Master Development Drainage Plan and Final Drainage Report
Colorado Crossing Filing Nos. 1 and 2
A Replat of Fairlane Technological Park Filing No. 1
Colorado Springs, Colorado

Kiowa Engineering Corporation

Master Development Drainage Plan and Final Drainage Report Colorado Crossing Filing Nos. 1 and 2 A Replat of Fairlane Technological Park Filing No. 1 Colorado Springs, Colorado

Prepared For:

Sunshine Home Development, Inc.
9475 Briar Village Point Suite 300
Colorado Springs, Colorado 80920

Prepared By:

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904

July 16, 2007
Revised October 12, 2007
Revised November 9, 2007
Project No. 05045

ENGINEER'S STATEMENT:

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors and omissions on my part in preparing this report.

Kiowa Engineering Corporation, 1604 South 21st Street, Colorado Springs, CO 80904

Richard N. Wray
Registered Engineer #19310

11/7/07
Date

OWNER'S STATEMENT:

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

BY: _____ 11/26/07
Date

ADDRESS:

Sunshine Home Development, Inc.

9475 Briar Village Point Suite 300

Colorado Springs, CO 80920

CITY OF COLORADO SPRINGS

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

_____ Dec 13, 2007

City Engineer Dated

PROJECT DESCRIPTION

The Colorado Crossing Filing No. 1 and 2 project will be a multi-tenant commercial development located at the southeast corner of Voyager Parkway and Interquest Parkway in northern Colorado Springs. Colorado Crossing Filings No. 1 and 2 are a replat of the Fairlane Technological Park Filing No. 1. The overall property will be broken into individual filings, of which Filings 1 and 2 are the first two filings to commence. The overall property covers 152 acres. Filing 1 and 2 encompass 17.2 acres and 23 acres, respectively.

The property is located within portions of southeast quarter of Section 20, the southwest quarter of Section 21, the northwest quarter of Section 28 and the northeast quarter of Section 29, Township 12 South Range 66 West of the 6th Principal Meridian, in Colorado Springs, Colorado. The property is bounded on the south and east by Federal Drive, on the west by Voyager Parkway (State Highway 83) and Interquest Parkway (State Highway 83) on the north. The location of the site is shown on Figure 1.

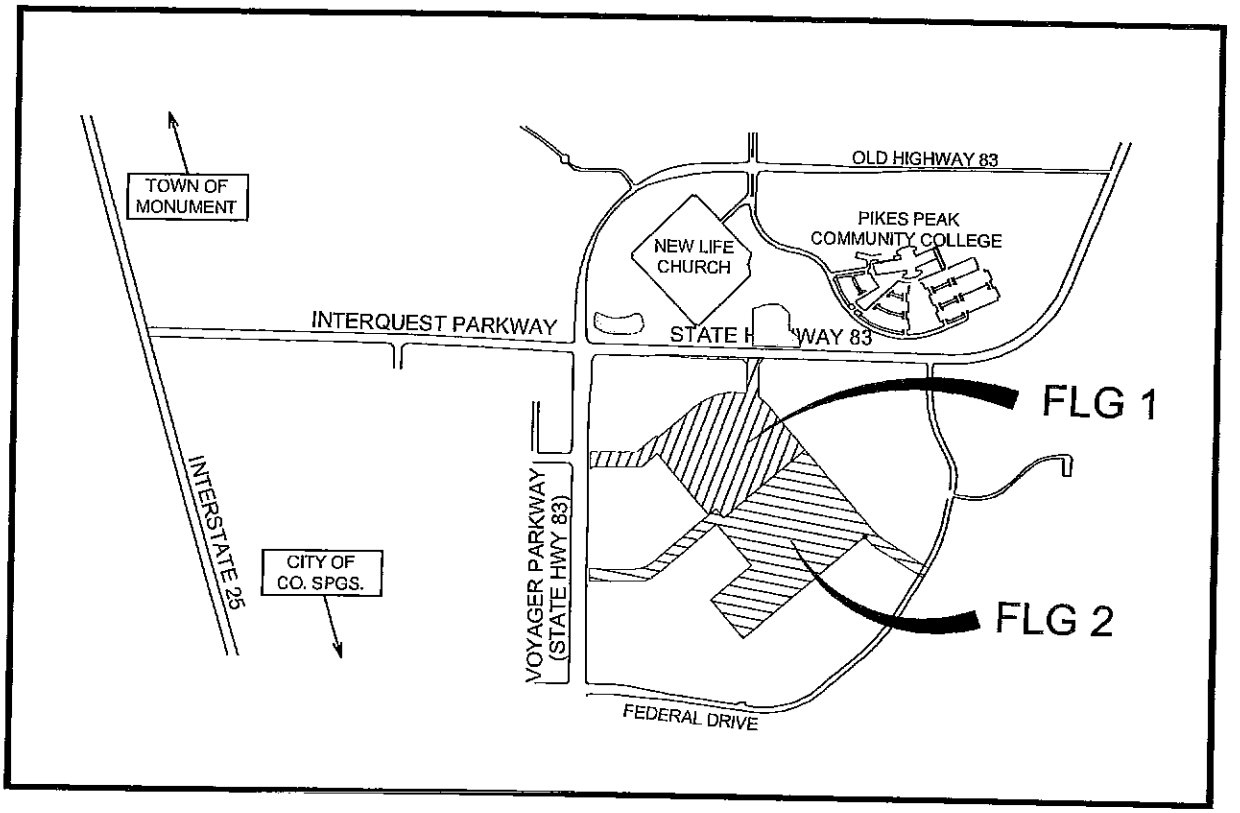
The site lies within the Elkhorn Basin drainage basin. The site presently drains towards the south and west by sheet flow over undeveloped land with slopes ranging from 3 to 5 percent. At the southwest corner of the site an area inlet that drains to a 60-inch RCP collects all of the existing runoff from the site. The 60-inch RCP outfalls to and existing concrete lined channel that then flows south along Voyager. Parkway. The concrete channel has sufficient capacity to convey the 100-year developed discharge from the site. There are no existing major drainageways in the property and there are no proposed drainageway facilities that are defined in the Elkhorn Basin DBPS required for this site.

Soils within the property are classified to be within Hydrologic Soils Group B as shown in the El Paso County Soils Survey. The existing vegetative cover within the area subject to development is in good condition and can be characterized as native grasses.

PREVIOUS REPORTS

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

1. Soil Survey for El Paso County, Colorado, dated June 1981.
2. "City of Colorado Springs/El Paso County Drainage Criteria Manual", prepared by City of Colorado Springs, El Paso County, dated May 1987, revised 1996.



SCALE: NTS

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado
80904-4208
(719) 630-7342

COLORADO CROSSING FLG. NO. 1
VICINITY MAP
COLORADO SPRINGS, COLORADO

FIGURE 1

PROJECT NO.: 05045
DATE: JULY 2007
DESIGN: RNW
REVISIONS:

3. "Flood Insurance Studies for Colorado Springs, and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), revised March, 1997.

4. Master Development Drainage Plan, Fairlane Technological Park prepared by URS Consultants, Inc., dated October 1993, revised January 1994.

5. Master Development Drainage Plan Update, Fairlane Technological Park prepared by Ayres Associates, Inc., dated November 1997.

6. Drainage Memorandum for Pikes Peak Community College North Campus, prepared by URS Consultants, Inc., dated October 1996.

7. Drainage Addendum No. 1 for the New Life Church Filing No. 2., prepared by Haynes and Associates, Ltd., dated May 1996.

8. Final Hydraulic Report, Interstate 25 and Fairlane Parkway Interchange, Phase I, prepared by DMJM, Inc., dated August 1998.

9. Final Hydraulic Report, Interstate 25, Interquest Parkway/S. H. 83 Relocation, prepared by DMJM, Inc., dated March 1999.

10. Master Development Drainage Plan for Interquest/Retail and Apartment Site and Final Drainage Report for Shops and College Creek and Federal/Republic Filing No. 1, prepared by Rockwell Consulting, April 2006.

11. Final Drainage Report for Storage Co-op Filing No.1 prepared by Rockwell Consulting, April 2006.

12. Master Development Plan Update, Fairlane Technological Park, prepared by Kiowa Engineering, February 2001.

Reference 4 was prepared as an update to the original Master Development Drainage Plan prepared for the Technological Park in 1986. The primary purpose of completing Reference 4 was to incorporate drainage criteria changes that were adopted in 1987, and to resize the stormwater infrastructure accordingly.

Reference 5 was completed in order to update Reference 4 so that changes in roadway layouts with regard to Interquest Parkway, State Highway 83 and Stout Allen Road could be accounted for in the hydrologic modeling of the watershed. Reference 5 also addressed the capacity of the existing Detention Basin "A" and defined the capacity for proposed Detention Basin "B". Both of these detention facilities were analyzed so that the maintenance of historic flows onto the Air Force Academy property could be assured. This study also recommended that detention basins A and B be located on Air Force Academy land. Siting the detention basins onto Air Force property has since been rejected by the Air Force.

References 8 and 9 were prepared as part of the construction of the Interquest Parkway/I-25 Interchange Project. These studies utilized the basic hydrologic analysis prepared as part of the work summarized in Reference 5. However the hydrologic changes affected by the realignment of State Highway 83 and future Powers Boulevard were considered in the reanalysis of the peak flow data and in the sizing of the storm sewer system for the Interchange and Interquest Parkway. Also the detention storage at the New Life Church and Pikes Peak Community College sites were modeled.

Reference 12 was prepared in order to provide additional stormwater planning for the Fairlane Technological Park, and to further define the need for detention within the basin. The Fairlane Technological Center presently outfalls to an existing detention basin that lies west of the existing Intel building. As a result of preparing Reference 12 it was found that the detention basin did not have sufficient storage capacity. Due to the changes in the land use in the watershed tributary to Detention Basin A compared to the land uses assumed when the facility was initially designed, a greater runoff volume was estimated. The increase is due to a more intense development pattern with more impervious surfaces. Consequently, approximately 25 percent more storage volume is needed to store and release the 100-year runoff at historic rates. It was found that the embankment would have to be raised approximately 3.5 feet from its current crest elevation. The outlet structure also needs to be modified in order to release runoff from the facility at historic levels for the 2, 5, and 10-year recurrence intervals. This will require either a whole new outlet structure or the modification of the existing structure to control the higher frequencies storms. The U. S. Air Force Academy has expressed concern to the City regarding the degradation of the channel that leads from the existing detention facility across Academy property.

The modifications to the detention basin would have to be installed as part of the further development of the Technological Center. This includes land within the Fairlane Technological Park on the west side of Voyager designated as Interquest South, as well at the areas to be developed as part of the Colorado Crossing. Initial meetings have been held with the City and the two major land owners that remain in the Technological Park to discuss funding of the of the improvements to Detention Basin A. Cost sharing would be determined by the acreage to be developed by each of the respective major landowners. The design of the improvements to Detention Basin A is being currently being developed by Classic Consulting. A cost estimate of the improvements will also be developed so that the funding scheme can be developed between the two landowners. At this time the design has not as yet been finalized, nor has a cost sharing and funding program been developed. In order to facilitate the development of Filings 1 and 2 of the

Colorado Crossing property, temporary detention storage is being proposed that will store the increase in runoff attributable to Filings 1 and 2 and release it into the existing downstream drainage systems at historic levels.

EXISTING BASIN CONDITIONS

Contained within Appendix A of the report is the Hydrologic Sub-basin Map from Reference 12. The Colorado Crossing property lies within sub-basins A3 and A5 as defined in Reference 12. The existing watersheds within Colorado Crossing are not impacted by offsite runoff and there are no defined drainageways that pass through sub-basins A3 or A5. These sub-basins are well vegetated with native grasses. Slopes in the existing sub-basin range from 2 to 5 percent. The entire Colorado Crossing site presently drains to the northeast corner of Voyager Parkway and Federal Drive. At this location runoff is conveyed off of the property via a culvert and concrete channel. Runoff from the Colorado Crossing property eventually is collected in Detention Basin A. Approximately one-half of the property is presently conveyed to the northeast corner of Voyager Parkway and Federal Drive via a grass-lined channel. The grass-lined channel outfalls to the culvert described above. There are no other drainage facilities within the Colorado Crossing property at this time.

PROPOSED BASIN DESCRIPTIONS

Three major flow paths with fifty-one sub-basins were delineated that lie within or immediately adjacent to Filings 1 and 2. Offsite sub-basins have been defined for those areas outside of Filings 1 and 2 that do not drain onto the Filings, however no runoff calculations have been produced for these basins. There are no sub-basins that enter Colorado Crossing from offsite areas. The proposed sub-basin boundaries, discharges and design points are presented on Figure 3. Descriptions for each of the major flow paths are provided below. Peak sub-basin discharges for the five-year and 100-year recurrence intervals are summarized on Tables 1 through 3.

Drainage Flow Path A: This flow path was broken into 12 sub-basins ranging in size from .4 acres to 14.4 acres. Runoff collected in this flow path is primarily from Filing 1. The sub-basins will be developed into a theater complex with retail business as well. The runoff coefficients for the proposed condition were held constant for each of the sub-basins with the 5-year and 100-year coefficients being .9 and .95 respectively. Due to the size of the sub-basins, a minimum time of concentration of 5 minutes was applied when determining the rainfall intensities with the exception of sub-basin A1.

Table 1: Summary of Design Point and Sub-basin Discharges
COLORADO CROSSING FILINGS NO. 1 AND 2
A-Basins

SB/DP NO.	AREA (AC)	RUNOFF (CFS) Q5	Q100
A1	14.4	53.1	98.5
A2	1.1	5.1	9.4
A3	0.44	2.1	3.8
A4	0.51	2.4	4.4
A5	2.8	13.1	23.9
A6	4.0	18.7	34.2
A7	1.2	5.6	10.3
A8	0.75	3.5	6.4
A9	2.7	12.6	23.1
A10	4.2	19.7	35.9
A11	0.78	3.7	6.7
A12	0.57	2.7	4.9
DP1	32.90	121.4	228.2
DP2	33.50	120.6	229.1

Table 2: Summary of Design Point and Sub-basin Discharges
COLORADO CROSSING FILINGS NO. 1 AND 2
B-Basins

SB/DP NO.	AREA (AC)	RUNOFF (CFS) Q5	Q100
B1	5.4	25.3	46.2
B2	4.9	22.9	41.9
B3	1.1	5.1	9.4
B4	0.9	4.2	7.7
B5	1.5	7.0	12.8
B6	2.6	12.2	22.2
B7	0.89	4.2	7.6
B8	0.77	3.6	6.6
B9	2.30	3.0	7.2
DP 3	54.00	150.7	312.9

Table 3: Summary of Design Point and Sub-basin Discharges
COLORADO CROSSING FILINGS NO. 1 AND 2
C-Basins

SB/DP NO.	AREA (AC)	RUNOFF (CFS) Q5	Q100
C1	4.9	22.9	41.9
C2	0.98	4.6	8.4
C3	0.78	3.7	6.7
C4	1.3	6.1	11.1
C5	2.3	10.8	19.7
C6	0.8	3.8	6.9
C7	0.34	1.6	2.9
C8	3.00	14	25.7
C9	0.37	1.7	3.2
C10	0.42	2.0	3.6
C11	0.54	2.5	4.6
C12	0.36	1.7	3.1
C13	1.80	8.4	15.4
C14	3.40	15.9	29.1
C15	0.34	1.6	2.9
C16	1.10	1.1	2.5
C17	1.60	7.5	13.7
C18	3.40	15.9	29.1
C19	0.50	2.3	4.3
C20	2.50	11.7	21.4
C21	0.74	3.5	6.3
C22	5.50	25.7	47
C23	6.80	31.8	58.1
C24	1.90	8.9	16.2
C25	0.69	3.2	5.9
C26	0.30	1.4	2.6
C27	0.42	2.0	3.6
C28	0.36	1.7	3.1
C29	4.90	22.9	41.9
C30	3.40	15.9	29.1
DP 4	25.20	113.4	213.1
DP 5	30.60	134.9	255.8
DP 6	38.10	145.7	293.2
DP 7	44.60	166.8	316.6
DP 8	50.40	186.3	346.9

Discharges for the 5- and 100-year recurrence intervals are presented on Figure 3. Two design points were determined for this flow path whereby a lumped basin peak flow estimate was performed. Peak discharges for design points 1 and 2 are summarized on Figure 3. Sub-basins A1, A9 and A10 lay offsite from Filing 1 but will be conveyed through flow path A.

Drainage Flow Path B: This flow path was broken into 9 sub-basins ranging in size from .9 acres to 5.4 acres. Runoff collected in this flow path is primarily from Filing 2 however a small portion of the theater complex within Filing 1 (i.e., sub-basins B6 and B8) drains to flow path B as well. The sub-basins will be developed into a theater complex, retail and high-density residential uses. The runoff coefficients for the proposed condition were held constant for each of the sub-basins with the 5-year and 100-year coefficients being .9 and .95 respectively, with the exception of sub-basin B9 which is a grass-lined channel along Voyager Parkway. Due to the size of the sub-basins, a minimum time of concentration of 5 minutes was applied when determining the rainfall intensities. Discharges for the 5- and 100-year recurrence intervals are presented on Figure 3 and Table 2. One design point was determined for this flow path whereby a lumped basin peak flow estimate was performed. Peak discharges for design point 3 are summarized on Figure 3 and Table 2. Sub-basins B1 and B2 lie offsite from Filing 1 and 2 and will be collected by means of onsite storm sewer systems and discharged to the grass-lined swale along Voyager Parkway (i.e., sub-basin B9).

Drainage Flow Path C: This flow path was broken into 30 sub-basins ranging in size from .34 acres to 6.8 acres. Runoff collected in this flow path is primarily from Filing 2 however there are areas offsite from Filing 2 that will be developed in the future that will be conveyed by flow path C. The sub-basins will be developed into retail and high-density residential uses. The runoff coefficients for the proposed condition were held constant for each of the sub-basins with the 5-year and 100-year coefficients being .9 and .95 respectively, with the exception of sub-basin C17 that is to be a park. Due to the size of the sub-basins, a minimum time of concentration of 5 minutes was applied when determining the rainfall intensities. Discharges for the 5- and 100-year recurrence intervals are presented on Figure 3 and Table 3. Five design points were determined for this flow path whereby lumped basin peak flow estimates were performed. Peak discharges for design points 4 through 8 are summarized on Figure 3 and Table 3.

HYDROLOGY

The onsite hydrology for the site was estimated using the methods outlined in the City/County Storm Drainage Criteria Manual. Topographic mapping was prepared in February 2006. The mapping was compiled from a field survey at a one-foot contour interval and a horizontal scale of 50-feet. The mapping was used to verify the onsite and offsite sub-basin boundaries. The evaluation of offsite runoff that reaches the site was conducted using field review and FIMS mapping.

The hydrologic analysis for the onsite sub-basin utilized the rational formula methodology as described in the City/County Storm Drainage Criteria. This method was used to estimate peak discharges for the 5- and 100-year frequencies for the existing and proposed development condition. The peak flow data generated using the rational method was used to verify street capacities and to size storm sewers within the subdivision. The drainage basin area, time of concentration, and rainfall intensity were determined for each of the sub-basins within the property. Because of the small acreages associated with each sub-basin a five-minute minimum time of concentration was applied to a majority of the sub-basins for the estimation of runoff. Runoff coefficients for the 5-year and 100-year frequencies as tabulated on Table 5-1 of the DCM were used in the rational formula calculations. Presented on Figure 3 are the proposed condition sub-basin boundaries and peak discharges for the various sub-basin and design points within for the subdivision. Peak discharges for each sub-basin and design points are presented in the calculations contained within Appendix A and on Figure 3.

Hydrology that is referenced in this report from Reference 12 was produced using the U. S. Army Corps of Engineers HEC-1 Flood Hydrograph Program. A copy of the input and output from the HEC-1 analysis has been included within Appendix A of this report.

HYDRAULICS AND PROPOSED FACILITIES

The evaluation related to the sizing of the onsite drainage improvements were carried out in accordance with the City/County Storm Drainage Criteria Manual. The capacities of the proposed onsite facilities were calculated in accordance with the Criteria Manual. The site will be drained primarily via sheet flow through the parking areas. The drainage from roofs and parking lots will be conveyed via underground conduits to the storm sewer outfalls that have bee sized for each flow path. The size, type and locations of the proposed stormwater collection facilities for flow path A, B and C is presented on Figure 4.

Private Storm Sewer System A: This storm sewer system will collect runoff from each of the A-basins shown on Figure 3. The storm sewer was sized to collect the 100-year runoff from Filing 1 and from areas offsite from Filing 1. This system has storm sewers ranging in size from 18 to 48-inches. Minimum design slopes have been presented on Figure 4. All conduits have assumed to be reinforced concrete pipe (RCP). Inlets have been sited at locations where the street capacity has been exceeded or where sump areas have been created as a result of the grading on the site or the street design. The system is aligned within Democracy Point and outfalls to the intersection of Democracy Point and Voyager Parkway. The storm sewer system will discharge to an improved grass-lined channel along Voyager at design point 2. This channel has sufficient capacity to carry the developed 100-year discharge from design point 2. As an alternative to the grass-lined channel from design point 1 to 2, a 48-inch RCP could be installed. The calculations used to support the sizing of the system are summarized in Appendix B.

Private Storm Sewer System B: This storm sewer system will collect runoff from each of the B-basins shown on Figure 3. The storm sewer was sized to collect the 100-year runoff from portion of Filings 1 and 2 and from parcels to be developed in the future that lay within the Colorado Crossing property upstream from Filings 1 and 2. This system has storm sewers ranging in size from 18- to 54-inches. Minimum design slopes have been presented on Figure 4. Inlets have been sited at locations where the street capacity has been exceeded or where sump areas have been created as a result of the grading on the site or the street design. The system is aligned within Spring Water Point and outfalls to the intersection of Spring Water Point and Voyager Parkway (i.e., design point 3). The discharges at design point 3 are 150.7 cubic feet per second and 312.9 cubic feet per second for the 5- and 100-year recurrence intervals, respectively. The storm sewer system will ultimately combine with the runoff from design point 2 and will then be conveyed south along Voyager Parkway in a 4-foot by 12- foot box culvert. The discharges at design point 2 are 120.6 cubic feet per second and 229.1 cubic feet per second for the 5- and 100-year recurrence intervals, respectively. The calculations used to support the sizing of the system are summarized in Appendix B.

Private Storm Sewer System C: This storm sewer system will collect runoff from each of the C-basins shown on Figure 3. The storm sewer was sized to collect the 100-year runoff from portions of Filing 2 and from areas offsite from Filing 2. This system has storm sewers ranging in size from 18- to 60-inches. Minimum design slopes

have been presented on Figure 4. Inlets have been sited at locations where the street capacity has been exceeded or where sump areas have been created as a result of the grading on the site or the street design. The system is aligned within Stream View and outfalls to the intersection of Stream View and Federal Drive (i.e., design point 8). The discharges at design point 8 are 186.3 cubic feet per second and 346.3 cubic feet per second for the 5- and 100-year recurrence intervals, respectively. The storm sewer system will ultimately combine with the runoff from design point 3 and will then be conveyed south along Voyager Parkway in the existing concrete channel shown on Figure 4. The concrete swale south of design point 9 has sufficient capacity to convey the 100-year developed runoff that that will be delivered to this point. The developed discharges at design point 9 are estimated to be 280 and 647 cubic feet per second for the 5- and 100-year recurrence intervals per the Fairlane Technological Park Master Development Drainage Plan Update (Reference 12). The calculations used to support the sizing of the system are summarized in Appendix B.

TEMPORARY STORMWATER DETENTION

As discussed above, the detention storage required for the Fairlane Technological was identified as Detention Basin A in the Fairlane Technological Park Master Development Drainage Plan Update (Reference 12). This detention basin does not have sufficient capacity to store the developed runoff without modification. The costs associated with modifying Detention Basin A will be the responsibility of the developers of the Colorado Crossing and Interquest South properties. At this time a funding agreement has not been finalized between the developers and the City. As such it is proposed that developed runoff from Filings 1 and 2 be stored in temporary detention basins. Presented on Figure 4 are the locations and sized for two temporary detention basins. The detention basin at design point 1 will serve Filing 1 and has a volume of 1.0 and 1.8 acre-feet for the 5- and 100-year recurrence intervals, respectively. The detention basin at design point 9 will serve Filing 2 and has a volume of 1.4 and 2.5 acre-feet for the 5- and 100-year recurrence intervals, respectively. The intent of these facilities is to limit discharges from Filings 1 and 2 to historic. The historic rate of runoff for the 100-year frequency was calculated assuming .5 cubic feet per second per acre for B-soils. These temporary detention basin must remain in pace and functioning until such time that the Regional Detention basin A has been upgraded per the requirements of Reference 12. The temporary detention facilities are to be maintained by the developer of the Colorado Crossing property.

FLOODPLAIN STATEMENT

Shown on Figure 2 is the City of Colorado Springs and El Paso County Flood Insurance Study FIRM panel that covers the area encompassed by the Colorado Crossing project site. There are no areas within the proposed site that lie within a delineated 100-year or 500-year floodplain.

DRAINAGE FEES

The site lies within the Elkhorn Creek Drainage Basin. Drainage and bridge and fees have not been established for the Elkhorn basin. As such there would not be any drainage or a bridge fee due for the Colorado Crossing project.

DRAINAGE FACILTY COSTS

Presented on Table 4 is a summary of the costs for the storm sewer systems shown on Figure 4. These systems will not be subject to reimbursement since no public facility funding was every established in the Elkhorn Basin Drainage Basin Planning Study.

REGIONAL DETENTION/WATER QUALITY BASIN COST SHARING

As discussed above the detention basin designated as Detention Basin A in Reference 12, and as Detention Basin EK-1A in the Master Development Drainage Plan for Fairlane Technological Park Interquest South and Final Drainage Report for Lots 1 and 2, Interquest Filing No. 6, prepared by Classic Consulting dated April 2007, has to be modified by expanding the storage area and redesigning the outlet structure. The modifications are needed to accommodate a higher level of imperviousness than originally assumed in Reference 4 and to allow for the provision of water quality capture volume for the areas yet to be developed within the watershed tributary to this facility. The cost for the reconstruction of Detention Basin A is estimated at $332,017 in the report prepared by Classic Consulting. The percentage of the land owned by the developer of the Colorado Crossing project that is tributary to Detention Basin A is estimated at 68.2 percent. Accordingly, the estimated share of the construction cost for the developer of Colorado Crossing is $226,436. The final agreements with regard to the cost sharing arrangement between the developers and the posting of financial assurances with the City of Colorado Springs will need to be finalized once the final design plans are completed and a more detailed construction developed.

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 506 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0506	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0506	F

MAP NUMBER 08041C0506 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

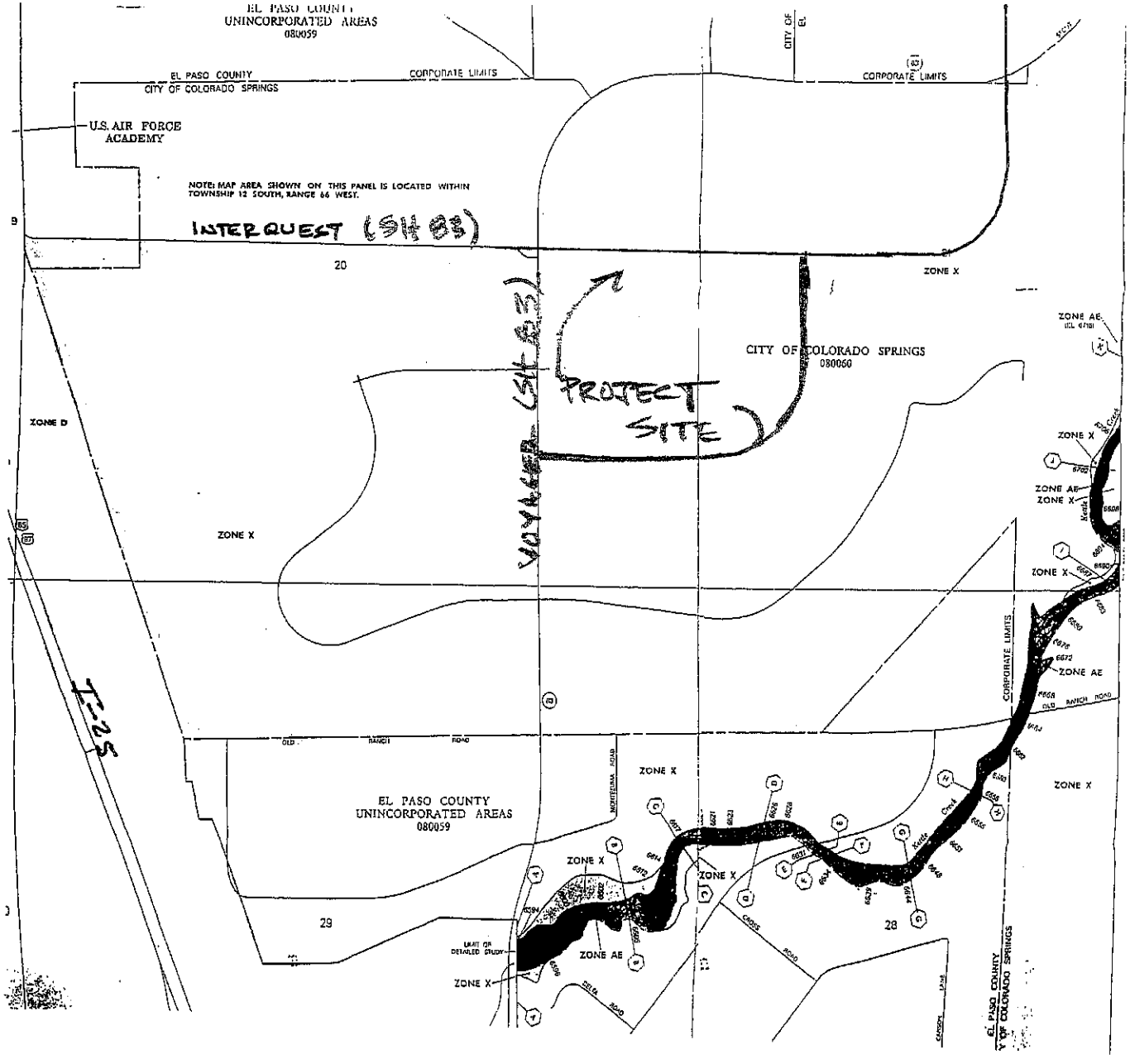


FIGURE 2

Table 4: Summary of Private Storm Drainage Facility Costs

SUBDIVISION NAME: Colorado Crossing Filings 1 and 2

Item	Quantity	Units	Unit Cost	Estimated Cost
Onsite Storm Drainage				
5' Type 'R' Inlet	18	EA	$ 5,000.00	$ 90,000.00
8' Type 'R' Inlet	2	EA	$ 6,000.00	$ 12,000.00
10' Type 'R' Inlet	1	EA	$ 6,500.00	$ 6,500.00
15' Type 'R' Inlet	2	EA	$ 8,000.00	$ 16,000.00
18" RCP CLIII	1,690	LF	$ 42.00	$ 70,980.00
24" RCP CL III	2,830	LF	$ 54.00	$ 152,820.00
30" RCP CL III	2,070	LF	$ 62.00	$ 128,340.00
36" RCP CL III	1,500	LF	$ 68.00	$ 102,000.00
42" RCP CL III	490	LF	$ 75.00	$ 36,750.00
48" RCP CL III	1,020	LF	$ 90.00	$ 91,800.00
54" RCP CL III	410	LF	$ 110.00	$ 45,100.00
60" RCP CL III	1,470	LF	$ 125.00	$ 183,750.00
4' x 12' CBC	800	LF	$ 250.00	$ 200,000.00
Storm Sewer Manhole	38	EA	$ 3,500.00	$ 133,000.00
Grasslined Swale	720	LF	$ 25.00	$ 18,000.00
Temporary detention basin grading	2	LS	$ 10,000.00	$ 20,000.00
Detention basin outlet structure	2	EA	$ 6,000.00	$ 12,000.00
			SUBTOTAL	**$ 1,319,040.00**
			10% Engineering	**$ 131,904.00**
			5% Contingency	**$ 65,952.00**
			TOTAL	**$ 1,516,896.00**
Offsite Drainage Improvements Public				
Cost Share, Elkhorn Detention Basin EK1A	1	LS	$ 226,436.00	$ 226,436.00

To be collected with F.I. No 1 RKM 12/13/07

WATER QUALITY MEASURES

As required by the City in Volume 2 of the Drainage Criteria Manual, water quality measures need to be introduced in new developments in order to reduce the detrimental effects of impervious areas upon stormwater runoff. The water quality measures that will be instituted for the Colorado Crossing project will be phased into interim and permanent facilities.

Interim water quality measures:

1. Slow flow swale along Voyager Parkway has been designed at a grade of 0.5 percent and will be used to slow the runoff from the site and to drop sediment out prior to reaching the existing stormwater system at design point 9.
2. Temporary detention basins will be constructed at design points 1 and 9 and will serve Filings 1 and 2. These facilities will be designed in accordance with Volume 2 of the DCM and will have a pre-sedimentation basin, and a phased outlet structure that will release the 5-year and the 100-year runoff to historic rates. During construction these facilities will serve as sedimentation basins as well by blocking off the outlets structures until such time that final stabilization has been reached within all areas disturbed by the development of Filings 1 and 2

Permanent water quality measures:

1. Regional Detention Basin A will be designed to accommodate the required storage water quality storage volume for the Colorado Crossing and Interquest South projects. The Colorado Crossing property contributes 160 acres to Regional Detention Basin A. The total required water quality capture volume for the Colorado Crossing project has been estimated at 5.8 acre-feet for an extended detention basin and 4.3 acre-feet if an constructed wetland basin is assumed.
2. Covered parking areas will be designed with sand-oil and grease traps and will be discharged to the sanitary sewer system.

EROSION CONTROL PLAN

The City of Colorado Springs and El Paso County Drainage Criteria Manual specifies that an Erosion Control Plan and associated cost estimate be submitted in conjunction with Final Drainage Report. It is requested on the behalf of the Owner that the Erosion Control Plan be submitted with the Final Construction Grading Plan upon which the cost for the erosion control will be shown. Assurances for the erosion control facilities will be posted as part of obtaining a grading permit.

APPENDIX A

HYDROLOGY CALCULATIONS

Kiowa Engineering Corporation

CLIENT Colorado Springs JOB NO. 05045 PAGE 1
PROJECT Fig 1 + 2 & DATE CHECKED DATE 7/7/07
DETAIL CHECKED BY COMPUTED BY [illegible]

① Basin Areas

① A-Basins:

Basin #	Area (ac)	C_5	C_{100}
A1	14.4	.9	.95
A2	1.1		
A3	.44		
A4	.51		
A5	2.8		
A6	4.0		
A7	1.2		
A8	.75		
A9	2.7		
A10	4.2		
A11	.41		
A12	.57		

② Rainfall Intensity:

Use $I_5 = 5.2$"/hr $I_{100} = 9.0$"/hr

except for SB # A1

$t_o = 1.8(1.1 - C_5)L_o^{.5} S^{-.33}$ where S = 2% L = 300'

$t_o = 1.8(1.1 - .9)(300)^{.5}(2)^{-.33} = 5.0$ min

$t = L_t/V = 1520/4(60) = 6.3$

$t_c = 5.0 + 6.3 = 11.3$ min

$\therefore I_5 = 4.1$"/hr $I_{100} = 7.2$"/hr

DESIGN POINT △1

Area = A1 + A11 + A3 + A2 + A4 + A5 + A6 + A7 + A8 + A10 + A9

= 32.9 Ac

$C_5 = .9$ $C_{100} = .95$

t_o: $l_o = 300'$ @ 2.0%

$t_o = 5.0$ min

t_t: l_t (From SB A9) = 3270 ft

V_t (Pipe flow) average 11 fps

$\therefore t_t = 3270/11(60) = 4.95$

$t_c = t_o + t_t = 10$ min.

$\therefore I_5 = 4.1$"/hr $I_{100} = 7.3$"/hr

A SUB-BASINS AND DESIGN POINT CALCULATIONS: PROPOSED CONDITIONS
PROJECT: COLORADO CROSSING FILING NO. 1
PROJECT NO: 05045
RATIONAL METHOD FORMULA: Q=CIA

SB/DP NO.	AREA (AC)	RUNOFF COEFFICIENTS C5	C100	RAINFALL INTENSITY I5	I100	RUNOFF (CFS) Q5	Q100
				(INCHES/HR)			
A1	14.4	0.9	0.95	4.1	7.2	53.1	98.5
A2	1.1	0.9	0.95	5.2	9.0	5.1	9.4
A3	0.44	0.9	0.95	5.2	9.0	2.1	3.8
A4	0.51	0.9	0.95	5.2	9.0	2.4	4.4
A5	2.8	0.9	0.95	5.2	9.0	13.1	23.9
A6	4.0	0.9	0.95	5.2	9.0	18.7	34.2
A7	1.2	0.9	0.95	5.2	9.0	5.6	10.3
A8	0.75	0.9	0.95	5.2	9.0	3.5	6.4
A9	2.7	0.9	0.95	5.2	9.0	12.6	23.1
A10	4.2	0.9	0.95	5.2	9.0	19.7	35.9
A11	0.78	0.9	0.95	5.2	9.0	3.7	6.7
A12	0.57	0.9	0.95	5.2	9.0	2.7	4.9
DP1	32.90	0.9	0.95	4.1	7.3	121.4	228.2
DP2	33.50	0.9	0.95	4.0	7.2	120.6	229.1

Kiowa Engineering Corporation

CLIENT Lake County JOB NO. 05045 PAGE 4
PROJECT DATE CHECKED DATE 7/7/07
DETAIL Hydrology CHECKED BY COMPUTED BY TAW

② B-Basins

Basin #	Area (ac)	C5	C100
B1	5.4	.90	.95
B2	4.9		
B3	1.1		
B4	0.9		
B5	1.5		
B6	2.6		
B7	.89		
B8	.77		
B9	2.3	.25	.35
	20.4 Ac		

② Rainfall Intensity

use t_c min ∴ $I_5 = 5.2$"/hr $I_{100} = 9.0$"/hr

Design Point #3

Area = DP 2 + B-basins :

= 33.6 + 20.4 = 54.0 ac.

t_c = t_c @ DP 2 + t_c DP 2 → DP 2 @ A pt.

l_t = 900' ∴ t_t = 900/(4(60)) = 3.8 min

∴ t_c @ DP 3 = 11.3 + 3.8 = 15.1

DP 3 cont'd:

$I_5 = 3.4"/hr$ $I_{100} = 6.1"/hr$

$Q_5 = 150.7 cfs$ $Q_{100} = 312.9 cfs$

B SUB-BASINS AND DESIGN POINT CALCULATIONS: PROPOSED CONDITIONS
PROJECT: COLORADO CROSSING FILING NO. 1
PROJECT NO: 05045
RATIONAL METHOD FORMULA: Q=CIA

SB/DP NO.	AREA (AC)	RUNOFF COEFFICIENTS C5	C100	RAINFALL INTENSITY I5	I100 (INCHES/HR)	RUNOFF (CFS) Q5	Q100
B1	5.4	0.9	0.95	5.2	9.0	25.3	46.2
B2	4.9	0.9	0.95	5.2	9.0	22.9	41.9
B3	1.1	0.9	0.95	5.2	9.0	5.1	9.4
B4	0.9	0.9	0.95	5.2	9.0	4.2	7.7
B5	1.5	0.9	0.95	5.2	9.0	7.0	12.8
B6	2.6	0.9	0.95	5.2	9.0	12.2	22.2
B7	0.89	0.9	0.95	5.2	9.0	4.2	7.6
B8	0.77	0.9	0.95	5.2	9.0	3.6	6.6
B9	2.30	0.25	0.35	5.2	9.0	3.0	7.2
DP 3	54.00	0.9	0.95	3.1	6.1	150.7	312.9

(3) C-Basins

For basin area and runoff coefficients, see page 8. All sub Basins to use t_c = 5 min

$\therefore I_5 = 5.2$"/hr $I_{100} = 9.0$"/hr

DESIGN POINTS

DP 4 Basin Area = C19 + C20 + C21 + C29 + C22 + C30 + C23

= .5 + 2.5 + .74 + 4.9 + 5.5 + 4.3 + 6.8

= 25.2 ac.

t_c:

$t_o = 1.87(1.1 - C_5)L^{1/2}S^{-.33}$ C_5=.90 S = 2% L = 300'

t_o = 5.2 min

$t_t = l_t / V$ l_t = 550' @ 6 fps as every pipe + street flow

$\therefore t_t = 550/660 = .83$ min

$t_c = 5.2 + .8 = 6.0$"/hr

$\therefore I_5 = 5.0$ $I_{100} = 8.9$"/hr

C SUB-BASINS AND DESIGN POINT CALCULATIONS: PROPOSED CONDITIONS
PROJECT: COLORADO CROSSING FILING NO. 1
PROJECT NO: 05045
RATIONAL METHOD FORMULA: Q=CIA

SB/DP NO.	AREA (AC)	RUNOFF COEFFICIENTS C5	C100	RAINFALL INTENSITY I5	I100	RUNOFF (CFS) Q5	Q100
				(INCHES/HR)			
C1	4.9	0.9	0.95	5.2	9.0	22.9	41.9
C2	0.98	0.9	0.95	5.2	9.0	4.6	8.4
C3	0.78	0.9	0.95	5.2	9.0	3.7	6.7
C4	1.3	0.9	0.95	5.2	9.0	6.1	11.1
C5	2.3	0.9	0.95	5.2	9.0	10.8	19.7
C6	0.8	0.9	0.95	5.2	9.0	3.8	6.9
C7	0.34	0.9	0.95	5.2	9.0	1.6	2.9
C8	3.00	0.9	0.95	5.2	9.0	14.0	25.7
C9	0.37	0.9	0.95	5.2	9.0	1.7	3.2
C10	0.42	0.9	0.95	5.2	9.0	2.0	3.6
C11	0.54	0.9	0.95	5.2	9.0	2.5	4.6
C12	0.36	0.9	0.95	5.2	9.0	1.7	3.1
C13	1.80	0.9	0.95	5.2	9.0	8.4	15.4
C14	3.40	0.9	0.95	5.2	9.0	15.9	29.1
C15	0.34	0.9	0.95	5.2	9.0	1.6	2.9
C16	1.10	0.2	0.25	5.2	9.0	1.1	2.5
C17	1.60	0.9	0.95	5.2	9.0	7.5	13.7
C18	3.40	0.9	0.95	5.2	9.0	15.9	29.1
C19	0.50	0.9	0.95	5.2	9.0	2.3	4.3
C20	2.50	0.9	0.95	5.2	9.0	11.7	21.4
C21	0.74	0.9	0.95	5.2	9.0	3.5	6.3
C22	5.50	0.9	0.95	5.2	9.0	25.7	47.0
C23	6.80	0.9	0.95	5.2	9.0	31.8	58.1
C24	1.90	0.9	0.95	5.2	9.0	8.9	16.2
C25	0.69	0.9	0.95	5.2	9.0	3.2	5.9
C26	0.30	0.9	0.95	5.2	9.0	1.4	2.6
C27	0.42	0.9	0.95	5.2	9.0	2.0	3.6
C28	0.36	0.9	0.95	5.2	9.0	1.7	3.1
C29	4.90	0.9	0.95	5.2	9.0	22.9	41.9
C30	3.40	0.9	0.95	5.2	9.0	15.9	29.1
DP 4	25.20	0.9	0.95	5.0	8.9	113.4	213.1
DP 5	30.60	0.9	0.95	4.9	8.8	134.9	255.8
DP 6	38.10	0.85	0.95	4.5	8.1	145.7	293.2
DP 7	44.60	0.86	0.91	4.35	7.8	166.8	316.6
DP 8	50.40	0.88	0.93	4.2	7.4	186.3	346.9

DP 5

Basin Area = DP 4 + C18 + C17 + C28
= 25.2 + 3.4 + 1.6 + .42 = 30.6

$t_c = t_c$ DP 4 + t_t DP 4 → DP 5 (pipe flow)

$t_t = 400/10(60) = .67$

∴ $t_c = 6.0 + .7 = 6.7$ min.

∴ $I_5 = 4.9$"/hr $I_{100} = 8.8$"/hr

DP 6 Basin Area = DP 5 + C11 + C12 + C14 + C13 + C15 + C16
= 30.6 + 7.5 = 38.1

$t_c = t_c$ DP 5 + t_t DP 5 → DP 6 (pipe flow)

$t_t = 420/10(60) = .7$

∴ $t_c = 6.7 + .7 = 8.4$ min

∴ $I_5 = 4.5$"/hr $I_{100} = 8.1$"/hr

C_5 = .85 C_{100} = .90 (accounting for ponds in DB C16)

DP 7

Basin Area = DP6 + C7 + C6 + C8 + C10 + C24
= 38.1 + 5.4 + 3.0 + .42 + 1.9
= 44.6 ac

t_c = t_c @ DP6 + t_t DP6 → DP7 (pipeflow)

t_t = 420/1060 = .7

t_c = 8.1 + .7 = 8.8 min

∴ I_5 = 4.3" /hr I_{100} = 7.8" /hr

DP 8

Basin Area = DP7 + C4 + C5 + C2 + C3 + C27
= 44.6 + 1.3 + 2.3 + .98 + .78 + .42
= 50.4 Ac.

t_c = t_c @ DP 7 + t_t DP 7 → DP 8 (pipeflow)

= 8.8 + 500/1060 = .9

t_c = 8.8 + .9 = 9.7 min

∴ I_5 = 4.2" /hr I_{100} = 7.4 " /hr

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   08FEB01  TIME  11:28:18   *
*                                       *
*****************************************
```

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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
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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

1

HEC-1 INPUT


```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
   1          ID   HEC-1
   2          ID   FAIRLANE TECHNOLOGICAL PARK MDDP UPDATE
   3          ID   KIOWA ENGINEERING CORPORATION  JOB NO. 00084
   4          ID   DEVELOPED HYDROLOGY 2, 5, 10, 25, 50 AND 100-YEAR STORMS, 24 HOUR DURATION
   5          ID   FILENAME FT100A.DAT  ALTERATIONS TO EX DETENTION BASIN A:  RAISE 3.8'
              *DIAGRAM
   6          IT       3       0       0     300
   7          IO       5
   8          JR    PREC     .48     .56     .73     .82     .91     1.0

   9          KK    B O1
  10          KM   MODIFIED BASIN O1 TO ACCOUNT FOR POWERS BLVD EXTENSION DIVERSION
  11          BA    .030
  12          LS             67.8
```

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13          UD    .080
14          IN      15
15          PB     4.4
16          PC      0.0   .0005   .0015   .0030   .0045   .0060   .0080   .0100   .0120   .0143
17          PC    .0165   .0188   .0210   .0233   .0255   .0278   .0320   .0390   .0460   .0530
18          PC    .0600   .0750   .1000   .4000   .7000   .7250   .7500   .7650   .7800   .7900
19          PC    .8000   .8100   .8200   .8250   .8300   .8350   .8400   .8450   .8500   .8550
20          PC    .8600   .8638   .8675   .8713   .8750   .8788   .8825   .8863   .8900   .8938
21          PC    .8975   .9013   .9050   .9083   .9115   .9148   .9180   .9210   .9240   .9270
22          PC    .9300   .9325   .9350   .9375   .9400   .9425   .9450   .9475   .9500   .9525
23          PC    .9550   .9575   .9600   .9625   .9650   .9675   .9700   .9725   .9750   .9775
24          PC    .9800   .9813   .9825   .9838   .9850   .9863   .9875   .9888   .9900   .9913
25          PC    .9963   .9975   .9988  1.0000

26          KK  B-O1
27          KM   ROUTE B O1 TO DP1
28          RD    2650   0.022   0.013            CIRC     3.0

29          KK  B9
30          KM   PIKES PEAK COMMUNITY COLLEGE BASIN
31          BA   0.098
32          LS              75
33          UD    .114

34          KK  B9OUT
35          KM   ROUTE B9 THROUGH PIKES PEAK COLLEGE DETENTION BASIN
36          RS      1     ELEV    6757
37          SV      0      1.0    2.56    4.89    6.97
38          SE   6757     6760    6762    6763    6764
39          SQ      0     35.0    55.0    70.0     139

40          KK  DP1
41          KM    COMBINE B9OUT AND B-O1
42          HC      2

43          KK  B-9
44          KM   ROUTE DP1 TO DP2
45          RD    1375    .012    .013            CIRC     3.5
1                                        HEC-1 INPUT                                          PAGE  2
LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

46          KK  B10
47          KM
48          BA    .024
49          LS              68
50          UD    .126

51          KK  O2B
52          KM   OFFSITE BASIN O2B PER DMJM PHASE II
53          BA     .07
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54          LS              60
55          UD    .170

56          KK  O2B-1
57          KM   ROUTE O2B TO DP2
58          RD    3475   0.030   0.035            TRAP     6.0   3.0

59          KK  B8
60          KM   NEW LIFE CHURCH BASIN
61          BA    .063
62          LS              80
63          UD    .138

64          KK  B8OUT
65          KM    ROUTE B8 THROUGH NEW LIFE CHURCH DETENTON BASIN
66          RS       1    ELEV    6736
67          SV       0     .65    1.43    2.11    3.30    4.41
68          SE    6736    6737    6738    6739    6740    6741
69          SQ       0     4.3    14.0    22.0    28.0    31.0

70          KK    DP2
71          KM   COMBINE B8OUT, B10, B-9 AND O2B-1
72          HC       4

73          KK   B-9A
74          KM    ROUTE DP2 TO DP 2A (6 X 2 CBC EQUIVALENT)
75          RD     250    .005    .013            CIRC      4

76          KK    B-8
77          KM   ROUTE TO B-8 TO DP3  54-INCH RCP
78          RD    1670    .025    .013            CIRC      4.5

79          KK      B7
80          KM   SUB-BASIN B7, NORTH PORTION OF INTERQUEST FILING NO. 3
81          BA    .020
82          LS              88
83          UD    .152

84          KK   DP3
85          KM   COMBINE B-8 AND BASIN B7
86          HC       2
```



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

87          KK    B-7
88          KM   ROUTE DP3 TO DP4  54-INCH RCP
89          RD     550    .015    .013            CIRC      4.5

90          KK   B7A
91          KM    SOUTH PORTION OF INTERQUEST FILING NO. 3
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   92          BA    .029
   93          LS              88
   94          UD    .152

   95          KK   DP4
   96          KM   COMBINE BASIN B7A AND B-7
   97          HC      2

   98          KK   B-7A
   99          KM   ROUTE DP4 TO DP4A 60-INCH RCP
  100          RD     150    .015    .013            CIRC      5.0

  101          KK   B6
  102          KM    INTERQUEST FILING NO. 2
  103          BA    .028
  104          LS              88
  105          UD    .158

  106          KK   B-6
  107          KM   ROUTE SUB-BASIN B6 TO DP 4A  42-INCH RCP
  108          RD     150    .015    .013            CIRC      3.5

  109          KK   DP4A
  110          KM   COMBINE B6 AND B-7A
  111          HC      2

  112          KK    B-5
  113          KM   ROUTE TO DP4A TO DP 5 60-INCH RCP
  114          RD    1150    .024    .013            CIRC      5.0

  115          KK     B4A
  116          KM   SUB-BASIN B4A
  117          BA    .011
  118          LS              88
  119          UD    .158

  120          KK    DP5
  121          KM   COMBINE B4A AND B-5
  122          HC      2

  123          KK    B-5A
  124          KM   ROUTE TO DP5 TO DP 6 60-INCH RCP
  125          RD     650    .020    .013            CIRC      5
1
                                    HEC-1 INPUT                                    PAGE  4
LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  126          KK      B5
  127          KM    SUB-BASIN B5
  128          BA    .032
  129          LS              88
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130          UD    .141

131          KK      B3
132          KM    SUB-BASIN B3
133          BA    .027
134          LS                88
135          UD    .150

136          KK    B-4
137          KM    ROUTE TO B3 TO DP5A 36 -INCH RCP
138          RD     650     .010     .013             CIRC        3

139          KK      B4
140          KM    SUB-BASIN B4
141          BA    .014
142          LS                88
143          UD    .119

144          KK    DP5A
145          KM    COMBINE B-4 AND B4
146          HC       2

147          KK    B-2
148          KM    ROUTE TO DP5A TO DP6 42-INCH RCP
149          RD     680     .010     .013             CIRC        3.5

150          KK      B2
151          KM    SUB-BASIN B2
152          BA    .009
153          LS                88
154          UD    .083

155          KK     DP6
156          KM    COMBINE B-5A, B5, B-2 AND B2
157          HC       4

158          KK    B-1
159          KM    ROUTE TO DP6 TO DP8  66-INCH RCP
160          RD    1000     .025     .013             CIRC        5.5

161          KK      B2A
162          KM    SUB-BASIN B2A
163          BA    .016
164          LS                88
165          UD    .133
1
                                        HEC-1 INPUT                                                    PAGE  5
LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

166          KK    B-2A
167          KM    ROUTE B2A TO DP7  30-INCH RCP
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168          RD     600     .020     .013             CIRC        3

169          KK      B1
170          KM    SUB-BASIN B1
171          BA    .017
172          LS                88
173          UD    .120

174          KK     DP7
175          KM    COMBINE B1 AND B-2A
176          HC       2

177          KK    B-2B
178          KM    ROUTE DP7 TO DP 8, DETETNION BASIN A  48-INCH RCP
179          RD    1000     .004    .013             CIRC        4

180          KK      B1A
181          KM    SUB-BASIN B1A DIRECT FLOW TO DP 8 DETENTION BASIN A
182          BA    .021
183          LS                88
184          UD    .141

185          KK      B1B  DIRECT FLOW TO DP 8, DETENTION BASIN A
186          KM    SUB-BASIN B1B
187          BA    .014
188          LS                88
189          UD    .107

190          KK      A3
191          KM    SUB-BASIN A3
192          BA    .089
193          LS                88
194          UD    .230

195          KK    A-3
196          KM    ROUTE SUB-BASIN A3 TO DP10  48-INCH RCP
197          RD    1800    0.018    0.013             CIRC        4

198          KK      A5
199          KM    SUB-BASIN A5
200          BA    0.164
201          LS                88
202          UD    .250

203          KK    DP10
204          KM    COMBINE A-3 AND A5
205          HC       2
1
                                        HEC-1 INPUT                                                    PAGE  6
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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206          KK    A-7
207          KM    ROUTE DP10 TO DP 12
208          RD    1100     .005     .015            TRAP       6      1.5

209          KK      A7
210          KM    SUB-BASIN A7
211          BA    .039
212          LS              68
213          UD    .140

214          KK    C
215          KM    SUB-BASIN C
216          BA    .043
217          LS              68
218          UD    .160

219          KK    D-1
220          KM     ROUTE SUB-BASIN C TO DP 11  30" RCP
221          RD    2400     .020     .013             CIRC       4      2.5

222          KK      D
223          KM    SUB-BASIN D
224          BA    .063
225          LS              85
226          UD    .200

227          KK    DOUT
228          KM    DETENTION BASIN D OUTFLOW
229          RS       1     ELEV     6689
230          SV       0      .01      .30      .90     1.68     2.68     3.28
231          SE    6689     6690     6692     6694     6696     6698     6699
232          SQ       0        0     22.0     70.0      110      140      150

233          KK    DP11
234          KM     COMBINE D-1 AND DOUT
235          HC       2

236          KK    A-7A
237          KM    ROUTE DP11 TO DP12
238          RD    1050     .020     .013             CIRC       4

239          KK    DP12
240          KM    COMBINE A-7A, A7, AND A-7
241          HC       3

242          KK    A-8
243          KM    ROUTE DP12 TO DP8, DETENTION BASIN A
244          RD    3200     .020     .015              TRAP       6      1.5
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9.....10
```

```
245          KK    A4
246          KM    SUB-BASIN A4, DIRECT FLOW TO DP8, DETENTION BASIN A
247          BA    .037
248          LS              74
249          UD    .162

250          KK   A1
251          KM    SUB-BASIN A1
252          BA    .039
253          LS              88
254          UD    .223

255          KK   A-1
256          KM    ROUTE A1 TO DP 13  30-INCH RCP
257          RD     800     .013     .013             CIRC      2.5

258          KK   A2
259          KM    SUB-BASIN A2  INTERQUEST FILING NO. 1
260          BA    .043
261          LS              88
262          UD    .212

263          KK    DP13
264          KM    COMBINE A2 AND A-1
265          HC       2

266          KK   A-2
267          KM    ROUTE DP13 TP DP8. DETENTION BASIN A
268          RD     500     .030     .013             CIRC      4.0

269          KK   A6
270          KM   SUB-ASIN A6, DIRECT FLOW TO DP8. DETENTION BASIN A
271          BA    .054
272          LS              76
273          UD    .263

274          KK   A8
275          KM   SUB-BASIN A8 FAIRLANE TECH PARK NO. 3
276          BA    .029
277          LS              88
278          UD    .237

279          KK   A-8A
280          KM    ROUTE A8 TO DP 8, DETENTION BASIN A
281          RD     520     .020     .035             TRAP      6.0     3.0

282          KK   DP 8
283          KM    INFLOW TO DETENTION BASIN A
284          HC       9
```

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

 285      KK  DP8OUT
 286      KM   DETENTION BASIN A OUTFLOW WITH NO MODIFICATIONS
 287      RS       1     ELEV     6614
 288      SV       0     0.84     7.06    19.91    36.66    55.02    74.87    96.98   112.72
 289      SE    6614     6616     6618     6620     6622     6624     6626     6628     6630
 290      SQ       0       16       39       52      125      150      170      170      170

 291      KK   A-12
 292      KM    ROUTE DP8OUT TO DP14
 293      RD     700     .010     .035             TRAP     20.0      2.0

 294      KK   A12
 295      KM   SUB-BASIN A12, AFA DIRECT FLOW TO DP14
 296      BA    .036
 297      LS              70
 298      UD    .400

 299      KK   DP 14
 300      KM    COMBINE A-12 AND A12
 301      HC       2

 302      KK   E1
 303      KM   SUB-BASIN E1
 304      BA    .026
 305      LS              88
 306      UD    .20

 307      KK   E1OUT
 308      KM    DETENTION BASIN E1A
 309      RS       1     ELEV     6620
 310      SV       0      .65     1.43     2.11     3.30     4.41
 311      SE    6620     6621     6622     6623     6624     6625
 312      SQ       0      2.3      6.0     10.0     15.0     20.0

 313      KK   E-1
 314      KM    ROUTE DETTENION BASIN E1OUT TO DP 15
 315      RD     900     .020     .035             TRAP     10.0      2.0

 316      KK   E2
 317      KM   SUB-BASIN E2   AFA DIRECT FLOW TO DP15
 318      BA    .053
 319      LS              70
 320      UD    .400

 321      KK   DP 15
 322      KM    COMBINE E-1 AND E2
 323      HC       2
 324      ZZ
```

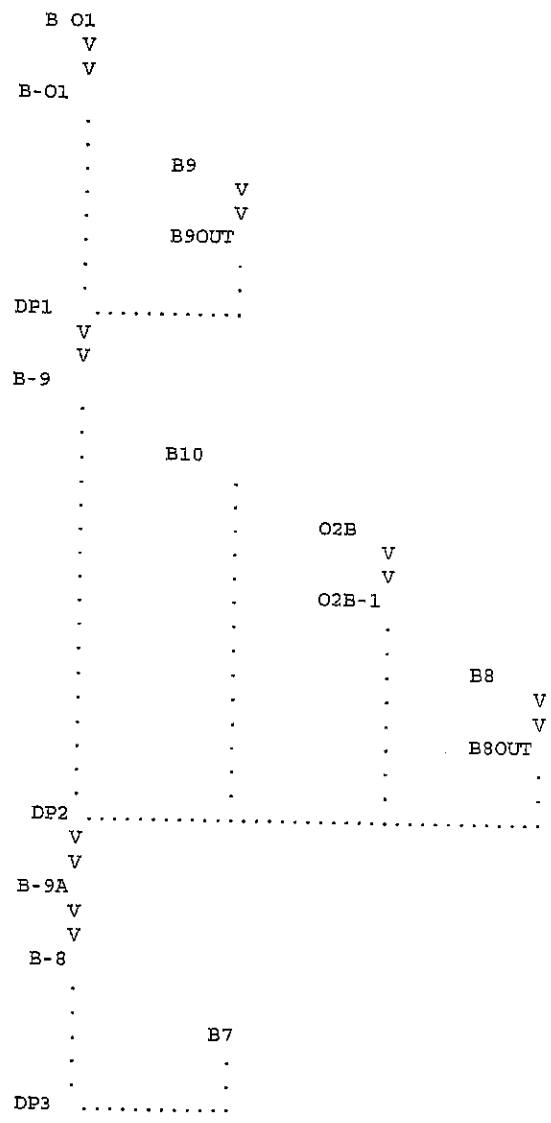
1

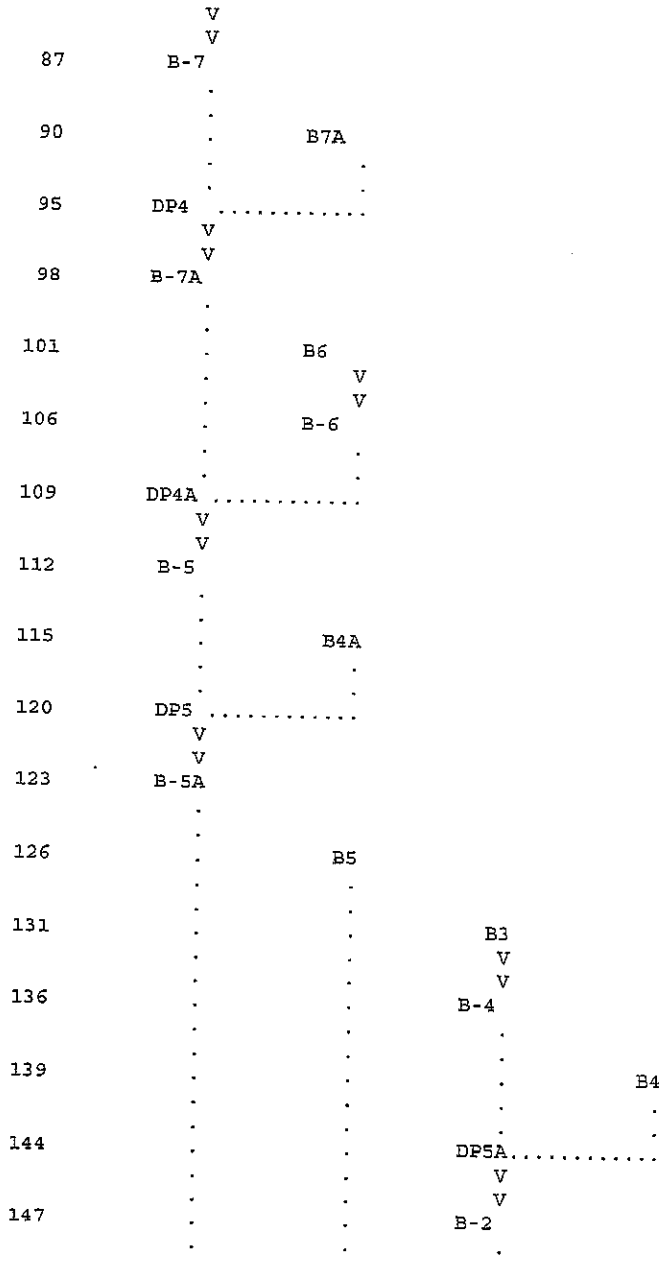
SCHEMATIC DIAGRAM OF STREAM NETWORK

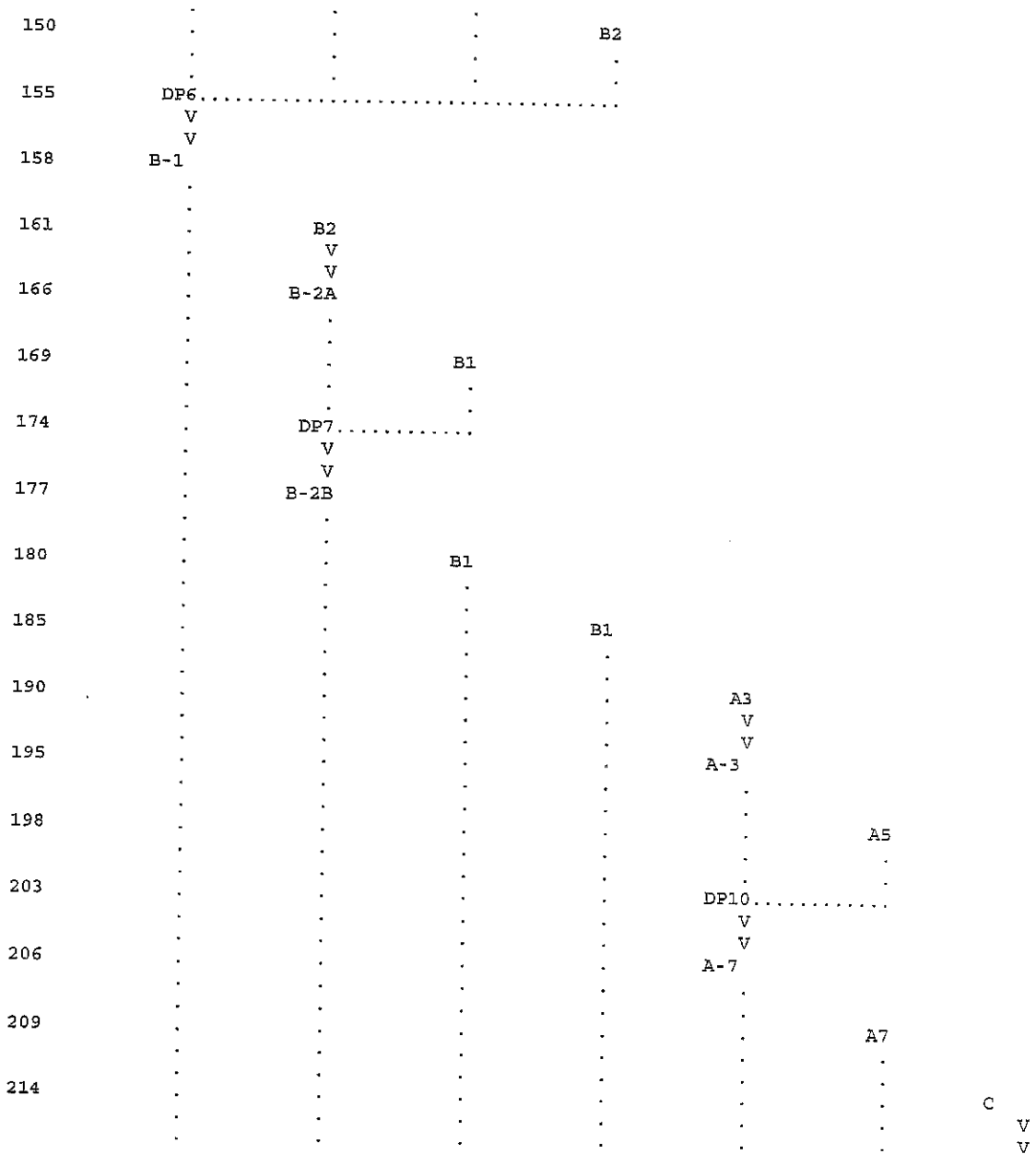
INPUT LINE NO.

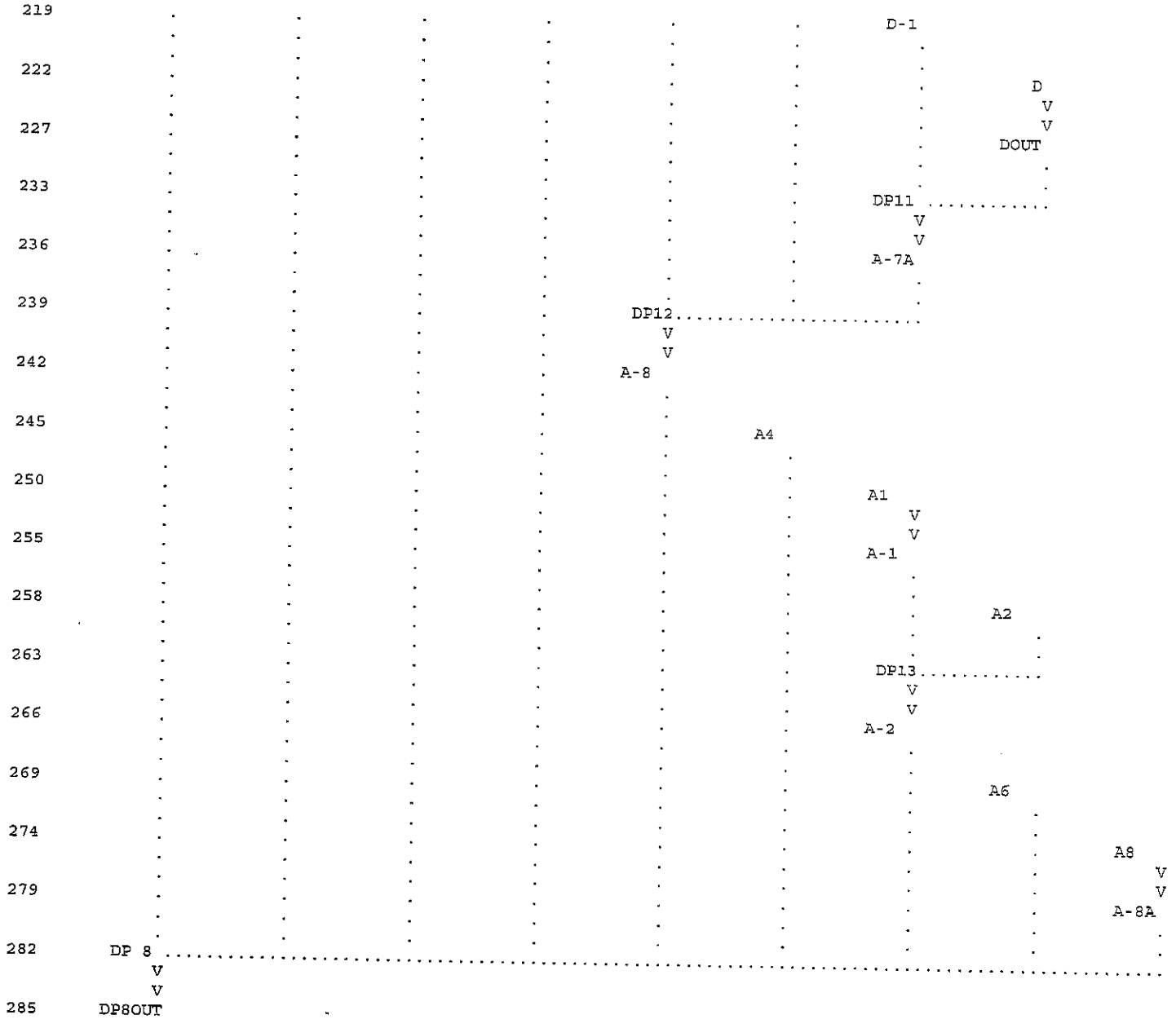
(V) ROUTING (---->) DIVERSION OR PUMP FLOW

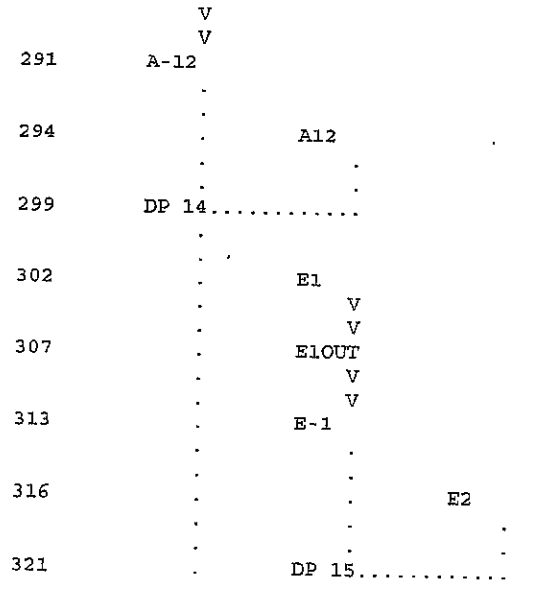
(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW




87
B-7
90
B7A
95
DP4
98
B-7A
101
B6
106
B-6
109
DP4A
112
B-5
115
B4A
120
DP5
123
B-5A
126
B5
131
B3
136
B-4
139
B4
144
DP5A
147
B-2


150
155
158
161
166
169
174
177
180
185
190
195
198
203
206
209
214
B2
DP6
B-1
B2
B-2A
B1
DP7
B-2B
B1
B1
A3
A-3
A5
DP10
A-7
A7
C


219
222
227
233
236
239
242
245
250
255
258
263
266
269
274
279
282
285
D-1
D
DOUT
DP11
A-7A
DP12
A-8
A4
A1
A-1
A2
DP13
A-2
A6
A8
A-8A
DP 8
DP8OUT



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   08FEB01  TIME  11:28:18   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

HEC-1
FAIRLANE TECHNOLOGICAL PARK MDDP UPDATE
KIOWA ENGINEERING CORPORATION JOB NO. 00084
DEVELOPED HYDROLOGY 2, 5, 10, 25, 50 AND 100-YEAR STORMS, 24 HOUR DURATION
FILENAME FT100A.DAT ALTERATIONS TO EX DETENTION BASIN A: RAISE 3.8'

7 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		3	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1457	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .05 HOURS
TOTAL TIME BASE 14.95 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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1 .48 .56 .73 .82 .91 1.00

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .48	RATIO 2 .56	RATIO 3 .73	RATIO 4 .82	RATIO 5 .91	RATIO 6 1.00
HYDROGRAPH AT										
+	B O1	.03	1	FLOW	7.	12.	25.	33.	41.	50.
				TIME	6.05	6.05	6.00	6.00	6.00	6.00
ROUTED TO										
+	B-O1	.03	1	FLOW	7.	12.	25.	33.	41.	49.
				TIME	6.10	6.10	6.05	6.05	6.05	6.05
HYDROGRAPH AT										
+	B9	.10	1	FLOW	45.	66.	115.	142.	171.	200.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
ROUTED TO										
+	B9OUT	.10	1	FLOW	21.	32.	46.	55.	59.	65.
				TIME	6.20	6.15	6.20	6.20	6.20	6.20

			** PEAK STAGES IN FEET **							
			1	STAGE	6758.81	6759.76	6761.14	6761.95	6762.30	6762.64
				TIME	6.20	6.15	6.20	6.20	6.20	6.20
2 COMBINED AT										
+	DP1	.13	1	FLOW	26.	42.	67.	81.	95.	108.
				TIME	6.15	6.10	6.10	6.10	6.05	6.05
ROUTED TO										
+	B-9	.13	1	FLOW	27.	42.	67.	80.	94.	107.
				TIME	6.15	6.15	6.10	6.10	6.10	6.10
HYDROGRAPH AT										
+	B10	.02	1	FLOW	5.	9.	18.	24.	30.	37.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
HYDROGRAPH AT										
+	O2B	.07	1	FLOW	2.	6.	23.	34.	47.	60.
				TIME	6.15	6.15	6.10	6.10	6.10	6.10
ROUTED TO										
+	O2B-1	.07	1	FLOW	2.	5.	22.	33.	45.	60.
				TIME	6.55	6.40	6.25	6.25	6.20	6.20
HYDROGRAPH AT										
+	B8	.06	1	FLOW	40.	55.	90.	109.	128.	148.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
ROUTED TO										
+	B8OUT	.06	1	FLOW	8.	13.	23.	25.	28.	30.
				TIME	6.35	6.30	6.30	6.30	6.30	6.35
			** PEAK STAGES IN FEET **							
			1	STAGE	6737.38	6737.85	6739.09	6739.56	6740.08	6740.67
				TIME	6.35	6.30	6.30	6.30	6.30	6.35
4 COMBINED AT										
+	DP2	.28	1	FLOW	37.	58.	106.	140.	173.	207.
				TIME	6.15	6.15	6.20	6.15	6.15	6.10
ROUTED TO										
+	B-9A	.28	1	FLOW	36.	58.	105.	139.	172.	206.
				TIME	6.15	6.15	6.20	6.15	6.15	6.10
ROUTED TO										
+	B-8	.28	1	FLOW	36.	57.	105.	137.	172.	205.
				TIME	6.20	6.15	6.25	6.20	6.15	6.15
HYDROGRAPH AT										
+	B7	.02	1	FLOW	21.	26.	38.	45.	52.	58.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05

2 COMBINED AT										
+	DP3	.31	1	FLOW	50.	76.	133.	167.	209.	252.
				TIME	6.15	6.15	6.10	6.15	6.15	6.10
ROUTED TO										
+	B-7	.31	1	FLOW	50.	76.	132.	167.	209.	249.
				TIME	6.15	6.15	6.10	6.15	6.15	6.10
HYDROGRAPH AT										
+	B7A	.03	1	FLOW	30.	38.	56.	65.	75.	84.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
2 COMBINED AT										
+	DP4	.33	1	FLOW	75.	108.	183.	223.	272.	325.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
ROUTED TO										
+	B-7A	.33	1	FLOW	74.	108.	183.	223.	272.	325.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
HYDROGRAPH AT										
+	B6	.03	1	FLOW	29.	36.	53.	62.	72.	81.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
ROUTED TO										
+	B-6	.03	1	FLOW	28.	36.	53.	62.	72.	81.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
2 COMBINED AT										
+	DP4A	.36	1	FLOW	101.	142.	232.	281.	338.	399.
				TIME	6.10	6.10	6.10	6.05	6.10	6.10
ROUTED TO										
+	B-5	.36	1	FLOW	100.	141.	232.	281.	337.	398.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
HYDROGRAPH AT										
+	B4A	.01	1	FLOW	11.	14.	21.	25.	28.	32.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
2 COMBINED AT										
+	DP5	.37	1	FLOW	110.	154.	252.	304.	362.	427.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
ROUTED TO										
+	B-5A	.37	1	FLOW	109.	153.	251.	303.	361.	425.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
HYDROGRAPH AT										
+	B5	.03	1	FLOW	34.	43.	62.	73.	83.	94.
				TIME	6.05	6.05	6.05	6.05	6.00	6.00

HYDROGRAPH AT										
+	B3	.03	1	FLOW	28.	35.	52.	61.	70.	79.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
ROUTED TO										
+	B-4	.03	1	FLOW	28.	35.	52.	61.	69.	78.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
HYDROGRAPH AT										
+	B4	.01	1	FLOW	15.	19.	28.	33.	38.	43.
				TIME	6.00	6.00	6.00	6.00	6.00	6.00
2 COMBINED AT										
+	DP5A	.04	1	FLOW	43.	54.	79.	93.	106.	120.
				TIME	6.05	6.05	6.05	6.05	6.05	6.00
ROUTED TO										
+	B-2	.04	1	FLOW	42.	54.	79.	92.	106.	119.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
HYDROGRAPH AT										
+	B2	.01	1	FLOW	10.	13.	19.	22.	25.	28.
				TIME	6.00	6.00	6.00	6.00	6.00	6.00
4 COMBINED AT										
+	DP6	.45	1	FLOW	188.	252.	402.	482.	563.	651.
				TIME	6.05	6.05	6.05	6.05	6.05	6.05
ROUTED TO										
+	B-1	.45	1	FLOW	186.	249.	397.	477.	559.	645.
				TIME	6.10	6.10	6.05	6.05	6.05	6.05
HYDROGRAPH AT										
+	B2	.02	1	FLOW	17.	21.	31.	37.	42.	48.
				TIME	6.05	6.05	6.00	6.00	6.00	6.00
ROUTED TO										
+	B-2A	.02	1	FLOW	17.	21.	31.	37.	42.	47.
				TIME	6.05	6.05	6.05	6.05	6.05	6.00
HYDROGRAPH AT										
+	B1	.02	1	FLOW	18.	23.	34.	40.	46.	52.
				TIME	6.05	6.00	6.00	6.00	6.00	6.00
2 COMBINED AT										
+	DP7	.03	1	FLOW	35.	44.	65.	76.	87.	99.
				TIME	6.05	6.05	6.00	6.00	6.00	6.00
ROUTED TO										
+	B-2B	.03	1	FLOW	34.	44.	64.	75.	86.	97.
				TIME	6.10	6.05	6.05	6.05	6.05	6.05

HYDROGRAPH AT										
+	B1	.02	1	FLOW	22.	28.	41.	48.	55.	62.
				TIME	6.05	6.05	6.05	6.05	6.00	6.00
HYDROGRAPH AT										
+	B1	.01	1	FLOW	15.	20.	29.	33.	38.	43.
				TIME	6.00	6.00	6.00	6.00	6.00	6.00
HYDROGRAPH AT										
+	A3	.09	1	FLOW	79.	102.	151.	178.	205.	232.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
ROUTED TO										
+	A-3	.09	1	FLOW	78.	100.	150.	176.	203.	231.
				TIME	6.15	6.10	6.10	6.10	6.10	6.10
HYDROGRAPH AT										
+	A5	.16	1	FLOW	139.	180.	269.	318.	366.	416.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
2 COMBINED AT										
+	DP10	.25	1	FLOW	217.	280.	419.	494.	570.	647.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
ROUTED TO										
+	A-7	.25	1	FLOW	217.	278.	414.	486.	563.	640.
				TIME	6.15	6.15	6.15	6.10	6.10	6.10
HYDROGRAPH AT										
+	A7	.04	1	FLOW	8.	13.	28.	38.	47.	58.
				TIME	6.10	6.05	6.05	6.05	6.05	6.05
HYDROGRAPH AT										
+	C	.04	1	FLOW	8.	14.	29.	39.	49.	60.
				TIME	6.10	6.10	6.10	6.05	6.05	6.05
ROUTED TO										
+	D-1	.04	1	FLOW	8.	13.	29.	39.	49.	60.
				TIME	6.15	6.15	6.10	6.10	6.10	6.10
HYDROGRAPH AT										
+	D	.06	1	FLOW	49.	64.	98.	117.	137.	157.
				TIME	6.10	6.10	6.10	6.05	6.05	6.05
ROUTED TO										
+	DOUT	.06	1	FLOW	39.	52.	79.	92.	106.	117.
				TIME	6.20	6.20	6.20	6.20	6.20	6.20

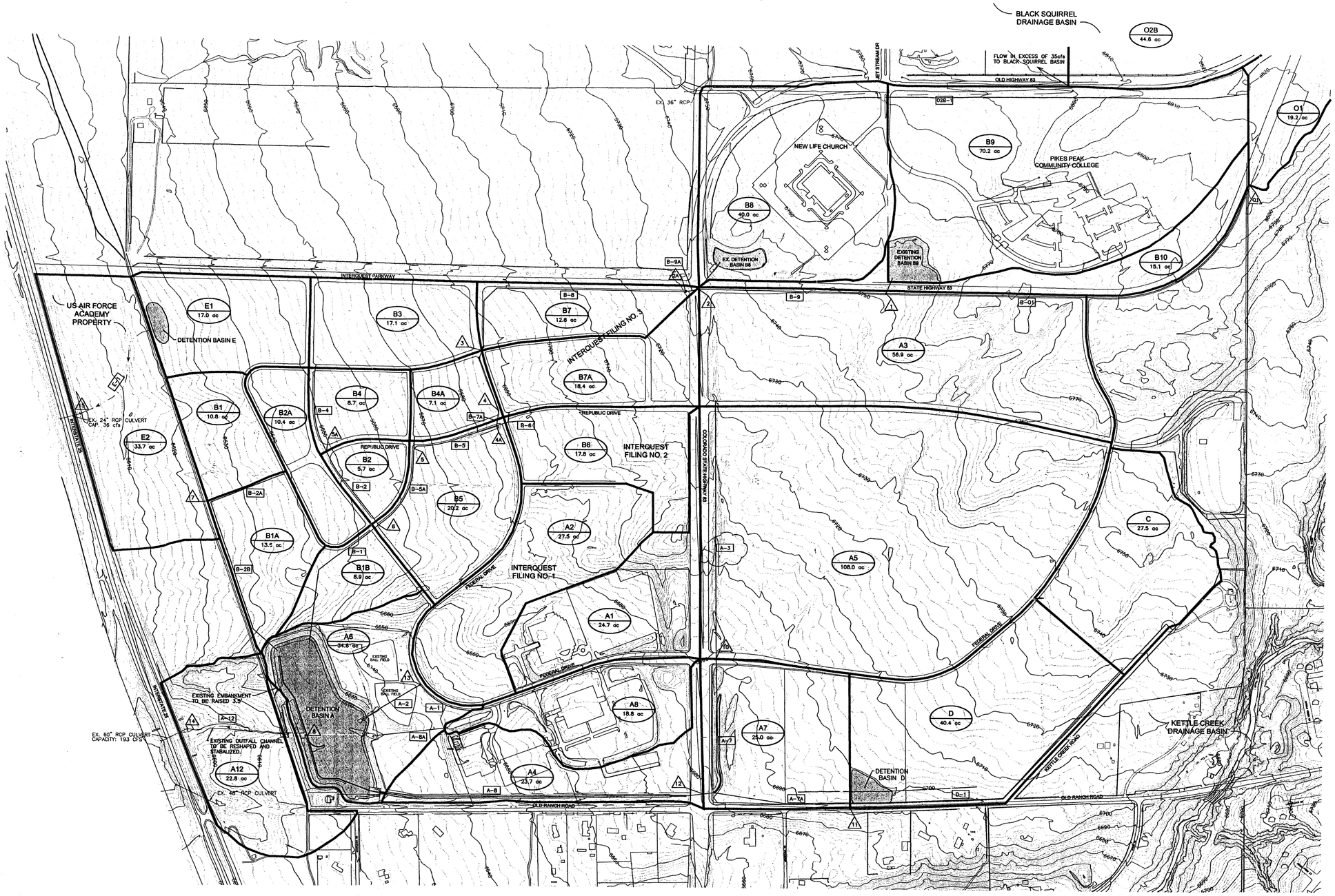
** PEAK STAGES IN FEET **

1	STAGE	6692.72	6693.26	6694.44	6695.10	6695.81	6696.47
	TIME	6.20	6.20	6.20	6.20	6.20	6.20

2 COMBINED AT										
+	DP11	.11	1	FLOW	46.	65.	106.	128.	151.	171.
				TIME	6.20	6.15	6.15	6.15	6.15	6.15
ROUTED TO										
+	A-7A	.11	1	FLOW	46.	64.	105.	127.	150.	171.
				TIME	6.20	6.20	6.15	6.15	6.15	6.15
3 COMBINED AT										
+	DP12	.40	1	FLOW	268.	351.	540.	643.	752.	860.
				TIME	6.15	6.15	6.15	6.10	6.10	6.10
ROUTED TO										
+	A-8	.40	1	FLOW	265.	347.	537.	640.	747.	855.
				TIME	6.20	6.20	6.15	6.15	6.15	6.15
HYDROGRAPH AT										
+	A4	.04	1	FLOW	13.	20.	37.	46.	57.	67.
				TIME	6.10	6.10	6.05	6.05	6.05	6.05
HYDROGRAPH AT										
+	A1	.04	1	FLOW	35.	45.	67.	79.	91.	103.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
ROUTED TO										
+	A-1	.04	1	FLOW	35.	45.	67.	78.	90.	102.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
HYDROGRAPH AT										
+	A2	.04	1	FLOW	40.	51.	75.	88.	101.	115.
				TIME	6.10	6.10	6.10	6.10	6.05	6.05
2 COMBINED AT										
+	DP13	.08	1	FLOW	74.	95.	141.	166.	191.	216.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
ROUTED TO										
+	A-2	.08	1	FLOW	74.	95.	141.	166.	191.	216.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
HYDROGRAPH AT										
+	A6	.05	1	FLOW	18.	27.	48.	60.	73.	87.
				TIME	6.15	6.15	6.15	6.15	6.15	6.15
HYDROGRAPH AT										
+	A8	.03	1	FLOW	25.	33.	49.	57.	66.	75.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
ROUTED TO										
+	A-8A	.03	1	FLOW	25.	32.	48.	57.	66.	74.
				TIME	6.15	6.15	6.10	6.10	6.10	6.10

9 COMBINED AT										
+	DP 8	1.12	1	FLOW	610.	820.	1294.	1549.	1817.	2091.
				TIME	6.10	6.10	6.10	6.10	6.10	6.10
ROUTED TO										
+	DP8OUT	1.12	1	FLOW	71.	106.	147.	160.	170.	170.
				TIME	7.10	6.95	7.05	7.15	6.70	6.40
			** PEAK STAGES IN FEET **							
			1	STAGE	6620.53	6621.48	6623.75	6625.01	6626.29	6627.58
				TIME	7.10	6.95	7.05	7.15	7.25	7.40
ROUTED TO										
+	A-12	1.12	1	FLOW	71.	106.	147.	160.	170.	170.
				TIME	7.15	7.00	7.10	7.20	6.80	6.55
HYDROGRAPH AT										
+	A12	.04	1	FLOW	5.	8.	16.	22.	28.	34.
				TIME	6.35	6.30	6.30	6.30	6.30	6.30
2 COMBINED AT										
+	DP 14	1.16	1	FLOW	73.	109.	153.	170.	185.	200.
				TIME	7.05	6.90	6.55	6.45	6.45	6.40
HYDROGRAPH AT										
+	E1	.03	1	FLOW	24.	31.	46.	54.	63.	71.
				TIME	6.10	6.10	6.05	6.05	6.05	6.05
ROUTED TO										
+	E1OUT	.03	1	FLOW	3.	4.	7.	9.	10.	12.
				TIME	6.65	6.60	6.55	6.55	6.55	6.50
			** PEAK STAGES IN FEET **							
			1	STAGE	6621.23	6621.55	6622.28	6622.71	6623.09	6623.35
				TIME	6.65	6.65	6.55	6.55	6.50	6.50
ROUTED TO										
+	E-1	.03	1	FLOW	3.	4.	7.	9.	10.	12.
				TIME	6.75	6.70	6.65	6.60	6.55	6.55
HYDROGRAPH AT										
+	E2	.05	1	FLOW	7.	11.	24.	32.	41.	50.
				TIME	6.35	6.30	6.30	6.30	6.30	6.30
2 COMBINED AT										
+	DP 15	.08	1	FLOW	9.	15.	30.	40.	50.	61.
				TIME	6.40	6.35	6.30	6.30	6.30	6.30
1										

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

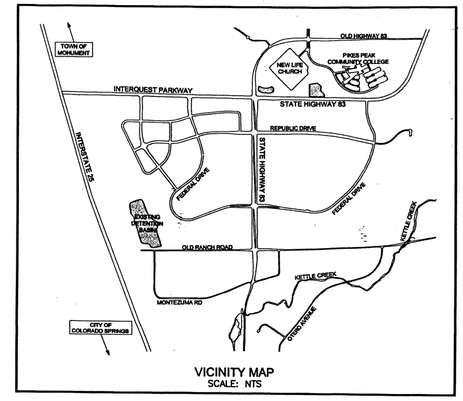


LEGEND	
A / 14.68 oc	DRAINAGE BASIN DESIGNATION / DRAINAGE BASIN AREA
2.2 cfs / 4.3 cfs	10-YEAR RUNOFF / 100-YEAR RUNOFF
1	DESIGN POINT
	DRAINAGE BASIN BOUNDARY
	FLOW DIRECTION
C-13	CONVEYANCE ELEMENT

0 300' 600'

SCALE: 1"=300'

NOTE: TOPOGRAPHY USED IN THIS MDDP DOES NOT REFLECT THE EXISTING CONDITIONS FOR ALL AREAS OF THE DRAINAGE BASINS.



VICINITY MAP
SCALE: NTS

SUMMARY OF DESIGN POINT DISCHARGES (24-HOUR STORM)

DESIGN POINT	LOCATION	DRAINAGE AREA		DEVELOPED CONDITION 5 Year	100 Year
DP 1	AT OUTLET OF DETENTION BASIN B9	83.2 oc	0.13 sm	42 cfs	108 cfs
DP 2	SH 83 AND INTERQUEST PARKWAY	179.2 oc	0.28 sm	58 cfs	207 cfs
DP 2A	SH 83 AND INTERQUEST PARKWAY	179.2 oc	0.28 sm	58 cfs	207 cfs
DP 3		198.4 oc	0.31 sm	76 cfs	252 cfs
DP 4	FEDERAL DRIVE AND REPUBLIC DRIVE	211.2 oc	0.33 sm	108 cfs	325 cfs
DP 4A	FEDERAL DRIVE AND REPUBLIC DRIVE	230.4 oc	0.36 sm	142 cfs	399 cfs
DP 5		236.8 oc	0.37 sm	154 cfs	427 cfs
DP 5A		25.6 oc	0.04 sm	54 cfs	120 cfs
DP 6		288.0 oc	0.45 sm	252 cfs	651 cfs
DP 7		19.2 oc	0.03 sm	44 cfs	990 cfs
DP 8	INFLOW TO DETENTION BASIN A	716.8 oc	1.12 sm	820 cfs	2091 cfs
DP 8 OUT	OUTFLOW FROM DETENTION BASIN A	716.8 oc	1.12 sm	126 cfs	170 cfs
DP 10	SH 83 AND FEDERAL DRIVE	160.0 oc	0.25 sm	280 cfs	647 cfs
DP 11	OUTFLOW FROM DETENTION BASIN D	70.4 oc	0.11 sm	65 cfs	171 cfs
DP 12	SH 83 AND OLD RANCH ROAD	256.0 oc	0.40 sm	351 cfs	860 cfs
DP 13	FEDERAL DRIVE	51.2 oc	0.08 sm	95 cfs	216 cfs
DP 14	EX. 60" RCP UNDER I-25	739.6 oc	1.16 sm	130 cfs	200 cfs
DP 15	EX. 24" RCP UNDER I-25	50.7 oc	0.08 sm	19 cfs	61 cfs
E1	AIR FORCE ACADEMY BOUNDARY	17.0 oc	0.03 sm	35 cfs	71 cfs
E1 OUT	OUTFLOW DETENTION BASIN E	17.0 oc	0.03 sm	4 cfs	12 cfs

SUMMARY OF DRAINAGE CONVEYANCES (24-HOUR STORM)

CONVEYANCE NUMBER	SIZE / TYPE	CAPACITY	DEVELOPED CONDITION 5 Year	100 Year
02B-1	GRASSLINED SWALE	100 cfs	5 cfs	60 cfs (1)
B-01	EXISTING 36-INCH RCP	89 cfs	12 cfs	49 cfs
B-9	EXISTING 48-INCH RCP	157 cfs	42 cfs	107 cfs
B-9A	EXISTING 6' x 2' CBC	140 cfs	58 cfs	206/171 cfs (1)
B-8	EXISTING 54-INCH RCP	310 cfs	57 cfs	205 cfs
B-7	54-INCH RCP	264 cfs	76 cfs	249 cfs
B-6	36-INCH RCP	79 cfs	36 cfs	81 cfs
B-5	60-INCH RCP	404 cfs	141 cfs	398 cfs
B-5A	60-INCH RCP	451 cfs	153 cfs	425 cfs
B-4	30-INCH RCP (5-YEAR)	41 cfs	35 cfs	78 cfs
B-2 (2)	36-INCH RCP (5-YEAR)	67 cfs	54 cfs	118 cfs
B-1 (2)	60-INCH RCP (10-YEAR)	410 cfs	249 cfs	646 cfs
	72-INCH RCP (100-YEAR)	670 cfs		
B-2A (2)	24-INCH RCP (5-YEAR)	32 cfs	21 cfs	47 cfs
	30-INCH RCP (100-YEAR)	58 cfs	65 cfs	171 cfs
B-2B	48-INCH RCP	91 cfs	44 cfs	97 cfs
A-3	EXISTING CONCRETE CHANNEL	300 cfs	100 cfs	231 cfs
A-7	EXISTING CONCRETE CHANNEL	880 cfs	278 cfs	640 cfs
D-1	30-INCH RCP	58 cfs	13 cfs	60 cfs
A-7A	30-INCH RCP (5-YEAR)	58 cfs	64 cfs	171 cfs
	48-INCH RCP (100-YEAR)	203 cfs		
A-1	EXISTING 30-INCH RCP	45 cfs	45 cfs	102 cfs
A-2 (A)	36-INCH RCP (5-YEAR)	249 cfs	95 cfs	216 cfs
A-12	GRASS AND RIPRAP LINED CHANNEL	190 cfs	126 cfs	170 cfs
E-1	GRASS AND RIPRAP LINED CHANNEL	20 cfs	5 cfs	12 cfs

(1) FLOW IN EXCESS OF 35 cfs DIVERTS TO THE BLACK SQUIRREL BASIN.
(2) PIPE WITH OVERFLOW CHANNEL REQUIRED FOR FULL 100-YEAR CONVEYANCE.

SUMMARY OF DETENTION BASIN DATA (24-HOUR STORM)

EXISTING DETENTION BASIN B9
(PIKES PEAK COMMUNITY COLLEGE)

	Q_5	Q_{10}	Q_{100}
IN	66 cfs	106 cfs	200 cfs
OUT	32 cfs	44 cfs	65 cfs

100 yr WATER SURFACE EL.=6762.6
TOP OF EMBANKMENT=6765.0
100 yr VOLUME=4.0 oc-ft

EXISTING DETENTION BASIN B8
(NEW LIFE CHURCH)

	Q_5	Q_{10}	Q_{100}
IN	55 cfs	83 cfs	148 cfs
OUT	13 cfs	21 cfs	30 cfs

100 yr WATER SURFACE EL.=6740.7
TOP OF EMBANKMENT=6743.0
100 yr VOLUME=3.5 oc-ft

PROPOSED DETENTION BASIN E

	Q_5	Q_{10}	Q_{100}
IN	35 cfs	46 cfs	71 cfs
OUT	5 cfs	7 cfs	12 cfs

100 yr WATER SURFACE EL.=6623.4
TOP OF EMBANKMENT=6624.0
100 yr VOLUME=12.0 oc-ft

EXISTING DETENTION BASIN D
(KETTLE CREEK ROAD)

	Q_5	Q_{10}	Q_{100}
IN	64 cfs	92 cfs	157 cfs
OUT	52 cfs	75 cfs	117 cfs

100 yr WATER SURFACE EL.=6696.5
TOP OF EMBANKMENT=6698.0
100 yr VOLUME=1.9 oc-ft

EXISTING DETENTION BASIN A
(EMBANKMENT RAISED AND OUTLET MODIFIED)

	Q_5	Q_{10}	Q_{100}
IN	820 cfs	1209 cfs	2091 cfs
OUT	126 cfs	147 cfs	170 cfs

100 yr WATER SURFACE EL.=6627.6
TOP OF EMBANKMENT=6628.0
100 yr VOLUME=92.6 oc-ft

FAIRLANE TECHNOLOGY PARK
MASTER DEVELOPMENT DRAINAGE PLAN UPDATE
HYDROLOGIC SUB-BASIN MAP AND PROPOSED STORM DRAINAGE FACILITIES

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

APPENDIX B

HYDRAULIC CALCULATIONS

PBL 10-7-07

Storm Sewer System Hydraulics

System #1: A-Series.

① Stubout to SB A9

$Q_5 = 12.6$ cfs $Q_{100} = 23.9$ cfs

Pick up 100-year.

Use 18" RCP @ 3.0% $Q_{cap} = 19.5$ cfs.

Per Final Design Profile:

Use 24" @ 2.0% $Q_{cap} = 32$ cfs

② Inlet @ A10:

Since 100-year picked up @ A9, use single 5' DIDR in sump to pickup street flow.

③ Inlet @ SB A8

$Q_5 = 3.5$ cfs $Q_{100} = 6.4$ cfs

Assume sump condition of Type I cfg

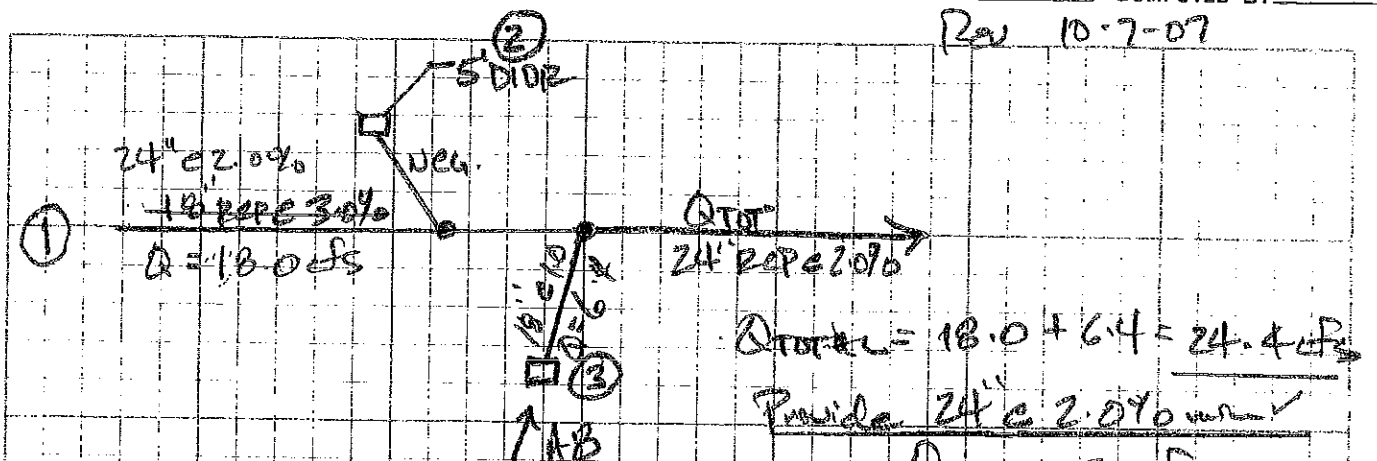
$Q_i = 3.0 L d_i^{1.5}$ w/ $d_i = .67'$

for 5' DIDR $Q_i = 3(5)(.67)^{1.5} = 8.2$ cfs ∴ ok

Use 18" RCP at @ 1.0% min.

$Q_{cap} = 11$ cfs ∴ ok

Rev 10-2-07



$Q_{TOT} = 18.0 + 6.4 = 24.4$ cfs

Provide 24" @ 2.0% min ✓

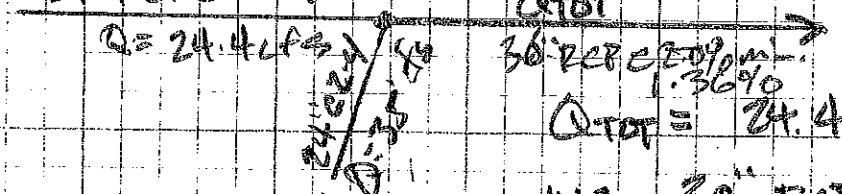
$Q_{cap} = 32$ cfs.

④ Stub-out to SS A10

$Q_5 = 19.1$ $Q_{100} = 35.9$ cfs

Provide 100-year @ this stub out:

use 24" REP @ 2.4% min $Q_{cap} = 35$ cfs.



$Q_{TOT} = 24.4$ cfs + 35 = 59.4 cfs

use 30" REP @ 2.0% min.

$Q_{cap} = 58$ cfs ∴ ok

Per Final Design Profiles

Use 36" REP @ 1.36%

$Q_{cap} = 76$ cfs ∴ OK

10-7-07

⑤ Inlet @ SB A2

$Q_5 = 5.1$ ✓ $Q_{100} = 9.4$ ✓

for 5' DIOR w/ 12" throat

$Q_i = 3(5)(1)^{1.5} = 15$ cfs ∴ ok

36 RCP @ 1.36% $Q = 59.4$ cfs → Q_{TOT} → 36" RCP @ 1.36%

⑤ 5' DIOR $Q_i = 9.4$ cfs

$Q_{TOT} = 59.4 + 9.4 = 68.8$ cfs

36" RCP @ 1.36% $Q_{cap} = 76$ cfs ∴ ok

⑥ Inlet @ SB A4

$Q_5 = 2.4$ cfs ✓ $Q_{100} = 4.4$ cfs ✓

use 5' DIOR $d_i = .67'$ $Q_i = 8.2$ cfs ∴ ok

36" RCP @ 1.36% $Q = 71.0$ → Q_{TOT} → 36" RCP @ 1.36% $Q = 75.4$ cfs

⑥ 5' DIOR

A4

$Q_{TOT} = 71.0 + 4.4$ cfs $= 75.4$ cfs

36" RCP @ 1.36% $Q_{cap} = 76$ cfs

Per Final Desn. Plans 36" @ 3.0% $Q_{cap} = 116$ cfs ∴ ok

10-7-07

(7) Stub out to Parking Garage

SB A16 $Q_5 = 18.7$ cfs ✓ $Q_{100} = 34.2$ cfs ✓

use 24" RCP @ 2.0% min $Q_{cap} = 33$ cfs ∴ ok

Per Final Design: 24" @ 1.5% $Q = 28$ cfs ok for 5 year

(8) Stub out to SB A5

$Q_5 = 13.1$ cfs ✓ $Q_{100} = 23.9$ cfs ✓

use 24" RCP @ 1.0% min $Q_{cap} = 23$ cfs ∴ ok

(7) A6 24" RCP @ 1.5% $Q_{cap} = 28$ cfs → Q_{TOT} 30" RCP @ 2.8% $Q = 51$ cfs

24" RCP @ 1.0% $Q = 23$ cfs

(8) A5

$Q_{TOT} = 28 + 23 = 51$ cfs

use 30" RCP @ 2.0% $Q_{cap} = 58$ cfs ∴ ok

Per Final Des: 30" RCP @ 2.8% $Q_{cap} = 69$ cfs ∴ ok

(9) Inlet @ SB A7

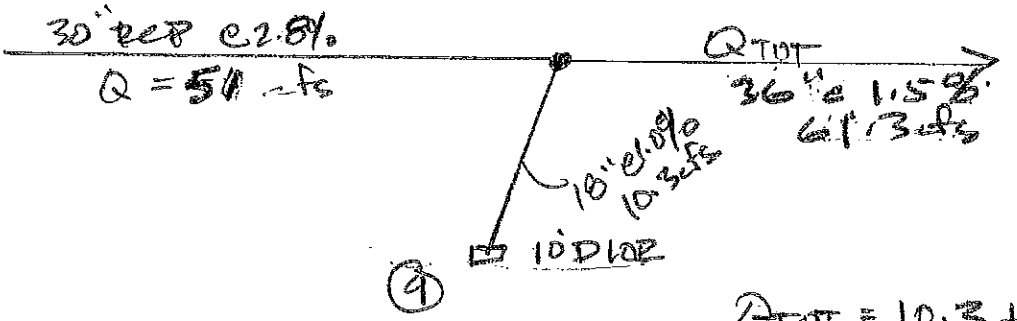
$Q_5 = 5.6$ cfs ✓ $Q_{100} = 10.3$ cfs ✓

use DIOR Sump

$Q_i = 3(10)(d_i)^{1.5}$ $d_i = .67$

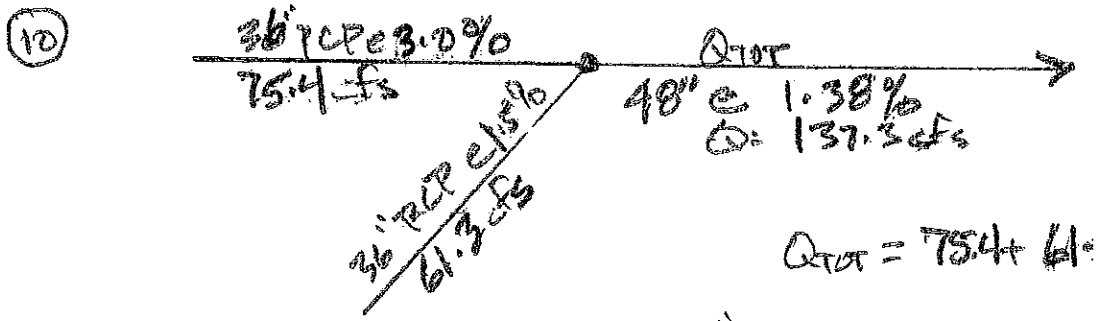
$= 16.5$ cfs ∴ ok

18" RCP @ 1.0% min



$Q_{TOT} = 10.3 + 51$
$= 61.3$ cfs

PER Final Design: 36" @ 1.5% $Q_{cap} = 68$ cfs ✓
36" @ 1.0% $Q_{cap} = 52$ cfs ∴ ok



$Q_{TOT} = 75.4 + 61.3 \text{ cfs} = 136.7$ cfs

48" RCP @ 1.4%
$Q_{cap} = 170$ cfs ∴ ok

(11) Stub out to SB A1

$Q_5 = 53.1$ cfs $Q_{100} = 98.5$ cfs

pickup 100 year 36" RCP @ 2.0% 94 cfs ∴ ok

(12) inlet @ SB A11

$Q_5 = 3.7$ cfs $Q_{100} = 6.7$ cfs

5' DIOR w/ di = .67', $Q_i = 8.4$ cfs ∴ ok

For FD use 8' DIOR $Q_i = 13$ cfs ∴ ok

Rev 10-07-09

(13) Inlet @ SB's A12 + A13

$Q_5 = 2.7 + 2.1 = 4.8$ cfs

$Q_{100} = 4.9 + 3.8 = 8.7$ cfs

use 5' DIOR = $Q_{cap} = 8.4$ ∴ ok

per Final Design use 8' DIOR Cap = Both ∴ ok

(14) Outfall Storm @ DP #1

$Q_5 = 121.4$ cfs $Q_{100} = 228.2$ cfs

48" @ 2.6% $Q_{cap} = 232$ cfs ∴ ok

(15) Outfall Storm @ DP #2

$Q_5 = 120.6$ cfs $Q_{100} = 229.1$

use same as DP #1

48" RCP @ 2.6% min

Per Final Design: 48" @ 2.6% ∴ ok

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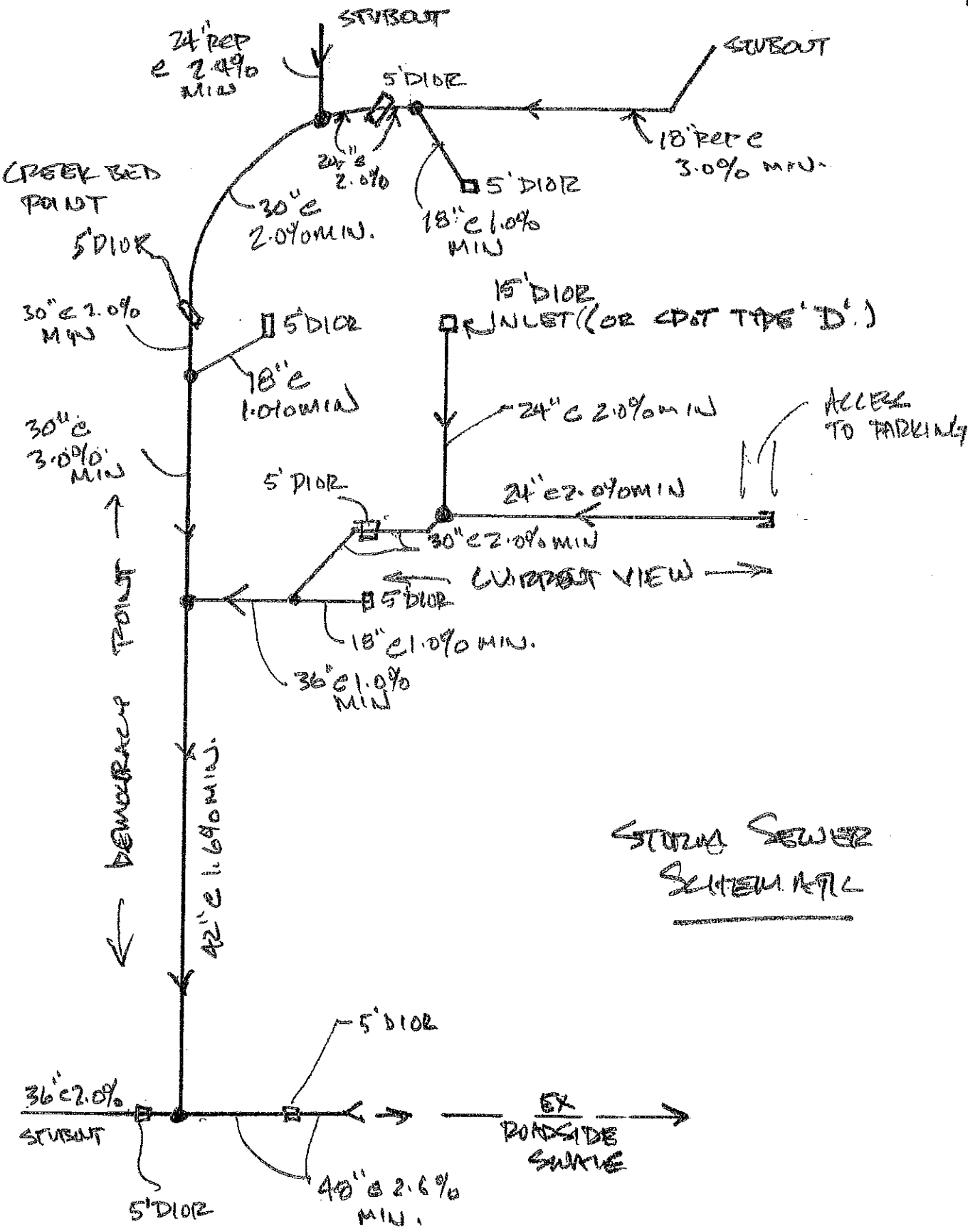
CLIENT SYSTEM 1 "A" JOB NO. 0504.5 PAGE 7
PROJECT BASINS DATE CHECKED DATE 7/11/07
DETAIL CHECKED BY COMPUTED BY DJW

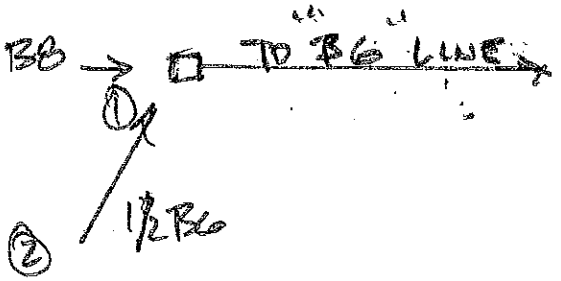


Storm Sewer System Hydraulics

SYSTEM # 2 - FB - Sub-basins

① SB FSB $Q_5 = 3.6$ $Q_{100} = 6.6$ cfs

Pickup FB in front of theatre entry road.



5' DIOR Cap = 8.2 cfs
@ di = .67' ∴ ok

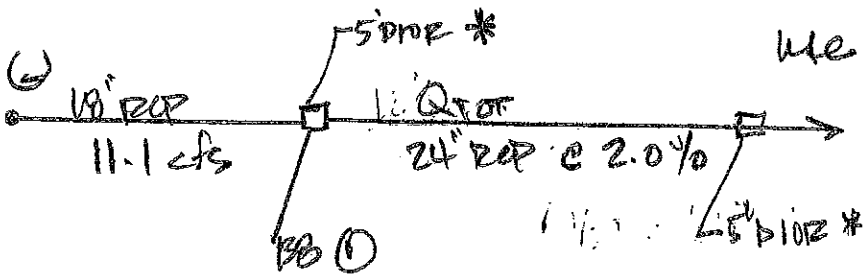
use 18" @ 2.0%
Qcap = 15 cfs ∴ ok

② SB FG (BUILDINGS)

$Q_5 = 12.2$ cfs $Q_{100} = 22.2$ cfs

Split flow 1/2 between theatre entrance and intersection of Current View & Stream View

∴ 11.1 cfs @ each location



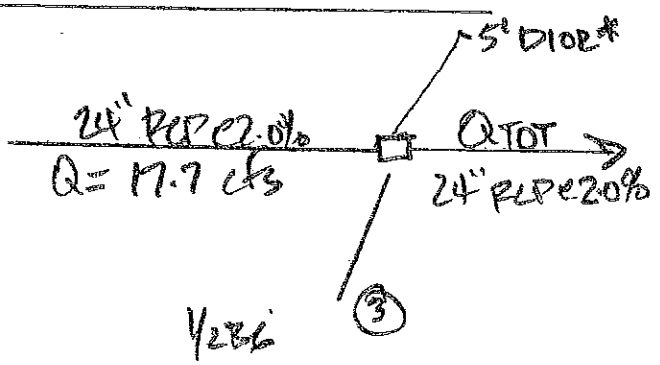
use 18" RCP @ 2.0% Qcap = 15 cfs
∴ ok

$Q_{TOT} = 6.6 + 11.1 = 17.7$ cfs

use 24" RCP @ 2.0%
Q cap = 32 cfs ∴ ok

* DIOR's pick up remain surface flows from SB FB

③ Second ½ SB B6

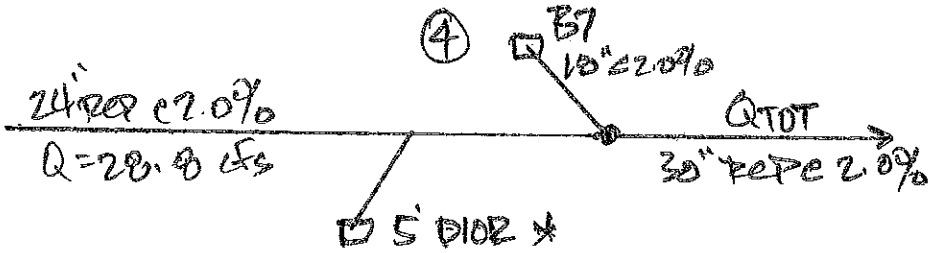


$Q_{TOT} = 17.7 + 11.1$
$= 28.8$ cfs
use 24" RCP @ 2.0%
$Q_{cap} = 32$ cfs ∴ ok

* Residual surface flow only

④ SB B7

$Q_c = 42$ cf $Q_{100} = 7.6$ cfs



* RESIDUAL SURFACE FLOW

pickup B7 ∴ inlet 5' DIOR $d_i = .67'$ $Q_i = 8.2$ cfs ok
use 18" RCP @ 2.0% $Q_{cap} = 15$ cfs ∴ ok

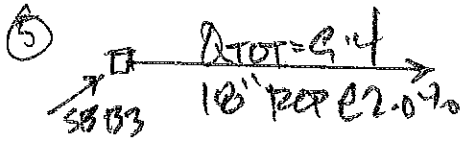
$Q_{TOT} = 28.8$ cfs + 7.6 cfs = 36.4 cfs

use 30" RCP @ 2.0% min $Q_{cap} = 58$ cfs ∴ ok

⑤ SB B3

$Q_5 = 5.1$ $Q_{100} = 9.4$ cfs

5' DIOR w di = 12"
Q_i = 15 cfs ∴ ok

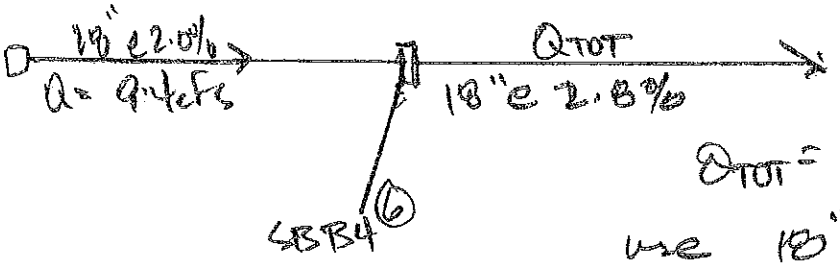


use 18" RCP ast @ 2.0%
Qcap 15 cfs ∴ ok

⑥ SB B4

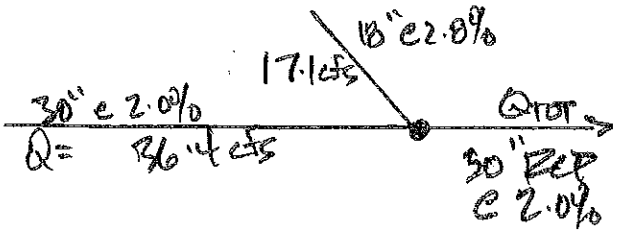
$Q_5 = 4.2$ cfs $Q_{100} = 7.7$ cfs

use same as SB B3 5' DIOR w/ 18" @ 2.0%



Q_{TOT} = 9.4 + 7.7 = 17.1 cfs
use 18" @ 2.8% min.

⑦ Junction @ SB B4...

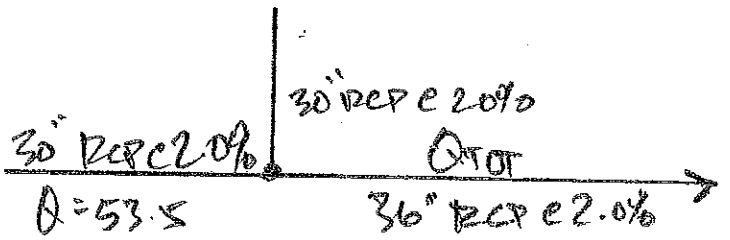


Q_{TOT} = 36.4 + 17.1 cfs = 53.5
30" RCP @ 2.0% Q_{cap} = 58 cfs ∴ ok

⑧ SB B2

Q_5 = 22.9 cfs Q_{100} = 41.9 cfs

Stub out 30" RCP @ 20% Q_{cap} = 58 cfs ∴ ok



Q_{TOT} = 41.9 + 53.5 cfs = 95.4 cfs

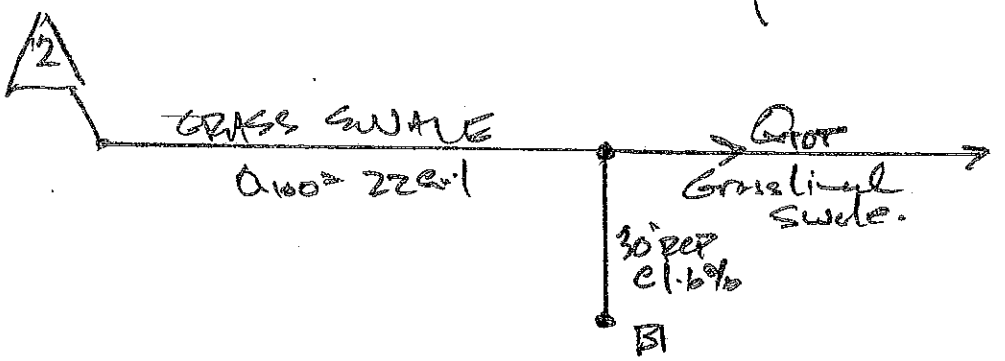
36" RCP @ 2.0% Q_{cap} = 94 cfs

w/ lagging probably ok

⑨ @ SB B1 Stub out

Q_5 = 25.3 cfs Q_{100} = 46.2 cfs

Need Storm Sewer from DP 3 to DP 4



use 30" RCP @ 1.6% min Q = 52 cfs ∴ ok

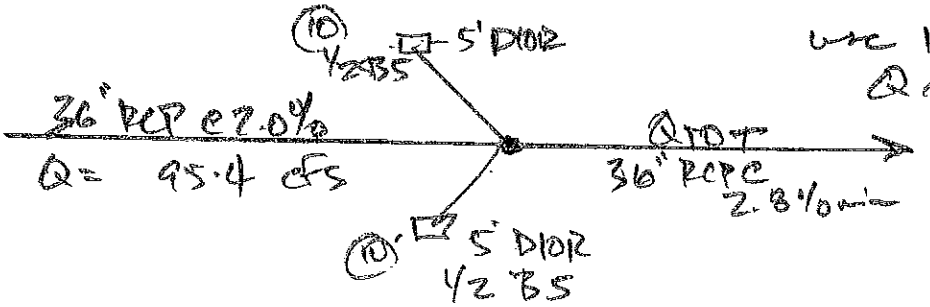
Q_{TOT} = 229.1 + 46.2 cfs = 275.3 cfs

(10) @ SB B5

Q_5 = 7.0 cfs Q_{100} = 12.8 cfs

Split flows from SB to each Flowline ∴
Q each inlet = 3.5 cfs & 6.4 cfs

5' DIOR @ d_i = .67 Q_i = 8.4 cfs
use 18" RCP @ 1.0% slope
Q_{cap} = 11 cfs ∴ o/k



Q_{TOT} = 95.4 cfs + 12.8 cfs = 108.2 cfs
36" RCP @ 2.8% = Q_{cap} = 112 cfs ∴ o/k

(11) @ Culvert @ DP 3

Q_{100} = 275.3 cfs @ inlet
Q_{100} = 312 @ DP 3 size for 312.
Per H9 used 4'x12' CBC
Normal Depth Capacity

$$Q = \frac{1.49}{.013}\sqrt{.01}\,AR^{2/3} = 11.5\,AR^{2/3}$$

for 4'x12' A = 48 R = A/P = 48/32 = 1.5 $R^{2/3}$ = 1.3

$$Q = = 11.5(48)(1.3) = 720 \text{ cfs ample}$$

4'x12' CBC @ DP3

CURRENT DATE: 07-11-2007
CURRENT TIME: 12:14:27

FILE DATE: 07-11-2007
FILE NAME: COXSING

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA: INLET ELEV. (ft)	SITE DATA: OUTLET ELEV. (ft)	SITE DATA: CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS / SHAPE / MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	100.00	92.00	700.05	1 RCB	12.00	4.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

Hw/D = 4.35/4 = 1.08 ok

SUMMARY OF CULVERT FLOWS (cfs) FILE: COXSING DATE: 07-11-2007

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
100.98	35.0	35.0	0.0	0.0	0.0	0.0	0.0	0.00	1
101.55	70.0	70.0	0.0	0.0	0.0	0.0	0.0	0.00	1
102.03	105.0	105.0	0.0	0.0	0.0	0.0	0.0	0.00	1
102.47	140.0	140.0	0.0	0.0	0.0	0.0	0.0	0.00	1
102.88	175.0	175.0	0.0	0.0	0.0	0.0	0.0	0.00	1
103.26	210.0	210.0	0.0	0.0	0.0	0.0	0.0	0.00	1
103.62	245.0	245.0	0.0	0.0	0.0	0.0	0.0	0.00	1
103.99	280.0	280.0	0.0	0.0	0.0	0.0	0.0	0.00	1
104.33	312.0	312.0	0.0	0.0	0.0	0.0	0.0	0.00	1
104.76	350.0	350.0	0.0	0.0	0.0	0.0	0.0	0.00	1
106.00	446.4	446.4	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: COXSING DATE: 07-11-2007

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
100.00	0.000	0.00	0.00	0.00
100.98	0.000	35.00	0.00	0.00
101.55	0.000	70.00	0.00	0.00
102.03	0.000	105.00	0.00	0.00
102.47	0.000	140.00	0.00	0.00
102.88	0.000	175.00	0.00	0.00
103.26	0.000	210.00	0.00	0.00
103.62	0.000	245.00	0.00	0.00
103.99	0.000	280.00	0.00	0.00
104.33	0.000	312.00	0.00	0.00
104.76	0.000	350.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 07-11-2007
CURRENT TIME: 12:14:27

FILE DATE: 07-11-2007
FILE NAME: COXSING

PERFORMANCE CURVE FOR CULVERT 1 - 1(12.00 (ft) BY 4.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	100.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
35.00	100.98	0.98	0.98	1-S2n	0.41	0.64	0.34	0.51	8.50	6.84
70.00	101.55	1.55	1.55	1-S2n	0.62	1.02	0.52	0.79	11.20	8.86
105.00	102.03	2.03	2.03	1-S2n	0.82	1.34	0.74	1.02	11.86	10.26
140.00	102.47	2.47	2.47	1-S2n	0.97	1.62	0.92	1.23	12.68	11.35
175.00	102.88	2.88	2.88	1-S2n	1.13	1.88	1.08	1.43	13.50	12.26
210.00	103.26	3.26	3.26	1-S2n	1.27	2.12	1.22	1.61	14.31	13.04
245.00	103.62	3.62	3.62	1-S2n	1.40	2.35	1.35	1.79	15.09	13.73
280.00	103.99	3.99	3.99	1-S2n	1.54	2.57	1.47	1.95	15.85	14.34
312.00	104.33	4.33	4.33	5-S2n	1.65	2.76	1.56	2.10	16.62	14.85
350.00	104.76	4.76	4.76	5-S2n	1.78	2.98	1.68	2.27	17.31	15.40

El. inlet face invert 100.00 ft
El. outlet invert 92.00 ft
El. inlet throat invert 0.00 ft
El. inlet crest 0.00 ft

*** SITE DATA ***** CULVERT INVERT **********

INLET STATION	100.00 ft
INLET ELEVATION	100.00 ft
OUTLET STATION	800.00 ft
OUTLET ELEVATION	92.00 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0114
CULVERT LENGTH ALONG SLOPE	700.05 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	12.00 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (30-75 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 07-11-2007
CURRENT TIME: 12:14:27

FILE DATE: 07-11-2007
FILE NAME: COXSING

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	10.00 ft
SIDE SLOPE H/V (X:1)	0.0
CHANNEL SLOPE V/H (ft/ft)	0.010
MANNING'S n (.01-0.1)	0.013
CHANNEL INVERT ELEVATION	92.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	92.00 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	92.00	0.000	0.00	0.00	0.00
35.00	92.51	1.686	0.51	6.84	0.32
70.00	92.79	1.756	0.79	8.86	0.49
105.00	93.02	1.786	1.02	10.26	0.64
140.00	93.23	1.801	1.23	11.35	0.77
175.00	93.43	1.808	1.43	12.26	0.89
210.00	93.61	1.811	1.61	13.04	1.00
245.00	93.79	1.810	1.79	13.73	1.11
280.00	93.95	1.808	1.95	14.34	1.22
312.00	94.10	1.805	2.10	14.85	1.31
350.00	94.27	1.799	2.27	15.40	1.42

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	84.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	106.00 ft

COLORADO CROSSING FILING NOS. 1 AND 2

Swale Capacity Calculation

GRASS-LINED SWALE, DESIGN POINT 2 TO 3

Trapezoidal Channel Capacity Calculation (Values to be Input)			
Design Flow	275.0 cfs	Channel Side Slope	4.0:1
Bottom Width	20.0 ft	Channel Longitudinal Slope	0.5 %
Depth of Flow	2.25 ft	Manning's Roughness Coef.	0.035

Channel Area	65.3 sf
Channel Wetted Perimeter	38.6 ft
Hydraulic Radius	1.69 ft

Channel Flow Velocity	4.3 ft/sec
Channel Flow Capacity	279 cfs
Capacity Check	Okay

Freeboard	1.1 ft
Swale Depth	3.4 ft
Top Width	47.1 ft

Equations:

Area (A) = b(d)

b = width

d = depth

Perimeter (P) = $b+2d*(1+z^2)^{0.5}$

z = side slope

Hydraulic Radius = A/P

Velocity = $(1.49/n)R_n^{2/3} S^{1/2}$

Slope (S) = Slope of the channel

n = Manning's number

R_n = Hydraulic Radius (Reynold's Number)

Flow = $(1.49/n)AR_n^{2/3} S^{1/2}$

Freeboard = $1.0+0.025(v)d^{0.33}$

Section 3: C Basins

① SB C23. $Q_5 = 31.8$ cfs $Q_{100} = 58.1$ cfs.
Pick up 100-year; stub to prop.
30" @ 2.0% $Q_{cap} = 58$ cfs ∴ ok

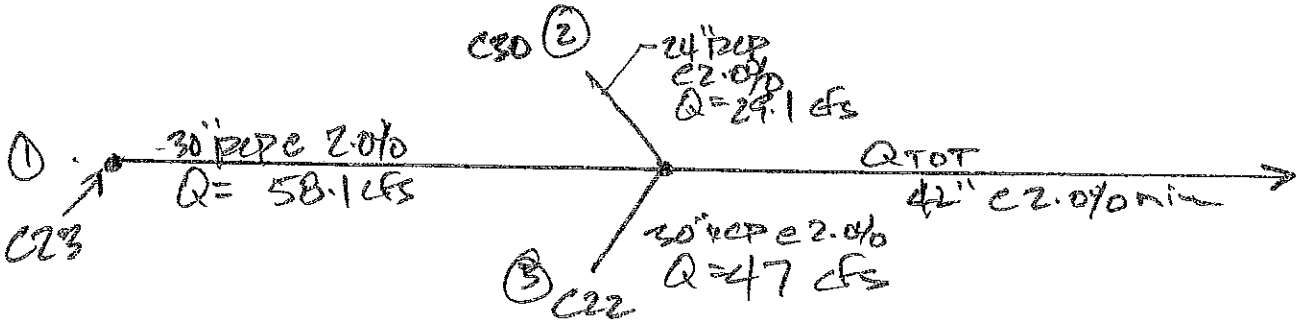
② SB C30 $Q_5 = 15.9$ $Q_{100} = 29.1$ cfs
Stub out to future development
24" @ 2.0% $Q_{cap} = 32$ cfs ∴ ok

③ SB C22 $Q_5 = 25.7$ cfs $Q_{100} = 47.0$ cfs
pick up 100 year w/ stub out to future dev.
30" @ 2.0% $Q_{cap} = 58$ ∴ ok

④ SB C29 $Q_5 = 22.9$ cfs $Q_{100} = 41.9$ cfs
use 30" RCP

⑤ @ SB C 20 $Q_5 = 11.7$ cfs $Q_{100} = 21.4$ cfs
24" RCP @ 2.0% $Q_{cap} = 32$ cfs ∴ ok

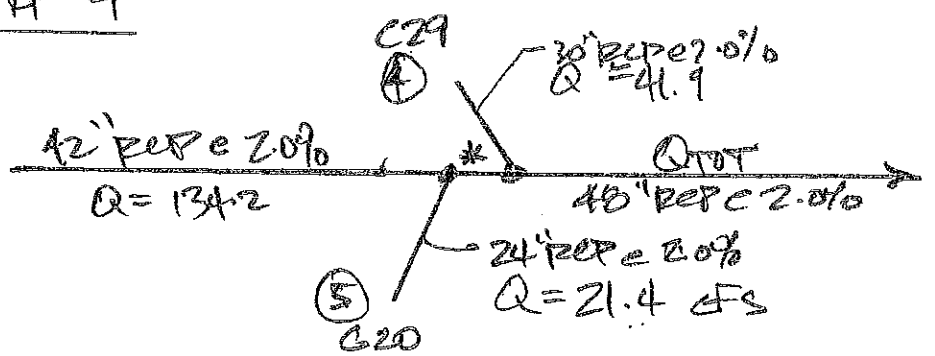
Storm Sewer Schematic to DP 4



$Q_{TOT} = 58.1 + 47 + 29.1 = 134.2$ cfs

42" RCP S 2.0% $Q_{cap} = 142$ cfs ∴ ok

@ DP 4



* $Q_{TOT} = 134.2$ cfs + 21.4 cfs = 155.6 cfs

48" RCP S 2.0% $Q_{cap} = 205$ cfs.

∴ ok

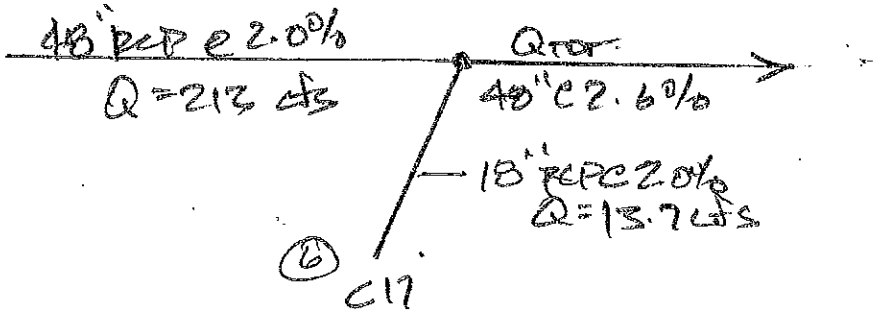
$Q_{TOT} = 155.6 + 41.9 = 197.5$ cfs.

48" RCP ok

Check w/ DP 4 Impoundflow = 210 cfs : 48" puts ok

⑥ SB C17 $Q_5 = 1.5$ cfs $Q_{100} = 13.7$ cfs

18" RCP @ 2.0% $Q_{cap} = 15$ cfs ∴ ok

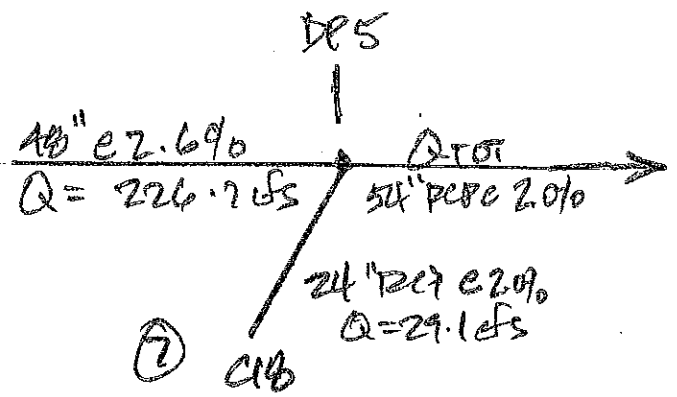


$Q_{TOT} = 213 + 13.7 = 226.7$ cfs

48" @ 2.6% $Q_{cap} = 232$ ∴ ok

⑦ C18 $Q_5 = 15.9$ $Q_{100} = 29.1$ cfs

24" RCP @ 2.0% = 32 cfs ∴ ok



Q_{TOT} w/ Retiming = 226.7 + 29.1 = 255.8 cfs

check DP 5 flow: $Q_{100} = 255.8$ ∴ ok

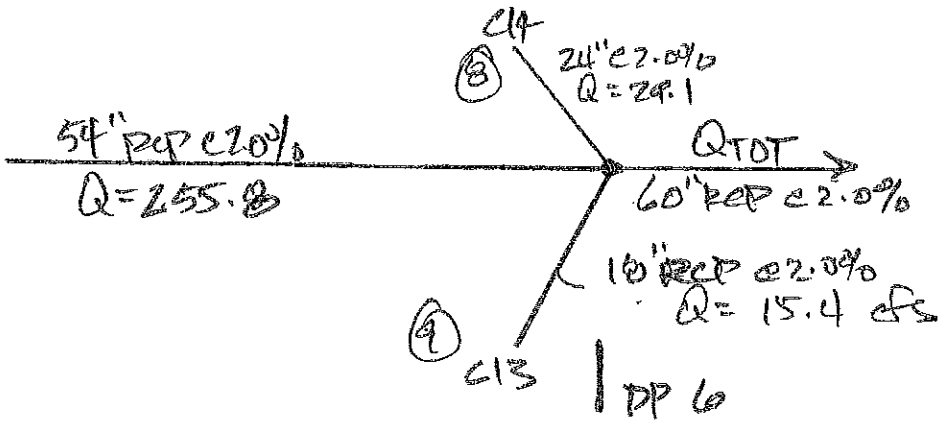
54" RCP @ 2.0% $Q_{cap} = 278$ cfs ∴ ok

(8) SB C14 $Q_5 = 15.4$ cfs $Q_{100} = 29.1$ cfs

24" @ 2.0% $Q_{cap} = 32$ cfs ∴ OK

(9) SB C13 $Q_5 = 8.4$ cfs $Q_{100} = 15.4$ cfs

18" @ 2.0% $Q_{cap} = 15$ cfs ∴ OK



$Q_{TOT} = 255.8 + 29.1 + 15.4 = 300.3$

check w/ DP 6 $Q_{100} = 293.2$ cfs — use

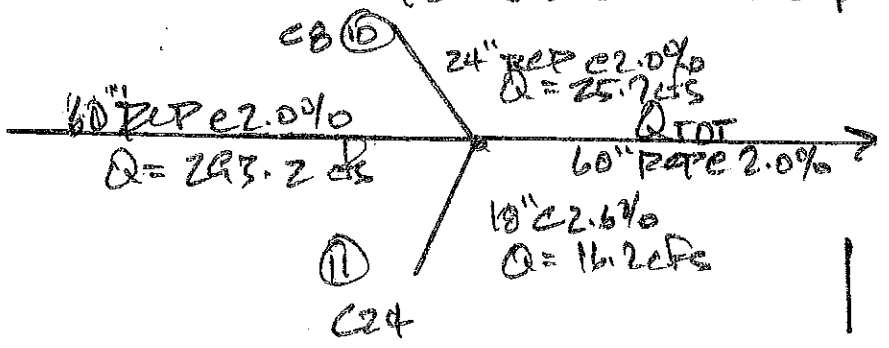
60" RCP @ 2.0% $Q_{cap} = 368$ cfs ∴ OK

(10) C8 $Q_5 = 14.0$ cfs $Q_{100} = 25.7$

24" RCP @ 2.0% $Q_{cap} = 32$ ∴ OK

(11) C24 $Q_5 = 8.9$ cfs $Q_{100} = 16.2$ cfs

18" @ 2.6% $Q_{cap} = 17$ cfs ∴ OK



$Q_{TOT} = 293.2 + 25.7 + 16.2 = 335.1$ cfs

CDP7 $Q = 344.6$

use

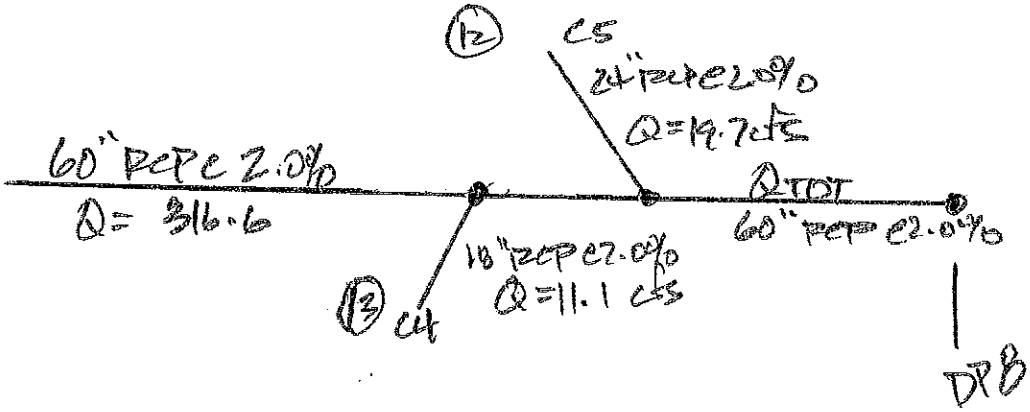
60" RCP @ 2.0%

(12) C5 $Q_5 = 10.8$ cfs $Q_{100} = 19.7$ cfs

24" RCP @ 2.0% $Q_{cap} = 32$ cfs ∴ ok

(13) C4 $Q_5 = 6.1$ cfs $Q_{100} = 11.1$ cfs

18" RCP @ 2.0% $Q_{cap} = 15$ cfs ∴ ok



$Q_{TOT} = 316.6 + 11.1 + 19.7 = 347.4$ cfs

Lumped Flow @ PT B $Q = 346.9$ ← use

60" RCP @ 2.0% ok $Q_{cap} = 348$ cfs

Kiowa Engineering Corporation

CLIENT Cao County JOB NO. 05045 PAGE 1
PROJECT DATE CHECKED DATE 7/10/07
DETAIL CHECKED BY COMPUTED BY RJW

Temporary Detention Basins.

@ DP 1 $Q_{100} = 228.2$ $Q_5 = 121.4$ (ultimate)

Provide Volume for Filing #1 sub-basins only
Future filings will require implementation of upgraded @ Intel site, per Fairlane MDDP

Basins: A11 + A12 + A3 + A5 + A7 + A6 + A4

Area = .41 + .57 + .44 + 2.8 + 1.2 + 4.04 + .51

= 9.92 ac

$C_5 = .90$ $C_{100} = .95$

"Hist" $C_5 = .15$ $C_{100} = .20$

For B-Soils assume .5 cfs/acre historic for 100 year

$\therefore Q_{Ex}(100) = .5(9.9) = 4.45$ cfs

Pre-storm Rate Calculations:

100-YR Reqd Volume = 78,200 cf = 1.8 ac-ft.

5-YR Reqd Volume = 45,040 cf = 1.0 ac-ft

Colorado Crossing
Filing No. 1
Temporary
Detention @ DP1

	100-yr
Drainage Area	*9.90 ac*
Runoff Coef.	*0.95*
Discharge Rate	*4.4 cfs*

Storage (Rational Stored Rate Method):

100-year

t	Intensity	Q	T_c	Volume (in)	Volume (out)	Detention Basin Volume	
5.0 min.	9.0 in/hr	84.6 cfs	300 sec.	25,394 cf	1,320 cf	24,074 cf	0.55 ac-ft
10.0 min.	7.0 in/hr	65.8 cfs	600 sec.	39,501 cf	2,640 cf	36,861 cf	0.85 ac-ft
15.0 min.	5.8 in/hr	54.5 cfs	900 sec.	49,094 cf	3,960 cf	45,134 cf	1.04 ac-ft
20.0 min.	5.2 in/hr	48.9 cfs	1200 sec.	58,687 cf	5,280 cf	53,407 cf	1.23 ac-ft
25.0 min.	4.6 in/hr	43.3 cfs	1500 sec.	64,895 cf	6,600 cf	58,295 cf	1.34 ac-ft
30.0 min.	4.1 in/hr	38.6 cfs	1800 sec.	69,409 cf	7,920 cf	61,489 cf	1.41 ac-ft
35.0 min.	3.7 in/hr	34.8 cfs	2100 sec.	73,077 cf	9,240 cf	63,837 cf	1.47 ac-ft
40.0 min.	3.5 in/hr	32.9 cfs	2400 sec.	79,002 cf	10,560 cf	68,442 cf	1.57 ac-ft
45.0 min.	3.2 in/hr	30.1 cfs	2700 sec.	81,259 cf	11,880 cf	69,379 cf	1.59 ac-ft
50.0 min.	3.0 in/hr	28.2 cfs	3000 sec.	84,645 cf	13,200 cf	71,445 cf	1.64 ac-ft
60.0 min.	2.6 in/hr	24.5 cfs	3600 sec.	88,031 cf	15,840 cf	72,191 cf	1.66 ac-ft
70.0 min.	2.4 in/hr	22.6 cfs	4200 sec.	94,802 cf	18,480 cf	76,322 cf	1.75 ac-ft
80.0 min.	2.2 in/hr	20.7 cfs	4800 sec.	99,317 cf	21,120 cf	78,197 cf	1.80 ac-ft
90.0 min.	2.0 in/hr	18.8 cfs	5400 sec.	101,574 cf	23,760 cf	77,814 cf	1.79 ac-ft

Detention Basin Sizing:

Reqrd Volume	**78,197 cf**
Reqrd Volume	**1.80 ac-ft**

Elevation	Basin Volume	
#REF!	#REF!	#REF!

Colorado Crossing
Filing No. 1
Temporary
Detention Basin @ DP 1
5-year frequency

	5-yr
Drainage Area	*9.90 ac*
Runoff Coef	*0.9*
Discharge Rate	*2.2 cfs*

Storage (Rational Stored Rate Method):

5-year

Time	Intensity	Q	tc	Volume (in)	Volume (out)	Detention Basin Volume	
5.0 min.	5.2 in/hr	46.3 cfs	300 sec.	13,900 cf	660 cf	13,240 cf	0.30 ac-ft
10.0 min.	4.1 in/hr	36.5 cfs	600 sec.	21,919 cf	1,320 cf	20,599 cf	0.47 ac-ft
15.0 min.	3.4 in/hr	30.3 cfs	900 sec.	27,265 cf	1,980 cf	25,285 cf	0.58 ac-ft
20.0 min.	2.9 in/hr	25.8 cfs	1200 sec.	31,007 cf	2,640 cf	28,367 cf	0.65 ac-ft
25.0 min.	2.7 in/hr	24.1 cfs	1500 sec.	36,086 cf	3,300 cf	32,786 cf	0.75 ac-ft
30.0 min.	2.4 in/hr	21.4 cfs	1800 sec.	38,491 cf	3,960 cf	34,531 cf	0.79 ac-ft
35.0 min.	2.2 in/hr	19.6 cfs	2100 sec.	41,164 cf	4,620 cf	36,544 cf	0.84 ac-ft
40.0 min.	1.9 in/hr	16.9 cfs	2400 sec.	40,630 cf	5,280 cf	35,350 cf	0.81 ac-ft
45.0 min.	1.8 in/hr	16.0 cfs	2700 sec.	43,303 cf	5,940 cf	37,363 cf	0.86 ac-ft
50.0 min.	1.7 in/hr	15.1 cfs	3000 sec.	45,441 cf	6,600 cf	38,841 cf	0.89 ac-ft
60.0 min.	1.5 in/hr	13.4 cfs	3600 sec.	48,114 cf	7,920 cf	40,194 cf	0.92 ac-ft
70.0 min.	1.4 in/hr	12.5 cfs	4200 sec.	52,391 cf	9,240 cf	43,151 cf	0.99 ac-ft
80.0 min.	1.3 in/hr	11.6 cfs	4800 sec.	55,598 cf	10,560 cf	45,038 cf	1.03 ac-ft
90.0 min.	1.2 in/hr	10.7 cfs	5400 sec.	57,737 cf	11,880 cf	45,857 cf	1.05 ac-ft

Detention Basin Sizing:

Req'd Volume	**45,038 cf**
Req'd Volume	**1.03 ac-ft**

Elevation	Basin Volume	
#REF!	#REF!	#REF!

@ DP "B" Q_{100} = 346 cfs (ultimate)

Runoff Volume for portions of Filings 1 + 2 only

Basins: B5 + B3 + B6 + B7 + B4 + C18 + C14 + C7 + C21 + C24 + C10 + C17 + C08 + C11 + C12 + C13 + C15 + C16 + C19

"B" = 1.5 + 1.1 + 2.6 + .90 + .9 = 7.0 ac (B-basins)

"C" = 3.4 + 3.4 + .34 + .74 + 1.9 + .42 + 1.6 + .30 + .54 + .36 + .34 + 1.1 + .50 = 14.9 ac (C-basins)

Total B+C = 7.0 + 14.9 = 21.9 acres

Historic 100 year 0.5 cfs/acre for 'B' Soils

Q_{HIST} = 14.9 (.5) = 7.5 cfs

For Storage Rate Method

Vol 100 = 108,800 cf = 2.5 AF

Vol 5 = 61,700 cf = 1.42 AF

Colorado Crossing
Filing No. 1
Temporary
Detention @ DP8

	100-yr
Drainage Area	*14.90 ac*
Runoff Coef	*0.92*
Discharge Rate	*7.5 cfs*

Storage (Rational Stored Rate Method):

100-year

T	Intensity	Q	Tc	Volume (in)	Volume (out)	Detention Basin Volume	
5.0 min.	9.0 in/hr	123.4 cfs	300 sec.	37,012 cf	2,250 cf	34,762 cf	0.80 ac-ft
10.0 min.	7.0 in/hr	96.0 cfs	600 sec.	57,574 cf	4,500 cf	53,074 cf	1.22 ac-ft
15.0 min.	5.8 in/hr	79.5 cfs	900 sec.	71,556 cf	6,750 cf	64,806 cf	1.49 ac-ft
20.0 min.	5.2 in/hr	71.3 cfs	1200 sec.	85,538 cf	9,000 cf	76,538 cf	1.76 ac-ft
25.0 min.	4.6 in/hr	63.1 cfs	1500 sec.	94,585 cf	11,250 cf	83,335 cf	1.91 ac-ft
30.0 min.	4.1 in/hr	56.2 cfs	1800 sec.	101,165 cf	13,500 cf	87,665 cf	2.01 ac-ft
35.0 min.	3.7 in/hr	50.7 cfs	2100 sec.	106,511 cf	15,750 cf	90,761 cf	2.08 ac-ft
40.0 min.	3.5 in/hr	48.0 cfs	2400 sec.	115,147 cf	18,000 cf	97,147 cf	2.23 ac-ft
45.0 min.	3.2 in/hr	43.9 cfs	2700 sec.	118,437 cf	20,250 cf	98,187 cf	2.25 ac-ft
50.0 min.	3.0 in/hr	41.1 cfs	3000 sec.	123,372 cf	22,500 cf	100,872 cf	2.32 ac-ft
60.0 min.	2.6 in/hr	35.6 cfs	3600 sec.	128,307 cf	27,000 cf	101,307 cf	2.33 ac-ft
70.0 min.	2.4 in/hr	32.9 cfs	4200 sec.	138,177 cf	31,500 cf	106,677 cf	2.45 ac-ft
80.0 min.	2.2 in/hr	30.2 cfs	4800 sec.	144,756 cf	36,000 cf	108,756 cf	2.50 ac-ft
90.0 min.	2.0 in/hr	27.4 cfs	5400 sec.	148,046 cf	40,500 cf	107,546 cf	2.47 ac-ft

Detention Basin Sizing:

Reqd Volume	**108,756 cf**
Reqd Volume	**2.50 ac-ft**

Elevation	Basin Volume	
#REF!	#REF!	#REF!

Colorado Crossing
Filing No. 1
Temporary
Detention Basin @ DP 8
5-year frequency

	5-yr
Drainage Area	*14.90 ac*
Runoff Coef.	*0.87*
Discharge Rate	*4.0 cfs*

Storage (Rational Stored Rate Method):

5-year

Tc	Intensity	Q	T	Volume (in)	Volume (out)	Detention Basin Volume	
5.0 min.	5.2 in/hr	67.4 cfs	300 sec.	20,222 cf	1,200 cf	19,022 cf	0.44 ac-ft
10.0 min.	4.1 in/hr	53.1 cfs	600 sec.	31,889 cf	2,400 cf	29,489 cf	0.68 ac-ft
15.0 min.	3.4 in/hr	44.1 cfs	900 sec.	39,667 cf	3,600 cf	36,067 cf	0.83 ac-ft
20.0 min.	2.9 in/hr	37.6 cfs	1200 sec.	45,111 cf	4,800 cf	40,311 cf	0.93 ac-ft
25.0 min.	2.7 in/hr	35.0 cfs	1500 sec.	52,500 cf	6,000 cf	46,500 cf	1.07 ac-ft
30.0 min.	2.4 in/hr	31.1 cfs	1800 sec.	56,000 cf	7,200 cf	48,800 cf	1.12 ac-ft
35.0 min.	2.2 in/hr	28.5 cfs	2100 sec.	59,889 cf	8,400 cf	51,489 cf	1.18 ac-ft
40.0 min.	1.9 in/hr	24.6 cfs	2400 sec.	59,111 cf	9,600 cf	49,511 cf	1.14 ac-ft
45.0 min.	1.8 in/hr	23.3 cfs	2700 sec.	63,000 cf	10,800 cf	52,200 cf	1.20 ac-ft
50.0 min.	1.7 in/hr	22.0 cfs	3000 sec.	66,111 cf	12,000 cf	54,111 cf	1.24 ac-ft
60.0 min.	1.5 in/hr	19.4 cfs	3600 sec.	70,000 cf	14,400 cf	55,600 cf	1.28 ac-ft
70.0 min.	1.4 in/hr	18.1 cfs	4200 sec.	76,222 cf	16,800 cf	59,422 cf	1.36 ac-ft
80.0 min.	1.3 in/hr	16.9 cfs	4800 sec.	80,889 cf	19,200 cf	61,689 cf	1.42 ac-ft
90.0 min.	1.2 in/hr	15.6 cfs	5400 sec.	84,000 cf	21,600 cf	62,400 cf	1.43 ac-ft

Detention Basin Sizing:

Reqd. Volume	**61,689 cf**
Reqd Volume	**1.42 ac-ft**

Elevation	Basin Volume	
#REF!	#REF!	#REF!

Kiowa Engineering Corporation

CLIENT Rampart Communities JOB NO. 05045 PAGE 1
PROJECT DATE CHECKED DATE 7/7/09
DETAIL CHECKED BY COMPUTED BY RJM

Detention Pond 'F'

FT = Fairfax Technology

use Historic or early runoff @ DP10 per FT MDDP.

DP 10 DA = .28 SM

Q_{100} Ex = 110 cfs Q_{5} Ex = 24

DP 10 100 YR Developed = 647 cfs per FT MDDP

Model DTS @ DP 10.

Q_{100} IN = 647 cfs.

Q_{100} OUT = 110 cfs

Q_5 IN = 280

Q_5 OUT = 25 cfs

Discharge constraint @ DP 14 (USAFA)

Q_{100} = 200 cfs

DETENTION POND F:

PER HEC 1:

Pre Pond Volume =

Q_{100}	IN	647	out	108
Q_5	IN	280	out	29

Stage	100-year	=	10.3'
Stage	5-year	=	6.5'

Vol	100-year	=	24.9 AF
Vol	5-year	=	11.5 AF

Impact a Det Aj DP 14 u/s USAFA

	PER FT UDDP	PER Colo Cross-sect FLO
Q_5 in	1820 cfs	558 cfs
Q_5 out	104 cfs	69 cfs
Q_{100} IN	2091 cfs	1478 cfs
Q_{100} out	170 cfs	190 cfs
Stage 5yr	6621.5	6620.5
Stage 100yr	6629.6	6625.8
Vol 5yr	32.5 AF	24.1 AF
Vol 100yr	92.6 AF	72.9 AF
5yr Flow @ USAFA DP 14	109	71
100yr "	170	193

Water Quality Capture DA = 160 Ac

① For Constructed Wetland Basin (CWB)

% Imp. For Basins #3 + #5

85%

Assume 24 hr Drain Time.

$WQCV = a(.91i^3 - 1.19i^2 + .78i)$

$a = .9$ for 24 hr

$\therefore WQCV = .9(.91(.85)^3 - 1.19(.85)^2 + .78(.85))$

$= .9(.56 - .86 + .66)$

$= .32''$

$DV = \left(\frac{.32}{12}\right) \cdot 160$ Acres $=$ 4.3 AF

② For Extend Det. Basin. (EDB)

% IMP = 85% Drain time = 40 hrs.

$WQCV = .36''$

$DV = \left(\frac{WQCV}{12}\right) A \times 1.2 = \left(\frac{.36}{12}\right)(160)1.2 =$ 5.8 AF

Kiowa Engineering Corporation

CLIENT Colo Crossing JOB NO. 05045 PAGE 1/2
PROJECT DATE CHECKED DATE 11/2/07
DETAIL MDDP / FDR E1/E2 CHECKED BY COMPUTED BY DJO

Cost Sharing: Detention Basin EK-1A

Total Cost per Closeic

$ 332,017.48

Percent ownership by Colo. Crossing

68.2%

∴ Cost Share .682 (332017.48)

= $226,435.92