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Interstate 25
Circle Drive/Lake Avenue (SH 29)
Interchange Complex

Project No. IM 0252-300

Hydraulic Report

Prepared for: **Colorado Department of Transportation**
Region 2

May 1, 1997

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I. Introduction

A. General Discussion

This project is an element of a larger corridor along Interstate 25 through Colorado Springs extending from south of the Circle/Lake Interchange to the Briargate Interchange and the SH 105 - Monument Interchange. The emphasis of this particular project is to provide safety improvements to the Circle/Lake Interchange complex. These improvements consist of providing acceleration and deceleration lanes for ramps, providing adequate capacity for Circle Drive and the movements onto and off the Interstate, coordinating signal timing and intersection design and capacity, modifying existing access and possible reconfiguration of existing local streets.

The design team for this segment is part of a larger "corridor design team". This "corridor team" consists of consultant firms, CDOT design units, City agencies and contractors. It is CDOT's intent to provide a consistent and well coordinated plan as it relates to Interstate 25 improvements within this urbanized corridor. This coordinated plan will include project development, design, project schedules and eventual construction.

This report includes determining the limits of contributory drainage basins and the major drainage facilities. The drainage basin data was established including: delineating basins, determining size, determining waterway geometries, and establishing vegetation cover and land use. Historical data was collected such as flood history and data from other sources such as CDOT maintenance and local residents. The report includes a hydrology analysis, minor structure hydraulic design, structure cross-sections, storm water pollution prevention plan and in the appendix; drainage basin maps and project design criteria.

This report includes the preliminary design of minor drainage structures. The locations, crossing alignment, type and size of structure, the allowable headwater, the degree of sediment and debris problems that may be encountered were determined. Preliminary structure cross-sections were prepared to determine elevations, flowlines, slopes and lengths of structures.

A Storm Water Pollution Prevention Plan will be prepared in accordance with the latest CDOT standard specifications, standard plans and other appropriate documents. The plan will include erosion and sediment control best management practices to reduce pollutants in storm water discharges both during and after construction. This plan will be developed during the final design of the project and includes erosion control measures. The mitigation measures will be incorporated into the construction plans.

B. Project Limits

This particular project segment is located in Colorado Springs along Interstate 25. The approximate limits of analysis along I-25 are from the Fort Carson RR overpass structure at the south, to the US 24 Bypass at the north. The construction limits for this project are anticipated to be considerably less than these limits. The limits along Circle/Lake are from SH 85/Venetucci Blvd., at the west, to Janitell Road, at the east. The design of this project is being done using metric standards. Figure 1 on page 2 shows the approximate project limits.

VICINITY MAP

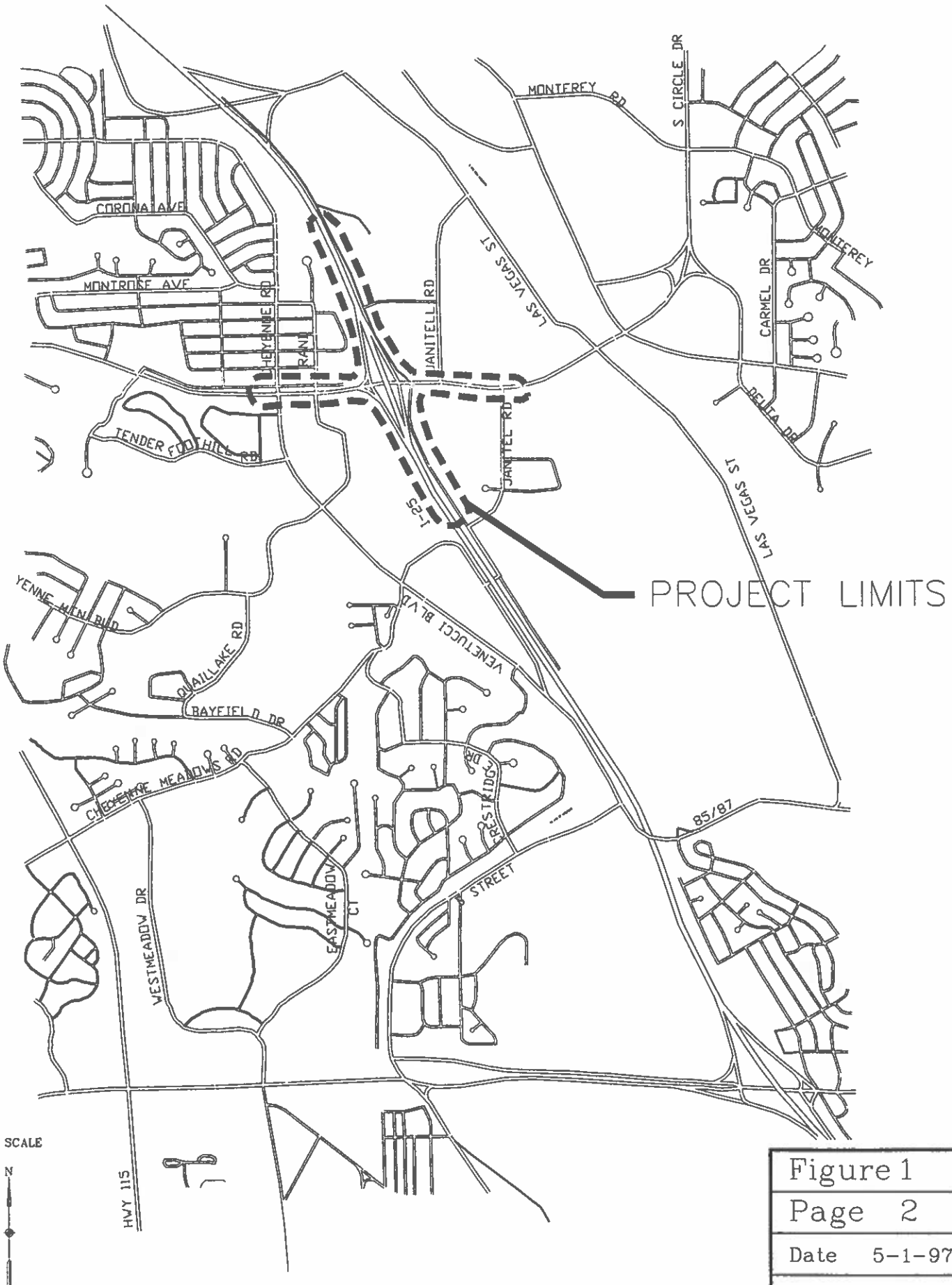

Figure 1
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II. HYDROLOGY

II. Hydrology

A. General Discussion

This report included review of the drainage limits associated with the I-25 and Circle/Lake Interchange. The review included previous drainage reports and plans that were available from CDOT or the City as well as limited on site inspections. These drainage reports and plans include the following:

1. "Preliminary Design Report Stratton Drainage Basin Outfall Study", Drexel Barrell. December, 1994.

2. "Stratton Basin Outfall Storm Sewer, As Built Copy", Drexel Barrell, November, 1994.

3. "Cheyenne Mountain Center Master Drainage Report and Filing No. 1", Drexel Barrell, November, 1985.

4. "Engineering Study of Southwest Area Drainage Basin (Cheyenne Creek, Cheyenne Run and Spring Run)", Lincoln DeVore, February, 1984.

5. "Preliminary and Final Drainage Report and Plan for World Arena Subdivision Filing No. 1", Obering, Wurth & Associates, August, 1994.

6. "Design Analysis of Box Culvert at I-25 Station 432+30", Leigh Whitehead & Associates, May 6, 1988.

7. "Preliminary Drainage Study, U.S. Highway 85/87 (Venetucci Boulevard) and State Highway 29 (Lake Avenue)", Drexel Barrell, March, 1995.

8. "Drainage Conditions at and Recommended Modifications to the Harrison Outfall", Drexel Barrell, February, 1997.

9. "U.S. Highway 85/87 (Venetucci Boulevard), Final Review Set, Storm Sewer Package" Drexel Barrell, March, 1997.

B. Drainage Area Characteristics

There are four overall drainage basins that comprise the drainage associated with the project. All of these basins eventually outfall into Fountain Creek east of this project. The drainage areas are as follows:

1. Sinton Outfall
2. Harrison Outfall
3. Circle/Lake Outfall
4. Spring Run Outfall

SINTON OUTFALL

The existing Sinton Outfall crossing of I-25 is located at approximately Station 17+815. The outfall is located just north of the one way road crossing that goes between the two frontage roads on either side of I-25. This basin generally drains from west to east. The approximate limits of this drainage basin extend from I-25 west to Nevada Avenue, where the basin narrows and continues to the west approximately another 1.7 kilometers. The approximate north boundary of this basin is Cheyenne Meadows Road and the south boundary is approximately 0.5 kilometers south of the I-25 crossing. The majority of the basin is developed with a mix of residential and higher density land uses.

HARRISON OUTFALL

The existing Harrison Outfall is located at approximately Station 18+655. The outfall is located just south of Harrison High School. This basin generally drains from west to east. The limits of this drainage basin extend from I-25 west to approximately Nevada Avenue. The north boundary of this basin is approximately Lake Avenue and the south boundary is approximately Cheyenne Meadows Road. The majority of the basin is developed with higher density land uses.

CIRCLE/LAKE OUTFALL

The Circle Lake Outfall is considered the area of the interchange and east that flows directly to the east along Circle Drive. This area includes ramps and ramp infield areas. There is an existing drainage system that runs along the north side of Circle/Lake from the westerly ramps to the westerly Janitell intersection where it crosses over to the south side into a ditch along the south side of Circle/Lake. This area is completely developed as the interchange, roadways and adjacent commercial areas and schools.

SPRING RUN OUTFALL

The I-25 crossing of the Spring Run Outfall is located at approximately Station 20+250. The Spring Run basin extends west to the top of Cheyenne Mountain. The lower area of the basin is mostly developed as residential land uses in the Stratton Meadows area. The main channel of Spring Run runs west to east until it intersects the freeway ditch at approximately Station 19+770. It then runs along the west side of the freeway until it reaches the crossing previously described. The limits of construction for the project are approximately where the main channel of Spring Run approaches the freeway.

C. Design Methods and Criteria

Project design criteria was developed which incorporated critical elements of both CDOT and City of Colorado Springs criteria. The methods and criteria utilized are included in Appendix B. The design references used for this project are as follows:

1. "Drainage Design Manual, 1995 Draft", Colorado Department of Transportation, July, 1995.

2. "Erosion Control and Stormwater Quality Guide", Colorado Department of Transportation, June, 1995.

3. "Drainage Criteria Manual", City of Colorado Springs and El Paso County, October, 1997 including Amendments in November, 1991 and October, 1994.

D. Offsite Hydrology

SINTON OUTFALL

Reference number 1 (page 3) describes the proposed system in detail and utilizes current hydrologic methods from the City of Colorado Springs drainage criteria as well as TR-20 computer analysis. Reference number 1 identifies upstream detention built to reduce the peak flows at this crossing to near historic flows. The proposed systems in reference number 1 have been constructed as explained in reference number 8.

The 100 year storm for the Sinton Outfall exceeds the crossing capacity at I-25 despite the improvements detailed in references 1 and 8. Higher flows travel out of a grate on a junction box and down through an existing box culvert/traffic underpass into a recently constructed channel and existing pond. Although not contained within our project boundary, flow limitations imposed by the Sinton Outfall affect the design and flow bypass considerations of the Harrison Outfall box culvert and its downstream channel. It is our understanding that peak flows above historic in the Harrison Outfall system will drain to the Sinton Outfall despite its capacity constraints. The 100 year peak flows from reference number 1 are as follows:

Design Point (x-y, where x is the design point and y is the reference number)	Drainage Area (km^2)	Historic 100 yr Peak Flow (cms)	Developed 100yr Peak Flow (cms)
5-1 Upstream end of 1800 mm pipe crossing I-25	5.36	44.2	44.17 (with detention)
12-1 For 2000 mm pipe to the north of crossing	1.36	---	17.27 (with storm align 2)
13-1 and 13-2 For 2600 mm pipe to the west of crossing	4.01	---	31.1 (with storm align 2)

HARRISON OUTFALL

The channel upstream (west) of I-25 was improved as a grass lined channel when the Red Lion Inn was constructed. This channel is described in reference number 3 and was sized to carry the peak flow estimated from older City design criteria. The method used was the graphical method for the SCS 6 hour design storm. Typically, this method predicted lower flows than the current City criteria predict. In addition, the earlier reference did not size the channel for the 100 year storm due to the previous criteria not requiring a 100 year design for 100 year flows less than 14.2 cms. The overall flows at the crossing were updated in reference number 1. In addition to the difference in methods, the later study also revised the drainage area due to the availability of better mapping. The comparison of the design flows from the studies are as follows:

Design Point (x-y, where x is the design point and y is the reference number)	Drainage Area (km^2)	Historic 100yr Peak Flow (cms)	Developed 100 yr Peak Flow (cms)
4-3 (6 hour storm) Upstream end of concrete box crossing I-25	.83	---	13.1
1-1 (24 hour storm) Upstream end of concrete box crossing I-25	1.04	15.9	18.1

From reference number 1, it is indicated that the flow through the box culvert will be limited to historic flows of 9.9 cms with the remainder of the flow directed to the south into the Sinton Outfall system. This issue was recently discussed with the City and other concerned parties. Based on information from this meeting, the Harrison Crossing is presently re-designed for the historic flow of 9.9 cms. Low flows and excess peak flows over historic will be diverted south to the Sinton Outfall with a weir system designed and built separately from the project. Of course, as previously mentioned, the existing downstream Sinton Outfall system is currently over capacity.

The new alignment of the box culvert crossing at the south end of the Harrison system is designed to outfall in parallel to the existing downstream channel. This alignment eliminates an abruptly angled open channel that presently exists at the corner of Gorman Junior High's parking lot. The school has also requested that low flow pipes be installed to prevent water from low intensity storms from free flowing across the road.

It is also possible that some trans-basin flow may occur at the Venetucci/Lake intersection of the Harrison Outfall system which presently is under-designed for the 5 year flow and 100 year flow. The intersection is presently scheduled for drainage modification by others and the proposed southwest Circle/Lake storm sewer system is sized to convey the 5 year storm overflow from the existing system. However, the system designed for the 5 year flow will not contain 100 year flow. Flooding will first occur at the intersection of Lake and Venetucci. Water will flow out of the proposed "bubbler" and into an exiting grass lined ditch. Flow will travel east toward the interchange in this ditch to the vicinity of Cheyenne Mountain and Lake. At this intersection the flow will be bottle necked as a result of the diminishing ditch and increased width of the road. Flow will accumulate but is not predicted to overtop the crown of the road at Cheyenne Mountain and Lake. Overflow will continue down the grade on the south side of the road, cross over to the median at the reverse crown and flow to inlet 6. Bypass flow from inlet 6 will travel to inlet 26 and outfall at the Circle/Lake Outfall. 100 year flow will also flood on the east side of the interchange at MH 6 and across the road to the east storm sewer system. Minor bypass flow would also occur during a 100 year storm at the east end of the Harrison frontage road as well as INL 2.

CIRCLE/LAKE OUTFALL

An existing channel and outfall system already exists northeast of the Gorman Junior High parking lot. At this location (design point 2) a 900 mm CMP drains into an asphalt lined ditch, which eventually outfalls into Fountain Creek. Flow from this existing pipe is estimated at 1.3 cms. At this location another 750 mm RCP will daylight that drains the proposed construction improvements of the east side of Circle/Lake and the pedestrian underpass. 5 year flow from this pipe is .618 cms at initial design. Total flow for both pipes outfalling at design point 2 is approximately 2 cms. The asphalt lined channel has sufficient capacity to carry the flow until Circle/Lake Station 2+160. At this location the south side of the ditch drops off allowing flow over 1.39 cms to overtop the channel and flow south into an existing channel/lowland area. Below Station 2+200 the channel has improved capacity but it is still insufficient. Upon field inspection it is evident that the land south of the ditch has been utilized for drainage of the Harrison School system property and regularly carries drainage. It appears that overflow from the asphalt lined channel successfully routes through this drainage area when it overflows. However, all flows eventually consolidate at the 900 mm CMP that carries flow under Janitell Road. Higher flows appear to pond in various areas south of channel/pipe. The area south of the channel/culvert appears to act as a natural detention site for channel overflow.

To improve the channel, 145 meters of the south side of the channel would need to be bermed, and a larger pipe placed under Janitell Road. Also a pipe or open channel would be required to drain the cumulative flow of the land south of the ditch from its collection point to the culvert under Janitell. These improvements are not planned for this project. It should also be noted that these flows do not take into account any trans-basin diversion from the Harrison Outfall, that as previously mentioned, that could occur and route east into the Circle/Lake Outfall.

SPRING RUN OUTFALL

Reference number 4 indicates the overall basin limits and hydrology for the basin. The drainage study completed in Reference 4 was based on the older City design criteria. Typically, this method predicts lower flows than the current City criteria predicted. Reference 6 was prepared for the Highway 24 Bypass Project. This report utilizes the Colorado Urban Hydrograph procedure for computing runoff. The comparison of the design flows from the studies are as follows:

Design Point (x-y, where x is the design point and y is the reference number)	Drainage Area (km^2)	Historic 100yr Peak Flow (cms)	Developed 100yr Peak Flow (cms)
37-4 (6 hour storm)	9.635	------	43.13
37-6	10.441	------	63.71

The design flow in reference 6, prepared for the State in 1988, was used to design the double box culvert which exists under I-25. This box culvert is the outfall for Spring Run into Fountain Creek. Upon investigation, the channel immediately upstream from the box is slightly under-designed for this flow. However, the channel is presently well vegetated and has right-of-way restrictions. Therefore, modification of the channel for slight design optimization may not be worthwhile. Reaches of this channel from Stations 19+370 to 19+764 have been designed for proposed improvements based on width constraints. It should also be noted that these flows do not take into account any trans-basin diversion from the Harrison Outfall, that as previously mentioned, could occur.

III. EXISTING STRUCTURE

III. Existing Structure

A. General Discussion

Existing drainage systems vary in design capacity and function at the Circle/Lake interchange. As a result of the different design criteria and land use during original construction most existing systems are undersized for predicted flows.

B. Existing Highway Crossings/Channels

SINTON OUTFALL

Historically, the drainage flowed along the west side of the freeway in a ditch from north to south and discharged through the road crossing, (which was originally a 4.267 m x 3.658 m concrete box used as a drainage/cattle crossing).

An outfall, which was constructed more recently, consists of an 1800 mm reinforced concrete pipe running underneath I-25. The invert of this pipe is housed in a 6.1 m x 4.9 m junction box which daylights from the top with a metal grate. A 2000 mm pipe from the north and a 2600 mm pipe from the west also come together at this junction box. Until recently this system was plugged at the downstream end. Construction on the outfall has progressed allowing drainage to flow from this box to an outfall at Fountain Creek. The 2600 mm pipe presently is flowing, while the 2000 mm pipe is not.

It should be noted that even with the new systems in place there is a bottleneck created at the existing 1800 mm crossing of I-25. This pipe does not have the capacity needed to carry the full 100 year flow. Reference number 1 indicates the storm water overflow will flow through the one way road crossing at a depth of approximately 1.4 m. In order for the 1800 mm pipe to carry the design flow of 44.17 cms, the water would have a velocity of 17 mps which seems to be excessive. Even though downstream improvements are being constructed, the junction box and the 1800 mm outfall pipe simply do not have the capacity to accommodate the flow from the 2000 mm pipe from the north and the 2600 mm pipe from the west. The most likely route for water exceeding design capacity is to flow over the top of the junction box and overland to I-25. There is also an existing 600 mm RCP near the one way crossing that appears to collect the ditch flows on the west side of the frontage road and carry them across I-25. On inspection the upstream end of this pipe is half full of mud and debris.

The majority of the system described is outside the anticipated limits of the Phase 1 construction along I-25. The northerly part of this drainage basin is at Station 18+650. The anticipated start of construction is at Station 18+200, so there is approximately 450 m of freeway that is within this basin. It appears that we can use the existing roadside and median ditch system from Station 18+650 south to the limits of the project with only minor modifications. Considering the new pipe construction paralleling I-25, it may be desirable to connect median inlets to the roadside ditch and/or the proposed pipe. There appears to be one existing median inlet located at Station 18+250+/-.

Please note that in the ultimate condition, the grade change due to the I-25 crossing at Bob Johnson Road may drastically alter the drainage patterns in this area.

HARRISON OUTFALL

The outfall is a 3.048 m x 1.829 m box culvert located at the southwest edge of the Harrison High School parking area. Currently, the drainage flows along the west side of the freeway in a ditch from north to south and discharges through the crossing directly onto the east frontage road. The discharge east of I-25 has been a point of contention between Harrison School District and the developer on the west side of I-25. The discharge is currently across the surface of the east frontage road into a concrete pan on the east side of the frontage road which redirects it into a natural drainage channel along the south side of Harrison High School. The developer was required by the City to post assurance for part of the cost of improving this natural channel. Upon inspection of the site it is evident that the section downstream of the frontage road that parallels the school is eroding.

The channel upstream of the Harrison crossing of I-25 was designed as a grass lined channel with a design capacity of 9.9 cms with 0.4 m of freeboard. From the project topographic mapping, it appears that this channel is capable of passing the newer peak flows (18.1 cms) predicted by reference number 1, except there is no freeboard left in the channel. The latter analysis indicates that the velocities in the channel (2.3 mps) are higher than typically used in a grass lined channel.

The upstream end of the grass lined channel has a corrugated metal arch pipe (1850 mm x 1400 mm) that carries storm water from Venetucci Boulevard to this channel. This pipe was originally designed for the 5 year storm under older City criteria. It has been indicated by residents of the area (in a public meeting) that this pipe has caused flooding to pass from the south side of Lake Avenue to the north side of Lake Avenue, thereby flooding nearby residences. It should be noted that the hydraulic grade line for the proposed crossing of Venetucci Boulevard recently designed by Drexel Barrell indicates a 5 year hydraulic gradeline that flows 1.23 m over the roadway rather than being contained in the pipe. In addition, reference number 4 indicates that larger storms result in a diversion of storm water from the Harrison Basin into the Spring Run Basin.

Another channel recently constructed exists which borders Phase 2 of the World Arena Development. This channel flows directly into the Harrison crossing. It consists of a 1200 mm RCP discharging into a channel that varies in bottom width from 2 m to 4 m. This flow may not have been taken into account in reference 1. The flow for this pipe is shown in reference 3. The 100 year flow shown in reference 3 (1985) for this pipe was 2.8 cms. It is not currently known from the references if this pipe (which on inspection is new) is intended to carry flow from the World Arena Site. Flow from this pipe will be verified with the consultant who performed the study in reference 5.

SPRING RUN OUTFALL

The outfall is a double 3.048 m x 1.829 m box culvert located at the south side of the U.S. Highway 24 Bypass Interchange. Currently, the main channel for Spring Run drainage flows parallel along the west side of the freeway from south to north beginning at Station 19+262 and increasing in size to the culvert at Station 20+242. This channel is a well vegetated grass lined V-ditch which discharges through the crossing directly into a channel on the east side of the east frontage road. A 600 mm CMP

drains into this west channel as well as a 1400 mm RCP and two concrete lined channels as it runs south to north. Localized drainage also flows along the west side of the freeway from north to south into the crossing. The crossing of I-25 and downstream was rebuilt as part of the U.S. Highway 24 Bypass project.

Over half of the system described is outside the anticipated limits of the Phase 1 construction along I-25. The southerly part of this channel is at Station 19+370 and the northerly part at 20+242. The anticipated construction limit is at 19+750, so there is approximately 380 m of freeway that is within this basin. Slight channel improvements are proposed from Stations 19+370 to 19+750.
The proposed channel will tie into to an existing concrete and rip-rap structure at Station 19+645 and tie into the existing channel downstream at Station 19+750.

C. Existing Storm Sewer

CIRCLE/LAKE OUTFALL

Presently a storm sewer system exists in the area of the interchange and east that flows directly to the east along Circle Drive. This includes ramps and infield areas. An existing 600 mm CMP pipe is the first upstream pipe in this system. This pipe collects flow from the area directly west of the northwest ramp, including parking lot areas for Denny's, a vacant lot and 130 m of the existing frontage road. Flow is collected in a small ditch which parallels the ramp directing flow into this pipe. Drainage from this area flows in the northwest infield where it joins local flows and I-25 runoff. It is then conveyed through another 600 mm RCP under I-25 to the northeast infield area. Drainage then flows through a grate where two additional 600 mm CMPs join, bringing flow from the southeast infield and northeast frontage road areas. Another 600 mm pipe conveys flow directly east to a existing concrete channel, through a 600 mm CMP under Janitell Rd, and into another concrete channel. This channel drains to a 900 mm CMP pipe which crosses circle and outfalls into an existing asphalt lined channel. This storm sewer system collects flow approaching the northeast side of Circle/Lake from station 1+462 to Station 2+240 .

IV. DESIGN DISCUSSION

IV. Design Discussion

A. General Discussion

A preliminary drainage design based on the most current alignments and profiles has been developed for this area. Local flows have developed using the rational method and initial inlet locations established. This information is subject to refinement as alignments and profiles are altered.

B. Specific Site Conditions & Constraints

The intersection of Venetucci and Lake Avenue imposes a special condition on the design of the southwest storm sewer along Lake Avenue. The existing 2850 mm x 1400 mm corrugated metal arch pipe does not have the capacity to accommodate the existing flow. The hydraulic grade line for the proposed crossing of Venetucci Boulevard recently designed by Drexel Barrell indicates a 5 year hydraulic gradeline that flows 1.23 m over the roadway rather than being contained in the pipe. It was decided in a meeting with CDOT what the new storm sewer in Lake Avenue would be designed for the 5 year storm. This design incorporates the available capacity of the existing CMP arch and is designed to convey the 5 year storm.

From Station 1+500 to 1+580 the proposed roadway will cover the existing open channel. As a result the storm sewer system will be extended through this area. There are some constraints in this 80 m segment which influence storm sewer design. First, the 1050 mm proposed storm sewer will need to cross an existing 400 mm (16") water line and 380 mm (15") sanitary sewer to tie into the proposed junction with the existing southeast system. Second, there is limited right-of-way in this area between the road and existing Red Lion parking lot.

From Station 18+655 to 19+150 an upgraded channel will be required, as previously discussed, to convey flow from the Circle/Lake storm sewer system to the Harrison Outfall. The channel upgrade is considered a better alternative than retaining walls (to avoid filling in the existing channel) on the southwest ramp when considering construction costs and the nature of the existing channel described previously. This design is limited by width constraints resulting from an existing sanitary sewer line and a required access road. The downstream section of the existing ditch flows into a 1830 mm x 3050 mm RCBC. Flow from the existing culvert presently flows across the frontage road. The school has requested that low flow pipes be placed under the road at the end of the RCBC.

The proposed pedestrian underpass under the northwest ramp also poses some significant design and construction challenges. First, the sump and flanking inlets located in the low point of the ramp and above the tunnel have clearance constraints and draining these locations may require special design. Second, and most important, the tunnel requires the entire east trunkline to be dropped an additional 2.5 m to 3.5 m for most of its length. This design will drain the tunnel but impose significant construction and maintenance challenges.

The existing northeast drainage system presently drains all flow approaching Circle from the northeast. The north side of the road from I-25 east will receive only minor road modifications. As a result the

north side of Circle east of the interchange will receive only minor drainage modifications.

At the west side of the northwest ramp there is not sufficient width to construct the required grass ditch. This constraint is imposed by the alignment change from existing to proposed. The option being considered for this area is to provide a berm along the bottom of the retaining wall to keep offsite flows away from the base of the retaining wall.

C. Major Drainage Alternatives

The Circle/Lake and Harrison frontage road area on the west side of the interchange has historically drained into the Harrison Outfall system with the exception with a small area near Denny's. In an effort to preserve historical basins the proposed system on the southwest side of Circle/Lake has been oversized to accommodate 5 year flows. This proposed southwest system would operate in parallel with the existing undersized southwest system. Flows from the undersized existing system would overflow into the proposed system. A second alternative that accomplishes this goal would require removal and up-sizing of the existing southwest pipe system from Venetucci to the junction with the proposed system. This would provide for the 5 year flows and allow the proposed southwest lake storm sewer system to be downsized. This design would decrease the conflict with utilities by eliminating the need for connecting pipes which must cross some significant existing utilities. However, it should be noted that the proposed design attempts to utilize the existing system in order to keep costs down and up-size only the proposed system.

The box culvert at the Harrison Crossing has been designed to carry 9.9 cms and the additional 8.4 cms will be diverted south to the Sinton Outfall system. The Harrison Crossing could be improved to accommodate the total flow of 18.13 cms. The improvement would include designing a larger box culvert and improving the downstream channel.

D. Permitting Requirements

A stormwater drainage permit will be prepared and submitted by CDOT. ***CHECK***

A section 404 permit will not be submitted as there are no wetlands in the project limits. ***CHECK***

A floodplain development permit will be submitted for Spring Run for the designated flood plain within the project area. 100 year flood levels backup from Fountain Creek and through the existing box culvert under I-25. The flood occupies the existing grass lined channel on the northwest side of I-25 from the box culvert to approximately Station 19+500. ***CHECK***

It is assumed that CDOT has or will obtain all other permits for the project. This assumption includes the fugitive dust permit. ***CHECK***

V. RECOMMENDED DESIGN

V. Recommended Design

A. General Discussion

Appendix A includes maps and preliminary design drawings for the recommended system. Appendix B includes the criteria used for the recommended design. This section includes information related to the analysis performed for the recommended system. It is organized by the four drainage outfalls described previously.

B. Sinton Outfall Facilities

The proposed system as previously described is complete with the exception of a 1700 mm-2000 mm pipe proposed by others which will connect the Harrison Outfall facilities to the Sinton Outfall facilities. Our proposed system is based on the installation of this pipe. Flow over 9.9 cms in the Harrison Channel would be conveyed through this pipe to the Sinton Outfall facility.

C. Harrison Outfall Facilities

The proposed west Circle/Lake storm sewer system consists of a proposed trunkline, proposed major left lateral system and the existing major right lateral system.

The existing right lateral will convey flow from the southwest of Venetucci and Lake to a junction with the proposed trunkline. 5 year flow that cannot be conveyed in this existing system would be transferred through a junction box into the proposed southwest (trunkline) storm sewer system. The purpose is to convey the 5 year storm without flooding. Reference 4 indicates that larger storms result in a diversion of storm water from the Harrison Basin to the Spring Run Basin.

The trunkline will be oversized, as previously mentioned, to accommodate overflow from the existing system. It should be noted that an existing 400 mm (16") water and 380 mm (15") sanitary sewer line will be crossed directly southeast of the Venetucci/Lake intersection to accommodate this overflow design. From Station 1+500 to 1+580 the proposed roadway will cover the existing open channel. As a result, two additional 1400 mm RCP's in parallel will be utilized to extend the trunkline and convey flow to a new outfall location at Station 1+580. It should be noted that the existing 400 mm water and 380 mm sanitary sewer line will again be crossed between Stations 1+340 and 1+540 to accommodate this design.

The left lateral will be designed to convey the flow from the northwest side of Venetucci/Lake intersection to the trunkline. This system will include inlets on Lake as well as on Harrison Road. A schematic of the proposed west Circle/Lake storm sewer, as well as reference locations, hydrology and hydraulic grade line calculations are included at the end of this section.

Proposed grading for the southwest ramp fills in part of the existing grass lined channel. A concrete lined ditch from station 18+655 to 19+150 was selected to convey flow from the storm sewer outfall location to the Harrison RCBC as it had the minimum width to convey the required flow. This minimum width was essential to provide clearance for the relocation of a sanitary sewer line and an access road.

The design parameters for the proposed concrete lined ditch are as follows:

Q_{100} = 18.13 cms
Manning's n = 0.015
Longitudinal Slope = 0.80%
Bottom Width = 3 m
Side Slope = 1.5:1

Normal depth = .93 m
Freeboard = .46 m
Total Depth = 1.39 m
Average Velocity = 4.44 mps
Froude Number = 1.47

The design parameters for the proposed reinforced concrete box culvert are as follows:

Q_{design} = 9.91 cms
Manning's n=0.015 (partially full)
Longitudinal Slope = 1.0%
Width = 3.05 m
Height = 1.83 m

Box Culvert Operates Under Inlet Control
HW/D = .86
HW = 1.57 m
HW Elevation = 1787.54

The downstream section of the concrete lined ditch flows into a flow separation system, controlled by a weir proposed by others. Flow under 9.9 cms will be conveyed through a 1830 mm x 3050 mm RCBC which is aligned parallel to the downstream channel. Low flow from the proposed RCBC will be conveyed in a low flow pipe to the existing channel. Higher flows will flow across the road to the channel.

D. Circle/Lake Storm Sewer

As discussed previously, the existing northeast drainage system presently drains all flow approaching Circle from the northeast. The road system will receive only minor road modifications. As a result, leaving the existing drainage system in place has been proposed. To assist the existing system capacity, the southeast and northwest infield drainage areas have been removed from this existing

system and re-routed into the proposed southeast system.

The proposed pedestrian underpass forces deep construction of the trunkline to convey the flow downhill to the nearest outfall. Minimum pipe slopes are used and laterals kept shallow to reduce excavation to the greatest degree possible.

All flows consolidate at Station 2+039.118 into an existing asphalt lined channel. This existing channel is not recommended for improvement. Historical flows that leave this channel have consolidated in lowland areas adjoining the Harrison School system. This land has been used in the past to accommodate drainage from the school and its use would not change with the addition of our proposed outfall. In addition, the majority of the Circle Drive roadway improvements end at the westerly Janitell Road. If the channel was to be improved, the south side of the channel would need to be bermed for 145 meters, and a larger pipe placed under Janitell Road.

A schematic of the proposed east Circle/Lake storm sewer system, as well as reference locations and hydrology and hydraulic grade line calculations are included at the end of this section.

The analysis parameters for the existing asphalt lined ditch are as follows:

Station 2+034 to 2+082
Q_5 = 2 cms
Manning's n = .035
Longitudinal Slope = 1.82%
Normal depth = .34 m
Area = 1.41 square m
Wetted Perimeter = 7.32 m
Average Velocity = 1.42 mps
Froude Number = .70
Required Freeboard = .34 m
Total Depth = .75 m (existing)
Actual Freeboard = .41 meters

Station 2+082 to 2+155
Q_5 = 2 cms
Manning's n = .035
Longitudinal Slope = 1.82%
Normal depth = .54 m
Area = 1.15 square m
Wetted Perimeter = 4.43 m
Average Velocity = 1.57 mps
Froude Number = .68
Required Freeboard = .35 m
Total Depth = .5 m (existing)
Actual Freeboard = -.07 m

Station 2+160 to 2 +180
Q_5 = 2 cms
Manning's n = .035
Longitudinal Slope = 7.0%
Normal depth = .618 m
Area = 1.07 square m
Wetted Perimeter = 3.68 m
Average Velocity = 3.32 mps
Froude Number = 1.35
Required Freeboard = .41 m
Total Depth = .125 m (existing)
Actual Freeboard = -.493 m

Station 2+290
Q_5 = 2 cms
Manning's n = .035
Longitudinal Slope = 1.75%
Normal depth = .537 m
Area = 1.15 square m
Wetted Perimeter = 4.43 m
Average Velocity = 1.54 mps
Froude Number = .67
Required Freeboard = .35 m
Total Depth = .25 m (existing)
Actual Freeboard = -.29 m

E. Spring Run Outfall Facilities

Improvements to the Spring Run Outfall Facilities are proposed from Station 19+370 to 19+764. From Station 19+370 to 19+450 a 6 m wide grass lined ditch is proposed. From Station 19+450 to 19+645 a 9.76 m wide grass lined ditch is proposed which will tie into an existing concrete and riprap channel facility installed to protect an existing 1400 mm inlet pipe outfall. From Station 19+675 to 19+764 a 17.47 m wide grass lined trapezoidal channel will be built, which will tie into the existing channel. No improvements are recommended north of Station 19+764.

The design parameters for the proposed grass lined ditch are as follows:

Station 19+370 to 19+450
Q_{100} = .63 cms
Manning's n = .035
Longitudinal Slope = .79%
Bottom Width = 0 m
Side Slope = 4:1

Normal depth = .42 m
Freeboard = .33 m
Total Depth = .75 m
Average Velocity = .88 mps
Froude Number = .43
Total Width=6.01

Station 19+450 to 19+645
Q_{100} = 2.59 cms
Manning's n =.035
Longitudinal Slope = .25%
Bottom Width = 0 m
Side Slope = 4:1

Normal depth = .89 m
Freeboard = .28 m
Total Depth = 1.22 m
Average Velocity = .82 mps
Froude Number = .28
Total Width=9.79

Station 19+675 to 19+764
Q_{100} = 15.43 cms
Manning's n = .035
Longitudinal Slope = .22%
Bottom Width = 3 m
Side Slope = 4:1

Normal depth = 1.45 m
Freeboard = .33 m
Total Depth = 1.22 m
Average Velocity = .82 mps
Froude Number = .32
Total Width=17.47

The analysis parameters for the existing Spring Run grass lined ditch are as follows:

Station 19+370 to 19+450
Q_{100} = .63 cms
Manning's n = .035
Longitudinal Slope = .79%
Bottom Width = 0 m
Side Slope =5.3:1

Normal depth = .38 m
Freeboard = .33 m
Total Depth = .71 m
Average Velocity = .83 mps
Froude Number =.43
Total Width=7.50m

Station 19+450 to 19+645
Q_{100} = 2.59 cms
Manning's n =.035
Longitudinal Slope = .25%
Bottom Width = 0 m
Side Slope =8:1

Normal depth =.68 m
Freeboard =.33 m
Total Depth =1.1 m
Average Velocity =.69 mps
Froude Number =.27
Total Width=16.12m

Station 19+675 to 19+764
Q_{100} = 15.43 cms
Manning's n = .035
Longitudinal Slope = .22%
Bottom Width = 0 m
Side Slope = 4:1

Normal depth = 1.53 m
Freeboard = .35 m
Total Depth = 1.89 m
Average Velocity = 1.11 mps
Froude Number = .29
Total Width=22.27m

Comparison of existing Spring Run ditch with updated flows:

Station 19+764 to 20+245
Q_{100} = 43.13 cms (1984)
Manning's n = .035
Longitudinal Slope = .24%

Normal depth = 2.89 m
Area = 24.96 square m
Wetted Perimeter = 18.25 m
Average Velocity = 1.62 mps
Froude Number = .32

Required Freeboard = .39 m
Total Depth = 3.5 m (existing)
Actual Freeboard = .31 m

Station 19+764 to 20+245
Q_{100} = 63.7cms- (1988)
Manning's n = .035
Longitudinal Slope = .24%

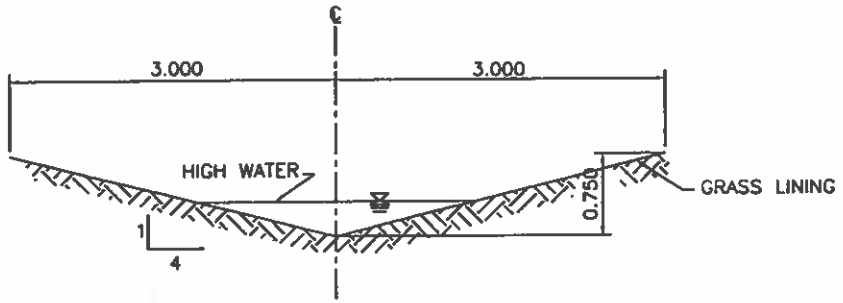
Normal depth = 3.34 m
Area = 33.47 square m
Wetted Perimeter = 18.25 m
Average Velocity = 1.62 mps
Froude Number = .32

Required Freeboard = .41 m
Total Depth = 3.5 m(existing)
Actual Freeboard = .16 m

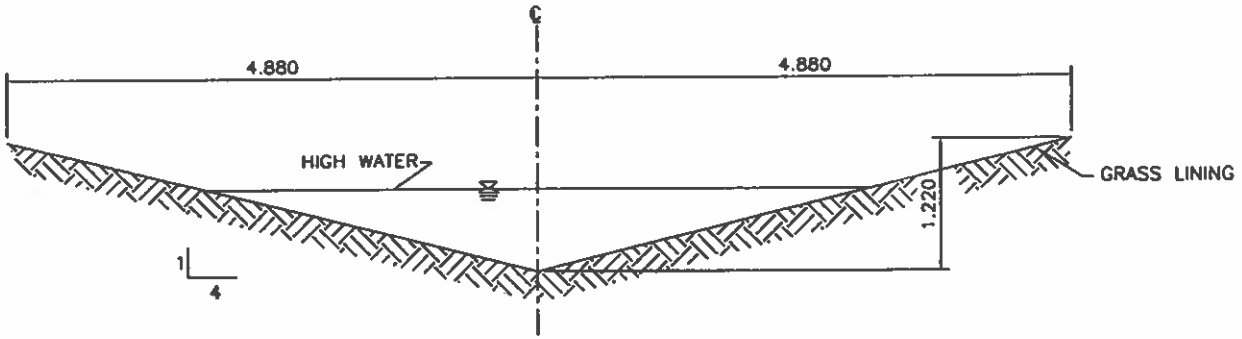
The analysis parameters for the existing reinforced concrete box culvert are as follows:

Q_{100} = 70.8 cms
Manning's n=0.012 (partially full)
Longitudinal Slope = 1%
Width = 3.66 m
Height = 3.05 m

Box Culvert Operates Under Inlet Control
HW/D = .92
HW = 1.68 m
HW Elevation = 1789.03



SPRING RUN
CHANNEL SECTION A



SPRING RUN
CHANNEL SECTION B

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Last Modification Date: 05/01/97	Initials: INITIALS					DANIEL, MANN, JOHNSON, & MENDENHALL	Revised: DATE	Designer: RBB	Structure Numbers:	
Full Path: S:\4900\CADD\FIGURES\DRAINAGE\						410 17th Street Suite 300 Denver, Colorado 80202 Phone: (303) 892-1300 Fax: (303) 892-1356	Void: DATE	Detailer: TDW		
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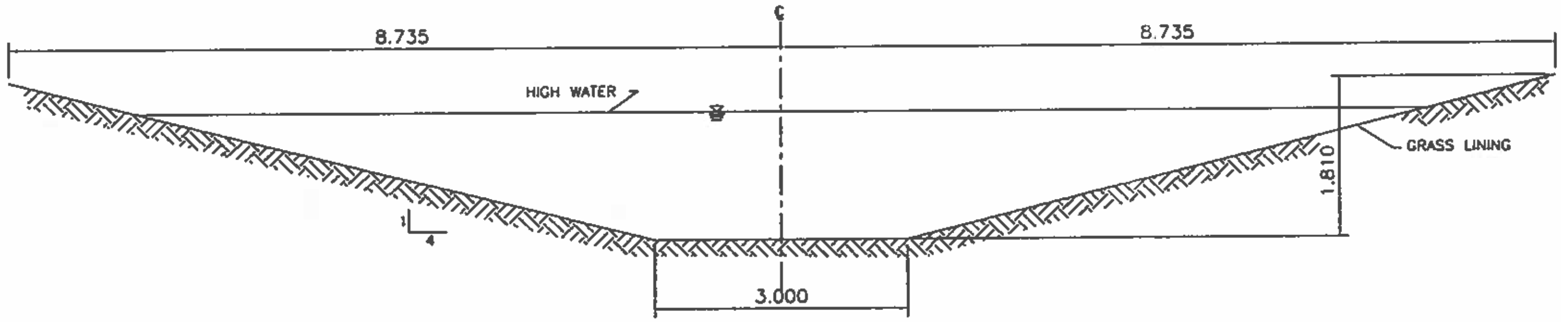
Acad Ver. VER.#	Scale:	Units: METRIC								



SPRING RUN
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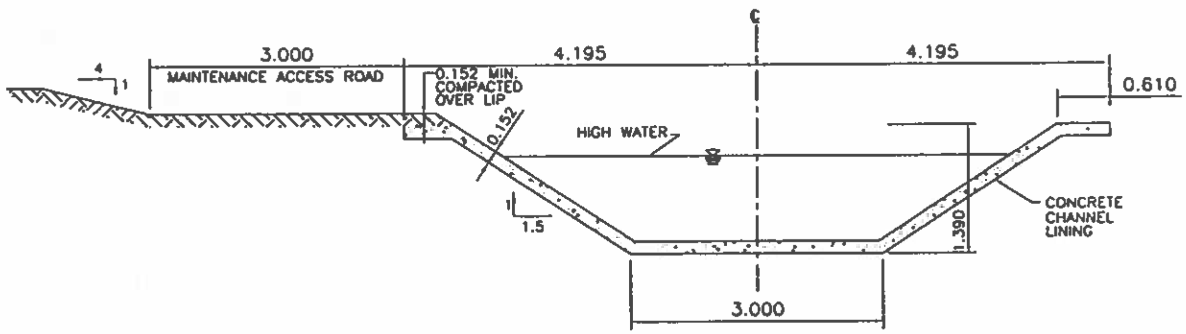

HARRISON
CHANNEL SECTION

Computer File Information		
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Acad Ver. VER.#	Scale:	Units: METRIC

Index of Revisions

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As Constructed	
No Revisions:	DATE
Revised:	DATE
Void:	DATE

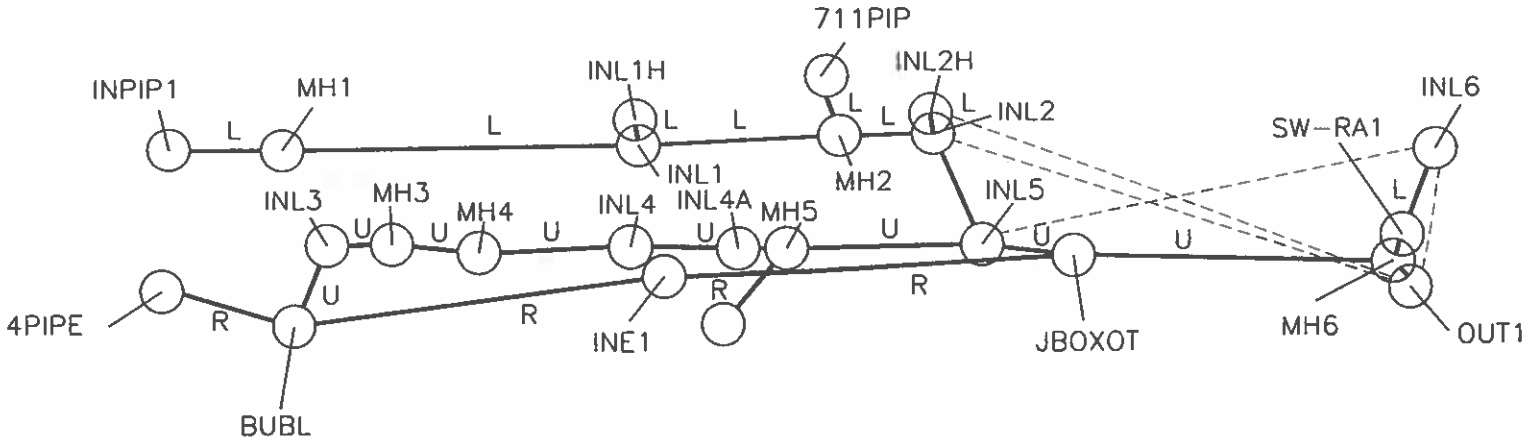
CHANNEL SECTIONS

Designer:	RBB	Structure Numbers	
Detailer:	TDW		
Sheet Subset: Drainage		Sheet Subset:	of

Project No./Code

Sheet Number

WEST CIRCLE\LAKE STORM SEWER SCHEMATIC



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Acad Ver: VER.#	Scale: NO SCALE	Units:									

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CIRCLE/LAKE INLET REFERENCE LOCATIONS

NODE NAME	ROAD STATION	NODE DESCRIPTION	SHEET No.*
LEFT MAIN LATERAL			
INPIP1	1+121.665	INLET PIPE 1	DR14
MH1	1+180.055	MANHOLE 1	DR14
INL1	0+302.055	INLET 2	DR14
MH2	1+381.816	MANHOLE 2	DR15
INL2	1+417.923	INLET 2	DR15
INL5	1+432.987	INLET 5	DR15
LATERALS			
INL1H	1+302.055	INL 1 H	DR14
711PIP	1+380.418	711 PIPE	DR15
INL2H	1+417.861	INL 2 H	DR14
TRUNKLINE			
BUBBL	1+169.5	BUBBLER	DR14
INL3	1+190.295	INLET 4	DR14
MH3	1+212.895	MANHOLE 3	DR14
MH4	1+241.747	MANHOLE 4	DR14
INL4	1+278.186	INLET 4	DR14
INL4A	1+345	INLET 4A	DR14
INL5	1+432.987	INLET 5	DR15
JBOXOT	1+450.940	JUNCTION BOX	DR15
MH6	1+582.289	MANHOLE 6	DR15
OUT1	1+583.887	OUTLET 1	DR15
LATERALS			
INL6	1+603.464	INLET 6	DR11
RIGHT MAIN LATERAL			
4PIPE	1+127.0	4 PIPES	DR14
BUBL	1+169.5	BUBBLER	DR14
INE1A	1+311	INLET 1A	DR14
JBOXOT	1+450.940	JUNCTION BOX	DR15
INDEPENDENT INLETS			
SW-INF	1+633	SW-INF	DR11
SW-RA1	1+625.964	INLET SW-RA1	DR11
EXISTING INLETS TO BE REPLACED			
INE1	1+311	INLET 1A	DR14

WEST CIRCLE LAKE
XPRAT HYDROLOGIC DATA
5 YEAR STORM

NODE NAME	AREA		FLOWS						CRITICAL AREA DATA			
					SURFACE FLOWS							
							OVERFLOW					
	TOTAL	IMPERVIOUS	PIPE FLOW	CATCHMENT CONTRIBUTIO	TOTAL GUTTER FLOW	CAPTURED FLOW	BYPASS FLOW	OVERFLOW DESTINATION	CRITICAL AREA Tc	INTENSITY	EQ. IMPERVIOUS AREA	CRITICAL PEAK FLOWS
	ha	ha	cms	cms	cms	cms	cms		min	mm/hr	ha	
INPIP1	-	-	0.212	0.212	0.212	0.212	0.000	MH1	8.34	112.79	0.677	0.170
MH1	-	-	0.205	0.000	0.000	0.000	0.000	INL1	8.96	109.16	0.677	0.165
INL1H	0.151	0	0.030	0.050	0.050	0.030	0.020	INL2H	5.00	132.30	0.136	0.040
INL1	0.4413	0	0.294	0.113	0.113	0.078	0.034	MH2	10.31	102.08	1.21	0.276
711PIP	-	-	0.050	0.199	0.199	0.050	0.149	INL2H	5.52	129.26	0.554	0.160
MH2	-	-	0.321	0.000	0.032	0.000	0.031	INL2	11.58	97.90	1.764	0.385
INL2H	0.0797	0	0.083	0.026	0.199	0.082	0.116	OUT1	5.00	132.30	0.072	0.021
INL2	0.2973	0	0.417	0.090	0.128	0.085	0.042	OUT1	6.99	120.65	1.683	0.453
BUBBL	-	-	1.416	1.416	1.416	1.416	0.000	INL3	24.00	68.78	7.411	1.138
INL3	0.127	0	1.429	0.022	0.022	0.021	0.005	MH3	24.14	68.57	7.526	1.152
MH3	-	-	1.417	0.000	0.005	0.000	0.011	MH4	24.31	68.32	7.526	1.148
MH4	-	-	1.404	0.000	0.011	0.000	0.017	INL4	24.53	68.00	7.526	1.142
INL4	0.1669	0	1.433	0.028	0.045	0.039	0.010	INL4A	24.75	67.67	7.676	1.159
INL4A	0.161	0	1.453	0.027	0.037	0.037	0.000	INL5	25.28	66.91	7.821	1.168
INL5	0.2674	0	1.744	0.044	0.044	0.004	0.046	INL6	25.72	66.28	10.165	1.504
4PIPE	-	-	5.098	5.098	5.098	5.098	0.000	BUBL	24.00	68.78	26.683	4.096
BUBL	-	-	5.030	0.000	0.000	0.000	0.000	INE1	24.62	67.86	26.683	4.042
INE1	-	-	5.233	0.315	0.315	0.315	0.026	JBOXOT	25.42	66.70	28.386	4.226
JBOXOT	-	-	6.827	0.000	0.025	0.025	0.000	MH6	26.68	64.92	38.551	5.586
INL6	0.2676	0	0.085	0.089	0.181	0.085	0.096	OUT1	5.00	132.30	0.241	0.071
SW-RA1	-	-	0.083	0.000	0.000	0.000	0.000	MH6	5.44	129.74	0.241	0.070
MH6	-	-	6.757	0.000	0.000	0.000	0.000	OUT1	27.42	63.86	38.791	5.529
OUT1	-	-	-	0.000	0.124	0.000	0.000	-	27.45	63.82	38.791	5.526

CIRCLE/LAKE STREET SYSTEM-WEST TRUNK

HYDRAULIC GRADE LINE

DATA AT D/S MH				CONDUIT DATA						DATA AT U/S MH			
D/S PIT NAME	D/S REF STATION	D/S INVERT	D/S HGL	PIPE FLOW	DIAMETER OR HEIGHT	# OF PAR. CONDUITS	DISTANCE BTWN MH'S	PIPE LENGTH	CONDUIT GRADE	U/S PIT NAME	U/S REF. STATION	U/S INVERT	U/S HGL
		m	m	cms	m	#	m	m	%			m	m
INL3	1+190.295	1793.35	1794.873	1.416	0.75	1	27.000	24.000	1.25	BUBBL	1+169.5	1793.65	1795.311
MH3	1+212.895	1793.14	1794.681	1.429	0.9	1	22.600	20.350	0.54	INL3	1+190.295	1793.25	1794.822
MH4	1+241.747	1792.89	1794.166	1.428	0.9	1	29.060	27.560	0.54	MH3	1+212.895	1793.04	1794.347
INL4	1+278.185	1792.47	1793.61	1.422	0.9	1	36.440	34.190	0.94	MH4	1+241.747	1792.79	1793.835
INL4A	1+345	1791.88	1793.035	1.435	0.9	1	83.170	68.000	0.52	INL4	1+278.185	1792.37	1793.558
INL5	1+432.987	1791.49	1792.242	1.435	0.9	1	71.150	80.000	0.53	MH5	1+361.385	1791.88	1792.75
JBOXOT	1+475.940	1790.35	1791.731	1.79	1.05	1	43.000	40.000	0.53	INL5	1+432.987	1790.56	1791.916
MH6	1+582.289	1789.65	1791.052	6.878	1.4	2	115.000	112.750	0.53	JBOXOT	1+475.940	1790.25	1791.23
OUT1	-	1789.55	1790.7	6.809	1.4	2	5.000	4.250	0.71	MH6	1+582.289	1789.58	1790.552

CIRCLE/LAKE STREET SYSTEM-WEST RIGHT LATERAL

HYDRAULIC GRADE LINE

DATA AT D/S MH				CONDUIT DATA						DATA AT U/S MH			
D/S PIT NAME	D/S REF STATION	D/S INVERT	D/S HGL	PIPE FLOW	DIAMETER OR HEIGHT	# OF PAR. CONDUITS	DISTANCE BTWN MH'S	PIPE LENGTH	CONDUIT GRADE	U/S PIT NAME	U/S REF. STATION	U/S INVERT	U/S HGL
		m	m	cms	m	#	m	m	%			m	m
BUBL	1+169.5	1793.45	1794.48	5.098	0.965	4	57.000	55.500	2.29	4PIPE	1+127.0	1794.72	1795.225
INE1	1+315	1792.45	1793.51	5.03	1.4	1	150.000	147.000	0.61	BUBL	1+169.5	1793.35	1794.381
MHE1	1+355	1791.95	1793.573	5.233	1.4	1	40.000	37.750	1.06	INE1	1+315	1792.35	1793.408
JBOXOT	1+450.940	1790.47	1791.854	5.233	1.4	1	150.000	147.750	0.93	MHE1	1+355	1791.85	1792.905

CIRCLE/LAKE STREET SYSTEM-WEST LEFT LATERAL

HYDRAULIC GRADE LINE

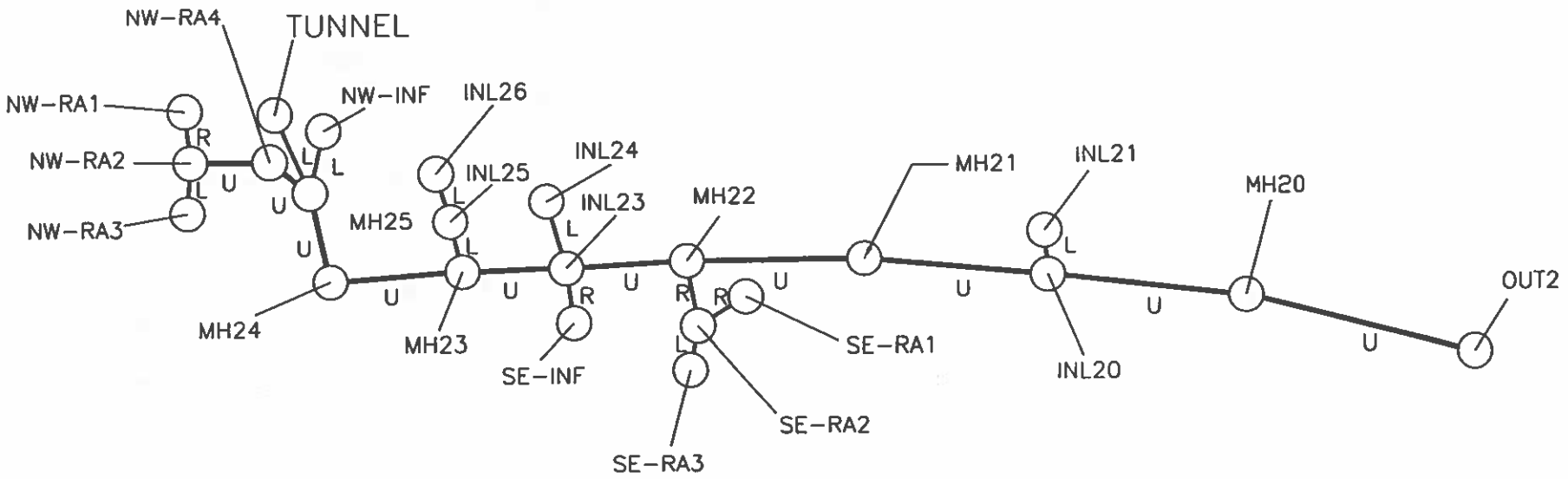
DATA AT D/S MH				CONDUIT DATA						DATA AT U/S MH			
D/S PIT NAME	D/S REF STATION	D/S INVERT	D/S HGL	PIPE FLOW	DIAMETER OR HEIGHT	# OF PAR. CONDUITS	DISTANCE BTWN MH'S	PIPE LENGTH	CONDUIT GRADE	U/S PIT NAME	U/S REF. STATION	U/S INVERT	U/S HGL
		m	m	cms	m	#	m	m	%			m	m
MH1	1+180.055	1793.28	1793.692	0.212	0.45	1	58.412	57.662	1.02	INPIP1	1+121.665	1793.87	1794.192
INL1	0+302.055	1791.96	1792.751	0.205	0.45	1	122.000	119.750	1.02	MH1	1+180.055	1793.18	1793.497
MH2	1+381.816	1791.26	1792.519	0.301	0.6	1	79.761	77.511	0.77	INL1	0+302.055	1791.86	1792.71
INL2	1+417.861	1790.99	1792.385	0.48	0.75	1	36.107	33.857	0.5	MH2	1+381.816	1791.16	1792.452
INL5	1+432.987	1790.66	1792.26	0.54	0.75	1	46.875	43.875	0.52	INL2	1+417.861	1790.89	1792.37

CIRCLE/LAKE STREET SYSTEM WEST SYSTEM

HYDRAULIC GRADE LINE FOR LATERALS

DATA AT D/S MH				CONDUIT DATA						DATA AT U/S MH			
D/S PIT NAME	D/S REF STATION	D/S INVERT	D/S HGL	PIPE FLOW	DIAMETER OR HEIGHT	# OF PAR. CONDUITS	DISTANCE BTWN MH'S	PIPE LENGTH	CONDUIT GRADE	U/S PIT NAME	U/S REF. STATION	U/S INVERT	U/S HGL
		m	m	cms	m	#	m	m	%			m	m
INL1	0+302.055	1792.06	1792.734	0.03	0.45	1	7.630	5.380	9.29	INL1H	1+302.055	1792.56	1792.677
MH2	1+381.816	1791.92	1792.502	0.05	0.4	1	8.000	5.750	6.09	711PIP	1+380.418	1792.27	1792.372
INL2	1+417.861	1791.09	1792.368	0.021	0.45	1	8.214	5.964	3.35	INL2H	1+417.861	1791.29	1792.369
MH5	1+361.385	1792.72	1793.035	0.05	0.45	1	35.362	33.112	1.93	INL7	1+336.427	1793.36	1793.511
MH6	1+582.289	1790.06	1791.052	0.096	0.45	1	14.158	11.158	0.72	SW-RA1	1+591.592	1790.14	1791.068

EAST CIRCLE\LAKE STORM SEWER SCHEMATIC



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Acad Ver. VER.#	Scale: NO SCALE Units:						Sheet Number

DMJM — Daniel, Mann, Johnson, & Mendenhall
410 17th Street Suite 300
Denver, Colorado 80202
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CIRCLE/LAKE EAST SYSTEM INLET REFERENCE LOCATIONS

NODE NAME	ROAD STATION	NODE DESCRIPTION	SHEET No.*
TRUNKLINE			
NW-RA2	419+225	NW-RA2	DR11
NW-RA4	1+581	NW-RA4	DR11
MH25	1+636.058	MANHOLE 25	DR11
MH24	1+636.058	MANHOLE 24	DR11
MH23	1+685.935	MH23	DR11
INL23	1+724.590	INLET 23	DR11
MH22	1+786.385	MANHOLE 22	DR11
MH21	1+843.333	MANHOLE 21	DR16
INL20	1+916.527	INLET 20	DR16
MH20	1+966.657	MANHOLE 20	DR16
OUT2	2+039.118	OUT 2	DR16
LATERALS			
NW-RA1	419+247	NW-RA1 (Flanking)	DR11
NW-RA3	419+203	NW-RA3 (Flanking)	DR11
TUNNEL	1+618	TUNNEL	DR11
NW-INF	1+636	NW-INF	DR11
INL26	1+685.935	INLET 26	DR11
INL25	1+685.935	INLET 25	DR11
INL24	1+724.590	INLET 24	DR11
SE-INF	1+724	SE-INF	DR11
SE-RA1	119+117	SE-RA1 (Flanking)	DR11
SE-RA2	119+138	SE-RA2 (Flanking)	DR11
SE-RA3	1+741.00	SE-RA3 (Flanking)	DR11
INL21	1+916.527	INLET 21	DR16
INDEPENDENT INLETS			
INL 19	2+039.118	INLET 19	DR16
INL 18	2+286	INLET 18	DR17
EXISTING INLETS TO BE REPLACED			
INE1	1+820.543	INLET E1	DR16

EAST CIRCLE LAKE
XPRAT HYDROLOGIC DATA
5 YEAR STORM

NODE NAME	AREA		FLOWS						CRITICAL AREA DATA			
				SURFACE FLOWS								
							OVERFLOW					
	TOTAL	IMPERVIOUS	PIPE FLOW	CATCHMENT CONTRIBUTIO	TOTAL GUTTER FLOW	CAPTURED FLOW	BYPASS FLOW	OVERFLOW DESTINATION	CRITICAL AREA Tc	INTENSITY	EQ. IMPERVIOUS AREA	CRITICAL PEAK FLOWS
	ha	ha	cms	cms	cms	cms	cms		min	mm/hr	ha	
NW-RA1	0.154	0	0.044	0.051	0.051	0.044	0.007	NW-RA2	5.00	132.30	0.139	0.041
NW-RA3	0.154	0	0.044	0.051	0.051	0.044	0.007	NW-RA2	5.00	132.30	0.139	0.041
NW-RA2	0.154	0	0.151	0.050	0.063	0.063	0	NW-RA4	5.32	130.45	0.416	0.121
NW-RA4	0.0186	0	0.154	0.006	0.006	0.006	0	MH25	5.67	128.39	0.433	0.124
NW-INF	1.59	0	0.262	0.262	0.262	0.262	0	MH25	15.74	84.84	1.113	0.211
TUNNEL	0.109	0	0.032	0.032	0.032	0.032	0	MH25	5.00	132.30	0.087	0.026
MH25	-	-	0.383	0.000	0.000	0.000	0	MH24	15.87	84.53	1.633	0.308
MH24	-	-	0.378	0.000	0.000	0.000	0	MH23	16.40	83.27	1.633	0.304
INL26	0.1555	0	0.042	0.051	0.051	0.042	0.009	INL25	5.00	132.30	0.14	0.041
INL25	0.102	0	0.081	0.038	0.047	0.039	0.007	MH23	5.38	130.09	0.245	0.071
MH23	-	-	0.422	0.000	0.005	0.000	0.005	INL23	17.02	81.79	1.879	0.343
INL24	0.0761	0	0.024	0.025	0.025	0.024	0.001	INL23	5.00	132.30	0.068	0.020
SE-INF	0.875	0	0.096	0.097	0.097	0.097	0	INL23	5.00	132.30	0.263	0.078
INL23	0.08	0	0.513	0.024	0.032	0.029	0.004	MH22	7.46	117.94	1.578	0.415
SE-RA3	0.04	0	0.013	0.013	0.013	0.013	0	SE-RA2	5.00	132.30	0.036	0.011
SE-RA1	0.04	0	0.013	0.013	0.013	0.013	0	SE-RA2	5.00	132.30	0.036	0.011
SE-RA2	0.04	0	0.039	0.013	0.013	0.013	0	MH22	5.32	130.45	0.108	0.031
MH22	-	-	0.532	0.000	0.004	0.000	0.006	MH21	7.97	114.96	1.686	0.433
MH21	-	-	0.515	0.000	0.006	0.000	0.009	INL20	8.50	111.88	1.686	0.421
INL21	0.212	0	0.060	0.070	0.070	0.060	0.01	INL20	5.00	132.30	0.191	0.056
INL20	0.2123	0	0.613	0.058	0.074	0.063	0.012	MH20	9.03	108.75	2.068	0.502
MH20	-	-	0.596	0.000	0.012	0.000	0.011	OUT2	9.56	105.66	2.068	0.488
OUT2	-	-	-	0.000	0.011	0.000	0	-	10.26	102.25	2.068	0.472

CIRCLE/LAKE STREET SYSTEM-EAST TRUNKLINE
HYDRAULIC GRADE LINE

DATA AT D/S MH				CONDUIT DATA						DATA AT U/S MH			
D/S PIT NAME	D/S REF STATION	D/S INVERT	D/S HGL	PIPE FLOW	DIAMETER OR HEIGHT	# OF PAR. CONDUITS	DISTANCE BTWN MH'S	PIPE LENGTH	CONDUIT GRADE	U/S PIT NAME	U/S REF. STATION	U/S INVERT	U/S HGL
		m	m	cms	m	#	m	m	%			m	m
NW-RA4	419+225.0	1789.48	1789.752	0.151	0.45	1	31.88	28.88	0.55	NW-RA2	419+225.0	1789.64	1789.912
MH25	1+636.058	1789.27	1789.545	0.154	0.45	1	22.25	20	0.55	NW-RA4	419+225.0	1789.38	1789.655
MH24	1+636.058	1785.07	1785.811	0.383	0.6	1	43.03	40.78	0.42	MH25	1+636.058	1785.24	1785.979
MH23	1+685.935	1784.77	1785.395	0.378	0.6	1	49.9	48.4	0.41	MH24	1+636.058	1784.97	1785.584
INL23	1+724.590	1784.52	1784.989	0.422	0.6	1	38.7	36.45	0.41	MH23	1+685.935	1784.67	1785.27
MH22	1+771.242	1784.24	1784.8	0.513	0.75	1	45.52	43.27	0.3	INL23	1+724.590	1784.37	1784.907
MH21	1+843.333	1783.94	1784.517	0.532	0.75	1	50.48	48.98	0.41	MH22	1+771.242	1784.14	1784.629
INL20	1+916.527	1783.63	1784.169	0.515	0.75	1	52.42	50.17	0.42	MH21	1+843.333	1783.84	1784.316
MH20	1+966.657	1783.38	1784.024	0.613	0.75	1	49.18	46.93	0.32	INL20	1+916.527	1783.53	1784.144
OUT2	-	1783	1783.75	0.596	0.75	1	70.04	69.29	0.4	MH20	-	1783.28	1783.759

CIRCLE/LAKE STREET SYSTEM-EAST LATERALS
HYDRAULIC GRADE LINE

DATA AT D/S MH				CONDUIT DATA						DATA AT U/S MH			
D/S PIT NAME	D/S REF STATION	D/S INVERT	D/S HGL	PIPE FLOW	DIAMETER OR HEIGHT	# OF PAR. CONDUITS	DISTANCE BTWN MH'S	PIPE LENGTH	CONDUIT GRADE	U/S PIT NAME	U/S REF. STATION	U/S INVERT	U/S HGL
		m	m	cms	m	#	m	m	%			m	m
NW-RA2	419+225.0	1789.74	1790.486	0.044	0.45	1	19	16	0.62	NW-RA1	419+247	1789.84	1790.491
NW-RA2	419+225.0	1789.74	1790.486	0.044	0.45	1	19	16	0.62	NW-RA3	419+203	1789.84	1790.491
MH25	1+636.058	1785.45	1786.082	0.262	0.45	1	14	11.75	9.87	NW-INF	1+636	1786.61	1786.969
MH25	1+636.058	1785.35	1786.082	0.032	0.45	1	40	38.5	0.36	TUNNEL	419+227	1785.49	1786.087
INL25	1+685.935	1789.18	1789.32	0.042	0.45	1	22.73	19.73	0.56	INL26	1+685.935	1789.29	1789.436
MH23	1+685.935	1788.98	1789.176	0.081	0.45	1	20.3	18.05	0.55	INL25	1+685.935	1789.08	1789.288
INL23	1+724.590	1788.8	1788.905	0.024	0.45	1	22.73	19.73	0.56	INL24	1+724.590	1788.91	1789.02
INL23	1+724.590	1788.82	1789.035	0.096	0.45	1	10	9.25	0.54	SE-INF	1+724	1788.87	1789.102
SE-RA2	1+772.201	1787.9	1788.158	0.013	0.45	1	19	16	1.19	SE-RA3	119+117	1788.09	1788.176
SE-RA2	1+772.201	1787.9	1788.158	0.013	0.45	1	19	16	1.19	SE-RA1	1-741.00	1788.09	1788.176
MH22	1+771.242	1787.72	1787.855	0.039	0.45	1	16.44	14.19	0.56	SE-RA2	1+772.201	1787.8	1787.94
INL20	1+916.527	1786.57	1786.692	0.06	0.45	1	16.5	13.5	2.15	INL21	1+916.527	1786.86	1786.982

I-25 & CIRCLE/LAKE INTERCHANGE COMPLEX

I-25 NORTH BASIN DESIGNATOR BASIN FLOW CONTRIBUTION

BASIN	*AREA*	*FLOW*
BASIN	A (km^2)	Q (cms)
NE-RA1	0.0026	*0.084*
NW-RA1	0.0029	*0.095*
25-5	0.0019	*0.064*
25-6A	0.0031	*0.102*
25-6A1	0.0018	*0.061*
25-6A2	0.0012	*0.041*
25-6B	0.0015	*0.050*
25-6C	0.0015	*0.048*

I-25 SOUTH - INLET/MANHOLE REFERENCE LOCATIONS

NODE NAME	ROAD STATION
INLET I-25 6A1	19+490
INLET I-25 6A2	19+538
INLET I-25 6B	19+598
INLET I-25 6C	19+669
INDEPENDENT INLETS	
INLET NE-RA2	19+365

I-25 & CIRCLE/LAKE INTERCHANGE COMPLEX

I-25 SOUTH BASIN DESIGNATOR BASIN FLOW CONTRIBUTION

BASIN	*AREA*	*FLOW*
BASIN	A (km^2)	Q (cms)
25-1	0.0036	*0.119*
25-1A	0.0015	*0.051*
25-1B	0.0021	*0.068*
25-2	0.0074	*0.244*
25-2A	0.0035	*0.116*
25-2B	0.0040	*0.131*
25-3A	0.0029	*0.095*
25-3B	0.0026	*0.085*
25-3C	0.0008	*0.025*
25-4	0.0043	*0.143*
25-4A	0.0020	*0.068*
25-4B	0.0023	*0.076*
SE-RA1	0.0016	*0.051*

I-25 NORTH - INLET/MANHOLE REFERENCE LOCATIONS

NODE NAME	ROAD STATION
INLET I-25 3A	18+691
INLET I-25 2B	18+803
INLET I-25 3B	18+803
INLET I-25 3C	18+888
INLET I-25 4A	18+907
INDEPENDENT INLETS	
INLET I-25 1	18+442.826
INLET I-25 1A	18+550
MANHOLE I-25 1	18+442.826
MANHOLE I-25 2	18+545
INLET I-25 2A	18+650
INLET I-25 4B	19+021

APPENDIX A
DRAINAGE MAPS AND PLANS

STORMWATER MANAGEMENT PLAN

PROJECT AREA: _____

AREA TO BE DISTURBED: _____

ATED RUNOFF COEFFICIENT:

PRE-CONSTRUCTION _____

POST CONSTRUCTION _____

NG DATA DESCRIBING SOIL OR QUALITY OF DISCHARGE:

NG VEGETATION AND COVER:

OF RECEIVING WATERS:

tain Creek via Sinton Channel, Harrison Channel, Circle Ditch, and Spring Run nel.

ED ENVIRONMENTAL PERMITS REQUIRED:

SECTION 404 ____ YES X NO No wetlands impacted.

FLOOD PLAIN DEVELOPMENT ____ YES X NO No regulatory flood plains in project limits.

MANAGEMENT PRACTICES:

EROSION AND SEDIMENT CONTROL

- X SEEDING
- X MULCHING
- X SODDING
- ____ EROSION CONTROL BLANKETS
- ____ SURFACE ROUGHENING
- X EROSION BALE
- X SILT FENCE
- X BERM / DIVERSION
- X SLOPE DRAIN
- X STORM DRAIN INLET PROTECTION
- ____ CHECK DAMS
- X OUTLET PROTECTION
- X CHANNEL STABILIZATION
- ____ SEDIMENT TRAP
- ____ SEDIMENT BASIN
- ____ DEWATERING STRUCTURE
- ____ TEMPORARY STREAM CROSSING
- X STABILIZED CONSTRUCTION ENTRANCE
- ____ LEVEL SPREADER
- ____ BRUSH BARRIER
- ____ SANDBAG BARRIER

STORMWATER QUALITY MANAGEMENT

- ____ GRASS LINED SWALE
- ____ GRASS BUFFER STRIP
- ____ EXTENDED DRY DETENTION BASIN
- ____ WET DETENTION POND
- ____ CONSTRUCTED WETLAND
- ____ INFILTRATION BASIN
- ____ INFILTRATION TRENCH

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: (303) 892-1300

As Constructed	DRAINAGE COVER SHEET		Project No./Code
No Revisions: DATE			
Revised: DATE	Designer: CLP	Structure Numbers	
Void: DATE	Detailer: TDW		
	Sheet Subset: Drainage	Sheet Subset: DR1 of 27	Sheet Number 72

INDEX OF DRAINAGE SHEETS

STORMWATER MANAGEMENT PLAN

TOTAL PROJECT AREA: _____

TOTAL AREA TO BE DISTURBED: _____

ESTIMATED RUNOFF COEFFICIENT:

PRE-CONSTRUCTION _____

POST CONSTRUCTION _____

EXISTING DATA DESCRIBING SOIL OR QUALITY OF DISCHARGE:

EXISTING VEGETATION AND COVER:

NAME OF RECEIVING WATERS:

Fountain Creek via Sinton Channel, Harrison Channel, Circle Ditch, and Spring Run Channel.

RELATED ENVIRONMENTAL PERMITS REQUIRED:

SECTION 404 ____ YES __X__ NO No wetlands impacted.

FLOOD PLAIN DEVELOPMENT ____ YES __X__ NO No regulatory flood plains in project limits.

BEST MANAGEMENT PRACTICES:

EROSION AND SEDIMENT CONTROL	STORMWATER QUALITY MANAGEMENT
X SEEDING	____ GRASS LINED SWALE
X MULCHING	____ GRASS BUFFER STRIP
X SODDING	____ EXTENDED DRY DETENTION BASIN
____ EROSION CONTROL BLANKETS	____ WET DETENTION POND
____ SURFACE ROUGHENING	____ CONSTRUCTED WETLAND
X EROSION BALE	____ INFILTRATION BASIN
X SILT FENCE	____ INFILTRATION TRENCH
X BERM / DIVERSION	
X SLOPE DRAIN	
X STORM DRAIN INLET PROTECTION	
____ CHECK DAMS	
X OUTLET PROTECTION	
X CHANNEL STABILIZATION	
____ SEDIMENT TRAP	
____ SEDIMENT BASIN	
____ DEWATERING STRUCTURE	
____ TEMPORARY STREAM CROSSING	
X STABILIZED CONSTRUCTION ENTRANCE	
____ LEVEL SPREADER	
____ BRUSH BARRIER	
____ SANDBAG BARRIER	

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Acad Ver. 13	Scale: SCALE	Units: METRIC

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No Revisions: DATE
Revised: DATE
Void: DATE

DRAINAGE COVER SHEET

Designer: CLP
Detailer: TDW
Structure Numbers
Sheet Subset: Drainage
Sheet Subset: DR1 of 27

Project No./Code

Sheet Number 72

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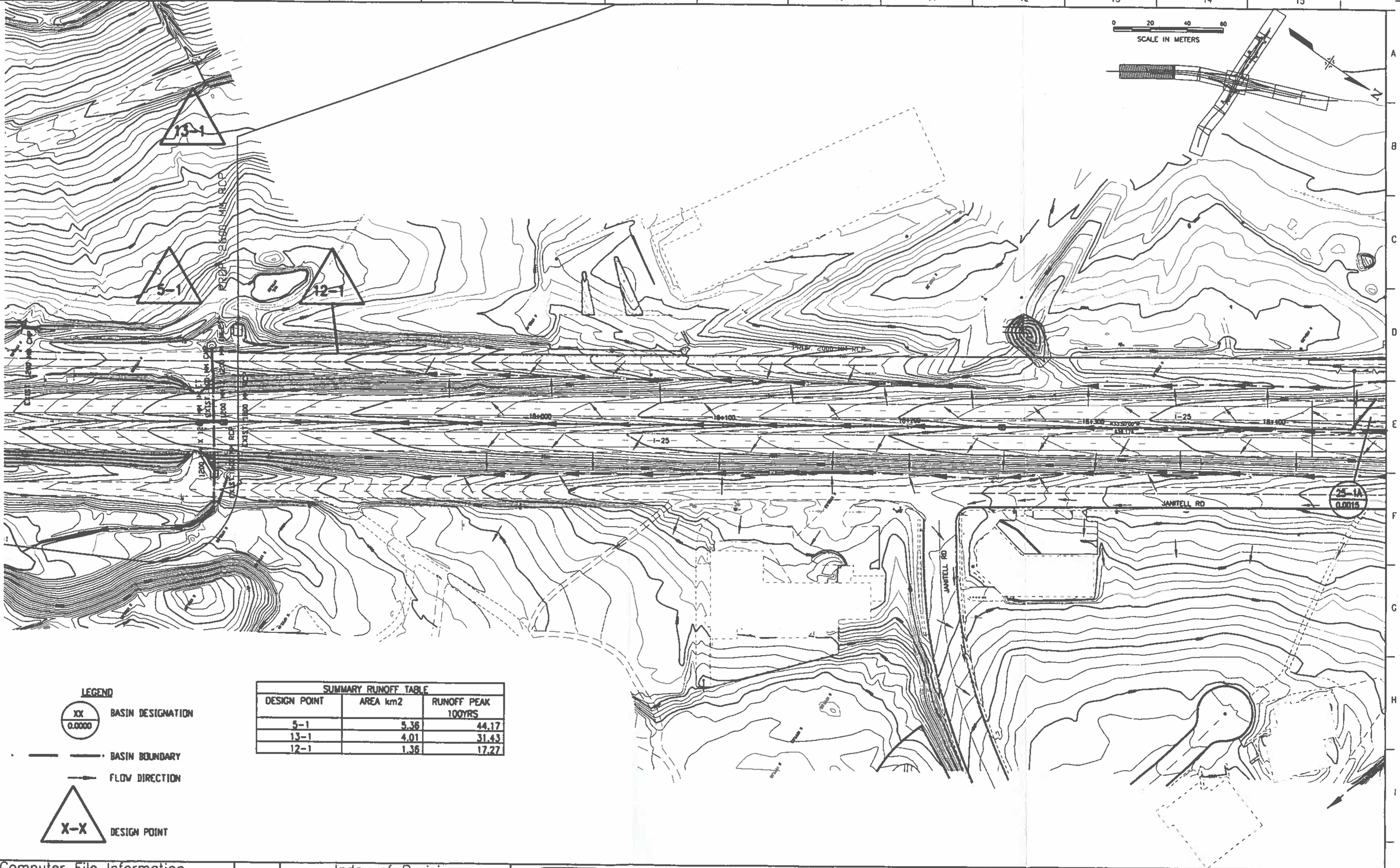

LEGEND

XX / 0.0000 — BASIN DESIGNATION

BASIN BOUNDARY

FLOW DIRECTION

X-X — DESIGN POINT

SUMMARY RUNOFF TABLE		
DESIGN POINT	AREA km2	RUNOFF PEAK 100YRS
5-1	5.36	44.17
13-1	4.01	31.43
12-1	1.36	17.27

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Computer File Information

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Drawing File Name: HYPL02.DWG		
Acad Ver. R13	Scale: 1:500	Units:METRIC

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No Revisions:DATE

Revised: DATE

Void: DATE

SURFACE DRAINAGE PLAN

Designer: RBB

Detailer: DEM

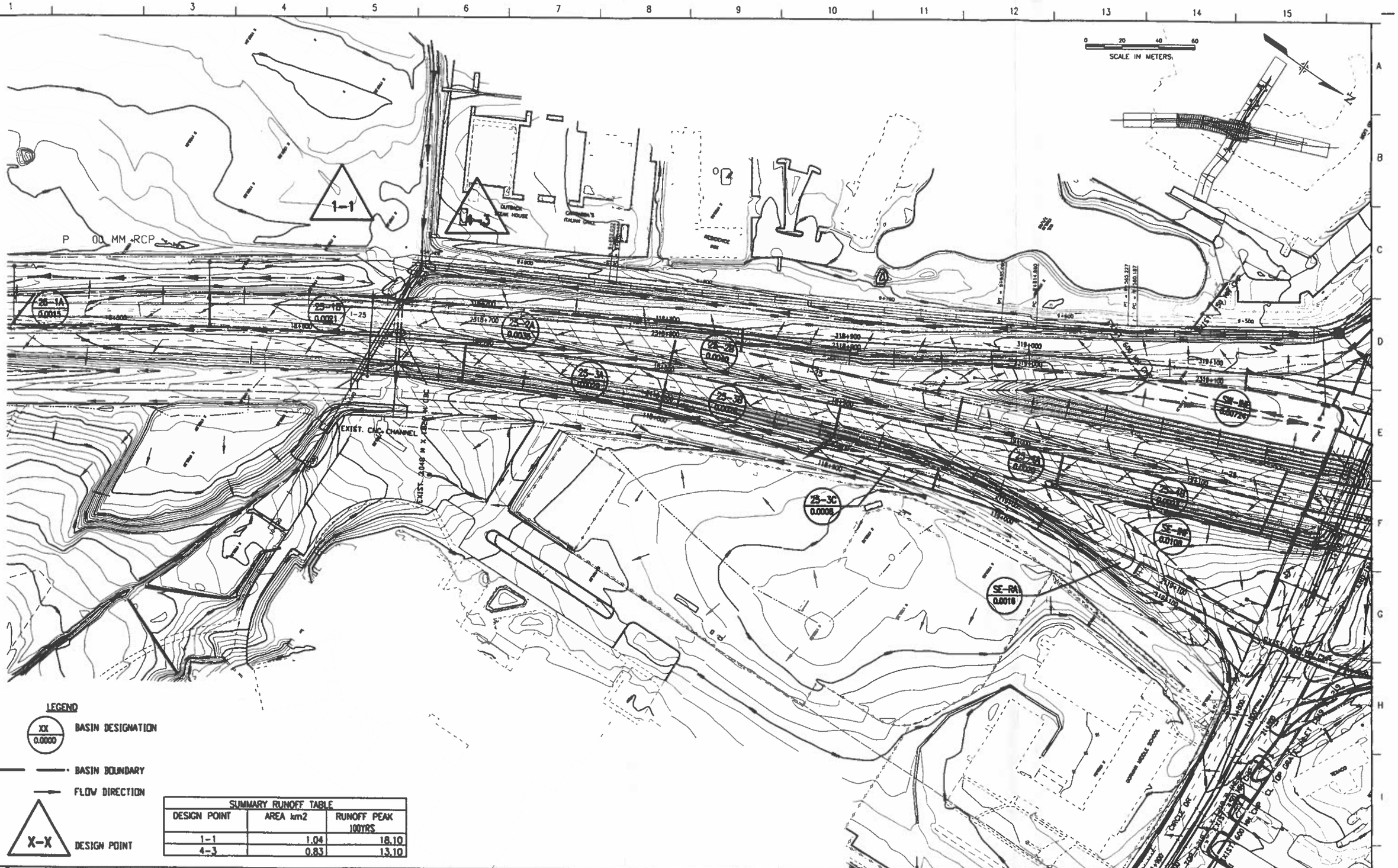
Structure Numbers

Sheet Subset:Drainage

Sheet Subset: DR2 of 27

Project No./Code

Sheet Number 73



LEGEND

XX / 0.0000 — BASIN DESIGNATION

BASIN BOUNDARY

FLOW DIRECTION

X-X — DESIGN POINT

SUMMARY RUNOFF TABLE		
DESIGN POINT	AREA km2	RUNOFF PEAK 100YRS
1-1	1.04	18.10
4-3	0.83	13.10

Computer File Information		
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Acad Ver. R13	Scale: 1:500	Units:METRIC

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No Revisions:DATE

Revised: 5/1/97

Void: DATE

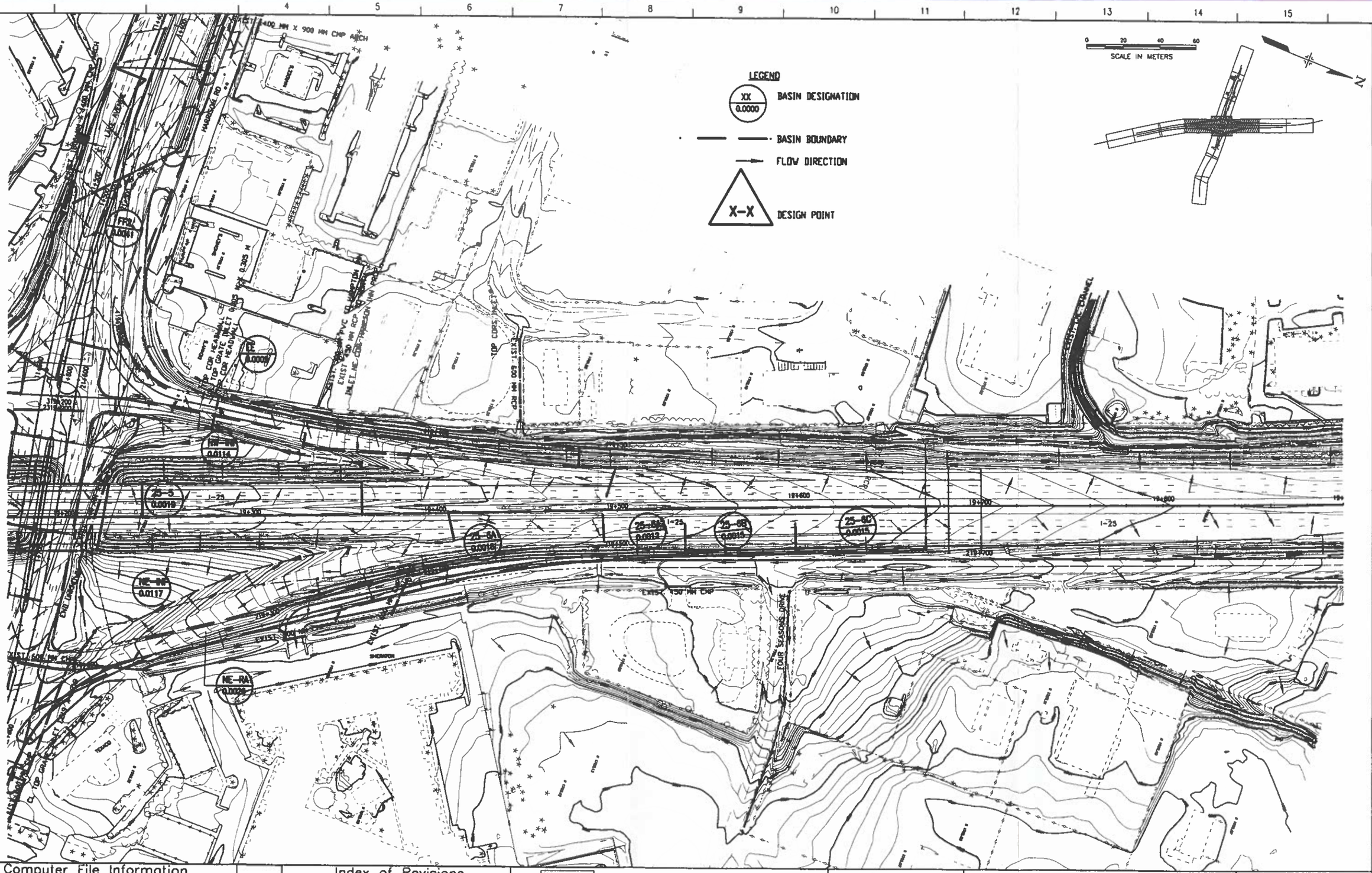
SURFACE DRAINAGE PLAN

Designer: RBB
Detailer: DEM
Sheet Subset: Drainage
Structure Numbers
Sheet Subset: DR3 of 27

Project No./Code

Sheet Number 74

DRDMA01 ROXRKEY HYXREX HYXRO1-C SUXRCN04 SUXRCN03 SUXRCN05 SUXRO3 SUXRO4 SUXRO5 HYXRPAT CGXRO1 ROXRTB XREF = 22 18



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No Revisions:DATE
Revised: 05/01/97
Void: DATE

SURFACE DRAINAGE PLAN

Designer: RBB
Detailer: DEM
Sheet Subset: Drainage
Structure Numbers
Sheet Subset: DR4 of 27

Project No./Code

Sheet Number 75

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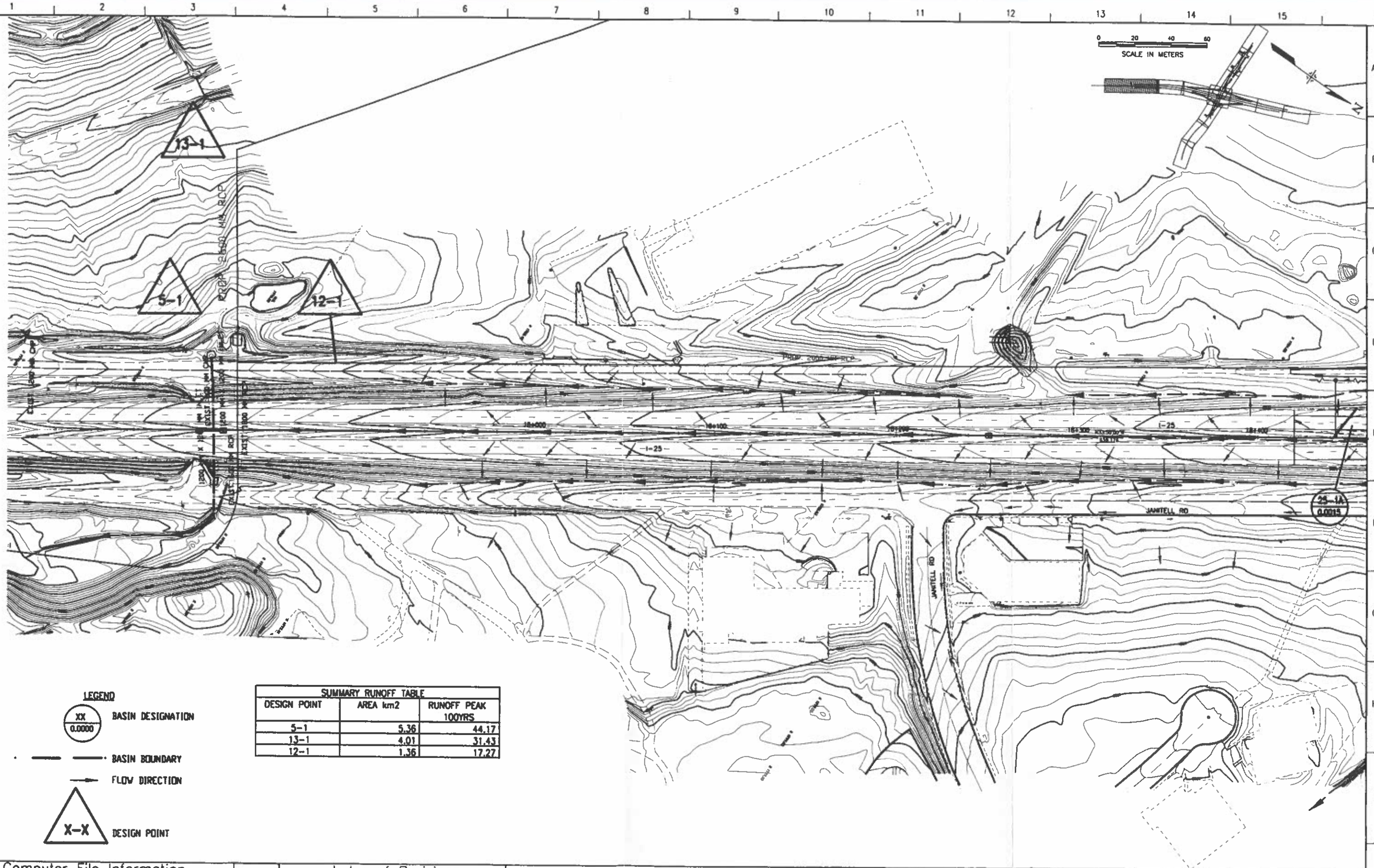

LEGEND

XX / 0.0000 — BASIN DESIGNATION

BASIN BOUNDARY

FLOW DIRECTION

X-X — DESIGN POINT

SUMMARY RUNOFF TABLE		
DESIGN POINT	AREA km2	RUNOFF PEAK 100YRS
5-1	5.36	44.17
13-1	4.01	31.43
12-1	1.36	17.27

Computer File Information	
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Last Modification Date: 05/01/97	Initials: DEM
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Acad Ver. R13 Scale: 1:500	Units:METRIC

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No Revisions:DATE
Revised: DATE
Void: DATE

SURFACE DRAINAGE PLAN

Designer: RBB
Detailer: DEM
Sheet Subset: Drainage
Structure Numbers
Sheet Subset: DR2 of 27

Project No./Code

Sheet Number 73

22:12 XREF = RDXRTB DRDMAQ1 RDXRKEY SUXR02 SUXR03 HYXREX HYXR01-C SUXRCN02 SUXRCN03 HYXRPAT CGXR01

PROP. 1700 MM RCP

SCALE IN METERS

EXIST. CMC CHANNEL

LEGEND

XX / 0.0000 — BASIN DESIGNATION

BASIN BOUNDARY

FLOW DIRECTION

X-X — DESIGN POINT

SUMMARY RUNOFF TABLE

DESIGN POINT	AREA km2	RUNOFF PEAK 100YRS
1-1	1.04	18.10
4-3	0.83	13.10

Computer File Information

Creation Date: 1/1/97 Initials: TDW

Last Modification Date: 05/01/97 Initials: DEM

Full Path: S:\4900\CADD\PLANS\DRAIN-C\PL1000SC\

Drawing File Name: HYPL03.DWG

Acad Ver. R13 Scale: 1:500 Units:METRIC

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No Revisions:DATE

Revised: 5/1/97

Void: DATE

SURFACE DRAINAGE PLAN

Designer: RBB

Detailer: DEM

Sheet Subset: Drainage

Structure Numbers

Sheet Subset: DR3 of 27

Project No./Code

Sheet Number 74

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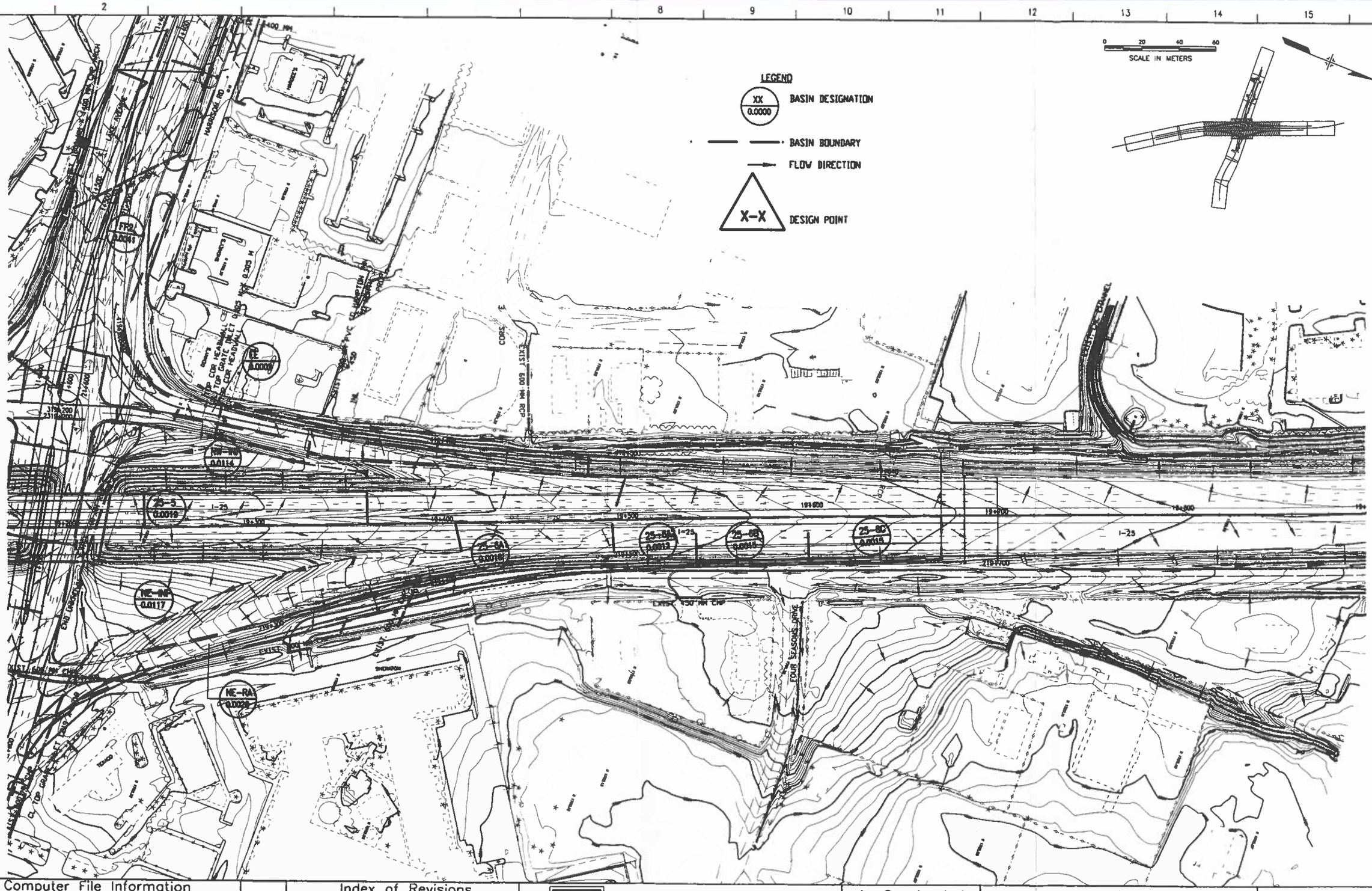

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Drawing File Name: HYPL04.DWG		
Acad Ver. R13	Scale: 1:500	Units:METRIC

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As Constructed
No Revisions: DATE
Revised: 05/01/97
Void: DATE

SURFACE DRAINAGE PLAN

Designer: RBB
Detailer: DEM
Sheet Subset: Drainage
Structure Numbers
Sheet Subset: DR4 of 27

Project No./Code

Sheet Number 75

SUMMARY RUNOFF TABLE		
DESIGN POINT	AREA km2	RUNOFF PEAK 100YRS
37-4	9.64	43.13
37-6	10.44	63.71

LEGEND

- XX / 0.0000 — BASIN DESIGNATION
- BASIN BOUNDARY
- FLOW DIRECTION
- X–X — DESIGN POINT

Computer File Information		
Creation Date: 1/1/97		Initials: TDW
Last Modification Date: 05/01/97		Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\PL1000SC\		
Drawing File Name: HYPL05.DWG		
Acad Ver. R13	Scale: 1:500	Units: METRIC

Index of Revisions

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Void:	DATE

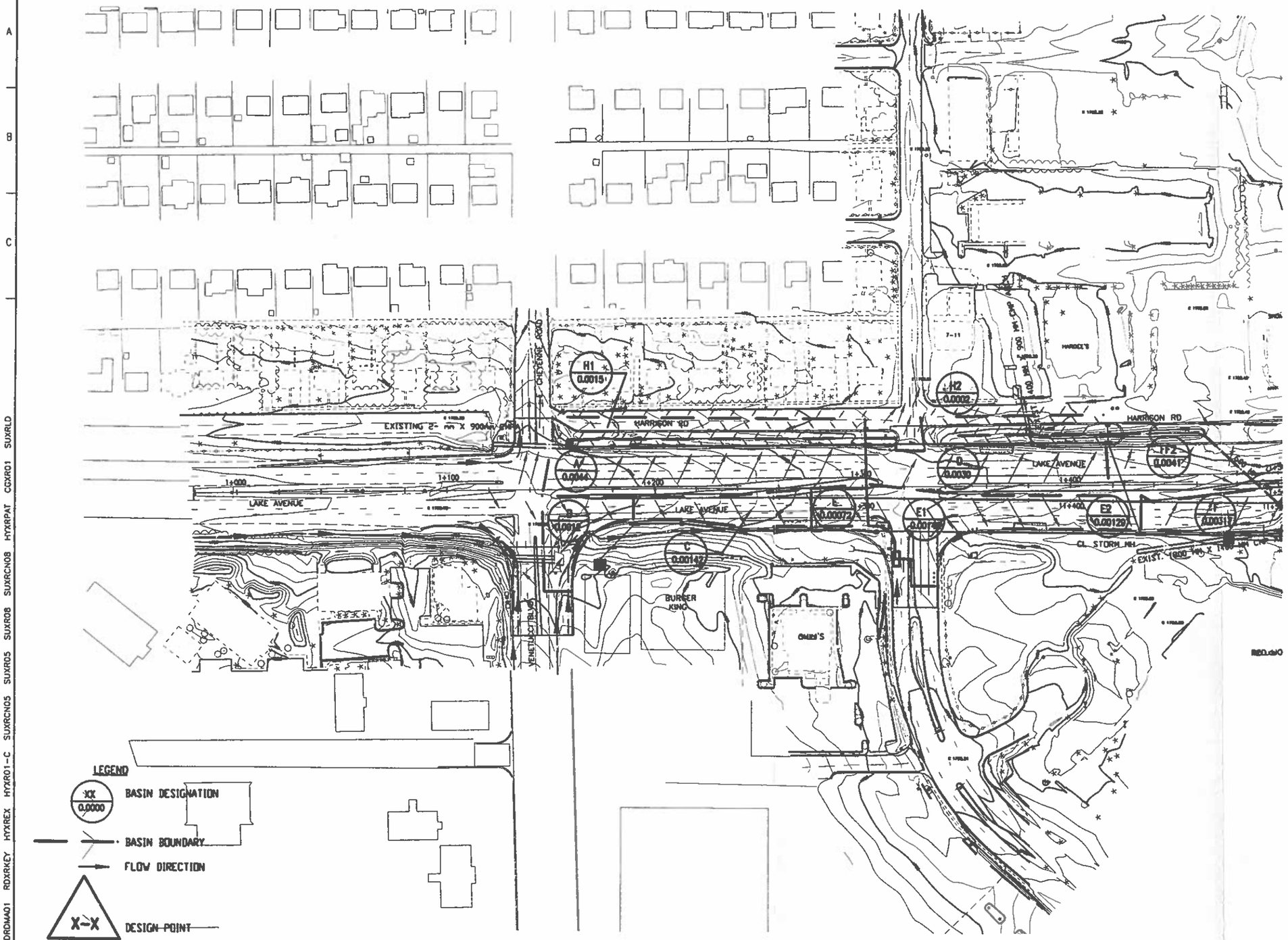
SURFACE DRAINAGE PLAN

Designer: RBB
Detailer: DEM
Structure Numbers
Sheet Subset: Drainage
Sheet Subset: DR5 of 27

Project No./Code

Sheet Number 76

11:21 XREF = RDXRTB DRDMA01 RDXRKEY HYXREX HYXR01-C SUXR07 SUXRCN07 HYXRPAT



Computer File Information		
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Last Modification Date: 05/01/97		Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\PL1000SC\		
Drawing File Name: HYPL06B.DWG		
Acad Ver. R13	Scale: 1:500	Units:METRIC

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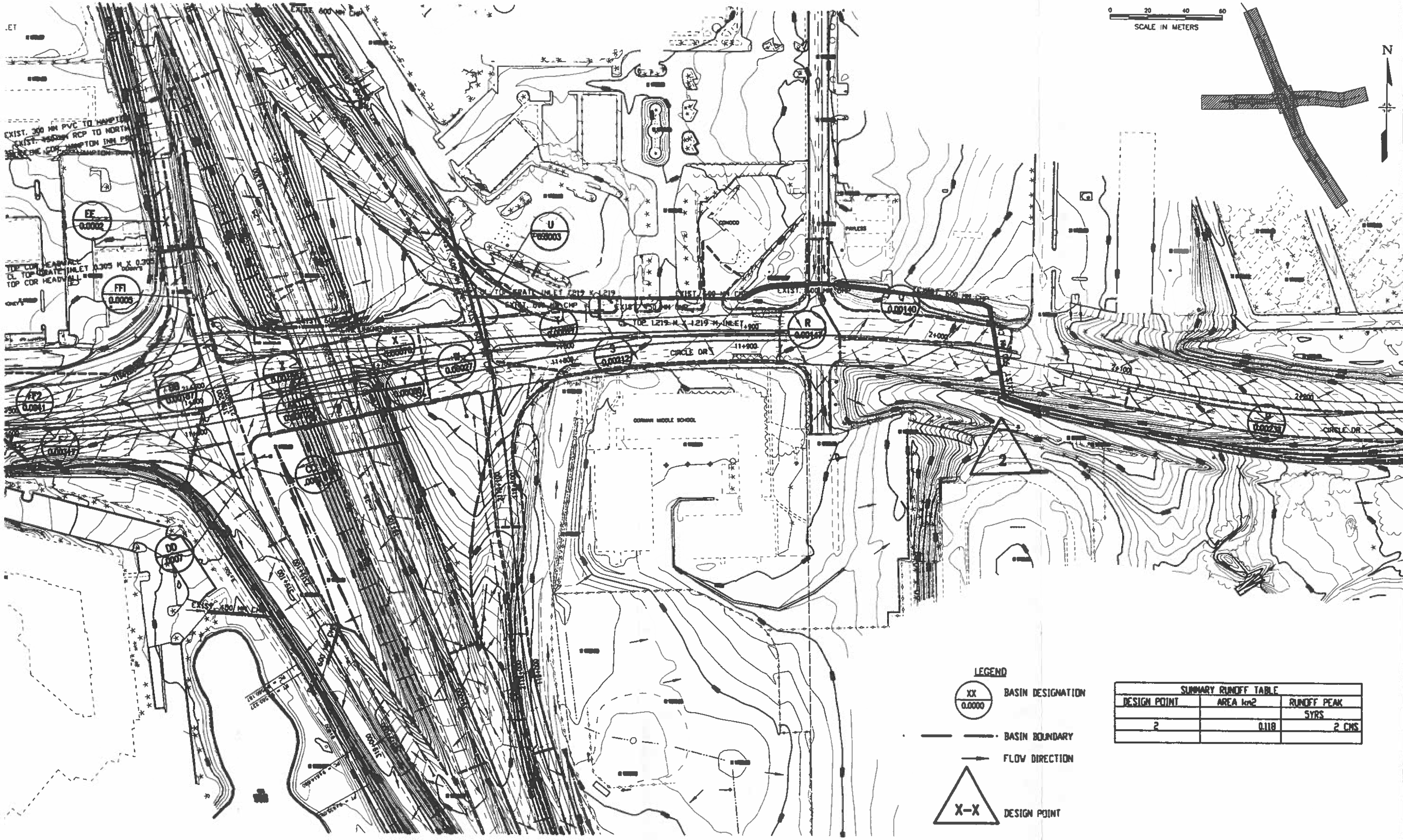
No Revisions: DATE	
Revised: 05/01/97	
Void: DATE	

SURFACE DRAINAGE PLAN

Designer: RBB		Structure Numbers	
Detailer: DEM			
Sheet Subset: Drainage	Sheet Subset: DR6 of 27		Sheet Number 77

Project No./Code

DRDMA01 RDXRKEY HYXREX HYXR01-C SUXRCN05 SUXR05 SUXR08 SUXRCN08 HYXRPAT CGXR01 SUXRLD RDXRTB ≡ XREF 16:15



LEGEND

XX / 0.0000 BASIN DESIGNATION

BASIN BOUNDARY

FLOW DIRECTION

X-X DESIGN POINT

SUMMARY RUNOFF TABLE

DESIGN POINT	AREA km2	RUNOFF PEAK 5YRS
2	0.118	2 CMS

Computer File Information	
Creation Date: 1/1/97	Initials: DEM
Last Modification Date: 05/01/97	Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\PL1000SC\	
Drawing File Name: HYPL07.DWG	
Acad Ver. R13 Scale: 1:500	Units: METRIC

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Revised: 05/01/97
Void: DATE

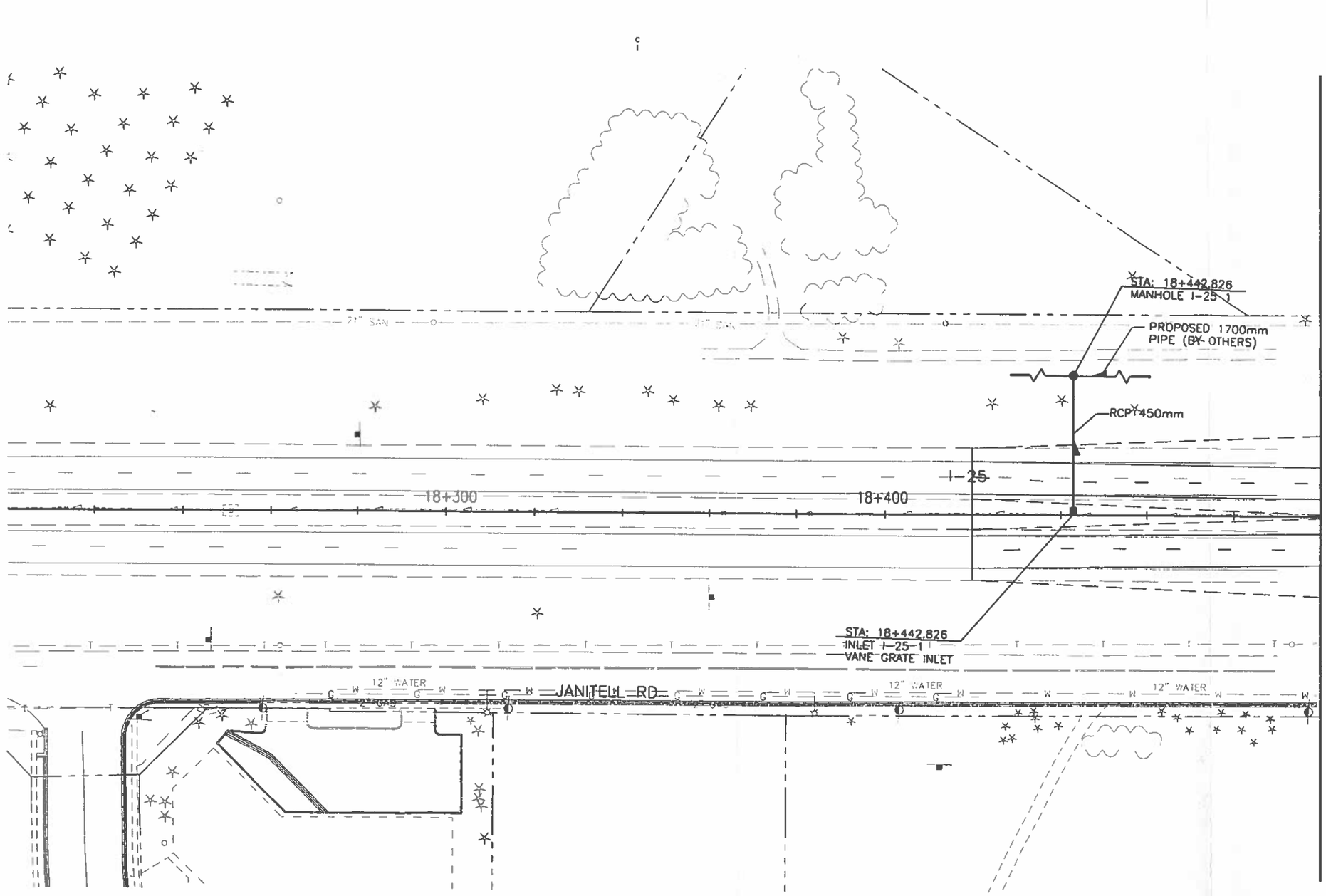
SURFACE DRAINAGE PLAN

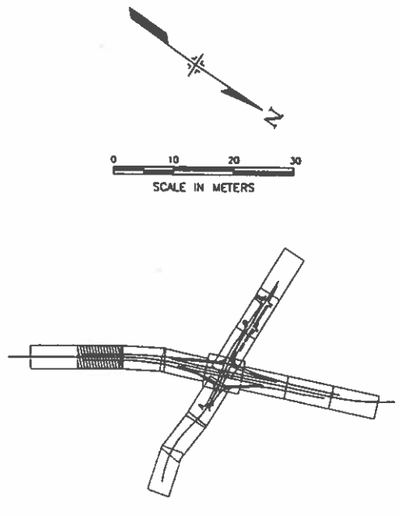
Designer: RBB
Detailer: DEM
Structure Numbers
Sheet Subset: Drainage
Sheet Subset: DR7 of 27

Project No./Code

Sheet Number 78

16:32 XREF = RDXRTB DRDMA01 RDXRKEY HYXREX HYXR01-C SUXRCN05 SUXR05 SUXR09 SUXRCN09 HYXRPAT CGXR01 SUXRLD





KEYPLAN

NOTES:

1. ALL MEDIAN INLETS ARE CDOT TYPE C UNLESS OTHER WISE NOTED.
2. ALL CURB INLETS ARE CDOT TYPE R, MODIFIED FOR 200mm CURB UNLESS OTHERWISE NOTED.
3. FOR ADDITIONAL UTILITY INFORMATION SEE UTILITY PLANS.
4. STATIONS ON CIRCLE AND LAKE ARE W/ RESPECT TO THE CENTERLINE CONTROL LINE.

LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

XREF = RDXRTB DRDMAQ01 RDXRKEY HYXRLG HYXRNT RDXRITT UTXRD1-C HYXRD1-C CGXRD1 UTXREX HYXREX RWXRD1-D LDXRD1 SUXRLD SUXRD3 14:34

Computer File Information		
Creation Date:	3/10/97/	Initials: DEM
Last Modification Date:	05/01/97	Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL03.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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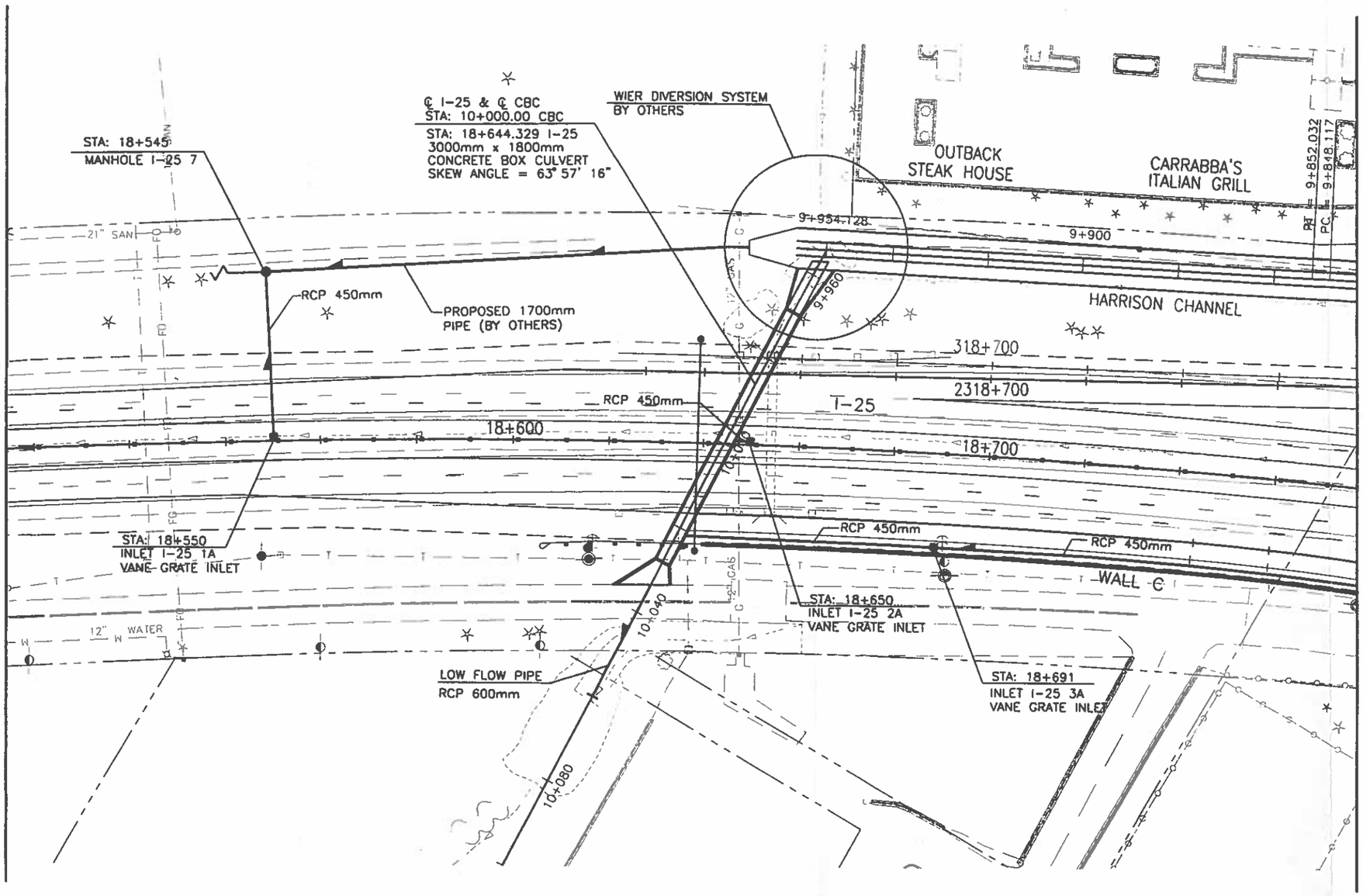
No Revisions:	DATE
Revised:	DATE
Void:	DATE

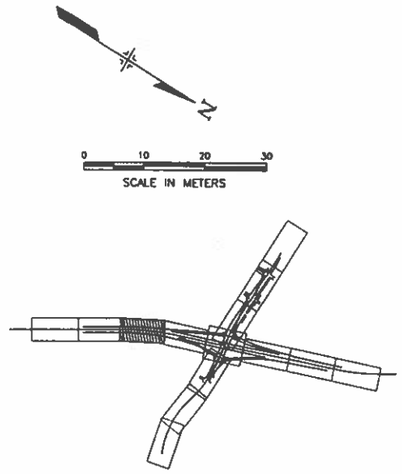
I-25 DRAINAGE PLAN

Designer:	RBB	Structure Numbers	
Detailer:	TDW		
Sheet Subset:	Drainage	Sheet Subset:	DR8 of 27

Project No./Code

Sheet Number 79





KEYPLAN

NOTES:

1. ALL MEDIAN INLETS ARE CDOT TYPE C UNLESS OTHER WISE NOTED.
2. ALL CURB INLETS ARE CDOT TYPE R, MODIFIED FOR 200mm CURB UNLESS OTHERWISE NOTED.
3. FOR ADDITIONAL UTILITY INFORMATION SEE UTILITY PLANS.
4. STATIONS ON CIRCLE AND LAKE ARE W/ RESPECT TO THE CENTERLINE CONTROL LINE.

LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

Computer File Information		
Creation Date: 3/10/97		Initials: DEM
Last Modification Date: 05/01/97		Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL04.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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Revised:	DATE
Void:	DATE

I-25 DRAINAGE PLAN

Designer:	RBB	Structure Numbers	
Detailer:	TDW		
Sheet Subset:	Drainage	Sheet Subset:	DR9 of 27

Project No./Code

Sheet Number 80

XREF || 14:36 RDXRTB DRDMA01 RWXR01-D UTXREX RDXRKEY HYXRLG HYXRNT SUXR0B LDXR01 HYXR01-C SUXR04 CGXR01 HYXREX SUXRLD UTXR01-C RDXRTB

RESIDENCE INN

HARRISON CHANNEL

SOUTHWEST RAMP

SOUTHEAST RAMP

WALL C

I-25

MATCHLINE

MATCHLINE

9+600

9+700

9+800

15" SAN

PT = 9+635.095

PC = 9+614.860

PT = 9+565.227

RC = 9+560.187

318+800

2318+800

318+900

2318+900

319+000

2319+000

18+800

2118+800

18+900

2118+900

19+000

118+800

118+900

2119+000

119+000

RCP 450mm

RCP 450mm

RCP 450mm

RCP 450mm

RCP 450mm (OH)E

STA: 19+021
INLET I-25 4B
VANE GRATE INLET

STA: 18+803
INLET I-25 2B
VANE GRATE INLET

STA: 18+803
INLET I-25 3B
VANE GRATE INLET

STA: 18+907
INLET I-25 4A
VANE GRATE INLET

STA: 18+888
INLET I-25 3C
VANE GRATE INLET

8" WATER

N

0 10 20 30
SCALE IN METERS

KEYPLAN

NOTES:

1. ALL MEDIAN INLETS ARE CDOT TYPE C UNLESS OTHER WISE NOTED.
2. ALL CURB INLETS ARE CDOT TYPE R, MODIFIED FOR 200mm CURB UNLESS OTHERWISE NOTED.
3. FOR ADDITIONAL UTILITY INFORMATION SEE UTILITY PLANS.
4. STATIONS ON CIRCLE AND LAKE ARE W/ RESPECT TO THE CENTERLINE CONTROL LINE.

LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

Computer File Information		
Creation Date: 3/10/97		Initials: DEM
Last Modification Date: 05/02/97		Initials: DEM
Full Path: J:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL05.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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Revised: DATE
Void: DATE

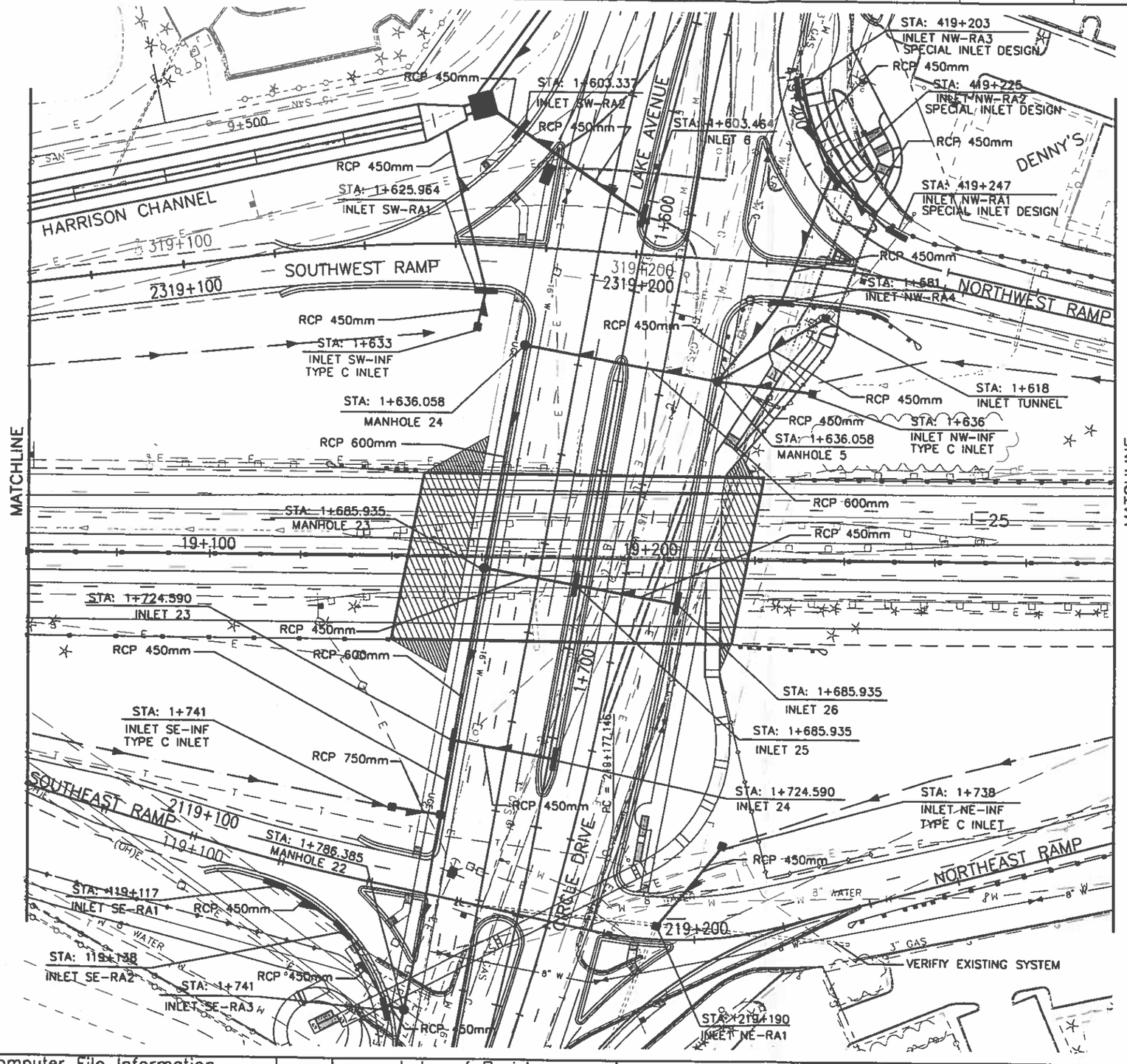
I-25 DRAINAGE PLAN

Designer: RBB
Detailer: TDW
Sheet Subset: Drainage
Structure Numbers
Sheet Subset: DR10 of 27

Project No./Code

Sheet Number 81

RDXRTB ≡ XREF 06:55 DRDMA01 SUXR04 SUXR05 RDXRKEY HYXRLG HYXRNT RDXRTIT UTXR01-C HYXR01-C RWXR01-D CGXR01 HYXREX UTXREX LDXRD1 SUXRLD2



KEYPLAN

NOTES:

1. ALL MEDIAN INLETS ARE CDOT TYPE C UNLESS OTHER WISE NOTED.
2. ALL CURB INLETS ARE CDOT TYPE R, MODIFIED FOR 200mm CURB UNLESS OTHERWISE NOTED.
3. FOR ADDITIONAL UTILITY INFORMATION SEE UTILITY PLANS.
4. STATIONS ON CIRCLE AND LAKE ARE W/ RESPECT TO THE CENTERLINE CONTROL LINE.

LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

Computer File Information		
Creation Date: 3/10/97		Initials: DEM
Last Modification Date: 05/01/97		Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL06.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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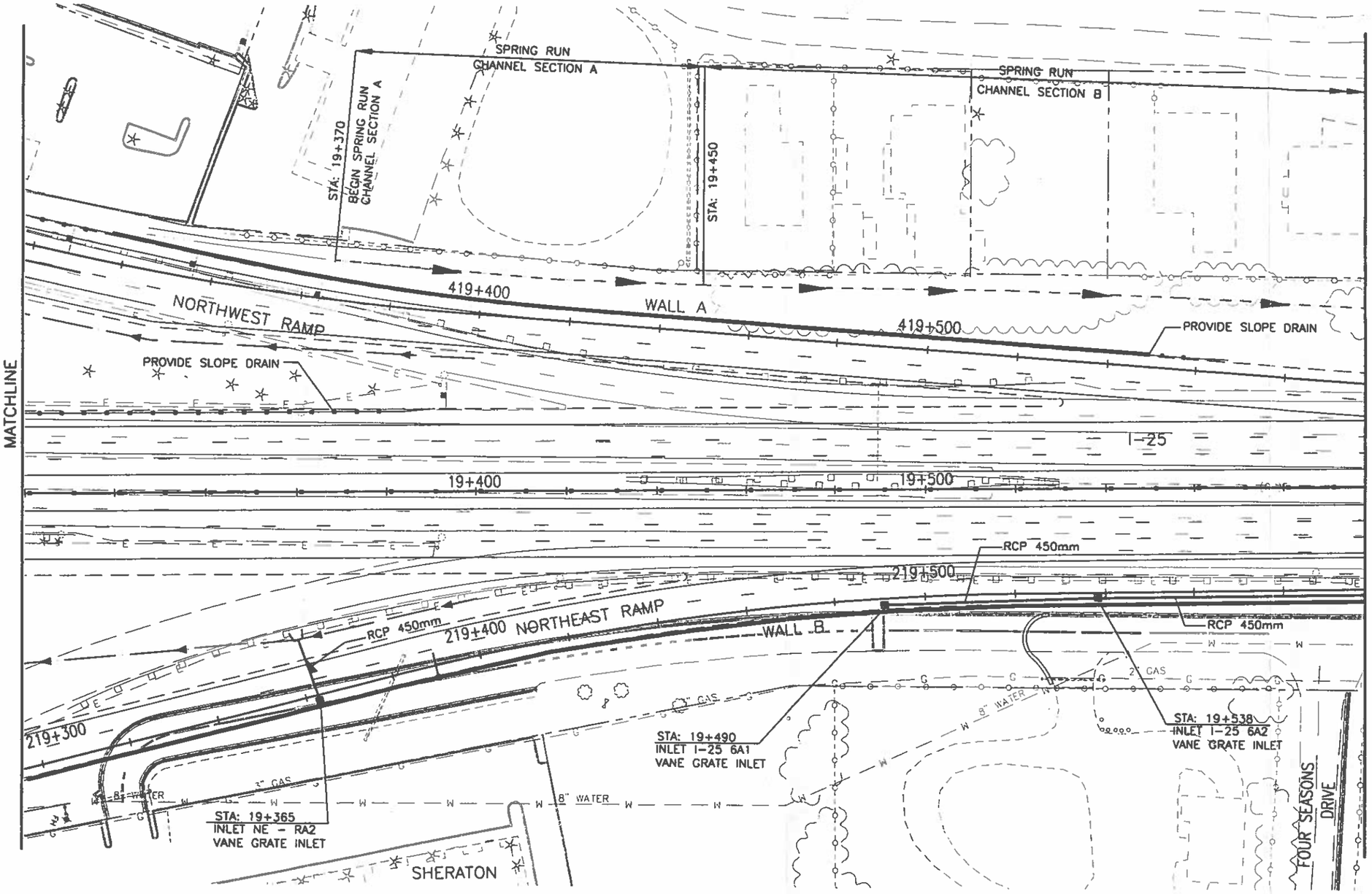
As Constructed	
No Revisions:	DATE
Revised:	DATE
Void:	DATE

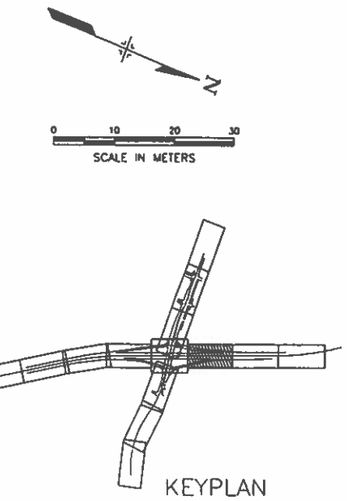
I-25 DRAINAGE PLAN

Designer: RBB		Structure Numbers	
Detailer: DEM			
Sheet Subset: Drainage	Sheet Subset: DR11 of 27		Sheet Number 82

Project No./Code

RDXRTB = 14:56 XREF HYXR01-C CGXR01 HYXREX SUXRLD UTXREX LDXR01 BRXR01 DRDMA01 RWXR01-D SUXR05 RDXRKEY HYXRNT HYXRLG RDXRTIT UTXR01-C HYXR01-C





NOTES:

1. ALL MEDIAN INLETS ARE CDOT TYPE C UNLESS OTHER WISE NOTED.
2. ALL CURB INLETS ARE CDOT TYPE R, MODIFIED FOR 200mm CURB UNLESS OTHERWISE NOTED.
3. FOR ADDITIONAL UTILITY INFORMATION SEE UTILITY PLANS.
4. STATIONS ON CIRCLE AND LAKE ARE W/ RESPECT TO THE CENTERLINE CONTROL LINE.

LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

Computer File Information		
Creation Date: 3/10/97		Initials: DEM
Last Modification Date: 05/01/97		Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL07.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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As Constructed

No Revisions:	DATE
Revised:	DATE
Void:	DATE

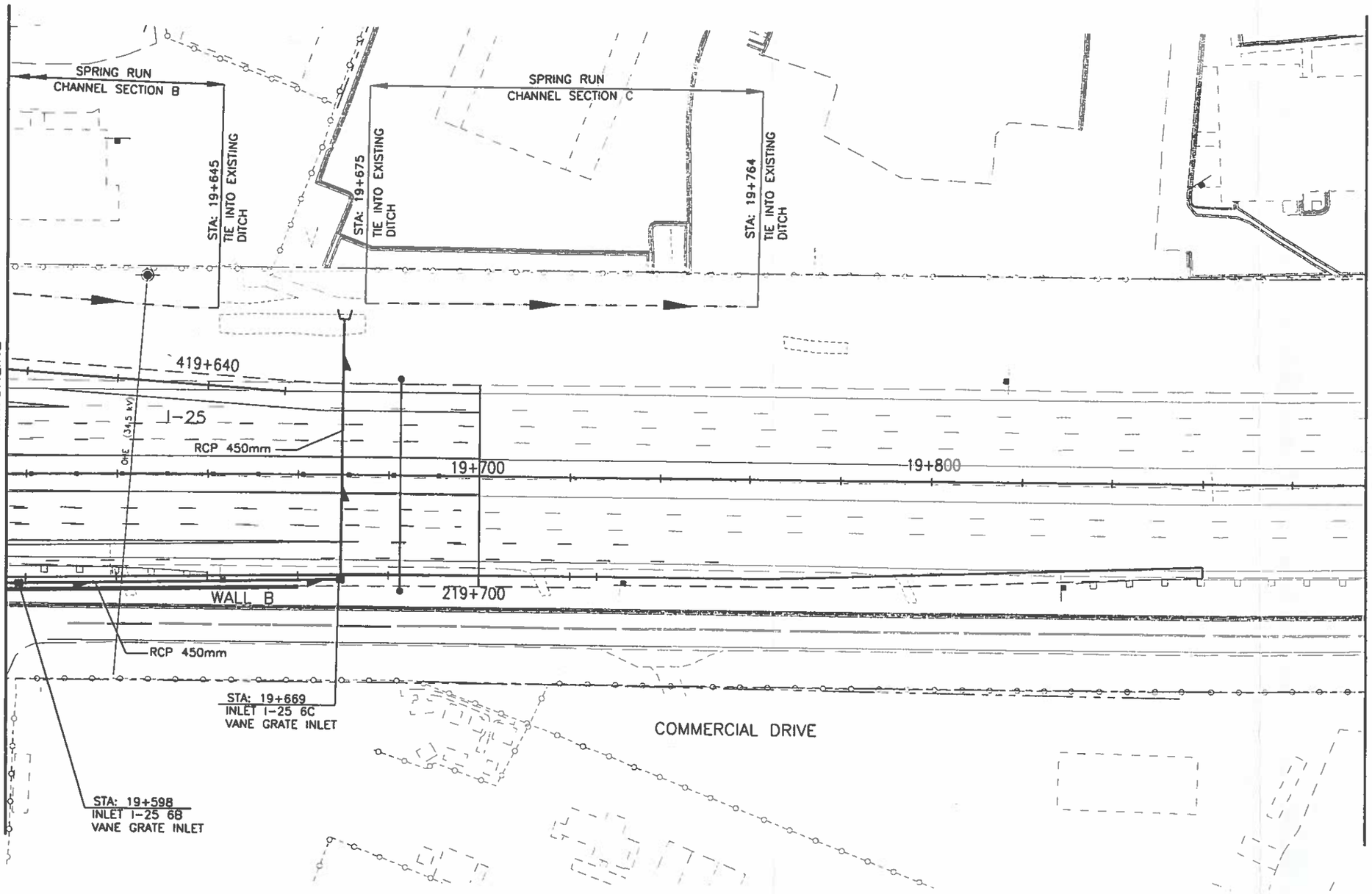
I-25 DRAINAGE PLAN

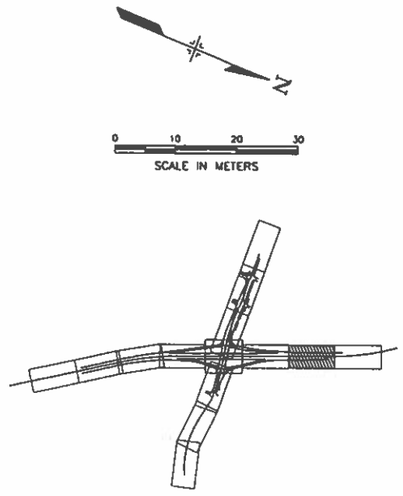
Designer:	RBB	Structure Numbers	
Detailer:	TDW		
Sheet Subset:	Drainage	Sheet Subset:	DR12 of 27

Project No./Code

Sheet Number 83

DRDMA01 RWXR01-D SUXR05 SUXR06 RDXRKEY HYXRNT HYXRLG RDXRTT UTXR01-C HYXR01-C CGXR01 HYXREX SUXRLD UTXREX
RDXRTB
14:59 XREF =





KEYPLAN

NOTES:

1. ALL MEDIAN INLETS ARE CDOT TYPE C UNLESS OTHER WISE NOTED.
2. ALL CURB INLETS ARE CDOT TYPE R, MODIFIED FOR 200mm CURB UNLESS OTHERWISE NOTED.
3. FOR ADDITIONAL UTILITY INFORMATION SEE UTILITY PLANS.
4. STATIONS ON CIRCLE AND LAKE ARE W/ RESPECT TO THE CENTERLINE CONTROL LINE.

LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

XREF: RDXRTB SUXR07 DRDMA01 SUXR06 RWXR01-D RDXRKEY HYXRNT HYXRLG RDXRTT UTXR01-C HYXR01-C CGXR01 HYXREX LDXR01 SUXRLD UTXREX

Computer File Information		
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Last Modification Date: 05/01/97		Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL08.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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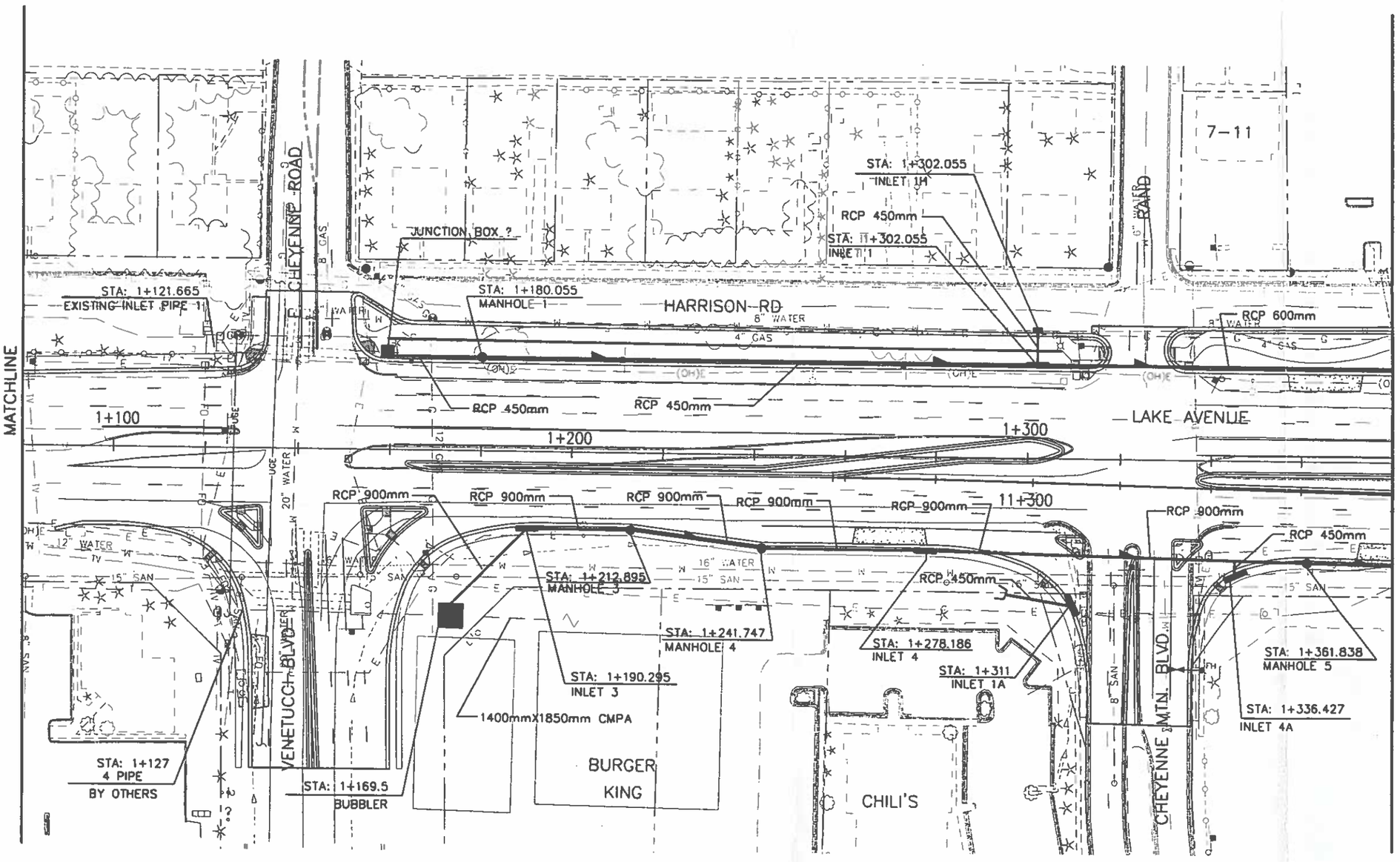
No Revisions:DATE
Revised: DATE
Void: DATE

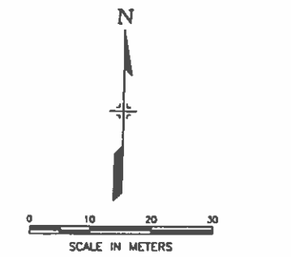
I-25 DRAINAGE PLAN

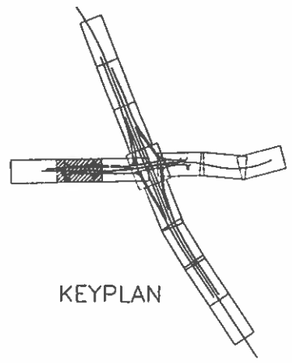
Designer: RBB
Detailer: DEM
Sheet Subset: Drainage
Structure Numbers
Sheet Subset: DR13 of 27

Project No./Code

Sheet Number 84







NOTES:

1. ALL MEDIAN INLETS ARE CDOT TYPE C UNLESS OTHER WISE NOTED.
2. ALL CURB INLETS ARE CDOT TYPE R, MODIFIED FOR 200mm CURB UNLESS OTHERWISE NOTED.
3. FOR ADDITIONAL UTILITY INFORMATION SEE UTILITY PLANS.
4. STATIONS ON CIRCLE AND LAKE ARE W/ RESPECT TO THE CENTERLINE CONTROL LINE.

LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

Computer File Information		
Creation Date: 3/10/97		Initials: DEM
Last Modification Date: 05/01/97		Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL11.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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Phone: (303) 892-1300

As Constructed

No Revisions:	DATE
Revised:	DATE
Void:	DATE

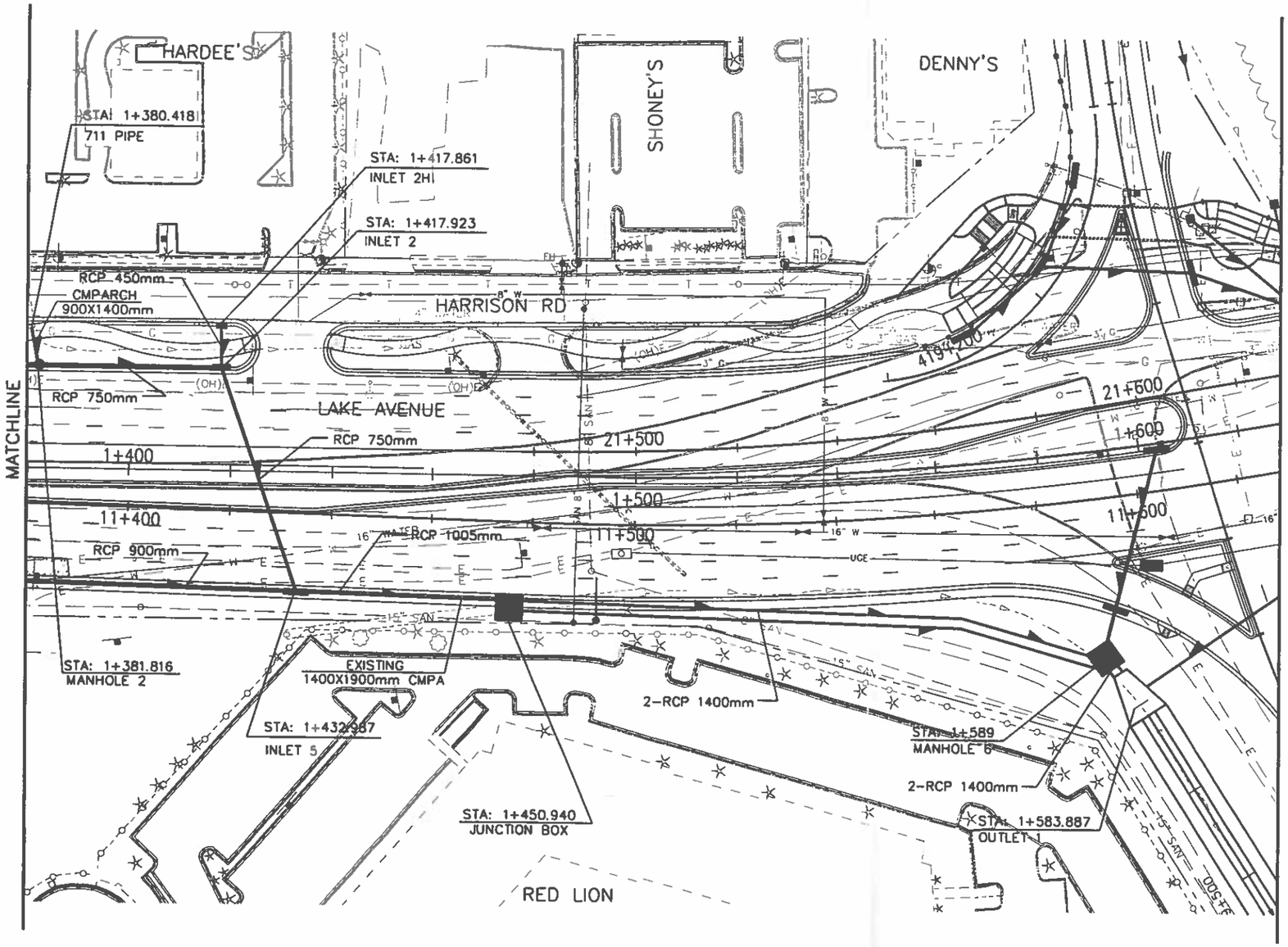
LAKE DRAINAGE PLAN

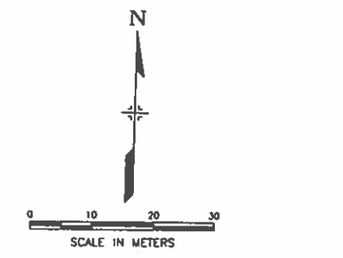
Designer: RBB		Structure Numbers	
Detailer: DEM			
Sheet Subset: Drainage		Sheet Subset: DR14 of 27	

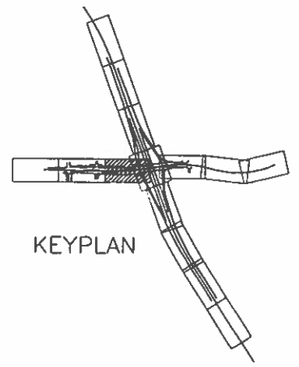
Project No./Code

Sheet Number 85

15:23 XREF = ROXRTB DRDMA01 SUXR08 HYXRLG HYXRNT ROXRKEY ROXRTY UTXR01-C HYXR01-C CGXR01 SUXRLD UTXREX LDXR01 RWXR01+D







NOTES:

1. ALL MEDIAN INLETS ARE CDOT TYPE C UNLESS OTHER WISE NOTED.
2. ALL CURB INLETS ARE CDOT TYPE R, MODIFIED FOR 200mm CURB UNLESS OTHERWISE NOTED.
3. FOR ADDITIONAL UTILITY INFORMATION SEE UTILITY PLANS.
4. STATIONS ON CIRCLE AND LAKE ARE W/ RESPECT TO THE CENTERLINE CONTROL LINE.

LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

Computer File Information		
Creation Date: 3/10/97		Initials: DEM
Last Modification Date: 05/01/97		Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL12.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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Fax: (303) 892-1356

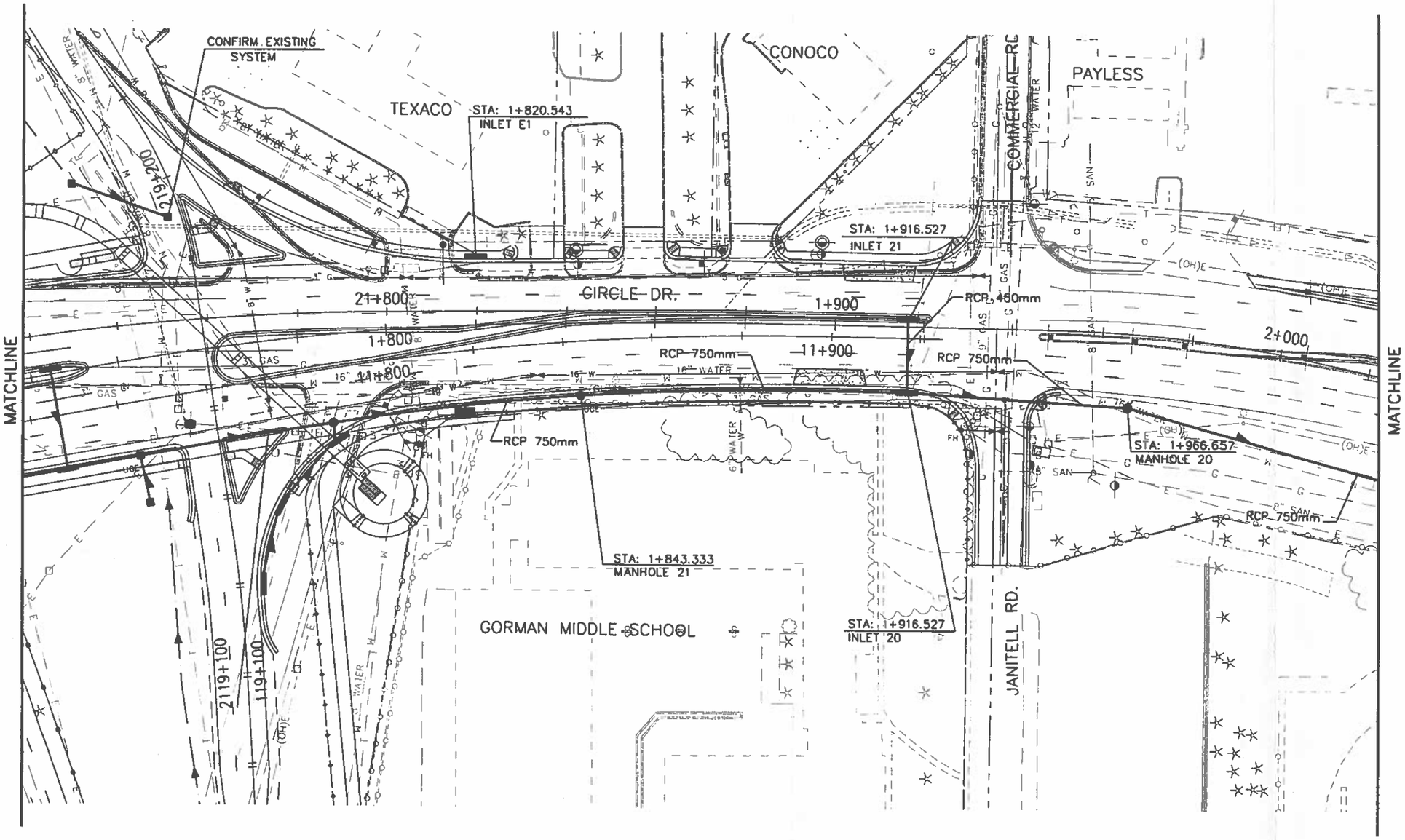
As Constructed	
No Revisions: DATE	
Revised: DATE	
Void: DATE	

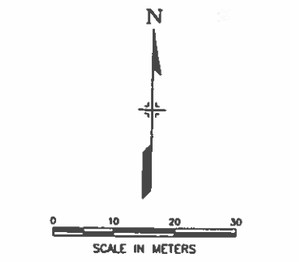
LAKE DRAINAGE PLAN

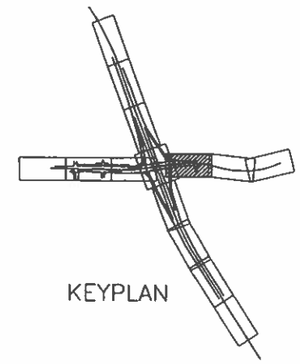
Designer: RBB		Structure Numbers	
Detailer: TDW			
Sheet Subset: Roadway	Sheet Subset: DR15 of 27		Sheet Number 86

Project No./Code

XREF * RDXRTB DRDMA01 RWXR01-D SUXR05 RDXRKEY HYXRLG HYXRNT UTXR01-C RDXRTIT HYXR01-C CGXR01 HYXREX SUXRLD UTXREX







NOTES:

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LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

HYXR01-C CGXR01 HYXREX SUXRLD UTXREX HYXR01-C RDXRTIT HYXR01-C UTXR01-C HYXRLG HYXRNT RDXRKEY SUXR05 RWXR01-D DRDMA01 RDXRTIB XREF 16:07

Computer File Information		
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Last Modification Date: 05/01/97		Initials: DEM
Full Path: S:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL13.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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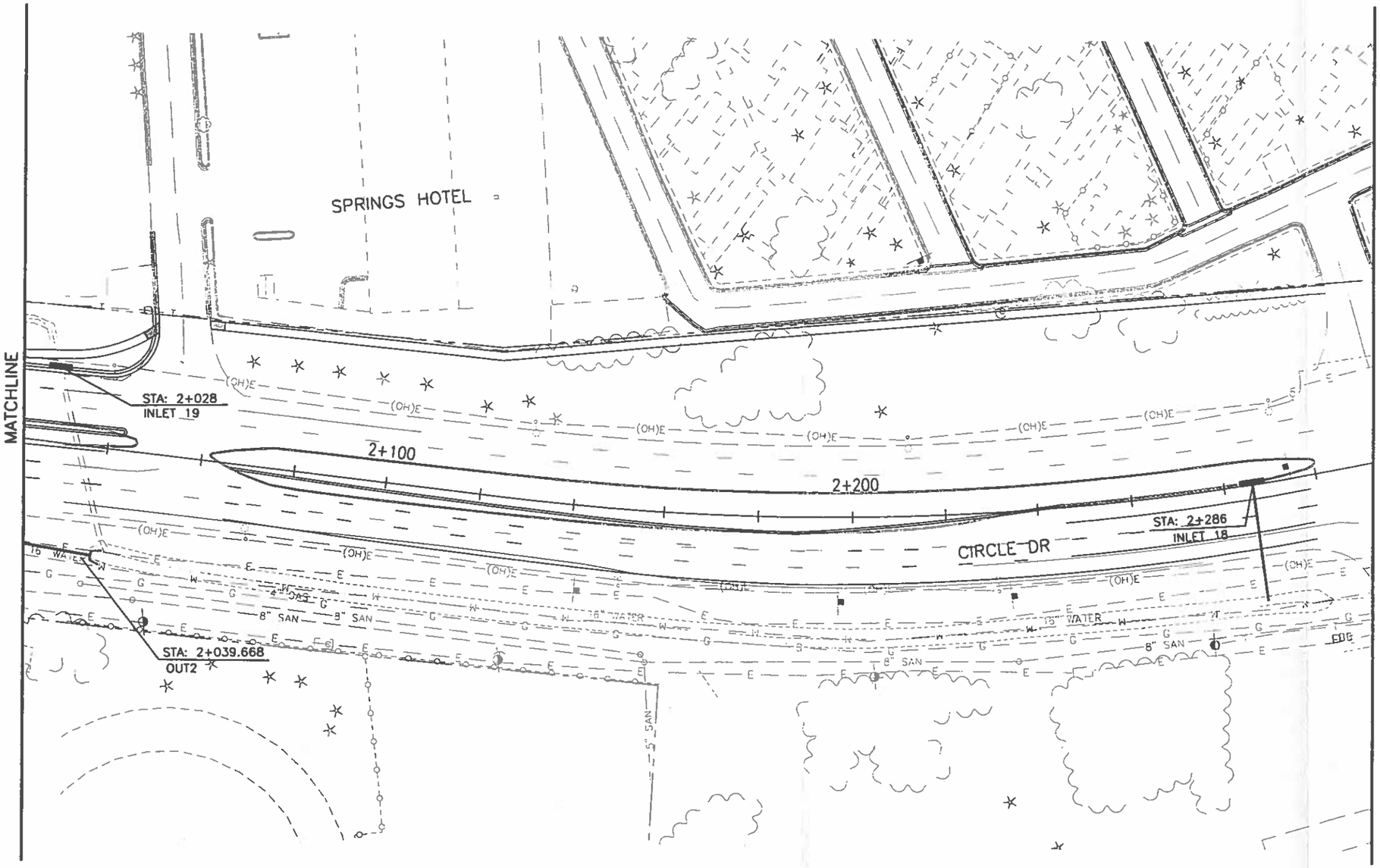
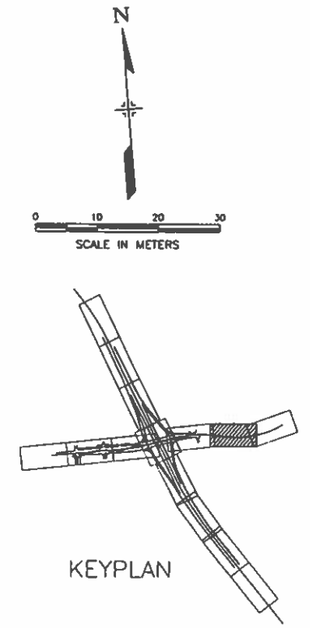
Void:	DATE

CIRCLE DRAINAGE PLAN

Designer: RBB		Structure Numbers	
Detailer: TDW			
Sheet Subset: Drainage		Sheet Subset: DR16 of 27	

Project No./Code	
Sheet Number	87





NOTES:

1. ALL MEDIAN INLETS ARE CDOT TYPE C UNLESS OTHER WISE NOTED.
2. ALL CURB INLETS ARE CDOT TYPE R, MODIFIED FOR 200mm CURB UNLESS OTHERWISE NOTED.
3. FOR ADDITIONAL UTILITY INFORMATION SEE UTILITY PLANS.
4. STATIONS ON CIRCLE AND LAKE ARE W/ RESPECT TO THE CENTERLINE CONTROL LINE.

LEGEND

- PROPOSED MANHOLE
- PROPOSED INLET
- PROPOSED CURB INLET
- PROPOSED DRAINAGE DITCH
- PROPOSED CONCRETE DITCH
- PROPOSED STORM SEWER
- PROPOSED SWALE

Computer File Information		
Creation Date: 3/10/97		Initials:
Last Modification Date: 05/01/97		Initials:
Full Path: S:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: DRPL14.DWG		
Acad Ver. R12	Scale: 1:500	Units:METRIC

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Void:	DATE

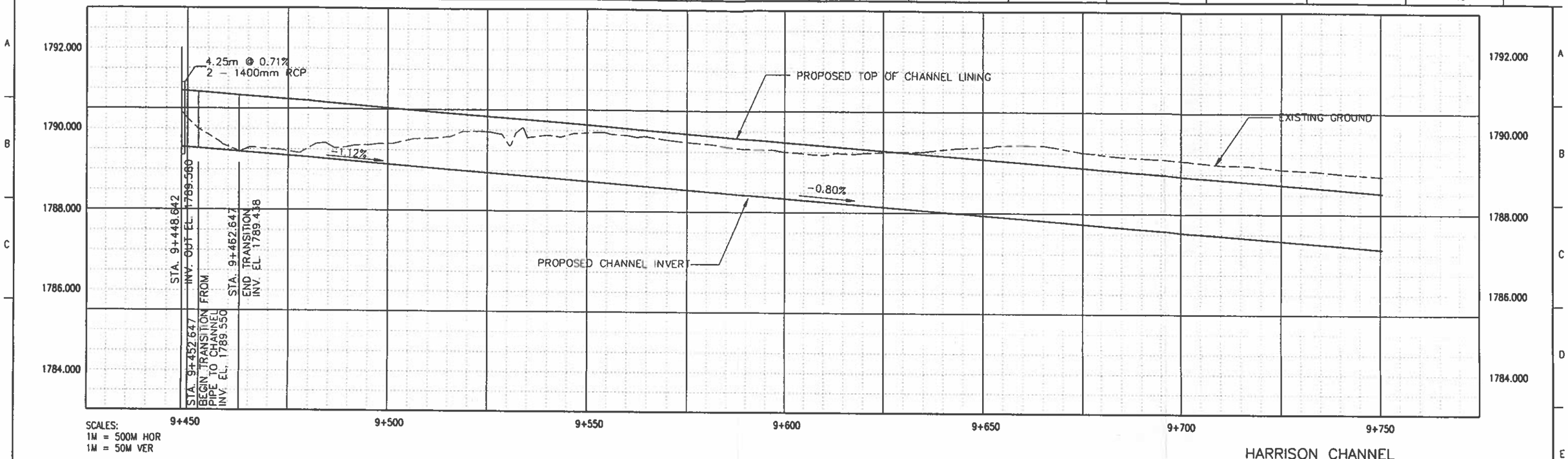
CIRCLE DRAINAGE PLAN

Designer:	RBB	Structure Numbers	
Detailer:	DEM		
Sheet Subset:	Drainage	Sheet Subset:	DR17 of 27

Project No./Code

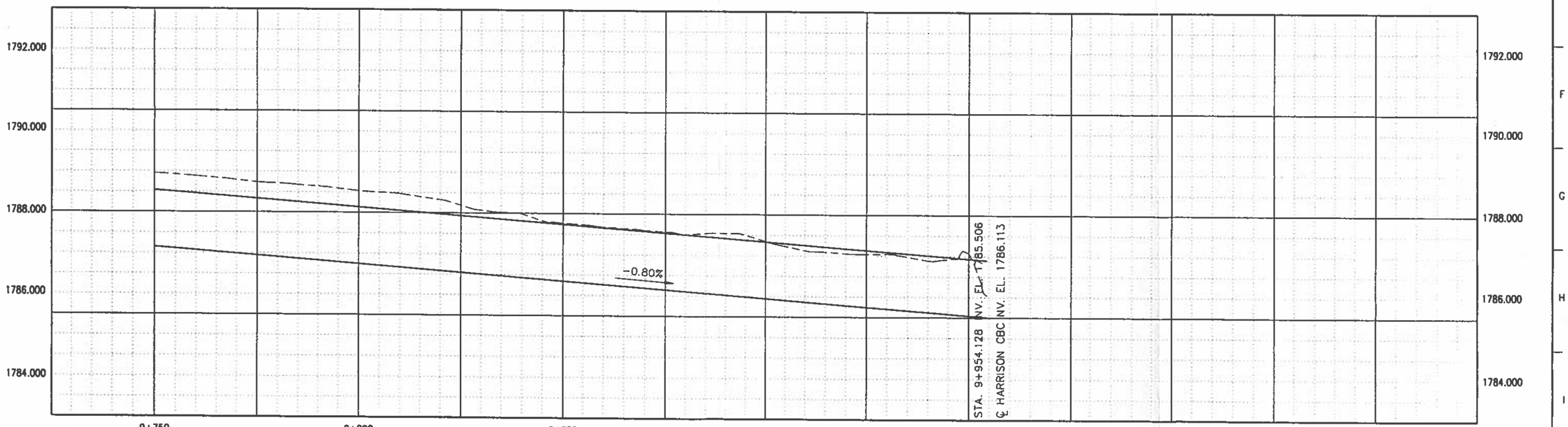
Sheet Number 88

XREF # RDXRTB ORDMA01 RWXR01-D SUXR09 RDXRKEY RDXRLG RDXRNT RDXRTIT UTXR01-C HYXR01-C CGXR01 HYXREX SUXRLD UTXREX LDXRD1 16:13



SCALES:
1M = 500M HOR
1M = 50M VER

HARRISON CHANNEL



SCALES:
1M = 500M HOR
1M = 50M VER

HARRISON CHANNEL

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Last Modification Date: 05/01/97		Initials: TDW
Full Path: J:\4900\CADD\PLANS\DRAIN-C\PROF\		
Drawing File Name: HYPRO8.DWG		
Acad Ver. 13	Scale: SCALE	Units: METRIC

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Revised: DATE
Void: DATE

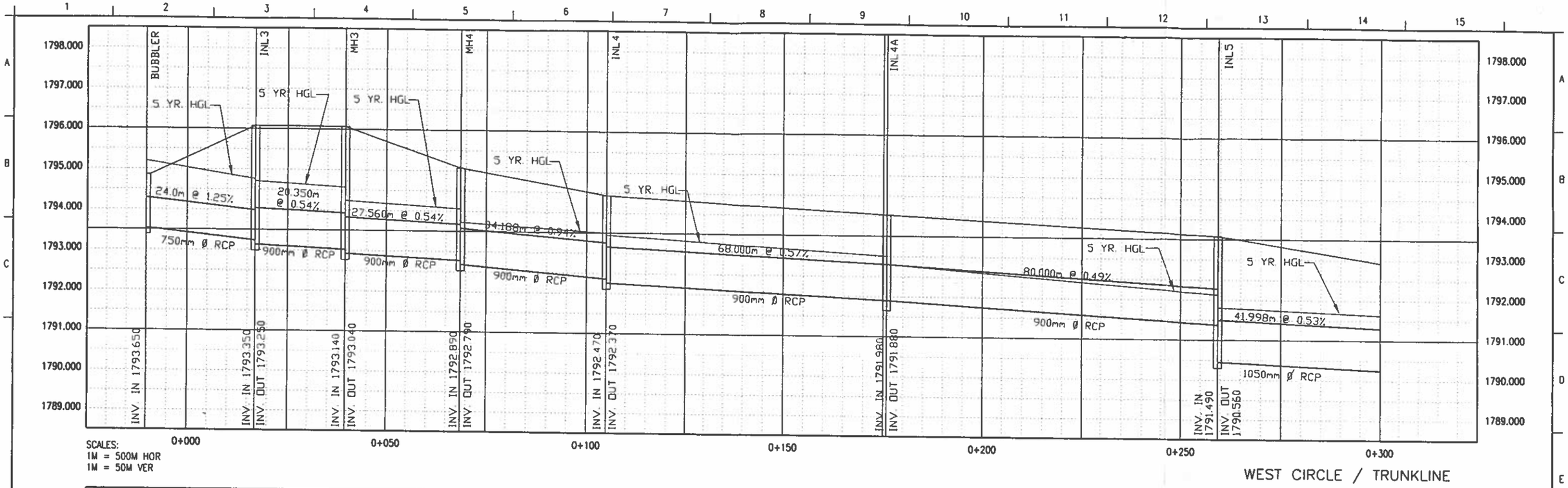
DRAINAGE PROFILE

Designer: RBB
Detailer: TDW
Sheet Subset: Drainage
Structure Numbers:
Sheet Subset: DR18 of 27

Project No./Code:

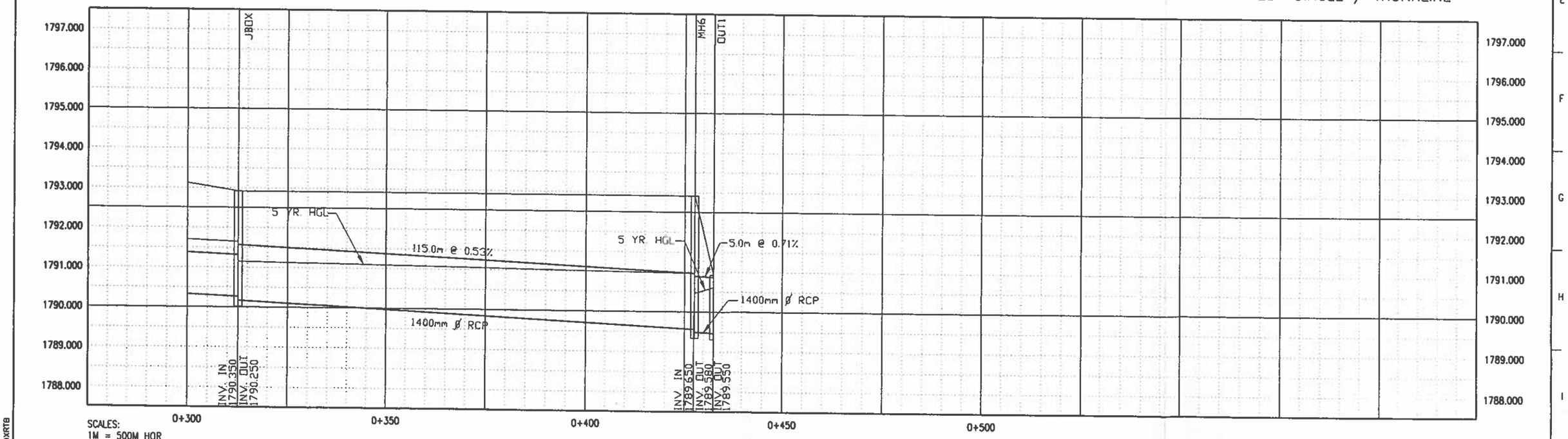
Sheet Number 89

RDXRTB RDPRGR ■ XREF 10:24



SCALES:
1M = 500M HOR
1M = 50M VER

WEST CIRCLE / TRUNKLINE



SCALES:
1M = 500M HOR
1M = 50M VER

WEST CIRCLE / TRUNKLINE

Computer File Information		
Creation Date: 4/4/97		Initials: TDW
Last Modification Date: 05/01/97		Initials: TDW
Full Path: J:\4900\CADD\PLANS\DRAIN-C\PROF\		
Drawing File Name: HYPR04.DWG		
Acad Ver. 13	Scale: SCALE	Units: METRIC

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Void: DATE

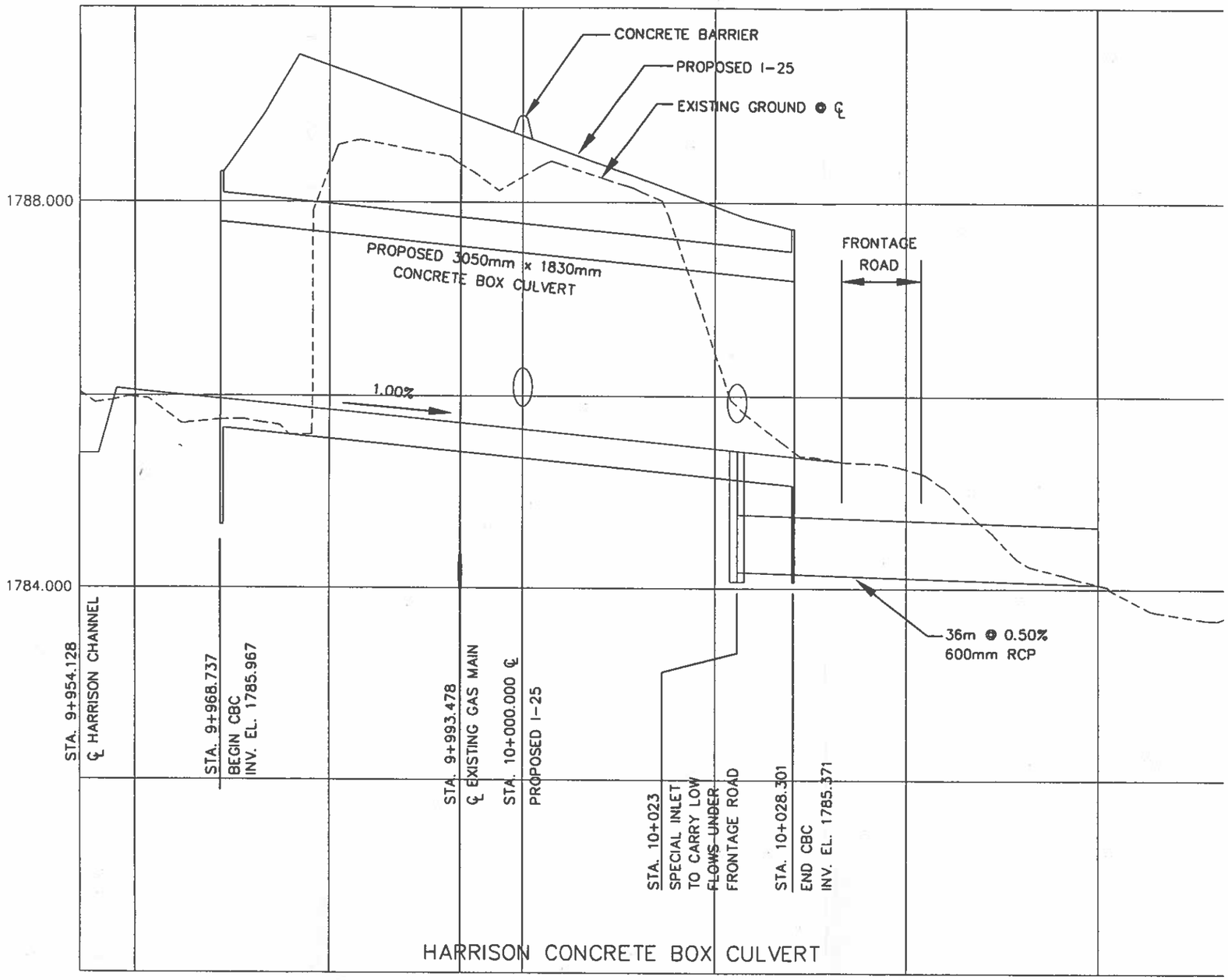
DRAINAGE PROFILE

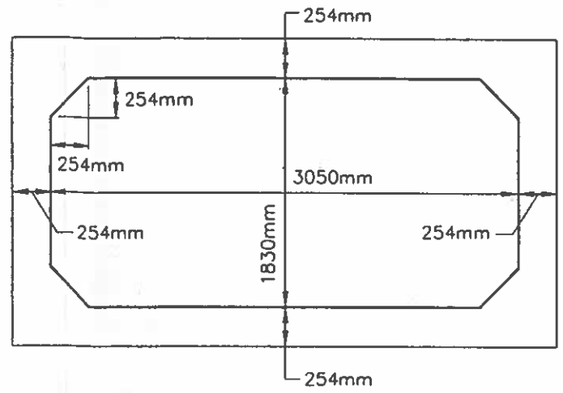
Designer: RBB		Structure Numbers	
Detailer: TDW			
Sheet Subset: Drainage		Sheet Subset: DR19 of 27	

Project No./Code

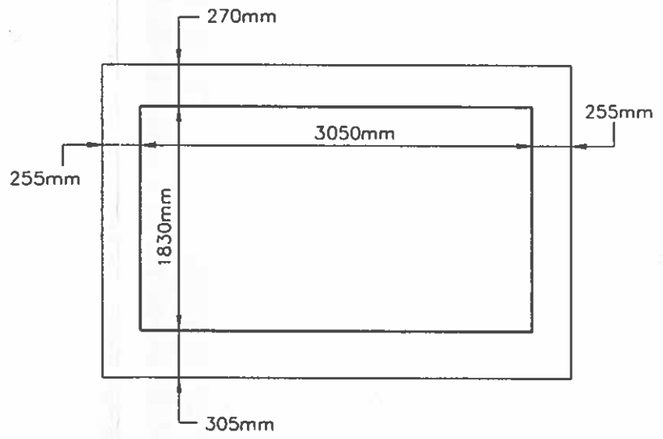
Sheet Number 90

10:26 XREF = RDPRGR RDXRTB





PRECAST ALTERNATE
(PER ASTM C850)



CAST IN PLACE ALTERNATE
(USE CDOT STD. PLAN M-601)

NOTES:

1. FINAL DESIGN OF SELECTED BOX CULVERT ALTERNATIVE TO BE PROVIDED AT FINAL OFFICE REVIEW.
2. REINFORCING STEEL NOT SHOWN FOR EITHER ALTERNATE.

Computer File Information		
Creation Date: 04/14/97		Initials: TDW
Last Modification Date: 05/01/97		Initials: INITIALS
Full Path: J:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: HYDTCBC.DWG		
Acad Ver. 13	Scale: 1:250	Units:METRIC

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Void:	DATE		

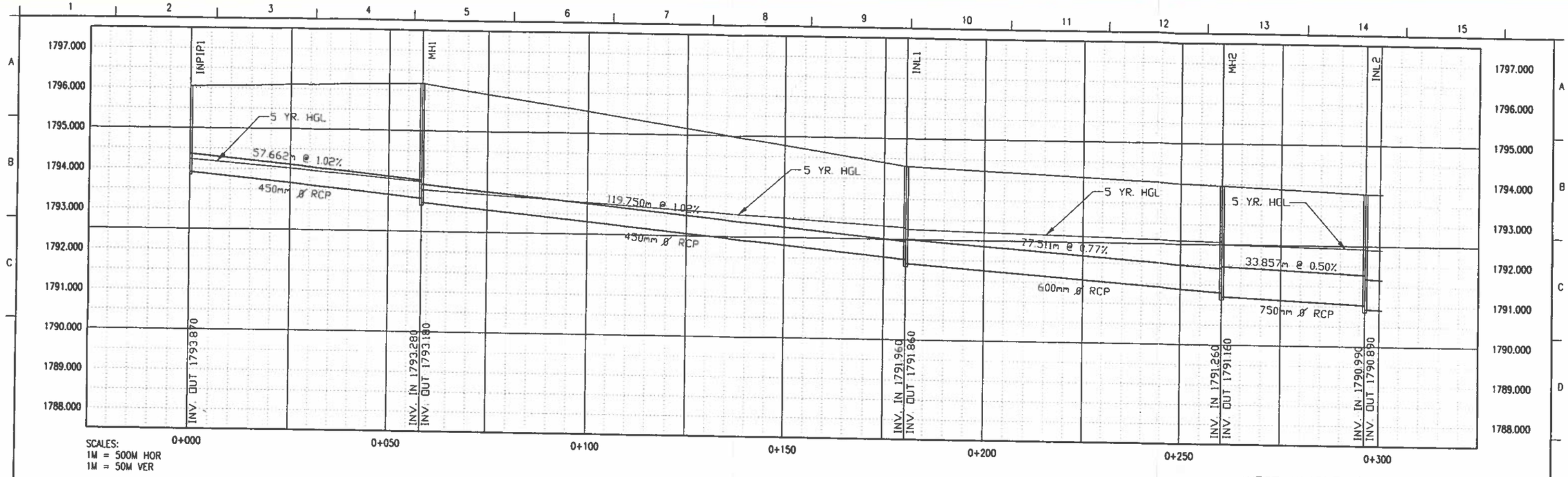
DRAINAGE SHEET

Designer:	INITIALS	Structure Numbers	
Detailer:	TDW		
Sheet Subset:	Drainage	Sheet Subset:	DR26 of 27

Project No./Code

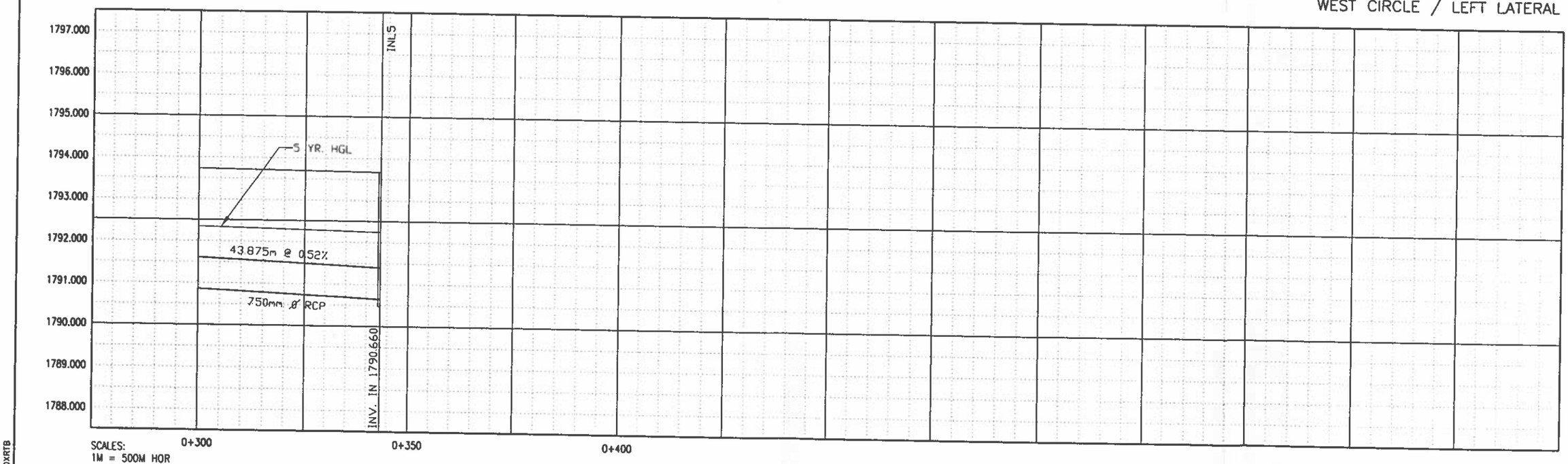
Sheet Number 97

10:37 XREF = ROXRTB



SCALES:
1M = 500M HOR
1M = 50M VER

WEST CIRCLE / LEFT LATERAL



SCALES:
1M = 500M HOR
1M = 50M VER

WEST CIRCLE / LEFT LATERAL

RDXRTB RDPRGR # 10:27 XREF

Computer File Information		
Creation Date: 4/4/97		Initials: TDW
Last Modification Date: 05/01/97		Initials: TDW
Full Path: J:\4900\CADD\PLANS\DRAIN-C\PROF\		
Drawing File Name: HYPR01.DWG		
Acad Ver. 13	Scale: SCALE	Units:METRIC

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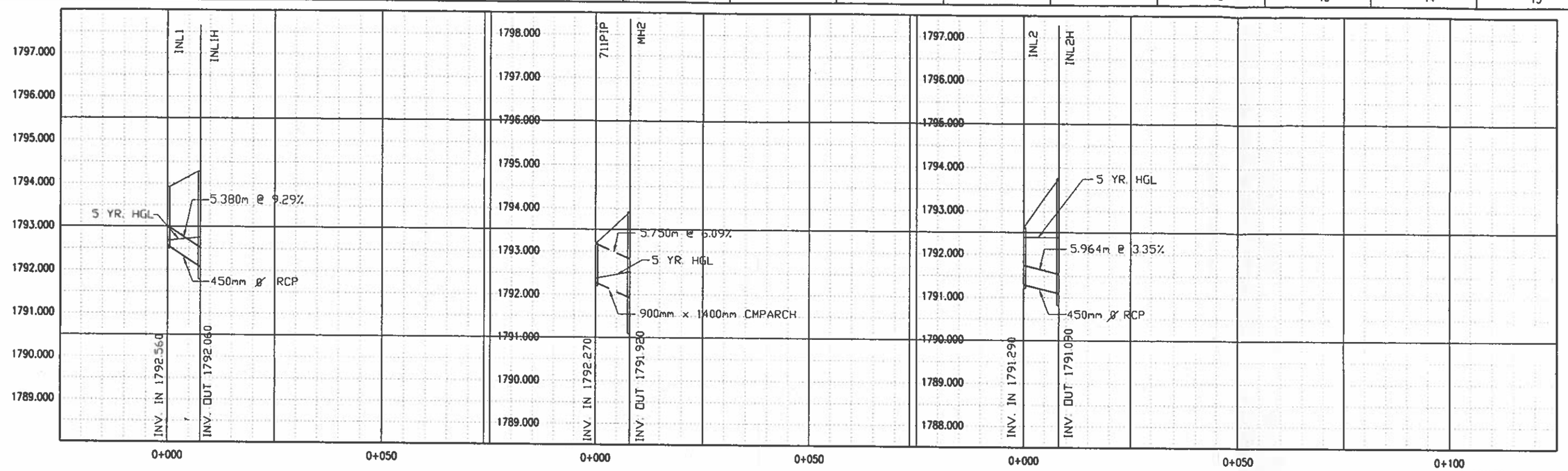
Void: DATE

DRAINAGE PROFILE

Designer: RBB
Detailer: TDW
Sheet Subset: Drainage
Structure Numbers
Sheet Subset: DR20 of 27

Project No./Code

Sheet Number 91

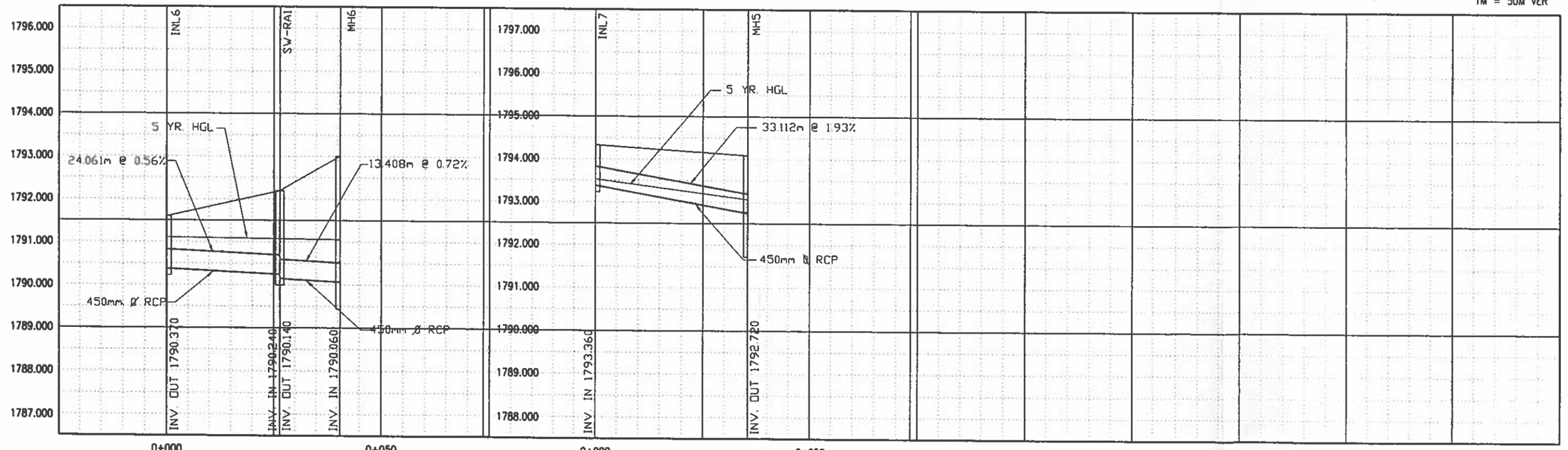


WEST CIRCLE / LEFT LATERAL / LAT1

WEST CIRCLE / LEFT LATERAL / LAT2

WEST CIRCLE / LEFT LATERAL / LAT3

SCALES:
1M = 500M HOR
1M = 50M VER



WEST CIRCLE / LEFT LATERAL
INLET 6 – MANHOLE 6

WEST CIRCLE / RIGHT LATERAL
INLET 7 – MANHOLE 5

SCALES:
1M = 500M HOR
1M = 50M VER

Computer File Information		
Creation Date: 04/08/97		Initials: TDW
Last Modification Date: 05/01/97		Initials: INITIALS
Full Path: S:\4900\CADD\PLANS\DRAIN-C\PROF\		
Drawing File Name: HYPRO2.DWG		
Acad Ver. 13	Scale: SCALE	Units: METRIC

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Revised:	DATE
Void:	DATE

DRAINAGE PROFILE

Designer: RBB		Structure Numbers	
Detailer: TDW			
Sheet Subset: Drainage		Sheet Subset: DR21 of 27	

Project No./Code

Sheet Number 92

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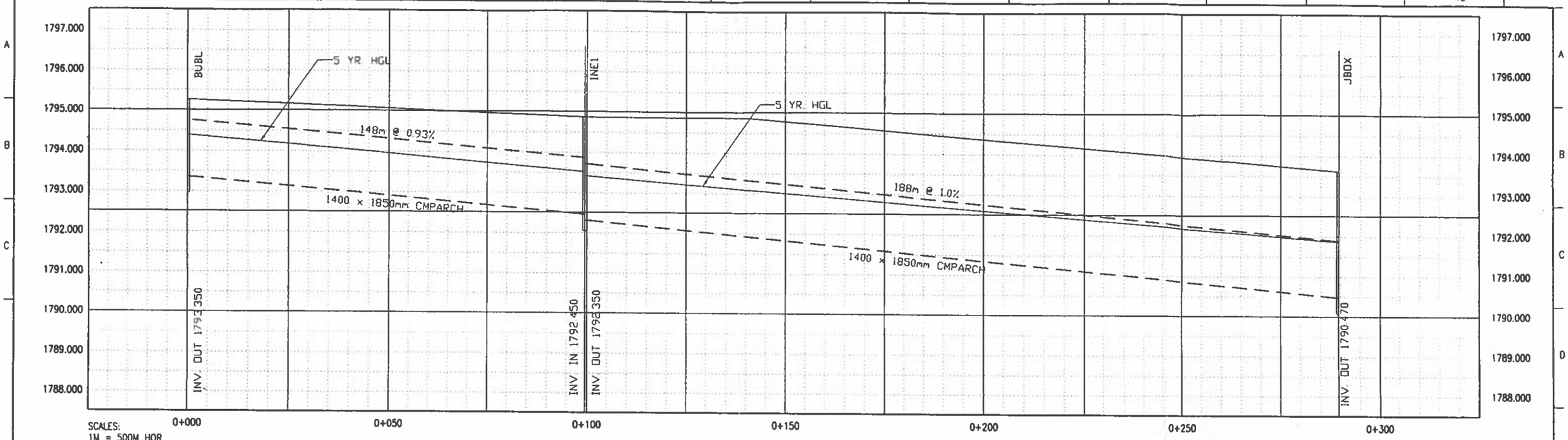

SCALES:
1M = 500M HOR
1M = 50M VER

EXISTING WEST CIRCLE / RIGHT LATERAL

Computer File Information		
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Last Modification Date: 05/01/97		Initials: TDW
Full Path: J:\4900\CADD\PLANS\DRAIN-C\PROF\		
Drawing File Name: HYPRO3.DWG		
Acad Ver. 13	Scale: SCALE	Units:METRIC

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Revised: DATE
Void: DATE

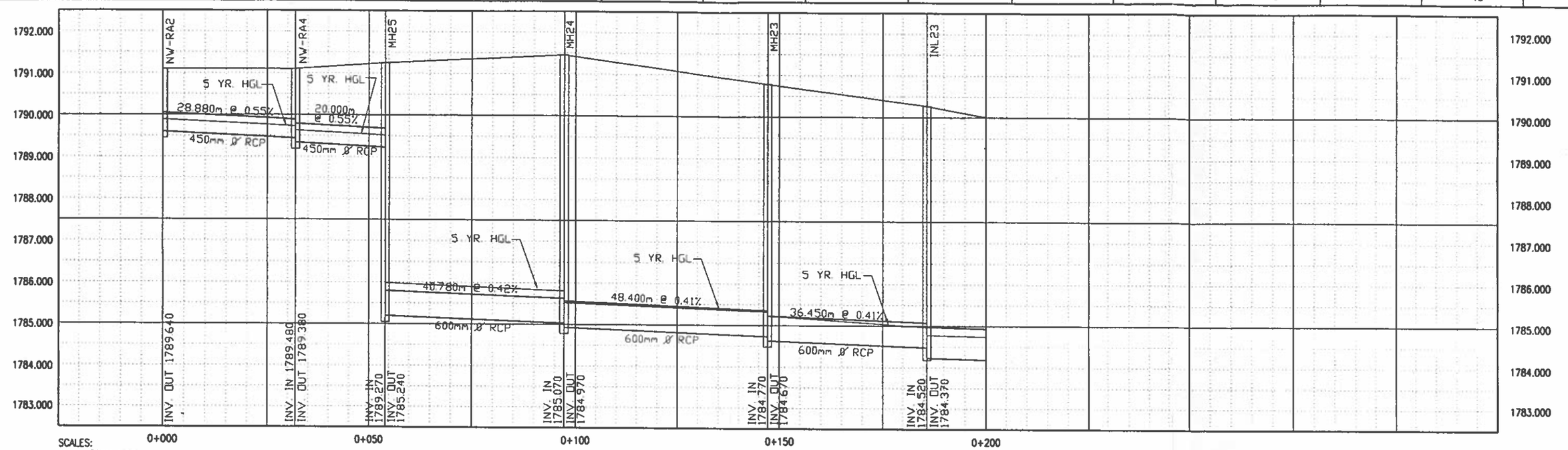
DRAINAGE PROFILES

Designer: RBB
Detailer: TDW
Structure Numbers:
Sheet Subset: Drainage
Sheet Subset: DR22 of 27

Project No./Code:

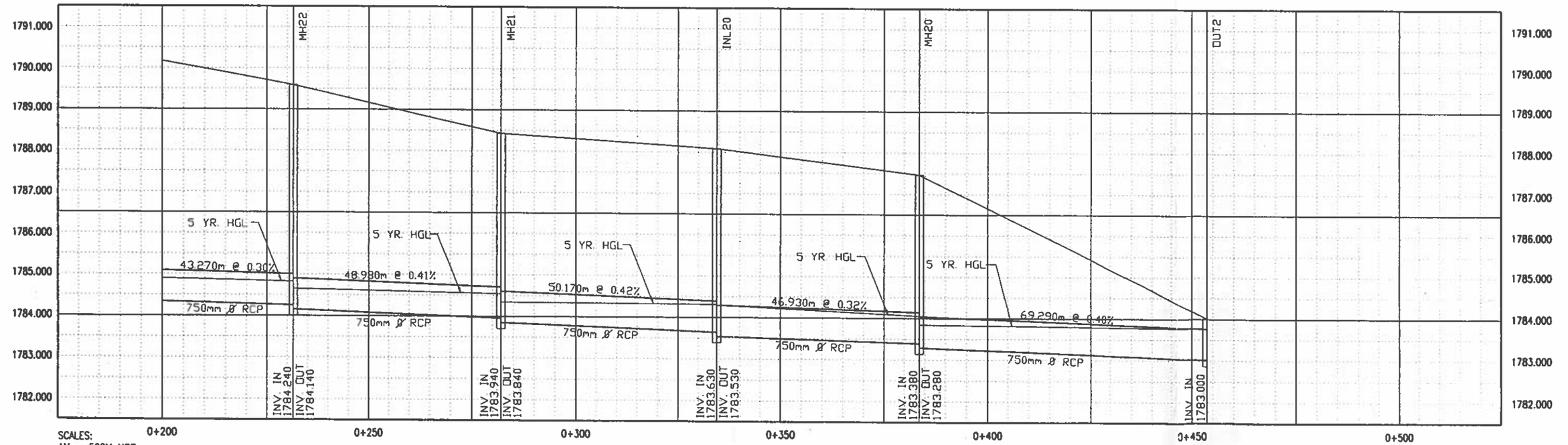
Sheet Number 93

10:30 XREF = RDPRGR RDXRTB



SCALES:
1M = 500M HOR
1M = 50M VER

EAST CIRCLE / LAKE TRUNKLINE



SCALES:
1M = 500M HOR
1M = 50M VER

EAST CIRCLE / LAKE TRUNKLINE

Computer File Information		
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Last Modification Date: 05/01/97		Initials: TDW
Full Path: J:\4900\CADD\PLANS\DRAIN-C\PROF\		
Drawing File Name: HYPR05.DWG		
Acad Ver. 13	Scale: SCALE	Units: METRIC

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Revised: DATE
Void: DATE

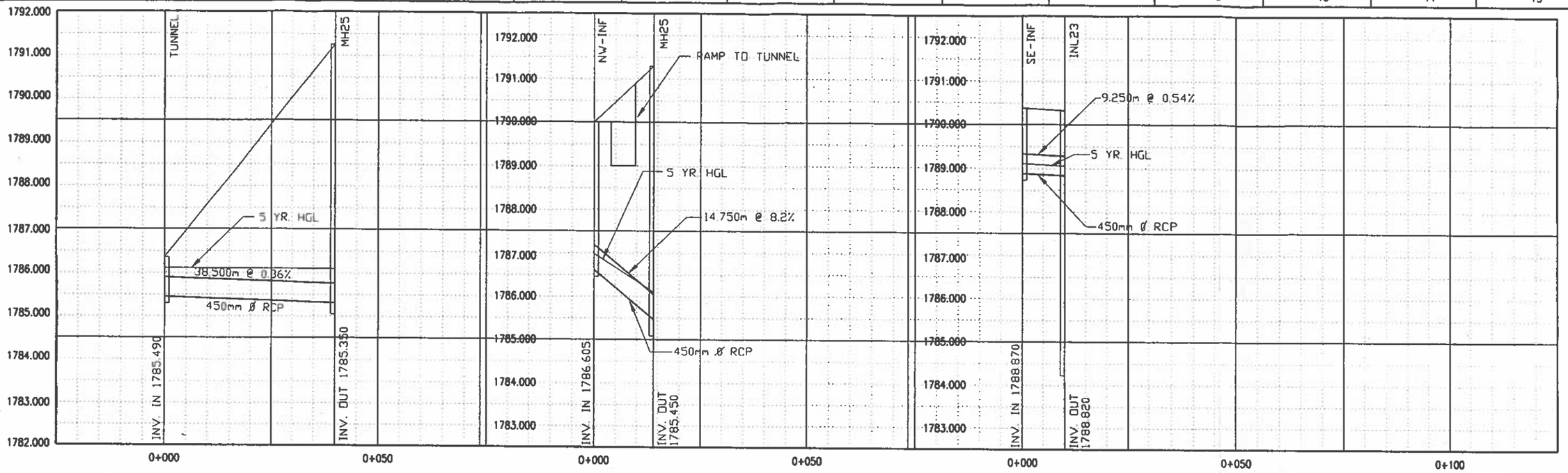
DRAINAGE PROFILE

Designer: RBB
Detailer: TDW
Sheet Subset: Drainage
Structure Numbers
Sheet Subset: DR23 of 27

Project No./Code

Sheet Number 94

10:33 XREF = RDPRGR RDXRTB

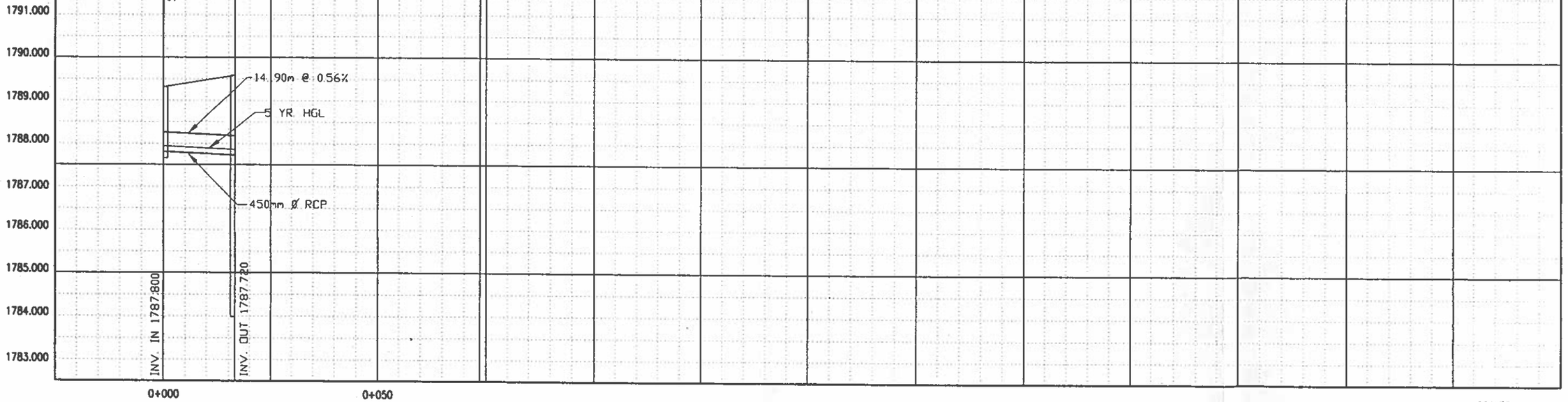


EAST CIRCLE / LAKE TUNNEL

EAST CIRCLE / LAKE NORTHWEST INFIELD

EAST CIRCLE / LAKE SOUTHEAST INFIELD

SCALES:
1M = 500M HOR
1M = 50M VER



EAST CIRCLE / LAKE SOUTHEAST RAMP 2

SCALES:
1M = 500M HOR
1M = 50M VER

14-47 XREF = RDPRGR RDXRTB

Computer File Information		
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Last Modification Date: 05/01/97		Initials: TDW
Full Path: S:\4900\CADD\PLANS\DRAIN-C\PROF\		
Drawing File Name: HYPR06.DWG		
Acad Ver. 13	Scale: SCALE	Units:METRIC

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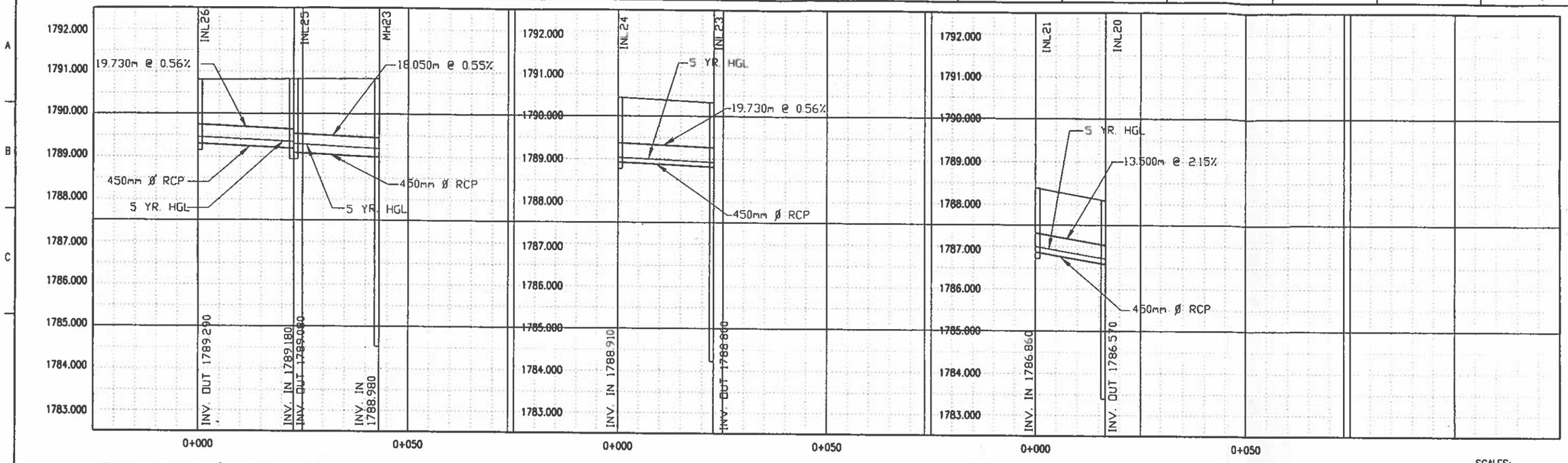
Revised:	DATE
Void:	DATE

DRAINAGE PROFILE

Designer: RBB		Structure Numbers	
Detailer: TDW			
Sheet Subset: Drainage		Sheet Subset: DR24 of 27	

Project No./Code	
Sheet Number	95



EAST CIRCLE / LAKE INLET 26 – MANHOLE 23

EAST CIRCLE / LAKE INLET 24 – INLET 23

EAST CIRCLE / LAKE INLET 21 – INLET 20

SCALES:
1M = 500M HOR
1M = 50M VER

10:36 XREF = RDPRGR RDXRTB

Computer File Information		
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Last Modification Date: 05/01/97		Initials: TDW
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Drawing File Name: HYPR07.DWG		
Acad Ver. 13	Scale: SCALE	Units: METRIC

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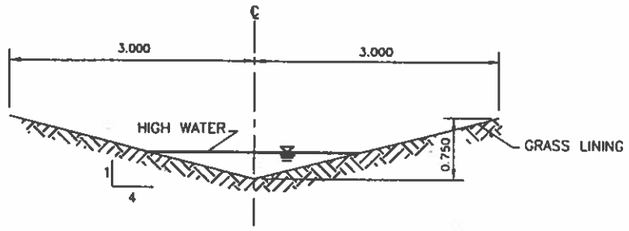
Revised: DATE
Void: DATE

DRAINAGE PROFILE

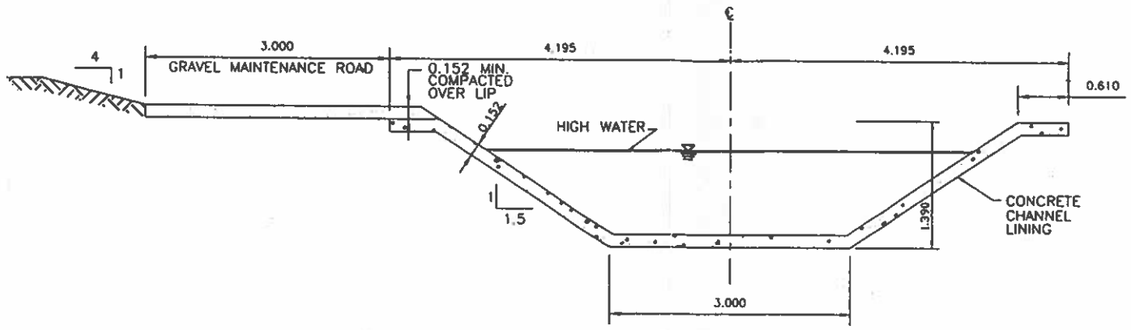
Designer: RBB
Detailer: TDW
Sheet Subset: Drainage
Structure Numbers
Sheet Subset: DR25 of 27

Project No./Code

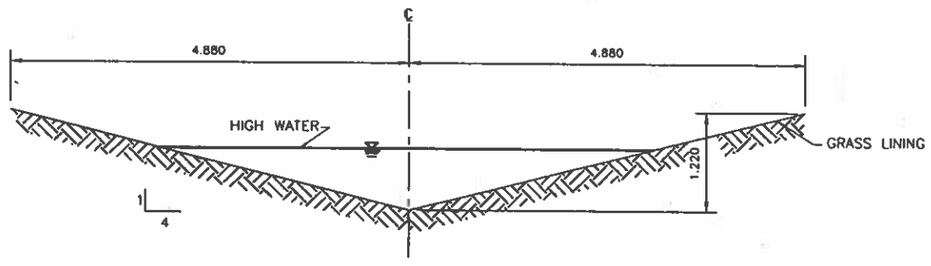
Sheet Number 96



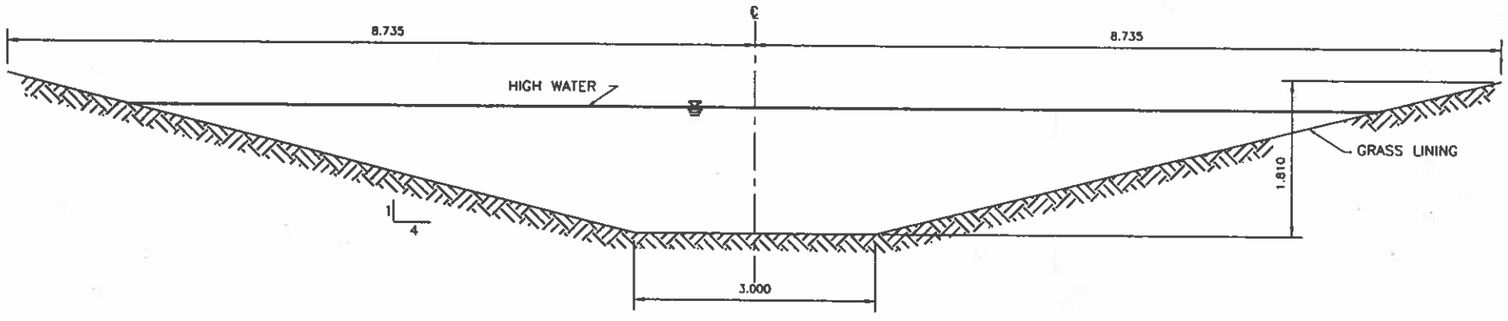
SPRING RUN
CHANNEL SECTION A



HARRISON
CHANNEL SECTION



SPRING RUN
CHANNEL SECTION B



SPRING RUN
CHANNEL SECTION C

Computer File Information		
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Last Modification Date: 05/01/97		Initials: INITIALS
Full Path: J:\4900\CADD\PLANS\DRAIN-C\		
Drawing File Name: HYDTO1.DWG		
Acad Ver. VER.#	Scale:	Units:METRIC

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Revised:	DATE
Void:	DATE

CHANNEL SECTIONS

Designer:	RBB	Structure Numbers	
Detailer:	TDW		
Sheet Subset:	Drainage	Sheet Subset:	DR27 of 27

Project No./Code

Sheet Number 98

11:14 XREF

APPENDIX B
DESIGN CRITERIA

APPENDIX B - DESIGN CRITERIA

DRAINAGE - PERMITS

STORMWATER DISCHARGE PERMIT

ANY CONSTRUCTION PROJECT WHICH DISTURBS OVER 5 ACRES REQUIRES A STORMWATER DISCHARGE PERMIT FROM CDPHE. THIS PROJECT IS EXPECTED TO DISTURB OVER THIS AMOUNT. THIS WILL INVOLVE CREATING A STORM WATER MANAGEMENT PLAN FOR THE PROJECT. THE KEY ELEMENTS OF THIS ARE EROSION CONTROL MEASURES AND A LIST OF BEST MANAGEMENT PRACTICES TO BE USED DURING CONSTRUCTION OF THE PROJECT. THE PLAN WILL BE SUBMITTED BY CDOT. A COPY OF THE LIKELY GENERAL PERMIT TO BE USED ON THE PROJECT IS INCLUDED. ADDITIONAL INFORMATION IS AVAILABLE.

CDOT DRAINAGE DESIGN MANUAL
CDPHE GENERAL PERMIT FORMS

SECTION 404 PERMIT

ANY CONSTRUCTION PROJECT WHICH DISTURBS JURISDICTIONAL WETLANDS OR "WATERS OF THE U.S." REQUIRES A 404 PERMIT FROM THE CORPS OF ENGINEERS. IT IS ANTICIPATED THAT THE PROJECT WILL EITHER REQUIRE NO PERMIT OR WILL BE PERMITTED UNDER A NATIONWIDE OR REGIONAL PERMIT. THE EXISTENCE OF WETLANDS WITHIN THE PROJECT NEEDS TO BE VERIFIED WITH CDOT. IT APPEARS THAT THERE MAY NOT BE ANY WETLANDS AFFECTED. ADDITIONAL INFORMATION IS AVAILABLE.

CDOT DRAINAGE DESIGN MANUAL

FLOODPLAIN DEVELOPMENT PERMIT

ANY PROJECT WHICH AFFECTS AREAS DESIGNATED AS FLOODPLAINS BY THE NATIONAL FLOOD INSURANCE ACT REQUIRE A PERMIT FROM FEMA. IT IS ANTICIPATED THAT THERE ARE NO DESIGNATED FLOODPLAINS WITHIN THE PROJECT AREA. THIS WILL BE VERIFIED WITH THE REGIONAL FLOOD PLAIN ADMINISTRATOR FOR THE PIKES PEAK AREA.

CDOT DRAINAGE DESIGN MANUAL

OTHER PERMITS

IT IS ASSUMED THAT CDOT HAS OR WILL OBTAIN ALL OTHER PERMITS FOR THE PROJECT. IT NEEDS TO BE VERIFIED IF THE FUGITIVE DUST PERMIT IS INCLUDED.

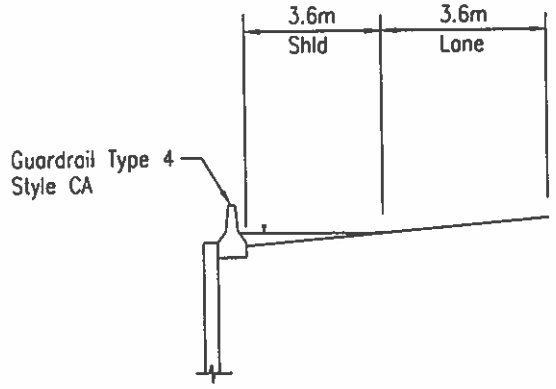
DRAINAGE - DATA COLLECTION

THE FOLLOWING REPORTS HAVE BEEN OBTAIN THAT ARE RELATED TO THE PROJECT:

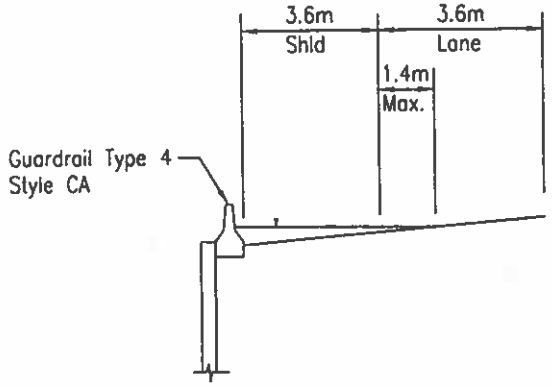
PROJECT SPECIFIC

"PRELIMINARY DESIGN REPORT STRATTON DRAINAGE BASIN OUTFALL STUDY", DREXEL BARRELL, DECEMBER, 1994.

I-25 MAINLINE DRAINAGE ASSUMPTIONS FOR LOCATIONS WITH CONCRETE GUARDRAIL



MAINLINE FOR INITIAL STORM
(MAX. SPREAD TO EDGE OF SHLDR.)



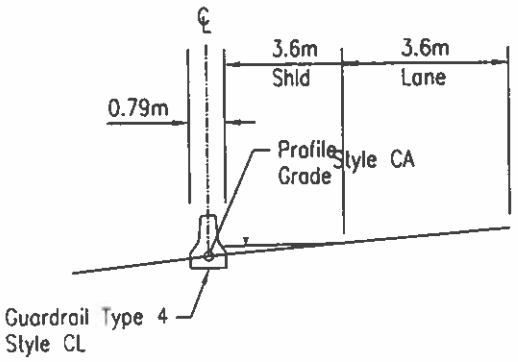
MAINLINE FOR MAJOR STORM
(MAX. ENCROACHMENT 1.4 M ONTO LANE)

NO SCALE

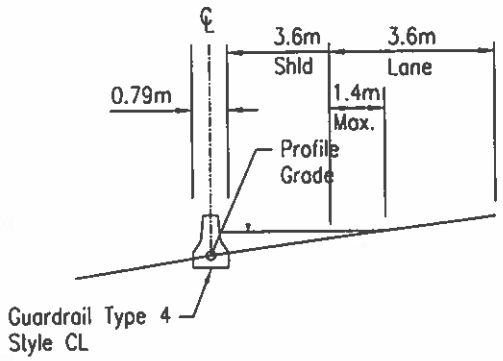
Figure	B1
Page	N/A
Date	4-4-97

DMJM

I-25 MAINLINE DRAINAGE ASSUMPTIONS FOR MEDIAN ON SUPERELEVATED SECTIONS



MAINLINE (SUPERELEVATED) FOR INITIAL STORM
(MAX. SPREAD TO EDGE OF SHLDR.)



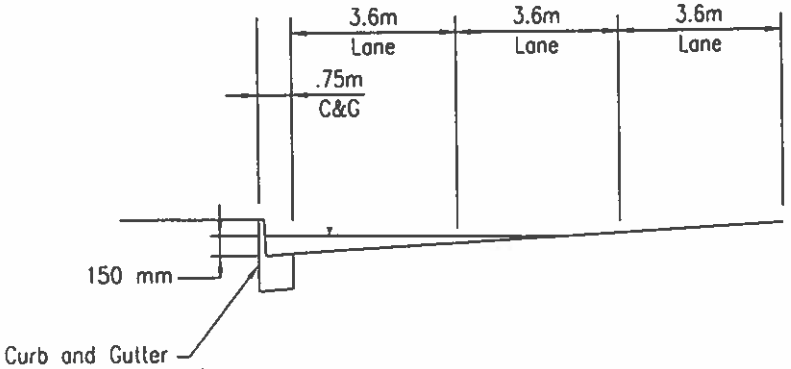
MAINLINE (SUPERELEVATED) FOR MAJOR STORM
(MAX. ENCROACHMENT 1.4 M ONTO LANE)

NO SCALE

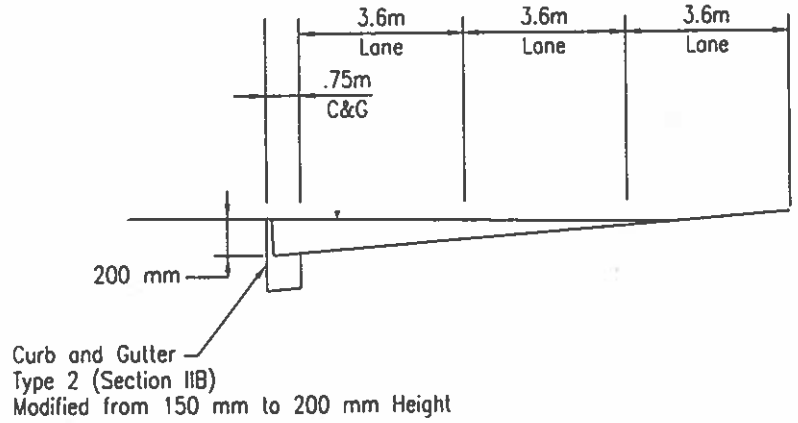
Figure	B2
Page	N/A
Date	4-4-97

DMJM

CIRCLE/LAKE DRAINAGE ASSUMPTIONS
NORMAL SECTION W/ 203 MM (8") VERTICAL CURB



CIRCLE/LAKE FOR INITIAL STORM
(MAX. DEPTH @ GUTTER OF 150 MM)



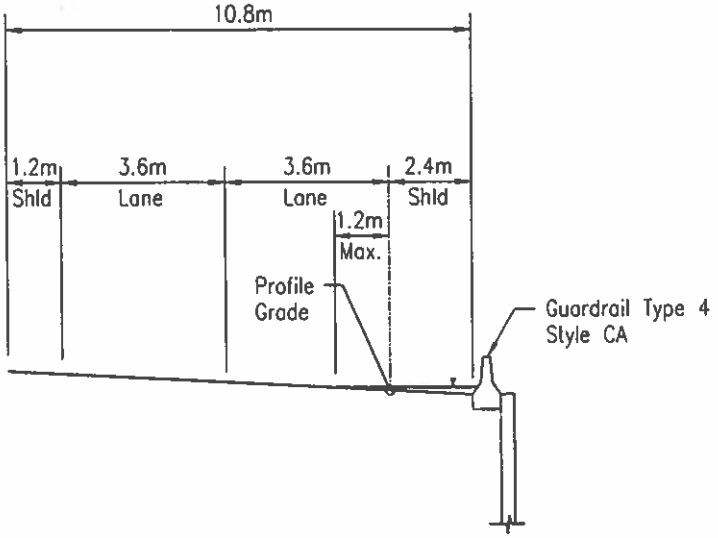
CIRCLE/LAKE FOR MAJOR STORM
(MAX. DEPTH @ GUTTER OF 200 MM)

NO SCALE

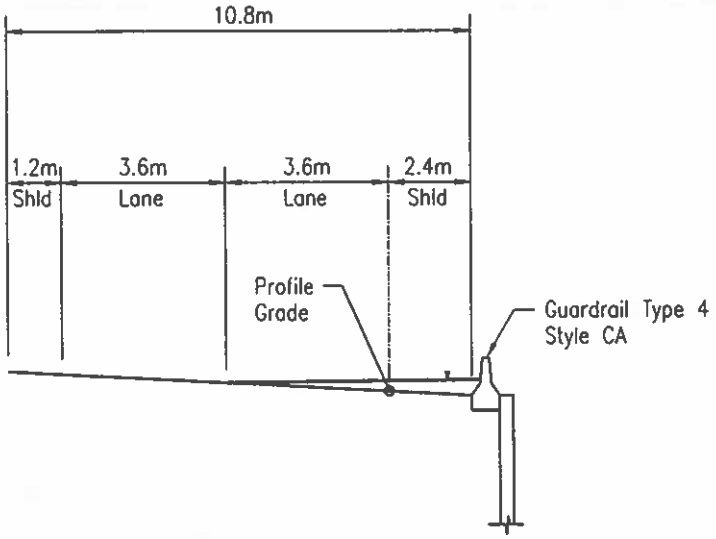
Figure	B3
Page	N/A
Date	4-4-97

DMJM

2 LANE RAMP DRAINAGE ASSUMPTIONS FOR LOCATIONS WITH CONCRETE GUARDRAIL



2 LANE RAMP FOR INITIAL STORM
(MAX. ENCROACHMENT 1.2 M ONTO LANE)



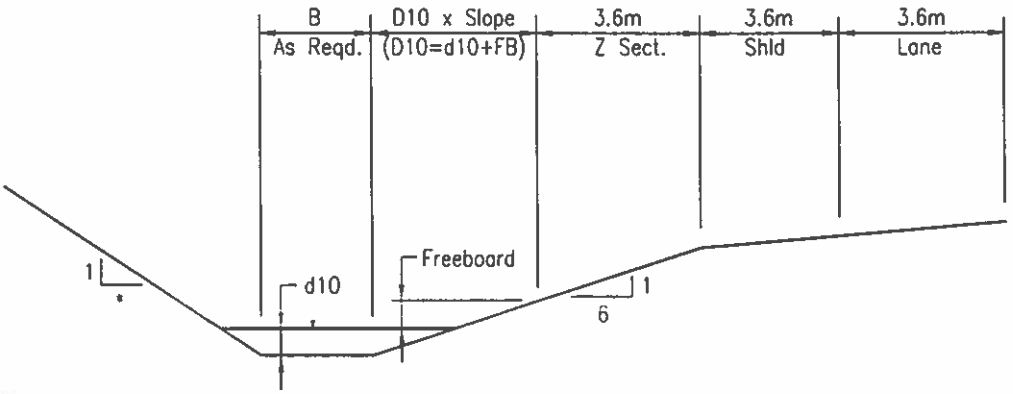
2 LANE RAMP FOR MAJOR STORM
(MAX. ENCROACHMENT ONTO ONE LANE)

NO SCALE

Figure	B4
Page	N/A
Date	4-4-97

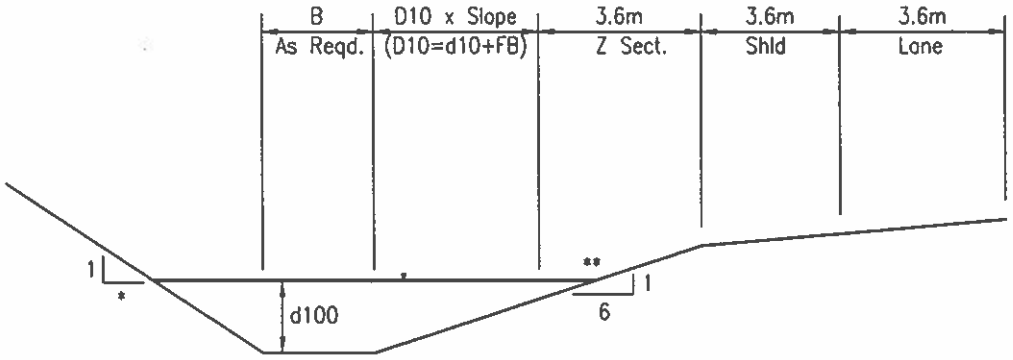
DMJM

I-25 MAINLINE DRAINAGE ASSUMPTIONS FOR LOCATIONS WITH ROADSIDE DITCH



* per project table of values

MAINLINE FOR INITIAL STORM



* per project table of values

MAINLINE FOR MAJOR STORM

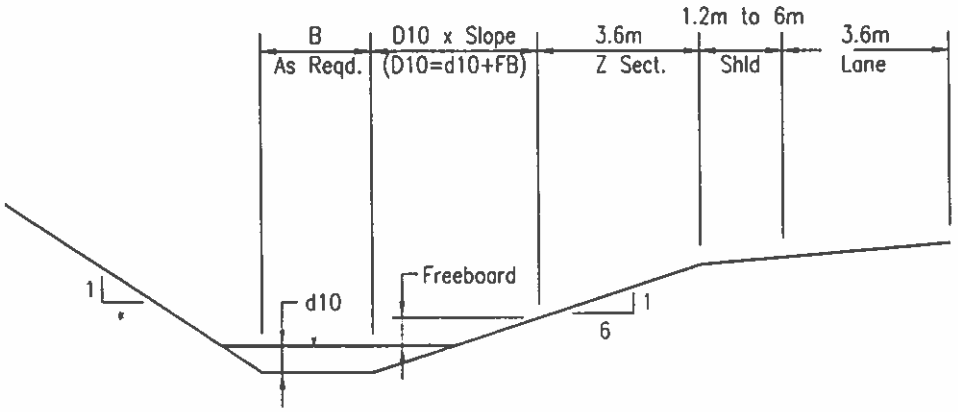
(** AVOID ENCROACHMENT INTO PVMT OR BASE)

Figure	B5
Page	N/A
Date	4-4-97

DMJM

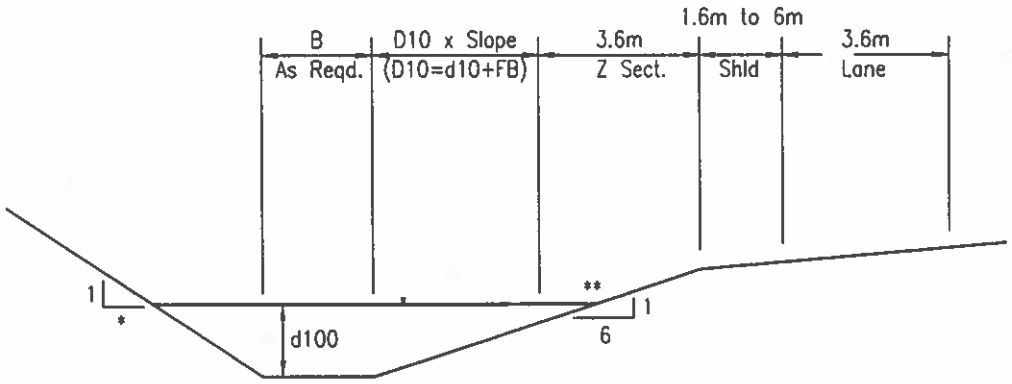
NO SCALE

RAMP DRAINAGE ASSUMPTIONS FOR LOCATIONS WITH ROADSIDE DITCH



* per project table of values

RAMP FOR INITIAL STORM



* per project table of values

RAMP FOR MAJOR STORM
(** AVOID ENCROACHMENT INTO PVMT OR BASE)

NO SCALE

Figure	B6
Page	N/A
Date	4-4-97

DMJM

"PRELIMINARY AND FINAL DRAINAGE REPORT AND PLAN FOR WORLD ARENA SUBDIVISION FILING NO. 1", OBERING, WURTH, & ASSOC., AUGUST, 1994.

"CHEYENNE MOUNTAIN CENTER MASTER DRAINAGE REPORT AND FILING NO. 1", DREXEL BARRELL, NOVEMBER, 1985.

"ENGINEERING STUDY OF SOUTHWEST AREA DRAINAGE BASIN (CHEYENNE CREEK, CHEYENNE RUN, AND SPRING RUN)", LINCOLN DEVORE, FEBRUARY, 1984.

"STRATTON BASIN OUTFALL STORM SEWER, AS BUILT COPY", DREXEL BARRELL, NOVEMBER, 1994.

"DESIGN ANALYSIS OF BOX CULVERT AT I-25 STATION 432+30", LEIGH WHITEHEAD & ASSOCIATES, MAY 6 1988.

"PRELIMINARY DRAINAGE STUDY, U.S. HIGHWAY 85/87 (VENETUCCI BOULEVARD) AND STATE HIGHWAY 29 (LAKE AVENUE)", DREXEL BARRELL, MARCH, 1995.

"DRAINAGE CONDITIONS AT AND RECOMMENDED MODIFICATIONS TO THE HARRISON OUTFALL", DREXEL BARRELL, FEBRUARY, 1997.

U.S. HIGHWAY 85/87 (VENETUCCI BOULEVARD), FINAL REVIEW SET, STORM SEWER PACKAGE", DREXEL BARRELL, MARCH, 1997

DRAINAGE - HYDROLOGY

I-25 MAINLINE DESIGN STORMS

I-25 CROSS CULVERTS WILL BE DESIGNED FOR THE 100 YEAR STORM — CDOT DRAINAGE DESIGN MANUAL

I-25 PARALLEL STORM SEWER - INITIAL STORM IS THE 5 YEAR STORM WITH A MAXIMUM ALLOWABLE SPREAD TO THE EDGE OF SHOULDER.

I-25 PARALLEL STORM SEWER - MAJOR STORM IS THE 100 YEAR STORM WITH A MAXIMUM ALLOWABLE SPREAD OF 1.4 M (4') ONTO ANY TRAVEL LANE.

I-25 PERMANENT INFIELD SWALES WILL BE DESIGNED FOR THE 10 YEAR STORM. — CDOT DRAINAGE DESIGN MANUAL

I-25 DRAINAGE CHANNELS, NORTHWEST AND SOUTHWEST OF THE CIRCLE/LAKE INTERCHANGE WILL BE DESIGNED FOR THE 100 YEAR STORM. — CCS DRAINAGE CRITERIA MANUAL

CIRCLE/LAKE DESIGN STORMS

CIRCLE/LAKE CROSS CULVERTS WILL BE DESIGNED FOR THE 100 YEAR STORM — CCS DRAINAGE CRITERIA MANUAL

CIRCLE/LAKE PARALLEL STORM SEWER - INITIAL STORM IS THE 5 YEAR STORM WITH A MAXIMUM DEPTH OF 152 MM (6") @ FLOWLINE UP TO A MAXIMUM OF 0.96 CMS (34 CFS) PER SIDE. THE 100 YEAR FLOOD WILL BE CHECKED FOR AREAS OF FLOODING.

COLORADO SPRINGS TIME INTENSITY FREQUENCY CURVES

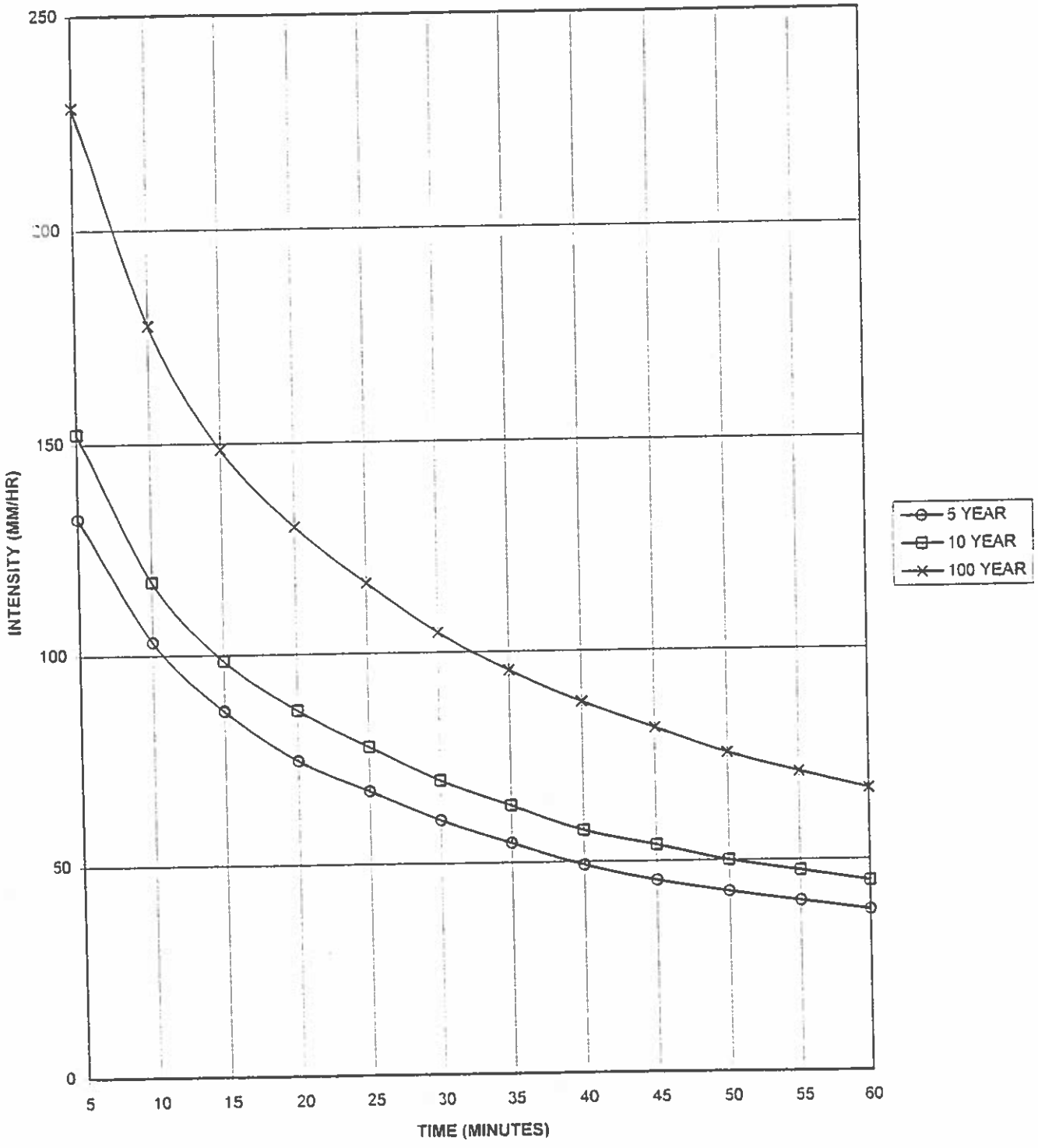


FIGURE 8

Table 8-2

UNIFORM FLOW

Values of Roughness Coefficient n (Uniform Flow)

Type Of Channel and Description	Minimum	Normal	Maximum
EXCAVATED OR DREDGED			
a. Earth, straight and uniform	0.016	0.018	0.020
1. Clean, recently completed	0.018	0.022	0.025
2. Clean, after weathering	0.022	0.025	0.030
3. Gravel, uniform section	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense Weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom, rubble sides	0.025	0.030	0.035
5. Stony bottom, weedy sides	0.025	0.035	0.045
6. Cobble bottom, clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
NATURAL STREAMS			
1. Minor streams (top width at flood stage < 100 ft)			
a. Streams on Plain			
1. Clean, straight, full stage,	0.025	0.030	0.033

Table 8-2 (CONTINUED)

UNIFORM FLOW

Values of Roughness Coefficient n (Uniform Flow)

Type Of Channel and Description	Minimum	Normal	Maximum
no rifts or deep pools			
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools	0.033	0.040	0.045
4. Same as above, but some weeds and some stones	0.035	0.045	0.050
5. Same as above, lower stages more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with	0.040	0.050	0.070
2. Flood Plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated area			
1. No crop	0.020	0.030	0.040

Table 8-2 (CONTINUED)

UNIFORM FLOW

Values of Roughness Coefficient n (Uniform Flow)

Type Of Channel and Description	Minimum	Normal	Maximum
2. Mature crops	0.025	0.035	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in summer	0.040	0.060	0.080
3. Medium to dense brush, in summer	0.050	0.090	0.160
d. Trees			
1. Dense Willows, summer, straight	1.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
3. Major Streams (top width at flood stage > 100 ft). The n value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	.....	0.060
b. Irregular and rough section	0.035	.....	0.100

GENERALLY, THE VELOCITY SHOULD BE WITHIN THE FOLLOWING LIMITS FOR NATURAL OR GRASS LINED CHANNELS: — PROJECT SPECIFIC

V > 0.6 MPS WHERE POSSIBLE
V < 0.9 MPS FOR BARE ERODIBLE SOILS
V < 1.5 MPS FOR BARE NON-ERODIBLE SOILS
V < 1.5 MPS FOR VEGETATED ERODIBLE SOILS
V < 2.1 MPS FOR VEGETATED NON-ERODIBLE SOILS

ADDITIONAL DETAILED INFORMATION IS AVAILABLE FOR THIS, IF NECESSARY. THE FROUDE NUMBER SHOULD ALSO BE CALCULATED FOR EACH CASE, AS FOLLOWS: — CCS DRAINAGE CRITERIA MANUAL

$$F_r = \frac{V}{(g\,d)^{0.5}}$$

WHERE: Fr = FROUDE NUMBER
g = ACCELERATION DUE TO GRAVITY (9.8 MPS^2)
d = NORMAL DEPTH IN METERS

IT SHOULD BE NOTED THAT THE FOLLOWING GUIDELINES SHOULD BE USED WHERE POSSIBLE WHEN CHECKING THE FROUDE NUMBER: — PROJECT SPECIFIC

$F_r = 1$	CRITICAL DEPTH
$F_r < 1$	SUBCRITICAL FLOW
$F_r > 1$	SUPERCRITICAL FLOW
$F_r < 0.9$ OR $F_r > 1.1$	DESIRABLE RANGE OF FROUDE NUMBERS SINCE THE FLOW IS GENERALLY UNSTABLE NEAR CRITICAL DEPTH.

CRITERIA FOR ELEMENTS OF CHANNEL PROTECTION WILL BE DEVELOPED IN MORE DETAIL BEFORE FOR.

DRAINAGE - CROSS CULVERTS

FOR PURPOSES OF CONCEPT DESIGN, THE CROSS CULVERTS WILL BE ASSUMED TO BE REINFORCED CONCRETE PIPE (RCP) OR REINFORCED CONCRETE BOX CULVERTS (CBC). THE DESIRABILITY OF USING ALTERNATIVE CULVERT MATERIALS WILL BE DISCUSSED FURTHER WITH CDOT PRIOR TO DEVELOPING THE FOR PLANS. FOR CONCEPT DESIGN, USE A MANNING'S n VALUE OF 0.013 FOR RCP'S AND 0.012 FOR CBC'S. — PROJECT SPECIFIC

CROSS CULVERTS WILL BE INITIALLY SIZED BASED ON THE "HYDRAULIC DESIGN OF HIGHWAY CULVERTS" BY FHWA. — CDOT DRAINAGE DESIGN MANUAL

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

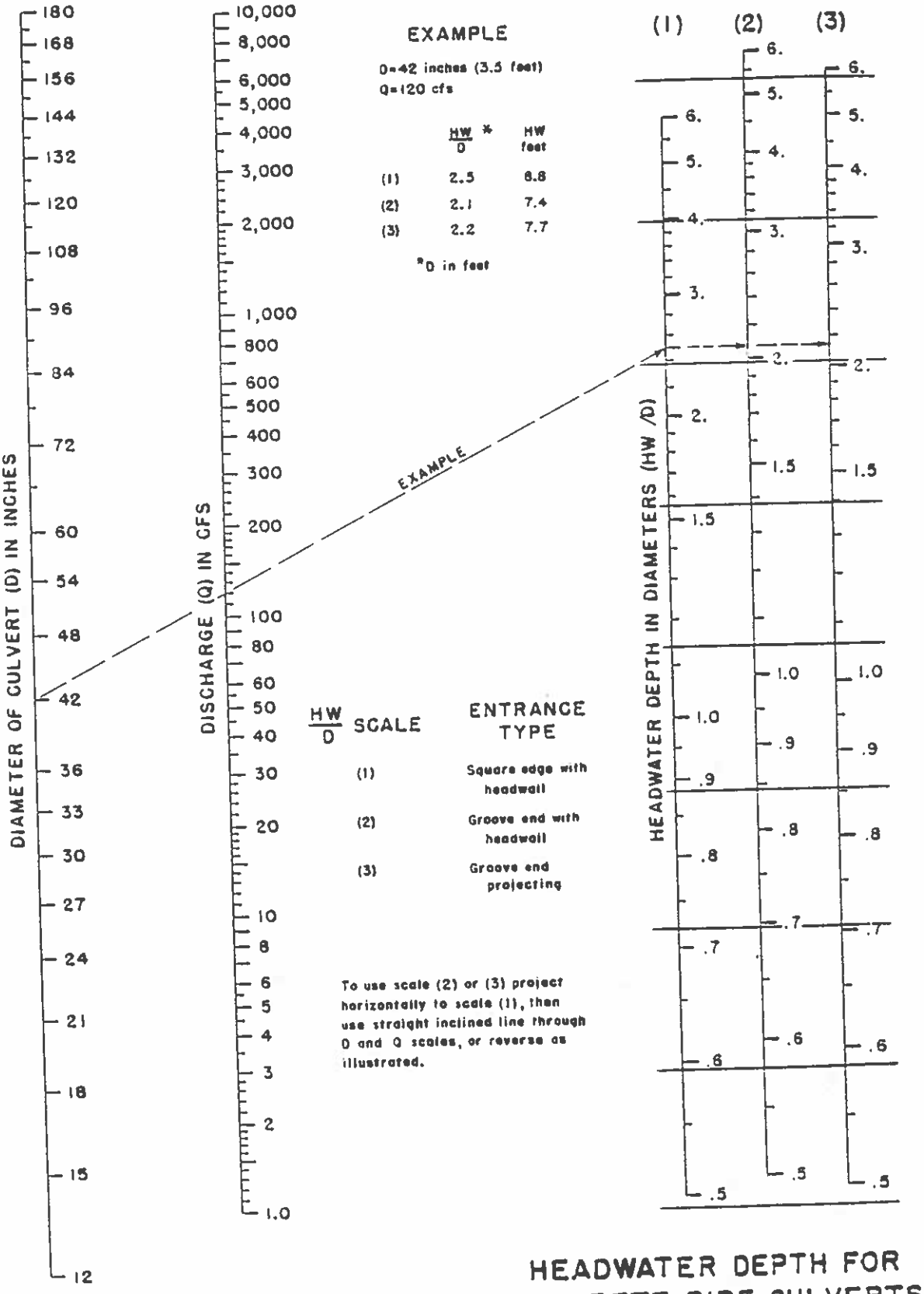
Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

CHART 1

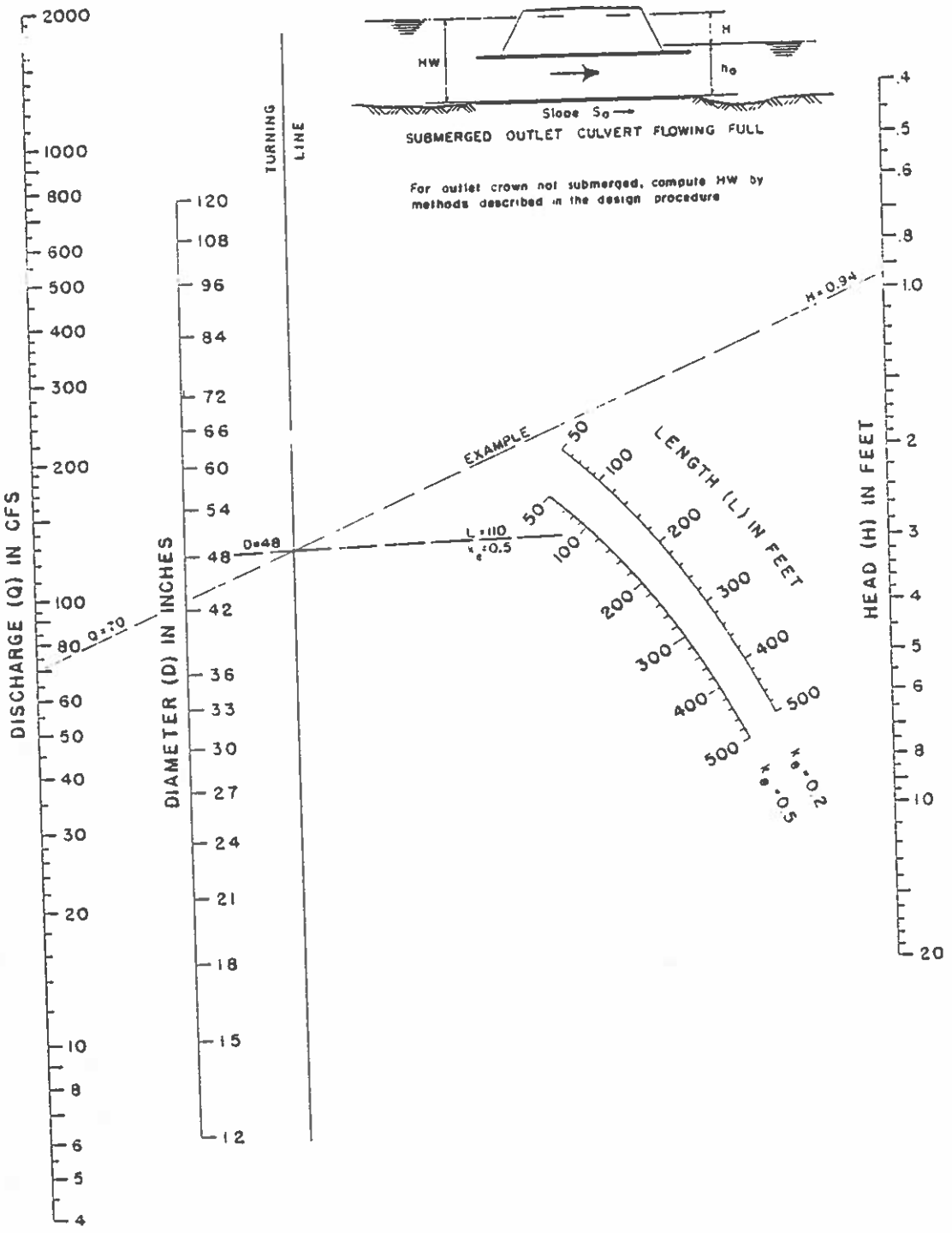


HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

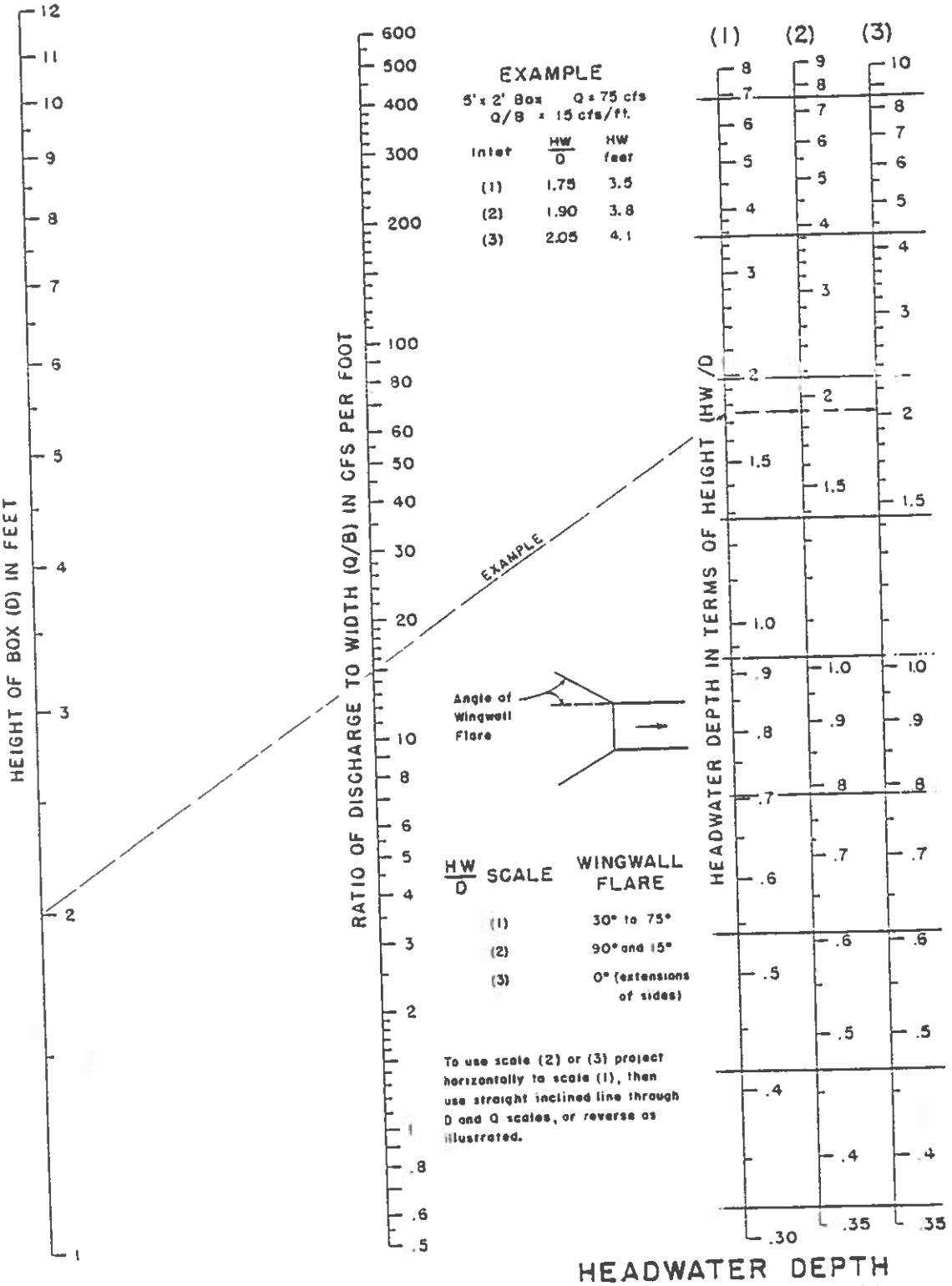
CHART 5



HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963

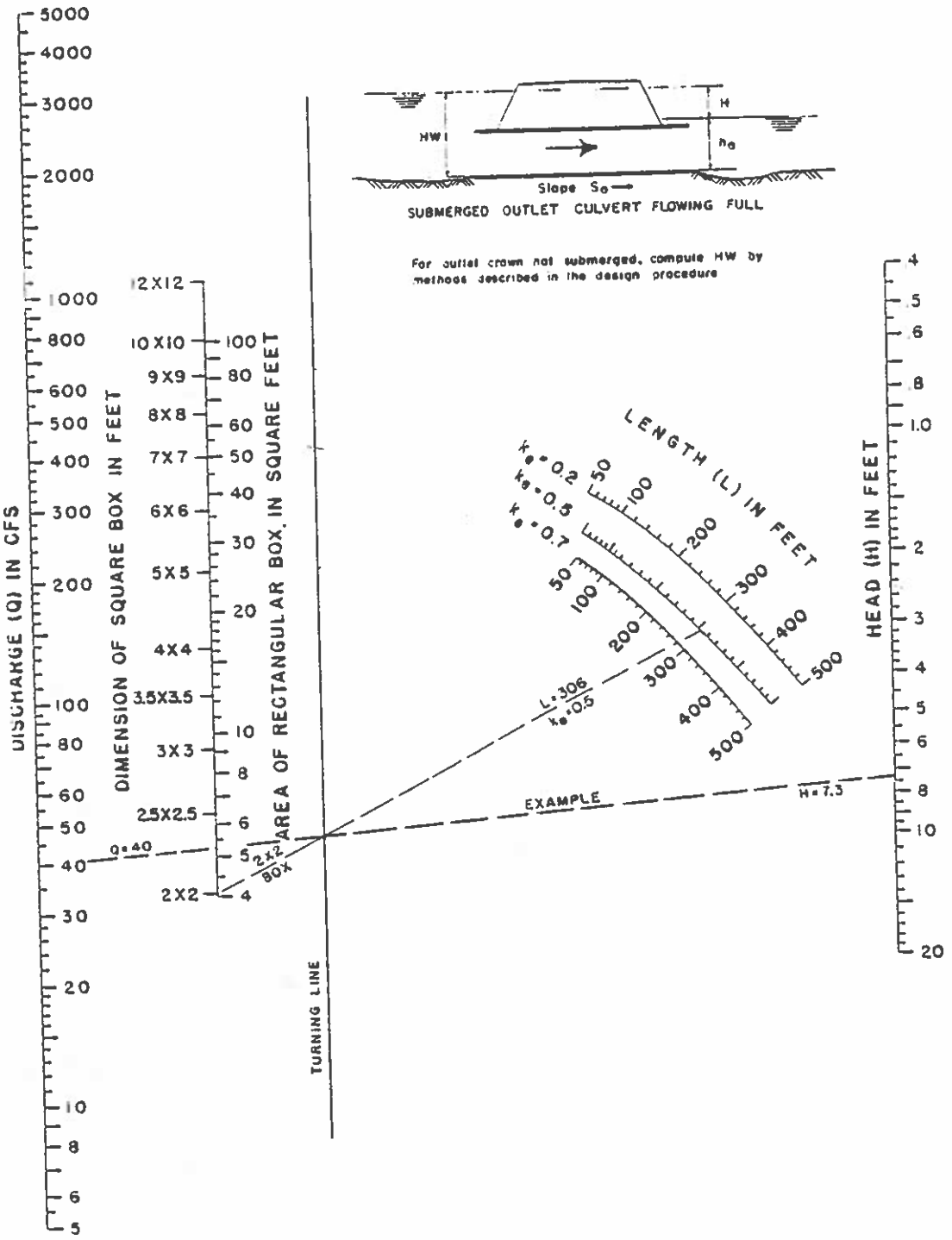
CHART 8



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

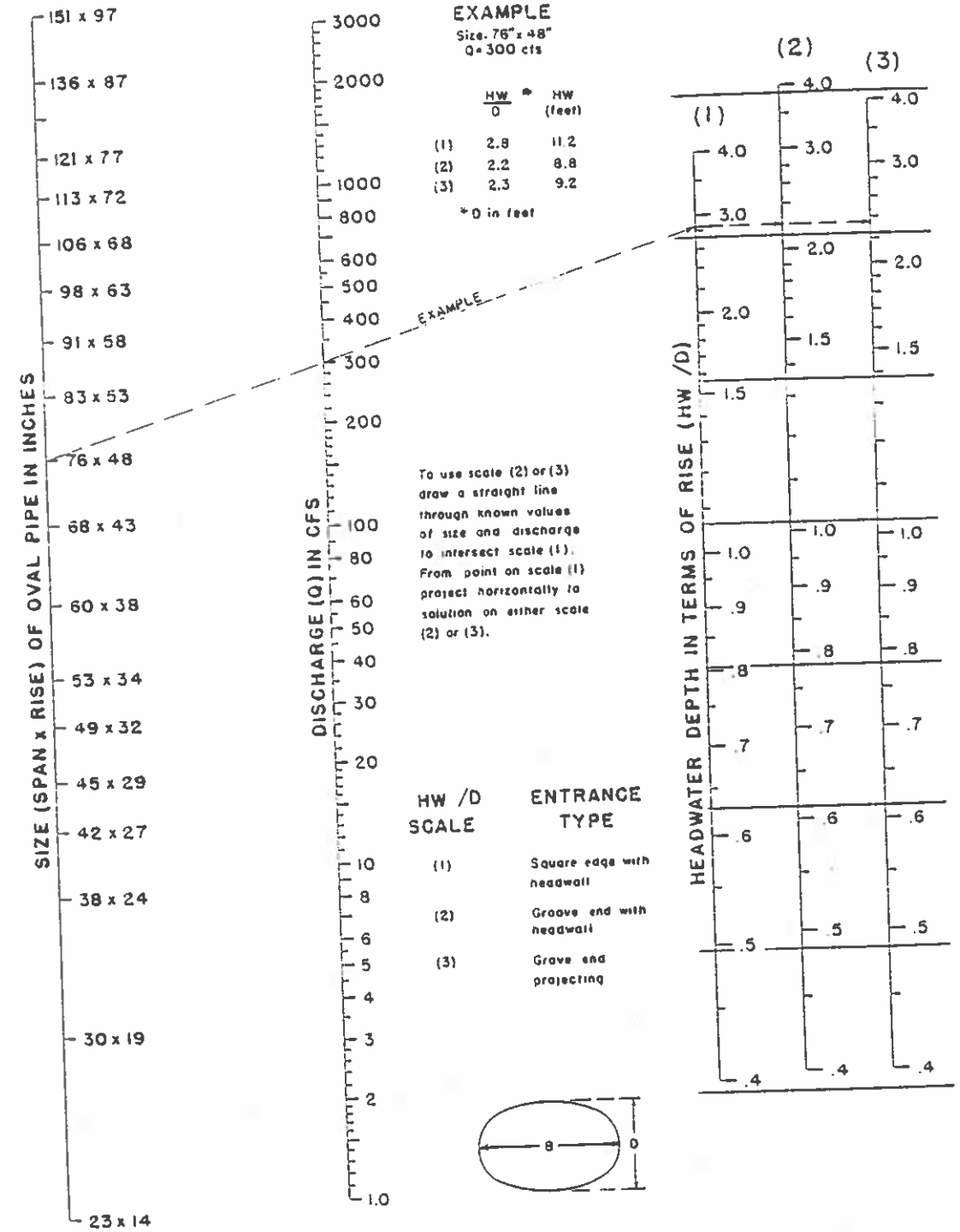
CHART 15



HEAD FOR
CONCRETE BOX CULVERTS
FLOWING FULL
n = 0.012

AU OF PUBLIC ROADS JAN. 1963

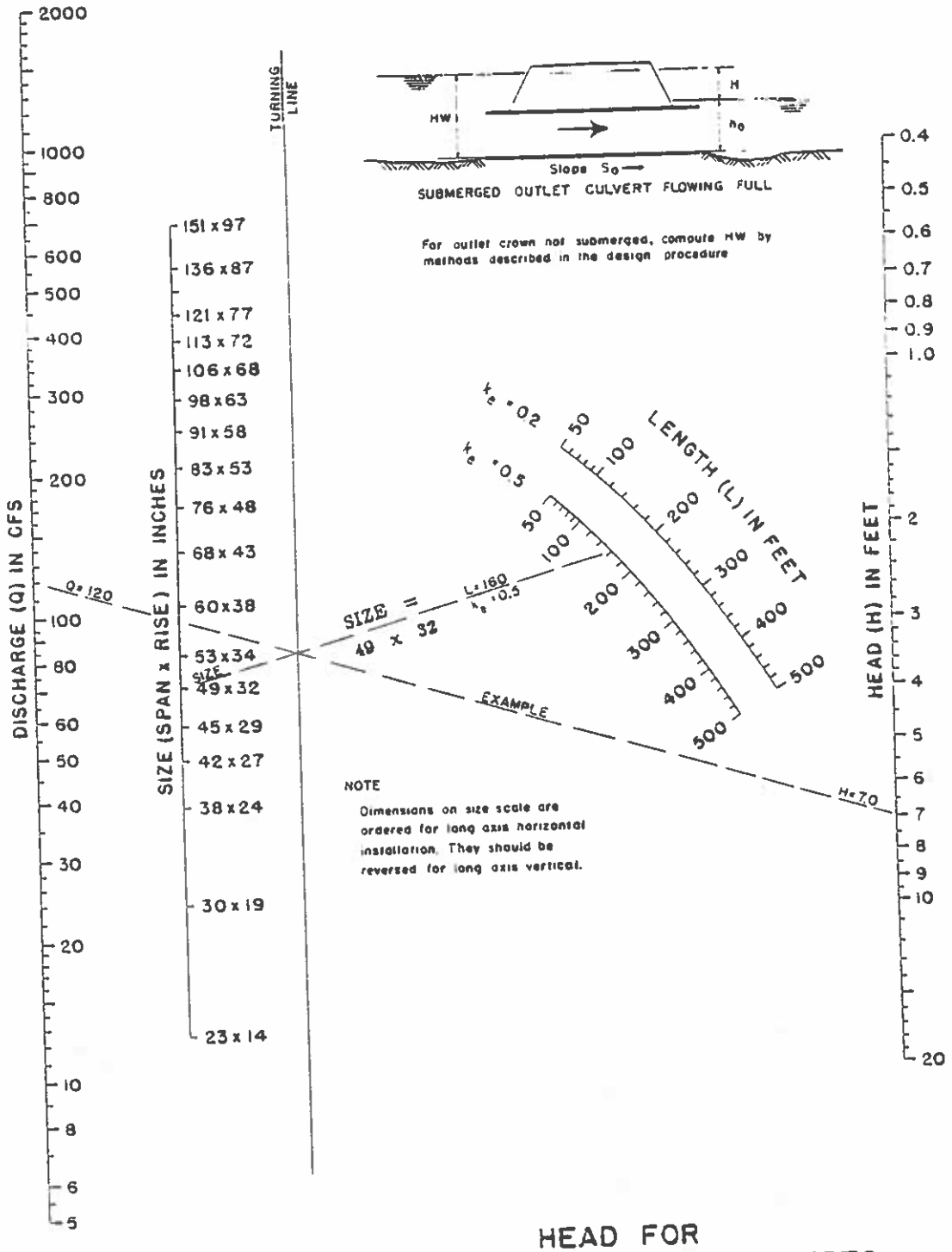
CHART 29



HEADWATER DEPTH FOR OVAL CONCRETE PIPE CULVERTS LONG AXIS HORIZONTAL WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

CHART 33



HEAD FOR OVAL CONCRETE PIPE CULVERTS LONG AXIS HORIZONTAL OR VERTICAL FLOWING FULL n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963

RAMP DESIGN STORMS

RAMP CROSS CULVERTS WILL BE DESIGNED FOR THE 100 YEAR STORM — CDOT DRAINAGE DESIGN MANUAL

RAMP PARALLEL STORM SEWER - INITIAL STORM IS THE 5 YEAR STORM WITH A MAXIMUM ALLOWABLE SPREAD OF 1.2 M ONTO ONE TRAVEL LANE FOR MULTI-LANE RAMPS.

RAMP PARALLEL STORM SEWER - MAJOR STORM IS THE 100 YEAR STORM WITH A MAXIMUM ALLOWABLE SPREAD OF 3.6 M (ONE TRAVEL LANE) FOR MULTI-LANE RAMPS.

RAMP PERMANENT ROADSIDE DITCHES WILL BE DESIGNED FOR THE 10 YEAR STORM. THE EXCEPTION TO THIS IS FOR THE CHANNEL ON THE NORTHWEST SIDE OF THE CIRCLE/LAKE INTERCHANGE WHICH WILL BE DESIGNED FOR THE 100 YEAR STORM. — CDOT DRAINAGE DESIGN MANUAL; CCS DRAINAGE CRITERIA MANUAL

RAMP PERMANENT ROADSIDE DITCHES WILL BE CHECKED FOR THE 100 YEAR STORM TO ENSURE THAT THE WATER LEVEL IS BELOW THE PAVEMENT OR BASE.

HYDROLOGIC METHODS

THE OFFSITE DRAINAGE ANALYSIS WILL BE DEVELOPED USING THE PREVIOUS DRAINAGE STUDIES IN THE AREA. — PROJECT SPECIFIC; CCS DRAINAGE CRITERIA MANUAL

THE ONSITE DRAINAGE ANALYSIS WILL BE DEVELOPED FROM PROJECT TOPOGRAPHY AND PREVIOUS DRAINAGE STUDIES IN THE AREA. THE METHOD USED WILL BE THE RATIONAL METHOD WHICH IS AS FOLLOWS FOR SI UNITS: — CDOT DRAINAGE DESIGN MANUAL

$$Q = 0.278\ C\ i\ A$$

WHERE: Q = THE RUNOFF IN CUBIC METERS PER SECOND (CMS)
C = RUNOFF COEFFICIENT OF THE AREA
i = THE AVERAGE RAINFALL INTENSITY IN MM/HR
A = THE AREA IN SQUARE KILOMETERS

VALUES FOR C AND i ARE PROVIDED FROM CDOT AND THE CITY, RESPECTIVELY.

THE INTENSITIES ARE BASED ON THE TIME OF CONCENTRATION FOR A BASIN. THIS IS CALCULATED BASED ON THE FOLLOWING: — CDOT DRAINAGE DESIGN MANUAL

$$T_c = T_i + T_t$$

WHERE: T_c = TIME OF CONCENTRATION IN MINUTES
T_i = OVERLAND FLOW TIME IN MINUTES

T_t = TRAVEL TIME IN MINUTES

$$T_t = \frac{1.8\,(1.1-C)\,D^{1.5}}{S^{0.33}}$$

WHERE: C = RUNOFF COEFFICIENT FROM THE RATIONAL METHOD
D = DISTANCE OF FLOW PATH IN FEET
(152 M MAX. NON-URBAN AREAS)
(91 M MAX. URBAN AREAS)
S = AVERAGE SLOPE OF BASIN IN %

TIME OF CONCENTRATION WAS ALSO BASED ON THE FOLLOWING:
THIS FORMULA WAS USED AS A CHECK FOR LARGER BASINS.

$$Tc=[(11.9L^3)/H]^{.385}$$

WHERE: T_c = TIME OF CONCENTRATION IN HOURS
L=LENGTH OF LONGEST WATERCOURSE IN MILES
H=ELEVATION DIFFERENCE IN FEET

VARIOUS METHODS ARE AVAILABLE TO ESTIMATE THE TRAVEL TIME BASED ON AVERAGE VELOCITIES OR EMPIRICAL FORMULAS.

DRAINAGE - CHANNELS

DESIGN OF CHANNELS AND ROADSIDE DITCHES WILL BE DONE USING MANNING'S EQUATION. IN SIMPLE CASES THIS WILL BE DONE ASSUMING UNIFORM FLOW AND DIRECT APPLICATION OF THE MANNING EQUATION TO DETERMINE THE NORMAL DEPTH. THIS IS AS FOLLOWS:

CDOT DRAINAGE DESIGN MANUAL

$$Q = (1/n)\,A\,R^{2/3}\,S^{1/2}$$

WHERE: Q = DISCHARGE IN CUBIC METERS PER SECOND (CMS)
n = MANNING'S ROUGHNESS COEFFICIENT
A = CROSS SECTIONAL AREA IN SQUARE METERS
R = HYDRAULIC RADIUS IN METERS
S = CHANNEL SLOPE IN M/M

VALUES OF MANNING'S ROUGHNESS COEFFICIENT ARE AVAILABLE IN THE CDOT MANUAL. THE INITIAL ANALYSIS SHOULD INCLUDE A CHECK OF THE FOLLOWING PARAMETERS:

CDOT DRAINAGE DESIGN MANUAL

$$V = Q / A$$

WHERE: V = AVERAGE VELOCITY IN METERS PER SECOND (MPS)

where:

T_c = time of concentration, in minutes, at the first design point

L = basin length in feet

A minimum T_c is to be 5 minutes in urban areas and 10 minutes in rural areas.

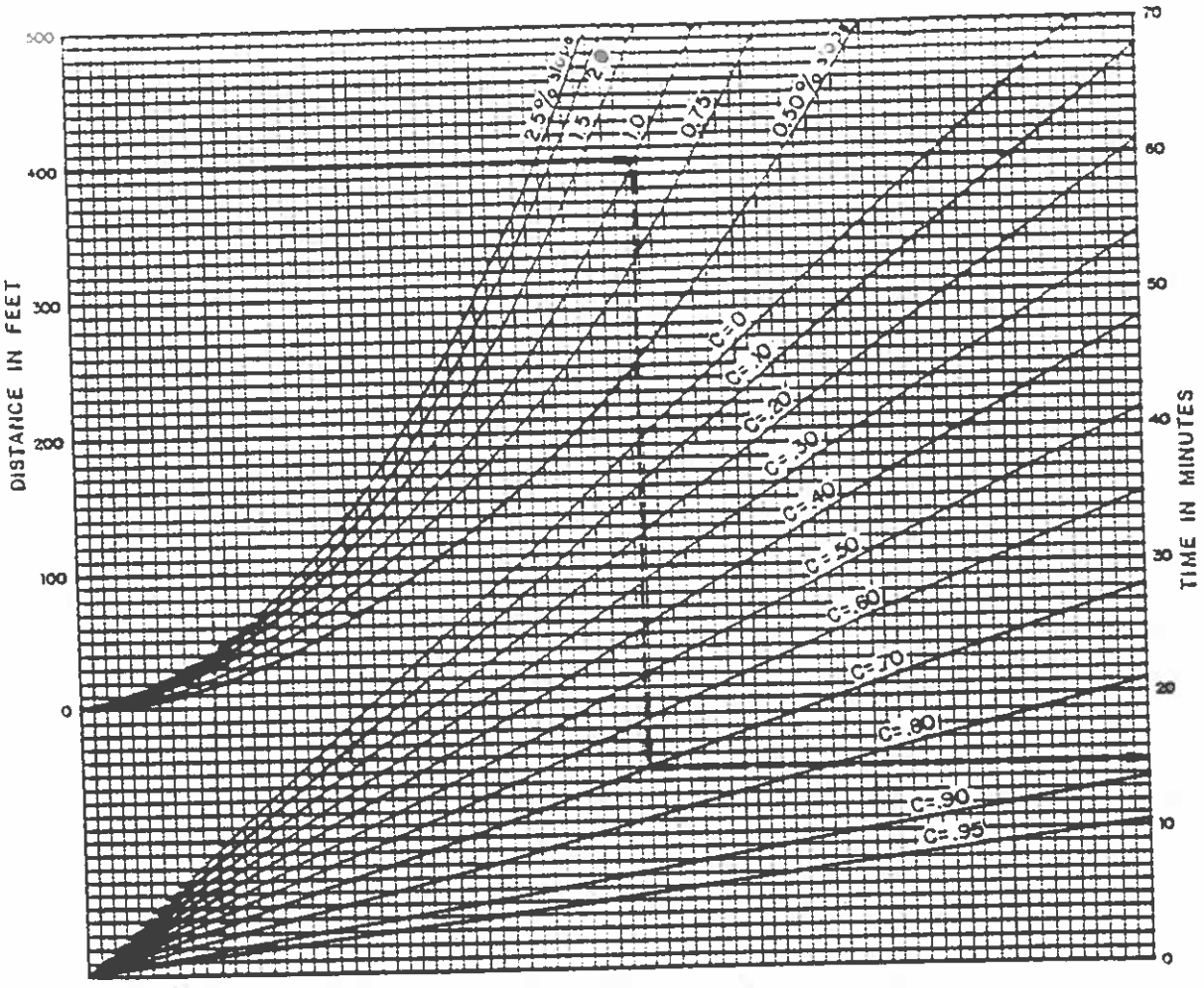


Figure 7-1 Time of Concentration for Overland Flow

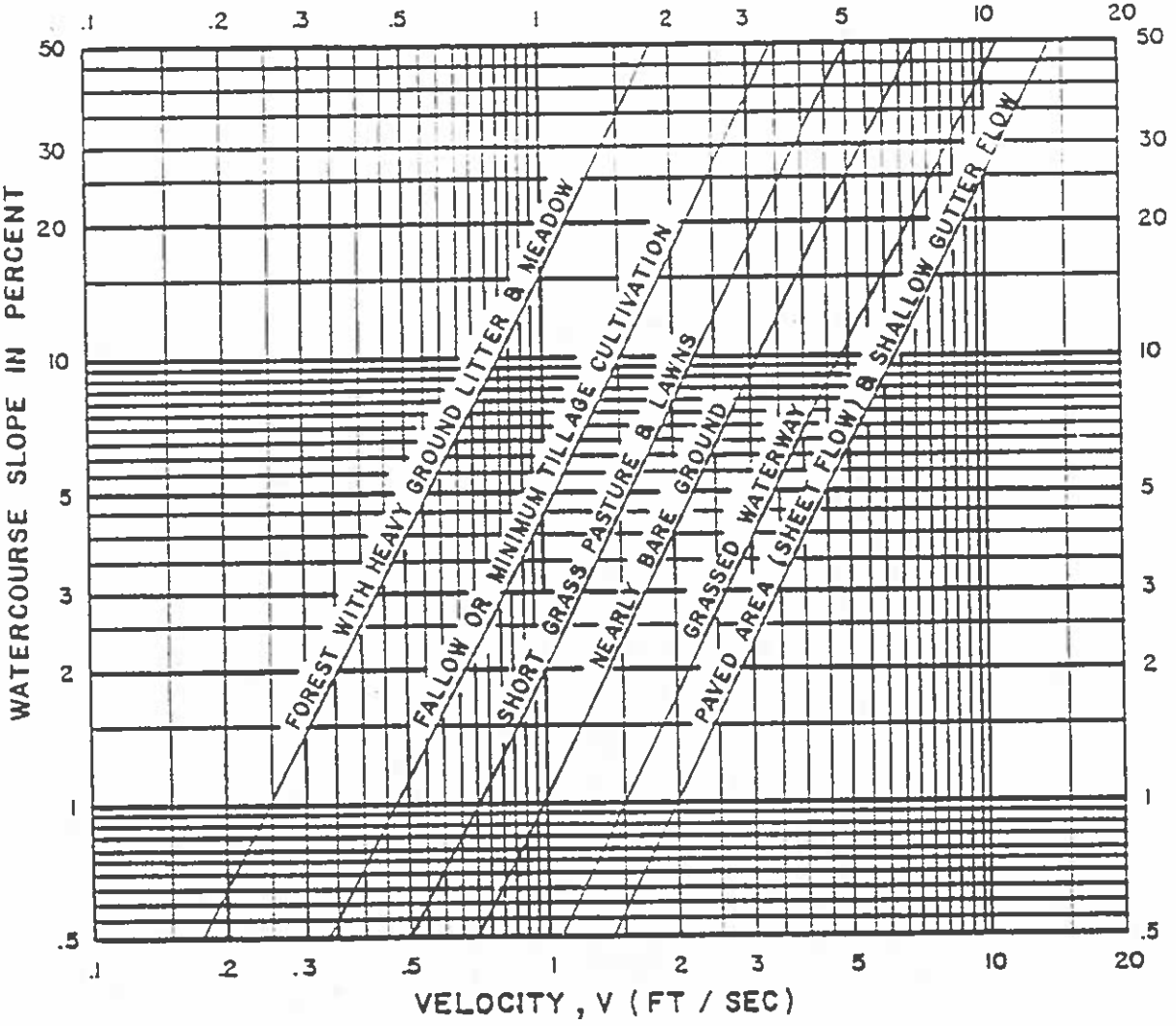


Figure 7-2 Velocities for Estimation of Time of Concentration

Table 7.4 Recommended Runoff Coefficients and Percent Impervious

Land Use or Surface Characteristics	Percent Impervious	Frequency			
		2	5	10	100
Business:					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	70	.60	.65	.70	.80
Residential:					
Single-Family		.40	.45	.50	.60
Multi-Unit (detached)	50	.45	.50	.60	.70
Multi-Unit (attached)	70	.60	.65	.70	.80
½ Acre Lot or Larger		.30	.35	.40	.60
Apartments	70	.65	.70	.70	.80
Industrial:					
Light Areas	80	.71	.72	.76	.82
Heavy Areas	90	.80	.80	.85	.90
Parks, Cemeteries:	7	.10	.10	.35	.60
Playgrounds:	13	.15	.25	.35	.65
Schools:	50	.45	.50	.60	.70
Railroad Yard Areas:	40	.40	.45	.50	.60
Undeveloped Areas:					
Historic Flow Analysis, Greenbelt, Agricultural:	2	See	Lawns		
Offsite Flow Analysis: (when land use not defined)	45	.43	.47	.55	.65
Streets:					
Paved	100	.87	.88	.90	.93
Gravel	13	.15	.25	.35	.65
Drive and Walks:	96	.87	.87	.88	.89
Roofs:	90	.80	.85	.90	.90
Lawns, Sandy Soil:	0	.00	.01	.05	.20
Lawns, Clayey Soil:	0	.05	.10	.20	.40

Note: These Rational Formula coefficients may not be valid for large basins.

Source: Urban Storm Drainage Criteria Manual (UDFCD, 1969).

STATE OF COLORADO
GENERAL PERMIT APPLICATION

STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY

This application is for use by all stormwater dischargers engaged in construction activities. Construction activities include clearing, grading and excavation activities. Construction does not include routine maintenance performed by public agencies, or their agents to maintain original line and grade, hydraulic capacity, or original purpose of the facility.

Application Due Dates: At least **ten days** prior to the anticipated date of discharge, or by **October 1, 1992**, whichever is later, the owner or operator of the construction activity shall submit an application as provided by the Water Quality Control Division (the "Division").

Application Completeness: All items of the application must be completed accurately and in their entirety or the application will be deemed incomplete, and processing of the permit will not begin until all information is received. If an item does not apply to you, enter "NA", for "Not Applicable", to show that you considered the question. Each application shall be submitted by certified mail or hand delivered, only to:

Colorado Department of Health
Water Quality Control Division
WQCD-PE-B2
4300 Cherry Creek Drive South
Denver, Colorado 80222-1530
Attention: Permits and Enforcement Section

If you have questions on completing this application, you may contact the Section at (303) 692-3590.

INSTRUCTIONS

Item 1 - Provide the name and address of the permit applicant, including the company name, local contact, and mailing address. Indicate whether the applicant is the owner, developer or contractor of the construction site, and the status as a private, federal, state, county or other public entity. Include the applicant taxpayer identification number (nine digits). Public entities should use their employer identificaion number. This number will be used as an identifier for billing purposes.

Item 2 - Provide the location of the approximate center point of the construction site. Both types of descriptions (legal in terms of Township, Range, section and ¼ section; and longitude/latitude, to the nearest 15 seconds) must be included. If this is a part of a larger common plan of development or sale, include the name of the project.

Item 3 - Briefly describe the nature of the construction activities. Include such things as what is being constructed, the ultimate land use, construction methods, or other factors which might affect stormwater quality.

em 4 - Provide the current estimated start and completion dates for the construction project.

em 5 - Provide the total area of the construction site and the area that will undergo disturbance.

em 6 - Identify the receiving water. Receiving waters are any waters of the state of Colorado. These include any and all surface waters that are contained in or flow in or through the state of Colorado (except for water withdrawn for use until use and treatment have been completed). This definition includes all water courses, even if they are usually dry.

If stormwater from the construction site enters a storm sewer system, please identify that system and indicate the ultimate receiving water for the storm sewer. **Note:** a stormwater discharge permit does not allow a discharge into the a municipal storm sewer system without the approval of the operator of that system.

em 7 - Indicate any other environmental permits, such as city or county grading or erosion control permits or dredge and fill (COE 404) permits, that are held for this construction site.

If you currently have a discharge permit from the Division for the discharge of process water (such as construction dewatering), include the number here.

em 8 - The certification of completion of a Stormwater Management Plan must be signed by the applicant. Appendix A contains the requirements for the Stormwater Management Plan (as listed in the general permit).

em 9 - <u>In all cases</u>, the application shall be signed as follows:

a) In the case of corporations, by a principal executive officer of at least the level of vice-president or his or her duly authorized representative, if such representative is responsible for the over-all operation of the facility from which the discharge described in the application originates.

b) In the case of a partnership, by a general partner.

c) In the case of a sole proprietorship, by the proprietor.

d) In the case of a municipal, state, or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

GENERAL PERMIT APPLICATION

STORMWATER DISCHARGES ASSOCIATED WITH:

CONSTRUCTION ACTIVITY

(Permit No. COR-030000)

FOR AGENCY USE ONLY									
Certification Number									
C	O	R	-	0	3				

Date Received	Fee Category
Year Month Day	

Please print or type. All items must be completed accurately and in their entirety or the application will be deemed incomplete and processing of the permit will not begin until all information is received. Please refer to the instructions for information about the required items. An original signature of the applicant is **required.**

1. **Name and address of the permit applicant:**

Name _____

Mailing Address _____

City, State and Zip Code _____

Phone Number (____) _____ Taxpayer (or Employer) ID _____

Who is applying? Owner ☐ Developer ☐ Contractor ☐

Entity Type: Private ☐ Federal ☐ State ☐ County ☐ City ☐ Other: _____

Local Contact _____

Title _____ Phone Number _____

2. **Location of the construction site:**

Street Address _____

City, State and Zip Code _____

County _____ Name of plan of development _____

Township, Range, section, 1/4 section _____

Latitude and Longitude _____

3. **Briefly describe the nature of the construction activity:**

_____

_____

_____

_____

4. **Anticipated construction schedule:**

Commencement date: _____ Completion date: _____

5. **Area of the construction site:** Total area _____

Area to undergo excavation or grading: _____

6. **The name of the receiving stream(s). (If discharge is to a ditch or storm sewer, also include the name of the ultimate receiving water):** _____

_____

7. **Other environmental permits held for this construction activity (include permit number):**

_____

_____

_____

8. **Stormwater Management Plan Certification:**

I certify under penalty of law that a complete Stormwater Management Plan, as described in Appendix A of this application, has been prepared for my facility. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the Stormwater Management Plan is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for falsely certifying the completion of said SWMP, including the possibility of fine and imprisonment for knowing violations.

_____

Signature of Applicant Date Signed

_____

Name (printed) Title

9. **Signature of applicant:**

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment.

_____

Signature of Applicant Date Signed

_____

Name (printed) Title

APPENDIX A

CONTENTS OF THE STORMWATER MANAGEMENT PLAN

The SWMP shall be prepared in accordance with good engineering, hydrologic and pollution control practices. (The SWMP need not be prepared by a registered engineer.) The main objective of the plan shall be to identify Best Management Practices (BMPs) which when implemented will meet the terms and conditions of this permit (see Part I.C., below).

The plan shall identify potential sources of pollution (including sediment) which may reasonably be expected to affect the quality of stormwater discharges associated with construction activity from the facility. In addition, the plan shall describe and ensure the implementation of BMPs which will be used to reduce the pollutants in stormwater discharges associated with construction activity. Construction operations must implement the provisions of the SWMP required under this part as a condition of this permit.

The SWMP shall include the following items, at a minimum:

1. Site Description

Each plan shall provide a description of the following:

a) A description of the construction activity.
b) The proposed sequence for major activities.
c) Estimates of the total area of the site, and the area of the site that is expected to undergo clearing, excavation or grading.
d) An estimate of the runoff coefficient of the site before and after construction activities are completed and any existing data describing the soil, soil erosion potential or the quality of any discharge from the site.
e) A description of the existing vegetation at the site and an estimate of the percent vegetative ground cover.
f) The location and description of any other potential pollution sources, such as vehicle fueling, storage of fertilizers or chemicals, etc.
g) The location and description of any anticipated non-stormwater components of the discharge, such as springs and landscape irrigation return flow.
h) The name of the receiving water(s) and the size, type and location of any outfall or, if the discharge is to a municipal separate storm sewer, the name of that system, the location of the storm sewer discharge, and the ultimate receiving water(s).

2. Site Map

Each plan shall provide a generalized site map or maps which indicate:

- construction site boundaries
- all areas of soil disturbance
- areas of cut and fill
- areas used for storage of building materials, soils or wastes
- location of any dedicated asphalt or concrete batch plants
- location of major erosion control facilities or structures
- springs, streams, wetlands and other surface waters
- boundaries of 100-year flood plains, if determined.

3. BMPs for Stormwater Pollution Prevention

The plan shall include a narrative description of appropriate controls and measures that will be implemented before and during construction activities at the facility. The plan shall clearly describe the relationship between the phases of construction and the implementation and maintenance of controls and measures. For

example, which controls will be implemented during each of the following stages of construction: clearing and grubbing necessary for perimeter controls, initiation of perimeter controls, remaining clearing and grubbing, road grading, storm drain installation, final grading, stabilization, and removal of control measures.

The description of controls shall address the following minimum components:

a) Erosion and Sediment Controls.

1) **Structural Practices.** A description of structural site management practices which will minimize erosion and sediment transport. Such practices may include: straw bales, silt fences, earth dikes, drainage swales, sediment traps, subsurface drains, pipe slope drains, inlet protection, outlet protection, gabions, and temporary or permanent sediment basins.

2) Non-Structural Practices. A description of interim and permanent stabilization practices, including site-specific scheduling of the implementation of the practices. Site plans should ensure that existing vegetation is preserved where possible and that disturbed areas are stabilized. Non-structural practices may include: temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, and preservation of mature vegetation.

b) Materials Handling and Spill Prevention.

The SWMP shall identify any procedures or significant materials (see definitions at Part I.D.) handled at the site that could contribute pollutants to runoff. These could include: exposed storage of building materials, fertilizers or chemicals; waste piles; and equipment maintenance or fueling procedures. Areas or procedures where potential spills can occur shall have spill prevention and response procedures identified.

Measures to control stormwater pollution from dedicated concrete batch plants or dedicated asphalt batch plants covered by this certification, must be identified in the SWMP.

4. Final Stabilization and Long-term Stormwater Management

A description of the measures used to achieve final stabilization and measures to control pollutants in stormwater discharges that will occur after construction operations have been completed.

Final stabilization is reached when all soil disturbing activities at the site have been completed, and uniform vegetative cover has been established with a density of at least 70 percent of pre-disturbance levels or equivalent permanent, physical erosion reduction methods has been employed. The Division may, after consultation with the permittee and upon good cause, amend the final stabilization criteria for specific operations.

5. Other Controls

A description of other measures to control pollutants in stormwater discharges including plans for waste disposal and limiting off site soil tracking.

6. Inspection and Maintenance

A description of procedures to inspect and maintain in good and effective operating condition the vegetation, erosion and sediment control measures and other protective measures identified in the SWMP.

DRAINAGE - STORM SEWER

AREAS THAT REQUIRE STORM SEWER WILL BE DESIGNED WITH STORM SEWER DESIGN SOFTWARE. CONCEPTUAL DESIGN WILL ALSO UTILIZE SPREADSHEETS TO HELP ESTIMATE THE LOCATION AND NUMBER OF INLETS, PIPE SIZES AND KEY LOCATIONS.

INLETS

INLETS ARE REQUIRED 3 M BEFORE THE POINT WHERE STREET CROSS SLOPE BEGINS TO SUPERLEVATE TOWARDS THE OPPOSITE SIDE TO PREVENT CROSS STREET FLOW. — CDOT DRAINAGE DESIGN MANUAL

SUMP INLETS REQUIRE FLANKING INLETS ON EACH SIDE OF THE SUMP INLET TO PROVIDE RELIEF FROM DEBRIS CLOGGING. SUMP INLETS ON I-25 SHOULD BE CHECKED TO ENSURE THAT THE 50 YEAR STORM DOES NOT CAUSE PONDING OF WATER OUTSIDE THE SHOULDER. — CDOT DRAINAGE DESIGN MANUAL

FOR SIMPLICITY IN CONCEPTUAL DESIGN, THE FOLLOWING FORMULAS WILL BE USED FOR DETERMINING THE APPROXIMATE INLET LOCATIONS:

THE ROAD CAPACITY IS BASED ON MANNING'S EQUATION WITH THE SIMPLIFYING ASSUMPTION THAT THE WETTED PERIMETER IS EQUAL TO THE WIDTH OF FLOW. ASSUME n=0.016. — HEC-12 FROM FHWA

THE INLETS ON I-25 WILL BE VANE GRATE INLETS ADJACENT TO THE CONCRETE GUARDRAIL. XPRAT STORMSEWER SOFTWARE AND VARIOUS SPREADSHEETS HAVE BEEN PREPARED FOR THE PROJECT TO ESTIMATE INLET LOCATIONS BASED ON HEC-12 AND SEVERAL SIMPLIFYING ASSUMPTIONS.

THE EXACT TYPE OF INLET TO BE USED IT STILL TO BE DETERMINED. FOR DESIGN PURPOSES A TYPE 13 INLET ON I-25 WAS ORIGINALLY USED IN XPRAT. THE PLANS HOWEVER DETAIL A VANE GRATE INLET FOR I-25. — HEC-12 FROM FHWA
WE HAVE COMPARED THE VANE GRATE AND TYPE 13 INLET CHARACTERISTICS WITH MANUAL CALCULATIONS AND HAVE FOUND THAT THE VANE GRATE IS LESS EFFICIENT THAN THE TYPE 13 INLET IN MOST CASES. WE HAVE ALSO COMPARED THE MANUAL CALCULATIONS TO THE XPRAT SOFTWARE AND FOUND THAT XPRAT HAS A SIMILAR OR MORE RESTRICTIVE CLOGGING FACTOR.

XPRAT STORM SEWER SOFTWARE ASSUMPTIONS USED:
TYPE 13 INLET GRATED INLET
ASSUME GRATE IS 570 MM WIDE
ASSUME GRATE IS 997 MM LONG

TYPE R INLETS USED THROUGHOUT THE MAJORITY OF THE PROJECT ALSO HAVE A CLOGGING FACTOR BUILT INTO XPRAT.

THE ROADSIDE INLETS ON CIRCLE/LAKE WILL BE CURB OPENING INLETS IN IN THE 200MM CURB
THE MEDIAN INLETS ON CIRCLE/LAKE WILL BE CURB OPENING INLETS IN THE 150MM CURB