MASTER DEVELOPMENT DRAINAGE PLAN
for
NEWPORT TECHNICAL CENTER (NORTH)

September, 1996
Revised April, 1997
Revised August, 1997

CPC CP 04-344
CPC DP 04-345
CPC FP 04-346
PLANNER: SCHULTZ

MASTER DEVELOPMENT DRAINAGE PLAN
for
NEWPORT TECHNICAL CENTER (NORTH)

September, 1996
Revised April, 1997
Revised August, 1997

Project No. 96046

Prepared for:

NEWPORT TECH ASSOCIATES
1401 N. Potter Drive, Suite 201
Colorado Springs, CO 80909

Prepared by:

OBERING, WURTH & ASSOCIATES
Consulting Civil Engineers
Professional Land Surveyors

1015 Elkton Drive
Colorado Springs, Colorado 80907
Phone: (719) 531-6200
Fax: (719) 531-6266

TABLE OF CONTENTS

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

August 8, 1997

City of Colorado Springs
Department of Planning & Development
Engineering Division
101 W. Costilla, Suite 22
P.O. Box 1575, Mail Code 1119
Colorado Springs, CO 80901

Re: Master Development Drainage Plan
Newport Technical Center (North)

Project No. 96046

Attn: Mr. Gary Haynes
Mr. Brian Kelley

Gentlemen:

Attached, for your review and comment, is a copy of the Master Development Drainage Plan (MDDP) which has been prepared for the referenced development. The MDDP has been prepared at the City's request and its approval has been placed as a condition for the recording of any future plats located within the study area. The main purpose of the MDDP is to provide an overall plan indicating both existing and proposed drainage facilities that will be utilized to safely convey the runoff created by the design storm events to the development's design outfall point. All of the existing and proposed drainage facilities will be evaluated in accordance with the criteria presented in the most current edition of the City of Colorado Springs Drainage Criteria manual.

The attached report is a resubmittal of the report that was submitted in April of 1997. Since the time of the April submittal the following changes and additions have been made:

- The Drainage Board met on July 10, 1997 to discuss and approve the proposed amendment to the Peterson Field Drainage Basin. The amendment is discussed in this report.
- Additional hydraulic analysis was performed on existing drainage structures downstream of Fountain Boulevard.
- Construction plans for the Fountain Boulevard have been through the preliminary review process and will be submitted for final review in the near future.
- Routing of the 100 year storm event was evaluated.
- Changes to the anticipated costs were made to reflect the above modifications.

A summary of each of the above items is included in this report. The report also addresses the review comments that were made by the City of Colorado Springs staff on the April 1997 report. Hopefully the attached report will satisfactorily address and resolve all issues and concerns to the mutual satisfaction of all parties involved in this project.

It is the desire of the owner/developer to obtain approval of the MDDP as soon as possible in order that they may proceed with the additional development of the Newport site.

If you need additional information or have any questions, please do not hesitate to contact the undersigned.

Very truly yours,
OBERING, WURTH & ASSOCIATES

Kenneth C. Harrison, P.E.

KCH/hr

cc: SCI Manufacturing, Inc., Bill Nelson
Newport Tech Associates, Ray O'Sullivan, Peter Martz

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

Master Development Drainage Plan
Newport Tech Center
Project No. 96046

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.

ROLAND G. OBERING REGISTERED 13226 9/11/91 P.E. & L.S. STATE OF COLORADO

Roland G. Obering

Roland G. Obering, P.E. & P.L.S. Colorado 13226

DEVELOPER'S STATEMENT

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

Newport Tech Associates
Business Name

By

Managing Partner
Title

1401 N. Potter Dr. #201
Address

Colorado Springs, CO 80909

CITY OF COLORADO SPRINGS

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

City Engineer

9/23/97
Date

Conditions:

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

Master Development Drainage Plan
Newport Technical Center
Project No. 96046

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, only the Northerly portion of the Newport Technical Center (North) is located within the designated floodplain as designated by the Flood Insurance Rate Map Panel No. 283 of 625 dated December 18, 1986 (see Appendix for Exhibit).

Roland G. Obering, P.E. & P.L.S.
Colorado No. 13226

I. PURPOSE

The purpose of the following study is to present an analysis of the drainage characteristics of the Newport Technical Center North (NTCN) site located at the Northeast corner of the Powers Boulevard and Fountain Boulevard intersection. Both the existing and proposed development conditions will be analyzed. The following will be provided:

- An overall drainage plan for the orderly design and construction of additional drainage facilities required to accommodate runoff from future developments within the Newport site.

- An overall description of the site regarding location, land use, soils, existing and proposed development conditions.

- A summary of the overall hydrologic characteristics of the site which is to include design storm discharges for both the initial 5 year and major 100 year storms.

- A summary of a general hydraulic analysis performed for the existing and proposed drainage systems within the Newport site as well as for pertinent offsite facilities that are to be utilized as outfalls for the Newport drainage systems.

- A summary of recommendations for drainage system alternatives that will safely convey the design discharges of both the minor and major storms from the Newport site to acceptable downstream facilities.

The analysis was performed with the use of pertinent information obtained from drainage basin planning studies, final drainage reports for onsite as well as pertinent offsite platted subdivisions. Various roadway and drainage facility construction plans were also reviewed to obtain information pertinent for the preparation of this MDDP.

II. GENERAL

A. PROJECT LOCATION

The NTCN development is located East of downtown Colorado Springs in Section 24, Township 14 South, Range 66 West (see Vicinity map, Appendix). The development is bounded on the North by the East Fork of Sand Creek, on the East by City of Colorado Springs Municipal Airport property, on the South by Fountain Boulevard, and on the West by Powers Boulevard.

B. PROJECT DESCRIPTION

The NTCN development consists of approximately 190 acres excluding street rights-of-way, proposed and existing. The site is accessed from two locations, one off of Fountain Boulevard via North Newport Road, and the other off of Powers Boulevard via Aeroplaza Drive. No additional site access points are planned at this time. Existing onsite streets include North Newport Road, Vapor Trail, and Aeroplaza Drive, all of which are located in the Southerly portion of the development. Extensions of North Newport Road and Vapor Trail to the North of Aeroplaza Drive are proposed in the near future as the area North of Aeroplaza Drive develops. The configurations of these roads are shown on the Concept Plan Amendment which has been submitted and approved by the City of Colorado Springs. The Concept Plan Amendment includes approximately 88.3 acres North of Aeroplaza Drive (see Map Pocket).

The site generally slopes from the Northeast to the Southwest with an average cross slope of approximately 1.5%. Vegetation on the undeveloped parcels generally consist of native grasses and weeds. Vegetation on developed parcels generally consists of landscaping items such as trees, shrubs, and sod. Onsite soils consist of Blakeland Sandy Loam (#8) and Truckton Sandy Loam (#96) which are included in the hydrological soil groups of A and B, respectively. These soils types are typically well drained with a high erosive potential.

C. LAND USE

Roadway, utility and drainage improvements within the NTCN development have already been constructed to serve tracts located in the Southern two thirds of the site. The Northerly limits of the existing improvements extend to Aeroplaza Drive. North of Aeroplaza Drive is approximately 88.3 acres for which a Concept Plan Amendment [DS-CP-71-51-A22(96)] has been filed and approved by Development Services (see map pocket). Roadway, utilities and drainage improvements are to be constructed within this area as required by the City of Colorado Springs as the parcels are platted. Currently one tract, Newport

Subdivision Filing No. 13, has been platted and recorded. Construction of both the required public and private infrastructure facilities has currently being accomplished. Table I (see Appendix) summarizes the current land use for the NTCN development.

The remaining undeveloped tracts located South of Aeroplaza Drive are anticipated to be developed as industrial/commercial sites.

D. PROJECT PHASING

Phasing for the development of the remaining acreage within the NTCN site will be accomplished on an "as needed" basis. Currently, the development of two tracts are underway. Newport Filing No. 13, which is located at the Northeast corner of the Aeroplaza/Vapor Trail intersection, is being developed as a manufacturing facility for the Springs Fabrication company. The facility is approximately 95% complete. The development of Newport Filing No. 14, located South of Aeroplaza Drive and in between Vapor Trail and North Newport Road, is currently on hold. Development plans for other tracts within the NTCN site are currently pending with no specific schedule for platting and facility construction.

III. DATA SUMMARY

A. MAJOR DRAINAGE BASIN PLANNING STUDIES

The NTCN site is located within both the Sand Creek and Peterson Field Drainage basins (see Appendix) as defined by the current drainage basin planning studies. The Northerly one third of the site is located within the Sand Creek Basin and the remaining two thirds of the site is located in the Peterson Field Drainage basin. However, due to the construction of Powers Boulevard, all runoff from the area located in the Sand Creek has been rerouted to the Peterson Field Basin via a roadside ditch constructed along the East side of Powers Boulevard. This trans-basin diversion is not addressed in either the Sand Creek or the Peterson Field drainage basin planning studies. It is also not discussed in the "Powers Boulevard North Drainage Study" which was used to design the drainage facilities that were constructed as a part of the Powers Boulevard construction project. Drainage reports for adjacent platted developments affected by this diversion were also reviewed and it was discovered that none of these reports discussed this condition. The impact of this condition on downstream facilities will be discussed in subsequent sections of this report.

The following presents brief summaries of the various drainage reports reviewed for the preparation of this MDDP:

Sand Creek Drainage Basin Planning Study

Date Prepared: January 1996 with latest revision March of 1996.
Prepared by: Kiowa Engineering Corporation
Designated Land Use: Industrial
Hydrological Method: Soil Conservation Service (TR20) for 10 year and 100 year storms.

Comments: The portion of the NTCN site that is located within the Sand Creek Drainage Basin lies within subbasin number 23 as shown on the Sand Creek Planning Study Drainage Plan (see Appendix). The DBPS plan indicates that the drainage way crosses Powers Boulevard. Field reconnaissance revealed that a culvert was not installed as part of the Powers Boulevard construction project in order to maintain this drainage way. This condition was also verified by information obtained from the Powers Boulevard construction plans. Since the drainage way was not maintained, all of the runoff from in Subbasin 23 of the DBPS is redirected into the Peterson Field Drainage Basin via the Easterly roadside ditch along Powers Boulevard. This essentially shifts the drainage basin boundary line northward to the Southerly high bank of the East Fork of Sand Creek Tributary.

Peterson Field Drainage Basin Planning Study

Date Prepared: August 1984
Prepared by: URS/NES
Designated Land Use: Industrial
Hydrological Criteria: Modified SCS Method for 5 year and 100 year storm events.

Comments: The Peterson Field Drainage Basin Planning Study only minimally addresses runoff and drainage facilities pertinent to the Newport Technical Center site. It identifies the crossing under Fountain Boulevard as a 72" RCP culvert as opposed to a field verified 66" RCP culvert. The calculated 5 year and 100 year storm flows at the crossing (#21, see Appendix) were determined to be 553 cfs and 1200 cfs respectively. It appears that there was no recommendation to replace the culvert even though it was significantly undersized to accommodate the design flows stated in the report.

B. NEWPORT DEVELOPMENT MASTER DEVELOPMENT DRAINAGE PLAN

Date Prepared: November, 1976
Prepared by: United Planning & Engineering Company
Designated Land Use: Commercial/Industrial/Office Park
Hydrological Criteria: USDA-SCS synthetic hydrograph for 50 year and 100 year as specified in City of Colorado Springs 1976 criteria.

Comments: The following main points were presented in the Newport MDDP:

- The Sand Creek/Peterson Field Drainage Basin boundary line was located as described in both Drainage Basin Planning Studies available at that date.

- Offsite flows from areas East of the NTCN site located within the Sand Creek Drainage Basin were to pass through the NTCN site and discharge under Powers Boulevard at two (2) separate locations. These locations are shown on the drainage plan that was prepared for this MDDP. As previously discussed, Powers Boulevard was constructed without these crossings.

- Storm sewer systems were to be installed in Vapor Trail and along the East side of Powers Boulevard.

- The existing 66" pipe under Fountain Boulevard was to be either replaced by a 72" RCP or a 42" RCP was to be added to accommodate the proposed design runoff.

C. ONSITE/OFFSITE FINAL DRAINAGE REPORTS.

Drainage reports for previously onsite platted and developed properties were reviewed in order to determine existing drainage patterns and facilities. Drainage reports for offsite platted areas adjacent to the Newport Technical Center site were also reviewed in order to investigate drainage facilities that were either designed or constructed to intercept developed flow from the NTCN site. The final drainage reports for the Powers Boulevard/Highway 24 Bypass Project were also reviewed in order to determine current drainage patterns and facility construction resulting from the construction of the Highway 24 Bypass Project. Table 2 (see Appendix) summarizes each of the drainage reports that were reviewed.

Final Drainage Reports Summary for Onsite Platted Properties

The drainage analysis presented in the drainage studies for onsite platted properties generally followed the recommendations presented in the Newport MDDP. Several modifications were made, however, in order to accommodate the various drainage criteria changes that were made by the City of Colorado Springs since the preparation of the MDDP in 1976. These changes are listed below:

- A storm sewer system was added in North Newport Drive.
- A storm sewer system replaced a portion of the ditch system located along the Easterly side of the property.
- Runoff from the area East of the Newport Development site was not accounted for in the overall Newport drainage systems. It appears that this runoff was to be intercepted and accommodated by a drainage system independent of the Newport Drainage system.

Since all of the currently platted sites are located in the Peterson Field Drainage Basin, none of the drainage studies addressed the issue of the Sand Creek drainage basin diversion created by the construction of Powers previously discussed in this report.

Final Drainage Reports Summary for Offsite Properties

The drainage reports that have been prepared for offsite platted properties adjacent to the NTCN site generally reflect the drainage patterns shown in the 1976 Newport MDDP. The reports indicate that there were to be two

crossings of Powers Boulevard to accommodate developed flows from the Sand Creek portion of the NTCN development.

Final Drainage Report for Powers Boulevard from Drennan Road to Fountain Boulevard.
Date Prepared: August 1989
Prepared by: CH2M Hill
Designated Land Use: Industrial
Hydrologic Criteria: SCS-TR20 for the 10 year and 100 year storms.

Comments: This study was used to size drainage facilities which were to be constructed for the Powers Boulevard project South of Fountain Boulevard. In accordance with this study the drainage facilities were sized to accommodate developed runoff from areas located in the Peterson Field drainage basin as defined by the DBPS. Runoff from the Sand Creek drainage basin located in the Northerly part of the NTCN site was not included. It was assumed that runoff from this area would remain in the Sand Creek drainage basin and be routed across Powers Boulevard. It was also stated in this study that the existing structure (66" RCP under Fountain Boulevard) was substantially undersized and could not accommodate the design flow in accordance with current City of Colorado Springs drainage criteria. It was recommended that this facility be replaced.

Roadway Drainage Hydrology and Hydraulic Report for US-24 Phase II Bypass Project

Date Prepared: September 1990
Prepared by: Kiowa Engineering Corporation
Designated Land Use: Industrial
Hydrologic Criteria: SCS-TR20, 10 year and 100 year storms

Comments: This study was prepared in order to size drainage facilities for the US-24 Phase II Bypass Project. This included drainage facilities along the Westerly and Southerly boundaries of the NTCN site property. The following is a brief summary of the items discussed in the report that impact the NTCN site:

- For both the interim and future roadway scenarios, the basins contributing runoff to the US 24 Bypass alignment were assumed to be fully developed.

- Basin boundaries were delineated based on areas contributing runoff to the bypass drainage facilities.

- The Sand Creek/Peterson Field Drainage basin boundary was not indicated on the drainage plan.

- Developed runoff from the Sand Creek drainage basin area within the NTCN site was designated to be diverted to the Peterson Field drainage basin via a roadside ditch along the Easterly side of Powers Boulevard. No crossings of Powers Boulevard were to be constructed to accommodate existing drainage patterns. All flow from the NTCN area was designated to discharge under Fountain Boulevard via the existing 66" culvert. As a result of this diversion a substantial amount of additional runoff was directed to the Fountain Boulevard crossing that was not accounted for in any of the previously prepared drainage studies.

- The report states that the capacity of the 66 inch culvert under Fountain Boulevard was checked and was found to be of adequate capacity to convey the future condition flow rate to downstream facilities. However, in the report, the contributing drainage area upstream of the culvert only included a small portion of the actual drainage area contributing runoff to the Fountain Boulevard culvert. In actuality, as described in numerous previously prepared reports, the 66 inch pipe is substantially undersized and will need to be replaced or its capacity supplemented in order to meet current City criteria.

D. CONSTRUCTION PLANS/FIELD RECONNAISSANCE

Construction plans were obtained for onsite and offsite drainage systems. The information was used to verify data that was obtained from the various reports reviewed for this study. The information was also used to provide the basis for the hydraulic analysis that was performed for the existing drainage systems. Any discrepancies that were found were visually checked in the field. The information that was obtained is shown on the attached drainage plans (map pocket) prepared for this report.

IV. HYDROLOGICAL ANALYSIS

A. CRITERIA

The hydrologic criteria used in this analysis is based on the criteria set forth in the current City of Colorado Springs Drainage Criteria Manual. Previously prepared drainage reports were reviewed in order to verify runoff coefficients, times of concentrations, and anticipated discharges at the various design points. Since previously prepared reports were typically prepared under older and obsolete City of Colorado Springs Criteria, the entire development was analyzed as a whole in accordance with the current Colorado Springs drainage criteria.

Methods

Since each parcel within the NTCN development is less than 100 acres, the 5 year and 100 year storm event design flows were determined with the use of the Rational Method. These design flows were used to evaluate the capacities of the existing storm sewer systems within the NTCN site and to size proposed drainage systems required for future development.

Since the entire drainage area upstream of the Fountain Boulevard culvert crossing is greater than 100 acres the SCS method was used to determine the anticipated flows at the upstream end of the existing 66 inch culvert. The HEC-1 computer model was used. Only the 100 year design flow was evaluated since the culvert is to be sized to pass the 100 year storm flow under Fountain Blvd.

Runoff Coefficients

Runoff coefficients for both the hydrological methods were obtained from the City of Colorado Springs Criteria Manual. These coefficients were also checked with those used in previously prepared reports.

Time of Concentration

Times of concentration were determined by combining travel times for overland flow, channel flow, curb and gutter flow, and storm sewer flow where applicable. Specific charts and formulas as presented in the City of Colorado Springs Drainage Criteria Manual (DCM) and the Colorado Department of Transportation Design Manual were used to determine the appropriate travel time for each of the above components.

Rainfall Intensities

Rainfall intensities for specific times of concentration for both the 5 year and 100 year storm frequencies for the Rational Method were obtained from the Drainage Criteria Manual (DCM). The rainfall distribution used for the SCS method was the 24 hour SCS Type IIA storm as designated in the DCM.

B. EXISTING CONDITIONS

Design flows for both the 5 year and 100 year storm events were determined at various design points indicated on the drainage plan. The flows are summarized on Table 4 (see Appendix).

Offsite flows enter the NTCN site from undeveloped properties located East of the site and North of Aeroplaza Drive. Runoff from properties South of Aeroplaza Drive and East of the NTCN site enter a small swale located along the Easterly side of Aviation Way. This water flows in a Southerly direction and is discharged across Fountain Boulevard at the Southeast corner of the NTCN site. Hydrological analysis of the area East of the NTCN site is beyond the scope of this report. It is assumed that this analysis will be accomplished in future drainage studies that will be required upon development of the area East of the NTCN site.

Onsite design flows were determined for each developed tract and were accumulated as the drainage runoff moved downstream to the outfall point at Fountain Boulevard. These flows were used to check the capacity of the existing storm sewer systems.

Currently there are four (4) separate drainage systems that serve the Newport development. The Powers Boulevard system consists of an roadside ditch that drains the area West of North Newport Road. The North Newport Road storm sewer system drains the area located between Vapor Trail and North Newport Road. This system has a separate outfall into a drainage ditch located along the Northerly side of Fountain Boulevard. The Vapor Trail storm sewer system drains the area located between Aviation Way and Vapor Trail. This system outfalls into a 66" storm sewer located along the Northerly side of Fountain Boulevard. The Aviation Way drainage system consists of a concrete lined channel and an underground storm sewer system which combines with the Vapor Trail storm sewer system at the entrance to the NTCN development off of Fountain Boulevard.

The storm sewer systems installed in North Newport Road, Vapor Trail and Aviation way outfall into an open "grassland" channel located West of the North Newport Road entrance into the NTCN site and North of and adjacent to Fountain Boulevard. This grass lined channel extends from the storm sewer outfall point

to the upstream end of the existing 66 inch culvert under Fountain Boulevard. Currently, the City of Colorado Springs has awarded a contract for the construction of a concrete lined channel which is to replace the grass lined channel.

In determining the flows that enter the existing drainage systems described above it was assumed that the runoff from undeveloped property to the North of Aeroplaza Drive and to the West of North Newport Road had little effect on the peak flow generated by the existing development located south of Aeroplaza Drive. This is due to the fact that the times of concentrations for the undeveloped tracts were substantially longer than those for the developed tracts. A preliminary analysis was performed utilizing the different times of concentration. The analysis demonstrated that runoff from only the developed areas, excluding runoff from the undeveloped areas, was greater than runoff from the entire area when the longer time of concentrations were used.

C. FULLY DEVELOPED CONDITIONS ANALYSIS

A hydrologic analysis was performed for the NTCN site with the following parameters:

1. All undeveloped areas are to be developed as industrial/commercial sites. Runoff coefficients used for all tracts were assumed to be $C_5 = 0.80$ and $C_{100} = 0.90$. The curve number used for all developed tracts was 92. The above is generally consistent with information obtained from previously prepared drainage reports.

2. Public storm sewer systems are to be constructed in Vapor Trail and along the East side of Powers Boulevard in order to accommodate runoff from future developments located within the NTCN area.

3. No storm sewer facilities are to be constructed across Powers Boulevard in order to re-establish historic drainage ways that were eliminated with the construction of Powers Boulevard north of Fountain Boulevard.

4. Areas SCI, SC2, and SC3 located at the North end of the NTCN site are to be graded and drained to the Sand Creek channel thus reducing the impact of the trans-basin diversion to Peterson Field drainage basin.

It is proposed, under developed conditions, to prevent all runoff from areas located East of the NTCN site from entering the NTCN site. It is proposed that this water be directed in a Southerly direction along Aviation Way and be collected by a drainage system independent of the systems proposed for the NTCN development. Inclusion of developed offsite flows into the Newport drainage

system will only increase the flows at the already undersized Fountain Boulevard culvert crossing.

Onsite design discharges are summarized on Table 5 (see Appendix). Under fully developed conditions, the estimated 100 year storm event discharge at the upper end of the Fountain Boulevard culvert is 997 cfs (see HEC-1 - Appendix). According to the Powers Boulevard drainage report downstream facilities were designed based on only 665 cfs at this point. The additional 330 cfs is generated from the Sand Creek Basin area of the NTCN site which was diverted to the Peterson Field drainage basin as a result of the construction of Powers Boulevard.

V. HYDRAULIC ANALYSIS

A. CRITERIA

The following criteria was used in the evaluation of the existing drainage systems as well as for the concept design of the proposed drainage systems. The criteria was obtained from the City of Colorado Springs Drainage Criteria Manual.

Street Classifications

All interior streets are classified as industrial with a 44 foot face to face pavement width.

Street Capacities

The hydraulic capacities of the street sections for North Newport Road and Vapor Trail Drive were evaluated for the 100 year storm event only. Analysis of the 5 year events is beyond the scope of this report. The following assumptions/criteria were followed for the 100 year storm analysis.

- Surface flow within the street section was determined by subtracting the cumulative runoff estimated for the 5 year storm event from the cumulative runoff estimated for the 100 year storm event. This assumes that there are currently a sufficient number of inlets within the street section that will intercept all of the runoff produced by the 5 year storm event. As previously stated, a detailed analysis of the existing inlet system is beyond the scope of this report.

- The typical street section is 44 feet wide, face to face with a two percent cross-slope.

- The time of concentration at each summary point evaluated is the same time of concentration reflected in the pertinent tables presented in this report. This assumption typically produces greater runoff amount since the times of concentration used in this report are based on storm sewer velocities which are typically substantially higher than velocities in the street curb and gutter section.

- Street capacity was determined based on a 12 inch maximum depth at the street flowline along with the street slope obtained from the drainage plan.

A summary of results of this analysis is presented in subsequent sections of this report.

Inlet Design

Due to the concept nature of this analysis inlets were conservatively sized. Methods presented in the "Hydraulic Engineering Circular No. 12 - Drainage of Highway Pavements" were used in the sizing of the inlets. It was assumed that the majority of runoff from the individual tracts will be intercepted by private onsite storm sewer systems consisting of inlets, manholes, and storm sewers prior to entering the public rights-of-way. Inlet interception rates were based on the hydraulic characteristics of the typical City of Colorado Springs, D-10-R inlet. An analysis of the interception rates of the existing inlets in North Newport Drive and Vapor Trail was not included in this study. It was assumed that future drainage reports prepared for undeveloped tracts located South of Aeroplaza Drive and East of North Newport Drive will identify and correct any deficiencies in the existing surface runoff collection system.

Storm Sewer Design

Storm sewers were sized and hydraulically evaluated based on principals of uniform open channel flow. It is anticipated that losses through manholes will be minimized as a result of the relatively high velocities entering and exiting each manhole.

Existing and proposed public storm sewer systems are shown on the attached drainage plan. Since the configuration of future developments are unknown at this time, the location and design of the private systems located within the individual tracts were not shown. It is anticipated that as the undeveloped tracts are platted, final drainage reports will provide a more detailed analysis of the proposed drainage systems, both public and private.

Culvert Analysis

The hydraulic capacity of the 66 inch culvert under Fountain Boulevard as well as all recommended proposed drainage facilities were evaluated based on the assumption that the culvert will be operating under inlet control with a maximum headwater to depth ratio of 1.0. Inlet control was assumed since the downstream facilities consist of a concrete channel that is hydraulically functioning under supercritical flow conditions.

Detention Pond Evaluation

It was recommended in the initial submittal of the MDDP that a regional detention pond be constructed within the area located at the Southwest corner of the NTCN site. The concept design and size of this facility was

determined in the initial submittal. However, as a result of numerous meetings with the City of Colorado Springs, it was decided that this facility would be eliminated from the final MDDP and that, in its place, additional drainage facilities would be constructed under Fountain Boulevard which would be sized to accommodate the additional runoff. Therefore, all exhibits relating to the design and sizing of the regional detention pond that were included in the initial MDDP submittal have been eliminated from the Appendix of this report.

B. HYDRAULIC ANALYSIS OF THE EXISTING/PROPOSED DRAINAGE FACILITIES

The existing drainage facilities were evaluated with respect to existing development and future development. The results of this analysis are presented in Tables 3, 4 and 5. The following is a summary of the results of the analysis:

Overall

All the existing systems in Powers Boulevard, North Newport Road, Vapor Trail, and Aviation Way are adequately sized to accommodate runoff from the 5 year storm event from the existing developed sites.

Fountain Boulevard Crossing Under Existing Condition

The 66 inch culvert under Fountain Boulevard currently has the capacity of approximately 160 cfs under current City criteria. It is estimated that the existing 5 year and 100 year discharge at the point is approximately 175 and 350 respectively (see Appendix for calculations). Therefore, based on the current criteria the existing culvert is undersized to accommodate even the existing runoff.

Aviation Drainage System

The existing drainage system along the Westerly side of Aviation Way has sufficient capacity to accommodate additional developed flow from the Easterly half of Newport Filing 13 (Subbasin PF22) and from the remaining undeveloped portion of Filing 9A (Subbasin PF19). This is consistent with the statements made in the respective drainage reports previously prepared for this site.

Vapor Trail Drainage System

The existing drainage system in Vapor Trail has sufficient capacity to accommodate additional developed flow from Newport Filing No. 13 (Subbasin PF15) and from the proposed Filing No. 15 (Subbasin PF14). It is

recommended that a storm sewer system be extended North of Aeroplaza Drive along the proposed Vapor Trail right-of-way to the Southerly boundary line of Filing No. 15 (PF#14). It is anticipated that private drainage systems will be extended into the adjacent tracts to intercept flows onsite and to limit runoff from entering the public right-of-way. It should be noted from the drainage plan that PF14 and PF15 lie within the historical Peterson field drainage basin. Inclusion of any runoff from developed tracts North of PF14 will overload the Vapor Trail system.

North Newport Road Drainage System

The existing drainage system in North Newport Drive has sufficient capacity to accommodate additional developed flow from the area shown on the drainage plan as PF7 and from remaining undeveloped tracts South of Aeroplaza Drive. These tracts are noted as Newport Filing No. 14 (PF8) and the remaining undeveloped portion of the TRW Subdivision No. 4 (PF10 and PF11). This is consistent with statements made on the respective drainage reports.

Powers Boulevard Drainage System

The existing drainage system that parallels Powers Boulevard along its Easterly right-of-way line is a grass lined ditch with several rock riprap drop structures. The facility was apparently sized to accommodate only roadside runoff and does not have the capacity to accommodate any developed flow from the NTCN site. Since no drainage facilities were constructed across Powers Boulevard in order to maintain the historical drainage patterns within the Sand Creek Drainage Basin area, this runoff will have to be directed to the South into the Peterson Field drainage basin. Constructing the required facilities across Powers Boulevard in order to re-establish historic drainage basin boundaries would be financially prohibitive.

Therefore, it was assumed that an underground storm sewer system will be required along the Easterly side of Powers Boulevard. It is recommended that the proposed facilities be publicly owned and maintained by the City of Colorado Springs. Runoff from the adjacent tracts is anticipated to be accommodated by various types of private drainage facilities which will be identified in final drainage reports as the individual tracts are platted. The proposed drainage system is to be designed to accommodate developed runoff from PF1, PF1a, PF1b, PF2, PF3, PF4, PF5, PF6 and PF13.

Sub basin PF1a and PF1b were initially to drain to Sand Creek as described in the initial submittal of this MDDP. However, after reviewing the grading effort

that would be required to accomplish this it was decided to redirect the runoff from PF1a and PF1b to the Powers Boulevard drainage system.

Fountain Boulevard Crossing Under Developed Conditions

The existing crossing at Fountain Boulevard consists of a 66 inch RCP culvert which discharges into a concrete ditch which was constructed in conjunction with the Powers Boulevard project South of Fountain. The existing capacity of the culvert, based on current City of Colorado Springs criteria, is approximately 160 cfs. In order to comply with current criteria this culvert is to accommodate the proposed 100 year developed flow with a maximum headwater to depth ratio of 1.0. Based on the analysis presented in this report as well as in the other reports previously discussed the anticipated 100 year storm design flow at the upstream end of this culvert was determined to be as follows:

Newport MDDP (1976)	410 cfs
Peterson Field DBPS (1976)	443 cfs
Powers Boulevard (South of Fountain) 1989)	665 cfs
Proposed Newport MDDP (pending)	997 cfs

The majority of the 330 cfs increase in runoff calculated in this study compared to the 1989 Powers Boulevard study is the result of the additional runoff being diverted from the Sand Creek drainage basin area located with the NTCN site. This can be demonstrated as follows:

Total Contributing Drainage Area =	226 acres
Peak Flow =	997 cfs
Discharge Per Acre =	4.4 cfs
Drainage Area of Sand Creek Drainage Basin Transfer =	81.5 acres (Approximate)
Approximate flow from Sand Creek Diversion =	359 cfs

Therefore, in order to accommodate the developed runoff from the NTCN site the following alternatives were evaluated:

Alternate #1: Powers Boulevard Culverts

This alternate includes the construction of two culverts across Powers Boulevard at locations that would re-establish the existing drainage patterns within Sand Creek drainage basin. This alternate was only evaluated briefly since the construction costs and regulatory requirements to construct such a system would likely be prohibitively restrictive.

Alternate #2: Regional Detention Pond and Replacement of Existing 66" RCP Culvert

This option was evaluated in detail in the initial submittal of the MDDP. The option basically included the following:

- a regional detention pond which was to be constructed in the Southwest corner of the NTCN site. The pond would be designed to limit the discharge from the Fountain Boulevard structures to the official design flow of 665 cfs.

- The existing 66 inch culvert under Fountain Boulevard would be removed and replaced with an 8 foot by 10 foot concrete box culvert which would be adequate to safely convey the design flow under Fountain Boulevard.

- Downstream modifications to the existing concrete channel South of Fountain Boulevard would also need to be accomplished in order to accommodate the proposed 8' by 10' box culvert.

This alternate was recommended as the preferred facility in the initial MDDP that was submitted to the City in September of 1996. However, after numerous meetings, it was decided that this alternate was not acceptable to the City.

Alternate #3: Additional Facilities Under Fountain Boulevard

Several schemes of drainage facility construction were evaluated in order to determine the one that would best serve the area most economically and efficiently. The schemes that were evaluated were as follows:

a. removal and replacement of the existing culvert

b. construction of an additional box culvert adjacent to the existing culvert such that the combined capacity would accommodate the design flow.

c. construction of a dual culvert adjacent to the existing 66 inch RCP which when combined would accommodate the design flow.

It was decided to proceed with alternate (c). This alternate basically includes the following items:

- a double parallel pipe system, consisting of one-72 inch pipe and one -66 inch pipe that would be constructed East of and adjacent to the existing 66 inch RCP culvert.

- upstream modifications to the drainage channel and would be required in order to accommodate the 100 year design flow.

- downstream modifications would include the removal and reconstruction of the receiving concrete channel.

- the culverts would be constructed to improve entrance conditions at the upper end of the culvert crossing.

Included in the map pocket of this report is the final design plan and profile portion of the proposed drainage facilities described above. Design notes and hydraulic data are included in the Design Notes section of the Appendix of the report. Approvals for the construction plans is anticipated in the near future with a "Notice to Proceed" with construction issued shortly after all approvals have been obtained.

The construction of this alternate is to coincide with the construction of the channel improvements contract currently awarded by the City of Colorado Springs. The City of Colorado Springs contract includes a concrete lined channel from the current Vapor Trail/North Newport Road storm sewer outfall, located just West of the entrance to the development, to the exiting 66 inch culvert under Fountain Boulevard. When combined with the facilities recommended in Alternate "3c", the complete facility will be hydraulically sized to accommodate the expected 100 year storm runoff from the NTCN site.

Downstream Facilities

The following is a summary of the limited hydraulic analysis that was performed on the culvert at Astrozon Boulevard located South of the Fountain Boulevard crossing:

Flow at Fountain Boulevard per the Newport MDDP	997	cfs
Flow at Fountain Boulevard per CH2M Hill	665	cfs
Difference:	332	cfs
Flow at the Astrozon crossing per CH2M Hill	1,399	cfs
Additional Flow per this MDDP	332	cfs
Total adjusted Flow at Astrozon Crossing	1,731	cfs
Culvert at Astrozon Boulevard	17' by 10' CBC	
Headwater to Depth Ratio to Accommodate 1731 cfs Under Inlet Control	1.05	

The culvert was evaluated for inlet control which assumes little, if any, velocity head at the upstream end of the culvert. In actuality, both ends of the box are constructed with smooth concrete lined transitions that provide for efficient entrance and exit conditions. Therefore, based on actual conditions, it appears that the existing box is adequate to accommodate the increased flow from NTCN development. Analysis of additional drainage facilities downstream of the Astrozon culvert is beyond the scope of this report.

VI. MAJOR STORM ANALYSIS

A limited analysis of the major 100 year storm event was performed as part of this study. The main purpose was to determine the most probable routing that surface runoff would take once the capacities of the individual storm sewer systems were exceeded.

The streets that were evaluated were Vapor Trail and North Newport Road. Following this report section is a table that summarizes the various street sections that were evaluated. In summary, it appears that runoff from the 100 year storm event will be contained within both the right-of-way sections of North Newport Road and Vapor Trail with the exception of the Southerly portion of North Newport Road at Points #10 and #11. It appears that the storm water has the potential to leave the right-of-way at these locations and flow in a Southerly direction to Point #24. Currently the route is across undeveloped land. It is recommended that when this tract develops that no obstructions, ie. buildings, walls, etc. be constructed across this route. This route is indicated on Sheet 3 of the attached Drainage Plan.

An anlysis was also performed for the 100 year stormwater runoff that enters the roadside ditch located along the east side of Powers Boulevard. The purpose of this analysis was to size a channel along the East side of Powers Boulevard that would be capable of accommodating the excess runoff produced by the 100 year storm event from parcel PF3, PF4, PF5 and PF6. The following assumptions were used in this analysis:

- All surface runoff produced within the areas North of Aeroplaza Drive will be diverted away from Powers Boulevard in an Easterly direction along the Northerly curb and gutter of Aeroplaza Drive.

- All storm sewer facilities, both public and private, will be sized to accommodate at least the runoff produced by the 5 year event.

- Any runoff in excess of the 5 year storm event will flow overland to the channel improvements proposed along the East side of Powers Boulevard.

The following table summarizes the analysis that was performed:

Channel Reach	Estimate Q	Slope	Bottom Width	Type	Estimated Velocity
3 to 4	32.8	1%	6′	Grass	3.5
4 to 5	71.4	1.5%	6′	Grass	4.6
5 to 24	90.4	2.0%	6′	Grass	5.5

Based on the above analysis it is recommended that the swale have the following physical characteristics:

Bottom Width:	6 feet
Depth:	3 feet
Side Slopes:	3:1
Slope:	1%

Since the average slope from Aeroplaza Drive (Point #3) to Point #24 is approximately 1.5% it is recommended that riprap drop structures be constructed at various locations. These locations are to be determined upon final design of the drainage facilities. Included in the Appendix of this report are calculations and details regarding this evaluation and above recommendations.

Hydraulic Analysis of Street Cross Sections

Newport Tech Center MDDP

Date: April 14, 1997

Project #: 96046

Summ Pnt	Runoff 5 yr	100 yr	Excess Flow	Street Flow Upstream	Addition	Combined Flow	Exist Rdway Slope	Cap	Future Rdway Slope	Cap	Comments
VAPOR TRAIL											
12a	27.2	52.8	25.60	0.00	25.6	25.6			1.50%	141.0	Flow to sump @ Pnt 12
13	28.2	54.6	26.40	0.00	26.4	26.4			0.80%	103.0	Flow to Aeroplaza
14	20.7	40.3	19.60	26.40	19.6	46.0	0.80%	103.0			Flow to cross Aeroplaza crown
15	27.8	55.3	27.50	46.00	27.5	73.5	1.40%	136.0			Flow to Pnt 16
16	24	48.3	24.50	73.50	24.5	98.0	2.40%	178.0			Flow to pnt 17
17	17.5	35.6	18.10	98.00	18.1	116.1	2.50%	182.0			Flow to Pnt 18
18	12.1	24.7	12.60	116.10	12.6	128.7	1.00%	115.0			Flow outside of ROW
North Newport Road											
12	43.9	84.7	40.80	25.60	40.8	66.4	1.50%	141.0			Flow to N Newport
7	50.7	97.8	47.10	66.40	47.1	113.5	1.30%	135.0			
8	37.4	73.7	36.30	113.50	36.3	149.8	2.00%	163.0			
9	27.2	52.2	25.00	149.80	25.0	174.8	2.00%	163.0			Flow outside of ROW
10	42.6	85.7	43.10	174.80	43.1	217.9	1.30%	131.0			Flow outside of ROW
11	29.3	59.7	30.40	217.90	30.4	248.3	1.70%	150.0			Flow outside of ROW
22/23											

Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors

1015 Elkton Drive
Colorado Springs, Colorado 80907
(719) 531-6200

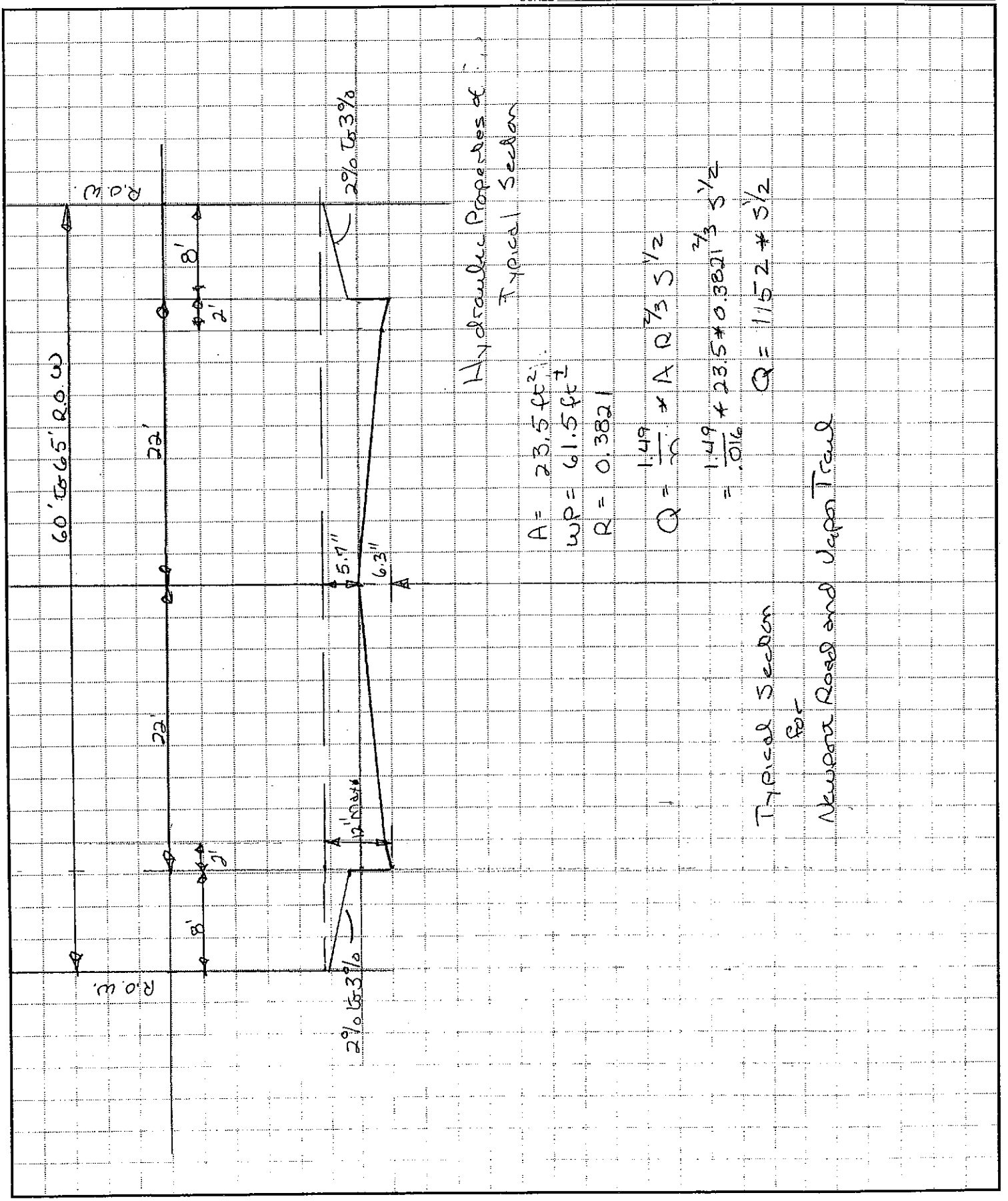
JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____



Hydraulic Properties of Typical Section

$A = 23.5\ ft^2$

$WP = 61.5\ ft$

$R = 0.3821$

$Q = \frac{1.49}{n} \times A R^{2/3} S^{1/2}$

$= \frac{1.49}{.016} \times 23.5 \times 0.3821^{2/3} S^{1/2}$

$Q = 1152 \times S^{1/2}$

Typical Section for Newport Road and Aspen Trail

VII. ENVIRONMENTAL ISSUES

Based on information obtained from field reconnaissance and the review of the Sand Creek Drainage Basin Planning Study it appears that the only environmental issue is associated with the Sand Creek 100 year floodplain located along the Northerly side of the Newport site. All restrictions associated with building in or modifying the area within a designated floodplain apply to this area.

VIII. CONSTRUCTION COST SUMMARY

Immediately following this section are Preliminary Cost Estimate for the following:

- Powers Boulevard and Culvert Crossing
- City of Colorado Springs Contract Portion of the Fountain Boulevard Drainage Improvements
- Onsite Public Drainage Facilities
- Riprap Drop Structures along East Side of Powers Boulevard
- Drainage Basin Analysis for Structure Cost Determination

All of the above systems, with the exception of the Fountain Boulevard crossing, are to be constructed on an as-required basis. Currently there is no schedule for the construction of these facilities. The Fountain Boulevard crossing is to be constructed in the near future. Final construction plans for this facility are currently being prepared by Obering, Wurth & Associates and are anticipated to be issued in the near future.

It is anticipated that all drainage facilities required for the interior sections of each undeveloped tract will be privately owned and maintained and will be identified in the individual drainage reports which will be required for each tract as it is platted.

Preliminary Cost Estimate for Fountain Blvd Culvert Crossing

Date: April 14, 1997

Project No.: 96046

Item #	Description	Approx Quant	Unit	Unit Cost	Total Cost
1	Sawcut and Remove Exist Concrete Curb and Gutter	70	lf	$6.50	$455.00
2	Sawcut and Remove Asphalt Pavement	300	sy	$8.50	$2,550.00
3	Remove Exist Concrete Channel	160	sy	$18.00	$2,880.00
4	Sawcut and Remove Exist Headwall	110	sf	$4.00	$440.00
5	Remove Existing 18" CMP	60	lf	$6.00	$360.00
8	Remove Existing Chain Link Fence	15	lf	$8.00	$120.00
9	72" RCP Storm Sewer	160	lf	$260.00	$41,600.00
10	66" RCP Storm Sewer	152	lf	$225.00	$34,200.00
11	18" CMP Temporary Pipe	90	lf	$32.00	$2,880.00
12	66' x 60" RCP x 45deg Wye	2	ea	$4,200.00	$8,400.00
13	60" RCP 45deg Ell	1	ea	$2,800.00	$2,800.00
14	72" RCP 45deg Ell	2	ea	$3,400.00	$6,800.00
15	72" x 36" RCP Tee	1	ea	$2,600.00	$2,600.00
16	72" x 84" Reducer	1	ea	$4,000.00	$4,000.00
17	66" x 84" Increaser	1	ea	$4,000.00	$4,000.00
18	66" 45deg Ell	2	ea	$3,200.00	$6,400.00
19	66" RCP Bend	1	ea	$3,000.00	$3,000.00
20	72" RCP Bend	1	ea	$3,200.00	$3,200.00
21	Upstream Concrete Headwall for Dual Pipe	7.5	cy	$350.00	$2,625.00
22	Upstream Concrete Wingwalls for Dual Pipe	9	cy	$350.00	$3,150.00
23	Upstream Concrete Headwall for 60" Pipe	4	ls	$350.00	$1,400.00
24	Downstream Concrete Headwall for Dual Pipe	7.5	ls	$350.00	$2,625.00

Item #	Description	Approx Quant	Unit	Unit Cost	Total Cost
26	Concrete Channel (Downstream)	195	sy	$71.75	$13,991.25
27	Concrete Cutoff Walls (Upstream and Downstream ends)	8	cy	$250.00	$2,000.00
29	Waterline Lowering	1	ls	$14,250.00	$14,250.00
30	Asphalt Pavement Repair	300	sy	$25.00	$7,500.00
31	Install Concrete Median Curb and Gutter	70	lf	$25.00	$1,750.00
32	Irrigation System Repair	1	ls	$500.00	$500.00
34	Access Road Construction	230	sy	$15.00	$3,450.00
36	Chain Link Fence (Upstream and Downstream Headwalls)	75	lf	$18.00	$1,350.00
37	Traffic Control	1	ls	$2,500.00	$2,500.00
38	Landscaping	1	ls	$500.00	$500.00
	SUBTOTAL				$184,276.25

NOTES

The above estimate is based on a prelim design plan recently approved by the City of Col Springs

The following items are not included in the above cost estimate:

1 Relocation of other util lines located in Fountain Blvd other than the existing 12" water line

2 Land costs for public easements and right-of-way

3 Additional downstream channel imprvts and/or modifications other than those shown on the approved preliminary design plans

Preliminary Cost Estimate for City of Colorado Springs Contract Portion

Date: June 4, 1997

Project No.: 97007

Item #	*Description*	*Approx Quant*	*Unit*	*Unit Cost*	*Total Cost*	*Comments*
1	Reinforced Concrete Headwall	6.4	CY	$300.00	$1,920.00	
2	Reinforced Concrete Wingwalls	23.4	CY	$300.00	$7,020.00	
3	Reinforced Concrete Channel	60.7	SY	$38.25	$2,320.50	
4	84" RCP	11.0	LF	$325.00	$3,575.00	
5	18" RCP Trickle Flow Pipe	110.0	LF	$35.00	$3,850.00	
	TOTAL				$18,685.50	

Preliminary Cost Estimate for Riprap Drop Structures Along East Side of Powers Blvd

Date: June 4, 1997

Project No.: 97007

Item #	*Description*	*Approx Quant*	*Unit*	*Unit Cost*	*Total Cost*	*Comments*
1	12" D50 Riprap on 8" Granular Bedding and Geotextile Fabric	300.0	CY	$35.00	$10,500.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
	TOTAL				$10,500.00	

PRELIM COST ESTIMATE FOR ONSITE PUBLIC DRAINAGE FACILITIES

NEWPORT TECH CENTER MDDP

DATE: APRIL 14, 1997

PROJECT #: 96046

Item #	Item Description	Approx Quantity	Units	Unit Price	Total
Public Underground Storm Sewer System					
1	24" RCP Storm Sewer	1020	LF	$35.00	$35,700.00
1	30" RCP Storm Sewer	1000	LF	$42.00	$42,000.00
2	36" RCP Storm Sewer	1230	LF	$50.00	$61,500.00
3	42" RCP Storm Sewer	750	LF	$57.00	$42,750.00
4	48" RCP Storm Sewer	1170	LF	$72.00	$84,240.00
5	54" RCP Storm Sewer	1760	LF	$88.00	$154,880.00
6	60" RCP Storm Sewer	1060	LF	$130.00	$137,800.00
8	Type I Box Base Manhole	9	EA	$4,200.00	$37,800.00
9	Type II Manhole	1	EA	$2,200.00	$2,200.00
10	Type D10R Inlet - 10'	3	EA	$4,200.00	$12,600.00
	Subtotal				**$611,470.00**

NOTES

The above estimate is based on a concept plan prepared for the MDDP.

The following items are not included;

1 Street inlets for North Newport Road and Vapor Trail Extension. These will be included upon approval of initial storm sewer layout

2 Land costs for drainage easements and public right of way

3 Utility adjustment costs in Aeroplaza Drive

4 Road repair costs for the Aeroplaza Drive crossing

5 Drainage channel costs upstream of the Fountain Blvd. 66" RCP

Drainage Basin Fee Analysis for Structure Cost Determination

Project: Newport MDDP, #96046

Date: April 15, 1997

	Peterson Field Drainage Basin			*Sand Creek Drainage Basin*		
Year	*Drainage Fee*	*Percent Change*	*Updated Facility Cost*	*Drainage Fee*	*Percent Change*	*Updated Facility Cost*
1985	$3,612.00		$82,900.00	$4,794.00		$0.00
1986	$3,793.00	5%	$87,054.18	$5,034.00	5%	
1987	$3,983.00	5%	$91,414.92	$5,286.00	5%	
1988	$4,102.00	3%	$94,146.12	$5,445.00	3%	
1989	$4,102.00	0%	$94,146.12	$5,445.00	0%	
1990	$4,102.00	0%	$94,146.12	$5,445.00	0%	
1991	$4,102.00	0%	$94,146.12	$5,445.00	0%	
1992	$4,180.00	2%	$95,936.32	$5,554.00	2%	
1993	$4,310.00	3%	$98,919.99	$5,615.00	1%	
1994	$4,439.00	3%	$101,880.70	$5,783.00	3%	
1995	$4,572.00	3%	$104,933.22	$5,957.00	3%	
1996	$4,775.00	4%	$109,592.33	$4,895.00	-18%	
1997	$4,945.00	4%	$113,494.05	$5,258.00	7%	

IX. DRAINAGE FEES

The Newport Technical Center site is currently located in both the Sand Creek and Peterson Field drainage basins with the basin boundary depicted on the attached drainage plan. Both drainage basins have established drainage and bridge fees based on recommended drainage facilities and drainage areas described in their respective drainage basin planning studies. However, as a result of the Powers Boulevard construction, the common basin boundary has been altered. The boundary has shifted to the north along the South high bank of the East Fork of Sand Creek. As a result, the drainage area in the Sand Creek and Peterson Field Drainage basins have been decreased and increased respectively. Also, in order to accommodate the additional runoff resulting from the trans-basin diversion, substantial additional public facilities are recommended to be installed in the Peterson Field drainage basin. As a result, facility cost in the Peterson Field drainage basin will increase.

The following summarizes the factors and assumptions that were used in the recalculation of the drainage fees for the Peterson Field and Sand Creek drainage basins.

Peterson Field Drainage Basin

Date Report Prepared December 11, 1984

A. 1997 Basin Fees per Acre

Drainage Fee	$	4,945.00
Bridge Fee	$	286.00

B. Area used in Determination of Fees

Unplatted Area	570 Acres
Remaining Diversion Area (per this report)	82 Acres
Revised Area	652 Acres

C. Reimbursable Improvements Modifications

Fountain Boulevard Crossing		
Estimated Construction Cost	$ 184,300.00	
(Less) City Contract Portion	(18,685).00	
Sub-Total:	$ 165,615.00	
Engineering & Contingencies (15%)	$ 24,840.00	
TOTAL:	$ 190,455.00	
Onsite Public Storm Sewer Systems		
Estimated Construction Cost	$ 611,475.00	
Sloping Riprap Drop Structures along Powers Boulevard	$ 10,500.00	
Sub-Total:	$ 621,975.00	
Engineering & Contingencies (15%)	$ 93,295.00	
Sub-Total:	$ 715,270.00	
(Less) Concrete Channel per Peterson Field Drainage Basin Planning Study	(113,500.00)	
Total:	$ 601,770.00	
TOTAL CHANGE:	$ 792,225.00	

D. Drainage Fee Recalculation

1997 Drainage Fee	$ 4,945.00	
Additional Fee for Proposed Improvement (Public Improvement/Area	$ 1,215.00	
Revised Drainage Fee	$ 6,160.00	
Percent Increase	24.6%	
Revised Bridge Fee	$ 286.00	(Unchanged)

Sand Creek Drainage Basin

Date Report Prepared October 1995

A. 1997 Basin Fees per Acres

Drainage Fee	$	5,258
Bridge Fee	$	336
Pond Fee	$	1,524

B. Area Used in Determination of Fees

DBPS Study Area	18,809 Acres
Diversion Area (per this report)	82 Acres
Revised Area	18,727 Acres

C. Reimbursable Improvements Modifications

All minor systems located within the Sand Creek Drainage Basin were not included in the calculation of the drainage fee. Therefore no modifications are required.

D. Drainage Fee Recalculation

Revised Drainage Fee	$	5,281.00
Revised Bridge Fee	$	338.00
Pond Fee	$	1,531.00
Increase		0.5% ±

X. SUMMARY AND RECOMMENDATIONS

In summary, the Master Development Drainage Plan (MDDP) has established the following:

1. The internal drainage systems constructed in Aviation Way, Vapor Trail, and North Newport Road are currently adequate to accommodate the 5 year design storm discharge from the existing development.

2. The existing drainage systems in Aviation Way, Vapor Trail, and North Newport Road also appear to be adequately sized to accommodate additional developed runoff from a portion of the currently undeveloped parcels located within the existing Peterson Field drainage basin as described in this report (Filing 13, 14 and 15).

3. The existing 66 inch culvert under Fountain Boulevard serves as the outfall for the entire NTCN site. The culvert is substantially undersized and will not even accommodate runoff from the existing developments. This condition is described in this report as well as numerous of other drainage reports.

4. A trans-basin diversion was created from the Sand Creek drainage basin to the Peterson Field drainage basin as a result of the construction of Powers Boulevard North of Fountain Boulevard. Culverts were not installed with the construction of Powers Boulevard in order to maintain currently approved drainage basin boundaries. As a result, a substantial amount of additional runoff enters the Peterson Field drainage basin further overloading the Fountain Boulevard crossing.

5. A limited analysis of the downstream reinforced concrete box culvert was performed at the Astrozon crossing. It appears that this culvert is adequate to accommodate the 997 cfs flow produced by the 100 year storm event for the NTCN site. Facilities further downstream of this crossing were not evaluated as part of this report.

6. The Peterson Field and Sand Creek Drainage Basin Planning Studies do not reflect the trans-basin diversion in the determination of overall drainage areas and drainage and bridge fees.

In order to accomplish the purposes presented at the beginning of this report the following is recommended:

1. Construct additional drainage facilities under Fountain Boulevard which, when combined with the hydraulic capacity of the existing 66 inch culvert, will be able to accommodate the proposed 100 year storm design discharge from the NTCN site.

2. Construct upstream and downstream improvements in order to improve the hydraulic characteristics of the entrance and exit conditions of the proposed and exiting culverts.

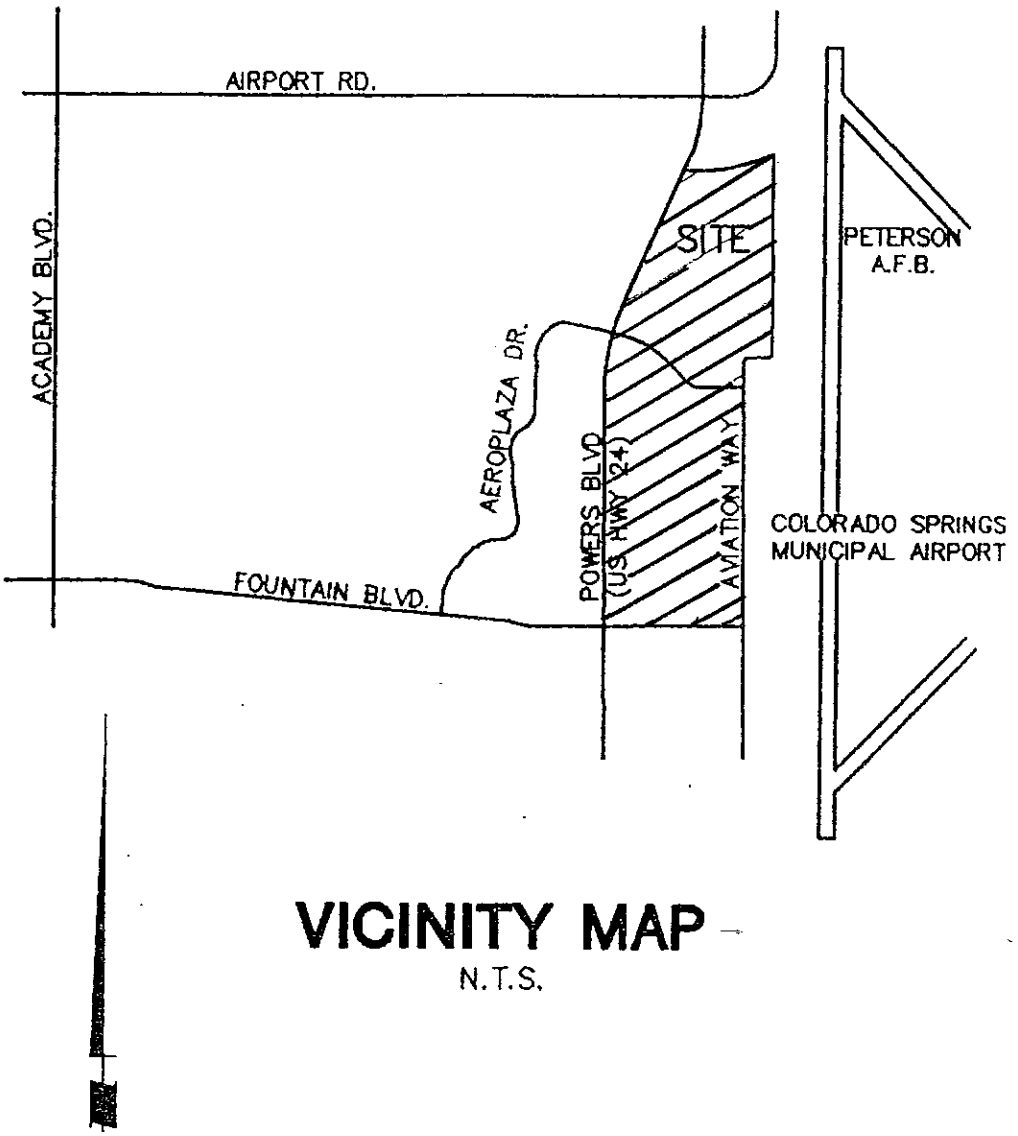
3. Coordinate the construction of the proposed Fountain Crossing improvements with the drainage improvements currently being constructed by the City of Colorado Springs. These improvements include the construction of a concrete lined channel along and adjacent to the North side of Fountain Boulevard from North Newport Road to the existing 66 inch culvert.

4. Construct a public drainage system along the East side of Powers Boulevard that will be sized to accommodate developed runoff from the area currently located in the Sand Creek drainage basin potion of the NTCN site.

5. Adjust drainage fees for both the Peterson Field and Sand Creek drainage basins in order to accommodate the proposed changes discussed in this report. This fee adjustment was discussed and approved at the July 10, 1997 Drainage Board meeting.

APPENDIX

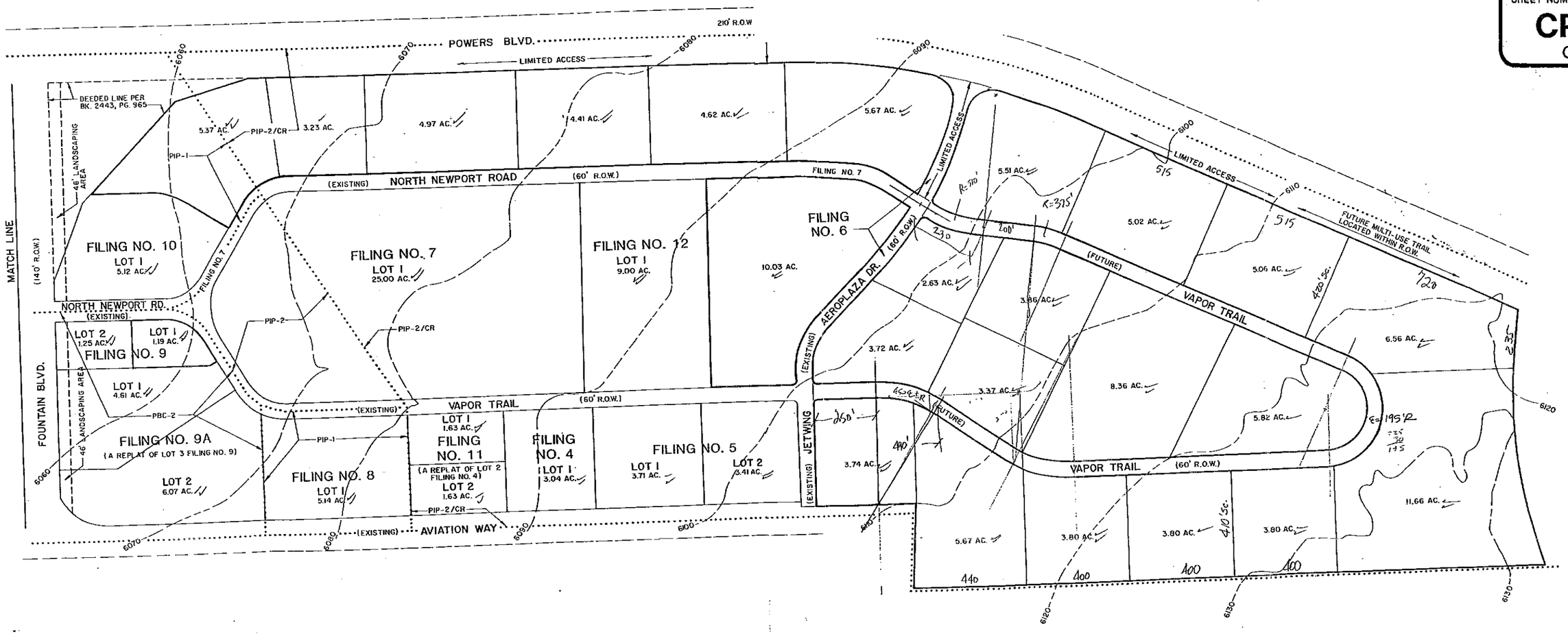
VICINITY MAP

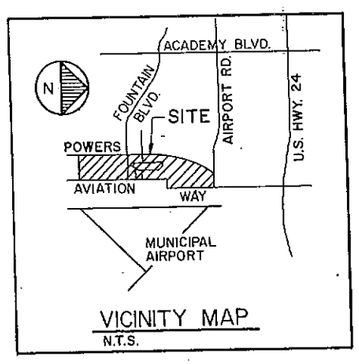


VICINITY MAP

N.T.S.

DRAWN BY	RKHW
CHECKED BY	RAS
DATE	4-28-92
SCALE	1"= 200'
JOB NUMBER	92203
SHEET NUMBER	CP-1 OF 1





Existing File No. PD DP 71-51-A15(84)

jwn & associates

AMENDED CONCEPT PLAN

NEWPORT TECHNICAL CENTER

POWERS BOULEVARD AT FOUNTAIN BOULEVARD

COLORADO SPRINGS, COLORADO

SCS SOILS MAP

Study Area
PETERSON
FIELD
Elsmere
Sand
Creek
East
R. 66 W. | R. 65 W.
2 220 000 FEET
EL PASO
(EL
SOIL SURVEY OF EL PAS
By Lynn S. Larse
Fieldwork by Lynn S. Larsen, Jerry B. H
Stanley R. Albe
United States Department of Agricultur
Colorado Agri

FEMA FLOODPLAIN EXHIBIT

OTHER FLOOD AREAS

ZONE X — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X — Areas determined to be outside 500-year flood plain.

ZONE D — Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

D — D — Cross Section Line

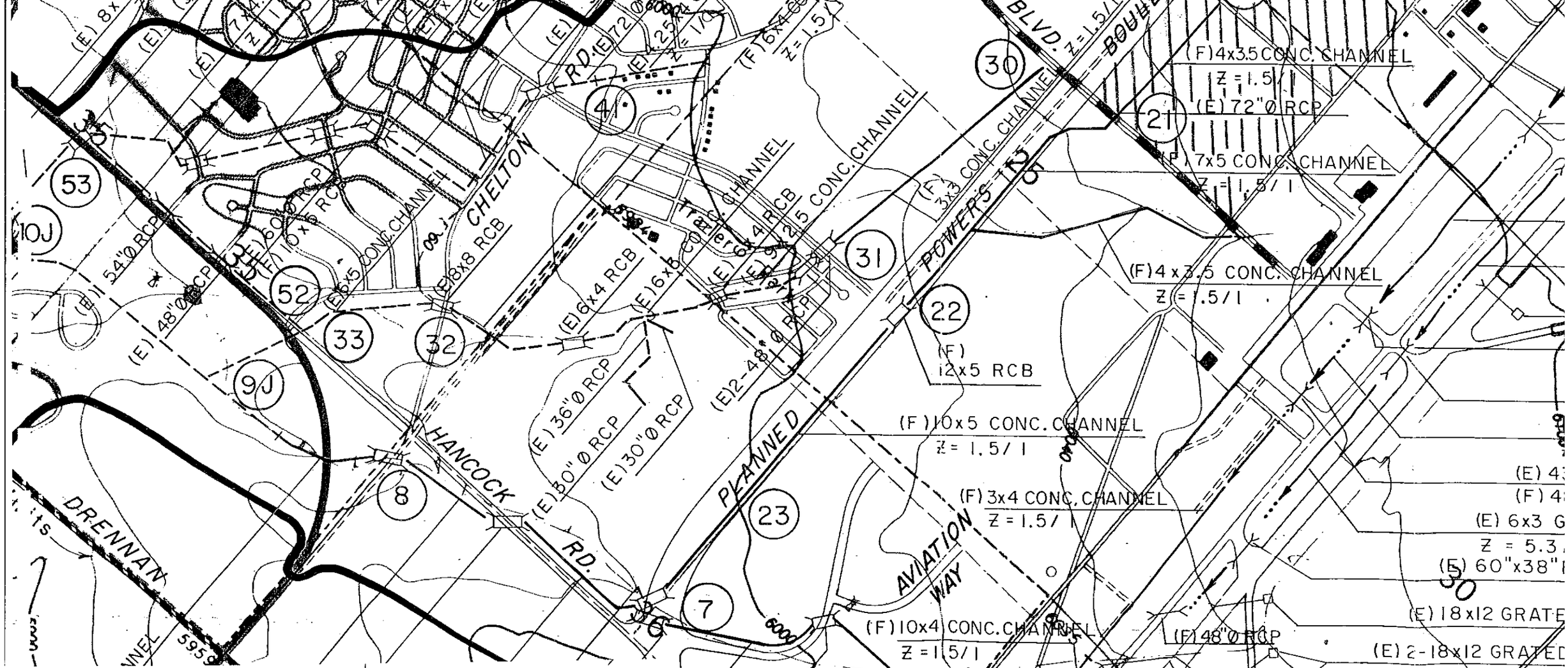
(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*

RM7X — Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

6165
6160
Sand Creek East Fork
6155
6152
6151
H
H
R. 66 W.
R. 65 W.
POWERS
6148
6145
6140
6136
6132
G
6128
G
6124
ROAD
ZONE AE
ZONE X
F
F
AIRPORT
Sand Creek Center Tributary
6110
6105
6108
6106
6102
6098
6100
E
E
IE AE
095
DRIVE
NORDIC
NORTH
24
BOULEVARD
FOUNTAIN
BOULEVARD
POWERS

DRAINAGE BASIN PLANNING STUDY EXHIBITS



LEGEND

- DRAINAGE BASIN BOUNDARY
- (31) DESIGN POINT
- REINFORCED CONCRETE BOX (RCB) CULVERT or BRIDGE (W-W) x H
- PIPE CULVERT
- EXISTING CONCRETE CHANNEL
- PLANNED CONCRETE CHANNEL
- EXISTING DRAINAGEWAY
- (E) EXISTING
- (F) FUTURE

PETERSON FIELD B
DRAINAGE MASTER
SEPTEMBER 28, 198

FINAL DRAINAGE REPORT EXHIBITS

Final Drainage Report
for
Powers Boulevard
from Drennan Road to Fountain Boulevard
Colorado Springs, Colorado

Prepared for

THE CITY OF COLORADO SPRINGS, COLORADO

This Document Has Been Prepared Under the Direction
of a Registered Professional Engineer

by

CH2M HILL
DENVER, COLORADO

August 1989

Table 4
SUMMARY OF DESIGN DISCHARGES USED FOR HYDRAULIC ANALYSIS

Facility Description	Design[a] Point	Design Discharge (cfs)
Concrete channel upstream of Zeppelin Road and culverts at Zeppelin Road	4	1,794
Concrete channel upstream of Powers Boulevard and south Powers Boulevard culverts	5	1,873
North Powers Boulevard culverts	3	1,816/580[b]
Culvert at Fountain Boulevard	1	665

[a]See Figure 8.
[b]Design discharge based on existing land development conditions.

STUDY RESULTS

The results of the existing channels hydraulic analyses are given in Table 5. The results of the channel analyses show that the new design flows can be conveyed within the existing channels under the city/county criteria.

The results of the existing culverts hydraulic analyses are given in Table 6. The results show that the culverts at Zeppelin Road have the capacity to convey the new design flows. However, the upstream headwater depth exceeds the allowable depth by approximately 0.3 feet. The north and south Powers Boulevard culverts were determined to have adequate capacity to convey the new design flows within the city/county criteria.

Based upon the prevention of floodwater encroachment of the roadway shoulder, the capacity of the existing 66-inch culvert at Fountain Boulevard was determined to be approximately 250 cfs. Since the new 100-year design flow at this

RECOMMENDATIONS FOR UPGRADING EXISTING AND PROPOSED MASTER PLANNED DRAINAGE FACILITIES AT POWERS BOULEVARD

EXISTING FACILITIES

The existing drainage facilities at Powers Boulevard have been determined to have adequate capacity to convey the new design discharge determined using the new city/county criteria. As previously discussed, the adequacy of the north Powers Boulevard culverts is based upon the existing land use conditions 100-year flow.

The 66-inch culvert at Fountains Boulevard has been determined to have inadequate capacity to convey the future land use conditions 100-year design discharge within the city/county criteria. As the drainage subbasin tributary to this culvert is developed, the City will need to upgrade this crossing to handle the increased stormwater flows. The determination of an upgraded crossing at Fountain Boulevard is beyond the scope of this report.

PROPOSED FACILITIES

The proposed master planned concrete channel located east of Powers Boulevard between Zeppelin Road and Fountain Boulevard and the crossing at the extension of Astrozon Boulevard east of Powers will be constructed along with the Powers Boulevard Roadway.

The recommended channel and crossing presented herein are based upon the design criteria used in the analyses of the existing facilities as presented in the previous section. Design discharges of 1,399 cfs and 1,816 cfs were used in sizing the concrete channel. The crossing at Astrozon was sized based on a design discharge of 1,399 cfs.

Based upon the criteria and design flows, a 6-foot-deep concrete channel with side slopes of three horizontal to one vertical and bottom widths ranging from 9 feet to 17 feet is recommended. A 17-foot-wide by 6-foot-high concrete box culvert is recommended at Astrozon Boulevard. The locations and designs of these facilities are shown on the Powers Boulevard design drawings, which are separate from this report.

PROJECT: POWERS
CULVERT @ FOUNTAIN BLVD

STATION: —

SHEET 1 OF 1

CULVERT DESIGN FORM

DESIGNER / DATE: KLK / 7/87

REVIEWER / DATE: / /

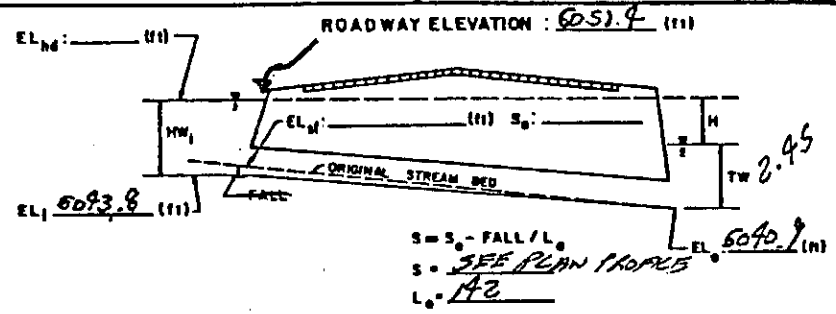
HYDROLOGICAL DATA

SEE ADDL. DATA.

- ☐ METHOD: SEE REPORT
- ☐ DRAINAGE AREA: SEE ☐ STREAM SLOPE:
- ☐ CHANNEL SHAPE:
- ☐ ROUTING: ☐ OTHER:

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
100	665	2.45



S = S_o - FALL / L_e

S = SEE PLAN PROFILE

L_e = 42

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	@ 250 OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	h_e	H (7)	EL_he (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
66" CONC	250	250	1.4	7.6	—	51.4	1.5	4.4	4.9	4.9	0.2	2.7	6046.9	6051.4		CAP = 260 CFS

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW /D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{of})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL_i (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) EL_{he} = EL_o + H + h_o

SUBSCRIPT DEFINITIONS:

e. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
of. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

EXIST CAPACITY OF 250 CFS UP TO SHOULDER. HILL OVERTOP AT DESIGN Q_{100} = 665

CULVERT BARREL SELECTED:

SIZE:
SHAPE:
MATERIAL:
ENTRANCE:

REFERENCE: Federal Highway Administration, Hydraulic Design of Highway Culverts; Hydraulic Design Series No. 5 1985

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date
OCT. 1987

Figure
9 - 40

TABLE B-3 - 100 ACRE FEET ADDITIONAL DETENTION ALTERNATIVE
PETERSON FIELD ALTERNATIVE BASIN
Colorado Springs, Colorado
ESTIMATED CONCEPTIONAL DESIGN IMPROVEMENT COSTS

1 REACH OR DESIGN POINT	2 DESIGN DIS-CHARGE (cfs)	3 LENGTH (feet)	4 SLOPE (%)	5 IMPROVEMENT Trapezoidal Conc Channel b x d x L RCB (w-w) x d x L	6 ESTIMATED 1984 CONSTRUCTION COSTS *** AIRPORT ($)	7 DRAINAGE FEE ($)	8 BRIDGE FEE ($)
		80	1.00	60" DIA RCP AT HWY 94		11,600	
1-2	1240	3670	1.10	8 x 5.5 x 3670		322,100	
	1240	120		12 x 6 RCB x 120	MARKSHEFFEL RD.		92,600
2-3	2540	3400	0.80	22 x 5.5 x 3400	438,000		
3-4	3250 *			CONSTRUCTED			
4-5	1220	7300	1.20	7 x 6 x 7300	669,700		
5	330	650	1.00	NO IMPROVEMENT REQUIRED 100 ACRE-FT. DETENTION			
5-6	30	1275	0.80	NO IMPROVEMENT REQUIRED			
6-6'	790	1450	1.20	4 x 6 x 1400		116,600	
6'	790	120	1.00	12 x 6 x 120 RCB	BROADVIEW BUS. PARK	69,600	
6'-7	880	1200	1.20	4 x 6 x 1200		100,000	
		1200		GUARDRAIL (TYPE 3)		35,200	
				SEE TABLE 7	BROADVIEW BUS. PARK	123,300	
7	1130	320	1.00	(8-8) x 6 x 320 RCB	POWERS BLVD.		211,300
7	880	300	1.00	12 x 6 x 7 x 300 RCB	POWERS BLVD.		229,400
7-8	1907	2700	1.60	7 x 8 x 2700		302,400	
		2700		GUARDRAIL (TYPE 3)		79,200	
	1907	140	1.00	(10-10) x 8 x 140 RCB	HANCOCK EXPRESSWAY		147,800
	1970	140	1.00	(10-10) x 8 x 140 RCB	HANCOCK EXPRESSWAY		147,800
8-9J	2368	1000	0.90	11 x 8 x 1000		123,300	
20-21	273 **	1430	1.30	4 x 3.5 x 1430		82,900	
21-22	900	2700	1.10	7 x 5 x 2700		220,300	
		2450	1.00	4 x 3.5 x 2450		142,000	
		2700		GUARDRAIL (TYPE 3)		79,200	
22	900	80	1.00	12 x 5 x 80 RCB	ASTROZON BLVD.		54,100
22-23	1128	3600	1.00	10 x 5 x 3600		324,100	
		3600		GUARDRAIL (TYPE 3)		105,600	
30-31	105 **	2000	1.30	3 x 3 x 2000		100,200	
33	850	140	1.00	10 x 5 x 140 RCB	HANCOCK EXPRESSWAY		87,100
		110	1.00	8 x 6 x 110		8,300	
40-41	550	600	1.40	6 x 4 x 600		41,200	
NON-SPECIFIED DRAINAGE IMPROVEMENTS					326,732	473,268	
					SUBTOTAL	2,860,368	
COST TO PREPARE THIS MASTER PLAN						27,200	
REIMBURSIBLE DRAINAGE FEES OWED AS OF SEPT. 1984						1,722,728	
BASIN FUND BALANCE AS OF SEPT. 1984						(88,288)	
				TOTAL ESTIMATED COSTS	$1,434,432	$4,522,000	$970,100

* 1976 Master Drainage Report
** 50-year Design Criteria
*** Line Item Costs Include 15% Engineering and Contingency

URS NO. 4125 DATE 7/16/84
CLIENT: CRESTONE DEVELOPMENT CORPORATION

URS

TABLE 2
AIRPORT PEAK FLOOD FLOWS
PETERSON FIELD BASIN
COLORADO SPRINGS, COLORADO

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DESIGN POINT FIGURE 3	DRAINAGE AREA (ACRES)	RUNOFF CURVE NUMBER, CN	DIRECT RUNOFF 24-HOUR STORM 5-YEAR 2.7 IN.	100-YEAR 4.6 IN.	SUB-BASIN ELEVATIONS MAX.	MIN.	ΔH (FT)	SUB-BASIN LENGTH (FT)	SLOPE, S_O %	OVERLAND FLOW TIME T_O (HRS)	CHANNEL FLOW TIME T_T (HRS)	TIME OF CONCENT. T_C (HRS)	24-HR. CSM IN	Q5 (CFS)	Q100 (CFS)	NOTES
1	188.0	69	0.52	1.67	6168	6052	116	9,600	1.21	0.83	NA	0.830	440	67	216	B
2	40.0	69	0.52	1.67	6168	6112	56	3,750	1.49	0.37	NA	0.370	650	21	68	D
3	252.0	70	0.56	1.75	6112	6084	28	2,320	1.21	---	0.0921	0.922	410	90	283	B,D,H
4	276.0	70	0.56	1.75	6084	6056	28	2,150	1.30	---	0.0853	1.007	370	89	280	B,D,H,N
5	425.0	69	0.52	1.67	6158	6054	104	7,850	1.32	---	0.3150	1.322	325	112	361	A
6	740.0	70	0.56	1.75	6056	6036	20	2,300	0.87	---	0.0913	1.413	310	201	627	B,D,H,N,A,S
7	34.0	69	0.52	1.67	6170	6140	30	2,300	1.30	0.27	NA	0.270	740	20	66	E
8	34.0	100	2.70	4.60	6140	6110	30	2,200	1.36	0.25	NA	0.250	760	109	186	U,V,W
9	97.0	73	0.68	1.97	6146	6110	36	2,080	1.73	---	0.0825	0.353	660	68	197	E,T,U,V,W
10	20.0	98	2.47	4.46	6110	6064	46	3,300	1.39	0.34	NA	0.340	670	52	94	A_1
11	150.0	77	0.87	2.29	6110	6074	36	2,300	1.57	---	0.0913	0.431	605	123	325	E,T,U,V,W,A_1,I
12	164.0	77	0.87	2.29	6074	6060	14	1,220	1.15	---	0.0484	0.479	580	129	340	E,T,U,V,W,A_1,I,F_1
13	178.0	76	0.82	2.21	6060	6054	6	960	0.63	---	0.0381	0.518	560	128	344	E,T,U,V,W,A_1,I,F_1,L
14	952.0	70	0.56	1.75	6062	6058	4	600	0.67	---	0.0238	1.477	305	255	794	(6)+(13)+Q
15	8.4	100	2.70	4.60	6058	6052	6	650	0.92	0.12	NA	0.120	950	34	57	E_1
16	16.9	100	2.70	4.60	6052	6038	14	1,220	1.15	---	0.0484	0.168	870	62	105	E_1, G_1
17	988.8	72	0.64	1.89	6038	6024	14	2,800	0.50	---	0.0476	1.525	295	292	862	(14)+(16)+I_1
18	INFLOW TO PETERSON FIELD STORM WATER DETENTION RESERVOIRS							---	---	---	---	---	---	---	---	---
19	RELEASE FROM PETERSON FIELD DETENTION RESERVOIR NO. 2							---	---	---	---	---	---	---	130*	---
20	369.0	93	1.97	3.81	6126	6040	86	7,100	1.21	0.66	NA	0.66	495	562	1217*	C^1
21	378.4	93	1.97	3.81	6040	6034	6	1,450	0.41	---	0.0575	0.718	475	553	1200*	$C^1 + K_1$
22	1371.8	78	0.92	2.38	6034	6024	10	725	1.38	---	0.0400	1.525	295	582	1635*	(17) + C^1+K_1+J_1
23	460.0	96	2.26	4.13	6150	5992	158	12,600	1.25	1.009	NA	1.009	380	617	1128	---
24	1951.8	84	1.28	2.91	6024	5992	32	2,640	1.21	---	0.105	1.630	280	1093	2615*	---
---	1491.8	80	1.03	2.55	---	---	---	---	---	---	---	1.630	280	672	1794*	---

COLUMN 1: URS 1984.
COLUMNS 2 AND 3: R. KEITH HOOK 1973.
COLUMN 11: T_O (HR) = $\frac{(11.9 \times L(mi)^3)^{0.385}}{H\ (FT)}$
COLUMN 12: CHANNEL FLOW TIME BASED ON V_{AVE} = 7 FT/SEC.
*INCLUDES 130 CFS 100-YEAR RELEASE FROM PETERSON FIELD STORM WATER DETENTION PONDS #1 AND #2.

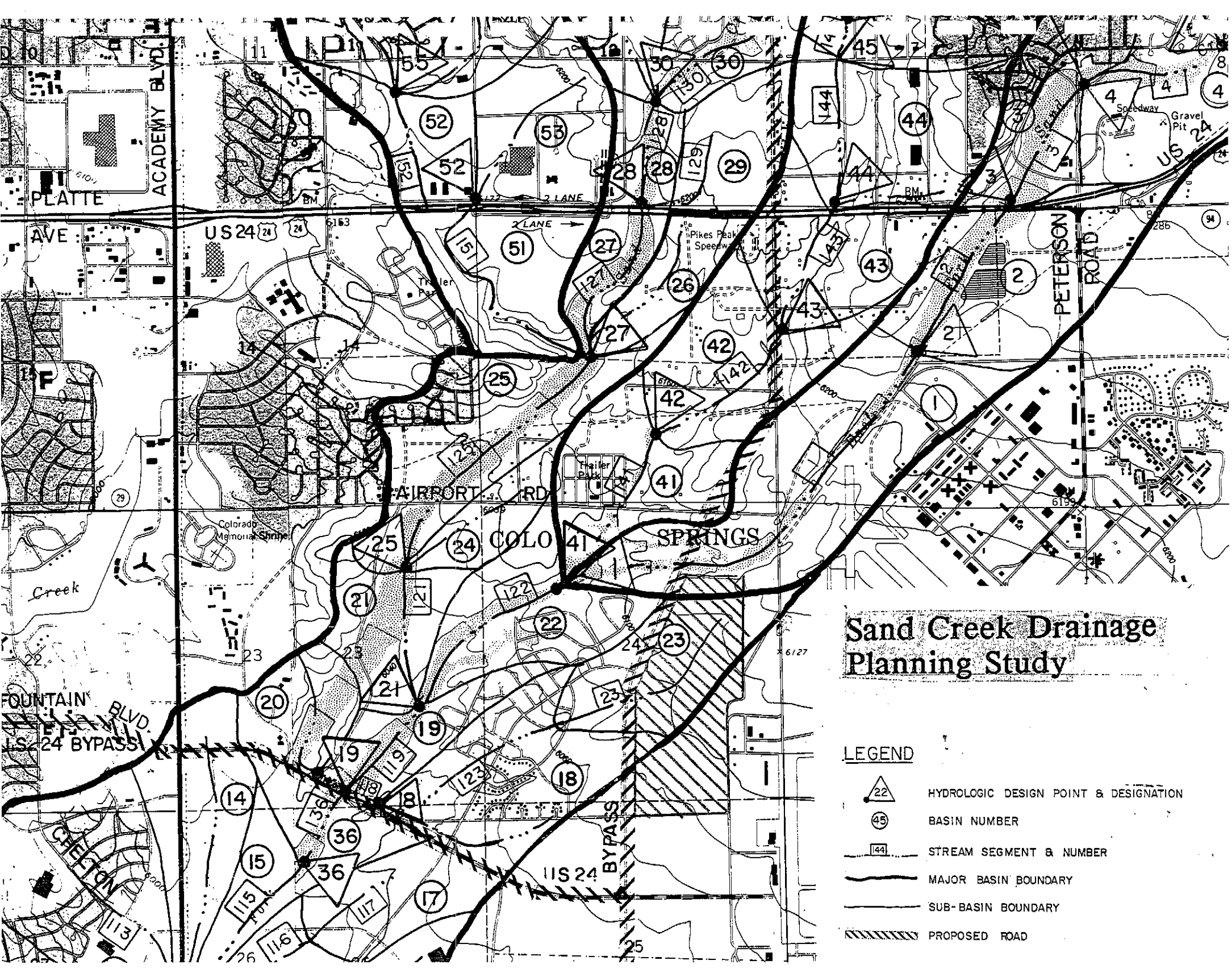

Sand Creek Drainage
Planning Study
LEGEND
HYDROLOGIC DESIGN POINT & DESIGNATION
BASIN NUMBER
STREAM SEGMENT & NUMBER
MAJOR BASIN BOUNDARY
SUB-BASIN BOUNDARY
PROPOSED ROAD
ACADEMY BLVD.
PLATTE AVE.
US 24
PETERSON ROAD
AIRPORT RD.
COLO SPRINGS
FOUNTAIN BLVD.
US 24 BYPASS
CHELTON
Pikes Peak Speedway
Gravel Pit
Trailer Park
Colorado Memorial Shrine
Creek

Table VIII-8: Sand Creek Drainage Basin Planning Study
Drainage Basin Fee Estimation

Reimbursable Drainageway Improvements		Construction Costs
Lower and Upper Sand Creek		$15,560,220
Center Tributary Sand Creek		$862,700
West Fork Sand Creek		$1,004,400
East Fork Sand Creek		$15,674,470
East Fork Sub-Tributary		$6,227,600
East and West Bierstadt Creeks		$6,688,270
Toy Ranch Tributary		$4,398,550
Tributary Drainageways	Sand Creek	$7,420,650
Tributary Drainageways	East Fork Sand Creek	$16,917,940
Roadway Culverts	Sand Creek	$1,111,000
Roadway Culverts	East Fork Sand Creek	$2,201,500
Habitat Mitigation	Sand Creek	$263,200
Miscellaneous Improvements		$65,000
Total Reimbursable Improvements		$78,395,500
10% Engineering		$7,839,550
5% Contingency		$3,919,775
Total Drainageway Costs		$90,154,825
Study Costs		$139,000
Existing basin outstanding claims (city)		$1,392,635
Existing basin outstanding claims (county)		$376,913
Total		$92,063,373
Unplatted Acreage	Sand Creek	11312
Unplatted Acreage	East Fork Sand Creek	7497
City drainage fee		$4,895
County drainage fee with detention facilities		$6,108

Cost Estimates

Presented on Table VIII-1 (at the conclusion of this section) are the unit costs used to estimate for the total construction costs for drainageway and roadway crossing improvements shown on the preliminary design plans. The cost estimates for the major drainageways, tributary drainageways, roadway culverts, regional detention basins, miscellaneous improvements and bridges are presented on Tables VIII-2 through VIII-7. The estimates represent total improvement costs for the entire Sand Creek basin, including the costs for proposed facilities in the East Fork Sand Creek basin. No estimated costs for local or initial systems has been made, and therefore no costs attributable to local or minor drainage systems have been computed in the estimation of the drainage basin fee. Several areas within the basin are known to have local drainage problems. In such areas, systems have been sized, however the cost for the systems have not been included within the fee calculation. Costs associated with utility relocations have not been estimated or included in the fee. A review of utility maps provided by the City Utilities Department indicated that the majority of the potential relocations occur at the roadway crossings.

The costs for habitat mitigation have been included within the drainageway improvement costs. The cost of protection and/or replacement of habitat impacted by the construction of the facilities can be minimized by paying attention to siting, construction sequencing and access.

Local drainage improvements have been sized for several areas within the City. These systems have been sized to address drainage problems which have been identified by the City through contacts with local residents. Improvements have been shown on the plans for the Monterey Drive Outfall channel, the Valli Vista Drive Outfall channel, the Serendipity Lane storm sewer and the Maizeland Drive/Turnberry Court storm sewer system. The information in this report for the above systems has been provided to assist the City in future budgeting for capital improvements.

Unplatted Acreage

Using El Paso County Tax Assessor maps, plats, and ownership records, the amount of unplatted acreage was estimated. From these records a total of 18,809 acres is unplatted, and subject to future development. Of this total, 7,497 acres lies within the County and 11,312 lies within the City of Colorado Springs. Park areas have been excluded from the unplatted acreage total, as has City owned property within the corporate limits, and property within Peterson Air Force Base. In reviewing the unplatted acreage estimates shown in the 1985 Sand Creek Master

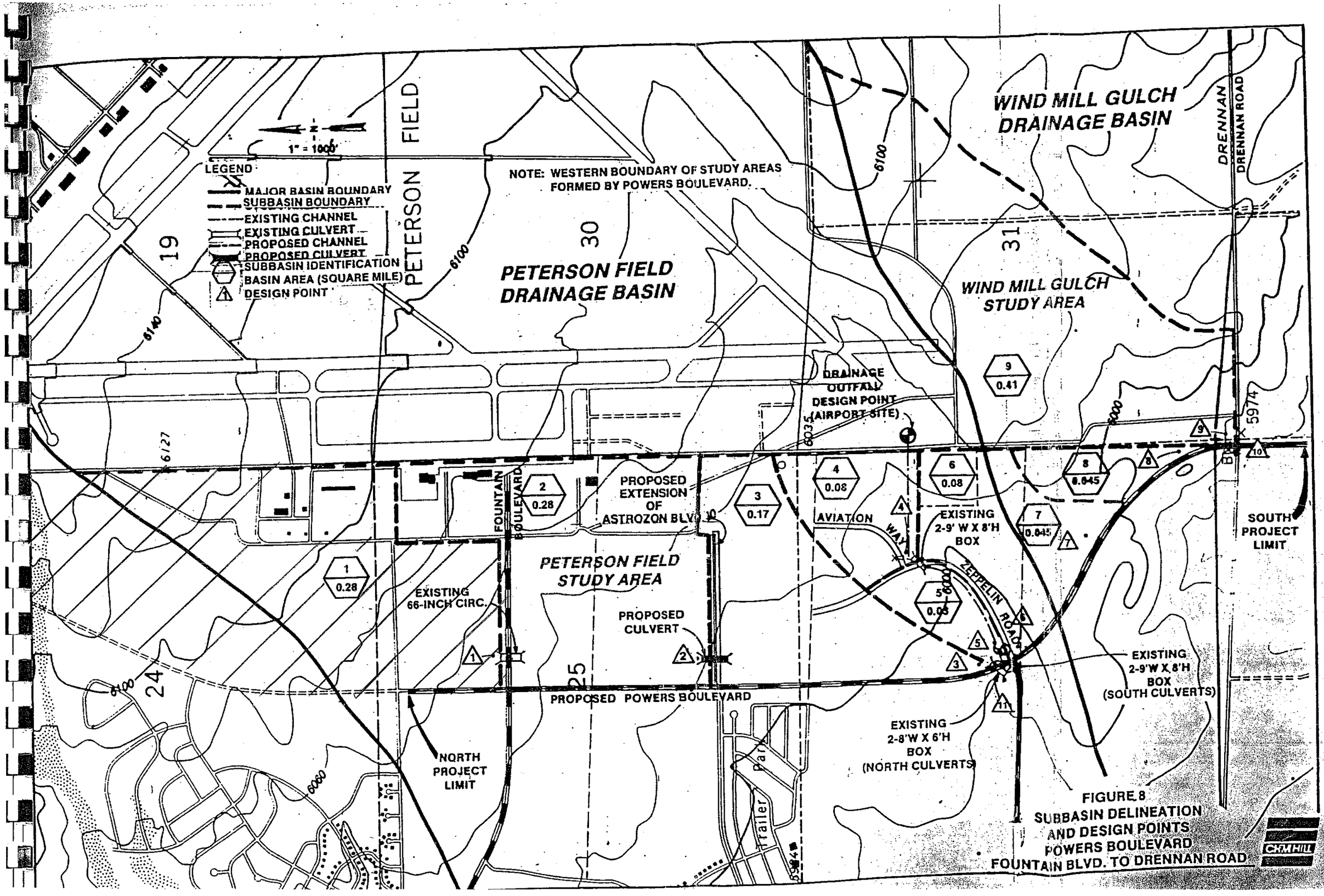


FIGURE 8
SUBBASIN DELINEATION AND DESIGN POINTS
POWERS BOULEVARD
FOUNTAIN BLVD. TO DRENNAN ROAD

Table 2
HYDROLOGY STUDY RESULTS COMPARISON

Design Point	Peak Discharges Determined This Study: 24-Hour[b] Duration Storm Event (cfs)	Peak Discharges Determined This Study: 2-Hour Duration Storm Event	Peak[a] Discharges Previous Studies (cfs)
Airport site[c]	1,627[d]	N/A	1,635
1	665	560	443[e]
2	1,399	1,210	900
3	1,816	1,570	1,128
4	1,794[f]	N/A[g]	N/A[h]
5	1,873[f]	N/A[g]	1,800
6	219	205	N/A[h]
7	126	122	N/A[h]
8	122	114	N/A[h]
9	39	100	N/A[h]
10[i]	126	121	N/A[h]
11[j]	3,902[f]	N/A[g]	2,615

[a]Results form Peterson Field Drainage Basin Master Plan Update, URS, 1984, unless otherwise noted.

[b]Critical design storm.

[c]Discharge design point No. 5 from Colorado Springs Municipal Airport Master Drainage Study, Greiner Inc., July 1988.

[d]Result from Colorado Springs Municipal Airport Master Drainage Study, Greiner, Inc., July 1988. Revised hydrograph received from Greiner, Inc., November 1988--Appendix A.

[e]Results form Peterson Field Master Drainage Report, Department of Public Works, City of Colorado Springs, 1976.

[f]Includes 1,627 cfs flowing from the municipal airport based on results taken from Colorado Springs Municipal Airport Master Drainage Study, Greiner Inc., July 1988.

ROADWAY DRAINAGE
HYDROLOGY AND HYDRAULICS REPORT

US-24 PHASE II
BYPASS PROJECT

COLORADO SPRINGS, COLORADO

Prepared for:

CRS Sirrine, Inc.
216 Sixteenth Street Mall, Suite 1700
Denver, Colorado 80202

Prepared by:

Kiowa Engineering Corporation
1776 South Jackson Street
Suite 1001
Denver, Colorado 80210-3809

KIOWA Project No. 89.06.14

SEPTEMBER 1990

II. Hydrologic Analysis

A hydrologic analysis was performed in order to identify the peak discharges for the 10- and 100-year design frequencies. The peak discharges generated were used in the sizing of the roadway drainage systems for the US 24 Phase II Bypass project. The hydrologic analysis has been conducted for both the interim and ultimate roadway system. At a number of locations, the future interchanges at Academy Boulevard, Fountain Boulevard, Airport Road and at Platte Avenue change the flow routing for the side drainages which cross the alignment. For both the interim and future roadway scenarios, the basins flowing to the US 24 Bypass alignment were assumed to be fully developed.

Runoff Model

The methodology and procedures outlined in the City of Colorado Springs/El Paso County Drainage Criteria Manual was followed. The Soil Conservation Service (SCS) TR-20 Project Formulation - Hydrology Technical Release 20 computer model was used to generate the peak flow data summarized herein. This version is available for use with personal computer (PC) "XT" and "AT" models.

Basin Hydrologic Characteristics

For analysis purposes the areas tributary to the Bypass alignment were divided in to sub-basins. Presented on Figures 2 3, and 4 (within map pocket), are the basins which were delineated for this analysis. Figure 3 presents the basins, reaches and routing paths for the interim roadway configuration and Figure 4 presents the same information for the ultimate roadway layout. The basin characteristics such as basin size, SCS curve numbers (CN), basin slope, flow path, flow time, channel type, slope and size, channel routing coefficients "X" and "M" values, and velocity were deterimined using the topographic mapping and storm drainage utility data generated as part of the Bypass project.

Presented on Figure 5 are the basin soils which were used in the hydrologic analysis. This information was obtained from the El Paso County Soil Survey referenced earlier in this report. For the future development condition, all soils classified as hydrologic soils group "A" were assumed to be type "B" soils, in accordance with the City/County criteria manual.

Presented on Figure 6 are the land uses which were assumed for the purposes of hydrologically modeling the sub-basins along the Bypass alignment. The land use data was generated from

III. Hydraulic Analysis

Contained within this section are the results of the hydraulic analysis for the interim roadway condition only. The interim roadway improvements begin at the intersection of Fountain Boulevard and Powers Boulevard and end at Powers Boulevard and Platte Avenue. Procedures outlined in the City/County Drainage Criteria Manual and the CDoH Roadway Design Manual were used in the sizing of roadside swales, roadway drainage systems (i.e., storm sewers and inlets), and culverts which cross the proposed Bypass alignment. These systems have been shown of the Preliminary Design drawings, which have been submitted to the CDoH under a separate cover.

Basis of Design

The following assumptions were made in the sizing of the various drainage systems:

(1) Roadside swales were designed to convey only the drainage generated by the road itself for the 10-year frequency flow;

(2) The roadway drainage systems were sized to convey the 100-year flow generated by the roadway. Inlets were spaced along the roadway whenever the street flow spread exceeded 12-feet;

(3) Culverts crossing the roadway alignment which collect flow from the side drainages were sized to convey the developed condition 100-year flow, assuming a headwater-to-depth ratio of 1.0;

(4) Developed flow generated from the side drainage basins were assumed to be conveyed to the major drainageways or to the 100-year culverts crossing the Bypass alignment via storm sewers and channel systems to be constructed by the Owner or developer of the property tributary to such systems.

The methodology used in sizing the roadside ditches was the Federal Highways Administration HEC-15, "Design of Roadside Channels with Flexible Linings," dated May 1986. The treatment of the roadside swales primarily are intended to use native grasses in conjunction with erosion control netting. In some cases riprap is needed to stabilize the invert of the roadside swales. Roughness values were chosen to reflect the type of treatment used in the swale.

Existing Systems

Along the interim roadway alignment there are no

existing storm sewer systems which convey flow from the side drainages. At Fountain Boulevard and Powers Boulevard, an existing 66-inch corrugated metal culvert crosses beneath Fountain Boulevard. This culvert conveys flow which originates in the industrial areas north of Fountain and east of Powers. The capacity of this culvert was checked and it was found to be of adequate capacity to convey the future condtion flow rate to the proposed concrete lined channel to be constructed as part of the City of Colorado Spring's Powers Boulevard Improvement project between Fountain Boulevard and Drennan Road.

Results

Contained within the Appendix C are the hydraulic calculations for the roadside swales, roadway drainage systems and culverts which cross the interim roadway alignment. As stated above the drainage systems sized as part of this work have been shown on the Preliminary Design drawings for the Bypass project.

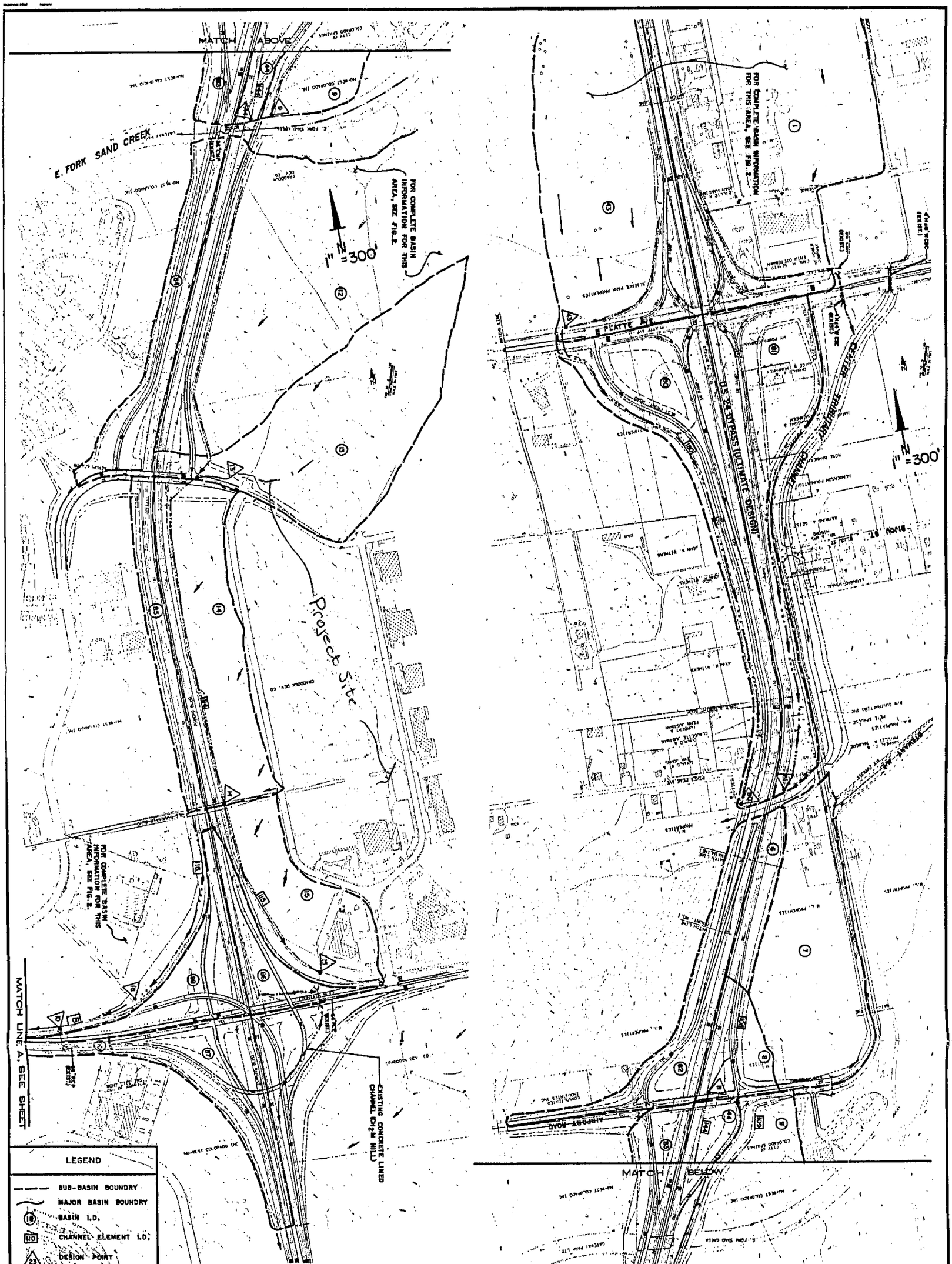


FIGURE 3
CONTD

Project No. 89-06-14
Date: 9/90
Design: JVC
Drawn: EAK
Check: RHW
Revisions:

U.S. 24 BYPASS- PHASE II
QUIVIRA STREET to PLATTE AVENUE
COLORADO SPRINGS, COLORADO
HYDROLOGIC BASIN MAP FOR ULTIMATE CONDITION

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

MAJOR STORM ANALYSIS EXHIBITS

Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors

1015 Elkton Drive
Colorado Springs, Colorado 80907
(719) 531-6200

JOB

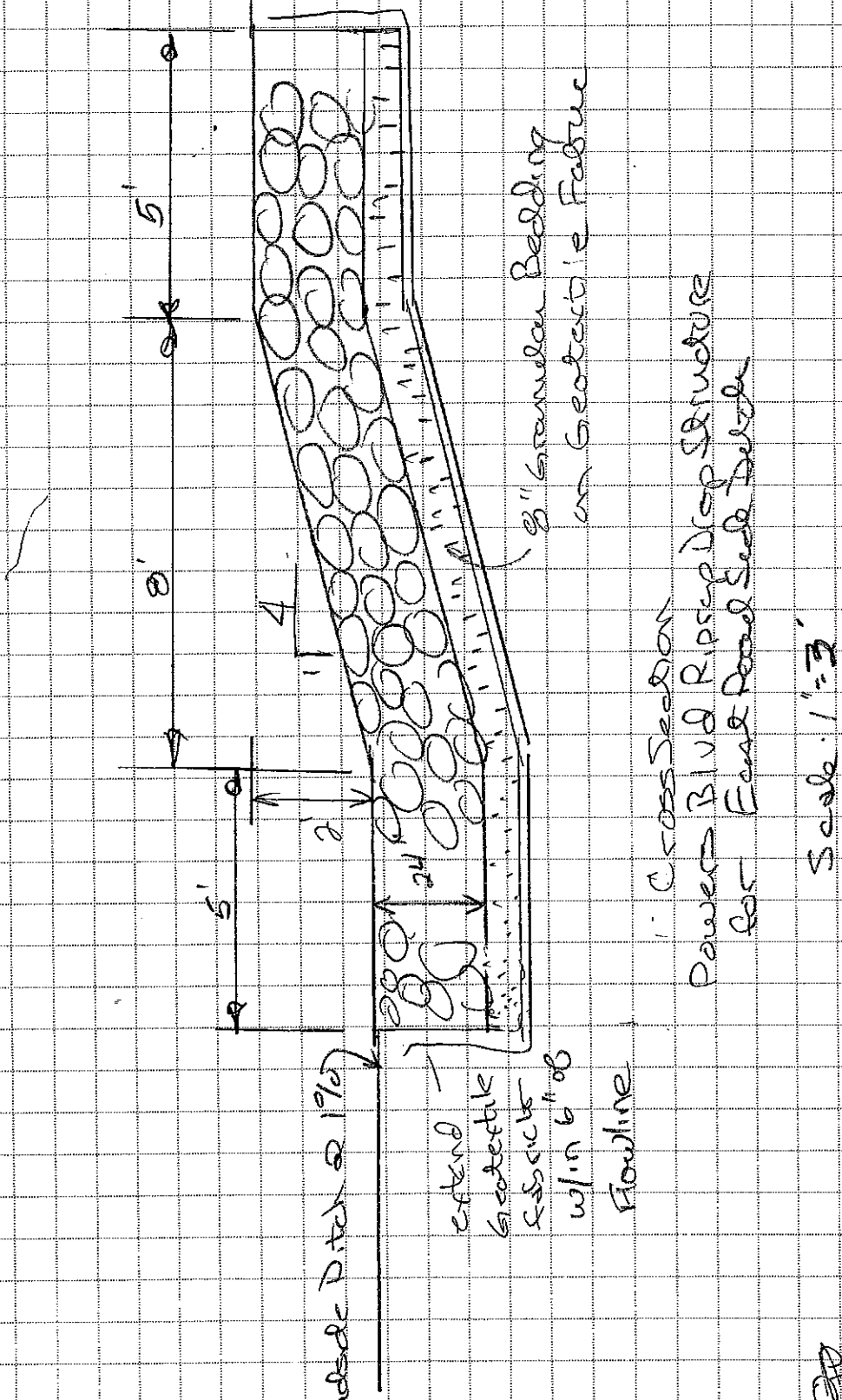
SHEET NO. OF

CALCULATED BY DATE

CHECKED BY DATE

SCALE

Roadside Ditch @ 1%



Cross Section
Paved Rip Rap Drop Structure
for Roadside Ditch

Scale: 1" = 2'

Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors

1015 Elkton Drive
Colorado Springs, Colorado 80907
(719) 531-6200

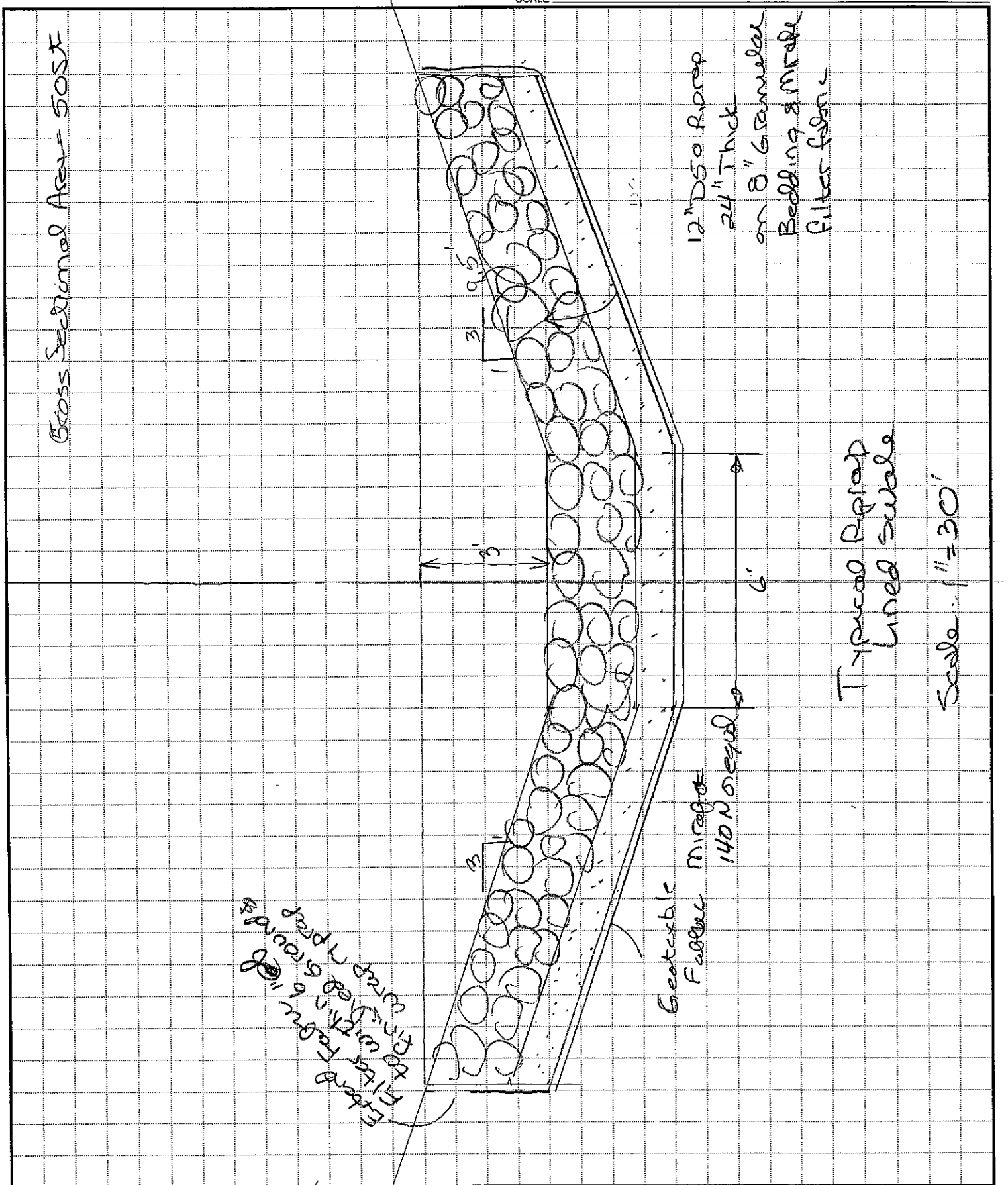
JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____



Time of Concentration for Powers Blvd Roadside Swale

Newport MDDP

Date: June 3, 1997

Project #: 96046

	Overland Travel Time				Channel Travel Time				Curb And Gutter Travel Time				Strm Swr Travel Time				
Summ Pnt	Length	C	Slope	Tt	Length	H1 - H2	Ave. Vel (fps)	Tt	Length	Slope	Vel	Tt	Length	Diam	Approx Vel	Tt	Cummul Tc
3	300	0.9	2	5					800	1 to 2	4	3.3					8.3
4					1200		8	2.5									10.8
5					600		8	1.3									12.1

Summary of Design Flows for Powers Blvd Roadside Swale

Newport MDDP

Date: June 3, 1997

Project #: 96046

	Drainage Area		Runoff Coefficients			Rainfall Intensity				Surface Flow		
Summ Pnt	PF ID	Area (acres)	C5	C100	Tc (min)	I5	I100	Q5	Q100	Incr	Cumm	Comments
3	PF3	10.2	0.80	0.90	8.3	4.3	7.4	35.1	67.9	32.8	32.8	
4	PF4	12.5	0.80	0.90	10.8	3.9	6.9	39.0	77.6	38.6	71.4	
5	PF5	6.2	0.80	0.90	12.1	3.7	6.7	18.4	37.4	19.0	90.4	

Storm Sewer/ Drainage Facilities Summary for Powers Roadside Swale

Crestone DevelopmentNewport MDDP

Date: June 3, 1997

Project #: 96046

					Exist Drainage Facilities				Proposed Channel Facilities				
Summ Pnt	Upstream Q	Additional Q	Drainage Area ID	Design Q	Diameter/Size	Slope	Capacity	Vel.	Size	Slope	Capacity	Vel.	Comments
3/4	0	32.8		32.8						1			
4/5	32	38.6		71.4						1.5			
5/24	71.4	19		90.4						2			

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

June 3, 1997
Newport MDDP
Powers Blvd Open Channel Analysis
100 yr Storm Overflow Concrete Lined Swale

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0100
Manning's Roughness Coefficient (n-value).....	0.0130
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	2.00
Channel Bottom Width (feet).....	4.0

==========

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
0.5	15.5	6.21	1.697	0.600	1.100	2.5	6.0
1.0	54.5	9.08	1.848	1.281	2.281	6.0	8.0
1.5	118.5	11.28	1.940	1.976	3.476	10.5	10.0

==========

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

June 3, 1997
Newport MDDP
Powers Blvd Open Channel Analysis
100 yr Storm Overflow Concrete Lined Swale

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0150
Manning's Roughness Coefficient (n-value).....	0.0130
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	2.00
Channel Bottom Width (feet).....	4.0

==========

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
0.5	19.0	7.61	2.078	0.900	1.400	2.5	6.0
1.0	66.7	11.12	2.263	1.921	2.921	6.0	8.0
1.5	145.1	13.82	2.376	2.965	4.465	10.5	10.0

==========

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

June 3, 1997
Newport MDDP
Powers Blvd Open Channel Analysis
100 yr Storm Overflow Concrete Lined Swale

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0200
Manning's Roughness Coefficient (n-value).....	0.0130
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	2.00
Channel Bottom Width (feet).....	4.0

==========

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
0.5	22.0	8.79	2.400	1.200	1.700	2.5	6.0
1.0	77.1	12.84	2.614	2.562	3.562	6.0	8.0
1.5	167.5	15.96	2.744	3.953	5.453	10.5	10.0
2.0	297.9	18.62	2.842	5.383	7.383	16.0	12.0

==========

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

June 3, 1997
Newport MDDP
Powers Blvd Open Channel Analysis
100yr Storm Overflow Grasslined Swale

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0100
Manning's Roughness Coefficient (n-value).....	0.0400
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	6.0

==========

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
1.0	27.1	3.01	0.613	0.141	1.141	9.0	12.0
1.5	59.2	3.76	0.646	0.219	1.719	15.7	15.0
2.0	105.5	4.40	0.671	0.300	2.300	24.0	18.0
2.5	167.7	4.97	0.691	0.384	2.884	33.8	21.0

==========

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

June 3, 1997
Newport MDDP
Powers Blvd Open Channel Analysis
100yr Storm Overflow Grasslined Swale

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0150
Manning's Roughness Coefficient (n-value).....	0.0400
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	6.0

==========

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
1.0	33.2	3.69	0.751	0.211	1.211	9.0	12.0
1.5	72.5	4.60	0.791	0.329	1.829	15.7	15.0
2.0	129.2	5.38	0.822	0.450	2.450	24.0	18.0
2.5	205.4	6.09	0.846	0.575	3.075	33.8	21.0

==========

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

June 3, 1997
Newport MDDP
Powers Blvd Open Channel Analysis
100yr Storm Overflow Grasslined Swale

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0200
Manning's Roughness Coefficient (n-value).....	0.0400
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	6.0

==========

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
1.0	38.3	4.26	0.867	0.282	1.282	9.0	12.0
1.5	83.7	5.31	0.914	0.438	1.938	15.7	15.0
2.0	149.2	6.22	0.949	0.600	2.600	24.0	18.0
2.5	237.2	7.03	0.977	0.767	3.267	33.8	21.0

==========

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

TABLES, CHARTS, DESIGN CALCULATIONS

TABLE 1: LAND USE SUMMARY

Newport Technical Center MDDP

Date: April 14, 1997

Project #: 95046

		Area (acres)		Land Use		
Tract I.D.	Description	Platted	Unplatted	Exist Use	Future Use	Comments
Information Source:Amended Concept Plan PD DP 71-51-A15(84)						
Prepared By: Nakai and Associates, April, 1992						
Location: South of Aeroplaza Drive						
	Newport Filing 10	5.12		Commercial /Industrial	Commercial /Industrial	
	Newport Filing 9	2.44		Commercial /Industrial	Commercial /Industrial	
	Newport Filing 9A	10.68		Commercial /Industrial	Commercial /Industrial	
	Newport Filing 8	5.14		Commercial /Industrial	Commercial /Industrial	
	Newport Filing 11	3.26		Commercial /Industrial	Commercial /Industrial	
	Newport Filing 4	3.04		Commercial /Industrial	Commercial /Industrial	
	Newport Filing 5	7.12		Commercial /Industrial	Commercial /Industrial	
	Newport Filing 6					Aeroplaza Drive Right of Way
	Proposed Newport Filing 14		10.03	Pasture	Commercial /Industrial	Proposed Minco Development
	Newport Filing 12	9.00		Commercial /Industrial	Commercial /Industrial	
	Newport Filing 7	25.00		Commercial /Industrial (Partially Developed)	Commercial /Industrial	
			5.37	Pasture	Commercial /Industrial	
			3.23	Pasture	Commercial /Industrial	

			4.97	Pasture	Commercial /Industrial	
			4.41	Pasture	Commercial /Industrial	
			4.62	Pasture	Commercial /Industrial	
			5.67	Pasture	Commercial /Industrial	
Information Source: Concept Plan Amendment of a Portion of Newport Technical Center						
Prepared By: Ocering Wurth and Associates, May, 1996						
Location: North of Aeroplaza Drive						
	Newport Filing 13	10.69		Pasture	Commercial /Industrial	
	Proposed Newport Filing15		7.50	Pasture	Commercial /Industrial	
			7.50	Pasture	Commercial /Industrial	
			14.00	Pasture	Commercial /Industrial	
			11.00	Pasture	Commercial /Industrial	
			10.00	Pasture	Commercial /Industrial	
			10.00	Pasture	Commercial /Industrial	
			10.00	Pasture	Commercial /Industrial	
			2.75	Pasture	Commercial /Industrial	
TOTALS		**81.49**	**111.05**			

TABLE 2: FINAL DRAINAGE REPORT SUMMARY

Newport Technical Center MDDP

Date: April 14, 1997

Project #: 96046

Drainge Report Title	Date	Prepared By	Comments
Newport MDDP	Nov-76		Shows 2 crossings across Powers Blvd. located in the Sand Creek Basin
Pikes Peak Panorama #1	Nov-76		Drainage Plan only. Indicates 62.1 cfs entering storm sewer @ East end of storm sewer on Ridenour Drive
Aeroplaza S/D #1	Sep-81		Shows 82cfs crossing Powers w/ a 36" RCP to tie into a system in Aeroplaza
Aeroplaza S/D #3	Aug-83		No storm sewer crossing of Powers Blvd indicated. Report recommended to not divert the flow across Powers Blvd. No analysis of impact of dowmstream structures done.
Gateway S/D #12	Nov-84		Indicates no storm sewer crossong of Powers Blvd
NCR S/D #1	Nov-80		Indicates an assumed storm sewer crossing of Powers north of subdivision
Gateway S/D #10	Nov-84		Indicates 36" RCP storm sewer crossing of Powers North of Aeroplaza Drive
Gateway S/D #7	Nov-84		No esternal flows indicated across Powers
Powers Blvd (Drennan to Fountain)	Oct-93		Shows no basin diversion from Sand Creek to Reterson Field. Indicates that the culvert under Fountain Blvd. is undersized
Powers Blvd (Phase II)			Indicates tha 100% of the runoff from the East side of Powers is not to cross Powers thus creating a trans-basin diversion. States that the 66" RCP culvert under Fountain Blvd. is adequately sized to accomodate developed flows.
Powers Blvd Construction Plans	Oct-93		Indicates no crossings of Powers Blvd. in accordance with previously prepared drainage studies

TABLE 3

Time of Concentration for Developed Conditions

Newport Tech Center MDDP

Date: April 14, 1997

Project #: 96046

	Overland Travel Time				Channel Travel Time				Curb And Gutter Travel Time				Strm Swr Travel Time				
Summ Pnt	Length	C	Slope	Tt	Length	H1 - H2	Ave. Vel (fps)	Tt	Length	Slope	Vel	Tt	Length	Diam	Approx Vel	Tt	Cummul Tc
	VAPOR TRAIL DRAINAGE SYSTEM																
13				1.1								6.7					7.8
14													800	24/30	8	1.7	9.5
15													800	30	10	1.3	10.8
16													750	36	14	0.9	11.7
17													550	36	16	0.6	12.3
18													300	36	17	0.3	12.6
	NORTH NEWPORT DRAINAGE SYSTEM																
7				1.5								7					8.5
8													850	36	10	1.4	9.9
9													500	36	12	0.7	10.6
10													700	42	14	0.8	11.4
11													750	42/21	12	1	12.4
	POWERS BLVD SYSTEM																
12A	300	0.8	2	5					800	2	2.5	5.3					10.3
12													450	24	7	1.1	11.4
1A	300	0.9	2	5					800	2	2.5	5.3					10.3
1													1200	30/36	10	2	13.4
2													850	42	12	1.2	14.6
3													1100	48	12	1.5	16.1
4													1200	54	15	1.3	17.4
5													610	54	15	0.7	18.1

6													570	60	12	0.8	18.9
	AVIATION WAY SYSTEM																
20									720		2	6	660	18/24	12	0.9	6.9
21													2950	27	12	4.1	11
22													700	30	11	1.1	12.1

TABLE 4

Summary of Design Flows for Developed Conditions

Newport Tech Center MDDP

Date: April 14, 1997

Project #: 96046

	Drainage Area		Runoff Coefficients			Rainfall Intensity				Cummulative		
Summ Pnt	PF ID	Area (acres)	C5	C100	Tc (min)	I5	I100	Q5	Q100	Q5	Q100	Comments
VAPOR TRAIL SYSTEM												
13	14	8.2	0.80	0.90	7.8	4.3	7.4	28.2	54.6	28.2	54.6	
14	15	6.3	0.80	0.90	9.5	4.1	7.1	20.7	40.3	48.9	94.9	
15	16	8.9	0.80	0.90	10.8	3.9	6.9	27.8	55.3	76.6	150.1	
16	17	7.9	0.80	0.90	11.1	3.8	6.8	24.0	48.3	100.7	198.5	
17	18	5.9	0.80	0.90	12.3	3.7	6.7	17.5	35.6	118.1	234.1	
18	20	4.1	0.80	0.90	12.6	3.7	6.7	12.1	24.7	130.3	258.8	
	TOTAL	41.3										
NORTH NEWPORT DRAINAGE SYSTEM												
7	7	15.1	0.80	0.90	8.5	4.2	7.2	50.7	97.8	50.7	97.8	
8	8	11.7	0.80	0.90	9.9	4.0	7.0	37.4	73.7	88.2	171.6	
9	9	9.7	0.72	0.78	10.6	3.9	6.9	27.2	52.2	115.4	223.8	
10	10	14.0	0.80	0.90	11.4	3.8	6.8	42.6	85.7	158.0	309.4	
11	11	9.9	0.80	0.90	12.4	3.7	6.7	29.3	59.7	187.3	369.1	
	TOTAL	60.4										
POWERS BLVD DRAINAGE SYSTEM												
12A	SC2	8.5	0.80	0.90	10.3	4.0	6.9	27.2	52.8	27.2	52.8	
12	13	11.2	0.80	0.90	5.9	4.9	8.4	43.9	84.7	43.9	84.7	

1A	SC1	6.9	0.80	0.90	10.3	4.0	6.9	22.0	42.8	22.0	42.8	
1	1	14.7	0.80	0.90	13.4	3.6	6.1	42.3	80.7	125.5	244.8	
2	2	11.5	0.80	0.90	14.6	3.5	6.0	32.2	62.1	157.7	306.9	
3	3	10.2	0.80	0.90	16.1	3.4	5.8	27.7	53.2	185.4	360.1	
4	4	12.5	0.80	0.90	17.4	3.2	5.5	32.0	61.9	217.4	422.0	
5	5	6.2	0.80	0.90	18.1	3.1	5.3	15.4	29.6	232.8	451.6	
6	6	8.2	0.80	0.90	19.1	3.0	5.2	19.7	38.4	252.5	490.0	
24	12	6.7	0.80	0.90	13.6	3.5	6.0	18.8	36.2	261.6	512.1	
6	23	7.3	0.80	0.90	13.6	3.5	6.0	20.4	39.4	282.0	551.5	
	TOTAL	95.4										
AVIATION WAY DRAINAGE SYSTEMS												
20	22	5.8	0.80	0.90	6.9	4.5	7.9	20.9	41.2	20.9	41.2	
21	19	5.6	0.80	0.90	11.0	3.9	6.8	17.5	34.3	38.4	75.5	
22	21	8.9	0.80	0.90	12.1	3.8	6.5	27.1	52.1	65.4	127.6	
	TOTAL	20.3										
TOTAL ACREAGE		217.4										
SUMMARY												
Combined Flows # 23												
	Vapor Trail System				12.6			130.3	258.8			
	Aviation Way Systems				12.1			65.5	127.6	195.8	386.4	
Combined Flows @ #24												
	Vapor Trail System				12.6			130.3	258.8			
	Aviation Way Systems				12.1			65.5	127.6			
	North Newport Drive Systems				12.4			187.2	129.3			
	Powrs Blvd Systems				13.6			281.1	551.1	665.0	1308.6	

TABLE 5

Storm Sewer/ Drainage Facilities Summary for Developed Conditions

Newport Tech Center MDDP

Date: April 14, 1997

Project #: 98046

					Exist Drainage Facilities				Proposed Drainage Facilities				
Summ Pnt	Upstream Q	Additional Q	Drainage Area ID	Design Q	Diameter/Size	Slope	Capacity	Vel.	Diameter/Size	Slope	Capacity	Vel.	Comments
VAPOR TRAIL DRAINAGE SYSTEM													
13/14	0	28.2	14	28.2					24	1	26	7.5	
14/15	28.2	20.7	15	48.9	30	1.05	45.2	10					
15/16	48.9	27.8	16	76.7	36	1.92	99.4	14					
16/17	76.7	24	17	100.7	36	2.34	110	16					
17/18	100.7	17.5	18	118.2	36	3.46	133.4	20					
					36	2.16	105.4	15					
18/19	118.2	12.1	20	130.3	48	0.75	134.7	11					
19/23	130.3	0		130.3	54	0.96	207.1	12					
NORTH NEWPORT ROAD DRAINAGE SYSTEM													
7/8	0	50.7	7	50.7	27	1	32						
					36	0.8	64.8	10					
8/9	50.7	37.4	8	88.1	36	1.38	84.3	12					
9/10	88.1	27.2	9	115.3	42	1.38	126.8	14					
10/11	115.3	42.6	10	157.9	42	1.59	136.5	12					
	Dual System(East side)				21	1.38	22	10					
	Total						158.5						
11/23	157.9	29.3	11	187.2	48	1.7	201.4						
	Dual System				30	1.7	56						
	Total						257.4						
	Outfall				54	0.96	207.1	12					

POWERS BLVD DRAINAGE SYSTEM													
12A/12	0	27.2	SC2	27.2					30	0.5	30	7	
12/1	27.2	34	13	61.2					36	1	68	10	
									36	1.3		12	
1A/1	0	22	SC1	22					24	1.3	28	10	
1/2	83.2	42.3	1	125.5					42	1.2	130	12	
2/3	125.5	32.2	2	157.7					48	1.2	160	12	
3/4	157.1	27.7	3	185.4					54	1	190	15	
4/5	185.4	32	4	217.4					54	1.4	230	15	
5/6	217.4	15.4	5	232.8					60	1	290	12	
6/24	232.8	19.7	PF6	252.5					60	1	290	12	
AVIATION WAY DRAINAGE SYSTEM													
20/21	0	20.9	22	20.9	2x2 conc ditch	1.48	26.3	9					
				20.9	27	2.1	48.2	12.4					
				20.9	27	1.1	34.9	9.1					
				20.9	27	3.48	62.1	16					
21/22	20.9	17.5	19	38.4	30	1.33	50.8	11					
22/23	38.4	27.1	21	65.5	36	1.11	75.6						
					54	1.03	24.6						

HEC1 S/N: 1906330095 HMVersion: 6.30 Data File: rev5yr.hc1

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*           VERSION 4.0.1E              *
*                                       *
*  RUN DATE  02/18/1997  TIME  17:04:00 *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*         609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```

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

```
::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::
:::                                    :::
:::  Full Microcomputer Implementation :::
:::                 by                 :::
:::        Haestad Methods, Inc.       :::
:::                                    :::
::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1       ID      NEWPORT TECH CENTER MDDP (Rev #1 to include 15.4 acres of Sand Creek)
  2       ID      DEVELOPED RUNOFF W/ NO DETENTION/ SUMMARY OF FLOWS @ FOUNTAIN BLVD
  3       ID        5 YR/ 24 HR STORM = 2.6"  (rev5YR.HC1)
  4       IT     15 18FEB97    1000     300
  5       IO      5       0       0

  6       KK      A     POWERS BLVD DRAINGE SYSTEM
  7       KM      BASIN RUNOFF FOR PF1,2,3,4,5,6,12,23,SC1(part),SC2(Part)
  8       BA  0.1624
  9       PB    2.6
 10       IN     15
 11       PC  .0005  .0015  .0030  .0045  .0060  .0080  .0100  .0120  .0143  .0165
 12       PC  .0188  .0210  .0233  .0255  .0278  .0320  .0390  .0460  .0530  .0600
 13       PC  .0750  .1000  .4000  .7000  .7250  .7500  .7650  .7800  .7900  .8000
 14       PC  .8100  .8200  .8250  .8300  .8350  .8400  .8450  .8500  .8550  .8600
 15       PC  .8638  .8675  .8713  .8750  .8788  .8825  .8863  .8900  .8938  .8975
 16       PC  .9013  .9050  .9083  .9115  .9148  .9180  .9210  .9240  .9270  .9300
 17       PC  .9325  .9350  .9375  .9400  .9425  .9450  .9475  .9500  .9525  .9550
 18       PC  .9575  .9600  .9625  .9650  .9675  .9700  .9725  .9750  .9775  .9800
 19       PC  .9813  .9825  .9838  .9850  .9863  .9875  .9888  .9900  .9913  .9925
 20       PC  .9938  .9950  .9963  .9975  .9988 1.0000
 21       LS           92
 22       UD   0.20

 23       KK      B     NORTH NEWPORT ROAD DRAINAGE SYSTEM
 24       KM      BASIN RUNOFF FOR PF 7,8,9,10,11
 25       BA  0.0944
 26       LS           92
 27       UD  0.1240

 28       KK      C     VAPOR TRAIL DRAINAGE SYSTEM
 29       KM      BASIN RUNOFF FROM PF 14,15,16,17,18,20
 30       BA  0.0645
 31       LS           92
 32       UD  0.1260

 33       KK      D     AVIATION WAY(WEST SIDE) DRAINAGE SYSTEM
 34       KM      BASIN RUNOFF FROM PF 19,21,22
 35       BA  0.0317
 36       LS           92
 37       UD  0.1210

 38       KK      E     COMBINED FLOWS @ FOUNTAIN BLVD CROSSING
 39       KO      1                              21
 40       KM      COMBINED FLOWS FROM ALL PROPOSED DRAINAGE FACILITIES
 41       HC      4
 42       ZZ
```

```
HEC1 S/N: 1906330095        HMVersion: 6.30    Data File: rev5yr.hc1

****************************************                    ***************************************
*                                      *                    *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS      *
*              MAY   1991              *                    *   HYDROLOGIC ENGINEERING CENTER     *
*           VERSION 4.0.1E             *                    *        609 SECOND STREET            *
*                                      *                    *     DAVIS, CALIFORNIA 95616         *
*  RUN DATE  **/**/1997  TIME  00:00:** *                   *         (916) 756-1104              *
*                                      *                    *                                     *
****************************************                    ***************************************


                    NEWPORT TECH CENTER MDDP (Rev #1 to include 15.4 acres of Sand Creek)
                    DEVELOPED RUNOFF W/ NO DETENTION/ SUMMARY OF FLOWS @ FOUNTAIN BLVD
                      5 YR/ 24 HR STORM = 2.6"  (rev5YR.HC1)

  5 IO        OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                     NMIN         15  MINUTES IN COMPUTATION INTERVAL
                    IDATE    18FEB97  STARTING DATE
                    ITIME       1000  STARTING TIME
                       NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE    21FEB97  ENDING DATE
                   NDTIME       1245  ENDING TIME
                   ICENT          19  CENTURY MARK

              COMPUTATION INTERVAL    0.25 HOURS
                   TOTAL TIME BASE   74.75 HOURS

        ENGLISH UNITS
            DRAINAGE AREA           SQUARE MILES
            PRECIPITATION DEPTH     INCHES
            LENGTH, ELEVATION       FEET
            FLOW                    CUBIC FEET PER SECOND
            STORAGE VOLUME          ACRE-FEET
            SURFACE AREA            ACRES
            TEMPERATURE             DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  38 KK    *      E     *          COMBINED FLOWS @ FOUNTAIN BLVD CROSSING
           *            *
           **************

  39 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          1  PRINT CONTROL
```

IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE
IPNCH	0	PUNCH COMPUTED HYDROGRAPH
IOUT	21	SAVE HYDROGRAPH ON THIS UNIT
ISAV1	1	FIRST ORDINATE PUNCHED OR SAVED
ISAV2	300	LAST ORDINATE PUNCHED OR SAVED
TIMINT	0.250	TIME INTERVAL IN HOURS

COMBINED FLOWS FROM ALL PROPOSED DRAINAGE FACILITIES

41 HC HYDROGRAPH COMBINATION

ICOMP 4 NUMBER OF HYDROGRAPHS TO COMBINE

***

HYDROGRAPH AT STATION E

SUM OF 4 HYDROGRAPHS

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
18 FEB 1000	1	0.	19 FEB 0445	76	5.	19 FEB 2330	151	0.	20 FEB 1815	226	0.
18 FEB 1015	2	0.	19 FEB 0500	77	5.	19 FEB 2345	152	0.	20 FEB 1830	227	0.
18 FEB 1030	3	0.	19 FEB 0515	78	5.	20 FEB 0000	153	0.	20 FEB 1845	228	0.
18 FEB 1045	4	0.	19 FEB 0530	79	5.	20 FEB 0015	154	0.	20 FEB 1900	229	0.
18 FEB 1100	5	0.	19 FEB 0545	80	5.	20 FEB 0030	155	0.	20 FEB 1915	230	0.
18 FEB 1115	6	0.	19 FEB 0600	81	4.	20 FEB 0045	156	0.	20 FEB 1930	231	0.
18 FEB 1130	7	0.	19 FEB 0615	82	3.	20 FEB 0100	157	0.	20 FEB 1945	232	0.
18 FEB 1145	8	0.	19 FEB 0630	83	3.	20 FEB 0115	158	0.	20 FEB 2000	233	0.
18 FEB 1200	9	0.	19 FEB 0645	84	3.	20 FEB 0130	159	0.	20 FEB 2015	234	0.
18 FEB 1215	10	0.	19 FEB 0700	85	3.	20 FEB 0145	160	0.	20 FEB 2030	235	0.
18 FEB 1230	11	0.	19 FEB 0715	86	3.	20 FEB 0200	161	0.	20 FEB 2045	236	0.
18 FEB 1245	12	0.	19 FEB 0730	87	3.	20 FEB 0215	162	0.	20 FEB 2100	237	0.
18 FEB 1300	13	0.	19 FEB 0745	88	3.	20 FEB 0230	163	0.	20 FEB 2115	238	0.
18 FEB 1315	14	0.	19 FEB 0800	89	3.	20 FEB 0245	164	0.	20 FEB 2130	239	0.
18 FEB 1330	15	0.	19 FEB 0815	90	3.	20 FEB 0300	165	0.	20 FEB 2145	240	0.
18 FEB 1345	16	0.	19 FEB 0830	91	3.	20 FEB 0315	166	0.	20 FEB 2200	241	0.
18 FEB 1400	17	0.	19 FEB 0845	92	3.	20 FEB 0330	167	0.	20 FEB 2215	242	0.
18 FEB 1415	18	0.	19 FEB 0900	93	3.	20 FEB 0345	168	0.	20 FEB 2230	243	0.
18 FEB 1430	19	0.	19 FEB 0915	94	3.	20 FEB 0400	169	0.	20 FEB 2245	244	0.
18 FEB 1445	20	0.	19 FEB 0930	95	3.	20 FEB 0415	170	0.	20 FEB 2300	245	0.
18 FEB 1500	21	0.	19 FEB 0945	96	3.	20 FEB 0430	171	0.	20 FEB 2315	246	0.
18 FEB 1515	22	4.	19 FEB 1000	97	1.	20 FEB 0445	172	0.	20 FEB 2330	247	0.
18 FEB 1530	23	246.	19 FEB 1015	98	0.	20 FEB 0500	173	0.	20 FEB 2345	248	0.
18 FEB 1545	24	480.	19 FEB 1030	99	0.	20 FEB 0515	174	0.	21 FEB 0000	249	0.
18 FEB 1600	25	222.	19 FEB 1045	100	0.	20 FEB 0530	175	0.	21 FEB 0015	250	0.
18 FEB 1615	26	94.	19 FEB 1100	101	0.	20 FEB 0545	176	0.	21 FEB 0030	251	0.
18 FEB 1630	27	50.	19 FEB 1115	102	0.	20 FEB 0600	177	0.	21 FEB 0045	252	0.
18 FEB 1645	28	36.	19 FEB 1130	103	0.	20 FEB 0615	178	0.	21 FEB 0100	253	0.
18 FEB 1700	29	26.	19 FEB 1145	104	0.	20 FEB 0630	179	0.	21 FEB 0115	254	0.
18 FEB 1715	30	22.	19 FEB 1200	105	0.	20 FEB 0645	180	0.	21 FEB 0130	255	0.
18 FEB 1730	31	22.	19 FEB 1215	106	0.	20 FEB 0700	181	0.	21 FEB 0145	256	0.
18 FEB 1745	32	21.	19 FEB 1230	107	0.	20 FEB 0715	182	0.	21 FEB 0200	257	0.
18 FEB 1800	33	15.	19 FEB 1245	108	0.	20 FEB 0730	183	0.	21 FEB 0215	258	0.
18 FEB 1815	34	12.	19 FEB 1300	109	0.	20 FEB 0745	184	0.	21 FEB 0230	259	0.
18 FEB 1830	35	11.	19 FEB 1315	110	0.	20 FEB 0800	185	0.	21 FEB 0245	260	0.
18 FEB 1845	36	11.	19 FEB 1330	111	0.	20 FEB 0815	186	0.	21 FEB 0300	261	0.

18 FEB 1900	37	11.	*	19 FEB 1345	112	0.	*	20 FEB 0830	187	0.	*	21 FEB 0315	262	0.		
18 FEB 1915	38	11.	*	19 FEB 1400	113	0.	*	20 FEB 0845	188	0.	*	21 FEB 0330	263	0.		
18 FEB 1930	39	11.	*	19 FEB 1415	114	0.	*	20 FEB 0900	189	0.	*	21 FEB 0345	264	0.		
18 FEB 1945	40	11.	*	19 FEB 1430	115	0.	*	20 FEB 0915	190	0.	*	21 FEB 0400	265	0.		
18 FEB 2000	41	9.	*	19 FEB 1445	116	0.	*	20 FEB 0930	191	0.	*	21 FEB 0415	266	0.		
18 FEB 2015	42	8.	*	19 FEB 1500	117	0.	*	20 FEB 0945	192	0.	*	21 FEB 0430	267	0.		
18 FEB 2030	43	8.	*	19 FEB 1515	118	0.	*	20 FEB 1000	193	0.	*	21 FEB 0445	268	0.		
18 FEB 2045	44	8.	*	19 FEB 1530	119	0.	*	20 FEB 1015	194	0.	*	21 FEB 0500	269	0.		
18 FEB 2100	45	8.	*	19 FEB 1545	120	0.	*	20 FEB 1030	195	0.	*	21 FEB 0515	270	0.		
18 FEB 2115	46	8.	*	19 FEB 1600	121	0.	*	20 FEB 1045	196	0.	*	21 FEB 0530	271	0.		
18 FEB 2130	47	8.	*	19 FEB 1615	122	0.	*	20 FEB 1100	197	0.	*	21 FEB 0545	272	0.		
18 FEB 2145	48	8.	*	19 FEB 1630	123	0.	*	20 FEB 1115	198	0.	*	21 FEB 0600	273	0.		
18 FEB 2200	49	8.	*	19 FEB 1645	124	0.	*	20 FEB 1130	199	0.	*	21 FEB 0615	274	0.		
18 FEB 2215	50	8.	*	19 FEB 1700	125	0.	*	20 FEB 1145	200	0.	*	21 FEB 0630	275	0.		
18 FEB 2230	51	8.	*	19 FEB 1715	126	0.	*	20 FEB 1200	201	0.	*	21 FEB 0645	276	0.		
18 FEB 2245	52	8.	*	19 FEB 1730	127	0.	*	20 FEB 1215	202	0.	*	21 FEB 0700	277	0.		
18 FEB 2300	53	8.	*	19 FEB 1745	128	0.	*	20 FEB 1230	203	0.	*	21 FEB 0715	278	0.		
18 FEB 2315	54	7.	*	19 FEB 1800	129	0.	*	20 FEB 1245	204	0.	*	21 FEB 0730	279	0.		
18 FEB 2330	55	7.	*	19 FEB 1815	130	0.	*	20 FEB 1300	205	0.	*	21 FEB 0745	280	0.		
18 FEB 2345	56	7.	*	19 FEB 1830	131	0.	*	20 FEB 1315	206	0.	*	21 FEB 0800	281	0.		
19 FEB 0000	57	7.	*	19 FEB 1845	132	0.	*	20 FEB 1330	207	0.	*	21 FEB 0815	282	0.		
19 FEB 0015	58	7.	*	19 FEB 1900	133	0.	*	20 FEB 1345	208	0.	*	21 FEB 0830	283	0.		
19 FEB 0030	59	7.	*	19 FEB 1915	134	0.	*	20 FEB 1400	209	0.	*	21 FEB 0845	284	0.		
19 FEB 0045	60	7.	*	19 FEB 1930	135	0.	*	20 FEB 1415	210	0.	*	21 FEB 0900	285	0.		
19 FEB 0100	61	6.	*	19 FEB 1945	136	0.	*	20 FEB 1430	211	0.	*	21 FEB 0915	286	0.		
19 FEB 0115	62	6.	*	19 FEB 2000	137	0.	*	20 FEB 1445	212	0.	*	21 FEB 0930	287	0.		
19 FEB 0130	63	5.	*	19 FEB 2015	138	0.	*	20 FEB 1500	213	0.	*	21 FEB 0945	288	0.		
19 FEB 0145	64	5.	*	19 FEB 2030	139	0.	*	20 FEB 1515	214	0.	*	21 FEB 1000	289	0.		
19 FEB 0200	65	5.	*	19 FEB 2045	140	0.	*	20 FEB 1530	215	0.	*	21 FEB 1015	290	0.		
19 FEB 0215	66	5.	*	19 FEB 2100	141	0.	*	20 FEB 1545	216	0.	*	21 FEB 1030	291	0.		
19 FEB 0230	67	5.	*	19 FEB 2115	142	0.	*	20 FEB 1600	217	0.	*	21 FEB 1045	292	0.		
19 FEB 0245	68	5.	*	19 FEB 2130	143	0.	*	20 FEB 1615	218	0.	*	21 FEB 1100	293	0.		
19 FEB 0300	69	5.	*	19 FEB 2145	144	0.	*	20 FEB 1630	219	0.	*	21 FEB 1115	294	0.		
19 FEB 0315	70	5.	*	19 FEB 2200	145	0.	*	20 FEB 1645	220	0.	*	21 FEB 1130	295	0.		
19 FEB 0330	71	5.	*	19 FEB 2215	146	0.	*	20 FEB 1700	221	0.	*	21 FEB 1145	296	0.		
19 FEB 0345	72	5.	*	19 FEB 2230	147	0.	*	20 FEB 1715	222	0.	*	21 FEB 1200	297	0.		
19 FEB 0400	73	5.	*	19 FEB 2245	148	0.	*	20 FEB 1730	223	0.	*	21 FEB 1215	298	0.		
19 FEB 0415	74	5.	*	19 FEB 2300	149	0.	*	20 FEB 1745	224	0.	*	21 FEB 1230	299	0.		
19 FEB 0430	75	5.	*	19 FEB 2315	150	0.	*	20 FEB 1800	225	0.	*	21 FEB 1245	300	0.		
			*				*				*					

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
(CFS)	(HR)		6-HR	24-HR	72-HR	74.75-HR
480.	5.75	(CFS)	57.	17.	6.	5.
		(INCHES)	1.492	1.786	1.786	1.786
		(AC-FT)	28.	34.	34.	34.

CUMULATIVE AREA = 0.35 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	A	201.	5.75	26.	8.	3.	0.16		
HYDROGRAPH AT	B	138.	5.75	15.	5.	2.	0.09		
HYDROGRAPH AT	C	94.	5.75	10.	3.	1.	0.06		
HYDROGRAPH AT	D	46.	5.75	5.	2.	1.	0.03		
4 COMBINED AT	E	480.	5.75	57.	17.	6.	0.35		

*** NORMAL END OF HEC-1 ***

HEC1 S/N: 1906330095 HMVersion: 6.30 Data File: REV100yr.hc1

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*           VERSION 4.0.1E              *
*                                       *
*  RUN DATE  02/18/1997  TIME  16:52:22 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

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

```
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::         Haestad Methods, Inc.        :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1       ID      NEWPORT TECH CENTER MDDP (Rev #1 to include 15.4 acres of Sand Creek)
  2       ID      DEVELOPED RUNOFF W/ NO DETENTION/ SUMMARY OF FLOWS @ FOUNTAIN BLVD
  3       ID      100 YR/ 24 HR STORM = 4.6"  (REV100YR.HC1)
  4       IT    15 18FEB97    1000     300
  5       IO     5       0       0

  6       KK      A     POWERS BLVD DRAINGE SYSTEM
  7       KM      BASIN RUNOFF FOR PF1,2,3,4,5,6,12,23,SC1(part),SC2(Part)
  8       BA  0.1624
  9       PB    4.6
 10       IN     15
 11       PC  .0005   .0015   .0030   .0045   .0060   .0080   .0100   .0120   .0143   .0165
 12       PC  .0188   .0210   .0233   .0255   .0278   .0320   .0390   .0460   .0530   .0600
 13       PC  .0750   .1000   .4000   .7000   .7250   .7500   .7650   .7800   .7900   .8000
 14       PC  .8100   .8200   .8250   .8300   .8350   .8400   .8450   .8500   .8550   .8600
 15       PC  .8638   .8675   .8713   .8750   .8788   .8825   .8863   .8900   .8938   .8975
 16       PC  .9013   .9050   .9083   .9115   .9148   .9180   .9210   .9240   .9270   .9300
 17       PC  .9325   .9350   .9375   .9400   .9425   .9450   .9475   .9500   .9525   .9550
 18       PC  .9575   .9600   .9625   .9650   .9675   .9700   .9725   .9750   .9775   .9800
 19       PC  .9813   .9825   .9838   .9850   .9863   .9875   .9888   .9900   .9913   .9925
 20       PC  .9938   .9950   .9963   .9975   .9988  1.0000
 21       LS            92
 22       UD   0.20

 23       KK      B     NORTH NEWPORT ROAD DRAINAGE SYSTEM
 24       KM      BASIN RUNOFF FOR PF 7,8,9,10,11
 25       BA  0.0944
 26       LS            92
 27       UD  0.1240

 28       KK      C     VAPOR TRAIL DRAINAGE SYSTEM
 29       KM      BASIN RUNOFF FROM PF 14,15,16,17,18,20
 30       BA  0.0645
 31       LS            92
 32       UD  0.1260

 33       KK      D     AVIATION WAY(WEST SIDE) DRAINAGE SYSTEM
 34       KM      BASIN RUNOFF FROM PF 19,21,22
 35       BA  0.0317
 36       LS            92
 37       UD  0.1210

 38       KK      E     COMBINED FLOWS @ FOUNTAIN BLVD CROSSING
 39       KO      1                              21
 40       KM      COMBINED FLOWS FROM ALL PROPOSED DRAINAGE FACILITIES
 41       HC      4
 42       ZZ
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*           VERSION 4.0.1E              *
*                                       *
*  RUN DATE  **/**/1997  TIME  00:00:** *
*                                       *
*****************************************
```


```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*         609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```


NEWPORT TECH CENTER MDDP (Rev #1 to include 15.4 acres of Sand Creek)
DEVELOPED RUNOFF W/ NO DETENTION/ SUMMARY OF FLOWS @ FOUNTAIN BLVD
100 YR/ 24 HR STORM = 4.6" (REV100YR.HC1)

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	15	MINUTES IN COMPUTATION INTERVAL
IDATE	18FEB97	STARTING DATE
ITIME	1000	STARTING TIME
NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	21FEB97	ENDING DATE
NDTIME	1245	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL 0.25 HOURS
TOTAL TIME BASE 74.75 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

*** ***

```
**************
*            *
*          E *
*            *
**************
```

38 KK COMBINED FLOWS @ FOUNTAIN BLVD CROSSING

39 KO OUTPUT CONTROL VARIABLES

IPRNT	1	PRINT CONTROL

IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE
IPNCH	0	PUNCH COMPUTED HYDROGRAPH
IOUT	21	SAVE HYDROGRAPH ON THIS UNIT
ISAV1	1	FIRST ORDINATE PUNCHED OR SAVED
ISAV2	300	LAST ORDINATE PUNCHED OR SAVED
TIMINT	0.250	TIME INTERVAL IN HOURS

COMBINED FLOWS FROM ALL PROPOSED DRAINAGE FACILITIES

41 HC HYDROGRAPH COMBINATION

ICOMP 4 NUMBER OF HYDROGRAPHS TO COMBINE

***

HYDROGRAPH AT STATION E

SUM OF 4 HYDROGRAPHS

DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
18 FEB 1000	1	0.	*	19 FEB 0445	76	10.	*	19 FEB 2330	151	0.	*	20 FEB 1815	226	0.
18 FEB 1015	2	0.	*	19 FEB 0500	77	10.	*	19 FEB 2345	152	0.	*	20 FEB 1830	227	0.
18 FEB 1030	3	0.	*	19 FEB 0515	78	10.	*	20 FEB 0000	153	0.	*	20 FEB 1845	228	0.
18 FEB 1045	4	0.	*	19 FEB 0530	79	10.	*	20 FEB 0015	154	0.	*	20 FEB 1900	229	0.
18 FEB 1100	5	0.	*	19 FEB 0545	80	10.	*	20 FEB 0030	155	0.	*	20 FEB 1915	230	0.
18 FEB 1115	6	0.	*	19 FEB 0600	81	7.	*	20 FEB 0045	156	0.	*	20 FEB 1930	231	0.
18 FEB 1130	7	0.	*	19 FEB 0615	82	5.	*	20 FEB 0100	157	0.	*	20 FEB 1945	232	0.
18 FEB 1145	8	0.	*	19 FEB 0630	83	5.	*	20 FEB 0115	158	0.	*	20 FEB 2000	233	0.
18 FEB 1200	9	0.	*	19 FEB 0645	84	5.	*	20 FEB 0130	159	0.	*	20 FEB 2015	234	0.
18 FEB 1215	10	0.	*	19 FEB 0700	85	5.	*	20 FEB 0145	160	0.	*	20 FEB 2030	235	0.
18 FEB 1230	11	0.	*	19 FEB 0715	86	5.	*	20 FEB 0200	161	0.	*	20 FEB 2045	236	0.
18 FEB 1245	12	0.	*	19 FEB 0730	87	5.	*	20 FEB 0215	162	0.	*	20 FEB 2100	237	0.
18 FEB 1300	13	0.	*	19 FEB 0745	88	5.	*	20 FEB 0230	163	0.	*	20 FEB 2115	238	0.
18 FEB 1315	14	0.	*	19 FEB 0800	89	5.	*	20 FEB 0245	164	0.	*	20 FEB 2130	239	0.
18 FEB 1330	15	0.	*	19 FEB 0815	90	5.	*	20 FEB 0300	165	0.	*	20 FEB 2145	240	0.
18 FEB 1345	16	0.	*	19 FEB 0830	91	5.	*	20 FEB 0315	166	0.	*	20 FEB 2200	241	0.
18 FEB 1400	17	0.	*	19 FEB 0845	92	5.	*	20 FEB 0330	167	0.	*	20 FEB 2215	242	0.
18 FEB 1415	18	1.	*	19 FEB 0900	93	5.	*	20 FEB 0345	168	0.	*	20 FEB 2230	243	0.
18 FEB 1430	19	2.	*	19 FEB 0915	94	5.	*	20 FEB 0400	169	0.	*	20 FEB 2245	244	0.
18 FEB 1445	20	4.	*	19 FEB 0930	95	5.	*	20 FEB 0415	170	0.	*	20 FEB 2300	245	0.
18 FEB 1500	21	12.	*	19 FEB 0945	96	5.	*	20 FEB 0430	171	0.	*	20 FEB 2315	246	0.
18 FEB 1515	22	29.	*	19 FEB 1000	97	2.	*	20 FEB 0445	172	0.	*	20 FEB 2330	247	0.
18 FEB 1530	23	602.	*	19 FEB 1015	98	0.	*	20 FEB 0500	173	0.	*	20 FEB 2345	248	0.
18 FEB 1545	24	997.	*	19 FEB 1030	99	0.	*	20 FEB 0515	174	0.	*	21 FEB 0000	249	0.
18 FEB 1600	25	449.	*	19 FEB 1045	100	0.	*	20 FEB 0530	175	0.	*	21 FEB 0015	250	0.
18 FEB 1615	26	186.	*	19 FEB 1100	101	0.	*	20 FEB 0545	176	0.	*	21 FEB 0030	251	0.
18 FEB 1630	27	96.	*	19 FEB 1115	102	0.	*	20 FEB 0600	177	0.	*	21 FEB 0045	252	0.
18 FEB 1645	28	69.	*	19 FEB 1130	103	0.	*	20 FEB 0615	178	0.	*	21 FEB 0100	253	0.
18 FEB 1700	29	50.	*	19 FEB 1145	104	0.	*	20 FEB 0630	179	0.	*	21 FEB 0115	254	0.
18 FEB 1715	30	42.	*	19 FEB 1200	105	0.	*	20 FEB 0645	180	0.	*	21 FEB 0130	255	0.
18 FEB 1730	31	41.	*	19 FEB 1215	106	0.	*	20 FEB 0700	181	0.	*	21 FEB 0145	256	0.
18 FEB 1745	32	40.	*	19 FEB 1230	107	0.	*	20 FEB 0715	182	0.	*	21 FEB 0200	257	0.
18 FEB 1800	33	28.	*	19 FEB 1245	108	0.	*	20 FEB 0730	183	0.	*	21 FEB 0215	258	0.
18 FEB 1815	34	22.	*	19 FEB 1300	109	0.	*	20 FEB 0745	184	0.	*	21 FEB 0230	259	0.
18 FEB 1830	35	21.	*	19 FEB 1315	110	0.	*	20 FEB 0800	185	0.	*	21 FEB 0245	260	0.
18 FEB 1845	36	20.	*	19 FEB 1330	111	0.	*	20 FEB 0815	186	0.	*	21 FEB 0300	261	0.

18 FEB 1900	37	20.	*	19 FEB 1345	112	0.	*	20 FEB 0830	187	0.	*	21 FEB 0315	262	0.
18 FEB 1915	38	20.	*	19 FEB 1400	113	0.	*	20 FEB 0845	188	0.	*	21 FEB 0330	263	0.
18 FEB 1930	39	20.	*	19 FEB 1415	114	0.	*	20 FEB 0900	189	0.	*	21 FEB 0345	264	0.
18 FEB 1945	40	20.	*	19 FEB 1430	115	0.	*	20 FEB 0915	190	0.	*	21 FEB 0400	265	0.
18 FEB 2000	41	17.	*	19 FEB 1445	116	0.	*	20 FEB 0930	191	0.	*	21 FEB 0415	266	0.
18 FEB 2015	42	16.	*	19 FEB 1500	117	0.	*	20 FEB 0945	192	0.	*	21 FEB 0430	267	0.
18 FEB 2030	43	15.	*	19 FEB 1515	118	0.	*	20 FEB 1000	193	0.	*	21 FEB 0445	268	0.
18 FEB 2045	44	15.	*	19 FEB 1530	119	0.	*	20 FEB 1015	194	0.	*	21 FEB 0500	269	0.
18 FEB 2100	45	15.	*	19 FEB 1545	120	0.	*	20 FEB 1030	195	0.	*	21 FEB 0515	270	0.
18 FEB 2115	46	15.	*	19 FEB 1600	121	0.	*	20 FEB 1045	196	0.	*	21 FEB 0530	271	0.
18 FEB 2130	47	15.	*	19 FEB 1615	122	0.	*	20 FEB 1100	197	0.	*	21 FEB 0545	272	0.
18 FEB 2145	48	15.	*	19 FEB 1630	123	0.	*	20 FEB 1115	198	0.	*	21 FEB 0600	273	0.
18 FEB 2200	49	15.	*	19 FEB 1645	124	0.	*	20 FEB 1130	199	0.	*	21 FEB 0615	274	0.
18 FEB 2215	50	15.	*	19 FEB 1700	125	0.	*	20 FEB 1145	200	0.	*	21 FEB 0630	275	0.
18 FEB 2230	51	15.	*	19 FEB 1715	126	0.	*	20 FEB 1200	201	0.	*	21 FEB 0645	276	0.
18 FEB 2245	52	15.	*	19 FEB 1730	127	0.	*	20 FEB 1215	202	0.	*	21 FEB 0700	277	0.
18 FEB 2300	53	14.	*	19 FEB 1745	128	0.	*	20 FEB 1230	203	0.	*	21 FEB 0715	278	0.
18 FEB 2315	54	13.	*	19 FEB 1800	129	0.	*	20 FEB 1245	204	0.	*	21 FEB 0730	279	0.
18 FEB 2330	55	13.	*	19 FEB 1815	130	0.	*	20 FEB 1300	205	0.	*	21 FEB 0745	280	0.
18 FEB 2345	56	13.	*	19 FEB 1830	131	0.	*	20 FEB 1315	206	0.	*	21 FEB 0800	281	0.
19 FEB 0000	57	13.	*	19 FEB 1845	132	0.	*	20 FEB 1330	207	0.	*	21 FEB 0815	282	0.
19 FEB 0015	58	12.	*	19 FEB 1900	133	0.	*	20 FEB 1345	208	0.	*	21 FEB 0830	283	0.
19 FEB 0030	59	12.	*	19 FEB 1915	134	0.	*	20 FEB 1400	209	0.	*	21 FEB 0845	284	0.
19 FEB 0045	60	12.	*	19 FEB 1930	135	0.	*	20 FEB 1415	210	0.	*	21 FEB 0900	285	0.
19 FEB 0100	61	11.	*	19 FEB 1945	136	0.	*	20 FEB 1430	211	0.	*	21 FEB 0915	286	0.
19 FEB 0115	62	10.	*	19 FEB 2000	137	0.	*	20 FEB 1445	212	0.	*	21 FEB 0930	287	0.
19 FEB 0130	63	10.	*	19 FEB 2015	138	0.	*	20 FEB 1500	213	0.	*	21 FEB 0945	288	0.
19 FEB 0145	64	10.	*	19 FEB 2030	139	0.	*	20 FEB 1515	214	0.	*	21 FEB 1000	289	0.
19 FEB 0200	65	10.	*	19 FEB 2045	140	0.	*	20 FEB 1530	215	0.	*	21 FEB 1015	290	0.
19 FEB 0215	66	10.	*	19 FEB 2100	141	0.	*	20 FEB 1545	216	0.	*	21 FEB 1030	291	0.
19 FEB 0230	67	10.	*	19 FEB 2115	142	0.	*	20 FEB 1600	217	0.	*	21 FEB 1045	292	0.
19 FEB 0245	68	10.	*	19 FEB 2130	143	0.	*	20 FEB 1615	218	0.	*	21 FEB 1100	293	0.
19 FEB 0300	69	10.	*	19 FEB 2145	144	0.	*	20 FEB 1630	219	0.	*	21 FEB 1115	294	0.
19 FEB 0315	70	10.	*	19 FEB 2200	145	0.	*	20 FEB 1645	220	0.	*	21 FEB 1130	295	0.
19 FEB 0330	71	10.	*	19 FEB 2215	146	0.	*	20 FEB 1700	221	0.	*	21 FEB 1145	296	0.
19 FEB 0345	72	10.	*	19 FEB 2230	147	0.	*	20 FEB 1715	222	0.	*	21 FEB 1200	297	0.
19 FEB 0400	73	10.	*	19 FEB 2245	148	0.	*	20 FEB 1730	223	0.	*	21 FEB 1215	298	0.
19 FEB 0415	74	10.	*	19 FEB 2300	149	0.	*	20 FEB 1745	224	0.	*	21 FEB 1230	299	0.
19 FEB 0430	75	10.	*	19 FEB 2315	150	0.	*	20 FEB 1800	225	0.	*	21 FEB 1245	300	0.
			*				*				*			

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
(CFS)	(HR)		6-HR	24-HR	72-HR	74.75-HR
997.	5.75	(CFS)	119.	35.	12.	11.
		(INCHES)	3.128	3.699	3.699	3.699
		(AC-FT)	59.	70.	70.	70.

CUMULATIVE AREA = 0.35 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	A	426.	5.75	55.	16.	5.	0.16		
HYDROGRAPH AT	B	283.	5.75	32.	9.	3.	0.09		
HYDROGRAPH AT	C	193.	5.75	22.	6.	2.	0.06		
HYDROGRAPH AT	D	95.	5.75	11.	3.	1.	0.03		
4 COMBINED AT	E	997.	5.75	119.	35.	12.	0.35		

*** NORMAL END OF HEC-1 ***

Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors

1015 Elkton Drive
Colorado Springs, Colorado 80907
(719) 531-6200

JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

Existing Flow @ 66" Pipe under Fountain Blvd

I Drainage Area

A Total Area

I.D	Usage	Area	C_5	C_{100}
A1	Vacant	0.140	0.25	0.35
A2	Developed/Vacant	46.9	0.73	0.83
B1	Vacant	26.4	0.25	0.35
B2	Developed/Vacant	44.1	0.39	0.49
C1	Vacant	60.3	0.25	0.35
C2	Vacant	47.6	0.31	0.41
		230.30	0.38_{AVE}	0.48_{AVE}

B Area South of Aeroplaza

A2	Dev/Vacant	46.9	0.73	0.83
B2	" "	44.1	0.39	0.49
C2	" "	47.6	0.31	0.41
		138.6	0.48_{AVE}	0.58_{AVE}

C Developed Area South of Aeroplaza

PF1	PF9	9.8	
	PF11	1.5	(Undeveloped portion only)
	PF12	5.2	
	PF15	5.9	
	PF16	8.1	
	PF17	7.8	
	PF18	5.9	
	PF20	9.2	
	Total	53.4 acre	$C_5 = 0.80$ $C_{100} = 0.90$

Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors

1015 Elkton Drive
Colorado Springs, Colorado 80907
(719) 531-6200

JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

II Time of Concentration

A T_c for Entire area

Overland: L=500, C=0.25, S=1.8 — T_T = 28 min

Channel: L=4500' Vel ≈ 3.5 fps — T_T = 21 min

T_c = 49 min

B T_c for Area South of Aeroplaza

Overland: L=300', C=0.95, S ≈ 2% — T_T = 2.1 min

Channel: L=550' S ≈ 2% Vel ≈ 3.5 fps — T_T = 2.6 min

Storm Sewer L=2800', Vel ≈ 12 fps — T_T = 3.9 min

T_c = 27.5 min

C. T_c for Developed Area Only

Curb & Gutter L=750' Vel=2.5 — T_T = 5.0 min

Storm Sewer L=3700' Vel ≈ 12.0 fps — T_T = 5.1 min

T_c = 10.1

III Rainfall Intensity

A I_5 = 1.7 I_{100} = 3.0

B I_5 = 2.5 I_{100} = 4.4

C I_5 = 4.0 I_{100} = 7.0

IV Runoff (Q=CIA)

A Q_5 = 0.38 * 1.7 * 236.3 = 152.6 cfs Q_{100} = 0.48 * 3.0 * 236.3 = 340.3 cfs

B Q_5 = 0.48 * 2.5 * 138.6 = 166.3 cfs Q_{100} = 0.58 * 4.4 * 138.6 = 353.7 cfs

C. Q_5 = 0.80 * 4.0 * 53.4 = 170.9 cfs Q_{100} = 0.90 * 7.0 * 53.4 = 336.4 cfs

V Summary

Runoff from the undeveloped parcels north of Aeroplaza do not significantly impact the total runoff amount. The controlling flows are from conditions B or C.

Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors

1015 Elkton Drive
Colorado Springs, Colorado 80907
(719) 531-6200

JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

I Fountain Blvd Facilities

A. Existing Facility = 66" RCP
C/CS criteria: No overtopping of road w/ 100 year storm
HW to Depth ratio ≤ 1.0
Capacity w/ no blockage = 160 cfs
Assuming Inlet Control Conditions

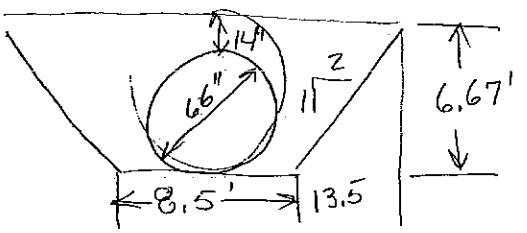
B Proposed Additional Drainage Facility
Design Flow 665 - 160 = 505 cfs

Try 6' high @ 42.5 cfs per foot 12' required
Try 8' high @ 65.0 cfs per foot 8' required

C. Proposed Replacement Facility

Design Flow = 665 cfs
Try 8' high @ 65.0 cfs = 10.2 ft use 10' Wide

D. Downstream Facilities



MEETING MINUTES

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors

1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

MEMO: Newport Tech North - MDDP
Fountain Boulevard Crossing
February 6, 1997
Project No. 96046

TO: NTA, Peter, Ray, Bill

FROM: OWA, Roland RGO

☎ VIA FAX

I received a call from Brian Kelly (Stormwater and Subdivision) this date responding to our request for deferring the open channel construction and the possibility of using those funds to assist in the construction of the crossing upgrade across Fountain Boulevard. Gary Haynes, City Engineer, had met with Bruce Thorson and Ken Sampley and Gary's decisions were as follows:

1. The City will defer construction on the channel until March 1, 1997.

2. If NTA can provide preliminary design plans of the new crossing to the City by March 1, the City will include any entrance conditions in their design/ construction of the channel

3. The City intends to construct the open channel with the $125K± cashed letter of credit starting in early March.

OWA has received design plans from the City and Water Department for current Fountain Boulevard improvements and we are proceeding with the preliminary design at this time. We confirmed with Brian that it is prudent to at least inform CDOT with a copy of the plans as they have an interest in the project, if not jurisdiction.

RGO/p
97MEMOS\96046FTN.CRS

cc: City Engineering, Brian Kelly

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors

1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

MEMO: Newport Tech North
MDDP Meeting
Project No. 96046
January 31, 1997

TO: Department of Planning, Development & Finance
Engineering Division
Attn: Gary Haynes

FROM: OWA, Roland Obering

ATTENDING:
Stormwater & Subdivision - Bruce Thorson, Brian Kelly
Capital Projects - Ken Sampley (part time), Don Sherman
Newport Tech Associates - Ray O'Sullivan, Peter Martz, Bill Nelson (SCI)
Obering, Wurth & Associates - Roland Obering

The purpose of the meeting was to discuss the Newport Tech Center-North MDDP particularly as it relates to the City's CIP project for the open improvements adjacent to and North of Fountain Boulevard and its impact on the existing/proposed Fountain Boulevard crossing. After review of background information, considerable discussion followed with regard to how the problems could be solved to the mutual benefit of the City and the Newport Center. The following summarizes decisions/conclusions reached:

1. Ken Sampley directed Don Sherman to correspond in writing with the CIP contractor indicating that the project is on hold until further notice. This will give everyone an opportunity to evaluate that project as it relates to the bigger picture in the basin and particularly to the proposed Fountain Boulevard crossing upgrade.

2. Newport Tech Associates (NTA) directed Obering, Wurth & Associates (OWA) to proceed with a preliminary design of the Fountain Boulevard crossing. The initial investigation indicated a double box culvert in the 5'x8' to 6'x10' range would be required for a total replacement (removal of the 66"). Final hydrology and hydraulics will set the final size.

   The City (Don Sherman) will provide OWA with street plans for existing Fountain Boulevard. They will also assist with record utility information, utility

design plans, and coordinate potholing of potentially affected utilities. The pothole assistance is to be confirmed.

Downstream capacities will be checked by the consultant preparing the MDDP for Newport South.

3. Bruce Thorson will check on the possibility of use of the funds the City acquired by cashing the letter of credit for Newport Filing #10 being applied toward the cost of the Fountain Boulevard crossing upgrades. It was noted that the system required in Filing No. 10 will still need to be constructed at some point in time. OWA will check with the City Street Department regarding where CDOT jurisdiction ends on Fountain Boulevard and will the crossing upgrade require CDOT review?

4. Regarding the MDDP, it was agreed that the two major improvements identified in the study, those being the Fountain Boulevard crossing and the underground system or a suitable alternative parallel to Powers Boulevard, would be considered public systems and the construction costs credited against drainage fee obligations in the Peterson Field Basin. Details will be documented in the MDDP.

5. Regarding basin boundary changes and fee impacts in both Peterson and Sand Creek as they relate to the Drainage Ordinance, it was agreed OWA would prepare a brief analysis summarizing acreage, proposed (old DBPS) facilities, and potential impact to the current basin fee amounts. Those impacts are expected to be relatively small (< $10/Ac.) and with this back-up the City staff agreed to go to the Drainage Board with the recommendation to amend the two DBPS's with the MDDP document with fee adjustments deferred until the first of the year (1998) annual adjustments.

6. It was agreed that all drainage obligations generated in the Newport Tech Center-North would first go directly to the costs of construction of the facilities mentioned in Item 4 above in order to correct the outfall deficiencies the MDDP has identified. Fees being paid by Filing No. 14 (Minco) will be escrowed for assistance in funding the new crossing as well.

7. OWA will investigate the impact of including the 15 to 17 acres adjacent to Sand Creek at the North end of Newport Tech North in the Peterson Basin. Those drainage fees would then be available to the Peterson basin for hopefully a small increase to the Powers Boulevard outfall system and the Fountain Boulevard crossing.

8. The MDDP will formalize all of these decisions reached. OWA would anticipate completing the preliminary crossing design, cost/area analysis, and Sand Creek additional acreage in the next 30 calendar days.

Gary, thank you for making your staff available on short notice to discuss these rather complicated issues. We have reached some important decisions with regard to the Newport Tech-North drainage problems and this will allow NTA to proceed with planning of necessary systems and upgrades to solve the problems so development North of Fountain Boulevard can continue. If you or your staff have any questions or comments regarding this meeting summary, please contact the undersigned.

Roland G. Obering RGO

RGO/p

97MEMOS\96046CTY.MTG

cc: Attendees

CITY OF COLORADO SPRINGS **ENGINEERING DIVISION**

Project: Newport Drain. Chann./Fountain Blvd. Added Culvert Sheet: 1 of _____

Calculations for: Meeting Notes - Review & Selection for Design of Added Culvert Capacity

Made by: DKH Date: 3/17/97 Checked by: _____ Date _____

Present: Ken Sumpley, Don Sherman & Brian Kelly of City Engineering; Roland Obering & Assoc. in Land Devel't Venture; Bruce Thorson-Stormwater & Subdivision Manager

Meeting: 3:40 P.M. to 4:45 P.M. at Stormwater & Subdiv. Confer. Room

Four alternate designs were reviewed for selecting a Design for Added Culvert Capacity under Fountain Blvd. to augment the existing 66" R.C.P. located 550' ± West of Newport Rd. The attached review of the four candidate schemes, done prior to the meeting, gives the main features of each. Only 2 alternates had a Cost Estimate given in our meeting:

(a) $350,000 for Alt. #2 - The plan keeping the 66" ØR.C.P. and adding 2 - 146' x 10'x6' R.C.B. having a 20° bend at 23' north of the outlet end to direct outlet flows into the path of the existing 66" pipe outflow. There was a 100-yr flood overflow open earth channel from W. of the 66" RCP ending into a riprapped approach and concrete apron having a vertical drop of approx. 6'-7' over a vertical wall (the curved north wall of the concrete channel, Newport Drainage Channel, from east of the 66" R.C.P.). No Design or Construction Services were included in the cost estimate.

(b) $150,000. for a 4th design: 2 - 72" R.C.P's angled from a concrete widened entrance, at Newport Drainage Channel at ≈ 150' east of the existing 66" R.C.P., crossing Fountain Blvd. into the east wall of the existing conc. channel. This alternative had an extension of 275' north on the 66" RCP and a small conc. apron & wing walls; also an in-coming 60" R.C.P. // to Fountain from the west, into the extension of the 66" R.C.P.

The warning was that the 2-72" R.C.P. ending into the downstream channel was overly-short and the high velocity outflow would tend to cross and flow over the west side of the downstream channel. Oscillating waves, from west side to eastside to west, etc., would result unless a longer, curving transition brought the outflows more gradually into the existing 66" R.C.P. outflow direction. No Design or Construc. Services were included in the cost estimate.

Open concrete channel was observed to be the least expensive north of Fountain Blvd. - Covered concrete pipes were less expensive as a culvert under Fountain Blvd. than concrete box culvert and would also speed up construction / be less inconvenient for public travel east and west. The optimum point for constructing

OS 149

CITY OF COLORADO SPRINGS **ENGINEERING DIVISION**

Project: Newport Drain. Chann./Fountain Blvd. Added Culvert Sheet: 2 of _____

Calculations for: Meeting Notes (contin.)

Made by: DHS Date: 3/17/92 Checked by: _____ Date _____

and to be furnished to Don Sherman for implementation of Construction to proceed on the eastern portion of Newport Channel, and to Brian Kelly for review concerning Stormwater & Subdivision requirements. Also, more of the 100-year overflow from west and north of the existing 66" R.C.P. was to be directed into an inlet arrangement directing approx. 150 to 200 c.f.s. into the 84" R.C.P.

Design by Obering/Wurth will proceed and be funded by the upstream land developer(s). The widened concrete entrance for bringing the Newport Channel flow into the two large R.C.P.'s will be designed by Obering/Wurth and will be an "add" to the Newport Channel Contract, while the portion of Newport Channel between the original ending at the 66" R.C.P. apron/headwall and the new ending will be a "delete" to that Contract. The Contractor on Newport Channel will be negotiated with for portions not falling under current contract bid items.

D.H. Sherman, P.E.

cc: Bruce Thorson – Stormwater & Subdiv.
Ken Sampley – City Engineering
Roland Obering – Obering, Wurth & Assoc.

OS 149

CITY OF COLORADO SPRINGS **ENGINEERING DIVISION**

Project: Newport Drain. Chann./Fountain Culv. Enlarge/Sheet: _____ of _____

Calculations for: O.&W.'s Proposals - Comparisons

Made by: DHP Date: 3/17/97 Checked by: _____ Date _____

① 1st Proposal: Retain 66" R.C.P., add 2-14' x 10'x6' R.C.B.
(Add 27.5' of 66" and Conn. to new 60" RCP W. of culv., // to Fountain)
Downstr. transition from 29' Bott. to 9' Bott. in 305'
Newport-Fount. Conc. Channel ≈ 35' shorter (w/aprons incl.)
Extra: Conc. Overflow Spillway for 100-yr flood Overflow N.&W.

→ Costly 305' long outlet transition
→ Maybe over-design for new rated Q's.
Southern Knights portion nearly same, probably no lawsuit-

Cost Est.:
$ (not given)

② Alt. 1: Remove 66" R.C.P. - Add 2-14' x 10'x6' R.C.B.
60" RCP from W. of 66" requires 60' long diagonal into W. Side of RCB.
The Newport-Fountain Conc. Chann. is ≈ to this version of channel.
Downstr. transition from 22' bottom & vert. sides to existing
9' bottom 2:1 sides in 110'.
Extra: Conc. Overflow Spillway for 100-yr. flood Overflow N.&W.
Southern Knights portion approx. same, probably no lawsuit
→ Could salvage 113' of 66" R.C.P.
Appears able to carry required flows

Cost Est.:
$ (Not given)

③ Alt. 2 - Retain 66" R.C.P. add 2-146' x 10' x6' R.C.B. having 20° bend at 23' N. of outlet end
(Add 8" + 27.5' = 35.5' of 66" R.C.P., conn. to new 60" W. of Culv.)
Downstr. transition from 22' bott. Sym. sides to 9' bott. in 115'.
Newport-Fountain Conc. Channel ≈ 35' shorter (w/aprons included)
Extra: Conc. Overflow Spillway for 100-yr. flood Overflow N. & W.

Southern Knights portion nearly same, probably no lawsuit.

Cost Est.
$350,000 - max.

④ Added Twin 72" R.C.P.'s / Shorter Newport-Fountain Chann. Version:

430' - 72" R.C.P. @ 1.3% - 1.4% - on diagonal into exist. E. Side of downstream conc. channel
2-84" x 72" RCP Reducers + Conc. transition 25' long to Newp. Chann.
Exist. 66" RCP Remains -
(Add 27.5' of 66" and Conn. to new 60" RCP W. of Culv.)
Newport-Fount. Chann. ≈ 155' shorter.

Extra 28' - 66" R.C.P. and small conc. flared entr./elbow with 60" RCP from W. of culv.
Short 60' long transition of E. Wall of downstr. channel
→ Southern Knights likely to sue for lost quant.'s

Cost Est.:
$ 150,000

OS 1497

Project: Fountain – Newport Drain-Added Culvert Sheet: 1 of _____

Made by: D.H.S Date: 4/1/92

To: Obering, Wurth & Assoc. Att'n: Ken Harrison

From: D. H. Sherman, Proj. Manager- City Engineering

Subject: Added Culvert Under Fountain Blvd. West of Newport Rd.

For the dialogue of Friday, March 28th that Toni Wurth had with me, we agreed that Obering, Wurth & Assoc. would proceed on Final Design of the alternate which utilizes the 72" & 66" R.C.P.'s having the 19°17'± bend for the outlet end and the two 45° bends at the north end with 84" to 72" reducer and 84" to 66" reducer aligned east-west. Toni was also going to review the combined capacities of the two new pipes plus the existing 66" R.C.P. (extended northerly and having a 66"-60" Wye to bring in the 60" R.C.P. from the west). If necessary to meet 100-year flood requirements, the new 66" would be changed to a 72" R.C.P.

The 66" R.C.P. extension of existing 66" will have the headwall with cutoff wall and the concrete apron which will have a cutoff at its upstream side. The pipe from this apron and wingwall directed southeast into the 72" R.C.P. between its 45° bends is a 36" RCP, per Toni.

At the east end of the 84" to 72"/66" reducers, 84" R.C.P.'s are set into the headwall with cutoff wall at base. A 25' long transition extends east from the headwall to the

OS 1497-93

Project: Fountain-Newport Drainage-Added Culvert Sheet: 2 of

Made by: DWH Date: 4/1/97

Newport Drainage Channel normal section, its walls transitioning from near-vertical to the 2:1 slope.

Toni informed me that the existing 66" R.C.P. is 3' farther or closer east-west than thought. Also, the vertical distance from outlet invert at the concrete channel to proposed inlet invert at the apron for the 84" pipe-ends, to assure that the two new pipes slope at ≥ 1.2% from outlet to inlet end, may result in a flat or low slope of the 25' transition. We agreed that the pipes should be kept sloped as planned, and the apron could have a lesser slope than originally shown (at 4.42%) to assure the pipes would keep as free of debris as possible.

There is also an 18" temporary R.C.P. from the transition on the east to the existing 66" R.C.P., to be plugged at the east end and removed after completion of the two new pipes and the channel downstream-end transition. Then the 60"-66" Wye and 66" extension, its headwall with cutoff, the wingwalls, and the apron and 36" auxiliary-flows connector to the 72" RCP would all be completed.

The City's current Contractor on Newport Drainage Channel is to have the 25' long transition, its headwall with cutoff, and the 84" R.C.P. single length sections added into their contract (also the 18" RCP temporary pipe) to replace

OS 1407-83

Made by: DHA Date: 4-1-97

Co./Dept.	Obering, Wirth & Assoc.	Co.	City Engin.
Phone #	531-6200	Phone #	385-5418
Fax #	531-6266	Fax #	578-6216

approximately 70 L.F. of concrete channel, the riprap section at the tributary north, the headwall and cutoff wall that were to be at the existing 66" pipe entrance, and grouted riprap over fill around that pipe's north end.

Toni agreed to prepare a realistic cost estimate on designed quantities for that portion to be given the City's current Contractor (Southern Knights, Inc.) early-on, as we need to negotiate the deletions and additions to their Contract prior to having them proceed with construction.

Lastly, Ken Sampley had me request assurances that the Developer will, in fact, pay for the added culvert construction project, as we could not provide funds for that portion, and if there are no assurances we would have to revert back to our original Newport Drainage Channel design and the existing Contract improvements. I made the request to Bruce Thorson on our needing assurances from the Developer, at Ken Sampley's request.

We look forward to an early completion of this Design with Specifications and to our receiving, early-on, the designed quantities and cost estimate for the portion to be given to the City's current Contractor.

D. H. Hamman, Proj. Mgr.

cc: Bruce Thorson, Stormwater Subdiv. Mgr.
Ken Sampley, C.E. Supervisor

CS 1497-93

CITY ENGINEERING DIVISION

CITY OF COLORADO SPRINGS

CITY OF COLORADO SPRINGS/EL PASO COUNTY

SPECIAL DRAINAGE BOARD MEETING

JULY 10, 1997 - 2:00 PM

DRAINAGE BOARD AGENDA

The City of Colorado Springs/El Paso County Drainage Board will hold a **Special Drainage Board meeting** at 2:00 PM on July 10, 1997 in the City Council Chambers, City Administration Building, 30 South Nevada Avenue.

The agenda items will be the same as intended for the regularly scheduled June 19, 1997 meeting that was canceled due to a lack of a quorum.

Item 1

Election of new Board Chairperson and Vice-Chairperson.

Item 2

Approval of the minutes of the April 17, 1997 Board Meeting. The minutes were previously mailed out.

Item 3

Approval of an amendment to the Peterson Field Drainage Basin Study that includes revising the basin boundary and incorporating additional reimbursable drainage facilities resulting in a new Drainage Basin Fee of $6160/acre, as submitted by Obering, Wurth & Associates, on behalf of Newport Tech Associates (NTA), **for Board action.** See attached information from Obering, Wurth & Associates and the City background information/recommendation.

Item 4

Open Discussion

A. Stormwater Enterprise

FOR THE CITY ENGINEER

Bruce A. Thorson

Bruce A. Thorson
Stormwater & Subdivision Manager

Stormwater and Subdivision, 101 West Costilla, Suite 113 • TEL 719-578-6212 FAX 719-578-6161
Mailing Address: Post Office Box 1575, Mail Code 1110 • Colorado Springs, Colorado 80901-1575

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

May 28, 1997
Project # 96046

Newport Technical Center (North)
Peterson Field Drainage Basin
Master Development Drainage Plan

Executive Summary

A Master Development Drainage Plan (MDDP) has been prepared by Obering, Wurth, & Associates on behalf of the Newport Tech Associates (NTA) for a portion of the Newport Technical Center-North (NTCN) lying north of Fountain Boulevard and east of Powers Boulevard adjacent to the Colorado Springs Municipal Airport. The study area now lies hydrological within the Peterson Field Drainage Basin. A portion of the study previously was contained topographically within the Sand Creek Drainage Basin.

The MDDP was required by the City Engineer as a condition of approval of Newport Filing No. 13 and No. 14. The study was conducted in accordance with current City/County Drainage Criteria and contains review recommendations of the City staff. The study identified two significant issues: 1) The existing structure crossing Fountain Boulevard is inadequate to convey the 100 year storm event even under current development conditions and 2) the construction of Powers Boulevard did not provide for stormwater management system crossings that were masterplanned for the Sand Creek Drainage Basin resulting in approximately 82 acres of Sand Creek being hydrological diverted to the Peterson Field Basin.

The MDDP has identified new hydrology, facilities, and costs associated with the deficient Fountain Boulevard crossing. The 100 year design flow at Fountain Boulevard has increased from 665 CFS to 997 CFS (a 50% increase). Facilities required to accommodate the flow at this location include a new culvert crossing system. Costs for the new crossing are estimated to be $190,455.

The MDDP has also identified new facilities and costs associated with providing a proper outfall for the former Sand Creek Basin area. The stormwater management system for the Sand Creek diversion consists of a 24"-60" storm sewer system (5yr) with manholes and inlets. A 100yr overflow swale with rock checks completes the proposed system. The current Peterson Field Master Plan includes an open concrete ditch along the lower section of this outfall route which has been credited in the new fee computations. This outfall -referred to as the Powers Boulevard System- is estimated to cost $715,270 with the credited concrete ditch estimated to cost $113,500 in 1997 dollars. Net increase to the basin for this outfall system is $601,770.

In order to restore the integrity of the Peterson Field Drainage Basin it is recommended that these additional construction costs be included in the basin fee computations and a new fee established, based on the increased costs and increased basin area. We have determined from the City's GIS data the remaining unplatted property within the Peterson Field Basin and subject to fees. The following summarizes the new fee computations:

AREA: 570(unplatted) + 82(diverted) = 652 acres

INCREASED COSTS-PUBLIC: $792,225

FEE INCREASE: $1215/acres

NEW DRAINAGE FEES: $4945(current) + $1215(addition) = $6160/acres

This is an increase of 24.6% to accommodate the two basin deficiencies that have been identified. The balance of the basin is assumed to have been developed in accordance with the DIPS. Bridge fees are proposed to remain unchanged.

Sand Creek fees would increase by approximately 0.5% as a result of the basin diversion and the reduced acreage in that basin. This is a relatively large basin (19,000 acres) so the impact is negligible. No adjustment to Sand Creek fees is proposed.

In summary, it is believed that this Peterson Field Drainage Basin Planning Study amendment and subsequent fee adjustment is appropriate and is fair and equitable to NTA, the City, and the entire basin. It is the intent of NTA, upon favorable consideration of this request, to proceed immediately with construction of the new Fountain Boulevard crossing. The Powers Boulevard System will be implemented as development of the remaining 100+ acres occurs and the system is required.

A copy of the entire MDDP is available at the office of the Consultant upon request or at the office of Stormwater & Subdivision. A vicinity map is attached for reference for the subject study area.

OBERING, WURTH & ASSOCIATES

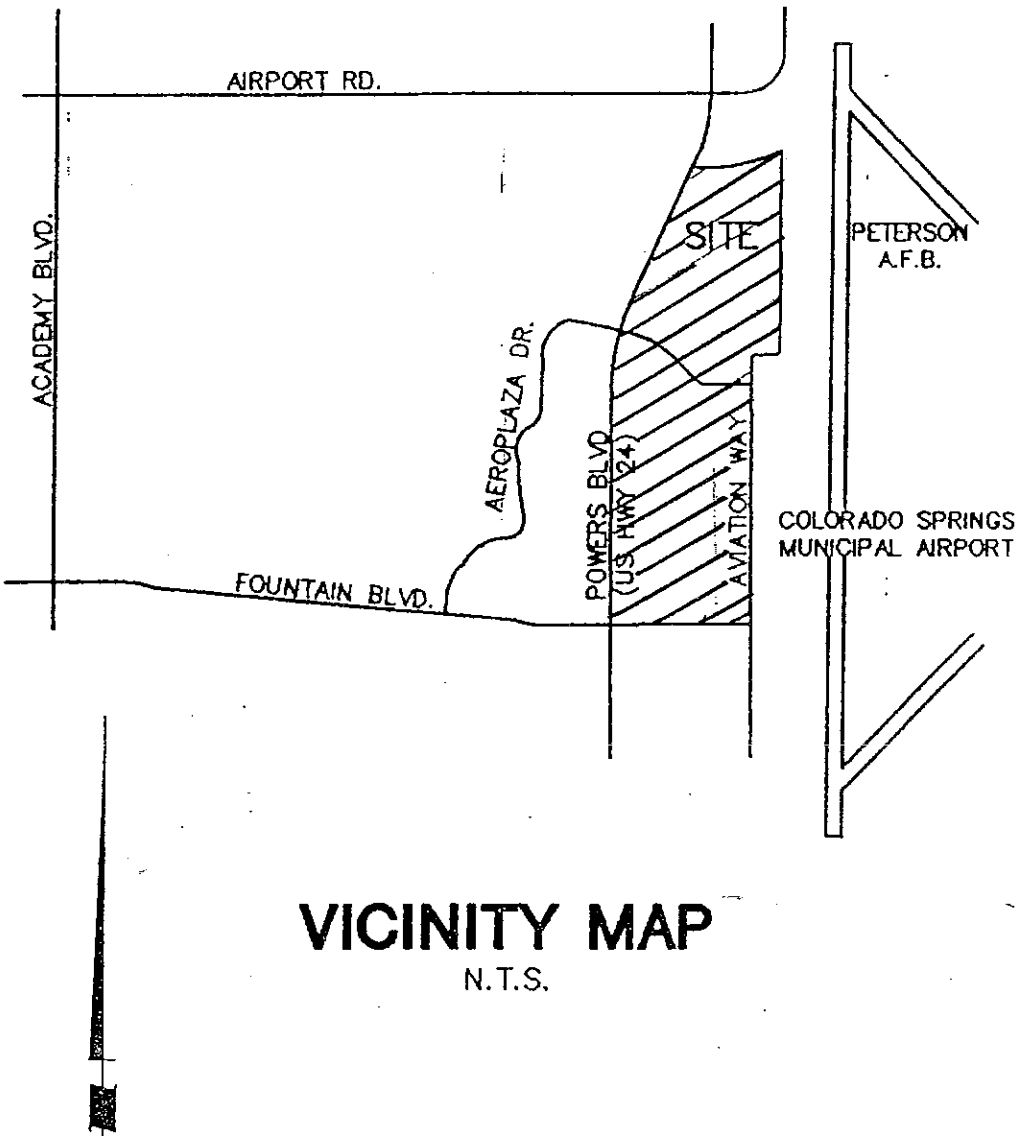
Roland G. Obering

Roland G. Obering, P.E. & P.L.S.

RGO/p

cc: City Engineering-Stormwater & Subdivision
Drainage Board Members
Newport Tech Associates

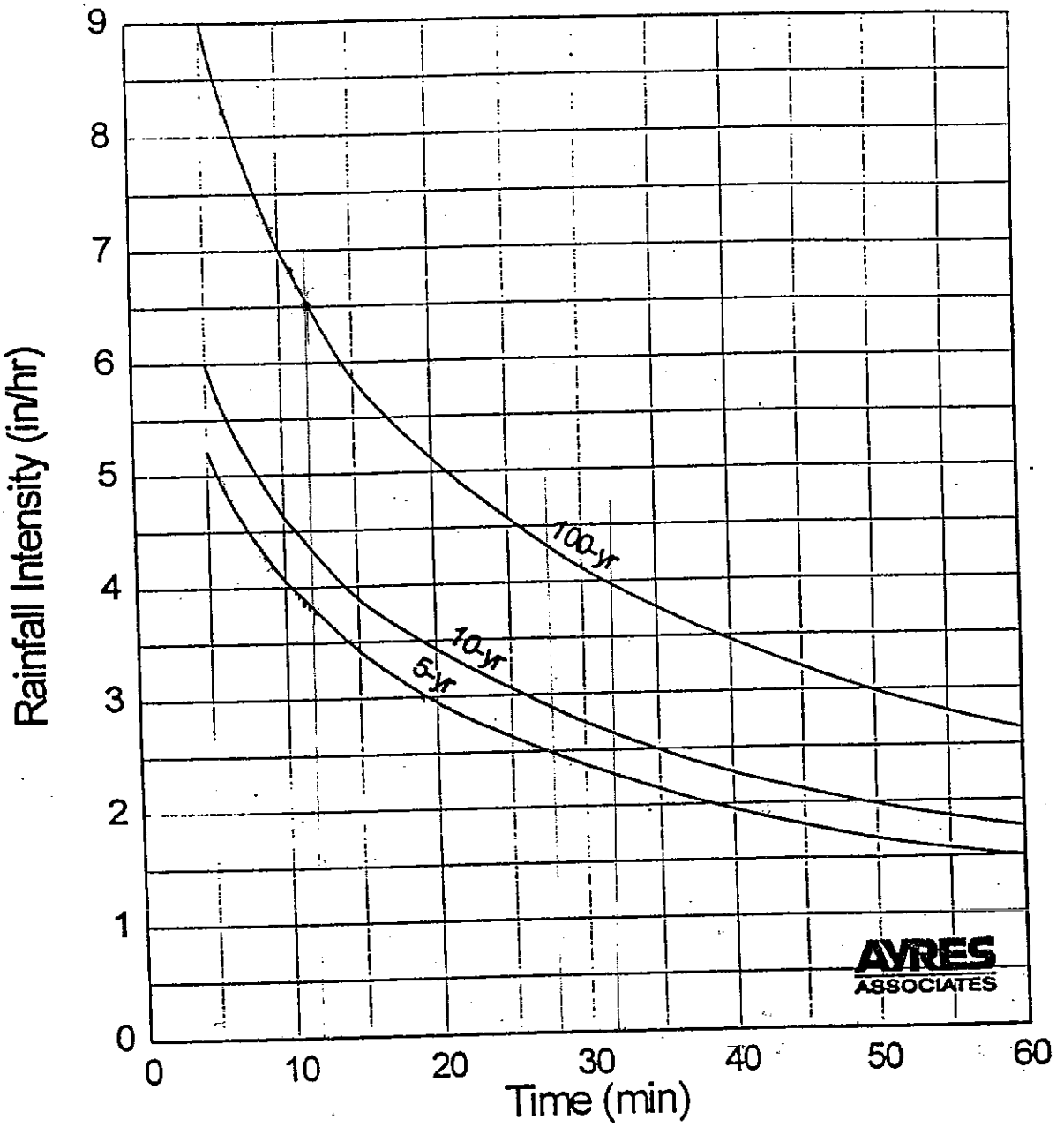
Attachment:
Vicinity Map



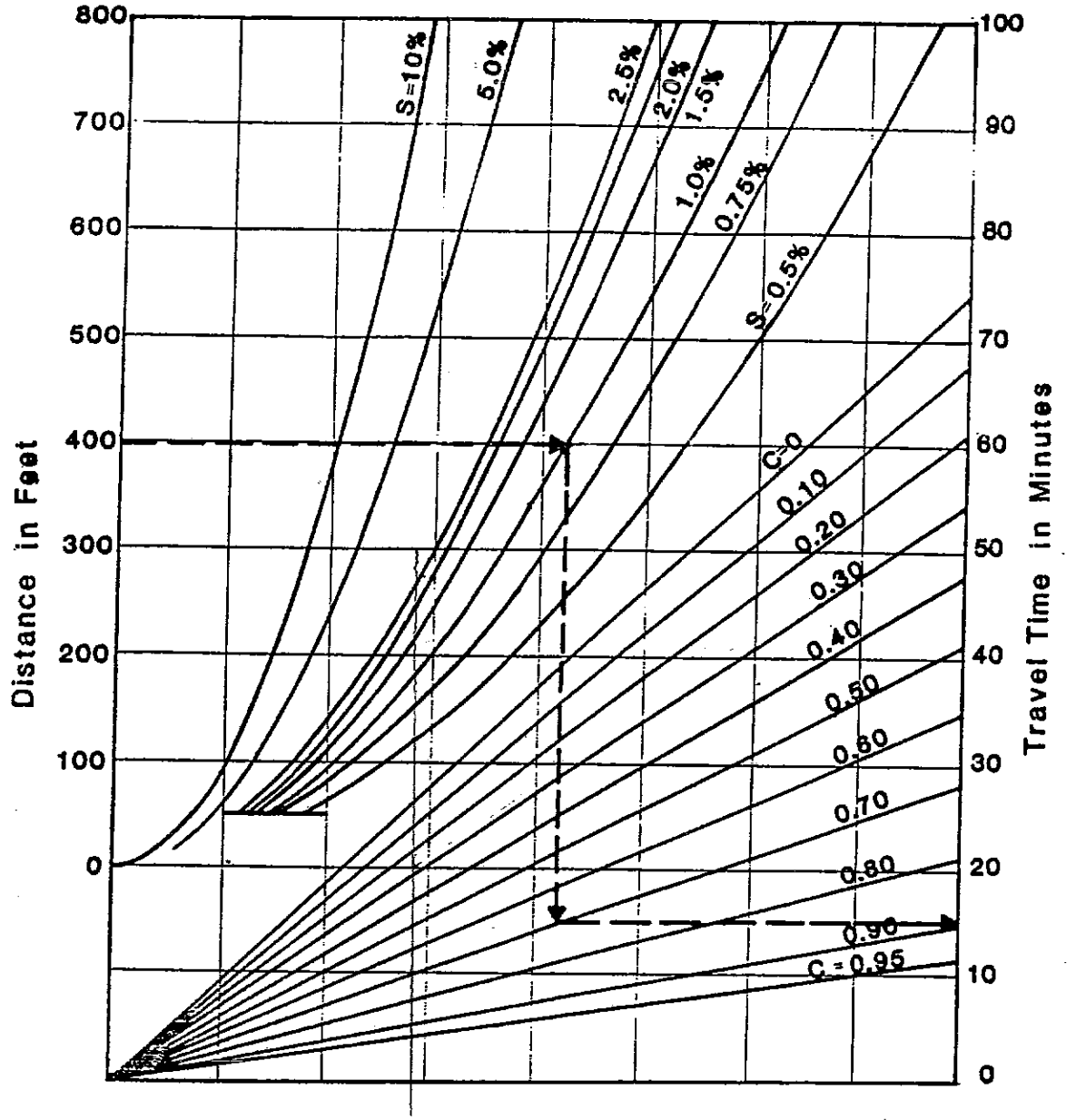
VICINITY MAP

N.T.S.

MISCELLANEOUS EXHIBITS



Interim Release October 12, 1994 , Rainfall Intensity Curves
City Of Colorado Springs Drainage Criteria Manual



REFERENCE : Wright - McLaughlin Engineers, Urban Storm Drainage Criteria Manual, Vol. 1, Denver Regional Council of Governments, Denver, Co. 1977

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Overland Flow Curves

Date
OCT. 1987

Figure
5-2

TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY 10 A&B*	"C" FREQUENCY 10 C&D*	"C" FREQUENCY 100 A&B*	"C" FREQUENCY 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