# MASTER DEVELOPMENT DRAINAGE PLAN UPDATE FOR THE PRINTERS PARK DEVELOPMENT COLORADO SPRINGS, COLORADO EL PASO COUNTY



URS Greiner

# MASTER DEVELOPMENT DRAINAGE PLAN UPDATE FOR THE PRINTERS PARK DEVELOPMENT COLORADO SPRINGS, COLORADO EL PASO COUNTY

Prepared for:
DEVELOPERS OF PRINTERS PARK
Colorado Springs, Colorado
September, 1997
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COLORADO SPRINGS, CO 80920

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Engineer's Statement:

The attached Master Development Drainage Plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said report has been prepared according to the criteria established by the City/County for drainage reports and said report is in conformity with the Drainage Basin Planning Study for the Spring Creek Drainage Basin. I accept responsibility for any liability caused by any negligent acts, errors or omission on my part in preparing this report.

COLORADO REGISTERED PROFESSIONAL ENGINEER
CHARLES K. COTHERN
24997
Seal

Name

Developers' Statements:

We, the undersigned owners and developers, have read and will comply with all of the requirements specified in this Master Development Drainage Plan:

Printed Name:
Life Care Centers of America

Printed Name:
Printers Park, LLC
By BRE/CH Development LLC, Manager

DRAINAGE REVIEW

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

For the City Engineer

Date 2/4/99

## I. PURPOSE AND SCOPE

The purpose of the following Master Development Drainage Plan report is to update conceptual drainage improvements for the Printers Park Development. The City of Colorado Springs, Stormwater Division has requested that this development be reviewed in light of current drainage criteria. Existing site drainage facilities, drainage plans and downstream facilities had been designed and approved with criteria that was previously in effect. Therefore, this report addresses conceptual drainage mitigation based on calculated developed flows in excess of allowable present day "historic" runoff discharge. Concepts presented in this report will be refined and specific improvements will be addressed during the Final Plat process for the development of each site.

Runoff quantities and proposed facilities have been calculated utilizing the current City of Colorado Springs/El Paso County Drainage Criteria Manual.

## II. GENERAL LOCATION AND DESCRIPTION

The Printers Park Development is located within the city limits of Colorado Springs, Colorado in El Paso County as shown on Figure 1. The property is located within Section 16, Township 14 South, Range 66 West of the 6th P.M. and contains approximately 153 acres.

Development near Printers Park includes, multi-family and commercial developments. Pikes Peak Avenue generally borders the site to the north, Airport Road to the south, Union Boulevard to the west, and Garo Avenue to the east. The site is quartered by Printers Parkway traversing north and south, and Parkside Drive traversing east and west. International Circle completes three-fourths of a circle and intersects Parkside Drive and Printers Parkway. The site is partially developed and consists primarily of multi-family residences and commercial/business. Planned development for the remainder of the property consists of commercial and business facilities. Table 1 lists approximate land uses for the existing and proposed development.

**TABLE 1**
**SUMMARY OF LAND USE**

| Land Use | Acres |
|---|---|
| Commercial/Business | 121.98 |
| Residential/Multi-Family | 15.43 |
| Roads/ROW | 14.18 |
| Open Space | 2.31 |
| **TOTAL** | **153.9** |

The terrain has varying degrees of relief and ranges in slope from 1 to 9 percent. The site generally drains from the northwest to the southeast. Runoff travels overland and is intercepted by curb and gutter, inlets and storm sewers and discharged into a drainage channel located along the southeast corner of the site. Undeveloped ground cover is typical eastern prairie grasses with trees located along


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# LOCATION MAP

PRINTERS PARK DEVELOPMENT

FIGURE 1

\\42229\ADMIN\REPORTS\MDDP\FIG1.DWG RJS 3/17/97 predominant drainage paths. Developed areas consist of landscaped areas, pavement and buildings. The site is a sub-basin of the Spring Creek drainage basin.

The site and surrounding area have soil characteristics of hydrologic soil Group B with isolated areas having characteristics of hydrologic Group C as classified by the Soil Conservation Service. The following is a list of predominant soil types found on the site as shown in Figure 2.

**TABLE 2**
**SUMMARY OF SOIL CHARACTERISTICS**

| Soil No. | Soil Type | Slope Range | Hydrologic Soil Group |
|---|---|---|---|
| 3 | Ascalon sandy loam | 1 % to 3% | B |
| 6 | Blakeland loamy sand | 1% to 9% | A |
| 97 | Truckton sandy loam | 3% to 9% | B |
| 101 | Ustic Torrifluvents, loamy | 0 % to 3% | B |

The proposed development is not located in a FEMA regulated flood plain.

## III. DRAINAGE BASINS AND SUB-BASINS

Several reports have been written addressing the development of Printers Park in this sub-basin of the Spring Creek Drainage Basin. A draft report of the Spring Creek Drainage Basin Planning Study (DBPS) has been completed. The following reports were reviewed in preparing this MDDP:

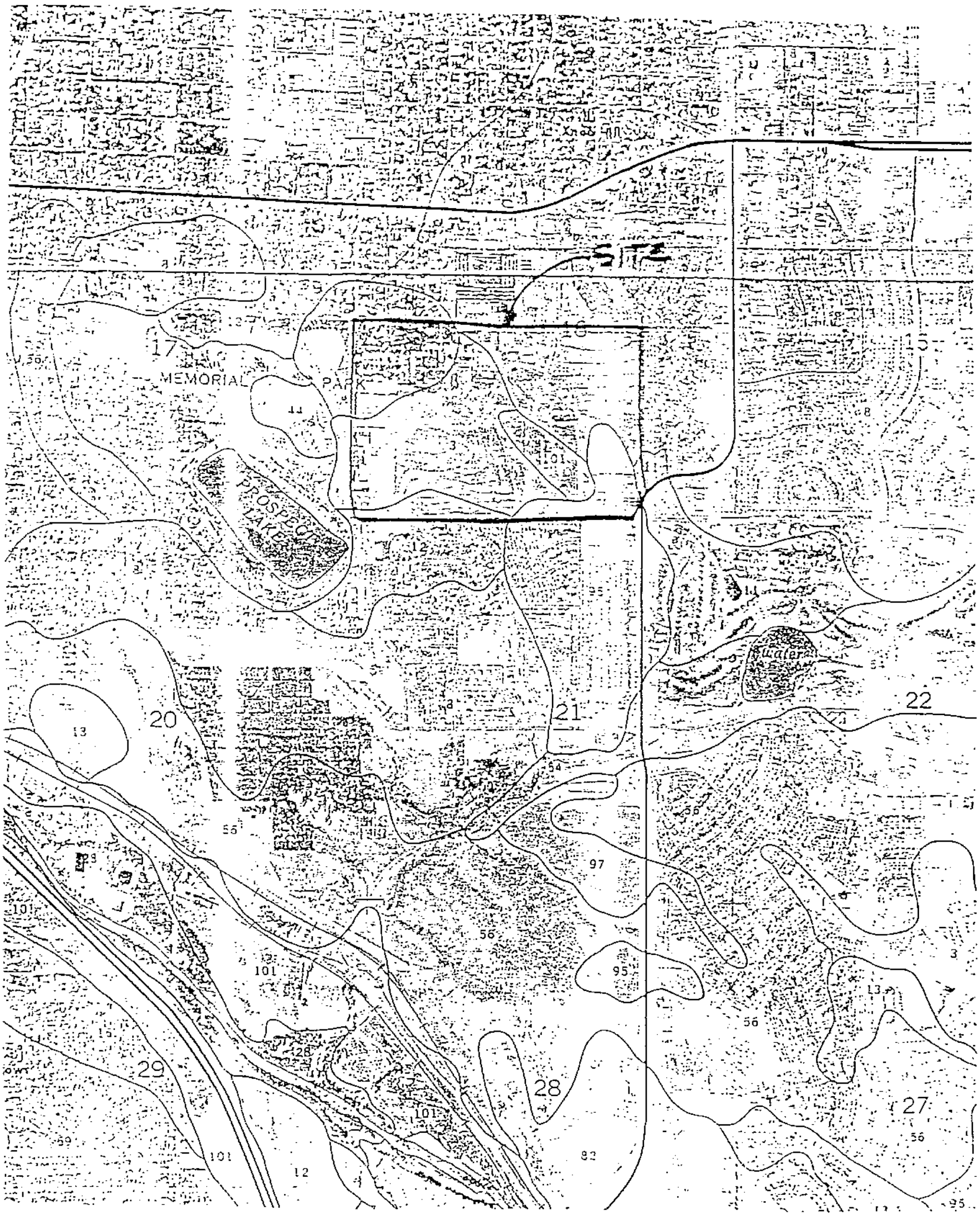
1. <u>Printers Park Drainage Report, April 1981</u>
   Engineer: Oliver Watts, Consulting Engineer, Colorado Springs, CO

2. <u>Drainage Report: Printers Park Subdivision, December 1981</u>
   Engineer: Oliver Watts, Consulting Engineer, Colorado Springs, CO

3. <u>Spring Creek Drainage Basin Planning Report (DRAFT), revised September, 1993</u>
   Owner: City of Colorado Springs
   Engineer: URS Consultant, Inc., Colorado Springs, CO.

These reports were obtained and used as a reference to determine the criteria used to implement the existing drainage facilities and assess the potential effect of increased runoff to these facilities. The original Drainage Report dated April 1981 used drainage criteria requiring the sizing of storm facilities for the 5 year SCS Method without routing the 100-year storm. The draft DBPS Drainage Criteria uses the 10-year Rational Method and routing of the 100-year storm for sizing storm facilities. This report analyzes the drainage basin with the current drainage criteria.

Sub-basin naming convention used in the DBPS has been retained to identify the sub-basin in which Printers Park lies. The site is in sub-basin K1 of the Spring Creek DBPS. Figures 3 and 4 illustrate the

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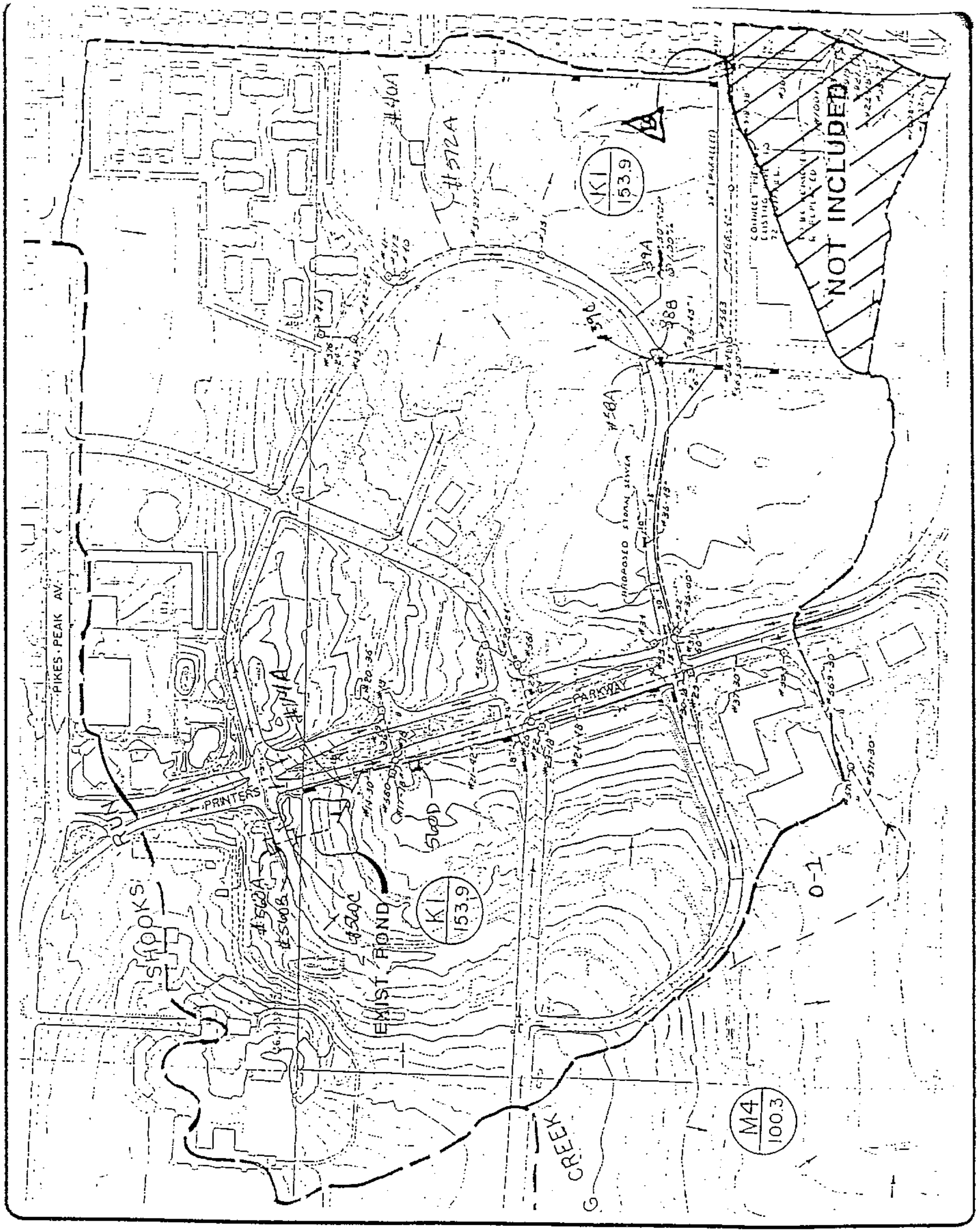
SOILS MAP

PRINTERS PARK DEVELOPMENT

FIGURE 2

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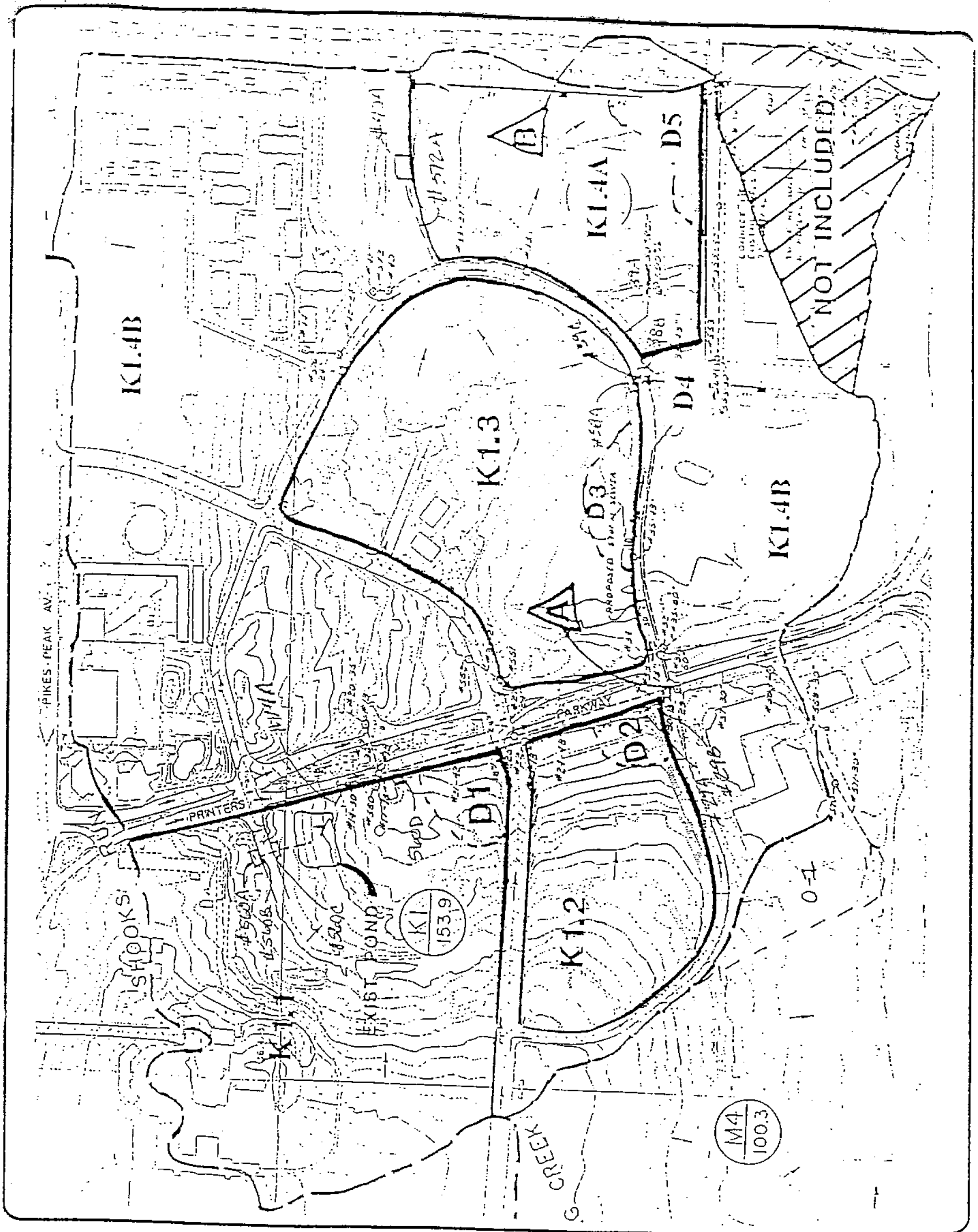
# HISTORIC BASIN MAP

PRINTERS PARK DEVELOPMENT

FIGURE 3

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# DEVELOPED BASIN MAP

PRINTERS PARK DEVELOPMENT

FIGURE 4

Historic and Developed Basin Map for the Printers Park Development. The area to the north/northeast of the site drains into the Shooks Run drainage basin.

A small area at the southeast portion of the basin has been excluded from the analysis of this report. This portion was excluded due to the inability of the site to drain into either the proposed detention ponds or channel as discussed in a latter portion of this report. Several roads within the basin intercept and route the runoff to the southeast corner of the basin. Design Point B has been identified as determining acceptable flow leaving the site.

Off-site flow (O-1) from a portion of sub-basin M4 of the DBPS was not taken into consideration at this time. This area does not contribute to the total surface runoff of basin K1. Runoff from M4 is intercepted via an existing channel and is conveyed into the storm sewer system located within Printers Park.

## IV. DRAINAGE DESIGN CRITERIA

### A. SCS Hydrologic Criteria

Basin areas were calculated using a planimeter on topographic maps obtained from the Spring Creek DBPS. A basin time of concentration of 24.5 minutes from the Spring Creek DBPS was used for consistency in determining peak flows. Based upon the hydrologic soil type (B or C), the natural conditions found in the basins and the CN chart from Table 5-4 of the Drainage Criteria Manual, the following CN values were used for the given conditions:

| Land Use | CN |
|---|---|
| Commercial/Business | 92 |
| Residential (Multi-Family) | 85 |
| Roadways | 98 |
| Open Space/Undeveloped | 61 |

The weighted CN values used for the present day "historic" conditions were 74 and 91 for full development. The 5-year, 24 hour storm rainfall intensity interpolated from the NOAA isopluvial map in Figure 5-4d from the Drainage Criteria Manual was 2.7 inches per hour. The 100-year, 24 hour storm rainfall intensity selected from the NOAA isopluvial map in Figure 5-4e from the Drainage Criteria Manual was 4.4 inches per hour.

Historic and developed design storms for the 5-year and 100-year was generated using HEC-1 to determine acceptable flows leaving the site at Design Point B. The HEC-1 computer model results for historic and developed conditions are located in appendix A and B.

Peak design flows for historic and developed conditions are summarized in Table 3 and discussed in Sections V and VI. Alphanumeric symbols correspond to design points shown in Figure 3 and 4 and on HEC-1 models.

TABLE 3
HEC-1 BASIN/DESIGN POINT RUNOFF PEAK FLOWS

| Basin No./ Design Point | Historic Flows Q5 (cfs) Q100 (cfs) | Developed Flows Q5 (cfs) Q100 (cfs) | Difference (cfs) | Difference (+) Increase (-) Decrease |
|---|---|---|---|---|
| K1/DP B | 101<br>293 | 299<br>572 | 197<br>279 | 196.0%<br>95.25% |
| *K1.1 | | 68<br>125 | | |
| *K1.2 | | 25<br>46 | | |
| *K1.3 | | 51<br>93 | | |
| *K1.4 | | 182<br>348 | | |
| *DP-A | | 17<br>36 | | |
| *DP-B | 101<br>293 | 150<br>294 | 49<br>1 | 48.5%<br>0.3% |

*Note: Historic Flows for K1.1-K1.4 were not modeled. All basins modeled with detention ponds.

## B. Rational Method

Basin areas were calculated using a planimeter on topographic maps obtained from the Spring Creek DBPS. A basin time of concentration of 18.5 minutes from the DBPS was used for consistency in determining rational method flows for the initial 5-year storm and 100-year storm.

A 5-year and 100-year rainfall intensity of 3.15 inches per hour and 5.45 inches per hour was selected from the revised rainfall intensity curves dated October 12, 1994. Rational method "C" coefficients were selected from Table 5-1 for each land use as follows:

| Land Use | "C" Coefficient |
|---|---|
| Commercial/Business | .90 |
| Residential (Multi-Family) | .60 |
| Roadways | .90 |
| Open Space/Undeveloped | .15 |

A weighted "C" coefficient of 0.86 was used for the 5-year and 100-year storm. The rational method flows were obtained to determine the capacities of the existing curb inlets. Hydraulic grade line computations were not determined for either the existing conditions or proposed conditions. Hydraulic grade line calculations will be determined during the Final Drainage Report Submittal for each property. Calculations for runoff flows are shown in appendix E.

### C. Detention Storage Criteria

Preliminary detention/storage requirements were estimated graphically using the SCS method for single stage structure routing. The ratio between allowable Outflow (Qo) and Inflow (Qi) from the pond is correlated to the Volume of Direct Runoff (Vr) and Volume of Storage (Vs) to obtain a graphical solution. Preliminary sizing was then optimized using the HEC-1 Modified Puls routing function for storage reservoirs. Results are located in Appendix D.

## V. EXISTING DRAINAGE CONDITIONS

### A. Existing Facilities

Printers Park is located in a partially developed drainage basin. An existing storm drainage system is currently in place along Printers Parkway and International Circle. Runoff generally travels overland from the north, northwest, and drains to the south and southeast. Runoff is intercepted by curb and gutter and discharged into curb inlets. Runoff is then conveyed through the storm sewer system and is eventually discharged at Design Point B into an existing concrete lined trapezoidal channel. Runoff is then conveyed to the southeast within the vicinity of Airport Road and Circle Drive. Drainage facilities downstream of the site are inadequate and the intersection experiences severe flooding during a major storm.

Inventories of the existing drainage structures were field verified and obtained from the Spring Creek DBPS and are located in appendix F. Inlets 38A, 38B, 40A, and 560A-560D were field verified and not listed in the draft DBPS. Inlet 29A was constructed as a radial curb inlet according to City Storm Drainage Division officials. Historic HEC-1 flows are summarized in Table 3.

A temporary pond is located in the northwest area of the property and primarily serves the Memorial Hospital site. Inlets 560A-560C currently intercept runoff and discharges into the pond. The pond discharges directly into the existing storm sewer system.

The existing storm sewer system was constructed in the mid-1980's, and is inadequate in conveying the 5-year initial design storm as required by the current drainage criteria. The system consists of public and privately maintained 4 to 20 foot type D10R inlets, 18" to 48" RCP, several junction boxes, and manholes.

## B. Existing Drainage Characteristics

HEC-1 Methodology

The Printers Park development lies within Basin K1 as shown in Figure 3. Peak runoff for the present day "historic" 5-year and 100-year storm was 101cfs and 293 cfs, respectively.

Rational Method Methodology

The rational method was used to determine the capacity of the existing drainage system. The basins were numbered 1-21 to determine the areas that contributed runoff to each inlet. Inlet 29A was modeled as an existing inlet in determining the inlet capacities of the storm sewer system. Calculations are located in appendix G.

The results of the analysis indicated that the number of curb inlets is inadequate. It was found that runoff not intercepted during the 5-year storm flooded the west intersection of Printers Parkway and International Circle. A flow of 58 cfs at a depth of 4 inches will crown the intersection and flow to the east towards a low point at inlet 38A and 38B. During the 100-year storm, 162.5 cfs at a depth of 7.5" would crown the intersection and flow to the east. Currently, 116.3 cfs overtops the inlets at inlet 38A and 38B and eventually drains to the southeast to Design Point B.

Based on the interception capacity of the inlets and the 100-year HEC 1 analysis, it is anticipated that flows in excess of 200 cfs currently overtops inlets 38A and 38B and drains to the southeast overland.

Table 4 is a summary of existing inlet capacities and bypass flows for the 5-year storm. The 100-year storm was not analyzed for the existing system.

# VI. DEVELOPED DRAINAGE CONDITIONS

## A. General Concept

Due to the inadequate capacity of downstream facilities, runoff leaving the site is required to be within present day "historic" levels. Drainage features will maintain present day "historic" flows at Design Point B. The historic flow patterns of the site is based on the partial development of the area. Runoff currently travels overland and is intercepted by curb and gutter and discharged into the storm sewer. Proposed development of the remaining site will not alter current flow patterns. Runoff not intercepted by the storm inlets is conveyed to a low point at inlet 38A and 38B. Flow in excess of the inlet capacity overtops and will be conveyed to Design Point B via proposed drainage channels and proposed detention ponds. Runoff routed through the ponds will discharge at or below historic levels when combined with the discharge from the existing 48-inch storm sewer. Five detention ponds are proposed ranging in storage capacity from 1.5-acre ft to 4-acre ft. The ponds will be designed to reduce peak-flow out of the basin as measured at Design Point B. Developed flows are summarized in Table 3.

**TABLE 4**
**INLET CAPACITIES: 5-Year Storm: Existing Conditions**

| INLET NO. | TYPE | LENGTH (ft) | Qi[1] (cfs) | Qb[1] (cfs) | CONDITION |
|---|---|---|---|---|---|
| 13 | D-10R | 8.0 | 3.8 | 8.4 | Cont. Grade |
| 22 | D-10R | 8.0 | 9.8 | 60.5 | Cont. Grade |
| 29 | D-10R | 6.0 | 16.7 | 58.0 | Sump |
| 29A | D-10R | 15.0 | 30.0 | 58.4 | Virtual Sump |
| 32 | D-10R | 8.0 | 8.5 | 23.1 | Cont. Grade |
| 34 | D-10R | 8.0 | 13.3 | 31.1 | Cont. Grade |
| 38 | D-10R | 6 | 6.8 | 23.9 | Cont. Grade |
| 38A | D-10R | 10 | 29.4 | 56.4 | Sump |
| 38B | D-10R | 10 | 29.4 | 59.3 | Sump |
| 40 | D-10R | 8 | 6.8 | 29.0 | Cont. Grade |
| 40A | D-10R | 10 | 8.4 | 0.0 | Sump |
| 41 | D-10R | 20 | 10.9 | 6.6 | Cont. Grade |
| 43 | D-10R | 8 | 5.8 | 28.4 | Cont. Grade |
| 44 | D-10R | 10 | 5.5 | 7.9 | Cont. Grade |
| 560 | D-10R | 4.0 | 1.1 | 3.9 | Cont. Grade |
| 560A [2] | D-10R | 5 | 0.0 | 0.0 | Sump |
| 560B [2] | D-10R | 15 | 0.0 | 0.0 | Sump |
| 560C [2] | D-10R | 60 | 8.9 | 0.0 | Sump |
| 560D | D-10R | 4 | 1.9 | 11.6 | Cont. Grade |
| 561 | D-10R | 10.0 | 1.9 | 1.3 | Cont. Grade |
| 562 | D-10R | 10.0 | 7.7 | 23.2 | Cont. Grade |
| 564 | D-10R | 14 | 14.8 | 0.0 | Sump |
| 568 | D-10R | 10.0 | 2.8 | 1.7 | Cont. Grade |
| TOTAL | | | 224.1 | | |

NOTE:
1. Qi = INTERCEPTED FLOWS, Qb = BY-PASS FLOWS.
2. 560A-C INTERCEPT ALL OF BASIN 1.

## B. Developed Drainage Characteristics

HEC-1 Methodology

Basin K1 was subdivided into five basins K1.1, K1.2, K1.3, K1.4A and K1.4B to model the proposed ponds in each of the sub-basins. Runoff for sub-basins K1.1 through K1.3 were each routed through proposed detention ponds D1 through D3, respectively, and discharged directly into the storm sewer system. Basin K1.4A was routed through pond D5 and discharged into the existing concrete trapezoidal channel. A flow of 160cfs was bypassed from Basin K1.4B to model the runoff intercepted in the existing storm sewer. This flow was then added back downstream of pond D4 to determine total basin discharge. The combined discharge from the existing 48-inch storm sewer and detention ponds D4 and D5 is essentially equivalent to the historic flow calculated at Design Point B.

Basin K1.1 has a 100-year peak discharge of 125 cfs and is routed through pond D1. A reduced flow of 25 cfs is discharged into the existing storm sewer and routed to Design Point A.

Basin K1.2 has a 100-year peak discharge of 46 cfs and is routed through pond D2. A reduced flow of 12 cfs is discharged into the existing storm sewer to Design Point A.

Design Point A is the combined flow from Basin K1.1 and K1.2. The 100-year peak flow at Design Point A is 36 cfs and is routed to Design Point B via an existing 48-inch storm sewer.

Basin K1.3 has a 100-year peak discharge of 93 cfs and is routed through pond D3. A reduced flow of 23 cfs is discharged into an existing inlet 38B and routed to Design Point B.

Basin K1.4B has a 100-year peak discharge of 293 cfs. This flow is reduced by 160 cfs, which represents surface flow intercepted by the existing storm sewer (surcharged). The remaining 133 cfs is routed through pond D4. A reduced flow of 57cfs discharges directly into the existing 48-inch storm sewer near inlet 564 along the K-Mart property and is routed to Design Point B. Hydraulic calculations have been prepared for the 48-inch storm sewer adjacent to the K-Mart property and are included in Appendix I. These calculations assume the concrete channel at the outlet of the basin will be flowing full, creating a tail water on the 48-inch storm sewer. Friction loss calculations assumed the 48-inch storm sewer conveys the routed peak flow of 277 cfs, 294 cfs basin discharge less the Pond D5 discharge of 17 cfs. These calculations indicate conveyance of the full flow (277 cfs) with a freeboard of 0.62 ft. at the manhole near inlet 564.

Basin K1.4A has a 100-year peak discharge of 66 cfs and is routed through pond D5. A reduced flow of 17 cfs combines with a full pipe flow of 277 cfs (surcharged) from the existing 48-inch storm sewer. The total routed flow of 294 cfs, which is essentially equivalent to the calculated historic flow of 293 cfs, at Design Point B discharges into the existing offsite concrete trapezoidal channel. Any emergency overflow from Detention Pond D4 would follow an overland route along the K-mart property.

HEC-1 calculations for the 5-year storm did not meet the historic flows at Design Point B due to the hydraulic performance of the detention ponds. It is anticipated that the ponds will function during design storms greater than the 5-year.

Rational Method Methodology

The Rational Method for runoff was calculated to determine the performance of the existing inlets with the proposed ponds in place. The basins were reconfigured to reflect the runoff that would be intercepted by the drainage inlets. By reducing the area contributing to the inlets, the overall interception of runoff was improved and flooding at the intersection of Printers Parkway and International Circle was within acceptable drainage criteria levels. Table 5 and 6 is a summary of the inlet capacities for the 5-year and 100-year storms. Calculations are located in appendix H.

**TABLE 5**
**INLET CAPACITIES: 5-Year Storm: with Pond Improvements**

| INLET NO. | TYPE | LENGTH | Qi | Qb | CONDITION |
|---|---|---|---|---|---|
| | | (ft) | (cfs) | (cfs) | |
| 13 | D-10R | 8.0 | 3.8 | 8.4 | Cont. Grade |
| 22 | D-10R | 8.0 | 2.5 | 5.4 | Cont. Grade |
| 29 | D-10R | 6.0 | 10.4 | 0.0 | Sump |
| 29A | D-10R | 15.0 | 9.3 | 0.0 | Virtual Sump |
| 32 | D-10R | 8.0 | 1.8 | 0.8 | Cont. Grade |
| 34 | D-10R | 8.0 | 13.3 | 31.1 | Cont. Grade |
| 38 | D-10R | 6 | 6.8 | 23.9 | Cont. Grade |
| 38A | D-10R | 10 | 29.4 | 7.6 | Sump |
| 38B | D-10R | 10 | 29.4 | 7.6 | Sump |
| 40 | D-10R | 8 | 6.8 | 29.0 | Cont. Grade |
| 40A | D-10R | 10 | 8.4 | 0.0 | Sump |
| 41 | D-10R | 20 | 10.9 | 6.6 | Cont. Grade |
| 43 | D-10R | 8 | 5.8 | 28.4 | Cont. Grade |
| 44 | D-10R | 10 | 5.5 | 7.9 | Cont. Grade |
| 560 | D-10R | 4.0 | 0.8 | 2.7 | Cont. Grade |
| 560A | D-10R | 5 | 0.0 | 0.0 | Sump |
| 560B | D-10R | 15 | 0.0 | 0.0 | Sump |
| 560C | D-10R | 6 | 8.9 | 0.0 | Sump |
| 560D | D-10R | 4 | 0.6 | 2.3 | Cont. Grade |
| 561 | D-10R | 10.0 | 1.9 | 1.3 | Cont. Grade |
| 562 | D-10R | 10.0 | 7.7 | 23.2 | Cont. Grade |
| 564 | D-10R | 14 | 14.8 | 0.0 | Sump |
| 568 | D-10R | 10.0 | 2.8 | 1.7 | Cont. Grade |
| TOTAL | | | 181.6 | | |
| NOTE: | | | | | |
| 1. Qi = INTERCEPTED FLOWS, Qb = BY-PASS FLOWS | | | | | |
| 2. 560A-C INTERCEPT ALL OF BASIN 1. | | | | | |
| | | | | | |
| | | | | | |

**TABLE 6**
**INLET CAPACITIES: 100-Year Storm: with Pond Improvements**

| INLET NO. | TYPE | LENGTH (ft) | Qi (cfs) | Qb (cfs) | CONDITION |
|---|---|---|---|---|---|
| 13 | D-10R | 8.0 | 4.5 | 16.1 | Cont. Grade |
| 22 | D-10R | 8.0 | 3.9 | 9.9 | Cont. Grade |
| 29 | D-10R | 6.0 | 17.6 | 20.9 | Sump |
| 29A | D-10R | 15.0 | 13.0 | 3.7 | Virtual Sump |
| 32 | D-10R | 8.0 | 6.4 | 13.5 | Cont. Grade |
| 34 | D-10R | 8.0 | 19.4 | 61.5 | Cont. Grade |
| 38 | D-10R | 6 | 11.9 | 54.3 | Cont. Grade |
| 38A | D-10R | 10 | 29.4 | 38.0 | Sump |
| 38B | D-10R | 10 | 29.4 | 38.0 | Sump |
| 40 | D-10R | 8 | 9.1 | 60.9 | Cont. Grade |
| 40A | D-10R | 10 | 14.5 | 0.0 | Sump |
| 41 | D-10R | 20 | 15.6 | 14.7 | Cont. Grade |
| 43 | D-10R | 8 | 8.7 | 53.9 | Cont. Grade |
| 44 | D-10R | 10 | 6.7 | 16.5 | Cont. Grade |
| 560 | D-10R | 4.0 | 1.1 | 4.9 | Cont. Grade |
| 560A | D-10R | 5 | 0.0 | 0.0 | Sump |
| 560B | D-10R | 15 | 0.0 | 0.0 | Sump |
| 560C | D-10R | 6 | 15.3 | 0.0 | Sump |
| 560D | D-10R | 4 | 1.0 | 4.2 | Cont. Grade |
| 561 | D-10R | 10.0 | 2.9 | 2.6 | Cont. Grade |
| 562 | D-10R | 10.0 | 11.2 | 42.2 | Cont. Grade |
| 564 | D-10R | 14 | 23.0 | 2.7 | Sump |
| 568 | D-10R | 10.0 | 2.8 | 1.7 | Cont. Grade |
| TOTAL | | | 247.4 | | |

NOTE:

1. Qi = INTERCEPTED FLOWS, Qb = BY-PASS FLOWS.

2. 560A-C INTERCEPT ALL OF BASIN 1.

The performance of the existing inlets improved significantly. Runoff into the detention ponds reduced surface runoff in the roadways and was modeled to discharge directly into the existing storm sewer. For the 5-year storm, 100% of runoff was intercepted at the west intersection of Printers Parkway and International Circle (inlet 29). Excess flows not intercepted by inlets on the east side of the intersection continued to flow to the east to a low point at inlet 38A and 38B. Excess runoff north of inlet 38A and 38B along International Circle also continues to flow to the low point. A flow of 15.3 cfs will overtop the inlets and be conveyed from the low point to proposed pond D4 via a proposed channel. A preliminary design of this channel is that of a V-ditch with 5:1 sides, 2-foot depth and 20 foot top width. The channel slope is ± 0.90% to the outlet of Detention Pond D4.

During the 100-year storm, 20.9 cfs will crown the intersection of Printers Parkway and International Circle at a depth of 2.8 inches and a width of 53.8 feet. Flow will continue to inlet 38A and 38B. An excess flow of 79.4 cfs will overtop the inlets and will be conveyed to the proposed detention pond D4 via a curb cut and trapezoidal overflow swale graded from the inlets to pond D4.

## C. Proposed Facilities

Detention Pond

Due to the partial development of the site and multiple site owners within the development, a single location for a detention pond was not feasible. A series of five detention ponds ranging in size from approximately 1.5 to 4 acre-feet is proposed to maintain historic flows at Design Point B. Detention ponds D1 and D2 will reduce peak flow within basin K1.1 and K1.2, respectively. These two ponds are important to reduce the flooding of the intersection of Printers Parkway and International Circle to within criteria. Pond D1 is the largest pond (4 acre-feet) because Basin K1.1 is the largest basin west of Printers Parkway. Detention Pond D3 reduces peak flow within Basin K1.3. These ponds will discharge directly into the existing storm sewer and outfall into the existing trapezoidal concrete lined ditch at Design Point B. Detention Pond D4 will accept flow from International Circle that overtops inlets 38A and 38B. This pond will discharge to the existing storm sewer. Any emergency overflow will travel east adjacent to the north boundary of the K-Mart property with an ultimate outfall to the existing concrete trapezoidal channel at Design Point B. The fifth pond, D5, will be located at the southeast area of the site and will discharge directly into the existing channel. Table 7 is a summary of pond volume requirements.

**TABLE 7**
**SUMMARY OF POND REQUIREMENTS**

| POND | Req'd Volume (acre-feet) |
|---|---|
| D1 | 4 |
| D2 | 1.5 |
| D3 | 2.0 |
| D4 | 3.5 |
| D5 | 1.5 |
| **TOTAL** | **12.5** |

Parking lot detention is anticipated at pond sites D1, D2 and D3 due to the limited area available within the development. Due to its size, pond D1 is likely to also require detention to be incorporated into site landscaping. It is anticipated that approximately 1 acre of landscaped area throughout Basin K1.1 will be required for detention with an average detention depth of 3 feet (3 acre-feet) and one acre of parking detention with and average depth of 12 inches (1 acre-foot) for a total detention within Basin K1.1 of 4 acre-feet. Ponds D4 and D5 will be designed into site landscaping. Each pond will consist of a landscaped berm to capture runoff and detain flows on site. Landscaped berms will consist of erosion resistant material and will accommodate the outlet structure required for each pond. It is anticipated that a depth of 18 inches will not be exceeded within the inundated area of the parking lots.

The outlet structures will consist of inlets or culverts and risers with a trash rack. An emergency spillway capable of passing the 100-year flow will be constructed above the outlet structure should the pipes become inoperable. The weir and downstream face will be protected with an erosion resistant material.

The detention ponds will be private structures. Each property owner will be responsible for the daily maintenance and operation of the detention pond facilities as outlined in private maintenance agreements. This will include the removal of sediment and trash build up.

Drainage Channels

Drainage channel improvements will be required to convey overflow at inlet 38A and 38B to pond D4. The channel will consist of a trapezoidal section with a W=4', Z=5', and a depth of approximately 2.0'. A slope of 2.0% is anticipated given the existing topography. Channel velocities will not exceed 7.0 fps. It is anticipated that channel protection and check dam structures will be required in specific areas to prevent the degradation of the channels. The proposed channel will discharge into proposed pond D4.

The channel from inlets 38A and 38B will be constructed as part of pond D4 construction. The emergency overflow along the K-mart property will be constructed as part of the development of the proposed District 11 Alternative School Site adjacent to the K-mart property.

## VII. EROSION CONTROL

### A. General Concept

Historically, erosion on this property has been held to a minimum primarily by substantial prairie grass growth. Printers Park Development will minimize site erosion by employing best management practices during construction. Final erosion control plans will be prepared with final plan submittals.

### B. Detention Pond

The detention ponds, once in place, will act as the primary erosion control facility for the areas upstream. Runoff will be diverted into detention ponds where practical. The pond will serve dual purposes in facilitating the settling of sediment in runoff during and after construction and maintaining runoff to historic levels.

### C. Silt Fencing

Silt Fencing will be placed along limits of disturbed areas. This will prevent suspended sediment from leaving the site during infrastructure construction. Silt fencing is to remain in place until vegetation is reestablished after completion of construction.

### D. Erosion Bales

Erosion bales will be placed 10' from the inlet of all culverts during construction to prevent culverts from filling with sedimentation. Erosion bales will remain in place until vegetation is reestablished. Erosion bale ditch checks will be used on slopes greater than 1% to reduce flow velocities until vegetation is reestablished.

### E. Miscellaneous

Best erosion control practices will be utilized as deemed necessary by the Contractor or Engineer and is not limited to the measures described above.

# APPENDICES

EXHIBIT 5.3-1
URS Consultants, Inc.
CALCULATION COVER SHEET

Client: TSchultz + Keys Project Name: Pranke Park

Project/Calculation Number: 32234

Title: HEC-1 Historic 5/100 YR

Total number of pages (including cover sheet): 12

Total number of computer runs: 2

Prepared by: R. Saunders Date: 2/18/97

Checked by: Charles K. Cathers Date: 3/20/97

Description and Purpose:

Determine Historic Developed Runoff.

Design bases/references/assumptions:

City/County Criteria.

Remarks/conclusions:

| | 5 YR | 100 YR |
|---|---|---|
| HISTORIC | 101 | 291 |

Calculation Approved by: Charles K. Cathers 3/28/97

Project Manager/Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

QAM 5.3 - 03/18/96

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*     BY THE COE IN FEBRUARY 1981      *
*         REVISED 02 AUG 83            *
*                                      *
*  RUN DATE  02/19/1997  TIME  10:09:41 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    DODSON AND ASSOCIATES, INC.       *
*  HYDROLOGIST AND CIVIL ENGINEERS     *
*     7015 W TIDWELL SUITE 107         *
*      HOUSTON, TEXAS  77092           *
*         (713) 895-8322               *
*                                      *
****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT



```
LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1            ID        URS GREINER PROJECT NO 42229 - PRINTERS PARK MOOP
  2            ID        PRESENT DAY HYDROLOGY FOR BASIN K-1 OF SPRING CREEK DBPS
  3            ID        USING THE 5 YEAR / 24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
  4            ID        INPUT FILE: K1-524H.INP  PRESENT DAY "HISTORIC"
  5            ID        RUN DATE: 02-11-97
  6            ID
               *DIAGRAM
  7            IT       5 11FEB97     800     300
  8            IO       5

  9            KK     K-1
 10            KM        RUNOFF FROM BASIN K-1
 11            BA    .228
 12            LS       0       74
 13            UD     .24
 14            IN      15
 15            PB       0
 16            PC   0.000   0.001   0.004   0.008   0.012   0.016   0.022   0.027   0.032   0.039
 17            PC   0.045   0.051   0.057   0.063   0.069   0.075   0.086   0.105   0.124   0.143
 18            PC   0.162   0.203   0.270   1.080   1.890   1.958   2.025   2.066   2.106   2.133
 19            PC   2.160   2.187   2.214   2.228   2.241   2.255   2.268   2.282   2.295   2.309
 20            PC   2.322   2.332   2.342   2.353   2.363   2.371   2.383   2.393   2.403   2.413
 21            PC   2.423   2.434   2.444   2.452   2.461   2.470   2.479   2.487   2.495   2.503
 22            PC   2.511   2.518   2.525   2.531   2.538   2.545   2.552   2.558   2.565   2.572
 23            PC   2.579   2.585   2.592   2.599   2.606   2.612   2.619   2.626   2.633   2.639
 24            PC   2.646   2.650   2.653   2.656   2.660   2.663   2.666   2.670   2.673   2.677
 25            PC   2.680   2.683   2.687   2.690   2.693   2.697   2.700
 26            ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

| INPUT LINE NO. | (V) ROUTING | (--->) DIVERSION OR PUMP FLOW |
|---|---|---|
| | (.) CONNECTOR | (<---) RETURN OF DIVERTED OR PUMPED FLOW |
| 9 | K-1 | |

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*     BY THE COE IN FEBRUARY 1981      *
*         REVISED 02 AUG 88            *
*                                      *
* RUN DATE  02/19/1997  TIME  10:09:41 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    DODSON AND ASSOCIATES, INC.       *
*  HYDROLOGIST AND CIVIL ENGINEERS     *
*    7015 W TIDWELL SUITE 107          *
*      HOUSTON, TEXAS  77092           *
*        (713) 895-8322                *
*                                      *
****************************************
```

```
                    URS GREINER PROJECT NO 42229 - PRINTERS PARK MOOP
                    PRESENT DAY HYDROLOGY FOR BASIN K-1 OF SPRING CREEK DBPS
                    USING THE 5 YEAR / 24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
                    INPUT FILE: K1-524H.INP  PRESENT DAY "HISTORIC"
                    RUN DATE: 02-11-97

 8 IO         OUTPUT CONTROL VARIABLES
                    IPRNT            5  PRINT CONTROL
                    IPLOT            0  PLOT CONTROL
                    QSCAL           0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                     NMIN            5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      11FEB97  STARTING DATE
                    ITIME         0800  STARTING TIME
                       NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      12FEB97  ENDING DATE
                   NDTIME         0855  ENDING TIME
                    ICENT           19  CENTURY MARK

               COMPUTATION INTERVAL    .08 HOURS
                    TOTAL TIME BASE  24.92 HOURS

       ENGLISH UNITS
           DRAINAGE AREA           SQUARE MILES
           PRECIPITATION DEPTH     INCHES
           LENGTH, ELEVATION       FEET
           FLOW                    CUBIC FEET PER SECOND
           STORAGE VOLUME          ACRE-FEET
           SURFACE AREA            ACRES
           TEMPERATURE             DEGREES FAHRENHEIT
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|
| HYDROGRAPH AT | K-1 | 101. | 6.17 | 13. | 4. | 4. | .23 | | |

*** NORMAL END OF HEC-1 ***

```
****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *      DODSON AND ASSOCIATES, INC.     *
*     BY THE COE IN FEBRUARY 1981      *                    *   HYDROLOGIST AND CIVIL ENGINEERS    *
*          REVISED 02 AUG 88           *                    *       7015 W TIDWELL SUITE 107       *
*                                      *                    *        HOUSTON, TEXAS  77092         *
* RUN DATE  02/19/1997  TIME  10:12:29 *                    *           (713) 895-8322             *
*                                      *                    *                                      *
****************************************                    ****************************************


                         X     X  XXXXXXX   XXXXX           X
                         X     X  X        X     X         XX
                         X     X  X        X                X
                         XXXXXXX  XXXX     X       XXXXX    X
                         X     X  X        X                X
                         X     X  X        X     X          X
                         X     X  XXXXXXX   XXXXX          XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
```

HEC-1 INPUT



```
LINE     ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1      ID        URS GREINER PROJECT NO 42229 - PRINTERS PARK MDDP
  2      ID        PRESENT DAY HYDROLOGY FOR BASIN K-1 OF SPRING CREEK DBPS
  3      ID        USING THE 100 YEAR/24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
  4      ID        INPUT FILE: K110024H.INP  PRESENT DAY "HISTORIC"
  5      ID        RUN DATE: 02/11/97
  6      ID
         *DIAGRAM
  7      IT      5 11FEB97     800     300
  8      IO      5

  9      KK    K-1
 10      KM        RUNOFF FROM BASIN K-1
 11      BA   .223
 12      LS      0      74
 13      UD    .24
 14      IN     15
 15      PB      0
 16      PC  0.000   0.002   0.007   0.013   0.020   0.026   0.035   0.044   0.053   0.063
 17      PC  0.073   0.083   0.092   0.103   0.112   0.122   0.141   0.172   0.202   0.233
 18      PC  0.264   0.330   0.440   1.760   3.080   3.190   3.300   3.366   3.432   3.476
 19      PC  3.520   3.564   3.608   3.630   3.652   3.674   3.696   3.718   3.740   3.762
 20      PC  3.784   3.801   3.817   3.834   3.850   3.867   3.883   3.900   3.916   3.933
 21      PC  3.949   3.966   3.982   3.997   4.011   4.025   4.039   4.052   4.066   4.079
 22      PC  4.092   4.103   4.114   4.125   4.136   4.147   4.158   4.169   4.180   4.191
 23      PC  4.202   4.213   4.224   4.235   4.246   4.257   4.268   4.279   4.290   4.301
 24      PC  4.312   4.318   4.323   4.329   4.334   4.340   4.345   4.351   4.356   4.362
 25      PC  4.367   4.373   4.378   4.384   4.389   4.395   4.400
 26      ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9          K-1

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
**************************************
*                                    *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1) *
*    BY THE COE IN FEBRUARY 1981     *
*       REVISED 02 AUG 88            *
*                                    *
* RUN DATE  02/19/1997  TIME 10:12:29 *
*                                    *
**************************************
```

```
**************************************
*                                    *
*   GOODSON AND ASSOCIATES, INC.     *
* HYDROLOGIST AND CIVIL ENGINEERS    *
*    7015 W TIDWELL SUITE 107        *
*     HOUSTON, TEXAS  77092          *
*       (713) 895-8322               *
*                                    *
**************************************
```

```
                URS GREINER PROJECT NO 42229 - PRINTERS PARK MDDP
                PRESENT DAY HYDROLOGY FOR BASIN K-1 OF SPRING CREEK DBPS
                USING THE 100 YEAR/24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
                INPUT FILE: K110024H.INP  PRESENT DAY "HISTORIC"
                RUN DATE: 02/11/97

  8 IO         OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT         HYDROGRAPH TIME DATA
                      NMIN          5  MINUTES IN COMPUTATION INTERVAL
                     IDATE    11FEB97  STARTING DATE
                     ITIME       0800  STARTING TIME
                        NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE    12FEB97  ENDING DATE
                    NDTIME       0855  ENDING TIME
                     ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL     .08 HOURS
                     TOTAL TIME BASE   24.92 HOURS

        ENGLISH UNITS
            DRAINAGE AREA            SQUARE MILES
            PRECIPITATION DEPTH      INCHES
            LENGTH, ELEVATION        FEET
            FLOW                     CUBIC FEET PER SECOND
            STORAGE VOLUME           ACRE-FEET
            SURFACE AREA             ACRES
            TEMPERATURE              DEGREES FAHRENHEIT
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|
| HYDROGRAPH AT | K-1 | 293. | 6.08 | 37. | 12. | 11. | .23 | | |

*** NORMAL END OF HEC-1 ***

APPENDIX B:
HEC-1 Computer Results: Developed Conditions

EXHIBIT 5.3-1
URS Consultants, Inc.
CALCULATION COVER SHEET

Client: T. Schuster Enc. Project Name: Rancho Park HDCP

Project/Calculation Number: 42229

Title: HEC-1 - Developed

Total number of pages (including cover sheet): 12

Total number of computer runs: 2

Prepared by: R Sanchez Date: 8/18/97

Checked by: Charles K. Cotten Date: 3/20/97

Description and Purpose:

Determine Developed Runoff

Design bases/references/assumptions:

City/County Drainage Criteria

Remarks/conclusions:

| | 5 YR | 100 YR |
|---|---|---|
| Developed | 291 | 570 |

Calculation Approved by: Charles K. Cotten 3/20/97

Project Manager/Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*     BY THE COE IN FEBRUARY 1981       *
*          REVISED 02 AUG 88            *
*                                       *
* RUN DATE  02/19/1997  TIME  10:10:41  *
*                                       *
*****************************************

*****************************************
*                                       *
*     DODSON AND ASSOCIATES, INC.       *
*  HYDROLOGIST AND CIVIL ENGINEERS      *
*     7015 W TIDWELL SUITE 107          *
*      HOUSTON, TEXAS  77092            *
*         (713) 895-8322                *
*                                       *
*****************************************


                    X     X  XXXXXXX   XXXXX           X
                    X     X  X        X     X         XX
                    X     X  X        X                X
                    XXXXXXX  XXXX     X         XXXXX  X
                    X     X  X        X                X
                    X     X  X        X     X          X
                    X     X  XXXXXXX   XXXXX          XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
```

```
LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            ID        URS GREINER PROJECT NO 42229 - PRINTERS PARK MDOP
            ID        FULL BUILD  HYDROLOGY FOR BASIN K-1 OF SPRING CREEK OBPS
            ID        USING THE 5 YEAR / 24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
            ID        INPUT FILE: K1-5240.INP: DEVELOPED
            ID        RUN DATE: 02-11-97
            ID
            *DIAGRAM
            IT       5 11FEB97     800     300
            IO       5

            KK     K-1
            KM         RUNOFF FROM BASIN K-1
            BA    .228
            LS       0      91
            UD     .24
            IN      15
            PB       0
            PC   0.000   0.001   0.004   0.008   0.012   0.016   0.022   0.027   0.032   0.039
            PC   0.045   0.051   0.057   0.063   0.069   0.075   0.086   0.105   0.124   0.143
            PC   0.162   0.203   0.270   1.080   1.890   1.958   2.025   2.066   2.106   2.133
            PC   2.160   2.187   2.214   2.228   2.241   2.255   2.268   2.282   2.295   2.309
            PC   2.322   2.332   2.342   2.353   2.363   2.371   2.383   2.393   2.403   2.413
            PC   2.423   2.434   2.444   2.452   2.461   2.470   2.479   2.487   2.495   2.503
            PC   2.511   2.518   2.525   2.531   2.538   2.545   2.552   2.558   2.565   2.572
            PC   2.579   2.585   2.592   2.599   2.606   2.612   2.619   2.626   2.633   2.639
            PC   2.646   2.650   2.653   2.656   2.660   2.663   2.666   2.670   2.673   2.677
            PC   2.680   2.683   2.687   2.690   2.693   2.697   2.700
            ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE     (V) ROUTING     ---    (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR          (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9         K-1

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*     BY THE COE IN FEBRUARY 1981       *
*        REVISED 02 AUG 88              *
*                                       *
*  RUN DATE  02/19/1997  TIME  10:10:41 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    DODSON AND ASSOCIATES, INC.        *
*  HYDROLOGIST AND CIVIL ENGINEERS      *
*    7015 W TIDWELL SUITE 107           *
*      HOUSTON, TEXAS  77092            *
*        (713) 895-8322                 *
*                                       *
*****************************************
```

```
                    URS GREINER PROJECT NO 42229 - PRINTERS PARK MDOP
                    FULL BUILD  HYDROLOGY FOR BASIN K-1 OF SPRING CREEK DBPS
                    USING THE 5 YEAR / 24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
                    INPUT FILE: K1-5240.INP: DEVELOPED
                    RUN DATE: 02-11-97

  8 IO        OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                   NMIN           5  MINUTES IN COMPUTATION INTERVAL
                  IDATE     11FEB97  STARTING DATE
                  ITIME        0800  STARTING TIME
                     NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE     12FEB97  ENDING DATE
                 NDTIME        0855  ENDING TIME
                  ICENT          19  CENTURY MARK

               COMPUTATION INTERVAL    .08 HOURS
                    TOTAL TIME BASE  24.92 HOURS

         ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|
| HYDROGRAPH AT | K-1 | 299. | 6.08 | 37. | 11. | 11. | .23 | | |

*** NORMAL END OF HEC-1 ***

```
****************************************                ****************************************
*                                      *                *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                *   DODSON AND ASSOCIATES, INC.        *
*     BY THE COE IN FEBRUARY 1981      *                * HYDROLOGIST AND CIVIL ENGINEERS      *
*         REVISED 02 AUG 88            *                *   7015 W TIDWELL SUITE 107           *
*                                      *                *    HOUSTON, TEXAS  77092             *
* RUN DATE  02/19/1997  TIME  10:11:57 *                *      (713) 895-8322                  *
*                                      *                *                                      *
****************************************                ****************************************
```

```
                    X     X  XXXXXXX   XXXXX           X
                    X     X  X        X     X         XX
                    X     X  X        X                X
                    XXXXXXX  XXXX     X        XXXXX   X
                    X     X  X        X                X
                    X     X  X        X     X          X
                    X     X  XXXXXXX   XXXXX          XXX
```

```
THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
```

HEC-1 INPUT



```
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

ID        URS GREINER PROJECT NO 42229 - PRINTERS PARK MOOP
ID        FULL BUILD  HYDROLOGY FOR BASIN K-1 OF SPRING CREEK DBPS
ID        USING THE 100 YEAR/24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
ID        INPUT FILE: K110024F.INP: DEVELOPED
ID        RUN DATE: 02/11/97
ID
*DIAGRAM
IT       5 11FE397     800      300
IO       5

KK     K-1
KM        RUNOFF FROM BASIN K-1
BA    .228
LS       0      91
UD     .24
IN      15
PB       0
PC   0.000   0.002   0.007   0.013   0.020   0.026   0.035   0.044   0.053   0.063
PC   0.073   0.083   0.092   0.103   0.112   0.122   0.141   0.172   0.202   0.233
PC   0.264   0.330   0.440   1.760   3.080   3.190   3.300   3.366   3.432   3.476
PC   3.520   3.564   3.608   3.630   3.652   3.674   3.696   3.718   3.740   3.762
PC   3.784   3.801   3.817   3.834   3.850   3.867   3.883   3.900   3.916   3.933
PC   3.949   3.966   3.982   3.997   4.011   4.025   4.039   4.052   4.066   4.079
PC   4.092   4.103   4.114   4.125   4.136   4.147   4.158   4.169   4.180   4.191
PC   4.202   4.213   4.224   4.235   4.246   4.257   4.268   4.279   4.290   4.301
PC   4.312   4.318   4.323   4.329   4.334   4.340   4.345   4.351   4.356   4.362
PC   4.367   4.373   4.378   4.384   4.389   4.395   4.400
ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9          K-1

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*     BY THE COE IN FEBRUARY 1981       *
*         REVISED 02 AUG 88             *
*                                       *
* RUN DATE  02/19/1997  TIME  10:11:57  *
*                                       *
*****************************************

*****************************************
*                                       *
*    DODSON AND ASSOCIATES, INC.        *
*  HYDROLOGIST AND CIVIL ENGINEERS      *
*     7015 W TIDWELL SUITE 107          *
*     HOUSTON, TEXAS  77092             *
*        (713) 895-8322                 *
*                                       *
*****************************************

                    URS GREINER PROJECT NO 42229 - PRINTERS PARK MDOP
                    FULL BUILD  HYDROLOGY FOR BASIN K-1 OF SPRING CREEK DBPS
                    USING THE 100 YEAR/24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
                    INPUT FILE: K110024F.INP: DEVELOPED
                    RUN DATE: 02/11/97

  8 IO         OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT         HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE    11FEB97  STARTING DATE
                    ITIME       0800  STARTING TIME
                       NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE    12FEB97  ENDING DATE
                   NDTIME       0855  ENDING TIME
                    ICENT         19  CENTURY MARK

               COMPUTATION INTERVAL     .08 HOURS
                    TOTAL TIME BASE   24.92 HOURS

       ENGLISH UNITS
            DRAINAGE AREA           SQUARE MILES
            PRECIPITATION DEPTH     INCHES
            LENGTH, ELEVATION       FEET
            FLOW                    CUBIC FEET PER SECOND
            STORAGE VOLUME          ACRE-FEET
            SURFACE AREA            ACRES
            TEMPERATURE             DEGREES FAHRENHEIT
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|
| HYDROGRAPH AT | K-1 | 572. | 6.08 | 70. | 21. | 20. | .23 | | |

*** NORMAL END OF HEC-1 ***

APPENDIX C:
HEC-1 Computer Results: Developed Conditions w/ Ponds

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*      BY THE COE IN FEBRUARY 1981      *
*          REVISED 02 AUG 88            *
*                                       *
*  RUN DATE  09/18/1998  TIME  09:06:04 *
*                                       *
*****************************************
```



```
*****************************************
*                                       *
*      DODSON AND ASSOCIATES, INC.      *
*    HYDROLOGIST AND CIVIL ENGINEERS    *
*      7015 W TIDWELL SUITE 107         *
*        HOUSTON, TEXAS  77092          *
*           (713) 895-8322              *
*                                       *
*****************************************
```



```
X     X  XXXXXXX   XXXXX        X
X     X  X        X     X      XX
X     X  X        X             X
XXXXXXX  XXXX     X     XXXXX   X
X     X  X        X             X
X     X  X        X     X       X
X     X  XXXXXXX   XXXXX       XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM



```
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

ID        URS GREINER PROJECT NO 42229 - PRINTERS PARK MDDP
ID        FULL BUILD  HYDROLOGY FOR BASIN K-1 OF SPRING CREEK DBPS
ID        USING THE 100 YEAR/24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
ID        INPUT FILE: DIVRT160.INP: DEVELOPED
ID        RUN DATE: 09/18/98
ID
*DIAGRAM
IT       5 09SEP98     800     300
IO       5

KK    K1.1
KM        RUNOFF FROM BASIN K1.1
BA   .0415
LS       0      91
UD     .10
IN      15
PB       0
PC   0.000   0.002   0.007   0.013   0.020   0.026   0.035   0.044   0.053   0.063
PC   0.073   0.083   0.092   0.103   0.112   0.122   0.141   0.172   0.202   0.233
PC   0.264   0.330   0.440   1.760   3.080   3.190   3.300   3.366   3.432   3.476
PC   3.520   3.564   3.608   3.630   3.652   3.674   3.696   3.718   3.740   3.762
PC   3.784   3.801   3.817   3.834   3.850   3.867   3.883   3.900   3.916   3.933
PC   3.949   3.966   3.982   3.997   4.011   4.025   4.039   4.052   4.066   4.079
PC   4.092   4.103   4.114   4.125   4.136   4.147   4.158   4.169   4.180   4.191
PC   4.202   4.213   4.224   4.235   4.246   4.257   4.268   4.279   4.290   4.301
PC   4.312   4.318   4.323   4.329   4.334   4.340   4.345   4.351   4.356   4.362
PC   4.367   4.373   4.378   4.384   4.389   4.395   4.400

KK      D1
KM        ROUTE K1.1 THRU D1 W/ 30" RCP
SV       0     2.5       4       5       5       5       5
SQ       0      17      29      40      45      50      50
SE    6060    6062    6063    6064    6065    6066    6068
RS       1    ELEV    6060

KK    D1-A
KM        ROUTE D1    TO DP-A
RK     500     .01    .016            CIRC       4             YES

KK    K1.2
KM        RUNOFF FROM BASIN K1.2
BA   .0152
LS       0      91
UD     .10

KK      D2
KM        ROUTE K1.2 THRU D2 W/ 30" RCP
SV       0       1       2       3       3       3
SQ       0       5      12      22      26      26
SE    6060    6061    6062    6063    6064    6065
RS       1    ELEV    6060
```

```
LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          KK      A
          KM       COMBINE K1.1,K1.2
          HC      2

          KK    A-B1
          KM       ROUTE DPA TO DPB1
          RK    1800   .0188    .025            CIRC       4               YES

          KK    K1.3
          KM       RUNOFF FROM BASIN K1.3
          BA    .031
          LS      0       91
          UD     .10

          KK      D3
          KM       ROUTE K1.3 THRU D3 w/ 30" rcp
          SV      0        2     3.5       4       5       6
          SQ      0       17      29      40      50      50
          SE    6048    6050    6051    6052    6054    6054
          RS      1     ELEV    6048

          KK  K13-B1
          KM       ROUTE K1.3 TO B
          RK    1200   .0188    .025            CIRC       4       0       YES

          KK   K1.4A
          KM       RUNOFF FROM BASIN K1.4A
          BA   .0218
          LS      0       91
          UD     .10

          KK      D5
          KM       ROUTE K1.4A THRU D5 W/ 30" RCP
          SV      0      1.5     2.5     3.5       4       4
          SQ      0        7      25      45      60      60
          SE    6010    6011    6012    6013    6014    6014
          RS      1     ELEV    6010

          KK   K1.4B
          KM       RUNOFF FROM BASIN K1.4B
          BA   .1169
          LS      0       91
          UD     .24

          KK   K1.4B
          KM       DIVERT 160 CFS TO MODEL 48" RCP
          DT   DVK14            160
          DI      0      160
          DQ      0      160
```



```
LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          KK      D4
          KM       ROUTE K1.4B THRU D4 W/2-54" RCP
          SV      0        3       5     6.6       8
          SQ      0       80     180     310     400
          SE    6044    6046    6048    6050    6052
          RS      1     ELEV    6044

          KK   K1.4B
          KM       RETURN DIVERTED FLOW
          DR   DVK14

          KK      B1
          KM       COMBINE K1.1, K1.2, K1.3, K1.4A, K1.4B
          HC      5
          ZZ
```

```
                SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE        (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.        (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9           K1.1
                  V
                  V
  26             D1
                  V
                  V
  32           D1-A
                  .
                  .
  35              .          K1.2
                  .             V
                  .             V
  40              .            D2
                  .             .
                  .             .
  46              A.............
                  V
                  V
  49           A-B1
                  .
                  .
  52              .          K1.3
                  .             V
                  .             V
  57              .            D3
                  .             V
                  .             V
  63              .        K13-B1
                  .             .
                  .             .
  66              .             .          K1.4A
                  .             .              V
                  .             .              V
  71              .             .             D5
                  .             .              .
                  .             .              .
  77              .             .              .          K1.4B
                  .             .              .              .
                  .             .              .              .
  84              .             .              .              .------->  DVK14
  82              .             .              .          K1.4B
                  .             .              .              V
                  .             .              .              V
  87              .             .              .             D4
                  .             .              .              .
                  .             .              .              .
  95              .             .              .              .              .<-------  DVK14
  93              .             .              .              .          K1.4B
                  .             .              .              .              .
                  .             .              .              .              .
  96             B1..........................................................

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*     BY THE COE IN FEBRUARY 1981       *
*         REVISED 02 AUG 88             *
*                                       *
* RUN DATE  09/18/1998  TIME  09:06:04  *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*     DODSON AND ASSOCIATES, INC.       *
*  HYDROLOGIST AND CIVIL ENGINEERS      *
*     7015 W TIDWELL SUITE 107          *
*       HOUSTON, TEXAS  77092           *
*         (713) 895-8322                *
*                                       *
*****************************************
```

```
                    URS GREINER PROJECT NO 42229 - PRINTERS PARK MDDP
                    FULL BUILD  HYDROLOGY FOR BASIN K-1 OF SPRING CREEK DBPS
                    USING THE 100 YEAR/24 HOUR DESIGN STORM FROM CITY/COUNTY CRITERIA
                    INPUT FILE: DIVRT160.INP: DEVELOPED
                    RUN DATE: 09/18/98

8 IO         OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

 IT          HYDROGRAPH TIME DATA
                  NMIN           5  MINUTES IN COMPUTATION INTERVAL
                  IDATE     9SEP98  STARTING DATE
                  ITIME       0800  STARTING TIME
                     NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE    10SEP98  ENDING DATE
                 NDTIME       0855  ENDING TIME
                  ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL    .08 HOURS
                  TOTAL TIME BASE   24.92 HOURS

      ENGLISH UNITS
          DRAINAGE AREA          SQUARE MILES
          PRECIPITATION DEPTH    INCHES
          LENGTH, ELEVATION      FEET
          FLOW                   CUBIC FEET PER SECOND
          STORAGE VOLUME         ACRE-FEET
          SURFACE AREA           ACRES
          TEMPERATURE            DEGREES FAHRENHEIT
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|
| HYDROGRAPH AT | K1.1 | 125. | 6.00 | 13. | 4. | 4. | .04 | | |
| ROUTED TO | D1 | 28. | 6.25 | 12. | 4. | 4. | .04 | 6062.93 | 6.25 |
| ROUTED TO | D1-A | 28. | 6.25 | 12. | 4. | 4. | .04 | | |
| HYDROGRAPH AT | K1.2 | 46. | 6.00 | 5. | 1. | 1. | .02 | | |
| ROUTED TO | D2 | 8. | 6.25 | 4. | 1. | 1. | .02 | 6061.49 | 6.25 |
| 2 COMBINED AT | A | 37. | 6.25 | 16. | 5. | 5. | .06 | | |
| ROUTED TO | A-B1 | 36. | 6.33 | 16. | 5. | 5. | .06 | | |
| HYDROGRAPH AT | K1.3 | 93. | 6.00 | 10. | 3. | 3. | .03 | | |
| ROUTED TO | D3 | 23. | 6.25 | 9. | 3. | 3. | .03 | 6050.53 | 6.25 |
| ROUTED TO | K13-B1 | 23. | 6.25 | 9. | 3. | 3. | .03 | | |
| HYDROGRAPH AT | K1.4A | 66. | 6.00 | 7. | 2. | 2. | .02 | | |
| ROUTED TO | D5 | 17. | 6.25 | 6. | 2. | 2. | .02 | 6011.57 | 6.25 |
| HYDROGRAPH AT | K1.4B | 293. | 6.08 | 36. | 11. | 10. | .12 | | |
| DIVERSION TO | DVK14 | 160. | 6.08 | 29. | 9. | 9. | .12 | | |
| HYDROGRAPH AT | K1.4B | 133. | 6.08 | 7. | 2. | 2. | .12 | | |
| ROUTED TO | D4 | 57. | 6.25 | 7. | 2. | 2. | .12 | 6045.42 | 6.25 |
| HYDROGRAPH AT | K1.4B | 160. | 5.83 | 29. | 9. | 9. | .00 | | |
| 5 COMBINED AT | B1 | 294. | 6.25 | 67. | 21. | 20. | .23 | | |

SUMMARY OF KINEMATIC WAVE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

| ISTAQ | ELEMENT | DT | PEAK | TIME TO PEAK | VOLUME | INTERPOLATED TO COMPUTATION INTERVAL DT | PEAK | TIME TO PEAK | VOLUME |
|---|---|---|---|---|---|---|---|---|---|
| | | (MIN) | (CFS) | (MIN) | (IN) | (MIN) | (CFS) | (MIN) | (IN) |
| D1-A | 3 | .26 | 28.13 | 375.47 | 3.37 | 5.00 | 28.09 | 375.00 | 3.37 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= 7.469 EXCESS= .000 OUTFLOW= 7.468 BASIN STORAGE= .001 PERCENT ERROR= .008

| ISTAQ | ELEMENT | DT | PEAK | TIME TO PEAK | VOLUME | DT | PEAK | TIME TO PEAK | VOLUME |
|---|---|---|---|---|---|---|---|---|---|
| A-B1 | 3 | .99 | 36.53 | 377.19 | 3.37 | 5.00 | 36.31 | 380.00 | 3.37 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= 10.189 EXCESS= .000 OUTFLOW= 10.183 BASIN STORAGE= .004 PERCENT ERROR= .019

| ISTAQ | ELEMENT | DT | PEAK | TIME TO PEAK | VOLUME | DT | PEAK | TIME TO PEAK | VOLUME |
|---|---|---|---|---|---|---|---|---|---|
| K13-B1 | 3 | .72 | 23.40 | 376.26 | 3.38 | 5.00 | 23.35 | 375.00 | 3.38 |

CONTINUITY SUMMARY (AC-FT) - INFLOW= 5.593 EXCESS= .000 OUTFLOW= 5.591 BASIN STORAGE= .001 PERCENT ERROR= .016

*** NORMAL END OF HEC-1 ***

# APPENDIX D:
## HEC-1 Data-Basin Characteristics and Detention Pond Calculations

EXHIBIT 5.3-1
URS Consultants, Inc.
CALCULATION COVER SHEET

Client: Islandview Assoc. Project Name: Timber Lake Mod.

Project/Calculation Number: 48229.01

Title: Basin Characteristics / Prelim Pond Sizing

Total number of pages (including cover sheet): 15

Total number of computer runs: ______

Prepared by: R. Saunders Date: [illegible]

Checked by: [signature] Date: 3/20/97

Description and Purpose:

Determine HEC-1 Basin Characteristics, Prelim Detention Pond Sizing

Design bases/references/assumptions:

Spring Creek DBPs

City/County Drainage Criteria

Remarks/conclusions:

Calculation Approved by: [signature] 3/20/97

Project Manager/Date

| Revision No.: | Description of Revision: | Approved by: |
| --- | --- | --- |
| | | |
| | | |
| | | |

Project Manager/Date

**URS CONSULTANTS, INC.**

URS JOB NO. 5E229 PAGE 2 OF 11
DATE 2/10/97 BY R.S. CHECKED BY G/Kc 3/2?/?
CLIENT T. [illegible]
PROJECT Powers Parkway
SUBJECT HC-1

PROBLEM STATEMENT - P.P. LOCATED IN SPRING CREEK BASIN. AREA TO BE DEVELOPED HAS BEEN PLATTED W/ OUTDATED DRAINAGE CRITERIA.

NEED

1) PRESENT DAY "HISTORIC" FLOWS.
2) ULTIMATE BUILD OUT FLOWS.
3) DETENTION [illegible] REQ'D TO MAINTAIN 100YR HISTORIC FLOWS.

SOL'N

REF: City of Colo. Spg. DRAINAGE CRITERIA. SPRING Creek DBPS. OCT. 1993

1) DETERMINE BASIN CHARACTERISTICS

TOTAL AREA = 153.9 Ac.

EXIST DEVELOPMENT

| | Acres. | CN | |
|---|---|---|---|
| · COMMERCIAL / BUISNESS: | 36.14 | 92 | ✓ |
| · RESIDENTIAL (M.F) | 15.43 | 85 | ✓ |
| · STREETS + ROADS | 14.18 | 98 | ✓ |
| · OPEN SPACE / UNDEVELOPED | 88.15 | 61 | ✓ |
| TOTAL | 153.90 | | |

WEIGHTED CN (PRESENT DAY)

$$\overline{CN} = \frac{36.14(92) + 15.43(85) \quad 14.18(98) + 88.15(61)}{153.90}$$

$\overline{CN} = 74.1$ ✓

# URS CONSULTANTS, INC.

URS JOB NO. 02229 PAGE 3 OF 11
DATE 5/10/97 BY TA CHECKED BY CKC 3/2/11
CLIENT [illegible]
PROJECT [illegible]
SUBJECT HEC-1

FULL BUILDOUT

| | Acres | CN |
|---|---|---|
| COMMERCIAL/BUSINESS | 121.98 | 92 |
| RESIDENTIAL | 15.43 | 85 |
| ROADS | 14.18 | 98 |
| OPEN SPACE | 2.31 | 61 |

$$\overline{CN} = \frac{121.98(92) + 15.43(85) + 14.18(98) + 2.31(61)}{153.9}$$

$\overline{CN} = 91.3$ ← ULTIMATE BUILDOUT

TIME OF CONCENTRATION

Tc = 24.5 MIN → FROM SPRING CREEK DBPS OCT. 1993 BASIN K1

Tc = 0.408 hr

Tlag = 0.244 hr

2) DETERMINE DESIGN STORM PRECIPITATION

FROM FIG 5-4d, 5-4e, 5-6.

100 yr - 24 hr = 4.4 in/hr

5 yr - 24 hr = 2.7 in/hr

3) Determine Direct Runoff for Both.

$$EQN: \quad Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad S = \frac{1000}{CN} - 10$$

"Historic"
$Q_5 = 0.723"$
$Q_{100} = 1.896"$

Full Build
$Q_5 = 1.793"$
$Q_{100} = 3.402"$

4) Determine Detention Storage Req'd.

Assumption: Runoff not to exceed Present Day "Historic" Flows.

Historic $Q_5 = 108$ cfs. $Q_{100} = 309$ cfs.
Full Build $Q_5 = 322$ cfs. $Q_{100} = 603$ cfs.
$\Delta Q_5$: 214 cfs. $\Delta Q_{100}$: 294 cfs.

Volume of Runoff $V_r = Q_{DR} A$

5YR: $V_{r5} = \frac{(1.793")(153.9 Ac)}{12"/FT} = 23.0$ Ac-ft

100YR $V_{r100} = \frac{(3.402)(153.9 Ac)}{12"/FT} = 43.63$ Ac-ft

# URS CONSULTANTS, INC.

URS JOB NO. 42229 PAGE 5 OF 11

DATE 3/4/97 BY RCS. CHECKED BY CK 3/4/97

CLIENT [illegible]

PROJECT [illegible] Park

SUBJECT HEC-1

USING SCS GRAPHICAL METHOD

5 yr $\frac{Q_o}{Q_i} = \frac{108}{322} = 0.335$

$\frac{V_s}{V_r} = .41$

$\therefore V_s = .41(23.0 \text{ Ac-Ft}) = 9.43 \text{ Ac-ft} = 410,770 \text{ ft}^3$

100 yr: $\frac{Q_o}{Q_i} = \frac{310}{610} = 0.508$

$\frac{V_s}{V_r} = .275$

$V_s = .275(43.63 \text{ Ac-Ft}) = 12.0 \text{ Ac-ft} = 522,614 \text{ ft}^3$

∴ Detention STORAGE REQ'D

Assuming Avg. Depth

| | |
|---|---|
| D = 5.0' | A = 2.4 Ac |
| = 6.0' | A = 2.0 Ac |
| = 7.0' | A = 1.71 Ac |

**URS**
CONSULTANTS, INC.

URS JOB NO. 4992a PAGE 5a OF 11
DATE 2/1/6 BY [illegible] CHECKED BY [illegible] 3/2/
CLIENT [illegible]
PROJECT [illegible]
SUBJECT [illegible]

DETERMINE STORAGE AVAILABLE

DET 1.

| Elev | Area | Volume | Ac. ft | 42" Hw/D | 42" Q | 54" Hw/D | 54" Q | 60" Hw/D | 60" Q |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 5200 | 0 | 0 | | | | | | |
| 2 | 15,000 | 23,200 | .53 | 0 | 0 | 0 | 0 | 0 | |
| 4 | 36,800 | 78,000 | 1.79 | .5 | 25 | .44 | 30 | .4 | 40 |
| 6 | 65,200 | 180,000 | 4.13 | 1 | 70 | .89 | 85 | .7 | 70 |
| 8 | 90,000 | 335,200 | 7.69 | 1.5 | 110 | 1.3 | 130 | 1.2 | 155 |
| | | | | 2.0 | 140 | 1.8 | 180 | 1.6 | 200 |

DET 2

| Elev | Area | Volume | Ac-ft |
|---|---|---|---|
| 0 | 3600 | 0 | 0 |
| 2 | 9200 | 12,800 | .29 |
| 4 | 22800 | 44800 | 1.0 |
| 6 | 40,000 | 107,600 | 2.5 |
| 8 | 56,000 | 203,600 | 4.67 |

30"

| Hw/D | Q |
|---|---|
| 0.5 | 7 |
| 1.0 | 22 |
| 1.5 | 35 |
| 2.0 | 45 |
| 2.5 | 55 |

6/11
CKC 1/12

# TABLE 5-5
## RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL COVER COMPLEXES - URBAN AND SUBURBAN CONDITIONS 1/
(Antecedent Moisture Condition II)
(From: U.S. Dept. of Agriculture, Soil Conservation Service, 1977)

| Land Use | | Hydrologic Soil Group A | B | C | D |
|---|---|---|---|---|---|
| Open spaces, lawns, parks, golf courses, cemeteries, etc. | | | | | |
| Good condition: grass cover on 75% or more of the area | | 39* | 61 | 74 | 80 |
| Fair condition: grass cover on 50% to 75% of the area | | 49* | 69 | 79 | 84 |
| * Commercial and Business areas (85% Impervious) | | 89* | 92 | 94 | 95 |
| Industrial Districts 72% Impervious) | | 81* | 88 | 91 | 93 |
| Residential: 2/ | | | | | |
| Acres per Dwelling Unit | Average % Impervious 3/ | | | | |
| * 1/8 acre or less | 65 | 77* | 85 | 90 | 92 |
| 1/4 acre | 38 | 61* | 75 | 83 | 87 |
| 1/3 acre | 30 | 57* | 72 | 81 | 86 |
| 1/2 acre | 25 | 54* | 70 | 80 | 85 |
| 1 acre | 20 | 51* | 68 | 79 | 84 |
| Paved parking lots, roofs, driveways, etc. | | 98 | 98 | 98 | 98 |
| * Streets and Roads: | | | | | |
| paved with curbs and storm sewers | | 98 | 98 | 98 | 98 |
| gravel | | 76* | 85 | 89 | 91 |
| dirt | | 72* | 82 | 87 | 89 |

1/ For a more detailed description of agricultural land use curve numbers, refer to the National Engineering Handbook (U.S. Dept. of Agriculture, Soil Conservation Service, 1972).
2/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.
3/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

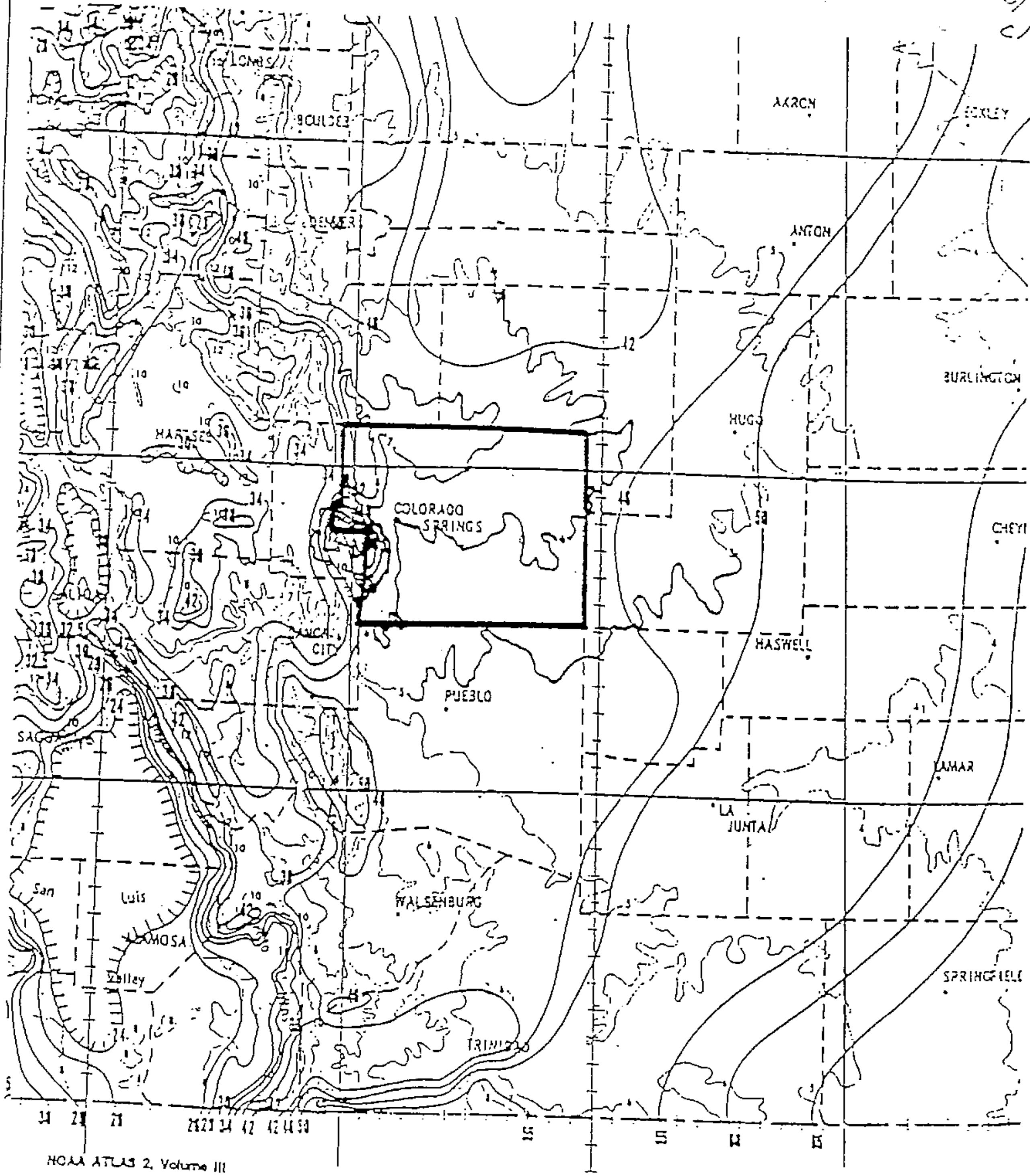
* Not to be used wherever overlot grading or filling is to occur.

7/11
CKC 3/2/13

TABLE 5-4
RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL
COVER COMPLEXES - RURAL CONDITIONS
(Antecedent Moisture Condition II, and Ia = 0.2 S)
(From: U.S. Dept. of Agriculture,
Soil Conservation Service, 1977)

| Land Use | Cover Treatment or Practice | Hydrologic Condition | Runoff Curve Number by Hydrologic Soil Group A | B | C | D |
|---|---|---|---|---|---|---|
| Fallow | Straight Row | ---- | 77 | 86 | 91 | 94 |
| Row Crops | Straight Row | Poor | 72 | 81 | 88 | 91 |
| | Straight Row | Good | 67 | 78 | 85 | 89 |
| | Contoured | Poor | 70 | 79 | 84 | 88 |
| | Contoured | Good | 65 | 75 | 82 | 86 |
| | Cont. & Terraced | Poor | 66 | 74 | 80 | 82 |
| | Cont. & Terraced | Good | 62 | 71 | 78 | 81 |
| Small Grain | Straight Row | Poor | 65 | 76 | 84 | 88 |
| | Straight Row | Good | 63 | 75 | 83 | 87 |
| | Contoured | Poor | 63 | 74 | 82 | 85 |
| | Contoured | Good | 61 | 73 | 81 | 84 |
| | Cont. & Terraced | Poor | 61 | 72 | 79 | 82 |
| | Cont. & Terraced | Good | 59 | 70 | 78 | 81 |
| Close-seeded legumes 1/ or rotation meadow | Straight Row | Poor | 66 | 77 | 85 | 89 |
| | Straight Row | Good | 58 | 72 | 81 | 85 |
| | Contoured | Poor | 64 | 75 | 83 | 85 |
| | Contoured | Good | 55 | 69 | 78 | 83 |
| | Cont. & Terraced | Poor | 63 | 73 | 80 | 83 |
| | Cont. & Terraced | Good | 51 | 67 | 76 | 80 |
| Pasture or range | | Poor | 68 | 79 | 86 | 89 |
| | | Fair | 49 | 69 | 79 | 84 |
| | | Good | 39 | 61 | 74 | 80 |
| | Contoured | Poor | 47 | 67 | 81 | 88 |
| | Contoured | Fair | 25 | 59 | 75 | 83 |
| | Contoured | Good | 6 | 35 | 70 | 79 |
| Meadow | | Good | 30 | 58 | 71 | 78 |
| Woods | | Poor | 45 | 66 | 77 | 83 |
| | | Fair | 36 | 60 | 73 | 79 |
| | | Good | 25 | 55 | 70 | 77 |
| Farmsteads | | ---- | 59 | 74 | 82 | 86 |
| Roads (dirt) 2/ | | ---- | 72 | 82 | 87 | 89 |
| (hard surface) 2/ | | ---- | 74 | 84 | 90 | 92 |

1/ Close-drilled or broadcast
2/ Including right-of-way




NOAA ATLAS 2, Volume III
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

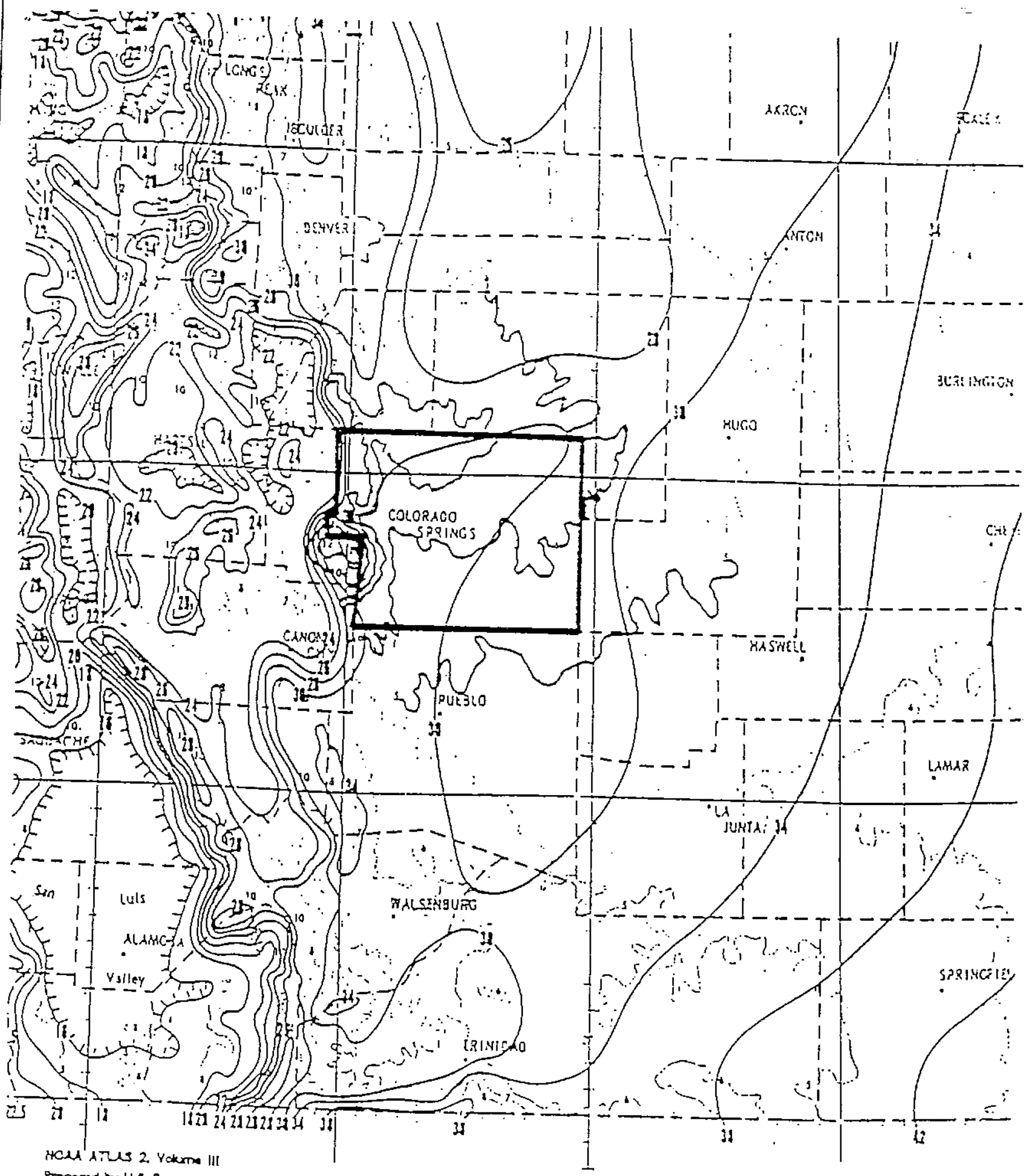
ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date
OCT. 1987

Figure
5-4 e




NOAA ATLAS 2, Volume III
Prepared by U.S. Department of Commerce
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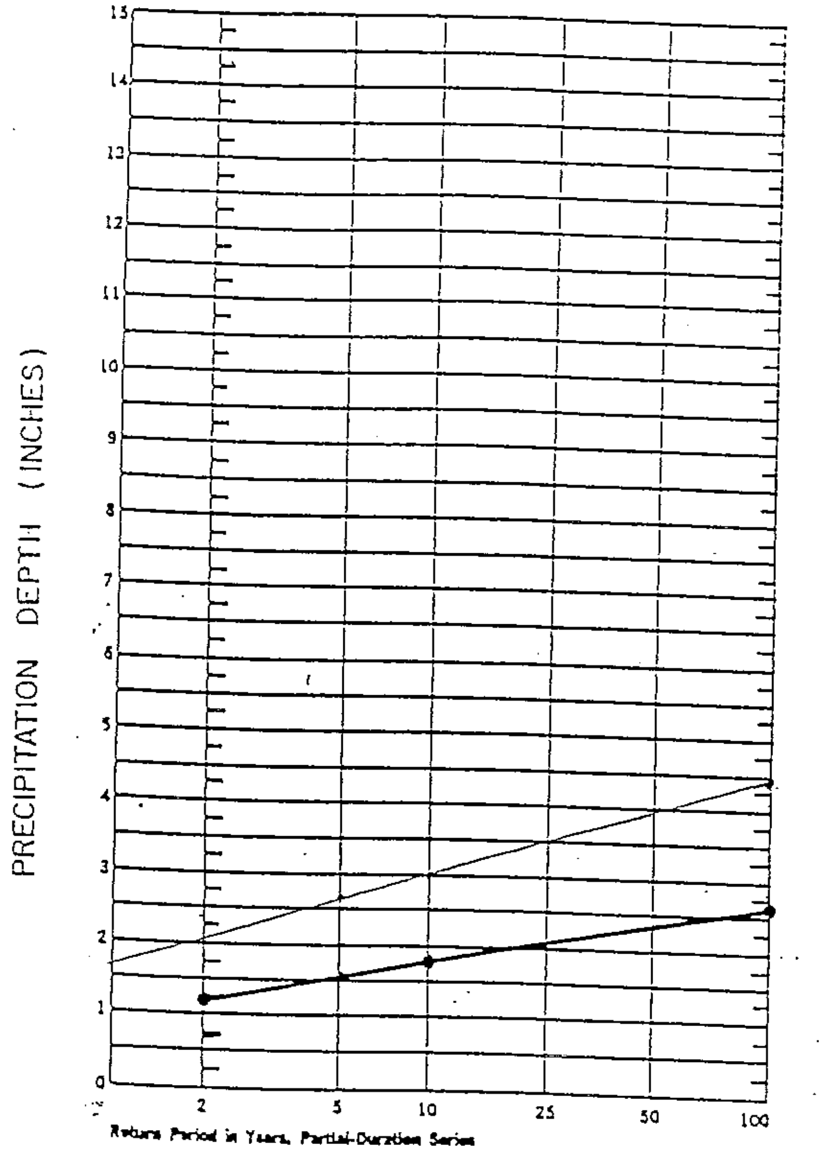
Date
OCT. 1987

Figure
5-4d




100yr/24hr = 4.4 in/hr
10yr/24hr: 3.0 in/hr
5yr/24hr: 2.7 in/hr

## EXAMPLE

2 yr. 1 hr rainfall (calculated) = 1.19"
100 yr. 1 hr rainfall (calculated) = 2.64"
10 yr. 1 hr rainfall (interpolated) = 1.78"

REFERENCE : NOAA Atlas 2, Volume 3 – Colorado

NOTE: This example is for Colorado Springs as indicated on the Isopluvials.

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date: OCT. 1987

RAINFALL DEPTH – DURATION RELATIONSHIP

Figure 5 – 6

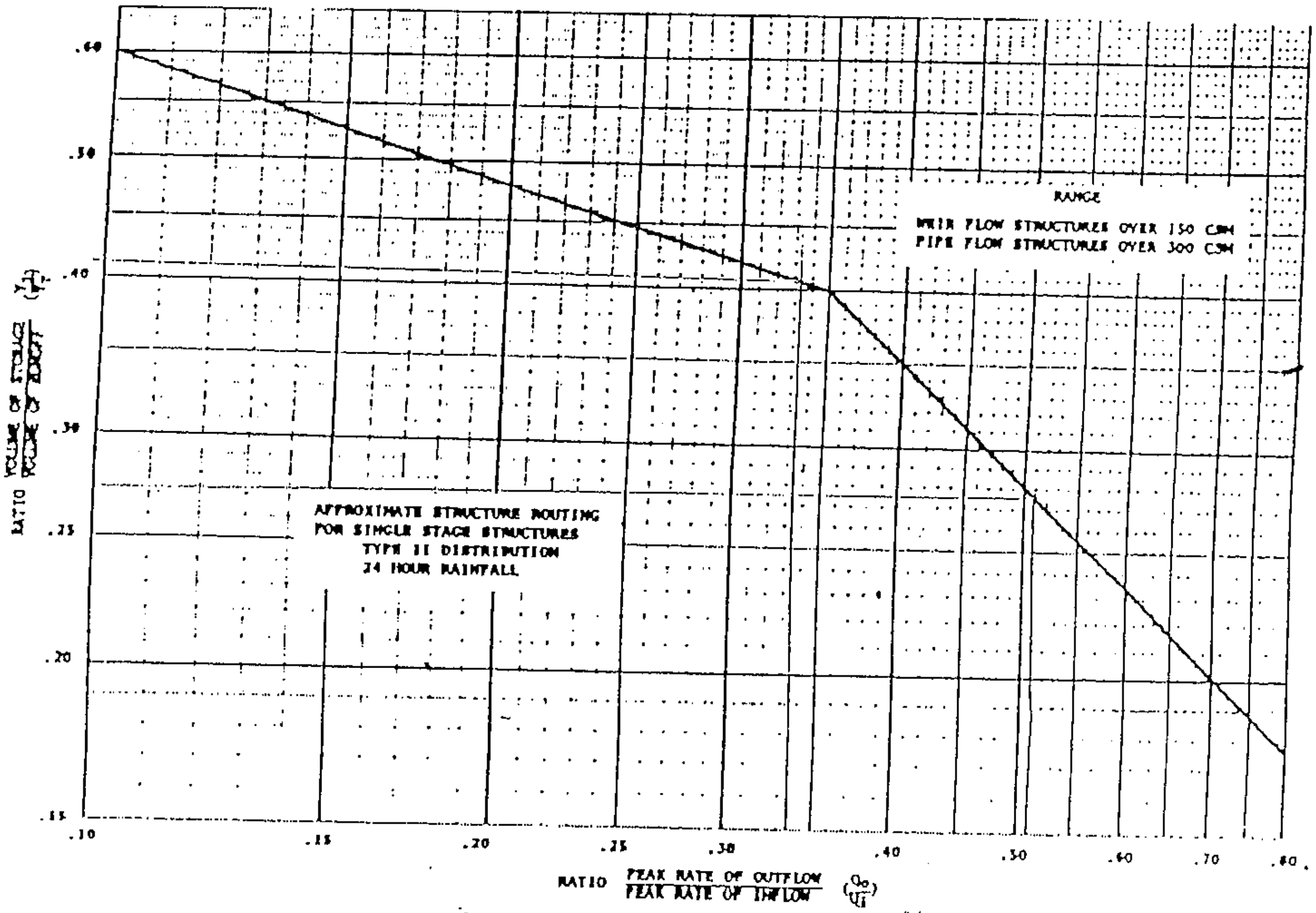
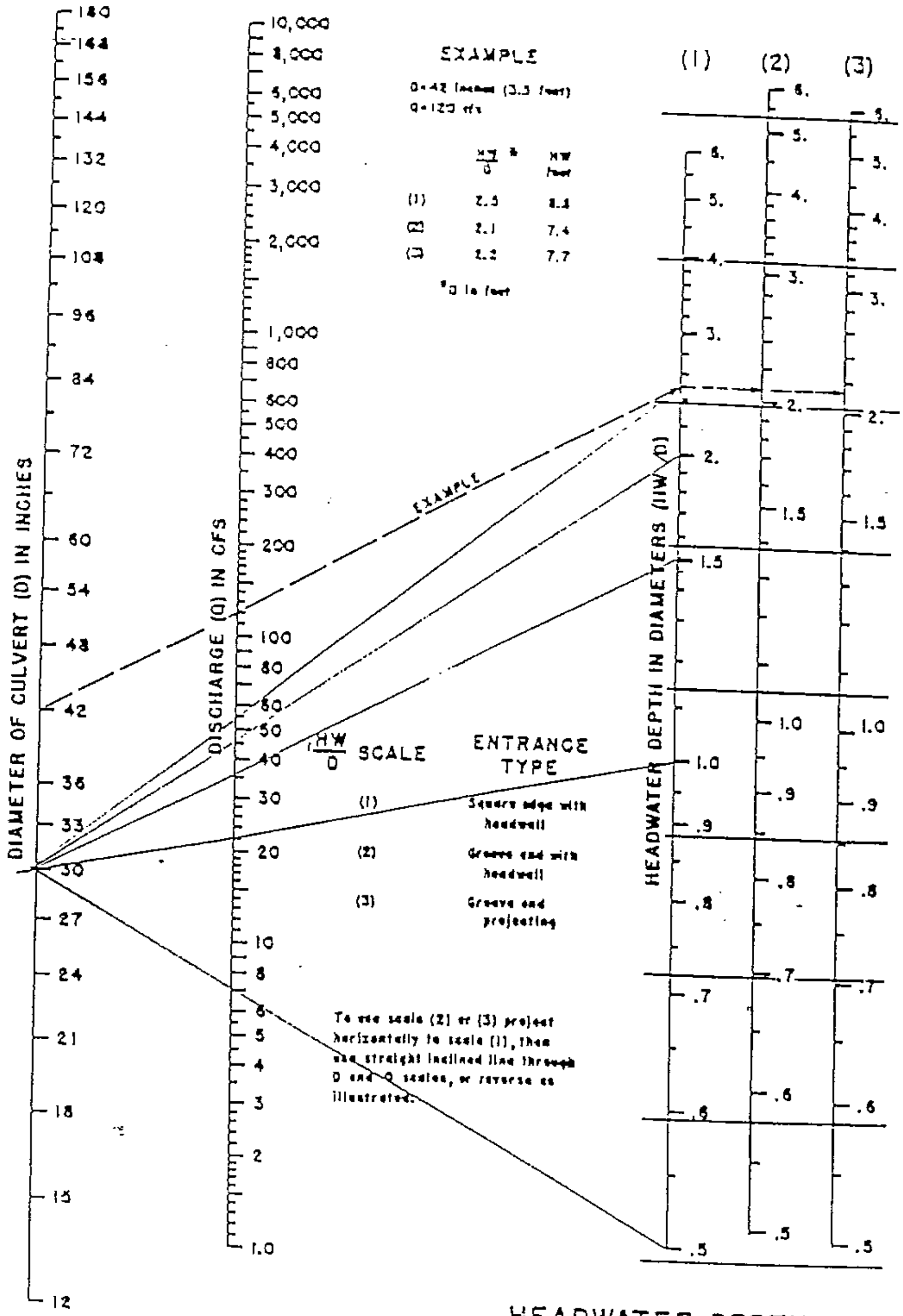



Figure 7-2.--Approximate single-stage structure routing for weir flow structures over 150 csm release rate and pipe flow structures over 300 csm release rate.




HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

# HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HDR Infrastructure, Inc.
A Centerra Company

EXHIBIT 5.3-1
URS Consultants, Inc.
CALCULATION COVER SHEET

Client: T-Schlumberger Project Name: Franklin Park WWTP.

Project/Calculation Number: 42229

Title: Rational Method.

Total number of pages (including cover sheet): 8

Total number of computer runs: ____

Prepared by: P. Sandhu. Date: 3/11/97

Checked by: Charles K. Cotter Date: 3/20/97

Description and Purpose:

Determine Rational Method Flows

Design bases/references/assumptions:

County/City criteria

Remarks/conclusions:

See Tables

Calculation Approved by: Charles K. Cotter 3/20/97

Project Manager/Date

| Revision No.: | Description of Revision: | Approved by: |
|---|---|---|
| | | |
| | | |
| | | |

Project Manager/Date

# URS CONSULTANTS, INC.

URS JOB NO. 40229 PAGE 2 OF 8

DATE 2/12/97 BY RJS. CHECKED BY CRC 3/20/97 (date)

CLIENT T. Schmidt + Assoc.

PROJECT Pioneer Park.

SUBJECT Rational Analysis

PROBLEM STATEMENT: DETERMINE Hydraulic Performance of EXISTING STORM SYSTEM IN P.P.

REQ'D.
1) AREA
2) FLOWS
3) INLET + Curb Capacity.
4) Bypass flows.

SOL'N:

Assumptions: 1) Initial 5YR STORM
2) TC = 18.5 For entire Basin, See SPRING Creek DBPS
3) SEE FIG 7-9 For inlet Capacity

1) DETERMINE BASIN AREA, Tc, RAINFALL INTENSITY, Q

SEE FOLLOWING TABLE

| BASIN # | PLAN READ | AREA (Ac) | BASIN Tc (MIN) | i | Q |
|---|---|---|---|---|---|
| 1 | .56 | 2.06 | 18.5 | 3.15 | 5.6 |
| 2 | 7.80 | 28.65 | | | 77.6 |
| 3 | 4.11 | 15.10 | | | 40.9 |
| 4 | .61 | 2.24 | | | 6.1 |
| 5 | .29 | 1.07 | | | 2.9 |
| 6 | 1.60 | 5.88 | | | 15.9 |
| 7 | 1.41 | 5.18 | | | 14.0 |
| 8 | 3.19 | 11.72 | | | 31.8 |
| 9 | 0.55 | 2.02 | | | 5.5 |

"C" coeff.

5YR

| | | | |
|---|---|---|---|
| Comm/Business | = | .90 | 121.95 |
| Residential | = | .60 | 15.43 |
| Roads | = | .90 | 14.18 |
| Open Space | = | .15 | 2.31 |

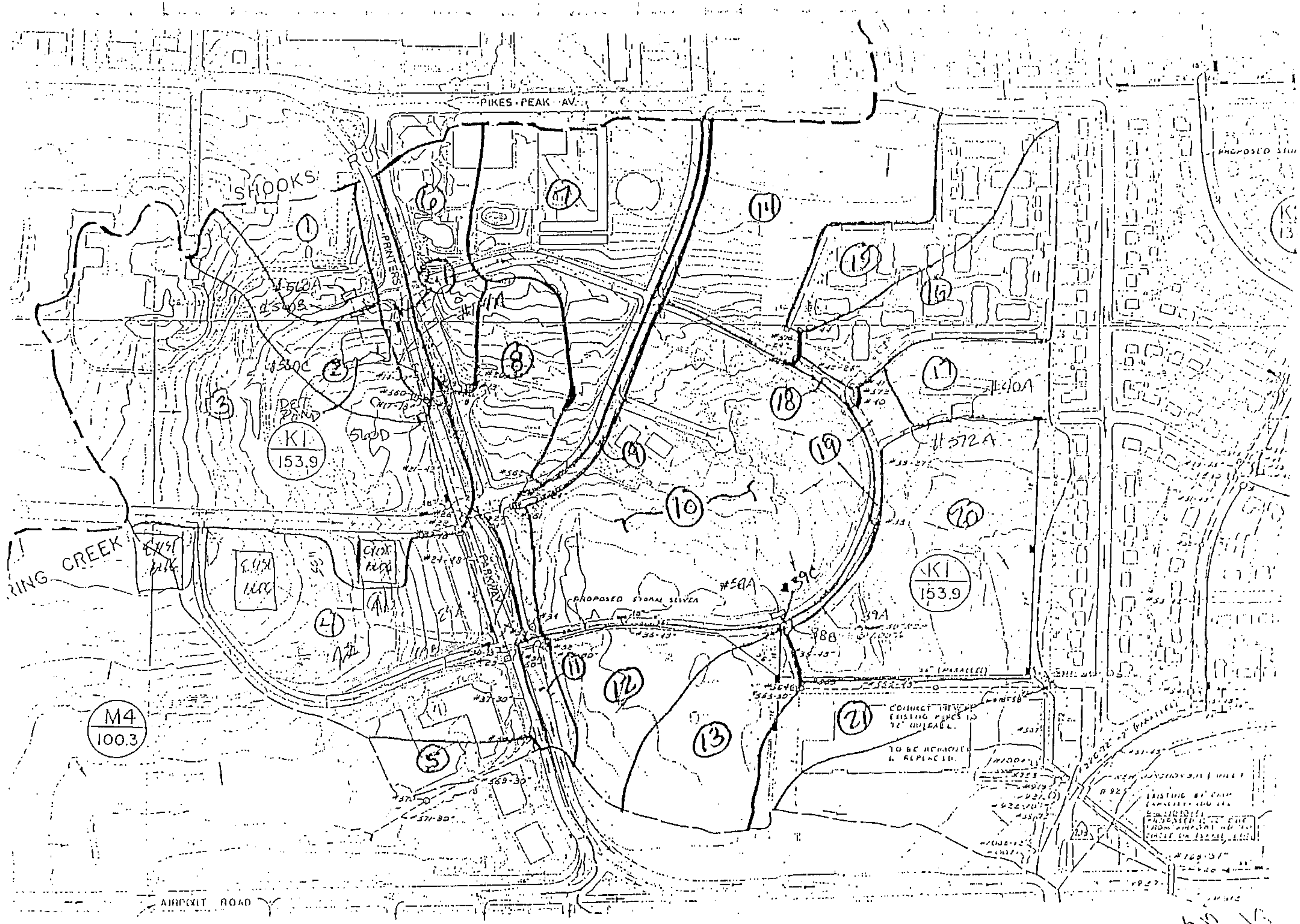
$$\bar{C} = \frac{.90(121.95) + .60(15.43) + .90(14.18) + .15(2.31)}{153.9} = 0.86$$

$$Q = CiA = .86(3.15)(153.9) = 416.9 \text{ cfs} = 2.71 \text{ cfs/Acre}$$

100 yr

$\bar{C} = .86$

$Q = CIA = .86(5.45)(153.9) = 721.3\ cfs = 4.68\ cfs/ac$



PIKES PEAK AV
SHOOKS RUN
PRINTERS
PARKWAY
CREEK
AIRPORT ROAD
K1
153.9
K1
153.9
M4
100.3
DET. POND
PROPOSED STORM SEWER
TO BE REMOVED & REPLACED

5/5
CKC 3/2/

5YR

| BASIN NO. | AREA (Ac.) | TIME OF CONCENTRATION (Tc, MIN.) | RAINFALL INTENSITY (In/hr) | Q (cfs) |
|---|---|---|---|---|
| 1 | 3.27 | 18.5 | 3.15 | 8.9 |
| 2 | 3.53 | 18.5 | 3.15 | 9.6 |
| 2.1 | 1.84 | 18.5 | 3.15 | 5.0 |
| 3 | 21.67 | 18.5 | 3.15 | 58.7 |
| 4 | 5.25 | 18.5 | 3.15 | 14.2 |
| 4.1 | 4.96 | 18.5 | 3.15 | 13.4 |
| 4.2 | 5.36 | 18.5 | 3.15 | 14.5 |
| 5 | 1.65 | 18.5 | 3.15 | 4.5 |
| 6 | 4.52 | 18.5 | 3.15 | 12.2 |
| 7 | 11.39 | 18.5 | 3.15 | 30.9 |
| 8 | 4.26 | 18.5 | 3.15 | 11.5 |
| 9 | 1.18 | 18.5 | 3.15 | 3.2 |
| 10 | 20.20 | 18.5 | 3.15 | 54.7 |
| 11 | 0.96 | 18.5 | 3.15 | 2.6 |
| 12 | 4.92 | 18.5 | 3.15 | 13.3 |
| 13 | 5.47 | 18.5 | 3.15 | 14.8 |
| 14 | 9.84 | 18.5 | 3.15 | 26.7 |
| 15 | 4.96 | 18.5 | 3.15 | 13.4 |
| 16 | 6.46 | 18.5 | 3.15 | 17.5 |
| 17 | 3.09 | 18.5 | 3.15 | 8.4 |
| 18 | 0.29 | 18.5 | 3.15 | 0.8 |
| 19 | 1.14 | 18.5 | 3.15 | 3.1 |
| 20 | 12.96 | 18.5 | 3.15 | 35.1 |
| 21 | 4.19 | 18.5 | 3.15 | 11.4 |
| Total | 139.17 | 18.5 | 3.15 | 377.1 |

Chk 3/23/?

100 YR

| BASIN NO. | AREA (Ac.) | TIME OF CONCENTRATION (Tc, MIN.) | RAINFALL INTENSITY (In/hr) | Q (cfs) |
|---|---|---|---|---|
| 1 | 3.27 | 18.5 | 5.45 | 15.3 |
| 2 | 3.53 | 18.5 | 5.45 | 16.5 |
| 2.1 | 1.84 | 18.5 | 5.45 | 8.6 |
| 3 | 21.67 | 18.5 | 5.45 | 101.6 |
| 4 | 5.25 | 18.5 | 5.45 | 24.6 |
| 4.1 | 4.96 | 18.5 | 5.45 | 23.2 |
| 4.2 | 5.36 | 18.5 | 5.45 | 25.1 |
| 5 | 1.65 | 18.5 | 5.45 | 7.7 |
| 6 | 4.52 | 18.5 | 5.45 | 21.2 |
| 7 | 11.39 | 18.5 | 5.45 | 53.4 |
| 8 | 4.26 | 18.5 | 5.45 | 20.0 |
| 9 | 1.18 | 18.5 | 5.45 | 5.5 |
| 10 | 20.20 | 18.5 | 5.45 | 94.7 |
| 11 | 0.96 | 18.5 | 5.45 | 4.5 |
| 12 | 4.92 | 18.5 | 5.45 | 23.1 |
| 13 | 5.47 | 18.5 | 5.45 | 25.7 |
| 14 | 9.84 | 18.5 | 5.45 | 46.1 |
| 15 | 4.96 | 18.5 | 5.45 | 23.2 |
| 16 | 6.46 | 18.5 | 5.45 | 30.3 |
| 17 | 3.09 | 18.5 | 5.45 | 14.5 |
| 18 | 0.29 | 18.5 | 5.45 | 1.4 |
| 19 | 1.14 | 18.5 | 5.45 | 5.3 |
| 20 | 12.96 | 18.5 | 5.45 | 60.7 |
| 21 | 4.19 | 18.5 | 3.15 | 11.4 |
| Total | 139.17 | 18.5 | 5.45 | 652.3 |

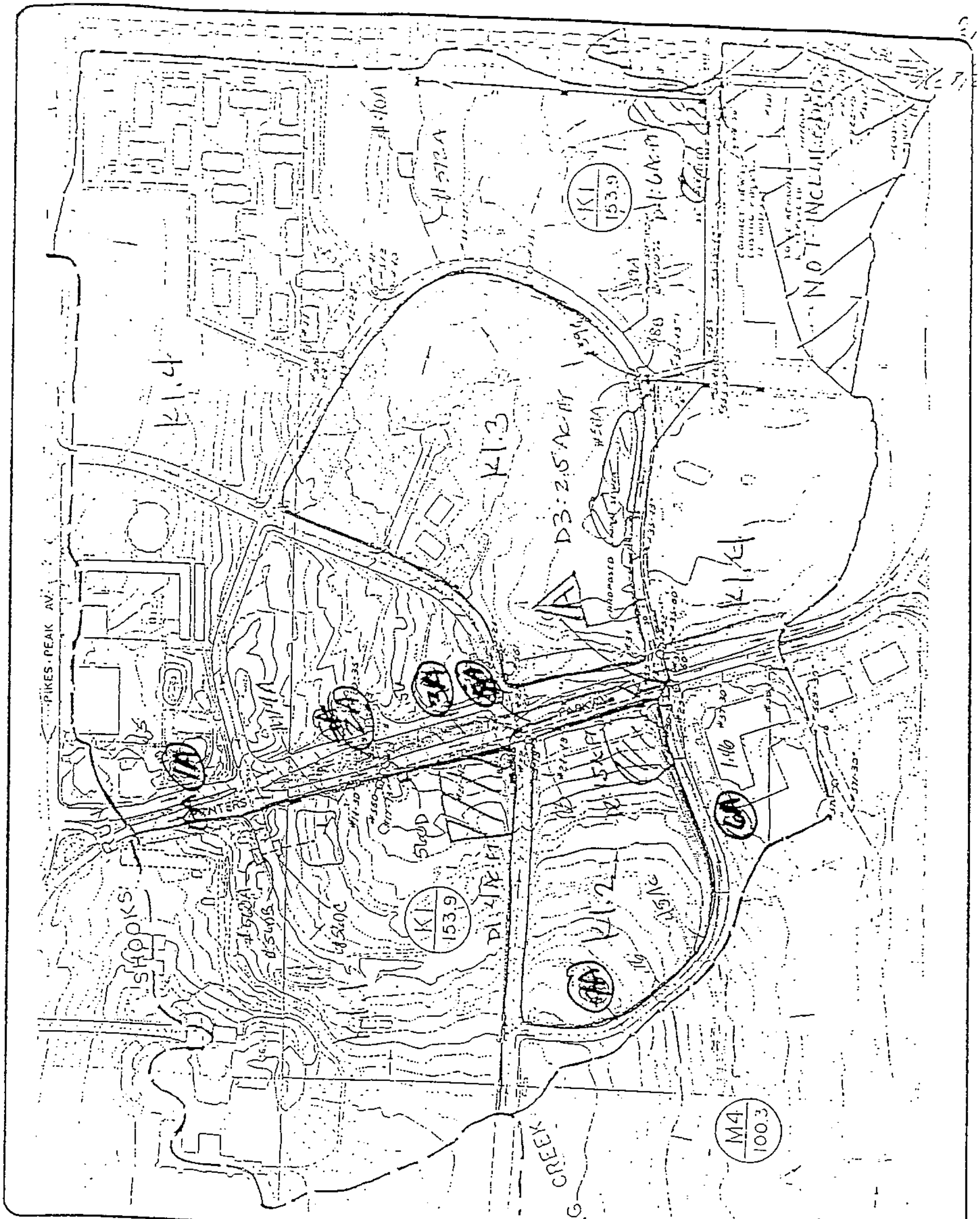
7/8
CKC 3/2/?

5YR W/ PONDS IN PLACE

| BASIN NO. | AREA (Ac.) | TIME OF CONCENTRATION (Tc, MIN.) | RAINFALL INTENSITY (In/hr) | Q (cfs) |
|---|---|---|---|---|
| 1A | 1.29 | 18.5 | 3.15 | 3.5 |
| 2A | 0.06 | 18.5 | 3.15 | 0.2 |
| 3A | 2.06 | 18.5 | 3.15 | 5.6 |
| 4A | 0.59 | 18.5 | 3.15 | 1.6 |
| 5A | 0.84 | 18.5 | 3.15 | 2.3 |
| 6A | 5.36 | 18.5 | 3.15 | 14.5 |

100 YR W/ PONDS IN PLACE

| BASIN NO. | AREA (Ac.) | TIME OF CONCENTRATION (Tc, MIN.) | RAINFALL INTENSITY (In/hr) | Q (cfs) |
|---|---|---|---|---|
| 1A | 1.29 | 18.5 | 5.45 | 6.0 |
| 2A | 0.06 | 18.5 | 5.45 | 0.3 |
| 3A | 2.06 | 18.5 | 5.45 | 9.6 |
| 4A | 0.59 | 18.5 | 5.45 | 2.8 |
| 5A | 0.84 | 18.5 | 5.45 | 4.0 |
| 6A | 5.36 | 18.5 | 5.45 | 25.1 |



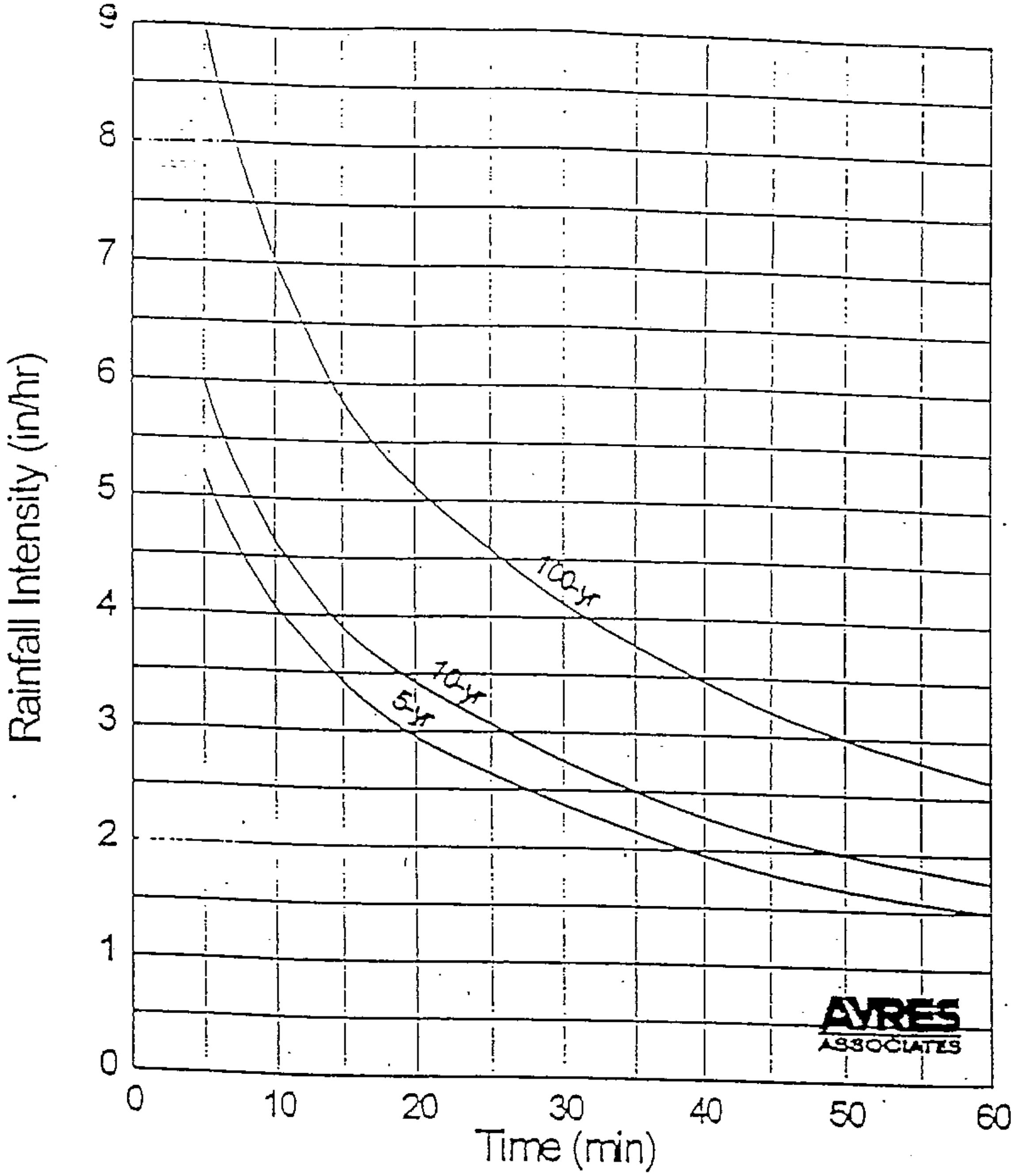

URS Greiner

PROJ. NO.

# PRINTERS PARK

DEVELOPED BASIN MAP

FIGURE 4




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

C/C 3/2/?

# 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 | 7 | 0.30 | 0.35 | 0.55 | 0.60 |
| Playgrounds | 13 | 0.30 | 0.35 | 0.60 | 0.65 |
| Railroad Yard Areas | 40 | 0.50 | 0.55 | 0.60 | 0.65 |
| Undeveloped Areas | | | | | |
| Historic Flow Analysis- Greenbelts, Agricultural | 2 | 0.15 | 0.25 | 0.20 | 0.30 |
| Pasture/Meadow | 0 | 0.25 | 0.30 | 0.35 | 0.45 |
| Forest | 0 | 0.10 | 0.15 | 0.15 | 0.20 |
| Exposed Rock | 100 | 0.90 | 0.90 | 0.95 | 0.95 |
| Offsite Flow Analysis (when land use not defined) | 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 | 100 | 0.90 | 0.90 | 0.95 | 0.95 |
| Roofs | 90 | 0.90 | 0.90 | 0.95 | 0.95 |
| Lawns | 0 | 0.25 | 0.30 | 0.35 | 0.45 |

* Hydrologic Soil Group

9/30/90

# APPENDIX F:
# Existing Facility Survey

EXHIBIT 5.3-1
URS Consultants, Inc.
CALCULATION COVER SHEET

Client: T Schlinder & Assoc. Project Name: Franklin Park MCP.
Project/Calculation Number: 47779.01
Title: EXIST. STORM SEWER SURVEY
Total number of pages (including cover sheet): 7
Total number of computer runs: ______
Prepared by: TRS Date: 2/10/97
Checked by: Charles K. Colter Date: 3/2/97

Description and Purpose:

Facility Inventory

Design bases/references/assumptions:

N/A

Remarks/conclusions:

Calculation Approved by: Charles K. Colter 3/20/97
Project Manager/Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

2/
chk 3/20/07

| INLET NO. | TYPE | LENGTH (ft) | CONDITION |
|---|---|---|---|
| 13 | D-10R | 8.0 | Cont. Grade |
| 18 | 6' X 6' JCTN BOX | | |
| 22 | D-10R | 8.0 | Cont. Grade |
| 25 | 10' x 10' JCTN BOX | | D ≡ 14.2' |
| 26 | 5' Dia. MH | | |
| 29 | D-10R | 6.0 | Sump |
| 29A* | D-10R | 12.0 | Cont. Grade |
| 29B* | D-10R | 12.0 | Cont. Grade |
| 32 | D-10R | 8.0 | Cont. Grade |
| 34 | D-10R | 8.0 | Cont. Grade |
| 38 | D-10R | 6 | Cont. Grade |
| 38A | D-10R | 10 | Sump |
| 38B | D-10R | 10 | Sump |
| 40 | D-10R | 8 | Cont. Grade |
| 40A | D-10R | 10 | Cont. Grade |
| 41 | D-10R | 20 | Cont. Grade |
| 43 | D-10R | 8 | Cont. Grade |
| 44 | D-10R | 10 | Cont. Grade |
| 560 | D-10R | 4.0 | Cont. Grade |
| 560A | D-10R | 5 | Sump |
| 560B | D-10R | 15 | Sump |
| 560C | D-10R | 60 | Sump |
| 560D | D-10R | 4 | Cont. Grade |
| 561 | D-10R | 10.0 | Cont. Grade |
| 562 | D-10R | 10.0 | Cont. Grade |
| 563 | 5' Dia. MH | | |
| 564 | D-10R | 14 | Sump |
| 568 | D-10R | 10.0 | Cont. Grade |
| 570 | 5' Dia. MH | | |

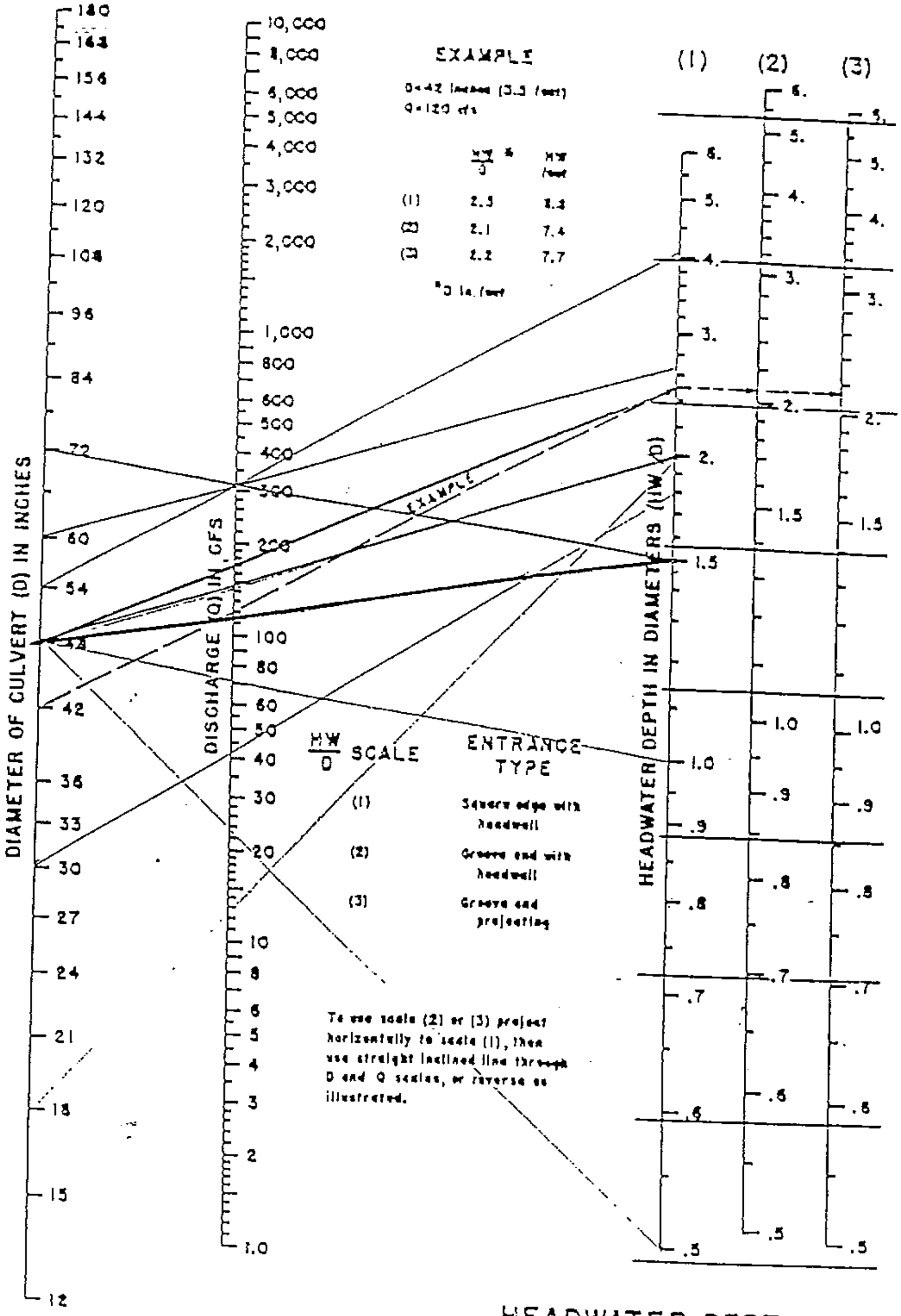
* TO BE CONSTRUCTED

| EXISTING PIPE NUMBER | PIPE SIZE (in) | LENGTH (ft) | UPSTREAM NODE | DOENSTREAM NODE | TYPE OF PIPE | MANNING'S N | MIN SLOPE | FULL PIPE CAPACITY (MGD) | 75% CAPACITY (MGD) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 30 | 127 | n/a | 18 | RCP | 0.013 | 0.0283 | 44.504 | 33.378 | |
| 14A | 30 | | Det. Pond | Pipe #14 | RCP | 0.013 | | | | Incomplete Data |
| 17 | 18 | 14 | 560 | 18 | RCP | 0.013 | 0.2030 | 30.473 | 22.855 | |
| 19 | 36 | 121 | 13 | 18 | RCP | 0.013 | 0.0228 | 64.997 | 48.747 | |
| 20 | 36 | 50 | n/a | 13 | RCP | 0.013 | 0.03 | 74.556 | 55.917 | |
| 21 | 42 | 381 | 18 | 26 | RCP | 0.013 | 0.0144 | 77.956 | 58.467 | |
| 23 | 18 | 23 | 22 | Pipe #24 | RCP | 0.013 | 0.125 | 23.913 | 17.934 | Discharges into Pipe #24 |
| 24 | 48 | 463 | 26 | 25 | RCP | 0.013 | 0.0144 | 111.350 | 83.513 | |
| 27 | 24 | 165 | 561 | 26 | RCP | 0.013 | 0.0182 | 19.670 | 14.752 | |
| 28 | 24 | 100 | 562 | 561 | RCP | 0.013 | 0.01 | 14.580 | 10.935 | |
| 30 | 18 | 22 | 29 | 25 | RCP | 0.013 | 0.0133 | 7.800 | 5.850 | |
| 31 | 60 | 77 | 25 | 32 | RCP | 0.013 | 0.0049 | 117.858 | 88.393 | |
| 33 | 18 | 64 | 34 | 32 | RCP | 0.013 | 0.0306 | 11.831 | 8.873 | |
| 36 | 48 | 870 | 32 | 563 | RCP | 0.013 | 0.004 | 58.687 | 44.015 | Min. Slope of pipe #36 |
| 36 | 48 | 1148 | 32 | 563 | RCP | 0.013 | 0.0216 | 136.375 | 102.282 | |
| 37 | 30 | 263 | 25 | 568 | RCP | 0.013 | 0.022 | 39.239 | 29.429 | |
| 39 | 27 | 419 | 40 | 40A | RCP | 0.013 | 0.016 | 25.258 | 18.943 | |
| 39A | 30 | 400 | 38 | 38B | RCP | 0.013 | 0.01 | 26.455 | 19.841 | |
| 39C | | 60 | 38A | 38B | RCP | 0.013 | | | | Incomplete Data |
| 42 | 24 | 224 | 43 | 40 | RCP | 0.013 | 0.045 | 30.929 | 23.197 | |
| 565 | 30 | 19 | 564 | 563 | RCP | 0.013 | | | | Incomplete Data |
| 566 | 48 | 797 | 563 | Outfall | RCP | 0.013 | 0.0052 | 66.913 | 50.185 | Outfall: V-ditch, D=6', Z=1 |
| 569 | 30 | 397 | 568 | 570 | RCP | 0.013 | 0.009 | 25.097 | 18.823 | Incomplete Data |
| 571 | 30 | 194 | 570 | Outfall | RCP | 0.013 | 0.009 | 25.097 | 18.823 | Incomplete Data |
| 572 | 24 | 35 | 41 | 40 | RCP | 0.013 | | | | |
| 572A | 18 | | 40A | Pipe #39 | RCP | 0.013 | | | | |
| 576 | 24 | 90 | 43 | 43 | RCP | 0.013 | | | | Incomplete Data |

Reference: Spring Creek DBPS, OCT '93/Field Visit

* SURCHARGE PIPE TO INCREASE CAPACITY

| Hw/D | Hw | Q= |
|---|---|---|
| 1.5 | 6.0' | 110cfs. |
| 2.0 | 8.0' | 150cfs. |
| 2.5 | 10.0' | 170cfs. |




# HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3 REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date: OCT. 1987

Figure 9-34

SPRING CREEK DRAINAGE BASIN PLANNING STUDY
DRAINAGE FACILITY INVENTORY FORM
DATE: 3-22-93

| STRUCTURE NUMBER | MAP # | LOCATION/ DESCRIPTION | SIZE | TYPE | SLOPE | LENGTH | MAINTENANCE RESPONSIBILITY | OUTLET PIPE CHARACT. | SPILLWAY CHARACT. | CONDITION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 02-INL- 542 | 020 | FROM PIP 541 | 6' | D-10-R | | | PRIVATE | | | | |
| 02-PIP- 543 | 020 | FROM INL 542 TO MH 544 | 18" | RCP | | | PRIVATE | | | | |
| 02-MAN- 544 | 020 | S. SIDE TRAILER PARK ENT. | 6' | D-10-R | | | PRIVATE | | | | |
| 02-PIP- 545 | 020 | FROM MH 544 RUN. N.SIDE MURRAY BLVD. | 24" | RCP | 1.13 | 1169' | CITY | | | | |
| 02-INL- 546 | 020 | N. SIDE OF MURRAY | | | | | CITY | | | | |
| 02-PIP- 547 | 020 | FROM INL 546 TO PIP 545 | 18" | | | | CITY | | | | |
| 02-PIP- 548 | 020 | OUTFALL STRUCTURE FROM PIP 545 | | | | | CITY | | | | |
| 02-INL- 549 | 020 | S. SIDE EASTCREST CIR. W. | 5' | C.B. | | | CITY | | | | |
| 02-PIP- 550 | 020 | FROM INL 549 THRU EASM'T TO V DITCH | 18" | CMP | 5.2 | 185' | CITY | | | | |
| 02-CHA- 551 | 020 | E. SIDE MURRAY BLVD. THRU EASTCREST SUB. | 5'W(TOP) | CONC DI | 5.46 | 130' | CITY | | | | |
| 02-INL- 552 | 020 | W. SIDE SHADY CREST SUB. | 4' | D10R | | | PRIVATE | | | | |
| 02-PIP- 553 | 020 | FROM INL 552 NORTH TO AIRPORT RD. | 15" | RCP | 4.59 | 105' | PRIVATE | | | | |
| 02-INL- 554 | 020 | N.SIDE SHADY CREST CIR 250'+- W OF CRESTLINE | 6' | D10R | | | PRIVATE | | | | |
| 02-PIP- 555 | 020 | FROM INL 554 N. TO AIRPORT RD. | 15" | RCP | 8.07 | 112' | PRIVATE | | | | |
| 02-INL- 556 | 020 | E. SIDE MURRAY BLVD. AT CHAPMAN DR. | 16' | D10R | | | CITY | | | | |
| 02-PIP- 557 | 020 | FROM INL557 XING MURRAY TO S.SIDE CHAPMAN DR. | 27" | RCP | 2.00 | 83' | CITY | | | | |
| 02-PIP- 558 | 020 | FROM PIP 557 X-ING TO N.SIDE OF CHAPMAN | 27" | RCP | 2.00 | 63' | CITY | | | | |
| 02-INL- 559 | K21 | INL BETWEEN PIP'S 1&2 (PROSPECT LK.) | 4' | D-10R | | | CITY | | | | |
| 02-INL- 560 | L21 | W.SIDE PRINTERS PKWY. | 4' | D-10R | | | CITY | | | | |
| 02-INL- 561 | L21 | PARKSIDE DR.-C.R. PRINTERS PKWY. | 12' | D-10R | | | CITY | | | | |
| 02-INL- 562 | L21 | N. SIDE PARKSIDE DR. | 10' | D-10R | | | CITY | | | | |
| 02-MAN- 563 | L21 | PRINTERS PKWY #5 SUB S.PROP. LINE | 5' | | | | CITY | | | | |
| 02-INL- 564 | L21 | SAME AS ABOVE | 14' | D-10R | | | CITY | | | | |
| 02-PIP- 565 | L21 | FROM INL 564 TO MH 563 | 30" | RCP | | 19' | CITY | | | | |
| 02-PIP- 566 | L21 | S.PROP. LINE P.P #5 FROM MH563 TO DITCH | 48" | RCP | 0.52 | 797' | CITY | | | | |
| 02-CHA- 567 | L21 | FROM PIP 566 SOUTH TO CIRCLE DR. V-DITCH, D=6', Z=1:1 | | CONC | | | CITY | | | | |
| 02-INL- 568 | L21 | W.SIDE PRINTERS PKWY. PRINTERS PL. SUB #3 | 10' | D-10R | | | PRIVATE | | | | |
| 02-PIP- 569 | L21 | FROM INL 568 S.W. THRU PRINTERS PARK | 30" | RCP | 0.90 | 397' | PRIVATE | | | | |
| 02-MAN- 570 | L21 | FROM PIP 568 | 5' | | | | PRIVATE | | | | |
| 02-PIP- 571 | L21 | FROM MH 570 TO S.W. TO OUTFALL | 30" | RCP | 0.90 | 194' | PRIVATE | | | | |
| 02-PIP- 572 | L21 | INLET PIPE TO INL 41 TO 40 | 24" | RCP | | 35' | PRIVATE | | | | |
| 02-INL- 573 | L21 | W. SIDE BASSETT AT GOHER AVE. | 12' | D-10R | | | CITY | | | | |
| 02-CHA- 574 | M19 | EASTMORELAND CONC. CHANNEL 4' CHAN 13' WIDE (T) | | CONC | VARIES | 1363'+/ | CITY | | | | |
| 02-CHA- 575 | M19 | FROM PIP 193 TO 194 | 6'x 6' | RC BOX | | 300'+/- | CITY | | | | |
| 02-PIP- 576 | L21 | FROM INL. 44 TO INL 43 | 24" | RCP | | 90' | PRIVATE | | | | |
| 02-INL- 577 | N19 | N SIDE OF GALLEY E SIDE OF REINHART DR | 8' | | | | CITY | | | | |
| 02-PIP- 578 | N19 | X-ING GALLEY AT REINHART DR | 38" X 60" | RCP | | 75' | CITY | | | | |
| 02-INL- 579 | N19 | X-ING REINHART E TO W/B SIDE OF GALLEY | 2' X 48' | G INLET | | 48' | CITY | | | | |
| 02-PIP- 580 | N19 | FROM 579 TO CITADEL DR NORTH | 42" | RCP | 4.9 | 430' | CITY | | | | |
| 02-INL- 581 | N19 | N SIDE CITADEL DR NORTH/W SIDE REINHART DR | 8' | | | | CITY | | | | |
| 02-PIP- 582 | N19 | FROM 581 TO 66" RCP | 30" | RCP | | 31' | CITY | | | | |

SPRING CREEK DRAINAGE BASIN PLANNING STUDY
DRAINAGE FACILITY INVENTORY FORM
DATE: 10-17-91

| STRUCTURE NUMBER | MAP # | LOCATION/ DESCRIPTION | SIZE | TYPE | SLOPE | LENGTH | MAINTENANCE RESPONSIBILITY | OUTLET PIPE CHARACT. | SPILLWAY CHARACT. | CONDITION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 02-PIP- 48 | L21 | GOYER AVE. & BASSETT DR. | 24" | CS | 1.6 | 42' | CITY | | | | |
| 02-PIP- 49 | L21 | GOYER AVE. & BASSETT DR. | 48" | CS | 1.7 | 102' | CITY | | | | |
| 02-INL- 50 | L21 | GOYER AVE. & BASSETT DR. | 8' | D-10R | | | CITY | | | | |
| 02-PIP- 51 | L21 | SOUTH ON BASSETT DR. | 48" | CS | VARIES | 273' | CITY | | | | |
| 02-MAN- 52 | L21 | SOUTH ON BASSETT DR. | 4' | PRECAST | | | CITY | | | | |
| 02-PIP- 53 | L21 | SOUTH ON BASSETT DR. | 48" | CS | 1.52 | 417' | CITY | | | | |
| 02-INL- 54 | L21 | CIRCLE DR. & BASSETT DR. | 10'+/- RADIAL C.B. | | | | CITY | | | | |
| 02-PIP- 55 | L21 | 54 TO 56 | 48" | CS | 1.19 | 129' | CITY | | | | |
| 02-PIP- 57 | L21 | SOUTH ON CIRCLE DR. | 48" | CS | 1.74 | 453' | CITY | | | | |
| 02-PIP- 58 | L21 | CIRCLE DR. | 72" | RCP | | 240' | CITY | | | | |
| 02-INL- 59 | L22 | E. SIDE BOGGS PL. | 10' | D-10R | | | CITY | | | | |
| 02-PIP- 60 | L22 | 59 TO 64 | 21" | RCP | 3.0 | 65' | CITY | | | | |
| 02-INL- 61 | L22 | W. SIDE BOGGS PL. | 8' | D-10R | | | CITY | | | | |
| 02-INL- 62 | L22 | FOUNTAIN BLVD. & BOGGS PL. | 6' | D-10R | | | CITY | | | | |
| 02-PIP- 63 | L22 | 62 TO 64 | 15" X 26" | RCAP | 0.5 | 15' | CITY | | | | |
| 02-PIP- 64 | L22 | 63 TO 67 | 30" | RCP | 0.95 | 76' | CITY | | | | |
| 02-INL- 65 | L22 | S. SIDE FOUNTAIN BLVD. & BOGGS | 6' | D-10R | | | CITY | | | | |
| 02-PIP- 66 | L22 | S. SIDE FOUNTAIN BLVD. & BOGGS | 18" | RCP | 3.26 | 33' | CITY | | | | |
| 02-PIP- 67 | L22 | S. SIDE FOUNTAIN BLVD. | 33" | RCP | 0.066 | 99' | CITY | | | | |
| 02-INL- 68 | L22 | S. SIDE FOUNTAIN BLVD. | 14' | D-10R | | | CITY | | | | |
| 02-PIP- 69 | L22 | 68 TO 67; 70 | 42" | RCP | | 15' | CITY | | | | |
| 02-PIP- 70 | L22 | S. SIDE FOUNTAIN BLVD. | 42" | RCP | SEE RE: | 537' | CITY | | | | 0.36 TO 0.44 |
| 02-INL- 71 | L22 | S. SIDE FOUNTAIN BLVD. | 6' | D-10R | | | CITY | | | | |
| 02-PIP- 72 | L22 | S. SIDE FOUNTAIN BLVD. | 36" | RCP | 1.22 | 397' | CITY | | | | |
| 02-CHA- 73 | L22 | DRAINAGE CHAN. N. SIDE FOUNTAIN BLVD. | V-DITCH, D=6', Z=1:1 | CONC. | | 1415+/- | CITY | | | | |
| 02-PIP- 74 | L22 | N. SIDE FOUNTAIN BLVD. | 60" | RCP | 3.00 | 100' | CITY | | | | |
| 02-INL- 75 | L22 | S. SIDE FOUNTAIN BLVD. | 4' | D-10-R | | | CITY | | | | |
| 02-PIP- 76 | L22 | 75 TO PROSPECT PARK GREEN BELT | 60" | RCP | SEE RE: | 480' | CITY | | | | (405') 7.78 & 2.40 (75') |
| 02-PIP- 77 | L22 | S.H. 29 & FOUNTAIN BLVD. | 48" | CMP | 2.20 | 320' | CDOH | | | FAIR | |
| 02-BRI- 78 | L22 | BRIDGE UNDER FOUNTAIN BLVD. E. OF S.H. 29 | 31' SPAN X 10' D | BRIDGE | | | CITY | | | | |
| 02-CHA- 79 | L22 | DRAINAGE CHANNEL FOUNTAIN BLVD. & S.H. 29 | B=36', D=10' | CONC. | 1.5 | 370' | CDOH | | | | |
| 02-PIP- 80 | L22 | E. OF S.H. 29 | (3)54" | CMP | 1.47 | 460'+/- | CITY | | | FAIR | |
| 02-PIP- 81 | L23 | VERDE & CAPULIN DR. | (3)54" | CMP | 1 | 66' | CITY | | | POOR | |
| 02-CHA- 82 | L23 | DRAINAGE CHANNEL S. OF VERDE DR. | B=4', D=6', Z=1:1 | CONC | | | CITY | | | | |
| 02-INL- 83 | M19 | N. SIDE GALLEY &CIRCLE DR. | 6' | D-10R | | | CITY | | | | |
| 02-PIP- 84 | M19 | 83 TO 85 | 21" | RCP | 4.91 | 65' | CITY | | | | |
| 02-INL- 85 | M19 | E. SIDE CIRCLE DR. | 16' | D-10R | | | CITY | | | | |
| 02-PIP- 86 | M19 | FROM 85 X-ING CRCLE DR. | 36" | RCP | 12.45 | 65' | CITY | | | | |
| 02-PIP- 87 | M19 | E. SIDE CIRCLE DR. & GALLEY RD. | 21" | RCP | 4.91 | 65' | CITY | | | | |
| 02-PIP- 88 | M19 | S. SIDE GALLEY RD. | 27" | RCP | 3.56 | 294' | CITY | | | | |
| 02-INL- 89 | M19 | S. SIDE TAMPA ST. 200'+/- W. OF N. CIRCLE DR. | 10' | D-10R | | | CITY | | | | |

RING CREEK DRAINAGE BASIN PLANNING STUDY
RAINAGE FACILITY INVENTORY FORM
ATE: 10-17-91

| TRUCTURE UMBER | | MAP # | LOCATION/ DESCRIPTION | SIZE | TYPE | SLOPE | LENGTH | MAINTENANCE RESPONSIBILITY | OUTLET PIPE CHARACT. | SPILLWAY CHARACT. | CONDITION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-PIP- | 1 | K21 | 200' NE OF PROSPECT LAKE | 18" | RCP | 4.08 | 100' | CITY | | | | |
| 2-PIP- | 2 | K21 | OUTFALL INTO PROSPECT LAKE | 18" | RCP | 2.00 | 100' | CITY | | | | |
| 2-INL- | 3 | K22 | N. SIDE FOUNTAIN BLVD. | 6'-6" | D-10R | | | CITY | | | | |
| 2-PIP- | 4 | K22 | #3 TO 5 INL. PIPE | 21" | RCP | 1.00 | 110' | CITY | | | | |
| 2-INL- | 5 | K22 | S. SIDE FOUNTAIN BLVD. | 6'-6" | D-10R | | | CITY | | | | |
| 2-PIP- | 6 | K22 | FROM INL. 5 TO DITCH | 36" | RCP | 1.00 | 20'+/- | CITY | | | | |
| 2-INL- | 13 | L21 | E. SIDE PRINTERS PKWY. | 8' | D-10R | | | CITY | | | | |
| 2-PIP- | 14 | L21 | W. SIDE PRINTERS PKWY. | 30" | RCP | 2.83 | 127' | CITY | | | | |
| 2-INL- | 15 | L21 | W. SIDE PRINTERS PKWY. | 4' | D-10R | | | CITY | | | | |
| 2-PIP- | 16 | L21 | FROM 15 TO 14 | 18" | RCP | 14.4 | 18' | CITY | | | | |
| 2-PIP- | 17 | L21 | TO JUNC. BOX 18 | 18" | RCP | 20.3 | 14' | CITY | | | | |
| 2-CRC- | 18 | L21 | W. SIDE PRINTERS PKWY. | 6'X 6' | | | | CITY | | | | |
| 2-PIP- | 19 | L21 | TO JCT. BOX 18 | 36" | RCP | 2.28 | 121' | CITY | | | | |
| 2-PIP- | 20 | L21 | TO JCT. BOX 18 | 36" | RCP | 3.00 | 50' | CITY | | | | |
| 2-PIP- | 21 | L21 | FROM JCT. BOX 18 SOUTH | 42" | RCP | 1.44 | 381' | PRIVATE | | | | |
| 2-INL- | 22 | L21 | PARKSIDE & PRINTERS PKWY. | 8' | D-10R | | | CITY | | | | |
| 2-PIP- | 23 | L21 | FROM 22 TO 24 | 18" | RCP | 12.5 | 23' | CITY | | | | |
| 2-PIP- | 24 | L21 | CONT. FROM 21 | 48" | RCP | | 463' | CITY | | | | |
| 2-CRC- | 25 | L21 | INTERNATIONAL CIRCLE & PRINTERS PKWY. | 10'X 7' JCT. BOX | | | | CITY | | | | |
| 2-MH- | 26 | L21 | PARKSIDE & PRINTERS PKWY. | 5' | | | | CITY | | | | |
| 2-PIP- | 27 | L21 | FROM MH 26 EAST | 24" | RCP | 1.82 | 165' | CITY | | | | |
| 2-PIP- | 28 | L21 | FROM INL. 561 TO INL. 562 | 24" | RCP | 1.00 | 100' | CITY | | | | |
| -INL- | 29 | L21 | INTERNATIONAL CIRCLE & PRINTERS PKWY. | 6' | D-10R | | | CITY | | | | |
| -PIP- | 30 | L21 | 29 TO 25 | 18" | RCP | 1.33 | 22' | CITY | | | | |
| -PIP- | 31 | L21 | 25 TO 32 | 60" | RCP | 0.49 | 77' | CITY | | | | |
| -INL- | 32 | L21 | INTERNATIONAL CIRCLE & PRINTERS PKWY. | 8' | D-10R | | | CITY | | | | |
| -PIP- | 33 | L21 | 32 TO 34 | 18" | RCP | 3.06 | 64' | CITY | | | | |
| -INL- | 34 | L21 | INTERNATIONAL CIRCLE & PRINTERS PKWY. | 8' | D-10R | | | CITY | | | | |
| -PIP- | 35 | L21 | FROM 32 | 60" | RCP | 2.52 | 26' | CITY | | | | |
| -PIP- | 36 | L21 | FROM PIP 35 S. SIDE INTERNATIONAL CIR. | 48" | RCP | REMRKS | REMRKS | PRIVATE | | | | |
| -PIP- | 37 | L21 | FROM 25 SOUTH ON PRINTERS PKWY. | 30" | RCP | 2.20 | 263' | CITY | | | | 0.158(870')2.16/1,148 TO MH 562 |
| -INL- | 38 | L21 | E. SIDE INTERNATIONAL CIR. | 6' | D-10R | | | PRIVATE | | | | |
| -PIP- | 39 | L21 | E. SIDE INTERNATIONAL CIR. | 27" | RCP | 1.60 | 419' | CITY | | | | |
| -INL- | 40 | L21 | E. SIDE INTERNATIONAL CIR. | 8' | D-10R | | | CITY | | | | |
| -INL- | 41 | L21 | E. SIDE INTERNATIONAL CIR. | 6' | D-10R | | | CITY | | | | |
| -PIP- | 42 | L21 | E. SIDE INTERNATIONAL CIR. | 24" | RCP | 4.5 | 224' | PRIVATE | | | | |
| -INL- | 43 | L21 | E. SIDE INTERNATIONAL CIR. | 8' | D-10R | | | CITY | | | | |
| -INL- | 44 | L21 | E. SIDE INTERNATIONAL CIR. | 6' | D-10R | | | CITY | | | | |
| -INL- | 45 | L21 | COMER AVE. & BASSETT DR. | 8' | D-10R | | | PRIVATE | | | | |
| -PIP- | 46 | L21 | COMER AVE. & BASSETT DR. | 18" | CS | 1.6 | 15' | CITY | | | | |
| -INL- | 47 | L21 | COMER AVE. & BASSETT DR. | 12' | D-10R | | | CITY | | | | |

| | |
|---|---|
| | CITY |

# APPENDIX G:
Inlet Capacities: Existing Condition

EXHIBIT 5.3-1
URS Consultants, Inc.
CALCULATION COVER SHEET

Client: Tschudin-Hayes Project Name: ___
Project/Calculation Number: 6922a
Title: Inlet Capacity (#1) - Rational Method Flows
Total number of pages (including cover sheet): 19
Total number of computer runs: ___
Prepared by: TCM. Date: 3/18/97
Checked by: Charles K. Colter Date: 3/20/97

Description and Purpose:

Determine Inlet capacity using Rational Method Flows.

Design bases/references/assumptions:

City/County Initial 5yr storm ✓

Remarks/conclusions:

Calculation Approved by: Charles K. Colter 3/20/97

Project Manager/Date

| Revision No.: | Description of Revision: | Approved by: |
|---|---|---|
| | | |
| | | |
| | | |

Project Manager/Date

# URS CONSULTANTS, INC.

URS JOB NO. 07279 PAGE 2 OF 19
DATE 5/13/97 BY RJS CHECKED BY CKC 3/?/?
CLIENT J.S. [illegible] Assoc.
PROJECT [illegible] Park [illegible]
SUBJECT Inlet Capacity – CONTINUOUS GRADE

DETERMINE INLET CAPACITY + BYPASS.

REF ASSUMPTIONS: FIG 7-9
$SX = 0.02$ ft/ft.
$n = 0.016$.

See Sheet 12+19/19

T = spread
Q = flow
$S_x$ = X-slope
S = slope
$Q_i$ = intercept
$Q_b$ = bypass

WEST OF [illegible] PKWY — S/B FLOW.

@ Inlet 5?? (BASIN 2.1)

$Q = 5.0$ cfs
$T = 9.6$
$L = 4'$
$S = .054$ ft/ft.

$d_w = S_x(T-2) = .15$

$\therefore \frac{Q_i}{Q} = .22 \therefore$

$Q_i = 1.1$ cfs
$Q_b = 3.9$ cfs ✓

@ Inlet 5??D (BASIN 2+2.1)

$Q = 9.6 + 3.9 = 13.5$
$T = 13.9$
$L = 4'$
$S = .054$.

$d_w = .23$

$\therefore \frac{Q_i}{Q} = .14$

$Q_i = 1.90$ cfs.
$Q_b = 11.6$ cfs

@ ??? 22 (BASIN 2, 2.1, 3)

$Q = 58.7 + 11.6 = 70.3$ cfs.

$T = 29.5'$
$L = 8'$
$S = 0.027$

$d_w = 0.55$

$\therefore \frac{Q_i}{Q} = .14$

$Q_i$ 9.8 cfs.
$Q_b$ 60.5 cfs

# URS
CONSULTANTS, INC.

URS JOB NO. [illegible]  PAGE 3 OF 19
DATE 2/24/97  BY RJS  CHECKED BY [illegible]
CLIENT [illegible]
PROJECT [illegible]
SUBJECT

@ Inlet 508 (BASIN 5)

$Q = 4.5$ cfs.
$S = .02$
$T = 11.1$
$L = 10'$
$d_w = .18$
$\frac{Q_i}{Q} = 0.62$

$Q_i = 2.8$ cfs.
$Q_B = 1.7$ cfs.

@ Inlet 29 (SUMP CONDITION) (BASIN 4 + 5, 2, 2.1, 3)

$Q = 60.5 + 1.7 + 42.2 = 104.4$ cfs.
$L = 6.0'$

Inlet Capacity $= 0.67 A [2g\, d_i - h/2]^{0.5}$

$h = 0.67'$

$d_i = 1.4h = .93 \quad h = .67$

$Q = .67 (6' \times .67) [2 (32.2)(.93 - .67/2)]^{0.5}$

$Q_i = 16.67$ cfs.

$Q_b = 87.7$ cfs. ← EXISTING CONDITIONS

@ INLET 29A (BASIN 4.1 + Bypass)

Q = 13.44 + 60.55 = 73.9
T = 35.9'
S = .0104
L = 12'

$d_w$ = .68

$\frac{Q_i}{Q_o}$ = .31

| Qi = 22.9 |
|---|
| Qb = 51.0 cfs |

@ Inlet 29B (BASIN 4.2)

Q = 14.4 cfs.
T = 15.1
S = .04
L = 12.0'

dw = .26

$\frac{Q_i}{Q_w}$ = 0.4

| Qi = 5.8 cfs. |
|---|
| Qb = 8.6 cfs. |

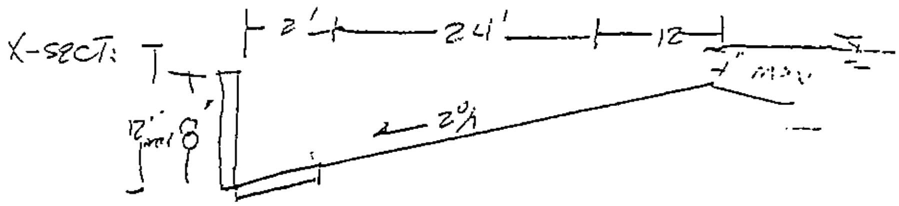
@ Inlet 27 w/ Req'd Inlet Improvements (2 - 12' D10R INLETS by OTHERS)

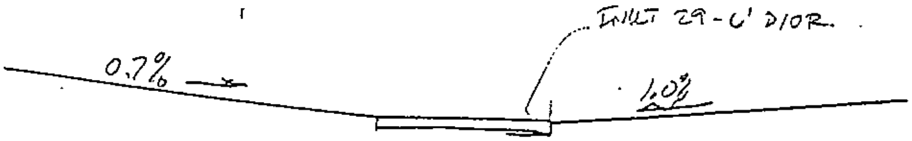
Q = 14.3 + 51.0 + 8.6 + 1.7 = 75.6 cfs.

Determine extent of flooding @ Rainbow Parkway + International circle

Assumption: Flooding occurs on west side only. Flow on east side drains towards 58A + B.

X-SECT:




$Q = .67A\sqrt{2g(d_i - h/2)}$

h = .67 (height of opening)    L = 6'
d = depth of flow.

Solve for d to pass 75.6 cfs for 5 YR.

$d = \left[\left(\frac{Q}{.67A}\right)^2 / 2(g) + h/2\right]$

∴ d = 12.2'
dmax = 1.0 , Q = 17.6 cfs. ✓

$Q_b = 75.6 - 17.6$ = 58 cfs. → TO Inlet 58B

USING WEIR FLOW DETERMINE WIDTH OF SPREAD

$$Q = 3.33 L H^{1.5}$$

$H = .24'$ Above Crown : $H = 38' \times .02 = .76'$
Max Depth @ E = 1.0'
$\therefore H = 1.0 - .76 = .24'$

Solve for L

$$L = \frac{Q}{3.33 H^{1.5}} =$$

$$= \frac{58}{3.33(.24)^{1.5}} = 149.5 \text{ ft}$$ ← Restricted by L = 100' @ Intersection + median

$$\therefore h^{1.5} = \left(\frac{Q}{3.33L}\right)^{1/1.5} =$$

$$= \left(\frac{58}{3.33(100)}\right)^{1/1.5} = 0.31' = 3.7''$$

FLOW NOT INTERCEPTED WILL CROSS CROWN @ A Depth of 4'' @ Q = 58 cfs

# URS
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URS JOB NO. 4229 PAGE 7 OF 19
DATE 26Jul07 BY RJS CHECKED BY CKC (date)
CLIENT [illegible]
PROJECT [illegible]
SUBJECT

*Inlet East of Pueblo Parkway — 5YR Flows*

@ Inlet 13 (BASIN 6)

$Q = 12.2$
$S = 0.044$
$T = 13.9$
$L = 8.0'$

$d_w = .27$

$\frac{Q_i}{Q} = .31$ — $Q_i = 3.8$, $Q_b = 8.4$

@ Inlet 502 (BASIN 7)

$Q = 30.9$ cfs.
$S = .033$
$L = 10'$
$T = 20.9$

$d_w = .37$

$\frac{Q_i}{Q} = .25$ — $Q_i = 7.7$ cfs, $Q_B = 23.2$ cfs.

@ Inlet 501 (BASIN 9)

$Q = 3.2$ cfs.
$S = .033$.
$L = 10'$
$T = 8.9'$.

$d_w = 0.13$

$\frac{Q_i}{Q} = .60$ — $Q_i = 1.9$ cfs, $Q_B = 1.3$ cfs

**URS**
CONSULTANTS, INC.

URS JOB NO. 02229 PAGE 3 OF 14
DATE 5/21/97 BY RJS CHECKED BY CMC
CLIENT T. Schomburg ...
PROJECT Franklin Park M.D.P.
SUBJECT

@ Inlet 34. (BASIN 8 + 6,7,9)

Q: 11.5 + 11.4 + 23.2 + 1.3 = 47.4

S = .007

L = 8'

T = 31.2

dw = .58

$\frac{Qi}{Q}$ = .28

Qi = 13.3 cfs.
Qb : 34.1 cfs.

@ Inlet. 32 (BASIN 11) + ½ overflow from inlet 29 @ flood stage.

Q = 2.6 cfs. + ½(58) = 31.60

S = 0.01

L = 8

T : 26.3

dw = .48

$\frac{Qi}{Q_o}$ = .27

Qi = 8.5 cfs.
Qb = 23.1 → TO 38B

EAST OF Parkside

@ Inlet 44 (BASIN 15)

Q = 13.4 cfs.

S = .033

L = 10'

T : 15.3

dw : .26

$\frac{Qi}{Q_o}$ : .41

Qi - 5.5 cfs
Qb . 7.9 cfs.

@ Inlet #43 (BASIN 14 + 15)

$Q = 26.7 + 7.9 = 34.6$

$S = 0.05$

$L = 8.0'$

$T = 20.10$

$d_w = .36$

$\frac{Q_i}{Q} = .17$

$Q_i = 5.8$ cfs.
$Q_B$ 28.4 cfs

@ Inlet 41 (BASIN 16)

$Q = 17.5$ cfs.

$S = .036$

$L = 20'$

$T = 16.6$

$d_w = .29$

$\frac{Q_i}{Q} = .62$

$Q_i = 10.9$
$Q_B = 6.6$ cfs.

@ Inlet 40 (BASIN 13, 14, 15, 16)

$Q = 6.8 + (6.6 + 28.4) = 35.8$ cfs.

$S = .036$

$L = 8'$

$T = 21.6$

$d_w = .39$

$\frac{Q_i}{Q} = .19$

$Q_i = 6.8$
$Q_B = 29.0$ cfs

@ Inlet 40A (BASIN 17)

$Q = 3.0 L d_i^{1.5}$

$Q = 3.0(10')(.67)^{1.5} = 16.45 \text{ cfs.}$

100% Capture ($Q = 8.4$)

@ Inlet 38 (BASIN 19, 18, 16, 15, 14)

$Q = 1.7 + 29 = 30.7 \text{ cfs.}$

S .009'

L = 6.0'

T = 25.6

$d_w$ = .48

$\frac{Q_i}{Q} = .22$

$Q_i$ = 6.8 cfs
$Q_b$ 23.9 cfs.

@ Inlet 38A+38B (SUMP CONDITION)

$Q = .67A(2(32.2)(d_i - h/2))^{.5}$

$A = .67 \times 10 = 6.7$

$d_{max}$ 1.0'

h = .67

$Q = .67(.67 \times 10)[2(32.2)(.93 - .67/2)]^{.5}$

$Q = 29.4 \text{ cfs.}$

# URS
CONSULTANTS, INC.

URS JOB NO. [illegible] PAGE 11 OF 17
DATE [illegible] BY [illegible] CHECKED BY [illegible]
CLIENT [illegible]
PROJECT [illegible]
SUBJECT

@ Inlet 38A: (BASIN 10 + Bypass [illegible])
$Q = 54.7 + 31.1 = 85.8$ cfs.
$Q_i = 29.4$
$Q_b = 56.4$

Overflow @ 38A+B GR. 3ft STORM.
116.3 cfs.

@ Inlet 38B: (BASIN 12 + Bypass @ Inlet #29 3.8)
$Q = 13.3 + 23.1 + 29. + 23.9 = 89.3$
$Q_i = 29.4$
$Q_B = 59.3$

@ Inlet 504

$$Q = 3.0\,L\,d_i^{1.5}$$

$$= 3.0(14)(.67)^{1.5} = 23.0 \text{ cfs.}$$

∴ 100% capture ⇒ $Q = 14.8$ cfs

@ Inlet 500A, 500B, 500C

ALL RUNOFF FROM BASIN ① [illegible] INTO STORM SEWER SYSTEM

∴ $Q_i = 8.9$ cfs.

12/19
c/c

5 Year Storm
Curb and Gutter Capacity

| Inlet No | Q | SLOPE | X-SLOPE | Manning's "n" | DEPTH | SPREAD |
|---|---|---|---|---|---|---|
| 13 | 12.2 | 0.044 | 0.02 | 0.016 | 0.3 | 13.9 |
| 22 | 70.3 | 0.027 | 0.02 | 0.016 | 0.6 | 29.5 |
| 29A | 73.9 | 0.0104 | 0.02 | 0.016 | 0.7 | 35.9 |
| 29B | 14.4 | 0.04 | 0.02 | 0.016 | 0.3 | 15.1 |
| 32 | 31.6 | 0.01 | 0.02 | 0.016 | 0.5 | 26.3 |
| 34 | 47.4 | 0.009 | 0.02 | 0.016 | 0.6 | 31.2 |
| 38 | 30.7 | 0.011 | 0.02 | 0.016 | 0.5 | 25.6 |
| 40 | 35.8 | 0.036 | 0.02 | 0.016 | 0.4 | 21.7 |
| 41 | 17.5 | 0.036 | 0.02 | 0.016 | 0.3 | 16.6 |
| 43 | 34.6 | 0.05 | 0.02 | 0.016 | 0.4 | 20.1 |
| 44 | 13.4 | 0.033 | 0.02 | 0.016 | 0.3 | 15.3 |
| 560 | 5.0 | 0.054 | 0.02 | 0.016 | 0.2 | 9.6 |
| 560D | 13.5 | 0.054 | 0.02 | 0.016 | 0.3 | 13.9 |
| 561 | 3.2 | 0.033 | 0.02 | 0.016 | 0.2 | 8.9 |
| 562 | 30.9 | 0.033 | 0.02 | 0.016 | 0.4 | 20.9 |
| 563 | 2.9 | 0.011 | 0.02 | 0.016 | 0.2 | 10.6 |
| 568 | 4.5 | 0.02 | 0.02 | 0.016 | 0.2 | 11.1 |

5 YEAR FLOWS
EXISTING CONDITIONS

| INLET NO. | TYPE | LENGTH (ft) | Qi[1] (cfs) | Qb[1] (cfs) | CONDITION |
|---|---|---|---|---|---|
| 13 | D-10R | 8.0 | 3.8 | 8.4 | Cont. Grade |
| 22 | D-10R | 8.0 | 9.8 | 60.5 | Cont. Grade |
| 29 | D-10R | 6.0 | 16.7 | 58.0 | Sump |
| 29A[2] | D-10R | 12.0 | 22.9 | 51.0 | Cont. Grade |
| 29B[2] | D-10R | 12.0 | 5.8 | 8.6 | Cont. Grade |
| 32 | D-10R | 8.0 | 8.5 | 23.1 | Cont. Grade |
| 34 | D-10R | 8.0 | 13.3 | 31.1 | Cont. Grade |
| 38 | D-10R | 6 | 6.8 | 23.9 | Cont. Grade |
| 38A | D-10R | 10 | 29.4 | 56.4 | Sump |
| 38B | D-10R | 10 | 29.4 | 59.3 | Sump |
| 40 | D-10R | 8 | 6.8 | 29.0 | Cont. Grade |
| 40A | D-10R | 10 | 8.4 | 0.0 | Sump |
| 41 | D-10R | 20 | 10.9 | 6.6 | Cont. Grade |
| 43 | D-10R | 8 | 5.8 | 28.4 | Cont. Grade |
| 44 | D-10R | 10 | 5.5 | 7.9 | Cont. Grade |
| 560 | D-10R | 4.0 | 1.1 | 3.9 | Cont. Grade |
| 560A[3] | D-10R | 5 | 0.0 | 0.0 | Sump |
| 560B[3] | D-10R | 15 | 0.0 | 0.0 | Sump |
| 560C[3] | D-10R | 60 | 8.9 | 0.0 | Sump |
| 560D | D-10R | 4 | 1.9 | 11.6 | Cont. Grade |
| 561 | D-10R | 10.0 | 1.9 | 1.3 | Cont. Grade |
| 562 | D-10R | 10.0 | 7.7 | 23.2 | Cont. Grade |
| 564 | D-10R | 14 | 14.8 | 0.0 | Sump |
| 568 | D-10R | 10.0 | 2.8 | 1.7 | Cont. Grade |
| TOTAL | | | 222.8 | | |

NOTE:

1. Qi = INTERCEPTED FLOWS, Qb = BY-PASS FLOWS.
2. TO BE CONSTRUCTED.
3. 560A-B INTERCEP ALL OF BASIN 1.

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URS JOB NO. [illegible] PAGE 14 OF 19
DATE [illegible] BY [illegible] CHECKED BY [illegible] (Calc)
CLIENT [illegible]
PROJECT [illegible]
SUBJECT [illegible] Analysis - [illegible]

[illegible]: Determine Storm Sewer System Capacity During 100yr

See Sheet 2/19 + 17/19, 19/19

C = .86.

Q = CIA : .86 (5.45)(153.9) = 721.3 cfs. = 4.68 cfs/ac.

WEST OF PRINTER'S PKWY

@ Inlet 560 (BASIN 2.1)

Q = 8.6
T = 11.8'
L = 4.0'
S = 0.054

dw = .20

$\frac{Q_i}{Q_o}$ = .15

| Qi = 1.3 cfs. |
|---|
| Qb = 7.3 cfs. |

@ Inlet 560D (BASIN 2, 2.1)

Q = 16.5 + 7.3 = 23.8

T = 17.2
L = 4.0'
S = 0.054'
dw = 0.30

$\frac{Q_i}{Q_o}$ = .10

| Qi = 1.7 cfs |
|---|
| Qb = 15.5 cfs |

@ Inlet 22 (Basin 2, 2.1, 3)

Q = 101.6 + 15.5 = 117.1
T = 35.7
L = 8
S = .127

dw = .67

$\frac{Q_i}{Q_o}$ = .14

| Qi = 16.4 cfs. |
|---|
| Qb = 100.7 |

@ Inlet 56B (BASIN 5)

Q = 7.7
S = 0.2
T = 23.9
L = 10

dw = .44

$\frac{Q_i}{Q_o}$ = .29

Qi = 2.2 cfs.
Qb = 5.5 cfs

@ Inlet 29 (Sump Condition) (BASIN 4, 5, 2, 2.1, 3)

Q = 73.0 + 100.7 + 5.5 = 179.2 cfs.

Qi = 16.7 cfs.
Qb = 162.5 cfs ← EXIST CONDITIONS

d = .61' = 7.5" Depth @ Crown OVERFLOW

W/ IMPROVEMENTS - 2 - 12' INLETS.

@ Inlet 29A (BASIN 4.1 + Bypass)

Q = 23.2 + 100.7 = 123.9 cfs.

T = 43.6'
S = 0.0104
L = 12'

dw = .83

$\frac{Q_i}{Q_o}$ = .29

Qi = 36.0 cfs.
Qb = 87.9 cfs

# URS CONSULTANTS, INC.

URS JOB NO. 42229 PAGE 16 OF 19

DATE 7/26/97 BY [illegible] CHECKED BY [illegible]

CLIENT [illegible]

PROJECT [illegible] Park [illegible]

SUBJECT

@ Inlet 29B. (BASN 4.2)

$Q = 25.0$

$T = 18.6$

$S = 0.04$

$L = 12'$

$d_w = .33$

$\frac{Q_i}{Q} = .29$

$Q_i = 7.3$ cfs.
$Q_b = 17.7$ cfs.

@ Inlet 29. w/ 2-12' Inlets.

$Q = 24.7 + 17.7 + 87.9 + 5.5 = 135.8$ cfs.

$Q_i =$ 17.6 cfs @ $d = 1.0$ max

$Q_b = 118.2$ cfs.

- ASSUMING WEIR FLOW:

$$L = \frac{Q}{3.3H^{1.5}} = \frac{118.2}{3.33(.24)^{1.5}} = 301.9 \text{ ft.}$$

W/ 100' MEDIAN L is [illegible]

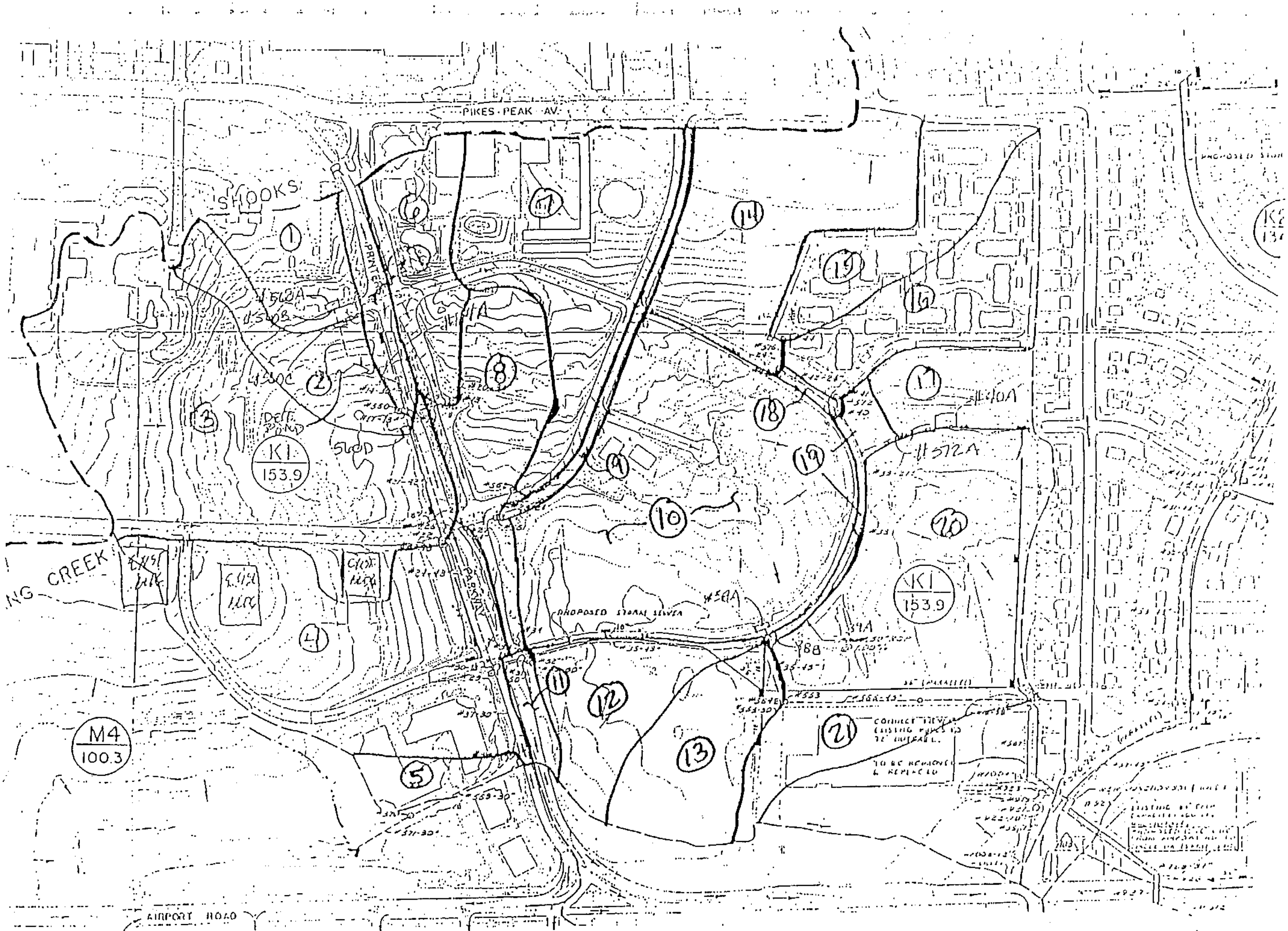
$$\therefore h = \left(\frac{Q}{3.33L}\right)^{1/1.5}$$

$$h = \left(\frac{118.2}{3.33(100)}\right)^{1/1.5} = 0.50' =$$ 6" depth @ crown

17/19

100 Year Storm
Curb and Gutter Capacity

| Inlet No | Q | SLOPE | X-SLOPE | Manning's "n" | DEPTH | SPREAD |
|---|---|---|---|---|---|---|
| ~~13~~ | ~~21.2~~ | ~~0.044~~ | ~~0.020~~ | ~~0.016~~ | ~~0.3~~ | ~~17.2~~ |
| 22 | 117.1 | 0.027 | 0.020 | 0.016 | 0.7 | 35.7 |
| 29A | 123.9 | 0.0104 | 0.02 | 0.016 | 0.9 | 43.6 |
| 29B | 25.0 | 0.04 | 0.02 | 0.016 | 0.4 | 18.6 |
| ~~32~~ | ~~25.4~~ | ~~0.016~~ | ~~0.020~~ | ~~0.016~~ | ~~0.5~~ | ~~24.2~~ |
| ~~34~~ | ~~80.9~~ | ~~0.009~~ | ~~0.020~~ | ~~0.016~~ | ~~0.8~~ | ~~38.2~~ |
| ~~38~~ | ~~66.2~~ | ~~0.011~~ | ~~0.020~~ | ~~0.016~~ | ~~0.7~~ | ~~34.1~~ |
| ~~40~~ | ~~70.0~~ | ~~0.038~~ | ~~0.020~~ | ~~0.016~~ | ~~0.6~~ | ~~27.9~~ |
| ~~41~~ | ~~30.3~~ | ~~0.036~~ | ~~0.020~~ | ~~0.016~~ | ~~0.4~~ | ~~20.4~~ |
| ~~43~~ | ~~62.8~~ | ~~0.050~~ | ~~0.020~~ | ~~0.016~~ | ~~0.5~~ | ~~25.1~~ |
| ~~44~~ | ~~23.2~~ | ~~0.033~~ | ~~0.020~~ | ~~0.016~~ | ~~0.4~~ | ~~18.7~~ |
| 560 | 8.6 | 0.054 | 0.020 | 0.016 | 0.2 | 11.8 |
| 560D | 23.8 | 0.054 | 0.020 | 0.016 | 0.3 | 17.2 |
| ~~561~~ | ~~5.5~~ | ~~0.033~~ | ~~0.020~~ | ~~0.016~~ | ~~0.2~~ | ~~10.9~~ |
| ~~562~~ | ~~53.4~~ | ~~0.033~~ | ~~0.020~~ | ~~0.016~~ | ~~0.5~~ | ~~25.6~~ |
| ~~563~~ | ~~2.8~~ | ~~0.011~~ | ~~0.020~~ | ~~0.016~~ | ~~0.2~~ | ~~10.6~~ |
| 568 | 7.7 | 0.001 | 0.020 | 0.016 | 0.5 | 23.9 |


PIKES PEAK AV.
SHOOKS
PRINTERS
PARKWAY
NG CREEK
DET. POND
K1
153.9
K1
153.9
M4
100.3
PROPOSED STORM SEWER
AIRPORT ROAD
#572A
1
2
3
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5
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14
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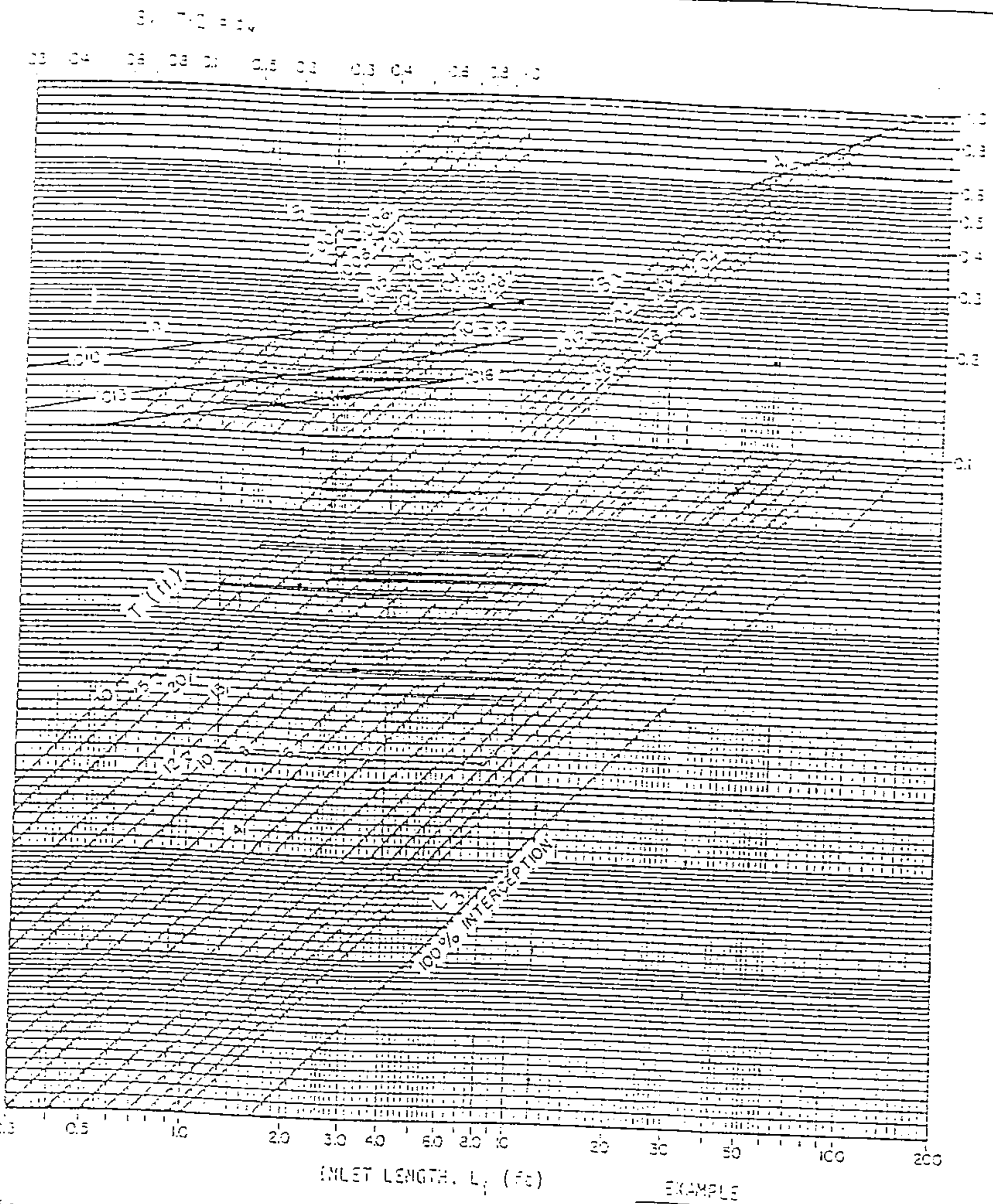
20
21




This chart assumes, w=2 ft., a = 2" and n=5in.

REFERENCE:

Izzard, Carl. F., Report presented at the Annual Meeting of the National Transportation Board, January 1977: Simplified Method For Design of Curb-opening Inlets

EXAMPLE

| | |
|---|---|
| Given | $S_x$ = 0.02 ft/ft<br>T = 10 ft.<br>S = 0.03 ft/ft |
| Find | $L_i$ = 11.8 ft $L_T$ = 34 ft.<br>$Q_i/Q$= 0.55 $Q_i/Q$=1.0 |

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

CONTINUOUS GRADE
Standard Curb-Opening Inlet Chart

Date
OCT. 1987

Figure
7-9

# APPENDIX H:
Inlet Capacities: with Pond Improvements

EXHIBIT 5.3-1
URS Consultants, Inc.
CALCULATION COVER SHEET

Client: T. Schwartz + Assoc. Project Name: Paradise Point MPEP
Project/Calculation Number: 6742229
Title: Inlet Capacity #2 w/ PONDS
Total number of pages (including cover sheet): 16
Total number of computer runs:
Prepared by: TP Date: 7/18/97
Checked by: Charles K. Cotten Date: 3/20/97

Description and Purpose:
Determine inlet Capacities w/ PONDS.

Design bases/references/assumptions:
City/County Drainage Criteria.
4 PONDS INPLACE.

Remarks/conclusions:

Calculation Approved by: Charles K. Cotten 3/20/97
Project Manager/Date

| Revision No.: | Description of Revision: | Approved by: |
| --- | --- | --- |
| | | |
| | | |
| | | |

Project Manager/Date

SEE BASIC ASSUMPTIONS IN INLET CAPACITY #1

BASIN RECONFIGURED AS 1-6

WEST OF POINTERS PARKWAY - 5 YR FLOW
@ Inlet. 560

Q = 3.5 cfs.
S = 0.054
T = 8.4'
L = 4'

dw = .13

$\frac{Q_i}{Q_o}$ = .23

Qi = .8 cfs.
Qb = 2.7 cfs.

@ Inlet 560D

Q = 2.7 cfs + .2 = 2.9 cfs

T = 7.8
S = .054
L = 4'

dw = .12

$\frac{Q_i}{Q_o}$ = .24

Qi = .6
Qb = 2.3 cfs.

@ Inlet 22

Q = 2.3 + 5.6 = 7.9 cfs.

T = 13.0
S = .027
L = 8'
dw = .22

$\frac{Q_i}{Q_o}$ = .32 =

Qi = 2.5 cfs
Qb = 5.4 cfs.

@ Inlet 29A

$Q = 5.4 + 2.3 = 7.7$ cfs.

T: 15.4
S = .0104
L = 12'

dw: .27

$\frac{Q_i}{Q_o}$ : .62

$Q_i$ 4.8 cfs.
$Q_o$ = 2.9 cfs.

@ Inlet 56B From Adjacent

Q = 4.5 cfs.

$Q_i$ = 2.8

$Q_o$ = 1.7

@ Inlet 29B.

Q = 1.6 cfs.

T: 6.6
S = .04
L = 12'

dw = .09

$\frac{Q_i}{Q_o}$ : .15

$Q_i$ = 1.2 cfs.
$Q_o$ = .4 cfs.

@ Inlet 29 (Sump Condition)

$Q = .4 + 2.9 + 5.4$ cfs = 8.7 cfs. + 1.7 = 10.4 cfs.

$Q_i$ · 16.67 cfs. ← See Previous Calc.

$Q_{INTERCEPT}$ = 100% → 10.4 cfs

**URS CONSULTANTS, INC.**

URS JOB NO. 42229 PAGE 16 OF 16
DATE 3/7/97 BY R/S CHECKED BY CKC
CLIENT T. Schmidt + Assoc.
PROJECT Rumba Park West

SUBJECT

Check rest of system -5YR.

FROM PREVIOUS CALC IN Appendix ____

@ Inlet 13: $Q_i$ = 3.8, $Q_b$ = 6.4

@ Inlet 502 $Q_i$ = 7.7, $Q_b$ = 23.2

@ Inlet 501 $Q_i$ = 1.9, $Q_b$ = 1.3

@ Inlet 34 $Q_i$ = 13.3, $Q_b$ = 31.1 ⟶ TO Inlet 38A

@ Inlet 32
Q = 2.6
S = .01
T = 10.3
L = 8'
$d_w$ = .17
$\frac{Q_i}{Q_a}$ : .70

$Q_i$ = 1.80 cfs
$Q_b$ = .80 cfs ⟶ TO 38B

@ Inlet 44 $Q_i$ = 5.5, $Q_b$ = 7.9

@ Inlet 43 $Q_i$ = 5.8, $Q_b$ = 28.4

@ Inlet 41 $Q_i$ = 10.9, $Q_b$ = 6.6

@ Inlet 40 $Q_i$ = 6.8, $Q_b$ = 29.0

@ Inlet 40A Q = 8.4 (100%)

@ Inlet 38 $Q_i$ = 6.8 cfs, $Q_b$ = 23.9 cfs

@ Inlet 38B

Q = 23.9 + 13.3 + .80 = 38 cfs.

@ Inlet 39A: Q = 34.1 + 2.0 = 36.1 cfs.

$Q_i$ = 29.4 × 2 = 58.8 cfs.

$Q_b$ = (38. + 36.1) - 58.8 = 15.30

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URS JOB NO. [illegible] PAGE 5 OF 1[illegible]
DATE 3/1/97 BY [illegible] CHECKED BY [illegible]
CLIENT T. [illegible]
PROJECT [illegible] Park [illegible]

SUBJECT

* WEST OF [illegible] PKWY – 100YR FLOWS
CHECK 100YR.

@ Inlet 520

Q = 6.0 cfs.
S = .054
T = 10.3
L = 4'

dw = .17

$\frac{Q_i}{Q_o}$ = .18

Qi = 1.1 cfs.
Qb = 4.9 cfs

@ Inlet 560D.

Q = .3 + 4.9 = 5.2 cfs.
T = 9.8
L = 4'
S = .054

dw = .156

$\frac{Q_i}{Q_o}$ = .19

Qi = 1.0 cfs.
Qb = 4.2 cfs.

@ Inlet 22

Q = 4.2 + 9.6 = 13.8
T = 16.0'
L = 8'
S = .027

dw = .28

$\frac{Q_i}{Q_o}$ = .28

Qi = 3.9
Qb = 9.9 cfs.

@ Inlet 29A.

Q = 9.9 + 4.0 = 13.9
T = 19.2 cfs.
S = .0104.
L = 12'
$d_w$ = .34
$\frac{Q_i}{Q_0}$ = .50 =

$Q_i$ = 7.0 cfs.
$Q_o$ = 6.9 cfs.

@ Inlet 56B (From Assembly)

Q = 7.7
$Q_i$ = 2.2 cfs
$Q_o$ = 5.5 cfs.

@ Inlet 29B.

Q = 2.8 cfs.
T = 8.2 cfs.
S = .04
L = 12'
$d_w$ = .12
$\frac{Q_i}{Q_0}$ = .66

$Q_i$ = 1.8
$Q_b$ = 1.0 cfs.

@ Inlet 29 (Sump Condition)

Q = 1.0 + 6.9 + 25.1 + 5.5 = 38.5 cfs.
L = 6'
d req'd to pass Q = 33.0

$d = \left(\frac{\left(\frac{Q}{.67A}\right)^2}{2(32.2)}\right)$ = 2.31'

$d_{max}$ = 1.0' Q = 17.6 cfs.

Overflow = 20.9 cfs.

**URS**
CONSULTANTS, INC.

URS JOB NO. [illegible] PAGE 7 OF 16
DATE [illegible] BY [illegible] CHECKED BY [illegible]
CLIENT [illegible]
PROJECT [illegible]
SUBJECT

Determine width of flow for [illegible] flow.

Assume weir flow.

$Q = 3.33 L H^{1.5}$

Max H = .20' above crown.

Solve for $L = \frac{Q}{3.33 H^{1.5}} = \frac{20.9}{3.33(.20)^{1.5}} =$ **53.8' @ 2.8" depth**

or. L = 100' Restriction w/ median.

H = .15' = **1.9" @ crown.**

CHECK: PERFORMANCE OF REST OF SYS. - 100 YR. FLOWS

+ [illegible] SIDE OF PRINTERS PRKWY

@ Inlet 13. (BASIN 6)

Q = 21.2 cfs.

T = 17.2

dw = .30

$\frac{Q_i}{Q_o}$ = .21

$Q_i$ = 4.5 cfs.

$Q_b$ = 16.1 cfs → TO INLET [illegible]

@ Inlet 562. (BASIN 7)

Q = 53.4

T = 25.6

dw = .47

$\frac{Q_i}{Q_o}$ = .21

$Q_i$ = 11.2 cfs

$Q_b$ = 42.2 → TO INLET 34

# URS CONSULTANTS, INC.

URS JOB NO. [illegible] PAGE 8 OF 14
DATE 3/7/97 BY [illegible] CHECKED BY [illegible]
CLIENT T. Schindler + Assoc.
PROJECT [illegible] Park [illegible]

SUBJECT

@ Inlet 501 (BASIN 9)

Q = 5.5

L = 10'

T = 10.9

$d_w$ = .18

$\frac{Q_i}{Q_o}$ = .52

$Q_i$ = 2.9 cfs.
$Q_b$ = 2.6 cfs → TO INLET 34

@ Inlet 34 (BASIN 8)

Q = 20.0 + 2.6 + 42.2 + 16.1 = 80.9 cfs.

T = 30.0'

$d_w$ = .56

$\frac{Q_i}{Q_o}$ = .24

$Q_i$ = 19.4 cfs.
$Q_b$ = 61.5 cfs. → TO 35A.

@ Inlet 32 (BASIN 11 + INLET 29 OVERFLOW)

Q = 4.5 + 20.9 = 25.4 cfs.

T = 24.2

$d_w$ = .44

$\frac{Q_i}{Q_o}$ = .32 = 6.4 cfs.
$Q_b$ = 19.0 → TO 33E

EAST OF PARKSIDE

@ Inlet 44 (BASIN 15)

Q = 23.2 cfs.

T = 18.-

$d_w$ = .33

$\frac{Q_i}{Q}$ = .29

$Q_i$ = 6.7
$Q_b$ = 16.5 → TO 43

# URS CONSULTANTS, INC.

URS JOB NO. 42229 PAGE 9 OF 16

DATE 8/7/97 BY RJS. CHECKED BY [illegible]

CLIENT [illegible]

PROJECT [illegible]

SUBJECT

@ Inlet 43. (BASIN ... + Bypass)

Q = 46.1 + 16.5 = 62.6 cfs.

T = 25.1 , L = 80'

dw = .46.

Qi/Q0 = .14

Qi = 8.7
Qb = 53.9 → TO 40

@ Inlet 41. (BASIN 16)

Q = 30.3

T = 20.4
L = 25'
dw = .37

Qi/Q0 = .52

Qi = 15.6
Qb = 14.7 → TO 40'

@ Inlet 40 (BSN 18 + Bypass)

Q = 1.4 + 14.7 + 53.9 = 70 cfs.

T = 27.8
dw = .52
L = 8'

Qi/Q = .13

Qi = 9.10
Qb = 60.9 cfs. → TO 38

@ Inlet. 40A: (BASIN 17)

Q: 3.0Lid^1.5

Q = 16.c/s ; L = 10' d: .67'

Q = 14.5 100% CAPTURE

**URS**
CONSULTANTS, INC.

URS JOB NO. [illegible] PAGE 10 OF
DATE [illegible] BY RES CHECKED BY [illegible]
CLIENT T. Schuler + Assoc
PROJECT [illegible]

SUBJECT

@ Inlet 38 (BASIN A + Bypass)

Q = 5.3 + 60.9 = 66.2

T = 34.1

L = 6.0'

d/v = .64

$\frac{Q_i}{Q}$ = .18

Qi = 11.9 cfs
Qb = 54.3 cfs → TO 38B

@ Inlet 38A + 38B. (DOES NOT INCLUDE BASIN 10 DUE TO POND)

Q = 54.3 + 61.5 + 19 = 134.8 + 3.42 = 138.2 ✓
Q=CIA (For Roadway in Basin 10)

Qi = 2(29.4 cfs) = 58.8 cfs.

OVERFLOW = ~~76.0~~ 79.4 cfs.

@ Inlet 56.4

Q = 25.7 cfs.

Qi = 23.0 cfs.

OVERFLOW = 2.7 cfs.

100 Year Storm
Curb and Gutter Capacity

| Inlet No | Q | SLOPE | X-SLOPE | Manning's "n" | DEPTH | SPREAD |
|---|---|---|---|---|---|---|
| 13 | 21.2 | 0.044 | 0.020 | 0.016 | 0.3 | 17.2 |
| ~~22~~ | ~~117.1~~ | ~~0.027~~ | ~~0.020~~ | ~~0.016~~ | ~~0.7~~ | ~~35.7~~ |
| ~~29A~~ | ~~123.9~~ | ~~0.0104~~ | ~~0.02~~ | ~~0.016~~ | ~~0.9~~ | ~~42.6~~ |
| ~~29B~~ | ~~25.0~~ | ~~0.04~~ | ~~0.02~~ | ~~0.016~~ | ~~0.4~~ | ~~18.6~~ |
| ~~32~~ | ~~18.9~~ | ~~0.016~~ | ~~0.020~~ | ~~0.016~~ | ~~0.4~~ | ~~22.4~~ |
| 34 | 80.9 | 0.009 | 0.020 | 0.016 | 0.8 | 38.2 |
| 38 | 66.2 | 0.011 | 0.020 | 0.016 | 0.7 | 34.1 |
| 40 | 70.0 | 0.036 | 0.020 | 0.016 | 0.6 | 27.9 |
| 41 | 30.3 | 0.036 | 0.020 | 0.016 | 0.4 | 20.4 |
| 43 | 62.6 | 0.050 | 0.020 | 0.016 | 0.5 | 25.1 |
| 44 | 23.2 | 0.033 | 0.020 | 0.016 | 0.4 | 18.7 |
| ~~560~~ | ~~8.6~~ | ~~0.054~~ | ~~0.020~~ | ~~0.016~~ | ~~0.2~~ | ~~11.8~~ |
| ~~560D~~ | ~~23.8~~ | ~~0.054~~ | ~~0.020~~ | ~~0.016~~ | ~~0.3~~ | ~~17.2~~ |
| 561 | 5.5 | 0.033 | 0.020 | 0.016 | 0.2 | 10.9 |
| 562 | 53.4 | 0.033 | 0.020 | 0.016 | 0.5 | 25.6 |
| 563 | 2.9 | 0.011 | 0.020 | 0.016 | 0.2 | 10.6 |
| 568 | 7.7 | 0.001 | 0.020 | 0.016 | 0.5 | 23.9 |

5YR W/ PONDS IN PLACE

| BASIN NO. | AREA (Ac.) | TIME OF CONCENTRATION (Tc, MIN.) | RAINFALL INTENSITY (In/hr) | Q (cfs) |
|---|---|---|---|---|
| 1A | 1.29 | 18.5 | 3.15 | 3.5 |
| 2A | 0.06 | 18.5 | 3.15 | 0.2 |
| 3A | 2.06 | 18.5 | 3.15 | 5.6 |
| 4A | 0.59 | 18.5 | 3.15 | 1.6 |
| 5A | 0.84 | 18.5 | 3.15 | 2.3 |
| 6A | 5.36 | 18.5 | 3.15 | 14.5 |

100 YR W/ PONDS IN PLACE

| BASIN NO. | AREA (Ac.) | TIME OF CONCENTRATION (Tc, MIN.) | RAINFALL INTENSITY (In/hr) | Q (cfs) |
|---|---|---|---|---|
| 1A | 1.29 | 18.5 | 5.45 | 6.0 |
| 2A | 0.06 | 18.5 | 5.45 | 0.3 |
| 3A | 2.06 | 18.5 | 5.45 | 9.6 |
| 4A | 0.59 | 18.5 | 5.45 | 2.8 |
| 5A | 0.84 | 18.5 | 5.45 | 4.0 |
| 6A | 5.36 | 18.5 | 5.45 | 25.1 |

5 Year Storm w/ Pond
Curb and Gutter Capacity

| Inlet No | Q | SLOPE | X-SLOPE | Manning's "n" | DEPTH | SPREAD |
|---|---|---|---|---|---|---|
| 22 | 7.9 | 0.027 | 0.02 | 0.016 | 0.3 | 13.0 |
| 32 | 2.6 | 0.01 | 0.02 | 0.016 | 0.2 | 10.3 |
| 29A | 7.7 | 0.0104 | 0.02 | 0.016 | 0.3 | 15.4 |
| 29B | 1.6 | 0.04 | 0.02 | 0.016 | 0.1 | 6.6 |
| 560 | 3.5 | 0.054 | 0.02 | 0.016 | 0.2 | 8.4 |
| 560D | 2.9 | 0.054 | 0.02 | 0.016 | 0.2 | 7.8 |

100 Year Storm w/ Pond
Curb and Gutter Capacity

| Inlet No | Q | SLOPE | X-SLOPE | Manning's "n" | DEPTH | SPREAD |
|---|---|---|---|---|---|---|
| 22 | 13.8 | 0.027 | 0.020 | 0.016 | 0.3 | 16.0 |
| 29A | 13.9 | 0.0104 | 0.02 | 0.016 | 0.4 | 19.2 |
| 29B | 2.8 | 0.04 | 0.02 | 0.016 | 0.2 | 8.2 |
| 560 | 6.0 | 0.054 | 0.020 | 0.016 | 0.2 | 10.3 |
| 560D | 5.2 | 0.054 | 0.020 | 0.016 | 0.2 | 9.8 |

13/16
GKC

5 YEAR FLOWS
W/ POND IMPROVEMENTS

| INLET NO. | TYPE | LENGTH (ft) | Qi[1] (cfs) | Qb[1] (cfs) | CONDITION |
|---|---|---|---|---|---|
| 13 | D-10R | 8.0 | 3.8 | 8.4 | Cont. Grade |
| 22 | D-10R | 8.0 | 2.5 | 5.4 | Cont. Grade |
| 29 | D-10R | 6.0 | 10.4 | 0.0 | Sump |
| 29A[2] | D-10R | 12.0 | 4.8 | 2.9 | Cont. Grade |
| 29B[2] | D-10R | 12.0 | 1.2 | 0.4 | Cont. Grade |
| 32 | D-10R | 8.0 | 1.8 | 0.8 | Cont. Grade |
| 34 | D-10R | 8.0 | 13.3 | 31.1 | Cont. Grade |
| 38 | D-10R | 6 | 6.8 | 23.9 | Cont. Grade |
| 38A | D-10R | 10 | 29.4 | 7.6 | Sump |
| 38B | D-10R | 10 | 29.4 | 7.6 | Sump |
| 40 | D-10R | 8 | 6.8 | 29.0 | Cont. Grade |
| 40A | D-10R | 10 | 8.4 | 0.0 | Sump |
| 41 | D-10R | 20 | 10.9 | 6.6 | Cont. Grade |
| 43 | D-10R | 8 | 5.8 | 28.4 | Cont. Grade |
| 44 | D-10R | 10 | 5.5 | 7.9 | Cont. Grade |
| 560 | D-10R | 4.0 | 0.8 | 2.7 | Cont. Grade |
| 560A[3] | D-10R | 5 | 0.0 | 0.0 | Sump |
| 560B[3] | D-10R | 15 | 0.0 | 0.0 | Sump |
| 560C[3] | D-10R | 6 | 8.9 | 0.0 | Sump |
| 560D | D-10R | 4 | 0.6 | 2.3 | Cont. Grade |
| 561 | D-10R | 10.0 | 1.9 | 1.3 | Cont. Grade |
| 562 | D-10R | 10.0 | 7.7 | 23.2 | Cont. Grade |
| 564 | D-10R | 14 | 14.8 | 0.0 | Sump |
| 568 | D-10R | 10.0 | 2.8 | 1.7 | Cont. Grade |
| TOTAL | | | 178.3 | | |

NOTE:

1. Qi = INTERCEPTED FLOWS, Qb = BY-PASS FLOWS.
2. TO BE CONSTRUCTED.
3. 560A-B INTERCEP ALL OF BASIN 1.

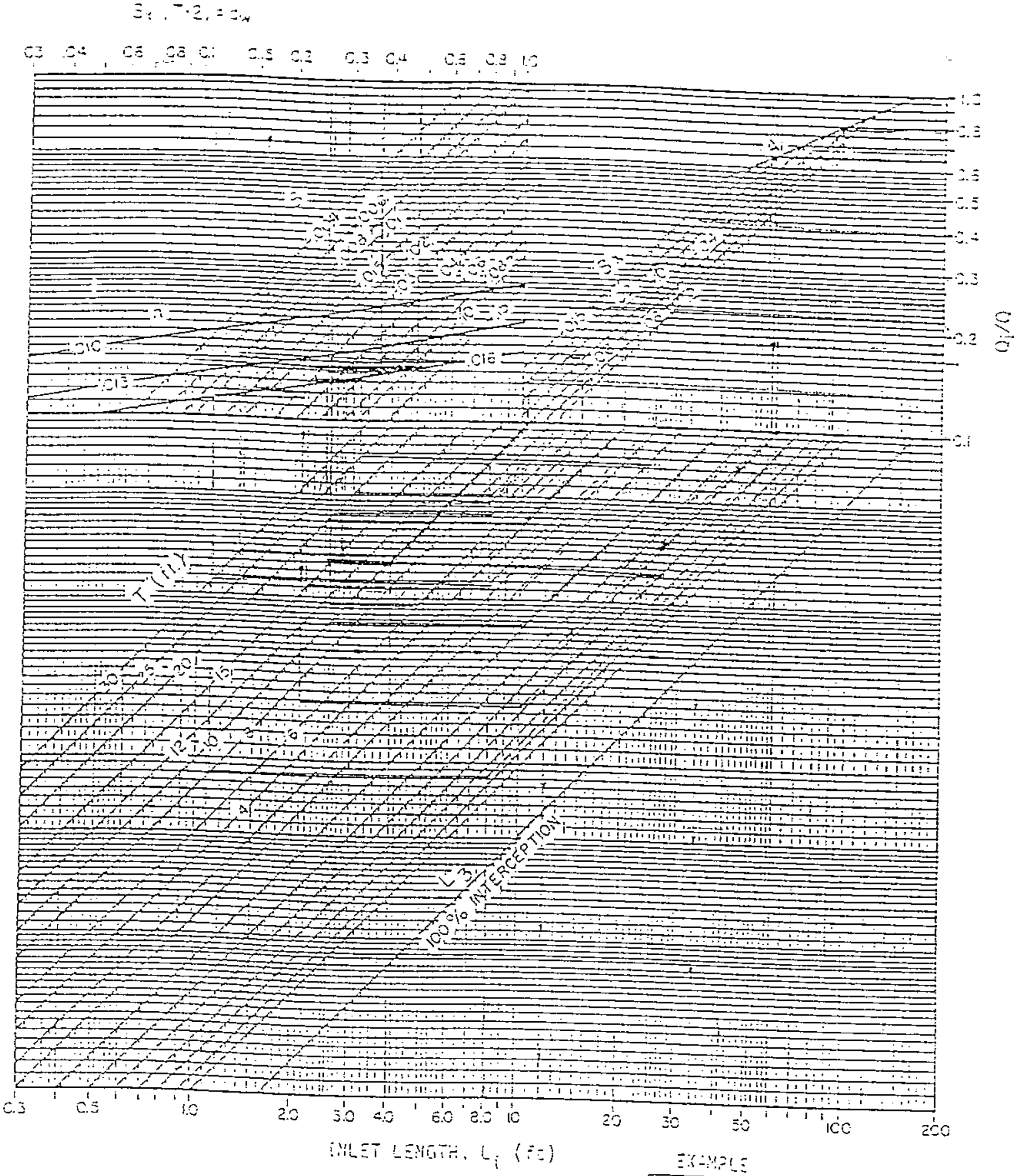
15/16
c/c2

100 YEAR FLOWS
W/ PROPOSED PONDS

| INLET NO. | TYPE | LENGTH (ft) | Qi[1] (cfs) | Qb[1] (cfs) | CONDITION |
|---|---|---|---|---|---|
| 13 | D-10R | 8.0 | 4.5 | 16.1 | Cont. Grade |
| 22 | D-10R | 8.0 | 3.9 | 9.9 | Cont. Grade |
| 29 | D-10R | 6.0 | 17.6 | 20.9 | Sump |
| 29A[2] | D-10R | 12.0 | 7.0 | 6.9 | Cont. Grade |
| 29B[2] | D-10R | 12.0 | 1.8 | 1.0 | Cont. Grade |
| 32 | D-10R | 8.0 | 6.4 | 13.5 | Cont. Grade |
| 34 | D-10R | 8.0 | 19.4 | 61.5 | Cont. Grade |
| 38 | D-10R | 6 | 11.9 | 54.3 | Cont. Grade |
| 38A | D-10R | 10 | 29.4 | 38.0 | Sump |
| 38B | D-10R | 10 | 29.4 | 38.0 | Sump |
| 40 | D-10R | 8 | 9.1 | 60.9 | Cont. Grade |
| 40A | D-10R | 10 | 14.5 | 0.0 | Sump |
| 41 | D-10R | 20 | 15.6 | 14.7 | Cont. Grade |
| 43 | D-10R | 8 | 8.7 | 53.9 | Cont. Grade |
| 44 | D-10R | 10 | 6.7 | 16.5 | Cont. Grade |
| 560 | D-10R | 4.0 | 1.1 | 4.9 | Cont. Grade |
| 560A[3] | D-10R | 5 | 0.0 | 0.0 | Sump |
| 560B[3] | D-10R | 15 | 0.0 | 0.0 | Sump |
| 560C[3] | D-10R | 6 | 15.3 | 0.0 | Sump |
| 560D | D-10R | 4 | 1.0 | 4.2 | Cont. Grade |
| 561 | D-10R | 10.0 | 2.9 | 2.6 | Cont. Grade |
| 562 | D-10R | 10.0 | 11.2 | 42.2 | Cont. Grade |
| 564 | D-10R | 14 | 23.0 | 2.7 | Sump |
| 568 | D-10R | 10.0 | 2.8 | 1.7 | Cont. Grade |
| TOTAL | | | 243.2 | | |

NOTE:

1. QI = INTERCEPTED FLOWS, Qb = BY-PASS FLOWS.
2. TO BE CONSTRUCTED.
3. 560A-B INTERCEP ALL OF BASIN I.




This chart assumes, w=2 ft., a = 2" and h=6in.

REFERENCE:

Izzard, Carl. F., Report presented at the Annual Meeting of the National Transportation Board, January 1977; Simplified Method For Design of Curb-opening Inlets

EXAMPLE

| | | |
|---|---|---|
| Given | $S_x$ = 0.02 ft/ft<br>T = 10 ft.<br>S = 0.03 ft/ft | |
| Find | $L_i$ = 11.3 ft<br>$Q_i/Q$ = 0.65 | $L_i$ = 34 ft.<br>$Q_i/Q$ = 1.0 |

HCR Infrastructure Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

CONTINUOUS GRADE
Standard Curb-Opening Inlet Chart

Date OCT. 1987

Figure 7-9

**URS Greiner**

JOB NUMBER 6742229 PAGE 1 OF ____

DATE 01/14/98 BY ALE CHECKED BY ____ (date)

CLIENT DEVELOPERS OF PAINTERS PARK

PROJECT MDDP

SUBJECT CITY COMMENTS - INLET 29A & B

INLET CALCS - REPLACE INLETS 29A and 29B w/ a single 15 ft. radial inlet 29A at the corner.

EXISTING CONDITION: 5 YEAR STORM

Q ΣBASINS 4.1 + BYPASS 4.2

$Q_5 = 13.44 + 60.55 + 14.40 = 88.39$ cfs.

SLOPE: SUMP   X SLOPE = 2%   n = 0.016   a = 2"

depth = 0.8 ft

FIG 7-11 → $Q_i = 30$ cfs.   $Q_b = 58.39$ cfs

EXISTING CONDITIONS: 100 YEAR STORM

$Q_{100} = 23.2 + 100.7 + 25.0 = 148.9$

depth = 0.97 ft say 1 ft.

FIG 7-11   $Q_i = 42$ cfs   $Q_b = 106.9$ cfs

WITH POND IMPROVEMENTS: 5 YEAR STORM

$Q_5 = 5.4 + 2.3 + 1.6 = 9.3$ cfs

depth = 0.41

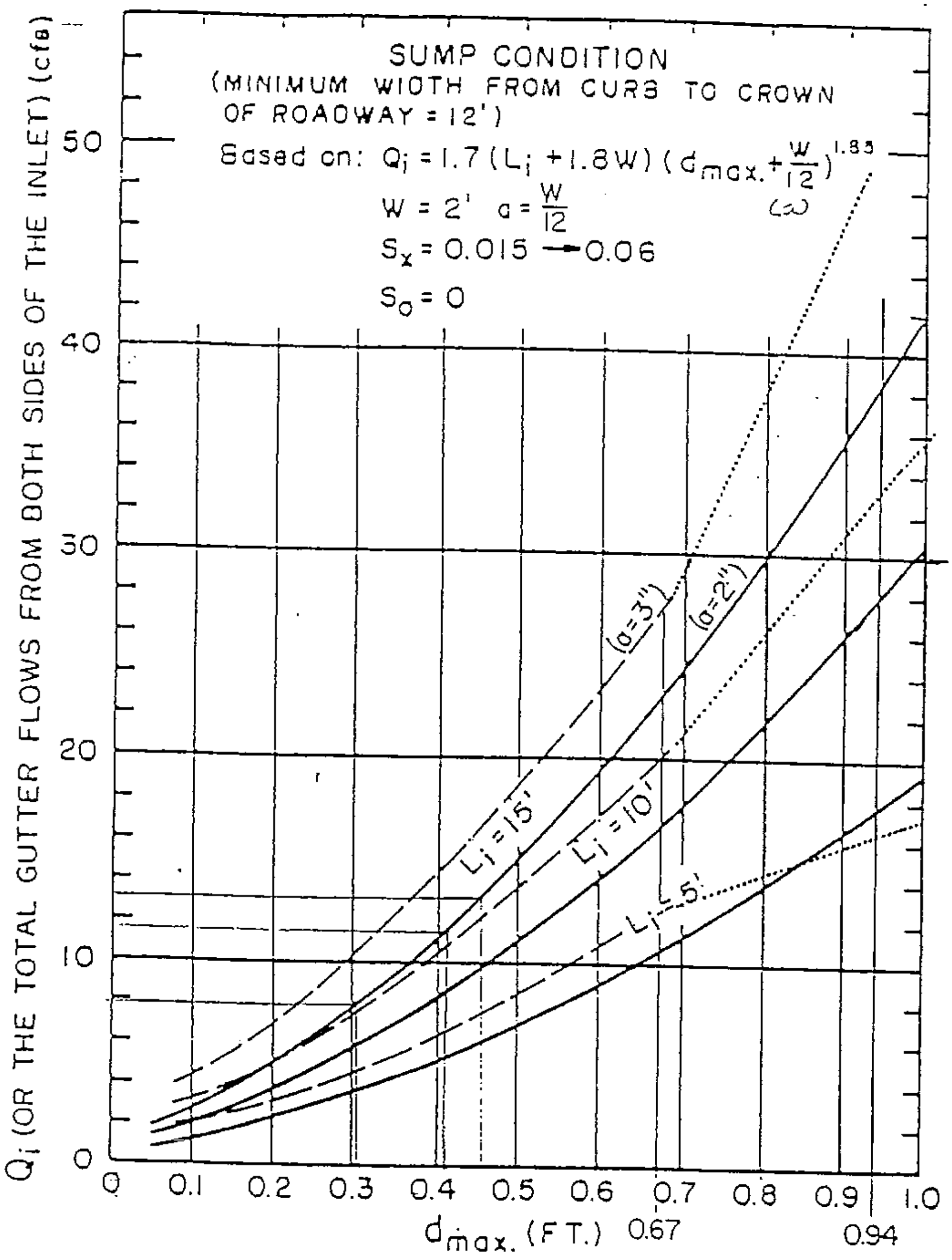
FIG 7-11   $Q_i = 12.0$ cfs   → 100% ∵ sump condition.

WITH PONDS: 100 YEAR STORM

$Q_{100} = 9.9 + 4.0 + 2.8 = 16.7$ cfs

depth = 0.45

FIG 7-11   $Q_i = 13.0$ cfs   $Q_b = 3.7$ cfs




REFERENCE : Izzard, Carl. f., Report presented at the Annual Meeting of the National Transportation Board, January 1977; Simplified Method For Design of Curb-opening Inlets

— — — (As Modified by El Paso County, per Type R Inlet)

Note: Depth of ponding measured at curb above depressed area ; a = 3", For d ≤ .67

$Q_i = (1.7\,L_i + 6.12)(d_{max} + .25)^{1.85}$; $Q_i = 3.60\,L_i\,(d - .08)^{.5}$ For d ≥ .94; Note: No Clogging Factor

9/30/90

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The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date: OCT. 1987

Sump Capacity for Curb-opening Inlets

Figure 7-11

# APPENDIX I:
Drainage Channel and Storm Sewer Calculations

EXHIBIT 5.3-1
URS Consultants, Inc.
CALCULATION COVER SHEET

Client: TS... Project Name: ... Park ...
Project/Calculation Number: 68779
Title: DRAINAGE CHANNEL
Total number of pages (including cover sheet): 6
Total number of computer runs: ______
Prepared by: Ron Sanchez Date: 3/5/97
Checked by: Charles K. Cotten Date: 3/20/97

Description and Purpose:

Size Drainage Chanel Along South Prop. line of School site.

Design bases/references/assumptions:

City/County Drainage Criteria.

Remarks/conclusions:

See Tables for Different Slopes

@ S ≈ 2.0% w = 4
z = 4 V < 7.0 fps.
d = 3'

Calculation Approved by: Charles K. Cotten 3/20/97
Project Manager/Date

| Revision No.: | Description of Revision: | Approved by: |
|---|---|---|
| | | |
| | | |
| | | |

Project Manager/Date

**URS CONSULTANTS, INC.**

URS JOB NO. 43229 PAGE 2 OF 6
DATE 3/5/97 BY RS. CHECKED BY [illegible]
CLIENT I. Schutter/Assoc
PROJECT [illegible]
SUBJECT DRAINAGE CHANNEL

* SIZE CHANNEL FOR OVERFLOW

CAPACITY REQD:

1) OVERFLOW FROM INLET 38A+38B

$Q_5$ = ~~Ø~~ 15.2

$Q_{100}$ = ~~76~~ 79.4 + 2.7 = ~~78.7~~ 82.1 cfs. ✓

2) BASIN 21 RUNOFF.

$Q_5$ - 11.4 cfs.

$Q_{100}$ = 19.6 cfs.

∴ TOTAL $Q_5$ = 26.6 cfs.

$Q_{100}$ = ~~98.3~~ 101.70 cfs.

* Design Per City/County Criteria:

F < .80

V = 4 ~ 7 fps.

Design Slope = 0.5% → 3%

n = 0.03 ~ 0.04

CONCLUSION - SEE FOLLOWING TABLES

FOR Q = 101.7 cfs

z = 4
w = 4
d = 3'

USE GRASSLINED CHANNEL @ V < 7 fps
CONSIDER REINFORCED Channel bottom.

✓ This channel should be away from the stairs/public travell area(s) for public safety.

Channel Sizing

n = 0.030

| Q-100 (cfs) | s (%) | z (ft/ft) | W (ft) | A (sq. ft) | P (ft) | R (ft/ft) | d (ft) | V (fps) | F | frbd req'd (ft) | min chnl depth (ft) | Top Width (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101.2 | 0.50% | 4 | 4.0 | 25.4 | 21.07 | 1.21 | 2.07 | 4.0 | 0.2 | 1.1 | 3.2 | 29.3 |
| 102.2 | 1.00% | 4 | 4.0 | 19.8 | 18.68 | 1.06 | 1.78 | 5.2 | 0.5 | 1.2 | 2.9 | 27.5 |
| 101.8 | 1.50% | 4 | 4.0 | 17.0 | 17.36 | 0.98 | 1.62 | 6.0 | 0.7 | 1.2 | 2.9 | 26.4 |
| 102.3 | 2.00% | 4 | 4.0 | 15.3 | 16.53 | 0.93 | 1.52 | 6.7 | 0.9 | 1.2 | 2.7 | 25.7 |
| 101.8 | 2.50% | 4 | 4.0 | 14.1 | 15.97 | 0.89 | 1.44 | 7.2 | 1.1 | 1.2 | 2.5 | 25.2 |
| 101.7 | 3.00% | 4 | 4.0 | 13.1 | 15.38 | 0.85 | 1.38 | 7.7 | 1.3 | 1.2 | 2.5 | 24.8 |

n = 0.030

| Q-100 (cfs) | s (%) | z (ft/ft) | W (ft) | A (sq. ft) | P (ft) | R (ft/ft) | d (ft) | V (fps) | F | frbd req'd (ft) | min chnl depth (ft) | Top Width (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101.2 | 0.50% | 4 | 3.0 | 25.3 | 20.89 | 1.21 | 2.17 | 4.0 | 0.2 | 1.1 | 3.3 | 29.4 |
| 101.4 | 1.00% | 4 | 3.0 | 19.5 | 18.42 | 1.06 | 1.87 | 5.2 | 0.4 | 1.2 | 3.0 | 27.2 |
| 101.3 | 1.50% | 4 | 3.0 | 16.9 | 17.10 | 0.98 | 1.71 | 6.0 | 0.7 | 1.2 | 2.9 | 26.1 |
| 102.0 | 2.00% | 4 | 3.0 | 15.2 | 16.28 | 0.93 | 1.61 | 6.7 | 0.9 | 1.2 | 2.8 | 25.5 |
| 101.7 | 2.50% | 4 | 3.0 | 14.0 | 15.62 | 0.89 | 1.53 | 7.3 | 1.1 | 1.2 | 2.7 | 24.9 |
| 101.8 | 3.00% | 4 | 3.0 | 13.1 | 15.12 | 0.86 | 1.47 | 7.8 | 1.3 | 1.2 | 2.7 | 24.5 |

n = 0.030

| Q-100 (cfs) | s (%) | z (ft/ft) | W (ft) | A (sq. ft) | P (ft) | R (ft/ft) | d (ft) | V (fps) | F | frbd req'd (ft) | min chnl depth (ft) | Top Width (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102.0 | 0.50% | 4 | 0.0 | 25.4 | 20.78 | 1.22 | 2.52 | 4.0 | 0.2 | 1.1 | 3.7 | 29.2 |
| 101.6 | 1.00% | 4 | 0.0 | 19.5 | 18.22 | 1.07 | 2.21 | 5.2 | 0.4 | 1.2 | 3.4 | 27.0 |
| 101.9 | 1.50% | 4 | 0.0 | 16.8 | 16.90 | 0.99 | 2.05 | 6.1 | 0.5 | 1.2 | 3.2 | 25.9 |
| 101.5 | 2.00% | 4 | 0.0 | 15.1 | 16.00 | 0.94 | 1.94 | 6.7 | 0.7 | 1.2 | 3.1 | 25.2 |
| 101.5 | 2.50% | 4 | 0.0 | 13.8 | 15.34 | 0.90 | 1.86 | 7.3 | 0.9 | 1.2 | 3.1 | 24.7 |
| 101.8 | 3.00% | 4 | 0.0 | 13.0 | 14.84 | 0.87 | 1.80 | 7.9 | 1.1 | 1.2 | 3.0 | 24.3 |

USE Z=4', W=4',
D ≈ 3.0'

Channel Sizing

| | Q-5 (cfs) | s (%) | z (ft/ft) | W (ft) | A (sq. ft) | P (ft) | R (ft/ft) | d (ft) | V (fps) | F | frbrd req'd (ft) | min chnl depth (ft) | Top Width (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n = 0.030 | | | | | | | | | | | | | |
| | 28.2 | 0.50% | 4 | 4.0 | 9.4 | 13.15 | 0.71 | 1.11 | 2.8 | 0.2 | 1.1 | 2.2 | 21.5 |
| | 28.3 | 1.00% | 4 | 4.0 | 7.4 | 11.33 | 0.63 | 0.95 | 3.8 | 0.4 | 1.1 | 2.0 | 20.3 |
| | 28.3 | 1.50% | 4 | 4.0 | 6.3 | 11.01 | 0.57 | 0.85 | 4.2 | 0.6 | 1.1 | 1.9 | 19.8 |
| | 28.9 | 2.00% | 4 | 4.0 | 5.8 | 10.30 | 0.54 | 0.80 | 4.7 | 0.8 | 1.1 | 1.9 | 19.3 |
| | 28.5 | 2.50% | 4 | 4.0 | 5.3 | 10.18 | 0.52 | 0.75 | 5.0 | 1.1 | 1.1 | 1.9 | 18.9 |
| | 28.8 | 3.00% | 4 | 4.0 | 5.0 | 9.94 | 0.50 | 0.72 | 5.4 | 1.3 | 1.1 | 1.8 | 18.7 |
| n = 0.030 | | | | | | | | | | | | | |
| | 28.5 | 0.50% | 4 | 3.0 | 9.4 | 12.90 | 0.73 | 1.20 | 2.3 | 0.2 | 1.1 | 2.3 | 21.2 |
| | 28.4 | 1.00% | 4 | 3.0 | 7.2 | 11.41 | 0.63 | 1.02 | 3.7 | 0.4 | 1.1 | 2.1 | 19.9 |
| | 28.8 | 1.50% | 4 | 3.0 | 6.2 | 10.67 | 0.59 | 0.93 | 4.3 | 0.6 | 1.1 | 2.0 | 19.3 |
| | 28.7 | 2.00% | 4 | 3.0 | 5.8 | 10.17 | 0.55 | 0.87 | 4.7 | 0.8 | 1.1 | 2.0 | 18.9 |
| | 28.4 | 2.50% | 4 | 3.0 | 5.1 | 9.73 | 0.53 | 0.82 | 5.1 | 1.0 | 1.1 | 1.9 | 18.5 |
| | 28.8 | 3.00% | 4 | 3.0 | 4.9 | 9.51 | 0.51 | 0.79 | 5.5 | 1.2 | 1.1 | 1.9 | 18.3 |
| n = 0.030 | | | | | | | | | | | | | |
| | 28.5 | 0.50% | 4 | 0.0 | 9.2 | 12.53 | 0.74 | 1.52 | 2.9 | 0.2 | 1.1 | 2.6 | 20.8 |
| | 28.2 | 1.00% | 4 | 0.0 | 7.1 | 10.97 | 0.65 | 1.33 | 3.7 | 0.3 | 1.1 | 2.4 | 19.5 |
| | 28.7 | 1.50% | 4 | 0.0 | 6.2 | 10.23 | 0.60 | 1.24 | 4.3 | 0.5 | 1.1 | 2.4 | 18.9 |
| | 28.4 | 2.00% | 4 | 0.0 | 5.5 | 9.65 | 0.57 | 1.17 | 4.8 | 0.6 | 1.1 | 2.3 | 18.4 |
| | 28.2 | 2.50% | 4 | 0.0 | 5.0 | 9.24 | 0.54 | 1.12 | 5.2 | 0.8 | 1.1 | 2.3 | 18.0 |
| | 28.7 | 3.00% | 4 | 0.0 | 4.8 | 8.99 | 0.53 | 1.09 | 5.6 | 0.9 | 1.1 | 2.2 | 17.9 |

S/6 [handwritten initials]

TABLE 10-2 (Continued)

TYPICAL ROUGHNESS COEFFICIENTS FOR OPEN CHANNELS

| Type of Channel and Description | Minimum | Normal | Maximum |
|---|---|---|---|
| c. Concrete bottom float finished with sides of | | | |
| 1. Dressed stone in mortar | 0.015 | 0.017 | 0.020 |
| 2. Random stone in mortar | 0.017 | 0.020 | 0.024 |
| 3. Cement rubble masonry, plastered | 0.016 | 0.020 | 0.024 |
| 4. Cement rubble masonry | 0.020 | 0.025 | 0.030 |
| 5. Dry rubble or riprap | 0.020 | 0.030 | 0.035 |
| d. Gravel bottom with sides of | | | |
| 1. Formed concrete | 0.017 | 0.020 | 0.025 |
| 2. Random stone in mortar | 0.020 | 0.023 | 0.026 |
| 3. Dry rubble or riprap | 0.023 | 0.033 | 0.036 |
| e. Asphalt | | | |
| 1. Smooth | | 0.013 | |
| 2. Rough | | 0.016 | |
| f. Grassed | 0.030 | 0.040 | 0.050 |

TABLE 10-3

MAXIMUM PERMISSIBLE DESIGN
OPEN CHANNEL FLOW VELOCITIES IN EARTH*

| Soil Types | Permissible Mean Channel Velocity (ft/sec) |
|---|---|
| Fine Sand (noncolloidal) | 2.0 |
| Coarse Sand (noncolloidal) | 4.0 |
| Sandy Loam (noncolloidal) | 2.5 |
| Silt Loam (noncolloidal) | 3.0 |
| Ordinary Firm Loam | 3.5 |
| Silty Clay | 3.5 |
| Fine Gravel | 5.0 |
| Stiff Clay (very colloidal) | 5.0 |
| Graded, Loam to Cobbles (noncolloidal) | 5.0 |
| Graded, Silt to Cobbles (colloidal) | 5.5 |
| Alluvial Silts (noncolloidal) | 3.5 |
| Alluvial Silts (colloidal) | 5.0 |
| Coarse Gravel (noncolloidal) | 6.0 |
| Cobbles and Shingles | 5.5 |
| Hard Shales and Hard Pans | 6.0 |
| Soft Shales | 3.5 |
| Soft Sandstone | 8.0 |
| Sound rock (usu. igneous or hard metamorphic) | 20.0 |

* These velocities shall be used in conjunction with scour calculations and as approved by City/County.

## TABLE 10-4

## MAXIMUM PERMISSIBLE VELOCITIES FOR EARTH CHANNELS WITH VARIED GRASS LININGS AND SLOPES

| Channel Slope | Lining | Permissible Mean Channel Velocity * (ft/sec) |
|---|---|---|
| 0 - 5% | Sodded grass | 7 |
| | Bermudagrass | 6 |
| | Reed canarygrass | 5 |
| | Tall fescue | 5 |
| | Kentucky bluegrass | 5 |
| | Grass-legume mixture | 4 |
| | Red fescue | 2.5 |
| | Redtop | 2.5 |
| | Sericea lespedeza | 2.5 |
| | Annual lespedeza | 2.5 |
| | Small grains (temporary) | 2.5 |
| 5 - 10% | Sodded grass | 6 |
| | Bermudagrass | 5 |
| | Reed canarygrass | 4 |
| | Tall fescue | 4 |
| | Kentucky bluegrass | 4 |
| | Grass-legume mixture | 3 |
| Greater than 10% | Sodded grass | 5 |
| | Bermudagrass | 4 |
| | Reed canarygrass | 3 |
| | Tall fescue | 3 |
| | Kentucky bluegrass | 3 |

* For highly erodible soils, decrease permissible velocities by 25%.

* Grass lined channels are dependent upon assurances of continuous growth and maintenance of grass.

**URS Greiner**

JOB NUMBER 67422 PAGE 1 OF ____
DATE 11/17/98 BY ALR CHECKED BY ____ (date)
CLIENT ____
PROJECT PRINTER'S PARK MDDP / ALT. SCHOOL SITE
SUBJECT HYDRAULICS OF 48" RCP

DESIGN Q - $Q_{100}$ @ DP B = 294 cfs
LESS $Q_{100}$ FROM DS OF 17cfs

⇒ $Q_{100}$ (DESIGN) = 277 cfs

GIVEN = INV AT OUTLET = 6012.0
INV AT MH = 6025.23
GROUND AT MH = 6042.38 (Near Inlet #564)
L MH TO OUTLET = ±813.0 ft
SLOPE OF PIPE = (6025.23 - 6012)/813 = 0.016 ft/ft = 1.6 %
48" Ø RCP n = 0.012 A = 12.57 s.f $R_H$ = 1.0 (full)

ASSUME: ALL 277 cfs gets in 48" RCP → V = 22.04 fps

CALCULATE FRICTION LOSS

$$S_f = \left(\frac{K}{R_H^{4/3}}\right)\left(\frac{V^2}{2g}\right)^*$$

K = 0.906gn² = 0.0042
constant for pipe

* PPACG DCM pg 43

$$S_f = \left(\frac{.00493}{1^{4/3}}\right)\left(\frac{22.04^2}{2 \times 32.2}\right) = 0.03168 \text{ ft/ft}$$

ALONG 813 ft of pipe $H_L$ = .03168 × 813 = 25.76

HGL - D/S END (ATMOSPHERE) DEPTH = TOP OF PIPE (Full Channel)
∴ WATER SURFACE = 6012+4 = 6016 = HGL

HGL @ MH = 6016 + 25.76 = 6041.76 ft
RIM = 6042.38 - 6041.76 = 0.62 ft freeboard.