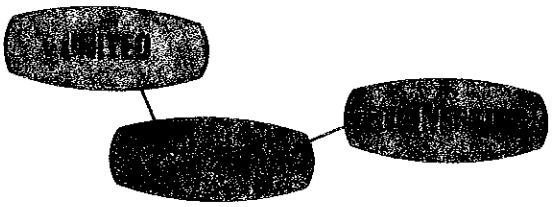
HOLLAND PARK NORTH SUBDIVISION

MASTER DRAINAGE REPORT

SEPTEMBER, 1979

PREPARED BY:

UNITED PLANNING & ENGINEERING CO.
3730 Sinton Road
Colorado Springs, CO 80907



planners · consultants · engineers

3730 Sinton Road
Colorado Springs, Colorado 80907
(303) 471-8222

September 28, 1979

Mr. Dewitt Miller
City of Colorado Springs
Director of Public Works
P. O. Box 1575
Colorado Springs, CO 80901

SUBJECT: Holland Park North Subdivision
Master Drainage Report

Dear Deke:

Transmitted herewith is the drainage report for Holland Park North Subdivision for your review and approval.

Please contact me if I may answer any questions.

Respectfully submitted,

UNITED PLANNING & ENGINEERING CO.

Max S. Anthis
Design Engineer

MSA:pq
Enclosure

HOLLAND PARK NORTH SUBDIVISION

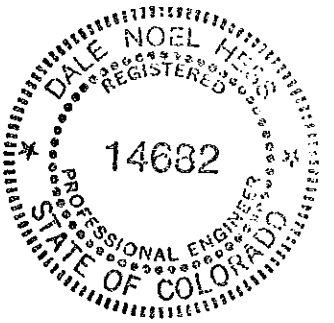
MASTER DRAINAGE REPORT

CERTIFICATIONS AND APPROVALS

REGISTERED ENGINEER

I, Dale N. Hess, a registered engineer in the State of Colorado, hereby certify that the attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. I further certify that said drainage report is in accordance with all City of Colorado Springs Ordinances and specification and criteria.

Dale N. Hess



Colorado P. E.--14682

OWNER OR DEVELOPER OF THE SITE

"The developer has read and will comply with all of the requirements specified in this drainage report as approved by the City Engineer."

BY_____

TITLE_____

APPROVED:

City of Colorado Springs, Department of Public Works

_____ CITY ENGINEER

_____ DATE

1. SCOPE:

This report is a master study of the Holland Park North Subdivision including adjacent areas contributing to the greenbelt. It is intended to convey the proposed plan for routing storm runoff and its effects on proposed and existing structures.

2. GENERAL DESCRIPTION:

The Holland Park North Subdivision is located in the east half of the northeast quarter of Section 26 and the west half of the northwest quarter of Section 25, all in Township 13 South, Range 67 West of the 6th P.M., containing 45.609 acres, more or less.

Other areas contributing to the greenbelt include the following:

1. Unplatted land in the west half of the northeast quarter of Section 26, Township 13 South, Range 67 West of the 6th P.M., containing 27.4364 acres, more or less.

2. The proposed Highland Park duplexes in the northwest quarter of the northwest quarter of the southwest quarter of Section 25, Township 13 South, Range 67 West of the 6th P.M., containing 2.498 acres, more or less.

3. The proposed Centennial Heights Subdivision in the south half of the southeast quarter of the northeast quarter of Section 26, Township 13 South, Range 67 West of the 6th P.M., containing 23.000 acres, more or less.

4. The proposed Holland Park West Subdivision Filing No. 4 in the southwest quarter and the southwest quarter of the southwest quarter of the northwest quarter of Section 25 and the southeast quarter of the southeast quarter of the northeast quarter of Section 26, all in Township 13 South, Range 67 West of the 6th P.M., containing 4.950 acres, more or less.

5. The proposed Holli Heights Subdivision in the south half of the northwest quarter of Section 25, Township 13 South, Range 67 West of the 6th P.M., containing 7.080 acres, more or less.

The existing Douglas Creek Channel enters the site on the west and leaves the site through the existing box culvert at Holland Park Boulevard.

The Holland Park North Subdivision has been prepared in conjunction with all the above mentioned areas. All computations and the drainage plan are included in this report. The site is located in the Douglas Creek Drainage Basin. References have been made to drainage reports that are either in or adjoining this site. These include:

"Douglas Creek Drainage Study", June, 1974.
"Holland Park West Master and Filing No. 1 Drainage Plan", January, 1978.
"Holland Park Subdivision No. 7 Drainage Report", March, 1972.
"Buckingham Industrial Park Drainage Report", September, 1979.
"Holland Park West Subdivision Filing No. 2 and 2A Drainage Report".
"Holland Park West Subdivision Filing No. 3 Drainage Report".

3. METHOD:

The method used for computations is the USDA/SCS Synthetic Hydrograph Method as prescribed by the City of Colorado Springs. All interior flows are based on the "5-year" rainfall of 2.1 inches in 6 hours. The primary greenbelt flows are based on a "100-year" rainfall of 3.5 inches in 6 hours. All computations are enclosed. Primary greenbelt inflows were given by the City Engineer of Colorado Springs. All soils are Type "D" as obtained from the local SCS office.

4. EXTERNAL FLOW:

An inflow of 2300 CFS will enter the western portion of the site from the Mostek Corporation development. This is the projected peak "100-year" flow in the Douglas Creek Channel. An external flow of 196 CFS will enter from the north in a storm sewer at the intersection of Garden of the Gods Road and Centennial Boulevard.

Assuming 100 feet of frontage will drain toward Garden of the Gods Road for a distance of 1300 feet to the west, a developed flow of 13.3 CFS will enter Basin C-1 in the street.

Basin 2A of the Holland Park West Master and Filing No. 1 drainage plan has been divided into two (2) basins (K (9.0 CFS) and L (18.7 CFS), entering the south line of Centennial Heights Subdivision.

Re-calculation of Basin 3H in the Holland Park West Master and Filing No. 1 drainage plan produces an increased flow of 33.4 CFS in Basin M entering on the west line of the Highland Park duplex site. Basin 1A of this same report indicates an inflow to this site of 71.8 CFS on the drainage plan and a flow of 75.3 CFS in the report. This study considers the 75.3 CFS entering on the west line of Centennial Heights Subdivision.

Holland Park West Filing No. 3 conveys 103.1 CFS through a storm sewer system and some street flow in Centennial and Vondelpark to the south line of Holland Park West Subdivision No. 4.

Inflow from Holland Park West Filing Nos. 2 and 2A is street flow with a small concrete swale delivering 2.8 CFS to the east line of the Holli Heights Subdivision.

Runoff from Buckingham Industrial Park does not enter directly on this site. Flow, after development of the existing gravel pits, will be conveyed by way of an existing drainage easement, as shown on the Holland Park No. 7 drainage plan, to the north line of Holland Park North (55.5 CFS). Numerous other flows enter the site along this line from Holland Park No. 7 as shown on the attached drainage plan. The 66.1 CFS street flow in Holland Park Boulevard shown on the Holland Park No. 7 drainage plan presents a collection problem at the Douglas Creek crossing. Curb cuts in this location are inadequate.

5. INTERNAL FLOW:

Flow from Basin L (18.7 CFS) will be collected by a catch basin on the south line of Centennial Heights Subdivision continuing through an 18-inch RCP at 3.17 percent minimum slope to two (2) 8-foot D-10R curb inlets collecting flow from Basins K (9.0 CFS) and F-3 (14.2 CFS) outfalling through a 24-inch RCP at 7.03 percent minimum slope into Douglas Creek at the northeast corner of the proposed multi-family development.

The 75.3 CFS on the west line of Centennial Heights Subdivision will be collected into a catch basin and flow through a 30-inch RCP at 3.37 percent minimum slope into the west line of Centennial Heights Subdivision, turn north in the street to outfall in Douglas Creek at the north line of the subdivision.

Flow from Basins K and L of this report and 1A of the Holland Park Master and Filing No. 1 drainage plan will be routed through proposed drainage swales along the west and south lines of Centennial Heights Subdivision to their respective catch basins.

Runoff generated from site development will flow through inverted crown streets (Basins F-1, F-2, F-4) into proposed drainage swales between buildings, discharging into Douglas Creek on the north line of Centennial Heights Subdivision.

The 33.4 CFS from Basin M will be collected by a drainage swale proposed in the Holland Park West Filing No. 3 drainage report, located along the west line of Holland Park West Filing No. 3. This report continues this swale to the catch basin located on the west line of the proposed Highland Park Duplex Addition. Flow is then routed through a 21-inch RCP at 4.47 percent minimum slope to the storm sewer system in Centennial Boulevard.

Continuation of the storm sewer in Centennial Boulevard will provide numerous curb inlet collection points and discharge into Douglas Creek on the downstream side of the Centennial Boulevard crossing. These curb inlets allow Centennial Boulevard to have one lane free of water for emergency traffic.

The assumed street flow (13.3 CFS) entering Basin C-1 (3.4 CFS) will be collected by a 10-foot D-10R catch basin in Garden of the Gods Road, allowing 6.7 CFS to turn the corner and flow into Centennial Boulevard.

A 48-inch RCP conveying 196 CFS to the north line of the site will be continued in Centennial Boulevard as a main storm sewer system.

Flows from Basins C-9 (0.7 CFS) are collected in a curb inlet sump condition through an 18-inch RCP at 1.96 percent minimum slope to a lateral storm sewer system branching from the main system in Centennial Boulevard. This lateral system also collects runoff from Basins C-5 (11.8 CFS), C-10 (13.2 CFS) and C-12 (1.4 CFS) through a 12-foot D-10R and two (2) 4-foot D-10R curb inlets as shown on the drainage plan. The flow from these basins (total of 41.1 CFS) is conveyed to the main system in Centennial Boulevard by a 30-inch RCP at 1.00 percent minimum slope.

The 5.6 CFS from Basin C-3 and the 6.7 CFS allowed to turn the corner at the Garden of the Gods Road and Centennial Boulevard intersection will be collected by an 8-foot D-10R prior the aforementioned lateral storm sewer system junction.

The unplatted parcel lying along the west line of Holland Park North Subdivision indicates an access road to the west off Centennial Boulevard. The lateral storm sewer system lies in this road and with the aid of the 8-foot D-10R on Centennial Boulevard at this intersection allows no flow to continue through the intersection. Flow in the main storm sewer system is 259.4 CFS carried by a 48-inch RCP at 3.26 percent minimum slope at this point.

The 10.26 CFS generated by Basin C-4 is collected in a 6-foot D-10R catch basin downstream from the above mentioned intersection constituting a combined main system pipe flow of 269.60 CFS.

Where Centennial Boulevard transitions into a 1.67 percent slope, it is required to change the main storm sewer system pipe size to a 60-inch RCP at 1.07 percent minimum slope.

Two (2) 6-foot D-10R curb inlets located at the low point in Centennial Boulevard on the north side of the Douglas Creek crossing collect the remaining excess street flows in a sump condition. The proposed 60-inch main discharges downstream of the Douglas Creek crossing with a total flow of 294.6 CFS.

Basin D flow is respective of the proposed grading for this unplatted area. Runoff is expected to flow overlot to Douglas Creek (32.3 CFS). Basins E-1 (12.1 CFS) and E-2 (12.6 CFS) will require a storm sewer system to comply with allowable flows in the street. E-3 (14.6 CFS) will flow overlot into Douglas Creek.

Basin A is a proposed shopping center. Valley gutter at all accesses and a warped parking lot will prevent runoff from entering Centennial Boulevard. The parking lot will route flow to the southeast corner of this basin collecting a total of 64.4 CFS plus 58.9 CFS from overlot flow and an existing drainage easement in Holland Park No. 7. A total of 122.9 CFS will be conveyed through a proposed drainage swale along the north line of Holland Park North Subdivision. This swale will collect numerous incoming flows from Holland Park No. 7 resulting in a total discharge of 140.1 CFS into Douglas Creek.

The 8-inch vertical curbs will be constructed in the Holland Park West No. 4 Subdivision and Holli Heights Subdivision. The accumulated flows of 19.3 CFS and 5.2 CFS will be within the acceptable capacity. At the east end of Holli Heights Subdivision a 6-foot D-10R and 8-foot D-10R curb inlets will collect the above mentioned street flows into a 21-inch RCP at 1.73 percent minimum slope. This pipe will be connected to a 20-foot D-10R sump curb inlet collecting 48.6 CFS from Holland Park Boulevard. Continuing from this point to outfall at the upstream end of the Holland Park Boulevard box culvert, the pipe will enlarge to a 30-inch RCP at 2.87 percent minimum slope discharging a total of 69.4 CFS into Douglas Creek.

Basins I (5.2 CFS), J (3.2 CFS), B-1 (21.7 CFS) and B-2 (8.4 CFS) will flow overlot discharging into Douglas Creek.

6. GREENBELT FLOWS:

As indicated on the drainage plan, the Douglas Creek channel will follow nearly the existing thalwag. It will enter at the west line of the site with approximately 2300 CFS of flow. At the Centennial Boulevard a 2-cell 10-foot by 7-foot box culvert is proposed to carry a "100-year" design flow of 2502 CFS. At the east end of the site Douglas Creek crosses Holland Park Boulevard. An existing 2-cell 10-foot by 6-foot box culvert at 0.60 percent slope will be modified to flow the "100-year" design flow of 3033 CFS. Maintaining a minimum slope of 2.4 percent entering the box produces enough energy at the slope break that flow will not begin to reach normal depth of 6.60 feet on the 0.6 percent grade for 1448 feet downstream. In the condition velocities will be high (37 FPS±). It is proposed to transition the channel out of the box for at least 50.00 feet and reconstruct the existing channel bed with larger riprap for a distance of 100 feet downstream. Considering the increased design flow of 3674 CFS at Chestnut, it was found that overtopping of

the road will occur to 2.02 feet above the existing low point of curb and gutter.

Flow through the existing 96-inch CMP at Chestnut would require 160.0 feet of head to accept 3674 CFS.

Since 23.4 feet above the top of pipe is all the head that is available to prevent overtopping, it would be recommended an area of 81.2 square feet in addition to the existing 96-inch CMP. It is notes that these recommendations are only estimated and a complete unit hydrograph be developed for design of future improvements.

7. DESIGN DETAILS: (Holland Park North Subdivision only):

A. STREETS:

NAME	LOCATION	WIDTH	RUNOFF CFS	CURB	MIN. SLOPE
Centennial Blvd.	C-2	33'FF.	8.6	Vertical	1.7%
	C-3	33'FF.	12.3	Vertical	3.5%
	C-4	33'FF.	10.2	Vertical	3.3%
	C-11 (One-Way Art.)	33'FF.	2.1	Vertical	1.7%
Access to unplatted land on west line	C-5	40'FF.	12.8	Vertical	2.5%
	C-12 (Residential)	40'FF.	1.4	Vertical	2.5%

B. DRAINAGE CHANNEL: (Concrete, n=.013):

10' x 7' Major Channel:

LOCATION	RUNOFF CFS	SLOPE	BOTTOM WIDTH	DEPTH	FREEBOARD	RIGHT OF WAY
Point 3	2444	1.5	10'	4.89	2.11	60'
Point 4	2479	1.5	10'	4.89	2.11	60'
Point 5	2502	1.5	10'	4.89	2.11	60'
Point 6	2824	2.4	10'	4.79	2.21	60'
Point 7	2840	2.4	10'	4.79	2.21	60'
Point 8	3033	2.4	10'	4.79	2.21	60'

2' x 3' Drainage Swale (Concrete, n=.013):

North of B-1 & B-2	140.1	1.79	2'	3.00	1.00	10'

C. STORM SEWERS: (All pipe is RCP, n=.013):

LOCATION	RUNOFF CFS	DIA. (IN.)	MIN. SLOPE
East of C-3 & C-4	259.4	48	3.26%
East of C-4	269.6	60	1.07%
North of C-4 & West of Cent. Blvd.	41.1	30	1.00%
To West Bndy. North of C-4	14.7	18	1.96%

8. COST ESTIMATES:

All costs are based on current construction prices (bids on work in progress). (Holland Park North Subdivision only.)

A. STORM SEWER:

ITEM	QUANTITY	UNIT PRICE	PRICE
18" RCP	490 LF	$ 15.50/LF	$ 7,595.00
30" RCP	170 LF	30.50/LF	5,185.00
48" RCP	1570 LF	71.50/LF	112,255.00
60" RCP	1065 LF	118.50/LF	126,202.50
4' D-10R	2 EA	1,150.00 EA.	2,300.00
6' D-10R	3 EA	1,430.00 EA.	4,290.00
8' D-10R	1 EA	1,700.00 EA.	1,700.00
10' D-10R	1 EA	1,940.00 EA.	1,940.00
12' D-10R	1 EA	2,145.00 EA.	2,145.00
	SUBTOTAL...		$263,612.50 (Dev. pays)

B. CHANNEL:

			OTHERS	DEVELOPER
10' x 7' Conc. Channel	2750 LF	$90.00/LF (Dev. pays 1375 LF)	$123,750.00	$123,750.00
2' x 3' Conc. Channel	1090 LF	40.00/LF		43,600.00
	SUBTOTAL...		$123,750.00	$430,962.50
	10% Engr. & Cont....		12,375.00	43,096.25
	TOTAL...		$136,125.00	$474,058.75

9. FEES:

1979 Douglas Creek Fees for Holland Park North Subdivision:

Drainage:	45.609 acres @ $1,797.00	=	$81,959.37
Bridge:	45.609 acres @ $69.00	=	$3,147.02

N O T E

Further study of the greenbelt crossing of Centennial Boulevard has indicated that the 2-cell 10' x 7' box culvert proposed in this report can be replaced by two (2) 8' x 7' cells. With these findings, the two (2) 8' x 7' cells will be used for the crossing and a design will be submitted at a later date.

- JR. STR...N

14

MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	K	SOIL GROUP	DEV. TYPE	CURVE NO.	FLOW Q	FLOW qp	
ESTIMATED FLOW IN GARDEN OF THE GODS ROAD													
			0.0074	1330	13.3	0.1949	1080	COLLECT 100' FRONT.	35% 98 65% 95	96	1.67	13.3	
A	1	28.50	0.0102	1250	38	0.1211	1220	D	PARK. LOT	98	1.87	23.3	
	2	29.57	0.0106	1870	56	0.1661	1120	D	PARK. LOT	98	1.87	22.2	
	3	21.67	0.0078	850	28	0.0873	1270	D	PARK. LOT	98	1.87	18.5	
B	1	27.04	0.0108	670	34	0.0615	1270	D	comm	95	1.58	21.7	
	2	10.46	0.0042	550	24	0.0560	1270	D	comm	95	1.58	8.4	
C	1	4.23	0.0015	780	8	0.1280	1200	D	STREET	98	1.87	3.4	
	2	12.39	0.0044	2320	53	0.2176	1050	D	STREET	98	1.87	8.6	
	3	7.75	0.0028	700	19	0.0809	1270	D	comm	95	1.58	5.6	
	4	14.19	0.0051	850	21	0.0975	1270	D	comm	95	1.58	10.2	
	5	16.49	0.0059	790	19	0.0931	1270	D	comm	95	1.58	11.8	
	6	9.51	0.0034	520	12	0.0685	1270	D	comm	95	1.58	6.8	

HYDROLOGIC COMPUTATION – BASIC DATA

PROJ:

By:

Date:

UNITED PLANNING ENGINEERG

916 North Weber
Colorado Springs, Colo. 80902

MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	K	SOIL GROUP	DEV. TYPE	CURVE NO.	FLOW Q	FLOW qp	
C	7	1.01	0.0004	350	6	0.0567	1270	D	STREET	98	1.87	1.0	
	8	0.85	0.0003	270	4	0.0491	1270	D	STREET	98	1.87	0.7	
	9	8.73	0.0031	520	12	0.0685	1270	D	comm	95	1.58	6.2	
	10	18.32	0.0066	520	14	0.0646	1270	D	comm	95	1.58	13.2	
	11	3.31	0.0012	820	8	0.1356	1200	D	STREET	98	1.87	2.1	
	12	1.61	0.0006	560	18	0.0639	1270	D	STREET	98	1.87	1.4	
D		49.54	0.0178	1680	45	0.1597	1150	D	comm	95	1.58	32.3	
E	1	17.74	0.0064	900	12	0.1292	1200	D	comm	95	1.58	12.1	
	2	17.58	0.0063	680	10	0.1002	1270	D	comm	95	1.58	12.6	
	3	20.38	0.0073	880	32	0.0863	1270	D	comm	95	1.58	14.6	
F	1	21.13	0.0076	710	50	0.0567	1270	D	MULTI. FAMILY	95	1.58	15.3	
	2	34.80	0.0125	660	34	0.0605	1270	D	"	95	1.58	25.0	
	3	19.67	0.0071	1350	70	0.1046	1270	D	"	95	1.58	14.2	

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F	4	8.58	0.0031	350	24	0.0332	1270	D	MULTI. FAMILY	95	1.58	6.2	
	5	4.96	0.0018	210	14	0.0227	1270	D	comm	95	1.58	3.6	
G	1	4.63	0.0019	825	4.6	0.1690	1130	D	STREET	98	1.87	4.0	
	2	0.91	0.0004	175	1	0.5070	1270	D	"	98	1.87	0.9	
	3	5.17	0.0021	455	18	0.0530	1270	D	50% MF 50% SF	91	1.26	3.4	
	4	8.05	0.0032	555	22	0.0585	1270	D	MULTI. FAMILY	95	1.58	6.5	
	5	0.83	0.0003	290	16	0.0313	1270	D	"	95	1.58	0.6	
	6	4.55	0.0018	325	23	0.0310	1270	D	comm	95	1.58	3.6	
	7	11.17	0.0045	500	35	0.0434	1270	D	comm	95	1.58	9.0	
	8	0.80	0.0003	380	0.2	0.2308	1020	D	STREET	98	1.87	0.6	
	9	1.83	0.0007	340	2	0.0836	1270	D	"	98	1.87	1.7	
	10	0.72	0.0003	150	1	0.0424	1270	D	"	98	1.87	0.7	
	11	1.33	0.0005	220	1.2	0.0616	1270	D	"	98	1.87	1.3	
H	1	11.26	0.0045	490	29	0.0456	1270	D	MULTI. FAMILY	95	1.58	9.0	

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H	2	3.51	0.0014	420	17	0.0468	1270	D	MULTI. FAMILY	95	1.58	2.8	
	3	5.07	0.0020	730	42	0.0626	1270	D	"	95	1.58	4.1	
	4	5.17	0.0021	550	33	0.0495	1270	D	"	95	1.58	4.1	
	5	4.13	0.0017	460	28	0.0429	1270	D	"	95	1.58	3.4	
	6	6.48	0.0026	1100	66	0.0845	1270	D	"	95	1.58	5.2	
	7	1.35	0.0005	250	6	0.0384	1270	D	"	95	1.58	1.1	
I		1.87	0.0007	380	20	0.0392	1270	D	MULTI. FAMILY	95	1.58	1.5	
J		4.02	0.0016	650	15	0.0814	1270	D	MULTI. FAMILY	95	1.58	3.2	
SPLIT BASIN 2A OF HOLLAND PARK SUBDIVISION MASTER DRAINAGE PLAN													
K		18.01	0.0072	700	122	0.0396	1270	D	SINGLE FAMILY	87	0.99	9.0	
L		37.14	0.0149	890	164	0.0470	1270	D	"	87	0.99	18.7	
M		66.38	0.0266	1150	180	0.0604	1270	D	"	87	0.99	33.4	

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Page of Pages

10 yr. STORM

MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	K	SOIL GROUP	DEV. TYPE	CURVE NO.	FLOW Q	FLOW qp	
① FLOW AS ENGR.		CITY	2.5245			0.52	720			74.3	1.26	2300	
+ F-1			0.0076										
+ 1A (HOLLAND PARK MASTER DRAIN. PLAN)			0.093	260	V=30fps	0.0024			92% 82 8% 95	83			
②			2.6251			0.5224	718		4% 83 96% 74.3	74.6	1.28	2413	
+ E1,2,3			0.0200										
+ F-2			0.0125	480	V=30fps	0.0044							
③			2.6576			0.5268	713		1.2% 95 98.8% 74.6	74.8	1.29	2444	
+ F-4			0.0031										
+ F-3			0.0071										
+ K			0.0072						32% 95 68% 87	89.6			
+ L			0.0149	490	V=30fps	0.0045							
④			2.6899			0.5313	709		98.8% 74.8 1.2% 89.6	75.0	1.30	2479	

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MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	K	SOIL GROUP	DEV. TYPE	CURVE NO.	FLOW Q	FLOW qp	
+ D			0.0178										
+ F-5			0.0018	355	V=30 fps	0.0033							
(5)	CROSSING CENT. BLVD.		2.7095			0.5346	705		99.3% 75.0 0.7% 95	75.1	1.31	2502	
+ C			0.0353						14.7% 95				
+ G			0.0160						6.7% 95				
+ 3 (HOLLAND PARK MASTER DRAIN. PLAN)			0.1625						67.5% 84.3				
+ M			0.0266	195	V=30 fps	0.0018			11.1% 87	86.9			
(6)			2.9499			0.5364	704		92% 75.1 8% 86.9	76.0	1.36	2824	
+ B-1			0.0108										
+ I			0.0007	390	V=30 fps	0.0036							
(7)			2.9614			0.5400	700		99.6% 76.0 .4% 95	76.1	1.37	2840	

HYDROLOGIC COMPUTATION – BASIC DATA

PROJ:

By:

Date:

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Colorado Springs, Colo. 80902

MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	K	SOIL GROUP	DEV. TYPE	CURVE NO.	FLOW Q	FLOW qp	
+ B-2			0.0042						95 3.7%				
+ A			0.0286						98 25.2%				
+ HOLLAND PARK													
NO. 7 DRAIN. PLAN. (EST.)			0.0224						94.6 13.3%				
+ H			0.0148						95 13.1%				
+ J			0.0016						95 1.4%				
+ HOLLAND PARK													
NO. 2 & 2A DRAIN PLAN.			0.0076						85 6.7%				
+ BUCKINGHAM													
END. SUBD. +			0.0263						95 23.2%				
UNPLATED OLD MIT* (ESTIMATED)			0.0151	785	V=30fps	0.0073			95 13.4%				
			—			—							
(8)	CROSSING HOLLAND PK. BLVD		3.0820			0.5473	693		96.3% 76.1 3.7% 95.0	76.8	1.42	3033	

HYDROLOGIC COMPUTATION – BASIC DATA

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Page of Pages

FROM HOLLAND PK. BLVD.
TO CHESTNUT

MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	K	SOIL GROUP	DEV. TYPE	CURVE NO.	FLOW Q	FLOW qp
HP NORTH MSTR. HOLLAND	PK		3.0820			0.5473	693			76.8	1.92	3025
BLVD. SIDE FROM	EAST HP#7 (EST.)		0.0194	180	V=30fps	0.0017			76.9 99.1% 95 .9%			
*			3.1014			.5490	691			77.0	1.43	3064
HPM 5A			0.0056	630	V=30fps	0.0058			77.0 % 77 93.2%			
			3.1070			0.5548	690			77.0	1.43	3066
+ HPM 6 (EST.)			.0358	1140	V=30fps	0.0106			98.9% 77.0 81.9 1.1%			
*			3.1428			.5654	685			77.0	1.43	3078
+ 7			.0875						85.4 .6%			
+ 8			.0142	1170	V=30fps	0.0108			86 .14%			
		→	.3090						96.8% 77 85.5 3.2%			
		*	3.5393			.5762	680			77.3	1.45	3490
+ NORTH SIDE OF CREEK D.C. STUDY												

HYDROLOGIC COMPUTATION – BASIC DATA

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Page of Pages

FROM HOLLAND PK. BLVD. TO CHESTNUT

MAJOR BASIN	SUB BASIN	AREA Planim. Read.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	K	SOIL GROUP	DEV. TYPE	CURVE NO.	FLOW Q	FLOW qp	
D-10			.034						88 11%				
D-11	From DOUGLAS CREEK STUDY		.076						27 24.6%				
D-12b			.104						92 33.7%				
F-1			.032						96 10.9%				
F-2		.3090	.063						96 20.9%				
						0.0056			91.3% 72.3 91.7 8.7%				
CHESTNUT	(EST.)		3.5393	600	V=30 fps	.5E18	674			78.6	1.54	3674	
											TOTAL @		
											CHESTNUT		

HYDROLOGIC COMPUTATION – BASIC DATA

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Page 1 of

Project

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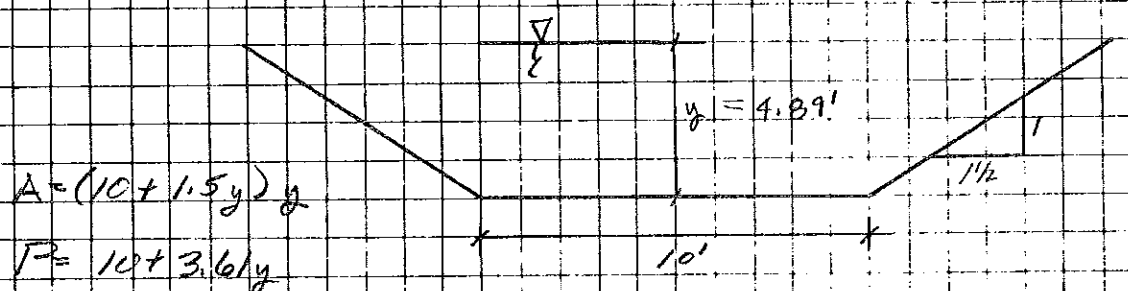
SIZE TRAPEZOIDAL CHANNEL
REACH — WEST LINE TO CENTENNIAL BLVD.

DESIGN FLOW Q = 2502 cfs
SLOPE = 1.50%
CONC. LINED n = 0.013



$A = (10 + 1.5y)y$

$T = 10 + 3.6y$

	y	A	P	R	$R^{2/3}$	Q	V	
	4.00	64.00	24.94	2.62	1.90	1702.4		INCREASE
NORMAL	4.80	82.56	27.33	3.02	2.09	2415.4		INCREASE
DEPTH	4.90	85.02	27.69	3.07	2.11	2514.5		DECREASE
→	4.89	84.77	27.65	3.07	2.11	2504.6	29.55	OK

CRITICAL DEPTH $\frac{Q^2}{g} = \frac{A^3}{B} = \frac{(2502)^2}{32.2} = 194410.00$

$A = (10 + 1.5y_c)y_c$

$B = 10 + 3.00y_c$

$V_c = \frac{Q}{A} = \frac{2502}{189.84} = 13.18$ fps

$S_c = 0.17\%$

	y_c	A	A^3	B	194410.00	
	6.00	114.00	1481544.00	28.00	5291212.29	INCREASE
	10.00	250.00	15625000.00	40.00	3906250.00	DECREASE
	9.00	211.50	9460870.88	37.00	2556699.21	DECREASE
CRITICAL	8.50	193.38	7231043.60	35.50	2036911.37	DECREASE
DEPTH	8.30	186.34	6469687.64	34.90	1853778.87	INCREASE
→	8.40	189.84	6841686.59	35.20	1943666.10	OK

FLOW IS SUPERCRITICAL

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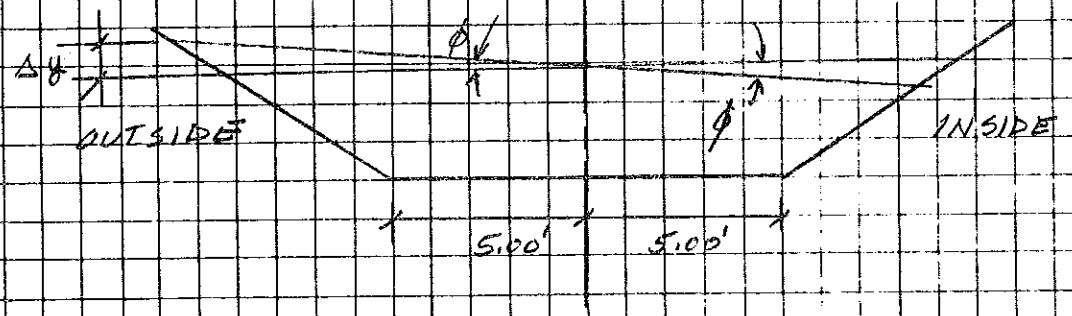
RAISED WATER SURFACE AT OUT SIDE WALL OF CURVE $R = 400.00'$

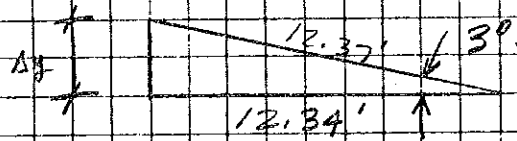


$$\tan\phi = \frac{V^2}{gr} = \frac{(29.55)^2}{32.2(400)} = 0.0678$$

$$\phi = 3^\circ 52' 42''$$

NORMAL WATER SURFACE $B = 10 + 3.00(4.89) = 24.67'$

$$\frac{B}{2} = 12.34$$



$$\frac{12.34}{\cos 3^\circ 52' 42''} = 12.37$$

$$\Delta y = 12.37 \sin 3^\circ 52' 42'' = 0.84'$$

NORMAL $y + \Delta y = 4.89 + 0.84 = 5.73$

CHANNEL DEPTH $= 5.73 + FB = 7.00'$

$FB = 7.00 - 5.73 = 1.27'$

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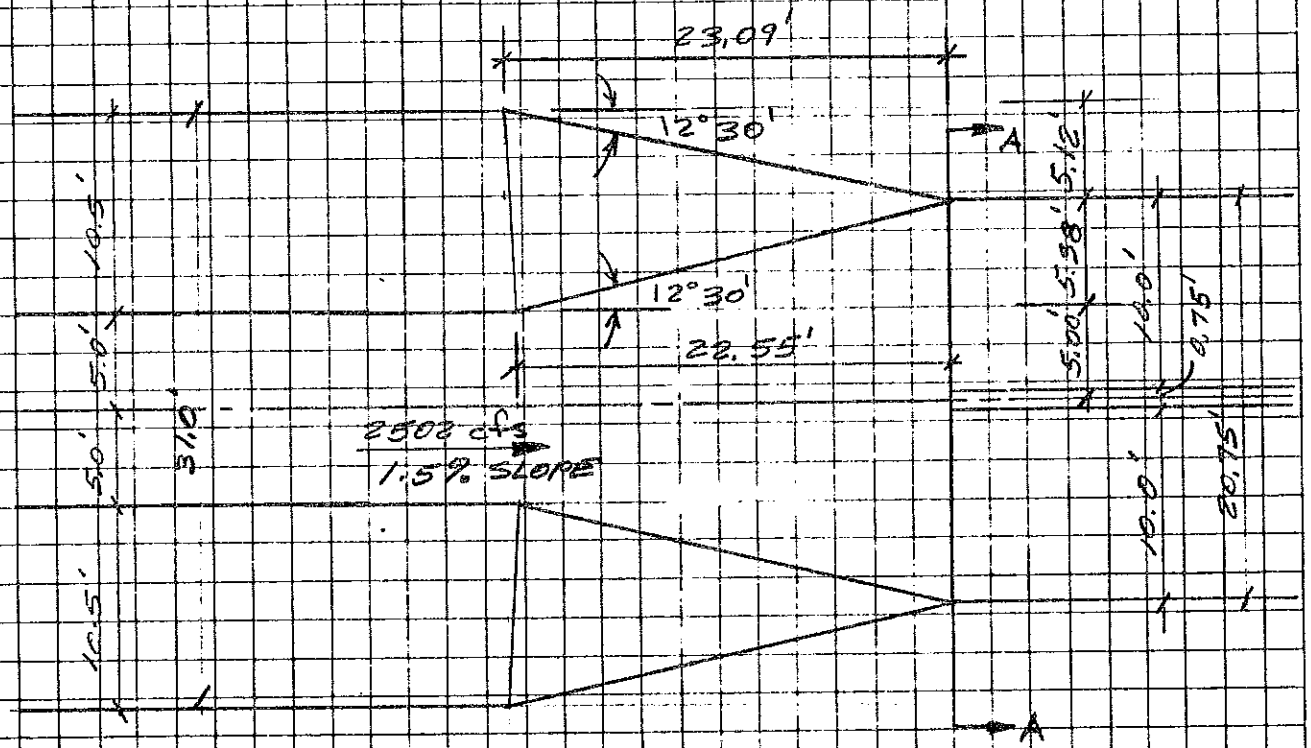
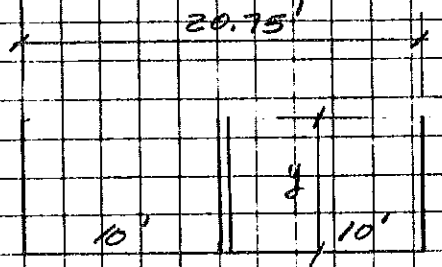
CHANNEL TRANSITION INTO PROPOSED CENT. BLVD. BOX CULVERT



SIZE BOX CULVERT AT CENTENNIAL BLVD.



SECTION A-A

$A = 20.75\,y$

$P = 20.75 + 2y$

$R = \frac{20.75\,y}{20.75 + 2y}$

$Q = 2502$ cfs

$S = 1.5\%$

$n = 0.013$

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Project

Calc. by date

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INLET SECTION DEPTH W = 20.75 S = 1.50 %

y_n	A	R	$R^{2/3}$	Q	V	
4.50	93.38	3.14	2.14	2797.6		DECREASE
4.30	89.23	3.04	2.10	2623.3		DECREASE
4.20	87.15	3.00	2.08	2537.8		DECREASE
4.16	86.32	2.97	2.07	2504.5	29.99	USE 4.17'

INSIDE BOX DEPTH : PIER JUMP REF DB-9.3 L.A. MANUAL

$\frac{V_1^2}{2g} = 13.97$ $\frac{d_1}{13.97} = 0.2985$ $X = \frac{20.00}{20.75} = 0.9639$

$y = \frac{d_2}{d_1} = 1.093$

$d_2 = 1.093 \times 4.17 = 4.56$

USE 2 - 10'X 7' RCB FB = 2.44'

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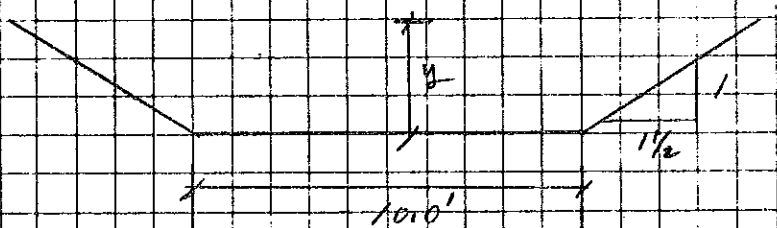
SIZE CHANNEL FROM CENTINNIAL BLVD. TO HOLLAND PARK BLVD.

$Q = 3033$ cfs
$S = 2.40\%$
$n = .013$

NORMAL DEPTH = y

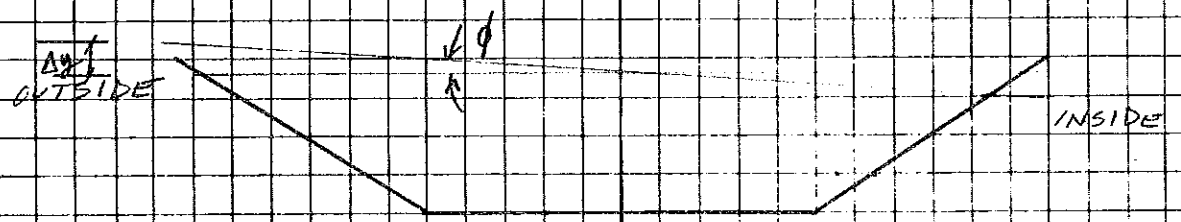
y	A	P	R	$R^{2/3}$	CQ	V	
1.00	64.00	24.44	2.62	1.90	2153.4		INCREASE
6.00	114.00	31.66	3.60	2.35	4794.1		DECREASE
5.00	87.50	28.05	3.12	2.14	3315.9		DECREASE
4.80	82.56	27.33	3.02	2.09	3055.6		DECREASE
4.78	82.07	27.26	3.01	2.08	3022.9		INCREASE
→ 4.79	82.32	27.29	3.02	2.09	3046.7	37.01	✓



$A = (10 + 1.5y)\,y$

$P = 10 + 3.61y$

RAISED WATER SURFACE AT OUTSIDE WALL OF CURVE

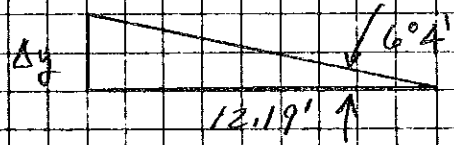


$$\tan\phi = \frac{V^2}{gr} = \frac{(37.01)^2}{32.2(400)} = 0.1063$$

$$\phi = 6^\circ 4' 13''$$

NORMAL WATER SURFACE = $10+3(4.79) = 24.37'$

$$\frac{24.37}{2} = 12.19'$$



$\Delta y = 1.30'$

$y + \Delta y = 4.79 + 1.30 = 6.09$

CHANNEL DEPTH = $6.09 + FB = 7.00'$

$FB = 7.00 - 6.09 = 0.91'$

USE SAME TRANSITION SECTION FOR EXIT AT CENTENNIAL BLVD. AND ENTRANCE AT HOLLAND PARK BLVD. AS DESIGNED FOR ENTRANCE AT CENT. BLVD.

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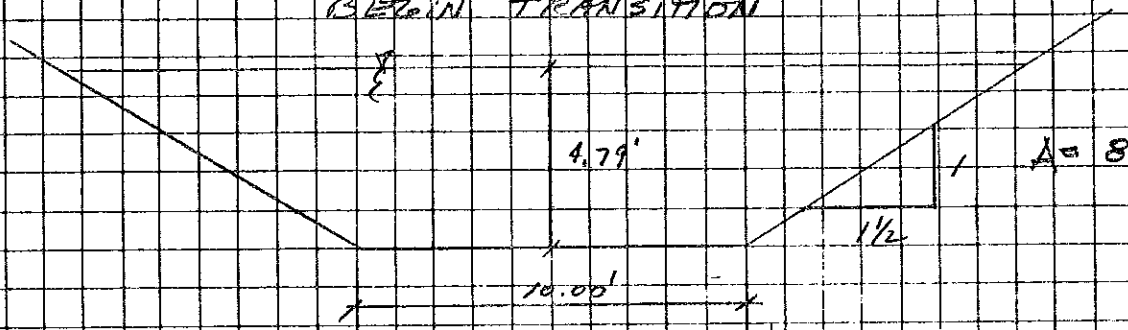
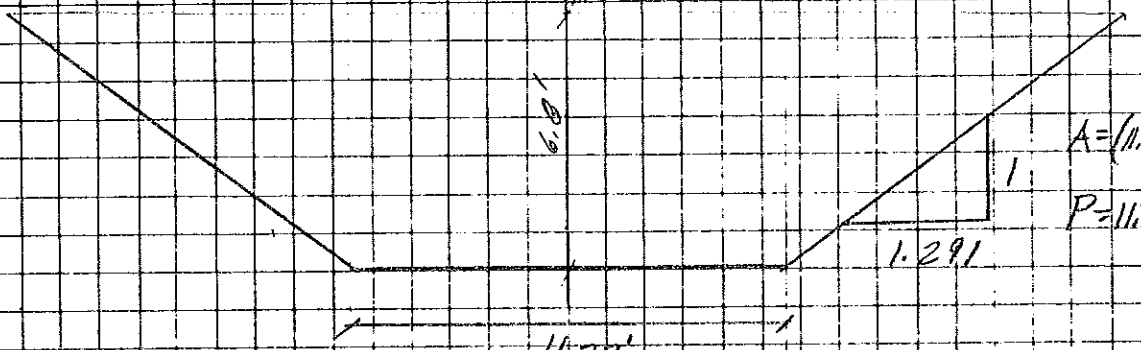
CHANNEL TRANSITION INTO HOLLAND PARK BLVD.

STA. 0+00.00

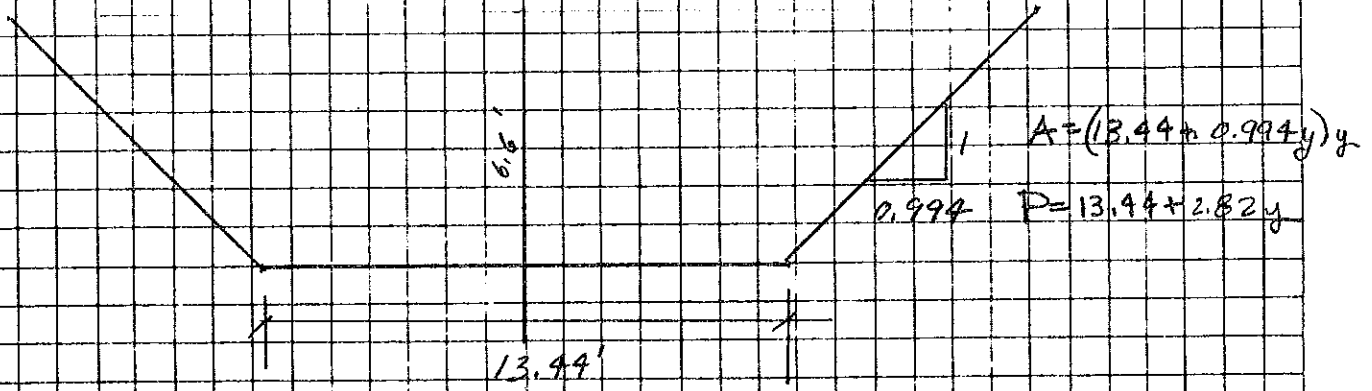
BEGIN TRANSITION



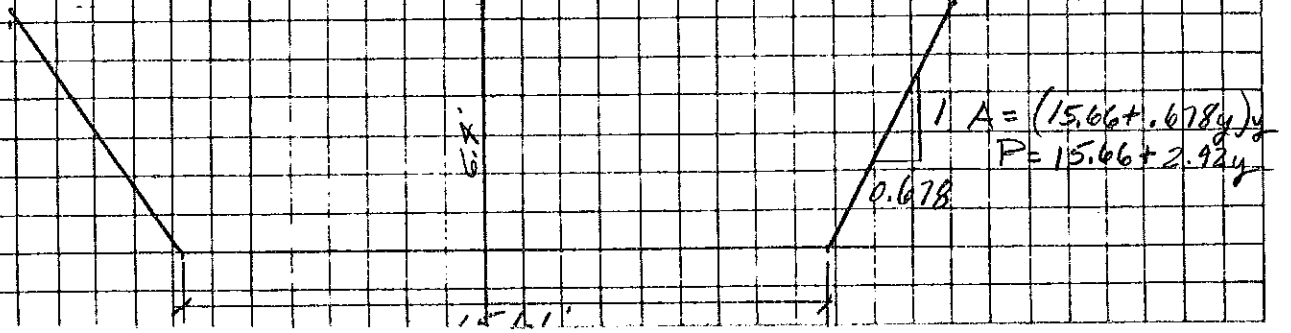
STA. 0+05.00



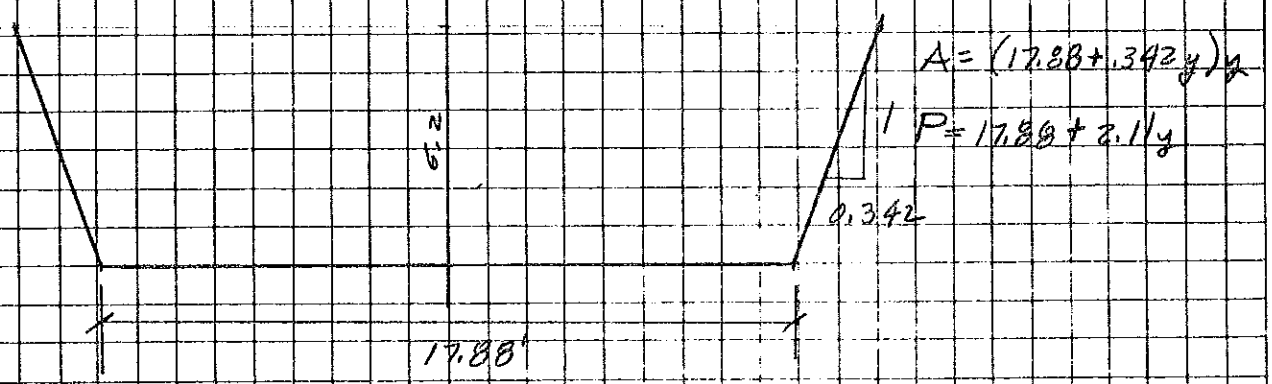
STA. 0+10.00



STA. 0+15.00



STA. 0+20.00



S = 0.024
n = 0.013

	y	A	P	R	R^2/3	CR	V	
0+05.00	4.50	76.63	25.94	2.95	2.06	2795.4		INCREASE
→	4.70	81.25	26.59	3.06	2.11	3035.9	37.33	OK
0+10.00	4.70	85.13	26.69	3.19	2.17	3271.3		DECREASE
	4.60	82.83	26.41	3.14	2.14	3138.9		DECREASE
→	4.50	80.61	26.13	3.09	2.12	3026.3	37.63	OK
0+15.00	4.30	79.87	26.07	3.06	2.11	2984.3		INCREASE
	4.40	82.03	26.31	3.12	2.13	3099.1		DECREASE
→	4.35	80.95	26.19	3.09	2.12	3041.8	37.47	OK
0+20.00	4.30	83.21	26.95	3.09	2.12	3123.9		DECREASE
	4.20	81.13	26.74	3.03	2.10	3017.0		INCREASE
→	4.23	81.75	26.80	3.05	2.10	3040.1	37.10	OK
0+24.81	4.15	86.11	29.05	2.96	2.06	3146.7		DECREASE
	4.10	85.08	28.95	2.94	2.05	3091.3		DECREASE
→	4.07	84.45	28.89	2.92	2.04	3057.5	35.91	OK

EFFECT OF BRIDGE PIER

$\frac{V_1^2}{2g} = 20.02$ $\quad \frac{d_1}{20.02} = \frac{4.07}{20.02} = 0.2033$

$X = \frac{20.00}{20.75} = 0.9639$

$y = \frac{d_2}{d_1} = 1.073$ $\quad d_2 = 1.073 \times 4.07 = 4.37' < 6.0'$

$A = 20.75 \times 4.37 = 90.68$ sf

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Project _____ Page 9 of _____

Calc. by _____ date _____

Checked by _____ date _____

DETERMINATION OF WHERE SURFACE PROFILE BEGINS TO ACHIEVE NORMAL DEPTH AT 0.60% SLOPE THROUGH BOX CULVERT AT HOLLAND PARK BLVD.

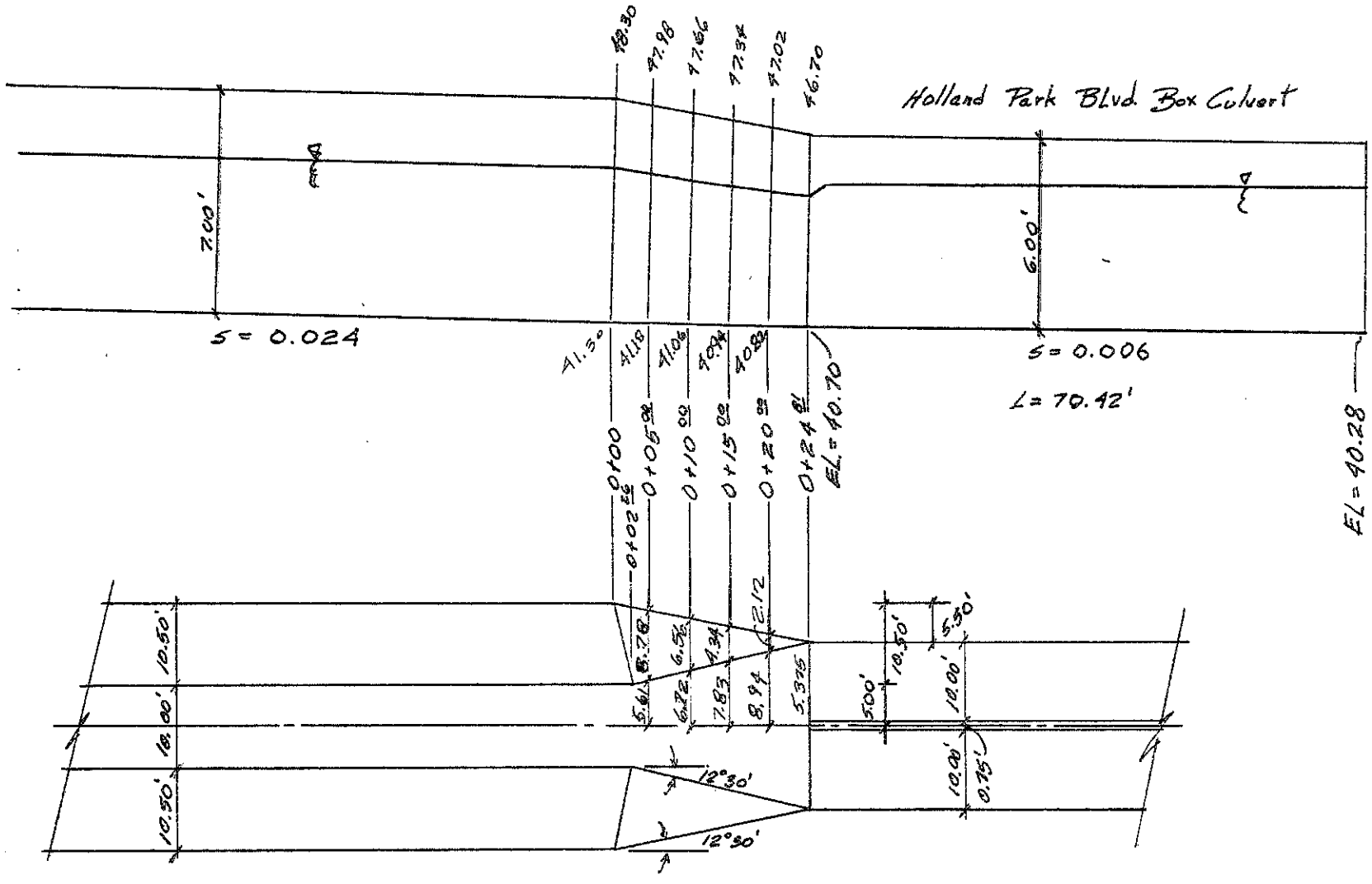
$Q = 3038$ cfs $n = 0.013$ $S_o = 0.60\%$ $y_c = 8.72'$ $y_n = 6.60'$ $\alpha = 1.10$

y	A	R	$R^{2/3}$	V	$V^2/2g$	E	ΔE	S_f	$\bar{S}_f$	$S_o - \bar{S}_f$	Δx
4.37	90.68	3.07	4.47	33.45	17.37	23.47	- - -	0.0191	- - - -		- - -
4.50	93.38	3.14	4.60	32.48	16.38	22.52	-.9500	0.0175	0.0183	0.0123	77.24
6.60	139.95	4.12	6.61	21.67	7.29	14.62	-7.90	0.0054	0.01145	-0.0055	1448.5
									TOTAL =		1525.69

THE WATER SURFACE DOES CLEAR THE TOP OF THE BRIDGE BY MORE THAN 1.50'

(DIRECT STEP METHOD)

WATER SURFACE PROFILE - HOLLAND PARK BLVD.
BOX CULVERT



HEAD REQ'D FOR 96"ϕ CMP AT CHESTNUT

Q = 3674 cfs. 100 YEAR STORM (EST.)

REF. CHOW - PG. 495

DIA. = 96" 2 2/3" x 1/2" CORR.
L = 174.0' n = 0.024
S = 1.67%

$\frac{L}{D} = \frac{174}{8} = \underline{21.75}$ (r/D = 0

PIPE CONSIDERED HYDRAULICALLY SHORT AND SHOULD PERFORM AS AN ORIFICE

$V = C_v \sqrt{2gh}$ $C_v = 0.72$

$V = 73.09(0.72)\sqrt{2gh}$ $A = \pi \frac{d^2}{4} = 50.27$ sf

$V = \frac{3674}{50.27} = 73.09$ fps

h REQUIRED TO FLOW 3674 cfs

$h = \frac{V^2}{(.72)^2 2g} = \frac{(73.09)^2}{(.72)^2(64.4)} = 160.0'$

HEAD AVAILABLE = 23.4' TO TOP OF CURB

$V = 0.72\sqrt{64.4(23.4)} = 27.95$ fps

ASSUME FLOWING FULL

Q = 50.27 x 27.95 = 1405.05 cfs

3674 - 1405 = 2268 cfs

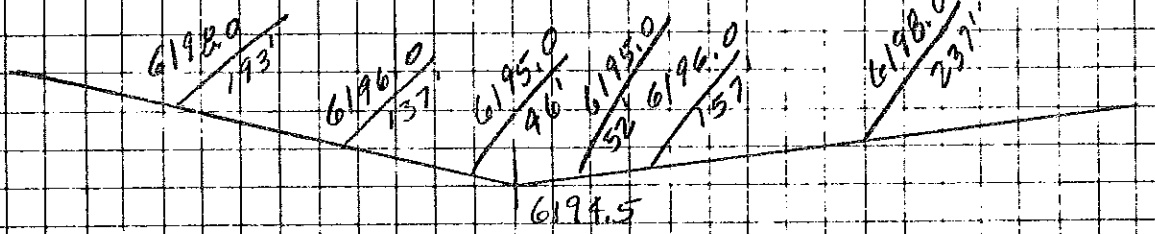
FOR OVERTOPPING ROAD

WEIR + PIPE FLOW = 3674 cfs

WEIR = $Q = 3.087 L H^{3/2}$

PIPE = $Q = 290.46 \sqrt{H}$

PROFILE OF CURB



ELEV.	WEIR FLOW			PIPE FLOW		
	L	H	Q	H	Q	TOTAL
6194.5	0	0	0	23.4	1405.0	1405.0
6195.5	122.8	1.0	379.1	24.4	1434.8	1813.9
6196.5	245.7	2.0	2145.3	25.4	1463.9	3609.2
6196.6	258.0	2.1	2423.7	25.5	1466.8	3890.5
6196.52	248.2	2.02	2199.7	25.42	1464.4	3664.1
6196.53	249.4	2.03	2226.8	25.43	1464.7	3691.5 ←

ROAD OVERTOPS BY 2.03'

ALLOWABLE STORAGE WITHOUT OVERTOPPING FROM HOLLAND PARK WEST MASTER & FILING NO. 1 DRAINAGE PLAN = 41.395 AF

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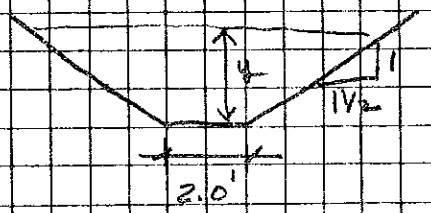
Project
Calc. by date
Checked by date

CONCRETE DRAINAGE SWALE

$Q = 140.1$ cfs
$S = 1.79\%$
$n = 0.013$



$A = (2.0 + 1.5y)\,y$

$P = 2.0 + 3.61y$

	y	A	P	R	$R^{2/3}$	Q	V
→	2.00	10.00	9.22	1.08	1.05	160.58	14.01
	1.75	8.09	8.32	0.97	0.98	121.25	

CHANNEL $y = 3.00'$ FB = 1.00'