

MASTER DEVELOPMENT DRAINAGE PLAN

POWERS WEST DEVELOPMENT
POWERS BOULEVARD AND
AND PALMER PARK BOULEVARD

COLORADO SPRINGS, COLORADO

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AND PALMER PARK BOULEVARD

COLORADO SPRINGS, COLORADO

Prepared for:

Metro Capital Corporation
716 College View Drive
Riverton, Wyoming 82501

Prepared by:

Kiowa Engineering Corporation
1011 North Weber Street Suite 200
Colorado Springs, Colorado 80903

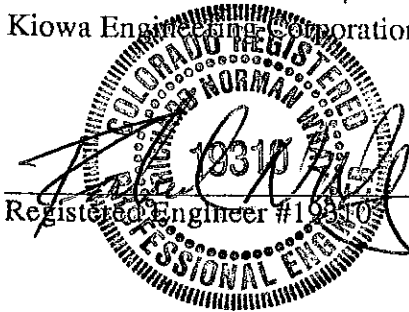
KIOWA Project No. 96.42
R484

OCTOBER 1996
REVISED NOVEMBER 18, 1996
DECEMBER 3, 1996

ENGINEER'S STATEMENT:

The attached drainage plan and report was 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 any negligent acts, errors and omissions on my part in preparing this report.

Kiowa Engineering Corporation, 1011 North Weber St., Suite 200, Colorado Springs, CO 80903



Registered Engineer #19310

12-2-96
Date

OWNER'S STATEMENT:

The Owner and/or his representative has read and will comply with all of the requirements specified in this drainage report and plan.

BISHOP POWERS LTD.

BY: [Signature]
President
Bishop Capital Corporation
General Partner

11/25/96
Date

ADDRESS:

CITY OF COLORADO SPRINGS

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

[Signature]
City Engineer

12/16/96
Dated

Conditions:

PROJECT DESCRIPTION

The Powers West Planned Business Center is to be located at the northwest corner of Palmer Park Boulevard and Powers Boulevard in Colorado Springs, Colorado. The property lies within the southeast quarter of Section 1, Township 14 South, Range 66 West of the 6th Principal Meridian. The property covers approximately 44 acres. The location of the property has been shown on Figure 1.

This property is bounded on the north and west by Sand Creek, on the east by Powers Boulevard and on the south by Palmer Park Boulevard. The property is currently unplatted and has the zoning classification of PBC/cr. The property lies within the City of Colorado Springs corporate limits. It is proposed to plat the property in phases, with the first phase being the frontage along Palmer Park Boulevard.

The site presently drains in a sheet flow manner to the southwest. The existing flow for the portion of the property which lies east of the Creek would concentrate near the northeast corner of the existing Palmer Park Boulevard Bridge. An existing unimproved swale outfalls to this same point. The swale conveys flow which originates east of the Powers Boulevard and enters the property via twin corrugated metal arch pipes. There are no other storm sewer facilities within the property. Sand Creek crosses the property. The creek banks within this segment of Sand Creek are unimproved at this time.

PREVIOUS REPORTS

The following reports and plans were reviewed in the process of preparing this final drainage plan:

City of Colorado Springs and El Paso County Flood Insurance Study, prepared by the Federal Emergency Management Agency, dated September, 1992, with most current revisions.

City of Colorado Springs and El Paso County, Storm Drainage Criteria Manual, dated October, 1987.

Sand Creek Drainage Basin Planning Study, prepared by Kiowa Engineering, Inc., dated March 1996.

Powers Boulevard Phase 1 Drainage Plan, prepared by KKBNA, Inc.

There are no prior drainage reports prepared for this property on file at the City Stormwater Engineering Division.

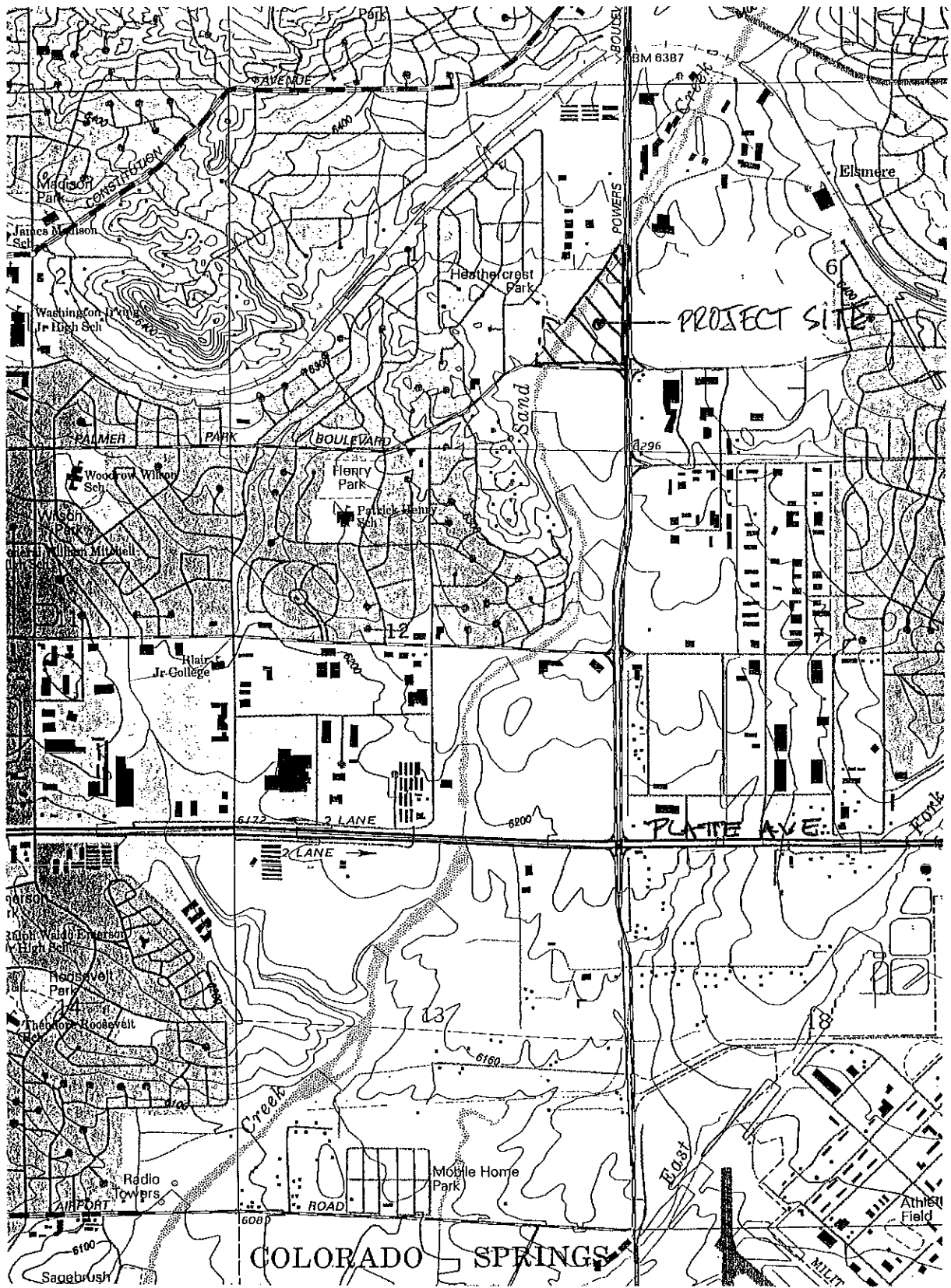


FIGURE 1

HYDROLOGY

The offsite and onsite hydrology for the site was estimated using the methods outlined in the City/County Storm Drainage Criteria Manual. The topography compiled by the City of Colorado Springs Department of Utilities (i.e., the FIMS mapping), was used to verify the offsite sub-basin boundaries. Presented on Figure 2 is the proposed condition onsite and offsite sub-basin boundaries and data relevant to the project site.

Also summarized on Figure 2 is the hydrology data and summary of runoff rates for the frequencies specified in the City/County Storm Drainage Criteria Manual. Hydrology calculations were performed in order to verify the offsite drainage facility capacity, and to calculate the capacity of proposed stormwater facilities to receive the developed runoff from the site.

The rational method was used to determine peak discharges for the 5-year and 100-year frequencies. The basin area, time of concentration and rainfall intensity were determined for each of the sub-basins. Because of the size of the sub-basins, a minimum time of concentration of 5 minutes was assumed for most of the sub-basins. The hydrology calculations are presented in Appendix A of this Report.

HYDRAULICS

The sizing of the required onsite drainage improvements were carried out in accordance with the City/County Storm Drainage Criteria Manual. The capacity of the offsite street capacities were verified. Calculations are contained within Appendix A.

STORM ROUTING AND PROPOSED FACILITIES

Presented on Figure 3, contained within the map pocket of this report, are the proposed storm drainage facilities which will be required for the development of this site. The majority of the site will be drained by sheet flow to inlets to sump areas within proposed parking areas and along the access drive of the development. The inlets will convey flow to a storm sewer which will outfall to the Sand Creek Drainageway. Palmer Park is to be widened as part of this project. Because of the flowline grades of the existing inlet and storm sewer under Palmer Park Boulevard, the discharge of the inlet will be directed to the grasslined swale mentioned above. Offsite flow from the areas east of Powers Boulevard will be conveyed in an open channel along the south side of the property.

The City of Colorado Springs has prepared the Sand Creek Drainage Basin Planning Study (DBPS). This study is currently being used to direct the planning, design and construction for Sand Creek. Improvements to the segment of Sand Creek adjacent

to the property are shown in the DBPS. The improvements consist of five-foot high buried riprap channel bank linings and grade control structures. A channel section has been shown on Figure 3 of this MDDP. Improvements to this segment of Sand Creek would be reimbursable through the drainage basin fee system.

It is anticipated that the portion of the property within the future Sand Creek drainageway and the undeveloped area west of the drainageway will be dedicated to the City for park land or open space. The design of the west channel bank within the existing and/or proposed park lands will need to be refined in later phases of the planning. It may be possible to vary the channel bank height and location along the west bank from the general layout shown in the Sand Creek DBPS.

FLOODPLAIN STATEMENT

As shown on Figure 4, a portion of this site is located within the 100-year floodplain of Sand Creek as depicted in the City of Colorado Springs Flood Insurance Study, prepared by the Federal Emergency Management Agency (FEMA). The site also encroaches into the regulatory floodway of Sand Creek. It is not anticipated that any commercial building structures will encroach into the regulatory floodplain.

DRAINAGE FACILITY COSTS

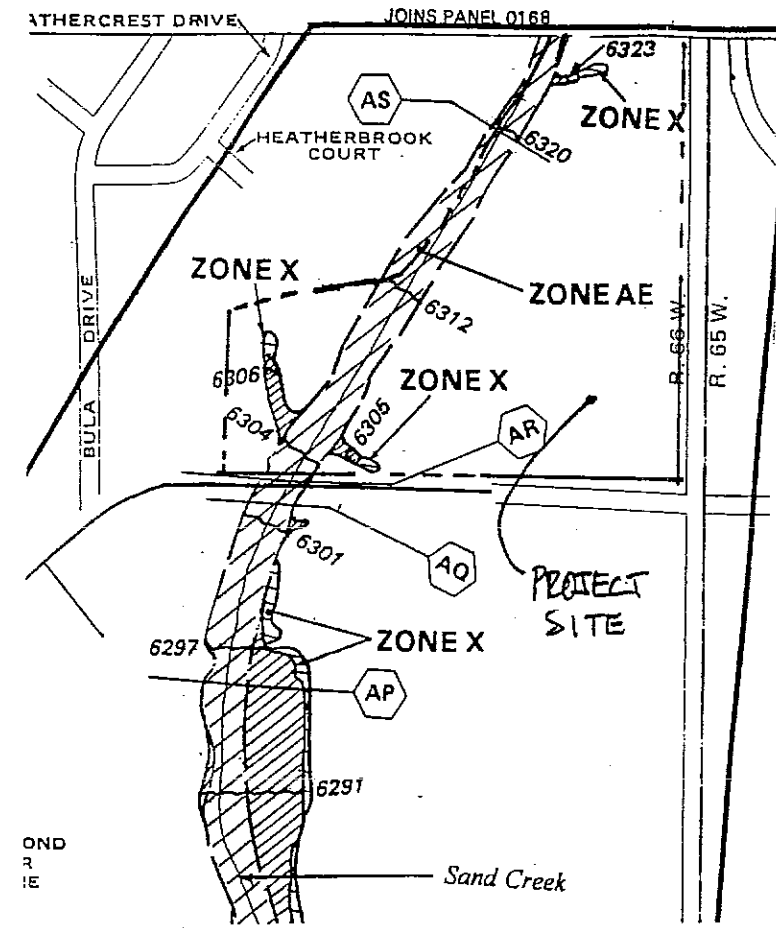
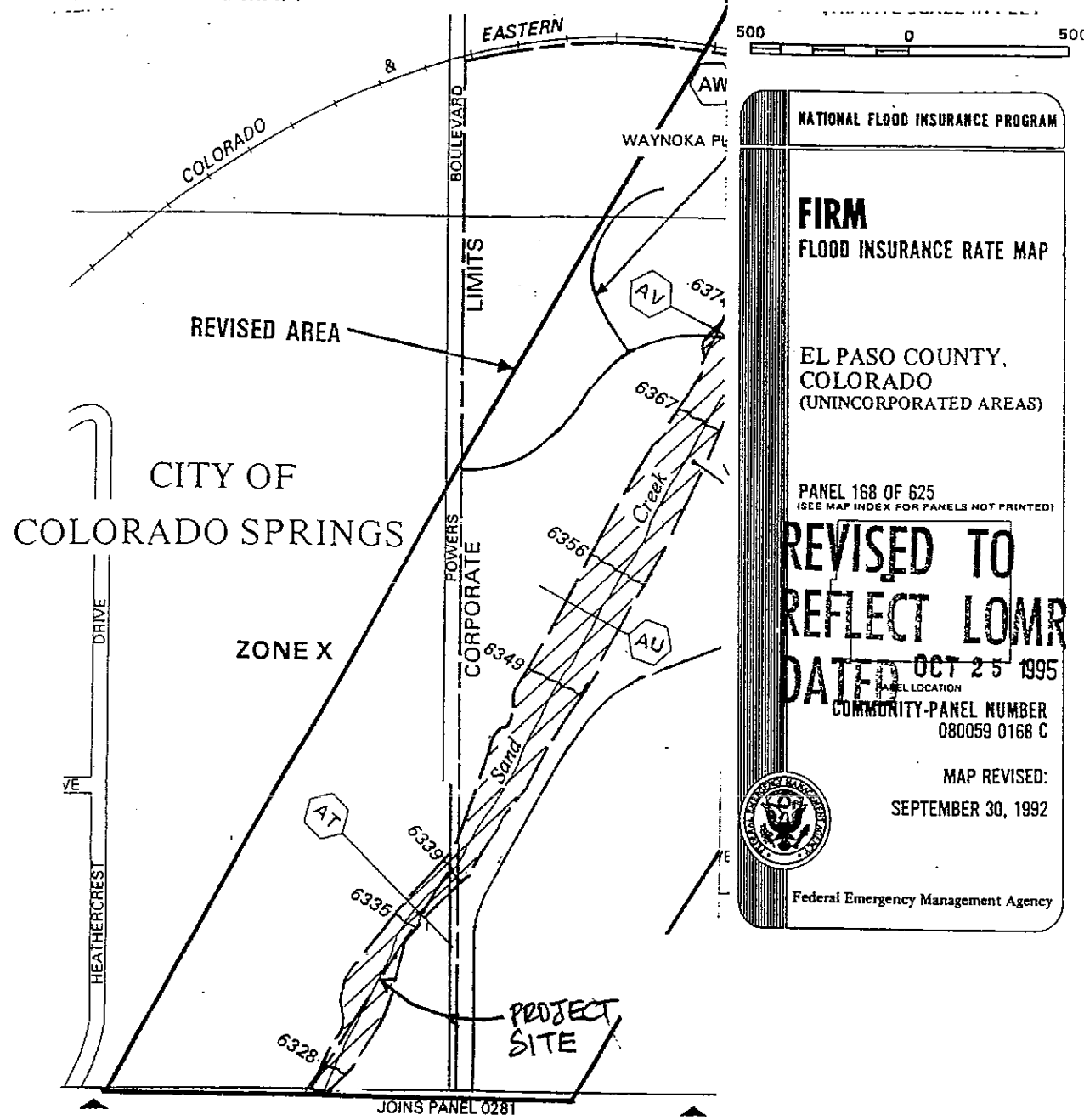
Summarized on Tables 1, 2 and 3 are the estimated costs of the public and private drainage facilities required for the development of the property. Table 1 shows the public drainage facility costs which would include the inlets and storm sewers along Palmer Park Boulevard which convey offsite flows to Sand Creek. Also shown on Table 1 are the estimated cost of the private drainage facilities. The exact location and type of private drainage facilities will be further identified and designed as the property plats into the individual filings.

Table 2 presents the total costs of the proposed Sand Creek drainageway improvements as identified in the Sand Creek DBPS. The unit costs used were obtained from the DBPS. Summarized on Table 3 are the drainageway costs associated with the development of the Powers West property. The total length of channel bank lining (one side only), includes approximately 700-feet of the west bank downstream of Powers Boulevard, to the north limit of Heathercrest Park.

DRAINAGE FEES

Drainage fees for this final drainage plan have been based upon the total plattable acreage and the Sand Creek basin fees. The fees are as follows:

FLOOD HAZARDS SHOWN WITHIN THE CITY OF COLORADO SPRINGS IS FOR INFORMATION ONLY. FOR FLOOD INSURANCE PURPOSES, REFER TO SEPARATELY PUBLISHED FLOOD INSURANCE RATE MAP.



NATIONAL FLOOD INSURANCE PROGRAM


FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
 (UNINCORPORATED AREAS)

PANEL 281 OF 625
 (SEE MAP INDEX FOR PANELS NOT PRINTED)

REVISED TO REFLECT LOMR DATED OCT 25 1995

PANEL LOCATION
COMMUNITY-PANEL NUMBER 080059 0281 C
 MAP REVISED: SEPTEMBER 30, 1992



Federal Emergency Management Agency

FIGURE 4

Drainage fee:

\$4,895 per acre

Regional Detention Basin fee:

\$1,213 per acre

Regional Detention Basin land fee:

\$175 per acre

Bridge fee:

\$323 per acre

The above fees will be paid as the property develops. It is anticipated that the development of the property will be completed in at least two plats, and possibly more. Financial assurances for the construction of the public and private systems shown herein will be required for each of the platted portions of the subdivision.

TABLE 1:
PUBLIC DRAINAGE IMPROVEMENTS
POWERS WEST DEVELOPMENT MASTER DEVELOPMENT DRAINAGE PLAN

ITEM	UNIT COST	UNIT	QUANTITY	TOTAL CONSTRUCTION
48" RCP	\$72	LF	370	\$26,640
42" RCP	\$60	LF	490	\$29,400
5' CO INLET	\$2,000	EA	1	\$2,000
JUNCTION STRUCTURE	\$9,000	EA	1	\$9,000
OUTLET STRUCTURE	\$2,000	EA	1	\$2,000
SUBTOTAL				\$69,040.00
10% ENGINEERING				\$6,904.00
5% CONTINGENCY				\$3,452.00
TOTAL PUBLIC COSTS				\$79,396.00

PRIVATE DRAINAGE IMPROVEMENTS
POWERS WEST DEVELOPMENT

ITEM	UNIT COST	UNIT	QUANTITY	TOTAL CONSTRUCTION
18" RCP	\$28	LF	40	\$1,120
30" RCP	\$36	LF	130	\$4,680
9' CO INLET	\$2,000	EA	1	\$2,000
10' CO INLET	\$2,800	EA	1	\$2,800
12' CO INLET	\$3,000	EA	3	\$9,000
OUTLET STRUCTURES	\$1,500	EA	3	\$4,500
MISC INLETS AND PIPES	\$2,000	EA	4	\$8,000
SUBTOTAL				\$32,100.00
10% ENGINEERING				\$3,210.00
5% CONTINGENCY				\$1,605.00
TOTAL PRIVATE COSTS				\$36,915.00

TABLE 2:
 SAND CREEK CHANNEL IMPROVEMENTS
 PALMER PARK BOULEVARD TO POWERS BOULEVARD

ITEM	UNIT COST	UNIT	QUANTITY	TOTAL CONSTRUCTION
GRADE CONTROL STRUCTURES	\$155	LF	650	\$100,750
CHANNEL LININGS	\$134	LF	4100	\$549,400
SUBTOTAL				\$650,150.00
10% ENGINEERING				\$65,015.00
5% ENGINEERING				\$32,507.50
TOTAL ESTIMATED PUBLIC COSTS, SAND CREEK IMPROVEMENTS				\$747,672.50

TABLE 3:
 SAND CREEK CHANNEL IMPROVEMENTS
 PUBLIC IMPROVMENT COSTS FOR POWERS WEST DEVELOPMENT

ITEM	UNIT COST	UNIT	QUANTITY	TOTAL CONSTRUCTION
GRADE CONTROL STRUCTURES	\$155	LF	650	\$100,750
CHANNEL LININGS (1)	\$134	LF	2700	\$361,800
SUBTOTAL				\$462,550.00
10% ENGINEERING				\$46,255.00
5% ENGINEERING				\$23,127.50
TOTAL ESTIMATED PUBLIC COSTS, SAND CREEK IMPROVEMENTS				\$531,932.50

(1) INCLUDES APPROXIMATELY 700 LINEAL FEET OF THE WEST CHANNEL BANK, DOWNSTREAM OF POWERS BOULEVARD BOX CULVERT.

APPENDIX A
HYDROLOGY AND HYDRAULIC CALCULATIONS

Hydrology - Proposed Conditions:

① Basin Areas

Sub-basin #	Area (Ac)
1	2.89
2	1.05
3	1.23
4	4.87
5	4.38
6	1.79
7	4.49

② SOIL TYPE

Use Hydrologic Soil Group B for Proposed Conditions.

③ Runoff Coefficients

Two landuses:

Commercial
 Roadway / Paved Surfaces.

Sub Basin #	C _s	C ₁₀₀
1	.9	.9
2	.9	.9
3	.9	.9
4	.9	.9
5	.9	.9
6	.9	.9
7 (1/2 Paved 1/2 Roadside landscaping)	.58	.63

Sub-basin 7: ~~Wtd~~ $C_s = \frac{1}{2}(.25) + \frac{1}{2}(.90) = .58$

$C_{100} = \frac{1}{2}(.35) + \frac{1}{2}(.90) = .63$

④ Rainfall Intensity: $T_c = 5$ min (unimodal)

$I_5 = 5.2$ in/hr

$I_{100} = 9.0$ in/hr.

⑤ Basin Discharges (See spreadsheet)

Sub-basement	Q ₅	Q ₁₀₀
1	13.6	23.4
2	4.9	8.5
3	5.8	10.0
4	22.8	39.5
5	20.5	35.5
6	8.4	14.5
7	13.5	25.5

⑥ Design Points

DP 7 = SB 7 · Q₅ = 13.5
 Q₁₀₀ = 25.5

DP 1 = DP 7 + SB 1 Q₅ = 13.5 + 13.6 = 27.1
 Q₁₀₀ = 25.5 + 23.4 = 48.9

Plus Discharge from Powers Culverts

DP 1 ∴ Q₅ = 27.1 + 38.0 = 65.1 cfs
 Q₁₀₀ = 48.9 + 71.0 = 119.9 cfs

3A

RATIONAL METHOD CALCULATIONS (DEVELOPED)

PROJECT: POWERS WEST SUBDIVISION MDDP

DATE: OCTOBER 1996

SUB BASIN #	AREA (AC)	RUNOFF COEFFICIENT		RAINFALL INTENSITY		DISCHARGE	
		C5	C100	I5	I100	Q5 CFS	Q100 CFS
1	2.890	0.90	0.90	5.20	9.00	13.53	23.41
2	1.050	0.90	0.90	5.20	9.00	4.91	8.51
3	1.230	0.90	0.90	5.20	9.00	5.76	9.96
4	4.870	0.90	0.90	5.20	9.00	22.79	39.45
5	4.380	0.90	0.90	5.20	9.00	20.50	35.48
6	1.790	0.90	0.90	5.20	9.00	8.38	14.50
7	4.490	0.58	0.63	5.20	9.00	13.54	25.46

$$DP\ 2 = SB\ 2$$

$$Q_5 = 4.9\ cfs$$

$$Q_{100} = 8.5\ cfs$$

$$DP\ 3 = DP1 + DP2$$

$$Q_5 = 65.1 + 4.9 = 70.0\ cfs$$

$$Q_{100} = 119.4 + 8.5 = 128.4\ cfs$$

$$DP\ 4 = SB\ 4$$

$$DP\ 5 = SB\ 5$$

$$DP\ 6 = SB\ 6$$

Hydraulics

① Design Point 7

Collect 100-year in area inlet

$Q_{100} = 25.5$

try Type 'e', 2' x 3' GI

$A = 6'$ $H = 1'$ $C = .64$

$Q = .64 (6) \sqrt{2gH} = 30.8 \text{ cfs}$

Single 2' x 3' GI

Total Flow @ DP 7

$\Rightarrow 25.5 + 71 \text{ cfs} = 96.5$

② DP 7 \rightarrow DP 1

- Place in pipe out of GI/Junction Structure

Need 42" RCP @ 1.0%

1.0% ~~adjacent~~ adjacent roadway slope

REVISED INLET CALC'S.

Design Point 7 : $Q_{100} = 25.5 \text{ cfs}$

Try 2' x 4' GI

Apply Orifice Eq: $Q = .64(8) \sqrt{2g(1.5')}$
 $= 50.3 \text{ cfs.}$

$FS = 50.3 / 25.5 = 1.97$ close to 2.

use single 2' x 4' GI

Pipe: DP-7 to DP1

Σ Max Q₁₀₀ in segment = DP1 = 120 cfs

Available Slope to Sand Creek from Powers

$$\text{Slope} = \frac{6314 - 6303}{800'} = 1.01$$

use 1.0 % as available slope to creek.

Max Q₁₀₀@ DP3 = 128.4 cfs.

Need 48" RCP @ 10%

Can use 42" RCP from DP7 - DP1
Q₁₀₀ = 101 cfs Q₁₀₀ = 96.5

Increase to 48" RCP from DP1 to Sand Creek

④ DP-1 → DP 2

Total flow @ DP 2 = $Q_5 = 4.9 + DP1$

~~$Q_{100} = 8.5 + 96.5 = 105$~~

∴ use same grasslined swale section

Check ^{EX} inlet (5' DIOR) · D = .67'

$Q_i = 3.0 \cdot L_i \cdot D_i^{1.5} = 3.0(5)(.67)^{1.5}$
 $= 8.2 \text{ cfs}$

close enough to $Q_{100} = 8.5$

∴ Inlet adequate to intercept Q_{100}

⑤ DP 3

$Q_5 = 70.0 \text{ cfs}$ $Q_{100} = 128.4$ ^{REVISED} 11/18

Culvert under entry roadway @ DP 3

use Slope = 1.0 %

use from 36" DEP, $Q_{culv} = 67 \text{ cfs}$
 $Q_{TOT} = 134 \text{ cfs} \therefore \text{ok}$

⑤ DP 3 cont'd

Try Steeper Slope: $\approx 2.0\%$
 & take pipe to Sand Creek.

~~REVISED
11/18/96~~

~~42" RCP @ 2.0 cfs $Q_{cap} = 142$ cfs - ok~~

Use 42" RCP @ 2.0% to Creek.
(min)

⑥ DP 4 $Q_{100} = 34.5$ cfs

size inlet in sump condition

$$Q_i = 3.0 L_i D_i^{1.5}$$

$$L_i = \frac{Q}{3.0 D_i^{1.5}} = \frac{34.5}{3(.67)^{1.5}} = \frac{13.2}{(.67)^{1.5}} = 24'$$

use Twin 12" DIOR'S

Pipe to Creek @ 2.0% Min.

Use 30" RCP @ 2.0% Min

⑦ DP 5 $Q_{100} = 35.8 \text{ cfs}$

Size inlet to intercept 100-year in Sump condition

$$L_i = \frac{35.5}{3.0(.67)^{1.5}} = \frac{11.8}{.55} = 21.5'$$

use 1 ~~24~~ 10' DIOR & 1-12' DIOR

Pipe to Creek

use 30" RCP @ 2.0% Min.

$Q_{cap} = 58 \text{ cfs} \therefore \text{ok}$

⑧ DP 6 $Q_{100} = 14.5 \text{ cfs}$

Size inlet to intercept 100-yr in Sump condition

$$L_i = \frac{14.5}{3(.67)^{1.5}} = \frac{4.23}{.55} = 8.8'$$

use 9' DIOR

Pipe to Creek: use 18" @ 2.0% Min
 $Q_{cap} = 15 \text{ cfs} \therefore \text{ok}$