RETURN WITHIN 2 WEEKS TO:
CITY OF COLORADO SPRINGS
STORM WATER & SUBDIVISION
101 W. COSTILLA , SUITE 113
COLORADO SPRINGS, CO 80903
(719) 578-6212

MASTER DEVELOPMENT DRAINAGE PLAN
FOR
SUNDOWN DEVELOPMENT
COLORADO SPRINGS, COLORADO

January, 1994

Prepared for :

NOR'WOOD Development

Prepared by:

KLH Engineering, Inc.
206-208 Sutton Lane
Colorado Springs, CO 80907
KLH # 93561.00

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ENGINEERING, INC.

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SUNDOWN DEVELOPMENT
DRAINAGE PLAN STATEMENTS

ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City/County for drainage reports and said report is in conformity with the master plan of the basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Kent D. Rockwell, P.E. FEB 2, 199

Kent D. Rockwell, P.E. FOR AND ON BEHALF OF KEH ENGINEERING, INC.

COLORADO REGISTERED KENT D. ROCKWELL 25086 PROFESSIONAL ENGINEER

DEVELOPER'S STATEMENT

I, the developer, have read and will comply with all the requirements in this drainage report and plan to include acceptance and maintenance developed flow onto our property.

BY: _____ DATE: 3/7/94

TITLE Tony Petree Pres. President

ADDRESS: 4065 N Sinton Rd.

C.S. Co 80907

CITY OF COLORADO SPRINGS

Filed in accordance with Section 15-3-906 of the code of the City of Colorado Springs, 1980, as amended.

_____ for

CITY ENGINEER

3/20/94

DATE

Conditions: This report makes a preliminary breakdown of what are major system costs and what are initial system costs. This breakdown which is found on the cost estimate pages, is not accepted at this time. At the time of final drainage report, initial/major systems will be determined. Reimbursement/credit will be per the DBPS in effect at that time.

MASTER DEVELOPMENT DRAINAGE PLAN (MDDP)

SUNDOWN DEVELOPMENT

Scope and Purpose:

The purpose of this study is to update the "Master Drainage Study for Sunrise Amended" by KLH Engineering, Inc., July, 1986, here after referred to as the 1986 MDDP. Data contained herein is intended to identify major drainageways, locations of culverts, open channels and contributory drainage areas. This study provides information on total developed flows and approximate sizing and general locations of required drainage facilities. This plan should be used as a guide for the required facilities and not as an inflexible design. A more detailed examination of drainage facilities will be made in the final reports for each filing as they are platted (see Exhibit D).

General:

The Sundown Subdivisions included in this Sunrise Amended Master Development Drainage study are located to the northwest of Powers Boulevard and Templeton Gap Road as shown on Exhibit A. The subdivisions contain 130 acres and to date Sundown Subdivision Filings 12, 14, 15, 17A and 17B have been platted and developed.

Land use for the unplatted portion of offsite basin A-1 east of Powers (currently zoned agricultural) is from URS Consultants "Cottonwood Creek Drainage Basin Planning Study" August, 1992 (unapproved as of this date). Land use for portions of basin A-1 west of Powers Boulevard are consistent with those previously outlined in the 1986 MDDP. Land use in this study area is shown as a combination of 1 acre and 1/4 acre residential lots, commercial and industrial development. Land use for unplatted offsite basin A-12 east of Powers is assumed to be a combination of commercial and industrial development and it is assumed 1/6 acre residential west of Powers Boulevard (which is consistent with the onsite land use for Sunrise Amended). Onsite land use is the same as indicated in the 1986 MDDP.

Soil Types:

Soil types for this study were determined from the Soil Conservation Services Soil Survey of El Paso County Area, Colorado. Soil types onsite and in the immediate offsite area are:

1. Blakeland loamy sand; S.C.S. Hydrologic group A; map symbol 8.
2. Bresser sandy loam; S.C.S. Hydrologic group B; map symbol 13.
3. Stapleton - Bernal sandy loams; S.C.S. Hydrologic group B; map symbol 85.
4. Truckton loamy sand; S.C.S. Hydrologic group B; map symbol 95.

Hydrologic group boundaries are shown on the attached Drainage Plan.

Existing Drainage Patterns:

Much of the runoff being conveyed across this site is generated from offsite drainage basins. While onsite flow is generated from 130 acres there are 186.9 acres offsite generating runoff.

Flow running onto the site from the southeast results from basin A-1. This basin begins on the east side of Powers Boulevard (approximately 7.2 acres). 107.9 acres of basin A-1 lies south of Templeton Gap and west of Powers Boulevard and the runoff from the entire 115.1 acres has a confluence on the south side of Templeton Gap Road at an existing sump. A 36" CMP at this location conveys this runoff across Templeton Gap Road to the north. The 36" CMP was found to have a capacity of 58.2 cfs by studying the hydraulic grade line of the existing system in the Sundown Development. The capacity is indicative of how much flow can be in the system without "bubbling out" of inlets further down in the system (i.e. the inlet at Bow River Drive and Stillwater "controlled" the hydraulic grade line). Flows in excess of 58.2 CFS (Q CAP of 36" CMP) during the 10 year and 100 year storm event will flow overland through a sodded overflow swale provided in a storm drainage easement constructed for this purpose. The swale running from Templeton Gap to Stillwater lies within a 30 foot wide easement and utilizes 20 feet of the easement for the swale. The allowable runoff is 199.2 cfs in the swale vs. developed Q10 = 56.8 cfs and Q100 = 185.8 cfs, therefore the swale is adequate. The expected, developed runoff of 10/100 = 56.8/185.8 cfs will result in discharge velocities of 5.9/7.8 fps. Rip-rap may be installed at the end of the swale at Stillwater to decrease the velocity. There are 8" vertical curbs and no driveways across from the swale discharge point, therefore no flow is expected to inundate the landowners across from the swale outlet. The 36" CMP runs northwesterly to Stillwater Drive where a confluence with onsite Basins A-4 and A-3 occurs. The pipe is increased to an existing 42" RCP and heads northerly up Dutchess Drive to a confluence with Basin A-5 and then turns west to Bow River Drive where approximately 100' of 42" RCP has been installed and daylights at the end of Bow River drive to a natural drainage channel.

Offsite basin A-12 develops flow from 71.8 acres. 43.0 acres lie east of Powers Boulevard and runoff from this land is collected in a sump on the east side of Powers Boulevard and conveyed via 3 - 48" CMPs to the west side. Runoff proceeds in a roadside ditch westerly along Aberdeen Street towards a 15" x 30" CMHP which directs flow to the north side of Aberdeen. From this point the runoff heads northwesterly to a 24" CMP approximately 200 feet north of Aberdeen Street which also directs flows to the west side of Oakwood Drive. Flows north of this CMP are directed northerly to Balsam Road in a roadside ditch where they are directed northerly via an 18" CMP. A 1.8 acre portion of Basin A-12 drains westerly to Oakwood where it crosses in a 24" CMP. It appears that the intent of the previous developer was to direct the majority of Basin A-12 to the 24" CMP 200' northerly of Aberdeen on Oakwood.

A natural channel is located adjacent to the southwest boundary of Sunrise Amended. This Cottonwood East Drainageway collects flow from offsite basins A-1 and A-12 as well as all onsite flows and runoff from the land adjacent to and westerly of the drainageway. This drainageway runs northerly past Balsam Road where there is a confluence with a natural channel directing flows from the northeast.

Proposed Drainage System:

The proposed onsite drainage system within Sundown Development (excluding the Balsam Road system) essentially the same as indicated in the 1986 Sunrise Amended report. Pipe and inlet sizes have been increased which reflects the changes in city adopted allowable street flow criteria, change

from 5 year to 10 year storm and change to minimum B hydrologic group resultant curve numbers from accepting group A curve numbers.

The historic runoff expected from Basin A-1 has been analyzed to determine the adequacy of the existing storm drain system. The existing, historic CN is 54.4 (vs. a developed CN of 77.2) yielding 10/100 runoff of 6/51 cfs. As stated above, the 36" CMP will accept 58.2 cfs, therefore the existing system is adequate to accept all historic flows without the use of the overflow swale.

Dutchess Drive has a minimum slope of 0.82% with vertical curbs. Criteria is met when analyzing historic runoff. When analyzing the developed upstream condition, it has been determined that in the 10 year storm the city criteria is adhered to however in the 100 year storm the depth of flow will be approximately 2" above the allowable 12" depth at flow line for residential streets. The finished floor elevations of the existing homes along Dutchess Drive were designed to be 2.7 feet to 5.3 feet above the flow line based on city requirements at the time of construction. The finished floor elevations are shown on the original VA/FHA grading plans for this portion of the development.

One possible method to meet city criteria in Dutchess Drive in the 100 year storm is to install a parallel 30" RCP system from the current outlet of the 42" RCP at the end of Bow River Drive to the intersection of Stillwater and Dutchess Drive. An 8' D10R will be installed at this intersection to collect the excess 100 year flows. Alternately, a detention system may be constructed south of Templeton - Gap Road in Basin A-1. To ensure that Bow River Drive street flow meets current criteria it is recommended that one of those systems be installed by others at the time upstream development occurs.

A Box Manhole will be constructed at the current end of the 42" RCP in Bow River Drive. A 48" RCP will continue from this point and will increase to a 54" RCP heading northerly to Hatteras Drive. A new pipe line and inlets have been added to this plan from the 1986 MDDP running east-west in Hatteras Drive in order to comply with city criteria for allowable flow in residential streets. Runoff in excess of allowable street capacity from Basin A-14, A-15, A-16, A-17 and A-13 will be collected in curb opening inlets and piped westerly down Hatteras Drive. This system in Hatteras Drive will connect with the system in Bow River Drive at the intersection of Hatteras Drive and Bow River in a 6' Type II Manhole. From Hatteras Drive and Bow River Drive a 60" RCP, increasing to a 66" RCP will convey flow to the Cottonwood East Drainageway. An emergency overflow swale will be built above the pipe and an energy dissipator will be constructed at the outlet of the 66" RCP to reduce the outlet velocity of the 1336 cfs which will be generated in the developed condition.

Runoff form Basin A-12 will not be handled as shown in the 1986 study. The DBPS will be amended prior to its adoption to show a Major System through Basin A-12 outfalling into the existing drainageway to the north of Sundown Development. This proposed system will not enter the Sundown Development but will follow the Oakwood alignment. In the interim, as Sundown basins A-14 and A-16 develop, historic tributary flows will be carried through the proposed streets.

Runoff from basins A-21 and A-22 is routed westerly to curb opening inlets at Ticonderoga and Corinth. An 18" RCP connects the 2 inlets and directs flow to basin A-29. Runoff from basin A-29 is collected in a sump inlet where the above mentioned 18" RCP connects and a 24" RCP directs runoff from all three basins to the Cottonwood East Drainageway. An emergency overflow swale will be built above the pipe and an energy dissipator will be constructed at the outlet of the 66" RCP to reduce the outlet velocity of the developed condition runoff.

At the time of construction of the "Nor'wood East Trunk Sewer," several downstream improvements

were made to what this report refers to as the Cottonwood East Drainageway owned by Nor'wood. These improvements were based upon the February, 1985 "Master Drainage Study for Nor'wood East" prepared by KLH Engineering Consultants, Inc. Rip-rap was placed at various points along the drainageway to stabilize it for developed runoff and several substantial CMP crossings were installed based on developed runoff. Nor'wood is responsible for maintenance of the downstream channel. At this time, Nor'wood owns the land downstream of Sundown Development including the drainage channels to Austin Bluffs. As a condition of approval of this MDDP, Nor'wood (and its successors) agrees to accept the developed flows from Sundown Development and maintain the drainageways in such a manner as to control erosion and preserve the natural character of the channels. As future development occurs along the drainageways, the requirements of the DBPS, with repect to channel stabilization will be implemented.

At Balsam Road a 42" CMP was constructed which will not accept the developed Q100 of 1336 cfs (42" CMP @ 2% will accept 74.0) and will be either rebuilt as 2- 6'x13.5' RCBs or have an additional structure placed parallel to this pipe to meet the required capacity (this is a reimbursable major storm improvement). The confluence of Basin A-12 with the remainder of the basins will occur on the north side of Balsam Road in order to decrease the necessary size of the culvert.

Method of Computation:

Basin modelling for basins in excess of 100 acres was performed using the U.S. Army Corps of Engineers HEC-1 program with the SCS Unit Hydrograph method. Results shown are for 10 year and 100 year 24 hour storm using AMC-II. Results for the 10 year and 100 year 2 hour storm were compared and found to generate peaks less than those of the 24 hour storm. A rainfall depth of 4.4 inches for a 24 hour period was used for the basin. B Hydrologic Soil Groups' resultant Curve Numbers were used in this study for both A and B Hydrologic Soil Groups.

Basin runoff for areas less than 100 acres was calculated by the Rational Method outlined in Chapter 5 of the City of Colorado Springs and El Paso County Drainage Criteria Manual. Drainage criteria has been adhered to for all street flow in proposed construction areas. For existing streets the allowable flow for the initial storm has been increased to the top of curb in an effort to avoid prohibitive retrofitting costs. This design waiver was agreed to by City Engineering.

Inlet sizing and resultant "flow-by" street flows have been determined using Rational Method flows. Pipe sizing has been determined from HEC-1/SCS method flows as the majority of flow is coming from a 115.1 acre offsite area. Basin runoff, inlet sizing, and pipe sizing tables are attached.

Drainage Facilities Cost Estimate:

At the time of this writing, the proposed Cottonwood Creek DBPS is not adopted. The proposed study limits reimbursement/credit to Major Systems are identified in the DBPS. The DBPS is being amended to include the information in this MDDP.

Cost estimates are separated into Initial systems and Major Systems (refer to attached construction cost estimates). Reimbursement/credit for costs will be subject to the rules in effect at the time of seeking cost reimbursement.

SUNDOWN MDDP MAJOR STORM
DRAINAGE IMPROVEMENTS – CONSTRUCTION COST ESTIMATE

ITEM	UNIT	UNIT COST	– QUANTITIES – QUANTITY	TOTAL COST
PIPE:				
18" RCP	LF	$20	665	13, 300
24" RCP	LF	$25	475	11, 875
30" RCP	LF	$36	520	18, 720
48" RCP	LF	$60	180	10, 800
54" RCP	LF	$75	1, 410	105, 750
60" RCP	LF	$90	2350	211, 500
66" RCP	LF	$105	560	58, 800
72" RCP	LF	$120	50	6, 000
Bends:				
30" – 45deg Bend	EA	$490	2	980
54" – 45deg Bend	EA	$800	3	2, 400
60" – 45deg Bend	EA	$920	2	1, 840
66" – 22.5deg Bend	EA	$920	2	1, 840
60" X 72" Reducer	EA	$900	1	900
Wyes:				
18"x18"x45deg WYE	EA	$640	1	640
24"x18"x45deg WYE	EA	$680	4	2, 720
54"x24"x45deg WYE	EA	$1, 100	4	4, 400
60"x24"x45deg WYE	EA	$1, 220	2	2, 440
30"x18"x45deg WYE	EA	$770	2	1, 540
54"x18"x45deg WYE	EA	$1, 080	4	4, 320
60"x18"x45deg WYE	EA	$1, 200	4	4, 800
66"x18"x45deg WYE	EA	$1, 320	2	2, 640
Inlets:				
14' D10R Inlet	EA	$5, 600	2	11, 200
Energy Dissipator:	EA	$8, 565	1	8, 565
SUBTOTAL				$487, 970
Contingency 10%				$48, 797
TOTAL				$536, 767

SUNDOWN MDDP MAJOR STORM
DRAINAGE IMPROVEMENTS – CONSTRUCTION COST ESTIMATE

ITEM	UNIT	UNIT COST	– QUANTITIES – QUANTITY	TOTAL COST
Retrofitted area:				
8' D10R Inlet	EA	$3, 360	1	3, 360
Rem.&rep. AC & Base	SY	$16	239	3, 824
30" RCP	LF	$36	430	15, 480
SUBTOTAL				$22, 664
Contingency 10%				$2, 266
TOTAL				$24, 930

BASIN A–12 TO DRAIN PARALLEL TO OAKWOOD NORTHERLY TO URS CHANNEL
TO BE AN AMENDMENT TO THE DBPS

5'x4' RCB	CY	$350	23	8, 050
Energy Dissip.	EA	$1, 833	2	3, 666
Grass swale	LF	$6	1000	6, 000
SUBTOTAL				$17, 716
Contingency 10%				$1, 772
TOTAL				$19, 488

SUNDOWN MDDP INITIAL STORM
DRAINAGE IMPROVEMENTS – CONSTRUCTION COST ESTIMATE

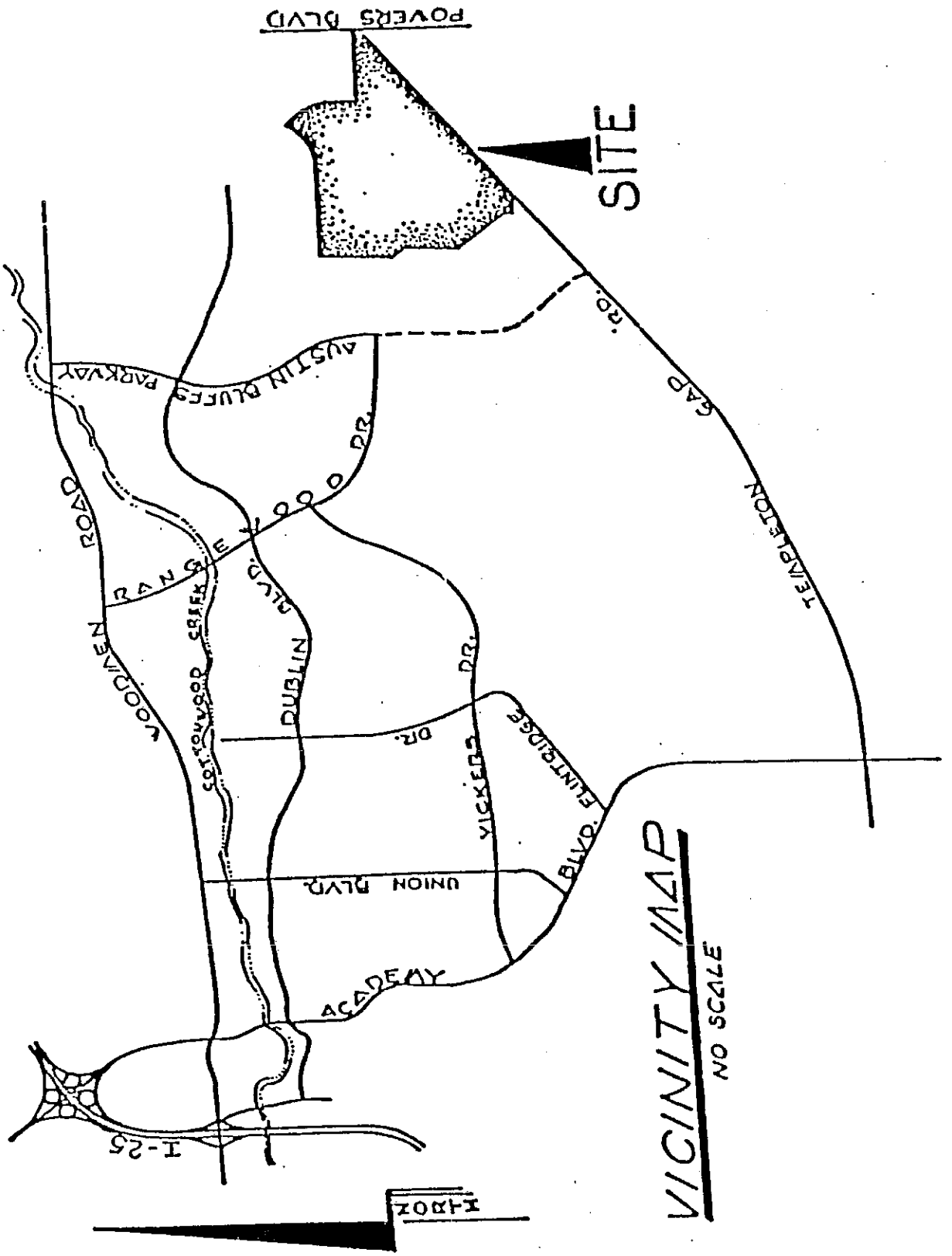
ITEM	UNIT	UNIT COST	– QUANTITIES – QUANTITY	TOTAL COST
Manholes:				
6' MH, Type II	EA	$1,600	1	1,600
Box MH, Type I	EA	$2,500	7	17,500
Inlets:				
6' D10R Inlet	EA	$2,720	2	5,440
8' D10R Inlet	EA	$3,360	4	13,440
10' D10R Inlet	EA	$4,000	3	12,000
12' D10R Inlet	EA	$4,800	1	4,800
14' D10R Inlet	EA	$5,600	5	28,000
16' D10R Inlet	EA	$6,400	2	12,800
18' D10R Inlet	EA	$7,200	1	7,200
20' D10R Inlet	EA	$8,000	3	24,000
25' D10R Inlet	EA	$10,000	1	10,000
Other:				
Riprap	CY	$40	530	21,200
SUBTOTAL				$157,980
Contingency 10%				$15,798
TOTAL				$173,778

NOTE: EXISTING SYSTEMS ARE NOT INCLUDED IN THE ABOVE QUANTITIES OR COSTS.

ALL DRAINAGE FACILITIES INSTALLED PRIOR TO OFFICIAL CITY COUNCIL ACCEPTANCE OF COTTONWOOD CREEK MASTER DRAINAGE BASIN STUDY SHALL BE CREDITED TO REIMBURSEMENT COSTS FOR EXISTING CRITERIA.

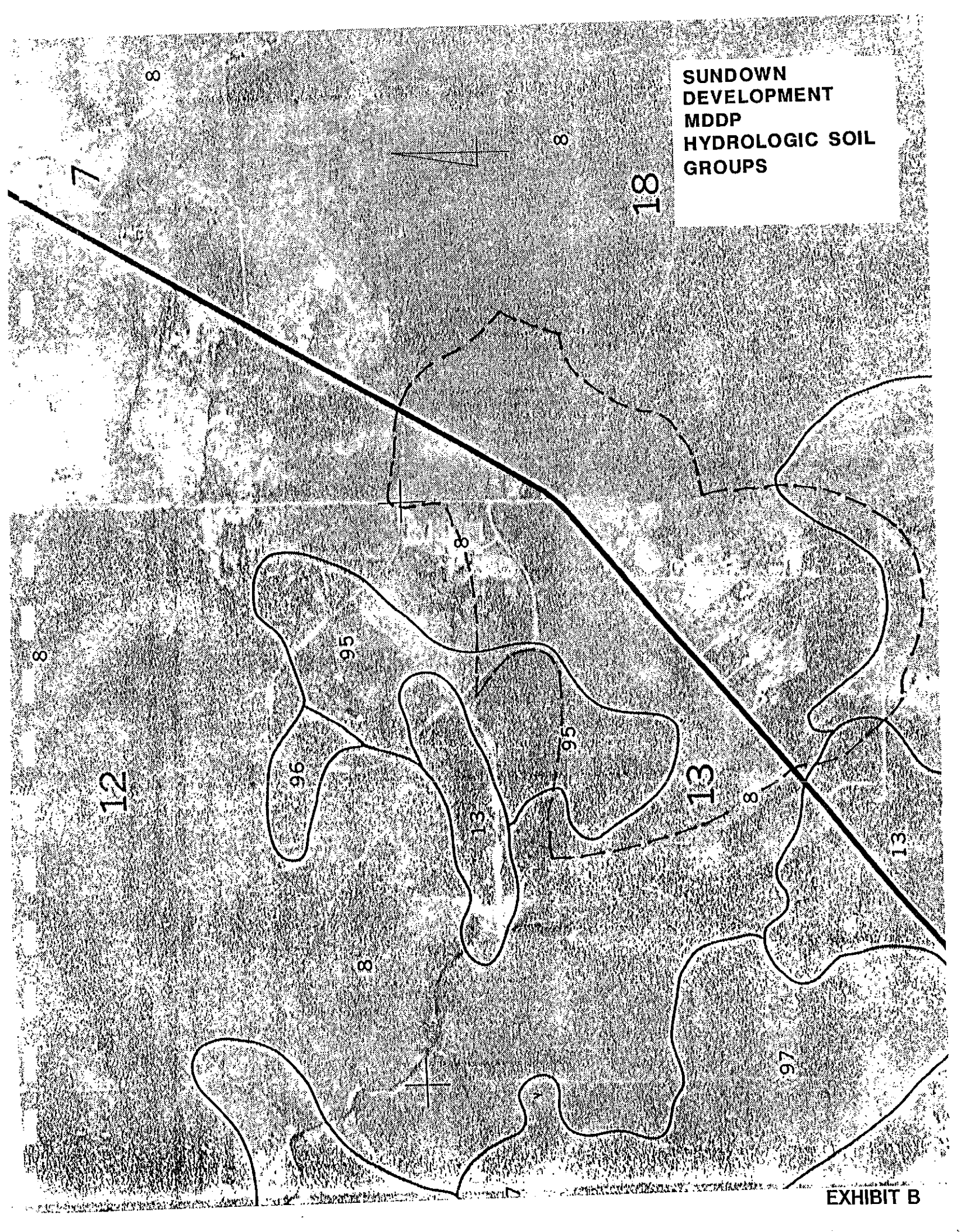
SUNRISE AMENDED MDDP – TABLE 1
BASIN HYDROLOGY – SUMMARY OF PEAK FLOWS
10 YEAR AND 100 YEAR STORM

		RATIONAL		HEC-1	
BASIN	CONTRIBUTORY AREA (ACRES)	10 YR (CFS)	100 YR (CFS)	10 YR (CFS)	100YR (CFS)
A-1	115.1			115.0	244.0
A-2	1.6	5.3	8.8		
A-3	4.6	14.5	24.8		
A-4	16.3	37.1	63.6		
A-5	7.6	19.3	32.9		
A-6	9.9	26.4	46.0		
A-7	4.7	13.7	23.7		
A-8	4.9	13.4	22.5		
A-9	4.8	13.8	23.7		
A-10	10.2	28.9	49.7		
A-11	4.4	14.2	24.4		
A-12	71.8	178.0	288.0		
A-13	3.0	9.3	16.2		
A-14	5.6	17.6	30.2		
A-15	2.8	8.4	14.3		
A-16	6.8	19.4	33.0		
A-17	5.5	16.4	28.5		
A-18	4.3	12.9	22.6		
A-19	3.6	10.9	18.1		
A-20	7.9	22.9	37.7		
A-21	7.0	18.8	31.9		
A-22	8.3	23.4	39.7		
A-29	0.8	3.5	5.9		
A-30	10.9	21.5	48.9		



SUNDOWN DEVELOPMENT

EXHIBIT A


SUNDOWN
DEVELOPMENT
MDDP
HYDROLOGIC SOIL
GROUPS
EXHIBIT B

N

SCALE: 1" = 400'

SUNDOWN DEVELOPMENT

MDDP
LAND USE

COMMERCIAL

INDUSTRIAL

COMMERCIAL

RESIDENTIAL 1/4 AC

RESIDENTIAL 1/6 AC

RESIDENTIAL 1 AC.

A 1 1/2

A 1 1/4

3'x4' CMP

15"x30" CMP

CHURCH

15" CMP

24" CMP

24" CMP

18" CMP

36" CMP

NOTE: PIPES SHOWN ARE EXISTING

LEGEND

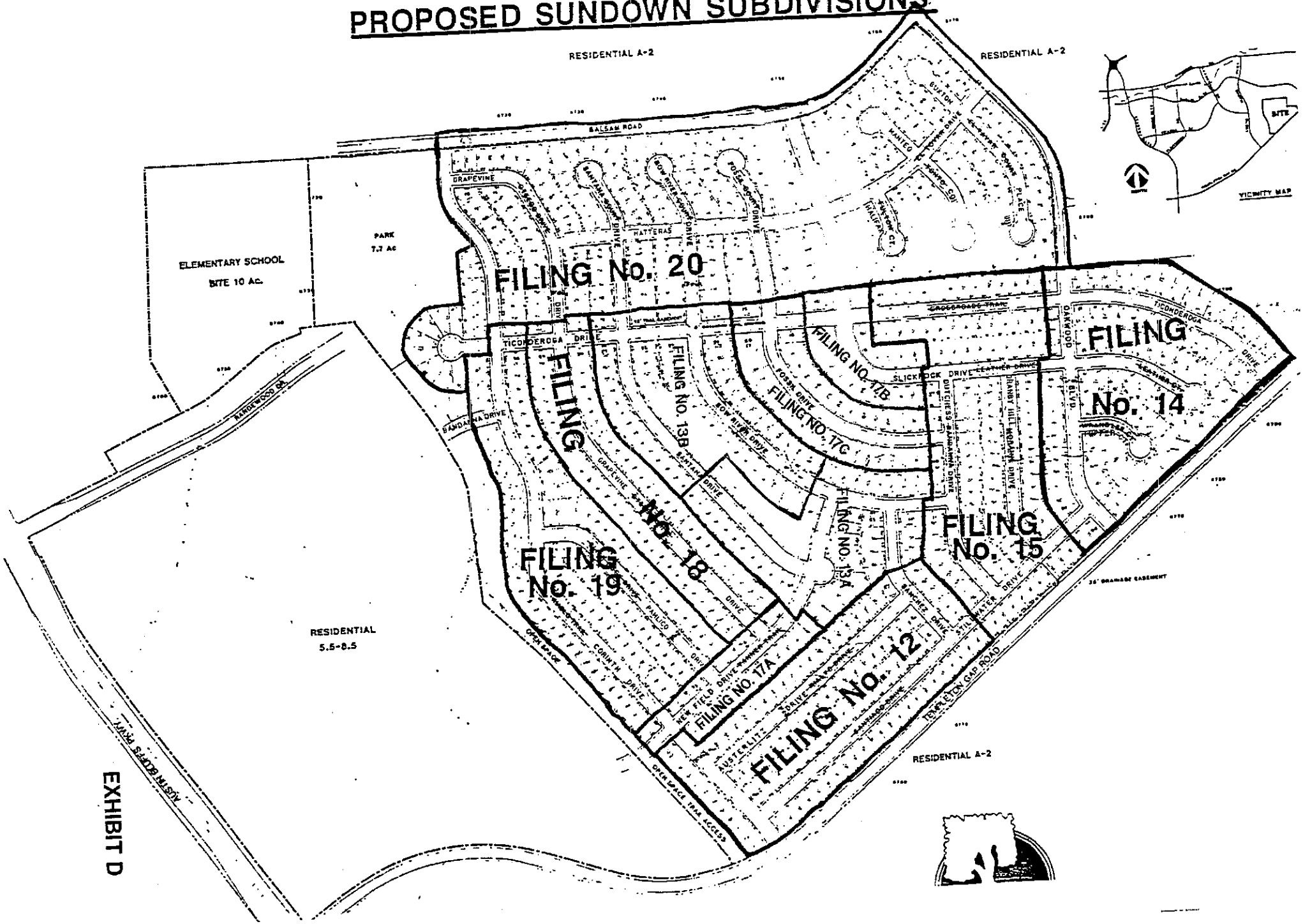
SUB BASIN BOUNDARY

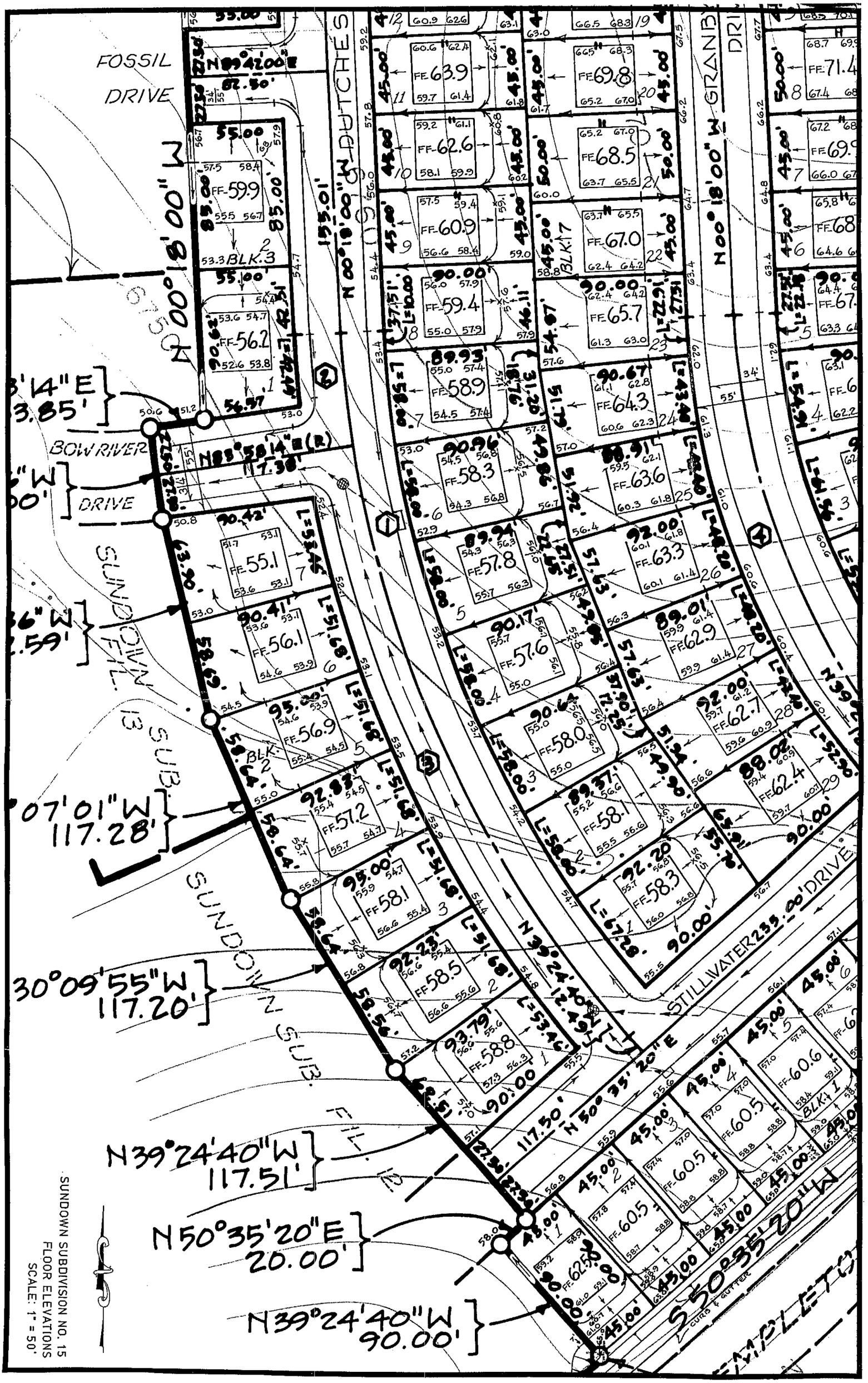
ZONING BOUNDARY

EXHIBIT C

REVISED SUNDOWN DEVELOPMENT

PROPOSED SUNDOWN SUBDIVISIONS





SUNDOWN SUBDIVISION NO. 15
FLOOR ELEVATIONS
SCALE: 1" = 50'

INLET SIZING | SUNDOWN | 11-15-93 CKM

INLET #	SIZE & PERCENT SLOPE	Q_{10}	Q_{100} INTO INLET
I1	EXIST. 36" CMP STUB IN SUMP	58.2	58.2
I2	10' DIOR SUMP	5.3	8.8
I3	6' DIOR SUMP	9.9	18.0
I4	10' DIOR SUMP	16.5	23.5
I5	8' DIOR SUMP	13.2	0
[illegible]	8' DIOR @ 0.82%	37.8	37.8
I6	2~14' DIOR @ 0.99%	28.8	67.8
I7	2~8' DIOR @ 0.99%	12.6	37.0
I9A	16' DIOR SUMP	13.8	23.7
I10C	20' DIOR SUMP	16.6	32.9
I10A	25' DIOR SUMP	20.8	41.1
I9A	50' DIOR SUMP	16.6	32.9
I15	14' DIOR @ 1.6%	13.3	22.8
I16A	14' DIOR @ 1.6%	7.9	13.4
I16	14' DIOR @ 1.6%	7.0	12.0
I17	14' DIOR @ 1.6%	7.7	13.2
I14	14' DIOR @ 1.6%	8.4	22.2
I18A	18' DIOR SUMP	15.8	15.8
I17A	20' DIOR SUMP	17.6	17.6
I9C	10' DIOR @ 1%	16.1	-
I20D	12' DIOR @ 1.1%	8.0	54.2
I20B	16' DIOR SUMP	13.3	26.3

INLET #	SIZE & PERCENT SLOPE	Q_{10}/Q_{100} INTO INLET	
I20A	8' DIOR SUMP	6.6	13.2
I20C	6' DIOR SUMP	4.6	9.9
I21	10' DIOR SUMP	6.6	13.2
I22	10' DIOR SUMP	6.6	13.2
I29	6' DIOR SUMP	5.0	9.9

PIPE SIZING:

PIPE #	SIZE & MIN % SLOPE	PIPE DESIGN Q_{10}	PIPE DESIGN Q_{100}	STREET Q_{10}	STREET Q_{100}
L1	36" CMP	58.2	58.2	13.8	122.8
L2	18" RCP		8.8	T-GAP	T-GAP
L1A	36" CMP		67.0	51.5	122.8
L4	21" RCP		20.6	20.6	40.1
L4A	36" RCP		90.5	72.1	162.9
L3	42" RCP		108.5	16.7	155.7
L5	42" RCP		108.5	54.3	183.7
L5A	48" RCP @ 1.04% SL		146.3		
RL3	30" RCP @ 0.95% SL.			16.7	155.7
L6	54" RCP @ 0.97% SL		194.1	14.1	151.9
L7	54" RCP @ 1.4% SL		231.1	15.2	151.9
L10	54" RCP @ 1.97% SL		276.0	17.7	176.0
L15	24" RCP @ 0.9% SL	21.2		8.5	14.6
L16	30" RCP @ 0.8% SL	36.1		18.8	57.8
L18	30" RCP @ 1.2% SL	44.3		24.1	85.8
L20A	60" RCP @ 2.4% SL		402.2	10.3	156.8
L20	66" RCP @ 1.3% SL		389.0	9.1	200
L19	66" RCP @ 1.4% SL		402.1	8.9	195.1
L21	18" RCP @ 1.6% SL	13.2		29.0	58.4
L29	24" RCP @ 0.6% SL	18.2		27.5	68.3

MINIMUM SLOPE

CKM 11-12-93

ALLOWABLE STREET CAPACITIES FOR AREAS ALREADY BUILT:

INITIAL, 10 YR STORM: MAY GO TO TOP OF CURB (T.C)

8" VERTICAL CURB, 34' CURB - CURB.

MAJOR, 100 YR STORM:

SAME, DEPTH OF FLOW @ GUTTER FLOW LINE < 12"
8" VERTICAL CURB, 34' CURB - CURB

ALLOWABLE STREET CAPACITIES FOR NEW AREAS:

FOLLOW ALL CURRENT CRITERIA:

INITIAL, 10 YR STORM: FLOW TO CROWN ONLY
NO CURB OVERTOPPING

MAJOR, 100 YR STORM: FLOW @ GUTTER FLOW LINE < 12"

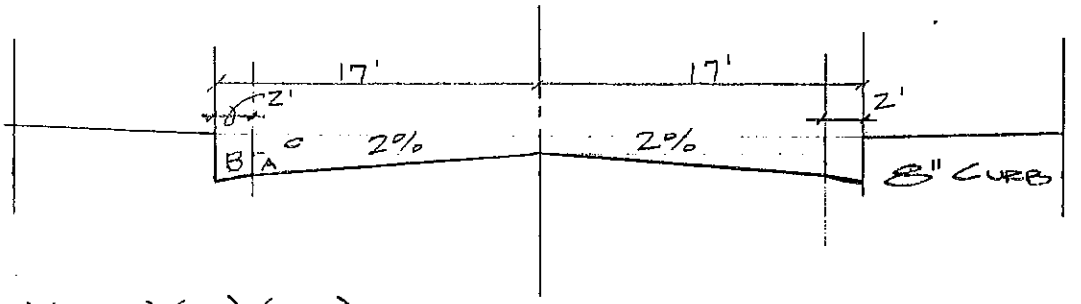
NOTE:
MAIN FLOW PATH TO HAVE 8" VERTICAL CURB IN NEW AREAS

Use For Existing Condition Only	Flow to Top of Curb	8" C.F.

Local / Residential 10-YR
Top of 8" C.F.

Top Exists Areas

$Q_{cap\ of\ Street}$



A: $(15)(0.02)(15)(0.5) = 2.25$

B: $\left(\frac{1\frac{1}{2}}{12}\right)(2)(0.5) + \left(\frac{8-1\frac{1}{2}}{12}\right)2 = 1.21$

$C = \left[\frac{8}{12} - (15)(0.02) - \left(\frac{1\frac{1}{2}}{12}\right)\right](15) = 3.63$

$7.08 \times 2 = 14.17\ \phi$

$\Sigma A = 14.17$
$R = 0.40$

$P = (17.67)(2) = 35.33$

$\therefore\ Q = 715.71\sqrt{S}$

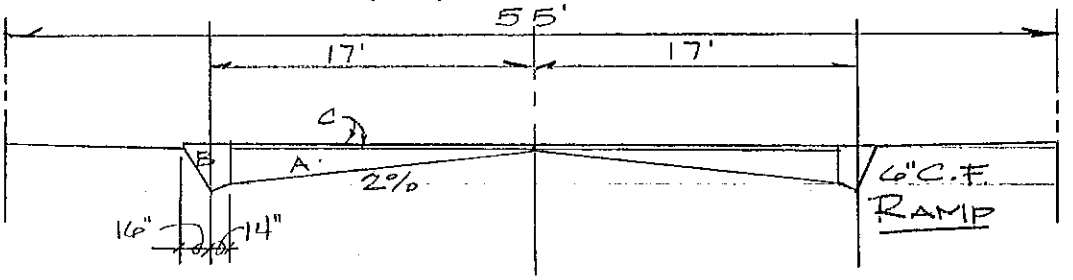
Slope, %	Q, cfs
0.5	50.61
0.8	64.02
1.2	78.40
1.5	87.66
1.7	93.32
2.0	101.22
2.2	106.16
2.5	113.16
2.7	117.60
3.0	123.96
3.2	128.03
3.5	133.90
3.7	137.67

USE FOR EXISTING CONDITION ONLY | FLOW TO TOP OF CURB | 6" C.F.

LOCAL/RESIDENTIAL 10-YR
TOP OF CURB

Q_{cap} OF STREET:

$A = (15.83)(0.02)(0.5)(15.83)$



AREA =

$A = (17' - 14/12)(0.02)(0.5)(17' - 14/12) = 2.507$

$B = (1\frac{1}{2}/12)(0.5)(14/12) + \left(\frac{6 - 1\frac{1}{2}}{12}\right)(14/12) + (0.5)(\frac{16}{12})(\frac{6}{12})$

$= 0.84$

$C = \left[\left(\frac{6" - 1\frac{1}{2}}{12}\right) - 0.02(17 - 14/12)\right](17 - 14/12) = 0.92$

$\Sigma A = 4.27$

$2 \times \Sigma A = \overset{*2}{8.554}$

$P = 2 \times (15.83 + 0.13 + 1.\bar{3} + 1.1\bar{6}) = \boxed{36.92'}$

$R = A/P = 0.23$

$\therefore \quad Q = 209.39\sqrt{S}$

Slope, %	Q, cfs
0.5	21.17
0.8	26.78
1.2	32.80
1.5	36.67
1.7	39.04
2.0	42.34
2.2	44.41
2.5	47.34
2.7	49.20
3.0	42.34
3.2	53.56
3.5	56.01
3.7	57.59

FOR EXISTG AREAD

SUNDOWN | TABLE 6-1 STREET CAPACITY | 6" C.F. | CKM 10-5-93

TYPE A (LOCAL/RESIDENTIAL) 10-YR

TOP OF CURB OR CROWN - WHICHEVER LIMITS

RAMP CURBS 34' C-C

DEPTH OF FLOW @ FC = 0.4417'

A = 5.01 ac + 0.74 ac + 0.15 ac + 0.59 ac = 6.5 ac

P = 34.9

R = 0.186 Q = 107.09√S

Q ALLOWABLE FOR VARIOUS SLOPES

Q, CFS	SLOPE, %
13.9	0.5
19.7	1.0
24.1	1.5
27.9	2.0
31.1	2.5
34.1	3.0
36.8	3.5
39.4	4.0
41.8	4.5
44.0	5.0
46.2	5.5
48.2	6.0
50.2	6.5
52.1	7.0
53.9	7.5

100 YR - GUTTER DEPTH ≤ 12" (E)

RAMP CURB - 34' C-C Q = 1746.69√S

Q ALLOWABLE FOR VARIOUS SLOPES

Q, CFS	SLOPE, %
123.5	0.5
174.7	1.0
213.9	1.5
247.0	2.0
276.2	2.5
302.5	3.0
326.8	3.5
349.4	4.0
370.5	4.5
390.6	5.0
409.7	5.5
427.9	6.0
445.3	6.5
[illegible]	7.0

CURRENT LANE

9356100

8" C.F.

CKM 11-1-93

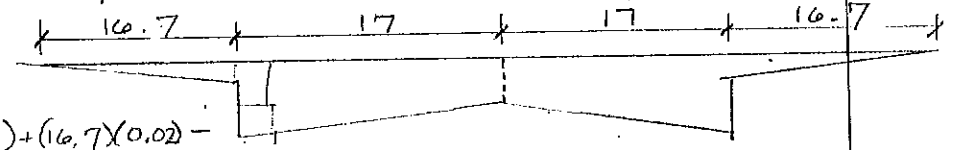
10 YR CRITERIA - TOP OF CURB OR CROWN WHICHEVER IS LESS

8 VERTICAL CURB, 1/2 STREET

CURRENT CRITERIA

S %	Q CFS
0.5	6.0
0.9	8.1
1.0	8.5
1.5	10.4
1.55	10.6
2	12.0
2.5	13.4
3	14.7

100 YR - 12" DEPTH @ FL, FULL STREET



$A = [16.7)(0.02)(0.5)(16.7)$

$[15^2(0.02)](0.5) + [(0.67)+(16.7)(0.02) - 0.125 - 15(0.02)]17 + 0.125(2)(0.5) + 15(0.02)(2) = 15.61$

$\times 2 = 31.21$

$P = 68.34'$ $\therefore R = 0.4567$ $\therefore Q = 1719.3\sqrt{S}$

S %	Q CFS
0.5	121.6
0.9	163.1
1.0	171.9
1.5	210.6
1.55	214.1
2.0	243.2
2.5	271.9
3	297.8

METHOD:

INLETS: SIZE INLETS FOR RATIONAL Q TO HAVE ADEQUATE FLOW BY ASSUME PIPE IS PROPERLY SIZED TO ACCEPT THE FLOW. CHECK HW/D

PIPE: SIZE "MAIN SYSTEM" TO SCS FLOWS LESS THE Q ALLOWABLE IN THE STREET - THIS WILL NOT YIELD SCS Qs + RATIONAL Qs

SIZE "SIDE SYSTEMS" (ie. HATTERAS) TO RATIONAL Q, SIMPLE SUM OF AREAS & Qs (ie. NO CONFLUENCE ANALYSIS) WHEN "SIDE SYS" COMBINES WITH "MAIN SYS" SIZE PIPE TO THE SCS Qs.

Q FOR EXISTG SYS. DETERMINED FROM HGL ANALYSIS TO FIND MAX Q W/ OUT "BUBBLING OUT" OF EXISTG INLETS/MHS ETC.

INLET/LINE	$Q_{in\ PIPE}$	$Q_{10\ FT.}$	$Q_{10\ ALL\ ST.}$	$Q_{100\ PIPE}$	$Q_{100\ ST}$	$Q_{100\ ALL\ ST}$	ST. %/FT.
I1	58.2	13.8	199.2	58.2	122.8	199.2	
I2	+5.3 ← add inlet		flow →	+8.8			
L1A	63.5	51.5	< 199.2 OK	67.0	122.8	< 199.2 OK	
	these SCS	sum to: 116		these SCS	sum to: 246		
I4	+16.5	20.6		23.5	40.1		
L4A	80.0	72.1	< 109.9 OK	90.5	162.9	< 204.1 OK	2.36%
I3	+14.5			+8	+6.8		
L3	94.5	54.5	< 64.8 OK	108.5	193.5	> 155.7 NG	0.82%
	these SCS	sum to: 149		these SCS	sum to: 302		
			Q = 37.8	RETROFIT a 0	30" @ 0.95%		1.55%
I5	+13.2	6.1					
	107.7	60.6	< 89.1 OK	108.5	221.5	> 214 NG	
	SCS	162		these SCS	sum to: 330		
			Q = 37.8	RETROFIT a	30" @ 0.95%		
L5	107.7	60.6	< 89.1 OK	108.5	221.5	> 214 NG	
	SCS	162		SCS	330		

Must design retrofitted system:

Begin retrofit at L3:

For Q_{100}, need inlet for 37.8 cfs or 39.1% of ½ Q_{ST} = 193.5 cfs (½ = 96.8 cfs)
Slope of street = 0.82%, install inlet @ N.W. corner of Stillwater & Dutchess Dr.
Try 8' DIOR ∴ Q_i/Q = 50% (Q_{10} & Q_{100})
∴ Q_i = 48.4 cfs (Q_{10} & Q_{100})

Inlet / Line	Q_{10} Pipe	Q_{10} St.	Q_{10} All St	Q_{100} Pipe	Q_{100} St	Q_{100} All St	St %
I3	+14.5			+18	+6.8		
L3	94.5	54.5		108.5	193.5		
RI3	+~~48.4~~			+~~48.4~~			
RI3	+37.8	(-37.8)		+37.8	(-37.8)		
RL3	37.8			37.8			
	132.3	16.7	< 64.8 OK	146.3	155.7	= 155.7 OK	0.82%
	sum: SCS	149		sum: SCS	302		
A5	19.3			32.9			
I5	+13.2	6.1		0			1.55%
L5	107.7	54.3	< 89.1 OK	108.5	183.7	< 214 OK	
	sum: SCS	162		sum SCS	330		
	145.5	16.5		146.3	183.7		

Need Box MH. @ End of existing line to connect to proposed line.

A6	26.4			46.0			
	145.4	42.9	> 17.0	146.3	219.7	> 171.9	
I6			< 17.0			< 171.9	0.99%
	sum: SCS:	184.0		sum: SCS	366		

Install 1 ~14 DIOR on each side, (2 Total)
Q_i/Q = 0.67 Q_i/Q = only add Q_{10} to pipe.

I6	+14.4			+33.9			
I6	+14.4			+33.9			
L6	169.9	14.1	< 17.0 OK	194.1	151.9	< 171.9 OK	
	Sum: SCS:	184.0		Sum: SCS:	366		

INLET/LINE	Q_{10} PIPE	Q_{10} ST	Q_{10} ALL ST	Q_{100} PIPE	Q_{100} ST	Q_{100} ALL ST	ST SL
A7		13.7			23.7		
		27.8	> 17.0 NG		175.6	> 171.9	0.99%
	Install	1~8' D10R on	each side		Q_i/Q = 45%		
I7	+6.3			+18.5			
	+6.3			+18.5			
L7	177	15.2	< 17.0 OK	231.1	151.9	< 171.9	0.99%
	Sum:			Sum:			
	SCS:	193		SCS:	383		
A9		13.8			23.7		
	√Install	16' SUMP:					
I9A	+13.8	0		+23.7	0		
A11		14.2			24.4		
A10 (½)		14.5			24.9		
		28.7	< 31.1 OK		49.3	< 276.2	2.5%
A10		14.2			24.4		
A11		28.9			49.7		
		43.1	> 19.4 NG		74.1	< 196.0	1.3%
	Install	20' Sump:					
I10C	+16.6	26.5	> 19.4 NG	+32.9			
	Install	25 Sump					
I10B	+20.8	5.7	< 19.4 OK	+41.1		< 196.0 OK	
Flow to	I9B = ½L7 + A8 = 21.0/98.5			Install 20' D10R Sump			
I9B	+16.6	19.3		+32.9			
NET PICKUP	67.8			130.6			
NET FLOW	85.5 √			272.2			
NET FLOWBY	17.7	< 19.4 OK!		141.6	< 196.0		
				DESIGN For more flow instreet:			
L10	216.3	17.7	< 19.4 OK	276	176.0	< 196.0 OK	
	Sum:			Sum:			
	SCS:	234		SCS:	452		

INLET / LEG	Q_{10} PIPE	Q_{10} STREET	Q_{10} ALL ST	Q_{100} PIPE	Q_{100} STREET	Q_{100} ALL ST

$Q_{CONTRIBUTING}$ TO I15 = A14 + ½A15 = 17.6 + 8.4/2 = 21.8 CFS (10)

30.2 + 14.3/2 = 37.8 CFS (100)

TRY 14' D10R @ 1.6% ~ 61%

∴ I15	(+13.3)	8.5	< 24.0	22.8	14.6	<< 215

$Q_{CONT.}$ = A14 + A15 − I15 PICKUP: Q_{10} = 26 − 13.3 = 12.7 CFS

Q_{100} = 44.5 − 22.8 = 21.7 CFS

TRY 14' D10R @ 1.6% ~61% PICKUP

I17	(+7.7)	5.0		13.2	8.5

Q_{CONT} = ⅔ A16 : Q_{10} = 12.9 CFS

Q_{100} = 22.0 CFS

TRY 14' D10R @ 1.6% ~61% PICKUP

I16A	(+7.9)	5.0		13.4	8.6

Q_{CONT} = PASS FROM I16A + ⅓ A-16 =

Q_{10} = 5 + ⅓(10.4) = 11.5 CFS

Q_{100} = 8.6 + ⅓(33.0) = 19.6 CFS

TRY 14' D10R @ 1.6% ~61% PICKUP

I16	(7.0)	4.5		12.0	7.6

A14, 15 & 16, TOTAL CONTRIBUTING:		45.4		77.5	
TOTAL PICKUP:	−35.9	= 9.5		−35.9	41.6
RUNOFF FROM A13 (NO INLET)		9.3			16.2

18.8 CFS < 24.0 OK

57.8 CFS << 215 OK

↑ FLOW BY TO I18

Q_{CONT} TO I18 = Q_{10} = 18.8/2 + ⅓ A-18 = 13.7

Q_{100} = 57.8/2 + ⅓ A-18 = 36.4

(I 18 CONT.)

TRY 14 DIOR @ 1.6% ~ 61%

I 18	8.4	5.3	22.2	14.2
PREVIOUS FLOWBY	35.9	18.8	35.9	57.8
	(44.3)	24.1 < 24.9 OK	58.1	72.0
				+ 13.8
			44.3	85.8 << 215 OK

SAME

$Q_{CONT.}$ TO I 18A = PREVIOUS FLOW BY/2 + 2/3 A 18

$Q_{10} = 24.1/2 + 2/3(102.0) = 20.7$ CFS

$Q_{100} = 85.8/2 + 2/3(22.6) = 58.0$ CFS

TRY 18' SUMP INLET

I 18A	15.8	4.0	15.8	42.2

SAME

Q_{CONT} TO I 17A = PREV. FLOW BY/2 + A-17

$Q_{10} = 24.1/2 + 16.4 = 28.5$ CFS

$Q_{100} = 85.2/2 + 28.5 = 71.1$ CFS

TRY 20' SUMP INLET

I 17A	17.6	10.9	~~32.9~~ 17.6	53.5

SAME

Q_{CONT} TO I 9C:

FLOW BY FROM L 10: $Q_{10} = 17.7$ $Q_{100} = 176.0$

FLOW BY FROM I 17A: $Q_{10} = 10.9$ $Q_{100} = 53.5$

28.6 CFS 229.5

ON GRADE INLET @ 1% - NOTE: FLOW BY FROM I 18A IS 4.0 CFS ∴ TOTAL FLOW BY FROM I 9C MUST BE < 10.7 - 4.0 = 14.8 CFS OR 51% PICKUP REQ'D.!

TRY 12' DIOR @ 1% ≈ 64% PICKUP

I 9C	18.3	10.3 < 14.8 OK	+146.9	82.6 < 174.7
		INLET CAPABLE OF THIS MUCH Q	276 ← PREVIOUS L 10 SCS FLOW	
SCS Q =	200	SCS Q = FF^0.3 · 156.8	402.2	← SIZE PIPE

INLET/LINE	Q_{10} PIPE	Q_{10} ST	Q_{10} ALL ST	Q_{100} PIPE	Q_{100} ST	Q_{100} ALL ST	ST % SL.
(8" L20A	CURB) 282.1	10.3*	< 17.0	402.2	156.8	< 171.9	1.1%
	Sum: SCS: 299			Sum: SCS: 559			

* Flow is 4.9 on N side, 5.4 on S side

Q Contributing to I20D = ⅓ A20A, Q_{10} = 7.6 Q_{100} = 12.6

$+Q_{10}$ on N side = 4.9 + 7.6 = 12.5 cfs $Q_{100} = \frac{156.8 + 12.6}{2} = 84.7$

FLOW HAS CROSSED CROWN & EQUALIZED

½ Q allowable = 8.5 (Q_{10}) NG 86.0 (Q_{100})

Try 12' DIOR @ 1.1%

Q/Q = 64%

I20D	+ 8.0	9.9	< 17.0 OK	+ 54.2	115.2	< 171.9 OK	1.1%
L20D							

Q Contributing to I20B = ½ A20, Q_{10} = 11.5 + 5.4 = 16.9 cfs Q_{100} = 18.9 + 57.6 (½(115.2)) = 76.5 cfs

½ Q allowable = 8.5 (Q_{10}) 86.0 (Q_{100})

Try 16' Sump

I20B	+ 13.3	+ 3.6	< 8.5	+ 26.3	+ 50.2	< 86.0

Q Contributing to I20A = ⅓ A20, + flow by: Q_{10} = 7.6 + 14.5 = 12.1, Q_{100} = 12.6 + 30.5 = 43.1

½ Q allowable = 8.5 (Q_{10}) 86.0 (Q_{100})

Try 8' Sump

I20A	+ 6.6	5.5		+ 13.2	29.9		
					200 ← MORE INST.		
L20	307.9	9.1	< 20.8 OK	389.0	~~80.1~~	< 210.6 OK	1.48%
	Sum: SCS: 317			Sum: SCS: 589			

Q contributing to I20C = previous flow by = $\frac{9.1}{2} / \frac{200}{2}$

Try 6 Sump

I20C	+ 4.6	0		+ 9.9	90.1

INLET / LINE	Q_{10} PIPE	Q_{10} ST.	Q_{10} ALL ST	Q_{100} PIPE	Q_{100} ST	Q_{100} ALL ST	STREET %SL.
Q contributing to		I 19 =	A 19 =	10.9/18.1	+ previous flow-by		
				+ 4.6/100			
				= 15.5/118.1			
Try 8'	Sump:						
I19	+ 6.6	+ 8.9		+ 13.2	+ 105.0		
	307.9			389.0			
	+ 4.6	+ " 0		+ 9.9	+ 90.1		
	+ 6.6	+ 8.9		+ 13.2	+ 105.0		
	319.1	8.9		402.1	195.1		
Adjust	% SCS	Sum:	323/601				
L19	314.1	8.9		405.9	195.1		
A21		18.8 <	22.8 OK		31.9	< 199.2 OK	1.3%
A22		23.4 <	24.1 OK		39.7	< 213.9 OK	1.5%
Street	flow allowed in		A21 and	A22,	check confluence:		
		42.2 >	31.1 NG		71.6	< 276.2 OK	2.5%
Try 2-8'	D10R	Sump:					
I21	+ 6.6			+ 13.2			
I22	+ 6.6	29.0 <	31.1 OK	+ 13.2	45.2 <	276.2 OK	2.5%
L21	13.2	29.0		26.4	45.2		
	↑ USE FOR DESIGN (Q_{100}			OK IN	STREET)		
A20		+ 3.5			+ 5.9		
		32.5 >	31.1 NG		51.1 <	276.2 OK	
Try 6'	D10R	Sump:					
I20	+ 5.0			+ 9.9			
L20	18.2	27.5 <	31.1 OK	36.3	41.2 <	276.2 OK	

ANALYZE EARTH SWALE:

LLHS = 20' S = 2% Q = 199.2 CFS
K = 4:1 n = 0.03
D_{MAX} = 2.5' H = 10'

$Q_{100\ SWALE}$ = 244 − 58.2 (↓ Q_{PIPE}) = 185.8 < 199.2 CFS OK

$Q_{10\ SWALE}$ = 115 − 58.2 (↓ Q_{PIPE}) = 56.8 << 199.2 CFS OK

FIND VELOCITY OF Q_{10} & Q_{100} LEAVING SWALE:

$Q_{10\ SWALE}$ = 56.8 CFS
D = 1.5
n = 0.03
S = 2.0%
K = 4:1
∴ V = 5.7 FPS

$Q_{100\ SWALE}$ = 185.8 CFS
D = 2.45'
n = 0.03
S = 2.0%
K = 4:1
∴ V = 7.9 FPS

- THERE ARE NO DRIVEWAYS DIRECTLY ACROSS FROM SWALE OUTLET
- WITH 8" CURBS ∴ $Q_{ST_{10}}$ = 110 CFS - ALLOWABLE @ 2.36% ST. SL.

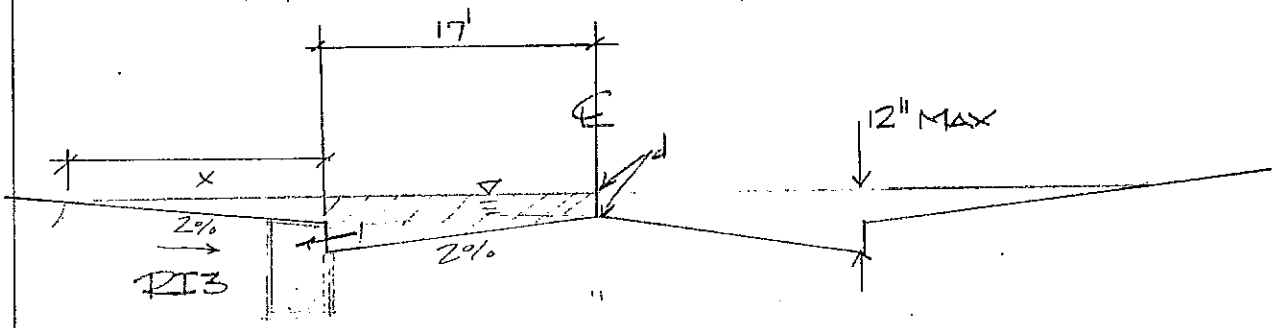
$Q_{ST_{100}}$ = 268 CFS - ALLOWABLE @ 2.36% ST. SL.

"FLOW-BY" Q_{10} / Q_{100} FROM A4 & I4 = 20.6/40.1

TOTAL FLOW IN STREET =
Q_{10} = 56.8 + 20.6 = 77.4 CFS < 110 CFS OK

Q_{100} = 185.8 + 40.1 = 225.9 CFS < 268 CFS OK

ANALYZE INLET PROPOSED TO RETROFIT @ NW COR STILLWATER & DUCHESS DRIVE:



Q_{100} = 193.5 cfs = TOTAL Q IN STREET

CONSIDER UPSTREAM Q TO BE ONLY THAT FLOW EXTENDING A DISTANCE OF 17' FROM THE CURB FACE, FLOW BEHIND THE CURB WILL NOT BE CONSIDERED.

FIND $Q_{17'}$ & d @ ℄

FIND FLOW SPREAD BEHIND THE CURB (x):

$$Q = \frac{1.486}{0.016} S^{1/2} R^{2/3} A = \frac{1.486\ (0.0082)^{1/2}}{0.016} R^{2/3} A = \frac{193.5}{2}$$

$$\therefore R^{2/3} A = 11.5039$$

$$A = 0.02(15)^2(0.05) + (0.67 - 0.125)(2) + 0.245(15) + (0.125)(0.5)(2) + 0.02(x)^2(0.5) + 0.02(x)(17)$$
$$= 5.115 + 0.01x^2 + 0.34x$$
$$P = x + 0.67 + 17 = 17.67 + x$$
$$\therefore x = 24.3'$$

FIND Q IN AREA X = 19.1 cfs.

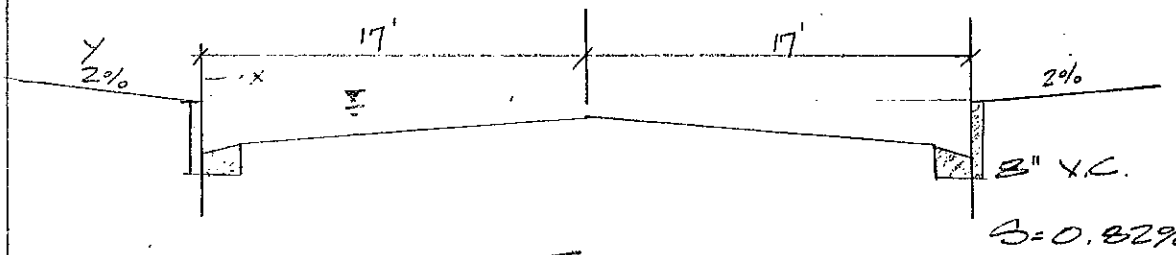
$$\therefore Q \text{ IN STREET} = 193.5/2 - 19.1 = 77.6 \text{ cfs}$$

$\frac{Q_i}{Q}$: 50% FOR 8' DIOR = 38.8 cfs > 37.8 OK

GUNDOKIN DEVELOPMENT	CKM 93556100	1-6-94

FIND DEPTH OF FLOW IN BOW RIVER RETROFITTED AREA IF PARALLEL SYSTEM IS NOT INSTALLED:

EXPECTED Q100 = 193.5 CFS



S = 0.82%

Q IF T.C. = $715.71\sqrt{S}$ ∴ 64.8 CFS

$A = \frac{1}{2}[0.02(y)(y)(0.5)] + 2[0.02(y)(17)] = 0.02y^2 + 0.68y$

$P = 2y + 34$

$R = A/P = \dfrac{0.02y^2 + 0.68y}{2y + 34}$

$Q = \dfrac{1.486}{0.016} S^{1/2} R^{2/3} A$ ∴

$$15.3 = \left[\frac{0.02y^2 + 0.68y}{2y + 34}\right]^{2/3} [0.02y^2 + 0.68y]$$

$$15.3 = \frac{[0.02y^2 + 0.68y]^{2/3}}{[2y + 34]^{2/3}} \; y[0.02y + 0.68]$$

∴ Y = 25.5'

∴ DEPTH ABOVE CURB = 0.51'
+ 0.67
1.18'

ALLOWABLE DEPTH = 1'
EXPECTED DEVELOPED FLOW WILL BE ≈ 2" ABOVE ALLOWABLE LIMIT

15" x 30" CMHP:
$HW/D = 2 \Rightarrow 21$ cfs

24" CMP:
$HW/D = 2 \Rightarrow 26$ cfs

18" CMP:
$HW/D = 2 \Rightarrow 13$ cfs

[36" CMP $HW/D = 2 \Rightarrow 70$ cfs]

A-12: HISTORIC 10/100 FLOWS ARE 59.3/125.7

BASIN A-12 WILL NOT ALL CROSS OAKWOOD,* A PORTION WILL HEAD NORTHERLY ALONG OAKWOOD TO BALSAM & CROSS NORTHERLY @ BALSAM (STILL ON THE EAST SIDE) FROM THIS POINT FLOW WILL CROSS IN AN 18" CMP TO THE NORTH & CONTINUE TO THE LOW IN OAKWOOD (SITE OF URS DBPS CHANNEL) AT THIS POINT FLOW WILL CROSS IN 2 ~ 24" x 24" CMHPs. TO THE WEST WHERE IT WILL HAVE A CONFLUENCE WITH THE COTTONWOOD EAST DRAINAGEWAY & SUNDOWN DEVELOPMENT'S RUNOFF @ BALSAM RD.

* BASED ON THE PIPE CAPACITIES & CONTOURS

SIZE TEMPORARY V-DITCH (EARTH-LINED):

DESIGN FOR HISTORIC MAJOR STORM:

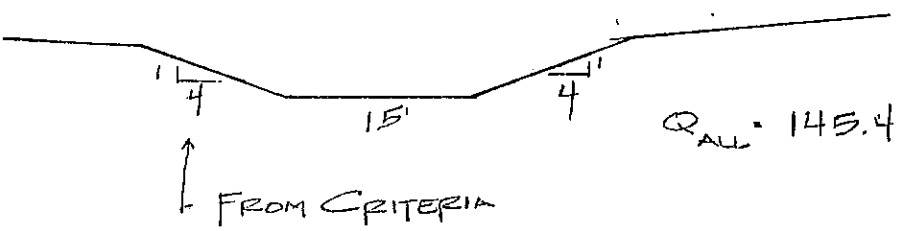
$Q_{100} = 125.7$ cfs

$V_{MAX} = 2.5 - 3.5$ FPS

$S = 0.5\%$

$D = 1.5$ FT.

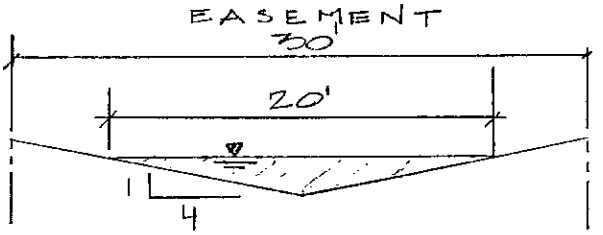
$n = 0.025$
EARTH, WINDING & SLUGGISH



$Q_{ALL} = 145.4$ cfs.

FROM CRITERIA

- ANALYZE SWALE USED FOR EMERGENCY OVERFLOW FROM TEMPLETON-GAP TO STILLWATER



SLOPE ≈ 2.0%
n = 0.03

USING ENTIRE W = 20' ⇒ MANNING'S Q ALLOWABLE =

199.2 cfs

- FROM DETERMINATION OF HGL OF EXISTING PIPE SYSTEM, REQUIRING NO FLOW "BUBBLES OUT" OF EXISTING INLETS, 58.2 CFS MAY BE PICKED UP FROM FLOWS SOUTH OF T-GAP RD.

THE Q_{10} & Q_{100} EXPECTED AT THE SUMP INLET AT THE SOUTH SIDE OF T-GAP ARE:

Q_{10} = 115 cfs − 58.2 = 56.8 cfs

Q_{100} = 244 cfs − 58.2 = 185.8 cfs

∴ OVERFLOW SWALE IS ADEQUATE FOR BOTH Q_{10} & Q_{100}

FIND VELOCITY OF WATER LEAVING SWALE FOR BOTH 10 & 100 YEAR STORM EVENTS:

Q_{10} = 56.8 cfs

DEPTH = 1.6'
LWS = 12.8'
V = 5.9 FPS

Q_{100} = 185.8 cfs

DEPTH = 2.4'
LWS = 19.2'
V = 7.8 FPS

FLOW LEAVING EMERGENCY SWALE HEADS WESTERLY ON STILLWATER. STILLWATER HAS 8" CURBS & SLOPE OF 2.36% ∴ STREET CAPACITY = Q_{10} = 110 cfs, Q_{100} = 268 cfs

(½ OF STREET CAN ACCEPT ≈ 3/4 OF Q_{100}) THERE ARE <u>NO</u> DWYS IN VICINITY OF SWALE OUTLET ∴ <u>NO</u> HOUSE FLOODING

WHAT IS Q BASED ON H_W/D:

H_W TO T-GAP = 7.52'

D = 3' ∴ H_W/D = 2.5 CFS FOR 3' Φ CMP

∴ Q ALLOWABLE = 80 CFS

THIS WILL CAUSE DOWNSTREAM INLETS TO "BURBLE OUT" (BOW RIVER & STILLWATER)

DESIGN DISSIPATORS TO COTTONWOOD EAST DRAINAGEWAY:

I. OUTLET FROM BASIN A-20 (+A-12)

HEC-1 COMBINED @ DP30:
Q10 = 881 CFS
Q100 = 1605 CFS

DP30 INCLUDES RUNOFF EXPECTED FROM BASINS ADJACENT TO & WEST OF THIS SUNDOWN DEVELOPMENT I.E. BASIN NOS: A-26, A-23, A-24, A-25 & A-30

ANALYZE THE EXISTING EARTH CHANNEL:

BOTTOM WIDTH, W ≈ 7'
n = 0.03
K1 = K2 = 0.5:1
G = 2.9%
D = 3.3'

MANNING'S Q = 1583.6 CFS

DETERMINE D REQUIRED FOR 10 YR FLOW:

D = 2.6'
MANNING'S Q = 892.4 CFS

∴ D_{10} = 2.6'
D_{100} = 3.3'

SUNDOWN DEVELOPMENT | CKM | 93S6100 | 12-30-93

- BOWL RIVER DRIVE DOES NOT MEET CURRENT CITY CRITERIA, WHAT CRITERIA ARE NOT BEING MET?

(SEE P. 1 OF INLET/PIPE CALCS)

EXISTING INLET I3 DOES NOT PICK UP ADEQUATE RUNOFF TO MEET THE 100 YR. CRITERIA FOR A RESIDENTIAL STREET WITH 8' CURBS & 0.82% SL. i.e. 193.5 CFS IN STREET AFTER PASSING I3 > 155.7 CFS ALLOWED IN STREET. (I3 IS A 6' DIOR SUMP)

THE RETROFITED INLET RI3 HAS BEEN DESIGNED FOR THE DIFF. IN ALLOWABLE TO ACTUAL FLOW.

- DETERMINE IF HISTORIC CONDITION RESULTS IN OVERFLOW/ EXCEEDING OF CRITERIA:

FIND CURRENT CN OF AREA A-1:
AMC II, SOIL GROUP B:

ACRES	DEV. TYPE	CN	%	%×CN
11	1 AC. RES	68	9.6%	1.05
35.1	OPEN SPACE	61	30.5%	18.6
61.8	GOOD MEADOW	58	53.7%	31.1
7.2	GOOD MEADOW	58	6.3%	3.6
115.1 AC.				(54.4)

FROM HEC-1 RUN FOR HISTORIC FLOWS, A-1
Q10 = 6 CFS Q100 = 51 CFS

∴ THE HISTORIC (EXISTING) RUNOFF WILL NOT HAVE ANY OVERFLOW ONTO T-GAP AS THE EXISTING PIPE SYSTEM WILL ACCEPT 58.2 CFS. EXISTING STREETS ARE WITHIN THE CURRENT CRITERIA WHEN CONSIDERING HISTORIC A-1 & ALL OTHER BASINS DEVELOPED.

Sht ___ of ___

HYDRAULIC GRADE LINE CALCULATION SHEET

PROJECT GUNDOWN 17A & B

LINE EXISTING

CALCULATED BY CKM

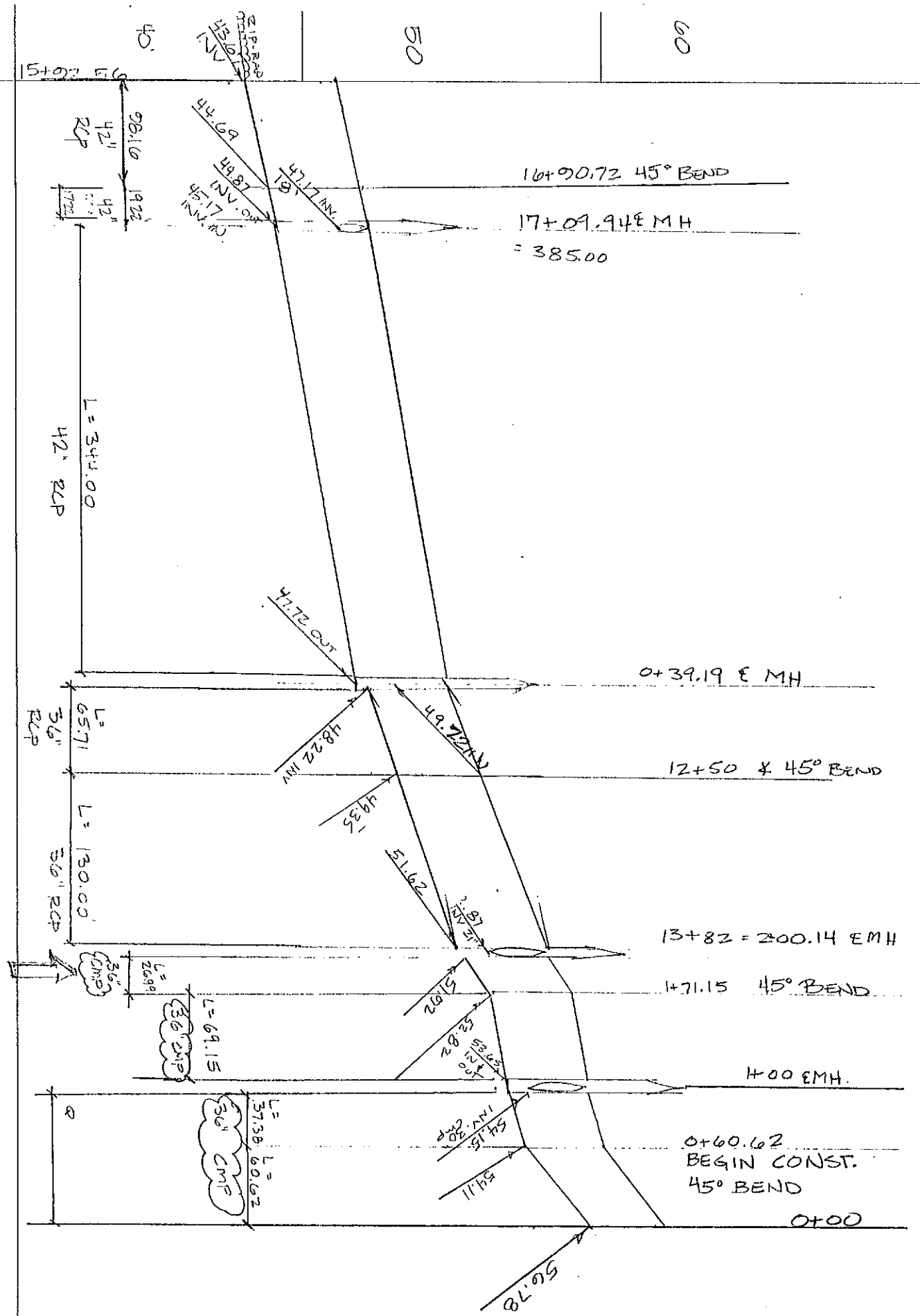
DATE 2-16-93

*Conduit unseals when D is less than d

STA.	ELEV. INV.	D*	ELEV. H.G.L.	SECTION	d	A	Q	V	$\frac{v^2}{2g}$	K.	S_f	Av. S_f	L	h_f	h_b	h_j	h_t	ELEV. E.G.L.
15+92.56	43.67	42	47.17	Ø	3.5	9.62	108.5	11.28	1.98	1006	0.012	0.012	99.16	1.19	0.28			
16+90.72	44.67	"	48.63	"	"	"	108.5		1.98	"	0.012	0.012	19.22	0.23				
17+09.94	44.87	"	48.86	"	"	"	108.5		1.98	"	0.012					0.10		
17+09.94	45.17	"	48.96	"	"	9.62	95.5	9.93	1.53	"	0.009	0.009	344	3.10				
0+39.19	47.77	"	52.06	"	"	7.068	95.5	13.51	2.83	"	0.009					0.14		
0+39.10	48.22	36	52.20	"	3.0	"	85.6	12.11	2.28	6669	0.016	0.016	65.71	1.05	0.32			
12+50	49.35	"	53.57	"	"	"	85.6	12.11	2.28	"	0.016	0.016	130.0	2.08				
13+82	51.62	"	55.65	"	"	"	85.6	12.11	2.28	"	0.016					0.11		
13+82	51.92	36 CMP	55.76	"	"	"	67.0	9.48	1.40	"	0.037	0.037	26.99	1.00	0.10			
14+71.15	52.82	"	56.86	"	"	"	67.0	9.48	1.40	"	0.037	0.037	71.15	2.63				
100	53.65		59.49	"	"	"	67.0	9.48	1.40	"	0.037					0.07		
1+00	53.65		59.56	"	"	"	58.2	8.23	1.05	"	0.026	0.026	39.38	1.02	0.15			
0+62.62	54.11		60.73	"	"	"	58.2	8.23	1.05	"	0.026	0.026	60.62	1.58				
0+00	56.78	"	62.31	V	V	V	58.2	8.23	1.05		0.026							
							↑											
							L	ALLOWABLE		FOR	A-1							

B-01

Page G-1


40
50
60
15+07.56
42" RCP
98.10
19.22
44.69
49.87 INV.
47.17 INV.
45.17 INV.
47.17 INV.
16+90.72 45° BEND
17+09.94℄ MH
= 385.00
L = 342.00
42" RCP
47.72 OUT
0+39.19 ℄ MH
36" RCP
L = 65.71
48.22 INV
49.72 INV
12+50 & 45° BEND
L = 130.00
36" RCP
49.35
51.62
49.87 INV
13+82 = 200.14 ℄MH
36" CMP
L = 20.98
1+71.15 45° BEND
L = 69.15
36" CMP
20.15
28.25
53.63 INV
52.13 OUT
H-00 ℄MH.
D
36" CMP
L = 37.38
L = 60.62
54.15 INV. 30° BEND
11.45
0+60.62
BEGIN CONST.
45° BEND
0+00
80.05

Hydrology

Location: A-2
Area: 1.6 Ac.
Soil or Landuse: A (SCS=8)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
STREET	0.90	0.95	69%
PARK/OPEN	0.25	0.35	31%

Composite: C10: 0.70 C100: 0.79 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	50'	2%		4.2
GUTTER	1270'	2%	4.5	4.7

Tc Total: 8.9 MIN.

Intensity, I (inches/hr) from Fig 5-1
I5: 4.7
I10: 4.7 in/hr I100: 7.2 in/hr

Peak Flow: Q = CIA in cfs
Q5 = 5.3
Q10: 5.3 cfs Q100: 8.8 cfs

OVERLAND $t_c = 1.87(1.1 - C_{10}) L^{0.5} S^{-0.33}$

Hydrology

Location: A-3
Area: 4.6 Ac.
Soil or Landuse: A (SCS=8)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
STREET	0.9	0.95	22%
1/2 AC REG.	0.6	0.7	78%

Composite: C10: 0.67 C100: 0.76 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	95' (4/95')	4.2%		5.7
GUTTER	1140' (30/1140')	2.6%	5.2	3.7

Tc Total: 9.4 MIN.

Intensity, I (inches/hr) from Fig 5-1
I5: 4.6
I10: 4.7 in/hr I100: 7.1 in/h

Peak Flow: Q = CIA in cfs
Q5 14.2
Q10: 14.5 cfs Q100: 24.8 cfs

Hydrology - SUNDOWN 93:1 OC

Location: A-4
Area: 16.3 Ac.
Soil or Landuse: A (SCS=8)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC. RES	0.6	0.7	82%
STREET	0.9	0.95	18%

Composite: C10: 0.65 C100: 0.75 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	300'	2.3%		12.3
GUTTER	580'	1.0%	3.2	3.0
GUTTER	520'	1.2%	3.3	2.6
GUTTER	270'	1.9%	4.6	1.0

Tc Total: 18.9

Intensity, I (inches/hr) from Fig 5-1
I5: 3.2
I10: 3.5 in/hr I100: 5.2 in/hr

Peak Flow: Q = CIA in cfs
Q5 33.0
Q10: 37.1 cfs Q100: 63.6 cfs

Location: A-5
Area: 7.6 Ac.
Soil or Landuse: A (SCS=8)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC. RES.	0.6	0.7	76%
STREET	0.9	0.95	24%

Composite: C10: 0.67 C100: 0.76 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	195'	1.8% 11/620		10.8
GUTTER	620'	1.8% 4/180	4.5	2.3
GUTTER	180'	2.2% 3/300	4.8	0.6
GUTTER	360'	0.8%	2.8	2.1

Tc Total: 15.8 MIN.

Intensity, I (inches/hr) from Fig 5-1
I5: 3.5
I10: 3.8 in/hr I100: 5.7 in/h

Peak Flow: Q = CIA in cfs
Q5 17.8
Q10: 19.3 cfs Q100: 32.9 cfs

Hydrology - SUNLOWN ST. SIDE

Location: A-6
Area: 9.9 Ac. (SCS #8)
Soil or Landuse: A

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC. RES.	0.6	0.7	82%
STREET	0.9	0.95	18%
Composite: C10: 0.65		C100: 0.75	100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	180'	3.3% (25/890)		8.5
GUTTER	890'	2.8% (5/360)	5.5	2.7
GUTTER	360'	1.4%	3.8	1.6

Tc Total: 12.8 MIN

Intensity, I (inches/hr) from Fig 5-1
I5: 4.05
I10: 4.1 in/hr
I100: 6.2 in/hr

Peak Flow: Q = CIA in cfs
Q5 26.1
Q10: 26.4 cfs
Q100: 46.0 cfs

Location: A-7
Area: 4.7 Ac. (SCS #8 + #5)
Soil or Landuse: A & B

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC RES.	0.6	0.7	85%
STREET	0.9	0.95	15%
Composite: C10: 0.65		C100: 0.74	100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	180'	3.8%		8.1
GUTTER	960'	3.8%	6.5	2.5

Tc Total: 10.6

Intensity, I (inches/hr) from Fig 5-1
I5: 4.5
I10: 4.5 in/hr
I100: 6.8 in/h

Peak Flow: Q = CIA in cfs
Q5: 13.7
Q10: 13.7 cfs
Q100: 23.7 cfs

Hydrology - Subbasin 9 - 61

Location: A-8
Area: 4.9 Ac.
Soil or Landuse: A & B (SCS # 8 & # 95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 Ac Res	0.6	0.7	84%
Street	0.9	0.95	16%

Composite: C10: 0.65 C100: 0.74 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
Overland	180'	2.7%		9.0
Gutter	760'	1.1%	3.4	3.7

Tc Total: 12.7

Intensity, I (inches/hr) from Fig 5-1

I10: 4.2 in/hr I100: 6.2 in/hr

Peak Flow: Q = CIA in cfs

Q10: 13.4 cfs Q100: 22.5 cfs

Hydrology

Location: A-9
Area: 4.8 Ac.
Soil or Landuse: A & B (SCS # 8 & # 95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 Ac. Res.	0.6	0.7	77%
Street	0.9	0.95	23%

Composite: C10: 0.67 C100: 0.76 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
Overland	140'	3.6%		6.2
Gutter	1200'	1.3%	3.6	5.6

Tc Total: 11.8

Intensity, I (inches/hr) from Fig 5-1

I10: 4.3 in/hr I100: 6.5 in/h

Peak Flow: Q = CIA in cfs

Q10: 13.8 cfs Q100: 23.7 cfs

Hydrology Sundown 5-30-00

Location: A-10
Area: 10.2 Ac.
Soil or Landuse: A & B (SCS #8 & #95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 Ac. Res.	0.6	0.7	81%
Street	0.9	0.95	19%

Composite: C10: 0.66 C100: 0.75 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
Overland	180'	3/180 1.7%		9.3
Gutter	820'	20/820 2.4%	5.2	2.6

Tc Total: 11.9

Intensity, I (inches/hr) from Fig 5-1

I10: 4.3 in/hr I100: 6.5 in/hr

Peak Flow: Q = CIA in cfs

Q10: 28.9 cfs Q100: 49.7 cfs

Hydrology

Location: A-11
Area: 4.4 Ac.
Soil or Landuse: A & B (SCS #8 & #95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 Ac. Res.	0.6	0.7	77%
Street	0.9	0.95	23%

Composite: C10: 0.67 C100: 0.76 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
Overland	90'	3.3%		6.0
Gutter	850'	21/850 2.5%	5.2	2.7

Tc Total: 8.7

Intensity, I (inches/hr) from Fig 5-1

I10: 4.8 in/hr I100: 7.3 in/hr

Peak Flow: Q = CIA in cfs

Q10: 14.2 cfs Q100: 24.4 cfs

Hydrology – SUNDOWN 9356100

Location: A-12 SCS
Area: 71.8 Ac. = 0.11 SQ MILES
Soil or Landuse:

~~Runoff Coefficient, C:~~ AMC II CN:

Area Zone	~~C10~~	~~C100~~	% Area
INDUSTRIAL	88	17.2/71.8 =	24%
STREETS	98	14.4/71.8 =	20%
RES 1/6 AC	82	23.0/71.8 =	32%
COMMERCIAL	92	17.2/71.8	24%
		COMPOSITE CN = 89.0	

Composite: ~~C10:~~ ~~C100:~~ 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	300'	8'/300' 2.7%		9.3
GUTTER	460'	2/460' 0.4%	2.2	3.5
ROADSIDE DITCH	950'	6.5%	9.0	1.8
PIPE	200'	20/1000 1.0%	8.5	0.4
DITCH	1900'	1.0%	5.0	6.3

Tc Total: 21.3

Intensity, I (inches/hr) from Fig 5-1

~~I10:~~ ~~in/hr~~ ~~I100:~~ ~~in/hr~~

~~Peak Flow: Q = CIA in cfs~~ SCS;

Q10: 150 cfs Q100: 260 cfs

Hydrology

Location: A-12 RATIONAL
Area: 71.8 Ac.
Soil or Landuse:

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
INDUSTRIAL	0.70	0.80	24%
STREETS	0.90	0.95	20%
RES 1/6 AC	0.57	0.65	32%
COMMERCIAL	0.90	0.90	24%

Composite: C10: 0.75 C100: 0.81 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc

Tc Total: 21.3

Intensity, I (inches/hr) from Fig 5-1

I10: 3.3 in/hr I100: 4.95 in/hr

Peak Flow: Q = CIA in cfs RATIONAL

Q10: 178 cfs Q100: 288 cfs

..ydrology (RATIONAL) SUN-JUN MDDP

Location: A-12 - HISTORIC CONDITION
Area: 71.8 Ac.
Soil or Landuse: B

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
PASTURE/MEADOW	0.25	0.35	100%
FIMS INDICATES 4 STRUCTURES IN THIS 71.8 AC. BASIN			

Composite: C10: 0.25 C100: 0.35 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	300'	2.7%		19.8
GUTTER	460'	0.4%	2.2	3.5
ROADSIDE DITCH	950'	6.5%	9.0	1.8
PIPE	200'	1.0%	8.5	0.4
DITCH	1000'	1.0%	5.0	6.3

Tc Total: 21.3

Intensity, I (inches/hr) from Fig 5-1

I10: 3.3 in/hr I100: 5.0 in/hr

Peak Flow: Q = CIA in cfs

Q10: 59.2 cfs Q100: 125.7 cfs

Hydrology

Location:
Area: Ac.
Soil or Landuse:

Runoff Coefficient, C:

Area Zone	C10	C100	% Area

Composite: C10: C100: 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc

Tc Total:

Intensity, I (inches/hr) from Fig 5-1

I10: in/hr I100: in/hr

Peak Flow: Q = CIA in cfs

Q10: cfs Q100: cfs

Hydrology – SUNKOWN 9-36LL

Location: A-13
Area: 3.0 Ac.
Soil or Landuse: A & B (SCS = B & #95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 Ac. Res	0.6	0.7	80%
STREET	0.9	0.95	20%

Composite: C10: 0.66 C100: 0.75 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	85'	4%		5.5
GUTTER	1150'	31/1150 2.7%	5.3	3.6

Tc Total: 9.1

Intensity, I (inches/hr) from Fig 5-1

I10: 4.7 in/hr I100: 7.2 in/hr

Peak Flow: Q = CIA in cfs

Q10: 9.3 cfs Q100: 16.2 cfs

Hydrology

Location: A-14
Area: 5.6 Ac.
Soil or Landuse: A & B (SCS = B & #95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 Ac. Res	0.6	0.7	77%
STREET	0.9	0.95	23%

Composite: C10: 0.67 C100: 0.76 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	130'	3.6%		7.0
GUTTER	710'	2.0%	4.6	2.6

Tc Total: 9.6

Intensity, I (inches/hr) from Fig 5-1

I10: 4.7 in/hr I100: 7.1 in/h

Peak Flow: Q = CIA in cfs

Q10: 17.6 cfs Q100: 30.2 cfs

Hydrology - SUNDOWN 9356100

Location: A-15
Area: 2.8 Ac.
Soil or Landuse: B (SCS # 95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC. RES.	0.6	0.7	75%
STREET	0.9	0.95	25%

Composite: C10: 0.68 C100: 0.76 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	200'	4.5%		9.7
GUTTER	350'	2.0%	5.7	1.0

Tc Total: 10.7

Intensity, I (inches/hr) from Fig 5-1

I10: 4.4 in/hr I100: 6.7 in/hr

Peak Flow: Q = CIA in cfs

Q10: 8.4 cfs Q100: 14.3 cfs

Hydrology

Location: A-16
Area: 6.8 Ac.
Soil or Landuse: B (SCS # 95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC. RES.	0.6	0.7	74%
STREET	0.9	0.95	26%

Composite: C10: 0.68 C100: 0.77 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	125'	1.3%		9.6
GUTTER	830'	2.2%	4.7	2.9

Tc Total: 12.5 MIN.

Intensity, I (inches/hr) from Fig 5-1

I10: 4.2 in/hr I100: 6.3 in/h

Peak Flow: Q = CIA in cfs

Q10: 19.4 cfs Q100: 33.0 cfs

Hydrology - SUNDOWN C-56-D

Location: A-17
Area: 5.5 Ac.
Soil or Landuse: B (SCS = 95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC RES	0.60	0.70	85%
STREET	0.90	0.95	15%

Composite: C10: 0.65 C100: 0.74 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	190'	4.2%		8.0
GUTTER	560'	2.0%	4.7	2.0

Tc Total: 10.0 MIN

Intensity, I (inches/hr) from Fig 5-1

I10: 4.6 in/hr I100: 7.0 in/hr

Peak Flow: Q = CIA in cfs

Q10: 16.4 cfs Q100: 28.5 cfs

Hydrology

Location: A-18
Area: 4.3 Ac.
Soil or Landuse: B (SCS = 95)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC RES.	0.64	0.7	86%
STREET	0.9	0.95	14%

Composite: C10: 0.664 C100: 0.74 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	200'	4.5%		8.0
GUTTER	470'	2.8%	5.5	1.4

Tc Total: 9.4

Intensity, I (inches/hr) from Fig 5-1

I10: 4.7 in/hr I100: 7.1 in/h

Peak Flow: Q = CIA in cfs

Q10: 12.7 cfs Q100: 22.6 cfs

Hydrology - SUNDOWN #U56.10

Location: A-10
Area: 3.6 Ac.
Soil or Landuse: A (SCS = 8)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 Ac Res	0.6	0.7	78%
STREET	0.9	0.95	22%

Composite: C10: 0.67 C100: 0.74 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	190'	3.2%		8.8
GUTTER	600'	2.0%	4.7	2.1

Tc Total: 10.9 MIN

Intensity, I (inches/hr) from Fig 5-1

I10: 4.5 in/hr I100: 6.8 in/hr

Peak Flow: Q = CIA in cfs

Q10: 10.9 cfs Q100: 18.1 cfs

Hydrology

Location: A-20
Area: 7.0 Ac.
Soil or Landuse: A & B (SCS = 8, = 13 & = 05)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 Ac Res	0.6	0.7	71%
STREET	0.9	0.95	29%

Composite: C10: 0.69 C100: 0.77 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	300'	3.3%		10.9
GUTTER	500'	1.2%	3.5	2.4

Tc Total: 13.3

Intensity, I (inches/hr) from Fig 5-1

I10: 4.2 in/hr I100: 6.2 in/h

Peak Flow: Q = CIA in cfs

Q10: 22.9 cfs Q100: 37.7 cfs

Hydrology - GUNDOWN 930610

Location: A-21
Area: 7.0 Ac.
Soil or Landuse: A & B (SCS = 8 & 75)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/2 Ac. Res	0.6	0.7	76%
STREET	0.9	0.95	24%

Composite: C10: 0.67 C100: 0.76 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	190'	3.7%		8.4
GUTTER	1400'	1.7%	4.2	5.6

Tc Total: 14.0

Intensity, I (inches/hr) from Fig 5-1

I10: 4.0 in/hr I100: 6.0 in/hr

Peak Flow: Q = CIA in cfs

Q10: 18.8 cfs Q100: 31.9 cfs

Hydrology

Location: A-22
Area: 8.3 Ac.
Soil or Landuse: A (SCS = 8)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/2 Ac. Res.	0.6	0.7	78%
STREET	0.9	0.95	22%

Composite: C10: 0.67 C100: 0.76 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	150'	2.9%		8.0
GUTTER	1540'	2.3%	4.8	5.3

Tc Total: 13.3

Intensity, I (inches/hr) from Fig 5-1

I10: 4.2 in/hr I100: 6.3 in/h

Peak Flow: Q = CIA in cfs

Q10: 23.4 cfs Q100: 35.7 cfs

Hydrology- SUNDOWN 9356100

Location: A-23
Area: 113.3 Ac. 0.177 S.MI.
Soil or Landuse: B

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/2 Ac			
1/5 Ac			
COMMERCIAL			
STREETS & WALKS			
Composite: ~~C10:~~		~~C100:~~ 84.1	100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
STREET	2810	2.4%	3.1	0.153
PIPE	1820	2.0%	13.3	0.038

Tc Total: 0.191 HRS

Intensity, I (inches/hr) from Fig 5-1

I10: _____ in/hr I100: _____ in/hr

Peak Flow: Q = CIA in cfs

Q10: _____ cfs Q100: _____ cfs

Hydrology

Location: _____
Area: _____ Ac.
Soil or Landuse: _____

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
Composite: C10:		C100:	100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc

Tc Total: _____

Intensity, I (inches/hr) from Fig 5-1

I10: _____ in/hr I100: _____ in/hr

Peak Flow: Q = CIA in cfs

Q10: _____ cfs Q100: _____ cfs

Hydrology - SUNDOWN 93560100

Location: A-24
Area: 12.5 Ac.
Soil or Landuse: A (SCS = 8)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/5 AC. REC	0.54	0.64	85%
STREET	0.9	0.95	15%

Composite: C10: 0.59 C100: 0.69 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	790'	7.9%		6.5
GUTTER	590'	0.7%	2.7	3.6

Tc Total: 10.1 MIN

Intensity, I (inches/hr) from Fig 5-1

I10: 4.7 in/hr I100: 7.0 in/hr

Peak Flow: Q = CIA in cfs

Q10: 34.7 cfs Q100: 60.4 cfs

Hydrology

Location: A-25
Area: 20.7 Ac.
Soil or Landuse: A (SCS = 8)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
SCHOOL	0.6	0.7	22%
1/5 AC REC.	0.54	0.64	63%
STREET	0.9	0.95	15%

Composite: C10: 0.61 C100: 0.70 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	300'	3%		11.3
GUTTER	900'	4%	5.5	2.7

Tc Total: 14.0 MIN

Intensity, I (inches/hr) from Fig 5-1

I10: 4.0 in/hr I100: 5.9 in/h

Peak Flow: Q = CIA in cfs

Q10: 72.5 cfs Q100: 122.7 cfs

Hydrology - SUNDOWN 0356100

Location: A-26 (URS H16)
Area: 35.3 Ac.
Soil or Landuse: B (SCS=13)

Runoff Coefficient, C: ZONE PER URS

Area Zone	C10	C100	% Area
1/8 AC RES.	0.6	0.7	71%
COMMERCIAL	0.9	0.9	29%

Composite: C10: 0.69 C100: 0.76 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	300'	6.7% (ΔH=20)		8.6
GUTTER	510'	5.6% (ΔH=16)	7.7	1.2
GUTTER	560	2.9% (ΔH=2.2')	5.7	1.6
ROADSIDE "V" DITCH	170'	1.3%	4	0.7

Tc Total: 12.1

Intensity, I (inches/hr) from Fig 5-1

I10: 4.3 in/hr I100: 6.5 in/hr

Peak Flow: Q = CIA in cfs

Q10: 104.7 cfs Q100: 174.4 cfs

Hydrology

Location:
Area: Ac.
Soil or Landuse:

Runoff Coefficient, C:

Area Zone	C10	C100	% Area

Composite: C10: C100: 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc

Tc Total:

Intensity, I (inches/hr) from Fig 5-1

I10: in/hr I100: in/hr

Peak Flow: Q = CIA in cfs

Q10: cfs Q100: cfs

Hydrology – SUNDOWN -J356100

Location: A-27
Area: 10.4 Ac.
Soil or Landuse: A (SCS=B)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC RES	0.60	0.7	72%
PARK	0.3	0.55	28%

Composite: C10: 0.52 C100: 0.66 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	240'	2.5%		10.7
"V" DITCH	1640'	5%	3.4	8.0

Tc Total: 18.7 MIN

Intensity, I (inches/hr) from Fig 5-1

I10: 3.5 in/hr I100: 5.3 in/hr

Peak Flow: Q = CIA in cfs

Q10: 18.9 cfs Q100: 36.4 cfs

Hydrology

Location: A-28
Area: 2.5 Ac.
Soil or Landuse: A (SCS=B)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC RES.	0.6	0.7	56%
STREET	0.9	0.95	44%

Composite: C10: 0.73 C100: 0.81 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	40'	5%		3.5
GUTTER	1300'	2.5%	5.2	4.1

Tc Total: 7.6

Intensity, I (inches/hr) from Fig 5-1

I10: 5.1 in/hr I100: 7.7 in/h

Peak Flow: Q = CIA in cfs

Q10: 9.3 cfs Q100: 15.6 cfs

Hydrology - SUNDOWN 9356100

Location: A-20
Area: 0.9 Ac.
Soil or Landuse: A (SCS=8)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC RES	0.6	0.7	50%
STREE	0.9	0.95	50%

Composite: C10: 0.75 C100: 0.82 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	30'	6.7%		2.7
STREET	70'	2.9%	5.6	0.2

Tc Total: ~~2.9~~ 5

Intensity, I (inches/hr) from Fig 5-1

I10: 5.8 in/hr I100: 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q10: 3.5 cfs Q100: 5.0 cfs

Hydrology

Location: A-30
Area: 10.0 Ac.
Soil or Landuse: A & B (SCS=8 & =13)

Runoff Coefficient, C:

Area Zone	C10	C100	% Area
1/8 AC RES	0.6	0.7	27%
PARK	0.3	0.55	73%

Composite: C10: 0.38 C100: 0.59 100%

Time of Concentration: Tc, in minutes:

Travel Type	L(ft)	s (%)	v (fps)	Tc
OVERLAND	120'	9.2%		4.9
TRAP CHANNEL	1080'	1.9%	7	2.6

Tc Total: 7.5

Intensity, I (inches/hr) from Fig 5-1

I10: 5.2 in/hr I100: 7.6 in/hr

Peak Flow: Q = CIA in cfs

Q10: 21.5 cfs Q100: 48.9 cfs

BASIN: A-1

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
43.4	0.0678	1 AC RES	B	68	37.7%	25.6	A	51	19.2	Cn A:
43.4	0.0678	1/4 AC RES	B	75	37.7%	28.3	A	61	23.0	65.0
5.1	0.0079	COMMERCIAL	B	92	4.4%	4.1	A	89	3.9	Cn B:
17.2	0.0268	STREETS & WALKS	B	98	14.9%	14.6	A	98	14.6	77.2
6.1	0.0095	INDUSTRIAL	B	88	5.3%	4.7	A	81	4.3	AVG Cn:
					100.0%	77.2			65.0	71.1
115.1	0.1799									

BASIN: A-2

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
0.5	0.0008	PARK/OPEN SPACE	B	61	31.3%	19.1	A	39	12.2	Cn A:
1.1	0.0017	STREETS & WALKS	B	98	68.8%	67.4	A	98	67.4	79.6
									79.6	Cn B:
					100.0%	86.4				86.4
1.6	0.0025									AVG Cn:
										83.0

BASIN: A-3

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
3.6	0.0056	1/8 AC	B	85	78.3%	66.5	A	77	60.3	Cn A:
1.0	0.0016	STREETS & WALKS	B	98	21.7%	21.3	A	98	21.3	81.6
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	87.8
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
					100.0%	87.8			81.6	84.7
4.6	0.0072									

BASIN: A-4

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
13.4	0.0209	1/8 AC	B	85	82.2%	69.9	A	77	63.3	Cn A:
2.9	0.0045	STREETS & WALKS	B	98	17.8%	17.4	A	98	17.4	80.7
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	87.3
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
					100.0%	87.3			80.7	84.0
16.3	0.0255									

BASIN: A-5

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
5.8	0.0091	1/8 AC	B	85	76.3%	64.9	A	77	58.8	Cn A:
1.8	0.0028	STREETS & WALKS	B	98	23.7%	23.2	A	98	23.2	82.0
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	88.1
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
					100.0%	88.1			82.0	85.0
7.6	0.0119									

BASIN: A-6

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
8.1	0.0127	1/8 AC	B	85	81.8%	69.5	A	77	63.0	Cn A:
1.8	0.0028	STREETS & WALKS	B	98	18.2%	17.8	A	98	17.8	80.8
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	87.4
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
					100.0%	87.4			80.8	84.1
9.9	0.0155									

BASIN: A-7

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
4.0	0.0063	1/8 AC	B	85	85.1%	72.3	A	77	65.5	Cn A:
0.7	0.0011	STREETS & WALKS	B	98	14.9%	14.6	A	98	14.6	80.1
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	86.9
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
					100.0%	86.9			80.1	83.5
4.7	0.0073									

CN A & B: 80.3
B: 86.9 AVG: 83.6

BASIN: A-8

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
4.1	0.0064	1/8 AC	B	85	83.7%	71.1	A	77	64.4	Cn A:
0.8	0.0013	STREETS & WALKS	B	98	16.3%	16.0	A	98	16.0	80.4
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	87.1
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
					100.0%	87.1			80.4	83.8
4.9	0.0077									

CN A & B: 84.5
B: 87.1 AVG: 85.8

BASIN: A-9

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
3.7	0.0058	1/8 AC	B	85	77.1%	65.5	A	77	59.4	Cn A:
1.1	0.0017	STREETS & WALKS	B	98	22.9%	22.5	A	98	22.5	81.8
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	88.0
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
4.8	0.0075				100.0%	88.0			81.8	84.9

CN A & B: 84.9

B: 88 AVG: 86.4

BASIN: A-10

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
8.3	0.0130	1/8 AC	B	85	81.4%	69.2	A	77	62.7	Cn A:
1.9	0.0030	STREETS & WALKS	B	98	18.6%	18.3	A	98	18.3	80.9
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	87.4
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
10.2	0.0159				100.0%	87.4			80.9	84.2

CN A & B: 86.6

B: 87.4 AVG: 87

BASIN: A-11

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
3.4	0.0053	1/8 AC	B	85	77.3%	65.7	A	77	59.5	Cn A:
1.0	0.0016	STREETS & WALKS	B	98	22.7%	22.3	A	98	22.3	81.8
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	88.0
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
4.4	0.0069				100.0%	88.0			81.8	84.9

CN A & B: 84.5

B: 88 AVG: 86.3

BASIN: A-12

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
17.2	0.0269	INDUSTRIAL	B	88	24.0%	21.1	A	81	19.7	Cn A:
14.4	0.0225	STREETS & WALKS	B	98	20.1%	19.7	A	98	23.0	63.9
23.0	0.0359	RES 1/6 AC	B	82	32.0%	26.3	A	71.7	21.3	Cn B:
17.2	0.0269	COMMERCIAL	B	92	24.0%	22.0	A	89	0.0	89.0
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
71.8	0.1122				100.0%	89.0			63.9	76.5

BASIN: A-13

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
2.4	0.0038	1/8 AC	B	85	80.0%	68.0	A	77	61.6	Cn A:
0.6	0.0009	STREETS & WALKS	B	98	20.0%	19.6	A	98	19.6	81.2
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	87.6
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
3.0	0.0047				100.0%	87.6			81.2	84.4

CN A & B: 85.7

B: 87.6 AVG: 86.7

BASIN: A-14

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
4.3	0.0067	1/8 AC	B	85	76.8%	65.3	A	77	59.1	Cn A:
1.3	0.0020	STREETS & WALKS	B	98	23.2%	22.8	A	98	22.8	81.9
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	88.0
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
5.6	0.0088				100.0%	88.0			81.9	84.9

BASIN: A-15

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
2.1	0.0033	1/8 AC	B	85	75.4%	64.0	A	77	58.0	Cn A:
0.7	0.0011	STREETS & WALKS	B	98	24.6%	24.2	A	98	24.2	82.2
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	88.2
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:
2.8	0.0044				100.0%	88.2			82.2	85.2

BASIN: A-16

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn	
5.0	0.0078	1/8 AC	B	85	73.5%	62.5	A	77	56.6	Cn A:
1.8	0.0028	STREETS & WALKS	B	98	26.5%	25.9	A	98	25.9	82.6
	0.0000		B		0.0%	0.0	A		0.0	Cn B:
	0.0000		B		0.0%	0.0	A		0.0	88.4

	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
6.8	0.0106				100.0%	88.4			82.6		85.5

BASIN: A-17

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
4.7	0.0073	1/8 AC	B	85	85.5%	72.6	A	77	65.8	Cn A:	
0.8	0.0013	STREETS & WALKS	B	98	14.5%	14.3	A	98	14.3		80.1
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	
	0.0000		B		0.0%	0.0	A		0.0		86.9
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
5.5	0.0086				100.0%	86.9			80.1		83.5

BASIN: A-18

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
3.7	0.0058	1/8 AC	B	85	86.0%	73.1	A	77	66.3	Cn A:	
0.6	0.0009	STREETS & WALKS	B	98	14.0%	13.7	A	98	13.7		79.9
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	
	0.0000		B		0.0%	0.0	A		0.0		86.8
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
4.3	0.0067				100.0%	86.8			79.9		83.4

BASIN: A-19

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
2.8	0.0044	1/8 AC	B	85	77.8%	66.1	A	77	59.9	Cn A:	
0.8	0.0013	STREETS & WALKS	B	98	22.2%	21.8	A	98	21.8		81.7
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	
	0.0000		B		0.0%	0.0	A		0.0		87.9
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
3.6	0.0056				100.0%	87.9			81.7		84.8

BASIN: A-20

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
5.6	0.0088	1/8 AC	B	85	70.9%	60.3	A	77	54.6	Cn A:	
2.3	0.0036	STREETS & WALKS	B	98	29.1%	28.5	A	98	28.5		83.1

A-20

	0.0000		B		0.0%	0.0	A		0.0	Cn B:	
	0.0000		B		0.0%	0.0	A		0.0		88.8
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
7.9	0.0123				100.0%	88.8			83.1		85.9

BASIN: A-21

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
5.3	0.0083	1/8 AC	B	85	75.7%	64.4	A	77	58.3	Cn A:	
1.7	0.0027	STREETS & WALKS	B	98	24.3%	23.8	A	98	23.8		82.1
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	
	0.0000		B		0.0%	0.0	A		0.0		88.2
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
7.0	0.0109				100.0%	88.2			82.1		85.1

BASIN: A-22

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
6.5	0.0102	1/8 AC	B	85	78.3%	66.6	A	77	60.3	Cn A:	
1.8	0.0028	STREETS & WALKS	B	98	21.7%	21.3	A	98	21.3		81.6
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	
	0.0000		B		0.0%	0.0	A		0.0		87.8
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
8.3	0.0130				100.0%	87.8			81.6		84.7

BASIN: A-24

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
10.6	0.0166	1/5 AC	B	79	84.8%	67.0	A	67.4	57.2	Cn A:	
1.9	0.0030	STREETS & WALKS	B	98	15.2%	14.9	A	98	14.9		72.1
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	
	0.0000		B		0.0%	0.0	A		0.0		81.9
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
12.5	0.0195				100.0%	81.9			72.1		77.0

CN A & B: 72.5

B: 81.9 AVG: 77.2

BASIN: A-25

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn

A-25

18.9	0.0295	1/5 AC	B	79	63.6%	50.3	A	67.4	42.9	Cn A:	76.6
4.4	0.0069	STREETS & WALKS	B	98	14.8%	14.5	A	98	14.5		
6.4	0.0100	SCHOOL	B	92	21.5%	19.8	A	89	19.2	Cn B:	84.6
	0.0000		B		0.0%	0.0	A		0.0		
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
29.7	0.0464				100.0%	84.6			76.6		80.6

CN A & B: 75.7

B: 84.6 AVG: 80.2

BASIN: A-26

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
25.1	0.0392	1/8 AC	B	85	71.1%	60.4	A	77	54.8	Cn A:	80.5
10.2	0.0159	COMMERCIAL	B	92	28.9%	26.6	A	89	25.7		
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	87.0
	0.0000		B		0.0%	0.0	A		0.0		
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
35.3	0.0552				100.0%	87.0			80.5		83.7

CN A & B: 75.6

B: 78.4 AVG: 77

BASIN: A-27

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
3.0	0.0047	1/8 AC	B	85	28.8%	24.5	A	77	22.2	Cn A:	62.3
2.9	0.0045	PARKS/OPEN SPACE	B	61	27.9%	17.0	A	39	10.9		
4.5	0.0070	1/5 AC	B	79	43.3%	34.2	A	67.4	29.2	Cn B:	75.7
	0.0000		B		0.0%	0.0	A		0.0		
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
10.4	0.0163				100.0%	75.7			62.3		69.0

BASIN: A-28

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
1.4	0.0022	1/8 AC	B	85	56.0%	47.6	A	77	43.1	Cn A:	86.2
1.1	0.0017	STREETS & WALKS	B	98	44.0%	43.1	A	98	43.1		
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	90.7
	0.0000		B		0.0%	0.0	A		0.0		
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
2.5	0.0039				100.0%	90.7			86.2		88.5

BASIN: A-28

A-28

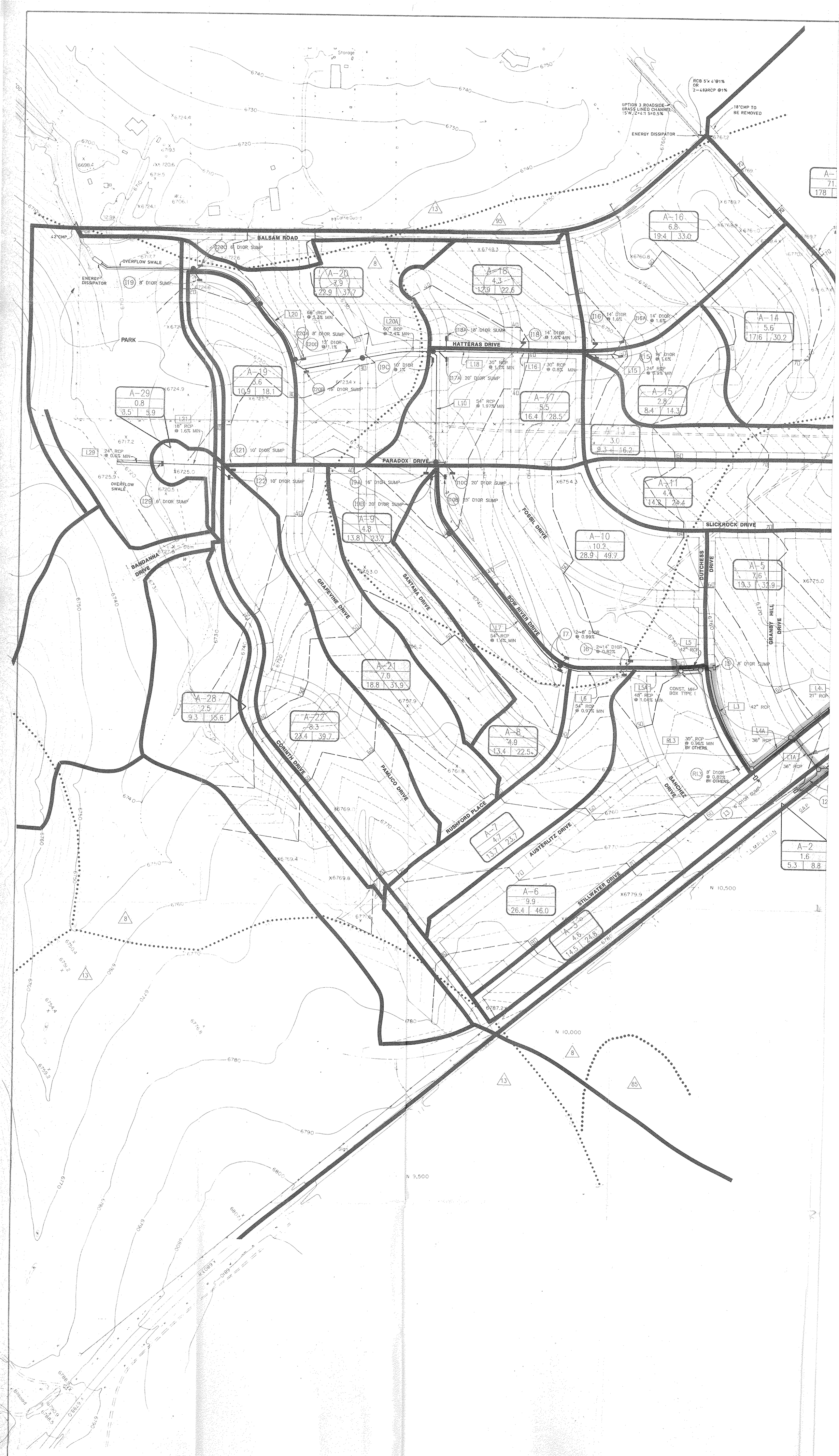
ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
1.4	0.0022	1/8 AC	B	85	56.0%	47.6	A	77	43.1	Cn A:	86.2
1.1	0.0017	STREETS & WALKS	B	98	44.0%	43.1	A	98	43.1		
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	90.7
	0.0000		B		0.0%	0.0	A		0.0		
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
2.5	0.0039				100.0%	90.7			86.2		88.5

BASIN: A-29

ACREAGE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
0.4	0.0006	1/8 AC	B	85	50.0%	42.5	A	77	38.5	Cn A:	87.5
0.4	0.0006	STREETS & WALKS	B	98	50.0%	49.0	A	98	49.0		
	0.0000		B		0.0%	0.0	A		0.0	Cn B:	91.5
	0.0000		B		0.0%	0.0	A		0.0		
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
0.8	0.0013				100.0%	91.5			87.5		89.5

BASIN: A-30

ACRE	SQ. MI.	LAND USE	SOIL	Cn	%	% x Cn	SOIL	Cn	% x Cn		
1.7	0.0027	1/8 AC	B	85	15.6%	13.3	A	77	12.0	Cn A:	48.1
8.0	0.0125	PARK/OPEN SPACE	B	61	73.4%	44.8	A	39	28.6		
1.2	0.0019	1/5 AC	B	79	11.0%	8.7	A	67.4	7.4	Cn B:	66.7
	0.0000		B		0.0%	0.0	A		0.0		
	0.0000		B		0.0%	0.0	A		0.0	AVG Cn:	
10.9	0.0170				100.0%	66.7			48.1		57.4


BALSAM ROAD
HATTERAS DRIVE
PARADOX DRIVE
SLICKROCK DRIVE
FOSSIL DRIVE
BOW RIVER DRIVE
GRANBY HILL DRIVE
DUTCHESS DRIVE
SANCHEZ DRIVE
AUSTERLITZ DRIVE
STILLWATER DRIVE
RUSHFORD PLACE
CORINTH DRIVE
PAMLICO DRIVE
GRAPEVINE DRIVE
SANTANA DRIVE
BANDANNA DRIVE
PARK
Storage
Cattle Guard
Dam
Billboard
Sign
OVERFLOW SWALE
ENERGY DISSIPATOR
OPTION 3 ROADSIDE GRASS LINED CHANNEL 15'W, Z=4:1 S=0.5%
RCB 5'x 4'@1% OR 2-48"RCP @1%
18"CMP TO BE REMOVED
42"CMP
I20C 6' D10R SUMP
I19 8' D10R SUMP
I20 66" RCP @ 1.3% MIN
I20A 60" RCP @ 2.4% MIN
I20A 8' D10R SUMP
I20D 12' D10R @ 1.1%
I20B 18' D10R SUMP
I9C 10' D10R @ 1%
I18A 18' D10R SUMP
I18 14' D10R @ 1.6% MIN
L18 30" RCP @ 1.2% MIN
L16 30" RCP @ 0.8% MIN
I17A 20' D10R SUMP
L10 54" RCP @ 1.97% MIN
I16 14' D10R @ 1.6%
I16A 14' D10R @ 1.6%
I15 14' D10R @ 1.6%
L15 24" RCP @ 0.9% MIN
L21 18" RCP @ 1.6% MIN
I21 10' D10R SUMP
L29 24" RCP @ 0.6% MIN
I29 6' D10R SUMP
I22 10' D10R SUMP
I9A 16' D10R SUMP
I9B 20' D10R SUMP
I10C 20' D10R SUMP
I10B 25' D10R SUMP
L7 54" RCP @ 1.4% MIN
I7 2~8' D10R @ 0.99%
I6 2~14' D10R @ 0.82%
I5 8' D10R SUMP
L5 42" RCP
L5A 48" RCP @ 1.04% MIN
CONST. MH BOX TYPE 1
L6 54" RCP @ 0.97% MIN
L3 42" RCP
L4 21" RCP
L4A 36" RCP
L1A 36" RCP
RL3 30" RCP @ 0.95% MIN BY OTHERS
RI3 8' D10R @ 0.82% BY OTHERS
I3 6' D10R SUMP
I2 GAP
A-20 7.9 22.9 37.7
A-18 4.3 12.9 22.6
A-19 3.6 10.9 18.1
A-29 0.8 3.5 5.9
A-16 6.8 19.4 33.0
A-14 5.6 17.6 30.2
A-15 2.8 8.4 14.3
A-17 5.5 16.4 28.5
A-13 3.0 9.3 16.2
A-11 4.4 14.2 24.4
A-9 4.8 13.8 23.7
A-10 10.2 28.9 49.7
A-5 7.6 19.3 32.9
A-21 7.0 18.8 31.9
A-28 2.5 9.3 15.6
A-22 8.3 23.4 39.7
A-8 4.9 13.4 22.5
A-7 4.7 13.7 23.7
A-6 9.9 26.4 46.0
A-3 4.6 14.5 24.8
A-2 1.6 5.3 8.8
N 10,500
N 10,000
N 9,500

FOR UNDERGROUND UTILITY LOCATIONS
CALL 48 HOURS PRIOR TO EXCAVATING, FOR LOCATING AND MARKING OF ELECTRIC, GAS, AND TELEPHONE LINES.
636-5333 (CITY UTILITIES)
634-3778 (TELEPHONE)

ALL OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS AGENT. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND WILL BE RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

KLH ENGINEERING CONSULTANTS INC.
ENGINEERS/SURVEYORS/PLANNERS PUEBLO/COLORADO SPRINGS

TITLE: AMENDED SUNDOWN
SCALE: 1"=100' 2' contours DRAWN BY: AES
DATE: REVISED BY: TCL JOB NO.