Maricopa County
Department of Transportation
Engineering Division

INITIAL DRAINAGE REPORT

83rd Avenue from
Northern Avenue to Olive Avenue

January 31, 2000

Prepared By:

INCA ENGINEERS INC.

3800 N. Central Ave.
Suite 200
Phoenix, Arizona 85012
(602) 277-8161

Property of
Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

Maricopa County Department of Transportation Engineering Division

INITIAL DRAINAGE REPORT

83rd Avenue from Northern Avenue to Olive Avenue

January 31, 2000

Prepared By:

INCA ENGINEERS INC.

3800 N. Central Ave.
Suite 200
Phoenix, Arizona 85012
(602) 277-8161

TABLE OF CONTENTS

LIST OF FIGURES

APPENDICES

The proposed project will provide roadway and storm improvements along 83rd Avenue, between Olive Avenue and Northern Avenue. The project encompasses approximately 1.5 kilometers (1 mile) of 83rd Avenue roadway and improvements, including roadway widening, new curbs, and gutters as well as, a new storm drainage collection and conveyance system. No detention or water quality treatment facilities are proposed. (See Vicinity Map page 4 and Location Map page 5.)

Runoff from the improved roadway section will be collected from south of the Olive Avenue intersection by the new storm system and conveyed to the south and discharged to an existing 1676 mm (66-inch) system near the intersection of Las Palmaritas Drive and 83rd Avenue. Runoff from adjacent off-site areas that will contribute flow to the new storm system are north of Alice Avenue and west of 83rd Avenue, north of Butler Drive and east of 83rd Avenue, and Las Palmaritas Drive from the west. These additional flows have been included in the analysis of the new storm system to verify adequate system capacity and function.

The purpose of this report is to describe the existing and proposed drainage conditions associated with the project, and to provide a brief overview of the storm drainage system analysis and design, including system layout, sizing and locations of required drainage facilities. Supporting calculations for conveyance system sizing utilize the Rational Method, with runoff coefficients and rainfall data obtained from the *Drainage Design Manual for Maricopa County, Volume 1, Hydrology* prepared by the Flood Control District of Maricopa County (FCDMC). The design storm for conveyance system sizing is the 10-year, 6-hour storm event, in accordance with the FCDMC Design Manual Standards. Analysis and modeling of the proposed storm system utilized the StormCAD software, version 3, the results of which are provided in Appendix A.

In general, the new 83rd Avenue drainage system design will collect and convey runoff from the area within the right-of-way, and identified off-site areas. Off-site flow draining to the project area and associated drainage systems will be identified and quantified by the FCDMC. A coordination meeting was held in November 1999 with the Maricopa County Department of Transportation (MCDOT), city of Peoria and the FCDMC to identify (off-site) areas that are tributary to the new storm drainage system.

Other consultants have evaluated runoff from (upstream) off-site areas adjacent to 83rd Avenue. Available hydraulic gradient and existing pipe size information for the downstream system have been provided in the Northern/Orangewood Storm Drain Report, Contract FCD 94-12, Phase II and the FCDMC. Available information and the results of these analyses have been provided by the FCDMC for use in the capacity analysis of the new storm system.

Following are recommendations to the Northern and Butler Storm Drains Sub-Phase "A" in order to improve off-site conditions at the 83rd Avenue and Las Palmaritas Drive intersection and to better prepare for construction coordination of the MCDOT 83rd Avenue project.

Off-Site Improvements

1) Up size the storm drain pipe in Las Palmaritas Drive to 750 mm.

2) Provide larger catch basins on both sides of Las Palmaritas Drive. Increase the catch basins to city of Phoenix, P-1569, M2, L=5.182 m.
3) Provide a 610 mm stub to the west from the manhole in Las Palmaritas Drive.

On-Site Coordination

1) Provide an additional connector pipe stub (381 mm) to the west at Station 0+425 (MH 33) for roadway water.
2) Provide two (2) connector pipe stubs (381 mm) east and west from Station 0+555 (MH 34) for roadway water.

Maricopa County proposes to upgrade the existing 83rd Avenue from Northern Avenue to Olive Avenue a minor arterial roadway to a city of Peoria 5-lane section. (See Vicinity Map page 4 and Location Map page 5) This section consists of a 4.0 meter (13-foot) edge lane with curb and gutter in both directions, a 3.7 meter (12-foot) through lane in each direction, and a 4.2 meter (14-foot) two-way left turn lane which becomes a directional left turn lane at the intersections. The minor arterial right-of-way is based on 33.528 meters (110-foot). This improvement begins at the north end of the improvements on 83rd Avenue that are the result of the intersection improvements for MCDOT Work Order 68915, Northern Avenue from Loop 101 to 67th Avenue. A new drainage system shall be developed to convey roadway for the 10-year and 100-year storm flows as required by the Flood Control District of Maricopa County (FCDMC) Drainage Design Manuals.

The roadway shall be designed so that drainage follows the historic flow paths and does not create off-site flooding or adverse ponding within the right-of-way. Runoff from intersection streets shall be designed to maintain or improve existing drainage conditions, as economically feasible, and in no case adversely impact 83rd Avenue.

The project site is located within the selected Peoria Watershed Storm Drain System. Currently, there are no underground drainage facilities located in 83rd Avenue. All other roadway drainage currently flows along the roadway until it reaches a low spot to drain off into a farm field or along the roadway until it passes under 83rd Avenue. The improvement to 83rd Avenue will propose storm drainage improvements that shall include the construction of storm drains and enlarging drainage ditches behind the curb and gutter to accept greater flows. The proposed final outfall of the off-site surface runoffs along 83rd Avenue will be conveyed to the existing SRP irrigation discharge ditch south of Las Palmaritas Drive.

Design of drainage facilities will be coordinated with current and on-going drainage studies and roadway design projects. This will include studies being prepared by FCDMC for the Northern/Orangewood Storm Drain Project Concept/Routing Study Area (FCD Contract 94-12). Wood, Patel & Associates, Inc. completed the study for the FCDMC. This project does not lie within a Federal Emergency Management Agency (FEMA) 100-year flood plain. This may also include any studies being performed by the FCDMC.

This report provides a brief description of the project design requirements and design issues. Supporting information and calculations are presented in Appendix A, which includes runoff summaries and conveyance system analysis output results. Appendix B provides supporting documentation of the catch basin and connector pipe hydraulic analysis. Supporting information regarding off-site flows tributary to the project are presented in Appendix C and project correspondence and design background information are presented in Appendix D.

Figure 1

VICINITY MAP

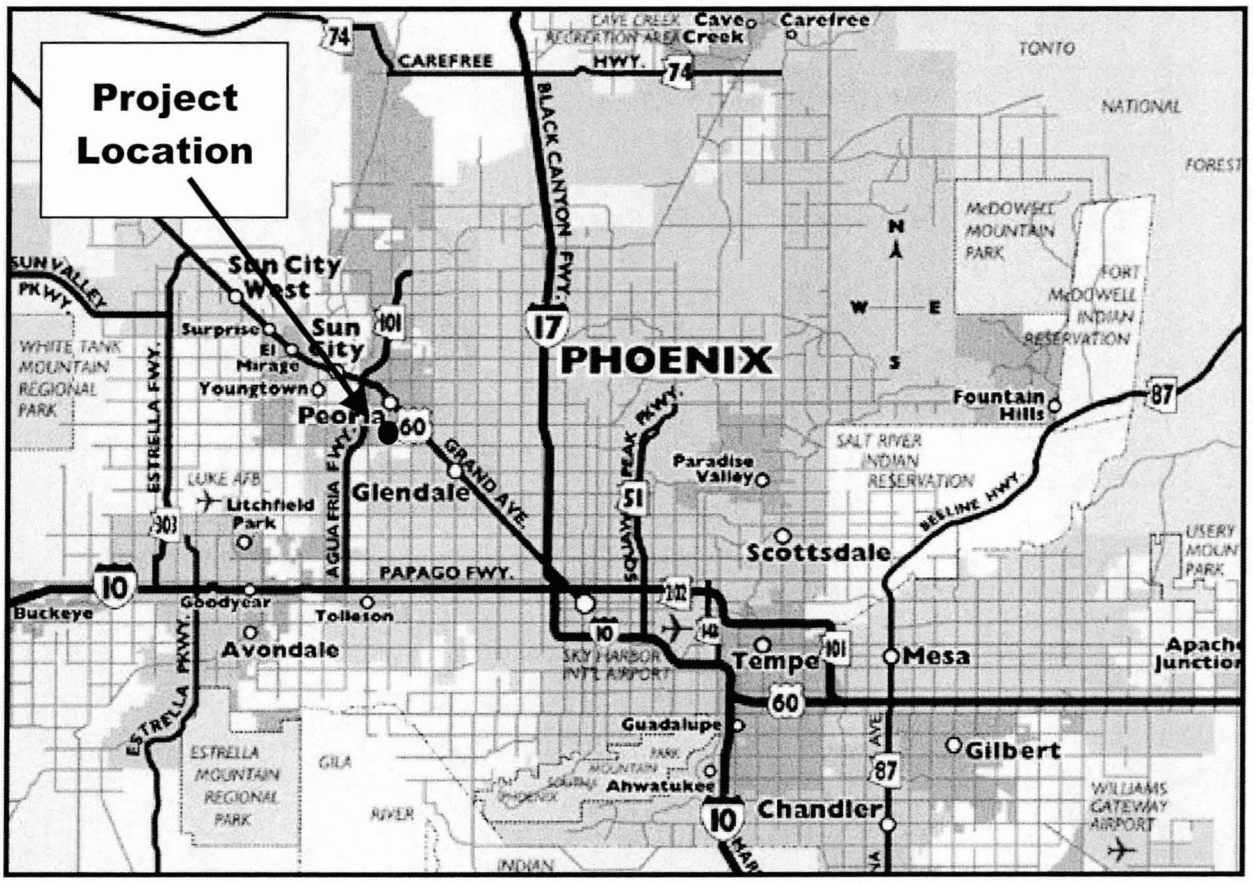
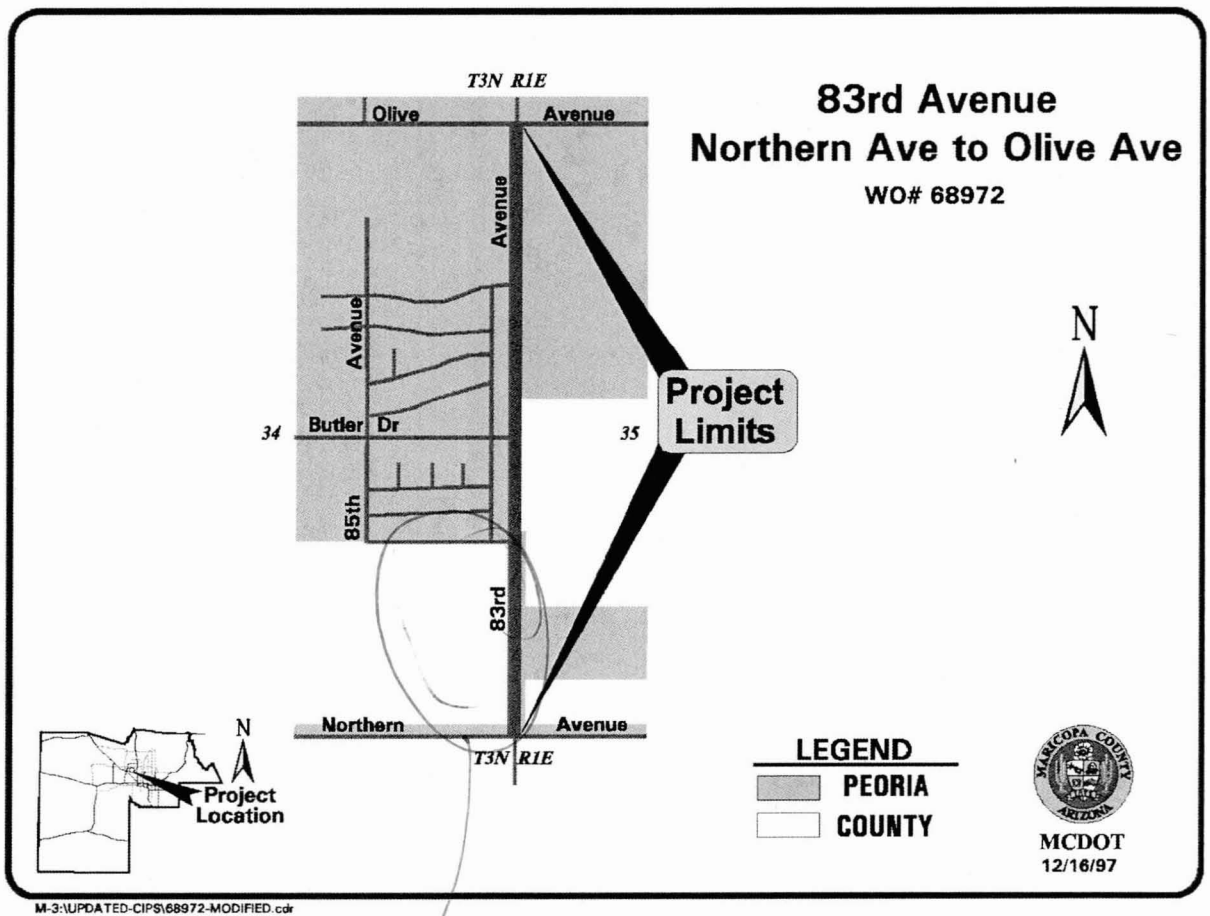


Figure 2

LOCATION MAP



Show Las Palmaritas Drive

An existing 2-lane urban roadway, with no curb, gutter or sidewalks currently occupies the project area. Currently there are no designed drainage roadway facilities located along this section of 83rd Avenue. Runoff from the west side of 83rd Avenue, between Alice Avenue and Las Palmaritas Drive, flows south along the curb to a 760 mm (30-inch) CMP culvert, which conveys flow beneath Las Palmaritas Drive to an existing drainage ditch along the west side of 83rd Avenue. From this point, flow is conveyed further downstream, where it discharges to an existing Salt River Project (SRP) irrigation ditch. All other roadway drainage currently flows along the roadway to the south until it is able to drain into adjacent farm fields or underneath the roadway in irrigation pipes.

The northern section of the proposed project will connect downstream to an existing 1676 mm (66-inch) stub, located north of the 83rd Avenue and Las Palmaritas Drive intersection. The existing stub will be constructed in conjunction with the FCDMC Northern/Orangewood Storm Drain Project (Wood, Patel and Associates, Inc). Discussions with the FCDMC indicate that the downstream system(s) have been sized to accommodate all upstream flows, including the runoff from the portion of 83rd Avenue between Las Palmaritas Drive and Olive Avenue. Existing invert elevations, hydraulic gradients, and information regarding the downstream storm system(s) were obtained from the FCDMC Northern/Orangewood Storm Drain Project design drawings and drainage report.

Additionally, the southern section of storm sewer will connect to the existing 460 mm (18-inch) storm system constructed in conjunction with the MCDOT project on Northern Avenue (Stanley Consultants, Inc.). This portion of the new storm drainage system will collect runoff from the 83rd Avenue roadway, between Griswold Road alignment and Northern Avenue, and convey the flow to the existing 460 mm (18-inch) stub, located approximately 121 meters north of the Northern Avenue and 83rd Avenue intersection.

1. Hydrology: The roadway surface runoffs were conducted using the rational method based upon the 10-year storm event. The runoff coefficient for the pavement surface and the rainfall depths for determination of the rainfall intensity were obtained from the *Drainage Design Manual for Maricopa County, Volume 1, Hydrology* for the FCDMC.

2. Catch Basins: The catch basin type used on the 83rd Avenue project will be city of Phoenix curb opening Type M1 with 150 mm (6-inch) high vertical curb and gutter. The location of catch basins shall be set to provide one driving lane in each direction during the 10-year storm event or maximum spacing of 200 meters (660 feet), whichever is governing.

3. The Starting HGL Elevation for analysis north of the Griswold Road alignment is 334.8 meters (1098.5 feet) taken from Northern and Butler Storm Drains Contract Drawing Sheet 20, prepared by Wood, Patel & Associates, Inc.

   The Starting HGL Elevation for analysis south of the Griswold Road alignment is 335.3 meters (1100.1 feet) taken from the Northern Avenue Loop 101 to 67th Avenue (Work Order No. 68915) Drawing Sheet D20, prepared by Stanley Consultants, Inc.

4. Off-Site Flow: Evaluation of off-site conditions is not required in this scope of work. But the estimated off-site flow coming into the 83rd Avenue system was given by FCDMC as follows:

   - The off-site flow from the field west of 83rd Avenue between Olive Avenue and Alice Avenue based on 2-year storm event is 0.085 cms (3 cfs).
   - The off-site flow from areas east of 83rd Avenue and north of Butler Drive based on the 2-year storm event is 3.31 cms (117 cfs).
   - The off-site flow from areas west of 83rd Avenue and north of Las Palmaritas Drive based on the 2-year storm event is 0.85 cms (30 cfs) west of the intersection of Las Palmaritas Drive and 83rd Avenue.

   This information is supplied in Appendix C.

I haven't seen this, yet

SUMMARY OF CONVEYANCE SYSTEM ANALYSIS AND RECOMMENDATION

1. Conveyance Facilities: The proposed storm system(s) were sized to accommodate runoff from the 10-year, 6-hour storm per FCDMC Standards utilizing the StormCAD software, version 3, by Haestad Methods, Inc. The results of the analysis are attached in Appendix A.

2. Catch Basin: Catch basin locations and spacing were set based on maximum 200 meter (660 feet) interval criteria given in *the Drainage Design Manual for Maricopa County, Volume 2, Hydraulics* from the FCDMC. The catch basin locations were then adjusted to immediately upstream of the intersections with cross streets to minimize the surface drainage leaving the cross section of 83rd Avenue.

   The catch basin locations and wing lengths, which are based upon the configuration of city of Phoenix P-1569 Catch Basin Type M1, are listed in following table. The hydraulic analysis results are included in Appendix B.

Station	CB Type / Length	Remarks
11+410	M1 W/1.829 m (6') Wing	
11+230	M1 W/1.829 m (6') Wing	
11+030	M1 W/1.829 m (6') Wing	
10+840	M1 W/1.829 m (6') Wing	
10+730	M1 W/1.829 m (6') Wing	
10+560	M1 W/1.829 m (6') Wing	Connect to manhole stubs*
10+425	M1 W/1.829 m (6') Wing	Connect to manhole stubs*
10+225	M1 W/1.829 m (6') Wing	
10+022	M1 W/1.829 m (6') Wing	Existing to remain**

* FCDMC - Northern and Butler Storm Drains Sub-Phase "A"
** MCDOT - Northern Avenue Plans

3. Off-Site Flow: The 0.085 cms (3 cfs) off-site flow from the property west of 83rd Avenue and north of Alice Avenue will be picked up by an inlet structure and connected to the 83rd Avenue storm drain system.

no longer will apply since flows go west, not east

The 3.31 cms (117 cfs) off-site flow coming from east of 83rd Avenue and north of Butler Drive will be handled by a 1350 mm (54-inch) pipe and we will provide a 1350 mm (54-inch) stub to the east limit of right-of-way for future connection.

The Las Palmaritas Drive and 83rd Avenue intersection is a known trouble spot to the city of Peoria and is subject to flooding in every rainstorm. As off-site flow information is provided by FCDMC, there is an estimated 0.85 cms (30 cfs) of flow coming from west of this intersection. Based on the existing topography survey information, there is a roll type curb and gutter with approximate curb height of 75 mm (3-inch) along Las Palmaritas Drive. A preliminary calculation (see Appendix C) of the roadway flow capacity between the curb to curb without over topping is 0.11 cms (3.93 cfs) and maximum capacity within the right-of-way is 0.22 cms (7.67 cfs). This indicates that a set

of oversized catch basins installed at the intersection will not resolve the ponding situation because the storm water will overtop the existing curb and sidewalk and dissipate into the adjacent low area and ditches.

We recommend the existing Northern and Butler Storm Drain, Sub-Phase "A" project city of Phoenix, P-1569, Type M1, L=5.182 meters on Las Palmaritas Drive be replaced with Type M2, L=1.829 meters and the storm drain pipe in Las Palmaritas Drive be increased to 750 mm. We also recommend providing a stub to allow for future extension to the west.

The second alternative is to install an additional ditch inlet type structure downstream of the Las Palmaritas Drive and 83rd Avenue intersection to pick up the excess flow and connect to the 1676 mm storm drain on 83rd Avenue.

APPENDIX A

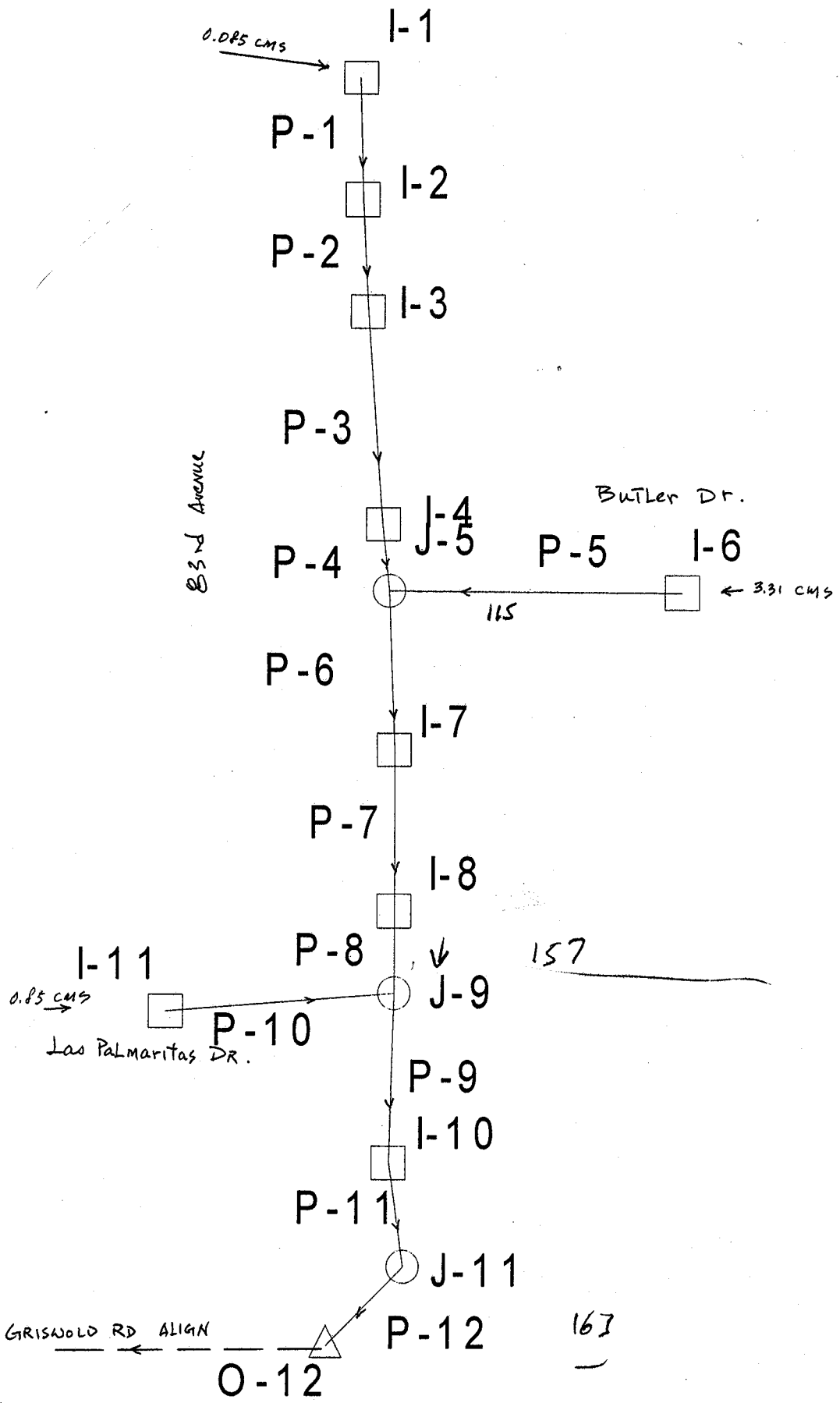
STORM DRAIN HYDRAULIC ANALYSIS

Scenario: Base

Combined Pipe/Node Report

Label	Up. Node	Dn. Node	Length (ft)	C	Area (acres)	System CA (acres)	System Tc (min)	I (in/hr)	System Q (cfs)	Size	Manning's n	Cap (cfs)	Average Velocity (ft/s)	Up Gr Elev (ft)	Dn Gr Elev (ft)	Up Invert (ft)	Dn Invert (ft)	S (ft/ft)	Calculated Headloss (ft)	HGL In (ft)	HGL Out (ft)	Up Cover (ft)	Dn Cover (ft)	Hyd. Drop (ft/ft)
P-1	I-1	I-2	590.55	0.85	0.84	0.71	10.00	4.50	3.24	24 inch	0.012	14.50	2.59	1,121.00	1,119.00	1,111.45	1,108.36	0.003500	1.38	1,112.09	1,110.71	7.55	7.62	0.002335
P-2	I-2	I-3	556.17	0.85	0.88	1.46	15.00	3.75	8.53	24 inch	0.012	20.21	4.54	1,119.00	1,114.50	1,109.38	1,104.92	0.008000	4.20	1,110.42	1,106.23	7.82	7.58	0.005394
P-3	I-3	I-4	623.36	0.85	0.96	2.28	17.41	3.55	8.15	24 inch	0.012	15.11	4.99	1,114.50	1,112.00	1,104.92	1,102.55	0.003800	2.40	1,105.97	1,103.57	7.58	7.45	0.003847
P-4	I-4	J-5	32.81	0.85	0.92	3.08	19.49	3.38	10.41	30 inch	0.012	31.42	4.66	1,112.00	1,111.90	1,102.05	1,101.90	0.005000	-0.02	1,103.14	1,103.16	7.44	7.50	-0.000565
P-5	I-6	J-5	1,000.66	0.85	41.00	34.85	20.00	3.33	117.10	54 inch	0.012	160.73	9.66	1,115.00	1,111.90	1,104.94	1,099.93	0.005007	4.97	1,108.12	1,103.16	5.56	7.47	0.004962
P-6	J-5	I-7	328.08			37.91	21.73	3.19	121.88	66 inch	0.012	171.40	7.03	1,111.90	1,110.60	1,098.95	1,098.22	0.002220	0.42	1,102.57	1,102.15	7.45	8.88	0.001281
P-7	I-7	I-8	557.74	0.85	0.53	38.36	22.50	3.12	120.92	66 inch	0.012	427.70	7.01	1,110.60	1,109.00	1,098.23	1,090.52	0.013824	0.58	1,101.28	1,100.60	6.87	12.98	0.001227
P-10	I-11	J-9	75.00	0.85	10.00	5.50	18.00	3.50	29.98	27 inch	0.012	77.58	7.54	1,103.90	1,103.50	1,095.86	1,091.85	0.053467	0.80	1,100.68	1,100.28	5.19	14.40	0.007990
P-8	I-8	J-9	40.00	0.85	0.82	39.06	23.83	3.01	118.86	66 inch	0.012	136.97	4.99	1,109.00	1,108.60	1,090.52	1,090.46	0.001459	0.04	1,100.32	1,100.28	12.99	12.54	0.001064
P-9	J-9	I-10	400.00			47.56	23.97	3.00	143.95	66 inch	0.012	120.65	6.06	1,106.50	1,107.38	1,090.48	1,090.02	0.001100	0.63	1,099.68	1,099.26	12.54	11.86	0.001586
P-11	I-10	J-11	30.00	0.85	0.65	48.11	25.07	2.91	141.18	66 inch	0.012	127.75	5.94	1,107.38	1,107.00	1,090.03	1,089.99	0.001233	0.05	1,098.87	1,098.83	11.85	11.51	0.001505
P-12	J-11	O-12	30.00			48.11	25.15	2.90	140.84	66 inch	0.012	126.01	5.93	1,107.00	1,106.70	1,089.99	1,089.95	0.001200	0.04	1,098.44	1,098.40	11.51	11.25	0.001499

Scenario: Base



Scenario: Base

Combined Pipe/Node Report

Label	Up Node	Dn Node	Length (m)	C	Area (ha)	System CA (ha)	System Tc (min)	I (mm/hr)	System Q (m³/s)	Size	Mannings n	Cap (m³/s)	Average Velocity (m/s)	Up Gr Elev (m)	Dn Gr Elev (m)	Up Invert (m)	Dn Invert (m)	S (m/m)	Calculated Headloss (m)	HGL In (m)	HGL Out (m)	Up Cover (m)	Dn Cover (m)	Hyd. Drop (m/m)	Velocity Head In (m)
P-1	I-1	I-2	180.00	0.85	0.34	0.29	10.00	114.30	0.0917	600 mm	0.012	0.4105	0.79	341.69	341.07	338.77	338.14	0.003600	0.42	338.97	338.55	2.90	2.32	0.002335	0.07
P-2	I-2	I-3	200.00	0.85	0.36	0.59	15.00	95.25	0.2414	600 mm	0.012	0.5722	1.38	341.07	339.70	338.14	336.78	0.006800	1.28	338.46	337.18	2.32	2.31	0.006394	0.13
P-3	I-3	I-4	190.00	0.85	0.39	0.92	17.41	90.15	0.2308	600 mm	0.012	0.4278	1.52	339.70	338.94	336.78	336.06	0.003800	0.73	337.10	336.37	2.31	2.27	0.003847	0.11
P-4	I-4	J-5	10.00	0.85	0.37	1.24	19.49	85.74	0.2948	750 mm	0.012	0.6897	1.42	338.94	338.91	335.91	335.86	0.005000	-0.01	336.24	336.24	2.27	2.29	-0.000565	0.12
P-5	I-5	J-5	305.00	0.85	16.59	14.10	20.00	84.67	3.3158	1350 mm	0.012	4.2682	2.94	339.85	338.91	336.79	335.26	0.005007	1.51	337.76	336.24	1.70	2.28	0.004962	0.45
P-6	J-5	I-7	100.00			15.34	21.73	81.01	3.4512	1650 mm	0.012	4.8535	2.14	338.91	338.51	334.96	334.74	0.002220	0.13	336.06	335.93	2.27	2.10	0.001291	0.28
P-7	I-7	I-8	170.00	0.85	0.21	15.52	22.50	79.37	3.4213	1650 mm	0.012	12.1111	2.14	338.51	338.02	334.74	332.39	0.013824	0.21	335.67	335.46	2.09	3.96	0.001227	0.38
P-10	I-11	J-9	22.96	0.85	4.05	3.44	18.00	88.90	0.8492	975 mm	0.012	2.1967	2.30	336.29	337.87	334.02	332.80	0.053487	0.18	335.55	335.37	1.58	4.39	0.007890	0.27
P-8	I-8	J-9	12.19	0.85	0.33	15.81	23.83	76.56	3.3601	1650 mm	0.012	3.9351	1.52	338.02	337.87	332.39	332.37	0.001459	0.01	335.38	335.37	3.96	3.82	0.001064	0.12
P-9	J-9	I-10	121.92			19.25	23.97	76.27	4.0783	1650 mm	0.012	3.4164	1.86	337.87	337.53	332.37	332.24	0.001100	0.19	335.24	335.05	3.82	3.61	0.001566	0.17
P-11	I-10	J-11	9.14	0.85	0.26	19.47	25.07	73.94	3.9977	1650 mm	0.012	3.6178	1.91	337.53	337.41	332.24	332.23	0.001233	0.01	334.94	334.92	3.61	3.61	0.001606	0.17
P-12	J-11	O-12	9.14			19.47	25.15	73.77	3.9881	1650 mm	0.012	3.5683	1.91	337.41	337.32	332.23	332.22	0.001200	0.01	334.81	334.79	3.61	3.43	0.001499	0.17

Scenario: Base

Combined Pipe/Node Report

Label	Upstream Node	Downstream Node	Length (m)	Section Size	Average Velocity (m/s)	Upstream Invert Elevation (m)	Downstream Invert Elevation (m)	Constructed Slope (m/m)	Hydraulic Grade In (m)	Hydraulic Grade Out (m)	Total System Flow (m³/s)	Downstream Ground Elevation (m)	Upstream Ground Elevation (m)
P-1	I-1	I-2	180.00	600 mm	0.79	338.77	338.14	0.003500	338.97	338.55	0.0917	341.07	341.68
P-2	I-2	I-3	200.00	600 mm	1.38	338.14	336.78	0.006800	338.46	337.18	0.2414	339.70	341.07
P-3	I-3	I-4	190.00	600 mm	1.52	336.78	336.06	0.003800	337.10	336.37	0.2308	338.94	339.70
P-4	I-4	J-5	10.00	750 mm	1.42	335.91	335.86	0.005000	336.24	336.24	0.2948	338.91	338.94
P-5	I-6	J-5	305.00	1350 mm	2.94	336.79	335.26	0.005007	337.76	336.24	3.3158	338.91	339.85
P-6	J-5	I-7	100.00	1650 mm	2.14	334.96	334.74	0.002220	336.06	335.93	3.4512	338.51	338.91
P-7	I-7	I-8	170.00	1650 mm	2.14	334.74	332.39	0.013824	335.67	335.46	3.4213	338.02	338.51
P-10	I-11	J-9	22.86	675 mm	2.30	334.02	332.80	0.053467	335.55	335.37	0.8492	337.87	336.29
P-8	I-8	J-9	12.19	1650 mm	1.52	332.39	332.37	0.001459	335.38	335.37	3.3601	337.87	338.02
P-9	J-9	I-10	121.92	1650 mm	1.85	332.37	332.24	0.001100	335.24	335.05	4.0763	337.53	337.87
P-11	I-10	J-11	9.14	1650 mm	1.81	332.24	332.23	0.001233	334.94	334.92	3.9977	337.41	337.53
P-12	J-11	O-12	9.14	1650 mm	1.81	332.23	332.22	0.001200	334.81	334.79	3.9881	337.32	337.41

Junction loss greatly underestimated use absolute 2.2 m from eqtn. per sheet D6

769 mm for 30" pipe

Why a drop in flow between P7 & P8?

88" per sheet D6

1692 for 66"

1384 mm for 54" pipe

not same el. as shown on sheet D4

drop of flow

should have column showing discharge

30" = 769 mm

Why is sump elev. = ∅ at O-12

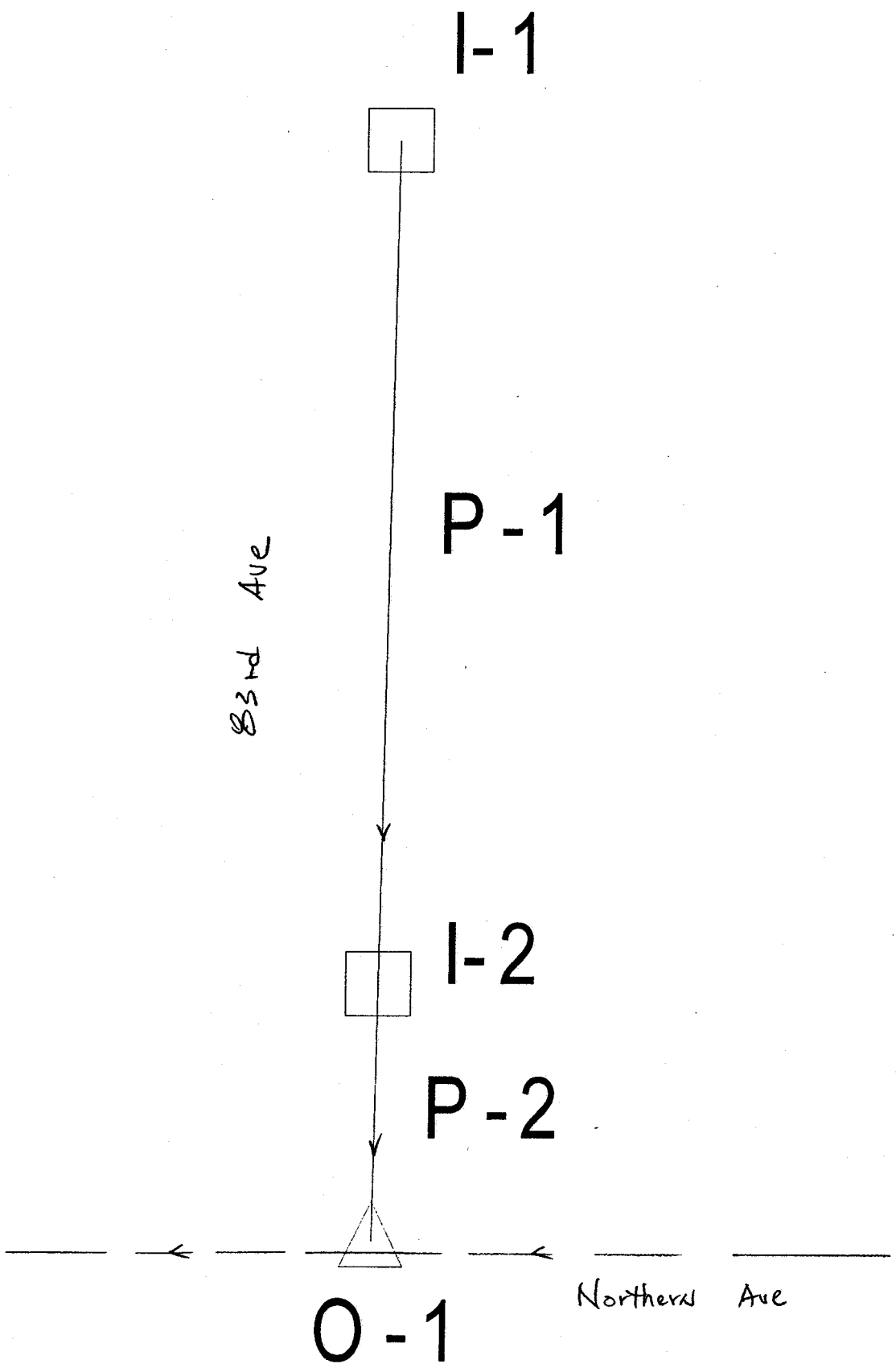
Electronic file shows ∅ inflow at Las Palmaritas.

Please provide calculations to substantiate modeled junction headloss inputs.

Model schematic shows bend at lowermost segment of pipe, but invert elevations don't match Wood, Patel & Assoc. plans

substantiate sump elev. = ∅ for J5

Scenario: Base



Scenario: Base

Combined Pipe/Node Report

Label	Up. Node	Dn. Node	Length (m)	System Q (m^3/s)	Size	Mannings n	Cap (m^3/s)	Average Velocity (m/s)	Up Gr Elev (m)	Dn Gr Elev (m)	Up Invert (m)	Dn Invert (m)	S (m/m)	Calculated Headloss (m)	HGL In (m)	HGL Out (m)	Up Cover (m)	Dn Cover (m)	Hyd. Drop (m/m)	Velocity Head In (m)	Velocity Head Out (m)
P-1	I-1	I-2	200.00	0.0280	450 mm	0.013	0.1629	0.17	337.40	336.70	333.47	332.87	0.003000	0.02	335.33	335.31	3.47	3.37	0.000089	1.48e-3	1.48e-3
P-2	I-2	O-1	21.39	0.0560	450 mm	0.013	0.2024	0.34	336.70	336.30	331.86	331.76	0.004629	0.01	335.31	335.30	4.38	4.08	0.000354	0.01	0.01

— Output should show existing ground elevation; check this elevation for "upstream" at node I1

Please substantiate why there is "0" headloss at node I2 although the flow doubles, there

Model Revisions
(1) Check Inlet Q's (revise Rat calc sheets)
(2) Add H_j at I2
(3) Add MH between I1 & I2 (breaks up length of P1)

$$H_j = \left(\frac{8^2}{(32.2)(1.77)} - \frac{4^2}{(32.2)(1.77)}\right)\frac{}{1.77} \approx 0.42'$$

APPENDIX B

CATCH BASIN INLET HYDRAULICS

- CATCH BASIN HYDRAULICS
- CATCH BASIN CONNECTOR PIPE HYDRAULICS

ENGINEERS INC.

Job No. 69422

Vol./Sheet No. 1 of 1

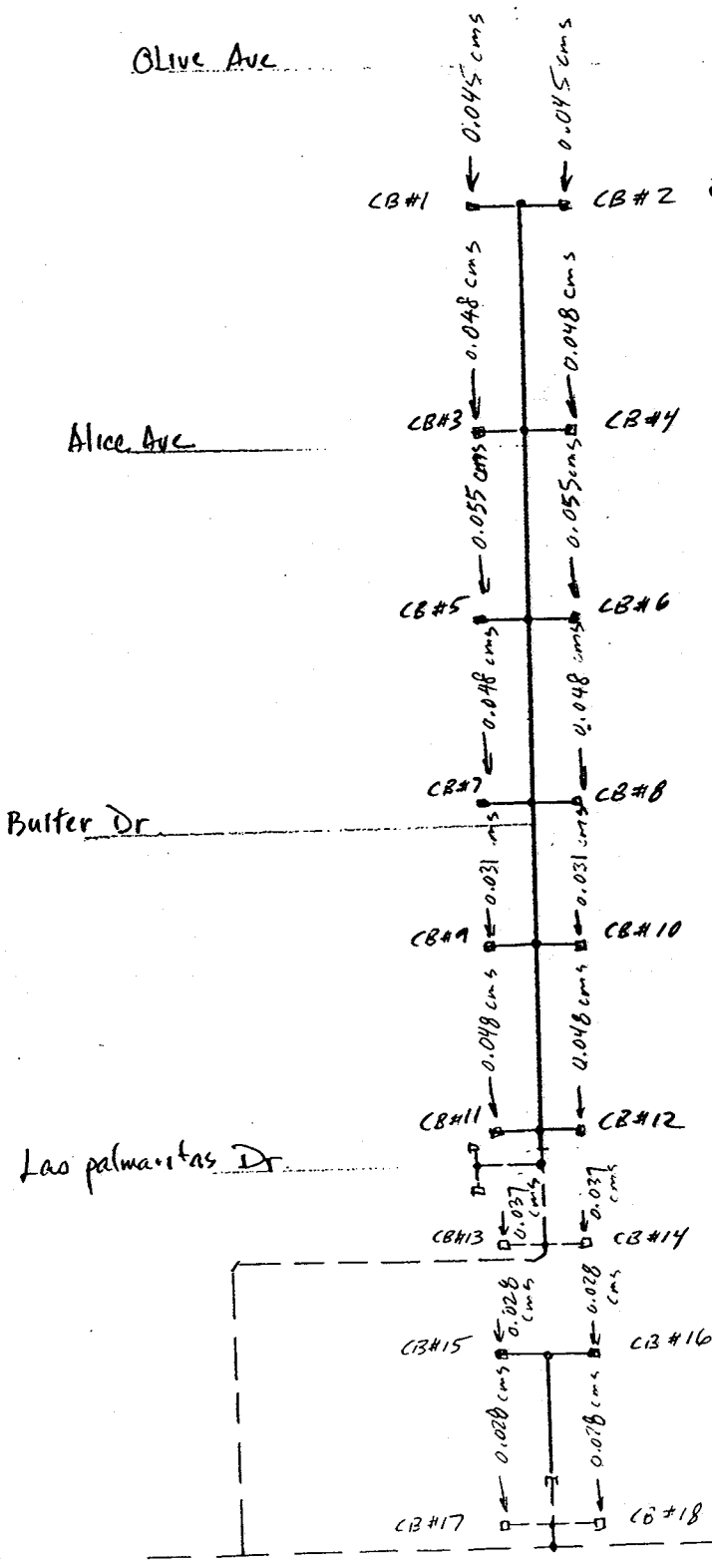
Contract/Client

Phase/Subject 83rd Ave - Catch Basins

Design Topic

Made By EAG Date 1-31-00 Checked By 1-31-00 Date

Page No.



CB#	FLOW (cms)	CAPTURED	FLOW BY	FLOW BY TO CB#
2	0.045	0.044	0.001	4
4	0.049	0.048	0.000	
6	0.057	0.050	0.006	8
8	0.054	0.051	0.003	10
10	0.034	0.034	0.000	
12	0.048	0.046	0.002	14
14	0.039	0.039	0.000	
16	0.028	0.027	0.001	18
18	0.029	0.028	0.000	

CB#	FLOW (cms)	CAPTURED	FLOW BY	FLOW BY TO CB#
1	0.045	0.044	0.001	3
3	0.049	0.048	0.002	
5	0.057	0.050	0.006	7
7	0.054	0.051	0.003	9
9	0.034	0.034	0.000	
11	0.048	0.046	0.002	13
13	0.039	0.039	0.000	
15	0.028	0.027	0.001	17
17	0.029	0.028	0.000	

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: INCA ENGINEERS Date: 01-12-2000

LOCATION DATA

Location: 83rd Ave - Olive to Northern Ave

Project Name: 83rd Ave Subarea id: 1 I-1

Drainage Area Cover: Sta 11+585 To 11+410

DESIGN DATA

Drainage Area	0.42	acres ✓
Watercourse Length	575.0	feet ✓
Top Elevation	1123.0	feet
Bottom Elevation	1121.0	feet
Slope	.00348	feet/feet
Roughness Coefficient (Kb)	.03997	
10-Year, 6-Hour Rainfall	2.07	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	1	1.6	2	3	3
(cms)			0.045			
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	11.7	10.3	9.7 (10)	8.8	8.4	7.9
i (in/hr)	2.8	3.8	4.5	5.8	6.6	7.7

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: INCA ENGINEERS Date: 01-12-2000

LOCATION DATA

Location: 83rd Ave - Olive to Northern Ave

Project Name: 83rd Ave Subarea id: 2 I-2

Drainage Area Cover: Sta 11+410 To 11+230

DESIGN DATA

Drainage Area	0.44	acres
Watercourse Length	590.0	feet
Top Elevation	1121.0	feet
Bottom Elevation	1119.0	feet
Slope	.00339	feet/feet
Roughness Coefficient (Kb)	.03997	
10-Year, 6-Hour Rainfall	2.07	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	1	1.7	2	3	3
(cms)			0.048			
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	12.0	10.6	9.9 (10)	9.0	8.6	8.1
i (in/hr)	2.7	3.8	4.5	5.7	6.6	7.6

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: INCA ENGINEERS Date: 01-12-2000

LOCATION DATA

Location: 83rd Ave - Olive to Northern Ave

I-3

Project Name: 83rd Ave Subarea id: 3

Drainage Area Cover: Sta 11+230 To 11+030

DESIGN DATA

Drainage Area	0.48 acres ✓
Watercourse Length	650.0 feet ✓
Top Elevation	1119.0 feet
Bottom Elevation	1114.5 feet
Slope	.00692 feet/feet
Roughness Coefficient (Kb)	.03997
10-Year, 6-Hour Rainfall	2.07 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	2	2.0	3	3	4
(cms)			0.057			
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	9.7	8.6	8.1 (8)	7.4	7.0	6.6
i (in/hr)	3.0	4.1	4.9	6.2	7.1	8.2

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: INCA ENGINEERS Date: 01-12-2000

LOCATION DATA

Location: 83rd Ave - Olive to Northern Ave

Project Name: 83rd Ave Subarea id: 4

Drainage Area Cover: Sta 11+030 To 10+840

DESIGN DATA

Drainage Area	0.46 acres
Watercourse Length	620.0 feet ✓
Top Elevation	1114.5 feet
Bottom Elevation	1112.3 feet
Slope	.00355 feet/feet
Roughness Coefficient (Kb)	.03997
10-Year, 6-Hour Rainfall	2.07 inches

I-4

17 min in Stormcad

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	1	1.7	2	3	3
(cms)			0.048			
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	12.1	10.7	10.0	9.1	8.7	8.2
i (in/hr)	2.7	3.8	4.5	5.7	6.5	7.5

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: INCA ENGINEERS Date: 01-12-2000

LOCATION DATA

Location: 83rd Ave - Olive to Northern Ave

Project Name: 83rd Ave Subarea id: 5

Drainage Area Cover: Sta 10+340 To 10+730

I-7

DESIGN DATA

Drainage Area	0.26	acres
Watercourse Length	360.0	feet
Top Elevation	1112.3	feet
Bottom Elevation	1111.3	feet
Slope	.00278	feet/feet
Roughness Coefficient (Kb)	.03997	
10-Year, 6-Hour Rainfall	2.07	inches

I-6 is beg. of Butler Lateral
- Tc = 20 minutes?
substantiate (originally NEC-1 input)

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	1	1.1	2	2	2
(cms)			0.031			
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	9.6	8.5	7.9	7.3	6.9	6.5
			10 minutes			
i (in/hr)	3.0	4.1	4.9	6.2	7.1	8.2

throws off intensities further downstream

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: INCA ENGINEERS Date: 01-12-2000

LOCATION DATA

Location: 83rd Ave - Olive to Northern Ave

Project Name: 83rd Ave Subarea id: 6

Drainage Area Cover: Sta 10+730 To 10+560

I-8

DESIGN DATA

Drainage Area	0.41 acres
Watercourse Length	560.0 feet
Top Elevation	1111.3 feet
Bottom Elevation	1108.6 feet
Slope	.00482 feet/feet
Roughness Coefficient (Kb)	.03997
10-Year, 6-Hour Rainfall	2.07 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	1	1.7	2	3	3
(cms)			0.048			
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	10.2	9.0	8.4	7.7	7.3	6.9
i (in/hr)	2.9	4.0	4.8	6.1	7.0	8.0

10 min. in Stormcad

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: INCA ENGINEERS Date: 01-12-2000

LOCATION DATA

Location: 83rd Ave - Olive to Northern Ave

Project Name: 83rd Ave Subarea id: 7

Drainage Area Cover: Sta 10+560 To 10+425 B-10

DESIGN DATA

Drainage Area	0.32 acres
Watercourse Length	440.0 feet ✓
Top Elevation	1108.6 feet
Bottom Elevation	1107.0 feet
Slope	.00364 feet/feet
Roughness Coefficient (Kb)	.03997
10-Year, 6-Hour Rainfall	2.07 inches

Hydrological Summary Table

10 in Stormcad

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	1	1.3	2	2	3
(cms)			0.037			
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	9.8	8.7	8:1	7.4	7.0	6.7
i (in/hr)	3.0	4.1	4.9	6.2	7.1	8.2

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: INCA ENGINEERS Date: 01-27-2000

LOCATION DATA

Location: 83rd Avenue

Project Name: 83rs Avenue ~~Subarea~~ id: 8

Drainage Area Cover: sta 10+425 To 10+225

DESIGN DATA

Drainage Area	0.15 acres
Watercourse Length	200.0 feet
Top Elevation	1107.0 feet
Bottom Elevation	1104.7 feet
Slope	.01150 feet/feet
Roughness Coefficient (Kb)	.03997
10-Year, 6-Hour Rainfall	2.07 inches

stations are in meters → convert to feet → Δ in area → ΔQ !

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	0	1	1	1	1	1
(cms)			0.028			
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	5.0	5.0	5.0	5.0	5.0	5.0
i (in/hr)	3.8	5.0	5.9	7.0	8.0	9.0

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: INCA ENGINEERS Date: 01-27-2000

LOCATION DATA

Location: 83rd Avenue

Project Name: 83rs Avenue Subarea id: 9

Drainage Area Cover: Sta 10+225 To 10+025

DESIGN DATA

Drainage Area	0.15 acres
Watercourse Length	200.0 feet
Top Elevation	1104.7 feet
Bottom Elevation	1103.0 feet
Slope	.00850 feet/feet
Roughness Coefficient (Kb)	.03997
10-Year, 6-Hour Rainfall	2.07 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	0	1	1	1	1	1
(c.s)			0.028			
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	5.0	5.0	5.0	5.0	5.0	5.0
i (in/hr)	3.8	5.0	5.9	7.0	8.0	9.0

****
***** ROADWAY DRAINAGE DESIGN *****
****

DESIGNER: INCA ENGINEERS

DATE: 01-31-2000

PROJECT: 83rd Ave Widening

PROJECT NO.: 69422

INLET NO.: 1 & 2

STATION: 11+410

DRAINAGE AREA: .42 ACRES

DESIGN FREQUENCY: 10 Years

ROADWAY & DISCHARGE DATA

Cross-Slope	S (m/m)	Sx (m/m)	n	Q (m^3/s)	T (m)
Composite	0.0030	0.0200	0.016	0.045	3.209

GUTTER FLOW

W (m)	Sw (m/m)	a (mm)	Eo	d (mm)	V (m/s)
0.433	0.0500	50.800	0.358	77.181	0.425

INLET INTERCEPTION

Inlet Type	LT (m)	L (m)	E	Qi (m^3/s)	Qb (m^3/s)
Curb-Opening	2.236	2.190	0.999	0.044	0.001

****
***** ROADWAY DRAINAGE DESIGN *****
****

DESIGNER: INCA ENGINEERS

DATE: 01-31-2000

PROJECT: 83rd Ave Widening

PROJECT NO.: 69422

INLET NO.: 3 & 4

STATION: 11+230

DRAINAGE AREA: .44 ACRES

DESIGN FREQUENCY: 10 Years

ROADWAY & DISCHARGE DATA

Cross-Slope	S (m/m)	Sx (m/m)	n	Q (m^3/s)	T (m)
Composite	0.0030	0.0200	0.016	0.049	3.318

GUTTER FLOW

W (m)	Sw (m/m)	a (mm)	Eo	d (mm)	V (m/s)
0.433	0.0500	50.800	0.347	79.357	0.432

INLET INTERCEPTION

Inlet Type	LT (m)	L (m)	E	Qi (m^3/s)	Qb (m^3/s)
Curb-Opening	2.349	2.190	0.992	0.048	0.000

****
***** ROADWAY DRAINAGE DESIGN *****
****

DESIGNER: INCA ENGINEERS

DATE: 01-31-2000

PROJECT: 83rd Ave Widening

PROJECT NO.: 69422

INLET NO.: 5 & 6

STATION: 11+030

DRAINAGE AREA: .48 ACRES

DESIGN FREQUENCY: 10 Years

ROADWAY & DISCHARGE DATA

Cross-Slope	S (m/m)	Sx (m/m)	n	Q (m^3/s)	T (m)
Composite	0.0070	0.0200	0.016	0.057	2.980

GUTTER FLOW

W (m)	Sw (m/m)	a (mm)	Eo	d (mm)	V (m/s)
0.433	0.0500	50.800	0.384	72.624	0.620

INLET INTERCEPTION

Inlet Type	LT (m)	L (m)	E	Qi (m^3/s)	Qb (m^3/s)
Curb-Opening	3.088	2.190	0.891	0.050	0.006

****
***** ROADWAY DRAINAGE DESIGN *****
****

DESIGNER: INCA ENGINEERS

DATE: 01-31-2000

PROJECT: 83rd Ave Widening

PROJECT NO.: 69422

INLET NO.: 7 & 8

STATION: 10+840

DRAINAGE AREA: .46 ACRES

DESIGN FREQUENCY: 10 Years

ROADWAY & DISCHARGE DATA

Cross-Slope	S (m/m)	Sx (m/m)	n	Q (m^3/s)	T (m)
Composite	0.0040	0.0200	0.016	0.054	3.257

GUTTER FLOW

W (m)	Sw (m/m)	a (mm)	Eo	d (mm)	V (m/s)
0.433	0.0500	50.800	0.354	78.156	0.495

INLET INTERCEPTION

Inlet Type	LT (m)	L (m)	E	Qi (m^3/s)	Qb (m^3/s)
Curb-Opening	2.648	2.190	0.957	0.051	0.003

****
***** ROADWAY DRAINAGE DESIGN *****
****

DESIGNER: INCA ENGINEERS

DATE: 01-31-2000

PROJECT: 83rd Ave Widening

PROJECT NO.: 69422

INLET NO.: 9 & 10

STATION: 10+730

DRAINAGE AREA: .26 ACRES

DESIGN FREQUENCY: 10 Years

ROADWAY & DISCHARGE DATA

Cross-Slope	S (m/m)	Sx (m/m)	n	Q (m^3/s)	T (m)
Composite	0.0030	0.0200	0.016	0.034	2.874

GUTTER FLOW

W (m)	Sw (m/m)	a (mm)	Eo	d (mm)	V (m/s)
0.433	0.0500	50.800	0.398	70.470	0.398

INLET INTERCEPTION

Inlet Type	LT (m)	L (m)	E	Qi (m^3/s)	Qb (m^3/s)
Curb-Opening	1.897	2.190	1.000	0.034	0.000

****
***** ROADWAY DRAINAGE DESIGN *****
****

DESIGNER: INCA ENGINEERS

DATE: 01-31-2000

PROJECT: 83rd Ave Widening

PROJECT NO.: 69422

INLET NO.: 11 & 12

STATION: 10+560

DRAINAGE AREA: .41 ACRES

DESIGN FREQUENCY: 10 Years

ROADWAY & DISCHARGE DATA

Cross-Slope	S (m/m)	Sx (m/m)	n	Q (m^3/s)	T (m)
Composite	0.0050	0.0200	0.016	0.048	2.976

GUTTER FLOW

W (m)	Sw (m/m)	a (mm)	Eo	d (mm)	V (m/s)
0.433	0.0500	50.800	0.386	72.539	0.523

INLET INTERCEPTION

Inlet Type	LT (m)	L (m)	E	Qi (m^3/s)	Qb (m^3/s)
Curb-Opening	2.594	2.190	0.964	0.046	0.002

****
***** ROADWAY DRAINAGE DESIGN *****
****

DESIGNER: INCA ENGINEERS

DATE: 01-31-2000

PROJECT: 83rd Ave Widening

PROJECT NO.: 69422

INLET NO.: 13 & 14

STATION: 10+425

DRAINAGE AREA: .32 ACRES

DESIGN FREQUENCY: 10 Years

ROADWAY & DISCHARGE DATA

Cross-Slope	S (m/m)	Sx (m/m)	n	Q (m^3/s)	T (m)
Composite	0.0040	0.0200	0.016	0.039	2.865

GUTTER FLOW

W (m)	Sw (m/m)	a (mm)	Eo	d (mm)	V (m/s)
0.433	0.0500	50.800	0.400	70.319	0.458

INLET INTERCEPTION

Inlet Type	LT (m)	L (m)	E	Qi (m^3/s)	Qb (m^3/s)
Curb-Opening	2.189	2.190	1.000	0.039	0.000

****
***** ROADWAY DRAINAGE DESIGN *****
****

DESIGNER: INCA ENGINEERS

DATE: 01-31-2000

PROJECT: 83rd Ave Widening

PROJECT NO.: 69422

INLET NO.: 15 & 16

STATION: 10+225

DRAINAGE AREA: .15 ACRES

DESIGN FREQUENCY: 10 Years

ROADWAY & DISCHARGE DATA

Cross-Slope	S (m/m)	Sx (m/m)	n	Q (m^3/s)	T (m)
Composite	0.0115	0.0200	0.016	0.028	2.023

GUTTER FLOW

W (m)	Sw (m/m)	a (mm)	Eo	d (mm)	V (m/s)
0.433	0.0500	50.800	0.544	53.467	0.638

INLET INTERCEPTION

Inlet Type	LT (m)	L (m)	E	Qi (m^3/s)	Qb (m^3/s)
Curb-Opening	2.266	2.190	0.997	0.027	0.001

****
***** ROADWAY DRAINAGE DESIGN *****
****

DESIGNER: INCA ENGINEERS

DATE: 01-31-2000

PROJECT: 83rd Ave Widening

PROJECT NO.: 69422

INLET NO.: 17 & 18

STATION: 10+025

DRAINAGE AREA: .15 ACRES

DESIGN FREQUENCY: 10 Years

ROADWAY & DISCHARGE DATA

Cross-Slope	S (m/m)	Sx (m/m)	n	Q (m^3/s)	T (m)
Composite	0.0085	0.0200	0.016	0.029	2.184

GUTTER FLOW

W (m)	Sw (m/m)	a (mm)	Eo	d (mm)	V (m/s)
0.433	0.0500	50.800	0.509	56.705	0.573

INLET INTERCEPTION

Inlet Type	LT (m)	L (m)	E	Qi (m^3/s)	Qb (m^3/s)
Curb-Opening	2.166	2.190	1.000	0.028	0.000

Catch Basin Connector Pipe Hydraulics

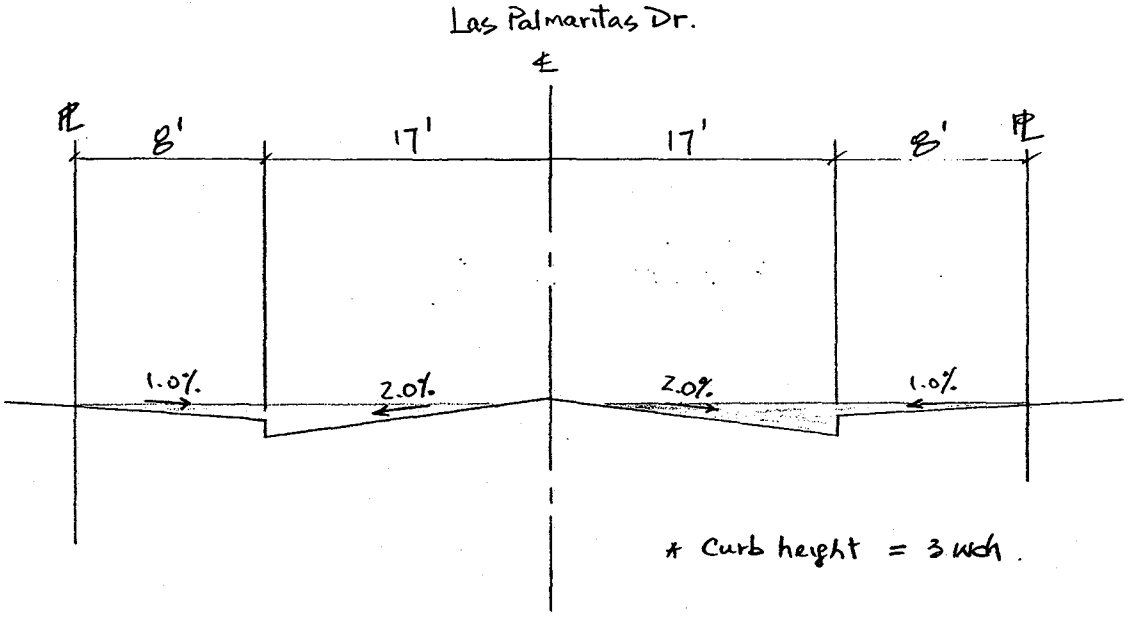
CB#	LATERAL PIPE No.	Q (cms)	PIPE DIA. (mm)	INVERT AT CB (m)	SLOPE (m/m)	TOP OF CURB (m)	GUTTER (m)	D/S HGL CONTROL	D/S HGL ELEV (m)	D/S INVERT (m)	PIPE LENGTH (m)	TAILWATER (m)	INLET CONTROL HW (m)	OUTLET CONTROL HW (m)	INLET CONTROL HW ELEV (m)	OUTLET CONTROL HW ELEV (m)	CONTROLLING HW	GUTTER-HW ELEV (m)	CB#
1 & 2	L1,L2	0.045	381	340.31	0.02	341.53	341.38	MH	338.22	340.12	9.75	-1.895	0.30	--	340.61	--	INLET CNTRL	0.8	1 & 2
3 & 4	L3, L4	0.049	381	339.82	0.02	341.04	340.89	MH	337.65	339.63	9.75	-1.975	0.30	--	340.12	--	INLET CNTRL	0.8	3 & 4
5 & 6	L5, L6	0.057	381	338.57	0.02	339.79	339.64	MH	336.45	338.38	9.75	-1.925	0.30	--	338.87	--	INLET CNTRL	0.8	5 & 6
7 & 8	L7, L8	0.054	381	337.69	0.02	338.91	338.75	MH	336.22	337.50	9.75	-1.275	0.30	--	337.99	--	INLET CNTRL	0.8	7 & 8
9 & 10	L9, L10	0.034	381	337.26	0.02	338.48	338.33	MH	335.63	337.07	9.75	-1.435	0.30	--	337.56	--	INLET CNTRL	0.8	9 & 10
11 & 12	L11, L12	0.048	381	336.77	0.02	337.99	337.84	MH	335.36	336.58	9.75	-1.215	0.30	--	337.07	--	INLET CNTRL	0.8	11 & 12
13 & 14	L13, L14	0.039	381	336.25	0.02	337.47	337.32	MH	334.93	336.06	9.75	-1.125	0.30	--	336.55	--	INLET CNTRL	0.8	13 & 14
15 & 16	L15, L16	0.028	381	337.15	0.02	337.35	337.20	MH	335.33	336.96	9.75	-1.625	0.30	--	337.45	--	INLET CNTRL	-0.3	15 & 16

Wierd input

reference eqtns.
provide electronic version of file

APPENDIX C

OFF-SITE FLOW ANALYSIS



Street flow Capacity (FULL R.O.W.)

Xec Area = 6.08 ft².

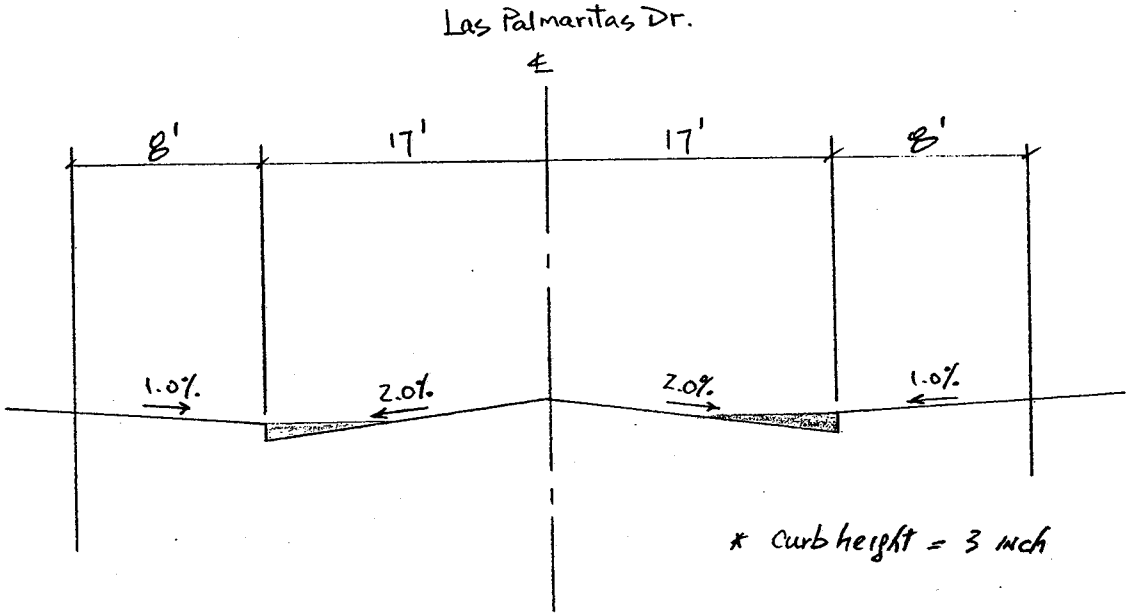
W.P. = 49.50 ft.

$$Q = \frac{1.486}{n} R^{2/3} S^{0.5} A.$$

$$= \frac{1.486}{0.013} \left(\frac{6.08}{49.5}\right)^{2/3} (0.002)^{0.5} \times 6.08$$

$$= 7.67 \text{ cfs.} \quad (0.22 \text{ CMS})$$

With this design, still need to address what will happen to 30-7.7 cfs in the interim condition before city extends lateral



STreet flow Capacity . e Curb height. (No overTopping)

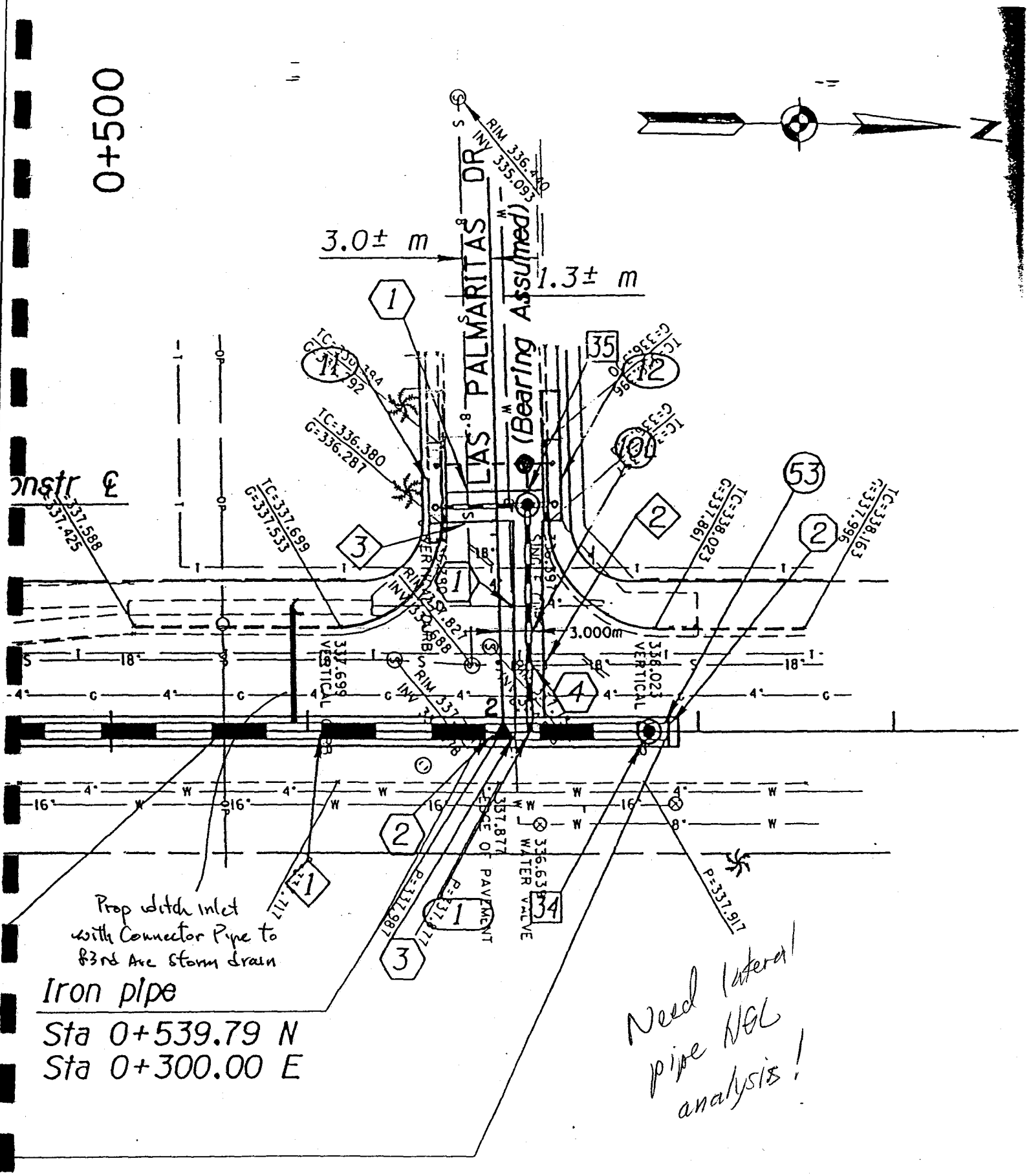
Xec Area = 3.12 ft².

W.P. = 25.5 ft

$$Q = \frac{1.486}{n} R^{2/3} S^{0.5} A$$

$$= \frac{1.486}{0.013} \left(\frac{3.12}{25.5}\right)^{0.667} (0.002)^{0.5} \times 3.12$$

$$= 3.93 \text{ cfs} . \quad (0.11 \text{ CMS})$$


0+500
PALMARITAS DR
(Bearing Assumed)
3.0± m
1.3± m
RIM 336.440
INV 335.093
TC=337.588
G=337.425
TC=337.699
G=337.533
TC=336.380
G=336.281
TC=337.92
3.000m
337.699 VERTICAL
338.023 VERTICAL
337.877 EDGE OF PAVEMENT
336.631 WATER VALVE
P=337.987
P=337.917
Prop ditch inlet with Connector Pipe to 83rd Ave storm drain
Iron pipe
Sta 0+539.79 N
Sta 0+300.00 E
Need lateral pipe HGL analysis!

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT 83RD AVE DCR - MCDOT PAGE 2 OF 2

DETAIL NORTHERN/ORANGEWOOD SD COMPUTED CAP DATE 11/8

HEC-1 MOD. CHECKED BY _____ DATE _____

NODE	2-YEAR 6-HR Q_{MOD} ft³/s	2-YEAR 6-HR Q_{ORIG}	10-YEAR 6-HR Q_{MOD} ft³/s	10-YEAR 6-HR Q_{ORIG}
60DC1	115	115	200	200
* Butler/83rd 60DC2	117	117	204	204
60DR	117	117	204	204
80AC	157	126	289	220
80AR	156	126	288	220
80BC	163	132	300	231
110BR	3	3	5	5

offsite

ON site/Roadway.

Las Palmaritas CR picked up @ 30 cfs per modeling by Chris Perry 10/8/99

→ Inlet. detail

Hec-12. ← Richard.

→ Stormcad ver:3.

→ Flowmaster

1" ≈ 770'

1125 OLIVE AVE

Well

Peoria Cotton Well

Peoria Substation

Peoria Steam Plant

BM 1145

BUTLER

NORTHERN

ATCHISON

83RD AVE

79TH AVE

75TH AVE

67TH AVE

N

36

APPENDIX D

PROJECT CORRESPONDENCES AND DESIGN BACKGROUND INFORMATION

FLOOD CONTROL DISTRICT
of
Maricopa County

Interoffice Memorandum

DATE: January 6, 2000

TO: NMZ, MCDOT

VIA: MAL

FROM: RPH

SUBJECT: **Preliminary Catch Basin Capacity Calculations for 83rd Avenue Widening and Storm Drain Project**

I have reviewed the subject materials, and offer the following comments:

1) Overall, the calculation method used by the consultant to estimate catch basin capacity is acceptable. However, the current submittal does not include a street-full flow analysis, which is needed to estimate the actual flow that the two catch basins to be located along Palmaritas Street could actually intercept. This analysis is needed not only to size the two catch basins that already are planned at that location, but also for use by the City of Peoria regarding possible future lateral pipe extension and additional catch basin construction.

2) A metric scale is still needed in order to measure features that will be submitted by the consultant.

3) In order to apply MAG Standard Detail COP P1569 type catch basins to the design at the location described, curb transition from roll to vertical will need to be provided for. Based upon the survey information provided in the current submittal, the existing curb is only about 3 inches high. Therefore, the catch basin design will require depressed curbs at the inlets. As discussed with the consultant this morning, the design plans should include notes to indicate the transition sections and the CB profiles should include inlet invert elevations.

File Folder: IO-MEM79

4) The consultant has asked that the District provide a modified version of it's computer program, Rational.exe, that will give discharge values that include one decimal place instead of only whole numbers. I am currently working on this and will electronically forward a copy to them as soon as it is ready. It is understood that this model will be used only for the street drainage design, and not to estimate offsite flows.

File Folder: IO-MEM79

MEETING MINUTES

PROJECT: **83rd Avenue from Northern Avenue to Olive Avenue**

DATE: Dec. 10, 1999 at 1:15 – 1:45PM

SUBJECT: **Discussion on Drainage Design Parameters and Criteria**

ATTENDEES: **Richard Harris (FCDMC), Rajesh Christian (INCA), and Dennis Cheung (INCA)**

Design Parameters and Criteria:

- Design shall based upon Drainage Design Manual for Maricopa County by Flood Control District of Maricopa County (FCDMC), latest version.
- Onsite (Roadway) flow is based on 10-year storm event.
- Offsite flow is based on 2-year storm event.
- Provided by FCDMC, the offsite 2-yr flow from west property off 83rd Avenue between Olive Avenue and Alice Ave. is 3 cfs.
- Provided by FCDMC, the offsite 2-yr flow from area north and east of 83rd Ave/Butler Drive intersection is 117 cfs.
- Provided by FCDMC, the offsite 2-yr. flow from area north and west 83rd Ave/Las Palmaritas Dr. intersection is 30 cfs.

Discussion

- INCA will accommodate all the offsite flow in the drainage model.
- Richard H. would like to see the design of the future storm line with HGL to the east aprox. ½ mile on Butler Drive for his review.
- On Las Palmaritas Dr., INCA will design details of two (2) catch basins and possible combination with slot drain to pick up the 100% offsite flow (30 cfs) from the west in order to eliminate any bypass flow and save the piping downstream of Las Palmaritas.
- INCA will confirm with the project manager of Northern and Butler Storm Drain project to add an 18" (460mm) stub out to the manhole just north of the 45 degrees bend onto 83rd Ave.
- A design drainage report will be submitted to FCDMC for review at 40% project submission.

If the foregoing minutes are not in accordance with your understanding, please contact Rajesh Christian at (602) 277-8161.

WOOD/PATEL fax transmittal

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS

	PAGE 1 OF 3
	DATE: 11/12/99
	TIME: 8 AM.
TO: Mark Wavering PE	FAX NO: 277-8163
COMPANY: INCA	
FROM: Ash Patel	JOB NO.:
PROJECT: 83rd Ave	

COMMENTS:

please note corrections on your minutes.
please redistribute after correction.

fyi

☐ copy to: ☐ hard copy to follow in mail

Wood, Patel & Associates, Inc. • 1550 East Missouri, Suite 203, Phoenix, Arizona 85014 • (602) 234-1344 • Fax (602) 234-1322
E-Mail: woodpatl@netzone.com

11/15/99

Starting Tailwater -

MH 34 0.55 jump in Hydraulic Grade line -

=

HOW MUCH FLOW

INVERT DITCH =

=

HEC 1 - Diversion -

ADOT - location -

Street 10yr vs 2yr.

=

No

10°C Impervious

Nov 15, 1999 9:00 AM 11/15/99

FLOOD CONTROL -

CHRIS PERRY -

Junction Loss for 2 CB's
75% into Catch Basin

State Stone
Trunk Line 10 year
offsi

100 yr

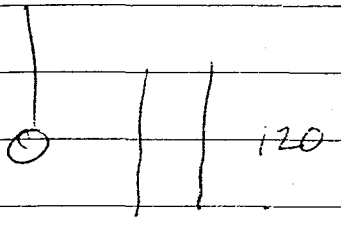
Flow Capacity -

CHECK

25
ROUTE

30 CFS HAS PA

124 CFS



Stuck 30 of 38

0.6' Higher -

Post-it® Fax Note 7671	Date 11/11	# of pages ▶ 4
To Ashok Patel	From Mark Wavering	
Co./Dept. Wood Patel	Co. INCA	
Phone #	Phone # 277-8161	
Fax # 234-1322	Fax #	

69422 ph 01.

MEETING MINUTES

PROJECT: 83rd Avenue from Northern Avenue to Olive Avenue

DATE: November 1, 1999 at 1:30 – 3:00 PM

SUBJECT: **Discussion Concept Report Drainage Issues**

ATTENDEES: See Attached

Design Parameters

- The design concept report shows 610mm (24") pipe extending north from Northern Avenue to approximately 90m (300') south of the Northern and Butler Storm Drain Plans.

- The design concept reports shows 1676mm (66") pipe extending north from the end of the Northern and Butler Storm Drain plans to Olive Avenue.

Discussion

Ashok Patel discussed the background for the area. In 1987, there was a Camp Dresser & McKee report for the Glendale Peoria, Area Drainage Master Plan (ADMP). The Northern and Butler Storm Drain plan was based on the City of Peoria in the future extending the 1676mm (66") pipe to Butler Drive and approximately 800m (2600') to the east.

The Northern and Butler Storm Drain was based on existing 1996 conditions for a 2 year storm for the area mostly north and east of the Butler Drive and 83rd Avenue intersection. Future development of the area would incorporate 100 year 2 hour retention on site.

The size of 1676mm (66") was based on a Wood Patel and Associates (WP) 1996-1997 Concept Routing Study. The critical element of the routing study is the hydraulic grade line (HGL) of the 1676mm (66") pipe at Las Palmaritas. The catch basins at Las Palmaritas were installed to alleviate the ~~100 year off-site~~ flows (undetermined frequency) that collect at the intersection prior to traveling south in a ditch to the irrigation waste ditch. Ashok will review WP files to determine the Q and impact to the HGL and losses from the catch basins and pipes that contribute to the 1676mm (66") trunk line.

low

After numerous discussions to determine the impact of the flows from northeast of the Butler and 83rd Avenue the following conclusions were reached:

- The 460mm (18") pipe from Northern Avenue would be sufficient to serve the four catch basins to the north along 83rd Avenue.

- The Northern and Butler Storm Drain would add a 460mm (18") stub-out to the manhole west just north of the 45 degrees bend onto 83rd Avenue. The plans currently show a stub-out to the east (Sta 0+425).

- The 1676mm (66") pipe would be extended to Butler Drive with a stub-out to the east. The size would be determined at a later date. The stub-out would be smaller than the 1676mm (66"), possibly a 1220mm (48").

- INCA would design the main trunk line north of Butler Drive and 83rd Avenue to accommodate the eight (8) catch basins north of Butler Drive and 83rd Avenue intersection.

- The City of Peoria requires RGRCP for this stormdrain system.

- An intergovernmental agreement (IGA) is currently being prepared between MCDOT and the City for the stormdrain work.

If the foregoing minutes are not in accordance with your understanding please contact Mark E. Wavering, INCA Engineers at (602) 277-8161 within 7 days of receipt of minutes.

FLOOD CONTROL DISTRICT
of
Maricopa County

Interoffice Memorandum

+ Updated FCDMC Design Manual Vol I & II
+ H.G.L INFO ON 83rd Ave From Stanley.

DATE: October 26, 1999

TO: AMM

VIA: MAL

FROM: RPH

SUBJECT: **DCR for 83rd Avenue From Northern to Olive Avenue- WO #68972**

I have reviewed the subject materials, and offer the following comments:

1) Additional hydrologic analysis will be needed for the storm drain design (see comment number 1, below, from my review last February). A copy of the final report for the Northern Avenue SD by Wood, Patel & Associates, Inc is included for your reference. Please note the catch basin schematic from that report. A review of FCD file correspondence shows the consultant that did the Northern Ave SD never did any hydrologic analysis for the catch basins located along Palmaritas Drive immediately west of 83rd Avenue. Therefore, such an analysis should be done at this time in order to ensure proper catch basin performance, since that location is a known trouble spot.

2) A catch basin list in Table 4.3-1 on page 8 of the DCR indicates that the design will include COP Type M-1 catch basins, although the capacity calculation sheets show ADOT Type C 15.20 CB's. Please check. Also, please check the CB dimensions used in the capacity calculation sheets. For example the opening length of an M-1, L=6' catch basin is 7.2' after a 0.8 clogging factor is applied. Such a CB is proposed for station 10+840, but the output does not show that this length is applied as input. Please revise the calculations, accordingly.

File Folder: IO-MEM79

3) From the onsite hydrologic calculation sheets included in the DCR appendix, it appears that the FCD's version of the rational method was not used for the catch basin hydrology. Please check and revise accordingly.

4) It is not clear why there are numerous items with ▒0▒ quantities listed in the cost estimate. Please explain. Also, the unit costs for storm drain pipe are much too low. For example, the unit cost used for 1676-mm diameter RGRCP used by Wood, Patel & Associates, Inc for the Northern Ave SD is closer to $600.00 per LM. Please check the unit costs with a pipe manufacturer.

5) Based upon the approved plans for the Northern Ave SD, the SD is shown to end about 100 meters short (to the west of) of the 83rd Ave-Northern Ave intersection. As a result, the Hydraulic analysis for the lateral extension planned from that intersection and extending northward should be modeled to include the ▒missing▒ pipe segment, as well as a bend and junction loss for the pipe features at the intersection. Similarly, the extension of the Northern SD from the Palmaritas Drive-83rd Ave intersection should be analyzed with a hydraulic model that includes a junction loss for the SD features at the intersection.

6) Please include the cost of needed SD manholes in the cost estimate.

The following comments that were made by me to PBS&J around February 11, 1999 as a result of my initial review still apply:

1) For the next level of design for this project, more detailed hydrologic and and hydraulic analyses need to be provided for review. The hydrological analysis should include onsite drainage area maps to substantiate the rational method calculations, and offsite flow information which reflects approved hydrology from the District's report entitled, ▒Northern Orangewood Storm Drain Project, Concept/Routing Study▒, dated March 14, 1996. The hydraulic analysis should include hydraulic grade line calculations for the trunkline and lateral pipes. Overall, designs should adhere to guidelines provided in the Drainage Design Manual for Maricopa County. If they desire, I would invite the consultant to contact me at 506-4767 to discuss these design issues, or to clarify information provided in the Manual.

2) Plans need to be provided to substantiate the features from the hydraulic analysis. The plans should include storm drain dimensions with an HGL profile plot. Also, catch basin connector pipe profiles and details will be needed.

File Folder: IO-MEM79

3) According to the approved plans for the Northern-Orangewood Storm Drain, stamp-dated February 24, 1998, there was only one stub-out planned for the two proposed catch basins shown located near station 10+425 (see plans in the DCR report). Please review and revise if necessary.

Wood, Patel will install the other stub !!

File Folder: IO-MEM79

Prop. 6th Review Comments & Responses

Comment #7: Change "price per meter" to "price per linear meter".
Page 15

Response: Will comply.

Comment #8: Section 615 is not in the right place.
Page 16

Response: Will comply.

DESIGN REPORT:

Appendix II the catch basins appear to be numbered differently than the plans:

Comment #1: CB # 3 should be # 1.

Response: Corrected.

Comment #2: CB # 4 should be #3.

Response: Corrected

Comment #3: CB # 5 should be # 4.

Response: Corrected

Comment #4: CB # 6 should be # 5.

Response: Corrected.

Comment #5: CB # I I & 12 at Las Palmaritas Dr. was not included.

Response: The basins were added per City of Peoria request to intercept nuisance flows. No calculations were performed. These calculations would be outside the original Scope of Services.

Appendix III response to review comments:

Peoria:

Comment #1: Sheet 5, comment # 1, did not see any accomplishment.

Response: SD alignment has shifted to the south. The construction units should not impact existing irrigation and plants.

Design Report
for
60 Percent Plan Submittal
Northern and Butler Storm Drains
Sub-Phase "A"

Northern/Orangewood
Storm Drain Project
Contract FCD 94-12 Phase II

Prepared by

Wood, Patel & Associates, Inc.
1550 East Missouri, Suite 203
Phoenix, Arizona 85014

Phone: (602) 234-1344
Fax: (602) 234-1322

Prepared for

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Phone: (602) 506-1501

November 12, 1997
WP #94153.02

1.0 Introduction

This Report has been compiled to document significant matters relating to the design of the 60 percent plan for the Flood Control District of Maricopa County (District) Contract FCD 94-12 Phase II, Northern and Butler Storm Drains, Sub-Phase "A".

2.0 Project Background

On April 20, 1996, the *Concept/Routing Study Update* for the *Northern/Orangewood Project* was submitted by Wood, Patel & Associates, Inc. (Wood/Patel) to the District and the Cities of Glendale and Peoria.

The Study addressed a number of issues raised by the Area Drainage Master Plan Team (District, Glendale and Peoria) during the review process. A meeting was held with the team members on July 23, 1996, to discuss the *Concept/Routing Study Update* and to arrive at a consensus for the *Construction Phasing Plan* portion of this project.

Subsequently, the *Construction Phasing Plan* recommendation was prepared on August 14, 1996. The Plan was based on the July 23rd meeting and incorporated into other considerations including: capital improvement costs, fiscal year budgets, hydrologic impacts, hydraulic effectiveness and the impact of other projects.

Based upon the District's budgetary constraints, three separate construction phases were recommended. The first phase named Subphase "A" included implementation of Northern Avenue and Butler Drive storm drains. Wood/Patel initiated the design of Subphase "A" on February 25, 1997. The 30% plan submittal was made on July 8, 1997. This submittal represents the 60% plan, which accounts for all the requirements for the 60% plan submittal, including incorporation of all the review comments.

2.1 Butler Drive Storm Drain

The Butler Drive Storm Drain, which is scheduled for construction in FY 1998/1999, will include the installation of storm drain pipes in Butler Drive from the Agua Fria Freeway outfall to approximately 87th Avenue. This system will utilize pipe sized that range from 1220 mm to 910 mm.

2.2 Northern Avenue Storm Drain

This storm drain follows the Northern Avenue alignment from its beginning point, which is approximately 100 meters east of 91st Avenue and ends at about 100 meters west of 83rd Avenue. The District's portion of storm drain improvement should continue east to end at 83rd Avenue. However, the Maricopa County Department of Transportation (MCDOT) Roadway Improvement Project will require a major modification to the 83rd Avenue and Northern Avenue

intersection. In order to preserve the existing well site located on the northwest corner of the intersection, per the MCDOT Design Concept Report, the center line of the roadway is likely to shift several meters south of the monument line. This issue, together with numerous utility conflicts, has created a need to postpone the location of the horizontal alignment of the storm drain. It was mutually agreed by the District and MCDOT that this portion of storm drain can only be laid out after the roadway issues are properly addressed. As a result, Wood/Patel has been requested to submit the pothole data to Stanley, MCDOT's roadway consultant, so that they can incorporate the storm drain design into their roadway plan in the future. This was documented in the minutes dated September 4, 1997 (see Appendix IV).

The storm drain is also connected to a major lateral at 85th Avenue. The lateral continues north to Griswold Road and then easterly along the transmission line corridor to 83rd Avenue. At that point, the lateral continues north along 83rd Avenue to terminate at Las Palmaritas Drive. A stub will be provided at the north end of lateral to accommodate future extensions.

Las Palmaritas Drive is significantly lower than the 83rd Avenue roadway elevation. To improve drainage conditions for Las Palmaritas Drive, two major catch basins are designed to intercept significant local drainage.

3.0 Hydrology/Hydraulics

Runoff used for the design of the storm drains is based on the 2-year, 6-hour storm event as developed in the *Northern/Orangewood Storm Drain Project Concept/Routing Study* by Wood, Patel & Associates, Inc., dated March 14, 1996.

Storm drain hydraulic grade lines were computed using the Quattro Pro software program by Borland and is based on the *Drainage Design Manual for Maricopa County, Arizona., Volume II, Hydraulics, January, 1996.* Necessary modifications to the spreadsheet were made to allow for comments from the 30% plan submittal. A spreadsheet of the hydraulic data is included in this document (see Appendix I).

The stormwater surge (detention) basin located at the northwest corner of Northern Avenue and 85th Avenue is designed to detain 34 acre-feet of runoff with a hydraulic grade line elevation of 1093.88 feet MSL (333.414 meters MSL).

4.0 Utilities

Utilities shown on the 60 percent plan were initially derived from utility maps obtained from the utilities and from field surveys locating any visible surface facilities/appurtenances. An exception to this is the Northern Avenue utilities. Wood/Patel

STORM DRAIN HYDRAULIC GRADE LINE COMPUTATION WORKSHEET

Project: Northern/Orangewood Storm Drain Phase IIA - City of Peoria

Engineer: JGT **File Name:** q:\northern_ph1\hydraulics\northe4m.xls **Date:** 11/10/97

Description: Computation of EGL and HGL for storm drain system

Reference: Drainage Design Manual for Maricopa County, Arizona
Volume II, Hydraulics, January, 1996

Last Revised: August 22, 1997

Notes:

1. This spreadsheet is developed to compute storm drain hydraulic grade line based on the above mentioned reference. All Equations used and minor loss coefficients shall be referred to this reference.
2. The blue areas are user input blocks, the grey areas are computed values, and the dark grey areas are check cells.
3. The recommended flow type for storm drain systems by the reference is pressure flow. Therefore, open channel flow computation is only an approximation here. The hydraulic grade line at the outfall is assumed to be the invert elevation plus the pipe diameter. If the tailwater elevation is different from this value, the user should change this number manually.
4. The station is located at the immediate downstream of a change point.
5. If the number of rows of the spreadsheet is not enough for a project, the user can copy more rows to the bottom of the spreadsheet.
6. In column *"Pipe Diameters - Sheet Suggested"*, suggested pipe diameters are computed by the spreadsheet with increment of 6 inches. User can select different values than suggested under *"Pipe Diameters - User Selected"*.
7. In column "n ",Manning's n values can be selected from Table 4.1.
8. In column *"Transition Loss Coeff."*, the summation of Kt values for each section, and the individual Kt values are from Tables 4.2-4.4 based on the transition types: a) gradual enlargement, b) sudden enlargement, c) contraction, the Column *"D2/D1"* ratio, the velocity in Column *"Vel."*, and other related information on these tables.
9. In Column *"Bend Loss Coeff."* are the summation of Kb values for each section, and the individual Kb values are from Figure 4.7.
10. In *"Junction Losses "* columns are input data for computation of junction losses: Q3 is the lateral flow, D3 is the pipe diameter of the lateral flow, and theta is the angle between the main flow pipe and the lateral flow pipe.
11. In Column *"Losses - Others"*, are minor loses other than the types considered in the spreadsheet. The user should input these values directly.
12. If users find any error or have any suggestion, please contact Wood/Patel & Associates.

Northern Avenue - AFF Outfall Channel to Detention Basin

Storm Sewer Line Station Location	Pipe #	Exist SD Station	Const Centerline Station	Pipe Diameter Sheet Suggested (mm)	Pipe Diameter User Selected (mm)	n	Natural Ground Elevation (m)	Invert Elev. (m)	Pipe Slope (m/m)	Design Q (cms)	Transition Loss Coeff. Sum(Kt)	Bend Losses Angles & Manholes	Bend Loss Coeff. Sum(Kb)	Junction Losses Q3 (cms)	Junction Losses D3 (mm)	Junction Losses Theta (deg.)	D2/D1	Vel. (m/s)	Full Area (m²)	Length (m)	V^2/(2g) (m)	K	Sf (m/m)	Losses hf (m)	Losses ht (m)	Losses hb (m)	Losses hj (m)	Losses Others (m)	Total Losses (m)	Hydraulic Grade Line Elevation (m)	Energy Grade Line Elevation (m)	Pressure Flow Check	"Overflow" Check	Comments	Depth to Hydraulic Grade Line (m)	Depth to Invert (m)
Outfall @ AFF Channel	Exist	-0+100.8		760	1524	0.013	331.622	328.544	-	1.246	0.00	-	0.00	0.00	0	0	-	0.68	1.82	-	0.02			-	0.00	0.00	0.00	0.000	-	330.068	330.092	-	-	-	-	-
Sta -0+076.5	Exist	-0+076.5		760	1524	0.013	331.622	328.940	0.0185	1.246	0.00	1mh	0.05	0.00	460	90	1.00	0.68	1.82	24.08	0.02	0.0109	0.0009	0.01	0.00	0.00	0.00	0.000	0.01	330.464	330.099	Open	OK	Reduce D	1.2	2.7
Sta -0+026.5	Exist	-0+026.5		1370	1524	0.013	331.622	328.971	0.0006	1.246	0.00	-	0.00	0.14	460	90	1.00	0.68	1.82	49.99	0.02	0.0109	0.0009	0.01	0.00	0.00	0.01	0.000	0.02	330.495	330.114	Open	OK	Reduce D	1.1	2.7
Sta 0+396.2	Exist	0+396.2		1370	1524	0.013	333.451	329.214	0.0006	1.104	0.00	1mh	0.05	0.11	460	90	1.00	0.61	1.82	422.76	0.02	0.0109	0.0007	0.09	0.00	0.00	0.01	0.000	0.10	330.738	330.219	Open	OK	Reduce D	2.7	4.2
Sta 0+749.8	Exist	0+749.8		1220	1524	0.013	333.908	329.458	0.0007	0.991	0.00	1mh	0.05	0.00	0	0	1.00	0.54	1.82	353.57	0.02	0.0109	0.0006	0.06	0.00	0.00	0.00	0.000	0.07	330.982	330.291	Open	OK	Reduce D	2.9	4.5
Sta 0+754.1	Exist	0+754.1		460	1524	0.013	333.908	330.159	0.1643	0.991	0.00	1mh	0.05	0.00	0	0	1.00	0.54	1.82	4.27	0.02	0.0109	0.0006	0.00	0.00	0.00	0.00	0.000	0.00	331.683	330.292	Open	OK	Reduce D	2.2	3.7
Sta 0+762.0	Exist	0+762.0		760	1524	0.013	333.939	330.220	0.0077	0.991	0.00	1mh	0.05	0.00	0	0	1.00	0.54	1.82	7.92	0.02	0.0109	0.0006	0.00	0.00	0.00	0.00	0.000	0.00	331.744	330.295	Open	OK	Reduce D	2.2	3.7
Sta 0+784.9	Exist	0+784.9		760	1524	0.013	334.061	330.403	0.0080	0.991	0.00	1mh	0.05	0.34	0	0	1.00	0.54	1.82	22.86	0.02	0.0109	0.0006	0.00	0.00	0.00	0.02	0.000	0.01	331.927	330.299	Open	OK	Reduce D	2.1	3.7
Sta 0+853.4	Exist	0+853.4	0+291.4	1070	1524	0.013	334.061	330.448	0.0007	0.651	0.00	20° +1mh	0.17	0.00	460	90	1.00	0.36	1.82	68.58	0.01	0.0109	0.0003	0.01	0.00	0.00	0.00	0.000	0.02	331.972	330.323	Open	OK	Reduce D	2.1	3.6
Sta 0+853.66 to 89th Ave		1+160.0	0+598.0	1070	762	0.012	334.061	330.602	0.0005	0.651	0.50	5mh	0.25	0.31	460	90	2.00	1.43	0.46	306.60	0.10	0.0093	0.0088	0.82	0.02	0.03	0.30	0.018	0.84	332.049	331.163	Open	OK	Reduce D	2.0	3.5
89th Ave to 87th Ave		1+560.0	0+998.0	910	610	0.012	334.061	330.802	0.0005	0.340	0.10	4mh	0.20	0.00	0	0	1.25	1.16	0.29	400.00	0.07	0.0093	0.0079	0.96	0.00	0.01	0.00	0.009	1.31	332.402	332.471	OK	OK	-	1.7	3.3
87th Ave to 85th Ave Alignment		1+936.0	1+374.0	910	610	0.012	334.061	330.990	0.0005	0.340	0.00	45° +4mh	0.80	0.00	0	0	1.00	1.16	0.29	376.00	0.07	0.0093	0.0079	0.90	0.00	0.06	0.00	0.009	0.92	333.325	333.394	OK	OK	-	0.7	3.1
85th Ave to NE Basin		1+945.0	1+383.0	760	610	0.012	334.061	331.010	0.0014	0.340	0.00	45° +1mh	0.65	0.00	0	0	1.00	1.16	0.29	14.00	0.07	0.0093	0.0079	0.03	0.00	0.04	0.00	0.000	0.09	333.414	333.483	OK	OK	-	0.6	3.1

Northern Avenue - Detention Basin to 83 Avenue

Storm Sewer Line Station Location	Pipe #	Exist SD Station	Const Centerline Station	Pipe Diameter Sheet Suggested (mm)	Pipe Diameter User Selected (mm)	n	Natural Ground Elevation (m)	Invert Elev. (m)	Pipe Slope (m/m)	Design Q (cms)	Transition Loss Coeff. Sum(Kt)	Bend Losses Angles & Manholes	Bend Loss Coeff. Sum(Kb)	Junction Losses Q3 (cms)	Junction Losses D3 (mm)	Junction Losses Theta (deg.)	D2/D1	Vel. (m/s)	Full Area (m²)	Length (m)	V^2/(2g) (m)	K	Sf (m/m)	Losses hf (m)	Losses ht (m)	Losses hb (m)	Losses hj (m)	Losses Others (m)	Total Losses (m)	Hydraulic Grade Line Elevation (m)	Energy Grade Line Elevation (m)	Pressure Flow Check	"Overflow" Check	Comments	Depth to Hydraulic Grade Line (m)	Depth to Invert (m)
Outfall @ SE Corner of Basin		1+945.0	1+383.0	1830	1830	0.012	334.061	331.010	-	6.428	0.00	-	0.00	0.000	0	0	-	2.45	2.63	-	0.30			-	0.00	0.00	0.00	0.000	-	333.414	333.718	-	-	-	-	-
85th Ave South to Northern		1+951.5	1+388.0	1830	1830	0.012	334.061	331.019	0.0014	6.428	0.00	90° + 45°	1.40	0.368	460	90	1.00	2.45	2.63	6.40	0.31	0.0093	0.0080	0.02	0.00	0.43	0.07	0.000	0.02	333.429	333.734	OK	OK	-	0.6	3.0
85th Ave to 100m West of 83rd Ave		2+258.5	1+695.0	2440	1830	0.012	335.400	331.172	0.0005	6.060	0.00	1mh	0.05	0.000	0	0	1.00	2.31	2.63	307.00	0.27	0.0093	0.0071	0.67	0.00	0.01	0.00	0.013	1.18	334.639	334.910	OK	OK	-	0.8	4.2

85th Avenue - SE Corner of Detention Basin, North to NE Basin Outfall

Storm Sewer Line Station Location	Pipe #	Exist SD Station	Const Centerline Station	Pipe Diameter Sheet Suggested (mm)	Pipe Diameter User Selected (mm)	n	Natural Ground Elevation (m)	Invert Elev. (m)	Pipe Slope (m/m)	Design Q (cms)	Transition Loss Coeff. Sum(Kt)	Bend Losses Angles & Manholes	Bend Loss Coeff. Sum(Kb)	Junction Losses Q3 (cms)	Junction Losses D3 (mm)	Junction Losses Theta (deg.)	D2/D1	Vel. (m/s)	Full Area (m²)	Length (m)	V^2/(2g) (m)	K	Sf (m/m)	Losses hf (m)	Losses ht (m)	Losses hb (m)	Losses hj (m)	Losses Others (m)	Total Losses (m)	Hydraulic Grade Line Elevation (m)	Energy Grade Line Elevation (m)	Pressure Flow Check	"Overflow" Check	Comments	Depth to Hydraulic Grade Line (m)	Depth to Invert (m)
Outfall @ SE Corner of Basin		1+945.0	0+012.0	910	760	0.012	334.061	331.01	-	0.538	0.00	-	0.00	0.000	0	0	-	1.18	0.46	-	0.07			-	0.00	0.00	0.00	0.000	-	333.414	333.485	-	-	-	-	-
SE Basin outfall to NE Basin Outfall		2+193.1	0+260.0	910	760	0.012	336.200	331.38	0.0015	0.538	0.00	3mh + 45°	0.75	0.000	0	0	1.00	1.18	0.46	248.01	0.07	0.0093	0.0060	0.45	0.00	0.05	0.00	0.016	0.47	333.883	333.954	OK	OK	-	2.3	4.8

NE Basin Inlet, Griswold RD - 85th Ave to 83rd Ave, 83rd Ave North to Las Palmaritas Drive

Storm Sewer Line Station Location	Pipe #	Exist SD Station	Const Centerline Station	Pipe Diameter Sheet Suggested (mm)	Pipe Diameter User Selected (mm)	n	Natural Ground Elevation (m)	Invert Elev. (m)	Pipe Slope (m/m)	Design Q (cms)	Transition Loss Coeff. Sum(Kt)	Bend Losses Angles & Manholes	Bend Loss Coeff. Sum(Kb)	Junction Losses Q3 (cms)	Junction Losses D3 (mm)	Junction Losses Theta (deg.)	D2/D1	Vel. (m/s)	Full Area (m²)	Length (m)	V^2/(2g) (m)	K	Sf (m/m)	Losses hf (m)	Losses ht (m)	Losses hb (m)	Losses hj (m)	Losses Others (m)	Total Losses (m)	Hydraulic Grade Line Elevation (m)	Energy Grade Line Elevation (m)	Pressure Flow Check	"Overflow" Check	Comments	Depth to Hydraulic Grade Line (m)	Depth to Invert (m)
Outfall @ NE Corner of Basin		2+193.1	0+260.0	1680	1680	0.012	336.200	331.382	-	3.738	0.00	-	0.00	0.000	0	0	-	1.69	2.21	-	0.15			-	0.00	0.00	0.00	0.000	-	333.883	334.029	-	-	-	-	-
Basin Outfall to Griswold Rd		2+333.1	0+400.0	1680	1680	0.012	336.652	331.585	0.0015	3.738	0.00	45° +1mh	0.65	0.000	460	0	1.00	1.69	2.21	140.02	0.15	0.0093	0.0043	0.18	0.00	0.09	0.00	0.000	0.18	334.067	334.213	OK	OK	-	2.6	5.1
45° Pipe Section to NW Corner SRP		2+343.9	0+503.0	1830	1680	0.012	336.895	331.597	0.0011	3.738	0.00	45°	0.60	0.000	460	0	1.00	1.69	2.21	10.87	0.15	0.0093	0.0043	0.01	0.00	0.09	0.00	0.000	0.11	334.176	334.322	OK	OK	-	2.7	5.3
NW Cor SRP to 83rd Ave		2+741.9	0+901.0	1830	1680	0.012	337.261	332.076	0.0012	3.738	0.00	2mh	0.10	0.000	0	0	1.00	1.69	2.21	398.00	0.15	0.0093	0.0043	0.52	0.00	0.01	0.00	0.000	0.61	334.788	334.934	OK	OK	-	2.5	5.2
83rd Ave NE Angle		2+750.9	0+907.0	1830	1680	0.012	337.353	332.086	0.0011	3.738	0.00	45°	0.60	0.198	460	90	1.00	1.69	2.21	9.00	0.15	0.0093	0.0043	0.01	0.00	0.09	0.03	0.009	0.03	334.823	334.969	OK	OK	-	2.5	5.3
SRP North to Las Palmaritas		2+890.3	0+555.0	1680	1680	0.012	336.316	332.254	0.0012	3.568	0.00	45° +1mh	0.65	0.000	0	0	1.00	1.62	2.21	139.40	0.13	0.0093	0.0039	0.17	0.00	0.09	0.00	0.000	0.28	335.116	335.249	OK	OK	-	1.2	4.1

Gutter Elev at Las Palmaritas

126 cfs

1 cfs = 0.02831685 cms

1 cms = 35.31466 cfs