Q.S. # 65
HTE: 07-2047

OPTIMUS
CIVIL DESIGN GROUP

FINAL DRAINAGE REPORT
for
Canyon Trails Towne Center

Optimus Project #031039
January 2008

2/11/08 KR

Prepared by:

Optimus Civil Design Group
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Phoenix, Arizona 85034

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1.0 Scope

The objectives of this preliminary drainage report are:

1. To research and identify the current offsite drainage impacts associated with the property.

2. To determine the hydrologic and hydraulic conditions for the proposed development.

3. To create a drainage concept which adequately conveys site-generated discharges and offsite flow through and/or around the parcel in accordance with City of Goodyear and Maricopa County drainage design standards.

4. To ensure that proposed finish floor elevations are free from the 100-year storm event in accordance with City of Goodyear and Maricopa County drainage design standards.

This study has been performed utilizing an aerial-generated topography map and field reconnaissance conducted by Optimus Civil Design staff. This preliminary drainage report was prepared in accordance with the current City of Goodyear and Maricopa County Floodplain Ordinance, design criteria, regulations, and policies.

2.0 Site Location

The project site is located on the northeast corner of Yuma Road and Cotton Lane in the City of Goodyear, Arizona. Please see Figure 1 for a Vicinity Map.

More specifically, the project site is located within the west half of Section 12, Township 1 North, Range 2 West, of the Gila and Salt River Base and Meridian, Maricopa County, Arizona.

3.0 Description and Proposed Development

The project site is currently undeveloped farm land as shown on the Aerial Map on Figure 2 of this report. The natural ground is relatively flat with varying slopes from North to South of approximately 0.50%. The project site has a total net area of approximately 91 acres and is proposed to be developed as a commercial center. Underground storage tanks and retention basins will be used to retain 100% of the runoff generated from the 100-year, 6-hour storm within its developed boundary. Runoff from the outlot pads will be incorporated into the master site retention facilities, and shall therefore not be required to provide for additional retention facilities at the time of the development of the pad. The offsite drainage design associated with this site includes routing existing half-street offsite flows from the adjacent roadways (Yuma Road and Canyon Trails Boulevard) through curb openings and catch basins into the proposed onsite retention facilities. Runoff generated within the proposed half street right of way for Cotton Lane will be stored within four 1' deep aesthetically contoured retention basins located within the right of way. Runoff generated within the north side of Canyon Trails Boulevard will be stored within a temporary retention basin on the north side of the roadway. These basins will be installed as part of the offsite improvements under separate contract from the onsites. The discharge from the south side of Yuma Road will pass into the existing parcels to the south through curb inlets designed to duplicate existing conditions. The proposed procedures and methodologies used within this report are consistent with the latest

rules and regulations adopted by the City of Goodyear. Please see Figure 4 for the Proposed Drainage Exhibit depicting the proposed development.

4.0 FIRM Classification

The Maricopa County, Arizona and Incorporated Area Flood Insurance Rate Map (FIRM) map number 04103C2060 F, panel 2060 of 4350, dated July 19, 2001 and (FIRM) map number 04103C2070 G, panel 2070 of 4350, dated July 19, 2001 shows that the project site is located within the "shaded" Zone X flood hazard. The "shaded" Zone X is defined by FEMA as: areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, and areas protected by levees from 100-year flood. Figure 3 shows the project location depicted on the FIRM.

5.0 Offsite Drainage

5.1 OFFSITE HYDROLOGY

The natural topography for the project site flows from the north to the south at approximately 0.5% slope. In the interim condition, the majority of the offsite flows in the Canyon Trails Master planned Community that would have originally affected the site are directed to the Canyon Trails regional channel system. A series of diversion channels have been constructed along Van Buren Street to redirect upstream flows into this channel. According to the "Canyon Trails Master Drainage Study Update", prepared by Coe & Van Loo all off-site flows will be directed to this channel system and will not affect the Canyon Trails Towne Center site when the community is fully developed. The Canyon Trails Towne Center site is bounded on the east side by an approximately 100 ft. wide channel which is part of this system. All runoff from the east is intercepted by an existing regional drainage channel, and flows do not enter the site from the south due to the existing topography of the land which is toward the south direction. Depressed curb inlets will be installed at

approximately 20' on center on the south side of Yuma road to reproduce the existing pavement flows condition along Yuma Road. The site is protected by existing runoff for the 10-year storm from the north and west by the installation of curb and gutter on both Canyon Trails Boulevard and Cotton Lane along with the drainage conveyance and retention facilities designed to accept these flows. During the 100-year storm, excess runoff generated from the parcel north of the site sheet flows into the Canyon Trails Boulevard right of way. The existing low point for the roadway occurs near the middle of the site, so the proposed catch basin and storm drain on the south side of the road has been designed to accept these flows and route them through the onsite retention system for the interim condition (see Appendix D). Should this runoff ever reach the site, it will be routed through the offsite catch basin and into retention basin A1. The flows will then travel from basin to basin in an overflow condition within the series of retention basins in the rear of the in-line majors. The ultimate outfall is back into the Yuma Road right of way. This project will provide temporary retention basins to collect the east half Cotton Lane Street run-off in the future Loop 303 right-of-way area which will otherwise be left undeveloped at this time. No curbing is proposed on the east half of Cotton, so these flows will remain unchanged from existing conditions. A temporary retention basin is proposed on the north side of Canyon Trails Boulevard to collect the runoff within the north half street. The developer is in negotiations with the current landowner to procure a temporary drainage easement until the north parcel is developed.

6.0 Onsite Drainage

All onsite overland and sheet flow drainage facilities have been sized for the 10-year event per the rational method. A runoff coefficient of 0.95 was chosen to represent the proposed site conditions in the calculations. The rainfall intensity was retrieved from Figure 3.2 of the Maricopa County Drainage Design Manual, Volume I which calculates to 4.5" for the 10-year storm (see Appendix B).

All overland drainage facilities (catch basins and curb inlets) are sized for the 10-year event per the Rational Method and the standard weir equation for both curb inlet and grated inlet structures (see Appendix B). Reduction factors of 0.8 and 0.5 respectively were applied for curb inlets and grated inlets. Depressed curb inlets with

grouted riprap erosion protection will be used wherever possible to reduce construction and maintenance costs.

The onsite and offsite stormdrain pipes will be sized under a pressure flow situation due to the fact that the pipes outlet into retention basins, and will function under a submerged outlet situation under most conditions. The pipes were sized using a friction slope analysis, and the design incorporates junction and pipe friction losses to ensure that the upstream hydraulic grade line does not exceed the grate of the catch basin during the 10-year event wherever possible (see Appendix C). The H.G.L. exceeds the grate at two locations. The H.G.L. exceeds the grate elevation by 0.06 feet at catch basin #68 and by 0.29 feet at catch basin #76 which are in a secluded region of the parking field. This occurs due to the fact that the storm drain lines are bucking grade in order to flow into retention basin A1. The depth is in each instance is less than 6", which is an acceptable ponding depth in Maricopa County. It should be noted that this is the worst case H.G.L. for the 10-year event, and only would occur for a few seconds at the very peak of this storm event. Under no conditions will there be standing water after this brief peak has passed, nor after the basins are at capacity for the 100-year, 6-hour storm unless an extraordinary storm event is witnessed. The outlet retention facilities are assumed to be 65% full during the 10-year peak flow condition for the stormdrain design. See the intensity ratio analysis contained in Appendix C for tail water depth calculations.

Onsite storm water storage will be provided in several proposed retention basins and underground storage tanks (see Figures 4 and 5) to accommodate the storm runoff volume of the 100-year, 6-hour storm. Appendix A includes retention calculations for each retention basin that are designed for this development as well as an infiltration/drywell analysis. Retention basins A-H will drain within the required 36 hour time period by means of natural ground infiltration and drywells, where required. A reduction factor of 50% was factored into the site percolation rates which equates to a ground infiltration depth of 2.35' (see Appendix A). The remaining depth of retention volume is drained via drywells. 18" bleed-off storm drain pipes are provided for retention basins C, D and E which outlet into the regional drainage channel east of the site. Check valves will be installed at the outlets of these pipes to ensure that the water from the channel does not backup into the retention basins during the peak flow event. The onsite ends of the pipes are capped for the interim until the channel is completed to the ultimate build-out condition. Per the

requirements of the City of Goodyear, a wrought iron fence will be installed around the perimeter of all retention basins that exceed 3' in depth in order to prevent the public from entering the retention basin. Underground retention network I is percolated by means of Maxwell Plus drywell units. Per the request of the City of Goodyear staff, an additional 25% was added as a factor of safety to account for sedimentation and decreasing effectiveness of the drywell percolation. All surface runoff will be conveyed to the retention facilities by surface flow and collection through catch basins and conveyed through underground storm drain pipes.

At the request of the Anchor C tenant, Retention basin A was separated from retention basin B in order to separate the runoff within the parcel of Anchor C from the remainder of the site, wherever possible. Runoff from drainage area A travels through storm drain networks and depressed curb inlets into the proposed retention basins A1 and A2. Runoff from the south half street of Canyon Trails Boulevard is included in the retention calculations as well. The basins are equalized by means of a 24" storm drain pipe with a common 100-year high water elevation of 74.50. Basin A1 is 3' deep with 4:1 sideslopes. Basin A2 is designed at 4' deep with 4:1 sideslopes. A proposed retaining wall located on the east side of the basin provides for additional retention volume as well as protection of the proposed 30" R.I.D. irrigation pipe. Two Maxwell Plus drywell units are attached to the bubbler catch basins to drain any water remaining in the storm drain network which is below the bottom of the basin floor elevation. A total of 141,927 c.f. is provided to retain an anticipated volume of 141,922 c.f.

Runoff from drainage area B travels through a storm drain network and depressed curb inlet into the proposed retention basin B. Basin B is 4' deep with 4:1 sideslopes and a high water of 74.50. A proposed retaining wall located on the east side of the basin provides for additional retention volume as well as protection of the proposed 30" R.I.D. irrigation pipe, the same as retention basin A2. A single Maxwell Plus drywell units will assist in percolating the remaining volume beyond the capacity of the ground infiltration (see Appendix A). A total of 76,094 c.f. is provided to retain an anticipated volume of 71,328 c.f. (including 42,091 c.f. of excess/overflow from retention basin C, see Appendix A).

Retention basin C provides 20,924 c.f. of volume for an anticipated runoff volume of 63,014 c.f. (see Appendix A). The remainder of the runoff (42,091 c.f.) will travel

into retention basin B which has been sized to retain the additional volume. The runoff passes into retention basin B through a riprap lined spillway after the high water reaches an elevation of 75.50. The basin is 3' deep with 4:1 sideslopes, and has a high water elevation of 75.50. A single Maxwell Plus drywell unit will assist in percolating the remaining volume beyond the capacity of the ground infiltration (see Appendix A). Runoff travels into the basin by sheet flow through depressed curb inlets.

Retention basin D provides for 99,629 c.f. of volume for an anticipated runoff volume of 96,246 c.f. (see Appendix A). The runoff within drainage area D passes into the basin through proposed depressed curb inlets. The basin is 5.5' deep with 4:1 sideslopes, and has a high water elevation of 69.00. Two Maxwell Plus drywell units will assist in percolating the remaining volume beyond the capacity of the ground infiltration (see Appendix A).

Runoff from drainage area E travels through a storm drain network as well as depressed curb inlets into the proposed retention basins E1, E2 and E3. Runoff from the north half of a portion of Yuma Road is included in the retention calculations as well. The basins are equalized by means of 24" storm drain pipes. The basins share a common high water elevation of 67.00. Both basins are three feet deep and are designed with a 4:1 sideslope (6:1 adjacent to pedestrian access). A single Maxwell Plus drywell unit will assist in percolating the remaining volume beyond the capacity of the ground infiltration (see Appendix A). A total of 55,255 c.f. is provided to retain an anticipated volume of 53,630 c.f. (see Appendix A).

Runoff from onsite drainage area F travels through depressed curb inlets into the proposed retention basins F1 and F2. The basins are equalized by means of proposed an 18" stormdrain equalizer pipe. The basins share a common high water elevation of 66.00. All three basins are three feet deep and are designed with a 4:1 sideslope (6:1 adjacent to pedestrian access). A single Maxwell Plus drywell unit will assist in percolating the remaining volume beyond the capacity of the ground infiltration (see Appendix A). A total of 43,858 c.f. is provided to retain an anticipated volume of 43,851 c.f. (see Appendix A).

Offsite retention basin G provides for 57,590 c.f. of volume for an anticipated runoff volume of 28,114 c.f. (see Appendix A). The runoff within drainage area G passes

into the basin by means of sheet flow for the landscape region and through a proposed scupper and depressed curb inlet. All of the runoff contributing to retention basin G is generated within the Cotton Lane right of way as well as the north half of Yuma Road. The contoured basin is 1' deep with 4:1 maximum sideslopes (6:1 adjacent to pedestrian access), and has a high water elevation of 63.50. Since the basin is less than 2.35' deep, it will percolate by means of natural ground infiltration.

Offsite retention basin H provides for 27,782 c.f. of volume for an anticipated runoff volume of 23,410 c.f. (see Appendix A). The runoff within drainage area H passes into the basin by means of sheet flow for the landscape region and through a proposed scupper along Cotton Lane. All of the runoff contributing to retention basin H is generated within the Cotton Lane right of way. The contoured basin is 1' deep with 4:1 maximum sideslopes (6:1 adjacent to pedestrian access), and has a high water elevation of 69.50. Since the basin is less than 2.35' deep, it will percolate by means of natural ground infiltration.

Onsite discharges flow into underground retention network I through storm drain lines as well as grated inlets placed directly above the pipes. The north half street runoff for a portion of Yuma Road is included in the retention volume provided. A total of 6,388 feet of 10' diameter underground pipes arranged in six individual rows provides for 501,714 c.f. of retention volume. Each pipe is equalized by means of bottom tangent 36" pipes at each end of the storage tanks. Drainage area I produces 501,672 c.f. of runoff during the 100 year, 6-hour storm event. Twenty Maxwell Plus drywell units are provided to drain the retention network within 36 hours (see Appendix A).

Offsite retention basin J provides for 35,941 c.f. of volume for an anticipated runoff volume of 16,974 c.f. (see Appendix A). The runoff within drainage area J passes into the basin by means of sheet flow for the landscape region and through a proposed depressed curb inlet within one of the proposed driveway entrances. All of the runoff contributing to retention basin J is generated within the Cotton Lane right of way. The contoured basin is 1' deep with 4:1 maximum sideslopes (6:1 adjacent to pedestrian access), and has a high water elevation of 73.50. Since the basin is less than 2.35' deep, it will percolate by means of natural ground infiltration.

Offsite retention basin K provides for 18,349 c.f. of volume for an anticipated runoff volume of 16,817 c.f. (see Appendix A). The runoff within drainage area K passes

into the basin by means of sheet flow for the landscape region and through a proposed scupper along Cotton Lane. All of the runoff contributing to retention basin K is generated within the Cotton Lane right of way. The contoured basin is 1' deep with 4:1 maximum sideslopes (6:1 adjacent to pedestrian access), and has a high water elevation of 76.50. Since the basin is less than 2.35' deep, it will percolate by means of natural ground infiltration.

Offsite retention basin L provides for 11,495 c.f. of volume for an anticipated runoff volume of 9,094 c.f. (see Appendix A). The runoff within drainage area L passes through a proposed scupper along Canyon Trails Boulevard. All of the runoff contributing to retention basin L is generated within the Canyon Trails Bouleard right of way. The basin is 3' deep with 6:1 maximum sideslopes, and has a high water elevation of 73.30.

All of the runoff generated by the various future outlot pads along Yuma Road and Cotton Lane is included in the calculations for retention requirements, so these pads will not have to provide additional retention provisions.

The ultimate outfall from the site for an extreme storm will occur at the southwest corner of the site at an approximate elevation of 966.00.

7.0 Summary and Conclusions

The 100 year, 6-hour storm event will be retained on-site for this project in accordance with the City of Goodyear requirements. The 100 year, 6-hour event run-off for the half streets of Yuma Road and Canyon Trails Boulevard will be conveyed to the on-site retention system. Conveyance of the run-off to these facilities will be accomplished using catch basins and storm drain pipes in combination with surface flow. (see Figure 4 for the Proposed Peak Flow Map).

According to the "Canyon Trails Master Drainage Study Update", prepared by Coe & Van Loo all off-site flows will be directed to the Canyon Trails channel system and will not affect the Canyon Trails Towne Center site when fully developed.

8.0 References

1. City of Goodyear Code of Ordinances

2. City of Goodyear Guideline Manual

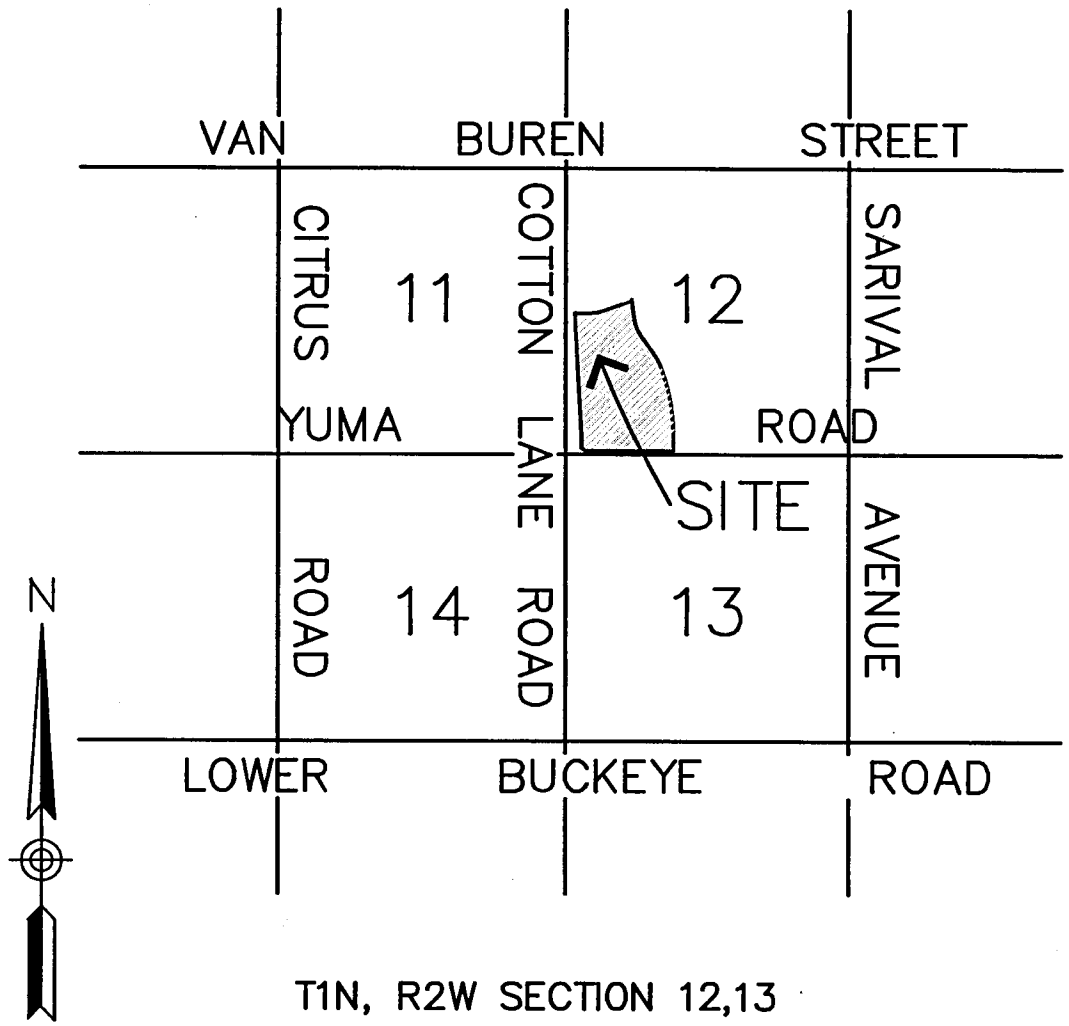
3. City of Goodyear Engineering Design Standards and Policy Manual

4. Drainage Design Manual for Maricopa County, Arizona, Volume 1 Hydrology, January 1, 1995.

5. Drainage Design Manual for Maricopa County, Arizona, Volume 2 Hydraulics, January 28, 1996.

FIGURES

Subject: CANYON TRAILS TOWNE CENTER **Job No:** 031039



T1N, R2W SECTION 12,13
VICINITY MAP
N.T.S.

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FIGURE 1
VICINITY MAP

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Prepared By: EDS **Date:** 5/25/06 **Checked By:** EDS **Sheet No:** 1 **Of** 1

Subject: CANYON TRAILS TOWNE CENTER **Job No.:** 031039

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FIGURE 2
AERIAL PHOTO MAP

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Prepared By: CDU **Date:** 5/25/06 **Checked By:** JDB **Sheet No.:** 1 **Of** 1

Subject: CANYON TRAILS TOWNE CENTER

Job No: 031039

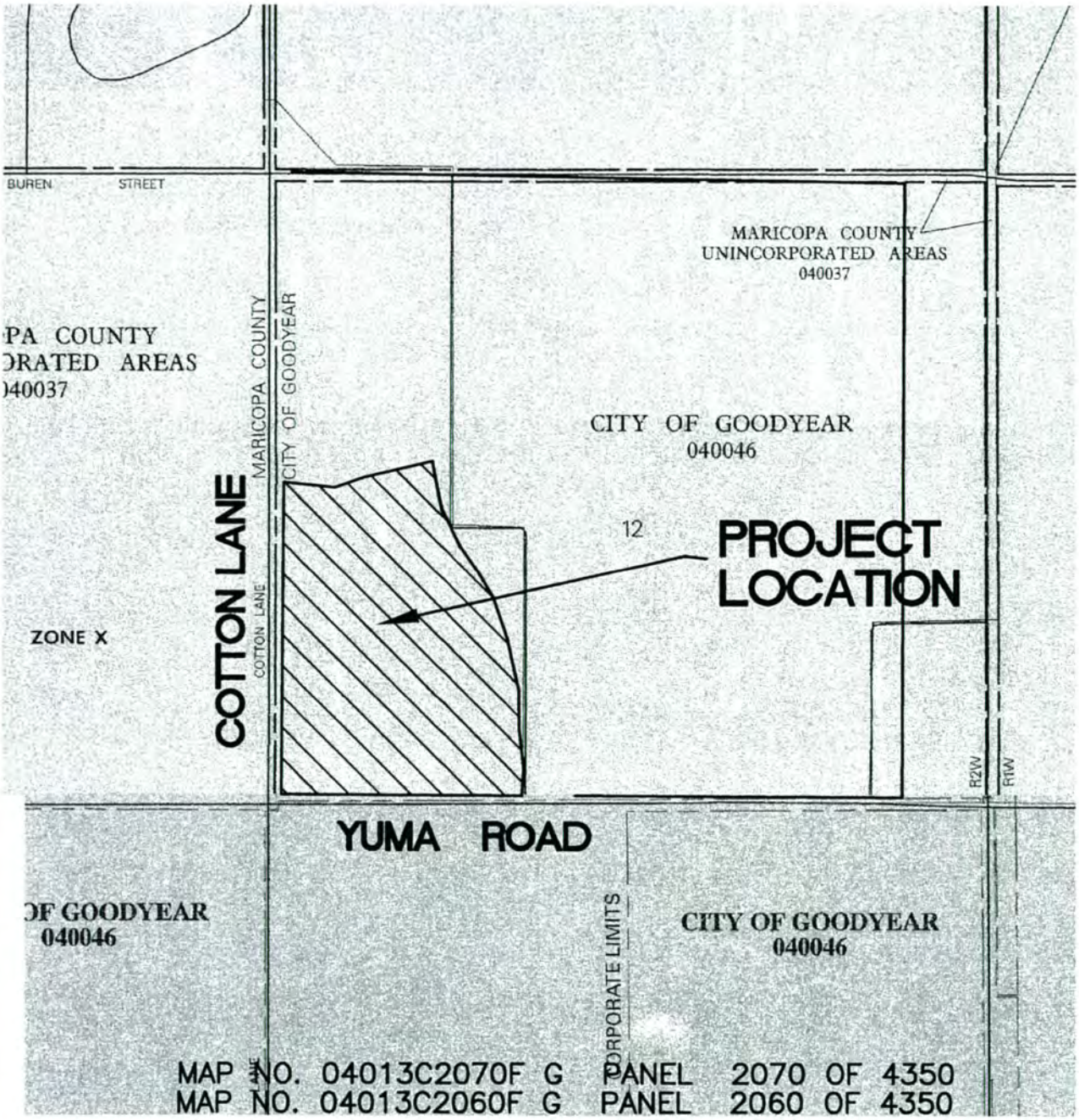

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FIGURE 3
FIRM MAP

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Prepared By: CDU **Date:** 5/25/06 **Checked By:** JDB **Sheet No:** 1 **Of** 1

PEAK DISCHARGE CALCULATIONS

PEAK DISCHARGE PER MARICOPA COUNTY FLOOD CONTROL DISTRICT
DISCHARGE = C * I * A
WHERE: C = RUNOFF COEFFICIENT = 0.95 – COMMERCIAL
I = RAINFALL INTENSITY: 10–YEAR STORM = 4.50"/HR.
A = AREA (ACRES)

DRAINAGE AREA\PEAK FLOW INFORMATION

DRAINAGE AREA	AREA	Q_{10}
49	0.77 A.C.	3.29
50	0.88 A.C.	3.78
51	0.78 A.C.	3.33
52	0.83 A.C.	3.55
53	1.27 A.C.	5.43
54	1.59 A.C.	6.80
55	0.41 A.C.	1.75
56	0.59 A.C.	2.52
57	0.60 A.C.	2.57
58	0.66 A.C.	2.82
59	0.58 A.C.	2.48
60	0.60 A.C.	2.57
61	0.60 A.C.	2.57
62	0.66 A.C.	2.82
63	0.42 A.C.	1.80
64	0.67 A.C.	2.86
65	1.05 A.C.	4.49
66	0.59 A.C.	2.52
67	0.29 A.C.	1.24
68	0.51 A.C.	2.18
69	0.58 A.C.	2.48
70	0.60 A.C.	2.57
71	0.58 A.C.	2.48
72	0.64 A.C.	2.74
73	0.47 A.C.	2.00
74	1.22 A.C.	5.22
75	0.92 A.C.	3.93
76	0.34 A.C.	1.45
77	0.95 A.C.	4.06
78	0.56 A.C.	2.39
79	0.44 A.C.	1.88
80	0.11 A.C.	0.47
81	0.06 A.C.	0.26
82	0.06 A.C.	0.26
83	0.40 A.C.	1.71
84	0.15 A.C.	0.64
85	1.05 A.C.	3.20
86	1.13 A.C.	4.8
87	1.28 A.C.	5.47
88	0.96 A.C.	4.10
89	0.69 A.C.	2.95
90	0.73 A.C.	3.12
91	0.70 A.C.	2.99
92	0.43 A.C.	1.84
93	1.21 A.C.	5.17
106	0.07 A.C.	0.30
107	0.43 A.C.	1.84
108	0.50 A.C.	2.14
110	0.17 A.C.	0.73
111	0.38 A.C.	1.62
112	1.09 A.C.	4.66
115	0.56 A.C.	2.39
116	0.54 A.C.	2.29
119	0.68 A.C.	2.91

SYMBOL LEGEND

- (X) DRAINAGE AREA DESIGNATOR
- [#] CATCH BASIN DESIGNATOR
- (X) CURB OPENING DESIGNATOR
- ◇X◇ STORMDRAIN SEGMENT NUMBER

N

80 40 0 40 80 160
SCALE IN FEET 1"=80'

NO.	REVISION	DATE

CANYON TRAILS TOWNE CENTER
PROPOSED PEAK FLOW MAP

PREPARED FOR
VESTAR DEVELOPMENT COMPANY
2425 E. CAMELBACK RD. ST# 750
PHOENIX, AZ 85016

Registered Professional Engineer
CERTIFICATE
38800
ADAM J.
RAUSCHER
Date Signed 11-2-07
ARIZONA U.S.A.

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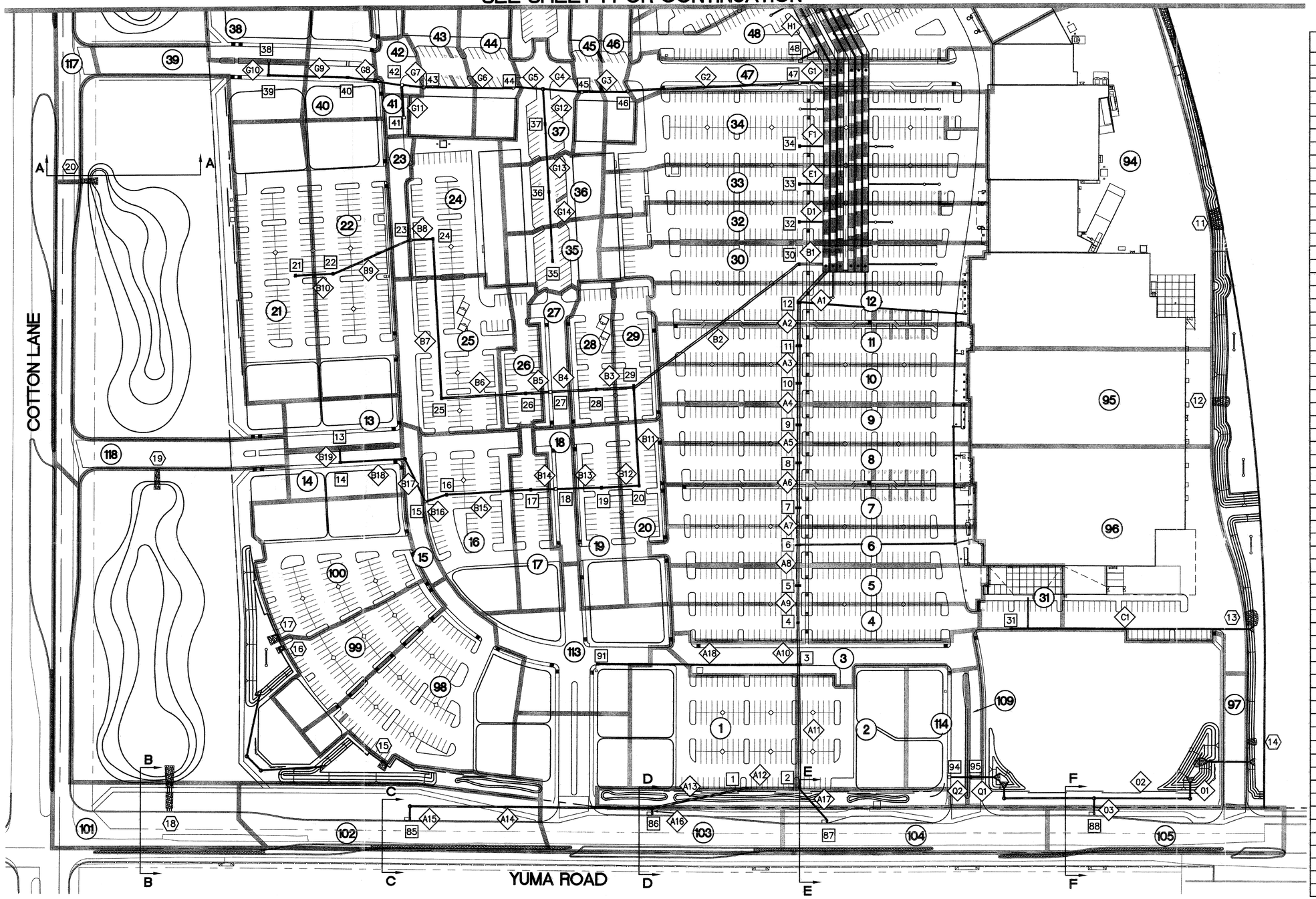
DESIGNED:	AJR
DRAWN:	JS
CHECKED:	AJR
DATE:	03/02/07
JOB NO.:	031039

DRAWING NO
FIGURE 4
1 OF 2

SEE SHEET 1 FOR CONTINUATION



DRAINAGE AREA\ PEAK FLOW INFORMATION

DRAINAGE AREA	AREA	Q_{10}
1	1.27 A.C.	5.43
2	0.81 A.C.	3.46
3	0.63 A.C.	2.69
4	0.70 A.C.	2.99
5	0.81 A.C.	3.46
6	0.81 A.C.	3.46
7	0.81 A.C.	3.46
8	0.81 A.C.	3.46
9	0.79 A.C.	3.38
10	0.79 A.C.	3.38
11	0.83 A.C.	3.55
12	0.83 A.C.	3.55
13	0.38 A.C.	1.62
14	0.37 A.C.	1.58
15	0.19 A.C.	0.81
16	0.96 A.C.	4.10
17	0.43 A.C.	1.84
18	0.24 A.C.	1.03
19	0.53 A.C.	2.27
20	0.50 A.C.	2.14
21	1.33 A.C.	5.69
22	1.43 A.C.	6.11
23	0.19 A.C.	0.81
24	0.85 A.C.	3.63
25	1.06 A.C.	4.53
26	0.30 A.C.	1.28
27	0.28 A.C.	1.20
28	0.40 A.C.	1.71
29	0.39 A.C.	1.67
30	0.93 A.C.	3.98
31	0.33 A.C.	1.41
32	0.97 A.C.	4.15
33	0.95 A.C.	4.06
34	1.75 A.C.	7.48
35	0.36 A.C.	1.67
36	0.43 A.C.	1.84
37	0.42 A.C.	1.80
38	0.36 A.C.	1.54
39	0.54 A.C.	2.31
40	0.52 A.C.	2.22
41	0.07 A.C.	0.30
42	0.15 A.C.	0.64
43	0.52 A.C.	2.22
44	0.44 A.C.	1.88
45	0.29 A.C.	1.24
46	0.27 A.C.	1.15
47	0.81 A.C.	3.46
48	1.70 A.C.	7.27
94	4.62 A.C.	19.75
95	1.52 A.C.	6.50
96	2.76 A.C.	11.80
97	0.20 A.C.	0.86
98	1.47 A.C.	6.28
99	0.68 A.C.	2.91
100	1.21 A.C.	5.17
101	1.23 A.C.	5.26
102	1.44 A.C.	6.16
103	1.49 A.C.	6.40
104	0.99 A.C.	4.23
105	0.89 A.C.	3.80
109	0.10 A.C.	0.43
113	1.00 A.C.	4.28
114	0.49 A.C.	2.09
117	0.68 A.C.	2.91
118	0.77 A.C.	3.29

SYMBOL LEGEND

- (X) DRAINAGE AREA DESIGNATOR
- [#] CATCH BASIN DESIGNATOR
- ⟨X⟩ CURB OPENING DESIGNATOR
- ◇X◇ STORMDRAIN SEGMENT NUMBER

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N

80 40 0 40 80 160
SCALE IN FEET 1"=80'

NO.	REVISION	DATE

CANYON TRAILS TOWNE CENTER
PROPOSED PEAK FLOW MAP

PREPARED FOR
VESTAR DEVELOPMENT COMPANY
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PHOENIX, AZ 85016

OPTIMUS
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DESIGNED:	AJR
DRAWN:	JS
CHECKED:	AJR
DATE:	03/02/07
JOB NO.:	031039

DRAWING NO

FIGURE 4

2 OF 2

REQUIRED RETENTION CALCULATIONS

MARICOPA COUNTY 100-YEAR, 2-HOUR STORM
VOLUME REQUIRED = A * P/12 * C
WHERE: A = AREA (S.F.)
P = 100-YEAR, 6-HOUR RAINFALL = 3.0"
C = RUNOFF COEFFICIENT
= 0.90-COMMERCIAL
= 0.50-COTTON LANE R/W

AREA A
VOLUME REQUIRED = 630,766 * (3.0/12) * 0.90
= 141,922 CF

AREA B
VOLUME REQUIRED = 129,921 * (3.0/12) * 0.90
= 29,237 CF + 43,145 CF (D.A.C)
= 72,382 CF 3

AREA C
VOLUME REQUIRED = 280,063 * (3.0/12) * 0.90
= 63,014 CF

AREA D
VOLUME REQUIRED = 427,760 * (3.0/12) * 0.90
= 96,246 CF

AREA E
VOLUME REQUIRED = 238,357 * (3.0/12) * 0.90
= 53,630 CF

AREA F
VOLUME REQUIRED = 194,892 * (3.0/12) * 0.90
= 43,851 CF

AREA G
VOLUME REQUIRED = 224,914 * (3.0/12) * 0.50
= 28,114 CF

AREA H
VOLUME REQUIRED = 187,277 * (3.0/12) * 0.50
= 23,410 CF

AREA I
VOLUME REQUIRED = 2,229,655 * (3.0/12) * 0.90
= 501,672 CF

AREA J
VOLUME REQUIRED = 135,793 * (3.0/12) * 0.50
= 16,974 CF

AREA K
VOLUME REQUIRED = 134,536 * (3.0/12) * 0.50
= 16,817 CF

AREA L
VOLUME REQUIRED = 40,416 * (3.0/12) * 0.90
= 9,094 CF

RETENTION BASIN G
DEPTH = 1.0', BOTT. = 62.50, H.W. = 63.50
VOLUME REQUIRED = 28,114 C.F.
VOLUME PROVIDED = 57,590 C.F.

RETENTION BASIN H
DEPTH = 1.0', BOTT. = 69.50, H.W. = 70.50
VOLUME REQUIRED = 23,410 C.F.
VOLUME PROVIDED = 27,782 C.F.

RETENTION BASIN J
DEPTH = 1.0', BOTT. = 72.50, H.W. = 73.50
VOLUME REQUIRED = 16,974 C.F.
VOLUME PROVIDED = 35,941 C.F.

RETENTION BASIN K
DEPTH = 1.0', BOTT. = 75.50, H.W. = 76.50
VOLUME REQUIRED = 16,817 C.F.
VOLUME PROVIDED = 18,349 C.F.

COTTON LANE

RETENTION BASIN F1
DEPTH = 3.0', BOTT. = 63.00, H.W. = 66.00
VOLUME REQUIRED = 43,851 C.F.
VOLUME PROVIDED = 23,764 C.F.
COMBINED VOLUME PROVIDED = 43,858 C.F.

RETENTION BASIN F2
DEPT = 3.0', BOTT. = 63.00, H.W. = 66.00
VOLUME REQUIRED = 43,851 C.F.
VOLUME PROVIDED = 20,094 C.F.
COMBINED VOLUME PROVIDED = 43,858 C.F.

RETENTION BASIN L
DEPTH = 3.0', BOTT, = 70.30, H.W. = 73.30
VOLUME REQUIRED = 9,094 C.F.
VOLUME PROVIDED = 9,467 C.F.

RETENTION BASIN A1
DEPTH = 3.0', BOTT, = 71.50, H.W. = 74.50
VOLUME REQUIRED = 141,922 C.F.
VOLUME PROVIDED = 13,225 C.F.
COMBINED VOLUME PROVIDED = 141,927 C.F.

CANYON TRAILS BLVD.

UNDRGROUND RETENTION NETWORK I
6,388 L.F OF 10'ø STORAGE PIPE
VOLUME REQUIRED = 501,672 C.F.
VOLUME PROVIDED = 501,714 C.F.

YUMA ROAD

RETENTION BASIN A2
DEPTH = 4.0', BOTT. = 70.50, H.W. = 74.50
VOLUME REQUIRED = 141,922 C.F.
VOLUME PROVIDED = 128,703 C.F.
COMBINED VOLUME PROVIDED = 141,927 C.F.

RETENTION BASIN B
DEPTH=4.0', BOTT.=70.50, H.W.=74.50
VOLUME REQUIRED = 71,328 C.F.
VOLUME PROVIDED = 72,382 C.F.

RETENTION BASIN C
DEPTH = 3.0', BOTT. = 72.50, H.W. = 75.50
VOLUME REQUIRED = 63,014 C.F.
VOLUME PROVIDED = 19,869 C.F.
EXCESS VOLUME TO RETENTION
BASIN B = 43,145 C.F. 3

RETENTION BASIN E3
DEPTH = 3.0',BOTT. = 64.00, H.W. = 67.00
VOLUME REQUIRED = 53,630 C.F.
VOLUME PROVIDED = 2,923 C.F.
COMBINED VOLUME PROVIDED = 55,255 C.F.

RETENTION BASIN E2
DEPTH = 5.0', BOTT.=62.00, H.W.=67.00
VOLUME REQUIRED = 53,630 C.F.
VOLUME PROVIDED = 12,091 C.F.
COMBINED VOLUME PROVIDED = 55,255 C.F.

RETENTION BASIN E1
DEPTH = 3.0', BOTT. = 64.00, H.W.= 67.00
VOLUME REQUIRED = 53,630 C.F.
VOLUME PROVIDED = 40,241 C.F.
COMBINED VOLUME PROVIDED = 55,255 C.F.

RETENTION BASIN D
DEPTH = 5.5', BOTT. = 63.50, H.W.= 69.00
VOLUME REQUIRED = 96,246 C.F.
VOLUME PROVIDED = 98,684 C.F. 3

LEGEND

X — RETENTION BASIN AREA DESIGNATOR

DRAINAGE AREA BOUNDARY

X — APPROXIMATE PERCOLATION TEST LOCATION

Revision
APPROVED
DATE 11/23/08 BY K.R. Atteberry
CITY OF GOODYEAR ENGINEERING

120 60 0 60 120 240
SCALE IN FEET 1"=120'

NO.	REVISION	DATE
3	DRAINAGE REVISION	04/16/08

CANYON TRAILS TOWNE CENTER
PROPOSED RETENTION MAP

PREPARED FOR
VESTAR DEVELOPMENT COMPANY
2425 E. CAMELBACK RD. ST# 750
PHOENIX, AZ 85016

Registered Professional Engineer
CERTIFICATE NO.
38800
ADAM J.
RAUSCHER
Date Signed
ARIZONA U.S.A.
EXPIRES 3-31-09

OPTIMUS
CIVIL DESIGN GROUP
4450 E. COTTON CENTER BLVD.
SUITE 250
PHOENIX, AZ 85040
PH: (602) 286-9300 FAX: (602) 286-9350

DESIGNED:	AJR
DRAWN:	JS
CHECKED:	AJR
DATE:	03/02/07
JOB NO.:	031039

DRAWING NO
FIGURE 5
1 OF 1

APPENDIX A

Retention and Infiltration Calculations

PROPOSED RETENTION BASIN SUMMARY

DATE: JUNE '07
DESIGN: AJR
JOB #: 31039
PROJECT: CANYON TRAILS TOWNE CENTER

V_{REQ} =C*A*P/12
MARICOPA COUNTY 100-YEAR, 6- HOUR STORM
WHERE:
C = RUNOFF COEFFICIENT = 0.90 (COMMERCIAL), 0.50 (FUTURE 303 R/W)
P = 100-YR., 6-HOUR RAINFALL DEPTH = 3.0"
A = DRAINAGE AREA IN SQUARE FEET

V_{PROV} =1/2*H*(A1+A2)
WHERE:
H = BASIN CONTOUR INCREMENT
A1 = LOWER CONTOUR AREA
A2 = UPPER CONTOUR AREA

DRAINAGE AREA A
AREA = 630,766 S.F.
RETENTION VOLUME REQUIRED:
V_{REQ} =C*A*P/12
= 630,766 * 3.0/12 * 0.90
= 141,922 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:
V_{PROV} = 1/2*H(A1 + A2)
BASIN A1

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
74.50	6771		
		1.00	5901
73.50	5031		
		1.00	4307
72.50	3582		
		1.00	3017
71.50	2452		

VOLUME PROVIDED: 13,225 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:
V_{PROV} = 1/2*H(A1 + A2)
BASIN A2

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
74.50	37175		
		1.00	35899
73.50	34623		
		1.00	33373
72.50	32122		
		1.00	30910
71.50	29698		
		1.00	28521
70.50	27344		

VOLUME PROVIDED: 128,703 Cu.Ft.
COMB. VOL. PROV.: 141,927 Cu.Ft.
VOLUME REQUIRED: 141,922 Cu.Ft.

DRAINAGE AREA B

AREA = 129,941 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

=129,921 * 3.0/12 * 0.90

= 29,237 Cu.Ft. (D.A. B) + 42,091 (D.A.C)

= 71,328 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:

V_{PROV} = 1/2*H(A1 + A2)

BASIN B

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
74.50	22603		
		1.00	21654
73.50	20705		
		1.00	19815
72.50	18925		
		1.00	18103
71.50	17280		
		1.00	16523
70.50	15765		

VOLUME PROVIDED: 76,094 Cu.Ft.

VOLUME REQUIRED: 71,328 Cu.Ft.

DRAINAGE AREA C

AREA = 280,063 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

= 280,063 * 3.0/12 * 0.90

= 63,014 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:

V_{PROV} = 1/2*H(A1 + A2)

BASIN C

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
75.50	12479		
		1.00	10611
74.50	8742		
		1.00	6905
73.50	5067		
		1.00	3409
72.50	1750		

VOLUME PROVIDED: 20,924 Cu.Ft.

VOLUME REQUIRED: 63,014 Cu.Ft.

EXCESS VOL. REQ'D: 42,091 Cu.Ft.*

*EXCESS RETENTION VOLUME IS TO BE DIVERTED TO RETENTION BASIN B

DRAINAGE AREA D

AREA = 427,760 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

= 427,760 * 3.0/12 * 0.90

= 96,246 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:

V_{PROV} = 1/2*H(A1 + A2)

BASIN D

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
69.00	26858		
		1.00	25098
68.00	23338		
		1.00	21629
67.00	19920		
		1.00	18257
66.00	16593		
		1.00	15437
65.00	14281		
		1.00	13293
64.00	12305		
		0.50	5916
63.50	11357		

VOLUME PROVIDED: 99,629 Cu.Ft.

VOLUME REQUIRED: 96,246 Cu.Ft.

DRAINAGE AREA E

AREA = 238,357 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

= 238,357 * 3.0/12 * 0.90

= 53,630 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:

V_{PROV} = 1/2*H(A1 + A2)

BASIN E1

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
67.00	21807		
		1.00	17607
66.00	13407		
		1.00	12350
65.00	11293		
		1.00	10284
64.00	9275		

VOLUME PROVIDED: 40,241 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:
V_{PROV} = 1/2*H(A1 + A2)
BASIN E2

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
67.00	5400		
		1.00	4672
66.00	3943		
		1.00	3320
65.00	2696		
		1.00	2176
64.00	1656		
		1.00	1270
63.00	884		
		1.00	654
62.00	423		

VOLUME PROVIDED: 12,091 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:
V_{PROV} = 1/2*H(A1 + A2)
BASIN E3

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
67.00	2300		
		1.00	1711
66.00	1122		
		1.00	829
65.00	535		
		1.00	384
64.00	232		

VOLUME PROVIDED: 2,923 Cu.Ft.
COMB. VOL. PROV.: 55,255 Cu.Ft.
VOLUME REQUIRED: 53,630 Cu.Ft.

DRAINAGE AREA F
AREA = 194,892 S.F.
RETENTION VOLUME REQUIRED:
V_{REQ} =C*A*P/12
= 194,892 * 3.0/12 * 0.90
= 43,851 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:
V_{PROV} = 1/2*H(A1 + A2)
BASIN F1

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
66.00	10887		
		1.00	9867
65.00	8847		
		1.00	7882
64.00	6916		
		1.00	6016
63.00	5115		

VOLUME PROVIDED: 23,764 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:
V_{PROV} = 1/2*H(A1 + A2)
BASIN F2

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
66.00	9994		
		1.00	8819
65.00	7643		
		1.00	6584
64.00	5525		
		1.00	4692
63.00	3858		

VOLUME PROVIDED: 20,094 Cu.Ft.
COMB. VOL. PROV.: 43,858 Cu.Ft.
VOLUME REQUIRED: 43,851 Cu.Ft.

DRAINAGE AREA G

AREA = 224,914 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

= 224,914 * 3.0/12 * 0.50

= 28,114 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:

V_{PROV} = 1/2*H(A1 + A2)

BASIN G

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
63.50	70494		
		0.50	28795
63.00	44685		
		0.50	28795
62.50	70494		

VOLUME PROVIDED: 57,590 Cu.Ft.

VOLUME REQUIRED: 28,114 Cu.Ft.

DRAINAGE AREA H

AREA = 187,277 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

=187,277 * 3.0/12 * 0.50

= 23,410 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:

V_{PROV} = 1/2*H(A1 + A2)

BASIN H

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
70.50	52342		
		0.50	19305
70.00	24877		
		0.50	8477
69.50	9032		

VOLUME PROVIDED: 27,782 Cu.Ft.

VOLUME REQUIRED: 23,410 Cu.Ft.

DRAINAGE AREA I

AREA = 2,228,812 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

= 2,229,655 * 3.0/12 * 0.90

= 501,672 Cu.Ft.

UNDERGROUND VOLUME PROVIDED:

V_{PROV} = LENGTH*X-SECTION AREA

UNDERGROUND STORAGE

6,388 L.F. OF 10' DIAMETER PIPE

VOL. PER L.F. = $3.14*5^2$ = 78.54 Cu.Ft./L.F.

TOTAL VOLUME = 6,388*78.54 = 501,714 Cu.Ft.

VOLUME CALCULATIONS:

VOLUME PROVIDED: 501,714 Cu.Ft.

VOLUME REQUIRED: 501,672 Cu.Ft.

DRAINAGE AREA J

AREA = 135,793 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

= 135,793 * 3.0/12 * 0.50

= 16,974 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:

V_{PROV} = 1/2*H(A1 + A2)

BASIN J

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
73.50	56026		
		0.50	22684
73.00	34709		
		0.50	13258
72.50	18321		

VOLUME PROVIDED: 35,941 Cu.Ft.

VOLUME REQUIRED: 16,974 Cu.Ft.

DRAINAGE AREA K

AREA = 135,793 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

= 134,536 * 3.0/12 * 0.50

= 16,817 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:

V_{PROV} = 1/2*H(A1 + A2)

BASIN J

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
73.50	30990		
		0.50	11977
73.00	16917		
		0.50	6372
72.50	8571		

VOLUME PROVIDED: 18,349 Cu.Ft.

VOLUME REQUIRED: 16,817 Cu.Ft.

DRAINAGE AREA L

AREA = 40,416 S.F.

RETENTION VOLUME REQUIRED:

V_{REQ} =C*A*P/12

= 40,416 * 3.0/12 * 0.90

= 9,094 Cu.Ft.

RETENTION BASIN VOLUME PROVIDED:

V_{PROV} = 1/2*H(A1 + A2)

BASIN L

Elevation (ft)	Area (sf)	Elevation Increment (ft)	Volume Increment (cf)
77.30	6737		
		1.00	5706
76.30	4674		
		1.00	3756
75.30	2838		
		1.00	2034
74.30	1229		

VOLUME PROVIDED: 11,495 Cu.Ft.

VOLUME REQUIRED: 9,094 Cu.Ft.

INFILTRATION RATE/ DRYWELL CALCULATIONS

DATE: JUNE '07
DESIGN BY: AJR
JOB #: 31039
PROJECT: CANYON TRAILS TOWNE CENTER

RATE OF INFILTRATION (NATURAL GROUND INFILTRATION)

$D = T / ((I * F(s)) * (12INCH/FT) * (1HR/60MINUTES))$

WHERE:
D = DEPTH OF RETENTION BASIN (FT)
I = AVERAGE INFILTRATION RATE FOR THE SITE (MINUTES/INCH)
I = (79+88+18+16+42+49+66) / 7 = 51 MIN/IN
F(s) = FACTOR OF SAFETY = 1.5 (50%)
T = TIME OF INFILTRATION = 36 HRS

D = 36 / ((51 * 2) * (12) * (1/60)
D = APPROX. 2.35'
THEREFORE, THE REMAINING DEPTH OF WATER BEYOND 2.35'
MUST BE DRAINED VIA DRYWELLS

RATE OF INFILTRATION (DRYWELL PERCOLATION)

$N = V_P/(T * R * 3,600)$

WHERE:
T = MAXIMUM TIME REQUIRED FOR VOLUME TO COMPLETELY DRAIN = 36 HOURS
N = TOTAL NUMBER OF DRYWELLS
V_P = TOTAL VOLUME PERCOLATED WITHIN 36 HOURS (C.F.)
R = RATE OF PERCOLATION PER DRYWELL = 0.25 C.F.S.
V_R = TOTAL VOLUME REQUIRED TO PERCOLATE (HOURS)

RETENTION BASINS A

DEPTH = 4', HIGH WATER = 74.5, BOTTOM = 70.5, TOTAL VOL. REQ'D. = 141,922 C.F.
TOTAL VOLUME RATIO DRAINED VIA INFILTRATION = 2.35/4 = 59% = 0.59 * 141,922 = 93,734 c.f.
TOTAL VOLUME TO BE DRAINED VIA DRYWELLS = 141,922 - 93,734 = 48,188 C.F.

NUMBER OF DRYWELLS REQUIRED:
N = 48,188/(36*0.25*3,600) = 1.5
THEREFORE, USE 2 DRYWELLS

RETENTION BASIN B

DEPTH = 4', HIGH WATER = 74.5, BOTTOM = 70.5, TOTAL VOL. REQ'D. = 71,328 C.F.
TOTAL VOLUME RATIO DRAINED VIA INFILTRATION = 2.35/4 = 59% = 0.59 * 71,328 = 42,084 c.f.
TOTAL VOLUME TO BE DRAINED VIA DRYWELLS = 71,328 - 42,084 = 29,244 C.F.

NUMBER OF DRYWELLS REQUIRED:
N = 29,422/(36*0.25*3,600) = 0.9
THEREFORE, USE 1 DRYWELL

RETENTION BASIN C
DEPTH = 3', HIGH WATER = 75.5, BOTTOM = 72.5, TOTAL VOL. REQ'D. = 20,924 C.F.
TOTAL VOLUME RATIO DRAINED VIA INFILTRATION = 2.35/3 = 78% = 0.78 * 20,924 = 16,321 c.f.
TOTAL VOLUME TO BE DRAINED VIA DRYWELLS = 20,924 - 16,321 = 4,603 C.F.

NUMBER OF DRYWELLS REQUIRED:
N = 4,603/(36*0.25*3,600) = 0.1
THEREFORE, USE 1 DRYWELL

RETENTION BASIN D
DEPTH = 5.5', HIGH WATER = 69.0, BOTTOM = 63.5, TOTAL VOL. REQ'D. = 96,246 C.F.
TOTAL VOLUME RATIO DRAINED VIA INFILTRATION = 2.35/5.5 = 43% = 0.43 * 96,246 = 41,386 c.f.
TOTAL VOLUME TO BE DRAINED VIA DRYWELLS = 96,246 - 41,386 = 54,860 C.F.

NUMBER OF DRYWELLS REQUIRED:
N = 54,860/(36*0.25*3,600) = 1.7
THEREFORE, USE 2 DRYWELLS

RETENTION BASINS E
DEPTH = 5', HIGH WATER = 67.0, BOTTOM = 62.0, TOTAL VOL. REQ'D. = 53,630 C.F.
TOTAL VOLUME RATIO DRAINED VIA INFILTRATION = 2.35/5.0 = 47% = 0.47 * 53,630 = 25,206 c.f.
TOTAL VOLUME TO BE DRAINED VIA DRYWELLS = 53,630 - 25,206 = 28,424 C.F.

NUMBER OF DRYWELLS REQUIRED:
N = 28,424/(36*0.25*3,600) = 0.9
THEREFORE, USE 1 DRYWELL

RETENTION BASINS F
DEPTH = 3', HIGH WATER = 66.0, BOTTOM = 63.0, TOTAL VOL. REQ'D. = 43,851 C.F.
TOTAL VOLUME RATIO DRAINED VIA INFILTRATION = 2.35/3.0 = 78% = 0.78 * 43,851 = 34,204 c.f.
TOTAL VOLUME TO BE DRAINED VIA DRYWELLS = 43,851 - 34,204 = 9,647 C.F.

NUMBER OF DRYWELLS REQUIRED:
N = 9,647/(36*0.25*3,600) = 0.3
THEREFORE, USE 1 DRYWELL

RETENTION BASINS G
DEPTH = 1', HIGH WATER = 73.5, BOTTOM = 72.5, TOTAL VOL. REQ'D. = 33,354 C.F.
DEPTH IS LESS THAN 2.35' DEEP, THEREFORE WILL DRAIN VIA NATURAL INFILTRATION

RETENTION BASINS H
DEPTH = 1', HIGH WATER = 66.0, BOTTOM = 65.0, TOTAL VOL. REQ'D. = 47,042 C.F.
DEPTH IS LESS THAN 2.35' DEEP, THEREFORE WILL DRAIN VIA NATURAL INFILTRATION

UNDERGROUND RETENTION NETWORK I

V_R = 501,483 C.F.
NUMBER OF DRYWELLS = 16
V_P = 36 * 0.25 *3,600 * 16
V_P = 518,400 C.F.

***NOTE: IN ORDER TO BE CONSERVATIVE AND ACCOUNT FOR POTENTIAL CLOGGING, DUE TO THE FACT THAT THE RUNOFF DRAINS DIRECTLY INTO THE UNDERGROUND STORAGE SYSTEM WITHOUT CLEANSING, THE NUMBER OF DRYWELLS PROVIDED HAS BEEN INCREASED BY 25% TO 20 TOTAL.**

APPENDIX B

Overland Flow System Calculations

ONSITE CATCH BASIN IN SAG

DATE: JUNE '07
DESIGN: AJR
JOB #: 31039
PROJECT: CANYON TRAILS TOWNE CENTER

TYPICAL GRATE CATCH BASIN CAPACITY:

$Q_{CAPACITY} = C_F * C_W * P * d^{1.5}$
where:
C_F = REDUCTION FACTOR = 0.5
C_W = WEIR COEFFICIENT = 3
P = GRATE PERIMETER (Ft)
d = MAXIMUM PONDING DEPTH (FT) = 0.67'

SINGLE 36" GRATED MANHOLE LID (ABOVE UNDERGROUND STORAGE):
P = 9.42'
$Q_{CAPACITY} = 0.5*3*9.42*.67^{1.5} = 7.7$ c.f.s.

SINGLE TYPE "F" CATCH BASIN:
P = 11.67'
$Q_{CAPACITY} = 0.5*3*11.67*.67^{1.5} = 9.6$ c.f.s.

SINGLE TYPE "E" CATCH BASIN:
P = 9.17'
$Q_{CAPACITY} = 0.5*3*9.17*.67^{1.5} = 7.5$ c.f.s.

DOUBLE TYPE "F" CATCH BASIN:
P = 18.33'
$Q_{CAPACITY} = 0.5*3*18.33*.67^{1.5} = 15.1$ c.f.s.

DOUBLE TYPE "E" CATCH BASIN:
P = 15.83'
$Q_{CAPACITY} = 0.5*3*15.83*.67^{1.5} = 13.0$ c.f.s.

TYPICAL CURB INLET CATCH BASIN CAPACITY:

$Q_{CAPACITY} = 0.8*C_W(L + 1.8W)d^{1.5}$
where:
C_W = WEIR COEFFICIENT = 2.3
L = CURB OPENING LENGTH (FT) = VARIES
W = WIDTH OF GUTTER (FT) = 1.5'
REDUCTION FACTOR = 0.8
d = MAXIMUM PONDING DEPTH (FT) = 0.67'

SINGLE TYPE "A" CATCH BASIN:
$Q_{CAPACITY} = 0.8*2.3*(3.5+1.8*1.5)*.67^{*1.5} = 6.26$ c.f.s.

SINGLE TYPE "B" CATCH BASIN:
$Q_{CAPACITY} = 0.8*2.3*(5.5+1.8*1.5)*.67^{*1.5} = 8.27$ c.f.s.

SINGLE TYPE "C" CATCH BASIN:
$Q_{CAPACITY} = 0.8*2.3*(8+1.8*1.5)*.67^{*1.5} = 10.80$ c.f.s.

SINGLE TYPE 3535-1, L=6' CATCH BASIN:
$Q_{CAPACITY} = 0.8*2.3*(9+1.8*1.5)*.67^{*1.5} = 11.81$ c.f.s.

10-YEAR DISCHARGE (RATIONAL METHOD)

$Q_{10} = C*I*A$

where:
Q_{10} = 10-YEAR DISCHARGE (CFS)
C = RUNOFF COEFFICIENT = 0.95
I = 10-YEAR RAINFALL INTENSITY (IN/HR) = 4.5 (ASSUMED 10 MIN Tc)
A = DRAINAGE AREA (ACRES)

CATCH BASIN #1
A= 1.27 Ac.
Q_{10}= 5.43 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #2
A= 0.81 Ac.
Q_{10}= 3.46 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #3
A= 0.63 Ac.
Q_{10}= 2.69 c.f.s.
SINGLE TYPE "E" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #4
A= 0.70 Ac.
Q_{10}= 2.99 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #5
A= 0.81 Ac.
Q_{10}= 3.46 c.f.s.
SINGLE TYPE "F" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #6
A= 0.81 Ac.
Q_{10}= 3.46 c.f.s.
SINGLE TYPE "F" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #7
A= 0.81 Ac.
Q_{10}= 3.46 c.f.s.
SINGLE TYPE "F" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #8
A= 0.81 Ac.
Q_{10}= 3.46 c.f.s.
SINGLE TYPE "F" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #9
A= 0.79 Ac.
Q_{10}= 3.38 c.f.s.
SINGLE TYPE "F" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #10
A= 0.79 Ac.
Q_{10}= 3.38 c.f.s.
SINGLE TYPE "F" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #11
A= 0.83 Ac.
Q_{10}= 3.55 c.f.s.
SINGLE TYPE "F" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #12
A= 0.83 Ac.
Q_{10}= 3.55 c.f.s.
SINGLE TYPE "F" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #13
A= 0.38 Ac.
Q_{10}= 1.62 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #14
A= 0.37 Ac.
Q_{10}= 1.58 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #15
A= 0.19 Ac.
Q_{10}= 0.81 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #16
A= 0.96 Ac.
Q_{10}= 4.10 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #17
A= 0.43 Ac.
Q_{10}= 1.84 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #18
A= 0.24 Ac.
Q_{10}= 1.03 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #19
A= 0.53 Ac.
Q_{10}= 2.27 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #20
A= 0.50 Ac.
Q_{10}= 2.14 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #21
A= 1.33 Ac.
Q_{10}= 5.69 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #22
A= 1.43 Ac.
Q_{10}= 6.11 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #23
A= 0.19 Ac.
Q_{10}= 0.81 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #24
A= 0.85 Ac.
Q_{10}= 3.63 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #25
A= 1.09 Ac.
Q_{10}= 4.66 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #26
A= 0.30 Ac.
Q_{10}= 1.28 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #27
A= 0.28 Ac.
Q_{10}= 1.20 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #28
A= 0.40 Ac.
Q_{10}= 1.71 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #29
A= 0.39 Ac.
Q_{10}= 1.67 c.f.s.
SINGLE TYPE "F" REQUIRED
(DOUBLE PROVIDED)

CATCH BASIN #30
A= 0.93 Ac.
Q_{10}= 3.98 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #31
A= 0.33 Ac.
Q_{10}= 1.41 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #32
A= 0.97 Ac.
Q_{10}= 4.15 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #33
A= 0.95 Ac.
Q_{10}= 4.06 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #34
A= 1.75 Ac.
Q_{10}= 7.48 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #35
A= 0.36 Ac.
Q_{10}= 1.54 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #36
A= 0.43 Ac.
Q_{10}= 1.84 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #37
A= 0.42 Ac.
Q_{10}= 1.80 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #38
A= 0.36 Ac.
Q_{10}= 1.54 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #39
A= 0.54 Ac.
Q_{10}= 2.31 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #40
A= 0.52 Ac.
Q_{10}= 2.22 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #41
A= 0.07 Ac.
Q_{10}= 0.30 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #42
A= 0.15 Ac.
Q_{10}= 0.64 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #43
A= 0.52 Ac.
Q_{10}= 2.22 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #44
A= 0.44 Ac.
Q_{10}= 1.88 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #45
A= 0.29 Ac.
Q_{10}= 1.24 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #46
A= 0.27 Ac.
Q_{10}= 1.15 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #47
A= 0.81 Ac.
Q_{10}= 3.46 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #48
A= 1.70 Ac.
Q_{10}= 7.27 c.f.s.
SINGLE TYPE "B" REQUIRED

CATCH BASIN #49
A= 0.77 Ac.
Q_{10}= 3.29 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #50
A= 0.88 Ac.
Q_{10}= 3.76 c.f.s.
SINGLE 36" GRATED MANHOLE REQUIRED

CATCH BASIN #51
A= 0.78 Ac.
Q_{10}= 3.33 c.f.s.
SINGLE 36" GRATED MANHOLE REQUIRED

CATCH BASIN #52
A= 0.83 Ac.
Q_{10}= 3.55 c.f.s.
SINGLE 36" GRATED MANHOLE REQUIRED

CATCH BASIN #53
A= 1.27 Ac.
Q_{10}= 5.43 c.f.s.
SINGLE 36" GRATED MANHOLE REQUIRED

CATCH BASIN #54
A= 1.59 Ac.
Q_{10}= 6.80 c.f.s.
SINGLE 36" GRATED MANHOLE REQUIRED

CATCH BASIN #55
A= 0.41 Ac.
Q_{10}= 1.75 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #56
A= 0.59 Ac.
Q_{10}= 2.52 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #57
A= 0.61 Ac.
Q_{10}= 2.61 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #58
A= 0.65 Ac.
Q_{10}= 2.78 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #59
A= 0.58 Ac.
Q_{10}= 2.48 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #60
A= 0.60 Ac
Q_{10}= 2.57 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #61
A= 0.60 Ac.
Q_{10}= 2.57 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #62
A= 0.66 Ac.
Q_{10}= 2.82 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #63
A= 0.42 Ac.
Q_{10}= 1.80 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #64
A= 0.66 Ac.
Q_{10}= 2.82 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #65
A= 1.05 Ac.
Q_{10}= 4.49 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #66
A= 0.60 Ac.
Q_{10}= 2.57 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #67
A= 0.29 Ac.
Q_{10}= 1.24 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #68
A= 0.51 Ac.
Q_{10}= 2.18 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #69
A= 0.58 Ac.
Q_{10}= 2.48 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #70
A= 0.60 Ac.
Q_{10}= 2.57 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #71
A= 0.58 Ac.
Q_{10}= 2.48 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #72
A= 0.64 Ac.
Q_{10}= 2.74 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #73
A= 0.47 Ac.
Q_{10}= 2.01 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #74
A= 1.22 Ac.
Q_{10}= 5.22 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #75
A= 0.92 Ac.
Q_{10}= 3.93 c.f.s.
SINGLE TYPE "F" REQUIRED

CATCH BASIN #76
A= 0.34 Ac.
Q_{10}= 1.45 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #77
A= 0.95 Ac.
Q_{10}= 4.06 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #78
A= 0.56 Ac.
Q_{10}= 2.39 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #79
A= 0.44 Ac.
Q_{10}= 1.88 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #80
A= 0.11 Ac.
Q_{10}= 0.47 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #81
A= 0.06 Ac.
Q_{10}= 0.26 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #82
A= 0.06 Ac.
Q_{10}= 0.26 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #83
A= 0.40 Ac.
Q_{10}= 1.71 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #84
A= 0.38 Ac.
Q_{10}= 1.62 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #85
A= 1.44 Ac.
Q_{10}= 6.16 c.f.s.
SINGLE TYPE 3535-1 REQUIRED

CATCH BASIN #86
A= 1.49 Ac.
Q_{10}= 6.37 c.f.s.
SINGLE TYPE 3535-1 REQUIRED

CATCH BASIN #87
A= 0.99 Ac.
Q_{10}= 4.23 c.f.s.
SINGLE TYPE 3535-1 REQUIRED

CATCH BASIN #88
A= 0.89 Ac.
Q_{10}= 3.80 c.f.s.
SINGLE TYPE 3535-1 REQUIRED

CATCH BASIN #89
A= 0.07 Ac.
Q_{10}= 0.30 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #90
A= 0.57 Ac.
Q_{10}= 2.44 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #91
A= 1.00 Ac.
Q_{10}= 4.28 c.f.s.
SINGLE TYPE "E" REQUIRED

CATCH BASIN #92
A= 0.50 Ac.
Q_{10}= 2.14 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #93
A= 0.17 Ac.
Q_{10}= 0.73 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #94
A= 0.49 Ac.
Q_{10}= 2.09 c.f.s.
SINGLE TYPE "A" REQUIRED

CATCH BASIN #95
A= 0.10 Ac.
Q_{10}= 0.43 c.f.s.
SINGLE TYPE "E" REQUIRED

CURB OPENINGS/SCUPPERS IN GUTTER DEPRESSION

DATE: JUNE '07
DESIGN: AJR
JOB #: 31039
PROJECT: CANYON TRAILS TOWNE CENTER

DEPRESSED CURB CAPACITY (PER 3 FOOT OPENING):

$Q_{CAPACITY} = 0.8*CW(L + 1.8W)d^{1.5}$
where:
Q = DISCHARGE RATE (CFS)
C_W = WEIR COEFFICIENT = 2.3
L = CURB OPENING LENGTH (FT) = 3'
W = WIDTH OF GUTTER (FT) = 1.5'
REDUCTION FACTOR = 0.8
d = MAXIMUM PONDING DEPTH (FT) = 0.5'

$Q_{CAPACITY} = 0.8*2.3*(3 + 1.8*1.5)*0.5^{1.5}$
= 3.7 c.f.s. (PER 3' OPENING)

10-YEAR DISCHARGE (RATIONAL METHOD)

$Q_{10} = C*I*A$

where:
Q_{10} = 10-YEAR DISCHARGE (CFS)
C = RUNOFF COEFFICIENT = 0.95
I = 100-YEAR RAINFALL INTENSITY (IN/HR) = 4.5 (ASSUMED 10 MIN Tc)
A = DRAINAGE AREA (ACRES)

CURB OPENING #1
A= 0.15 Ac.
Q_{10}= 0.64 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #2
A= 1.05 Ac.
Q_{10}= 4.49 c.f.s.
2 CURB INLETS REQUIRED

CURB OPENING #3
A= 1.13 Ac.
Q_{10}= 4.83 c.f.s.
2 CURB INLETS REQUIRED

CURB OPENING #4
A= 1.28 Ac.
Q_{10}= 5.47 c.f.s.
2 CURB INLETS REQUIRED

CURB OPENING #5
A= 0.96 Ac.
Q_{10}= 4.10 c.f.s.
2 CURB INLETS REQUIRED

CURB OPENING #6
A= 0.69 Ac.
Q_{10}= 2.95 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #7
A= 0.73 Ac.
Q_{10}= 3.12 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #8
A= 0.70 Ac.
Q_{10}= 2.99 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #9
A= 0.43 Ac.
Q_{10}= 1.84 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #10
A= 1.21 Ac.
Q_{10}= 5.17 c.f.s.
2 CURB INLETS REQUIRED

CURB OPENING #11
A= 4.62 Ac.
Q_{10}= 19.75 c.f.s.
6 CURB INLETS REQUIRED

CURB OPENING #12
A= 1.52 Ac.
Q_{10}= 6.50 c.f.s.
2 CURB INLETS REQUIRED

CURB OPENING #13
A= 2.76 Ac.
Q_{10}= 11.80 c.f.s.
4 CURB INLETS REQUIRED

CURB OPENING #14
A= 0.20 Ac.
Q_{10}= 0.86 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #15
A= 1.47 Ac.
Q_{10}= 6.28 c.f.s.
2 CURB INLETS REQUIRED

CURB OPENING #16
A= 0.68 Ac.
Q_{10}= 2.91 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #17
A= 1.21 Ac.
Q_{10}= 5.17 c.f.s.
2 CURB INLETS REQUIRED

SCUPPER #18
A= 1.23 Ac.
Q_{10}= 5.26 c.f.s.
2 CURB INLETS REQUIRED

CURB OPENING #19
A= 0.77 Ac.
Q_{10}= 3.29 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #20
A= 0.68 Ac.
Q_{10}= 2.91 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #21
A= 0.54 Ac.
Q_{10}= 2.31 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #22
A= 0.56 Ac.
Q_{10}= 2.39 c.f.s.
1 CURB INLET REQUIRED

CURB OPENING #23
A= 0.68 Ac.
Q_{10}= 2.91 c.f.s.
1 CURB INLET REQUIRED

APPENDIX C

Storm Drain System Analysis

STORM DRAIN SYSTEM (LINE-A)

PIPE SECTION	BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-A18	113	4.28	332	18	2.42	1	0.0017	0.55	0.045	63.76	67.30
L-A17	104	4.23	41	18	2.40	1	0.0016	0.07	0.045	63.67	65.31
L-A16	103	6.37	4	18	3.61	1	0.0037	0.01	0.101	64.03	64.72
L-A15	102	6.16	16	18	3.49	1	0.0034	0.06	0.094	64.40	64.89
L-A14	102	6.16	413	24	1.96	1	0.0007	0.31	0.030	64.25	65.62
L-A13	102,103	12.53	151	30	2.55	1	0.0009	0.14	0.051	63.92	65.71
L-A12	1,102-103	22.19	85	36	3.14	1	0.0011	0.09	0.077	63.73	65.05
L-A11	1,2,102-104	25.65	194	36	3.63	1	0.0015	0.29	0.102	63.56	66.00
L-A10	1-3,102-104,113	32.62	70	36	4.62	1	0.0024	0.17	0.165	63.17	66.40
L-A9	1-4,102-104,113	35.61	60	36	5.04	1	0.0029	0.17	0.197	62.83	66.00
L-A8	1-5,102-104,113	39.07	66	42	4.06	1	0.0015	0.10	0.128	62.46	66.40
L-A7	1-6,102-104,113	42.54	60	42	4.42	1	0.0018	0.11	0.152	62.24	66.50
L-A6	1-7,102-104,113	46.00	70	42	4.78	1	0.0021	0.15	0.178	61.98	66.50
L-A5	1-8,102-104,113	49.46	60	48	3.94	1	0.0012	0.07	0.120	61.65	66.50
L-A4	1-9,102-104,113	52.84	66	48	4.21	1	0.0014	0.09	0.137	61.46	66.50
L-A3	1-10,102-104,113	56.22	60	48	4.48	1	0.0015	0.09	0.156	61.23	66.50
L-A2	1-11,102-104,113	59.76	69	48	4.76	1	0.0017	0.12	0.176	60.99	66.50
L-A1	1-12,102-104,113	63.31	66	54	3.98	1	0.0010	0.07	0.123	60.69	66.50

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-B)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-B19	13	1.62	22	18	0.92	1	0.0002	0.01	0.007	67.95	69.90
L-B18	13,14	3.21	105	18	1.82	1	0.0009	0.10	0.026	67.94	69.30
L-B17	13,14	3.21	71	18	1.82	1	0.0009	0.07	0.026	67.81	69.90
L-B16	13-15	4.02	34	18	2.28	1	0.0015	0.05	0.040	67.72	68.45
L-B15	13-16	8.12	138	18	4.60	1	0.0060	0.83	0.164	67.63	68.00
L-B14	13-17	9.96	38	18	5.64	1	0.0090	0.34	0.247	66.64	68.85
L-B13	13-18	10.99	73	18	6.22	1	0.0110	0.80	0.300	66.05	68.95
L-B12	13-19	13.25	60	18	7.50	1	0.0159	0.96	0.437	64.95	68.95
L-B11	13-20	15.39	156	24	4.90	1	0.0046	0.72	0.187	63.56	68.95
L-B10	21	5.69	60	18	3.22	1	0.0029	0.18	0.080	66.77	68.20
L-B9	21,22	11.80	139	24	3.76	1	0.0027	0.38	0.110	66.51	68.20
L-B8	21-23	12.61	33	24	4.02	1	0.0031	0.10	0.125	66.02	70.60
L-B7	21-24	16.25	260	24	5.17	1	0.0052	1.34	0.208	65.80	70.00
L-B6	21-25	20.78	138	30	4.23	1	0.0026	0.35	0.139	64.25	68.75
L-B5	21-26	22.06	38	30	4.50	1	0.0029	0.11	0.157	63.75	69.80
L-B4	21-27	23.26	73	30	4.74	1	0.0032	0.23	0.174	63.48	69.80
L-B3	21-28	24.97	60	30	5.09	1	0.0037	0.22	0.201	63.08	69.85
L-B2	13-29	42.02	344	36	5.95	1	0.0040	1.37	0.275	62.65	69.85
L-B1	13-30	46.00	38	36	6.51	1	0.0048	0.18	0.329	61.01	66.50

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-C)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-C1	31	1.41	399	18	0.80	1	0.0002	0.07	0.005	60.58	69.00

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-D)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-D1	32	4.15	38	18	2.35	1	0.0016	0.06	0.043	60.60	67.70

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-E)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-E1	33	4.06	38	18	2.30	1	0.0015	0.06	0.041	60.60	67.70

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-F)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-F1	34	7.48	38	18	4.24	1	0.0051	0.19	0.139	60.83	67.80

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-G)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-G14	35	1.54	109	18	0.87	1	0.0002	0.02	0.006	67.94	71.20
L-G13	35,36	3.38	109	18	1.91	1	0.0010	0.11	0.028	67.91	71.20
L-G12	35-37	5.17	55	18	2.93	1	0.0024	0.13	0.067	67.77	71.20
L-G11	41	0.30	57	18	0.17	1	0.0000	0.00	0.000	67.57	71.60
L-G10	38	1.54	22	18	0.87	1	0.0002	0.00	0.006	67.57	72.40
L-G9	38,39	2.91	128	18	1.65	1	0.0008	0.10	0.021	69.92	72.00
L-G8	38-40	5.13	89	18	2.90	1	0.0024	0.21	0.065	69.80	71.80
L-G7	38-42	6.07	32	18	3.44	1	0.0033	0.11	0.092	69.52	71.90
L-G6	38-43	8.29	146	18	4.70	1	0.0062	0.91	0.171	69.32	71.85
L-G5	38-44	10.17	45	18	5.76	1	0.0094	0.42	0.258	68.24	71.85
L-G4	35-44	15.35	60	18	8.69	1	0.0214	1.28	0.586	67.56	71.95
L-G3	35-45	16.59	73	18	9.39	1	0.0250	1.82	0.685	65.69	71.85
L-G2	35-46	17.74	285	24	5.65	1	0.0062	1.75	0.248	63.18	71.85
L-G1	35-47	21.20	37	24	6.75	1	0.0088	0.33	0.354	61.18	69.25

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-H)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-H1	48	7.27	30	18	4.11	1	0.0048	0.14	0.131	60.78	69.70

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-I)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-I1	49	3.29	40	18	1.86	1	0.0010	0.04	0.027	60.57	71.05

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-J)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-J4	55	1.75	110	18	0.99	1	0.0003	0.03	0.008	62.84	72.30
L-J3	56	2.52	156	18	1.43	1	0.0006	0.09	0.016	62.81	72.35
L-J2	55-57	6.84	67	18	3.87	1	0.0042	0.28	0.116	62.70	72.40
L-J1	55-58	9.66	185	18	5.47	1	0.0085	1.57	0.232	62.30	72.05

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-K)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-K11	67	1.24	30	18	0.70	1	0.0001	0.00	0.004	65.85	76.10
L-K10	66,67	3.76	240	18	2.13	1	0.0013	0.31	0.035	65.84	75.40
L-K9	59	2.48	60	18	1.40	1	0.0006	0.03	0.015	65.50	72.50
L-K8	59,60	5.04	60	18	2.86	1	0.0023	0.14	0.063	70.85	72.50
L-K7	59-61	7.61	60	18	4.31	1	0.0053	0.32	0.144	70.65	72.50
L-K6	59-62	10.43	68	18	5.91	1	0.0099	0.67	0.271	70.19	72.20
L-K5	59-63	12.23	7	18	6.92	1	0.0136	0.09	0.372	69.25	71.70
L-K4	59-64	15.09	9	18	8.54	1	0.0207	0.19	0.567	68.78	71.20
L-K3	59-65	19.58	304	24	6.24	1	0.0075	2.28	0.302	68.03	71.20
L-K2	59-67	23.34	334	24	7.43	1	0.0107	3.56	0.429	65.45	77.50
L-K1	59-67	23.34	50	24	7.43	1	0.0107	0.53	0.429	61.46	74.30

10-YEAR TAIL WATER ELEVATION= 60.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-L)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-L16	107	1.84	21	18	1.04	1	0.0003	0.01	0.008	74.50	76.05
L-L15	109	0.43	21	18	0.24	1	0.0000	0.00	0.000	73.85	77.10
L-L14	110	0.73	20	18	0.41	1	0.0000	0.00	0.001	73.59	77.00
L-L13	68	2.18	61	18	1.23	1	0.0004	0.03	0.012	75.92	76.25
L-L12	68,69	4.66	73	18	2.64	1	0.0020	0.14	0.054	75.88	76.25
L-L11	68-70	7.22	60	18	4.09	1	0.0047	0.28	0.130	75.69	76.20
L-L10	68-71	9.70	66	24	3.09	1	0.0018	0.12	0.074	75.27	76.20
L-L9	68-72	12.44	60	24	3.96	1	0.0030	0.18	0.122	75.08	76.20
L-L8	68-73	14.45	76	30	2.95	1	0.0012	0.09	0.067	74.77	76.05
L-L7	68-73	14.45	47	30	2.95	1	0.0012	0.06	0.067	74.61	N/A TEE
L-L6	68-73,107	16.29	194	30	3.32	1	0.0016	0.31	0.086	74.49	N/A TEE
L-L5	68-73,107	16.29	7	30	3.32	1	0.0016	0.01	0.086	74.09	N/A TEE
L-L4	68-73,107	16.29	38	30	3.32	1	0.0016	0.06	0.086	74.00	N/A TEE
L-L3	68-73,107,108	18.43	77	30	3.76	1	0.0020	0.16	0.109	73.85	N/A TEE
L-L2	68-73,107,108,110	19.15	119	30	3.90	1	0.0022	0.26	0.118	73.59	77.65
L-L1	68-73,107,108-111	21.20	39	36	3.00	1	0.0010	0.04	0.070	73.21	76.10

10-YEAR TAIL WATER ELEVATION= 73.10

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-M)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-M10	83	1.71	67	18	0.97	1	0.0003	0.02	0.007	75.04	75.05
L-M9	75	3.93	162	18	2.23	1	0.0014	0.23	0.038	75.09	75.45
L-M8	75,76,83	7.10	157	24	2.26	1	0.0010	0.15	0.040	75.02	74.75
L-M7	75-77,83	11.16	185	30	2.27	1	0.0007	0.14	0.040	74.82	74.95
L-M6	75-78,83	13.55	104	30	2.76	1	0.0011	0.11	0.059	74.64	74.85
L-M5	75-79,83	15.43	250	30	3.15	1	0.0014	0.35	0.077	74.47	74.80
L-M4	75-80,83	15.90	82	30	3.24	1	0.0015	0.12	0.082	74.04	77.55
L-M3	75-81,83	16.16	7	30	3.29	1	0.0016	0.01	0.084	73.84	77.55
L-M2	75-83	16.42	64	30	3.35	1	0.0016	0.10	0.087	73.74	77.55
L-M1	75-83,106	16.72	92	36	2.37	1	0.0006	0.06	0.043	73.55	77.55

10-YEAR TAIL WATER ELEVATION= 73.45

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-N)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-N4	116	#REF!	22	18	#REF!	1	#REF!	#REF!	#REF!	#REF!	77.00
L-N3	74	5.22	181	18	2.95	1	0.0025	0.45	0.068	#REF!	75.00
L-N2	74,116	#REF!	121	18	#REF!	1	#REF!	#REF!	#REF!	#REF!	77.50
L-N1	74,116	#REF!	184	18	#REF!	1	#REF!	#REF!	#REF!	#REF!	77.90

10-YEAR TAIL WATER ELEVATION= 73.10

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-O)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-O3	105	3.80	12	18	2.15	1	0.0013	0.02	0.036	65.56	66.17
L-O2	105	3.80	109	18	2.15	1	0.0013	0.14	0.036	65.51	67.50
L-O1	105	3.80	34	18	2.15	1	0.0013	0.04	0.036	65.33	67.50

10-YEAR TAIL WATER ELEVATION= 65.25

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-P)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-P1	112	0.73	46	36	0.10	1	0.0000	0.00	0.000	74.50	78.34
L-P1	112	1.62	103	36	0.23	1	0.0000	0.00	0.000	74.50	78.34
L-P1	112	4.66	7	36	0.66	1	0.0000	0.00	0.003	74.50	78.34

10-YEAR TAIL WATER ELEVATION= 74.50

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

STORM DRAIN SYSTEM (LINE-Q)

PIPE SECTION	CONTRIBUTING BASIN AREAS	Q10 CUMULATIVE (CFS)	LENGTH OF PIPE (FT)	SIZE OF PIPE (IN)	FLOW VELOCITY (FT/SEC)	NUMBER OF PIPES	Sf (FT/S)	Hf (FT)	JUNCTION LOSS (FT)	HGL (FT)	CATCH BASIN ELEVATION (FT)
L-Q2	114	2.09	30	18	1.19	1	0.0004	0.01	0.011	65.31	67.00
L-Q1	114,109	2.52	34	18	1.43	1	0.0006	0.02	0.016	65.29	67.00

10-YEAR TAIL WATER ELEVATION= 65.25

DESIGNER: AJR LOCATION: Canyon Trails Towne Center

APPENDIX D

Offsite 100-Year Storm Analysis

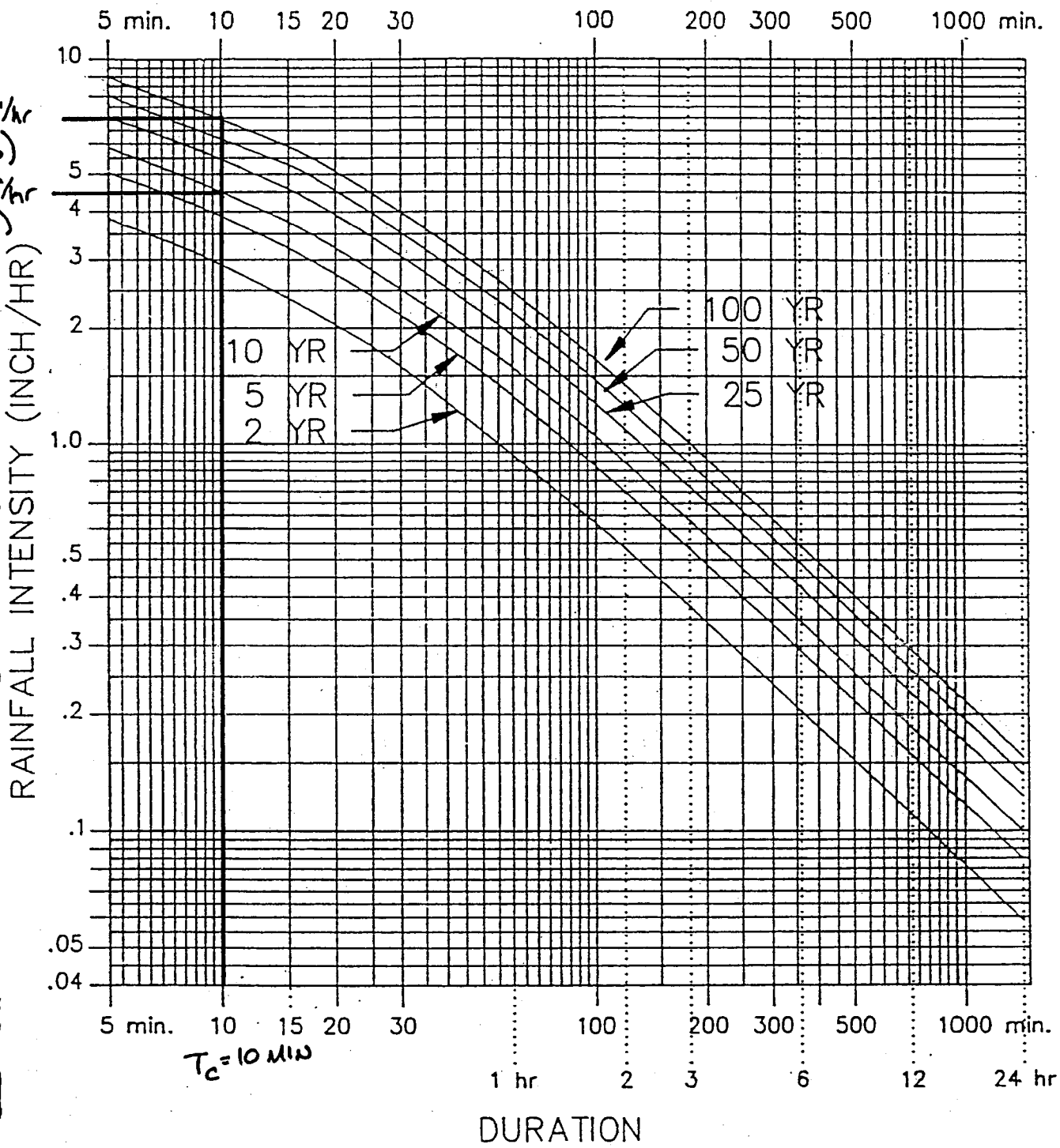


Figure 3.2
Rainfall Intensity-Duration-Frequency Relation
(Phoenix Metro Area)

CURB OPENINGS/SCUPPERS IN GUTTER DEPRESSION

DATE: JUNE '07
DESIGN: AJR
JOB #: 31039
PROJECT: CANYON TRAILS TOWNE CENTER

DEPRESSED CURB CAPACITY (PER 3 FOOT OPENING):

$Q_{CAPACITY} = 0.8*CW(L + 1.8W)d^{1.5}$
where:
Q = DISCHARGE RATE (CFS)
C_W = WEIR COEFFICIENT = 2.3
L = CURB OPENING LENGTH (FT) = 3'
W = WIDTH OF GUTTER (FT) = 1.5'
REDUCTION FACTOR = 0.8
d = MAXIMUM PONDING DEPTH (FT) = 0.5'

$Q_{CAPACITY} = 0.8*2.3*(3 + 1.8*1.5)*0.5^{1.5}$
= 3.7 c.f.s. (PER 3' OPENING)

Q_{100} = 113 c.f.s., THEREFORE 113 c.f.s./3.7 c.f.s./opening = 30.5*3' (opening length) = 91.5'
USE 93' CURB INLET

36" Storm Drain - Canyon Trails Boulevard 100-Year Storm
Worksheet for Pressure Pipe

Project Description	
Worksheet	Canyon Trail 100-year Stror
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Discharge

Input Data		
Pressure at	0.00	psi
Pressure at :	0.00	psi
Elevation at	78.84	ft
Elevation at	74.50	ft
Length	56.00	ft
C Coefficien	150.0	
Diameter	36	in

Results		
Discharge	168.49	cfs
Headloss	4.34	ft
Energy Grade at	87.67	ft
Energy Grade at	83.33	ft
Hydraulic Grade :	78.84	ft
Hydraulic Grade :	74.50	ft
Flow Area	7.1	ft²
Wetted Perimeter	9.42	ft
Velocity	23.84	ft/s
Velocity Head	8.83	ft
Friction Slope	027821	ft/ft

Cotton Lane Section A-A 10-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Cotton Lane A-A, 10
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	002000	ft/ft
Discharge	2.91	cfs

Options	
Current Roughness Method	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weighting	Horton's Method

Results		
Mannings Coefficient	0.016	
Water Surface Elev	8.97	ft
Elevation Range	66 to 10.00	
Flow Area	2.4	ft²
Wetted Perimeter	15.96	ft
Top Width	15.64	ft
Actual Depth	0.31	ft
Critical Elevation	8.90	ft
Critical Slope	0.007738	ft/ft
Velocity	1.19	ft/s
Velocity Head	0.02	ft
Specific Energy	8.99	ft
Froude Number	0.53	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+10	0+52	0.016

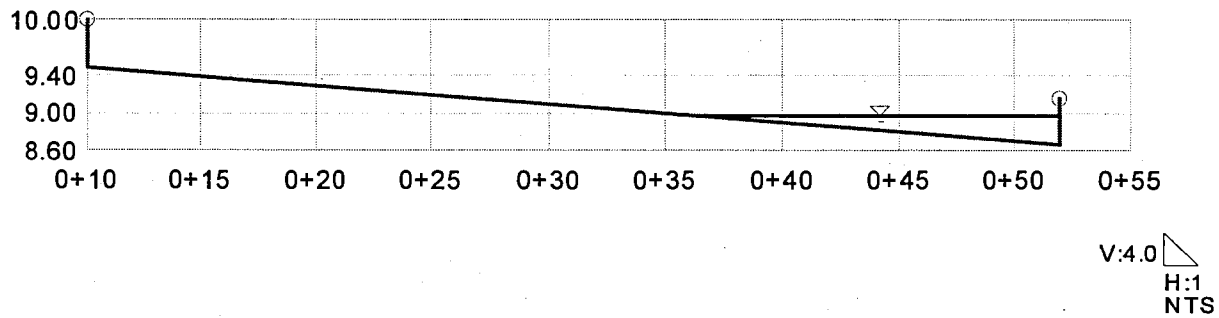
Natural Channel Points

Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+52	8.66
0+52	9.16

Cotton Lane Section A-A 10-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Cotton Lane A-A, 10
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.002000	ft/ft
Water Surface Elev	8.97	ft
Elevation Range	66 to 10.00	
Discharge	2.91	cfs



Cotton Lane Section A-A 100-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Cotton Lane A-A, 10(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Slope	002000	ft/ft
Water Surface Elev	9.16	ft

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coeffic	0.027	
Elevation Range	16 to 10.00	
Discharge	658.83	cfs
Flow Area	216.8	ft²
Wetted Perimeter	153.79	ft
Top Width	153.00	ft
Actual Depth	3.00	ft
Critical Elevation	8.20	ft
Critical Slope	0.010402	ft/ft
Velocity	3.04	ft/s
Velocity Head	0.14	ft
Specific Energy	9.30	ft
Froude Number	0.45	
Flow Type	Subcritical	

Calculation Messages:
Flow is divided.

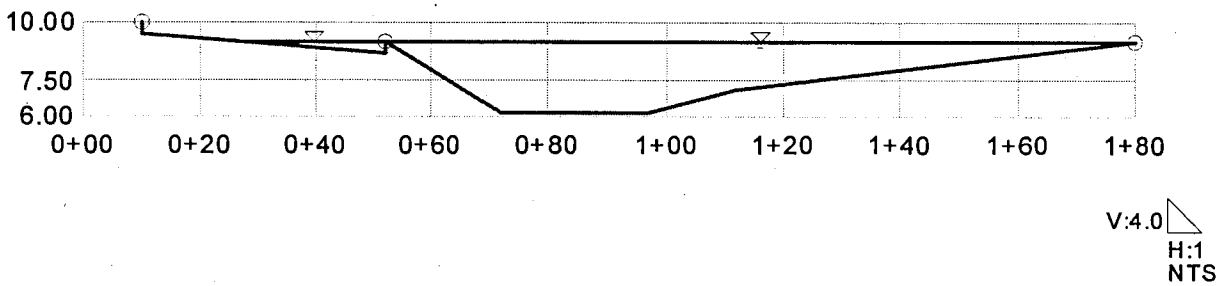
Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+10	0+52	0.016
0+52	1+80	0.030

Natural Channel Points	
Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+52	8.66
0+52	9.16
0+72	6.16
0+97	6.16
1+12	7.16
1+80	9.16

Cotton Lane Section A-A 100-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Cotton Lane A-A, 10(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

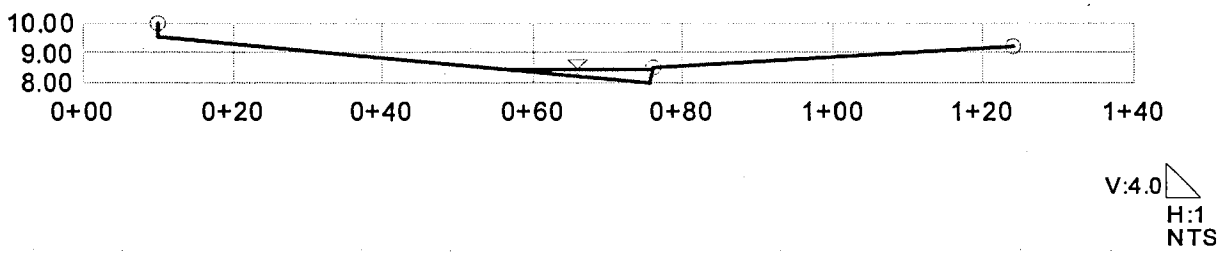
Section Data		
Mannings Coefficie	0.027	
Slope	0.002000	ft/ft
Water Surface Elev	9.16	ft
Elevation Range	16 to 10.00	
Discharge	658.83	cfs



Yuma Road Section B-B 10-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road B-B, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.002500	ft/ft
Water Surface Elev	8.44	ft
Elevation Range	00 to 10.00	
Discharge	7.44	cfs



Yuma Road Section B-B 10-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road B-B, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	002500	ft/ft
Discharg	7.44	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.016	
Water Surface Elev	8.44	ft
Elevation Range	00 to 10.00	
Flow Area	4.4	ft²
Wetted Perimeter	20.01	ft
Top Width	19.82	ft
Actual Depth	0.44	ft
Critical Elevation	8.37	ft
Critical Slope	0.006632	ft/ft
Velocity	1.69	ft/s
Velocity Head	0.04	ft
Specific Energy	8.49	ft
Froude Number	0.63	
Flow Type	Subcritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+10	0+76	0.016
0+76	1+24	0.030

Natural Channel Points	
Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+76	8.00
0+76	8.50
1+24	9.22

Yuma Road Section B-B 100-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road B-B, 1(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	002500	ft/ft
Discharg(	11.57	cfs

Options	
Current Roughness Meth(	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin(	Horton's Method

Results		
Mannings Coefficie(	0.018	
Water Surface Elev	8.57	ft
Elevation Range	00 to 10.00	
Flow Area	7.3	ft²
Wetted Perimeter	29.93	ft
Top Width	29.72	ft
Actual Depth	0.57	ft
Critical Elevation	8.44	ft
Critical Slope	0.008274	ft/ft
Velocity	1.58	ft/s
Velocity Head	0.04	ft
Specific Energy	8.61	ft
Froude Number	0.56	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+10	0+76	0.016
0+76	1+24	0.030

Natural Channel Points

Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+76	8.00
0+76	8.50
1+24	9.22

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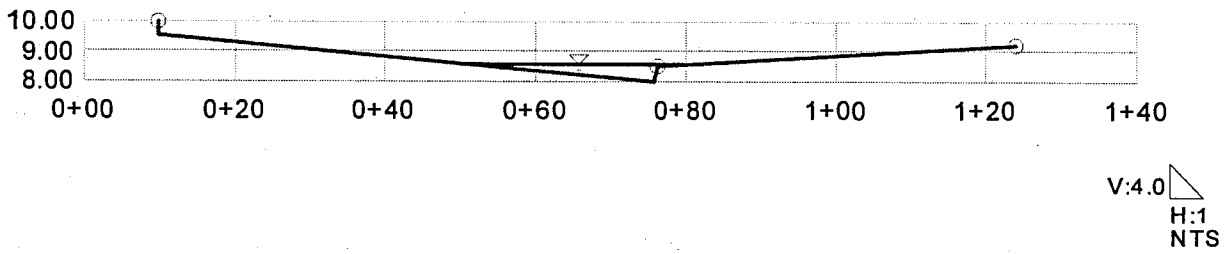
Yuma Road Section B-B 100-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road B-B, 1(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.018	
Slope	0.002500	ft/ft
Water Surface Elev	8.57	ft
Elevation Range	00 to 10.00	
Discharge	11.57	cfs



Yuma Road Section C-C 10-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road C-C, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	002500	ft/ft
Discharge	6.16	cfs

Options	
Current Roughness Method	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weighting	Horton's Method

Results		
Mannings Coefficient	0.016	
Water Surface Elev	9.06	ft
Elevation Range	66 to 10.24	
Flow Area	3.9	ft²
Wetted Perimeter	20.27	ft
Top Width	19.87	ft
Actual Depth	0.40	ft
Critical Elevation	8.99	ft
Critical Slope	0.007002	ft/ft
Velocity	1.56	ft/s
Velocity Head	0.04	ft
Specific Energy	9.10	ft
Froude Number	0.62	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+10	0+52	0.016
0+52	1+24	0.030

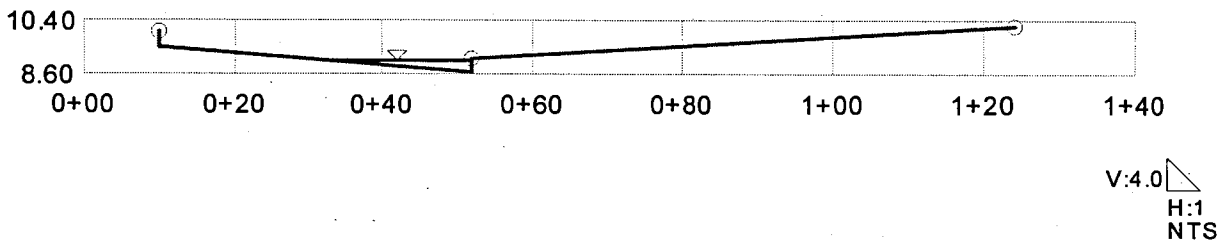
Natural Channel Points

Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+52	8.66
0+52	9.16
1+24	10.24

Yuma Road Section C-C 10-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road C-C, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.002500	ft/ft
Water Surface Elev	9.06	ft
Elevation Range	66 to 10.24	
Discharge	6.16	cfs



Yuma Road Section C-C 100-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road C-C, 1(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	002500	ft/ft
Discharg(	9.58	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin(	Horton's Method

Results		
Mannings Coefficie(	0.016	
Water Surface Elev	9.13	ft
Elevation Range	66 to 10.24	
Flow Area	5.5	ft²
Wetted Perimeter	23.92	ft
Top Width	23.45	ft
Actual Depth	0.47	ft
Critical Elevation	9.05	ft
Critical Slope	0.006602	ft/ft
Velocity	1.74	ft/s
Velocity Head	0.05	ft
Specific Energy	9.18	ft
Froude Number	0.63	
Flow Type	Subcritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+10	0+52	0.016
0+52	1+24	0.030

Natural Channel Points	
Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+52	8.66
0+52	9.16
1+24	10.24

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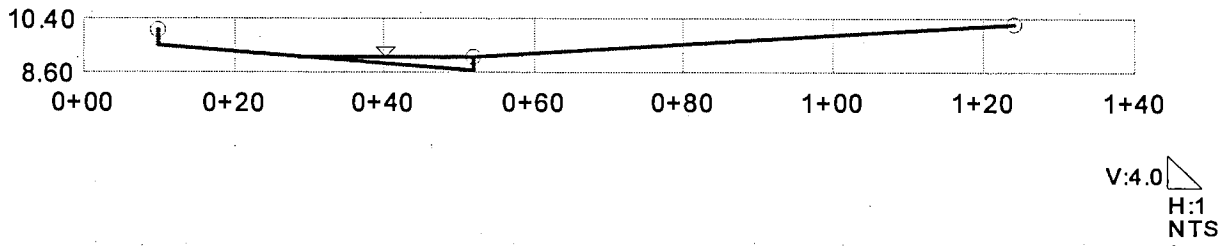
Yuma Road Section C-C 100-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road C-C, 1(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.002500	ft/ft
Water Surface Elev	9.13	ft
Elevation Range	66 to 10.24	
Discharge	9.58	cfs



Yuma Road Section D-D 10-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road D-D, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	002500	ft/ft
Discharge	6.40	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.016	
Water Surface Elev	8.83	ft
Elevation Range	43 to 10.00	
Flow Area	4.1	ft²
Wetted Perimeter	20.68	ft
Top Width	20.27	ft
Actual Depth	0.40	ft
Critical Elevation	8.76	ft
Critical Slope	0.006973	ft/ft
Velocity	1.57	ft/s
Velocity Head	0.04	ft
Specific Energy	8.87	ft
Froude Number	0.62	
Flow Type	Subcritical	

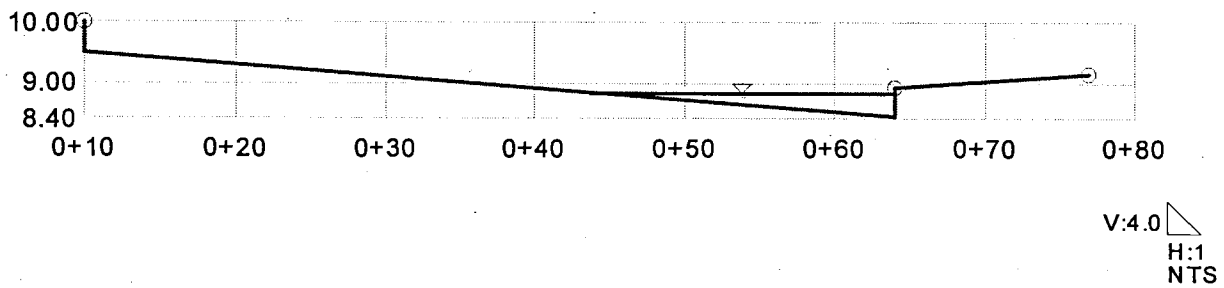
Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+10	0+64	0.016
0+64	0+77	0.030

Natural Channel Points	
Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+64	8.43
0+64	8.93
0+77	9.14

Yuma Road Section D-D 10-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road D-D, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.002500	ft/ft
Water Surface Elev	8.83	ft
Elevation Range	43 to 10.00	
Discharge	6.40	cfs



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Yuma Road Section D-D 100-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road D-D, 1(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	002500	ft/ft
Discharg(	9.10	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin(	Horton's Method

Results		
Mannings Coefficie	0.016	
Water Surface Elev	8.89	ft
Elevation Range	43 to 10.00	
Flow Area	5.3	ft²
Wetted Perimeter	23.60	ft
Top Width	23.13	ft
Actual Depth	0.46	ft
Critical Elevation	8.81	ft
Critical Slope	0.006654	ft/ft
Velocity	1.72	ft/s
Velocity Head	0.05	ft
Specific Energy	8.93	ft
Froude Number	0.63	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+10	0+64	0.016
0+64	0+77	0.030

Natural Channel Points

Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+64	8.43
0+64	8.93
0+77	9.14

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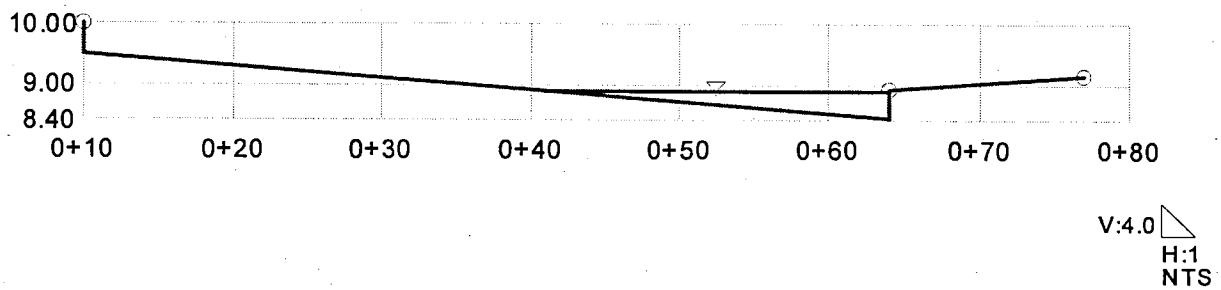
Yuma Road Section D-D 100-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road D-D, 1(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.002500	ft/ft
Water Surface Elev	8.89	ft
Elevation Range	43 to 10.00	
Discharge	9.10	cfs



Yuma Road Section E-E 10-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road E-E, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	002500	ft/ft
Discharge	4.23	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.016	
Water Surface Elev	9.01	ft
Elevation Range	66 to 10.00	
Flow Area	3.0	ft²
Wetted Perimeter	17.61	ft
Top Width	17.26	ft
Actual Depth	0.35	ft
Critical Elevation	8.94	ft
Critical Slope	0.007362	ft/ft
Velocity	1.42	ft/s
Velocity Head	0.03	ft
Specific Energy	9.04	ft
Froude Number	0.60	
Flow Type	Subcritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+10	0+52	0.016
0+52	0+77	0.030

Natural Channel Points	
Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+52	8.66
0+52	9.16
0+77	9.53

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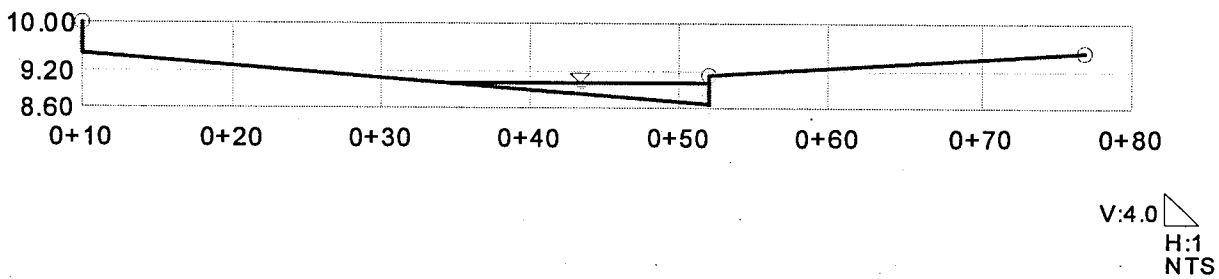
Yuma Road Section E-E 10-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road E-E, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.002500	ft/ft
Water Surface Elev	9.01	ft
Elevation Range	66 to 10.00	
Discharge	4.23	cfs



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Yuma Road Section E-E 100-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road E-E, 1(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	002500	ft/ft
Discharg(	6.58	cfs

Options	
Current Roughness Meth(	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin(	Horton's Method

Results		
Mannings Coefficie	0.016	
Water Surface Elev	9.07	ft
Elevation Range	66 to 10.00	
Flow Area	4.1	ft²
Wetted Perimeter	20.78	ft
Top Width	20.37	ft
Actual Depth	0.41	ft
Critical Elevation	9.00	ft
Critical Slope	0.006941	ft/ft
Velocity	1.59	ft/s
Velocity Head	0.04	ft
Specific Energy	9.11	ft
Froude Number	0.62	
Flow Type	Subcritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+10	0+52	0.016
0+52	0+77	0.030

Natural Channel Points	
Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+52	8.66
0+52	9.16
0+77	9.53

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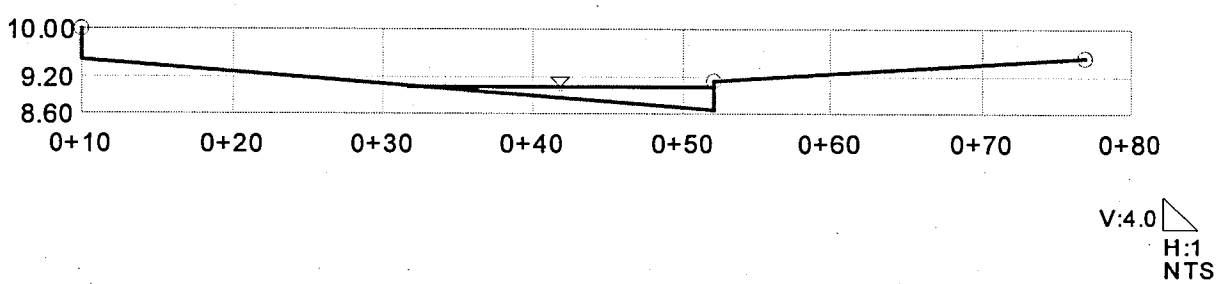
Yuma Road Section E-E 100-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road E-E, 1(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.002500	ft/ft
Water Surface Elev	9.07	ft
Elevation Range	66 to 10.00	
Discharge	6.58	cfs



Yuma Road Section F-F 10-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road F-F, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	003800	ft/ft
Discharg	3.80	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.016	
Water Surface Elev	8.74	ft
Elevation Range	43 to 10.00	
Flow Area	2.4	ft²
Wetted Perimeter	15.72	ft
Top Width	15.41	ft
Actual Depth	0.31	ft
Critical Elevation	8.70	ft
Critical Slope	0.007475	ft/ft
Velocity	1.61	ft/s
Velocity Head	0.04	ft
Specific Energy	8.78	ft
Froude Number	0.73	
Flow Type	Subcritical	

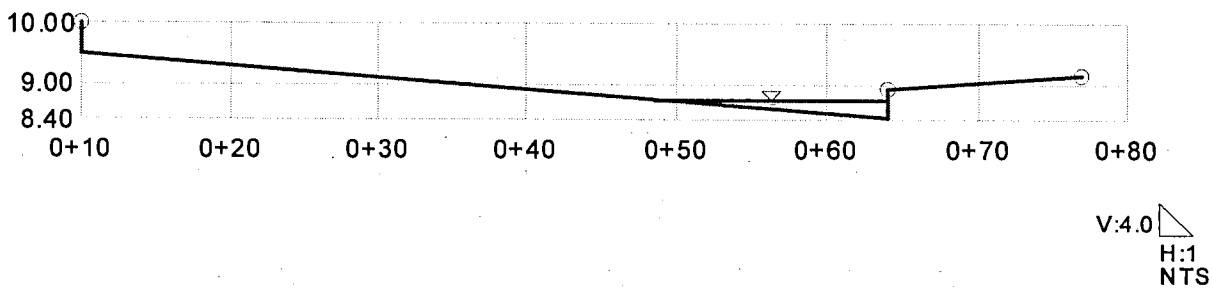
Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+10	0+64	0.016
0+64	0+77	0.030

Natural Channel Points	
Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+64	8.43
0+64	8.93
0+77	9.14

Yuma Road Section F-F 10-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road F-F, 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.003800	ft/ft
Water Surface Elev	8.74	ft
Elevation Range	43 to 10.00	
Discharge	3.80	cfs



Yuma Road Section F-F 100-Year Storm
Worksheet for Irregular Channel

Project Description	
Worksheet	Yuma Road F-F, 10
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	003800	ft/ft
Discharg	5.79	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.016	
Water Surface Elev	8.79	ft
Elevation Range	43 to 10.00	
Flow Area	3.2	ft²
Wetted Perimeter	18.41	ft
Top Width	18.05	ft
Actual Depth	0.36	ft
Critical Elevation	8.75	ft
Critical Slope	0.007067	ft/ft
Velocity	1.79	ft/s
Velocity Head	0.05	ft
Specific Energy	8.84	ft
Froude Number	0.75	
Flow Type	Subcritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+10	0+64	0.016
0+64	0+77	0.030

Natural Channel Points	
Station (ft)	Elevation (ft)
0+10	10.00
0+10	9.50
0+64	8.43
0+64	8.93
0+77	9.14

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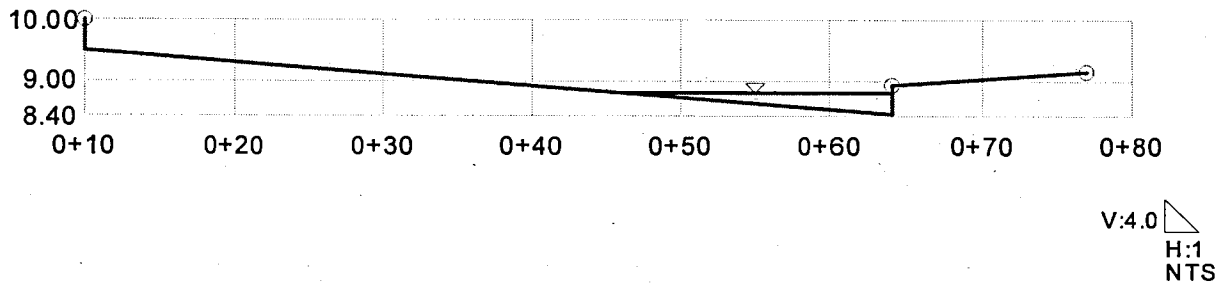
Yuma Road Section F-F 100-Year Storm
Cross Section for Irregular Channel

Project Description	
Worksheet	Yuma Road F-F, 10
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.003800	ft/ft
Water Surface Elev	8.79	ft
Elevation Range	43 to 10.00	
Discharge	5.79	cfs



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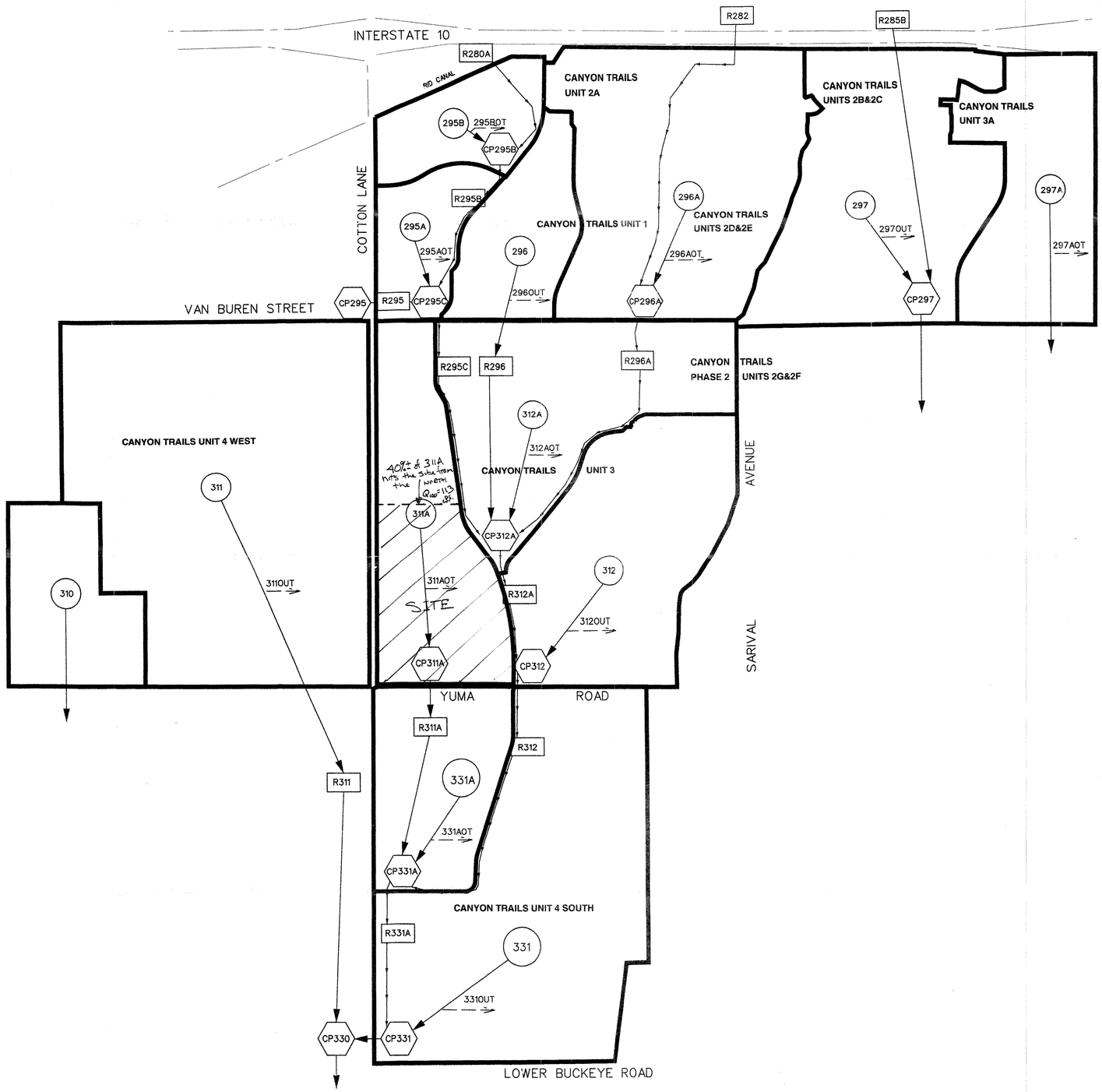

KEY TO SYMBOLS

- 297A — SUB-BASIN ID
- CP296A — CONCENTRATION POINT
- R296A — ROUTE ID
- SUB-BASIN BOUNDARY
- CHANNEL (GREENBELT) FLOWLINE
- RETENTION DIVERSION

800' 400' 0 800'

SCALE: 1" = 800'

Jun. 18, 2004
06:44:07
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CANYON TRAILS

COE & VAN LOO
PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
TELEPHONE (602) 264-6831

HEC-1 ROUTING MAP

JOB NO
020026

PLATE 2

HYDROGRAPH AT	312A	257.	12.33	39.	12.	6.	0.33
DIVERSION TO	296AOT	257.	12.33	39.	12.	6.	0.33
HYDROGRAPH AT	312ART	0.	0.08	0.	0.	0.	0.33
4 COMBINED AT	CP312A	1057.	18.50	750.	258.	124.	109.87
ROUTED TO	R312A	1056.	18.50	749.	258.	124.	109.87
HYDROGRAPH AT	312	232.	12.33	32.	10.	5.	0.36
DIVERSION TO	312OUT	232.	12.33	32.	9.	4.	0.36
HYDROGRAPH AT	312RET	1.	17.00	1.	0.	0.	0.36
2 COMBINED AT	CP312	1056.	18.50	749.	258.	124.	110.23
ROUTED TO	R312	1055.	18.67	749.	258.	124.	110.23
→ HYDROGRAPH AT	311A	283.	12.17	35.	11.	5.	0.26
DIVERSION TO	311AOT	283.	12.17	35.	11.	5.	0.26
HYDROGRAPH AT	311ART	3.	20.50	2.	1.	0.	0.26
ROUTED TO	R311A	3.	21.67	2.	1.	0.	0.26
HYDROGRAPH AT	331A	208.	12.25	31.	10.	5.	0.19
DIVERSION TO	331AOT	208.	12.25	29.	8.	4.	0.19
HYDROGRAPH AT	331ART	11.	13.17	4.	2.	1.	0.19
3 COMBINED AT	CP331A	1055.	18.67	749.	258.	124.	110.67
ROUTED TO	R331A	1054.	18.75	748.	258.	124.	110.67
HYDROGRAPH AT	331	367.	12.42	70.	22.	11.	0.55
DIVERSION TO	331OUT	367.	12.42	49.	14.	7.	0.55
HYDROGRAPH AT	331RET	212.	12.83	28.	8.	4.	0.55
2 COMBINED AT	CP331	1059.	18.75	753.	262.	126.	111.23
HYDROGRAPH AT	311	703.	12.25	111.	36.	17.	0.77
DIVERSION TO	311OUT	703.	12.25	91.	25.	12.	0.77
HYDROGRAPH AT	311RET	197.	12.83	35.	11.	5.	0.77
ROUTED TO	R311	125.	13.25	34.	11.	5.	0.77
HYDROGRAPH AT	330	484.	12.67	80.	22.	10.	0.59
DIVERSION TO	330RET	460.	12.58	41.	11.	5.	0.59
HYDROGRAPH AT	330OUT	460.	12.75	42.	11.	5.	0.59
2 COMBINED AT	11330	352.	12.83	52.	16.	8.	38.03
2 COMBINED AT	CP330	1059.	18.75	756.	271.	130.	149.26
ROUTED TO	R330	1008.	19.25	727.	262.	126.	149.26
HYDROGRAPH AT	346A	102.	13.00	21.	5.	3.	0.16
2 COMBINED AT	CP346A	1176.	19.00	843.	308.	148.	48.75
DIVERSION TO	DI346C	1090.	19.00	801.	297.	143.	48.75
HYDROGRAPH AT	D346A	86.	19.00	42.	10.	5.	48.75
ROUTED TO	R346A	84.	20.17	42.	10.	5.	48.75

← 40% of 311A affects Canyon Trails Towne Center.
= .40 × 283
= 113 cfs