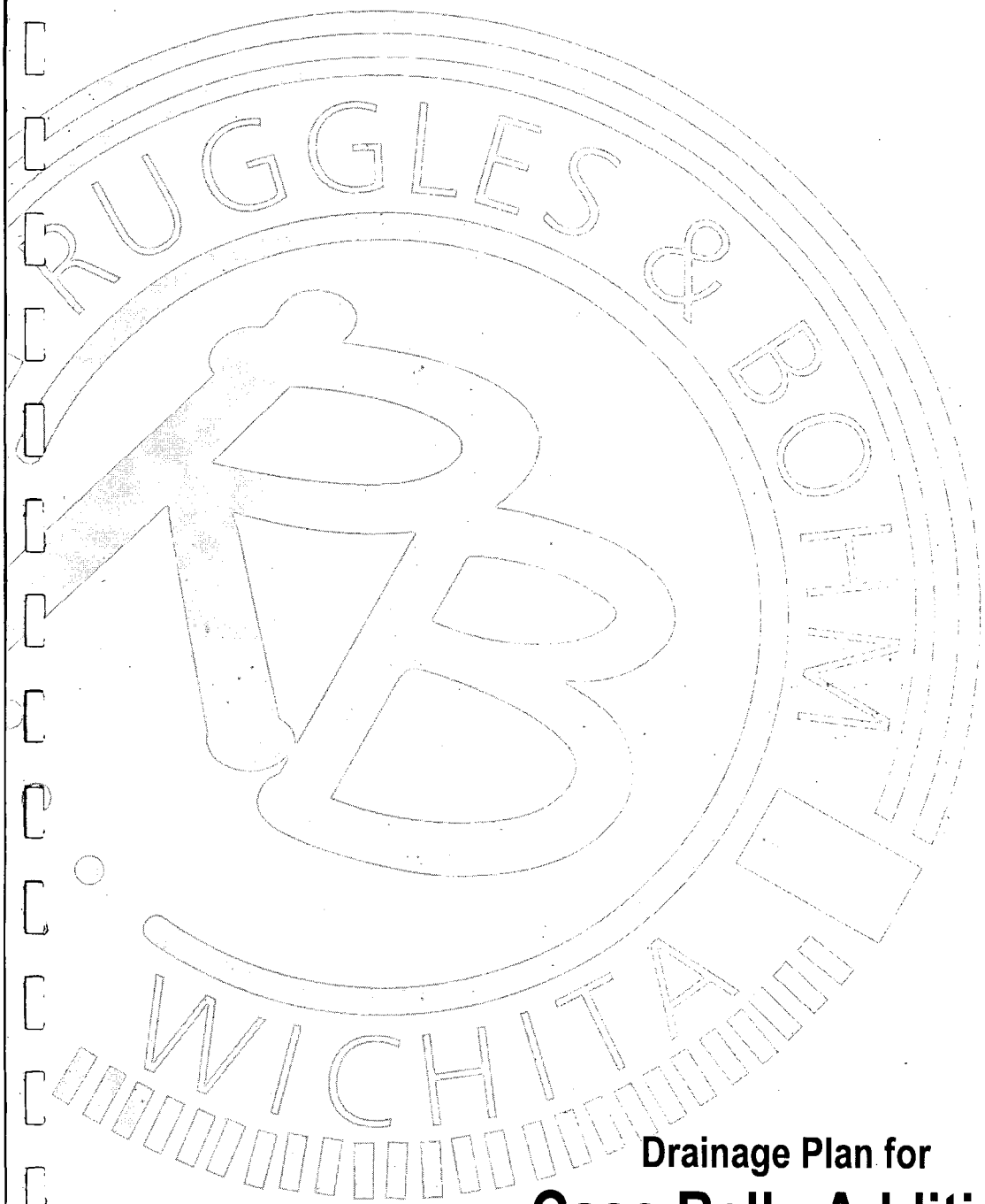

Drainage Plan for

Casa Bella Addition

Wichita, Sedgwick County, Kansas

July 1, 2005

Ruggles & Bohm P.A.

Engineering, Surveying, Land Planning

Ruggles & Bohm P.A.
Engineering, Surveying, Land Planning

924 North Main
Wichita, Kansas 67203

(316) 264-8008
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www.rbkansas.com
info@rbkansas.com

July 1, 2005

Vicky Huang, P.E.
Subdivision Engineer
City of Wichita – 7th Floor
455 N. Main
Wichita, KS 67202

Re: Final Drainage Plan for Casa Bella Addition

Dear Ms. Huang,

Attached with this letter are the drainage calculations and supporting information for Casa Bella Addition. The report consists of the pond routing calculations with detailed output from HEC-1, followed by interior pipe and structure analysis and sizing. All of the storm water sewer system designs will be validated by the use of Hastead Methods StormCAD program at the time of final design. Similarally, all pond design (both storage and outlet capabilities) will be re-routed at the time of final design.

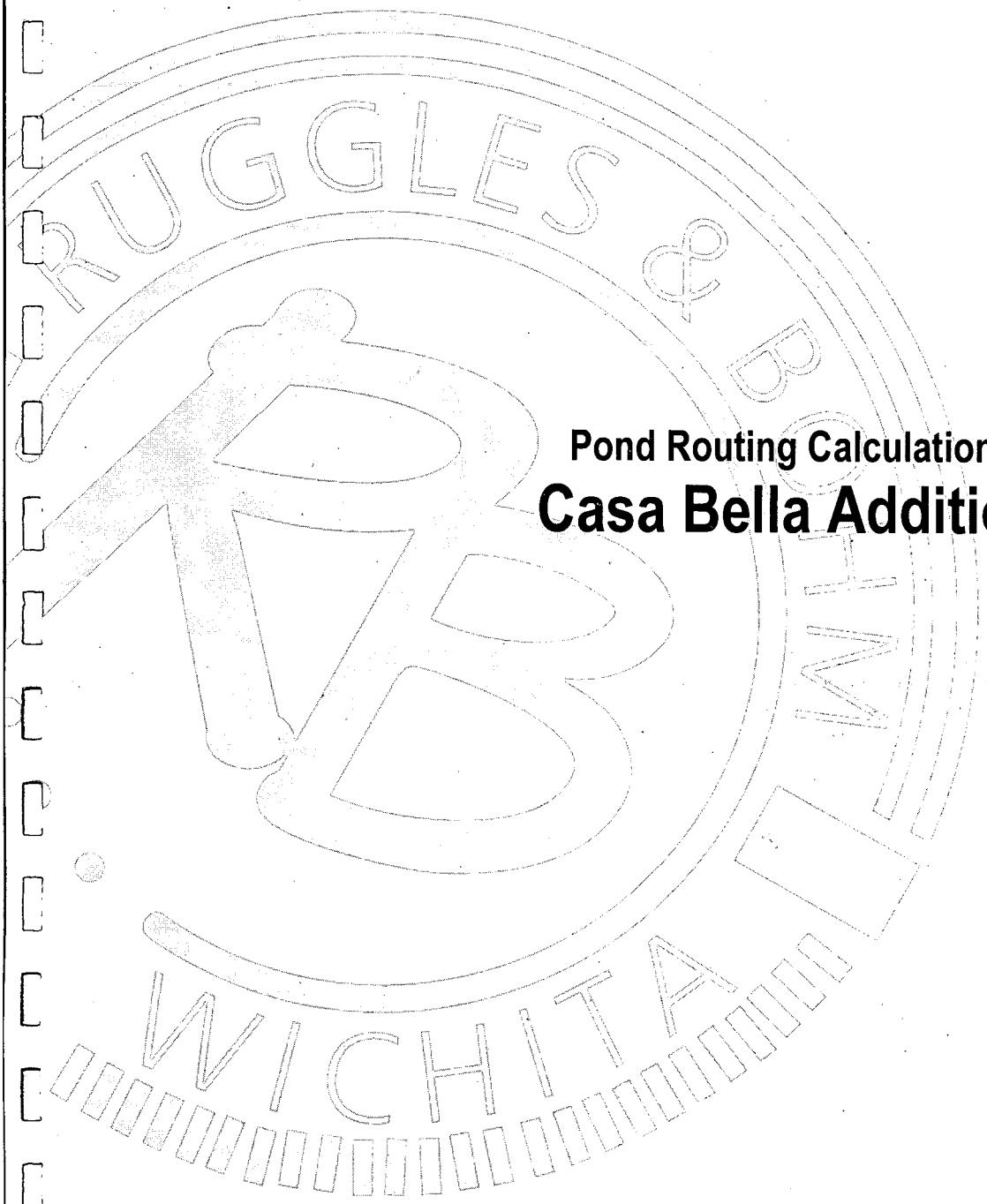
Also included with this report is a four-corner lot grading plan for Casa Bella Addition, and a drainage plan map.

Please review this information and advise me of any questions or comments you may have.

Regards,

Christopher M. Bohm, P.E.

Encl.



Pond Routing Calculations

Casa Bella Addition

Ruggles & Bohm P.A.

Engineering, Surveying, Land Planning

Casa Bella Addition: 4/6/05
Drainage Calcs. CMB
1/6

Total Drng. Area to North Line of Casa Bella = 196 Acres = 0.306 sq. mi

Tc, Velocity method: D = 3900 feet

First 400' sheet flow, V_1 = 0.28 f/sec (Pasture @ 1.0%)

Next 400' Grassed Waterway @ 1.0% V_2 = 1.12 f/sec

Next 800', Channel, Assume V = 2.0 f/sec

Balance of Distance = 2300 feet, Assume Channel velocity = 2.5 f/sec

Tc = 400'/(0.28)(60) + 400'/(1.12)(60) + 800/(2.0)(60) + 2300/(2.5)(60) = 52 minutes (seems reasonable).

SCS Lag = 0.6 Tc ; Sb Lag = 0.52 hours

Hydrological Soils Group "D" (Clay Soil)

Current Land Use = Crops, Small grain, good condition; CN = 87

There is a small amount of existing residential property in the basin, however, this is a very small percentage, so ignore.

Determine the existing peak flow from the watershed using HEC-1.

File = CASA.hc1 CASA.out

Results: $Q_{100} = \underline{436}$ cfs natural from Basin.

Developed Basin: Of the 196 Acres in the basin, new development = 133 Acres

Find New $\overline{CN} = \dfrac{((196\,Ac - 133\,Ac)87 + 133(91))}{196\,Ac}$

$\overline{CN} = 89.7$ or Use 90 developed CN.

Time of Concentration offsite will not be effected, however local, onsite travel

times will be reduced (somewhat).
Assume Tc will be reduced by 20% due to development,

or $TC_D = 0.8\,(T_c) = 0.8\,(52\ min)$

$TC_D = 42$ minutes,

SCS Lag $= 0.6\,T_c$, so → SCS Lag $= 0.42$ hrs for developed condition.

Detention Requirements, CASA BELLA Addition, target Q max out developed condition = 436 cfs.

Pond System Design:
Pond A (South Pond)
Pond B (South Res C Pond)
Pond C (North Res C Pond)
Pond D (Feture Pond on Unplatted Tract).

Route such that Pond A, B & C Provide All of the Detention Required. Pond D is feture, so ignore storage in this pond.

So, Q_{100} from Pond C + Developed flow @ Pond D site total discharge $\leq$ 436 cfs.

Developed Condition Pond Routing: 4/6

Pond A: D_A = 81 Acres, T_c = 30 min
(from V_1 + V_2, original T_c Run)

$$\overline{CN} = \frac{(53\,Ac\,(und)(87) + (28\,Ac\,(Dev)(91)}{81}$$

$\overline{CN}$ = 88 Developed Pond A.

$T_c = V_1 + V_2$ from previous calculation = 30 min
SCS lag = 0.6 T_c = 0.30 Hours

Q_{100} Pond A = 198 cfs
USE Single 5'*4' RCBC outlet
w/ Soil Saver WS @ 1344.0
(See Box 1 output for P Curve)

Pond A:

Elev	Ac
1344	1.35 Ac
1348	1.76 Ac

Route w/ Basin A; Q_{out} = 160 cfs
@ Elev = 1347.0

OK For Now

Pond E (Far West Side, Reserve J)

BA = 11.0 AC

T_c = 20 min, Lag = 0.20 hrs

CN = 88 (Developed)

Pond E Data

1346	0.8
1349	1.0

Q_{100} In = 28 cfs

Try 24" RCP

		HW/D	Q
1346	–	–	0.5
46.5	0.5	0.125	1
47	1	0.15	4.5
47.5	1.5	0.175	9
48	2	1	14
48.5	2.5	1.25	18

OK - Q out = 16 cfs @ 1348.3 Elev

POND B: (Developed) 6/6

BA = 37 Acres (All on site)
CN = 91
Tc = 30 min = SCS Lag = 0.30 hours

Add Hydro Pond A and Pond E to Pond B Hydro for total Q in

Pond Data: Pond B
@ 1339.5 = 2.2AC 12.5' Wier wall
@ 1343 = 2.7 Ac
Qout = 242 cfs, Stage = 1342.96 (1343) OK

Pond Data, Pond C
BA = 51 Acres; Assume that all will be developed = CN = 91
Tc = 30 min, SCS Lag = 0.30 hours

Add To Pond B out-flow = peak In = 352 cfs.

SINGLE 5'* 4' RCBC
10' TAILWATER / MITERED E.S.

n=0.013

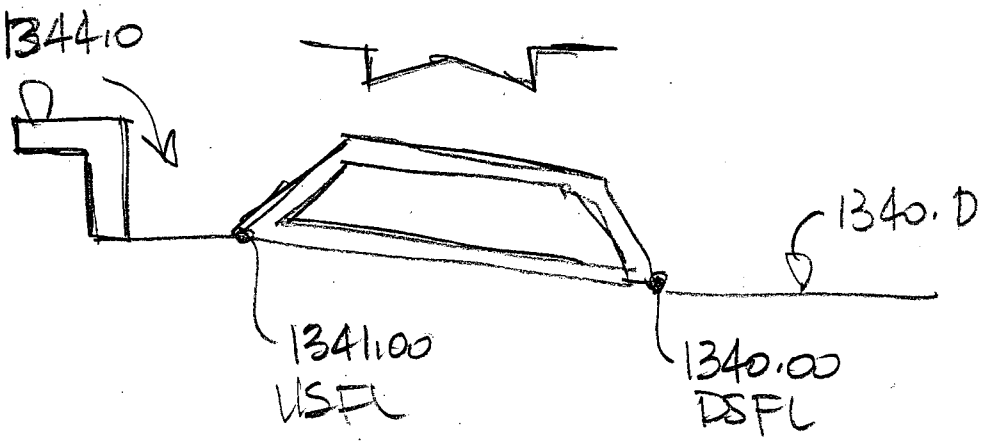
tmp#1.txt

#Units=Flowrate,cfs,Elevation,ft,Elevation,ft,Elevation,ft
Flowrate Outlet Elev Inlet Elev Cntrl Elev
#---------- ---------- ---------- ----------

10.0000,	0.0000,	1341.8041,	1341.8041
20.0000,	0.0000,	1342.3027,	1342.3027
30.0000,	0.0000,	1342.7231,	1342.7231
40.0000,	0.0000,	1343.0997,	1343.0997
50.0000,	0.0000,	1343.4467,	1343.4467
60.0000,	0.0000,	1343.7719,	1343.7719
70.0000,	0.0000,	1344.0800,	1344.0800
80.0000,	0.0000,	1344.3741,	1344.3741
90.0000,	0.0000,	1344.6567,	1344.6567
100.0000,	0.0000,	1344.9292,	1344.9292
110.0000,	0.0000,	1345.1931,	1345.1931
120.0000,	0.0000,	1345.4494,	1345.4494
130.0000,	0.0000,	1345.6989,	1345.6989
140.0000,	0.0000,	1345.9423,	1345.9423
150.0000,	0.0000,	1346.5517,	1346.5517
160.0000,	0.0000,	1346.9564,	1346.9564
170.0000,	0.0000,	1347.3054,	1347.3054
180.0000,	0.0000,	1347.6755,	1347.6755
190.0000,	0.0000,	1348.0668,	1348.0668
200.0000,	0.0000,	1348.4792,	1348.4792

USFL 1341.0 DSFL 1340.0

US SOIL SAVER ELEV= 1344.0



POND A OUTLET STRUCTURE

HEC1 S/N: 1343000364 HMVersion: 6.33 Data File: casa.hc1

```
*****************************************
*****************************************
*                                       *
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
ENGINEERS     *
*             MAY   1991                *
CENTER    *
*           VERSION 4.0.1E              *
*                                       *
*                                       *
95616       *
*  RUN DATE  04/19/2005  TIME  10:09:05 *
*                                       *
*                                       *
*                                       *
*****************************************
*****************************************
```

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*                                       *
*                                       *
*    U.S. ARMY CORPS OF
*    HYDROLOGIC ENGINEERING
*          609 SECOND STREET
*       DAVIS, CALIFORNIA
*           (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                    :::
:::        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

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

*** FREE ***
              *DIAGRAM
    1         ID    CASA BELLA ADDITION POND ROUTING CALCULATIONS
    2         ID    24-HOUR STORM W/15 MINUTE DISTRIBUTION AND SCS UNIT HYDROGRAPH AND LAG METHO
    3         ID    NATURAL DRAINAGE AREA TO POND SITE
    4         IT       5                    289
    5         IN      30
    6         IO       4

    7         KK   UNDEV
              * TOTAL DRAINAGE AREA TO 2-36" RCP PIPES UNDER MT. VERNON
              * USED TO DETERMINE MAXIMUM OUTFLOW FROM SITE
    8         PB     7.8
    9         PC       0       2       4       6       9      12      15      19      27      46
   10         PC      62      68      72      76      79      82      85      87      90      92
   11         PC      94      96      98      99     100
   12         BA   0.306
   13         UD    0.52
   14         LS       0      87

   15         KK    ADEV
              * BASIN A (SOUTH POND) IN DEVELOPED CONDITION
   16         BA   0.127
   17         UD    0.30
   18         LS       0      88

   19         KK   PONDA
              * POND DATA FOR SOUTH POND, DEVELOPED BASIN A WILL BE ROUTED THROUGH THIS POND
              * OUTLET STRUCTURE A SINGLE 5'x4' RCBC
   20         RS       1    ELEV  1344.0
   21         SA    1.35    1.76
   22         SE    1344    1348
   23         SQ       0      10      50      90     130     160     180
              * NOTE ELEVATIONS ARE LOWER ON OUTFLOW - SOIL SAVER UPSTREAM CONTROLS STORAGE
   24         SE    1341  1341.8  1343.4 1344.65 1345.69 1346.95 1347.67
   25         KO       0       0       0       0      21

   26         KK    EDEV
              * AREA FOR POND E IN DEVELOPED CONDITION
   27         BA   0.017
   28         UD    0.30
   29         LS       0      88

   30         KK   PONDE
              * STAGE STORAGE DATA FOR POND E
              * OUTLET STRUCTURE IS 24 INCH RCP (INLET CONTROLLED)
   31         RS       1    ELEV    1347
   32         SA     0.8     1.0
   33         SE    1346    1349
   34         SQ       0       1     4.5       9      14      18
   35         SE    1346  1346.5    1347  1347.5    1348  1348.5
```

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

  36      KK    BDEV
          * DATA FOR DEVELOPED AREA B
  37      BA   0.058
  38      UD     .30
  39      LS       0      91

  40      KK   ABACK
  41      BI   PONDA      21
          * NOTE - THE BI CARD BRINGS FORWARD THE DATA FROM PONDA SO HYDROGRAPHS PONDA
          * POND E AND BASIN B CAN BE COMBINED INTO ONE INPUT HYDROGRAPH FOR POND B

  42      KK    COMB
  43      HC       3
          * THIS HAS CALCULATED THE INFLOW HYDROGRAPH INTO POND B

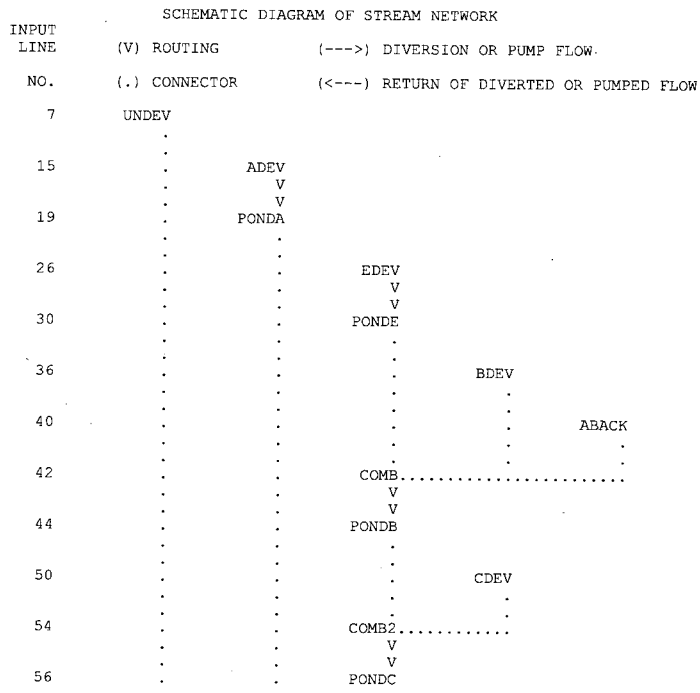
  44      KK   PONDB
          * STAGE STORAGE DATA FOR POND B
          * OUTLET STRUCTURE IS 12.5 FOOT WEIR WALL
  45      RS       1    ELEV 1339.50
  46      SA     2.2     2.7     2.8
  47      SE  1339.5    1343    1344
  48      SQ       0    13.3    37.5    68.9   106.1   148.2   194.9   245.5     300
  49      SE  1339.5    1340  1340.5    1341  1341.5    1342  1342.5    1343  1343.5

  50      KK    CDEV
          * DATA FOR DEVELOPED AREA C
  51      BA   0.080
  52      UD    0.30
  53      LS       0      91

  54      KK   COMB2
          * COMBINE AREA C HYDROGRAPH WITH OUTLET HYDROGRAPH FROM POND B
          * THIS WILL GENERATE THE INFLOW HYDROGRAPH FOR POND C
  55      HC       2

  56      KK   PONDC
          * STAGE STORAGE DATA FOR POND C
          * OUTLET STRUCTURE IS A 20 FOOT WEIR WALL
  57      RS       1    ELEV    1334
  58      SA     2.3     3.0
  59      SE    1334    1337
  60      SQ       0      21      60     110     169     237     312     392
  61      SE    1334  1334.5    1335  1335.5    1336  1336.5    1337  1337.5
  62      ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

HEC1 S/N: 1343000364 HMVersion: 6.33 Data File: casa.hc1

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**************************************
**************************************
*                                    *                                    *
*                                    *                                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                 *   U.S. ARMY CORPS OF
ENGINEERS      *
*             MAY   1991             *                                    *   HYDROLOGIC ENGINEERING
CENTER     *
*           VERSION 4.0.1E           *                                    *         609 SECOND STREET
*                                    *                                    *
*                                    *                                    *      DAVIS, CALIFORNIA
95616       *
*  RUN DATE  04/19/2005  TIME  10:09:05 *                                 *          (916) 756-1104
*                                    *                                    *
*                                    *                                    *
**************************************
**************************************
```

CASA BELLA ADDITION POND ROUTING CALCULATIONS
24-HOUR STORM W/15 MINUTE DISTRIBUTION AND SCS UNIT HYDROGRAPH AND LAG METHO
NATURAL DRAINAGE AREA TO POND SITE

6 IO OUTPUT CONTROL VARIABLES

IPRNT	4	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		289	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	0	ENDING DATE
NDTIME		0000	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL 0.08 HOURS
TOTAL TIME BASE 24.00 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

*** ***

```
**************
*            *
*     UNDEV  *
*            *
**************
```

5 IN TIME DATA FOR INPUT TIME SERIES

JXMIN		30	TIME INTERVAL IN MINUTES
JXDATE	1	0	STARTING DATE
JXTIME		0	STARTING TIME

SUBBASIN RUNOFF DATA

12 BA SUBBASIN CHARACTERISTICS

TAREA	0.31	SUBBASIN AREA

PRECIPITATION DATA

8 PB STORM 7.80 BASIN TOTAL PRECIPITATION

9 PI INCREMENTAL PRECIPITATION PATTERN

0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.67	0.67	0.67	0.67
0.67	0.67	1.33	1.33	1.33	1.33	1.33	1.33	3.17	3.17
3.17	3.17	3.17	3.17	2.67	2.67	2.67	2.67	2.67	2.67
1.00	1.00	1.00	1.00	1.00	1.00	0.67	0.67	0.67	0.67
0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.33	0.33	0.33	0.33
0.33	0.33	0.50	0.50	0.50	0.50	0.50	0.50	0.33	0.33
0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
0.33	0.33	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
0.17	0.17	0.17	0.17						

14 LS SCS LOSS RATE

STRTL	0.30	INITIAL ABSTRACTION

```
                CRVNBR       87.00  CURVE NUMBER
                 RTIMP        0.00  PERCENT IMPERVIOUS AREA

 13 UD          SCS DIMENSIONLESS UNITGRAPH
                   TLAG        0.52  LAG

                                                  ***

                                                UNIT HYDROGRAPH
                                          33 END-OF-PERIOD ORDINATES
                17.       49.      101.      170.      228.      259.      262.      247.      219.      183.
               139.      106.       83.       66.       52.       41.       32.       25.       20.       15.
                12.       10.        8.        6.        5.        4.        3.        2.        2.        1.
                 1.        1.        0.

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


              **************
              *            *
 15 KK        *      ADEV  *
              *            *
              **************

                 SUBBASIN RUNOFF DATA

 16 BA             SUBBASIN CHARACTERISTICS
                      TAREA        0.13  SUBBASIN AREA

                   PRECIPITATION DATA

  8 PB                STORM        7.80  BASIN TOTAL PRECIPITATION

  9 PI               INCREMENTAL PRECIPITATION PATTERN
                     0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33
                     0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.50      0.50
                     0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50
                     0.50      0.50      0.50      0.50      0.50      0.50      0.67      0.67      0.67      0.67
                     0.67      0.67      1.33      1.33      1.33      1.33      1.33      1.33      3.17      3.17
                     3.17      3.17      3.17      3.17      2.67      2.67      2.67      2.67      2.67      2.67
                     1.00      1.00      1.00      1.00      1.00      1.00      0.67      0.67      0.67      0.67
                     0.67      0.67      0.67      0.67      0.67      0.67      0.67      0.67      0.50      0.50
                     0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50
                     0.50      0.50      0.50      0.50      0.50      0.50      0.33      0.33      0.33      0.33
                     0.33      0.33      0.50      0.50      0.50      0.50      0.50      0.50      0.33      0.33
                     0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33
                     0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33
                     0.33      0.33      0.17      0.17      0.17      0.17      0.17      0.17      0.17      0.17
                     0.17      0.17      0.17      0.17

 18 LS             SCS LOSS RATE
                      STRTL        0.27  INITIAL ABSTRACTION
                     CRVNBR       88.00  CURVE NUMBER
                      RTIMP        0.00  PERCENT IMPERVIOUS AREA

 17 UD             SCS DIMENSIONLESS UNITGRAPH
                      TLAG        0.30  LAG

                                                  ***

                                                UNIT HYDROGRAPH
                                          20 END-OF-PERIOD ORDINATES
               25.       81.      154.      180.      165.      129.       82.       55.       38.       25.
               17.       11.        8.        5.        3.        2.        2.        1.        1.        0.

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


              **************
              *            *
 19 KK        *     PONDA  *
              *            *
              **************

 25 KO             OUTPUT CONTROL VARIABLES
                     IPRNT           4  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         289  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS


                 HYDROGRAPH ROUTING DATA

 20 RS             STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC     1344.00  INITIAL CONDITION
                         X        0.00 WORKING R AND D COEFFICIENT

 21 SA               AREA         1.4       1.8
```

```
 22 SE          ELEVATION     1344.00   1348.00

 23 SQ          DISCHARGE          0.       10.       50.       90.      130.      160.      180.

 24 SE          ELEVATION     1341.00   1341.80   1343.40   1344.65   1345.69   1346.95   1347.67
```

***

COMPUTED STORAGE-ELEVATION DATA

STORAGE	0.00	6.20
ELEVATION	1344.00	1348.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.00	0.00	0.00	0.90	2.42	4.41	5.63	6.20
OUTFLOW	0.00	10.00	50.00	69.20	90.00	130.00	160.00	180.00	189.16
ELEVATION	1341.00	1341.80	1343.40	1344.00	1344.65	1345.69	1346.95	1347.67	1348.00

*** ***

```
          **************
          *            *
 26 KK    *      EDEV  *
          *            *
          **************
```

SUBBASIN RUNOFF DATA

```
 27 BA          SUBBASIN CHARACTERISTICS
                     TAREA        0.02  SUBBASIN AREA

                PRECIPITATION DATA

  8 PB               STORM        7.80  BASIN TOTAL PRECIPITATION

  9 PI            INCREMENTAL PRECIPITATION PATTERN
                    0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33
                    0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.50      0.50
                    0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50
                    0.50      0.50      0.50      0.50      0.50      0.50      0.67      0.67      0.67      0.67
                    0.67      0.67      1.33      1.33      1.33      1.33      1.33      1.33      3.17      3.17
                    3.17      3.17      3.17      3.17      2.67      2.67      2.67      2.67      2.67      2.67
                    1.00      1.00      1.00      1.00      1.00      1.00      0.67      0.67      0.67      0.67
                    0.67      0.67      0.67      0.67      0.67      0.67      0.67      0.67      0.50      0.50
                    0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50      0.50
                    0.50      0.50      0.50      0.50      0.50      0.50      0.33      0.33      0.33      0.33
                    0.33      0.33      0.50      0.50      0.50      0.50      0.50      0.50      0.33      0.33
                    0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33
                    0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33      0.33
                    0.33      0.33      0.17      0.17      0.17      0.17      0.17      0.17      0.17      0.17
                    0.17      0.17      0.17      0.17

 29 LS          SCS LOSS RATE
                     STRTL        0.27  INITIAL ABSTRACTION
                    CRVNBR       88.00  CURVE NUMBER
                     RTIMP        0.00  PERCENT IMPERVIOUS AREA

 28 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG        0.30  LAG
```

***

UNIT HYDROGRAPH
20 END-OF-PERIOD ORDINATES

3.	11.	21.	24.	22.	17.	11.	7.	5.	3.
2.	2.	1.	1.	0.	0.	0.	0.	0.	0.

*** ***

```
          **************
          *            *
 30 KK    *     PONDE  *
          *            *
          **************
```

HYDROGRAPH ROUTING DATA

```
 31 RS          STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC    1347.00  INITIAL CONDITION
                        X       0.00 WORKING R AND D COEFFICIENT

 32 SA               AREA        0.8       1.0

 33 SE          ELEVATION     1346.00   1349.00

 34 SQ          DISCHARGE          0.        1.        5.        9.       14.       18.

 35 SE          ELEVATION     1346.00   1346.50   1347.00   1347.50   1348.00   1348.50
```

***

COMPUTED STORAGE-ELEVATION DATA

STORAGE	0.00	2.69
ELEVATION	1346.00	1349.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.41	0.83	1.27	1.73	2.20	2.69
OUTFLOW	0.00	1.00	4.50	9.00	14.00	18.00	22.00
ELEVATION	1346.00	1346.50	1347.00	1347.50	1348.00	1348.50	1349.00

*** ***

```
**************
*            *
*      BDEV  *
*            *
**************
```

SUBBASIN RUNOFF DATA

SUBBASIN CHARACTERISTICS
TAREA 0.06 SUBBASIN AREA

PRECIPITATION DATA

STORM 7.80 BASIN TOTAL PRECIPITATION

INCREMENTAL PRECIPITATION PATTERN

0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.67	0.67	0.67	0.67
0.67	0.67	1.33	1.33	1.33	1.33	1.33	1.33	3.17	3.17
3.17	3.17	3.17	3.17	2.67	2.67	2.67	2.67	2.67	2.67
1.00	1.00	1.00	1.00	1.00	1.00	0.67	0.67	0.67	0.67
0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.33	0.33	0.33	0.33
0.33	0.33	0.50	0.50	0.50	0.50	0.50	0.50	0.33	0.33
0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
0.33	0.33	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
0.17	0.17	0.17	0.17						

SCS LOSS RATE
STRTL 0.20 INITIAL ABSTRACTION
CRVNBR 91.00 CURVE NUMBER
RTIMP 0.00 PERCENT IMPERVIOUS AREA

SCS DIMENSIONLESS UNITGRAPH
TLAG 0.30 LAG

***

UNIT HYDROGRAPH
20 END-OF-PERIOD ORDINATES

11.	37.	70.	82.	75.	59.	37.	25.	17.	11.
8.	5.	3.	2.	2.	1.	1.	1.	0.	0.

*** ***

```
**************
*            *
*     ABACK  *
*            *
**************
```

READ STATION PONDA HYDROGRAPH FROM UNIT 21

***

*** ***

```
**************
*            *
*      COMB  *
*            *
**************
```

HYDROGRAPH COMBINATION
ICOMP 3 NUMBER OF HYDROGRAPHS TO COMBINE

***

*** ***

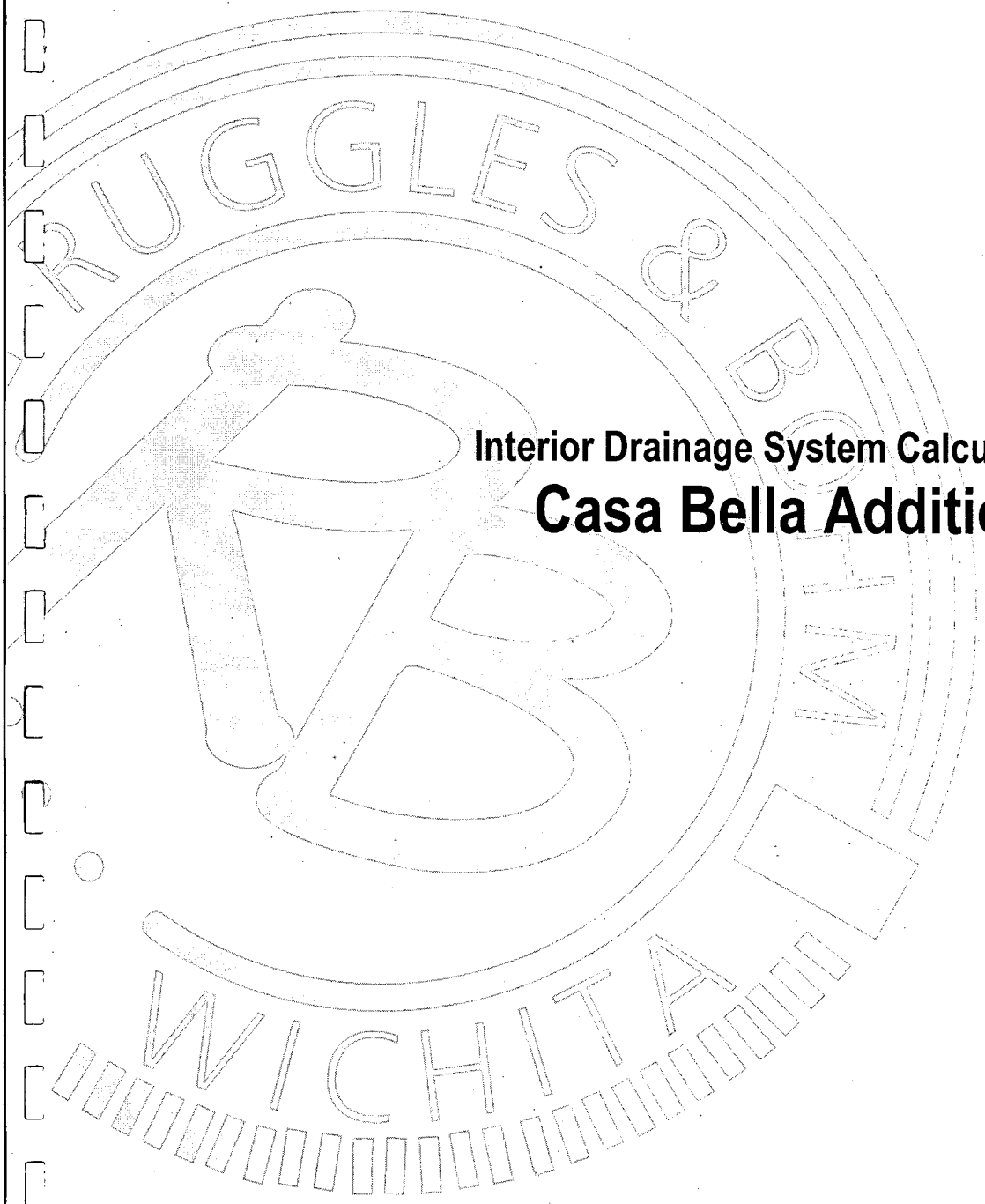
```
*** *** ***

              **************
              *            *
   44 KK      *    PONDB   *
              *            *
              **************

                HYDROGRAPH ROUTING DATA

   45 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     1339.50  INITIAL CONDITION
                            X        0.00  WORKING R AND D COEFFICIENT

   46 SA                 AREA         2.2        2.7        2.8

   47 SE          ELEVATION     1339.50    1343.00    1344.00

   48 SQ          DISCHARGE          0.         13.        38.        69.       106.       148.       195.       246.       300.

   49 SE          ELEVATION     1339.50    1340.00    1340.50    1341.00    1341.50    1342.00    1342.50    1343.00    1343.50

                                                                 ***

                                                COMPUTED STORAGE-ELEVATION DATA

           STORAGE        0.00       8.56      11.31
         ELEVATION     1339.50    1343.00    1344.00

                                            COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

           STORAGE        0.00       1.12       2.27       3.45       4.68       5.93       7.23       8.56       9.92      11.31
           OUTFLOW        0.00      13.30      37.50      68.90     106.10     148.20     194.90     245.50     300.00     354.50
         ELEVATION     1339.50    1340.00    1340.50    1341.00    1341.50    1342.00    1342.50    1343.00    1343.50    1344.00


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

              **************
              *            *
   50 KK      *    CDEV    *
              *            *
              **************

                SUBBASIN RUNOFF DATA

   51 BA          SUBBASIN CHARACTERISTICS
                        TAREA        0.08  SUBBASIN AREA

                  PRECIPITATION DATA

    8 PB                STORM        7.80  BASIN TOTAL PRECIPITATION

    9 PI            INCREMENTAL PRECIPITATION PATTERN
                       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33
                       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.50       0.50
                       0.50       0.50       0.50       0.50       0.50       0.50       0.50       0.50       0.50       0.50
                       0.50       0.50       0.50       0.50       0.50       0.50       0.67       0.67       0.67       0.67
                       0.67       0.67       1.33       1.33       1.33       1.33       1.33       1.33       3.17       3.17
                       3.17       3.17       3.17       3.17       2.67       2.67       2.67       2.67       2.67       2.67
                       1.00       1.00       1.00       1.00       1.00       1.00       0.67       0.67       0.67       0.67
                       0.67       0.67       0.67       0.67       0.67       0.67       0.67       0.67       0.50       0.50
                       0.50       0.50       0.50       0.50       0.50       0.50       0.50       0.50       0.50       0.50
                       0.50       0.50       0.50       0.50       0.50       0.50       0.33       0.33       0.33       0.33
                       0.33       0.33       0.50       0.50       0.50       0.50       0.50       0.50       0.33       0.33
                       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33
                       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33       0.33
                       0.33       0.33       0.17       0.17       0.17       0.17       0.17       0.17       0.17       0.17
                       0.17       0.17       0.17       0.17

   53 LS          SCS LOSS RATE
                        STRTL        0.20  INITIAL ABSTRACTION
                       CRVNBR       91.00  CURVE NUMBER
                        RTIMP        0.00  PERCENT IMPERVIOUS AREA

   52 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG        0.30  LAG

                                                                 ***

                                                          UNIT HYDROGRAPH
                                                     20 END-OF-PERIOD ORDINATES
               16.        51.        97.       113.       104.        81.        52.        35.        24.        16.
               11.         7.         5.         3.         2.         1.         1.         1.         0.         0.


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

              **************
              *            *
   54 KK      *    COMB2   *
```

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

 55 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                    ***


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


          **************
          *            *
 56 KK    *     PONDC  *
          *            *
          **************

             HYDROGRAPH ROUTING DATA

 57 RS          STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC     1334.00  INITIAL CONDITION
                         X        0.00 WORKING R AND D COEFFICIENT

 58 SA              AREA         2.3       3.0

 59 SE          ELEVATION     1334.00   1337.00

 60 SQ          DISCHARGE          0.       21.       60.      110.      169.      237.      312.      392.

 61 SE          ELEVATION     1334.00   1334.50   1335.00   1335.50   1336.00   1336.50   1337.00   1337.50

                                                                    ***

                                        COMPUTED STORAGE-ELEVATION DATA

          STORAGE       0.00      7.93
        ELEVATION    1334.00   1337.00

                                        COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       0.00      1.18      2.41      3.70      5.05      6.46      7.93      9.46
          OUTFLOW       0.00     21.00     60.00    110.00    169.00    237.00    312.00    392.00
        ELEVATION    1334.00   1334.50   1335.00   1335.50   1336.00   1336.50   1337.00   1337.50
```

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

OF STAGE	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME MAX
	HYDROGRAPH AT	UNDEV	436.	5.08	169.	51.	51.	0.31		
	HYDROGRAPH AT	ADEV	198.	4.75	71.	22.	22.	0.13		
	ROUTED TO	PONDA	160.	5.25	71.	22.	22.	0.13	1346.97	
5.25										
	HYDROGRAPH AT	EDEV	27.	4.75	10.	3.	3.	0.02		
	ROUTED TO	PONDE	16.	5.42	9.	3.	3.	0.02	1348.27	
5.42										
	HYDROGRAPH AT	BDEV	95.	4.75	34.	10.	10.	0.06		
	HYDROGRAPH AT	ABACK	160.	5.25	71.	22.	22.	0.13		
	3 COMBINED AT	COMB	261.	5.08	114.	36.	36.	0.20		
	ROUTED TO	PONDB	242.	5.33	113.	36.	36.	0.20	1342.96	
5.33										
	HYDROGRAPH AT	CDEV	130.	4.75	47.	14.	14.	0.08		
	2 COMBINED AT	COMB2	352.	5.17	160.	50.	50.	0.28		
	ROUTED TO	PONDC	335.	5.33	159.	50.	50.	0.28	1337.14	
5.33										

*** NORMAL END OF HEC-1 ***



Interior Drainage System Calculations

Casa Bella Addition

Ruggles & Bohm P.A.

Engineering, Surveying, Land Planning

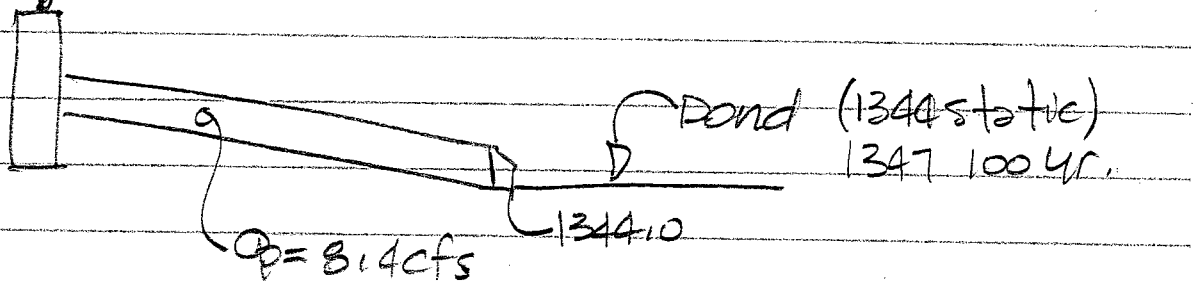
CMB
6/30/05
1/8

Casa Bella Addn
Interim Drainage Calcs.

See Drainage Map for Areas and Calculated Flows.

Pipe 100 (Area A)
100 yr design

Q_{100} = 8.4 cfs



$L = 250'$; $HGL = 1350 - 1347 = \frac{3'}{250} = 1.2\%$ HGL

From Design Data 4; 18" RCPC 0.64 O.K.
Inlet to be sized w/ SWD project.
100 yr. Overspill O.K. (to road)

Pipe 200 (B, C, and D).

Area C, rear yard drainage.
100 year pipe required.

CMB
4-30-05
2/8

Q_{100} (Area C) = 17.4 cfs

Check Inlet Capacity:
Beehive Inlet; orifice flow;

$Q = 0.6A\sqrt{2gh}$ where max $h = 1.0$ feet
$g = 32.2 f/s^2$

Area Beehive top = 1.8 sq. ft.

$Q = 0.6(1.8)\sqrt{(2)(32.2)(1.0)}$

$Q = 8.7$ cfs

Need @ least 2 beehive Inlets in this basin, both in sump conditions.

$Q_p = 17.4$ cfs

Area B = Q_{100} = 17.4 cfs
To bypass Inlet.
From Inlet program, S = 0.5%;
Inlet can intercept 7.0 cfs, bypass the balance. L = 10' for the Inlet.

Area D; Q_{100} = 3.4 cfs, Should be intercepted in whole by Inlet.

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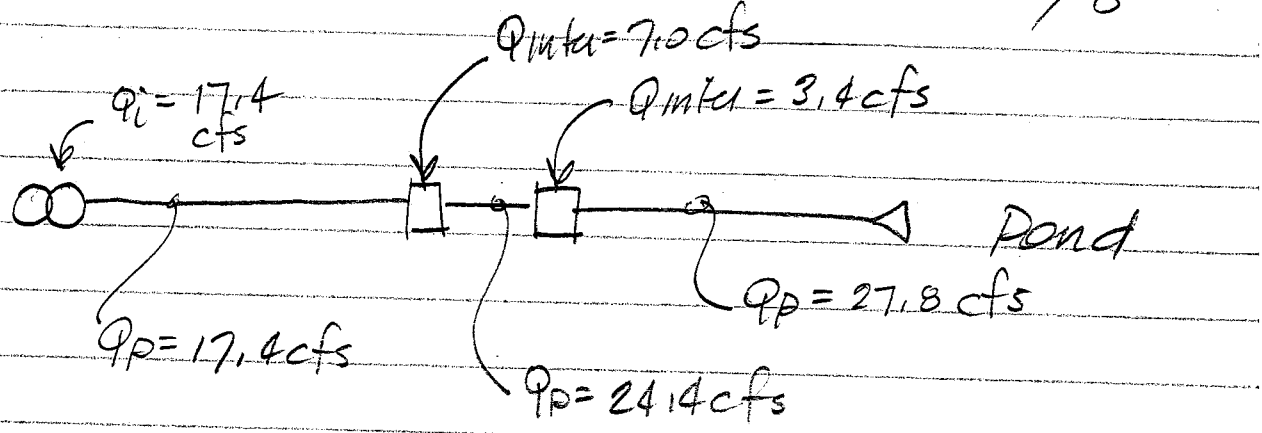
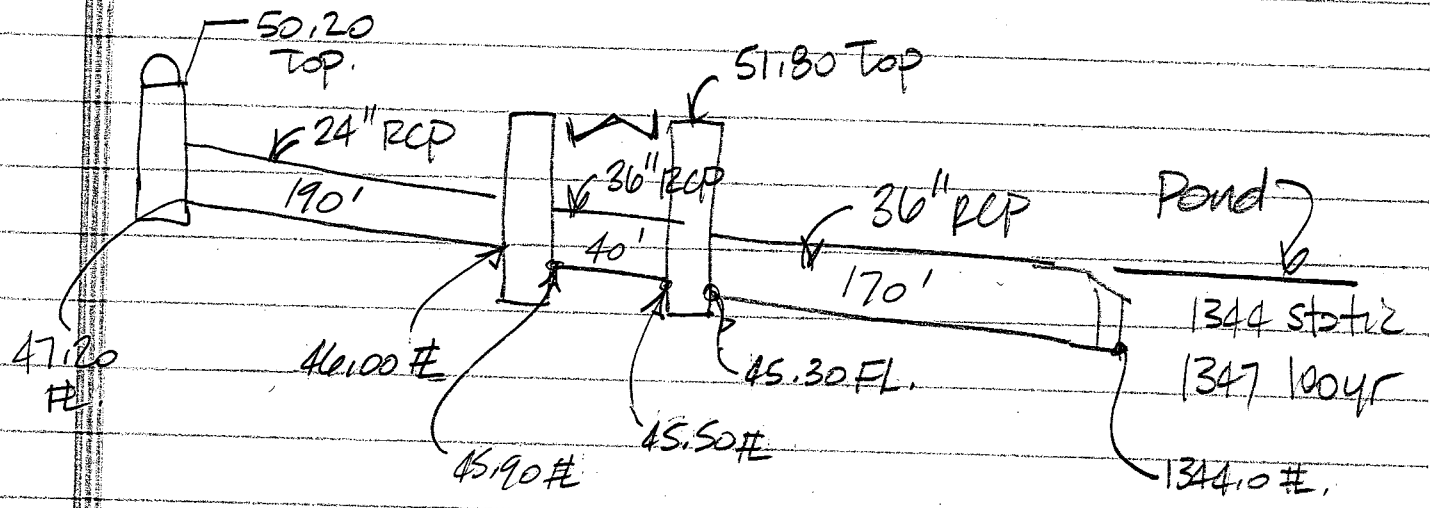
3/8

System 200





System Max HGL = $\frac{50.20 - 1347}{400} = 0.80\%$

From Design Data 4:

Q = 17.4 ; 24" @ 0.60 ; OK

Q = 24.4 ; 24" @ 1.16 – No

36" @ 0.13% – O.K.

Q = 27.8 ; 36" @ 0.17% – O.K.

Storm-CAD final system @ design.

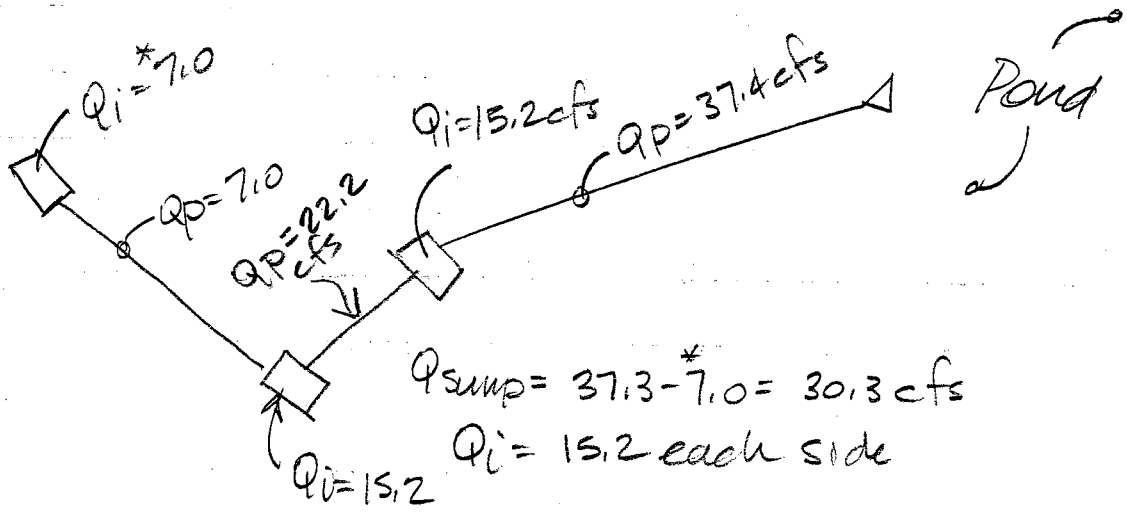
CWB
6-30-05
4/8

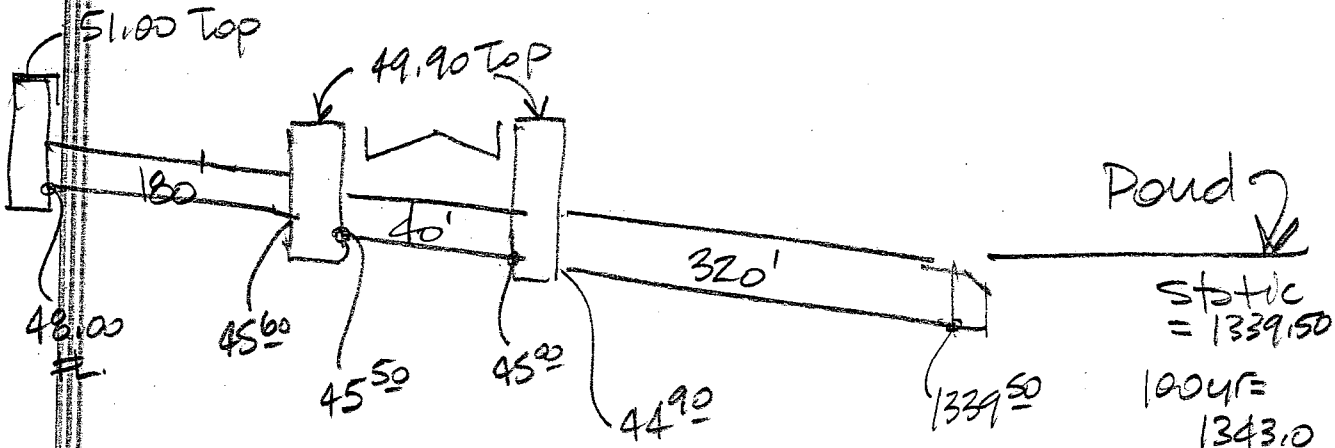
System 300 (Area B, E)

Total Flow to Sump = Area E = 26.9 cfs
+ Bypass B = 17.4 cfs - 7.0 cfs = 10.4 cfs

Total Flow = 37.3 cfs @ Sump

Note: Bypass Inlet @ NW Cor. Michelle Cir and Tara Falls.
This Inlet will Intercept 7.0 cfs @ L = 10'





CWB
6-29-05
5/8

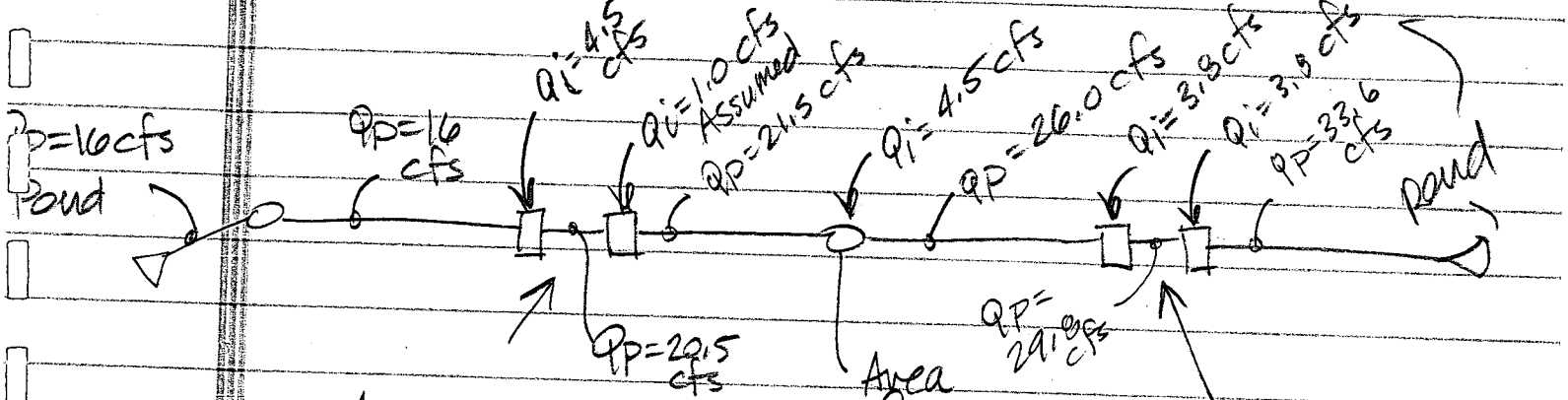
Available HGL (System 400)
$= \frac{48.90 - 43.0}{(320+40)} = 1.64\%$

Top pipe; Q = 7.0 cfs; 15" RCPC 1.17% - O.K.

Qp = 22.2 cfs (street xing); 24" RCPC 0.96 - O.K.

Qp (last pipe) = 34.7 cfs; 36" RCPC 0.30 - O.K.

<u>System 400</u> (Areas F, G & H)
This system also includes the outflow from to Pond in Reserve I. This pond can discharge 16.0 cfs in the 100yr event.



Area F
Q_{100} = 11.8 cfs approach
From Inlet program
Q_i (west) = 4.5 cfs
slope = 1.5%

Area G
Q_{100} = 4.5 cfs

Area H
Q_{100} = 11.8 cfs
Bypass
= 5.9 cfs/side
slope = 0.5%
Q = 3.8 cfs per Inlet

OMB
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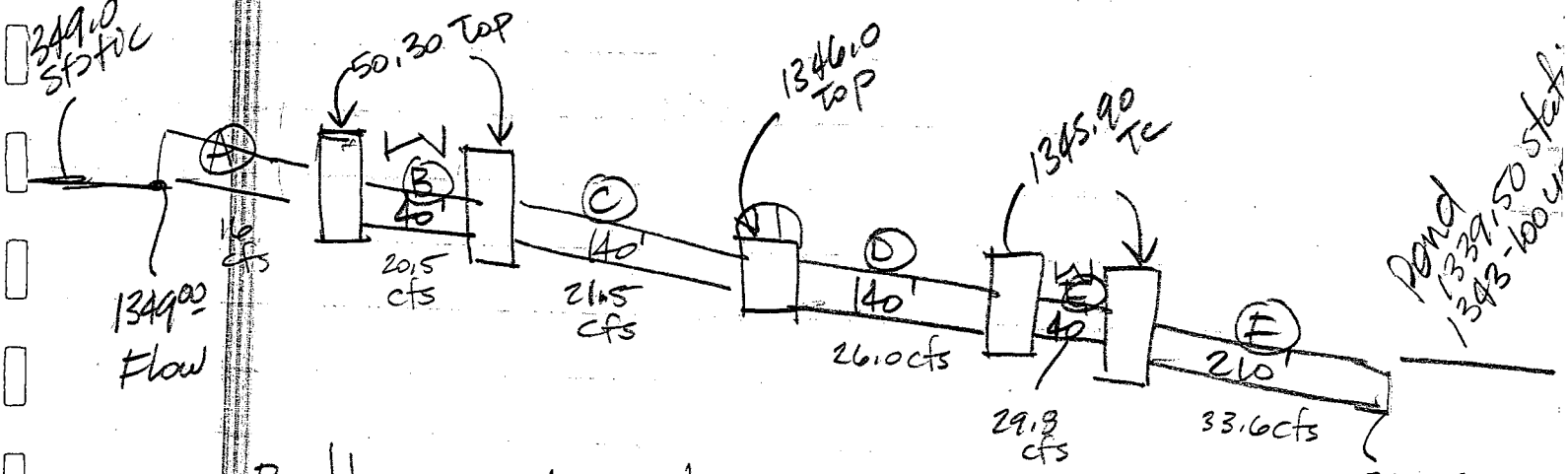
6/8

System 400

$\frac{44.90 - 43.0}{250} = 0.76\%$

HGL

Available HGL=



Bottom end system HGL= 0.76%
Upper reaches may be better, keep, check for design w/ Storm-CAD.

Pipe A; Qp= 16 cfs; 24" @ 1.02% (Marginal)

Pipe F; Qp= 33.6%; 36" RCP @ 0.25% - OK

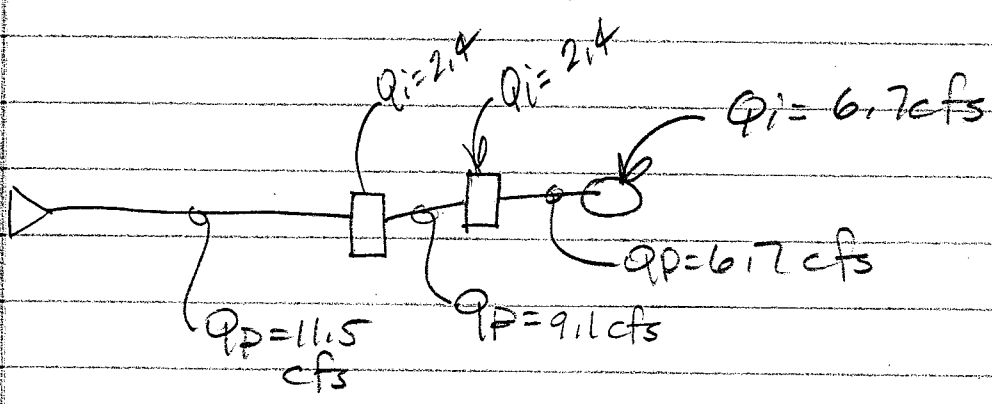
Balance of System = 36"

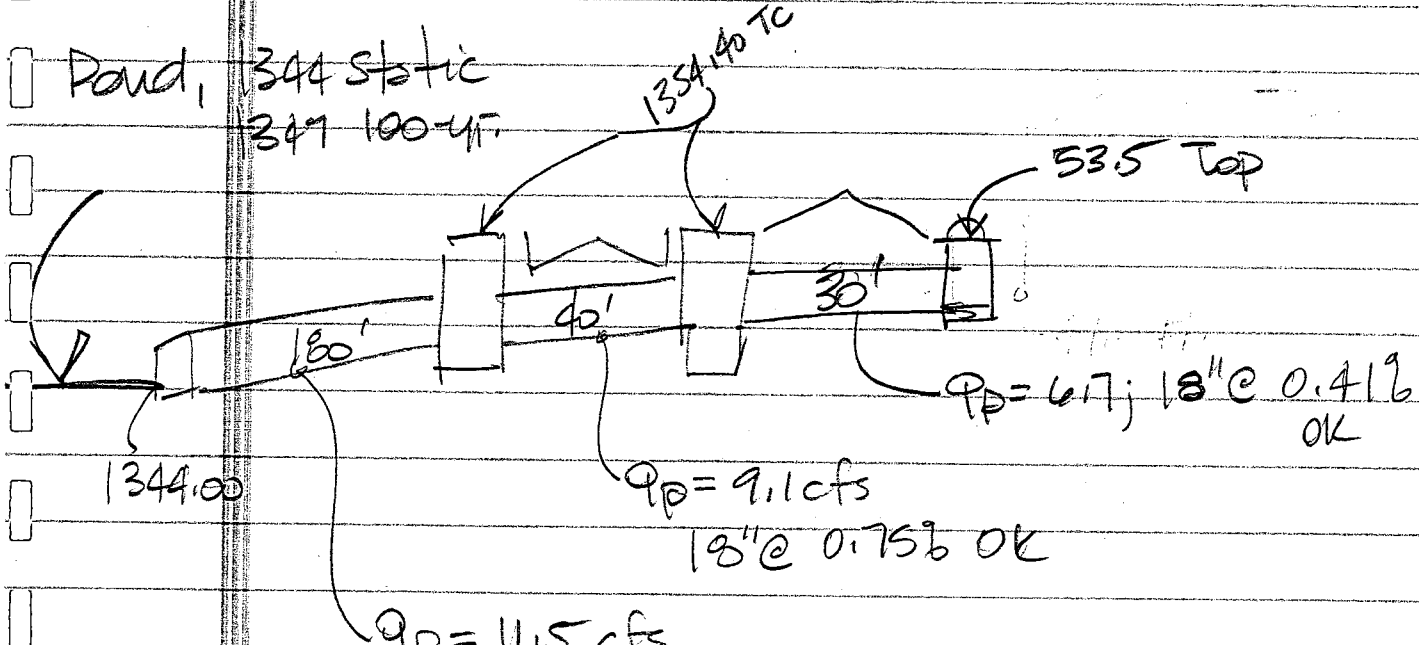
CWB
6-30-05
7/8

System 500 (Areas I & J)

Area I; Q100 = 8.4 cfs
= 4.2/side @ 1.3% Slope
10' Inlets Collect = 2.4 cfs/side

Area J (Rear Yard - Com bypass)
Q_{100} = 6.7 cfs





CNB
6-30-05
8/8

Area J Drains to Box Culvert Inlet Openings @ Willowgreen.

Q_{100} = 31.4 cfs + Bypass from I = 3.6 cfs

totaling = 35 cfs (100 yr).

For 2 year Storm = 10.7 cfs.

Check Street Capacity:
Full Curb Across Box Area to Willowgreen Ct.

A = 9.35 ft²
WP = 35.1 ft.

$$V = \frac{1.49}{0.02}\left(\frac{9.35}{35.1}\right)^{0.67}(1.3\%)^{1/2}$$

V = 3.5 f/sec; Q = V·A

Q = (9.35)(3.5) = 32 cfs

O.K.! — 2yr storm in curb - No problem w/ 100 year storm.

MKEC ENGINEERING CONSULTANTS, INC.
411 North Webb Road
Wichita, Kansas 67206
316-684-9600 FAX 316-684-5100

LETTER OF TRANSMITTAL

PROJECT: YMCA Northwest

PROJECT NO: 0401010094

DATE: September 27, 2004

TO: Ms. Vicky Huang, P.E.
City of Wichita
455 N. Main - 7th Floor
Wichita, KS 67202

We are sending you the following items:
_X_ Attached
____ Under separate cover
_X_ Via DELIVERY

____ Drawings ____ Specifications ____ Computer Disk(s)

____ Maps ____ Petitions _X_ Other

COMMENTS: Attached please find one copy of the Revised Drainage Report for the above referenced Project.

____ For Your Approval ____ As Requested

_X_ For Your Use ____ For Your Files

____ Approved As Noted ____ For Review and Comment

REMARKS: Please feel free to contact us with any questions you might have.

Signed: Greg Allison by cw
Greg Allison, P.E.

GA/cw

RECEIVED
SEP 27 2004
CITY - ENGINEERING

K:\WP\PROJECT\2004\04094\Drainage\Tr-Huang@COW_DrgReport_revised.wpd