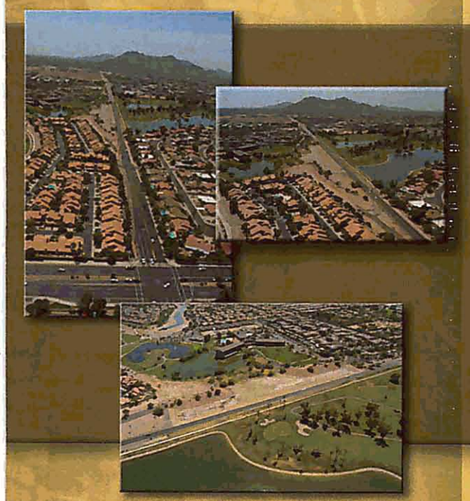
Final Drainage Report

Indian Bend Road Improvements
Scottsdale Road to Hayden Road



Project No. 410-S-0402

Volume 1 of 2

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April 2007

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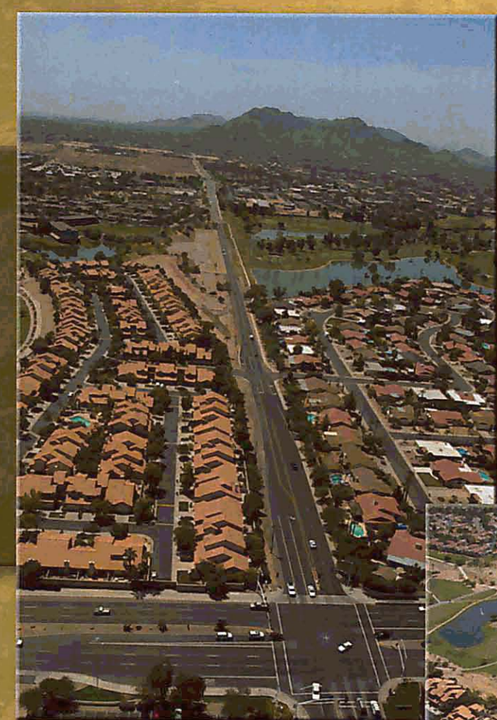

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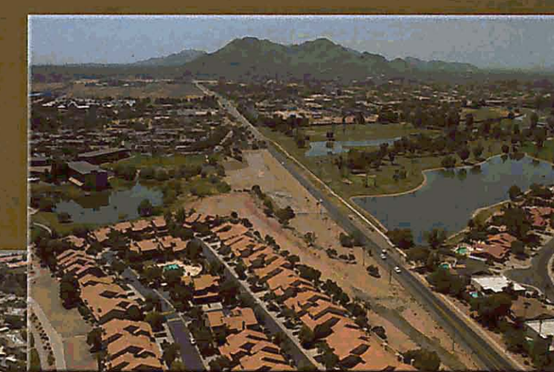

URS

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Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Project No. 410-S-0402

Final Drainage Report

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April 2007
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Registered Professional Engineer (Civil) CERTIFICATE NO. 23663 DAVID J. SCHAUB Date Signed 6-29-07 ARIZONA, U.S.A.

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1.0 INTRODUCTION

The City of Scottsdale "Indian Bend Road Improvement Project" begins at Scottsdale Road and extends east to Hayden Road. The project has an overall length of 1.07 miles and will upgrade Indian Bend Road to a minor arterial with a typical right-of-way width of 110 feet. The roadway will consist of two lanes in each direction with a 16-foot raised median. Pedestrian facilities will include an 8 to 10-foot wide multi-use path on the north side of the roadway and an 8-foot sidewalk on the south side. The project will include widening of the existing roadway and realignment. The location of the project is shown on the Vicinity Map, Figure 1.1.

The Final Drainage Report documents the on-site and off-site drainage improvements. This report includes discussion on the reconstruction of the drop structure in Indian Bend Wash, the installation of concrete arch culverts under the realigned Indian Bend Road, the hydraulic evaluation of the Seville Channel, roadway drainage improvements, the removal and replacement of an existing cross culvert associated with the McCormick-Stillman Railroad Park's drainage basin and installation of area drains in the Park.

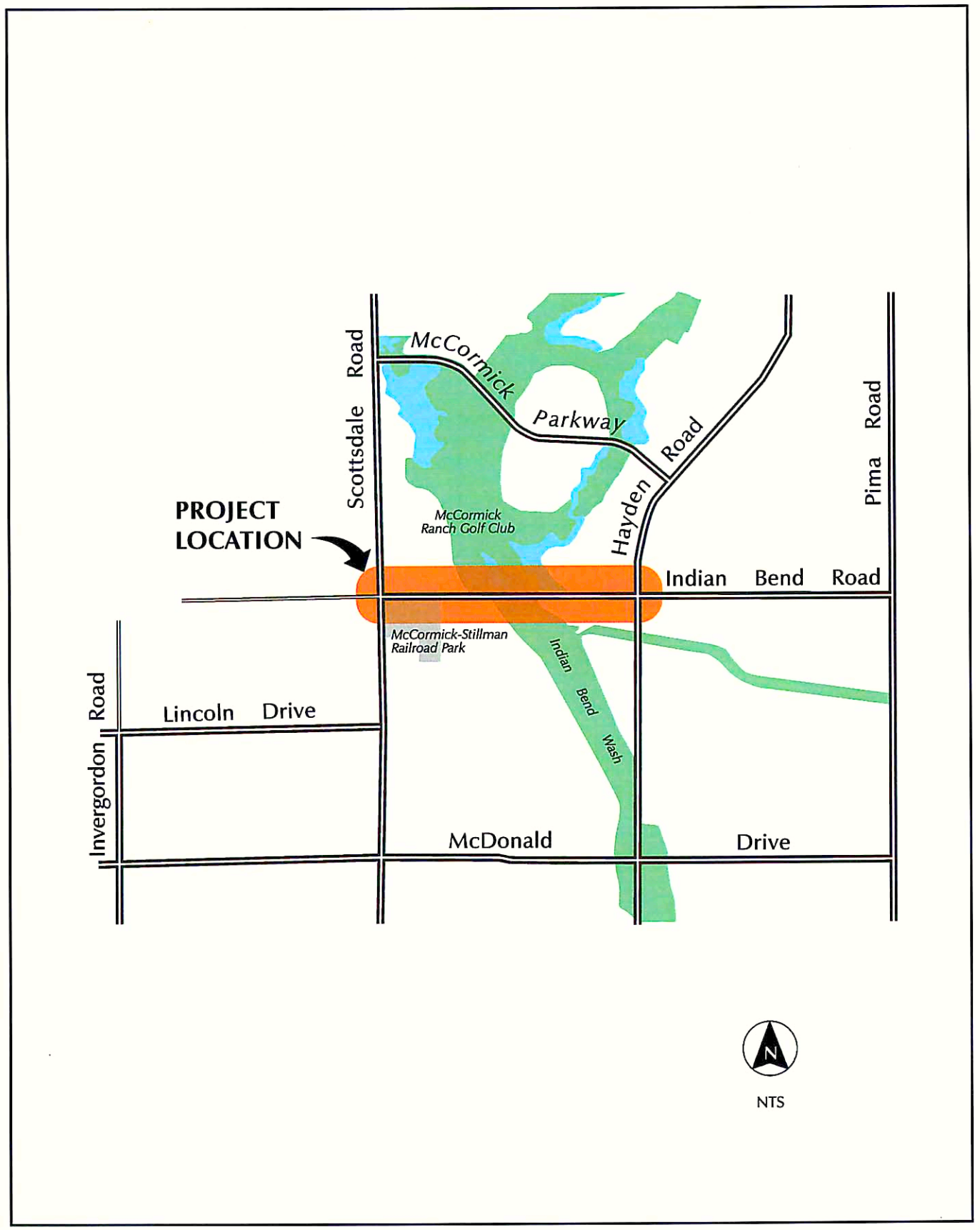


Figure 1.1
Vicinity Map

Final Drainage Report

Indian Bend Road Improvements
Scottsdale Road to Hayden Road
Project No. 410-S-0402

URS

2.0 DESCRIPTION OF EXISTING DRAINAGE CONDITIONS AND CHARACTERISTICS

On-site and off-site drainage for this segment of Indian Bend Road is handled by interconnected on-site and off-site drainage systems. Runoff from the roadway is collected in catch basins and side-road ditches and carried in closed and open channel conveyance systems with discharge to either the Seville Channel or Indian Bend Wash. Contributing off-site runoff west of Indian Bend Wash (enters the project from both south and west of the project) is collected and directed to existing cross culverts with discharge to the Seville Channel. On-site and off-site runoff east of Indian Bend Wash is collected in an existing storm drain and carried to the wash.

Representative photos of the project site are included in Appendix B.

2.1 WATERSHED AND FLOODPLAIN BOUNDARIES

Three drainage areas have been identified as contributing off-site runoff to the Indian Bend Road drainage systems. The undeveloped land to the southwest of the Scottsdale Road intersection, the McCormick-Stillman Railroad Park and residential development to its south and residential development to the north of Indian Bend Road between Indian Bend Wash and Hayden Road.

Off-site runoff from the Seville Shopping Center to the north of Indian Bend Road discharges directly to the Seville Channel and is not impacted by the project.

2.2 EXISTING MAJOR DRAINAGE STRUCTURES

The major drainage structures along this segment of Indian Bend Road includes the Seville Channel, the upstream multi-barrel culvert crossing under Scottsdale Road (located south of Indian Bend Road), two multi-barrel box culverts and a single barrel circular culvert crossing under Indian Bend Road and the Indian Bend Wash drop structure. The existing drainage structures are shown on the drainage plans included in Appendix A and Exhibit 1.

The Seville Channel runs along the north side of Indian Bend Road from Scottsdale Road to Indian Bend Wash. The channel conveys storm water from two culverts located under Scottsdale Road; one is a triple barrel 10' x 6' concrete box culvert located just south of Indian Bend Road and the other is a 36" x 22" arch culvert located just north of Indian Bend Road. The Stormwater Master Plan indicates the total discharge entering the channel is 1,073 cfs, increasing to 1,292 cfs at its outfall to Indian Bend Wash. The geometry of the channel varies; the upstream end of the channel has vertical walls and the downstream end has a vertical wall along the north side with

the channel bottom and south bank being trapezoidal grass-lined. The channel outlets to the McCormick Ranch Golf Course as a wide, grass-lined channel with the roadway fill along the south side and the Indian Bend Wash floodplain along the north side. Entrances to the Seville Shopping Center cross the Seville Channel with bridges.

The triple barrel 10'x6' box culvert that crosses under Scottsdale Road just south of Indian Bend Road discharges into a grassed lined channel that passes through the McCormick-Stillman Railroad Park. The capacity of the box culvert is estimated at 1,195 cfs based on inlet control computations. The channel through the park is grass-lined trapezoidal with a meandering alignment through the Park to the box culvert under Indian Bend Road. The inlet of the culvert has been modified with the installation of grate inlets. The northwest area of the Park provides some detention prior to the runoff being carried under Indian Bend Road through a triple barrel 10'x4' concrete box culvert to the Seville Channel.

A double barrel 8'x4' concrete box culvert along the eastern boundary of the Park passes under Indian Bend Road to the Seville Channel. The culvert carries flows from the eastern portion of the McCormick-Stillman Railroad Park including its parking lot, the Sands North residential development, and Scottsdale Road pavement. A 16-inch cast iron overflow pipe from the City of Scottsdale Reservoir 14 outlets to the inlet of the culvert. A flap gate has been installed at the outlet to prevent backflow. To prevent erosion, the entrance to the concrete box culvert has been concrete lined.

A 32-inch diameter concrete culvert crosses under Indian Bend Road along the west side of Paradise View Road and outlets to the Seville Channel at its entrance to Indian Bend Wash. The culvert carries off-site runoff from residential development to the south. A flood (flap) gate has been installed at the outlet. The design flow through the culvert is not known.

The McCormick Ranch Golf Course occupies the wash to the north of Indian Bend Road. Immediately north of the road are two golf course lakes with small diameter overflow pipes to maintain the lakes normal water level. The overflows are carried in a swale along the north side of Indian Bend Road to two area drains. When significant runoff overtops the south edges of the lakes, the runoff drains along the north swale where the two area drains intercept the flow. The area drains outlet with 36-inch diameter concrete pipes through the downstream face of the existing drop structure. Once flows exceed the capacity of the area drains, the runoff spills over the roadway and down the drop structure.

The Indian Bend Road drop structure is approximately 1,660 feet long with the 3:1 downstream face slope constructed of concrete. Its crest is located 15 feet downstream of the south edge of

the road with an overflow length of 870 feet. This drop structure was designed and constructed by the U.S. Army Corps of Engineers in the late 1970s and is currently maintained by the Flood Control District of Maricopa County. Additional discussions on the hydraulic design of this facility are contained in Section 5. Design Memorandum No. 3, Features Design For Inlet Channel Project Design for Indian Bend Wash. A copy of this Memorandum is contained in Appendix D. This memorandum documents the design of the Indian Bend Wash Inlet Channel, which is defined as extending for about 1.1 miles from Indian Bend Road downstream to McDonald Drive.

Design Memorandum No. 3 indicates that the water depth over the drop structure would be 3.6-feet for the design discharge of 30,000 cfs, with the hydraulic jump occurring on the sloping face for all significant flow conditions. At the standard project flood of 62,000 cfs about 48,000 cfs would be directed to the drop structure with the remaining 14,000 cfs overflowing the left and right banks upstream of existing Indian Bend Road. Should the entire standard project flood of 62,000 cfs be directed to the drop structure the critical depth at the crest would be 5.7 feet. Based on previous discussions with the Corps, there are no requirements to use the standard project flood for design.

Memorandum No. 3 states that a minimum of 1.0 feet freeboard at the design discharge is required upstream of Indian Bend Road and on Indian Bend Road at the right and left banks. Memorandum No. 3 documents the design of the approaches and drop structure on page V-3 as follows:

- "Approaches and drop structure. Upstream from the existing Indian Bend Road, local interests plan to floodproof the floodway fringes by placing fill along the left and right banks of the wash prior to project construction to provide a minimum of 1.0 ft freeboard at the design discharge (see pl. 5). The existing Indian Bend Road (pl. 14) would be raised on the left and right banks to elevation 1288.5. This would provide a minimum freeboard of 1.0 ft at the design discharge of 30,000 cfs. Downstream from the road, levees (pl. 6) would be required along the alinement of the future Indian Bend Road."

Memorandum No. 3 states that a minimum of 3.0 feet freeboard at the design discharge is required downstream of Indian Bend Road for the inlet channel banks. Memorandum No. 3 documents the freeboard requirements page V-4 as follows:

- "Freeboard. The top of levees at the drop structure would provide a minimum freeboard of 3.0 ft at the standard project flood of 62,000 cfs (future conditions). The top of channel walls would be set at a minimum of 1.0 ft above the water surface elevation of

the standard project flood discharge of 62,000 cfs. The top of the inlet channel banks was set to provide a minimum freeboard of 3.0 ft at the 100-year design discharge of 30,000 cfs. During construction of the inlet channel the areas adjacent to the left bank would be filled to the top of the channel bank. Areas adjacent to the right bank of the channel would be filled to the elevation of the 100-year water surface (future conditions). During construction of the interceptor channel the following year the right bank areas of the inlet channel would be filled to the top of the bank (see plate 10). The top of the channel banks would provide 1.0 ft of freeboard at the standard project flood discharge of 42,000 cfs under present conditions."

The Corp's of Engineers freeboard requirements for the 30,000 cfs design flow are as follows:

Figure 2.1 Corps' of Engineers Freeboard Requirements

Feature	Freeboard Required (ft)
Upstream Channel Banks	1
Levees	3
Inlet Channel Banks (Downstream)	3

FEMA's freeboard requirements for the 100-year flow of 17,000 cfs are as follows:

Figure 2.2 FEMA's Freeboard Requirements

Feature	Freeboard Required (ft)
Upstream Channel Banks	1
Levees	3
Inlet Channel Banks (Downstream)	1

The design of this project is designed to meet the Corp's of Engineers freeboard requirements, which are more stringent than the FEMA requirements.

2.3 EXISTING ON-SITE DRAINAGE SYSTEM

The existing on-site drainage system for this section of Indian Bend Road includes open channel and closed conduit drainage systems. The existing drainage systems are shown on the drainage plans included in Appendix A and Exhibit 1.

A series of catch basins are positioned along the north side of Indian Bend Road from Scottsdale Road to Rocking Road, with discharge to the Seville Channel. Drainage along the south side of the road is collected in roadside ditches and carried to the double barrel 8'x4' box culvert located at the east side of the Park's parking lot. The McCormick-Stillman Railroad Park's parking lot and residential development to the south also contributes runoff to the box culvert.

From Rocking Road to the east side of the Indian Bend Road drop structure, along the north side of the roadway, runoff sheet flows or is carried in roadside ditches to the two area catch basins that drain south into the drop structure. Runoff along the south side of the road is carried overland or discharges directly to Indian Bend Wash.

From the east side of Indian Bend Wash east to Hayden Road, roadway runoff is carried in a 42"/48" storm drain. The storm drain originally began east of Hayden Road by carrying runoff through a small swale (along the north right-of-way) to a 43"x27" CMP. The CMP had crossed to the west side of Hayden Road and had connected to a junction structure located in the northwest quadrant of the Hayden Road/Indian Bend Road intersection. When the 66-inch storm drain was constructed along Hayden Road, the 43"x27" CMP was severed and both ends were connected to a manhole on the 66-inch storm drain. Off-site runoff east of Hayden Road now outlets to the 66-inch storm drain and is removed from the Indian Bend Road storm drain.

The junction structure located in the northwest quadrant of the Hayden Road/Indian Bend Road intersection also contains a connection from a 43"x27" CMP storm drain located along the west side of Hayden Road from the north. This storm drain has been abandoned, however an existing catch basin located in the northwest corner of the intersection captures runoff from the west side of Hayden Road for a distance of approximately 175' north of the Indian Bend/Hayden Road intersection. This runoff is then conveyed west within the Indian Bend Road storm drain. The remaining drainage further to the north has been redirected to the 66" storm drain.

The storm drain continues, from the junction structure located in the northwest corner of the Indian Bend Road/Hayden Road intersection, west along the north right-of-way as a 42-inch RCP to a junction structure at the 78th Place intersection. Then the storm drain crosses Indian Bend Road to the southwest as a 48-inch diameter RCP. The storm drain continues west within

the roadway for some distance, then turns southwest outside the roadway, where it continues west and discharges through the drop structure into Indian Bend Wash. Runoff enters this storm drain as follows:

- Two curb-opening catch basins located on the north leg of the 78th Place intersection collect runoff from the residential development to the north.
- A Curb opening and a grate catch basin are located in the roadway sump condition between 78th Place and Hayden Road. An 18-inch lateral connects these catch basins to the 42-inch storm drain.
- A catch basin, located in the northwest corner of the Hayden Road intersection, collects runoff from the west side of Hayden Road to the north. It is connected to the junction structure with a 30-inch lateral.

The residential privacy wall along the north side of the Indian Bend Road, from the wash eastward to Hayden Road, has a series of small wire-meshed rectangular openings that allow runoff from the backyards of the residential properties to drain onto the right-of-way. A similar situation exists for the residential privacy wall along the east and west sides of Hayden Road to the north of Indian Bend Road.

As-built and design drawings for the existing drainage systems are included in Appendix N.

2.4 FLOOD HAZARD ZONE

The Indian Bend Wash crossing at Indian Bend Road has a Special Flood Hazard Classification of Zone AE. The FIRM shows that the 100-year flood event overtops Indian Bend Road. Storm events of lesser frequencies also overtop the roadway. The remaining segments of Indian Bend Road are located outside the floodplain of Indian Bend wash.

A copy of the Federal Emergency Management Agency (FEMA) flood insurance map for Indian Bend Wash crossing of Indian Bend Road is included in Appendix C.

3.0 PROPOSED DRAINAGE PLAN

The proposed improvements to the on-site and off-site drainage systems will maintain existing overall drainage characteristics including outfalls. The existing on-site drainage systems will be modified to meet the drainage needs of the new roadway and be in compliance with the City of Scottsdale design criteria. Known drainage problems will be corrected and any changes or alterations to have occurred since implementation of the existing drainage systems will be incorporated into the design. All impacts from the roadway improvements to the off-site drainage systems will be identified and addressed. The proposed off-site improvements include one cross culvert replacement, area drains, and reconstruction of the Indian Bend Wash drop structure.

Development for this segment of Indian Bend Road is at full build-out and any significant land use changes, other than those associated with this project, is not expected in the foreseeable future.

The proposed on-site and off-site drainage improvements are shown on the drainage plans in Appendix A and Exhibit 2.

3.1 OFF-SITE DRAINAGE IMPROVEMENTS

General Discussion

The three offsite drainage systems along this corridor are the Indian Bend Wash roadway overflow crossing within the middle of the project, the Seville Channel along the western segment of the project, and the 2-8'x4' concrete box culvert that drains the McCormick-Stillman Railroad Park offsite basin.

All offsite and onsite drainage systems outlet to Indian Bend Wash. HEC-RAS models have been prepared for Indian Bend Wash and the Seville Channel. These models are contained in the Appendices K and J of this report. During the review process with the Flood Control District of Maricopa County interpolated cross-sections were added to the Indian Bend Wash HEC-RAS model. These evaluations, completed in June 2007, are documented in Appendix P of this report.

Indian Bend Wash/Structure Crossing

An existing condition model was developed for comparison to the proposed drop structure relocation, concrete arch structure and roadway realignment to the south. Before construction of the existing Indian Bend Wash channel drop structure, a golf course mound was constructed

within the middle of the inflow channel. This mound still exists and it divides the flow between the western and eastern segments of the channel drop. To effectively capture this divided flow, it is necessary to install two drainage structures under Indian Bend Road, one for each concentrated inflow point. Furthermore, the opening through the levees was widened from 350 feet to 633 feet in order to better accommodate the upstream split flow condition. These measurements are parallel to the roadway, at the flow line and at the downstream face of the structures. These two structures will be separated by approximately 218 feet of roadway embankment, and therefore, the net effective widening is 415 feet. Upstream of the roadway, a new continuous channel drop will equalize the flows between these two structure crossings.

The proposed structure type is two crossings of 36'x9'-6" Concrete Arches (10 cells total, 5 at each crossing). HEC-RAS Models were run for the selected COE Design Discharge of 30,000 cfs and the FEMA 100-Year peak runoff of 17,000 cfs. Printouts of the HEC-RAS Models along with tabulated summary tables are contained in both the Table Section at the end of this narrative and in Appendix K. Exhibits 4A and 4B and 5A and 5B are the Cross-Section Location Maps for existing conditions and proposed conditions.

The proposed new drop structure/concrete arch drainage system will result in similar or lower upstream water surface elevations at all sections for both the 30,000 cfs Design Discharge and the 17,000 cfs FEMA 100-Year peak flow. For the design flow of 30,000 cfs, the water surface elevation would drop 0.19 feet at the relocated drop, rise an insignificant 0.02 feet at the flow split by the golf course mounds, and remain the same approximately 700 feet upstream of the inlet channel. For the 100-Year flow of 17,000 cfs, the water surface elevation would drop 0.12 feet at the relocated drop, remain the same at the flow split by the golf course mounds, and remain the same approximately 700 feet upstream of the inlet channel.

At the proposed culvert inlet/existing channel entrance, the water surface elevation would rise 0.16 feet for the 30,000 cfs and drop 0.08 feet for the 17,000 cfs.

The proposed downstream widening of the existing channel entrance results in a reduction in channel velocity and a rise in the water surface elevation. This rise is well below the top of channel bank and it dissipates to zero at the downstream lake. The top of the channel banks range from 4 to 11 feet above these new water surface elevations. For the design flow of 30,000 cfs, the water surface would drop 0.63 feet at the culvert outlet, rise 0.64 feet approximately 170 feet downstream of the culvert outlet, rise 0.48 feet 300 feet downstream, and dissipate to zero change 475 feet downstream at the first downstream lake. For the FEMA 100-Year flow of 17,000 cfs, the water surface would drop 0.28 feet at the culvert outlet, rise 0.33 feet

approximately 170 feet downstream of the culvert outlet, rise 0.28 feet 300 feet downstream, and dissipate to zero change 475 feet downstream at the first downstream lake.

The existing bank elevation upstream of the relocated drop structure is slightly higher than 1290.0, which is above all of the modeled water surface elevations. For the design flow (30,000 cfs), the modeled water surface elevations range from 1285.57 to 1288.61. For the FEMA 100-Year flow (17,000 cfs), the modeled water surface elevations for the proposed project range from 1284.61 to 1287.25.

The bank elevations downstream of the box culvert outlet range from 1282 feet to 1290 feet, which is above the modeled water surface elevations. For the design flow (30,000 cfs), the modeled water surface elevations range from 1277.98 to 1278.66. For the FEMA 100-Year flow (17,000 cfs), the modeled water surface elevations range from 1275.99 to 1276.70.

The proposed concrete arch structure meets FEMA requirements of not raising the water surface by more than 1-foot, and therefore, a Conditional Letter of Map Revision may not be required.

The Indian Bend Wash/Indian Bend Road Drainage Structure is further described in Section 4.0.

Seville Channel Drainage Structure

The existing system, which is described within Section 2.2, consists of a grassed channel with retaining walls along a major portion of the channel. Three bridges cross the channel. The proposed roadway improvements have been selected to minimize impact to the capacity of the existing system. Currently, the only impact to the channel is the installation of a right turn lane; Station 32+80 to 35+15 Lt. These impacts will be minimized by the installation of a retaining wall. In addition, removal of the existing 2-8'x4' CBC outfall at Station 32+86 will also result in the removal of an earthen hump in the channel bottom. Removal of this hump will eliminate a ponding situation for irrigation water as well as create a more efficient flow section.

HEC-RAS models were prepared for both the existing and proposed conditions. These models are contained in Appendix J. There is an insignificant change in the water surface elevation for the proposed encroachment by the retaining wall. For easy reference, the cross-sections for the channel segment along Indian Bend Road uses the Indian Bend Roadway stationing. This channel has the following characteristics:

- The existing upstream box under Scottsdale Road would handle the 100-year runoff.

- The existing upstream box under Indian Bend Road is slightly undersized for the anticipated 100-Year runoffs. Approximately 52 cfs would overflow to the east along Indian Bend Road.
- A new roadway ditch is required from the existing channel outlet to the relocated Indian Bend Wash channel drop in order to get positive flow. This can be accomplished within the existing right-of-way. Minor flows within this roadway ditch will be captured and conveyed into the drop structure. The new multi-use path will be located within the bottom of the drop structure. The multi-use path will not remain dry during nuisance flows. The City of Scottsdale has approved this concept.
- The proposed changes will result in water surface elevation changes at three cross sections during the 100-year flow event. These changes are a 0.05-foot drop, a 0.07-foot rise, and a 0.01-foot rise. These changes will not affect the overall capacity of the system, and will not flood any property outside of the channel.

McCormick-Stillman Railroad Park Offsite Drainage System

The existing system, which is described within Section 2.2, consists of an earthen channel along the east side of the parking lot that discharges into the Seville Channel through a double barrel 8'x4' concrete box culvert. The roadway cover over this culvert is very shallow and the proposed roadway widening to the south would cut into the top slab of this culvert. Therefore, the top of the culvert would need to be lowered in order to accommodate the new roadway. A complete hydrologic/hydraulic evaluation of this offsite drainage basin and culvert requirements show that this culvert needs to be replaced. Appendix I contains the hydrologic/hydraulic evaluations for this system. The contributing areas are shown in Exhibit 3A. A summary of this evaluation is as follows:

- The hydrology was determined using both the Rational Method and the HEC-1 methodology as specified by the COS. The HEC-1 evaluation was performed to model the existing storage within the park. One hundred (100) year peak discharges for the Rational Method and the HEC-1 method are 74 cfs and 87 cfs, respectively. Design flow is set at 87 cfs.
- The existing twin 8'x4' concrete box has more capacity than required to pass the selected design flow of 87 cfs. The peak discharge has been reduced because the upstream drainage area reaching this structure has been substantially reduced with the construction of the existing 3-10'x4' concrete box under Indian Bend Road located just east of

Scottsdale Road. A substantial portion of the runoff is now directed through the 3-10'x4' concrete box.

- The parking lot is being expanded to the east, which requires replacing the existing earthen channel with a storm drain system. The design flow of 87 cfs requires twin 42 inches concrete pipes with an allowable headwater of 1292. The calculated headwater is 1290.74 assuming tailwater from 100-year flow within the Seville Channel.
- The allowable headwater elevation of 1292 was selected based on an existing berm elevation of 1293 at the inlet of the proposed pipes.
- A special grate drop inlet has been designed to minimize additional head losses that can be created by grates. The proposed grate will not create any additional head losses over pipe entrance losses.

Indian Bend Wash to Hayden Road Off-Site Drainage

The existing system along this segment of Indian Bend Road begins with two existing curb-opening catch basins on the north side of Indian Bend Road at 78th Place. The two catch basins handle drainage from the McCormick Ranch residential development as shown in Exhibit 3B. Their runoff is carried to the existing 42"/48" trunk line located within Indian Bend Road. The two catch basins/laterals will not be impacted by the proposed roadway improvements. Appendix I contains the hydrologic evaluations.

The existing catch basin in the northwest corner of the Hayden Road intersection collects runoff from the west side of Hayden Road to the north. The widening of the roadway will require replacement of the existing catch basin and a portion of the 30-inch lateral.

The existing scupper in the northeast corner of the intersection collects roadway drain from the east side of Hayden Road to the north. The existing scupper will be replaced with a curb opening catch basin/lateral connecting to the existing 66-inch trunk line along Hayden Road.

The existing 42"x27" CMP pipe and inlet structure in the northeast quadrant of the intersection handles off-road drainage to the east. This existing pipe inlet and headwall will be removed and the drainage area will be re-graded to provide overland drainage to Indian Bend Road.

3.2 ON-SITE DRAINAGE IMPROVEMENTS

The approach selected for the on-site drainage improvements is to augment the existing drainage systems to handle the proposed improvements to Indian Bend Road. The proposed on-site drainage improvements are based on as-built drawings received from the City of Scottsdale

supported by field survey investigation. Additional survey information and potholing of existing utilities have been performed.

Development of the on-site drainage improvements is based on the following criteria and assumptions:

- Existing catch basins located along the north side of Indian Bend Road with laterals that outlet to Seville Channel will continue to be used where possible. Laterals that cannot be utilized will either be removed or abandoned and plugged.
- The existing overall drainage patterns of the McCormick-Stillman Railroad Park parking lot will be maintained. A series of four catch basins will be installed at the east end of the parking lot with a waterway to collect and direct flow to these catch basins. One catch basin will be installed at the east entrance to the parking lot to collect runoff prior to Indian Bend Road. The west end of the parking lot will be drained to a curb opening catch basin at the north end of the lot.
- Three area drains will be installed in the northwest corner of the McCormick-Stillman Railroad Park to intercept local runoff from the park prior to reaching the road. These will be connected to a storm drain system that will outlet to the Seville Channel.
- The majority of the existing 42" to 48" storm drain that drains from Hayden Road west to Indian Bend Wash will continue to be utilized. The section of the 42" storm drain from east of 78th Place to Hayden Road and the junction structure will be removed because of conflict with the new sidewalk. The hydraulic analysis of the existing storm system indicates adequate capacity to accommodate the additional roadway runoff. A portion of the roadway runoff to the north along Hayden Road will be diverted to the 66-inch storm drain along Hayden Road with the remaining runoff contributing to the Indian Bend Road storm drain. The contributing drainage areas along Hayden Road are shown on Exhibit 3B. A major portion of the existing storm drain capacity is required to carry the runoff from Hayden Road and the residential development to the north of Indian Bend Road between Indian Bend Wash and Hayden Road.
- As stated in the above bullet, a portion of the roadway runoff from north along Hayden Road will be diverted to the existing 66-inch storm drain within Hayden Road. The existing catch basin and lateral located in the northwest corner of the Hayden Road intersection will be replaced with a catch basin along Indian Bend Road. Relocation of the catch basin to Hayden Road was considered because it mainly captures runoff from the Hayden Road Southbound roadway. However, relocation would severely impact an existing concrete barrier along Hayden Road resulting in additional cost and disturbance

to traffic, and therefore, it was eliminated from consideration. Unfortunately, by maintaining the existing flow condition, runoff from the north will continue to interfere with pedestrian movements at the intersection during every storm event. The lateral line from the replacement catch basin will be inserted into the existing 43"x27" CMPA with runoff to the 66" storm drain. Field surveys indicate that the 43"x27" inlet to the manhole still exists. However, this pipe may have been plugged at the western side of Hayden Road.

- The existing drainage system on the east side of Hayden Road will be re-built with the runoff continuing to outlet to the 66-inch storm drain. The existing scupper located in the northeast corner of the intersection will be replaced with a curb-opening inlet. The existing pipe inlet and headwall also in the northeast corner of the intersection will be removed and the drainage area will be re-graded to provide overland drainage to Indian Bend Road.
- The City of Scottsdale has approved a modified curb return radius at the 78th Street intersection in order to not affect the two existing 21-foot curb-opening inlets located on the north leg of the intersection.
- After further field investigation for the design storm of 10-years, it was determined that the small rectangular openings in the residential privacy walls along Indian Bend Road and Hayden Road have the potential to contribute significant runoff and should be included in the design of the roadway drainage system.
- Because the north side of the Indian Bend Road improvements from the Wash east to 78th Place will be higher than the existing adjacent ground, residential runoff from the north will not be able to drain overland to the road. Therefore, a drainage swale and a series of catch basins will be needed to collect the runoff. The collected runoff will be discharged to the existing 48" storm drain located within Indian Bend Road.

The proposed on-site drainage improvements for Indian Bend Road, Scottsdale Road to Hayden Road, are shown on plan sheets contained in Appendix A and Exhibit 2. These drainage facilities, beginning at Scottsdale Road and proceeding east to Hayden Road, are described as follows:

- *Scottsdale Road to Rocking Road:* New curb-opening catch basins will be installed along both sides based on sump conditions, interception of flow upstream of the side road intersections, and allowable ponding spread criteria. The runoff collected in curb opening catch basins will be conveyed through either existing or new laterals north to the Seville

Channel. The lateral outlets will either penetrate through the existing retaining wall or require installation of headwalls.

- *McCormick-Stillman Railroad Park:* Three area drains will be provided in the northwest corner of the McCormick-Stillman Railroad Park to collect local offsite runoff from the grassed area. A new storm drain system will collect runoff from these catch basins and discharge it to the Seville Channel. Penetration through the existing retaining wall will be required. Four area drains interconnected by a waterway will be provided at the east end of the parking lot to collected the parking lot runoff. The four catch basins will be integrated with the dual 42" pipes, which will accommodate off-site flow from the south. Two additional catch basins will be installed at the parking lot, one at the west entrance and one at the east entrance to collect the runoff prior to Indian Bend Road. The existing 16" overflow pipe from the City of Scottsdale's Reservoir 14 will be rerouted to one of the dual 42" pipes.

- *Indian Bend Wash Crossing:* The on-site drainage system improvements for the segment of the roadway crossing Indian Bend Wash will be integrated into the replacement drop structure and the retaining walls along the north side of the road. Catch basins will be installed at both the east and west ends to intercept roadway flows prior to the concrete arch culverts. A single grate catch basin with two flanking inlets will be installed at the sump located between the two concrete arch culvert systems. The laterals from the catch basins will exit the bottom of the catch basins with outfalls located near the bottom of the wall. Concrete thrust blocks will be provided at the bends to counteract the force of the falling runoff.

- *Rocking Road to Indian Bend Wash:* On-site drainage system improvements in this segment of roadway will be integrated into the Indian Bend Wash replacement drop structure and its transition levees. Along the Indian Bend Road pavement, runoff will be collected in curb-opening inlets with laterals discharging into either the Seville Channel or Indian Bend Wash. Along the south side of Indian Bend Road, runoff between Rocking Road and Paradise View Road Connector will be collected in a drainage ditch and conveyed east to Indian Bend Wash. A culvert will carry the runoff under the Paradise View Connector Road and east to an area drain/lateral with discharged to Indian Bend Wash.

  The existing 32-inch culvert crossing Indian Bend Road just west of Paradise View Road will be extended northward. The extension will require removal of the existing outlet headwall and salvaging of the existing flap gate to be reinstalled at the new headwall. The trash rack at the existing outlet structure will not be replaced at the relocated outlet

structure. The flap gate will provide adequate protection to access and the trash rack removal will make periodic cleaning and maintenance easier.

The access/maintenance road from Paradise View Road Connector east to Indian Bend Wash will require a roadside ditch on its north side. Drainage from the west end of the maintenance road will be collected in an area drain/lateral that carries the flow to the area drain to the north. The remaining runoff from the maintenance road will be collected and carried in a lined ditch to Indian Bend Wash. Drainage from the area south of the access/maintenance road will be collected and carried in a grader ditch along the top of the retaining wall to Indian Bend Wash.

- *Indian Bend Wash to Hayden Road:* As discussed above under criteria and assumptions, additional field investigations and reviews of As-Built Plans has provided an overall understanding of the existing drainage system. Based on current understanding of the system the proposed system will consist of:

    - The existing 42-inch/48-inch trunk line from Hayden Road to Indian Bend Wash appears to have sufficient capacity to accept the additional runoff from the proposed roadway improvements. The installation of the 66" storm drain along Hayden Road has redirected much of the upstream drainage from the Indian Bend Road storm drain.
    - A new 48" trunk line extension to the concrete arch culverts at Indian Bend Wash. A recessed structure will be required at the outlet of the 48" storm drain to the culvert for installation of a flap gate. The structure needs to be recessed to avoid damage to the flap gate from debris and flow.
    - New curb-opening catch basins will be installed along both sides of the road based on sump conditions and allowable ponding spread criteria.
    - As previously discussed, the alignment along the north side of Indian Bend Road from Indian Bend Wash to 78th Place is higher than the adjacent property, which prevents runoff from the backyards of the residences from draining overland to the road. Therefore, it is proposed a drainage swale and a series of area drains/laterals be constructed within the right-of-way to collect and carry the runoff to the existing 48" storm drain.

- *Northeast Corner of Hayden Road/Indian Bend Road Intersection:* The existing scupper at the northeast corner of Hayden Road intersection will be replaced with a curb-opening catch basin. Currently flow from this scupper along with flow from the Indian Bend Roadway ditch east of Hayden Road flow through an existing 43"x27" CMPA into the

66-inch trunk line manhole. This CMPA has very little cover and it is not feasible to connect a lateral to this pipe. Therefore a new lateral will connect to the 66" storm drain manhole. This new lateral will handle flow from both the curb opening along Hayden Road. The section of CMPA upstream and east of the manhole will be removed at the manhole and plugged.

4.0 SPECIAL CONDITIONS

4.1 INDIAN BEND WASH DROP STRUCTURE

As previously stated, this structure was designed and constructed by the U.S. Army Corps of Engineers and is currently maintained by the Flood Control District of Maricopa County. The original design is explained in Design Memorandum No. 3, Features Design For Inlet Channel Project Design for Indian Bend Wash. A copy of the memorandum has been included in Appendix D. Design criteria and modifications or improvements to the Indian Bend Wash were discussed with the U.S. Army Corps of Engineers and the Flood Control District of Maricopa County. The results of those discussions are as follows:

Hydrology: The original 100-year design discharge for the wash is documented to be 30,000 cfs. This value is the original 100-year design discharge determined when the Indian Bend Wash was designed in 1978. The 1997 FEMA study performed by Simons, Li & Associates calculated a 100-year discharge of 17,000 cfs at Indian Bend Road. The results of the study reduced the 100-year discharge for Indian Bend Wash to 17,000 cfs due to a reduction in watershed area as a result of construction of the Central Arizona Project Canal. In discussions with the Corps of Engineers and the Flood Control District, it was agreed that the design discharge would remain at 30,000 cfs so as to preserve the capacity of the wash. FEMA, in recent discussions with the City, has stated that the flood carrying capacity including freeboard requirements must be maintained for the COE Design Discharge of 30,000 cfs. Therefore, evaluations of water surface elevations for floodplain purposes were performed for both the 30,000 cfs design discharge and the 17,000 cfs FEMA 100-year discharge.

The Corps has no requirements to use the standard project flood discharge of 62,000 cfs for design. There are no hydrology models available from the Corps for the Indian Bend Wash. A new HEC RAS design model was prepared with the downstream starting water surface elevation calibrated to elevations based on the FEMA HEC-2 model.

Hydraulics: The Corps is primarily concerned with maintaining the freeboard on the levees of the drop structure and not the freeboard associated with the proposed structure for the roadway. The freeboard requirement for the levee is 3-feet for the standard project flood flow of 62,000 cfs. However, this freeboard does not currently apply because the standard project flood discharge is not a requirement. There are no Corps requirements for the proposed roadway structure provided there is no increase in water surface elevation for the design discharge of

30,000 cfs. The freeboard requirements upstream and downstream of Indian Bend Road for 30,000 cfs are 1-foot and 3-feet, respectively, as discussed in Section 2.2.

Structures/Geotechnical: The Corps does not consider the drop structure a structure since it is not made of reinforced concrete. However, the Corps will require a geotechnical review of any modifications.

Design Review Requirements: The Corps does not want to review any interim plans. They prefer that the Flood Control District of Maricopa County perform all review until the final plan submittal. At that time they would like to review the final plans.

4.2 INDIAN BEND WASH/INDIAN BEND ROAD STRUCTURE DESCRIPTION

The existing Indian Bend Wash crossing at Indian Road consists of the golf course (green belt type floodway) upstream of the road, the drop structure at the downstream edge of the road and the inlet channel (as named by the Corps of Engineers) from Indian Bend Road downstream to McDonald Road, a distance of approximately 1100 feet. The inlet channel also now contains a golf course similar to the one upstream of the road. This project was designed by the Corps of Engineers to convey the design flood of 30,000 cfs. The improvement of Indian Road will require revisions to the drop structure from the upstream roadway (north) right-of-way line to a point 380 feet downstream of the north right-of-way line. These revisions have been designed to maintain conveyance of the 30,000 cfs through this segment of Indian Bend Wash.

Plans of the proposed revision are depicted on the three plan sheets located at the end of Appendix A-Drainage Plans (Final Review) and at the beginning of Appendix K-Indian Bend Wash Drop Structure HEC-RAS Analysis. Physical features of the proposed Indian Bend Wash/Indian Bend Road Structure include: (1) a drop structure immediately upstream of relocated Indian Bend Road; (2) two sets of culvert crossings to convey the 30,000 cfs under Indian Bend Road, and a widened channel immediately downstream of the road. Detailed descriptions of these features are:

Approach to Drop Structure: Upstream of existing Indian Bend Road, large plateaus of fill were placed along both banks of the wash to provide a minimum 1.0 feet freeboard at the design discharge of 30,000 cfs. These plateaus have been developed with single-family homes along the east bank and commercial/retail buildings along the west bank. The proposed design will not change the upstream water surface elevations as shown by Table 1-Comparisons of Water Surface Elevations, and therefore, the integrity of the original design will be maintained. Exhibits 6A and 6B are Hydraulic Plans and Profiles of the Left (East) and Right (West) Banks for these

Proposed Conditions. The east bank top is delineated with a concrete wall topped with a wrought iron fence. A September 2006 field survey of the natural ground at the west side of this wall reveals that the minimum 1.0 feet freeboard is being maintained. The west bank consists of a natural bank for a distance of approximately 400 feet upstream from the centerline of Indian Bend road and then a concrete wall delineates the edge of the wash, which is probably the right-of-way/drainage easement line for the wash. A September 2006 survey shows that the natural ground at the top of the wash bank for the first 400 feet is above the minimum 1.0 feet freeboard. Further upstream survey shots on the concrete wall reveal three locations that do not meet the 1.0 feet minimum freeboard. However, the minimum 1.0 feet freeboard is maintained because the ground continues to rise behind this concrete wall.

The existing Indian Bend Road profile was established to maintain the minimum 1.0 feet freeboard at the left and right banks. Existing left (east) and right (west) bank elevations on the roadway crests are 1289.5 and 1290.0, respectively. The proposed roadway profile will be slightly below the east crest elevation and slightly above the west crest elevation. The east crest elevations are 1289.18 at the north gutter flowline, 1288.32 at the centerline, and 1286.70 at the south gutter flowline. The hydraulic gradeline at the drop structure is 1285.57, and therefore, the minimum 1-foot is maintained at the south gutter flowline. The installation of a 32-inch concrete barrier along the north side of the roadway will maintain the minimum 1-foot freeboard to within 92 feet of the eastern edge of the culverts.

Drop Structure: The crest of the drop structure will be located approximately 15 feet down stream of the roadway north right-of-way line. A 2-foot wide concrete pavement (to function as a broad-crested weir) will be constructed upstream of the crest. The upstream end of the concrete pavement will be constructed with a reinforced concrete toe-down slanted at 1:1 for a depth of 4 feet. This 2-foot wide concrete pavement will replace an existing path, which is currently the controlling section for the existing drop structure. The same grade control will be maintained by constructing the new concrete pavement with a profile that closely mimics the existing path profile. The existing path has an undulating profile that has elevations varying from 1281.6 to 1283.1 and the new path will be designed with a smoother profile that will maintain the existing hydraulic performance. The 30,000 cfs design flow will produce a water surface elevation of 1285.76 for existing conditions and 1285.57 for proposed conditions. Depth of flow along the undulating path will range from 2.47 to 3.97 feet for proposed conditions.

The existing drop is approximately 920 feet long and the proposed drop is approximately 1300 feet long. The effective channel flow widths at the controlling upstream cross-section, the

concrete path, are 910 feet and 1033 feet for the existing and proposed conditions, respectively. These effective widths are shown on Exhibits 4B and 5B.

The drop structure will consist of a 3:1 slope from the crest to the floor of the drop, a minimum 0.5% and desirable 1.0% for the floor of the drop, and vertical retaining walls along the upstream side of relocated Indian Bend Road. Maintenance ramps parallel to Indian Bend Road will be installed at each end of the drop structure. Maintenance vehicles would enter the drop from the east and exit to the west in the same direction as the westbound roadway. Total drop depth is approximately 12 feet. All surfaces within the drop will be reinforced concrete. As discussed previously, upstream art will consist of installing 6 horse gargoyles on the 3:1 slope. Further explanation of these features is contained in Section 5.2.

Levees Parallel to Indian Bend Road: The Corps of Engineers set the top of levees at a minimum freeboard of 3.0 feet at the standard project flood of 62,000 cfs. The existing west levee top elevations range from 1291.3 to 1294.5 and the existing east levee top elevations range from 1290.5 to 1294.3. The middle 500 feet length of both levees has the higher elevations. These elevations are 1293.0 to 1294.5 for the west levee and 1293.0 to 1294.3 for the east levee. The Corps of Engineers stated that this structure crossing should be designed for 30,000 cfs, and therefore, the top elevations of these levees can be lowered. The top of levee elevations should be set to have a minimum 3.0 feet freeboard during the 30,000 cfs event. At the weir crest the water surface elevation will be 1285.57 and therefore, the minimum top of levee elevation is 1288.57. This project will maintain the top of levee elevation of 1290.06 as decided earlier in the design process.

Concrete Barrier along North Edge of Indian Bend Road: The concrete barrier along the north edge of Indian Bend Road in combination with the 10 Con Span type culverts will accommodate the design flows while meeting freeboard requirements. The 2'8" concrete barrier begins at Station 41+80 on the west and ends at Station 60+50 on the east. The elevations along the top of barrier range from highs of 1292.48 at the west end and 1291.55 at the east end to a low elevation of 1285.29 in the sag over the culverts at Station 52+00. Elevations of the curb heads at the barrier termini are 1290.14 at the west end and 1289.39 at the east end.

This barrier takes the place of the levees located along the south edge of the roadway. Assuming that this is a levee, the minimum 3' of freeboard is met as demonstrated by the following table:

Table 4.1 Concrete Barrier Meets Freeboard Requirements For Design Flow of 30,000 cfs

Roadway Station	Description	W.S.E.	Minimum Top of Barrier Elevation(1)	Actual Top of Barrier Elevation	Meets 3-foot Freeboard Requirements
		(ft)	(ft)	(ft)	(ft)
< 44+00	West Bank	1285.57	1288.57	1289.69(2)	Yes
44+00	Begin Drawdown to Bridge	1285.57	1288.57	1290.67	Yes
48+36	Begin Bridge	1280.74	1283.74	1287.56	Yes
52+00	Low Point	1280.74	1283.74	1285.29	Yes
54+79	End Bridge	1280.74	1283.74	1286.15	Yes
58+58	Begin Drawdown to Bridge	1285.57	1288.57	1288.57	Yes
> 58+58	East Bank	1285.57	1288.57	1290.39(2)	Yes

(1) Water Surface Elevation plus 3 feet freeboard.

(2) Elevations on Top of Curb.

Drainage Structure under Indian Bend Road: The 30,000 cfs will be passed under Indian Bend Road through 10 Con Span type culverts with a span/rise ratio of approximately 4:1. These will be separated into two individual crossings, each with 5 of the culverts. Each culvert will be a 36' x 9'-6" concrete arch. The floor of the western culvert will be 0.5 feet higher than the floors of the other culverts to maintain a dry, sediment free pedestrian path. Therefore, this culvert will have a 9' height. The inlet and outlet headwalls of the culverts will be retaining walls parallel to the roadway. Culvert lengths will vary due to the skew and curvature of the roadway, but the average length is approximately 86 feet for the western set of culverts and 81 feet for the eastern set of culverts. The inlet and outlet elevations are set at 1270.94 and 1270.44, respectively, with an average slope of approximately 0.005 ft/ft. Water surface elevation at the culvert entrance is 1280.74 and the energy gradeline elevation is 1281.81. The outlet velocity of the culverts is approximately 9.9 fps with a downstream channel velocity estimated at 7.7 fps.

Channel Downstream of Indian Bend Road: The existing outlet trapezoidal channel has a 295-feet wide bottom with 2.67:1 sideslopes. The sideslopes are protected with 15" thick grouted riprap to an unknown distance downstream and then it changes to a 15-inch thick riprap blanket. The bottom is protected with 15" thick grouted riprap for a distance of 50-feet downstream ending with a 5-foot deep toe-down. The toe-down is sloped at a 2.5:1 slope with a longitudinal length of 12.5 feet. An additional 110 linear feet of riprap blanket is installed beginning at the

downstream end of the grouted riprap. This blanket is 2-foot thick for the first 20 feet and then its decreases to 15-inches thick. The outlet velocity at the end of this blanket is approximately 12 fps.

The downstream end of the proposed culverts and edge of roadway will be on a curvilinear alignment that is parallel to and at the entrance of the existing outlet trapezoidal channel. The proposed outlet channel will be widened toward the east to accommodate the proposed location of the east set of culverts. The proposed downstream outlet channel bottom varies from a width of 560 feet at the culvert outlets to 380-feet at the downstream point where it begins a gradual widening to a width of 500 feet. The right (west) bank begins to widen approximately 88-feet upstream of the point where the left (east) bank begins to widen. As stated above, the culvert outlet velocity of 9.9 fps will decrease to 7.7 fps at the point of the 380-feet wide channel. These velocities are less than the existing condition of 11 to 12 fps, and therefore, the existing riprap protection system described in the above paragraph will be reconstructed with this improvement project. The banks and bottom of the channel widening to the east will be protected with the same or similar materials.

The proposed design will raise the water surface elevation for a distance of 300 feet downstream of the culvert outlet as shown by Table 1-Comparisons of Water Surface Elevations. After that point the existing and proposed water surface elevations are the same. The proposed widening of the outlet channel will drop the outlet velocity, which will cause a rise in the water surface elevation. This is confirmed by the fact that the energy grade line is higher for the existing condition than for the proposed condition. Exhibits 6A and 6B are Hydraulic Plans and Profiles of the Left (East) and Right (West) Banks for these Proposed Conditions. Water surface elevation at the culvert outlet is 1278.66 and the energy gradeline elevation is 1280.19. These profiles show that the top of banks (east and west) meet the minimum 3.0 feet freeboard established by the Corp of Engineers for the downstream inlet channel banks.

4.3 404/401 PERMIT REQUIREMENTS

Work within Indian Bend Wash will result in fill within Waters of the United States and a 404/401 Permit will need to be obtained from the U.S. Army Corps of Engineers before beginning construction.

5.0 DATA ANALYSIS METHODS

The design criteria for drainage analysis and design of drainage improvements for Indian Bend Road are in conformance with Chapter 2, *Design Standards and Policies Manual,* City of Scottsdale, 2006 Update. This manual refers to the Flood Control District of Maricopa County (FCDMC) manuals for various procedures and design standards. These manuals, which consist of the Hydrology and Hydraulics Manuals, January 1995 and the Drainage Design Manual, November 2003 (Draft), were used as appropriate.

5.1 OFF-SITE DRAINAGE

Both the Rational Method and the HEC-1 methodology were employed to determine peak runoffs for offsite areas along the project. In particular these methods were used for the McCormick-Stillman Railroad Park offsite drainage basin. All large offsite systems are sized to handle at least the 100-year peak runoff.

The peak discharges (10, 25, 50, and 100-year) for the Seville Channel were obtained from the City of Scottsdale Stormwater Master Plan, 1994. A copy of the pertinent portions of this report is contained in Appendix J.

Design discharges for Indian Bend Wash were obtained from Design Memorandum No. 3-Feature Design for Inlet Channel, Project Design for Indian Wash, Los Angeles Corps of Engineers, January 1978. Further discussion of the design criteria for Indian Bend Wash in contained in Section 4, Special Conditions.

The 100-year peak flow for Indian Bend Wash was obtained from FEMA Floodplain Study, Simons, Li & Associates, 1997.

The U.S. Army Corps of Engineers HEC-RAS 3.1.3 May 2005, was used to evaluate the Seville Channel and Indian Bend Wash. The cross-sections for the Seville Channel are a combination of recent field ground surveys and the 1993 contour GIS mapping provided by the City of Scottsdale. The cross-sections for Indian Bend Wash were obtained from the 1993 GIS mapping provided by the City of Scottsdale supplemented with project mapping and field surveys in the vicinity of the Indian Bend Road drop structure.

The Haestad Methods computer programs were used to evaluate minor channel flow and to size cross culverts. These programs are Culvertmaster and Flowmaster, which are registered

trademarks of Haestad Methods, Inc., 37 Brookside Road, Waterbury, Connecticut, 06708. The theory behind these two programs is included in Appendix O.

5.2 INDIAN BEND WASH HEC-RAS HYDRAULICS

The U.S. Army Corps of Engineers HEC-RAS 3.1.3 May 2005 was used for hydraulic analyses of the existing channel and the proposed relocated Indian Bend Road with an upstream drop structure and two crossings of 36'x9'6" Concrete Arches (10 cells total, 5 at each crossing).

The preparation and execution of the HEC-RAS models is described below:

Methodology: The USACE computer program HEC-RAS River Analysis System (Ref. 21) is used to compute water surface profiles for one-dimensional steady flow conditions. Computational procedure is based on solving the one-dimensional energy equation. Energy losses are due to friction (using Manning's equation for uniform flow) and contraction/expansion (coefficient multiplied by change in velocity head). The method utilized to compute losses through culvert structures is the Federal Highway Administration (FHWA) culvert routine specified in the HY-8 computer program. The highest calculated water surface elevation between inlet and outlet control is selected for the culvert losses.

Topographic Data Set: Data for all HEC-RAS project models were obtained from the 1993 GIS mapping provided by the City of Scottsdale supplemented with project mapping and recent field surveys for the Indian Bend Road drop structure. The HEC-RAS design model prepared by URS for this project is in the 1988 NGVD Datum.

The cross-sections for the Seville Channel are a combination of recent field ground surveys and the 1993 contour GIS mapping provided by the City of Scottsdale. The cross-sections for Indian Bend Wash were obtained from the 1993 GIS mapping provided by the City of Scottsdale supplemented with project mapping and field surveys in the vicinity of the Indian Bend Road drop structure.

Modeling Lakes: During major storm events, the upstream and downstream lakes were considered to be full and ready to overflow in the downstream direction. The first downstream lake elevation was set at 1270.0 and the first upstream lake elevation was set at 1282.0.

Boundary Conditions: Subcritical flow regime was used for this analysis. The downstream starting water surface elevation for the FEMA 100-year discharge of 17,000 cfs was obtained from the FEMA HEC-2 Model dated September 2000. Copies of the model Input/Output and working maps are contained in Appendix L. Although all the FEMA published water surface

elevations are in the 1929 NGVD Datum, the HEC-2 Model provided by FEMA to URS in fall 2005 is in the 1988 NAVD Datum. The starting water surface elevation computed for Model Station 10 is 1275.99 (1988 NAVD) as shown in Table 6.0.

The downstream starting water surface elevation for the COE Design Discharge of 30,000 cfs was obtained from the HEC-RAS Model converted from the FEMA HEC-2 Model dated September 2000. The HEC-RAS Model input/output and with hydraulic parameter summaries are contained in Appendix M. The hydraulic parameters produced by this model for the FEMA 100-year flow without floodway, FEMA 100-year flow with floodway, and the COE Design Flow are also summarized in Table 9.0. The HEC-RAS model duplicates the HEC-2 water surface elevations very closely as shown by the tabulated comparisons shown in Table 8.0. In fact downstream of the drop structure, all water surface elevations within the vicinity of the starting water surface elevation station show differences varying from 0.00 to 0.01 feet. The starting water surface elevation computed for Model Station 10 is 1277.98 (1988 NAVD) as shown in Table 7.0.

Manning's Energy Loss Coefficients: Roughness coefficients were set equal to the same coefficients used in the FEMA HEC-2 Model as explained in the Indian Bend Wash Floodplain Delineation Study (Ref. 19). Both upstream and downstream of the Indian Bend Road, the roughness coefficients were set according to calculations contained in the study as follows:

Portion of Cross Section	"n" Total
Channel Bank Areas with Small Shrubs	0.035
Lake	0.020
Fairways	0.025
Concrete Drop (Rough)	0.020

These roughness coefficients were assigned to the appropriate segment of each cross section after several field visits, a study of aerial mosaics in combination with project contour maps, ground photographs, and oblique aerial photographs. Exhibits 4A and 4B show the existing condition with aerial mosaics and project contour maps, respectively. Exhibits 5A and 5B show the proposed condition with aerial mosaics and project contour maps, respectively. Project photographs of the existing condition are contained in Appendix B.

Expansion/Contraction loss coefficients: The expansion and contraction coefficients were set equal to the same coefficients used in the FEMA HEC-2 Model as explained in the Indian Bend Wash Floodplain Delineation Study (Ref. 19). Copies of portions of this study are contained in Appendix L. The expansion and contraction coefficients used in the model upstream and downstream of the drop are 0.4 and 0.2, respectively. Through the drop for existing conditions and through the drop structure/arch culverts for proposed conditions, the expansion and contraction coefficients were revised to 0.5 and 0.3, respectively. The HEC-RAS Hydraulic Reference Manual (Ref. 21) recommends using these hydraulic parameters.

Ineffective Flow: Engineering judgment and the criteria suggested in the HEC-RAS Reference Manual (Ref. 1) are used in limiting effective flow areas. The ineffective flow area option is exercised in modeling the expansion of flow upstream and downstream of the drop structure for existing conditions and the drop structure/arch culverts for proposed conditions. Ineffective flow areas were defined to model expanding and contracting flows. Flow was expanded at a rate of 4:1 and contracted at a rate of 1:1 relative to the flowline.

Reach Lengths: Channel reach lengths between cross-sections were taken along the thalweg as is traditionally done (Ref. 21). The overbank reach lengths were measured approximately between the center of mass flow at adjacent cross-sections.

Upstream and Downstream Obstructions: The proposed improvement will have artwork installed within the channel at the upstream drop and at the discharge of the arch culverts. The upstream artwork will consist of six horse gargoyles installed on the drop structure. It is also proposed that the 3:1 slope, which is approximately a 12-foot drop, be constructed with 6-foot(H) x 2-foot(V) steps. These have been modeled at the crest of the drop (River Station 16.5) as six individual obstructions, each 4-feet wide x 4.5-feet high). Eight teardrop linear serpentine features will be installed at the outlet of the arches, one at each interior wall. These will increase in width from 1-foot at the culvert outlet to 4-foot wide approximately 225 feet downstream. These have been modeled at downstream River Station 13 as eight individual obstructions, each 4-feet wide x 3-feet high.

Culvert Hydraulic Computations: The HEC-RAS culvert routine was used to model the Con Span type culverts with a span/rise ratio of approximately 4:1. This routine is similar to the bridge routines, except that the Federal Highway Administration's (FHWA 1985) standard equations for culvert hydraulics are used to compute inlet control losses at the structure. The exit and entrance loss coefficients were set at 1.0 and 0.5 respectively. The exit loss coefficient (k_{ex}) can vary from 0.3 to 1.0 with 1.0 being the value normally set by FHWA, 1985. The selected entrance loss coefficient (k_{en}) of 0.5 is for a Con Span culvert with headwall parallel to

embankment (no wingwalls). The Manning's roughness coefficient was set at 0.013 for the culvert bottom plus 1-foot of the culvert sides and the culvert top was set at 0.012.

Errors, Warnings, and Notes: The HEC-RAS program has a system of Errors, Warnings, and Notes that are generated during the execution of the software. No error messages were generated for any of HEC-RAS model runs for this project. The Warnings and Notes that were generated during the computations have been summarized in the appendices for the model runs. The five common Warning messages are:

1. Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

2. Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

3. Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

4. Warning: The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.

5. Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

These types of warning message are very common for stream reaches that have large changes in cross-section widths, bridge/culvert crossings, and abrupt changes in vertical profiles. This segment of Indian Bend Wash has all three of these conditions. These warning messages were generated by all three of the HEC-RAS models run for this design project. These models are the FEMA HEC-2 Model converted to a HEC-RAS Model and the project design HEC-RAS models for existing and proposed conditions. The FEMA HEC-2 Model's "Summary of Errors, Warnings, and Notes" is contained in Appendix M and the project design HEC-RAS models' "Summary of Errors, Warnings, and Notes" is contained in Appendix L. It has been our experience that modifying the models through the addition of cross-sections or ineffective flow lines does not eliminate these messages nor change the model output. Hence, it is not necessary to modify the enclosed models.

5.3 ON-SITE DRAINAGE

The Rational Method is employed to determine the peak runoffs from pavement and landscape areas.

Parameters used:

Design storm	-	10-year (Street with curb and gutter to maintain one 12- foot dry driving lane in each direction.)
	-	100-year (Street with curb and gutter the runoff is to be confined to the roadway right-of-way or drainage easement. Maximum ponding depth d_{max} = 8-inches above the street.)
Time of concentration	-	5-minutes
Rainfall intensity (10 yr.)	-	6.1 inches/hr. Maximum
Runoff Coefficients	-	Refer to the following table

Peak runoff values are calculated using the Rational Method methodology based on the Flood Control District of Maricopa County's "*Hydrology Manual*":

$$Q = CiA$$

Where:

Q =	the peak discharge from a given area, cfs.
C =	a coefficient relating the runoff to rainfall.
I =	the average rainfall intensity lasting for the computed T_c.
A =	drainage area, acres.

The runoff coefficients for the various land use types specific to the site and corresponding Hydrologic Soil Group Classifications are obtained from the Table 5.2 to compute a composite runoff coefficient for each concentration point. Land use and the SCS soil maps are contained in Appendix I. Hydrologic data calculated by the Flood Control District of Maricopa County method using the City of Scottsdale Isopluvials is presented in Appendix F. This appendix also contains the Arizona Department of Transportation method calculations, which provides the same answers.

The time of concentration is based on the methodology presented in NRCS TR-55 (1986). Time of concentration is the sum of travel time from runoff to travel from the hydraulically most distant point of the drainage area to the point of interest. The time of concentration is the sum of travel time for sheet flow, shallow concentrated flow and channel flow.

The sheet flow is flow of runoff on a plan surface with the depth uniform across the sloping surface. The travel times for sheet flow are commonly estimated using the NRCS TR-55 (1986) variation of the kinematic wave equation. As documented at the end of Appendix I, the Connecticut Department of Transportation *Drainage Manual, Hydrology* Section 6.C.1, October 2000 contains the following equation:

$$T_{Sheet} = \frac{0.007(nL)^{0.8}}{P_2^{\,0.5}\, S^{\,0.4}}$$

Where:

T_{Sheet} =	travel time, hours
n =	Manning Roughness Coefficient, Table 5.1
L =	Flow Length, ft
S =	Slope of the hydraulic grade line (land slope), ft/ft
P_2 =	2-year, 24-hour rainfall depth, in.

Table 5.1. Manning's Roughness Coefficient for Overland Sheet Flow

Roughness Coefficient 'n'	Surface Description
0.011	Smooth Asphalt
0.012	Smooth Concrete
0.05	Fallow (no residue)
	Cultivated Soils
0.06	Residue Cover = 10%
0.17	Residue Cover > 20%
0.13	Range (Natural)
	Grass
0.15	Short Grass Prairie
0.24	Dense grasses
0.41	Bermuda Grass
	Woods
0.40	Light Underbrush
0.80	Dense Underbrush

Values taken from NRCS TR-55 (1986) and McCuen (1989).

Shallow concentrated flow usually occurs after sheet flow has traveled a maximum distance of 300 feet. The following equations determine the average velocity of shallow concentrated flow for both paved and unpaved surfaces.

Paved: $V = 20.32814\ S^{0.5}$

Unpaved: $V = 16.1345\ S^{0.5}$

Where: V = Average velocity, fps
S = Slope of hydraulic grade (watercourse slope), ft/ft

The above equations are based on a Manning Roughness Coefficients of 0.05 and 0.025 for unpaved and paved, respectively.

The flow in curb and gutter sections is modeled as open channel flow. The average velocity is based on the Manning's Equation for triangular flow in the curb and gutter.

$$V = \frac{1.49\ R^{2/3}\ S^{1/2}}{n}$$

Where: V = Average velocity, fps
R = Hydraulic radius, ft
S = Slope of hydraulic grade (watercourse slope) ft/ft
n = Manning Roughness Coefficient

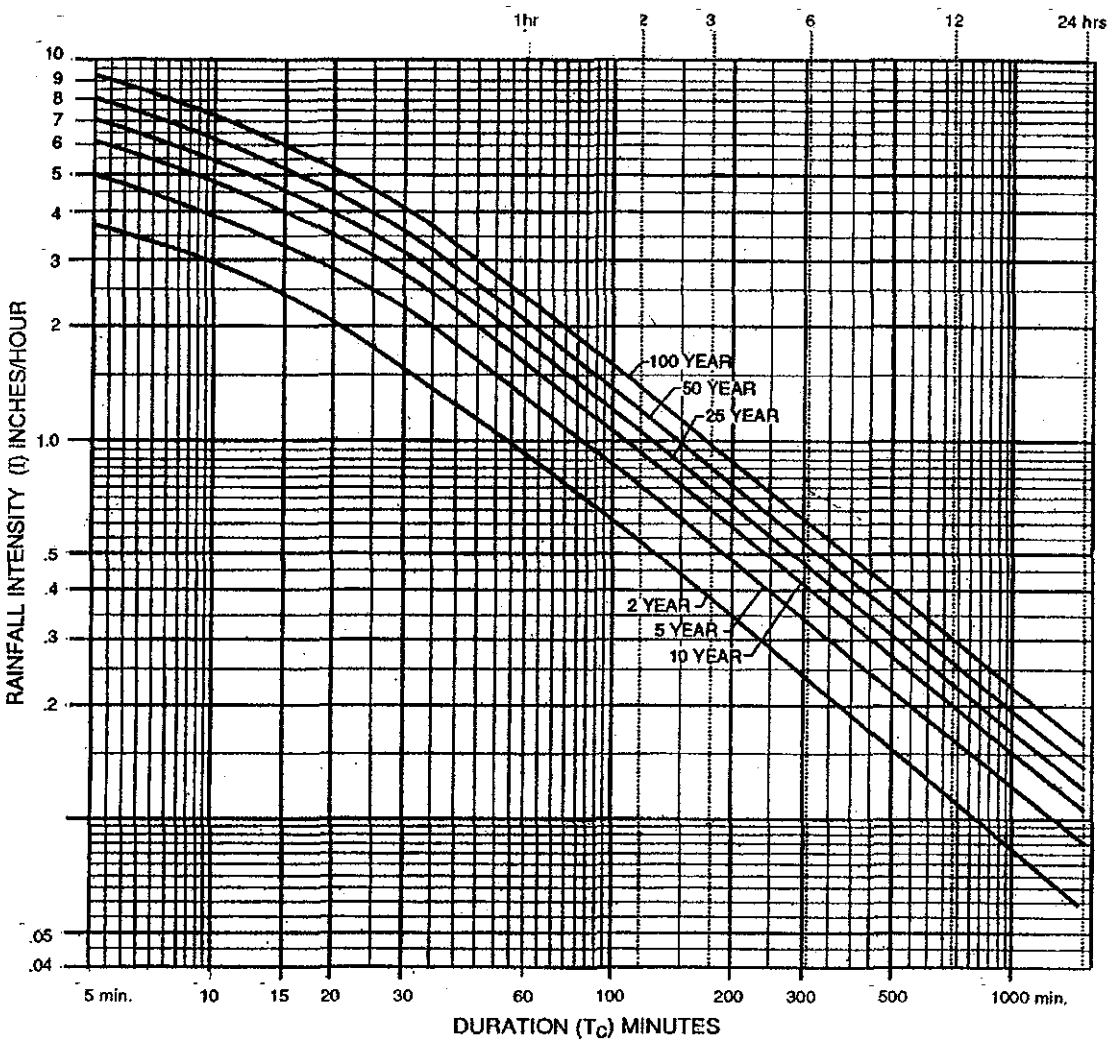
The travel time for both shallow concentrated flow and open channel flow is computed using the following equation.

$T_{Shallow} = L/V60$

Where: T = Travel time, min.
L = Flow length, ft
V = Average velocity, fps
60 = Conversion factor from seconds to minutes

The rainfall intensity, "i" is obtained from Figure 5.1 for the selected storm frequency.

The drainage areas are obtained from delineation of the contributing areas for each point of concentration.



(source: Hydrologic Design Manual for Maricopa County)

Figure 5.1. Rainfall Intensity (I) Values for Use in Rational Equation.

Table 5.2 Runoff Coefficients for Use with Rational Method

RUNOFF COEFFICIENTS – "C" VALUE[1]			
LAND USE	**Hydrologic Soil Group**		
Composite Area-Wide Values	**B**	**C**	**D**
Commercial & Industrial Areas	0.90		
Residential Areas-Single Family (av. lot size)			
R1-1-1901	0.33	0.35	0.58
R1-130	0.35	0.51	0.59
R1-70	0.37	0.52	0.60
R1-43	0.38	0.55	0.61
R1-35 (35,000 sq. ft./lot)	0.40	0.56	0.62
R1-18 (18,000 sq. ft./lot)	0.43	0.58	0.64
R1-10 (10,000 sq. ft./lot)	0.47	0.62	0.67
1-7 (7,000 sq. ft./lot)	0.51	0.64	0.70
Townhouses (R-2, R-4)	0.63	0.74	0.78
Apartments & Condominiums (R-3, R-5)	0.76	0.83	0.87
Specific Surface Type Values			
Paved Streets, parking lots (concrete or asphalt), roofs, & driveways, etc.	0.95		
Lawns, golf courses, & parks (grassed areas)	0.33	0.56	0.66
Undisturbed natural desert or desert landscaping (no impervious weed barrier)	0.31	0.48	0.56
Desert Landscaping (with Impervious weed barrier)	0.83	0.83	0.83
Mountain terrain - slopes greater than 10%	0.70	0.70	0.70
Agricultural areas (flood-irrigated fields)	0.20	0.20	0.20

[1]Table taken from Figure 4-5 of City of Scottsdale Standards & Policies Manual, 2004.

The sizing of the storm drain maximum pipe sizes is usually determined with a computer program. One such program is StormCad, a computer program that analyzes any new and existing storm sewer system for non-uniform flow. StormCad is a registered trademark of Haestad Methods, Inc., 37 Brookside Road, Waterbury, Connecticut, 06708. The storm sewer design would be based on criteria contained in ADOT's Roadway Design Guidelines Manual dated May 1996, Metric Version with English Appendix. The theory behind the StormCad program is included in Appendix O.

These are:

Minimum Pipe Size

Trunk Lines - 24-inches, except 18-inch pipes may be used where conflicts occur with utilities or other highway appurtenances.

Laterals - 18-inches

Pipe Material and Roughness

Pipe material would be selected based on the requirements of ADOT's Pipe Selection Guidelines and Procedures, February 1, 1996. Manning's "n" values used for selected pipe materials are as follows:

Pipe Material	Manning's "n"
Concrete Pipe	0.012
Cast-in-Place Concrete Pipe	0.014
Plastic Pipe, Smooth	0.012

Pipe Size Design

Pipe size selection should be based on full pipe flow with the 10-year storm event

The following criteria were followed in design of the storm drain systems:

- Hydraulic Grade Lines: Six inches below the top of grate/inlet elevation. In case of a segment of depressed roadway use a 50-year frequency storm event. In non-depressed areas a 10-year storm event is selected for design.
- Catch Basins: the City of Phoenix Standard Detail No. P-1569-1, Catch Basin Type M will be used for Indian Bend Wash roadway and the side roads and MAG 550 Spillway Inlet and Outlet structure when an outlet pipe will not work. Either MAG Standard Detail 537, Catch Basin Type 'G' or ADOT C-15.30 catch basin will be used for the off-roadway catch basins. And City of Scottsdale Detail No. 2560, Storm Drain Inlet Marker. All grate inlets shall comply with City of Scottsdale bicycle safe grates, COP Detail No. 2535.

Reduction Factors to Apply to Catch Basins

Condition	Inlet Type	Reduction Factor
Sump	Curb Opening	0.80
Sump	Grated	0.50
Sump	Combination	0.65
Continuous Grade	Curb Opening	0.80
Continuous Grade	Longitudinal Bar Grate Longitudinal Bar Grate with Recessed transverse bars	0.75 0.60
Continuous Grade	Combination[1]	Apply factors separately to grate and curb opening
Shallow Sheet Flow[2]	Slotted Drains	0.80

[1] See Section 3.3.4.3, Combination Catch Basins.

[2] Slotted drains are most effective for shallow sheet flow conditions. With Greater depths and flows, a different type of inlet should be used.

- Manholes:

  MAG Standard Detail No. 520, Storm Drain Manhole Base (48" and Smaller)

  MAG Standard Detail No. 522, Storm Drain Manhole Shaft

  MAG Standard Detail No. 424, 24" and 30" Manhole Frame and Cover

  COP Standard Detail 2520, Storm Drainage Manhole Cover

- Storm Drains: Desirable minimum criteria:
  - Minimum velocity: 2 feet per second flowing full
  - Preferable minimum velocity: 3 feet per second flowing full

6.0 CONCLUSIONS

6.1 OFF-SITE DRAINAGE

The proposed offsite drainage systems meet current design requirements for the 100-year runoff event. The Indian Bend Wash structure has been sized to maintain the original design to pass 30,000 cfs and to pass the FEMA 100-year peak flow of 17,000 cfs without raising the upstream water surface elevations. This has been accomplished with the proposed upstream concrete drop structure and concrete arches under the roadway. Both peak flows will pass under the roadway.

Digital copies of the HEC-2 and HEC-RAS hydraulic models for Seville Channel and Indian Bend Wash Drop Structure have been provided in Appendix E of this report. Digital copies of the HEC-RAS hydraulic models with interpolated cross-sections are contained in Appendix P of this report. The Flood Control District of Maricopa County, during the May and June review process, requested that the model be revised to include interpolated cross-sections in order to better determine the location of the hydraulic jump.

6.2 ON-SITE DRAINAGE

The selected on-site drainage approach for this project is to utilize the existing drainage systems as much as possible. Where the existing systems cannot be used, new drainage systems are provided. While the overall existing drainage characteristics and outfall locations are maintained.

The major on-site drainage improvements associated with the proposed roadway improvements include the installation of roadway curb-opening inlets/grate inlets and outlet pipes along Indian Bend Road. The placement of area drains in the northwest corner of the McCormick-Stillman Railroad Park to intercept local runoff prior to flowing onto Indian Bend Road. The placement of additional catch basins within the Park's expanded parking lot to capture the flow that currently sheet flows into an existing ditch located along the east side of the parking lot.

Based on available survey information and limited as-built information, the hydraulic analysis of the existing 42-inch to 48-inch trunk line from beginning at Hayden Road with its outfall into Indian Bend Wash has adequate capacity to accept the increase in runoff associated with the proposed roadway improvements. However, based on pothole information it has been determined that the 42-inch pipe that is flowing west from the Hayden Road/Indian Bend Road intersection is located along the alignment of a proposed retaining wall at the back of the new sidewalk. Relocation of this shallow storm drain to back of the wall is not possible due to inadequate space between the new wall and the existing privacy wall. Therefore, the existing

catch basin located in the northwest corner of the intersection will be relocated and drained east into an existing 66" storm drain in Hayden Road. An existing 43"x27" CMPA storm drain that crosses Hayden Road at this location will be used as a sleeve to connect an 18-inch pipe from the new catch basin to the existing manhole located in the northeast corner of the Hayden Road/Indian Bend Road intersection. Field surveys indicate that the existing 43"x27" CMPA is connected to the existing manhole.

Supporting on-site hydrologic and hydraulic computations are included in Appendix G.

7.0 REFERENCES

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1.0

Indian Bend Wash

Comparison of Water Surface Elevations

Existing Conditions Versus Proposed 10-36'x9'-6" Concrete Arch

Design Discharge = 30,000 cfs

FEMA 100-Year Discharge = 17,000 cfs

Reach	River Sta & Indian Bend Road Station	Profile	Q Total	W.S. Elevation		Change in W.S.	Comments
				Existing	Proposed		
			(cfs)	(ft)	(ft)	(ft)	
Indian Bend Road	17	COE Design Flow	30000	1288.61	1288.61	0.00	
Indian Bend Road	17	FEMA 100-Yr Flow	17000	1287.25	1287.25	0.00	
Indian Bend Road							
Indian Bend Road	16.75	COE Design Flow	30000	1286.72	1286.74	0.02	
Indian Bend Road	16.75	FEMA 100-Yr Flow	17000	1285.64	1285.64	0.00	
Indian Bend Road							
Indian Bend Road	16.5	COE Design Flow	30000	1285.76	1285.57	-0.19	
Indian Bend Road	16.5	FEMA 100-Yr Flow	17000	1284.73	1284.61	-0.12	
Indian Bend Road							
Indian Bend Road	15 Upstream Face of Concrete Arch	COE Design Flow	30000	1280.58	1280.74	0.16	
Indian Bend Road	15 Upstream Face of Concrete Arch	FEMA 100-Yr Flow	17000	1277.63	1277.55	-0.08	
Indian Bend Road							
Indian Bend Road	14.25		Culvert				
Indian Bend Road							
Indian Bend Road	14/13.5 Levee Toe of Slope @ Entrance to Indian Bend Wash Entrance Channel or D.S. Face of Conc. Arch	COE Design Flow	30000	1279.29	1278.66	-0.63	
Indian Bend Road	14/13.5 Levee Toe of Slope @ Entrance to Indian Bend Wash Entrance Channel or D.S. Face of Conc. Arch	FEMA 100-Yr Flow	17000	1276.98	1276.70	-0.28	
Indian Bend Road							
Indian Bend Road	13	COE Design Flow	30000	1278.16	1278.80	0.64	
Indian Bend Road	13	FEMA 100-Yr Flow	17000	1276.39	1276.72	0.33	
Indian Bend Road							
Indian Bend Road	12	COE Design Flow	30000	1278.20	1278.68	0.48	
Indian Bend Road	12	FEMA 100-Yr Flow	17000	1276.33	1276.61	0.28	
Indian Bend Road							
Indian Bend Road	11	COE Design Flow	30000	1278.26	1278.26	0.00	
Indian Bend Road	11	FEMA 100-Yr Flow	17000	1276.23	1276.23	0.00	
Indian Bend Road							
Indian Bend Road	10	COE Design Flow	30000	1277.98	1277.98	0.00	
Indian Bend Road	10	FEMA 100-Yr Flow	17000	1275.99	1275.99	0.00	

Table 2.0
HEC-RAS Table 1-Hydraulic Parameters (Indian Bend Wash)
Proposed 10-36'x9'-6" Concrete Arch
Design Discharge = 30,000 cfs
FEMA 100-Year Discharge = 17,000 cfs

HEC-RAS Plan: Concrete Arch 10-36'x9'-6" River: Indian Bend Wash Reach: Indian Bend Road

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Indian Bend Rd	17	COE Design Flow	30000	1282.00	1288.61	1285.94	1288.96	0.000792	4.76	6300	1498	0.37
Indian Bend Rd	17	FEMA 100-Yr Flow	17000	1282.00	1287.25	1285.02	1287.46	0.000644	3.62	4700	1447	0.32
Indian Bend Rd	16.75	COE Design Flow	30000	1282.00	1286.74	1286.74	1288.10	0.004214	9.35	3209	1270	1.00
Indian Bend Rd	16.75	FEMA 100-Yr Flow	17000	1282.00	1285.64	1285.64	1286.71	0.004354	8.30	2049	1005	1.00
Indian Bend Rd	16.5	COE Design Flow	30000	1281.60	1285.57	1285.57	1287.06	0.004138	9.80	3061	1425	0.99
Indian Bend Rd	16.5	FEMA 100-Yr Flow	17000	1281.60	1284.61	1284.61	1285.64	0.004705	8.15	2087	1406	1.00
Indian Bend Rd	15 Upstream Face of Conc. Arch	COE Design Flow	30000	1270.94	1280.74	1276.82	1281.81	0.000598	8.32	3605	921	0.47
Indian Bend Rd	15 Upstream Face of Conc. Arch	FEMA 100-Yr Flow	17000	1270.94	1277.55	1274.98	1278.31	0.000715	6.99	2431	888	0.48
Indian Bend Rd	14.25		Culvert									
Indian Bend Rd	13.5 Downstream Face of Conc. Arch	COE Design Flow	30000	1270.44	1278.66	1276.36	1280.19	0.001073	9.91	3026	610	0.61
Indian Bend Rd	13.5 Downstream Face of Conc. Arch	FEMA 100-Yr Flow	17000	1270.44	1276.70	1274.51	1277.55	0.000854	7.38	2305	599	0.52
Indian Bend Rd	13	COE Design Flow	30000	1270.30	1278.80		1279.72	0.001296	7.69	3900	494	0.48
Indian Bend Rd	13	FEMA 100-Yr Flow	17000	1270.30	1276.72		1277.26	0.001079	5.89	2885	481	0.42
Indian Bend Rd	12	COE Design Flow	30000	1270.00	1278.68		1279.53	0.001168	7.39	4058	517	0.47
Indian Bend Rd	12	FEMA 100-Yr Flow	17000	1270.00	1276.61		1277.11	0.000948	5.65	3008	500	0.41
Indian Bend Rd	11	COE Design Flow	30000	1270.00	1278.26		1279.28	0.001203	8.10	3702	549	0.55
Indian Bend Rd	11	FEMA 100-Yr Flow	17000	1270.00	1276.23		1276.90	0.001101	6.54	2601	534	0.52
Indian Bend Rd	10	COE Design Flow	30000	1268.00	1277.98	1274.91	1278.82	0.001154	7.34	4089	549	0.47
Indian Bend Rd	10	FEMA 100-Yr Flow	17000	1268.00	1275.99	1273.38	1276.48	0.000960	5.64	3013	532	0.42

Table 3.0
HEC-RAS Table 2-Hydraulic Parameters (Indian Bend Wash)
Proposed 10-36'x9'-6" Concrete Arch
Design Discharge = 30,000 cfs
FEMA 100-Year Discharge = 17,000 cfs

HEC-RAS Plan: Concrete Arch 10-36'x9'-6" River: Indian Bend Wash Reach: Indian Bend Road

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Indian Bend Rd	17	COE Design Flow	1288.96	1288.61	0.35	0.66	0.20		30000		1498
Indian Bend Rd	17	FEMA 100-Yr Flow	1287.46	1287.25	0.20	0.58	0.17		17000		1447
Indian Bend Rd	16.75	COE Design Flow	1288.10	1286.74	1.36	0.13	0.03		30000		1270
Indian Bend Rd	16.75	FEMA 100-Yr Flow	1286.71	1285.64	1.07	0.14	0.02		17000		1005
Indian Bend Rd	16.5	COE Design Flow	1287.06	1285.57	1.49	0.13	0.17		30000		1425
Indian Bend Rd	16.5	FEMA 100-Yr Flow	1285.64	1284.61	1.03	0.16	0.11		17000		1406
Indian Bend Rd	15 Upstream Face of Conc. Arch	COE Design Flow	1281.81	1280.74	1.08				30000		921
Indian Bend Rd	15 Upstream Face of Conc. Arch	FEMA 100-Yr Flow	1278.31	1277.55	0.76				17000		888
Indian Bend Rd	14.25		Culvert								
Indian Bend Rd	13.5 Downstream Face of Conc. Arch	COE Design Flow	1280.19	1278.66	1.53	0.16	0.30		30000		610
Indian Bend Rd	13.5 Downstream Face of Conc. Arch	FEMA 100-Yr Flow	1277.55	1276.70	0.84	0.13	0.15		17000		599
Indian Bend Rd	13	COE Design Flow	1279.72	1278.80	0.92	0.16	0.03		30000		494
Indian Bend Rd	13	FEMA 100-Yr Flow	1277.26	1276.72	0.54	0.13	0.02		17000		481
Indian Bend Rd	12	COE Design Flow	1279.53	1278.68	0.85	0.21	0.03		30000		517
Indian Bend Rd	12	FEMA 100-Yr Flow	1277.11	1276.61	0.50	0.18	0.03		17000		500
Indian Bend Rd	11	COE Design Flow	1279.28	1278.26	1.02	0.39	0.07		30000		549
Indian Bend Rd	11	FEMA 100-Yr Flow	1276.90	1276.23	0.66	0.34	0.07		17000		534
Indian Bend Rd	10	COE Design Flow	1278.82	1277.98	0.84				30000		549
Indian Bend Rd	10	FEMA 100-Yr Flow	1276.48	1275.99	0.49				17000		532

Table 4.0
HEC-RAS Table 1-Hydraulic Parameters (Indian Bend Wash)
Existing Conditions
Design Discharge = 30,000 cfs
FEMA 100-Year Discharge = 17,000 cfs

HEC-RAS Plan: Exst Plan River: Indian Bend Wash Reach: Indian Bend Road

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Indian Bend Rd	17	COE Design Flow	30000	1282.00	1288.61	1285.92	1288.97	0	5	6309	1497.94	0.36
Indian Bend Rd	17	FEMA 100-Yr Flow	17000	1282.00	1287.25	1285.03	1287.45	0	4	4698	1447.04	0.32
Indian Bend Rd	16.75	COE Design Flow	30000	1282.00	1286.72	1286.72	1288.10	0	9	3185	1267.64	1.01
Indian Bend Rd	16.75	FEMA 100-Yr Flow	17000	1282.00	1285.64	1285.64	1286.71	0	8	2054	1005.12	1
Indian Bend Rd	16.5	COE Design Flow	30000	1281.60	1285.76	1285.76	1287.36	0	10	2955	1435.52	0.99
Indian Bend Rd	16.5	FEMA 100-Yr Flow	17000	1281.60	1284.73	1284.73	1285.83	0	8	2020	1366.27	1
Indian Bend Rd	15	COE Design Flow	30000	1272.00	1280.58	1277.18	1281.40	0	7	4134	790.05	0.45
Indian Bend Rd	15	FEMA 100-Yr Flow	17000	1272.00	1277.63	1275.68	1278.27	0	6	2641	771.39	0.5
Indian Bend Rd	14	COE Design Flow	30000	1271.00	1279.29	1277.28	1281.07	0	11	2801	779.39	0.66
Indian Bend Rd	14	FEMA 100-Yr Flow	17000	1271.00	1276.98	1275.32	1278.08	0	8	2015	763.09	0.61
Indian Bend Rd	13	COE Design Flow	30000	1270.30	1278.16		1280.53	0	12	2427	332.82	0.81
Indian Bend Rd	13	FEMA 100-Yr Flow	17000	1270.30	1276.39		1277.70	0	9	1849	321.16	0.68
Indian Bend Rd	12	COE Design Flow	30000	1270.00	1278.20		1279.78	0	10	2975	405.19	0.66
Indian Bend Rd	12	FEMA 100-Yr Flow	17000	1270.00	1276.33		1277.23	0	8	2230	388.66	0.56
Indian Bend Rd	11	COE Design Flow	30000	1270.00	1278.26		1279.28	0	8	3702	549.15	0.55
Indian Bend Rd	11	FEMA 100-Yr Flow	17000	1270.00	1276.23		1276.90	0	7	2601	534.12	0.52
Indian Bend Rd	10	COE Design Flow	30000	1268.00	1277.98	1274.91	1278.82	0	7	4089	549.03	0.47
Indian Bend Rd	10	FEMA 100-Yr Flow	17000	1268.00	1275.99	1273.37	1276.48	0	6	3013	532.32	0.42

Table 5.0
HEC-RAS Table 2-Hydraulic Parameters (Indian Bend Wash)
Existing Conditions
Design Discharge = 30,000 cfs
FEMA 100-Year Discharge = 17,000 cfs

HEC-RAS Plan: Exst Plan River: Indian Bend Wash Reach: Indian Bend Road

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Indian Bend Rd	17	COE Design Flow	1288.97	1288.61	0.35	0.66	0.21		30000		1498
Indian Bend Rd	17	FEMA 100-Yr Flow	1287.45	1287.25	0.20	0.58	0.17		17000		1447
Indian Bend Rd	16.75	COE Design Flow	1288.10	1286.72	1.38	0.12	0.04		30000		1268
Indian Bend Rd	16.75	FEMA 100-Yr Flow	1286.71	1285.64	1.06	0.13	0.01		17000		1005
Indian Bend Rd	16.5	COE Design Flow	1287.36	1285.76	1.60	0.13	0.31		30000		1436
Indian Bend Rd	16.5	FEMA 100-Yr Flow	1285.83	1284.73	1.10	0.17	0.18		17000		1366
Indian Bend Rd	15	COE Design Flow	1281.40	1280.58	0.82	0.04	0.29		30000		790
Indian Bend Rd	15	FEMA 100-Yr Flow	1278.27	1277.63	0.64	0.05	0.14		17000		771
Indian Bend Rd	14	COE Design Flow	1281.07	1279.29	1.78	0.37	0.18		30000		779
Indian Bend Rd	14	FEMA 100-Yr Flow	1278.08	1276.98	1.10	0.32	0.06		17000		763
Indian Bend Rd	13	COE Design Flow	1280.53	1278.16	2.37	0.35	0.40		30000		333
Indian Bend Rd	13	FEMA 100-Yr Flow	1277.70	1276.39	1.31	0.27	0.20		17000		321
Indian Bend Rd	12	COE Design Flow	1279.78	1278.20	1.58	0.27	0.22		30000		405
Indian Bend Rd	12	FEMA 100-Yr Flow	1277.23	1276.33	0.90	0.24	0.10		17000		389
Indian Bend Rd	11	COE Design Flow	1279.28	1278.26	1.02	0.39	0.07		30000		549
Indian Bend Rd	11	FEMA 100-Yr Flow	1276.90	1276.23	0.66	0.34	0.07		17000		534
Indian Bend Rd	10	COE Design Flow	1278.82	1277.98	0.84				30000		549
Indian Bend Rd	10	FEMA 100-Yr Flow	1276.48	1275.99	0.49				17000		532

Table 6.0

Water Surface Elevation Comparisons (Indian Bend Wash Existing Conditions)
FEMA FIS Versus COS Indian Bend Road Project HEC-RAS
FEMA 100-Year Discharge = 17,000 cfs

COS Indian Bend Road Project	Corps of' Engineers'	FEMA FIS	Distance Upstream of Confluence	Indian Bend Wash Floodplain Delineation Study, Salt River to 40th Street Salt River to 40th Street FCD 93-05, November 1997 HEC-2 Sep 2000 From FEMA, June 2004		Study Maps Nov 1997	Flood Insurance Study Maricopa County, AZ Revised Sep 30, 2005 Table 5 Floodway Data			COS Indian Bend Road Project Apr-07 HEC-RAS for Indian Bend Rd Project	
				1988 NAVD	1929 NGVD (NAVD-1.8')	1988 NAVD	FIRM	1929 NGVD	1988 NAVD (NGVD+1.8')	FIRM	1988 NAVD
Station	Station	River Mile		100-Year WS Elev	100-Year WS Elev	100-Year WS Elev	Letter Designation	100-Year WS Elev	100-Year WS Elev	Letter Designation	100-Year WS Elev
(ft)	(ft)	(miles)	(ft)	(ft)	(ft)	(ft)	(letter)	(ft)	(ft)	(letter)	(ft)
	393+67.60	7.390	38864	1272.08	1270.28	1272.1	Y	1270.6	1272.4	Y	
	398+67.60	7.481	39364	1273.16	1271.36	1273.2					
	403+67.60	7.576	39864	1273.86	1272.06	1273.9					
	408+67.60	7.670	40364	1274.75	1272.95	1274.8					
	412+50.00	7.743	40746								
	412+63.00	7.745	40759								
	413+67.60	7.765	40864	1275.5	1273.7	1275.5	Z	1273.8	1275.6	Z	
	416+25.00	7.814	41108								
10	416+55.60	7.820	41152	1275.99 (1)							1275.99
	417+45.00	7.836	41241								

Table 6.0

Water Surface Elevation Comparisons (Indian Bend Wash Existing Conditions)
FEMA FIS Versus COS Indian Bend Road Project HEC-RAS
FEMA 100-Year Discharge = 17,000 cfs

COS Indian Bend Road Project	Corps of' Engineers'	FEMA FIS	Distance Upstream of Confluence	Indian Bend Wash Floodplain Delineation Study, Salt River to 40th Street Salt River to 40th Street FCD 93-05, November 1997			Flood Insurance Study Maricopa County, AZ Revised Sep 30, 2005			COS Indian Bend Road Project Apr-07	
				HEC-2 Sep 2000 From FEMA, June 2004		Study Maps Nov 1997	Table 5 Floodway Data			HEC-RAS for Indian Bend Rd Project	
				1988 NAVD	1929 NGVD (NAVD-1.8')	1988 NAVD	FIRM	1929 NGVD	1988 NAVD (NGVD+1.8')	FIRM	1988 NAVD
Station	Station	River Mile		100-Year WS Elev	100-Year WS Elev	100-Year WS Elev	Letter Designation	100-Year WS Elev	100-Year WS Elev	Letter Designation	100-Year WS Elev
(ft)	(ft)	(miles)	(ft)	(ft)	(ft)	(ft)	(letter)	(ft)	(ft)	(letter)	(ft)
	417+50.00	7.837	41246	1276.14	1274.34	1276.1					
	418+45.00	7.855	41341								
11	419+90.87	7.883	41487	1276.7	1274.9	1276.7					1276.23
12	421+65.87	7.916	41662								1276.33
	422+30.00	7.928	41726								
	422+50.00	7.932	41746								
13	422+95.87	7.941	41792								1276.39
	423+87.87	7.955	41884	1276.45	1274.65	1276.5					
	424+00.00	7.960	41896								
14	424+64.42	7.973	41961								1276.98

Table 6.0

Water Surface Elevation Comparisons (Indian Bend Wash Existing Conditions)
FEMA FIS Versus COS Indian Bend Road Project HEC-RAS
FEMA 100-Year Discharge = 17,000 cfs

COS Indian Bend Road Project	Corps of' Engineers'	FEMA FIS	Distance Upstream of Confluence	Indian Bend Wash Floodplain Delineation Study, Salt River to 40th Street Salt River to 40th Street FCD 93-05, November 1997 HEC-2 Sep 2000 From FEMA, June 2004		Study Maps Nov 1997	Flood Insurance Study Maricopa County, AZ Revised Sep 30, 2005 Table 5 Floodway Data			COS Indian Bend Road Project Apr-07 HEC-RAS for Indian Bend Rd Project	
				1988 NAVD	1929 NGVD (NAVD-1.8')	1988 NAVD	FIRM	1929 NGVD	1988 NAVD (NGVD+1.8')	FIRM	1988 NAVD
Station	Station	River Mile		100-Year WS Elev	100-Year WS Elev	100-Year WS Elev	Letter Designation	100-Year WS Elev	100-Year WS Elev	Letter Designation	100-Year WS Elev
(ft)	(ft)	(miles)	(ft)	(ft)	(ft)	(ft)	(letter)	(ft)	(ft)	(letter)	(ft)
	425+07.42	7.979	42004	1277.88	1276.08	1277.9					
15	425+45.73	7.988	42054	1284.07	1282.27	1284.1					1277.63
	425+75.73	7.992	42084	1284.35	1282.55	1284.4					
	426+34.00	8.005	42142								
16.5	426+63.44	8.010	42172								1284.73
16.75	427+01.47	8.018	42210								1285.64
17	431+64.42	8.105	42672								1287.25
	431+58.42	8.144	42666	1286.12	1284.32	1286.1					
	436+58.42	8.239	43166	1287.16	1285.36	1287.2	AA	1285.4	1287.2	AA	

Notes: (1) 100-Year known water surface elevation for Section 10, Indian Bend Road HEC-RAS model. Pro-ratio of water surface elevations at River Miles 7.765 and 7.837.

Table 7.0
Water Surface Elevation Comparisons (Indian Bend Wash Existing Conditions)
FEMA FIS Versus COS Indian Bend Road Project HEC-RAS
COE Design Discharge = 30,000 cfs

COS Indian Bend Road Project	Corps of' Engineers'	FEMA FIS	Distance Upstream of Confluence	Design Memorandum No. 3 Corps of Engineers'		Final Hydraulic Analysis Scottsdale Links at Indian Bend Inlet Golf Course Design	Indian Bend Wash Floodplain Delineation Study, Salt River to 40th Street Salt River to 40th Street		COS Indian Bend Road Project	
				January 1978		October 1998	FCD 93-05, November 1997		October 2006	
				Plate 7, Hydraulic Elements Table		HEC-2 Summary Table	HEC-RAS Converted from FEMA HEC-2 Sep 2000		HEC-RAS for Indian Bend Road Project	
				1929 NGVD	1988 NAVD (NGVD+1.8	1988 NAVD	1988 NAVD	1929 NGVD (NAVD-1.8')	FIRM	1988 NAVD
Station (ft)	Station (ft)	River Mile (miles)	(ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	Letter Designation (letter)	30,000 cfs WS Elev (ft)
	393+67.60	7.390	38864				1274.06	1272.26	Y	
	398+67.60	7.481	39364				1274.98	1273.18		
	403+67.60	7.576	39864				1275.69	1273.89		
	408+67.60	7.670	40364				1276.71	1274.91		
	412+50.00	7.743	40746	1277.8	1279.6					
	412+63.00	7.745	40759			1279.53				
	413+67.60	7.765	40864				1277.42	1275.62	Z	
	416+25.00	7.814	41108			1279.88				
10	416+55.60	7.820	41152				1277.98 (1)			1277.98
	417+45.00	7.836	41241			1280.36				

Table 7.0
Water Surface Elevation Comparisons (Indian Bend Wash Existing Conditions)
FEMA FIS Versus COS Indian Bend Road Project HEC-RAS
COE Design Discharge = 30,000 cfs

COS Indian Bend Road Project	Corps of' Engineers'	FEMA FIS	Distance Upstream of Confluence	Design Memorandum No. 3 Corps of Engineers'		Final Hydraulic Analysis Scottsdale Links at Indian Bend Inlet Golf Course Design	Indian Bend Wash Floodplain Delineation Study, Salt River to 40th Street Salt River to 40th Street		COS Indian Bend Road Project	
				January 1978		October 1998	FCD 93-05, November 1997		October 2006	
				Plate 7, Hydraulic Elements Table		HEC-2 Summary Table	HEC-RAS Converted from FEMA HEC-2 Sep 2000		HEC-RAS for Indian Bend Road Project	
				1929 NGVD	1988 NAVD (NGVD+1.8	1988 NAVD	1988 NAVD	1929 NGVD (NAVD-1.8')	FIRM	1988 NAVD
Station (ft)	Station (ft)	River Mile (miles)	(ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	Letter Designation (letter)	30,000 cfs WS Elev (ft)
	417+50.00	7.837	41246	1278.7	1280.5		1278.15	1276.35		
	418+45.00	7.855	41341			1280.73				
11	419+90.87	7.883	41487				1278.9	1277.1		1278.26
12	421+65.87	7.916	41662							1278.2
	422+30.00	7.928	41726			1281.06				
	422+50.00	7.932	41746	1279.4	1281.2					
13	422+95.87	7.941	41792							1278.16
	423+87.87	7.955	41884				1278.48	1276.68		
	424+00.00	7.960	41896	1279.6	1281.4					
14	424+64.42	7.973	41961							1279.29

Table 7.0
Water Surface Elevation Comparisons (Indian Bend Wash Existing Conditions)
FEMA FIS Versus COS Indian Bend Road Project HEC-RAS
COE Design Discharge = 30,000 cfs

COS Indian Bend Road Project	Corps of' Engineers'	FEMA FIS	Distance Upstream of Confluence	Design Memorandum No. 3 Corps of Engineers'		Final Hydraulic Analysis Scottsdale Links at Indian Bend Inlet Golf Course Design	Indian Bend Wash Floodplain Delineation Study, Salt River to 40th Street Salt River to 40th Street		COS Indian Bend Road Project	
				January 1978		October 1998	FCD 93-05, November 1997		October 2006	
				Plate 7, Hydraulic Elements Table		HEC-2 Summary Table	HEC-RAS Converted from FEMA HEC-2 Sep 2000		HEC-RAS for Indian Bend Road Project	
				1929 NGVD	1988 NAVD (NGVD+1.8	1988 NAVD	1988 NAVD	1929 NGVD (NAVD-1.8')	FIRM	1988 NAVD
Station (ft)	Station (ft)	River Mile (miles)	(ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	30,000 cfs WS Elev (ft)	Letter Designation (letter)	30,000 cfs WS Elev (ft)
	425+07.42	7.979	42004				1280.78	1278.98		
15	425+45.73	7.988	42054				1284.91	1283.11		1280.58
	425+75.73	7.992	42084				1285.17	1283.37		
	426+34.00	8.005	42142	1284.6	1286.4					
16.5	426+63.44	8.010	42172							1285.76
16.75	427+01.47	8.018	42210							1286.72
17	431+64.42	8.105	42672							1288.61
	431+58.42	8.144	42666				1287.18	1285.38		
	436+58.42	8.239	43166				1288.16	1286.36	AA	

Notes: (1) Design Discharge known water surface elevation for Section 10, Indian Bend Road HEC-RAS model. Pro-ratio of water surface elevations at River Miles 7.765 and 7.837.

Table 8.0

Water Surface Elevation Comparisons (Indian Bend Wash Existing Conditions)
FEMA HEC-2 Model Versus HEC-RAS Model converted from FEMA Model
FEMA Q100 =17,000 cfs

River Milepost	Cross-Section Description	Channel Distance to Downstream Section	WSE HEC-2	WSE HEC-RAS	WSE Δh(1)	EGL HEC-2	EGL HEC-RAS	EGL Δh(1)
(miles)		(ft)	(msl)	(msl)	(ft)	(msl)	(msl)	(ft)
8.239		500	1287.16	1286.79	-0.37	1288.55	1286.94	-1.61
8.239			1287.22	1287.26	0.04	1288.63	1288.63	0.00
8.144		582	1286.12	1286.13	0.01	1286.44	1286.45	0.01
8.144			1286.49	1286.48	-0.01	1286.81	1286.8	-0.01
7.992		30	1284.35	1284.34	-0.01	1285.23	1285.23	0.00
7.992			1285.31	1285.29	-0.02	1286.03	1286.02	-0.01
7.988	Indian Bend Road, Upstream Edge of Drop Structure	50	1284.07	1284.07	0.00	1284.96	1284.96	0.00
7.988			1284.58	1284.58	0.00	1285.79	1285.79	0.00
7.979	Indian Bend Road, Base of Drop Structure	120	1277.88	1277.88	0.00	1278.03	1278.03	0.00
7.979			1278.51	1278.49	-0.02	1278.84	1278.83	-0.01
7.955		400	1276.45	1276.44	-0.01	1277.66	1277.66	0.00
7.955			1276.52	1276.21	-0.31	1278.32	1278.23	-0.09
7.883		240	1276.70	1276.70	0.00	1276.99	1276.99	0.00
7.883			1276.88	1276.80	-0.08	1277.24	1277.16	-0.08
7.837		380	1276.14	1276.14	0.00	1276.80	1276.8	0.00
7.837			1276.35	1276.32	-0.03	1277.01	1276.99	-0.02
7.765		500	1275.50	1275.50	0.00	1276.19	1276.19	0.00
7.765			1275.80	1275.78	-0.02	1276.46	1276.45	-0.01
7.67		500	1274.75	1274.75	0.00	1275.37	1275.37	0.00
7.67			1274.75	1274.70	-0.05	1275.61	1275.58	-0.03
7.576		500	1273.86	1273.85	-0.01	1274.56	1274.56	0.00
7.576			1273.95	1273.90	-0.05	1274.64	1274.6	-0.04
7.481		500	1273.16	1273.15	-0.01	1273.77	1273.76	-0.01
7.481			1273.25	1273.22	-0.03	1273.85	1273.83	-0.02
7.39		500	1272.08	1272.00	-0.08	1272.84	1272.8	-0.04
7.39			1272.18	1272.07	-0.11	1272.97	1272.9	-0.07

Notes: (1) Δh is the change in water surface elevation (WSE) in relation to existing conditions.

Conclusion: **Similar hydraulic results are produced by the HEC-RAS Model (converted from the FEMA HEC-2 Model) and the original FEMA HEC-2 Model. Hence, the HEC-RAS Model will be used to model the COE Design Discharge of 30,000 cfs and to determine the starting downstream water surface elevation for the COS design HEC-RAS Model.**

Table 9.0

HEC-RAS Table 1-Hydraulic Parameters (Indian Bend Wash Existing Conditions)
FEMA HEC-2 Model converted to HEC-RAS Model
FEMA 100-Year Discharge = 17,000 cfs
COE Design Discharge = 30,000 cfs

HEC-RAS Plan: Exst Plan River: Indian Bend Wash Reach: Indian Bend Road

Reach	River Mile	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(Miles)		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Indian Bend Rd	7.39	FEMA 100-Yr Flow-w/o Fldwy	17000	1264	1272.00		1272.80	0.0026	7.16	2374	629	0.65
Indian Bend Rd	7.39	FEMA 100-Yr Flow-w/ Fldwy	17000	1264	1272.07		1272.90	0.0024	7.29	2332	583	0.64
Indian Bend Rd	7.39	COE Design Flow	30000	1264	1274.06		1275.09	0.0020	8.14	3687	646	0.60
Indian Bend Rd	7.481	FEMA 100-Yr Flow-w/o Fldwy	17000	1265	1273.15		1273.76	0.0014	6.25	2722	583	0.51
Indian Bend Rd	7.481	FEMA 100-Yr Flow-w/ Fldwy	17000	1265	1273.22		1273.83	0.0013	6.24	2725	558	0.50
Indian Bend Rd	7.481	COE Design Flow	30000	1265	1274.98		1275.94	0.0015	7.89	3800	599	0.55
Indian Bend Rd	7.576	FEMA 100-Yr Flow-w/o Fldwy	17000	1267	1273.85		1274.56	0.0017	6.73	2525	547	0.55
Indian Bend Rd	7.576	FEMA 100-Yr Flow-w/ Fldwy	17000	1267	1273.90		1274.60	0.0016	6.73	2524	527	0.54
Indian Bend Rd	7.576	COE Design Flow	30000	1267	1275.69		1276.80	0.0018	8.46	3544	562	0.59
Indian Bend Rd	7.67	FEMA 100-Yr Flow-w/o Fldwy	17000	1268	1274.75		1275.37	0.0015	6.30	2700	599	0.52
Indian Bend Rd	7.67	FEMA 100-Yr Flow-w/ Fldwy	17000	1268	1274.70		1275.58	0.0020	7.53	2258		0.61
Indian Bend Rd	7.67	COE Design Flow	30000	1268	1276.71		1277.64	0.0015	7.73	3880	606	0.54
Indian Bend Rd	7.765	FEMA 100-Yr Flow-w/o Fldwy	17000	1270	1275.50		1276.19	0.0017	6.65	2557	522	0.53
Indian Bend Rd	7.765	FEMA 100-Yr Flow-w/ Fldwy	17000	1270	1275.78		1276.45	0.0014	6.57	2588	486	0.50
Indian Bend Rd	7.765	COE Design Flow	30000	1270	1277.42		1278.52	0.0018	8.39	3574	540	0.58
Indian Bend Rd	7.837	FEMA 100-Yr Flow-w/o Fldwy	17000	1271	1276.14		1276.80	0.0015	6.51	2611	534	0.52
Indian Bend Rd	7.837	FEMA 100-Yr Flow-w/ Fldwy	17000	1271	1276.32		1276.99	0.0014	6.55	2597	494	0.50
Indian Bend Rd	7.837	COE Design Flow	30000	1271	1278.15		1279.17	0.0016	8.11	3698	550	0.55
Indian Bend Rd	7.883	FEMA 100-Yr Flow-w/o Fldwy	17000	1266	1276.70		1276.99	0.0002	4.27	3985	540	0.28
Indian Bend Rd	7.883	FEMA 100-Yr Flow-w/ Fldwy	17000	1266	1276.80		1277.16	0.0002	4.84	3515	403	0.29
Indian Bend Rd	7.883	COE Design Flow	30000	1266	1278.90		1279.42	0.0003	5.78	5187	554	0.33

Table 9.0

HEC-RAS Table 1-Hydraulic Parameters (Indian Bend Wash Existing Conditions)
FEMA HEC-2 Model converted to HEC-RAS Model
FEMA 100-Year Discharge = 17,000 cfs
COE Design Discharge = 30,000 cfs

HEC-RAS Plan: Exst Plan River: Indian Bend Wash Reach: Indian Bend Road

Reach	River Mile	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(Miles)		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Indian Bend Rd	7.955	FEMA 100-Yr Flow-w/o Fldwy	17000	1271	1276.44		1277.66	0.0027	8.87	1917	368	0.68
Indian Bend Rd	7.955	FEMA 100-Yr Flow-w/ Fldwy	17000	1271	1276.21	1275.79	1278.23	0.0043	11.41	1490	286	0.88
Indian Bend Rd	7.955	COE Design Flow	30000	1271	1278.48		1280.43	0.0029	11.20	2678	380	0.74
Indian Bend Rd	7.979	FEMA 100-Yr Flow-w/o Fldwy	17000	1271	1277.88		1278.03	0.0002	3.12	5447	891	0.22
Indian Bend Rd	7.979	FEMA 100-Yr Flow-w/ Fldwy	17000	1271	1278.49		1278.83	0.0003	4.62	3678	497	0.30
Indian Bend Rd	7.979	COE Design Flow	30000	1271	1280.78		1280.99	0.0001	3.72	8055	912	0.22
Indian Bend Rd	7.988	FEMA 100-Yr Flow-w/o Fldwy	17000	1282	1284.07	1284.07	1284.96	0.0049	7.56	2249	1280	1.01
Indian Bend Rd	7.988	FEMA 100-Yr Flow-w/ Fldwy	17000	1282	1284.58	1284.58	1285.79	0.0044	8.83	1926	804	1.01
Indian Bend Rd	7.988	COE Design Flow	30000	1282	1284.91	1284.91	1286.15	0.0044	8.93	3359	1372	1.01
Indian Bend Rd	7.992	FEMA 100-Yr Flow-w/o Fldwy	17000	1282	1284.34	1284.34	1285.23	0.0049	7.57	2245	1281	1.01
Indian Bend Rd	7.992	FEMA 100-Yr Flow-w/ Fldwy	17000	1282	1285.29	1284.75	1286.02	0.0022	6.86	2480	899	0.73
Indian Bend Rd	7.992	COE Design Flow	30000	1282	1285.17	1285.17	1286.43	0.0044	9.02	3326	1334	1.01
Indian Bend Rd	8.144	FEMA 100-Yr Flow-w/o Fldwy	16000	1282	1286.13		1286.45	0.0010	4.56	3509	1253	0.48
Indian Bend Rd	8.144	FEMA 100-Yr Flow-w/ Fldwy	16000	1282	1286.48		1286.80	0.0007	4.54	3527	1031	0.43
Indian Bend Rd	8.144	COE Design Flow	30000	1282	1287.18		1287.77	0.0012	6.18	4854	1303	0.56
Indian Bend Rd	8.239	FEMA 100-Yr Flow-w/o Fldwy	16000	1282	1286.79		1286.94	0.0009	3.09	5182	1833	0.32
Indian Bend Rd	8.239	FEMA 100-Yr Flow-w/ Fldwy	16000	1282	1287.26	1287.26	1288.63	0.0042	9.39	1704	625	1.00
Indian Bend Rd	8.239	COE Design Flow	30000	1282	1288.16		1288.38	0.0010	3.77	7962	2096	0.34

Table 10.0

HEC-RAS Table 2-Hydraulic Parameters (Indian Bend Wash Existing Condtions)
FEMA HEC-2 Model converted to HEC-RAS Model
FEMA 100-Year Discharge = 17,000 cfs
COE Design Discharge = 30,000 cfs

HEC-RAS Plan: Exst Plan River: Indian Bend Wash Reach: Indian Bend Road

Reach	River Mile	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
	(mile)		(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Indian Bend Rd	7.39	FEMA 100-Yr Flow-w/o Fldwy	1272.80	1272.00	0.80	0.89	0.11		17000		629
Indian Bend Rd	7.39	FEMA 100-Yr Flow-w/ Fldwy	1272.90	1272.07	0.83	0.80	0.13		17000		583
Indian Bend Rd	7.39	COE Design Flow	1275.09	1274.06	1.03	0.70	0.13		30000		646
Indian Bend Rd	7.481	FEMA 100-Yr Flow-w/o Fldwy	1273.76	1273.15	0.61	0.92	0.04		17000		583
Indian Bend Rd	7.481	FEMA 100-Yr Flow-w/ Fldwy	1273.83	1273.22	0.60	0.88	0.04		17000		558
Indian Bend Rd	7.481	COE Design Flow	1275.94	1274.98	0.97	0.84	0.01		30000		599
Indian Bend Rd	7.576	FEMA 100-Yr Flow-w/o Fldwy	1274.56	1273.85	0.70	0.76	0.04		17000		547
Indian Bend Rd	7.576	FEMA 100-Yr Flow-w/ Fldwy	1274.60	1273.90	0.70	0.74	0.04		17000		527
Indian Bend Rd	7.576	COE Design Flow	1276.80	1275.69	1.11	0.80	0.06		30000		562
Indian Bend Rd	7.67	FEMA 100-Yr Flow-w/o Fldwy	1275.37	1274.75	0.62	0.79	0.02		17000		599
Indian Bend Rd	7.67	FEMA 100-Yr Flow-w/ Fldwy	1275.58	1274.70	0.88	0.90	0.07		17000		470
Indian Bend Rd	7.67	COE Design Flow	1277.64	1276.71	0.93	0.80	0.04		30000		606
Indian Bend Rd	7.765	FEMA 100-Yr Flow-w/o Fldwy	1276.19	1275.50	0.69	0.79	0.03		17000		522
Indian Bend Rd	7.765	FEMA 100-Yr Flow-w/ Fldwy	1276.45	1275.78	0.67	0.83	0.04		17000		486
Indian Bend Rd	7.765	COE Design Flow	1278.52	1277.42	1.09	0.81	0.07		30000		540
Indian Bend Rd	7.837	FEMA 100-Yr Flow-w/o Fldwy	1276.80	1276.14	0.66	0.61	0.01		17000		534
Indian Bend Rd	7.837	FEMA 100-Yr Flow-w/ Fldwy	1276.99	1276.32	0.67	0.54	0.00		17000		494
Indian Bend Rd	7.837	COE Design Flow	1279.17	1278.15	1.02	0.64	0.01		30000		550
Indian Bend Rd	7.883	FEMA 100-Yr Flow-w/o Fldwy	1276.99	1276.70	0.28	0.11	0.08		17000		540
Indian Bend Rd	7.883	FEMA 100-Yr Flow-w/ Fldwy	1277.16	1276.80	0.36	0.11	0.06		17000		403
Indian Bend Rd	7.883	COE Design Flow	1279.42	1278.90	0.52	0.15	0.10		30000		554

Table 10.0

HEC-RAS Table 2-Hydraulic Parameters (Indian Bend Wash Existing Condtions)
FEMA HEC-2 Model converted to HEC-RAS Model
FEMA 100-Year Discharge = 17,000 cfs
COE Design Discharge = 30,000 cfs

HEC-RAS Plan: Exst Plan River: Indian Bend Wash Reach: Indian Bend Road											
Reach	River Mile	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
	(mile)		(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Indian Bend Rd	7.955	FEMA 100-Yr Flow-w/o Fldwy	1277.66	1276.44	1.22	0.21	0.47		17000		368
Indian Bend Rd	7.955	FEMA 100-Yr Flow-w/ Fldwy	1278.23	1276.21	2.02	0.24	0.83		17000		286
Indian Bend Rd	7.955	COE Design Flow	1280.43	1278.48	1.95	0.29	0.71		30000		380
Indian Bend Rd	7.979	FEMA 100-Yr Flow-w/o Fldwy	1278.03	1277.88	0.15	0.05	0.32		17000		891
Indian Bend Rd	7.979	FEMA 100-Yr Flow-w/ Fldwy	1278.83	1278.49	0.33	0.08	0.51		17000		497
Indian Bend Rd	7.979	COE Design Flow	1280.99	1280.78	0.22	0.04	0.52		30000		912
Indian Bend Rd	7.988	FEMA 100-Yr Flow-w/o Fldwy	1284.96	1284.07	0.89	0.02	0.37		17000		1280
Indian Bend Rd	7.988	FEMA 100-Yr Flow-w/ Fldwy	1285.79	1284.58	1.21	0.04	0.44		17000		804
Indian Bend Rd	7.988	COE Design Flow	1286.15	1284.91	1.24	0.02	0.51		30000		1372
Indian Bend Rd	7.992	FEMA 100-Yr Flow-w/o Fldwy	1285.23	1284.34	0.89	0.15	0.00		17000		1281
Indian Bend Rd	7.992	FEMA 100-Yr Flow-w/ Fldwy	1286.02	1285.29	0.73	0.09	0.14		17000		899
Indian Bend Rd	7.992	COE Design Flow	1286.43	1285.17	1.26	0.13	0.01		30000		1334
Indian Bend Rd	8.144	FEMA 100-Yr Flow-w/o Fldwy	1286.45	1286.13	0.32	1.10	0.11		16000		1253
Indian Bend Rd	8.144	FEMA 100-Yr Flow-w/ Fldwy	1286.80	1286.48	0.32	0.70	0.08		16000		1031
Indian Bend Rd	8.144	COE Design Flow	1287.77	1287.18	0.59	1.20	0.13		30000		1303
Indian Bend Rd	8.239	FEMA 100-Yr Flow-w/o Fldwy	1286.94	1286.79	0.15	0.45	0.03		16000		1833
Indian Bend Rd	8.239	FEMA 100-Yr Flow-w/ Fldwy	1288.63	1287.26	1.37	0.73	0.42		16000		625
Indian Bend Rd	8.239	COE Design Flow	1288.38	1288.16	0.22	0.54	0.07		30000		2096

1.0

Indian Bend Wash

Comparison of Water Surface Elevations

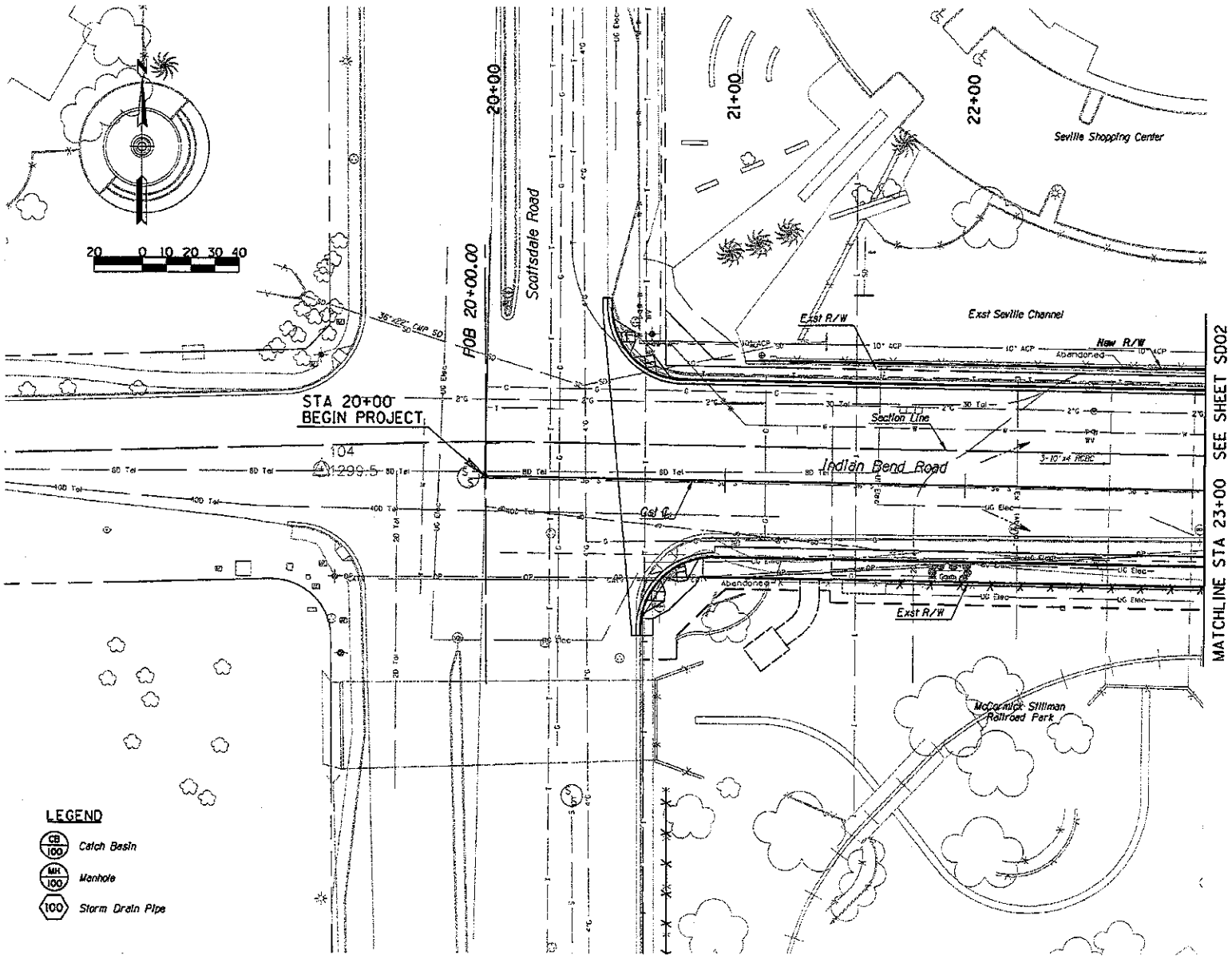
Existing Conditions Versus Proposed 10-36'x9'-6" Concrete Arch

Design Discharge = 30,000 cfs

FEMA 100-Year Discharge = 17,000 cfs

Reach	River Sta & Indian Bend Road Station	Profile	Q Total	W.S. Elevation		Change in W.S.	Comments
				Existing	Proposed		
			(cfs)	(ft)	(ft)	(ft)	
Indian Bend Road	17	COE Design Flow	30000	1288.61	1288.61	0.00	
Indian Bend Road	17	FEMA 100-Yr Flow	17000	1287.25	1287.25	0.00	
Indian Bend Road							
Indian Bend Road	16.75	COE Design Flow	30000	1286.72	1286.74	0.02	
Indian Bend Road	16.75	FEMA 100-Yr Flow	17000	1285.64	1285.64	0.00	
Indian Bend Road							
Indian Bend Road	16.5	COE Design Flow	30000	1285.76	1285.57	-0.19	
Indian Bend Road	16.5	FEMA 100-Yr Flow	17000	1284.73	1284.61	-0.12	
Indian Bend Road							
Indian Bend Road	15 Upstream Face of Concrete Arch	COE Design Flow	30000	1280.58	1280.74	0.16	
Indian Bend Road	15 Upstream Face of Concrete Arch	FEMA 100-Yr Flow	17000	1277.63	1277.55	-0.08	
Indian Bend Road							
Indian Bend Road	14.25		Culvert				
Indian Bend Road							
Indian Bend Road	14/13.5 Levee Toe of Slope @ Entrance to Indian Bend Wash Entrance Channel or D.S. Face of Conc. Arch	COE Design Flow	30000	1279.29	1278.66	-0.63	
Indian Bend Road	14/13.5 Levee Toe of Slope @ Entrance to Indian Bend Wash Entrance Channel or D.S. Face of Conc. Arch	FEMA 100-Yr Flow	17000	1276.98	1276.70	-0.28	
Indian Bend Road							
Indian Bend Road	13	COE Design Flow	30000	1278.16	1278.80	0.64	
Indian Bend Road	13	FEMA 100-Yr Flow	17000	1276.39	1276.72	0.33	
Indian Bend Road							
Indian Bend Road	12	COE Design Flow	30000	1278.20	1278.68	0.48	
Indian Bend Road	12	FEMA 100-Yr Flow	17000	1276.33	1276.61	0.28	
Indian Bend Road							
Indian Bend Road	11	COE Design Flow	30000	1278.26	1278.26	0.00	
Indian Bend Road	11	FEMA 100-Yr Flow	17000	1276.23	1276.23	0.00	
Indian Bend Road							
Indian Bend Road	10	COE Design Flow	30000	1277.98	1277.98	0.00	
Indian Bend Road	10	FEMA 100-Yr Flow	17000	1275.99	1275.99	0.00	

APPENDIX A
DRAINAGE PLANS



URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

SHEET NOTES

1 For Paving Plans, See Sheet PA01.

Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

STORM DRAIN PLANS
STA 20+00 TO STA 23+00

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORZ. 1"=20'	DNJ	06/07		SD01
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE:6/28/2007 @TIME@

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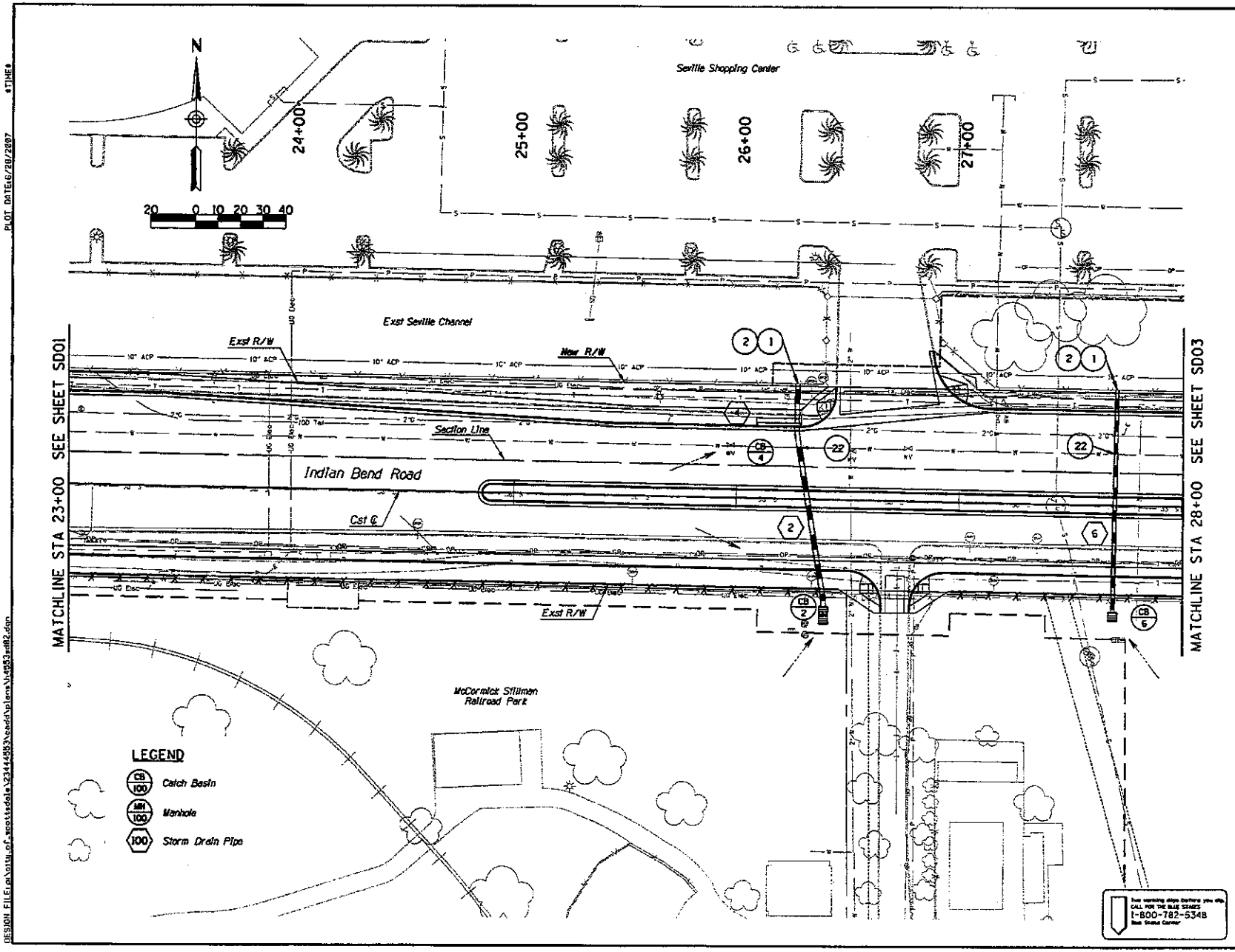


URS
7720 N. 16th Street, Suite 100
Phoenix, AZ, 85020
(602) 371-1100

CATCH BASINS

CB No.	Station	Type	Offset
2	26+40	MAG Dtl 537 Type G, Double COS Dtl 2535	50' RT (Center)
4	26+26	COP Dtl P-1569, W-1, L= 17' COS Dtl 2560-3	32.5' LT
6	27+70	MAG Dtl 537 Type G, Single COS Dtl 2535	50' RT (Center)

PIPE

SD No.	Station	Size	Feet
2	26+40 to 26+26	24"	81.3
4	26+26	24"	16.4
6	27+70	18"	100.7

CONSTRUCTION NOTES

	Description	Unit	Quan
1	Install Storm Sewer Outfall Access Barrier, COP Dtl No. P1562 & P1563	EA	2
2	For Pipe Penetration Through Exst Retaining Wall, See Dtl on Sheet SD29	EA	2
22	Install Vertical Realignment of Water Main, COS Dtl No. 2370 & MAG Dtls. 303-1 & 2. See Dtl on Sht SD33.	LF	165'

SHEET NOTES

1. For Paving Plans, See Sheet PA03.
2. For Connector Pipe Profiles, See Sheet SD18.
3. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
3. For Utility Relocation Details, See Utility Plans.

STORM DRAIN PLANS
STA 23+00 TO STA 28+00

DATE	REVISION	BY

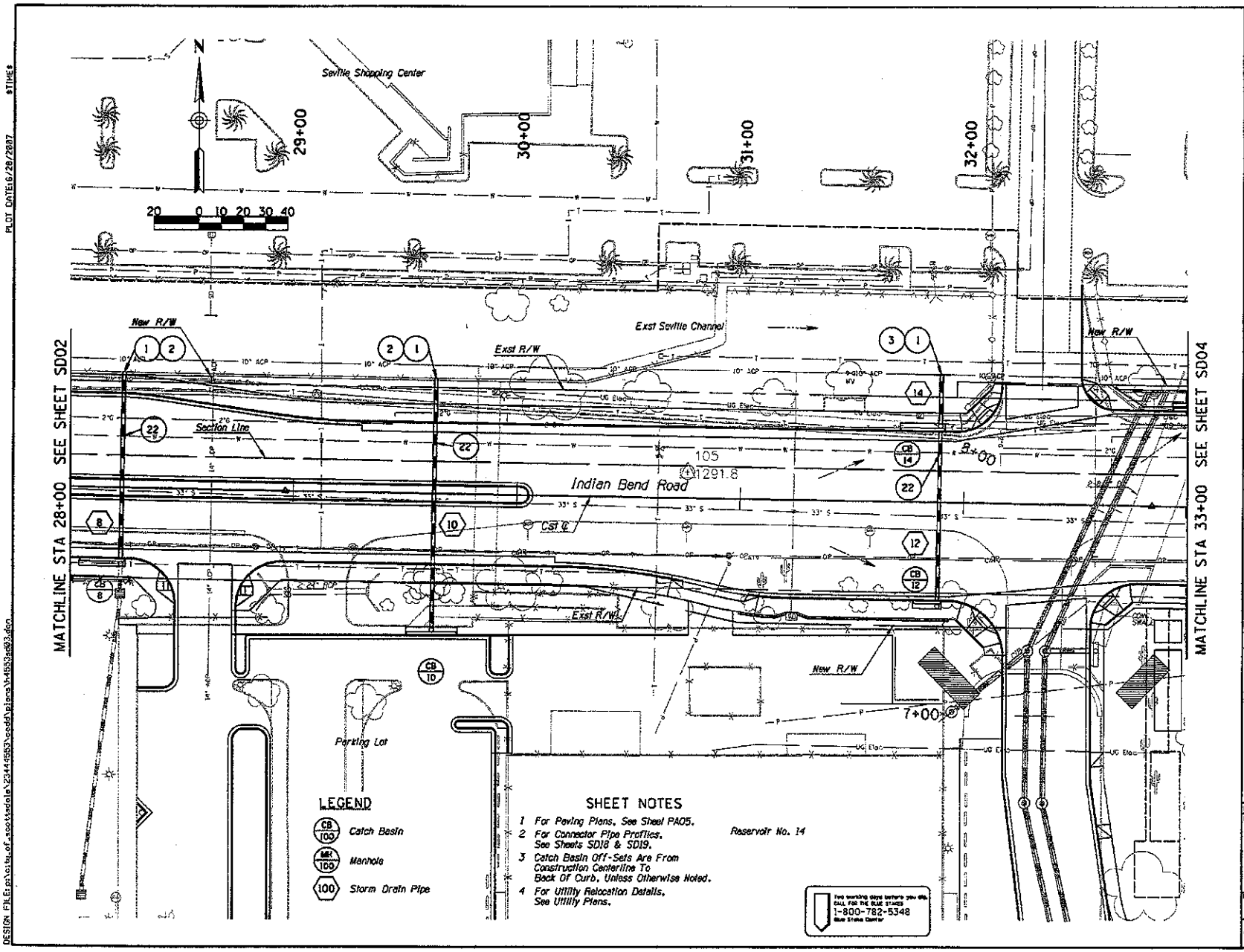
ENGINEER: 23955 DENNIS E. JOHNELING, REGISTERED PROFESSIONAL ENGINEER, ARIZONA

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20' VERT. N/A	DNJ	06/07		SD02
	DRAWN VS	AS-BUILT	PROJECT NO. 410-5-0402	OF

DESIGN FILE: p:\city_of_scottsdale\23444583\cadd\plans\h4583sd02.dgn
PLOT DATE: 6/28/2007 $TIME$



URS 7720 N. 16th Street, Suite 100 Phoenix, AZ, 85020 (602) 371-1100

CATCH BASINS

CB No.	Station	Type	Offset
8	28+23	COP Dtl P-1569, M-1, L= 17' COS Dtl 2560-3	32' RT
10	29+63	COP on P-1569 M-2, L=10' COS Dtl 2560-3	63.53' Rt
12	31+89	COP Dtl P-1569, M-1, L= 10' COS Dtl 2560-3	44.5' RT
14	31+89	COP Dtl P-1569, M-1, L= 17' COS Dtl 2560-3	32' LT

PIPE

SD No.	Station	Size	Feet
8	28+23	18"	83.7
10	29+63	24"	112.4
12	31+89	18"	76.5
14	31+89	18"	21

CONSTRUCTION NOTES

Description	Unit	Quan
(1) Install Storm Sewer Outfall Access Barrier, COP Dtl No. P1562 & P1563	EA	3
(2) For Pipe Penetration Through Exst Retaining Wall, See Dtl on Sheet SD29	EA	2
(3) Install Concrete Headwall, 18" Pipe, MAG Dtl 501, Straight Type, COS Dtl 2560-2	EA	1
(22) Install Vertical Realignment of Water Main, COS Dtl No. 2370 & MAG Dtls. 303-1 & 2. See Dtl on Sht SD33.	LF	245'

STORM DRAIN PLANS
STA 28+00 TO STA 33+00

DATE	REVISION	BY

ENGINEER: DONALD N. JOHNELAND

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD. SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	DWG NO.	SHT.
HORIZ. 1"=20' VERT. N/A	DNJ DRAWN JS	06/07 AS-BUILT	SD03	OF

PROJECT NO. 410-S-0402

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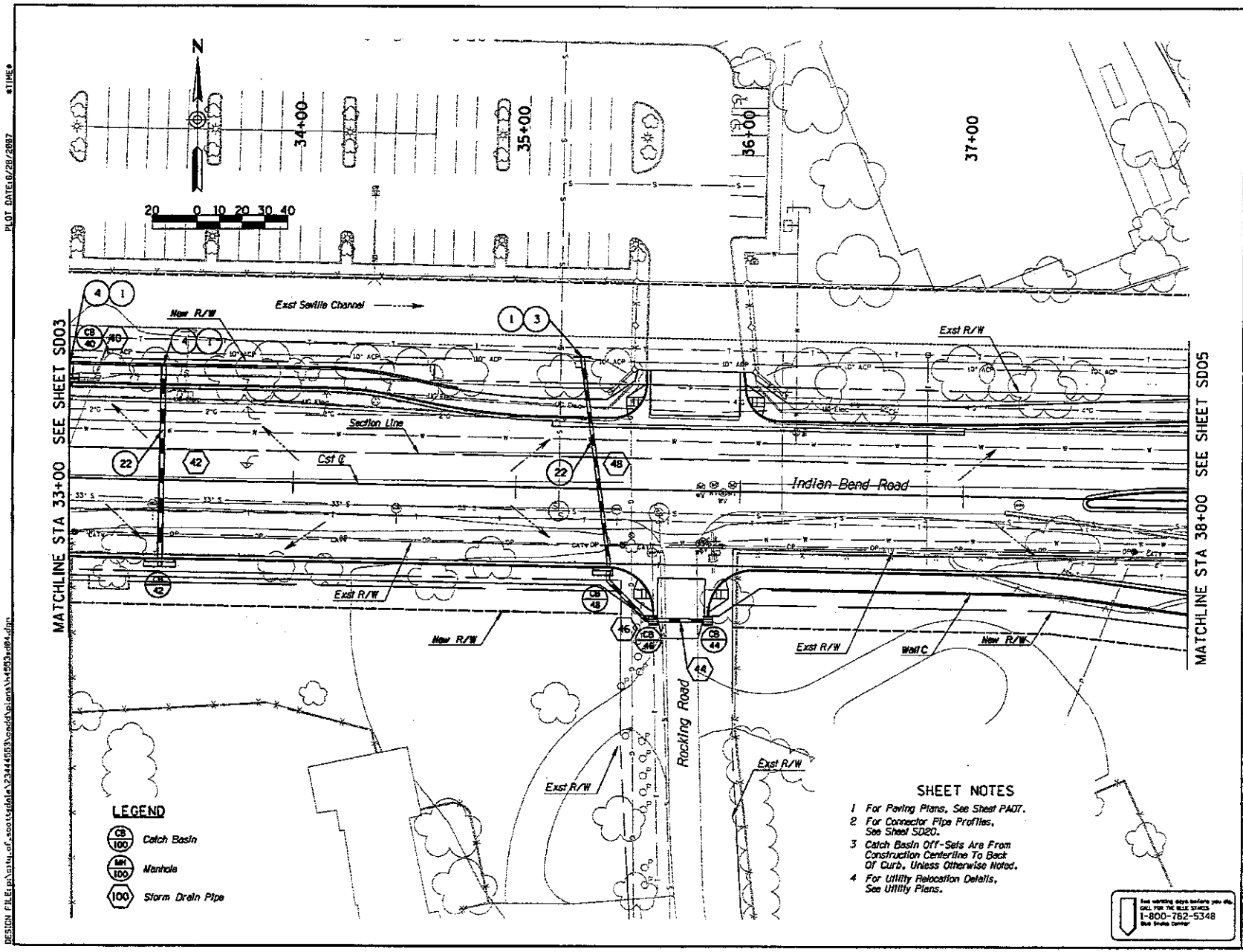

URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

CATCH BASINS

CB No.	Station	Type	Offset
40	33+00	COP Dtl P-1569, M-2, L=3' COS Dtl 2560-3	43' LT
42	33+41.6	COP Dtl P-1569, M-2, L=3' COS Dtl 2560-3	35.5' RT
44	35+86.7	MAG Dtl 537, Type G, Single COS Dtl 2560-3 COS Dtl 2535	58.5 Rt (Center)
46	35+62.7	MAG Dtl 537, Type G, Single COS Dtl 2560-3 COS Dtl 2535	58.5 Rt (Center)
48	35+42	COP Dtl P-1569, M COS Dtl 2560-3	35.5' RT

PIPE

SD No.	Station	Size	Feet
40	33+00	18"	6.1
42	33+41.6	18"	87.3
44	35+62.7 to 35+86.7	18"	22
46	35+68 to 35+42	18"	30.7
48	36+42 to 35+28.04	18"	94.8

CONSTRUCTION NOTES

Description	Unit	Quan
(1) Install COP Storm Sewer Outfall Access Barrier, COP Dtl No. P1562 & P1563	EA	3
(3) Install Concrete Headwall, 18" Pipe, MAG Dtl 501, Straight Type COS Dtl 2560-2	EA	1
(4) For Pipe Penetration Through New Retaining Wall, See Wall Plans	EA	2
(22) Install Vertical Realignment of Water Main, COS Dtl No. 2370 & MAG Dtls. 303-1 & 2. See Dtl on Sht SD33.	LF	165'

STORM DRAIN PLANS
STA 33+00 TO STA 38+00

DATE | REVISION | BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	SHT.
HORIZ. 1"=20'	DNJ	06/07	SD04
VERT. N/A	DRAWN JS	APPROVED	PROJECT NO. 410-S-0402

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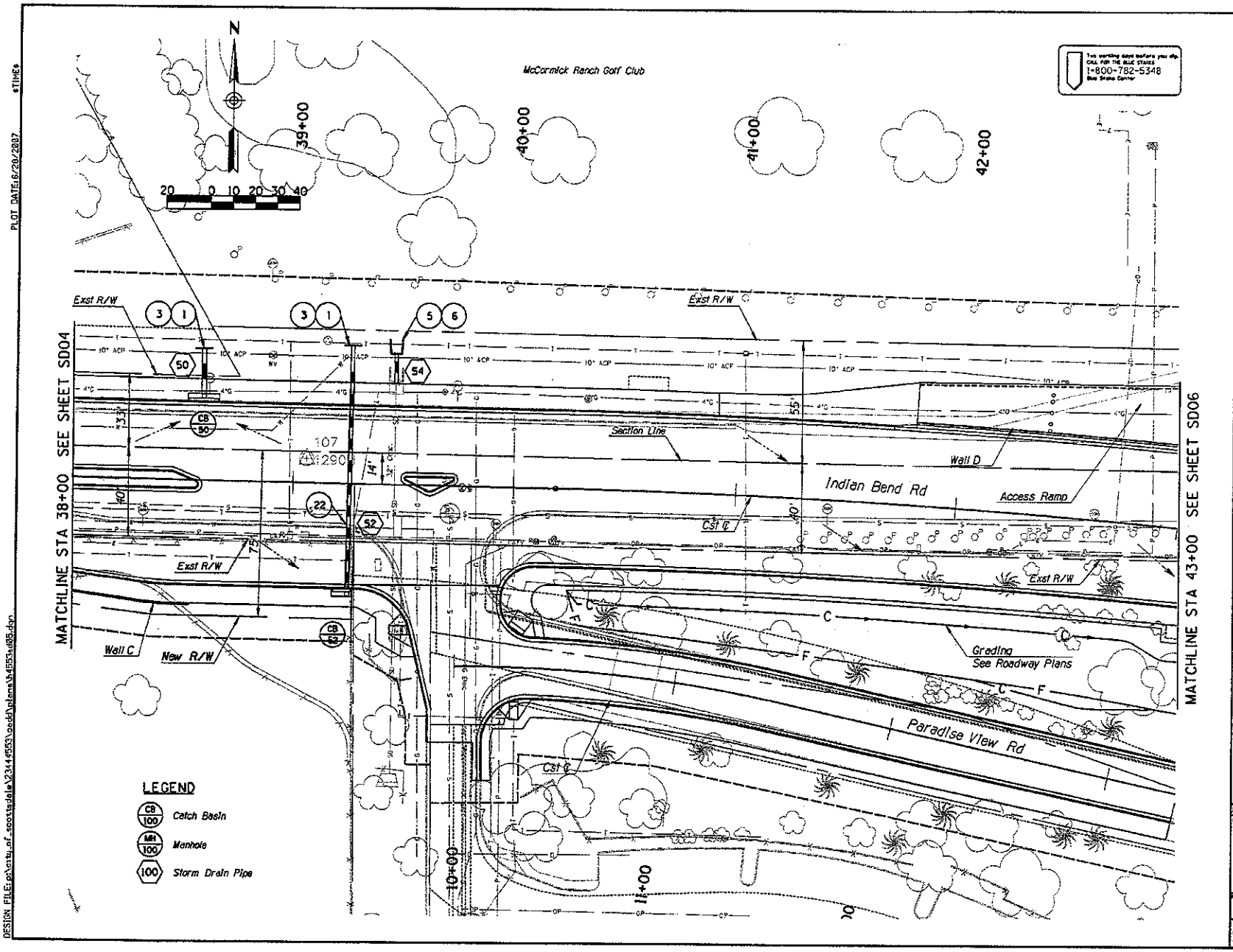

URS 7720 N. 16th Street, Suite 100 Phoenix, AZ. 85020 (602) 371-1100

CATCH BASINS

CB No.	Station	Type	Offset
50	38+58.8	COP Dtl P-1569, M-2, L = 3' COS Dtl 2560-3	35.5' LT
52	39+25.5	COP Dtl P-1569, M-1, L = 6' COS Dtl 2560-3	47.5' RT

PIPE

SD No.	Station	Size	Feet
50	38+58.8	18"	21
52	39+25.5	18"	109.5
54	39+45.24	36" (HDPE)	16

CONSTRUCTION NOTES

	Description	Unit	Quan
1	Install COP Storm Sewer Outfall Access Barrier. COP Dtl No. P1562 & P1563	EA	2
3	Install Concrete Headwall, 18" Pipe. MAG Dtl 501, Straight, COS Dtl 2560-2	EA	2
5	Install Headwall, MAG Dtl 501-4, 36" HDPE Pipe, 30° Wings COS Dtl 2560-2	EA	1
6	Remove & Reinstall Existing Flap Gate	EA	1
22	Install Vertical Realignment of Water Main, COS Dtl No. 2370 & MAG Dtls. 303-1 & 2. See Dtl on Sht SD33.	LF	41'

SHEET NOTES

1. For Paving Plans, See Sheet PA09.
2. For Connector Pipe Profiles, See Sheet SD21.
3. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
4. For Utility Relocation Details, See Utility Plans.
5. For Off-Road Drainage Details, See Drop Structure Plans.
6. For Drop Structure Details, See Indian Bend Wash Drop Structure Plans.

STORM DRAIN PLANS
STA 38+00 TO STA 43+00

DATE	REVISION	BY

ENGINEER: 33995 DENIS M. EMMELAND ARIZONA

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD. SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DNJ	06/07		SD05
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE: 6/28/2007 STIME

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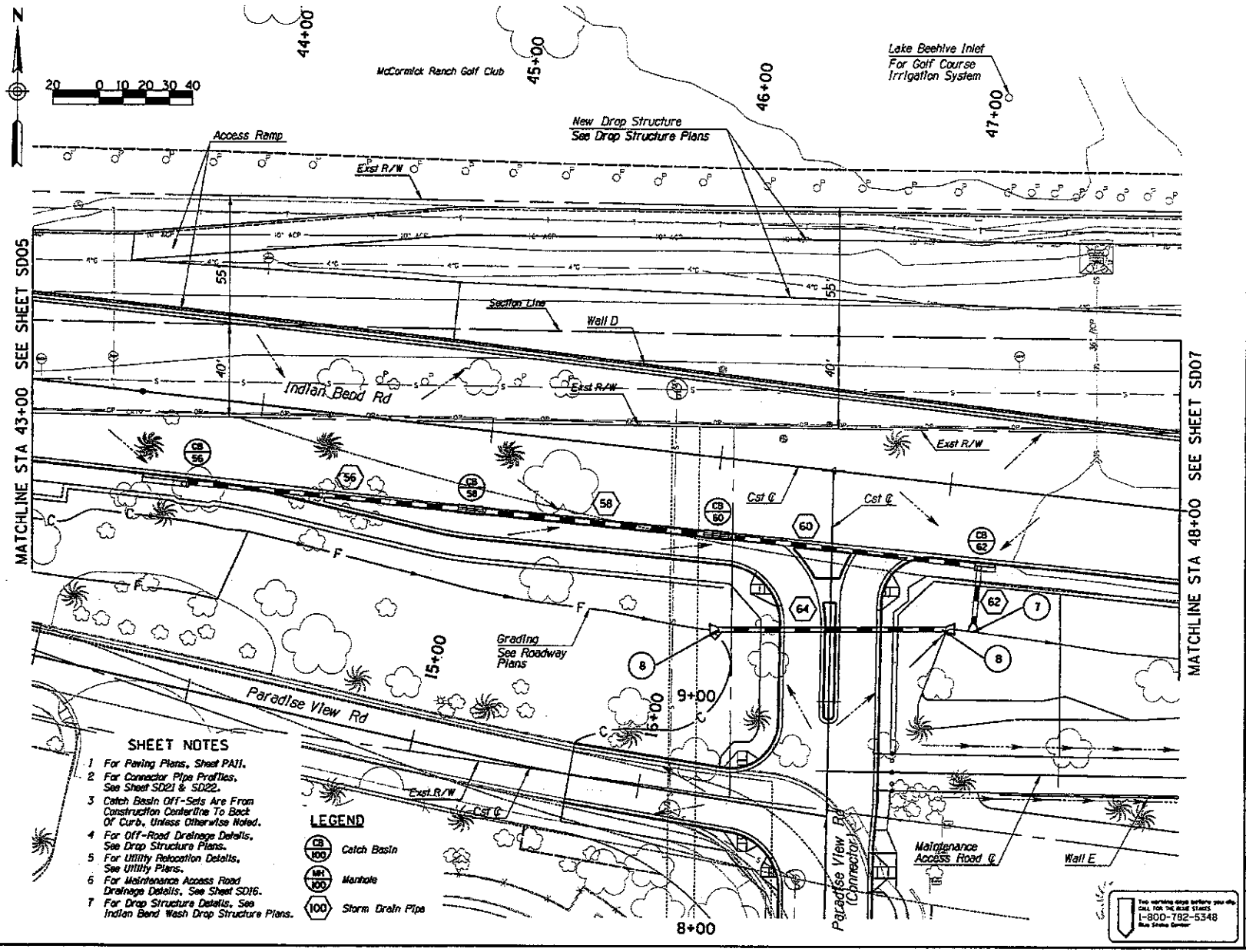

SHEET NOTES

1. For Paving Plans, Sheet PA11.
2. For Connector Pipe Profiles, See Sheet SD21 & SD22.
3. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
4. For Off-Road Drainage Details, See Drop Structure Plans.
5. For Utility Relocation Details, See Utility Plans.
6. For Maintenance Access Road Drainage Details, See Sheet SD16.
7. For Drop Structure Details, See Indian Bend Wash Drop Structure Plans.

LEGEND

- CB 100 — Catch Basin
- MH 100 — Manhole
- 100 — Storm Drain Pipe

Two working days before you dig, CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

CATCH BASINS

CB No.	Station	Type	Offset
56	43+70.00	COP Dtl P-1569 W-1, L=17' COS Dtl 2560-3	35.5' RT
58	44+95.06	COP P-1570 Type N Triple COS Dtl 2535	34.79' RT (Center)
60	46+01.96	COP P-1570 Type N Triple COS Dtl 2535	33.43' RT (Center)
62	47+16.50	COP Dtl P-1569, W-1, L= 10' COS Dtl 2560-3	32.5' RT

PIPE

SD No.	Station	Size	Feet
56	43+70.00 to 44+95.06	18"	118.6
58	44+95.06 to 46+01.96	18"	97
60	46+01.96 to 47+16.50	18"	108.2
62	47+16.50	18"	19
64	46+07.42 to 47+05.11	24"	88.8

CONSTRUCTION NOTES

	Description	Unit	Quan
7	Install 18" End Section-Reinforced Concrete Pipe, MAG Dtl 545	EA	1
8	Install 24" End Section-Reinforced Concrete Pipe, MAG Dtl 545	EA	2

STORM DRAIN PLANS
STA 43+00 TO STA 48+00

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	SHT. NO.	SHT.
HORIZ. 1"=20'	DMJ	06/07	SD06	
VERT. N/A	DRAWN JG	AS-BUILT	PROJECT NO. 410-S-0402	OF

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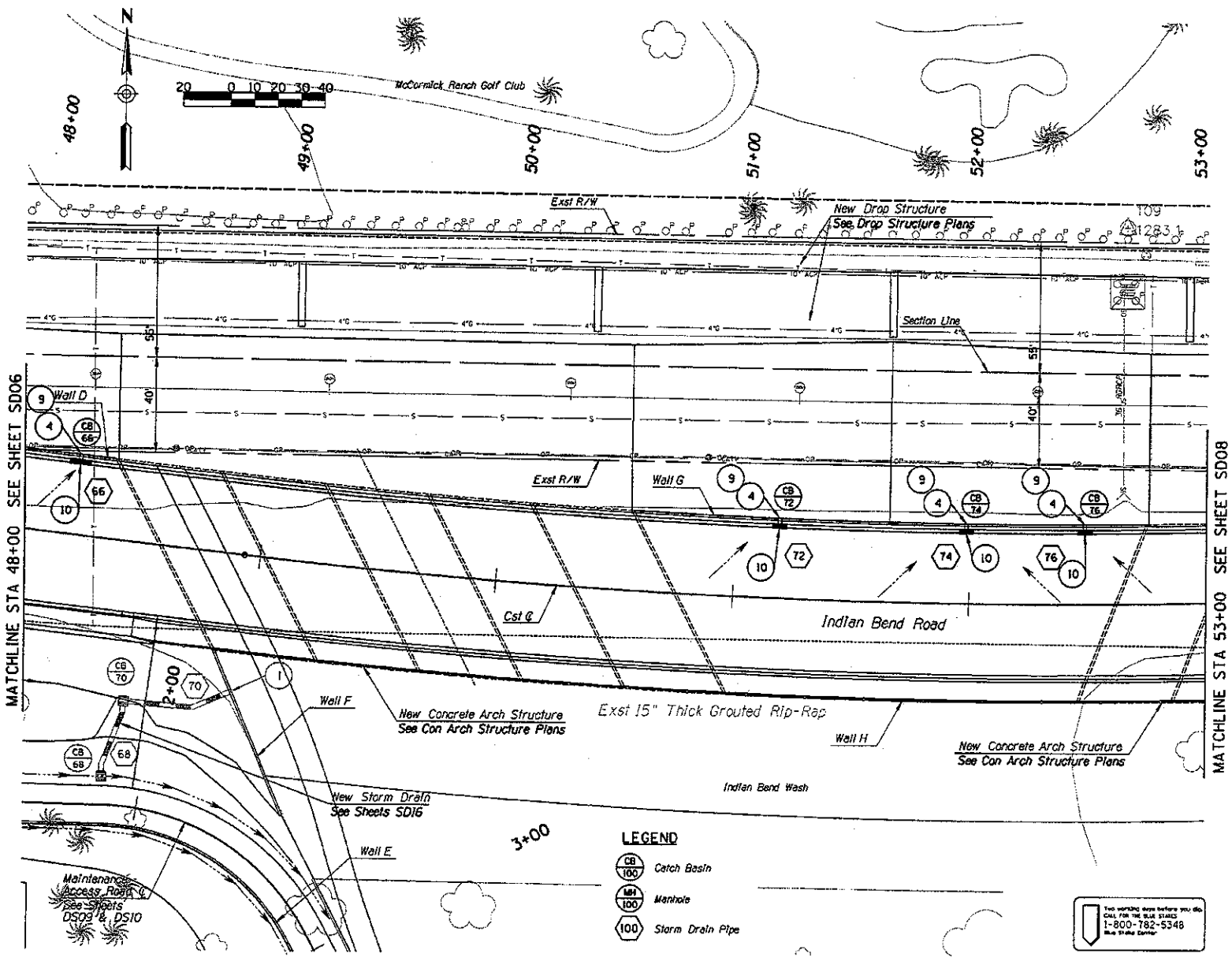

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CATCH BASINS

CB No.	Station	Type	Offset
66	48+20	COP Dtl P-1570 Type N, Triple COS Dtl 2560-3 COS Dtl 2535	32' LT
72	51+20	COP Dtl P-1570 Type N, Double COS Dtl 2560-3 COS Dtl 2535	31.5' LT
74	52+00	COP Dtl P-1570 Type N, Double COS Dtl 2560-3 COS Dtl 2535	31.5' LT
76	52+50	COP Dtl P-1570 Type N, Double COS Dtl 2560-3 COS Dtl 2535	31.5' LT

PIPE

SD No.	Station	Size	Feet
66	48+20	18"	14
72	51+20	18"	9
74	52+00	18"	8
76	52+50	18"	9

CONSTRUCTION NOTES

Description	Unit	Quan
(4) For Pipe Penetration Through New Retaining Wall, See Wall Plans	EA	4
(9) Install Outfall Access Barrier, See Sheet 30	EA	4
(10) Provide Curb & Gutter Transition, See Dtl on Sheet SD30	EA	4

SHEET NOTES

1. For Paving Plans, See Sheet PA13.
2. For Connector Pipe Profiles, See Sheets SD23, SD24 & SD27.
3. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
4. For Off-Road Drainage Details, See Drop Structure Plans.
5. For Utility Relocation Details, See Utility Plans.
6. For Maintenance Access Road Drainage Details, See Sheet SD16.
7. For Drop Structure Details, See Indian Bend Wash Drop Structure Plans.

STORM DRAIN PLANS
STA 48+00 TO STA 53+00

DATE	REVISION	BY

ENGINEER: 22393 DENNIS M. JENNELAND ARIZONA, U.S.A.

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD. SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DNJ	06/07		SD07
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE(s):city of scottsdale\23444553\cadd\plans\h4553sd07.dgn
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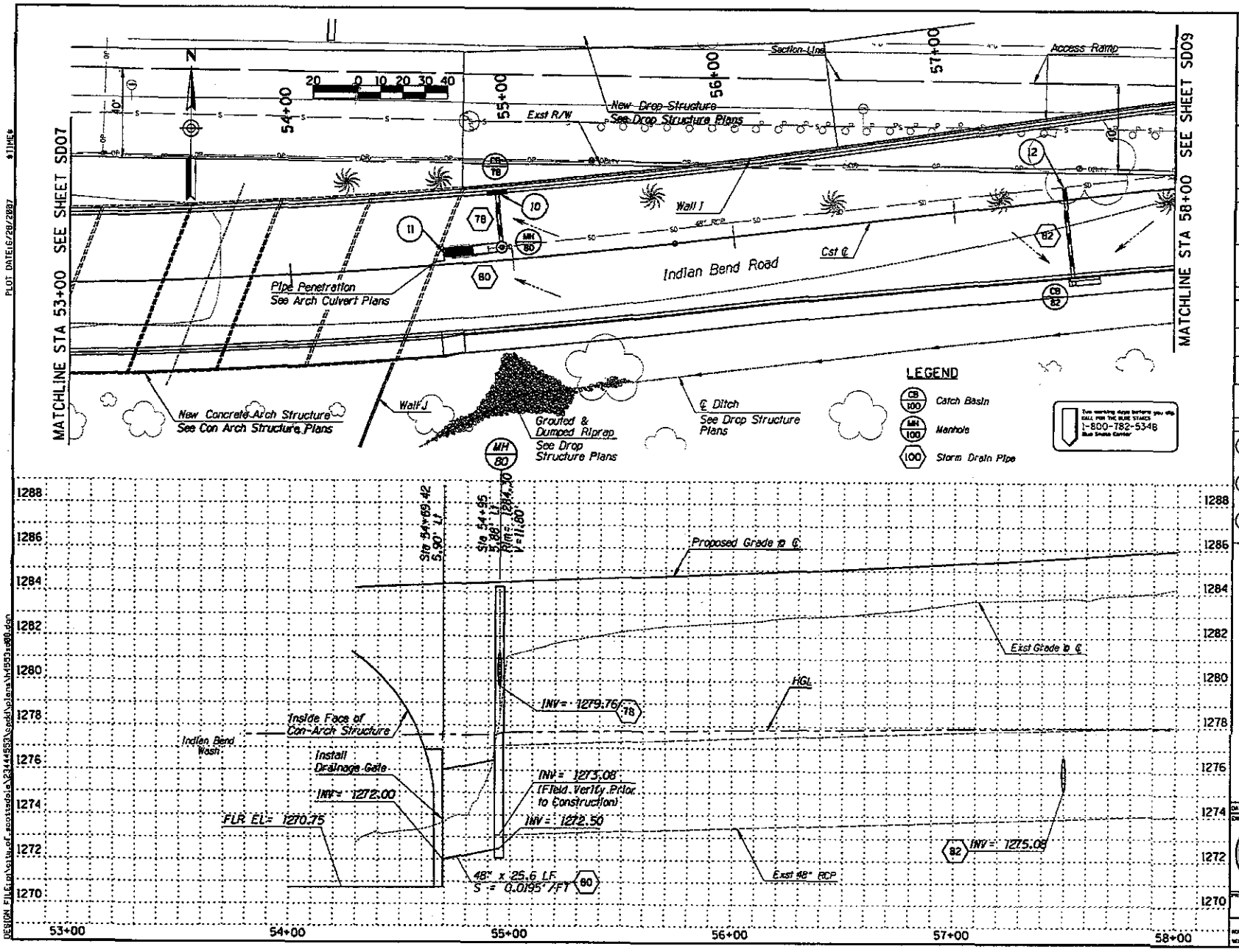

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7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
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CATCH BASINS

CB No.	Station	Type	Offset
78	54+95.00	COP Dtl P-1570 Type M, Triple COS Dtl 2560-3	32' Lt
82	57+50.50	COP Dtl P-1569 M-1, L=17' COS Dtl 2560-3	35.19' Rt

MANHOLES

MH No.	Station	Type	Offset
80	54+95.00	MAG Dtl 424, 520, 522 COS Dtl 2520	5.88' Lt

PIPE

SD No.	Station	Size	Feet
78	54+95.00	18"	23.6'
80	54+69.46 to 54+95.00	48"	25.6'
82	57+50.5	18"	41.5'

CONSTRUCTION NOTES

	Description	Unit	Quan
10	Provide Curb & Gutter Transition, See Dtl on Sheet SD 30	EA	1
11	Install 48" Waterman F-55 Heavy Duty Drainage Gate Or Approved Equal	EA	1
12	Connect to Exst 48" RCP, Mag Dtl 524	EA	1

SHEET NOTES:

1. For Paving Plans, See Sheet PA15.
2. For Connector Pipe Profiles, See Sheets SD24.
3. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
4. For Off-Road Drainage Details, See Drop Structure Plans.
5. For Utility Relocation Details, See Utility Plans.
6. For Drop Structure Details, See Indian Bend Wash Drop Structure Plans.

STORM DRAIN PLANS
STA 53+00 TO STA 58+00

DATE	REVISION	BY

ENGINEER: 23965 DENNIS M. JOHNELAND

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: FORMS 8A
Indian Bend Wash
Hydraulic Plan & Profile
For Left Bank Proposed Conditions

SCALE	DESIGNED	DATE	SID NO.	SHT.
HORIZ. 1"=20' VERT. 1"=5'	DNJ / JS	AS-BUILT		SD08 OF

PROJECT NO. 410-S-0402

PLOT DATE:6/28/2007 $TIME$

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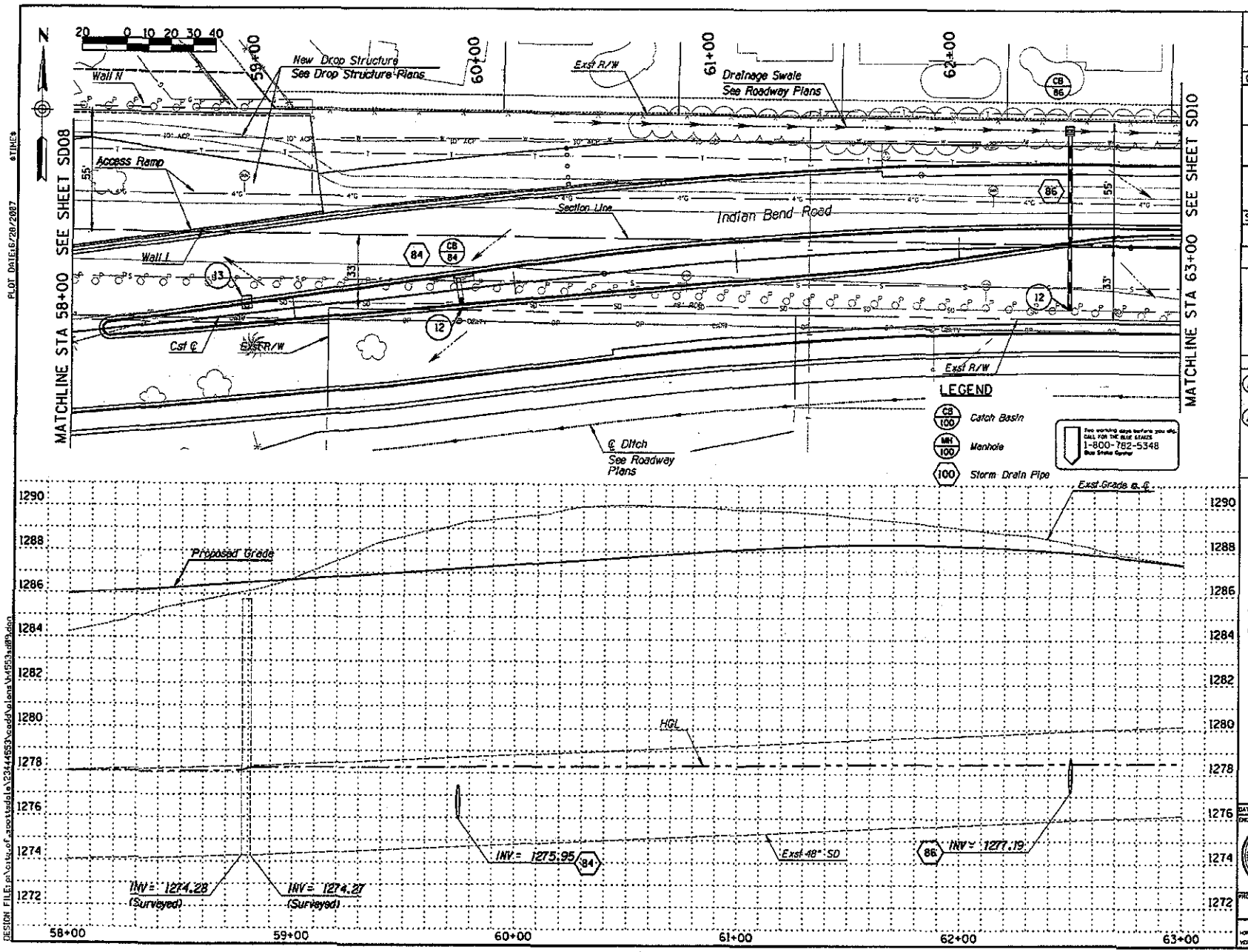

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Phoenix, AZ. 85020
(602) 371-1100

CATCH BASINS

CB No.	Station	Type	Offset
84	59+75	COP Dtl P-1569, M-1, L= 6'	6.46' LT
86	62+50	MAG Dtl 537 Type G, Single COS Dtl 2535	51.50' LT

PIPE

SD No.	Station	Size	Feet
84	59+75	18"	11.7
86	62+50	18"	79.5

CONSTRUCTION NOTES

Description	Unit	Quan
(12) Connect to Exst 48" RCP, MAG Dtl 524	EA	2
(13) Install Junction Structure. See Sheet SD 34	EA	1

SHEET NOTES:

1. For Paving Plans, See Sheet PA17.
2. For Connector Pipe Profiles, See Sheet SD24 & SD25.
3. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
4. For Off-Road Drainage Details, See Drop Structure Plans.
5. For Utility Relocation Details, See Utility Plans.
6. For Drop Structure Details, See Indian Bend Wash Drop Structure Plans.

STORM DRAIN PLANS
STA 58+00 TO STA 63+00

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: BIDDER 6A
Indian Bend Wash
Hydraulic Plan & Profile
For Left Bank Proposed Conditions

SCALE	DESIGNED	DATE	SD NO.	SHT.
HORZ. 1"=20' VERT. 1"=5'	DNJ			SD09
	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE:6/20/2007 &TIME$

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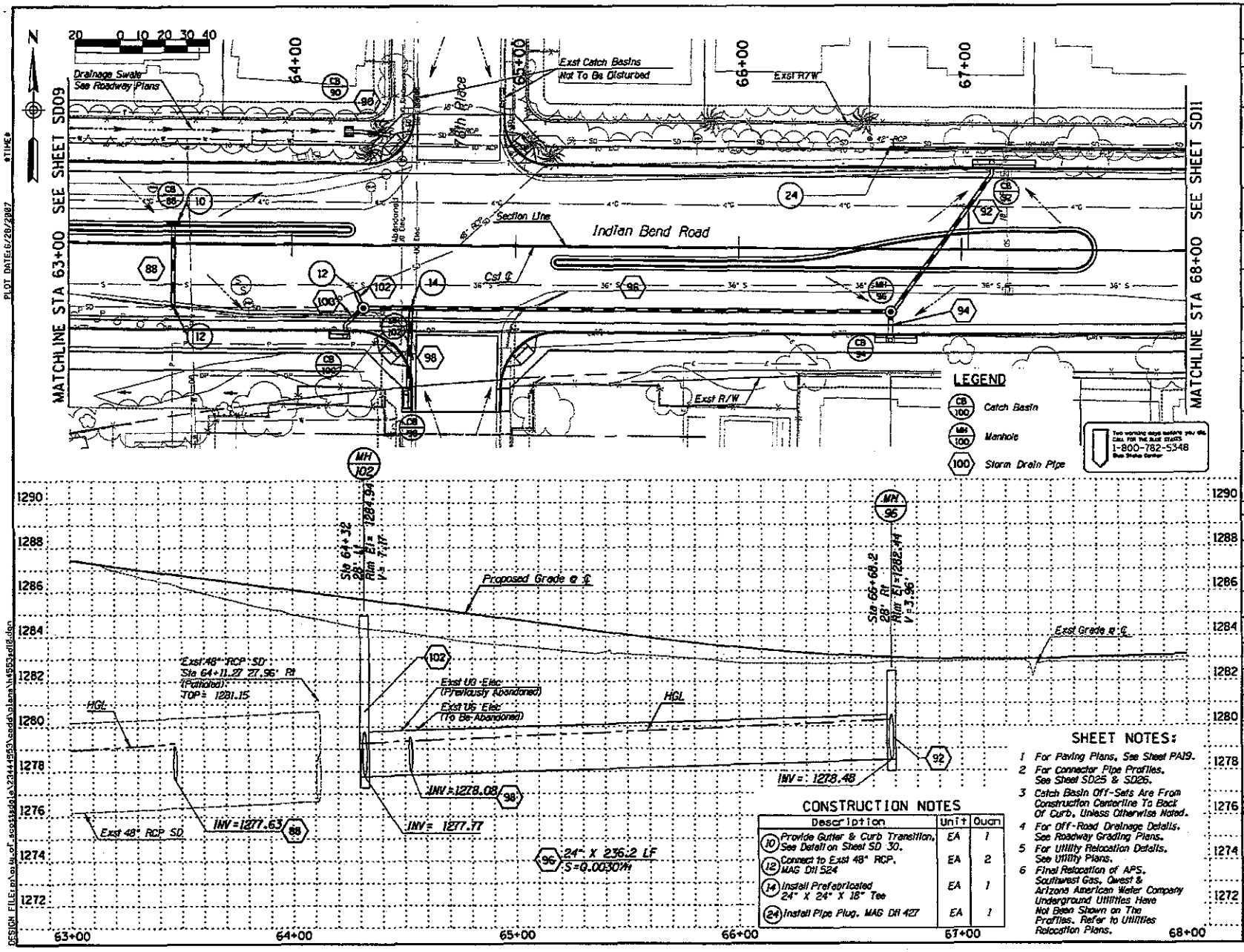


CONSTRUCTION NOTES

Description	Unit	Quan
(10) Provide Gutter & Curb Transition, See Detail on Sheet SD 30.	EA	1
(12) Connect to Exst 48" RCP, MAG Dtl 524	EA	2
(14) Install Prefabricated 24" X 24" X 18" Tee	EA	1
(24) Install Pipe Plug, MAG Dtl 427	EA	1

SHEET NOTES:

1. For Paving Plans, See Sheet PA19.
2. For Connector Pipe Profiles, See Sheet SD25 & SD26.
3. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
4. For Off-Road Drainage Details, See Roadway Grading Plans.
5. For Utility Relocation Details, See Utility Plans.
6. Final Relocation of APS, Southwest Gas, Qwest & Arizona American Water Company Underground Utilities Have Not Been Shown on The Profiles. Refer to Utilities Relocation Plans.

URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1900

CATCH BASINS

CB No.	Station	Type	Offset
88	63+47	COP Dtl P-1570 Double COS Dtl 2560-3	8.5' LT (Face of Curb)
90	64+25	MAG Dtl 537 Type G, Single COS Dtl 2535	50.5' Lt (Center)
92	67+13.4	COP Dtl P-1569 M-2, L=6' & 10' COS Dtl 2560-3	36.5' LT
94	66+68.2	COP Dtl P-1569 M-2, L=3' & 10' COS Dtl 2560-3	38.5' RT
98	64+53.88	COP Dtl P-1569 M COS Dtl 2560-3	66.0' RT
100	64+24	COP Dtl P-1569 M-1, L=6' COS Dtl 2560-3	38.5' RT

MANHOLES

MH No.	Station	Type	Offset
96	66+68.2	MAG Dtl. 424, 520, 522, COS Dtl. 2520	28.0' RT
102	64+32	MAG Dtl. 424, 520, 522, COS Dtl. 2520	28.0' RT

PIPE

SD No.	Station	Size	Feet
88	63+47	18"	37.1
90	64+25 to 64+35.8	18"	17.8
92	67+13.4 to 66+68.2	24"	79.3
94	66+68.2	18"	10.5
96	66+68.2 to 64+32	24"	236.2
98	64+53.88	18"	36.6
100	64+24 to 64+32	18"	14
102	64+32 to 64+28.8	24"	8.1

STORM DRAIN PLANS
STA 63+00 TO STA 68+00

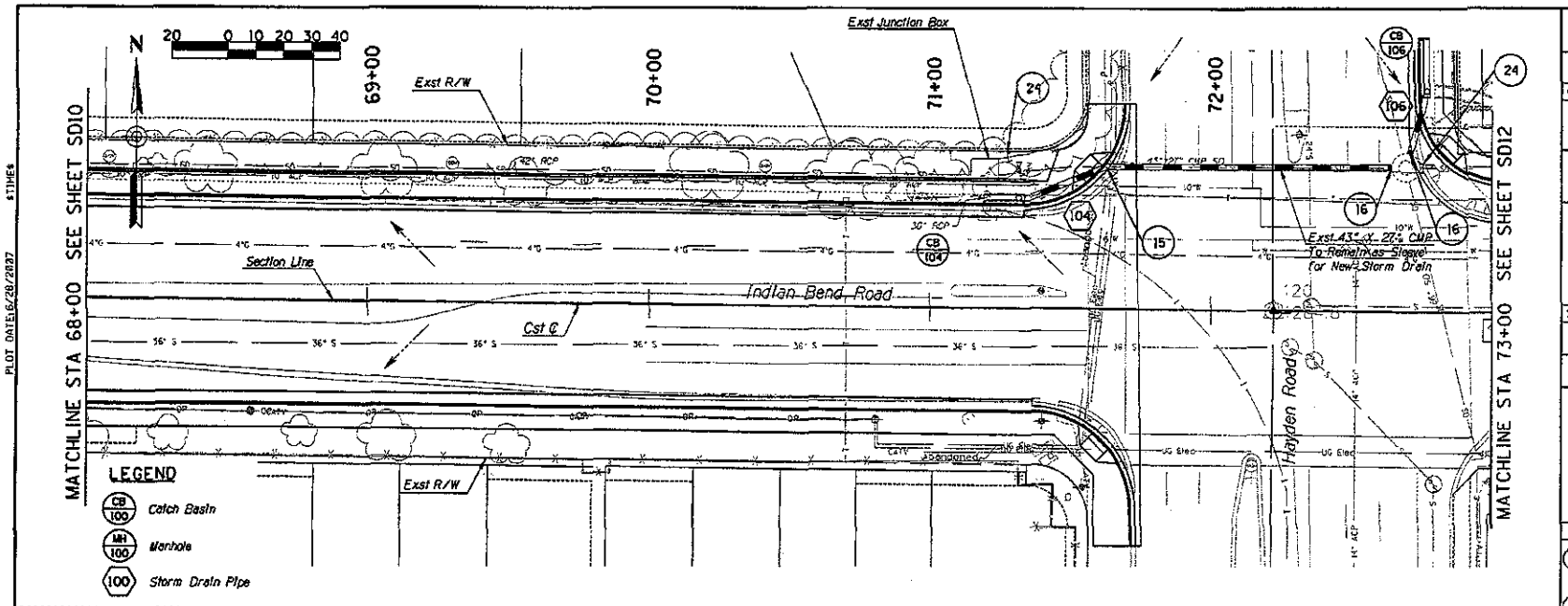
DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Wash Hydraulic Plan & Profile For Left Bank Proposed Conditions

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORZ. 1"=20' VERT. 1"=5'	DNJ DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	SD10 OF



URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1300

CATCH BASINS

CB No.	Station	Type	Offset
104	71+31.50	COP Dtl P-1569 M-1, L=10' COS Dtl 2560-3	36.5' LT
106	72+73.65	COP Dtl P-1569 M-1, L=17' COS Dtl 2560-3	78' LT

PIPE

SD No.	Station	Size	Feet
104	71+31.50 to xx	18"	138
106	72+73.65 to xx	18"	26.5

CONSTRUCTION NOTES

Description	Unit	Quan
(15) Connect to Exst 43"x27" CMP, Place 18" Pipe Inside CMP.	EA	1
(16) Connect to Exst 66" RCP Manhole	EA	2
(24) Install Pipe Plug, MAG Dtl 427	EA	2

SHEET NOTES:

1. For Paving Plans, See Sheet PA21.
2. For Connector Pipe Profiles, See Sheet SD27.
3. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
4. For Utility Relocation Details, See Utility Plans.

Two working days before you dig, CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

STORM DRAIN PLANS
STA 68+00 TO STA 73+00

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Exhibit 6A
Indian Bend Wash
Hydraulic Plan & Profile
For Left Bank Proposed Conditions

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20' VERT. 1"=5'	DNJ			SD11
	DRAWN XS	AS-BUILT	PROJECT NO. 410-3-0802	OF

PLOT DATE:6/28/2007 &TIME&

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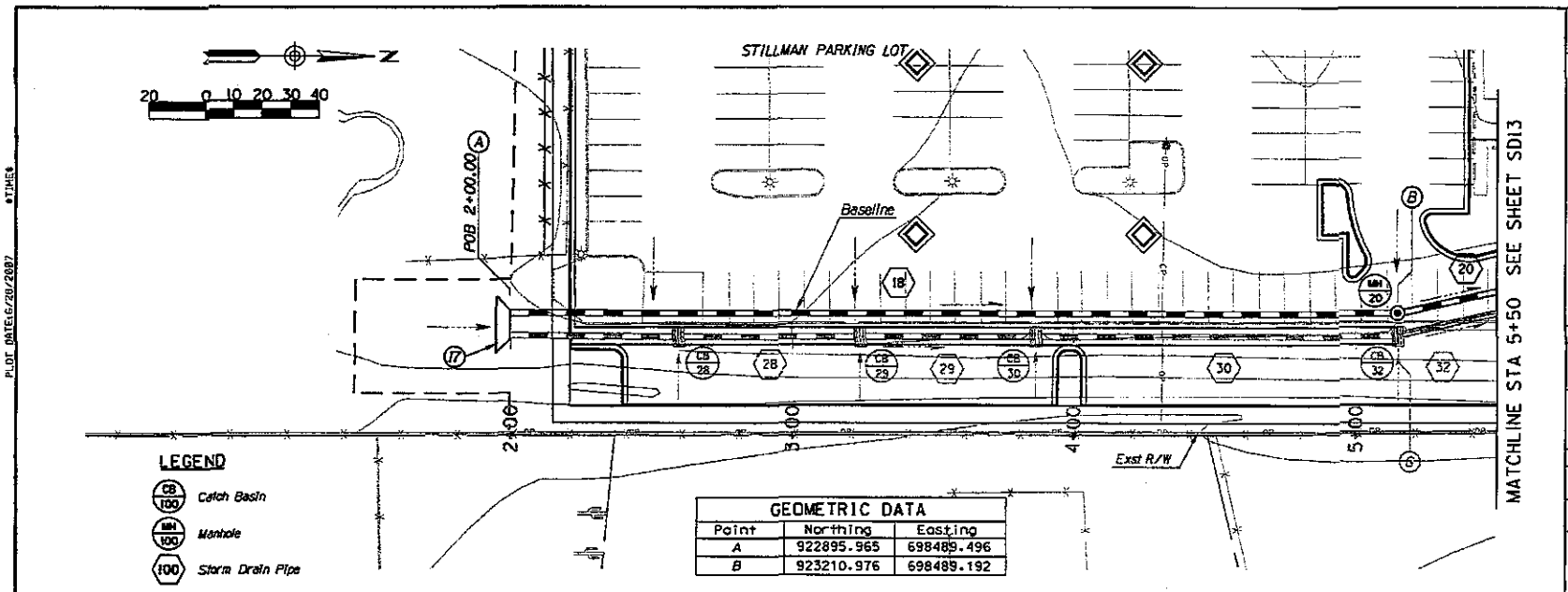

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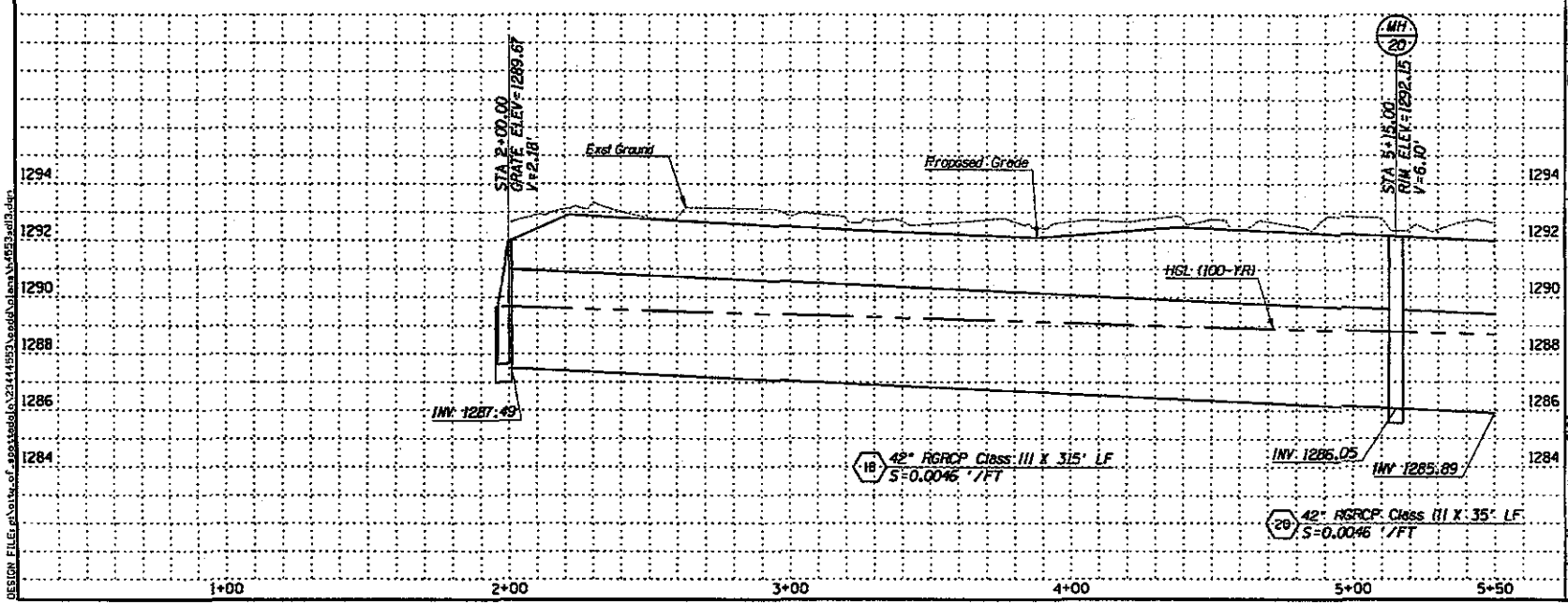

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7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

MANHOLES

MH No.	Station	Type	Offset
20	5+15.00	MAG Dtl 424, 520, 522 COS Dtl 2520	0

PIPE

SD No.	Station	Size	Feet
18	2+00 To 5+15	42"	315
20	5+15 To 5+50	42"	35

CONSTRUCTION NOTES

Description	Unit	Quan
(17) For Special Drop Structure, See Sheet SD 31.	*	*
* Quantity Listed on Sheet SD 14		

SHEET NOTES:

1 For Stillman Parking Lot See Sheets GRP1-GRP4.

Two working days before you dig, CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stakes Center

STORM DRAIN PLANS
PARKING LOT

DATE | REVISION | BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Exhibit 4A
Indian Bend Wash
Hydraulic Plan & Profile
For Left Bank Proposed Conditions

SCALE	DESIGNED	DATE	BID NO.	SHT.
horiz. 1"=20' vert. 1"=2'	D.J.S.			SD12
	DRAWN	AS-BUILT	PROJECT NO.	OF
	J.S.		410-S-0402	

PLOT DATE:6/20/2007 *TIME*

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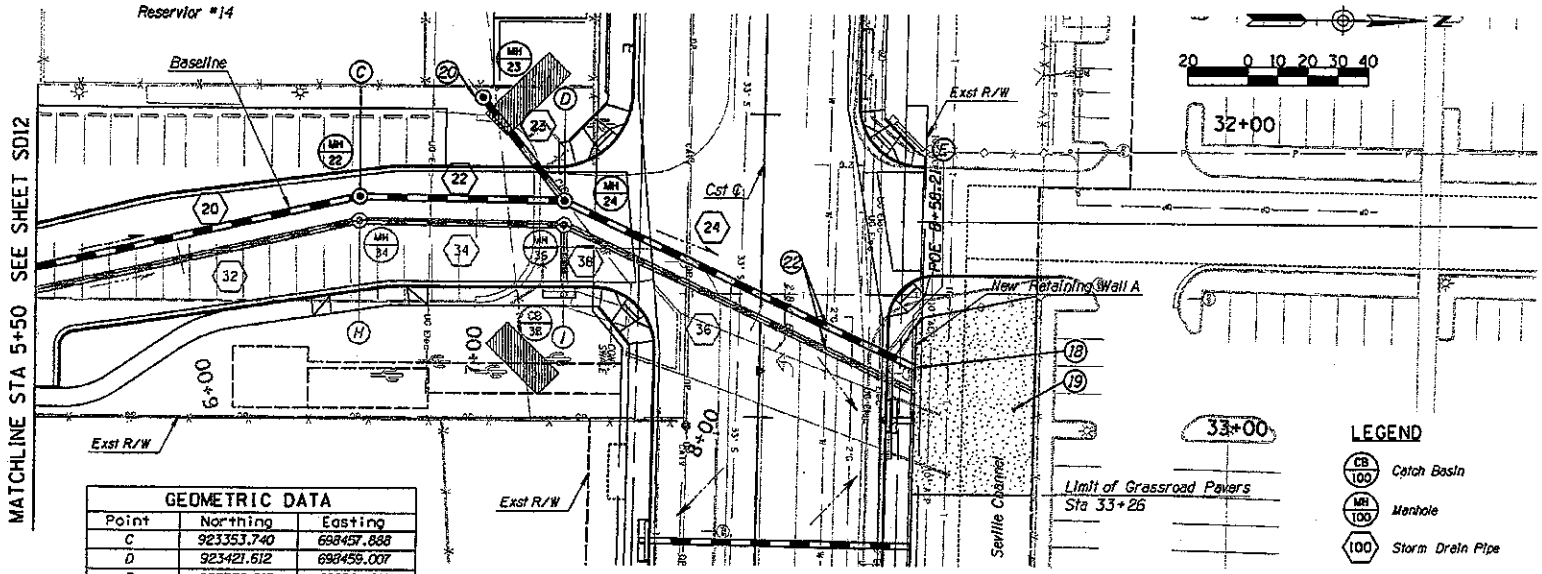

GEOMETRIC DATA		
Point	Northing	Easting
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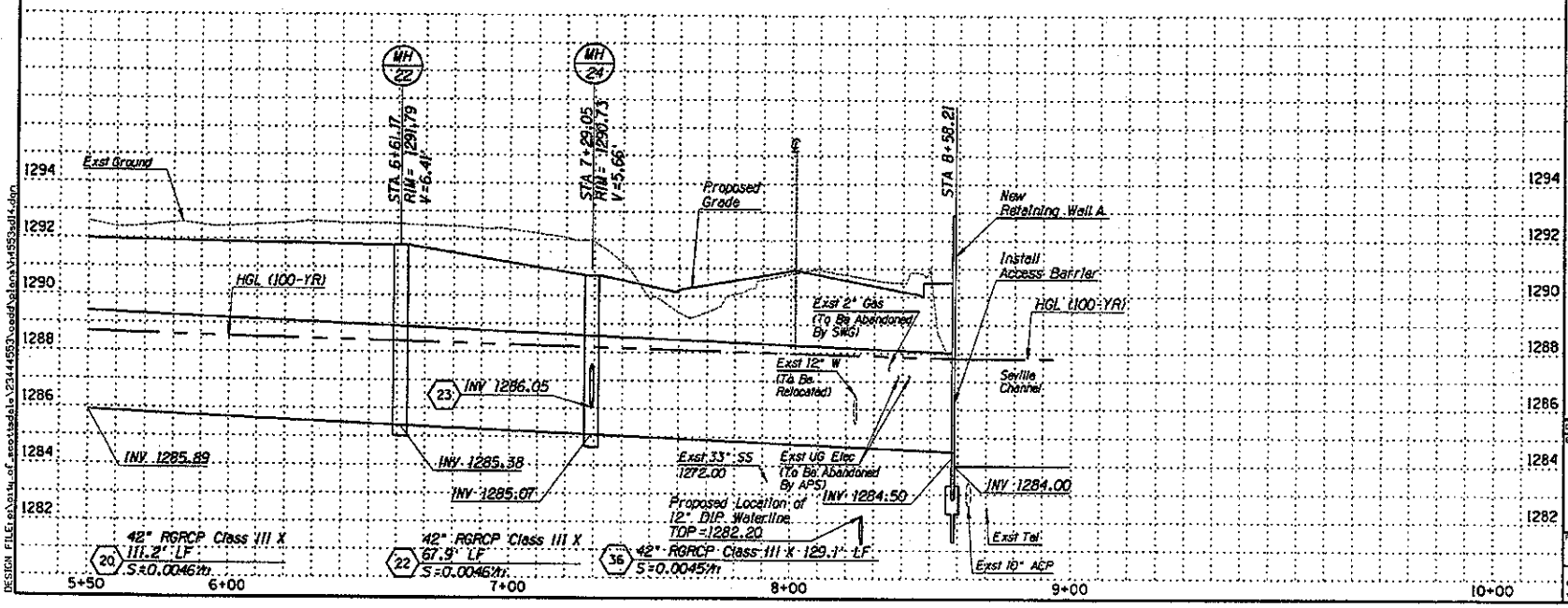
D	923421.612	698459.007
E	923538.018	698504.916

LEGEND

- CB 100 — Catch Basin
- MH 100 — Manhole
- 100 — Storm Drain Pipe



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MANHOLES

MH No.	Station	Type	Offset
22	6+61.17	MAG Dtl 424, 520, 522 COS Dtl 2520	0
23	7+01.26	MAG Dtl 424, 520, 522 COS Dtl 2520	33.4'
24	7+29.05	MAG Dtl 424, 520, 522 COS Dtl 2520	0

PIPE

SD No.	Station	Size	Feet
20	5+50.00 To 6+61.17	42"	111.2
22	6+61.17 To 7+29.05	42"	67.9
23	7+01.26 To 7+29.05 Lt	18"	44
24	7+29.05 To 8+58.21	42"	129.1

CONSTRUCTION NOTES

	Description	Unit	Quan
18	Install Access Barrier, COS Dtl 2562 Modified for 42" Skewed Outlet	EA	1
19	Install Grassroad Pavers Per Dtl. Sht SD32	SF	2478
20	Install Watermain 16" F-10 Drainage Gate or Approved Equal.	EA	1
22	Install Vertical Realignment of Watermain, COS Dtl No. 2370 & MAG Dtls 303-1 & 2. See Dtl on Sht SD33.	LF	99

SHEET NOTES:

1. For Stillman Parking Lot See Sheets GRP1-GRP4.
2. For Connector Pipe Profiles, See Sht. SD 19.
3. For Utility Relocation Details, See Utility Plans.
4. For Penetration Thru Retaining Wall A, See Shts WA2 & WA8

Two working days before you dig, CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

STORM DRAIN PLANS PARKING LOT

DATE	REVISION	BY

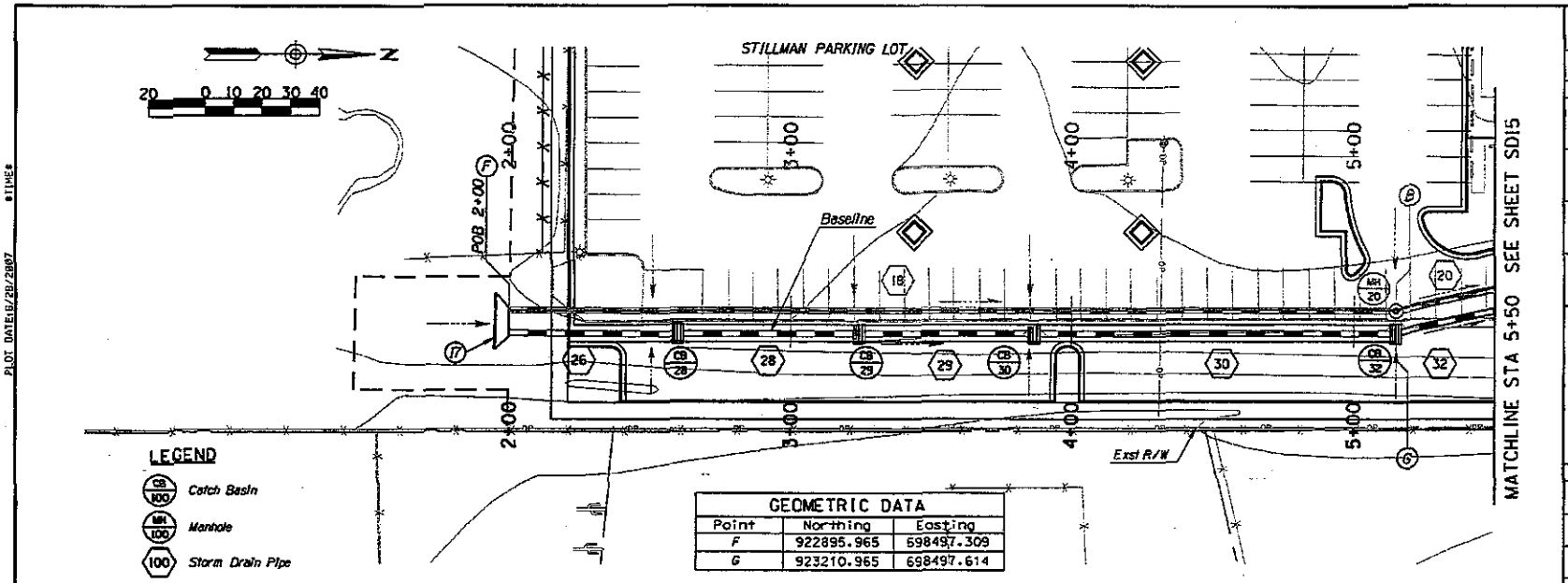
ENGINEER: 23663 DAVID A. SCHAAF ARIZONA, U.S.A.

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD. SUITE 205 SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: EXHIBIT 6A Indian Bend Wash Hydraulic Plan & Profile Pre Last Week Proposed Conditions

SCALE	DESIGNED	DATE	DWG NO.	SHT.
HORZ. 1"=20' VERT. 1"=2'	DWG DRAWN JS	AS-BUILT	PROJECT NO. 410-5-0402	SD13 of

DESIGN FILE:e:\city_of_scottsdale\23444553\sedd\plans\in5553sd14.dgn PLOT DATE:6/20/2007 $TIME$



GEOMETRIC DATA		
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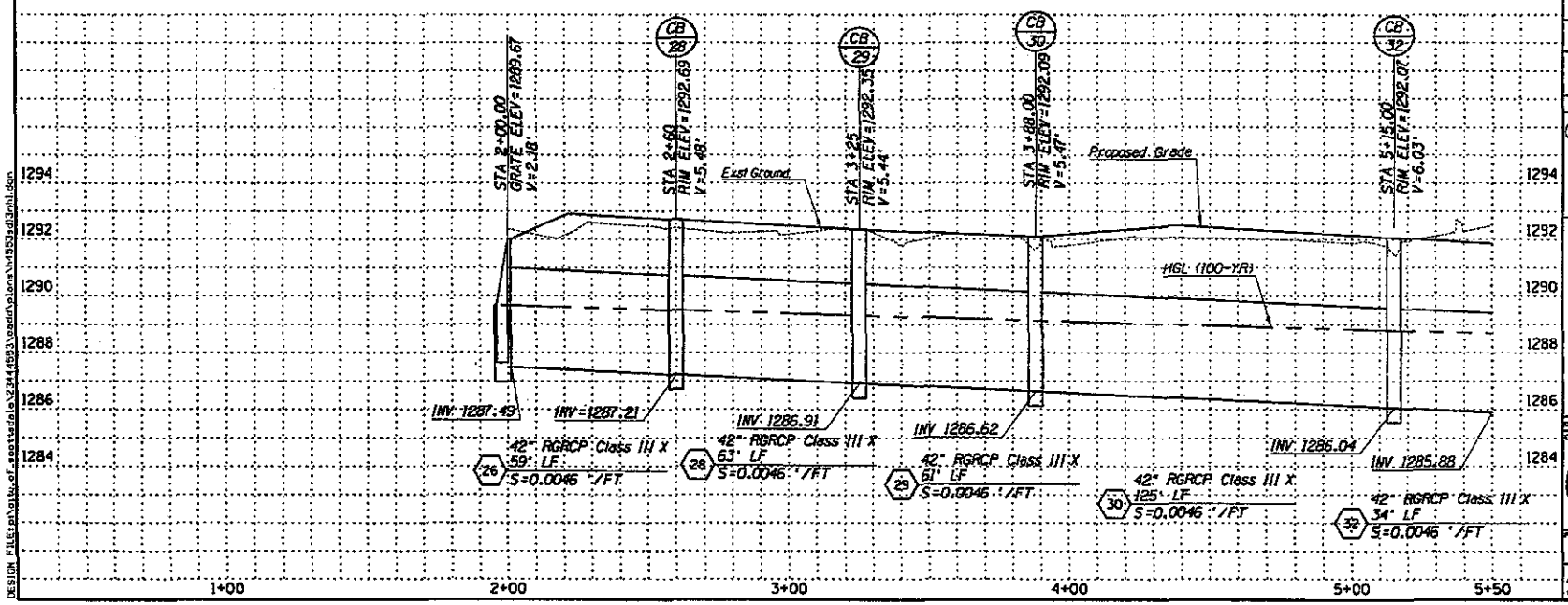

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(602) 371-1100

CATCH BASINS

CB No.	Station	Type	Offset
28	2+60	Cap Dtl P-1570 Type N, Double Cap Dtl P-1564, P-1565 Type 1	0.0
29	3+25	Cap Dtl P-1570 Type N, Double Cap Dtl P-1564, P-1565 Type 1	0.0
30	3+88	Cap Dtl P-1570 Type N, Double Cap Dtl P-1564, P-1565 Type 1	0.0
32	5+15	Cap Dtl P-1570 Type N, Double Cap Dtl P-1564, P-1565 Type 1	0.0

PIPE

SD No.	Station	Size	Feet
26	2+00 To 2+60	42"	59
28	2+60 To 3+25	42"	63
29	3+25 To 3+88	42"	61
30	3+88 To 5+15	42"	125
32	5+15 To 5+50	42"	34

CONSTRUCTION NOTES

Description	Unit	Quan
(17) For Special Drop Structure, See Sheet SD 31.	EA	1

SHEET NOTES:

1 For Stillman Parking Lot See Sheets GRP1-GRP4.

Five working days before you dig, CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

STORM DRAIN PLANS
PARKING LOT

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Exhibit 6A, Indian Bend Wash Hydraulic Flow & Profile For Left Bank Processor Conditions

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORZ. 1"=20' VERT. 1"=2'	DJS			SD14
	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE:6/28/2007 #TIME#

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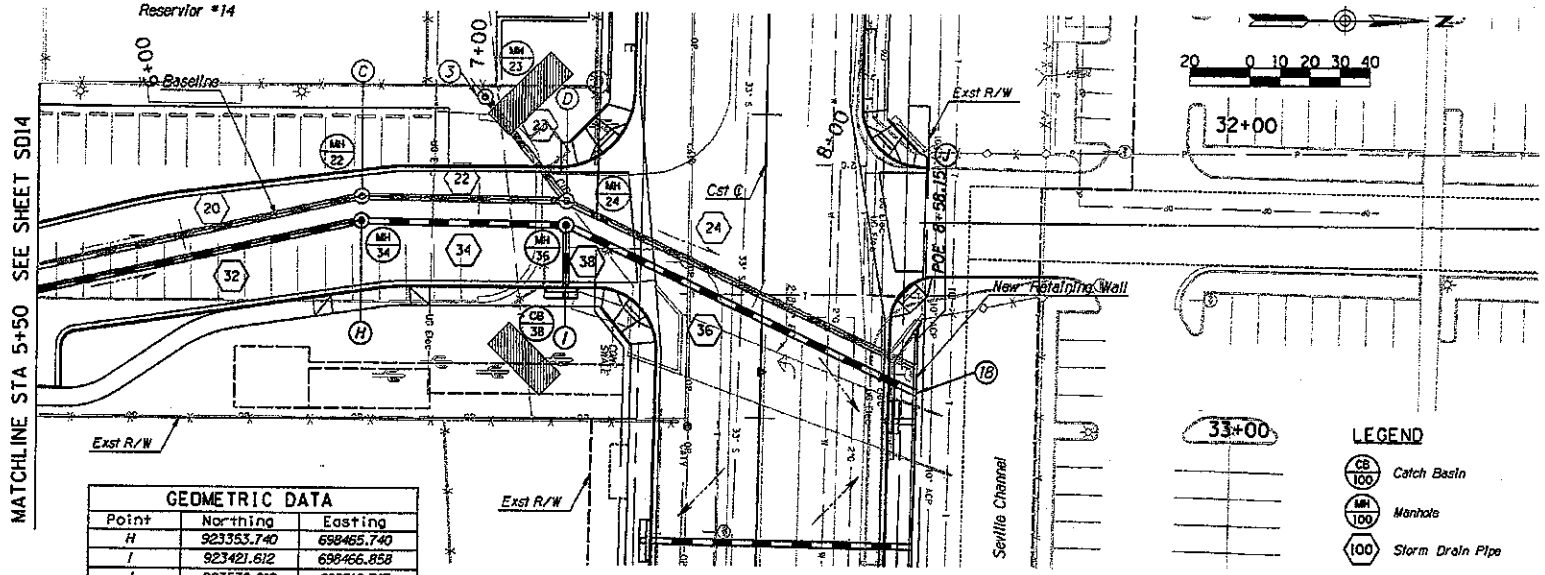
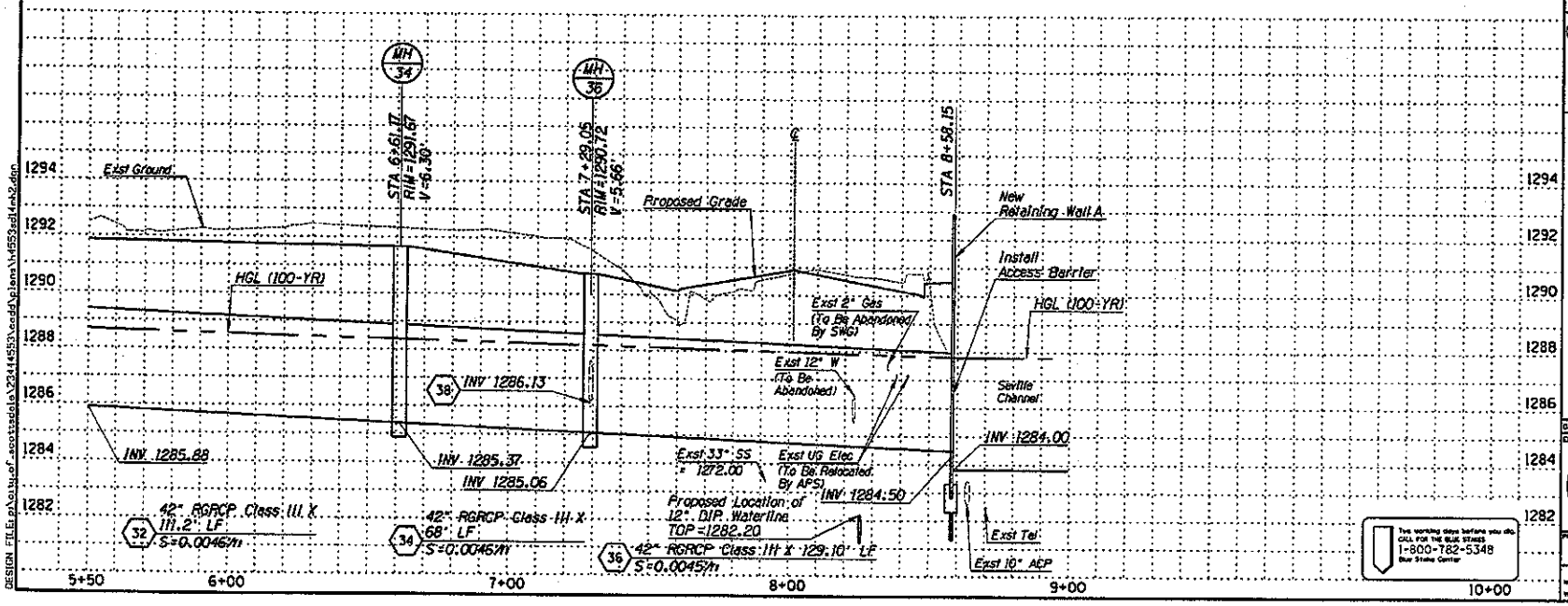


GEOMETRIC DATA		
Point	Northing	Easting
H	923353.740	698465.740
I	923421.612	698466.858
J	923538.018	698512.767

LEGEND

- CB 100 — Catch Basin
- MH 100 — Manhole
- 100 — Storm Drain Pipe



URS 7720 N. 16th Street, Suite 100 Phoenix, AZ. 85020 (602) 371-1100

CATCH BASINS

CB No.	Station	Type	Offset
38	7+29.05	COP Dtl P-1569 M-1, L = 10' COS Dtl 2560-3	20.59'

MANHOLES

MH No.	Station	Type	Offset
34	6+61.17	MAG Dtl 424, 520, 522 COS Dtl 2520	0'
36	7+29.05	MAG Dtl 424, 520, 522 COS Dtl 2520	0'

PIPE

SD No.	Station	Size	Feet
32	5+50.00 To 6+61.17	42"	111.2
34	6+61.17 To 7+29.05	42"	68
36	7+29.05 To 8+58.15	42"	129.1
38	7+29.05	18"	20.5

CONSTRUCTION NOTES

Description	Unit	Quan
(18) Install Access Barrier, COS Dtl 2562 Modified for 42" Skewed Outlet	EA	1

SHEET NOTES:

1. For Stillman Parking Lot See Sheets GRP1-GRP4.
2. For Connector Pipe Profiles, See Sheet SD 19.
3. For Utility Relocation Details, See Utility Plans.
4. For Penetration Thru Retaining Wall A Note for Offset Distance to Catch Basins. See Sheets WA2 & WA8

STORM DRAIN PLANS
PARKING LOT

DATE | REVISION | BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Exhibit 6A Indian Bend Wash Hydraulic Plan & Profile For Left Bank Proposed Conditions

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20' VERT. 1"=2'	DJS			SD15
	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

PLOT DATE:6/26/2007 TIME:

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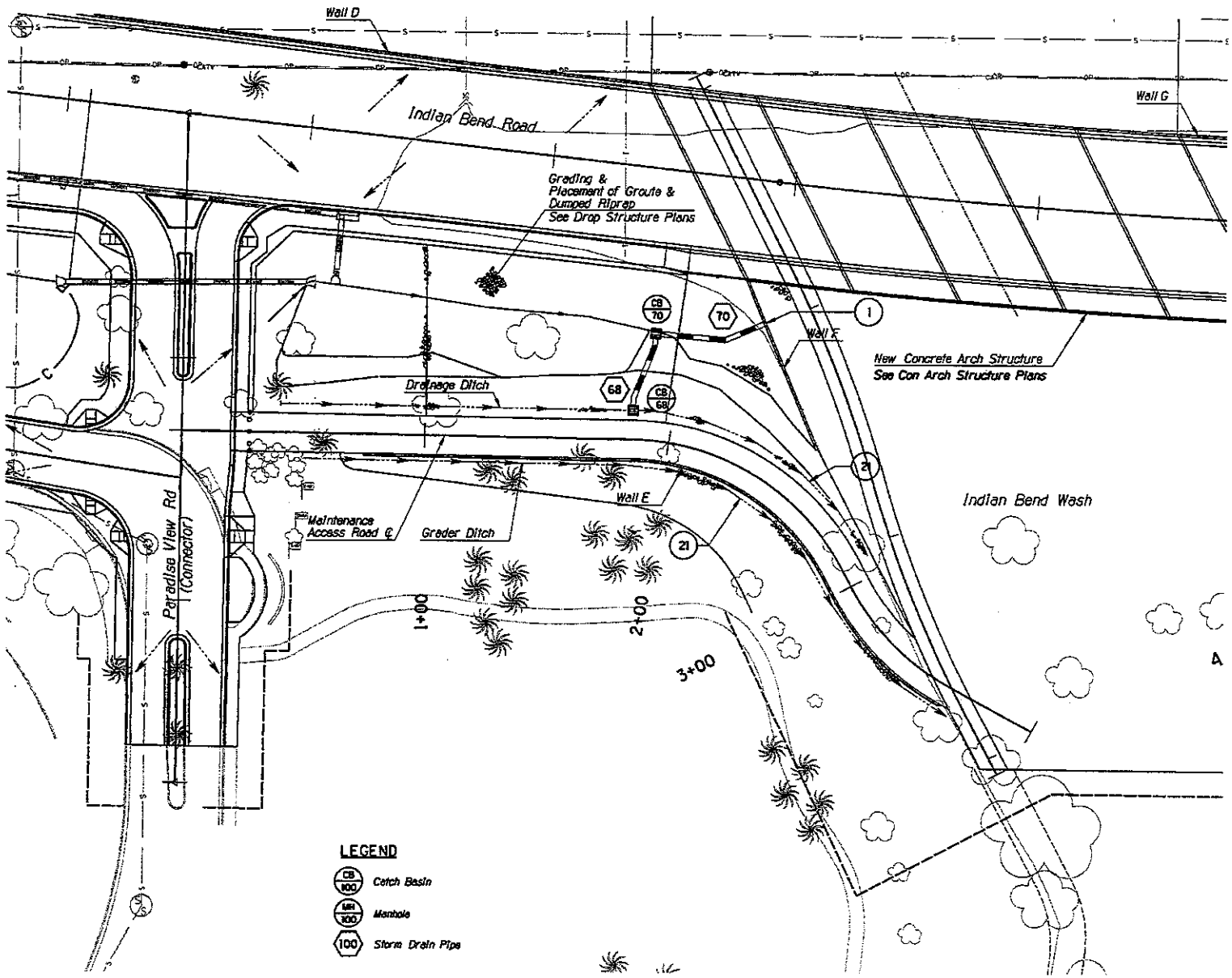

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Phoenix, AZ. 85020
(602) 371-1100

CATCH BASINS

CB No.	Station	Type	Offset
68	1+85 (Maintenance Access Rd)	MAG Dtl 537 Type G, Single COS Dtl 2535	12' Lt (Center)
70	48+50	MAG Dtl 537 Type G, Double COS Dtl 2535	67.52 Lt (Center)

PIPE

SD No.	Station	Size	Feet
68	1+85 to 48+50	18"	30.3
70	48+50 to 48+94.53	30"	47.3

CONSTRUCTION NOTES

Description	Unit	Quan
(1) Install Storm Sewer Outfall Access Barrier, COP Dtl No. P1562 & P1563	EA	1
(21) Riprap Drainage Ditch, See Dtls on Sheet SD32	Cyd	156

SHEET NOTES:

1. For Maintenance Access Road Paving Plan, See Sheet DS 09.
2. For Indian Bend Wash Grading, See Grading Plans.
3. For Connector Pipe Profiles, See Sheet SD 23.
4. Catch Basins Off-Sets Are From Construction Centerline to Center of Structures.

STORM DRAIN PLANS
MAINTENANCE ACCESS ROAD

DATE | REVISION | BY

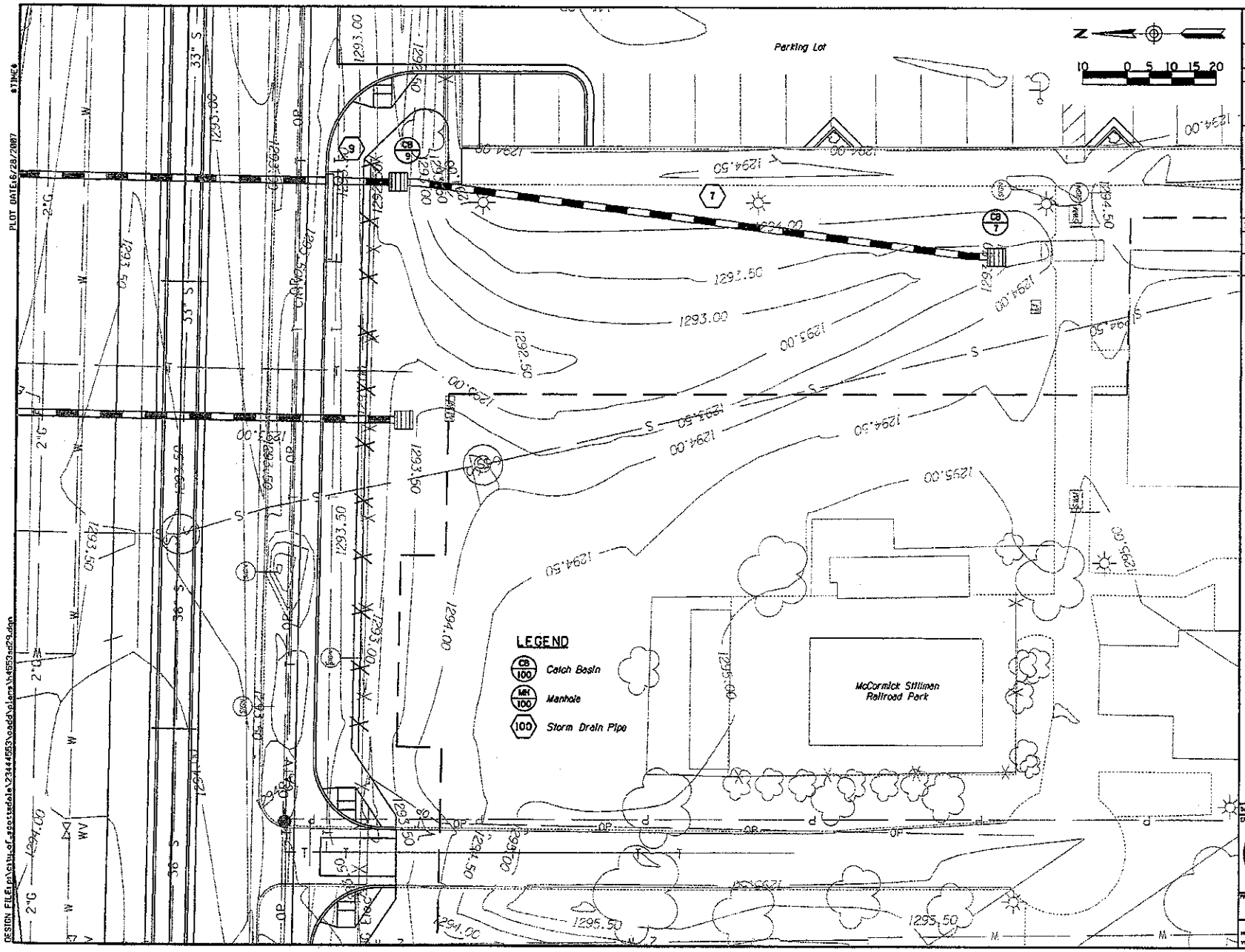
ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=	DNJ	06/07		SD16
VERT.	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE:p:\city_of_scottsdale\23444553\acad\plans\h4553sd18.dgn
PLOT DATE:6/28/2007 @TIME@



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CATCH BASINS

CB No.	Station	Type	Offset
7	28+23	MAG Dtl 537, Type G, Single COS Dtl 2530-3 COS Dtl 2535	47.7' Rt (Center)
9	28+08.9	MAG Dtl 537, Type G, Single COS Dtl 2530-3 COS Dtl 2535	182.6' Rt (Center)

PIPE

SD No.	Station	Size	Feet
7	28+23	18"	131.7
9	28+23 to 28+08.9	18"	12.0

SHEET NOTES

1. For Paving Plans, See Sheet PA05.
2. For Connector Pipe Profiles, See Sheet SD28.
3. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
4. For Utility Relocation Details, See Utility Plans.
5. Refer to Landscaping Plans for Grading & Turf Restoration.

Two working days before you dig, CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

STORM DRAIN PLANS
McCORMICK STILLMAN RAILROAD PARK

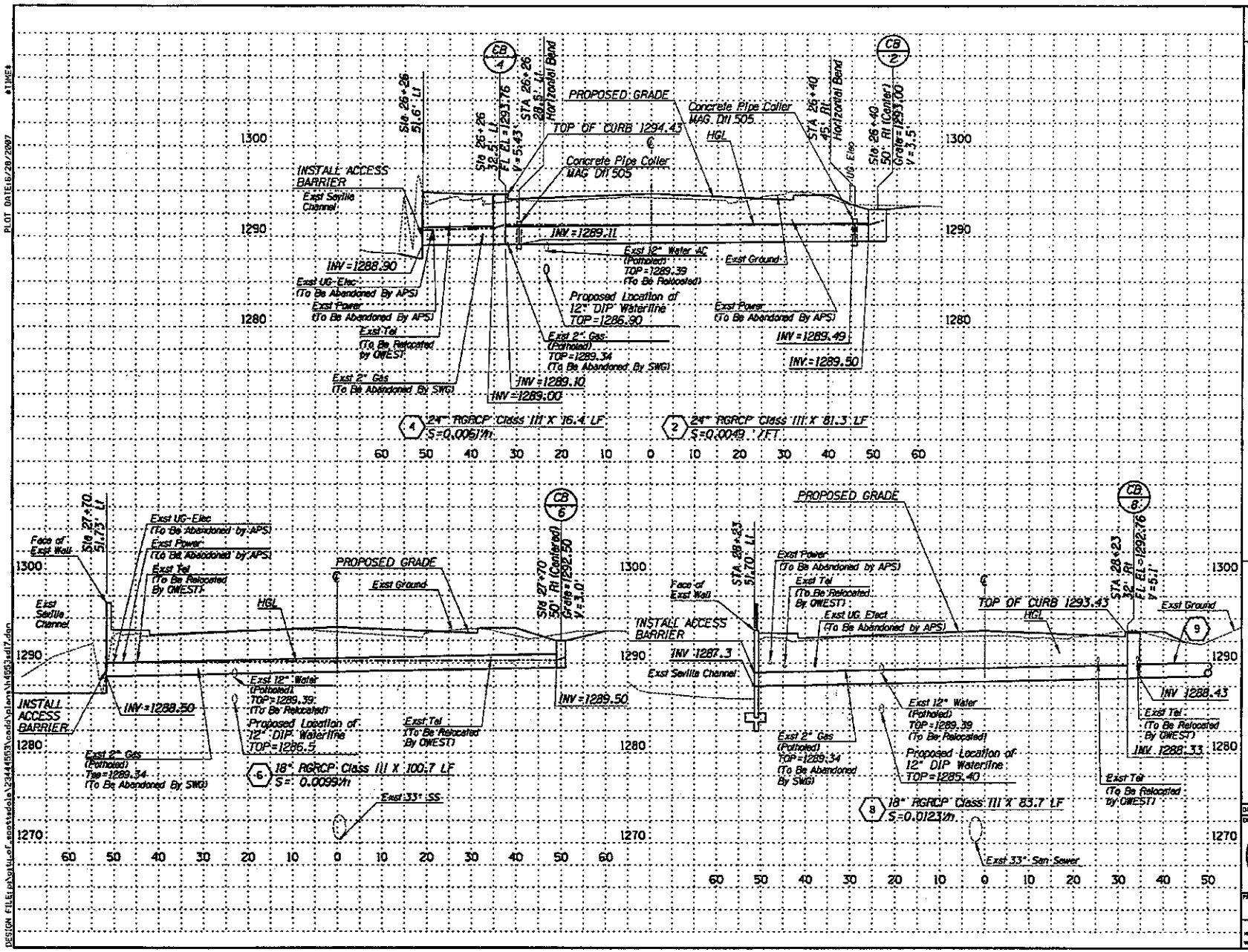
DATE	REVISION	BY

ENGINEER: 33993 DENNIS M. JERNEGAN, REGISTERED PROFESSIONAL ENGINEER, ARIZONA, U.S.A.

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORZ. 1"=10'	ONJ	06/07		SD17
VERT. N/A	DRAWN JS	AS-BUILT	MANAGER NO. 410-5-0402	OF



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SHEET NOTES:

1. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.
2. Final Relocation of APS, Southwest Gas, Qwest & Arizona American Water Company Underground Utilities Have Not Been Shown on The Profiles. Refer to Utilities Relocation Plans.

Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=10' VERT. 1"=5'	DNV	10/06		SD18
	DRAWN JS	AS-BUILT	PROJECT NO. 410-5-0402	OF

PLOT DATE:6/28/2007 #TIME#

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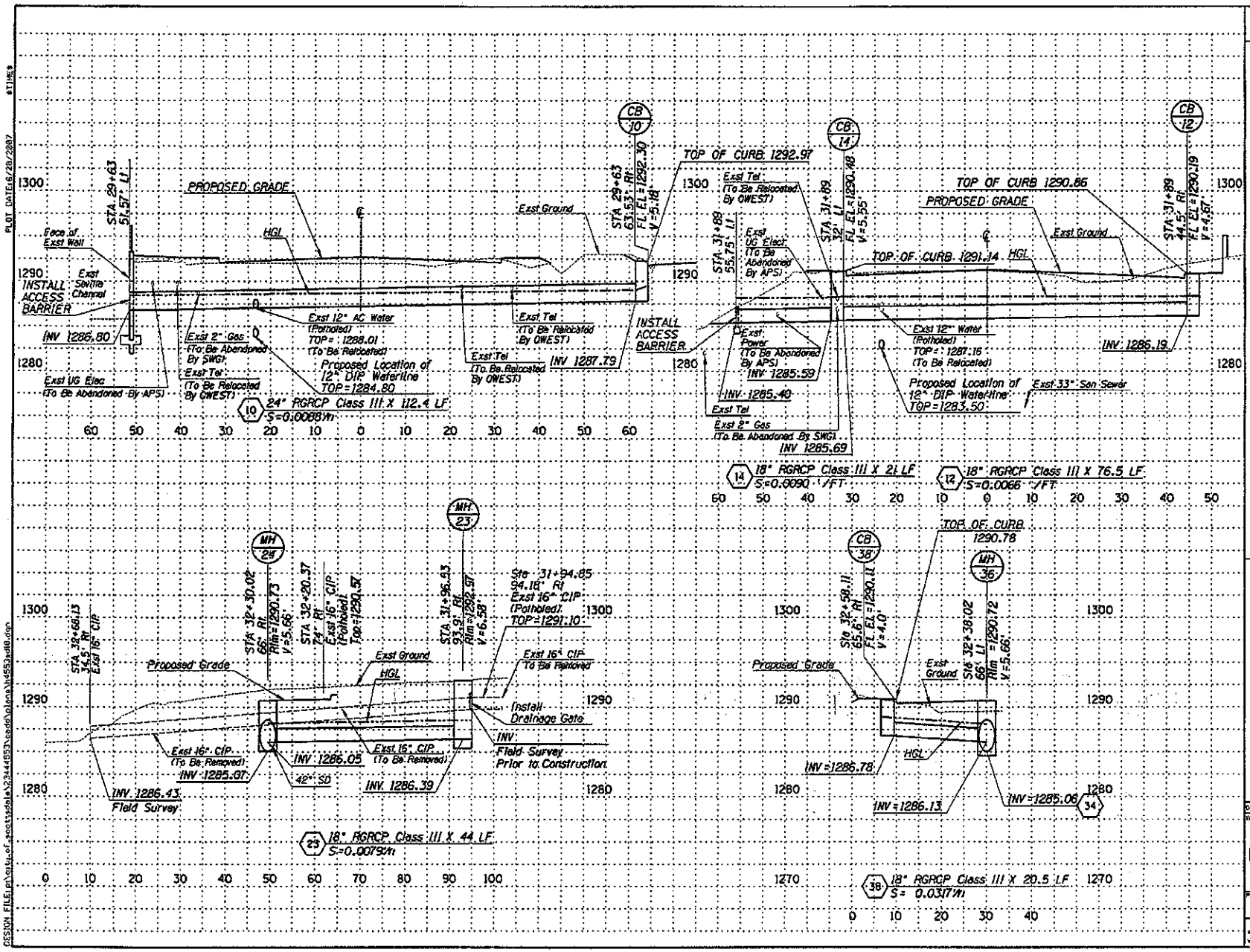

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DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT
HORIZ. 1"=10'	GNJ	10/06		SD19
VERT. 1"=5'	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE:6/28/2007 $TIME$

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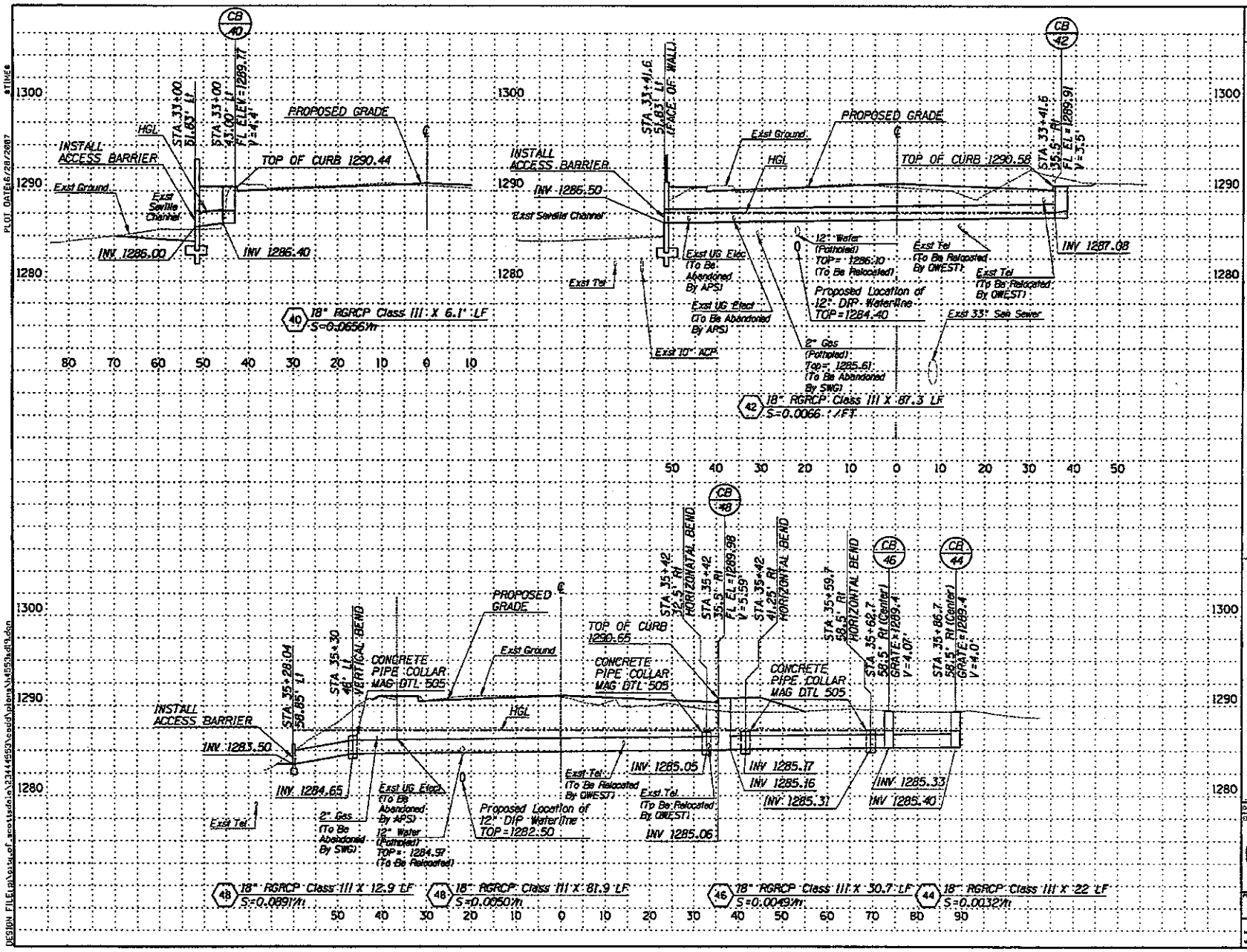

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SHEET NOTES:

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Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20' VERT. 1"=10'	DNJ	10/06		5020
	DRAWN JS	AS-BUILT	PROJECT NO. 410-5-0402	OF

PLOT DATE:6/28/2007 #TIME
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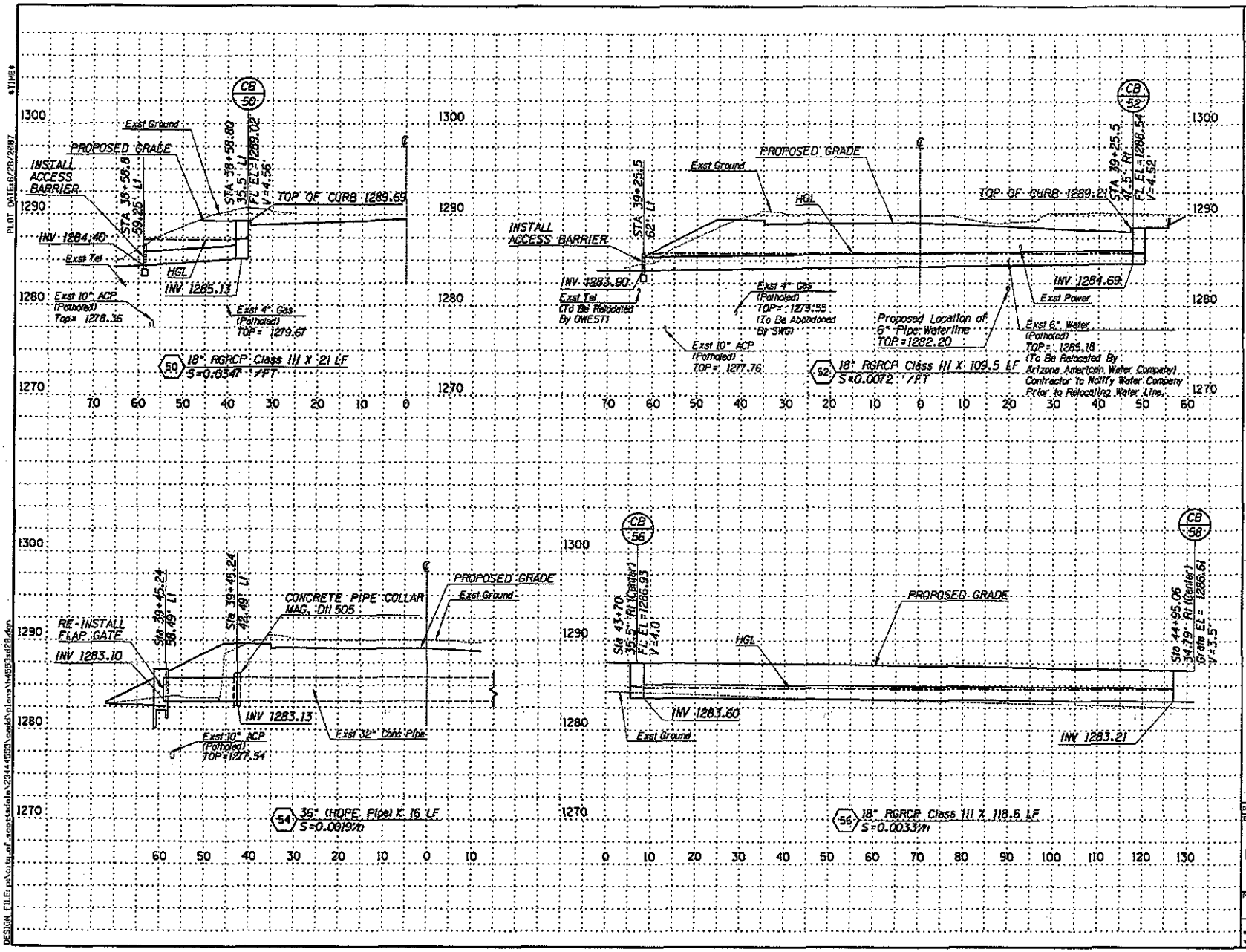

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Phoenix, AZ. 85020
(602) 371-1100

SHEET NOTES:

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Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DATE	REVISION	BY

ENGINEER: DENNIS R. SUMMERLAND

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	GO NO.	SHT.
HORIZ. 1"=20'	DNJ	10/06		SD21
VERT. 1"=10'	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

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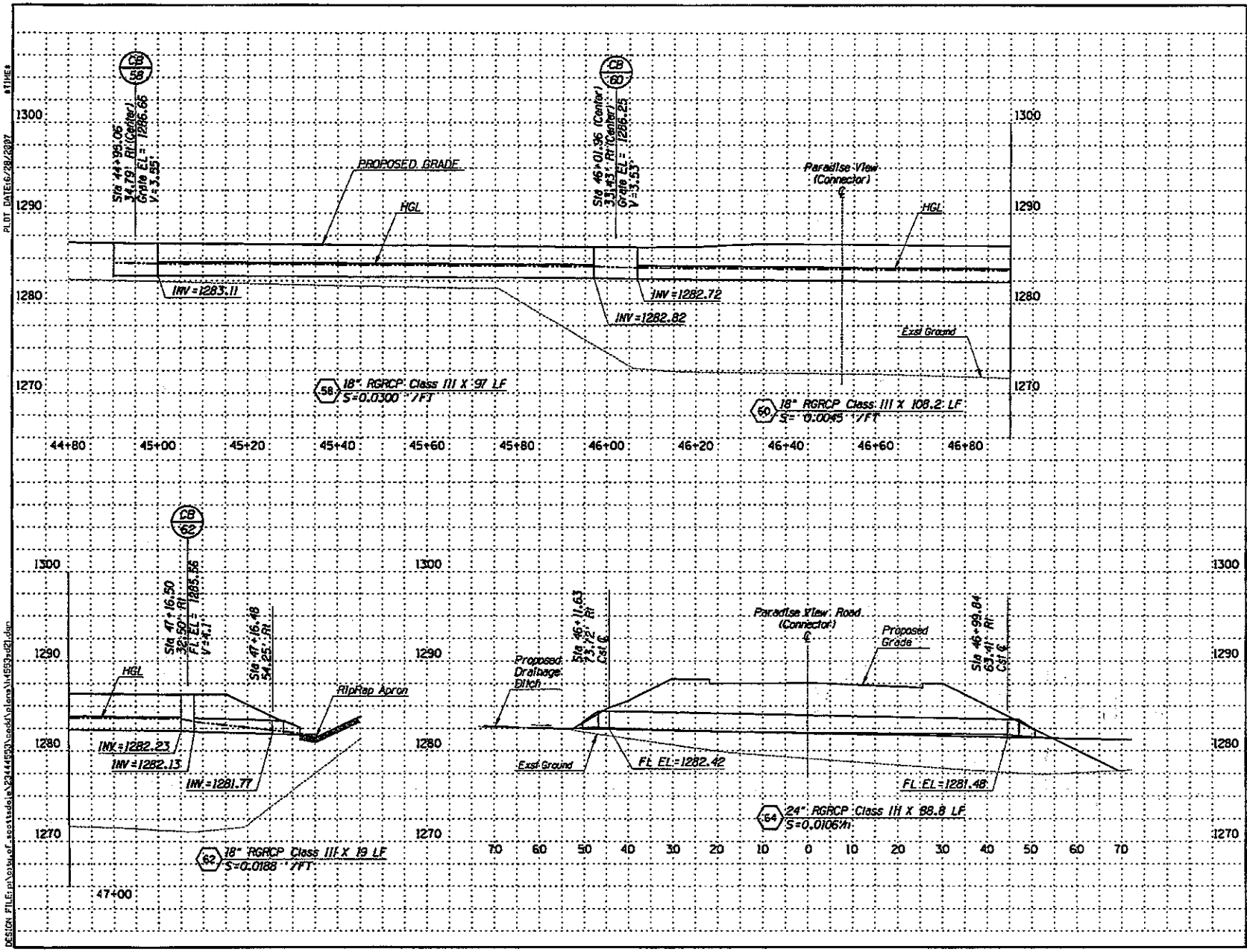
PLOT DATE: 6/28/2007 TIME:



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SHEET NOTES:

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Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DNJ	10/06		SD22
VERT. 1"=10'	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE:6/28/2007
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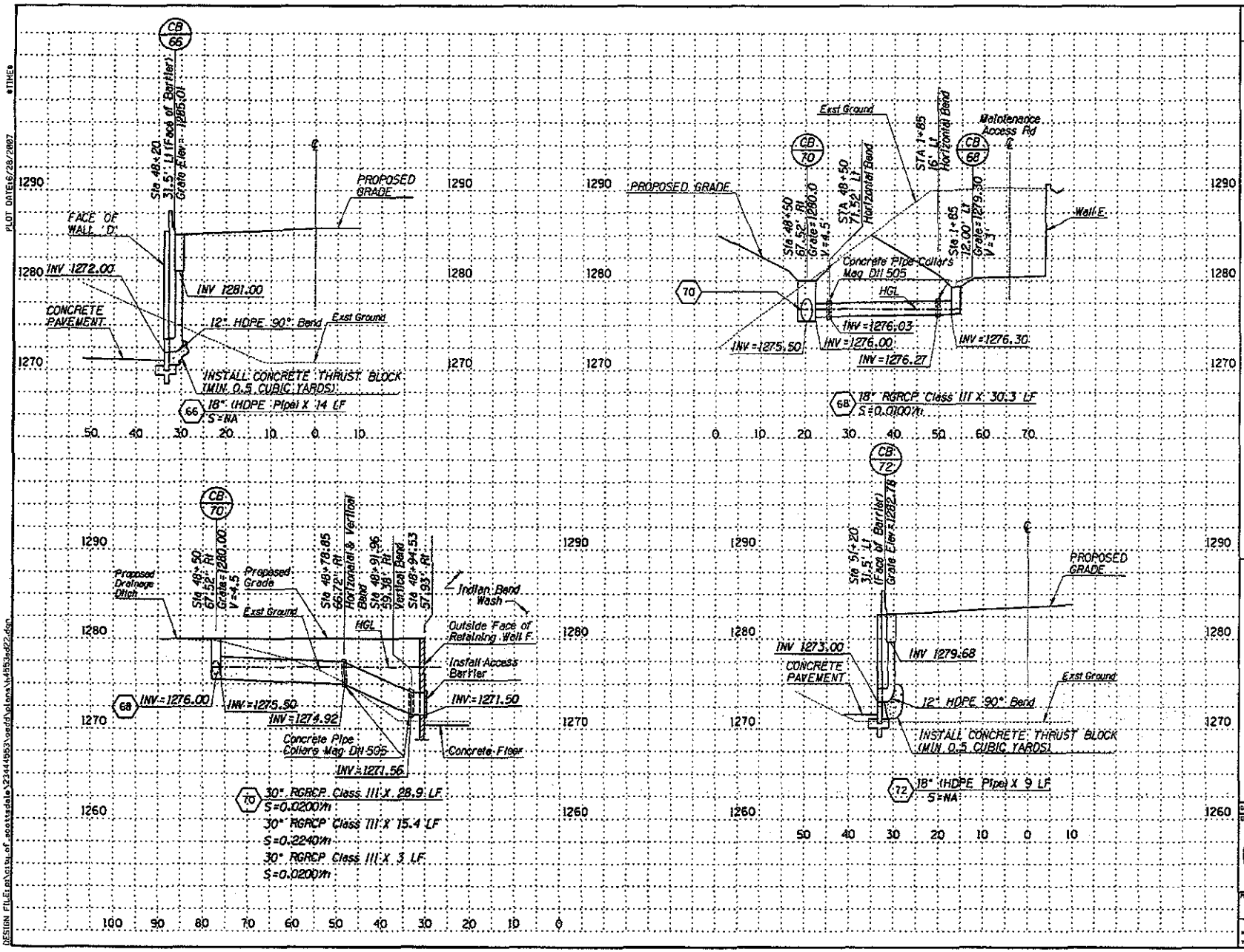

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SHEET NOTES:

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Two working days before you dig, CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DNJ	10/06		S023
VERT. 1"=10'	DRAWN JS	AS-BUILT	PROJECT NO. 410-5-0402	OF

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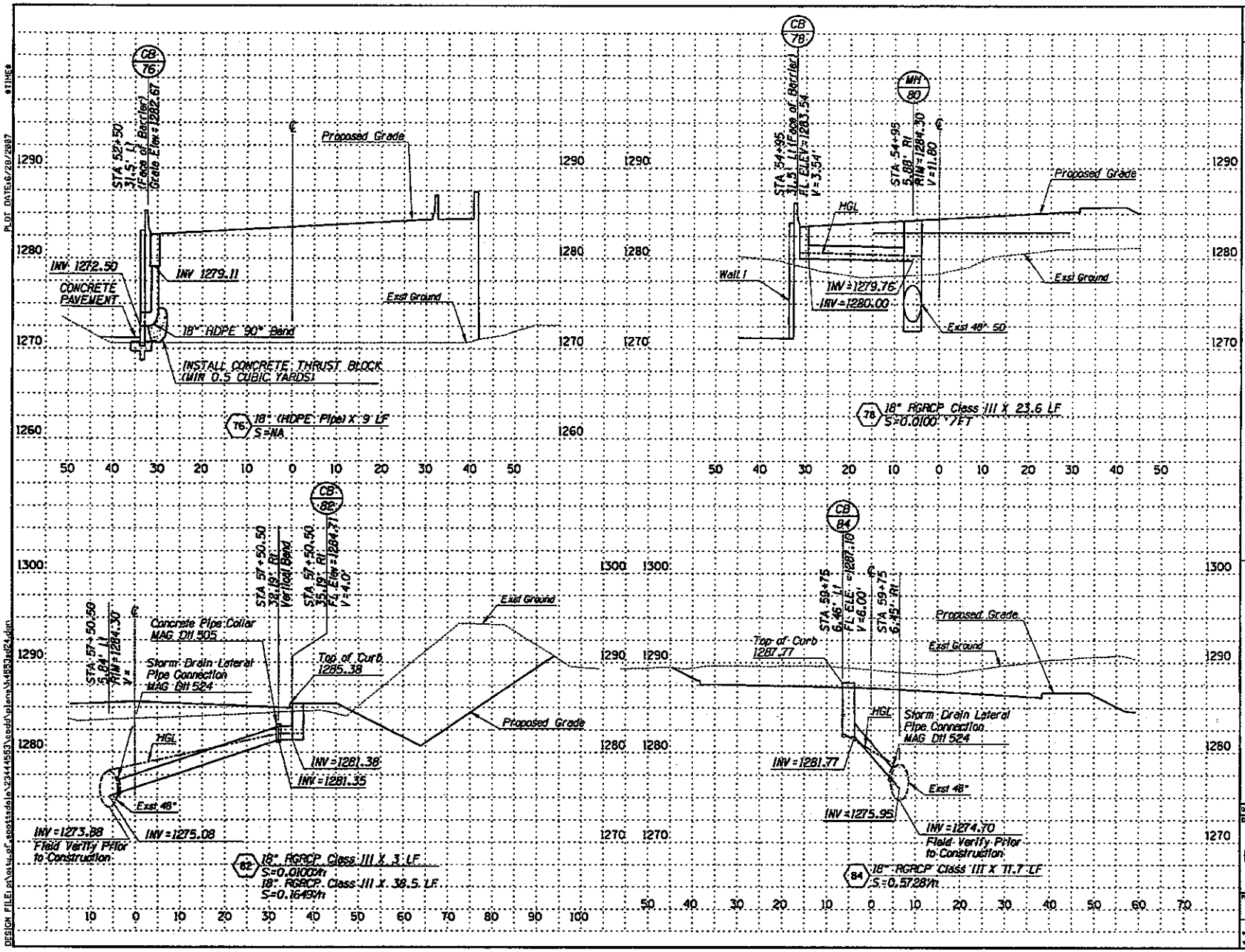

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(602) 371-1100

SHEET NOTES:

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Two working days before you dig, CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	SHT NO.	SHT.
HORZ. 1"=20'	DNJ	10/06		5024
VERT. 1"=10'	DRAWN SS	AS-BUILT	PROJECT NO. 410-S-0402	OF

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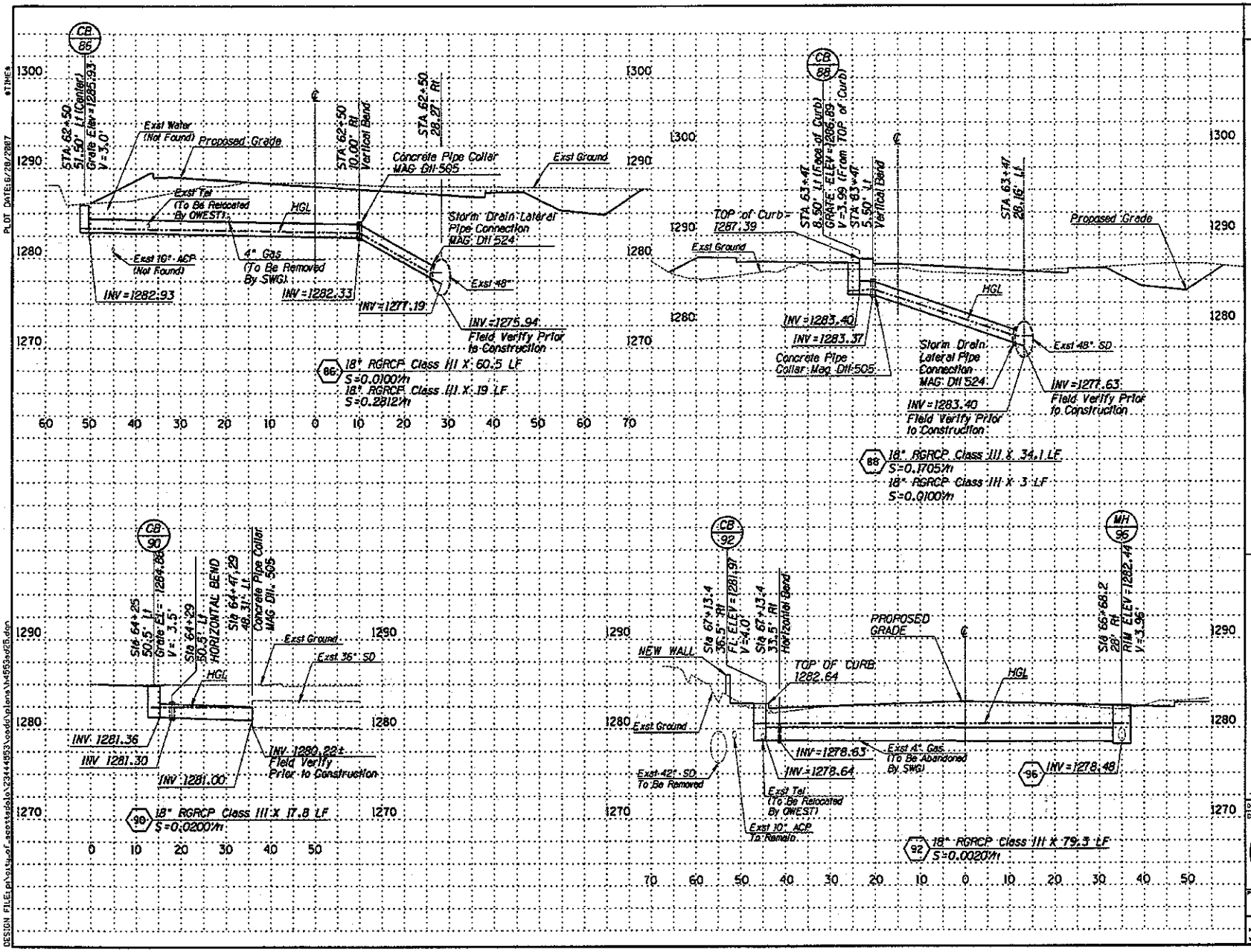
PLOT DATE: 6/20/2007



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SHEET NOTES:

1. Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb. Unless Otherwise Noted.
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Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DNJ	10/05		5025
VERT. 1"=10'	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE:6/28/2007 *TIME*

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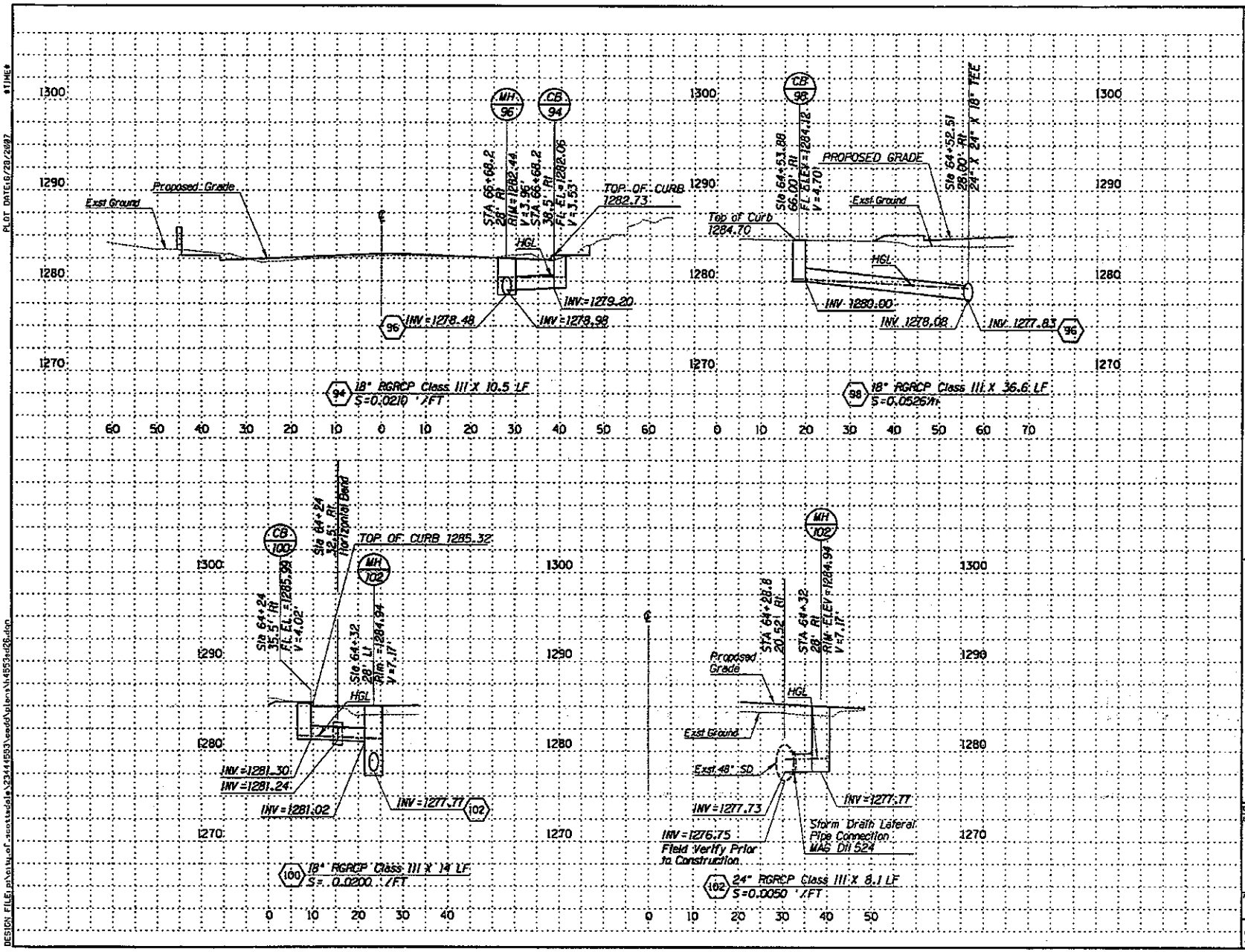

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Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20' VERT. 1"=10'	DNJ	10/06		5026
	DRAWN JS	AS-BUILT	PROJECT NO. 410-5-0402	OF

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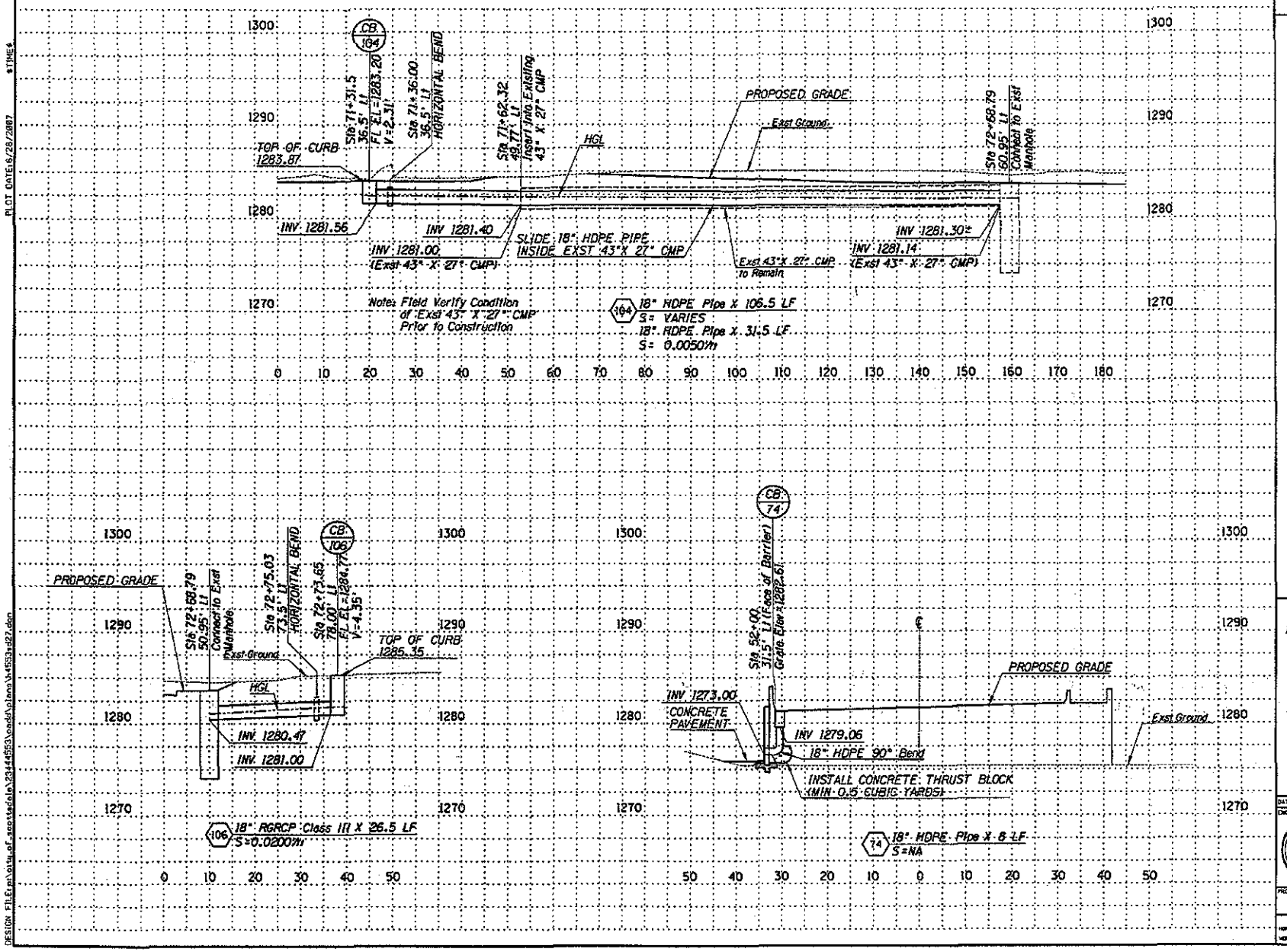
PLOT DATE:6/28/2007



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(602) 371-1100

SHEET NOTES:

1 Catch Basin Off-Sets Are From Construction Centerline To Back Of Curb, Unless Otherwise Noted.

Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DAN	10/06		5021
VERT. 1"=10'	DRAWN JS	12-06-07	PROJECT NO. 410-S-0402	OF

PLOT DATE: 6/28/2007 $TIME$
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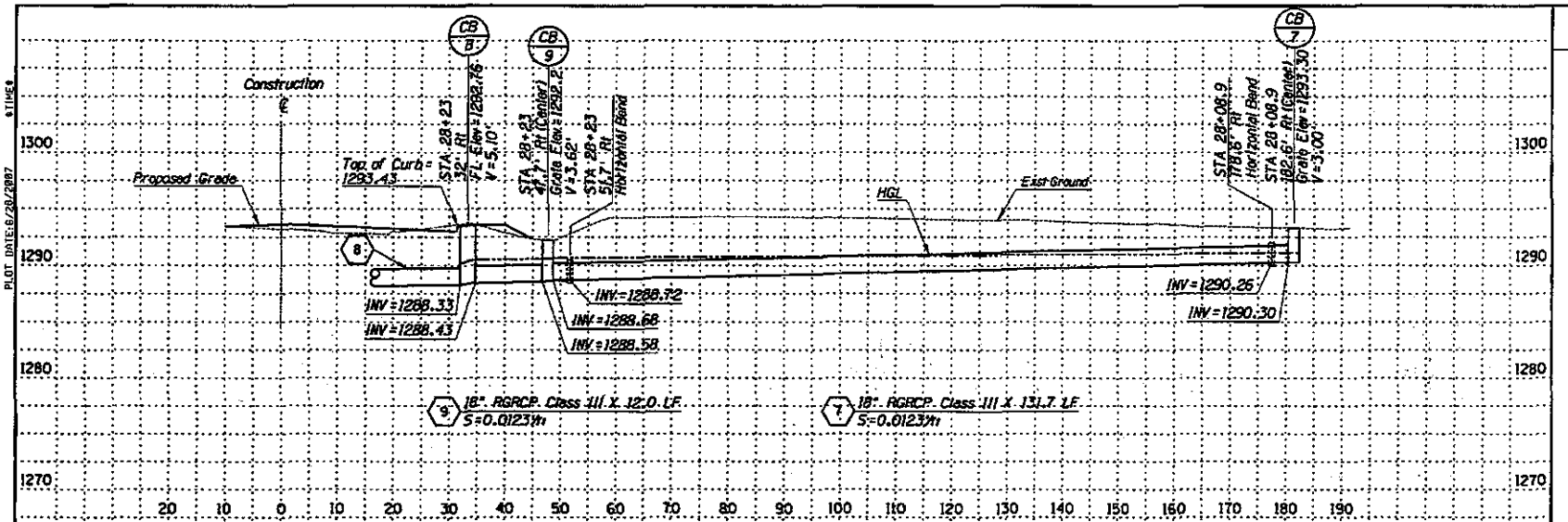

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7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

SHEET NOTES:

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Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORZ. 1"=20'	DMJ	10/06		SD28
VERT. 1"=10'	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE: 6/28/2007 *TIME*

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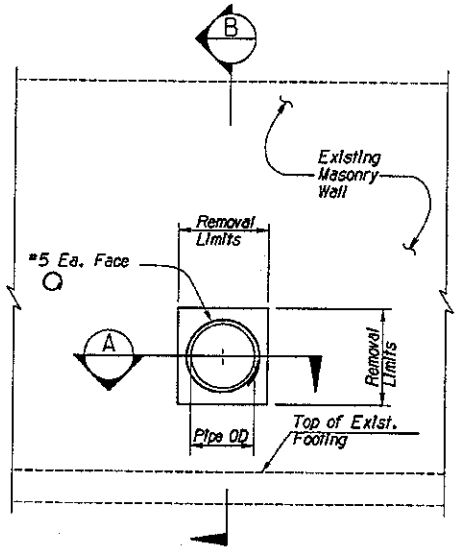
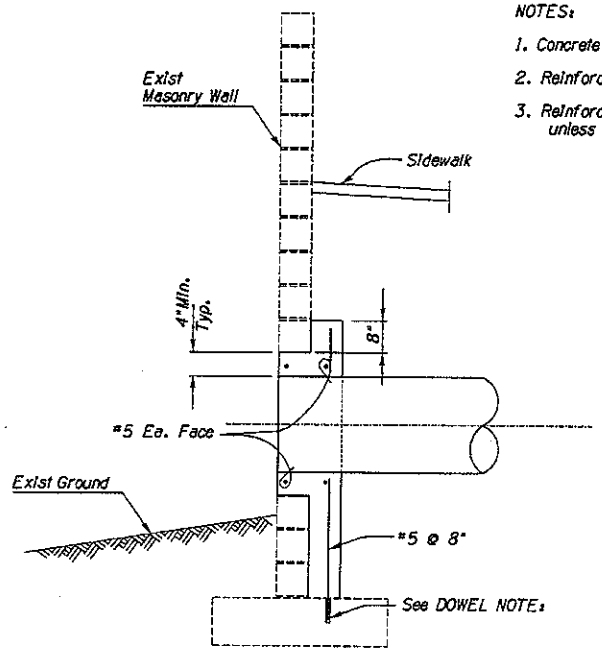


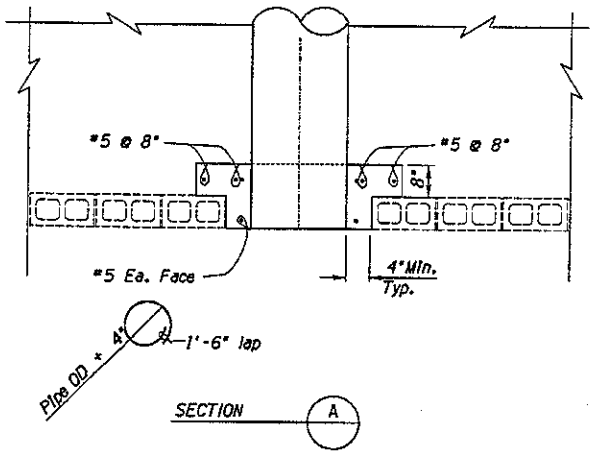
ELEVATION - NEW PIPE THROUGH EXIST. WALL



SECTION B

NOTES:

1. Concrete shall be class 'A' f'c = 3000 psi.
2. Reinforcing steel shall be ASTM A615 Grade 60.
3. Reinforcing bars shall have 2" clear cover unless noted otherwise.



SECTION A

DOWEL NOTE:

Drill ¾ inch diameter hole 6 inches deep for #5 dowel. Epoxy dowel in hole with an approved epoxy adhesive. Epoxy anchorage shall develop a tensile pullout strength of 18 kips for #5 dowels. Details of the anchorage system shall be submitted to the Engineer for approval prior to installation.

URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

Two working days before you dig, CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE 06/07	SHEET 5029
HORIZ. 1"= VERT.	DRAWN	AS-BUILT	PROJECT NO. 410-5-0402

PLOT DATE: 6/28/2007 $TIME$

DESIGN FILE: P:\City of Scottsdale\23445523\pedd\Plans\h4553ad23.dgn

URS
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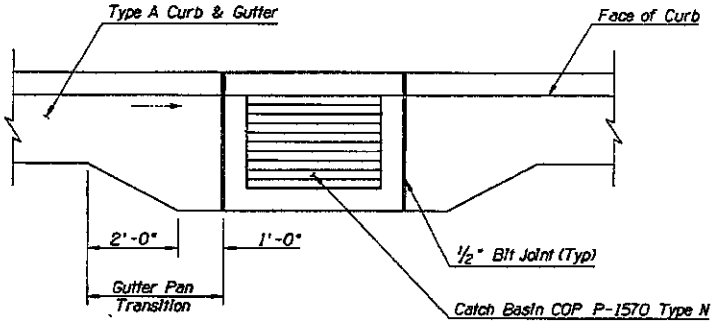
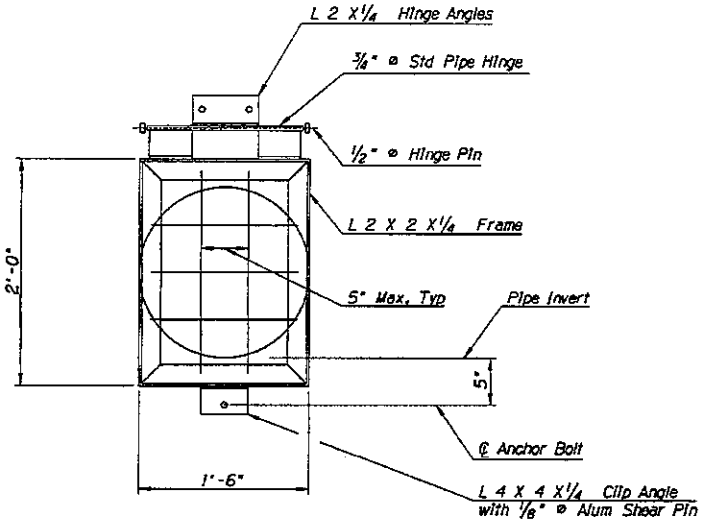
Phoenix, AZ. 85020
(602) 371-1100



CURB & GUTTER TRANSITION DETAIL
3/4" = 1'-0"

Note: See COS Std Dtl 2562 for Add'l Notes, Dims and Details not Shown



SPECIAL ACCESS BARRIER AT 18" Φ PIPE
NTS

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CALL FOR UNE BLUE STAKES
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Blue Stake Center

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=		5/07		S030
VERT.	DRAWN	AS-BUILT	PROJECT NO.	OF

DESIGN FILE: phoenix, of-scottsdale\23444553\esdd\plans\k4553d\02.dgn PLOT DATE: 6/28/2007 $TIME$

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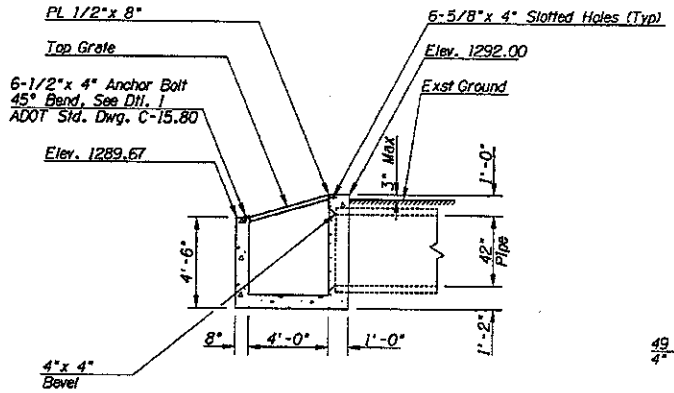
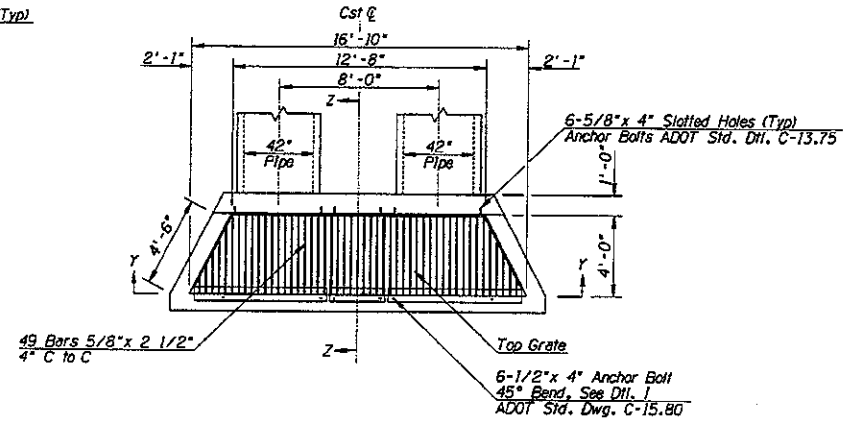
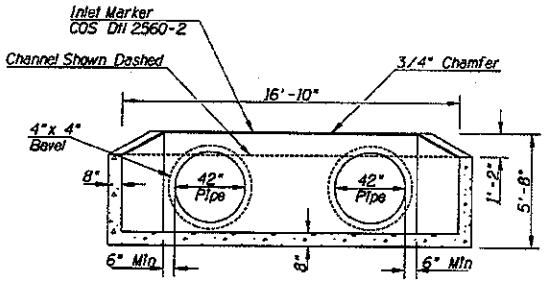
Phoenix, AZ. 85020
(602) 371-1100



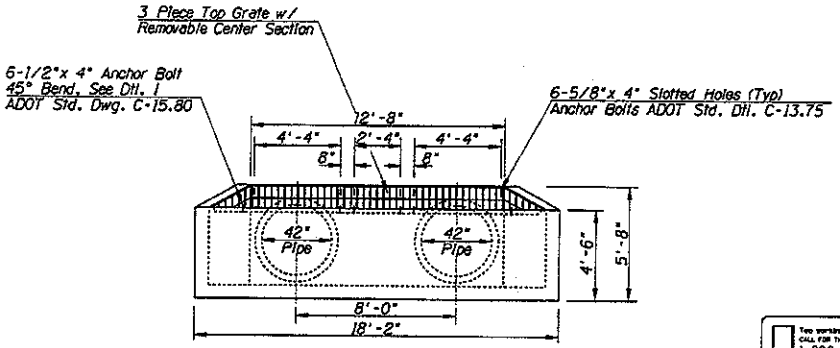
SECTION Z-Z



PLAN



SECTION Y-Y



ELEVATION

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Blue Stake Center

SPECIAL DROPSTRUCTURE

Notes:
1. All Concrete Shall be Class A.
2. For Drop Inlet Reinforcing, See ADOT Std. Dwg. C-15.75.
3. Bell End of Concrete Pipe May Replace Bevel.
4. Grate Similar to ADOT Std. Dwg. C-15.80. Bar Spacing 4" C to C.

DATE	REVISION	BY

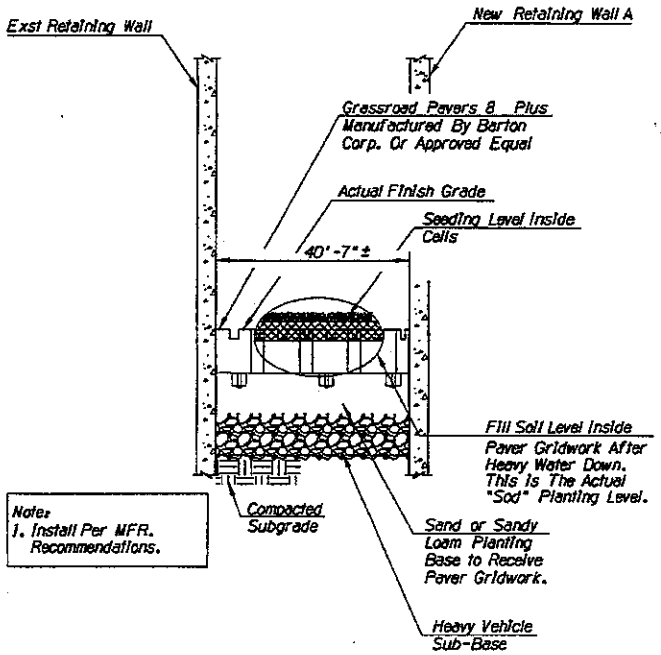
ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

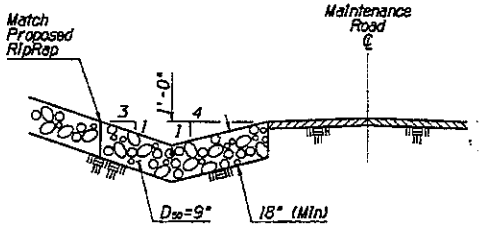
SCALE	DESIGNED	DATE	DWG NO.	SHT.
HORIZ. 1"=		5/07		5031
VERT.	DRAWN	AS-BUILT	PROJECT NO.	OF

DESIGN FILE: p:\city_of_scottsdale\23446563\coadd\plans\4-65524d03.dgn
PLOT DATE: 6/28/2007 $TIME$

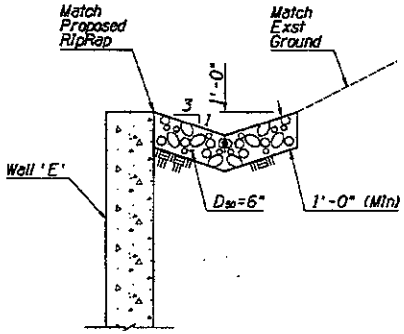


Note:
1. Install Per MFR. Recommendations.

GRASSROAD PAVERS



MAINTENANCE ROAD DRAINAGE DITCH
Sta 1+00 to 2+80



WALL 'E' INTERCEPTOR DITCH
Sta 2+00 to 3+59

URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

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DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=		06/07		5032
VERT.	DRAWN	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE: p:\city_of_scottsdale\23444553\addd\plans\h4053rd28.dgn
PLOT DATE: 6/20/2007

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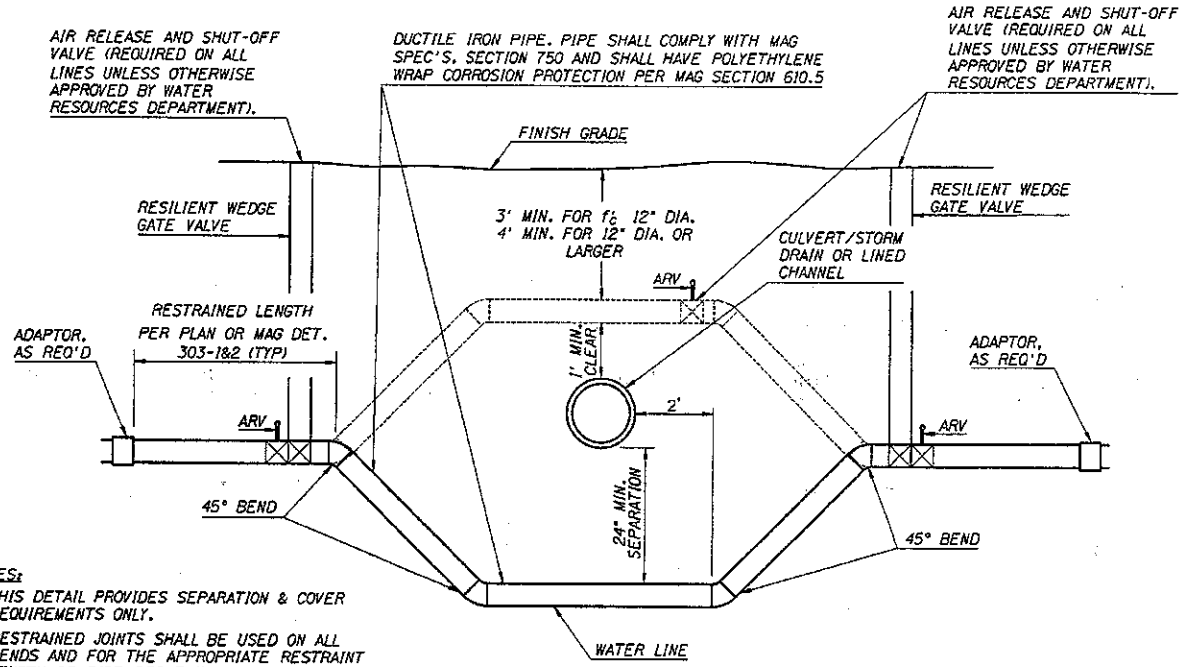


NOTES:

1. THIS DETAIL PROVIDES SEPARATION & COVER REQUIREMENTS ONLY.
2. RESTRAINED JOINTS SHALL BE USED ON ALL BENDS AND FOR THE APPROPRIATE RESTRAINT LENGTH OF PIPE PER THE MANUFACTURERS SPECIFICATION.

VERTICAL REALIGNMENT OF WATER MAINS (C.O.S. STD. DETAIL 2370)

Scale: 3/8"=1'-0"

WATER LINE RELOCATIONS AND RECONSTRUCTION SCHEDULE

Storm Drain Pipe	Station (Off-Set)	Size	Existing Top of Pipe Elevation	Proposed Top of Pipe Elevation	Remarks
4	26+27.69, 23.1' Lt	12"	1289.39	1286.90	Vertical Relocation. See Detail This Sheet Reference Profile on Sht SD18
6	27+70.00, 23.4' Lt	12"	1289.39	1286.50	Vertical Relocation. See Detail This Sheet Reference Profile on Sht SD18
8	28+23. 23.4' Lt	12"	1289.39	1285.40	Vertical Relocation. See Detail This Sheet Reference Profile on Sht SD18
10	29+63. 23.29' Lt	12"	1288.01	1284.80	Vertical Relocation. See Detail This Sheet Reference Profile on Sht SD19
14	31+89. 23.45' Lt	12"	1287.16	1283.50	Vertical Relocation. See Detail This Sheet Reference Profile on Sht SD19
42	33+41.6. 23.50' Lt	12"	1286.10	1283.40	Vertical Relocation. See Detail This Sheet Reference Profile on Sht SD20
48	35+33.5. 21.93' Lt	12"	1284.97	1282.50	Vertical Relocation. See Detail This Sheet Reference Profile on Sht SD20
52	39+25.5. 19.72' Rt	6"	1285.70	1283.10	Vertical Relocation. See Detail This Sheet Reference Profile on Sht SD21
24 & 36	32+69.3/ 32+77.3. 22.1' Lt	12"	N/A	1282.20	Vertical Relocation. See Detail This Sheet Reference Profile on Sht SD15

DATE	REVISION	BY

ENGINEER: 23395 DONALD K. JERMELAND

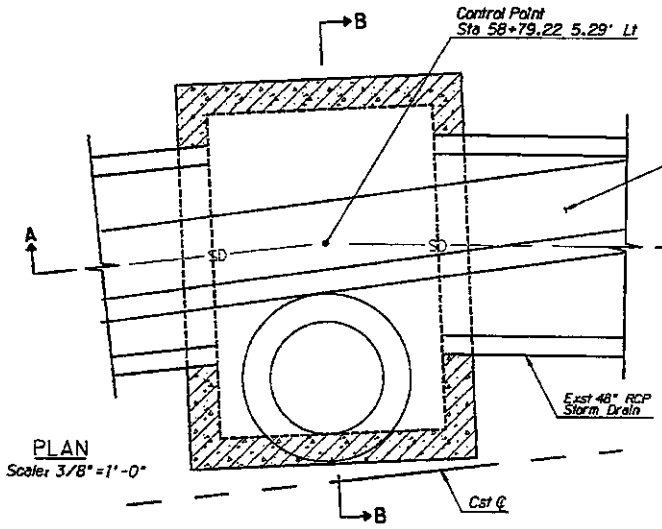
MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: SOBOBA Indian Bend Wash Hydraulic Plan & Profile For Left Bank Proposed Conditions

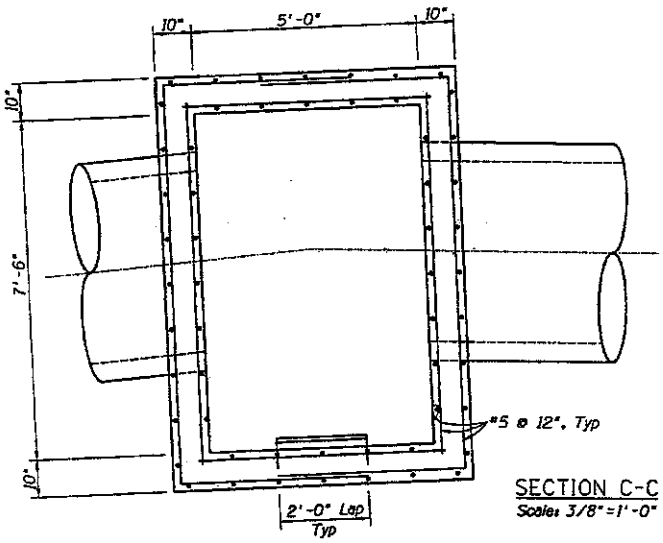
SCALE	DESIGNED	DATE	SHT. NO.	SHT.
HORIZ. 1"=1'-0"	DNJ	04/07	SD33	
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE: p:\city_of_scottsdale\23441553\cadd\plans\h4553ed30.dgn PLOT DATE:6/28/2007 TIME:

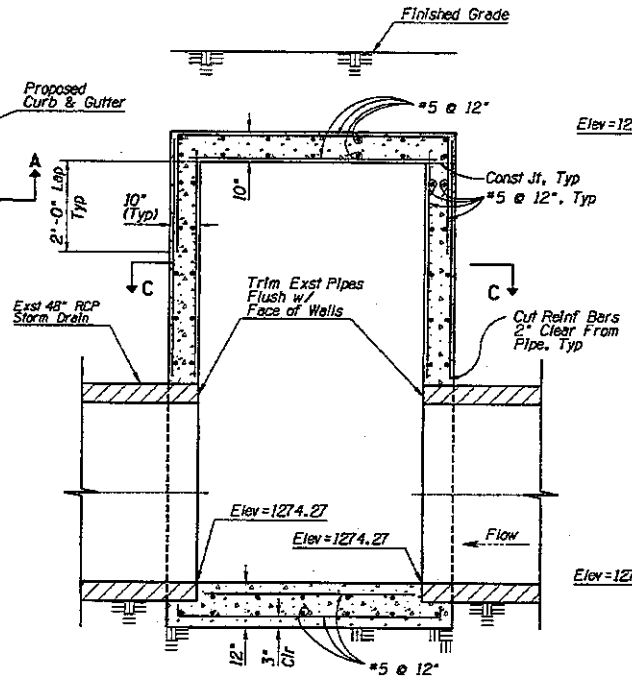
URS



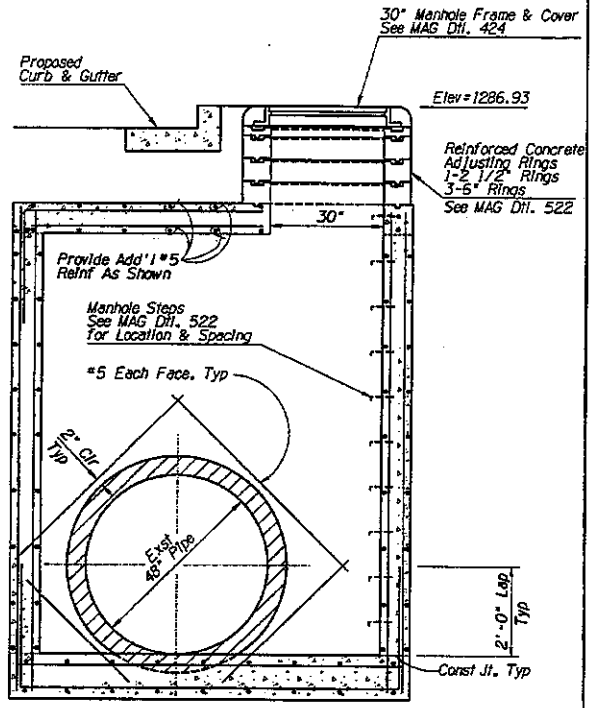
PLAN
Scale: 3/8"=1'-0"



SECTION C-C
Scale: 3/8"=1'-0"



SECTION A-A
Scale: 3/8"=1'-0"



SECTION B-B
Scale: 3/8"=1'-0"

Notes:

1. Materials:
   Class 5 Concrete 3000 psi
   Reinforcing Steel ASTM A615 Grade 60
2. All Reinforcing Shall Be Placed 2" Clear, Unless Noted Otherwise.

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Exhibit 6A
Indian Bend Wash
Hydraulic Plan & Profile
For Left Bank Improved Conditions

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORZ. 1"=1'-0"	DNJ	04/07		SD34
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE: 6/28/2007 TIME:

DESIGN FILE: f:\pm\city of scottsdale\23444593\cpd\plans\w4593sd89.dgn

URS
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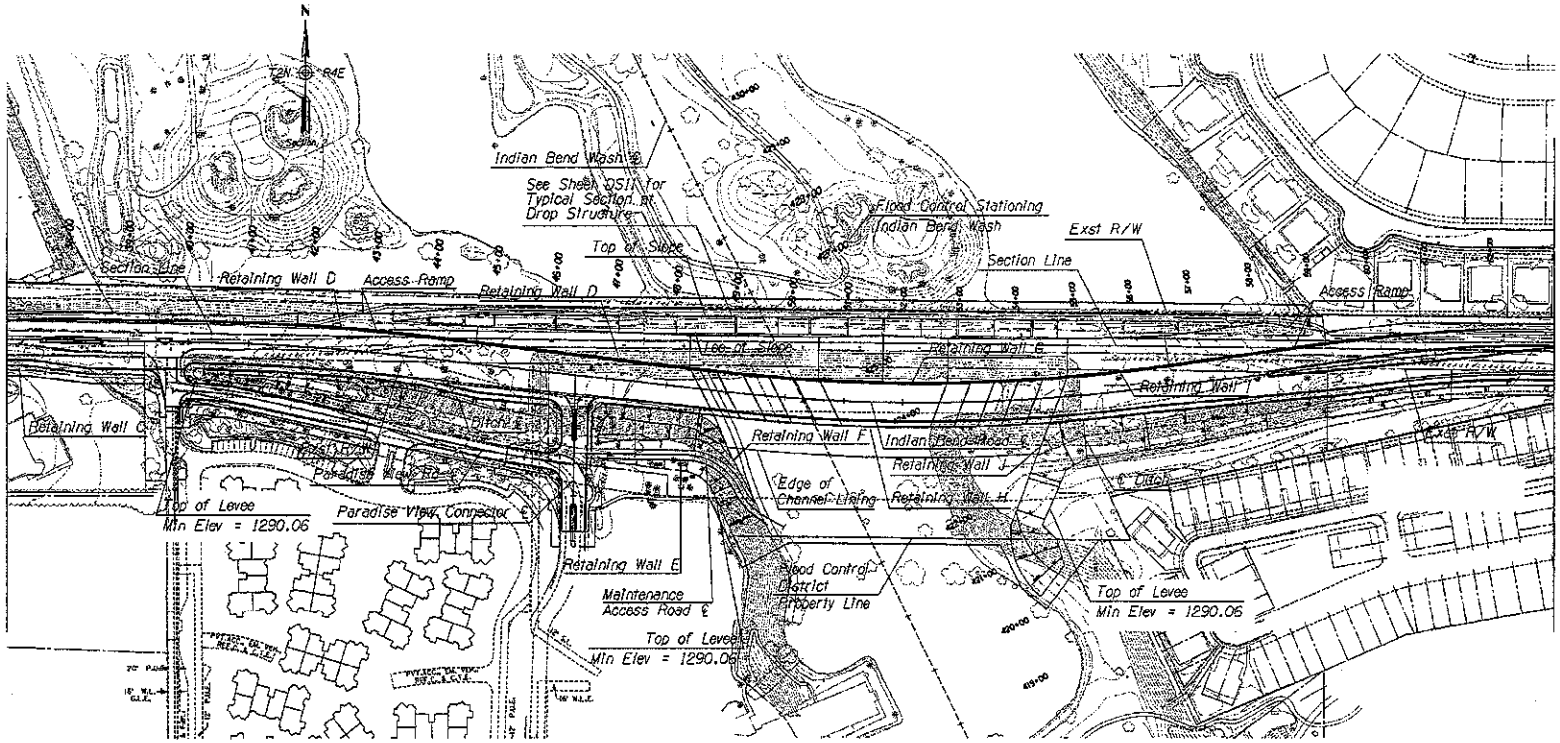
Phoenix, AZ, 85020
(602) 371-1100



Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

1. Contractor must obtain necessary District Permit prior to commencement of construction with District right-of-way and maintain a copy of the permit on the project site at all times.
2. Notify the District's Permit Inspector at 602-506-4727 or 602-506-4723 at least 48 hours prior to any work being performed in the District's right-of-way.
3. Contractor performing excavation operations is responsible for locating and protecting all underground utilities.
4. All compaction and backfill within District's right-of-way shall conform to the latest MAG Specifications unless stipulated otherwise in the District's Permit.
5. Any damage to District's structures, equipment, materials, vegetation, and/or property shall be replaced and/or repaired in-kind to the satisfaction of the District.

BENCH MARKS

1. Indian Bend Rd & Scottsdale Rd
   MCED BC HH, Elev 1299.33'
   N 923523.229, E 697230.576
2. Indian Bend Rd & Hayden Rd
   COS BC HH, Down 0.25', Elev 1284.38'
   N 923450.201, E 702442.981

DROP STRUCTURE PLANS
STA 37+00 TO STA 63+00

DATE	REVISION	BY

ENGINEER: REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 22085 RANDALL D. BECK ARIZONA, U.S.A.

CITY OF SCOTTSDALE ARIZONA

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: **Indian Bend Road Improvements**
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=200'		5/07		DS01
VERT.	DRAWN	AS-BUILT	PROJECT NO. 410-5-0402	OF

PLOT DATE:6/29/2007 8:15:21 AM
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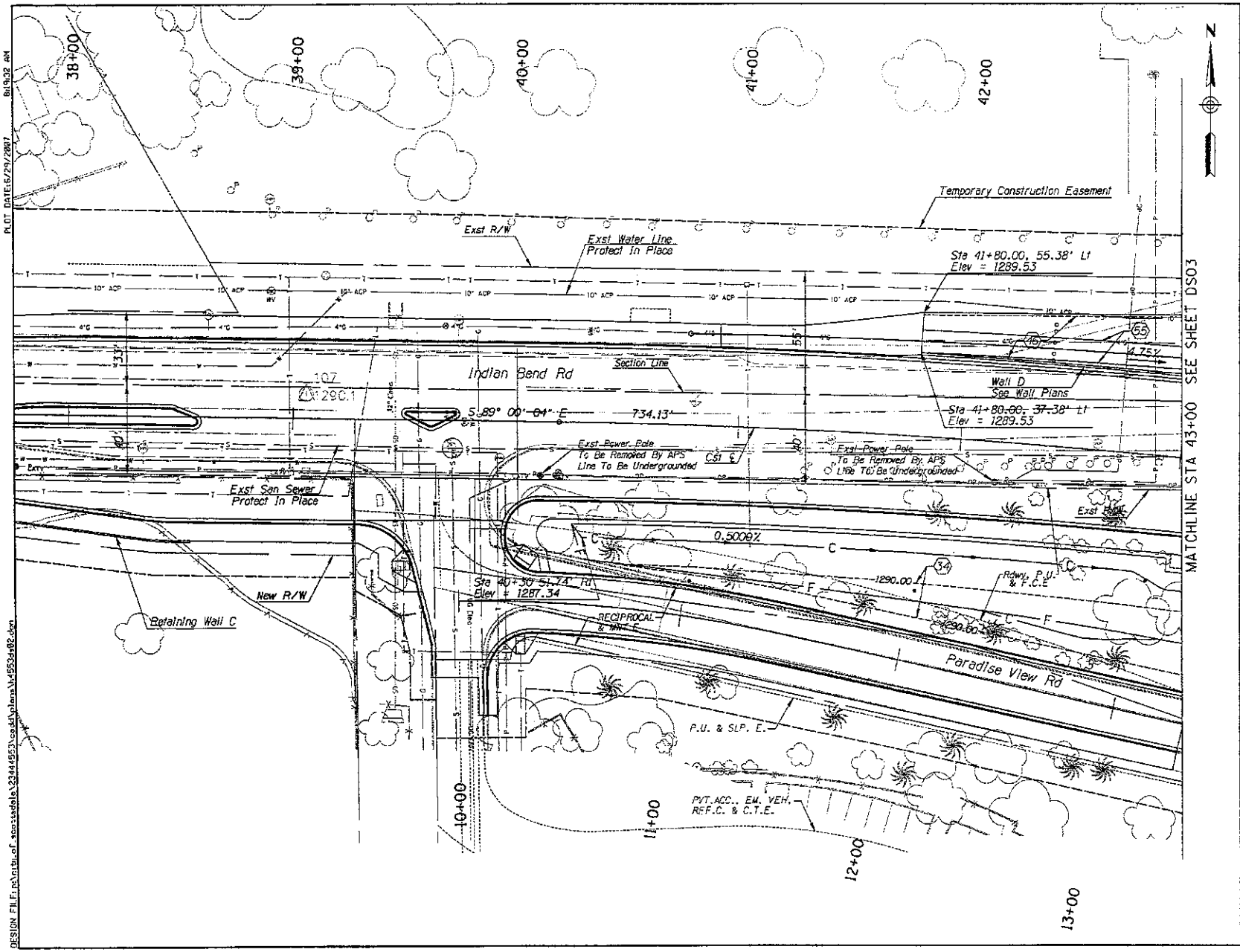


URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

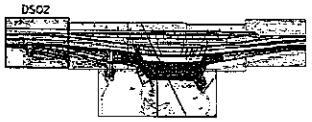
CONSTRUCTION NOTES

Description	Unit	Quan
(34) Reconstruct Levee to Grades as Shown on plans.		
(46) Construct New Drop Structure See Sheet DS10 & DS11	SY	289
(55) Multi-Use Path Shall Have a Broom Finish. All Other Drop Structure Areas to Be Exposed Aggregate Finish.		

SHEET NOTES:

1. For Retaining Wall Quantities, See Retaining Wall Plans, Sheet WA4 & WA5.
2. For On-Site Drainage, See Storm Drain Plans, Sheet SD05.

DS02



Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DROP STRUCTURE PLANS
STA 38+00 TO STA 43+00

DATE	REVISION	BY

ENGINEER: STEVEN RANDALL D. BECK

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: **Indian Bend Road Improvements Scottsdale Rd To Hayden Rd**

SCALE: HORIZ. 1"=20' VERT.	DESIGNED	DATE 06/07	DD NO.	SHT. DS02
	DRAWN	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE:6/29/2007 8:49:32 AM
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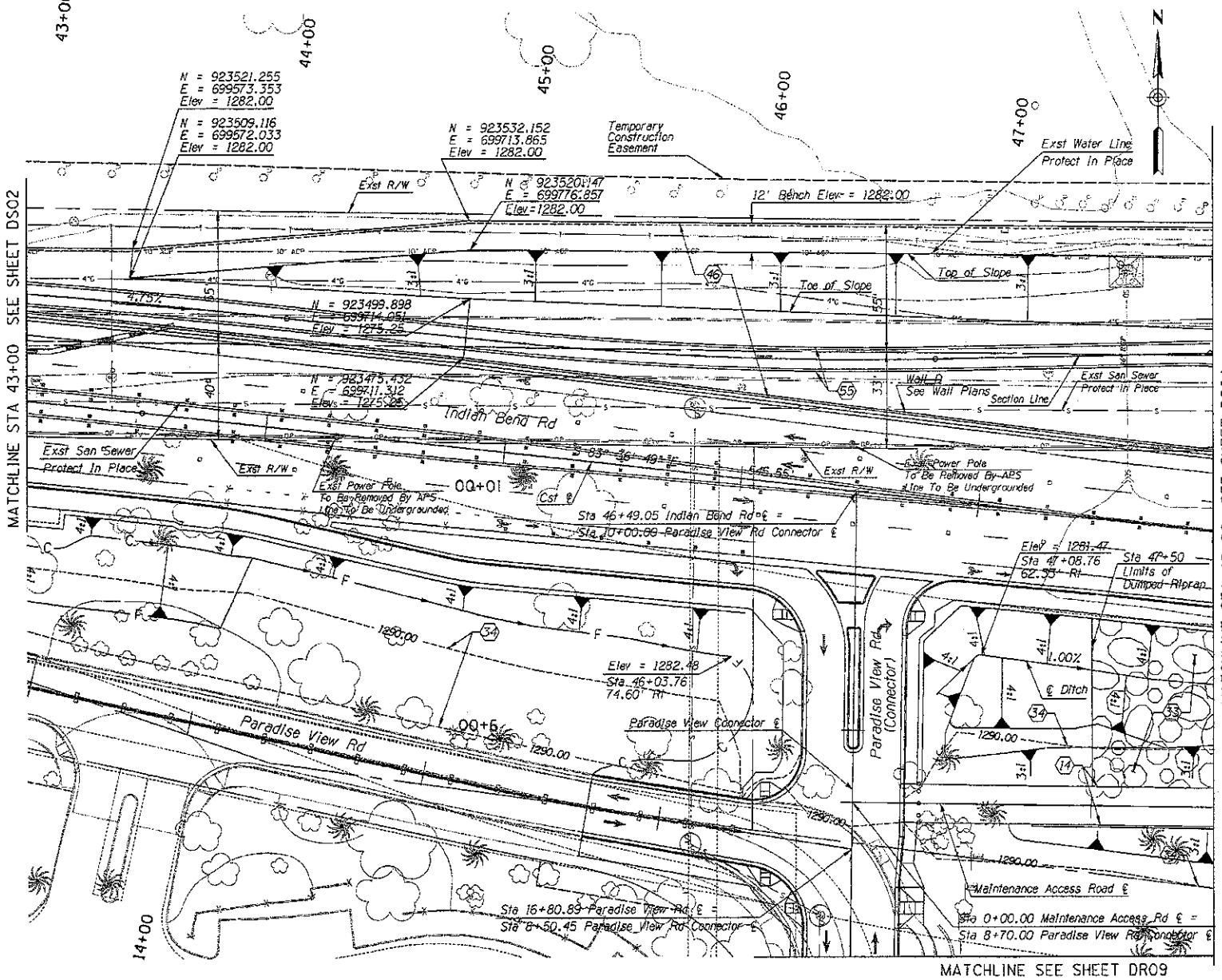


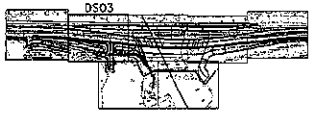
URS 7120 N. 16th Street, Suite 100, Phoenix, AZ, 85020, (602) 371-1100

CONSTRUCTION NOTES

Description	Unit	Quan
(14) Construct Maintenance Ramp See Sheets DS11		
(33) Install Dumped Riprap Depth = 18", D_{50}=9"	CY	200
(34) Reconstruct Levee to Grades as Shown on plans.		
(46) Construct New Drop Structure. See Sheet DS10 & DS11	SY	3485
(55) Multi-Use Path Shall Have a Broom Finish. All Other Drop Structure Areas to Be Exposed Aggregate Finish.		

SHEET NOTES:

1. For Retaining Wall Quantities, See Retaining Wall Plans, Sheet WA4 & WA5
2. For On-Site Drainage, See Storm Drain Plans, Sheet SD06.
3. For Maintenance Rd Quantities, See Drop Structure Plans, Sheet DS09.
4. For Layout of Multi-Use Path, See Drop Structural Plans Sheets DS14 & DS 15



Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DROP STRUCTURE PLANS
STA 43+00 TO STA 48+00

DATE	REVISION	BY

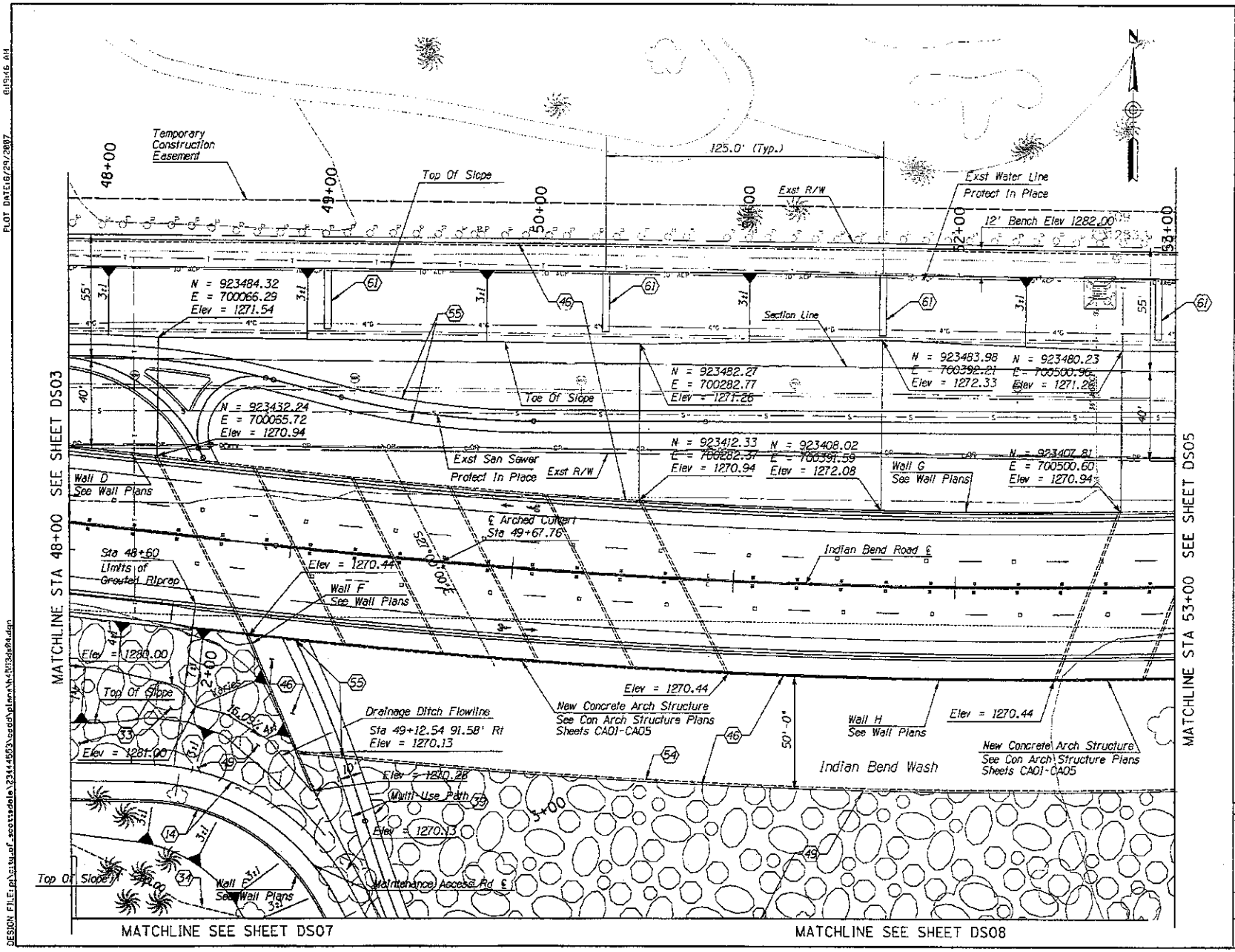
ENGINEER: 22953 RANDALL D. BLICK

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD. SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DS	06/07		DS03
VERT.	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE: p:\city_of_scottsdale\23444553\cadd\plans\h45534s83.dgn
PLOT: 06/16/29/2007 8:19:39 AM



URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

CONSTRUCTION NOTES

Description	Unit	Quan
(14) Construct Maintenance Ramp See Sheet DS09		
(33) Install Dumped Riprap Depth = 18", D_{50} =9"	CY	180
(34) Reconstruct Levee to Grades as Shown on plans.		
(39) Install 10' Multi-use Path, 8" Thick, MAG Std 230	SY	740
(46) Construct New Drop Structure. See Sheet DS10 & DS11	SY	8415
(49) Install Grouted Riprap Depth= 18", D_{50}=9"	CY	1380
(54) Install Concrete Toedown. See Sheet DS13		
(55) Multi-Use Path Shall Have A Broom Finish. All Other Drop Structure Areas to Be Exposed Aggregate Finish.		
(61) Construct Concrete Plinth See Sheet DS12	EA	4

SHEET NOTES:

1. For Retaining Wall Quantities, See Retaining Wall Plans, Sheet WA4, WA5 & WA6.
2. For On-Site Drainage, See Storm Drain Plans, Sheet SD07.
3. For Maintenance Rd Quantities, See Drop Structure Plans, Sheet DS09.
4. For Layout of Multi-Use Path, See Drop Structure Plans, Sheets DS14 & DS15.

Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DROP STRUCTURE PLANS
STA 48+00 TO STA 53+00

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	SHEET NO.	SHT.
HORZ. 1"=20'		06/07		DS04
VERT.	DRAWN	AS-BUILT	PROJECT NO. 410-5-0402	OF

DESIGN FILE:p:\city of scottsdale\23445653\cadd\plans\hh\hh133dsRd.dgn
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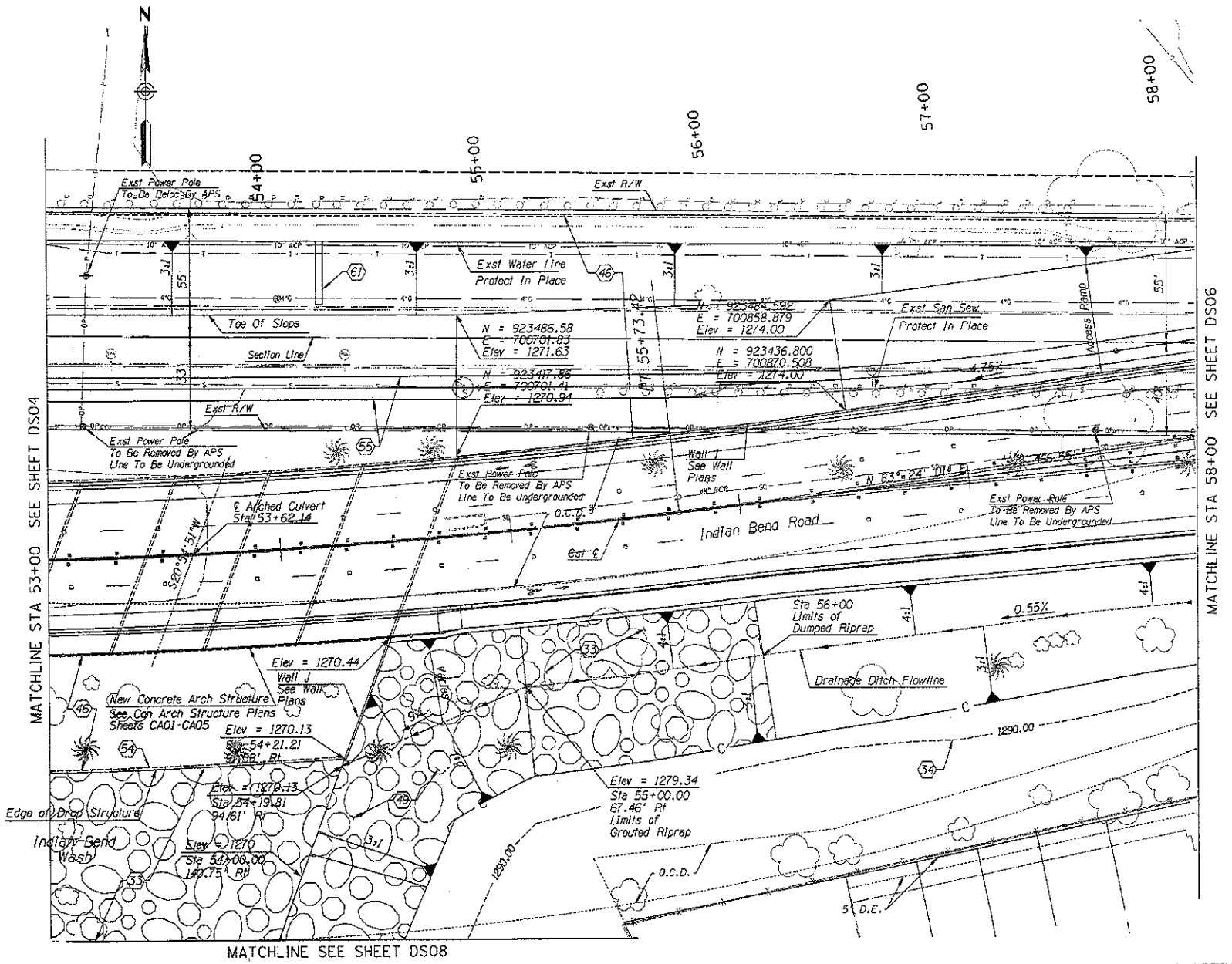


URS 7720 N. 16th Street, Suite 100, Phoenix, AZ. 85020, (602) 371-1100

CONSTRUCTION NOTES

Description	Unit	Quan
(53) Install Dumped Riprap Depth = 18", D_{50} = 9"	CY	370
(34) Reconstruct Levee to Grades as Shown on plans.		
(46) Construct New Drop Structure. See Sheet DS10 & DS11	SY	5978
(49) Install Grouted Riprap. Depth = 18", D_{50} = 9"	CY	930
(54) Install Concrete Toedown. See Sheet DS13		
(55) Multi-Use Path Shall Have A Broom Finish. All Other Drop Structure Areas to Be Exposed Aggregate Finish.		
(61) Construct Concrete Plinth See Sheet DS12	EA	1

SHEET NOTES:

1. For Retaining Wall Quantities, See Retaining Wall Plans, Sheet WAT.
2. For On-Site Drainage, See Storm Drain Plans, Sheet SD08.
3. For Layout of Multi-Use Path, See Drop Structure Plans, Sheets DS14 & DS15.

Two working days before you dig CALL FOR THE BLUE STAKES 1-800-782-5348 Blue Stake Center

DROP STRUCTURE PLANS
STA 53+00 TO STA 58+00

DATE	REVISION	BY

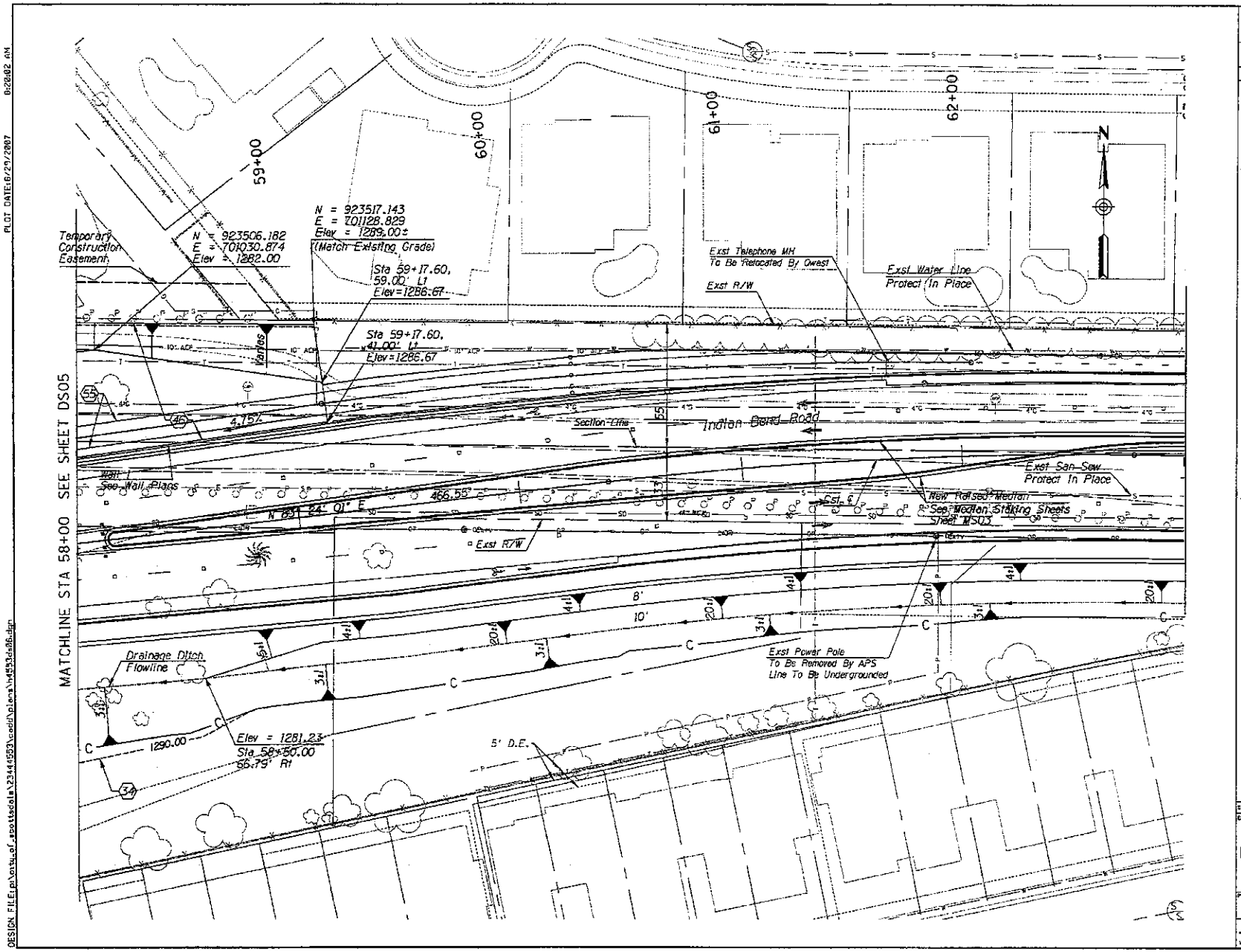
ENGINEER: 22851 RANDALL D. BECK

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD. SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	DD NO.	SHT.
HORIZ. 1"=20'		06/07		DS05
VERT.	DRAWN	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE: p:\city of scottsdale\23444583\cadd\plans\h4553ds05.dgn PLOT DATE: 6/29/2007 8:19:54 AM



URS

7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

CONSTRUCTION NOTES

Description	Unit	Quan
(34) Reconstruct Levee to Grades as Shown on plans.		
(46) Construct New Drop Structure, See Sheet SD10 & DS11.	SY	630
(55) Multi-Use Path Shall Have A Broom Finish. All Other Drop Structure Areas to Be Exposed Aggregate Finish.		

SHEET NOTES:

1. For Retaining Wall Quantities, See Retaining Wall Plans, Sheet WA7.
2. For On-Site Drainage, See Storm Drain Plans, Sheet SD09.
3. For Layout of Multi-Use Path, See Drop Structure Plans, Sheets DS14 & DS15.

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Blue Stake Center

DROP STRUCTURE PLANS
STA 58+00 TO STA 63+00

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'		06/07		DS06
VERT.	DRAWN	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE: p:\city_of_scottsdale\23445953\cadd\plans\h4553s06.dgn
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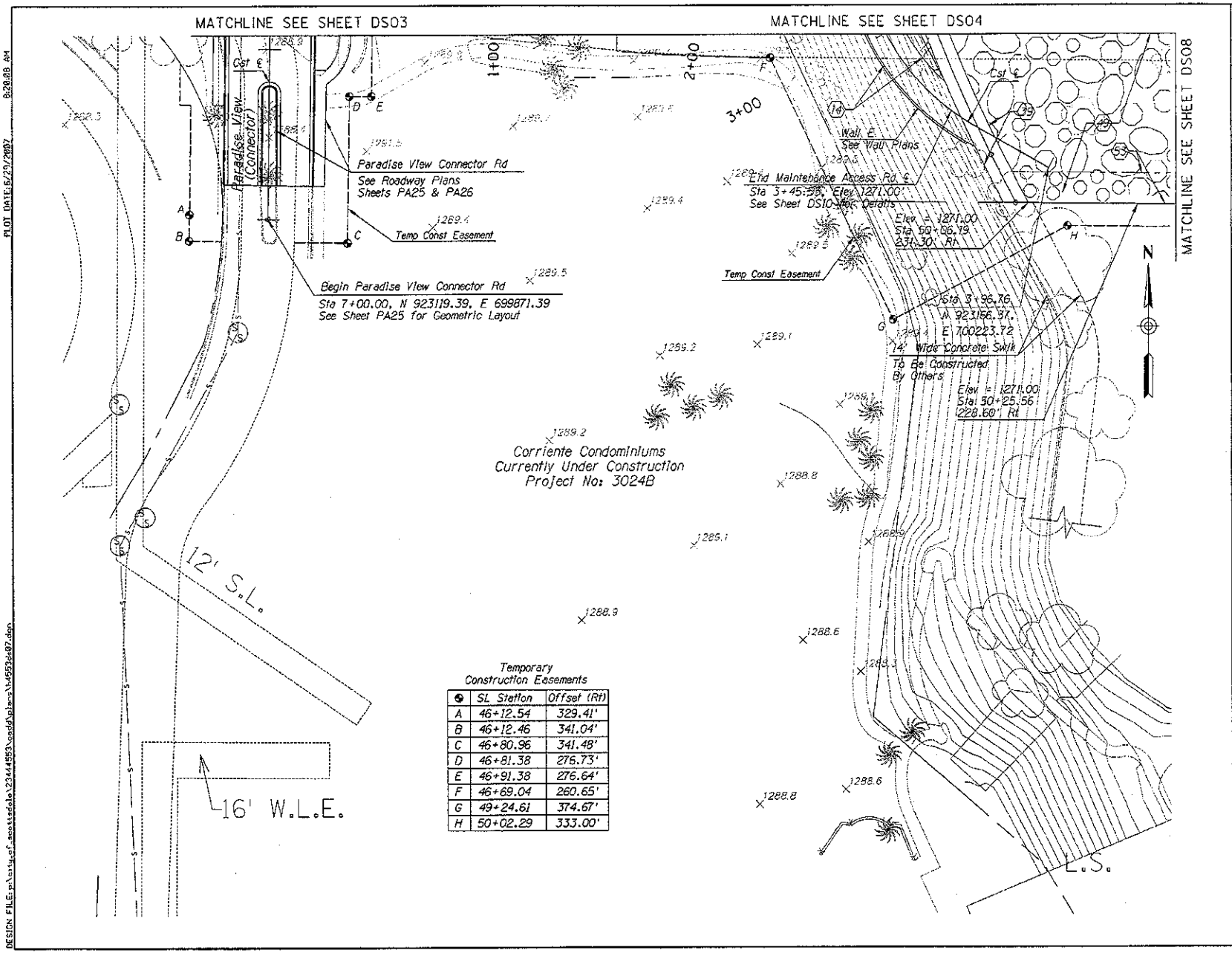

Temporary
Construction Easements

	SL Station	Offset (Rt)
A	46+12.54	329.41'
B	46+12.46	341.04'
C	46+80.96	341.48'
D	46+81.38	276.73'
E	46+91.38	276.64'
F	46+69.04	260.65'
G	49+24.61	374.67'
H	50+02.29	333.00'

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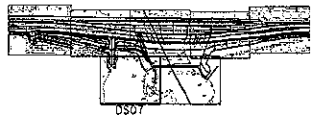
CONSTRUCTION NOTES

Description	Unit	Quan
(14) Construct Maintenance Ramp Quantities See Drop Structure Plans, Sheets DS09		
(39) Install 8" Thick Concrete Swik, 10' Wide, MAG Dtl 230	SY	92
(49) Install Grouted Riprap Depth = 18", D_{50} = 9"	CY	445
(53) Install Riprap Toedown, See Sheet DS13		

SHEET NOTES:

1. For Retaining Wall Quantities, See Retaining Wall Plans, Sheet WA5.
2. For Maintenance Rd Quantities, See Drop Structure Plans, Sheet DS09.
3. For On-Site Drainage, See Storm Drain Plans, Sheet SD16.
4. For Layout of Multi-Use Path, See Drop Structure Plans, Sheets DS14 & DS15.



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Blue Stake Center

DROP STRUCTURE PLANS

DATE	REVISION	BY

ENGINEER: REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 22861 RANDALL D. BECK ARIZONA, U.S.A.

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20	BWG	06/07		DS07
VERT.	DRAWN	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE: 6/29/2007 9:20:08 AM

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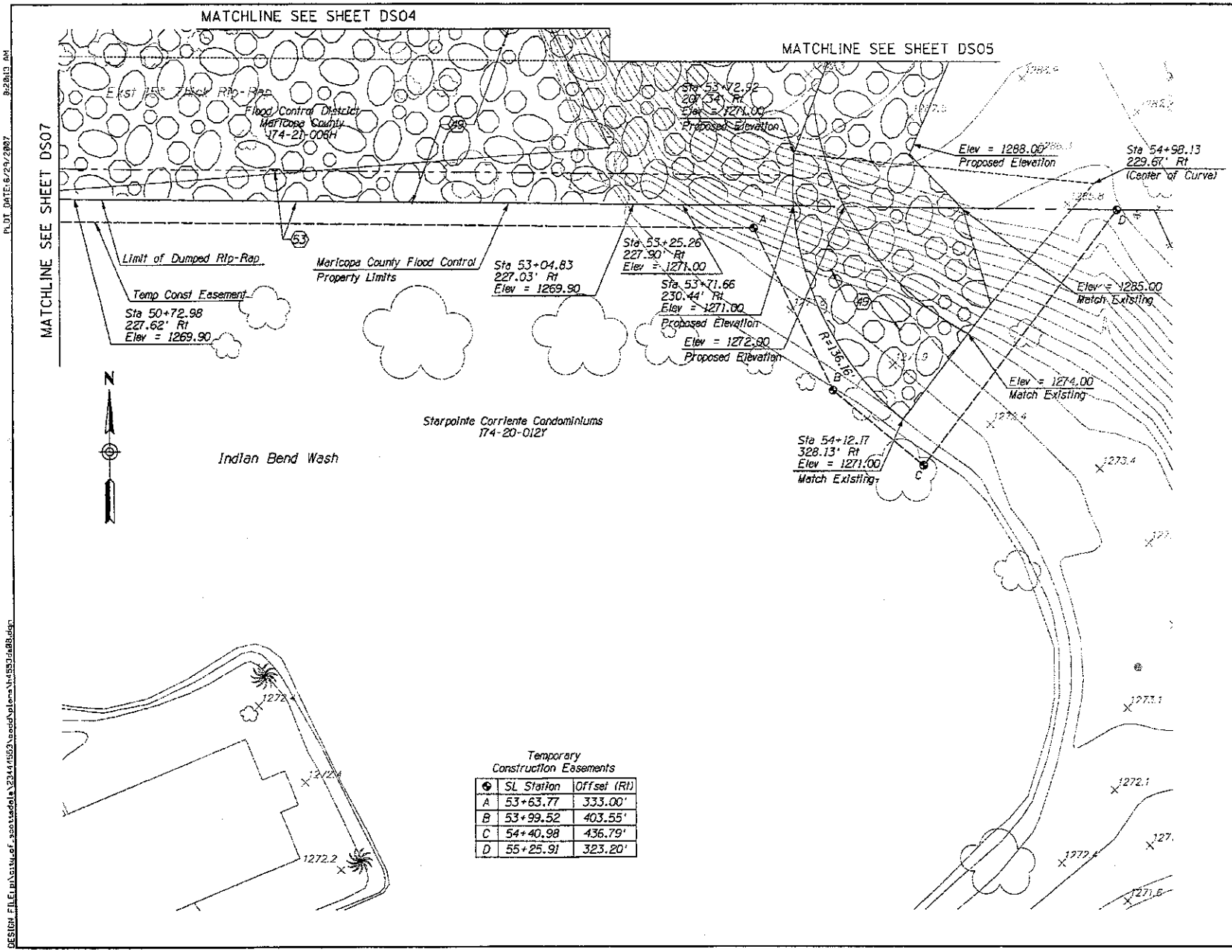

Temporary
Construction Easements

	SL Station	Offset (Rt)
A	53+63.77	333.00'
B	53+99.52	403.55'
C	54+40.98	436.79'
D	55+25.91	323.20'

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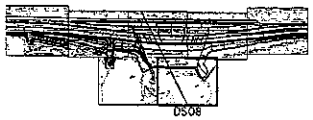
(602) 371-1100

CONSTRUCTION NOTES

Description	Unit	Quan.
(49) Install Grouted Riprap Depth = 18", D_{50}=9"	CY	2280
(53) Install Riprap Toe Down. See Sheet DS13		



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Blue Stake Center

DROP STRUCTURE PLANS

DATE	REVISION	BY

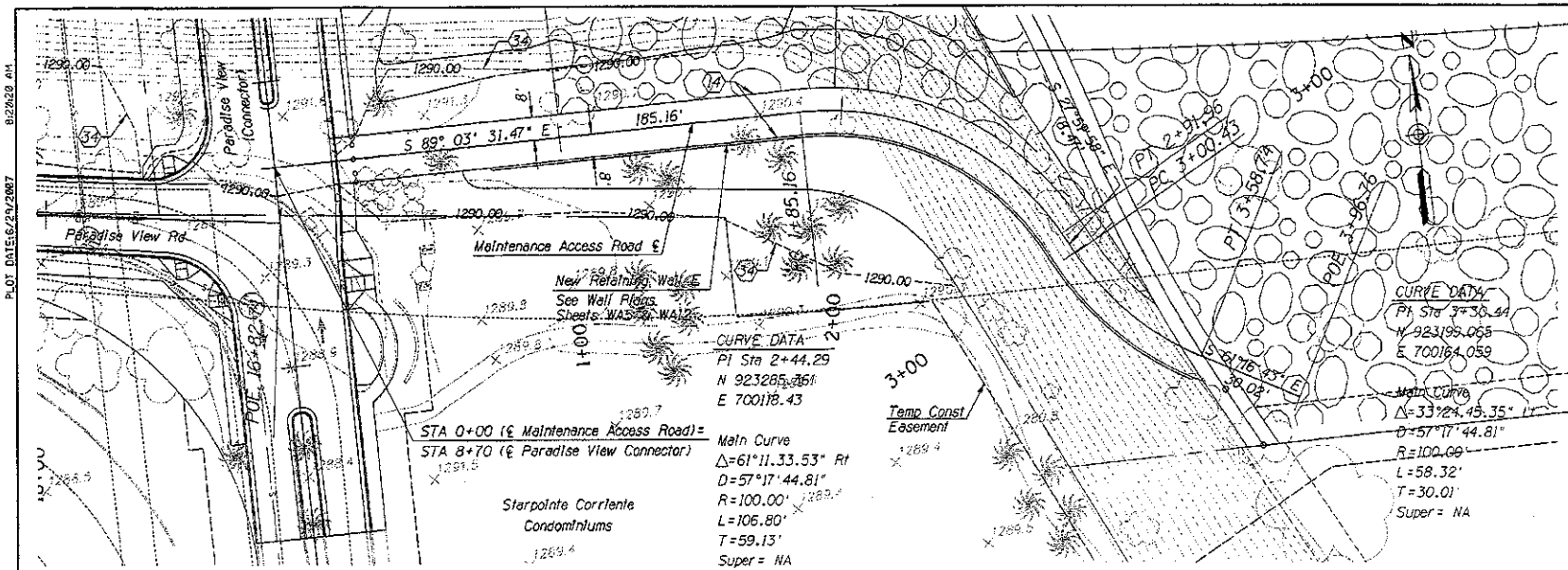
ENGINEER: 22851 RANDALL D. BECK

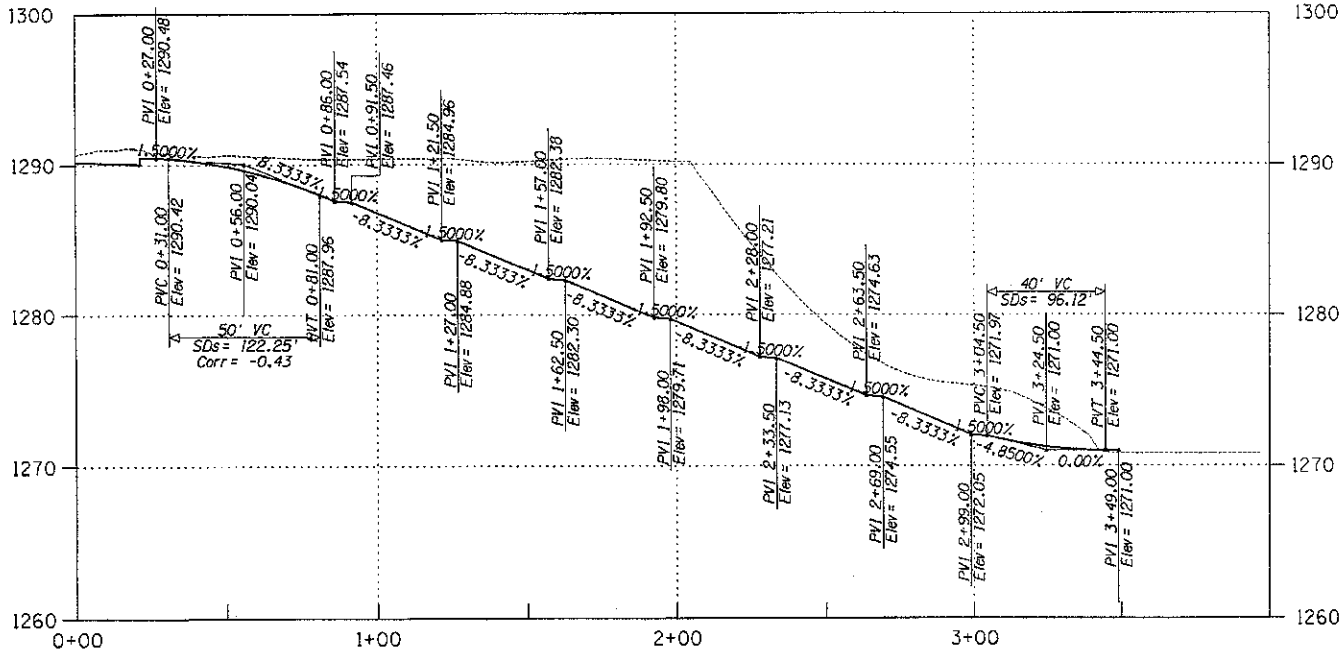
MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	DWG NO.	SHT.
HORIZ. 1"=20	SWG	06/07		DS08
VERT.	DRAWN	REVISED	PROJECT NO. 410-S-0402	OF

DESIGN FILE: p:\city_of_scottsdale\23441553\scott\plans\h4553da88.dgn PLOT DATE: 6/29/2007 9:28:13 AM





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Phoenix, AZ. 85020
(602) 371-1100

CONSTRUCTION NOTES

Description	Unit	Quan
(14) Install Concrete Pvmt. Structural Sct No. 10. See Sheet DS11	SY	584
(34) Reconstruct Levee to Grades as Shown on plans.		

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Blue Stake Center

Maintenance Access Road
Plan And Profile

DATE	REVISION	BY

ENGINEER: 22851 RANDALL D. BECK

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'		06/07		DS09
VERT.	DRAWN	AS-BUILT	PROJECT NO. 410-5-0402	OF

PLOT DATE:6/29/2007 8:29:20 AM

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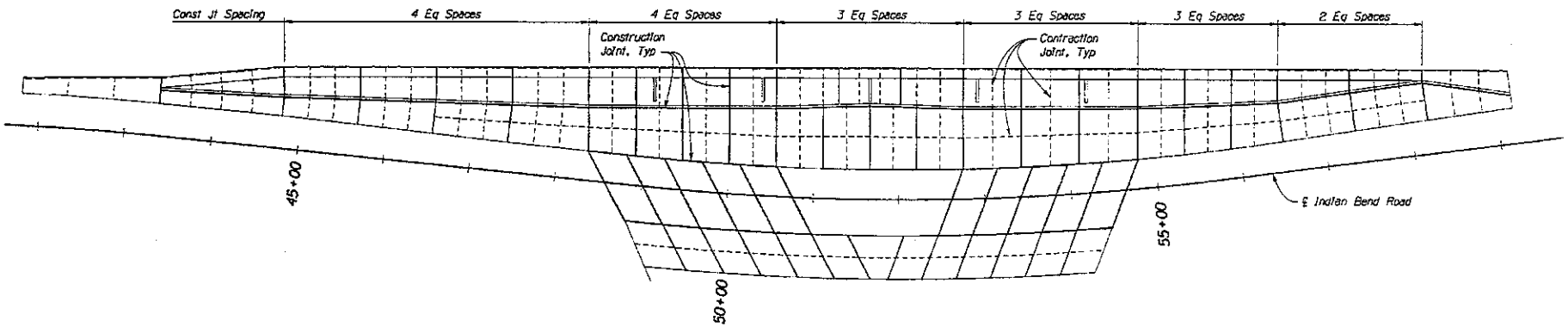
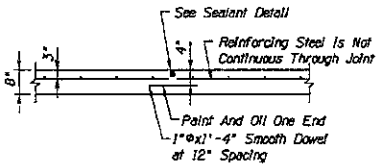
Phoenix, AZ. 85020
(602) 371-1100



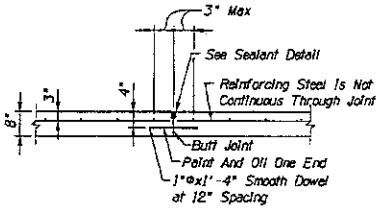
DROP STRUCTURE PLAN
Scale: 1"=60'

DROP STRUCTURE NOTES

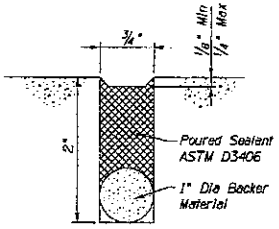
1. Materials:
   Concrete.....MAg Class 'A' f'c=3000 PSI
   Reinforcement.....ASTM A615, Grade 60
2. Concrete Lining Shall be 8" Thick with #5 Reinforcing Bars Spaced at 12" Centers Each way. Reinforcing Shall Have 3" Clear Cover From The Top Lining.
3. Construction Joints Shall be Located as Shown on The Plan. Contraction Joints Shall be Evenly Spaced Between Construction Joints.
4. Provide ½" Bituminous Joint Filler Where Drop Structure Abuts Retaining Walls.
5. Drop Structure Shall Have an Exposed Aggregate Finish, Except That a Medium Broom Finish Shall be Provided at the Multi-Use Paths. See Special Provisions.
6. See Sheets DS11 and DS13 For Typical Drop Structure Sections.
7. The Cost To Provide Construction Joints, Contraction Joints, and Poured Sealant Is Included With The Cost Of Drop Structure.



TYPICAL CONTRACTION JOINT



TYPICAL CONSTRUCTION JOINT



SEALANT DETAIL

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Blue Stake Center

DROP STRUCTURE LAYOUT

DATE	REVISION	BY

ENGINEER: 22851 RANDALL D. BECK

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"= 60'	RAS	06/07		DS10
VERT.	DRAWN AG	AS-BUILT	PROJECT NO. 410-5-0402	0"

PLOT DATE:6/29/2007 9:29:03 AM
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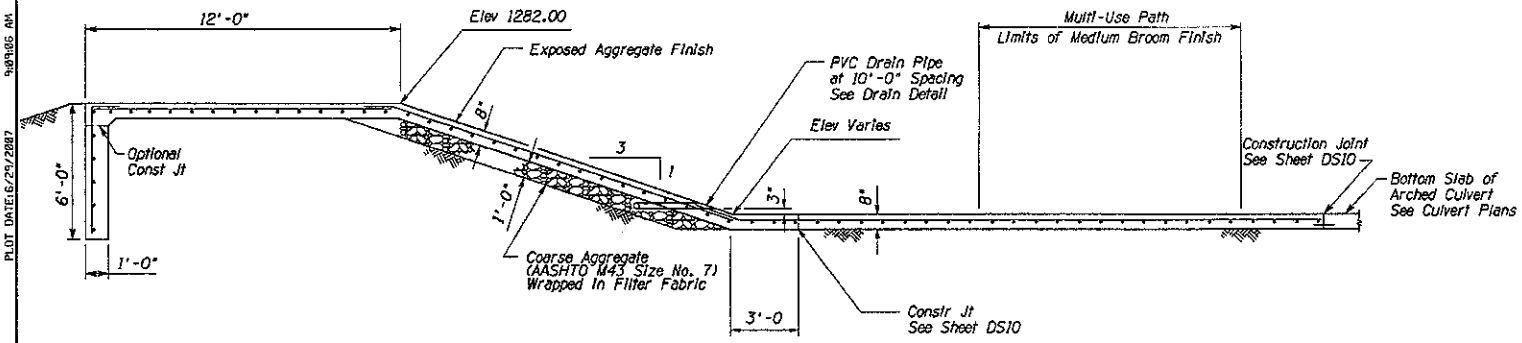
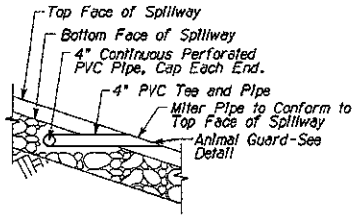
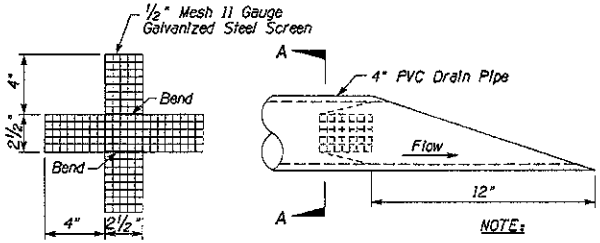


TYPICAL DROP STRUCTURE SECTION UPSTREAM OF ROADWAY

Scale 3/8" = 1'-0"



DRAIN DETAIL
N.T.S.

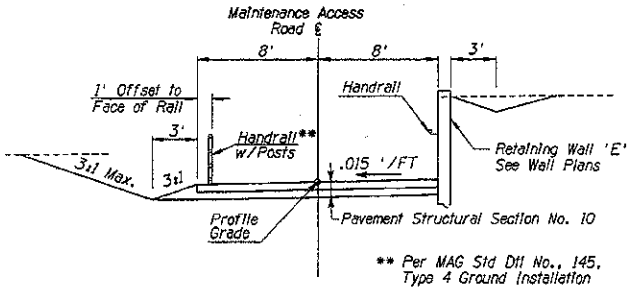


SECTION

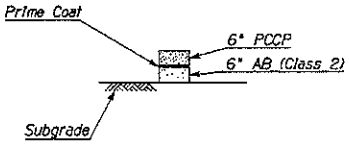
NOTE:

An Animal Guard Shall Be Installed In Each 4" PVC Drain Pipe. A Commercial Animal Guard May be Substituted for Approval.

ANIMAL GUARD DETAIL
N.T.S.



TYPICAL MAINTENANCE ROAD SECTION



Total Thickness = 12"

SECTION NO. 10

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7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
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CONSTRUCTION NOTES

Description	Unit	Quan

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TYPICAL SECTIONS

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
(14) E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ.	RAS	06/07		DS11
VERT.	DRAWN AG	AS-BUILT	PROJECT NO. 410-5-0402	OF

PLOT DATE 6/29/2007 9:09:06 AM
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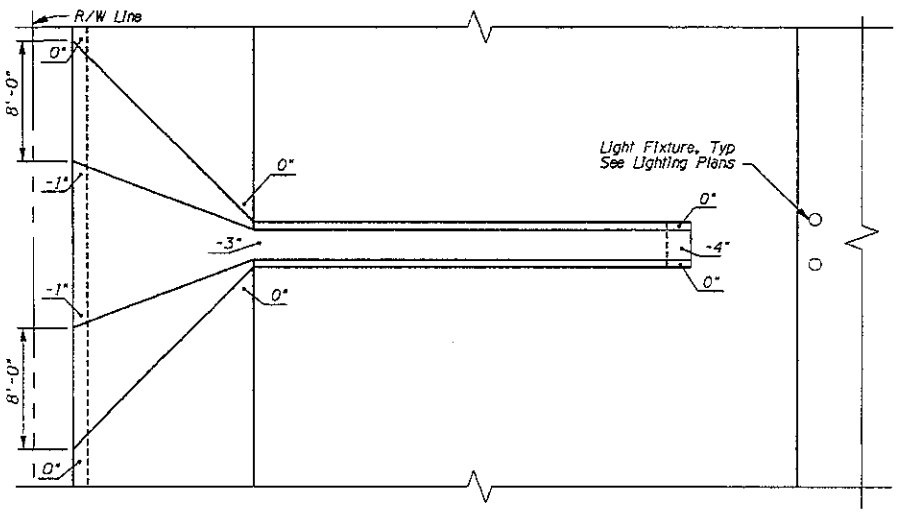
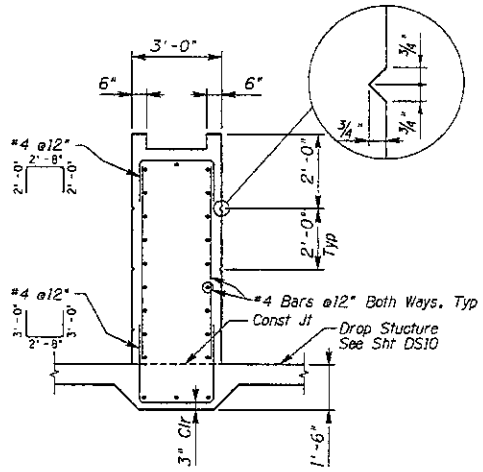
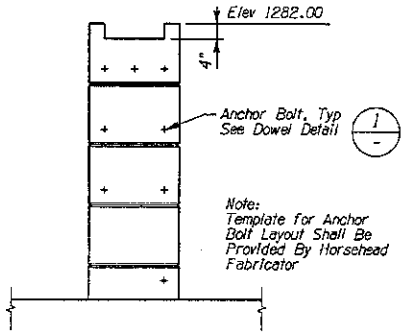


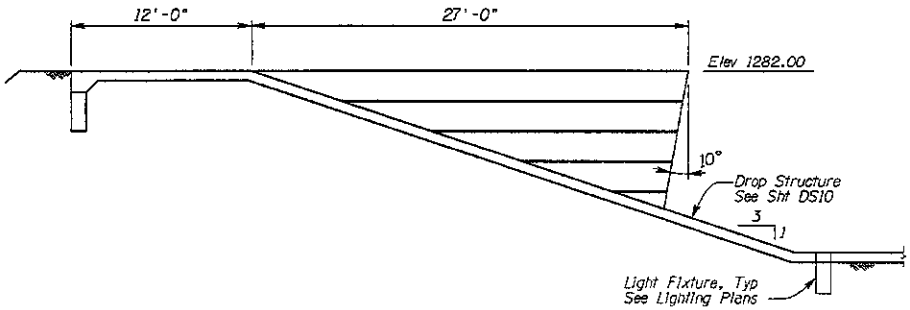
PLINTH PLAN
Scale: 1/4" = 1'-0"



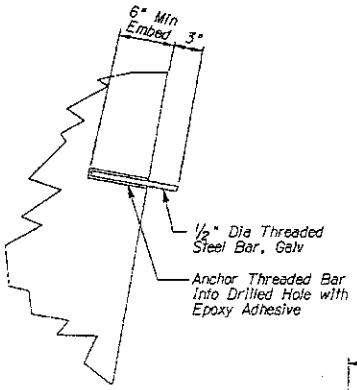
TYPICAL SECTION
Scale: 1/2" = 1'-0"



END VIEW
Scale: 1/2" = 1'-0"



PLINTH ELEVATION
Scale: 1/4" = 1'-0"



DOWEL DETAIL
NTS

Notes:

1. Materials
   Concrete.....MAG Class A
   Reinforcing Steel.....ASTM A615, Grade 60
   Threaded Bars.....ASTM A36, Galvanized ASTM A153
2. Plinth Concrete Shall Be Integrally Colored "Dark Gray".
3. Spot Elevations In Plan View are With Respect to Elev 1282.00.

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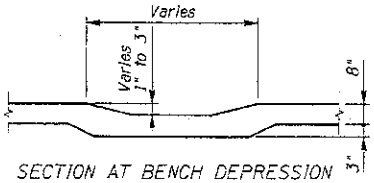

SECTION AT BENCH DEPRESSION
NTS

PLINTH DETAILS

DATE	REVISION	BY

ENGINEER

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED RAS	DATE 6/07	DWG NO.	SHT DS12
HORZ.	DRAWN AG	AS-BUILT	PROJECT NO. 410-S-0402	OF
VERT.				

PLOT DATE:6/29/2007 9:05:18 AM
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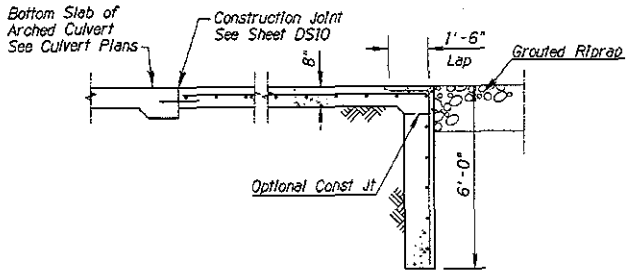
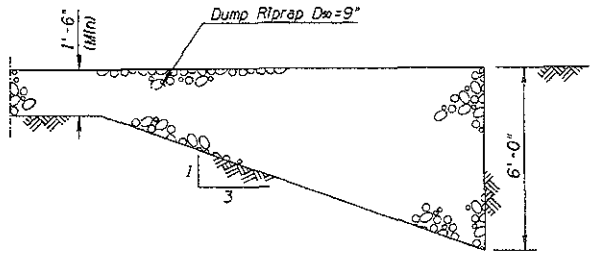


TYPICAL DROP STRUCTURE SECTION DOWNSTREAM OF ROADWAY
Scale: 1/2" = 1'-0"



GROUTED RIPRAP TOE DOWN DETAIL
Scale: 1/2" = 1'-0"

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Blue Stake Center

DATE	REVISION	BY

ENGINEER
REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO. 22851
RANDALL D. BECK
ARIZONA, U.S.A.

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
9191 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1/2"=1'		06/07		DS13
VERT.	DRAWN	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE: 6/29/2007 9:09:13 AM
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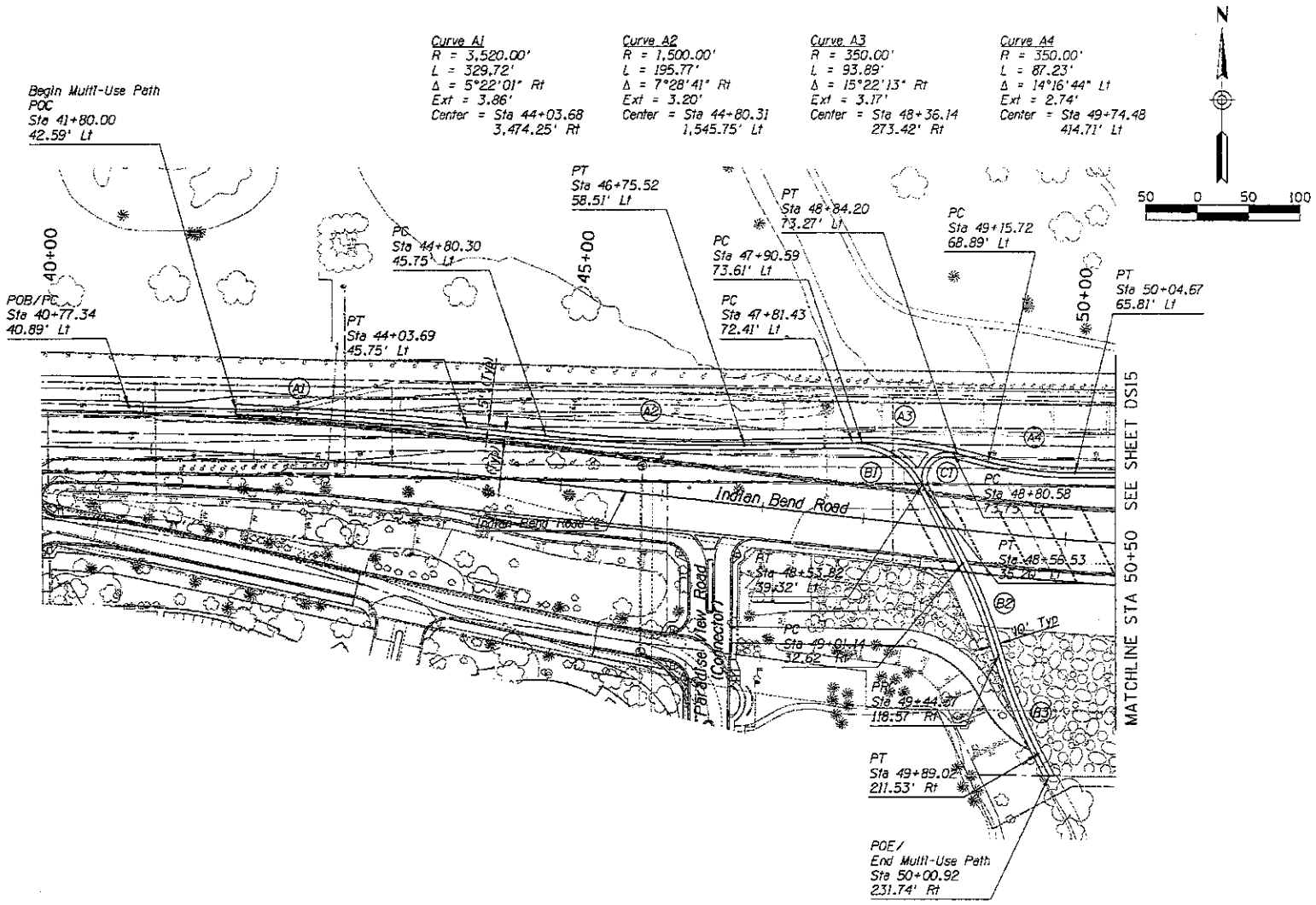

Curve B1
R = 75.00'
L = 83.90'
Δ = 64°05'28" Rt
Ext = 13.48'
Center = Sta 47+91.20
1.95' Rt

Curve B2
R = 500.00'
L = 96.85'
Δ = 11°05'53" Rt
Ext = 2.35'
Center = Sta 44+83.73
307.75' Rt

Curve B3
R = 500.00'
L = 104.41'
Δ = 11°57'50" Lt
Ext = 2.74'
Center = Sta 54+16.25
26.48' Lt

Curve C1
R = 25.00'
L = 57.02'
Δ = 130°40'57" Lt
Ext = 34.92'
Center = Sta 48+77.41
48.95' Lt

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CONSTRUCTION NOTES

Description	Unit	Quan

SHEET NOTES:

1. All Stations and Offsets Reference to Indian Bend Road Construction Centerline.
2. Offset Distances Reference to Center of Multi-Use Path.

Two working days before you dig, CALL FOR THE BLUE STAKES
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MULTI-USE PATH GEOMETRY
STA 40+00 TO STA 50+50

DATE	REVISION	BY

ENGINEER: 22051 RANDALL D. BECK

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	SHT. NO.
HORZ. 1"=50'	MHW	06/07	DS14
VERT.	DRAWN DNJ	AS-BUILT	PROJECT NO. 410-S-0402

DESIGN FILE:P:\City of Scottsdale\23414593\CADD\Plans\tn553ds14.dgn
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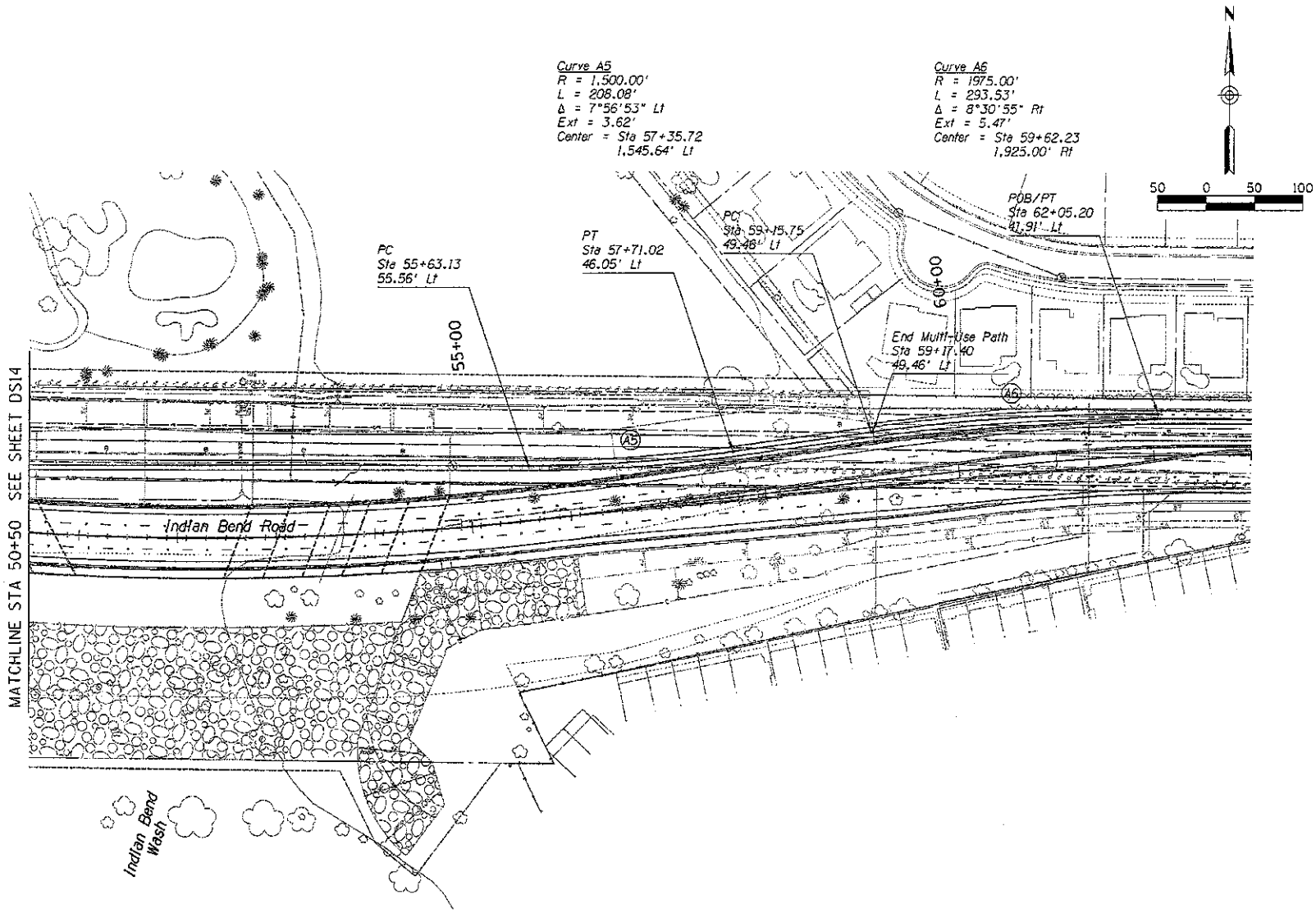

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(602) 371-1100

CONSTRUCTION NOTES

Description	Unit	Quan

SHEET NOTES:

1. All Stations and Offsets Reference to Indian Bend Road Construction Centerline.
2. Offset Distances Reference to Center of Multi-Use Path.

Two working days before you dig, CALL FOR THE BLUE STAKES
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Blue Stake Center

MULTI-USE PATH GEOMETRY
STA 50+50 TO STA 63+00

DATE	REVISION	BY

ENGINEER: 22951 RANDALL D. BECK, REGISTERED PROFESSIONAL ENGINEER, ARIZONA, U.S.A.

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE: Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=50'	MHW	06/07		DS15
VERT.	DRAWN DNJ	AS-BUILT	PROJECT NO. 410-5-0402	OF

DESIGN FILE: P:\City of Scottsdale\23444553\CADD\Plans\4553ds15.dgn PLOT DATE:6/29/2007 8:22:04 AM

APPENDIX B
PROJECT PHOTOGRAPHS

Photo 01: Beginning of Seville Channel. Grated inlet to 3-10'x6' CBC located under Scottsdale Road, south of Indian Bend Road intersection.

Photo 02: Same Description as Photo 01, but looking north along the west side of Scottsdale Road.

Photo 03: Outlet of 3-10'x6' CBC located under Scottsdale Road, south of Indian Bend Road intersection.

Photo 04: Seville Channel within McCormick Railroad Park. Looking east from outlet of 3-10'x6' CBC located under Scottsdale Road.

Photo 05: Inlet of 3-10'x4' CBC located under Indian Bend Road, east of the Scottsdale intersection.

Photo 06: Outlet of 3-10'x4' CBC located under Indian Bend Road, east of the Scottsdale Road. intersection.

Photo 01: Beginning of Seville Channel. Grated inlet to 3-10'x6' CBC located under Scottsdale Road, south of Indian Bend Road intersection.

Photo 02: Same Description as Photo 01, but looking north along the west side of Scottsdale Road.

Photo 03: Outlet of 3-10'x6' CBC located under Scottsdale Road, south of Indian Bend Road intersection.

Photo 04: Seville Channel within McCormick Railroad Park. Looking east from outlet of 3-10'x6' CBC located under Scottsdale Road.

Photo 05: Inlet of 3-10'x4' CBC located under Indian Bend Road, east of the Scottsdale intersection.

Photo 06: Outlet of 3-10'x4' CBC located under Indian Bend Road, east of the Scottsdale Road. intersection.

Photo 13: Two pipes outlet into the Seville Channel at the NE corner of the Indian Bend/Scottsdale Road intersection. A 36"x22" CMPA under Scottdale Road and a 15" CMP from the Seville parking lot.

Photo 14: Inlet grate to the 15" CMP outlet shown in Photo 13. Inlet is located in the Seville parking lot

Photo 15: Inlet grate in Seville parking lot. Discharge is to the Seville Channel.

Photo 16: Inlet grate in Seville parking lot. The parking lot functions as a detention basin.

Photo 17: Outlet to Seville Channel from one of the inlet grates located in the Seville parking lot.

Photo 18: Indian Bend Road curb opening catch basin that outlets to the Seville Channel located along the north side of Indian Bend Road.

Photo 19: Outlet from Indian Road catch basin shown in Photo 18. The outlet is into the Seville Channel.

Photo 20: Entrance to 2-8'x4' CBC that crosses Indian Bend Road into the Seville Channel. It drains a channel located along the east side of the McCormick Railroad Park.

Photo 21: Outlet of 2-8'x4' CBC shown in Photo 20. Outlet is into the Seville Channel.

Photo 22: Looking south along the channel that drains to the 2-8'x4' CBC shown in Photo 20. This is the south end of the McCormick Railroad Park parking lot.

Photo 23: Location of same channel shown in Photo 22, but looking north toward entrance of 2-8'x4' CBC.

Photo 24: Looking south along channel from entrance to the 2-8'x4' CBC. Red cover is a flap gate on a 16" CIP discharge from a COS well.

Photo 25: City of Scottsdale water facility located in the northeast corner of McCormick Railroad Park.

Photo 26: City of Scottsdale well located in the northeast corner of McCormick Railroad Park.

Photo 27: Outlet of 10' pipe from Hayden Rd into interceptor channel.

Photo 28: Inlet to 43"x27" CMPA in northeast corner of Indian Bend/ Hayden Road intersection. Beginning of storm drain that discharges into the IBW inlet channel.

Photo 29: Catch basin on north side of Indian Bend Road, west of Hayden Road. It drains to 42" RCP.

Photo 30: Manhole located in the northeast corner of the 78th Place/ Indian Bend Road intersection. Pipe size increases from 42" to 48" RCP.

Photo 31: Two 21′ long curb opening catch basins capture runoff from the north along 78th Place street.

Photo 32: 21′ curb opening catch basin located on 78th Place street in the northwest corner of the 78th Place/Indian Bend Road intersection.

Photo 33: 21′ curb opening catch basin located on 78th Place street in the NE corner of the 78th Place/ Indian Bend Road intersection.

Photo 34: 48″ RGRCP outlet into the IBW inlet channel. This is the oulet of the pipe system that begins at the Indian Bend Road/ Hayden Road intersection.

Photo 35: Same 48″ outlet shown in Photo 34.

Photo 36: Looking west along the south side of Indian Bend Road within McCormick Railroad Park. The swale within the park drains the park runoff to the east.

Photo 37: Looking east along the south side of Indian Bend Road within McCormick Railroad Park. The swale within the park drains the park runoff to the east.

Photo 38: Looking north along a gated maintenance driveway to the McCormick Railroad Park.

Photo 39: South side of Indian Bend Road looking west within the McCormick Railroad Park. The swale behind the sidewalk drains the park runoff to the east.

Photo 40: Same location as Photo 39, but looking east across the maintenance driveway. Widening of Indian Bend Road will require an offroad catch basin west of this driveway.

Photo 41: East of the driveway shown in Photo 39. Another offroad catch basin will be required near the bush shown in this photo. Looking east.

Photo 42: 2-24" RCP located under the entrance to the McCormick Railroad Park parking lot. Runoff that currently flows through these pipes will be captured by new offroad catch basins.

Photo 43: 6" outlet pipe from McCormick Park parking lot, which functions as a detention basin.

Photo 44: Oulet of 30" pipe with flap gate located just east of and across the road from the resort entrance.

Photo 45: Outlet of 36" RCP, which drains the north roadway ditch of Indian Bend Road. It is located just west of the IBW inlet channel.

Photo 46: Catch Basin of 36" RCP shown in Photo 45. Looking east along north side of Indian Bend Road.

Photo 47: Bee hive catch basin, which maintains the maximum water surface elevation in the west lake.

Photo 48: Outlet of 36" RCP, which drains the north roadway ditch of Indian Bend Road. It is located just east of the IBW inlet channel.

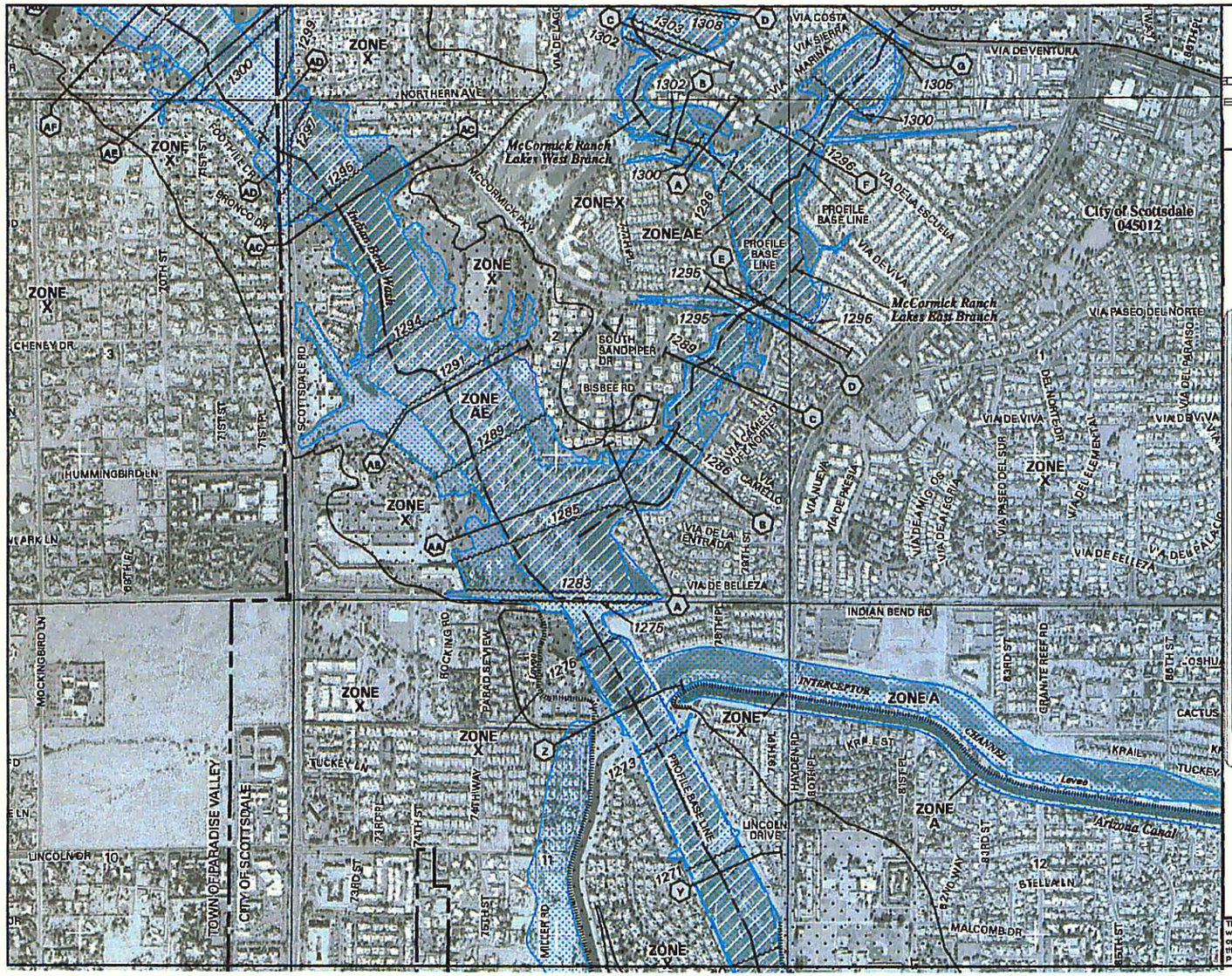
Photo 49: Catch Basin of 36" RCP shown in Photo 48. Looking west along north side of Indian Bend Road.

Photo 50: 6" pipe outlet, which maintains the maximum water surface elevation of the east lake.

Photo 51: 6" pipe inlet, which maintains the maximum water surface elevation of the east lake.

Panoramic View of Indian Bend Wash inlet channel. Standing on north side of Indian Bend Road looking southwest toward resort.

APPENDIX C
FEMA FLOOD INSURANCE RATE MAP (FIRM)



MAP SCALE 1" = 1000'

0 1000 2000 FEET

0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1695H

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 1695 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1695	H
PARADISE VALLEY, TOWN OF	040049	1695	H
SCOTTSDALE, CITY OF	045012	1695	H

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

MAP NUMBER

04013C1695H

MAP REVISED

SEPTEMBER 30, 2005

Federal Emergency Management Agency

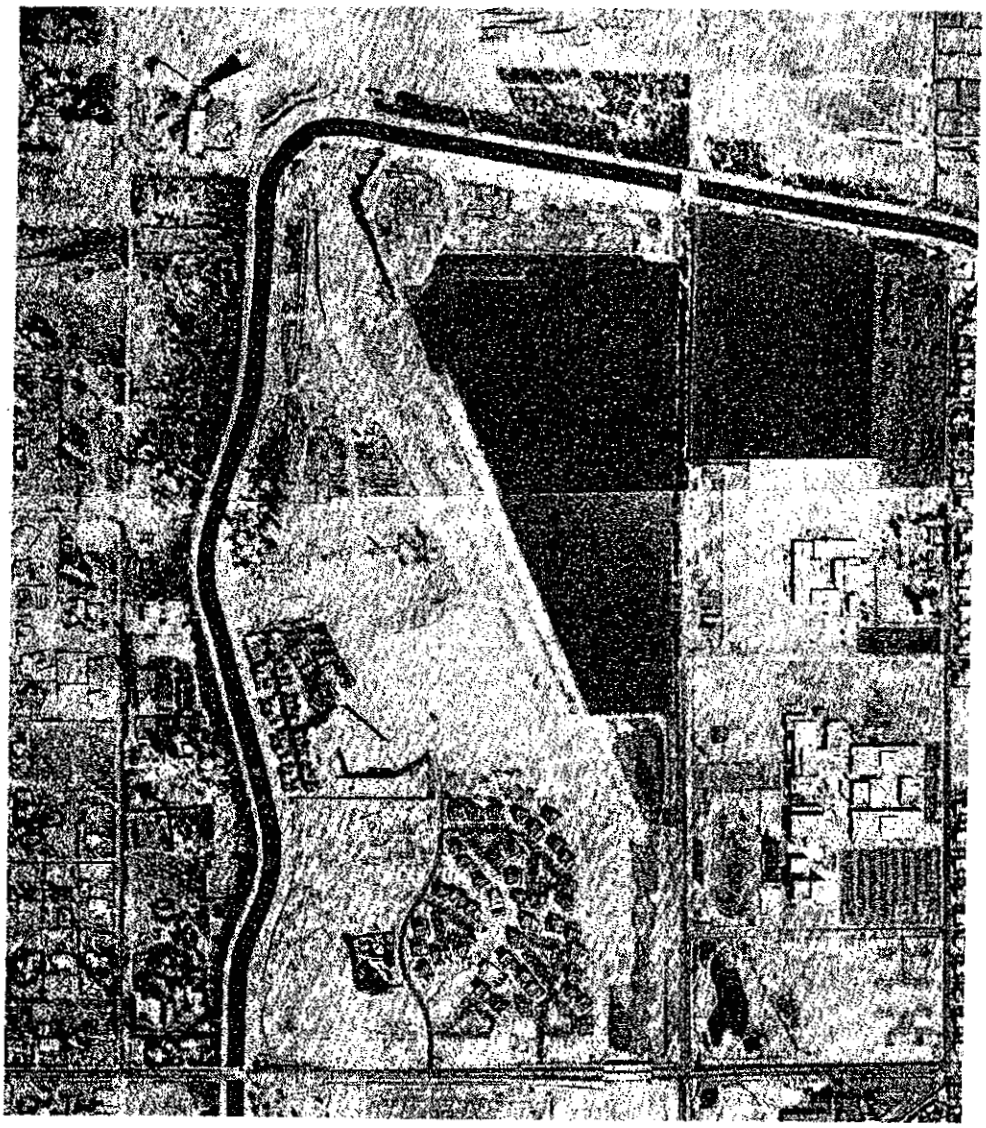
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

APPENDIX D
CORPS OF ENGINEERS' DESIGN MEMO NO. 3

William A Euler

GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
Design Memorandum No. 3
FEATURE DESIGN FOR INLET CHANNEL
Project Design
for
INDIAN BEND WASH

121



Los Angeles District
U. S. Army Corps of Engineers
January 1978

GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
DESIGN MEMORANDUM NO. 3

FEATURE DESIGN
FOR
INLET CHANNEL

Los Angeles District
U.S. Army Corps of Engineers

January 1978

REPORTS PREVIOUSLY ISSUED (Continued)

Title	Date of Report	Date Approved
Design Memorandum No. 2 Recreation Master Plan Indian Bend Wash Supplemental Report No. 1*	15 Apr 1976	18 Jun 1976 (by SPD)
Design Memorandum No. 2 Recreation Master Plan Indian Bend Wash Supplemental Report No. 2	Jan 1977	23 Feb 1977 (by SPD)

SCHEDULED FOR FUTURE ISSUANCE

Title	Date of Report	Date Approved
Design Memorandum No. 4, Feature Design for Interceptor and Side Channels System, Indian Bend Wash	Mar. 1978**	May 1978** (by SPD)

* A supplemental letter report for General Design Memorandum - Phase II and the Recreation Master Plan. The report presented a revised beautification plan for the outlet and reallocated costs for recreation landscaping.

** Anticipated date.

Project Functions (Continued)

Flood Control Components	Design Discharge (cfs)**	Length (mi)(ft)	Type of channel	Width*** (ft)	206* Depth (ft)
† Side channels					
McDonald Drive	645	0.4	Two reinforced concrete pipes	75" dia.	---
Chapparral Road	610	0.6	One reinforced concrete pipe	93" dia.	---
Camelback Road	1,100	1.0	Two reinforced concrete pipes	90" dia.	---

Recreation Components	Location	Size
Trail Systems	Salt River -Pima Rd.	11 miles
Scottsdale Bike Stop	Thomas Rd.	2 acres
Indian School Park	Between Camelback Rd. and Indian School Rd.	60 acres
Hohokam Plaza	McDowell Rd.	8 acres
McKellips Lake	Upstream from McKellips Rd.	18 acres

* Does not not include drainage area east of Pima Road, which contributes flow to Arizona Canal and interceptor channel.

** Design discharges are based on a 100-year flood, except for the collector and side channels which are based on 50- and 25-year floods.

*** Bottom width for trapezoidal section.

**** Stone revetted banks covered by landscape fill-unlined invert.

† Data shown for Interceptor and Side Channels System is in accordance with Phase II GDM design. Feature Design will be presented in DM No. 4.

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INDIAN BEND WASH

DESIGN MEMORANDUM NO. 3

FEATURE DESIGN FOR INLET CHANNEL

I - INTRODUCTION

1-01. PROJECT HISTORY

a. In recognition of the flood problem that exists along Indian Bend Wash in Scottsdale and Tempe, Arizona, Congress (under the 1965 Flood Control Act-Public Law 89-298, 89th Congress, 1st Session) authorized a flood control project, consisting of a 7 mile long concrete-lined channel, for Indian Bend Wash. At the request of local interests the authorized plan was reformulated in the report titled "Design Memorandum No. 1, General Design Memorandum - Phase I, Plan Formulation for Indian Bend Wash" (hereinafter referred to as the Phase I GDM) published in October 1973. The reformulated plan which was approved by OCE in April 1974 included recreation as a project purpose and provided for a combination of structural and nonstructural measures in lieu of the concrete channel along Indian Bend Wash. The reformulated plan also provided for construction of a collector and side-channel system to relieve ponding along the west levee of the Arizona Canal west of Indian Bend Wash and to ensure that 100-year floodflows, emanating from the Camelback Mountain drainage area would not overtop nor breach the east levee of the canal. OCE withheld approval of this feature of the recommended plan and requested that additional justification data be provided. A supplementary report to the Phase I GDM, containing the required data, was approved by OCE in May 1975.

b. General Design Memorandum - Phase II (hereinafter referred to as the Phase II GDM) and Design Memorandum No. 2 (Recreation Master Plan) were prepared concurrently and were approved by OCE on 17 July 1975 and 25 September 1975, respectively. The reports provided sufficient technical and supporting data to confirm project justification for the plan recommended in the Phase I GDM and the supplementary report on the side channels system. The reports also provided a reliable cost estimate for the flood control and recreation features for the entire project.

c. To satisfy the desires of local interests for an early start of project construction, the Phase II GDM and the Recreation Master Plan were developed to feature design scope for the outlet portion of the project only. Upon approval, the reports were used as the basis for preparing plans and specifications for constructin of the outlet. A $3,000,000 contract, for construction of the flood control and recreation features for the outlet, (as presented in the two reports) was awarded in January 1976. The outlet was completed in December 1977.

I.03 LOCAL COOPERATION

a. As formulated, the project requires local cooperation in the areas of flood control, recreation, fish and wildlife and mitigation.

(1) Flood Control. Assurances pertinent to flood control have been provided by local interests and are presented in Design Memorandum No. 1. The current officials responsible for flood control are:

Name	Title	Address
Hawley Atkinson	Chairman, Board of Directors of Flood Control District of Maricopa County	603 County Administration Bldg. 111 South Third Ave. Phoenix, Arizona 85009
Herbert P. Donald	Chief Engineer and General Manager, Flood Control District of Maricopa County	3335 W. Durango Street Phoenix, Arizona 85009

(2) Recreation. Resolutions supporting the recreation features of the project were included in Design Memorandums No's. 1 and 2 and cost sharing agreements have been approved by OCE. The Flood Control District of Maricopa County has no responsibilities for project recreation development. However, as local sponsor for the flood control features of the project, the Flood Control District has the responsibility of assuring that the existing and proposed recreation features are compatible with the flood control features of the project. The Flood Control District has also adopted a resolution dated 3 June 1974 permitting compatible recreational use of its project lands. The current contacts for recreation for the inlet area are listed below.

Name	Title	Address
David H. Harris	Community Services Department Head, City of Scottsdale	3939 Civic Center Plaza Scottsdale, Arizona 85251

(3) Fish and Wildlife. The principal State official concerned with fish and wildlife associated with the project is: Robert A. Jantzen, Director, Arizona Game and Fish Department, 222 West Greenway Road, Phoenix, Arizona 85023.

(4) Mitigation. The project plan provides for a 100-foot-wide corridor between the interceptor channel and the Arizona Canal to preserve the native mesquite in this area and to partially mitigate for the loss of vegetation and wildlife habitat resulting from construction of the inlet. During construction of the interceptor channel mesquite will be planted in and adjacent to the channel to provide additional wildlife habitat in the area. Although construction of the interceptor will not begin until the fall of 1978, local interests are acquiring permanent rights-of-way for the corridor at the present time. Operation and maintenance of the corridor will be a responsibility of the City of Scottsdale in cooperation with the Arizona Game and Fish Department. To further mitigate for loss of wildlife habitat

II - PROJECT PLAN

2-01. PROJECT LOCATION. The 206-square-mile Indian Bend Wash drainage basin lies entirely within Maricopa County, Arizona. About 24 percent of the area is mountainous and the remainder is alluvial plains. The elevations in the drainage area range from 4,034 feet to 1,160 feet above mean sea level, with a gradient of about 100 feet per mile in the headwaters and about 20 feet per mile at the lower end of the wash. The Indian Bend Wash project is located along the lower 7.7 miles of the wash and lies entirely within the corporate limits of the Cities of Scottsdale and Tempe. A more detailed discussion of the topography and geology in the project area is presented in section IV.

2-02. FLOOD PROBLEM

a. The Paradise Valley Detention Dikes (see pl. 1), recently constructed by the Bureau of Reclamation as part of the Central Arizona Project, provide substantial flood protection to the areas below the dikes. However, without the protection to be provided by the Indian Bend Wash project both Scottsdale and Tempe would still be subject to extensive damages from floodflows emanating from the drainage areas below the dikes.

b. Under normal conditions, Indian Bend Wash is dry and the Arizona Canal carries irrigation water. The area, however, is subject to high intensity rainfall that causes flash flooding on Indian Bend Wash. The existing streambed is inadequate in capacity, and during floods the overflows cause damage to major urban developments located along the lower reaches of the wash. In addition, some of the flows spread across the alluvial plains as sheetflow and are intercepted by the right (uphill) levee of the Arizona Canal. The canal intercepts runoff from as far east as the Evergreen Wasteway on the Arizona Canal, located about 4 miles east of Pima Road, and runoff from the Phoenix Mountains west of Indian Bend Wash. This water collects and ponds causing flood damage north and west of the canal. Eventually, higher floodflows enter the canal causing overtopping and subsequent breaks in the downhill (left) levee. Overtopping and breaks in the canal levee have occurred in the past at many points along the canal resulting in extensive flooding in Scottsdale.

2-03. PROJECT DESCRIPTION

a. Flood Control. The Indian Bend Wash project consists of the Indian Bend Wash channel, a side-channel system, and the interceptor channel. The Indian Bend Wash channel is subdivided into three reaches; the inlet channel including a siphon to carry Arizona Canal irrigation water under Indian Bend Wash; the greenbelt floodway; and the outlet channel. The Indian Bend Wash channel is designed to convey the 100-year project design flood of 30,000 cfs (future conditions). The greenbelt floodway, between the inlet and outlet channels, is an integral part of the total flood control plan. The Federal Government is responsible for all project flood control costs except those within the greenbelt floodway. The greenbelt floodway, including necessary flood control features to control the 100-year flood, is being developed by the City of Scottsdale in cooperation with the Maricopa County Flood Control District. All costs for flood control features in the greenbelt floodway are the responsibility of local interests. The inlet channel (including the siphon and wasteway) together with the interceptor channel and side channels system will alleviate the flood problem caused by the Arizona Canal. The inlet levees will collect flows originating upstream from Indian Bend Road and direct them to the inlet channel. The

d. Indian Bend Road Relocation. The inlet channel design has been modified to provide for construction of channel inlet levees with a top width of 16 feet in lieu of the roadway embankments for a future bridge as shown in the Phase II GDM. The design and alinement of the levees was coordinated with the Flood Control District of Maricopa County. The Flood Control District advises that the design and alinement of the levees as presented herein will minimize conflict with local interests' future roadway embankments and bridge. Plans for the future bridge and roadway will be submitted to the Los Angeles District for approval prior to construction.

e. Changes Upstream From Indian Bend Road. To ensure that floodflows upstream from Indian Bend Road would be safely directed to the inlet channel the plan presented in the Phase II GDM provided for construction of a levee on the left bank immediately upstream from the existing road. The upstream levee has been deleted from the recommended plan because local interests have furnished grading plans which provide for filling this area, along with the area west of the wash to an elevation that would confine the 100-year design flood with adequate freeboard. The revised plan is discussed in section V and is shown on plates 5 and 9.

f. Interceptor Channel. The Phase II GDM, approved in July 1975, assumed that portions of floodflows that presently flow southwesterly to the Arizona Canal and the proposed interceptor channel would be diverted westerly to Indian Bend Wash through the McCormick Ranch development. The assumption was made as a result of close coordination with the City of Scottsdale, the Flood Control District of Maricopa County and the A-E doing the hydrology and hydraulic studies for Kaiser-Aetna (K-A), the developer for McCormick Ranch. However, no formal assurances were obtained from local interests that the above assumption would be implemented. In February 1977, the City of Scottsdale informed the Los Angeles District and the Flood Control District that K-A did not intend to divert flows as assumed in the Phase II GDM. A review of the hydrology indicated that this change would reduce the level of protection afforded by the interceptor channel to about 50 years in lieu of the approximate 100-year level provided in the Phase II GDM plan. Although the subject flows will not be diverted by Kaiser-Aetna, local interests have provided letters assuring the Corps of Engineers that detention facilities, in lieu of the diversion assumed in the Phase II GDM, would be provided prior to completion of the interceptor channel. Additional details concerning this proposed change are presented in section III.

g. Additional Facilities for Arizona Canal. Subsequent to completion of the Phase II GDM, the Salt River Project (SRP) advised that the presence of the siphon would complicate their procedures for draining the canal and removing sediment. SRP requested that a sluice gate and sediment basin, upstream from the siphon, be provided to enable them to operate and maintain the canal in accordance with their present standards and criteria. The addition of these facilities is discussed in further detail in section V. Additional costs are reflected in section XII.

h. Streamgages. Because of the nature of this project, i.e. the complications posed by the presence of the Arizona Canal, the greenbelt floodway and the contemplated use of the entire wash for recreational purposes, it is essential that reliable floodflow records be available for local interests' use in operating, maintaining and managing the project. It has been determined that the existing U.S.G.S. streamgage, located in the wash upstream from

III - HYDROLOGY

3-01. INTRODUCTION. This section presents results of hydrologic studies related to the inlet channel for Indian Bend Wash. Also presented is a brief discussion of the impacts due to revised local interest drainage plans which affect the interceptor channel (see paragraph 2-04 herein). Hydrology for the design of the inlet channel is outlined in the previous Indian Bend Wash Design Memorandums. The 100-year flood hydrographs which were the basis for the design of the inlet, are shown on plate 4-A. Revision of the 100-year discharge at the interceptor (Table 3-1) has not changed the 100-year design discharge of 30,000 cfs for the inlet channel. Peak discharges, volumes and contemporaneous discharges used for the design of the inlet channel side drainage structures are also presented. All side drainage discharges computed for this report represent future (year 2077) conditions.

3-02. PREVIOUS REPORTS

a. Two reports published by the Corps of Engineers are cited as references:

(1) "Gila River Basin, New River and Phoenix City Streams, Arizona, Design Memorandum No. 2, Hydrology, Part 1, October 1974."

(2) "Gila River Basin, Indian Bend Wash, Design Memorandum No. 1, General Design Memorandum Phase II, Project Design for Indian Bend Wash, May 1975."

3-03. INTERCEPTOR CHANNEL. Discharges at the Indian Bend Wash inlet emanate from two sub-watersheds; Indian Bend Wash watershed and the interceptor watershed. The interceptor channel discharge-frequency values presented in table 4-1 of reference 3-02a(2) have been amended as per table 3-1 herein because the McCormick Ranch diversion channel assumed to be in place in the Phase II GDM studies (see para. 2-04f) will not be built. Also additional information has permitted better definition of routing characteristics and conveyance capacities along the Arizona Canal. In addition, the Bureau of Reclamation has recently provided design information on the proposed reach 12 of the Granite Reef Aqueduct for the Central Arizona Project (CAP). The interceptor watershed subareas and the CAP facilities to be located within the watershed are shown on plate 4-B. Without the assumed McCormick Ranch diversion along Shea Boulevard the 100-year design discharge for the interceptor would increase to 11,700 cfs. The revised 100-year peak discharges at the interceptor inlet for several conditions are shown in table 3-1. To reduce the 100-year peak discharge to 8,000 cfs, it is necessary to attenuate and/or detain floodflows from subareas 2-4 (pl. 4-B).

The City of Scottsdale and the Flood Control District of Maricopa County have given formal assurances to the Corps that detention facilities would be provided which would reduce the contributing floodflows from subareas 2-4 (pl. 4-B). This plan could be implemented by providing either a 400 ac-ft detention basin with a 200 cfs outlet at CP 102; or a 400 ac-ft capacity detention basin with a 200 cfs outlet located at CP 103 together with a smaller 50 ac-ft. capacity detention basin with a 200 cfs outlet at CP 102 or equivalent detention storage located in subarea 2. Table 3-2 lists the 100-year subarea hydrographs, table 3-3 lists the 100-year subarea hydrographs combined and routed to the interceptor inlet with detention in subareas 2-4. Detailed hydrology for the interceptor will be incorporated in Design Memorandum No. 4.

portion of the Indian Bend Wash watershed permitted determination of a standard project flood peak discharge at CP 310 with residual rainfall over the inlet subareas. The 100-year flood hydrographs were computed using the relationships developed in reference 3-02a(1), namely the ratio of the 100-year flood to standard project flood for an urbanized area. Table 3-6 summarizes the contemporaneous discharge values for Indian Bend Wash at CP 310 and the inlet side drainage areas.

TABLE 3-1

100-Year Peak Discharges at Interceptor Inlet, Future Conditions

All flows reach interceptor[1]	With Aqueduct[2] and dike	With aqueduct, dike[3] and detention structures
11,700	11,000	8,000

[1] Represents maximum runoff at CP 101 with the hypothetical condition of no overtopping of the Arizona Canal south levee, without CAP in reach 12 (Granite Reef Aqueduct, dikes overchutes etc.) and without detention facilities to be constructed by local interests.

[2] Represents maximum runoff at CP 101 where the south levee can be overtopped and with the aqueduct and dike (CAP) in place.

[3] Same as 2 plus detention storage at CP 103 and detention storage at CP 102 or detention storage in subarea 2.

TABLE 3-3

Interceptor Subarea Hydrographs Combined and Routed to CP 101; 100-year Flood

Period (15 Min.)	Subareas 5-8	Subareas 1	Subtotal. Subareas 1, 5-8	Subareas 2-4	Total
1	0	0	0	6	6
2	0	1	1	6	6
3	1	2	3	6	9
4	4	2	6	6	12
5	7	3	10	7	17
6	11	3	14	10	24
7	15	4	19	14	33
8	19	4	23	20	43
9	23	5	28	27	55
10	22	5	31	35	67
11	30	5	35	44	79
12	33	5	38	52	90
13	36	6	42	60	102
14	39	6	45	68	113
15	43	6	49	74	123
16	47	6	53	81	134
17	55	22	77	86	163
18	78	114	192	92	284
19	167	381	538	98	636
20	380	1,004	1,384	106	1,490
21	951	1,929	2,880	119	2,999
22	2,025	2,858	4,883	137	5,020
23	2,794	3,024	5,818	164	5,982
24	3,933	2,426	6,359	212	6,571
25	5,216	1,593	6,809	296	7,105
26	6,414	965	7,379	415	7,793
27	7,000*	539	7,539	547	8,086
28	7,000*	291	7,291	659	7,950
29	6,794	136	6,935	728	7,663
30	6,189	60	6,249	761	7,009
31	5,404	26	5,430	781	6,210
32	4,571	11	4,572	816	5,398
33	3,808	3	3,811	879	4,690
34	3,177	1	3,178	966	4,144
35	2,684	0	2,684	1,061	3,745
36	2,234		2,234	1,148	3,381
37	1,657		1,657	1,216	2,873
38	1,165		1,165	1,263	2,428
39	940		940	1,291	2,230
40	770		770	1,305	2,075
41	591		591	1,310	1,902
42	433		433	1,309	1,742
43	306		306	1,301	1,607
44	210		210	1,283	1,492
45	139		139	1,246	1,385
46	90		90	1,182	1,272
47	57		57	1,088	1,145
48	35		35	969	1,004
49	21		21	836	851
50	13		13	702	715
51	7		7	581	588
52	4		4	478	462
53	2		2	397	399
54	1		1	336	337
55	1		1	292	292
56	0		0	261	261
57				240	240
58				226	226
59				217	217
60				211	211
61				201	201
62				204	204
63				203	203
64				202	202
65				201	201
66				201	201
67				200	200

*Peak = 7400 cfs which exceeds canal and overbank capacity of 7,000 cfs at Station 60+00. Flows less than 1,000 cfs are conveyed to interceptor. Flows in excess of 7,000 cfs overtop south levee and travel south.

TABLE 3-5

Inlet Side Drains

100 Year Peak Discharges and Volumes, Future Conditions

Concentration Point	Drainage Area (sq mi)	Peak Discharge (cfs)	Volume (ac-ft)
301	.153	230	19
302	.048	80	6
303	.297	950	35
308	.993	1,040	122
311	.270	430	36

TABLE 3-6

100 Year Peak and Contemporaneous Discharges

At the confluence of Indian Bend Wash and the Inlet Side Drainage Subareas with local storm centered over inlet subareas (31-39) and residual rainfall over Indian Bend Wash.

Concentration Point	Drainage Area (sq mi)	Peak Discharge (cfs)	Contemporaneous Discharge (cfs)
301	.153	230	
302	.048	80	
303	.297	450	
308	.993	1,040	
310	91		8,600

At the confluence of Indian Bend Wash and the Inlet Side Drainage Subareas with local storm centered over Indian Bend Wash at CP 310.

Concentration Point	Drainage Area (sq mi)	Peak Discharge (cfs)	Contemporaneous Discharge (cfs)
310	91	30,000	
301	.153		11
302	.048		3
303	.297		17
308	.993		159

4-04. SUBSIDENCE. No major subsidence or earth fissures have occured in the Scottsdale-Paradise Valley area. Data presented by the United States Department of the Interior Geological Survey in an undated report titled, "Investigation of Vertical Displacement of Ground Surface Phoenix-Mesa Arizona", indicate an estimated subsidence of 0.4 ft near the north end of the project measured from 1948-1967 surveys and an increase in elevation of approximately 0.2 ft near the south end of the project measured from 1933-1962 surveys. Estimates of latest surveys, based on adjusted U.S. Coast and Geodetic Survey level data for 1948-1967, indicate that only a slight amount of subsidence of less than 1 ft has occurred in the vicinity of the site. See "Land Subsidence and Earth Fissures in Alluvial Deposits in Phoenix Area, Arizona" by H. H. Shumann, 1974. This data was based on water level declines, geographic and geophysical data.

Future subsidence at the site of the proposed improvements should not exceed the total amount of subsidence that has occurred. Since no damage related to subsidence has been reported to any existing structures near the site, and considering the nature of the proposed structural improvements of this project, no significant adverse impact is anticipated from differential settlement due to subsidence.

4-05. SEISMICITY. Earthquake records indicate that Arizona is outside the circum-Pacific belt that includes the Pacific Coast and adjacent parts of the Western Mountain Region of the United States. Thirty-nine earthquakes of maximum intensity IV to VI (modified-Mercalli intensity scale) have occurred within a 150-mile radius of the project area from 1852 through 1974, see plate 21. The largest known earthquake in the state's history was one of intensity VIII recorded in 1910 some 75 miles northeast of Flagstaff and approximately 190 miles from the project area.

a. Two earthquakes of maximum intensity IV were reported within a 50-mile radius of project area between 1875 and 1974.

b. Seven earthquakes of intensity IV to V were reported between 1922 and 1973 within a 50 to 100-mile radius.

c. Twenty-seven earthquakes of intensities IV to VI were reported between 1906 and 1974 within a 100 to 150-mile radius. One of the most significant faults within 100 miles of Phoenix, is approximately 33 miles long and is located north-northeast of Globe, Arizona.

d. The project site is in Zone 2 according to the Seismic Zone Map of Contiguous States in ER 1110-2-1806, dated 30 April 1977. An evaluation of the geologic and seismic conditions within a 150-mile radius of the project site indicates that this is an area of low seismicity.

Soils and Materials

4-06. FIELD INVESTIGATIONS. Field investigations were conducted during March 1974 and January 1977 in order to determine the nature of materials that would be encountered during construction and to evaluate the foundation conditions for the inlet and major proposed structures in Indian School Park. Results of field investigations for Indian School Park are presented in this report because rights-of-entry for field investigations were not furnished by local interests in time for results to be included in Supplemental Report No. 2 to the Recreation Master Plan. Investigations included bucket auger drilling with continuous standard penetration tests, backhoe trenching with random in-place density tests

4-09. DESIGN VALUES

a. Unit Weights. The values in table 4-2 were adopted for design of flood control facilities. They are based on results of classification tests, compaction studies, and density tests conducted for this project; and detailed laboratory tests conducted for other projects using similar materials.

TABLE 4-2

Unit Weights and Friction Angles

	Unit Weights (pcf)			Internal Friction
	Dry	Drained	Saturated	Angle (deg)
Levee fills	102	112	126	30
Foundations	95	105	122	26
Backfills	105	118	128	*

* See table 4-3 for equivalent fluid pressures.

b. Backfills. Adopted equivalent fluid pressures for backfill reflect the availability of only cohesive soils within the inlet and greenbelt areas. Earth pressures were derived by taking into account the residual lateral pressures produced by compaction and the yielding characteristics of the proposed structures. The design values from backfills are given in table 4-3.

TABLE 4-3

Equivalent Fluid Pressures (pcf)

	Moist	Saturated	Submerged
Yielding walls	54	58	30
Non-yielding walls	88	96	58

c. Foundation Design. Building and Wall Foundations. Proposed structures would be supported by spread and continuous footings or thickened-edge slab-type foundations based at a minimum depth of 18 inches below finished grade. The footings would undergo maximum settlements of 1/2 inch and maximum differential settlements of 1/2 inch when based on undisturbed native material or on compacted fill. The allowable soil bearing pressure would be 1,500 psf and may be increased 750 psf for each foot below minimum depth not to exceed a maximum of 3,000 psf. A one-third increase in soil bearing pressure may be used when considering dead load plus maximum live load. The allowable passive lateral soil pressure would be 400 psf per foot of depth. All fill or backfill placed under structures would be compacted to at least 100 percent of maximum density. (D-698.70)

d. Balance Factors. For earthwork or material distribution computations, a balance factor of 0.87 would be used when converting bank volumes into compacted volumes. The factor would apply to all areas of the project and would take into account loss of material during handling.

c. Levees and Embankments. Levees and embankments would be constructed of materials obtained from required excavations and would consist predominantly of cohesive soils. Fills would be compacted to at least 90 percent of maximum density for cohesive soils and to 95 percent of maximum density for cohesionless soils, as determined by ASTM test method 698-70. Structural geometry of the levees would also include a 16-foot wide berm and a 1V to 2H backslope. Landscape fill and topsoil would be placed on a 1V to 4H slope on the channel side of the levee to accommodate plantings for esthetic treatment.

d. Backfill Compaction Requirements. In general, backfill would consist of material obtained from required excavations. Material types would be designated as cohesive or cohesionless soil. Compaction by flooding would not be permitted. Cohesionless soil is unavailable from the inlet excavations. Table 4-4 lists the compaction requirements (ASTM method D 698-70) for fills and backfills for the proposed structures.

TABLE 4-4

Compaction Requirements (ASTM D 698-70)

Feature	Cohesive Soils (% max. density)	Cohesionless Soils (% max. density)
Abutments	95	100
Footings and slabs	100	100
Walls	90	95
Invert	90	95
Drop structures	95	*
Siphon	90	*

* Only cohesive soils would be used as backfill for the siphon and drop structures.

e. Indian School Park Lake Lining. Materials to be used for the lake lining would consist of sandy clay (CL) and would be obtained from designated required excavation areas. The materials would be mixed with sodium chloride, moistened and compacted. Suitable materials would be selected and stockpiled. Sodium Chloride, which may be rock salt, will be finely ground having at least 95 percent passing the No. 30 sieve and less than 5 percent passing the No. 100 sieve. Chemical composition shall not be less than 97% sodium chloride. The salt will be uniformly blended with the designated select material. The soil-sodium chloride mixture will consist of 0.270 percent by weight of NaCl (approximately 6,200 pounds) per acre per 6 inches of compacted sealing blanket. At the time of compaction the material would be at approximately optimum moisture. The lining would be compacted to at least 95 percent of maximum density (ASTM-D 698) and would consist of three 6-inch layers.

4-11. UPLIFT. For floodwall and siphon structural design, uplift computations would be in accordance with procedures outlined in EM 1110-2-2501, Wall Design - Flood Walls. Safety factors against uplift would be conservative due to the combination of short duration floods and existing low permeability foundation soils. Inasmuch as the siphon would be periodically emptied for maintenance purposes, future recreation lakes within the channel would be constructed at least 100 feet from the siphon to insure against seepage uplift.

Their locations are shown on plate 25. Information on these aggregate sources is given in index 2 and 3, for latitude 33 degrees N. and 111 degrees W., and in indexes 2, 4, 6, and 7 for latitude 33 degrees N. and longitude 112 degrees W. of the Waterways Experiment Station Technical Memorandum No. 6-370, September 1953, titled "Test Data, Concrete Aggregates in Continental United States," Volume 1, Area 3, Western United States. The previous testing performed on coarse and fine aggregates from plants along the Salt River indicated potentially reactive materials; however, the materials have been used extensively for various civil works and military projects in the area and have produced concrete with suitable service records. Commercial plants along the Agua Fria River and the Salt River will be listed as concrete aggregate sources in the project specifications.

c. Cement. Type II, low alkali cement suitable for concrete construction would be available from cement plants at Clarkdale, about 100 miles north of the project site; or at Rillito, about 120 miles southeast of the project site.

d. Stonework. There are no known operating hard rock quarry sites in the vicinity of the project. Cobblestones that would meet the requirements for stonework could be obtained from rock processing plants along the Salt River in the Phoenix metropolitan area. The maximum size stone available would be about 3 feet in diameter.

c. Alinement and cross sections. The channel would be partly entrenched and would generally follow the existing wash from Indian Bend Road to McDonald Drive. Because of rights-of-way constraints, the channel is not always symmetrical about a common centerline. A project control line has therefore been established to delineate the channel alinement. The project control line would have one curve with a deflection angle of 23°-38'-27" and a radius of 4,000 feet. The inlet channel would be trapezoidal in cross section with base widths ranging from about 420 feet to 640 feet. The invert would generally be V-shaped with the mid point being 2 feet below the elevation at the toe of the side slopes. The V-shaped invert would provide capacity for low flows and would probably be modified in the future by local interests to be compatible with the design of the proposed golf course. Riprap on the side slopes would be placed on a 1V to 2.5H slope. For landscaping purposes the riprap would generally be covered with fill and topsoil placed on a 1V to 4H slope.

d. Rights-of-way restrictions along the constricted reach from Station 385+00 to McDonald Drive necessitated use of vertical concrete walls on the left and right banks of the channel. A low vertical wall would also be required near the hotel complex along the right bank for similar reasons.

e. Invert gradient. Local interests have done considerable excavation within the project area in anticipation of the construction of the inlet channel. The inlet channel grades would vary from 0.0012 to 0.00184.

f. Water surface computations. Hydraulic computations for the water surface profile (pls. 7-8) were based on the reach method, using Manning's formula, and on the HEC-2 computer program. Contraction and expansion coefficients of 0.2 and 0.4, respectively, were used in the hydraulic analysis. Values of n=0.045 and n=0.030 were used for establishing top of channel bank elevations and for computing design velocities, respectively. The n value of 0.045 reflects the construction of a proposed golf course, including landscaping, in the inlet channel by local interests. The existing lake at the hotel complex was assumed to be filled with sediment and debris. The higher n value of 0.045 was used in this area to allow for losses caused by the piers supporting the hotel.

g. The following conditions for the future golf course were assumed for computing the water surface elevations: (1) mounds would be at a maximum height of 3 feet and a maximum width of 100 feet perpendicular to the flow; (2) one mound in a transverse section from station 383+60 to about station 377+00, and not more than two mounds in a transverse section from Station 415+00 to about Station 383+00; (3) no mounds or obstructions would be located in the constricted section downstream from Station 377+00; (4) longitudinal lengths of the mounds would not exceed 200 feet; (5) distance between mounds would be not less than 300 feet; and (6) sand traps, lakes, and mounds would not be allowed within 50 feet of the revetted side slopes of the inlet channel.

h. Development plans for the future golf course should be in accordance with the conditions assumed in subparagraph g. All plans for the golf course would be subject to approval by the Flood Control District.

on McDonald Drive and into the greenbelt floodway. The remaining 13,000 cfs would be flowing through the existing low-flow bridge. Local interests have constructed a low-flow channel downstream of McDonald Drive bridge in the greenbelt floodway. The capacity of this channel ranges from 8,000 cfs at the bridge to 4,000 cfs at some distance downstream of the bridge.

o. Freeboard. The top of levees at the drop structure would provide a minimum freeboard of 3.0 ft at the standard project flood of 62,000 cfs (future conditions). The top of channel walls would be set at a minimum of 1.0 ft above the water surface elevation of the standard project flood discharge of 62,000 cfs. The top of the inlet channel banks was set to provide a minimum freeboard of 3.0 ft at the 100-year design discharge of 30,000 cfs. During construction of the inlet channel the areas adjacent to the left bank would be filled to the top of the channel bank. Areas adjacent to the right bank of the channel would be filled to the elevation of the 100-year water surface (future conditions). During construction of the interceptor channel the following year the right bank areas of the inlet channel would be filled to the top of the bank (see plate 10). The top of the channel banks would provide 1.0 ft of freeboard at the standard project flood discharge of 42,000 cfs under present conditions.

p. Bridges. The proposed Indian Bend Road bridge at about Station 423+70 is to be designed and constructed in the future by local interests. For the hydraulic analysis the following data was used: (1) base width would be 300 feet perpendicular to the flow with section side slopes of 1V to 2.5H; and (2) seven 1.5 ft thick piers as proposed by local interests would be alined with the direction of flow. The soffit elevation of the bridge would be set not lower than elevation 1,286.5 ft. This would provide 6.0 ft freeboard at the 100-yr. design discharge of 30,000 cfs. Freeboard at the standard project flood of 62,000 cfs would be about 2.0 ft. Flow through the proposed Indian Bend Road bridge with 2 feet of debris on each face of the pier would be Class A. A velocity of flow of 11 feet per second would prevail at the design discharge of 30,000 cfs.

q. The existing low-flow bridge at McDonald Drive would accomodate 8,000 cfs. The bridge has a total length of about 213 feet and is supported on 3 piers. Four feet of debris accumulation at each pier was assumed in the hydraulic analysis.

r. Existing hotel complex. The existing structure extends about 145 feet into the inlet channel and is supported on five piers. The bottom of the hotel overhang is at elevation 1,286.4 ft. Freeboard at the standard project flood of 62,000 cfs and the 100-year flood of 30,000 cfs would be about 3 feet and 7.5 feet respectively.

s. Stone Revetment. Critical design values occur at Station 375+00 where the velocity of flow is about 10 feet per second at a flow depth of about 8.9 ft for a roughness coefficient of n = .03. The local boundary shear for riprap on 1V to 2.5H side slope would be 1.8 lb/ft^2. A riprap thickness of 15 inches with a gradation of W (50) maximum of 60 lb/ft^2 and a W (50) minimum of 35 lb/ft^2 would provide a design shear value of 2.1 lb/ft^2. A minimum riprap thickness of 15 inches would be used to revet the side slopes of the inlet channel.

TABLE 5-1

PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION – INDIAN BEND WASH INLET CHANNEL

LEFT AND RIGHT BANKS

DRAIN NO.	SUBAREA NAME	SUBAREA SIZE SQ. MI.	SUBAREA DISCHARGE PEAK C.F.S.	TOTAL Q C.F.S.	SIDE-DRAINAGE REQUIREMENTS INDIVIDUAL Q C.F.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
						LEFT BANK			
1	33-36	.395	450	450	225	3-48" RCP with flapgates	371+47	Proposed by C.E. to connect to drains	No excess flows
					225	3-48" RCP with flapgates	372+00	to be constructed by local interests.	
2	-	-	-	-	-	24" RCP with flapgate	376+20	Proposed by C.E. to relieve miscellaneous	No excess flows
3	-	-	-	-	-	24" RCP with flapgate	382+30	runoff.	
-	32	.05	80	80	-	-	-	Overland flow to inlet channel.	No excess flows
-	37-39	0.99	1040	***		100-ft. wide stub-out for future	414+94.14	Temporary ditch to be constructed by	No blockage to existing flows
						interceptor channel.		local interests to stub-out.	
						RIGHT BANK			
4	-	-	-	-	-	24" RCP with flapgate	368+65	Proposed by C.E. to relieve miscellaneous	No excess flows
								runoff.	
-	-	-	-	-	-	270-ft. wide temporary opening	416+95	Proposed by C.E.	No blockage to existing flows
						in channel berm.			
5	670	0.27	430	200	200	2-42" RCP	427+18	Proposed by C.E. to connect to drainage	Excess flows to temporary opening
								ditch to be constructed by local	(sta. 415+60 to Sta. 418+30)
								interests.	

* Subareas designated on Plate 3.

** Based on 100-year storm.

*** Based on flows from subareas 37-39 only. There would be no blockage to additional flows under present conditions.

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(5) The open channel section for the siphon outlet works would have divider walls separating flows from each of the three siphon boxes. Each of the separate channels would have a base width of 10 feet at the siphon box, transitioning to a base width of 20 feet. Transition length would be 83 feet. Stop log slots would be provided at the end of each channel at Station 12+99.23. A concrete lined trapezoidal channel with a base width of 62 feet and side slopes of 1V to 1H would extend 412 feet downstream from Station 12+99.23 to Station 8+87 where it meets the existing canal. The right bank of the canal would be lined with concrete for and additional 300 feet downstream to protect against erosion.

(6) Dewatering sumps at the low point of the siphon boxes would be provided. Access manholes for each siphon box would be located near the toe of the side slopes of the inlet channel at the request of SRP.

(7) The hydraulic analysis for the siphon structure is based on the design canal flow of 2,000 cfs. Backwater studies, beginning at the canal control structure at Scottsdale Road and using the HEC-2 computer program and field survey cross sections, established a water surface elevation of 1,278.4 ft at Station 8+87. Roughness coefficient n values of 0.024 and 0.014, respectively, were applied for the existing canal reach and the concrete lined trapezoidal channel for the outlet works. Expansion coefficients of 0.3 for abrupt transitions and 0.2 for gradual transitions, and a contraction coefficient of 0.1 were applied in computing the siphon structure losses. A roughness coefficient n value of 0.012 was used for the covered siphon boxes.

(8) Head losses for the design of the siphon (Q = 2,000 cfs) from Station 8+87 to Station 26+50 are shown in table 5-2.

TABLE 5-2

Siphon Head Losses

Item	Head Loss (ft)
Outlet works:	
friction	.053
others*	.055
	.108
Covered box:	
friction	.480
others*	.041
	.521
Inlet works:	
friction	.058
others*	.079
	.137
Total head loss	.766 ft. (use 0.8 ft.)

*Others include losses from expansion, contractions, gate slots, and trash rack. Bend losses are negligible.

establishing: (1) that the 100-year frequency flood capacity is maintained; (2) that minimum floor elevations are above the 100-year water surface elevation for residential structures and above or protected from the 100-year water surface elevation for non residential structures; and (3) that there is no substantial hazard to either the proposed improvements or to adjoining property. In recognition of the city's ordinance the Flood Control District of Maricopa County requested the Corps to reevaluate the hydraulics for the greenbelt floodway without confining the flows within a designated floodway as originally defined by encroachment lines. In accordance with the Flood Control District's request the hydraulic analysis for the greenbelt floodway in this report (pls. 29-32) establishes the unconfined limits of the design discharge of 30,000 cfs, except in areas where containment by flood protective measures is required to prevent significant flood damages to existing developments.

b. The required flood control measures in the greenbelt floodway are the responsibility of local interests. The Corps' involvement in the greenbelt floodway is limited to development of recreation features and providing technical assistance, at local interests request, in maintaining the integrity of the greenbelt floodway to convey the design discharge of 30,000 cfs. The Corps has analyzed the hydraulics for the greenbelt floodway in this report primarily to assist local interests in identifying deficient areas where flood protective measures would be required. Deficient areas that were found to exist at the time of this report are identified on plates 29 through 32. Those areas identified would require flood protective measures. This does not preclude the requirements for providing proper flood protective works for additional areas that are later found to be deficient. The Flood Control District of Maricopa County, under provisions of the section 221 agreement (Public Law 91-611), has the responsibility of providing adequate flood protective works in the greenbelt floodway in order to ensure the safe passage of the design discharge of 30,000 cfs without signficant flood damages.

c. The computed water surface profile reflects physical conditions as they existed in the greenbelt floodway, as of January 1976, except for the following assumptions and modifications:

(1) Deficiencies in the greenbelt floodway, identified and discussed in subsequent paragraphs, are rectified.

(2) The McDowell Plaza (formerly Hohokam Plaza) recreation development is in place.

(3) The proposed El Dorado Dike is in place in accordance with the most recent drawings (August 1977) submitted by local interests for review.

(4) The proposed excavated golf course between Thomas Road and Indian School Road is in place in accordance with the most recent preliminary grading plans (September 1977) submitted by local interests for review.

(3) McDowell Plaza (Station 152+31 to Station 160+00). The proposed recreation development, assumed to be in place, is located immediately upstream of McDowell Road bridge. The City of Scottsdale has constructed a concrete sill 3 feet in height about 30 feet upstream from the bridge. An opening about 18 feet wide is provided at the west end of the sill for channeling low flows.

(4) In essence, the grading for McDowell Plaza creates two flow paths separated by high ground. The festival plaza, stage, and primary parking area are located within the west flow path. A stepped drop structure, which would also serve as a seating area for the stage, is located at the north, or upstream, end of the west path. A parking lot within the east path would be used primarily by maintenance and service vehicles. A swale in an east-west direction along the northern limits of the recreation development would direct low flows up to about 2,000 cfs to the west path. Flows in the swale are directed to a low-flow channel adjacent to the parking lot. At a discharge of 2,000 cfs floodwaters in the swale would flow into the low-flow channel with the excess spilling over the stepped drop structure and flowing through the festival plaza area at an average depth of about 1 foot (Sta. 157+00) and at a velocity of about 3 feet per second. A drop structure for the low-flow channel is provided near the north end of the parking lot. Depth of flow (Sta. 157+00) in the low-flow channel would be about 3.3 ft at a velocity of about 7 feet per second. The west parking lot would be located above the water surface elevation for 2,000 cfs. Backwater caused by the concrete sill at McDowell Bridge would pond water to elevation 1,200 feet in the east path. Floodwaters would be flowing about 2 feet deep over the concrete sill at a discharge of 2,000 cfs. The following coefficient of rougnness n values were applied in McDowell Plaza:

(a) n = .045 Along the slopes of the east and west banks.

(b) n = .03 Along the parking lots.

(c) n = .04 Along the festival plaza area.

(d) n = .07 Along the middle (high ground) where the trees are concentrated.

(5) The water surface profile in the park area at the design discharge of 30,000 cfs is presented on plate 32. Average velocity of flow through the recreation area would be about 6 feet per second. The structure for the restooms and maintenance storage would be located about 2 feet above the design water surface elevation.

(6) Baseball Field Fences in the Vicinity of Station 170+00. The outfield chain link fences have been removed by the City of Scottsdale. The area occupied by the backstop fences was excluded from the conveyance section in computing the water surface elevations.

(7) El Dorado Park Dike. This dike, proposed for construction by the City of Scottsdale, generally extends from the upstream end of McDowell Plaza (Sta. 160+00) to Murray Lane (Sta. 183+00). The top of the proposed dike, based on the most recent plans

(15) Indian School Road (Station 260+72)-Right Bank. Flood protective works would be required to prevent floodwaters from escaping along Indian School Road. Local interests would develop plans to raise Indian School Road at the right bank of the greenbelt channel and to construct tie-back levees to confine the design discharge of 30,000 cfs. The plans would include appropriate interior drainage facilities.

(16) Indian School Road (Station 260+72)-Left Bank. Three commercial buildings immediately north of Indian School Road would be flooded to a depth ranging from about 1 ft to 3.5 ft. Local interests have proposed to floodproof two of these buildings and to obtain flow easements for the other, a service station, located nearest the wash. Local interests would develop and institute the necessary floodproofing plans. Local interests have been notified that comfort stations, fuel facilities, grease traps and other possible sources of pollutants that could contaminate the floodwaters during floods must be floodproofed.

(17) Indian School Park Recreation Development - Indian School Road to Camelback Road. The floodway would generally be excavated about two to three feet below the existing grade. The park would, among other recreation facilities, have four baseball fields with backstops and baseline fences. The baseline fences would be designed to permit lifting the fences out of the floodpath. The tennis courts would be constructed at elevations not less than two feet below the water surface elevation for the 30,000 cfs discharge. Plate 30 presents the water surface profiles with and without the recreation park in place. The hydraulic analysis was based on preliminary plans for the park. The following was assumed for hydraulic computations:

(a) The areas occupied by the baseball backstop fences would not convey flows.

(b) The baseline fences for the ballfields would be lifted out of the path of floodflows.

(c) Areas occupied by the elevated tennis courts (east bank) would not convey flows.

(d) The proposed Indian School Road low flow bridge is in place.

(e) The lakes would be filled with sediment and debris.

(18) Coefficient of roughness values ranging from n=.035 to n=.07 were used in the hydraulic computations.

(19) Local interests would provide a continuous 4,000 cfs capacity low-flow channel extending from McDonald Drive to Indian School Road, with proposed low-flow bridges at Chaparral Road, Camelback Road, and Indian School Road. The construction of these low-flow facilities would provide the Indian School Park recreation developments with protection from floodflows ranging up to 4,000 cfs (5-year flood under future conditions).

(20) Indian School Road (Station 260+72) to Station 274+00-Right Bank. An existing slump wall extends about 1,080 feet north from Indian School Road between the existing low-flow channel and the residential tract at the right bank of the floodway. Wall height ranges up to about 5.3 ft on the channel side and up to about 3.0 ft on the land side.

(28) Existing Drains Terminating at the Greenbelt Floodway. Existing drains which discharge into the greenbelt floodway and subject to backflow conditions would be modified by local interests. Local interests should recognize that temporary ponding could occur during high stages of floodflows in the Indian Bend Wash greenbelt floodway.

(29) Developed Areas in Floodway. Some of the developed areas that are within the overflow limits of the 30,000 cfs discharge, as indicated on plates 29 through 32, are not classified as deficient areas because the floor level of these developments, based on field survey data, were found to be above the design water surface elevation. Requirements for flowage easements for the developed areas within the 30,000 cfs overflow limits are under consideration by the Maricopa County Flood Control District.

Table 6-1 (Continued)

Reinforcing Steel, grade 40	
Allowable tensile strength:	
For retaining walls, floodwalls, and siphon structure	fs = 20,000 psi
For siphon structure under bursting heads between 16 ft and 22 ft	fs = 17,000 psi
Modulus of elasticity	Es = 29,000,000 psi
Prestressed Concrete:	
Concrete	
Compressive strength of concrete at 28 days	f'c = 5,000 psi
Compressive strength of concrete at time of initial prestress	f'ci = 3,500 psi
Modulus of elasticity of concrete	Ec = 4,300 Ksi
Modulus of elasticity of concrete at time of initial prestress	Eci = 3,600 Ksi
Prestressing steel	
Ultimate strength of prestressing steel	f's = 270 Ksi
Initial tensioning stress in prestressing steel	fsi = 0.7 f's = 189 Ksi
Effective stress in prestressing steel after losses	fse = 0.8 fsi = 151 Ksi
Steel:	
Structural steel A-36	
Yield strength	Fy = 36 Ksi
Allowable tensile stress	Ft = 0.60 Fy = 22 Ksi
Allowable bending stress	Fb - 0.66 Fy = 24 Ksi
Allowable shear stress	Fv = 0.40 Fy = 14.5 Ksi
Weights and Properties	
Concrete weight	150 pcf
Water weight	62.5 pcf

NOTE: The weights and properties of soils are presented in section IV.

(3) Outlet Structure. The outlet structure design would be the same as for the inlet structure.

b. Wasteway Structure. The wasteway structure includes a rectangular concrete channel and a gate structure to support three radial gates.

(1) Rectangular Channel Walls. The rectangular channel walls would be designed as L-type walls in accordance with the design presented herein for the inlet structure.

(2) Gate Structure. The gate structure for the wasteway would consist of three chambers, open at the top, and would be designed by SRP in accordance with standard practice. The three radial gates from the existing wasteway structure would be salvaged and installed at the new location shown on plate 9. Details for the gate structures and radial gates are shown on plates 17 and 18.

c. Channel Walls. All inlet channel walls would be designed as T-type walls. The walls would be designed for the same loading conditions as the siphon inlet and outlet structures except that 100 percent uplift forces, due to hydrostatic pressures, would be considered for design of the left wall between Station 387+40 and Station 374+00.

d. Wasteway Bridge. The bridge would have a clear roadway width of 18 feet and would be built on a skew angle of 38°49′10″. Two spans of about 41 feet each would be supported by a 9 ft 6 inch high central pier and the two abutments which would be part of the channel walls. In order to eliminate fixity and thereby minimize the size of the supports, the spans would bear on elastomeric pads. Each span would comprise three 36 inch-deep prestressed concrete I girders spaced 7 ft 3 inches center to center, with a 6-1/4 inch thick cast-in-place concrete deck. The design live load would be HS 20-44. Cast-in-place concrete handrails 2 ft 9 inches high would be provided on top of the 9 inch high concrete curbs.

e. Side Drainage Structures. Various sizes of drainage pipes would be provided to drain concentrated ponding areas and to connect street drainage facilities to the the proposed channel improvements. The design loads for pipes would be determined by combining an HS 20-44 live load and the load due to the weight of fill over the pipes. Inlet and outlet structures would be designed in accordance with the design requirements for channel walls.

VIII – ESTHETIC TREATMENT AND RECREATION

Esthetics

8-01. GENERAL. The feature design for beautification of the inlet channel presented herein has been prepared in accordance with EM 1110-2-38. The basic concept for project beautification was presented in the Phase I GDM. Feature design for the outlet channel was presented in the Phase II GDM and feature design for the interceptor and side channels system will be developed and presented in Design Memorandum No. 4. All costs for beautification of the inlet channel, ad shown in table 12-1, are considered to be flood control costs to be paid for by the Federal Government.

8-02. BEAUTIFICATION PLAN. The basic concept (see pls. 26 and 27) for beautification of the inlet channel has been to select a planting plan that would minimize the detrimental visual effects of the flood control project on the surrounding environment, provide food and cover for wildlife and be compatible with the hydraulic design for the inlet channel. This has been accomplished for the most part through planting with native and climate adapted trees, shrubs and grasses.

a. Plant Selection. The plants selected for beautification of the inlet channel are native to desert wash plant communities and associated desert plant communities. They were selected on the basis of their food value (see table 8-1) and cover value for wildlife as well as their hardiness to fluctuating desert conditions.

(1) Plants with food value, selected for the inlet channel, include mesquite, saltbush, paloverde, desert willow and desert sunflower.

(2) Plants with wildlife cover value include mesquite, saltbush, paloverde, ironwood, desert willow, desert sunflower, and smoketree.

b. Landscaping Plan. Trees would be planted on the channel invert and along the channel banks between the access maintenance roads and the channel rights-of-way. Trees to be planted on the channel invert would be arranged and spaced to minimize impedance to floodflows. Because of hydraulic design considerations no trees would be planted on the channel side slopes. However, low-lying shrubs would be permitted. See table 8-2 for complete list of trees to be planted in the inlet area.

(1) A seed mixture consisting of native grasses and shrubs would be seeded in the channel invert and side slopes. The same seed mixture would be seeded between the access road and the project rights-of-way. See table 8-3 for inlet channel seed mix.

c. Floodwall. The project plans provide for esthetic treatment to both sides of an exposed channel wall located along Hayden Road near Saguaro High School. Because of the difficulty and high cost involved in constructing a free standing flood control wall with an exposed aggregate finish, it was determined that a similar textured effect in concrete can be achieved using a sandblasting process. This process affords us the freedom of designing expressive finishes and patterns to be uninterrupted in its flow because any form joints would be erased by sandblasting to a depth of 1/8 inch. This process will minimize the detrimental visual impact of the wall and will cost less than an exposed aggregate finish technique.

	Jojoba	Burrage	Desert Willow	Yucca	Giantcactus	Lupin	Sage	Paloverde	Fiddleneck	Saltbush	Buckwheat	Mesquite	Prickly pear	Panicgrass	Filaree	Bristlegrass	Number of Users
	1	1	2	2	2	4	4	4	6	8	10	13	20	24	29	31	
Scaled Quail						#	+					*	*		*		
Gambel Quail						**				+		***	+		*	+	
Mearns Quail											+		*				
Mourning Dove									#					#	+	*	
White-Winged Dove	+		*		**							+	+	#		#	
Ground Dove														#		#	
Hummingbirds			#	#			#	#									
Horned Lark									#	+				+	#	***	
Common Raven												+	#				
Brown Creeper														+			
Cactus Wren									+				*		+		
Curve-Billed Thrasher													**			+	
American Pipit														#		#	
Cedar Waxwing															#		
Phainopepla																	
English Sparrow															+	#	
Meadowlark														#	#	***	
Yellow-Headed Blackbird																***	
Redwing														#	#	#	
Brewer Blackbird															#	+	
Cowbird														+		****	
Cardinal														#		#	
Pyrrhuloxia														#		#	
Black-Headed Grosbeak															#		
Blue Grosbeak														#		***	
Lazuli Bunting															#		
House Finch											#				#		
Common Goldfinch															#		
Lesser Goldfinch							#								#		
Lawrence Goldfinch									***								
Green-Tailed Towhee															+		
Rufus-Sided Towhee											#						
Brown Towhee							#		#		#				#		
Abert Towhee									**							**	
Savannah Sparrow														#	#	#	
Vesper Sparrow														*		#	
Lark Sparrow														*	+		
Botteri Sparrow														*			
Sage Sparrow											#				#		
Dark Eyed Junco											#				#		
Chipping Sparrow														*	***	*	
Brewer Sparrow															#	+	
White-Crowned Sparrow														#		#	
Lincoln Sparrow														#		#	
Song Sparrow														#	#	#	
McCown Longspur																#	
Northern Oriole																	
Painted Bunting														#		#	
Northern Hooded Skunk												****					
Gray Fox													+				
Coyote												+	+				
Antelope Jack Rabbit												****	*	+:		*	
Black-Tailed Jack Rabbit										#	*		*	+	+	+	
Cottontails												****	***	#	#	#	
Antelope Ground Squirrel				*				*		+			***				
Harris Ground Squirrel								**				**	*****				
Black-Tailed Prarie Dog										#			*				
Western Chipmunk													**				
Pocket Mouse										*		***					
Bannel-Tailed Kangaroo Rat											+	*			+		
Merriam Kangaroo Rat						*		*				*	+		*		
Ord Kangaroo Rat		*								*			*			+	
Grasshopper Mouse																#	
White Throated Wood Rat					**						+	****	****				
Peccary													*				
Mule Deer					*					#	+				#		

#	Use in Other Area
+	½ to 2 % of Diet
*	2 to 5 % of Diet
**	5 to 10 % of Diet
***	10 to 25 % of Diet
****	25 to 50 % of Diet
*****	50 % or More of Diet

LEGEND

TABLE 8-1

BASED ON "AMERICAN WILDLIFE AND PLANTS, A GUIDE TO WILDLIFE FOOD HABITS" by Martin, Zim, and Nelson, Dover Publications, New York, 1961.

INLET CHANNEL PLANT PALETTE
WILDLIFE FOOD HABITS for the SOUTHWESTERN DESERTS

IX – ENVIRONMENTAL ANALYSIS

9-01. GENERAL. The environmental analysis presented in this report evaluates the design modifications made subsequent to completion of the environmental impact statement and the Phase II GDM. An environmental analysis, if required, for design modifications for the interceptor and side channels system would be presented in Design Memorandum No. 4. The Phase II GDM and the Final Environmental Impact Statement, Indian Bend Wash, October 1973 (filed with the Council on Environmental Quality on 2 August 1974) were used as source documents in preparing this analysis.

9-02. ENVIRONMENTAL SETTING. No substantive change has occurred in the general environmental setting since publication of the Final Environmental Impact Statement (FEIS).

9-03. IMPACTS OF THE PROPOSED MODIFICATIONS. This section briefly describes the modifications in design that were made in the Design Memorandum No. 3 studies and their impact on the environment.

a. The existing Indian Bend Road on the east and west side of the inlet channel would be elevated up to 12 feet in height to provide tie-in points for the channel levees. This road modification would eliminate the proposed 2,900-foot-long dike along the south side of Indian Bend Road west of the channel presented in the Phase II GDM. This modification would have no effect on wildlife habitat or esthetics over those discussed in the FEIS. The road modification would, however, require the closure of the road during construction for a period of 60 days. This would result in a short term inconvenience to drivers of approximately 4,100 vehicles per day for about 8 weeks. An alternate route across Indian Bend Wash would be available on McDonald Drive 1 mile to the south.

b. The Timber-Bridge Inn, a privately developed hotel, has been constructed 400 feet north of the Arizona Canal on the west side of the recommended inlet channel. A portion of the hotel extends on piers over a 2-acre lake located in the recommended inlet channel. The lake is lined and does not contribute to ground water recharge. The lake will provide aquatic habitat for wildlife species that are tolerant of urbanization and public use. The proposed esthetic treatment for the inlet channel has been designed to be consistent with the lake habitat. (See section VIII.)

c. The construction of the inlet features as described in this report will have no additional impacts on the environment over those described in the FEIS.

9-04. MITIGATION. As described in the FEIS, the entrenchment of the inlet will necessitate removing 28 acres of mesquite bosque habitat of excellent wildlife value. To mitigate for the loss of wildlife habitat the Flood Control District of Maricopa County is acquiring a 100-foot wide corridor between the interceptor channel and the Arizona Canal. This corridor will be managed by the City of Scottsdale. In addition the Flood Control District has acquired a single offsite parcel that contains sufficient acreage to satisfy the wildlife mitigation requirements for both the New River and Phoenix City Streams and the Indian Bend Wash Flood Control Projects. This mitigation parcel comprises 409 acres of land located immediately west of US Highway 80 on the north side of the Gila River. An agreement was executed 13 December 1976 between the Flood Control District and the Arizona Game and Fish Department relative to the establishment and management of mitigation lands.

X – REAL ESTATE REQUIREMENTS

10-01. INLET CHANNEL.

a. Flood Control. Construction of the inlet channel would require about 90 acres of land for flood control purposes. In addition, approximately 52.5 acres of land including 12.4 acres for a mitigation corridor between the Arizona Canal and the interceptor are being acquired by the Flood Control District of Maricopa County to mitigate for loss of vegetative growth and wildlife habitat due to project construction. Additional details concerning the required mitigation lands are presented in Chapter IX.

b. Recreation. A riding and hiking trail is the only project recreation feature planned for the inlet channel. No additional lands will be required for this feature because the Flood Control District has indicated that project lands acquired for flood control purposes will be made available for recreation use such as the proposed trail system.

10-02. SIPHON-WASTEWAY. Lands, outside of the channel rights-of-way, required for construction and operation of the siphon and wasteway for the Arizona Canal are being acquired by the Flood Control District. Acquisition of these lands is being coordinated by the Bureau of Reclamation, the Salt River Project, the City of Scottsdale, and the Flood Control District. Final acquisition of required lands is subject to approval of the Bureau of Reclamation and the Salt River Project. Joint use agreements would be negotiated between the Flood Control District and Salt River Project for use of lands required for both flood control and irrigation purposes. Temporary easements, required for construction of the siphon and wasteway, will be acquired by the Flood Control District.

a. Indian Bend Road. The south side of Indian Bend Road would be excavated 12 feet to form a drop structure which would create a hazardous condition to motorists unless a barrier is provided. A steel cable supported by pipes is recommended instead of guardrail; because the latter would form an obstruction to floodflows. The steel pipes would be embedded in a concrete cutoff wall. The length of this barrier would be approximately 1,230 feet.

b. Vertical concrete walls for the siphon and wasteway would vary from 10 to 17.5 feet in height. To prevent people from falling into the invert area of the siphon or wasteway, a chain link fence would be provided on top of these walls.

c. Between Station 368+58.18 and Station 387+40, vertical concrete channel walls are proposed. These channel walls would have heights that would vary from 2 feet to 13.5 feet above the adjacent ground surface. Easy access to the top of the channel wall at left bank would be possible from the top of modified Hayden Road or East Valley Vista Lane. Access to the top of wall at right bank could be gained from the proposed berms adjacent to the walls. Installation of chain link fence on top of this wall would be esthetically unacceptable and such a fence would not be a positive deterrent to anyone who wants to walk on the top of this wall. Consideration would be given to installed barriers or some modification in wall design before these walls are constructed. Safety considerations at this location would be coordinated with local interests.

A breakdown of the cost estimates shows a net increase of $1,330,000 in Federal costs and a net increase of $268,000 in non-Federal first costs.

TABLE 12-1

Detailed Cost Estimates
(October 1977 Price level)

INLET CHANNEL

Acct. No.	Description	Quantity	Unit	Unit Cost	Total Cost
	FLOOD CONTROL COSTS				
	FEDERAL FIRST COSTS				
09	Diversion and control of water	1	Job	LS	$189,000
	Clear site and remove obstructions	90	Acre	$200.00	18,000
	Excavation, channel	636,000	CY	0.85	540,600
	Compacted-fill, channel	90,000	CY	0.33	29,700
	Asphalt concrete pavement	870	Ton	20.00	17,400
	Facing stone	33,000	CY	11.50	379,500
	Filter material	10,600	CY	11.00	116,600
	Grouting stonework	3,500	CY	32.40	113,400
	Backfill, toe	950	CY	0.40	380
	Side drains	1	Job	LS	247,000
	Siphon and wasteway				
	Excavation	40,000	CY	0.65	26,000
	Compacted fill	19,000	CY	0.33	6,270
	Concrete, invert and footings	3,740	CY	43.00	160,820
	Concrete, walls	1,900	CY	135.00	256,500
	Concrete, side slopes	700	CY	52.00	36,400
	Concrete, roof slab	970	CY	162.00	157,140
	Portland cement	41,300	CWT	2.90	119,770
	Reinforcing steel	563,000	Lbs	0.27	152,010
	Control house	1	Job	LS	10,800
	Trash rack	1	Job	LS	29,000
	Manhole, frame and cover	6	Each	490.00	2,940
	Radial gate	3	Each	14,000.00	42,000
	Mechanical, electrical and gate control equipment	1	Job	LS	133,000
	Relocation of gates	1	Job	LS	43,000
	Prestressed concrete bridge	1	Job	LS	54,000
	Facing stone	300	CY	11.50	3,450
	Filter material	100	CY	11.00	1,100
	Gate Chamber structures	2	Each	68,300.00	136,600

Table 12-1 (Continued)

Detailed Cost Estimates
(October 1977 Price level)

INLET CHANNEL

Acct. No.	Description	Quantity	Unit	Unit Cost	Total Cost
31	Supervision and administration				
	Supervision and inspection during construction				200,000
	District office overhead				160,000
	Subtotal				$360,000
51	Operation and maintenance				
.22	Operation and maintenance manual	1	Job	LS	6,000
	TOTAL, FEDERAL FIRST COSTS				$5,250,000
	NON-FEDERAL FIRST COSTS				
	Lands and damages				
	Levee and channel	90	Acre	7,500.00	736,000
	Offsite Mitigation	40	Acre	300.00	12,000
	Mitigation Corridor	12	Acre	12,500.00	150,000
	Rights-of-way acquisition				45,000
	Contingencies				113,000
	Total, lands and damages				$1,056,000
	Relocations:				
	Roads				
	Indian Bend Road	1	Job	LS	181,000
	Hayden Road and East Valley Vista Lane	1	Job	LS	129,000
	Pipe gates, 12-foot	6	Each	450.00	2,700
	Contingencies				38,000
	Subtotal				351,000
	Utilities				
	Power line	1	Job	LS	49,000
	Telephone line	1	Job	LS	36,000
	Contingencies				10,000
	Subtotal				$95,000

Table 12-2

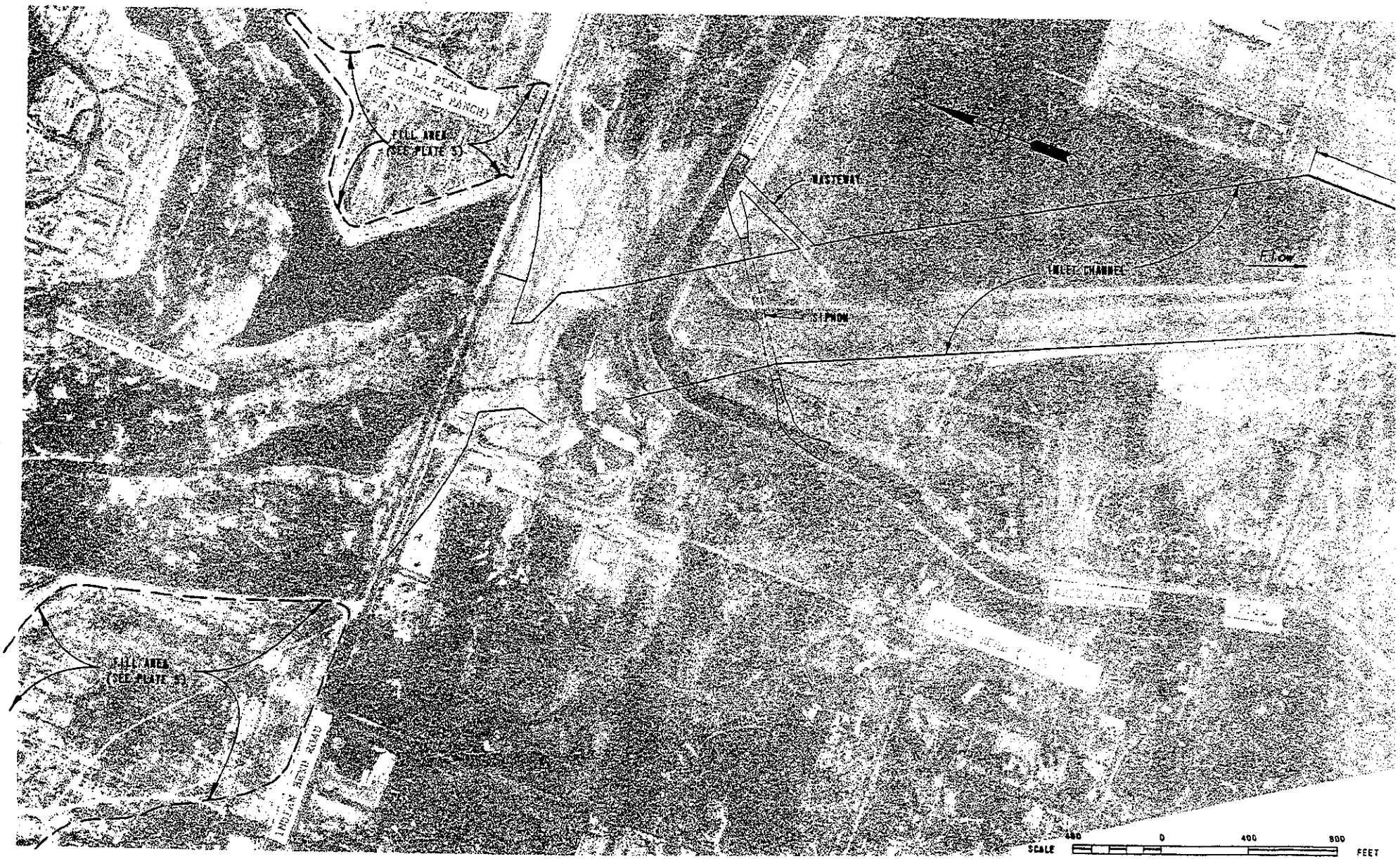
Flood Control Costs Presented
in the Phase II GDM
(July 1974 Price level)

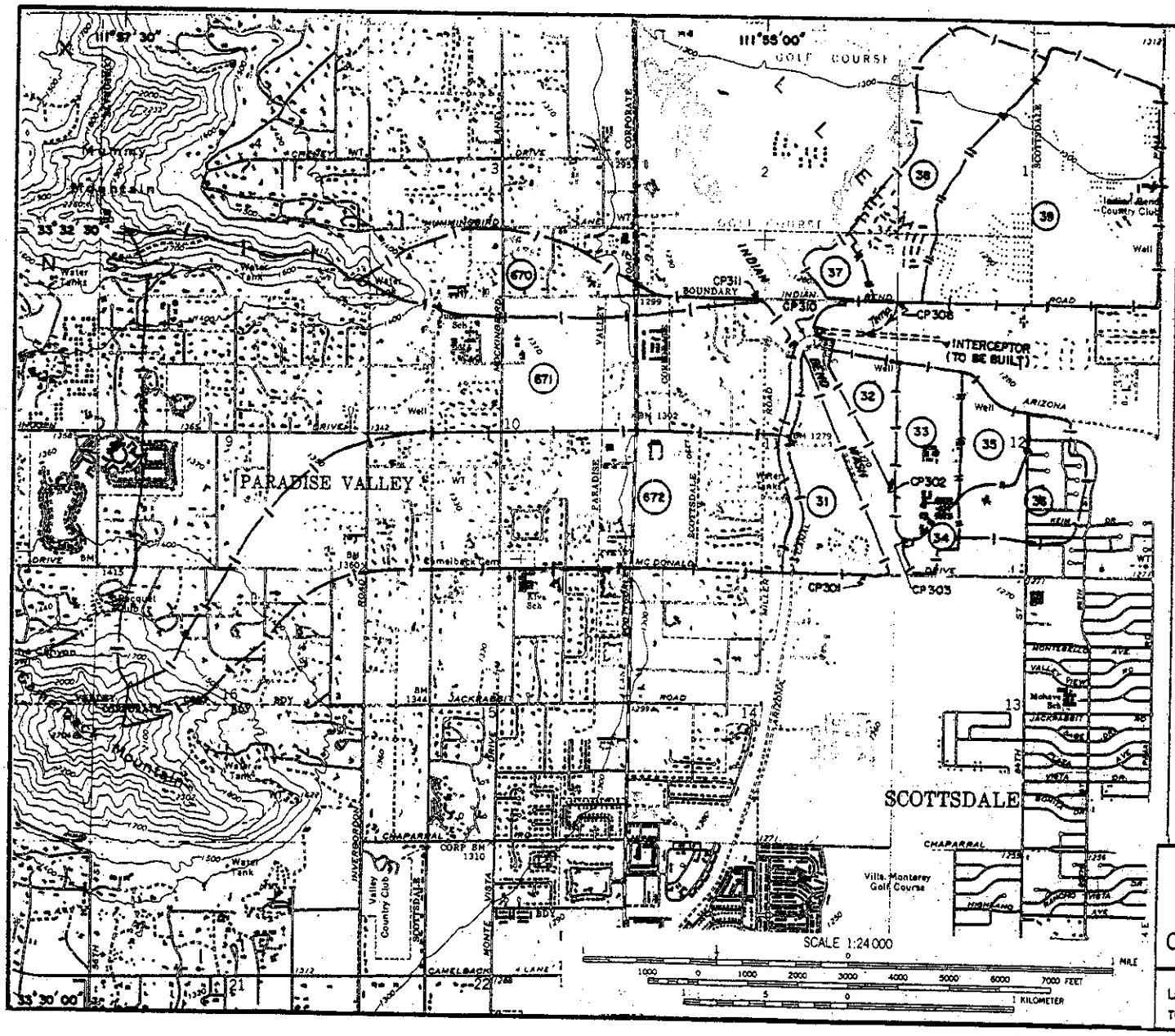
Cost Acct. No.	Description	Inlet Channel	Interceptor Channel
	FEDERAL FIRST COST		
09	Diversion and control of water	$27,000	-
	Clear site and remove obstruction	14,100	-
	Earthwork	208,000	-
	Channel, stonework, and sidedrains	-	$560,025
	Stone, filter material, and grouting stonework	627,875	-
	Asphalt concrete paving	26,000	-
	Siphon	995,420	-
	Flood wall	98,480	-
	Esthetic treatment	35,260	131,550
	Contingencies	232,865	83,425
	Total channel	$2,265,000	$775,000
30	Engineering and design	410,000	140,000
31	Supervision and administration	204,000	71,000
55	Operation and maintenance		
.22	Operation and maintenance manual	3,000	2,000
	TOTAL FEDERAL FIRST COSTS	$2,882,000	$988,000
	NON-FEDERAL FIRST COSTS		
	Lands and damages	660,000	840,000
	For mitigation	60,000	
	Rights-of-way acquisition	44,000	31,000
	Contingencies	91,000	94,000
	Total lands and damages	$855,000	$965,000
	Relocations		
	Roads and bridges	98,600	739,200
	Utilities	29,500	40,900
	Contingencies	15,300	66,500

XIII - STATEMENT OF FINDINGS AND RECOMMENDATIONS

13-01. FINDINGS. The inlet channel is a vital segment of the overall flood control plan for Indian Bend Wash. When completed, the inlet channel would safely convey the project design flood of 30,000 cfs to the greenbelt floodway which is being managed and improved (as described in this report) by local interests. Flows from the greenbelt floodway would be conveyed to the Salt River by the recently completed outlet channel. Construction of the siphon for the Arizona Canal would permit floodflows that are presently intercepted by the canal, to be safely confined in the inlet channel. The wasteway, together with the siphon, would permit the Salt River Project to discharge floodflows and irrigation waters from the canal into the wash during emergency situations thus reducing the chances of overtopping and breaching of the canal banks downstream from Indian Bend Wash. Completion of the inlet channel would protect the City of Scottsdale from damages from a 100-year frequency flood along the wash. The plans for the inlet channel have been coordinated with local interests and environmental groups, there is no known opposition to the plan. Changes from the plan presented in the Phase II GDM are summarized in section II.

13-02. RECOMMENDATIONS. It is recommended that the Federal Government participate in construction of the inlet channel as described herein. The project recommended for construction consists of three major features; (1) the inlet channel, (2) the siphon and (3) the wasteway structure for the Arizona Canal. A riding and hiking trail is also recommended for construction within the inlet channel. Total estimated Federal first costs for the flood control features are $5,250,000. Total estimated non-Federal first costs are $1,603,000. Costs for the riding and hiking trail are presented in Supplemental Report No. 2 to the Recreation Master Plan.


FILL AREA
(SEE PLATE 5)
WESTERN
INLET CHANNEL
Flow
SIPHON
FILL AREA
(SEE PLATE 5)
INDIAN HILL ROAD
SCALE
400
0
400
800
FEET



LEGEND

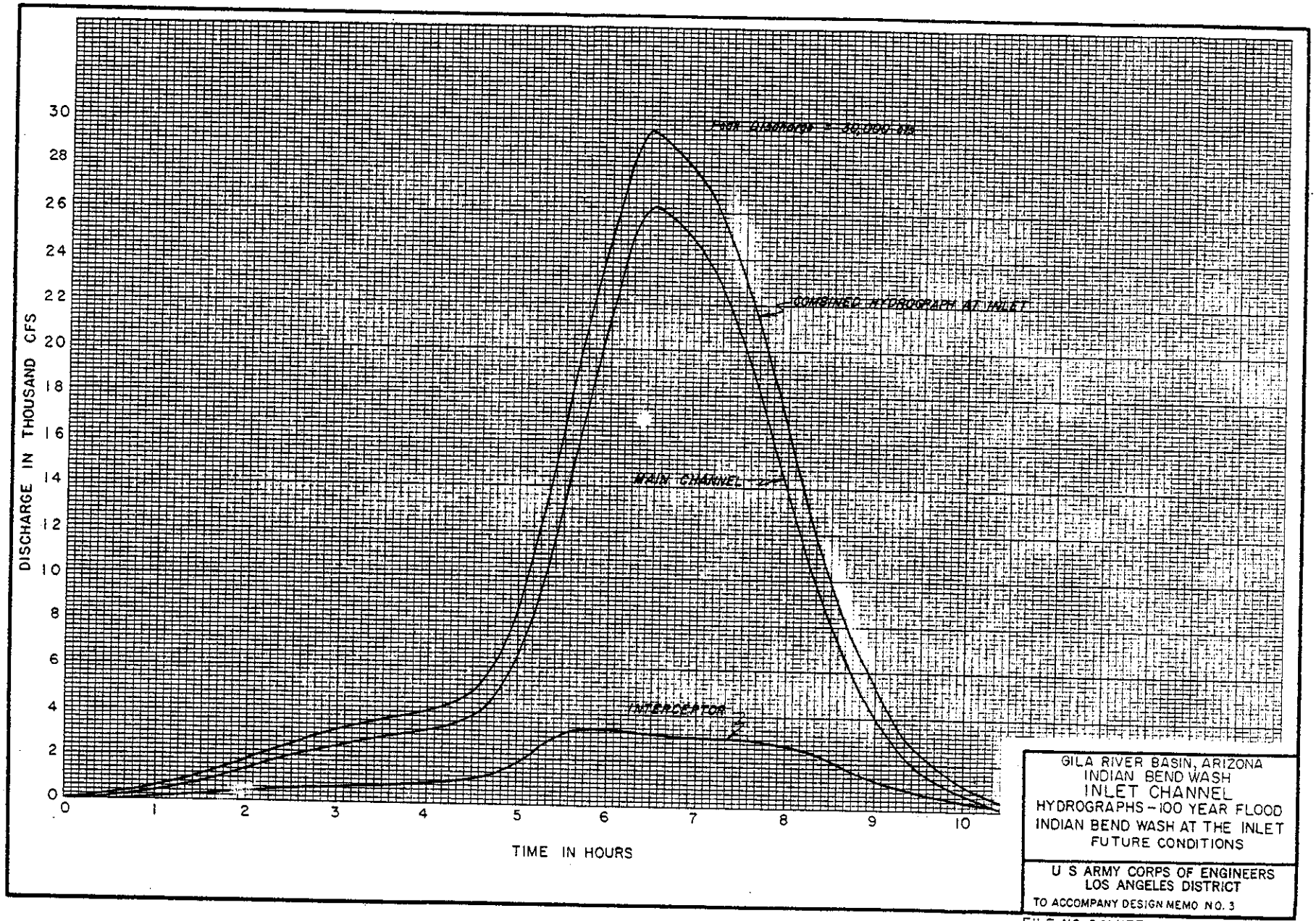
- —I— BOUNDARY OF DRAINAGE AREA
- —II— BOUNDARY OF DRAINAGE SUBAREA
- (32) SUBAREA DESIGNATION NUMBER
- CP302 CONCENTRATION POINT NUMBER

GILA RIVER BASIN, ARIZONA

INDIAN BEND WASH INLET CHANNEL CHANNEL SUBAREAS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY DESIGN MEMO NO. 3

FILE NO. 241 / 107 PLATE 3



GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
INLET CHANNEL
HYDROGRAPHS - 100 YEAR FLOOD
INDIAN BEND WASH AT THE INLET
FUTURE CONDITIONS

U S ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
TO ACCOMPANY DESIGN MEMO NO. 3

FILE NO. 241/137

PLATE 4A

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS

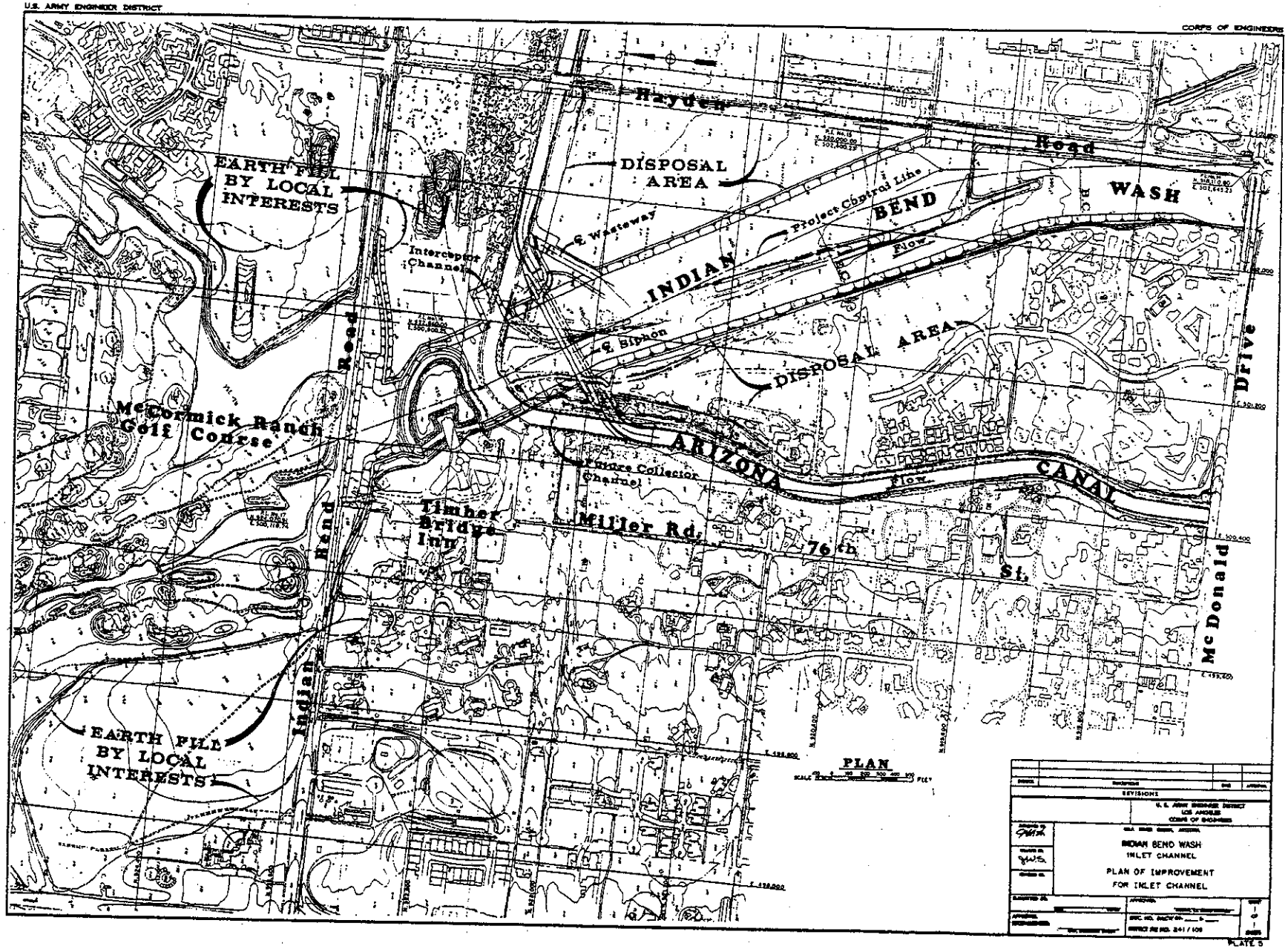
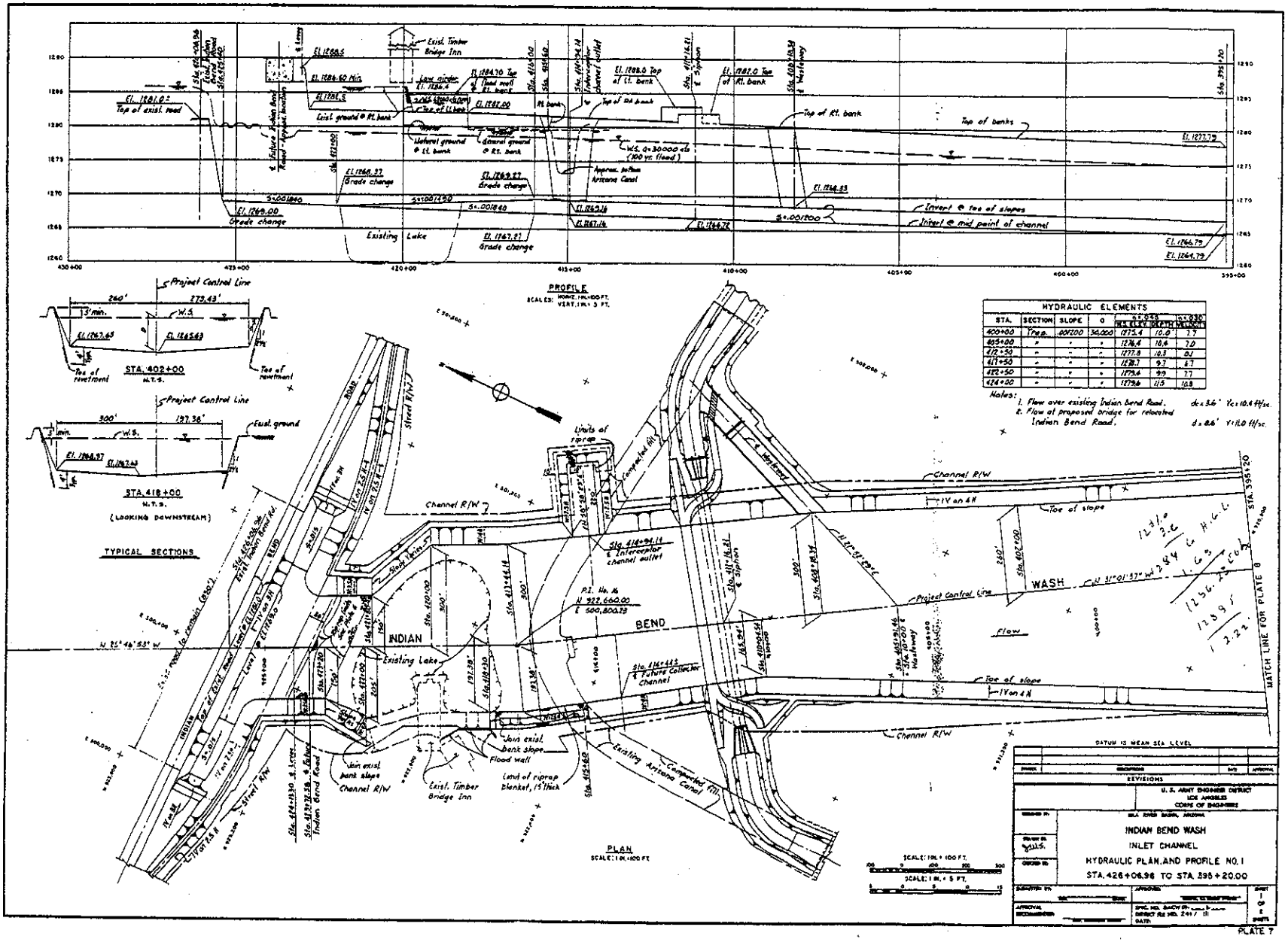


PLATE 5



HYDRAULIC ELEMENTS					
STA.	SECTION	SLOPE	Q	0+00 (0+00) W.S. ELEV.	0+00 (0+00) DEPTH
400+00	Trap.	.001200	30,000	1275.4	10.0
405+00	"	"	"	1276.4	10.6
412+50	"	"	"	1277.8	10.3
417+50	"	"	"	1278.7	9.7
422+50	"	"	"	1279.6	9.9
424+00	"	"	"	1279.6	11.5

Notes:
1. Flow over existing Indian Bend Road. d = 3.6' V = 10.4 ft/sec.
2. Flow at proposed bridge for relocated Indian Bend Road. d = 8.6' V = 11.0 ft/sec.

PLATE 7

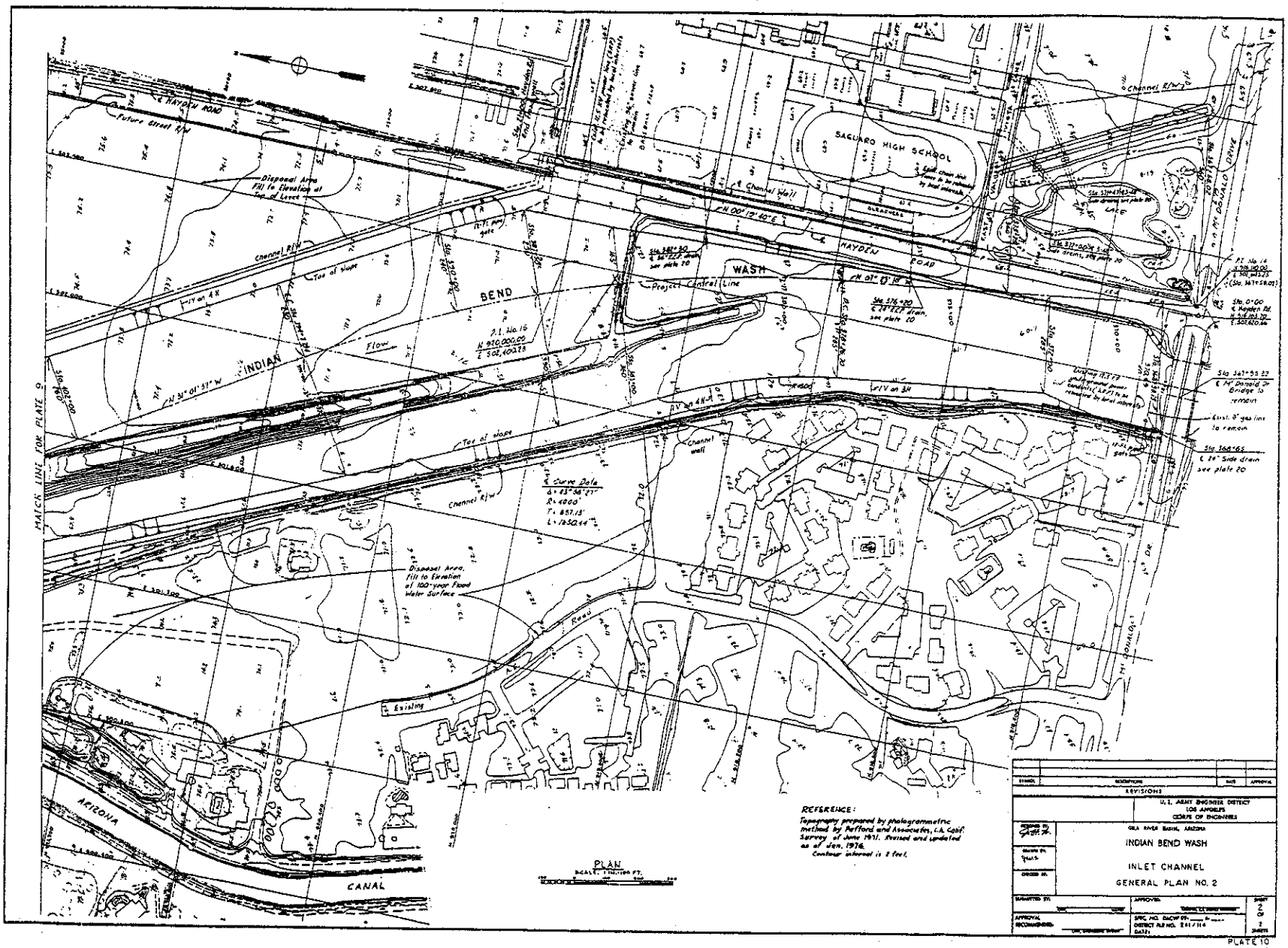

MATCH LINE FOR PLATE 9
HAYDEN ROAD
SAGUARO HIGH SCHOOL
INDIAN BEND WASH
Project Control Line
Channel Wall
Channel R/W
Toe of slope
Flow
Disposal Area Fill to Elevation of Top of Levee
Disposal Area, Fill to Elevation of 100-year Flood Water Surface
Existing Road
ARIZONA CANAL
McDONALD DRIVE
LAKE
Curve Data
Δ = 23°38'27"
R = 4000'
T = 837.13'
L = 1650.44'
REFERENCE:
Topography prepared by photogrammetric method by Pelford and Associates, Calif. Survey of June 1971. Revised and updated as of Jan. 1976.
Contour interval is 2 feet.
PLAN
SCALE: 1" = 100 FT.
REVISIONS
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
INLET CHANNEL
GENERAL PLAN NO. 2
SHEET 2 OF 2 SHEETS

PLATE 10

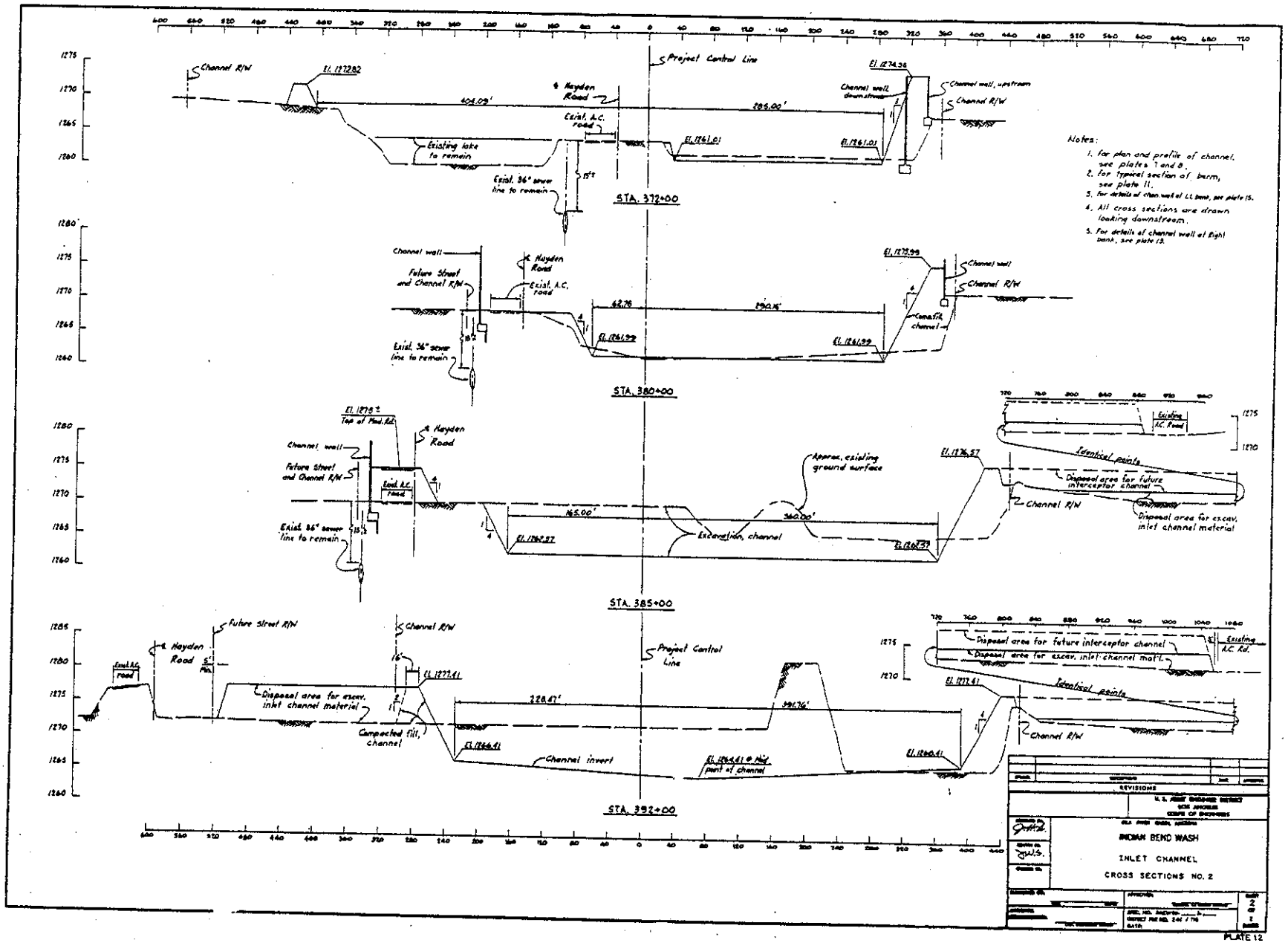

Project Central Line
Channel R/W
El. 1272.82
℄ Hayden Road
405.09'
285.00'
Exist. A.C. road
Existing lake to remain
El. 1261.01
El. 1274.36
Channel wall, downstream
Channel wall, upstream
Exist. 36" sewer line to remain
STA. 372+00
Channel wall
Future Street and Channel R/W
62.76
190.16'
El. 1261.99
El. 1275.99
Concrete channel
STA. 380+00
El. 1275.2 Top of Med. Rd.
Approx. existing ground surface
165.00'
360.00'
Excavation, channel
El. 1262.27
El. 1276.57
Existing A.C. Road
Identical points
Disposal area for future interceptor channel
Disposal area for excav. inlet channel material
STA. 385+00
Future Street R/W
Exist. A.C. road
Disposal area for excav. inlet channel material
Compacted fill, channel
El. 1277.41
228.47'
396.76'
El. 1266.41
Channel invert
El. 1264.61 @ Mid point of channel
El. 1260.41
Disposal area for future interceptor channel
Disposal area for excav. inlet channel material
STA. 392+00
Notes:
1. For plan and profile of channel, see plates 7 and 8.
2. For typical section of berm, see plate 11.
3. For details of chan. wall at LL bank, see plate 15.
4. All cross sections are drawn looking downstream.
5. For details of channel wall at Right bank, see plate 13.
REVISIONS
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS
INDIAN BEND WASH
INLET CHANNEL
CROSS SECTIONS NO. 2
SHEET 2 OF 2

PLATE 12

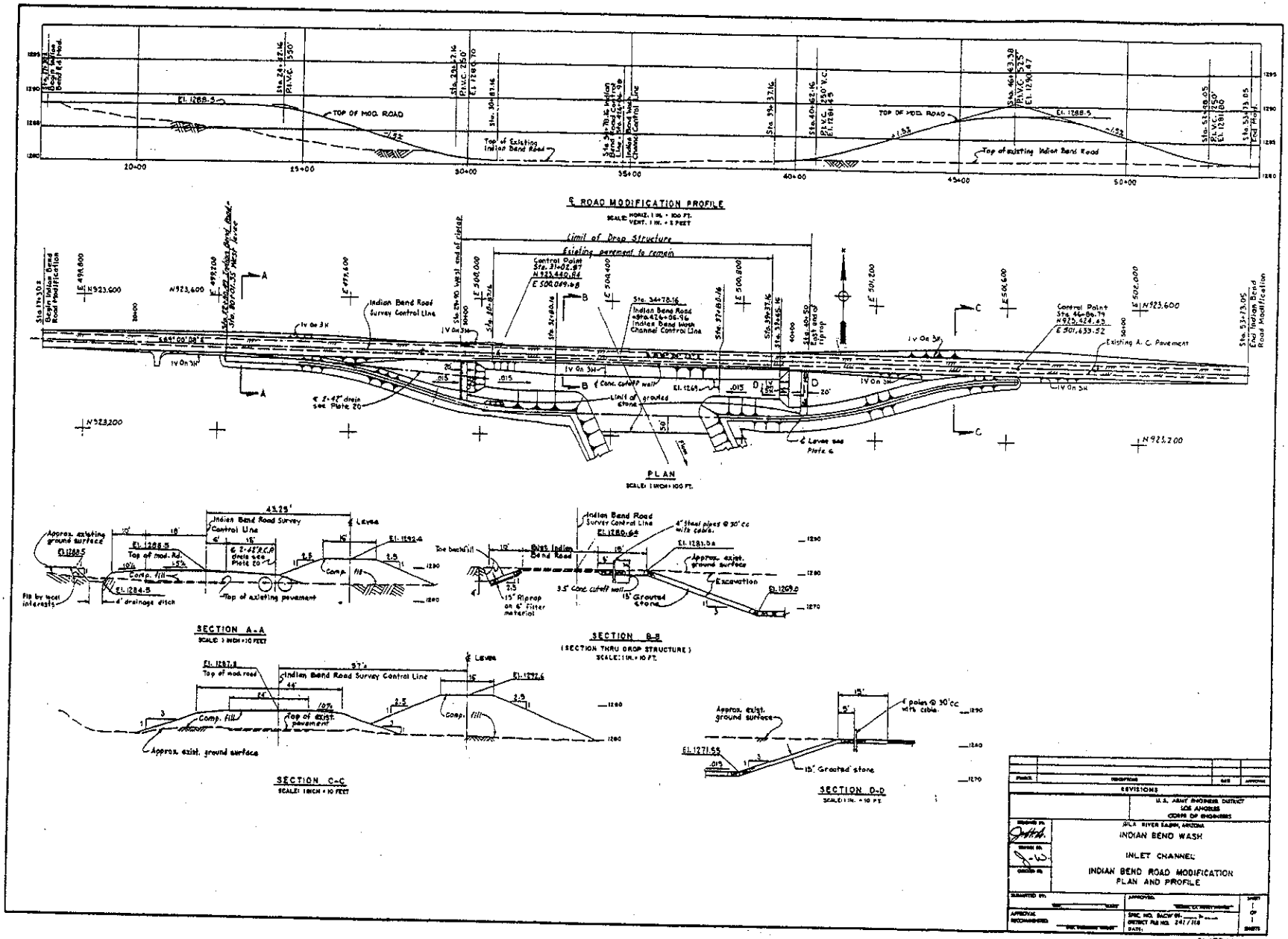

℄ ROAD MODIFICATION PROFILE
SCALE: HORIZ. 1 IN. = 100 FT.
VERT. 1 IN. = 5 FEET
TOP OF MOD. ROAD
Top of Existing Indian Bend Road
Top of existing Indian Bend Road
Limit of Drop Structure
Existing pavement to remain
Indian Bend Road Survey Control Line
Indian Bend Road Survey Control Line
Existing A. C. Pavement
PLAN
SCALE: 1 INCH = 100 FT.
SECTION A-A
SCALE: 1 INCH = 10 FEET
SECTION B-B
(SECTION THRU DROP STRUCTURE)
SCALE: 1 IN. = 10 FT.
SECTION C-C
SCALE: 1 INCH = 10 FEET
SECTION D-D
SCALE: 1 IN. = 10 FT.
REVISIONS
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
INLET CHANNEL
INDIAN BEND ROAD MODIFICATION
PLAN AND PROFILE

PLATE 14

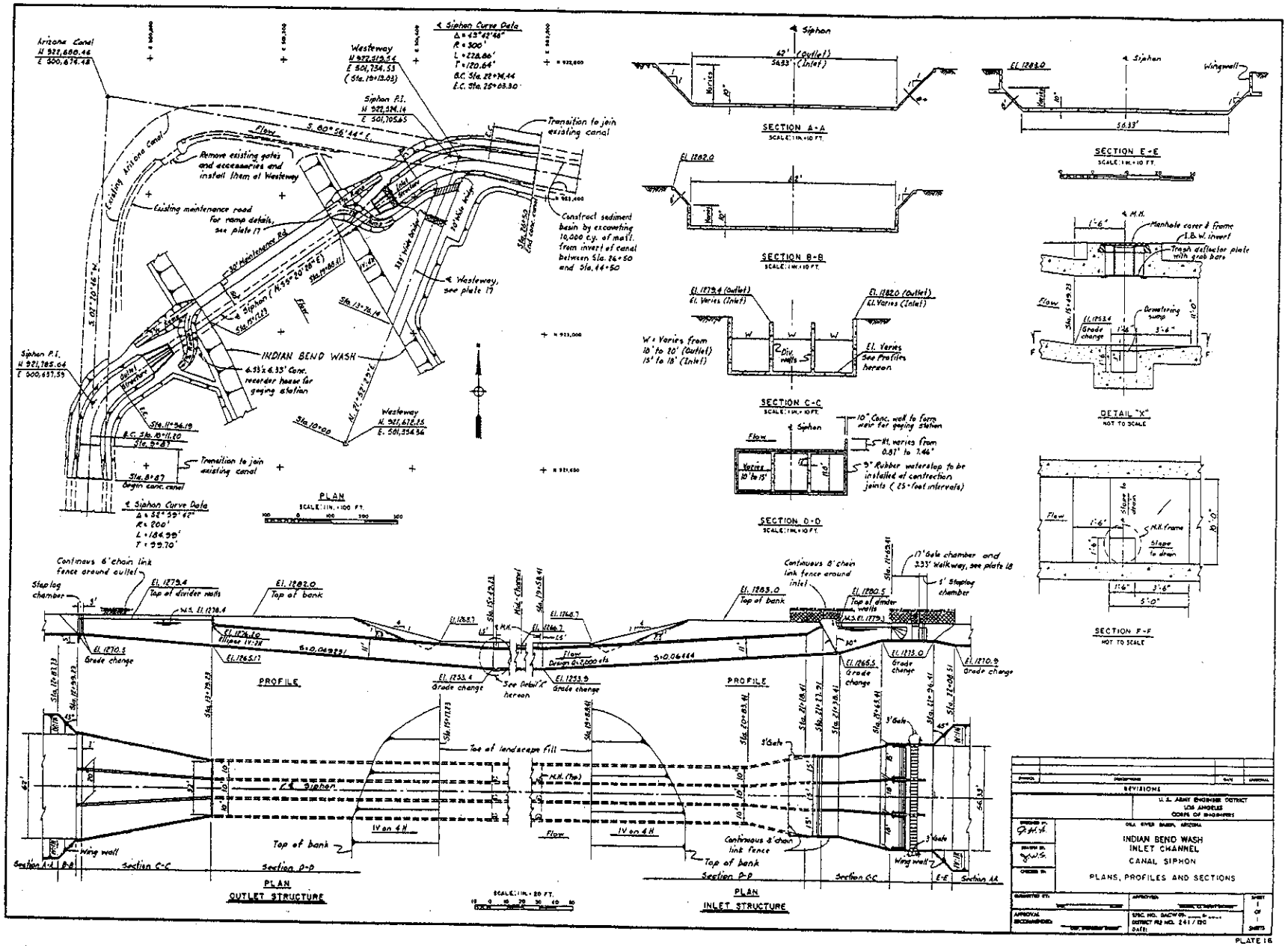
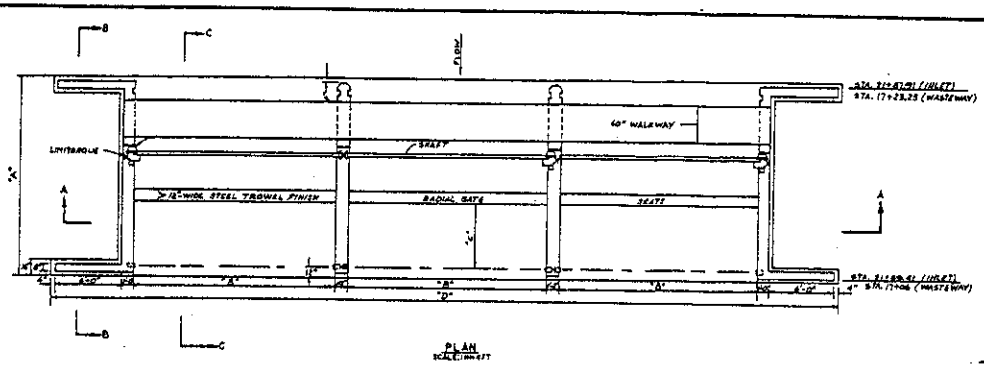
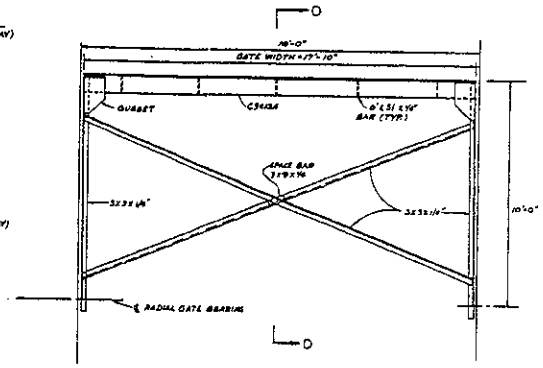
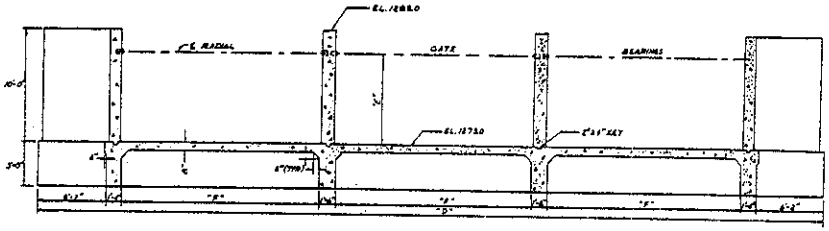

PLAN
SCALE: 1 IN. = 100 FT.
Arizona Canal
Existing Arizona Canal
Westeway
Siphon P.I.
INDIAN BEND WASH
Transition to join existing canal
Remove existing gates and accessories and install them at Westeway
Existing maintenance road for ramp details, see plate 17
Construct sediment basin by excavating 10,000 c.y. of matl. from invert of canal between Sta. 26+50 and Sta. 44+50
Wasteway, see plate 17
6.33' x 6.33' Conc. recorder house for gaging station
Outlet Structure
Inlet Structure
Flow
SECTION A-A
SCALE: 1 IN. = 10 FT.
SECTION B-B
SCALE: 1 IN. = 10 FT.
SECTION C-C
SCALE: 1 IN. = 10 FT.
SECTION D-D
SCALE: 1 IN. = 10 FT.
SECTION E-E
SCALE: 1 IN. = 10 FT.
DETAIL "X"
NOT TO SCALE
SECTION F-F
NOT TO SCALE
Siphon
Wingwall
Manhole cover & frame
Trash deflector plate with grab bars
Dewatering sump
Stop log chamber
Continuous 6' chain link fence around outlet
Continuous 8' chain link fence around inlet
Top of bank
Top of divider walls
Grade change
Top of landscape fill
See Detail "X" hereon
PROFILE
Section A-A
Section B-B
Section C-C
Section D-D
Section E-E
Section F-F
PLAN
OUTLET STRUCTURE
PLAN
INLET STRUCTURE
SCALE: 1 IN. = 20 FT.
REVISIONS
U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
INLET CHANNEL
CANAL SIPHON
PLANS, PROFILES AND SECTIONS
SHEET 1 OF 1 SHEETS
DISTRICT FILE NO. 241/DC

PLATE 16

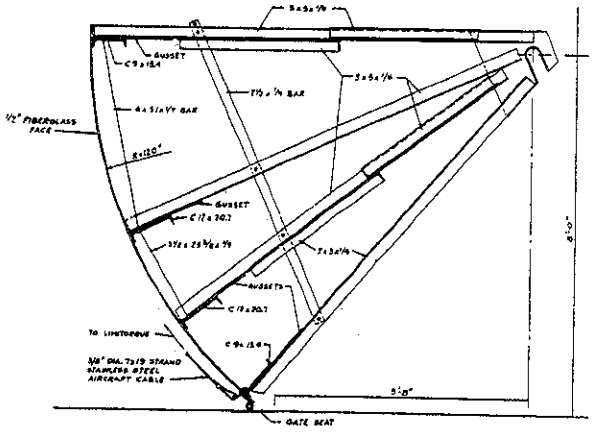




TOP VIEW
(SHOWING TOP FRAME ONLY)
SCALE: 1/2 IN=1FT.

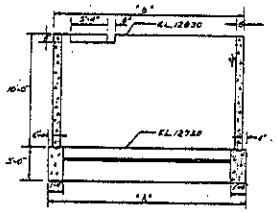


SECTION A-A
SCALE: 1IN=4FT

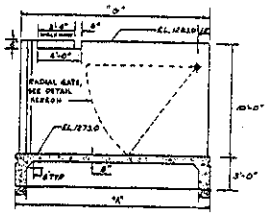


SECTION D-D
SCALE: 1 IN. = 1 FT.

RADIAL GATE DETAIL



SECTION B-B
SCALE: 1IN=4FT.



SECTION C-C
SCALE: 1IN=4FT.

TABULATION		
DIMENSION	WASTEWAY	INLET
"A"	17'-11"	19'-2"
"B"	26'-0"	18'-0"
"C"	4'-11"	5'-8"
"D"	17'-0"	17'-0"
"E"	7'-0"	8'-0"
"F"	19'-8"	17'-8"
"G"	11'-3"	18'-6"

GATE CHAMBER AND WALKWAY AT SIPHON INLET AND WASTEWAY

SCALE: 1IN=4FT
SCALE: 1/2 IN=1FT
SCALE: 1IN=1FT.

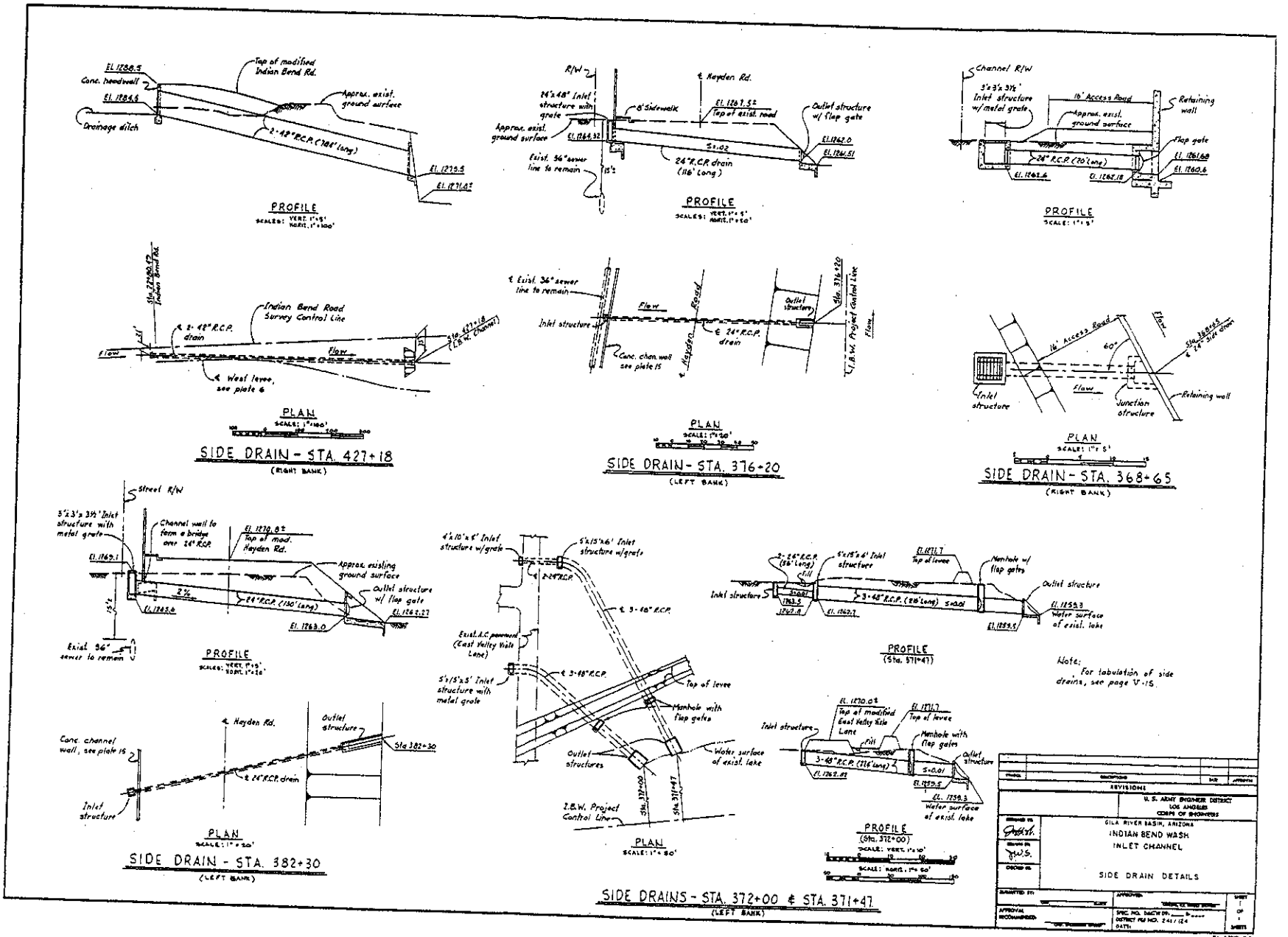
REVISIONS			
SYMBOL	DESCRIPTION	DATE	APPROVAL

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
INLET CHANNEL
DETAILS OF IRRIGATION GATES AND APPURTENANCES

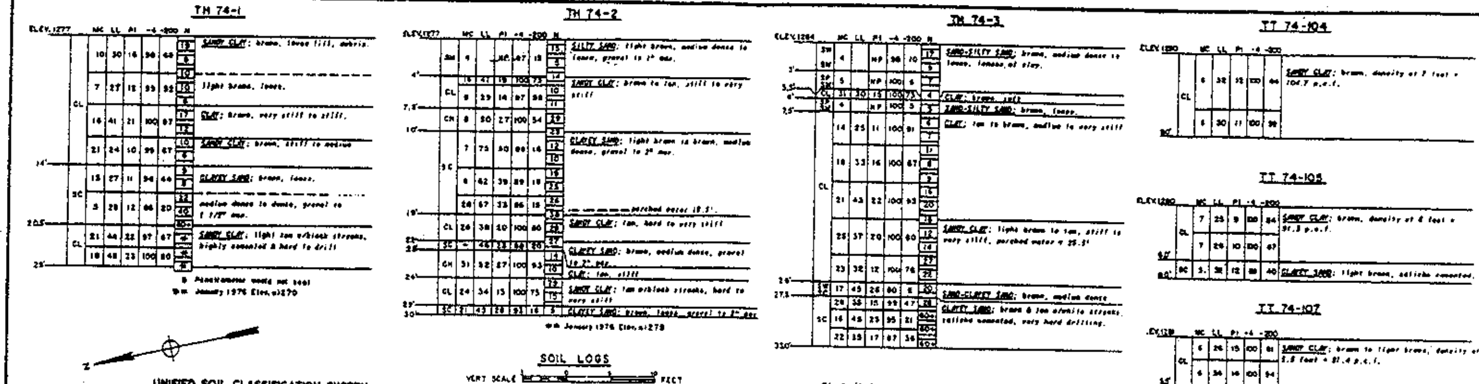
DESIGNED BY: GHH
DRAWN BY: RJP
CHECKED BY:
SUBMITTED BY:
APPROVED:
APPROVAL RECOMMENDED:
SPEC. NO. DACW09-
DISTRICT FILE NO. 241/122
DATE:
SHEET 1 OF 1 SHEETS

PLATE 18


PROFILE
PLAN
SIDE DRAIN - STA. 427+18
(RIGHT BANK)
SIDE DRAIN - STA. 376+20
(LEFT BANK)
SIDE DRAIN - STA. 368+65
(RIGHT BANK)
SIDE DRAIN - STA. 382+30
(LEFT BANK)
SIDE DRAINS - STA. 372+00 & STA. 371+47
(LEFT BANK)
Note:
For tabulation of side drains, see page V-15.
REVISIONS
U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
INLET CHANNEL
SIDE DRAIN DETAILS
PLATE 20

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS



UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS	GRAVELS	Clean gravels	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS	Clean sands	SW	Well-graded sands, gravelly sands, little or no fines.
			SP	Poorly-graded sands, gravelly sands, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS	Low liquid limit	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts, with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
		High liquid limit	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
Highly organic soils			Pt	Peat and other highly organic soils.

NOTES:

1. Boundary Classification: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example, GW-GC, well-graded gravel-sand mixture with clay binder.
2. All sieve sizes on this chart are U. S. Standard.
3. The terms "silt" and "clay" are used respectively to distinguish materials exhibiting lower plasticity from those with higher plasticity. The minus no. 200 sieve material is silt if the liquid limit and plasticity index plot below the "A" line on the plasticity chart (Table V), Military Standard 619B, and is clay if the liquid limit and plasticity index plot above the "A" line on the chart.
4. For a complete description of the Unified Soil Classification System, see "Military Standard 619B" dated 20 MARCH 1974

LEGEND

H.A. 77-4	LOCATION AND NUMBER OF HAND AUGER
T.T. 74-104	LOCATION AND NUMBER OF TEST TRENCH
T.H. 74-1	LOCATION AND NUMBER OF TEST HOLE.
MC	FIELD MOISTURE CONTENT IN PERCENT OF DRY WEIGHT.
LL	LIQUID LIMIT.
PI	PLASTICITY INDEX (LIQUID LIMIT MINUS PLASTIC LIMIT).
NP	NONPLASTIC
-4	PERCENT OF MATERIAL BY WEIGHT PASSING NO. 4 SIEVE.
-200	PERCENT OF MATERIAL BY WEIGHT PASSING NO. 200 SIEVE.
N	NUMBER OF BLOWS OF A 140-POUND DROPHAMMER FALLING 30 INCHES REQUIRED TO DRIVE A SAMPLING SPOON ONE FOOT. OUTSIDE DIAMETER OF SPOON IS 2 INCHES; INSIDE DIAMETER IS 1-3/8 INCHES. PROCEDURE IS CALLED STANDARD PENETRATION TEST.
[illegible]	APPROXIMATE INVERT OF PROPOSED CHANNEL.
[illegible]	ELEVATION OF GROUND SURFACE JANUARY 1976 TOPOGRAPHY

GENERAL NOTES

1. FOUNDATION INVESTIGATION DRAWINGS ARE TO BE USED FOR LOCATIONS AND LOGS OF EXPLORATIONS ONLY. SEE OTHER SHEETS FOR DETAILS OF PROPOSED CONSTRUCTION.

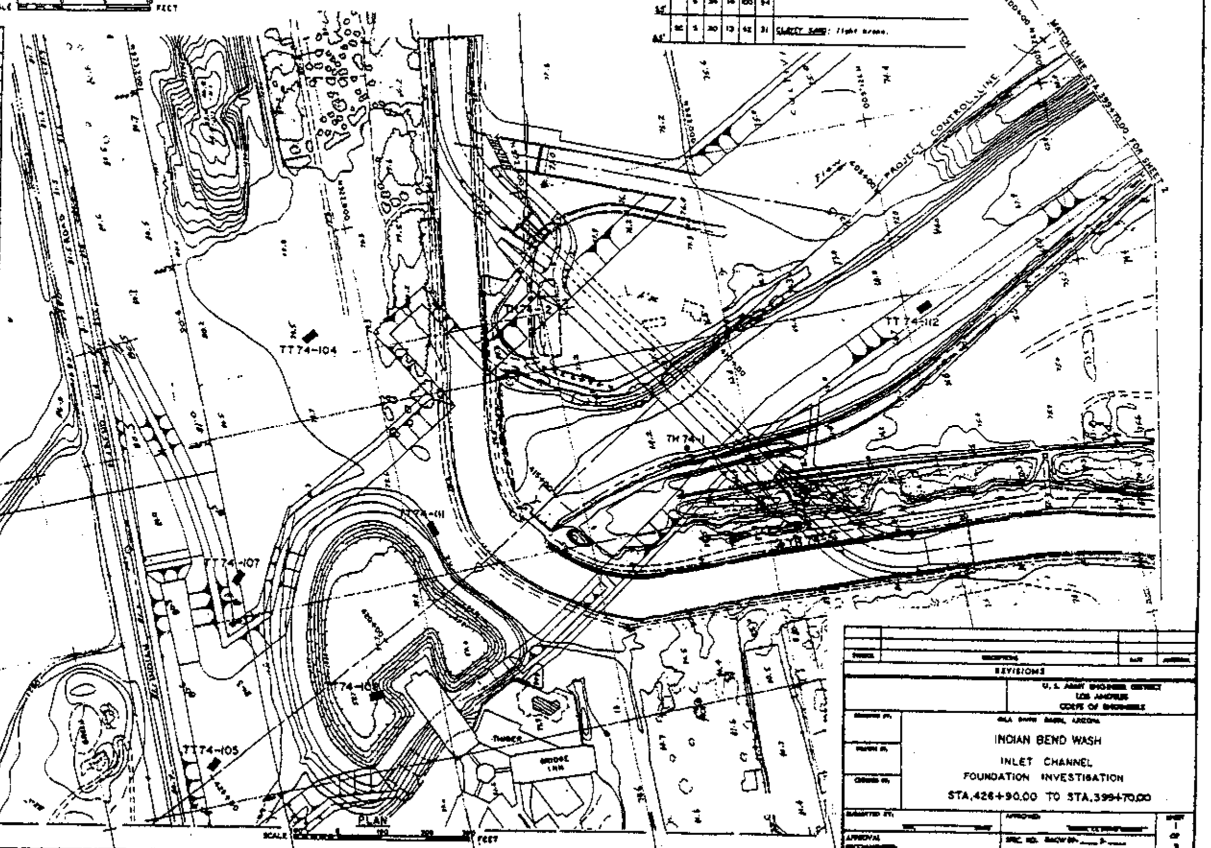
2. FIELD EXPLORATION WORK WAS CONDUCTED DURING MARCH 1974. TEST HOLES WERE DRILLED WITH A POWER AUGER USING A 16-INCH DIAMETER BUCKET. TEST TRENCHES WERE EXCAVATED BY A BACKHOE USING A 30-INCH BUCKET

3. GROUND WATER WAS NOT ENCOUNTERED.

4. DENSITY DATA, INDICATED ON THE LOGS, ARE IN-PLACE DRY DENSITIES TAKEN IN ACCORDANCE WITH ASTM METHOD D 1556-64 (DENSITY OF SOIL IN-PLACE BY THE SAND-CONE METHOD)

5. ALL ELEVATIONS SHOWN ON LOGS ARE FROM TOPOGRAPHY TAKEN DURING 1974. LOGS OF EXPLORATION WORK CONDUCTED IN AREAS WHERE THE TOPOGRAPHY SUBSEQUENTLY CHANGED, ALSO INDICATE THE MOST RECENT ELEVATION. WHERE MOST RECENT ELEVATION IS ABOVE 1974 ELEVATION, FILL HAS BEEN PLACED AND WHERE MOST RECENT ELEVATION IS BELOW 1974 ELEVATION, MATERIALS HAVE BEEN REMOVED.

6. FOR LOGS OF TEST TRENCHES SEE SHEET 2



REVISIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN, ARIZONA

INDIAN BEND WASH
INLET CHANNEL
FOUNDATION INVESTIGATION
STA.426+90.00 TO STA.399+70.00

SHEET 1 OF 3

SPEC. NO. DACW 09-_ _-B-_ _
DRAWING NO. 241/104

PLATE 22

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS

TH 77-1

ELEV.	SOIL LOG	WC	LL	PI	-4	-200	K	
1.5'	CL	15	34	11	99	78	23	SANDY CLAY; red brown, very stiff
	CL	12	27	6	97	64	10	SANDY CLAY SANDY SILT; brown, medium stiff
6.0'	ML	11	25	5	96	56	5	
7.5'	CL	14	29	10	98	64	7	SANDY CLAY; light brown, medium stiff, some caliche present
		12	28	8	96	47	13	
	SC	17	36	13	89	43	50+	CLAYEY SAND; light brown, hard, becomes well cemented by caliche below 10'
13.5'							6	
							8	

TH 77-2

ELEV.	SOIL LOG	WC	LL	PI	-4	-200	K	
	SC	8	40	18	90	41	17	CLAYEY SAND; light brown, very stiff to hard, caliche encountered from 1.5' to 6.5' which includes concrete pieces 4" max. size.
4.5'		7	33	13	88	49	31	
	SM	8	42	18	90	42	14	SILTY SAND; light brown, medium dense to very dense, becomes well cemented by caliche below 7'
9.0'		9	42	14	90	42	50+	
							14	
10.5'	CL ML	8	26	5	96	56	10	SANDY CLAY-SANDY SILT; light brown, stiff, caliche present

TH 77-3

ELEV.	SOIL LOG	WC	LL	PI	-4	-200	K	
	CL	14	34	16	100	90	33	SANDY CLAY; red brown to light brown, very stiff
		11	33	15	100	92	19	
		10	29	10	100	81	27	
		13	34	12	100	66	23	
7.5'							20	
9.0'	SC SC	10	25	7	99	45	15	SANDY CLAY-SANDY SILT; red brown to light brown, stiff, caliche encountered
10.5'	SC	9	31	11	83	46	19	GRAVELLY CLAYEY SAND; white-brown, medium dense, caliche present, some gravel are caliche clods
12.0'	SM	13	5	16	76	22	50+	GRAVELLY SILTY SAND; white-brown, very dense, well cemented by caliche, gravel is 60% caliche

TH 77-5

ELEV.	SOIL LOG	WC	LL	PI	-4	-200	K	
1.5'	CL	10	26	6	96	56	20	SANDY CLAY; light brown, very stiff
3.0'	CL ML	8	28	7	96	54	21	SANDY CLAY-SANDY SILT; light brown, very stiff
6.0'	SC	7	29	8	92	43	53	CLAYEY SAND; light brown, dense, some caliche cementation
		6	31	9	92	48	49	
	SM	11	35	9	88	29	45	SILTY GRAVELLY SAND; white-brown, very dense, some gravels are caliche clods, well cemented by caliche
10.5'		15	45	15	79	18	9	
12.0'	GC	12	49	21	55	13	9	CLAYEY SANDY GRAVEL; white, well cemented by caliche
13.5'	GM	13	42	15	53	16	8	SILTY SANDY GRAVEL; white, well cemented by caliche

TH 77-6

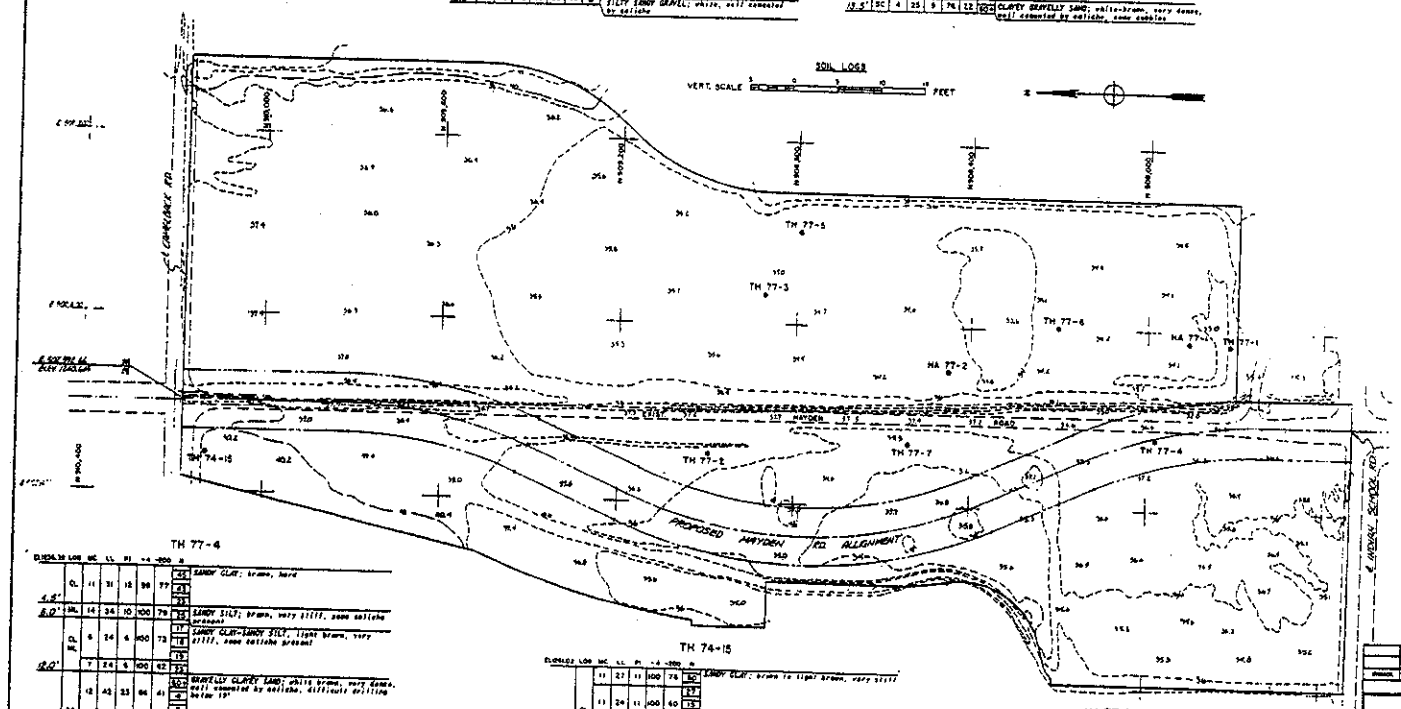
ELEV.	SOIL LOG	WC	LL	PI	-4	-200		
1.5'	CL	11	25	9	94	57		SANDY CLAY; brown
	CL	12	25	7	96	60		SANDY CLAY-SANDY SILT; brown
6.0'	ML	14	25	7	96	62		
	CL	19	32	13	98	66		SANDY CLAY, light brown, some caliche present
9.0'		16	31	8	99	62		
10.5'	SC	9	31	10	96	28		CLAYEY SANDY GRAVEL; white-brown, well cemented by caliche
13.5'	SM	13	42	13	85	30		GRAVELLY SILTY SAND; red brown, well cemented by caliche, difficult to drill
14.0'	SC	14	34	17	78	14		GRAVELLY CLAYEY SAND; white-brown, well cemented by caliche, very difficult to drill

TH 77-7

ELEV.	SOIL LOG	WC	LL	PI	-4	-200	K	
	CL	9	31	13	100	88	25	SANDY CLAY; light brown, very stiff
		12	38	18	100	92	21	
		13	33	13	100	81	30	
		13	33	13	100	69	27	
6.0'							31	
7.5'	CL ML	7	25	8	100	71	31	SANDY CLAY-SANDY SILT; light brown, hard, some caliche present
9.0'	CL	6	24	8	99	65	40	SANDY CLAY; white-brown, hard, well cemented by caliche
	CL ML	6	28	7	98	61	35	
12.0'		5	26	7	96	43	24	SANDY CLAY-SANDY SILT; white-brown, hard, well cemented by caliche
13.5'	SC	4	25	9	76	12	50+	CLAYEY GRAVELLY SAND; white-brown, very dense, well cemented by caliche, some cobbles

SOIL LOGS

VERT. SCALE 5 0 5 10 15 FEET



TH 77-4

ELEV.	SOIL LOG	WC	LL	PI	-4	-200	K	
	CL	11	31	12	98	77	45	SANDY CLAY; brown, hard
4.5'							43	
6.0'	ML	14	36	10	100	79	35	SANDY SILT; brown, very stiff, some caliche present
	CL ML	6	24	6	100	73	17	SANDY CLAY-SANDY SILT; light brown, very stiff, some caliche present
12.0'							19	
		7	24	6	100	42	22	
	SC	12	43	23	86	41	50+	GRAVELLY CLAYEY SAND; white brown, very dense, well cemented by caliche, difficult drilling below 19'
							9	
21.0'		14	32	24	90	26	50+	
							9	
	SM	17	49	17	84	40	50+	GRAVELLY SILTY SAND; light brown, well cemented by caliche, difficult drilling
							9	
27.0'		15	46	16	70	26	50+	
29.0'	GM	9	31	21	47	17	50+	SILTY SANDY GRAVEL; light brown, about 50% cobbles to 2" max. size, very difficult drilling

TH 74-15

ELEV.	SOIL LOG	WC	LL	PI	-4	-200	K	
	CL	11	27	11	100	76	50+	SANDY CLAY; brown to light brown, very stiff
							23	
		13	24	11	100	60	15	
							15	
		9	36	21	100	79	15	
							15	
10.0'							20	
	SC	9	35	18	84	21	25	CLAYEY SAND; brown, medium dense to very dense, well cemented by caliche, gravel particles are caliche clods, very difficult to drill below 17'
							25	
		11	39	24	94	18	50+	
							9	
20.0'		13	36	21	89	18	50+	
							9	

HA 77-1

ELEV.	SOIL LOG	WC	LL	PI	-4	-200		
2.0'	CL ML		26	7	92	65		SANDY CLAY-SANDY SILT; brown
	ML			NP	97	64		SANDY SILT; brown
5.0				NP	97	61		

HA 77-2

ELEV.	SOIL LOG	WC	LL	PI	-4	-200		
	CL		35	18	100	69		SANDY CLAY; brown
			29	6	99	57		
			31	10	100	51		
4.5'			33	13	100	50		

GENERAL NOTES:

1. FOUNDATION INVESTIGATION DRAWINGS ARE TO BE USED FOR LOCATIONS AND LOGS OF EXPLORATIONS ONLY. SEE OTHER SHEETS FOR DETAILS OF PROPOSED CONSTRUCTION.
2. TEST HOLE 74-15 WAS DRILLED DURING MARCH 1974. TEST HOLES 77-1 THRU 77-7 WERE DRILLED DURING JANUARY 1977. THE TEST HOLES WERE DRILLED WITH A POWER AUGER USING A 10-INCH DIAMETER BUCKET.
3. HAND AUGER HOLES WERE DRILLED DURING JANUARY 1977 USING A 4-INCH DIAMETER AUGER.
4. FOR BASIS OF SOILS CLASSIFICATION SEE SHEET 7

PLAN

SCALE 100 0 100 200 300 FEET

SYMBOL	DESCRIPTION	DATE	APPROVAL
	REVISIONS		

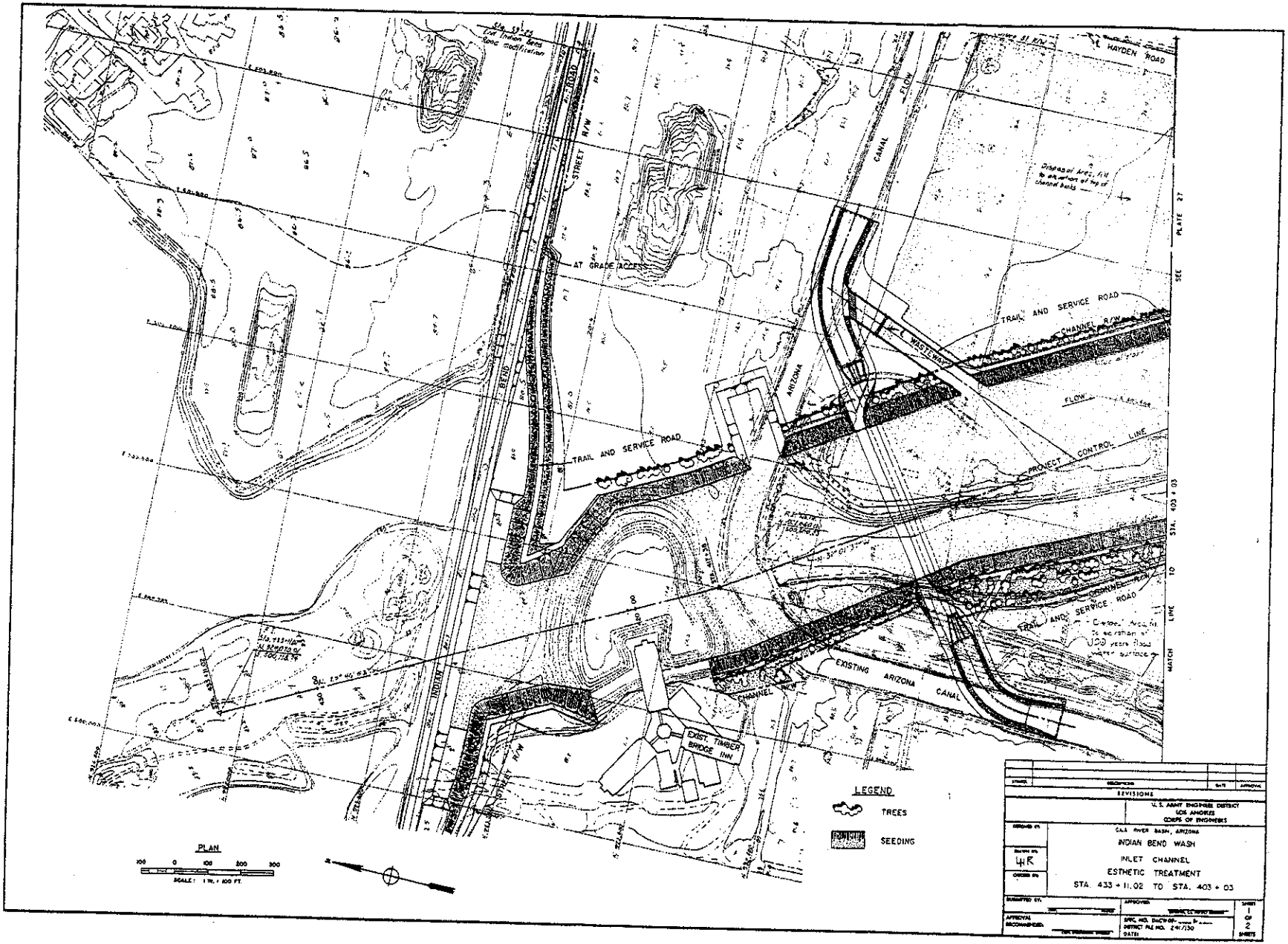
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH

INLET CHANNEL
INDIAN SCHOOL PARK
FOUNDATION INVESTIGATION

DESIGNED BY: | DRAWN BY: | TRACED BY: | SUBMITTED BY: | APPROVED RECOMMENDED: | APPROVED: | SHEET 3 OF 3 SHEETS | SPEC. NO. DACW09- | DISTRICT FILE NO. 241/126

PLATE 24


HAYDEN ROAD
STREET R/W
AT GRADE ACCESS
TRAIL AND SERVICE ROAD
CHANNEL R/W
WASTEWAY
FLOW
PROJECT CONTROL LINE
ARIZONA
CANAL
INDIAN BEND
EXISTING ARIZONA CANAL
CHANNEL
EXIST. TIMBER BRIDGE INN
MATCH LINE STA. 403 + 03
SEE PLATE 27
LEGEND
TREES
SEEDING
PLAN
SCALE: 1 IN. = 100 FT.
REVISIONS
U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
INLET CHANNEL
ESTHETIC TREATMENT
STA. 433 + 11.02 TO STA. 403 + 03
4R
APPROVAL RECOMMENDED
DISTRICT FILE NO. 24-7130
DATE:
SHEET 1 OF 2 SHEETS

COST ACCOUNT NUMBER	FEATURE ITEMS	PROJECT COST ESTIMATE	TOTAL AS OF	FY 1978				FY 1979				FY				FY				FY				BALANCE TO COMPLETE
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	
09	INLET CHANNEL AND SIPHON																							
	DIVERSION AND CONTROL OF WATER	189.0																						
	CLEAR SITE AND REMOVE OBSTRUCTIONS	18.0																						
	EARTHWORK	570.7																						
	STONE, FILTER MATERIAL AND GROUTING																							
	STONEWORK	609.5																						
	SIDE DRAINS	247.0																						
	ASPHALT CONCRETE PAVING	17.4																						
	SIPHON, INCLUDING WASTEWAY	1,419.4																						
	CHANNEL WALLS	400.8																						
	ESTHETIC TREATMENT	198.2																						
	CONTINGENCIES	450.0																						
	TOTAL, CHANNEL AND SIPHON	4,120.0																						
20	PERMANENT OPERATING EQUIPMENT	9.0																						
30	ENGINEERING AND DESIGN	755.0																						
31	SUPERVISION AND ADMINISTRATION	360.0																						
51	OPERATION AND MAINTENANCE MANUAL	6.0																						
	TOTAL, FEDERAL FIRST COSTS	5,250.0																						

FUNDS IN THOUSANDS OF DOLLARS

DESIGN | NO ACTIVITY | CONSTRUCTION

GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
INLET CHANNEL
CONSTRUCTION SCHEDULE

U S ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
TO ACCOMPANY DESIGN MEMO. NO. 3

FILE NO. 241/132 PLATE 28

SPL FORM 1 NOV 75 571 A (07)

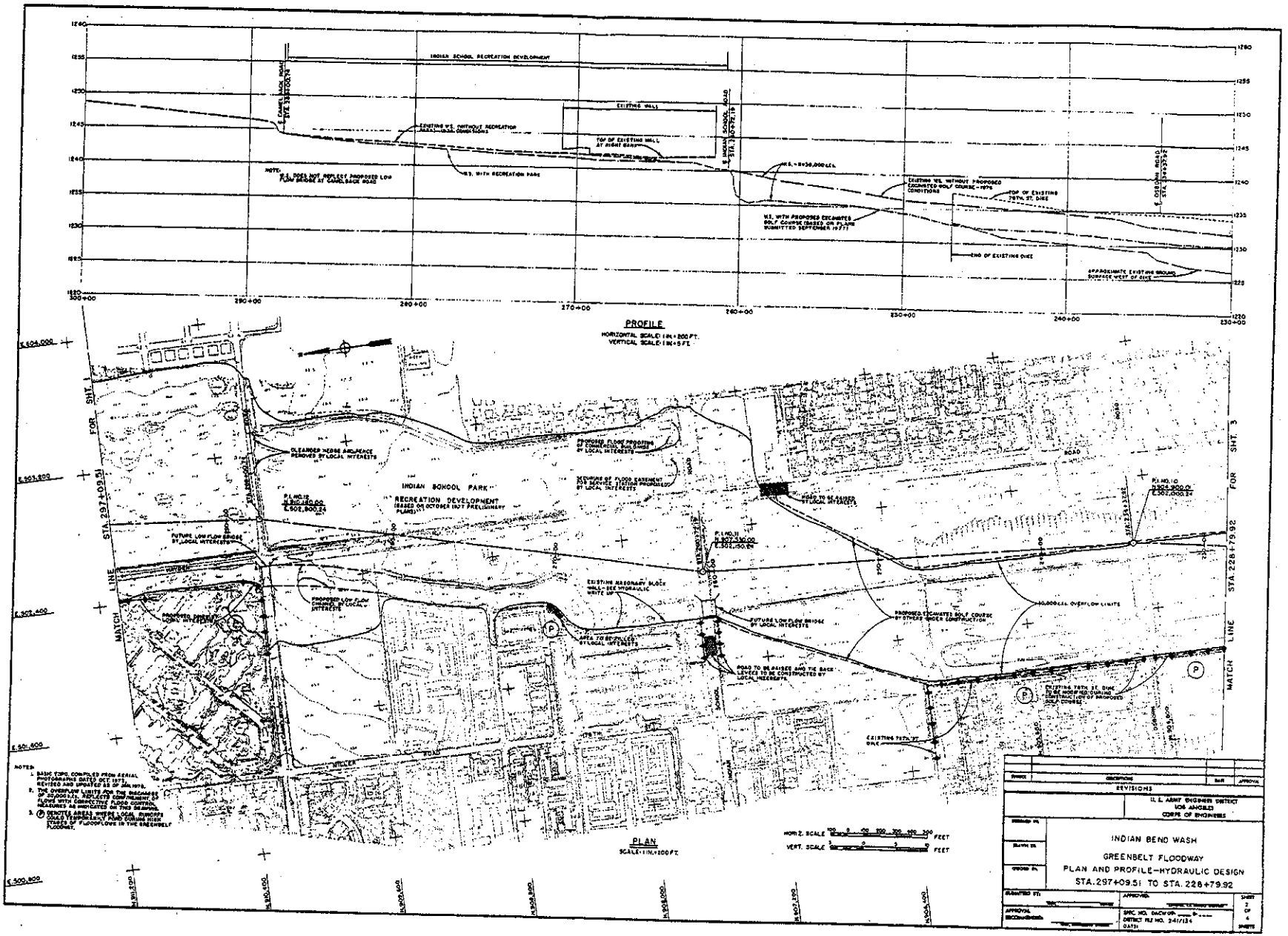

PROFILE
HORIZONTAL SCALE: 1 IN = 200 FT.
VERTICAL SCALE: 1 IN = 5 FT.
INDIAN SCHOOL RECREATION DEVELOPMENT
EXISTING WALL
TOP OF EXISTING WALL AT RIGHT BANK
EXISTING W.S. WITHOUT RECREATION
W.S. WITH RECREATION PARK
NOTE:
P.L. DOES NOT REFLECT PROPOSED LOW FLOW BRIDGE AT CAMELBACK ROAD
E. OSBORN ROAD
END OF EXISTING DIKE
APPROXIMATE EXISTING GROUND SURFACE WEST OF DIKE
PLAN
SCALE: 1 IN. = 200 FT.
INDIAN SCHOOL PARK
RECREATION DEVELOPMENT
(BASED ON OCTOBER 1977 PRELIMINARY PLANS)
CLEARED WEEDS AND BRUSH REMOVED BY LOCAL INTERESTS
FUTURE LOW FLOW BRIDGE BY LOCAL INTERESTS
PROPOSED LOW FLOW BRIDGE BY LOCAL INTERESTS
EXISTING MASONRY BLOCK WALL - SEE HYDRAULIC WRITE UP
AREA TO BE PILLED BY LOCAL INTERESTS
ROAD TO BE RAISED AND TIE BACK LEVEES TO BE CONSTRUCTED BY LOCAL INTERESTS
PROPOSED EXCAVATED GOLF COURSE BY OTHERS (NOT CONSTRUCTED)
50,000 C.F.S. OVERFLOW LIMITS
EXISTING 75TH ST. DIKE
MATCH LINE
STA. 297+09.51
STA. 228+79.92
FOR SHT. 3
FOR SHT. 1
NOTES:
1. BASE TOPO COMPILED FROM AERIAL PHOTOGRAPHS DATED OCT. 1977. REVISED AND UPDATED AS OF JAN. 1978.
2. THE OVERFLOW LIMITS FOR THE MAGNITUDE OF 50,000 C.F.S. REFLECTS COMPLIMENT OF FLOWS WITH CORRECTIVE FLOOD CONTROL MEASURES AS INDICATED ON THIS DRAWING.
3. (P) DENOTES AREAS WHERE LOCAL RUNOFF COULD TEMPORARILY POND DURING HIGH STAGES OF FLOODFLOWS IN THE GREENBELT FLOODWAY.
HORIZ. SCALE
VERT. SCALE
FEET
REVISIONS
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS
INDIAN BEND WASH
GREENBELT FLOODWAY
PLAN AND PROFILE-HYDRAULIC DESIGN
STA. 297+09.51 TO STA. 228+79.92
SHEET 2 OF 4 SHEETS

PLATE 30

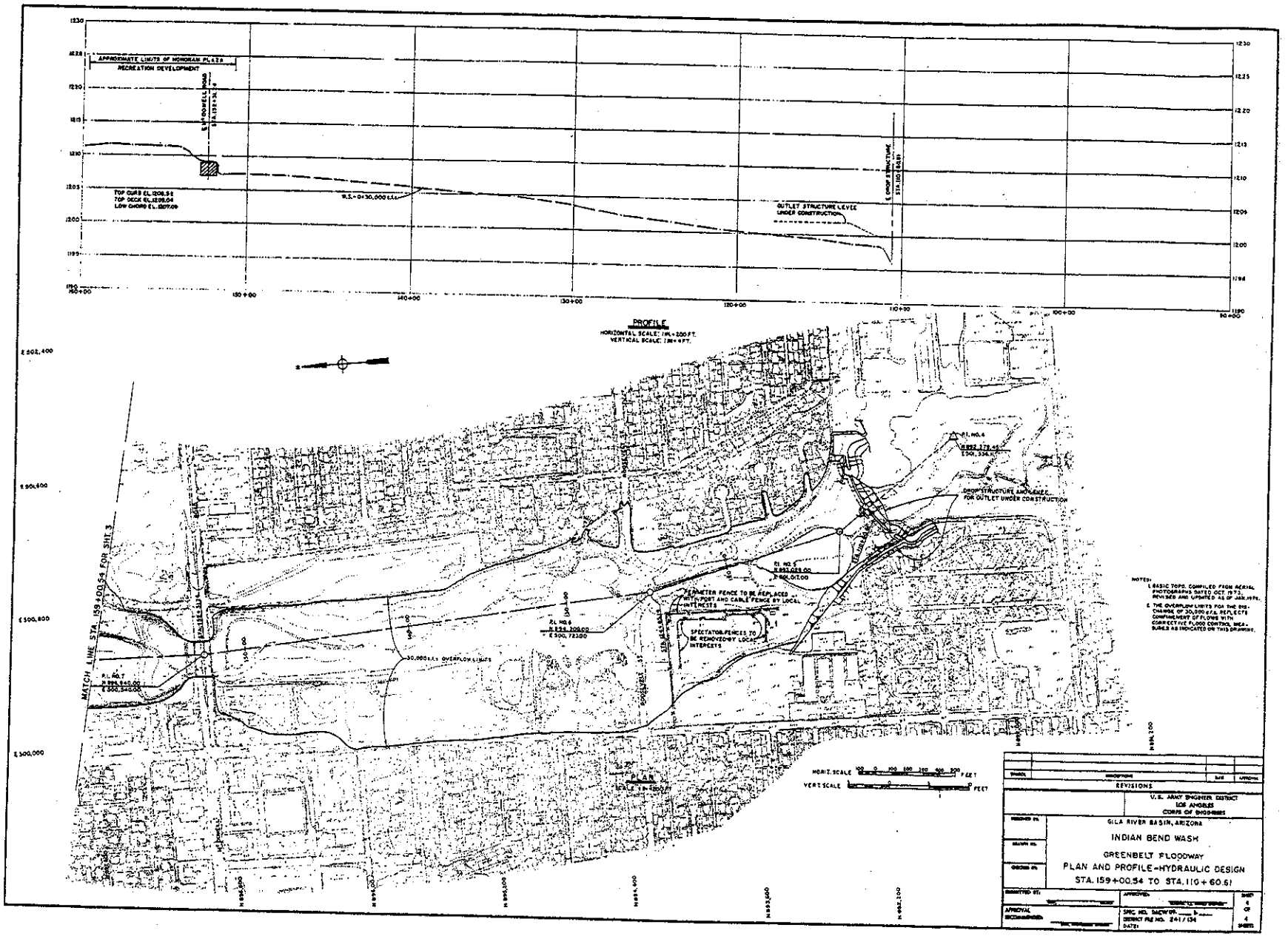

PROFILE
HORIZONTAL SCALE: 1IN.=200 FT.
VERTICAL SCALE: 1IN.=4FT.
APPROXIMATE LIMITS OF MONORAIL PLATE
RECREATION DEVELOPMENT
OUTLET STRUCTURE LEVEE UNDER CONSTRUCTION
PLAN
SCALE 1 IN.=200 FT.
MATCH LINE STA. 159+00.54 FOR SHT. 3
PERIMETER FENCE TO BE REPLACED WITH POST AND CABLE FENCE BY LOCAL INTERESTS
SPECTATOR FENCES TO BE REMOVED BY LOCAL INTERESTS
DROP STRUCTURE AND LEVEE FOR OUTLET UNDER CONSTRUCTION
NOTES:
1. BASIC TOPO. COMPILED FROM AERIAL PHOTOGRAPHS DATED OCT. 1973, REVISED AND UPDATED AS OF JAN. 1975.
2. THE OVERFLOW LIMITS FOR THE 100 YR. CHANGE OF 20,000 c.f.s. REFLECTS COMPLEMENT OF FLOWS WITH CORRECTIVE 15,000 CONTROL MEASURES AS INDICATED ON THIS DRAWING.
HORIZ. SCALE
VERT. SCALE
REVISIONS
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
GREENBELT FLOODWAY
PLAN AND PROFILE-HYDRAULIC DESIGN
STA. 159+00.54 TO STA. 110+60.61
SHEET 4 OF 4 SHEETS
DISTRICT FILE NO. 241/134

PLATE 32

APPENDIX E
HEC-1 AND HEC-RAS FILES ON DISK

APPENDIX F
HYDROLOGIC DATA

Flood Control District of Maricopa County
INDIAN BEND RD - Indian Bend Road, Scottsdale Road to Hayden Road
Rainfall Data

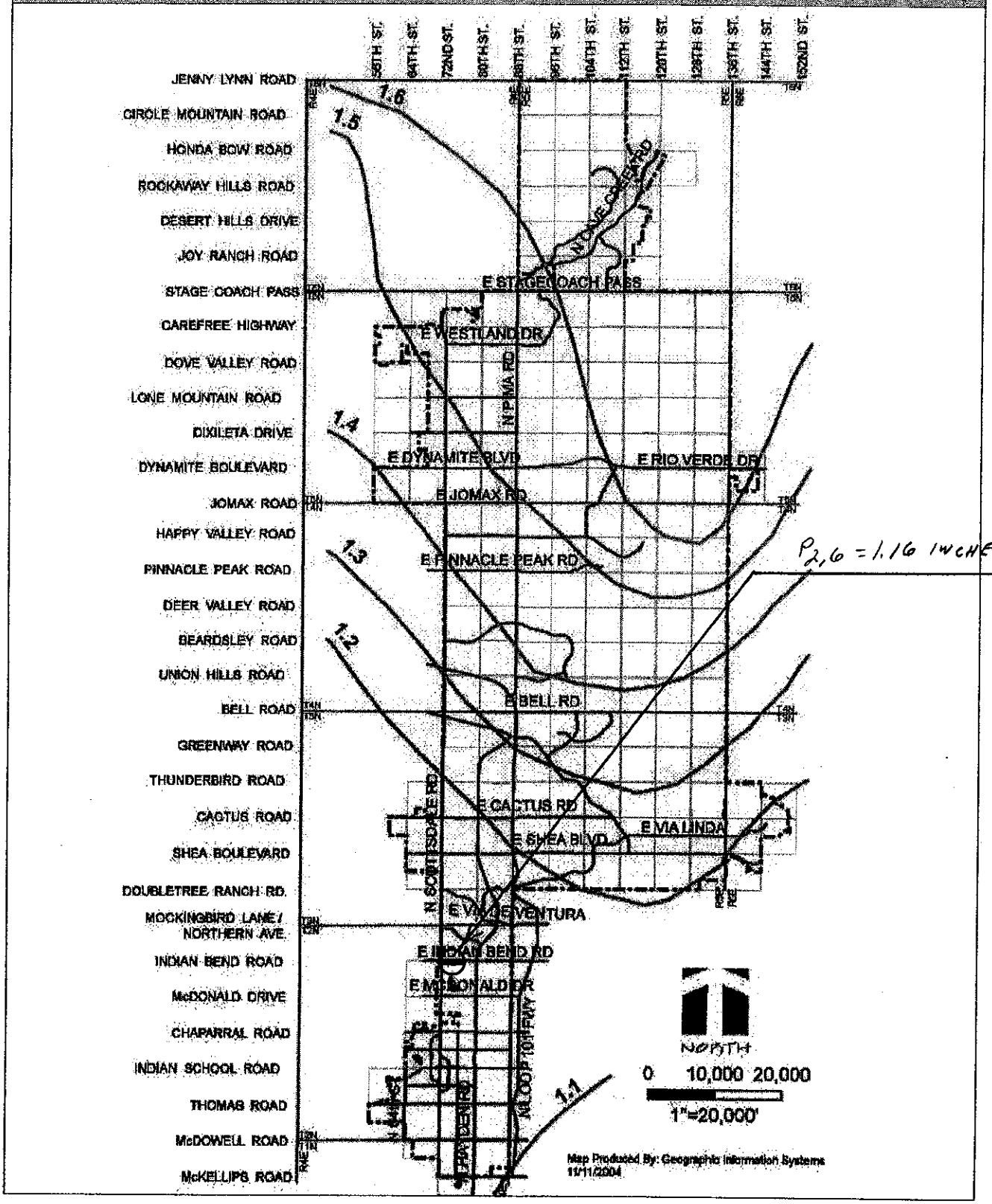
Primary Zone Number:	7	Latitude:	0.0	Elevation:	0
Short Duration Zone Number:	8	Longitude:	0.0		

	Point Values (in)					
Duration	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
5 MIN	0.30	0.42	0.49	0.60	0.68	0.76
10 MIN	0.46	0.63	0.75	0.91	1.04	1.16
15 MIN	0.55	0.79	0.95	1.16	1.33	1.49
30 MIN	0.73	1.06	1.27	1.57	1.80	2.02
1 HOUR	0.89	1.31	1.58	1.95	2.24	2.53
2 HOUR	0.98	1.43	1.73	2.13	2.45	2.76
3 HOUR	1.05	1.52	1.83	2.25	2.58	2.91
6 HOUR	1.16	1.67	2.01	2.48	2.84	3:20
12 HOUR	1.28	1.84	2.21	2.72	3.11	3.50
24 HOUR	1.40	2.00	2.40	2.95	3.38	3.80

NOTE: Rainfall data computed with FCDMC program. The attached ADOT method computations provide the same results.

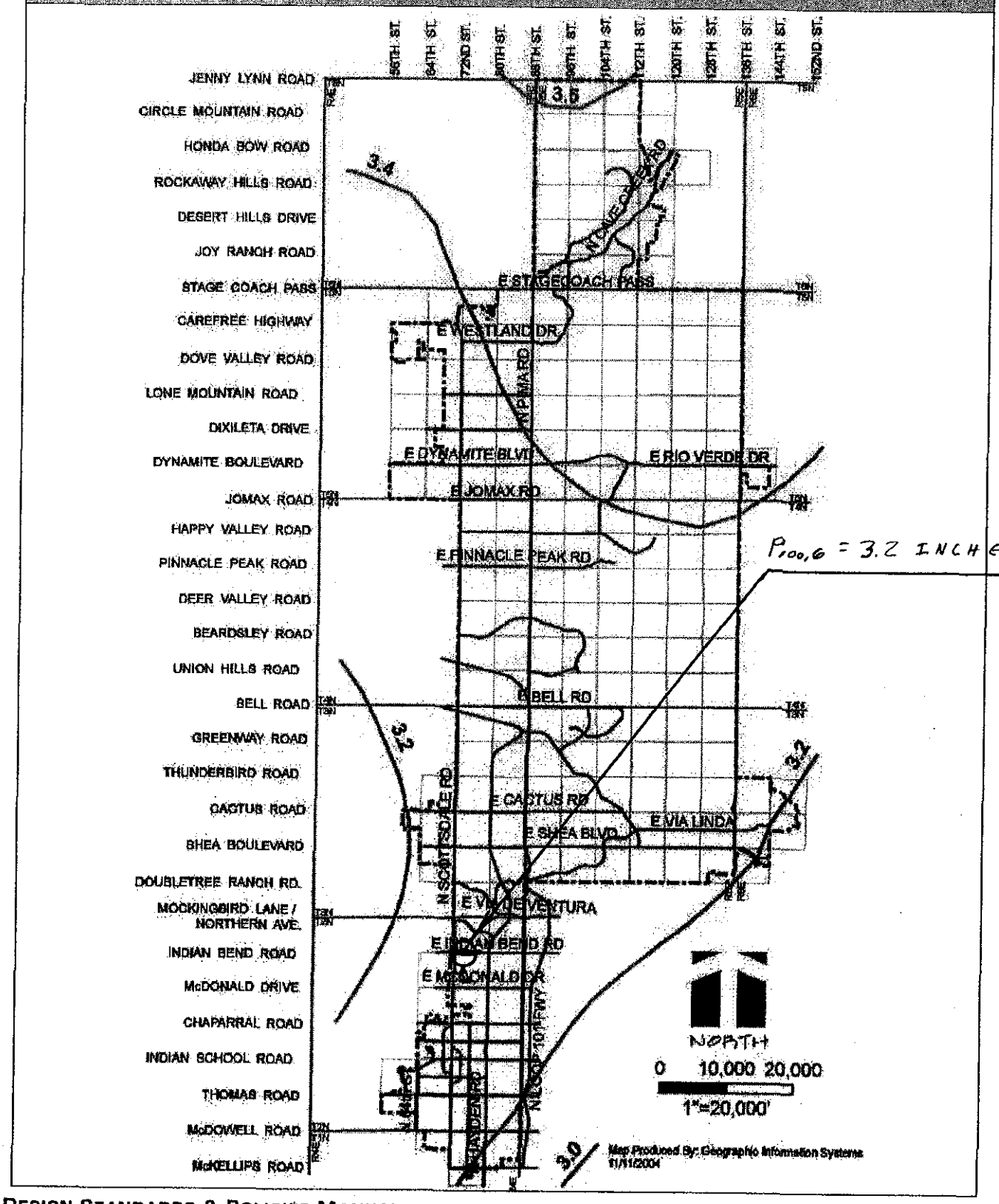
ISOPLUVIALS

2 Year 6 Hour Precipitation in Inches



ISOPLUVIALS

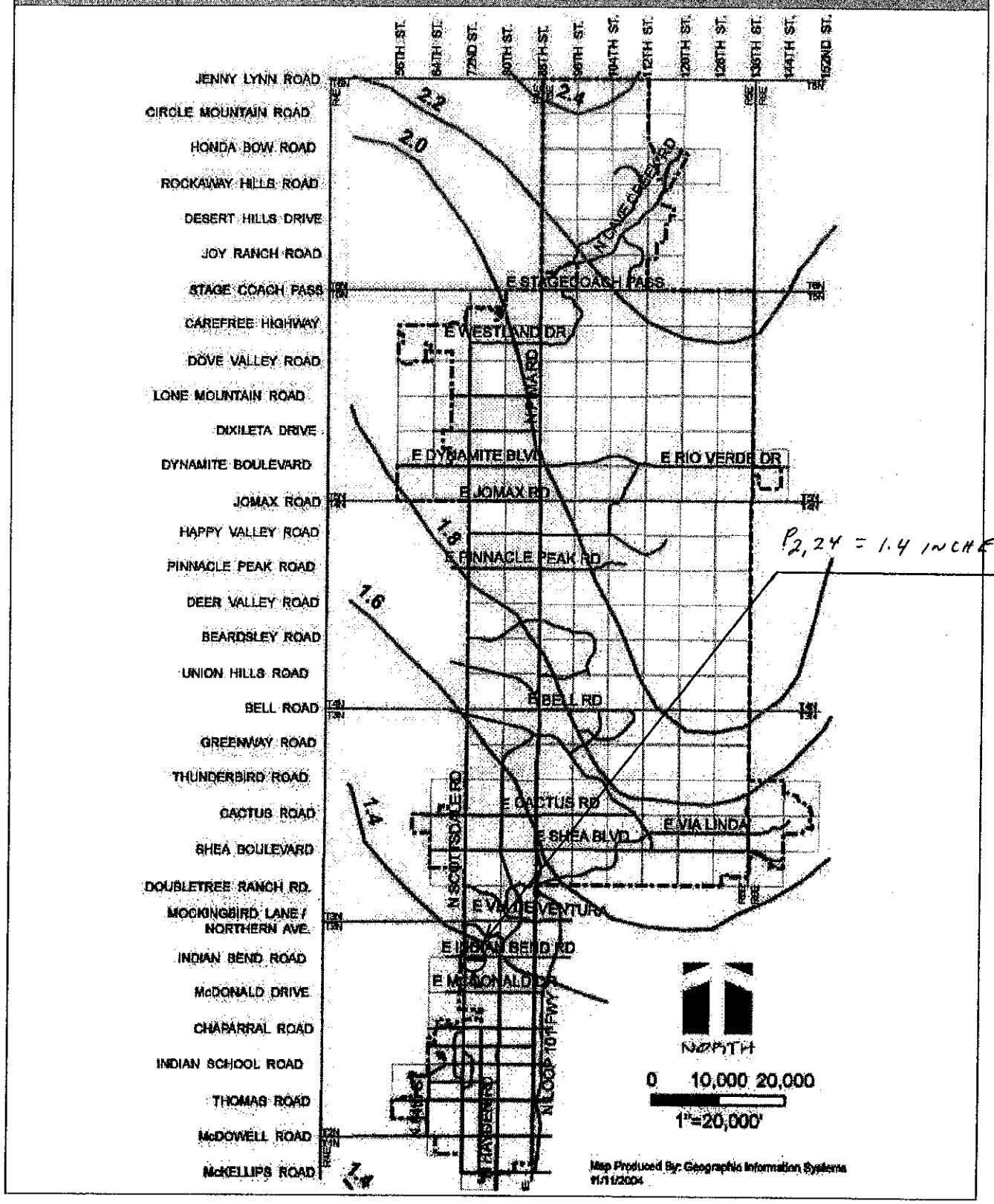
100 Year 6 Hour Precipitation in Inches



$P_{100,6}$ = 3.2 INCHES

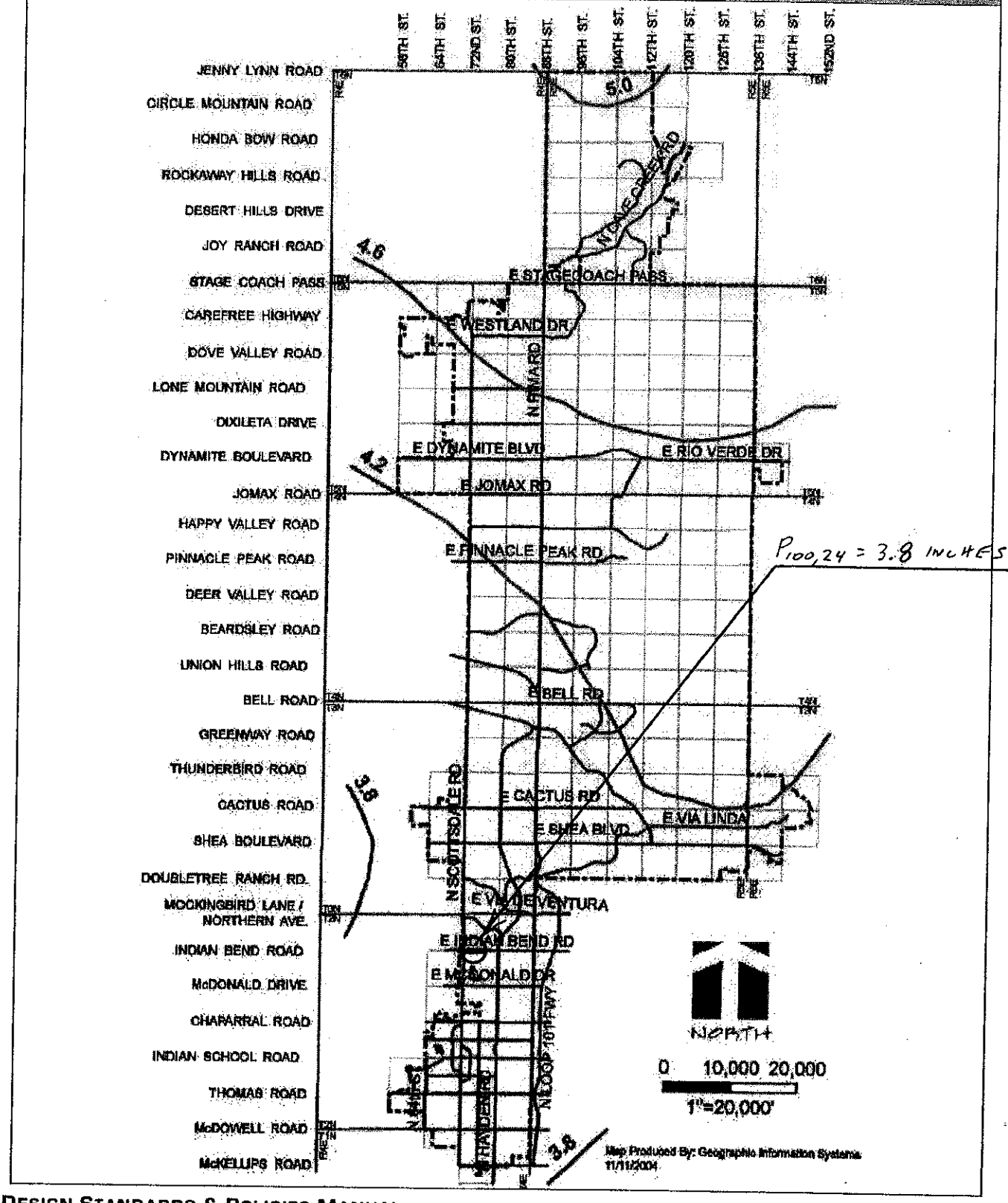
ISOPLUVIALS

2 Year 24 Hour Precipitation in Inches



ISOPLUVIALS

100 Year 24 Hour Precipitation in Inches



ARIZONA DEPARTMENT OF TRANSPORTATION
HYDROLOGIC DESIGN DATA

Project No.	S0402	TRACS No.	
Project Name	Indian Bend Road	Date	April 11 2006
Location	Scottsdale Road to Hayden Road		
Designer	Dave Schaub	Checker	

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet

PART A

Determine rainfall depths from the isopluvial maps (Appendix):

2-year, 6-hour		P 2, 6'	=	1.16
2-year, 24-hour		P 2, 24'	=	1.40
100-year, 6-hour		P 100, 6'	=	3.20
100-year, 24-hour		P 100, 24'	=	3.80

PART B

Compute the following:

2-year, 1-hour	$-0.011+\frac{.942(P_{2,6'})^2}{(P_{2,24'})}$	=	-0.011	+	$\frac{.942\ (\ 1.16\ )^2}{1.40}$				=	0.89
100-year, 1-hour	$0.494+\frac{.755(P_{100,6'})^2}{(P_{100,24'})}$	=	0.494	+	$\frac{.755\ (\ 3.20\ )^2}{3.80}$				=	2.53
2-year, 2-hour	$.341(P_{2,6'}) + .659(P_{2,1'})$	=	0.341	(	1.16)	+	0.659	(0.89)	=	0.98
2-year, 3-hour	$.569(P_{2,6'}) + .431(P_{2,1'})$	=	0.569	(	1.16)	+	0.431	(0.89)	=	1.05
2-year, 12-hour	$.500(P_{2,6'}) + .500(P_{2,24'})$	=	0.500	(	1.16)	+	0.500	(1.40)	=	1.28
100-year, 2-hour	$.341(P_{100,6'}) + .431(P_{100,1'})$	=	0.341	(	3.20)	+	0.659	(2.53)	=	2.76
100-year, 3-hour	$.569(P_{100,6'}) + .431(P_{100,1'})$	=	0.569	(	3.20)	+	0.431	(2.53)	=	2.91
100-year, 12-hour	$.500(P_{100,6'}) + .500(P_{100,24'})$	=	0.500	(	3.20)	+	0.500	(3.80)	=	3.50

Note: 5" denotes 5 mintes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part C

Determine the short-duration zone (Figure 1-1):

Zone = 8

Determine the short-duration rainfall ratios (Table 1-1):

Duration (Minutes)	Ratio			
	2-year		100-year	
5	A=	0.34	E=	0.30
10	B=	0.51	F=	0.46
15	C=	0.62	G=	0.59
30	D=	0.82	H=	0.80

Compute the following:

2-year, 5-min	(A) ($P_{2,1'}$)	=	0.34	*	0.89	$P_{2,5''}$	=	0.30
2-year, 10-min	(B) ($P_{2,1'}$)	=	0.51	*	0.89	$P_{2,10''}$	=	0.46
2-year, 15-min	(C) ($P_{2,1'}$)	=	0.62	*	0.89	$P_{2,15''}$	=	0.55
2-year, 30-min	(D) ($P_{2,1'}$)	=	0.82	*	0.89	$P_{2,30''}$	=	0.73
100-year, 5-min	(E) ($P_{100,1'}$)	=	0.30	*	2.53	$P_{100,5''}$	=	0.76
100-year, 10-min	(F) ($P_{100,1'}$)	=	0.46	*	2.53	$P_{100,10''}$	=	1.16
100-year, 15-min	(G) ($P_{100,1'}$)	=	0.59	*	2.53	$P_{100,15''}$	=	1.49
100-year, 30-min	(H) ($P_{100,1'}$)	=	0.80	*	2.53	$P_{100,30''}$	=	2.02

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2

Rainfall Depth-Duration-Frequency (D-D-F) Worksheet

(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)\,(P_{2,t}) + (Y)\,(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 5 yr X = 0.674 Y = 0.278

5-min	$(X)\,(P_{2,5''}) + (Y)\,(P_{100,5''})$	=	(	0.674	) (	0.30	) + (	0.278	) (	0.76	)	$P_{5,5''}$	=	0.42
10-min	$(X)\,(P_{2,10''}) + (Y)\,(P_{100,10''})$	=	(	0.674	) (	0.46	) + (	0.278	) (	1.16	)	$P_{5,10''}$	=	0.63
15-min	$(X)\,(P_{2,15''}) + (Y)\,(P_{100,15''})$	=	(	0.674	) (	0.55	) + (	0.278	) (	1.49	)	$P_{5,15''}$	=	0.79
30-min	$(X)\,(P_{2,30''}) + (Y)\,(P_{100,30''})$	=	(	0.674	) (	0.73	) + (	0.278	) (	2.02	)	$P_{5,30''}$	=	1.06
1-hour	$(X)\,(P_{2,1'}) + (Y)\,(P_{100,1'})$	=	(	0.674	) (	0.89	) + (	0.278	) (	2.53	)	$P_{5,1'}$	=	1.31
2-hour	$(X)\,(P_{2,2'}) + (Y)\,(P_{100,2'})$	=	(	0.674	) (	0.98	) + (	0.278	) (	2.76	)	$P_{5,2'}$	=	1.43
3-hour	$(X)\,(P_{2,3'}) + (Y)\,(P_{100,3'})$	=	(	0.674	) (	1.05	) + (	0.278	) (	2.91	)	$P_{5,3'}$	=	1.51
6-hour	$(X)\,(P_{2,6'}) + (Y)\,(P_{100,6'})$	=	(	0.674	) (	1.16	) + (	0.278	) (	3.20	)	$P_{5,6'}$	=	1.67
12-hour	$(X)\,(P_{2,12'}) + (Y)\,(P_{100,12'})$	=	(	0.674	) (	1.28	) + (	0.278	) (	3.50	)	$P_{5,12'}$	=	1.84
24-hour	$(X)\,(P_{2,24'}) + (Y)\,(P_{100,24'})$	=	(	0.674	) (	1.40	) + (	0.278	) (	3.80	)	$P_{5,24'}$	=	2.00

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2

Rainfall Depth-Duration-Frequency (D-D-F) Worksheet

(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)(P_{2,t}) + (Y)(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 10 yr X = 0.496 Y = 0.449

5-min	$(X)(P_{2,5'}) + (Y)(P_{100,5'})$	=	(	0.496	) (	0.30	) + (	0.449	) (	0.76	)	$P_{10,5'}$	=	0.49
10-min	$(X)(P_{2,10'}) + (Y)(P_{100,10'})$	=	(	0.496	) (	0.46	) + (	0.449	) (	1.16	)	$P_{10,10'}$	=	0.75
15-min	$(X)(P_{2,15'}) + (Y)(P_{100,15'})$	=	(	0.496	) (	0.55	) + (	0.449	) (	1.49	)	$P_{10,15'}$	=	0.94
30-min	$(X)(P_{2,30'}) + (Y)(P_{100,30'})$	=	(	0.496	) (	0.73	) + (	0.449	) (	2.02	)	$P_{10,30'}$	=	1.27
1-hour	$(X)(P_{2,1'}) + (Y)(P_{100,1'})$	=	(	0.496	) (	0.89	) + (	0.449	) (	2.53	)	$P_{10,1'}$	=	1.58
2-hour	$(X)(P_{2,2'}) + (Y)(P_{100,2'})$	=	(	0.496	) (	0.98	) + (	0.449	) (	2.76	)	$P_{10,2'}$	=	1.73
3-hour	$(X)(P_{2,3'}) + (Y)(P_{100,3'})$	=	(	0.496	) (	1.05	) + (	0.449	) (	2.91	)	$P_{10,3'}$	=	1.83
6-hour	$(X)(P_{2,6'}) + (Y)(P_{100,6'})$	=	(	0.496	) (	1.16	) + (	0.449	) (	3.20	)	$P_{10,6'}$	=	2.01
12-hour	$(X)(P_{2,12'}) + (Y)(P_{100,12'})$	=	(	0.496	) (	1.28	) + (	0.449	) (	3.50	)	$P_{10,12'}$	=	2.21
24-hour	$(X)(P_{2,24'}) + (Y)(P_{100,24'})$	=	(	0.496	) (	1.40	) + (	0.449	) (	3.80	)	$P_{10,24'}$	=	2.40

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)(P_{2,t}) + (Y)(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 25 yr X = 0.293 Y = 0.669

5-min	$(X)(P_{2,5''}) + (Y)(P_{100,5''})$	=	(	0.293	) (	0.30	) + (	0.669	) (	0.76	)	$P_{25,5''}$	=	0.60
10-min	$(X)(P_{2,10''}) + (Y)(P_{100,10''})$	=	(	0.293	) (	0.46	) + (	0.669	) (	1.16	)	$P_{25,10''}$	=	0.91
15-min	$(X)(P_{2,15''}) + (Y)(P_{100,15''})$	=	(	0.293	) (	0.55	) + (	0.669	) (	1.49	)	$P_{25,15''}$	=	1.16
30-min	$(X)(P_{2,30''}) + (Y)(P_{100,30''})$	=	(	0.293	) (	0.73	) + (	0.669	) (	2.02	)	$P_{25,30''}$	=	1.57
1-hour	$(X)(P_{2,1'}) + (Y)(P_{100,1'})$	=	(	0.293	) (	0.89	) + (	0.669	) (	2.53	)	$P_{25,1'}$	=	1.95
2-hour	$(X)(P_{2,2'}) + (Y)(P_{100,2'})$	=	(	0.293	) (	0.98	) + (	0.669	) (	2.76	)	$P_{25,2'}$	=	2.13
3-hour	$(X)(P_{2,3'}) + (Y)(P_{100,3'})$	=	(	0.293	) (	1.05	) + (	0.669	) (	2.91	)	$P_{25,3'}$	=	2.25
6-hour	$(X)(P_{2,6'}) + (Y)(P_{100,6'})$	=	(	0.293	) (	1.16	) + (	0.669	) (	3.20	)	$P_{25,6'}$	=	2.48
12-hour	$(X)(P_{2,12'}) + (Y)(P_{100,12'})$	=	(	0.293	) (	1.28	) + (	0.669	) (	3.50	)	$P_{25,12'}$	=	2.72
24-hour	$(X)(P_{2,24'}) + (Y)(P_{100,24'})$	=	(	0.293	) (	1.40	) + (	0.669	) (	3.80	)	$P_{25,24'}$	=	2.95

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)(P_{2,t}) + (Y)(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 50 yr X = 0.146 Y = 0.835

5-min	$(X)(P_{2,5'})+(Y)(P_{100,5'})$	=	(	0.146	) (	0.30	) + (	0.835	) (	0.76	)	$P_{50,5'}$	=	0.68
10-min	$(X)(P_{2,10'})+(Y)(P_{100,10'})$	=	(	0.146	) (	0.46	) + (	0.835	) (	1.16	)	$P_{50,10'}$	=	1.04
15-min	$(X)(P_{2,15'})+(Y)(P_{100,15'})$	=	(	0.146	) (	0.55	) + (	0.835	) (	1.49	)	$P_{50,15'}$	=	1.33
30-min	$(X)(P_{2,30'})+(Y)(P_{100,30'})$	=	(	0.146	) (	0.73	) + (	0.835	) (	2.02	)	$P_{50,30'}$	=	1.80
1-hour	$(X)(P_{2,1'})+(Y)(P_{100,1'})$	=	(	0.146	) (	0.89	) + (	0.835	) (	2.53	)	$P_{50,1'}$	=	2.24
2-hour	$(X)(P_{2,2'})+(Y)(P_{100,2'})$	=	(	0.146	) (	0.98	) + (	0.835	) (	2.76	)	$P_{50,2'}$	=	2.45
3-hour	$(X)(P_{2,3'})+(Y)(P_{100,3'})$	=	(	0.146	) (	1.05	) + (	0.835	) (	2.91	)	$P_{50,3'}$	=	2.58
6-hour	$(X)(P_{2,6'})+(Y)(P_{100,6'})$	=	(	0.146	) (	1.16	) + (	0.835	) (	3.20	)	$P_{50,6'}$	=	2.84
12-hour	$(X)(P_{2,12'})+(Y)(P_{100,12'})$	=	(	0.146	) (	1.28	) + (	0.835	) (	3.50	)	$P_{50,12'}$	=	3.11
24-hour	$(X)(P_{2,24'})+(Y)(P_{100,24'})$	=	(	0.146	) (	1.40	) + (	0.835	) (	3.80	)	$P_{50,24'}$	=	3.38

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)(P_{2,t}) + (Y)(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 500 yr X = -0.337 Y = 1.381

5-min	$(X)(P_{2,5'}) + (Y)(P_{100,5'})$	=	(	-0.337	) (	0.30	) + (	1.381	) (	0.76	)	$P_{500,5'}$	=	0.95
10-min	$(X)(P_{2,10'}) + (Y)(P_{100,10'})$	=	(	-0.337	) (	0.46	) + (	1.381	) (	1.16	)	$P_{500,10'}$	=	1.45
15-min	$(X)(P_{2,15'}) + (Y)(P_{100,15'})$	=	(	-0.337	) (	0.55	) + (	1.381	) (	1.49	)	$P_{500,15'}$	=	1.87
30-min	$(X)(P_{2,30'}) + (Y)(P_{100,30'})$	=	(	-0.337	) (	0.73	) + (	1.381	) (	2.02	)	$P_{500,30'}$	=	2.55
1-hour	$(X)(P_{2,1'}) + (Y)(P_{100,1'})$	=	(	-0.337	) (	0.89	) + (	1.381	) (	2.53	)	$P_{500,1'}$	=	3.19
2-hour	$(X)(P_{2,2'}) + (Y)(P_{100,2'})$	=	(	-0.337	) (	0.98	) + (	1.381	) (	2.76	)	$P_{500,2'}$	=	3.48
3-hour	$(X)(P_{2,3'}) + (Y)(P_{100,3'})$	=	(	-0.337	) (	1.05	) + (	1.381	) (	2.91	)	$P_{500,3'}$	=	3.67
6-hour	$(X)(P_{2,6'}) + (Y)(P_{100,6'})$	=	(	-0.337	) (	1.16	) + (	1.381	) (	3.20	)	$P_{500,6'}$	=	4.03
12-hour	$(X)(P_{2,12'}) + (Y)(P_{100,12'})$	=	(	-0.337	) (	1.28	) + (	1.381	) (	3.50	)	$P_{500,12'}$	=	4.40
24-hour	$(X)(P_{2,24'}) + (Y)(P_{100,24'})$	=	(	-0.337	) (	1.40	) + (	1.381	) (	3.80	)	$P_{500,24'}$	=	4.78

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part E

Tabulate the rainfall Depth-Duration-Frequency statistics below:

Duration	Rainfall Depth, in inches Frequency, in Years						
	2	5	10	25	50	100	500
5-min	0.30	0.42	0.49	0.60	0.68	0.76	0.95
10-min *	0.46	0.63	0.75	0.91	1.04	1.16	1.45
15-min	0.55	0.79	0.94	1.16	1.33	1.49	1.87
30-min *	0.73	1.06	1.27	1.57	1.80	2.02	2.55
1-hour	0.89	1.31	1.58	1.95	2.24	2.53	3.19
2-hour	0.98	1.43	1.73	2.13	2.45	2.76	3.48
3-hour	1.05	1.51	1.83	2.25	2.58	2.91	3.67
6-hour	1.16	1.67	2.01	2.48	2.84	3.20	4.03
12-hour	1.28	1.84	2.21	2.72	3.11	3.50	4.40
24-hour	1.40	2.00	2.40	2.95	3.38	3.80	4.78

* Note: 10-min and 30-min values are not coded into the PH record
5" denotes 5 minute, etc; 1' denotes 1 hour, etc.

Rainfall Intensity-Duration-Frequency (D-D-F) Worksheet

Part F

Tabulate the rainfall Intensity-Duration-Frequency statistics below:

Duration	Rainfall Intensity, in inches/hour Frequency, in Years						
	2	5	10	25	50	100	500
5-min	3.65	4.99	5.90	7.16	8.13	9.10	11.34
10-min	2.74	3.78	4.49	5.47	6.23	6.98	8.72
15-min	2.22	3.15	3.78	4.64	5.31	5.97	7.50
30-min	1.47	2.11	2.54	3.14	3.59	4.05	5.09
1-hour	0.89	1.31	1.58	1.95	2.24	2.53	3.19
2-hour	0.49	0.72	0.86	1.07	1.22	1.38	1.74
3-hour	0.35	0.50	0.61	0.75	0.86	0.97	1.22
6-hour	0.19	0.28	0.34	0.41	0.47	0.53	0.67
12-hour	0.11	0.15	0.18	0.23	0.26	0.29	0.37
24-hour	0.06	0.08	0.10	0.12	0.14	0.16	0.20

* Note: 10-min and 30-min values are not coded into the PH record
5" denotes 5 minute, etc; 1' denotes 1 hour, etc.

APPENDIX G
ON-SITE HYDROLOGIC AND HYDRAULICS COMPUTATIONS

TIME OF CONCENTRATION COMPUTATIONS

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

:t Information:

Project Name:	Indian Bend Road Improvements	**Date:**	8/23/2006
Drainage Area:	CB-4	**Design:**	DNJ
Station:	26+26	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1299.63		ft
Downstream Elev.	1298.14		ft
Length	80		ft
Slope	0.02		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$	0.00	0.00	0.00	

Unpaved

	1	2	3	
				ft
				ft
				ft
				ft/ft
	0.00	0.00	0.00	min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1298.14			ft
Downstream Elev	1293.93			ft
Length	450			ft
Slope	0.0093556			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.76			fps
$T_{Channel}$ =	1.99			min

$T_{Channel}$ = 1.99 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

2.12 min ***Use 5 minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	5/7/2007
Drainage Area:	CB-6	**Design:**	DNJ
Station:	47+16.5	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1290.4		ft
Downstream Elev.	1290		ft
Length	20		ft
Slope	0.02		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.0		min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1290			ft
Downstream Elev	1285.73			ft
Length	165			ft
Slope	0.0258788			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	6.26			fps
$T_{Channel}$ =	0.44			min

$T_{Channel}$ = 0.44 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.48 min ***Use 5 minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	6/12/2007
Drainage Area:	CB-7	**Design:**	DNJ
Station:	28+08.9	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.			ft
Downstream Elev.			ft
Length			ft
Slope			ft/ft
n			
$P_{2\text{-yr } 24\text{-hr}}$			in
T_{sheet}	0.0		min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Swale			
Upstream Elev	1295.3			ft
Downstream Elev	1293.3			ft
Length	417			ft
Slope	0.0047962			ft/ft
Roughness Value	0.025			
Depth	0.5			ft
Area	2.00			ft^2
Wetted Perimeter	4.06			ft
Hydraulic Radius	0.49			ft
Velocity	2.57			fps
$T_{Channel}$ =	2.70			min

$T_{Channel}$ = 2.70 min

Time of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

2.70 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-8	**Design:**	DNJ
Station:	28+23	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1300		ft
Downstream Elev.	1298.65		ft
Length	30		ft
Slope	0.04		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$								min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1298.64			ft
Downstream Elev	1292.93			ft
Length	662			ft
Slope	0.0086254			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.61			fps
$T_{Channel}$ =	3.05			min

$T_{Channel}$ = 3.05 min

ne of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

3.14 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	6/12/2007
Drainage Area:	CB-9	**Design:**	DNJ
Station:	28+23	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.			ft
Downstream Elev.			ft
Length			ft
Slope			ft/ft
n			
$P_{2\text{-yr } 24\text{-hr}}$			in
T_{sheet}	0.0		min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Swale			
Upstream Elev	1293.3			ft
Downstream Elev	1292.2			ft
Length	152			ft
Slope	0.0072368			ft/ft
Roughness Value	0.025			
Depth	0.5			ft
Area	2.00			ft^2
Wetted Perimeter	4.06			ft
Hydraulic Radius	0.49			ft
Velocity	3.16			fps
$T_{Channel}$ =	0.80			min

$T_{Channel}$ = 0.80 min

Time of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.80 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-12	**Design:**	DNJ
Station:	31+89	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1293.64		ft
Downstream Elev.	1292.93		ft
Length	31.5		ft
Slope	0.02		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1292.93			ft
Downstream Elev	1290.36			ft
Length	365			ft
Slope	0.0070411			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.26			fps
$T_{Channel}$ =	1.86			min

$T_{Channel}$ = 1.86 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.93 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-14	**Design:**	DNJ
Station:	31+89	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1295.3		ft
Downstream Elev.	1295.2		ft
Length	20		ft
Slope	0.005		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.0		min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

	1	2	3	
				ft
				ft
				ft
				ft/ft
				min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1295.2			ft
Downstream Elev	1290.64			ft
Length	620			ft
Slope	0.0073548			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.34			fps
$T_{Channel}$ =	3.10			min

$T_{Channel}$ = 3.10 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

3.12 min ***Use 5 minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-40	**Design:**	DNJ
Station:	33+00	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1291.38		ft
Downstream Elev.	1290.49		ft
Length	30		ft
Slope	0.03		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$					0.00	0.00	0.00	min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1290.49			ft
Downstream Elev	1289.94			ft
Length	200			ft
Slope	0.00275			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.04			fps
$T_{Channel}$ =	1.63			min

$T_{Channel}$ = 1.63 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.70 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-42	**Design:**	DNJ
Station:	33+41.6	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1291.38		ft
Downstream Elev.	1290.19		ft
Length	35		ft
Slope	0.03		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1290.19			ft
Downstream Elev	1290.08			ft
Length	158			ft
Slope	0.0006962			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	1.03			fps
$T_{Channel}$ =	2.57			min

$T_{Channel}$ = 2.57 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

2.65 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	
Drainage Area:	CB-46	**Design:**	DNJ
Station:	35+68	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1291.38		ft
Downstream Elev.	1290.15		ft
Length	35.5		ft
Slope	0.03		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1290.15			ft
Downstream Elev	1289.4			ft
Length	35			ft
Slope	0.0214286			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	5.69			fps
$T_{Channel}$ =	0.10			min

$T_{Channel}$ = 0.10 min

ne of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.19 min ***Use 5 Minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	
Drainage Area:	CB-44	**Design:**	DNJ
Station:	35+83	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1291.98		ft
Downstream Elev.	1290.12		ft
Length	35.5		ft
Slope	0.05		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$								min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1290.12			ft
Downstream Elev	1289.4			ft
Length	35			ft
Slope	0.0205714			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	5.58			fps
$T_{Channel}$ =	0.10			min

$T_{Channel}$ = 0.10 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.20 min ***Use 5 minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-48	**Design:**	DNJ
Station:	35+42	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1291.38		ft
Downstream Elev.	1290.19		ft
Length	35.5		ft
Slope	0.03		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1290.19			ft
Downstream Elev	1290.15			ft
Length	42			ft
Slope	0.0009524			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	1.20			fps
$T_{Channel}$ =	0.58			min

$T_{Channel}$ = 0.58 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.67 min *Use 5 minutes.

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-50	**Design:**	DNJ
Station:	38+58.8	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1292.1		ft
Downstream Elev.	1292		ft
Length	20		ft
Slope	0.005		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.0		min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$	0.00	0.00	0.00	

Unpaved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1292			ft
Downstream Elev	1289.19			ft
Length	375			ft
Slope	0.0074933			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.37			fps
$T_{Channel}$ =	1.86			min

$T_{Channel}$ = 1.86 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.88 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	5/7/2007
Drainage Area:	CB-52	**Design:**	DNJ
Station:	39+25.5	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1290.98		ft
Downstream Elev.	1290.21		ft
Length	35.5		ft
Slope	0.022		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$	0.00	0.00	0.00	

Unpaved

	1	2	3	
				ft
				ft
				ft
				ft/ft
				min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1290.21			ft
Downstream Elev	1288.71			ft
Length	360			ft
Slope	0.0041667			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.51			fps
$T_{Channel}$ =	2.39			min

$T_{Channel}$ = 2.39 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

2.46 min ***Use 5 minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	5/7/2007
Drainage Area:	CB-56	**Design:**	DNJ
Station:	43+70	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1290.1		ft
Downstream Elev.	1288.44		ft
Length	105		ft
Slope	0.016		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$	0.00	0.00	0.00	

Unpaved

	1	2	3	
				ft
				ft
				ft
				ft/ft
				min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1288.44			ft
Downstream Elev	1287.1			ft
Length	375			ft
Slope	0.0035733			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.33			fps
$T_{Channel}$ =	2.69			min

$T_{Channel}$ = 2.69 min

Time of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

2.83 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	5/7/2007
Drainage Area:	CB-58	**Design:**	DNJ
Station:	44+95.06	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1287.9		ft
Downstream Elev.	1287		ft
Length	68		ft
Slope	0.01		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1287			ft
Downstream Elev	1286.61			ft
Length	193			ft
Slope	0.0020207			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	1.75			fps
$T_{Channel}$ =	1.84			min

$T_{Channel}$ = 1.84 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.94 min ***Use 5 minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	5/7/2007
Drainage Area:	CB-60	**Design:**	DNJ
Station:	46+01.96	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1287.28		ft
Downstream Elev.	1286.61		ft
Length	34		ft
Slope	0.02		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1286.61			ft
Downstream Elev	1286.22			ft
Length	138			ft
Slope	0.0028261			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.07			fps
$T_{Channel}$ =	1.11			min

$T_{Channel}$ = 1.11 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.18 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-66	**Design:**	DNJ
Station:	48+20	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1287.64		ft
Downstream Elev.	1286.6		ft
Length	69		ft
Slope	0.02		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$								min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1287.64			ft
Downstream Elev	1285.01			ft
Length	314			ft
Slope	0.0083758			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.56			fps
$T_{Channel}$ =	1.47			min

$T_{Channel}$ = 1.47 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.57 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	
Drainage Area:	CB-68	**Design:**	DNJ
Station:	Maintenance Rd 1+85	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1290.5		ft
Downstream Elev.	1290.2		ft
Length	16		ft
Slope	0.02		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.0		min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$								min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1290.2			ft
Downstream Elev	1279.3			ft
Length	334			ft
Slope	0.0326347			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	7.03			fps
$T_{Channel}$ =	0.79			min

$T_{Channel}$ = 0.79 min

Time of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.83 min *Use 5 minutes.

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	4/25/2007
Drainage Area:	CB-70	**Design:**	DNJ
Station:	48+50	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1288		ft
Downstream Elev.	1287.36		ft
Length	6		ft
Slope	0.11		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.0		min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$								min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1287.36			ft
Downstream Elev	1280			ft
Length	827			ft
Slope	0.0088996			ft/ft
Roughness Value	0.02			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.75			fps
$T_{Channel}$ =	5.01			min

$T_{Channel}$ = 5.01 min

Time of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

5.04 min *Use 5 minutes.

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	
Drainage Area:	CB-72	**Design:**	DNJ
Station:	51+20	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1284.35		ft
Downstream Elev.	1283.94		ft
Length	64		ft
Slope	0.01		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$								min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1283.097			ft
Downstream Elev	1282.68			ft
Length	295			ft
Slope	0.0014136			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	1.46			fps
$T_{Channel}$ =	3.36			min

$T_{Channel}$ = 3.36 min

e of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

3.43 min *Use 5 minutes.

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-74	**Design:**	DNJ
Station:	52+25	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1284.56		ft
Downstream Elev.	1282.68		ft
Length	60		ft
Slope	0.03		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1282.68			ft
Downstream Elev	1282.56			ft
Length	75			ft
Slope	0.0016			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	1.56			fps
$T_{Channel}$ =	0.80			min

$T_{Channel}$ = 0.80 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.93 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-76	**Design:**	DNJ
Station:	52+60	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1285.31		ft
Downstream Elev.	1283.54		ft
Length	60		ft
Slope	0.03		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$								min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1283.54			ft
Downstream Elev	1282.56			ft
Length	240			ft
Slope	0.0040833			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.49			fps
$T_{Channel}$ =	1.61			min

$T_{Channel}$ = 1.61 min

Time of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.73 min *Use 5 minutes.

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-78	**Design:**	DNJ
Station:	54+95	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1287.56		ft
Downstream Elev.	1286.24		ft
Length	110		ft
Slope	0.01		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

	1	2	3	
				ft
				ft
				ft
				ft/ft
	0.00	0.00	0.00	min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1286.24			ft
Downstream Elev	1283.54			ft
Length	385			ft
Slope	0.007013			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.26			fps
$T_{Channel}$ =	1.97			min

$T_{Channel}$ = 1.97 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

2.11 **min** ***Use 5 minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/24/2006
Drainage Area:	CB-82	**Design:**	DNJ
Station:	57+50.5	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1288.01		ft
Downstream Elev.	1286.7		ft
Length	38		ft
Slope	0.03		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1286.7			ft
Downstream Elev	1284.88			ft
Length	495			ft
Slope	0.0036768			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.36			fps
$T_{Channel}$ =	3.50			min

$T_{Channel}$ = 3.50 min

ne of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

3.59 min ***Use 5 Minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/25/2006
Drainage Area:	CB-84	**Design:**	DNJ
Station:	59+75	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1289.72		ft
Downstream Elev.	1288.6		ft
Length	34		ft
Slope	0.03		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$					0.00	0.00	0.00	min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1288.6			ft
Downstream Elev	1286.84			ft
Length	193			ft
Slope	0.0091192			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.71			fps
$T_{Channel}$ =	0.87			min

$T_{Channel}$ = 0.87 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.95 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/25/2006
Drainage Area:	CB-88	**Design:**	DNJ
Station:	63+47	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1289.72		ft
Downstream Elev.	1288.6		ft
Length	34		ft
Slope	0.03		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1288.6			ft
Downstream Elev	1286.89			ft
Length	180			ft
Slope	0.0095			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.79			fps
$T_{Channel}$ =	0.79			min

$T_{Channel}$ = 0.79 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.87 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/31/2006
Drainage Area:	CB-92	**Design:**	DNJ
Station:	67+13.4	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1284.14		ft
Downstream Elev.	1283.37		ft
Length	36		ft
Slope	0.02		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
0.00	0.00	0.00	min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1287.37			ft
Downstream Elev	1282.14			ft
Length	407			ft
Slope	0.0128501			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	4.41			fps
$T_{Channel}$ =	1.54			min

$T_{Channel}$ = 1.54 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.61 min *use 5 Minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	5/8/2007
Drainage Area:	CB-92 (West)	**Design:**	DNJ
Station:	67+13.4	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1286.89		ft
Downstream Elev.	1286.23		ft
Length	46		ft
Slope	0.01		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1286.23			ft
Downstream Elev	1282.14			ft
Length	325			ft
Slope	0.0125846			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	4.36			fps
$T_{Channel}$ =	1.24			min

$T_{Channel}$ = 1.24 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.31 min ***Use 5 Minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	5/8/2007
Drainage Area:	CB-94 East	**Design:**	DNJ
Station:	66+68.2	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1284.71		ft
Downstream Elev.	1283.7		ft
Length	76		ft
Slope	0.01		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$	0.00	0.00	0.00	

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
0.00	0.00	0.00	min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1283.7			ft
Downstream Elev	1282.23			ft
Length	503			ft
Slope	0.0029225			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.10			fps
$T_{Channel}$ =	3.99			min

$T_{Channel}$ = 3.99 min

ne of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

4.09 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/25/2006
Drainage Area:	CB-94 West	**Design:**	DNJ
Station:	66+68.2	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1284.7		ft
Downstream Elev.	1284.5		ft
Length	18		ft
Slope	0.01		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.0		min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1284.5			ft
Downstream Elev	1282.23			ft
Length	310			ft
Slope	0.0073226			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.33			fps
$T_{Channel}$ =	1.55			min

$T_{Channel}$ = 1.55 min

Time of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.58 min *Use 5 Minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/25/2006
Drainage Area:	CB-98	**Design:**	DNJ
Station:	64+53.88	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1284.7		ft
Downstream Elev.	1284.5		ft
Length	25		ft
Slope	0.01		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.0		min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$	0.00							min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1284.5			ft
Downstream Elev	1284.2			ft
Length	105			ft
Slope	0.0028571			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.08			fps
$T_{Channel}$ =	0.84			min

$T_{Channel}$ = 0.84 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.88 min * Use 5 minutes.

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/225/06
Drainage Area:	CB-100	**Design:**	DNJ
Sation:	64+24	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1288.01		ft
Downstream Elev.	1286.7		ft
Length	34		ft
Slope	0.04		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$					0.00	0.00	0.00	min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1286.7			ft
Downstream Elev	1284.82			ft
Length	174			ft
Slope	0.0108046			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	4.04			fps
$T_{Channel}$ =	0.72			min

$T_{Channel}$ = 0.72 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

0.80 min *Use 5 minutes

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	5/7/2007
Drainage Area:	CB-104	**Design:**	DNJ
Station:	71+31.5	**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1286.88		ft
Downstream Elev.	1285.31		ft
Length	36		ft
Slope	0.04		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1285.31			ft
Downstream Elev	1283.37			ft
Length	360			ft
Slope	0.0053889			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.86			fps
$T_{Channel}$ =	2.10			min

$T_{Channel}$ = 2.10 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

2.19 min ***Use 5 Minutes**

Indian Bend Road Improvements
Time of Concentration (TR-55 Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road	**Date:**	8/25/2006
Drainage Area:	CB-106 (Hayden Road)	**Design:**	DNJ
Station:		**Check:**	

Sheet Flow Component

	1	2	
Upstream Elev.	1286.8		ft
Downstream Elev.	1286.3		ft
Length	48		ft
Slope	0.01		ft/ft
n	0.025		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.1		min

T_{Sheet} = 0.1 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1286.3			ft
Downstream Elev	1285.18			ft
Length	450			ft
Slope	0.0024889			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	1.94			fps
$T_{Channel}$ =	3.86			min

$T_{Channel}$ = 3.86 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

3.93 min ***Use 5 Minutes**

RATIONAL METHOD

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-4
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 26+26
Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Paved Street/Sidewalks	A1	0.644	0.644	0.644	0.644	0.644	0.644	acres
Median (Pavers)	A2	0.012	0.012	0.012	0.012	0.012	0.012	acres
	A3							acres
	Total (A)	0.66	0.66	0.66	0.66	0.66	0.66	acres
Drainage Length		530	530	530	530	530	530	feet
Elevations:								
Top of Drainage Area		1299.63	1299.63	1299.63	1299.63	1299.63	1299.63	feet
At Structure		1293.93	1293.93	1293.93	1293.93	1293.93	1293.93	feet
Drainage Area Slope		1.075	1.075	1.075	1.075	1.075	1.075	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		2.28	3.11	3.68	4.47	5.07	5.68	cfs

Computed By: DNJ **Date:** 4/25/2006

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

URS

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-7
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 28+08.9
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Park Grassed Area	A1	0.600	0.6	0.6	0.6	0.6	0.6	acres
Impervious Areas, Bldgs & S/Ws	A2	0.600	0.600	0.600	0.600	0.600	0.600	acres
	A3							acres
	Total (A)	1.20	1.20	1.20	1.20	1.20	1.20	acres
Drainage Length		417	417	417	417	417	417	
Elevations:								
Top of Drainage Area		1295.3	1295.3	1295.3	1295.3	1295.3	1295.3	feet
At Structure		1293.3	1293.3	1293.3	1293.3	1293.3	1293.3	feet
Drainage Area Slope		0.480	0.480	0.480	0.480	0.480	0.480	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.33	0.33	0.33	0.33	0.33	0.33	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.64	0.64	0.64	0.64	0.64	0.64	
Peak Discharge $Q_p = C_wIA(F)$		2.80	3.83	4.53	5.50	6.24	6.99	cfs

Computed By: DNJ **Date:** 4/25/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

URS

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-8
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 28+23
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.918	0.918	0.918	0.918	0.918	0.918	acres
Median (Pavers)	A2	0.018	0.018	0.018	0.018	0.018	0.018	acres
	A3							acres
	Total (A)	0.94	0.94	0.94	0.94	0.94	0.94	acres
Drainage Length		692	692	692	692	692	692	
Elevations:								
Top of Drainage Area		1300	1300	1300	1300	1300	1300	feet
At Structure		1292.93	1292.93	1292.93	1292.93	1292.93	1292.93	feet
Drainage Area Slope		1.022	1.022	1.022	1.022	1.022	1.022	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_wIA(F)$		3.24	4.44	5.25	6.37	7.23	8.09	cfs

Computed By: DNJ **Date:** 4/25/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

URS

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-9
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 28+23
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Park Grassed Area	A1	0.230	0.230	0.230	0.230	0.230	0.230	acres
Impervious Areas, Bldgs & S/Ws	A2	0.230	0.230	0.230	0.230	0.230	0.230	acres
	A3							acres
	Total (A)	0.46	0.46	0.46	0.46	0.46	0.46	acres
Drainage Length		152	152	152	152	152	152	
Elevations:								
Top of Drainage Area		1293.3	1293.3	1293.3	1293.3	1293.3	1293.3	feet
At Structure		1292.2	1292.2	1292.2	1292.2	1292.2	1292.2	feet
Drainage Area Slope		0.724	0.724	0.724	0.724	0.724	0.724	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.33	0.33	0.33	0.33	0.33	0.33	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.64	0.64	0.64	0.64	0.64	0.64	
Peak Discharge $Q_p = C_wIA(F)$		1.07	1.47	1.74	2.11	2.39	2.68	cfs

Computed By: DNJ **Date:** 4/25/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

URS

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-12
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 31+89
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.366	0.366	0.366	0.366	0.366	0.366	acres
Median (Pavers)	A2	0.012	0.012	0.012	0.012	0.012	0.012	acres
	A3							acres
	Total (A)	0.38	0.38	0.38	0.38	0.38	0.38	acres
Drainage Length		396.5	396.5	396.5	396.5	396.5	396.5	feet
Elevations:								
Top of Drainage Area		1293.64	1293.64	1293.64	1293.64	1293.64	1293.64	feet
At Structure		1290.36	1290.36	1290.36	1290.36	1290.36	1290.36	feet
Drainage Area Slope		0.827	0.827	0.827	0.827	0.827	0.827	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_wIA(F)$		1.31	1.79	2.12	2.57	2.92	3.26	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-14
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 31+89
Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Paved Street/Sidewalks	A1	0.616	0.616	0.616	0.616	0.616	0.616	acres
Median (Pavers)	A2	0.035	0.035	0.035	0.035	0.035	0.035	acres
	A3							acres
	Total (A)	0.65	0.65	0.65	0.65	0.65	0.65	acres
Drainage Length		640	640	640	640	640	640	feet
Elevations:								
Top of Drainage Area		1295.30	1295.30	1295.30	1295.30	1295.30	1295.3	feet
At Structure		1290.64	1290.64	1290.64	1290.64	1290.64	1290.64	feet
Drainage Area Slope		0.73	0.73	0.73	0.73	0.73	0.73	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4* [4]		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		2.25	3.08	3.64	4.42	5.02	5.62	cfs

Computed By: DNJ **Date:** 4/25/2006

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-40
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 33+00
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/sidewalks	A1	0.419	0.419	0.419	0.419	0.419	0.0419	acres
	A2							acres
	A3							acres
	Total (A)	0.42	0.42	0.42	0.42	0.42	0.04	acres
Drainage Length		230	230	230	230	230	230	feet
Elevations:								
Top of Drainage Area		1291.38	1291.38	1291.38	1291.38	1291.38	1291.38	feet
At Structure		1289.94	1289.94	1289.94	1289.94	1289.94	1289.94	feet
Drainage Area Slope		0.63	0.63	0.63	0.63	0.63	0.63	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_wIA(F)$		1.45	1.99	2.35	2.85	3.24	0.36	cfs

Computed By: DNJ **Date:** 4/25/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-42
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 33+41.6
Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.380	0.38	0.38	0.38	0.38	0.38	acres
Desert Landscape - no barrier	A2	0.031	0.031	0.031	0.031	0.031	0.031	acres
	A3							acres
	Total (A)	0.41	0.41	0.41	0.41	0.41	0.41	acres
Drainage Length		193	193	193	193	193	193	feet
Elevations:								
Top of Drainage Area		1291.38	1291.38	1291.38	1291.38	1291.38	1291.38	feet
At Structure		1290.08	1290.08	1290.08	1290.08	1290.08	1290.08	feet
Drainage Area Slope		0.674	0.674	0.674	0.674	0.674	0.674	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.90	0.90	0.90	0.90	0.91	0.91	
Peak Discharge $Q_p = C_w IA(F)$		1.35	1.85	2.19	2.66	3.03	3.40	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-46
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 35+64
Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	
Drainage Area								year
Pavement/Sidewalk	A1	0.036	0.036	0.036	0.036	0.036	0.036	acres
	A2							acres
	A3							acres
	Total (A)	0.04	0.04	0.04	0.04	0.04	0.04	acres
Drainage Length		70.5	70.5	70.5	70.5	70.5	70.5	feet
Elevations:								
Top of Drainage Area		1291.38	1291.38	1291.38	1291.38	1291.38	1291.38	feet
At Structure		1289.4	1289.4	1289.4	1289.4	1289.4	1289.4	feet
Drainage Area Slope		2.81	2.81	2.81	2.81	2.81	2.81	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	
								year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		0.12	0.17	0.20	0.24	0.28	0.31	cfs

Computed By: DNJ **Date:** 5/8/2007

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-44
Location: Indian Bend Road
Project No.: **Station:** 35+83
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.031	0.031	0.031	0.031	0.031	0.031	acres
	A2							acres
	A3							acres
	Total (A)	0.03	0.03	0.03	0.03	0.03	0.03	acres
Drainage Length		70	70	70	70	70	70	feet
Elevations:								
Top of Drainage Area		1290.98	1290.98	1290.98	1290.98	1290.98	1290.98	feet
At Structure		1289.4	1289.4	1289.4	1289.4	1289.4	1289.4	feet
Drainage Area Slope		2.26	2.26	2.26	2.26	2.26	2.26	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_wIA(F)$		0.11	0.15	0.17	0.21	0.24	0.27	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-48
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 35+42
Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.008	0.008	0.008	0.008	0.008	0.008	acres
Desert Landscape - no barrier	A2	0.002	0.002	0.002	0.002	0.002	0.002	acres
	A3							acres
	Total (A)	0.01	0.01	0.01	0.01	0.01	0.01	acres
Drainage Length		73	73	73	73	73	73	feet
Elevations:								
Top of Drainage Area		1291.38	1291.38	1291.38	1291.38	1291.38	1291.38	feet
At Structure		1290.15	1290.15	1290.15	1290.15	1290.15	1290.15	feet
Drainage Area Slope		1.685	1.685	1.685	1.685	1.685	1.685	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.84	0.84	0.84	0.85	0.85	0.85	
Peak Discharge $Q_p = C_w IA(F)$		0.03	0.04	0.05	0.06	0.07	0.07	cfs

Computed By: DNJ **Date:** 9/12/2006

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-50
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 38+58.8
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.504	0.5044	0.5044	0.5044	0.5044	0.5044	acres
Median (Pavers)	A2	0.0089	0.0089	0.0089	0.0089	0.0089	0.0089	acres
	A3							acres
	Total (A)	0.51	0.51	0.51	0.51	0.51	0.51	acres
Drainage Length		395	395	395	395	395	395	feet
Elevations:								
Top of Drainage Area		1292.1	1292.1	1292.1	1292.1	1292.1	1292.1	feet
At Structure		1289.19	1289.19	1289.19	1289.19	1289.19	1289.19	feet
Drainage Area Slope		0.74	0.74	0.74	0.74	0.74	0.74	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_wIA(F)$		1.78	2.43	2.88	3.49	3.96	4.44	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-52
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 39+25.5
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.385	0.385	0.385	0.385	0.385	0.385	acres
Median (Pavers)	A2							acres
	A3							acres
	Total (A)	0.39	0.39	0.39	0.39	0.39	0.39	acres
Drainage Length		395.5	395.5	395.5	395.5	395.5	395.5	feet
Elevations:								
Top of Drainage Area		1290.98	1290.98	1290.98	1290.98	1290.98	1290.98	feet
At Structure		1288.71	1288.71	1288.71	1288.71	1288.71	1288.71	feet
Drainage Area Slope		0.57396	0.57396	0.57396	0.57396	0.57396	0.57396	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		1.33	1.83	2.16	2.62	2.97	3.33	cfs

Computed By: DNJ **Date:** 3/27/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-56
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 43+70
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.920	0.920	0.920	0.920	0.920	0.920	acres
Right-of-Way	A2	0.005	0.005	0.005	0.005	0.005	0.005	acres
	A3							acres
	Total (A)	0.93	0.93	0.93	0.93	0.93	0.93	acres
Drainage Length		480	480	480	480	480	480	feet
Elevations:								
Top of Drainage Area		1290.1	1290.1	1290.1	1290.1	1290.1	1290.1	feet
At Structure		1287.10	1287.10	1287.10	1287.10	1287.10	1287.10	feet
Drainage Area Slope		0.63	0.63	0.63	0.63	0.63	0.63	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_wIA(F)$		3.20	4.37	5.17	6.27	7.12	7.97	cfs

Computed By: DNJ **Date:** 5/9/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-58
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 44+95.06
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/sidewalks	A1	0.190	0.190	0.190	0.190	0.190	0.190	acres
	A2							acres
	A3							acres
	Total (A)	0.19	0.19	0.19	0.19	0.19	0.19	acres
Drainage Length		261	261	261	261	261	261	feet
Elevations:								
Top of Drainage Area		1287.9	1287.9	1287.9	1287.9	1287.9	1287.9	feet
At Structure		1286.61	1286.61	1286.61	1286.61	1286.61	1286.61	feet
Drainage Area Slope		0.49	0.49	0.49	0.49	0.49	0.49	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_wIA(F)$		0.66	0.90	1.06	1.29	1.47	1.64	cfs

Computed By: DNJ **Date:** 5/7/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-60
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 46+01.96
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/sidewalks	A1	0.136	0.136	0.136	0.136	0.136	0.136	acres
Right-of-Way	A2							acres
	A3							acres
	Total (A)	0.14	0.14	0.14	0.14	0.14	0.14	acres
Drainage Length		197	197	197	197	197	197	feet
Elevations:								
Top of Drainage Area		1287.28	1287.28	1287.28	1287.28	1287.28	1287.28	feet
At Structure		1286.22	1286.22	1286.22	1286.22	1286.22	1286.22	feet
Drainage Area Slope		0.54	0.54	0.54	0.54	0.54	0.54	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		0.47	0.64	0.76	0.93	1.05	1.18	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-62
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 47+16.50
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/sidewalks	A1	0.291	0.291	0.291	0.291	0.291	0.291	acres
Right-of-Way	A2	0.007	0.007	0.007	0.007	0.007	0.007	acres
	A3							acres
	Total (A)	0.30	0.30	0.30	0.30	0.30	0.30	acres
Drainage Length		185	185	185	185	185	185	feet
Elevations:								
Top of Drainage Area		1290.40	1290.40	1290.00	1290.00	1290.40	1290.40	feet
At Structure		1285.73	1285.73	1285.73	1285.73	1285.73	1285.73	feet
Drainage Area Slope		2.52	2.52	2.31	2.31	2.52	2.52	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.93	0.93	0.93	0.94	0.94	0.94	
Peak Discharge $Q_p = C_w IA(F)$		1.02	1.39	1.64	2.00	2.27	2.54	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** Culvert - 64
Location: Paradise View Road Connector Road
Project No.: 410-S-0402 **Station:** 46+55.59 to 68.54' Rt
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/sidewalks	A1	0.004	0.004	0.004	0.004	0.004	0.004	acres
Right-of-Way	A2	0.469	0.469	0.469	0.469	0.469	0.469	acres
	A3							acres
	Total (A)	0.47	0.47	0.47	0.47	0.47	0.47	acres
Drainage Length		582	582	582	582	582	582	feet
Elevations:								
Top of Drainage Area		1287.36	1287.36	1287.36	1287.36	1287.36	1287.36	feet
At Structure		1282.48	1282.48	1282.48	1282.48	1282.48	1282.48	feet
Drainage Area Slope		0.83849	0.83849	0.83849	0.83849	0.83849	0.83849	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.32	0.32	0.32	0.35	0.37	0.39	
Peak Discharge $Q_p = C_w IA(F)$		0.54	0.74	0.88	1.17	1.44	1.70	cfs

Computed By: DNJ **Date:** 3/28/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-66
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 48+20
Name of Stream Watershed NA

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.343	0.343	0.343	0.343	0.343	0.343	acres
	A2							acres
	A3							acres
	Total (A)	0.34	0.34	0.34	0.34	0.34	0.34	acres
Drainage Length		383	383	383	383	383	383	feet
Elevations:								
Top of Drainage Area		1287.64	1287.64	1287.64	1287.64	1287.64	1287.64	feet
At Structure		1285.01	1285.01	1285.01	1285.01	1285.01	1285.01	feet
Drainage Area Slope		0.687	0.687	0.687	0.687	0.687	0.687	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		1.19	1.62	1.92	2.33	2.65	2.96	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-68
Location: Paradise View Road Connector Road
Project No.: 410-S-0402 **Station:** Maintenance Rd 1+85
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Pavement/sidewalks	A1	0.062	0.062	0.062	0.062	0.062	0.062	acres
Right-of-Way	A2	0.068	0.068	0.068	0.068	0.068	0.068	acres
	A3							acres
	Total (A)	0.13	0.13	0.13	0.13	0.13	0.13	acres
Drainage Length		350	350	350	350	350	350	feet
Elevations:								
Top of Drainage Area		1290.5	1290.5	1290.5	1290.5	1290.5	1290.5	feet
At Structure		1279.30	1279.30	1279.30	1279.30	1279.30	1279.30	feet
Drainage Area Slope		3.2	3.2	3.2	3.2	3.2	3.2	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.62	0.62	0.62	0.63	0.65	0.66	
Peak Discharge $Q_p = C_w IA(F)$		0.29	0.40	0.47	0.59	0.68	0.78	cfs

Computed By: DNJ **Date:** 3/28/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-70
Location: Paradise View Road Connector Road
Project No.: 410-S-0402 **Station:** 48+50
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/sidewalks	A1	1.541	1.541	1.541	1.541	1.541	1.541	acres
Right-of-Way	A2	0.683	0.683	0.683	0.683	0.683	0.683	acres
	A3							acres
	Total (A)	2.22	2.22	2.22	2.22	2.22	2.22	acres
Drainage Length		820	820	820	820	820	820	feet
Elevations:								
Top of Drainage Area		1287.36	1287.36	1287.36	1287.36	1287.36	1287.36	feet
At Structure		1280.00	1280.00	1280.00	1280.00	1280.00	1280.00	feet
Drainage Area Slope		0.89756	0.89756	0.89756	0.89756	0.89756	0.89756	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.75	0.75	0.75	0.76	0.77	0.78	
Peak Discharge $Q_p = C_wIA(F)$		6.12	8.36	9.89	12.14	13.96	15.74	cfs

Computed By: DNJ **Date:** 3/28/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-72
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 51+20
Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.530	0.530	0.530	0.530	0.530	0.530	acres
	A2							acres
	A3							acres
	Total (A)	0.53	0.53	0.53	0.53	0.53	0.53	acres
Drainage Length		359	359	359	359	359	359	feet
Elevations:								
Top of Drainage Area		1284.33	1284.33	1284.33	1284.33	1284.33	1284.33	feet
At Structure		1282.68	1282.68	1282.68	1282.68	1282.68	1282.68	feet
Drainage Area Slope		0.460	0.460	0.460	0.460	0.460	0.460	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.954	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		1.84	2.52	2.97	3.61	4.09	4.58	cfs

Computed By: DNJ **Date:** 9/6/2006

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-74
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 52+25
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.222	0.222	0.222	0.222	0.222	0.222	acres
	A2							acres
	A3							acres
	Total (A)	0.22	0.22	0.22	0.22	0.22	0.22	acres
Drainage Length		135	135	135	135	135	135	feet
Elevations:								
Top of Drainage Area		1284.56	1284.56	1284.56	1284.56	1284.56	1284.56	feet
At Structure		1282.56	1282.56	1282.56	1282.56	1282.56	1282.56	feet
Drainage Area Slope		1.481	1.481	1.481	1.481	1.481	1.481	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_wIA(F)$		0.77	1.05	1.25	1.51	1.72	1.92	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-76
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 52+60
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.420	0.420	0.420	0.420	0.420	0.420	acres
	A2							acres
	A3							acres
	Total (A)	0.42	0.42	0.42	0.42	0.42	0.42	acres
Drainage Length		300	300	300	300	300	300	feet
Elevations:								
Top of Drainage Area		1285.31	1285.31	1285.31	1285.31	1285.31	1285.31	feet
At Structure		1282.56	1282.56	1282.56	1282.56	1282.56	1282.56	feet
Drainage Area Slope		0.917	0.917	0.917	0.917	0.917	0.917	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		1.46	1.99	2.35	2.86	3.24	3.63	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-78
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 54+95
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.552	0.552	0.552	0.552	0.552	0.552	acres
Median (Pavers)	A2	0.020	0.020	0.020	0.020	0.020	0.020	acres
	A3							acres
	Total (A)	0.57	0.57	0.57	0.57	0.57	0.57	acres
Drainage Length		495	495	495	495	495	495	feet
Elevations:								
Top of Drainage Area		1287.56	1287.56	1287.56	1287.56	1287.56	1287.56	feet
At Structure		1283.54	1283.54	1283.54	1283.54	1283.54	1283.54	feet
Drainage Area Slope		0.81212	0.81212	0.81212	0.81212	0.81212	0.81212	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		1.98	2.71	3.20	3.89	4.41	4.94	cfs

Computed By: DNJ **Date:** 5/8/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

URS

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-82
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 57+50.5
Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.566	0.566	0.566	0.566	0.566	0.566	acres
Median ((Pavers)	A2	0.054	0.054	0.054	0.054	0.054	0.054	acres
	A3							acres
	Total (A)	0.62	0.62	0.62	0.62	0.62	0.62	acres
Drainage Length		533	533	533	533	533	533	feet
Elevations:								
Top of Drainage Area		1288.01	1288.01	1288.01	1288.01	1288.01	1288.01	feet
At Structure		1284.88	1284.88	1284.88	1284.88	1284.88	1284.88	feet
Drainage Area Slope		0.59	0.59	0.59	0.59	0.59	0.59	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_wIA(F)$		2.15	2.94	3.48	4.22	4.79	5.36	cfs

Computed By: DNJ **Date:** 5/8/2007

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-84
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 59+75
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.193	0.193	0.193	0.193	0.193	0.193	acres
Median (Pavers)	A2	0.037	0.0374	0.0374	0.0374	0.0374	0.0374	acres
	A3							acres
	Total (A)	0.23	0.23	0.23	0.23	0.23	0.23	acres
Drainage Length		227	227	227	227	227	227	feet
Elevations:								
Top of Drainage Area		1289.72	1289.72	1289.72	1289.72	1289.72	1289.72	feet
At Structure		1286.84	1286.84	1286.84	1286.84	1286.84	1286.84	feet
Drainage Area Slope		1.269	1.269	1.269	1.269	1.269	1.269	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		0.80	1.09	1.29	1.57	1.78	1.99	cfs

Computed By: DNJ **Date:** 5/8/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-88
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 63+47
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.153	0.153	0.153	0.153	0.153	0.153	acres
Median (Pavers)	A2	0.0196	0.0196	0.0196	0.0196	0.0196	0.0196	acres
	A3							acres
	Total (A)	0.17	0.17	0.17	0.17	0.17	0.17	acres
Drainage Length		214	214	214	214	214	214	feet
Elevations:								
Top of Drainage Area		1289.72	1289.72	1289.72	1289.72	1289.72	1289.72	feet
At Structure		1286.89	1286.89	1286.89	1286.89	1286.89	1286.89	feet
Drainage Area Slope		1.322	1.322	1.322	1.322	1.322	1.322	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		0.60	0.82	0.97	1.17	1.33	1.49	cfs

Computed By: DNJ **Date:** 5/8/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-92 (West)
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 67+13.40
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.373	0.373	0.373	0.373	0.373	0.373	acres
Desert Landscaping	A2	0.065	0.065	0.065	0.065	0.065	0.065	acres
Residential	A3	0.269	0.269	0.269	0.269	0.269	0.269	acres
	Total (A)	0.71	0.71	0.71	0.71	0.71	0.71	acres
Drainage Length		371	371	371	371	371	371	feet
Elevations:								
Top of Drainage Area		1286.89	1286.89	1286.89	1286.89	1286.89	1286.89	feet
At Structure		1282.14	1282.14	1282.14	1282.14	1282.14	1282.14	feet
Drainage Area Slope		1.280	1.280	1.280	1.280	1.280	1.280	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3	0.51	0.51	0.51	0.56	0.61	0.64	
Weighted Runoff Coefficient (C_w)	C_w	0.72	0.72	0.72	0.75	0.77	0.78	
Peak Discharge $Q_p = C_wIA(F)$		1.87	2.55	3.02	3.77	4.41	5.01	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

URS

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-92 (East)
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 67+13.40
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.403	0.403	0.403	0.403	0.403	0.403	acres
Desert Landscape - no barrier	A2	0.101	0.101	0.101	0.101	0.101	0.101	acres
Residential	A3	0.514	0.514	0.514	0.514	0.514	0.514	acres
	Total (A)	1.02	1.02	1.02	1.02	1.02	1.02	acres
Drainage Length		443	443	443	443	443	443	feet
Elevations:								
Top of Drainage Area		1284.14	1284.14	1284.14	1284.14	1284.14	1284.14	feet
At Structure		1282.14	1282.14	1282.14	1282.14	1282.14	1282.14	feet
Drainage Area Slope		0.451	0.451	0.451	0.451	0.451	0.451	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3	0.51	0.51	0.51	0.56	0.61	0.64	
Weighted Runoff Coefficient (C_w)	C_w	0.66	0.66	0.66	0.69	0.72	0.74	
Peak Discharge $Q_p = C_w IA(F)$		2.47	3.38	3.99	5.05	5.98	6.83	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-94 (East)
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 66+68.2
Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.545	0.545	0.545	0.545	0.545	0.5453	acres
ROW (Desert Landscape)	A2	0.112	0.112	0.112	0.112	0.112	0.1121	acres
Townhouses	A3	0.399	0.399	0.399	0.399	0.399	0.399	acres
	Total (A)	1.06	1.06	1.06	1.06	1.06	1.06	acres
Drainage Length		100	579	579	579	579	579	feet
Elevations:								
Top of Drainage Area		1284.71	1284.71	1284.71	1284.71	1284.71	1284.71	feet
At Structure		1282.23	1282.23	1282.23	1282.23	1282.23	1282.23	feet
Drainage Area Slope		2.48	0.42832	0.42832	0.42832	0.42832	0.42832	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3	0.63	0.63	0.63	0.69	0.76	0.79	
Weighted Runoff Coefficient (C_w)	C_w	0.76	0.76	0.76	0.79	0.82	0.83	
Peak Discharge $Q_p = C_w IA(F)$		2.93	4.01	4.74	5.96	7.00	7.97	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-94 (West)
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:**
Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.274	0.274	0.274	0.274	0.274	0.274	acres
ROW (Desert Landscape)	A2	0.073	0.073	0.073	0.073	0.073	0.073	acres
Townhouses	A3	0.034	0.034	0.034	0.034	0.034	0.034	acres
	Total (A)	0.38	0.38	0.38	0.38	0.38	0.38	acres
Drainage Length		328	328	328	328	328	328	feet
Elevations:								
Top of Drainage Area		1284.7	1284.7	1284.7	1284.7	1284.7	1284.7	feet
At Structure		1282.23	1282.23	1282.23	1282.23	1282.23	1282.23	feet
Drainage Area Slope		0.753	0.753	0.753	0.753	0.753	0.753	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3	0.63	0.63	0.63	0.69	0.76	0.79	
Weighted Runoff Coefficient (C_w)	C_w	0.80	0.80	0.80	0.81	0.82	0.83	
Peak Discharge $Q_p = C_wIA(F)$		1.11	1.52	1.80	2.21	2.55	2.87	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-98
Location: Indian Bend Road
Project No.: **Station:** 64+53.88
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.134	0.134	0.134	0.134	0.134	0.134	acres
	A2							acres
	A3							acres
	Total (A)	0.13	0.13	0.13	0.13	0.13	0.13	acres
Drainage Length		130	130	130	130	130	130	feet
Elevations:								
Top of Drainage Area		1284.7	1284.7	1284.7	1284.7	1284.7	1284.7	feet
At Structure		1284.2	1284.2	1284.2	1284.2	1284.2	1284.2	feet
Drainage Area Slope		0.385	0.385	0.385	0.385	0.385	0.385	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		0.47	0.64	0.75	0.91	1.04	1.16	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-100
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 64+24
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalks	A1	0.212	0.2117	0.2117	0.2117	0.2117	0.2117	acres
Median (Desert Landscape)	A2	0.0089	0.0089	0.0089	0.0089	0.0089	0.0089	acres
	A3							acres
	Total (A)	0.22	0.22	0.22	0.22	0.22	0.22	acres
Drainage Length		208	208	208	208	208	208	feet
Elevations:								
Top of Drainage Area		1288.01	1288.01	1288.01	1288.01	1288.01	1288.01	feet
At Structure		1284.82	1284.82	1284.82	1284.82	1284.82	1284.82	feet
Drainage Area Slope		1.53	1.53	1.53	1.53	1.53	1.53	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		0.76	1.05	1.24	1.50	1.70	1.91	cfs

Computed By: DNJ **Date:** 5/8/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-104
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** 71+31.5
Name of Stream Watershed NA

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Pavement/Sidewalk	A1	0.558	0.558	0.558	0.558	0.558	0.558	acres
Median (Desert Landscape)	A2	0.048	0.048	0.048	0.048	0.048	0.048	acres
ROW (Desert Landscape)	A3	0.027	0.027	0.027	0.027	0.027	0.027	acres
	Total (A)	0.63	0.63	0.63	0.63	0.63	0.63	acres
Drainage Length		396	396	396	396	396	396	feet
Elevations:								
Top of Drainage Area		1286.88	1286.88	1286.88	1286.88	1286.88	1286.88	feet
At Structure		1283.37	1283.37	1283.37	1283.37	1283.37	1283.37	feet
Drainage Area Slope		0.886	0.886	0.886	0.886	0.886	0.886	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3	0.31	0.31	0.31	0.34	0.37	0.39	
Weighted Runoff Coefficient (C_w)	C_w	0.92	0.92	0.92	0.92	0.92	0.93	
Peak Discharge $Q_p = C_w IA(F)$		2.13	2.91	3.45	4.19	4.76	5.33	cfs

Computed By: DNJ **Date:** 5/9/2007

Checked By: _____ **Date:** _____

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

URS

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** CB-106
Location: Indian Bend Road
Project No.: 410-S-0402 **Station:** Hayden Road
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Pavement/sidewalk	A1	0.485	0.4851	0.485	0.485	0.485	0.4851	acres
Median/Desert Landscape	A2	0.269	0.2687	0.269	0.269	0.269	0.2687	acres
Residential	A3	0.499	0.4987	0.499	0.499	0.499	0.4987	acres
	Total (A)	1.25	1.25	1.25	1.25	1.25	1.25	acres
Drainage Length		498	498	498	498	498	498	feet
Elevations:								
Top of Drainage Area		1286.78	1286.78	1286.78	1286.78	1286.78	1286.78	feet
At Structure		1285.18	1285.18	1285.18	1285.18	1285.18	1285.18	feet
Drainage Area Slope		0.321	0.321	0.321	0.321	0.321	0.321	%
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	
Time of Concentation	T_c	5	5	5	5	5	5	min.
Rainfall Intensity (I) - *see Figure 4-4*		3.65	4.99	5.9	7.16	8.13	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3	0.51	0.51	0.51	0.56	0.61	0.64	
Weighted Runoff Coefficient (C_w)	C_w	0.77	0.77	0.77	0.80	0.82	0.83	
Peak Discharge $Q_p = C_w IA(F)$		3.54	4.84	5.73	7.13	8.30	9.41	cfs

Computed By: DNJ **Date:** 8/24/2006

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

URS

CATCH BASIN ANALYSES

Worksheet for Sag Inlet CB-2 at Sta. 26+40

Project Description

Solve For	Spread

Input Data

Discharge	19.30	ft^3/s
Left Side Slope	0.05	ft/ft (H:V)
Right Side Slope	0.05	ft/ft (H:V)
Bottom Width	2.00	ft
Grate Width	2.00	ft
Grate Length	4.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	41.80	ft
Depth	1.00	ft
Wetted Perimeter	41.85	ft
Top Width	41.80	ft
Open Grate Area	3.60	ft^2
Active Grate Weir Length	10.00	ft

Messages

Notes	Install MAG Detail 537, Type G catch basin, double.

Worksheet for Curb Inlet On Grade CB-4 at Sta. 26+26

Project Description

Solve For	Efficiency

Input Data

Discharge	3.69	ft^3/s
Slope	0.00488	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	16.00	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	3.69	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	13.23	ft < TDLL = 15' (4' BIKE LANE + 11' LANE)
Depth	0.32	ft < dALL = 0.5'
Flow Area	1.79	ft^2
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	2.06	ft/s
Equivalent Cross Slope	0.06632	ft/ft
Length Factor	1.25	
Total Interception Length	12.80	ft

Messages

Notes	Install COP P=1569 Type M catch basin, Single Wing L=17 feet.

Worksheet for Sag Inlet CB-6 at Sta. 27+70

Project Description

Solve For	Spread

Input Data

Discharge	4.90	ft^3/s
Left Side Slope	0.05	ft/ft (H:V)
Right Side Slope	0.02	ft/ft (H:V)
Bottom Width	2.00	ft
Grate Width	2.00	ft
Grate Length	2.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	31.40	ft
Depth	0.42	ft
Wetted Perimeter	31.42	ft
Top Width	31.40	ft
Open Grate Area	1.80	ft^2
Active Grate Weir Length	6.00	ft

Messages

Notes	Install MAG Detail 537 Type G catch basin, Single.

Worksheet for Ditch Inlet In Sag - CB-7 Sta 28+08.9

Project Description

Solve For	Spread

Input Data

Discharge		4.53	ft^3/s
Left Side Slope		4.00	ft/ft (H:V)
Right Side Slope		4.00	ft/ft (H:V)
Bottom Width		2.00	ft
Grate Width		2.00	ft
Grate Length		2.00	ft
Local Depression		0.00	in
Local Depression Width		0.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	2.20	ft
Depth	0.40	ft
Wetted Perimeter	2.82	ft
Top Width	2.20	ft
Open Grate Area	1.80	ft^2
Active Grate Weir Length	6.00	ft

Worksheet for Curb Inlet On Grade CB-8 at Sta. 28+23

Project Description

Solve For	Efficiency

Input Data

Discharge	5.25	ft^3/s
Slope	0.00627	ft/ft
Gutter Width	3.92	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	16.00	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	94.04	%
Intercepted Flow	4.94	ft^3/s
Bypass Flow	0.31	ft^3/s → TO CB-12
Spread	14.62	ft < TALL = 15.5' (4.5 BIKE LANE + 11' LANE)
Depth	0.30	ft < d_{ALL} = 0.5'
Flow Area	2.15	ft^2
Gutter Depression	0.01	ft
Total Depression	0.17	ft
Velocity	2.44	ft/s
Equivalent Cross Slope	0.04494	ft/ft
Length Factor	0.79	
Total Interception Length	20.22	ft

Messages

Notes	Install COP Detail P-1569 Type M -I catch basin, Single Wing L = 17 feet.

Worksheet for Ditch Inlet In Sag - CB-9 Sta 28+23

Project Description

Solve For	Spread

Input Data

Discharge		1.74	ft^3/s
Left Side Slope		4.00	ft/ft (H:V)
Right Side Slope		4.00	ft/ft (H:V)
Bottom Width		2.00	ft
Grate Width		2.00	ft
Grate Length		2.00	ft
Local Depression		0.00	in
Local Depression Width		0.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	2.11	ft
Depth	0.21	ft
Wetted Perimeter	2.43	ft
Top Width	2.11	ft
Open Grate Area	1.80	ft^2
Active Grate Weir Length	6.00	ft

Worksheet for Curb Inlet In Sag CB-10 at Sta 29+63 update ds

Project Description

Solve For	Spread

Input Data

Discharge	12.20	ft^3/s
Gutter Width	1.42	ft
Gutter Cross Slope	0.04	ft/ft
Road Cross Slope	0.02	ft/ft
Curb Opening Length	18.40	ft
Opening Height	0.50	ft
Curb Throat Type	Inclined	
Local Depression	2.00	in
Local Depression Width	1.42	ft
Throat Incline Angle	33.50	degrees

Results

Spread	20.01	ft
Depth	0.43	ft < dau = 0.5'
Gutter Depression	0.03	ft
Total Depression	0.20	ft

Messages

Notes

COP P-1569 catch basin, M-2 wings
17 feet.

STILLMAN PARKING LOT
NORTHWEST CORNER

Worksheet for Curb Inlet On Grade CB-12 at Sta. 31+89

Project Description

Solve For	Efficiency

Input Data

Discharge	2.43	ft^3/s
Slope	0.00627	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	99.93	%
Intercepted Flow	2.43	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	10.69	ft < TALL = 15.5' (4.5' BIKE LANE + 11' LANE)
Depth	0.27	ft < dall = 0.5'
Flow Area	1.18	ft^2
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	2.06	ft/s
Equivalent Cross Slope	0.07712	ft/ft
Length Factor	0.98	
Total Interception Length	10.58	ft

Messages

Notes	Install COP Detail P-1569 Type M catch basin, Single Wing L=10 feet.

Worksheet for Curb Inlet On Grade CB-14 at Sta 31+89

Project Description

Solve For	Efficiency

Input Data

Discharge	3.64	ft^3/s
Slope	0.00631	ft/ft
Gutter Width	3.92	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	16.00	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	99.60	%
Intercepted Flow	3.63	ft^3/s
Bypass Flow	0.01	ft^3/s → to CB-40
Spread	12.72	ft < T_{ALL} = 15.5'
Depth	0.26	ft
Flow Area	1.63	ft^2
Gutter Depression	0.01	ft
Total Depression	0.17	ft
Velocity	2.24	ft/s
Equivalent Cross Slope	0.04763	ft/ft
Length Factor	0.95	
Total Interception Length	16.78	ft

Messages

Notes	Install COP Detail P-1569 Type M catch basin, Single Wing L=17 feet.

Worksheet for Sag Curb Inlet CB-40 at Sta. 33+00

Project Description

Solve For	Spread

Input Data

Discharge	2.36	ft^3/s
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Curb Opening Length	7.20	ft
Opening Height	0.50	ft
Curb Throat Type	Inclined	
Local Depression	2.00	in
Local Depression Width	1.42	ft
Throat Incline Angle	33.50	degrees

Results

Spread	11.14	ft < TALL = 15.5'
Depth	0.28	ft < dall = 0.5'
Gutter Depression	0.06	ft
Total Depression	0.22	ft

Messages

Notes	Install COP Detail P-1569 Type M-2 catch basin, Double wings L=3 both sides.

Worksheet for Sag Curb Inlet CB-42 at Sta. 33+41.6

Project Description

Solve For	Spread

Input Data

Discharge		2.19	ft^3/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		7.20	ft
Opening Height		0.50	ft
Curb Throat Type	Inclined		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		33.50	degrees

Results

Spread		10.60	ft < TALL = 15.5'
Depth		0.27	ft < dALL = 0.5'
Gutter Depression		0.06	ft
Total Depression		0.22	ft

Messages

Notes	Install COP Detail P-1569 Type M-2 catch basin, Double Wing L=3 feet both sides.

Worksheet for Grate Inlet In Sag CB-44 Sta. 35+83

Project Description

Solve For	Spread

Input Data

Discharge	0.17	ft^3/s
Gutter Width	2.50	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.03	ft/ft
Grate Width	2.00	ft
Grate Length	3.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	3.21	ft
Depth	0.10	ft -ok!
Gutter Depression	0.02	ft
Total Depression	0.02	ft
Open Grate Area	2.70	ft^2
Active Grate Weir Length	5.00	ft

Messages

Notes	Install MAG 537 Type G, Single Catch Basin.

Worksheet for Grate Inlet In Sag CB-46 Sta. 35+68

Project Description

Solve For	Spread

Input Data

Discharge	0.20	ft^3/s
Gutter Width	2.50	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.03	ft/ft
Grate Width	2.00	ft
Grate Length	3.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	3.43	ft
Depth	0.11	ft – OK!
Gutter Depression	0.02	ft
Total Depression	0.02	ft
Open Grate Area	2.70	ft^2
Active Grate Weir Length	5.00	ft

Messages

Notes	Install MAG 537 Type G, Single Catch Basin.

Worksheet for Curb Inlet On Grade CB-48 at Sta. 35+42

Project Description

Solve For	Efficiency

Input Data

Discharge	0.05	ft^3/s
Slope	0.00086	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	2.40	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	0.05	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	2.74	ft < TALL = 15.5'
Depth	0.11	ft < dALL = 0.5'
Flow Area	0.11	ft^2
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	0.44	ft/s
Equivalent Cross Slope	0.16641	ft/ft
Length Factor	3.34	
Total Interception Length	0.72	ft

Messages

Notes	Install COP P-1569 M, no wings.

Worksheet for Curb Inlet In Sag CB-50 at Sta. 38+58.8

Project Description

Solve For	Spread

Input Data

Discharge		2.88	ft^3/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		7.20	ft
Opening Height		0.50	ft
Curb Throat Type	Inclined		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		33.50	degrees

Results

Spread		12.72	ft < TALL=18.4' (1.4 GUTTER + 6' BIKE LANE + 11' LANE
Depth		0.31	ft < dALL=0.5'
Gutter Depression		0.05	ft
Total Depression		0.22	ft

Messages

Notes	Install COP Detail P-1689 Type M-2 catch basin, Double Wings L=3' each side

Worksheet for Curb Inlet On Grade CB-52 at Sta. 39+25.5

Project Description

Solve For	Efficiency

Input Data

Discharge	2.16	ft^3/s
Slope	0.00469	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	93.26	%
Intercepted Flow	2.01	ft^3/s
Bypass Flow	0.15	ft^3/s
Spread	10.81	ft ← TOTAL = (TURN LANE 12' + 6' BIKE' + 11' LANE) = 29'
Depth	0.27	ft ← d_allow = 0.5
Flow Area	1.21	ft^2
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	1.79	ft/s
Equivalent Cross Slope	0.07652	ft/ft
Length Factor	0.78	
Total Interception Length	9.27	ft

Messages

Notes	Install COP Detail P-1569 Type M-1 catch basin with 6 foot wing.

Worksheet for Curb Inlet On Grade CB-56 at Sta. 43+70

Project Description

Solve For	Efficiency

Input Data

Discharge	5.31	ft^3/s
Slope	0.00136	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	16.00	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	5.31	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	19.45	ft ≈ TOTAL = (1.42' GUTTER + 6' BIKE LANE + 11' LANE)
Depth	0.44	ft < d_ALL = 0.5'
Flow Area	3.82	ft^2
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	1.39	ft/s
Equivalent Cross Slope	0.05146	ft/ft
Length Factor	1.35	
Total Interception Length	11.84	ft

Messages

Notes	Install COP Detail P-1569 Type M-1 catch basin with 17 foot wing.

Worksheet for Waterway Inlet On Grade CB-58 at Sta 44+95.06

Project Description

Solve For	Efficiency

Input Data

Roughness Coefficient	0.016	
Slope	0.00347	ft/ft
Left Side Slope	0.02	ft/ft (H:V)
Right Side Slope	0.03	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	1.06	ft^3/s
Grate Width	2.00	ft
Grate Length	9.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	40.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	82.11	%
Intercepted Flow	0.87	ft^3/s
Bypass Flow	0.19	ft^3/s → TO CB-60
Flow Area	1.06	ft^2
Wetted Perimeter	13.65	ft
Top Width	13.65	ft
Velocity	1.00	ft/s
Splash Over Velocity	13.81	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.76	
Grate Flow Ratio	0.24	
Active Grate Length	5.40	ft
Critical Depth	0.10	ft
Critical Slope	0.00931	ft/ft
Froude Number	0.63	
Flow Type	Subcritical	
Specific Energy	0.14	ft
Velocity Head	0.02	ft
Depth	0.13	ft

Worksheet for Waterway Inlet On Grade CB-60 at Sta 46+01.96

Project Description

Solve For	Efficiency

Input Data

Roughness Coefficient	0.016	
Slope	0.00381	ft/ft
Left Side Slope	0.02	ft/ft (H:V)
Right Side Slope	0.03	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	0.95	ft^3/s
Grate Width	2.00	ft
Grate Length	9.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	40.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	82.21	%
Intercepted Flow	0.78	ft^3/s
Bypass Flow	0.17	ft^3/s ← TO CB-62
Flow Area	0.95	ft^2
Wetted Perimeter	12.92	ft
Top Width	12.92	ft
Velocity	1.00	ft/s
Splash Over Velocity	13.81	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.76	
Grate Flow Ratio	0.25	
Active Grate Length	5.40	ft
Critical Depth	0.10	ft
Critical Slope	0.00946	ft/ft
Froude Number	0.65	
Flow Type	Subcritical	
Specific Energy	0.13	ft
Velocity Head	0.02	ft
Depth	0.12	ft

Worksheet for Sag Curb Inlet CB-62 at Sta. 47+16.50

Project Description

Solve For	Spread

Input Data

Discharge		1.81	ft^3/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		7.20	ft
Opening Height		0.50	ft
Curb Throat Type	Inclined		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		33.50	degrees

Results

Spread	9.33	ft
Depth	0.24	ft
Gutter Depression	0.06	ft
Total Depression	0.22	ft

Messages

Notes	Install COP Detail P-1569 Type M catch basin, Double wings L=3 both sides.

Worksheet for Grate Inlet On Grade CB-66 at Sta. 48+20

Project Description

Solve For	Efficiency

Input Data

Discharge	1.92	ft³/s
Slope	0.00790	ft/ft
Gutter Width	2.50	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Grate Width	2.00	ft
Grate Length	9.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	40.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	87.01	%
Intercepted Flow	1.67	ft³/s
Bypass Flow	0.25	ft³/s ← to CB-72
Spread	8.38	ft < TALL = 19.4'
Depth	0.22	ft < d ALL = 0.5'
Flow Area	0.87	ft²
Gutter Depression	0.02	ft
Total Depression	0.02	ft
Velocity	2.20	ft/s
Splash Over Velocity	13.81	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.72	
Grate Flow Ratio	0.53	
Active Grate Length	5.40	ft

Messages

Notes

Install COP Detail No. P-1570 Type
N Triple catch basin.

INTERCEPT FLOW UPSTREAM OF ARCHES

Worksheet for Ditch Inlet In Sag - CB-68 Maint. Rd Sta 1+85

Project Description

Solve For	Spread

Input Data

Discharge	0.47	ft^3/s
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Grate Width	2.00	ft
Grate Length	2.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	2.06	ft
Depth	0.09	ft
Wetted Perimeter	2.19	ft
Top Width	2.06	ft
Open Grate Area	1.80	ft^2
Active Grate Weir Length	6.00	ft

Worksheet for Ditch Inlet In Sag - CB-70 Sta 48+50

Project Description

Solve For	Spread

Input Data

Discharge		9.89	ft^3/s
Left Side Slope		3.00	ft/ft (H:V)
Right Side Slope		3.00	ft/ft (H:V)
Bottom Width		2.00	ft
Grate Width		2.00	ft
Grate Length		4.00	ft
Local Depression		0.00	in
Local Depression Width		0.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	2.32	ft
Depth	0.48	ft
Wetted Perimeter	3.01	ft
Top Width	2.32	ft
Open Grate Area	3.60	ft^2
Active Grate Weir Length	10.00	ft

Worksheet for Grate Inlet On Grade CB-72 Sta. 51+20

Project Description

Solve For	Efficiency

Input Data

Discharge	3.22	ft^3/s
Slope	0.00430	ft/ft
Gutter Width	2.50	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.016	
Grate Width	2.00	ft
Grate Length	6.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	40.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	70.41	%
Intercepted Flow	2.27	ft^3/s
Bypass Flow	0.95	ft^3/s ← TO CB74
Spread	10.85	ft
Depth	0.29	ft
Flow Area	1.59	ft^2
Gutter Depression	0.00	ft
Total Depression	0.00	ft
Velocity	2.03	ft/s
Splash Over Velocity	10.91	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.49	
Grate Flow Ratio	0.42	
Active Grate Length	3.60	ft

Messages

Notes	Install COP Detail P-1570 Type N catch basin, double catch basin.

Worksheet for Grate Inlet In Sag CB-74 Sta. 52+25

Project Description

Solve For	Spread

Input Data

Discharge	2.84	ft^3/s
Gutter Width	2.50	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.03	ft/ft
Grate Width	2.00	ft
Grate Length	6.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	10.49	ft
Depth	0.30	ft
Gutter Depression	0.02	ft
Total Depression	0.02	ft
Open Grate Area	5.40	ft^2
Active Grate Weir Length	8.00	ft

Messages

Notes	Install COP Detail No. P-1570 Type N, double catch basin.

Worksheet for Grate Inlet On Grade CB-76 Sta. 52+60 look at

Project Description

Solve For	Efficiency

Input Data

Discharge	2.81	ft³/s
Slope	0.00320	ft/ft
Gutter Width	2.50	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.016	
Grate Width	2.00	ft
Grate Length	6.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	40.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	77.32	%
Intercepted Flow	2.17	ft³/s
Bypass Flow	0.64	ft³/s ← CB 74
Spread	10.81	ft
Depth	0.31	ft
Flow Area	1.60	ft²
Gutter Depression	0.02	ft
Total Depression	0.02	ft
Velocity	1.76	ft/s
Splash Over Velocity	10.91	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.60	
Grate Flow Ratio	0.43	
Active Grate Length	3.60	ft

Messages

Notes	Install COP Detail No. P-1570 Type N, double catch basin.

Worksheet for Grate Inlet On Grade CB-78 at Sta 54+95

Project Description

Solve For	Efficiency

Input Data

Discharge	3.27	ft^3/s
Slope	0.00400	ft/ft
Gutter Width	2.50	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.016	
Grate Width	2.00	ft
Grate Length	9.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	40.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	85.92	%
Intercepted Flow	2.81	ft^3/s
Bypass Flow	0.46	ft^3/s ← TO CB-76
Spread	11.49	ft < TALL = 19.5' (1.5' + 6' + 12')
Depth	0.31	ft < dALL = 0.5'
Flow Area	1.68	ft^2
Gutter Depression	0.02	ft
Total Depression	0.02	ft
Velocity	1.95	ft/s
Splash Over Velocity	13.81	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.76	
Grate Flow Ratio	0.41	
Active Grate Length	5.40	ft

Messages

Notes	Install a COP Detail P-1570 Type N, triple catch basin.

Worksheet for Curb Inlet In Sag CB-82 at Sta. 57+50.5

Project Description

Solve For	Spread

Input Data

Discharge		3.48	ft^3/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		16.00	ft
Opening Height		0.50	ft
Curb Throat Type	Inclined		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		33.50	degrees

Results

Spread		9.40	ft < TALL = 19.5' (1.5' + 6' + 12')
Depth		0.24	ft < dALL = 0.5'
Gutter Depression		0.05	ft
Total Depression		0.22	ft

Messages

Notes	Install COP Detail P-1689 Type M-1 catch basin, Single Wing L-17 feet - east side.

Worksheet for Curb Inlet On Grade CB-84 at Sta. 59+75

Project Description

Solve For	Efficiency

Input Data

Discharge	1.29	ft^3/s
Slope	0.00910	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	7.20	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	94.59	%
Intercepted Flow	1.22	ft^3/s
Bypass Flow	0.07	ft^3/s → TO CB-78
Spread	11.08	ft < TALL = 13.5'
Depth	0.19	ft < dALL = 0.5'
Flow Area	0.72	ft^2
Gutter Depression	0.07	ft
Total Depression	0.23	ft
Velocity	1.78	ft/s
Equivalent Cross Slope	0.07845	ft/ft
Length Factor	0.80	
Total Interception Length	8.98	ft

Messages

Notes	Install COP P-1569 Type M-1 catch basin, Single Wing L=6 feet.

Worksheet for Ditch Inlet In Sag CB-86 at Sta 59+75

Project Description

Solve For	Spread

Input Data

Discharge	1.56	ft^3/s
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Grate Width	2.00	ft
Grate Length	2.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	2.13	ft
Depth	0.20	ft
Wetted Perimeter	2.41	ft
Top Width	2.13	ft
Open Grate Area	1.80	ft^2
Active Grate Weir Length	6.00	ft

Messages

Notes	COS Catch Basin Dtl 537, Type G, Single

Worksheet for Grate Inlet On Grade CB-88 at Sta 63+47

Project Description

Solve For	Efficiency

Input Data

Discharge	0.97	ft³/s
Slope	0.01430	ft/ft
Gutter Width	2.50	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Grate Width	2.00	ft
Grate Length	6.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	40.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	82.12	%
Intercepted Flow	0.80	ft³/s
Bypass Flow	0.17	ft³/s → TO CB-92
Spread	8.97	ft < TALL = 1.5' + 11' = 12.5'
Depth	0.15	ft < dALL = 0.5'
Flow Area	0.48	ft²
Gutter Depression	0.06	ft
Total Depression	0.06	ft
Velocity	2.03	ft/s
Splash Over Velocity	10.91	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.54	
Grate Flow Ratio	0.61	
Active Grate Length	3.60	ft

Messages

Notes	COP dtl P-1570 catch basin, Double

Worksheet for Ditch Inlet In Sag CB-90 at Sta 64+25

Project Description

Solve For	Spread

Input Data

Discharge	0.57	ft^3/s
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Grate Width	2.00	ft
Grate Length	2.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	2.07	ft
Depth	0.10	ft
Wetted Perimeter	2.21	ft
Top Width	2.07	ft
Open Grate Area	1.80	ft^2
Active Grate Weir Length	6.00	ft

Messages

Notes	COS Catch Basin Dtl 537, Type G, Single

Worksheet for Curb Inlet In Sag CB-92 (East) at Sta. 67+13.4

Project Description

Solve For	Spread

Input Data

Discharge	3.99	ft^3/s
Gutter Width	3.92	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Curb Opening Length	10.20	ft
Opening Height	0.50	ft
Curb Throat Type	Inclined	
Local Depression	2.00	in
Local Depression Width	1.42	ft
Throat Incline Angle	33.50	degrees

Results

Spread	10.81	ft
Depth	0.22	ft
Gutter Depression	0.00	ft
Total Depression	0.17	ft

Messages

Notes	Install COP Detail P-1569 Type M-2 catch basin, Double Wing L=10 feet (east side)

Worksheet for Curb Inlet In Sag CB-92 (West) at Sta. 67+13.4

Project Description

Solve For	Spread

Input Data

Discharge		3.19	ft^3/s
Gutter Width		3.92	ft
Gutter Cross Slope		0.02	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		7.20	ft
Opening Height		0.50	ft
Curb Throat Type	Inclined		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		33.50	degrees

Results

Spread	10.58	ft
Depth	0.21	ft
Gutter Depression	0.00	ft
Total Depression	0.17	ft

Messages

Notes	Install COP Detail P-1569 Type N catch basin, Double Wing L=6 feet (west side)

Worksheet for Curb Inlet In Sag CB-94 (East) at Sta. 66+68.2

Project Description

Solve For	Spread

Input Data

Discharge		4.74	ft^3/s
Gutter Width		3.92	ft
Gutter Cross Slope		0.02	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		10.40	ft
Opening Height		0.50	ft
Curb Throat Type	Inclined		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		33.50	degrees

Results

Spread		12.03	ft < TAW = 4'+11.5'=15.5'
Depth		0.25	ft < daw = 0.5'
Gutter Depression		0.01	ft
Total Depression		0.17	ft

Messages

Notes	Install COP Detail P=1569 Type M-2 catch Basin, Double Wings L=10 (East Side).

Worksheet for Curb Inlet In Sag CB-94 (West) at Sta. 66+68.2

Project Description

Solve For	Spread

Input Data

Discharge	1.84	ft^3/s
Gutter Width	3.92	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Curb Opening Length	4.80	ft
Opening Height	0.50	ft
Curb Throat Type	Inclined	
Local Depression	2.00	in
Local Depression Width	1.42	ft
Throat Incline Angle	33.50	degrees

Results

Spread	8.29	ft ← TALL = 4' + 11.5' = 15.5'
Depth	0.17	ft ← dALL = 0.5'
Gutter Depression	0.01	ft
Total Depression	0.17	ft

Messages

Notes: Install COP Detail P-1569 Type M-2 catch basin, Double Wings L=3' (west side).

Worksheet for Curb Inlet On Grade CB-100 at Sta. 64+24

Project Description

Solve For	Efficiency

Input Data

Discharge	1.24	ft^3/s
Slope	0.01080	ft/ft
Gutter Width	3.92	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	96.61	%
Intercepted Flow	1.20	ft^3/s
Bypass Flow	0.04	ft^3/s
Spread	12.05	ft < TOTAL = 4' + 12' = 16'
Depth	0.15	ft < dALL = 0.5'
Flow Area	0.68	ft^2
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	1.81	ft/s
Equivalent Cross Slope	0.04935	ft/ft
Length Factor	0.85	
Total Interception Length	12.27	ft

Messages

Notes	Install COP P-1569 Type G catch basin, Single Wing L= 6 feet.

Worksheet for Sag Curb Inlet CB-98 at Sta. 64+53.88 (side road)

Project Description

Solve For	Spread

Input Data

Discharge		0.75	ft^3/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		2.40	ft
Opening Height		0.50	ft
Curb Throat Type	Inclined		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		33.50	degrees

Results

Spread	8.15	ft
Depth	0.22	ft
Gutter Depression	0.06	ft
Total Depression	0.22	ft

Messages

Notes	Install COP Detail P-1569 Type M catch basin, no wings.

Worksheet for Curb Inlet On Grade CB-104 at Sta 71+31.5

Project Description

Solve For	Efficiency

Input Data

Discharge	3.45	ft^3/s
Slope	0.00455	ft/ft
Gutter Width	3.92	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	3.45	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	13.29	ft ~
Depth	0.27	ft
Flow Area	1.77	ft^2
Gutter Depression	0.00	ft
Total Depression	0.17	ft
Velocity	1.95	ft/s
Equivalent Cross Slope	0.09115	ft/ft
Length Factor	1.03	
Total Interception Length	10.07	ft

Messages

Notes	Install COP Detail P-1569 Type M catch basin, Single Wing L=10 feet.

Worksheet for Curb Inlet On Grade CB-106 Hayden Road

Project Description

Solve For	Efficiency

Input Data

Discharge	5.73	ft^3/s
Slope	0.00250	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	16.00	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

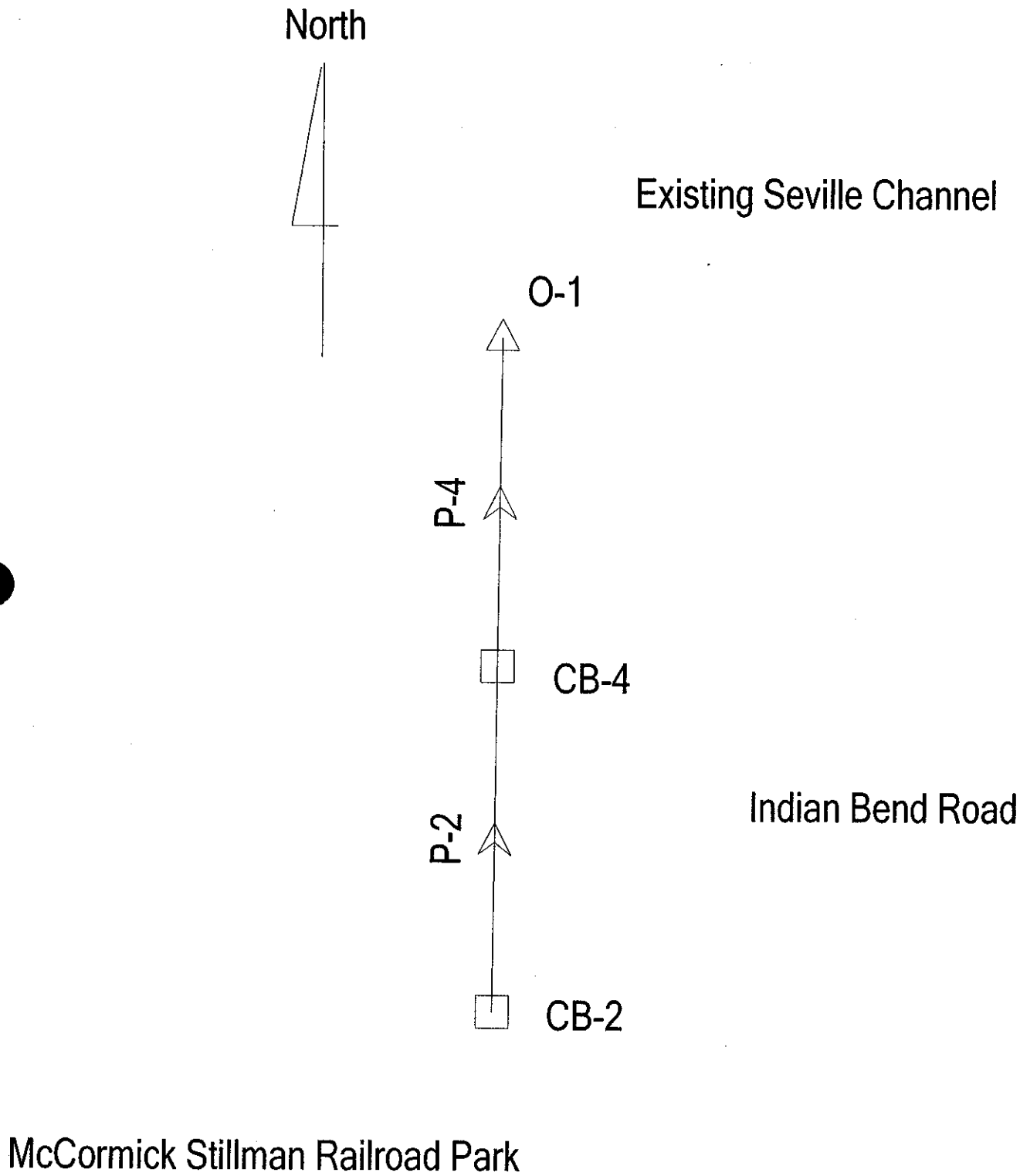
Efficiency	100.00	%
Intercepted Flow	5.73	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	17.83	ft
Depth	0.41	ft
Flow Area	3.22	ft^2
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	1.78	ft/s
Equivalent Cross Slope	0.05439	ft/ft
Length Factor	1.13	
Total Interception Length	14.20	ft

Messages

Notes	Install COP P-1569 catch basin, wing = 17 feet.

STORMCAD ANALYSES

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Altern	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Ste	5	
Return Period	10 year	
Minimum Time of Concentr	5.00	min

Created: 04/18/06 03:10:05 PM

Project Inventory

Title: Indian Bend Road Improvements
Project Engineer: Dennis Jermeland
Project Date: 04/18/06
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

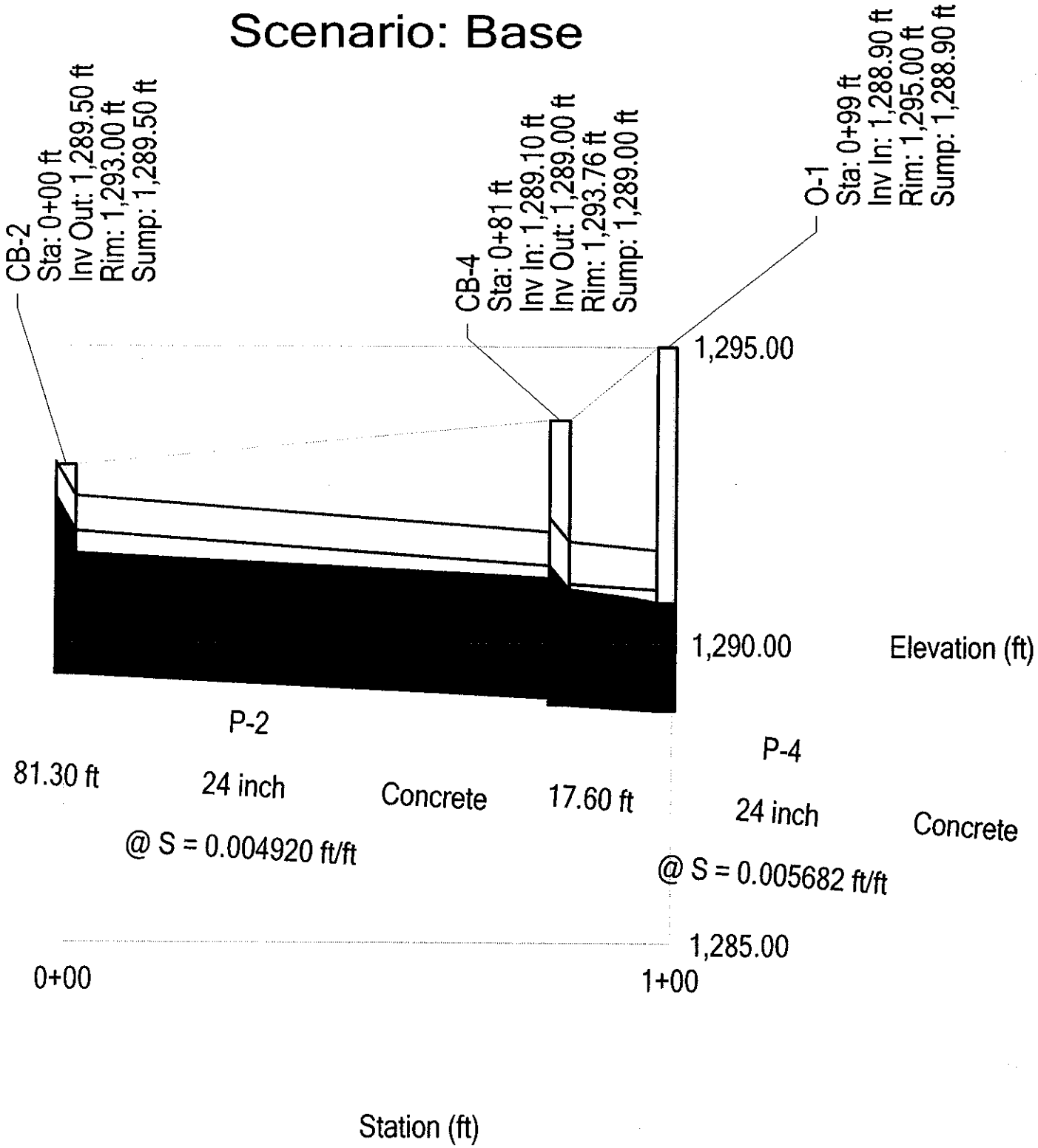
Network Inventory			
Number of Pipes	2	Number of Inlets	2
- Circular Pipes:	2	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	2
Number of Outlets	1		

Circular Pipes Inventory	
24 inch	98.90 ft
Total Length	98.90 ft

Generic Inlet Inventory	
Default 100%	2

Profile: 10-year Event

Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-2	CB-2	CB-4	8.63	0.40	3.45	3.45	5.49	19.09	81.30	0.004920	24 inch	0.013	15.87
P-4	CB-4	O-1	0.66	0.95	0.63	4.08	5.42	22.30	17.60	0.005682	24 inch	0.013	17.05

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,289.50	1,289.10	1,293.00	1,293.76	1.50	2.66	1,291.89	1,291.32	
1,289.00	1,288.90	1,293.76	1,295.00	2.76	4.10	1,290.91	1,290.70	

Scenario: Base

Node Report

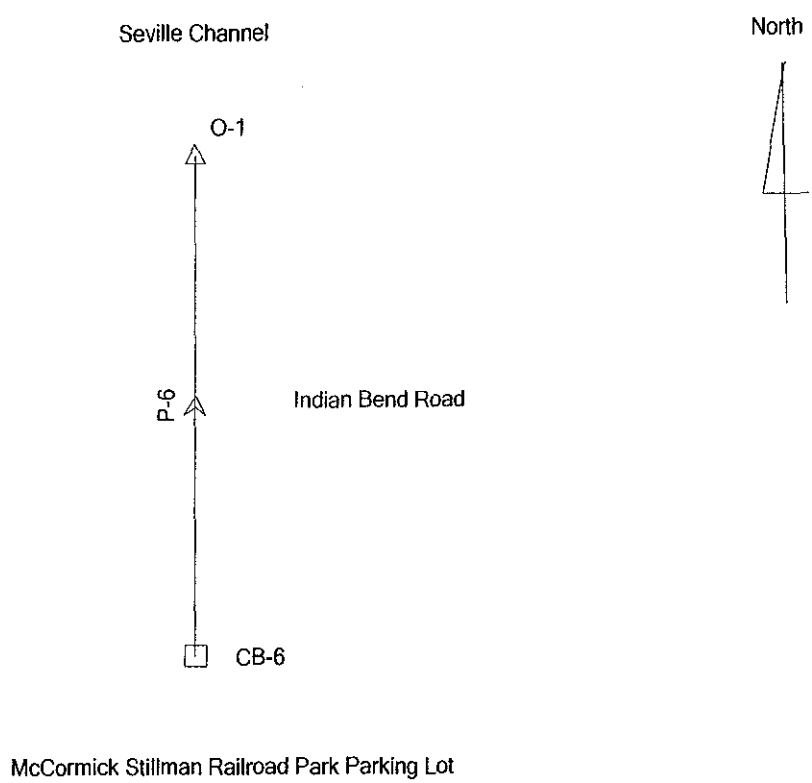
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					4.08				6.73	5.41	22.25			
CB-4	0.66	0.95	0.63	0.00	4.08	5.00	0.00	6.69	6.69	5.42	22.30	0.00	0.00	0.00
CB-2	8.63	0.40	3.45	0.00	3.45	6.47	0.00	0.00	6.47	5.49	19.09	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	22.25	1,295.00	1,295.00	1,290.70	1,290.70			
0.00	22.30	1,293.76	1,293.76	1,291.32	1,290.91	5.90	3.73	
0.00	19.09	1,293.00	1,293.00	1,292.47	1,291.89	5.49	19.09	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 09/18/06 04:36:23 PM

Project Inventory

Title: Indian Bend Road Improvements
Project Engineer: Dennis Jermeland
Project Date: 09/18/06
Comments: On-Site Drainage

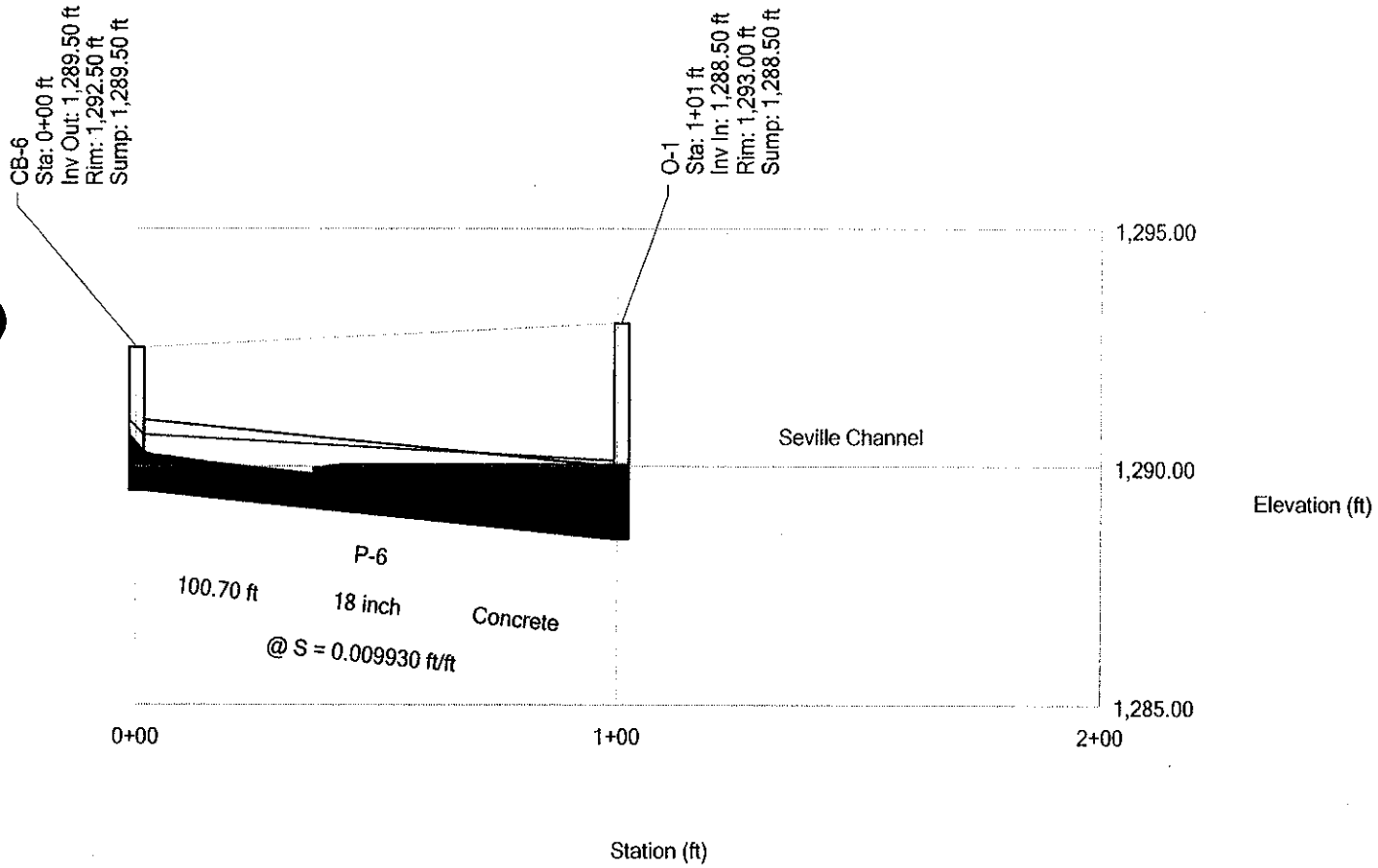
Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Network Inventory			
Number of Pipes	1	Number of Inlets	1
- Circular Pipes:	1	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	1
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	100.70 ft
Total Length	100.70 ft

Generic Inlet Inventory	
Default 100%	1

Profile: CB6 to Seville Channel
Scenario: 10-year Event



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-6	CB-6	O-1	1.66	0.64	1.06	1.06	4.35	4.65	100.70	0.009930	18 inch	0.013	10.47

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,289.50	1,288.50	1,292.50	1,293.00	1.50	3.00	1,290.33	1,290.04	

Scenario: Base

Node Report

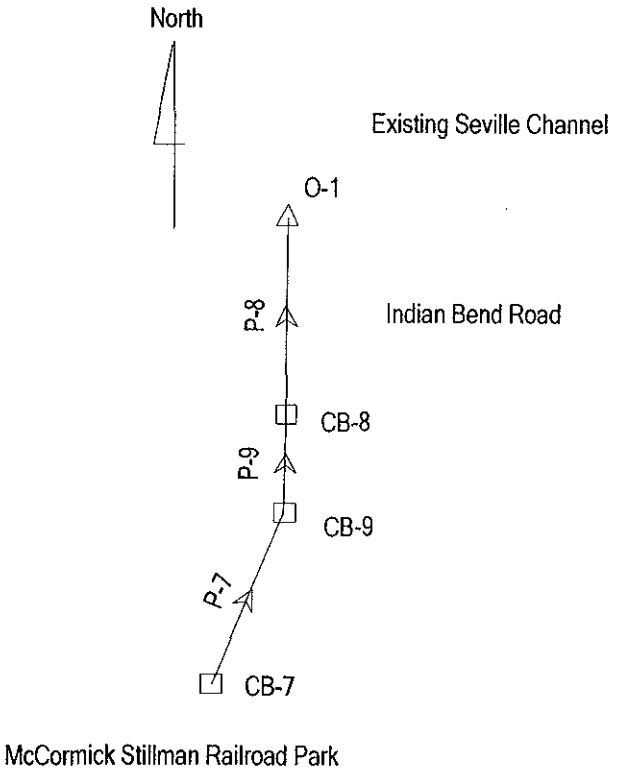
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					1.06				11.30	4.31	4.61			
CB-6	1.66	0.64	1.06	0.00	1.06	11.01	0.00	0.00	11.01	4.35	4.65	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	4.61	1,293.00	1,293.00	1,290.04	1,290.04			
0.00	4.65	1,292.50	1,292.50	1,290.66	1,290.33	4.35	4.65	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 04/18/06 03:10:05 PM

Project Inventory

Title: Indian Bend Road Improvements
Project Engineer: Dennis Jermeland
Project Date: 04/18/06
Comments:

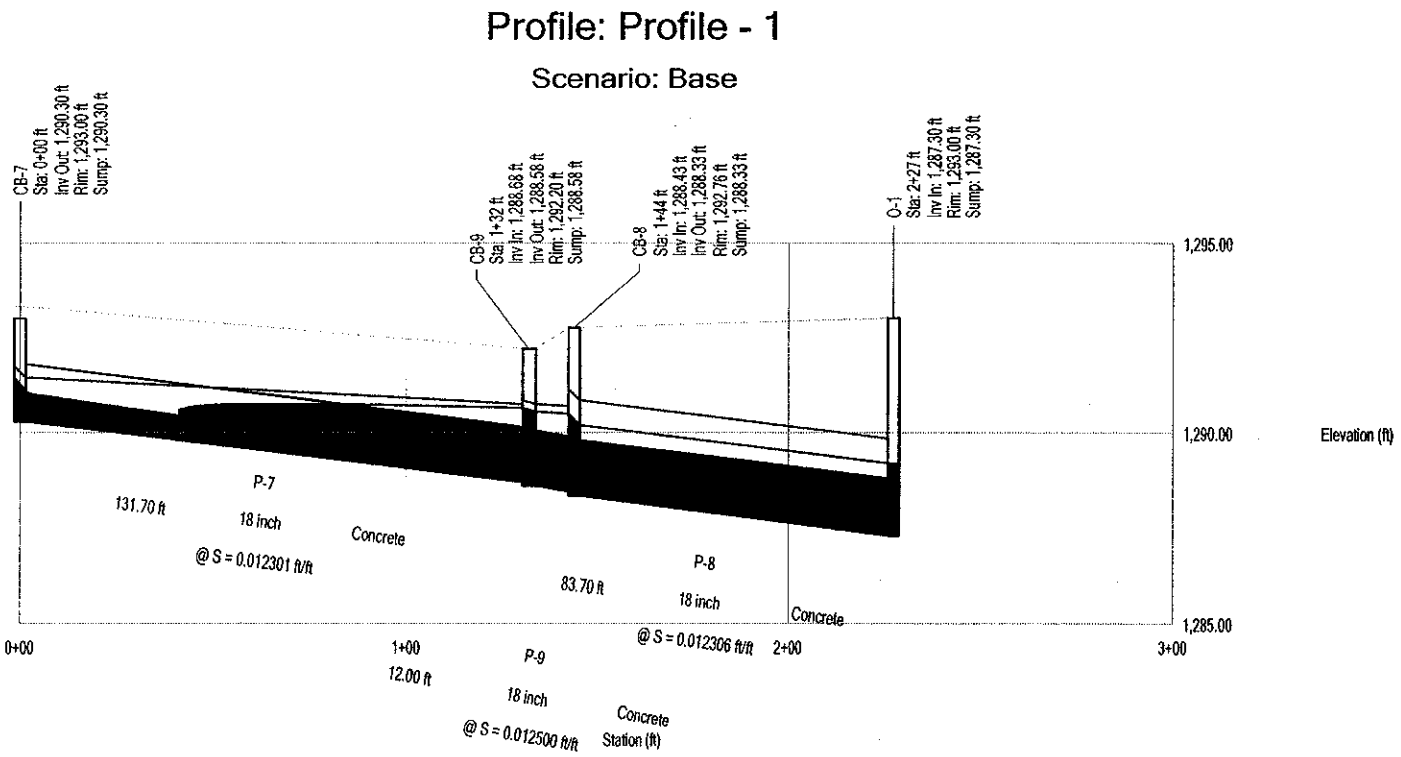
Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Network Inventory			
Number of Pipes	3	Number of Inlets	3
- Circular Pipes:	3	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	3
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	227.40 ft
Total Length	227.40 ft

Generic Inlet Inventory	
Default 100%	3

Profile
Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-8	CB-8	O-1	0.94	0.95	0.89	1.96	5.78	11.40	83.70	0.012306	18 inch	0.013	11.65
P-7	CB-7	CB-9	1.20	0.64	0.77	0.77	5.90	4.57	131.70	0.012301	18 inch	0.013	11.65
P-9	CB-9	CB-8	0.46	0.64	0.29	1.06	5.80	6.21	12.00	0.012500	18 inch	0.013	11.74

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,288.33	1,287.30	1,292.76	1,293.00	2.93	4.20	1,290.20	1,289.21	
1,290.30	1,288.68	1,293.30	1,292.20	1.50	2.02	1,291.12	1,290.66	
1,288.58	1,288.43	1,292.20	1,292.76	2.12	2.83	1,290.56	1,290.52	

Scenario: Base

Node Report

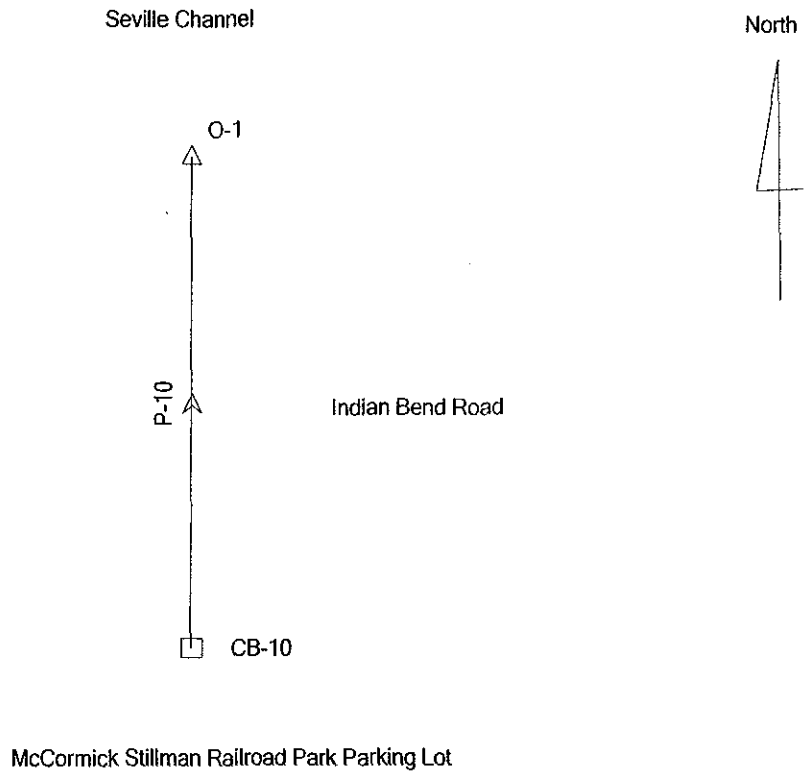
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					1.96				5.63	5.72	11.28			
CB-8	0.94	0.95	0.89	0.00	1.96	5.00	0.00	5.41	5.41	5.78	11.40	0.00	0.00	0.00
CB-9	0.46	0.64	0.29	0.00	1.06	5.00	0.00	5.35	5.35	5.80	6.21	0.00	0.00	0.00
CB-7	1.20	0.64	0.77	0.00	0.77	5.00	0.00	0.00	5.00	5.90	4.57	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	11.28	1,293.00	1,293.00	1,289.21	1,289.21			
0.00	11.40	1,292.76	1,292.76	1,290.52	1,290.20	5.90	5.31	
0.00	6.21	1,292.20	1,292.20	1,290.66	1,290.56	5.90	1.75	
0.00	4.57	1,293.30	1,293.00	1,291.45	1,291.12	5.90	4.57	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Altern	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 09/18/06 04:36:23 PM

Project Inventory

Title: Indian Bend Road Improvements
Project Engineer: Dennis Jermeland
Project Date: 09/18/06
Comments: On-Site Drainage

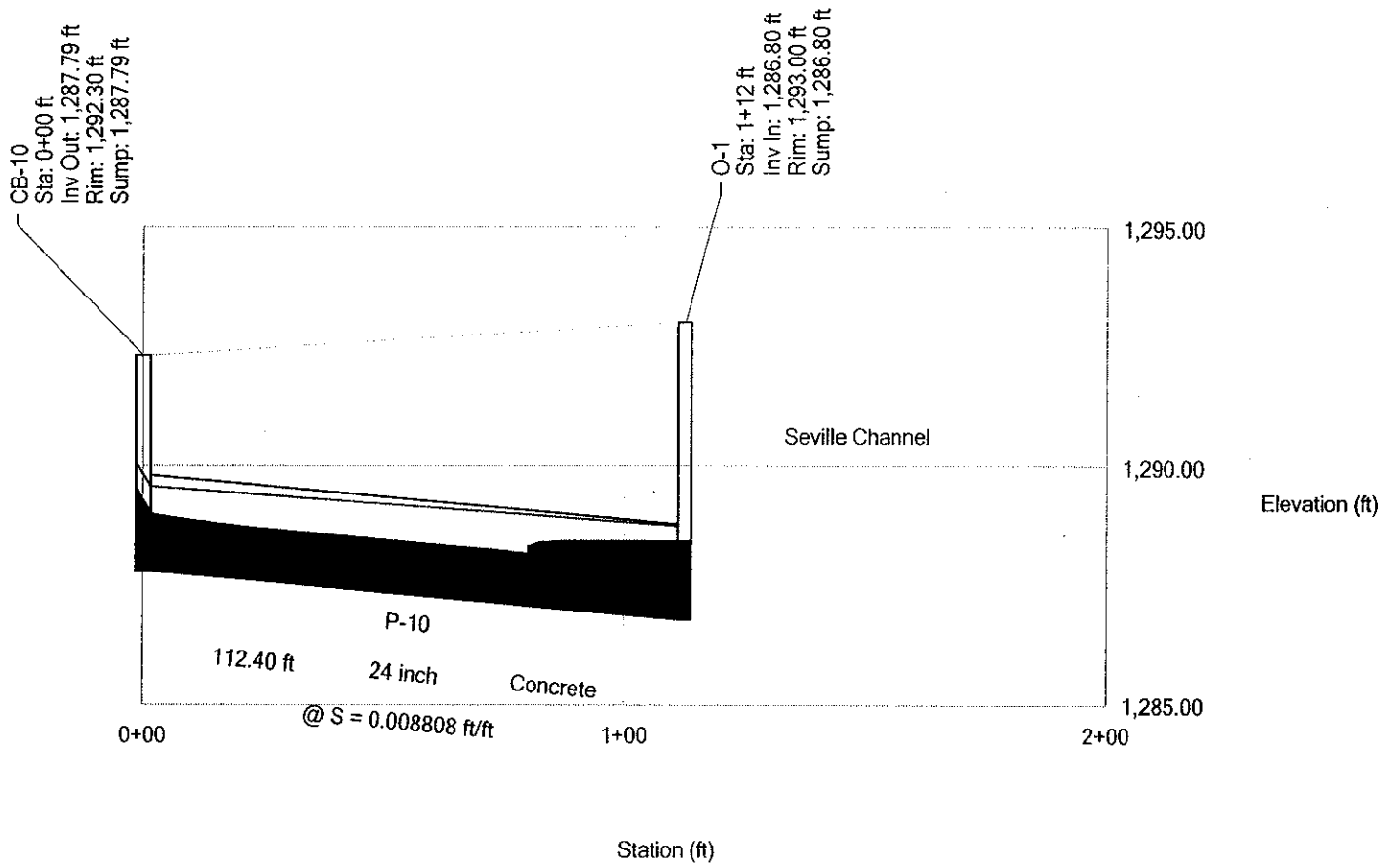
Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Network Inventory			
Number of Pipes	1	Number of Inlets	1
- Circular Pipes:	1	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	1
Number of Outlets	1		

Circular Pipes Inventory	
24 inch	112.40 ft
Total Length	112.40 ft

Generic Inlet Inventory	
Default 100%	1

Profile: CB10 to Seville Channel
Scenario: 10-year Event



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-10	CB-10	O-1	2.18	0.95	2.07	2.07	5.75	12.00	112.40	0.008808	24 inch	0.013	21.23

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,287.79	1,286.80	1,292.30	1,293.00	2.51	4.20	1,289.03	1,288.45	

Scenario: Base

Node Report

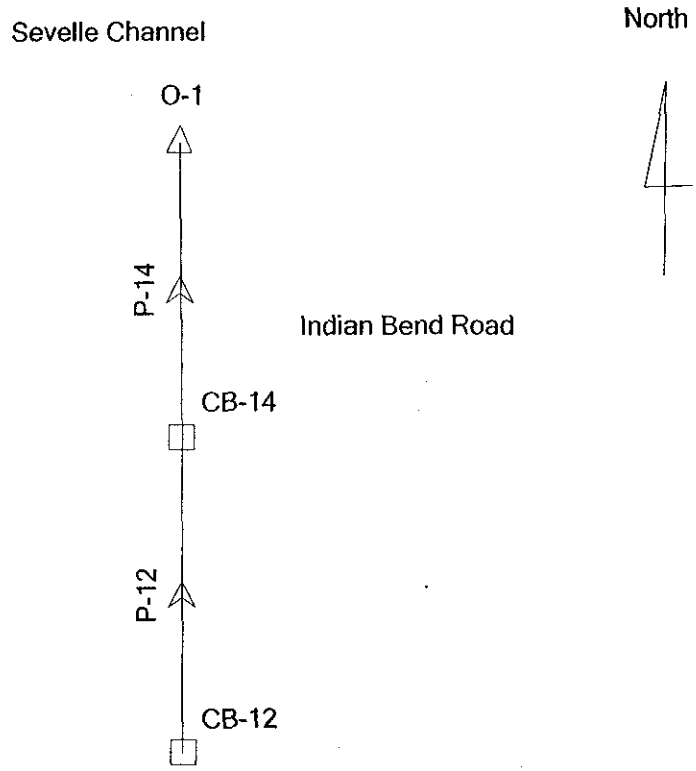
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					2.07				5.81	5.67	11.84			
CB-10	2.18	0.95	2.07	0.00	2.07	5.54	0.00	0.00	5.54	5.75	12.00	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	11.84	1,293.00	1,293.00	1,288.45	1,288.45			
0.00	12.00	1,292.30	1,292.30	1,289.56	1,289.03	5.75	12.00	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 09/18/06 04:46:03 PM

Project Inventory

Title: Indian Bend Road Improvements
Project Engineer: Dennis Jermeland
Project Date: 09/18/06
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

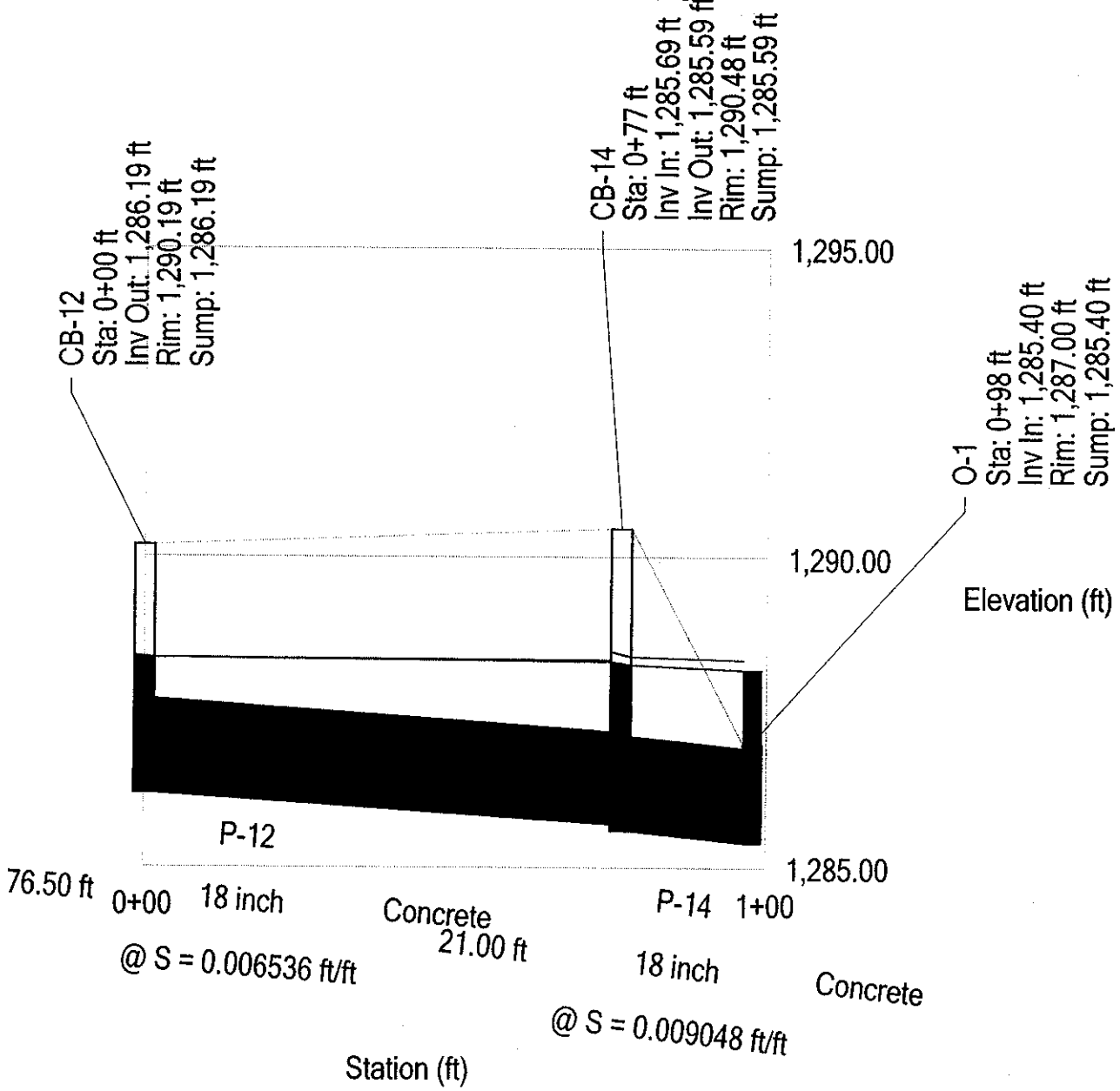
Network Inventory			
Number of Pipes	2	Number of Inlets	2
- Circular Pipes:	2	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	2
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	97.50 ft
Total Length	97.50 ft

Generic Inlet Inventory	
Default 100%	2

Profile: CB12 to CB 14 to Seville Channel

Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-12	CB-12	CB-14	0.38	0.95	0.36	0.36	5.90	2.14	76.50	0.006536	18 inch	0.013	8.49
P-14	CB-14	O-1	0.65	0.95	0.62	0.98	5.60	5.52	21.00	0.009048	18 inch	0.013	9.99

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,286.19	1,285.69	1,290.19	1,290.48	2.50	3.29	1,288.36	1,288.32	
1,285.59	1,285.40	1,290.48	1,287.00	3.39	0.10	1,288.25	1,288.19	

Scenario: Base

Node Report

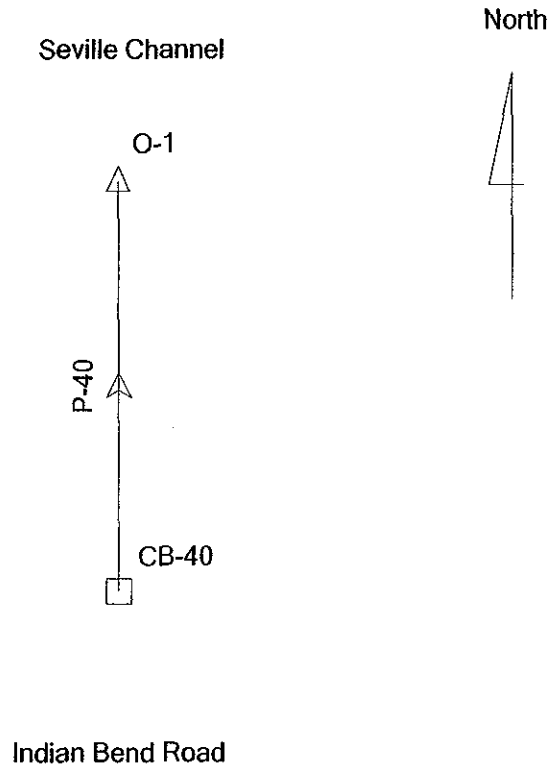
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					0.98				6.17	5.57	5.49			
CB-14	0.65	0.95	0.62	0.00	0.98	5.00	0.00	6.06	6.06	5.60	5.52	0.00	0.00	0.00
CB-12	0.38	0.95	0.36	0.00	0.36	5.00	0.00	0.00	5.00	5.90	2.14	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	5.49	1,287.00	1,287.00	1,288.19	1,288.19			
0.00	5.52	1,290.48	1,290.48	1,288.32	1,288.25	5.90	3.68	
0.00	2.14	1,290.19	1,290.19	1,288.38	1,288.36	5.90	2.14	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 09/19/06 10:45:32 AM

Project Inventory

Title: Indian Bend Road Improvements
Project Engineer: Dennis Jermeland
Project Date: 09/19/06
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

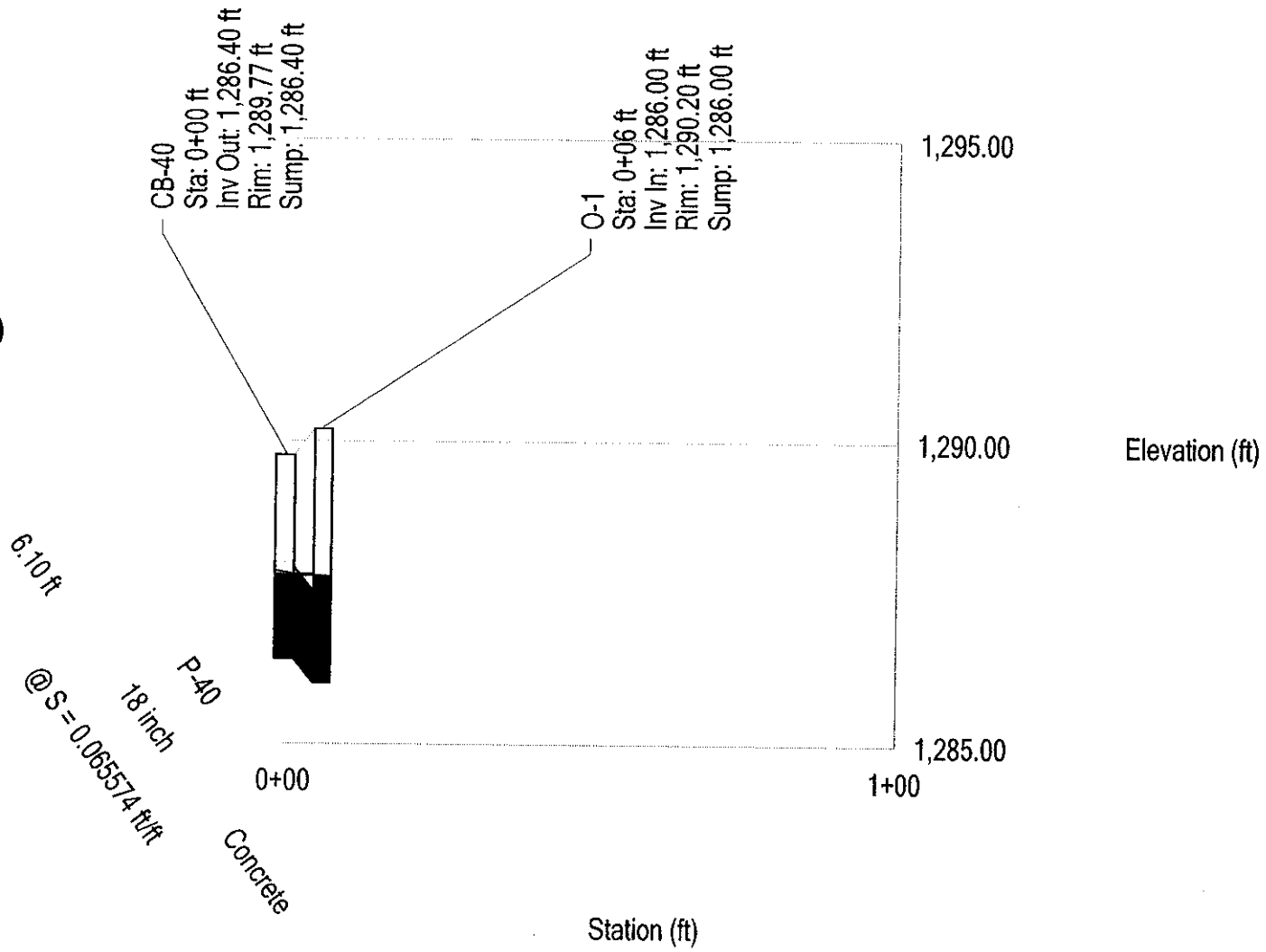
Network Inventory			
Number of Pipes	1	Number of Inlets	1
- Circular Pipes:	1	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	1
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	6.10 ft
Total Length	6.10 ft

Generic Inlet Inventory	
Default 100%	1

Profile: Profile - 1

Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-40	CB-40	O-1	0.42	0.95	0.40	0.40	5.90	2.37	6.10	0.065574	18 inch	0.013	26.90

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,286.40	1,286.00	1,289.77	1,290.20	1.87	2.70	1,287.78	1,287.78	

Scenario: Base

Node Report

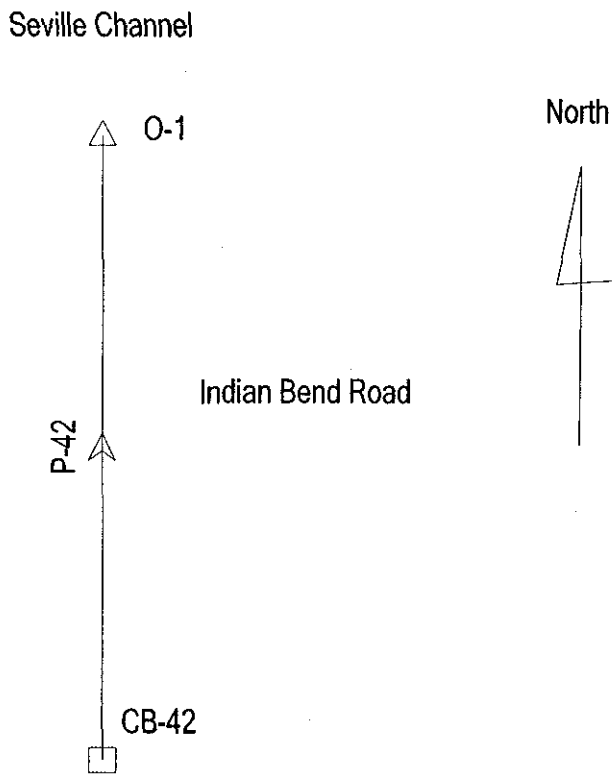
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					0.40				5.01	5.90	2.37			
CB-40	0.42	0.95	0.40	0.00	0.40	5.00	0.00	0.00	5.00	5.90	2.37	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	2.37	1,290.20	1,290.20	1,287.78	1,287.78			
0.00	2.37	1,289.77	1,289.77	1,287.81	1,287.78	5.90	2.37	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Altern	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 09/19/06 10:56:25 AM

Project Inventory

Title: Indian Bend Road Improvements
Project Engineer: Dennis Jermeland
Project Date: 09/19/06
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

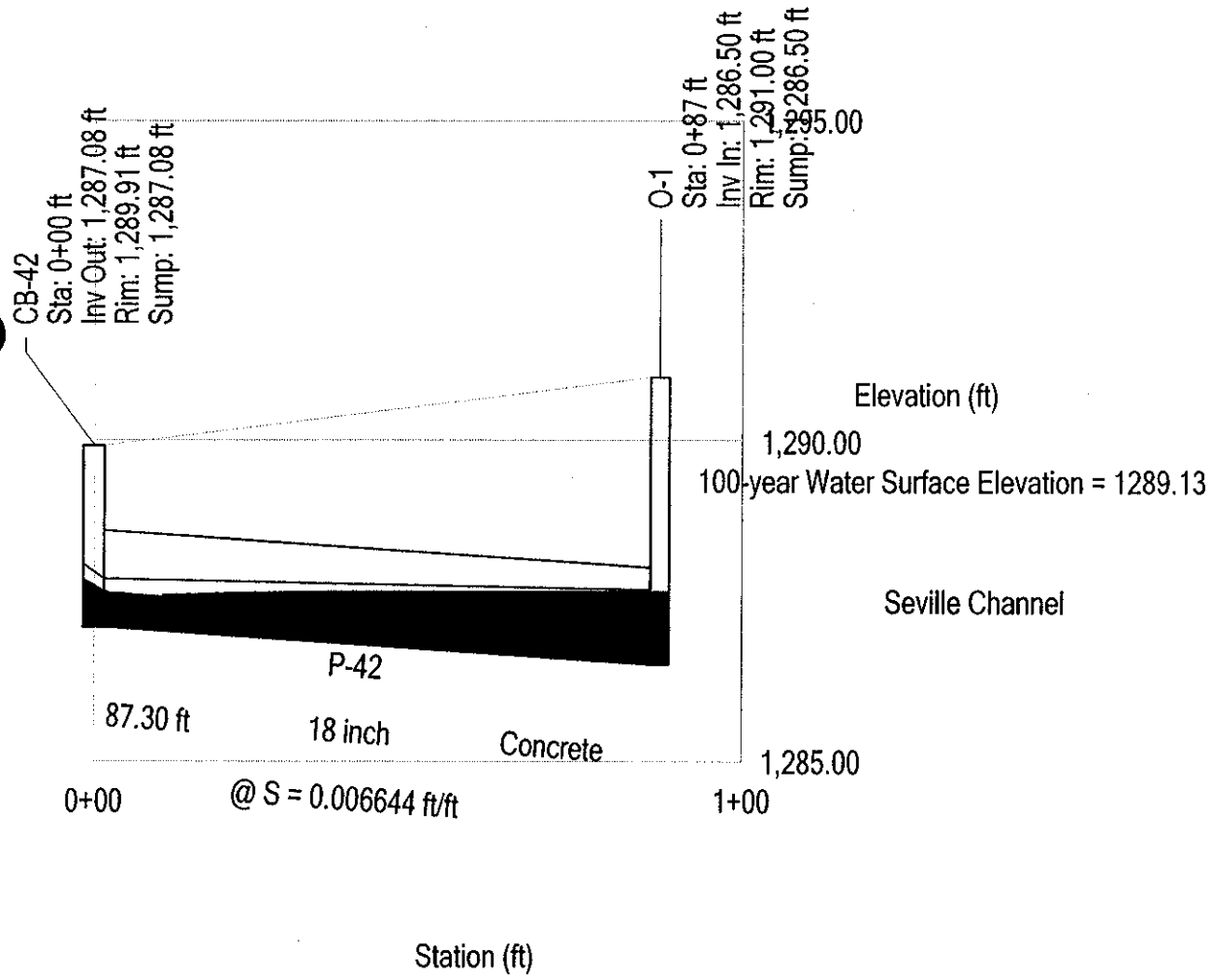
Network Inventory			
Number of Pipes	1	Number of Inlets	1
- Circular Pipes:	1	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	1
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	87.30 ft
Total Length	87.30 ft

Generic Inlet Inventory	
Default 100%	1

Profile: Lateral at Sta. 33+41.6

Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-42	CB-42	O-1	0.41	0.90	0.37	0.37	5.90	2.21	87.30	0.006644	18 inch	0.013	8.56

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,287.08	1,286.50	1,289.91	1,291.00	1.33	3.00	1,287.64	1,287.63	

Scenario: Base

Node Report

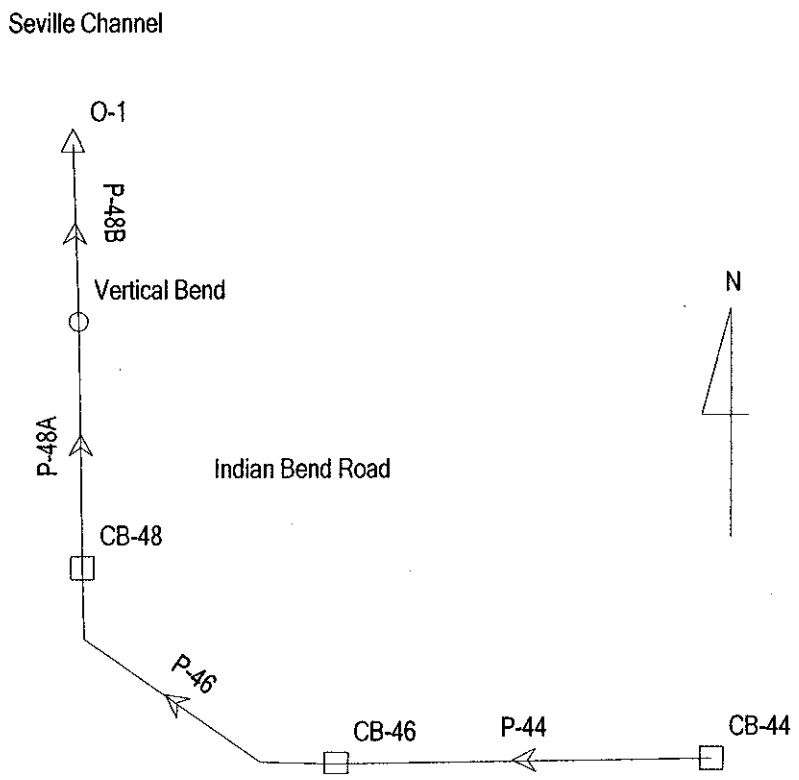
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					0.37				5.36	5.80	2.17			
CB-42	0.41	0.90	0.37	0.00	0.37	5.00	0.00	0.00	5.00	5.90	2.21	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	2.17	1,291.00	1,291.00	1,287.63	1,287.63			
0.00	2.21	1,289.91	1,289.91	1,287.85	1,287.64	5.90	2.21	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Ste	5	
Return Period	10 year	
Minimum Time of Concentr	5.00	min

Created: 09/30/06 04:42:24 PM

Project Inventory

Title:
Project Engineer:
Project Date: 05/11/07
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

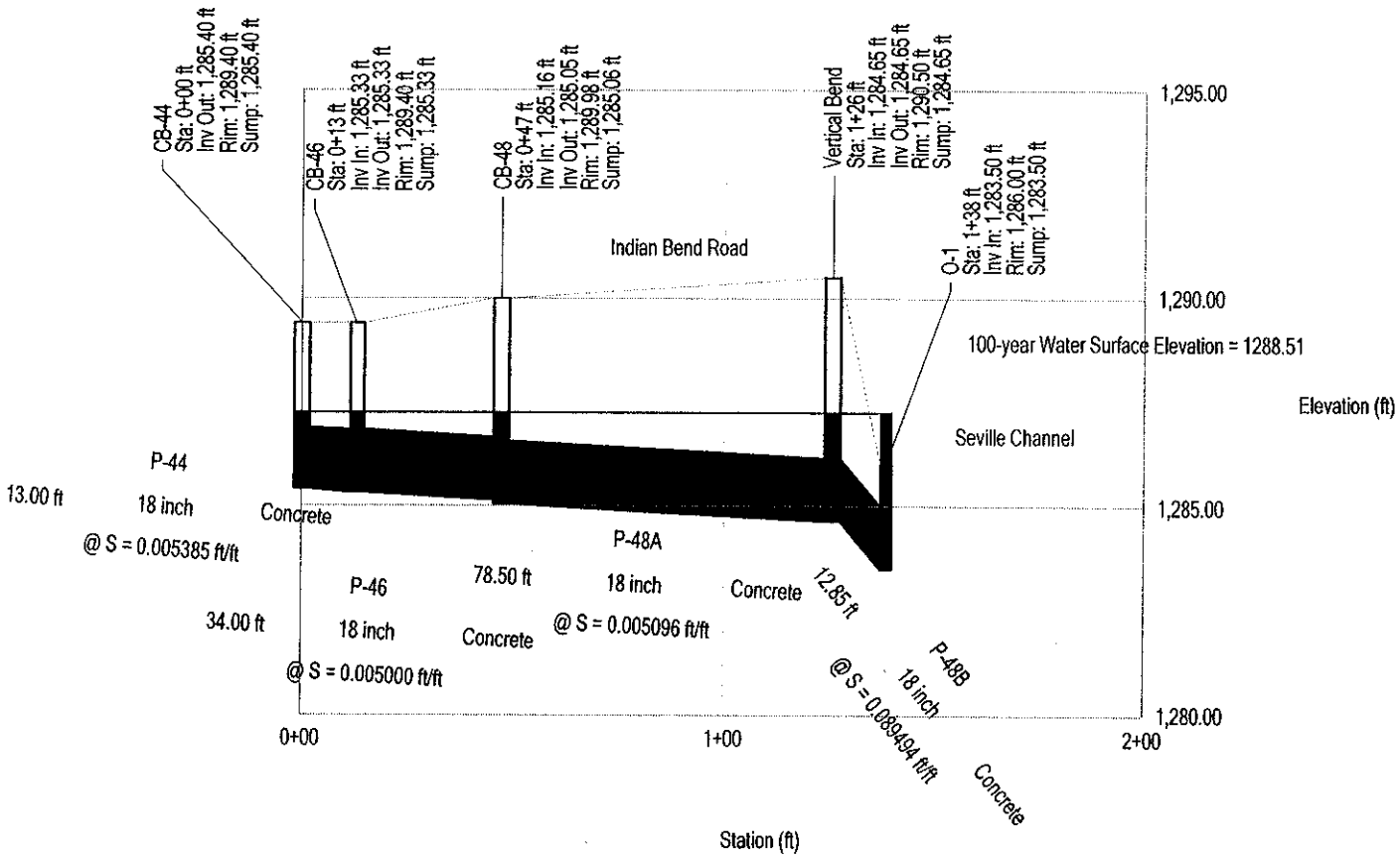
Network Inventory			
Number of Pipes	4	Number of Inlets	3
- Circular Pipes:	4	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	1	- Generic Inlets:	3
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	139.91 ft
Total Length	139.91 ft

Generic Inlet Inventory	
Default 100%	3

Profile: Lateral @ Sta.35+42

Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-44	CB-44	CB-46	0.03	0.95	0.03	0.03	5.90	0.18	13.00	0.005385	18 inch	0.013	7.71
P-46	CB-46	CB-48	0.03	0.95	0.03	0.06	5.28	0.31	34.00	0.005000	18 inch	0.013	7.43
P-48A	CB-48	Vertical Ber	0.01	0.82	0.01	0.07	4.44	0.30	79.43	0.005036	18 inch	0.013	7.45
P-48B	Vertical Ber	O-1	N/A	N/A	N/A	0.07	3.52	0.24	13.48	0.085312	18 inch	0.013	30.68

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,285.40	1,285.33	1,289.40	1,289.40	2.50	2.57	1,287.26	1,287.26	
1,285.33	1,285.16	1,289.40	1,289.98	2.57	3.32	1,287.26	1,287.26	
1,285.05	1,284.65	1,289.98	1,290.50	3.43	4.35	1,287.26	1,287.26	
1,284.65	1,283.50	1,290.50	1,286.00	4.35	1.00	1,287.26	1,287.26	

Scenario: Base

Node Report

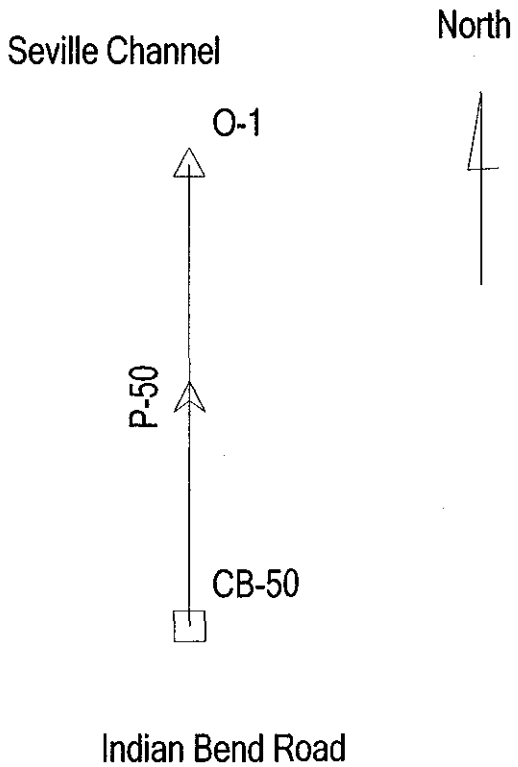
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					0.07				19.84	3.38	0.23			
Vertical Ber					0.07				18.17	3.52	0.24			
CB-48	0.01	0.82	0.01	0.00	0.07	5.00	0.00	10.38	10.38	4.44	0.30	0.00	0.00	0.00
CB-46	0.03	0.95	0.03	0.00	0.06	5.00	0.00	7.19	7.19	5.28	0.31	0.00	0.00	0.00
CB-44	0.03	0.95	0.03	0.00	0.03	5.00	0.00	0.00	5.00	5.90	0.18	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	0.23	1,286.00	1,286.00	1,287.26	1,287.26			
	0.24	1,290.50	1,290.50	1,287.26	1,287.26			
0.00	0.30	1,289.98	1,289.98	1,287.26	1,287.26	5.90	0.05	
0.00	0.31	1,289.40	1,289.40	1,287.26	1,287.26	5.90	0.18	
0.00	0.18	1,289.40	1,289.40	1,287.26	1,287.26	5.90	0.18	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 09/19/06 11:25:35 AM

Project Inventory

Title: Indian Bend Road Improvements
Project Engineer: Dennis Jermeland
Project Date: 09/19/06
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

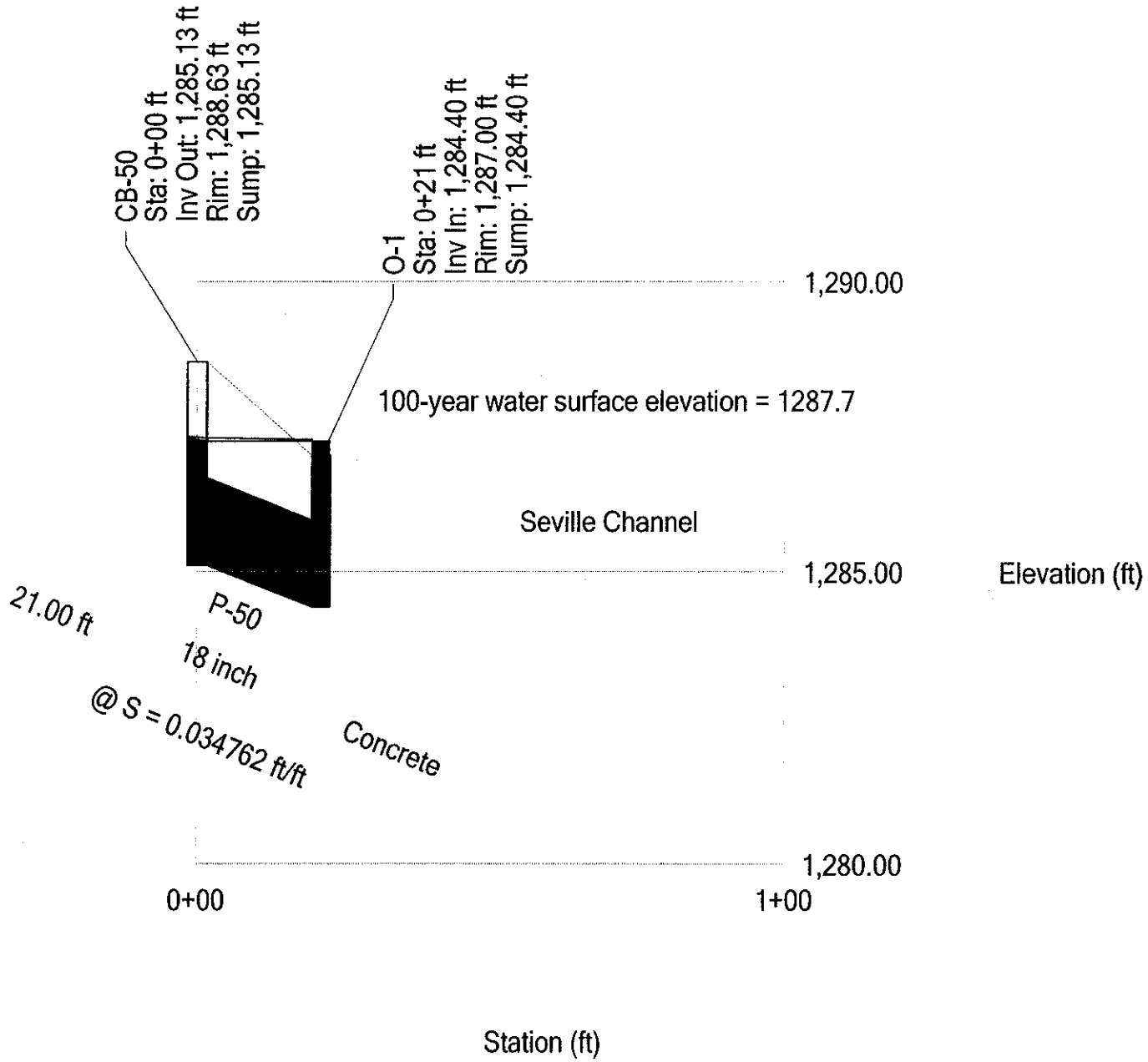
Network Inventory			
Number of Pipes	1	Number of Inlets	1
- Circular Pipes:	1	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	1
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	21.00 ft
Total Length	21.00 ft

Generic Inlet Inventory	
Default 100%	1

Profile: Lateral at Sta. 38+58.8

Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-50	CB-50	O-1	0.51	0.95	0.49	0.49	5.90	2.90	21.00	0.034762	18 inch	0.013	19.58

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,285.13	1,284.40	1,288.63	1,287.00	2.00	1.10	1,287.27	1,287.25	

Scenario: Base

Node Report

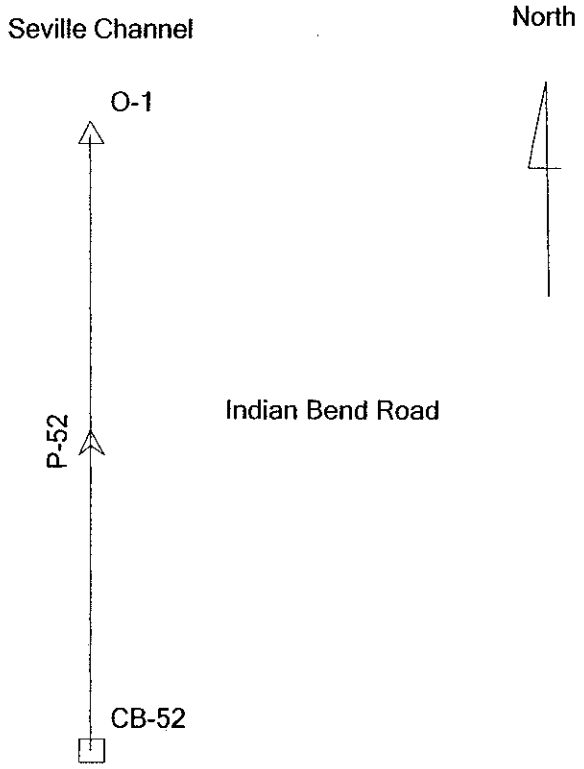
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					0.49				5.21	5.84	2.87			
CB-50	0.51	0.95	0.49	0.00	0.49	5.00	0.00	0.00	5.00	5.90	2.90	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	2.87	1,287.00	1,287.00	1,287.25	1,287.25			
0.00	2.90	1,288.63	1,288.63	1,287.31	1,287.27	5.90	2.90	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 09/19/06 11:31:37 AM

Project Inventory

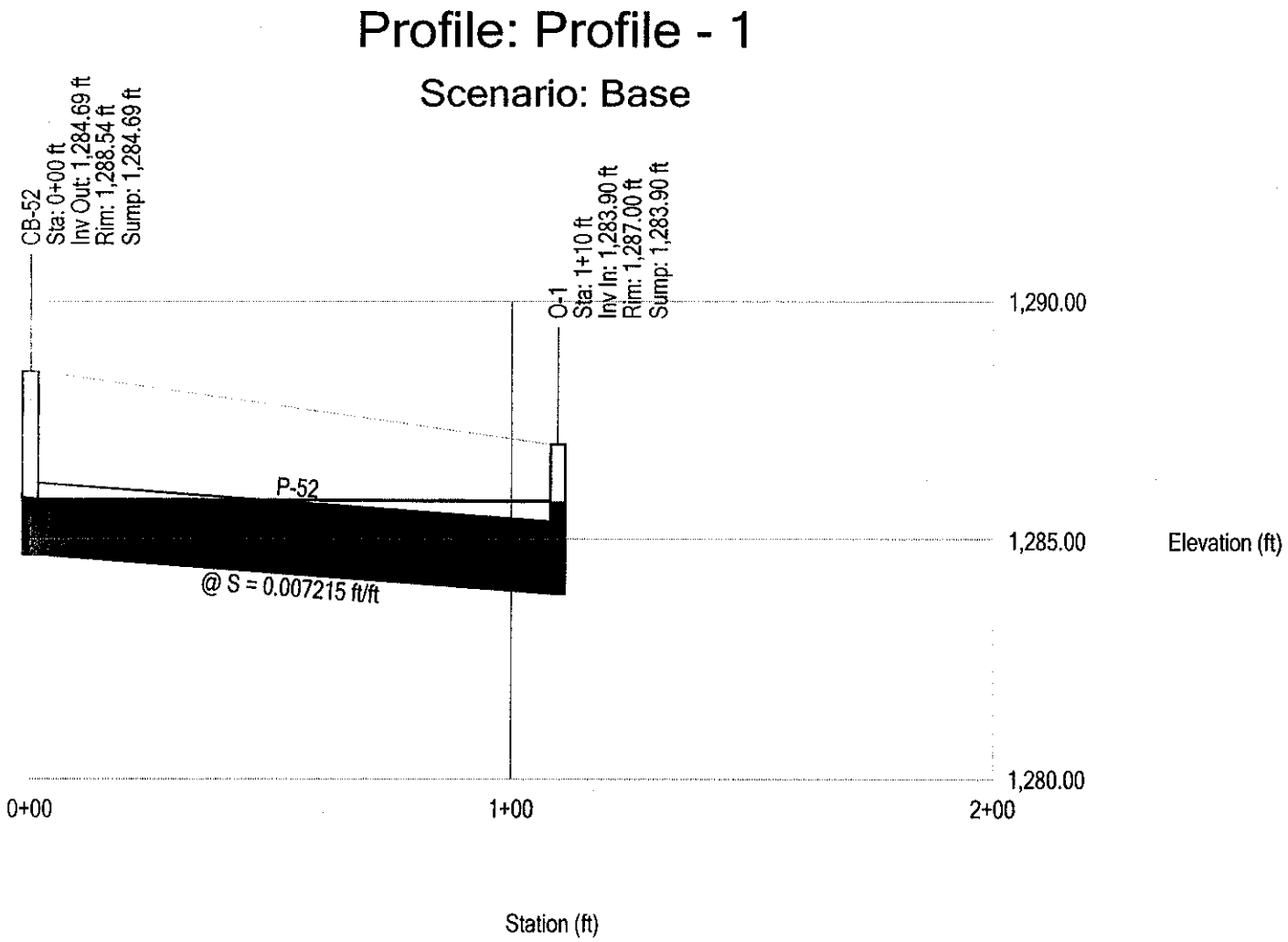
Title: Indian Bend Road Improvements
Project Engineer: dennis Jermeland
Project Date: 09/19/06
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Network Inventory			
Number of Pipes	1	Number of Inlets	1
- Circular Pipes:	1	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	1
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	109.50 ft
Total Length	109.50 ft

Generic Inlet Inventory	
Default 100%	1


Profile: Profile - 1
Scenario: Base
CB-52
Sta: 0+00 ft
Inv Out: 1,284.69 ft
Rim: 1,288.54 ft
Sump: 1,284.69 ft
O-1
Sta: 1+10 ft
Inv In: 1,283.90 ft
Rim: 1,287.00 ft
Sump: 1,283.90 ft
P-52
@ S = 0.007215 ft/ft
1,290.00
1,285.00
1,280.00
Elevation (ft)
0+00
1+00
2+00
Station (ft)

Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-52	CB-52	O-1	0.39	0.95	0.37	0.37	5.90	2.18	109.50	0.007215	18 inch	0.013	8.92

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,284.69	1,283.90	1,288.54	1,287.00	2.35	1.60	1,285.84	1,285.80	

Scenario: Base

Node Report

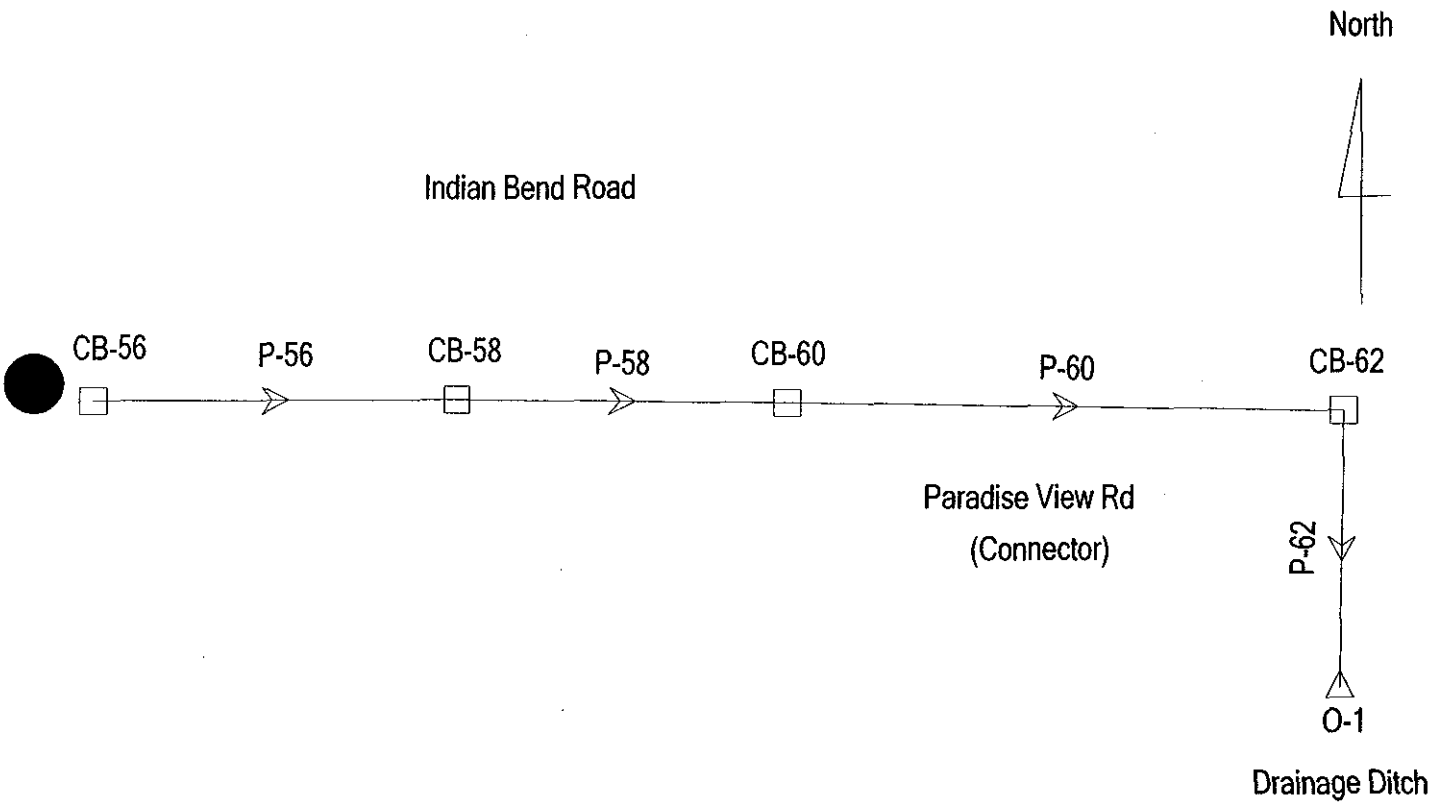
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					0.37				5.44	5.78	2.13			
CB-52	0.39	0.95	0.37	0.00	0.37	5.00	0.00	0.00	5.00	5.90	2.18	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	2.13	1,287.00	1,287.00	1,285.80	1,285.80			
0.00	2.18	1,288.54	1,288.54	1,285.87	1,285.84	5.90	2.18	

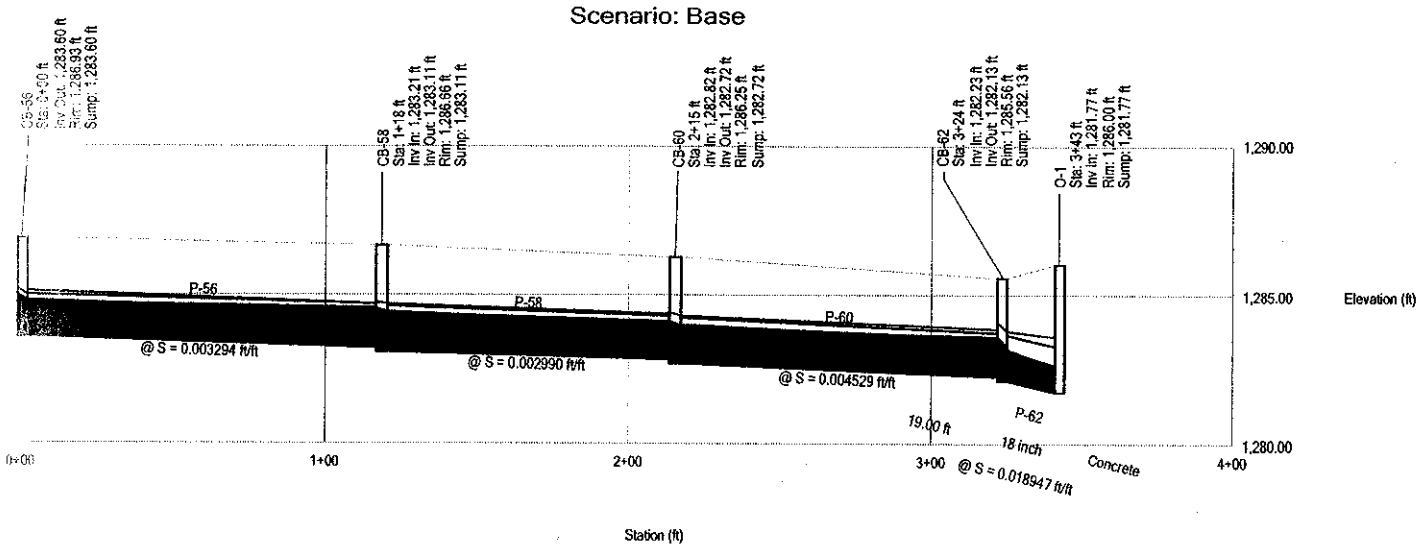
Scenario: Base



Profile
Scenario: Base

Profile: Profile - 1

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 04/27/07 02:15:39 PM

Project Inventory

Title: Indian Bend Road Project
Project Engineer: Dennis Jermeland
Project Date: 04/27/07
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Altern	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Network Inventory			
Number of Pipes	4	Number of Inlets	4
- Circular Pipes:	4	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	4
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	342.60 ft
Total Length	342.60 ft

Generic Inlet Inventory	
Default 100%	4

Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inle Rational Coefficient	Upstream Inlet CA (acres)	pstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-56	CB-56	CB-58	0.93	0.95	0.88	0.88	5.90	5.21	118.40	0.003294	18 inch	0.013	6.03
P-58	CB-58	CB-60	0.19	0.95	0.18	1.06	5.83	6.20	97.00	0.002990	18 inch	0.013	5.74
P-60	CB-60	CB-62	0.14	0.95	0.13	1.19	5.76	6.88	108.20	0.004529	18 inch	0.013	7.07
P-62	CB-62	O-1	0.30	0.93	0.28	1.46	5.71	8.42	19.00	0.018947	18 inch	0.013	14.46

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,283.60	1,283.21	1,286.93	1,286.66	1.83	1.95	1,284.79	1,284.54	
1,283.11	1,282.82	1,286.66	1,286.25	2.05	1.93	1,284.44	1,284.12	
1,282.72	1,282.23	1,286.25	1,285.56	2.03	1.83	1,283.98	1,283.58	
1,282.13	1,281.77	1,285.56	1,286.00	1.93	2.73	1,283.25	1,282.67	

Scenario: Base

Node Report

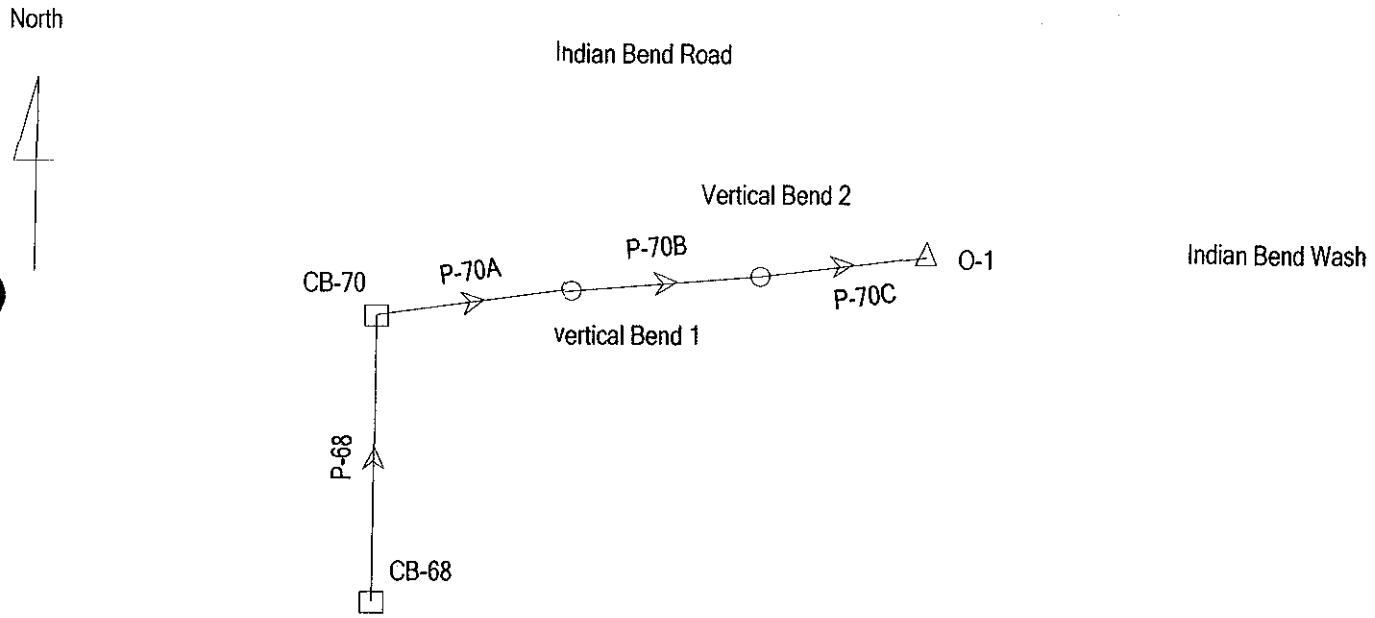
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					1.46				6.41	5.70	8.41			
CB-62	0.30	0.93	0.28	0.00	1.46	5.00	0.00	6.37	6.37	5.71	8.42	0.00	0.00	0.00
CB-60	0.14	0.95	0.13	0.00	1.19	5.00	0.00	5.97	5.97	5.76	6.88	0.00	0.00	0.00
CB-58	0.19	0.95	0.18	0.00	1.06	5.00	0.00	5.51	5.51	5.83	6.20	0.00	0.00	0.00
CB-56	0.93	0.95	0.88	0.00	0.88	5.00	0.00	0.00	5.00	5.90	5.21	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	8.41	1,286.00	1,286.00	1,281.77	1,281.77			
0.00	8.42	1,285.56	1,285.56	1,283.58	1,283.25	5.90	1.66	
0.00	6.88	1,286.25	1,286.25	1,284.12	1,283.98	5.90	0.77	
0.00	6.20	1,286.66	1,286.66	1,284.54	1,284.44	5.90	1.07	
0.00	5.21	1,286.93	1,286.93	1,284.98	1,284.79	5.90	5.21	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Actual Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Ste	5	
Return Period	10 year	
Minimum Time of Concentr	5.00	min

Created: 05/11/07 10:28:45 AM

Project Inventory

Title: Indian Bend Road Project
Project Engineer:
Project Date: 05/11/07
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Network Inventory			
Number of Pipes	4	Number of Inlets	2
- Circular Pipes:	4	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	2	- Generic Inlets:	2
Number of Outlets	1		

Circular Pipes Inventory			
18 inch	30.30 ft	30 inch	47.30 ft
Total Length	77.60 ft		

Generic Inlet Inventory	
Default 100%	2

Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n
P-68	CB-68	CB-70	1.00	0.31	0.31	0.31	1.90	0.59	30.30	0.009901	18 inch	0.013
P-70A	CB-70	vertical Bend	2.35	0.87	2.05	2.36	1.89	4.51	28.90	0.020069	30 inch	0.013
P-70B	vertical Bend	Vertical Bend	N/A	N/A	N/A	2.36	1.89	4.50	15.40	0.218182	30 inch	0.013
P-70C	Vertical Bend	O-1	N/A	N/A	N/A	2.36	1.89	4.50	3.00	0.020000	30 inch	0.013

Scenario: Base

Pipe Report

Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
10.45	1,276.30	1,276.00	1,279.30	1,280.00	1.50	2.50	1,276.86	1,276.86	
58.10	1,275.50	1,274.92	1,280.00	1,280.00	2.00	2.58	1,276.84	1,276.86	
191.58	1,274.92	1,271.56	1,280.00	1,280.00	2.58	5.94	1,276.84	1,276.85	
58.00	1,271.56	1,271.50	1,280.00	1,280.00	5.94	6.00	1,276.84	1,276.84	

Scenario: Base

Node Report

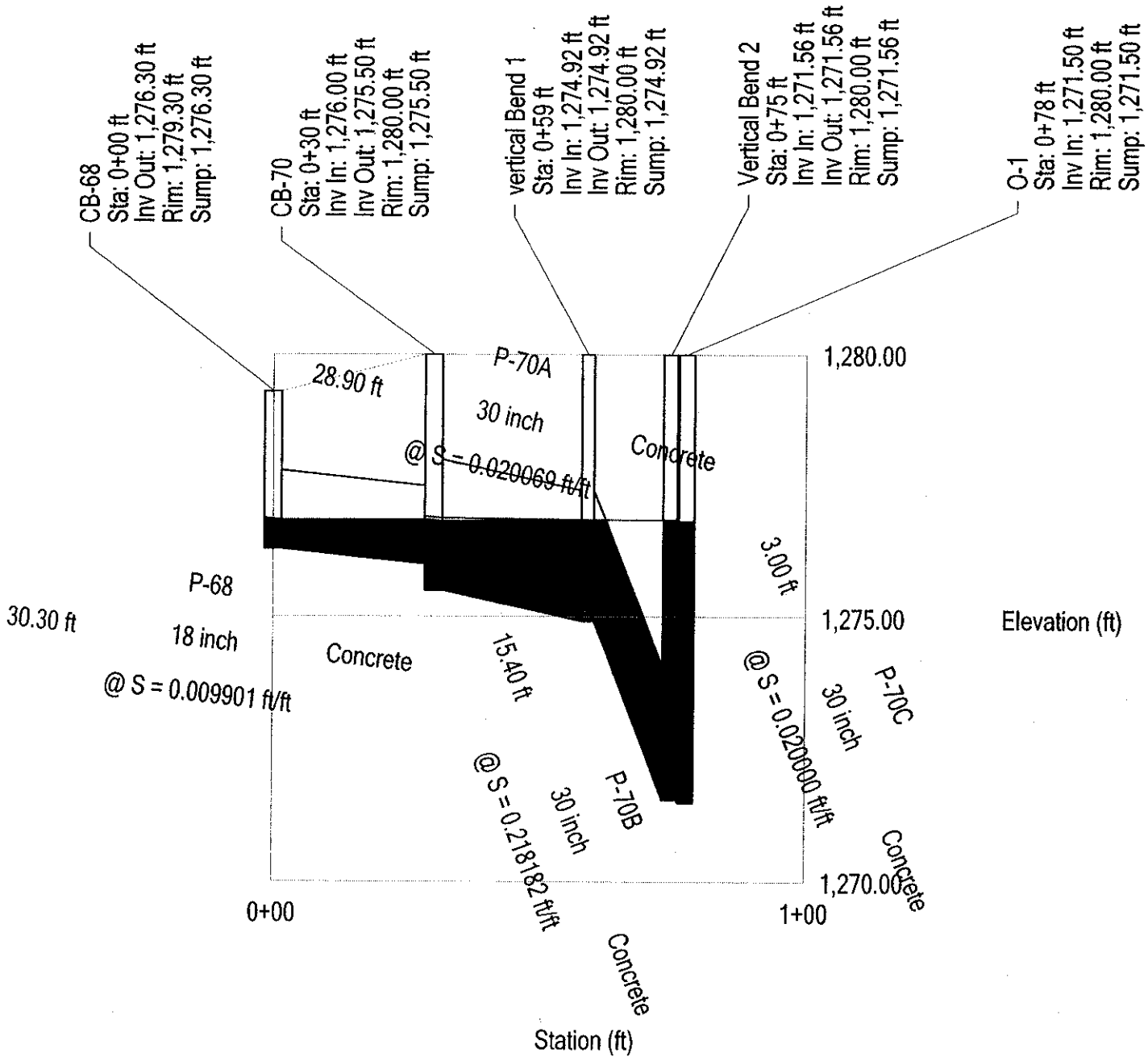
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)
O-1					2.36				50.30	1.89	4.50		
Vertical Bend					2.36				50.24	1.89	4.50		
vertical Bend					2.36				50.23	1.89	4.50		
CB-70	2.35	0.87	2.05	0.00	2.36	5.00	0.00	50.16	50.16	1.89	4.51	0.00	0.00
CB-68	1.00	0.31	0.31	0.00	0.31	50.00	0.00	0.00	50.00	1.90	0.59	0.00	0.00

Scenario: Base

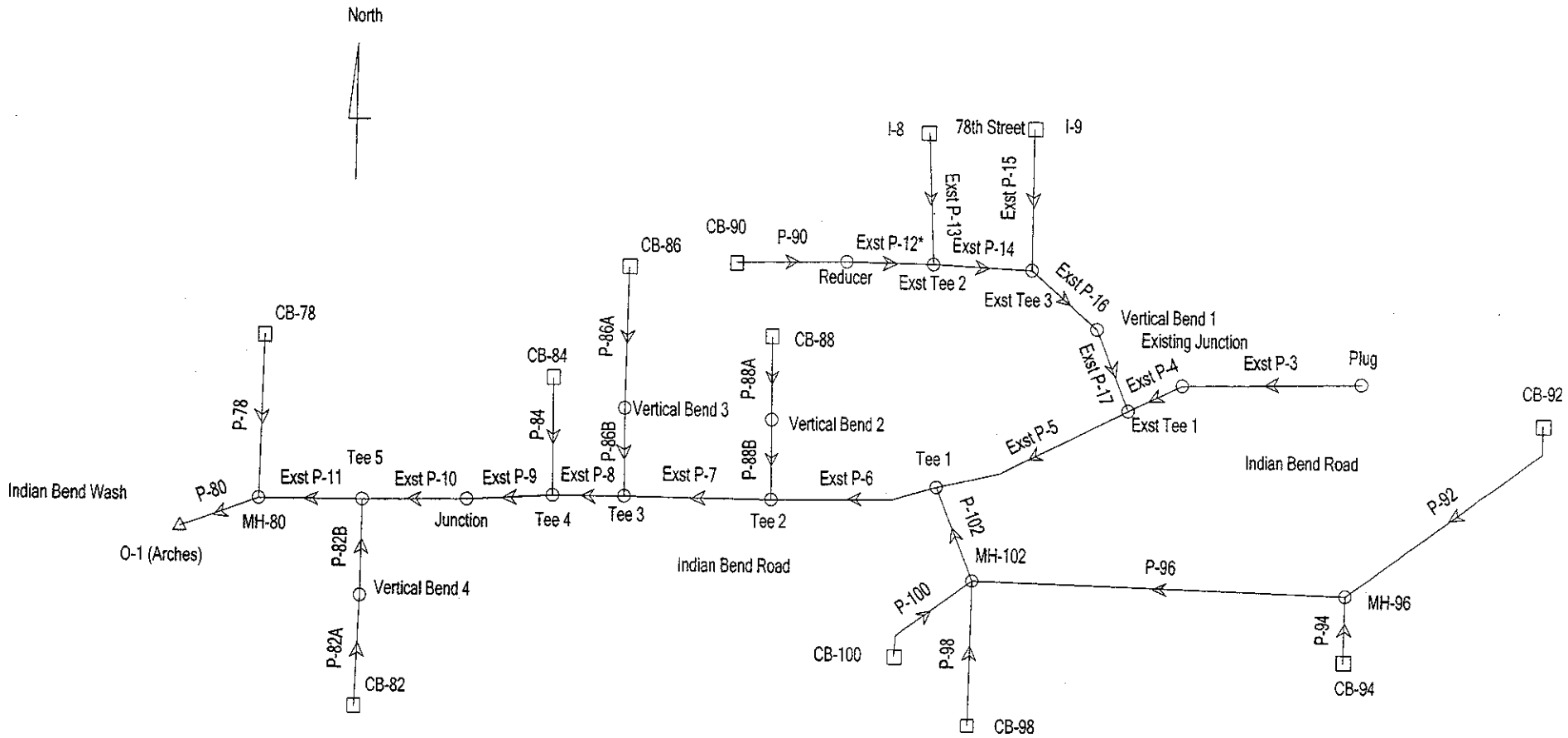
Node Report

Known Flow (cfs)	Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
		4.50	1,280.00	1,280.00	1,276.84	1,276.84			
		4.50	1,280.00	1,280.00	1,276.85	1,276.84			
		4.50	1,280.00	1,280.00	1,276.86	1,276.84			
0.00	0.00	4.51	1,280.00	1,280.00	1,276.86	1,276.84	5.90	12.19	
0.00	0.00	0.59	1,279.30	1,279.30	1,276.87	1,276.86	1.90	0.59	

Profile: Profile - 1
Scenario: Base



Scenario: Base



Title: Indian Bend Road Improvements
p:\...\stormcad\indian wash to hayden road.stm
06/08/07 10:14:14 AM

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Project Engineer: Dennis Jermeland
StormCAD v5.6 [05.06.007.00]

Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Ste	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 04/18/06 02:49:18 PM

Project Inventory

Title: Indian Bend Road Improvements
Project Engineer: Dennis Jermeland
Project Date: 04/18/06
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Network Inventory			
Number of Pipes	31	Number of Inlets	12
- Circular Pipes:	31	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	19	- Generic Inlets:	12
Number of Outlets	1		

Circular Pipes Inventory			
18 inch	265.06 ft	42 inch	144.52 ft
24 inch	323.60 ft	48 inch	1,078.80 ft
36 inch	71.73 ft		
Total Length	1,883.71 ft		

Generic Inlet Inventory	
Default 100%	12

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)
P-80	MH-80	O-1 (Arches)	N/A	N/A	N/A	11.27	4.21	47.81	25.60	0.019531	48 inch	0.013	200.74	1,272.50	1,272.00	1,284.30
P-78	CB-78	MH-80	0.57	0.95	0.54	0.54	5.90	3.23	23.60	0.010169	18 inch	0.013	10.59	1,280.00	1,279.76	1,283.54
Exst P-1	Tee 5	MH-80	N/A	N/A	N/A	10.73	4.37	47.24	254.91	0.002942	48 inch	0.013	77.91	1,273.83	1,273.08	1,285.30
Exst P-1	Junction	Tee 5	N/A	N/A	N/A	10.14	4.41	45.11	128.72	0.003418	48 inch	0.013	83.98	1,274.27	1,273.83	1,285.00
Exst P-3	Plug	Existing Juncti	N/A	N/A	N/A	0.00	0.00	0.00	144.52	0.004913	42 inch	0.013	70.52	1,279.22	1,278.51	1,285.70
Exst P-4	Existing Juncti	Exst Tee 1	N/A	N/A	N/A	0.00	0.00	0.00	2.97	0.010101	48 inch	0.013	144.36	1,278.01	1,277.98	1,285.59
Exst P-5	Exst Tee 1	Tee 1	N/A	N/A	N/A	6.78	4.74	32.38	116.68	0.010542	48 inch	0.013	147.47	1,277.98	1,276.75	1,285.60
Exst P-6	Tee 1	Tee 2	N/A	N/A	N/A	9.50	4.68	44.82	83.35	0.004439	48 inch	0.013	95.70	1,276.75	1,276.38	1,285.00
Exst P-7	Tee 2	Tee 3	N/A	N/A	N/A	9.66	4.63	45.08	96.93	0.004539	48 inch	0.013	96.77	1,276.38	1,275.94	1,287.00
P-102	MH-102	Tee 1	N/A	N/A	N/A	2.72	5.54	15.21	8.10	0.004938	24 inch	0.013	15.90	1,277.77	1,277.73	1,284.94
P-100	CB-100	MH-102	0.22	0.95	0.21	0.21	5.90	1.25	14.00	0.020000	18 inch	0.013	14.85	1,281.30	1,281.02	1,285.99
P-98	CB-98	MH-102	0.13	0.95	0.13	0.13	5.90	0.76	36.60	0.052459	18 inch	0.013	24.06	1,280.00	1,278.08	1,284.12
P-92	CB-92	MH-96	1.73	0.74	1.28	1.28	5.90	7.58	79.30	0.002018	24 inch	0.013	10.16	1,278.64	1,278.48	1,281.97
P-96	MH-96	MH-102	N/A	N/A	N/A	2.38	5.79	13.92	236.20	0.003006	24 inch	0.013	12.40	1,278.48	1,277.77	1,282.44
P-94	CB-94	MH-96	1.44	0.77	1.11	1.11	5.90	6.59	10.50	0.020952	18 inch	0.013	15.20	1,279.20	1,278.98	1,282.06
Exst P-8	Tee 3	Tee 4	N/A	N/A	N/A	9.92	4.57	45.67	273.14	0.004540	48 inch	0.013	96.78	1,275.94	1,274.70	1,287.10
Exst P-9	Tee 4	Junction	N/A	N/A	N/A	10.14	4.44	45.42	96.50	0.004456	48 inch	0.013	95.88	1,274.70	1,274.27	1,286.20
P-84	CB-84	Tee 4	0.23	0.95	0.22	0.22	5.90	1.30	10.16	0.572835	18 inch	0.013	79.50	1,281.77	1,275.95	1,287.10
P-88A	CB-88	Vertical Bend 1	0.17	0.95	0.16	0.16	5.90	0.98	3.00	0.010000	18 inch	0.013	10.50	1,283.40	1,283.37	1,288.00
P-88B	Vertical Bend 1	Tee 2	N/A	N/A	N/A	0.16	5.90	0.97	34.10	0.168328	18 inch	0.013	43.09	1,283.37	1,277.63	1,287.00
P-86A	CB-86	Vertical Bend 1	0.53	0.49	0.26	0.26	5.90	1.52	40.00	0.015000	18 inch	0.013	12.86	1,282.93	1,282.33	1,285.93
P-86B	Vertical Bend 1	Tee 3	N/A	N/A	N/A	0.26	5.86	1.51	18.27	0.281336	18 inch	0.013	55.71	1,282.33	1,277.19	1,287.50
P-82A	CB-82	Vertical Bend 4	0.62	0.95	0.59	0.59	5.90	3.50	3.00	0.010000	18 inch	0.013	10.50	1,281.38	1,281.35	1,284.71
P-82B	Vertical Bend 4	Tee 5	N/A	N/A	N/A	0.59	5.90	3.50	38.03	0.164870	18 inch	0.013	42.65	1,281.35	1,275.08	1,284.00
Exst P-1	I-8	Exst Tee 2	6.80	0.51	3.47	3.47	4.81	16.81	8.00	0.070000	18 inch	0.013	27.79	1,281.36	1,280.80	1,285.61
Exst P-1	Exst Tee 2	Exst Tee 3	N/A	N/A	N/A	3.61	4.81	17.47	45.32	0.001324	36 inch	0.013	24.27	1,280.05	1,279.99	1,285.60
Exst P-1	I-9	Exst Tee 3	6.22	0.51	3.17	3.17	5.25	16.80	8.00	0.081250	18 inch	0.013	29.94	1,281.39	1,280.74	1,285.59
Exst P-1	Exst Tee 3	Vertical Bend	N/A	N/A	N/A	6.78	4.75	32.45	8.53	0.001172	36 inch	0.013	22.84	1,279.99	1,279.98	1,285.60
Exst P-1	Vertical Bend	Exst Tee 1	N/A	N/A	N/A	6.78	4.74	32.39	10.00	0.150000	36 inch	0.013	258.31	1,279.98	1,278.48	1,285.60
P-90	CB-90	Reducer	0.29	0.48	0.14	0.14	5.90	0.82	17.80	0.020225	18 inch	0.013	14.94	1,281.36	1,281.00	1,284.86
Exst P-1	Reducer	Exst Tee 2	N/A	N/A	N/A	0.14	5.88	0.82	7.88	0.021574	36 inch	0.013	97.96	1,280.22	1,280.05	1,285.60

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Node Report

Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)	Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)
O-1 (Arches)					11.27				12.09	4.19	47.63					47.63	1,284.00	1,284.00	1,277.55
MH-80					11.27				11.98	4.21	47.81					47.81	1,284.30	1,284.30	1,277.69
CB-78	0.57	0.95	0.54	0.00	0.54	5.00	0.00	0.00	5.00	5.90	3.23	0.00	0.00	0.00	0.00	3.23	1,283.54	1,283.54	1,280.95
Tee 5					10.73				10.85	4.37	47.24					47.24	1,285.30	1,285.30	1,277.97
Junction					10.14				10.54	4.41	45.11					45.11	1,285.00	1,285.00	1,278.21
Tee 4					10.14				10.32	4.44	45.42					45.42	1,286.20	1,286.20	1,278.38
Tee 3					9.92				9.72	4.57	45.67					45.67	1,287.10	1,287.10	1,278.47
Tee 2					9.66				9.51	4.63	45.08					45.08	1,287.00	1,287.00	1,278.78
Tee 1					9.50				9.32	4.68	44.82					44.82	1,285.00	1,285.00	1,278.75
Exst Tee 1					6.78				9.12	4.74	32.38					32.38	1,285.60	1,285.60	1,279.67
Existing Juncti					0.00				0.00	0.00	0.00					0.00	1,285.59	1,285.59	1,279.67
Plug					0.00				0.00	0.00	0.00					0.00	1,285.70	1,285.70	1,279.67
MH-102					2.72				6.26	5.54	15.21					15.21	1,284.94	1,284.94	1,279.25
CB-100	0.22	0.95	0.21	0.00	0.21	5.00	0.00	0.00	5.00	5.90	1.25	0.00	0.00	0.00	0.00	1.25	1,285.99	1,285.99	1,281.87
CB-98	0.13	0.95	0.13	0.00	0.13	5.00	0.00	0.00	5.00	5.90	0.76	0.00	0.00	0.00	0.00	0.76	1,284.12	1,284.12	1,280.44
MH-96					2.38				5.37	5.79	13.92					13.92	1,282.44	1,282.44	1,280.47
CB-92	1.73	0.74	1.28	0.00	1.28	5.00	0.00	0.00	5.00	5.90	7.58	0.00	0.00	0.00	0.00	7.58	1,281.97	1,281.97	1,280.64
CB-94	1.44	0.77	1.11	0.00	1.11	5.00	0.00	0.00	5.00	5.90	6.59	0.00	0.00	0.00	0.00	6.59	1,282.06	1,282.06	1,280.73
CB-84	0.23	0.95	0.22	0.00	0.22	5.00	0.00	0.00	5.00	5.90	1.30	0.00	0.00	0.00	0.00	1.30	1,287.10	1,287.10	1,282.35
Vertical Bend					0.16				5.01	5.90	0.97					0.97	1,287.00	1,287.00	1,283.80
CB-88	0.17	0.95	0.16	0.00	0.16	5.00	0.00	0.00	5.00	5.90	0.98	0.00	0.00	0.00	0.00	0.98	1,288.00	1,288.00	1,283.77
Vertical Bend					0.26				5.14	5.86	1.51					1.51	1,287.50	1,287.50	1,282.88
CB-86	0.53	0.49	0.26	0.00	0.26	5.00	0.00	0.00	5.00	5.90	1.52	0.00	0.00	0.00	0.00	1.52	1,285.93	1,285.93	1,283.56
Vertical Bend					0.59				5.01	5.90	3.50					3.50	1,284.00	1,284.00	1,282.06
CB-82	0.62	0.95	0.59	0.00	0.59	5.00	0.00	0.00	5.00	5.90	3.50	0.00	0.00	0.00	0.00	3.50	1,284.71	1,284.71	1,282.37
Vertical Bend					6.78				9.11	4.74	32.39					32.39	1,285.60	1,285.60	1,281.83
Exst Tee 3					6.78				9.08	4.75	32.45					32.45	1,285.60	1,285.60	1,282.39
Exst Tee 2					3.61				8.88	4.81	17.47					17.47	1,285.60	1,285.60	1,282.50
I-8	6.80	0.51	3.47	0.00	3.47	8.87	0.00	0.00	8.87	4.81	16.81	0.00	0.00	0.00	0.00	16.81	1,285.61	1,285.61	1,284.24
I-9	6.22	0.51	3.17	0.00	3.17	7.29	0.00	0.00	7.29	5.25	16.80	0.00	0.00	0.00	0.00	16.80	1,285.59	1,285.59	1,284.27
Reducer					0.14				5.07	5.88	0.82					0.82	1,285.60	1,285.60	1,282.50
CB-90	0.29	0.48	0.14	0.00	0.14	5.00	0.00	0.00	5.00	5.90	0.82	0.00	0.00	0.00	0.00	0.82	1,284.86	1,284.86	1,282.50

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Node Report

Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
1,277.55			
1,277.58			
1,280.68	5.90	3.23	
1,277.97			
1,278.08			
1,278.27			
1,278.47			
1,278.39			
1,278.75			
1,279.67			
1,279.67			
1,279.67			
1,279.25			
1,281.72	5.90	1.25	
1,280.32	5.90	0.76	
1,280.27			
1,280.55	5.90	7.58	
1,280.45	5.90	6.59	
1,282.20	5.90	1.30	
1,283.74			
1,283.77	5.90	0.98	
1,282.79			
1,283.39	5.90	1.52	
1,282.06			
1,282.09	5.90	3.50	
1,281.83			
1,282.01			
1,282.42			
1,282.80	4.81	16.81	
1,282.83	5.25	16.80	
1,282.50			
1,282.50	5.90	0.82	

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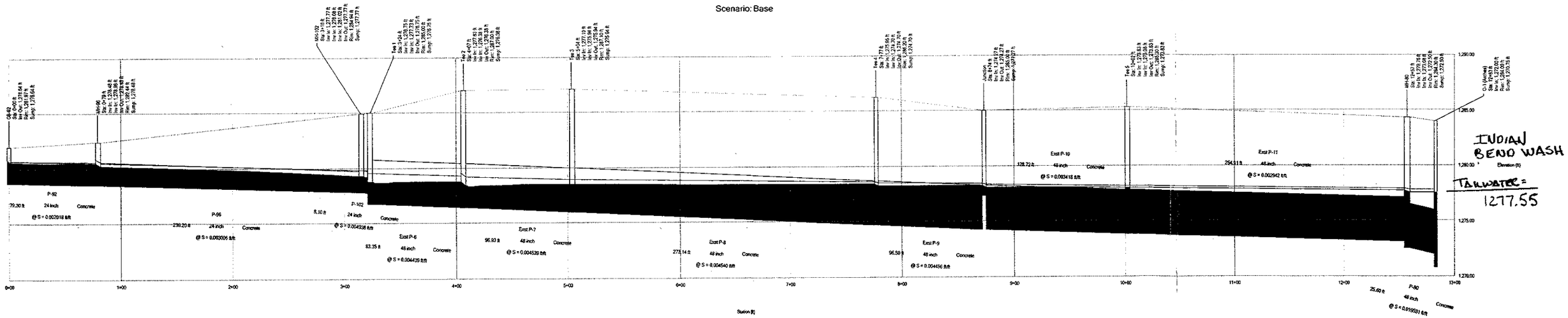
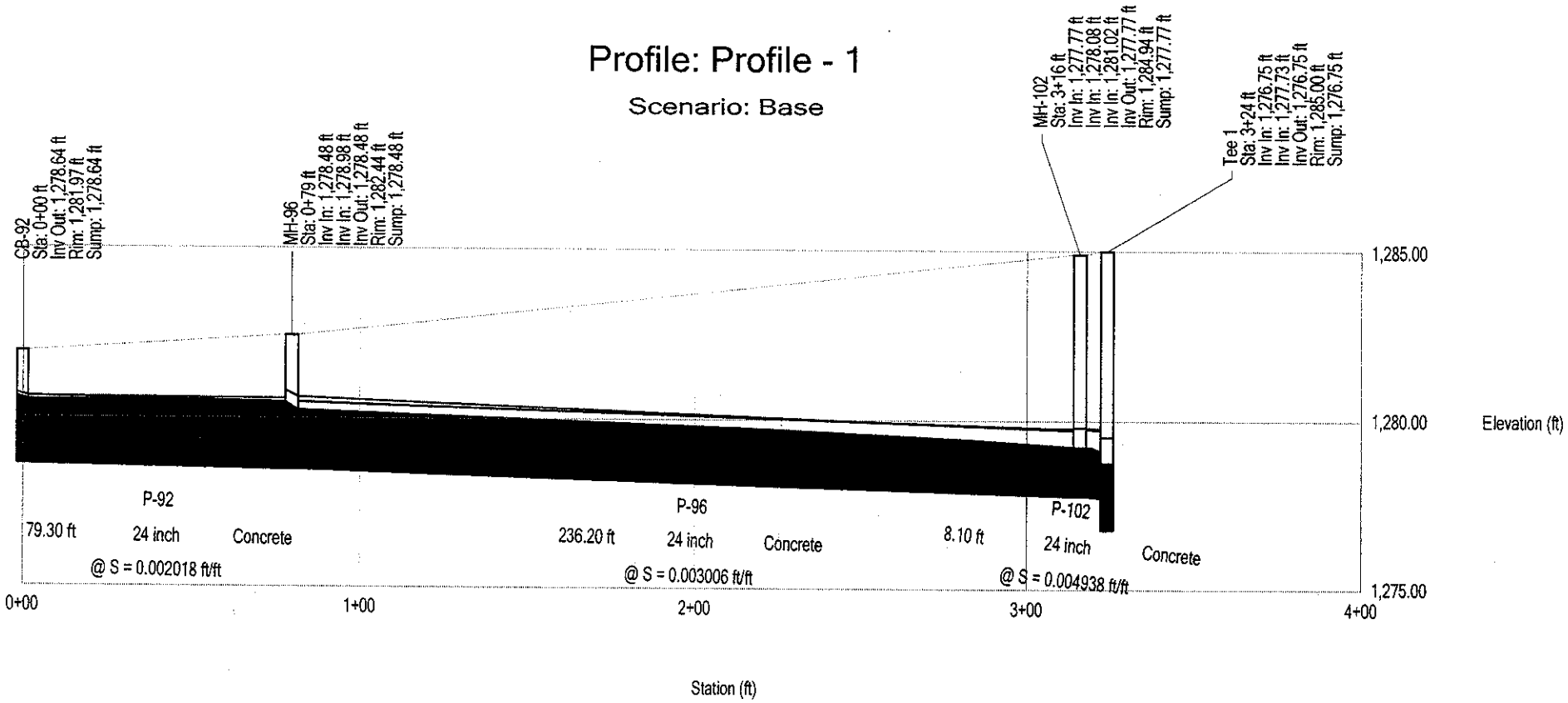
Profile
Scenario: Base

Profile: Trunkline

Scenario: Base





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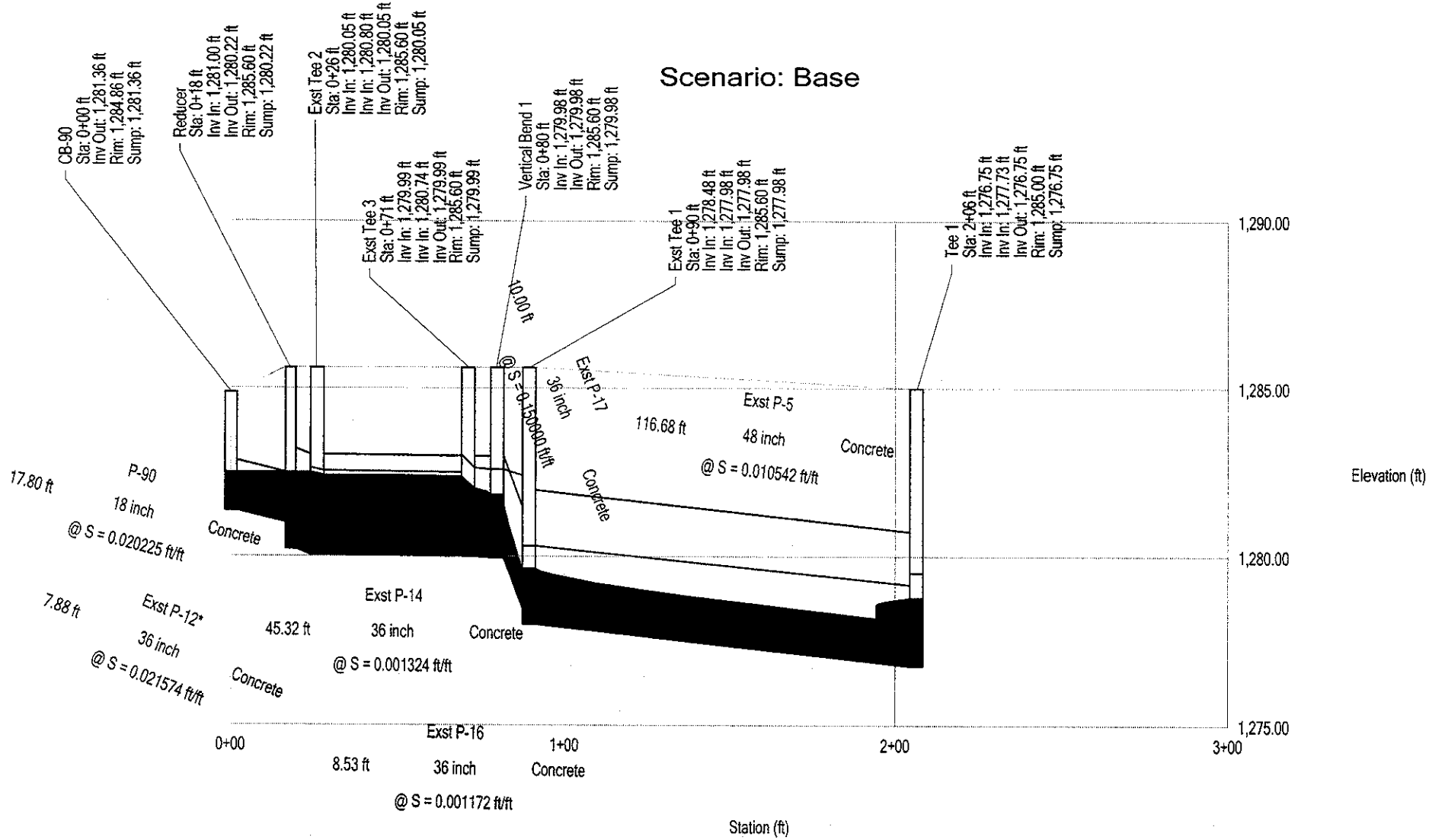
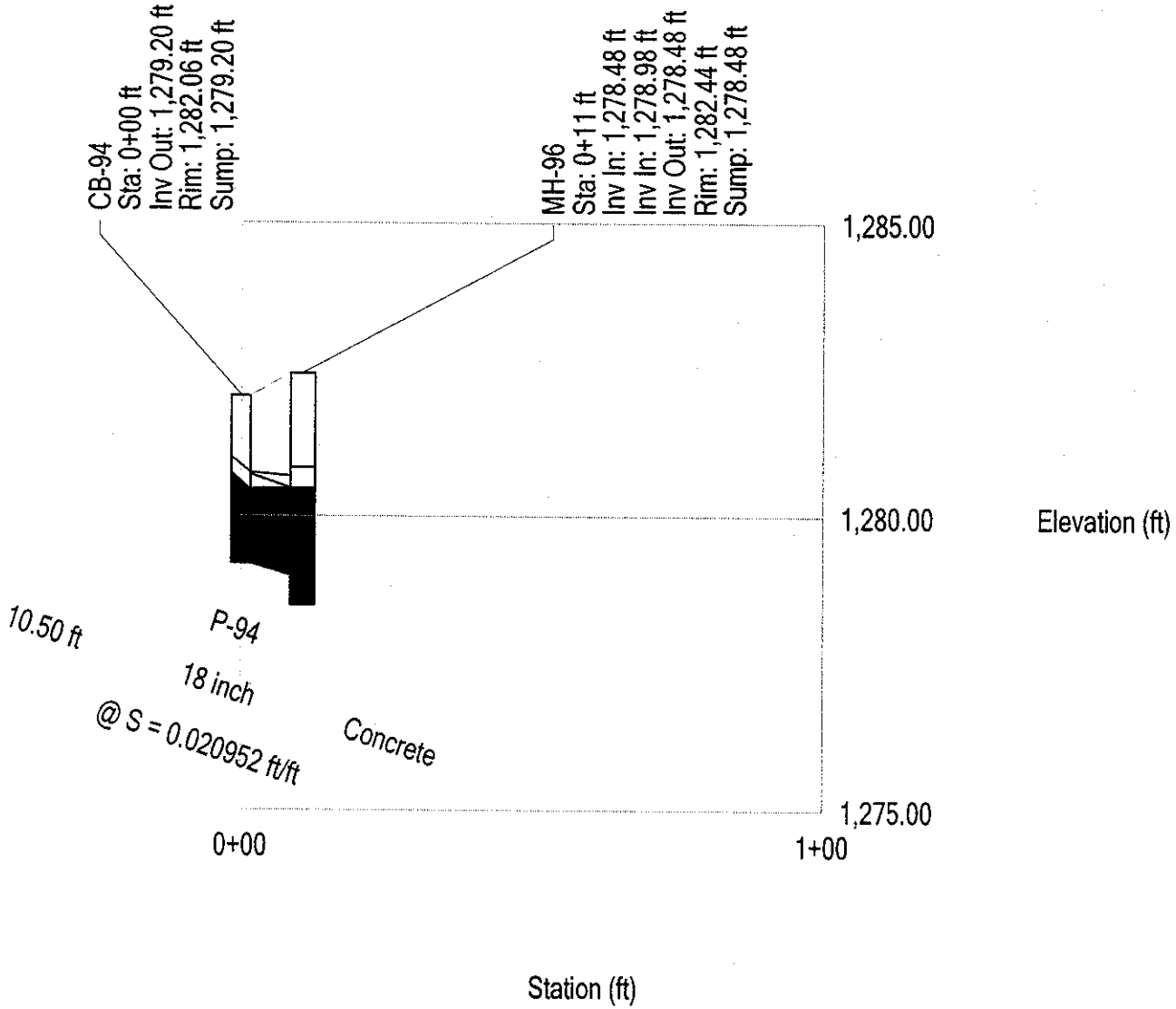
Profile: Profile - 2



Profile: Profile - 3

Scenario: Base



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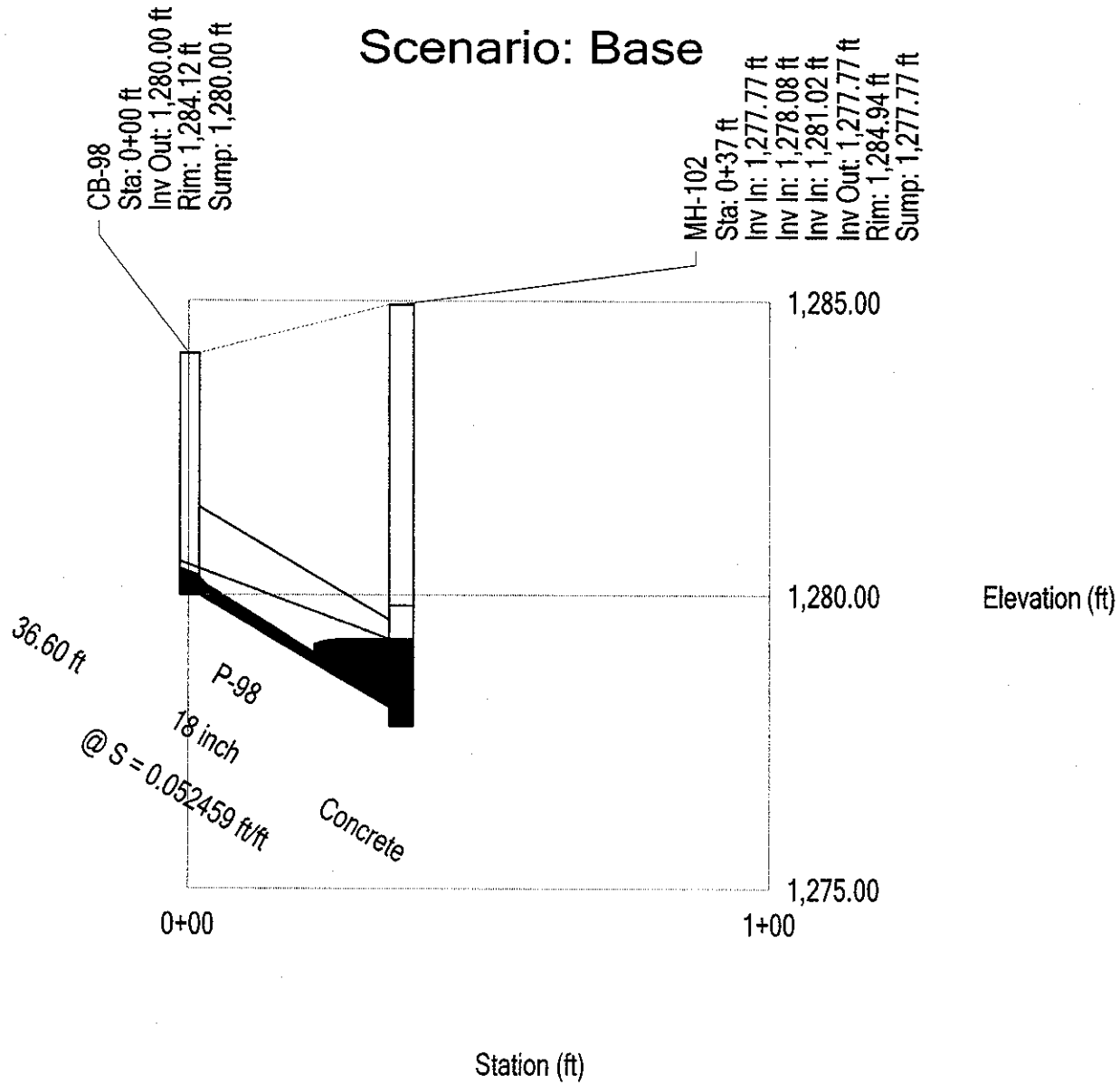
Profile: Profile - 4

Scenario: Base



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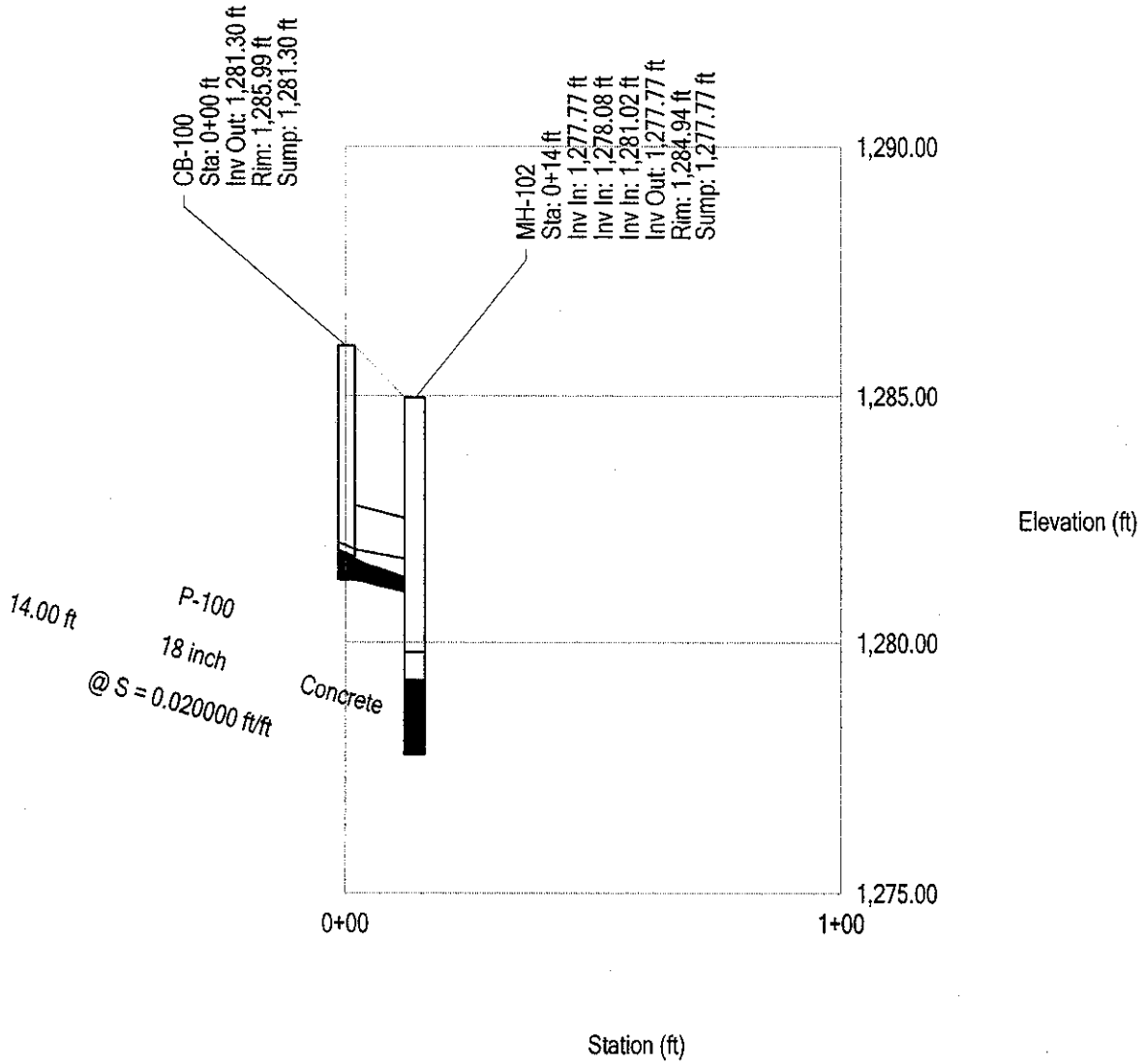
Profile: Profile - 5

Scenario: Base



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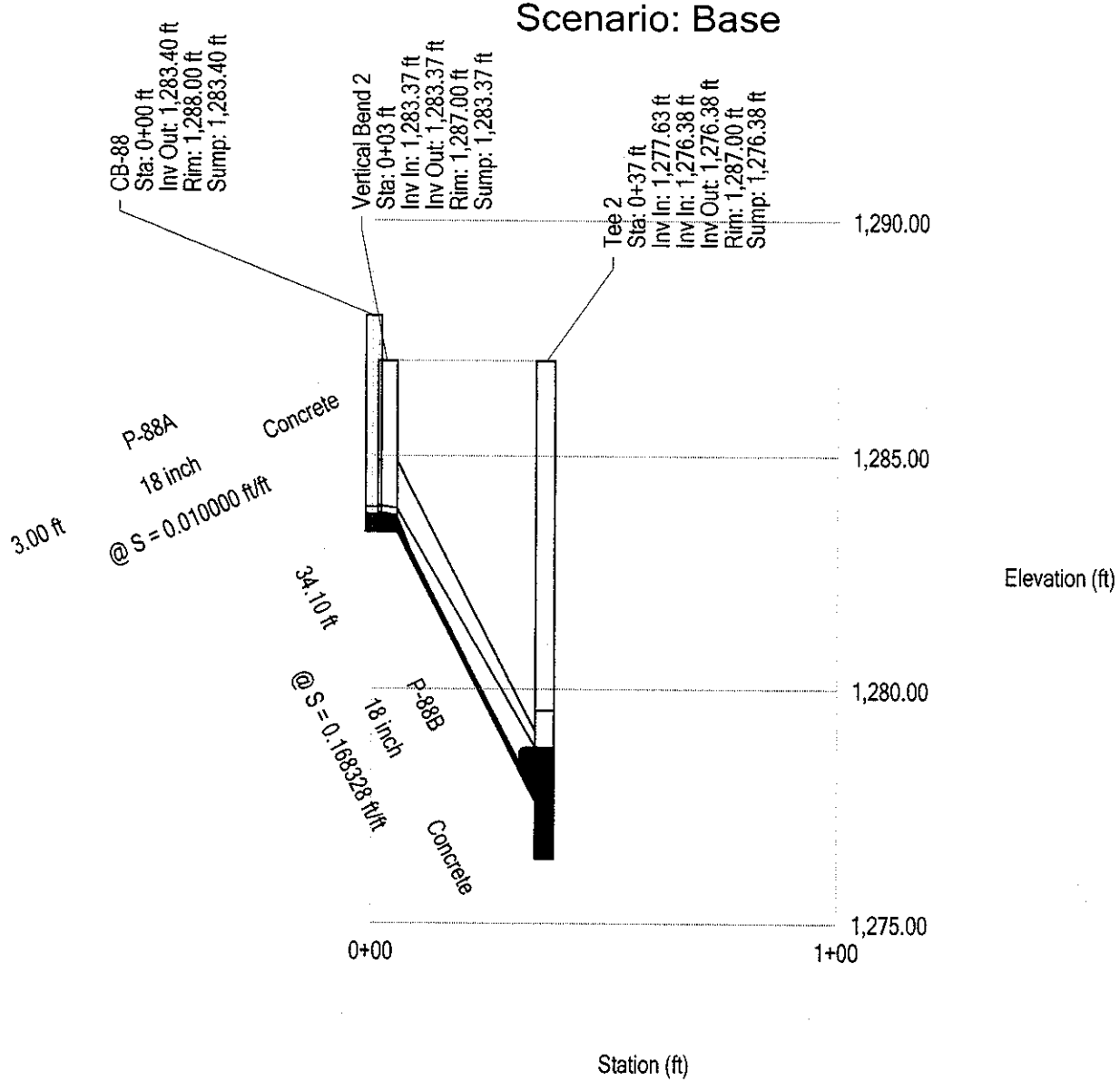
Profile: Profile - 6

Scenario: Base



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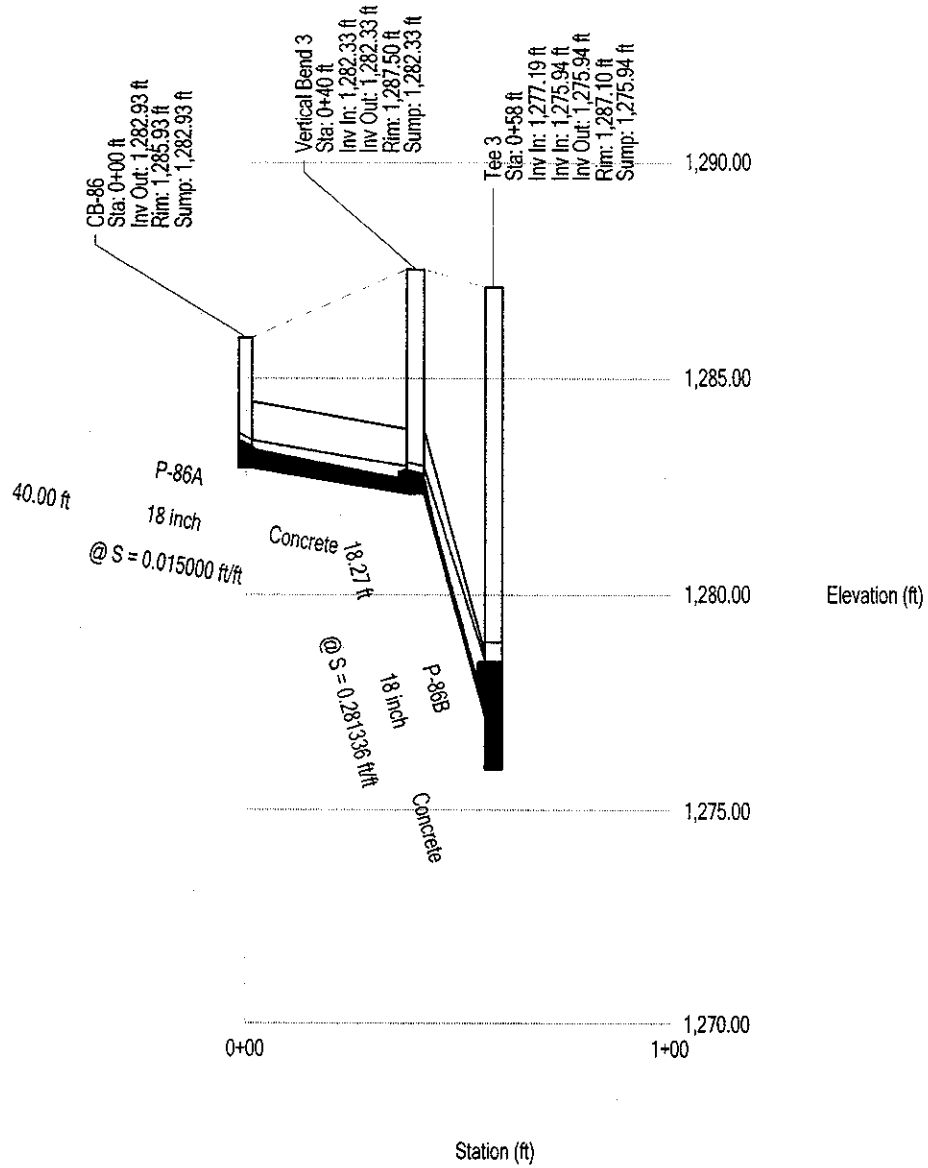
Profile: Profile - 7

Scenario: Base



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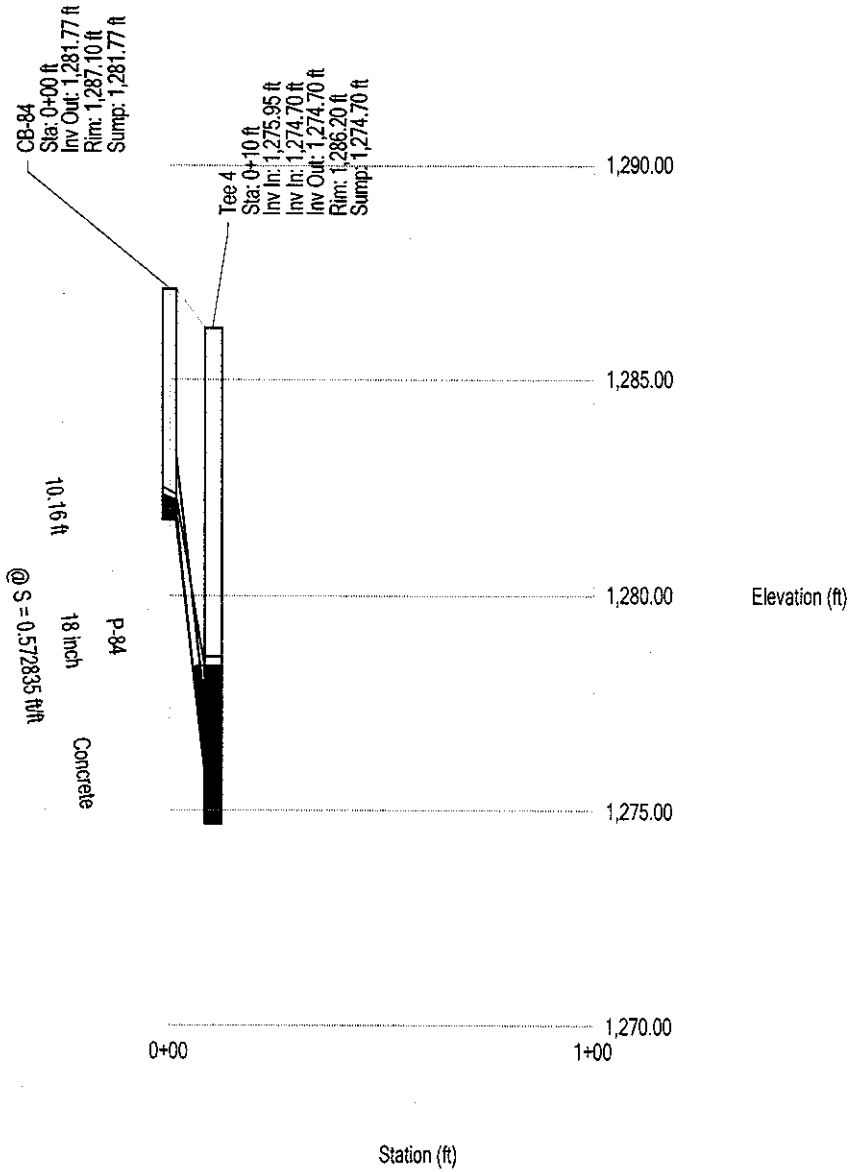
Profile: Profile - 8

Scenario: Base



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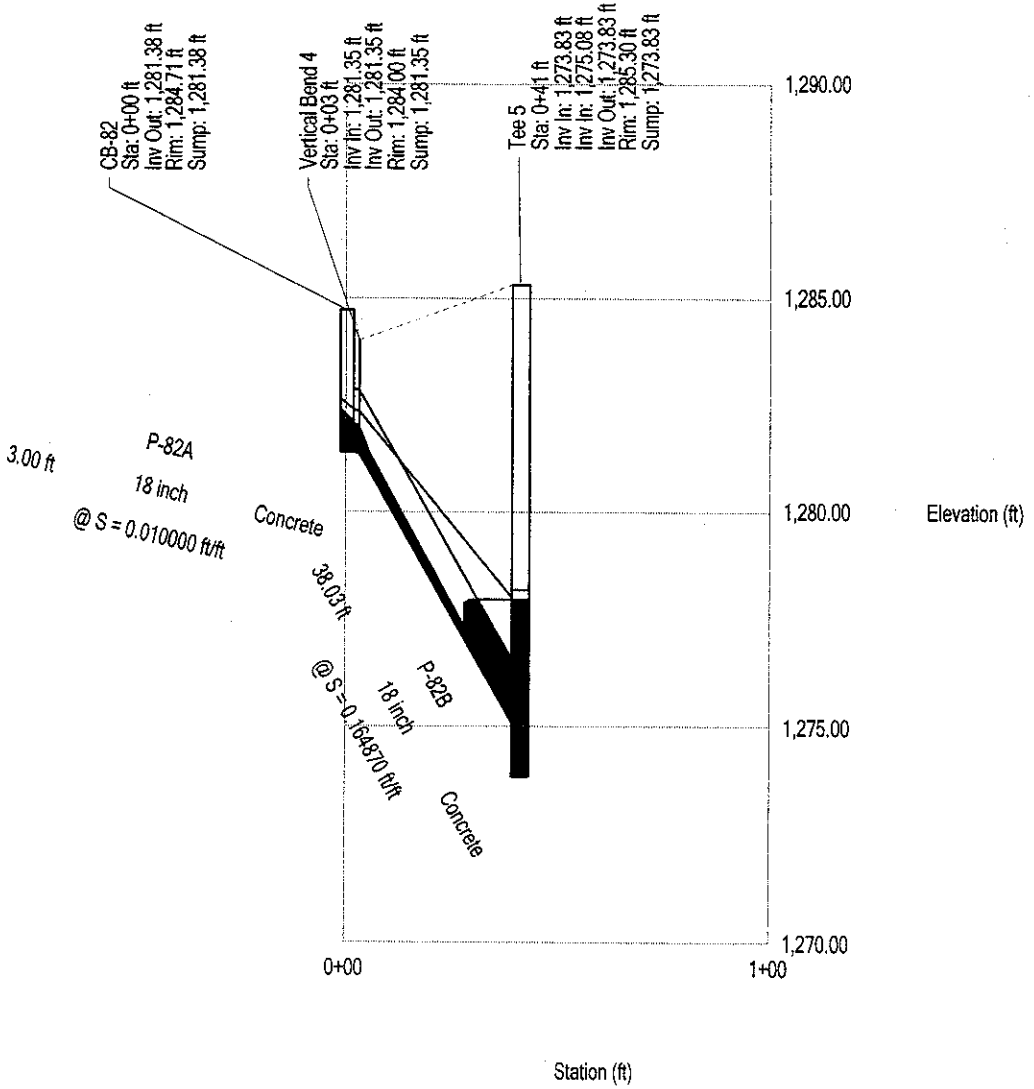
Profile: Profile - 9

Scenario: Base



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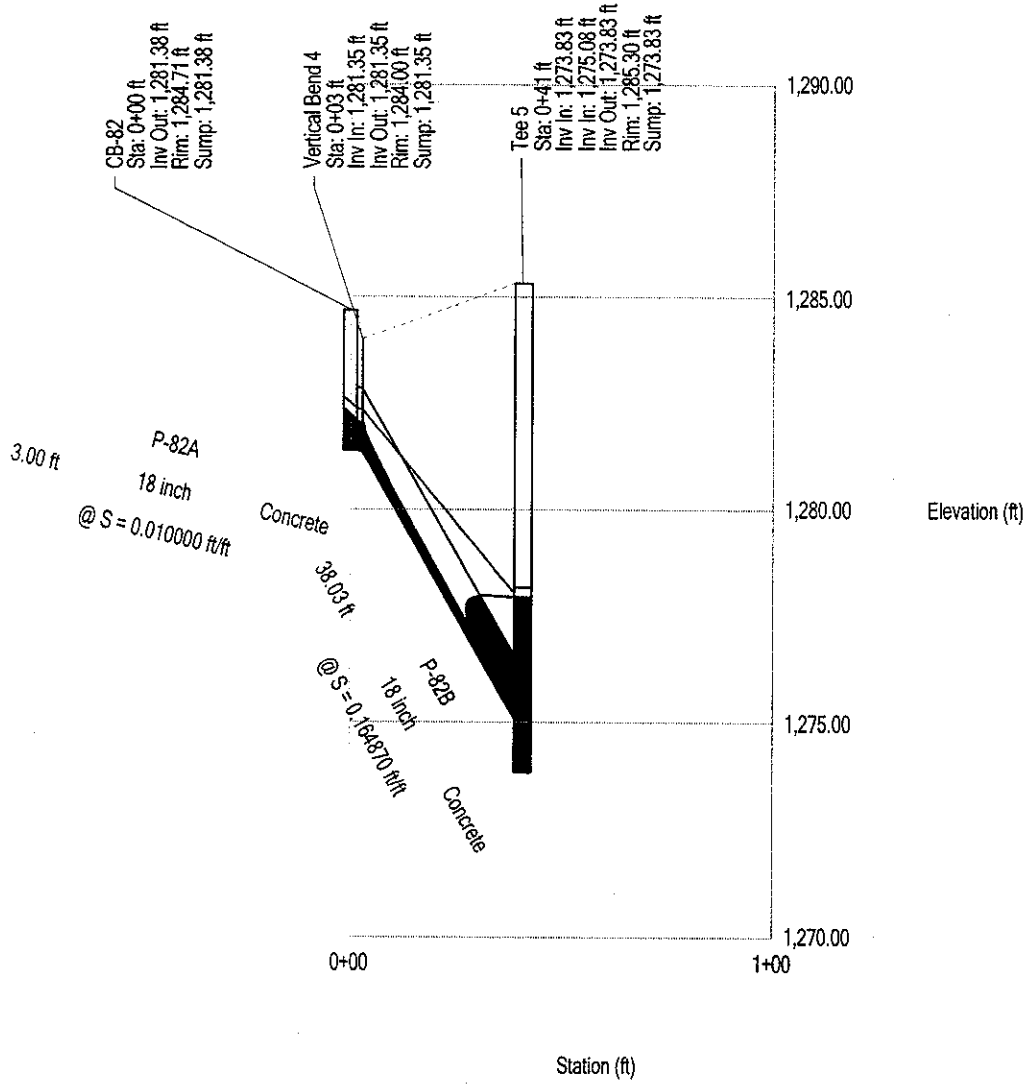
Profile: Profile - 9

Scenario: Base



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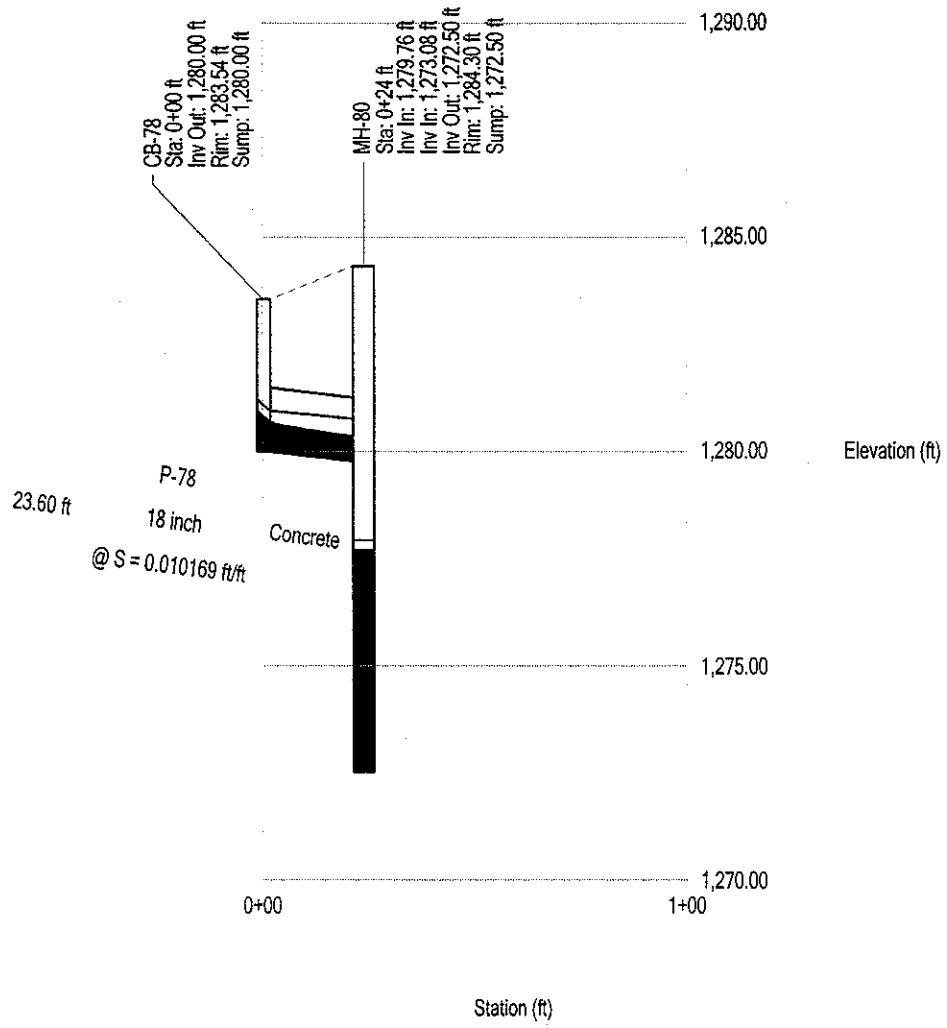
Profile: Profile - 10

Scenario: Base



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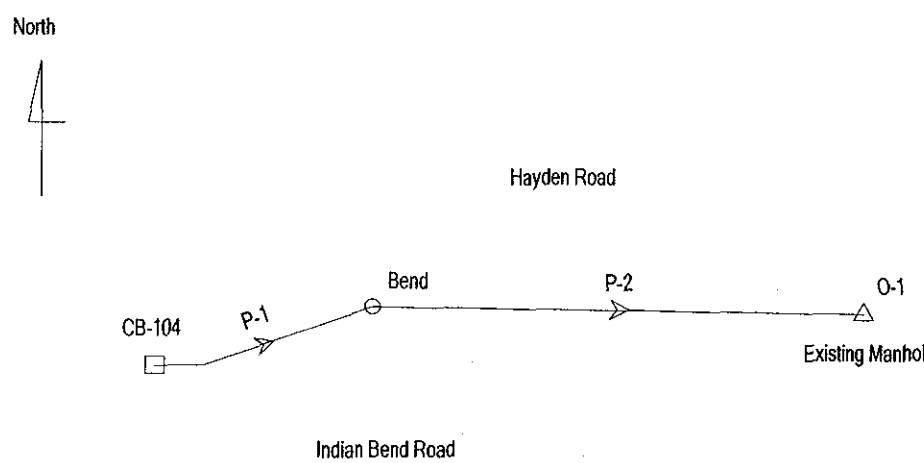
Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 06/08/07 02:58:46 PM

Project Inventory

Title:
Project Engineer:
Project Date: 06/08/07
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Network Inventory			
Number of Pipes	2	Number of Inlets	1
- Circular Pipes:	2	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	1	- Generic Inlets:	1
Number of Outlets	1		

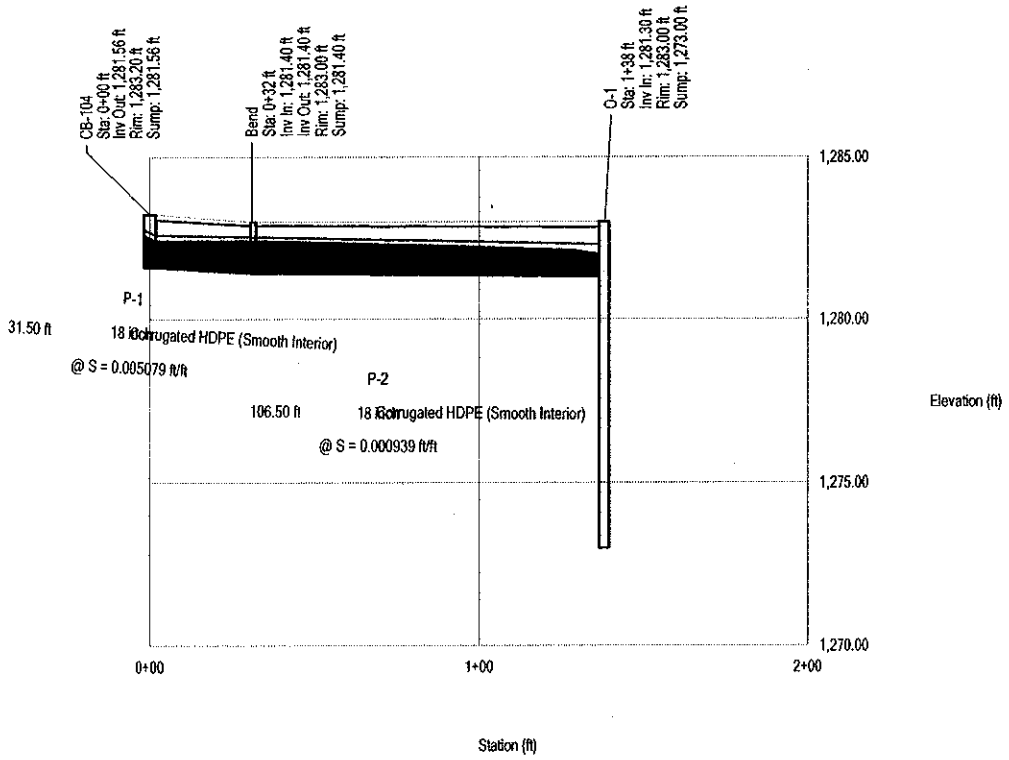
Circular Pipes Inventory	
18 inch	138.00 ft
Total Length	138.00 ft

Generic Inlet Inventory	
Default 100%	1

Profile
Scenario: Base

Profile: Profile - 1

Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-1	CB-104	Bend	0.63	0.92	0.58	0.58	5.90	3.47	31.50	0.005079	18 inch	0.012	8.11
P-2	Bend	O-1	N/A	N/A	N/A	0.58	5.87	3.45	106.50	0.000939	18 inch	0.012	3.49

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,281.56	1,281.40	1,283.20	1,283.00	0.14	0.10	1,282.39	1,282.39	
1,281.40	1,281.30	1,283.00	1,283.00	0.10	0.20	1,282.39	1,282.01	

Scenario: Base

Node Report

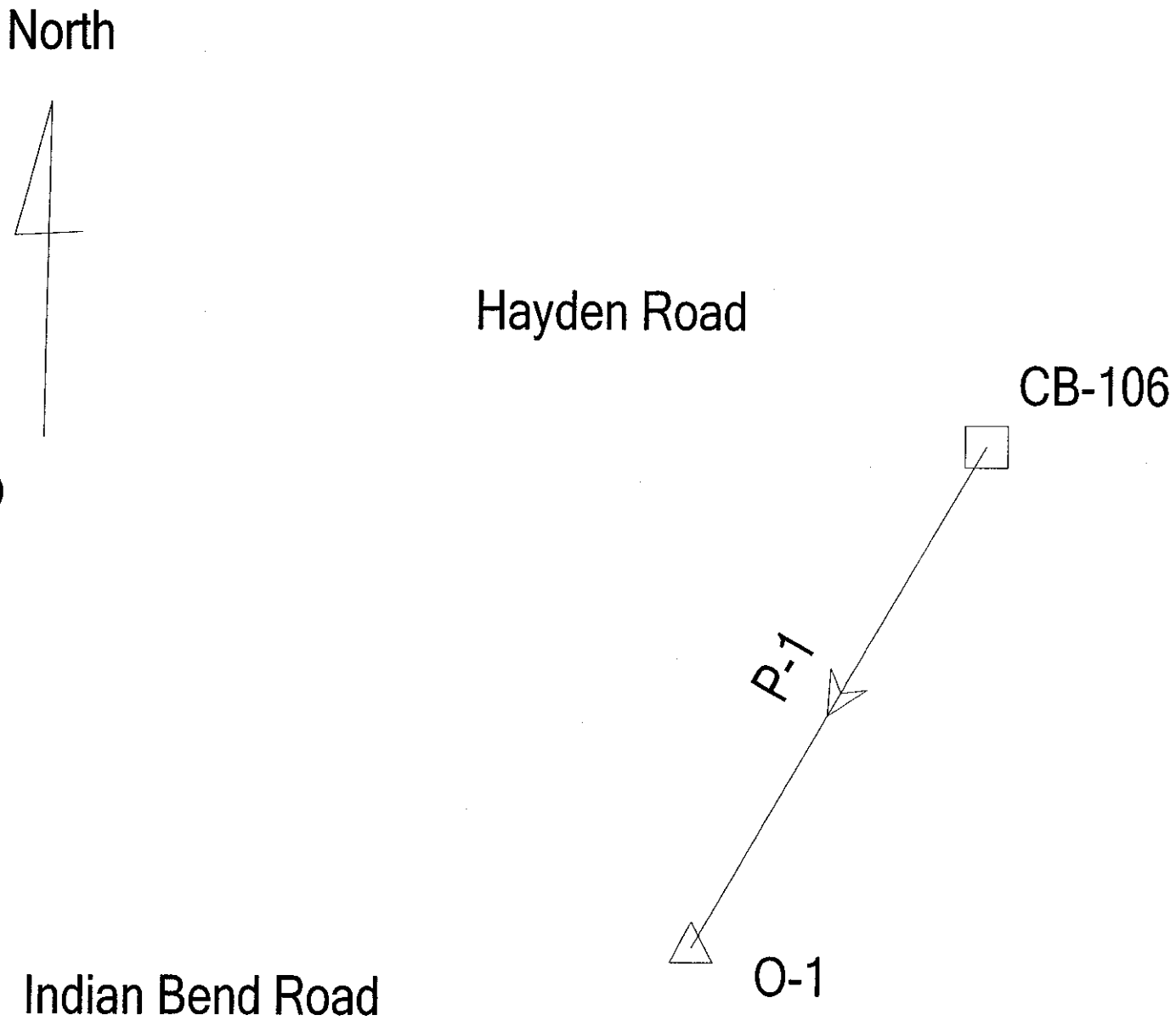
Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					0.58				5.91	5.64	3.32			
Bend					0.58				5.12	5.87	3.45			
CB-104	0.63	0.92	0.58	0.00	0.58	5.00	0.00	0.00	5.00	5.90	3.47	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	3.32	1,283.00	1,283.00	1,273.00	1,273.00			
	3.45	1,283.00	1,283.00	1,282.39	1,282.39			
0.00	3.47	1,283.20	1,283.20	1,282.58	1,282.39	5.90	3.47	

Scenario: Base



Scenario Summary Report
Scenario: Base

Scenario Summary	
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

Gravity Calculation Options		
Analysis Type	Backwater Analysis	
Average Velocity Method	Uniform Flow Velocity (Vn or Vf)	
Hydraulic Grade Converger	0.00	ft
Number of Flow Profile Step	5	
Return Period	10 year	
Minimum Time of Concentra	5.00	min

Created: 06/08/07 02:29:05 PM

Project Inventory

Title:
Project Engineer:
Project Date: 06/08/07
Comments:

Scenario Summary	
Scenario	Base
Physical Properties Alternat	Base-Physical Properties
Catchments Alternative	Base-Catchments
System Flows Alternative	Base-System Flows
Structure Headlosses Alterr	Base-Structure Headlosses
Boundary Conditions Altern	Base-Boundary Conditions
Design Constraints Alternat	Base-Design Constraints
Capital Cost Alternative	Base-Capital Cost
User Data Alternative	Base-User Data

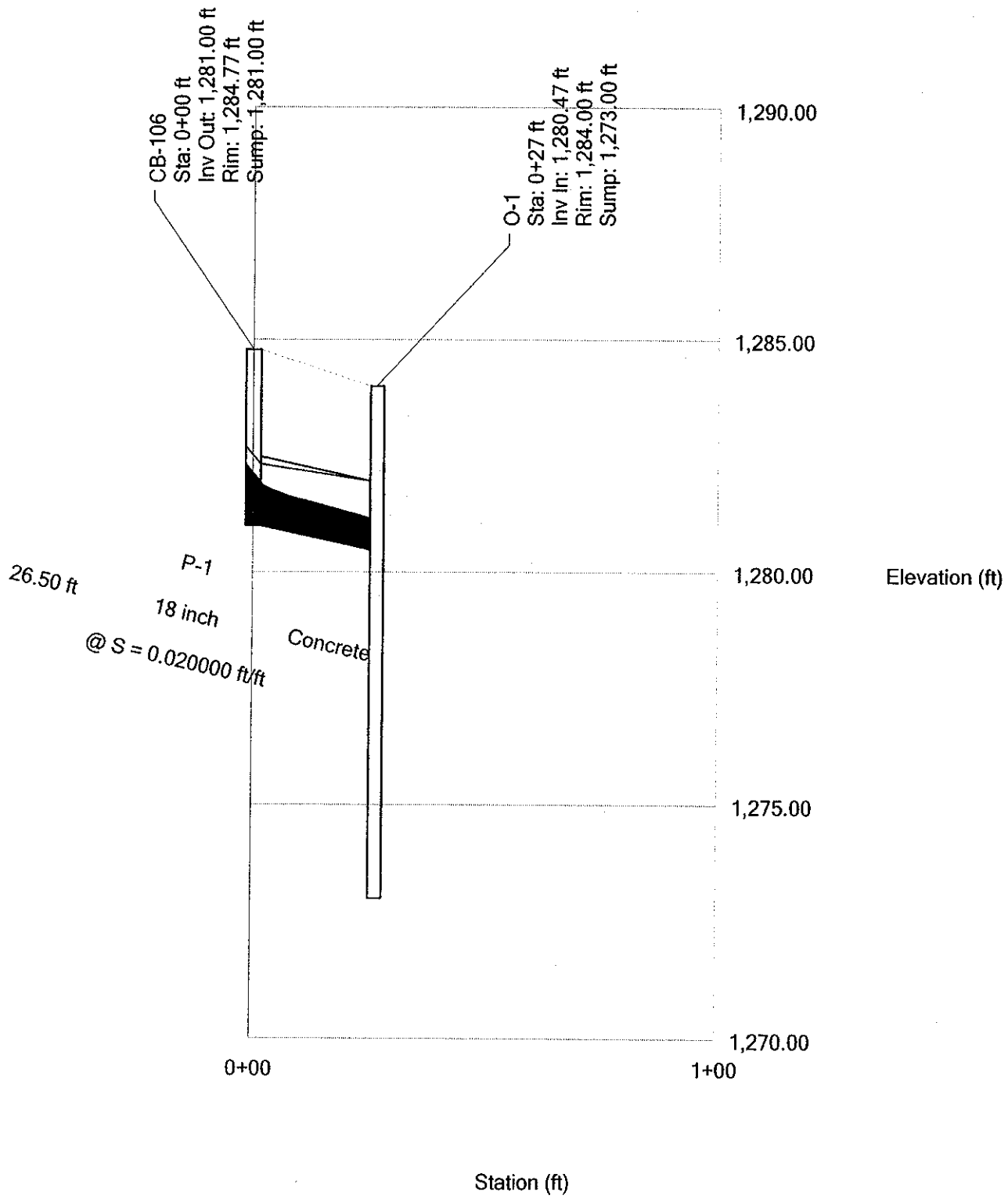
Network Inventory			
Number of Pipes	1	Number of Inlets	1
- Circular Pipes:	1	- Grate Inlets:	0
- Box Pipes:	0	- Curb Inlets:	0
- Arch Pipes:	0	- Combination Inlets:	0
- Vertical Elliptical Pipes:	0	- Slot Inlets:	0
- Horizontal Elliptical Pipes:	0	- Grate Inlets in Ditch:	0
Number of Junctions	0	- Generic Inlets:	1
Number of Outlets	1		

Circular Pipes Inventory	
18 inch	26.50 ft
Total Length	26.50 ft

Generic Inlet Inventory	
Default 100%	1

Profile: Profile - 1

Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Upstream Inlet Area (acres)	Upstream Inlet Rational Coefficient	Upstream Inlet CA (acres)	Upstream Calculated System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)
P-1	CB-106	O-1	1.25	0.77	0.97	0.97	5.90	5.77	26.50	0.020000	18 inch	0.013	14.85

Scenario: Base

Pipe Report

Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
1,281.00	1,280.47	1,284.77	1,284.00	2.27	2.03	1,281.93	1,281.16	

Scenario: Base

Node Report

Label	Area (acres)	Inlet C	Inlet CA (acres)	External CA (acres)	System CA (acres)	Time of Concentration (min)	External Time of Concentration (min)	Upstream Time Of Concentration (min)	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Additional Carryover (cfs)	Known Flow (cfs)
O-1					0.97				5.06	5.88	5.76			
CB-106	1.25	0.77	0.97	0.00	0.97	5.00	0.00	0.00	5.00	5.90	5.77	0.00	0.00	0.00

Scenario: Base

Node Report

Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Local Intensity (in/hr)	Local Rational Flow (cfs)	Description
	5.76	1,284.00	1,284.00	1,273.00	1,273.00			
0.00	5.77	1,284.77	1,284.77	1,282.32	1,281.93	5.90	5.77	

CULVERT ANALYSIS

Culvert Designer/Analyzer Report
Sta 46+55.59

Analysis Component			
Storm Event	Design	Discharge	1.44 cfs

Peak Discharge Method: User-Specified			
Design Discharge	1.44 cfs	Check Discharge	1.70 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	1,283.48 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	1.44 cfs	1,283.49 ft	0.46 ft/s
Weir	Not Considered	N/A	N/A	N/A

50-yr EVENT

Culvert Designer/Analyzer Report
Sta 46+55.59

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	1,283.49	ft	Discharge	1.44	cfs
Inlet Control HW Elev.	1,283.48	ft	Tailwater Elevation	1,283.48	ft
Outlet Control HW Elev.	1,283.49	ft	Control Type	Outlet Control	
Headwater Depth/Height	0.54				

Grades					
Upstream Invert	1,282.42	ft	Downstream Invert	1,281.48	ft
Length	88.82	ft	Constructed Slope	0.010583	ft/ft

Hydraulic Profile					
Profile	S1		Depth, Downstream	2.00	ft
Slope Type	Steep		Normal Depth	0.34	ft
Flow Regime	Subcritical		Critical Depth	0.41	ft
Velocity Downstream	0.46	ft/s	Critical Slope	0.004566	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,283.49	ft	Upstream Velocity Head	0.01	ft
Ke	0.20		Entrance Loss	0.00	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,283.48	ft	Flow Control	Unsubmerged	
Inlet Type	Groove end projecting		Area Full	3.1	ft^2
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Rating Table Report
Sta 46+55.59

Range Data:

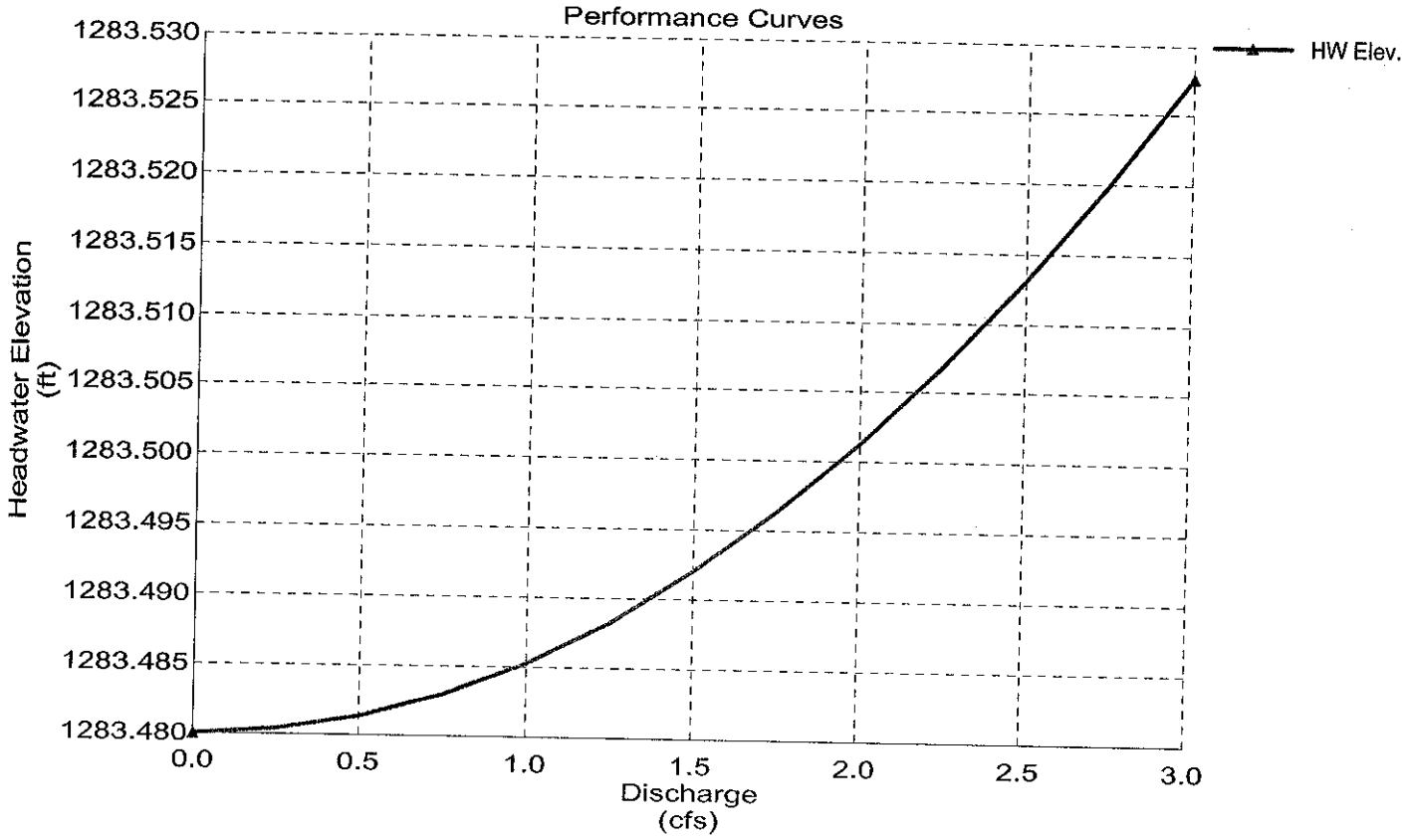
	Minimum	Maximum	Increment	
Discharge	0.00	3.00	0.25	cfs

Discharge (cfs)	HW Elev. (ft)	TW Elev. (ft)	(I) Hwi	(O) Hwo	(D) Dn. V	(D) Dn. depth
0.00	1,283.48	1,283.48	1,283.48	1,283.48	0.00	0.00
0.25	1,283.48	1,283.48	1,283.48	1,283.48	0.08	2.00
0.50	1,283.48	1,283.48	1,283.48	1,283.48	0.16	2.00
0.75	1,283.48	1,283.48	1,283.48	1,283.48	0.24	2.00
1.00	1,283.49	1,283.48	1,283.48	1,283.49	0.32	2.00
1.25	1,283.49	1,283.48	1,283.48	1,283.49	0.40	2.00
1.50	1,283.49	1,283.48	1,283.48	1,283.49	0.48	2.00
1.75	1,283.50	1,283.48	1,283.48	1,283.50	0.56	2.00
2.00	1,283.50	1,283.48	1,283.48	1,283.50	0.64	2.00
2.25	1,283.51	1,283.48	1,283.48	1,283.51	0.72	2.00
2.50	1,283.51	1,283.48	1,283.48	1,283.51	0.80	2.00
2.75	1,283.52	1,283.48	1,283.48	1,283.52	0.88	2.00
3.00	1,283.53	1,283.48	1,283.48	1,283.53	0.95	2.00

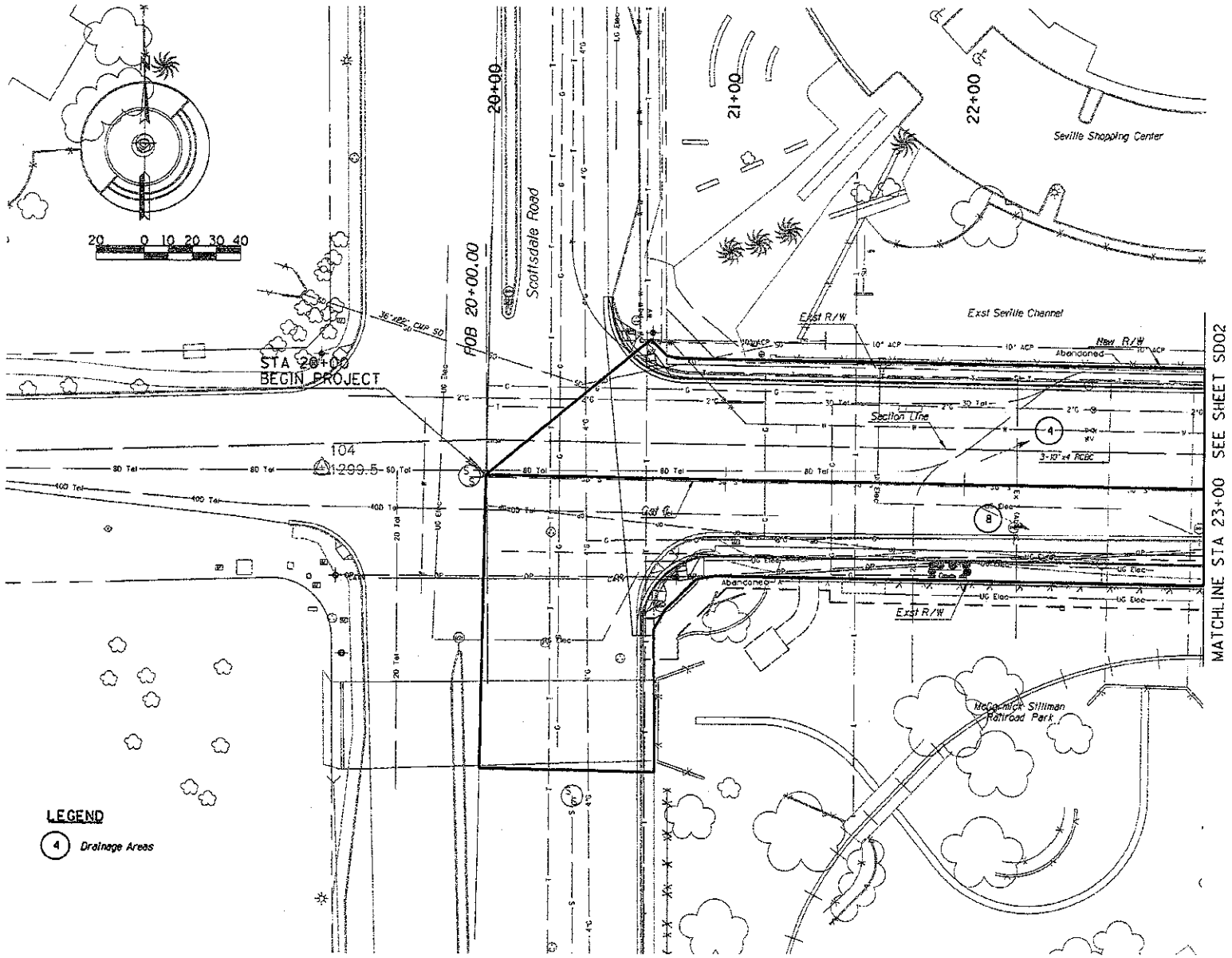
Performance Curves Report
Sta 46+55.59

Range Data:

	Minimum	Maximum	Increment	
Discharge	0.00	3.00	0.25	cfs



APPENDIX H
ONSITE DRAINAGE AREAS



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DATE	REVISION	BY

ENGINEER

FINAL

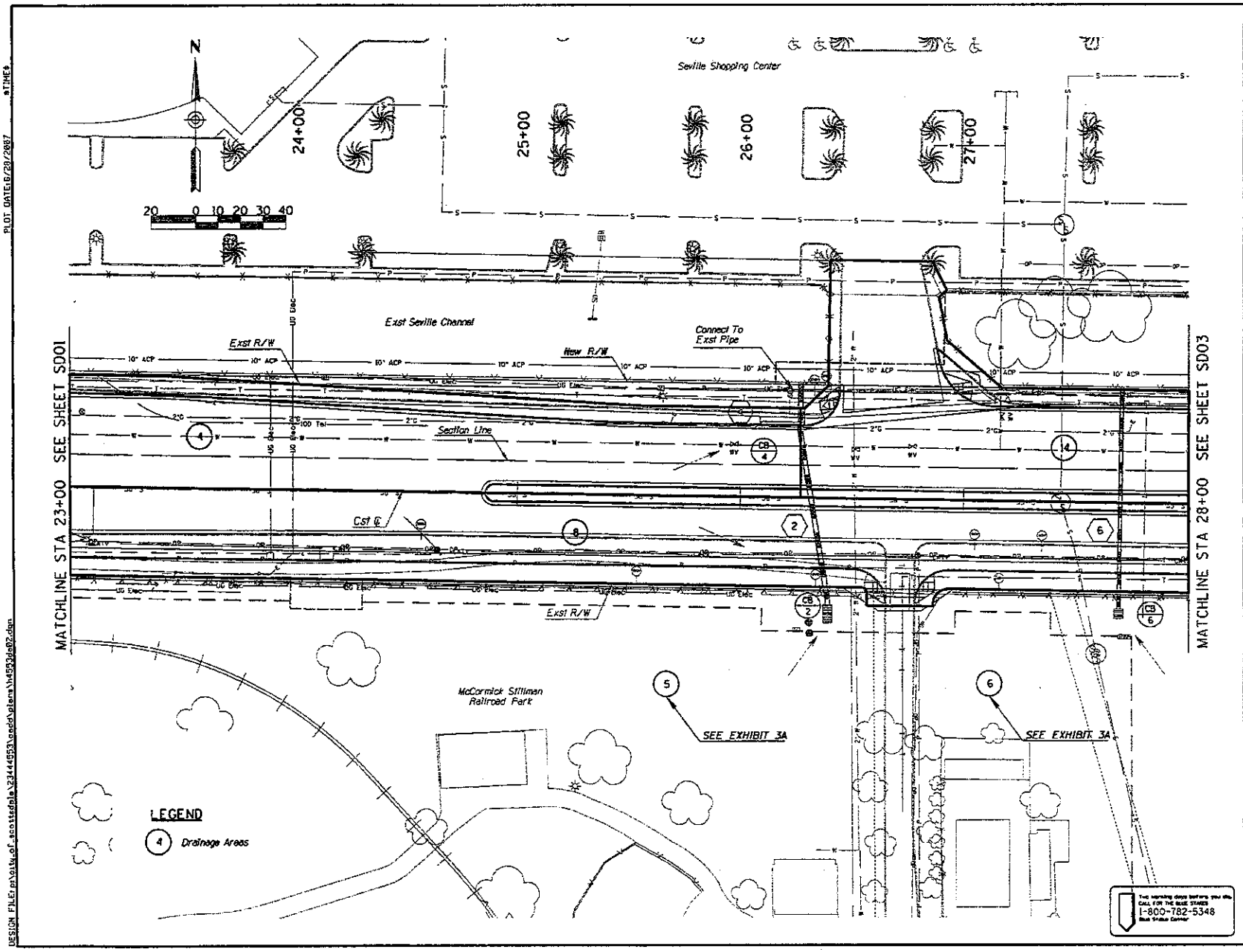
MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DNJ	06/07		DA01
VERT. N/A	DRAWN AS	AS-BUILT	PROJECT NO. 410-S-0402	OF

PLOT DATE:6/29/2007 $TIME$

DESIGN FILE:pw:\urs_of_scottsdale\23444553\add\plans\M4553da01.dgn



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7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

DRAINAGE AREAS
STA 23+00 TO STA 28+00

DATE	REVISION	BY

ENGINEER

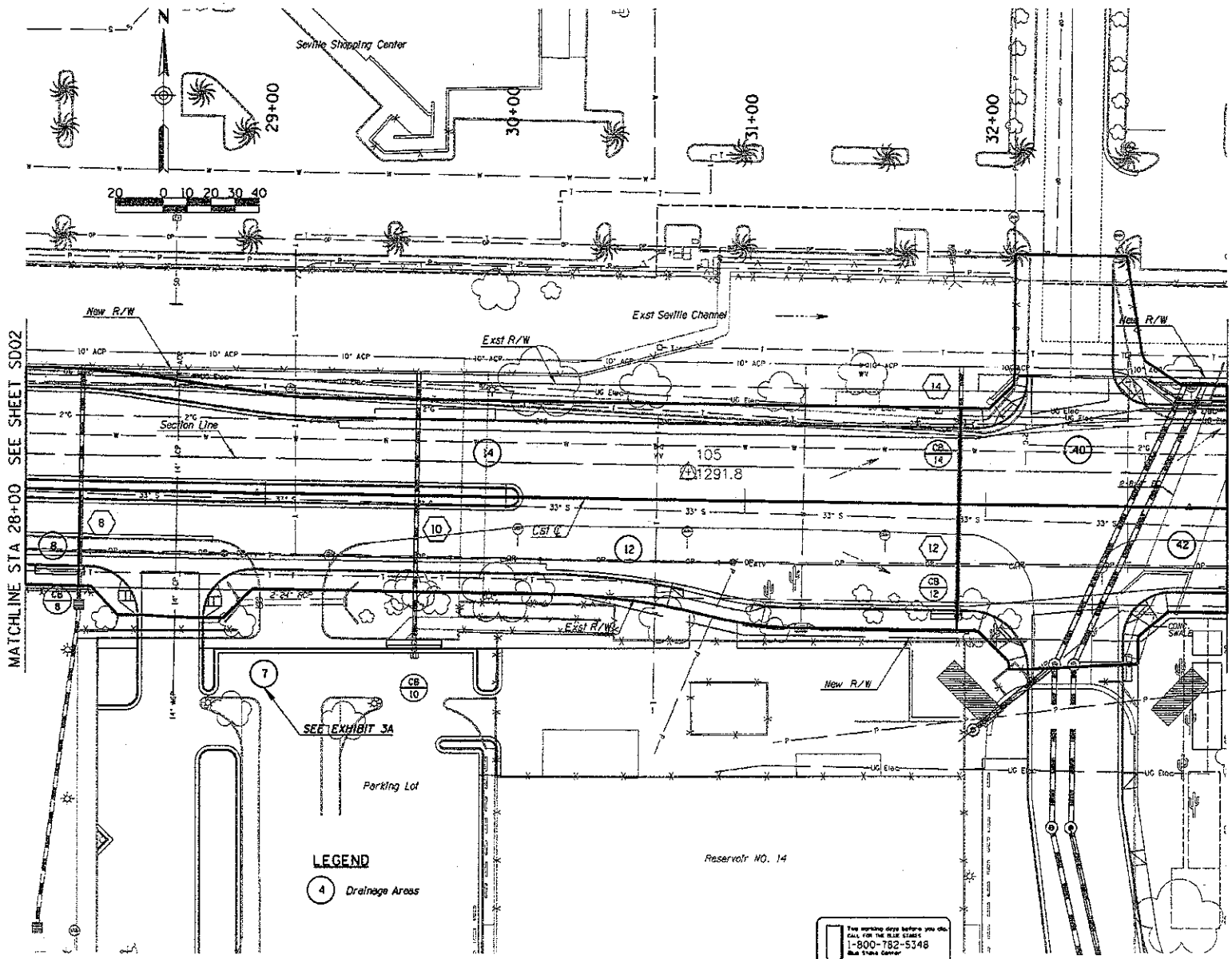
FINAL

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA (85251)

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORZ. 1"=20'	DNJ	06/07		DA02
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-5-0402	OF

DESIGN FILE:p:\city_of_scottsdale\23444553\oedd\plans\1453dae02.dgn
PLOT DATE:6/28/2007 $TIME$



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7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
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DRAINAGE AREAS
STA 28+00 TO STA 33+00

DATE	REVISION	BY

ENGINEER

FINAL

MUNICIPAL SERVICES DEPARTMENT

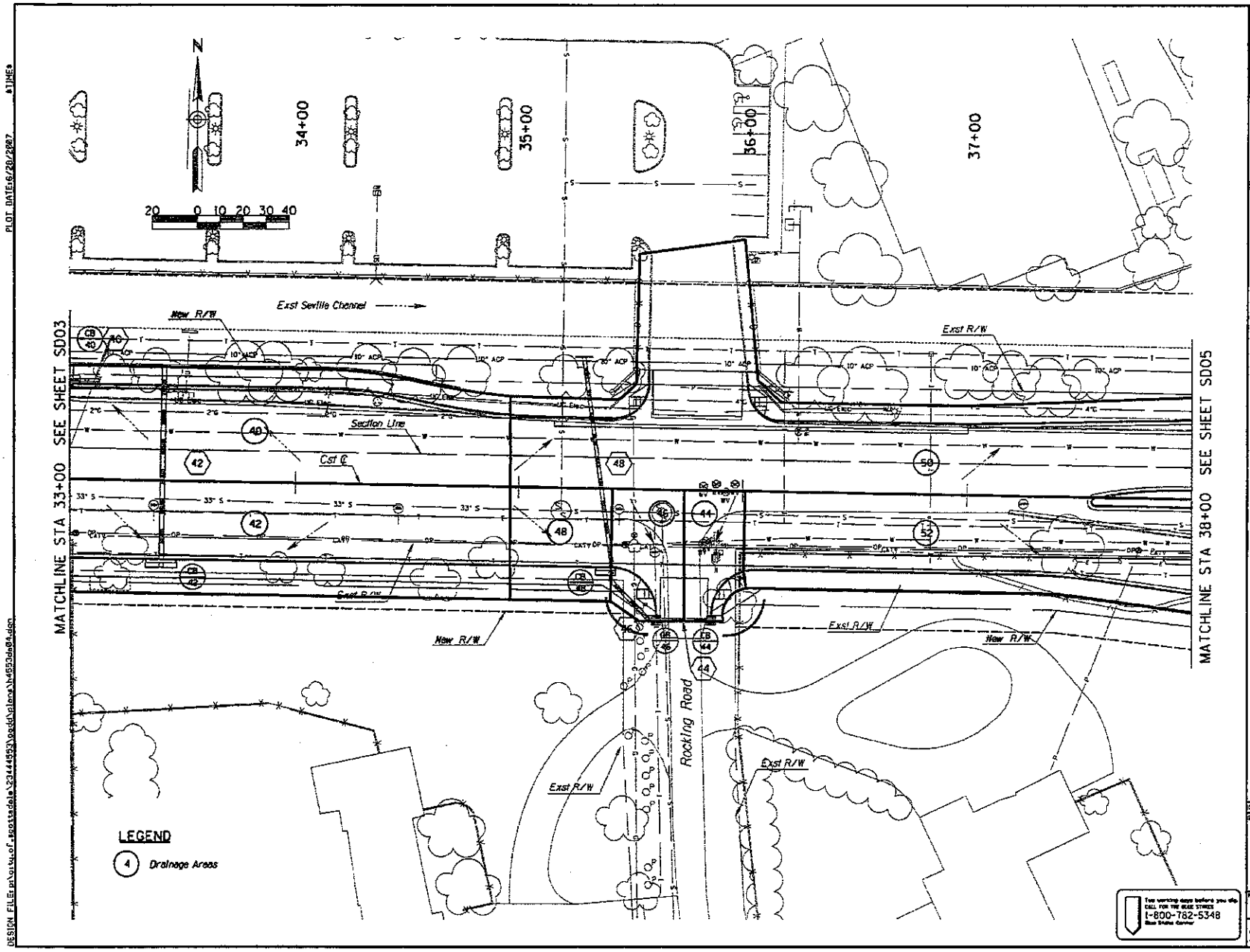
CAPITAL PROJECT MANAGEMENT

7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT
HORIZ. 1"=20'	DNJ	06/07		DA03
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE: p:\city_of_scottsdale\23444953\cadd\plans\h4953de03.dgn
PLOT DATE: 6/28/2007 $TIME$



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Phoenix, AZ. 85020
(602) 371-1100

DRAINAGE AREAS
STA 33+00 TO STA 38+00

DATE	REVISION	BY

ENGINEER

FINAL

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DNJ	06/07		DA04
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

Two working days before you dig
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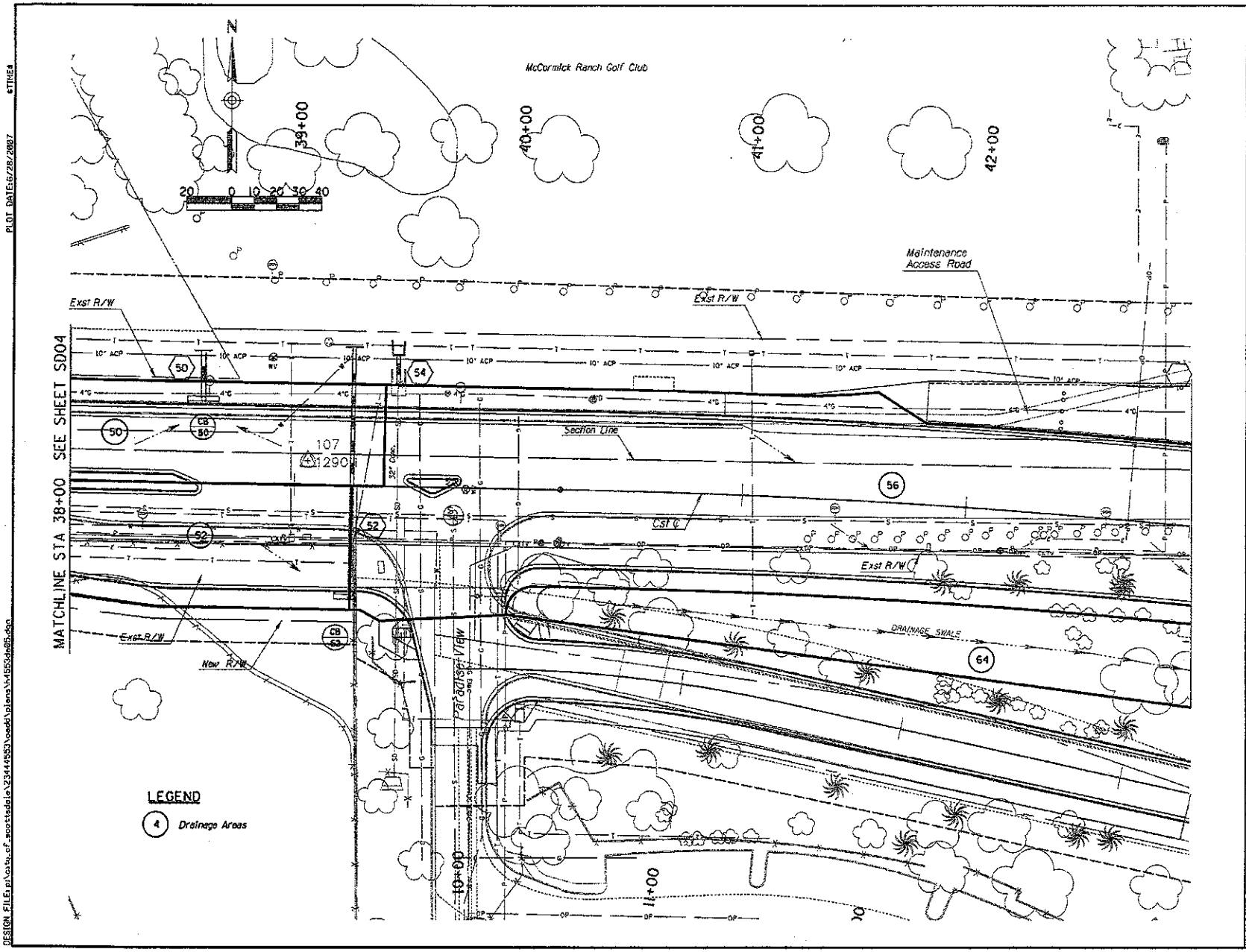
Blue Stake Center

PLOT DATE:6/28/2007 *TIME*
DESIGN FILE: p:\cou_of_scottsdale\23444993\dgn\plans\h4652da04.dgn



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7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

DRAINAGE AREAS
STA 38+00 TO STA 43+00

DATE	REVISION	BY

ENGINEER

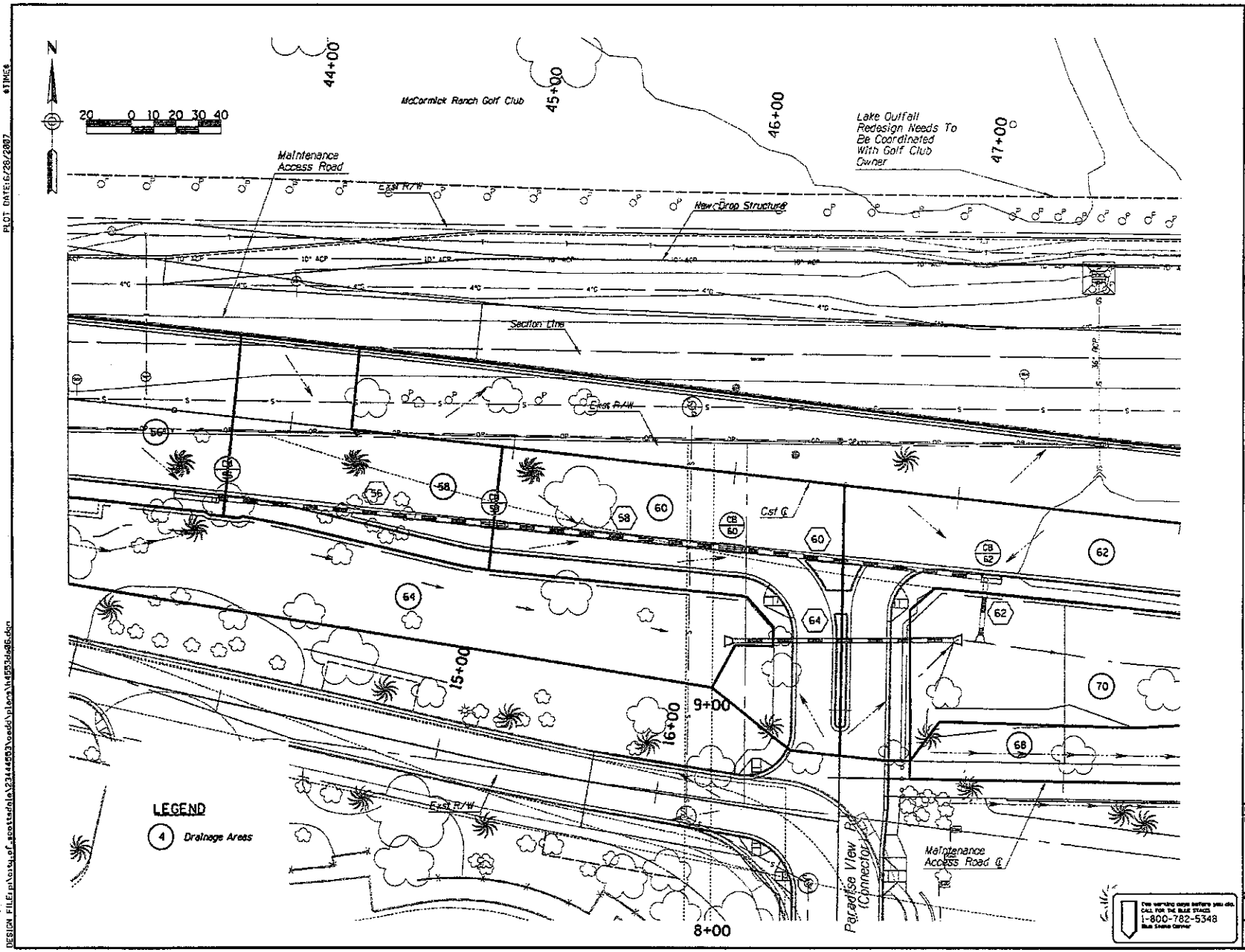
FINAL

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DNJ	06/07		DA05
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE: p:\cotsu_cf_scottsdale\23444553\cadd\plans\h4553de05.dgn
PLOT DATE: 6/28/2007 STIKES



DESIGN FILE: p:\city_of_scottsdale\23444593\cadd\plans\1b4553da-06.dgn

PLOT DATE: 6/28/2007 $TIME$

URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

DRAINAGE AREAS
STA 43+00 TO STA 48+00

DATE	REVISION	BY

ENGINEER

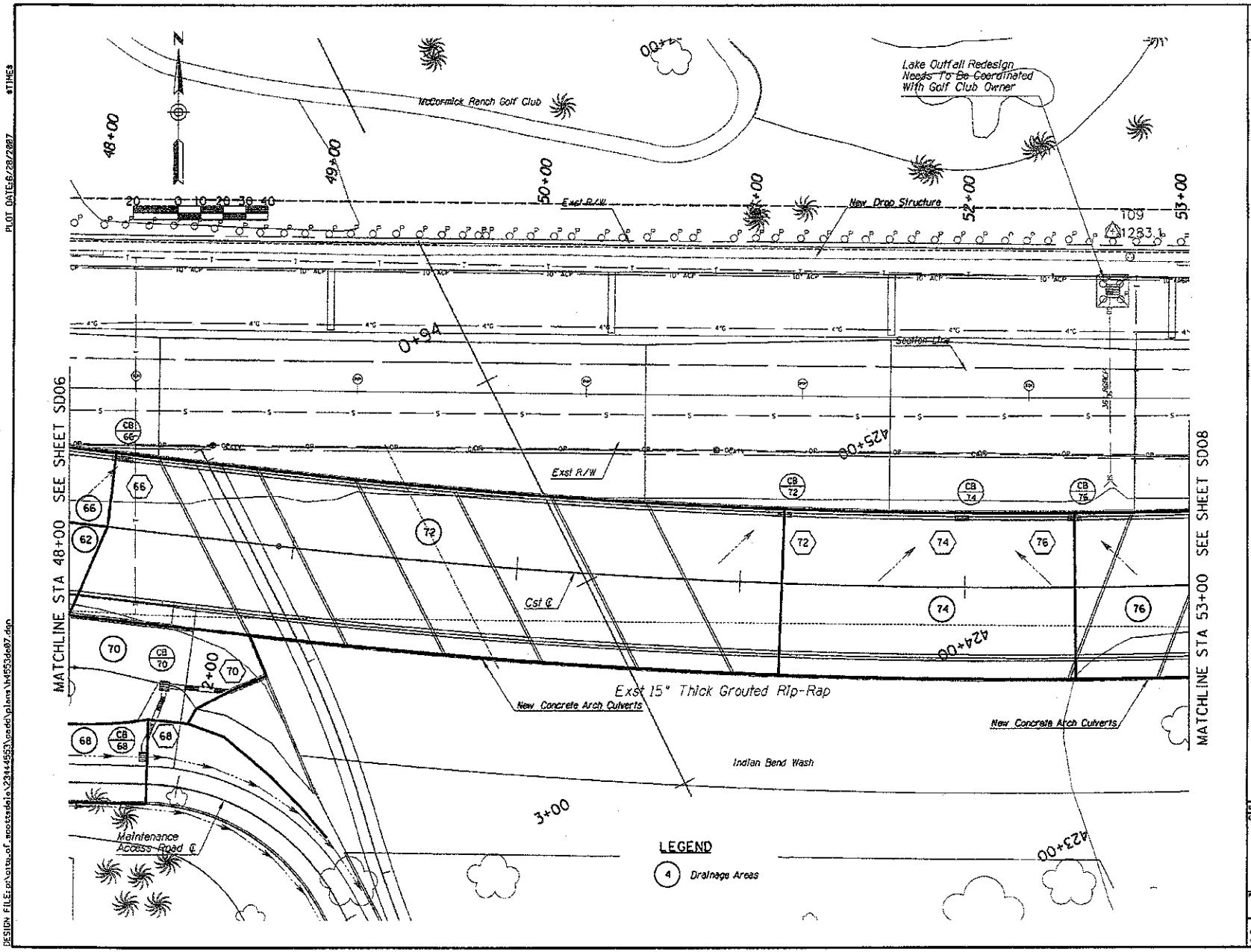
FINAL

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

This warning notice satisfies your obligation to CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORZ. 1"=20'	DNJ	05/07		D406
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-5-0402	OF



URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

DRAINAGE AREAS
STA 48+00 TO STA 53+00

DATE	REVISION	BY

ENGINEER

FINAL

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=20'	DNJ	06/07		DA07
VERT. N/A	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0602	OF

PLOT DATE:6/28/2007 STIMES

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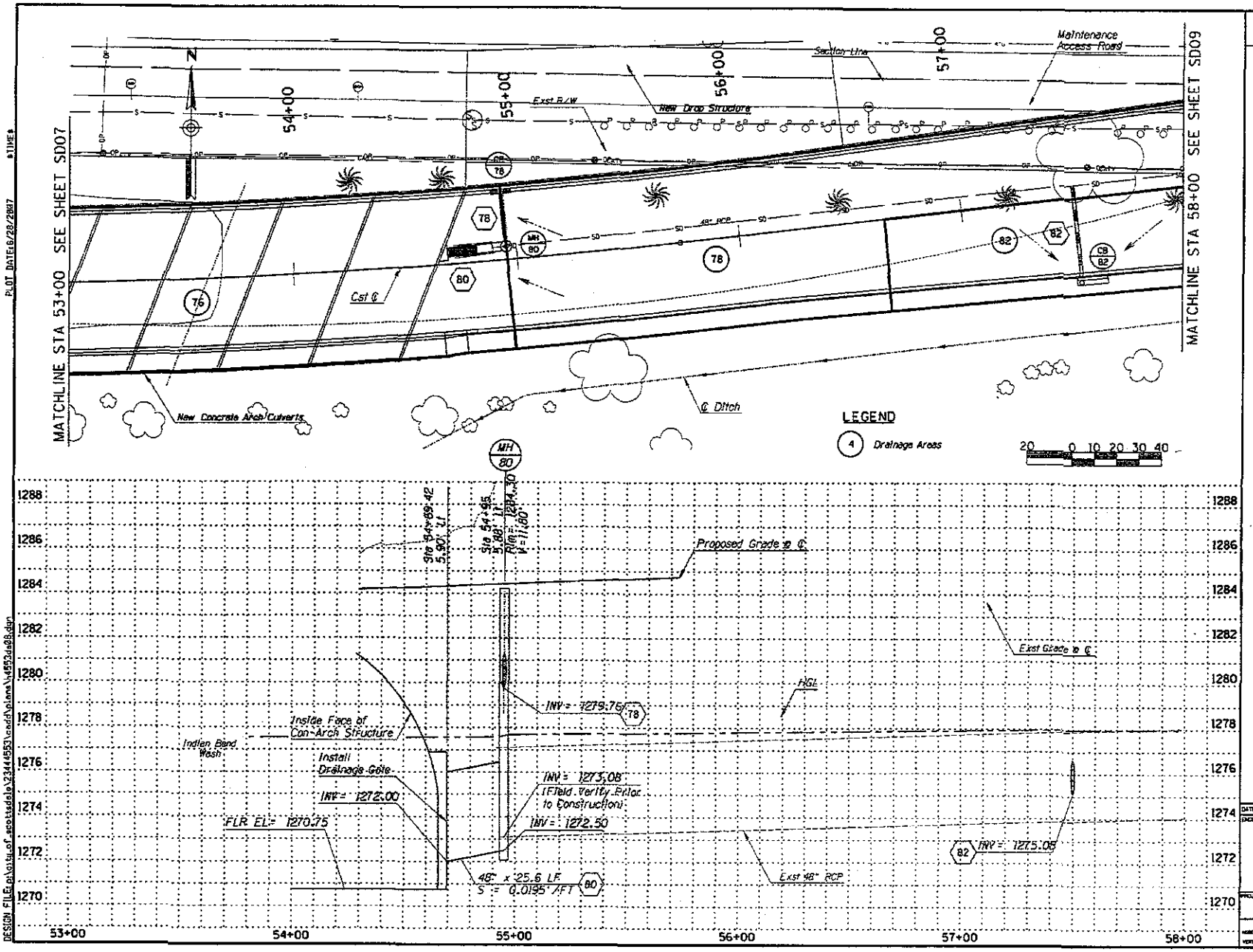


URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

Too working days before you dig
CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

DRAINAGE AREAS
STA 53+00 TO STA 58+00

DATE	REVISION	BY

ENGINEER

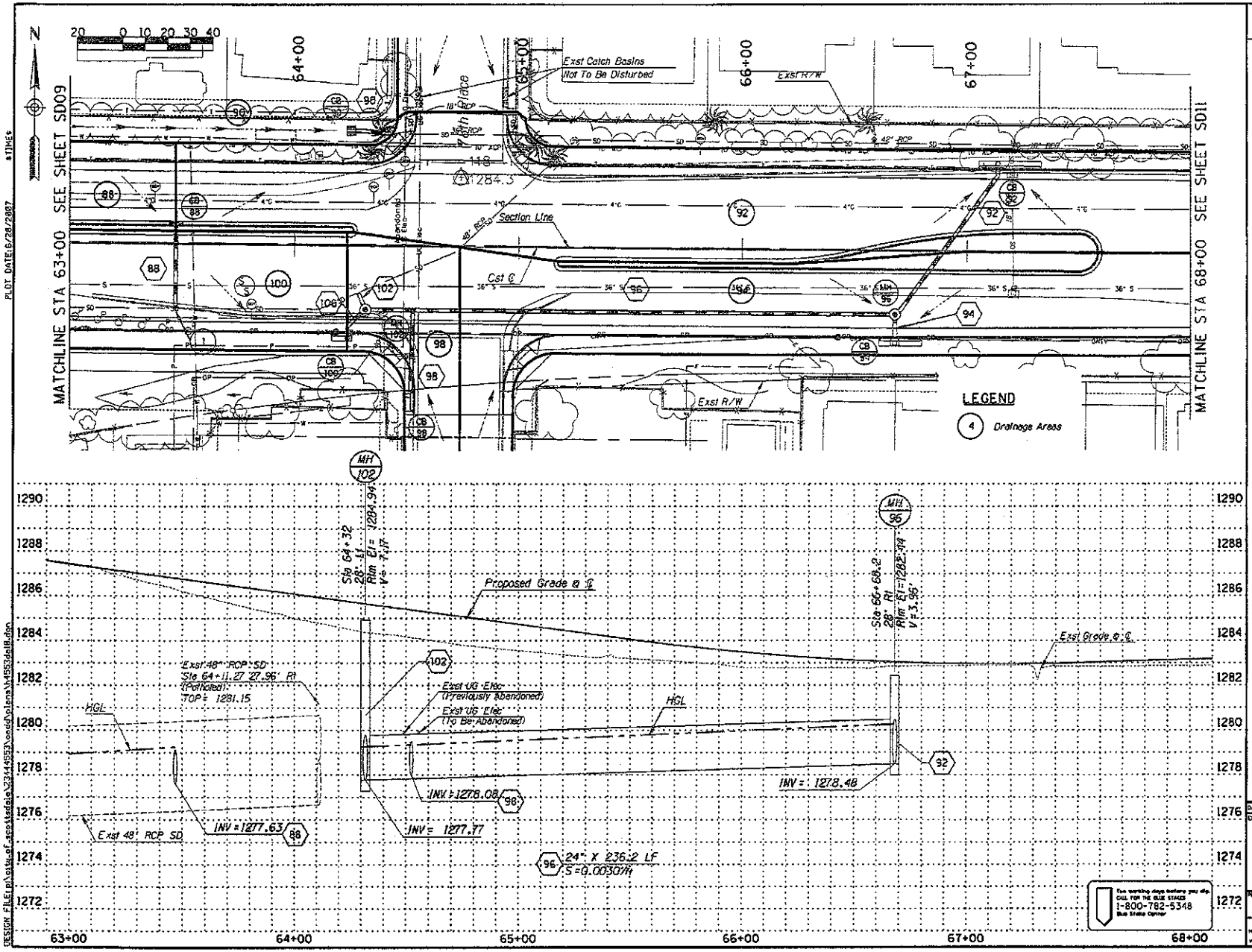
FINAL

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Bridge 64
Indian Bend Wash
Hydraulic Plan & Profile
For Left Bank Proposed Conditions

SCALE	DESIGNED	DATE	SHEET NO.	SHT.
HORZ. 1"=20' VERT. 1"=5'	DNJ			0408
	DRAWN JS	AS-BUILT	PROJECT NO. 410-5-0402	OF

PLOT DATE:6/28/2007
DESIGN FILE:p:\cts\of_scottsdale\23444553\road\plans\h4553da08.dgn



URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

DRAINAGE AREAS
STA 63+00 TO STA 68+00

DATE | REVISION | BY

ENGINEER

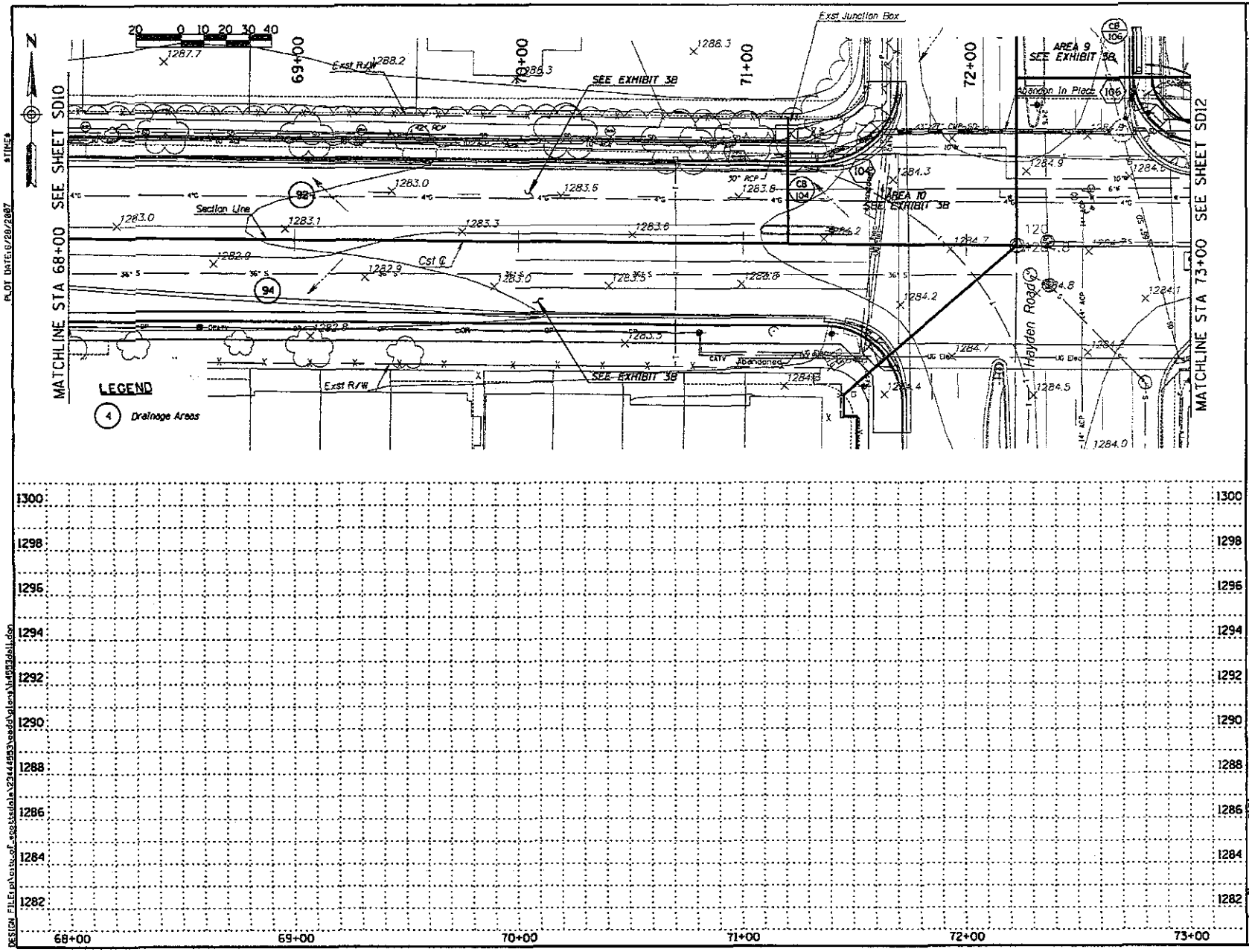
FINAL

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Exhibit 6A
Indian Bend Wash
Hydraulic Plan & Profile
For Left Bank Proposed Conditions

SCALE	DESIGNED	DATE	SID NO.	SHT.
HORIZ. 1"=20' VERT. 1"=5'	DNJ DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	DAIO of

DESIGN FILE:p:\city_of_scottsdale\23445593\cadd\plans\hh45533dei8.dgn
PLOT DATE:6/28/2007 $TIME$



URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

Two working days before you dig.
CALL FOR THE BLUE STAKES
1-800-782-5348
Blue Stake Center

DRAINAGE AREAS
STA 68+00 TO STA 73+00

DATE	REVISION	BY

ENGINEER

FINAL

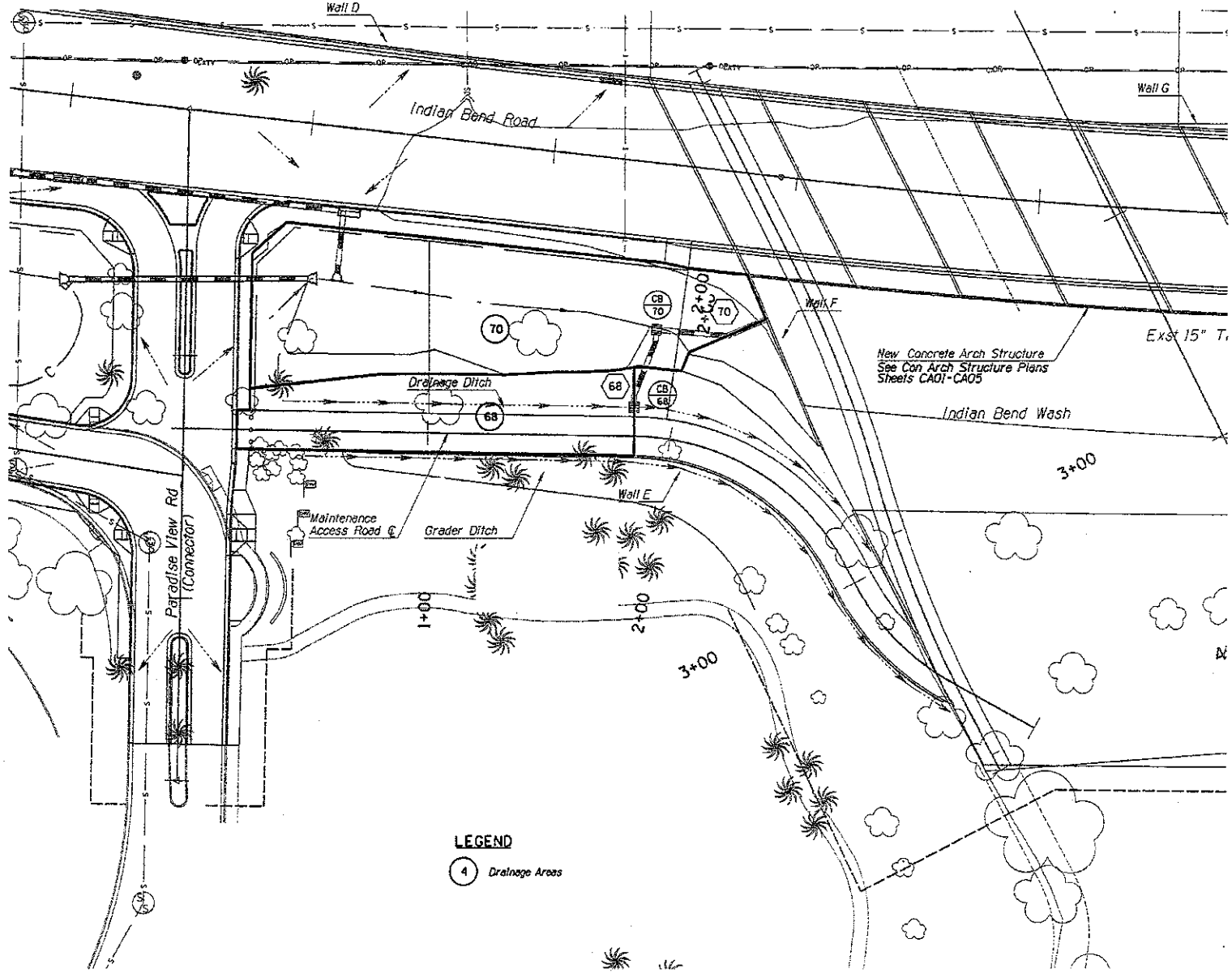
MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Exhibit 6A
Indian Bend Wash
Hydraulic Plan & Profile
For Left Bank Proposed Conditions

HORIZ.	DESIGNED	DATE	SHEET NO.	SHT.
HORIZ. 1"=20'	DNJ			DA11
VERT. 1"=5'	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE: p:\ccu_of_scottsdale\2344053\cadd\plans\in4053dell.dgn

PLOT DATE: 6/28/2007 $TIME$



URS
7720 N. 16th Street, Suite 100
Phoenix, AZ. 85020
(602) 371-1100

STORM DRAIN AREAS
MAINTENANCE ACCESS ROAD

DATE	REVISION	BY

ENGINEER

90% PRELIMINARY NOT FOR CONSTRUCTION

MUNICIPAL SERVICES DEPARTMENT
CAPITAL PROJECT MANAGEMENT
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

PROJECT TITLE
Indian Bend Road Improvements
Scottsdale Rd To Hayden Rd

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORZ. 1"=	DNJ	06/07		SD12
VERT.	DRAWN JS	AS-BUILT	PROJECT NO. 410-S-0402	OF

DESIGN FILE: pw:\city_of_scottsdale\23444553\ead\plans\h4553ed13.dgn
PLOT DATE: 6/28/2007

APPENDIX I
OFF-SITE HYDROLOGIC AND HYDRAULICS COMPUTATIONS

Hydrologic Data
McCormick-Stillman Railroad Park

Area No.	Description	Drainage Area	HGS	Composite Runoff Coefficient		Flow Path		Average Velocity	Time of Conc. Tc(2)	Rainfall Intensity		Total Q(2)	
		A	A, B, C or D	C-10 Year	C-100 Year	Length (L)	Slope	V_{av}	Tc	I-10 Year	I-100 Year	10-Year	100-Year
		acres				(ft)	(ft/ft)	(fps)	Minutes	Inches/Hour	Inches/Hour	cfs	cfs
1		3.07	B	0.89	0.89	710	0.005352	2.15	5.50	5.9	9.0	16.0	24.7
2		1.35	B	0.40	0.46	200	0.000500	1.25	2.67	6.1	9.2	3.6	6.5
3		9.08	B	0.39	0.47	1080	0.001870	2.32	7.74	5.2	8.0	18.6	34.0
4		10.62	B	0.68	0.81	1810	0.003646	1.59	18.93	3.6	5.3	25.9	45.3
5		8.63	B	0.40	0.47	660	0.010000	1.70	6.47	5.6	8.6	19.3	35.0
6		1.66	B	0.64	0.68	540	0.012121	0.82	11.01	4.6	7.0	4.9	7.9
7		2.18	B	0.95	0.95	400	0.016500	1.20	5.54	5.9	7.9	12.2	18.6
1, 2, 3 & 4		24.12	B	0.56	0.65	3390	0.003570	1.97	28.72	2.9	4.7	39.8	74.1

(1) Minimum T_c is set at 5 minutes.

(2) Runoff Peaks shown are from the specific area only. It does not include runoffs from upstream areas. Areas 1, 2 and 3 have upstream subfasins. Area 1 has Areas 2, 3, and 4. Area 2 has areas 3 and 4. Area 3 has area 4.

4/29/2006

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements
Concentration Point: CP1, Areas 1, 2, 3 and 4
Location: McCormick-Stillman Railroad Park
Project No.: 410-S-0402
Station:
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Scottsdale Road	A1	1.91	1.91	1.91	1.91	1.91	1.91	acres
Scottsdsale Road Grassed Ditch	A2	0.33	0.33	0.33	0.33	0.33	0.33	acres
Sands North Townhouses	A3	8.38	8.38	8.38	8.38	8.38	8.38	acres
Park Grassed Area	A4	8.14	8.14	8.14	8.14	8.14	8.14	acres
Desert Landscaping, no barrier	A5	1.31	1.31	1.31	1.31	1.31	1.31	acres
Impervious Area, Bldgs & Paved	A6	4.05	4.05	4.05	4.05	4.05	4.05	acres
	Total (A)	24.12	24.12	24.12	24.12	24.12	24.12	acres
Drainage Length		3390	3390	3390	3390	3390	3390	feet
Elevations:								
Top of Drainage Area		1302.6	1302.6	1302.6	1302.6	1302.6	1302.6	feet
At Structure		1290.5	1290.5	1290.5	1290.5	1290.5	1290.5	feet
Drainage Area Slope		0.00357	0.00357	0.00357	0.00357	0.00357	0.00357	ft/ft
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	28.72	28.72	28.72	28.72	28.72	28.72	minutes
Rainfall Intensity (I) - *see Figure 4-4*		1.7	2.3	2.9	3.3	3.7	4.7	in/hr
Runoff Coefficient (C) ↗	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.33	0.33	0.33	0.36	0.40	0.41	
	C_3	0.63	0.63	0.63	0.69	0.76	0.79	
	C_4	0.33	0.33	0.33	0.36	0.40	0.41	
	C_5	0.31	0.31	0.31	0.34	0.37	0.39	
	C_6	0.95	0.95	0.95	0.95	0.95	0.95	
Weighted Runoff Coefficient (C_w)	C_w	0.57	0.57	0.57	0.60	0.64	0.65	
Peak Discharge $Q_p = C_w IA(F)$		23.35	31.59	39.84	48.00	56.80	74.05	cfs

Computed By: Dave Schaub
Date: 29 April 2006

Checked By:
Date:

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements Concentration Point: CP1- Area 1 only
Location: McCormick-Stillman Railroad Park
Project No.: 410-S-0402 Station:
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Impervious Areas Bldgs & Paved	A1	2.76	2.76	2.76	2.76	2.76	2.76	acres
Desert Landscaping, no barrier	A2	0.31	0.31	0.31	0.31	0.31	0.31	acres
	A3							acres
	A4							acres
	A5							acres
	Total (A)	3.07	3.07	3.07	3.07	3.07	3.07	acres
Drainage Length		710	710	710	710	710	710	feet
Elevations:								
Top of Drainage Area		1294.3	1294.3	1294.3	1294.3	1294.3	1294.3	feet
At Structure		1290.5	1290.5	1290.5	1290.5	1290.5	1290.5	feet
Drainage Area Slope		0.00535	0.00535	0.00535	0.00535	0.00535	0.00535	ft/ft
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5.5	5.5	5.5	5.5	5.5	5.5	minutes
Rainfall Intensity (I) - *see Figure 4-4*		3.6	4.8	5.9	6.8	7.8	9	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.31	0.31	0.31	0.34	0.37	0.39	
	C_3							
	C_4							
	C_5							
Weighted Runoff Coefficient (C_w)	C_w	0.89	0.89	0.89	0.89	0.89	0.89	
Peak Discharge $Q_p = C_w IA(F)$		9.79	13.05	16.04	18.55	21.35	24.68	cfs

Computed By: Dave Schaub Date: 29 April 2006

Checked By: Date:

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

URS

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements Concentration Point: CP2-Area 2 only
Location: McCormick-Stillman Railroad Park
Project No.: 410-S-0402 Station:
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Desert Landscaping, no barrier	A1	1.00	1.00	1.00	1.00	1.00	1.00	acres
Railroad Bed	A2	0.18	0.18	0.18	0.18	0.18	0.18	acres
Impervious Areas, Bldgs & S/Ws	A3	0.17	0.17	0.17	0.17	0.17	0.17	acres
	A4							acres
	A5							acres
	Total (A)	1.35	1.35	1.35	1.35	1.35	1.35	acres
Drainage Length		670	670	670	670	670	670	feet
Elevations:								
Top of Drainage Area		1296.0	1296.0	1296.0	1296.0	1296.0	1296.0	feet
At Structure		1291.9	1291.9	1291.9	1291.9	1291.9	1291.9	feet
Drainage Area Slope		0.00619	0.00619	0.00619	0.00619	0.00619	0.00619	ft/ft
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	minutes
Rainfall Intensity (I) - *see Figure 4-4*		3.6	5	6.1	7	8	9.2	in/hr
Runoff Coefficient (C)	C_1	0.31	0.31	0.31	0.34	0.37	0.39	
	C_2	0.70	0.70	0.70	0.77	0.84	0.88	
	C_3	0.95	0.95	0.95	0.95	0.95	0.95	
	C_4							
	C_5							
Weighted Runoff Coefficient (C_w)	C_w	0.44	0.44	0.44	0.47	0.51	0.52	
Peak Discharge $Q_p = C_wIA(F)$		2.15	2.99	3.64	4.49	5.48	6.50	cfs

Computed By: Dave Schaub Date: 29 April 2006

Checked By: Date:

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements Concentration Point: CP3-Area 3 only
Location: McCormick-Stillman Railroad Park
Project No.: 410-S-0402 Station:
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Park Grass Area	A1	8.14	8.14	8.14	8.14	8.14	8.14	acres
Impervious Areas, Bldgs & S/Ws	A2	0.94	0.94	0.94	0.94	0.94	0.94	acres
	A3							acres
	A4							acres
	A5							acres
	Total (A)	9.08	9.08	9.08	9.08	9.08	9.08	acres
Drainage Length		670	670	670	670	670	670	feet
Elevations:								
Top of Drainage Area		1296.0	1296.0	1296.0	1296.0	1296.0	1296.0	feet
At Structure		1291.9	1291.9	1291.9	1291.9	1291.9	1291.9	feet
Drainage Area Slope		0.00619	0.00619	0.00619	0.00619	0.00619	0.00619	ft/ft
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	7.74	7.74	7.74	7.74	7.74	7.74	minutes
Rainfall Intensity (I) - *see Figure 4-4*		3.2	4.2	5.2	6	6.9	8	in/hr
Runoff Coefficient (C)	C_1	0.33	0.33	0.33	0.36	0.40	0.41	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
	C_4							
	C_5							
Weighted Runoff Coefficient (C_w)	C_w	0.39	0.39	0.39	0.42	0.45	0.47	
Peak Discharge $Q_p = C_w IA(F)$		11.45	15.03	18.61	23.09	28.40	34.01	cfs

Computed By: Dave Schaub Date: 29 April 2006

Checked By: Date:

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements Concentration Point: CP4, Area 4
Location: McCormick-Stillman Railroad Park
Project No.: 410-S-0402 Station:
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Scottsdale Road	**A1**	1.91	1.91	1.91	1.91	1.91	1.91	acres
Scottsdsale Road Grassed Ditch	**A2**	0.33	0.33	0.33	0.33	0.33	0.33	acres
Sands North Townhouses	**A3**	8.38	8.38	8.38	8.38	8.38	8.38	acres
	A4							acres
	A5							acres
	Total (A)	10.62	10.62	10.62	10.62	10.62	10.62	acres
Drainage Length		660	660	660	660	660	660	feet
Elevations:								
Top of Drainage Area		1296.3	1296.3	1296.3	1296.3	1296.3	1296.3	feet
At Structure		1293.9	1293.9	1293.9	1293.9	1293.9	1293.9	feet
Drainage Area Slope		0.00364	0.00364	0.00364	0.00364	0.00364	0.00364	ft/ft
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	18.93	18.93	18.93	18.93	18.93	18.93	minutes
Rainfall Intensity (I) - *see Figure 4-4*		2.1	2.8	3.6	4	4.6	5.3	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.33	0.33	0.33	0.36	0.40	0.41	
	C_3	0.63	0.63	0.63	0.69	0.76	0.79	
	C_4							
	C_5							
Weighted Runoff Coefficient (C_w)	C_w	0.68	0.68	0.68	0.73	0.78	0.81	
Peak Discharge $Q_p = C_wIA(F)$		15.13	20.17	25.93	30.97	38.09	45.31	cfs

Computed By: Dave Schaub Date: 29 April 2006

Checked By: Date:

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements Concentration Point: CP5
Location: McCormick-Stillman Railroad Park
Project No.: 410-S-0402 Station:
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Park Grass Area	A1	7.68	7.68	7.68	7.68	7.68	7.68	acres
Impervious Areas, Bldgs & S/Ws	A2	0.95	0.95	0.95	0.95	0.95	0.95	acres
	A3							acres
	A4							acres
	A5							acres
	Total (A)	8.63	8.63	8.63	8.63	8.63	8.63	acres
Drainage Length		660	660	660	660	660	660	feet
Elevations:								
Top of Drainage Area		1296.3	1296.3	1296.3	1296.3	1296.3	1296.3	feet
At Structure		1293.9	1293.9	1293.9	1293.9	1293.9	1293.9	feet
Drainage Area Slope		0.00364	0.00364	0.00364	0.00364	0.00364	0.00364	ft/ft
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	6.47	6.47	6.47	6.47	6.47	6.47	minutes
Rainfall Intensity (I) - *see Figure 4-4*		3.5	4.6	5.6	6.5	7.4	8.6	in/hr
Runoff Coefficient (C)	C_1	0.33	0.33	0.33	0.36	0.40	0.41	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
	C_4							
	C_5							
Weighted Runoff Coefficient (C_w)	C_w	0.40	0.40	0.40	0.43	0.46	0.47	
Peak Discharge $Q_p = C_wIA(F)$		12.03	15.81	19.25	23.99	29.18	35.01	cfs

Computed By: Dave Schaub Date: 29 April 2006

Checked By: Date:

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements Concentration Point: CP6
Location: McCormick-Stillman Railroad Park
Project No.: 410-S-0402 Station:
Name of Stream Watershed

Design Data:

		Design Frequency						
		2	5	10	25	50	100	year
Drainage Area								
Park Grassed Area	A1	0.83	0.83	0.83	0.83	0.83	0.83	acres
Impervious Areas, Bldgs & S/Ws	A2	0.83	0.83	0.83	0.83	0.83	0.83	acres
	A3							acres
	A4							acres
	A5							acres
	Total (A)	1.66	1.66	1.66	1.66	1.66	1.66	acres
Drainage Length		540	540	540	540	540	540	feet
Elevations:								
Top of Drainage Area		1295.3	1295.3	1295.3	1295.3	1295.3	1295.3	feet
At Structure		1293.9	1293.9	1293.9	1293.9	1293.9	1293.9	feet
Drainage Area Slope		0.00259	0.00259	0.00259	0.00259	0.00259	0.00259	ft/ft
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

		Design Frequency						
		2	5	10	25	50	100	year
Time of Concentation	T_c	11.01	11.01	11.01	11.01	11.01	11.01	minutes
Rainfall Intensity (I) - *see Figure 4-4*		2.8	3.8	4.6	5.3	6	7	in/hr
Runoff Coefficient (C)	C_1	0.33	0.33	0.33	0.36	0.40	0.41	
	C_2	0.95	0.95	0.95	0.95	0.95	0.95	
	C_3							
	C_4							
	C_5							
Weighted Runoff Coefficient (C_w)	C_w	0.64	0.64	0.64	0.66	0.67	0.68	
Peak Discharge $Q_p = C_w IA(F)$		2.97	4.04	4.89	5.78	6.70	7.92	cfs

Computed By: Dave Schaub Date: 29 April 2006

Checked By: Date:

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements Concentration Point: CP7
Location: McCormick-Stillman Railroad Park
Project No.: 410-S-0402 Station:
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Impervious Areas Bldgs & Paved	A1	2.18	2.18	2.18	2.18	2.18	2.18	acres
	A2							acres
	A3							acres
	A4							acres
	A5							acres
	Total (A)	2.18	2.18	2.18	2.18	2.18	2.18	acres
Drainage Length		400	400	400	400	400	400	feet
Elevations:								
Top of Drainage Area		1294.4	1294.4	1294.4	1294.4	1294.4	1294.4	feet
At Structure		1293.0	1293.0	1293.0	1293.0	1293.0	1293.0	feet
Drainage Area Slope		0.00350	0.00350	0.00350	0.00350	0.00350	0.00350	ft/ft
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5.54	5.54	5.54	5.54	5.54	5.54	minutes
Rainfall Intensity (I) - *see Figure 4-4*		3.6	4.8	5.9	6.8	7.8	9	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2							
	C_3							
	C_4							
	C_5							
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		7.46	9.94	12.22	14.08	16.15	18.64	cfs

Computed By: Dave Schaub Date: 29 April 2006

Checked By: Date:

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

Area 1 Time of Concentraton
McCormick-Stillman Railroad Park

Flow Path Segment (Beginning @ Upstream End	Description	Upstream	Downstream	Flow Path		Average Velocity	Time of Travel Tt
		Elevation	Elevation	Length (L)	Slope(1)	V_{av}	Tt
		(ft)	(ft)	(ft)	(ft/ft)	(fps)	Minutes
1	Pavement Sheet Flow	1294.30	1293.10	200	0.006111	1.59	2.10
2	Channel Flow in East side of Parking Lot	1292.00	1290.50	510	0.002326	2.50	3.40
Total		1294.30	1290.50	710.00	0.005352	2.15	5.50

Tc =	**5.50**

(1) Slope listed is the predominate slope of the overall travel path. Some flow segments have a substantial drop at one or both of the termini.

(2) $V = 20.3284(S)^{0.5}$ for Shallow Concentrated Flow over Paved Surface

(3) $V = 16.1345(S)^{0.5}$ for Shallow Concentrated Flow over Grassed Surface

4/29/2006

Park Channel, Area 1 (Flow Length = 510')
Rating Table for Irregular Channel

Project Description	
Worksheet	Park Channel, Area 1 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002326 ft/ft

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

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	60.00	5.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	1,290.00	0.00	0.0	0.00	0.00
5.00	1,290.77	1.70	2.9	7.83	7.67
10.00	1,291.00	2.02	5.0	10.15	9.95
15.00	1,291.17	2.16	6.9	12.79	12.56
20.00	1,291.30	2.29	8.7	14.80	14.56
25.00	1,291.41	2.40	10.4	16.46	16.20
30.00	1,291.51	2.50	12.0	17.89	17.62
35.00	1,291.59	2.58	13.5	19.16	18.87
40.00	1,291.67	2.66	15.0	20.31	20.01
45.00	1,291.74	2.74	16.4	21.36	21.06
50.00	1,291.80	2.80	17.8	22.34	22.02
55.00	1,291.86	2.87	19.2	23.26	22.93
60.00	1,291.92	2.92	20.5	24.11	23.78

← $V_{av.} = 2.50$ fps

$T_t = \frac{510'}{2.5 \text{ fps}} = 3.40$ minutes

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Park Channel, Area 1 (Flow Length = 510')
Worksheet for Irregular Channel

AREA 1, Segment 1 Travel Time

Project Description	
Worksheet	Park Channel, Area 1 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002326 ft/ft
Discharge	60.00 cfs

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

Results		
Mannings Coefficient	0.022	
Water Surface Elev	1,291.92	ft
Elevation Range	90.00 to 1,292.00	
Flow Area	20.5	ft²
Wetted Perimeter	24.11	ft
Top Width	23.78	ft
Actual Depth	1.92	ft
Critical Elevation	1,291.54	ft
Critical Slope	0.008117	ft/ft
Velocity	2.92	ft/s
Velocity Head	0.13	ft
Specific Energy	1,292.05	ft
Froude Number	0.56	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+25	0.022

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	1,292.00
0+05	1,291.00
0+10	1,290.00
0+15	1,291.00
0+25	1,292.00

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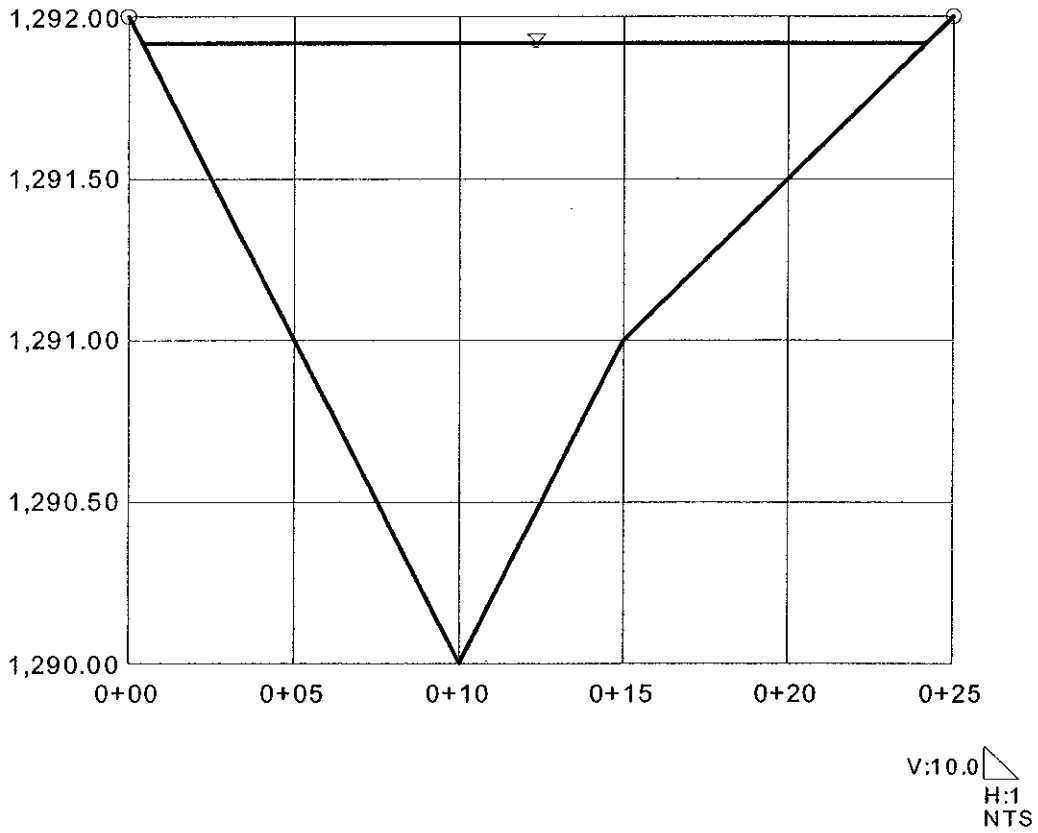
Park Channel, Area 1 (Flow Length = 510')
Cross Section for Irregular Channel

Project Description	
Worksheet	Park Channel, Area 1 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.022	
Slope	0.002326	ft/ft
Water Surface Elev	1,291.92	ft
Elevation Range	90.00 to 1,292.00	
Discharge	60.00	cfs



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Area 2 Time of Concentraton
McCormick-Stillman Railroad Park

Flow Path Segment (Beginning @ Upstream End	Description	Upstream	Downstream	Flow Path		Average Velocity	Time of Travel Tt
		Elevation	Elevation	Length (L)	Slope[1]	V_{av}	Tt
		(ft)	(ft)	(ft)	(ft/ft)	(fps)	Minutes
1	Channel Flow within the Park	1291.75	1291.65	200	0.000500	1.25	2.67
Total		1302.60	1296.00	200.00	0.000500	1.25	2.67

Tc =	**2.67**

(1) Slope listed is the predominate slope of the overall travel path. Some flow segments have a substantial drop at one or both of the termini.

4/28/2006

Park Channel, Area 2 (Flow Length = 200')
Rating Table for Irregular Channel

Channel Flow within Park

Project Description	
Worksheet	Park Channel, Area 2 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.000500 ft/ft

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

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	60.00	5.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	1,291.00	0.00	0.0	0.00	0.00
5.00	1,291.52	0.62	8.1	30.93	30.90
10.00	1,291.68	0.73	13.6	40.12	40.08
15.00	1,291.79	0.81	18.4	46.71	46.66
20.00	1,291.88	0.87	22.9	52.03	51.97
25.00	1,291.96	0.92	27.1	56.57	56.51
30.00	1,292.02	0.97	30.8	59.33	59.26
35.00	1,292.07	1.03	33.9	59.98	59.89
40.00	1,292.12	1.08	36.9	60.60	60.48
45.00	1,292.17	1.13	39.7	61.18	61.05
50.00	1,292.22	1.18	42.5	61.74	61.58
55.00	1,292.26	1.22	45.1	62.28	62.10
60.00	1,292.30	1.26	47.7	62.79	62.59

← $V_{av} = 1.25$ fps

$$T_t = \frac{200'}{1.25 fps} = 2.67 \text{ minutes}$$

1/7

Park Channel, Area 2 (Flow Length = 200')
Worksheet for Irregular Channel

Project Description	
Worksheet	Park Channel, Area 2 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.000500	ft/ft
Discharg	60.00	cfs

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

Results		
Mannings Coefficie	0.022	
Water Surface Elev	1,292.30	ft
Elevation Range	1.00 to 1,293.00	
Flow Area	47.7	ft²
Wetted Perimeter	62.79	ft
Top Width	62.59	ft
Actual Depth	1.30	ft
Critical Elevation	1,291.76	ft
Critical Slope	0.009741	ft/ft
Velocity	1.26	ft/s
Velocity Head	0.02	ft
Specific Energy	1,292.32	ft
Froude Number	0.25	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+71	0.022

Natural Channel Points

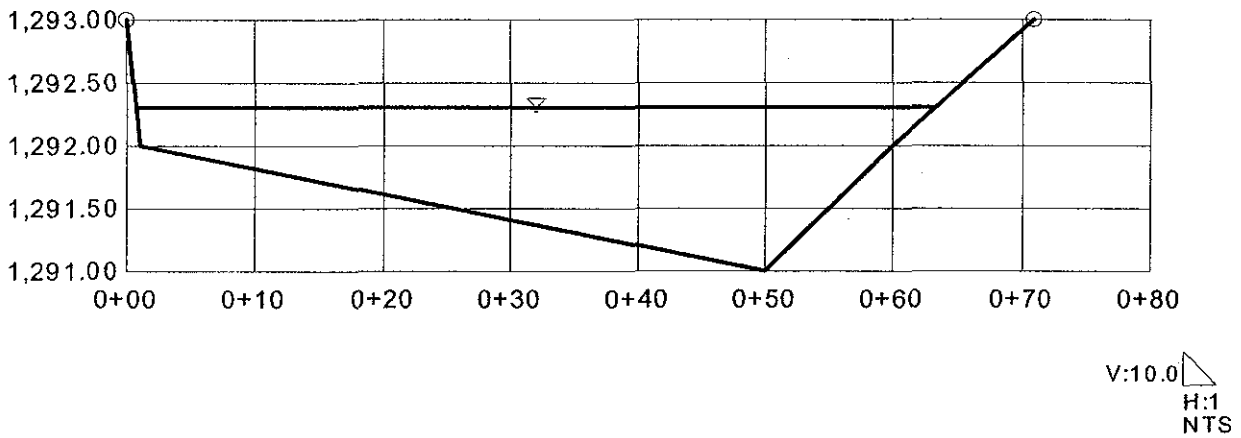
Station (ft)	Elevation (ft)
0+00	1,293.00
0+01	1,292.00
0+50	1,291.00
0+60	1,292.00
0+71	1,293.00

2/3

Park Channel, Area 2 (Flow Length = 200')
Cross Section for Irregular Channel

Project Description	
Worksheet	Park Channel, Area 2 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.022	
Slope	0.000500	ft/ft
Water Surface Elev	1,292.30	ft
Elevation Range	91.00 to 1,293.00	
Discharge	60.00	cfs



3/3

Area 3 Time of Concentraton
McCormick-Stillman Railroad Park

Flow Path Segment (Beginning @ Upstream End	Description	Upstream	Downstream	Flow Path		Average Velocity	Time of Travel Tt
		Elevation	Elevation	Length (L)	Slope[1]	V_{av}	Tt
		(ft)	(ft)	(ft)	(ft/ft)	(fps)	Minutes
1	McDowell Park Channel Flow	1297.00	1296.00	410	0.001870	1.70	4.02
2	Channel Flow within the Park	1296.00	1291.85	670	0.021500	3.00	3.72
Total		1297.00	1291.85	1080.00	0.001870	2.32	7.74

Tc =	**7.74**

(1) Slope listed is the predominate slope of the overall travel path. Some flow segments have a substantial drop at one or both of the termini.

4/29/2006

Park Channel, Area 3 (Flow Length = 670')
Rating Table for Irregular Channel

Channel Flow within Park

Project Description	
Worksheet	Park Channel, Area 3 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.021500 ft/ft

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

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	60.00	5.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	1,293.00	0.00	0.0	0.00	0.00
5.00	1,293.20	1.87	2.7	26.99	26.99
10.00	1,293.26	2.22	4.5	35.00	35.00
15.00	1,293.30	2.46	6.1	40.75	40.74
20.00	1,293.33	2.64	7.6	45.39	45.38
25.00	1,293.36	2.79	9.0	49.35	49.34
30.00	1,293.39	2.92	10.3	52.84	52.84
35.00	1,293.41	3.04	11.5	55.99	55.98
40.00	1,293.43	3.14	12.7	58.86	58.86
45.00	1,293.45	3.23	13.9	61.52	61.51
50.00	1,293.47	3.32	15.1	64.00	63.99
55.00	1,293.49	3.40	16.2	66.33	66.32
60.00	1,293.50	3.48	17.3	68.53	68.52

$V_{av} = 3.0$ fps

$T_c = \frac{670'}{3.0 \text{ fps}} = 3.72$ minutes

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Park Channel, Area 3 (Flow Length = 670')
Worksheet for Irregular Channel

Project Description	
Worksheet	Park Channel, Area 3 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.021500 ft/ft
Discharge	60.00 cfs

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

Results		
Mannings Coefficient	0.025	
Water Surface Elev	1,293.50	ft
Elevation Range	93.00 to 1,294.00	
Flow Area	17.3	ft²
Wetted Perimeter	68.53	ft
Top Width	68.52	ft
Actual Depth	0.50	ft
Critical Elevation	1,293.55	ft
Critical Slope	0.014044	ft/ft
Velocity	3.48	ft/s
Velocity Head	0.19	ft
Specific Energy	1,293.69	ft
Froude Number	1.22	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	1+36	0.025

Natural Channel Points

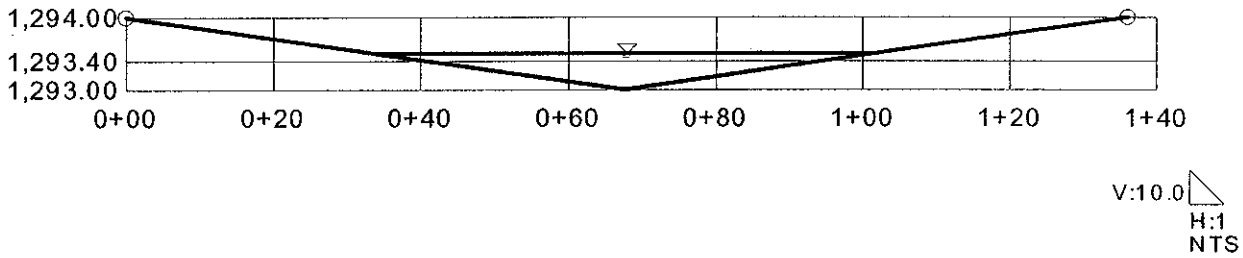
Station (ft)	Elevation (ft)
0+00	1,294.00
0+68	1,293.00
1+36	1,294.00

2 of 3

Park Channel, Area 3 (Flow Length = 670')
Cross Section for Irregular Channel

Project Description	
Worksheet	Park Channel, Area 3 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficiei	0.025	
Slope	0.021500	ft/ft
Water Surface Elev	1,293.50	ft
Elevation Range	93.00 to 1,294.00	
Discharge	60.00	cfs



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Area 4 Time of Concentraton
McCormick-Stillman Railroad Park

Flow Path Segment (Beginning @ Upstream End	Description	Upstream	Downstream	Flow Path		Average Velocity	Time of Travel Tt
		Elevation	Elevation	Length (L)	Slope[1]	V_{av}	Tt
		(ft)	(ft)	(ft)	(ft/ft)	(fps)	Minutes
1	Scottsdale Road Curb and Gutter	1302.60	1301.00	790	0.002025	1.60	8.23
2	Sands North Street Flow	1301.00	1297.00	610	0.002390	1.50	6.68
3	McDowell Park Channel Flow	1297.00	1296.00	410	0.001870	1.70	4.02
Total		1302.60	1296.00	1810.00	0.003646	1.59	18.93

Tc =	**18.93**

(1) Slope listed is the predominate slope of the overall travel path. Some flow segments have a substantial drop at one or both of the termini.

4/28/2006

Curb & Gutter Scottsdale Rd NB (Flow Length = 790')

Rating Table for Gutter Section

AREA 4, Segment 1 of Flow Path

Project Description	
Worksheet	ScottsdaleR
Type	Gutter Sectio
Solve For	Spread

Input Data		
Slope	002025	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slop	041667	ft/ft
Road Cross Slop	020000	ft/ft
Mannings Coeffic	0.016	

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.50	10.00	0.25

Discharge (cfs)	Spread (ft)	Velocity (ft/s)
0.50	7.27	0.91
0.75	8.54	1.00
1.00	9.56	1.07
1.25	10.42	1.13
1.50	11.18	1.18
1.75	11.87	1.22
2.00	12.49	1.26
2.25	13.06	1.30
2.50	13.60	1.34
2.75	14.11	1.37
3.00	14.58	1.40
3.25	15.03	1.42
3.50	15.46	1.45
3.75	15.87	1.48
4.00	16.27	1.50
4.25	16.65	1.52
4.50	17.01	1.54
4.75	17.36	1.56
5.00	17.70	1.58
5.25	18.03	1.60
5.50	18.35	1.62
5.75	18.67	1.64
6.00	18.97	1.66
6.25	19.26	1.67
6.50	19.55	1.69
6.75	19.83	1.71
7.00	20.11	1.72
7.25	20.37	1.74
7.50	20.64	1.75
7.75	20.89	1.77
8.00	21.15	1.78
8.25	21.39	1.79
8.50	21.64	1.81
8.75	21.87	1.82
9.00	22.11	1.83
9.25	22.34	1.85
9.50	22.56	1.86

← $V_{av} = 1.6$ fps

Travel Time $(T_t) = \frac{790'}{1.6 fps} = 8.23$ minutes

1/4

Curb & Gutter Scottsdale Rd NB (Flow Length = 790')
Rating Table for Gutter Section

Discharge (cfs)	Spread (ft)	Velocity (ft/s)
9.75	22.79	1.87
10.00	23.00	1.88

2/4

Curb & Gutter ScottsdaleRd NB (Flow Length = 790')
Worksheet for Gutter Section

Project Description	
Worksheet	ScottsdaleR
Type	Gutter Sectic
Solve For	Spread

Input Data		
Slope	0.002025	ft/ft
Discharge	10.00	cfs
Gutter Width	1.42	ft
Gutter Cross Slo	041667	ft/ft
Road Cross Slop	020000	ft/ft
Mannings Coeffic	0.016	

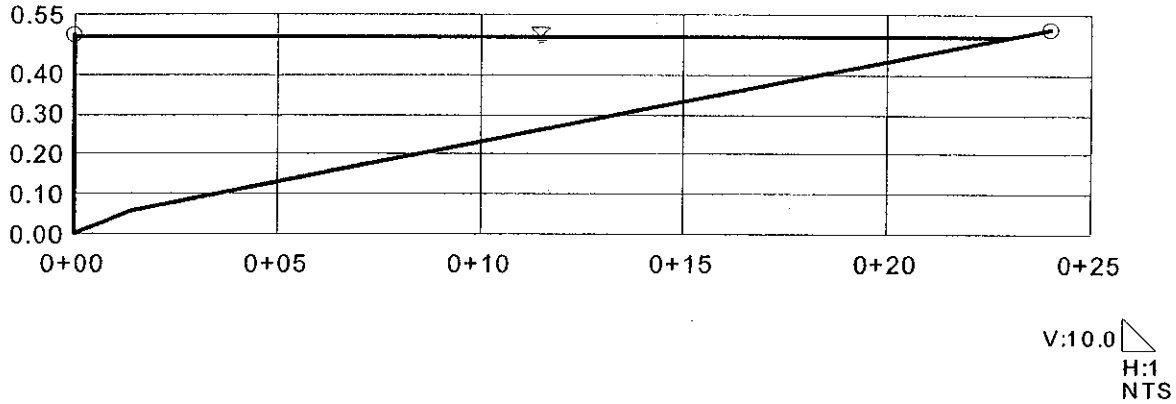
Results		
Spread	23.00	ft
Flow Area	5.3	ft²
Depth	0.49	ft
Gutter Depress	0.4	in
Velocity	1.88	ft/s

3/4

Curb & Gutter Scottsdale Rd NB(Flow Length = 790')
Cross Section for Gutter Section

Project Description	
Worksheet	ScottsdaleR
Type	Gutter Secti
Solve For	Spread

Section Data		
Slope	002025	ft/ft
Discharge	10.00	cfs
Gutter Width	1.42	ft
Gutter Cross Slo	041667	ft/ft
Road Cross Slop	020000	ft/ft
Spread	23.00	ft
Mannings Coeffic	0.016	



4/4

Sands North Townhouses (Flow Length = 601')

Rating Table for Irregular Channel

AREA 4, Segment 2 of Flow Path

Project Description	
Worksheet	Sands North Townhouses (Flow Le
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002390 ft/ft

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

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	15.00	1.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	100.00	0.00	0.0	0.00	0.00
1.00	100.16	0.82	1.2	15.94	15.63
2.00	100.20	0.97	2.1	20.68	20.27
3.00	100.24	1.08	2.8	24.07	23.60
4.00	100.26	1.16	3.5	26.81	26.28
5.00	100.28	1.23	4.1	28.57	28.00
6.00	100.30	1.33	4.5	28.61	28.00
7.00	100.32	1.41	5.0	28.64	28.00
8.00	100.33	1.49	5.4	28.67	28.00
9.00	100.35	1.56	5.8	28.70	28.00
10.00	100.36	1.63	6.2	28.73	28.00
11.00	100.37	1.69	6.5	28.75	28.00
12.00	100.39	1.75	6.9	28.78	28.00
13.00	100.40	1.80	7.2	28.80	28.00
14.00	100.41	1.86	7.5	28.82	28.00
15.00	100.42	1.91	7.9	28.85	28.00

← $V_{av.} = 1.5$ fps

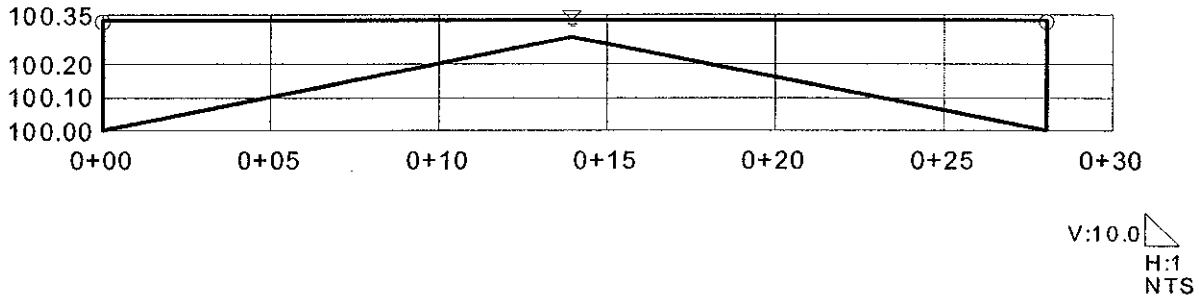
Travel time (T_t) = $\frac{601'}{1.5 fps}$ = 6.68 minutes

1/3

Sands North Townhouses (Flow Length = 601')
Cross Section for Irregular Channel

Project Description	
Worksheet	Sands North Townhouses (Flow Le
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.016	
Slope	0.002390	ft/ft
Water Surface Elev	100.33	ft
Elevation Range	).00 to 100.33	
Discharge	8.00	cfs



2/3

Sands North Townhouses (Flow Length = 601')
Worksheet for Irregular Channel

Project Description	
Worksheet	Sands North Townhouses (Flow Le
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.002390	ft/ft
Discharg	8.00	cfs

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

Results		
Mannings Coefficie	0.016	
Water Surface Elev	100.33	ft
Elevation Range	).00 to 100.33	
Flow Area	5.4	ft²
Wetted Perimeter	28.67	ft
Top Width	28.00	ft
Actual Depth	0.33	ft
Critical Elevation	100.28	ft
Critical Slope	0.007417	ft/ft
Velocity	1.49	ft/s
Velocity Head	0.03	ft
Specific Energy	100.37	ft
Froude Number	0.60	
Flow Type	Subcritical	

Calculation Messages:
Water elevation exceeds lowest end station by 0.20528662e-2 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00	0+28	0.016

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00	100.33
0+00	100.00
0+14	100.28
0+28	100.00
0+28	100.33

3/3

Channel E Wall Sands North Townhouses (Flow Length = 410')

Rating Table for Irregular Channel

AREA 4, Segment 3 of Flow Path

Project Description	
Worksheet	Channel E Wall North Sands Townhouses (Flov
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.001870 ft/ft

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

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	20.00	2.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	1,296.26	0.00	0.0	0.00	0.00
2.00	1,296.67	1.02	2.0	9.53	9.50
4.00	1,296.80	1.21	3.3	12.36	12.32
6.00	1,296.88	1.34	4.5	14.39	14.34
8.00	1,296.96	1.44	5.6	16.03	15.97
10.00	1,297.02	1.51	6.6	17.86	17.79
12.00	1,297.08	1.54	7.8	20.34	20.27
14.00	1,297.13	1.58	8.9	22.44	22.37
16.00	1,297.18	1.61	9.9	24.27	24.20
18.00	1,297.22	1.64	10.9	25.92	25.84
20.00	1,297.25	1.68	11.9	27.42	27.34

← $V_{av} = 1.7$ fps

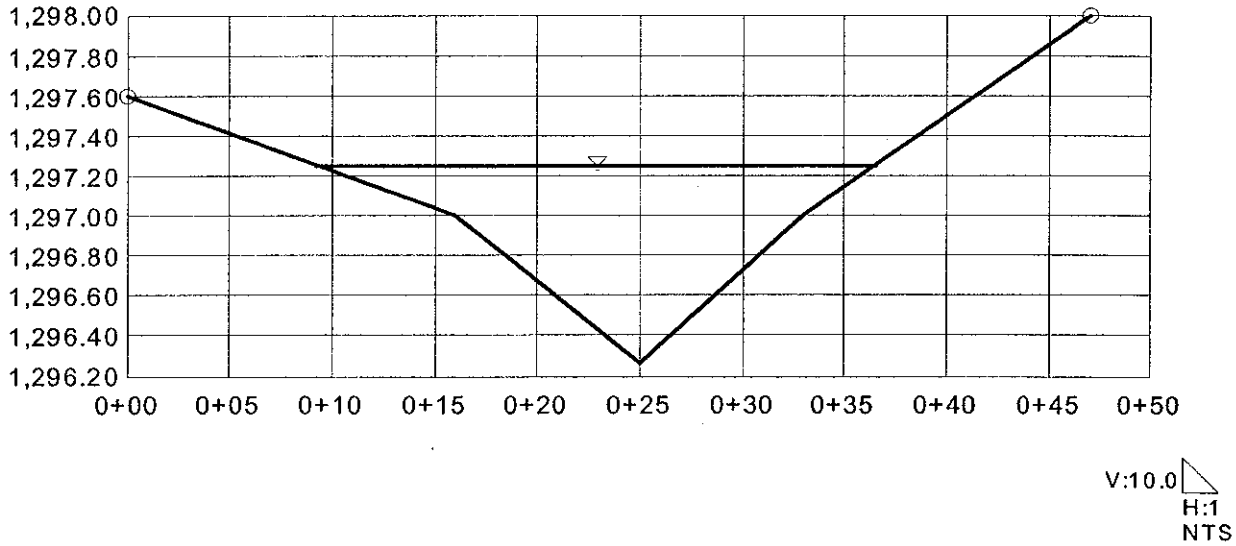
Travel Time (T_t) = $\frac{410'}{1.7 \text{ fps}}$ = 4.02 minutes

1/3

Channel E Wall Sands North Townhouses (Flow Length = 410')
Cross Section for Irregular Channel

Project Description	
Worksheet	Channel E Wall North Sands Townhouses (Flov
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficiei	0.022	
Slope	0.001870	ft/ft
Water Surface Elev	1,297.25	ft
Elevation Range	96.26 to 1,298.00	
Discharge	20.00	cfs



2/3

Channel E Wall North Sands Townhouses (Flow Length = 410')
Worksheet for Irregular Channel

Project Description	
Worksheet	Channel E Wall North Sands Townhouses (Flov
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	001870	ft/ft
Discharg	20.00	cfs

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

Results		
Mannings Coefficie	0.022	
Water Surface Elev	1,297.25	ft
Elevation Range	96.26 to 1,298.00	
Flow Area	11.9	ft²
Wetted Perimeter	27.42	ft
Top Width	27.34	ft
Actual Depth	0.99	ft
Critical Elevation	1,296.98	ft
Critical Slope	0.009982	ft/ft
Velocity	1.68	ft/s
Velocity Head	0.04	ft
Specific Energy	1,297.30	ft
Froude Number	0.45	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+47	0.022

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	1,297.60
0+16	1,297.00
0+25	1,296.26
0+33	1,297.00
0+47	1,298.00

3/3

		(ft)	(ft)	(ft)	(ft/ft)	(fps)	Minutes

Area 5 Time of Concentraton
McCormick-Stillman Railroad Park

Flow Path Segment (Beginning @ Upstream End	Description	Upstream	Downstream	Flow Path		Average Velocity	Time of Travel Tt
		Elevation	Elevation	Length (L)	Slope[1]	V_{av}	Tt
		(ft)	(ft)	(ft)	(ft/ft)	(fps)	Minutes
1	Channel Flow within the Park	1296.30	1293.90	660	0.003636	1.70	6.47
Total		1302.60	1296.00	660.00	0.010000	1.70	6.47

Tc =	**6.47**

(1) Slope listed is the predominate slope of the overall travel path. Some flow segments have a substantial drop at one or both of the termini.

4/29/2006

Park Channel, Area 5 (Flow Length = 660')
Rating Table for Irregular Channel

Channel Flow within Park

Project Description	
Worksheet	Park Channel, Area 5 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.003636 ft/ft

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

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	60.00	5.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	1,295.00	0.00	0.0	0.00	0.00
5.00	1,295.34	1.10	4.6	27.04	27.03
10.00	1,295.44	1.30	7.7	35.06	35.05
15.00	1,295.51	1.44	10.4	40.82	40.81
20.00	1,295.57	1.55	12.9	45.47	45.46
25.00	1,295.62	1.64	15.3	49.44	49.43
30.00	1,295.66	1.71	17.5	52.94	52.92
35.00	1,295.70	1.78	19.7	56.09	56.07
40.00	1,295.74	1.84	21.7	58.97	58.95
45.00	1,295.77	1.90	23.7	61.63	61.61
50.00	1,295.80	1.95	25.7	64.12	64.10
55.00	1,295.83	1.99	27.6	66.45	66.43
60.00	1,295.86	2.04	29.4	68.65	68.63

← $V_{av} = 1.9$ fps

Travel Time

$$T_t = \frac{660'}{1.9 \text{ fps}} = 6.47 \text{ minutes}$$

Park Channel, Area 5 (Flow Length = 660')
Worksheet for Irregular Channel

Project Description	
Worksheet	Park Channel, Area 5 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.003636	ft/ft
Discharge	35.00	cfs

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

Results		
Mannings Coefficient	0.025	
Water Surface Elev	1,295.70	ft
Elevation Range	95.00 to 1,296.00	
Flow Area	19.7	ft²
Wetted Perimeter	56.09	ft
Top Width	56.07	ft
Actual Depth	0.70	ft
Critical Elevation	1,295.54	ft
Critical Slope	0.014063	ft/ft
Velocity	1.78	ft/s
Velocity Head	0.05	ft
Specific Energy	1,295.75	ft
Froude Number	0.53	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+80	0.025

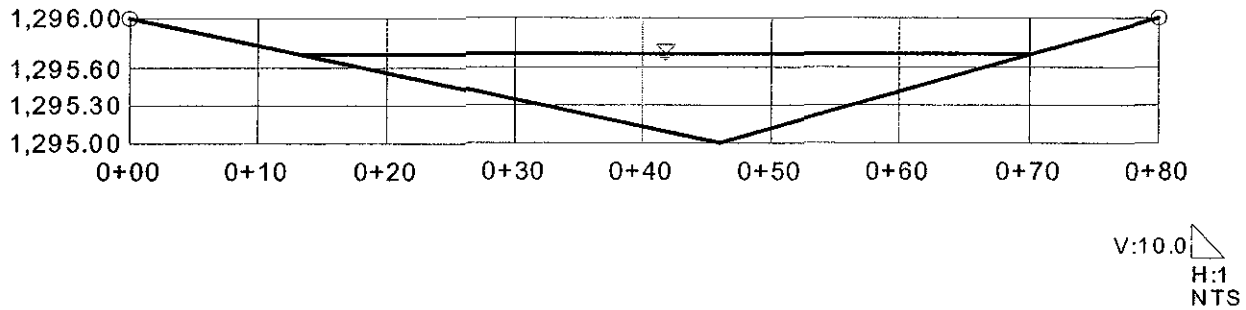
Natural Channel Points

Station (ft)	Elevation (ft)
0+00	1,296.00
0+46	1,295.00
0+80	1,296.00

Park Channel, Area 5 (Flow Length = 660')
Cross Section for Irregular Channel

Project Description	
Worksheet	Park Channel, Area 5 (Flow Lengt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficier	0.025	
Slope	0.003636	ft/ft
Water Surface Elev	1,295.70	ft
Elevation Range	95.00 to 1,296.00	
Discharge	35.00	cfs



Area 6 Time of Concentraton
McCormick-Stillman Railroad Park

Flow Path Segment (Beginning @ Upstream End	Description	Upstream	Downstream	Flow Path		Average Velocity	Time of Travel Tt
		Elevation	Elevation	Length (L)	Slope(1)	V_{av}	Tt
		(ft)	(ft)	(ft)	(ft/ft)	(fps)	Minutes
1	Grass Shallow Concentrated Flow	1295.30	1294.60	240	0.002917	0.87	4.59
2	Grass Shallow Concentrated Flow	1294.60	1293.90	300	0.002333	0.78	6.42
Total		1302.60	1296.00	540.00	0.012222	0.82	11.01

Tc =	**11.01**

(1) Slope listed is the predominate slope of the overall travel path. Some flow segments have a substantial drop at one or both of the termini.

(2) $V = 20.3284(S)^{0.5}$ for Shallow Concentrated Flow over Paved Surface

(3) $V = 16.1345(S)^{0.5}$ for Shallow Concentrated Flow over Grassed Surface

4/29/2006

Area 7 Time of Concentraton
McCormick-Stillman Railroad Park

Flow Path Segment (Beginning @ Upstream End	Description	Upstream	Downstream	Flow Path		Average Velocity	Time of Travel Tt
		Elevation	Elevation	Length (L)	Slope(1)	V_{av}	Tt
		(ft)	(ft)	(ft)	(ft/ft)	(fps)	Minutes
1	Pavement Shallow Concentrated Flow	1294.40	1293.00	400	0.003500	1.20	5.54
Total		1302.60	1296.00	400.00	0.016500	1.20	5.54

Tc =	**5.54**

(1) Slope listed is the predominate slope of the overall travel path. Some flow segments have a substantial drop at one or both of the termini.

(2) $V = 20.3284(S)^{0.5}$ for Shallow Concentrated Flow over Paved Surface

(3) $V = 16.1345(S)^{0.5}$ for Shallow Concentrated Flow over Grassed Surface

4/29/2006

Culvert Designer/Analyzer Report
1, BasinOF

Analysis Component			
Storm Event	Check	Discharge	200.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	10.00 cfs	Check Discharge	200.00 cfs

3 - 12" x 30' cmp under Railroad, AREA 3, "McClintock - Stillman Railroad Park"

NOTE: this culvert is upstream of another set of culverts located in Area #2.

Tailwater Conditions: Tailwater Rating	
Discharge (cfs)	TW Elev (ft)
0.00	1,291.70
5.00	1,292.93
10.00	1,293.96
15.00	1,294.03
20.00	1,294.07
25.00	1,294.10
30.00	1,294.12
35.00	1,294.14
40.00	1,294.16
45.00	1,294.18
50.00	1,294.20
55.00	1,294.22
60.00	1,294.24
65.00	1,294.25
70.00	1,294.27
75.00	1,294.28
80.00	1,294.30
85.00	1,294.31
90.00	1,294.32
95.00	1,294.34
100.00	1,294.35
110.00	1,294.37
120.00	1,294.40
130.00	1,294.42
140.00	1,294.45
150.00	1,294.47
160.00	1,294.49
170.00	1,294.51
180.00	1,294.53
190.00	1,294.55
200.00	1,294.57
220.00	1,294.61
240.00	1,294.65
260.00	1,294.68
280.00	1,294.72
300.00	1,294.75
350.00	1,294.83
400.00	1,294.91
450.00	1,294.99

Name	Description	Discharge	HW Elev	Velocity
Culvert-1	3-12 inch Circular	6.88 cfs	1,294.89 ft	2.92 ft/s
Weir	Roadway	193.28 cfs	1,294.89 ft	N/A
Total	----------	200.16 cfs	1,294.89 ft	N/A

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Rating Table Report
BasinOF

ange Data:

	Minimum	Maximum	Increment	
Discharge	0.00	400.00	5.00	cfs

Discharge (cfs)	HW Elev (ft)
0.00	1,291.70
5.00	1,293.10
10.00	1,294.09
15.00	1,294.14
20.00	1,294.18
25.00	1,294.22
30.00	1,294.25
35.00	1,294.28
40.00	1,294.31
45.00	1,294.34
50.00	1,294.36
55.00	1,294.39
60.00	1,294.41
65.00	1,294.43
70.00	1,294.45
75.00	1,294.48
80.00	1,294.50
85.00	1,294.52
90.00	1,294.54
95.00	1,294.56
100.00	1,294.58
105.00	1,294.59
110.00	1,294.61
115.00	1,294.63
120.00	1,294.65
125.00	1,294.66
130.00	1,294.68
135.00	1,294.70
140.00	1,294.71
145.00	1,294.73
150.00	1,294.75
155.00	1,294.76
160.00	1,294.78
165.00	1,294.79
170.00	1,294.81
175.00	1,294.82
180.00	1,294.84
185.00	1,294.85
190.00	1,294.86
195.00	1,294.88
200.00	1,294.89
205.00	1,294.91
210.00	1,294.92
215.00	1,294.93
220.00	1,294.95
225.00	1,294.96
230.00	1,294.97
235.00	1,294.98
240.00	1,295.00

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Rating Table Report
BasinOF

scharge (cfs)	HW Elev (ft)
245.00	1,295.01
250.00	1,295.02
255.00	1,295.03
260.00	1,295.04
265.00	1,295.06
270.00	1,295.07
275.00	1,295.08
280.00	1,295.09
285.00	1,295.10
290.00	1,295.11
295.00	1,295.13
300.00	1,295.14
305.00	1,295.15
310.00	1,295.16
315.00	1,295.17
320.00	1,295.18
325.00	1,295.19
330.00	1,295.20
335.00	1,295.22
340.00	1,295.23
345.00	1,295.24
350.00	1,295.25
355.00	1,295.26
360.00	1,295.27
365.00	1,295.28
370.00	1,295.29
375.00	1,295.30
380.00	1,295.31
385.00	1,295.32
390.00	1,295.33
395.00	1,295.34
400.00	1,295.35

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Culvert Designer/Analyzer Report
BasinOF

omponent:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,294.89 ft	Discharge	6.88 cfs
Inlet Control HW Elev	1,294.57 ft	Tailwater Elevation	1,294.57 ft
Outlet Control HW Elev	1,294.89 ft	Control Type	Outlet Control
Headwater Depth/ Height	3.04		

Grades			
Upstream Invert	1,291.85 ft	Downstream Invert	1,291.72 ft
Length	30.00 ft	Constructed Slope	0.004333 ft/ft

Hydraulic Profile			
Profile	Pressure	Depth, Downstream	2.85 ft
Slope Type	N/A	Normal Depth	0.80 ft
Flow Regime	N/A	Critical Depth	0.65 ft
Velocity Downstream	2.92 ft/s	Critical Slope	0.007307 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.00 ft
Section Size	12 inch	Rise	1.00 ft
Number Sections	3		

utlet Control Properties			
Outlet Control HW Elev	1,294.89 ft	Upstream Velocity Head	0.13 ft
Ke	0.50	Entrance Loss	0.07 ft

Inlet Control Properties			
Inlet Control HW Elev	1,294.57 ft	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall	Area Full	2.4 ft^2
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

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Culvert Designer/Analyzer Report
BasinOF

omponent:Weir

Hydraulic Component(s): Roadway					
Discharge	193.28	cfs	Allowable HW Elevation	1,294.89	ft
Roadway Width	28.00	ft	Overtopping Coefficient	2.69	US
Low Point	1,294.00	ft	Headwater Elevation	1,294.89	ft
Discharge Coefficient (Cr)	2.69		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,294.57	ft			

Sta (ft)	Elev (ft)
0.00	1,296.90
25.50	1,294.90
46.00	1,294.00
82.50	1,294.00
108.00	1,294.00
108.10	1,296.00
160.00	1,296.00
160.10	1,294.00
175.00	1,294.00
181.00	1,296.00

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Rating Table Report

2. DS Culvert

3 - 12" x 40.5' CMP under Railroad, AREA 2, "McCormick - Stillman Railroad Park."

Range Data:

	Minimum	Maximum	Increment
Discharge	0.00	400.00	5.00 cfs

Discharge (cfs)	HW Elev (ft)
0.00	1,291.70
5.00	1,292.93
10.00	1,293.96
15.00	1,294.03
20.00	1,294.07
25.00	1,294.10
30.00	1,294.12
35.00	1,294.14
40.00	1,294.16
45.00	1,294.18
50.00	1,294.20
55.00	1,294.22
60.00	1,294.24
65.00	1,294.25
70.00	1,294.27
75.00	1,294.28
80.00	1,294.30
85.00	1,294.31
90.00	1,294.32
95.00	1,294.34
100.00	1,294.35
105.00	1,294.36
110.00	1,294.37
115.00	1,294.39
120.00	1,294.40
125.00	1,294.41
130.00	1,294.42
135.00	1,294.43
140.00	1,294.45
145.00	1,294.46
150.00	1,294.47
155.00	1,294.48
160.00	1,294.49
165.00	1,294.50
170.00	1,294.51
175.00	1,294.52
180.00	1,294.53
185.00	1,294.54
190.00	1,294.55
195.00	1,294.56
200.00	1,294.57
205.00	1,294.58
210.00	1,294.59
215.00	1,294.60
220.00	1,294.61
225.00	1,294.62
230.00	1,294.63
235.00	1,294.64
240.00	1,294.65

NOTE: This culvert is downstream of another set of culverts located at CP 3, Area 3.

6/12

Rating Table Report
DS Culvert

Discharge (cfs)	HW Elev (ft)
245.00	1,294.65
250.00	1,294.66
255.00	1,294.67
260.00	1,294.68
265.00	1,294.69
270.00	1,294.70
275.00	1,294.71
280.00	1,294.72
285.00	1,294.72
290.00	1,294.73
295.00	1,294.74
300.00	1,294.75
305.00	1,294.76
310.00	1,294.77
315.00	1,294.77
320.00	1,294.78
325.00	1,294.79
330.00	1,294.80
335.00	1,294.81
340.00	1,294.81
345.00	1,294.82
350.00	1,294.83
355.00	1,294.84
360.00	1,294.85
365.00	1,294.85
370.00	1,294.86
375.00	1,294.87
380.00	1,294.88
385.00	1,294.88
390.00	1,294.89
395.00	1,294.90
400.00	1,294.91

7/12

Culvert Designer/Analyzer Report
DS Culvert

Analysis Component

Storm Event	Check	Discharge	200.00 cfs

Peak Discharge Method: User-Specified

Design Discharge	10.00 cfs	Check Discharge	200.00 cfs

Tailwater properties: Irregular Channel

Slope	0.006900 ft/ft	Mannings Coefficient	0.022

Roughness Segments

Start Station (ft)	End Station (ft)	Mannings Coefficient
0.00	36.10	0.022

Natural Channel Points

Station (ft)	Elevation (ft)
0.00	1,294.00
0.10	1,292.43
9.00	1,292.39
20.00	1,291.70
35.00	1,293.38
36.10	1,294.00

Tailwater conditions for Check Storm.

Discharge	200.00 cfs	Depth	1.67 ft
Velocity	5.59 ft/s		

Name	Description	Discharge	HW Elev	Velocity
Culvert-1	3-12 inch Circular	8.29 cfs	1,294.57 ft	3.52 ft/s
Weir	Roadway	192.17 cfs	1,294.57 ft	N/A
Total	----------	200.47 cfs	1,294.57 ft	N/A

8/12

Culvert Designer/Analyzer Report
DS Culvert

omponent:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,294.57 ft	Discharge	8.29 cfs
Inlet Control HW Elev	1,293.37 ft	Tailwater Elevation	1,293.37 ft
Outlet Control HW Elev	1,294.57 ft	Control Type	Outlet Control
Headwater Depth/ Height	2.85		

Grades			
Upstream Invert	1,291.72 ft	Downstream Invert	1,291.77 ft
Length	40.50 ft	Constructed Slope	-0.001086 ft/ft

Hydraulic Profile			
Profile	Pressure	Depth, Downstream	1.61 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	0.71 ft
Velocity Downstream	3.52 ft/s	Critical Slope	0.027941 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.00 ft
Section Size	12 inch	Rise	1.00 ft
Number Sections	3		

utlet Control Properties			
Outlet Control HW Elev	1,294.57 ft	Upstream Velocity Head	0.19 ft
Ke	0.90	Entrance Loss	0.17 ft

Inlet Control Properties			
Inlet Control HW Elev	1,293.37 ft	Flow Control	Transition
Inlet Type	Projecting	Area Full	2.4 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

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Culvert Designer/Analyzer Report
DS Culvert

omponent:Weir

Hydraulic Component(s): Roadway					
Discharge	192.17	cfs	Allowable HW Elevation	1,294.57	ft
Roadway Width	28.00	ft	Overtopping Coefficient	2.69	US
Low Point	1,293.90	ft	Headwater Elevation	1,294.57	ft
Discharge Coefficient (Cr)	2.69		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,293.37	ft			

Sta (ft)	Elev (ft)
0.00	1,295.00
0.10	1,294.00
48.00	1,294.00
85.00	1,294.00
99.00	1,293.90
123.00	1,293.90
162.00	1,294.20
162.10	1,295.00

10/12

Culvert Calculator Report
McCormick Park Storm Drain

(Replaces 2 - 8'x4' under Indian Bend Road, Sta 33+07)

Solve For: Headwater Elevation

Culvert Summary				
Allowable HW Elevation	1,292.00 ft		Headwater Depth/ Height	0.93
Computed Headwater Elevation	1,290.74 ft		Discharge	87.00 cfs
Inlet Control HW Elev	1,290.55 ft		Tailwater Elevation	1,289.30 ft
Outlet Control HW Elev	1,290.74 ft		Control Type	Outlet Control

Grades				
Upstream Invert	1,287.49 ft		Downstream Invert	1,284.50 ft
Length	652.00 ft		Constructed Slope	0.004586 ft/ft

Hydraulic Profile				
Profile	CompositePressureS1		Depth, Downstream	4.80 ft
Slope Type	N/A		Normal Depth	1.93 ft
Flow Regime	Subcritical		Critical Depth	2.06 ft
Velocity Downstream	4.52 ft/s		Critical Slope	0.003772 ft/ft

Section				
Section Shape	Circular		Mannings Coefficient	0.012
Section Material	Concrete		Span	3.50 ft
Section Size	42 inch		Rise	3.50 ft
Number Sections	2			

Outlet Control Properties				
Outlet Control HW Elev	1,290.74 ft		Upstream Velocity Head	0.47 ft
Ke	0.20		Entrance Loss	0.09 ft

Inlet Control Properties				
Inlet Control HW Elev	1,290.55 ft		Flow Control	Unsubmerged
Inlet Type	Groove end w/headwall		Area Full	19.2 ft²
K	0.00780		HDS 5 Chart	1
M	2.00000		HDS 5 Scale	2
C	0.02920		Equation Form	1
Y	0.74000			

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Rating Table Report
McCormick Park Storm Drain

Range Data:

	Minimum	Maximum	Increment
Discharge	0.00	170.00	17.00 cfs

Discharge (cfs)	HW Elev (ft)
0.00	1,287.49
17.00	1,289.37
34.00	1,289.58
51.00	1,289.88
68.00	1,290.25
85.00	1,290.68
102.00	1,291.24
119.00	1,291.96
136.00	1,292.77
153.00	1,293.69
170.00	1,294.72

12/12

STORM SEWER RUNOFF CALCULATION RECORD

(McCormick-Stillman Parking Lot-East Side)

URS CORP.
Engineering
Transportation

LOCATION DATA

STREET: Indian Bend Road
LOCATION: McCormick-Stillman Park
PROJ. NO.: 410-S-0402

DESIGN DATA

FREQUENCY: 10 years
P6= 2.01 Inches P24= 2.40 Inches P1= 1.58 Inches

RUNOFF CALCULATIONS

CONCENTRATION POINT (CP) NO.	DRAINAGE AREA Station		ACRES	PAV'T SLOPES & SPREAD (1) SX	SL	T	PAVEMENT C	A	CA	EMBANKMENT C	A	CA	DESERT LANDSCAPING C	A	CA	SUM CA	Tc min	INTENSITY inches/hr	Q(2) cfs
CB-28, 2+60	2+21	2+92	0.460				0.95	0.460	0.44			0.00			0.00	0.44	5	5.90	2.58
CB-29, Sta 3+25	2+92	3+56	0.500				0.95	0.500	0.48			0.00			0.00	0.48	5	5.90	2.80
CB-30, Sta 3+88	3+56	4+22	0.520				0.95	0.520	0.49			0.00			0.00	0.49	5	5.90	2.91
CB-32, Sta 5+15	4+22	5+55	0.660				0.95	0.660	0.63			0.00			0.00	0.63	5	5.90	3.70
CB-38, Sta 7+29.05	5+55	7+30	0.430				0.95	0.430	0.41			0.00			0.00	0.41	5	5.90	2.41

Sx: Cross-Slope SL: Longitudinal Slope T: Spread (feet) CB: Catch Basin SC: Scupper

Computed by: DJS Date: May 1, 2007 Checked by: DJS

NOTES:

(1) - See "STORM SEWER INLET CALCULATION RECORD" for pavement parameters.

(2) - See HEC12 results for actual Q interception at catch basin.

Sruncal

STORM SEWER INLET CALCULATION RECORD

(McCormick-Stillman Parking Lot-East Side)

URS CORP.
Engineering
Transportation

LOCATION DATA

STREET: Indian Bend Road
LOCATION: McCormick-Stillman Park
PRO. NO.: 410-S-0402

DESIGN DATA

FREQUENCY: 10 years
P6= 2.01 Inches
P24= 2.40 Inches
P1= 1.58 Inches

STORM SEWER INLET CALCULATIONS

Inlet			Q	Carryover	Design Q	Inlet	Curb Opening	Wing / Slot	Gutter	Pavement		Spread T(ft)		Intercepted	Flowby	Notes
No.	Station	Offset	(cfs)	(cfs)	(cfs)	Std.	L (ft)	L (ft)	Type	SX	SL	Actual	Allow	Flow (cfs)	(cfs)	
CB-28	2+60	0.000	2.58	0.00	2.58	8			9	0.0100	0.0052	24.26	N/A	1.84	0.74	
CB-29	3+25	0.000	3.54	0.74	2.80	8			9	0.0100	0.0052	28.90	N/A	2.16	1.38	
CB-30	3+88	0.000	4.29	1.38	2.91	8			9	0.0100	SAG	68.12	N/A	4.29	0.00	dn=0.34', WSE=1292.43
CB-32	5+15	0.000	3.70	0.00	3.70	8			9	0.0100	SAG	62.48	N/A	3.70	0.00	dn=0.31', WSE=1292.38
CB-38	7+29.05	0.000	2.41	0.00	2.41	10	3	13.0	11	0.0100	0.0092	15.40	N/A	2.11	0.30	

SX: Cross-Slope SL: Longitudinal Slope CB: Catch Basin SC: Scupper

Computed by: DJS Date: May 1, 2007 Checked by: DJS

NOTE: FOR ACTUAL Q CALCULATIONS, SEE APPENDIX C.

1- ADOT C-05.10 (CURB & GUTTER TYPE C)
2- ADOT C-05.10 (CURB & GUTTER TYPE D)
3- ADOT C-15.20 (ONE WING)
4- ADOT C-15.91
5- SCUPPER, PLAN DETAIL
6- ADOT C-15.30 with C-15.50
7- WALL DOWNDRAIN CATCH BASIN, PLAN DETAIL
8- COP DETAIL P-1570 TYPE N, DOUBLE, DETAIL P-1564, P-1565, TYPE 1
9- COS DETAIL 2240 (6' VALLEY GUTTER & ARPON)
10- COP DETAIL P-1569 M-1, L = 10'
11- MAG 220, TYPE A-6-INCH

Worksheet for Sta 2+60, CB28 Grate Inlet On Grade - 1, 10-Year

Project Description

Solve For	Efficiency

Input Data

Discharge	1.29	ft^3/s
Slope	0.00523	ft/ft
Gutter Width	3.37	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Grate Width	3.37	ft
Grate Length	2.00	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	71.40	%
Intercepted Flow	0.92	ft^3/s
Bypass Flow	0.37	ft^3/s
Spread	12.13	ft
Depth	0.20	ft
Flow Area	0.87	ft^2
Gutter Depression	0.08	ft
Total Depression	0.08	ft
Velocity	1.49	ft/s
Splash Over Velocity	2.66	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.03	
Grate Flow Ratio	0.70	
Active Grate Length	1.00	ft

Messages

Notes	Install COP Detail P-1570 Type N, Double, COP Detail P-1564, P-1565, Type 1 Gutter Type is COS Detial 2240 (6' Valley Gutter & Apron) Modeled Half of Runoff and Half of Grate Width to Obtain the Spread

Worksheet for Sta 3+25, CB29 Grate Inlet On Grade - 1, 10-Year

Project Description

Solve For	Efficiency

Input Data

Discharge	1.77	ft^3/s
Slope	0.00523	ft/ft
Gutter Width	3.37	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Grate Width	3.37	ft
Grate Length	2.00	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	60.83	%
Intercepted Flow	1.08	ft^3/s
Bypass Flow	0.69	ft^3/s
Spread	14.45	ft
Depth	0.20	ft
Flow Area	1.15	ft^2
Gutter Depression	0.06	ft
Total Depression	0.06	ft
Velocity	1.55	ft/s
Splash Over Velocity	2.66	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.03	
Grate Flow Ratio	0.60	
Active Grate Length	1.00	ft

Messages

Notes	Install COP Detail P-1570 Type N, Double, COP Detail P-1564, P-1565, Type 1 Gutter Type is COS Detial 2240 (6' Valley Gutter & Apron) Modeled Half of Runoff and Half of Grate Width to Obtain the Spread

Worksheet for Sta 3+88, CB30 Grate Inlet In Sag - 1, 10-Yr

Project Description

Solve For	Spread

Input Data

Discharge	4.29	ft^3/s
Gutter Width	6.73	ft
Gutter Cross Slope	0.01	ft/ft
Road Cross Slope	0.01	ft/ft
Grate Width	6.73	ft
Grate Length	2.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	34.06	ft
Depth	0.34	ft
Gutter Depression	0.00	ft
Total Depression	0.00	ft
Open Grate Area	6.06	ft^2
Active Grate Weir Length	8.73	ft

Messages

Notes

Install COP Detail P-1570 Type N, Double, COP Detail P-1564, P-1565, Type 1
Gutter Type is COS Detial 2240 (6' Valley Gutter & Apron)
Installation is in a Sag

Worksheet for Sta 5+15, CB32 Grate Inlet In Sag - 1, 10-Yr

Project Description

Solve For	Spread

Input Data

Discharge	3.70	ft^3/s
Gutter Width	6.73	ft
Gutter Cross Slope	0.01	ft/ft
Road Cross Slope	0.01	ft/ft
Grate Width	6.73	ft
Grate Length	2.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	31.24	ft
Depth	0.31	ft
Gutter Depression	0.00	ft
Total Depression	0.00	ft
Open Grate Area	6.06	ft^2
Active Grate Weir Length	8.73	ft

Messages

Notes

Install COP Detail P-1570 Type N, Double, COP Detail P-1564, P-1565, Type 1
Gutter Type is COS Detial 2240 (6' Valley Gutter & Apron)
Installation is in a Sag

Worksheet for Sta 7+29.05, CB38 Curb Inlet On Grade - 2, 10-Year

Project Description

Solve For	Efficiency

Input Data

Discharge	2.41	ft^3/s
Slope	0.00915	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.04	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	87.37	%
Intercepted Flow	2.11	ft^3/s
Bypass Flow	0.30	ft^3/s
Spread	15.40	ft
Depth	0.20	ft
Flow Area	1.22	ft^2
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	1.98	ft/s
Equivalent Cross Slope	0.05052	ft/ft
Length Factor	0.68	
Total Interception Length	15.22	ft

Messages

Notes	Install COP Detail P-1569 Type M-1 Catch Basin, L = 10 Feet

URS CORP.
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STORM SEWER RUNOFF CALCULATION RECORD
(McCormick-Stillman Parking Lot-East Side)

LOCATION DATA

STREET: Indian Bend Road
LOCATION: McCormick-Stillman Park
PROJ. NO.: 410-S-0402

DESIGN DATA

FREQUENCY: 50 years
P6= 2.84 Inches P24= 3.38 Inches P1= 2.24 Inches

RUNOFF CALCULATIONS

CONCENTRATION POINT (CP) NO.	DRAINAGE AREA Station		ACRES	PAV'T SLOPES & SPREAD (1) SX	SL	T	PAVEMENT C	A	CA	EMBANKMENT C	A	CA	DESERT LANDSCAPING C	A	CA	SUM CA	Tc min	INTENSITY inches/hr	Q(2) cfs
CB-28, 2+60	2+21	2+92	0.460				0.95	0.460	0.44			0.00			0.00	0.44	5	8.13	3.55
CB-29, Sta 3+25	2+92	3+56	0.500				0.95	0.500	0.48			0.00			0.00	0.48	5	8.13	3.86
CB-30, Sta 3+88	3+56	4+22	0.520				0.95	0.520	0.49			0.00			0.00	0.49	5	8.13	4.02
CB-32, Sta 5+15	4+22	5+55	0.660				0.95	0.660	0.63			0.00			0.00	0.63	5	8.13	5.10
CB-38, Sta 7+29.05	5+55	7+30	0.430				0.95	0.430	0.41			0.00			0.00	0.41	5	8.13	3.32

Sx: Cross-Slope SL: Longitudinal Slope T: Spread (feet) CB: Catch Basin SC: Scupper

Computed by: DJS Date: May 1, 2007 Checked by: DJS

NOTES:

(1) - See "STORM SEWER INLET CALCULATION RECORD" for pavement parameters.

(2) - See HEC12 results for actual Q interception at catch basin.

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STORM SEWER INLET CALCULATION RECORD

(McCormick-Stillman Parking Lot-East Side)

URS CORP.
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LOCATION DATA

STREET: Indian Bend Road
LOCATION: McCormick-Stillman Park
PRO. NO.: 410-S-0402

DESIGN DATA

FREQUENCY: 50 years
P6= 2.84 Inches
P24= 3.38 Inches
P1= 2.24 Inches

STORM SEWER INLET CALCULATIONS

Inlet			Q	Carryover	Design Q	Inlet	Curb Opening	Wing / Slot	Gutter	Pavement		Spread T(ft)		Intercepted	Flowby	Notes
No.	Station	Offset	(cfs)	(cfs)	(cfs)	Std.	L (ft)	L (ft)	Type	SX	SL	Actual	Allow	Flow (cfs)	(cfs)	
CB-28	2+60	0.000	3.55	0.00	3.55	8			9	0.0100	0.0052	29.14	N/A	2.13	1.42	
CB-29	3+25	0.000	5.28	1.42	3.86	8			9	0.0100	0.0052	34.40	N/A	2.76	2.52	
CB-30	3+88	0.000	6.54	2.52	4.02	8			9	0.0100	SAG	87.56	N/A	6.54	0.00	dn=0.44', WSE=1292.53
CB-32	5+15	0.000	5.10	0.00	5.10	8			9	0.0100	SAG	75.44	N/A	5.10	0.00	dn=0.38', WSE=1292.45
CB-38	7+29.05	0.000	3.32	0.00	3.32	10	3	10.0	11	0.0100	0.0092	17.45	N/A	2.57	0.75	

SX: Cross-Slope SL: Longitudinal Slope CB: Catch Basin SC: Scupper

Computed by: DJS Date: May 1, 2007 Checked by: DJS

NOTE: FOR ACTUAL Q CALCULATIONS, SEE APPENDIX C.

1- ADOT C-05.10 (CURB & GUTTER TYPE C)
2- ADOT C-05.10 (CURB & GUTTER TYPE D)
3- ADOT C-15.20 (ONE WING)
4- ADOT C-15.91
5- SCUPPER, PLAN DETAIL
6- ADOT C-15.30 with C-15.50
7- WALL DOWNDRAIN CATCH BASIN, PLAN DETAIL
8- COP DETAIL P-1570 TYPE N, DOUBLE, DETAIL P-1564, P-1565, TYPE 1
9- COS DETAIL 2240 (6' VALLEY GUTTER & ARPON)
10- COP DETAIL P-1569 M-1, L = 10'
11- MAG 220, TYPE A-6-INCH

Worksheet for Sta 2+60, CB28 Grate Inlet On Grade - 1, 50-Year

Project Description

Solve For	Efficiency

Input Data

Discharge	1.78	ft^3/s
Slope	0.00523	ft/ft
Gutter Width	3.37	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Grate Width	3.37	ft
Grate Length	2.00	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	60.00	%
Intercepted Flow	1.07	ft^3/s
Bypass Flow	0.71	ft^3/s
Spread	14.57	ft
Depth	0.20	ft
Flow Area	1.16	ft^2
Gutter Depression	0.06	ft
Total Depression	0.06	ft
Velocity	1.54	ft/s
Splash Over Velocity	2.66	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.03	
Grate Flow Ratio	0.59	
Active Grate Length	1.00	ft

Messages

Notes	Install COP Detail P-1570 Type N, Double, COP Detail P-1564, P-1565, Type 1 Gutter Type is COS Detial 2240 (6' Valley Gutter & Apron) Modeled Half of Runoff and Half of Grate Width to Obtain the Spread

Worksheet for Sta 3+25, CB29 Grate Inlet On Grade - 1, 50-Year

Project Description

Solve For	Efficiency

Input Data

Discharge	2.64	ft^3/s
Slope	0.00523	ft/ft
Gutter Width	3.37	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Grate Width	3.37	ft
Grate Length	2.00	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	52.40	%
Intercepted Flow	1.38	ft^3/s
Bypass Flow	1.26	ft^3/s
Spread	17.20	ft
Depth	0.23	ft
Flow Area	1.57	ft^2
Gutter Depression	0.06	ft
Total Depression	0.06	ft
Velocity	1.68	ft/s
Splash Over Velocity	2.66	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.03	
Grate Flow Ratio	0.51	
Active Grate Length	1.00	ft

Messages

Notes	Install COP Detail P-1570 Type N, Double, COP Detail P-1564, P-1565, Type 1 Gutter Type is COS Detial 2240 (6' Valley Gutter & Apron) Modeled Half of Runoff and Half of Grate Width to Obtain the Spread

Worksheet for Sta 3+88, CB30 Grate Inlet In Sag - 1, 50-Yr

Project Description

Solve For	Spread

Input Data

Discharge	6.54	ft^3/s
Gutter Width	6.73	ft
Gutter Cross Slope	0.01	ft/ft
Road Cross Slope	0.01	ft/ft
Grate Width	6.73	ft
Grate Length	2.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	43.78	ft
Depth	0.44	ft
Gutter Depression	0.00	ft
Total Depression	0.00	ft
Open Grate Area	6.06	ft^2
Active Grate Weir Length	8.73	ft

Messages

Notes	Install COP Detail P-1570 Type N, Double, COP Detail P-1564, P-1565, Type 1 Gutter Type is COS Detial 2240 (6' Valley Gutter & Apron) Installation is in a Sag

Worksheet for Sta 5+15, CB32 Grate Inlet In Sag - 1, 50-Yr

Project Description

Solve For	Spread

Input Data

Discharge	5.10	ft^3/s
Gutter Width	6.73	ft
Gutter Cross Slope	0.01	ft/ft
Road Cross Slope	0.01	ft/ft
Grate Width	6.73	ft
Grate Length	2.00	ft
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Results

Spread	37.72	ft
Depth	0.38	ft
Gutter Depression	0.00	ft
Total Depression	0.00	ft
Open Grate Area	6.06	ft^2
Active Grate Weir Length	8.73	ft

Messages

Notes

Install COP Detail P-1570 Type N, Double, COP Detail P-1564, P-1565, Type 1
Gutter Type is COS Detial 2240 (6' Valley Gutter & Apron)
Installation is in a Sag

Worksheet for Sta 7+29.05, CB38 Curb Inlet On Grade - 2, 50-Year

Project Description

Solve For	Efficiency

Input Data

Discharge	3.32	ft^3/s
Slope	0.00915	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.04	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	77.31	%
Intercepted Flow	2.57	ft^3/s
Bypass Flow	0.75	ft^3/s
Spread	17.45	ft
Depth	0.22	ft
Flow Area	1.56	ft^2
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	2.14	ft/s
Equivalent Cross Slope	0.04556	ft/ft
Length Factor	0.56	
Total Interception Length	18.53	ft

Messages

Notes	Install COP Detail P-1569 Type M-1 Catch Basin, L = 10 Feet

Green and Ampt Rainfall Loss Parameters
(Area Weighted)
McCormick-Stillman Railroad Park

Area No. 4							
Land Use	Area	RTIMP	XKSAT	DTHETA		PSIF	IA
		(Developed)		Dry	Normal		
	acres	%	in/hr	in/hr	in/hr	inches	inches
Scottsdale Road Pavement	1.91	95	0.25	0.35	0.25	4.9	0.05
Scottsdale Road Grass Ditch	0.33	0	0.25	0.35	0.25	4.9	0.20
Sands North Townhouses	8.38	85	0.25	0.35	0.25	4.9	0.10
Weighted Average =	***10.62***	***84.16***	***0.25***	***0.35***	***0.25***	***4.90***	***0.09***
Subbasin Area =	***0.01659***	***sq mi***					

Area No. 3							
Land Use	Area	RTIMP	XKSAT	DTHETA		PSIF	IA
		(Developed)		Dry	Normal		
	acres	%	in/hr	in/hr	in/hr	inches	inches
McCormick Park Grass	8.14	0	0.25	0.35	0.25	4.9	0.20
McCormick Park Impervious	0.94	95	0.25	0.35	0.25	4.9	0.05
Weighted Average =	***9.08***	***9.83***	***0.25***	***0.35***	***0.25***	***4.90***	***0.18***
Subbasin Area =	***0.01419***	***sq mi***					

Area No. 2							
Land Use	Area	RTIMP	XKSAT	DTHETA		PSIF	IA
		(Developed)		Dry	Normal		
	acres	%	in/hr	in/hr	in/hr	inches	inches
McCormick Park DL2	1	0	0.25	0.35	0.25	4.9	0.20
Railroad Bed	0.18	5	0.25	0.35	0.25	4.9	0.10
McCormick Park Impervious	0.17	95	0.25	0.35	0.25	4.9	0.05
Weighted Average =	***1.35***	***12.63***	***0.25***	***0.35***	***0.25***	***4.90***	***0.17***
Subbasin Area =	***0.00211***	***sq mi***					

Area No. 1							
Land Use	Area	RTIMP	XKSAT	DTHETA		PSIF	IA
		(Developed)		Dry	Normal		
	acres	%	in/hr	in/hr	in/hr	inches	inches
McCormick Park Parking Lot	2.76	95	0.25	0.35	0.25	4.9	0.05
McCormick Park DL2	0.31	0	0.25	0.35	0.25	4.9	0.20
Weighted Average =	***3.07***	***85.41***	***0.25***	***0.35***	***0.25***	***4.90***	***0.07***
Subbasin Area =	***0.0048***	***sq mi***					

TOTAL AREA =	***24.12 Acres***
	0.0377 sq mi

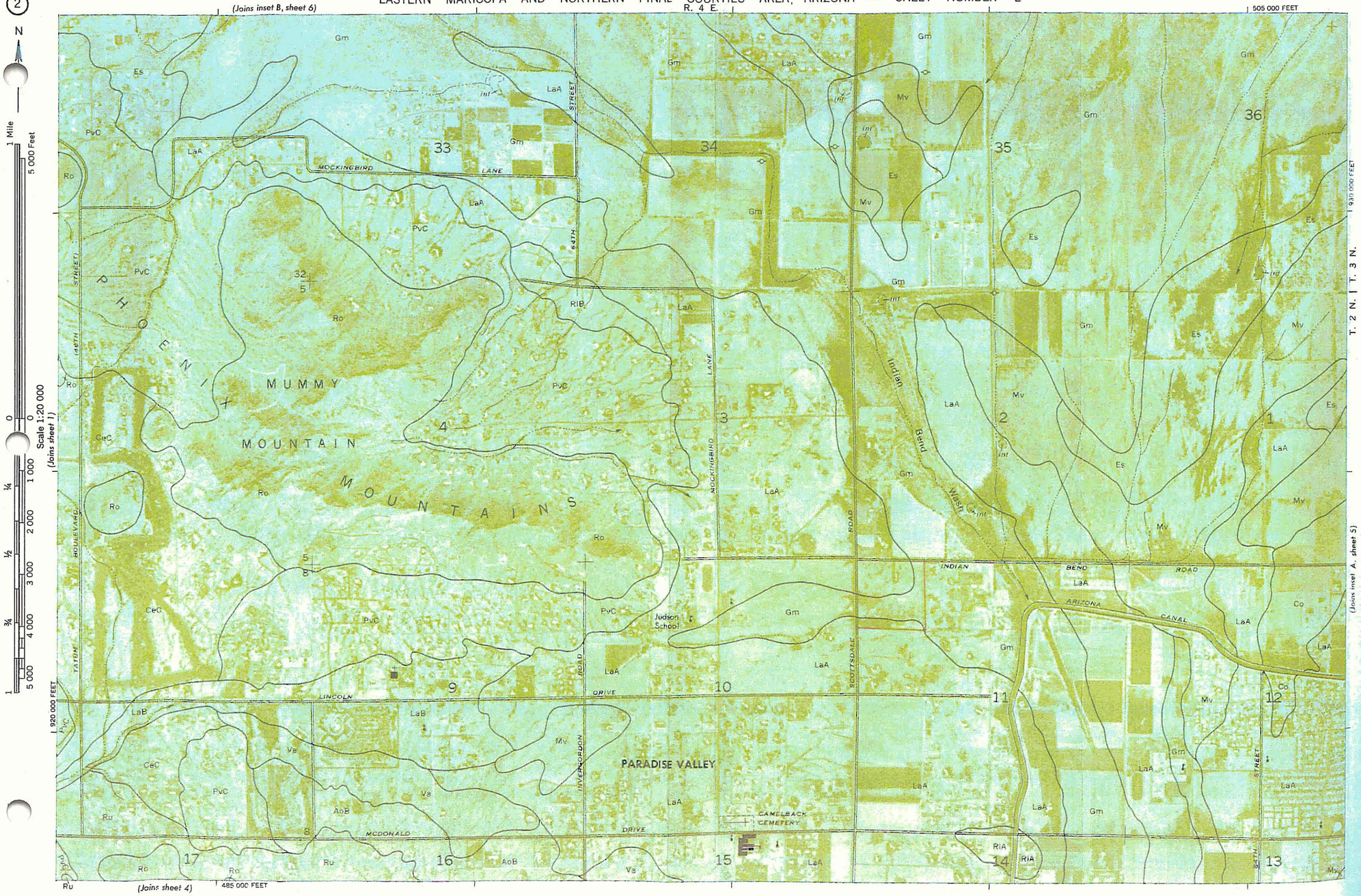
TABLE 5.—*Estimates of soil properties*

Soil series, land types, and map symbols	Hydrologic soil group	Depth to hardpan or bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
		Ft.	*In.*			
Cashion: Cc	C	>5	0–28	Clay	CH	A–7
			28–60	Fine sandy loam	SM	A–4
Cavelt: CeC	D	½–1½	0–10	Gravelly loam	ML or SM	A–4
			10	Indurated lime hardpan		
Contine: Co	C	>5	0–12	Clay loam	CL	A–6
			12–38	Clay	CH	A–7
			38–66	Clay loam and loam	CL	A–6 or A–7
Estrella: Es	B	>5	0–26	Loam	ML	A–4
			26–60	Clay loam	CL	A–6
Gilman: Gf, Gm	B	>5	0–60	Loam; fine sandy loam in places	ML or CL	A–4 or A–6
Glenbar: Gn	B	>5	0–60	Clay loam and heavy silt loam	CL	A–6
Gravelly alluvial land: Gr	A	>5	0–60	Very gravelly sandy loam or loamy sand.	GP–GM or GP	A–1
Laveen: LaA, LaB, LeA	B	>5	0–60	Loam; clay loam in LeA	ML, CL or CH	A–7, A–6 or A–4.
Mohall: Mo, Mv	B	>5	0–60	Loam and clay loam	ML or CL	A–4 or A–6
Pimer: Pm	B	>5	0–60	Clay loam and loam	CL	A–6
Pinal: PnA, PnC	D	½–1½	0–18	Gravelly loam	ML or SM	A–4
			18	Indurated lime-silica hardpan.		
Pinal, moderately deep variant: Po.	C	2½–3½	0–38	Loam	ML	A–4
			38	Indurated lime-silica hardpan.		
Pinamt: PvA, PvC	B	>5	0–60	Very gravelly sandy clay loam and very gravelly loam.	GC or GM	A–1
Rillito: RlA, RlB	B	>5	0–60	Gravelly loam	SM	A–2 or A–4
Rock land: Ro. Variable, not estimated.						
Rough broken land: Ru. Variable, not estimated.						
Tremant: TrB	B	>5	0–16	Gravelly sandy clay loam	SC	A–4
			16–60	Gravelly loam and gravelly sandy loam.	SM	A–2
Trix: Tx	B	>5	0–60	Clay loam	CL	A–6
Valencia: Va	B	>5	0–26	Sandy loam	SM	A–2 or A–4
			26–45	Sandy clay loam	SC	A–4
			45–60	Sandy loam	SM	A–2 or A–4
Vecont: Ve	C	>5	0–64	Clay and clay loam	CH	A–7
Vint: Vf	B	>5	0–60	Loamy fine sand	SM	A–2

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Salinity	Shrink-swell potential	Corrosivity to untreated steel
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
				In./hr.	*In./in. of soil*	*Mmhos./cm.*		
95–100	95–100	90–100	85–95	0.06–0.20	0.14–0.16	2–4	High	High.
95–100	90–100	80–95	35–45	2.0–6.3	0.13–0.15	2–4	Low	Moderate.
80–95	70–85	55–75	40–60	0.63–2.0	0.11–0.13	2–4	Low	Moderate.
----------	----------	----------	----------	<0.06				
95–100	90–100	85–95	65–75	0.20–0.63	0.19–0.21	<2	Moderate	Moderate.
95–100	85–100	80–90	70–80	0.06–0.20	0.14–0.16	<2	High	High.
95–100	85–100	85–95	65–75	0.20–0.63	0.19–0.21	<2	Moderate	Moderate.
95–100	90–100	80–90	60–70	0.63–2.0	0.16–0.18	<2	Low	Low.
95–100	95–100	85–95	70–80	0.20–0.63	0.19–0.21	<2	Moderate	Moderate.
100	100	70–100	60–85	0.63–2.0	0.16–0.18	2–4	Low	Moderate.
100	95–100	85–95	80–90	0.20–0.63	0.19–0.21	<2	Moderate	Moderate.
40–50	30–40	20–30	0–20	>20.0	0.03–0.05	<2	Very low	Low.
95–100	85–100	85–95	65–75	0.63–2.0	0.16–0.18	2–4	Low	Moderate.
95–100	90–100	80–90	50–70	0.20–0.63	0.17–0.19	<2	Moderate	Moderate.
95–100	95–100	85–95	80–90	0.20–0.63	0.19–0.21	<2	Moderate	Moderate.
80–95	70–85	55–75	40–60	0.63–2.0	0.11–0.13	2–4	Low	Moderate.
90–95	80–90	70–80	50–60	0.63–2.0	0.14–0.16	2–4	Low	Moderate.
20–55	15–50	10–45	5–25	0.2–0.63	0.05–0.07	<2	Low	Low.
55–90	50–85	45–80	30–45	0.63–2.0	0.09–0.12	<2	Low	Low.
70–90	65–85	45–55	35–45	0.2–0.63	0.10–0.12	<2	Low	Moderate.
70–90	65–85	35–45	20–30	0.63–2.0	0.07–0.11	<2	Low	Low.
95–100	95–100	90–100	80–90	0.20–0.63	0.19–0.21	<2	Moderate	Moderate.
95–100	90–100	60–70	30–40	2.0–6.3	0.11–0.13	<2	Low	Low.
95–100	95–100	80–95	35–50	0.2–0.63	0.14–0.16	<2	Moderate	Moderate.
95–100	90–100	60–70	30–40	2.0–6.3	0.11–0.13	<2	Low	Low.
95–100	95–100	90–100	80–90	0.06–0.20	0.14–0.16	<2	High	High.
95–100	90–100	70–80	15–25	2.0–6.3	0.07–0.09	<2	Low	Low.

EASTERN MARICOPA AND NORTHERN PINAL COUNTIES AREA, ARIZONA — SHEET NUMBER 2



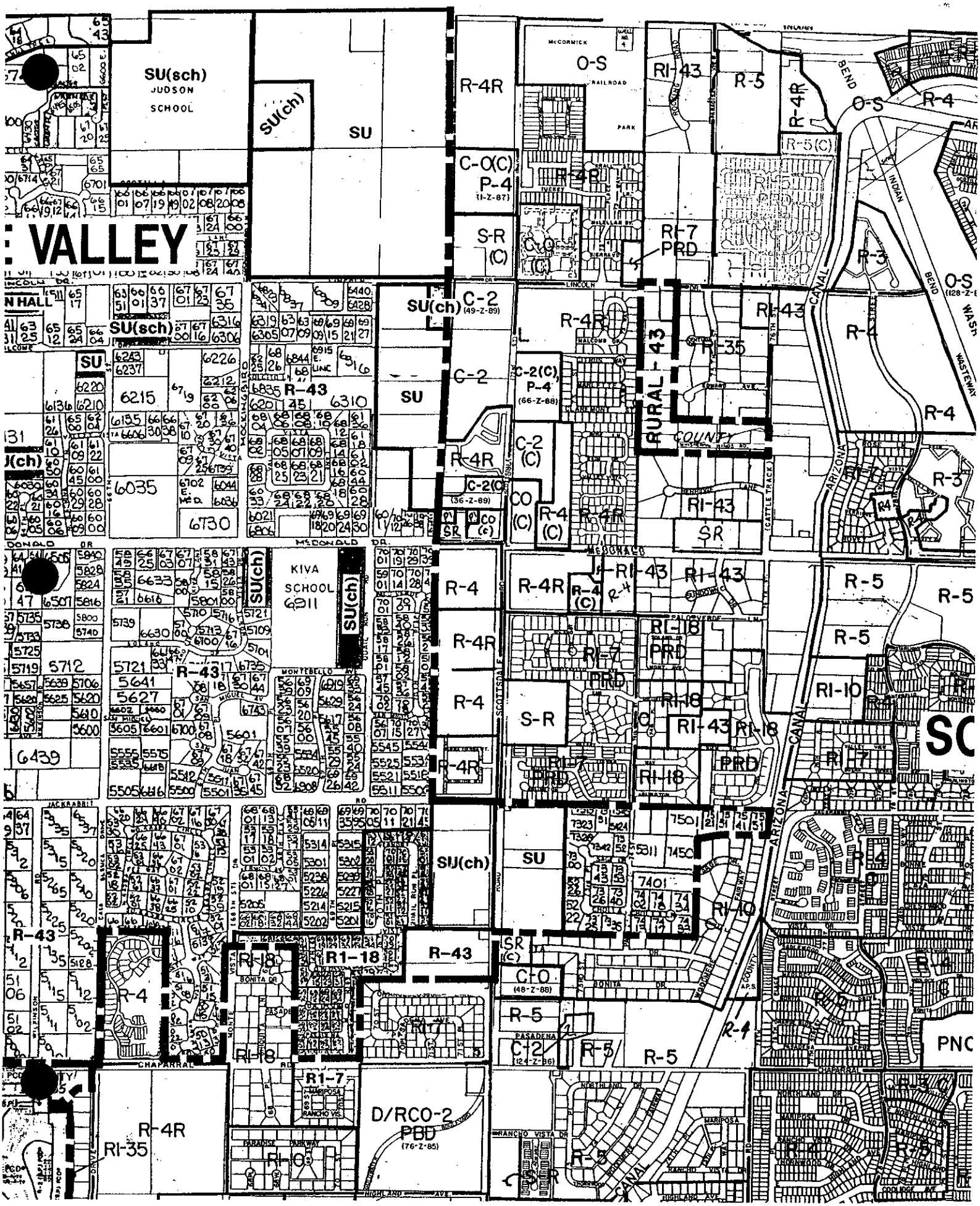

SU(sch)
JUDSON
SCHOOL
SU(ch)
SU
R-4R
O-S
RI-43
R-5
R-4
C-O(C)
P-4
(1-Z-87)
S-R
(C)
RI-7
PRD
R-3
C-2
(49-Z-89)
C-2(C),
P-4
(66-Z-88)
RI-35
RURAL-43
COUNTY
C-2
(C)
C-2(C)
(36-Z-89)
CO
(C)
R-4
(C)
SR
KIVA
SCHOOL
6911
R-43
RI-18
PRD
RI-10
S-R
C-O
(48-Z-88)
C-2
(124-Z-86)
R1-18
R1-7
D/RCO-2
PBD
(76-Z-85)
RI-6
PNC
CANAL
ARIZONA
SCOTTSDALE
McDONALD
LINCOLN
CHAPARRAL
PASADENA
BONITA
HIGHLAND
MARIPOSA
RANCHO VISTA
NORTHLAND
INDIAN
BEND
WASH
WASTEWAY

Table 4.2
IA, RTIMP, AND VEGETATIVE COVER DENSITY FOR REPRESENTATIVE LAND USES IN MARICOPA COUNTY

Land Use[1] Code	Land Use Category	Description	IA[2] inches	RTIMP[2,3] %	Vegetation Cover[2,4] %
VLDR	Very Low Density Residential[3]	40,000 sq. feet and greater lot size	0.30	5	30
LDR	Low Density Residential[3]	12,000 – 40,000 sq. feet lot size	0.30	15	50
MDR	Medium Density Residential[3]	6,000 – 12,000 sq. feet lot size	0.25	30	50
MFR	Multiple Family Residential[3]	1,000 – 6,000 sq. feet lot size (# du/ac)	0.25	45	50
I1	Industrial 1[3]	Light and General	0.15	55	60
I2	Industrial 2[3]	General and Heavy	0.15	55	60
C1	Commercial 1[3]	Light, Neighborhood, Residential	0.10	80	75
C2	Commercial 2[3]	Central, General, Office, Intermediate	0.10	80	75
P	Pavement and Rooftops	Asphalt and Concrete, Sloped Rooftops	0.05	95	0
GR	Gravel Roadways & Shoulders	Graded and Compacted, Treated and Untreated	0.10	5	0
AG	Agricultural	Tilled Fields, Irrigated Pastures, slopes < 1%	0.50	0	85
LPC	Lawns/Parks/Cemeteries	Over 80% maintained lawn	0.20	Varies[5]	80
DL1	Desert Landscaping 1	Landscaping with impervious under treatment	0.10	95	30
DL2	Desert Landscaping 2	Landscaping without impervious under treatment	0.20	0	30
NDR	Undeveloped Desert Rangeland	Little topographic relief, slopes < 5%	0.35	Varies[5]	Varies[6]
NHS	Hillslopes, Sonoran Desert	Moderate topographic relief, slopes > 5%	0.15	Varies[5]	Varies[6]
NMT	Mountain Terrain	High topographic relief, slopes > 10%	0.25	Varies[5]	Varies[6]

Notes:
1. Other land use or zoning classifications, such as Planned Area Development and Schools must be evaluated on a case by case basis.
2. These values have been selected to fit many typical settings in Maricopa County; however, the engineer/hydrologist should always evaluate the specific circumstances in any particular watershed for hydrologic variations from these typical values.
3. RTIMP = Percent Effective Impervious Area, including right-of-way. Effective means that all impervious areas are assumed to be hydraulically connected. The RTIMP values may need to be adjusted based on an evaluation of hydraulic connectivity.
4. Vegetation Cover = Percent vegetation cover for pervious areas only.
5. RTIMP values must be estimated on a case by case basis.
6. Vegetation Cover values must be estimated on a case by case basis.

```
ID      McCormick Park Outfall
ID      ULTIMATE OUTFALL ANALYSIS
ID      100-YEAR 6-HOUR EVENT
*DIAGRAM
IT     1 29APR06       0    1440
IO     3       0
*
KK Sub04 Scottsdale Road and Sands North Townhouses
KM       SCS RUNOFF COMPUTATION
BA .0166
IN    15
KM       Rainfall depth of 3.20 inches was not spacially reduced due to
KM       the small total drainage area of 24.12 acres
PB  3.20
PC  .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
PC  .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
PC  .962    .972    .983    .991   1.000
LG  0.10    0.25    4.90    0.25    84.2
UD 0.189
*
KK Rte01 Routing Flow through McCormick Park Grassed Area
KM       ROUTE HYDROGRAPH THROUGH EAST DITCH ALONG PARKING LOT
RS     1    STOR      -1
RC  .025    .025    .025     670 .021500
RX    0.     0.1    33.0    66.0    70.0   103.0   136.0   136.1
RY1294.1   1294.  1293.5   1293.   1293.  1293.5   1294.  1294.1
*
KK Sub03 McCormick Park Grassed Area
KM       SCS RUNOFF COMPUTATION
BA .0142
LG  0.18    0.25    4.90    0.25     9.8
UD0.0774
*
KK COM01 Combined Flow @ Outfall 3-12"X30' CMP/overflow Weir (RR Embankment)
KM       Combined Flow @ Outfall 3-12"X30' CMP/overflow Weir (RR Embankment)
HC     2
*
KK Rte01  ROUTING OF FLOW, 3-12"X31' CMP/overflow Weir (RR Embankment)
KM      ROUTE HYDROGRAPH THROUGH 3-12"X31' CMP/overflow Weir (RR Embankment)
RS     1    ELEV  1291.7
SV  0.00   0.120   0.820   1.796   2.420
SE1291.7  1293.0  1294.0 1294.60 1295.00
SQ  0.00    5.34   12.85  215.00  450.00
*
KK SUB02 Basin McCormick Park
KM       SCS RUNOFF COMPUTATION
BA.00211
LG  0.15    0.25    4.90    0.25    12.6
UD0.050
*
KK IBR  Final Runoff @ Outfall into East Ditch along Parking Lot
KM      COMBINED FLOW INTO EAST DITCH ALONG PARKING LOT
HC     2
*
KK Rte02 Routing Flow through East Ditch along Parking Lot
KM       ROUTE HYDROGRAPH through East Ditch along Parking Lot
RS     1    STOR      -1
RC  .022    .022    .022     510 .002326
RX    0.     0.1     5.0     9.5    10.5    15.0    20.0    20.1
RY1293.1   1293.   1292.   1291.   1291.   1292.   1293.  1293.1
*
KK SUB01 Parking Lot
KM      SCS RUNOFF COMPUTATION
BA .0048
LG  0.06    0.25    4.90    0.25    85.4
UD 0.055
*
KK IBR  Final Runoff @ Indian Bend Road & Exst 2-8'x4'CBC
KM      COMBINED FLOW FROM PARK AND PARKING LOT @ Indian Bend Road
```

HC 2
ZZ

```
1****************************************
 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
 *              JUN   1998              *
 *           VERSION 4.1                *
 *                                      *
 *  RUN DATE   29APR06  TIME  17:08:14  *
 *                                      *
 ****************************************
```

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

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X       XXXXX   X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

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

  1           ID        McCormick Park Outfall
  2           ID        ULTIMATE OUTFALL ANALYSIS
  3           ID          100-YEAR 6-HOUR EVENT
              *DIAGRAM
  4           IT       1 29APR06       0    1440
  5           IO       3       0
              *

  6           KK   Sub04 Scottsdale Road and Sands North Townhouses
  7           KM         SCS RUNOFF COMPUTATION
  8           BA   .0166
  9           IN      15
 10           KM         Rainfall depth of 3.20 inches was not spacially reduced due to
 11           KM         the small total drainage area of 24.12 acres
```

```
12          PB    3.20
13          PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
14          PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
15          PC    .962    .972    .983    .991   1.000
16          LG    0.10    0.25    4.90    0.25    84.2
17          UD   0.189
            *

18          KK   Rte01 Routing Flow through McCormick Park Grassed Area
19          KM         ROUTE HYDROGRAPH THROUGH EAST DITCH ALONG PARKING LOT
20          RS       1    STOR      -1
21          RC    .025    .025    .025     670 .021500
22          RX      0.     0.1    33.0    66.0    70.0   103.0   136.0   136.1
23          RY  1294.1   1294.  1293.5   1293.   1293.  1293.5   1294.  1294.1
            *

24          KK   Sub03 McCormick Park Grassed Area
25          KM         SCS RUNOFF COMPUTATION
26          BA   .0142
27          LG    0.18    0.25    4.90    0.25     9.8
28          UD  0.0774
            *

29          KK   COM01 Combined Flow @ Outfall 3-12"X30' CMP/overflow Weir (RR Embankment)
30          KM         Combined Flow @ Outfall 3-12"X30' CMP/overflow Weir (RR Embankment)
31          HC       2
            *

32          KK   Rte01  ROUTING OF FLOW, 3-12"X31' CMP/overflow Weir (RR Embankment)
33          KM        ROUTE HYDROGRAPH THROUGH 3-12"X31' CMP/overflow Weir (RR Embankment)
34          RS       1    ELEV  1291.7
35          SV    0.00   0.120   0.820   1.796   2.420
36          SE  1291.7  1293.0  1294.0 1294.60 1295.00
37          SQ    0.00    5.34   12.85  215.00  450.00
            *
```



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

38          KK   SUB02 Basin McCormick Park
39          KM         SCS RUNOFF COMPUTATION
40          BA  .00211
41          LG    0.15    0.25    4.90    0.25    12.6
42          UD  0.050
            *

43          KK   IBR  Final Runoff @ Outfall into East Ditch along Parking Lot
44          KM        COMBINED FLOW INTO EAST DITCH ALONG PARKING LOT
45          HC       2
            *
```

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46          KK   Rte02 Routing Flow through East Ditch along Parking Lot
47          KM         ROUTE HYDROGRAPH through East Ditch along Parking Lot
48          RS       1    STOR      -1
49          RC    .022    .022    .022     510 .002326
50          RX      0.     0.1     5.0     9.5    10.5    15.0    20.0    20.1
51          RY  1293.1   1293.   1292.   1291.   1291.   1292.   1293.  1293.1
            *

52          KK   SUB01 Parking Lot
53          KM        SCS RUNOFF COMPUTATION
54          BA   .0048
55          LG    0.06    0.25    4.90    0.25    85.4
56          UD   0.055
            *

57          KK   IBR  Final Runoff @ Indian Bend Road & Exst 2-8'x4'CBC
58          KM        COMBINED FLOW FROM PARK AND PARKING LOT @ Indian Bend Road
59          HC       2
60          ZZ
```

1

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                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     6       Sub04
                 V
                 V
    18       Rte01
                 .
                 .
    24           .       Sub03
                 .           .
                 .           .
    29       COM01............
                 V
                 V
    32       Rte01
                 .
                 .
    38           .       SUB02
                 .           .
                 .           .
    43       IBR  ............
                 V
                 V
    46       Rte02
                 .
                 .
    52           .       SUB01
                 .           .
```

```
   57       IBR .....:.....

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
 *               JUN   1998             *
 *            VERSION 4.1               *
 *                                      *
 *  RUN DATE   29APR06  TIME  17:08:14  *
 *                                      *
 ****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
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                              McCormick Park Outfall
                              ULTIMATE OUTFALL ANALYSIS
                            100-YEAR 6-HOUR EVENT

   5 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN           1  MINUTES IN COMPUTATION INTERVAL
                       IDATE     29APR 6  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ        1440  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     29APR 6  ENDING DATE
                      NDTIME        2359  ENDING TIME
                       ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .02 HOURS
                       TOTAL TIME BASE   23.98 HOURS

         ENGLISH UNITS
              DRAINAGE AREA          SQUARE MILES
              PRECIPITATION DEPTH    INCHES
              LENGTH, ELEVATION      FEET
              FLOW                   CUBIC FEET PER SECOND
              STORAGE VOLUME         ACRE-FEET
              SURFACE AREA           ACRES
              TEMPERATURE            DEGREES FAHRENHEIT
```

*** ***

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              **************
              *            *
 6 KK         *     Sub04  *      Scottsdale Road and Sands North Townhouses
              *            *
              **************
                                  SCS RUNOFF COMPUTATION
                                  Rainfall depth of 3.20 inches was not spacially reduced due to
                                  the small total drainage area of 24.12 acres

 9 IN            TIME DATA FOR INPUT TIME SERIES
                       JXMIN          15  TIME INTERVAL IN MINUTES
                      JXDATE     29APR 6  STARTING DATE
                      JXTIME           0  STARTING TIME

                SUBBASIN RUNOFF DATA

 8 BA            SUBBASIN CHARACTERISTICS
                       TAREA         .02  SUBBASIN AREA

                 PRECIPITATION DATA

12 PB                  STORM        3.20  BASIN TOTAL PRECIPITATION

13 PI              INCREMENTAL PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
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                      .01       .01       .01       .01       .01       .01       .01       .01       .01       .01
                      .01       .01       .01       .01       .01       .01       .01       .01       .01       .01
                      .01       .01       .01       .01       .01       .03       .03       .03       .03       .03
                      .03       .03       .03       .03       .03       .03       .03       .03       .03       .03
                      .01       .01       .01       .01       .01       .01       .01       .01       .01       .01
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.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

16 LG GREEN AND AMPT LOSS RATE

STRTL	.10	STARTING LOSS
DTH	.25	MOISTURE DEFICIT
PSIF	4.90	WETTING FRONT SUCTION
XKSAT	.25	HYDRAULIC CONDUCTIVITY
RTIMP	84.20	PERCENT IMPERVIOUS AREA

17 UD SCS DIMENSIONLESS UNITGRAPH

TLAG	.19	LAG

***

UNIT HYDROGRAPH
59 END-OF-PERIOD ORDINATES

1.	3.	6.	10.	14.	20.	26.	32.	36.	39.
40.	41.	40.	38.	36.	33.	30.	27.	23.	19.
17.	14.	13.	11.	10.	8.	7.	6.	6.	5.
4.	4.	3.	3.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	

*** *** *** *** ***

HYDROGRAPH AT STATION Sub04

TOTAL RAINFALL = 3.20, TOTAL LOSS = .23, TOTAL EXCESS = 2.97

	PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.98-HR
+	(CFS)	(HR)				
			(CFS)			
+	50.	4.08	5.	1.	1.	1.
			(INCHES) 2.965	2.974	2.974	2.974
			(AC-FT) 3.	3.	3.	3.

CUMULATIVE AREA = .02 SQ MI

*** ***

```
              **************
              *            *
   KK         *     Rte01  *      Routing Flow through McCormick Park Grassed Area
              *            *
              **************
                                  ROUTE HYDROGRAPH THROUGH EAST DITCH ALONG PARKING LOT

                 HYDROGRAPH ROUTING DATA

 20 RS             STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        STOR  TYPE OF INITIAL CONDITION
                        RSVRIC       -1.00  INITIAL CONDITION
                             X         .00 WORKING R AND D COEFFICIENT

 21 RC             NORMAL DEPTH CHANNEL
                          ANL        .025  LEFT OVERBANK N-VALUE
                         ANCH        .025  MAIN CHANNEL N-VALUE
                          ANR        .025  RIGHT OVERBANK N-VALUE
                        RLNTH        670.  REACH LENGTH
                          SEL       .0215  ENERGY SLOPE
                        ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                          CROSS-SECTION DATA
                            --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 23 RY        ELEVATION   1294.10   1294.00   1293.50   1293.00   1293.00   1293.50   1294.00   1294.10
 22 RX        DISTANCE        .00       .10     33.00     66.00     70.00    103.00    136.00    136.10

                                                                  ***

                                          COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .01       .02       .04       .07       .10       .14       .19       .25       .31
          OUTFLOW        .00       .45      2.00      5.04      9.96     17.09     26.75     39.23     54.82     75.53
        ELEVATION    1293.00   1293.06   1293.12   1293.17   1293.23   1293.29   1293.35   1293.41   1293.46   1293.52

          STORAGE        .38       .45       .53       .62       .72       .82       .93      1.04      1.16      1.28
          OUTFLOW     103.17    135.04    171.43    212.58    258.72    310.07    366.84    429.25    500.53    578.69
        ELEVATION    1293.58   1293.64   1293.69   1293.75   1293.81   1293.87   1293.93   1293.98   1294.04   1294.10

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION    Rte01

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.98-HR
+   (CFS)       (HR)
                           (CFS)
+      49.      4.12                   5.          1.          1.          1.
                         (INCHES)   2.961       2.974       2.974       2.974
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                        (AC-FT)        3.          3.          3.          3.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR       24-HR       72-HR     23.98-HR
+  (AC-FT)      (HR)
       0.       4.10                     0.          0.          0.          0.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR       24-HR       72-HR     23.98-HR
+   (FEET)      (HR)
   1293.44      4.12                 1293.13     1293.03     1293.03     1293.03

                        CUMULATIVE AREA =     .02 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  24 KK     *     Sub03  *      McCormick Park Grassed Area
            *            *
            **************
                                SCS RUNOFF COMPUTATION

               SUBBASIN RUNOFF DATA

  26 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PB                STORM        3.20  BASIN TOTAL PRECIPITATION

  13 PI            INCREMENTAL PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
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                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
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.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

```
27 LG          GREEN AND AMPT LOSS RATE
                     STRTL         .18  STARTING LOSS
                       DTH         .25  MOISTURE DEFICIT
                      PSIF        4.90  WETTING FRONT SUCTION
                     XKSAT         .25  HYDRAULIC CONDUCTIVITY
                     RTIMP        9.80  PERCENT IMPERVIOUS AREA

28 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG         .08  LAG

                                                  ***

                                                UNIT HYDROGRAPH
                                          25 END-OF-PERIOD ORDINATES
              8.      24.      50.      72.      80.      76.      65.      49.      34.      25.
             18.      13.      10.       7.       5.       4.       3.       2.       1.       1.
              1.       1.       0.       0.       0.

    ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION    Sub03

    TOTAL RAINFALL =    3.20, TOTAL LOSS =    1.32, TOTAL EXCESS =    1.88

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.98-HR
+   (CFS)        (HR)
                                     (CFS)
+      47.       4.00                    3.          1.          1.          1.
                                  (INCHES)     1.878       1.878       1.878       1.878
```

```
                    (AC-FT)        1.          1.          1.          1.

                    CUMULATIVE AREA =     .01 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  29 KK     *     COM01  *      Combined Flow @ Outfall 3-12"X30' CMP/overflow Weir (RR Embankment)
            *            *
            **************
                                 Combined Flow @ Outfall 3-12"X30' CMP/overflow Weir (RR Embankment)

  31 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

     ***             ***             ***             ***             ***

                       HYDROGRAPH AT STATION    COM01

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.98-HR
+   (CFS)       (HR)
                         (CFS)
+      88.      4.03                 8.          2.          2.          2.
                       (INCHES)    2.460       2.469       2.469       2.469
                        (AC-FT)      4.          4.          4.          4.

                    CUMULATIVE AREA =     .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  32 KK     *     Rte01  *       ROUTING OF FLOW, 3-12"X31' CMP/overflow Weir (RR Embankment)
            *            *
            **************
                                ROUTE HYDROGRAPH THROUGH 3-12"X31' CMP/overflow Weir (RR Embankment)

               HYDROGRAPH ROUTING DATA

  34 RS          STORAGE ROUTING
```

```
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       ELEV  TYPE OF INITIAL CONDITION
                   RSVRIC    1291.70  INITIAL CONDITION
                        X        .00 WORKING R AND D COEFFICIENT

  35 SV          STORAGE        .0       .1       .8      1.8      2.4

  36 SE        ELEVATION    1291.70  1293.00  1294.00  1294.60  1295.00

  37 SQ        DISCHARGE        0.       5.      13.      215.     450.

                                                          ***

     ***          ***          ***          ***          ***

                    HYDROGRAPH AT STATION    Rte01

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR      24-HR      72-HR    23.98-HR
+   (CFS)       (HR)
                            (CFS)
+     79.       4.08                8.         2.         2.         2.
                        (INCHES)  2.451      2.469      2.469      2.469
                         (AC-FT)     4.         4.         4.         4.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR      24-HR      72-HR    23.98-HR
+  (AC-FT)      (HR)
       1.       4.08                0.         0.         0.         0.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                     6-HR      24-HR      72-HR    23.98-HR
+   (FEET)      (HR)
   1294.19      4.08            1292.66    1291.96    1291.96    1291.96

                        CUMULATIVE AREA =     .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  38 KK     *     SUB02  *      Basin McCormick Park
            *            *
            **************
                                SCS RUNOFF COMPUTATION

               SUBBASIN RUNOFF DATA
```

40 BA SUBBASIN CHARACTERISTICS

TAREA	.00	SUBBASIN AREA

PRECIPITATION DATA

12 PB

STORM	3.20	BASIN TOTAL PRECIPITATION

13 PI INCREMENTAL PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.00	.00	.00	.00	.00
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.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

41 LG GREEN AND AMPT LOSS RATE

STRTL	.15	STARTING LOSS
DTH	.25	MOISTURE DEFICIT
PSIF	4.90	WETTING FRONT SUCTION
XKSAT	.25	HYDRAULIC CONDUCTIVITY
RTIMP	12.60	PERCENT IMPERVIOUS AREA

```
42 UD          SCS DIMENSIONLESS UNITGRAPH
                     TLAG         .05  LAG

                                                    ***

                                                UNIT HYDROGRAPH
                                           17 END-OF-PERIOD ORDINATES
               3.       11.       17.       17.       13.       8.        5.        3.        2.        1.
               1.        0.        0.        0.        0.       0.        0.

     ***             ***             ***             ***             ***

                     HYDROGRAPH AT STATION    SUB02

   TOTAL RAINFALL =    3.20, TOTAL LOSS =    1.27, TOTAL EXCESS =    1.93

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     23.98-HR
+   (CFS)       (HR)
                          (CFS)
+       7.      4.00                   0.          0.          0.          0.
                        (INCHES)    1.931       1.931       1.931       1.931
                         (AC-FT)      0.          0.          0.          0.

                     CUMULATIVE AREA =     .00 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  43 KK     *     IBR    *     Final Runoff @ Outfall into East Ditch along Parking Lot
            *            *
            **************
                                COMBINED FLOW INTO EAST DITCH ALONG PARKING LOT

  45 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***

     ***             ***             ***             ***             ***

                     HYDROGRAPH AT STATION    IBR

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     23.98-HR
+   (CFS)       (HR)
                          (CFS)
```

```
+      82.      4.07                    9.          2.          2.          2.
                          (INCHES)    2.418       2.434       2.434       2.434
                           (AC-FT)       4.          4.          4.          4.

                          CUMULATIVE AREA =     .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 46 KK      *     Rte02  *      Routing Flow through East Ditch along Parking Lot
            *            *
            **************
                                 ROUTE HYDROGRAPH through East Ditch along Parking Lot

              HYDROGRAPH ROUTING DATA

 48 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        STOR  TYPE OF INITIAL CONDITION
                     RSVRIC       -1.00  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 49 RC          NORMAL DEPTH CHANNEL
                        ANL        .022  LEFT OVERBANK N-VALUE
                       ANCH        .022  MAIN CHANNEL N-VALUE
                        ANR        .022  RIGHT OVERBANK N-VALUE
                      RLNTH        510.  REACH LENGTH
                        SEL       .0023  ENERGY SLOPE
                      ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                        CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 51 RY        ELEVATION   1293.10   1293.00   1292.00   1291.00   1291.00   1292.00   1293.00   1293.10
 50 RX        DISTANCE        .00       .10      5.00      9.50     10.50     15.00     20.00     20.10

                                                          ***

                                        COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .00       .01       .01       .02       .02       .03       .04       .05       .06
          OUTFLOW        .00       .10       .40       .93      1.76      2.92      4.45      6.41      8.82     11.72
        ELEVATION    1291.00   1291.11   1291.22   1291.33   1291.44   1291.55   1291.66   1291.77   1291.88   1291.99

          STORAGE        .08       .09       .11       .13       .15       .17       .19       .21       .24       .26
          OUTFLOW      15.92     20.78     26.31     32.55     39.55     47.34     55.95     65.41     75.76     87.47
        ELEVATION    1292.10   1292.22   1292.33   1292.44   1292.55   1292.66   1292.77   1292.88   1292.99   1293.10
```

```
     ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    Rte02

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.98-HR
+   (CFS)       (HR)
                            (CFS)
+      79.      4.10                       9.          2.          2.          2.
                         (INCHES)     2.417       2.434       2.434       2.434
                          (AC-FT)        4.          4.          4.          4.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR       24-HR       72-HR     23.98-HR
+  (AC-FT)      (HR)
       0.       4.10                       0.          0.          0.          0.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR       24-HR       72-HR     23.98-HR
+   (FEET)      (HR)
   1293.02      4.10                 1291.66     1291.18     1291.18     1291.18

                         CUMULATIVE AREA =     .03 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  52 KK     *     SUB01  *      Parking Lot
            *            *
            **************
                                 SCS RUNOFF COMPUTATION

               SUBBASIN RUNOFF DATA

  54 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

  12 PB                STORM        3.20  BASIN TOTAL PRECIPITATION

  13 PI            INCREMENTAL PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
```

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

```
55 LG          GREEN AND AMPT LOSS RATE
                    STRTL          .06  STARTING LOSS
                      DTH          .25  MOISTURE DEFICIT
                     PSIF         4.90  WETTING FRONT SUCTION
                    XKSAT          .25  HYDRAULIC CONDUCTIVITY
                    RTIMP        85.40  PERCENT IMPERVIOUS AREA

56 UD          SCS DIMENSIONLESS UNITGRAPH
                     TLAG          .05  LAG

                                                 ***

                                          UNIT HYDROGRAPH
                                       18 END-OF-PERIOD ORDINATES
               6.      19.      34.      36.      31.      21.      13.       9.       6.       4.
               2.       2.       1.       1.       0.       0.       0.       0.

   ***          ***          ***          ***          ***
```

HYDROGRAPH AT STATION SUB01

TOTAL RAINFALL = 3.20, TOTAL LOSS = .21, TOTAL EXCESS = 2.99

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	23.98-HR
+ (CFS)	(HR)					
		(CFS)				
+ 18.	4.00		2.	0.	0.	0.
		(INCHES)	2.991	2.994	2.994	2.994
		(AC-FT)	1.	1.	1.	1.

CUMULATIVE AREA = .00 SQ MI

*** ***

```
            **************
            *            *
 57 KK      *     IBR    *     Final Runoff @ Indian Bend Road & Exst 2-8'x4'CBC
            *            *
            **************
```

COMBINED FLOW FROM PARK AND PARKING LOT @ Indian Bend Road

59 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

***

*** *** *** *** ***

HYDROGRAPH AT STATION IBR

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	23.98-HR
+ (CFS)	(HR)					
		(CFS)				
+ 87.	4.07		10.	3.	3.	3.
		(INCHES)	2.482	2.506	2.506	2.506
		(AC-FT)	5.	5.	5.	5.

CUMULATIVE AREA = .04 SQ MI

1

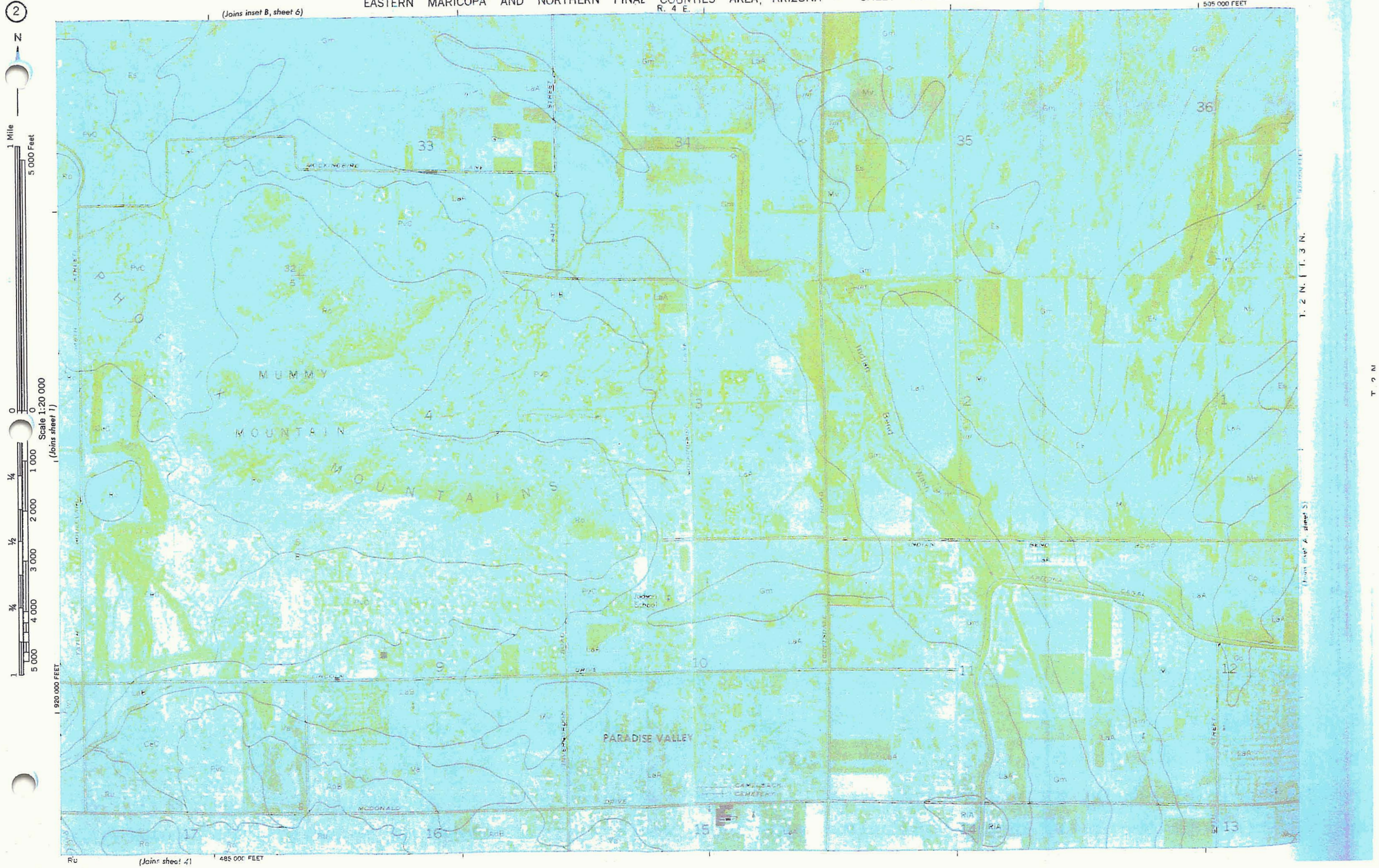
RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

PEAK TIME OF AVERAGE FLOW FOR MAXIMUM PERIOD BASIN MAXIMUM TIME OF

	OPERATION	STATION	FLOW	PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	STAGE	MAX STAGE
+	HYDROGRAPH AT	Sub04	50.	4.08	5.	1.	1.	.02		
+	ROUTED TO	Rte01	49.	4.12	5.	1.	1.	.02		
+									1293.44	4.12
+	HYDROGRAPH AT	Sub03	47.	4.00	3.	1.	1.	.01		
+	2 COMBINED AT	COM01	88.	4.03	8.	2.	2.	.03		
+	ROUTED TO	Rte01	79.	4.08	8.	2.	2.	.03		
+									1294.19	4.08
+	HYDROGRAPH AT	SUB02	7.	4.00	0.	0.	0.	.00		
+	2 COMBINED AT	IBR	82.	4.07	9.	2.	2.	.03		
+	ROUTED TO	Rte02	79.	4.10	9.	2.	2.	.03		
+									1293.02	4.10
+	HYDROGRAPH AT	SUB01	18.	4.00	2.	0.	0.	.00		
+	2 COMBINED AT	IBR	87.	4.07	10.	3.	3.	.04		

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

EASTERN MARICOPA AND NORTHERN PINAL COUNTIES AREA, ARIZONA — SHEET NUMBER 2



Hydrologic Data
Hayen Road Intersection

Area No.	Description[1]	Drainage Area	HSGC	Composite Runoff Coefficient		Time of Conc. Tc[(2)]	Rainfall Intensity		Total Q	
		A	A, B, C or D	C-10 Year	C-100 Year	Tc	I-10 Year	1-100 Year	10-Year	100-Year
		acres				Minutes	Inches/Hour	Inches/Hour	cfs	cfs
8A	North Side of Indian Bend Road	0.55	B	0.51	0.64	5.00	6.1	9.1	1.7	3.2
8B	North Side of Indian Bend Road	0.15	B	0.51	0.64	5.00	6.1	9.1	0.5	0.9
9	East Side of Hayden Road	0.76	B	0.92	0.95	5.00	6.1	9.1	4.2	6.5
10	West Side of Hayden Road	0.60	B	0.95	0.95	5.00	6.2	9.4	3.4	5.2
11	McCormick Ranch	6.24	B	0.51	0.64	7.29	5.3	8.1	16.8	32.2
12	McCormick Ranch	6.84	B	0.51	0.64	8.87	4.8	7.5	16.9	32.7

(1) Refer to Exhibit 3B.

(2) Minimum T_c is set at 5 minutes.

Indian Bend Road Improvements
Time of Concentration (Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road Improvements	**Date:**	4/29/2007
Drainage Area:	Area 8A/CB-86	**Design:**	DNJ
		Check:	

Sheet Flow Component

	1	2	
Upstream Elev.			ft
Downstream Elev.			ft
Length			ft
Slope			ft/ft
n			
$P_{2\text{-yr } 24\text{-hr}}$			in
T_{sheet}			min

T_{Sheet} = 0.00 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft
			min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3		
Channel Type	Swale				
Upstream Elev	1287.61			ft	
Downstream Elev	1285.93			ft	
Length	350			ft	
Slope	0.0048			ft/ft	
Roughness Value	0.024				
Depth	0.5			ft	
Bamk Sideslopes	0.02			ft/ft	3:1 H to V
Spread	25.0			ft	
Area	0.75			ft^2	
Wetted Perimeter	3.16			ft	
Hydraulic Radius	0.24			ft	
Velocity	1.65			fps	
$T_{Channel}$ =	3.54			min	

$T_{Channel}$ = 3.54 min

Time of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

3.54 min *** Use Minimum of 5 minutes**

Indian Bend Road Improvements
Time of Concentration (Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road Improvements	**Date:**	4/29/2007
Drainage Area:	Area 8B/CB-90	**Design:**	DNJ
		Check:	

Sheet Flow Component

	1	2	
Upstream Elev.			ft
Downstream Elev.			ft
Length			ft
Slope			ft/ft
n			
$P_{2\text{-yr } 24\text{-hr}}$			in
T_{sheet}			min

T_{Sheet} = 0.00 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$								min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3		
Channel Type	Swale				
Upstream Elev	1285.93			ft	
Downstream Elev	1284.86			ft	
Length	175			ft	
Slope	0.0061			ft/ft	
Roughness Value	0.024				
Depth	0.5			ft	
Bamk Sideslopes	0.02			ft/ft	3:1 H to V
Spread	25.0			ft	
Area	0.75			ft^2	
Wetted Perimeter	3.16			ft	
Hydraulic Radius	0.24			ft	
Velocity	1.86			fps	
$T_{Channel}$ =	1.57			min	

$T_{Channel}$ = 1.57 min

Time of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.57 min *** Use Minimum of 5 minutes**

Indian Bend Road Improvements
Time of Concentration (Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road Improvements	**Date:**	4/25/2006
Drainage Area:	Area 9/CB-106	**Design:**	DNJ
		Check:	

Sheet Flow Component

	1	2	
Upstream Elev.	1287.2		ft
Downstream Elev.	1286.3		ft
Length	45		ft
Slope	0.02		ft/ft
n	0.012		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.05		min

T_{Sheet} = 0.05 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

	1	2	3	
				ft
				ft
				ft
				ft/ft
				min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1287.2			ft
Downstream Elev	1286			ft
Length	450			ft
Slope	0.0027			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.01			fps
$T_{Channel}$ =	3.73			min

$T_{Channel}$ = 3.73 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

3.78 min *** Use Minimum of 5 minutes**

Indian Bend Road Improvements
Time of Concentration (Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road Improvements	**Date:**	4/25/2006
Drainage Area:	Area 10/CB-104	**Design:**	DNJ
		Check:	

Sheet Flow Component

	1	2	
Upstream Elev.	1287		ft
Downstream Elev.	1286.1		ft
Length	45		ft
Slope	0.02		ft/ft
n	0.012		
$P_{2\text{-yr } 24\text{-hr}}$	1.4		in
T_{sheet}	0.05		min

T_{Sheet} = 0.05 min

Shallow Concentrated Flow

	Paved 1	Paved 2	Paved 3		Unpaved 1	Unpaved 2	Unpaved 3	
Upstream Elev				ft				ft
Downstream Elev				ft				ft
Length				ft				ft
Slope				ft/ft				ft/ft
$T_{Shallow}$								min

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1286.1			ft
Downstream Elev	1283.51			ft
Length	360			ft
Slope	0.0071944			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	3.30			fps
$T_{Channel}$ =	1.82			min

$T_{Channel}$ = 1.82 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

1.86 min *** Use Minimum of 5 minutes**

Indian Bend Road Improvements
Time of Concentration (Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road Improvements	**Date:**	4/25/2006
Drainage Area:	Area 11	**Design:**	DNJ
		Check:	

Sheet Flow Component

	1	2	
Upstream Elev.			ft
Downstream Elev.			ft
Length			ft
Slope			ft/ft
n			
$P_{2\text{-yr } 24\text{-hr}}$			in
T_{sheet}			min

T_{Sheet} = 0.0 min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

	1	2	3	
				ft
				ft
				ft
				ft/ft

$T_{Shallow}$ = 0.00 min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1289.6			ft
Downstream Elev	1285			ft
Length	1100			ft
Slope	0.0042			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.52			fps
$T_{Channel}$ =	7.29			min

$T_{Channel}$ = 7.29 min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

7.29 min

Indian Bend Road Improvements
Time of Concentration (Travel Time Methodology)

Project Information:

Project Name:	Indian Bend Road Improvements	**Date:**	4/25/2006
Drainage Area:	Area 12	**Design:**	DNJ
		Check:	

Sheet Flow Component

	1	2	
Upstream Elev.			ft
Downstream Elev.			ft
Length			ft
Slope			ft/ft
n			
$P_{2\text{-yr } 24\text{-hr}}$			in
T_{sheet}			min

T_{Sheet} = **0.0** min

Shallow Concentrated Flow

Paved

	1	2	3	
Upstream Elev				ft
Downstream Elev				ft
Length				ft
Slope				ft/ft
$T_{Shallow}$				

Unpaved

1	2	3	
			ft
			ft
			ft
			ft/ft

$T_{Shallow}$ = **0.00** min

Open Channel Flow

	1	2	3	
Channel Type	Gutter			
Upstream Elev	1289.8			ft
Downstream Elev	1285			ft
Length	1272			ft
Slope	0.0038			ft/ft
Roughness Value	0.015			
Depth	0.5			ft
Transverse Slope	0.02			ft/ft
Spread	25.0			ft
Area	6.25			ft^2
Wetted Perimeter	25.50			ft
Hydraulic Radius	0.25			ft
Velocity	2.39			fps
$T_{Channel}$ =	8.87			min

$T_{Channel}$ = **8.87** min

me of Concentation (T_c) = $T_{Sheet} + T_{Shallow} + T_{Channel}$

8.87 min

HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** Area 8A/CB-86
Location:
Project No.: 2444553 **Station:**
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Residential - Single Family	A1	0.55	0.55	0.55	0.55	0.55	0.55	acres
(R1-7 - 7000 sq. ft/ lot)	A2							acres
	A3							acres
	Total (A)	0.55	0.55	0.55	0.55	0.55	0.55	
Drainage Length								feet
Elevations:								feet
Top of Drainage Area								feet
At Structure								%
Drainage Area Slope								
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min
Rainfall Intensity (I) - *see Figure 4-4*		3.7	5.0	6.1	7.2	8.1	9.1	in/hr
Runoff Coefficient (C)	C_1	0.51	0.51	0.51	0.56	0.61	0.64	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.51	0.51	0.51	0.56	0.61	0.64	
Peak Discharge $Q_p = C_wIA(F)$		1.03	1.40	1.71	2.21	2.74	3.19	cfs

Computed By: DNJ **Date:** 4/29/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** Area 8B/CB-90
Location:
Project No.: 2444553 **Station:**
Name of Stream Watershed

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Residential - Single Family	A1	0.15	0.148	0.148	0.148	0.148	0.148	acres
(R1-7 - 7000 sq. ft/ lot)	A2							acres
	A3							acres
	Total (A)	0.15	0.15	0.15	0.15	0.15	0.15	
Drainage Length								feet
Elevations:								feet
Top of Drainage Area								feet
At Structure								%
Drainage Area Slope								
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min
Rainfall Intensity (I) - *see Figure 4-4*		3.7	5.0	6.1	7.2	8.1	9.1	in/hr
Runoff Coefficient (C)	C_1	0.51	0.51	0.51	0.56	0.61	0.64	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.51	0.51	0.51	0.56	0.61	0.64	
Peak Discharge $Q_p = C_w IA(F)$		0.28	0.38	0.46	0.59	0.74	0.86	cfs

Computed By: DNJ **Date:** 4/29/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** Area 9/CB-106
Location:
Project No.: 23444553 **Station:**
Name of Stream Watershed

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Hayden Road	A1	0.536	0.536	0.536	0.536	0.536	0.536	acres
Right-of-way	A2	0.158	0.158	0.158	0.158	0.158	0.158	acres
Median	A3	0.063	0.063	0.063	0.063	0.063	0.063	acres
	Total (A)	0.76	0.76	0.76	0.76	0.76	0.76	
Drainage Length								feet
Elevations:								feet
Top of Drainage Area								feet
At Structure								%
Drainage Area Slope								
Hydrologic Soil Group								

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	5	5	5	5	5	5	min
Rainfall Intensity (I) - *see Figure 4-4*		3.7	5.0	6.1	7.2	8.1	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.83	0.83	0.83	0.913	0.95	0.95	
	C_3	0.83	0.83	0.83	0.913	0.95	0.95	
Weighted Runoff Coefficient (C_w)	C_w	0.92	0.92	0.92	0.94	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		2.52	3.45	4.22	5.08	5.84	6.53	cfs

Computed By: DNJ **Date:** 4/29/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road **Concentration Point:** Area 10/CB-104
Location:
Project No.: 234444553 **Station:**
Name of Stream Watershed NA

Design Data:

Design Frequency

		2	5	10	25	50	100	
Drainage Area								year
Hayden Road	A1	0.572	0.572	0.572	0.572	0.572	0.572	acres
Right-o-way	A2	0.019	0.019	0.019	0.019	0.019	0.019	acres
Median	A3	0.005	0.005	0.005	0.005	0.005	0.005	acres
	Total (A)	0.60	0.60	0.60	0.60	0.60	0.60	
Drainage Length								feet
Elevations:								feet
Top of Drainage Area								feet
At Structure								%
Drainage Area Slope								
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	
								year
Time of Concentation	T_c	5	5	5	5	5	5	min
Rainfall Intensity (I) - *see Figure 4-4*		3.7	5.0	6.1	7.2	8.1	9.1	in/hr
Runoff Coefficient (C)	C_1	0.95	0.95	0.95	0.95	0.95	0.95	
	C_2	0.83	0.83	0.83	0.91	0.95	0.95	
	C_3	0.83	0.83	0.83	0.91	0.95	0.95	
Weighted Runoff Coefficient (C_w)	C_w	0.95	0.95	0.95	0.95	0.95	0.95	
Peak Discharge $Q_p = C_w IA(F)$		2.06	2.81	3.43	4.05	4.60	5.15	cfs

Computed By: DNJ **Date:** 4/29/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** Area 11

Location:

Project No.: 23444553 **Station:**

Name of Stream Watershed NA

Design Data: **Design Frequency**

		2	5	10	25	50	100	year
Drainage Area								
Residential - Single Family	A1	6.22	6.22	6.22	6.22	6.22	6.22	acres
(R1-7 - 7000 sq. ft/ lot)	A2							acres
	A3							acres
	Total (A)	6.22	6.22	6.22	6.22	6.22	6.22	
Drainage Length								feet
Elevations:								feet
Top of Drainage Area								feet
At Structure								%
Drainage Area Slope								
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations: **Design Frequency**

		2	5	10	25	50	100	year
Time of Concentation	T_c	7.29	7.29	7.29	7.29	7.29	7.29	min
Rainfall Intensity (I) - *see Figure 4-4*		3.2	4.4	5.3	6.4	7.3	8.1	in/hr
Runoff Coefficient (C)	C_1	0.51	0.51	0.51	0.56	0.61	0.64	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.51	0.51	0.51	0.56	0.61	0.64	
Peak Discharge $Q_p = C_w IA(F)$		10.25	14.08	16.81	22.30	27.64	32.24	cfs

Computed By: DNJ **Date:** 4/29/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10, 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

[3] Runoff coefficients for urban land uses are for lot coverage only and do not include the adjacent street and right-of way, or alleys.

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HYDROLOGIC DESIGN DATA RECORD - RATIONAL METHOD

(Figure 4-3 Hydrologic Design Data Record - Rational Method)

Project: Indian Bend Road Improvements **Concentration Point:** Area 12
Location:
Project No.: 23444553 **Station:**
Name of Stream Watershed NA

Design Data:

Design Frequency

		2	5	10	25	50	100	year
Drainage Area								
Residential - Single Family	A1	6.88	6.88	6.88	6.88	6.88	6.88	acres
(R1-7 - 7000 sq. ft/ lot)	A2							acres
	A3							acres
	Total (A)	6.88	6.88	6.88	6.88	6.88	6.88	
Drainage Length								feet
Elevations:								feet
Top of Drainage Area								feet
At Structure								%
Drainage Area Slope								
Hydrologic Soil Group		B	B	B	B	B	B	

Design Computations:

Design Frequency

		2	5	10	25	50	100	year
Time of Concentation	T_c	8.87	8.87	8.87	8.87	8.87	8.87	min
Rainfall Intensity (I) - *see Figure 4-4*		3.0	4.1	4.8	5.9	6.7	7.5	in/hr
Runoff Coefficient (C)	C_1	0.51	0.51	0.51	0.56	0.61	0.64	
	C_2							
	C_3							
Weighted Runoff Coefficient (C_w)	C_w	0.51	0.51	0.51	0.56	0.61	0.64	
Peak Discharge $Q_p = C_wIA(F)$		10.35	14.21	16.88	22.58	28.00	32.72	cfs

Computed By: DNJ **Date:** 4/29/2007

Checked By: **Date:**

[1] Runoff Coefficients for 25-, 50- and 100-year storm frequencies were derived using adjustment facors of 1.10. 1.20 and 1.25, respectively, applied to the 2-10 year values with an upper limit of 0.95.

[2] The ranges of runoff coefficients shown for urban land uses were derived from lot coverage standards specified in the zoning ordinances for Maricopa County

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Appendix C - Time Of Concentration

6.C.1 Introduction

Travel time (T_t) is the time it takes runoff to travel from one location to another in a watershed (subreach) and is a component of time of concentration (T_c), which is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. **T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system.**

Following is a discussion of procedures and equations for calculating time of concentration and travel time.

6.C.2 Time Of Concentration

The time of concentration, which is denoted as T_c ,is defined as the time required for a particle of runoff to flow from the hydraulically most distant point in the watershed to the outlet or design point. Factors that affect the time of concentration are the length of flow, the slope of the flow path, and the roughness of the flow path. For flow at the upper reaches of a watershed, rainfall characteristics, most notably the intensity, may also influence the velocity of the runoff.

The time of concentration equals the sum of the travel times on each segment of the principal flow path, accordingly, it is useful to describe the segments of flow paths. Sheet flow occurs in the upper reaches of a watershed. Such flow occurs over short distances and at shallow depths prior to the point where topography and surface characteristics cause the flow to concentrate in rills and swales. The depth of such flow is usually 20 to 30mm (3/4 in to 1 in) or less. Concentrated flow is runoff that occurs in rills and swales and has depths on the order to 40 to 100 mm (1.5 in to 4 in). Part of the principal flow path may include pipes or small streams. The travel time through these segments would be computed separately. Velocities in open channels are usually determined assuming bank-full depths.

The following equation represents the time of concentration which is the sum of the travel times (T_t) values for the various consecutive flow segments:

$$\mathbf{T_c = T_{t1} + T_{t2} + \ldots T_{tm}} \qquad \textbf{(6.C.1)}$$

Where T_c = time of concentration, h
m = number of flow segments
T_{tm} = travel time segment, h

6.C.3 Travel Time, T_t

Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection.

6.C.4 Sheet-Flow Travel Time, T_t

Sheet flow is a shallow mass of runoff on a plane surface with the depth uniform across the sloping surface. **Typically flow depths will not exceed 30mm (1 in). Such flow occurs over relatively short distances, rarely more than about 91.4m (300 ft), but most likely less than 46m (150 ft).** Sheet flow rates are commonly estimated using the NRCS TR-55 (1986) variation of the kinematic wave equation:

$$T_t = \cancel{\frac{0.091(nL)^{0.8}}{P_2^{0.5} S^{0.4}}} \qquad \left(T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} S^{0.4}} \right) \qquad \textbf{(6.C.2)}$$

Where T_t = travel time, h
n = Manning's roughness coefficient (values of n can be obtained from Table C.1)
L = flow length, m (ft)
S = slope of the hydraulic grade line (land slope), m/m (ft/ft)
P_2 = 2 year, 24 hour rainfall depth, mm (in) (See Table B-1.)

TR-55 recommends an upper limit of L=91.4m (300 ft) for using Equation 6.C.2, although others have suggested that 91.4m (300 ft) is too long of a flow length for Connecticut so **engineering judgement should be used when selecting the flow length.**

Travel time is the ratio of flow length to flow velocity:

$$\mathbf{T_t = L/(3600V)} \qquad \textbf{(6.C.3)}$$

Where: T_t = travel time, h
L = flow length, m (ft)
V = average velocity, m/s (ft/s)
3600 = conversion factor from seconds to hours.

n	Surface Description
0.011	Smooth asphalt
0.012	Smooth concrete
0.05	Fallow (no residue)
	Cultivated soils
0.06	Residue cover = 20%
0.17	Residue cover >20%
0.13	Range (natural)
	Grass
0.15	Short grass prairie
0.24	Dense grasses
0.41	Bermuda grass
	Woods**
0.40	Light underbrush
0.80	Dense underbrush

Table C-1 Mannings's Roughness Coefficient (n) for Overland Sheet Flow*

* Values obtained from NRCS TR-55 (1986) and McCuen (1989).

** When selecting n for woody underbrush, consider cover to a height of about 25mm (1in). This is the only part of the plant cover that will obstruct sheet flow.

6.C.5 Shallow Concentrated Flow Travel Time

After a maximum of 91.4 m (300 ft), sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from equations 6.C.4 and 6.C.5, in which average velocity is a function of watercourse slope and type of channel.

Unpaved $V = 4.9178(s)^{0.5}$ $(V = 16.1345(s)^{0.5})$ **(6.C.4)**

Paved $V = 6.1961(s)^{0.5}$ $(V = 20.3284(s)^{0.5})$ **(6.C.5)**

Where: V = average velocity, m/s (ft/s)
s = slope of hydraulic grade line (watercourse slope), m/m (ft/ft)

These two equations are based on the solution of Manning's equation with different assumptions for n (Manning's roughness coefficient) and r (hydraulic radius, m (ft)). For unpaved areas, n is 0.05 and r is 0.12 m (0.4 ft); for paved areas, n is 0.025 and r is 0.06 m (0.2 ft).

After determining average velocity, use equation 6.C.3 to estimate travel time, T_t for the shallow concentrated flow segment.

6.C.6 Open Channel Flow Travel Time

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation but may change with respect to stream reach.

Manning's equation is

$$V = (r^{2/3} s^{1/2})/n \quad (V = (1.49 r^{2/3} s^{1/2})/n) \qquad \textbf{(6.C.6)}$$

where: V = average velocity, m/s (ft/s)
r = hydraulic radius, m (ft) (equal to a/p_w)
a = cross sectional flow area, m^2 (ft^2)
p_w = wetted perimeter, m (ft)
s = slope of the hydraulic grade line (watercourse slope), m/m (ft/ft)
n = Manning's roughness coefficient (see Appendix A of Chapter 8, Culverts and Table 7-1 of Chapter 7, Channels)

After average velocity is computed using equation 6.C.6, T_t for the channel segment can be estimated using equation 6.C.3.

6.C.7 Reservoir Or Lake Flow Travel Time

Sometimes it is necessary to compute a T_t for a watershed having a relatively large body of water in the flow path. In such cases, T_t is computed to the upstream end of the lake or reservoir, and for the body of water the travel time is computed using the equation:

$$V_w = (gD_m)^{0.5} \qquad \textbf{(6.C.7)}$$

Where: V_w = the wave velocity across the water, m/s (ft/s)
g = 9.81 m/s^2 (32.2 ft/s^2)
D_m = mean depth of lake or reservoir, m (ft)

Generally, V_w will be high 2.44 - 9.14 m/s (8-30 ft/s).

One must not overlook the fact that equation 6.C.7 only provides for estimating travel time across the lake and for the inflow hydrograph to the lake's outlet. It does not account for the travel time involved with the passage of the inflow hydrograph through spillway storage and the reservoir or lake outlet. This time is generally much longer and is added to the travel time across the lake. The travel time through lake storage and its outlet can be determined by the storage routing procedures in the Storage Chapter. Equation 6.C.7 can be used for swamps with much open water, but where the vegetation or debris is relatively thick (less than about 25% open water), Manning's equation is more appropriate. For additional discussion of equation 6.C.7 see King's Handbook of Hydraulics, fourth edition, page 8-50, or Elementary Mechanics of Fluids, by Hunter Rouse, John Wiley and Sons, Inc., 1946, page 142.

After wave velocity is computed using equation 6.C.7, T_t for the reservoir or lake can be estimated using equation 6.C.3.

Time of Concentration Worksheet (Page 2 of 3)

Channel flow		Segment ID					
12	Cross sectional flow area, a	m^2 (ft^2)					
13	Wetted perimeter, p_w	m (ft)					
14	Hydraulic radius, $r = a/p_w$	m (ft)					
15	Channel slope, s	m/m (ft/ft)					
16	Manning's roughness coeff., n (Table 7-1 & Append. A, Ch. 8)						
17	Average velocity, v (Equation 6.C.6)	m/s (ft/s)					
18	Flow length, L	m (ft)					
19	Travel Time, T_t (Equation 6.C.3)	h		+		=	

Channel Section ID Schematic

Channel Section ID Schematic

Time of Concentration Worksheet (Page 3 of 3)

Reservior or lake flow		Segment ID					
20	Mean depth of lake or reservoir, D_m	m (ft)					
21	Wave velocity across the water, V_w	m/s (ft/s)					
22	Travel time, T_t (Equation 6.C.3)	h			+		=

Total T_c = (add T_t in steps 6, 11, 19, and 22).....