F.C.D.

Baseline Road
51st Avenue to 7th Avenue

TECHNICAL MEMORANDUM
DRAINAGE REPORT

Prepared for:

Maricopa County
Department of Transportation

Prepared by:

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July 1997

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1.0 PURPOSE

The purpose of this Drainage Technical Memorandum is to address proposed drainage improvements to Baseline Road. Maricopa County Department of Transportation (MCDOT) plans to improve Baseline Road from a two-lane rural section to a five-lane urban section. The Baseline Road Design Concept Report (DCR), also prepared by URS Greiner, Inc., discusses the proposed roadway improvements from 51st Avenue to 7th Avenue. The DCR is sponsored by MCDOT with cooperative agreements with the City of Phoenix and the Flood Control District of Maricopa County (FCDMC). The Baseline Road DCR should be consulted for details of the project.

This drainage report will identify major drainage features that may influence the type of flood control facilities chosen to handle on-site and off-site flows as they affect Baseline Road and crossroads. Several drainage factors such as area characteristics, existing drainage patterns, and major drainage features are discussed below to define the factors that affect the behavior of storm water runoff. Recommendations will be made based on existing studies and report herewith. Ultimately, the data and results presented herein will be further developed for the design.

2.0 BACKGROUND

Baseline Road from 19th Avenue to 43rd Avenue has experienced some flooding problems in the past occurring as recently as July 1992. This problem is mainly due to lack of an effective drainage collection system for both off-site and on-site flows. Road improvements and agricultural practices have resulted in the disturbance of natural drainage patterns that ran east to west. In effect, east-west streets such as Baseline Road collect flows and convey them westward, but surface runoff is more prone to follow existing irrigation ditches in the area or flow across fields. In addition to Baseline Road, several other locations of flooding have also occurred within the vicinity. Locations of flood areas are shown on Figure 1.0. To reduce the chances of flooding, another engineering firm was contracted by FCDMC to conduct a planning study for the *South Phoenix / Laveen Drainage Improvement Project* and recommended a drainage collection system. FCDMC proposes to install a storm drain system along Baseline Road from 7th Avenue to 43rd Avenue. The proposed storm drain begins approximately 1.5 kilometers south of Baseline Road at 7th Avenue and discharges into the Salt River at 43rd Avenue. The majority of the mainline storm drain will be within travel under Baseline Road right-of-way. The storm drain system will consist of pipes ranging from 1500 mm (60") to 2850 mm (114") diameter pipes, reinforced concrete box, detention basins and several connector pipes to handle tributary flows. The overview plan is shown on Figure 1.0.

3.0 DRAINAGE AREA BOUNDARY

The drainage area limits as shown on Figure 1.0 are bounded by the ridge line of South Mountain Regional Park to the south, 7th Avenue to the east, the proposed South Mountain Freeway to the west and the Salt River to the north.

BASELINE ROAD

51ST AVENUE TO 7TH AVENUE

EXISTING DRAINAGE PATTERN AND PROPOSED DEVELOPMENTS

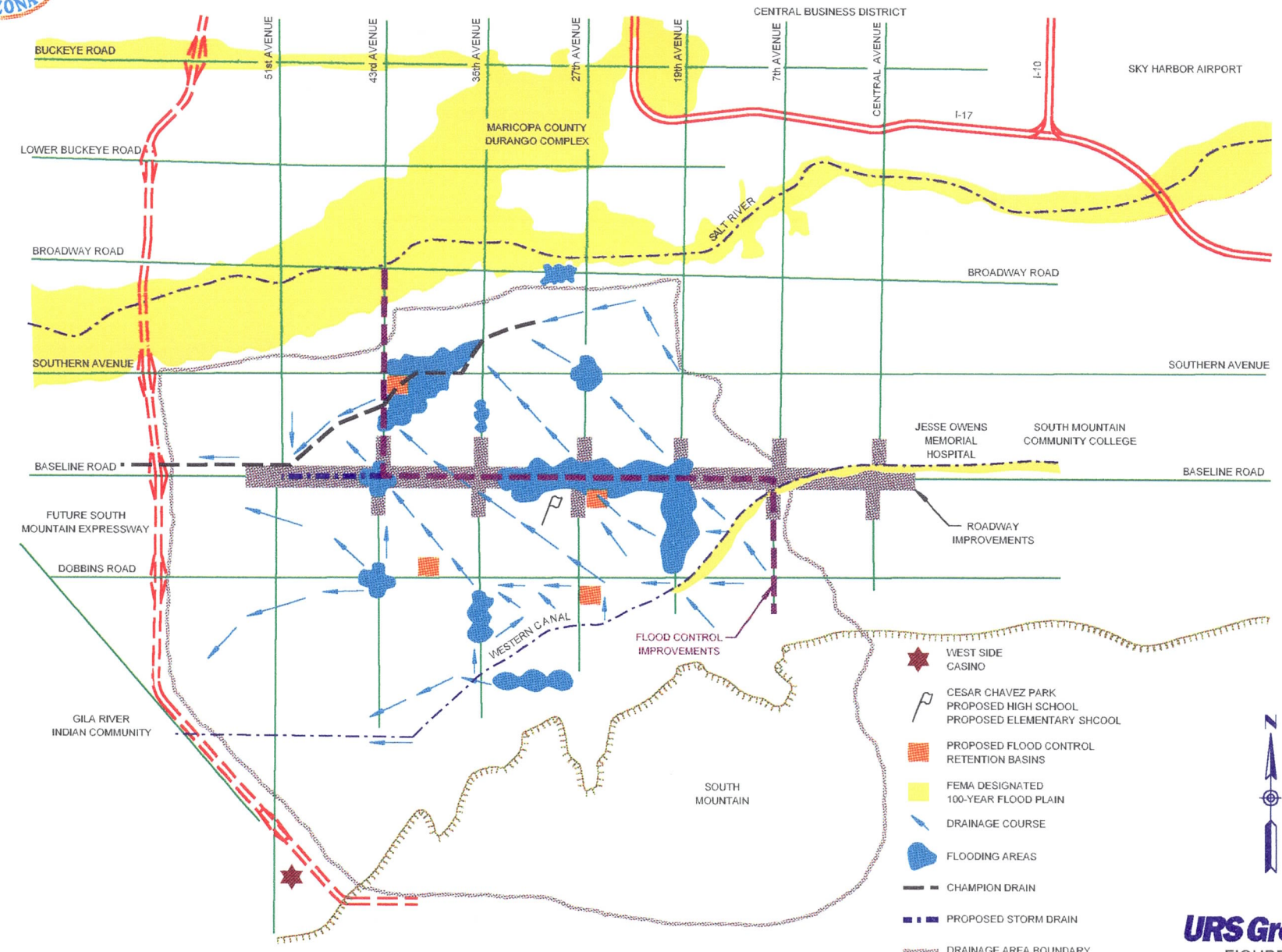

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FIGURE 1.0

4.0 DRAINAGE BASIN CHARACTERISTICS

4.1 Drainage Area

Figure 1.0 presents a vicinity map showing the Baseline Road improvement limits and the perimeter of the drainage area that contributes runoff to this segment of road.

The contributing watershed is located within the jurisdictional boundaries of Maricopa County and the City of Phoenix. The entire project lies within the Champion Drain watershed. Champion Drain is discussed in detail in Section 5.0 and 6.0.

The watershed varies from rugged mountainous terrain on the southeastern portion to flat agricultural farmland on the north and northwest. There are some residential dwellings and scattered commercial sites to the north, west and east.

4.2 Existing Drainage Facilities

The general flow pattern of the study area is southeast to northwest. Storm water runoff from South Mountain and lower agricultural farmland is collected via the Champion Drain. Champion Drain is a natural drainage course that runs east to west and has undergone extensive realignment due to agricultural land use. Between 51st Avenue and 32nd Avenue, the alignment has been rerouted along the edge of the fields. Salt River Project (SRP) has ownership of Champion Drain but it is occasionally maintained by FCDMC. It originates between 35th Avenue and 27th Avenue and flows southwesterly ultimately draining into the Salt River at 83rd Avenue.

The Western Canal is an irrigation canal that parallels the base of South Mountain. This irrigation canal collects storm runoffs but overtops during larger storms. FEMA designates some areas along the south side of Western Canal to be in the 100-year floodplain.

4.3 Soil Type and Vegetation

According to a recent geotechnical exploration prepared for the *South Phoenix / Laveen Drainage Improvement Project* conducted by Terrane Engineering on May 19, 1997, hydrologic soil groups along Baseline Road are Type B (substantial infiltration rate). From the *Concept Drainage Report of South Mountain Freeway*, hydrologic soil groups included Type A soils (high infiltration rate) at the base of the mountains and Type D soils (high runoff potential) at the upper areas.

Vegetative cover at higher elevations consists of desert flora such as cactus, mesquite, palo verde, creosote bush and various grasses. The vegetative cover at the lower elevations is mainly irrigated crops and urban landscape plants.

4.4 Land Use

Land use discussed in this section is limited to the foothills and flat areas. The steeper mountain areas are kept in its natural state with exceptions to some equestrian and hiking trails. The major existing land use in the flat drainage area is irrigated farming. There are existing scattered commercial parcels and single family residential homes within the drainage basin but it has kept its rural atmosphere.

4.5 Rainfall Characteristics

According to the *Laveen Area Master Drainage Study, Phase I,* the study area lies within the arid southwest climatic regime which is characterized by high summer temperature, winter and summer rainfall and extended periods of drought during the spring and fall. Mean annual rainfall in the vicinity of Phoenix is 7 inches. This precipitation value was determined from the information and procedures of the *Hydrologic Design Manual for Maricopa County, Arizona*, dated September 1, 1990.

5.0 EXISTING DRAINAGE PATTERNS

5.1 Off-Site

Off-site drainage patterns as discussed below were determined by field observations and topographic maps. Existing studies also provided verification to the flow pattern.

There are two very distinct off-site flow tributaries to Baseline Road — the steep mountainous area and the flat agricultural farmlands. The mountainous area has very defined drainage courses and tributary areas. The infiltration rate is low and flow velocity is high. The flat lands, however, have low velocity sheet flows and high infiltration rates. Collection of waste irrigation waters and storm runoff has been diverted to edge of fields in a shallow ditch that ultimately drains to an irrigation canal. Field inspections revealed that the agricultural fields were graded to a configuration that would promote retention of water; there were often small berms constructed around the perimeter of the fields. During major storms, these fields will probably function as very effective detention / retention basins.

5.2 On-Site

As previously mentioned, most of Baseline Road is currently a two-lane rural road section. Roadway storm water runoff is collected along roadside swales and flows west. Flows are ultimately intercepted by the Champion Drain at the intersection of Baseline Road and 59th Avenue.

The average roadway grade of Baseline Road is one-half percent (0.5%), and during heavy storms, ponding is not unusual for flat grades such as these without proper drainage. FCDMC has documented residential and street flooding problems along Baseline Road from 35th Avenue to 19th

Avenue and local flooding at 43rd Avenue. In August 1990, irrigation canals were filled with storm water and overflowed or damaged.

The *Laveen Area Drainage Master Study* indicates there are several concentration points along the south side of Baseline Road specifically at the southeast crossroad intersection. The concentration points are at 43rd Avenue, 35th Avenue, 27th Avenue and 19th Avenue. During small storms, these flows travel west on open irrigation ditches along Baseline Road and, during heavy periods, cross Baseline Road onto fields to Champion Drain.

There has not been any documented flooding on Baseline Road between 51st Avenue and 43rd Avenue. However, previous studies indicate that this area will be inundated with flood waters in the event of a 100-year flood.

6.0 EXISTING DRAINAGE FEATURES

A large storm water detention basin was constructed at South Mountain Regional Park at Central Avenue. The piped outflow is conveyed to the west from Central Avenue to 7th Avenue in a natural wash. These flows cross 7th Avenue, through a park, into a residential street in a mobile home development and eventually cross 15th Avenue eventually finding its way to the Champion Drain. The detention basin, built in 1970, provides control of what would be a large flow coming from some areas of South Mountain. As mentioned previously, other areas of the South Mountain drain to Champion Drain via streets, irrigation ditches and field slopes.

The Western Canal may have some delaying effect upon the storm runoff but field inspection suggests that numerous crossings over or under the irrigation canals reduce the impact of this barrier. The canals, as well as other minor obstacles, have more effect upon frequent storm events (2-year, 10-year, etc.) than on large scale, infrequent events (50-year, 100-year).

Baseline Road in the study area is paralleled by irrigation channels on both sides. In addition to providing irrigation water, it also serves as a drainage system to collect excess irrigation water.

During major storms, the agricultural fields will probably function as very effective detention / retention basins. Such a condition could result in very minimal runoff tributary to these irrigation channels.

There are existing retention basins within the study area, namely El Prado Park at 19th Avenue south of Southern Avenue and Alvord Park at 35th Avenue and Baseline Road.

Champion Drain, also known as Maricopa Drain, is an irrigation wastewater ditch which follows the course of a historical water supply ditch first dug in the late 1800's. This ditch also follows the alignment of a broad swale which is thought to convey Salt River breakout flow originating between 35th Avenue and 19th Avenue. This swale is not, however, designated in the Salt River 100-year floodplain. Irrigation facilities and irrigated farmland have altered its natural flow paths.

Transportation corridors and agricultural land leveling have replaced historic runoff patterns that serve to convey the storm water from South Mountain to the Salt River via the Maricopa Drain.

Over the years, changes in irrigation practices have converted the Champion Drain into a waste ditch. SRP obtained management of the ditch in the late 1960's, but Maricopa County routinely performs maintenance of the ditch from approximately 200 m east of 51st Avenue. The Champion Drain watershed and its utilization for the Baseline Road drainage system will be discussed further in this report.

North of Champion Drain and west of 35th Avenue, the drainage pattern is basically sheet flow or flow collection at roadside ditches. The Salt River intercepts these flows between 83rd Avenue and 75th Avenue

7.0 PROPOSED DEVELOPMENTS

The Baseline Road DCR discusses proposed developments along the corridor in detail. This drainage report will focus on the FCDMC storm drain project which impacts Baseline Road.

The need for a flow collection system in the Laveen area prompted FCDMC to initiate a project identification process. HDR Engineering was contracted to investigate conceptual alternatives and develop a proposed drainage system for the *South Phoenix / Laveen Drainage Improvement Project.* This project is currently in review by FCDMC. Unapproved plans were obtained as a guide for this memorandum. Ultimately, approved plans will be further developed and incorporated in the Baseline Road construction plans. Review of the drainage report prepared by HDR Engineering is recommended before proceeding with design. Modifications to the alignment and grade may be in order to avoid utilities and/or reflect the new roadway section. The system is described below.

The 1650 mm (66") mainline begins at 7th Avenue and just south of Dobbins Road whichs picks up flows from South Mountain Detention Basin immediately east of 7th Avenue. This basin protects the City of Phoenix Park and the downstream residential development. The pipe alignment is centered between edge of pavements avoiding the majority of the existing utilities. The pipe travels north to Baseline Road and heads west to 43rd Avenue. At Baseline Road, pipe sizes vary as it collects additional flow. The proposed alignment on Baseline Road appears to be south of the existing roadway centerline. The are some utility conflicts with this proposed alignment. However, major utilities were avoided.

At approximately 19th Avenue, the pipe transitions into a 950 mm (78") RCP. This pipe size remains unchanged until the proposed detention basin at the southeast quadrant of 27th Avenue and Baseline Road. The mainline transitions into a 1500 (60") RCP with a low flow bypass pipe draining into the detention basin.

At 27th Avenue, the system collects flows from two connector pipes — the outlet for the said detention basin and the 1500 (60") RCP along 27th Avenue. This 1500 mm line is an outlet for a

new detention basin at 27th Avenue and 215 m (700 feet) south of Dobbins Road. The purpose of this facility is to collect flows and to reduce the size of the storm drain required in 27th Avenue. At the same confluence point, the system utilizes a manhole drop structure to avoid a 1500 mm (60") waterline. There is a 4-m (13.3-foot) drop between pipe inverts.

At 35th Avenue, the mainline progresses into a 2400 mm (96") RCP. A proposed multi-use golf course / detention basin adjacent to Cesar Chavez Park will feed into this line. This facility integrates a regional detention facility into the development of a City of Phoenix Golf Course and provides for an outlet from the golf course and park area at 39th Avenue. This golf course facility protects two proposed schools west of 39th Avenue.

Another pipe transition is located 335 m (1,100 feet) west of 43rd Avenue. This 2700 mm (108") RCP will transition into a 2850 (114") RCP at 43rd Avenue as it heads north. Approximately 685 m (2,250 feet) north of 43rd Avenue and Baseline Road, the pipe transitions into a 3–3,048 mm x 2,134 mm (3–10'x7') Reinforced Concrete Box Structure. It picks up flows from a detention basin at the southeast corner of 43rd Avenue and Southern Avenue. This detention basin will eliminate flooding in the adjacent residential subdivision.

The remainder of the system, until it outlets to the Salt River, consists of pump stations and inverted siphons. Inverted siphons are utilized to avoid large utility conflicts.

8.0 PROPOSED DRAINAGE SYSTEMS

8.1 Storm Drain

The proposed mainline storm drain (43rd Avenue–7th Avenue) discussed in Section 7.0 will also be utilized to collect pavement runoff. A new 1050 mm (42") storm drain is proposed between 51st Avenue and 43rd Avenue to convey pavement runoff to Champion Drain. A conceptual plan of this storm drain is in Appendix B. URS Greiner staff has met with Mr. Robert Larchick with SRP to inform him of the plan to use Champion Drain as an outlet. A copy of the letter documenting the meeting is shown on Appendix A. It was agreed that SRP staff will review the proposal.

8.2 Pavement Drainage

Street drainage shall be designed based on the *Drainage Design Manual for Maricopa County, Arizona* prepared by FCDMC. A typical section of the mainline pipe, connector pipe and catch basins is shown on Figure 2.0. Type "M" Catch Basins shall be utilized to collect pavement runoff where maximum depth or driving lane inundation criteria are reached. Gutter capacity shall be calculated by applying a reduction factor caused by obstructions to flow.

BASELINE ROAD

ALTERNATIVE 1A
TYPICAL SECTION WITH
STORM DRAIN AND CATCH BASIN

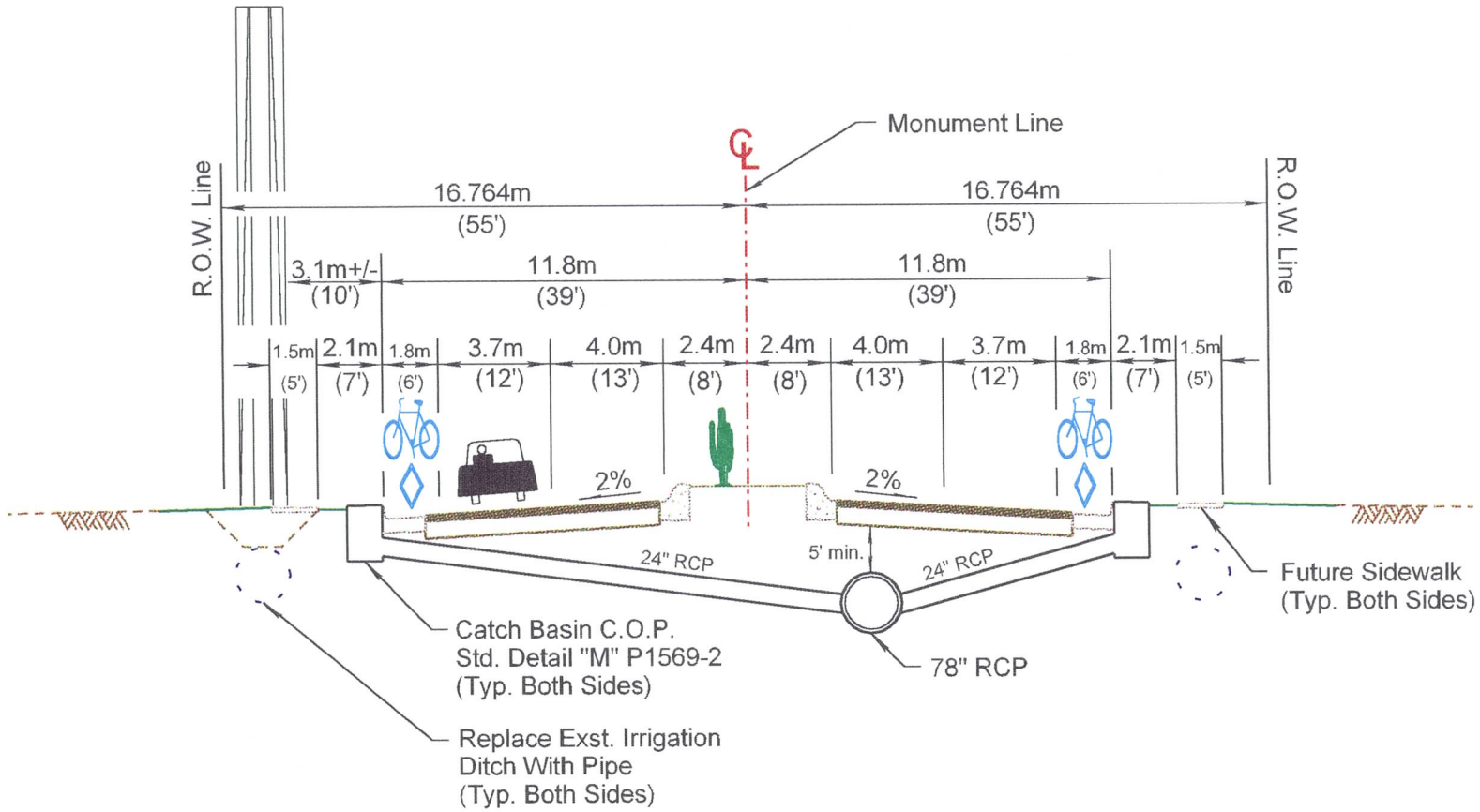

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FIGURE 2.0

Based on preliminary calculations and design criteria, catch basins will be installed at the following locations:

- Where maximum spread is approached.
- Upstream of curb returns.
- Sags of vertical curves.
- Where mainline pipe exceeds 200 meters.

9.0 DESIGN CRITERIA

The following criteria have been established as guidelines for design and construction development set forth by MCDOT and FCDMC. Urban sections with curb and gutter will utilize the City of Phoenix Type "M" catch basins. In rural sections with graded shoulders, the drainage will be carried in shoulder ditch sections and conveyed to a collector pipe.

Deviations from these criteria will require technical documentation for approval by MCDOT and FCDMC.

9.1 Street Design Criteria

- Design 10-year frequency storm to be conveyed within top of curb.
- Pavement with curb and gutter shall maintain one 3.6 m dry driving lane in each direction during a 10-year storm.
- Runoff dip road crossings or topping the roadway at any location shall be no deeper than 150 mm (6 inches), at the roadway crown, for the 100-year storm and shall have proper signage provided to identify potential hazards for flooding.
- For minor collector and local roads, the flow shall not exceed 200 mm (8 inches) inches over the crown of the road.

9.2 Storm Sewer and Culvert Design Criteria

- Mainline Storm Drain shall be designed to convey a 100-year storm.
- Minimum 450 mm (18 inches) diameter storm drain pipe shall be used.
- Cross road culverts shall be designed to pass the 50-year storm with maximum water surface at edge of pavement.

9.3 Open Channel Design Criteria

- Open channels shall be designed to carry a 50-year storm without flooding beyond the right-of way for the 100-year storm.
- Parallel roadside ditches shall be designed to carry a 10-year storm.

9.4 Regional Detention Basins Design Criteria

- Detention facilities shall be designed for a 100-year storm frequency, 2-hour rainfall retention volume.

10.0 EXISTING STUDIES

Existing studies are valuable resources for project development. Information taken from previous studies are instrumental in developing a drainage report. It provides consistency and continuity as one drainage area follows the next. In the case of Baseline Road, previous flooding problems and new developments have prompted several drainage studies in the area. We have utilized these studies to give us background information for the improvements of Baseline Road. The following summarizes the reports used in this project and their project background.

Project Summary for South Phoenix / Laveen Drainage Improvement Project, March 1997; HDR Engineering, Inc.

This project was prepared for the Flood Control District of Maricopa County. The study area covered by this report is the Salt River, Central Avenue, South Mountain Regional Park and 43rd Avenue. This project summary is an overview of the proposed major storm drain system under Baseline Road. It briefly describes the proposed system and historical events leading to the initiation of the project. The proposed storm drain will be installed under Baseline Road from 7th Avenue to 43rd Avenue. Baseline Road pavement runoff will be fed into this storm drain trunk. This project is currently in the review stage at FCDMC.

Concept Drainage Report for South Mountain Freeway (Loop 202), I-10 Papago to I-10 Maricopa, February 1993; HDR Engineering, Inc.

This project was prepared for the Arizona Department of Transportation. This study was to re-evaluate and refine previous hydrologic analysis, drainage concepts and prepare new design concept drainage plans.

The study area covered by this report varied depending on the five freeway segments studied. The overall boundary but not inclusive is the I-10 Freeway to the north, 67th Avenue to the west, the ridge line of South Mountain Regional Park to the south and I-10 Freeway to the east.

This report discussed a portion of Baseline Road drainage area from 51st Avenue to 43rd Avenue. The study area covered by this report is the Salt River, Central Avenue, South Mountain Regional Park and 43rd Avenue.

Although this report is a comprehensive study of the freeway drainage system, it discussed watersheds that includes Baseline Road from Central Avenue to the Salt River.

51st Avenue Safety Improvement Study, May 1997; Kirkham Michael Consulting Engineers

This study was prepared for the Maricopa County Department of Transportation, and it analyzed the existing conditions, accident history and projected traffic volumes to determine traffic and roadway needs for 51st Avenue from Pecos Road to Broadway Road.

Preliminary drainage requirements and recommendations were discussed in this study which could preclude the use of some other method of drainage for Baseline Road at 51st Avenue.

Laveen Area Master Drainage Study, September 1991; Cella-Barr Associates

This report was prepared for the Flood Control District of Maricopa County. It is to prepare an Area Drainage Master Study for stormwater management to identify flood hazard areas and develop drainage facility solutions in the Laveen Area. This hydrology report encompassed the Baseline Road study limit.

The study area boundary is bounded by the crest of South Mountain north to the Salt River and from approximately Central Avenue west to the Gila River Indian Reservation.

Three watersheds were identified in the report, namely Southwest South Mountain Watershed, Hidden Valley Watershed and Champion Drain Watershed. A hydrologic model for the study area was developed to estimate existing condition 100-year peak discharges at selected concentration points to be used for floodplain delineation at selected locations. Also included in this study is the delineation of Champion Drain's 100-year floodplain and floodway from 43rd Avenue to the Salt River.

The Champion Drain watershed is approximately 29 square miles with 68 sub-basins. Concentration points along Baseline Road and 100-year peak discharges are shown on Figure 1.0.

11.0 CONCLUSION AND RECOMMENDATIONS

This report presents an overview of the engineering parameters to be used in the drainage intercepted by the segment of Baseline Road from 51st Avenue to 7th Avenue. The proposed storm drain project by FCDMC is assumed to handle both off-site and on-site flows between 43rd Avenue and 7th Avenue. It is recommended that pavement drainage between 51st Avenue and 43rd Avenue be collected by a new 1050 (42") reinforced concrete pipe (RCP) draining into Champion Drain at 51st

Avenue. Figure 3.0 depicts this proposal. An assumption used in this analysis is the approval by SRP to allow 1.13 cmf (40 cfs) of inflow to Champion Drain. SRP staff is currently reviewing this plan.

Complete reliance of USGS quadrangle maps was used to determine flowage patterns through the area. Since the USGS maps do not reflect the land-leveling that has occurred in the watershed, edge of fields are assumed to carry sheet flows to the irrigation canals.

Currently, the agricultural fields have high infiltration rates. Should future development occur in this watershed that would alter this existing drainage pattern, the inflow points to the proposed storm drain could be altered. Depending on how such alterations might occur, the proposed storm drain capacity might be subjected to either an under- or over-design.

It is also important to emphasize that any future land-use changes (new high school) that might alter this watershed toward a more urbanized condition will undoubtedly generate a potential for increased runoff, as the farmland is covered with more impervious surfaces such as parking lots, rooftops, etc. If such changes are ever allowed to occur, it is important that effective drainage ordinances be enforced to ensure the peak discharges are not increased along Baseline Road.

In summary, URS Greiner, Inc. recommends that the *South Phoenix / Laveen Drainage Improvement Project* and a new 1050 (42") RCP be adopted for use in the concept design of drainage structures for this reach of Baseline Road. Both 100-year and 50-year storm frequencies should be considered for engineering and economic comparison.

Appendix A

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Offices in Principal Cities Nationwide

URS Greiner

Project No. E10102701

June 27, 1997

Mr. Robert E. Larchick, P.E.
Water Engineering Manager
Salt River Project
Mail Station PAB106
P.O. Box 52025
Phoenix, AZ 85072-2025

Re: **Baseline Road Design Concept Report**
Drainage Study

Dear Mr. Larchick:

URS Greiner, Inc. is in the process of preparing the Design Concept Report for the widening of Baseline Road from 51st Avenue to 7th Avenue in South Phoenix. This project is being sponsored by Maricopa County Department of Transportation (MCDOT), Flood Control District of Maricopa County (FCDMC), and the City of Phoenix and is scheduled for construction in the year 2000.

Our scope of work includes design of a major storm drain trunk under Baseline Road from 7th Avenue to 43rd Avenue. This storm drain system will significantly reduce the local flooding problem that has occurred in the past on Baseline Road and vicinity. However, we still need to mitigate stormwater runoff tributary to Baseline Road from 51st Avenue to 43rd Avenue. It would not be practical to collect flows at this location and outlet into the said storm drain system due to the reversed roadway grade. The intent of this letter is to discuss our plan to use Champion Drain to accept stormwater flows from a small drainage area which is already within the Champion Drain watershed.

Champion Drain is the natural east-west watercourse that carries flows from South Mountain and agricultural farmland into the Salt River. Studies indicate that the existing Champion Wash channel geometry is not adequate to carry the 100-year flood flows from its tributary area. However, with the new storm drain system, these flows will be reduced.

We are proposing that storm runoff (approximately 40 cubic feet per second) from a small drainage area be outlet into Champion Drain at 51st Avenue. The attached area drainage map shows that these sheet flows are currently being intercepted by Champion Drain. We have reviewed available drainage studies and have visited the project site and concluded that outletting into Champion Drain would not increase its flow or divert any new flows into it.

Jim Martin and Portia Gonzalez have informed me that they have met with you and Mr. Harold Biever earlier this month to discuss this issue and the irrigation ditch relocation. It was then decided that SRP will review the above request with staff and notify us whether we can proceed with this plan for further study. Should you have any questions or wish to discuss the project in more detail, please call myself or Portia Gonzalez. For your information, we are tentatively scheduled to begin design in mid-August.

Thank you for your cooperation.

Sincerely,

URS Greiner, Inc.

Ronald E. Price, P.E.
Project Manager

Enclosure

REP/mq
PG062797.L01

Appendix B

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	68914	1	1	

b.dgn 12/6/93

NO.	REVISION	BY	DATE
1			
2			
3			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

BASELINE ROAD DRAINAGE CONCEPT PLAN
(51st Ave - 43rd Ave)
PROJECT NO. 68914

		BY	DATE
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED		7/07/97
	DRAWN		7/07/97
	CHECKED		
	APPENDIX B		SHEET 1 OF 1

URS Greiner

TRACS NO.