qs (cfs) = 2.1 See Note 7
Gutter Flow, Qw (cfs) = 7.4
Eo = Qw/Q = 0.78

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB395	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.0 — See Note 5
Velocity (ft/sec) = 3.0
Rs at 50% Efficiency = 0.06 — Grate Length = 1.5'. See Note 6.
Eo = 0.78
Qi at 50% Efficiency (cfs) = 5.9 — Calculated
Qi at 50% Efficiency (cfs) = 6.1 — SMF Program - Use
Inlet Bypass (cfs) = 3.4

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 3.0
Sw (%) = 10
Se (%) = 10.8
Se (ft/ft) = 0.108
n = 0.016

Length for total interception, Lt (ft) = 9.6
Lt at 67% Efficiency (ft) = 14.3
Length of Slotted Drain used (ft) = 15
Slotted Drain Intercept. (cfs) = 3.4
Slotted Drain Bypass (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : SB395
      Catch Basin ID                   : 395
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          :  7.0
      Longitudinal Grade (ft/ft)       :  0.0055
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0300
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  7.0 cfs   Qtotal=  7.0 cfs  Flowby dn=  2.1 cfs
Qint  =  4.9 cfs   Depth  =  0.45 ft   Spread= 11.84 ft  Velocity =  2.78 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : SB395
      Catch Basin ID                   : 395
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          :  9.5
      Longitudinal Grade (ft/ft)       :  0.0055
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0300
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  9.5 cfs   Qtotal=  9.5 cfs  Flowby dn=  3.4 cfs
Qint  =  6.1 cfs   Depth  =  0.50 ft   Spread= 13.44 ft  Velocity =  2.98 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB404	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 404+00 S. Bound
End Sta. = 413+10 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 993 = 0.1880 mi.
Pvmnt. x-slope= 4.4 %
Ave. Slope, S = 0.52 % = 27.46 ft./mi.
Slope at Inlet = 0.545 %

Area

Width	Length	Area (sf)	Area (ac)
82.5	910	75,075	1.7235

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlets (cfs) = 0.0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)
Q10 (cfs) = CiA = 7.3

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.15
0.167	4.7	0.13
Use minimum Tc of 10 min. i = 4.7		

Spread, T (ft) = 9.6 SMF Program. See Note 1.
Allowable Spread (ft) = 10.2 See Note 3.

50 Year Event:

Carry over from upstream inlets (cfs) = 0.0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.13
0.167	6.4	0.11
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 9.9
Spread, T (ft) = 10.8 SMF Program. Spread, at inlet reduced by slotted drain.
Allowable Spread (ft) = 10.2 See Note 3.

Inlet location determined by spread criteria for 50-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 9.9**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 6.0% Composite Ave.
Sx = 5.2%
Spread (ft) = 9.5

Pavement Spread, Ts (ft) = 6.0
Pavement x-slope (%) = 4.4
Pavement Flow, Qs (cfs) = 1.5 See Note 7
Gutter Flow, Qw (cfs) = 8.4
Eo = Qw/Q = 0.85

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB404	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.0 — See Note 5
Velocity (ft/sec) = 3.2
Rs at 50% Efficiency = 0.08 — See Note 6. With 50% clogging, grate length = 1.5'.
Eo = 0.85
Qi at 50% Efficiency (cfs) = 7.2 — Calculated
Qi at 50% Efficiency (cfs) = 6.9 — SMF Program - Use
Inlet Bypass (cfs) = 3.0

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 7
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 8

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 17.0
Se (ft/ft) = 0.170
n = 0.016

Length for total interception, Lt (ft) = 6.8
Lt at 67% Efficiency (ft) = 10.2
Length of Slotted Drain used (ft) = 10
L/Lt = 0.99
Slotted Drain Intercept. (cfs) = 3.0
Slotted Drain Bypass (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: SB404	
Catch Basin ID	: 404	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 1.72	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0055	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0440	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 7.3 cfs Qtotal= 7.3 cfs Flowby dn= 1.8 cfs
Qint = 5.5 cfs Depth = 0.48 ft Spread= 9.57 ft Velocity = 3.02 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB404	
Catch Basin ID	: 404	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 9.9	
Longitudinal Grade (ft/ft)	: 0.0055	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0440	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 9.9 cfs Qtotal= 9.9 cfs Flowby dn= 3.0 cfs
Qint = 6.9 cfs Depth = 0.53 ft Spread= 10.78 ft Velocity = 3.25 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. SB413	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 413+10 S. Bound
End Sta. = 415+76.8 S. Bound (High Point)
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 343 = 0.0650 mi.
Pvmnt. x-slope= 2.5 %
Ave. Slope, S = 0.2 % = 10.56 ft./mi.
Slope at Inlet = 0.25 %

Area

Width	Length	Area (sf)	Area (ac)
76	267	20,292	0.4658

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlets (cfs) = 0.0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.10
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.0

Spread, T (ft) = 9.1 SMF Program. See Note 1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlets (cfs) = 0.0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.09
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.7
Spread, T (ft) = 10.4 See Note 1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 2.7**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.0% Composite Ave.
Sx = 4.4%
Spread (ft) = 8.5

Pavement Spread, Ts (ft) = 5.0
Pavement x-slope (%) = 2.5
Pavement Flow, Qs (cfs) = 0.25 See Note 7
Gutter Flow, Qw (cfs) = 2.4
Eo = Qw/Q = 0.91

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB413	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.0 — See Note 5
Velocity (ft/sec) = 1.6
Rs at 50% Efficiency = 0.08 — See Note 6. With 50% clogging, grate length = 1.5'.
Eo = 0.91
Qi at 50% Efficiency (cfs) = 2.2 — Calculated
Qi at 50% Efficiency (cfs) = 2.2 — SMF Program - Use
Inlet Bypass (cfs) = 0.5

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.5
Sw (%) = 10
Se (%) = 11.6
Se (ft/ft) = 0.116
n = 0.016

Length for total interception, Lt (ft) = 3.2
Lt at 67% Efficiency (ft) = 4.8
Length of Slotted Drain used (ft) = 5
Slotted Drain Intercept. (cfs) = 0.5
Slotted Drain Bypass (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB413
     Catch Basin ID                   : 413
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.47
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  0.0
     Longitudinal Grade (ft/ft)       :  0.0025
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0250
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.0 cfs   Qtotal=  2.0 cfs  Flowby dn=  0.3 cfs
Qint  =  1.7 cfs   Depth  =  0.33 ft   Spread=  9.07 ft  Velocity =  1.50 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB413
     Catch Basin ID                   : 413
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.47
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  0.0
     Longitudinal Grade (ft/ft)       :  0.0025
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0250
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.7 cfs   Qtotal=  2.7 cfs  Flowby dn=  0.5 cfs
Qint  =  2.2 cfs   Depth  =  0.37 ft   Spread= 10.43 ft  Velocity =  1.60 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. SB420	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 415+76.8 S. Bound - High Point
End Sta. = 420+00 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 750 = 0.1420 mi.
Pvmnt. x-slope= 4.4 %
Ave. Slope, S = 0.16 % = 8.45 ft./mi.
Slope at Inlet = 0.4 %

Area			
Width	Length	Area (sf)	Area (ac)
n/a	n/a	32,250	0.7404

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.18
0.167	4.7	0.16
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 3.1

Spread, T (ft) = 7.2 SMF Program. See Note 1.
Allowable Spread (ft) = 10.2 See Note 3.

50 Year Event:

Carry over from upstream inlets (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.16
0.167	6.4	0.14
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 4.3
Spread, T (ft) = 8.2 SMF Program.
Allowable Spread (ft) = 10.2 See Note 3.

Inlet location determined by spread criteria for 50-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 4.3**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 6.4% Composite Ave.
Sx = 5.5%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 4.4
Pavement Flow, Qs (cfs) = 0.60 See Note 7
Gutter Flow, Qw (cfs) = 3.66
Eo = Qw/Q = 0.86

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51		**Computed**	JPJ	12/20/95
Subject	Pavement Drainage		**Checked**	LSM	
Task	Interim Design Sub-basin No. SB420		**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf =	1.0	See Note 5
Velocity (ft/sec) =	2.4	
Rs at 50% Efficiency =	0.05	See Note 6. At 50% efficiency, grate length 1.5.
Eo =	0.86	
Qi at 50% Efficiency (cfs) =	3.2	Calculated
Qi at 50% Efficiency (cfs) =	3.5	SMF Program - Use
Inlet Bypass (cfs) =	0.8	

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8

Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) =	3		
W (ft.)=	2.5	Length for total interception, Lt (ft) =	4.7
Sx (%) =	2.0	Lt at 67% Efficiency (ft) =	7.0
Sw (%) =	10	Length of Slotted Drain used (ft) =	5
Se (%) =	10.6	L/Lt =	0.71
Se (ft/ft) =	0.106	Slotted Drain Intercept. (cfs) =	0.5
n =	0.016	Slotted Drain Bypass (cfs) =	0.2

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: SB420	
Catch Basin ID	: 420	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 3.1	
Longitudinal Grade (ft/ft)	: 0.0040	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0440	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.1 cfs Qtotal= 3.1 cfs Flowby dn= 0.4 cfs
Qint = 2.7 cfs Depth = 0.37 ft Spread= 7.16 ft Velocity = 2.20 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB420	
Catch Basin ID	: 420	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 4.3	
Longitudinal Grade (ft/ft)	: 0.0040	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0440	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 4.3 cfs Qtotal= 4.3 cfs Flowby dn= 0.8 cfs
Qint = 3.5 cfs Depth = 0.42 ft Spread= 8.21 ft Velocity = 2.37 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. SB422	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 420+00 S. Bound
End Sta. = 422+80 S. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 750 = 0.1420 mi.
Pvmnt. x-slope= 3.0 %
Ave. Slope, S = 0.4 % = 21.12 ft./mi.
Slope at Inlet = 0.4 %

Area

Width	Length	Area (sf)	Area (ac)
n/a	n/a	19,900	0.4568

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlets (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.14
0.167	4.7	0.12
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.9
Spread, T (ft) = 7.2 SMF Program. See Note 1.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlets (cfs) = 0.2

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.12
0.167	6.4	0.11
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.6
Q50 w/carryover = 2.8
Spread, T (ft) = 8.5 SMF Program.
Allowable Spread (ft) = 10.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 2.8**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.9% Composite Ave.
Sx = 5.1%
Spread (ft) = 7

Pavement Spread, Ts (ft) = 3.5
Pavement x-slope (%) = 3.0
Pavement Flow, Qs (cfs) = 0.18 See Note 7
Gutter Flow, Qw (cfs) = 2.7
Eo = Qw/Q = 0.94

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. SB422	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.00 — See Note 5
Velocity (ft/sec) = 2.0
Rs at 50% Efficiency = 0.13 — See Note 6. At 50% efficiency, grate length = 1.5'.
Eo = 0.94
Qi at 50% Efficiency (cfs) = 2.5 — Calculated
Qi at 50% Efficiency (cfs) = 2.4 — SMF Program - Use
Inlet Bypass (cfs) = 0.4

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 3.0
Sw (%) = 10
Se (%) = 12.4
Se (ft/ft) = 0.124
n = 0.016

Length for total interception, Lt (ft) = 3.4
Lt at 67% Efficiency (ft) = 5.0
Length of Slotted Drain used (ft) = 5
Slotted Drain Intercept. (cfs) = 0.4
Slotted Drain Bypass (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: SB422	
Catch Basin ID	: 422	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.46	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 0.0	
Longitudinal Grade (ft/ft)	: 0.0040	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0300	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 1.9 cfs Qtotal= 1.9 cfs Flowby dn= 0.2 cfs
Qint = 1.8 cfs Depth = 0.31 ft Spread= 7.24 ft Velocity = 1.87 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB422	
Catch Basin ID	: 422	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 2.8	
Longitudinal Grade (ft/ft)	: 0.0040	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0300	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.8 cfs Qtotal= 2.8 cfs Flowby dn= 0.4 cfs
Qint = 2.4 cfs Depth = 0.35 ft Spread= 8.54 ft Velocity = 2.01 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB426	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 422+80 N. Bound
End Sta. = 426+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 391 = 0.0740 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 0.2 % = 10.56 ft./mi.
Slope at Inlet = 0.1 %

Area			
Width	Length	Area (sf)	Area (ac)
70.5	320	22,560	0.5179

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.12
0.167	4.7	0.11
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.2 See Note 1.
Spread, T (ft) = 13.4 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder + 1/2 lane).

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.11
0.167	6.4	0.10
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.0
Spread, T (ft) = 15.3 SMF Program.
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane).

Inlet location determined by spread criteria for 10-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.0**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 3.7% Composite Ave.
Sx = 3.4%
Spread (ft) = 12

Pavement Spread, Ts (ft) = 8.5
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.3 See Note 7
Gutter Flow, Qw (cfs) = 2.8
Eo = Qw/Q = 0.92

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB426	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo))	See Note 4
Rf = 1.0	See Note 5
Velocity (ft/sec) = 2.1	
Rs at 50% Efficiency = 0.08	See Note 6. At 50% efficiency, grate length =1.5'.
Eo = 0.92	
Qi at 50% Efficiency (cfs) = 2.5	Calculated
Qi at 50% Efficiency (cfs) = 2.1	SMF Program - Use
Inlet Bypass (cfs) = 0.9	

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: SB426	
Catch Basin ID	: 426	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.2	
Longitudinal Grade (ft/ft)	: 0.0010	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.2 cfs Qtotal= 2.2 cfs Flowby dn= 0.5 cfs
Qint = 1.7 cfs Depth = 0.38 ft Spread= 13.36 ft Velocity = 1.02 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: SB426	
Catch Basin ID	: 426	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 3.0	
Longitudinal Grade (ft/ft)	: 0.0010	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.0 cfs Qtotal= 3.0 cfs Flowby dn= 0.9 cfs
Qint = 2.1 cfs Depth = 0.42 ft Spread= 15.26 ft Velocity = 1.09 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB427	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 426+00 S. Bound
End Sta. = 284+40 S. Bound
Inlet Condition = Sag Location - 427+09
Kb = 0.02
C = 0.90
Length, L (ft) = 175 = 0.0331 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 0.1 % = 5.28 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	240	16,920	0.3884

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlets (cfs) = 0.9

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.6
Q10 w/carryover (cfs) = 2.5
Spread, T (ft) = 10.4 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder + 1/2 lane).

50 Year Event:

Carry over from upstream inlets (cfs) = 1.8

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.2
Q50 w/carry-over (cfs) = 4.0
Spread, T (ft) = 16.4
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane).

Inlet location determined by spread criteria for 50-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 4.0**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB427	**Sheet**	2	of 2

Grate Interception: Sag Location

Qi = Cw*P*d^1.5 — See Note 3

Cw = 3

Qi max. at 100% Efficiency (cfs) = 7.9 — Calc. P (ft) = 9 — Disregard curb side.

d (ft) = 0.44

Qi at 50% Efficiency (cfs) = 4.0 — SMF Program - Use

Inlet Bypass (cfs) = 0.0

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5 — See Note 5

Qi = 0.94*L*d^.5 — See Note 6

Slotted Drain Length, L (ft) = 0.0

Approx. Depth, d (ft) = 0.44

Qi at 100% Efficiency (cfs) = 0.0

Qi at 50% Efficiency (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix, AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
4. n/a
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 23, page 80.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB427
     Catch Basin ID                   : 427
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  2.5
     Longitudinal Grade (ft/ft)       :  0.0000
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.5 cfs   Qtotal=  2.5 cfs  Flowby dn=  0.0 cfs
Qint  =  2.5 cfs   Depth  =  0.32 ft   Spread= 10.41 ft  Velocity =  0.00 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB427
     Catch Basin ID                   : 427
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  4.0
     Longitudinal Grade (ft/ft)       :  0.0000
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  4.0 cfs   Qtotal=  4.0 cfs  Flowby dn=  0.0 cfs
Qint  =  4.0 cfs   Depth  =  0.44 ft   Spread= 16.38 ft  Velocity =  0.00 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. SB428	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 428+40 S. Bound
End Sta. = 435+60 S. Bound - End Project
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 791 = 0.1498 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 1.0 % = 50.69 ft./mi.
Slope at Inlet = 0.4 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	n/a	40,538	0.9306

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 3.9
Velocity (ft/sec) = 2.0
Spread, T (ft) = 12.7 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder + 1/2 lane).

50 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 5.4
Velocity (ft/sec) = 2.1
Spread, T (ft) = 14.6 SMF Program
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane).

Inlet location determined by spread criteria for 10-yr. event (ultimate).
Inlet size Use 10-yr. Design Storm: **Q (cfs) = 5.4**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. SB428	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 3.9% Composite Ave.
Sx = 3.5%
Spread (ft) = 11.5

Pavement Spread, Ts (ft) = 8.0
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.8 See Note 7
Gutter Flow, Qw (cfs) = 4.6
Eo = Qw/Q = 0.85

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.00 See Note 5
Rs at 50% Efficiency = 0.08 Grate Length = 1.5'. See Note 6.
Eo = 0.85
Qi at 50% Efficiency (cfs) = 4.0 Calculated
Qi at 50% Efficiency (cfs) = 3.6 SMF Program - Use
Inlet Bypass (cfs) = 1.8

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 10.5
Se (ft/ft) = 0.105
n = 0.016

Length for total interception, Lt (ft) = 6.8
Lt at 67% Efficiency (ft) = 10.1
Length of Slotted Drain used (ft) = 5
L/Lt = 0.50
Slotted Drain Intercept. (cfs) = 0.9
Slotted Drain Bypass (cfs) = 0.9

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB428
     Catch Basin ID                   : 428
     Type of Inlet                    :  2.2        Grated Inlet
     Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  3.9
     Longitudinal Grade (ft/ft)       :  0.0040
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  3.9 cfs   Qtotal=  3.9 cfs  Flowby dn=  1.0 cfs
Qint  =  2.9 cfs   Depth  =  0.37 ft   Spread= 12.66 ft  Velocity =  2.00 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : SB428
     Catch Basin ID                   : 428
     Type of Inlet                    :  2.2        Grated Inlet
     Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  5.4
     Longitudinal Grade (ft/ft)       :  0.0040
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  5.4 cfs   Qtotal=  5.4 cfs  Flowby dn=  1.8 cfs
Qint  =  3.6 cfs   Depth  =  0.41 ft   Spread= 14.61 ft  Velocity =  2.13 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. BRA8	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 7+50 Ramp A
End Sta. = 10+00 Ramp A
Inlet Condition = Sag Location - 8+46.33
Kb = 0.02
C = 0.90
Length, L (ft) = 270 = 0.051 mi.
Pvmnt. x-slope= 3.0 %
Ave. Slope, S = 1.4 % = 73.92 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
30	230	6,900	0.1584

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.06
0.167	4.7	0.05
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 0.7
Q10 w/carry over (cfs) = 0.7
Spread, T (ft) = 2.0 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 0.8

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.05
0.167	6.4	0.04
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 0.9
Q50 w/carry-over 1.7
Spread, T (ft) = 5.3 SMF Program.
Allowable Spread (ft) = 10

Use 50-yr. Design Storm: **Q (cfs) = 1.7**

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. BRA8	**Sheet**	2	of 2

Grate Interception: Sag Location

Qi = Cw*P*d^1.5	See Note 3		
		Cw = 3	
Qi max. at 100% Efficiency (cfs) = 3.4	Calc.	P (ft) = 9	Disregard curb side.
	Calc.	d (ft) = 0.25	
Qi at 50% Efficiency (cfs) = 1.7	SMF Program - Use		
Inlet Bypass (cfs) = 0.0			

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5	See Note 5
Qi = 0.94*L*d^.5	See Note 6
Slotted Drain Length, L (ft) = 0.0	Slotted Drain Not Used.
Approx. Depth, d (ft) = 0.25	
Qi at 100% Efficiency (cfs) = 0.0	
Qi at 50% Efficiency (cfs) = 0.0	

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix, AZ.
2. n/a
3. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 23, page 80.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : BRA8
     Catch Basin ID                   : 8
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  0.7
     Longitudinal Grade (ft/ft)       :  0.0000
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0300
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  0.7 cfs   Qtotal=  0.7 cfs  Flowby dn=  0.0 cfs
Qint  =  0.7 cfs   Depth  =  0.14 ft   Spread=  2.08 ft  Velocity =  0.00 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : BRA8
     Catch Basin ID                   : 8
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  1.7
     Longitudinal Grade (ft/ft)       :  0.0000
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0300
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  1.7 cfs   Qtotal=  1.7 cfs  Flowby dn=  0.0 cfs
Qint  =  1.7 cfs   Depth  =  0.25 ft   Spread=  5.32 ft  Velocity =  0.00 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. BRA10	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 10+00 Ramp A
End Sta. = Bell Road Bridge Deck
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 950 = 0.180 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 2.0 % = 105.60 ft./mi.
Slope at Inlet = 1.2 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	950	61,000	1.40

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.09
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 5.9
Q10 w/carry-over (cfs) = 5.9
Spread, T (ft) = 11.9 SMF Program. See Note 1. Spread at inlet reduced by slotted drain.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 8.1
Q50 w/carry-over 8.1
Spread, T (ft) = 13.7 SMF Program. Spread at inlet reduced by slotted drain.
Allowable Spread (ft) = 10

Inlet location determined by spread criteria for 50-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 8.1**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 4.1% Composite Ave.
Sx = 3.7%
Spread (ft) = 10.5

Pavement Spread, Ts (ft) = 7.0
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.95 See Note 7
Gutter Flow, Qw (cfs) = 7.2
Eo = Qw/Q = 0.88

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. BRA10	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.0 — See Note 5
Velocity (ft/sec) = 2.4
Rs at 50% Efficiency = 0.04 — Grate Length = 1.5'. See Note 6.
Eo = 0.88
Qi at 50% Efficiency (cfs) = 6.3 — Calculated
Qi at 50% Efficiency (cfs) = 5.5 — SMF Program - Use
Inlet Bypass (cfs) = 2.6

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 2.0
Se (ft/ft) = 0.020
n = 0.016

Length for total interception, Lt (ft) = 34.6
Lt at 67% Efficiency (ft) = 51.7
Length of Slotted Drain used (ft) = 35
L/Lt = 0.68
Slotted Drain Intercept. (cfs) = 1.8
Slotted Drain Bypass (cfs) = 0.8

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. n/a
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : BRA10
     Catch Basin ID                   : 10
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  5.9
     Longitudinal Grade (ft/ft)       :  0.0120
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  5.9 cfs   Qtotal=  5.9 cfs  Flowby dn=  1.5 cfs
Qint  =  4.4 cfs   Depth  =  0.36 ft   Spread= 11.91 ft  Velocity =  3.36 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : BRA10
     Catch Basin ID                   : 10
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  8.1
     Longitudinal Grade (ft/ft)       :  0.0120
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  8.1 cfs   Qtotal=  8.1 cfs  Flowby dn=  2.6 cfs
Qint  =  5.5 cfs   Depth  =  0.39 ft   Spread= 13.71 ft  Velocity =  3.59 ft/s
```

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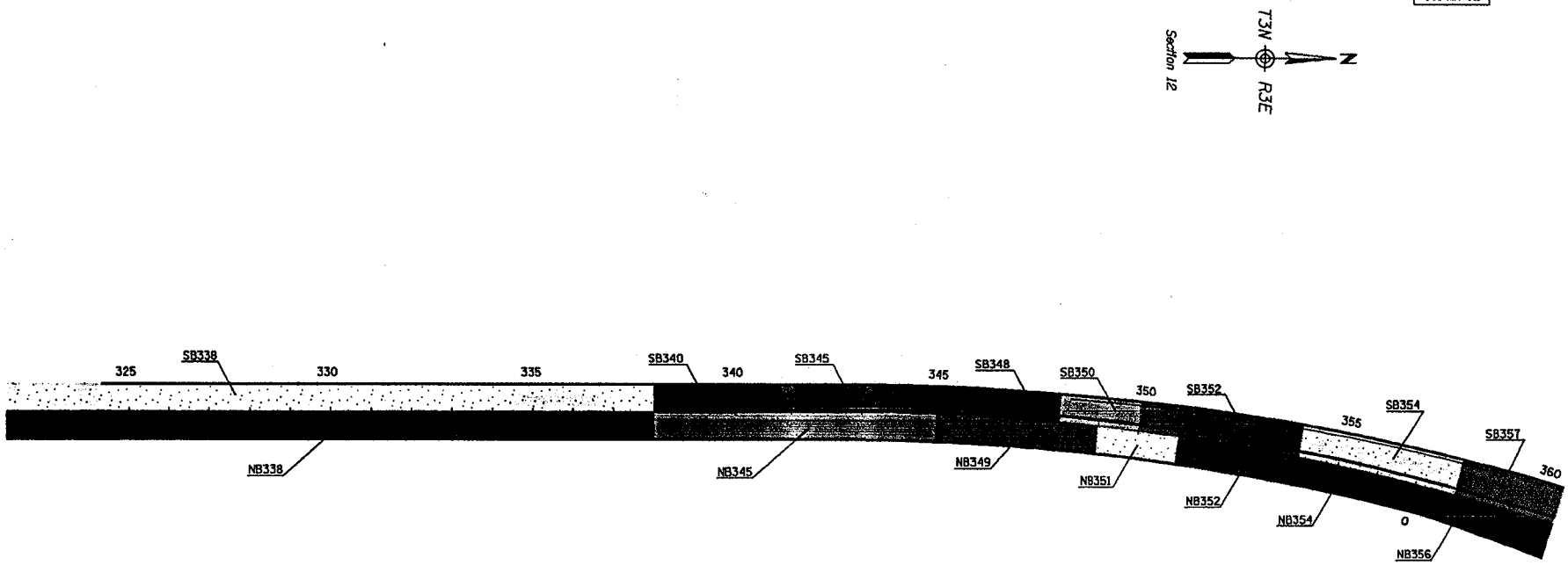
		051-MA-011			



60% SUBMITTAL

	NAME	DATE
DESIGN	JJ	
DRAWN	RH	
CHECKED		

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SR 51
PAVEMENT DRAINAGE SUBBASINS
Sta. 322+00 to 360+50

ROUTE: SR 51 LOCATION: THUNDERBIRD ROAD TO BELL ROAD

PRELIMINARY
NOT FOR
CONSTRUCTION
OR
RECORDING

SHEET D- OF

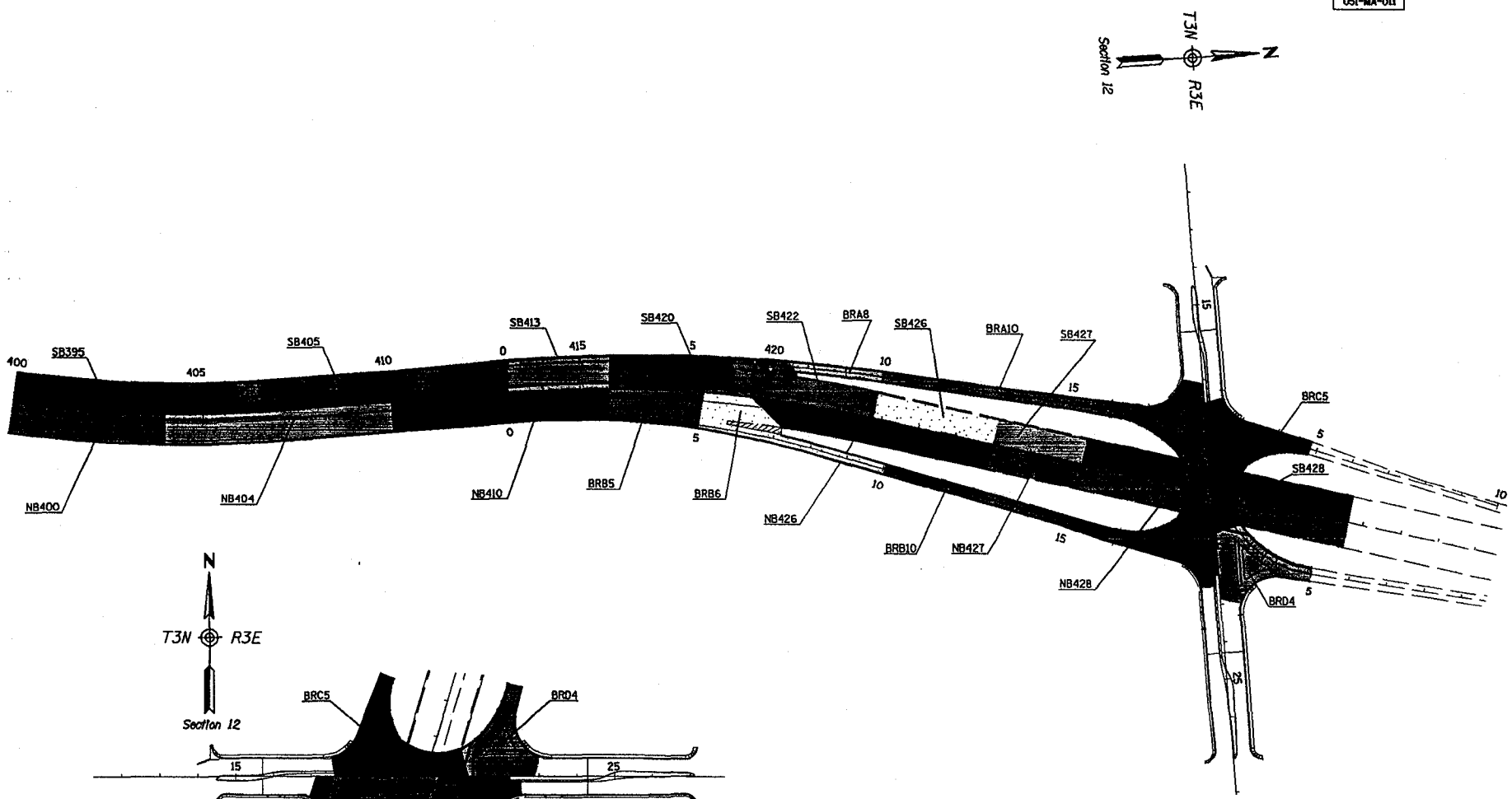
TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

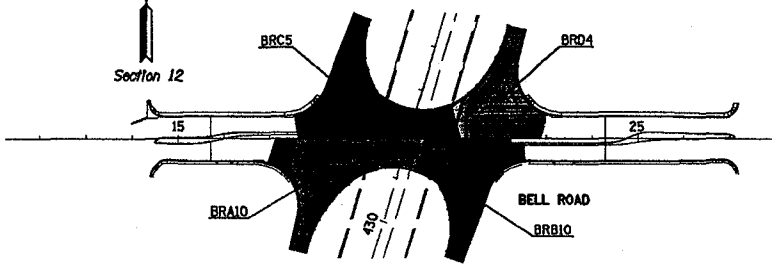
FILE: dh\sapeak\dr-sr5109.dgn
DATE: 1-Mar-96 12:50

SHEET NO.	PROJECT NO.	PROJECT NAME	REVISION	LOCATION	DATE

F.A.H.S.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			

051-MA-011





60% SUBMITTAL

	NAME	DATE
DESIGN	JJ	
DRAWN	WH	
CHECKED		

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SR 51
PAVEMENT DRAINAGE SUBBASINS
Sta 400+00 to 438+00

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

ROUTE: SR 51 LOCATION: THUNDERBIRD ROAD TO BELL ROAD

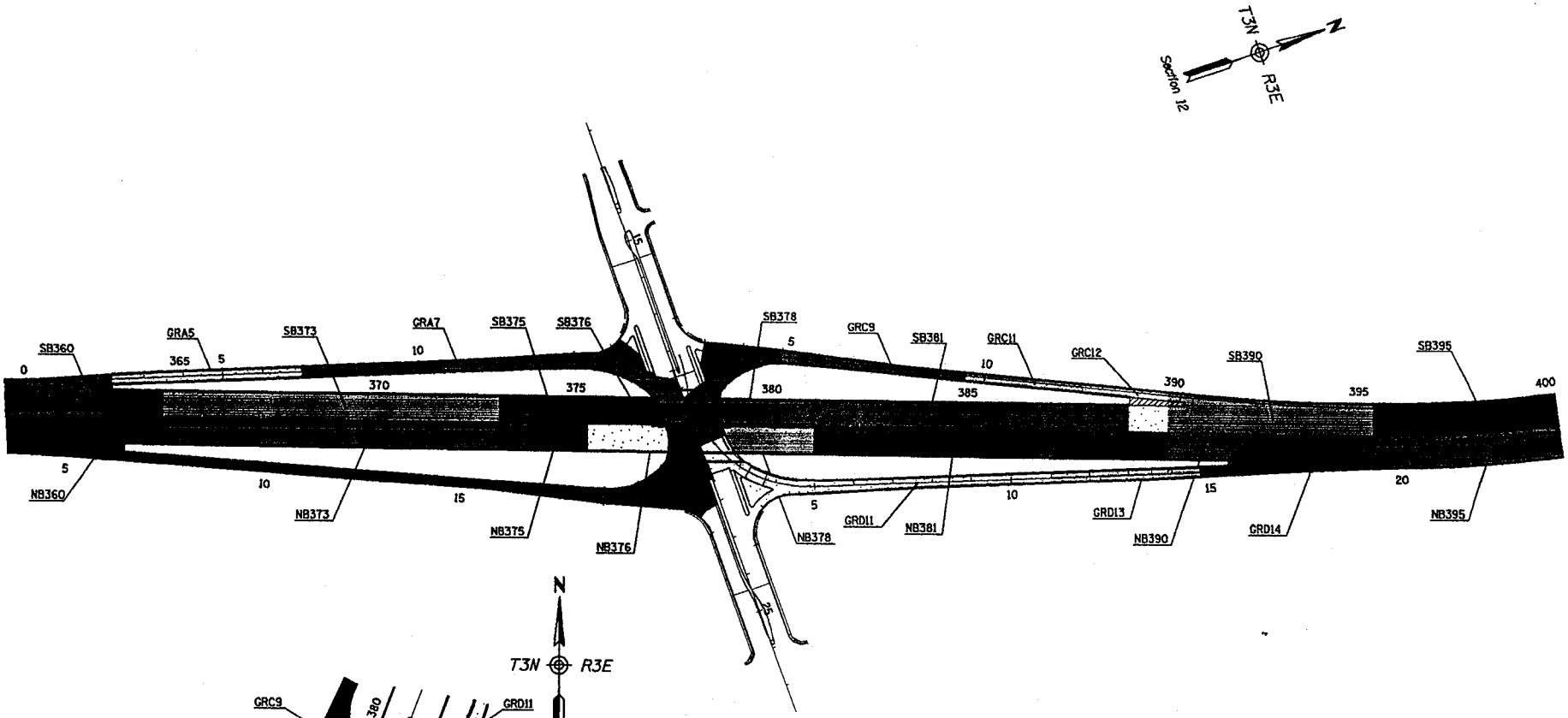
SHEET D- OF

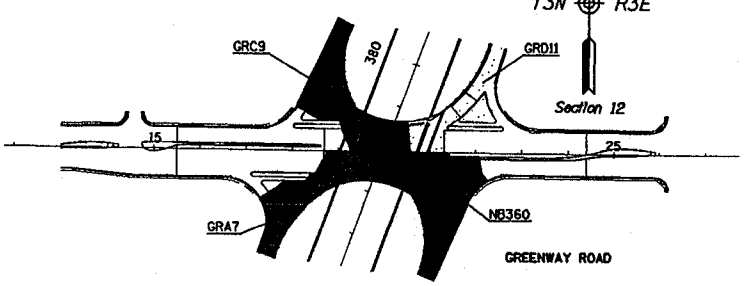
FILE: dt\sapeek\dr-sr5111.dgn
DATE: 1-Mar-96 12:51

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

F.A.P.N. NUMBER	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			

051-MA-011





60% SUBMITTAL

	NAME	DATE	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION	PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING
DESIGN	JJ			
DRAWN	WH			
CHECKED				
HDR Engineering, Inc.			SR 51 PAVEMENT DRAINAGE SUBBASINS Sta. 360+50 to 400+00	
ROUTE SR 51	LOCATION THUNDERBIRD ROAD TO BELL ROAD			SHEET 0- OF

FILE: dt\sapeek\dra=5110.dgn
DATE: 1-Mar-96 12:51

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

SR-51
Summary Table
Pavement Inlets - Northbound Ma

Area Desig.	*Inlet Station*	*Offset*	*Interim*	*by*	*Grate Elev.*	Notes
NB338	338+00	69' RT.	11.7		1416.08	Begin Project - 322+00
NB345	345+00	69' RT.	5.1		1410.67	
NB349	349+00	69' RT.	2.9		1409.01	
NB351	351+00	69' RT.	1.5		1408.64	
NB352	352+42.06	69' RT.	2.2		1408.57	Inlet at Sag Location
NB354	354+00	69' RT.	5.7		1408.66	
NB356	356+00	69' RT.	3.3		1409.05	
NB360	360+50	93.07' RT.	9.1		1410.37	
NB373	373+00	69' RT.	6.3		1408.53	
NB375	375+25	69' RT.	1.6		1407.43	
NB376	376+60.73	69' RT.	1.6		1407.24	Inlet at Sag Location
NB378	378+00	69' RT.	1.8		1410.96	
NB381	381+00	69' RT.	6.6		1409.19	
NB390	390+00	69' RT.	1.5		1422.50	
NB395	395+25	15' RT.	3.8		1429.19	Super Changes D/S of Inlet
NB400	400+00	15' RT.	3.6		1432.07	
NB404	404+00	15' RT.	5.4		1434.25	
NB410	410+00	81' RT.	5.1		1436.71	Super Changes D/S of Inlet
NB426	426+00	69' RT.	4.2		1435.38	
NB427	427+09.09	69' RT.	1.8		1435.27	Inlet at Sag Location
NB428	428+40	69' RT.	4.2		1435.43	
GRD11	11+00 Ramp D	14' RT.	4.9		1423.91	
GRD13	13+29.47 Ramp D	14' RT.	1.5		1422.33	Inlet at Sag Location
GRD14	14+80 Ramp D	11.70' RT.	3.7		1423.10	
BRB5	5+00 Ramp B	9.64' RT.	2.3		1435.96	
BRB6	6+85.91 Ramp B	13.35' RT.	3.6		1435.12	Inlet at Sag Location
BRB10	10+00 Ramp B	14' RT.	6.5		1439.54	
BRD4	4+80 Ramp D	16' LT.	3.5		1460.22	

Filename: Squaw6/Sheet8

Notes

a. Design Q shown inclu
b. Inlet spacing has beer
It is assumed that inlet
paved. Spread criteria
c. Minimum diameter for
d. GRD13 = Greenway R
e. Spread Criteria Used t
1. Allowa
2. 10-Ye
3. 50-Yeion.
4. Ramp

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB338	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 322+00 N. Bound - Begin Project
End Sta. = 338+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 1671 = 0.3164 mi.
Shldr. x-slope= 2.0 %
Ave. Slope, S = 0.72 % = 38.02 ft./mi.
Slope at Inlet = 0.72 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	1600	112,800	2.590

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.17
0.167	4.7	0.15
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 11.0

Spread, T (ft) = 17.4 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder +1/2 lane).

50 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.15
0.167	6.4	0.13
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 14.9
Spread, T (ft) = 19.7 See Note 1
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane).

Inlet location determined by spread criteria for 10 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 14.9**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 3.1% Composite Ave.
Sx = 2.9%
Spread (ft) = 17

Pavement Spread, Ts (ft) = 13.5
Shoulder x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 4.4 See Note 7
Gutter Flow, Qw (cfs) = 10.5
Eo = Qw/Q = 0.70

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB338	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf =	1.0	See Note 5
Velocity (ft/sec) =	3.5	See Note 1.
Rs at 50% Efficiency =	0.035	See Note 6. With 50% clogging, grate length = 1.5'.
Eo =	0.70	
Qi at 50% Efficiency (cfs) =	7.5	Calculated - Approx.
Qi at 50% Efficiency (cfs) =	7.6	SMF Program - Use
Inlet Bypass (cfs) =	7.3	

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8

Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) =	3		
W (ft.)=	2.5	Length for total interception, Lt (ft) =	15.9
Sx (%) =	2.0	Lt at 67% Efficiency (ft) =	23.7
Sw (%) =	10	Length of Slotted Drain used (ft) =	20
Se (%) =	9.0	L/Lt =	0.84
Se (ft/ft) =	0.090	Slotted Drain Intercept. (cfs) =	6.1
n =	0.016	Slotted Drain Bypass (cfs) =	1.2

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB338
      Catch Basin ID                   : 338
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          : 11.0
      Longitudinal Grade (ft/ft)       :  0.0072
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0200
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff= 11.0 cfs   Qtotal= 11.0 cfs  Flowby dn=  4.7 cfs
Qint  =  6.3 cfs   Depth  =  0.47 ft   Spread= 17.41 ft  Velocity =  3.14 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB338
      Catch Basin ID                   : 338
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          : 14.9
      Longitudinal Grade (ft/ft)       :  0.0072
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0200
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff= 14.9 cfs   Qtotal= 14.9 cfs  Flowby dn=  7.3 cfs
Qint  =  7.6 cfs   Depth  =  0.51 ft   Spread= 19.71 ft  Velocity =  3.37 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB345	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 338+00 N. Bound
End Sta. = 345+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 771 = 0.1459 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.71 % = 37.49 ft./mi.
Slope at Inlet = 0.54 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	700	49,350	1.1329

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event: Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.12
0.167	4.7	0.10
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 4.8

Spread, T (ft) = 8.5 SMF Program. See Note1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 1.2

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.09
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 6.5
Q50 w/carry-over (cfs) = 7.7
Spread, T (ft) = 10.4 See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 7.7**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.7% Composite Ave.
Sx = 5.0%
Spread (ft) = 10

Pavement Spread, Ts (ft) = 6.5
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 1.9 See Note 7
Gutter Flow, Qw (cfs) = 5.8
Eo = Qw/Q = 0.75

Job No. 00173 088 044

No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB345	**Sheet**	2	of 2

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo))	See Note 4.
Rf = 1.0	See Note 5
Velocity (ft/sec) = 3.0	See Note 1.
Rs at 50% Efficiency = 0.09	See Note 6. With 50% clogging, grate length = 1.5'.
Eo = 0.75	
Qi at 50% Efficiency (cfs) = 4.5	Calculated.
Qi at 50% Efficiency (cfs) = 5.6	SMF Program - Use
Inlet Bypass (cfs) = 2.1	

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : NB345
     Catch Basin ID                   : 345
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  4.8
     Longitudinal Grade (ft/ft)       :  0.0054
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0400
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  4.8 cfs   Qtotal=  4.8 cfs  Flowby dn=  0.9 cfs
Qint  =  3.9 cfs   Depth  =  0.41 ft   Spread=  8.53 ft  Velocity =  2.68 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : NB345
     Catch Basin ID                   : 345
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  7.7
     Longitudinal Grade (ft/ft)       :  0.0054
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0400
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  7.7 cfs   Qtotal=  7.7 cfs  Flowby dn=  2.1 cfs
Qint  =  5.6 cfs   Depth  =  0.48 ft   Spread= 10.36 ft  Velocity =  2.99 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB349	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 346+00 N. Bound
End Sta. = 349+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 471 = 0.0891 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.40 % = 21.12 ft./mi.
Slope at Inlet = 0.25 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	400	28,200	0.6474

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0.9

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.10
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.7
Q10 (cfs) w/ carry over = 3.6

Spread, T (ft) = 8.9 SMF Program. See Note 1.
Allowable Spread (ft) = 10.8 See Note 3

50 Year Event:

Carry over from upstream inlet (cfs) = 2.1

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.09
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.7
Q50 w/carry-over (cfs) = 5.8

Spread, T (ft) = 10.8 See Note 1
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 5.8**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB349	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.8% Composite Ave.
Sx = 5.0%
Spread (ft) = 10

Pavement Spread, Ts (ft) = 6.5
Shldr. x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 1.2 See Note 7
Gutter Flow, Qw (cfs) = 4.6
Eo = Qw/Q = 0.79

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Velocity (ft/sec) = 2.1 SMF Program.
Rs at 50% Efficiency = 0.14 See Note 6. With 50% clogging, grate length = 1.5'.
Eo = 0.79
Qi at 50% Efficiency (cfs) = 3.8 Calculated
Qi at 50% Efficiency (cfs) = 4.2 SMF Program - Use
Inlet Bypass (cfs) = 1.6

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 4.0
Sw (%) = 10
Se (%) = 11.9
Se (ft/ft) = 0.119
n = 0.016

Length for total interception, Lt (ft) = 5.2
Lt at 67% Efficiency (ft) = 7.7
Length of Slotted Drain used (ft) = 5
L/Lt = 0.65
Slotted Drain Intercept. (cfs) = 1.0
Slotted Drain Bypass (cfs) = 0.6

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread not limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: NB349	
Catch Basin ID	: 349	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 3.6	
Longitudinal Grade (ft/ft)	: 0.0025	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.6 cfs Qtotal= 3.6 cfs Flowby dn= 0.7 cfs
Qint = 2.9 cfs Depth = 0.42 ft Spread= 8.88 ft Velocity = 1.87 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB349	
Catch Basin ID	: 349	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 5.8	
Longitudinal Grade (ft/ft)	: 0.0025	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 5.8 cfs Qtotal= 5.8 cfs Flowby dn= 1.6 cfs
Qint = 4.2 cfs Depth = 0.50 ft Spread= 10.78 ft Velocity = 2.09 ft/s

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Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB351	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 349+00 N. Bound
End Sta. = 351+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 271 = 0.0512 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.25 % = 13.20 ft./mi.
Slope at Inlet = 0.1 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	200	14,100	0.3237

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0.1

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.4
Q10 (cfs) w/ carry over = 1.5

Spread, T (ft) = 7.5 SMF Program. See Note 1.
Allowable Spread (ft) = 10.8 See Note 3

50 Year Event:

Carry over from upstream inlet (cfs) = 0.6

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
0.167	6.4	0.07
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 1.9
Q50 w/carry-over (cfs) = 2.5

Spread, T (ft) = 9.2 See Note 1
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 2.5**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB351	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 6.0% Composite Ave.
Sx = 5.2%
Spread (ft) = 8.5

Pavement Spread, Ts (ft) = 5.0
Shldr. x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 0.4 See Note 7
Gutter Flow, Qw (cfs) = 2.1
Eo = Qw/Q = 0.84

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Velocity (ft/sec) = 1.2 See Note 1.
Rs at 50% Efficiency = 0.30 See Note 6. With 50% clogging, grate length = 1.5'.
Eo = 0.84
Qi at 50% Efficiency (cfs) = 1.9 Calculated
Qi at 50% Efficiency (cfs) = 2.1 SMF Program - Use
Inlet Bypass (cfs) = 0.4

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread not limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: NB351	
Catch Basin ID	: 351	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 1.5	
Longitudinal Grade (ft/ft)	: 0.0010	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 1.5 cfs Qtotal= 1.5 cfs Flowby dn= 0.1 cfs
Qint = 1.4 cfs Depth = 0.37 ft Spread= 7.46 ft Velocity = 1.08 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB351	
Catch Basin ID	: 351	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 2.5	
Longitudinal Grade (ft/ft)	: 0.0010	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.5 cfs Qtotal= 2.5 cfs Flowby dn= 0.4 cfs
Qint = 2.1 cfs Depth = 0.44 ft Spread= 9.23 ft Velocity = 1.21 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. NB352	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 351+00 N. Bound
End Sta. = 354+00 N. Bound
Inlet Condition = Sag Location - 352+42
Kb = 0.02
C = 0.90
Length, L (ft) = 175 = 0.0331 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.1 % = 5.28 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	300	21,150	0.4855

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event: Carry over from upstream inlets (cfs) = 0.3

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.1
Q10 w/carry-over (cfs) = 2.4
Velocity (ft/sec) = 0.0
Spread, T (ft) = 6.3 SMF Program - See Note 1
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlets (cfs) = 1.0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.8
Q50 w/carry over (cfs) = 3.8
Velocity (ft/sec) = 0.0
Spread, T (ft) = 9.1 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.8**

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51		**Computed**	JPJ	12/20/95
Subject	Pavement Drainage		**Checked**	LSM	
Task	Interim Design Sub-basin No. NB352		**Sheet**	2	of 2

Grate Interception: Sag Location

Qi = Cw*P*d^1.5 See Note 4

Cw = 3

Qi max. at 100% Efficiency (cfs) = 7.61 P (ft) = 9 Disregard curb side.

d (ft) = 0.43

Qi at 50% Efficiency (cfs) = 3.8 SMF Program - Use.

Inlet Bypass (cfs) = 0.0

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5 See Note 5

Qi = 0.94*L*d^.5 See Note 6

Slotted Drain Length, L (ft) = 0

Approx. Depth, d (ft) = 0.43

Qi at 100% Efficiency (cfs) = 0.0

Qi at 50% Efficiency (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoeniz, AZ..
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb for 10- yr. event.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 23, page 80.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: NB352	
Catch Basin ID	: 352	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.4	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.4 cfs Qtotal= 2.4 cfs Flowby dn= 0.0 cfs
Qint = 2.4 cfs Depth = 0.32 ft Spread= 6.24 ft Velocity = 0.00 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB352	
Catch Basin ID	: 352	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 3.8	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.8 cfs Qtotal= 3.8 cfs Flowby dn= 0.0 cfs
Qint = 3.8 cfs Depth = 0.43 ft Spread= 9.07 ft Velocity = 0.00 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB354	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 356+00 N. Bound
End Sta. = 354+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 271 = 0.0512 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.25 % = 13.20 ft./mi.
Slope at Inlet = 0.1 %

Area			
Width	Length	Area (sf)	Area (ac)
70.5	200	14,100	0.32

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0.5

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.4
Q10 w/ carry-over (cfs) = 1.9
Velocity (ft/sec) = 1.1
Spread, T (ft) = 8.2 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 1.2

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
0.167	6.4	0.07
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 1.9
Q50 w/ carry-over (cfs) = 3.1
Velocity (ft/sec) = 1.3
Spread, T (ft) = 10.1 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 10 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.1**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB354	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.8% Composite Ave.
Sx = 5.0%
Spread (ft) = 9.5

Pavement Spread, Ts (ft) = 6.0
Shldr. x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 0.6 See Note 7
Gutter Flow, Qw (cfs) = 2.5
Eo = Qw/Q = 0.82

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.30 Grate Length = 1.5'. See Note 6.
Velocity (ft/sec) = 1.3
Eo = 0.82
Qi at 50% Efficiency (cfs) = 2.2 Calculated
Qi at 50% Efficiency (cfs) = 2.5 SMF Program - Use
Inlet Bypass (cfs) = 0.6

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread not limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: NB354	
Catch Basin ID	: 354	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 1.9	
Longitudinal Grade (ft/ft)	: 0.0010	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 1.9 cfs Qtotal= 1.9 cfs Flowby dn= 0.2 cfs
Qint = 1.7 cfs Depth = 0.40 ft Spread= 8.23 ft Velocity = 1.14 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB354	
Catch Basin ID	: 354	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 3.1	
Longitudinal Grade (ft/ft)	: 0.0010	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.1 cfs Qtotal= 3.1 cfs Flowby dn= 0.6 cfs
Qint = 2.5 cfs Depth = 0.47 ft Spread= 10.08 ft Velocity = 1.27 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB356	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 360+50 N. Bound
End Sta. = 356+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 516 = 0.0976 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.6 % = 29.57 ft./mi.
Slope at Inlet = 0.32 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	445	31,373	0.72

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0.0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 3.0
Q10 w/ carry-over (cfs) = 3.0
Velocity (ft/sec) = 2.0
Spread, T (ft) = 7.8 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 1.1

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 4.1
Q50 w/ carry-over (cfs) = 5.2
Velocity (ft/sec) = 2.2
Spread, T (ft) = 9.8 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 5.2**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB356	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.8% Composite Ave.
Sx = 5.0%
Spread (ft) = 9.5

Pavement Spread, Ts (ft) = 6.0
Shldr. x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 1.1 See Note 7
Gutter Flow, Qw (cfs) = 4.1
Eo = Qw/Q = 0.79

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.13 Grate Length = 1.5'. See Note 6.
Velocity (ft/sec) = 2.3
Eo = 0.79
Qi at 50% Efficiency (cfs) = 3.4 Calculated
Qi at 50% Efficiency (cfs) = 4.0 SMF Program - Use
Inlet Bypass (cfs) = 1.2

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread not limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: NB356	
Catch Basin ID	: 356	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 3.0	
Longitudinal Grade (ft/ft)	: 0.0032	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.0 cfs Qtotal= 3.0 cfs Flowby dn= 0.4 cfs
Qint = 2.6 cfs Depth = 0.38 ft Spread= 7.83 ft Velocity = 1.97 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB356	
Catch Basin ID	: 356	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 5.2	
Longitudinal Grade (ft/ft)	: 0.0032	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 5.2 cfs Qtotal= 5.2 cfs Flowby dn= 1.2 cfs
Qint = 4.0 cfs Depth = 0.46 ft Spread= 9.81 ft Velocity = 2.24 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB360	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 18+60 Greenway Ramp B
End Sta. = 360+50 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 1850 = 0.3504 mi.
Pvmnt. x-slope= 2.9 %
Ave. Slope, S = 1.1 % = 58.08 ft./mi.
Slope at Inlet = 0.5029 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	1850	101,500	2.33

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.16
0.167	4.7	0.14
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 9.9
Q10 w/carry-over (cfs) = 9.9
Velocity (ft/sec) = 2.7
Spread, T (ft) = 14.2 SMF Program (See Note 1 and attached printout)
Allowable Spread (ft) = 15 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.14
0.167	6.4	0.12
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 13.4
Q50 w/carry-over (cfs) = 13.4
Velocity (ft/sec) = 3.1
Spread, T (ft) = 16.0 SMF Program. Spread at inlet reduced by slotted drain.
Allowable Spread (ft) = 15 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size Use 10-yr. Design Storm: **Q (cfs) = 13.4**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB360	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 4.2% Composite Ave.
Sx = 3.8%
Spread (ft) = 14.5

Pavement Spread, Ts (ft) = 11.0
Pavement x-slope (%) = 2.9
Pavement Flow, Qs (cfs) = 4.0 See Note 7
Gutter Flow, Qw (cfs) = 9.4
Eo = Qw/Q = 0.70

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Velocity (ft/sec) = 3.1 SMF Program
Rs at 50% Efficiency = 0.06 Grate Length = 1.5'. See Note 6.
Eo = 0.70
Qi at 50% Efficiency (cfs) = 6.8 Calculated
Qi at 50% Efficiency (cfs) = 7.6 SMF Program - Use.
Inlet Bypass (cfs) = 5.8

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.9
Sw (%) = 10
Se (%) = 9.9
Se (ft/ft) = 0.099
n = 0.016

Length for total interception, Lt (ft) = 12.3
Lt at 67% Efficiency (ft) = 18.3
Length of Slotted Drain used (ft) = 15
L/Lt = 0.82
Slotted Drain Intercept. (cfs) = 4.7
Slotted Drain Bypass (cfs) = 1.1

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread not limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: NB360	
Catch Basin ID	: 360	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 9.9	
Longitudinal Grade (ft/ft)	: 0.0050	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 9.9 cfs Qtotal= 9.9 cfs Flowby dn= 3.7 cfs
Qint = 6.2 cfs Depth = 0.51 ft Spread= 14.20 ft Velocity = 2.89 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB360	
Catch Basin ID	: 360	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 13.4	
Longitudinal Grade (ft/ft)	: 0.0050	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0290	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 13.4 cfs Qtotal= 13.4 cfs Flowby dn= 5.8 cfs
Qint = 7.6 cfs Depth = 0.56 ft Spread= 16.03 ft Velocity = 3.11 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB373	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 364+44 N. Bound
End Sta. = 373+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 927 = 0.1755 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.42 % = 22.18 ft./mi.
Slope at Inlet = 0.629 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	856	60,348	1.3854

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.15
0.167	4.7	0.13
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 5.9
Q10 w/carry-over (cfs) = 5.9
Velocity (ft/sec) = 3.0
Spread, T (ft) = 9.0 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.13
0.167	6.4	0.12
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 8.0
Q50 w/carry-over (cfs) = 8.0
Velocity (ft/sec) = 3.2
Spread, T (ft) = 10.2 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 8.0**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB 373	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.7% Composite Ave.
Sx = 5.0%
Spread (ft) = 10

Pavement Spread, Ts (ft) = 6.5
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 1.9 See Note 7
Gutter Flow, Qw (cfs) = 6.1
Eo = Qw/Q = 0.76

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.00 See Note 5
Rs at 50% Efficiency = 0.07 See Note 6. With 50% clogging, grate length = 1.5'.
Eo = 0.76
Qi at 50% Efficiency (cfs) = 4.8 Calculated
Qi at 50% Efficiency (cfs) = 5.9 SMF Program - Use
Inlet Bypass (cfs) = 2.1

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb for 10-yr. event.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB373
      Catch Basin ID                   : 373
      Type of Inlet                    :  2.2        Grated Inlet
      Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
      Drainage Area-1 (acres)          :  1.39
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          :  0.0
      Longitudinal Grade (ft/ft)       :  0.0063
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0400
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  5.9 cfs   Qtotal=  5.9 cfs  Flowby dn=  1.3 cfs
Qint  =  4.6 cfs   Depth  =  0.43 ft   Spread=  9.01 ft  Velocity =  2.98 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB373
      Catch Basin ID                   : 373
      Type of Inlet                    :  2.2        Grated Inlet
      Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
      Drainage Area-1 (acres)          :  1.39
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          :  0.0
      Longitudinal Grade (ft/ft)       :  0.0063
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0400
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  8.0 cfs   Qtotal=  8.0 cfs  Flowby dn=  2.2 cfs
Qint  =  5.9 cfs   Depth  =  0.48 ft   Spread= 10.21 ft  Velocity =  3.21 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB375	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 373+00 N. Bound
End Sta. = 375+25 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 296 = 0.0560 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.09 % = 4.75 ft./mi.
Slope at Inlet = 0.25 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	225	15,863	0.3642

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 1.3

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.14
0.167	4.7	0.12
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.5
Q10 w/carry-over (cfs) = 2.8
Velocity (ft/sec) = 1.8
Spread, T (ft) = 8.0 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 2.1

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.12
0.167	6.4	0.11
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.1
Q50 w/carry-over (cfs) = 4.2
Velocity (ft/sec) = 1.9
Spread, T (ft) = 9.5 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 4.2**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB 375	**Sheet**	2 of 2	

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.9% Composite Ave.
Sx = 5.1%
Spread (ft) = 9

Pavement Spread, Ts (ft) = 5.5
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 0.8 See Note 7
Gutter Flow, Qw (cfs) = 3.4
Eo = Qw/Q = 0.81

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.00 See Note 5
Rs at 50% Efficiency = 0.17 See Note 6. With 50% clogging, grate length = 1.5'.
Eo = 0.81
Qi at 50% Efficiency (cfs) = 2.9 Calculated
Qi at 50% Efficiency (cfs) = 3.4 SMF Program - Use
Inlet Bypass (cfs) = 0.8

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb for 10- yr. event.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: NB375	
Catch Basin ID	: 375	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.8	
Longitudinal Grade (ft/ft)	: 0.0025	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.8 cfs Qtotal= 2.8 cfs Flowby dn= 0.4 cfs
Qint = 2.4 cfs Depth = 0.39 ft Spread= 8.01 ft Velocity = 1.76 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB375	
Catch Basin ID	: 375	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 4.2	
Longitudinal Grade (ft/ft)	: 0.0025	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 4.2 cfs Qtotal= 4.2 cfs Flowby dn= 0.9 cfs
Qint = 3.3 cfs Depth = 0.45 ft Spread= 9.46 ft Velocity = 1.94 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB376	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 375+25 N. Bound
End Sta. = 378+00 N. Bound
Inlet Condition = Sag Location 376+60
Kb = 0.02
C = 0.90
Length, L (ft) = 175 = 0.0331 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.1 % = 5.28 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	n/a	15,015	0.3447

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlets (cfs) = 0.9

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.5
Q10 w/carryover (cfs) = 2.4
Spread, T (ft) = 6.2 SMF Program. See Note 1
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlets (cfs) = 1.8

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.0
Q50 w/carry-over (cfs) = 3.8
Spread, T (ft) = 9.0
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by sag location.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.8**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB376	**Sheet**	2	of 2

Grate Interception: Sag Location

Qi = Cw*P*d^1.5 — See Note 3

Cw = 3

Qi max. at 100% Efficiency (cfs) = 7.6 — Calc. P (ft) = 9 — Disregard curb side.

Calc. d (ft) = 0.43

Qi at 50% Efficiency (cfs) = 3.8 — SMF Program - Use.

Inlet Bypass (cfs) = 0.0

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5 — See Note 4

Qi = 0.94*L*d^.5 — See Note 5

Slotted Drain Length, L (ft) = 0.0

Approx. Depth, d (ft) = 0.43

Qi at 100% Efficiency (cfs) = 0.0

Qi at 50% Efficiency (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoeniz, AZ..
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb for 10- yr. event.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 23, page 80.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB376
      Catch Basin ID                   : 376
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          :  2.4
      Longitudinal Grade (ft/ft)       :  0.0000
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0400
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.4 cfs   Qtotal=  2.4 cfs  Flowby dn=  0.0 cfs
Qint  =  2.4 cfs   Depth  =  0.32 ft   Spread=  6.24 ft  Velocity =  0.00 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB376
      Catch Basin ID                   : 376
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          :  3.8
      Longitudinal Grade (ft/ft)       :  0.0000
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0400
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  3.8 cfs   Qtotal=  3.8 cfs  Flowby dn=  0.0 cfs
Qint  =  3.8 cfs   Depth  =  0.43 ft   Spread=  9.07 ft  Velocity =  0.00 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB378	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 378+00 N. Bound
End Sta. = 381+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 372 = 0.0705 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 0.5 % = 27.98 ft./mi.
Slope at Inlet = 0.3 %

Area

Width	Length	Area (sf)	Area (ac)
71.5	n/a	17,518	0.4022

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 1.2

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.09
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.7
Q10 w/carry-over (cfs) = 2.9
Velocity (ft/sec) = 1.9
Spread, T (ft) = 7.8 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 2.2

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
0.167	6.4	0.07
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.3
Q50 w/carry-over (cfs) = 4.5
Velocity (ft/sec) = 2.1
Spread, T (ft) = 9.4 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 4.5**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB378	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 6.0% Composite Ave.
Sx = 5.2%
Spread (ft) = 8.5

Pavement Spread, Ts (ft) = 5.0
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 0.6 See Note 7
Gutter Flow, Qw (cfs) = 3.9
Eo = Qw/Q = 0.87

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.07 Grate Length = 1.5'. See Note 6.
Eo = 0.87
Qi at 50% Efficiency (cfs) = 3.4 Calculated
Qi at 50% Efficiency (cfs) = 3.5 SMF Program - Use
Inlet Bypass (cfs) = 1.0

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB378
      Catch Basin ID                   : 378
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          :  2.9
      Longitudinal Grade (ft/ft)       :  0.0030
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0400
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.9 cfs   Qtotal=  2.9 cfs  Flowby dn=  0.4 cfs
Qint  =  2.5 cfs   Depth  =  0.38 ft   Spread=  7.81 ft  Velocity =  1.91 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB378
      Catch Basin ID                   : 378
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          :  4.5
      Longitudinal Grade (ft/ft)       :  0.0030
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0400
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  4.5 cfs   Qtotal=  4.5 cfs  Flowby dn=  1.0 cfs
Qint  =  3.5 cfs   Depth  =  0.44 ft   Spread=  9.38 ft  Velocity =  2.11 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB381	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 381+00 N. Bound
End Sta. = 390+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 972 = 0.1840 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 1.14 % = 60.19 ft./mi.
Slope at Inlet = 0.96 %

Area

Width	Length	Area (sf)	Area (ac)
71.5	900	64,350	1.4773

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.10
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 6.2
Velocity (ft/sec) = 3.5
Spread, T (ft) = 8.4 SMF Program - See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.09
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 8.5
Q50 w/carry-over (cfs) = 8.5
Velocity (ft/sec) = 3.8
Spread, T (ft) = 9.6 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 8.5**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB381	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.7% Composite Ave.
Sx = 5.0%
Spread (ft) = 9

Pavement Spread, Ts (ft) = 5.5
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 1.5 See Note 7
Gutter Flow, Qw (cfs) = 7.0
Eo = Qw/Q = 0.82

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.06 Grate Length = 1.5'. See Note 6.
Eo = 0.82
Qi at 50% Efficiency (cfs) = 5.8 Calculated
Qi at 50% Efficiency (cfs) = 6.3 SMF Program - Use
Inlet Bypass (cfs) = 2.2

Slotted Drain Calculations:

Slotted Drain Not Used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: NB381	
Catch Basin ID	: 381	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 6.2	
Longitudinal Grade (ft/ft)	: 0.0096	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 6.2 cfs Qtotal= 6.2 cfs Flowby dn= 1.2 cfs
Qint = 5.0 cfs Depth = 0.40 ft Spread= 8.43 ft Velocity = 3.54 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB381	
Catch Basin ID	: 381	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 8.5	
Longitudinal Grade (ft/ft)	: 0.0096	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 8.5 cfs Qtotal= 8.5 cfs Flowby dn= 2.2 cfs
Qint = 6.3 cfs Depth = 0.45 ft Spread= 9.58 ft Velocity = 3.82 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB390	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 390+00 N. Bound
End Sta. = 392+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 272 = 0.0514 mi.
Shldr. x-slope= 4.0 %
Ave. Slope, S = 1.3 % = 68.64 ft./mi.
Slope at Inlet = 1.4 %

Area

Width	Length	Area (sf)	Area (ac)
71.5	200	14,300	0.3283

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.06
0.167	4.7	0.05
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.4
Q10 w/carry-over (cfs) = 1.4
Velocity (ft/sec) = 3.0
Spread, T (ft) = 4.0 SMF Program. See Note 1.
Allowable Spread (ft) = 10.8 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.05
0.167	6.4	0.05
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 1.9
Q50 w/ carry-over (cfs) = 1.9
Velocity (ft/sec) = 3.2
Spread, T (ft) = 4.6 SMF Program
Allowable Spread (ft) = 10.8 See Note 3.

Inlet location determined by on-site storm drain.
Inlet size based on 50-yr. design storm: **Q (cfs) = 1.9**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB390	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 7.7% Composite Ave.
Sx = 6.4%
Spread (ft) = 4

Pavement Spread, Ts (ft) = 1.5
Shoulder x-slope (%) = 4.0
Pavement Flow, Qs (cfs) = 0.1 See Note 7
Gutter Flow, Qw (cfs) = 1.8
Eo = Qw/Q = 0.95

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.08 Grate Length = 1.5'. See Note 6.
Eo = 0.95
Qi at 50% Efficiency (cfs) = 1.7 Calculated
Qi at 50% Efficiency (cfs) = 1.9 SMF Program - Use
Inlet Bypass (cfs) = 0.0

Slotted Drain Calculations:

Slotted drain not used.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.

Output Screen ********** PgUp PgDn Esc

Station	: NB390	
Catch Basin ID	: 390	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 1.4	
Longitudinal Grade (ft/ft)	: 0.0140	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 1.4 cfs Qtotal= 1.4 cfs Flowby dn= 0.0 cfs
Qint = 1.4 cfs Depth = 0.22 ft Spread= 3.96 ft Velocity = 2.96 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB390	
Catch Basin ID	: 390	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 1.9	
Longitudinal Grade (ft/ft)	: 0.0140	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0400	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 1.9 cfs Qtotal= 1.9 cfs Flowby dn= 0.0 cfs
Qint = 1.9 cfs Depth = 0.25 ft Spread= 4.58 ft Velocity = 3.18 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. NB395	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 395+25 N. Bound
End Sta. = 400+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 493 = 0.0934 mi.
Pvmnt. x-slope= 3.0 %
Ave. Slope, S = 0.545 % = 28.78 ft./mi.
Slope at Inlet = 0.545 %

Area

Width	Length	Area (sf)	Area (ac)
68	425	28,900	0.6635

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.8
Velocity (ft/sec) = 2.3
Spread, T (ft) = 8.0 SMF Program. See Note 1.
Allowable Spread (ft) = 9.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.8
Velocity (ft/sec) = 2.4
Spread, T (ft) = 9.1 SMF Program.
Allowable Spread (ft) = 9.5 (gutter + shoulder).

Inlet location determined by spread criteria for 50-yr. event (ultimate).
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.8**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. NB395	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.5% Composite Ave.
Sx = 4.8%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 3.0
Pavement Flow, Qs (cfs) = 0.4 See Note 7
Gutter Flow, Qw (cfs) = 3.4
Eo = Qw/Q = 0.89

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.16 Grate Length = 1.5'. See Note 6.
Eo = 0.89
Qi at 50% Efficiency (cfs) = 3.1 Calculated
Qi at 50% Efficiency (cfs) = 3.1 SMF Program - Use
Inlet Bypass (cfs) = 0.7

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 3.0
Sw (%) = 10
Se (%) = 11.9
Se (ft/ft) = 0.119
n = 0.016

Length for total interception, Lt (ft) = 4.6
Lt at 67% Efficiency (ft) = 6.9
Length of Slotted Drain used (ft) = 10
Slotted Drain Intercept. (cfs) = 0.7
Slotted Drain Bypass (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

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Output Screen ********** PgUp PgDn Esc

Station	: NB395	
Catch Basin ID	: 395	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.8	
Longitudinal Grade (ft/ft)	: 0.0055	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0300	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.8 cfs Qtotal= 2.8 cfs Flowby dn= 0.3 cfs
Qint = 2.5 cfs Depth = 0.33 ft Spread= 7.98 ft Velocity = 2.27 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB395	
Catch Basin ID	: 395	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 3.8	
Longitudinal Grade (ft/ft)	: 0.0055	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0300	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.8 cfs Qtotal= 3.8 cfs Flowby dn= 0.7 cfs
Qint = 3.1 cfs Depth = 0.37 ft Spread= 9.14 ft Velocity = 2.42 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. NB400	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 400+00 N. Bound
End Sta. = 404+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 468 = 0.0886 mi.
Pvmnt. x-slope= 4.4 %
Ave. Slope, S = 0.545 % = 28.78 ft./mi.
Slope at Inlet = 0.545 %

Area

Width	Length	Area (sf)	Area (ac)
68.0	400	27,200	0.6244

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.6
Velocity (ft/sec) = 2.4
Spread, T (ft) = 6.3 SMF Program. See Note 1.
Allowable Spread (ft) = 9.5 (gutter + shoulder).

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.6
Velocity (ft/sec) = 2.6
Spread, T (ft) = 7.2 SMF Program.
Allowable Spread (ft) = 9.5 (gutter + shoulder).

Inlet location determined by spread criteria for 10-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.6**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. NB400	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 7.2% Composite Ave.
Sx = 6.1%
Spread (ft) = 6.4

Pavement Spread, Ts (ft) = 2.9
Pavement x-slope (%) = 4.4
Pavement Flow, Qs (cfs) = 0.3 See Note 7
Gutter Flow, Qw (cfs) = 3.3
Eo = Qw/Q = 0.93

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.22 Grate Length = 1.5'. See Note 6.
Eo = 0.93
Qi at 50% Efficiency (cfs) = 3.1 Calculated
Qi at 50% Efficiency (cfs) = 3.1 SMF Program - Use
Inlet Bypass (cfs) = 0.5

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 4.4
Sw (%) = 10
Se (%) = 13.7
Se (ft/ft) = 0.137
n = 0.016

Length for total interception, Lt (ft) = 3.7
Lt at 67% Efficiency (ft) = 5.5
Length of Slotted Drain used (ft) = 5
L/Lt = 0.90
Slotted Drain Intercept. (cfs) = 0.5
Slotted Drain Bypass (cfs) = 0.0

Notes

1. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB400
      Catch Basin ID                   : 400
      Type of Inlet                    :  2.2        Grated Inlet
      Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          :  2.6
      Longitudinal Grade (ft/ft)       :  0.0055
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0440
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.6 cfs   Qtotal=  2.6 cfs  Flowby dn=  0.2 cfs
Qint  =  2.4 cfs   Depth  =  0.33 ft   Spread=  6.26 ft  Velocity =  2.37 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : NB400
      Catch Basin ID                   : 400
      Type of Inlet                    :  2.2        Grated Inlet
      Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          :  3.6
      Longitudinal Grade (ft/ft)       :  0.0055
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0440
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  3.6 cfs   Qtotal=  3.6 cfs  Flowby dn=  0.5 cfs
Qint  =  3.1 cfs   Depth  =  0.37 ft   Spread=  7.16 ft  Velocity =  2.56 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Interim Design Sub-basin No. NB404	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 404+00 N. Bound
End Sta. = 410+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 668 = 0.1265 mi.
Pvmnt. x-slope = 4.4 %
Ave. Slope, S = 0.545 % = 28.78 ft./mi.
Slope at Inlet = 0.545 %

Area

Width	Length	Area (sf)	Area (ac)
68.0	600	40,800	0.9366

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry-over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.12
0.167	4.7	0.10
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 4.0
Velocity (ft/sec) = 2.6
Spread, T (ft) = 7.5 SMF Program. See note 1.
Allowable Spread (ft) = 9.5 (gutter + shoulder).

50 Year Event:

Carry-over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.09
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 5.4
Velocity (ft/sec) = 2.8
Spread, T (ft) = 8.5 SMF Program.
Allowable Spread (ft) = 9.5 (gutter + shoulder).

Inlet location determined by spread criteria for 10-yr. event..
Inlet size based on 50-yr. design storm: **Q (cfs) = 5.4**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Interim Design Sub-basin No. NB404	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 6.6% Composite Ave.
Sx = 5.6%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 4.4
Pavement Flow, Qs (cfs) = 0.9 See Note 7
Gutter Flow, Qw (cfs) = 4.5
Eo = Qw/Q = 0.83

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.12 Grate Length = 1.5'. See Note 6.
Eo = 0.83
Qi at 50% Efficiency (cfs) = 3.8 Calculated
Qi at 50% Efficiency (cfs) = 4.3 SMF Program - Use.
Inlet Bypass (cfs) = 1.1

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 4.4
Sw (%) = 10
Se (%) = 12.7
Se (ft/ft) = 0.127
n = 0.016

Length for total interception, Lt (ft) = 5.4
Lt at 67% Efficiency (ft) = 8.0
Length of Slotted Drain used (ft) = 10
Slotted Drain Intercept. (cfs) = 1.1
Slotted Drain Bypass (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: NB404	
Catch Basin ID	: 404	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 4.0	
Longitudinal Grade (ft/ft)	: 0.0055	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0440	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 4.0 cfs Qtotal= 4.0 cfs Flowby dn= 0.6 cfs
Qint = 3.4 cfs Depth = 0.39 ft Spread= 7.48 ft Velocity = 2.62 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB404	
Catch Basin ID	: 404	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 5.4	
Longitudinal Grade (ft/ft)	: 0.0055	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0440	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 5.4 cfs Qtotal= 5.4 cfs Flowby dn= 1.1 cfs
Qint = 4.3 cfs Depth = 0.43 ft Spread= 8.46 ft Velocity = 2.81 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB410	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 410+00 N. Bound
End Sta. = 415+76.8 N. Bound - (High Point)
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 659 = 0.1249 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 0.34 % = 17.86 ft./mi.
Slope at Inlet = 0.545 %

Area

Width	Length	Area (sf)	Area (ac)
82.5	576.8	47,586	1.0924

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry-over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.14
0.167	4.7	0.12
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 4.6
Velocity (ft/sec) = 2.3
Spread, T (ft) = 12.7 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder + 1/2 lane).

50 Year Event:

Carry-over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.12
0.167	6.4	0.11
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 6.3
Velocity (ft/sec) = 2.5
Spread, T (ft) = 14.6 SMF Program
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane)

Inlet location determined by spread criteria for 10-yr. event (ultimate).
Inlet size based on 50-yr. design storm: **Q (cfs) = 6.3**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB410	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 3.8% Composite Ave.
Sx = 3.5%
Spread (ft) = 12

Pavement Spread, Ts (ft) = 8.5
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 1.1 See Note 7
Gutter Flow, Qw (cfs) = 5.2
Eo = Qw/Q = 0.83

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.06 Grate Length = 1.5'. See Note 6.
Eo = 0.83
Qi at 50% Efficiency (cfs) = 4.3 Calculated
Qi at 50% Efficiency (cfs) = 4.2 SMF Program - Use
Inlet Bypass (cfs) = 2.1

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 10.3
Se (ft/ft) = 0.103
n = 0.016

Length for total interception, Lt (ft) = 8.0
Lt at 67% Efficiency (ft) = 12.0
Length of Slotted Drain used (ft) = 15
Slotted Drain Intercept. (cfs) = 2.1
Slotted Drain Bypass (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: NB410	
Catch Basin ID	: 410	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 4.6	
Longitudinal Grade (ft/ft)	: 0.0055	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 4.6 cfs Qtotal= 4.6 cfs Flowby dn= 1.2 cfs
Qint = 3.4 cfs Depth = 0.37 ft Spread= 12.71 ft Velocity = 2.34 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB410	
Catch Basin ID	: 410	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 6.3	
Longitudinal Grade (ft/ft)	: 0.0055	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 6.3 cfs Qtotal= 6.3 cfs Flowby dn= 2.1 cfs
Qint = 4.2 cfs Depth = 0.41 ft Spread= 14.61 ft Velocity = 2.49 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/26/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB426	**Sheet**	1	of 2

Sub-basin Data:

Begin. Sta. = 422+00 N. Bound
End Sta. = 426+00 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 471 = 0.0891 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 0.2 % = 10.56 ft./mi.
Slope at Inlet = 0.1 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	400	40,250	0.9240

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)
Q10 (cfs) = CiA = 3.9

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.13
0.167	4.7	0.12
Use minimum Tc of 10 min. i = 4.7		

Velocity (ft/sec) = 1.1
Spread, T (ft) = 17.0 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder + 1/2 lane).

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.12
0.167	6.4	0.11
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 5.3
Velocity (ft/sec) = 1.2
Spread, T (ft) = 19.3 SMF Program
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane).

Inlet location determined by spread criteria for 10-yr. event (ultimate).
Inlet size based on 50-yr. design storm: **Q (cfs) = 5.3**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB426	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 3.3% Composite Ave.
Sx = 3.0%
Spread (ft) = 16

Pavement Spread, Ts (ft) = 12.5
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 1.2 See Note 7
Gutter Flow, Qw (cfs) = 4.1
Eo = Qw/Q = 0.77

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.00 See Note 5
Rs at 50% Efficiency = 0.20 Grate Length = 1.5'. See Note 6.
Eo = 0.77
Qi at 50% Efficiency (cfs) = 3.4 Calculated
Qi at 50% Efficiency (cfs) = 3.1 SMF Program - Use
Inlet Bypass (cfs) = 2.2

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 9.7
Se (ft/ft) = 0.097
n = 0.016

Length for total interception, Lt (ft) = 5.1
Lt at 67% Efficiency (ft) = 7.6
Length of Slotted Drain used (ft) = 5
L/Lt = 0.66
Slotted Drain Intercept. (cfs) = 1.4
Slotted Drain Bypass (cfs) = 0.8

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: NB426	
Catch Basin ID	: 426	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 3.9	
Longitudinal Grade (ft/ft)	: 0.0010	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.9 cfs Qtotal= 3.9 cfs Flowby dn= 1.4 cfs
Qint = 2.5 cfs Depth = 0.46 ft Spread= 17.06 ft Velocity = 1.16 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB426	
Catch Basin ID	: 426	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 5.3	
Longitudinal Grade (ft/ft)	: 0.0010	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 5.3 cfs Qtotal= 5.3 cfs Flowby dn= 2.2 cfs
Qint = 3.1 cfs Depth = 0.50 ft Spread= 19.31 ft Velocity = 1.25 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/26/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB427	**Sheet**	1 of 2	

Sub-basin Data:

Begin. Sta. = 426+00 N. Bound
End Sta. = 284+40 N. Bound
Inlet Condition = Sag Location - 427+09
Kb = 0.02
C = 0.90
Length, L (ft) = 175 = 0.0331 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 0.1 % = 5.28 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	240	16,920	0.3884

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlets (cfs) = 0.7

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.6
Q10 w/carryover (cfs) = 2.3
Velocity (ft/sec) = 0.0
Spread, T (ft) = 9.5 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder + 1/2 lane).

50 Year Event:

Carry over from upstream inlets (cfs) = 1.7

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.2
Q50 w/carryover (cfs) = 3.9
Velocity (ft/sec) = 0.0
Spread, T (ft) = 16.1 SMF Program.
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane).

Inlet location determined by spread criteria for 10-yr. event (ultimate).
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.9**

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB427	**Sheet**	2	of 2

Grate Interception: Sag Location

Qi = Cw*P*d^1.5 — See Note 3

Cw = 3

Qi max. at 100% Efficiency (cfs) = 7.3 — Calc. P (ft) = 9 — Disregard curb side.

d (ft) = 0.42

Qi at 50% Efficiency (cfs) = 3.9 — SMF Program - Use

Inlet Bypass (cfs) = 0.0

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5 — See Note 5

Qi = 0.94*L*d^.5 — See Note 6

Slotted Drain Length, L (ft) = 0.0

Approx. Depth, d (ft) = 0.42

Qi at 100% Efficiency (cfs) = 0.0

Qi at 50% Efficiency (cfs) = 0.0

Notes

4. HEC 12 Software - SMF Engineering Corporation, Phoenix, AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
4. n/a
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 23, page 80.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.

Output Screen ********** PgUp PgDn Esc

Station	: NB427	
Catch Basin ID	: 427	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.3	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.3 cfs Qtotal= 2.3 cfs Flowby dn= 0.0 cfs
Qint = 2.3 cfs Depth = 0.31 ft Spread= 9.53 ft Velocity = 0.00 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: NB427	
Catch Basin ID	: 427	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 3.9	
Longitudinal Grade (ft/ft)	: 0.0000	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.9 cfs Qtotal= 3.9 cfs Flowby dn= 0.0 cfs
Qint = 3.9 cfs Depth = 0.44 ft Spread= 16.01 ft Velocity = 0.00 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. NB428	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 428+40 N. Bound
End Sta. = 435+60 N. Bound - End Project
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 791 = 0.1498 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 1.0 % = 50.69 ft./mi.
Slope at Inlet = 0.4 %

Area

Width	Length	Area (sf)	Area (ac)
70.5	n/a	40,538	0.9306

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 3.9
Velocity (ft/sec) = 2.0
Spread, T (ft) = 12.7 SMF Program. See Note 1.
Allowable Spread (ft) = 17.5 (gutter + shoulder + 1/2 lane).

50 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 5.4
Velocity (ft/sec) = 2.1
Spread, T (ft) = 14.6 SMF Program
Allowable Spread (ft) = 23.5 (gutter + shoulder + 1 lane).

Inlet location determined by spread criteria for 10-yr. event (ultimate).
Inlet size Use 10-yr. Design Storm: **Q (cfs) = 5.4**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. NB428	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 3.8% Composite Ave.
Sx = 3.5%
Spread (ft) = 11.5

Pavement Spread, Ts (ft) = 8.0
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.8 See Note 7
Gutter Flow, Qw (cfs) = 4.6
Eo = Qw/Q = 0.85

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.00 See Note 5
Rs at 50% Efficiency = 0.08 Grate Length = 1.5'. See Note 6.
Eo = 0.85
Qi at 50% Efficiency (cfs) = 4.0 Calculated
Qi at 50% Efficiency (cfs) = 3.6 SMF Program - Use
Inlet Bypass (cfs) = 1.8

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 10.5
Se (ft/ft) = 0.105
n = 0.016

Length for total interception, Lt (ft) = 6.8
Lt at 67% Efficiency (ft) = 10.1
Length of Slotted Drain used (ft) = 5
L/Lt = 0.50
Slotted Drain Intercept. (cfs) = 0.9
Slotted Drain Bypass (cfs) = 0.9

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : NB428
     Catch Basin ID                   : 428
     Type of Inlet                    :  2.2        Grated Inlet
     Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  3.9
     Longitudinal Grade (ft/ft)       :  0.0040
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  3.9 cfs   Qtotal=  3.9 cfs  Flowby dn=  1.0 cfs
Qint  =  2.9 cfs   Depth  =  0.37 ft   Spread= 12.66 ft  Velocity =  2.00 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : NB428
     Catch Basin ID                   : 428
     Type of Inlet                    :  2.2        Grated Inlet
     Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  5.4
     Longitudinal Grade (ft/ft)       :  0.0040
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  5.4 cfs   Qtotal=  5.4 cfs  Flowby dn=  1.8 cfs
Qint  =  3.6 cfs   Depth  =  0.41 ft   Spread= 14.61 ft  Velocity =  2.13 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. GRD11	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = Greenway Bridge Deck
End Sta. = 11+00 Ramp D
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 900 = 0.1705 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 0.7 % = 36.96 ft./mi.
Slope at Inlet = 1.15 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	900	36,730	0.843

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.13
0.167	4.7	0.11
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 3.6
Velocity (ft/sec) = 3.0
Spread, T (ft) = 9.6 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.11
0.167	6.4	0.10
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 4.9
Velocity (ft/sec) = 3.2
Spread, T (ft) = 11.1 SMF Program. Spread at inlet reduced by slotted drain.
Allowable Spread (ft) = 10

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 4.9**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. GRD11	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 4.9% Composite Ave.
Sx = 4.4%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.3 See Note 7
Gutter Flow, Qw (cfs) = 4.6
Eo = Qw/Q = 0.94

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.04 Grate Length = 1.5'. See Note 6.
Eo = 0.94
Qi at 50% Efficiency (cfs) = 4.4 Calculated
Qi at 50% Efficiency (cfs) = 3.9 SMF Program - Use
Inlet Bypass (cfs) = 1.0

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 11.4
Se (ft/ft) = 0.114
n = 0.016

Length for total interception, Lt (ft) = 6.9
Lt at 67% Efficiency (ft) = 10.3
Length of Slotted Drain used (ft) = 10
L/Lt = 0.97
Slotted Drain Intercept. (cfs) = 1.0
Slotted Drain Bypass (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. n/a
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: GRD11	
Catch Basin ID	: 11	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 3.6	
Longitudinal Grade (ft/ft)	: 0.0115	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 3.6 cfs Qtotal= 3.6 cfs Flowby dn= 0.5 cfs
Qint = 3.1 cfs Depth = 0.31 ft Spread= 9.56 ft Velocity = 2.99 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: GRD11	
Catch Basin ID	: 11	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 4.9	
Longitudinal Grade (ft/ft)	: 0.0115	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 4.9 cfs Qtotal= 4.9 cfs Flowby dn= 1.0 cfs
Qint = 3.9 cfs Depth = 0.34 ft Spread= 11.06 ft Velocity = 3.18 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. GRD13	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 11+00 Ramp D
End Sta. = 14+80 Ramp D
Inlet Condition = Sag Location -13+37.54
Kb = 0.02
C = 0.90
Length, L (ft) = 250 = 0.047 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 0.2 % = 10.56 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	380	11,400	0.262

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.10
0.167	4.7	0.09
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 1.1
Q10 w/carry-over (cfs) = 1.1
Velocity (ft/sec) = 0.0
Spread, T (ft) = 2.5 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 0.4

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.09
0.167	6.4	0.08
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 1.5
Q50 w/carry-over (cfs) = 1.9
Velocity (ft/sec) = 0.0
Spread, T (ft) = 7.7 SMF Program.
Allowable Spread (ft) = 10

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 1.9**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. GRD13	**Sheet**	2	of 2

Grate Interception: Sag Location

Qi = Cw*P*d^1.5 — See Note 3

Cw = 3

Qi max. at 100% Efficiency (cfs) = 3.8 — Calc. P (ft) = 9 — Disregard curb side.

Calc. d (ft) = 0.27

Qi at 50% Efficiency (cfs) = 1.9 — SMF Program - Use

Inlet Bypass (cfs) = 0.0

Slotted Drain Calculations:

Qi = 0.8*L*W*(2*g*d)^.5 — See Note 5

Qi = 0.94*L*d^.5 — See Note 6

Slotted Drain Length, L (ft) = 0.0

Approx. Depth, d (ft) = 0.27

Qi at 100% Efficiency (cfs) = 0.0

Qi at 50% Efficiency (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix, AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 17, page 69.
4. n/a
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 23, page 80.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 24, page 80.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : GRD13
     Catch Basin ID                   : 13
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  1.1
     Longitudinal Grade (ft/ft)       :  0.0000
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  1.1 cfs   Qtotal=  1.1 cfs  Flowby dn=  0.0 cfs
Qint  =  1.1 cfs   Depth  =  0.19 ft   Spread=  3.56 ft  Velocity =  0.00 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : GRD13
     Catch Basin ID                   : 13
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  1.9
     Longitudinal Grade (ft/ft)       :  0.0000
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0200
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  1.9 cfs   Qtotal=  1.9 cfs  Flowby dn=  0.0 cfs
Qint  =  1.9 cfs   Depth  =  0.27 ft   Spread=  7.69 ft  Velocity =  0.00 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. GRD14	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 14+80 Ramp D
End Sta. = 399+25 N. Bound
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 520 = 0.0985 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 1.5 % = 79.20 ft./mi.
Slope at Inlet = 1.0 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	450	33,120	0.7603

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.08
0.167	4.7	0.07
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 3.2
Velocity (ft/sec) = 2.8
Spread, T (ft) = 9.3 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.07
0.167	6.4	0.06
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 4.4
Velocity (ft/sec) = 3.0
Spread, T (ft) = 10.9 SMF Program. Spread at inlet reduced by slotted drain.
Allowable Spread (ft) = 10

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 4.4**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. GRD14	**Sheet**	2	of 2

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.1% Composite Ave.
Sx = 4.5%
Spread (ft) = 7.5

Pavement Spread, Ts (ft) = 4.0
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.19 See Note 7
Gutter Flow, Qw (cfs) = 4.2
Eo = Qw/Q = 0.96

Grate Interception:

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) See Note 4

Rf = 1.0 See Note 5
Rs at 50% Efficiency = 0.05 Grate Length = 1.5'. See Note 6.
Eo = 0.96
Qi at 50% Efficiency (cfs) = 4.0 Calculated
Qi at 50% Efficiency (cfs) = 3.5 SMF Program - Use
Inlet Bypass (cfs) = 0.9

Slotted Drain Calculations:

Se = Sx + SwEo See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 2.0
Sw (%) = 10
Se (%) = 11.6
Se (ft/ft) = 0.116
n = 0.016

Length for total interception, Lt (ft) = 6.3
Lt at 67% Efficiency (ft) = 9.4
Length of Slotted Drain used (ft) = 5
L/Lt = 0.53
Slotted Drain Intercept. (cfs) = 0.5
Slotted Drain Bypass (cfs) = 0.4

Notes

1. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 16, page 60.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn.16, page 60.

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : GRD14
      Catch Basin ID                   : 14
      Type of Inlet                    :  2.2        Grated Inlet
      Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          :  3.2
      Longitudinal Grade (ft/ft)       :  0.0100
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0200
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  3.2 cfs   Qtotal=  3.2 cfs  Flowby dn=  0.4 cfs
Qint  =  2.8 cfs   Depth  =  0.30 ft   Spread=  9.31 ft  Velocity =  2.78 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : GRD14
      Catch Basin ID                   : 14
      Type of Inlet                    :  2.2        Grated Inlet
      Runoff Coefficient for Area-1    :  0.90       P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          :  4.4
      Longitudinal Grade (ft/ft)       :  0.0100
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0200
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  4.4 cfs   Qtotal=  4.4 cfs  Flowby dn=  0.9 cfs
Qint  =  3.5 cfs   Depth  =  0.33 ft   Spread= 10.86 ft  Velocity =  2.95 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. BRB5	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = 4+15.77 N. Bound
End Sta. = 5+00 Ramp B
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 250 = 0.047 mi.
Pvmnt. x-slope= 4.4 %
Ave. Slope, S = 0.12 % = 6.34 ft./mi.
Slope at Inlet = 0.15 %

Area			
Width	Length	Area (sf)	Area (ac)
Varies	250	20,825	0.4781

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.11
0.167	4.7	0.10
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.0

Spread, T (ft) = 7.3 SMF Program. See Note 1.
Allowable Spread (ft) = 7.5 See Note 3.

50 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.10
0.167	6.4	0.09
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 2.8
Velocity (ft/sec) = 2.9
Spread, T (ft) = 8.4 SMF Program. Spread at inlet reduced by slotted drain.
Allowable Spread (ft) = 7.5 See Note 3.

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 2.8**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 6.4% Composite Ave.
Sx = 5.5%
Spread (ft) = 8

Pavement Spread, Ts (ft) = 4.5
Pavement x-slope (%) = 4.4
Pavement Flow, Qs (cfs) = 0.4 See Note 7
Gutter Flow, Qw (cfs) = 2.4
Eo = Qw/Q = 0.86

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. BRB5	**Sheet**	2	of 2

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf = 1.0 — See Note 5
Rs at 50% Efficiency = 0.06 — See Note 6. With 50% clogging, grate length = 1.5'.
Eo = 0.86
Qi at 50% Efficiency (cfs) = 2.1 — Calculated
Qi at 50% Efficiency (cfs) = 2.4 — SMF Program - Use
Inlet Bypass (cfs) = 0.4

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8
Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) = 3
W (ft.)= 2.5
Sx (%) = 4.4
Sw (%) = 10
Se (%) = 4.4
Se (ft/ft) = 0.044
n = 0.016

Length for total interception, Lt (ft) = 2.5
Lt at 67% Efficiency (ft) = 3.7
Length of Slotted Drain used (ft) = 5
Slotted Drain Intercept. (cfs) = 0.4
Slotted Drain Bypass (cfs) = 0.0

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb.
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn.16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: BRB5	
Catch Basin ID	: 500	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 2.0	
Longitudinal Grade (ft/ft)	: 0.0015	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0440	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.0 cfs Qtotal= 2.0 cfs Flowby dn= 0.2 cfs
Qint = 1.8 cfs Depth = 0.38 ft Spread= 7.32 ft Velocity = 1.36 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: BRB5	
Catch Basin ID	: 500	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 2.8	
Longitudinal Grade (ft/ft)	: 0.0015	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0440	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 2.8 cfs Qtotal= 2.8 cfs Flowby dn= 0.4 cfs
Qint = 2.4 cfs Depth = 0.43 ft Spread= 8.41 ft Velocity = 1.47 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/26/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. BRB6	**Sheet**	1	of 2

Sub-basin Data:

Begin. Sta. = 5+00 Ramp B
End Sta. = 10+00 Ramp B
Inlet Condition = Sag Location - 6+85.91
Kb = 0.02
C = 0.90
Length, L (ft) = 315 = 0.060 mi.
Pvmnt. x-slope= 4.4 %
Ave. Slope, S = 0.1 % = 5.28 ft./mi.
Slope at Inlet = 0 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	n/a	30,600	0.702

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

10 Year Event:

Carry over from upstream inlet (cfs) = 0

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.14
0.167	4.7	0.12
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 3.0
Velocity (ft/sec) = 0
Spread, T (ft) = 7.0 SMF Program. See Note 1.
Allowable Spread (ft) = 7.5 See Note 3.

50 Year Event:

Carry over from upstream inlet (cfs) = 0.1

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.12
0.167	6.4	0.11
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 4.0
Q50 w/carry-over (cfs) = 4.1
Velocity (ft/sec) = 0
Spread, T (ft) = 9.0 SMF Program. Spread at inlet reduced by slotted drain
Allowable Spread (ft) = 7.5 See Note 3

Inlet location determined by spread criteria for 50-yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 4.1**

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. BRB6	**Sheet**	2	of 2

Grate Interception:

Qi = Cw*P*d^1.5	See Note 3		
		Cw = 3	
Qi max. at 100% Efficiency (cfs) = 8.2	Calc.	P (ft) = 9	Disregard curb side.
		d (ft) = 0.45	
Qi at 50% Efficiency (cfs) = 4.1	SMF Program		
Inlet Bypass (cfs) = 0.0			

Slotted Drain Calculations:

Use 5 ft. of slotted drain on North side of grate to reduce spread at inlet.

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. Sub-basin area includes half of median. Assume future lanes will be added.
3. Allowable spread limited by depth of flow not exceeding height of curb for 10-yr. event.
4. n/a
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 23, page 80.

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : BRB6
     Catch Basin ID                   : 685
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  4.70
     Additional Runoff (cfs)          :  3.0
     Longitudinal Grade (ft/ft)       :  0.0000
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0440
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  3.0 cfs   Qtotal=  3.0 cfs  Flowby dn=  0.0 cfs
Qint  =  3.0 cfs   Depth  =  0.37 ft   Spread=  7.05 ft  Velocity =  0.00 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

     Station                          : BRB6
     Catch Basin ID                   : 685
     Type of Inlet                    :  2.2       Grated Inlet
     Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
     Drainage Area-1 (acres)          :  0.00
     Runoff Coefficient for Area-2    :  0.00
     Drainage Area-2 (acres)          :  0.00
     Runoff Coefficient for Area-3    :  0.00
     Drainage Area-3 (acres)          :  0.00
     Intensity (inch/hr)              :  6.40
     Additional Runoff (cfs)          :  4.1
     Longitudinal Grade (ft/ft)       :  0.0000
     Slope-1 (ft/ft)                  :  0.3333
     Slope-2 (ft/ft)                  :  0.0667
     Slope-3 (ft/ft)                  :  0.0440
     Gutter Width (ft)                :  2.50
     Depression=a (inch)              :  1.00
     Width Depression (ft)            :  2.50
     Area Grate (sq ft)               :  7.00
     Length Perimeter Grate (ft)      :  9.00
     Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  4.1 cfs   Qtotal=  4.1 cfs  Flowby dn=  0.0 cfs
Qint  =  4.1 cfs   Depth  =  0.45 ft   Spread=  8.98 ft  Velocity =  0.00 ft/s
```

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/26/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. BRB10	**Sheet**	1	of 2

Sub-basin Data:

Begin. Sta. = Bell Road Bridge Deck
End Sta. = 10+00 Ramp B
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 950 = 0.180 mi.
Pvmnt. x-slope= 2.0 %
Ave. Slope, S = 2.4 % = 126.72 ft./mi.
Slope at Inlet = 2.63 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	950	49,400	1.13

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.09
0.167	4.7	0.08
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 4.8

Spread, T (ft) = 9.0 SMF Program. See Note 1.
Allowable Spread (ft) = 10

50 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.08
0.167	6.4	0.07
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 6.5
Velocity (ft/sec) = 5.2
Spread, T (ft) = 10.4 SMF Program. Spread at inlet reduced by slotted drain.
Allowable Spread (ft) = 10

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 6.5**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.1% Composite Ave.
Sx = 4.5%
Spread (ft) = 7.5

Pavement Spread, Ts (ft) = 4.0
Pavement x-slope (%) = 2.0
Pavement Flow, Qs (cfs) = 0.32 See Note 7
Gutter Flow, Qw (cfs) = 6.2
Eo = Qw/Q = 0.95

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	12/20/95
Subject	Pavement Drainage	**Checked**	LSM	
Task	Ultimate Design Sub-basin No. BRB10	**Sheet**	2	of 2

Grate Intercept., Qi = Q(Rf*Eo+Rs(1-Eo)) — See Note 4

Rf =	1.0	See Note 5
Rs at 50% Efficiency =	0.04	See Note 6. With 50% clogging, grate length = 1.5'.
Eo =	0.95	
Qi at 50% Efficiency (cfs) =	5.9	Calculated
Qi at 50% Efficiency (cfs) =	4.7	SMF Program - Use
Inlet Bypass (cfs) =	1.8	

Slotted Drain Calculations:

Se = Sx + SwEo — See Note 8

Lt = K*(Q^.42)*(S^.3)*(1/(n*Se))^.6 — See Note 9

a (in.) =	3		
W (ft.)=	2.5	Length for total interception, Lt (ft) =	32.2
Sx (%) =	2.0	Lt at 67% Efficiency (ft) =	48.1
Sw (%) =	10	Length of Slotted Drain used (ft) =	45
Se (%) =	2.0	L/Lt =	0.94
Se (ft/ft) =	0.020	Slotted Drain Intercept. (cfs) =	1.7
n =	0.016	Slotted Drain Bypass (cfs) =	0.1

Notes

1. HEC 12 Software - SMF Engineering Corporation, Phoenix AZ.
2. n/a
3. n/a
4. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn 12, page 56.
5. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 7, page 55.
6. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 8, page 57.
7. Reference FHA, Drainage of Highway Pavements, HEC 12, Chart 3, page 23.
8. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 15, page 60.
9. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 16, page 60.

Output Screen ********** PgUp PgDn Esc

Station	: BRB10	
Catch Basin ID	: 10	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 4.70	
Additional Runoff (cfs)	: 4.8	
Longitudinal Grade (ft/ft)	: 0.0263	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 4.8 cfs Qtotal= 4.8 cfs Flowby dn= 1.0 cfs
Qint = 3.8 cfs Depth = 0.30 ft Spread= 8.96 ft Velocity = 4.44 ft/s

Output Screen ********** PgUp PgDn Esc

Station	: BRB10	
Catch Basin ID	: 10	
Type of Inlet	: 2.2	Grated Inlet
Runoff Coefficient for Area-1	: 0.90	P-1-7/8-4
Drainage Area-1 (acres)	: 0.00	
Runoff Coefficient for Area-2	: 0.00	
Drainage Area-2 (acres)	: 0.00	
Runoff Coefficient for Area-3	: 0.00	
Drainage Area-3 (acres)	: 0.00	
Intensity (inch/hr)	: 6.40	
Additional Runoff (cfs)	: 6.5	
Longitudinal Grade (ft/ft)	: 0.0263	
Slope-1 (ft/ft)	: 0.3333	
Slope-2 (ft/ft)	: 0.0667	
Slope-3 (ft/ft)	: 0.0200	
Gutter Width (ft)	: 2.50	
Depression=a (inch)	: 1.00	
Width Depression (ft)	: 2.50	
Area Grate (sq ft)	: 7.00	
Length Perimeter Grate (ft)	: 9.00	
Length Grate (ft)	: 3.00	Sheet 1

Flowby= 0.0 cfs Qrunoff= 6.5 cfs Qtotal= 6.5 cfs Flowby dn= 1.8 cfs
Qint = 4.7 cfs Depth = 0.33 ft Spread= 10.41 ft Velocity = 4.68 ft/s

Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ 12/26/95
Subject	Pavement Drainage	**Checked**	LSM
Task	Ultimate Design Sub-basin No. BRD4	**Sheet**	1 of 2

Sub-basin Data:

Begin. Sta. = Bell Road Bridge Deck
End Sta. = 4+80 Ramp D
Inlet Condition = On Grade
Kb = 0.02
C = 0.90
Length, L (ft) = 275 = 0.052 mi.
Pvmnt. x-slope= 1.4 %
Ave. Slope, S = 1.2 % = 63.36 ft./mi.
Slope at Inlet = 1.3 %

Area

Width	Length	Area (sf)	Area (ac)
Varies	275	n/a	0.61

P1(10), 1 hr. = 1.65 in.
P1(50), 1 hr. = 2.22 in.

Design Events:

Carry over from upstream inlet (cfs) = 0

10 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	3.4	0.06
0.167	4.7	0.05
Use minimum Tc of 10 min. i = 4.7		

Q10 (cfs) = CiA = 2.6

Spread, T (ft) = 9.7 SMF Program. See Note 1.
Allowable Spread (ft) = 14

50 Year Event:

Tc = 11.4*(L^.5)*(Kb*^.52)*(S^-.31)*(i^-.38)

Trial Tc, hr.	i, in/hr.	Calc Tc, hr.
0.33	4.65	0.05
0.167	6.4	0.05
Use minimum Tc of 10 min. i = 6.4		

Q50 (cfs) = CiA = 3.5
Velocity (ft/sec) = 2.9
Spread, T (ft) = 11.4 SMF Program.
Allowable Spread (ft) = 14

Inlet location determined by spread criteria for 50 yr. event.
Inlet size based on 50-yr. design storm: **Q (cfs) = 3.5**

Inlet Design

Flow Distribution at Depressed Inlet:

Depression = 1"
Sx1 = 38.9% See Note 7
Sx2 = 5.3% Composite Ave.
Sx = 4.7%
Spread (ft) = 6.5

Pavement Spread, Ts (ft) = 3.0
Pavement x-slope (%) = 1.4
Pavement Flow, Qs (cfs) = 0.10 See Note 7
Gutter Flow, Qw (cfs) = 3.4
Eo = Qw/Q = 0.97

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : BRD4
      Catch Basin ID                   : 480
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  4.70
      Additional Runoff (cfs)          :  2.6
      Longitudinal Grade (ft/ft)       :  0.0130
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0140
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  2.6 cfs   Qtotal=  2.6 cfs  Flowby dn=  0.2 cfs
Qint  =  2.4 cfs   Depth  =  0.27 ft   Spread=  9.66 ft  Velocity =  2.81 ft/s
```

```
Output Screen   ********************************   PgUp   PgDn   Esc

      Station                          : BRD4
      Catch Basin ID                   : 480
      Type of Inlet                    :  2.2       Grated Inlet
      Runoff Coefficient for Area-1    :  0.90      P-1-7/8-4
      Drainage Area-1 (acres)          :  0.00
      Runoff Coefficient for Area-2    :  0.00
      Drainage Area-2 (acres)          :  0.00
      Runoff Coefficient for Area-3    :  0.00
      Drainage Area-3 (acres)          :  0.00
      Intensity (inch/hr)              :  6.40
      Additional Runoff (cfs)          :  3.5
      Longitudinal Grade (ft/ft)       :  0.0130
      Slope-1 (ft/ft)                  :  0.3333
      Slope-2 (ft/ft)                  :  0.0667
      Slope-3 (ft/ft)                  :  0.0140
      Gutter Width (ft)                :  2.50
      Depression=a (inch)              :  1.00
      Width Depression (ft)            :  2.50
      Area Grate (sq ft)               :  7.00
      Length Perimeter Grate (ft)      :  9.00
      Length Grate (ft)                :  3.00                    Sheet    1
Flowby=  0.0 cfs   Qrunoff=  3.5 cfs   Qtotal=  3.5 cfs  Flowby dn=  0.5 cfs
Qint  =  3.0 cfs   Depth  =  0.29 ft   Spread= 11.38 ft  Velocity =  2.92 ft/s
```

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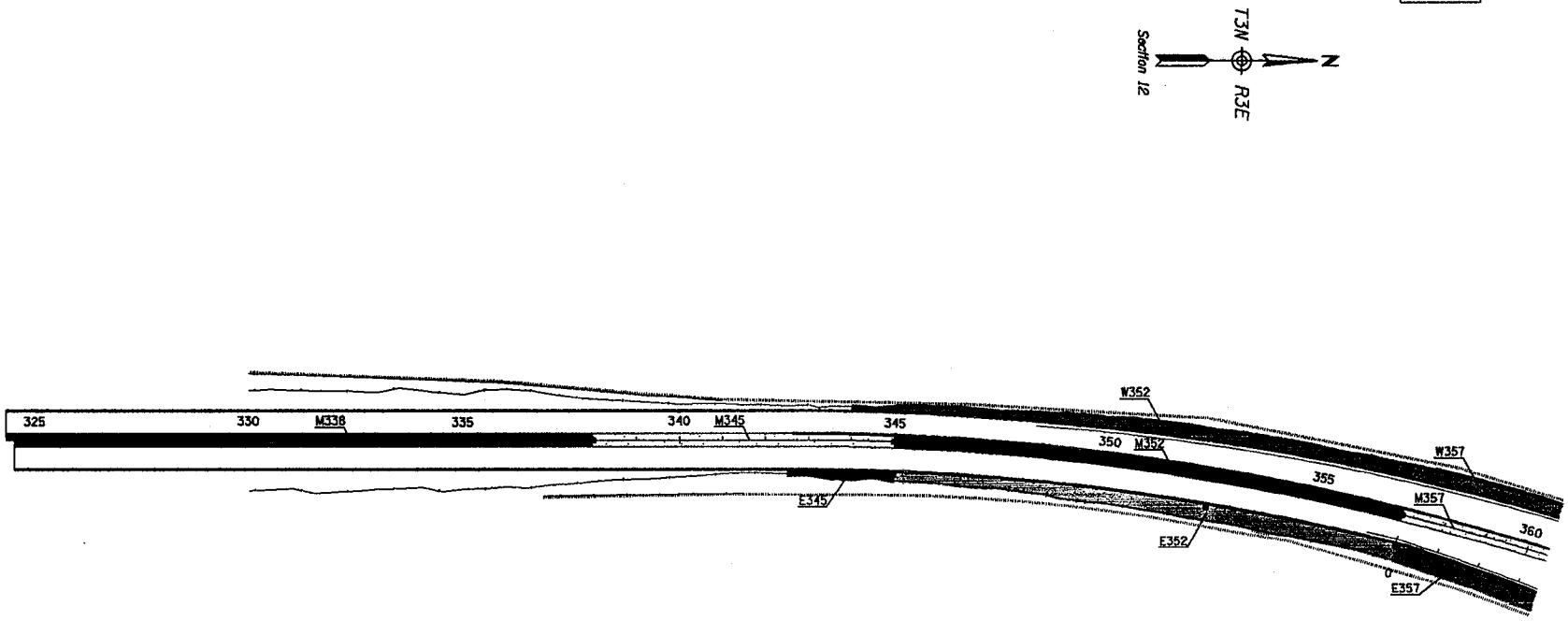
9	ARIZ.	600-2-522			

051-MA-011



60% SUBMITTAL

	NAME	DATE
DESIGN	JJ	
DRAWN	BH	
CHECKED		

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

SR 51
ON-SITE DRAINAGE SUBBASINS
Sta. 322+00 to 360+50

ROUTE: SR 51 LOCATION: THUNDERBIRD ROAD TO BELL ROAD

PRELIMINARY
NOT FOR
CONSTRUCTION
OR
RECORDING

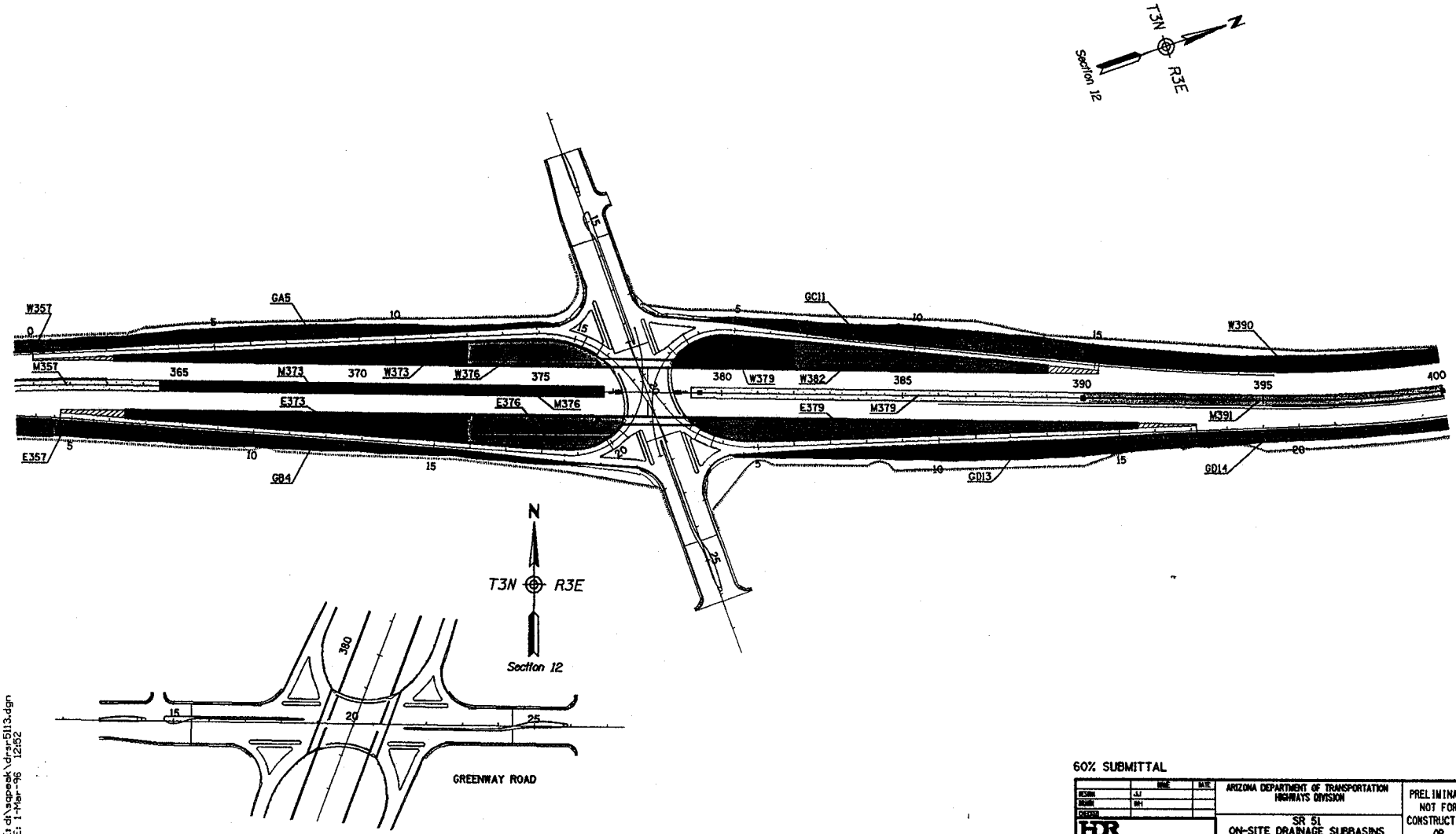
SHEET 0- OF

FILE: d:\agpeak\drsr5112.dgn
DATE: 1-Mar-96 12:52

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

F.A.H.S.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			

051-MA-011



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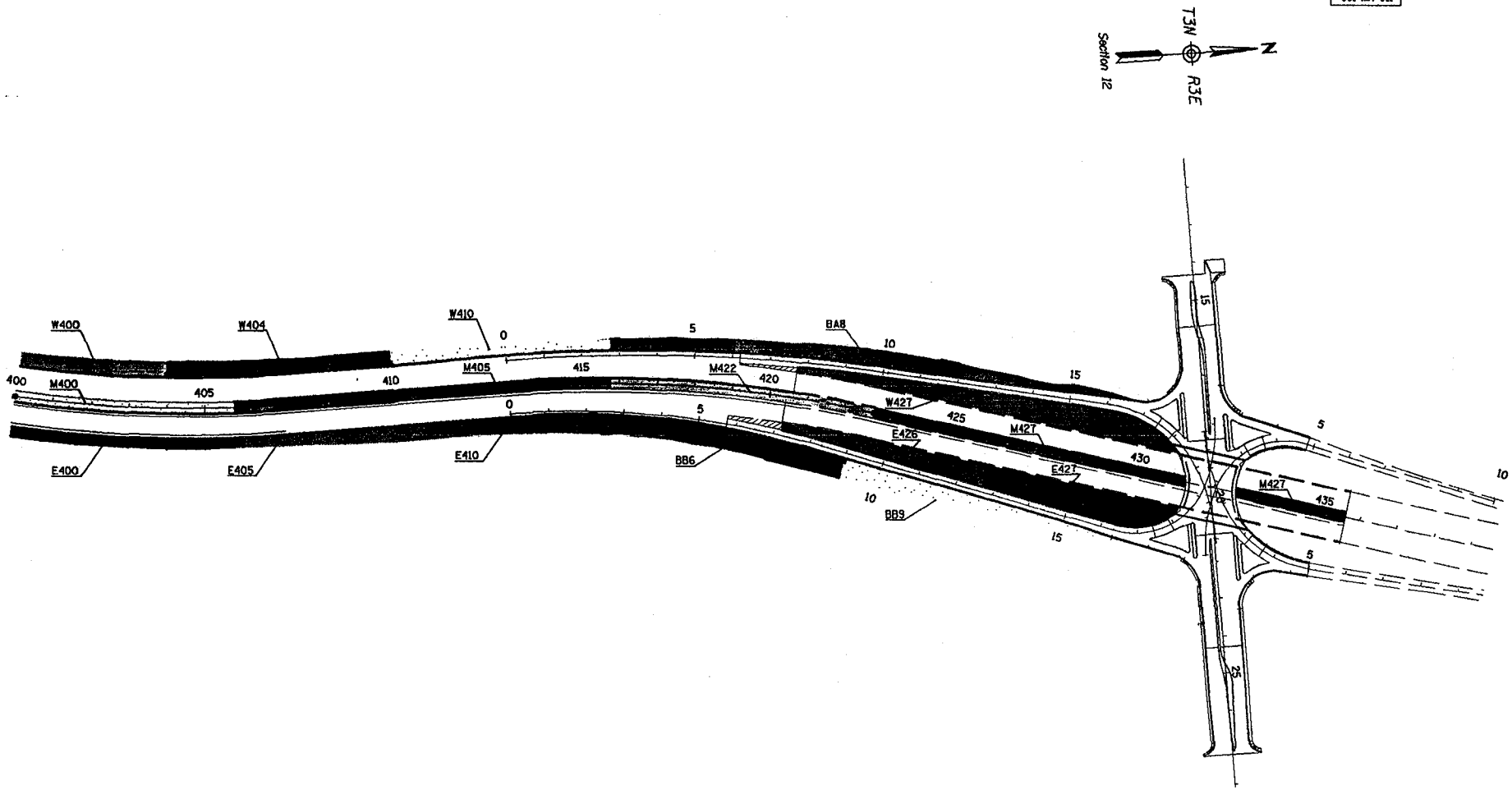
	NAME	DATE	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION	PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING
DESIGN	JJ			
DRAWN	WH			
CHECKED				
HDR Engineering, Inc.			SR 51 ON-SITE DRAINAGE SUBBASINS Sta. 360+50 to 400+00	
ROUTE SR 51	LOCATION THUNDERBIRD ROAD TO BELL ROAD			SHEET D- OF

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	600-2-522			
		051-MA-011			



60% SUBMITTAL

	NAME	DATE	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION	PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING
DESIGN	JJ		SR 51 ON-SITE DRAINAGE SUBBASINS Sta 400+00 to 438+00	
DRAWN	WH			
CHECKED				
HDR Engineering, Inc.				
ROUTE SR 51	LIGHTING		THUNDERBIRD ROAD TO BELL ROAD	SHEET D- OF

FILE: d:\sapeek\dran5114.dgn
DATE: 1-Mar-96 12:53

TRACS NO. H 4047 01C | 600-2-522 | ___ OF ___

SR-51
Summary Table
Median Inlets

Feb. 29,1996

Area Desig.	Inlet Station	Offset	Subbasin Data Width (ft)	Length (ft)	Area (ac)	Ave. Slope (%)	Slope at Inlet (%)	Tc (use)	i (in./hr.)	Design Storm
M338	338+00	0' RT.	30	1600	1.10	0.7	0.7	10 min.	6.4	50-yr.
M345	345+00	0' RT.	30	700	0.48	0.7	0.5	10 min.	6.4	50-yr.
M352	352+42.06	0' RT.	30	1200	0.83	0.3	0.0	10 min.	6.4	50-yr.
M357	357+00	0' RT.	30	744	0.51	0.3	0.4	10 min.	6.4	50-yr.
M373	373+00	0' RT.	30	856	0.59	0.4	0.6	10 min.	6.4	50-yr.
M376	376+60.73	0' RT.	30	400	0.28	0.4	0.0	10 min.	6.4	50-yr.
M381	381+00	0' RT.	30	1100	0.76	1.2	1.0	10 min.	6.4	50-yr.
M390	390+00	0' RT.	30	1000	0.69	0.9	1.7	10 min.	6.4	50-yr.
M400	400+00	0' RT.	30	500	0.34	0.6	0.5	10 min.	6.4	50-yr.
M405	405+75	0' RT.	30	1002	0.69	0.3	0.5	10 min.	6.4	50-yr.
M422	422+80	0' RT.	30	703	0.48	0.3	0.4	10 min.	6.4	50-yr.
M427	427+09.09	0' RT.	30	1280	0.88	0.3	0.0	10 min.	6.4	50-yr.

Area Desig.	Inlet Station	Q (cfs)	Carryover (cfs)	Design Q (cfs)	Inlet Stnd.	Intercept. (cfs)	Flowby (cfs)	Grate Elevation	Notes
M338	338+00	4.94	0.00	4.94	C-15.80	4.94	0.00	1415.29	
M345	345+00	2.16	0.00	2.16	C-15.80	2.16	0.00	1410.47	
M352	352+42.06	3.70	0.00	3.70	C-15.80	3.70	0.00	1407.91	Sag Location
M357	357+00	2.30	0.00	2.30	C-15.80	2.30	0.00	1408.70	
M373	373+00	2.64	0.00	2.64	C-15.80	2.64	0.00	1407.93	
M376	376+60.73	1.23	0.00	1.23	C-15.80	1.23	0.00	1406.65	Sag Location
M381	381+00	3.39	0.00	3.39	C-15.80	3.39	0.00	1408.60	
M390	390+00	3.09	0.00	3.09	C-15.80	3.09	0.00	1421.91	
M400	400+00	1.54	0.00	1.54	C-15.80	1.54	0.00	1430.20	
M405	405+75	3.09	0.00	3.09	C-15.80	3.09	0.00	1433.34	
M422	422+80	2.17	0.00	2.17	C-15.80	2.17	0.00	1435.37	
M427	427+09.09	3.95	0.00	3.95	C-15.80	3.95	0.00	1434.47	Sag Location

Notes

a. Use 50% clogging for grated inlets on grade and in sag locations.
b. Assume maximum flow depth at median inlets is 0.4 ft. See Calculation sheet for median inlets.

HDR Engineering, Inc.

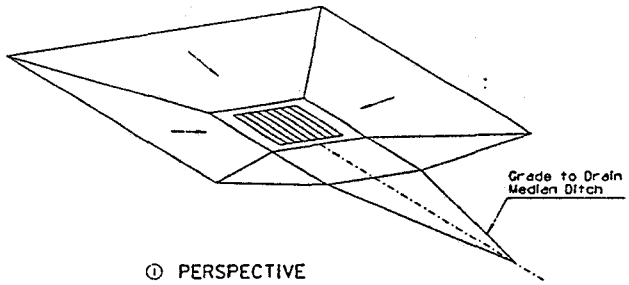
Job No. 00173 088 044 | No.

HDR Engineering, Inc.

Computation

Project	SR-51	Computed	JPJ	1/31/96
Subject	On-Site Drainage	Checked	LSM	
Task	Interim Design - Median Inlets	Sheet	1 of 2	

Use Median Flush Catch Basins per ADOT Standard Drawing C-15.80.



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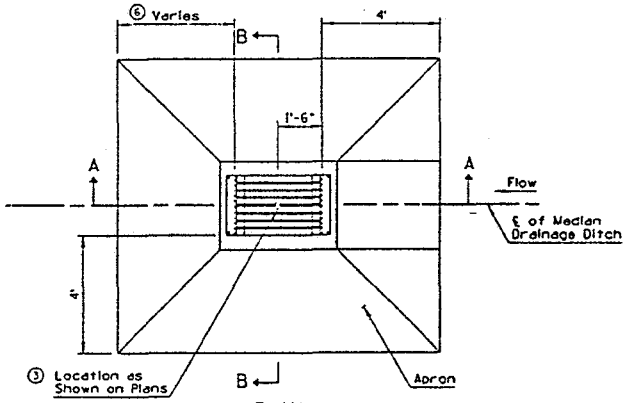

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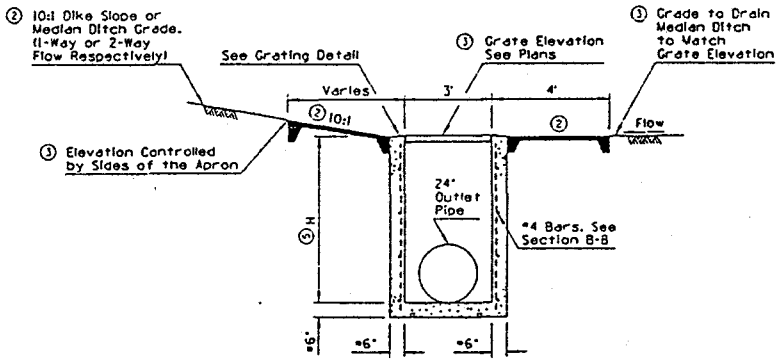


SECTION A-A

Assumptions for Median Inlet Design:

1. A 4' wide concrete apron will be used around each median inlet per ADOT Standard. Drawing C-15.80.
2. For median inlets on-grade, the slope of the concrete apron on the upstream side of the grate shall match the slope of the median v-ditch. The 4' wide apron on the remaining three sides of the grate shall be installed at a 10:1 slope per Standard Drawing C-15.80.
3. The maximum ponding depth is 0.4 feet for inlets on-grade and in sag locations.
4. Use a 50% Clogging Factor for median grate inlets on-grade and in sag locations. Assuming 50% clogging along the length of the grate, the 2' x 3' grate used in C-15.80 has a perimeter of 7'.

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	1/31/96
Subject	On-Site Drainage	**Checked**	LSM	
Task	Interim Design - Median Inlets	**Sheet**	1	of 2

Grate Interception:

Qi = CwPd^1.5 See Note 1 Below.

Cw = 3.0
Maximum depth (ft) = 0.4
Perimeter, P (ft) = 7.0 At 50% clogging. See Note 4 above.

Qi (cfs) = 5.3 At 50% clogging.

Use Maximum inlet interception for median inlets on-grade and in sag locations of 5.3 cfs.

Notes 1. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 17, page 69.

SR-51
Summary Table
On-Site Inlets - V-Ditch on East Side of Mainline

Feb. 29,1996

Area Desig.	Inlet Station	Offset	Subbasin Data Width (ft)	Subbasin Data Length (ft)	Subbasin Data Area (ac)	Ave. Slope (%)	Slope at Inlet (%)	Tc (use)	i (in./hr.)	Design Storm
E345	345+00	75.50' RT.	Varies	245	0.11	0.7	0.5	10 min.	6.4	50-yr.
E352	352+42.06	75.50' RT.	Varies	1200	1.01	0.3	0.0	10 min.	6.4	50-yr.
E357	357+00	75.50' RT.	Varies	450	0.48	0.1	0.4	10 min.	6.4	50-yr.
GB4	4+50 Ramp B	14.50' RT.	Varies	1460	0.93	1.2	0.4	10 min.	6.4	50-yr.
E373	373+00	75.50' RT.	Varies	950	1.03	0.4	0.6	10 min.	6.4	50-yr.
E376	376+60.73	75.50' RT.	Varies	400	0.79	0.1	0.0	10 min.	6.4	50-yr.
E379	379+40	75.50' RT.	Varies	1185	1.09	1.4	0.6	10 min.	6.4	50-yr.
BD13	13+29.47 Ramp D	20.50' RT.	Varies	980	0.76	0.9	0.0	10 min.	6.4	50-yr.
GD14	14+80 Ramp D	18.20' RT.	Varies	1015	0.79	0.1	0.4	10 min.	6.4	50-yr.
E400	400+00	87.50' RT.	Varies	580	0.35	0.5	0.5	10 min.	6.4	50-yr.
E405	405+80	87.50' RT.	Varies	425	0.33	0.5	0.5	10 min.	6.4	50-yr.
E410	410+00	87.50' RT.	Varies	570	0.56	0.3	0.5	10 min.	6.4	50-yr.
BB6	6+85.91 Ramp B	20.50' RT.	Varies	625	0.80	0.9	0.0	10 min.	6.4	50-yr.
BB9	9+00 Ramp B	20.50' RT.	Varies	800	0.54	2.9	1.8	10 min.	6.4	50-yr.
E426	426+00	75.50' RT.	Varies	375	0.50	0.4	0.1	10 min.	6.4	50-yr.
E427	427+09.09	75.50' RT.	Varies	500	0.81	0.1	0.0	10 min.	6.4	50-yr.

Area Desig.	Inlet Station	Q (cfs)	Carryover (cfs)	Design Q (cfs)	Inlet Stnd.	Intercept. (cfs)	Flowby (cfs)	Grate Elevation	Notes
E345	345+00	0.49	0.0	0.5	C-15.80	0.49	0.0	1410.67	
E352	352+42.06	4.52	0.0	4.5	C-15.80	4.52	0.0	1408.57	Sag Location
E357	357+00	2.15	0.0	2.2	C-15.80	2.15	0.0	1409.37	
GB4	4+50 Ramp B	4.17	0.0	4.2	C-15.80	4.17	0.0	1411.30	
E373	373+00	4.61	0.0	4.6	C-15.80	4.61	0.0	1408.53	
E376	376+60.73	3.54	0.0	3.5	C-15.80	3.54	0.0	1407.24	Sag Location
E379	379+40	4.88	0.0	4.9	C-15.80	4.88	0.0	1408.03	Flow-by not Allowed.
BD13	13+29.47 Ramp D	3.40	0.0	3.4	C-15.80	3.40	0.0	1422.33	Sag Location
GD14	14+80 Ramp D	3.54	0.0	3.5	C-15.80	3.54	0.0	1423.10	
E400	400+00	1.57	0.0	1.6	C-15.80	1.57	0.0	1434.97	
E405	405+80	1.48	0.0	1.5	C-15.80	1.48	0.0	1437.16	
E410	410+00	2.51	0.0	2.5	C-15.80	2.51	0.0	1436.71	
BB6	6+85.91 Ramp B	3.58	0.0	3.6	C-15.80	3.58	0.0	1435.09	Sag Location
BB9	9+00 Ramp B	2.42	0.0	2.4	C-15.80	2.42	0.0	1435.27	
E426	426+00	2.24	0.0	2.2	C-15.80	2.24	0.0	1435.39	
E427	427+09.09	3.63	0.0	3.6	C-15.80	3.63	0.0	1435.28	Sag Location

Notes

a. Use 50% clogging for grated inlets on grade and in sag locations.
b. Assume maximum flow depth at median inlets is 0.4 ft. See Calculation sheet for on-site inlets on east and west side of mainline.

HDR Engineering, Inc.

SR-51
Summary Table
On-Site Inlets - V-Ditch on West Side of Mainline

Feb. 29,1996

Area Desig.	Inlet Station	Offset	Subbasin Data Width (ft)	Length (ft)	Area (ac)	Ave. Slope (%)	Slope at Inlet (%)	Tc (use)	i (in./hr.)	Design Storm
W352	352+42.06	80.43' LT.	Varies	1300	0.82	0.3	0.0	10 min.	6.4	50-yr.
W357	357+00	93.00' LT.	Varies	470	0.34	0.2	0.4	10 min.	6.4	50-yr.
GA5	5+51.80 Ramp A	20.50 LT.	Varies	1400	0.87	0.1	0.0	10 min.	6.4	50-yr.
W373	373+00	75.50' LT.	Varies	985	0.81	0.4	0.6	10 min.	6.4	50-yr.
W376	376+60.73	75.50' LT.	Varies	400	0.53	0.1	0.0	10 min.	6.4	50-yr.
W379	379+40	75.50' LT.	Varies	320	0.59	0.8	0.6	10 min.	6.4	50-yr.
W382	382+00	75.50' LT.	Varies	700	0.75	1.6	1.1	10 min.	6.4	50-yr.
GC11	11+41.86 Ramp C	14.50' LT.	Varies	1050	0.98	1.4	0.0	10 min.	6.4	50-yr.
W390	390+00	109.55' LT.	Varies	1000	0.98	0.9	1.4	10 min.	6.4	50-yr.
W400	400+00	87.50' LT.	Varies	400	0.35	0.5	0.5	10 min.	6.4	50-yr.
W404	404+00	87.50' LT.	Varies	600	0.52	0.5	0.5	10 min.	6.4	50-yr.
W410	410+00	87.50' LT.	Varies	600	0.41	0.3	0.5	10 min.	6.4	50-yr.
BA8	8+46.33 Ramp A	20.50' LT.	Varies	1400	0.99	0.1	0.0	10 min.	6.4	50-yr.
W427	427+09.09	75.50' LT.	Varies	1040	0.99	0.3	0.0	10 min.	6.4	50-yr.

Area Desig.	Inlet Station	Q (cfs)	Carryover (cfs)	Design Q (cfs)	Inlet Stnd.	Intercept. (cfs)	Flowby (cfs)	Grate Elevation	Notes
W352	352+42.06	3.67	0.0	3.67	C-15.80	3.67	0.0	1411.59	Sag Location
W357	357+00	1.52	0.0	1.52	C-15.80	1.52	0.0	1412.65	
GA5	5+51.80 Ramp A	3.90	0.0	3.90	C-15.80	3.90	0.0	1413.60	Sag Location
W373	373+00	3.63	0.0	3.63	C-15.80	3.63	0.0	1408.53	
W376	376+60.73	2.37	0.0	2.37	C-15.80	2.37	0.0	1407.24	Sag Location
W379	379+40	2.64	0.0	2.64	C-15.80	2.64	0.0	1408.03	Flow-by not Allowed
W382	382+00	3.36	0.0	3.36	C-15.80	3.36	0.0	1410.19	
GC11	11+41.86 Ramp C	4.39	0.0	4.39	C-15.80	4.39	0.0	1418.69	Sag Location
W390	390+00	4.39	0.0	4.39	C-15.80	4.39	0.0	1421.93	
W400	400+00	1.57	0.0	1.57	C-15.80	1.57	0.0	1429.87	
W404	404+00	2.33	0.0	2.33	C-15.80	2.33	0.0	1432.05	
W410	410+00	1.84	0.0	1.84	C-15.80	1.84	0.0	1436.71	
BA8	8+46.33 Ramp A	4.44	0.0	4.44	C-15.80	4.44	0.0	1441.45	Sag Location
W427	427+09.09	4.44	0.0	4.44	C-15.80	4.44	0.0	1435.27	Sag Location

Notes

a. Use 50% clogging for grated inlets on grade and in sag locations.
b. Assume maximum flow depth at median inlets is 0.4 ft. See Calculation sheet for on-site inlets on east and west side of mainline.

HDR Engineering, Inc.

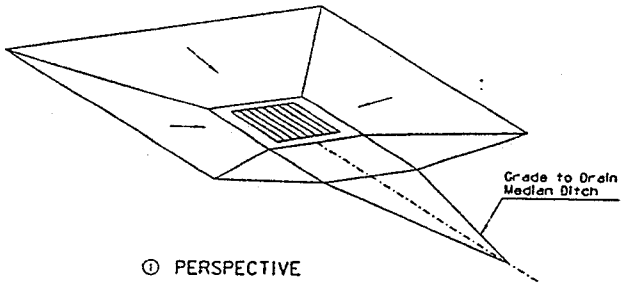
Job No. 00173 088 044 | No.

HDR Engineering, Inc.

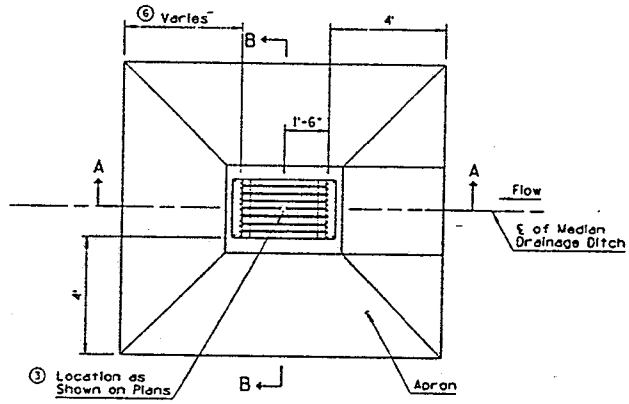
Computation

Project	SR-51	**Computed**	JPJ	2/8/96
Subject	On-Site Drainage	**Checked**	LSM	
Task	V-Ditch Inlets - E. & W. of Mainline	**Sheet**	1 of 2	

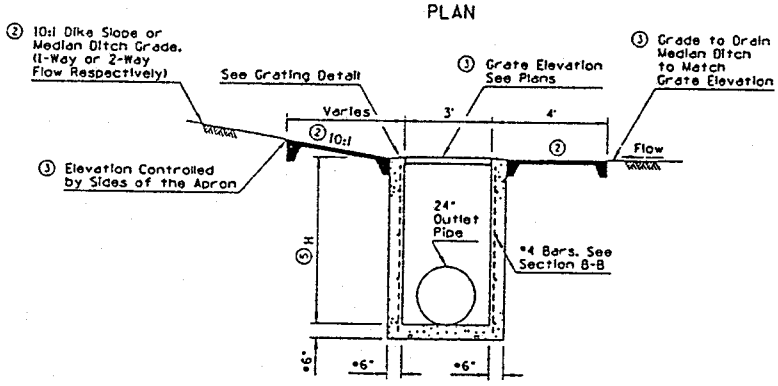
Use Flush Catch Basins per ADOT Standard Drawing C-15.80.



① PERSPECTIVE



PLAN



SECTION A-A

Assumptions for Inlet Design:

1. A 4' wide concrete apron will be used around each inlet per ADOT Standard. Drawing C-15.80.
2. For inlets on-grade, the slope of the concrete apron on the upstream side of the grate shall match the slope of the v-ditch. The 4' wide apron on the remaining three sides of the grate shall be installed at a 10:1 slope per Standard Drawing C-15.80.
3. The maximum ponding depth is 0.4 feet for inlets on-grade and in sag locations.
4. Use a 50% Clogging Factor for grate inlets on-grade and in sag locations. Assuming 50% clogging along the length of the grate, the 2' x 3' grate used in C-15.80 has a perimeter of 7'.

Job No.	00173 088 044	No.

HDR Engineering, Inc.

Computation

Project	SR-51	**Computed**	JPJ	2/8/96
Subject	On-Site Drainage	**Checked**	LSM	
Task	V-Ditch Inlets - E. & W. of Mainline	**Sheet**	1	of 2

Grate Interception:

Qi = CwPd^1.5		See Note 1 Below.
Cw =	3.0	
Maximum depth (ft) =	0.4	
Perimeter, P (ft) =	7.0	At 50% clogging. See Note 4 above.
Qi (cfs) =	5.3	At 50% clogging.

Use Maximum inlet interception for v-ditch inlets on-grade and in sag locations of 5.3 cfs.

Notes

1. Reference FHA, Drainage of Highway Pavements, HEC 12, Eqn. 17, page 69.

APPENDIX D

Custom Report

Pipe	Length (ft)	-Section- Shape Size	Discharge (cfs)	Average Velocity (ft/s)	-Depth- Upstream Downstream (ft)	-Node- Upstream Downstream	-Invert- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-EGL- Upstream Downstream (ft)	-Cover- Upstream Downstream (ft)
Pipe 14	224.74	Circular	62.36	2.51	4.88	MH 14	1,400.45	0.000185	1,409.50	1,405.33	1,405.43	3.05
		72 inch			4.97	MH 13	1,400.32	0.000578	1,410.00	1,405.29	1,405.39	3.68
Pipe 13	650.32	Circular	81.86	2.50	5.40	MH 13	1,399.82	0.000149	1,410.00	1,405.22	1,405.32	3.18
		84 inch			5.70	MH 12	1,399.43	0.000600	1,412.00	1,405.13	1,405.23	5.57
Pipe 12	249.94	Circular	89.66	2.68	5.63	MH 12	1,399.43	0.000172	1,412.00	1,405.06	1,405.17	5.57
		84 inch			5.74	MH 11	1,399.28	0.000600	1,414.00	1,405.02	1,405.13	7.72
Pipe 11	99.54	Circular	89.66	2.68	5.66	MH 11	1,399.28	0.000172	1,414.00	1,404.94	1,405.05	7.72
		84 inch			5.70	MH 10	1,399.22	0.000603	1,415.00	1,404.92	1,405.03	8.78
Pipe 10	262.90	Circular	89.66	2.68	5.62	MH 10	1,399.22	0.000171	1,415.00	1,404.84	1,404.96	8.78
		84 inch			5.74	MH 9	1,399.06	0.000609	1,416.00	1,404.80	1,404.91	9.94
Pipe 9	356.32	Circular	104.46	3.11	5.63	MH 9	1,399.06	0.000231	1,416.00	1,404.69	1,404.85	9.94
		84 inch			5.77	MH 8	1,398.85	0.000589	1,415.00	1,404.62	1,404.77	9.15
Pipe 8	465.81	Circular	110.96	3.29	5.65	MH 8	1,398.85	0.000259	1,415.00	1,404.50	1,404.67	9.15
		84 inch			5.82	MH 7	1,398.57	0.000601	1,413.50	1,404.39	1,404.55	7.93
Pipe 7	246.36	Circular	128.16	3.83	5.65	MH 7	1,398.57	0.000349	1,413.50	1,404.22	1,404.45	7.93
		84 inch			5.72	MH 6	1,398.42	0.000609	1,412.00	1,404.14	1,404.37	6.58
Pipe 6	202.69	Circular	132.96	4.05	5.54	MH 6	1,398.42	0.000392	1,412.00	1,403.96	1,404.22	6.58
		84 inch			5.59	MH 5	1,398.30	0.000592	1,412.50	1,403.89	1,404.14	7.20
Pipe 5	403.57	Circular	134.36	4.19	5.39	MH 5	1,398.30	0.000420	1,412.50	1,403.69	1,403.97	7.20
		84 inch			5.47	MH 4	1,398.06	0.000595	1,414.00	1,403.53	1,403.80	8.94
Pipe 4	403.57	Circular	134.36	4.13	5.47	MH 4	1,398.06	0.000407	1,414.00	1,403.53	1,403.80	8.94
		84 inch			5.56	MH 3	1,397.82	0.000595	1,414.00	1,403.38	1,403.64	9.18
Pipe 3	269.30	Circular	136.96	4.32	5.35	MH 3	1,397.82	0.000447	1,414.00	1,403.17	1,403.46	9.18
		84 inch			5.41	MH 2	1,397.65	0.000631	1,413.00	1,403.06	1,403.34	8.35
Pipe 2	490.65	Circular	153.76	5.11	5.12	MH 2	1,397.65	0.000634	1,413.00	1,402.77	1,403.18	8.35
		84 inch			5.10	MH 1	1,397.36	0.000591	1,411.00	1,402.46	1,402.87	6.64
Pipe 1	490.65	Circular	153.76	5.13	5.10	MH 1	1,397.36	0.000642	1,411.00	1,402.46	1,402.87	6.64
		84 inch			5.08	Outlet	1,397.07	0.000601	1,406.00	1,402.14	1,402.55	1.93

Custom Report

Pipe	Length (ft)	-Section- Shape Size	Discharge (cfs)	Average Velocity (ft/s)	-Depth- Upstream Downstream (ft)	-Node- Upstream Downstream	-Invert- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-EGL- Upstream Downstream (ft)	-Cover- Upstream Downstream (ft)
Pipe 24	108.14	Circular	2.00	1.06	1.01	CB	1,415.06	0.000163	1,419.00	1,416.07	1,416.10	1.94
		24 inch			1.38	MH 23	1,414.69	0.003421	1,418.50	1,416.07	1,416.08	1.81
Pipe 23	53.80	Circular	8.79	4.57	1.06	MH 23	1,414.59	0.018429	1,418.50	1,415.65	1,416.07	1.91
		24 inch			1.34	MH 22	1,413.50	0.020260	1,417.50	1,414.84	1,415.08	2.00
Pipe 22	191.86	Circular	8.79	4.19	1.06	MH 22	1,413.40	0.012328	1,417.50	1,414.46	1,414.88	2.10
		24 inch			1.65	MH 21	1,410.71	0.014021	1,414.50	1,412.36	1,412.51	1.79
Pipe 21	284.60	Circular	12.99	5.61	1.30	MH 21	1,410.61	0.015027	1,414.50	1,411.91	1,412.47	1.89
		24 inch			1.49	MH 20	1,406.29	0.015179	1,410.10	1,407.78	1,408.19	1.81
Pipe 20	100.00	Circular	16.35	4.62	1.29	MH 20	1,406.19	0.006472	1,410.10	1,407.48	1,407.97	0.91
		36 inch			1.83	MH 19	1,405.29	0.009000	1,409.10	1,407.12	1,407.32	0.81
Pipe 19	160.00	Circular	22.15	4.93	1.51	MH 19	1,405.19	0.003578	1,409.10	1,406.70	1,407.30	0.91
		36 inch			2.39	MH 18	1,404.13	0.006625	1,408.10	1,406.52	1,406.73	0.97
Pipe 18	74.07	Circular	27.57	4.47	2.27	MH 18	1,404.03	0.001466	1,408.10	1,406.30	1,406.66	1.07
		36 inch			2.68	MH 17	1,403.61	0.005670	1,407.90	1,406.29	1,406.55	1.29
Pipe 17	65.93	Circular	27.57	4.19	2.53	MH 17	1,403.61	0.001323	1,407.90	1,406.14	1,406.43	1.29
		36 inch			2.76	MH 16	1,403.33	0.004247	1,407.50	1,406.09	1,406.34	1.17
Pipe 16	139.27	Circular	30.87	4.80	2.66	MH 16	1,403.23	0.001707	1,407.50	1,405.89	1,406.22	1.27
		36 inch			2.48	MH 15	1,403.13	0.000718	1,407.20	1,405.61	1,405.99	1.07
Pipe 15	135.00	Circular	62.36	6.64	2.38	MH 15	1,402.53	0.003482	1,407.20	1,404.91	1,405.90	0.67
		48 inch			3.55	MH 14	1,401.45	0.008000	1,409.50	1,405.00	1,405.43	4.05