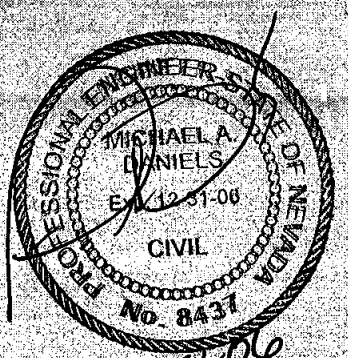
C.D. ENG.
JAN 3 1 2006
RENO

HYDROLOGY REPORT
for
SILVER CREEK APARTMENTS

prepared for

Arnaiz Development
3158 Auto Center Circle, Suite E
Stockton, CA 95212



1-31-06

prepared by

SUMMIT ENGINEERING CORPORATION
5405 Mae Anne Avenue
Reno, NV 89523

2/10/99

February 1999

INTRODUCTION

The following report represents the hydrology analysis for the proposed Silver Creek Apartments (SCA) development located on a portion of Assessor's Parcel # 39-112-13, Reno, Nevada. SCA consists of 374 multi-family dwellings within 29 buildings on a 26 acre site located within Section 7, Township 19 North, Range 19 East, M.D.M. This site lies east of Mae Anne Avenue, south of Sharlands Avenue, and north of the existing Interstate 80.

RATIONAL HYDROLOGY METHODOLOGY

The on-site 5-year and 100-year event hydrology was determined using the Rational Method equation, Q=C*I*A where;

Q = Runoff in cfs.
A = The drainage area in acres.
Tc = Time of concentration in minutes.
C = Runoff coefficient.
I = Rainfall intensity in inches per hour.

The time of concentrations is calculated based on the equation

$$tc = 10 \text{ min. or } \frac{L}{V \times 60}$$

where L = the travel distance, feet
V = channel or overland velocity, feet per second

Due to short travel distances on this project, the minimum tc of 10 minutes was used in all cases.

Rainfall intensities were obtained from the rainfall intensity-duration-frequency curves for Reno, which are contained in the City of Reno Public Works Design Manual. For Tc = 10 minutes, the

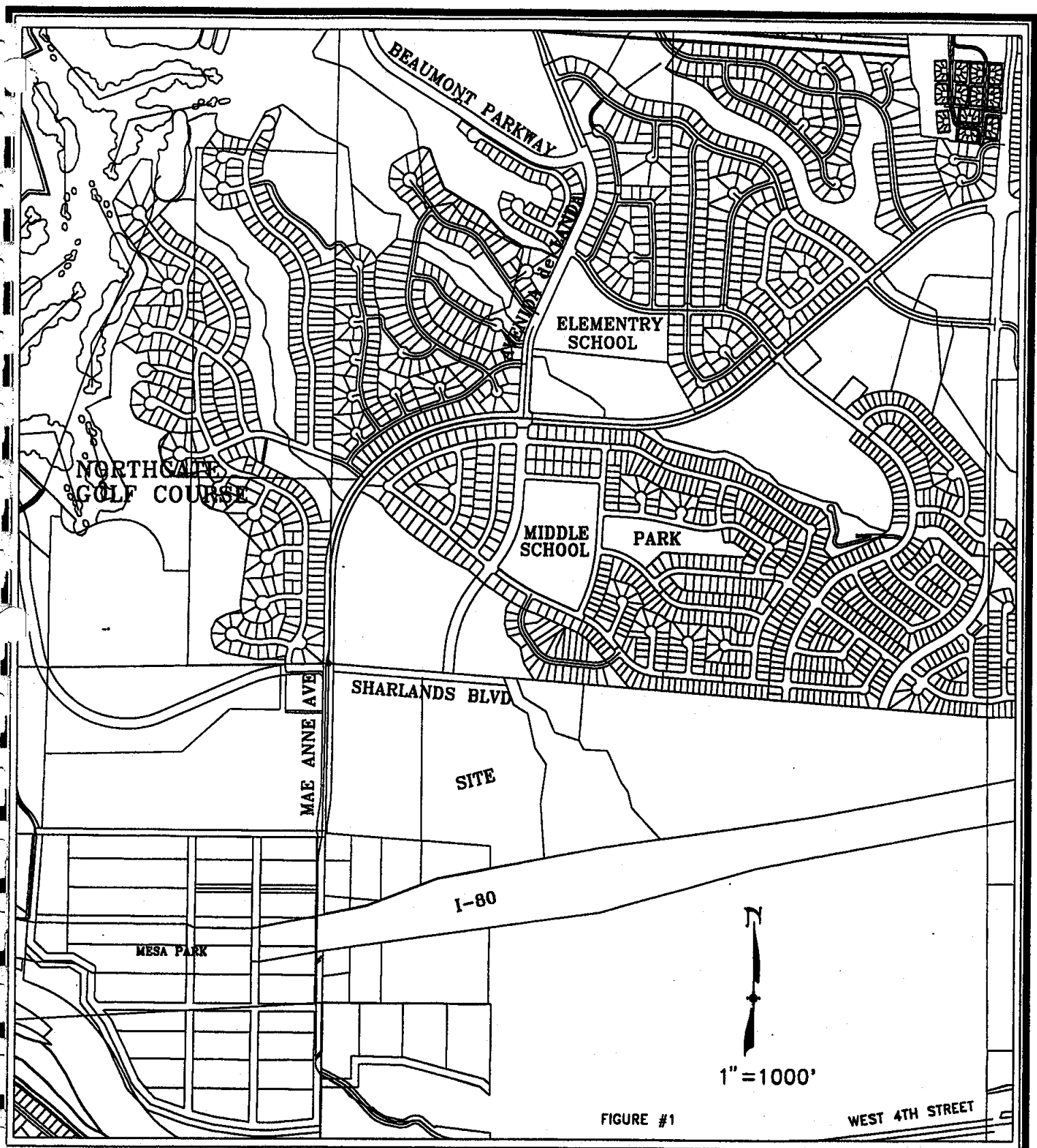


FIGURE #1

SILVER CREEK APARTMENTS VICINITY MAP

1"=1000'

10:44 AM * 10-FEB-1999

J:\DWGS\VMAPS\NGVMAP.DWG

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SHEET 1 OF 1

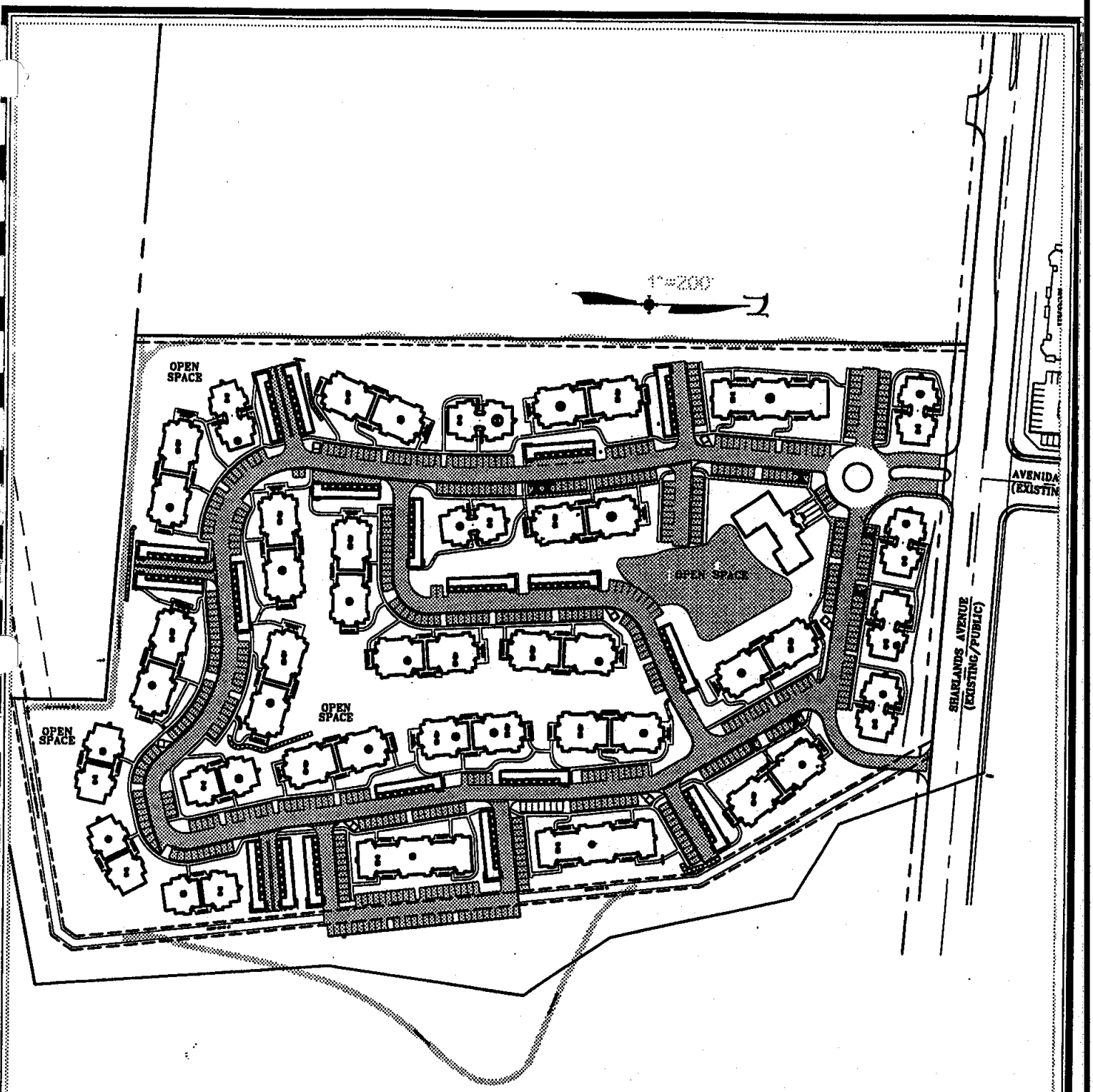

FIGURE #2

SILVER CREEK APARTMENTS
SITE PLAN

1"=200'

FEB. 10 1999

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SHEET 1

OF 1

rainfall intensities are I_5 = 1.4 in/hr (5-year), and I_{100} - 3.8 in/hr (100-year).

Runoff coefficients (c) were obtained for the proposed land uses from the City of Reno Public Works Design Manual. Runoff coefficients of C=0.30 were used for existing and proposed conditions and weighted C value was used for the developed condition.

EXISTING HYDROLOGY

The 26.24 acre site slopes form the west to the east with slopes varying from 2% to 15%. The site is sparsely vegetated. In an undeveloped state, storm water runoff drains to an existing major drainage way located roughly 300 feet east of the site. This drainage flows toward Interstate 80 and flows through existing culverts under I-80.

This existing drainage for which this site drains is extremely large being impacted by runoff from portions of the Peavine Mountain Range. It is highly likely that the peak flows from this site will have passed prior to the peak of the entire basin passing this area. Barring this, the site has been designed with on-site detention such that peak flows are not increased. Table #1 outlines the 5-year and 100-year peak flow calculations.

TABLE #1
EXISTING HYDROLOGY

AREA DESIGNATION	AREA (acres)	T_c (min)	RUNOFF COEFFICIENT	INTENSITY I_5/I_{100} (in/hr)	Q_5/Q_{100} (cfs)
A	26.24	10	0.30	1.4/3.8	11.02/29.91

PROPOSED HYDROLOGY

With development, the 26.24 acre site will be subdivided into 17 subareas which will discharge into Detention Pond #1, 4 subareas that discharge to Detention Pond #2 and 3 subareas that discharge directly off-site (ref. the 30 x 42 map in the map pocket of this report. Table #2 outlines the Rational Method calculations.

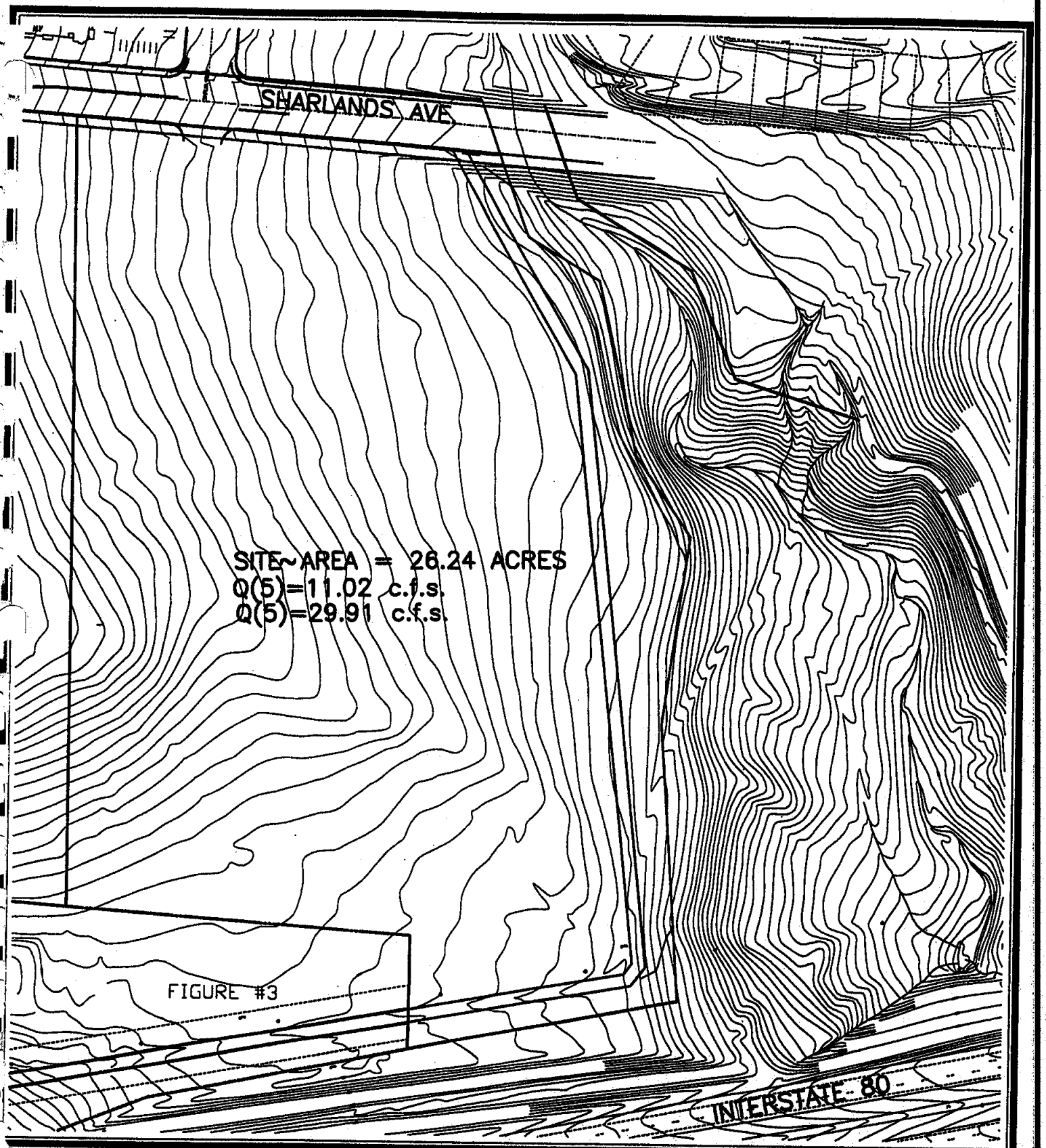

FIGURE #3

ILVER CREEK APARTMENTS
EXISTING HYDROLOGY

1"=200'

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SHEET 1 OF 1

TABLE #2

Area	C	I_5/I_{100}	A (acres)	Q_5 (cfs)	Q_{100} (cfs)
TO POND #1					
A-1	0.65	1.4/3.8	0.47	0.43	1.16
A-2	0.65	1.4/3.8	0.29	0.26	0.72
A-3	0.44	1.4/3.8	1.43	0.89	2.41
A-4	0.39	1.4/3.8	1.72	0.94	2.55
A-5	0.65	1.4/3.8	1.61	1.47	3.98
B-1	0.65	1.4/3.8	2.30	2.09	5.68
B-2	0.65	1.4/3.8	0.08	0.07	0.20
B-3	0.65	1.4/3.8	0.96	0.87	2.37
B-4	0.65	1.4/3.8	0.09	0.08	0.22
B-5	0.65	1.4/3.8	0.73	0.66	1.80
B-6	0.65	1.4/3.8	0.14	0.13	0.35
B-7	0.5	1.4/3.8	2.52	1.76	4.79
B-8	0.5	1.4/3.8	1.50	1.37	3.71
B-9	0.5	1.4/3.8	0.15	0.14	0.37
B-10	0.5	1.4/3.8	0.75	0.69	1.85
B-11	0.5	1.4/3.8	0.41	0.38	1.01
		TOTAL	15.15 acres	TOTAL	34.29 cfs
TO POND #2					
C-1	0.65	1.4/3.8	1.10	1.00	2.72
C-2	0.65	1.4/3.8	0.26	0.24	0.64
C-3	0.65	1.4/3.8	0.93	0.85	2.30
C-4	0.65	1.4/3.8	0.99	0.90	2.22
		TOTAL	3.28 acres	TOTAL	7.88 cfs

Area	C	I_5/I_{100}	A (acres)	Q_5 (cfs)	Q_{100} (cfs)
DRAIN OFF-SITE					
D	0.65	1.4/3.8	1.35	1.23	3.33
E	0.77	1.4/3.8	3.53	3.21	8.72
F	0.38	1.4/3.8	2.93	1.56	4.23
		TOTAL	7.81 acres	TOTAL	16.28 cfs

The storm drain system perpetuates the 5-year storm and the 100-year storm with minimum CB overflows during the 100-year storm. The following outlines the calculations used in the system's design.

TABLE #3
CATCH BASIN CAPACITIES

		CFS
A-1	sump/Type 3	6.59
A-2	sump/Type 3	5.75
A-3	Dual Type 4-R	3.26 (5)/4.82 (100)
A-4	sump/Type 3	2.58
A-5	Type 4-R	2.36 (5)/3.56 (100)
B-1	Type 4-%	2.39 (5)/4.02 (100)
B-2	Type 3	Q_{cap}=6.20
B-3	Type 3	1.25 (5)/3.00 (100)
B-4	sump/Type 3	3.47
B-5	Type 4-R	1.57 (5)/4.24 (100)
B-6	Type 3	5.66
B-7	sump/Type 3	5.86
B-8	Type 4-R	1.53 (5)/2.92 (100)
B-9	sump/Type 3	4.04

		CFS
B-10	sump/Type 3	4.13
C-1	Type 4-R	2.31 (5)/3.56 (100)
C-2	sump/Type 3	5.75
C-3	Type 4-R	1.77 (5)/2.65 (100)
C-4		

TABLE #4

LENGTH	PIPE SIZE (inches)	SLOPE %	Q_5 (cfs)	Q_{100} (cfs)	Q_{cap} (cfs)
CB (A-1) to MH #1	10	2.4	0.43	1.16	3.2
CB (A-2) to MH #1	12	2.24	0.26	0.72	5.4
CB (A-3) to Pipe 1	10	3.78	0.84	2.41	3.96
MH #1 to MH #23	12	4.35	1.99	4.29	7.0
MH #3 to MH #4	12	4.35	1.99	4.29	7.0
MH #4 to MH #5	12	1.7	1.99	4.29	4.35
MH #5 to MH #6	18	2.28	4.47	10.43	15.0
CB (A-4) to Pipe 4	10	10.29	0.94	2.55	6.54
CB (A-5) to Pipe 4	10	27.65	1.47	*3.56	10.72
CB (B-1) to MH #7	10	15.43	2.09	**3.80	8.0
MH #7 to MH #6	12	3.8	2.09	3.80	3.80
CB (B-2) to Pipe 6	8	0.75	0.07	0.20	1.0
MH #6 to MH #8	18	1.80	6.63	14.43	14.43
CB (B-3) to MH #8	10	11.11	0.87	***3.0	6.8
CB (B-4) to Pipe 7	10	1.29	0.08	0.22	2.50
MH #8 to MH #9	24	2.02	12.01	17.65	32.0
MH #9 to MH #9A	24	0.57	12.01	17.65	17.65
CB (B-7) to MH #9B	15	0.55	1.76	4.79	4.77

LENGTH	PIPE SIZE (inches)	SLOPE %	Q_5 (cfs)	Q_{100} (cfs)	Q_{cap} (cfs)
CB (B-6) to Pipe	10	4.19	0.13	0.35	4.25
MH #9B to MH #9A	15	0.65	1.77	5.14	5.14
CB (B-5) to Pipe	10	1.11	0.66	3.47	6.8
MH #9A to Pond 1	30	1.67	14.44	26.26	34.0
CB (B-8) to MH #10	10	3.50	1.37	****2.92	4.70
MH #10 to MH #11	12	0.68	1.37	2.92	2.92
CB #10 to MH #10B	10	4.15	0.14	0.37	4.15
MH #10B to Mh #11	12	0.50	0.14	0.37	2.5
C (B-9) to Pipe 12	10	5.11	0.69	2.67	8.0
MH #11 to Pond 1	15	0.82	2.20	5.96	5.96
CB (C-1) to MH #13	10	5.05	1.0	2.72	8.0
MH #13 to MH #14	12	1.34	1.0	2.72	4.20
CB (C-2) to MH #14	8	2.40	0.24	0.64	1.85
CB (C-3) to Pipe 14	10	23.69	0.85	2.30	9.91
MH #14 to MH #15	12	3.86	2.09	5.66	7.0
Mh #15 to MH #16	12	3.86	2.09	5.66	7.0
Mh #16 to MH #17	12	2.88	2.09	5.66	6.0
CB (C-4) to Pipe 17	10	46.74	0.90	2.22	13.93
MH #17 to Pond 2	15	3.58	2.99	7.88	12.00

* 0.42 cfs bypasses CB #A-5 during a 100-year storm due to catch basin capacity and flows to CB #B-3

** 1.88 cfs bypasses CB #B-1 during a 100-year storm due to catch basin capacity and flows to CB #B-3

*** 1.67 cfs bypasses CB #B-3 during a 100-year storm due to catch basin capacity and flows to CB #B-5

**** 0.82 cfs bypasses CB #B-8 during a 100-year storm due to catch basin capacity and flows to CB #B-9

Ref. the Utility Plans (Sheets C-8 and C-9) of the civil improvement plans for CB and MH locations.

Ref. the 30" x 42" map in the map pocket of this report for hydrologic areas.

DETENTION POND ANALYSIS

With development, two detention ponds will be developed (ref. the 30" x 42" map in the map pocket for location). Pond #1 has the following parameters:

	Hw (ft)	Area (ft^2)	Area (ac)
(0 to 1) 4886 to 87	1	2999.68	0.069
(1 to 2) 4887 to 88	2	4203.22	0.096
(2 to 3) 4888 to 89	3	5630.34	0.129
(3 to 4) 4889 to 90	4	7283.07	0.167
(4 to 5) 4890 to 91	5	9130.45	0.210
(5 to 6) 4891 to 92	6	11,197.83	0.257

STORAGE (ac-ft)	Q (cfs)
0.069	2.3
0.165	4.8
0.294	6.5
0.461	7.5
0.671	8.8
0.928	10.0

Allowable Q = 11.04 cfs
Outlet = 12" pipe (10 cfs)

Using the HEC-1 computer program (ref. Appendix "A" for printouts) the maximum discharge during a 100-year event will be 8.0 cfs with a maximum water surface elevation of 4890.52 (maximum allowed = 4892.00).

Pond #2, located behind building "P" has a total inflow of 12.11 cfs (includes Area "F"). Pond #2 has the following parameters:

	Hw (ft)	Area (ft^2)	Area (ac)
4886 to 87	1	2136	0.049
4887 to 88	2	3137	0.072
4888 to 89	3	4284	0.098
4889 to 90	4	5431.07	0.125

STORAGE (ac-ft)	Q (cfs)
0.049	2.3
0.121	4.8
0.219	6.5
0.34	8.0

Using the HEC-1 computer program (ref. Appendix "A" for printouts) the maximum discharge during a 100-year event will be 5.0 cfs with a maximum water surface elevation of 4888.0 (maximum allowed = 4890 cfs).

NOTE: Reference Appendix "A" for nomographs of detention pond discharge pipes.

CONCLUSION

With development, the total 100-year peak flow impacting the existing drainage east of the site is as follows:

Discharge Pond #1	=	8.00 cfs
Discharge Pond #2	=	5.00 cfs
Direct Discharge (Area E)	=	8.72 cfs
TOTAL	=	21.72 cfs

Discharge to Sharlands Avenue (Area D) Q_5 = 1.23 cfs
Q_{100} = 3.33 cfs

The undeveloped 100-year peak flow impacting the drainage channel east of the site (29.91 cfs) is reduced to 21.72 cfs, a reduction of 8.19 cfs.

The discharge directly to Sharlands Avenue is increased to 1.23 cfs during a 5-year event and 3.33 cfs during a 100-year event.

APPENDIX A

AR100.OUT

POND #1 [SUBBASINS A+B]

HEC1 S/N: 1343001909 HMVersion: 6.33 Data File: C:\WINDOWS\~vbh187D.TMP

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*            MAY  1991               *
*          VERSION 4.0.1E            *
*                                    *
*  RUN DATE  02/06/1999  TIME  15:35:28 *
*                                    *
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****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*         609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

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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
```

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::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::       Haestad Methods, Inc.          :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

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

POND #1 (100 YR)

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

   1      ID  ARNAIZ APARTMENTS 100-YEAR STORM   (INPUT IN AR100.NET)
   2      IT       2                    720
   3      IO       5         0

   4      KK  Node1
   5      KM
   6      KO                                      22
   7      BA    .024
   8      PH       1    .024     .47     .73    1.05    1.20    1.32    1.62    2.10    2.88
   9      LS            89
  10      UD    .14

  11      KK  Node2
  12      KM  detetion pond 1
  13      KO                                      22
  14      RS       1   STOR
  15      SV   0.069   0.165   0.294   0.461   0.671   0.928
  16      SE    4887    4888    4889    4890    4891    4892
  17      SQ     2.3     4.8     6.5     7.5     8.8      10
  18      SE    4887    4888    4889    4890    4891    4892
  19      ZZ
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*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            MAY   1991                 *
*         VERSION 4.0.1E                *
*                                       *
*  RUN DATE  02/06/1999  TIME  15:35:28 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*          (916) 756-1104               *
*                                       *
*****************************************
```


ARNAIZ APARTMENTS 100-YEAR STORM

3 IO	OUTPUT CONTROL VARIABLES			
	IPRNT		5	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		720	NUMBER OF HYDROGRAPH ORDINATES
	NDDATE	1	0	ENDING DATE
	NDTIME		2358	ENDING TIME
	ICENT		19	CENTURY MARK

COMPUTATION INTERVAL 0.03 HOURS
TOTAL TIME BASE 23.97 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

** ***

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			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	Node1	34.	12.13	3.	1.	1.	0.02		
ROUTED TO	Node2	8.	12.40	4.	3.	3.	0.02		
								4890.52	12.40

** NORMAL END OF HEC-1 ***

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            MAY  1991                  *
*          VERSION 4.0.1E               *
*                                       *
*  RUN DATE  02/10/1999  TIME  14:38:26 *
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*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*         (916) 756-1104                *
*                                       *
*****************************************
```


```
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
```

```
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
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DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

POND #2
(100 YR)

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

  1       ID  ARNAIZ APARTMENTS 100-YEAR STORM   (input in ar100-2.net)
  2       IT       2                    720
  3       IO       5       0

  4       KK  Node1
  5       KM  ARNAIZ 100-YEAR STORM
  6       KO                                    22
  7       BA   .0097
  8       PH       1   .0097     .47     .73   1.05    1.20    1.32    1.62    2.10    2.88
  9       LS           83.5
 10       UD     .10

 11       KK  Node2
 12       KM  detetion pond 2
 13       KO                                    22
 14       RS       1    STOR
 15       SV   0.049   0.121   0.219   0.340
 16       SE    4887    4888    4889    4890
 17       SQ     2.3     4.8     6.5     8.0
 18       SE    4887    4888    4889    4890
 19       ZZ
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY  1991                *
*         VERSION 4.0.1E                *
*                                       *
*   RUN DATE  02/10/1999  TIME  14:38:26 *
*                                       *
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104              *
*                                       *
*****************************************
```


ARNAIZ APARTMENTS 100-YEAR STORM

3 IO OUTPUT CONTROL VARIABLES

IPRNT	5	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		720	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		2358	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL 0.03 HOURS
TOTAL TIME BASE 23.97 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

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

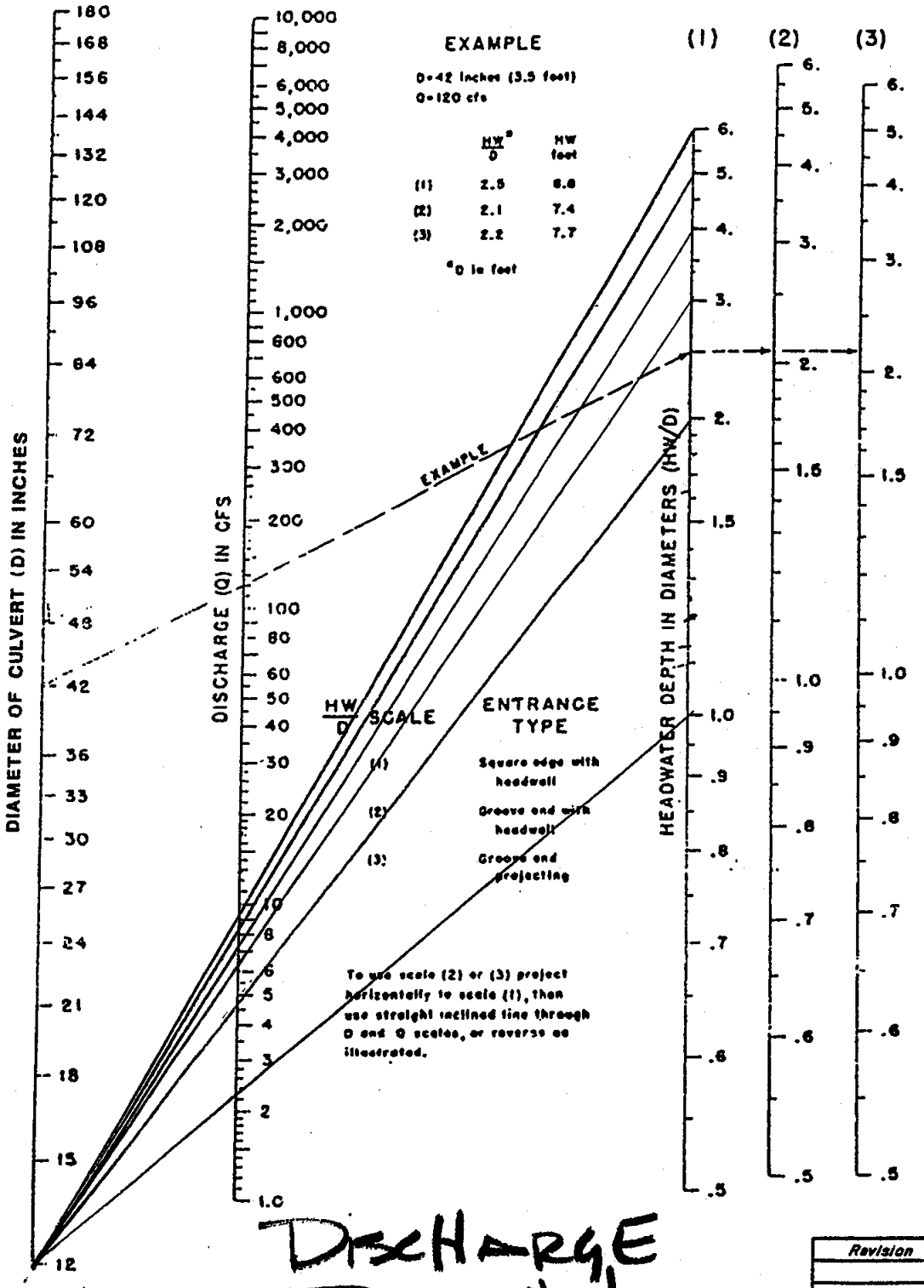
OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	Node1	12.	12.10	1.	0.	0.	0.01		
ROUTED TO	Node2	5.	12.23	2.	2.	2.	0.01		
								4888.00	12.23

* NORMAL END OF HEC-1 ***

POND#1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP



DISCHARGE
POND #1

Revision	Date

WRC ENGINEERING

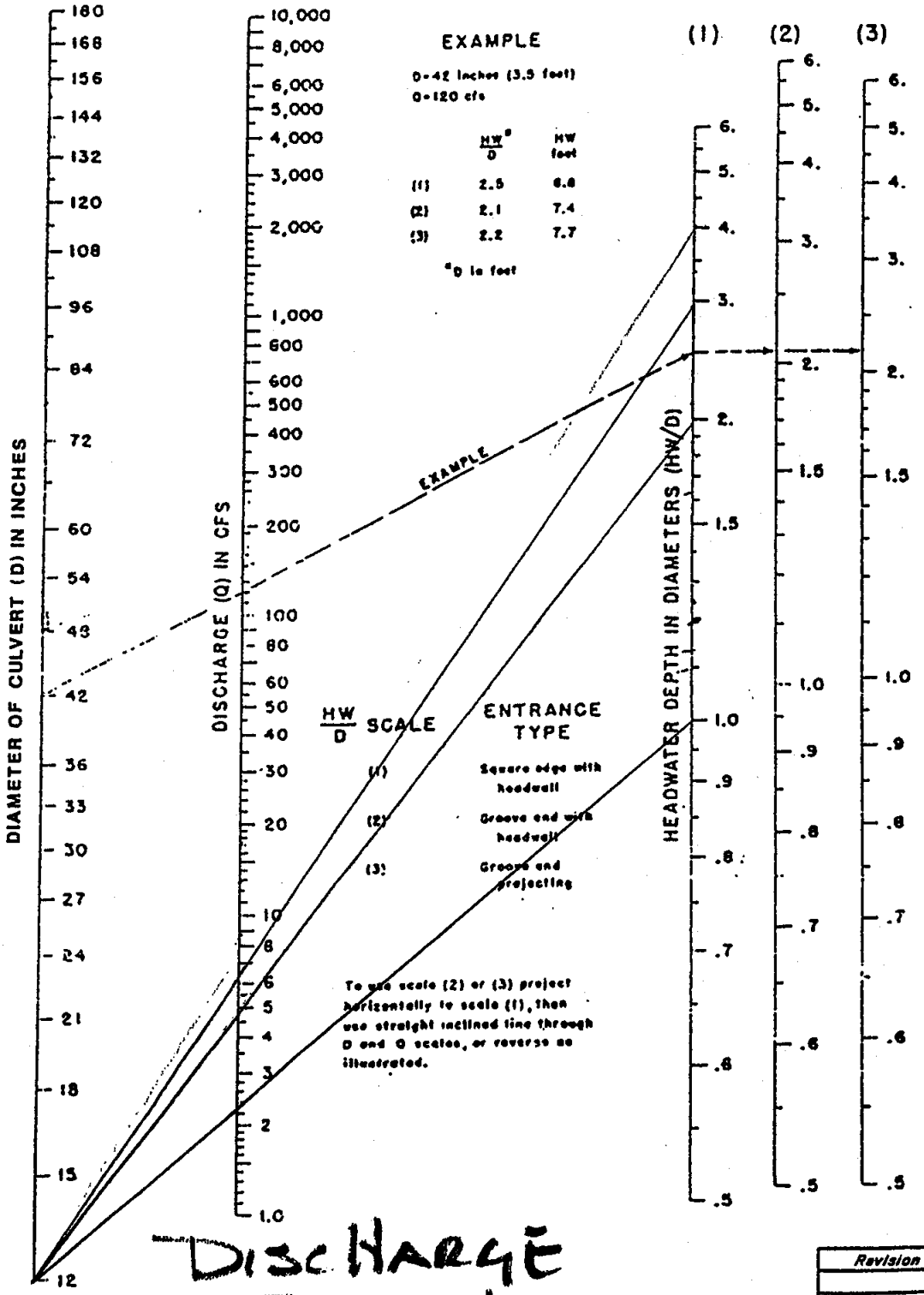
REFERENCE:
USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

POND #2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

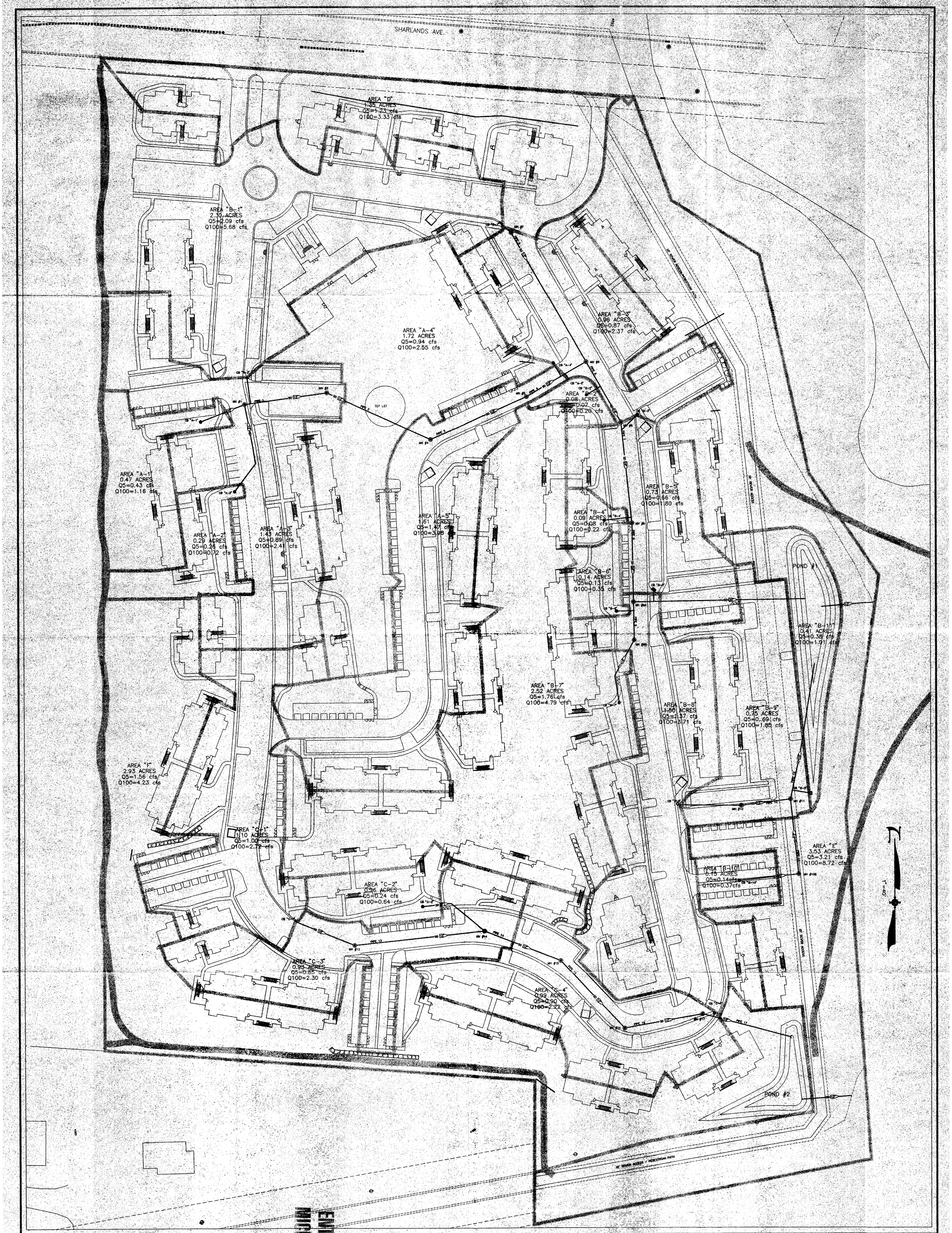
NOMOGRAPH – INLET CONTROL RCP



DISCHARGE
POND #2

Revision	Date

WRC | REFERENCE: | FIGURE 1005



SHEET	SCALE	REV.	DATE	DESCRIPTION	BY	APP'D
1 OF 1	HORIZ. 1"=40'					
	VERT.					
	JOB NO.					
	N:\DWGS\BANKS\SHARLAND\Arnhydro.DWG					

ENTERED IN MICROCRAFT

SILVER CREEK APARTMENTS
HYDROLOGIC SUB AREAS

RENO WASHOE COUNTY NEVADA

DESIGNED BY: MD
DRAWN BY: ACAD
CHECKED BY: MD
2:45 PM * 10-FEB-1999

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