DRAINAGE REPORT
FOR
SKYSONG ASU SCOTTSDALE
INNOVATION CENTER
INFRASTRUCTURE IMPROVEMENTS

Revised June 21, 2006
May 4, 2006
WP #052562 and WP #062663

Prepared For:

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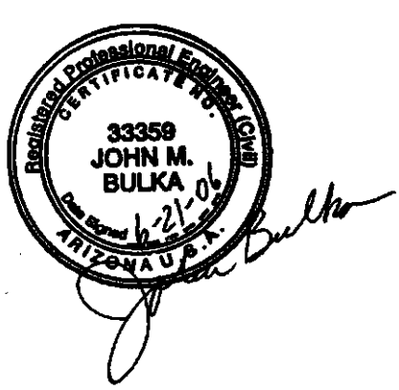

ENGINEER

Prepared By: Jesse Heywood E.I.T.

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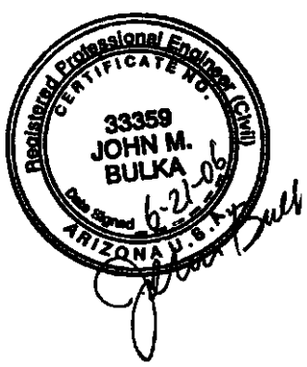

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1.0 INTRODUCTION

This Drainage Report for The Skysong ASU Scottsdale Innovation Center Infrastructure Street Improvements has been prepared as required by the City of Scottsdale. The Skysong ASU Scottsdale Innovation Center is a proposed in-fill project within the City of Scottsdale, Arizona. This development lies in Section 2, Township 1 North, Range 4 East of the Gila and Salt River Meridian. More particularly the site is located at the southeast corner of McDowell and Scottsdale Roads. (Please see Appendix 1, Vicinity Map.)

The Los Arcos Mall occupied this site for over 30 years, until its recent demolition. The existing mall site consisted of several large buildings located in the center of the site with parking around the perimeter. The proposed site is approximately 36.6 acres with land use to consist of office, research, residential and retail buildings. The mix of uses has not been fully determined at this time. At the ultimate build out condition, the site will have approximately 1.2 million square feet of commercial space and 604 residential condominium units. In addition, the City of Scottsdale will be building approximately 95,000 square feet of office space along with a possible 200 room hotel. The first phase of construction will consist of mass grading the entire site, constructing the major roads and utility infrastructure, and constructing one building shell and parking lot. Future buildings and parking areas will be constructed as determined by the developer. This report will analyze the drainage condition for the majority of the infrastructure improvements.

2.0 DESCRIPTION OF EXISTING DRAINAGE CONDITIONS

2.1 Existing On-Site Conditions

The existing site was formally the Los Arcos Mall and is currently vacant undeveloped land. The site slopes generally from northwest to southeast at approximately 1.0%. The site is bounded by Scottsdale Road to the west, McDowell Road to the north, 74th Street to the east, and an alley adjoining a multi family residential complex to the south. Other site features include large open pits on the site where old basements from the mall were located. (Please see Appendix 2, Existing Drainage Map.)

The Los Arcos Mall occupied this site for over 30 years, until its recent demolition. The mall site consisted of several large buildings located in the center of the site with parking around the perimeter. In a Memorandum prepared by Engineering and Environmental Consultants Inc. dated April 19, 2005 it is reported that onsite stormwater retention facilities were not accounted for, and the stormwater runoff generated from the site drained directly to the adjacent streets. This stormwater was conveyed to the east, through the Scottsdale municipal storm drain system, and ultimately to the Indian Bend Wash. In the Memorandum the existing Los Arcos Mall drainage pattern was analyzed as summarized below. (Please see Appendix 6, Memorandum by Engineering & Environmental Consultants.)

Table 1 Approximate Peak Discharge from Los Arcos Mall Site

Discharge to:	Drainage Area [acres]	10-year [cfs]	100-year [cfs]
Scottsdale Rd	8.8	48	91
McDowell Rd	7.8	43	81
74th Street	20.4	103	196
Total:	**37.0**	**194**	**368**

2.2 Offsite Conditions

The stormwater runoff from this site, outfalls directly to the adjacent City of Scottsdale Municipal storm drain system. This system consists of an existing 6-foot by 6-foot concrete box culvert located in McDowell Road. According to City of Scottsdale Utility Maps this storm drain travels east and eventually outfalls into Indian Bend Wash. There is an existing 60-inch storm drain in Scottsdale Road that that drains to the south. This pipe then turns east

along the south property line of the site and increases to a 72-inch storm drain pipe. This 72-inch pipe travels east along the south property line and is located in an existing 20-foot drainage easement. It then continues east to Miller Road where it increases to a 78-inch storm drain pipe. According to City of Scottsdale Utility Maps the pipe drains south on Roosevelt where it then turns east and eventually outfalls into Indian Bend Wash. The 60-inch storm drain and 6-foot by 6-foot box culvert are hydraulically connected at a manhole located in the intersection of McDowell Road and Scottsdale Road.

The *City of Scottsdale Storm Water Master Plan and Management Program,* prepared by KVL Consultants Inc., states that this site would discharge approximately 122 c.f.s. into the 72-inch pipe located at the southeast property corner during the 10-year storm event. The management program also states that the 72-inch pipe has sufficient capacity to accept this flow. We have calculated this 10 year flow to be approximately 200 c.f.s.

As a part of the City of Scottsdale Capital Improvement Program (C.I.P.), a 42-inch storm drain is planned to be constructed at the southeast corner of the site in 74th Street. According to the City of Scottsdale, this future storm drain will alleviate stormwater flow that is part of an existing 72-inch storm drain pipe.

2.3 Flood Hazard Zone

The Maricopa County, Arizona and Incorporated Areas Flood Insurance Rate Map (FIRM) Panel Number 04013C2160F, dated September 30, 2005 (see Appendix 3), indicates that the entire site falls in Flood zone "X".

Zone "X" is defined by FEMA as follows:

Areas determined to be outside the 0.2% annual chance floodplain.

3.0 PROPOSED DRAINAGE PLAN

3.1 General Description

This site will ultimately be developed in multiple phases. The first phase of construction will consist of mass grading the entire site, constructing the major roads and utility infrastructure, and constructing one building shell and parking lot. Future buildings and parking areas will be constructed as determined by the developer. The first phase of construction will include temporary de-silting basins. These de-silting basins have been designed for the undeveloped condition and will be removed as each quadrant of the site is developed.

This report addresses the impact of the infrastructure access roads to the overall drainage patterns of the site. This storm drain infrastructure will follow the preliminary drainage design that is outlined in the *Preliminary Drainage Report for ASU Scottsdale Center for New Technology and Innovation,* by Wood/Patel & Associates dated 10/31/2005. Runoff from the easterly half of the site will be collected at the southeast corner of the development and discharge to the existing 72-inch storm drain which conveys stormwater to the east to Indian Bend Wash. The westerly half of the site will be collected via inlets and also be conveyed to the existing 72-inch storm drain.

3.2 Stormwater Storage Requirements

On-site detention is not required per the stipulations defined in Case #26-ZN-2004 Section 3.2 Master Drainage Plan & Report. Therefore, a request for a Stormwater Storage Waiver was not submitted as a part of the submittal. Since the Los Arcos Mall historically did not provide any appreciable stormwater storage, this development will only need to provide retention for the excess of the post development stormwater runoff versus the pre development. The Los Arcos Mall consisted almost entirely of impervious parking lots and rooftops. Similarly this development has a land use of commercial, research, retail and/or residential with a runoff coefficient of 0.9. Therefore, the proposed development should not generate more runoff than what occurred when the Los Arcos Mall was in operation.

3.3 Project Phasing

The project will be built in phases. The first phase consists of mass grading the entire site, constructing the major roads and utility infrastructure, and constructing one building shell and parking lot. The major roads include the two main access roads running north-south and east-

west, which will bisect the site into quarter sections. All wet utilities including storm drain pipe, sanitary sewer, and water are provided in these access roads. These utilities are sized for the estimated demands that the site will have at projected ultimate build out. Since the project is still in the early phases of planning the exact limits and land use of each phase are unknown at this time. Ultimately, the site may consist of approximately 1.2 million square feet of commercial research and design office space and 609 residential condominiums. The City of Scottsdale may also build approximately 95,000 square feet of office space along with a possible 200 room hotel.

This project will not be performing any work in the right-of-way on Scottsdale and McDowell Road or within 30' of the back of curb. All turn lanes, deceleration lanes and bus bays that connect to this project are to be designed by others. These improvements are to be done as part of a larger street improvement project. The City of Scottsdale is also proposing angled parking along the 74th Street Right-of-Way which may alter the existing drainage patterns in 74th Street. This work is also to be performed by others.

4.0 SPECIAL CONDITIONS

4.1 Special Conditions

Currently, there are no washes with 100-year flows greater than 50cfs that traverses the project site. Where existing washes or planned drainage corridors convey greater than 50cfs, a drainage easement will be provided.

5.0 DATA ANALYSIS METHODS

5.1 Hydrologic Procedures

The drainage improvements will be developed consistent with Chapter 4 of the, *Design Standards and Policies Manual*, City of Scottsdale. The Rational Method has been used to quantify peak discharge values for the central concentration points on the site. (Please see Appendix 4, Drainage Calculations and Appendix 5, Drainage Map.)

5.2 Hydraulic Procedures

Onsite storm sewer has been designed to accommodate the 10-year storm event. Similarly, catch basins are designed according to their inlet capacity. StormCAD Version 5.0, by Haestad Methods, was utilized to analyze the proposed storm sewer system.

The methodology developed by the Federal Highway Administration is used to calculate the allowable street cross-section capacities. Street capacity is designed for an allowable depth of 8-inches per the City of Scottsdale Ordinance 37-42 (4).

5.3 Stormwater Storage Calculations

Onsite detention is not required per the stipulations defined in Case # 26-ZN-2004 Section 3.2 Master Drainage Plan & Report.

6.0 CONCLUSIONS

Based on the results of this report, we can conclude:

- The proposed major drainage infrastructure will be designed in accordance with the City of Scottsdale *Design Standards & Policies Manual* and the City's Capital Improvement Program.

- The Rational Method has been used to estimate peak discharges for all drainage areas in this report.

- Temporary de-silting basins have been installed to provide temporary erosion control and storm water detention in order to accommodate the undeveloped 100 year, 2 hour storm event.

- The storm drain infrastructure has been sized to drain the site at the ultimate build out condition.

- Onsite permanent detention will not be provided per the stipulations defined in Case # 26-ZN-2004 Section 3.2 Master Drainage Plan & Report at ultimate build out of this development.

- The onsite drives have been designed to convey the 100-year storm event with an allowable depth of 8-inches per City of Scottsdale Ordinance 37-42 (4).

- The flow capacity of each storm drain pipe, catch basin, and inlet has been designed to accept the 10-year storm event.

- The post development runoff characteristics will be similar to the pre development conditions for this development as a result of the consistent runoff characteristics of the existing and proposed developments.

7.0 WARNING AND DISCLAIMER OF LIABILITY

Appendix 4-C

Warning and Disclaimer of Liability

The Drainage and Floodplain Regulations and Ordinances of the City of Scottsdale are intended to "minimize the occurrence of losses, hazards and conditions adversely affecting the public health, safety and general welfare which might result from flooding caused by the surface runoff of rainfall" (Scottsdale Revised Code §37-16).

As defined in S.R.C. §37-17, a flood plain or "*Special flood hazard* area means an area having flood and/or flood related erosion hazards as shown on a FHBM or FIRM as zone A, AO, A1-30, AE, A99, AH, or E, and those areas identified as such by the floodplain administrator, delineated in accordance with subsection 37-18(b) and adopted by the floodplain board." It is possible that a property could be inundated by greater frequency flood events or by a flood greater in magnitude than a 100-year flood. Additionally, much of the Scottsdale area is a dynamic flood area; that is, the floodplains may shift from one location to another, over time, due to natural processes.

WARNING AND DISCLAIMER OF LIABILITY PURSUANT TO S.R.C §37-22
"The degree of flood protection provided by the requirements in this article is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Floods larger than the base flood can and will occur on rare occasions. Floodwater heights may be increased by manmade or natural causes. This article (Chapter 37, Article II) shall not create liability on the part of the city, any officer or employee thereof, or the federal government for any flood damages that result from reliance on this article or any administrative decision lawfully made thereunder."

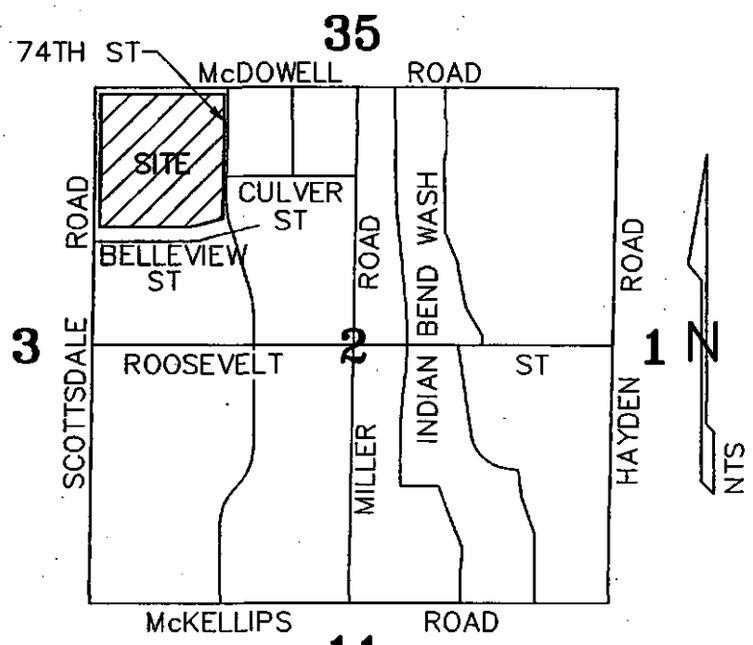
Compliance with Drainage and Floodplain Regulations and Ordinances does not insure complete protection from flooding. The Floodplain Regulations and Ordinances meet established local and federal standards for floodplain management, but neither this review nor the Regulations and Ordinances take into account such flood related problems as natural erosion, streambed meander or man-made obstructions and diversions, all of which may have an adverse affect in the event of a flood. You are advised to consult your own engineer or other expert regarding these considerations.

I have read and understand the above. If I am an agent for an owner I have made the owner aware of and explained this disclaimer.

_____	_____	_____
Plan Check No.	Owner or Agent	Date

APPENDIX 1

Vicinity Map



VICINITY MAP

NW 1/4 SECTION 2, T-1N, R-4E

VICINITY MAP

ASU CENTER FOR NEW TECHNOLOGY
SCOTTSDALE, AZ

ENGINEER	T. WONSESKI
DESIGNER	J. HEYWOOD
CAD TECHNICIAN	D. SAYRE
SCALE	NTS
DATE	09-26-05
JOB NUMBER	052562
REF. SHEET	1 OF 1

WOOD/PATEL ASSOCIATES INC.
Civil Engineers, Hydrologists and Land Surveyors
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(480) 834-3300
(480) 834-3320 FAX

APPENDIX 2

Existing Drainage Map

APPENDIX 3

Flood Insurance Rate Map

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

0 300 600 M

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2160F

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 2160 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	2160	F
MESA, CITY OF	040048	2160	F
SCOTTSDALE, CITY OF	045012	2160	F
TEMPE, CITY OF	040054	2160	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C2160F
MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

MAP SCALE 1" = 1000'

0 1000 2000 FEET

0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2160F

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 2160 OF 4350

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MAP NUMBER

04013C2160F

MAP REVISED

SEPTEMBER 30, 2005

Federal Emergency Management Agency

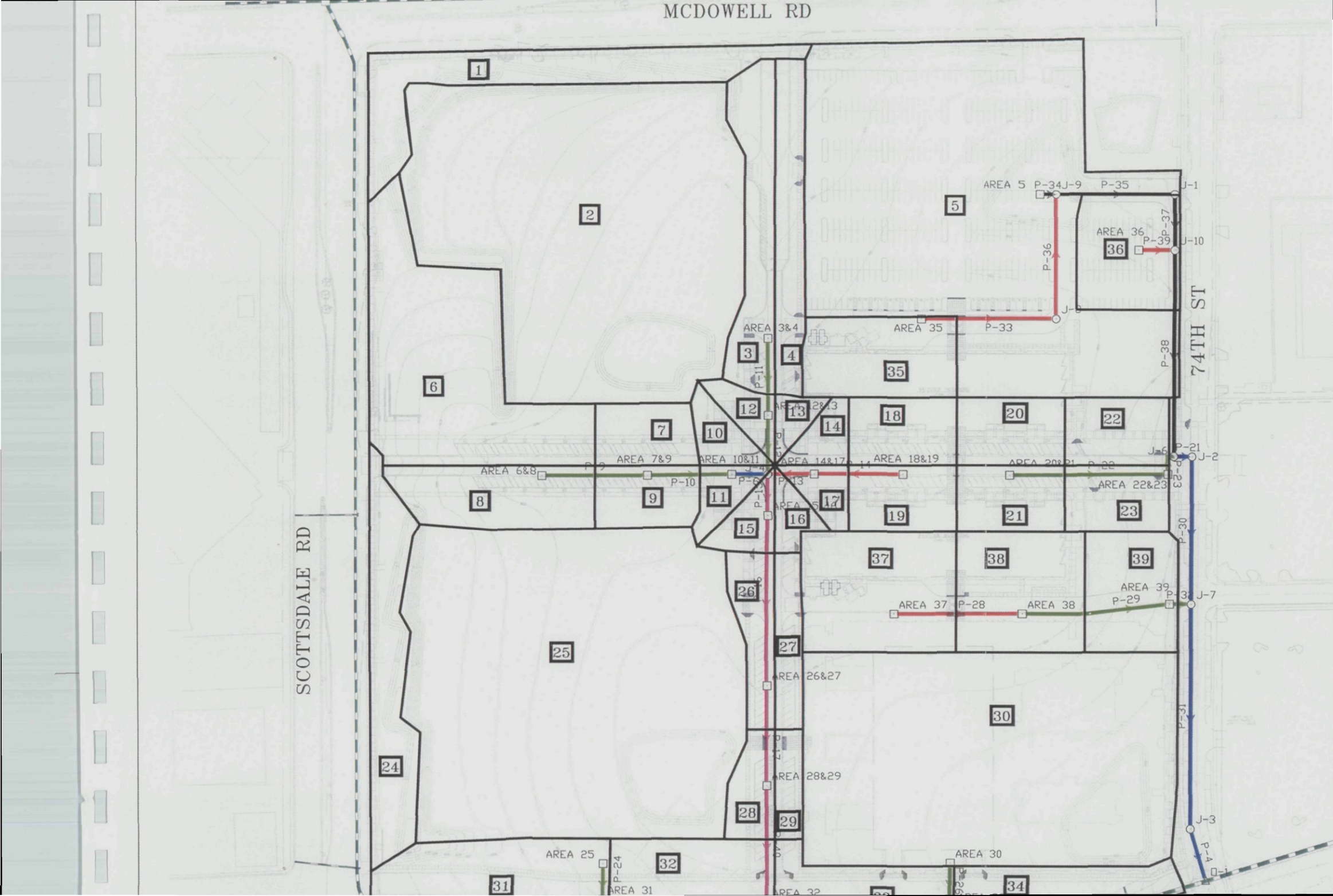
APPENDIX 4

Drainage Calculations

Drainage Calculations
ASU SCOTTSDALE CENTER FOR NEW TECHNOLOGY
6/21/2006
W/P Job No. 052562

See Drainage Map Exhibit for Sub-Area Designations
Q = C x I x A

Area Designation	Area (SF)	Area (Acres)	Runoff Coefficient	Time of Conc. (min)	I(2) in/hr	Q(2) cfs	I(10) in/hr	Q(10) cfs	I(25) in/hr	Q(25) cfs	I(50) in/hr	Q(50) cfs	I(100) in/hr	Q(100) cfs
1	39,870	0.92	0.90	5	3.7	3.05	6.1	5.02	7.0	5.77	8.0	6.59	9.2	7.58
2	208,019	4.78	0.90	5	3.7	15.90	6.1	26.22	7.0	30.09	8.0	34.38	9.2	39.54
3	28,257	0.65	0.90	5	3.7	2.16	6.1	3.56	7.0	4.09	8.0	4.67	9.2	5.37
4	22,732	0.52	0.90	5	3.7	1.74	6.1	2.86	7.0	3.29	8.0	3.76	9.2	4.32
5	220,095	5.05	0.90	5	3.7	16.83	6.1	27.74	7.0	31.83	8.0	36.38	9.2	41.84
6	80,168	1.84	0.90	5	3.7	6.13	6.1	10.10	7.0	11.59	8.0	13.25	9.2	15.24
7	14,268	0.33	0.90	5	3.7	1.09	6.1	1.80	7.0	2.06	8.0	2.36	9.2	2.71
8	27,913	0.64	0.90	5	3.7	2.13	6.1	3.52	7.0	4.04	8.0	4.61	9.2	5.31
9	14,836	0.34	0.90	5	3.7	1.13	6.1	1.87	7.0	2.15	8.0	2.45	9.2	2.82
10	7,754	0.18	0.90	5	3.7	0.59	6.1	0.98	7.0	1.12	8.0	1.28	9.2	1.47
11	7,200	0.17	0.90	5	3.7	0.55	6.1	0.91	7.0	1.04	8.0	1.19	9.2	1.37
12	6,716	0.15	0.90	5	3.7	0.51	6.1	0.85	7.0	0.97	8.0	1.11	9.2	1.28
13	4,692	0.11	0.90	5	3.7	0.36	6.1	0.59	7.0	0.68	8.0	0.78	9.2	0.89
14	6,734	0.15	0.90	5	3.7	0.51	6.1	0.85	7.0	0.97	8.0	1.11	9.2	1.28
15	7,787	0.18	0.90	5	3.7	0.60	6.1	0.98	7.0	1.13	8.0	1.29	9.2	1.48
16	5,695	0.13	0.90	5	3.7	0.44	6.1	0.72	7.0	0.82	8.0	0.94	9.2	1.08
17	6,704	0.15	0.90	5	3.7	0.51	6.1	0.84	7.0	0.97	8.0	1.11	9.2	1.27
18	16,483	0.38	0.90	5	3.7	1.26	6.1	2.08	7.0	2.38	8.0	2.72	9.2	3.13
19	16,212	0.37	0.90	5	3.7	1.24	6.1	2.04	7.0	2.34	8.0	2.68	9.2	3.08
20	16,664	0.38	0.90	5	3.7	1.27	6.1	2.10	7.0	2.41	8.0	2.75	9.2	3.17
21	16,388	0.38	0.90	5	3.7	1.25	6.1	2.07	7.0	2.37	8.0	2.71	9.2	3.12
22	16,202	0.37	0.90	5	3.7	1.24	6.1	2.04	7.0	2.34	8.0	2.68	9.2	3.08
23	15,934	0.37	0.90	5	3.7	1.22	6.1	2.01	7.0	2.30	8.0	2.63	9.2	3.03
24	35,319	0.81	0.90	5	3.7	2.70	6.1	4.45	7.0	5.11	8.0	5.84	9.2	6.71
25	229,390	5.27	0.90	5	3.7	17.54	6.1	28.91	7.0	33.18	8.0	37.92	9.2	43.60
26	14,283	0.33	0.90	5	3.7	1.09	6.1	1.80	7.0	2.07	8.0	2.36	9.2	2.71
27	11,161	0.26	0.90	5	3.7	0.85	6.1	1.41	7.0	1.61	8.0	1.84	9.2	2.12
28	10,470	0.24	0.90	5	3.7	0.80	6.1	1.32	7.0	1.51	8.0	1.73	9.2	1.99
29	6,987	0.16	0.90	5	3.7	0.53	6.1	0.88	7.0	1.01	8.0	1.15	9.2	1.33
30	181,125	4.16	0.90	5	3.7	13.85	6.1	22.83	7.0	26.20	8.0	29.94	9.2	34.43
31	49,023	1.13	0.90	5	3.7	3.75	6.1	6.18	7.0	7.09	8.0	8.10	9.2	9.32
32	33,998	0.78	0.90	5	3.7	2.60	6.1	4.28	7.0	4.92	8.0	5.62	9.2	6.46
33	25,963	0.60	0.90	5	3.7	1.98	6.1	3.27	7.0	3.75	8.0	4.29	9.2	4.94
34	26,411	0.61	0.90	5	3.7	2.02	6.1	3.33	7.0	3.82	8.0	4.37	9.2	5.02
35	27,989	0.64	0.90	5	3.7	2.14	6.1	3.53	7.0	4.05	8.0	4.63	9.2	5.32
36	27,192	0.62	0.90	5	3.7	2.08	6.1	3.43	7.0	3.93	8.0	4.49	9.2	5.17
37	42,272	0.97	0.90	5	3.7	3.23	6.1	5.33	7.0	6.11	8.0	6.99	9.2	8.04
38	35,554	0.82	0.90	5	3.7	2.72	6.1	4.48	7.0	5.14	8.0	5.88	9.2	6.76
39	25,710	0.59	0.90	5	3.7	1.97	6.1	3.24	7.0	3.72	8.0	4.25	9.2	4.89
TOTAL	1,590,171	36.51				121.56		200.41		229.98		262.84		302.26


MCDOWELL RD
SCOTTSDALE RD
74TH ST
AREA 5
P-34
J-9
P-35
J-1
AREA 36
P-39
P-37
J-10
P-36
J-8
AREA 35
P-33
P-38
AREA 3&4
P-11
AREA 7&9
AREA 10&11
AREA 14&17
AREA 18&19
AREA 20&21
P-22
AREA 22&23
P-21
J-2
J-6
P-23
AREA 6&8
P-9
P-10
P-8
P-13
P-14
P-12
AREA 37
P-28
AREA 38
AREA 39
P-29
P-32
J-7
P-30
AREA 26&27
P-31
AREA 28&29
J-3
P-4
AREA 25
P-24
AREA 31
AREA 30
AREA 32
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Onsite Rational Method Hydrology Worksheet
Reference: City of Scottsdale Engineering & Design Standards
Date: 6/21/2006

Known Values:
Design Storm: 10 & 100 Years

Calculated Values:
Tc=drainage length/avg.velocity/60
Q=CiA

Location of Drainage Sub Area denoted on Drainage Map.

Concentration Point Drainage Sub Area	Area (sq ft)	Area (ac)	Weighted "C" Value	Length of Area (ft)	Average Velocity (fps)	Initial Time of Concen. (min)	Time of Concen. (min)[1]	Half Street Flow Cap. w/ overtopping (cfs)[2]	10 - Year Intensity (in/hr)	10 - Year Q (cfs)	10 - Year Uncaptured flow from Upstream (cfs)	10 - Year Total Q (cfs)	10 - Year Captured (cfs)	10 - Year Bypass (cfs)	Intensity (in/hr)
Plaza Blvd															
6	80,168	1.8	0.90	240	9.3	0	0	49.1	6.1	10.1	0	10.1	10.1	0	9.2
8	27,913	0.6	0.90	240	9.3	0	0	49.1	6.1	3.5	0	3.5	3.5	0	9.2
7	14,268	0.3	0.90	80	4.0	0	0	21.1	6.1	1.8	0	1.8	1.8	0	9.2
9	14,836	0.3	0.90	80	4.0	0	0	21.1	6.1	1.9	0	1.9	1.9	0	9.2
10	7,754	0.2	0.90	50	8.1	0	0	42.7	6.1	1.0	0	1.0	1.0	0	9.2
11	7,200	0.2	0.90	50	8.1	0	0	42.7	6.1	0.9	0	0.9	0.9	0	9.2
14	6,734	0.2	0.90	50	4.0	0	0	21.1	6.1	0.8	0	0.8	0.8	0	9.2
17	6,704	0.2	0.90	50	4.0	0	0	21.1	6.1	0.8	0	0.8	0.8	0	9.2
18	16,483	0.4	0.90	80	8.1	0	0	42.7	6.1	2.1	0	2.1	2.1	0	9.2
19	16,212	0.4	0.90	80	8.1	0	0	42.7	6.1	2.0	0	2.0	2.0	0	9.2
20	16,664	0.4	0.90	80	4.0	0	0	21.1	6.1	2.1	0	2.1	2.1	0	9.2
21	16,388	0.4	0.90	80	4.0	0	0	21.1	6.1	2.1	0	2.1	2.1	0	9.2
22	16,202	0.4	0.90	130	7.8	0	0	41.1	6.1	2.0	0	2.0	1.9	0.2	9.2
23	15,934	0.4	0.90	130	7.8	0	0	41.1	6.1	2.0	0	2.0	1.8	0.2	9.2
Center Street															
3	28,257	0.6	0.90	420	5.0	0	1	23.0	6.1	3.6	0	3.6	3.6	0	9.2
4	22,732	0.5	0.90	420	5.0	0	1	23.0	6.1	2.9	0	2.9	2.9	0	9.2
12	6,716	0.2	0.90	75	4.2	0	0	19.2	6.1	0.8	0	0.8	0.8	0	9.2
13	4,692	0.1	0.90	75	4.2	0	0	19.2	6.1	0.6	0	0.6	0.6	0	9.2
15	7,787	0.2	0.90	75	4.2	0	0	19.2	6.1	1.0	0	1.0	1.0	0	9.2
16	5,695	0.1	0.90	75	4.2	0	0	19.2	6.1	0.7	0	0.7	0.7	0	9.2
26	14,283	0.3	0.90	200	4.2	0	1	19.2	6.1	1.8	0	1.8	1.8	0	9.2
27	11,161	0.3	0.90	200	4.2	0	1	19.2	6.1	1.4	0	1.4	1.4	0	9.2
South Drive															
31	49,023	1.1	0.9	355	5.4	0	1	32.3	6.1	6.2	0	6.2	3.2	3.0	9.2
32	33,998	0.8	0.9	245	4.2	0	1	25.3	6.1	4.3	3.0	7.2	5.6	1.6	9.2
33	25,963	0.6	0.9	280	3.6	0	1	21.8	6.1	3.3	1.6	4.9	4.5	0.4	9.2
34	26,411	0.6	0.9	230	3.6	0	1	21.8	6.1	3.3	0.4	3.7	3.7	0	9.2

[1] Minimum time of concentration used is 5 minutes.

[2] Includes flows above the crown elevation up to the specified flow depth elevation of 0.5'.

Street Capacity Computations

6" Vertical Curb

Description: Calculation of Local Street Flow Conveyance Capacity for Local Street

References: Federal Highway Administration, Hydraulic Engineering Circular No. 22, "Drainage of Highway Pavements", November 1996

Known Values:

Depth of Flow = 0.5 ft

Cross Slope = 0.02 ft/ft

Street Width (F/C to F/C) = 24 ft

Manning's "n" Value= 0.015

Calculated Values:

Referenced Equations:

$Q = 0.56 * (S_x^{1.67}) * (S^{0.5}) * (T^{2.67}) / n$ for flow below crown (FHWA Procedure)

$Q = 1.486 * A * (R^{0.67}) * (S^{0.5}) / n$ for flow above crown (Manning's equation)

where Q = flow rate, cfs; T = width of flow, ft; S_x = cross slope, ft/ft; A = conveyance area, sq ft; S = longitudinal slope, ft/ft; R = hydraulic radius, ft

Longitudinal Slope ft/ft	*Conveyance Area sq ft*	*Velocity fps*	*Full Street Flow Capacity[1] cfs*	*1/2 Street Flow Without Overtopping, cfs[1][2]*	*1/2 Street Flow with Overtopping, cfs[1][3]*
0.0050	9.12	3.56	33	3	16
0.0055	9.12	3.74	34	3	17
0.0060	9.12	3.90	36	3	18
0.0065	9.12	4.06	37	3	19
0.0070	9.12	4.22	38	3	19
0.0075	9.12	4.36	40	4	20
0.0080	9.12	4.51	41	4	21
0.0085	9.12	4.65	42	4	21
0.0090	9.12	4.78	44	4	22
0.0095	9.12	4.91	45	4	22
0.0100	9.12	5.04	46	4	23
0.0105	9.12	5.16	47	4	24
0.0110	9.12	5.29	48	4	24
0.0115	9.12	5.41	49	4	25
0.0120	9.12	5.52	50	5	25
0.0125	9.12	5.64	51	5	26
0.0130	9.12	5.75	52	5	26
0.0135	9.12	5.86	53	5	27
0.0140	9.12	5.96	54	5	27
0.0145	9.12	6.07	55	5	28
0.0150	9.12	6.17	56	5	28
0.0250	9.12	7.97	73	7	36
0.0350	9.12	9.43	86	8	43
0.0450	9.12	10.69	98	9	49
0.0550	9.12	11.82	108	10	54
0.0650	9.12	12.85	117	11	59

Notes:

1.) Street flow capacity does not include local gutter depression effect.

2.) Half-street flow capacity is limited to the lower of the crown elevation or top of curb elevation.

3.) Includes flows above the crown elevation up to the specified flow depth elevation.

Center Street Flow Capacity

Project: ASU Scottsdale Center
Date: 06/21/06

Description: Calculation of Local Street Flow Conveyance Capacity
References: Federal Highway Administration, Hydraulic Engineering
Circular No. 12,"Drainage of Highway Pavements", March 1984
CITY OF SCOTTSDALE ENGINEERING & DESIGN STANDARDS

Known Values:

Depth of Flow = 0.5 ft
Cross Slope = 0.02 $^{ft}/_{ft}$
Street Width (F/C to F/C) = 24 ft
Manning's "n" Value= 0.015

Calculated Values:

Referenced Equations:

$Q = 0.56 * (S_x^{1.67}) * (S^{0.5}) * (T^{2.67}) / n$ for flow below crown (FHWA Procedure)

$Q = 1.486 * A * (R^{0.67}) * (S^{0.5}) / n$ for flow above crown (Manning's equation)

where Q = flow rate, cfs; T = width of flow, ft
S_x = cross slope, ft/ft; A = conveyance area, sq ft
S = longitudinal slope, ft/ft; R = hydraulic radius, ft

Drainage Sub Area[1]	*Longitudinal Slope ft/ft*	*Conveyance Area sq ft*	*Velocity fps*	*Full Street Capacity*[2] *cfs*	*1/2 Street Flow with overtopping*[4] *cfs*	*1/2 Street Flow w/o overtopping*[2,3] *cfs*	*Actual 100 yr Flow (cfs)*
3	0.0100	9.12	5.04	46	23	4.13	5.37
4	0.0100	9.12	5.04	46	23	4.13	4.32
12	0.0070	9.12	4.22	38	19	3.46	1.28
13	0.0070	9.12	4.22	38	19	3.46	0.89
15	0.0070	9.12	4.22	38	19	3.46	1.48
16	0.0070	9.12	4.22	38	19	3.46	1.08
26	0.0070	9.12	4.22	38	19	3.46	2.71
27	0.0070	9.12	4.22	38	19	3.46	2.12

[1] Location Denoted on Drainage Map
[2] Street flow capacity does not include local gutter depression effect.
[3] Half-street flow capacity is limited to the lower of the crown elevation or top of curb elevation.
[4] Includes flows above the crown elevation up to the specified flow depth elevation.

Plaza Blvd. Flow Capacity

Project: ASU Scottsdale Center
Date: 06/21/06

Description: Calculation of Local Street Flow Conveyance Capacity
References: Federal Highway Administration, Hydraulic Engineering Circular No. 12,"Drainage of Highway Pavements", March 1984
CITY OF SCOTTSDALE ENGINEERING & DESIGN STANDARDS

Known Values:

Depth of Flow = 0.5 ft
Cross Slope = 0.02 $^{ft}/_{ft}$
Street Width (F/C to F/C) = 30 ft
Manning's "n" Value= 0.015

Calculated Values:

Referenced Equations:

$Q = 0.56 * (S_x^{1.67}) * (S^{0.5}) * (T^{2.67}) / n$ for flow below crown (FHWA Procedure)

$Q = 1.486 * A * (R^{0.67}) * (S^{0.5}) / n$ for flow above crown (Manning's equation)

where Q = flow rate, cfs T = width of flow, ft
S_x = cross slope, ft/ft A = conveyance area, sq ft
S = longitudinal slope, ft/ft R = hydraulic radius, ft

Drainage Sub Area[1]	*Longitudinal Slope ft/ft*	*Conveyance Area sq ft*	*Velocity fps*	*Full Street Capacity*[2] *cfs*	*1/2 Street Flow with overtopping*[4] *cfs*	*1/2 Street Flow w/o overtopping*[2,3] *cfs*	*Actual 100 yr Flow (cfs)*
6	0.0380	10.50	9.35	98	49	14.62	15.24
8	0.0380	10.50	9.35	98	49	14.62	5.31
7	0.0070	10.50	4.01	42	21	6.27	2.71
9	0.0070	10.50	4.01	42	21	6.27	2.82
10	0.0288	10.50	8.14	85	43	12.73	1.47
11	0.0288	10.50	8.14	85	43	12.73	1.37
14	0.0070	10.50	4.01	42	21	6.27	1.28
17	0.0070	10.50	4.01	42	21	6.27	1.27
18	0.0288	10.50	8.14	85	43	12.73	3.13
19	0.0288	10.50	8.14	85	43	12.73	3.08
20	0.0070	10.50	4.01	42	21	6.27	3.17
21	0.0070	10.50	4.01	42	21	6.27	3.12
22	0.0267	10.50	7.84	82	41	12.25	3.08
23	0.0267	10.50	7.84	82	41	12.25	3.03

[1] Location Denoted on Drainage Map

[2] Street flow capacity does not include local gutter depression effect.

[3] Half-street flow capacity is limited to the lower of the crown elevation or top of curb elevation.

[4] Includes flows above the crown elevation up to the specified flow depth elevation.

South Drive Flow Capacity

Project: ASU Scottsdale Center
Date: 06/21/06

Description: Calculation of Local Street Flow Conveyance Capacity
References: Federal Highway Administration, Hydraulic Engineering
Circular No. 12,"Drainage of Highway Pavements", March 1984
CITY OF SCOTTSDALE ENGINEERING & DESIGN STANDARDS

Known Values:

Depth of Flow = 0.5 ft
Cross Slope = 0.02 $^{ft}/_{ft}$
Street Width (F/C to F/C) = 40 ft
Manning's "n" Value= 0.015

Calculated Values:

Referenced Equations:

$Q = 0.56 * (S_x^{1.67}) * (S^{0.5}) * (T^{2.67}) / n$ for flow below crown (FHWA Procedure)

$Q = 1.486 * A * (R^{0.67}) * (S^{0.5}) / n$ for flow above crown (Manning's equation)

where Q = flow rate, cfs; T = width of flow, ft; S_x = cross slope, ft/ft; A = conveyance area, sq ft; S = longitudinal slope, ft/ft; R = hydraulic radius, ft

Drainage Sub Area [1]	*Longitudinal Slope ft/ft*	*Conveyance Area sq ft*	*Velocity fps*	*Full Street Capacity* [2] *cfs*	*1/2 Street Flow with overtopping* [4] *cfs*	*1/2 Street Flow w/o overtopping* [2,3] *cfs*	*Actual 100 yr Flow (cfs)*
31	0.0153	12.00	5.38	65	32	19.99	9.32
32	0.0094	12.00	4.22	51	25	15.67	6.46
33	0.0070	12.00	3.64	44	22	13.52	4.94
34	0.0070	12.00	3.64	44	22	13.52	5.02

[1] Location Denoted on Drainage Map

[2] Street flow capacity does not include local gutter depression effect.

[3] Half-street flow capacity is limited to the lower of the crown elevation or top of curb elevation.

[4] Includes flows above the crown elevation up to the specified flow depth elevation.

Inlet Capacity Calculations
ASU SCOTTSDALE CENTER FOR NEW TECHNOLOGY

6/21/2006
W/P Job No. 052562

								MIN. REQUIRED					
Area Designation	Condition	Area (SF)	Area (Acres)	Runoff Coefficient	Time of Conc. (min)	I(10) in/hr	Q(10) cfs	MAG 535 Double Grate[2]	MAG 535 Single Grate[3]	MAG 537 2'x2'[4]	City of Phoenix Det. P1569-2 M1 L=3'[5]	City of Phoenix Det. P1569-2 M1 L=6'[5]	City of Phoenix Det. P1569-2 M1 L=10'[5]
Onsite Areas[6]													
3	Sump	28,257	0.65	0.9	5	6.10	3.56	-	-	X	-	-	-
4	Sump	22,732	0.52	0.9	5	6.10	2.86	-	-	X	-	-	-
5	Sump	220,095	5.05	0.9	5	6.10	27.74	-	X	-	-	-	-
6	Sump	80,168	1.84	0.9	5	6.10	10.10	-	X	-	-	-	-
7	Sump	14,268	0.33	0.9	5	6.10	1.80	-	-	X	-	-	-
8	Sump	27,913	0.64	0.9	5	6.10	3.52	-	-	X	-	-	-
9	Sump	14,836	0.34	0.9	5	6.10	1.87	-	-	X	-	-	-
10	Sump	7,754	0.18	0.9	5	6.10	0.98	-	-	X	-	-	-
11	Sump	7,200	0.17	0.9	5	6.10	0.91	-	-	X	-	-	-
12	Sump	6,716	0.15	0.9	5	6.10	0.85	-	-	X	-	-	-
13	Sump	4,692	0.11	0.9	5	6.10	0.59	-	-	X	-	-	-
14	Sump	6,734	0.15	0.9	5	6.10	0.85	-	-	X	-	-	-
15	Sump	7,787	0.18	0.9	5	6.10	0.98	-	-	X	-	-	-
16	Sump	5,695	0.13	0.9	5	6.10	0.72	-	-	X	-	-	-
17	Sump	6,704	0.15	0.9	5	6.10	0.84	-	-	X	-	-	-
18	Sump	16,483	0.38	0.9	5	6.10	2.08	-	-	X	-	-	-
19	Sump	16,212	0.37	0.9	5	6.10	2.04	-	-	X	-	-	-
20	Sump	16,664	0.38	0.9	5	6.10	2.10	-	-	X	-	-	-
21	Sump	16,388	0.38	0.9	5	6.10	2.07	-	-	X	-	-	-
22	On Grade	16,202	0.37	0.9	5	6.10	2.04	-	-	-	-	X	-
23	On Grade	15,934	0.37	0.9	5	6.10	2.01	-	-	-	-	X	-
26	Sump	14,283	0.33	0.9	5	6.10	1.80	-	-	X	-	-	-
27	Sump	11,161	0.26	0.9	5	6.10	1.41	-	-	X	-	-	-
28	Sump	10,470	0.24	0.9	5	6.10	1.32	-	-	X	-	-	-
29	Sump	6,987	0.16	0.9	5	6.10	0.88	-	-	X	-	-	-
31	On Grade	49,023	1.13	0.9	5	6.10	6.18	-	X	-	-	-	-
32	On Grade	33,998	0.78	0.9	5	6.10	4.28	-	-	-	-	-	X
33	On Grade	25,963	0.60	0.9	5	6.10	3.27	-	-	-	-	-	X
34	Sump	26,411	0.61	0.9	5	6.10	3.33	-	-	-	-	X	-
35	Sump	27,989	0.64	0.9	5	6.10	3.53	-	-	X	-	-	-
36	Sump	27,192	0.62	0.9	5	6.10	3.43	-	-	X	-	-	-
37	Sump	42,272	0.97	0.9	5	6.10	5.33	-	-	-	-	X	-
38	Sump	35,554	0.82	0.9	5	6.10	4.48	-	-	-	-	X	-
39	On Grade	25,710	0.59	0.9	5	6.10	3.24	-	-	-	-	X	-

[1]FOR ON GRADE CATCH BASINS SEE ATTACHED ADOT DRAINAGE DESIGN PROGRAM PRINTOUTS.
[2]MAG STANDARD INLET 535 TYPE F DOUBLE GRATE CAN INTAKE 14.3 cfs WITH 6" OF HEAD .
[3]MAG STANDARD INLET 535 TYPE F SINGLE GRATE CAN INTAKE 6.4 cfs WITH 6" OF HEAD .
[4]MAG STANDARD INLET 537 TYPE G CAN INTAKE 3.8 cfs WITH 6" OF HEAD .
[5]City of Phoenix Det. P1569-2 INLET SEE ATTACHED SPREADSHEET FOR FLOW INTAKE.
[6]Area 5 & 6 will allow greater depths of ponding due to location.

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-30-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 22 CHECKER - _____ PAGE _____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS 10 yr flow
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.670
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	2.040
SPREAD-Ft.--T	=	7.198
Average Velocity-V-fps	=	3.661
FLOW in Gutter-CFS--Q	=	1.072
% Flow in Gutter-CFS	=	52.545
Velocity of Flow in Gutter-fps	=	4.805
Depth at Curb Line-Inches--d	=	2.391

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	2.040
Gutter Velocity at INLET-fps	=	6.000
GUTTER FLOW at INLET-CFS--Q	=	1.716
Depth at INLET Curb Line-Inches--d	=	3.924
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	13.144
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.382	0.779	1.261
6.583	0.714	1.456	0.584
→ 9.583	0.905	1.846	0.194
13.583	1.000	2.040	0.000
20.583	1.000	2.040	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-28-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 2a CHECKER - _____ PAGE _____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

100 yr flow

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.670
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	3.080
SPREAD-Ft.--T	=	8.543
Average Velocity-V-fps	=	4.005
FLOW in Gutter-CFS--Q	=	1.389
% Flow in Gutter-CFS	=	45.108
Velocity of Flow in Gutter-fps	=	5.319
Depth at Curb Line-Inches--d	=	2.713

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	3.080
Gutter Velocity at INLET-fps	=	6.551
GUTTER FLOW at INLET-CFS--Q	=	2.198
Depth at INLET Curb Line-Inches--d	=	4.343
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	17.009
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.302	0.931	2.149
6.583	0.586	1.804	1.276
→ 9.583	0.775	2.387	0.693
13.583	0.944	2.908	0.172
20.583	1.000	3.080	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-30-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 23 CHECKER - _____ PAGE _____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION 10 yr flow

Roadway Grade-% Per cent--G	=	2.670
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	2.010
SPREAD-Ft.--T	=	7.153
Average Velocity-V-fps	=	3.649
FLOW in Gutter-CFS--Q	=	1.062
% Flow in Gutter-CFS	=	52.830
Velocity of Flow in Gutter-fps	=	4.788
Depth at Curb Line-Inches--d	=	2.380

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	2.010
Gutter Velocity at INLET-fps	=	5.980
GUTTER FLOW at INLET-CFS--Q	=	1.700
Depth at INLET Curb Line-Inches--d	=	3.909
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	13.026
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.385	0.774	1.236
6.583	0.718	1.444	0.566
→ 9.583	0.909	1.827	0.183
13.583	1.000	2.010	0.000
20.583	1.000	2.010	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-28-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 23 CHECKER - _____ PAGE _____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

100 yr flow

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.670
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	3.030
SPREAD-Ft.--T	=	8.486
Average Velocity-V-fps	=	3.991
FLOW in Gutter-CFS--Q	=	1.375
% Flow in Gutter-CFS	=	45.385
Velocity of Flow in Gutter-fps	=	5.298
Depth at Curb Line-Inches--d	=	2.700

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	3.030
Gutter Velocity at INLET-fps	=	6.529
GUTTER FLOW at INLET-CFS--Q	=	2.177
Depth at INLET Curb Line-Inches--d	=	4.326
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	16.832
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.305	0.925	2.105
6.583	0.591	1.789	1.241
→9.583	0.780	2.365	0.665
13.583	0.948	2.873	0.157
20.583	1.000	3.030	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-30-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 31 CHECKER - _____ PAGE_____
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION 10 yr Flow

Roadway Grade-% Per cent--G	=	1.530
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.500
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.062
Manning's 'N	=	0.015
Flow-CFS--Q	=	6.180
SPREAD-Ft.--T	=	12.570
Average Velocity-V-fps	=	3.806
FLOW in Gutter-CFS--Q	=	2.038
% Flow in Gutter-CFS	=	32.981
Velocity of Flow in Gutter-fps	=	5.115
Depth at Curb Line-Inches--d	=	3.719

GRATE TYPE: NON-STD. GRATE

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	6.000
Capture Ratio -- GRATE	=	0.800
Effective Perimeter--Ft.	=	7.000
Splash-Over Velocity--FPS	=	5.400
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	6.180
GUTTER FLOW at INLET-CFS--Q	=	2.491
Gutter Velocity at INLET-fps	=	5.577
Depth at INLET Curb Line-Inches--d	=	4.605
Frontal Flow Intercepted by GRATE--CFS	=	2.857
Lateral Flow Intercepted by GRATE--CFS	=	0.360
TOTAL Flow Intercepted by GRATE--CFS	=	3.217 ←
% FLOW Intercepted	=	52.055
By-pass Flow--CFS	=	2.963 ←

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-30-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 31 CHECKER - _____ PAGE _____
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS 100 yr flow
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.530
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.500
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.062
Manning's 'N	=	0.015
Flow-CFS--Q	=	9.320
SPREAD-Ft.--T	=	14.755
Average Velocity-V-fps	=	4.196
FLOW in Gutter-CFS--Q	=	2.624
% Flow in Gutter-CFS	=	28.151
Velocity of Flow in Gutter-fps	=	5.654
Depth at Curb Line-Inches--d	=	4.243

GRATE TYPE: NON-STD. GRATE

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	6.000
Capture Ratio -- GRATE	=	0.800
Effective Perimeter--Ft.	=	7.000
Splash-Over Velocity--FPS	=	5.400
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	9.320
GUTTER FLOW at INLET-CFS--Q	=	3.142
Gutter Velocity at INLET-fps	=	6.105
Depth at INLET Curb Line-Inches--d	=	5.148
Frontal Flow Intercepted by GRATE--CFS	=	3.526
Lateral Flow Intercepted by GRATE--CFS	=	0.495
TOTAL Flow Intercepted by GRATE--CFS	=	4.021 ←
% FLOW Intercepted	=	43.141
By-pass Flow--CFS	=	5.299 ←

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-11-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 32 CHECKER - _____ PAGE_____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

10 yr flow + 2.96 cfs bypass flow from upstream inlet #31

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.940
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	7.240
SPREAD-Ft.--T	=	14.731
Average Velocity-V-fps	=	3.277
FLOW in Gutter-CFS--Q	=	1.929
% Flow in Gutter-CFS	=	26.639
Velocity of Flow in Gutter-fps	=	4.418
Depth at Curb Line-Inches--d	=	4.199

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	7.240
Gutter Velocity at INLET-fps	=	5.128
GUTTER FLOW at INLET-CFS--Q	=	2.729
Depth at INLET Curb Line-Inches--d	=	6.008
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	24.197
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.218	1.575	5.665
6.583	0.435	3.152	4.088
9.583	0.597	4.319	2.921
→ 13.583	0.773	5.597	1.643
20.583	0.967	7.004	0.236

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-11-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 32 CHECKER - _____ PAGE____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS 100yr flow + 5.3 cfs bypass flow from upstream inlet #31
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.940
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	11.760
SPREAD-Ft.--T	=	17.752
Average Velocity-V-fps	=	3.686
FLOW in Gutter-CFS--Q	=	2.597
% Flow in Gutter-CFS	=	22.082
Velocity of Flow in Gutter-fps	=	4.973
Depth at Curb Line-Inches--d	=	4.924

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	11.760
Gutter Velocity at INLET-fps	=	5.660
GUTTER FLOW at INLET-CFS--Q	=	3.521
Depth at INLET Curb Line-Inches--d	=	6.770
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	32.788
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.163	1.915	9.845
6.583	0.332	3.904	7.856
9.583	0.463	5.448	6.312
→13.583	0.618	7.270	4.490
20.583	0.831	9.774	1.986

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-11-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 33 CHECKER - _____ PAGE_____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS 10 yr flow + 1.64 cfs bypass flow from upstream inlet #32
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.700
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	4.910
SPREAD-Ft.--T	=	13.417
Average Velocity-V-fps	=	2.669
FLOW in Gutter-CFS--Q	=	1.436
% Flow in Gutter-CFS	=	29.238
Velocity of Flow in Gutter-fps	=	3.595
Depth at Curb Line-Inches--d	=	3.883

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	4.910
Gutter Velocity at INLET-fps	=	4.216
GUTTER FLOW at INLET-CFS--Q	=	2.076
Depth at INLET Curb Line-Inches--d	=	5.671
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	17.859
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.289	1.419	3.491
6.583	0.563	2.764	2.146
9.583	0.750	3.680	1.230
→13.583	0.924	4.535	0.375
20.583	1.000	4.910	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-11-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 33 CHECKER - _____ PAGE _____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS 100yr flow + 4.49 cfs bypass flow from upstream inlet #32
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.700
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	9.430
SPREAD-Ft.--T	=	17.260
Average Velocity-V-fps	=	3.125
FLOW in Gutter-CFS--Q	=	2.142
% Flow in Gutter-CFS	=	22.718
Velocity of Flow in Gutter-fps	=	4.215
Depth at Curb Line-Inches--d	=	4.805

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	9.430
Gutter Velocity at INLET-fps	=	4.811
GUTTER FLOW at INLET-CFS--Q	=	2.923
Depth at INLET Curb Line-Inches--d	=	6.646
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	26.956
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.196	1.852	7.578
6.583	0.396	3.733	5.697
9.583	0.546	5.153	4.277
→ 13.583	0.717	6.760	2.670
20.583	0.925	8.727	0.703

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

05-02-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 39 CHECKER - _____ PAGE_____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

10 yr flow

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.650
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	3.240
SPREAD-Ft.--T	=	11.570
Average Velocity-V-fps	=	2.351
FLOW in Gutter-CFS--Q	=	1.096
% Flow in Gutter-CFS	=	33.827
Velocity of Flow in Gutter-fps	=	3.159
Depth at Curb Line-Inches--d	=	3.440

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	3.240
Gutter Velocity at INLET-fps	=	3.766
GUTTER FLOW at INLET-CFS--Q	=	1.639
Depth at INLET Curb Line-Inches--d	=	5.186
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	13.482
Capture Ratio -- CURB OPENING	=	0.800

	LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
	3.083	0.373	1.210	2.030
	6.583	0.701	2.270	0.970
→	9.583	0.893	2.893	0.347
	13.583	1.000	3.240	0.000
	20.583	1.000	3.240	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

05-02-2006

PROJECT NAME- ASU Scottsdale TRACS NO.- _____
HIGHWAY NAME- _____ DESIGNER - _____
LOCATION - Area 39 CHECKER - _____ PAGE_____
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS 100 yr flow
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.650
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.059
Gutter Depression-Inches--	=	1.003
Manning's 'N	=	0.015
Flow-CFS--Q	=	4.890
SPREAD-Ft.--T	=	13.590
Average Velocity-V-fps	=	2.593
FLOW in Gutter-CFS--Q	=	1.412
% Flow in Gutter-CFS	=	28.868
Velocity of Flow in Gutter-fps	=	3.492
Depth at Curb Line-Inches--d	=	3.925

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	4.890
Gutter Velocity at INLET-fps	=	4.089
GUTTER FLOW at INLET-CFS--Q	=	2.035
Depth at INLET Curb Line-Inches--d	=	5.716
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	17.563
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.294	1.435	3.455
6.583	0.571	2.790	2.100
→ 9.583	0.758	3.708	1.182
13.583	0.931	4.552	0.338
20.583	1.000	4.890	0.000

Sump Catch Basin Orifice Calculation

ASU SCOTTSDALE CENTER

6/21/2006

WP Job No. 052562

For ponding depths 6" and over...

Known values and Equations

Q (cfs)[1]=$C_o hL(2gd_o)^{1/2}$		**d_i[3] (ft)=**	0.66
C_o=	0.67	**d_o (ft)=**	d_i-h/2
h (ft)=	0.46	**d_o (ft)=**	0.43

See Drainage Map for Drainage Sub Area. See Infrastructure Plans for exact location of Catch Basins.

Drainage Sub Area #	Q_{10}[2] (cfs)	Number of Catch Basins	Clogging Factor	Required Catch Basin Length (ft)	Catch Basin Type	Design Catch Basin Length (ft)
34	3.7	1	0.80	2.9	M-1 L=6'	9
37	5.3	1	0.80	4.1	M-1 L=6'	9
38	4.5	1	0.80	3.5	M-1 L=6'	9

Notes

(1) Per FCDMC Drainage Design Manual, Volume II, Hydraulics, equation 3.10.

(2) Catch basin design based on the 10-year peak discharge. Also includes any bypassed flow from upstream inlets.

(3) City of Phoenix Det. P1569-2 includes a 2" local depression which when added to a 6" curb height produces a total depth of 8".

Sump Catch Basin Orifice Calculation

ASU SCOTTSDALE CENTER

6/21/2006

WP Job No. 052562

For ponding depths 6" and over...

Known values and Equations

Q (cfs)[1]=$C_o hL(2gd_0)^{1/2}$		**d_i[3] (ft)=**	0.66
C_o=	0.67	**d_o (ft)=**	d_i-h/2
h (ft)=	0.46	**d_o (ft)=**	0.43

See Drainage Map for Drainage Sub Area. See Infrastructure Plans for exact location of Catch Basins.

Drainage Sub Area #	Q_{100}[2] (cfs)	Number of Catch Basins	Clogging Factor	Required Catch Basin Length (ft)	Catch Basin Type	Design Catch Basin Length (ft)
34	7.7	1	0.80	5.9	M1, L=6'	9
37	8.0	1	0.80	6.2	M1, L=6'	9
38	6.8	1	0.80	5.2	M1, L=6'	9

Notes

(1) Per FCDMC Drainage Design Manual, Volume II, Hydraulics, equation 3.10.

(2) Catch basin design based on the 100-year peak discharge.

(3) City of Phoenix Det. P1569-2 includes a 2" local depression which when added to a 6" curb height produces a total depth of 8".

Weir/Orifice Flow Capacities of MAG 537 'G'

Project : ASU Scottsdale
Date 06/21/06

Weir EQ. $Q_i = C_w P d^{1.5} (C_f)$ **Orifice EQ.** $Q_i = C_o A (2gd)^{0.5} (C_f)$

Where: $C_w = 3.0$, $C_o = 0.67$, and C_f = clogging factor = 0.5

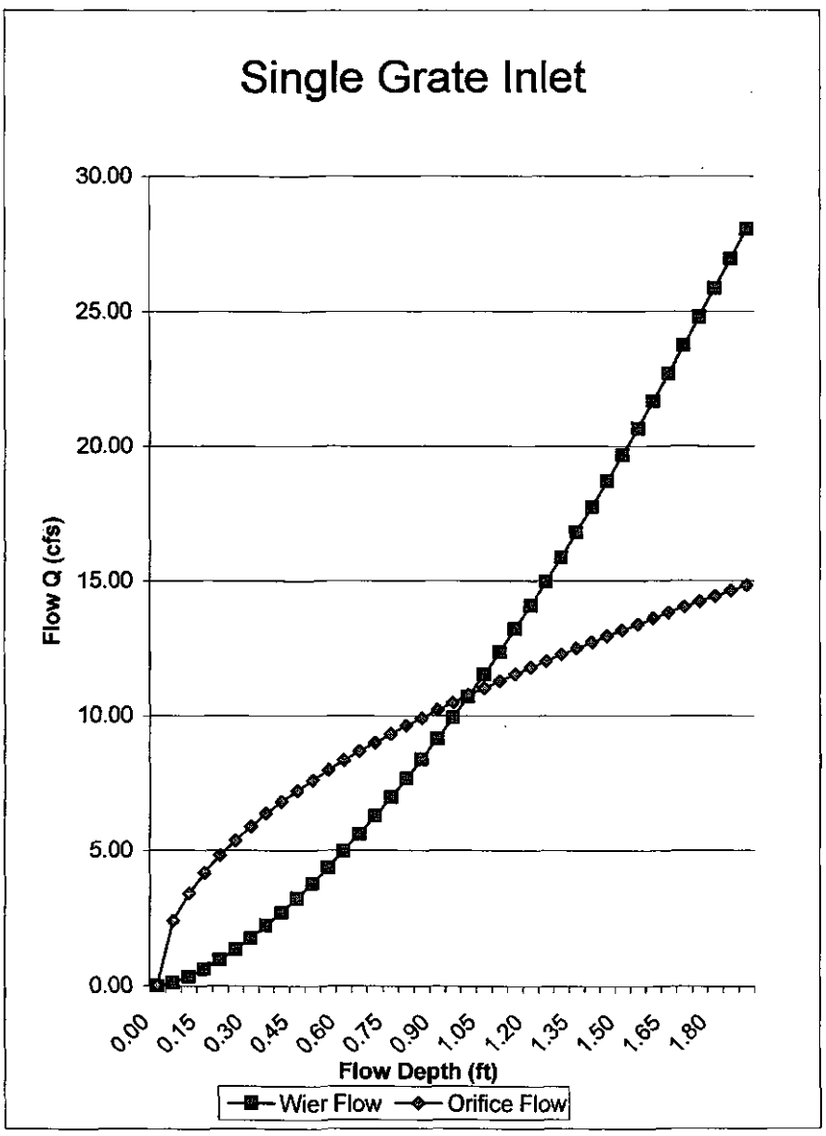
Single Grate (MAG 537 - type G)

P = 7.14 ft

A = 4.00 sq.ft.

where,
P = Perimeter of Catchbasin minus
area of longitudinal & lateral bars
A = Total area of grate minus
area of longitudinal & lateral bars

Depth (ft)	Weir Qi (cfs)	Orifice Qi (cfs)
0.00	**0.00**	0.00
0.05	**0.12**	2.40
0.10	**0.34**	3.40
0.15	**0.62**	4.16
0.20	**0.96**	4.81
0.25	**1.34**	5.38
0.30	**1.76**	5.89
0.35	**2.22**	6.36
0.40	**2.71**	6.80
0.45	**3.23**	7.21
0.50	**3.79**	7.60
0.55	**4.37**	7.97
0.60	**4.98**	8.33
0.65	**5.61**	8.67
0.70	**6.27**	9.00
0.75	**6.96**	9.31
0.80	**7.66**	9.62
0.85	**8.39**	9.91
0.90	**9.14**	10.20
0.95	**9.92**	10.48
1.00	**10.71**	10.75
1.05	11.52	**11.02**
1.10	12.36	**11.28**
1.15	13.21	**11.53**
1.20	14.08	**11.78**
1.25	14.97	**12.02**
1.30	15.87	**12.26**
1.35	16.80	**12.49**
1.40	17.74	**12.72**
1.45	18.70	**12.95**
1.50	19.68	**13.17**
1.55	20.67	**13.39**
1.60	21.68	**13.60**
1.65	22.70	**13.81**
1.70	23.74	**14.02**
1.75	24.79	**14.23**
1.80	25.86	**14.43**
1.85	26.95	**14.63**
1.90	28.05	**14.82**



Weir/Orifice Flow Capacities of MAG 535 'F'

Project : ASU Scottsdale
Date 06/21/06

Weir EQ. $Q_i = C_w P d^{1.5} (C_f)$ **Orifice EQ.** $Q_i = C_o A (2gd)^{0.5} (C_f)$

Where: $C_w = 3.0$, $C_o = 0.67$, and C_f = clogging factor = 0.5

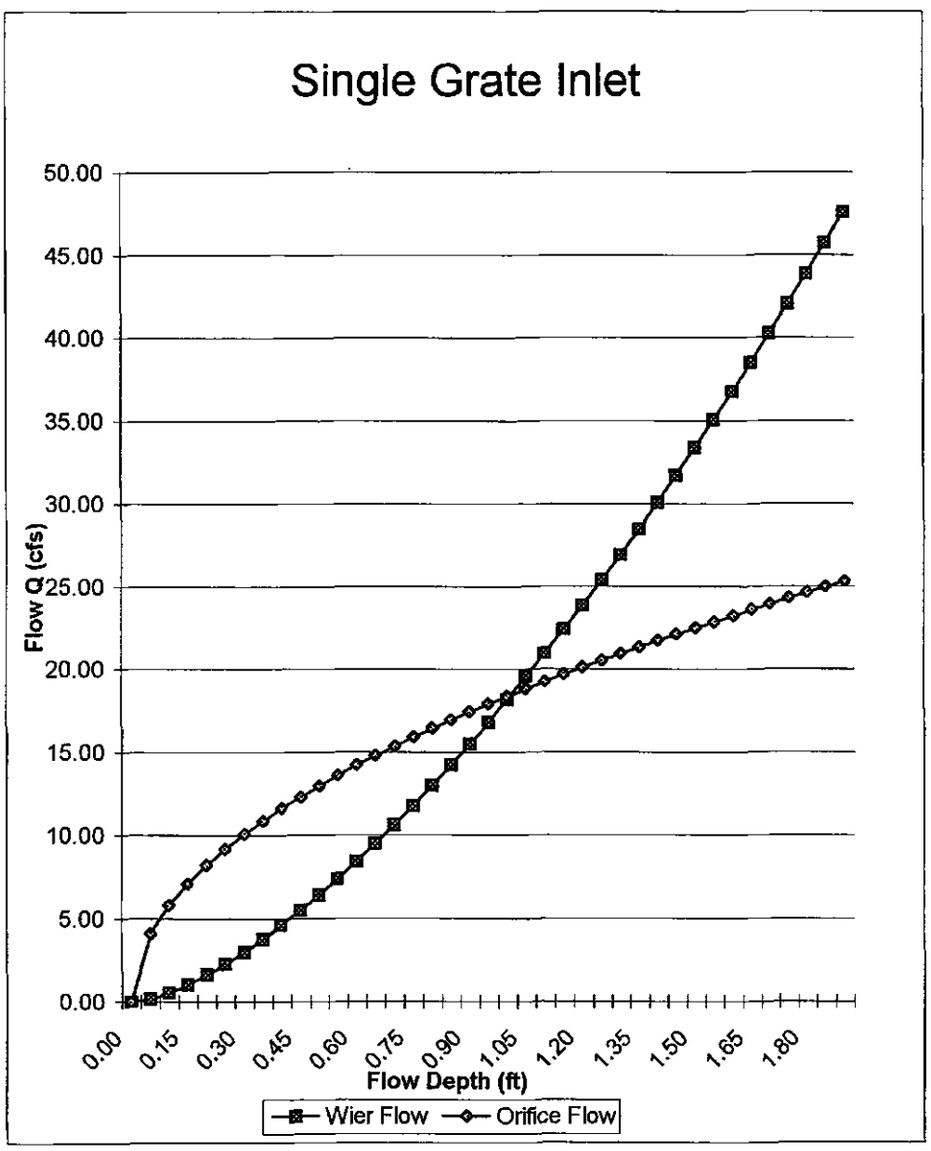
Single Grate (MAG 535 - type F)

P = 12.11 ft

A = 6.83 sq.ft.

where,
P = Perimeter of Catchbasin minus area of longitudinal & lateral bars
A = Total area of grate minus area of longitudinal & lateral bars

Depth (ft)	Weir Qi (cfs)	Orifice Qi (cfs)
0.00	**0.00**	0.00
0.05	**0.20**	4.11
0.10	**0.57**	5.81
0.15	**1.06**	7.11
0.20	**1.62**	8.22
0.25	**2.27**	9.19
0.30	**2.98**	10.06
0.35	**3.76**	10.87
0.40	**4.60**	11.62
0.45	**5.48**	12.32
0.50	**6.42**	12.99
0.55	**7.41**	13.62
0.60	**8.44**	14.23
0.65	**9.52**	14.81
0.70	**10.64**	15.37
0.75	**11.80**	15.91
0.80	**13.00**	16.43
0.85	**14.24**	16.94
0.90	**15.51**	17.43
0.95	**16.82**	17.91
1.00	**18.17**	18.37
1.05	19.54	**18.82**
1.10	20.96	**19.27**
1.15	22.40	**19.70**
1.20	23.88	**20.12**
1.25	25.39	**20.54**
1.30	26.92	**20.95**
1.35	28.49	**21.34**
1.40	30.09	**21.74**
1.45	31.72	**22.12**
1.50	33.37	**22.50**
1.55	35.05	**22.87**
1.60	36.76	**23.24**
1.65	38.50	**23.60**
1.70	40.26	**23.95**
1.75	42.05	**24.30**
1.80	43.87	**24.65**
1.85	45.71	**24.99**
1.90	47.57	**25.32**



Weir/Orifice Flow Capacities of Double Grate Inlet

Weir EQ. $Q_i = C_w P d^{1.5}$ **Orifice EQ.** $Q_i = C_o A (2gd)^{0.5}$

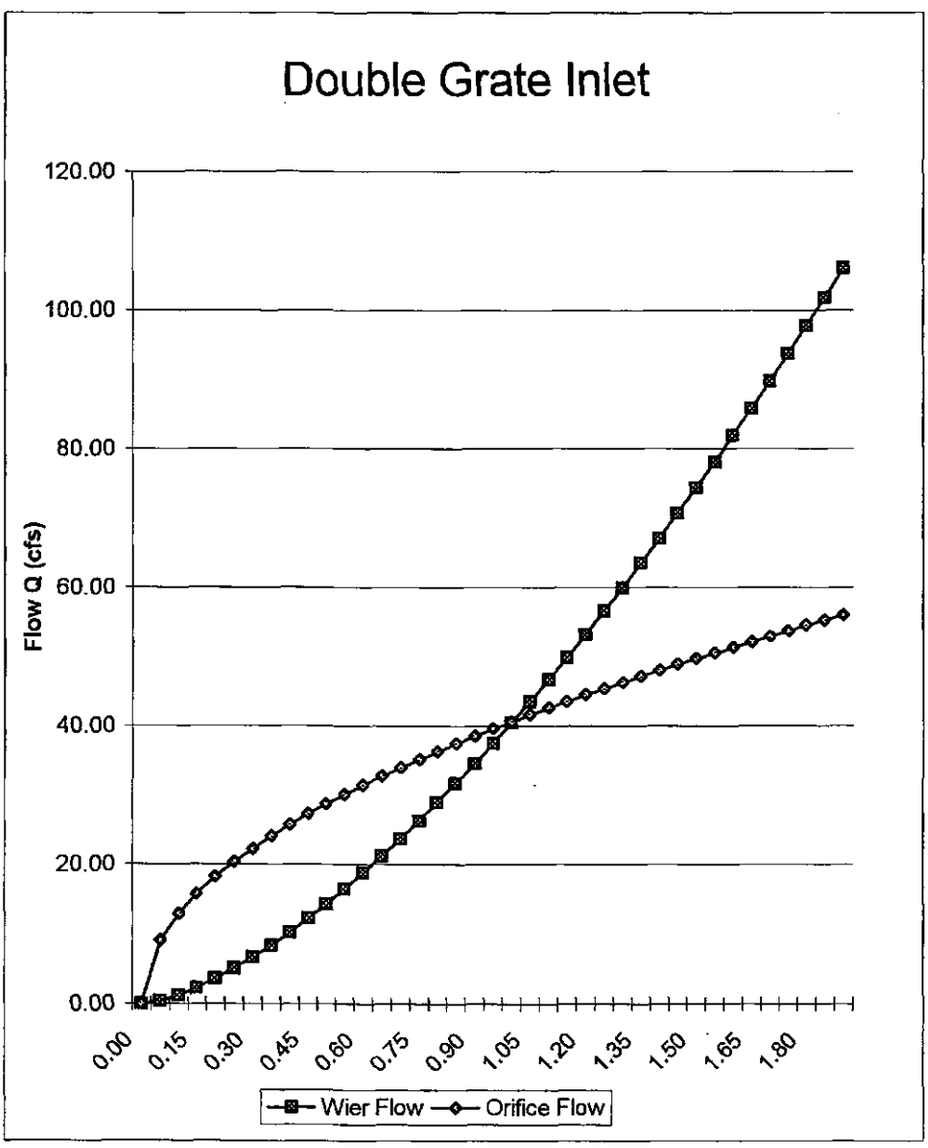
Where: $C_w = 3.0$ **and** $C_o = 0.67$

Double Grate

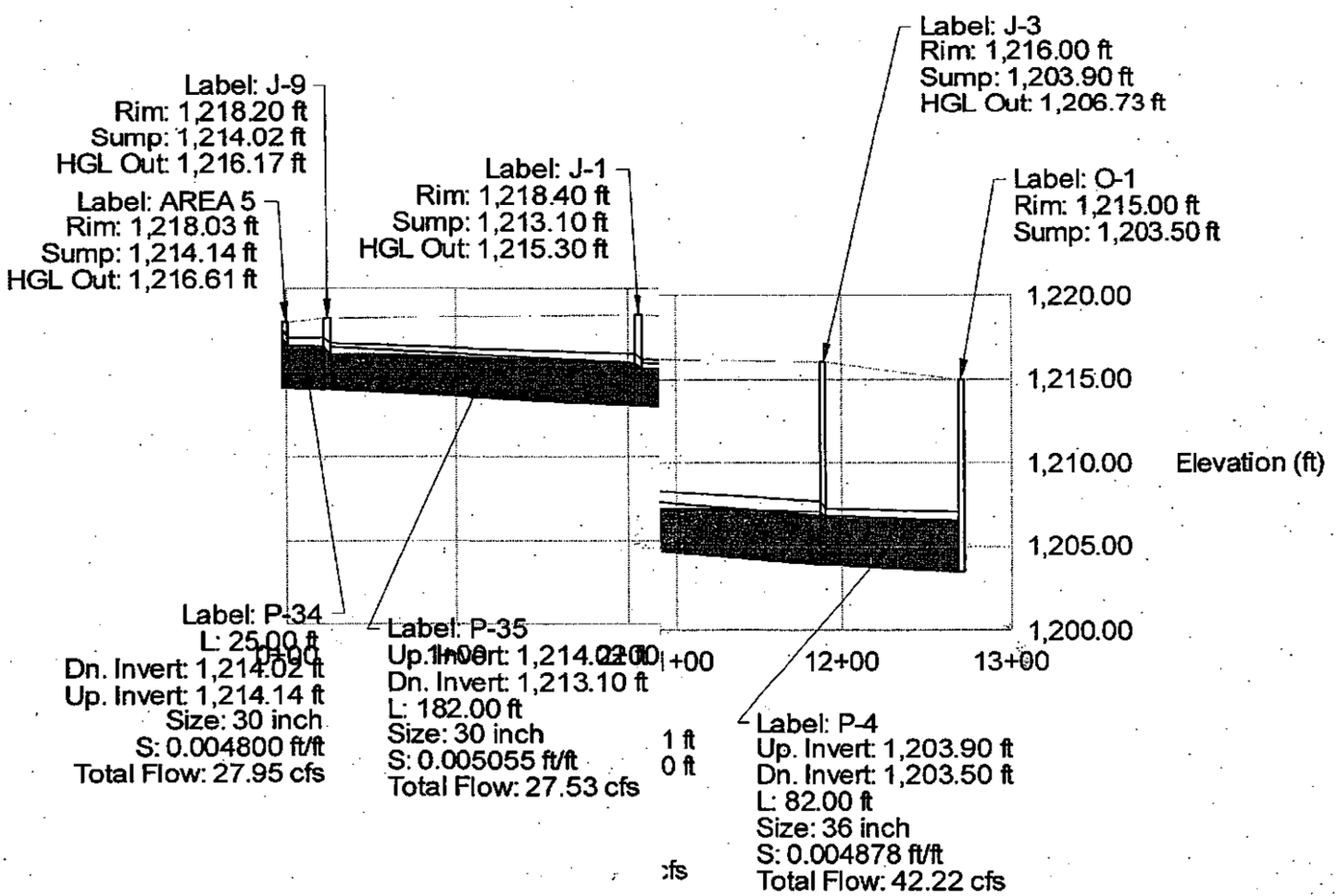
P = 13.50 ft **Grate Opening**

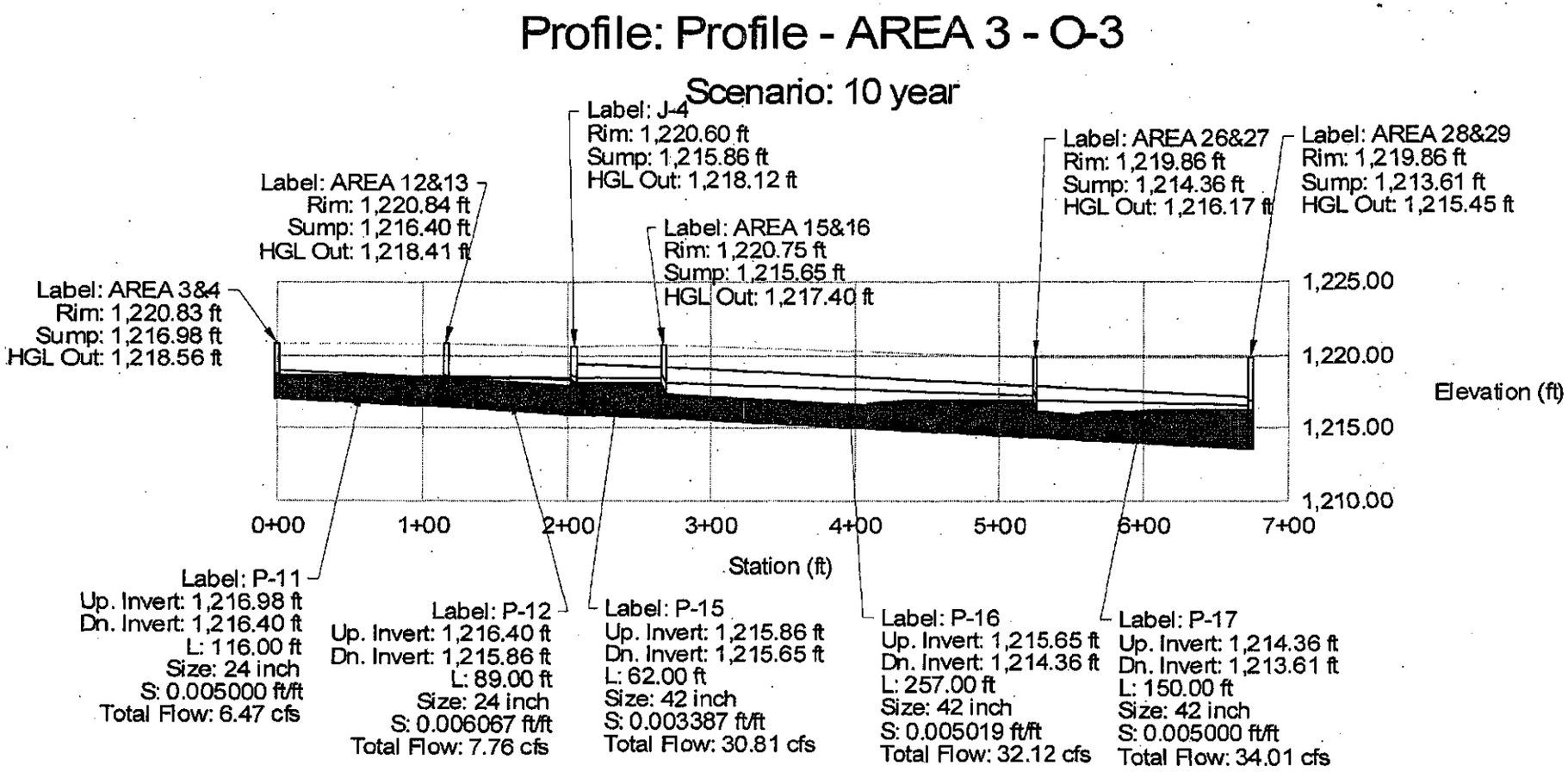
A = 7.56 ft^2

Depth (ft)	Weir Qi (cfs)	Orifice Qi (cfs)
0.00	0.00	0.00
0.05	0.45	9.09
0.10	1.28	12.85
0.15	2.35	15.74
0.20	3.62	18.18
0.25	5.06	20.32
0.30	6.65	22.26
0.35	8.39	24.05
0.40	10.25	25.71
0.45	12.23	27.27
0.50	14.32	28.74
0.55	16.52	30.15
0.60	18.82	31.49
0.65	21.22	32.77
0.70	23.72	34.01
0.75	26.31	35.20
0.80	28.98	36.36
0.85	31.74	37.48
0.90	34.58	38.56
0.95	37.50	39.62
1.00	40.50	40.65
1.05	43.58	41.65
1.10	46.72	42.63
1.15	49.95	43.59
1.20	53.24	44.53
1.25	56.60	45.45
1.30	60.03	46.35
1.35	63.53	47.23
1.40	67.09	48.10
1.45	70.71	48.95
1.50	74.40	49.78
1.55	78.15	50.61
1.60	81.97	51.42
1.65	85.84	52.21
1.70	89.77	53.00
1.75	93.76	53.77
1.80	97.81	54.54
1.85	101.91	55.29
1.90	106.07	56.03



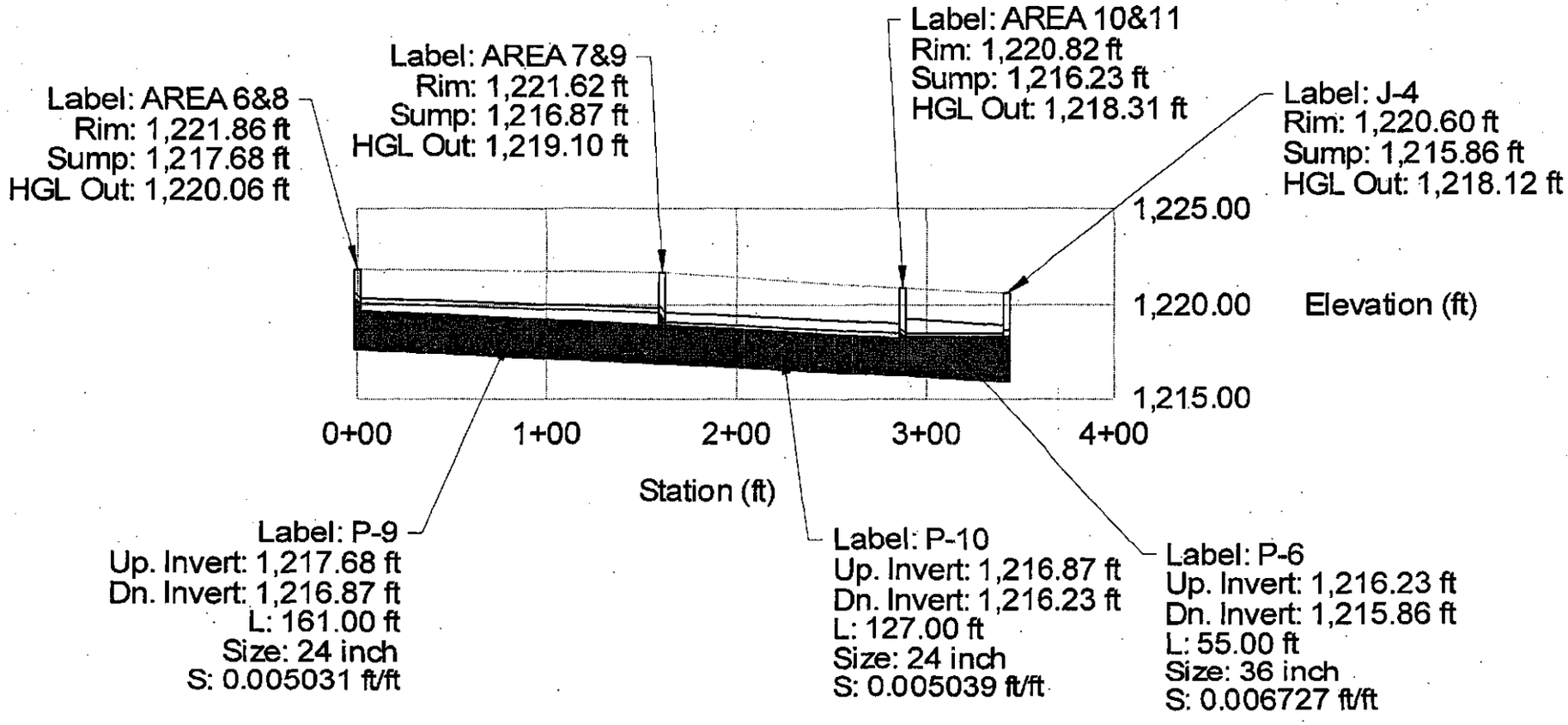
Maximum Depth = 1.14 ft. Maximum Inlet capacity = 0.5*43.4 = 21.7 cfs


Label: J-3
Rim: 1,216.00 ft
Sump: 1,203.90 ft
HGL Out: 1,206.73 ft
Label: J-9
Rim: 1,218.20 ft
Sump: 1,214.02 ft
HGL Out: 1,216.17 ft
Label: J-1
Rim: 1,218.40 ft
Sump: 1,213.10 ft
HGL Out: 1,215.30 ft
Label: O-1
Rim: 1,215.00 ft
Sump: 1,203.50 ft
Label: AREA 5
Rim: 1,218.03 ft
Sump: 1,214.14 ft
HGL Out: 1,216.61 ft
1,220.00
1,215.00
1,210.00
Elevation (ft)
1,205.00
1,200.00
Label: P-34
L: 25.00 ft
Dn. Invert: 1,214.02 ft
Up. Invert: 1,214.14 ft
Size: 30 inch
S: 0.004800 ft/ft
Total Flow: 27.95 cfs
Label: P-35
Dn. Invert: 1,213.10 ft
L: 182.00 ft
Size: 30 inch
S: 0.005055 ft/ft
Total Flow: 27.53 cfs
12+00
13+00
Label: P-4
Up. Invert: 1,203.90 ft
Dn. Invert: 1,203.50 ft
L: 82.00 ft
Size: 36 inch
S: 0.004878 ft/ft
Total Flow: 42.22 cfs


Profile: Profile - AREA 3 - O-3
Scenario: 10 year
Label: AREA 3&4
Rim: 1,220.83 ft
Sump: 1,216.98 ft
HGL Out: 1,218.56 ft
Label: AREA 12&13
Rim: 1,220.84 ft
Sump: 1,216.40 ft
HGL Out: 1,218.41 ft
Label: J-4
Rim: 1,220.60 ft
Sump: 1,215.86 ft
HGL Out: 1,218.12 ft
Label: AREA 15&16
Rim: 1,220.75 ft
Sump: 1,215.65 ft
HGL Out: 1,217.40 ft
Label: AREA 26&27
Rim: 1,219.86 ft
Sump: 1,214.36 ft
HGL Out: 1,216.17 ft
Label: AREA 28&29
Rim: 1,219.86 ft
Sump: 1,213.61 ft
HGL Out: 1,215.45 ft
1,225.00
1,220.00
1,215.00
1,210.00
Elevation (ft)
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
Station (ft)
Label: P-11
Up. Invert: 1,216.98 ft
Dn. Invert: 1,216.40 ft
L: 116.00 ft
Size: 24 inch
S: 0.005000 ft/ft
Total Flow: 6.47 cfs
Label: P-12
Up. Invert: 1,216.40 ft
Dn. Invert: 1,215.86 ft
L: 89.00 ft
Size: 24 inch
S: 0.006067 ft/ft
Total Flow: 7.76 cfs
Label: P-15
Up. Invert: 1,215.86 ft
Dn. Invert: 1,215.65 ft
L: 62.00 ft
Size: 42 inch
S: 0.003387 ft/ft
Total Flow: 30.81 cfs
Label: P-16
Up. Invert: 1,215.65 ft
Dn. Invert: 1,214.36 ft
L: 257.00 ft
Size: 42 inch
S: 0.005019 ft/ft
Total Flow: 32.12 cfs
Label: P-17
Up. Invert: 1,214.36 ft
Dn. Invert: 1,213.61 ft
L: 150.00 ft
Size: 42 inch
S: 0.005000 ft/ft
Total Flow: 34.01 cfs

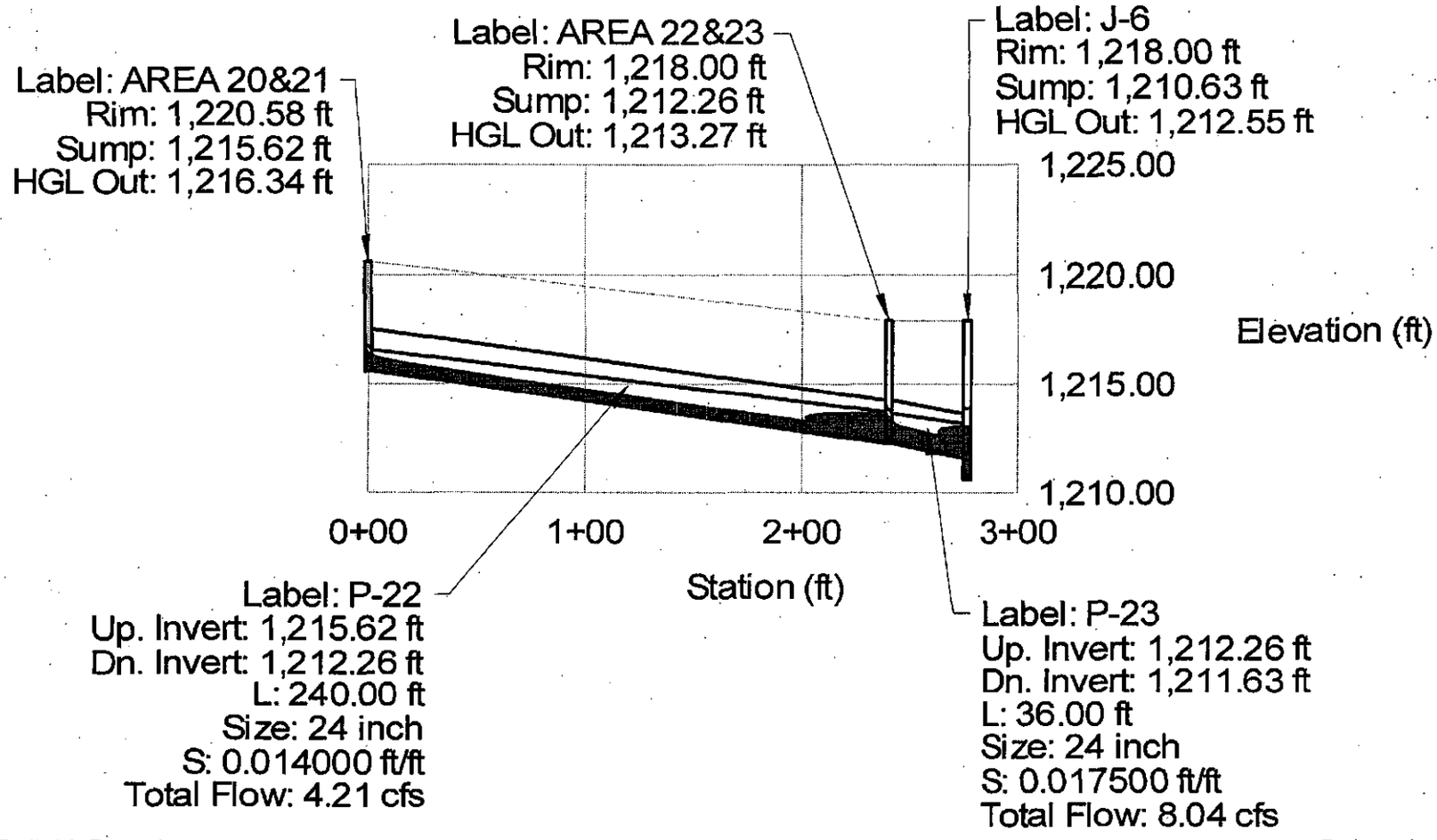
Profile: Profile - AREA 6 - J4

Scenario: 10 year



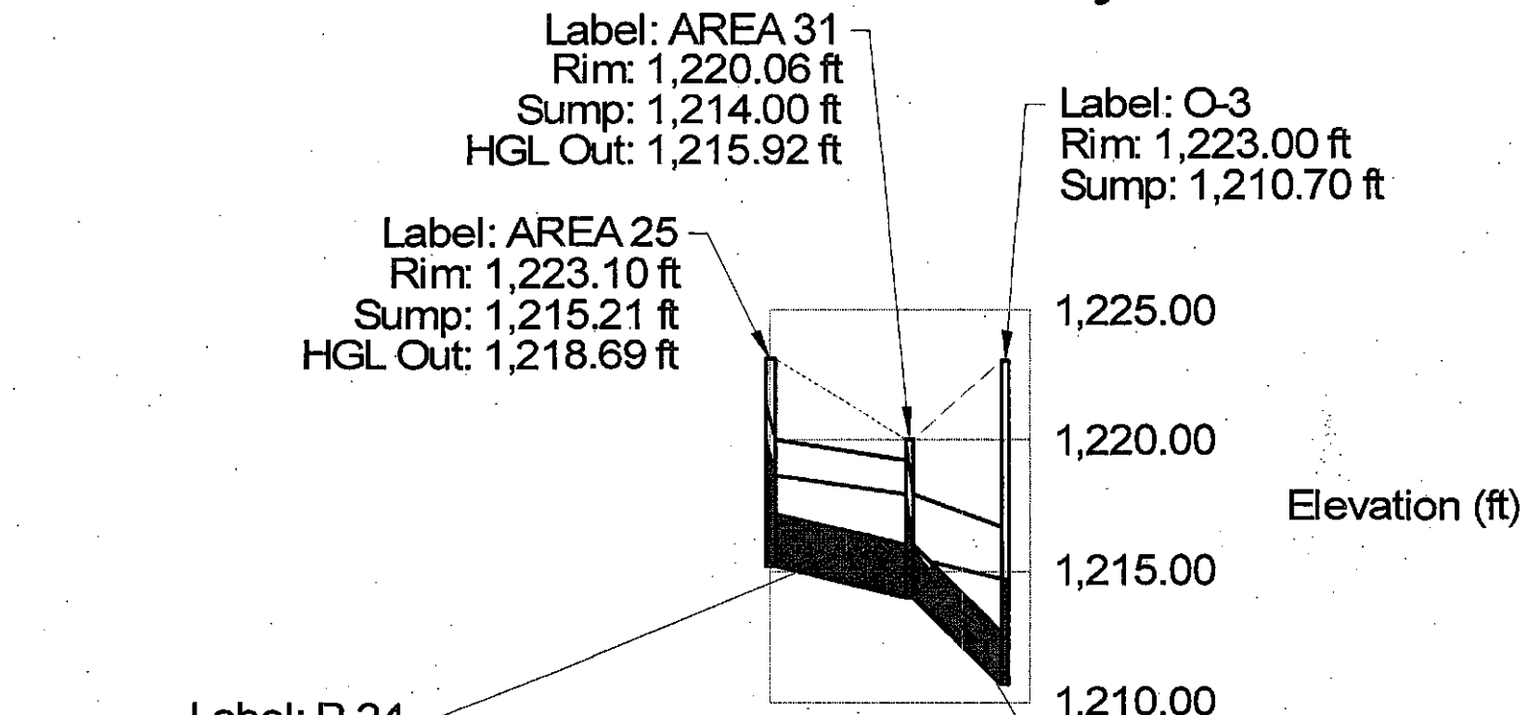
Profile: Profile - AREA 21 - J6

Scenario: 10 year



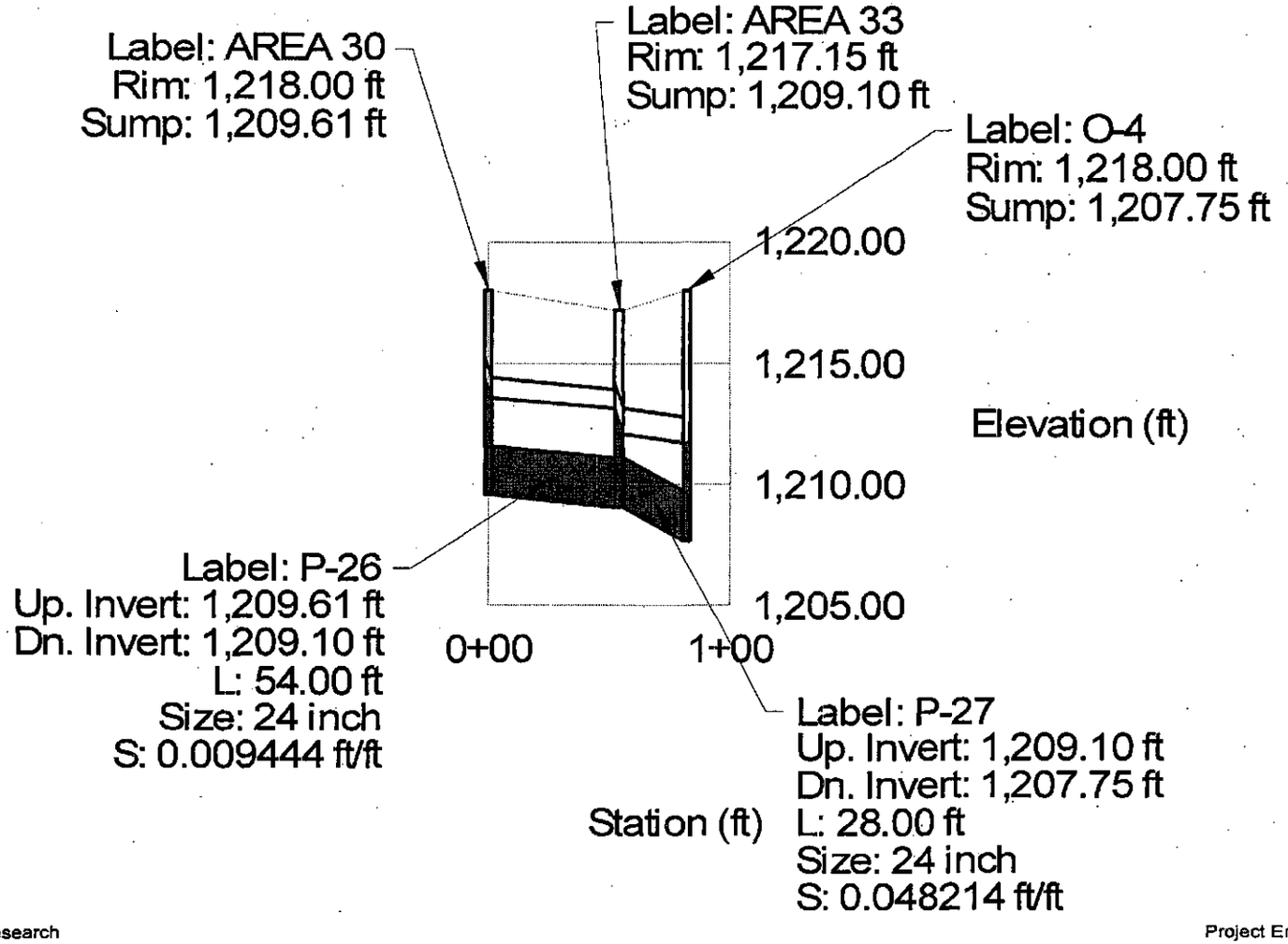
Profile: Profile - AREA 25 - O3

Scenario: 10 year



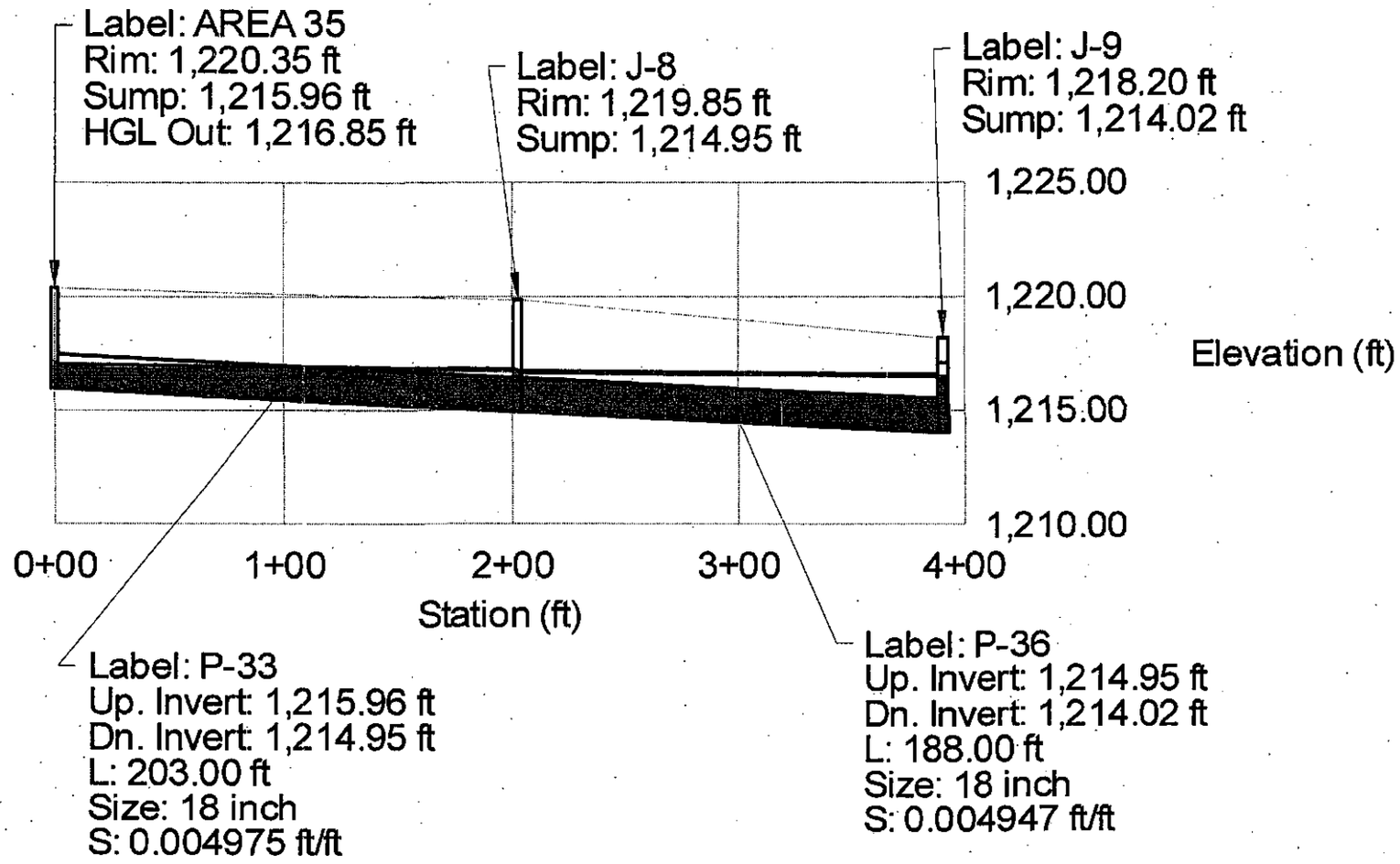
Profile: Profile - AREA 30 - O4

Scenario: 10 year



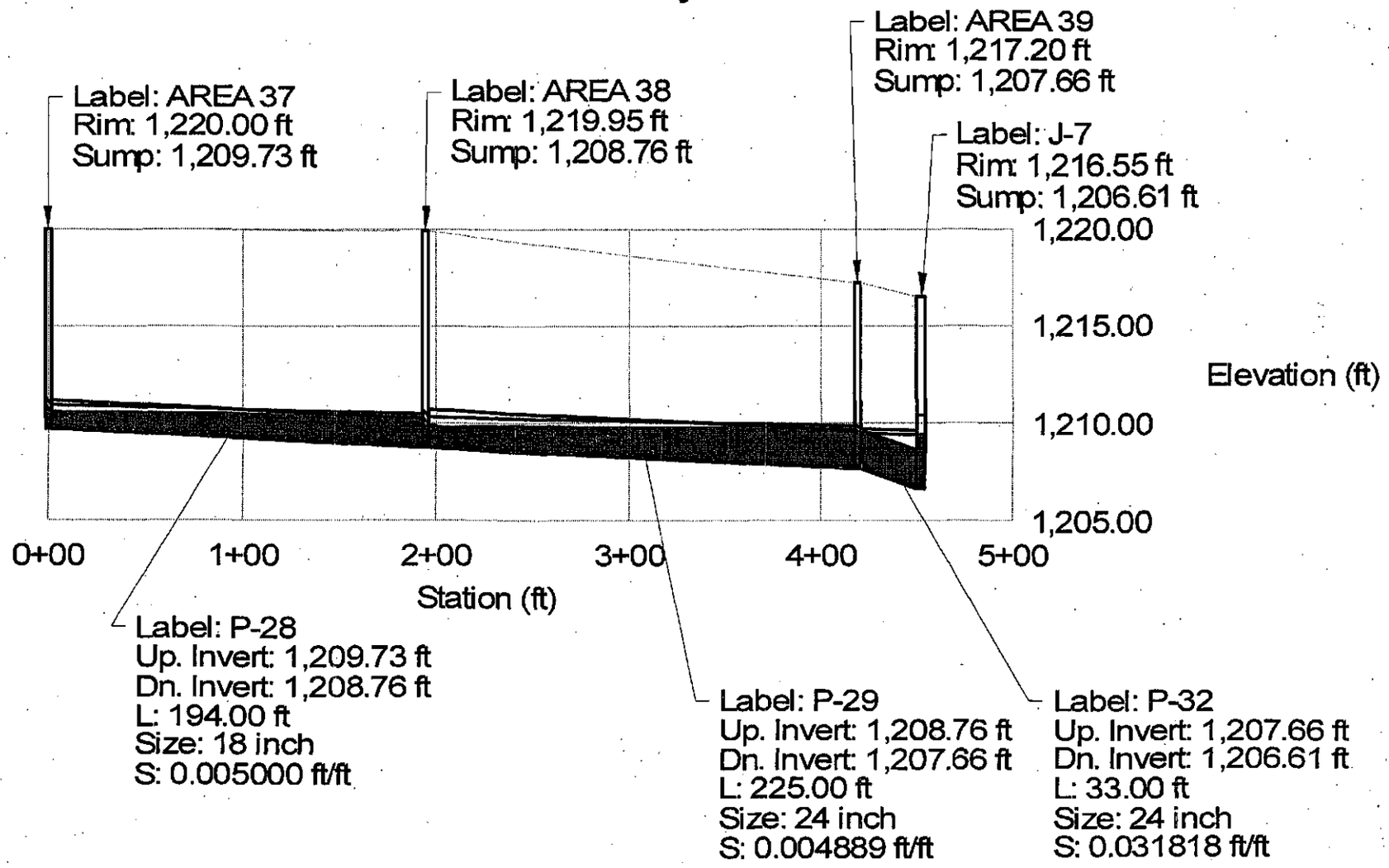
Profile: Profile - AREA 35 - J9

Scenario: 10 year



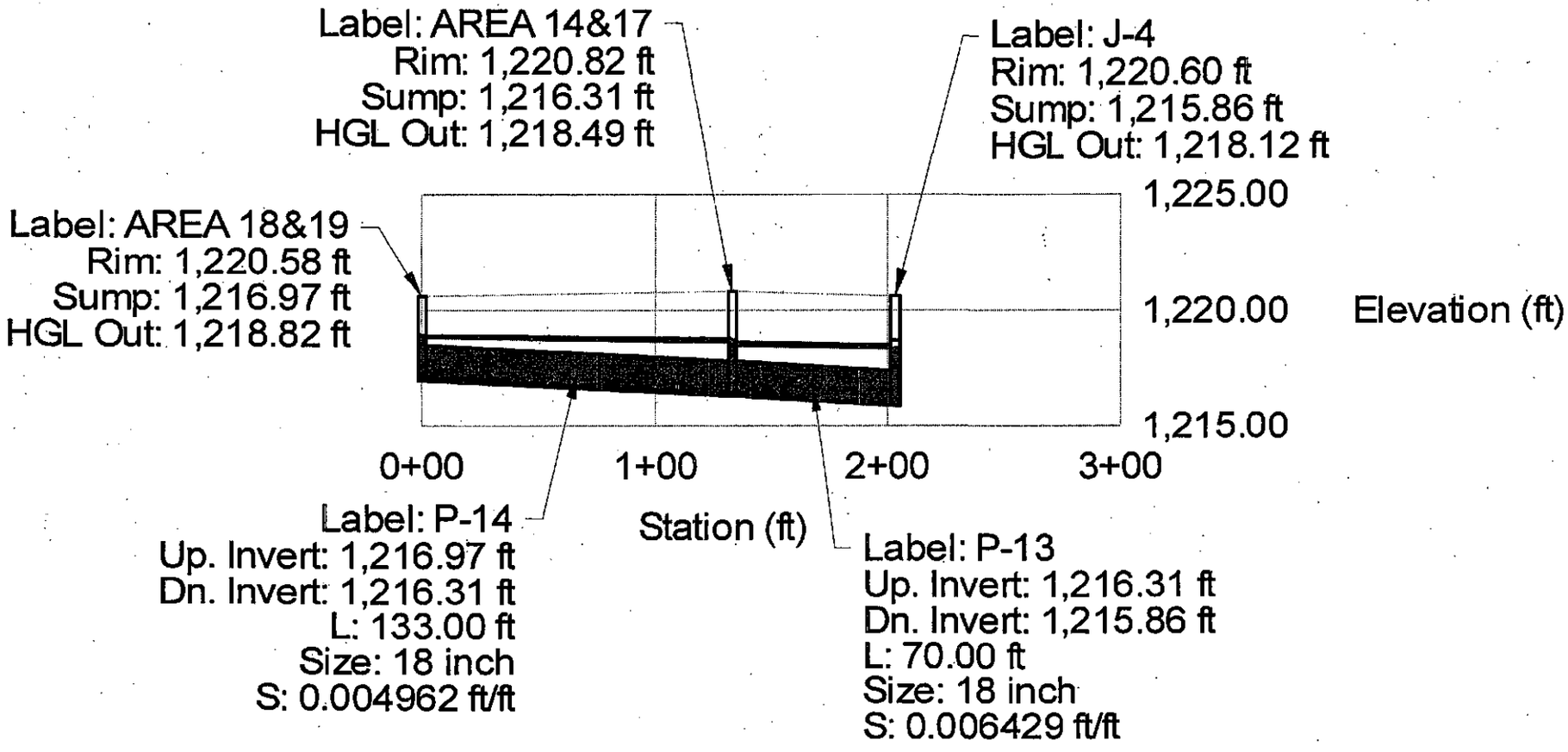
Profile: Profile - AREA 37 - J7

Scenario: 10 year



Profile: Profile - AREA18 - J4

Scenario: 10 year



Scenario: 10 year

Inlet Report

Label	Sump Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)	Intercepted Tc (min)	Inlet C	Intercepted Rational Flow (cfs)	Intercepted Intensity (in/hr)	System Flow Time (min)	Total Flow (cfs)
AREA 3&4	1,216.98	1,220.83	1,218.65	1,218.56	1,218.74	1,218.65	5.00	0.90	6.47	6.10	5.00	6.47
AREA 5	1,214.14	1,218.03	1,217.12	1,216.61	1,217.62	1,217.12	5.00	0.90	27.95	6.10	5.00	27.95
AREA 6&8	1,217.68	1,221.86	1,220.35	1,220.06	1,220.65	1,220.35	5.00	0.90	13.72	6.10	5.00	13.72
AREA 7&9	1,216.87	1,221.62	1,219.55	1,219.10	1,220.00	1,219.55	5.00	0.90	3.71	6.10	5.61	16.87
AREA 10&11	1,216.23	1,220.82	1,218.50	1,218.31	1,218.69	1,218.50	5.00	0.90	1.94	6.10	6.01	18.34
AREA 12&13	1,216.40	1,220.84	1,218.51	1,218.41	1,218.60	1,218.51	5.00	0.90	1.44	6.10	5.38	7.76
AREA 14&17	1,216.31	1,220.82	1,218.64	1,218.49	1,218.79	1,218.64	5.00	0.90	1.66	6.10	5.94	5.52
AREA 15&16	1,215.65	1,220.75	1,218.09	1,217.40	1,218.78	1,218.09	5.00	0.90	1.72	6.10	6.47	32.12
AREA 18&19	1,216.97	1,220.58	1,218.90	1,218.82	1,218.99	1,218.90	5.00	0.90	4.15	6.10	5.00	4.15
AREA 20&21	1,215.62	1,220.58	1,216.61	1,216.34	1,216.87	1,216.61	5.00	0.90	4.21	6.10	5.00	4.21
AREA 22&23	1,212.26	1,218.00	1,213.67	1,213.27	1,214.06	1,213.67	5.00	0.90	4.10	6.10	5.61	8.04
AREA 25	1,215.21	1,223.10	1,220.03	1,218.69	1,221.37	1,220.03	5.00	0.90	29.16	6.10	5.00	29.16
AREA 26&27	1,214.36	1,219.86	1,216.88	1,216.17	1,217.60	1,216.88	5.00	0.90	3.27	6.10	7.03	34.01
AREA 28&29	1,213.61	1,219.86	1,216.19	1,215.45	1,216.92	1,216.19	5.00	0.90	2.21	6.10	7.36	35.31
AREA 30	1,209.61	1,218.00	1,214.46	1,213.62	1,215.29	1,214.46	5.00	0.90	23.02	6.10	5.00	23.02
AREA 31	1,214.00	1,220.06	1,217.93	1,215.92	1,219.93	1,217.93	5.00	0.90	6.25	6.10	5.10	35.24
AREA 32	1,212.74	1,219.90	1,215.28	1,214.56	1,216.01	1,215.28	5.00	0.00	0.00	0.00	7.73	34.52
AREA 33	1,209.10	1,217.15	1,213.15	1,212.07	1,214.23	1,213.15	5.00	0.90	3.32	6.10	5.12	26.17
AREA 35	1,215.96	1,220.35	1,217.01	1,216.85	1,217.18	1,217.01	5.00	0.90	3.54	6.10	5.00	3.54
AREA 36	1,213.72	1,217.25	1,215.20	1,215.14	1,215.26	1,215.20	5.00	0.90	3.43	6.10	5.00	3.43
AREA 37	1,209.73	1,220.00	1,211.00	1,210.63	1,211.36	1,211.00	5.00	0.90	5.37	6.10	5.00	5.37
AREA 38	1,208.76	1,219.95	1,210.31	1,209.87	1,210.76	1,210.31	5.00	0.90	4.54	6.10	5.66	9.56
AREA 39	1,207.66	1,217.20	1,209.69	1,209.42	1,209.96	1,209.69	5.00	0.90	3.27	6.10	6.33	12.25

Scenario: 10 year

Combined Pipe\Node Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Section Size	Constructed Slope (ft/ft)	Upstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Invert Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-4	J-3	O-1	31.66	82.00	36 inch	0.004878	1,203.90	1,216.00	1,203.50	1,215.00	1,205.73	1,205.22	1,206.49	1,206.11
P-6	AREA 10&11	J-4	18.34	55.00	36 inch	0.006727	1,216.23	1,220.62	1,215.86	1,220.60	1,218.31	1,218.32	1,218.50	1,218.46
P-9	AREA 6&8	AREA 7&9	13.72	161.00	24 inch	0.005031	1,217.68	1,221.86	1,216.87	1,221.62	1,220.06	1,219.55	1,220.35	1,219.85
P-10	AREA 7&9	AREA 10&11	16.87	127.00	24 inch	0.005039	1,216.87	1,221.62	1,216.23	1,220.82	1,219.10	1,218.50	1,219.55	1,218.95
P-11	AREA 3&4	AREA 12&13	6.47	116.00	24 inch	0.005000	1,216.98	1,220.83	1,216.40	1,220.84	1,218.56	1,218.51	1,218.65	1,218.57
P-12	AREA 12&13	J-4	7.76	89.00	24 inch	0.006067	1,216.40	1,220.84	1,215.86	1,220.60	1,218.41	1,218.32	1,218.51	1,218.42
P-13	AREA 14&17	J-4	5.52	70.00	18 inch	0.006429	1,216.31	1,220.82	1,215.86	1,220.60	1,218.49	1,218.32	1,218.64	1,218.47
P-14	AREA 18&19	AREA 14&17	4.15	133.00	18 inch	0.004962	1,216.97	1,220.58	1,216.31	1,220.82	1,218.82	1,218.64	1,218.90	1,218.72
P-15	J-4	AREA 15&16	30.81	62.00	42 inch	0.003387	1,215.86	1,220.60	1,215.65	1,220.75	1,218.12	1,218.09	1,218.46	1,218.38
P-16	AREA 15&16	AREA 26&27	32.12	257.00	42 inch	0.005019	1,215.65	1,220.75	1,214.36	1,219.86	1,217.40	1,216.88	1,218.09	1,217.17
P-17	AREA 26&27	AREA 28&29	34.01	150.00	42 inch	0.005000	1,214.36	1,219.86	1,213.61	1,219.86	1,216.17	1,216.19	1,216.88	1,216.50
P-21	J-6	J-2	33.77	28.00	36 inch	0.103929	1,210.63	1,218.00	1,207.72	1,216.90	1,212.52	1,210.09	1,213.33	1,210.58
P-22	AREA 20&21	AREA 22&23	4.21	240.00	24 inch	0.014000	1,215.62	1,220.58	1,212.26	1,218.00	1,216.34	1,213.67	1,216.61	1,213.72
P-23	AREA 22&23	J-6	8.04	36.00	24 inch	0.017500	1,212.26	1,218.00	1,211.63	1,218.00	1,213.27	1,213.00	1,213.67	1,213.19
P-24	AREA 25	AREA 31	29.16	54.00	24 inch	0.022407	1,215.21	1,223.10	1,214.00	1,220.06	1,218.69	1,217.93	1,220.03	1,219.27
P-25	AREA 31	O-3	35.24	37.00	24 inch	0.089189	1,214.00	1,220.06	1,210.70	1,223.00	1,215.92	1,214.70	1,217.93	1,216.66
P-26	AREA 30	AREA 33	23.02	54.00	24 inch	0.009444	1,209.61	1,218.00	1,209.10	1,217.15	1,213.62	1,213.15	1,214.46	1,213.98
P-27	AREA 33	O-4	26.17	28.00	24 inch	0.048214	1,209.10	1,217.15	1,207.75	1,218.00	1,212.07	1,211.75	1,213.15	1,212.83
P-28	AREA 37	AREA 38	0.00	194.00	18 inch	0.005000	1,209.73	1,220.00	1,208.76	1,219.95	1,209.73	1,208.94	1,209.73	1,208.94
P-29	AREA 38	AREA 39	0.00	225.00	24 inch	0.004889	1,208.76	1,219.95	1,207.66	1,217.20	1,208.94	1,208.94	1,208.94	1,208.94
P-30	J-2	J-7	33.73	222.00	36 inch	0.005000	1,207.72	1,216.90	1,206.61	1,216.55	1,209.61	1,208.94	1,210.41	1,209.45
P-31	J-7	J-3	32.82	337.00	36 inch	0.008042	1,206.61	1,216.55	1,203.90	1,216.00	1,208.47	1,206.19	1,209.26	1,206.69
P-32	AREA 39	J-7	0.00	33.00	24 inch	0.031818	1,207.66	1,217.20	1,206.61	1,216.55	1,208.94	1,208.94	1,208.94	1,208.94
P-33	AREA 35	J-8	0.00	203.00	18 inch	0.004975	1,215.96	1,220.35	1,214.95	1,219.85	1,216.39	1,216.39	1,216.39	1,216.39
P-34	AREA 5	J-9	27.95	25.00	30 inch	0.004800	1,214.14	1,218.03	1,214.02	1,218.20	1,216.46	1,216.39	1,217.00	1,216.91
P-35	J-9	J-1	27.86	182.00	30 inch	0.005055	1,214.02	1,218.20	1,213.10	1,218.40	1,215.95	1,215.48	1,216.68	1,216.00
P-36	J-8	J-9	0.00	188.00	18 inch	0.004947	1,214.95	1,219.85	1,214.02	1,218.20	1,216.39	1,216.39	1,216.39	1,216.39
P-37	J-1	J-10	27.25	84.00	30 inch	0.023452	1,213.10	1,218.40	1,211.13	1,218.00	1,215.08	1,214.95	1,215.75	1,215.43
P-38	J-10	J-6	27.09	311.00	30 inch	0.004984	1,212.68	1,218.00	1,211.13	1,218.00	1,214.47	1,213.00	1,215.28	1,213.74
P-39	AREA 36	J-10	0.00	55.00	18 inch	0.018909	1,213.72	1,217.25	1,212.68	1,218.00	1,214.95	1,214.95	1,214.95	1,214.95
P-40	AREA 28&29	AREA 32'	35.31	175.00	42 inch	0.004971	1,213.61	1,219.86	1,212.74	1,219.90	1,215.45	1,215.28	1,216.19	1,215.63
P-41	AREA 32'	O-2	34.52	31.00	42 inch	0.177097	1,212.74	1,219.90	1,207.25	1,220.08	1,214.56	1,213.25	1,215.28	1,213.45

Scenario: 10 year

DOT Report

Label	-Node- Upstream Downstream	Upstream Inlet Area (acres)	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Total Flow (cfs)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	Section Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-11	AREA 3&4	1.17	1.05	1.05	5.00	6.10	6.47	1,220.83	1,218.56	6.47	Circular	116.00	5.12
	AREA 12&13							1,220.84	1,218.51	17.33	24 inch		
P-34	AREA 5	5.05	4.55	4.55	5.00	6.10	27.95	1,218.03	1,216.46	27.95	Circular	25.00	7.10
	J-9							1,218.20	1,216.39	30.78	30 inch		
P-9	AREA 6&8	2.48	2.23	2.23	5.00	6.10	13.72	1,221.86	1,220.06	13.72	Circular	161.00	4.37
	AREA 7&9							1,221.62	1,219.55	17.38	24 inch		
P-10	AREA 7&9	0.67	0.60	2.84	5.61	5.90	16.87	1,221.62	1,219.10	16.87	Circular	127.00	5.37
	AREA 10&11							1,220.82	1,218.50	17.40	24 inch		
P-6	AREA 10&11	0.35	0.32	3.15	6.01	5.78	18.34	1,220.82	1,218.31	18.34	Circular	55.00	7.39
	J-4							1,220.60	1,218.32	59.26	36 inch		
P-12	AREA 12&13	0.26	0.23	1.29	5.38	5.98	7.76	1,220.84	1,218.41	7.76	Circular	89.00	2.47
	J-4							1,220.60	1,218.32	19.09	24 inch		
P-13	AREA 14&17	0.30	0.27	0.95	5.94	5.80	5.52	1,220.82	1,218.49	5.52	Circular	70.00	3.13
	J-4							1,220.60	1,218.32	9.12	18 inch		
P-16	AREA 15&16	0.31	0.28	5.66	6.47	5.63	32.12	1,220.75	1,217.40	32.12	Circular	257.00	7.66
	AREA 26&27							1,219.86	1,216.88	77.22	42 inch		
P-14	AREA 18&19	0.75	0.68	0.68	5.00	6.10	4.15	1,220.58	1,218.82	4.15	Circular	133.00	2.35
	AREA 14&17							1,220.82	1,218.64	8.02	18 inch		
P-22	AREA 20&21	0.76	0.68	0.68	5.00	6.10	4.21	1,220.58	1,216.34	4.21	Circular	240.00	6.57
	AREA 22&23							1,218.00	1,213.67	29.00	24 inch		
P-23	AREA 22&23	0.74	0.67	1.35	5.61	5.91	8.04	1,218.00	1,213.27	8.04	Circular	36.00	8.56
	J-6							1,218.00	1,213.00	32.42	24 inch		
P-24	AREA 25	5.27	4.74	4.74	5.00	6.10	29.16	1,223.10	1,218.69	29.16	Circular	54.00	9.28
	AREA 31							1,220.06	1,217.93	36.68	24 inch		
P-17	AREA 26&27	0.59	0.53	6.19	7.03	5.45	34.01	1,219.86	1,216.17	34.01	Circular	150.00	7.76
	AREA 28&29							1,219.86	1,216.19	77.07	42 inch		
P-40	AREA 28&29	0.40	0.36	6.55	7.36	5.35	35.31	1,219.86	1,215.45	35.31	Circular	175.00	7.82
	AREA 32'							1,219.90	1,215.28	76.85	42 inch		
P-26	AREA 30	4.16	3.74	3.74	5.00	6.10	23.02	1,218.00	1,213.62	23.02	Circular	54.00	7.33
	AREA 33							1,217.15	1,213.15	23.82	24 inch		
P-25	AREA 31	1.13	1.02	5.76	5.10	6.07	35.24	1,220.06	1,215.92	35.24	Circular	37.00	23.08
	O-3							1,223.00	1,214.70	73.19	24 inch		
P-41	AREA 32'	0.78	0.00	6.55	7.73	5.23	34.52	1,219.90	1,214.56	34.52	Circular	31.00	28.04
	O-2							1,220.08	1,213.25	458.65	42 inch		
P-27	AREA 33	0.60	0.54	4.28	5.12	6.06	26.17	1,217.15	1,212.07	26.17	Circular	28.00	8.33

Scenario: 10 year

DOT Report

Label	-Node- Upstream Downstream	Upstream Inlet Area (acres)	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Total Flow (cfs)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	Section Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
	O-4							1,218.00	1,211.75	53.81	24 inch		
P-33	AREA 35	0.64	0.00	0.00	0.00	0.00	0.00	1,220.35	1,216.39	0.00	Circular	203.00	0.00
	J-8							1,219.85	1,216.39	8.03	18 inch		
P-39	AREA 36	0.62	0.00	0.00	0.00	0.00	0.00	1,217.25	1,214.95	0.00	Circular	55.00	0.00
	J-10							1,218.00	1,214.95	15.65	18 inch		
P-28	AREA 37	0.97	0.00	0.00	0.00	0.00	0.00	1,220.00	1,209.73	0.00	Circular	194.00	0.00
	AREA 38							1,219.95	1,208.94	8.05	18 inch		
P-29	AREA 38	0.82	0.00	0.00	0.00	0.00	0.00	1,219.95	1,208.94	0.00	Circular	225.00	0.00
	AREA 39							1,217.20	1,208.94	17.13	24 inch		
P-32	AREA 39	0.59	0.00	0.00	0.00	0.00	0.00	1,217.20	1,208.94	0.00	Circular	33.00	0.00
	J-7							1,216.55	1,208.94	43.71	24 inch		
P-37	J-1	N/A	N/A	4.55	5.48	5.95	27.25	1,218.40	1,215.08	27.25	Circular	84.00	13.09
	J-10							1,218.00	1,214.95	68.05	30 inch		
P-30	J-2	N/A	N/A	5.89	6.32	5.68	33.73	1,216.90	1,209.61	33.73	Circular	222.00	7.72
	J-7							1,216.55	1,208.94	51.09	36 inch		
P-4	J-3	N/A	N/A	5.89	7.41	5.33	31.66	1,216.00	1,205.73	31.66	Circular	82.00	7.54
	O-1							1,215.00	1,205.22	50.46	36 inch		
P-15	J-4	N/A	N/A	5.38	6.32	5.68	30.81	1,220.60	1,218.12	30.81	Circular	62.00	6.54
	AREA 15&16							1,220.75	1,218.09	63.43	42 inch		
P-21	J-6	N/A	N/A	5.89	6.30	5.68	33.77	1,218.00	1,212.52	33.77	Circular	28.00	23.47
	J-2							1,216.90	1,210.09	232.93	36 inch		
P-31	J-7	N/A	N/A	5.89	6.80	5.52	32.82	1,216.55	1,208.47	32.82	Circular	337.00	9.20
	J-3							1,216.00	1,206.19	64.79	36 inch		
P-36	J-8	N/A	N/A	0.00	0.00	0.00	0.00	1,219.85	1,216.39	0.00	Circular	188.00	0.00
	J-9							1,218.20	1,216.39	8.00	18 inch		
P-35	J-9	N/A	N/A	4.55	5.06	6.08	27.86	1,218.20	1,215.95	27.86	Circular	182.00	7.26
	J-1							1,218.40	1,215.48	31.59	30 inch		
P-38	J-10	N/A	N/A	4.55	5.58	5.91	27.09	1,218.00	1,214.47	27.09	Circular	311.00	7.19
	J-6							1,218.00	1,213.00	31.37	30 inch		

APPENDIX 5

Drainage Map

APPENDIX 6

Memorandum by EEC Dated April 19, 2005

Engineering and Environmental Consultants, Inc.
3003 North Central Avenue, Suite 600, Phoenix, Arizona 85012-2905
Tel: (602) 248-7702 Fax: (602)248-7851

MEMORANDUM

To: William Haas

Date: April 19, 2005

Copy:

From: Lloyd Vick

Project No. 305002.02

Project: ASU Scottsdale Center for New Technology and Innovation

Subject: Drainage Design Memorandum for Re-development of the Los Arcos Mall Site

This memorandum includes a brief description of the historic Los Arcos Mall Drainage patterns and a recommendation for drainage design for the re-development of this site.

History and Description of the Los Arcos Mall site

The site consists of approximately 37-acres and is located at the southeast corner of Scottsdale and McDowell Roads. The site is bounded by Scottsdale Road on the west, McDowell Road on the north, 74th Street on the east, and an alley adjoining a multi-family residential complex on the south. The site slopes generally to the east toward Indian Bend Wash.

Until the time of its demolition, Los Arcos Mall had been located on the site for more than 30 years. The mall was located in the center of the site with customer parking around the perimeter. The parking lots drained to the adjacent streets.

Los Arcos Mall Drainage

The Los Arcos Mall site did not include a storm drain system or any measurable storm water storage facilities. The site was developed before any storm water retention requirements were in effect. From aerial photos and contours of the site, there appears to have been three general outfalls. These are: Scottsdale Road to the west, McDowell Road to the north, and 74th Street to the east. Storm water runoff from the buildings and parking lots would surface flow across the site and discharge into the adjacent streets. The following table is based upon rational method calculations of the discharge to each of these outfalls.

Table 1 Approximate Peak Discharges from Los Arcos Mall Site

discharge to:	Drainage Area [acres]	10-year [cfs]	100-year [cfs]
Scottsdale Road	8.8	48	91
McDowell Road	7.8	43	81
74th Street	20.4	103	196

The City storm drain system includes 1) a 6-foot by 6-foot box culvert in McDowell Road from Scottsdale Road east to the outfall in Indian Bend Wash, 2) a 60-inch storm drain in Scottsdale Road that runs from McDowell Road to the southwest corner of the Los Arcos Mall site and, 3) a 72-inch storm drain from the southwest corner of Los Arcos Mall to 74th Street. The 72-inch pipe continues east to Miller Road where it increases to a 78-inch diameter and runs south to Roosevelt Street, then east to it's outfall in Indian Bend Wash.

According to the *City of Scottsdale–Storm Water Master Plan and Management Program*, prepared by KVL Consultants Inc., the 72-inch storm drain has sufficient capacity to accept the 10-year flow from the Los Arcos Mall site. The KVL report assumed that Los Arcos Mall would discharge to the pipe at the southeast corner of the site where it crosses 74th Street. From runoff data included in the KVL report, the 10-year peak discharge that was assumed to discharge from the site, into the 72-inch pipe, was 122 cfs.

The City has planned a new 42-inch storm drain in Scottsdale Road. This new storm drain is part of the City's 2005 C.I.P. program. The storm drain will begin at the southwest corner of the Los Arcos Mall site in Scottsdale Road and runs to the south to McKellips Road, then east to Indian Bend Wash. This new storm drain could potentially be considered as an additional outfall for storm water runoff from the western portion of the site.

Storm Water Storage Requirements

The City's standard storm water storage requirement is the runoff from the 100-year, 2-hour storm. Using a runoff coefficient of 0.9 and rainfall of 2.82 inches, the 37-acre site has a storm water storage requirement of approximately 7.8 acre-feet. A *Request for Stormwater Storage Waiver Form* should be processed to reduce or eliminate the storage requirement. The justification for this waiver request is that the pre-existing Los Arcos Mall site did not provide any appreciable storm water storage. Furthermore, the Mall site was nearly all impervious building rooftops and parking lots. Therefore, any new storm water detention and/or open space built into the re-development of the site will be an improvement and will represent a reduction in runoff leaving the site.

The City is considering a new requirement for storage of the "first flush" to improve storm water quality. The County and other municipalities have adopted this requirement and the City is anticipating doing the same. When this happens, there will be an additional requirement for storage of the first 0.5-inches of runoff. For this particular site, the "first flush" storage requirement would amount to approximately 1.4 acre-feet.

Drainage Design Recommendations

1. Design the site to collect and convey the 10-year peak flow from the parking lots and buildings to a new catchment basin located at the southeast corner of the site.

2. The catchment basin at the southeast corner of the site is to drain to the existing City owned 72-inch storm drain at a rate not to exceed 120 cfs.

3. The 100-year peak discharges from the site shall not exceed the 100-year runoff from the pre-existing Los Arcos Mall site.

If you have any questions regarding this drainage memorandum please contact Lloyd Vick at 602.248.7702.

Planned 42" S.D.
(Scottsdale 2005 C.I.P.)

ASU SCOTTSDALE CENTER FOR NEW TECHNOLOGY AND INNOVATION

CITY OF SCOTTSDALE
APRIL 2005
EXHIBIT 1
SCALE: 1" = 200'