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DRAINAGE REPORT
FOR
DUBLIN BOULEVARD
(From Rangewood Drive to Austin Bluffs Parkway)

PREPARED BY:

K L H ENGINEERING CONSULTANTS, INC.
206-208 Sutton Lane
Colorado Springs, CO 80907
J.N.: KLH 83 558 00

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COLORADO SPRINGS, COLO.

DEC 05 1985
AM 7 8 9 10 11 12 1 2 3 4 5 6 PM

July, 1985



GENERAL:

This Drainage Report is written for the 3,500 foot portion of Dublin Boulevard from Rangewood Drive to Austin Bluffs Parkway. This report is written in conjunction with the extension of Dublin Boulevard East. This portion of Dublin Boulevard is surrounded by presently unplatted lands. The Right-of-Way will have a nominal width of 114 feet and will increase in 12 foot increments to accommodate turn lanes. The street is considered as an arterial street and shall have vertical curb throughout. This portion of Dublin consists of 10.1 acres of Right-of-Way.

This street is located on terrain which slopes moderately, from South to North. Soils located in the tributary drainage area are classified in the Hydrologic Soil Groups A, B and D. S.C.S. Soils Map numbers are shown on the Drainage Plan.

This portion of Dublin Boulevard is in the Cottonwood Creek Drainage Basin and does not lie within the 100 year flood plain of Cottonwood Creek. Where Nor'wood Trail Drainageway and Nor'wood East Drainageway cross Dublin Boulevard the culverts have been sized to pass the 100 year flow with sufficient freeboard on the roadway embankment.

METHOD OF COMPUTATIONS:

Runoff quantities were calculated using the Modified S.C.S. Methodology as approved by the City of Colorado Springs Engineering Division. Runoff from both 5 year and 100 year storms were computed. A weighted curve number was utilized using respective percentages of area in the streets and on the lots, in calculating flows.

Per City of Colorado Springs Criteria, all drainage structures have been sized for the 5 year storm for peak 100 year flows less than 500 c.f.s., and for the 100 year storm for peak flows in excess of 500 c.f.s.

Flows and sub-basins shown at Dublin Boulevard and Rangewood Drive have been reproduced onto the drainage plan and are from "Drainage Report For Rangewood Drive (From Vickers Drive to Cottonwood Creek) and Dublin Boulevard (From Montarbor Drive 1,660 Feet East)", by KLH Engineering Consultants, Inc., filed with the City of Colorado Springs August 27, 1984.

INTERIOR DRAINAGE:

The amount of runoff generated on the Right-of-Way for this street is small compared to flows tributary to the Right-of-Way. Therefore, interior drainage area has been calculated as part of the exterior drainage area.

EXTERIOR DRAINAGE AND DRAINAGE IMPROVEMENTS:

Drainage basin delineations for areas tributary to this portion of Dublin are based on preliminary street layouts and existing topography. Preliminary street layouts were used for the Amended Nor'wood Master Plan area and lands East to Powers Boulevard. Land uses for tributary drainage areas are based on the Amended Nor'wood Master Plan with reasonable assumptions made for lands Eastward. See Figure 2 for tributary drainage areas.

Runoff from lands adjacent to Dublin Boulevard will flow overland to streets, and down the streets as gutter flow to catch basins in Dublin. Pipe stubs will be provided to private drives on the North side of Dublin for onsite pickup. Nor'wood Trail Drainageway and Nor'wood East Drainageway will cross Dublin Boulevard in large culverts. These culverts have been sized to pass the developed, 100 year storm flow.

All runoff flows exiting this portion of roadway flow onto and across lands owned by Nor'wood Development Corporation. Nor'wood Development Corporation agrees to accept the increased developed flows.

Drainage facilities for Austin Bluffs Parkway and Dublin Boulevard, to the East, will be discussed in individual drainage reports for each segment.

FACILITIES COST ESTIMATE - PUBLIC AND REIMBURSEABLE:

4' D-10R	2 Each @ \$ 1,600./Ea.	= \$ 3,200.
6' D-10R	8 Each @ \$ 1,800./Ea.	= \$ 14,400.
8' D-10R	2 Each @ \$ 2,200./Ea.	= \$ 4,400.
Manholes	4 Each @ \$ 1,200./Ea.	= \$ 4,800.
18" R.C.P.	750 L.F. @ \$ 26./L.F.	= \$ 19,500.
21" R.C.P.	1060 L.F. @ \$ 31./L.F.	= \$ 32,860.
30" R.C.P.	550 L.F. @ \$ 42./L.F.	= \$ 23,100.
9'x 9' R.C.B.	220 L.F. @ \$ 94,795. L.S.	= \$ 94,795.
Twin 10'x 7' R.C.B.	270 L.F. @ \$199,280. L.S.	= \$ 199,280.
TOTAL		\$ 396,335.

PRIVATE NON-REIMBURSEABLE:

Temporary Rip Rap	244 C.Y. @ \$ 35./C.Y.	= \$ 8,540.
TOTAL		\$ 8,540.

DRAINAGE AND BRIDGE FEES:

Cottonwood Creek Drainage Basin

1985 Drainage Fee: 10.1 ac. @ \$3,136.00 per ac. = \$31,673.60

1985 Bridge Fee : 10.1 ac. @ \$ 144.00 per ac. = \$ 1,454.40

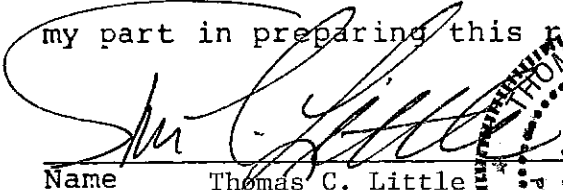
The Developer is providing the City of Colorado Springs with a Right-of-Way and Public Utility Easement to cover this street. The Developer will provide a letter of credit of an amount equal to the difference of the cost estimate and the drainage fee, to insure the construction of these facilities, at the time of platting.

DRAINAGE REPORT STATEMENTS

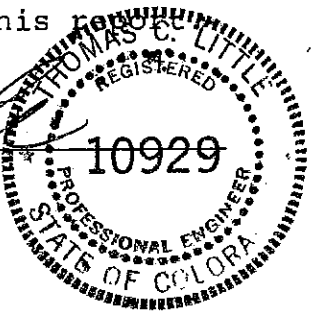
DUBLIN BOULEVARD - RANGEWOOD TO AUSTIN BLUFFS

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 for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by the negligent acts, errors or omissions on my part in preparing this report.



Name Thomas C. Little

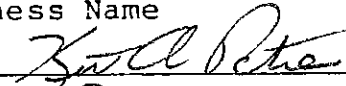


Seal

Developer's Statement:

The developer has read and will comply with all of the requirements specified in this drainage report.

NORWOOD DEVELOPMENT CORP.
Business Name

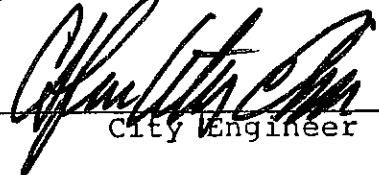
By: 

Title: PRESIDENT

Address: P.O. Box 552
MANITOU SPRINGS, CO
80829

City of Colorado Springs:

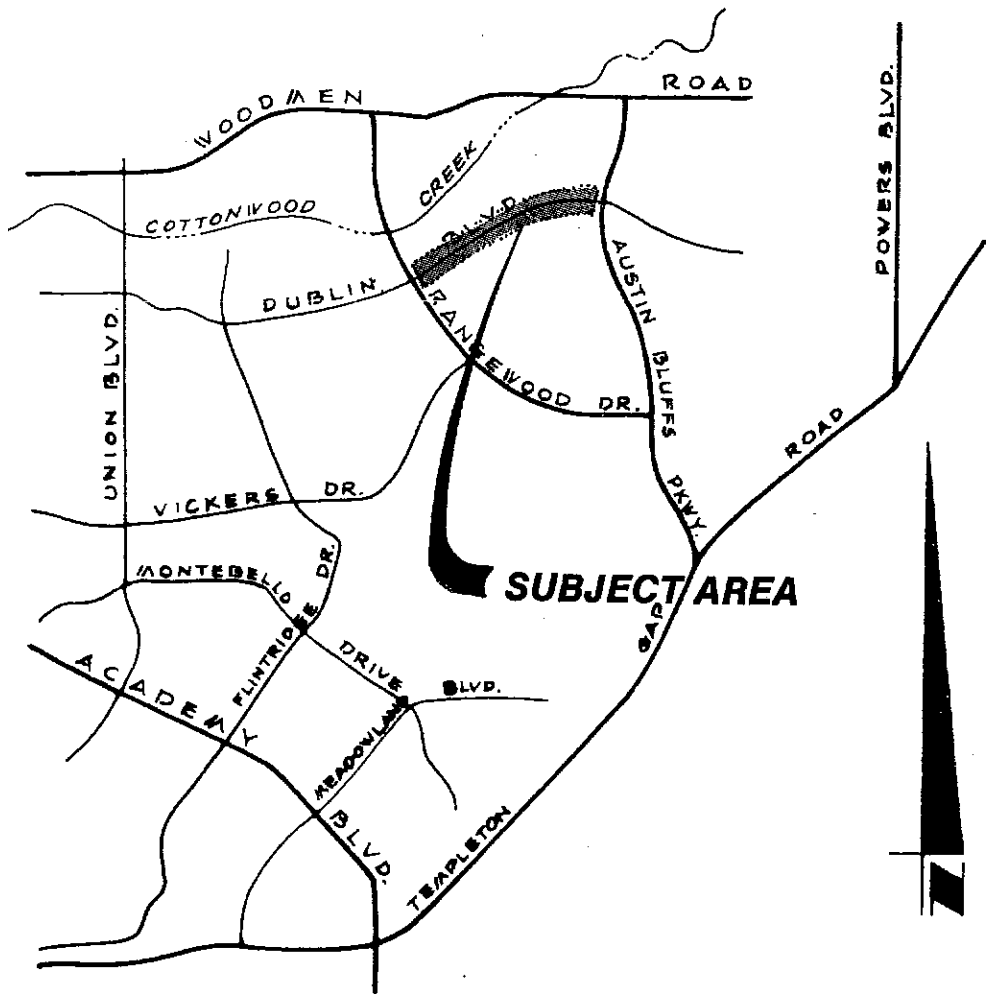
Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.


City Engineer

12/13/85
Date

Conditions:

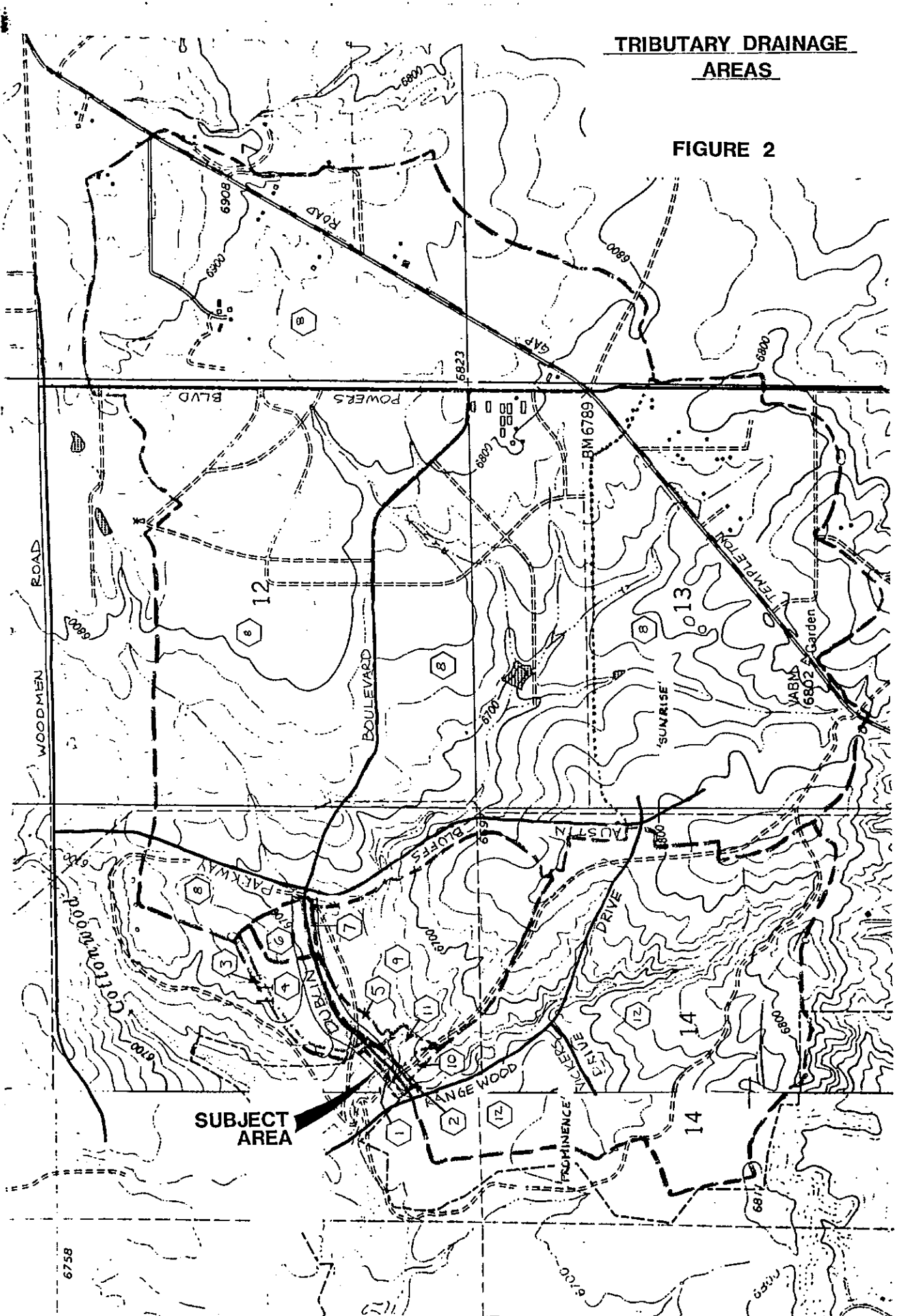
FIGURE 1



VICINITY MAP
NTS

**TRIBUTARY DRAINAGE
AREAS**

FIGURE 2



6758

PROJECT: DUBLIN BLVD

8355800

NORWOOD TRAIL X-INGS

DESIGNER: T.M.C.

DATE: 5-31-85

HYDROLOGIC AND CHANNEL INFORMATION

$Q_1 = \underline{870} = Q_{100}$

$Q_2 = \underline{\hspace{2cm}}$

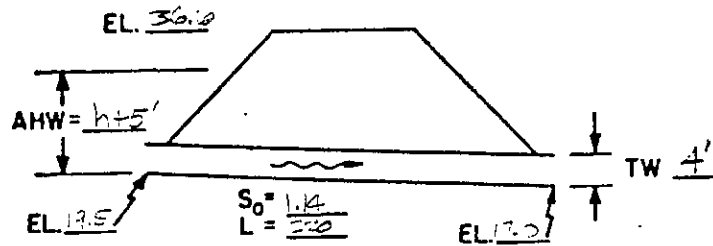
$TW_1 = \underline{40'}$

$TW_2 = \underline{\hspace{2cm}}$

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
 Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 49+00



MEAN STREAM VELOCITY =

MAX. STREAM VELOCITY =

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL HW = H + h ₀ - LS ₀											
			HW/D	HW	K _e	H	d _c	$\frac{d_c + D}{2}$	TW	h ₀	LS ₀	HW				
BOX CULVERT 7' X 8' w/ wingwalls	870		1.7	11.7	.2	1.0	6.7	1.6'	4.0	6.2	2.5	7.7	11.9			
BOX CULVERT 10 X 7 w/ wingwalls	370		1.27	12.7	.2	3.8'	7.3'	8.9'	4.0	7.8	2.5	9.1	12.7			WINGWALLS 30° TO 75°
BOX CULVERT 9 X 9 w/ wingwalls	370		1.20	12.3	.2	2.7	6.8'	7.9'	4.0	7.9	2.5	8.1	10.8	4.2		" "

SUMMARY & RECOMMENDATIONS:

CHOOSE : 9' X 9' R.C.B. w/ WINGWALLS (4' @ 30° TO 75°)
 9' HEIGHT ADDITIONAL FOR EQUESTRIAN TRAIL

PROJECT: DUBLIN BLVD

DESIGNER: JMC

DATE: 9-17-85

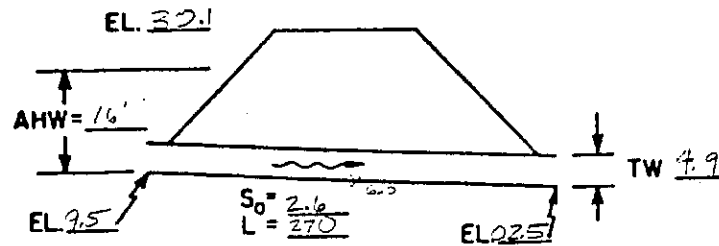
HYDROLOGIC AND CHANNEL INFORMATION

$Q_1 = 2239 = Q_{100}$ $TW_1 = 4.9'$
 $Q_2 = \underline{\hspace{2cm}}$ $TW_2 = \underline{\hspace{2cm}}$

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
 Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 55+00



MEAN STREAM VELOCITY =
 MAX. STREAM VELOCITY =

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	
			INLET CONT.		OUTLET CONTROL HW = H + h ₀ - LS ₀												
			HW/D	HW	K _e	H	d _c	$\frac{d_c + D}{2}$	TW	h ₀	LS ₀	HW					
TWIN 8'x6' RCB	2239	TWIN 8'x6'	2.03	12.5	.2	12	8.5'										10' H S. N.G.
SINGLE 10'x13'	2239	10x13	2.12	21.3'	.2	10.5	9.6	9.8	4.9	9.4	7.0	12.9	21.3				HW TOO HIGH
TWIN 10'x8'	2239	TWIN 10x8	1.45	14.5	.2	5.5	8.5'	7.0'	4.9	7.0	7.0	5.5	14.5	16.5			
TWIN 10'x7'	2239	TWIN 10x7	1.65	16.5	.2	5.5	9.2'	9.6'	4.9	9.6	7.0	8.1	16.5	16.7			CHOOSE

SUMMARY & RECOMMENDATIONS: CHOOSE: TWIN 10'x7' RCB w/ WINGWALLS (4 30° to 75°)
 10' HEIGHT ADEQUATE FOR EQUESTRIAN TRAIL



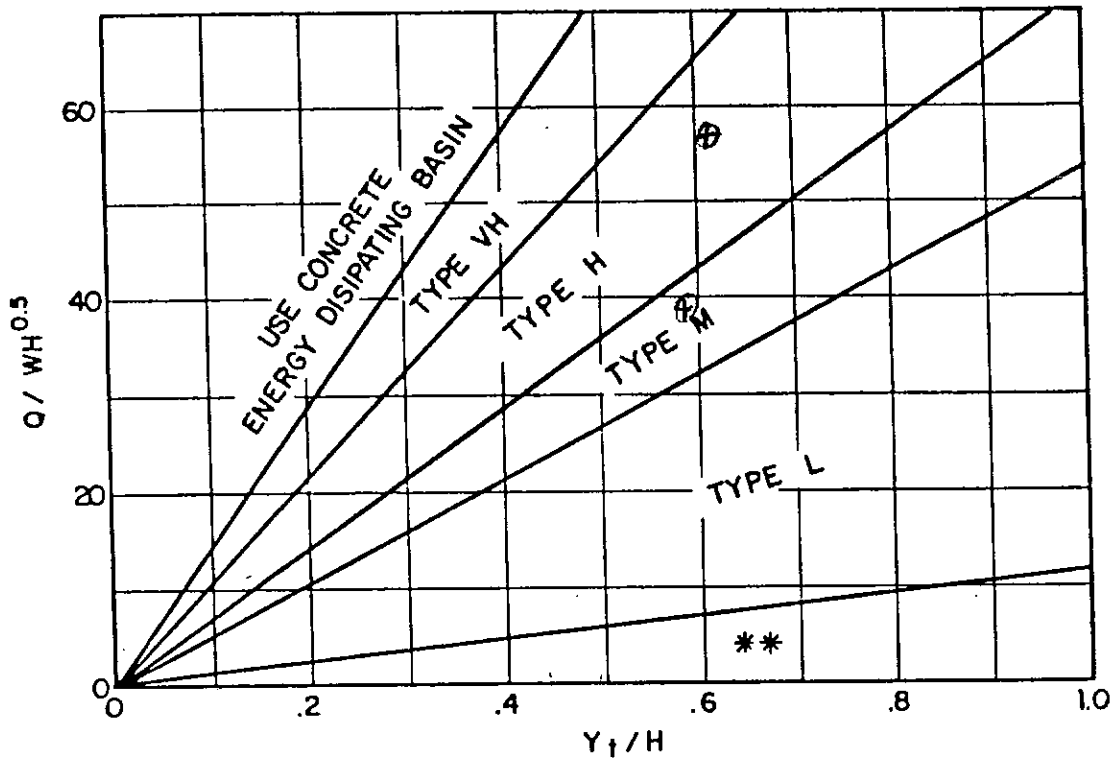
RIPRAP SIZING FOR BOX CULVERTS

FROM URBAN STORM DRAINAGE CRITERIA MANUAL

BOX	Q	Y _N	H _a	$\frac{Q}{WH_a^{0.5}}$	Y _T	$\frac{Y_T}{H}$	ROCK SIZE
9' x 9'	870	5.1	7.05	36.4	4.0'	.57	TYPE 'M' $\Rightarrow d_{50} = 18"$ USE $d_{50} = 24"$
TWIN 10' x 7'	2239	5.9	7.95	56.7	4.9'	.61	TYPE 'H' $\Rightarrow d_{50} = 24"$

$H_a = \frac{1}{2}(H + Y_N)$

FIGURE 5-8. RIPRAP EROSION PROTECTION AT RECTANGULAR CONDUIT OUTLET.



Use H_a instead of H whenever culvert has supercritical flow in the barrel.

**Use Type L for a distance of 3H downstream.

DUBLIN BOULEVARD - BETWEEN RANGWOOD AND AUSTIN BLUFFS

8355300

BASIN

DUBLN- 1

ACREAGE	SQ. MI.	LAND USE	SOIL	CN	I	Z x CN
.5		COMMERTIAL	A	89	33.8	3004.5
1.0		STREETS & WALKS	A	98	86.2	8491.7
1.6	.002				100.0	9496.2
						WEIGHTED CN = 95.0

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
STREET	750	8	.038			
	750	8	.038	1.57	1300	5.0 (5yr FLOW)
				2.94		9.4 (100yr FLOW)

BASIN

DUBLN- 2

ACREAGE	SQ. MI.	LAND USE	SOIL	CN	I	Z x CN
.6		P.U.D.	A	77	36.6	2817.1
1.0		STREETS & WALKS	A	98	83.4	8214.6
1.6	.003				100.0	9031.7
						WEIGHTED CN = 90.3

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
STREET	750	8	.038			
	750	8	.038	1.20	1300	4.0 (5yr FLOW)
				2.48		8.3 (100yr FLOW)

BASIN

DUBLN- 3

ACREAGE	SQ. MI.	LAND USE	SOIL	CN	I	Z x CN
7.1		INDUSTRIAL	A	81	92.4	7481.9
.6		STREETS & WALKS	A	98	7.6	748.0
7.7	.012				100.0	8229.8
						WEIGHTED CN = 82.3

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
SHEET	200	2	.028			
STREET	2600	90	.072			
	2800	92	.100	.73	1270	11.2 (5yr FLOW)
				1.81		27.7 (100yr FLOW)

DUBLIN BOULEVARD - BETWEEN RANGWOOD AND AUSTIN BLUFFS

8355300

BASIN

DUBLN- 4

ACREAGE	SQ. MI.	LAND USE	SOIL	CN	I	Z x CN
16.2		COMMERTIAL	A	89	90.9	9087.7
1.6		STREETS & WALKS	A	98	9.1	894.4
17.9	.028				100.0	8982.1
						WEIGHTED CN = 89.8

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
STREET	2600	90	.072			
	2600	90	.072	1.17	1300	42.3 (5yr FLOW)
				2.43		88.2 (100yr FLOW)

BASIN

DUBLN- 5

ACREAGE	SQ. MI.	LAND USE	SOIL	CN	I	Z x CN
5.7		P.U.D.	A	77	64.8	4987.5
3.1		STREETS & WALKS	A	98	35.2	3452.3
8.8	.014				100.0	8439.8
						WEIGHTED CN = 84.4

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
SHEET	900	34	.064			
STREET	600	8	.025			
	1500	42	.089	.84	1300	15.0 (5yr FLOW)
				1.97		35.2 (100yr FLOW)

BASIN

DUBLN- 6

ACREAGE	SQ. MI.	LAND USE	SOIL	CN	I	Z x CN
8.2		COMMERTIAL	A	89	89.1	7932.6
1.0		STREETS & WALKS	A	98	10.9	1065.2
9.2	.014				100.0	8997.8
						WEIGHTED CN = 90.0

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
SHEET	500	34	.028			
STREET	800	10	.048			
	1300	44	.076	1.18	1300	22.0 (5yr FLOW)
				2.45		45.7 (100yr FLOW)

DUBLIN BOULEVARD - BETWEEN RANSEWOOD AND JUSTIN BLUFFS

DUBLIN BOULEVARD - BETWEEN RANSEWOOD AND AUSTIN BLUFFS

83 553 00

83 553 00

BASIN

DUBLIN-7

ACREAGE SQ. MI.	LAND USE	SOIL	CN	%	% x CN
.5	P.U.D.	A	77	29.4	2264.7
1.2	STREETS & WALKS	A	99	70.6	6917.6
1.7	.003		100.0	9182.4	WEIGHTED CN = 91.8

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
SHEET	750	8	.043			
	750	8	.043	1.31	1300	4.5 (5yr FLOW)
				2.62		9.0 (100yr FLOW)

BASIN

DUBLIN-8

ACREAGE SQ. MI.	LAND USE	SOIL	CN	%	% x CN
1543.4	RES/COMM/INDS/R&D	A	76	100.0	7576.8
1543.4	2.412		100.0	7576.8	WEIGHTED CN = 75.8

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
STREET	3200	34	.244			
PIPE	6480	112	.148			
CREEK	2910	48	.105			
	12590	194	.497	.46	730	805.9 (5yr FLOW)
				1.35		2377.4 (100yr FLOW)

BASIN

DUBLIN-9

ACREAGE SQ. MI.	LAND USE	SOIL	CN	%	% x CN
11.8	OPEN SPACE	A	49	11.4	559.7
13.8	P.U.D.	A	77	13.4	1028.7
77.7	RESIDENTIAL 1/5Ac	A	65	75.2	4889.2
105.3	.161		100.0	6477.5	WEIGHTED CN = 64.8

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
OVERLAND	160	7	.030			
STREET	3340	116	.141			
	3500	123	.171	.16	1110	28.5 (5yr FLOW)
				.74		132.8 (100yr FLOW)

BASIN

DUBLIN-10

ACREAGE SQ. MI.	LAND USE	SOIL	CN	%	% x CN
2.3	P.U.D.	A	77	100.0	7700.0
2.3	.004		100.0	7700.0	WEIGHTED CN = 77.0

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
SHEET	650	14	.060			
	650	14	.060	.50	1300	2.3 (5yr FLOW)
				1.43		6.6 (100yr FLOW)

BASIN

DUBLIN-11

ACREAGE SQ. MI.	LAND USE	SOIL	CN	%	% x CN
2.9	P.U.D.	A	77	37.7	2900.0
1.7	P.U.D.	D	92	22.1	2031.2
.8	RESIDENTIAL 1/5Ac	A	65	10.4	675.3
2.3	OPEN SPACE	A	49	29.9	1463.6
7.7	.012		100.0	7070.1	WEIGHTED CN = 70.7

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
SHEET	450	20	.030			
CREEK	300	4	.039			
	750	24	.069	.30	1300	4.7 (5yr FLOW)
				1.05		16.4 (100yr FLOW)

DUBLIN BOULEVARD - BETWEEN RANGWOOD AND AUSTIN BLUFFS

8355200

DUBLIN BOULEVARD - RANGWOOD TO AUSTIN BLUFFS

1800 E 11

BASINS

DUBLN# 5, 6, 7, 8, 9, 11

ACREAGE	SQ. MI.	LAND USE	SOIL	CN	Z	Z x CN
1543.4		RES/COMM/INDS/R&D	A	76	92.2	6985.3
11.8		OPEN SPACE	A	49	.7	34.5
2.1		OPEN SPACE	A	49	.1	6.7
22.9		P.U.D.	A	77	1.4	105.3
1.7		P.U.D.	D	92	.1	9.3
78.5		RESIDENTIAL 1/5ac	A	65	4.7	304.8
8.2		COMMERTIAL	A	89	.5	43.6
5.3		STREETS & WALKS	A	98	.3	31.0
1674.1	2.616			100.0	7520.6	WEIGHTED CN = 75.2

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
STREET	3200	34	.244			
PIPE	6480	112	.148			
CREEK	5370	84	.195			
	15050	230	.587	.44	680	779.3 (5yr FLOW)
				1.31		2338.6 (100yr FLOW)

BASIN

DUBLN# 12

ACREAGE	SQ. MI.	LAND USE	SOIL	CN	Z	Z x CN
349.9		RES/COMM/PARK	B	84	100.0	8435.2
349.9	.547			100.0	3435.2	WEIGHTED CN = 84.4

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
STREET	1830	61	.274			
PIPE	2940	99	.048			
CREEK	2210	26	.080			
	6980	186	.402	.83	810	369.4 (5yr FLOW)
				1.96		869.9 (100yr FLOW)

BASINS

DUBLN# 1, 2, 3, 4, 5, 6, 7, 9, 10, 11

ACREAGE	SQ. MI.	LAND USE	SOIL	CN	Z	Z x CN
1543.4		RES/COMM/INDS/R&D	A	76	90.5	6858.0
11.9		OPEN SPACE	A	49	.7	33.9
2.3		OPEN SPACE	A	49	.1	6.6
25.8		P.U.D.	A	77	1.5	116.3
1.7		P.U.D.	D	92	.1	9.2
78.5		RESIDENTIAL 1/5ac	A	65	4.6	299.2
25.0		COMMERTIAL	A	89	1.5	130.3
7.1		INDUSTRIAL	A	81	.4	33.9
9.6		STREETS & WALKS	A	98	.6	55.2
1705.2	2.664			100.0	7542.6	WEIGHTED CN = 75.4

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
STREET	3200	34	.244			
PIPE	6480	112	.148			
CREEK	5370	86	.197			
	15250	232	.589	.45	680	807.6 (5yr FLOW)
				1.33		2407.2 (100yr FLOW)

DUBLIN BOULEVARD - BETWEEN RANGWOOD AND AUSTIN BLUFFS

BASINS

DUBLIN# 2, 10

ACREAGE	SQ. FT.	LAND USE	SOIL	CN	Z	Z x CN
2.9		P.U.D.	A	77	73.3	5646.7
1.0		STREETS & WALKS	A	98	26.7	2613.3
3.9	.006			100.0	8260.0	WEIGHTED CN = 82.6

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
SHEET	650	14	.060			
STREET	430	4	.022			
	1080	18	.082	.74	1300	5.9 (5yr FLOW)
				1.83		14.5 (100yr FLOW)

BASINS

DUBLIN# 3, 4

ACREAGE	SQ. FT.	LAND USE	SOIL	CN	Z	Z x CN
16.2		COMMERCIAL	A	89	63.4	5644.7
7.1		INDUSTRIAL	A	81	27.9	2260.0
2.2		STREETS & WALKS	A	98	8.7	850.2
25.6	.040			100.0	8751.9	WEIGHTED CN = 87.5

FLOW TYPE	L(ft)	H(ft)	Tc(hrs)	RUNOFF(in)	qp(CSM/in)	Q (cfs)
SHEET	200	2	.028			
STREET	2600	90	.072			
	2800	92	.100	1.02	1270	51.7 (5yr FLOW)
				2.23		113.2 (100yr FLOW)