AMENDED MASTER DEVELOPMENT DRAINAGE PLAN

For

PATRIOT PARK

Sand Creek Drainage Basin

(Amending the ***Master Development Drainage Plan for Patriot Park,*** by Nolte Associates, Inc., approved April 2006)

Prepared for:
City of Colorado Springs Subdivision
30 North Nevada Avenue, Suite 702
Colorado Springs, CO 80903

On Behalf of:
Corporate Office Properties Trust
101 North Cascade Ave., Suite 200
Colorado Springs, CO 80903

Prepared by:

Matrix Design Group, Inc.
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September 2007

06.299.001

17253-5

Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

COLORADO REGISTERED SEAL ELLIS DANIEL ELSNER 36217 9-25-07 PROFESSIONAL ENGINEER

Ellis D. Elsner, PE
Registered Professional Engineer
State of Colorado
No. 36217

Developer's Statement:

I, the developer have read and will comply with all of the requirements specified in this drainage report and plan.

Corporate Office Properties Trust
Business Name

By: Gregory B. Sloutz

Title: V.P. ~~ASSET~~ MANAGEMENT

Address: ~~101 N. Crusade Ave., Ste. 200~~ 102 S. Tejon Suite 720
Colorado Springs, CO 80903

City of Colorado Springs:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

For the City Engineer — Date: 10/4/07

Conditions:

The existing stormwater quality pond in the southwest corner of the site will be dedicated to the City of Colorado Springs and platted by separate instrument with the platting of Filing No. 5.

TABLE OF CONTENTS

APPENDIX

I. INTRODUCTION

A. Background

The Patriot Park Concept Plan area is a proposed 81.56± acre commercial subdivision located to the northwest of the intersection of Powers Boulevard and Platte Avenue. Sand Creek lies adjacent to the west and has been studied within the ***Final Drainage Report for Sand Creek Channel Improvements at Platte Avenue***, by Matrix Design Group dated August 2005. These channel improvements are reflected on the maps provided within this report.

The scope of this study is to amend the previous ***Master Development Drainage Plan, Patriot Park, for Patriot Park, LLC***, prepared by Nolte Associates, Inc., dated March 2006. Significant changes include the following: the purchase of additional land located between Sand Creek Channel and the original Patriot Park property line and changes to the drainage patterns of buildings 6 and 7 per the master concept plan for Patriot Park.

In addition to the significant changes from the previous MDDP, the existing conditions per this report differ from the existing conditions per the previous MDDP. First, Space Center Drive is fully built with a drainage system within its right-of-way. This report assumes the road as existing and analyzes the capacity of the roadway and drainage system. Second, a water quality pond exists onsite; however, changes to the pond have occurred since the previously approved MDDP for Patriot Park and this report reflects those changes. Third, Patriot Park Filing No. 1 has been developed and considered existing. Drainage patterns and quantities from this development have been referenced to the ***Final Drainage Report for Patriot Park Subdivision Filing 1***, by Matrix Design Group, Inc., dated July 2005. Finally, Filing 3 for Patriot Park has a drainage system independent of the master drainage system for Patriot Park. The ***Final Drainage Report Patriot Park Filing 3 for "Patriot Park Building #6,"*** prepared by Matrix Design Group, Inc., treats runoff via several onsite porous landscape detention areas and discharge directly into Sand Creek.

B. Project Location

The site area for construction is located in eastern Colorado Springs, Colorado northwest of the intersection of Powers Boulevard and Platte Avenue. See Vicinity Map, Appendix A. .

1. General Location. Southwest ¼ of Section 12 of Township 14 South, Range 66 West of the Sixth Principal Meridian, El Paso County, State of Colorado.

2. Surrounding Streets. Existing Powers Boulevard is east of the site, Galley Road borders the project to the north, and East Platte Avenue borders to the south.

3. Drainageway. The site is located within the Sand Creek Drainage Basin and is bounded by Technology Court, Space Center Drive, Powers Boulevard, Platte Avenue, and Sand Creek. Future phased improvements to Sand Creek will be incrementally made per the ***Final Drainage Report for Sand Creek Channel Improvements at Platte Avenue***, by

Matrix Design Group dated August 2005. Phasing of these improvements is described within this report under Section IV, Part E, Timing of Improvements to the Sand Creek Channel. The entire site drains towards Sand Creek.

4. Surrounding Developments. The following developments are located adjacent to the site.

   North: Galley Road and Science Park Subdivision, Filing 1.
   West: Unplatted land currently developed as a warehouse/storage site and undeveloped, unplatted land.
   South: Unplatted vacant land.
   East: Powers Boulevard lies adjacent to the property.

C. *Property Description*

1. Project Area. Patriot Park encompasses approximately 81.56± acres of land, which excludes the existing developments of Filing 1, Filing 3, Space Center Drive, and the water quality pond. Future developments consist of commercial property.

2. Ground Cover. The site is currently vacant and overlot graded. There are trees and some vegetation that lie adjacent to the Creek, but little to no vegetation exist onsite at this time. The area will be stabilized per the approved Overlot Grading and Erosion Control Plan.

3. General Topography. Drainage patterns in the surrounding area drain toward the channel from the northeast to the southwest. Slopes on the site range from 1%-5%.

4. General Soil Conditions. The *Soil Survey of El Paso County Area, Colorado*, published by the United States Department of Agriculture, dated November 1991, has been utilized to investigate the existing general soil types within and tributary to the area impacting the site. See Soils Map, Appendix A. Review of mapping reveals surrounding soil types consist of the following.

Table 1.1
Soil Conservation Service Soil Survey for El Paso County

Soil ID No.	*Soil*	*Hydrologic Classification*	*Permeability*	*Erosion Hazard*
10	Blendon Sandy Loam	B	Moderately Rapid	Moderate
11	Bresser Sandy Loam	B	Moderate	Slight to Moderate
28	Ellicot Loamy Coarse Sand	A	Rapid	High
95	Truckton Loamy Sand	B	Moderately Rapid	Moderate to High
96	Truckton Sandy Loam	B	Moderately Rapid	Moderate

Soils can be classified in four different hydrologic groups, A, B, C, or D to help predict stormwater runoff rates. Hydrologic group "A" is characterized by deep, well-drained coarse-grained soils with a rapid infiltration rate when thoroughly wet and having a low runoff potential. Group "D" typically has a clay layer at or near to the surface, or a very shallow depth to impervious bedrock and has a very slow infiltration rate and a high runoff potential. Hydrologic group "B" has been assumed across this site.

5. Major Drainageways. Patriot Park lies solely within the Sand Creek Drainage Basin. The property lies adjacent to Sand Creek, where future channel improvements will be made per the ***Final Drainage Report for Sand Creek Channel Improvements at Platte Avenue***, prepared by Matrix Design Group, Inc. in August 2005. Phasing of these improvements is described within this report under Section IV, Part E, Timing of Improvements to the Sand Creek Channel.

6. Irrigation Facilities. No existing irrigation facilities can be found on or around the site.

7. Existing Utilities. Within the Patriot Park area, the Platte Avenue and Space Center Drive right-of-ways provides a utility corridor for the City's infrastructure. The following is a summary of the existing utilities through the site, all maintained by Colorado Springs Utilities:

   Water: An existing 12" DIP main is located within the right-of-way for Space Center Drive.

   Wastewater: An existing 30" DIP is located on the east side of the channel in a north-south alignment and travels within the limits of Patriot Park to Technology Court. Also, an existing 8" DIP is located within the right-of-way for Space Center Drive.

8. Trails. As part of the Sand Creek channel improvements, a proposed 15' wide maintenance trail will also serve as part of a trail system in the future when the properties adjacent to Sand Creek are developed or the trail system is extended through the area. This trail will run along the eastern bank of the channel between East Platte Avenue and Galley Road.

9. Maintenance. Maintenance access for all proposed public drainage systems will be provided within any right-of-way or through means of an easement. Access to the water quality pond will be provided from Space Center Drive and will encircle the embankment of the pond. Per the improvements to the Sand Creek Channel, maintenance access to the bottom of the channel can be achieved via the proposed rough grades provided to allow for a future trail underpass at East Platte Avenue. Along the eastern side of the channel, a proposed 15' wide maintenance trail will be installed. Access will be provided to the trail at the intersection of Space Center Drive and East Platte Avenue. The exact location of the trail will be determined when Development Plans for the adjacent parcels are completed. The trail shall be continuous along the channel and meet the City of Colorado Springs Parks and Recreation Department requirements.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

Patriot Park lies entirely within the Sand Creek Drainage Basin as delineated within the ***Sand Creek Drainage Basin Planning Study Preliminary Drainage Report*** (DBPS), prepared by Kiowa Engineering Corporation, revised March 1996. The City of Colorado Springs has adopted the report to help plan infrastructure improvements and provide hydrologic analysis within the Sand Creek Basin.

Drainage from the development is directed to a stormwater quality pond in the fully developed conditions, which is located within the limits of Patriot Park. Stormwater from the site is treated for water quality within the proposed pond; however, changes have been made to the pond and the size of the water quality capture volume is reduced. These changes are discussed below under section IV, part C of the report.

B. Floodplain Statement

Review of the ***Flood Insurance Rate Map Panel 751 (08041CO751 F) and 753 (08041CO753 F)***, effective date March 17, 1997, published by the Federal Emergency Management Agency (FEMA), shows the Sand Creek Floodway and Floodplain for Sand Creek within the area of the proposed construction. Future improvements to the channel will be permitted through the Regional Floodplain Manager and FEMA if required.

C. Sub-Basin Description

As stated earlier, the purpose of this report is to amend the ***Master Development Drainage Plan for Patriot Park, LLC***, prepared by Nolte Associates, Inc., dated March 2006. One major change was the purchase of property between Patriot Park and the Sand Creek channel. This addition of land increased the drainage area approximately 20.8± acres; of which approximately 11.3 acres is commercial development that will drain south towards the water quality pond and the remaining 9.5 acres consists of graded slopes and drainageway.

Though the drainage patterns for the majority of Patriot Park will remain the same, the Master Development Plan Area for Patriot Park Buildings 6 and 7 has a drainage system independent of what was planned under the previous MDDP. Per the ***Final Drainage Report Patriot Park Filing 3 for "Patriot Park Building #6,"*** prepared by Matrix Design Group, Inc., the development has several porous landscaped detention areas to treat all runoff from Filing 3 and discharges directly into Sand Creek. These drainage patterns will be emulated under the drainage report for Building 7 under a future filing. The lots for Buildings 6 and 7 encompass approximately 11.5 acres of development; in comparison, the additional land acquired along Sand Creek contains approximately 11.3 acres of development.

The portion of Patriot Park adjacent to Sand Creek falls within the regulations of the Streamside Ordinance. As a result, the development plan(s) for all proposed projects adjacent to Sand Creek must identify and incorporate the Streamside Overlay Zone. The preliminary drainage report(s) will address any engineering issues related to the Streamside Overlay Zone once they are identified. For Patriot Park, Sand Creek is a Type-2 Streamside Overlay.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

This report has been prepared in accordance to the criteria set forth in the ***City of Colorado Springs and El Paso County Drainage Criteria Manual***, dated November 1991 and ***Volume 2*** of the City ***Drainage Criteria Manual***, dated November 1, 2002. In addition to the City Criteria Manual, the ***Urban Storm Drainage Criteria Manuals, Volumes 1-3***, published by the Urban Drainage and Flood Control District, latest update, have also been used to supplement the City Criteria Manual. The analysis and proposed improvements have also considered the recommendations as provided within the Sand Creek DBPS.

B. Hydrologic Criteria

Hydrologic analyses of the project have been performed using the Rational Method in accordance with the Criteria Manual for Colorado Springs. The Rational Method is used for basin areas that are less than 100 acres in size to help design localized facilities such as inlets and trunk infrastructure required:

$$Q=C*I*A$$

Where:

Q = Maximum runoff rate in cubic feet per second
C = Runoff coefficient
I = Average rainfall intensity in inches per hour
A = Area of drainage sub-basin in acres

The design storm events are:

- Initial Storm = 5-Year Storm
- Major Storm = 100-Year Storm

Runoff coefficients are based upon field observations of the area for the historic and interim conditions and anticipated development for the future conditions. Type "C" hydrologic soil characteristics have been assumed throughout the area.

C. Hydraulic Criteria

Detailed hydraulic analysis of the proposed channel has been completed for the area slated for channel stabilization improvements. Additional analysis has been completed for the reach upstream of the construction to Galley Road to determine a preliminary design of the channel. When channel improvements are completed for this area, the exact channel alignment, placement of drop structures, and the type of drop structure to be constructed will have to be evaluated and selected based upon the site constraints for any given area.

The proposed channel cross section is intended to mimic the existing cross section. A natural sandy bottom will remain allowing for runoff infiltration. The channel sides will be armored to protect from erosion.

Design of the existing channel has been designed under the ***Final Drainage Report for Sand Creek Channel Improvements at Platte Avenue***, prepared by Matrix Design Group, Inc. in August 2005. Please refer to that report for criteria used for channel improvements.

IV. DRAINAGE FACILITY DESIGN

A. Existing Conditions

Since the approval of the previous MDDP, a number of improvements have been constructed within Patriot Park. As a result, those improvements have been incorporated as existing conditions within this report. Those improvements include the construction of Space Center Drive, Filing No. 1, Buildings 6 and 7 development area, and the water quality pond. Drainage sub-basins in this report have been delineated to remain consistent with the previous MDDP.

Sub-basin OS-1 is an existing commercial development encompassing an area of 5.10 acres. Referred to as Science Park Subdivision No. 1, Filing 1, Phase 2, flows travel southwest onto Science Park Drive and are routed through sub-basin EX-2. Runoff rates for this sub-basin are Q(5) = 13.3 cfs and Q(100) = 26.9 cfs.

Sub-basin OS-2 is an existing commercial development encompassing an area of 1.25 acres. Flows from this sub-basin travel southeast within Technology Court and are routed through sub-basin EX-5. Runoff rates for this sub-basin are Q(5) = 3.2 cfs and Q(100) = 6.3 cfs.

Sub-basin OS-3 consists of 2.98 acres of existing commercial development referred to as Science Park Subdivision No. 1, Filing 1, Phase 1. This area generates runoff rates of Q(5) = 7.8 cfs and Q(100) = 15.8 cfs. Flows from this sub-basin travel to the west and are conveyed through an existing rundown. This rundown is laden with very dense vegetative cover and located entirely within the existing setback area. Runoff from this sub-basin is not routed through any sub-basin within Patriot Park.

Sub-basin EX-1 consists of 14.66 acres of undeveloped property located on the eastern portion of Patriot Park. This area is currently over lot graded and does not contain vegetation. Runoff generally travels southwest towards Space Center Drive at rates of Q(5) = 10.9 cfs and Q(100) = 27.1 cfs. Flows are collected by the existing storm drain system within Space Center Drive and are routed through design point E2.

Sub-basin EX-1a consists of 3.67 acres of undeveloped property located on the eastern portion of Patriot Park. This area is currently over lot graded and does not contain vegetation. Runoff generally travels southeast towards an existing drainage ditch along Powers Boulevard at rates of Q(5) = 3.1 cfs and Q(100) = 7.8 cfs. Flows from this existing condition is diverted toward Space Center Drive under developed conditions.

Sub-basin EX-2 encompasses 1.5 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is routed through an existing 30" RCP within Space Center Drive. Discharge rates from this sub-basin are Q(5) = 5.6 cfs and Q(100) = 10.8 cfs.

Sub-basin EX-3 consists of 4.66 acres of undeveloped property located adjacent to the intersection of Technology Court and Space Center Drive. This area is currently over lot graded and does not contain vegetation. Runoff generally travels southeast towards Space Center Drive

at rates of Q(5) = 4.2 cfs and Q(100) = 10.5 cfs. Flows are collected by the existing storm drain system within Space Center Drive and are routed through design point E1.

Design Point E1 has a tributary area of 11.85 acres, which includes both developed and undeveloped flows from sub-basins OS-1, EX-2, EX-3, and EX-6. Runoff at this design point is collected by two existing 10 foot D10-R inlets and is routed through a 30" RCP located within Space Center Drive. Discharge rates from this design point are Q(5) = 22.7 cfs and Q(100) = 47.1 cfs.

Sub-basin EX-4 encompasses 5.29 acres of undeveloped property. The area has been over lot graded and is bare ground that slopes to the south. Runoff from this sub-basin sheet flows towards Space Center Drive and is routed through design point E2. Discharge rates from this sub-basin are Q(5) = 4.4 cfs and Q(100) = 11.1 cfs.

Sub-basin EX-5 consists of 7.20 acres of undeveloped property located within the northwestern portion of Patriot Park. This area is currently over lot graded and does not contain vegetation. Runoff from this sub-basin sheet flows to the south and is routed through sub-basin EX-13 at rates of Q(5) = 6.4 cfs and Q(100) = 16.0 cfs.

Sub-basin EX-6 comprises of 0.52 acres of the existing Space Center Drive right-of-way. Runoff is collected by two existing 10 foot D10-R inlets and is routed through a 48" RCP within Space Center Drive. Discharge rates from this sub-basin are Q(5) = 2.1 cfs and Q(100) = 4.0 cfs.

Sub-basin EX-7 contains 0.61 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is routed through an existing 54" RCP within Space Center Drive. Discharge rates from this sub-basin are Q(5) = 2.4 cfs and Q(100) = 4.7 cfs.

Design Point E2 has a tributary area of 32.41 acres, which includes both developed and undeveloped flows from design point E1 and sub-basins EX-1, EX-4, and EX-7. Runoff at this design point is collected by two existing 10 foot D10-R inlets and is routed through a 54" RCP located within Space Center Drive. Discharge rates from this design point are Q(5) = 35.0 cfs and Q(100) = 78.6 cfs.

Sub-basin EX-8 encompasses 7.53 acres of undeveloped property located in the middle of the Patriot Park development. This area is currently over lot graded and does not contain vegetation. Runoff generally travels south towards Space Center Drive at rates of Q(5) = 6.4 cfs and Q(100) = 15.9 cfs. Flows are collected by the existing storm drain system within Space Center Drive and are routed through design point E4.

Sub-basin EX-9 encompasses 5.06 acres of existing commercial development known as Filing 1 of Patriot Park. Filing 1 consists of a two-story, 52,000 sq. ft. office building with a parking lot and a two-story parking structure. The area generates flows of Q(5) = 10.3 cfs and Q(100) = 20.5 cfs. Runoff is collected though an onsite drainage system that connects directly to the existing 54" RCP located within the Space Center Drive right-of-way. These flows are routed through design point E3 and discharged into the water quality pond.

Sub-basin EX-10 contains 0.37 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is routed through an existing 54" RCP within Space Center Drive. Discharge rates from this sub-basin are Q(5) = 1.5 cfs and Q(100) = 2.9 cfs.

Design Point E3 has a tributary area of 37.84 acres, which includes both developed and undeveloped flows from design point E2 and sub-basins EX-9 and EX-10. Runoff at this design point is collected by two existing 10 foot D10-R inlets and is routed through a 54" RCP located within Space Center Drive. Discharge rates from this design point are Q(5) = 43.9 cfs and Q(100) = 96.2 cfs.

Sub-basin EX-11 contains 0.59 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is routed through an existing 60" RCP within Space Center Drive. Discharge rates from this sub-basin are Q(5) = 2.4 cfs and Q(100) = 4.5 cfs.

Design Point E4 has a tributary area of 45.96 acres, which includes both developed and undeveloped flows from design point E3 and sub-basins EX-8 and EX-11. Runoff at this design point is collected by two existing 10 foot D10-R inlets and is routed through a 60" RCP located within Space Center Drive. Discharge rates from this design point are Q(5) = 49.3 cfs and Q(100) = 109.1 cfs.

Sub-basin EX-13 encompasses 8.72 acres of undeveloped property located within the western portion of Patriot Park. This area is currently over lot graded and does not contain vegetation. Runoff from this sub-basin sheet flows to the south and is routed through design point E5 at rates of Q(5) = 7.5 cfs and Q(100) = 18.6 cfs.

Design Point E5 has a tributary area of 17.17 acres, which includes both developed and undeveloped conditions from sub-basins EX-5, EX-13, and OS-2. Runoff at this design point sheet flows to the south directly into the existing water quality pond. Discharge rates from this design point are Q(5) = 16.3 cfs and Q(100) = 39.3 cfs.

Sub-basin EX-14 encompasses 11.45 acres of existing commercial development known as the Master Development Plan Area for Patriot Park Buildings 6 and 7. Buildings 6 and 7 consist of two three-story office buildings, each with an area of 109,105 sq. ft., and surface parking. The area generates flows of Q(5) = 28.5 cfs and Q(100) = 54.6 cfs. Runoff is collected though an onsite drainage system that discharges to the existing 36" RCP under Space Center Drive and routes directly into the Sand Creek Channel. Water quality is addressed internally through multiple porous landscaped detention areas, which allows for this development to discharge its runoff directly into Sand Creek. This sub-basin does not accept flow from any other sub-basin nor does this sub-basin route its flows through any other sub-basin located within Patriot Park.

Sub-basin EX-15 contains 0.55 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is routed through an existing 66" RCP within Space Center Drive. Flows from the 66" RCP within this sub-basin discharge its flows directly into the

water quality pond located in the southwestern corner of Patriot Park. Discharge rates from this sub-basin are Q(5) = 2.2 cfs and Q(100) = 4.3 cfs.

Sub-basin EX-16 contains 0.86 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is discharges directly into the water quality pond. Discharge rates from this sub-basin are Q(5) = 3.5 cfs and Q(100) = 6.7 cfs.

Sub-basin EX-17 consists of the water quality pond that encompasses 1.58 acres. The peak runoff rates generated by this sub-basin are Q(5) = 4.6 cfs and Q(100) = 9.3 cfs. The water quality pond discharges its runoff into the Sand Creek Channel. An outlet structure was previously proposed as part of earlier work. Modified conditions at the site necessitate that a second outfall structure be constructed to convey flows to Sand Creek.

Design Point E6 has a tributary area of 66.12 acres, which includes both developed and undeveloped flows from design points E4 and E5 and sub-basins EX-15, EX-16, and EX-17. This design point is located within the existing water quality pond that collects total runoff rates of Q(5) = 64.9 cfs and Q(100) = 144.7 cfs. Flows from the pond are discharged into the Sand Creek Channel via an existing outlet structure and an overflow weir.

B. Fully Developed Conditions

The Patriot Park Concept Plan area is a proposed 81.5± acre commercial subdivision. Since an exact site layout has not been planned at this time, appropriate runoff coefficients were determined based upon existing commercial developments within the boundary of the previous MDDP. The majority runoff is collected within the existing storm drain system located within Space Center drive, which directs flow into the water quality pond and eventually discharges into Sand Creek.

The existing storm drain system within the Space Center Drive right-of-way was designed and constructed as part of the previous MDDP for Patriot Park. Per the previous MDDP, it was proposed that each lot would be graded to allow drainage to flow towards the public street and be collected in a series of inlets; however, each lot would have the option to connect an on-site drainage system to the system within Space Center Drive. As a result, no stub-outs were provided along the existing storm drain system.

Per the approved MDDP for Patriot Park, an analysis of the existing storm drain system within Space Center Drive was performed. Flows at design points P1 through P4 were used in comparison to the analysis performed under the approved MDDP (see Appendix B). Flows at design points P1 and P4 are less than flows anticipated under the approved storm drain model. Design points P2 and P3 are slightly higher than the flows anticipated under the approved storm drain model; however, the proposed flows are well below the full capacity of the storm drain and increase the flows by six percent or less. Overall, the 100-year peak flow into the existing storm drain system is reduced by 25.0 cfs and will adequately contain the proposed flows per this drainage report.

Sub-basin OS-1 is an existing commercial development encompassing an area of 5.10 acres. Referred to as Science Park Subdivision No. 1, Filing 1, Phase 2, flows travel southwest onto Science Park Drive and are routed through sub-basin EX-2. Runoff rates for this sub-basin are Q(5) = 13.3 cfs and Q(100) = 26.9 cfs.

Sub-basin OS-2 is an existing commercial development encompassing an area of 1.25 acres. Flows from this sub-basin travel southeast within Technology Court and are routed through sub-basin PP-6. Runoff rates for this sub-basin are Q(5) = 3.2 cfs and Q(100) = 6.3 cfs.

Sub-basin OS-3 consists of 2.98 acres of existing commercial development referred to as Science Park Subdivision No. 1, Filing 1, Phase 1. This area generates runoff rates of Q(5) = 7.8 cfs and Q(100) = 15.8 cfs. Flows from this sub-basin travel to the west and are conveyed through an existing rundown. This rundown is laden with very dense vegetative cover and located outside the disturbance area for Patriot Park. If improvements to the rundown are warranted, such improvements shall be determined at the time of adjacent development. Runoff from this sub-basin is not routed through any sub-basin within Patriot Park.

Sub-basin PP-1 consists of 3.47 acres of commercial development located in the northeastern portion of Patriot Park. Runoff drains from the northeast to the southwest at rates of Q(5) = 8.7 cfs and Q(100) = 17.7 cfs. Flows are routed to Space Center Drive at design point 1.

Sub-basin PP-2 encompasses 1.57 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and routed through an existing 30" RCP within Space Center Drive. Discharge rates from this sub-basin are Q(5) = 5.6 cfs and Q(100) = 10.8 cfs.

Sub-basin PP-3 encompasses 3.83 acres of commercial development located near the intersection of Technology Court and Space Center Drive. The area generates flows of Q(5) = 10.5 cfs and Q(100) = 21.3 cfs and route through design point P1.

Design point P1 collects runoff from sub-basins OS-1, PP-1, PP-2, and PP-3, an area totaling 13.97 acres. Surface runoff is collected by two 10' D10-R inlets and routed through a 30" RCP located within the right-of-way of Space Center Drive. The peak discharge rates for this design point are Q(5) = 35.3 cfs and Q(100) = 71.1 cfs.

Sub-basin PP-4 encompasses 6.66 acres of commercial development located in the northeastern portion of Patriot Park. Runoff travels southwest at rates of Q(5) = 15.3 cfs and Q(100) = 31.1 cfs. Flows are routed to Space Center Drive at design point P2.

Sub-basin PP-5 comprises of 0.52 acres of the existing Space Center Drive right-of-way. Runoff is collected by two existing 10 foot D10-R inlets and is routed through a 48" RCP within Space Center Drive. Discharge rates from this sub-basin are Q(5) = 2.1 cfs and Q(100) = 4.0 cfs.

Sub-basin PP-6 consists of 5.84 acres of commercial development located in the central portion of Patriot Park. Flows from sub-basin OS-2 are tributary to this sub-basin and are routed to

design point P2 at Space Center Drive. Runoff travles from northeast to the southwest at rates of Q(5) = 14.6 cfs and Q(100) = 29.7 cfs.

Sub-basin PP-7 encompasses 5.69 acres of commercial development located in the northwestern portion of Patriot Park. An existing 30" DIP sewer line and its easement are located within this sub-basin and have been identified on the maps. The area generates flows of Q(5) = 14.8 cfs and Q(100) = 30.2 cfs to be discharged directly to Sand Creek. Since this sub-basin is not routed through the existing water quality pond, onsite water quality treatment and discharge into Sand Creek shall be designed under a preliminary/final drainage report once development plan(s) are created. The preliminary/final drainage report for this area must also incorporate the streamside overlay zone to be identified under the development plan(s).

Design point P2 collects runoff from design point P1 and sub-basins OS-2, PP-4, PP-5, and PP-6, an area totaling 28.24 acres. Surface runoff is collected by two 10' D10-R inlets and routed through a 48" RCP located within the right-of-way of Space Center Drive. The peak discharge rates for this design point are Q(5) = 65.0 cfs and Q(100) = 131.1 cfs.

Sub-basin PP-9 consists of 8.20 acres of commercial development located in the eastern portion of Patriot Park, just north of Filing 1. Runoff travels from northeast to the southwest at rates of Q(5) = 19.3 cfs and Q(100) = 39.2 cfs. Flows are routed to Space Center Drive towards design point P3.

Sub-basin PP-10 is comprised of 0.61 acres of Space Center Drive. The area generates flows of Q(5) = 2.4 cfs and Q(100) = 4.7 cfs that are collected by two 10' D10-R inlets. Within the right-of-way of Space Center Drive, an existing 48" RCP connects to an existing 54" RCP within sub-basin PP-10. This storm drain carries flow from design point P3 and is routed through sub-basin PP-15.

Sub-basin PP-11 encompasses 4.46 acres of commercial development located in the central portion of Patriot Park. The area generates flowrates of Q(5) = 11.6 cfs and Q(100) = 23.5 cfs that flow to the east into Space Center Drive at design point P3.

Design point P3 collects runoff from design point P2 and sub-basins PP-9, PP-10, and PP-11, an area totaling 41.51 acres. Surface runoff is collected by two 10' D10-R inlets and routed through a 54" RCP located within the right-of-way of Space Center Drive. The peak discharge rates for this design point are Q(5) = 92.2 cfs and Q(100) = 186.3 cfs.

Sub-basin PP-12 encompasses 4.98 acres of commercial development located in the western portion of Patriot Park. An existing 30" DIP sewer line and its easement are located within this sub-basin and have been identified on the maps. The area generates flowrates of Q(5) = 12.5 cfs and Q(100) = 25.5 cfs to be discharged directly to Sand Creek. Since this sub-basin is not routed through the existing water quality pond, onsite water quality treatment and discharge into Sand Creek shall be designed under a preliminary/final drainage report once development plan(s) are created. The preliminary/final drainage report for this area must also incorporate the streamside overlay zone to be identified under the development plan(s).

Sub-basin PP-14 encompasses 5.06 acres of existing commercial development known as Filing 1 of Patriot Park. Filing 1 consists of a two-story, 52,000 sq. ft. office building with a parking lot and a two-story parking structure. The area generates flows of Q(5) = 10.3 cfs and Q(100) = 20.5 cfs. Runoff is collected though an onsite drainage system that connects directly to the existing 54" RCP located within the Space Center Drive right-of-way. These flows are routed through desing point P4 and discharges into the water quality pond.

Sub-basin PP-15 contains 0.37 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is routed through an existing 54" RCP within Space Center Drive. Discharge rates from this sub-basin are Q(5) = 1.5 cfs and Q(100) = 2.9 cfs.

Sub-basin PP-16 contains 0.59 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is routed through an existing 60" RCP within Space Center Drive. Discharge rates from this sub-basin are Q(5) = 2.4 cfs and Q(100) = 4.5 cfs.

Sub-basin PP-17 encompasses 3.17 acres of commercial development located in the southern portion of Patriot Park. The area generates flowrates of Q(5) = 8.6 cfs and Q(100) = 17.6 cfs that flow to the south into Space Center Drive at design point P4.

Design point P4 collects runoff from design point P3 and sub-basins PP-14, PP-15, PP-16, and PP-17, an area totaling 50.7 acres. Surface runoff is collected by two 10' D10-R inlets and routed through a 60" RCP located within the right-of-way of Space Center Drive. The peak discharge rates for this design point are Q(5) = 105.3 cfs and Q(100) = 212.5 cfs.

Sub-basin PP-18 encompasses 6.53 acres of commercial development located in the southwestern portion of Patriot Park. An existing 30" DIP sewer line and its easement are located within this sub-basin and have been identified on the maps. The area generates flows of Q(5) = 17.6 cfs and Q(100) = 35.8 cfs to be discharged directly to Sand Creek. Since this sub-basin is not routed through the existing water quality pond, onsite water quality treatment and discharge into Sand Creek shall be designed under a preliminary/final drainage report once development plan(s) are created. The preliminary/final drainage report for this area must also incorporate the streamside overlay zone to be identified under the development plan(s).

Sub-basin PP-20 encompasses 11.45 acres of existing commercial development referred to as the Master Development Plan for Patriot Park Buildings 6 and 7. Buildings 6 and 7 consist of two three-story office buildings, each with an area of 109,105 sq. ft., and surface parking. The area generates flows of Q(5) = 28.5 cfs and Q(100) = 54.6 cfs. Runoff is collected though an onsite drainage system that discharges to the existing 36" RCP under Space Center Drive and routes directly into the Sand Creek Channel. Water quality is addressed internally through multiple porous landscaped detention areas, which allows for this development to discharge its runoff directly into Sand Creek. This sub-basin does not accept flow from any other sub-basin nor does this sub-basin route its flows through any other sub-basin located within Patriot Park.

Sub-basin PP-21 contains 0.55 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is routed through an existing 66" RCP within Space Center Drive. Flows from the 66" RCP within this sub-basin discharge its flows directly into the water quality pond located in the southwestern corner of Patriot Park. Discharge rates from this sub-basin are Q(5) = 2.2 cfs and Q(100) = 4.3 cfs.

Sub-basin PP-22 contains 0.86 acres of the existing Space Center Drive right-of-way. Runoff is collected by two 10 foot D10-R inlets and is discharges directly into the water quality pond. Discharge rates from this sub-basin are Q(5) = 3.5 cfs and Q(100) = 6.7 cfs.

Sub-basin PP-23 consists of the water quality pond that encompasses 1.58 acres. Located at design point P7, this sub-basin collects runoff from design point P4 and sub-basins PP-21, PP-22, and PP-23, an area totaling 53.69 acres. The peak runoff rates collected at this design point are Q(5) = 108.1 cfs and Q(100) = 217.9 cfs. The water quality pond discharges its runoff into the Sand Creek Channel. Due to changes made to the water quality pond, the water quality capture volume has reduced from the original design. These changes are discussed below.

C. Water Quality

A water quality pond exists within the Patriot Park concept plan area and was designed under the ***Master Development Drainage Plan for Patriot Park, LLC***, prepared by Nolte Associates, Inc., dated March 2006. The water quality capture volume is comprised of an Extended Detention Basin, where the "initial flush" of storm water is drained over a 40-hour time period. The footprint of the water quality pond has not changed from the previous MDDP; however, the outfall to Sand Creek was redesigned due to hydraulic issues with channel and, as a result, the water quality capture volume was reduced.

Instead of an outlet structure, a weir and culvert system was designed to alleviate some of the sediment issues Sand Creek was causing. With this new design, the water quality capture volume has been reduced to 1.095 ac-ft. With the changes made to the water quality capture volume, the redesigned pond can treat 36.55 acres of development with a percent imperviousness of 75.0%.

Since Patriot Park Filing No. 1 (5.07 acres) is already developed and drains to the water quality pond, the water quality pond can treat 31.48 acres of future development. The future development east of Space Center Drive (Sub-basins PP-1, PP-4, and PP-9) encompasses 18.33 acres. Since it is very likely the development plan(s) for this area will drain to the existing water quality pond, 13.15 acres of future development west of Space Center Drive may also be treated by the existing pond. The areas adjacent to Sand Creek (Sub-basins PP-7, PP-12, and PP-18) will drain directly to the channel; therefore, requiring onsite water quality treatment. In addition, sub-basin PP-20 (referred to as Buildings 6 and 7) are implementing on-site water quality treatment as well. The remaining areas (Sub-basins PP-3, PP-6, PP-11, and PP-17) encompass 17.30 acres, of which 4.15 acres must implement on-site water quality treatment. This shall be accomplished by distributing 1.04 acres to each sub-basin (PP-3, PP-6, PP-11, and PP-17). In the event that the first developments within these sub-basins can accommodate the entire 4.15 acres

of on-site water quality treatment, the remaining sub-basins will not require on-site water quality treatment.

The pond is privately maintained and will be platted under a future filing. The storm sewer outlets and riprap pads from Space Center Drive into the water quality pond are maintained by the City.

D. Improvements to Sand Creek Channel – Platte Avenue to Galley Road

Under the ***Final Drainage Report for Sand Creek Channel Improvements at Platte Avenue***, by Matrix Design Group, Inc., dated August 2005, improvements to the Sand Creek Channel have been identified as development encroaches the waterway. Between Platte Avenue and Galley Road, six drop structures will be spaced approximately 440 linear feet apart along the channel. The exact placement of each drop will be determined when a final analysis is completed and construction documents are prepared for this segment of Sand Creek. Excerpts from the approved Final Drainage Report for the Sand Creek Channel can be found under Appendix E, which include design plans, HEC-RAS, and hydraulic analysis of the proposed channel improvements.

Prior to constructing the Sand Creek channel improvements, a CLOMR must be submitted to the Regional Floodplain Administrator and FEMA to obtain a floodplain permit. This permit must be obtained prior to the commencement of work within the floodplain. Once construction is complete and as-builts are prepared, a LOMR must be submitted to the Regional Floodplain Administrator and FEMA for recordation.

E. Timing of Improvements to the Sand Creek Channel

Patriot Park lies adjacent to Sand Creek, where future channel improvements will be made per the ***Final Drainage Report for Sand Creek Channel Improvements at Platte Avenue***, prepared by Matrix Design Group, Inc. in August 2005. Armoring along the eastern bank of Sand Creek shall be constructed in conjunction with adjacent development within Patriot Park. This armoring shall be in compliance with the *FDR for Sand Creek Channel Improvements at Platte Avenue.* Construction of the armoring will begin from either the north or south and end at a location determined by engineering judgment to protect the development adjacent to the Sand Creek Channel.

In addition to armoring the eastern bank, COPT shall construct two of the four drop structures as indicated within the Final Drainage Report for *Sand Creek Channel Improvements at Platte Avenue.* The two drop structures to be constructed by COPT will be determined by the location of initial development adjacent to Sand Creek (see Exhibit A in the Appendix for construction scenarios). The drop structures will be embedded into the west bank, based upon existing grades. Improvements to the channel will be necessitated by development within sub-basins PP-7, PP-12, and/or PP-18 (please refer to Exhibit A in the Appendix).

COPT will provide drainage right-of-way for channel improvements located within Patriot Park property. This includes full right-of-way width for the portion of Sand Creek where COPT owns both sides of the channel and half right-of-way width for the portions where COPT only owns half the channel. For easements located outside of patriot park property, COPT will obtain the necessary easements. These include the two drop structures to be constructed by COPT.

F. Drainage, Bridge, and Pond Fees

The 2007 drainage and bridge fees as published by the City of Colorado Springs will be assessed to the site. Patriot Park is located entirely within the Sand Creek Drainage Fee Basin. At this time, two filings have been platted within the 81.56± acres site: Patriot Park Filing 1 (4.962 acres platted on August 17, 2005) and Patriot Park Filing 3 (5.728 acres platted on March 14, 2007). In addition, improvements specified within the DBPS for Sand Creek have been completed within the channel and are credited against the Drainage Fees. Of the remaining 70.87 acres to be platted within Patriot Park, the fees have been calculated as follows.

	Area (ac.)	Area Previously Platted	Fee/Acre	Fee Due	Reimbursable Const. Costs	Fee Due at Platting	*Est. Drainage Fee Credit
Drainage Fee	81.56	10.69	$8,946.00	$634,003.02	$0.00	$634,003.02	
Bridge Fee	81.56	10.69	$562.00	$39,828.94	$0.00	$39,828.94	
Pond Fee	81.56	10.69	$3,787.00	$268,384.69	$0.00	$268,384.69	$743,836.00
					Total Fee Due at Platting	***$198,380.65***	

*The Estimated Drainage Fee Credit in the amount of *$743,836.00* is the total cost of drainage improvements made to the Sand Creek channel by COPT as of September 2007. This fee amount is an estimate pending the approval of drainage fee credits by the Drainage Board.

VI. REFERENCES

1. ***Drainage Basin Planning Study for Sand Creek***, Kiowa Engineering, revised March 1996.

2. ***City of Colorado Springs & El Paso County Drainage Criteria Manual***, dated November 1991.

3. ***FEMA Flood Insurance Rate Map***, El Paso County Colorado and Incorporated Areas, Panels 751 and 753 of 1300. March 17, 1997.

4. ***Soil Survey of El Paso County Area, Colorado***. United States Department of Agriculture Soil Conservation Service. Issued June 1981.

5. ***Urban Storm Drainage Criteria Manual, Volumes 1-3***, Urban Drainage and Flood Control District, June 2001 and subsequent updates.

6. ***Master Development Drainage Plan, Patriot Park, for Patriot Park, LLC***, Nolte Associates, Inc., dated March 2006.

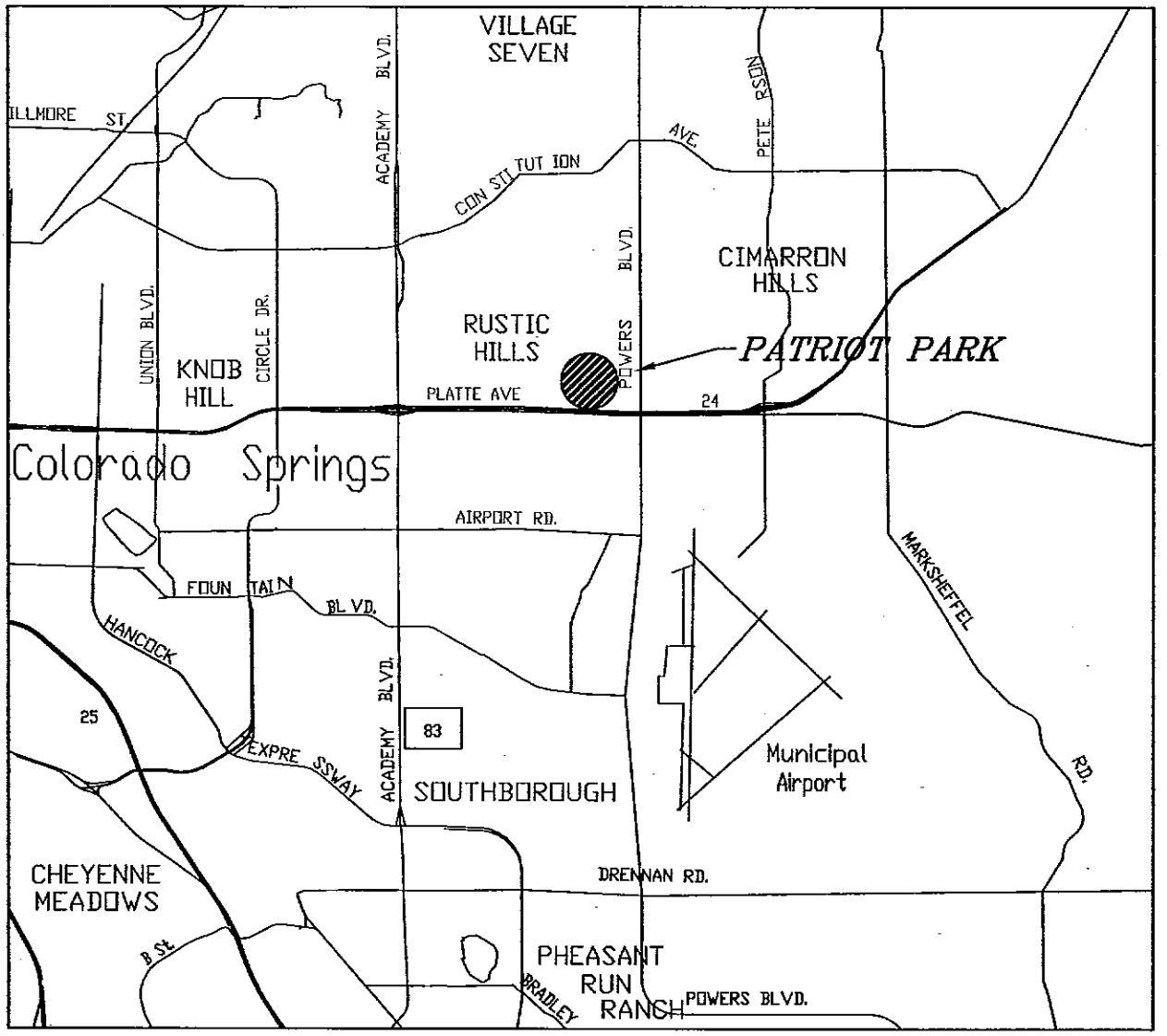
7. ***Final Drainage Report for Sand Creek Channel Improvements at Platte Avenue***, Matrix Design Group, Inc., dated August 2005.

8. ***Final Drainage Report for Patriot Park Subdivision Filing 1***, by Matrix Design Group, Inc., dated July 2005.

9. ***Final Drainage Report, Patriot Park Filing No. 3, for "Buildings 6 & 7,"*** by Matrix Design Group, Inc., currently under review.

APPENDIX A

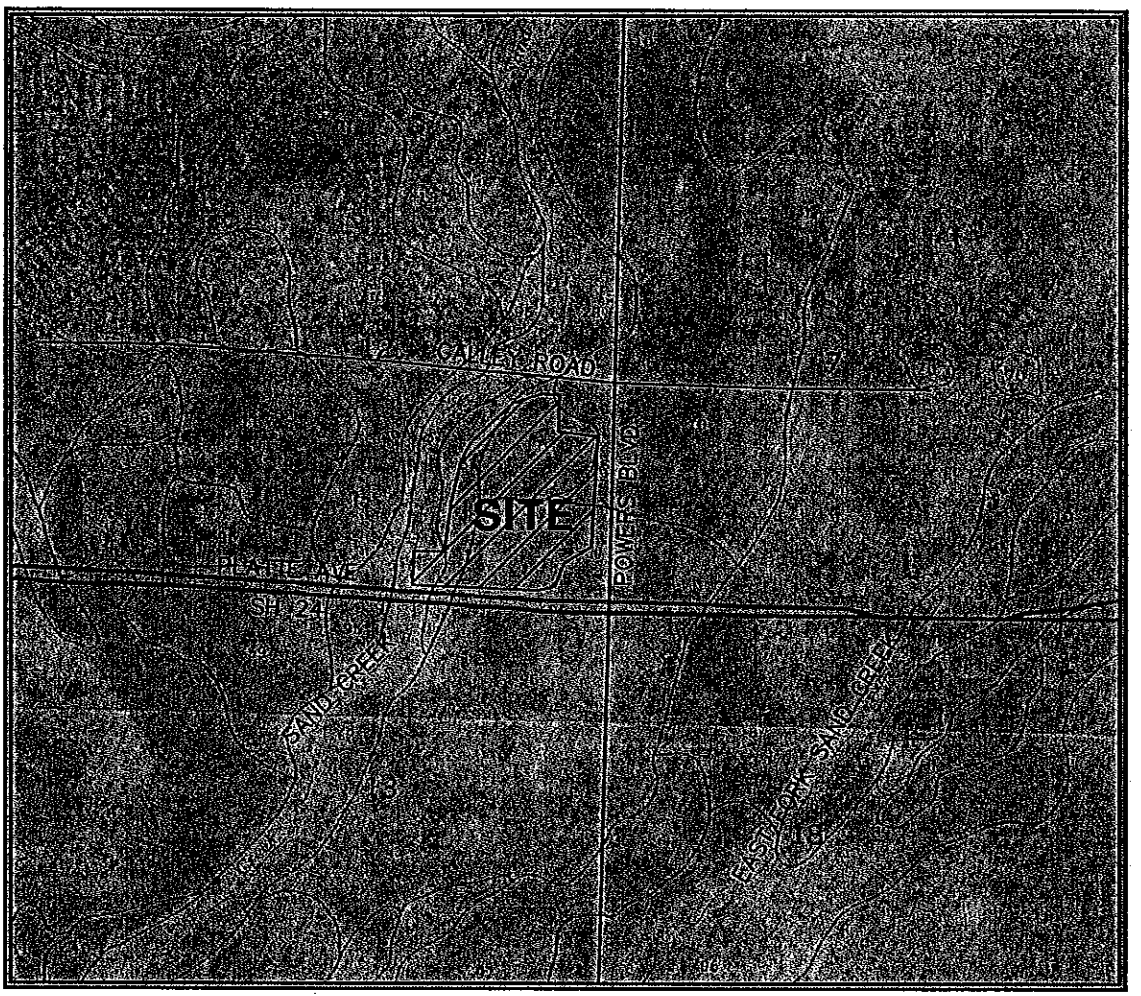
MAPS



VICINITY MAP

NORTH
N.T.S.

Matrix Design Group, Inc.
Integrated Design Solutions
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208



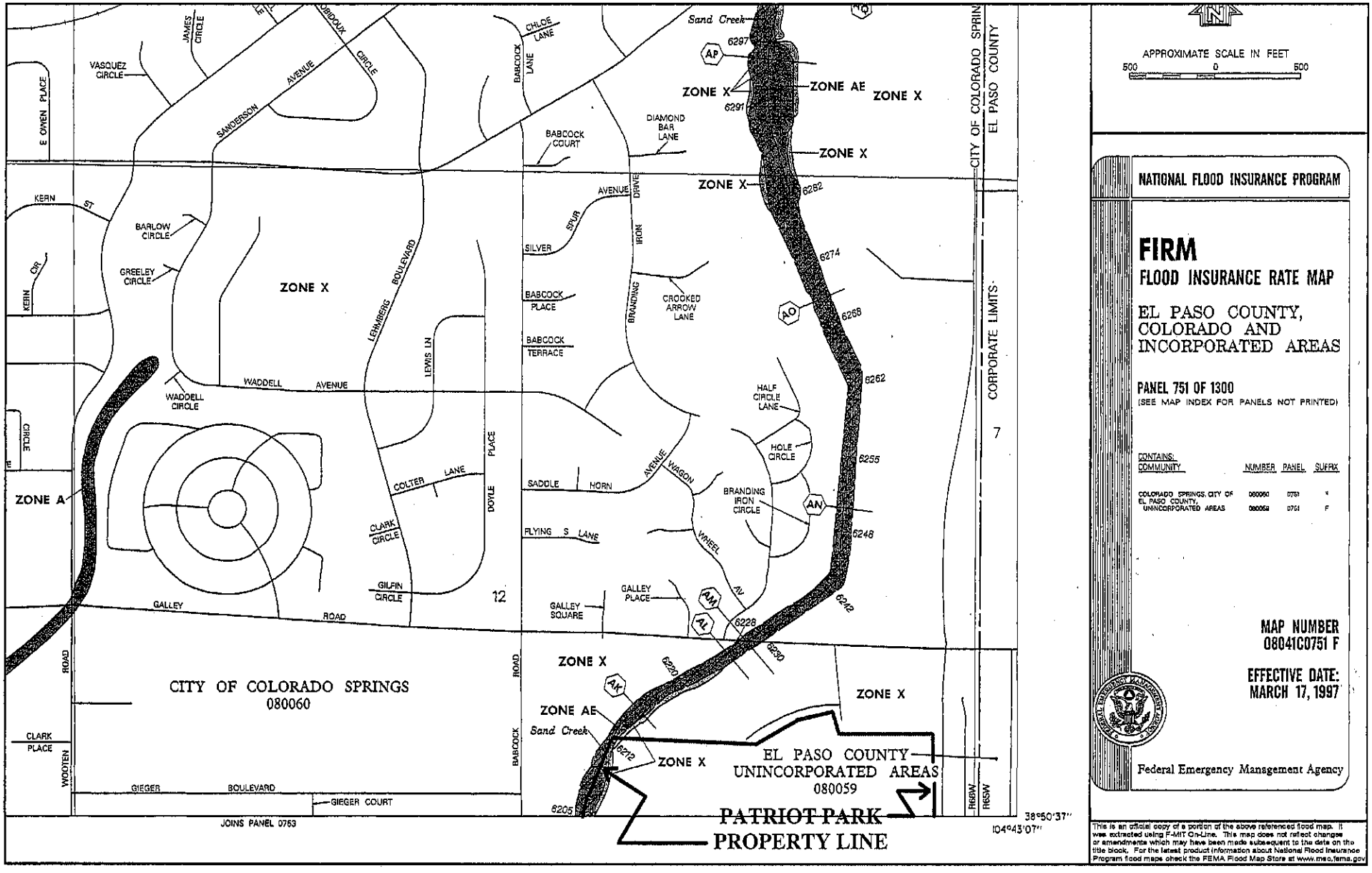
SOILS MAP

NORTH
N.T.S.

LEGEND

ID	SOIL NAME	HYD. GROUP
10	BLENDON SANDY LOAM	B
11	BRESSER SANDY LOAM	B
28	ELLICOT LOAMY COARSE SAND	A
95	TRUCKTON LOAMY SAND	B
96	TRUCKTON SANDY LOAM	B

Matrix Design Group, Inc.
Integrated Design Solutions
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208



APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

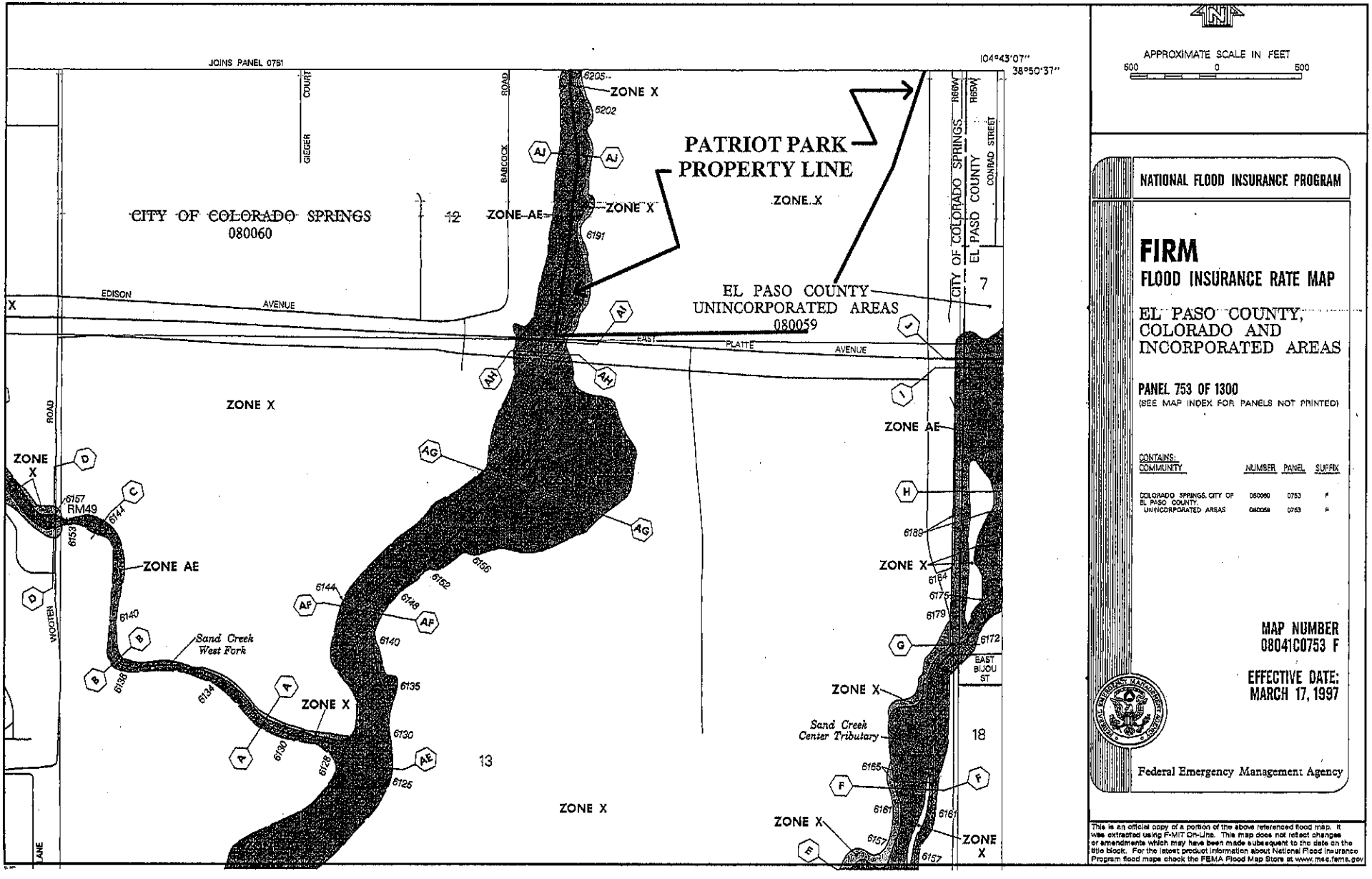
PANEL 751 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0751	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0751	F

MAP NUMBER
08041C0751 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 753 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0753	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0753	F

MAP NUMBER
08041C0753 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

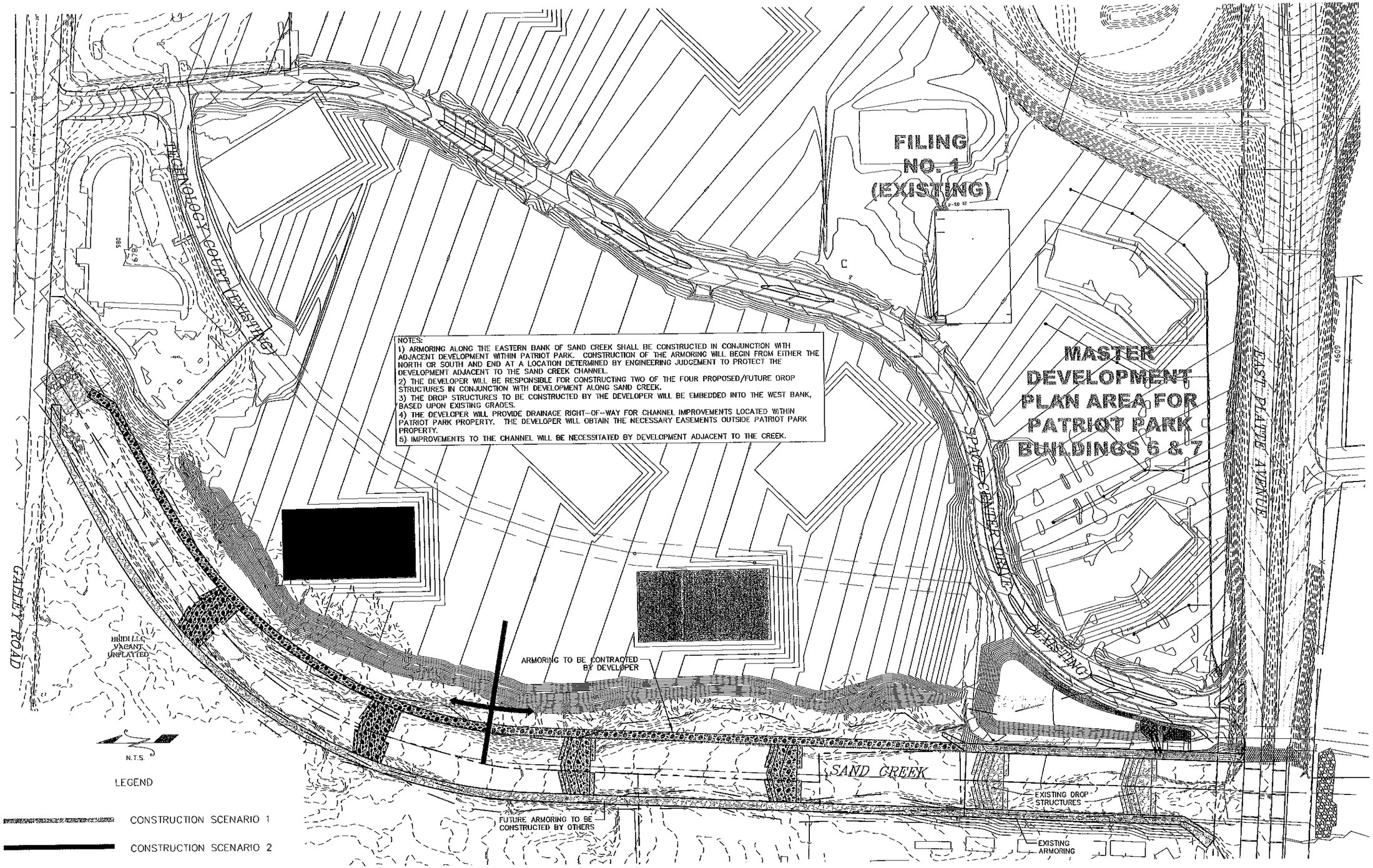


EXHIBIT A

SAND CREEK CHANNEL IMPROVEMENT SCENARIOS

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Integrated Design Solutions
3435 Research Parkway, Suite 300
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APPENDIX B

HYDROLOGIC AND HYDRAULIC CALCULATIONS

PATRIOT PARK MDDP
Sand Creek Drainage Basin

Rational Method Hydrologic Analysis
Existing and Developed Conditions

Sub-Basin Designation	Design Point	Tributary Basins	Total Area (ac.)	Weighted Coefficients		CA		Overland Time			Travel Time							Intensity		Peak Runoff	
				C(5)	C(100)	CA(5)	CA(100)	Overland Length (ft)	Overland Slope (%)	T(initial) (min.)	Travel Length (ft)	Weighted Slope (%)	Velocity (fps)	T(travel) (min.)	Final T(c)	T(c) check =d/180+10	Final T(c) (Min = 5)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
Existing Conditions																					
EX-1			14.66	0.25	0.35	3.67	5.13	100	3.0%	11.1	1800	1.6%	1.8	16.7	27.7	20.6	20.6	2.97	5.29	10.9	27.1
EX-1a			3.67	0.25	0.35	0.92	1.28	100	3.0%	11.1	900	1.6%	1.8	8.3	19.4	15.6	15.6	3.40	6.06	3.1	7.8
EX-2			1.57	0.80	0.86	1.26	1.35	10	2.0%	4.0	1150	2.6%	5.0	3.8	7.8	16.4	7.8	4.48	7.97	5.6	10.8
EX-3			4.66	0.25	0.35	1.17	1.63	75	3.0%	9.6	600	2.6%	2.2	4.5	14.1	13.8	13.8	3.60	6.41	4.2	10.6
EX-4			5.29	0.25	0.35	1.32	1.85	75	3.0%	9.6	1000	1.7%	2.0	8.3	17.9	16.0	16.0	3.36	5.99	4.4	11.1
EX-5			7.20	0.25	0.35	1.80	2.52	75	3.0%	9.6	650	1.7%	2.0	5.4	15.0	14.0	14.0	3.57	6.35	6.4	16.0
EX-6			0.52	0.80	0.86	0.42	0.45	10	2.0%	4.0	360	2.8%	5.0	1.2	5.2	12.1	5.2	5.05	9.00	2.1	4.0
EX-7			0.61	0.80	0.86	0.49	0.52	10	2.0%	4.0	400	1.5%	5.0	1.3	5.3	12.3	5.3	5.02	8.94	2.4	4.7
EX-8			7.53	0.25	0.35	1.88	2.64	75	3.0%	9.6	950	2.1%	2.1	7.5	17.1	15.7	15.7	3.39	6.04	6.4	15.9
EX-9			5.06	0.59	0.86	2.99	3.34	40	2.0%	8.0	880	1.0%	2.0	7.3	15.3	15.1	15.1	3.45	6.14	10.3	20.5
EX-10			0.37	0.80	0.86	0.30	0.32	10	2.0%	4.0	230	1.7%	5.0	0.8	4.8	11.3	5.0	5.10	9.09	1.5	2.9
EX-11			0.59	0.80	0.86	0.47	0.51	10	2.0%	4.0	380	2.1%	5.0	1.3	5.3	12.2	5.3	5.04	8.97	2.4	4.5
EX-12 (NOT USED)																					
EX-13			8.72	0.25	0.35	2.18	3.05	75	3.0%	9.6	900	2.3%	2.2	6.8	16.4	15.4	15.4	3.42	6.09	7.5	18.6
EX-14			11.45	0.77	0.83	8.82	9.50	40	2.0%	8.0	1470	1.5%	2.6	9.4	17.4	18.4	17.4	3.23	5.74	28.5	54.6
EX-15			0.55	0.80	0.86	0.44	0.47	10	2.0%	4.0	350	2.0%	5.0	1.2	5.2	12.0	5.2	5.06	9.01	2.2	4.3
EX-16			0.86	0.80	0.86	0.69	0.74	10	2.0%	4.0	260	1.5%	5.0	0.9	4.9	11.5	5.0	5.10	9.09	3.5	6.7
EX-17			1.58	0.70	0.80	1.11	1.26	20	2.0%	5.7	500	1.0%	2.0	4.2	9.8	12.9	9.8	4.13	7.35	4.6	9.3
OS-1			5.10	0.68	0.77	3.47	3.93	40	2.0%	8.0	630	1.9%	2.8	3.8	11.7	13.7	11.7	3.85	6.85	13.3	26.9
OS-2			1.25	0.64	0.71	0.80	0.89	40	2.0%	8.0	580	1.0%	3.5	2.8	10.8	13.4	10.8	3.99	7.10	3.2	6.3
OS-3			2.98	0.68	0.77	2.03	2.29	40	2.0%	8.0	600	1.0%	2.8	3.6	11.6	13.6	11.6	3.87	6.89	7.8	15.8
Fully Developed Conditions																					
PP-1			3.47	0.70	0.80	2.43	2.78	40	2.0%	8.0	700	1.1%	2.0	5.8	13.8	14.1	13.8	3.59	6.39	8.7	17.7
PP-2			1.57	0.80	0.86	1.26	1.35	10	2.0%	4.0	1150	2.6%	5.0	3.8	7.8	16.4	7.8	4.48	7.97	5.6	10.8
PP-3			3.83	0.70	0.80	2.68	3.06	40	2.0%	8.0	560	2.0%	2.8	3.3	11.3	13.3	11.3	3.91	6.95	10.5	21.3
PP-4			6.66	0.70	0.80	4.66	5.33	40	2.0%	8.0	1220	1.5%	2.3	8.8	16.8	17.0	16.8	3.28	5.84	15.3	31.1
PP-5			0.52	0.80	0.86	0.42	0.45	10	2.0%	4.0	360	3.1%	5.0	1.2	5.2	12.1	5.2	5.05	9.00	2.1	4.0
PP-6			5.84	0.70	0.80	4.09	4.67	40	2.0%	8.0	750	1.1%	2.1	6.0	13.9	14.4	13.9	3.58	6.37	14.6	29.7
PP-7			5.69	0.70	0.80	3.98	4.55	40	2.0%	8.0	650	1.4%	2.3	4.7	12.7	13.8	12.7	3.72	6.63	14.8	30.2
PP-8 (NOT USED)																					
PP-9			8.20	0.70	0.80	5.74	6.56	40	2.0%	8.0	1050	0.9%	1.9	9.2	17.2	16.1	16.1	3.36	5.97	19.3	39.2
PP-10			0.61	0.80	0.86	0.49	0.52	10	2.0%	4.0	400	1.5%	5.0	1.3	5.3	12.3	5.3	5.02	8.94	2.4	4.7
PP-11			4.46	0.70	0.80	3.12	3.57	40	2.0%	8.0	700	1.4%	2.4	4.9	12.9	14.1	12.9	3.71	6.60	11.6	23.5
PP-12			4.98	0.70	0.80	3.49	3.98	40	2.0%	8.0	700	1.0%	2.0	5.8	13.8	14.1	13.8	3.59	6.39	12.5	25.5
PP-13 (NOT USED)																					
PP-14			5.06	0.59	0.86	2.99	3.34	40	2.0%	8.0	880	1.0%	2.0	7.3	15.3	15.1	15.1	3.45	6.14	10.3	20.5
PP-15			0.37	0.80	0.86	0.30	0.32	10	2.0%	4.0	230	1.7%	5.0	0.8	4.8	11.3	5.0	5.10	9.09	1.5	2.9
PP-16			0.59	0.80	0.86	0.47	0.51	10	2.0%	4.0	380	2.1%	5.0	1.3	5.3	12.2	5.3	5.04	8.97	2.4	4.5
PP-17			3.17	0.70	0.80	2.22	2.54	40	2.0%	8.0	550	1.8%	2.7	3.4	11.4	13.3	11.4	3.90	6.94	8.6	17.6
PP-18			6.53	0.70	0.80	4.57	5.22	40	2.0%	8.0	700	2.6%	3.1	3.8	11.8	14.1	11.8	3.85	6.85	17.6	35.8
PP-19 (NOT USED)																					
PP-20			11.45	0.77	0.83	8.82	9.50	40	2.0%	8.0	1470	1.5%	2.6	9.4	17.4	18.4	17.4	3.23	5.74	28.5	54.6
PP-21			0.55	0.80	0.86	0.44	0.47	10	2.0%	4.0	350	2.0%	5.0	1.2	5.2	12.0	5.2	5.06	9.01	2.2	4.3
PP-22			0.86	0.80	0.86	0.69	0.74	10	2.0%	4.0	260	1.5%	5.0	0.9	4.9	11.5	5.0	5.10	9.09	3.5	6.7
PP-23			1.58	0.70	0.80	1.11	1.26	20	2.0%	5.7	500	1.0%	2.0	4.2	9.8	12.9	9.8	4.13	7.35	4.6	9.3
OS-1			5.10	0.68	0.77	3.47	3.93	40	2.0%	8.0	630	1.9%	2.8	3.8	11.7	13.7	11.7	3.85	6.85	13.3	26.9
OS-2			1.25	0.64	0.71	0.80	0.89	40	2.0%	8.0	580	1.0%	3.5	2.8	10.8	13.4	10.8	3.99	7.10	3.2	6.3
OS-3			2.98	0.68	0.77	2.03	2.29	40	2.0%	8.0	600	1.0%	2.8	3.6	11.6	13.6	11.6	3.87	6.89	7.8	15.8

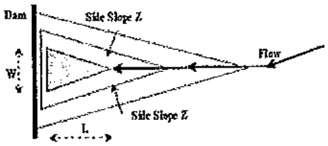
Routed Flows

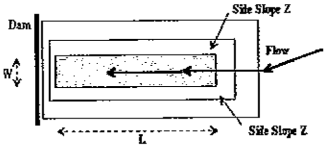
Existing Conditions																			
Surface	E1	OS1, EX2, EX3, EX5	11.85		6.31	7.36		13.8	0		5.0	0.0	13.8		3.60	6.41	22.7	47.1
Sewer	E2	DP-E1, EX1, EX4, EX7	32.41		11.78	14.86		20.6	0		5.0	0.0	20.6		2.97	5.29	35.0	78.6
Sewer	E3	DP-E2, EX9, EX10	37.84		15.06	18.52		20.6	230		5.0	0.8	21.3		2.92	5.19	43.9	96.2
Sewer	E4	DP-E3, EX8, EX11	45.96		17.42	21.66		21.3	380		5.0	1.3	22.6		2.83	5.04	49.3	109.1
Surface	E5	OS-2, EX5, EX13	17.17		4.78	6.46		15.4	0		5.0	0.0	15.4		3.42	6.09	16.3	39.3
Sewer	E6	DP-E4, DP-E5, EX15, EX16, EX17	66.12		24.43	30.60		22.6	850		5.0	2.8	25.4		2.66	4.73	64.9	144.7
Fully Developed Conditions																			
Surface	P1	OS1, PP1, PP2, PP3	13.97		9.83	11.12		13.8	0		5.0	0.0	13.8		3.59	6.39	35.3	71.1
Sewer	P2	DP-P1, OS2, PP4, PP5, PP6	28.24		19.80	22.45		16.8	0		5.0	0.0	16.8		3.28	5.84	65.0	131.1
Sewer	P3	DP-P2, PP9, PP10, PP11	41.51		29.15	33.10		16.8	400		5.0	1.3	18.2		3.16	5.63	92.2	186.3
Sewer	P4	DP-P3, PP14, PP15, PP16, PP17	50.70		35.12	39.81		18.2	610		5.0	2.0	20.2		3.00	5.34	105.3	212.5
Sewer	P7	DP-P4, PP21, PP22, PP23	53.69		37.36	42.28		20.2	430		5.0	1.4	21.6		2.89	5.15	108.1	217.9

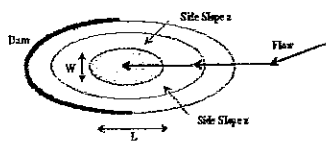
Redesigned Water Quality Volume

STAGE-STORAGE SIZING FOR POLYGONAL, ELLIPTICAL, OR IRREGULAR PONDS

Project: Patriot Park Water Quality Pond
Basin ID: ____________________







Design Information (Input):

Width of Pond Bottom, W = __________ ft
Length of Pond Bottom, L = __________ ft
Dam Side-slope (H:V), Z_d = __________ ft/ft

Right Triangular Pond [ ] OR...
:quilateral Triangular Pond [ ] OR...
Rectangular Pond [ ] OR...
Elliptical Pond [ ] OR...
Irregular Pond [ ] (Use Overide values in cells G32:G52)

Stage-Storage Relationship:

	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':	0.0000	0.0000	acre-ft.
Storage Requirement from Sheet 'Hydrograph':	0.0000	0.0000	acre-ft.
Water Quality Capture Design Volume from Sheet 'WQCV':	1.0948	acre-ft.	

Labels for WQCV, Minor, & Major Storage Stages (input)	Stage ft (input)	Side Slope (H:V) ft/ft Below El. (input)	Pond Width at Stage ft (output)	Pond Length at Stage ft (output)	Surface Area at Stage ft^2 (output)	Surface Area at Stage ft^2 User Overide	Volume Below Stage ft^3 (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
	6179.00					0		0.0000	0.0000	
	6179.50		0.00	0.00		6,985	1,746	0.1603	0.0401	
	6180.00		0.00	0.00		8,731	5,675	0.2004	0.1303	
	6180.50		0.00	0.00		18,818	12,563	0.4320	0.2884	
	6181.00		0.00	0.00		23,523	23,148	0.5400	0.5314	
	6181.50		0.00	0.00		24,545	35,165	0.5635	0.8073	
	6182.00		0.00	0.00		25,566	47,692	0.5869	1.0949	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
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							#N/A		#N/A	

DESIGN POINT PER REVISED MDDP

Scenario: Base

STORM CAD

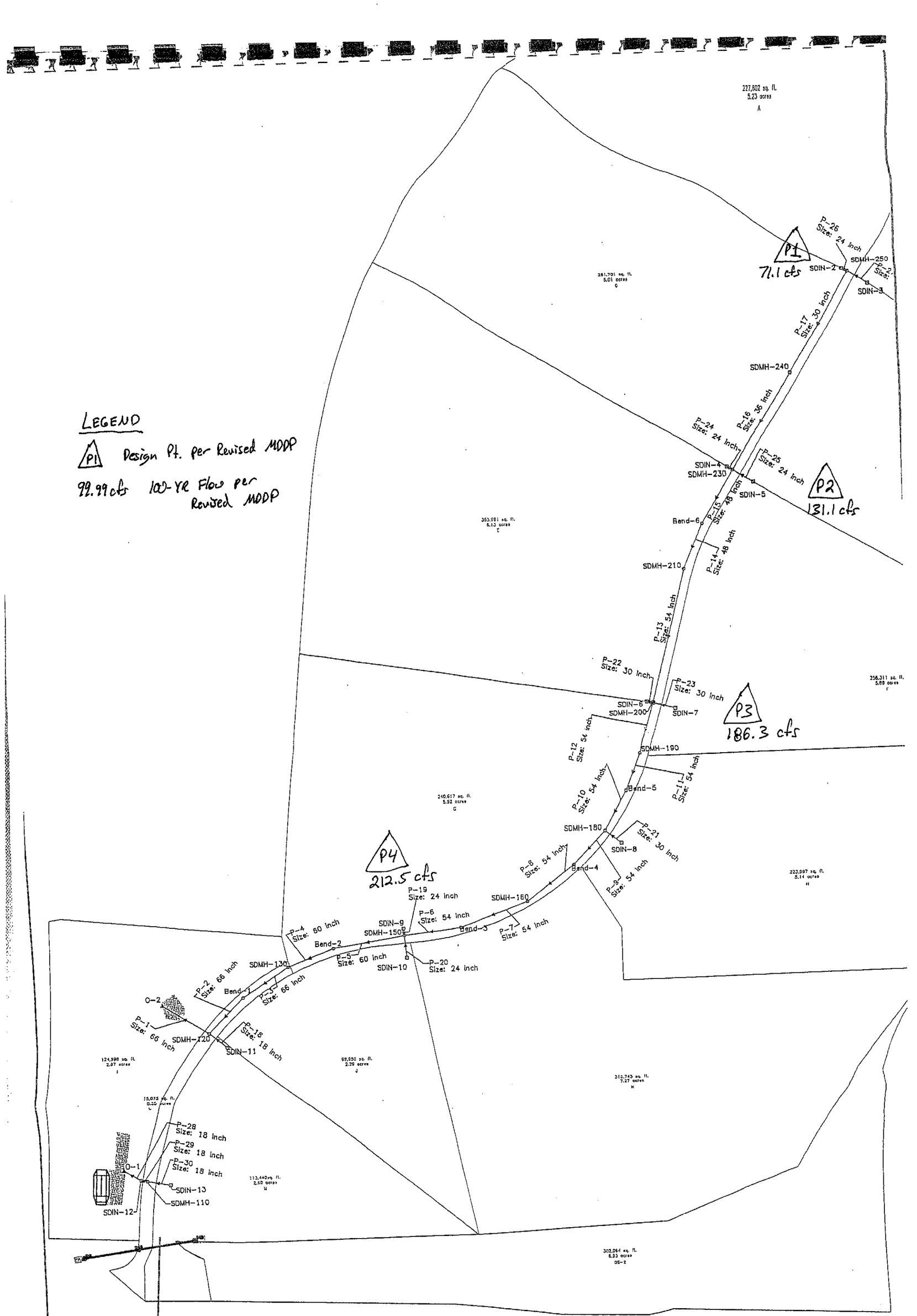
Report Output

BY NOLTE ASSOCIATES, INC.

	Label	Upstream Node	Downstream Node	Length (ft)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (%)	Section Size	Material	Total Flow (cfs)	Full Capacity (cfs)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Average Velocity (ft/s)
	P-1	SDMH-120	O-2	90.40	6,180.90	6,180.00	1.00	66 inch	Concrete	243.07	335.05	6,187.51	6,186.85	6,185.25	6,183.73	15.37
	P-2	Bend-1	SDMH-120	82.60	6,181.31	6,180.90	0.50	66 inch	Concrete	235.43	236.58	6,189.22	6,188.81	6,187.69	6,187.29	9.91
	P-3	SDMH-130	Bend-1	92.10	6,181.78	6,181.31	0.51	66 inch	Concrete	236.43	239.88	6,190.30	6,189.84	6,188.76	6,188.30	9.95
	P-4	Bend-2	SDMH-130	82.60	6,183.11	6,182.28	1.00	60 inch	Concrete	237.17	261.06	6,192.63	6,191.95	6,190.37	6,189.68	12.08
P4	P-5	SDMH-150	Bend-2	122.00	6,184.33	6,183.11	1.00	60 inch	Concrete	238.26	260.43	6,194.58	6,193.56	6,192.30	6,191.27	12.13
	P-6	Bend-3	SDMH-150	97.00	6,186.77	6,184.83	2.00	54 inch	Concrete	189.32	278.09	6,197.23	6,196.33	6,195.03	6,194.13	11.90
	P-7	SDMH-160	Bend-3	121.40	6,189.20	6,186.77	2.00	54 inch	Concrete	190.19	278.20	6,199.26	6,198.13	6,197.04	6,195.91	11.96
	P-8	Bend-4	SDMH-160	100.50	6,191.21	6,189.20	2.00	54 inch	Concrete	190.91	278.09	6,202.01	6,201.06	6,199.77	6,198.82	12.00
	P-9	SDMH-160	Bend-4	77.60	6,192.76	6,191.21	2.00	54 inch	Concrete	191.46	277.91	6,203.65	6,202.91	6,201.40	6,200.66	12.04
	P-10	Bend-5	SDMH-180	73.30	6,193.87	6,192.77	1.50	54 inch	Concrete	171.89	240.89	6,205.58	6,205.02	6,203.76	6,203.20	10.81
	P-11	SDMH-190	Bend-5	68.40	6,194.90	6,193.87	1.51	54 inch	Concrete	172.38	241.30	6,206.84	6,206.31	6,205.01	6,204.49	10.84
P3	P-12	SDMH-200	SDMH-190	92.80	6,196.29	6,194.90	1.50	54 inch	Concrete	173.03	240.66	6,209.03	6,208.31	6,207.19	6,206.47	10.88
	P-13	SDMH-210	SDMH-200	228.00	6,199.70	6,196.29	1.50	54 inch	Concrete	119.47	240.48	6,210.57	6,209.72	6,209.69	6,208.85	7.51
	P-14	Bend-6	SDMH-210	85.10	6,201.48	6,200.20	1.50	48 inch	Concrete	119.94	176.16	6,212.14	6,211.54	6,210.72	6,210.13	9.54
P2	P-15	SDMH-230	Bend-6	103.20	6,203.02	6,201.48	1.49	48 inch	Concrete	120.50	175.46	6,213.44	6,212.72	6,212.01	6,211.29	9.59
	P-16	SDMH-240	SDMH-230	187.70	6,207.78	6,204.02	2.00	36 inch	Concrete	71.89	94.40	6,217.09	6,214.91	6,215.48	6,213.30	10.17
P1	P-17	SDMH-250	SDMH-240	188.20	6,215.81	6,208.28	4.00	30 inch	Concrete	72.28	82.04	6,225.66	6,219.81	6,222.29	6,216.44	14.73
	P-18	SDIN-11	SDMH-120	37.90	6,184.79	6,184.03	2.01	18 inch	Concrete	11.47	14.87	6,188.39	6,187.94	6,187.74	6,187.29	6.49
	P-19	SDIN-9	SDMH-150	11.80	6,187.57	6,187.33	2.03	24 inch	Concrete	26.37	32.26	6,195.38	6,195.22	6,194.29	6,194.13	8.39
	P-20	SDIN-10	SDMH-150	37.50	6,188.27	6,187.33	2.51	24 inch	Concrete	32.76	35.81	6,196.60	6,195.82	6,194.91	6,194.13	10.43
	P-21	SDIN-8	SDMH-180	34.10	6,195.45	6,194.77	1.99	30 inch	Concrete	23.37	57.92	6,203.66	6,203.55	6,203.31	6,203.20	4.76
	P-22	SDIN-6	SDMH-200	10.30	6,198.49	6,198.28	2.01	30 inch	Concrete	33.97	58.56	6,209.66	6,209.59	6,208.92	6,208.85	6.92
	P-23	SDIN-7	SDMH-200	38.70	6,199.05	6,198.28	1.99	30 inch	Concrete	27.13	57.65	6,209.49	6,209.32	6,209.02	6,208.85	5.53
	P-24	SDIN-4	SDMH-230	10.50	6,205.23	6,205.02	2.00	24 inch	Concrete	26.01	31.99	6,214.50	6,214.36	6,213.44	6,213.30	8.28
	P-25	SDIN-5	SDMH-230	38.80	6,205.80	6,205.02	2.01	24 inch	Concrete	28.52	32.07	6,215.20	6,214.58	6,213.92	6,213.30	9.08
	P-26	SDIN-2	SDMH-250	10.30	6,216.52	6,216.31	2.04	24 inch	Concrete	21.07	32.30	6,225.77	6,225.68	6,225.07	6,224.98	6.71
	P-27	SDIN-3	SDMH-250	38.50	6,216.58	6,215.81	2.00	30 inch	Concrete	55.06	58.00	6,227.63	6,226.94	6,225.68	6,224.98	11.22
	P-28	SDIN-12	O-1	32.80	6,181.88	6,180.00	5.73	18 inch	Concrete	14.95	25.15	6,185.78	6,185.11	6,184.66	6,184.00	8.46
	P-29	SDMH-110	SDIN-12	10.20	6,182.04	6,181.88	1.57	18 inch	Concrete	12.86	13.16	6,186.64	6,186.49	6,185.82	6,185.66	7.28
	P-30	SDIN-13	SDMH-110	38.50	6,182.69	6,182.04	1.69	18 inch	Concrete	12.90	13.65	6,187.35	6,186.77	6,186.52	6,185.94	7.30
	P-35	I-13	O-3	186.60	6,184.00	6,176.00	4.29	30 inch	Concrete	12.28	84.92	6,185.63	6,179.00	6,185.18	6,176.64	12.31

P4	212.5
P3	186.5
P2	131.1
P1	71.1

100-YR FLOWS PER REVISED MDDP



NOLTE ENGINEERING

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DWG NAME: PRSTORMCAD.DWG

Patriot Park
StormCAD Layout

SHEET NUMBER 1
OF 1 SH
JOB NUMBE

APPENDIX C

STANDARD DESIGN CHARTS AND TABLES

2007 DRAINAGE, BRIDGE AND POND FEES -- CITY OF COLORADO SPRINGS
REVISED January 1, 2007

Basin Name		Drainage	Bridge	Pond Fees/Acre	
		Fee/Acre	Fee/Acre	Land	Facilities
Sand Creek*	1995	$8,946	$562	$1,070	$1,967
Spring Creek	1977	$7,841			
Templeton Gap	1977	$5,170	$56		
Douglas Creek	1981	$9,509	$210		
19th Street	1964	$2,978			
Pope's Bluff	1976	$3,027	$518		
Camp Creek	1964	$1,676			
Peterson Field	1984	$9,551	$441		
South Rockrimmon	1976	$3,554			
Pulpit Rock	1968	$5,014			
Dry Creek	1966	$4,314			
North Rockrimmon	1973	$4,547			
Cottonwood Creek**	2000	$10,963	$836		
Miscellaneous	n/a	$8,798			
Mesa	1986	$7,906			
21st Street	1977	$4,547			
Bear Creek	1980	$2,926	$275		
Southwest Area	1984	$9,951			
Windmill Gulch	1991	$10,410	$211	$3,055	
Black Squirrel Creek	1989	$10,369	$1,184	$789	
Monument Branch	1987	$6,984		$885	
Middle Tributary	1987	$5,169		$1,121	
Little Johnson	1988	$9,878		$1,227	
Big Johnson, Crews	1991	$11,319	$931	$241	
Fishers Canyon	1991	$9,483		$1,185	
Park Vista	2004	$12,640			

Notes for 2007 Fees:

All Drainage, Bridge and Detention Pond Facility Fees are increased by 10% over 2006; City Council Resolution, February 13, 2007.
Land Fees are based on the Park Land Dedication Fee of $76,602 per acre for 2007 (+ 45.7697% over 2006).

* Sand Creek Detention Pond Surcharges: Pond #2 (per Ridgeview MDDP) = $985/acre for 2007.

**Cottonwood Creek: The Drainage Fee consists of two components (capital improvements and land) that are adjusted annually using different procedures but are combined together for collection purposes. The 2007 Cottonwood Creek Drainage Fee = $10,963/ac. With $8,043/ac. for capital improvements (including $531/ac. to be paid to the City in cash) and + $2,920/ac. for land.

TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY 10 A&B*	10 C&D*	100 A&B*	100 C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
1/8 Acre or less	65	0.60	0.70	0.70	0.80
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries	7	0.30	0.35	0.55	0.60
Playgrounds	13	0.30	0.35	0.60	0.65
Railroad Yard Areas	40	0.50	0.55	0.60	0.65
Undeveloped Areas					
Historic Flow Analysis- Greenbelts, Agricultural	2	0.15	0.25	0.20	0.30
Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks	100	0.90	0.90	0.95	0.95
Roofs	90	0.90	0.90	0.95	0.95
Lawns	0	0.25	0.30	0.35	0.45

* Hydrologic Soil Group

9/30/90

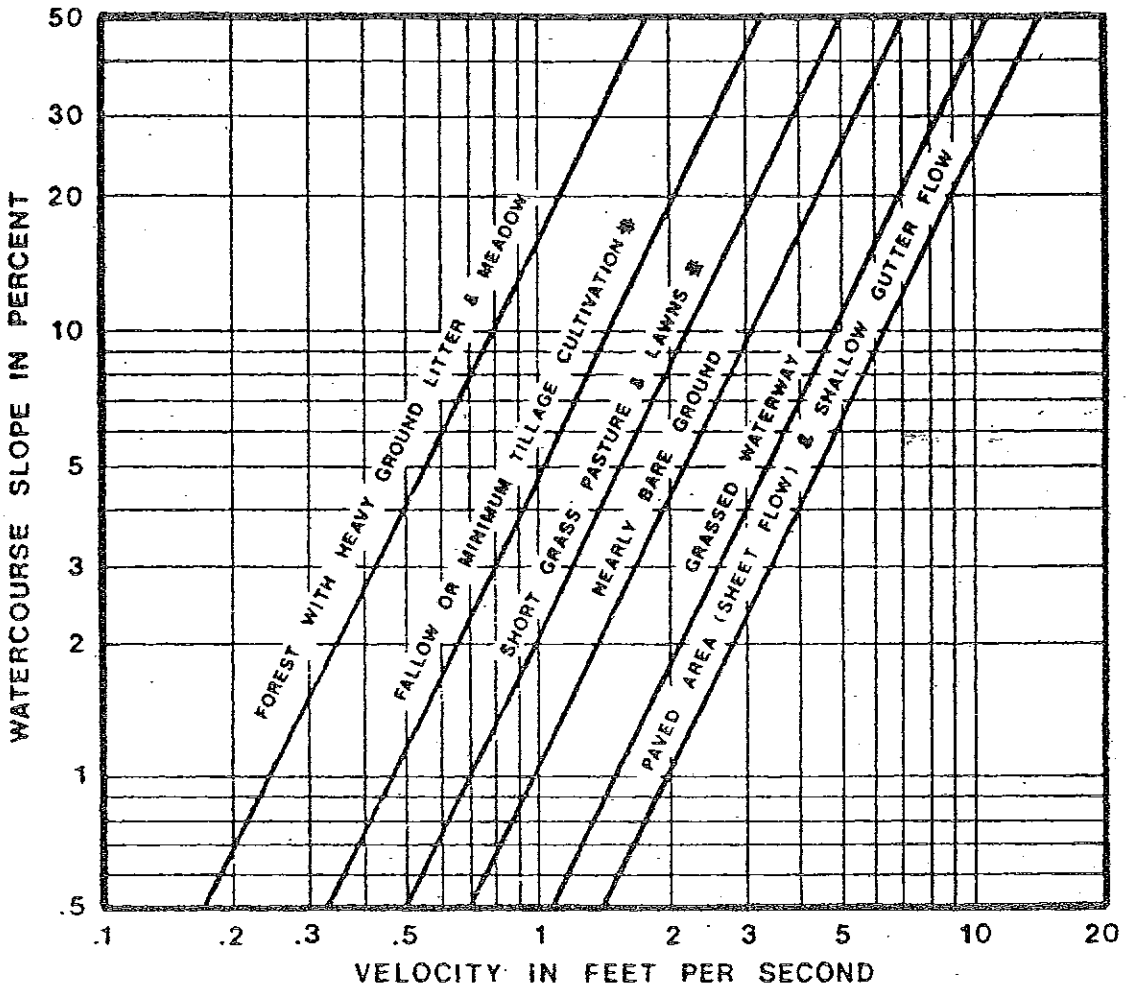

FIGURE RO-1

Estimate of Average Overland Flow Velocity for Use With the Rational Formula

APPENDIX D

EFFECTIVE FEMA HEC-2 MODEL OF THE SAND CREEK CHANNEL

(FINAL DRAINAGE REPORT FOR SAND CREEK CHANNEL IMPROVEMENTS AT PLATTE AVENUE, PATRIOT PARK CONCEPT PLAN AREA & PATRIOT PARK SUBDIVISION FILING NO. 1, BY MATRIX DESIGN GROUP, DATED AUGUST 2005)

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1*************************************************
 *  WATER SURFACE PROFILES                       *
 *  VERSION OF SEPTEMBER 1988                    *
 *  ERROR: 01,02                                 *
 *  UPDATED:  4 APRIL    1989                    *
 *  RUN DATE     9/26/95   TIME    4:19:13       *
 *************************************************

 ***************************************
 *  U.S. ARMY CORPS OF ENGINEERS       *
 *  THE HYDROLOGIC ENGINEERING CENTER  *
 *  609 SECOND STREET, SUITE D         *
 *  DAVIS, CALIFORNIA 95616-4687       *
 *  (916) 756-1104, (916) 551-1748     *
 ***************************************

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                                  X     X  X        X     X            X     X
                                  X     X  X        X                  X
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                                  X     X  X        X     X            X
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   HEC2 RELEASE DATED SEP 88 UPDATED APR  1989


   ERROR CORR -  01,02
   MODIFICATION -
 **************************************************

 T1       SAND CREEK LOMR  95.01.04 XSECS LOOKING L TO R DOWNSTREAM
 T2       REVISED FLOODWAY   CONDITION LOMRFWY.DAT
 T3       HIGHWAY 24 TO CRI&PACIFIC RR 100-YEAR FLOODWAY

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0        4         0         0         0         0         0         0   6145.95

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

       1        0        -1

 QT       4      1950      4230      5670      9200
 NC     .03       .03      .025        .1        .3
 X1      27        45      1394      2143      1450      1180      1160
 X3       0         0         0      1934         0      2143
 GR  6169.5      1000      6170      1042    6174.3      1084    6176.6      1126    6178.2      1173
 GR  6174.3      1202    6170.5      1249      6167      1294    6165.6      1329    6165.3      1369
 GR  6163.6      1405    6163.6      1416    6164.8      1442    6165.2      1509      6165      1536
 GR  6163.9      1556    6165.4      1583    6165.6      1614    6164.4      1624    6164.6      1665
 GR  6165.4      1680    6164.6      1726    6164.2      1781    6166.6      1796    6166.3      1820
 GR  6164.6      1855    6163.7      1871      6164      1934    6161.8      1945    6161.6      2027
 GR  6161.7      2098    6165.6      2143    6166.6      2188    6172.5      2254    6173.9      2282
 GR  6170.3      2388    6169.8      2454    6169.7      2540    6175.5      2621    6179.9      2686
 GR  6182.3      2736    6179.7      2778    6179.7      2859   6179.69      2938    6179.4      3000

 NC     .025      .025      .025        .3        .5
 X1       28        12      1390      1750       870       820       850
 X3        0         0         0      1407         0      1719
 GR     6192      1000      6190      1130    6189.3      1390    6176.9      1415    6176.9      1430
 GR  6176.9      1480      6178      1520      6180      1600      6180      1710      6182      1730
 GR  6189.3      1750      6190      2530

 SB     1.05       1.5       2.5         0       360        12      2140         0      6178    6176.9
          US HIGHWAY 24 (PLATTE AVENUE)
 X1     28.5         0         0         0        90        90        90
 X2        0         0         1    6185.2    6189.3
 X3        0         0         0      1407         0      1719
 BT        7      1000         0         0      1130         0         0      1390    6189.3    6189.3
 BT     1390    6189.3    6185.2      1750    6189.3    6185.2      1750    6189.3    6189.3      2530
 BT        0         0
1
     9/26/95       4:19:13                                                                    PAGE    2


 QT       4      1570      3350      4350      6740
 NC     .03       .03      .025        .1        .3
 X1      29        16      1220      1470      1050      1050      1050
 X3       0         0         0      1220         0      1470
 GR  6215.9      1000      6214      1020    6208      1036      6206      1052    6205.5      1070
 GR    6206      1090      6206      1130    6204      1160      6202      1220      6198      1240
 GR    6196      1300      6194      1320    6194      1420      6220      1470      6220      1650
 GR    6222      1670

 X1       30        10      1370      1545      1220      1280      1230
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X3        0         0         0      1431         0      1522
GR     6230      1000      6228      1010      6228      1130      6226      1180      6224      1370
GR     6216      1420      6214      1460      6209      1470      6209      1515      6232      1545

NC     .035      .035       .03        .1        .3
X1     30.5         5      1026      1133       565       565       565
X3        0         0         0      1033         0      1116
GR   6229.9      1000      6228      1026    6218.3      1041    6218.3      1111      6234      1133

X1     30.6         5      1026      1133         1         1         1
X3        0         0         0      1029         0      1121
GR   6229.9      1000      6228      1026    6221.3      1036    6221.3      1116      6234      1133

X1       31         8      1080      1168        95        95        95
X3        0         0         0      1080         0      1157
GR     6240      1000      6238      1080      6223      1080    6222.5      1099    6222.5      1149
GR     6233      1168      6238      1168    6238.8      1230

NC     .035      .035       .02        .2        .4
SB     1.05       1.5       2.5         0        50         2       725         0      6224    6222.5
            GALLEY ROAD
X1     31.2         8      1080      1168       135       135       135
X2        0         0         1      6233      6238
X3        0         0         0      1080         0      1158
BT        6      1000      6240      6240      1080      6238      6238      1080      6238      6233
BT     1168      6238      6233      1168      6238      6238      1230    6238.8    6238.8
GR     6240      1000      6238      1080      6225      1080      6224      1099      6224      1149
GR     6233      1168      6238      1168    6238.8      1230

QT        4      1570      3390      4370      6760
NC      .03       .05      .025        .1        .3
X1     31.3         0         0         0        50        50        50         0        .5
X3        0         0         0      1080         0      1158

X1     31.6         6      1000      1098       435       435       435
X3        0         0         0      1018         0      1082
GR     6244      1000    6234.1      1026    6230.2      1032    6230.2      1072    6234.1      1076
GR     6244      1098
1
     9/26/95      4:19:13                                                                    PAGE     3

X1     31.7         4      1000      1098         1         1         1
X3        0         0         0      1011         0      1088
GR     6244      1000    6234.1      1026    6234.1      1076      6244      1098

X1       32        10      1315      1440       573       573       573
X3        0         0         0      1321         0      1412
GR     6254      1000      6253      1085      6254      1150      6255      1218      6254      1270
GR     6252      1315      6245      1346      6245      1392      6258      1440      6260      1470

X1       33         9      1150      1330      1250      1270      1265
X3        0         0         0      1160         0      1275
GR     6276      1000      6274      1050      6272      1150      6266      1190      6266      1260
GR     6276      1295      6278      1305      6290      1330      6300      1385

X1       34        13      1240      1262      1500      1550      1480
X3        0         0         0      1200         0      1314
GR     6300      1000      6298      1010      6296      1040      6294      1170      6292      1235
GR     6290      1240      6288      1243      6286      1255      6290      1262      6292      1265
GR     6294      1310      6304      1332      6306      1520

QT        4      1650      3490      4470      6900
NC     .035      .035       .02        .1        .3
X1       35         4      1000      1160       500       460       490
X3        0         0         0      1018         0      1131
GR     6312      1000      6298      1025      6298      1120      6312      1160

NC     .035      .035       .02        .2        .4
SB     1.05       1.5       2.5         0       130         6      1254         1      6299      6298
          PALMER PARK BOULEVARD
X1     35.5         0         0         0        70        70        70         0         1         0
X3        0         0         0      1018         0      1131
X2        0         0         1    6308.4    6311.8
BT        6      1000      6312      6312      1000      6312    6308.4      1025      6312    6308.4
BT     1120      6312    6308.4      1160      6312    6308.4      1160      6312      6312

NC      .03       .03      .025        .1        .3
X1       36        10      1170      1255      1050      1120      1040
X3        0         0         0      1170         0      1248
GR     6328      1000      6322      1050      6322      1170      6315      1170      6315      1240
GR     6324      1255      6324      1320      6326      1340      6326      1550      6328      1650

X1     36.2         7      1110      1190       410       410       410
GR     6334      1000      6332      1090      6330      1110    6321.7      1125    6321.7      1180
GR     6330      1190      6332      1215
X3        0         0         0      1110         0      1190

NC      .03       .03      .016        .1        .3
X1     37.1         6      1415      1495       590       640       610
X3        0         0         0      1415         0      1495
GR     6340      1000    6346.5      1415    6331.5      1415    6331.5      1495    6348.9      1495
GR     6350      1650
1
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3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=    1170.0    1248.0  TYPE=       1  TARGET=       78.000
    36.00      4.92  6319.92  6319.92       .00  6322.25      2.34      4.48      .21  6322.00
    4470.        0.    4470.       0.        0.      365.       0.       99.      29.  100000.00
      .24       .00    12.26       .00      .000     .025     .000      .000  6315.00  1170.00
  .006048     1050.    1040.    1120.       20         8        0       .00    78.00  1248.00
0
 *SECNO 36.200
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
    36.20      5.58  6327.28  6327.28       .00  6329.76      2.48      2.41      .04  6330.00
    4470.        0.    4470.       0.        0.      354.       0.      102.      30.  6330.00
      .25       .00    12.63       .00      .000     .025     .000      .000  6321.70  1114.91
  .005728      410.     410.     410.       20         8        0       .00    71.82  1186.73
0
 CCHV=      .100 CEHV=      .300
 *SECNO 37.100
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED

 3470 ENCROACHMENT STATIONS=     1415.0    1495.0  TYPE=       1  TARGET=       80.000
    37.10      4.57  6336.07  6336.07       .00  6338.39      2.32      2.28      .02  6346.50
    4470.        0.    4470.       0.        0.      366.       0.      107.      31.  6331.50
      .27       .00    12.22       .00      .000     .016     .000      .000  6331.50  1415.00
  .002634      590.     610.     640.       20        15        0       .00    80.00  1495.00
0
 CCHV=      .200 CEHV=      .400
1
     9/26/95        4:19:13                                                                PAGE   13

    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS    BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA    LEFT/RIGHT
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN      SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID     ENDST


 SPECIAL BRIDGE

 5227 DOWNSTREAM ELEV IS     6335.09 , NOT     6336.07 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

 SB  XK         XKOR       COFQ       RDLEN      BWC        BWP        BAREA      SS         ELCHU      ELCHD
      1.05       1.50       2.50        .00      80.00       8.00     960.00        .00    6333.00    6331.50

 *SECNO 37.200
 6840, FLOW IS BY WEIR AND LOW FLOW

 3301 HV CHANGED MORE THAN HVINS


 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.71

 3420 BRIDGE W.S.=     6339.43 BRIDGE VELOCITY=        8.64      CALCULATED CHANNEL AREA=        463.

  EGPRS       EGLWC       H3        QWEIR       QLOW       BAREA    TRAPEZOID       ELLC       ELTRD      WEIRLN
                                                                        AREA
    6345.00    6340.59       3.36        15.      4469.       960.       864.     6345.00    6340.00        38.


 3470 ENCROACHMENT STATIONS=     1415.0    1495.0  TYPE=       1  TARGET=       80.000

 3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      6346.50 ELREA=      6333.00

          POWERS BOULEVARD
    37.20      6.41  6339.41       .00       .00  6340.59      1.18      2.20      .00  6346.50
    4470.        0.    4470.       0.        0.      513.       0.      109.      31.  6333.00
      .27       .00     8.71       .00      .000     .016     .000      .000  6333.00  1415.00
  .000898      150.     150.     150.        3         0        3       .00    80.00  1495.00
0
 CCHV=      .100 CEHV=      .300
 *SECNO 37.300

 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .55

    37.30      5.81  6339.31       .00       .00  6340.74      1.44       .08       .08  6345.00
    4470.        0.    4470.       0.        0.      465.       0.      109.      32.  6345.00
      .27       .00     9.62       .00      .000     .025     .000      .000  6333.58  1000.00
  .003006       50.      50.      50.        2         0        0       .00    80.00  1080.00
0
1
     9/26/95        4:19:13                                                                PAGE   14

    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS    BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA    LEFT/RIGHT
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN      SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID     ENDST
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*SECNO 38.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      1140.0    1383.0  TYPE=       1  TARGET=       243.000
     38.00      3.80  6352.80  6352.80       .00  6354.24      1.44      3.68       .00  6360.00
     4470.        0.    4378.      92.         0.      451.      19.       119.       34.    6350.00
       .30       .00     9.71     4.89       .000      .025      .030      .000  6349.00  1181.13
   .006388      870.     870.     870.         20        14         0       .00   167.33  1348.45
0
 *SECNO 39.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      1335.0    1665.0  TYPE=       1  TARGET=       330.000
          WAYNOKA ROAD
     39.00      3.88  6373.68  6373.68       .00  6374.86      1.18      6.28       .03  6376.00
     4470.        0.    4470.       0.         0.      514.       0.       129.       38.    6378.00
       .33       .00     8.70      .00       .000      .025      .000      .000  6369.80  1378.94
   .006835      950.     950.     950.         20         5         0       .00   217.73  1596.67
0
 *SECNO 4240.400
7185 MININUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      1555.0    1860.0  TYPE=       1  TARGET=       305.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=       6396.00 ELREA=     100000.00

   4240.40      2.26  6382.26  6382.26       .00  6383.36      1.10      4.65       .01  6396.00
     4400.        0.    4400.       0.         0.      523.       0.       137.       42. 100000.00
       .35       .00     8.42      .00       .000      .025      .000      .000  6380.00  1593.65
   .007057      670.     670.     670.          3        11         0       .00   237.94  1831.59
0
 *SECNO 4240.300
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
1
     9/26/95        4:19:13                                                                    PAGE   15

    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA     LEFT/RIGHT
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN       SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST


3470 ENCROACHMENT STATIONS=      1555.0    1860.0  TYPE=       1  TARGET=       305.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=       6396.00 ELREA=     100000.00

   4240.30      2.24  6386.24  6386.24       .00  6387.33      1.10       .04       .00  6396.00
     4400.        0.    4400.       0.         0.      524.       0.       137.       42. 100000.00
       .35       .00     8.40      .00       .000      .025      .000      .000  6384.00  1591.61
   .007199        5.       5.       5.         20         5         0       .00   243.18  1834.79
0
 *SECNO 4240.000

3265 DIVIDED FLOW

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      2020.0    2250.0  TYPE=       1  TARGET=       230.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=       6403.20 ELREA=     100000.00

          CHICAGO, ROCK ISLAND RAILROAD
   4240.00      3.87  6389.57  6389.57       .00  6390.81      1.24      1.81       .04  6403.20
     4400.        0.    4400.       0.         0.      493.       0.       140.       43. 100000.00
       .36       .00     8.93      .00       .000      .025      .000      .000  6385.70  2023.60
   .007866      260.     240.     260.         20        17         0       .00   204.97  2246.57
0
1
     9/26/95        4:19:13                                                                    PAGE   16



                                                                    THIS RUN EXECUTED  9/26/95      4:19:28

 **************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED APR  1989


  ERROR CORR -  01,02
  MODIFICATION -
 **************************************************
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

HIGHWAY 24 TO CRI&PACIF

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	27.000	.00	.00	.00	6161.60	5670.00	6164.95	6164.95	6166.41	65.04	9.71	584.22	703.07
*	28.000	850.00	.00	.00	6176.90	5670.00	6180.90	6180.90	6182.01	73.85	8.48	669.01	659.79
	28.500	90.00	6189.30	6185.20	6176.90	5670.00	6181.15	.00	6182.04	51.04	7.58	747.92	793.68
*	29.000	1050.00	.00	.00	6194.00	4350.00	6197.64	6197.64	6198.97	66.22	9.26	469.56	534.58
*	30.000	1230.00	.00	.00	6209.00	4350.00	6215.65	6215.65	6217.74	50.89	6.03	395.77	609.76
*	30.500	565.00	.00	.00	6218.30	4350.00	6223.06	6223.06	6225.29	105.42	8.07	365.29	423.66
*	30.600	1.00	.00	.00	6221.30	4350.00	6225.67	6225.67	6227.77	109.60	7.72	376.55	415.52
*	31.000	95.00	.00	.00	6222.50	4350.00	6227.40	6227.40	6229.73	88.08	12.25	355.12	463.50
	31.200	135.00	6238.00	6233.00	6224.00	4350.00	6228.42	.00	6231.36	57.18	13.75	316.26	575.28
*	31.300	50.00	.00	.00	6224.50	4370.00	6229.46	6229.46	6231.77	60.65	12.21	358.04	561.11
*	31.600	435.00	.00	.00	6230.20	4370.00	6237.00	6237.00	6239.81	52.10	13.61	341.08	605.40
*	31.700	1.00	.00	.00	6234.10	4370.00	6239.68	6239.68	6242.09	179.60	15.09	354.30	326.09
*	32.000	573.00	.00	.00	6245.00	4370.00	6250.69	6250.69	6252.92	55.28	12.32	393.01	587.76
*	33.000	1265.00	.00	.00	6266.00	4370.00	6270.40	6270.40	6272.20	61.22	10.76	406.04	558.51
*	34.000	1480.00	.00	.00	6286.00	4370.00	6296.21	6296.21	6298.30	35.28	14.07	509.06	735.76
*	35.000	490.00	.00	.00	6298.00	4470.00	6301.94	6301.94	6303.78	110.40	11.22	410.21	425.43
*	35.500	70.00	6311.80	6308.40	6299.00	4470.00	6303.17	.00	6304.80	32.19	10.24	436.41	787.80

1

9/26/95 4:19:13 PAGE 17

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	36.000	1040.00	.00	.00	6315.00	4470.00	6319.92	6319.92	6322.25	60.48	12.26	364.51	574.79
*	36.200	410.00	.00	.00	6321.70	4470.00	6327.28	6327.28	6329.76	57.28	12.63	353.97	590.61
*	37.100	610.00	.00	.00	6331.50	4470.00	6336.07	6336.07	6338.39	26.34	12.22	365.85	871.03
*	37.200	150.00	6340.00	6345.00	6333.00	4470.00	6339.41	.00	6340.59	8.98	8.71	513.43	1491.37
*	37.300	50.00	.00	.00	6333.50	4470.00	6339.31	.00	6340.74	30.06	9.62	464.65	815.32
*	38.000	870.00	.00	.00	6349.00	4470.00	6352.80	6352.80	6354.24	63.88	9.71	469.64	559.27
*	39.000	950.00	.00	.00	6369.80	4470.00	6373.68	6373.68	6374.86	68.35	8.70	513.60	540.69
*	4240.400	670.00	.00	.00	6380.00	4400.00	6382.26	6382.26	6383.36	70.57	8.42	522.61	523.78
*	4240.300	5.00	.00	.00	6384.00	4400.00	6386.24	6386.24	6387.33	71.99	8.40	523.85	518.59
*	4240.000	240.00	.00	.00	6385.70	4400.00	6389.57	6389.57	6390.81	78.66	8.93	492.59	496.11

1

9/26/95 4:19:13 PAGE 18

HIGHWAY 24 TO CRI&PACIF

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	27.000	5670.00	6164.95	.00	.00	19.00	201.49	.00
*	28.000	5670.00	6180.90	.00	15.95	.00	311.99	850.00
	28.500	5670.00	6181.15	.00	.25	.00	312.00	90.00
*	29.000	4350.00	6197.64	.00	16.49	.00	176.14	1050.00
*	30.000	4350.00	6215.65	.00	18.02	.00	91.00	1230.00
*	30.500	4350.00	6223.06	.00	7.40	.00	82.35	565.00
*	30.600	4350.00	6225.67	.00	2.62	.00	91.52	1.00

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CAUTION SECNO=      32.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=      33.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      33.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      33.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      34.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      34.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      34.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      35.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      35.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
1
    9/26/95       4:19:13                                                    PAGE   21

CAUTION SECNO=      35.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      35.500  PROFILE=  1  HYDRAULIC JUMP D.S.
WARNING SECNO=      35.500  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=      36.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      36.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      36.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      36.200  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      36.200  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      36.200  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      37.100  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      37.100  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      37.100  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      37.200  PROFILE=  1  HYDRAULIC JUMP D.S.
WARNING SECNO=      37.200  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=      37.300  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=      38.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      38.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      38.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      39.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      39.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      39.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=    4240.400  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    4240.400  PROFILE=  1  MINIMUM SPECIFIC ENERGY

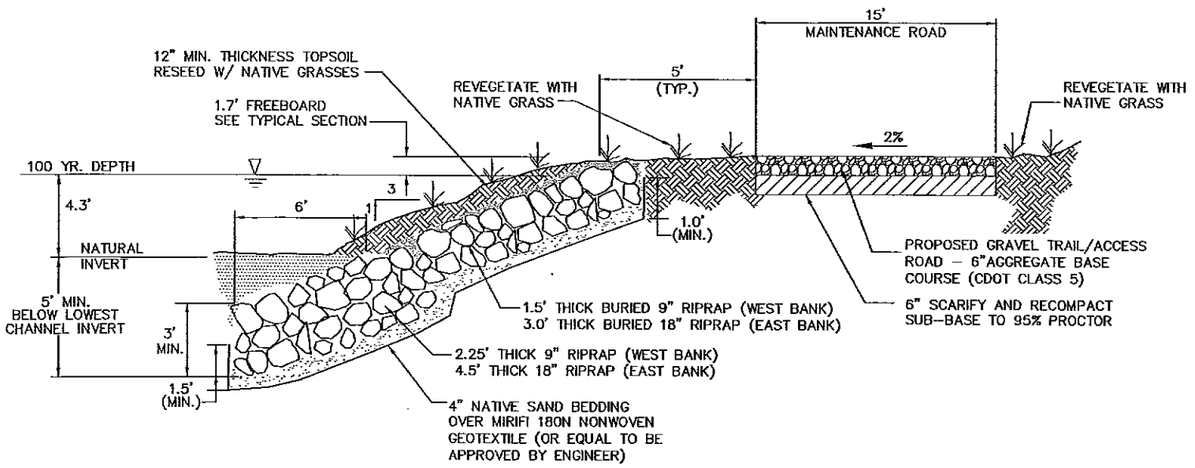
CAUTION SECNO=    4240.300  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    4240.300  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=    4240.300  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=    4240.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    4240.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=    4240.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
```

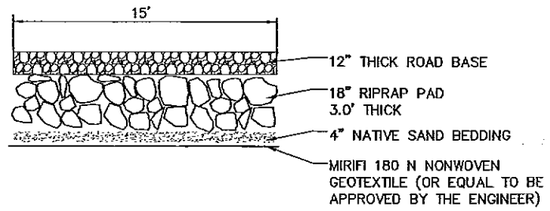
APPENDIX E

EXISTING SAND CREEK CHANNEL HYDRAULICS
HEC-RAS

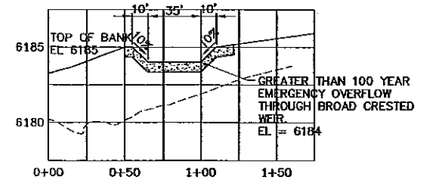
(FINAL DRAINAGE REPORT FOR SAND CREEK CHANNEL IMPROVEMENTS AT PLATTE AVENUE, PATRIOT PARK CONCEPT PLAN AREA & PATRIOT PARK SUBDIVISION FILING NO. 1, BY MATRIX DESIGN GROUP, DATED AUGUST 2005)



RIPRAP LINING DETAIL FOR
100-YR. CHANNEL SECTION
NTS

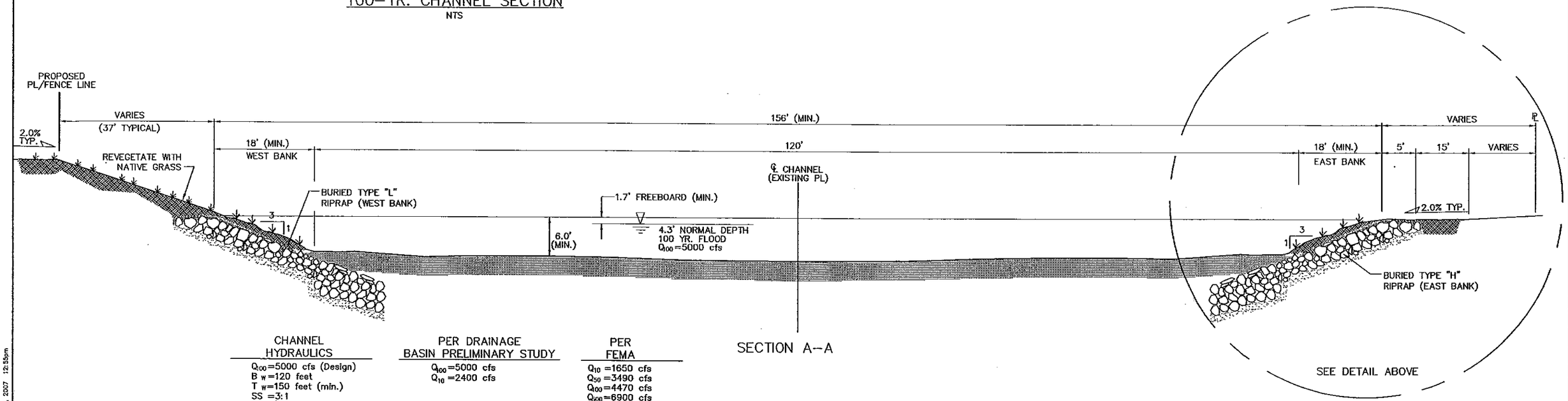


MAINTENANCE ROAD/TRAIL
CHANNEL ACCESS RIPRAP DETAIL
NTS



SECTION PROVIDED BY NOLTE AND ASSOCIATES, SEPTEMBER 2005. THIS SECTION IS PROVIDED FOR INFORMATION ONLY. SEE NOLTE PLANS FOR CONSTRUCTION DETAILS.

WATER QUALITY POND
OVERFLOW STRUCTURE
SCALE: HORZ.: 1"=50'
VERT.: 1"=5'



CHANNEL HYDRAULICS	PER DRAINAGE BASIN PRELIMINARY STUDY	PER FEMA
Q_{100}=5000 cfs (Design)	Q_{100}=5000 cfs	Q_{10} =1650 cfs
B_w=120 feet	Q_{10} =2400 cfs	Q_{50} =3490 cfs
T_w=150 feet (min.)		Q_{100}=4470 cfs
SS =3:1		Q_{500}=6900 cfs
S_o =0.06%		
n =0.032 (WEIGHTED)		
V_{100}=8.6 FPS		

SECTION A--A

100 YR. CHANNEL
SAND CREEK
NTS

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STATEMENT:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.
RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

REVIEW:

TRAFFIC ENGINEERING:_____DATE_____
CURB AND GUTTER REVIEW:_____DATE_____
FINAL DESIGN REVIEW:_____DATE_____
DRAINAGE DESIGN:_____DATE:_____
FILED IN ACCORDANCE WITH SECTION 7-7-906 OF THE CODE OF COLORADO SPRINGS 2001, AS AMMENDED.

DESIGN DATA:
SIDEWALKS: WIDTH _____
LOCATION: ATTACHED ☐
DETACHED ☐

CURB TYPE 1 ☐ 2 ☐ 3 ☐ 4 ☐
R/W WIDTH _____ F/C-F/C _____
STREET TYPE_____
HWEEM_____

ASPHALT THICKNESS:
AC SURFACE _____
AC BASE _____

AGGREGATE BASE THICKNESS:
CLASS 6 _____
CLASS 5 _____
CLASS 2 _____

SCALE: HORIZ. _____ VERT. _____

BENCHMARK:
FIMS MONUMENT PW 16 IS A 2-INCH DIAMETER ALUMINUM CAP STAMPED "CSU FIMS CONTROL PW 16" ON THE NORTH SIDE OF THE BASE OF LIGHT POLE NUMBER 10165 AT THE SOUTHEAST CORNER OF THE TRAFFIC ISLAND AT THE NORTHWEST CORNER OF GALLEY ROAD AND POWERS BOULEVARD.
ELEVATION = 6250.374

REVISIONS:

NO.	DESCRIPTION	DATE

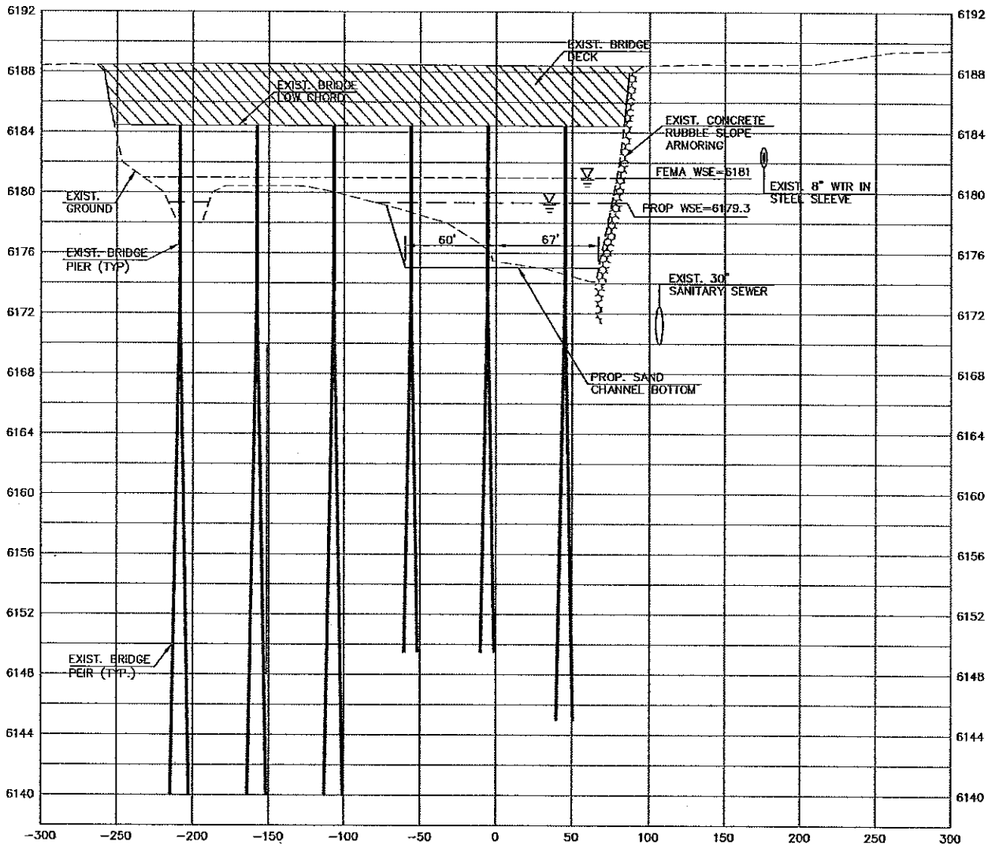
ENGINEER:

DESIGNED BY: RGG DATE: MAY, 2005
DRAWN BY: GES DATE: MAY, 2005
CHECKED BY: RGG DATE: MAY, 2005

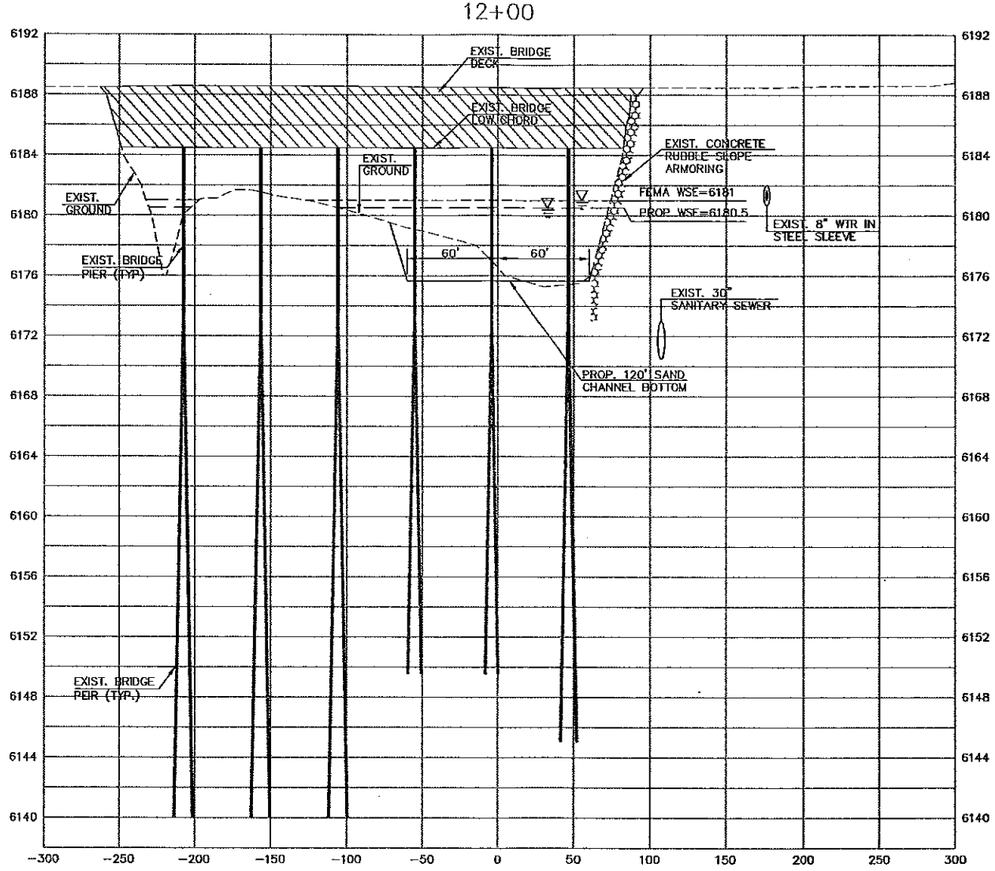
PATRIOT PARK CONCEPT PLAN AREA
SAND CREEK CHANNEL IMPROVEMENTS

PROJECT SAND CREEK AT EAST PLATTE AVENUE
STA_____TO_____
CITY PROJECT NO._____
DRAINAGE BASIN SAND CREEK
JOB NO. 05.168.004 SHEET 4 OF 8

11+40



12+00



NOTE:
BRIDGE AND PIER INFORMATION BASED UPON AS-BUILT RECORD DRAWINGS FOR PLATTE AVENUE TWIN BRIDGES OVER SAND CREEK, STRUCTURE I-18-A & I-18-N, CONSTRUCTION COMPLETED JULY 25, 1968.

GRAPHIC SCALE

50 0 25 50 100
(IN FEET)
1 inch = 50 ft.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

STATEMENT:

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REVIEW:

TRAFFIC ENGINEERING:_____ DATE _____
CURB AND GUTTER REVIEW:_____ DATE _____
FINAL DESIGN REVIEW:_____ DATE _____
DRAINAGE DESIGN:_____ DATE _____
FILED IN ACCORDANCE WITH SECTION 7-7-906 OF THE CODE OF COLORADO SPRINGS 2001, AS AMMENDED.

DESIGN DATA:
SIDEWALKS: WIDTH _____
LOCATION: ATTACHED ☐
DETACHED ☐

CURB TYPE 1 ☐ 2 ☐ 3 ☐ 4 ☐
R/W WIDTH _____ F/C-F/C _____
STREET TYPE _____
HYCEM _____

ASPHALT THICKNESS:
AC SURFACE _____
AC BASE _____

AGGREGATE BASE THICKNESS:
CLASS 6 _____
CLASS 5 _____
CLASS 2 _____

SCALE: HORIZ. 50' VERT. 5'

BENCHMARK:
FIMS MONUMENT PW 16 IS A 2-INCH DIAMETER ALUMINUM CAP STAMPED "CSU FIMS CONTROL PW 16" ON THE NORTH SIDE OF THE BASE OF LIGHT POLE NUMBER 10165 AT THE SOUTHEAST CORNER OF THE TRAFFIC ISLAND AT THE NORTHWEST CORNER OF GALLEY ROAD AND POWERS BOULEVARD.
ELEVATION = 6250.374

REVISIONS:

NO.	DESCRIPTION	DATE

ENGINEER:

DESIGNED BY: RGG DATE: MAY, 2005
DRAWN BY: GES DATE: MAY, 2005
CHECKED BY: RGG DATE: MAY, 2005

PATRIOT PARK CONCEPT PLAN AREA
SAND CREEK CHANNEL IMPROVEMENTS

PROJECT SAND CREEK AT EAST PLATTE AVENUE
STA _____ TO _____
CITY PROJECT NO. _____
DRAINAGE BASIN SAND CREEK
JOB NO. 05.168.004 SHEET 5 OF 8

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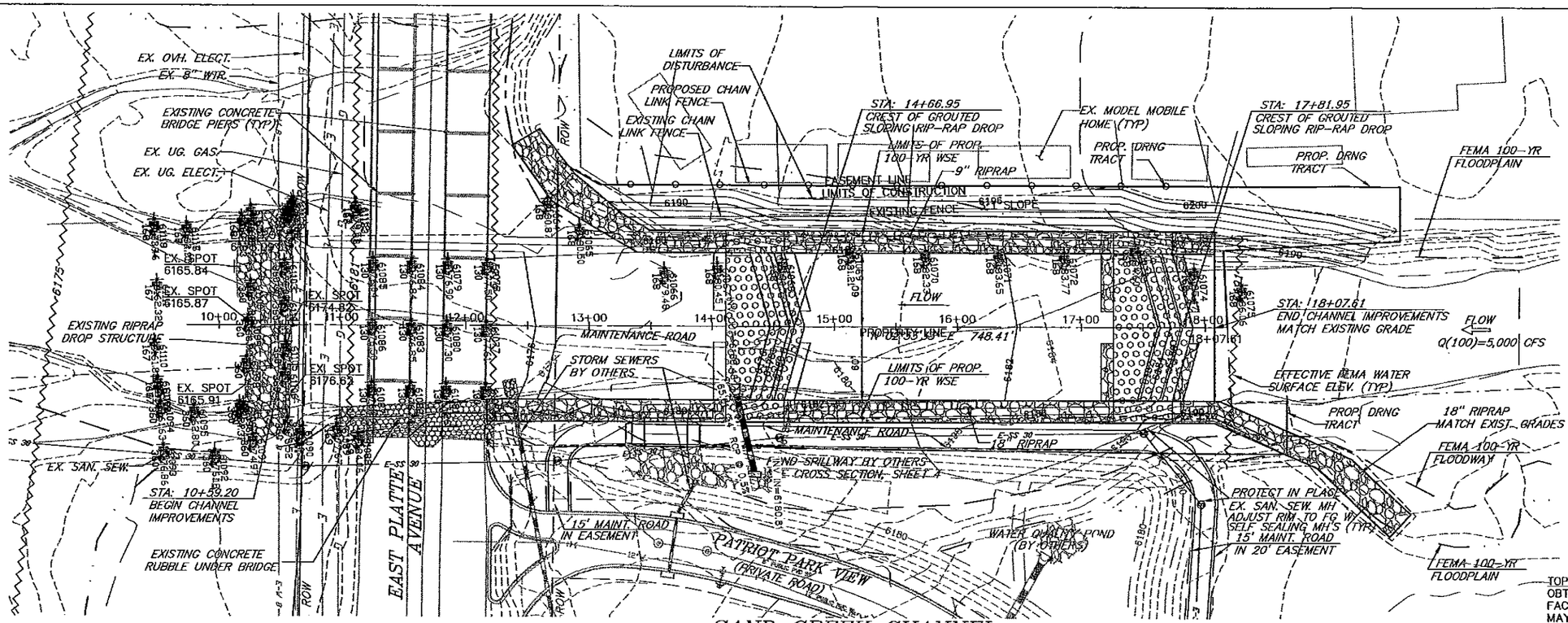

GRAPHIC SCALE

(IN FEET)
1 inch = 50 ft.

LEGEND

- 6520 PROPOSED CONTOUR
- 6520 EXISTING CONTOUR
- DRAINAGE CHANNEL
- EXIST. CONC. RUBBLE
- PROP. RIPRAP
- PROP. GROUTED RIPRAP
- EFFECTIVE FEMA 100-YR FLOODWAY
- EFFECTIVE FEMA 100-YR FLOODPLAIN
- PROPOSED 100-YR LIMITS
- 6520 EFFECTIVE FEMA WATER SURFACE ELEV.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
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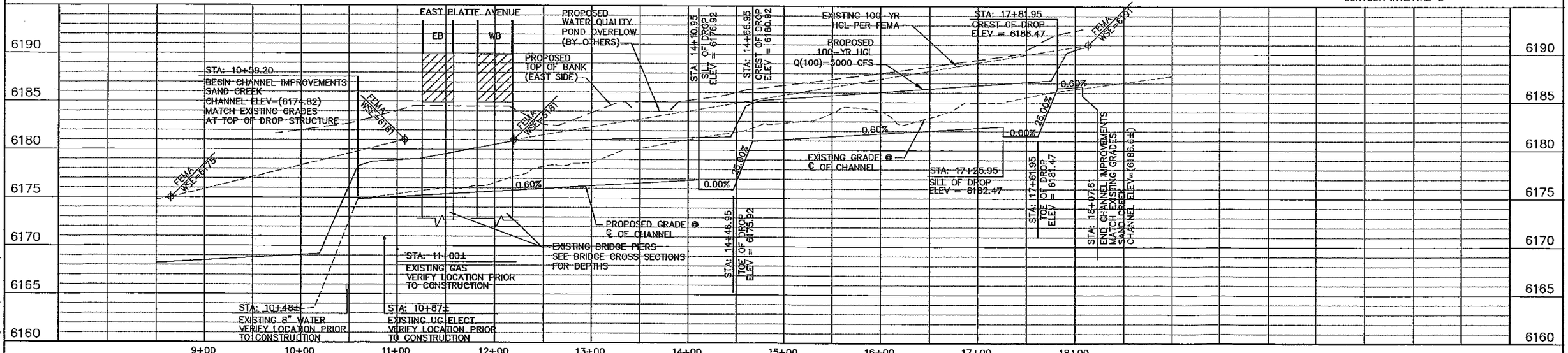
TOPOGRAPHIC MAPPING:
OBTAINED FROM COLORADO SPRINGS UTILITIES FACILITIES INFORMATION MANAGEMENT SYSTEM, MAY 2005. ADDITIONAL FIELD SURVEY COMPLETED MAY 2005.
CONTOUR INTERVAL=2'



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STATEMENT:
THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.
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REVIEW:
TRAFFIC ENGINEERING: _____ DATE _____
CURB AND GUTTER REVIEW: _____ DATE _____
FINAL DESIGN REVIEW: _____ DATE _____
DRAINAGE DESIGN: _____ DATE _____
FILED IN ACCORDANCE WITH SECTION 7-7-906 OF THE CODE OF COLORADO SPRINGS 2001, AS AMMENDED.

DESIGN DATA:
SIDEWALKS: WIDTH _____
LOCATION: ATTACHED ☐ DETACHED ☐
CURB TYPE 1 ☐ 2 ☐ 3 ☐ 4 ☐
R/W WIDTH _____ F/C-F/C _____
STREET TYPE _____
HVEEM _____
ASPHALT THICKNESS:
AC SURFACE _____
AC BASE _____
AGGREGATE BASE THICKNESS:
CLASS 6 _____
CLASS 5 _____
CLASS 2 _____

SCALE: HORIZ. 50' VERT. 5'
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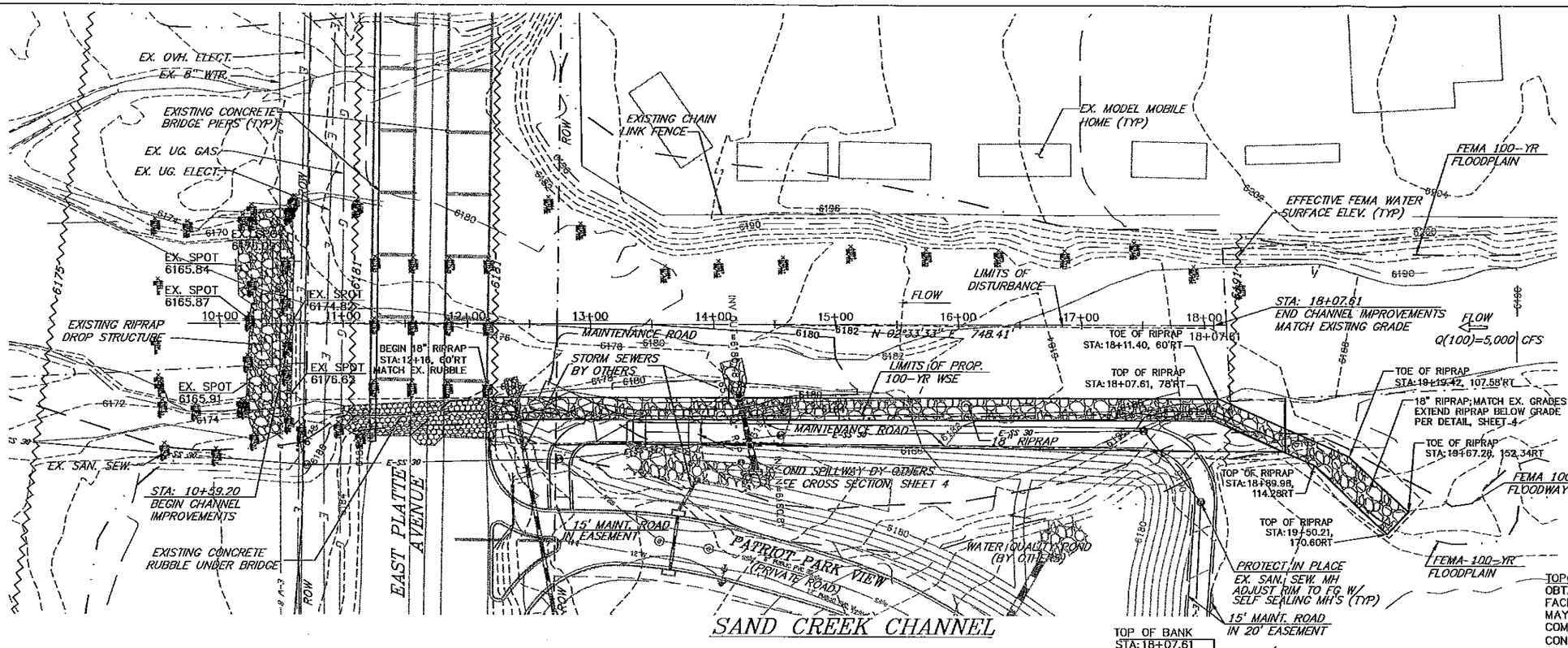
ELEVATION = 6250.374

REVISIONS:
NO. DESCRIPTION DATE

ENGINEER:
DESIGNED BY: RGG DATE: MAY, 2005
DRAWN BY: GES DATE: MAY, 2005
CHECKED BY: RGG DATE: MAY, 2005

PATRIOT PARK CONCEPT PLAN AREA
SAND CREEK CHANNEL IMPROVEMENTS

PROJECT SAND CREEK AT EAST PLATTE AVENUE
STA _____ TO _____
CITY PROJECT NO. _____
DRAINAGE BASIN SAND CREEK
JOB NO. 05.168.004 SHEET 6 OF 8



GRAPHIC SCALE

(IN FEET)
1 inch = 50 ft.

LEGEND

- PROPOSED CONTOUR
- EXISTING CONTOUR
- DRAINAGE CHANNEL
- EXIST. CONC. RUBBLE
- PROP. RIPRAP
- PROP. GROUTED RIPRAP
- EFFECTIVE FEMA 100-YR FLOODWAY
- EFFECTIVE FEMA 100-YR FLOODPLAIN
- PROPOSED 100-YR LIMITS
- EFFECTIVE FEMA WATER SURFACE ELEV.

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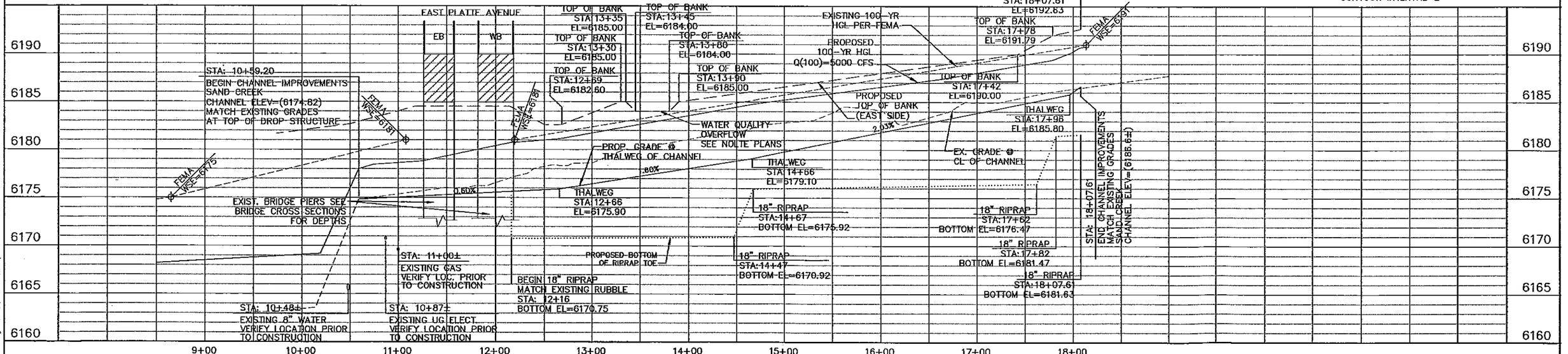
TOPOGRAPHIC MAPPING:
OBTAINED FROM COLORADO SPRINGS UTILITIES FACILITIES INFORMATION MANAGEMENT SYSTEM, MAY 2005. ADDITIONAL FIELD SURVEY COMPLETED MAY 2005.
CONTOUR INTERVAL=2'



INTERIM CHANNEL DESIGN

STATEMENT:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.
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REVIEW:

TRAFFIC ENGINEERING: _____ DATE _____
CURB AND GUTTER REVIEW: _____ DATE _____
FINAL DESIGN REVIEW: _____ DATE _____
DRAINAGE DESIGN: _____ DATE _____
FILED IN ACCORDANCE WITH SECTION 7-7-906 OF THE CODE OF COLORADO SPRINGS 2001, AS AMMENDED.

DESIGN DATA:

SIDEWALKS: WIDTH _____
LOCATION: ATTACHED ☐ DETACHED ☐
CURB TYPE 1 ☐ 2 ☐ 3 ☐ 4 ☐
R/W WIDTH _____ F/C-F/C _____
STREET TYPE _____
HVEEM _____

ASPHALT THICKNESS:
AC SURFACE _____
AC BASE _____

AGGREGATE BASE THICKNESS:
CLASS 6 _____
CLASS 5 _____
CLASS 2 _____

SCALE: HORIZ. 50' VERT. 5'

BENCHMARK:

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ELEVATION = 6250.374

REVISIONS:

NO.	DESCRIPTION	DATE

ENGINEER:

DESIGNED BY: RGG DATE: MAY, 2005
DRAWN BY: GES DATE: MAY, 2005
CHECKED BY: RGG DATE: MAY, 2005

PATRIOT PARK CONCEPT PLAN AREA
SAND CREEK CHANNEL IMPROVEMENTS

PROJECT SAND CREEK AT EAST PLATTE AVENUE
STA _____ TO _____
CITY PROJECT NO. _____
DRAINAGE BASIN SAND CREEK
JOB NO. 05.168.004 SHEET 7 OF 8

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Sand Creek-scour Plan: Imported Plan 01 7/6/2005

RIVER-1 Reach-1

Legend

WS 100-Year

WS 10-Year

Ground

GALLEY ROAD BRIDGE

PLATTE AVE. BRIDGE

Elevation (ft)

6240

6220

6200

6180

6160

1.8 1.9 2 2.5 3.1 3.3 4 5 6 8 9.5 10 11

1000 2000 3000 4000 5000

Main Channel Distance (ft)

Sand Creek-scour Plan: Imported Plan 01 7/6/2005

RIVER-1 Reach-1

Legend

WS 100-Year

WS 10-Year

Ground

Elevation (ft)

6400

6350

6300

6250

6200

6150

Platte Ave. Bridge

Gulley Road Bridge

1.8 2.5 3.1 3.3 4 5 6 8.5 11 13 14 15 16 18 19 20 20.5 23 24 25 27

0 2000 4000 6000 8000 10000 12000 14000

Main Channel Distance (ft)

S Plan: d Pla: VER-1 Reach-

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sqft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)	Shear LOB (lb/sq ft)	Shear ROB (lb/sq ft)	Power Total (lb/ft s)
			(CFS)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sqft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/ft s)
Reach		100 Year	2420.00	6385.70	6388.67	6388.67	6389.45	0.007783	7.06	342.73	240.12	0.99	0.76			0.76
Reach		100 Year	3190.00	6385.70	6389.01	6389.01	6389.92	0.007263	7.65	416.84	247.19	0.99	0.84			0.84
Reach		100 Year	2420.00	6384.00	6385.53	6385.53	6386.26	0.007854	6.86	353.01	500.33	0.99	0.73			0.73
Reach		100 Year	3190.00	6384.00	6385.82	6385.82	6386.70	0.007515	7.52	423.97	714.58	1.00	0.83			0.83
Reach		100 Year	2330.00	6380.00	6381.50	6381.50	6382.21	0.007829	6.79	343.26	233.58	0.99	0.72			0.72
Reach		100 Year	3620.00	6380.00	6381.98	6381.98	6382.96	0.007391	7.92	457.19	236.35	1.00	0.89			0.89
Reach		100 Year	2330.00	6369.80	6372.72	6372.72	6373.56	0.007738	7.34	317.27	190.48	1.00	0.80			0.80
Reach		100 Year	3620.00	6369.80	6373.33	6373.33	6374.39	0.007181	8.26	438.50	207.73	1.00	0.94			0.94
Reach		100 Year	2330.00	6349.00	6351.73	6351.73	6352.69	0.007526	7.88	295.65	156.01	1.01	0.89			0.89
Reach		100 Year	3620.00	6349.00	6352.40	6352.40	6353.65	0.006839	8.97	403.56	183.12	1.01	1.05			1.05
Reach		100 Year	2330.00	6333.50	6337.49		6338.32	0.002712	7.31	318.95	80.00	0.64	0.61			0.61
Reach		100 Year	3620.00	6333.50	6338.93		6340.01	0.002446	8.34	434.10	80.00	0.63	0.73			0.73
Reach		100 Year	2330.00	6333.00	6337.56	6336.00	6338.19	0.000722	6.39	364.84	80.00	0.53	0.18			0.18
Reach		100 Year	3620.00	6333.00	6339.00	6337.02	6339.88	0.000729	7.54	480.04	80.00	0.54	0.24			0.24
Reach		Bridge														
Reach		100 Year	2330.00	6331.50	6334.47	6334.47	6335.96	0.002877	9.81	237.50	80.00	1.00	0.50			0.50
Reach		100 Year	3620.00	6331.50	6335.48	6335.48	6337.49	0.002697	11.37	318.40	80.00	1.00	0.61			0.61
Reach		100 Year	2330.00	6321.70	6325.38	6325.38	6327.08	0.006429	10.47	222.55	66.07	1.01	1.31			1.31
Reach		100 Year	3620.00	6321.70	6326.58	6326.58	6328.78	0.005952	11.90	304.12	69.69	1.00	1.55			1.55
Reach		100 Year	2330.00	6315.00	6318.20	6318.20	6319.76	0.006794	10.02	232.44	75.38	1.01	1.24			1.24
Reach		100 Year	3620.00	6315.00	6319.27	6319.27	6321.33	0.006318	11.52	314.32	77.12	1.01	1.50			1.50
Reach		100 Year	2360.00	6299.00	6302.68	6301.61	6303.27	0.001389	6.20	380.67	112.07	0.59	0.29			0.29
Reach		100 Year	4320.00	6299.00	6304.26	6302.87	6305.17	0.001374	7.66	564.19	119.43	0.62	0.40			0.40
Reach		Bridge														
Reach		100 Year	2360.00	6298.00	6300.61	6300.61	6301.85	0.004443	8.98	263.38	107.10	1.01	0.68			0.68
Reach		100 Year	4320.00	6298.00	6301.87	6301.87	6303.66	0.003926	10.75	401.99	112.95	1.00	0.86			0.86
Reach		100 Year	2360.00	6286.00	6294.68	6294.68	6296.08	0.002387	10.35	424.39	199.19	0.68	1.00	0.19	0.29	0.31
Reach		100 Year	4320.00	6286.00	6296.32	6296.32	6297.47	0.002327	11.52	777.22	279.65	0.69	1.17	0.29	0.46	0.40
Reach		100 Year	2360.00	6266.00	6269.03	6269.03	6270.32	0.006754	9.12	258.80	100.81	1.00	1.08			1.08
Reach		100 Year	4320.00	6266.00	6270.39	6270.39	6272.15	0.006061	10.67	404.72	114.58	1.00	1.33			1.33
Reach		100 Year	2380.00	6245.00	6248.86	6248.86	6250.41	0.006423	10.00	238.05	77.35	1.00	1.22			1.22
Reach		100 Year	4690.00	6245.00	6250.73	6250.73	6252.90	0.005803	11.83	396.49	92.50	1.01	1.53			1.53
Reach		100 Year	2380.00	6234.10	6237.96	6237.96	6239.64	0.006322	10.39	229.04	68.71	1.00	1.29			1.29
Reach		100 Year	4690.00	6234.10	6239.96	6239.96	6242.37	0.005657	12.47	376.12	78.40	1.00	1.65			1.65
Reach		100 Year	2380.00	6230.20	6234.78	6234.78	6236.76	0.006216	11.29	210.73	59.31	1.00	1.45			1.45
Reach		100 Year	4690.00	6230.20	6237.21	6237.21	6239.93	0.005613	13.24	354.12	65.05	1.00	1.80			1.80
Reach		100 Year	2380.00	6224.50	6228.78		6229.71	0.003057	7.85	303.35	77.99	0.70	0.70			0.70
Reach		100 Year	4690.00	6224.50	6231.01		6232.46	0.002805	9.69	484.24	82.74	0.71	0.95			0.95
Reach		100 Year	2380.00	6224.00	6228.82	6227.39	6229.55	0.001278	6.84	347.82	79.16	0.58	0.33			0.33
Reach		100 Year	4690.00	6224.00	6231.09	6229.20	6232.29	0.001343	8.80	532.92	83.97	0.62	0.49			0.49

\S Plar ed Pla IVER-1 Reach- tued)

Reach	River Station	Profile	Q Total (cfs)	Min Ch El (ft)	W S Elev (ft)	Crit W S (ft)	E G Elev (ft)	E G Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sqft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)	Shear LOB (lb/sq ft)	Shear ROB (lb/sq ft)	Power Total (lb/ft sec)
Reach			Bridge													
Reach			2380.00	6222.50	6225.84	6225.84	6227.42	0.009647	10.10	235.61	75.04	1.00	1.80			1.80
Reach			4690.00	6222.50	6227.67	6227.67	6230.08	0.008662	12.48	375.77	78.35	1.00	2.41			2.41
Reach			2380.00	6221.30	6224.25	6224.25	6225.68	0.009689	9.57	248.64	88.36	1.01	1.66			1.66
Reach			4690.00	6221.30	6225.90	6225.90	6228.06	0.008477	11.78	398.23	93.03	1.00	2.20			2.20
Reach			2380.00	6218.30	6221.51	6221.51	6223.04	0.009473	9.91	240.12	79.47	1.00	1.74			1.74
Reach			4690.00	6218.30	6223.29	6223.29	6225.58	0.008376	12.16	385.65	84.70	1.00	2.30			2.30
Reach			2380.00	6209.00	6213.18	6213.18	6215.05	0.006297	10.97	217.04	58.82	1.01	1.39			1.39
Reach			4690.00	6209.00	6215.76	6215.76	6217.82	0.005958	11.51	407.41	98.98	1.00	1.48			1.48
Reach			2400.00	6194.00	6196.51	6196.51	6197.57	0.014265	8.23	291.54	140.21	1.01	1.84			1.84
Reach			5000.00	6194.00	6197.93	6197.93	6199.35	0.012839	9.56	522.99	165.57	1.00	2.25			2.25
Reach			2400.00	6186.57	6189.15	6188.85	6190.00	0.006526	7.52	330.87	136.82	0.83	1.05	0.51	0.50	0.98
Reach			5000.00	6186.57	6190.29	6190.25	6192.01	0.008069	10.69	492.23	144.31	0.98	1.88	0.90	0.89	1.70
Reach			2400.00	6186.47	6188.74	6188.74	6189.83	0.017573	8.50	288.89	134.80	0.99	2.49	1.20	1.18	2.34
Reach			5000.00	6186.47	6190.13	6190.13	6191.85	0.014760	10.73	483.08	143.90	0.99	3.38	1.63	1.60	3.07
Reach			2400.00	6182.47	6185.39		6186.05	0.004293	6.62	377.47	139.03	0.68	0.78	0.38	0.37	0.72
Reach			5000.00	6182.47	6187.06		6188.16	0.003940	8.59	619.54	149.96	0.71	1.13	0.54	0.54	1.01
Reach			2400.00	6181.02	6183.60	6183.30	6184.45	0.006522	7.52	330.93	136.82	0.83	1.05	0.50	0.50	0.98
Reach			5000.00	6181.02	6184.75	6184.70	6186.46	0.008058	10.69	492.44	144.32	0.98	1.87	0.90	0.89	1.70
Reach			2400.00	6180.92	6183.19	6183.19	6184.28	0.017534	8.49	289.09	134.81	0.99	2.48	1.20	1.18	2.34
Reach			5000.00	6180.92	6184.59	6184.59	6186.30	0.014631	10.69	484.63	143.97	0.98	3.35	1.61	1.59	3.05
Reach			2400.00	6176.92	6179.55		6180.37	0.006073	7.36	338.43	137.18	0.80	1.00	0.48	0.47	0.93
Reach			5000.00	6176.92	6180.95	6180.60	6182.40	0.008143	9.84	537.07	146.33	0.86	1.55	0.74	0.73	1.40
Reach			2400.00	6175.75	6178.72	6177.95	6179.20	0.003662	5.55	432.61	170.97	0.61	0.58			0.58
Reach			5000.00	6175.75	6180.69	6179.22	6181.30	0.002444	6.26	798.94	311.05	0.54	0.62			0.62
Reach			Bridge													
Reach			2400.00	6176.20	6177.76	6177.43	6178.46	0.006281	6.71	357.63	159.23	0.79	0.88			0.88
Reach			5150.00	6175.20	6178.86	6178.74	6180.26	0.008339	9.52	540.86	175.97	0.96	1.59			1.59
Reach			2400.00	6174.92	6177.51	6177.16	6178.09	0.006175	6.12	392.22	290.50	0.77	0.76			0.76
Reach			5150.00	6174.92	6178.70	6178.33	6179.71	0.006040	8.09	637.84	353.85	0.82	1.15	0.14		1.13
Reach			2400.00	6174.82	6177.06	6177.06	6177.91	0.020046	7.43	323.03	266.81	1.01	2.10			2.10
Reach			5150.00	6174.82	6178.23	6178.23	6179.54	0.016442	9.20	560.02	341.68	0.99	2.76	0.18		2.73
Reach			2400.00	6163.59	6167.90	6167.21	6168.41	0.003883	5.72	419.41	162.98	0.63	0.61			0.61
Reach			5150.00	6163.59	6169.19	6168.50	6170.22	0.004763	8.15	632.15	167.60	0.74	1.09			1.09
Reach			2400.00	6161.60	6163.59	6163.59	6164.45	0.007518	7.47	321.21	183.75	1.00	0.92			0.92
Reach			5150.00	6161.60	6164.85	6164.85	6165.60	0.008013	6.96	748.70	515.17	1.00	0.75	0.31		0.79

HEC-RAS Version 3.1.2 April 2004
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X     X
X     X  X        X           X   X    X    X    X
XXXXXXX  XXXX     X       XXX XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Sand Creek-scour
Project File : scour.prj
Run Date and Time: 7/6/2005 5:46:48 PM

Project in English units

Project Description:
Patriot Park - Sand Creek channel improvement analysis

Modified:

SAND CREEK LOMR 95.01.04
REVISED FLOODPLAIN CONDITION SCLOMR.DAT

HIGHWAY 24 TO CRI&PACIFIC RR 10-YEAR

PLAN DATA

Plan Title: Imported Plan 01
Plan File : s:\05.168.004(Sand Creek)\300 Water Resources\302 FDR\HEC-RAS\scour.p01

Geometry Title: Imported Geom 01
Geometry File : s:\05.168.004(Sand Creek)\300 Water Resources\302 FDR\HEC-RAS\scour.g01

Flow Title : Imported Flow 01
Flow File : s:\05.168.004(Sand Creek)\300 Water Resources\302 FDR\HEC-RAS\scour.f01

Plan Summary Information:

Number of:	Cross Sections	= 36	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 4	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	= 0.01
Critical depth calculation tolerance	= 0.01
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.3
Flow tolerance factor	= 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Imported Flow 01
Flow File : s:\05.168.004(Sand Creek)\300 Water Resources\302 FDR\HEC-RAS\scour.f01

Flow Data (cfs)

River	Reach	RS	10-Year	100-Year
RIVER-1	Reach-1	27	2420	3190
RIVER-1	Reach-1	25	2330	3620
RIVER-1	Reach-1	17	2360	4320
RIVER-1	Reach-1	13	2380	4690
RIVER-1	Reach-1	4	2400	5000
RIVER-1	Reach-1	2	2400	5150

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	10-Year		Known WS = 6163.34
RIVER-1	Reach-1	100-Year		Known WS = 6164.61

GEOMETRY DATA

Geometry Title: Imported Geom 01
Geometry File : s:\05.168.004(Sand Creek)\300 Water Resources\302 FDR\HEC-RAS\scour.g01

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 27

INPUT
Description: 4240
CHICAGO, ROCK ISLAND RAILROAD
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6413	2020	6403.2	2020	6395.6	2024	6388.9	2077	6386.3
2083	6386	2137	6385.7	2143	6388.3	2187	6387	2193	6387.7
2246	6387.6	2250	6393.8	3040	6395.4	3040	6391.4	3062	6385.3
3062	6391.8	3066	6391.8	3066	6385.3	3085	6391.8	3085	6395.4
3550	6393								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	2020	.025	2250	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
2020	2250	260	240	260 .1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
1000	2020	6403.2	F
2250	3550	6393.8	F

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 26

INPUT
Description: 4240.3

Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6400	1050	6396	1250	6392	1320	6388	1450	6389
1535	6396	1555	6396	1600	6384	1825	6384	1860	6392
1880	6392	1940	6388	2100	6386	2490	6385.4	2500	6384.8
2650	6385.2	2700	6386	2760	6388	2980	6390		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1555	.025	1860	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1555	1860	5	5	5 .1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
1000	1555	6396	F
1860	2980	6392	F

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 25

INPUT
Description: 4240.4

Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
10	6400	1050	6396	1250	6392	1320	6388	1450	6389
1535	6396	1555	6396	1600	6380	1825	6380	1860	6392
1880	6392	1940	6388	2100	6386	2490	6385.4	2550	6384.8
2650	6385.2	2700	6386	2760	6388	2980	6390		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
10	.03	1555	.025	1860	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1555	1860	670	670	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
10	1555	6396	F
1860	2980	6392	F

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 24

INPUT
Description: 39
WAYNOKA ROAD

Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6378	1080	6377.6	1115	6378	1260	6378	1335	6376
1340	6375.9	1375	6374	1400	6372	1490	6369.8	1570	6372
1665	6378	1800	6380	1950	6382				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1335	.025	1665	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1335	1665	950	950	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 23

INPUT
Description: 38

Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6361	1110	6360	1140	6360	1200	6349.5	1245	6349.5
1250	6350	1300	6350	1318	6349	1335	6350	1383	6360
1520	6362								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1140	.025	1383	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1140	1383	870	870	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 22

INPUT

Description: 37.3

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6345	1000	6333.5	1080	6333.5	1080	6345

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1000	.025	1080	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1000	1080	50	50	50	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 21

INPUT
Description: 37.2
POWERS BOULEVARD

Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6340	1415	6346.5	1415	6333	1495	6333	1495	6348.9
1650	6350								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1415	.016	1495	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1415	1495	150	150	150	.2	.4

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
1000	1415	6346.5	F
1495	1650	6348.9	F

BRIDGE

RIVER: RIVER-1
REACH: Reach-1 RS: 20.5

INPUT
Description: Bridge #4

Distance from Upstream XS = 1
Deck/Roadway Width = 148
Weir Coefficient = 2.5
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
1000	6340	6340	1415	6346.5	6346.5	1415	6346.5	6345
1495	6348.9	6345	1495	6348.9	6348.9	1650	6350	6350

Upstream Bridge Cross Section Data
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6340	1415	6346.5	1415	6333	1495	6333	1495	6348.9
1650	6350								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1415	.016	1495	.035

Bank Sta: Left	Right	Coeff Contr.	Expan.
1415	1495	.2	.4

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
1000	1415	6346.5	F
1495	1650	6348.9	F

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
1000	6340	6340	1415	6346.5	6346.5	1415	6346.5	6345
1495	6348.9	6345	1495	6348.9	6348.9	1650	6350	6350

Downstream Bridge Cross Section Data
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6340	1415	6346.5	1415	6331.5	1495	6331.5	1495	6348.9
1650	6350								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1415	.016	1495	.03

Bank Sta: Left	Right	Coeff Contr.	Expan.
1415	1495	.1	.3

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins = 6340
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Piers = 1

Pier Data
Pier Station Upstream= 1455 Downstream= 1455
Upstream num= 2

Width	Elev	Width	Elev
8	6333	8	6345

Downstream num= 2

Width	Elev	Width	Elev
8	6331.5	8	6345

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Yarnell KVal = 1.05
Selected Low Flow Methods = Yarnell

High Flow Method
Pressure and Weir flow
Submerged Inlet Cd =
Submerged Inlet + Outlet Cd =.8164966
Max Low Cord = 6345

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #10-Year

			Inside BR US	Inside BR DS
E.G. US. (ft)	6338.19	Element		
W.S. US. (ft)	6337.56	E.G. Elev (ft)	6338.08	6336.29
Q Total (cfs)	2330.00	W.S. Elev (ft)	6337.12	6334.72
Q Bridge (cfs)	2330.00	Crit W.S. (ft)	6336.22	6334.72
Q Weir (cfs)		Max Chl Dpth (ft)	4.12	3.22
Weir Sta Lft (ft)		Vel Total (ft/s)	7.85	10.06
Weir Sta Rgt (ft)		Flow Area (sq ft)	296.65	231.54
Weir Submerg		Froude # Chl	0.68	0.99
Weir Max Depth (ft)		Specif Force (cu ft)	1179.46	1100.46
Min El Weir Flow (ft)	6346.51	Hydr Depth (ft)	4.12	3.22
Min El Prs (ft)	6345.00	W.P. Total (ft)	88.48	84.86
Delta EG (ft)	2.23	Conv. Total (cfs)	61713.5	41985.8
Delta WS (ft)	3.09	Top Width (ft)	72.00	72.00
BR Open Area (sq ft)	864.00	Frctn Loss (ft)		
BR Open Vel (ft/s)	10.06	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	0.30	0.52
Br Sel Method	Momentum	Power Total (lb/ft s)	2.34	5.28

Warning: The flow regime calculated by the momentum equation shows class B flow. For the best solution, this profile should be run as a mixed flow problem.
Warning: Pier drag coefficient of 2.0 assumed for Class B flow.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

BRIDGE OUTPUT Profile #100-Year

			Inside BR US	Inside BR DS
E.G. US. (ft)	6339.88	Element		
W.S. US. (ft)	6339.00	E.G. Elev (ft)	6339.72	6337.92
Q Total (cfs)	3620.00	W.S. Elev (ft)	6338.35	6335.81
Q Bridge (cfs)	3620.00	Crit W.S. (ft)	6337.31	6335.81
Q Weir (cfs)		Max Chl Dpth (ft)	5.35	4.30
Weir Sta Lft (ft)		Vel Total (ft/s)	9.39	11.68
Weir Sta Rgt (ft)		Flow Area (sq ft)	385.52	309.94
Weir Submerg		Froude # Chl	0.72	0.99
Weir Max Depth (ft)		Specif Force (cu ft)	2087.77	1980.16
Min El Weir Flow (ft)	6346.51	Hydr Depth (ft)	5.35	4.30
Min El Prs (ft)	6345.00	W.P. Total (ft)	93.42	89.22
Delta EG (ft)	2.40	Conv. Total (cfs)	92116.9	66022.9
Delta WS (ft)	3.52	Top Width (ft)	72.00	72.00
BR Open Area (sq ft)	864.00	Frctn Loss (ft)		
BR Open Vel (ft/s)	11.68	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	0.40	0.65
Br Sel Method	Momentum	Power Total (lb/ft s)	3.74	7.62

Warning: The flow regime calculated by the momentum equation shows class B flow. For the best solution, this profile should be run as a mixed flow problem.
Warning: Pier drag coefficient of 2.0 assumed for Class B flow.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 20

INPUT
Description: 37.1

Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6340	1415	6346.5	1415	6331.5	1495	6331.5	1495	6348.9
1650	6350								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1415	.016	1495	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1415	1495	590	610	640	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 19

INPUT
Description: 36.2

Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6334	1090	6332	1110	6330	1125	6321.7	1180	6321.7
1190	6330	1215	6332						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1110	.025	1190	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1110	1190	410	410	410	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 18

INPUT
Description: 36

Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6328	1050	6322	1170	6322	1170	6315	1240	6315
1255	6324	1320	6324	1340	6326	1550	6326	1650	6328

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1170	.025	1255	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1170	1255	1050	1040	1120	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 17

INPUT
Description: 35.5
This is a REPEATED section.
PALMER PARK BOULEVARD

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6313	1025	6299	1120	6299	1160	6313

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1000	.02	1160	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1000	1160	70	70	.2	.4

BRIDGE

RIVER: RIVER-1
REACH: Reach-1 RS: 16.5

INPUT
Description: Bridge #3

Distance from Upstream XS = 1
Deck/Roadway Width = 68
Weir Coefficient = 2.5
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
1000	6312	6312	1000	6312	6308.4	1025	6312	6308.4
1120	6312	6308.4	1160	6312	6308.4	1160	6312	6312

Upstream Bridge Cross Section Data
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6313	1025	6299	1120	6299	1160	6313

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1000	.02	1160	.035

Bank Sta: Left	Right	Coeff Contr.	Expan.
1000	1160	.2	.4

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
1000	6312	6312	1000	6312	6308.4	1025	6312	6308.4
1120	6312	6308.4	1160	6312	6308.4	1160	6312	6312

Downstream Bridge Cross Section Data
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6312	1025	6298	1120	6298	1160	6312

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1000	.02	1160	.035

```
Bank Sta: Left   Right    Coeff Contr.   Expan.
          1000    1160            .1       .3

Upstream Embankment side slope                =       0 horiz. to 1.0 vertical
Downstream Embankment side slope              =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins           =  6311.8
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Piers =  1

Pier Data
Pier Station     Upstream=    1080    Downstream=    1080
Upstream      num=        2
   Width    Elev     Width    Elev
      6     6299         6  6308.4
Downstream      num=       2
    Width    Elev     Width    Elev
       6     6298         6  6308.4

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Yarnell                KVal =    1.05
Selected Low Flow Methods = Yarnell

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =.8164966
           Max Low Cord                =  6308.4

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #10-Year

  E.G. US. (ft)              6303.27    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              6302.68    E.G. Elev (ft)           6303.21       6302.01
  Q Total (cfs)              2360.00    W.S. Elev (ft)           6302.42       6300.75
  Q Bridge (cfs)             2360.00    Crit W.S. (ft)           6301.75       6300.75
  Q Weir (cfs)                          Max Chl Dpth (ft)           3.42          2.75
  Weir Sta Lft (ft)                     Vel Total (ft/s)            7.12          9.00
  Weir Sta Rgt (ft)                     Flow Area (sq ft)         331.52        262.31
  Weir Submerg                          Froude # Chl                0.71          0.99
  Weir Max Depth (ft)                   Specif Force (cu ft)      1073.16       1012.04
  Min El Weir Flow (ft)      6312.01    Hydr Depth (ft)             3.16          2.58
  Min El Prs (ft)            6308.40    W.P. Total (ft)           113.19        108.45
  Delta EG (ft)                 1.42    Conv. Total (cfs)        50421.4       35114.3
  Delta WS (ft)                 2.07    Top Width (ft)            104.88        101.77
  BR Open Area (sq ft)       1041.71    Frctn Loss (ft)
  BR Open Vel (ft/s)            9.00    C & E Loss (ft)
  Coef of Q                             Shear Total (lb/sq ft)      0.40          0.68
  Br Sel Method              Momentum   Power Total (lb/ft s)       2.85          6.14


Warning: The flow regime calculated by the momentum equation shows class B flow.  For the best solution,
         this profile should be run as a mixed flow problem.
Warning: Pier drag coefficient of 2.0 assumed for Class B flow.
Warning: The water surface upstream of the bridge computed by the Yarnell method was below critical
         depth.  The Yarnell solution has been disregarded.
Note:    Yarnell answer is not valid if the water surface is above the low chord or if there is weir
flow.  The
         Yarnell answer has been disregarded.

BRIDGE OUTPUT  Profile #100-Year

  E.G. US. (ft)              6305.17    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              6304.26    E.G. Elev (ft)           6305.07       6303.88
  Q Total (cfs)              4320.00    W.S. Elev (ft)           6303.85       6302.06
  Q Bridge (cfs)             4320.00    Crit W.S. (ft)           6303.06       6302.06
  Q Weir (cfs)                          Max Chl Dpth (ft)           4.85          4.06
```

Weir Sta Lft (ft)		Vel Total (ft/s)	8.89	10.81
Weir Sta Rgt (ft)		Flow Area (sq ft)	485.94	399.56
Weir Submerg		Froude # Chl	0.75	0.99
Weir Max Depth (ft)		Specif Force (cu ft)	2326.35	2235.68
Min El Weir Flow (ft)	6312.01	Hydr Depth (ft)	4.36	3.70
Min El Prs (ft)	6308.40	W.P. Total (ft)	123.29	117.72
Delta EG (ft)	1.51	Conv. Total (cfs)	90086.0	67046.4
Delta WS (ft)	2.40	Top Width (ft)	111.51	107.85
BR Open Area (sq ft)	1041.71	Frctn Loss (ft)		
BR Open Vel (ft/s)	10.81	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	0.57	0.88
Br Sel Method	Momentum	Power Total (lb/ft s)	5.03	9.51

Warning: The flow regime calculated by the momentum equation shows class B flow. For the best solution, this profile should be run as a mixed flow problem.
Warning: Pier drag coefficient of 2.0 assumed for Class B flow.

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 16

INPUT
Description: 35

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6312	1025	6298	1120	6298	1160	6312

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1000	.02	1160	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1000	1160	500	490	460	.1 .3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 15

INPUT
Description: 34

Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6300	1010	6298	1040	6296	1170	6294	1235	6292
1240	6290	1243	6288	1255	6286	1262	6290	1265	6292
1310	6294	1332	6304	1520	6306				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1240	.025	1262	.05

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1240	1262	1500	1480	1550	.1 .3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 14

INPUT
Description: 33

Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6276	1050	6274	1150	6272	1190	6266	1260	6266
1295	6276	1305	6278	1330	6290	1385	6300		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1150	.025	1330	.05

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.

```
          1150     1330             1250     1265     1270             .1        .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1             RS: 13

INPUT
Description: 32

Station Elevation Data     num=       10
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
     1000     6254     1085     6253     1150     6254     1218     6255     1270     6254
     1315     6252     1346     6245     1392     6245     1440     6258     1470     6260

Manning's n Values         num=       3
      Sta    n Val      Sta    n Val      Sta    n Val
     1000      .03     1315     .025     1440      .05

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
          1315     1440               573      573      573              .1        .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1             RS: 12

INPUT
Description: 31.7

Station Elevation Data     num=       4
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
     1000     6244     1026   6234.1     1076   6234.1     1098     6244

Manning's n Values         num=       3
      Sta    n Val      Sta    n Val      Sta    n Val
     1000      .03     1000     .025     1098      .05

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
          1000     1098                 1        1        1              .1        .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1             RS: 11

INPUT
Description: 31.6

Station Elevation Data     num=       6
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
     1000     6244     1026   6234.1     1032   6230.2     1072   6230.2     1076   6234.1
     1098     6244

Manning's n Values         num=       3
      Sta    n Val      Sta    n Val      Sta    n Val
     1000      .03     1000     .025     1098      .05

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
          1000     1098               435      435      435              .1        .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1             RS: 10

INPUT
Description: 31.3
This is a REPEATED section.

Station Elevation Data     num=       8
      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
     1000   6240.5     1080   6238.5     1080   6225.5     1099   6224.5     1149   6224.5
     1168   6233.5     1168   6238.5     1230   6239.3
```

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1080	.025	1168	.05

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1080	1168	50	50	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 9

INPUT
Description: 31.2
GALLEY ROAD

Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6240	1080	6238	1080	6225	1099	6224	1149	6224
1168	6233	1168	6238	1230	6238.8				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1080	.02	1168	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1080	1168	135	135	.2	.4

BRIDGE

RIVER: RIVER-1
REACH: Reach-1 RS: 8.5

INPUT
Description: Bridge #2 - Galley Road

Distance from Upstream XS = 1
Deck/Roadway Width = 133
Weir Coefficient = 2.5
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
1000	6240	6240	1080	6238	6238	1080	6238	6233
1168	6238	6233	1168	6238	6238	1230	6238.8	6238.8

Upstream Bridge Cross Section Data
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6240	1080	6238	1080	6225	1099	6224	1149	6224
1168	6233	1168	6238	1230	6238.8				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1080	.02	1168	.035

Bank Sta: Left	Right	Coeff Contr.	Expan.
1080	1168	.2	.4

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
1000	6240	6240	1080	6238	6238	1080	6238	6233
1168	6238	6233	1168	6238	6238	1230	6238.8	6238.8

Downstream Bridge Cross Section Data
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6240	1080	6238	1080	6223	1099	6222.5	1149	6222.5
1168	6233	1168	6238	1230	6238.8				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1080	.03	1168	.035

Bank Sta: Left	Right	Coeff Contr.	Expan.
1080	1168	.1	.3

```
Upstream Embankment side slope                =       0 horiz. to 1.0 vertical
Downstream Embankment side slope              =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow   =     .95
Elevation at which weir flow begins           =    6238
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Piers =  1

Pier Data
Pier Station     Upstream=    1124    Downstream=    1124
Upstream     num=        2
    Width   Elev    Width   Elev
       2    6224        2    6233
Downstream     num=        2
    Width   Elev    Width   Elev
       2  6222.5        2    6233

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Yarnell                KVal =    1.05
Selected Low Flow Methods = Yarnell

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =.8164966
           Max Low Cord                =    6233

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #10-Year

  E.G. US. (ft)              6229.55    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              6228.82    E.G. Elev (ft)           6229.51       6227.51
  Q Total (cfs)              2380.00    W.S. Elev (ft)           6228.69       6225.94
  Q Bridge (cfs)             2380.00    Crit W.S. (ft)           6227.49       6225.94
  Q Weir (cfs)                          Max Chl Dpth (ft)           4.69          3.44
  Weir Sta Lft (ft)                     Vel Total (ft/s)            7.25         10.08
  Weir Sta Rgt (ft)                     Flow Area (sq ft)         328.13        236.18
  Weir Submerg                          Froude # Chl                0.62          0.99
  Weir Max Depth (ft)                   Specif Force (cu ft)     1268.67       1137.15
  Min El Weir Flow (ft)      6238.01    Hydr Depth (ft)             4.27          3.23
  Min El Prs (ft)            6233.00    W.P. Total (ft)            91.06         83.92
  Delta EG (ft)                 2.13    Conv. Total (cfs)        57298.7       23318.7
  Delta WS (ft)                 2.99    Top Width (ft)             76.91         73.22
  BR Open Area (sq ft)         679.00   Frctn Loss (ft)
  BR Open Vel (ft/s)            10.08   C & E Loss (ft)
  Coef of Q                             Shear Total (lb/sq ft)      0.39          1.83
  Br Sel Method              Momentum   Power Total (lb/ft s)       2.82         18.44


Warning: The flow regime calculated by the momentum equation shows class B flow.  For the best solution,
         this profile should be run as a mixed flow problem.
Warning: Pier drag coefficient of 2.0 assumed for Class B flow.
Warning: The water surface upstream of the bridge computed by the Yarnell method was below critical
         depth.  The Yarnell solution has been disregarded.
Note:    Yarnell answer is not valid if the water surface is above the low chord or if there is weir
flow.  The
         Yarnell answer has been disregarded.

BRIDGE OUTPUT  Profile #100-Year

  E.G. US. (ft)              6232.29    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              6231.09    E.G. Elev (ft)           6232.23       6230.22
  Q Total (cfs)              4690.00    W.S. Elev (ft)           6230.86       6227.80
  Q Bridge (cfs)             4690.00    Crit W.S. (ft)           6229.35       6227.80
  Q Weir (cfs)                          Max Chl Dpth (ft)           6.86          5.30
  Weir Sta Lft (ft)                     Vel Total (ft/s)            9.38         12.48
  Weir Sta Rgt (ft)                     Flow Area (sq ft)         500.14        375.82
  Weir Submerg                          Froude # Chl                0.67          0.99
  Weir Max Depth (ft)                   Specif Force (cu ft)     2996.04       2779.45
```

Min El Weir Flow (ft)	6238.01	Hydr Depth (ft)	6.14	4.91
Min El Prs (ft)	6233.00	W.P. Total (ft)	102.65	93.37
Delta EG (ft)	2.21	Conv. Total (cfs)	106791.3	47103.2
Delta WS (ft)	3.43	Top Width (ft)	81.49	76.59
BR Open Area (sq ft)	679.00	Frctn Loss (ft)		
BR Open Vel (ft/s)	12.48	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	0.59	2.49
Br Sel Method	Momentum	Power Total (lb/ft s)	5.50	31.09

Warning: The flow regime calculated by the momentum equation shows class B flow. For the best solution, this profile should be run as a mixed flow problem.
Warning: Pier drag coefficient of 2.0 assumed for Class B flow.
Warning: The water surface upstream of the bridge computed by the Yarnell method was below critical depth. The Yarnell solution has been disregarded.
Note: Yarnell answer is not valid if the water surface is above the low chord or if there is weir flow. The Yarnell answer has been disregarded.

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 8

INPUT
Description: 31

Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6240	1080	6238	1080	6223	1099	6222.5	1149	6222.5
1168	6233	1168	6238	1230	6238.8				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1080	.03	1168	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1080	1168	95	95	.95	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 7

INPUT
Description: 30.6

Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6229.9	1026	6228	1036	6221.3	1116	6221.3	1133	6234

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1026	.03	1133	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1026	1133	1	1	1	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 6

INPUT
Description: 30.5

Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6229.9	1026	6228	1041	6218.3	1111	6218.3	1133	6234

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1026	.03	1133	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1026	1133	565	565	565	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 5

INPUT
Description: 30

Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6230	1010	6228	1130	6228	1180	6226	1370	6224
1420	6216	1460	6214	1470	6209	1515	6209	1545	6232

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1370	.025	1545	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1370	1545	1220	1230	1280	.1 .3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 4

INPUT
Description: 29
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6215.9	1020	6214	1036	6208	1052	6206	1070	6205.5
1090	6206	1130	6206	1160	6204	1220	6202	1240	6198
1300	6196	1320	6194	1420	6194	1470	6220	1650	6220
1670	6222								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1220	.035	1470	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1220	1470	460	460	460	.1 .3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 3.45

INPUT
Description:
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6191.95	1020	6191.65	1038	6186.57	1098	6186.57	1158	6186.57
1203	6201.65								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1038	.03	1158	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1038	1158	15	15	15	.1 .3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 3.4

INPUT
Description:
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6191.85	1020	6191.55	1038	6186.47	1098	6186.47	1158	6186.47
1203	6201.55								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

```
    1000      .04     1038      .04     1158      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
          1038    1158               16      16      16              .1        .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1             RS: 3.3

INPUT
Description:
Station Elevation Data     num=       6
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    1000 6187.85     1020 6187.55     1038 6182.47     1098 6182.47     1158 6182.47
    1203 6197.55

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
    1000      .04     1038      .03     1158      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
          1038    1158               300     300     300             .1        .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1             RS: 3.25

INPUT
Description:
Station Elevation Data     num=       6
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    1000   6186.4     1020   6186.1     1038 6181.02     1098 6181.02     1158 6181.02
    1203   6196.1

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
    1000      .04     1038      .03     1158      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
          1038    1158               15      15      15              .1        .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1             RS: 3.2

INPUT
Description:
Station Elevation Data     num=       6
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    1000   6186.3     1020     6186     1038 6180.92     1098 6180.92     1158 6180.92
    1203     6196

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
    1000      .04     1038      .04     1158      .04

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
          1038    1158               16      16      16              .1        .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1             RS: 3.1

INPUT
Description:
Station Elevation Data     num=       6
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    1000   6182.3     1020     6182     1038 6176.92     1098 6176.92     1158 6176.92
    1203     6192

Manning's n Values         num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .04    1038     .03    1158     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1038    1158              230     230     230             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 3

INPUT
Description: 28.5
This is a REPEATED section.
 US HIGHWAY 24 (PLATTE AVENUE)
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000    6192    1130    6190    1390  6189.3    1415 6175.75    1430 6175.75
    1535 6175.75    1600    6180    1710    6180    1730    6182    1750  6189.3
    2530    6190

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .04    1390     .03    1750     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1390    1750               90      90      90             .3       .5
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
    1600    2530    6186         F

BRIDGE


RIVER: RIVER-1
REACH: Reach-1            RS: 2.5

INPUT
Description: Bridge #1 - East Platte Avenue

Distance from Upstream XS =       1
Deck/Roadway Width        =      88
Weir Coefficient          =     2.5
Upstream  Deck/Roadway Coordinates
    num=       7
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    1000       0       0    1130       0       0    1390  6189.3  6189.3
    1390  6189.3  6185.2    1750  6189.3  6185.2    1750  6189.3  6189.3
    2530       0       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000    6192    1130    6190    1390  6189.3    1415 6175.75    1430 6175.75
    1535 6175.75    1600    6180    1710    6180    1730    6182    1750  6189.3
    2530    6190

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .04    1390     .03    1750     .04

Bank Sta: Left   Right    Coeff Contr.   Expan.
          1390    1750             .3       .5
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
    1600    2530    6186         F

Downstream  Deck/Roadway Coordinates
    num=       7
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    1000       0       0    1130       0       0    1390  6189.3  6189.3
    1390  6189.3  6185.2    1750  6189.3  6185.2    1750  6189.3  6189.3
    2530       0       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000    6192    1130    6190    1390  6189.3    1415  6175.2    1430  6175.2
```

```
    1535  6175.2    1600    6180    1710    6180    1730    6182    1750  6189.3
    2530    6190

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .04    1390     .03    1750     .04

Bank Sta: Left   Right    Coeff Contr.   Expan.
          1390    1750             .3       .5
Ineffective Flow     num=       1
  Sta L   Sta R    Elev  Permanent
    1600    2530    6186       F

Upstream Embankment side slope                =       0 horiz. to 1.0 vertical
Downstream Embankment side slope              =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =      .95
Elevation at which weir flow begins           =  6189.3
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Piers =  6

Pier Data
Pier Station     Upstream=    1430    Downstream=    1430
Upstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2
Downstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2

Pier Data
Pier Station     Upstream=    1480    Downstream=    1480
Upstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2
Downstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2

Pier Data
Pier Station     Upstream=    1530    Downstream=    1530
Upstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2
Downstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2

Pier Data
Pier Station     Upstream=    1580    Downstream=    1580
Upstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2
Downstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2

Pier Data
Pier Station     Upstream=    1630    Downstream=    1630
Upstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2
Downstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2

Pier Data
Pier Station     Upstream=    1680    Downstream=    1680
Upstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2
Downstream     num=       2
    Width   Elev    Width   Elev
       2  6176.9       2  6185.2

Number of Bridge Coefficient Sets =  1
```

RIVER: RIVER-1
REACH: Reach-1 RS: 2

INPUT
Description: 28
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6192	1130	6190	1390	6189.3	1415	6175.2	1430	6175.2
1535	6175.2	1600	6180	1710	6180	1730	6182	1750	6189.3
2530	6190								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1390	.03	1750	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1390	1750	50	50	.3	.5

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
1600	2530	6186	F

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 1.95

INPUT
Description:
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6182.1	1026	6177.97	1046	6176.72	1120	6175.19	1171	6174.92
1226	6175.02	1234	6178.46	1317	6176.1	1326	6175	1394	6180.1
1428	6186.1								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1026	.03	1234	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1026	1234	15	15	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
1234	1428	6182.1	F

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 1.9

INPUT
Description:
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6182	1026	6177.87	1046	6176.62	1120	6175.09	1171	6174.82
1226	6174.92	1234	6178.36	1317	6176	1326	6174.9	1394	6180
1428	6186								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1026	.04	1234	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1026	1234	40	40	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
1234	1428	6182	F

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 1.8

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6182	1010	6178	1028	6175.29	1058	6165.91	1102	6165.87
1147	6165.84	1194	6163.59	1213	6163.79	1218	6176.45	1293	6176
1318	6173.65	1336	6176	1378	6178	1401	6180	1425	6188

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.035	1028	.03	1218	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1028	1218	765	745	715	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
1218	1425	6182	F

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 1

INPUT
Description: 27

Station Elevation Data num= 45

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6169.5	1042	6170	1084	6174.3	1126	6176.6	1173	6178.2
1202	6174.3	1249	6170.5	1294	6167	1329	6165.6	1369	6165.3
1405	6163.6	1416	6163.6	1442	6164.8	1509	6165.2	1536	6165
1556	6163.9	1583	6165.4	1614	6165.6	1624	6164.4	1665	6164.6
1680	6165.4	1726	6164.6	1781	6164.2	1796	6166.6	1820	6166.3
1855	6164.6	1871	6163.7	1934	6164	1945	6161.8	2027	6161.6
2098	6161.7	2143	6165.6	2188	6166.6	2254	6172.5	2282	6173.9
2388	6170.3	2454	6169.8	2540	6169.7	2621	6175.5	2686	6179.9
2736	6182.3	2778	6179.7	2859	6179.7	2938	6179.69	3000	6179.4

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.03	1405	.025	2143	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1405	2143	1450	1160	1180	.1	.3

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	27	.03	.025	.03
Reach-1	26	.03	.025	.03
Reach-1	25	.03	.025	.03
Reach-1	24	.03	.025	.03
Reach-1	23	.03	.025	.03
Reach-1	22	.03	.025	.03
Reach-1	21	.035	.016	.035
Reach-1	20.5	Bridge		
Reach-1	20	.03	.016	.03
Reach-1	19	.03	.025	.03
Reach-1	18	.03	.025	.03
Reach-1	17	.035	.02	.035
Reach-1	16.5	Bridge		
Reach-1	16	.035	.02	.035
Reach-1	15	.03	.025	.05
Reach-1	14	.03	.025	.05
Reach-1	13	.03	.025	.05
Reach-1	12	.03	.025	.05
Reach-1	11	.03	.025	.05
Reach-1	10	.03	.025	.05
Reach-1	9	.035	.02	.035
Reach-1	8.5	Bridge		
Reach-1	8	.035	.03	.035
Reach-1	7	.035	.03	.035
Reach-1	6	.035	.03	.035
Reach-1	5	.03	.025	.03
Reach-1	4	.04	.035	.04
Reach-1	3.45	.04	.03	.04

Reach-1	3.4	.04	.04	.04
Reach-1	3.3	.04	.03	.04
Reach-1	3.25	.04	.03	.04
Reach-1	3.2	.04	.04	.04
Reach-1	3.1	.04	.03	.04
Reach-1	3	.04	.03	.04
Reach-1	2.5	Bridge		
Reach-1	2	.04	.03	.04
Reach-1	1.95	.04	.03	.04
Reach-1	1.9	.04	.04	.04
Reach-1	1.8	.035	.03	.035
Reach-1	1	.03	.025	.03

SUMMARY OF REACH LENGTHS

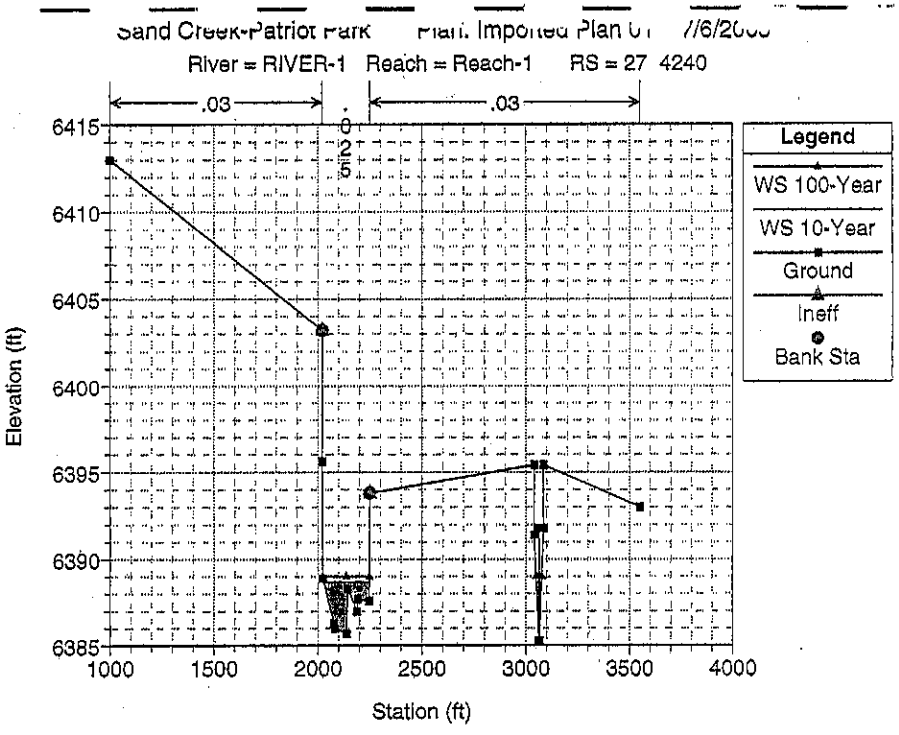
River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	27	260	240	260
Reach-1	26	5	5	5
Reach-1	25	670	670	670
Reach-1	24	950	950	950
Reach-1	23	870	870	870
Reach-1	22	50	50	50
Reach-1	21	150	150	150
Reach-1	20.5	Bridge		
Reach-1	20	590	610	640
Reach-1	19	410	410	410
Reach-1	18	1050	1040	1120
Reach-1	17	70	70	70
Reach-1	16.5	Bridge		
Reach-1	16	500	490	460
Reach-1	15	1500	1480	1550
Reach-1	14	1250	1265	1270
Reach-1	13	573	573	573
Reach-1	12	1	1	1
Reach-1	11	435	435	435
Reach-1	10	50	50	50
Reach-1	9	135	135	135
Reach-1	8.5	Bridge		
Reach-1	8	95	95	95
Reach-1	7	1	1	1
Reach-1	6	565	565	565
Reach-1	5	1220	1230	1280
Reach-1	4	460	460	460
Reach-1	3.45	15	15	15
Reach-1	3.4	16	16	16
Reach-1	3.3	300	300	300
Reach-1	3.25	15	15	15
Reach-1	3.2	16	16	16
Reach-1	3.1	230	230	230
Reach-1	3	90	90	90
Reach-1	2.5	Bridge		
Reach-1	2	50	50	50
Reach-1	1.95	15	15	15
Reach-1	1.9	40	40	40
Reach-1	1.8	765	745	715
Reach-1	1	1450	1160	1180

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.	Contr.	Expan.
Reach-1	27	.1	.3
Reach-1	26	.1	.3
Reach-1	25	.1	.3
Reach-1	24	.1	.3
Reach-1	23	.1	.3
Reach-1	22	.1	.3
Reach-1	21	.2	.4

Reach-1	20.5	Bridge		
Reach-1	20		.1	.3
Reach-1	19		.1	.3
Reach-1	18		.1	.3
Reach-1	17		.2	.4
Reach-1	16.5	Bridge		
Reach-1	16		.1	.3
Reach-1	15		.1	.3
Reach-1	14		.1	.3
Reach-1	13		.1	.3
Reach-1	12		.1	.3
Reach-1	11		.1	.3
Reach-1	10		.1	.3
Reach-1	9		.2	.4
Reach-1	8.5	Bridge		
Reach-1	8		.1	.3
Reach-1	7		.1	.3
Reach-1	6		.1	.3
Reach-1	5		.1	.3
Reach-1	4		.1	.3
Reach-1	3.45		.1	.3
Reach-1	3.4		.1	.3
Reach-1	3.3		.1	.3
Reach-1	3.25		.1	.3
Reach-1	3.2		.1	.3
Reach-1	3.1		.1	.3
Reach-1	3		.3	.5
Reach-1	2.5	Bridge		
Reach-1	2		.3	.5
Reach-1	1.95		.1	.3
Reach-1	1.9		.1	.3
Reach-1	1.8		.1	.3
Reach-1	1		.1	.3


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
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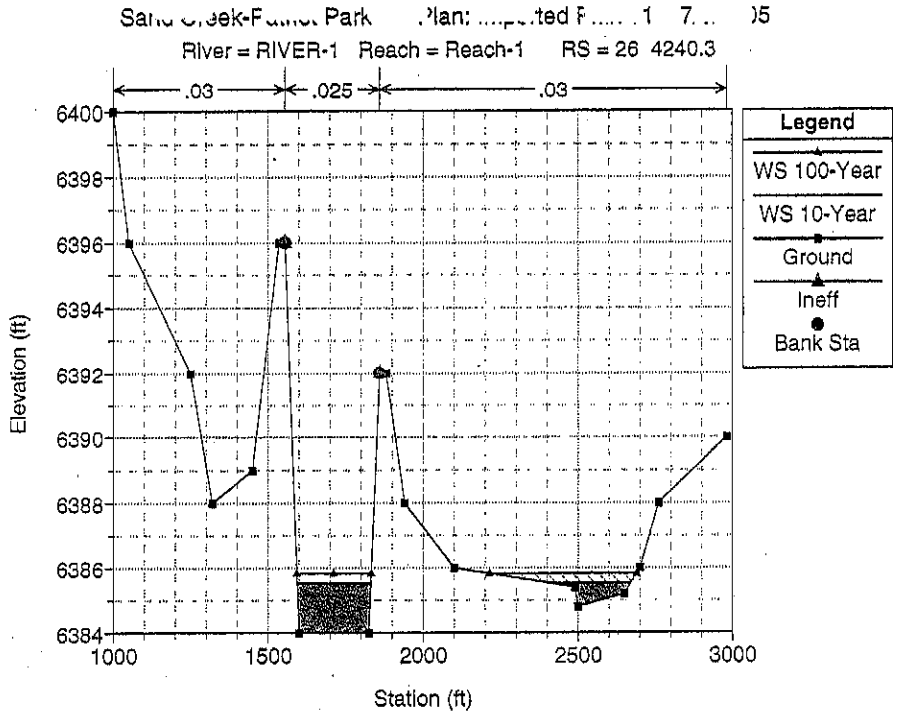
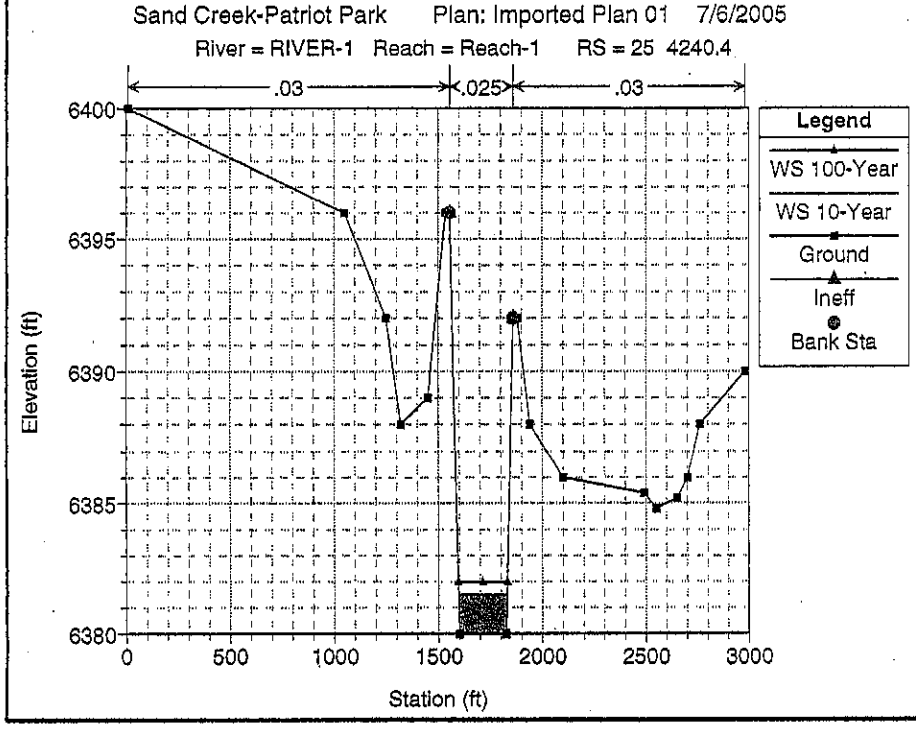
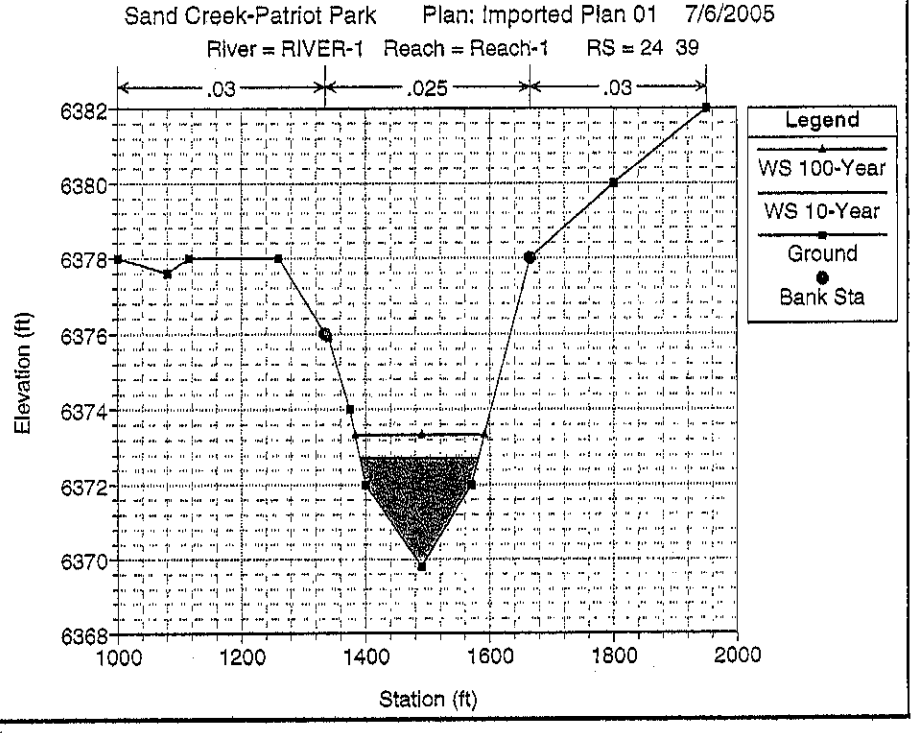
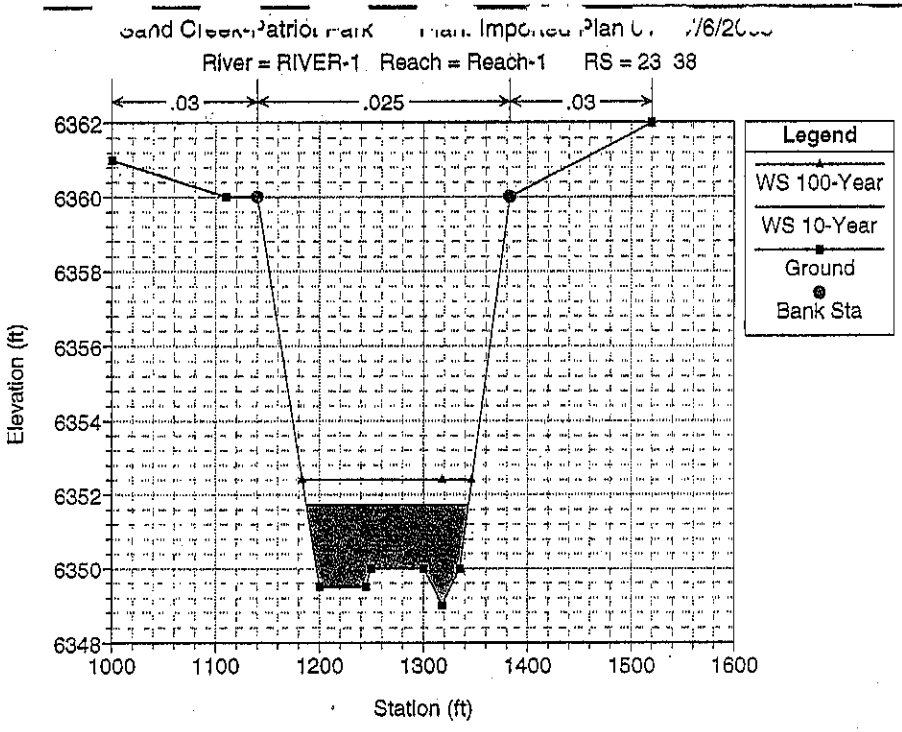
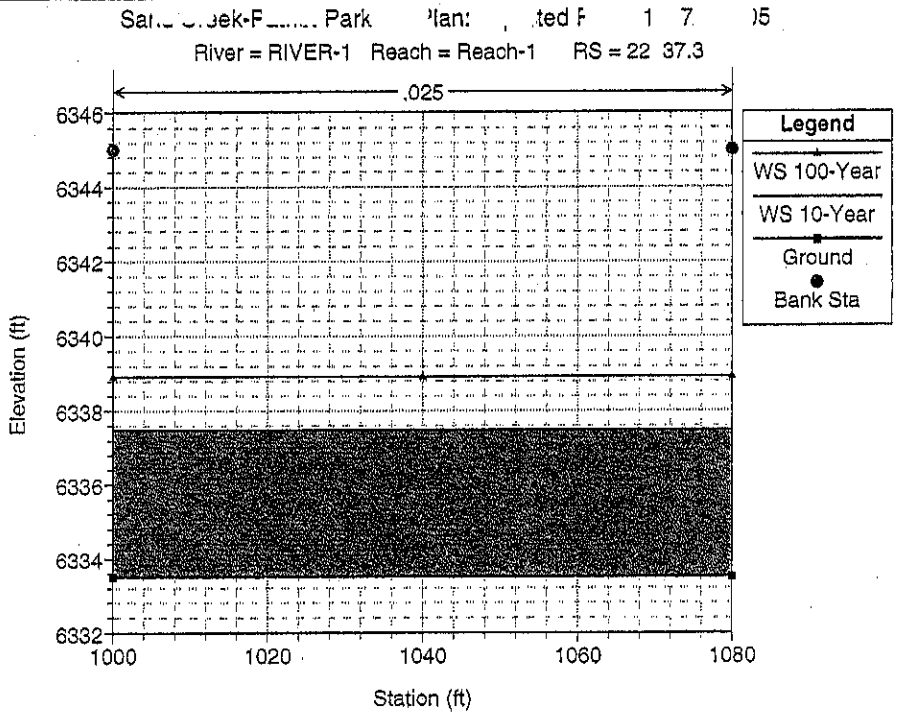
.03
.03
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

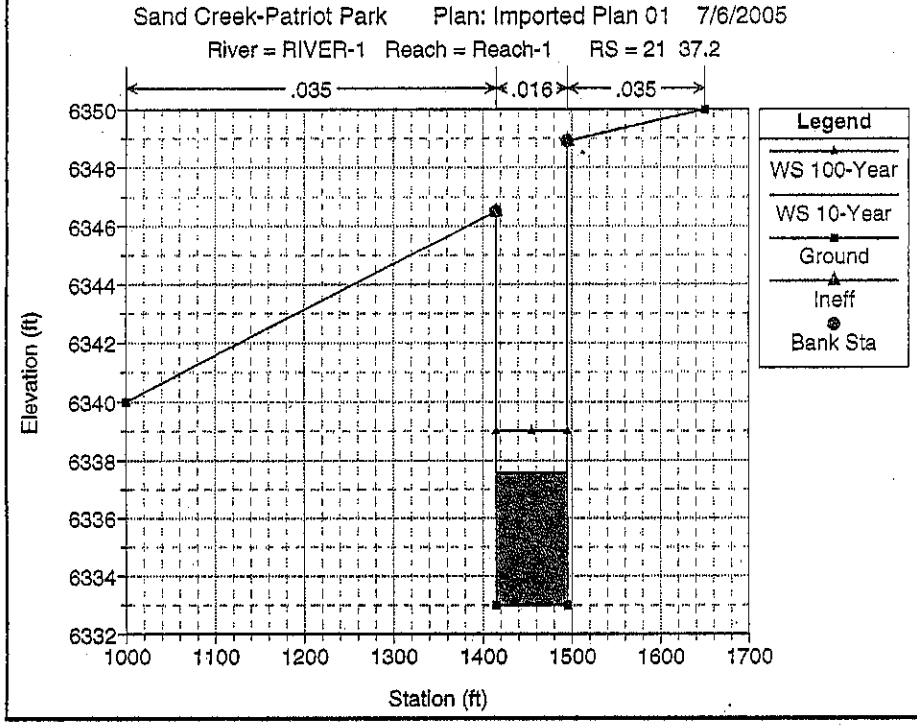

River = RIVER-1 Reach = Reach-1 RS = 26 4240.3
.03
.025
.03
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

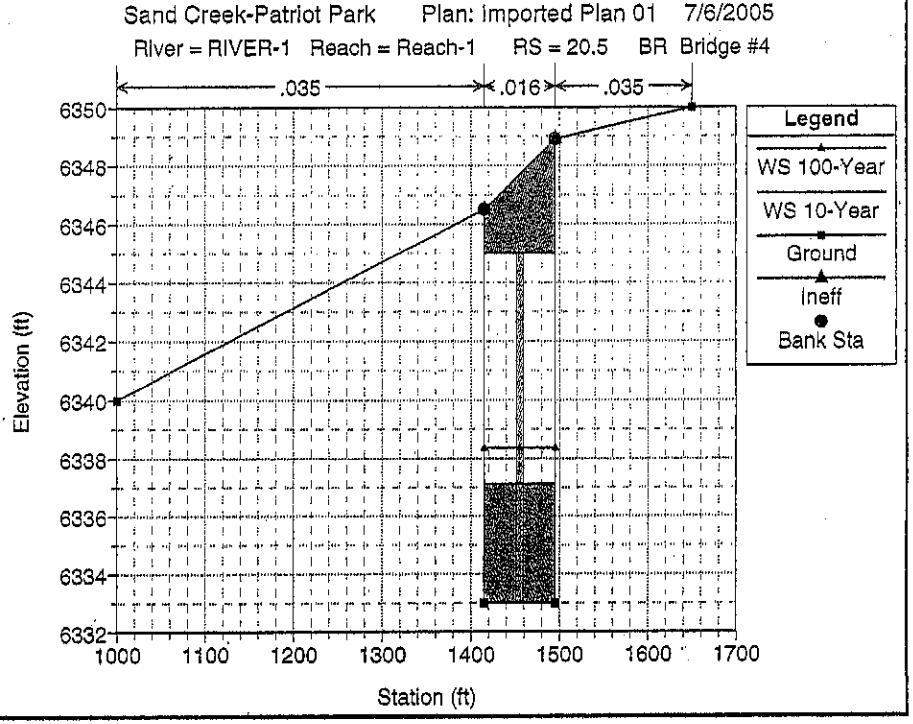

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 25 4240.4
.03
.025
.03
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

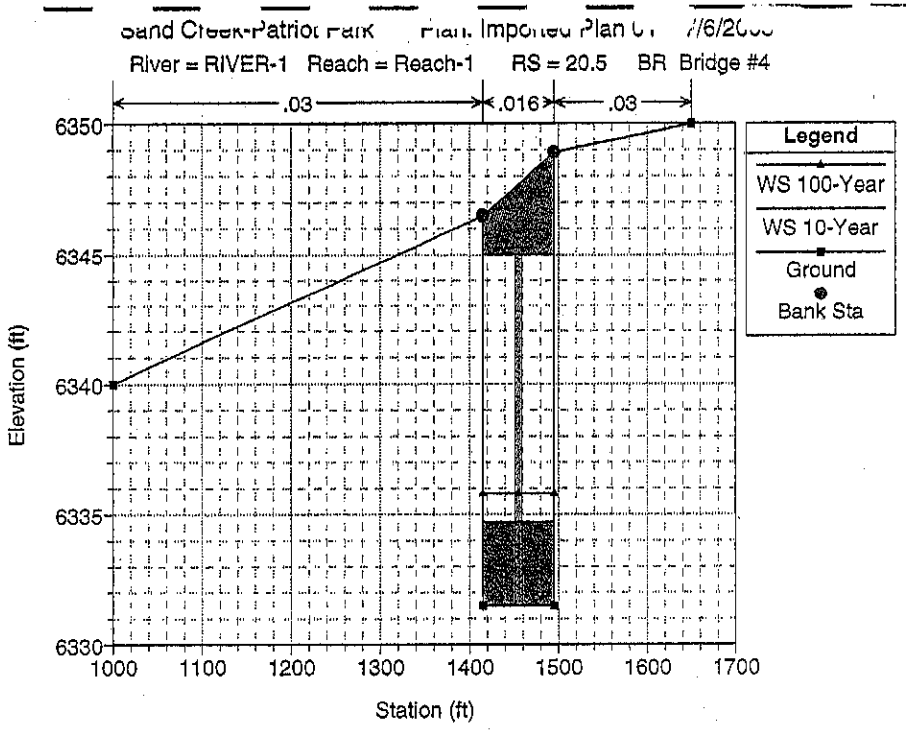

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 24 39
.03
.025
.03
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

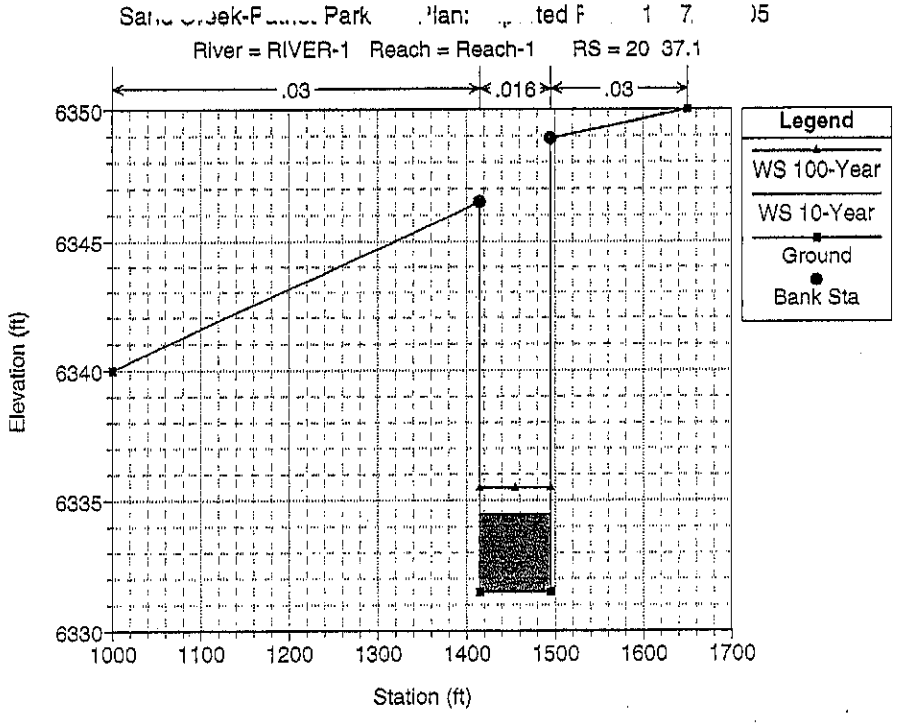

River = RIVER-1 Reach = Reach-1 RS = 23 38
.03
.025
.03
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

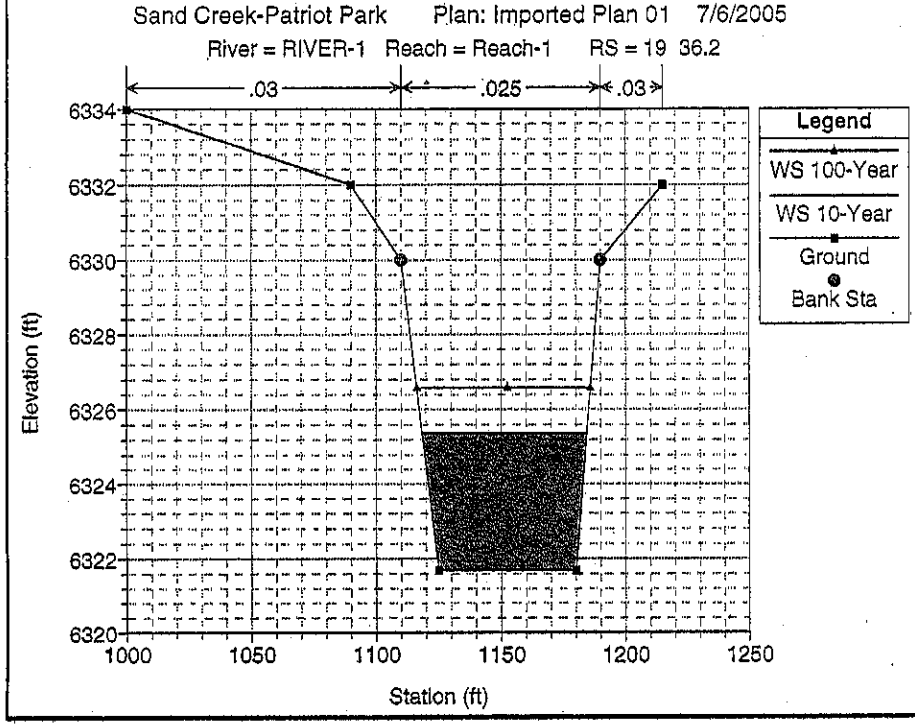

River = RIVER-1 Reach = Reach-1 RS = 22 37.3
.025
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

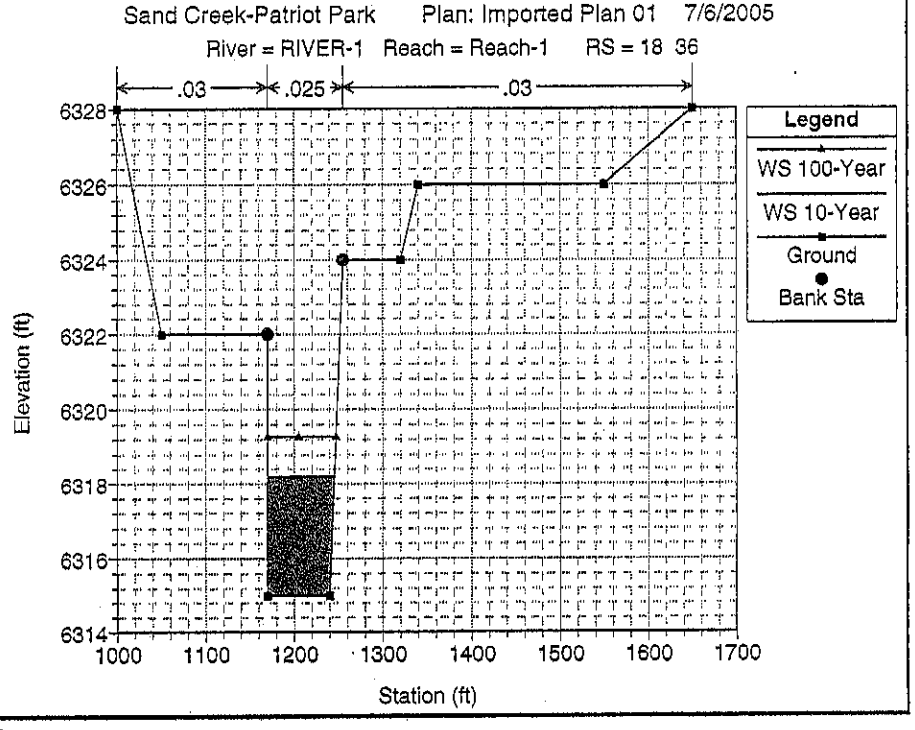

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 21 37.2
.035
.016
.035
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

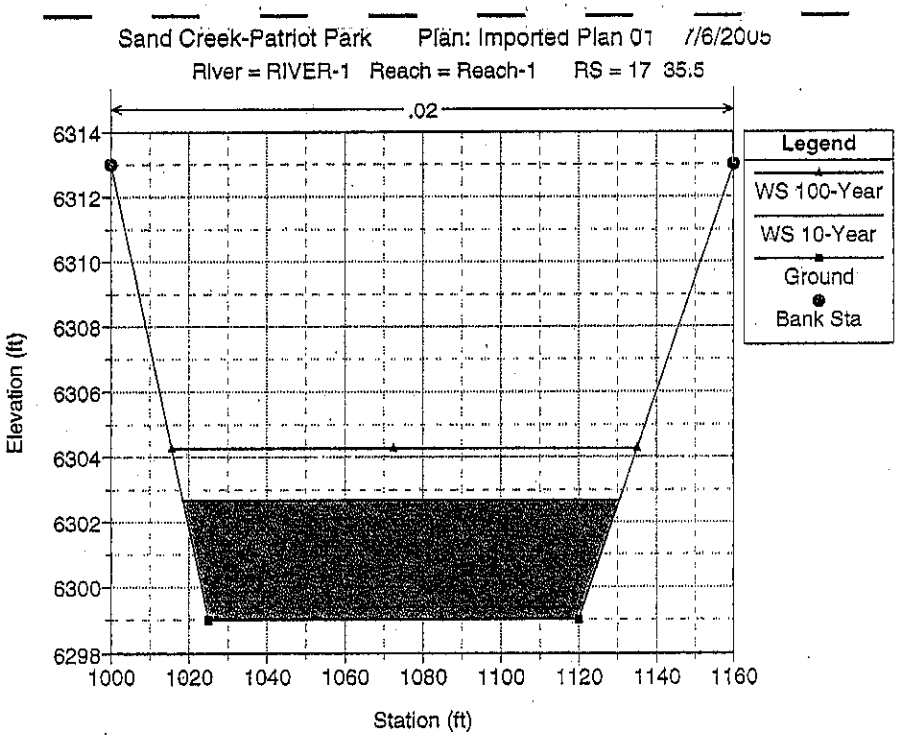

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 20.5 BR Bridge #4
.035
.016
.035
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

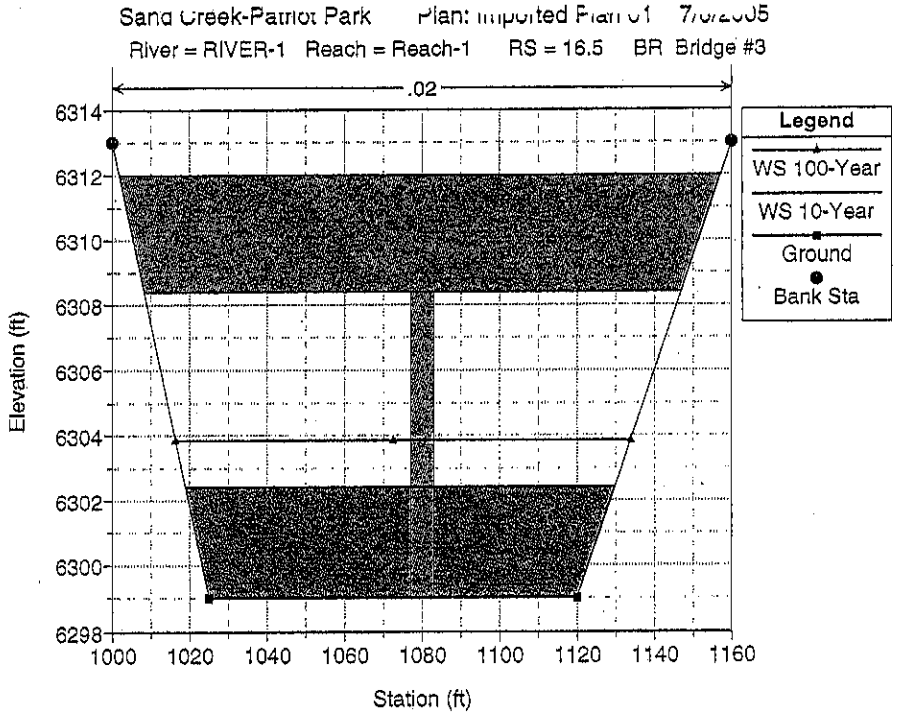

Sand Creek-Patriot Park
River = RIVER-1 Reach = Reach-1 RS = 20.5 BR Bridge #4
.03
.016
.03
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


River = RIVER-1 Reach = Reach-1
.03
.016
.03
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 19 36.2
.03
.025
.03
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 18 36
.03
.025
.03
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 17 35.5
.02
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6314
6312
6310
6308
6306
6304
6302
6300
6298
1000
1020
1040
1060
1080
1100
1120
1140
1160


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 16.5 BR Bridge #3
.02
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6314
6312
6310
6308
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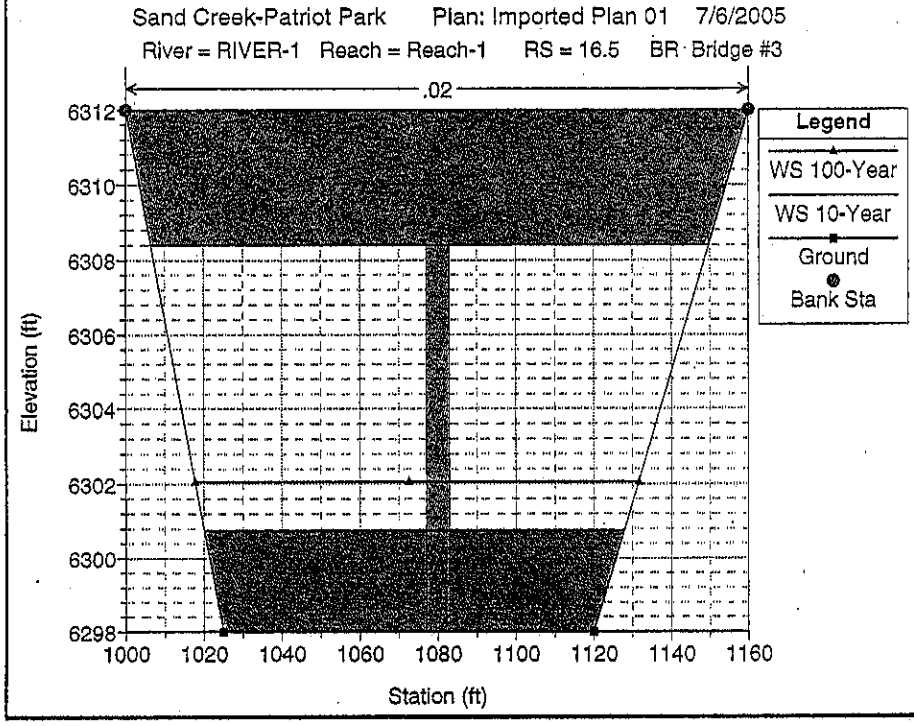
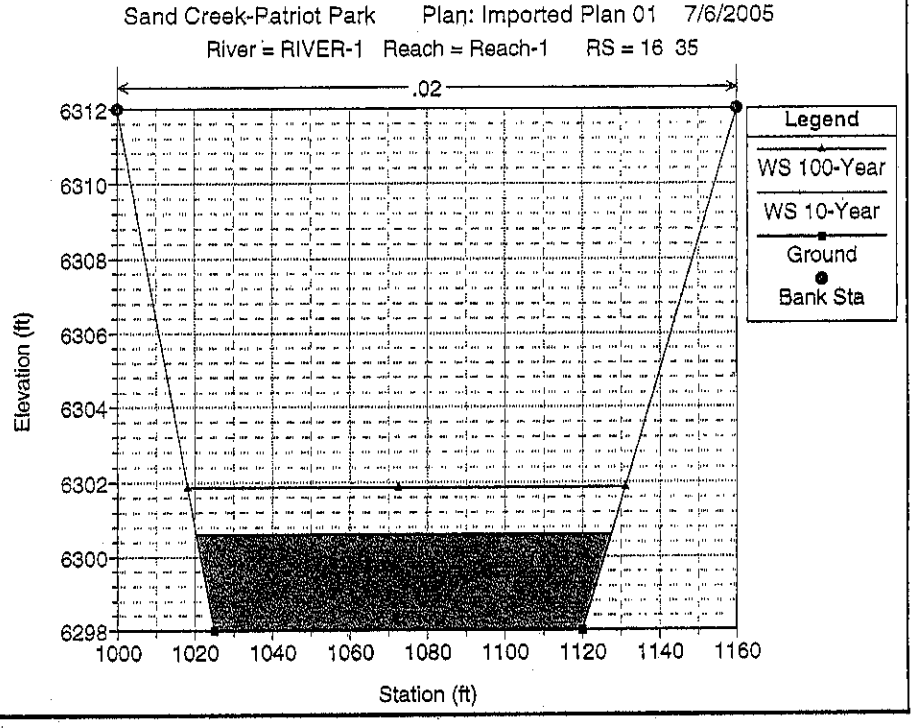
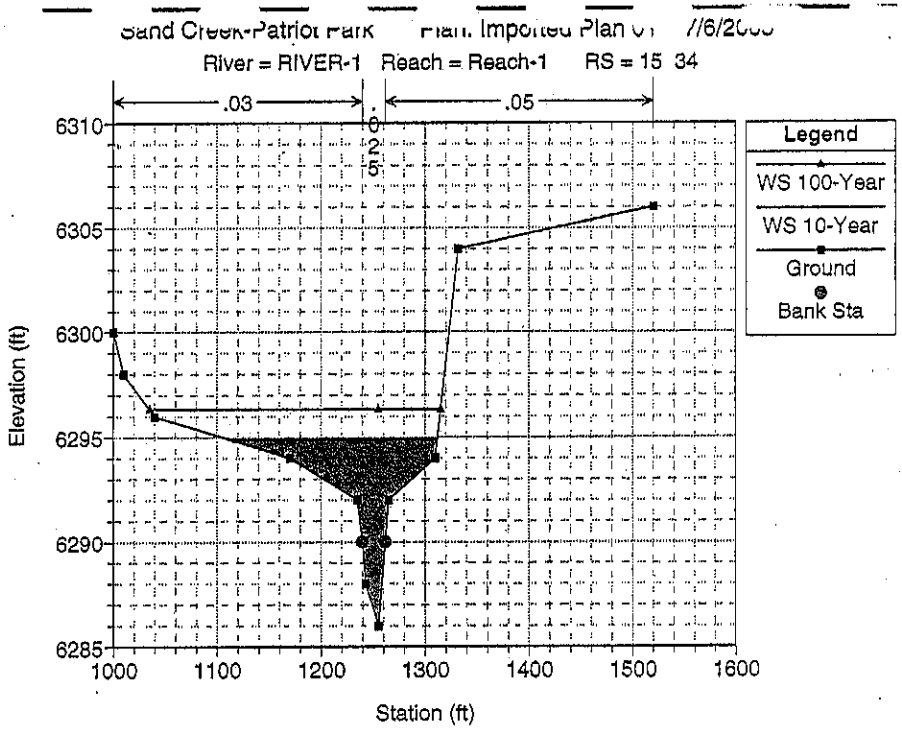
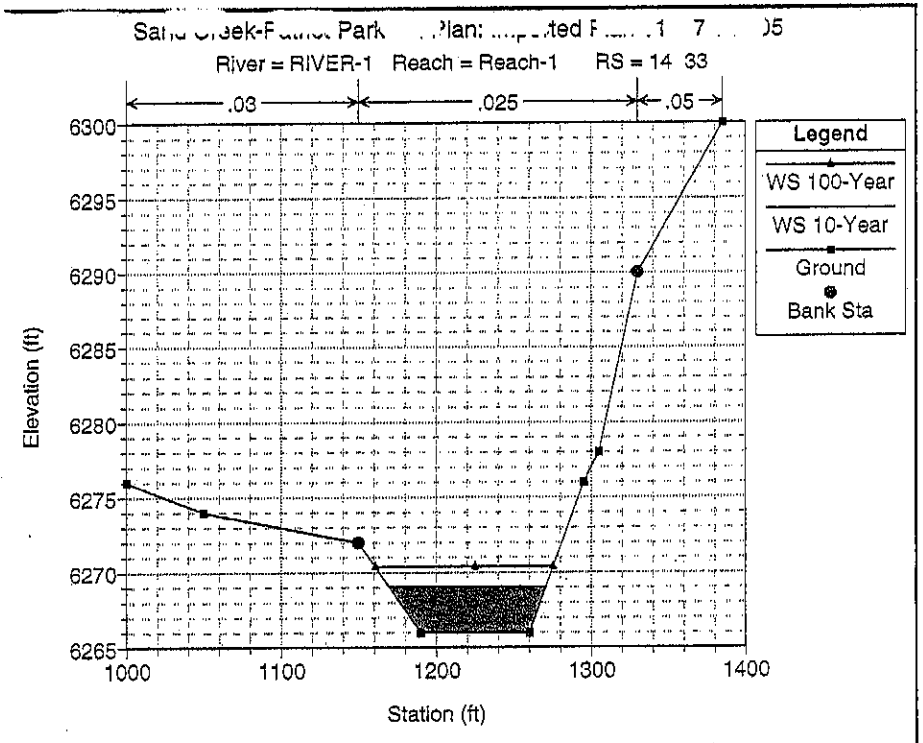
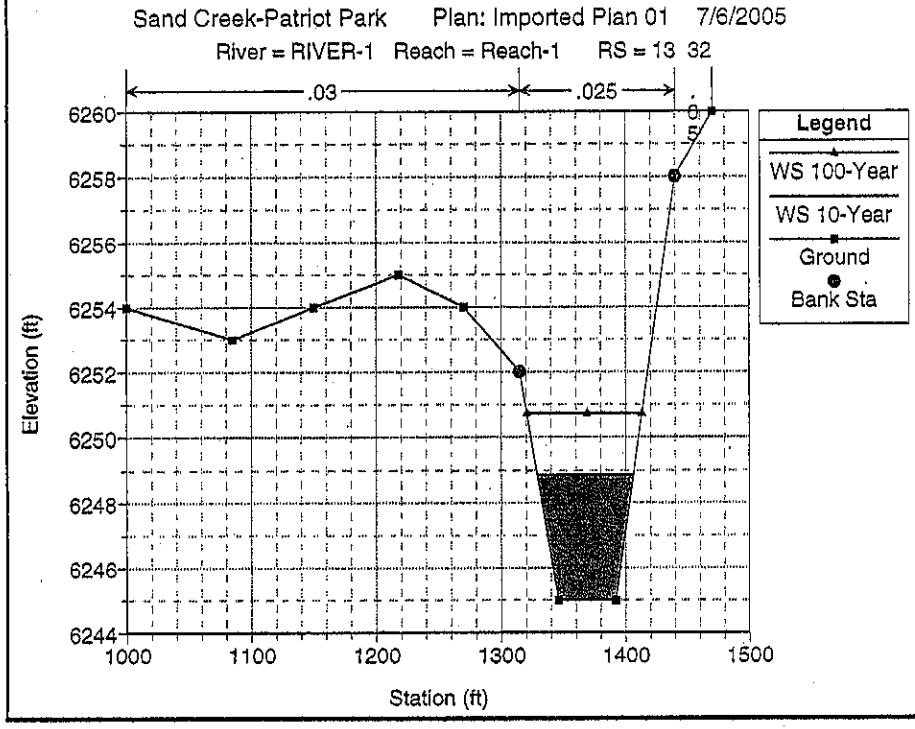
6304
6302
6300
6298
1000
1020
1040
1060
1080
1100
1120
1140
1160

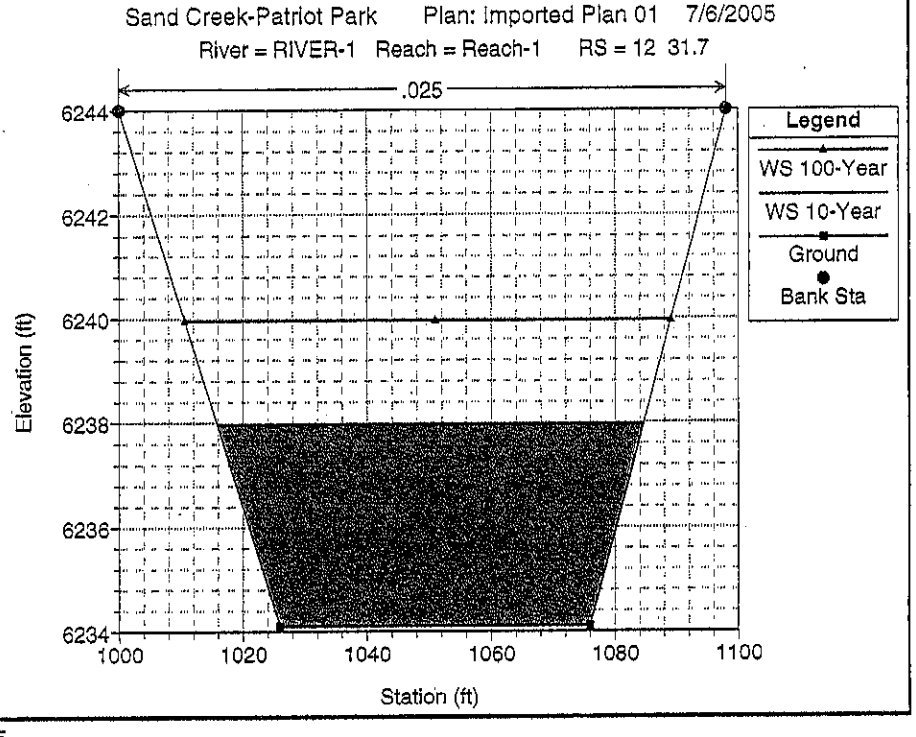

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 16.5 BR Bridge #3
.02
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6312
6310
6308
6306
6304
6302
6300
6298
1000
1020
1040
1060
1080
1100
1120
1140
1160

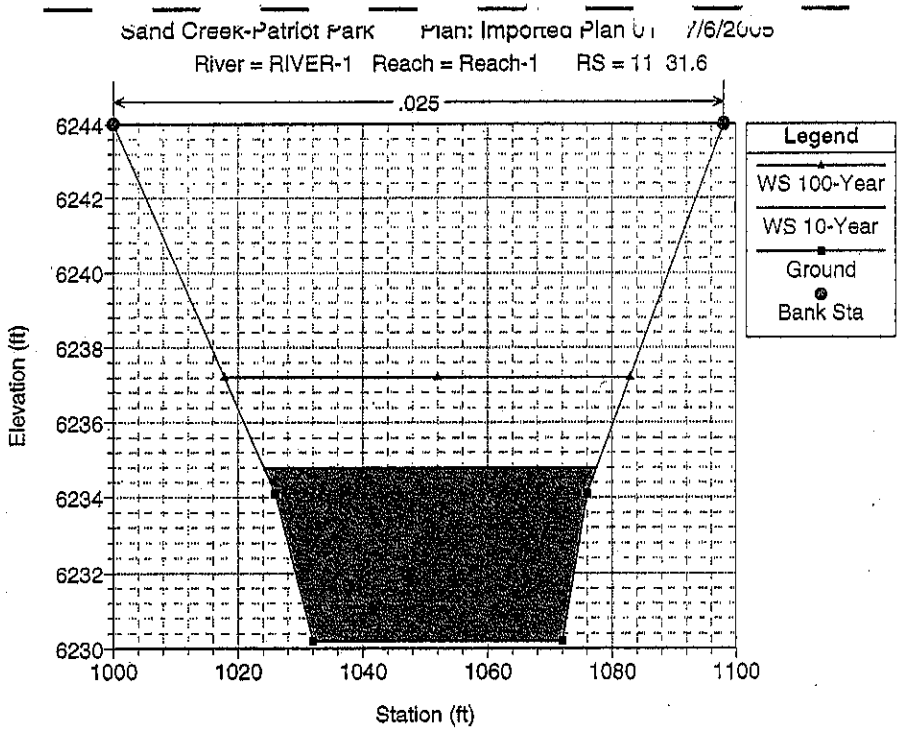

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 16 35
.02
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6312
6310
6308
6306
6304
6302
6300
6298
1000
1020
1040
1060
1080
1100
1120
1140
1160

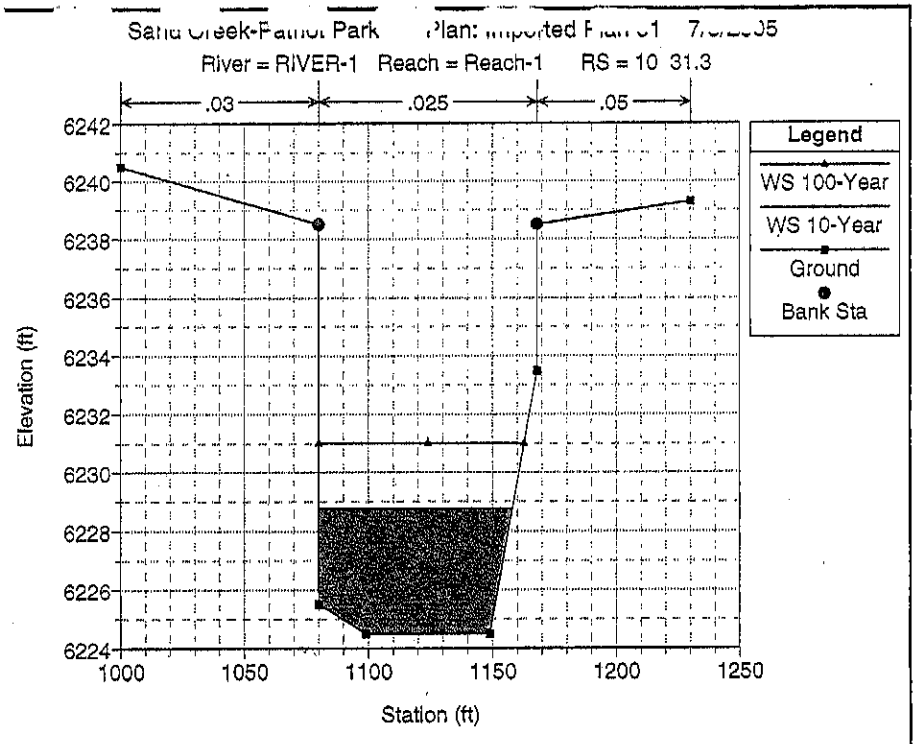

River = RIVER-1 Reach = Reach-1 RS = 15 34
.03
.05
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6310
6305
6300
6295
6290
6285
1000
1100
1200
1300
1400
1500
1600

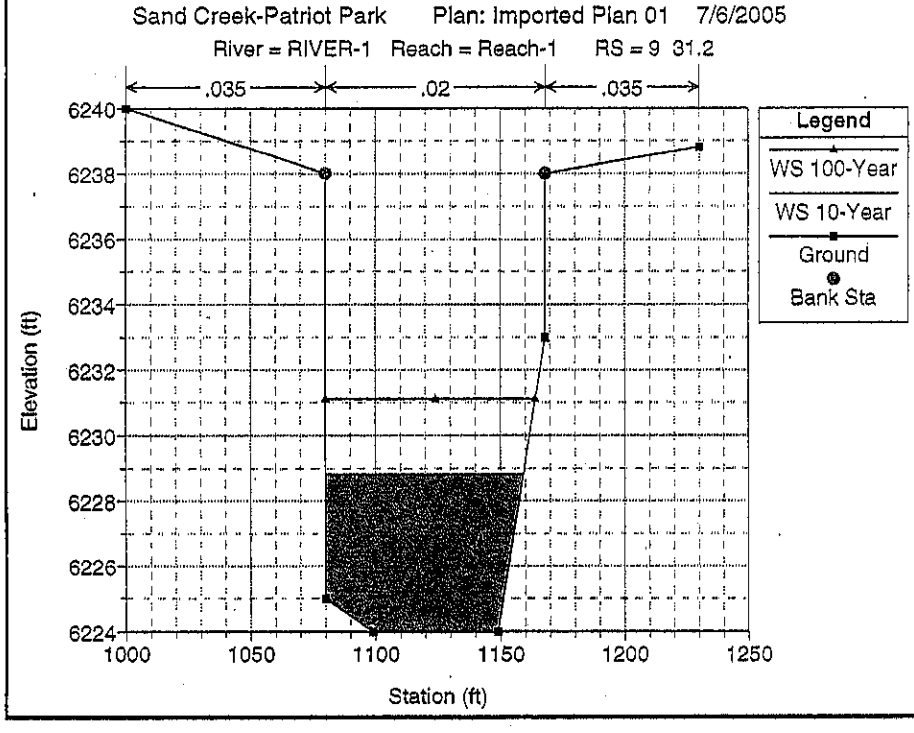

River = RIVER-1 Reach = Reach-1 RS = 14 33
.03
.025
.05
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6300
6295
6290
6285
6280
6275
6270
6265
1000
1100
1200
1300
1400

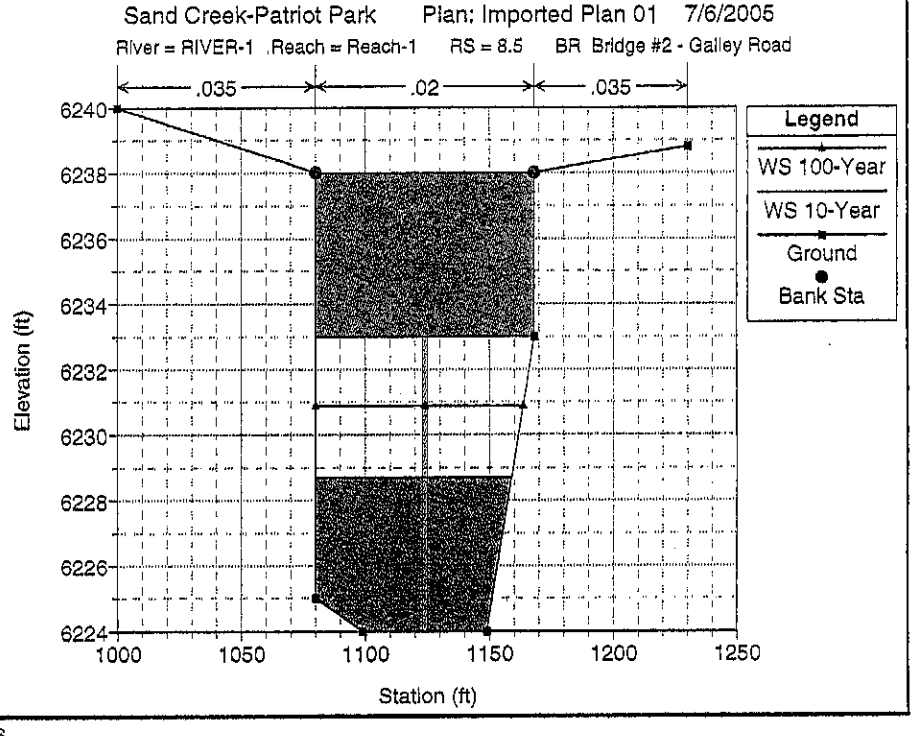

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 13 32
.03
.025
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6260
6258
6256
6254
6252
6250
6248
6246
6244
1000
1100
1200
1300
1400
1500

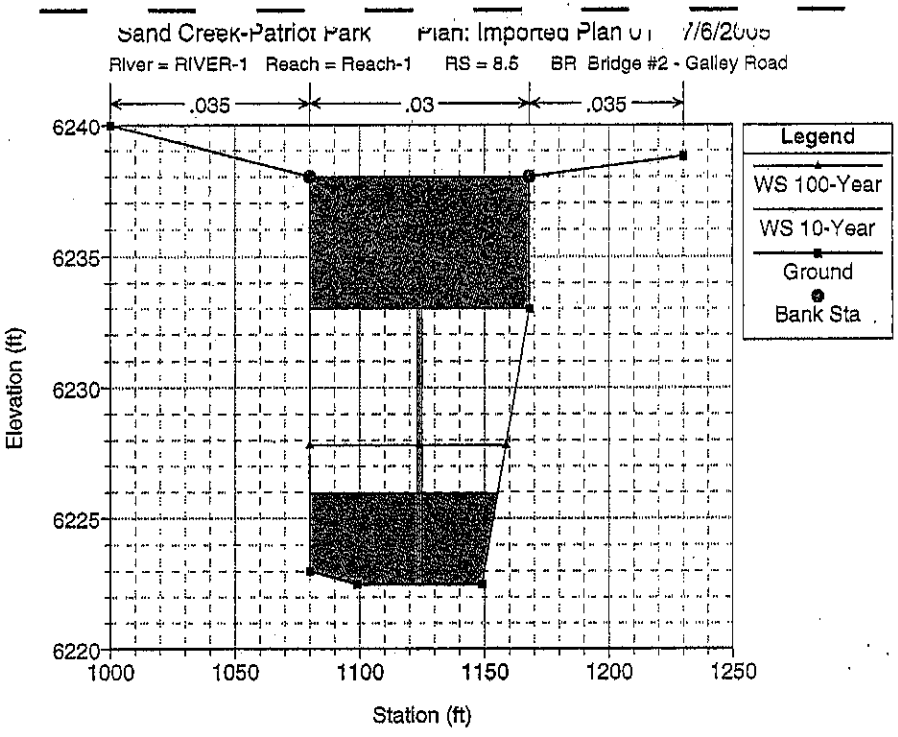

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 12 31.7
.025
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6244
6242
6240
6238
6236
6234
1000
1020
1040
1060
1080
1100

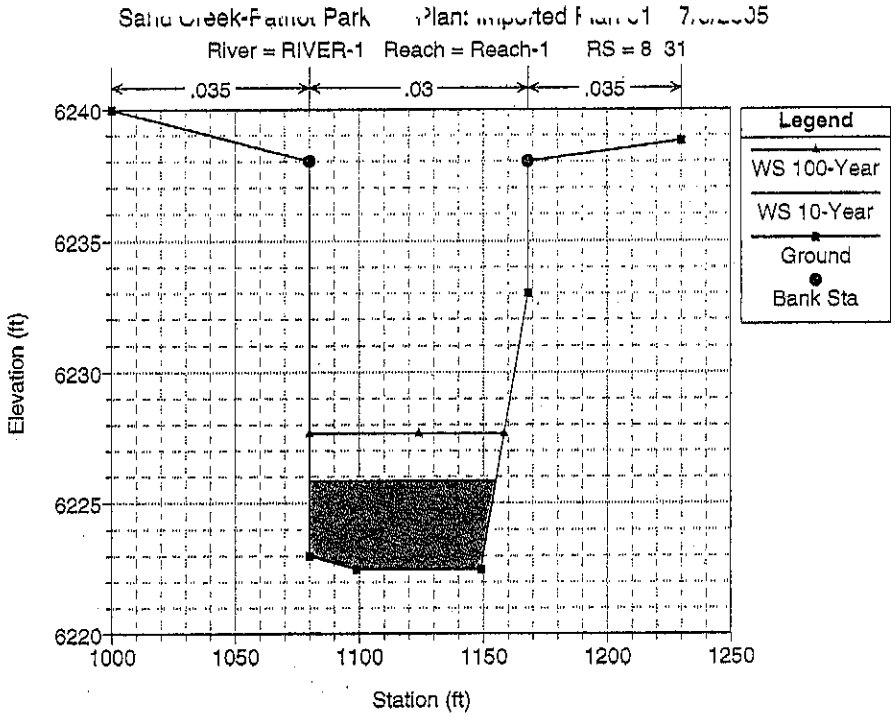

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 11 31.6
.025
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

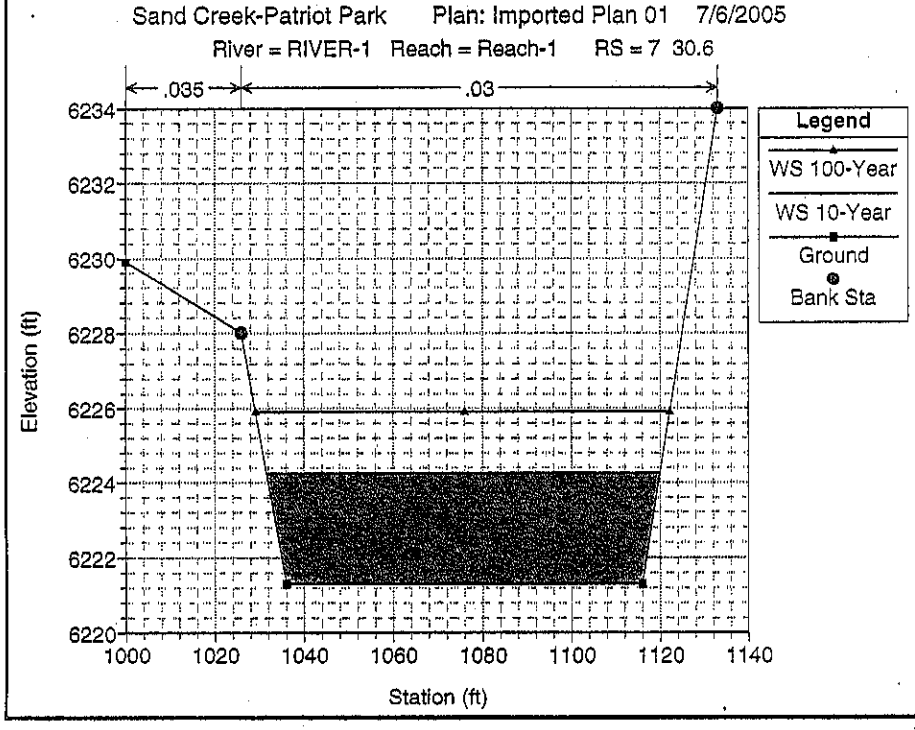

River = RIVER-1 Reach = Reach-1 RS = 10 31.3
.03
.025
.05
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

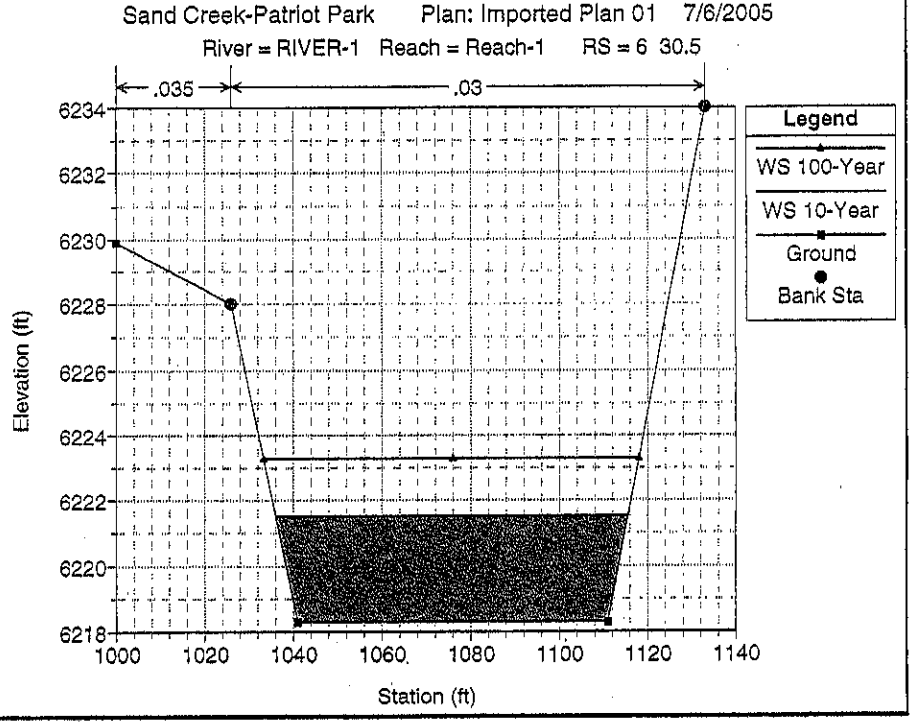

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 9 31.2
.035
.02
.035
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 8.5 BR Bridge #2 - Galley Road
.035
.02
.035
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 8.5 BR Bridge #2 - Galley Road
.035
.03
.035
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6240
6235
6230
6225
6220
1000
1050
1100
1150
1200
1250


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 8 31
.035
.03
.035
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6240
6235
6230
6225
6220
1000
1050
1100
1150
1200
1250


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 7 30.6
.035
.03
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6234
6232
6230
6228
6226
6224
6222
6220
1000
1020
1040
1060
1080
1100
1120
1140


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 6 30.5
.035
.03
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
6234
6232
6230
6228
6226
6224
6222
6220
6218
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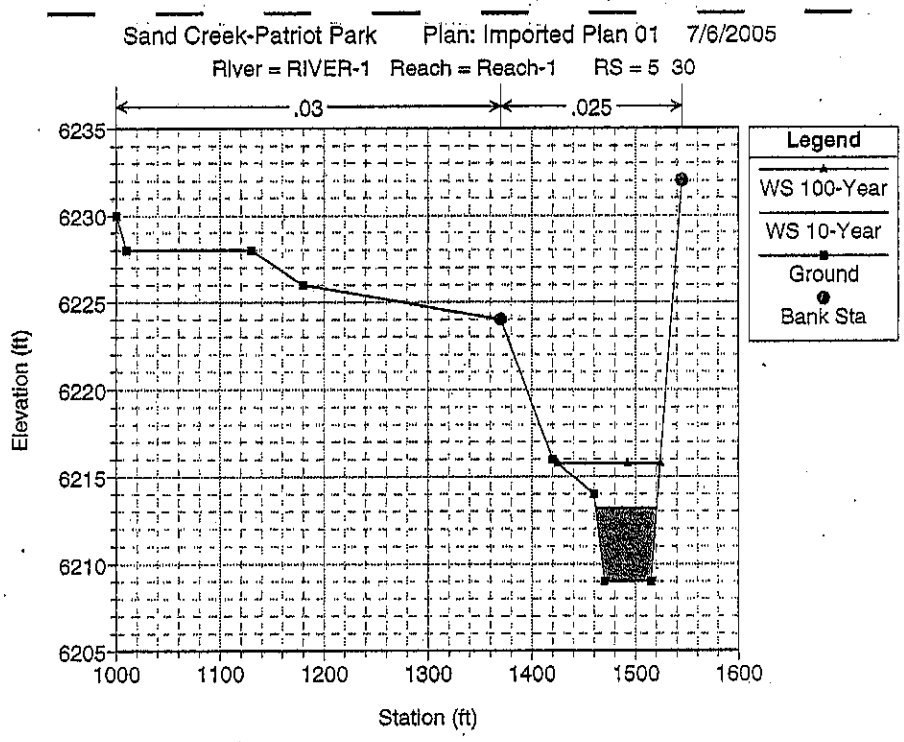
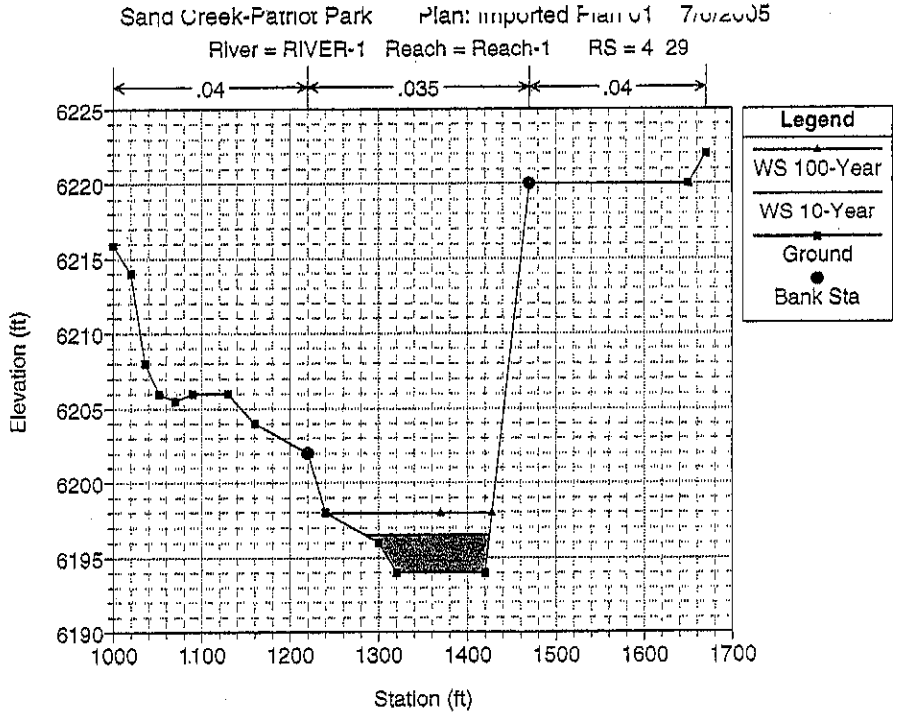
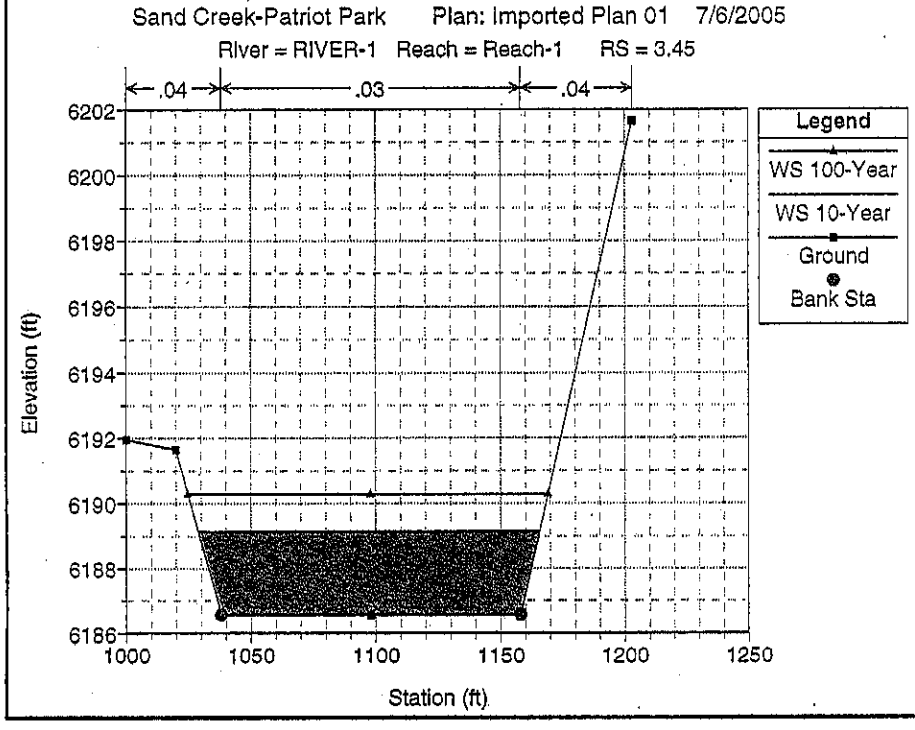
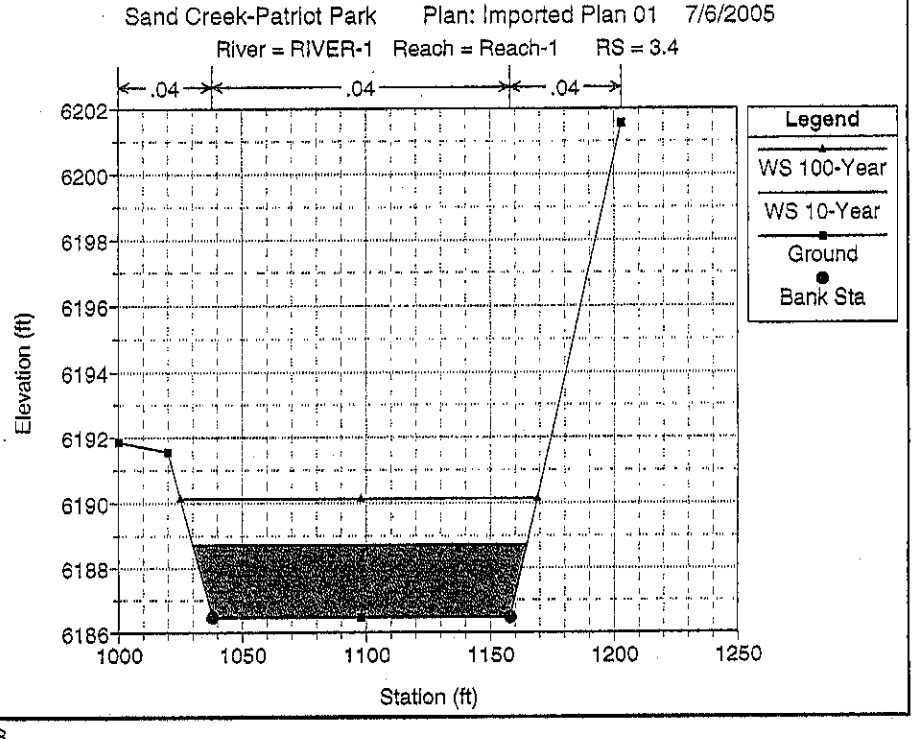
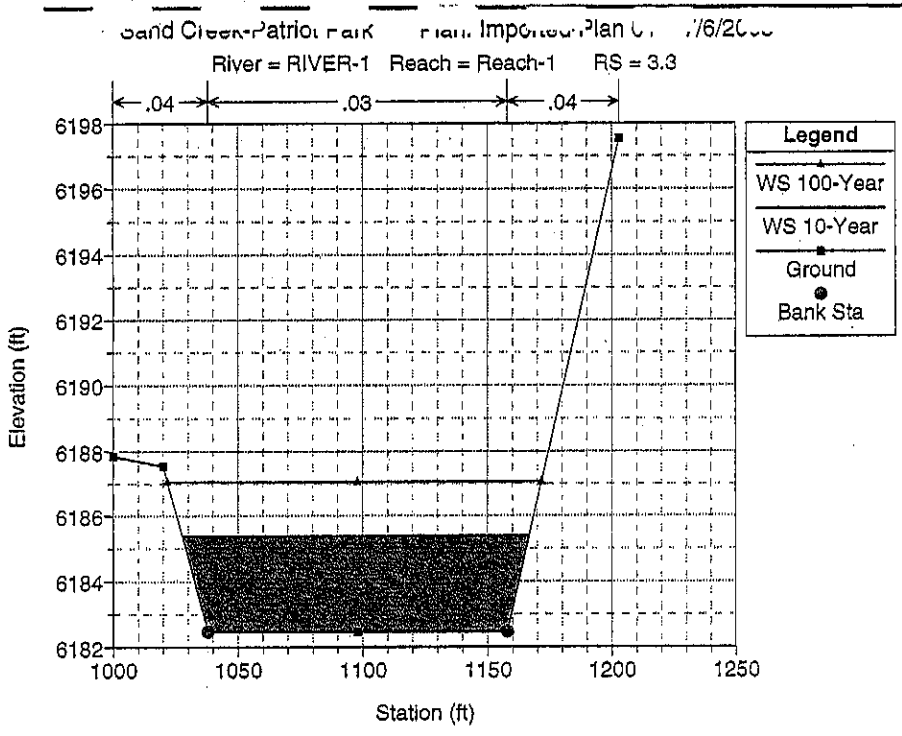
1020
1040
1060
1080
1100
1120
1140

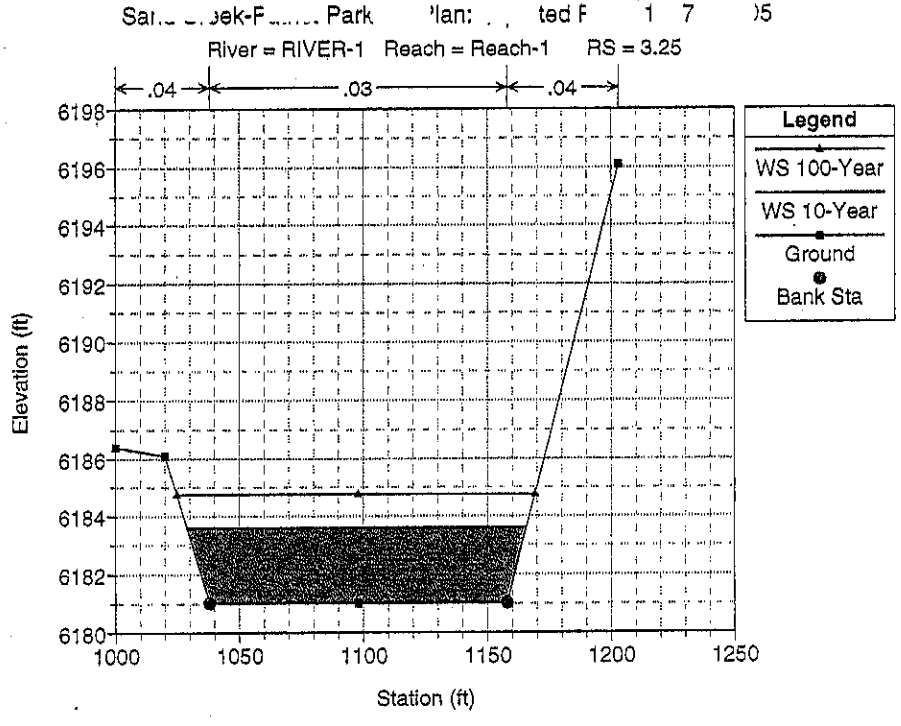

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 5 30
.03
.025
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 4 29
.04
.035
.04
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

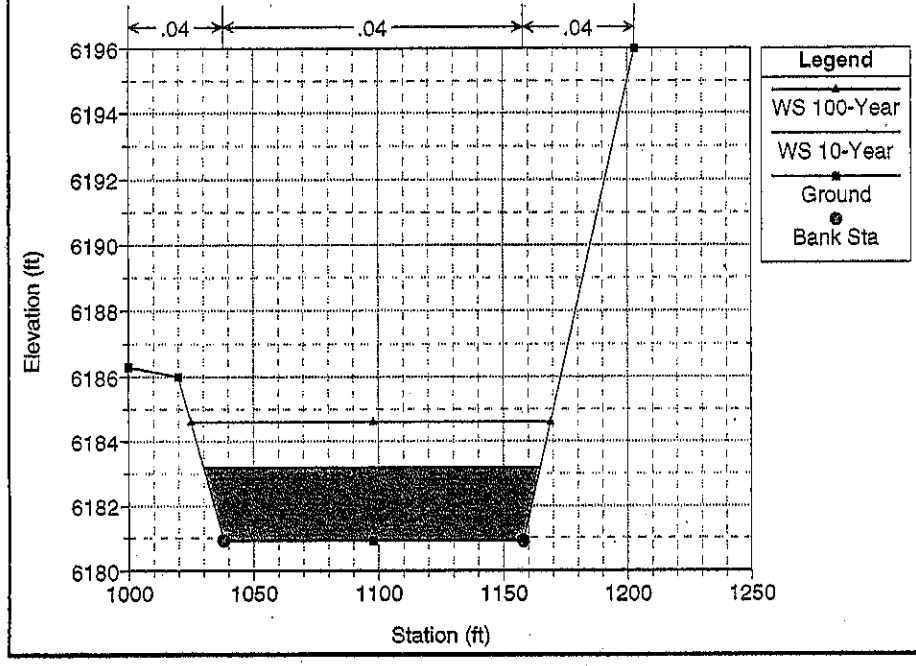

Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 3.45
.04
.03
.04
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 3.4
.04
.04
.04
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

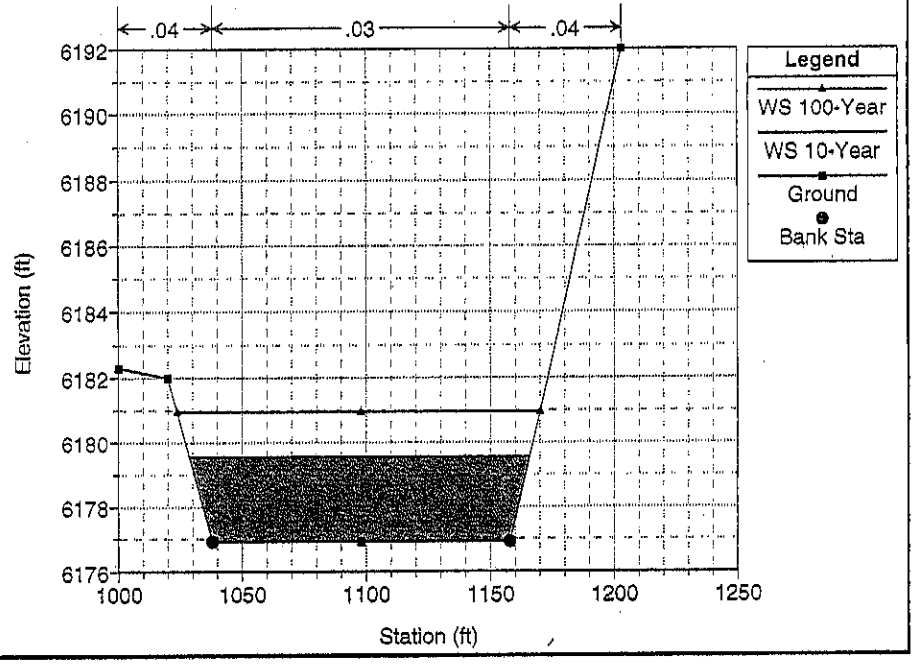


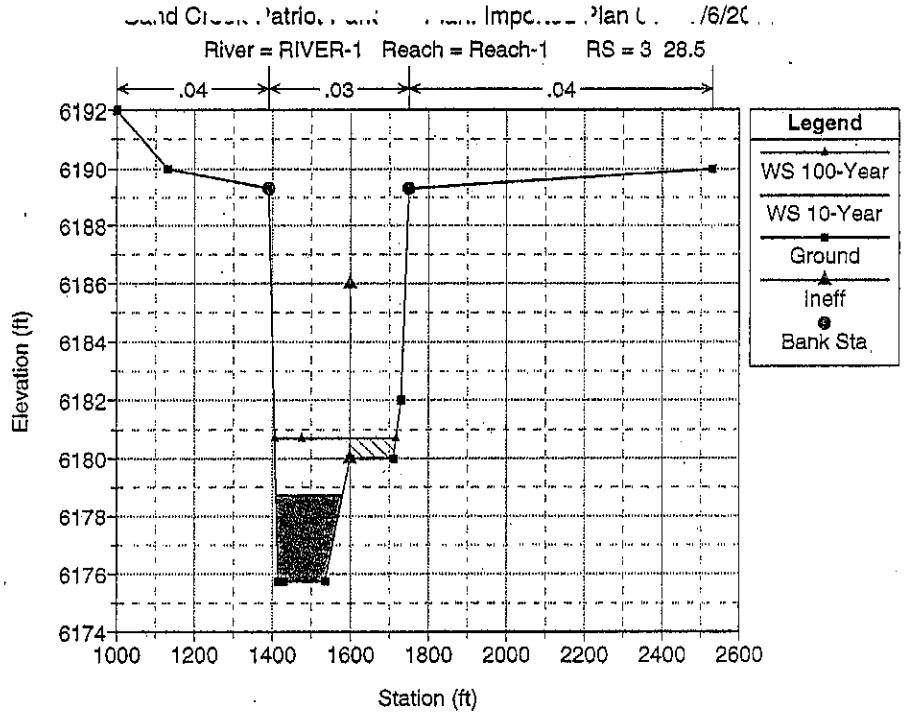


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005



Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005




River = RIVER-1 Reach = Reach-1 RS = 3 28.5
.04
.03
.04
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
6192
6190
6188
6186
6184
6182
6180
6178
6176
6174
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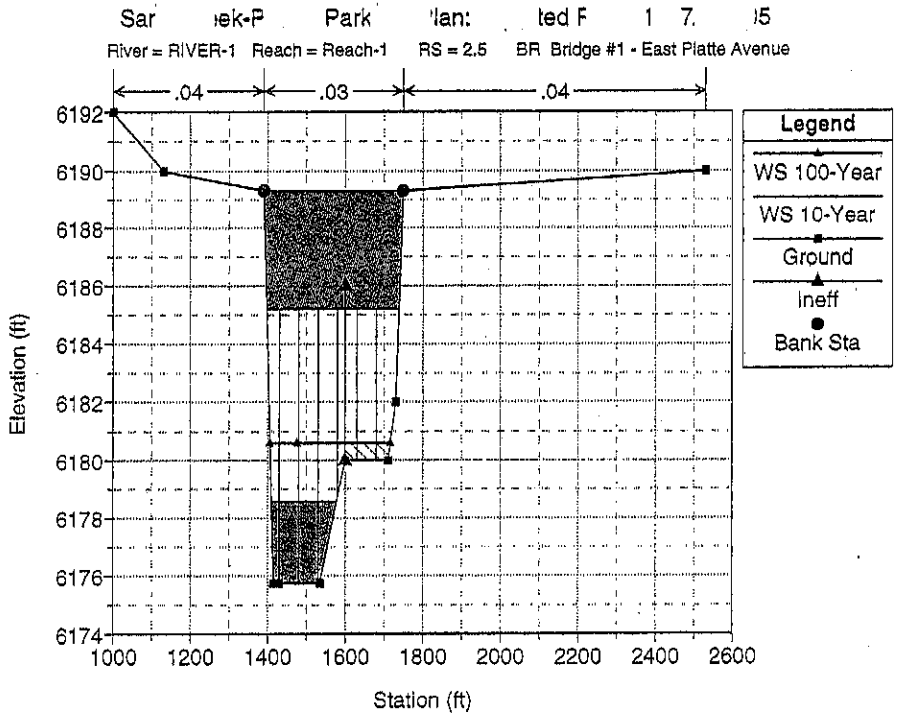
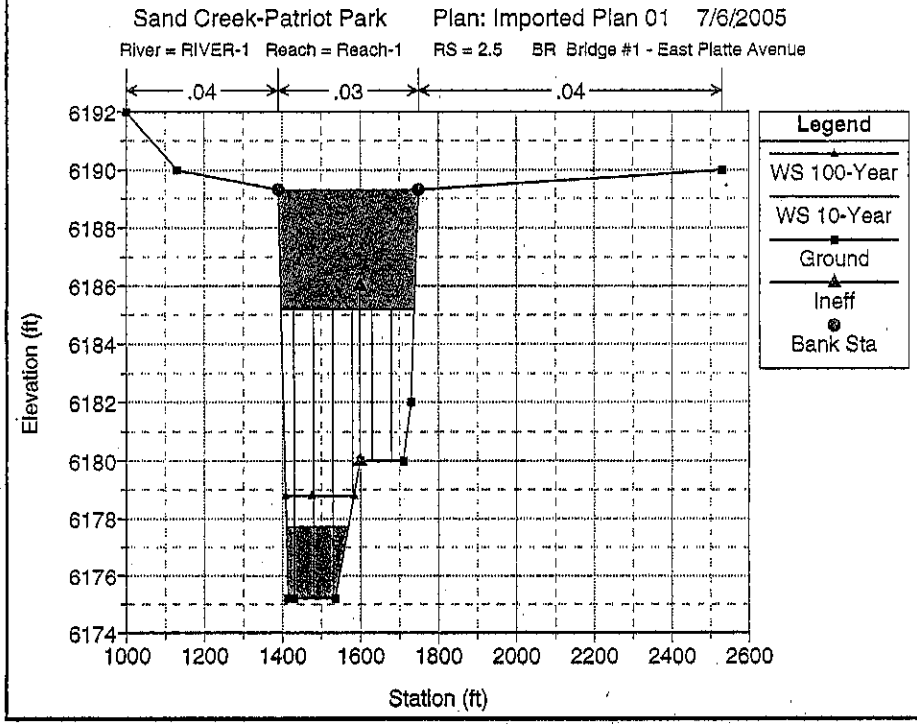
1200
1400
1600
1800
2000
2200
2400
2600


River = RIVER-1 Reach = Reach-1 RS = 2.5 BR Bridge #1 - East Platte Avenue
.04
.03
.04
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
6192
6190
6188
6186
6184
6182
6180
6178
6176
6174
1000
1200
1400
1600
1800
2000
2200
2400
2600


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 2.5 BR Bridge #1 - East Platte Avenue
.04
.03
.04
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
6192
6190
6188
6186
6184
6182
6180
6178
6176
6174
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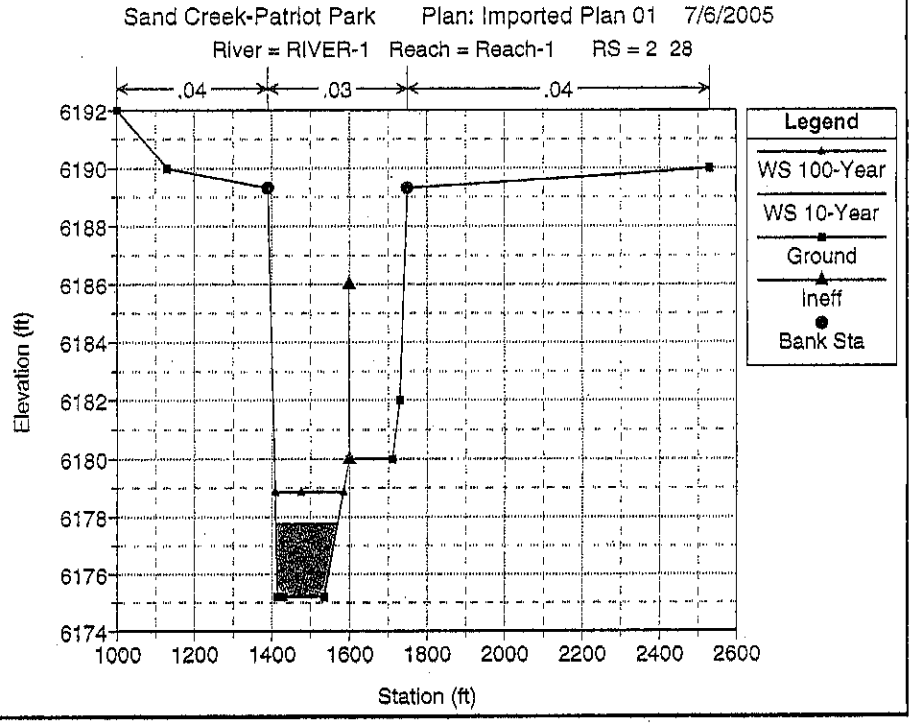
1200
1400
1600
1800
2000
2200
2400
2600


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 2 28
.04
.03
.04
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
6192
6190
6188
6186
6184
6182
6180
6178
6176
6174
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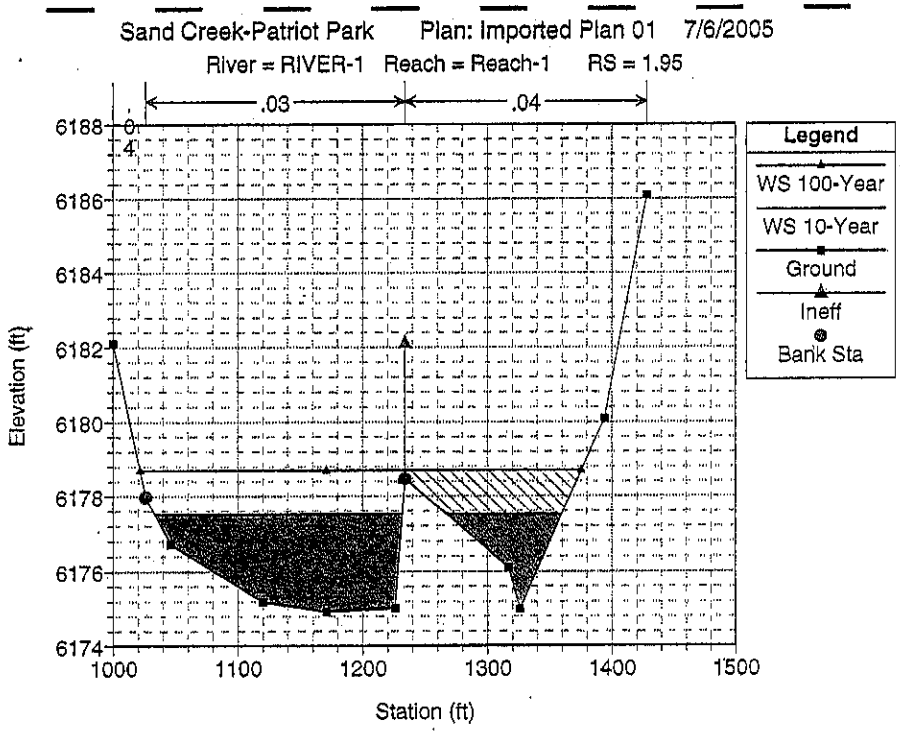
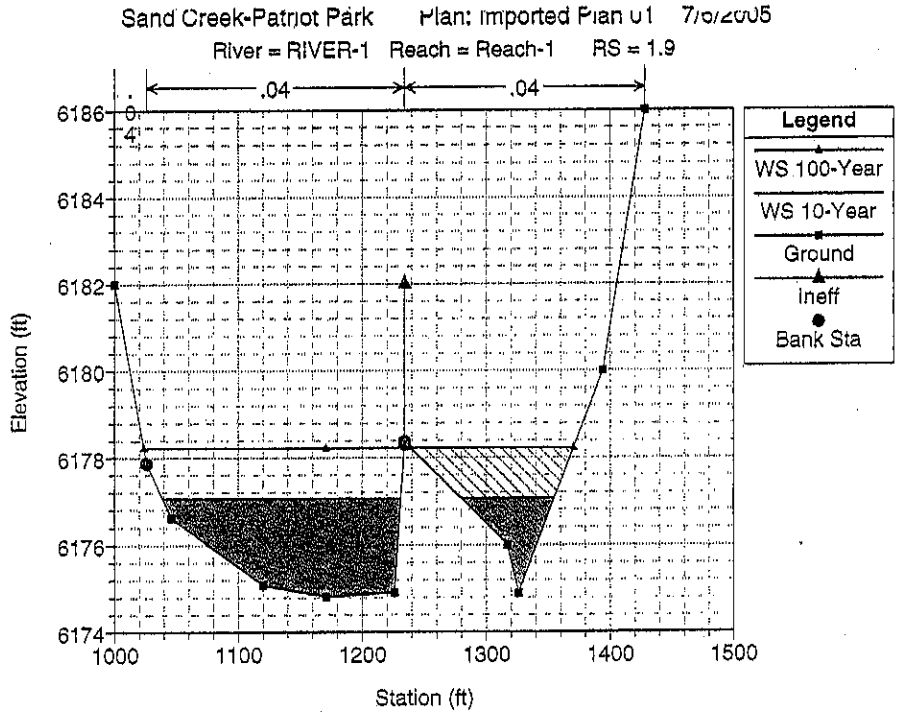
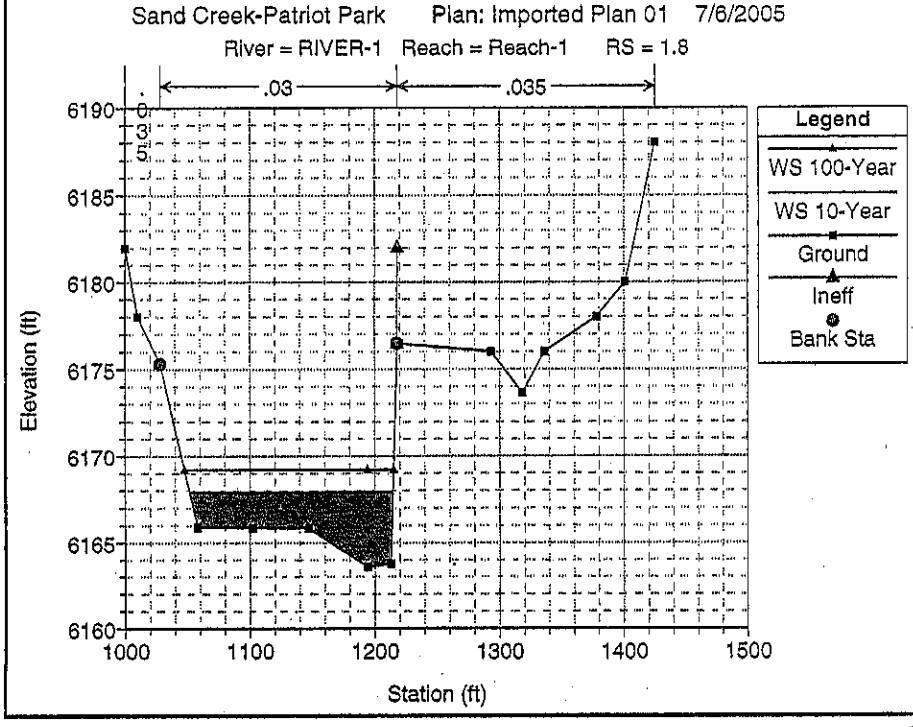
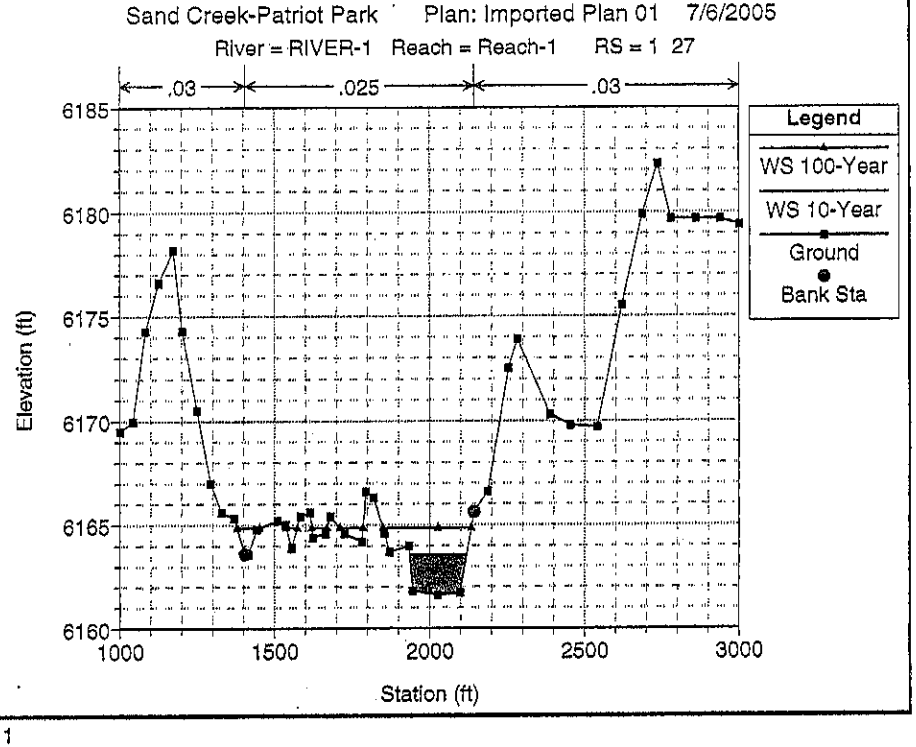
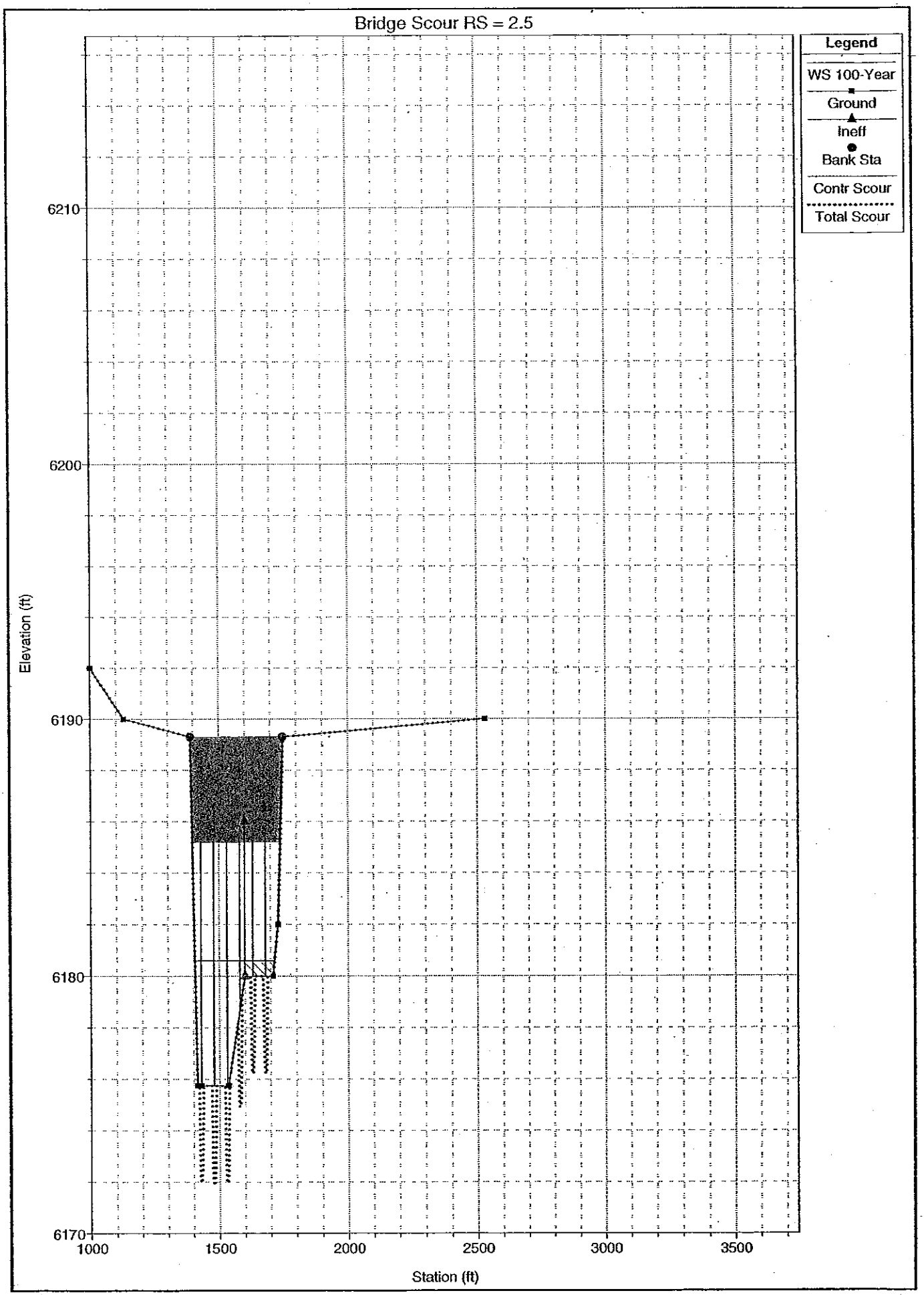
1200
1400
1600
1800
2000
2200
2400
2600


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 1.95
.03
.04
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 1.9
.04
.04
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 1.8
.03
.035
Legend
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Sand Creek-Patriot Park Plan: Imported Plan 01 7/6/2005
River = RIVER-1 Reach = Reach-1 RS = 1 27
.03
.025
.03
Legend
WS 100-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)



1 in Horiz. = 500 1 in Vert. = 5

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):	2.02	4.03	2.02
	Approach Velocity (ft/s):	4.53	9.84	4.49
	Br Average Depth (ft):		4.02	
	BR Opening Flow (cfs):		5000.00	
	BR Top WD (ft):		185.95	
	Grain Size D50 (mm):		1.55	
	Approach Flow (cfs):	130.55	4760.59	108.86
	Approach Top WD (ft):	14.29	120.00	12.04
	K1 Coefficient:	0.590	0.640	0.590
Results				
	Scour Depth Ys (ft):		0.00	
	Critical Velocity (ft/s):		2.43	
	Equation:		Live	

Pier Scour

All piers have the same scour depth

Input Data		
	Pier Shape:	Sharp nose
	Pier Width (ft):	2.00
	Grain Size D50 (mm):	1.55000
	Depth Upstream (ft):	4.94
	Velocity Upstream (ft/s):	6.93
	K1 Nose Shape:	0.90
	Pier Angle:	0.00
	Pier Length (ft):	88.00
	K2 Angle Coef:	1.00
	K3 Bed Cond Coef:	1.10
	Grain Size D90 (mm):	
	K4 Armouring Coef:	0.90
Results		
	Scour Depth Ys (ft):	3.78
	Froude #:	0.55
	Equation:	CSU equation

Matrix Design Group, Inc.
Integrated Design Solutions
Infrastructure Engineering
Community Development
Program Management

Project: PATRIOT PARK - SAND CREEK
Subject: RIPRAP SIZING / FREE BOARD

Job. No. _____
Date ____/____/____
Sheet ____ of ____
By _____

R. RAP SIZING (DESIGN FLOWS n = 0.032)

$V_{max} = 9.49$ FPS $F_r = 0.8$

$$\frac{VS^{0.17}}{(S-1)^{0.66}} = \frac{(9.49)(0.006)^{.17}}{(2.5-1)^{0.66}} = 3.04$$

∴ TYPE VL ROCK REQUIRED
(LOW UPPER LIMIT OF VL → USE TYPE "L"; $D_{50} = 9$)

VL ⇒ 1.9 → 3.2

CHECK FOR n = 0.028

$V_{max} = 9.6$ FPS $F_r = 0.89$

$$\frac{VS^{0.17}}{(S-1)^{.66}} = 3.08$$

∴ TYPE VL REQUIRED AS MIN. ROCK SIZE!!

FREE BOARD

$$FB = 1.0 + 0.025(V)d^{0.33}$$

$$FB = 1.0 + 0.025\,(9.49)(9.26)^{.33}$$

$FB = 1.3'$ (MIN)

DESIGN ALLOWS FOR 1.7' FREE BOARD

Worksheet for Trapezoidal Channel - 1

PROPOSED CHANNEL SECTION AS DESIGNED

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.032	
Channel Slope:	0.00600	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	3.00	ft/ft (H:V)
Bottom Width:	120.00	ft
Discharge:	5000.00	ft^3/s

Results		
Normal Depth:	4.26	ft
Flow Area:	565.84	ft^2
Wetted Perimeter:	146.95	ft
Top Width:	145.57	ft
Critical Depth:	3.66	ft
Critical Slope:	0.01006	ft/ft
Velocity:	8.84	ft/s
Velocity Head:	1.21	ft
Specific Energy:	5.47	ft
Froude Number:	0.79	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	4.26	ft
Critical Depth:	3.66	ft
Channel Slope:	0.00600	ft/ft

Worksheet for Trapezoidal Channel - 1

Critical Slope:	0.01006	ft/ft

Worksheet for Trapezoidal Channel - 2

PROPOSED CHANNEL SECTION – LOWEST "n" VALUE

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.028	
Channel Slope:	0.00600	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	3.00	ft/ft (H:V)
Bottom Width:	120.00	ft
Discharge:	5000.00	ft^3/s

Results		
Normal Depth:	3.94	ft
Flow Area:	519.38	ft^2
Wetted Perimeter:	144.92	ft
Top Width:	143.64	ft
Critical Depth:	3.66	ft
Critical Slope:	0.00770	ft/ft
Velocity:	9.63	ft/s
Velocity Head:	1.44	ft
Specific Energy:	5.38	ft
Froude Number:	0.89	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	3.94	ft
Critical Depth:	3.66	ft
Channel Slope:	0.00600	ft/ft

Worksheet for Trapezoidal Channel - 2

Critical Slope:	0.00770	ft/ft

Worksheet for Trapezoidal Channel - 3

PROPOSED CHANNEL SECTION - HIGHEST "n" VALUE

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.040	
Channel Slope:	0.00600	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	3.00	ft/ft (H:V)
Bottom Width:	120.00	ft
Discharge:	5000.00	ft^3/s

Results		
Normal Depth:	4.86	ft
Flow Area:	653.50	ft^2
Wetted Perimeter:	150.71	ft
Top Width:	149.14	ft
Critical Depth:	3.66	ft
Critical Slope:	0.01571	ft/ft
Velocity:	7.65	ft/s
Velocity Head:	0.91	ft
Specific Energy:	5.77	ft
Froude Number:	0.64	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

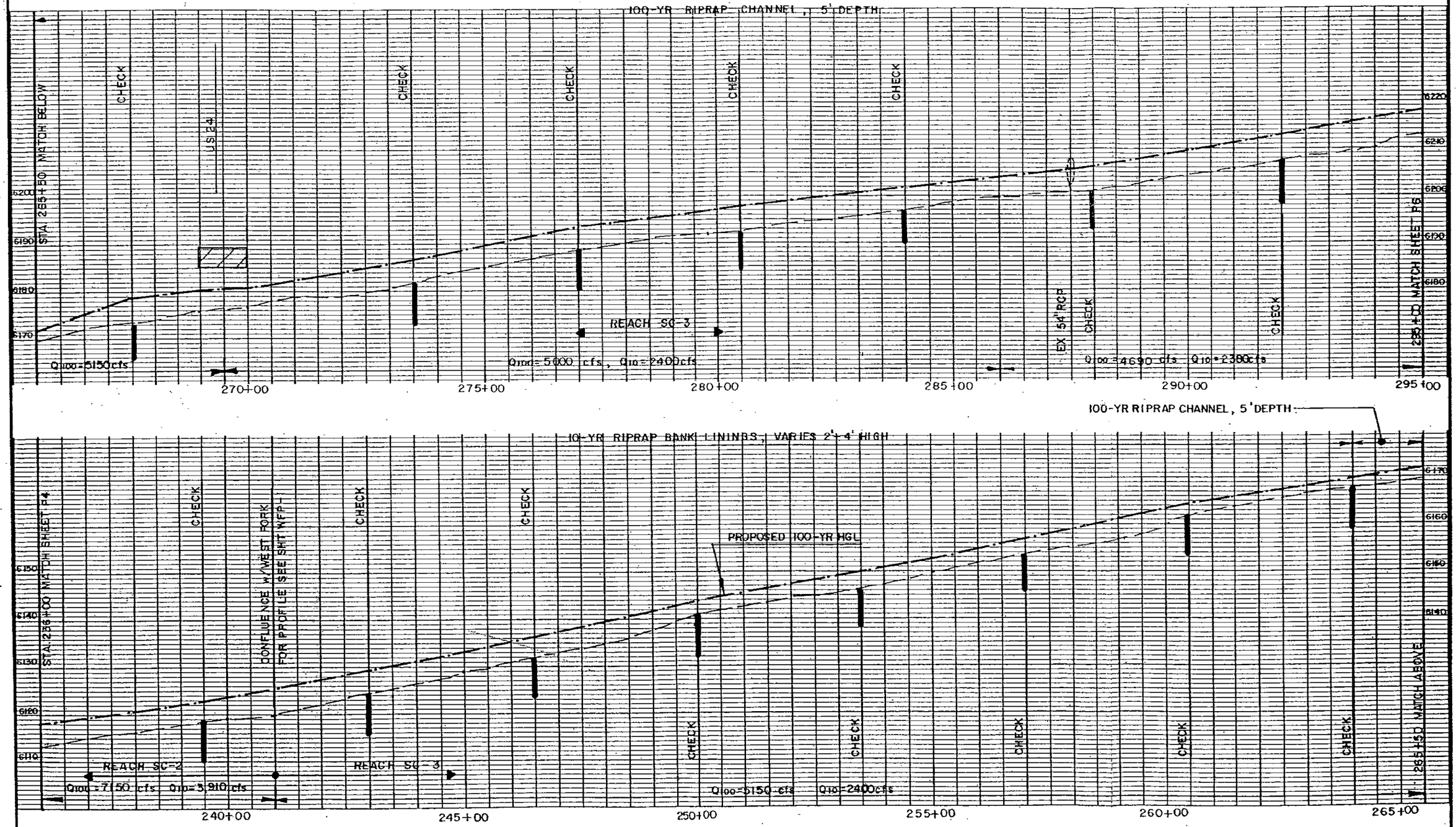
GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	4.86	ft
Critical Depth:	3.66	ft
Channel Slope:	0.00600	ft/ft

Worksheet for Trapezoidal Channel - 3

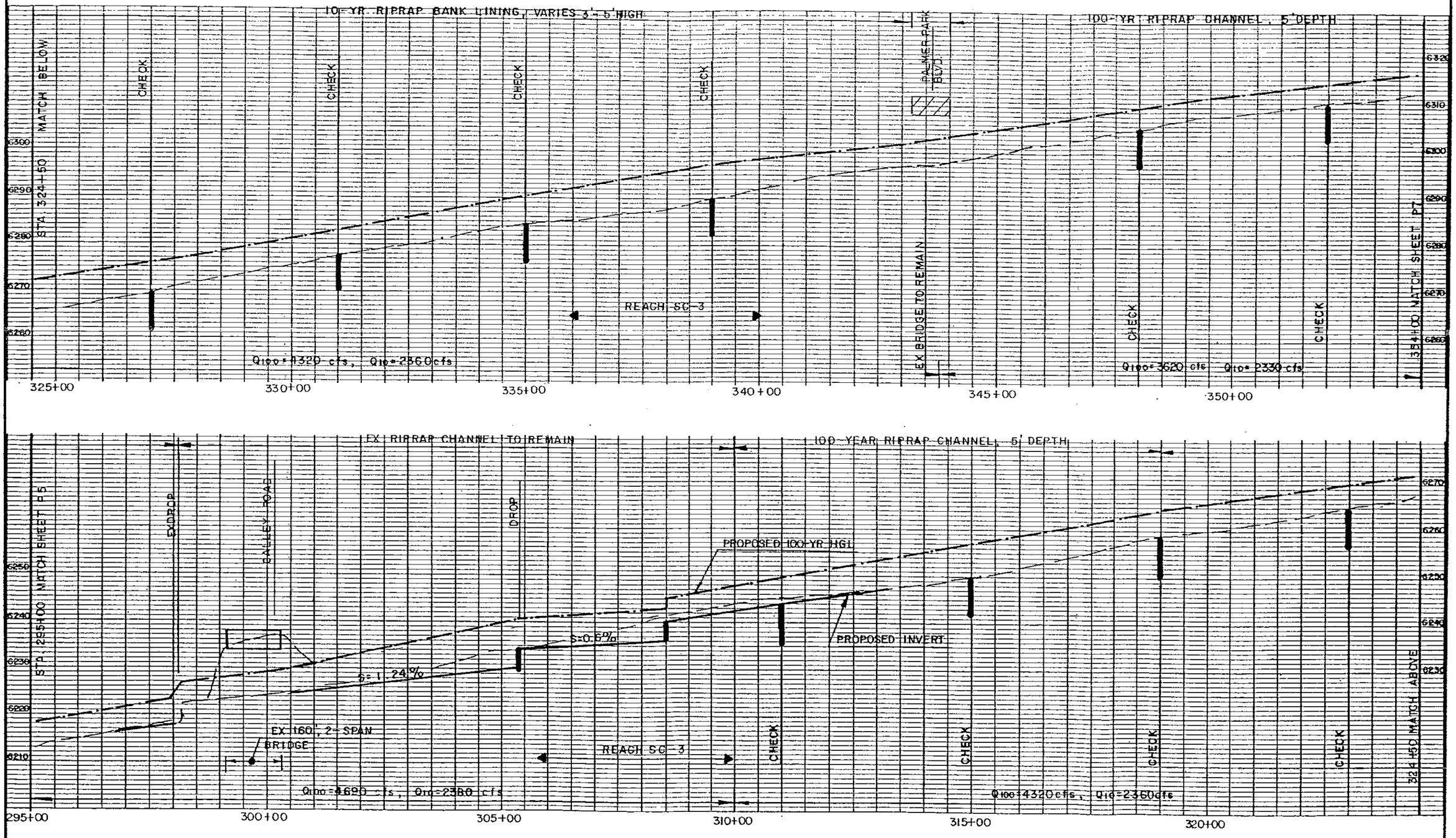
Critical Slope:	0.01571	ft/ft

APPENDIX F

EXCERPTS FROM THE DRAINAGE BASIN PLANNING STUDY FOR SAND CREEK



Kiowa Engineering Corporation	DESIGNED RNW DATE CHECKED JYC DATE DRAWN EAK DATE 7/92 REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	SAND CREEK Station 236+00 to 295+00	P-5



Kiowa Engineering Corporation	DESIGNED RNW DATE CHECKED JYC DATE DRAWN EAK DATE 7/92 REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	SAND CREEK Station 295+00 to 354+00	P-6

MATCH STA 276+50 SHT 19

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

OI-CUL-1374
24"CMP

OI-CUL-1375
24"RCP

OI-CUL-1376
18"RCP

OI-CUL-1377
18"RCP

STA 273+50
CHECK

PRESERVE EXISTING
FLOODPLAIN & VEGETATION ✓

OI-CHA-1380

OI-CHA-1378

OI-PIP-1381
36"CMP

REMOVE 36"CMP

OI-PIP-1384
18"CMP

OI-PIP-1379
18"CMP

OI-BRI-1385

EX BRIDGE TO REMAIN

STA 267+50 CHECK

STA 264+00 CHECK

STA 260+50 CHECK

PRESERVE EX FLOODPLAIN
& VEGETATION

STA 257+00 CHECK

STA 253+50 CHECK

SAND CREEK REACH SC-3

MATCH SHT 18A

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
127	80	10-YEAR RIPRAP LININGS, 4' DEPTH
128	115	100-YEAR RIPRAP 5' DEPTH

FOR PROFILE SEE SHEET P-5

0' 200' 400'

136.6 321.8

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE
BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No	90-04-09
Date:	9-92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

18

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

CHANNEL IMPROVEMENTS		
SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
128	115	100-YEAR RIPRAP LININGS 5' DEPTH
130	105	"
FOR PROFILE SEE SHEET P-5		

01-PIP-1300
30" RCP

01-INL-1301
6' D-10-R

01-PIP-1302
30" RCP

STA 288+00 CHECK

54" RCP
12' D-10-R

01-PIP-1305
18" RCP

01-INL-1306
12' D-10-R

MATCH STA 289+20 SHT 20

REACH SC-3

STA 284+00 CHECK

01-CHA-1297

01-CUL-1298
30" X52" CMPE

01-CHA-1299

SAND CREEK

PRESERVE & REPLACE
EXISTING TOE & BANK
VEGETATION

STA 280+50 CHECK

STA 277+00 CHECK

MATCH STA 276+50 SHT 18

0' 200' 400'

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No	90-04-09
Date:	9-92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

MATCH STA 301+60 SHT 21

01-CHA-1315

01-PIP-1316
60" CMP

01-INL-1307
10-6 RAD. INL

01-PIP-1308
24" RCP

01-INL-1309
10'-6" RAD. INL.

01-PIP-1310
30" RCP

PROP. ROADWAY

01-PIP-1313
12" CMP (PRIVATE)

SAND CREEK REACH SC-3

01-CHA-1314

STA 292+00 CHECK

EX 160', 2-SPAN BRIDGE

EX DROP

PRESERVE EX BANK-B
TOE VEGETATION

STA 288+00 CHECK

MATCH STA 289+20 SHT 19

TOPOGRAPHY DOES NOT REFLECT
EXISTING CONDITIONS
STA 298+00 to STA 305+00

01-CHA-1317

MATCH SHT CT6

CENTER TRIBUTARY
SAND CREEK BASIN

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

CHANNEL IMPROVEMENTS

SEGMENT NO	BOTTOM WIDTH (FT)	CHANNEL TYPE
130	105	100-YEAR RIPRAP LININGS 5' DEPTH

FOR PROFILE SEE SHEETS P-5 AND P-6

0' 200' 400'

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No	90-04-09
Date:	9-92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

APPENDIX G

DRAINAGE MAPS