

SIGNED

**Master Drainage and Development Plan
Lowell Neighborhood Redevelopment
Colorado Springs, Colorado**

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Lowell Neighborhood Redevelopment
Colorado Springs, Colorado**

Prepared for:
Lowell Neighborhood Partners, LLC
28 North Tejon Street
Colorado Springs, Colorado 80903

Prepared by:
Kiowa Engineering Corporation
2814 International Circle
Colorado Springs, Colorado 80910-3127

Kiowa Project No. 01014

August 24, 2001

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 drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Kiowa Engineering Corporation, 2814 International Circle, Colorado Springs, Colorado 80910



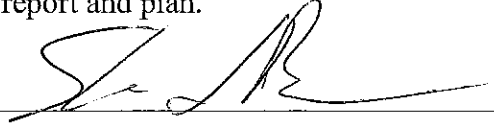
For and on Behalf of Kiowa Engineering Corporation

8/24/01

Date

DEVELOPER'S STATEMENT:

I, the Developer, have read and will comply with all of the requirements specified in this drainage report and plan.

BY: 

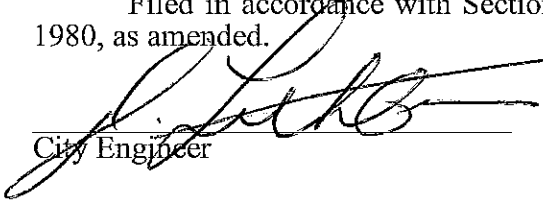
082401

Date

ADDRESS: Lowell Development Partners, LLC
28 North Tejon Street
Colorado Springs, Colorado 80903

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

8/24/01

Date

Conditions:

I. General Location and Description

The Lowell Neighborhood Redevelopment includes the redevelopment of the Lowell Neighborhood. The site is located in the northeast Quarter of Section 19, Township 14 South, Range 66 West of the 6th Principal Meridian, in the City of Colorado Springs, El Paso County, Colorado. The site is bounded to the north by East Rio Grande Street, to the south by the Denver and Rio Grande Railroad, to the east by South Wahsatch Avenue, and to the west by South Nevada Avenue. The proposed development is approximately 58 acres in area and the land is currently developed as both residential and commercial. A vicinity map showing the location of the Lowell Neighborhood is located on the following page, as Figure 1.

The site slopes from the north to the south at a slope of approximately 1 percent. The vegetation on the site consists of several different species of trees with both native and non-native grasses. The soil on the site consists of Chaseville Gravelly, Sandy Loam which is classified within Hydrological Soil Group A, using the *Soil Survey of El Paso County Area, Colorado*.

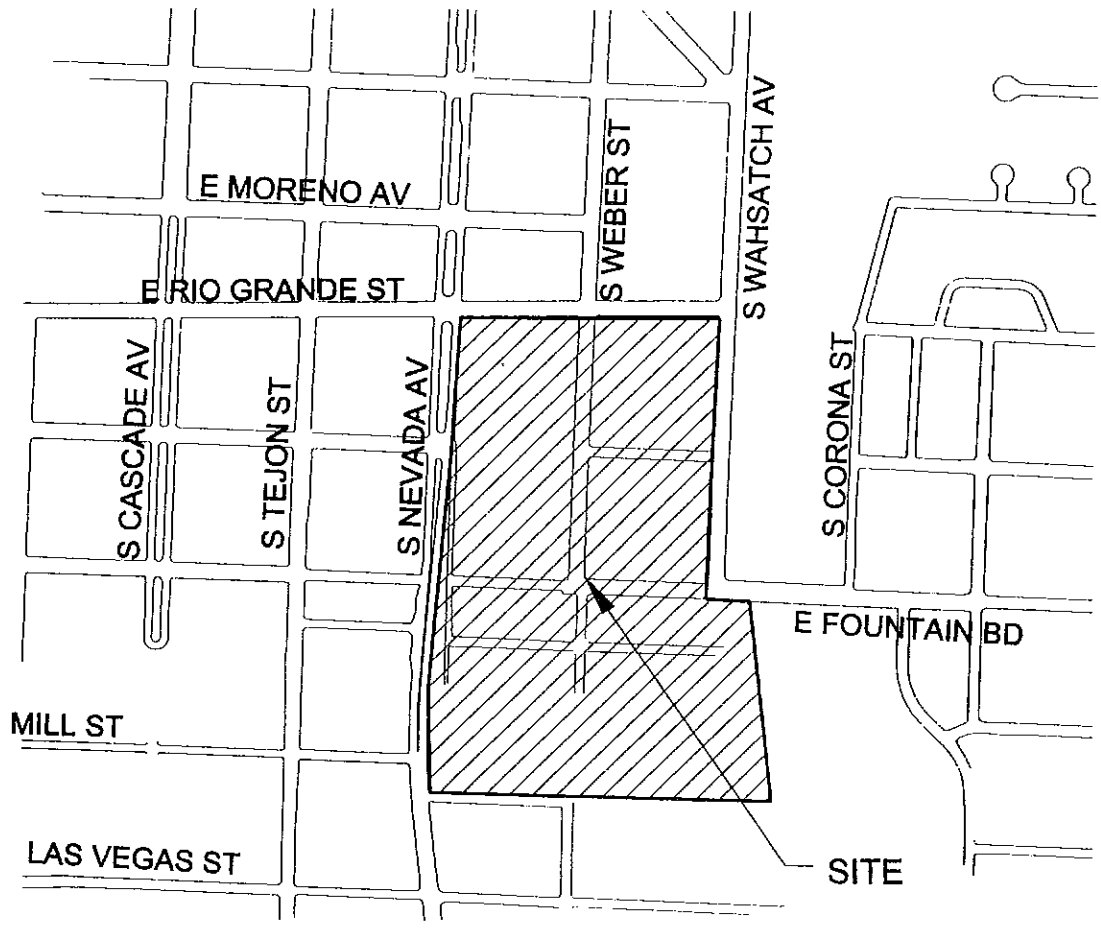
II. Hydrology

The hydrology for this site was estimated using the methods outlined in the *City of Colorado Springs and El Paso County, Drainage Criteria Manual*. The topography for the site was compiled using a one-foot contour interval and is presented at a horizontal scale of 1-inch to 60-feet in Exhibit 1, included in the pocket at the rear of this report. The hydrologic calculations were made assuming a fully developed site. Due to the imperviousness of the site and the small size of the drainage basins, the time of concentration for each basin was assumed to be five minutes. The proposed grading and drainage basins are shown on Exhibit 1. The peak flow rates for the drainage basins were estimated by using the Rational Method. Runoff for the 5-year and 100-year recurrence intervals were determined.

The runoff coefficients for the development were determined using Table 5-1 of the *City of Colorado Springs and El Paso County, Drainage Criteria Manual*, a copy of which is located in the Appendix of this report. The developed hydrological calculations were performed assuming Hydrological Soil Group B, per the *City/County Drainage Criteria Manual*, and are included in the Appendix.

III. Existing Drainage Patterns

The runoff from the Lowell Neighborhood site currently drains from north to south, with a high point along South Weber Street forcing the runoff to either the east or west. Runoff flowing to the east enters the Shook's Run Drainage Basin and runoff flowing to the west flows into the Miscellaneous Drainage Basin. Several inlets along the western edge of the site currently pick up the runoff that flows to the west. These inlets carry the runoff into the existing storm sewer system along South Nevada Avenue. In significant rainstorms the majority of the runoff overtops the curbs and flows down onto South Nevada Avenue. Runoff flowing to the east is carried as gutter flow to South Wahsatch Avenue and the intersection of East Fountain



VICINITY MAP
FIGURE 1



NOT TO SCALE

Boulevard. Two existing 4-foot curb inlets carry some of the runoff into the Shook's Run drainage way, but these inlets are insufficient in carrying runoff from the entire neighborhood. Overflow from these inlets runs down Fountain Boulevard and flows into the Shook's Run Drainage Way. The interior of the neighborhood currently has no existing storm sewer facilities. The southern section of the site flows directly south and across the Denver and Rio Grande Railroad where it eventually flows into Monument Creek.

IV. Site Drainage Plan

The development of the Lowell Neighborhood will consist of the construction of both residential and commercial buildings. The drainage patterns for the proposed site will remain very similar to the existing with the exception of the storm sewer system that will be installed to help drain the proposed site. For the Lowell Neighborhood, the City and County of Denver Standard Number 16 Combination Inlet will be used. The capacity for the single number 16-combination inlet is around 10 cfs. When the runoff exceeds 10 cfs, additional inlets can be added side by side. Information regarding the number 16-combination inlet is included at the rear of the report.

The following is a description of the onsite drainage basins.

Drainage Basin A: Drainage Basin A is approximately 1.01 acres in area with a 5-year developed flow of 4.7 cfs and a 100-year developed flow of 8.1 cfs. The basin includes the eastern portion of the Assisted Living/Independent Living Building and the western half of South Wahsatch Avenue down to Las Animas Street. The runoff will be carried to a triple no. 16 combination inlet located in the western curb line of South Wahsatch Street. An 18-in NRCP will carry the runoff to the south where it will enter the remainder of the storm sewer and Shook's Run drainage way.

Drainage Basin B: Drainage Basin B is approximately 0.56 acres in area with a 5-year developed flow of 2.6 cfs and a 100-year developed flow of 4.5 cfs. The basin includes half of the northern portion of the Assisted Living/Independent Living Building and a section of the southern half of East Rio Grande Street. The runoff will be carried to a triple no. 16 combination inlet located in the western curb line of South Wahsatch Street. An 18-in NRCP will carry the runoff to the south where it will enter the remainder of the storm sewer and Shook's Run drainage way.

Drainage Basin C: Drainage Basin C is approximately 1.39 acres in area with a 5-year developed flow of 6.5 cfs and a 100-year developed flow of 11.1 cfs. The basin includes half of the northern portion of the Assisted Living/Independent Living Building, a section of the southern half of East Rio Grande Street and a section of the eastern half of South Weber Street. Runoff will flow into the gutter of East Rio Grande Street and be carried to the west to South Weber Street where it will flow into a single number 16-combination inlet. A 15-inch NRCP will carry runoff to the south and into the remainder of the storm sewer system which outfalls into the Shook's Run drainage way.

Drainage Basin D: Drainage Basin D is approximately 1.81 acres in area with a 5-year developed flow of 8.5 cfs and a 100-year developed flow of 14.5 cfs. The basin includes the landscaped areas to the north and west of the existing Police Operations Center, a

portion of the eastern POC parking lot, the area from the centerline of Rio Grande Street to the southern curb line, and the area within the northbound lanes of Nevada Avenue south to Las Animas Street. Runoff will flow to the southern curb line of Rio Grande Street where it will be carried as gutter flow to the west onto South Nevada Avenue and then south into a single number 16-combination inlet located at the curb return of Las Animas Street. A 24-inch RCP will carry the runoff to the south into a proposed storm sewer junction box that will drain into the existing storm sewer system within Nevada Avenue. The Storm Sewer system within Nevada Avenue outfalls into Fountain Creek several blocks south of the Lowell Neighborhood.

Drainage Basin E: Drainage Basin E is approximately 1.41 acres in area with a 5-year developed flow of 6.6 cfs and a 100-year developed flow of 11.3 cfs. The basin includes the southern portion of the Assisted Living/Independent Living Building and the drive and parking lot to the south. The runoff will be carried to a triple no. 16 combination inlet located in the western curb line of South Wahsatch Street. An 18-in NRCP will carry the runoff to the south where it will enter the remainder of the storm sewer and Shook's Run drainage way.

Drainage Basin F: Drainage Basin F is approximately 0.62 acres in area with a 5-year developed flow of 2.9 cfs and a 100-year developed flow of 5.0 cfs. The basin includes a portion of the western half of South Weber Street and a landscaped area. Runoff will flow into the gutter South Weber Street where it will flow into a single number 16-combination inlet. A 15-inch NRCP will carry runoff to the south and into the remainder of the storm sewer system which outfalls into the Shook's Run drainage way.

Drainage Basin G: Drainage Basin G is approximately 1.29 acres in area with a 5-year developed flow of 6.0 cfs and a 100-year developed flow of 10.3 cfs. The basin includes the existing Police Operations Center building itself and a portion of the parking lot. Runoff from the building is captured by the building's roof drain system and several grated inlets. An existing 15" pipe carries the runoff to the south where it outfalls into the storm sewer system in Nevada Avenue.

Drainage Basin H: Drainage Basin H is approximately 0.90 acres in area with a 5-year developed flow of 4.2 cfs and a 100-year developed flow of 7.3 cfs. The basin includes two apartment buildings and the ramp and parking lot between the two of them. The ramp will drain into a single number 16-combination inlet. The roof drain systems of both buildings and the inlet will drain into an 18-inch NRCP that will carry the runoff into the remainder of the storm sewer system and into the Shook's Run drainage way.

Drainage Basin I: Drainage Basin I is approximately 0.52 acres in area with a 5-year developed flow of 2.4 cfs and a 100-year developed flow of 4.1 cfs. The basin includes a portion of Las Animas Street and the northeast portion of the Las Animas Promenade. Runoff will flow west into a single number 16-combination inlet. A 15-inch NRCP will carry the runoff to the west and into the remainder of the storm sewer system which outfalls into the Shook's Run drainage way.

Drainage Basin J: Drainage Basin J is approximately 0.82 acres in area with a 5-year developed flow of 3.8 cfs and a 100-year developed flow of 6.6 cfs. The basin includes a portion of Las Animas Street and the northwest portion of the Las Animas Promenade. Runoff will flow east into a single number 16-combination inlet and a 15-inch NRCP will

carry the runoff to the south and into the remainder of the storm sewer system which outfalls into the Shook's Run drainage way.

Drainage Basin K: Drainage Basin K is approximately 1.06 acres in area with a 5-year developed flow of 4.9 cfs and a 100-year developed flow of 8.5 cfs. The basin includes the proposed Police Parking Structure itself, which is to be constructed by the Colorado Springs Police Department in the near future. Runoff from the building is captured by the building's roof drain system, which outfalls into a 24-inch RCP that will carry the runoff to the west into the existing storm sewer system within Nevada Avenue.

Drainage Basin L: Drainage Basin L is approximately 0.65 acres in area with a 5-year developed flow of 3.0 cfs and a 100-year developed flow of 5.2 cfs. The basin includes a portion of Las Animas Street, the Las Animas Plaza North Live/Work Building and the northern half of the Las Animas Plaza. Runoff will flow to the west into a single number 16-combination inlet. A 24-inch RCP will carry the runoff to the west and into the remainder of the storm sewer system within Nevada Avenue.

Drainage Basin M: Drainage Basin M is approximately 0.73 acres in area with a 5-year developed flow of 3.4 cfs and a 100-year developed flow of 5.8 cfs. The basin includes the Las Animas Lofts Building and a portion of the northern half of Las Animas Street. Runoff will flow to the west into a single number 16-combination inlet. A 24-inch RCP will carry the runoff to the west and into the remainder of the storm sewer system within Nevada Avenue.

Drainage Basin N: Drainage Basin N is approximately 0.96 acres in area with a 5-year developed flow of 4.5 cfs and a 100-year developed flow of 7.7 cfs. The basin includes a portion of the hotel and the western half of South Wahsatch Avenue down to Fountain Boulevard. Runoff will flow to the south as gutter flow where it will be picked up by double number 16-combination inlet. A 15-inch NRCP will carry the flows to the east where it will enter the remainder of the storm sewer system which outfalls into the Shook's Run drainage way.

Drainage Basin O: Drainage Basin O is approximately 0.45 acres in area with a 5-year developed flow of 2.1 cfs and a 100-year developed flow of 3.6 cfs. The basin includes a portion of Las Animas Street and the southeast portion of the Las Animas Promenade. Runoff will flow west into a single number 16-combination inlet. A 15-inch NRCP will carry the runoff to the west and into the remainder of the storm sewer system which outfalls into the Shook's Run drainage way.

Drainage Basin P: Drainage Basin P is approximately 0.72 acres in area with a 5-year developed flow of 3.4 cfs and a 100-year developed flow of 5.8 cfs. The basin includes a portion of Las Animas Street and the southwest portion of the Las Animas Promenade. Runoff will flow east into a single number 16-combination inlet and a 24-inch RCP will carry the runoff to the north and into the remainder of the storm sewer system which outfalls into the Shook's Run drainage way.

Drainage Basin Q: Drainage Basin Q is approximately 0.86 acres in area with a 5-year developed flow of 4.0 cfs and a 100-year developed flow of 6.9 cfs. The basin includes a portion of the Las Animas Apartments South and the eastern half of a section of South Weber Street. Runoff will flow into the gutter and be carried to the south where it will flow

into a single number 16-combination inlet. A 15-inch NRCP will carry flows to the west and into the remainder of the storm sewer system which outfalls into the Shook's Run drainage way.

Drainage Basin R: Drainage Basin R is approximately 0.49 acres in area with a 5-year developed flow of 2.3 cfs and a 100-year developed flow of 4.0 cfs. The basin includes the western half of a section of South Weber Street and some landscaped areas. Runoff will flow into the gutter and be carried to the south where it will flow into a single number 16-combination inlet. A 15-inch NRCP will carry flows to the southeast and into the remainder of the storm sewer system which outfalls into the Shook's Run drainage way.

Drainage Basin S: Drainage Basin S is approximately 0.62 acres in area with a 5-year developed flow of 2.9 cfs and a 100-year developed flow of 4.9 cfs. The basin includes a portion of Las Animas Street, the Las Animas Plaza South Live/Work Building and the southern half of the Las Animas Plaza. Runoff will flow to the west into a single number 16-combination inlet. A 15-inch NRCP will carry the runoff to the north and into the remainder of the storm sewer system within Nevada Avenue.

Drainage Basin T: Drainage Basin T is approximately 0.26 acres in area with a 5-year developed flow of 1.2 cfs and a 100-year developed flow of 2.1 cfs. The basin includes a portion of the southern half of Las Animas Street. Runoff will flow to the west into a single number 16-combination inlet. A 15-inch NRCP will carry the runoff to the north and into the remainder of the storm sewer system within Nevada Avenue.

Drainage Basin U: Drainage Basin U is approximately 0.42 acres in area with a 5-year developed flow of 2.0 cfs and a 100-year developed flow of 3.4 cfs. The basin includes the Poet Lofts Building and the ramp down into its underground parking garage. Runoff is picked up by the roof drain system and the trench drain at the bottom of the ramp and carried into the existing storm sewer system within Nevada Avenue.

Drainage Basin V: Drainage Basin V is approximately 0.18 acres in area with a 5-year developed flow of 0.9 cfs and a 100-year developed flow of 1.5 cfs. The basin includes the landscaped area west of the Poet Lofts Building. Runoff will sheetflow to the west onto Nevada Avenue and then be picked up by the existing storm sewer system.

Drainage Basin W: Drainage Basin W is approximately 0.76 acres in area with a 5-year developed flow of 3.5 cfs and a 100-year developed flow of 6.1 cfs. The basin includes two apartment buildings and the ramp and parking lot between the two of them. The ramp will drain into a single number 16-combination inlet. The roof drain systems of both buildings and the inlet will drain into an 18-inch NRCP that will carry the runoff into the remainder of the storm sewer system and into the Shook's Run drainage way.

Drainage Basin X: Drainage Basin X is approximately 1.18 acres in area with a 5-year developed flow of 5.5 cfs and a 100-year developed flow of 9.5 cfs. The basin includes the drive and parking areas between the Las Animas Apartments South Building and the Fountain/Weber and Wahsatch Apartments. Runoff will flow to the east into the Western curb of Wahsatch Avenue where it will be picked up by a double number 16-combination inlet. A 15-inch NRCP will carry the runoff to the east and into the remainder of the storm sewer system and into the Shook's Run drainage way.

Drainage Basin Y: Drainage Basin Y is approximately 4.08 acres in area with a 5-year developed flow of 19.0 cfs and a 100-year developed flow of 32.8 cfs. The basin includes existing Lowell School Building, the existing String of Pearls, the parking lot and a section of Fountain Boulevard. Runoff will flow to the south and west where it will be carried as gutter flow in Fountain Boulevard to a triple number 16-combination inlet. An 18-inch NRCP will carry the runoff to the west and into the remainder of the storm sewer system within Nevada Avenue.

Drainage Basin Z: Drainage Basin Z is approximately 0.61 acres in area with a 5-year developed flow of 2.8 cfs and a 100-year developed flow of 4.9 cfs. The basin includes a portion of the Fountain/Wahsatch Apartment Building and the northern half of a section of Fountain Boulevard. A single number 16-combination inlet will pick up the flows and a 15-inch NRCP will carry the runoff to the south and into the remainder of the storm sewer system which drains into the Shook's Run drainage way.

Drainage Basin AA: Drainage Basin AA is approximately 0.52 acres in area with a 5-year developed flow of 2.4 cfs and a 100-year developed flow of 4.2 cfs. The basin includes a portion of the Fountain/Weber Apartment Building and the northern half of a section of Fountain Boulevard. A single number 16-combination inlet will pick up the flows and a 15-inch NRCP will carry the runoff to the south and into the remainder of the storm sewer system, which drains into the Shook's Run drainage way.

Drainage Basin BB: Drainage Basin BB is approximately 2.96 acres in area with a 5-year developed flow of 13.8 cfs and a 100-year developed flow of 23.8 cfs. The basin includes the area in which the town homes are to be constructed, the public alley to their southeast and the southern half of a section of Writers Way. A double number 16-combination inlet located near the southwest corner of the basin will pick up the flows and a 15-inch NRCP will carry the runoff to the south in a 36-inch RCP that will drain into an existing 36-inch CIP storm drain. The existing CIP carries the runoff from the Lowell Neighborhood to the south under the existing railroad spur.

Drainage Basin CC: Drainage Basin CC is approximately 1.23 acres in area with a 5-year developed flow of 5.8 cfs and a 100-year developed flow of 9.6 cfs. The basin includes the northeastern Courtyard Condominiums and half of each of the roadways which surround the building. Runoff will be picked up by the roof drain system and the curb and gutter and be carried to a single number 16-combination inlet. An 18-inch NRCP will carry the runoff to the southwest and into the remainder of the storm sewer system that carries the runoff from the Lowell Neighborhood to the south under the existing railroad spur.

Drainage Basin DD: Drainage Basin DD is approximately 0.10 acres in area with a 5-year developed flow of 0.5 cfs and a 100-year developed flow of 0.8 cfs. The basin includes the southwestern half of a portion of Founders Park Lane. Runoff will be picked up by a single number 16-combination inlet and an 18-inch NRCP will carry the runoff to the southeast and into the remainder of the storm sewer system that carries the runoff from the Lowell Neighborhood to the south under the existing railroad spur.

Drainage Basin EE: Drainage Basin EE is approximately 2.11 acres in area with a 5-year developed flow of 9.8 cfs and a 100-year developed flow of 16.9 cfs. The basin includes the southwestern Courtyard Condominiums, half of each of the roadways, which surround the building and Founders Park. Runoff will flow to the south where it will be picked up by

the curb and gutter and be carried to a double number 16-combination inlet. A 30-inch RCP will carry the runoff to the southeast and into the remainder of the storm sewer system that carries the runoff from the Lowell Neighborhood to the south under the existing railroad spur.

Drainage Basin FF: Drainage Basin FF is approximately 3.13 acres in area with a 5-year developed flow of 14.6 cfs and a 100-year developed flow of 25.2 cfs. The basin includes the multi-purpose area south of Fountain Boulevard and west of Weber Street. Runoff will flow to the south where it will be picked up by the curb and gutter and be carried to a double number 16-combination inlet. A 24-inch RCP will carry the runoff to the southeast and into the remainder of the storm sewer system that carries the runoff from the Lowell Neighborhood to the south under the existing railroad spur.

Drainage Basin GG: Drainage Basin GG is approximately 1.40 acres in area with a 5-year developed flow of 6.5 cfs and a 100-year developed flow of 11.3 cfs. The basin includes a section of Writers Way, the Extended Stay Hotel and the Office Building on the southwestern corner of the site. Runoff will flow to the south and west where it will be carried as gutter flow to a double number 16-combination inlet. An 18-inch NRCP will carry the runoff to the south where it can be tied into an existing pipe that will carry the runoff down to the existing storm sewer system within Nevada Avenue

V. Flood Plain Statement

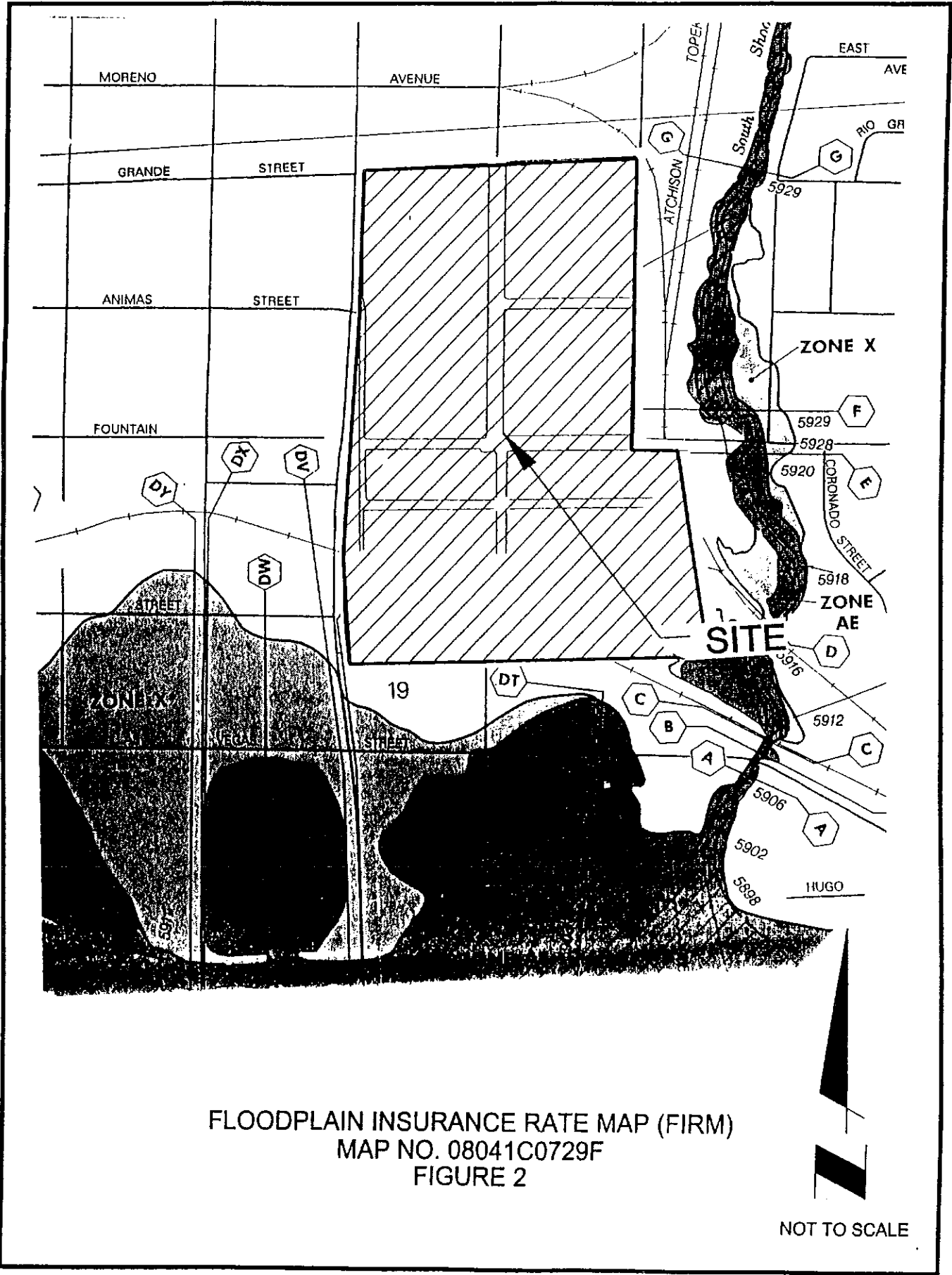
There is not a designated Federal Emergency Management Agency (FEMA) floodplain located within the subject site. The Floodplain Insurance Rate Map (FIRM) for El Paso County panel 08041C0729 F, dated March 17, 1997, was reviewed to determine any potential floodplain delineation. A copy of the relevant portion of this FIRM panel is shown on Figure 2.

VI. Economic Analysis and Drainage Fees

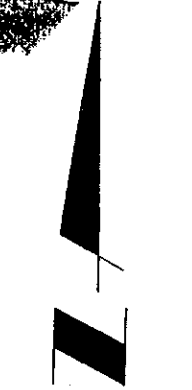
Table 1 presents a cost estimate for the construction of drainage improvements for the property. The site lies within both the Miscellaneous Drainage Basin and Shook's Run Drainage Basin. Shook's Run Drainage Basin is exempt from drainage fees and all of the lots located within the Miscellaneous Drainage Basin have previously been platted so there will be no drainage fees.

VII. Summary and Conclusions

The subject site is located between East Rio Grande Street the Denver and Rio Grande Railroad, South Wasatch Avenue, and South Nevada Avenue. The proposed development is approximately 58 acres in area and the land is currently developed as both residential and commercial. The redevelopment of the subject site will include the construction of buildings, both commercial and residential, parking lots, sidewalks, landscaped areas and parks, a parking structure, and a Corporate Headquarters. Runoff from the site will be carried by a storm sewer system that outfalls into Shook's Run drainage way and several other inlets that drain into the existing storm sewer system at South Nevada Avenue and to the south of the site. There will be no need for runoff to be detained on the site due to the minimal increase in flows. Some of the runoff from the Miscellaneous Drainage Basin will be transferred to the Shook's Run Drainage



FLOODPLAIN INSURANCE RATE MAP (FIRM)
 MAP NO. 08041C0729F
 FIGURE 2



NOT TO SCALE

Client: Lowell Neighborhood Partnership
 Project: Lowell Neighborhood Redevelopment
 Project No. 01014

Table 1: Opinion of Cost - Public Storm Drainage Facilities

Item	Quantity	Unit	Unit Cost	Item Total
15-inch Non-Reinforced Concrete Pipe	462	lf	\$16.00	\$ 7,399.52
18-inch Non-Reinforced Concrete Pipe	369	lf	\$22.00	\$ 8,118.00
24-inch Reinforced Concrete Pipe	1,191	lf	\$28.00	\$ 33,339.88
30-inch Reinforced Concrete Pipe	1,580	lf	\$35.00	\$ 55,293.35
36-inch Reinforced Concrete Pipe	820	lf	\$42.00	\$ 34,447.14
36-inch RCP Flared-End Section	1	ea	\$350.00	\$ 350.00
No. 16 Combination Inlet	33	ea	\$500.00	\$ 16,500.00
Outlet Structure	1	ea	\$5,000.00	\$ 5,000.00
Junction Box	1	ea	\$2,000.00	\$ 2,000.00
Storm Sewer Manhole	13	ca	\$4,000.00	\$ 52,000.00

Estimated Storm Drainage Facilities Cost \$ 214,447.89

Engineering 10% \$ 21,444.79

Contingency 5% \$ 10,722.39

Total Estimated Cost \$ 246,615.07

Basin to minimize the flows to the west onto South Nevada Avenue; otherwise the redevelopment of this site will also not significantly alter the existing drainage patterns.

APPENDIX

Proposed Hydrologic Calculations

Proposed Hydraulic Calculations

Basin Runoff Calculation

Basin / Design Point	Contributing Basins	Area	Area	C ₅	C ₁₀₀	Time of Concentration	Rainfall Intensity		Runoff		Basin / Design Point
							i ₅	i ₁₀₀	Q ₅	Q ₁₀₀	
A		43,885 sf	1.01 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	4.7 cfs	8.1 cfs	A
B		24,306 sf	0.56 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	2.6 cfs	4.5 cfs	B
C		60,389 sf	1.39 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	6.5 cfs	11.1 cfs	C
D		78,829 sf	1.81 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	8.5 cfs	14.5 cfs	D
E		61,468 sf	1.41 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	6.6 cfs	11.3 cfs	E
F		27,035 sf	0.62 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	2.9 cfs	5.0 cfs	F
G		56,006 sf	1.29 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	6.0 cfs	10.3 cfs	G
H		39,415 sf	0.90 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	4.2 cfs	7.3 cfs	H
I		22,468 sf	0.52 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	2.4 cfs	4.1 cfs	I
J		35,720 sf	0.82 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	3.8 cfs	6.6 cfs	J
K		46,034 sf	1.06 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	4.9 cfs	8.5 cfs	K
L		28,435 sf	0.65 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	3.0 cfs	5.2 cfs	L
M		31,600 sf	0.73 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	3.4 cfs	5.8 cfs	M
N		41,840 sf	0.96 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	4.5 cfs	7.7 cfs	N
O		19,748.8	0.45 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	2.1 cfs	3.6 cfs	O
P		31,567.71	0.72 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	3.4 cfs	5.8 cfs	P
Q		37,292 sf	0.86 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	4.0 cfs	6.9 cfs	Q
R		21,438 sf	0.49 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	2.3 cfs	4.0 cfs	R
S		26,810 sf	0.62 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	2.9 cfs	4.9 cfs	S
T		11,162 sf	0.26 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	1.2 cfs	2.1 cfs	T
U		18,312 sf	0.42 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	2.0 cfs	3.4 cfs	U
V		7,993 sf	0.18 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	0.9 cfs	1.5 cfs	V
W		33,015 sf	0.76 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	3.5 cfs	6.1 cfs	W
X		51,552 sf	1.18 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	5.5 cfs	9.5 cfs	X
Y		177,697 sf	4.08 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	19.0 cfs	32.8 cfs	Y
Z		26,549 sf	0.61 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	2.8 cfs	4.9 cfs	Z
AA		22,612 sf	0.52 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	2.4 cfs	4.2 cfs	AA
BB		128,886 sf	2.96 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	13.8 cfs	23.8 cfs	BB
CC		53,662 sf	1.23 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	5.8 cfs	9.9 cfs	CC
DD		4,252 sf	0.10 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	0.5 cfs	0.8 cfs	DD
EE		91,699 sf	2.11 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	9.8 cfs	16.9 cfs	EE
FF		136,397 sf	3.13 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	14.6 cfs	25.2 cfs	FF
GG		61,057 sf	1.40 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	6.5 cfs	11.3 cfs	GG
DP-1		93,392 sf	2.14 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	10.0 cfs	17.2 cfs	DP-1
DP-2		129,659 sf	2.98 ac	0.90	0.90	5.0 min.	5.2 in/hr	8.9 in/hr	13.9 cfs	23.9 cfs	DP-2

Equations:

$$i_5 = 75 / (10 + T_c^{0.786})$$

$$i_{100} = 54.6 / (\text{Power}(T_c, 0.83) + 6.72)$$

i₅ = Average 5-year Rainfall Intensity in inches per hour

i₁₀₀ = Average 100-year Rainfall Intensity in inches per hour

T_c = Time of Concentration

$$Q = CiA$$

Q = Peak Runoff Rate, in cubic feet per second (cfs)

C = Runoff coefficient representing a ration of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

Pipe Diameter Calculations

Pipe #	Q	Mannings 'n'	Pipe Length	Invert		Pipe Slope	Calculated Pipe Diameter	Proposed Pipe Diameter	Min. Slope of Pipe	Flow Velocity	Pipe Capacity
				In	Out						
1	4.1 cfs	0.013	46 lf	5965.50	5965.04	0.992 %	13-inch	15-inch	0.403 %	5.3 ft/sec	6.5 cfs
2	10.7 cfs	0.013	26 lf	5964.74	5963.73	3.883 %	14-inch	15-inch	2.746 %	10.4 ft/sec	12.8 cfs
3	3.6 cfs	0.013	46 lf	5965.50	5965.04	0.992 %	12-inch	15-inch	0.311 %	5.3 ft/sec	6.5 cfs
4	9.4 cfs	0.013	146 lf	5964.74	5963.73	0.692 %	19-inch	24-inch	0.173 %	6.0 ft/sec	18.9 cfs
5	20.1 cfs	0.013	196 lf	5963.43	5962.53	0.459 %	27-inch	30-inch	0.240 %	5.7 ft/sec	27.9 cfs
6	11.1 cfs	0.013	48 lf	5967.40	5963.53	8.135 %	12-inch	15-inch	2.955 %	15.1 ft/sec	18.5 cfs
7	31.2 cfs	0.013	41 lf	5962.53	5962.34	0.469 %	31-inch	30-inch	0.579 %	5.7 ft/sec	28.2 cfs
8	5.0 cfs	0.013	92 lf	5967.70	5962.34	5.854 %	10-inch	15-inch	0.600 %	12.8 ft/sec	15.7 cfs
9	36.2 cfs	0.013	496 lf	5962.04	5956.45	1.127 %	28-inch	30-inch	0.779 %	8.9 ft/sec	43.7 cfs
10	6.9 cfs	0.013	39 lf	5963.50	5957.70	14.872 %	9-inch	15-inch	1.142 %	20.4 ft/sec	25.0 cfs
11	43.1 cfs	0.013	24 lf	5956.45	5956.17	1.153 %	30-inch	30-inch	1.105 %	9.0 ft/sec	44.2 cfs
12	4.0 cfs	0.013	21 lf	5963.40	5957.42	29.071 %	7-inch	15-inch	0.384 %	28.5 ft/sec	34.9 cfs
13	47.1 cfs	0.013	53 lf	5956.17	5955.59	1.102 %	31-inch	30-inch	1.319 %	8.8 ft/sec	43.2 cfs
14	47.1 cfs	0.013	227 lf	5955.29	5953.02	1.000 %	32-inch	36-inch	0.499 %	9.5 ft/sec	66.9 cfs
15	4.2 cfs	0.013	38 lf	5961.74	5954.77	18.342 %	7-inch	15-inch	0.423 %	22.6 ft/sec	27.7 cfs
16	51.3 cfs	0.013	237 lf	5953.02	5950.65	1.000 %	33-inch	36-inch	0.592 %	9.5 ft/sec	66.9 cfs
17	4.9 cfs	0.013	38 lf	5958.22	5952.40	15.316 %	8-inch	15-inch	0.576 %	20.7 ft/sec	25.3 cfs
18	56.2 cfs	0.013	48 lf	5950.65	5950.17	1.001 %	34-inch	36-inch	0.710 %	9.5 ft/sec	66.9 cfs
19	7.3 cfs	0.013	135 lf	5963.00	5961.00	1.477 %	15-inch	18-inch	0.483 %	7.2 ft/sec	12.8 cfs
20	39.3 cfs	0.013	293 lf	5960.70	5957.00	1.263 %	28-inch	30-inch	0.919 %	9.4 ft/sec	46.2 cfs
21	6.1 cfs	0.013	134 lf	5960.00	5957.00	2.247 %	13-inch	18-inch	0.337 %	8.9 ft/sec	15.8 cfs
22	45.4 cfs	0.013	285 lf	5956.70	5952.50	1.472 %	29-inch	30-inch	1.226 %	10.2 ft/sec	49.9 cfs
23	17.2 cfs	0.013	5 lf	5958.00	5952.50	110.000 %	9-inch	15-inch	7.094 %	55.4 ft/sec	67.9 cfs

Equations:

$Pipe\ Diameter = ((2.16Qn)/(S^{0.5}))^{0.375}$
 Q = Discharge in cubic feet per second
 n = Manning's roughness coefficient
 S = Slope of the pipe
 $A = \pi (D^2/4)$
 D = Inside Diameter of Pipe

$Flow\ Velocity = (1.49/n)R_h^{2/3} S^{1/2}$
 n = Manning's roughness coefficient
 R_h = Hydraulic Radius
 S = Slope of the pipe
 $Pipe\ Capacity = (1.49/n)AR_h^{2/3} S^{1/2}$
 A = Cross-sectional area of pipe

$R_h = A_w/W_p$
 $A_w = \pi(d^2/4)$
 A_w = Water Cross Sectional Area
 d = Water (Flow) Depth Within Pipe
 $W_p = \pi d$ (For Capacity Calculation)
 W_p = Wetted Perimeter of Pipe

Pipe Diameter Calculations

Pipe #	Q	Mannings 'n'	Pipe Length	Invert		Pipe Slope	Calculated Pipe Diameter	Proposed Pipe Diameter	Min. Slope of Pipe	Flow Velocity	Pipe Capacity
				In	Out						
24	62.6 cfs	0.013	80 lf	5952.50	5950.17	2.915 %	29-inch	24-inch	7.662 %	12.3 ft/sec	38.7 cfs
25	118.8 cfs	0.013	164 lf	5949.87	5942.02	4.790 %	33-inch	36-inch	3.175 %	20.7 ft/sec	146.4 cfs
26	23.9 cfs	0.013	214 lf	5963.50	5961.00	1.168 %	24-inch	24-inch	1.117 %	7.8 ft/sec	24.5 cfs
27	32.8 cfs	0.013	25 lf	5956.00	5945.00	44.000 %	14-inch	18-inch	9.757 %	39.5 ft/sec	69.9 cfs
28	11.3 cfs	0.013	30 lf	5954.50	5948.13	21.233 %	10-inch	18-inch	1.158 %	27.5 ft/sec	48.5 cfs
29	9.6 cfs	0.013	30 lf	5953.87	5953.28	2.000 %	15-inch	18-inch	0.836 %	8.4 ft/sec	14.9 cfs
30	10.4 cfs	0.013	16 lf	5952.98	5952.66	2.000 %	16-inch	18-inch	0.981 %	8.4 ft/sec	14.9 cfs
31	10.4 cfs	0.013	264 lf	5952.36	5947.18	1.964 %	16-inch	24-inch	0.211 %	10.1 ft/sec	31.8 cfs
32	25.2 cfs	0.013	42 lf	5949.18	5948.34	1.978 %	22-inch	24-inch	1.242 %	10.2 ft/sec	31.9 cfs
33	42.1 cfs	0.013	44 lf	5948.04	5947.18	1.965 %	27-inch	30-inch	1.054 %	11.7 ft/sec	57.6 cfs
34	52.5 cfs	0.013	148 lf	5946.88	5943.98	1.955 %	29-inch	30-inch	1.639 %	11.7 ft/sec	57.5 cfs
35	52.5 cfs	0.013	116 lf	5943.68	5943.10	0.500 %	37-inch	36-inch	0.620 %	6.7 ft/sec	47.3 cfs
36	23.8 cfs	0.013	11 lf	5946.98	5943.10	34.581 %	13-inch	15-inch	13.584 %	31.0 ft/sec	38.1 cfs
37	76.3 cfs	0.013	28 lf	5946.88	5946.31	2.015 %	33-inch	36-inch	1.309 %	13.4 ft/sec	94.9 cfs
38	4.9 cfs	0.013	25 lf	5965.24	5965.00	0.960 %	14-inch	15-inch	0.576 %	5.2 ft/sec	6.3 cfs
39	10.1 cfs	0.013	211 lf	5964.70	5963.52	0.559 %	20-inch	24-inch	0.199 %	5.4 ft/sec	17.0 cfs
40	3.4 cfs	0.013	28 lf	5963.22	5962.95	0.967 %	12-inch	15-inch	0.277 %	5.2 ft/sec	6.4 cfs
41	19.3 cfs	0.013	28 lf	5963.22	5962.95	0.967 %	23-inch	24-inch	0.728 %	7.1 ft/sec	22.3 cfs
42	8.5 cfs	0.013	227 lf	5966.50	5965.30	0.529 %	19-inch	24-inch	0.141 %	5.2 ft/sec	16.5 cfs
43	18.8 cfs	0.013	28 lf	5965.30	5964.90	1.429 %	21-inch	24-inch	0.691 %	8.6 ft/sec	27.1 cfs
44	18.8 cfs	0.013	67 lf	5964.90	5964.30	0.896 %	23-inch	24-inch	0.691 %	6.8 ft/sec	21.5 cfs
45	33.3 cfs	0.013	30 lf	5964.00	5962.95	3.534 %	22-inch	24-inch	2.168 %	13.6 ft/sec	42.6 cfs
46	52.6 cfs	0.013	32 lf	5962.70	5961.98	2.250 %	28-inch	48-inch	0.134 %	17.2 ft/sec	216.0 cfs

Equations:

$$\text{Pipe Diameter} = ((2.16Qn)/(S^{0.5}))^{0.375}$$

Q = Discharge in cubic feet per second

n = Manning's roughness coefficient

S = Slope of the pipe

$$A = \pi (D^2/4)$$

D = Inside Diameter of Pipe

$$\text{Flow Velocity} = (1.49/n)R_h^{2/3} S^{1/2}$$

n = Manning's roughness coefficient

R_h = Hydraulic Radius

S = Slope of the pipe

$$\text{Pipe Capacity} = (1.49/n)AR_h^{2/3} S^{1/2}$$

A = Cross-sectional area of pipe

$$R_h = A_w/W_p$$

$$A_w = \pi(d^2/4)$$

A_w = Water Cross Sectional Area

d = Water (Flow) Depth Within Pipe

$$W_p = \pi d \text{ (For Capacity Calculation)}$$

W_p = Wetted Perimeter of Pipe

UDINLET: INLET HYDRAULICS AND SIZING
DEVELOPED BY
DR. JAMES GUO, CIVIL ENG DEPT. U OF COLORADO AT DENVER
SUPPORTED BY METRO DENVER CITIES/COUNTIES AND UD&FCD

:Kiowa Engineering Corp-Denver Colorado.....
DATE 07-12-2001 AT TIME 16:11:55

PROJECT TITLE: Lowell Neighborhood

*** COMBINATION INLET: GRATE INLET AND CURB OPENING:

*** GRATE INLET HYDRAULICS AND SIZING:

INLET ID NUMBER: 1

INLET HYDRAULICS: IN A SUMP.

GIVEN INLET DESIGN INFORMATION:

INLET GRATE WIDTH (ft)= 1.87
INLET GRATE LENGTH (ft)= 3.25
INLET GRATE TYPE =Type 16 Grate Inlet
NUMBER OF GRATES = 1.00
SUMP DEPTH ON GRATE (ft)= 0.05
GRATE OPENING AREA RATIO (%) = 0.60
IS THE INLET GRATE NEXT TO A CURB ?-- YES

Note: Sump is the additional depth to flow depth.

STREET GEOMETRIES:

STREET LONGITUDINAL SLOPE (%) = 1.00
STREET CROSS SLOPE (%) = 2.00
STREET MANNING N = 0.016
GUTTER DEPRESSION (inch) = 1.50
GUTTER WIDTH (ft) = 2.00

STREET FLOW HYDRAULICS:

WATER SPREAD ON STREET (ft) = 16.47
GUTTER FLOW DEPTH (ft) = 0.45
FLOW VELOCITY ON STREET (fps) = 3.52
FLOW CROSS SECTION AREA (sq ft) = 2.84
GRATE CLOGGING FACTOR (%) = 50.00
CURB OPENING CLOGGING FACTOR (%) = 10.00

INLET INTERCEPTION CAPACITY:

FOR 1 GRATE INLETS:
DESIGN DISCHARGE (cfs) = 10.00
IDEAL GRATE INLET CAPACITY (cfs) = 6.42
BY FAA HEC-12 METHOD:
FLOW INTERCEPTED (cfs) = 3.21
BY DENVER UDFCD METHOD:
FLOW INTERCEPTED (cfs) = 3.21

** CURB OPENING INLET HYDRAULICS AND SIZING:

INLET ID NUMBER: 1

INLET HYDRAULICS: IN A SUMP.

GIVEN INLET DESIGN INFORMATION:

GIVEN CURB OPENING LENGTH (ft)= 5.00
HEIGHT OF CURB OPENING (in)= 6.00
INCLINED THROAT ANGLE (degree)= 0.00
LATERAL WIDTH OF DEPRESSION (ft)= 2.00
SUMP DEPTH (ft)= 0.05

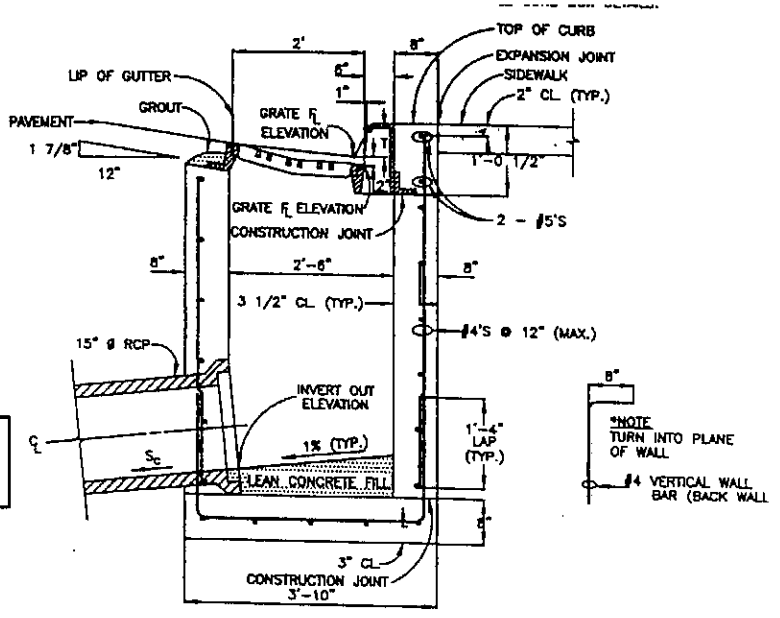
Note: The sump depth is additional depth to flow depth.

INLET INTERCEPTION CAPACITY:

IDEAL INTERCEPTION CAPACITY (cfs)= 7.09
BY FAA HEC-12 METHOD: DESIGN FLOW (cfs)= 6.79
FLOW INTERCEPTED (cfs)= 6.67
CARRY-OVER FLOW (cfs)= 0.12
BY DENVER UDFCD METHOD: DESIGN FLOW (cfs)= 6.79
FLOW INTERCEPTED (cfs)= 6.38
CARRY-OVER FLOW (cfs)= 0.41

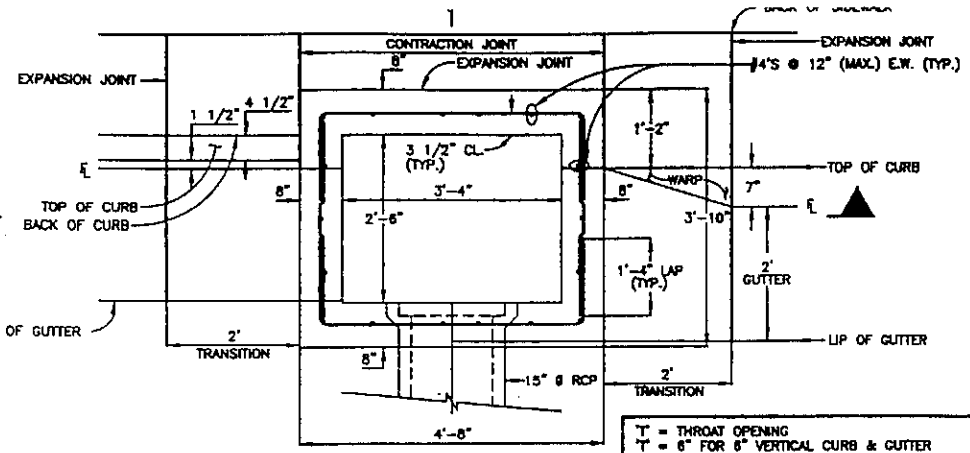
*** SUMMARY FOR THE COMBINATION INLET:

THE TOTAL DESIGN PEAK FLOW RATE (cfs)= 10.00
BY FAA HEC-12 METHOD:
FLOW INTERCEPTED BY GRATE INLET (cfs)= 3.21
FLOW INTERCEPTED BY CURB OPENING (cfs)= 6.67
TOTAL FLOW INTERCEPTED (cfs)= 9.88
CARRYOVER FLOW (cfs)= 0.12
BY DENVER UDFCD METHOD:
FLOW INTERCEPTED BY GRATE INLET (cfs)= 3.21
FLOW INTERCEPTED BY CURB OPENING (cfs)= 6.38
TOTAL FLOW INTERCEPTED (cfs)= 9.59
CARRYOVER FLOW (cfs)= 0.41



B SECTION
SCALE: 3/4"=1"

*NOTE
TURN INTO PLANE
OF WALL
#4 VERTICAL WALL
BAR (BACK WALL)

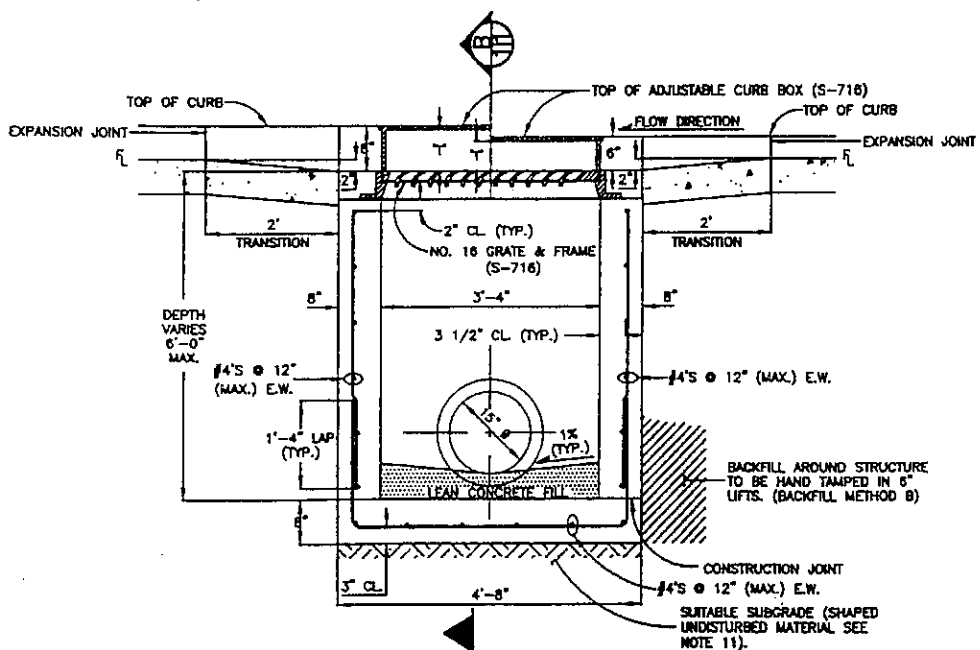


PLAN VIEW
SCALE: 3/4"=1"

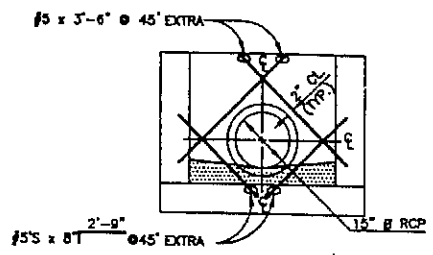
VERTICAL CURB & GUTTER

COMB. CURB, GUTTER & SIDEWALK

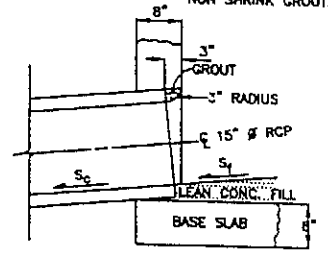
T = THROAT OPENING
T = 6" FOR 6" VERTICAL CURB & GUTTER
T = 5" FOR COMBINATION CURB GUTTER & SIDEWALK
DROP FROM GUTTER ELEVATION TO GRATE ELEVATION (TRANSITION) IS 2"



A SECTION
SCALE: 3/4"=1"



**REBAR PLACEMENT
DETAIL AROUND CONNECTOR**
SCALE: 1/2"=1"



DETAIL CONNECTOR OUTLET
SCALE: 3/4"=1" (OPTIONAL)

CONTRACTOR TO NOTCH
& BLOCK OUT AROUND
PIPE OPENING AND
FORM SMOOTH RADIUS
AROUND PIPE WITH
NON SHRINK GROUT.

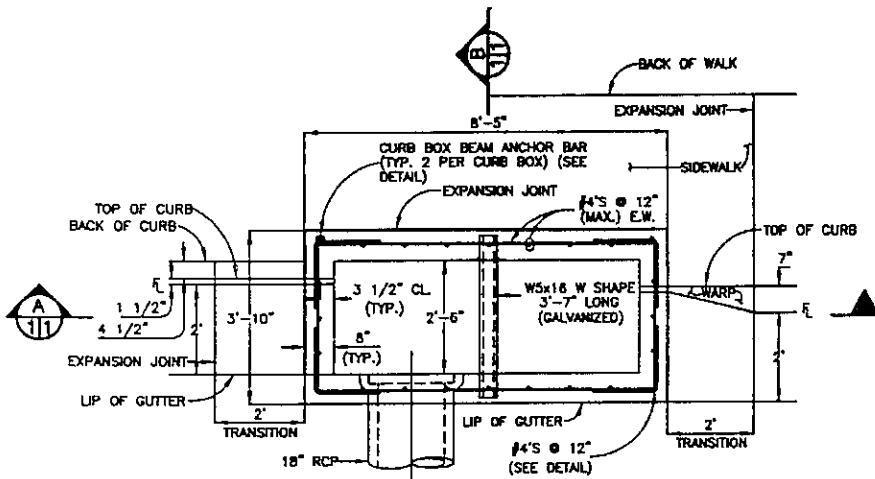
NOTE:
SEE DETAIL SPECIFICATIONS SECTION 11.04 SIDEWALK INLETS FOR
MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATION
SHALL BE CONSIDERED NON-COMPLIANT.

- NOTES:
1. FOR PAYMENT PURPOSES, INLET STRUCTURES SHALL ALSO INCLUDE 2'-0" CURB & GUTTER TRANSITION SECTION AT EACH END OF INLET PLUS SIDEWALK SECTIONS WHERE REQUIRED BEHIND INLET STRUCTURE AND TRANSITION SECTIONS.
 2. FLOOR SLOPE MAY BE POURED MONOLITHIC WITH BASE.
 3. S_c = SLOPE OF CONNECTOR = 1% MIN.
 4. UNLESS OTHERWISE SPECIFIED ON THE DRAWINGS OR OTHERWISE APPROVED, ALL #16 INLETS SHALL BE CONSTRUCTED WITH AN ADJUSTABLE C.I. CURB BOX (S-716).
 5. DESIGN CONDITIONS FOR INLET ALLOWS DEPTHS OF 6' (MAX.). FOR INLETS MORE THAN 6 FEET IN DEPTH, SHOP DRAWINGS AND DESIGN ANALYSIS SHALL BE SUBMITTED FOR APPROVAL.
 6. ALL REINFORCING STEEL SHALL BE ASTM, A-615, GRADE 60 DEFORMED BARS. DIAMETER OF BEND MEASURED ON THE INSIDE OF THE BAR SHALL BE A MINIMUM OF 6 BAR DIAMETER.

7. ALL WORK SHALL CONFORM TO AASHTO "STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES", FIFTEENTH EDITION, 1992.
8. CONCRETE SHALL HAVE A 28 DAY COMPRESSIVE STRENGTH OF 4000 PSL.
9. SUB-GRADE SHALL BE A GRADATION EQUAL TO CLASS B BEDDING COMPACTED TO 95% MAXIMUM DRY DENSITY, AASHTO DESIGNATION T-180.
10. NO FORMWORK SHALL REMAIN INSIDE STRUCTURE WHEN COMPLETE.
11. SUB-GRADE SHALL BE SHAPED UNDISTURBED MATERIAL OR OVEREXCAVATED AND BACKFILLED WITH CLASS B BEDDING MATERIAL, COMPACTED PER WMD SPECIFICATIONS.
12. SPLICING OF REINFORCING STEEL SHALL BE PERMITTED ONLY WHERE DETAILED IN DRAWINGS.
13. INLET WALLS SHALL BE FORMED BOTH INSIDE AND OUTSIDE. CASTING OF SIDEWALLS AGAINST EARTH IS NOT PERMITTED.
14. LEAN CONCRETE FILL TO BE f_c = 2000 PSL.

REVISED		CITY AND COUNTY OF DENVER	
BY	DATE	DEPARTMENT OF PUBLIC WORKS WASTEWATER MANAGEMENT DIVISION	
		STANDARD DETAILS SINGLE NO. 16 OPEN THROAT INLET ADJUSTABLE CURB BOX	
DATE: 6/04	DRAWN BY: JAL	SHEET NO.: 1	TOTAL SHEETS: 1

FILED IN: C:\Users\jwalsh\Documents\2004\11-1-04\11-1-04_3/07/04



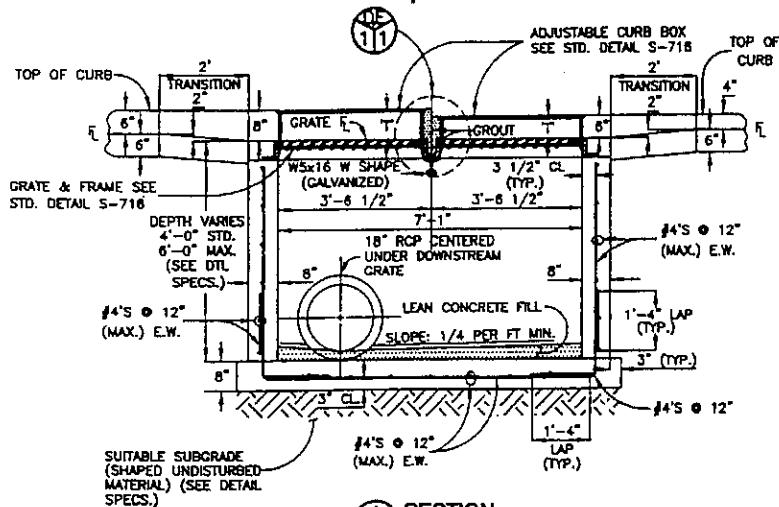
6" VERTICAL CURB & GUTTER

COMB. CURB GUTTER & SIDEWALK

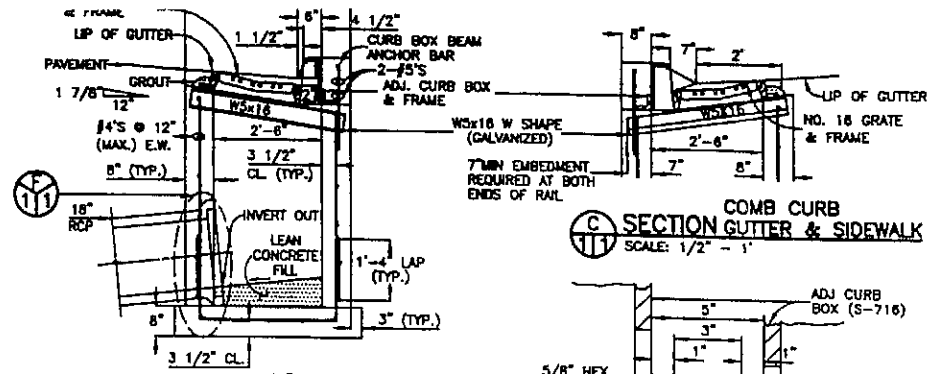
PLAN

SCALE: 1/2" = 1'

T₁ = THROAT OPENING
 T₂ = 6" FOR 6" VERTICAL CURB & GUTTER
 T₃ = 5" FOR COMBINATION CURB GUTTER & SIDEWALK
 DROP FROM GUTTER \bar{E}_1 ELEVATION TO GRATE \bar{E}_2 ELEVATION (TRANSITION) IS 2".

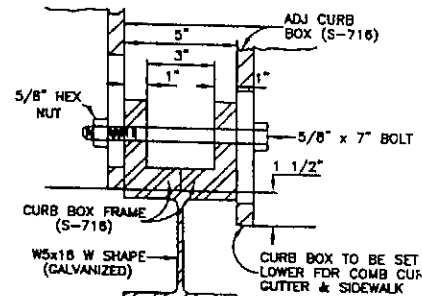


SECTION
SCALE: 1/2" = 1'

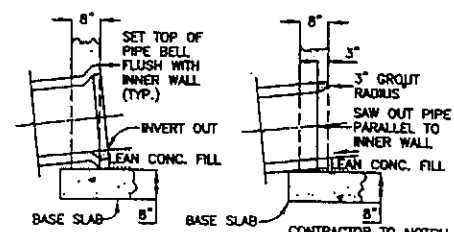


VERT. CURB SECTION & GUTTER
SCALE: 1/2" = 1'

SECTION GUTTER & SIDEWALK
SCALE: 1/2" = 1'



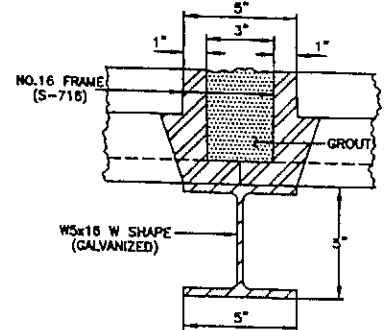
DETAIL CURB BOX ON SUPPORT RAIL (TYP.)
SCALE: 3" = 1'



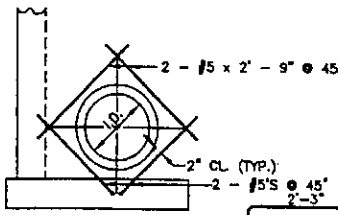
PREFERRED

OPTIONAL

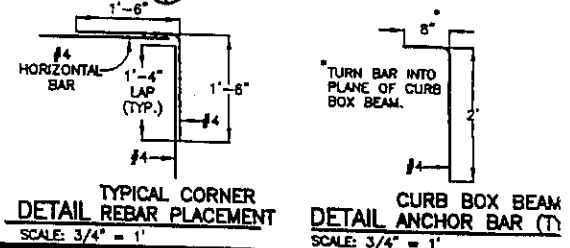
CONNECTOR PIPE DETAIL END TREATMENT (TYP.)
SCALE: 1/2" = 1'



FRAME PLACEMENT DETAIL ON SUPPORT RAIL (TYP.)
SCALE: 3" = 1'



REBAR PLACEMENT DETAIL INLET WALL PENETRATION
SCALE: 1/2" = 1'

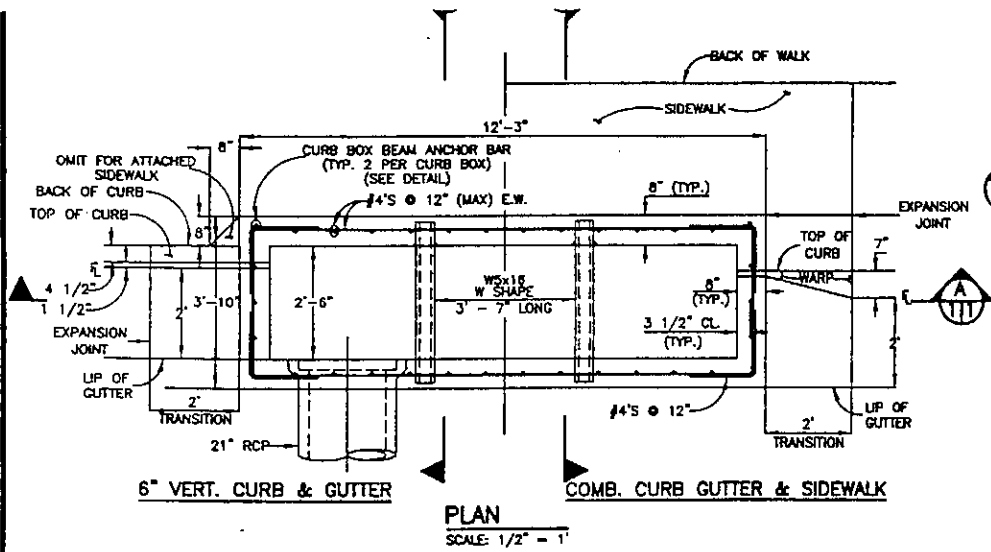


TYPICAL CORNER DETAIL REBAR PLACEMENT
SCALE: 3/4" = 1'

CURB BOX BEAM DETAIL ANCHOR BAR (T)
SCALE: 3/4" = 1'

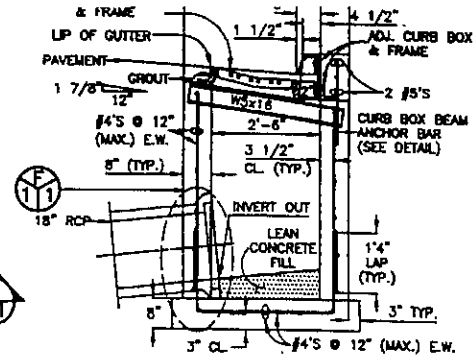
NOTES:
 1. SEE DETAIL SPECIFICATIONS SECTION 11.04 STORM INLETS FOR MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON-COMPLIANT.
 2. ALSO SEE GENERAL NOTES ON S-618.1.

REVISED		CITY AND COUNTY OF DENVER	
BY	DATE	DEPARTMENT OF PUBLIC WORKS WASTEWATER MANAGEMENT DIVISION	
STANDARD DETAILS DOUBLE NO. 16 INLETS O.T. ADJUSTABLE CURB BOX			
DATE	DESIGNED BY	DRAWN BY	CHECKED BY
6/84	J.M.L.	J.L.	S-618.2

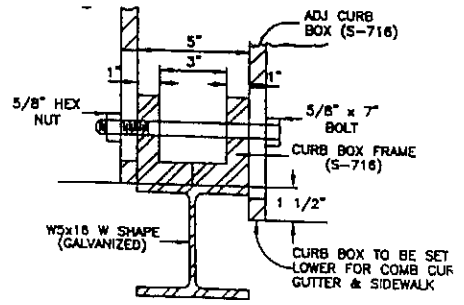


PLAN
SCALE: 1/2" = 1'

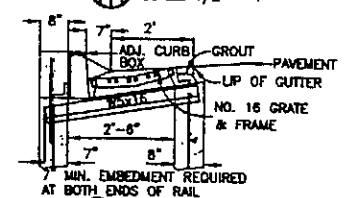
T = THROAT OPENING
 T' = 6" FOR VERTICAL CURB & GUTTER
 T'' = 5" FOR COMBINATION CURB GUTTER & SIDEWALK
 DROP FROM GUTTER \bar{r}_g ELEVATION TO GRATE \bar{r}_g ELEVATION (TRANSITION) IS 2".



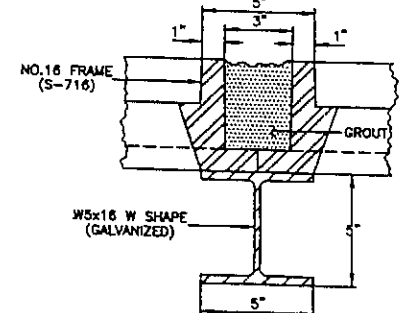
B SECTION
SCALE: 1/2" = 1'



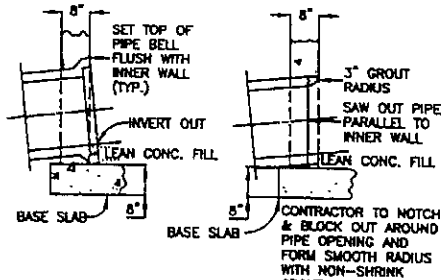
D Curb box placement detail on support rail
SCALE: 3" = 1'



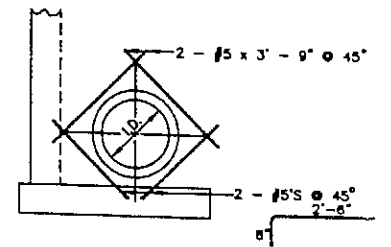
C SECTION
SCALE: 1/2" = 1'



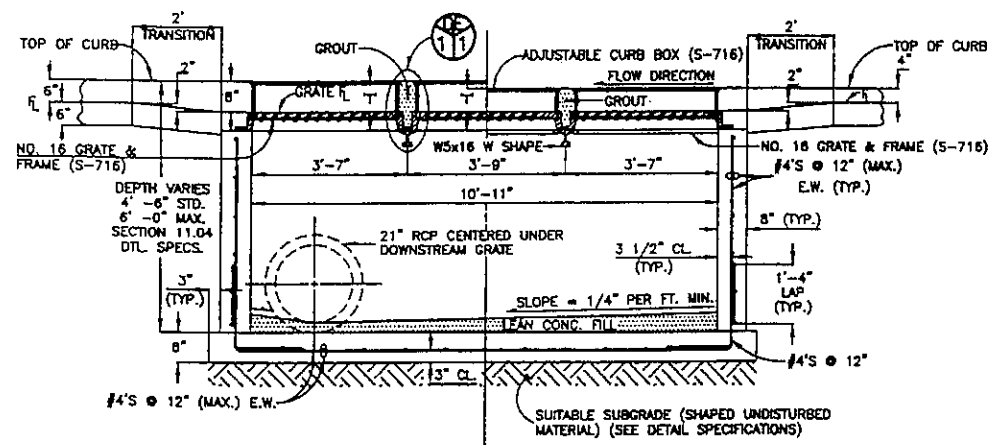
E FRAME PLACEMENT detail on support rail
SCALE: 3" = 1'



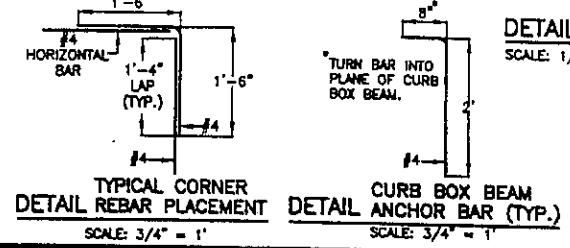
F CONNECTOR PIPE detail end treatment
SCALE: 1/2" = 1'



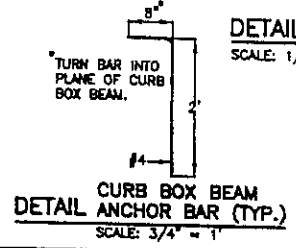
G REBAR PLACEMENT detail inlet wall penetration (TYP.)
SCALE: 1/2" = 1'



A SECTION
SCALE: 1/2" = 1'



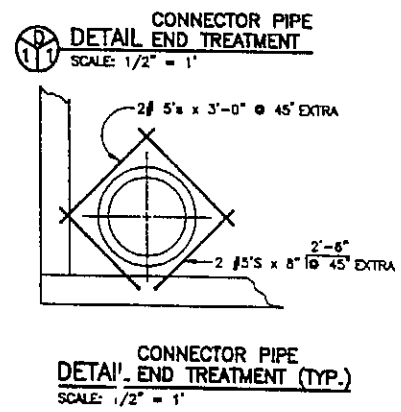
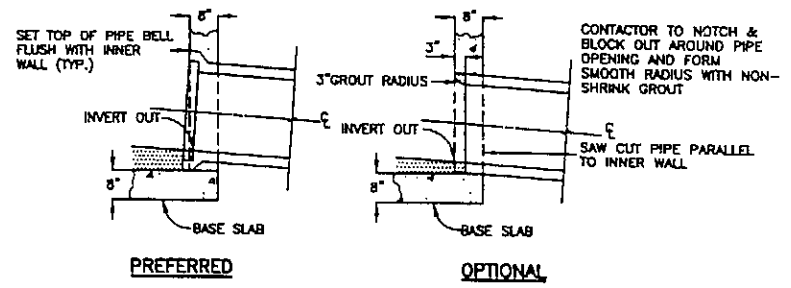
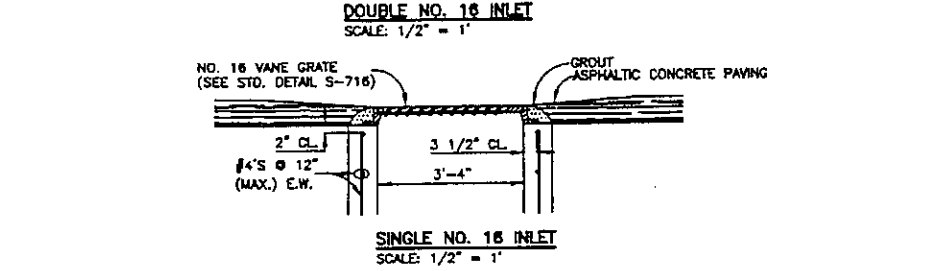
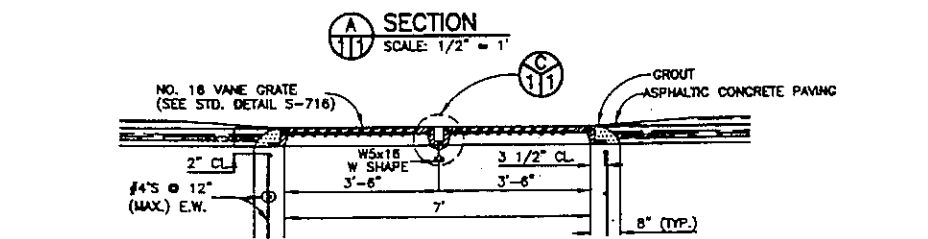
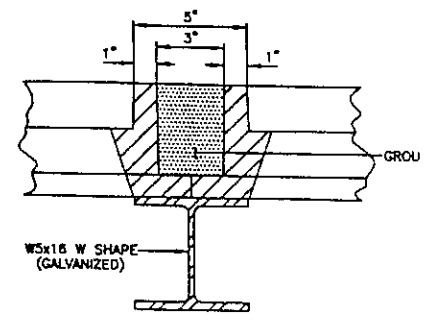
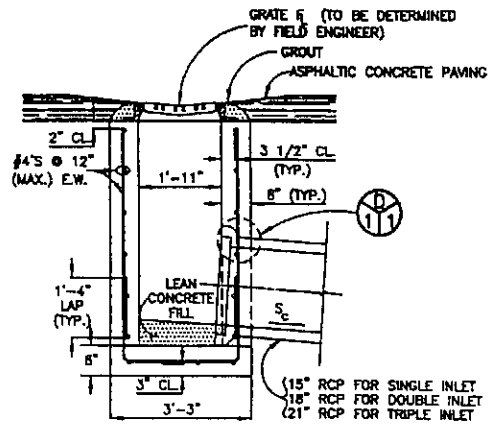
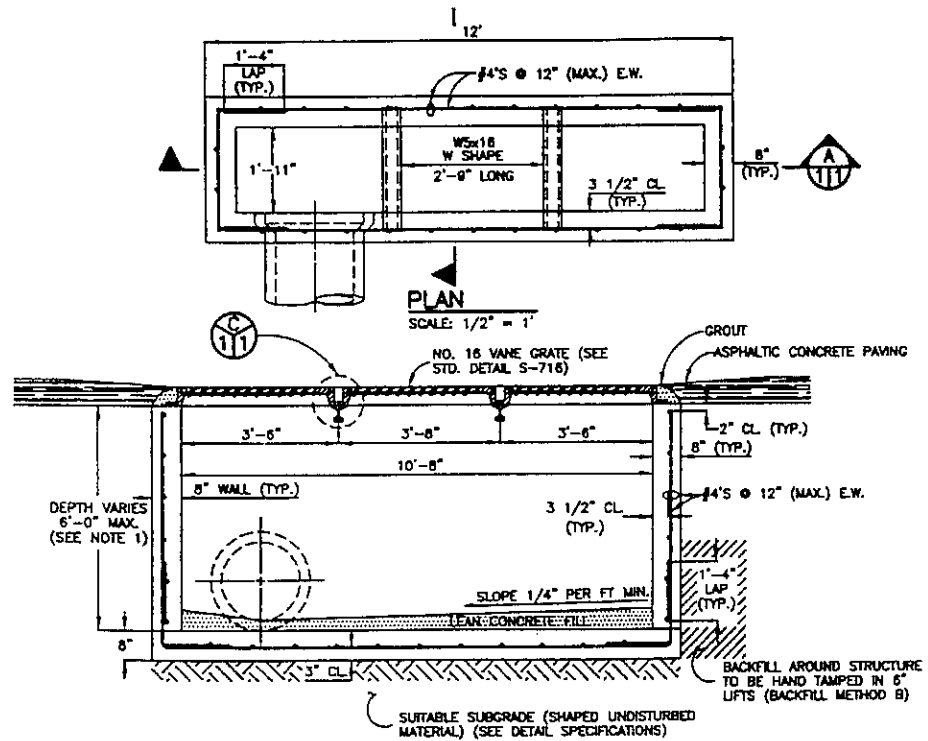
H TYPICAL CORNER detail rebar placement
SCALE: 3/4" = 1'



I CURB BOX BEAM detail anchor bar (TYP.)
SCALE: 3/4" = 1'

- NOTES:**
- SEE DETAIL SPECIFICATIONS (DETAIL SPECIFICATIONS) SECTION 11.04 STORM INLETS FOR MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON-COMPLIANT.
 - ALSO SEE GENERAL NOTES ON S-616.1

REVISED		CITY AND COUNTY OF DENVER	
BY	DATE	DEPARTMENT OF PUBLIC WORKS WASTEWATER MANAGEMENT DIVISION	
STANDARD DETAILS TRIPLE NO. 16 INLETS O.T. ADJUSTABLE CURB BOX			
DATE	DESIGNED BY	DRAWN BY	CHECKED BY
6/94	J.S.B.	J.M.	J.M.
		OF 1 SHEET	S-616.3



NOTES:

1. SEE DETAIL SPECIFICATIONS SECTION 11.04 STORM INLETS FOR MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON-COMPLIANT.
2. ALSO SEE GENERAL NOTES ON S616.1.

REVISED		CITY AND COUNTY OF DENVER	
BY	DATE	DEPARTMENT OF PUBLIC WORKS WASTEWATER MANAGEMENT DIVISION	
		STANDARD DETAILS SINGLE, DOUBLE & TRIPLE NO. 16 INLETS OPEN THROAT CONSTRUCTION	
DATE	DRAWN BY	CHECKED BY	DESIGNED BY
5/94	J. L. L.	J. L.	J. L.
			S-616Y

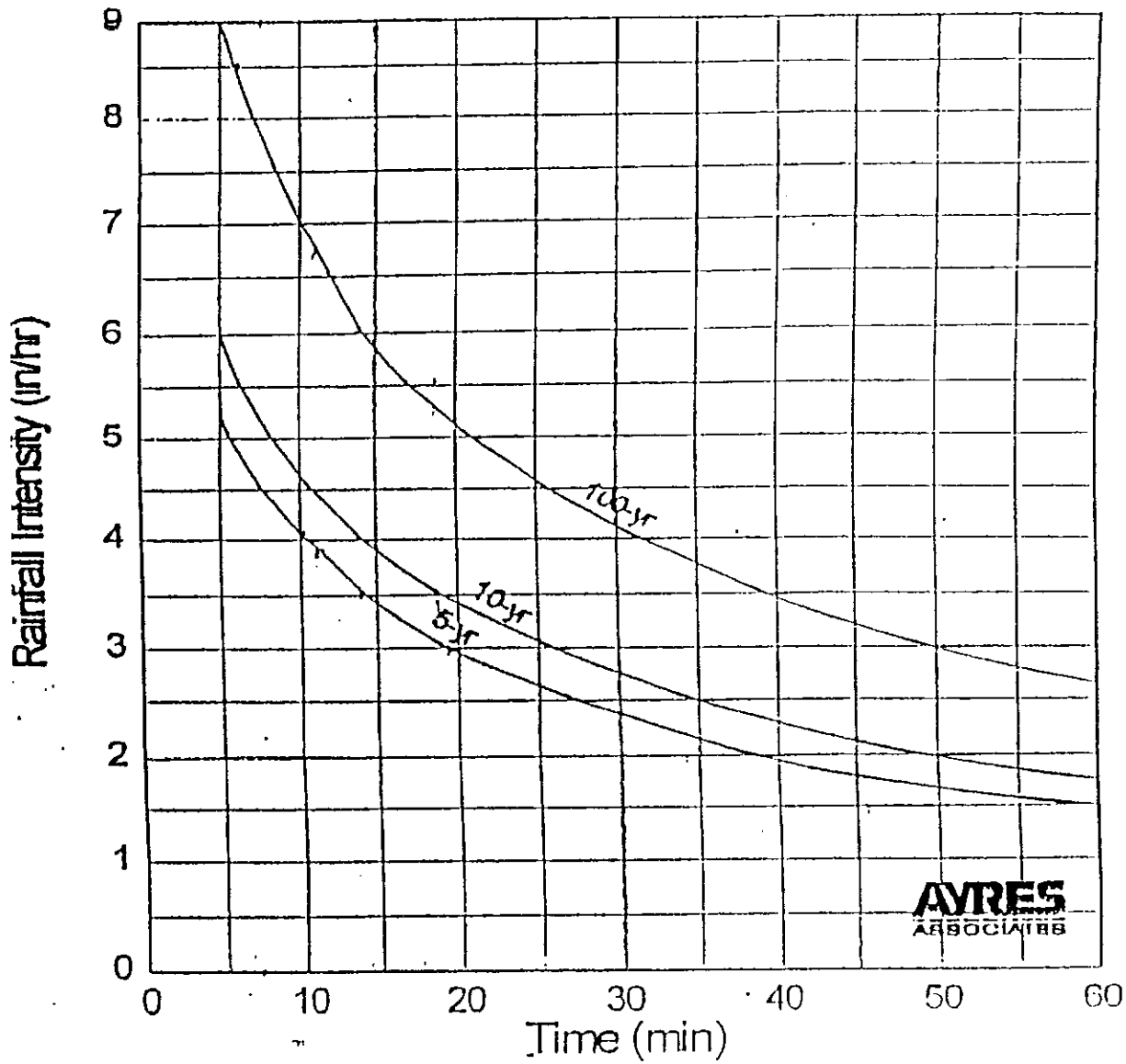
TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

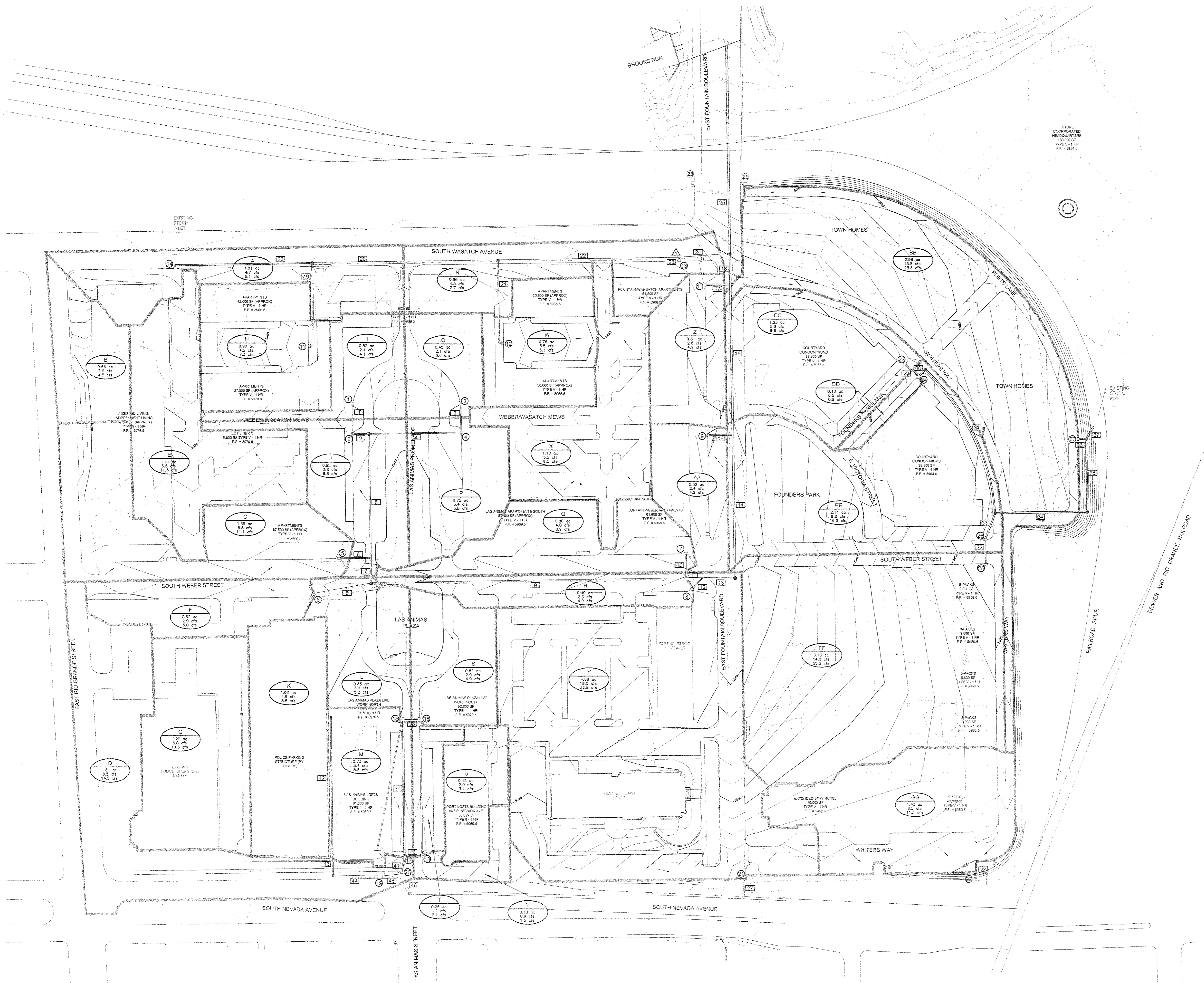
LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY			
		10		100	
		A&B*	C&D*	A&B*	C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
1/8 Acre or less	65	0.60	0.70	0.70	0.80
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries					
Playgrounds	7	0.30	0.35	0.55	0.60
Railroad Yard Areas	13	0.30	0.35	0.60	0.65
	40	0.50	0.55	0.60	0.65
Undeveloped Areas					
Historic Flow Analysis- Greenbelts, Agricultural Pasture/Meadow	2	0.15	0.25	0.20	0.30
Forest	0	0.25	0.30	0.35	0.45
Exposed Rock	0	0.10	0.15	0.15	0.20
Offsite Flow Analysis (when land use not defined)	100	0.90	0.90	0.95	0.95
	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks					
Roofs	100	0.90	0.90	0.95	0.95
Lawns	90	0.90	0.90	0.95	0.95
	0	0.25	0.30	0.35	0.45

* Hydrologic Soil Group

9/30/90



Interim Release October 12, 1994 , Rainfall Intensity Curves
 City Of Colorado Springs Drainage Criteria Manual



HYDRAULIC STRUCTURES	
1	15-INCH NRCP
2	15-INCH NRCP
3	15-INCH NRCP
4	24-INCH RCP
5	30-INCH RCP
6	15-INCH NRCP
7	30-INCH RCP
8	15-INCH NRCP
9	30-INCH RCP
10	15-INCH NRCP
11	30-INCH RCP
12	15-INCH NRCP
13	30-INCH RCP
14	36-INCH RCP
15	15-INCH NRCP
16	36-INCH RCP
17	15-INCH NRCP
18	36-INCH RCP
19	18-INCH NRCP
20	30-INCH RCP
21	18-INCH NRCP
22	30-INCH RCP
23	15-INCH NRCP
24	30-INCH RCP
25	36-INCH RCP
26	18-INCH RCP
27	18-INCH NRCP
28	18-INCH NRCP
29	18-INCH NRCP
30	18-INCH NRCP
31	24-INCH RCP
32	24-INCH RCP
33	30-INCH RCP
34	30-INCH RCP
35	36-INCH RCP
36	15-INCH NRCP
37	36-INCH RCP
38	15-INCH NRCP
39	24-INCH RCP
40	15-INCH NRCP
41	24-INCH RCP
42	24-INCH RCP
43	24-INCH RCP
44	24-INCH RCP
45	24-INCH RCP
46	30-INCH RCP
1	SINGLE NO. 16 COMB. INLET
2	SINGLE NO. 16 COMB. INLET
3	SINGLE NO. 16 COMB. INLET
4	SINGLE NO. 16 COMB. INLET
5	DOUBLE NO. 16 COMB. INLET
6	SINGLE NO. 16 COMB. INLET
7	SINGLE NO. 16 COMB. INLET
8	SINGLE NO. 16 COMB. INLET
9	SINGLE NO. 16 COMB. INLET
10	SINGLE NO. 16 COMB. INLET
11	SINGLE NO. 16 COMB. INLET
12	SINGLE NO. 16 COMB. INLET
13	DOUBLE NO. 16 COMB. INLET
14	TRIPLE NO. 16 COMB. INLET
15	SINGLE NO. 16 COMB. INLET
16	SINGLE NO. 16 COMB. INLET
17	SINGLE NO. 16 COMB. INLET
18	SINGLE NO. 16 COMB. INLET
19	SINGLE NO. 16 COMB. INLET
20	JUNCTION BOX
21	TRIPLE NO. 16 COMB. INLET
22	DOUBLE NO. 16 COMB. INLET
23	SINGLE NO. 16 COMB. INLET
24	SINGLE NO. 16 COMB. INLET
25	DOUBLE NO. 16 COMB. INLET
26	DOUBLE NO. 16 COMB. INLET
27	DOUBLE NO. 16 COMB. INLET
28	4" CURB INLET (EXISTING)
29	4" CURB INLET (EXISTING)

LEGEND	
	DESIGN POINT
	DRAINAGE BASIN BOUNDARY
	FLOW DIRECTION
	HYDRAULIC STRUCTURE IDENTIFIER
	STORM PIPE IDENTIFIER
	CROSS PAN

DESIGN POINT FLOWS		
DESIGN POINT	5-YEAR FLOW	100-YEAR FLOW
	10.0 cfs	17.2 cfs
	13.9 cfs	23.9 cfs

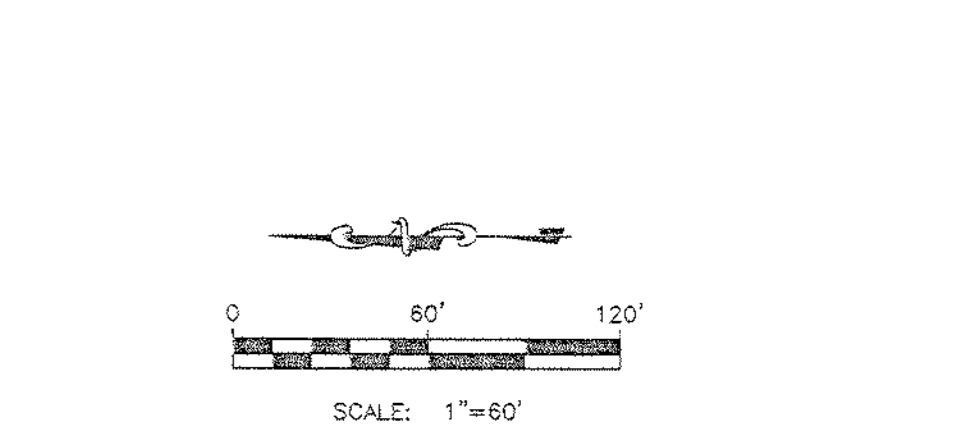
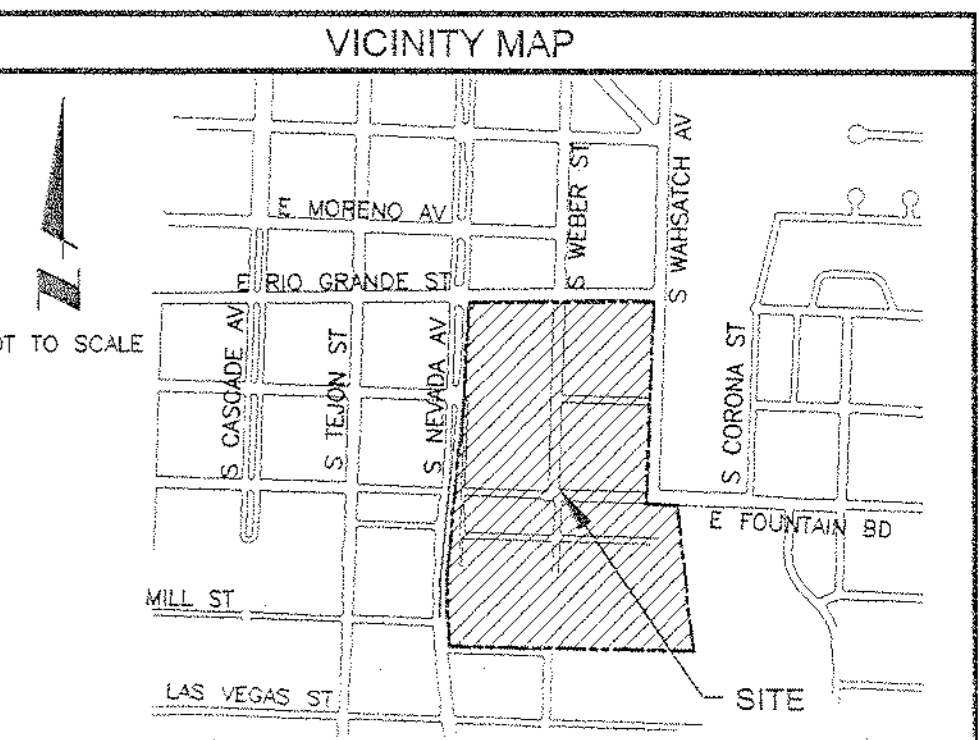


EXHIBIT 1
LOWELL NEIGHBORHOOD
DRAINAGE PLAN
COLORADO SPRINGS, COLORADO

Kiowa Engineering Corporation
 2814 International Drive
 Colorado Springs, Colorado
 80910-3127
 (719) 630-7342