Exhibit 7

Zoning

The entire site will, at least initially, be zoned R-1-15/PUD. This permits a density of up to 2.9 units per acre and affords flexibility in lot size and setbacks which is necessary to prudently implementing The Vistas Master Plan. As individual projects are designed (and legally described) pieces of The Vistas will be rezoned where necessary to accommodate a specific project. For example, an attached housing project is not now permitted under the R-1-15/PUD classification. The plan does envision some attached homes, so in that situation the subject property will be rezoned (eg. R-2) to accommodate the project when it is proposed for development. Also, the 3.0 acre convenience center (small-scale neighborhood retail) will be zoned C-1.

Phasing

The absorption rate for the project is estimated to run from 150 to 300 homes per year. Thus, the 1,604 homes project should take five to eleven years to complete. The phasing plan (Figure 6) shows the general sequence that will be followed during the buildout of the master plan. Note the significant common area/landscaping commitment that accompanies the first phase.

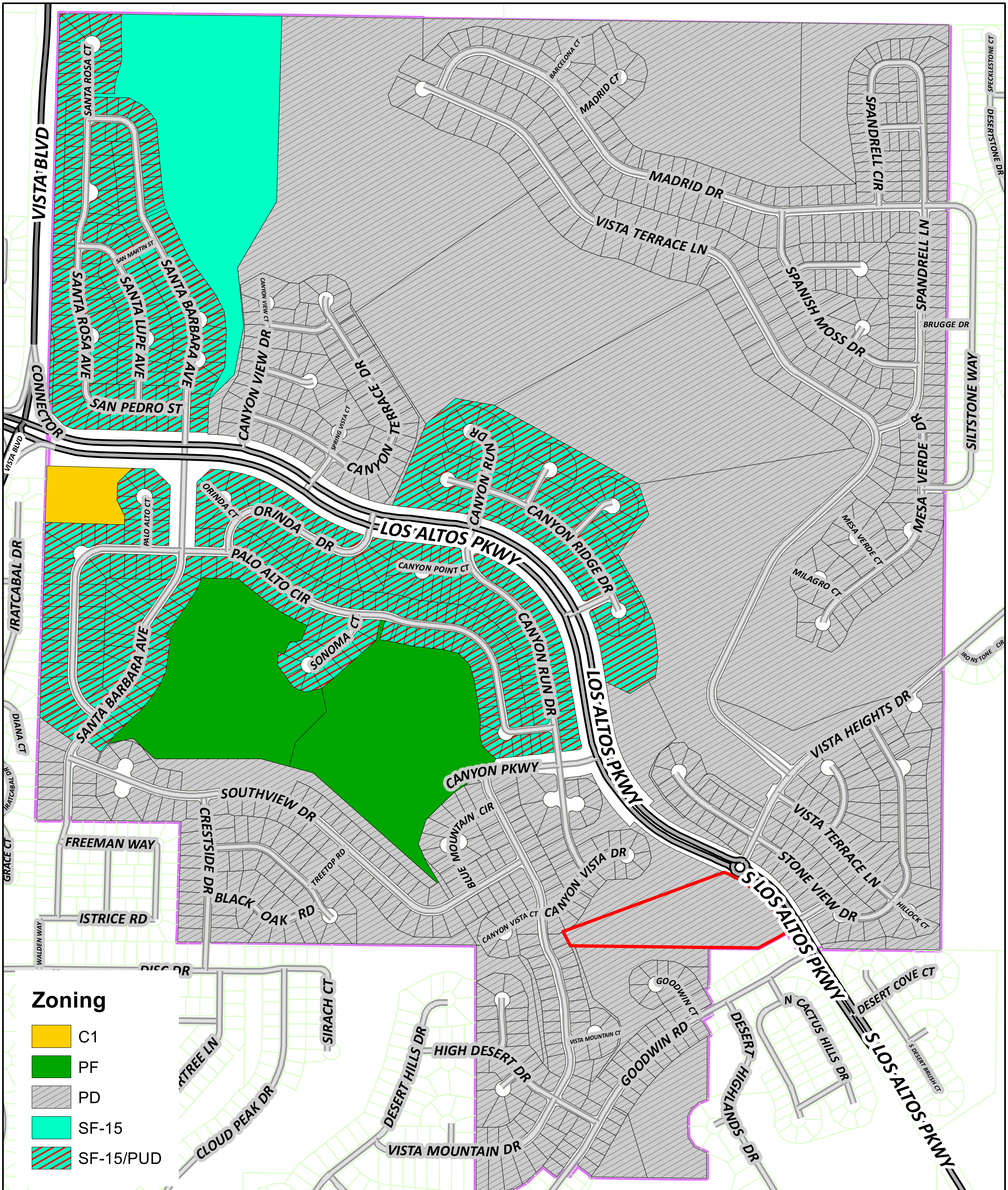
The intent of the phasing strategy presented here is to effect a balanced and efficient approach to the buildout of the project. The phasing plan is a statement of the developers' intentions related to the pattern and timing of construction. The phasing plan also permits governmental entities to undertake capital improvement and service programming. The phasing described is not "cast in concrete" -- it presents a likely and logical sequence for development of the project. Factors that will affect phasing plans include changes in interest rates, relative sales/demand for the various types of housing, the paces of individual developers of the project, and the availability of infrastructure.

The goal of the phasing is to at all times provide a mix of housing densities, types, sizes, prices and settings to the local housing market, to the extent feasible. The phasing schedule that follows shows how this mix is planned to be provided. The phasing plan strives to provide recreation facilities, shopping, services and the elementary school when justified to meet the needs of the project population and nearby residents. The phasing schedule also shows how support services are geared toward the residential buildout of the

The land use statistics for the master plan are presented in the following table:

Table #1
Land Use

Village/Plan Area	Acreage +/- (%)	Use	Density (du/ac)	Unit Yield +/-	Actual Unit Yield
1. Vista Hollow	42 (6.3)	Compact Lots	5.0	205	203 (-2)
2. Westview	44 (6.6)	UrbanLots	3.5	155	161 (+6)
3. Spring Vista	28 (4.2)	Urban Lots	3.5	100	82 (-18)
4. Canyon Vista N.	32 (4.8)	Compact Lots	5.0	160	59 (-101)
5. Canyon Vista S	11 (1.7)	Compact Lots	5.0	50	94 (+44)
6. Point Vista	26 (3.9)	Duplex	5.5	140	
7. Southview	27 (4.1)	Compact Lots	5.0	135	110 (-25)
8. Vista Village W.	5.5(0.8)	Apts./Condo.	12.0	64	
9. Park Vista	35 (5.3)	Mini-Estates	3.0	105	108 (+3)
10. City Vista	12 (1.8)	Townhomes	6.0	72	
11. Vistaridge	100(15.1)	Estates	2.4	235	
12. Vista Village E.	5.5(0.8)	Apts./Condo.	12.0	64	
13. Vista Village S.	5.5(0.8)	Apts./Condo.	12.0	64	
14. Vista Glen	18 (2.7)	Urban Lots	3.5	65	
RV Storage	4 (0.6)	RV Storage	N/A	N/A	
Fire Station	1.5(0.2)	Fire Station	N/A	N/A	
Convenience Center	3 (0.5)	Conven.Retail	N/A	N/A	
Community Center	2 (0.3)	Community	N/A	N/A	
Vista Village Park	9 (1.4)	Park	N/A	N/A	
Elementary School	5 (0.8)	School	N/A	N/A	
Major Roads	20 (3.0)	Transportation	N/A	N/A	
Open - Landscaped	16 (2.4)	Open Space	N/A	N/A	
Open - Natural	210(31.7)	Open Space	N/A	N/A	
TOTAL	662 (100)	N/A	2.4	1,614	

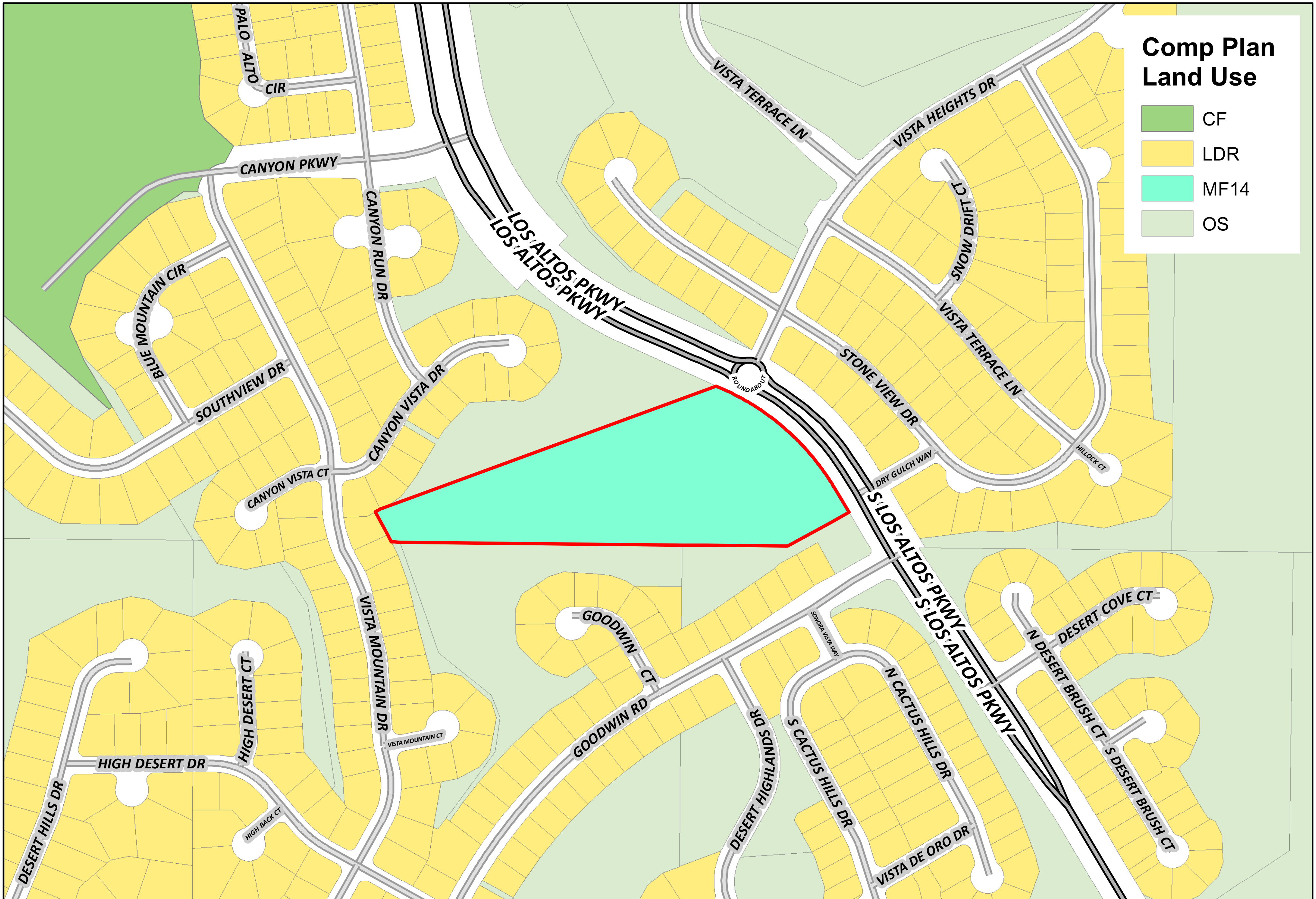


City of Sparks Community Services

PCN18-0019
Vistas Zoning Map

Exhibit 9

NOT TO SCALE



City of Sparks Community Services

PCN18-0019
Comprehensive Plan Land Use

Exhibit 10

NOT TO SCALE

REGIONAL TRANSPORTATION COMMISSION
Metropolitan Planning • Public Transportation & Operations • Engineering & Construction
Metropolitan Planning Organization of Washoe County, Nevada

May 10, 2018 FR: Chrono/PL 182-18

Ms. Karen Melby, Planner
Planning and Community Services Department
City of Sparks
431 Prater Way
Sparks, NV 89431

RE: PCN18-0017 / AX18-0001 / RZ18-0002 (Los Altos Zoning Map Amendment)

Dear Ms. Melby,

We have reviewed the subject application and have the following comments and recommendations.

Comments and Recommendations:

1. The 2040 Regional Transportation Plan (RTP) identifies Wingfield Springs Road as a collector with low-access control. To maintain arterial capacity, the following RTP access management standards should be maintained.

Access Management Standards-Arterials[1] and Collectors							
Access Management Class	Posted Speeds	Signals Per Mile and Spacing[2]	Median Type	Left From Major Street? (Spacing from signal)	Left From Minor Street or Driveway?	Right Decel Lanes at Driveways?	Driveway Spacing[3]
Low Access Control	35-40 mph	5 or less Minimum spacing 900 feet	Raised or painted w/turn pockets or undivided w/painted turn pockets or two-way, left-turn lane	Yes 350 ft. minimum	Yes	No	150 ft./200 ft.

[1] On-street parking shall not be allowed on any new arterials. Elimination of existing on-street parking shall be considered a priority for major and minor arterials operating at or below the policy level of service.
[2] Minimum signal spacing is for planning purposes only; additional analysis must be made of proposed new signals in the context of planned signalized intersections, and other relevant factors impacting corridor level of service.
[3] Minimum spacing from signalized intersections/spacing other driveways.

2. The policy Level of Service (LOS) standard for Los Altos Parkway is LOS D. Policy LOS for intersections shall be designed to provide a level of service consistent with maintaining the policy level of service of the intersection corridor. This project should be required to meet all the conditions necessary to complete road improvements to maintain policy LOS standards.

3. Additional comments may be provided once site plan has been submitted for the project that has been defined and traffic impacts have been evaluated.

PO Box 30002, Reno, NV 89520 · 1105 Terminal Way, Reno, NV 89502 · 775-348-0400 · rtcwashoe.com

4. The RTP, RTC Bicycle/Pedestrian Master Plan and the Nevada Department of Transportation Pedestrian Safety Action Plan, all indicate that new development and re-development will be encouraged to construct pedestrian and bicycle facilities, internal and/or adjacent to the development, within the regional road system. Also, these plans recommend that the applicant be required to design and construct any sidewalks along the frontage of the property in conformance with the stated ADA specifications.

Thank you for the opportunity to comment on this application. Please feel free to contact me at 775-332-0174 or email me at rkapuler@rtcwashoe.com if, you have any questions or comments.

Sincerely,

Rebecca Kapuler

Rebecca Kapuler
Planner

RK/jm

Copies: Jon Ericson, City of Sparks Public Works
Jae Pullen, Nevada Department of Transportation, District II
Daniel Doenges, Regional Transportation Commission
Tina Wu, Regional Transportation Commission
Mark Maloney, Regional Transportation Commission
Julie Masterpool, Regional Transportation Commission
David Jickling, Regional Transportation Commission

539 Los Altos Zoning Map Amendment

Exhibit 16
and Attachments

City of Sparks Community Services

To: Karen Melby, AICP – Development Services Manager

From: Jon R. Ericson, P.E., PTOE, – City Engineer

CC:

Date: July 28, 2017

Re: PCN17-0032 – Infrastructure Considerations in support of affirmation of Finding Z1

I have reviewed the staff report associated with PCN17-0032 with respect to the existing sanitary sewer, storm drain and transportation infrastructure that serves the subject site. Based upon my review, the following evidence is offered in support of finding Z1 – Master Plan Policy CF1:

Sanitary Sewer Sewer Infrastructure

Review of the City's current Sewer Model (ATKINS, November 3, 2016 as adopted by the Sparks City Council on February 27, 2017 via Resolution 3311) confirms that the subject property was included in the build out land use modeling scenario and was assigned a land use of Multi Family Residential (Figure 2-3, Atkins 2016). Additional consultation with ATKINS confirms (see attached email correspondence) that 107 multifamily units were assigned to the subject parcel in the build out land use model scenario which represents a density of 13.5 units per acre (107units/7.92 acres). The results of the build out land use model indicate that the existing sanitary sewer infrastructure in Los Altos Parkway has sufficient capacity to serve up to 107 multifamily units on the subject site (ATKINS, Figure 4-12).

Storm Drain Infrastructure

Existing storm drain facilities exist within Los Altos Parkway, adjacent to and downstream of the subject property. Review of the drainage study completed in support of the Desert Highlands Units 2 and 5 developments (Figure 3, Barker Homes 1996) indicates that developed runoff conditions for the subject site were included in the analysis and design of supporting infrastructure within Los Altos Parkway as well as other downstream facilities.

As the analysis provided in the report referenced above is dated, prior to approval of any building permits for development of the subject site, it will be incumbent upon the applicant to provide updated hydrologic and hydraulic calculations that clearly demonstrate the effects of post development runoff from the site on the existing infrastructure (SMC 17.24). Should the results of the calculations indicate that conveyance capacity of the existing storm drain infrastructure is insufficient to safely control run off from the site, it will also be incumbent upon the applicant to demonstrate mitigation. Such mitigation could include, but is not limited to, on-site detention or upsizing of the existing infrastructure.

Transportation Infrastructure

Los Altos Parkway will provide primary access to the subject site. The most recent traffic impact study of record for the area that includes the subject site was prepared by Traffic Works to support the recently approved Miramonte Townhome Development (Traffic Works, 2016). A review of the 2035 roadway analysis included in the report indicates that the subject property appears to be included in the analysis and was modeled as a developed multifamily land use (Page 11, Traffic Works, 2016). The results of the 2035 analysis conclude that Los Altos Parkway will have average daily volumes that correspond to a Level of Service C, which is in conformance with the standards of the 2035 Regional Transportation Plan (Page 4, Traffic Works 2016).

Attachments:

Email Correspondence: ATKINS and City of Sparks

Technical Drainage Study for Desert Highlands – Units 2 and 5, Barker Homes 1996.

Traffic Impact Study for Miramonte Townhome Development – Traffic Works 2016

From: "Janes, Brian" <Brian.Janes@atkinsglobal.com>
Date: July 26, 2017 at 12:05:42 PM PDT
To: "Hummel, Andy" <ahummel@cityofsparks.us>
Subject: RE: Need to check parameters on a parcel in sewer model

Andy, we do have that in as multi-family (apartment). Attached are the model details. Let me know if you need anything more specific.

Brian Janes, P.E., CFM
Project Manager, Integrated Water Resources

ATKINS

10509 Professional Circle, Suite 102, Reno, NV, 89521 | Tel: +1 (775) 828 1622 Ext. 4571831 | Direct: +1 (775) 789 9831 | Fax: +1 (775) 851 1687 |
Email: brian.janes@atkinsglobal.com | Web: www.atkinsglobal.com/northamerica www.atkinsglobal.com

From: Hummel, Andy [mailto:ahummel@cityofsparks.us]
Sent: Tuesday, July 25, 2017 6:13 PM
To: Janes, Brian <Brian.Janes@atkinsglobal.com>
Subject: Need to check parameters on a parcel in sewer model

Hey Brian –

Can you check parcel 518-150-11 in the model? Should show up as multi-family, but wanted to check.

Thanks!
Andy

Andrew Hummel, P.E.
Utility Manager
City of Sparks Community Services
775-353-2375 / 775-420-9771

Identify

Identify from: <Top-most layer>

- Future Development/Redevelopment
  - The Vistas

Location: 2,309,498.045 14,883,252.874 Feet

Field	Value
FID	26926
Shape	Polygon
APN	51815011
DU_2013	0
TOTAL_ACRE	7.695387
Sparks_LU	10
LU_Notes	
Inf_Node	
Fut_Inf_No	SSN004914
Septic	0
ADWF_MGD	0.01391
X	2309539.08625
Y	14883214.6985
UnitRate	130
Rooms	0
LU_Desc	Vacant/Undeveloped
ADWF_GPD	13910
Meter	
City	Sparks
Res	Suburban
LU_Fut_Des	Apartment
LU_Fut	4
Vacancy	1
Zoning	2
Zone_Desc	Low-Medium Density Residential
PUD	1
PUD_Name	The Vistas
DU_Approve	14
BO_DU	107
Check	1
DEV_Class	1
UC_Area	7.695356
Park_Lot	0
Notes	
Future	1
TMRPA_ID	150001
20_Yr	1
Dev_Year	2021
IS_Usage	2.2
Inf_Edit	0

TECHNICAL DRAINAGE STUDY
FOR
DESERT HIGHLANDS - UNITS 2 and 5

Prepared for:

BARKER HOMES,INC.
1955 Baring Boulevard
Sparks, Nevada 89454

Prepared by:

BARKER HOMES,INC. (Engineering Department)
1955 Baring Boulevard
Sparks, Nevada 89454

December 1996

December 1996

Mr. Scott Barnes
Engineering Services Manager
Development and Operations
City of Sparks
413 Prater Way
Sparks, NV 89431

RE: TECHNICAL DRAINAGE STUDY FOR DESERT HIGHLANDS-UNITS 2 and 5

Dear Mr. Barnes:

Submitted for your review are two copies of the *Technical Drainage Study for Desert Highlands-Units 2 and 5.*

If you have any questions, please contact me at 626-4144.

Sincerely,

Barker Homes, Inc.

Todd Gammill, E.I.T.

Karl Matzoll, P.E.

TABLE OF CONTENTS

TABLES AND FIGURES

APPENDICES

I. INTRODUCTION

This report presents the findings of a detailed evaluation of the drainage conditions at the proposed Desert Highlands Units 2 and 5 residential subdivision. The objective of this study is to establish 100-year storm and 5-year storm drainage design peak flow rates for use as the basis of design for permanent and temporary flood protection facilities, setting finish floor elevations and determination of impacts to adjacent properties.

II. GENERAL INFORMATION

A. Site Location and Description

The Desert Highlands Units 2 and 5 site is described as being within portions of the Northeast Quarter (NE1/4) of the Northeast Quarter (NE1/4) of Section 25 and the Northwest Quarter (NW1/4) of the Northwest Quarter (NW1/4), Township 20 North, Range 20 East.

The 20± acre parcels are located at the southern terminus of Los Altos Parkway, more generally north of Baring Boulevard and east of Vista Boulevard in the Pah Rah Canyon in northeast Sparks, Nevada. The site's location relative to the Reno/Sparks area is shown on **Figure 1**.

Desert Highland Units 2 and 5 will consist of single family residential homes, in addition to necessary civil improvements and amenities.

B. FEMA Floodplain Information

Figure 2 is reproduced from the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for Washoe County, Nevada and Unincorporated Areas, Community Panel Number 32031C3005 E, effective date September 30, 1994. The site is located entirely in Zone 'X', an area designated by FEMA to be outside the 500-year flood plain.

C. Rainfall and Runoff Parameters

The hydrologic analyses for offsite and onsite drainage under existing and future drainage conditions were performed using the United States Army Corps of Engineers (USACE) HEC-1 Flood Hydrograph Model

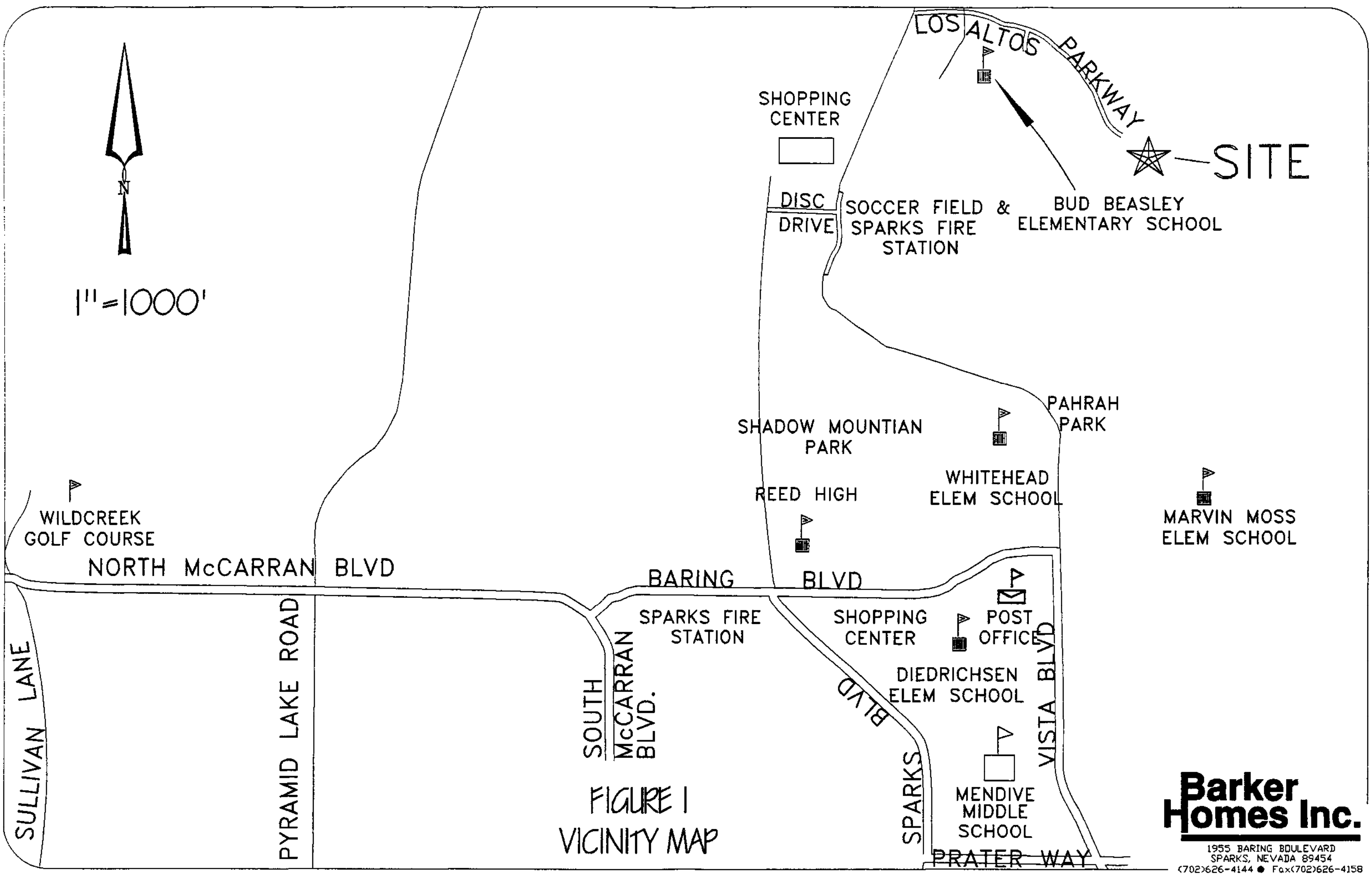
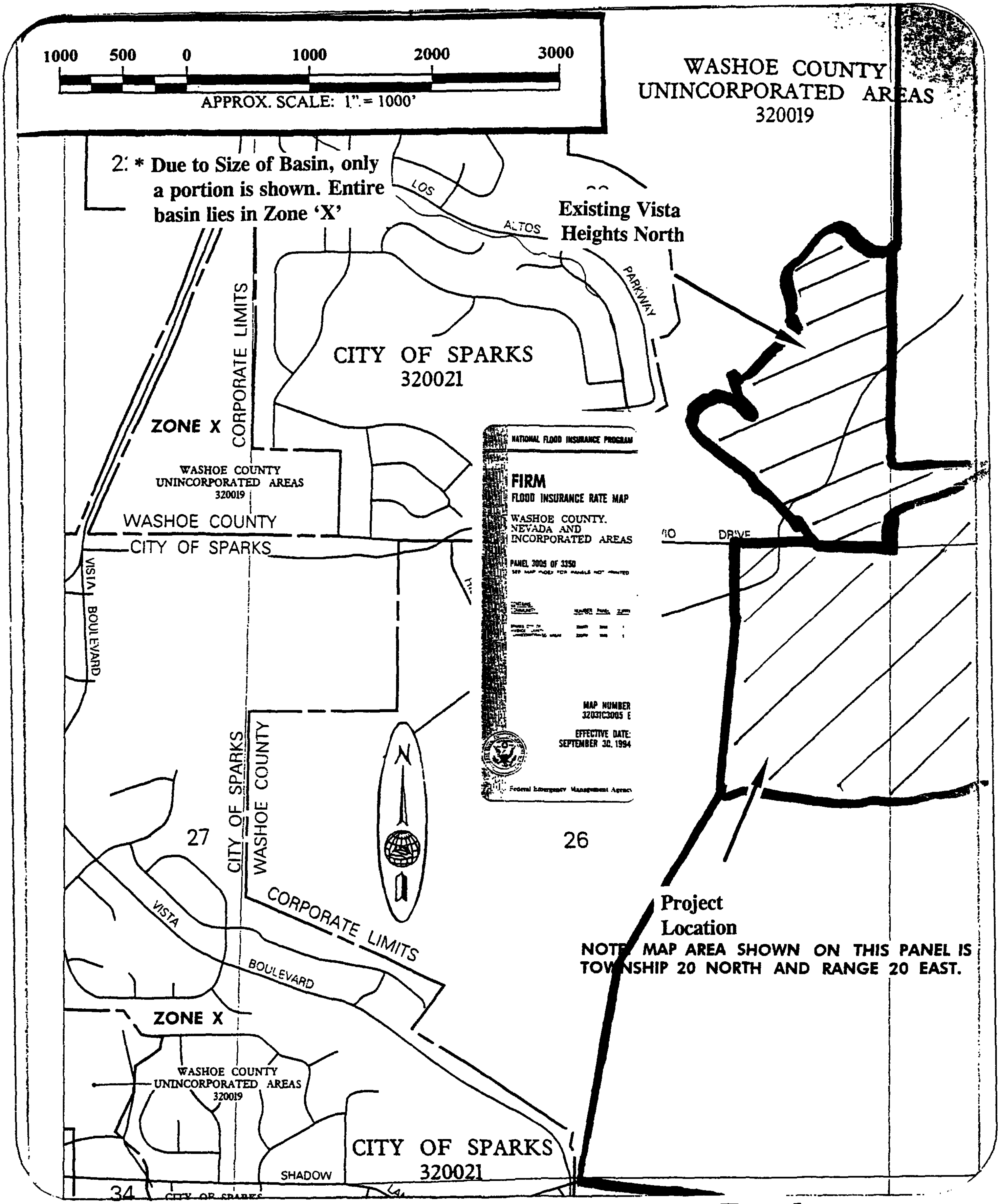


FIGURE 1
VICINITY MAP



FEMA MAP FIGURE 2

Barker Homes Inc.

1955 BARING BOULEVARD

(see **Appendix III** for applicable HEC-1 models). The rainfall and runoff data obtained for use in the HEC-1 analyses were developed using standard hydrologic techniques in addition to the guidelines given in the draft Washoe County Hydrologic Criteria and Drainage Design Manual (WCDDM, 1996). The procedures used in developing the rainfall and runoff parameters are discussed in **Appendix I**.

III. EXISTING DRAINAGE CONDITION HYDROLOGIC ANALYSIS

The drainage area analyzed for the purposes of determination of impacts made to the existing condition by development of Desert Highlands-Units 2 and 5 is shown on **Figure 3**. The basin was analyzed in previous drainage studies by WRC Engineering, Inc. of Denver, Colorado in the *Drainage Evaluation for Eastland Hills Channel* for the City of Sparks, Nevada. The majority of this drainage area is undeveloped, hilly area covered mostly by sagebrush and native grasses. The extreme northern portion of the basin is developed residential area. The hydrologic properties of this developed area were analyzed in the *Hydrology Report for Vista Ridge Unit 1 and Vista Terrace Lane* by Summit Engineering Corporation of Reno, Nevada. The methodology in the report was reviewed by Barker Homes, Inc. (Engineering Department) and referenced for this study.

A. Basin Description and Hydrologic Results

As is illustrated on **Figure 3**, the proposed Desert Highlands-Units 2 and 5 is located in the extreme northern portion of the basin just south and west of the existing Vista Ridge and Vista Heights North development. As the area of the proposed project is tributary to the entire basin shown, the entire area was analyzed to assure that the development of the project has no adverse impact on the existing condition, or if there is impact, mitigation measures can be taken.

Table 1 summarizes flow rates of interest generated by the 100-year and 5-year return period design storm with reference to the HEC-1 models and **Figure 3**:

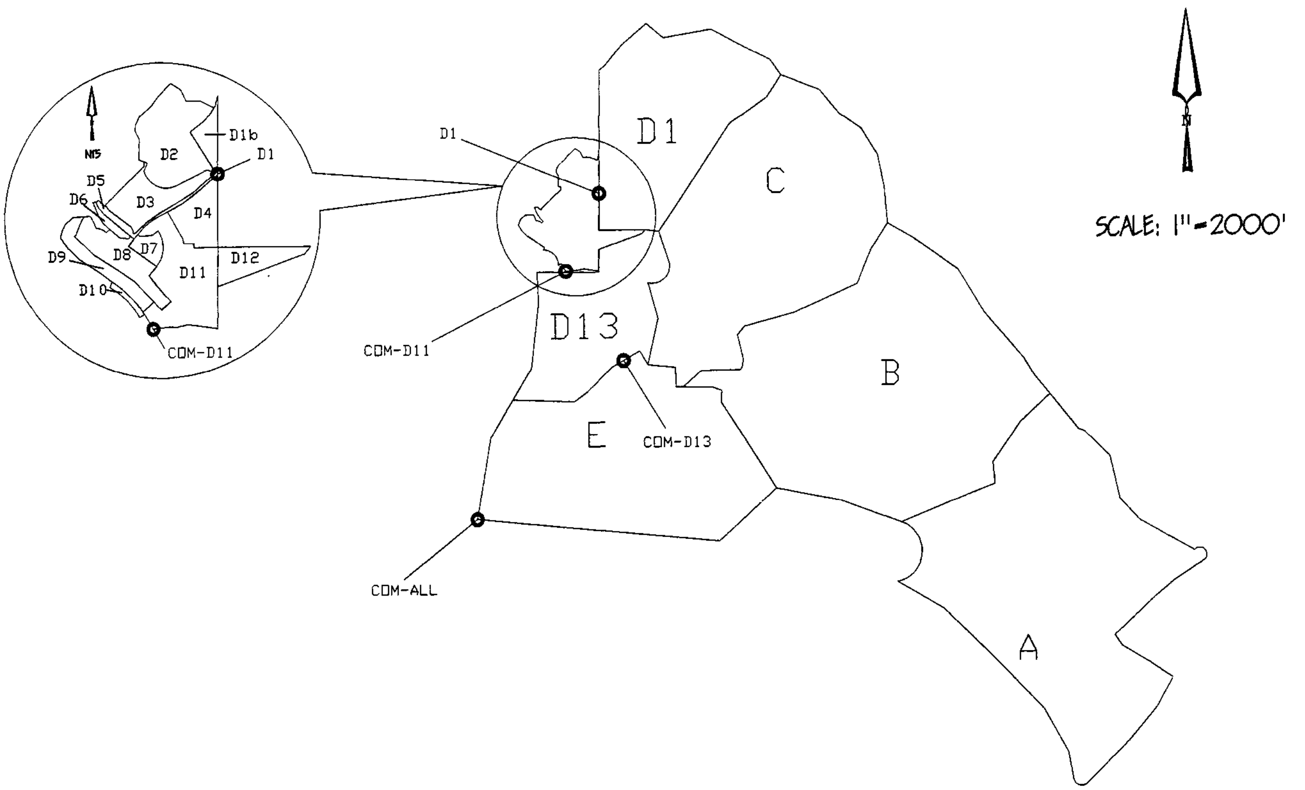


FIGURE 3
EXISTING CONDITION DRAINAGE AREA

Barker
Homes Inc.
1955 BARING BOULEVARD
SPARKS, NEVADA 89454
(702)626-4144 ● Fax(702)626-4158

Table 1 - Peak Flow Rates at Points of Interest

HEC-1 Conc. Point	Q_{100} *(cfs)*	Q_5 *(cfs)*
A	267	26
B	246	24
COM-AB	512	49
C	203	20
COM-D11	103	17
COM-D13	188	22
E	146	15
CM-ALL	990	99

B. WRC Engineering, Inc. Hydrologic Assumptions and Results

The 100-year peak flow rate at the terminus of the entire drainage basin differs from that obtained by WRC Engineering, Inc. in the *Drainage Evaluation for Eastland Hills Channel* (June 1996) by approximately 400 cfs (WRC-1367 cfs, Barker Homes, Inc.-990 cfs). The major difference between the two models lies in the selection of runoff curve numbers to model the existing basin. The WRC model utilizes a curve number of 86 to model basins A1 through A3 and a curve number of 89.3 to model basin A4 (please reference **Figure 4** for WRC basin delineation). It is the opinion of Barker Homes, Inc. that these curve numbers are overly conservative. Curve number tables as excerpted from the Soil Conservation Service (SCS) Technical Release 55 (TR-55) show curve numbers for soil type D, sagebrush with grass understory in poor condition of 85, in fair condition, 70. (Poor condition-less than 30% ground cover, Fair condition-between 30% and 70% ground cover). The curve number was chosen for this report by assuming a low percentage of ground cover within the fair condition for a curve number of 75. Generally, a decrease in curve number for a basin with equal properties will cause a corresponding decrease in peak outflow. Additionally, the basin delineation for use in HEC-1 for this report differs from the WRC model in two major ways: 1) Basin A1 in the WRC report was split into Basins A and B for this report. 2) Basin A3 in the WRC report was split into several subbasins in this report to reflect the development of Vista Heights North and Vista Ridge as outlined in the *Hydrology Report for Vista Ridge Unit 1 and Vista Terrace Lane* by Summit Engineering Corp. Both of these differences will cause a general rise in the peak outflow. Precipitation values for the two models differ as well. The 100-year, 24-hour rainfall amount used for this report is 2.66 inches,

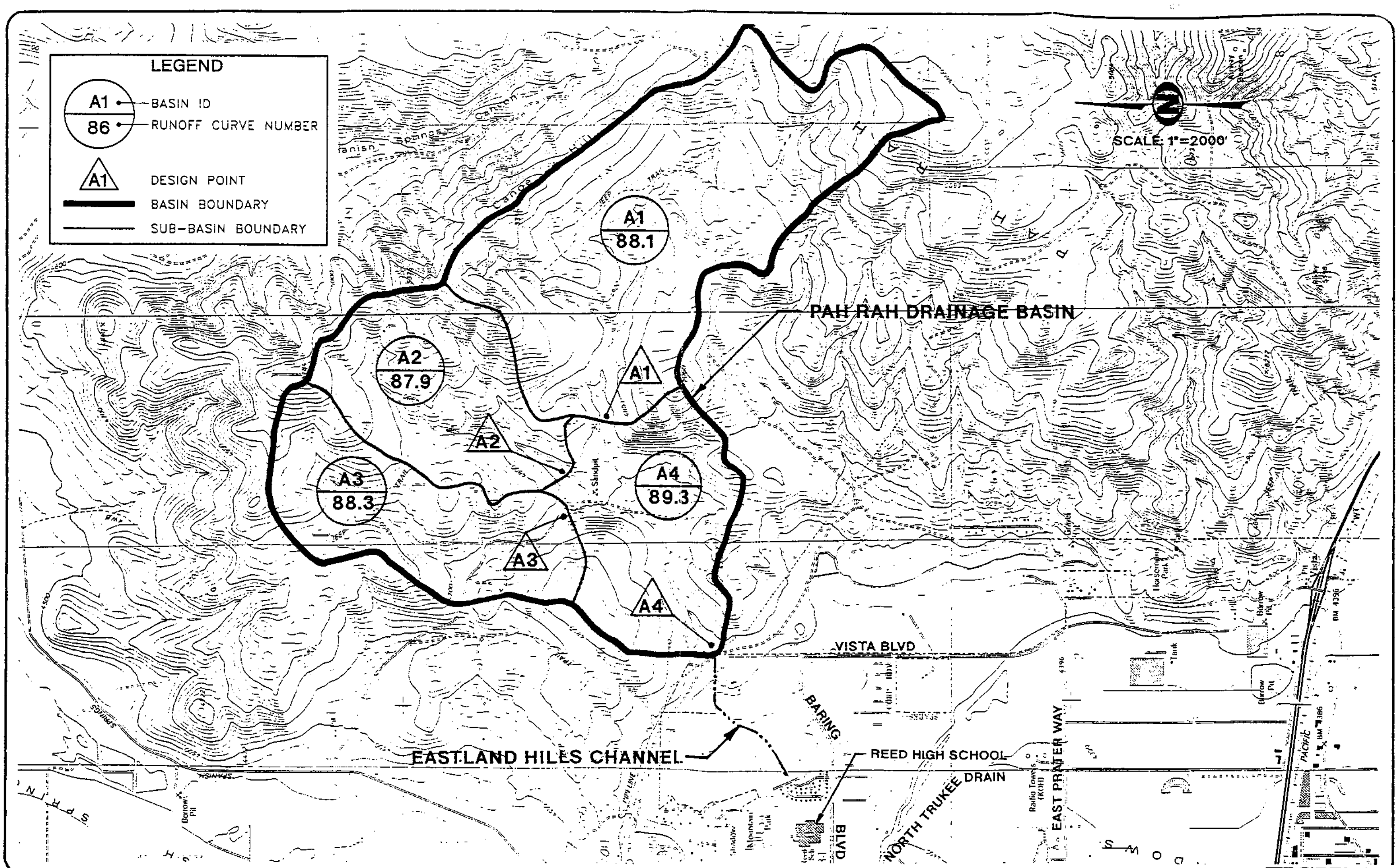


FIGURE 4

WRC | PAH RAH DETENTION BASIN | EASTLAND HILLS CHANNEL | PAH RAH DRAINAGE BASIN whereas the 100-year, 24-hour rainfall amount used by WRC is 2.40 inches. **Table 2** summarizes each model, a brief overview of the assumptions within and peak outflow:

Table 2 - Flow Rate Comparison (WRC model)

Description	*Assumptions*	Q_{100} *Peak*
WRC Model	CN's 86-89.3, 24-hr precip. 2.40 in.	1470 cfs*
WRC Model	CN's 86-89.3, 24-hr precip. 2.66 in.	1796 cfs
WRC Model	CN's 75, 24-hr precip. 2.40 in.	609 cfs
WRC Model	CN's 75, 24-hr precip. 2.66 in.	834 cfs

* This flow rate was obtained by manipulating a WRC model which includes detention basins. The detention basins were left out of the model for a flow rate of 1470 cfs, which differs only slightly from the 1367 cfs written in the *Drainage Evaluation for Eastland Hills Channel* (June 1996) and the 1400 cfs written in *Memorandum: Conceptual Cost Estimates for Drainage Improvements* (April 1996).

IV. PROPOSED DRAINAGE CONDITIONS HYDROLOGIC ANALYSIS

HEC-1 models were prepared to determine 100-year and 5-year peak flow rates for use in assessment of impact on existing conditions as well as for the purpose of sizing and location of flood control facilities assuming the development of Desert Highlands-Units 2 and 5 is complete.

A. Regional Impact of Desert Highlands-Units 2 and 5

Figure 5 depicts the basin area assumed for the post-development HEC-1 model. The 100-year and 5-year peak post-development flow rates versus pre-development flow rates at the terminus of the basin (Vista Boulevard at the existing 12 foot by 4 foot Reinforced Concrete Box [RCB] Culvert north of Baring Boulevard) are outlined in **Table 3**:

Table 3 - Flow Rate Comparison (pre vs. post development)

Description	*HEC-1 Conc. Point*	*Flow Rate (cfs)*
100-year, pre-development	CM-ALL	990 cfs
100-year, post-development	CM-ALL	971 cfs
5-year, pre-development	CM-ALL	99 cfs
5-year, post-development	CM-ALL	102 cfs

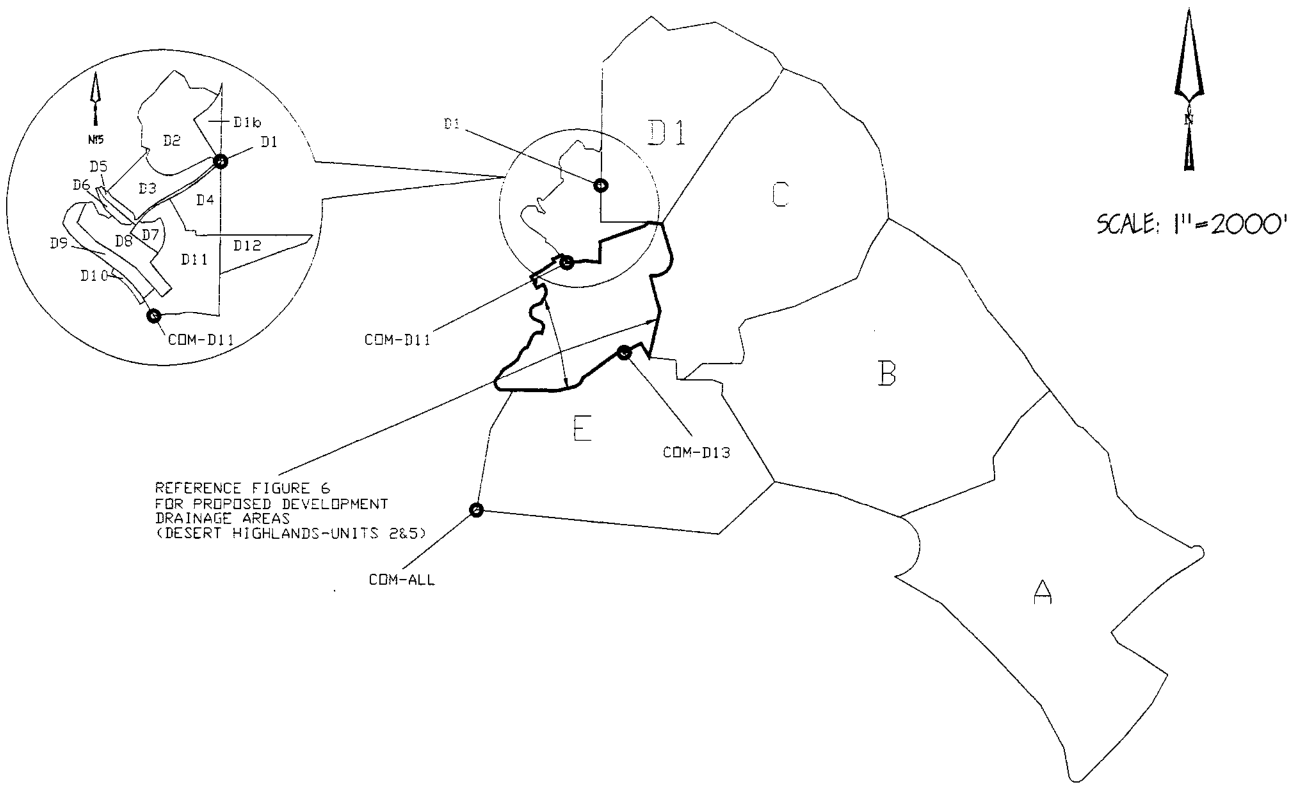


FIGURE 5
DEVELOPED CONDITION DRAINAGE AREA

Barker Homes Inc.
1955 BARING BOULEVARD
SPARKS, NEVADA 89454
(702)626-4144 ● Fax(702)626-4158

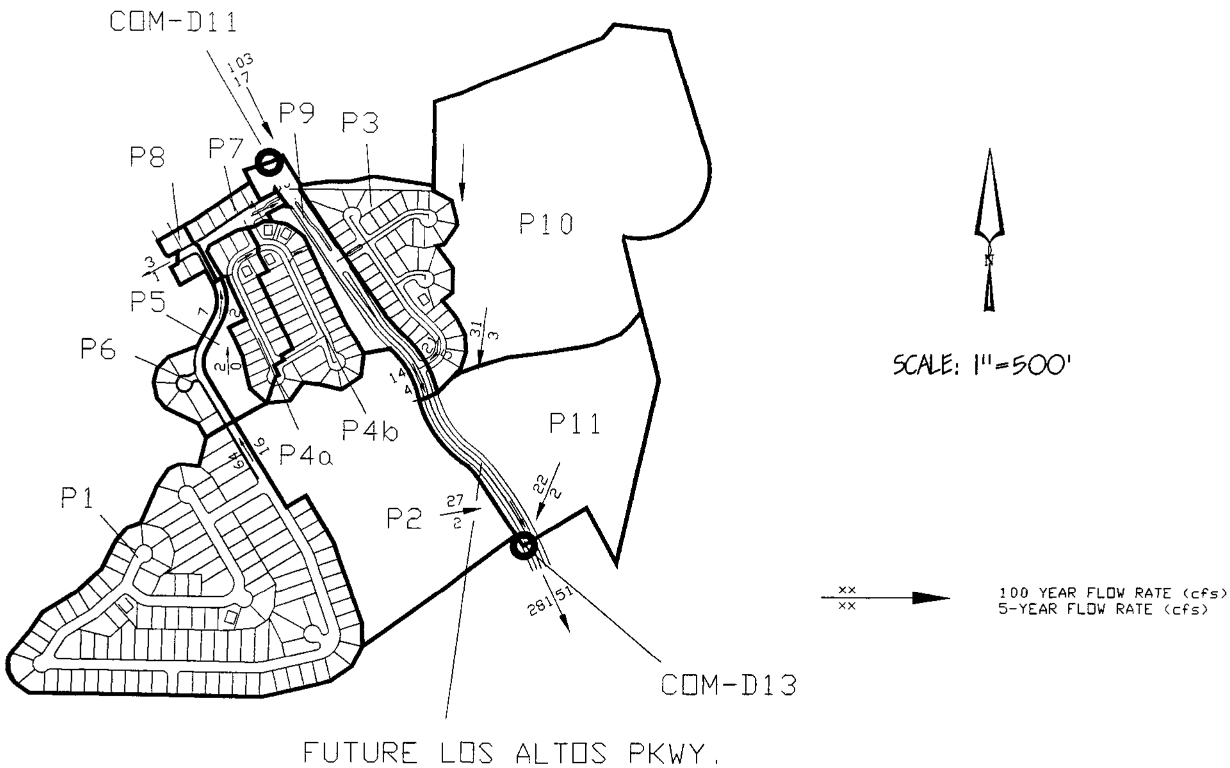


FIGURE 6
DEVELOPED CONDITION DRAINAGE AREA (LOCAL)

Barker Homes Inc.
1955 BARING BOULEVARD
SPARKS, NEVADA 89454

As is shown by the results, very little change in the regional outflow occurs at the regional basin(s) terminus (Vista Boulevard at existing 12'x4' RCB Culvert) due to the development of the project. This outcome is attributed to several factors, including the small area of development relative to the overall basin area, hydrograph timing, etc. It is concluded that the development of the project has no real impact on the outflow of the regional basin.

B. Local Impact of Desert Highlands-Units 2 and 5

Although the development of the project has relatively no impact on the outflow at the outlet of the regional basin, the 100-year peak flow rate at the outlet of Basin D (COM-D13) is increased locally. The flow rate at this point is increased from 188 cfs in the existing condition to 280 cfs in the proposed, developed condition. **Table 4** outlines the 100- and 5-year flow rates for each of the local basins (P1 through P11 - see **Figures 5 and 6**):

Table 4 - Local Basins - Peak Flow Rates

Basin ID	*100-Year Flow Rate (cfs)*	*5-Year Flow Rate (cfs)*
P1	64	16
P2	27	2
P3	21	5
P4a	8	2
P4b	15	4
P5	2	*
P6	7	2
P7	4	1
P8	3	1
P9	14	4
P10	31	3
P11	22	2

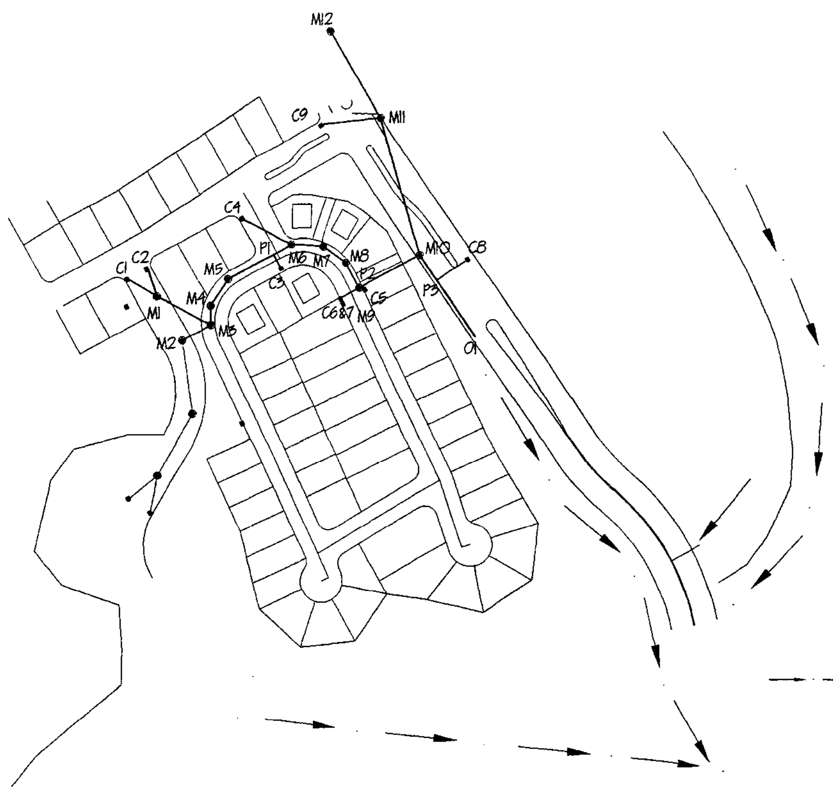
* flow rate is negligible

V. PROPOSED CONVEYANCE OF STORM WATER

Storm water generated within the proposed Desert Highlands-Units 2 and 5 project will be collected and conveyed within a system of catch basins and storm drain pipes for eventual outfall into the existing wash at COM-D13 adjacent to the future alignment of Los Altos Parkway. **Figure 7** depicts the layout of the storm drain system with catch basin and manhole locations, anticipated peak flow rates and storm drain pipe sizes. The storm drain system was analyzed using StormCAD® for Windows by Haestad Methods. The output generated in the analysis is included in **Appendix II**. Additionally, the grading and utility plans for the development are included with this report. This project includes only construction of Units 2 & 5 of Desert Highlands (Basins P4a, P4b, P7 and P9). Basins such as P1, P3 and P6 were delineated and analyzed to assure that all storm drain and other drainage improvements take into account that these areas will be developed within the near future. The area of the storm drain system near the intersection of Desert Highlands Drive and Goodwin Drive includes a stub to pick up future peak flows from Basin P6. Peak flows from Basin P1 will be directed east down the slope via a future open graded ditch to the proposed channel at the terminus of the 48" storm drain pipe in Los Altos Parkway (the 48" pipe will be constructed to its terminus with this project per the plan set). Basin P3 will be directed across Los Altos by a future underground storm drain to the channel, Basin P10 will directed around the back of P3 via a future graded ditch, and P10 and P11 will be directed across Los Altos, likely via a future headwall and concrete pipe system.

CATCH BASIN ID	PEAK FLOW RATE (cfs)
C1	nuisance
C2	0.3
C3	3.5
C4	7.0
C5	5.6
C6&7	9.4
C8	5.6
C9	1.4

PIPE SIZES AND TYPES	CUMULATIVE FLOW RATE (cfs)	PIPE SIZE
C1-M1	nuisance	12"
C2-M1	0.3	12"
M1-M3	0.3	12"
M2-M3	7.0	12"
M3-M4	7.3	15"
M4-M5	7.3	15"
M5-M6	10.8	15"
C3-P1	3.5	12"
C4-M6	7.0	18"
M6-M7	17.8	18"
M7-M8	17.8	18"
M8-M9	17.8	18"
C6&7-M9	9.4	18"
C5-P2	5.6	12"
M9-M10	32.8	24"
M11-M10	104.4	48"
M12-M11	103.0	48"
C9-M11	1.4	12"
C8-P3	5.6	12"
M10-O1	142.8	48"



SCALE: 1" = 200'

LEGEND

- PROPOSED MANHOLE
- FUTURE MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED SIDEWALK UNDERDRAIN
- PROPOSED OR FUTURE DRAINAGE SWALE

FIGURE 7
STORM DRAIN NETWORK

Barker Homes Inc.
1955 BARING BOULEVARD
SPARKS, NEVADA 89454
(702)626-4144 ● Fax(702)626-4158

VI. CONCLUSION

This study presents the findings of a detailed evaluation of the existing and future drainage conditions at and around the site of the proposed Desert Highlands-Units 2 and 5 residential development. The regional offsite area was addressed in the *Drainage Evaluation for Eastland Hills Channel* (June 1996) and the *Memorandum: Conceptual Cost Estimates for Drainage Improvements* (April 1996), both by WRC Engineering, Inc. of Denver, Colorado. Any differences between the results obtained in these reports and this report are substantiated in **Section B of Part III** contained within this report. Applicable portions of this study are excerpted, referenced and attached in **Appendix IV**. Additionally, information contained within the *Hydrology Report for Vista Ridge Unit 1 and Vista Terrace Lane* (August 1995), by Summit Engineering Corp. was included in the existing condition HEC-1 analysis as the area studied directly impacts the Desert Highland and regional subbasins. Any material referenced is attached in **Appendix IV**. Storm drain, catch basins, sidewalk underdrains and open channel reaches will be utilized to mitigate storm flows generated by the proposed development. The development of the parcels will not adversely impact existing drainage conditions at the existing 12 foot by 4 foot RCB Culvert at Vista Boulevard north of Baring Boulevard.

VII. REFERENCES

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SCS (1983). *Soil Survey of Washoe County, Nevada, South Part*. Soil Conservation Service, August, 1983.

USACE (1991). *HEC-1 Flood Hydrograph Package Version 4.0.1E*. U.S. Army Corps of Engineers, Hydrologic Engineering Center, May, 1991.

Washoe County (1996). *Washoe County Hydrologic Criteria and Drainage Design Manual (Draft)*. Prepared for: Washoe County, by: WRC Engineering, Inc., June, 1996.

WRC (1996). *Drainage Evaluation for Eastland Hills Channel*. Prepared by: WRC Engineering Inc., June, 1996.

WRC (1996). *Memorandum: Conceptual Cost Estimates for Drainage Improvements*. Prepared by: WRC Engineering Inc., April, 1996.

APPENDIX I

DEVELOPMENT OF HYDROLOGIC PARAMETERS

The rainfall and runoff date developed for this hydrologic analysis was prepared for used with the HEC-1 Flood Hydrograph computer program using standard hydrologic methods and in accordance with the draft *Washoe County Hydrologic Criteria and Drainage Design Manual* (WCDDM, 1996). Charts, figures and methods used in determining drainage basin hydrologic parameters are included in this appendix.

RAINFALL METHODOLOGY

A. Point Rainfall

The criteria for determination of the design storm frequencies and point precipitation was determined by the methods outlined in Section 600 of the WCDDM. Section 602 of the Manual outlines the conversion of 2-year return period storm data for durations of 1,6 and 24 hours to 5,10-25,50 and 100-year return period storms. For the purposes of this report, storm data was calculated for 5 and 100-year return period storms. The conversion methodology is explained specifically in Section 602.2 of the Manual and is included. Precipitation frequency maps with point precipitation isohyets excerpted from the Manual are attached and were used in determination of depth data for the 2-year storms. The conversion process entails use of Regional Growth Factors (RGF's) and United States Department of Commerce formulas. These factors and formulas are attached for reference.

B. Storm Distribution

Rainfall depths were calculated for the 5 and 100-year return period storms for 5 and 15 minute durations, as well as 1,2,3,6,12 and 24 hour durations for input into the HEC-1 PH card. A Microsoft Excel® Spreadsheet for determination of these values was set up for ease of calculation and is attached.

RUNOFF METHODOLOGY

A. Lag Time

A WCDDM Standard Form 2 (included, also setup as Microsoft Excel® Spreadsheet) was completed to determine the for all drainage basins. As these basins are less than one square mile in area, the time of concentration was calculated as follows:

$T_c = T_i + T_t$

Where:

T_c = Time of Concentration

T_i = Initial, Inlet or overland flow time

T_t = Travel time ditch, gutter, etc.

The velocity used in the travel time computations for the existing basins was estimated using Figure 701 of the Manual (attached).

For proposed conditions, such as streets, the velocity was estimated using approximate channel properties and applying Manning's equation as follows:

$Q=(1.49/n)\,AR^{2/3}\,S^{1/2}$; and $Q=VA$

$\therefore \quad V=(1.49/n)\,R^{2/3}\,S^{1/2}$

Initial flow time was calculated as follows:

$T_i = 1.8(1.1 - R)L_o^{1/2} / S^{1/3}$

Where:

T_i = Initial overland flow time (minutes)

$R = 0.0132CN - 0.39$

CN = Curve Number

L_o = Length of overland flow (max. 500 ft.)

S = Average Basin Slope (percent)

The lag time was calculated as follows:

$T_{lag} = 0.6T_c$ (hours)

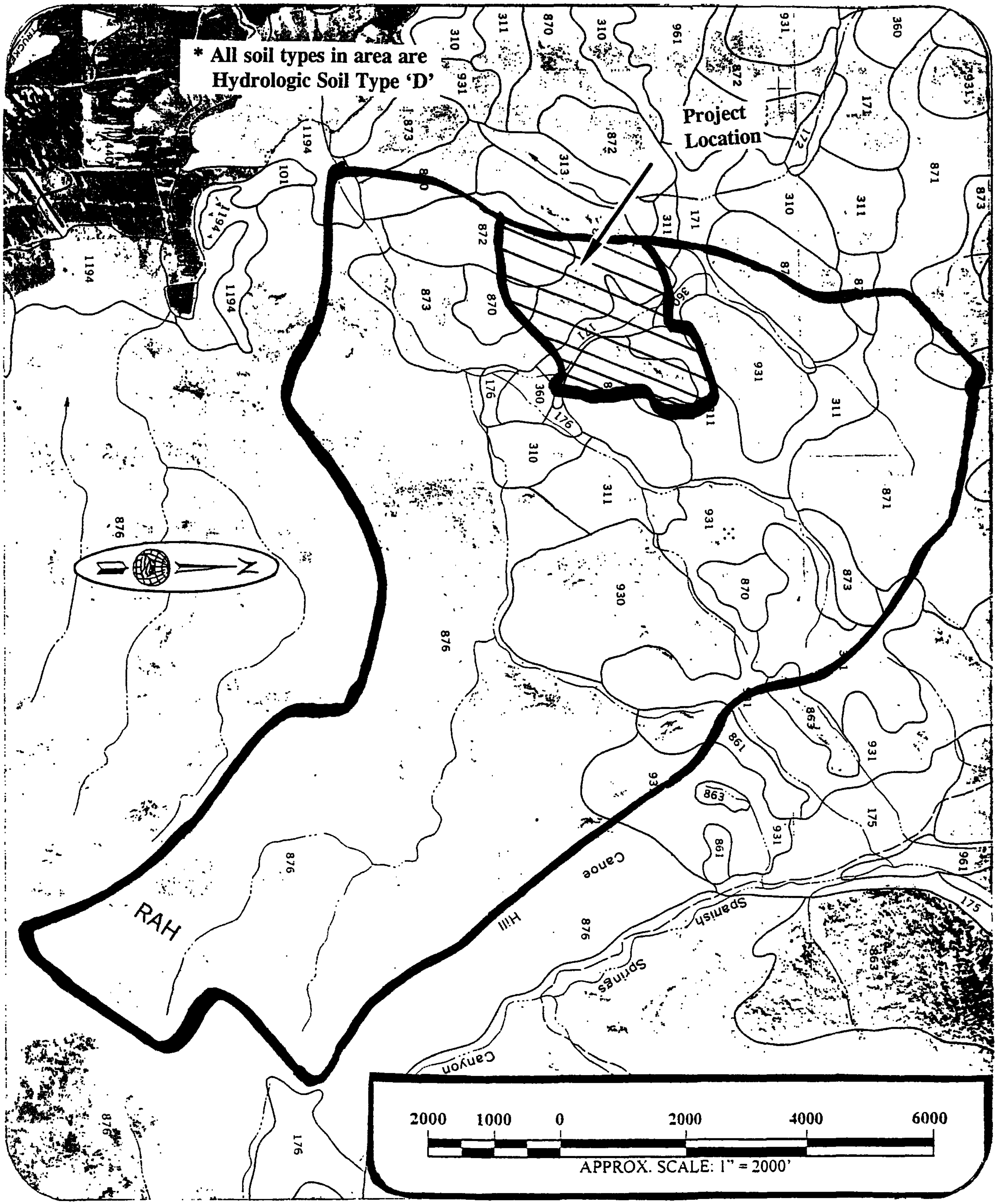
The lag time calculations were standardized for ease of computation using a Microsoft Excel® Spreadsheet and the format shown in the WCDDM's Standard Form 2.

B. Soils--Curve Number

The soils curve numbers for the existing and proposed hydrologic subbasins were obtained using Soil Conservation Service (SCS) soils maps for determination of soil types, and matching the SCS soil type to the corresponding SCS curve number for use in the Standard Form 2 and HEC-1 analysis. The offsite and onsite existing and proposed hydrologic subbasins are comprised of various soil numbers, all of which correspond to a hydrologic soil group of D. Therefore, no composite curve numbers were required due to hydrologic soil group.

Table 1. Curve Numbers for Various Land Uses-Soil Type D

	Cover Type and Hydrologic Condition			
Hydrologic Soil Group	Sagebrush w/ Grass Understory (poor condition)	Sagebrush w/ Grass Understory (fair condition)	Residential (1/4 acre lots)	Residential (1/8 acre lots)
D	85	70	87	92



SOILS MAP

Barker Homes Inc.
1955 BARING BOULEVARD
SPARKS, NEVADA 89454
(702)626-4144 ● Fax(702)626-4158

RAINFALL DISTRIBUTION CALCULATIONS FOR HEC-1 INPUT
(per methods described in the Washoe County Hydrologic and Drainage Design Manual - WCDDM)

INPUT: (per WCDDM)

2-YEAR DEPTH

2-year, 1 hour Depth:	0.40	inches	$D_{2,1}$
2-year, 6 hour Depth:	0.70	inches	$D_{2,6}$
2-year, 24 hour Depth:	1.20	inches	$D_{2,24}$

Regional Growth Factors
(conversion to 100-year storm)

$D_{100,1}$	3.62
$D_{100,6}$	2.26
$D_{100,24}$	2.22

Regional Growth Factors
(conversion to 5-year storm)

$D_{5,1}$	1.36
$D_{5,6}$	1.30
$D_{5,24}$	1.28

100-YEAR DEPTH

100-year, 1-hour Dept	1.45	inches	$D_{100,1}$
100-year, 6-hour Dept	1.58	inches	$D_{100,6}$
100-year, 24-hour Dep	2.66	inches	$D_{100,24}$

5-YEAR DEPTH

5-year, 1-hour Depth:	0.54	inches	$D_{5,1}$
5-year, 6-hour Depth:	0.91	inches	$D_{5,6}$
5-year, 24-hour Dept	1.54	inches	$D_{5,24}$

Ratios for Conversion of 1-hour depth to 5-minute and 15-minute depth from Table 602

RATIO5	0.33	$D_{100,5}$ (RATIO5x$D_{100,1}$)	0.48	$D_{5,5}$ (RATIO5x$D_{100,1}$)	0.18
RATIO15	0.60	$D_{100,15}$ (RATIO5x$D_{100,1}$)	0.87	$D_{5,15}$ (RATIO5x$D_{100,1}$)	0.33

Compute 100-yr, 2-hr; 100-yr, 3-hr; 100-yr, 12-hr events (using Equ. 606, 607 and 608)

$D_{100,2}$=	(Equ 606)*	1.49
$D_{100,3}$=	(Equ 607)**	1.52
$D_{100,12}$=	(Equ 608)**	2.12

Compute 5-yr, 2-hr; 5-yr, 3-hr; 5-yr, 12-hr events (using Equ. 606, 607 and 608)

$D_{5,2}$=	(Equ 606)*	0.65
$D_{5,3}$=	(Equ 607)**	0.74
$D_{5,12}$=	(Equ 608)**	1.22

* $0.299xD_{y,6}+0.701xD_{x,1}$
** $0.526xD_{y,6}+0.474xD_{y,1}$
*** $0.50xD_{y,6}+0.50xD_{y,24}$

SUMMARY OUTPUT (for HEC-1 Input)

$D_{100,1}$	1.45	$D_{5,1}$	0.54
$D_{100,2}$	1.49	$D_{5,2}$	0.65
$D_{100,3}$	1.52	$D_{5,3}$	0.74
$D_{100,6}$	1.58	$D_{5,6}$	0.91
$D_{100,12}$	2.12	$D_{5,12}$	1.22
$D_{100,24}$	2.66	$D_{5,24}$	1.54

SECTION 600
RAINFALL

601 INTRODUCTION

Presented in this section is the design rainfall data for the minor and major storm events as designated in Section 304.2. This data is used to determine storm runoff in conjunction with the runoff models designated in Section 304.3. All hydrologic analysis within the jurisdiction of this Manual shall utilize the rainfall data presented herein for calculating storm runoff.

The methodology used to generate the rainfall data will depend on the size of the drainage basin to be studied. The Rational Method for determining runoff is widely accepted as providing a sufficient level of detail for generating runoff from relatively small basins (area ≤ 100 acres). The Rational Method utilizes rainfall data in the form of time-intensity-frequency curves.

Since the assumptions used in the Rational Method become less valid over larger areas, larger basins (area ≥ 100 acres) require a more rigorous analysis to generate runoff data. The HEC-1 computer model developed by the U.S. Army Corps of Engineers is a commonly used model that generates storm runoff (U.S. Army, 1990). The rainfall data used in this model will be a centrally distributed storm event with depths at time intervals of 5 minutes, 15 minutes, 60 minutes, 2 hours, 3 hours, 6 hours, 12 hours, and 24 hours.

The information presented in this section is the state-of-the-art information available at the time of preparation of this Manual. The information should be updated as better techniques and data become available in the future.

602 RAINFALL DISTRIBUTION FOR SCS UNIT HYDROGRAPH METHOD

602.1 RAINFALL DEPTH - DURATION - FREQUENCY MAPS

The National Weather Service's Southwest Semiarid Precipitation Frequency Study (SSPFS, 1996) has developed three (3) rainfall depth maps for the 1-, 6-, and 24-hour storm durations for the 2-year recurrence frequency. These maps are shown in Figures 601 to 603. For the 2-year return periods, the rainfall depths for durations of 1 hour, 6 hours, and 24 hours can be estimated from the maps.

602.2 RAINFALL DEPTHS FOR DURATIONS FROM 5 MINUTES TO 24 HOURS

For return periods other than the 2-year event, the rainfall depths for durations of 1 hour, 6 hours, and 24 hours can be estimated using Table 601 and rainfall depth estimates for the 2-year event from Section 602.1. Table 601 supplies regional growth factors calculated by the SSPFS to estimate the 1-hour, 6-hour, and 24-hour storm events for a given return period from the 2-year values (Tarleton Julian, 1996) as follows:

$$D_{X,1} = D_{2,1} * RGF1 \qquad (601)$$

where $D_{X,1}$ = "X"-year, 1-hour rainfall depth (Inches)
$D_{2,1}$ = 2-year, 1-hour rainfall depth (Inches)

RGF1 = Regional Growth Factor for an "X"-year, 1-hour event (Inch/Inch)

$$D_{X,6} = D_{2,6} * RGF6 \quad (602)$$

where $D_{X,6}$ = "X"-year, 6-hour rainfall depth (Inches)
$D_{2,6}$ = 2-year, 6-hour rainfall depth (Inches)
RGF6 = Regional Growth Factor for an "X"-year, 6-hour event (Inch/Inch)

$$D_{X,24} = D_{2,24} * RGF24 \quad (603)$$

where $D_{X,24}$ = "X"-year, 24-hour rainfall depth (Inches)
$D_{2,24}$ = 2-year, 24-hour rainfall depth (Inches)
RGF24 = Regional Growth Factor for an "X"-year, 24-hour event (Inch/Inch)

Rainfall depths of 5 minutes and 15 minute durations can be estimated using ratios supplied in Table 602 and the previous calculation for the "X"-year, 1-hour rainfall depth (Tarleton Julian, 1996).

$$D_{X,5} = D_{X,1} * RATIO5 \quad (604)$$

where $D_{X,5}$ = "X"-year, 5-minute rainfall depth (Inches)
$D_{X,1}$ = "X"-year, 1-hour rainfall depth (Inches)
RATIO5 = Ratio to convert "X"-year, 1-hour rainfall depth to the "X"-year, 5-minute depth (Inch/Inch)

$$D_{X,15} = D_{X,1} * RATIO15 \quad (605)$$

where $D_{X,15}$ = "X"-year, 15-minute rainfall depth (Inches)
$D_{X,1}$ = "X"-year, 1-hour rainfall depth (Inches)
RATIO15 = Ratio to convert "X"-year, 1-hour rainfall depth to the "X"-year, 15-minute depth (Inch/Inch)

Rainfall depths for the 2-hour and 3-hour events can be estimated using the following formulas (U.S. Dept. of Commerce, 1973).

$$D_{X,2} = 0.299 * D_{X,6} + 0.701 * D_{X,1} \quad (606)$$

where $D_{X,2}$ = "X"-year, 2-hour rainfall depth (Inches)
$D_{X,1}$ = "X"-year, 1-hour rainfall depth (Inches)
$D_{X,6}$ = "X"-year, 6-hour rainfall depth (Inches)

$$D_{X,3} = 0.526 * D_{X,6} + 0.474 * D_{X,1} \quad (607)$$

where $D_{X,3}$ = "X"-year, 3-hour rainfall depth (Inches)
$D_{X,1}$ = "X"-year, 1-hour rainfall depth (Inches)
$D_{X,6}$ = "X"-year, 6-hour rainfall depth (Inches)

Based on Figure 17A in the NOAA Atlas 2, the 12-hour duration storm event for the desired recurrence frequency is essentially the average of the 6-hour and 24-hour storm events (U.S. Dept.

of Commerce. 1973).

$$D_{X,12} = (D_{X,6} + D_{X,24})/2 \quad (608)$$

where $D_{X,12}$ = "X"-year, 12-hour rainfall depth (Inches)
$D_{X,6}$ = "X"-year, 6-hour rainfall depth (Inches)
$D_{X,24}$ = "X"-year, 24-hour rainfall depth (Inches)

The preceding analysis provides the rainfall distribution for a 24-hour storm at time intervals of 5 minutes, 15 minutes, 1 hour, 2 hours, 3 hours, 6 hours, 12 hours, and 24 hours for the desired recurrence frequency. The rainfall distribution is centered around the midpoint of the design storm (time = 12 hours).

602.3 DEPTH-AREA REDUCTION FACTORS

The SSPFS precipitation depths are related to rainfall frequency at an isolated point. Storms, however, cause rainfall to occur over extensive areas simultaneously, with more intense rainfall typically occurring near the center of the storm. Standard precipitation analysis methods require adjusting point precipitation depths downward in order to estimate the average depth of rainfall over the entire storm area. This normally preformed using depth-area reduction curves relating point precipitation reduction factor to storm area and duration.

Figure 604 provides the depth-area reduction curve for the 24-hour storm event (U.S. Dept. of Commerce, 1973).

The ability of the thunderstorm generating mechanisms (i.e. available moisture, strong convective currents, etc.) to sustain a thunderstorm greater than 200 square miles in greatly reduced. Therefore, only a portion of an entire drainage basin could be subject to precipitation from the thunderstorm event. Analysis of this effect on runoff peaks and volumes is complicated by the necessity to determine the "storm centering" which produces the greatest peak flow and/or volume at the selected design point. In order to obtain a consistent method of analysis for these areas, the designer shall consult the local entity to determine the appropriate method of analysis and design rainfall area reduction factors for the specific location and basin under consideration.

603 RAINFALL DISTRIBUTION FOR RATIONAL METHOD

603.1 RAINFALL ZONES FOR RATIONAL METHOD

A review of the isopluvial maps generated by the SSPFS indicates that, for Rational Method analysis, Washoe County can be divided into three rainfall zones. Within each zone, the precipitation values were similar for the various return periods and duration storms. These zones are shown on Figure 605. Time-Intensity-Frequency data for Zones I and II are presented on Table 603.

If more than 50 percent of the basin lies in a given zone, the rainfall data for that zone shall be used. Basin area refers to the actual basin or sub-basin for which storm runoff information is being calculated and not necessarily the entire watershed area.

603.2 TIME-INTENSITY-FREQUENCY CURVES IN ZONE I

Within Zone I, the rainfall time-intensity-frequency curves used in the rational method are assumed

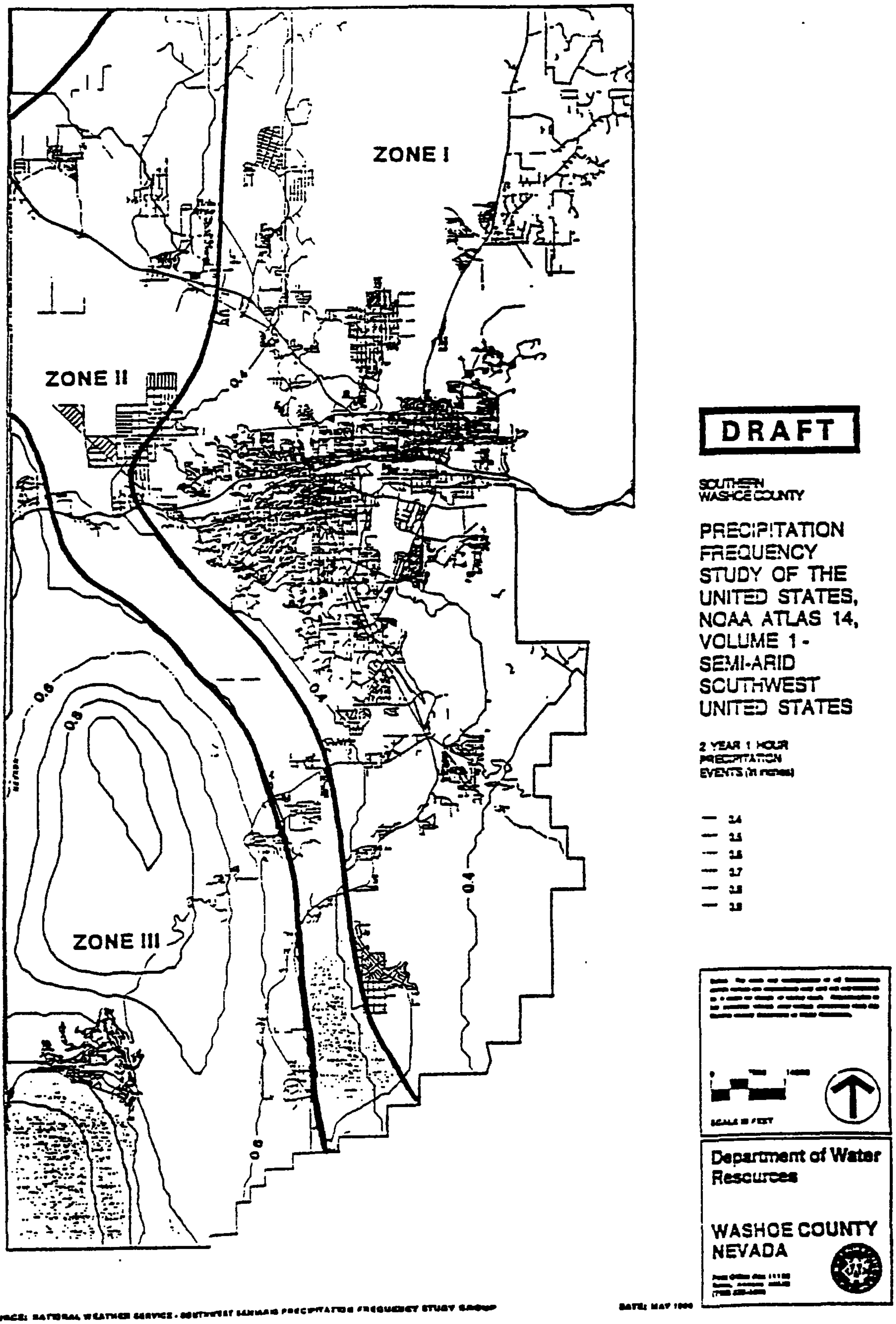
REGIONAL GROWTH FACTORS

Duration (Hours)	Return Period					
	2-yr.	5-yr.	10-yr	25-yr	50-yr	100-yr.
1	1.0	1.36	1.72	2.32	2.91	3.62
6	1.0	1.30	1.52	1.81	2.04	2.26
24	1.0	1.28	1.50	1.79	2.01	2.22

REFERENCE:
Tarleton Julian, "Personal Correspondence", 1996

WASHOE COUNTY

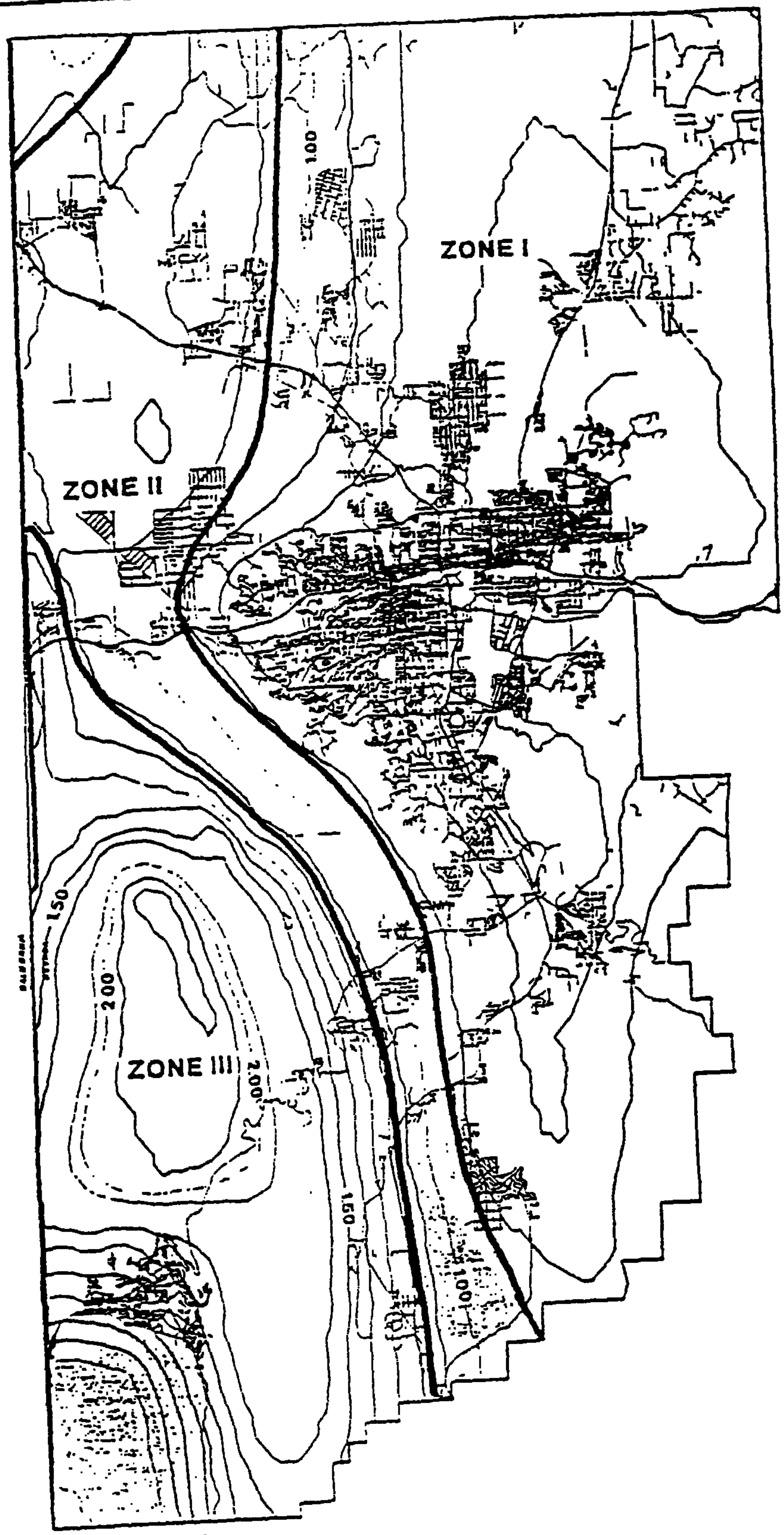
HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL



VERSION: 06-18-1996	REFERENCE:	FIGURE 601
WRC ENGINEERING INC		

WASHOE COUNTY

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL



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SOUTHERN WASHOE COUNTY

PRECIPITATION FREQUENCY STUDY OF THE UNITED STATES, NOAA ATLAS 14, VOLUME 1 - SEMI-ARID SOUTHWEST UNITED STATES

2 YEAR 6 HOUR PRECIPITATION EVENTS (in inches)

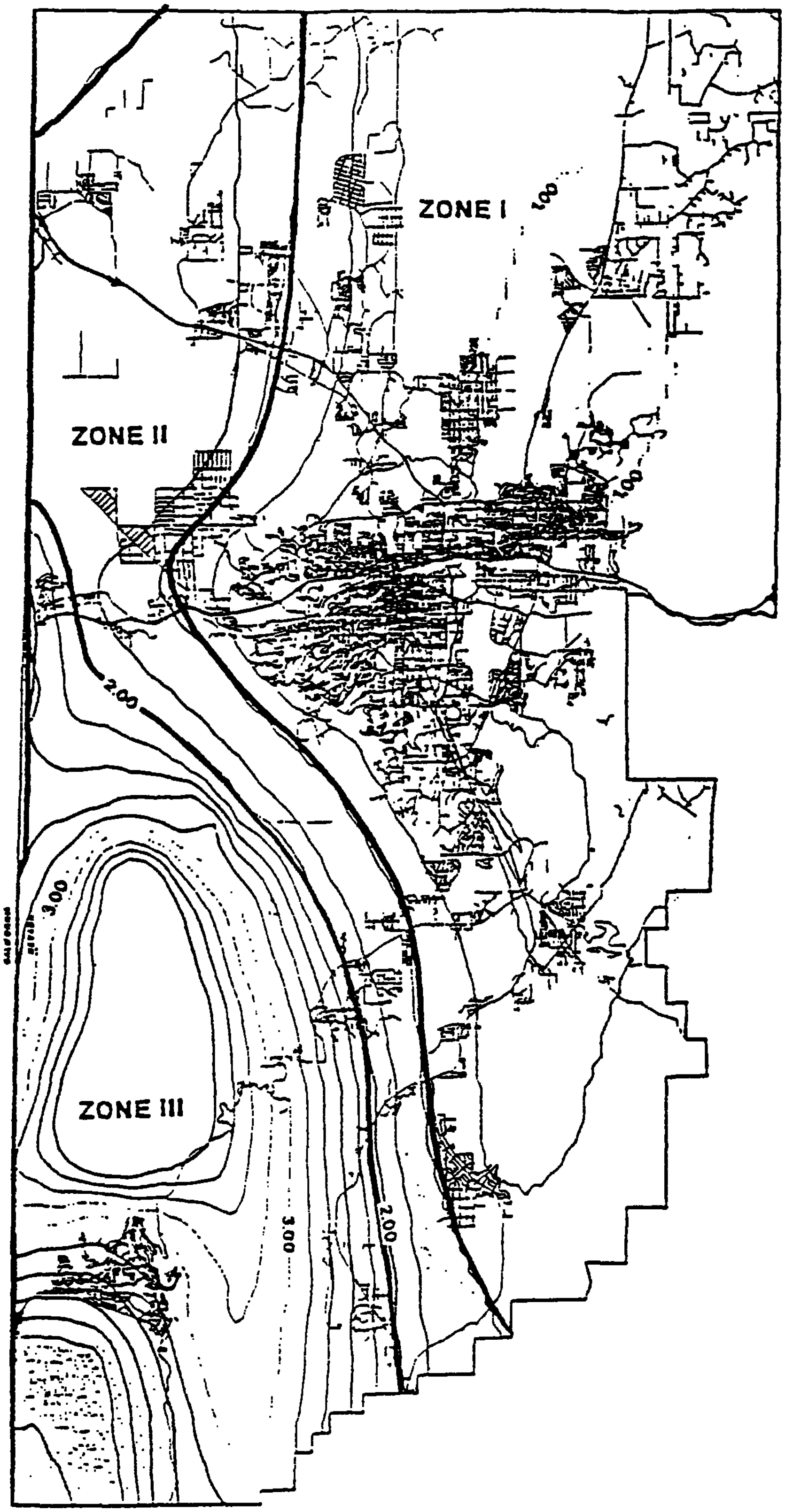
Department of Water Resources

WASHOE COUNTY NEVADA

SOURCE: NATIONAL WEATHER SERVICE - SOUTHWEST SEMIARID PRECIPITATION FREQUENCY STUDY GROUP

DATE: MAY 1996

VERSION: 06-18-1996	REFERENCE:	FIGURE 602
WRC ENGINEERING INC		



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SOUTHERN WASHOE COUNTY

PRECIPITATION FREQUENCY STUDY OF THE UNITED STATES, NOAA ATLAS 14, VOLUME 1 - SEMI-ARID SOUTHWEST UNITED STATES.

2 YEAR 24 HOUR PRECIPITATION EVENTS (in inches)

1.00	2.60
1.20	2.80
1.40	3.00
1.60	3.20
1.80	3.40
2.00	3.60
2.20	3.80
2.40	

SCALE IN FEET

Department of Water Resources

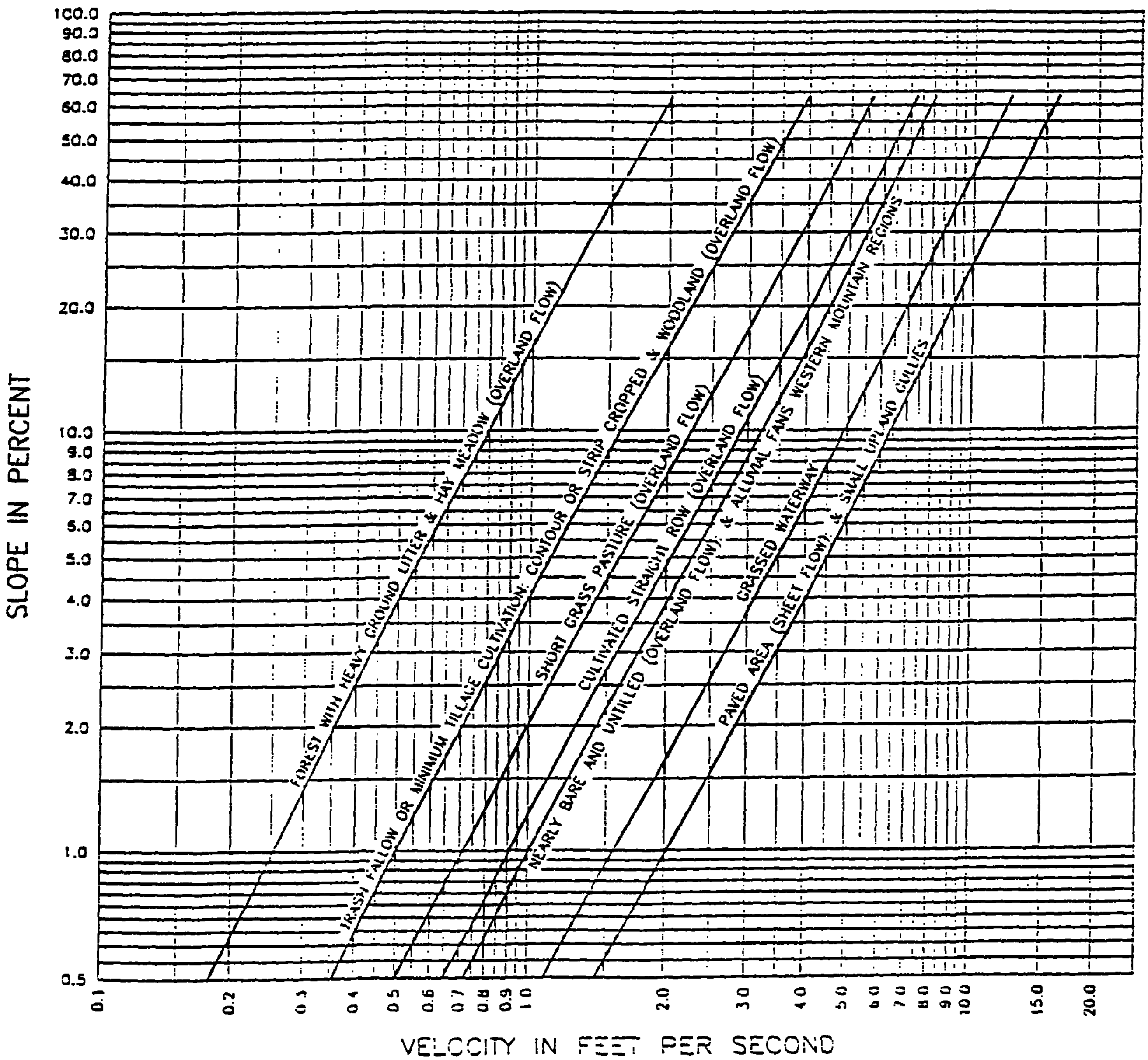
WASHOE COUNTY NEVADA

SOURCE: NATIONAL WEATHER SERVICE - SOUTHWEST SEMIARID PRECIPITATION FREQUENCY STUDY GROUP

DATE: MAY 1996

VERSION: 06-18-1996	REFERENCE:	FIGURE 603
WRC ENGINEERING INC		

TRAVEL TIME VELOCITY



APPENDIX II

HYDRAULIC ANALYSES

TRAVEL TIME (T_t) CALCULATIONS-EXISTING BASINS

WASHOE COUNTY
HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

Barker
Homes Inc.

DEVELOPMENT: **Desert Highlands**
Existing Conditions-Offsite Basin-Final

CALCULATED BY: **TG** **DATE:** **Dec-96**

PROJECT:

SUB-BASIN DATA					INITIAL/OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASINS		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	R (2)	AREA *(acres)* (3)	AREA *(mi2)*	LENGTH *max 500'(ft)* (4)	SLOPE *(%)* (5)	Ti *(min)* (6)	LENGTH *(ft)* (7)	SLOPE *(%)* (8)	VELOCITY* *(fps)* (9)	Tt *(min)* (10)	Tc=Ti+Tt (11)	TOTAL LENGTH *(ft)* (12)	T_c= (L/180)+10 *(min)* (13)	*(min)* (14)	T_{lag}= 0.6Tc/60 *(hrs)*	
A	75	0.600	543.0	0.848	500	15.90	8.0	1260	15.90	4.00	5.3	13.3					
								6400	10.90	3.30	32.3	45.6	8160	NA	45.6	**0.456**	
B	75	0.600	586.8	0.917	500	15.30	8.1	1460	15.30	3.90	6.2	14.3					
								5880	4.42	2.20	44.5	58.9	7840	NA	58.9	**0.589**	
C	75	0.600	442.0	0.691	500	18.00	7.7	50	18.00	4.40	0.2	7.9					
								6988	6.58	2.60	44.8	52.7	7538	NA	52.7	**0.527**	
D1	75	0.600	235.0	0.367	500	23.70	7.0	160	23.70	4.95	0.5	7.5					
								3957	6.82	2.60	25.4	32.9	4617	NA	32.9	**0.329**	
D2	75	0.600	5.0	0.008	500	23.00	7.1	465	23.00	4.80	1.6	8.7	965	NA	8.7	**0.087**	
D3	75	0.600	152.6	0.238	300	20.00	5.7	1295	12.40	3.50	6.2	11.9					
								2163	2.77	1.60	22.5	34.4	3758	NA	34.4	**0.344**	
E	75	0.600	367.9	0.575	480	10.40	9.0	2730	6.23	2.60	17.5	26.5					
								3677	2.72	1.60	38.3	64.8	6887	NA	64.8	**0.648**	

Tc=Ti+Tt $Ti=(1.8(1.1-R)L^{0.5})/S^{0.33}$ * Velocity estimated from Figure 701

$T_{lag}=0.6T_c$ R=0.0132(CN)-0.39

REFERENCE:

STANDARD FORM 2

WASHOE COUNTY
HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

Barker Homes Inc.

DEVELOPMENT: Desert Highlands
Existing Conditions-SUMMIT OFFSITES-for incorporation into model

CALCULATED BY: TG DATE: Dec-96

PROJECT:

SUB-BASIN DATA					INITIAL/OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASINS		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	R (2)	AREA (acres) (3)	AREA (mi2)	LENGTH max. 500'(ft) (4)	SLOPE (%) (5)	Ti (min) (6)	LENGTH (ft) (7)	SLOPE (%) (8)	VELOCITY* (fps) (9)	Tt (min) (10)	Tc=Ti+Tt (11)	TOTAL LENGTH (ft) (12)	T_c=(L/180)+10 (min) (13)	(min) (14)	T_{lag}=0.6Tc/60 (hrs)	
D1b	75	0.600	2.3	0.004	500	19.70	7.5	200	19.70	3.90	0.9	8.3	700	NA	8.3	**0.083**	
D2	87	0.758	13.5	0.021	110	1.00	6.4	1870	7.60	6.90	4.5	11.0	1980	11.1	11.0	**0.110**	
D3	75	0.600	7.1	0.011	100	16.00	3.6	1000	3.00	2.72	6.1	9.7	1100	NA	9.7	**0.097**	
D4	87	0.758	5.5	0.009	120	1.00	6.7	640	1.90	3.19	3.3	10.1	760	15.6	10.1	**0.101**	
D5	87	0.758	1.5	0.002	40	50.00	1.1	1000	2.60	2.73	6.1	7.2	1040	13.6	7.2	**0.072**	
D6	87	0.758	0.8	0.001	60	50.00	1.3	520	6.90	3.93	2.2	3.5	580	15.6	3.5	**0.035**	
D7	87	0.758	1.8	0.003	110	1.00	6.4	810	2.00	2.47	5.5	11.9	920	12.9	11.9	**0.119**	
D8	87	0.758	6.9	0.011	110	1.00	6.4	570	0.50	2.08	4.6	11.0	680	14.5	11.0	**0.110**	
D9	87	0.758	4.2	0.007	110	1.00	6.4	570	1.60	2.71	3.5	10.0	680	13.2	10.0	**0.100**	
D10	98	0.904	0.6	0.001	0	0.00	0.0	460	0.40	1.35	5.7	5.7	460	13.2	5.7	**0.057**	
D11	87	0.758	14.3	0.022	120	1.00	6.7	1190	4.40	5.59	3.5	10.3	1310	12.6	10.3	**0.103**	

Tc=Ti+Tt $Ti=(1.8(1.1-R)L^{0.5})/S^{0.33}$ * Velocity estimated from Figure 701

$T_{lag}=0.6T_c$ R=0.0132(CN)-0.39

REFERENCE: STANDARD FORM 2

TRAVEL TIME (T_t) CALCULATIONS-PROPOSED BASINS

WASHOE COUNTY

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

Barker
Homes Inc.

DEVELOPMENT: Desert Highlands
Proposed Conditions-for incorporation into offsite model

CALCULATED BY: TG DATE: Dec-96

PROJECT:

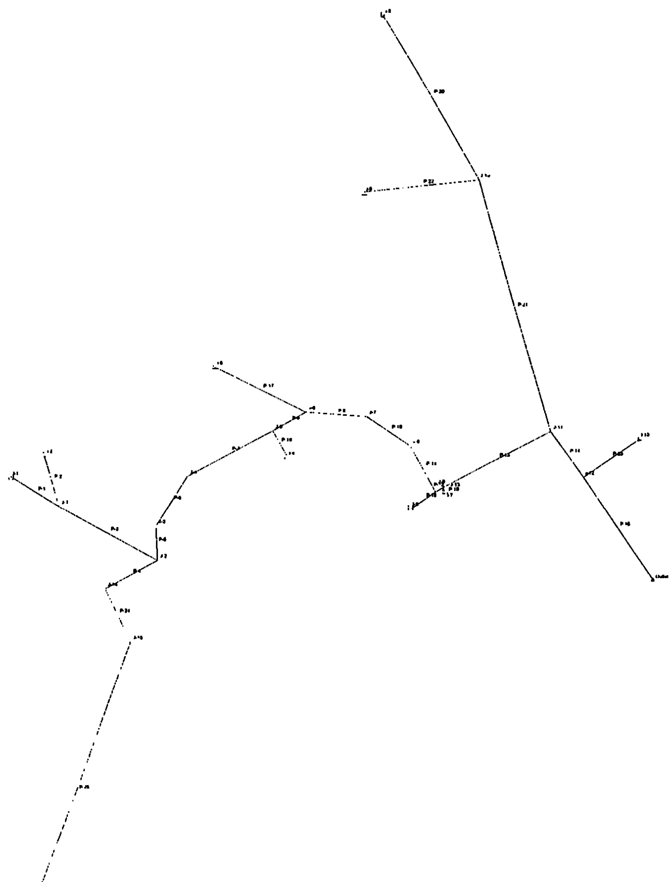
SUB-BASIN DATA					INITIAL/OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASINS		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	R (2)	AREA (acres) (3)	AREA (mi2)	LENGTH max. 500'(ft) (4)	SLOPE (%) (5)	Ti (min) (6)	LENGTH (ft) (7)	SLOPE (%) (8)	VELOCITY* (fps) (9)	Tt (min) (10)	Tc=Ti+Tt (11)	TOTAL LENGTH (ft) (12)	T_c= (L/180)+10 (min) (13)	(min) (14)	T_{lag}= 0.6Tc/60 (hrs)	
P1	87	0.758	36.1	0.056	120	1.00	6.7	3368	2.38	5.08	11.0	17.8	3488	29.4	17.8	**0.178**	
P2	75	0.600	24.1	0.038	500	21.6	7.2	325	21.60	4.75	1.1	8.4	825	NA	8.4	**0.084**	
P3	87	0.758	10.2	0.016	120	1.00	6.7	1140	3.60	4.72	4.0	10.8	1260	17.0	10.8	**0.108**	
P4a	87	0.758	3.9	0.006	100	1.00	6.1	893	3.58	3.66	4.1	10.2	993	15.5	10.2	**0.102**	
P4b	87	0.758	6.7	0.010	100	1.00	6.1	690	4.20	4.55	2.5	8.7	790	14.4	8.7	**0.087**	
P5	75	0.600	2.2	0.003	150	47.0	3.1	705	2.13	2.39	4.9	8.0	855	NA	8.0	**0.080**	
P6	87	0.758	3.0	0.005	120	1.00	6.7	803	10.60	5.13	2.6	9.3	923	15.1	9.3	**0.093**	
P7	87	0.758	2.0	0.003	120	1.00	6.7	690	3.80	3.08	3.7	10.5	810	14.5	10.5	**0.105**	
P8	87	0.758	1.0	0.002	120	1.00	6.7	340	2.95	2.75	2.1	8.8	460	12.6	8.8	**0.088**	
P9	91.1	0.813	5.2	0.008	150	3.71	4.1	1300	3.71	4.34	5.0	9.1	1450	18.1	9.1	**0.091**	
P10	75	0.600	41.7	0.065	500	20.60	7.3	874	20.60	4.50	3.2	10.6					
								1020	2.35	1.55	11.0	21.5	2394	NA	21.5	**0.215**	
P11	75	0.600	21.1	0.033	500	27.00	6.7	763	27.00	5.10	2.5	9.2	1263	NA	9.2	**0.092**	

Tc=Ti+Tt $Ti=(1.8(1.1-R)L^{0.5})/S^{0.33}$ * Velocity estimated by using street section (developed) or Figure 701 (undeveloped)

$T_{lag}=0.6T_c$ R=0.0132(CN)-0.39

REFERENCE: STANDARD FORM 2

STORM DRAIN (StormCAD® by Haestad Methods) OUTPUT



Project Title: Desert Highlands-Units2&5
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12/26/96 08:51:22 AM

BARKER HOMES

Project Engineer: Karl
StormCAD v1.0

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Description
P-23	I-10	0.00	0.00	0.00	174.00	171.74	0.023971	3.00	Circular	77.00	4.31	
	J-12				172.00	170.03	0.036753	6.83	12 inch			
P-22	I-9	0.00	0.00	0.00	185.80	183.30	0.012558	1.40	Circular	129.00	2.67	
	J-10				184.50	181.83	0.017829	4.76	12 inch			
P-20	I-8	0.00	0.00	0.00	188.70	185.27	0.018596	103.00	Circular	210.00	9.13	
	J-10				184.50	181.83	0.020000	203.13	48 inch			
P-21	J-10	N/A	N/A	0.00	184.50	180.89	0.032121	104.40	Circular	298.00	9.16	
	J-11				174.00	171.81	0.036913	275.96	48 inch			
P-19	I-7	0.00	0.00	0.00	191.40	187.34	0.034965	5.60	Circular	4.00	9.03	
	J-13				191.00	186.23	0.200000	15.93	12 inch			
P-18	I-6	0.00	0.00	0.00	191.40	189.07	0.023207	9.40	Circular	33.00	7.77	
	J-9				191.23	188.36	0.066667	16.68	15 inch			
P-17	I-5	0.00	0.00	0.00	198.50	197.58	0.004441	7.00	Circular	114.00	3.96	
	J-6				197.89	197.07	0.014123	12.48	18 inch			
P-16	I-4	0.00	0.00	0.00	200.30	198.65	0.009652	3.50	Circular	34.00	4.46	
	J-5				201.00	198.32	0.020000	5.04	12 inch			
P-26	I-3	0.00	0.00	0.00	271.70	269.68	0.088465	7.00	Circular	159.00	8.94	
	J-16				258.10	255.63	0.091824	10.80	12 inch			
P-25	J-16	N/A	N/A	0.00	258.10	254.88	0.095723	7.00	Circular	354.00	8.94	
	J-15				224.00	221.01	0.097232	11.11	12 inch			
P-24	J-15	N/A	N/A	0.00	224.00	220.26	0.067746	7.00	Circular	64.00	8.94	
	J-14				217.96	215.94	0.080000	10.08	12 inch			
P-4	J-14	N/A	N/A	0.00	217.96	214.94	0.133237	7.00	Circular	67.00	8.94	
	J-2				210.66	206.02	0.148060	13.71	12 inch			
P-2	I-2	0.00	0.00	0.00	208.10	206.06	0.000049	0.25	Circular	60.00	0.32	
	J-1				210.76	206.05	0.006000	2.76	12 inch			
P-1	I-1	0.00	0.00	0.00	208.10	206.06	0.000049	0.25	Circular	64.00	0.32	
	J-1				210.76	206.05	0.005625	2.67	12 inch			
P-3	J-1	N/A	N/A	0.00	210.76	206.05	0.000197	0.50	Circular	126.00	0.64	
	J-2				210.66	206.02	0.003968	2.24	12 inch			
P-5	J-2	N/A	N/A	0.00	210.66	205.50	0.013481	7.50	Circular	39.00	6.11	
	J-3				208.72	204.98	0.004103	4.14	15 inch			
P-6	J-3	N/A	N/A	0.00	208.72	204.57	0.029559	7.50	Circular	66.00	6.36	
	J-4				205.67	202.72	0.031212	11.41	15 inch			
P-7	J-4	N/A	N/A	0.00	205.67	202.31	0.037859	7.50	Circular	108.00	6.36	
	J-5				201.00	198.32	0.051852	14.71	15 inch			
P-8	J-5	N/A	N/A	0.00	201.00	198.32	0.029000	11.00	Circular	43.00	8.96	
	J-6				197.89	197.07	0.051860	14.71	15 inch			

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Description
P-9	J-6	N/A	N/A	0.00	197.89	195.78	0.029367	18.00	Circular	69.00	10.19	
	J-7				194.78	193.76	0.042174	21.57	18 inch			
P-10	J-7	N/A	N/A	0.00	194.78	192.79	0.029367	18.00	Circular	59.00	10.19	
	J-8				192.27	191.06	0.039153	20.78	18 inch			
P-11	J-8	N/A	N/A	0.00	192.27	190.09	0.029367	18.00	Circular	59.00	10.19	
	J-9				191.23	188.36	0.031695	18.70	18 inch			
P-12	J-9	N/A	N/A	0.00	191.23	187.32	0.112995	27.40	Circular	9.00	9.01	
	J-13				191.00	186.37	0.114444	76.53	24 inch			
P-13	J-13	N/A	N/A	0.00	191.00	186.37	0.106785	33.00	Circular	137.00	10.60	
	J-11				174.00	171.81	0.114380	76.50	24 inch			
P-14	J-11	N/A	N/A	0.00	174.00	170.29	0.009085	137.40	Circular	63.00	11.38	
	J-12				172.00	170.03	0.025873	231.04	48 inch			
P-15	J-12	N/A	N/A	0.00	172.00	168.68	0.015847	140.40	Circular	139.00	14.78	
	Outlet				165.50	163.93	0.026403	233.39	48 inch			

Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Description
P-23	I-10	J-12	77.00	0.00	0.00	0.00	0.00	0.00	12 inch	6.83	4.31	171.00	168.17	0.036753	
P-22	I-9	J-10	129.00	0.00	0.00	0.00	0.00	0.00	12 inch	4.76	2.67	182.80	180.50	0.017829	
P-20	I-8	J-10	210.00	0.00	0.00	0.00	0.00	0.00	48 inch	203.13	9.13	182.20	178.00	0.020000	
P-21	J-10	J-11	298.00	N/A	N/A	N/A	0.00	N/A	48 inch	275.96	9.16	177.80	166.80	0.036913	
P-19	I-7	J-13	4.00	0.00	0.00	0.00	0.00	0.00	12 inch	15.93	9.03	186.40	185.60	0.200000	
P-18	I-6	J-9	33.00	0.00	0.00	0.00	0.00	0.00	15 inch	16.68	7.77	187.90	185.70	0.066667	
P-17	I-5	J-6	114.00	0.00	0.00	0.00	0.00	0.00	18 inch	12.48	3.96	195.00	193.39	0.014123	
P-16	I-4	J-5	34.00	0.00	0.00	0.00	0.00	0.00	12 inch	5.04	4.46	197.30	196.62	0.020000	
P-26	I-3	J-16	159.00	0.00	0.00	0.00	0.00	0.00	12 inch	10.80	8.94	268.70	254.10	0.091824	
P-25	J-16	J-15	354.00	N/A	N/A	N/A	0.00	N/A	12 inch	11.11	8.94	253.90	219.48	0.097232	
P-24	J-15	J-14	64.00	N/A	N/A	N/A	0.00	N/A	12 inch	10.08	8.94	219.28	214.16	0.080000	
P-4	J-14	J-2	67.00	N/A	N/A	N/A	0.00	N/A	12 inch	13.71	8.94	213.96	204.04	0.148060	
P-2	I-2	J-1	60.00	0.00	0.00	0.00	0.00	0.00	12 inch	2.76	0.32	205.10	204.74	0.006000	
P-1	I-1	J-1	64.00	0.00	0.00	0.00	0.00	0.00	12 inch	2.67	0.32	205.10	204.74	0.005625	
P-3	J-1	J-2	126.00	N/A	N/A	N/A	0.00	N/A	12 inch	2.24	0.64	204.54	204.04	0.003968	
P-5	J-2	J-3	39.00	N/A	N/A	N/A	0.00	N/A	15 inch	4.14	6.11	203.84	203.68	0.004103	
P-6	J-3	J-4	66.00	N/A	N/A	N/A	0.00	N/A	15 inch	11.41	6.36	203.48	201.42	0.031212	
P-7	J-4	J-5	108.00	N/A	N/A	N/A	0.00	N/A	15 inch	14.71	6.36	201.22	195.62	0.051852	
P-8	J-5	J-6	43.00	N/A	N/A	N/A	0.00	N/A	15 inch	14.71	8.96	195.62	193.39	0.051860	
P-9	J-6	J-7	69.00	N/A	N/A	N/A	0.00	N/A	18 inch	21.57	10.19	193.19	190.28	0.042174	
P-10	J-7	J-8	59.00	N/A	N/A	N/A	0.00	N/A	18 inch	20.78	10.19	190.08	187.77	0.039153	
P-11	J-8	J-9	59.00	N/A	N/A	N/A	0.00	N/A	18 inch	18.70	10.19	187.57	185.70	0.031695	
P-12	J-9	J-13	9.00	N/A	N/A	N/A	0.00	N/A	24 inch	76.53	9.01	185.50	184.47	0.114444	
P-13	J-13	J-11	137.00	N/A	N/A	N/A	0.00	N/A	24 inch	76.50	10.60	184.47	168.80	0.114380	
P-14	J-11	J-12	63.00	N/A	N/A	N/A	0.00	N/A	48 inch	231.04	11.38	166.80	165.17	0.025873	
P-15	J-12	Outlet	139.00	N/A	N/A	N/A	0.00	N/A	48 inch	233.39	14.78	165.17	161.50	0.026403	

```
------------------ Beginning Calculation Cycle ------------------
Discharge: 0.25 cfs  at node I-1
Discharge: 0.25 cfs  at node I-2
Discharge: 0.50 cfs  at node J-1
Discharge: 7.00 cfs  at node I-3
Discharge: 7.00 cfs  at node J-16
Discharge: 7.00 cfs  at node J-15
Discharge: 7.00 cfs  at node J-14
Discharge: 7.50 cfs  at node J-2
Discharge: 7.50 cfs  at node J-3
Discharge: 7.50 cfs  at node J-4
Discharge: 3.50 cfs  at node I-4
Discharge: 11.00 cfs  at node J-5
Discharge: 7.00 cfs  at node I-5
Discharge: 18.00 cfs  at node J-6
Discharge: 18.00 cfs  at node J-7
Discharge: 18.00 cfs  at node J-8
Discharge: 9.40 cfs  at node I-6
Discharge: 27.40 cfs  at node J-9
Discharge: 5.60 cfs  at node I-7
Discharge: 33.00 cfs  at node J-13
Discharge: 103.00 cfs  at node I-8
Discharge: 1.40 cfs  at node I-9
Discharge: 104.40 cfs  at node J-10
Discharge: 137.40 cfs  at node J-11
Discharge: 3.00 cfs  at node I-10
Discharge: 140.40 cfs  at node J-12
Discharge: 140.40 cfs  at node Outlet
Beginning iteration 1
Discharge: 0.25 cfs  at node I-1
Discharge: 0.25 cfs  at node I-2
Discharge: 0.50 cfs  at node J-1
Discharge: 7.00 cfs  at node I-3
Discharge: 7.00 cfs  at node J-16
Discharge: 7.00 cfs  at node J-15
Discharge: 7.00 cfs  at node J-14
Discharge: 7.50 cfs  at node J-2
Discharge: 7.50 cfs  at node J-3
Discharge: 7.50 cfs  at node J-4
Discharge: 3.50 cfs  at node I-4
Discharge: 11.00 cfs  at node J-5
Discharge: 7.00 cfs  at node I-5
Discharge: 18.00 cfs  at node J-6
Discharge: 18.00 cfs  at node J-7
Discharge: 18.00 cfs  at node J-8
Discharge: 9.40 cfs  at node I-6
Discharge: 27.40 cfs  at node J-9
Discharge: 5.60 cfs  at node I-7
Discharge: 33.00 cfs  at node J-13
Discharge: 103.00 cfs  at node I-8
Discharge: 1.40 cfs  at node I-9
Discharge: 104.40 cfs  at node J-10
Discharge: 137.40 cfs  at node J-11
Discharge: 3.00 cfs  at node I-10
Discharge: 140.40 cfs  at node J-12
Discharge: 140.40 cfs  at node Outlet
Discharge Convergence Achieved in 1 iterations: relative error:  0.0
** Warning: Design constraints not met.
Warning: No Duration data exists in IDF Table
Information: Outlet Known flow propagated from upstream junctions.
Violation: P-15 does not meet minimum cover constraint at downstream end.
Information: J-12 Known flow propagated from upstream junctions.
Information: J-11 Known flow propagated from upstream junctions.
Information: J-10 Known flow propagated from upstream junctions.
Information: J-13 Known flow propagated from upstream junctions.
Violation: P-19 does not meet maximum slope constraint (try drop structure).
Information: J-9 Known flow propagated from upstream junctions.
Information: P-11 Surcharged condition
Information: J-8 Known flow propagated from upstream junctions.
```

```
Information: P-10 Surcharged condition
Information: J-7 Known flow propagated from upstream junctions.
Information: P-9 Surcharged condition
Information: J-6 Known flow propagated from upstream junctions.
Information: P-8 Surcharged condition
Information: P-17 Surcharged condition
Information: J-5 Known flow propagated from upstream junctions.
Information: P-16 Surcharged condition
Information: J-4 Known flow propagated from upstream junctions.
Information: J-3 Known flow propagated from upstream junctions.
Information: P-5 Surcharged condition
Information: J-2 Known flow propagated from upstream junctions.
Information: P-3 Surcharged condition
Violation: P-3 does not meet minimum slope constraint.
Information: J-14 Known flow propagated from upstream junctions.
Information: J-15 Known flow propagated from upstream junctions.
Information: J-16 Known flow propagated from upstream junctions.
Information: J-1 Known flow propagated from upstream junctions.
Violation: P-1 does not meet minimum velocity constraint.
Violation: P-2 does not meet minimum velocity constraint.
--------------------- Calculations Complete ---------------------

** Analysis Options **
Friction method:  Manning's Formula
HGL Convergence Test:  0.001000
Maximum Network Traversals:  5
Number of Flow Profile Steps:  5
Discharge Convergence Test:  0.001000
Maximum Design Passes:  3
```

----------------- Network Quick View -----------------------

Label	Length	Size	Discharge	Hydraulic Grade Upstream	Hydraulic Grade Downstream
P-1	64.00	12 inch	0.25	206.06	206.05
P-2	60.00	12 inch	0.25	206.06	206.05
P-3	126.00	12 inch	0.50	206.05	206.02
P-5	39.00	15 inch	7.50	205.50	204.98
P-6	66.00	15 inch	7.50	204.57	202.72
P-7	108.00	15 inch	7.50	202.31	198.32
P-8	43.00	15 inch	11.00	198.32	197.07
P-9	69.00	18 inch	18.00	195.78	193.76
P-10	59.00	18 inch	18.00	192.79	191.06
P-11	59.00	18 inch	18.00	190.09	188.36
P-12	9.00	24 inch	27.40	187.32	186.37
P-13	137.00	24 inch	33.00	186.37	171.81
P-14	63.00	48 inch	137.40	170.29	170.03
P-15	139.00	48 inch	140.40	168.68	163.93
P-16	34.00	12 inch	3.50	198.65	198.32
P-17	114.00	18 inch	7.00	197.58	197.07
P-18	33.00	15 inch	9.40	189.07	188.36
P-19	4.00	12 inch	5.60	187.34	186.23
P-20	210.00	48 inch	103.00	185.27	181.83
P-21	298.00	48 inch	104.40	180.89	171.81

Label	Length	Size	Discharge	Hydraulic Grade Upstream	Hydraulic Grade Downstream
P-22	129.00	12 inch	1.40	183.30	181.83
P-23	77.00	12 inch	3.00	171.74	170.03
P-24	64.00	12 inch	7.00	220.26	215.94
P-4	67.00	12 inch	7.00	214.94	206.02
P-25	354.00	12 inch	7.00	254.88	221.01
P-26	159.00	12 inch	7.00	269.68	255.63

Label	Discharge	Elevations Ground	Elevations Upstream HGL	Elevations Downstream HGL
I-1	0.25	208.10	206.06	206.06
I-2	0.25	208.10	206.06	206.06

I-4	3.50	200.30	198.65	198.65
I-5	7.00	198.50	197.70	197.58
I-6	9.40	191.40	189.55	189.07
I-7	5.60	191.40	187.76	187.34
I-8	103.00	188.70	186.04	185.27
I-9	1.40	185.80	183.40	183.30
I-10	3.00	174.00	171.92	171.74
J-1	0.50	210.76	206.05	206.05
J-2	7.50	210.66	206.02	205.50
J-3	7.50	208.72	204.98	204.57
J-4	7.50	205.67	202.72	202.31
J-5	11.00	201.00	198.32	198.32
J-6	18.00	197.89	197.07	195.78
J-7	18.00	194.78	193.76	192.79
J-8	18.00	192.27	191.06	190.09
J-9	27.40	191.23	188.36	187.32
J-10	104.40	184.50	181.83	180.89
J-11	137.40	174.00	171.81	170.29
		----------- Elevations ----------------		
Label	Discharge	Ground	Upstream HGL	Downstream HGL
J-12	140.40	172.00	170.03	168.68
J-13	33.00	191.00	186.37	186.37
Outlet	140.40	165.50	163.74	163.74
J-15	7.00	224.00	221.01	220.26
J-16	7.00	258.10	255.63	254.88
I-3	7.00	271.70	269.68	269.68
J-14	7.00	217.96	215.94	214.94

Elapsed: 0 minute(s) 5 second(s)

MISCELLANEOUS HYDRAULIC CALCULATIONS

P1

Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\vest.fm2
Worksheet	55'rw
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.023800 ft/ft

Elevation range: 0.00 ft to 3.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	3.00	0.00	55.00	0.016
0.00	0.63			
6.50	0.50			
6.50	0.00			
8.00	0.21			
27.50	0.60			
47.00	0.21			
48.50	0.00			
48.50	0.50			
55.00	0.63			
55.00	3.00			

Discharge 60.00 cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.64	ft
Flow Area	11.82	ft²
Wetted Perimeter	56.06	ft
Top Width	55.00	ft
Height	0.64	ft
Critical Depth	0.76	ft
Critical Slope	0.005551	ft/ft
Velocity	5.08	ft/s
Velocity Head	0.40	ft
Specific Energy	1.04	ft
Froude Number	1.93	

Flow is supercritical.

P3
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\vest.fm2
Worksheet	55'rw
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.036000 ft/ft

Elevation range: 0.00 ft to 3.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	3.00	0.00	55.00	0.016
0.00	0.63			
6.50	0.50			
6.50	0.00			
8.00	0.21			
27.50	0.60			
47.00	0.21			
48.50	0.00			
48.50	0.50			
55.00	0.63			
55.00	3.00			

Discharge 18.00 cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.45	ft
Flow Area	3.82	ft²
Wetted Perimeter	27.56	ft
Top Width	26.63	ft
Height	0.45	ft
Critical Depth	0.56	ft
Critical Slope	0.006893	ft/ft
Velocity	4.72	ft/s
Velocity Head	0.35	ft
Specific Energy	0.79	ft
Froude Number	2.20	

Flow is supercritical.
Flow is divided.

P4a
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\vest.fm2
Worksheet	55'rw
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.035800 ft/ft

Elevation range: 0.00 ft to 3.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	3.00	0.00	55.00	0.016
0.00	0.63			
6.50	0.50			
6.50	0.00			
8.00	0.21			
27.50	0.60			
47.00	0.21			
48.50	0.00			
48.50	0.50			
55.00	0.63			
55.00	3.00			

Discharge 6.00 cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.35	ft
Flow Area	1.64	ft²
Wetted Perimeter	17.28	ft
Top Width	16.56	ft
Height	0.35	ft
Critical Depth	0.41	ft
Critical Slope	0.007776	ft/ft
Velocity	3.66	ft/s
Velocity Head	0.21	ft
Specific Energy	0.55	ft
Froude Number	2.05	

Flow is supercritical.
Flow is divided.

P4b
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\vest.fm2
Worksheet	55'rw
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.042000 ft/ft

Elevation range: 0.00 ft to 3.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	3.00	0.00	55.00	0.016
0.00	0.63			
6.50	0.50			
6.50	0.00			
8.00	0.21			
27.50	0.60			
47.00	0.21			
48.50	0.00			
48.50	0.50			
55.00	0.63			
55.00	3.00			

Discharge 12.00 cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.40	ft
Flow Area	2.64	ft²
Wetted Perimeter	22.59	ft
Top Width	21.77	ft
Height	0.40	ft
Critical Depth	0.49	ft
Critical Slope	0.007090	ft/ft
Velocity	4.55	ft/s
Velocity Head	0.32	ft
Specific Energy	0.72	ft
Froude Number	2.30	

Flow is supercritical.
Flow is divided.

P6
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\vest.fm2
Worksheet	55'rw
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.100000 ft/ft

Elevation range: 0.00 ft to 3.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	3.00	0.00	55.00	0.016
0.00	0.63			
6.50	0.50			
6.50	0.00			
8.00	0.21			
27.50	0.60			
47.00	0.21			
48.50	0.00			
48.50	0.50			
55.00	0.63			
55.00	3.00			

Discharge 4.00 cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.28	ft
Flow Area	0.78	ft²
Wetted Perimeter	10.69	ft
Top Width	10.10	ft
Height	0.28	ft
Critical Depth	0.37	ft
Critical Slope	0.008201	ft/ft
Velocity	5.13	ft/s
Velocity Head	0.41	ft
Specific Energy	0.69	ft
Froude Number	3.25	

Flow is supercritical.
Flow is divided.

P7

Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\vest.fm2
Worksheet	55'rw
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.038000 ft/ft

Elevation range: 0.00 ft to 3.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	3.00	0.00	55.00	0.016
0.00	0.63			
6.50	0.50			
6.50	0.00			
8.00	0.21			
27.50	0.60			
47.00	0.21			
48.50	0.00			
48.50	0.50			
55.00	0.63			
55.00	3.00			

Discharge 2.00 cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.27	ft
Flow Area	0.65	ft²
Wetted Perimeter	9.29	ft
Top Width	8.72	ft
Height	0.27	ft
Critical Depth	0.32	ft
Critical Slope	0.008945	ft/ft
Velocity	3.08	ft/s
Velocity Head	0.15	ft
Specific Energy	0.41	ft
Froude Number	1.99	

Flow is supercritical.
Flow is divided.

P8
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\vest.fm2
Worksheet	55'rw
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.029500 ft/ft

Elevation range: 0.00 ft to 3.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	3.00	0.00	55.00	0.016
0.00	0.63			
6.50	0.50			
6.50	0.00			
8.00	0.21			
27.50	0.60			
47.00	0.21			
48.50	0.00			
48.50	0.50			
55.00	0.63			
55.00	3.00			

Discharge 2.00 cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.28	ft
Flow Area	0.73	ft²
Wetted Perimeter	10.14	ft
Top Width	9.56	ft
Height	0.28	ft
Critical Depth	0.32	ft
Critical Slope	0.008947	ft/ft
Velocity	2.75	ft/s
Velocity Head	0.12	ft
Specific Energy	0.39	ft
Froude Number	1.76	

Flow is supercritical.

Flow is divided.

P9

Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\vest.fm2
Worksheet	55'rw
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.037100 ft/ft

Elevation range: 0.00 ft to 3.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	3.00	0.00	55.00	0.016
0.00	0.63			
6.50	0.50			
6.50	0.00			
8.00	0.21			
27.50	0.60			
47.00	0.21			
48.50	0.00			
48.50	0.50			
55.00	0.63			
55.00	3.00			

Discharge 12.00 cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.40	ft
Flow Area	2.77	ft²
Wetted Perimeter	23.19	ft
Top Width	22.35	ft
Height	0.40	ft
Critical Depth	0.49	ft
Critical Slope	0.007090	ft/ft
Velocity	4.34	ft/s
Velocity Head	0.29	ft
Specific Energy	0.70	ft
Froude Number	2.17	

Flow is supercritical.

Flow is divided.

APPENDIX III

HEC-1 ANALYSIS OUTPUT

EXISTING SUBBASINS OUTPUT

```
HEC1 S/N: 1343001727        HMVersion: 6.33    Data File: allex100.dat

****************************************                                 ****************************************
*                                      *                                 *                                      *
*   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  12/03/1996  TIME  13:53:51 *                                *          (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
   2           ID
   3           ID   BARKER HOMES, INC.
   4           ID   1955 BARING BLVD.
   5           ID   SPARKS, NV 89434
   6           ID
   7           ID   DESERT HIGHLANDS-UNITS 2&5 - OVERALL EXISTING OFFSITE BASINS
   8           ID   DECEMBER 1996
   9           ID   INPUT FILE NAME:  ALLEX100.DAT
  10           ID   INPUT FILE NAME:  ALLEX100.OUT
  11           ID
  12           ID   PRE-DEVELOPED CONDITION FOR BASINS
  13           ID   Q100-24 HOUR STORM
  14           ID
  15           ID   RAINFALL FROM NOAA ATLAS 14-VOL 1-SEMI ARID SOUTHWEST U.S.
  16           ID   24-HOUR RAINFALL DERIVED FROM REGIONAL GROWTH FACTORS AS PER WASHOE
  17           ID   COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (WCDDM) TABLE 601
  18           ID
  19           ID
  20           ID   LAG TIMES COMPUTED USING STANDARED FORM 2 OF WCDDM
  21           ID   DEPTH-AREA-REDUCTION-FACTORS (DARF'S) COMPUTED USING
  22           ID   FIGURE 604 OF WCDDM-CURVE NUMBERS FROM SCS TABLES
  23           ID   MUSKINGUM-CUNGE ROUTING METHODOLOGY
  24           ID
  25           ID
               *DIAGRAM
*** FREE ***
  26           IT       8       0       0     300
  27           IN      15
  28           IO       5
  29           JR    PREC    1.00   0.993
               *

  30           KK       A
  31           KM   RUNOFF FROM EXISTING BASIN A
  32           BA   0.848
  33           LS       0      75
  34           PH                       0.48    0.87    1.45    1.49    1.52    1.58    2.12    2.66
  35           UD   0.456
               *

  36           KK   RT-AB
  37           KM   ROUTE BASIN A THROUGH BASIN B
  38           RD    5880  0.0442   0.025           TRAP       0       3
               *

  39           KK       B
  40           KM   RUNOFF FROM EXISTING BASIN B
  41           BA   0.917
  42           LS       0      75
  43           UD   0.589
               *
```

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

 44            KK  COM-AB
 45            HC       2
               *

 46            KK   RT-BE
 47            KM   ROUTE A AND B THROUGH E
 48            RD    5500  0.0291   0.025            TRAP        0       3
               *

 49            KK       C
 50            KM   RUNOFF FROM EXISTING BASIN C
 51            BA   0.691
 52            LS       0       75
 53            UD   0.527
               *

 54            KK   RT-CE
 55            RD    5200  0.0308   0.025            TRAP        0       3
               *

 56            KK      D1
 57            KM   RUNOFF FROM EXISTING BASIN D
 58            BA   0.367
 59            LS       0       75
 60            UD   0.329
               *

 61            KK     D1b
 62            BA   0.004
 63            LS       0       75
 64            UD   0.083
               *

 65            KK      D2
 66            BA   0.021
 67            LS       0       87
 68            UD   0.110
               *

 69            KK  COM-PR
 70            KM   COMBINE D1,D1b & D2
 71            HC       3
               *

 72            KK   RT-PR
 73            KM   ROUTE COMB TO D3
 74            RD    1050   0.040   0.025            TRAP       10       3
               *
```

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


  75            KK      D4
  76            BA   0.009
  77            LS       0      87
  78            UD   0.101
                *

  79            KK   RT-D4
  80            KM   ROUTE D4 TO D3
  81            RD     500   0.040   0.025              TRAP       10        3
                *

  82            KK      D3
  83            BA   0.011
  84            LS       0      75
  85            UD   0.097
                *

  86            KK      D5
  87            BA   0.002
  88            LS       0      87
  89            UD   0.072
                *

  90            KK      D6
  91            BA   0.001
  92            LS       0      87
  93            UD   0.035
                *

  94            KK COM-PR2
  95            KM   COMBINE RT-PR,RT-D4,D3,D5,D6
  96            HC       5
                *
                * NULL ROUTE
                * ROUTE IS SHORT-LEFT OUT
                * KK RT-ALL
                * KM ROUTE TO A7 THROUGH 48"PIPE
                * RD 190,0.064,0.013,,CIRC,4
                *

  97            KK      D7
  98            BA   0.003
  99            LS       0      87
 100            UD   0.119
                *

 101            KK  COM-D7
 102            KM   COMBINE ALL WITH D7
 103            HC       2
                *
                * NULL ROUTE
                * ROUTE IS SHORT-LEFT OUT
                * KK RT-D7
                * KM ROUTE TO A8 THROUGH 48" PIPE
                * RD 110,0.064,0.013,,CIRC,4
```

```
* RD 140,0.0142,0.013,,CIRC,4
*
```

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


 104           KK      D8
 105           BA   0.011
 106           LS       0      87
 107           UD   0.110
               *

 108           KK  COM-D8
 109           KM   COMBINE D8 WITH ALL
 110           HC       2
               *
               * NULL ROUTE
               * ROUTE IS SHORT-LEFT OUT
               * KK RT-D8
               * KM ROUTE TO D9 THROUGH 54" PIPE
               * RD 160,0 005,0.013,,CIRC,4.5
               *

 111           KK      D9
 112           BA   0.007
 113           LS       0      87
 114           UD   0.100
               *

 115           KK  COM-D9
 116           KM   COMBINE D9 WITH ALL
 117           HC       2
               *

 118           KK    DIV1
 119           KM   DIVERT PORTION OF FLOW NORTH PER
 120           KM   SUMMIT ENGINEERING MODEL
 121           DT    DIV1
 122           DI       0      50     100     150     174
 123           DQ       0      27      54      81      94
               *

 124           KK     D10
 125           BA  0.0009
 126           LS       0      98
 127           UD   0.057
               *

 128           KK     D12
 129           BA   0.008
 130           LS       0      75
 131           UD   0.087
               *

 132           KK  RT-D12
 133           KM   ROUTE D12 THROUGH D11
 134           RD     720   0.044   0.015            TRAP      50       5
               *
```

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


 135          KK     D11
 136          BA   0.022
 137          LS       0      87
 138          UD   0.103
              *

 139          KK COM-D11
 140          KM   COMBINE D12 AND D11
 141          HC       4
              *

 142          KK  RT-D11
 143          KM   ROUTE ALL THROUGH D13
 144          RD    2163  0.0277   0.025            TRAP       0       3
              *

 145          KK     D13
 146          KM   RUNOFF FROM EXISTING BASIN D13
 147          BA   0.238
 148          LS       0      75
 149          UD   0.344
              *

 150          KK COM-D13
 151          KM   COMBINE D13 WITH UPSTREAM
 152          HC       2
              *

 153          KK RT-D13E
 154          KM   ROUTE D13 THROUGH E
 155          RD    5100  0.0314   0.025            TRAP       0       3
              *

 156          KK       E
 157          KM   RUNOFF FROM EXISTING BASIN E
 158          BA   0.575
 159          LS       0      75
 160          UD   0.648
              *

 161          KK  CM-ALL
 162          HC       4
              *
 163          ZZ
```

```
                SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   30            A
                 V
                 V
   36        RT-AB
                 .
                 .
   39            .           B
                 .           .
                 .           .
   44      COM-AB.............
                 V
                 V
   46        RT-BE
                 .
                 .
   49            .           C
                 .           V
                 .           V
   54            .       RT-CE
                 .           .
                 .           .
   56            .           .          D1
                 .           .           .
                 .           .           .
   61            .           .           .         D1b
                 .           .           .           .
                 .           .           .           .
   65            .           .           .           .          D2
                 .           .           .           .           .
                 .           .           .           .           .
   69            .           .     COM-PR.........................
                 .           .           V
                 .           .           V
   72            .           .       RT-PR
                 .           .           .
                 .           .           .
   75            .           .           .          D4
                 .           .           .           V
                 .           .           .           V
   79            .           .           .       RT-D4
                 .           .           .           .
                 .           .           .           .
   82            .           .           .           .          D3
                 .           .           .           .           .
                 .           .           .           .           .
   86            .           .           .           .           .          D5
                 .           .           .           .           .           .
                 .           .           .           .           .           .
   90            .           .           .           .           .           .          D6
                 .           .           .           .           .           .           .
                 .           .           .           .           .           .           .
   94            .           .    COM-PR2.................................................
                 .           .           .
```

```
                  .           .            .
  97              .           .            .          D7
                  .           .            .           .
                  .           .            .           .
 101              .           .      COM-D7.............
                  .           .            .
                  .           .            .
 104              .           .            .          D8
                  .           .            .           .
                  .           .            .           .
 108              .           .      COM-D8.............
                  .           .            .
                  .           .            .
 111              .           .            .          D9
                  .           .            .           .
                  .           .            .           .
 115              .           .      COM-D9.............
                  .           .            .
                  .           .            .
 121              .           .            .-------->    DIV1
 118              .           .         DIV1
                  .           .            .
                  .           .            .
 124              .           .            .         D10
                  .           .            .           .
                  .           .            .           .
 128              .           .            .           .         D12
                  .           .            .           .           V
                  .           .            .           .           V
 132              .           .            .           .      RT-D12
                  .           .            .           .           .
                  .           .            .           .           .
 135              .           .            .           .           .          D11
                  .           .            .           .           .            .
                  .           .            .           .           .            .
 139              .           .     COM-D11......................................
                  .           .            V
                  .           .            V
 142              .           .      RT-D11
                  .           .            .
                  .           .            .
 145              .           .            .         D13
                  .           .            .           .
                  .           .            .           .
 150              .           .     COM-D13.............
                  .           .            V
                  .           .            V
 153              .           .     RT-D13E
                  .           .            .
                  .           .            .
 156              .           .            .           E
                  .           .            .           .
                  .           .            .           .
 161        CM-ALL......................................

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

HEC1 S/N: 1343001727   HMVersion: 6.33   Data File: allex100.dat

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  12/03/1996  TIME  13:53:51 *
*                                      *
****************************************
```

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

BARKER HOMES, INC.
1955 BARING BLVD.
SPARKS, NV 89434

DESERT HIGHLANDS-UNITS 2&5 - OVERALL EXISTING OFFSITE BASINS
DECEMBER 1996
INPUT FILE NAME: ALLEX100.DAT
INPUT FILE NAME: ALLEX100.OUT

PRE-DEVELOPED CONDITION FOR BASINS
Q100-24 HOUR STORM

RAINFALL FROM NOAA ATLAS 14-VOL 1-SEMI ARID SOUTHWEST U.S.
24-HOUR RAINFALL DERIVED FROM REGIONAL GROWTH FACTORS AS PER WASHOE
COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (WCDDM) TABLE 601

LAG TIMES COMPUTED USING STANDARED FORM 2 OF WCDDM
DEPTH-AREA-REDUCTION-FACTORS (DARF'S) COMPUTED USING
FIGURE 604 OF WCDDM-CURVE NUMBERS FROM SCS TABLES
MUSKINGUM-CUNGE ROUTING METHODOLOGY

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

    IT        HYDROGRAPH TIME DATA
                     NMIN            8  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1     0  STARTING DATE
                    ITIME         0000  STARTING TIME
                       NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      2     0  ENDING DATE
                   NDTIME         1552  ENDING TIME
                    ICENT           19  CENTURY MARK

               COMPUTATION INTERVAL    0.13 HOURS
                    TOTAL TIME BASE   39.87 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

JP MULTI-PLAN OPTION

NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION

RATIOS OF PRECIPITATION

1.00 0.99

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 1.00	RATIO 2 0.99
HYDROGRAPH AT						
	A	0.85	1	FLOW	267.	262.
				TIME	12.53	12.67
ROUTED TO						
	RT-AB	0.85	1	FLOW	268.	264.
				TIME	12.67	12.67
HYDROGRAPH AT						
	B	0.92	1	FLOW	246.	241.
				TIME	12.80	12.80
2 COMBINED AT						
	COM-AB	1.76	1	FLOW	512.	503.
				TIME	12.67	12.67
ROUTED TO						
	RT-BE	1.76	1	FLOW	509.	501.
				TIME	12.80	12.80
HYDROGRAPH AT						
	C	0.69	1	FLOW	203.	199.
				TIME	12.67	12.67
ROUTED TO						
	RT-CE	0.69	1	FLOW	200.	196.
				TIME	12.80	12.80
HYDROGRAPH AT						
	D1	0.37	1	FLOW	141.	138.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D1b	0.00	1	FLOW	3.	3.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D2	0.02	1	FLOW	27.	26.
				TIME	12.13	12.13
3 COMBINED AT						
	COM-PR	0.39	1	FLOW	155.	152.
				TIME	12.40	12.40
ROUTED TO						
	RT-PR	0.39	1	FLOW	151.	148.
				TIME	12.40	12.40
HYDROGRAPH AT						

	D4	0.01	1	FLOW	12.	12.
				TIME	12.13	12.13
ROUTED TO						
	RT-D4	0.01	1	FLOW	11.	11.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D3	0.01	1	FLOW	7.	7.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D5	0.00	1	FLOW	3.	3.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D6	0.00	1	FLOW	2.	2.
				TIME	12.13	12.13
5 COMBINED AT						
	COM-PR2	0.42	1	FLOW	161.	159.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D7	0.00	1	FLOW	4.	4.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D7	0.42	1	FLOW	163.	161.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D8	0.01	1	FLOW	14.	14.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D8	0.43	1	FLOW	170.	167.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D9	0.01	1	FLOW	10.	9.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D9	0.44	1	FLOW	174.	171.
				TIME	12.40	12.40
DIVERSION TO						
	DIV1	0.44	1	FLOW	94.	93.
				TIME	12.40	12.40
HYDROGRAPH AT						
	DIV1	0.44	1	FLOW	80.	79.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D10	0.00	1	FLOW	2.	2.
				TIME	12.13	12.13
HYDROGRAPH AT						

	D12	0.01	1	FLOW	6.	5.
				TIME	12.13	12.13
ROUTED TO						
	RT-D12	0.01	1	FLOW	5.	5.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D11	0.02	1	FLOW	29.	29.
				TIME	12.13	12.13
4 COMBINED AT						
	COM-D11	0.47	1	FLOW	103.	102.
				TIME	12.27	12.27
ROUTED TO						
	RT-D11	0.47	1	FLOW	100.	99.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D13	0.24	1	FLOW	89.	87.
				TIME	12.53	12.53
2 COMBINED AT						
	COM-D13	0.70	1	FLOW	188.	185.
				TIME	12.40	12.40
ROUTED TO						
	RT-D13E	0.70	1	FLOW	182.	184.
				TIME	12.53	12.53
HYDROGRAPH AT						
	E	0.57	1	FLOW	146.	144.
				TIME	12.80	12.80
4 COMBINED AT						
	CM-ALL	3.74	1	FLOW	990.	973.
				TIME	12.80	12.80

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)

FOR PLAN = 1 RATIO= 0.00

RT-AB	MANE	2.80	269.16	761.60	0.74	8.00	268.08	760.00	0.74

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3364E+02 EXCESS=0.0000E+00 OUTFLOW=0.3365E+02 BASIN STORAGE=0.1362E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-AB	MANE	3.20	265.29	761.60	0.73	8.00	264.16	760.00	0.73

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3314E+02 EXCESS=0.0000E+00 OUTFLOW=0.3315E+02 BASIN STORAGE=0.1588E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-BE	MANE	3.60	509.19	766.80	0.74	8.00	508.88	768.00	0.74

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7005E+02 EXCESS=0.0000E+00 OUTFLOW=0.7007E+02 BASIN STORAGE=0.1377E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-BE	MANE	3.60	500.83	766.80	0.73	8.00	500.51	768.00	0.73

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6908E+02 EXCESS=0.0000E+00 OUTFLOW=0.6910E+02 BASIN STORAGE=0.1390E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-CE	MANE	3.20	199.73	768.00	0.74	8.00	199.73	768.00	0.75

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2743E+02 EXCESS=0.0000E+00 OUTFLOW=0.2744E+02 BASIN STORAGE=0.1281E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-CE	MANE	3.20	196.31	768.00	0.73	8.00	196.31	768.00	0.73

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2702E+02 EXCESS=0.0000E+00 OUTFLOW=0.2702E+02 BASIN STORAGE=0.1271E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-PR	MANE	1.48	154.13	746.43	0.78	8.00	150.52	744.00	0.78

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1636E+02 EXCESS=0.0000E+00 OUTFLOW=0.1636E+02 BASIN STORAGE=0.4185E-03 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

```
     RT-PR  MANE        1.48    151.87    745.77      0.77       8.00    148.07    744.00        0.77

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1612E+02 EXCESS=0.0000E+00 OUTFLOW=0.1612E+02 BASIN STORAGE=0.4591E-03 PERCENT ERROR=   0.0

  FOR PLAN = 1  RATIO= 0.00
     RT-D4  MANE        1.48     12.09    729.91      1.45       8.00     10.91    728.00        1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6941E+00 EXCESS=0.0000E+00 OUTFLOW=0.6941E+00 BASIN STORAGE=0.2240E-03 PERCENT ERROR=   0.0

  FOR PLAN = 1  RATIO= 0.00
     RT-D4  MANE        1.49     11.89    729.33      1.43       8.00     10.84    728.00        1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6866E+00 EXCESS=0.0000E+00 OUTFLOW=0.6867E+00 BASIN STORAGE=0.2145E-03 PERCENT ERROR=   0.0

  FOR PLAN = 1  RATIO= 0.00
    RT-D12  MANE        1.60      5.65    731.20      0.75       8.00      4.59    736.00        0.75

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3183E+00 EXCESS=0.0000E+00 OUTFLOW=0.3184E+00 BASIN STORAGE=0.5345E-03 PERCENT ERROR=  -0.2

  FOR PLAN = 1  RATIO= 0.00
    RT-D12  MANE        1.60      5.55    731.20      0.73       8.00      4.52    736.00        0.74

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3134E+00 EXCESS=0.0000E+00 OUTFLOW=0.3136E+00 BASIN STORAGE=0.5309E-03 PERCENT ERROR=  -0.2

  FOR PLAN = 1  RATIO= 0.00
    RT-D11  MANE        3.44    102.14    740.30      0.44       8.00    100.01    744.00        0.44

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1104E+02 EXCESS=0.0000E+00 OUTFLOW=0.1104E+02 BASIN STORAGE=0.6195E-03 PERCENT ERROR=   0.0

  FOR PLAN = 1  RATIO= 0.00
    RT-D11  MANE        3.46    100.35    739.79      0.44       8.00     98.61    744.00        0.44

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1089E+02 EXCESS=0.0000E+00 OUTFLOW=0.1090E+02 BASIN STORAGE=0.6473E-03 PERCENT ERROR=   0.0

  FOR PLAN = 1  RATIO= 0.00
   RT-D13E  MANE        6.67    182.40    754.14      0.54       8.00    181.70    752.00        0.54

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2046E+02 EXCESS=0.0000E+00 OUTFLOW=0.2048E+02 BASIN STORAGE=0.1268E-02 PERCENT ERROR=  -0.1

  FOR PLAN = 1  RATIO= 0.00
   RT-D13E  MANE        6.70    186.69    750.45      0.54       8.00    183.84    752.00        0.54

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2026E+02 EXCESS=0.0000E+00 OUTFLOW=0.2027E+02 BASIN STORAGE=0.1300E-02 PERCENT ERROR=  -0.1
```

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

```
HEC1 S/N: 1343001727        HMVersion: 6.33    Data File: allex5.dat

*****************************************                ***************************************
*                                       *                *                                     *
*   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  12/03/1996  TIME  14:04:32 *                *         (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
   2         ID
   3         ID   BARKER HOMES, INC.
   4         ID   1955 BARING BLVD.
   5         ID   SPARKS, NV 89434
   6         ID
   7         ID   DESERT HIGHLANDS-UNITS 2&5 - OVERALL EXISTING OFFSITE BASINS
   8         ID   DECEMBER 1996
   9         ID   INPUT FILE NAME:  ALLEX5.DAT
  10         ID   INPUT FILE NAME:  ALLEX5.OUT
  11         ID
  12         ID   PRE-DEVELOPED CONDITION FOR BASINS
  13         ID   Q5-24 HOUR STORM
  14         ID
  15         ID   RAINFALL FROM NOAA ATLAS 14-VOL 1-SEMI ARID SOUTHWEST U.S.
  16         ID   24-HOUR RAINFALL DERIVED FROM REGIONAL GROWTH FACTORS AS PER WASHOE
  17         ID   COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (WCDDM) TABLE 601
  18         ID
  19         ID
  20         ID   LAG TIMES COMPUTED USING STANDARED FORM 2 OF WCDDM
  21         ID   DEPTH-AREA-REDUCTION-FACTORS (DARF'S) COMPUTED USING
  22         ID   FIGURE 604 OF WCDDM-CURVE NUMBERS FROM SCS TABLES
  23         ID   MUSKINGUM-CUNGE ROUTING METHODOLOGY
  24         ID
  25         ID
             *DIAGRAM
*** FREE ***
  26         IT       8       0       0     300
  27         IN      15
  28         IO       5
  29         JR    PREC    1.00   0.993
             *

  30         KK       A
  31         KM   RUNOFF FROM EXISTING BASIN A
  32         BA   0.848
  33         LS       0      75
  34         PH                       0.18    0.33    0.54    0.65    0.74    0.91    1.22    1.54
  35         UD   0.456
             *

  36         KK   RT-AB
  37         KM   ROUTE BASIN A THROUGH BASIN B
  38         RD    5880  0.0442   0.025           TRAP       0       3
             *

  39         KK       B
  40         KM   RUNOFF FROM EXISTING BASIN B
  41         BA   0.917
  42         LS       0      75
  43         UD   0.589
             *
```

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

  44          KK  COM-AB
  45          HC       2
              *

  46          KK   RT-BE
  47          KM   ROUTE A AND B THROUGH E
  48          RD    5500  0.0291   0.025           TRAP       0       3
              *

  49          KK       C
  50          KM   RUNOFF FROM EXISTING BASIN C
  51          BA   0.691
  52          LS       0      75
  53          UD   0.527
              *

  54          KK   RT-CE
  55          KM   ROUTE C THROUGH E
  56          RD    5200  0.0308   0.025           TRAP       0       3
              *

  57          KK      D1
  58          KM   RUNOFF FROM EXISTING BASIN D
  59          BA   0.367
  60          LS       0      75
  61          UD   0.329
              *

  62          KK     D1b
  63          BA   0.004
  64          LS       0      75
  65          UD   0.083
              *

  66          KK      D2
  67          BA   0.021
  68          LS       0      87
  69          UD   0.110
              *

  70          KK  COM-PR
  71          KM   COMBINE D1,D1b & D2
  72          HC       3
              *

  73          KK   RT-PR
  74          KM   ROUTE COMB TO D3
  75          RD    1050   0.040   0.025           TRAP      10       3
              *
```

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


  76          KK      D4
  77          BA   0.009
  78          LS       0       87
  79          UD   0.101
              *

  80          KK   RT-D4
  81          KM   ROUTE D4 TO D3
  82          RD     500   0.040   0.025               TRAP       10        3
              *

  83          KK      D3
  84          BA   0.011
  85          LS       0       75
  86          UD   0.097
              *

  87          KK      D5
  88          BA   0.002
  89          LS       0       87
  90          UD   0.072
              *

  91          KK      D6
  92          BA   0.001
  93          LS       0       87
  94          UD   0.035
              *

  95          KK     COM
  96          KM   COMBINE RT-PR,RT-D4,D3,D5,D6
  97          HC       5
              *
              * NULL ROUTE
              * ROUTE IS SHORT-LEFT OUT
              * KK RT-ALL
              * KM ROUTE TO A7 THROUGH 48"PIPE
              * RD 190,0.064,0.013,,CIRC,4
              *

  98          KK      D7
  99          BA   0.003
 100          LS       0       87
 101          UD   0.119
              *

 102          KK  COM-D7
 103          KM   COMBINE ALL WITH D7
 104          HC       2
              *
              * NULL ROUTE
              * ROUTE IS SHORT-LEFT OUT
              * KK RT-D7
              * KM ROUTE TO A8 THROUGH 48" PIPE
              * RD 110,0.064,0.013,,CIRC,4
```

```
* RD 140,0.0142,0.013,,CIRC,4
*
```

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


 105           KK      D8
 106           BA   0.011
 107           LS       0      87
 108           UD   0.110
               *

 109           KK  COM-D8
 110           KM   COMBINE D8 WITH ALL
 111           HC       2
               *
               * NULL ROUTE
               * ROUTE IS SHORT-LEFT OUT
               * KK RT-D8
               * KM ROUTE TO D9 THROUGH 54" PIPE
               * RD 160,0.005,0.013,,CIRC,4.5
               *

 112           KK      D9
 113           BA   0.007
 114           LS       0      87
 115           UD   0.100
               *

 116           KK  COM-D9
 117           KM   COMBINE D9 WITH ALL
 118           HC       2
               *

 119           KK    DIV1
 120           KM   DIVERT PORTION OF FLOW NORTH PER
 121           KM   SUMMIT ENGINEERING MODEL
 122           DT    DIV1
 123           DI       0      50     100     150     174
 124           DQ       0      27      54      81      94
               *

 125           KK     D10
 126           BA  0.0009
 127           LS       0      98
 128           UD   0.057
               *

 129           KK     D12
 130           BA   0.008
 131           LS       0      75
 132           UD   0.087
               *

 133           KK  RT-D12
 134           KM   ROUTE D12 THROUGH D11
 135           RD     720   0.044   0.015            TRAP      50       5
               *
```

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


 136          KK     D11
 137          BA   0.022
 138          LS       0      87
 139          UD   0.103
              *

 140          KK COM-D11
 141          KM   COMBINE D12 AND D11
 142          HC       4
              *

 143          KK      RT
 144          KM   ROUTE ALL THROUGH D13
 145          RD    2163  0.0277   0.025            TRAP       0       3
              *

 146          KK     D13
 147          KM   RUNOFF FROM EXISTING BASIN D13
 148          BA   0.238
 149          LS       0      75
 150          UD   0.344
              *

 151          KK COM-D13
 152          KM   COMBINE D13 WITH UPSTREAM
 153          HC       2
              *

 154          KK RT-D13E
 155          KM   ROUTE D13 THROUGH E
 156          RD    5100  0.0314   0.025            TRAP       0       3
              *

 157          KK       E
 158          KM   RUNOFF FROM EXISTING BASIN E
 159          BA   0.575
 160          LS       0      75
 161          UD   0.648
              *

 162          KK  CM-ALL
 163          HC       4
              *
 164          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  30                A
                    V
                    V
  36            RT-AB
                    .
                    .
  39                .           B
                    .           .
                    .           .
  44           COM-AB............
                    V
                    V
  46            RT-BE
                    .
                    .
  49                .           C
                    .           V
                    .           V
  54                .       RT-CE
                    .           .
                    .           .
  57                .           .          D1
                    .           .           .
                    .           .           .
  62                .           .           .         D1b
                    .           .           .           .
                    .           .           .           .
  66                .           .           .           .          D2
                    .           .           .           .           .
                    .           .           .           .           .
  70                .           .      COM-PR........................
                    .           .           V
                    .           .           V
  73                .           .       RT-PR
                    .           .           .
                    .           .           .
  76                .           .           .          D4
                    .           .           .           V
                    .           .           .           V
  80                .           .           .       RT-D4
                    .           .           .           .
                    .           .           .           .
  83                .                       .           .          D3
                    .           .           .                       .
                    .           .           .           .           .
  87                .           .           .           .           .          D5
                    .           .           .           .           .           .
                    .           .           .           .           .           .
  91                .           .           .           .           .           .          D6
                    .           .           .           .           .           .           .
                                .           .           .           .           .           .
  95                .           .         COM................................................
                    .           .           .
```

```
                 .           .           .
   98            .           .           .         D7
                 .           .           .          .
                 .           .           .          .
  102            .           .     COM-D7............
                 .           .           .
                 .           .           .
  105            .           .           .         D8
                 .           .           .          .
                 .           .           .          .
  109            .           .     COM-D8............
                 .           .           .
                 .           .           .
  112            .           .           .         D9
                 .           .           .          .
                 .           .           .          .
  116            .           .     COM-D9............
                 .           .           .
                 .           .           .
  122            .           .           .-------->  DIV1
  119            .           .       DIV1
                 .           .           .
                 .           .           .
  125            .           .           .        D10
                 .           .           .          .
                 .           .           .          .
  129            .           .           .          .         D12
                 .           .           .          .           V
                 .           .           .          .           V
  133            .           .           .          .      RT-D12
                 .           .           .          .           .
                 .           .           .          .           .
  136            .           .           .          .           .         D11
                 .           .           .          .           .           .
                 .           .           .          .           .           .
  140            .           .    COM-D11....................................
                 .           .           V
                 .           .           V
  143            .           .          RT
                 .           .           .
                 .           .           .
  146            .           .           .        D13
                 .           .           .          .
                 .           .           .          .
  151            .           .    COM-D13.... .......
                 .           .           V
                 .           .           V
  154            .           .    RT-D13E
                 .           .           .
                 .           .           .
  157            .           .           .          E
                 .           .           .          .
                 .           .           .          .
  162      CM-ALL....................................
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

HEC1 S/N: 1343001727   HMVersion: 6.33   Data File: allex5.dat

```
****************************************                  ****************************************
*                                      *                  *                                      *
*   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  12/03/1996  TIME  14:04:32 *                 *          (916) 756-1104              *
*                                      *                  *                                      *
****************************************                  ****************************************
```

BARKER HOMES, INC.
1955 BARING BLVD.
SPARKS, NV 89434

DESERT HIGHLANDS-UNITS 2&5 - OVERALL EXISTING OFFSITE BASINS
DECEMBER 1996
INPUT FILE NAME: ALLEX5.DAT
INPUT FILE NAME: ALLEX5.OUT

PRE-DEVELOPED CONDITION FOR BASINS
Q5-24 HOUR STORM

RAINFALL FROM NOAA ATLAS 14-VOL 1-SEMI ARID SOUTHWEST U.S.
24-HOUR RAINFALL DERIVED FROM REGIONAL GROWTH FACTORS AS PER WASHOE
COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (WCDDM) TABLE 601

LAG TIMES COMPUTED USING STANDARED FORM 2 OF WCDDM
DEPTH-AREA-REDUCTION-FACTORS (DARF'S) COMPUTED USING
FIGURE 604 OF WCDDM-CURVE NUMBERS FROM SCS TABLES
MUSKINGUM-CUNGE ROUTING METHODOLOGY

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

    IT        HYDROGRAPH TIME DATA
                   NMIN           8  MINUTES IN COMPUTATION INTERVAL
                  IDATE     1     0  STARTING DATE
                  ITIME        0000  STARTING TIME
                     NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE     2     0  ENDING DATE
                 NDTIME        1552  ENDING TIME
                  ICENT          19  CENTURY MARK

           COMPUTATION INTERVAL    0.13 HOURS
                TOTAL TIME BASE   39.87 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

JP MULTI-PLAN OPTION

NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION

RATIOS OF PRECIPITATION

1.00 0.99

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 1.00	RATIO 2 0.99
HYDROGRAPH AT						
	A	0.85	1	FLOW	26.	25.
				TIME	12.67	12.67
ROUTED TO						
	RT-AB	0.85	1	FLOW	25.	24.
				TIME	12.80	12.80
HYDROGRAPH AT						
	B	0.92	1	FLOW	24.	23.
				TIME	12.93	12.93
2 COMBINED AT						
	COM-AB	1.76	1	FLOW	49.	47.
				TIME	12.80	12.80
ROUTED TO						
	RT-BE	1.76	1	FLOW	49.	47.
				TIME	13.07	13.07
HYDROGRAPH AT						
	C	0.69	1	FLOW	20.	19.
				TIME	12.80	12.80
ROUTED TO						
	RT-CE	0.69	1	FLOW	19.	19.
				TIME	12.93	12.93
HYDROGRAPH AT						
	D1	0.37	1	FLOW	13.	13.
				TIME	12.53	12.53
HYDROGRAPH AT						
	D1b	0.00	1	FLOW	0.	0.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D2	0.02	1	FLOW	7.	7.
				TIME	12.13	12.13
3 COMBINED AT						
	COM-PR	0.39	1	FLOW	15.	15.
				TIME	12.53	12.53
ROUTED TO						
	RT-PR	0.39	1	FLOW	15.	15.
				TIME	12.53	12.53
HYDROGRAPH AT						

	D4	0.01	1	FLOW	3.	3.
				TIME	12.13	12.13
ROUTED TO						
	RT-D4	0.01	1	FLOW	3.	3.
				TIME	12.27	12.13
HYDROGRAPH AT						
	D3	0.01	1	FLOW	1.	1.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D5	0.00	1	FLOW	1.	1.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D6	0.00	1	FLOW	0.	0.
				TIME	12.13	12.13
5 COMBINED AT						
	COM	0.42	1	FLOW	17.	17.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D7	0.00	1	FLOW	1.	1.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D7	0.42	1	FLOW	18.	17.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D8	0.01	1	FLOW	3.	3.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D8	0.43	1	FLOW	20.	19.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D9	0.01	1	FLOW	2.	2.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D9	0.44	1	FLOW	22.	21.
				TIME	12.27	12.27
DIVERSION TO						
	DIV1	0.44	1	FLOW	12.	11.
				TIME	12.27	12.27
HYDROGRAPH AT						
	DIV1	0.44	1	FLOW	10.	10.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D10	0.00	1	FLOW	1.	1.
				TIME	12.13	12.13
HYDROGRAPH AT						

	D12	0 01	1	FLOW	0.	0.
				TIME	12.13	12.13
ROUTED TO						
	RT-D12	0.01	1	FLOW	0.	0.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D11	0.02	1	FLOW	7.	7.
				TIME	12.13	12.13
4 COMBINED AT						
	COM-D11	0.47	1	FLOW	17.	16.
				TIME	12.27	12.27
ROUTED TO						
	RT	0.47	1	FLOW	17.	16.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D13	0.24	1	FLOW	8.	8.
				TIME	12.53	12.53
2 COMBINED AT						
	COM-D13	0.70	1	FLOW	22.	21.
				TIME	12.40	12.40
ROUTED TO						
	RT-D13E	0.70	1	FLOW	25.	24.
				TIME	12.53	12.53
HYDROGRAPH AT						
	E	0.57	1	FLOW	15.	14.
				TIME	12.93	12.93
4 COMBINED AT						
	CM-ALL	3.74	1	FLOW	99.	96.
				TIME	12.93	12.93

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
						INTERPOLATED TO COMPUTATION INTERVAL			
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 0.00									
RT-AB	MANE	2.40	25.64	772.80	0.18	8.00	25.18	768.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.8171E+01 EXCESS=0.0000E+00 OUTFLOW=0.8173E+01 BASIN STORAGE=0.1461E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00									
RT-AB	MANE	2.40	24.74	772.80	0.18	8.00	24.24	768.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7991E+01 EXCESS=0.0000E+00 OUTFLOW=0.7993E+01 BASIN STORAGE=0.1445E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00									
RT-BE	MANE	3.20	49.42	780.80	0.18	8.00	48.88	784.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1699E+02 EXCESS=0.0000E+00 OUTFLOW=0.1699E+02 BASIN STORAGE=0.1415E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00									
RT-BE	MANE	3.20	47.69	780.80	0.18	8.00	47.25	784.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1661E+02 EXCESS=0.0000E+00 OUTFLOW=0.1662E+02 BASIN STORAGE=0.1400E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00									
RT-CE	MANE	2.80	19.35	778.40	0.18	8.00	19.32	776.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6662E+01 EXCESS=0.0000E+00 OUTFLOW=0.6664E+01 BASIN STORAGE=0.1390E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00									
RT-CE	MANE	2.80	18.67	778.40	0.18	8.00	18.63	776.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6515E+01 EXCESS=0.0000E+00 OUTFLOW=0.6517E+01 BASIN STORAGE=0.1369E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00									
RT-PR	MANE	2.91	15.50	747.81	0.20	8.00	15.37	752.00	0.20

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4213E+01 EXCESS=0.0000E+00 OUTFLOW=0.4213E+01 BASIN STORAGE=0.4496E-03 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

```
      RT-PR  MANE        2.94     14.95    749.49      0.20      8.00     14.84    752.00       0.20

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4125E+01 EXCESS=0.0000E+00 OUTFLOW=0.4125E+01 BASIN STORAGE=0.4213E-03 PERCENT ERROR=   0.0

    FOR PLAN = 1  RATIO= 0.00
      RT-D4  MANE        2.24      2.96    731.77      0.56      8.00      2.55    736.00       0.56

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2703E+00 EXCESS=0.0000E+00 OUTFLOW=0.2703E+00 BASIN STORAGE=0.2273E-03 PERCENT ERROR=  -0.1

    FOR PLAN = 1  RATIO= 0.00
      RT-D4  MANE        2.25      2.95    730.45      0.56      8.00      2.50    728.00       0.56

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2668E+00 EXCESS=0.0000E+00 OUTFLOW=0.2668E+00 BASIN STORAGE=0.2363E-03 PERCENT ERROR=  -0.1

    FOR PLAN = 1  RATIO= 0.00
     RT-D12  MANE        0.80      0.57    735.20      0.18      8.00      0.39    736.00       0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7736E-01 EXCESS=0.0000E+00 OUTFLOW=0.7749E-01 BASIN STORAGE=0.4816E-03 PERCENT ERROR=  -0.8

    FOR PLAN = 1  RATIO= 0.00
     RT-D12  MANE        0.80      0.53    735.20      0.18      8.00      0.41    736.00       0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7565E-01 EXCESS=0.0000E+00 OUTFLOW=0.7578E-01 BASIN STORAGE=0.4765E-03 PERCENT ERROR=  -0.8

    FOR PLAN = 1  RATIO= 0.00
         RT  MANE        5.44     16.82    739.99      0.13      8.00     16.63    736.00       0.13

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3245E+01 EXCESS=0.0000E+00 OUTFLOW=0.3245E+01 BASIN STORAGE=0.5429E-03 PERCENT ERROR=   0.0

    FOR PLAN = 1  RATIO= 0.00
         RT  MANE        5.47     17.27    738.01      0.13      8.00     16.12    736.00       0.13

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3187E+01 EXCESS=0.0000E+00 OUTFLOW=0.3187E+01 BASIN STORAGE=0.6588E-03 PERCENT ERROR=   0.0

    FOR PLAN = 1  RATIO= 0.00
    RT-D13E  MANE        8 00     25.02    752.00      0.15      8.00     25.02    752.00       0.15

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5546E+01 EXCESS=0.0000E+00 OUTFLOW=0.5550E+01 BASIN STORAGE=0.1822E-02 PERCENT ERROR=  -0.1

    FOR PLAN = 1  RATIO= 0.00
    RT-D13E  MANE        8.00     24.09    752.00      0.14      8.00     24.09    752.00       0.14

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5431E+01 EXCESS=0.0000E+00 OUTFLOW=0.5435E+01 BASIN STORAGE=0.1807E-02 PERCENT ERROR=  -0.1
```

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

PROPOSED SUBBASINS OUTPUT

HEC1 S/N: 1343001727   HMVersion: 6.33   Data File: ALLPR100.DAT

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE  12/16/1996  TIME  09:54:09 *
*                                      *
****************************************
```

```
**************************************
*                                    *
*   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
  2             ID
  3             ID   BARKER HOMES, INC.
  4             ID   1955 BARING BLVD.
  5             ID   SPARKS, NV 89434
  6             ID
  7             ID   DESERT HIGHLANDS - OVERALL W/PROPOSED UNITS 2 AND 5
  8             ID   DECEMBER 1996
  9             ID   INPUT FILE NAME:  ALLPR100.DAT
 10             ID   INPUT FILE NAME:  ALLPR100.OUT
 11             ID
 12             ID   DEVELOPED CONDITION (UNITS 2&5)
 13             ID   Q100-24 HOUR STORM
 14             ID
 15             ID   RAINFALL FROM NOAA ATLAS 14-VOL 1-SEMI ARID SOUTHWEST U.S.
 16             ID   24-HOUR RAINFALL DERIVED FROM REGIONAL GROWTH FACTORS AS PER WASHOE
 17             ID   COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (WCDDM) TABLE 601
 18             ID
 19             ID
 20             ID   LAG TIMES COMPUTED USING STANDARED FORM 2 OF WCDDM
 21             ID   DEPTH-AREA-REDUCTION-FACTORS (DARF'S) COMPUTED USING
 22             ID   FIGURE 604 OF WCDDM-CURVE NUMBERS FROM SCS TABLES
 23             ID   MUSKINGUM-CUNGE ROUTING METHODOLOGY
 24             ID
 25             ID
                *DIAGRAM
*** FREE ***
 26             IT       3       0       0     300
 27             IN      15
 28             IO       5
 29             JR    PREC    1.00   0.993
                *

 30             KK       A
 31             KM   RUNOFF FROM EXISTING BASIN A
 32             BA   0.848
 33             LS       0      75
 34             PH                       0.48    0.87    1.45    1.49    1.52    1.58    2.12    2.66
 35             UD   0.456
                *

 36             KK   RT-AB
 37             KM   ROUTE BASIN A THROUGH BASIN B
 38             RD    5880  0.0442   0.025            TRAP       0       3
                *

 39             KK       B
 40             KM   RUNOFF FROM EXISTING BASIN B
 41             BA   0.917
 42             LS       0      75
 43             UD   0.539
                *
```

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

 44            KK  COM-AB
 45            HC       2
               *

 46            KK   RT-BE
 47            RD    5500  0.0291   0.025             TRAP       0       3
               *

 48            KK       C
 49            KM   RUNOFF FROM EXISTING BASIN C
 50            BA   0.691
 51            LS       0      75
 52            UD   0.527
               *

 53            KK   RT-CE
 54            RD    5200  0.0308   0.025             TRAP       0       3
               *

 55            KK      D1
 56            KM   RUNOFF FROM EXISTING BASIN D
 57            BA   0.367
 58            LS       0      75
 59            UD   0.329
               *

 60            KK     D1b
 61            BA   0.004
 62            LS       0      75
 63            UD   0.083
               *

 64            KK      D2
 65            BA   0.021
 66            LS       0      87
 67            UD   0.110
               *

 68            KK  COM-PR
 69            KM   COMBINE D1,D1b & D2
 70            HC       3
               *

 71            KK   RT-PR
 72            KM   ROUTE COMB TO D3
 73            RD    1050   0.040   0.025             TRAP      10       3
               *

 74            KK      D4
 75            BA   0.009
 76            LS       0      87
 77            UD   0.101
               *
```

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

  78        KK   RT-D4
  79        KM   ROUTE D4 TO D3
  80        RD     500   0.040   0.025              TRAP       10        3
            *

  81        KK      D3
  82        BA   0.011
  83        LS       0      75
  84        UD   0.097
            *

  85        KK      D5
  86        BA   0.002
  87        LS       0      87
  88        UD   0.072
            *

  89        KK      D6
  90        BA   0.001
  91        LS       0      87
  92        UD   0.035
            *

  93        KK COM-PR2
  94        KM   COMBINE RT-PR,RT-D4,D3,D5,D6
  95        HC       5
            *
            * NULL ROUTE
            * ROUTE IS SHORT-LEFT OUT
            * KK RT-ALL
            * KM ROUTE TO D7 THROUGH 48"PIPE
            * RD 190,0.064,0.013,,CIRC,4
            *

  96        KK      D7
  97        BA   0.003
  98        LS       0      87
  99        UD   0.119
            *

 100        KK  COM-D7
 101        KM   COMBINE ALL WITH D7
 102        HC       2
            *
            * NULL ROUTE
            * ROUTE IS SHORT-LEFT OUT
            * KK RT-D7
            * KM ROUTE TO A8 THROUGH 48" PIPE
            * RD 110,0.064,0.013,,CIRC,4
            * RD 140,0.0142,0.013,,CIRC,4
            *
```

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

 103          KK      D8
 104          BA   0.011
 105          LS       0      87
 106          UD   0.110
              *

 107          KK  COM-D8
 108          KM   COMBINE D8 WITH ALL
 109          HC       2
              *
              * NULL ROUTE
              * ROUTE IS SHORT-LEFT OUT
              * KK RT-D8
              * KM ROUTE TO D9 THROUGH 54" PIPE
              * RD 160,0.005,0.013,,CIRC,4.5
              *

 110          KK      D9
 111          BA   0.007
 112          LS       0      87
 113          UD   0.100
              *

 114          KK  COM-D9
 115          KM   COMBINE D9 WITH ALL
 116          HC       2
              *

 117          KK    DIV1
 118          KM   DIVERT PORTION OF FLOW NORTH
 119          KM   PER SUMMIT ENGINEERING MODEL
 120          DT    DIV1
 121          DI       0      50     100     150     174
 122          DQ       0      27      54      81      94
              *

 123          KK     D10
 124          BA  0.0009
 125          LS       0      98
 126          UD   0.057
              *

 127          KK     D12
 128          BA   0.008
 129          LS       0      75
 130          UD   0.087
              *

 131          KK  RT-D12
 132          KM   ROUTE D12 THROUGH D11
 133          RD     720   0.044   0.015             TRAP      50       5
              *
```

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



 134          KK     D11
 135          BA   0.022
 136          LS       0      87
 137          UD   0.103
              *

 138          KK COM-D11
 139          KM   COMBINE D12 AND D11
 140          HC       4
              *

 141          KK      P6
 142          KM   RUNOFF FROM PROPOSED BASIN P6
 143          BA   0.005
 144          LS       0      87
 145          UD   0.093
              *

 146          KK      P7
 147          KM   RUNOFF FROM PROPOSED BASIN P7
 148          BA   0.003
 149          LS       0      87
 150          UD   0.105
              *

 151          KK     COM
 152          KM   COMBINE PREVICUS W/P6&P7
 153          HC       3
              *

 154          KK      RT
 155          KM   ROUTE ALL THROUGH P9
 156          RD     450   0.044   0.013            CIRC       6
              *

 157          KK      P5
 158          KM   RUNOFF FROM PROPOSED BASIN P5
 159          BA   0.003
 160          LS       0      75
 161          UD   0.080
              *

 162          KK     P4a
 163          KM   RUNOFF FROM PROPOSED BASIN P4a
 164          BA   0.006
 165          LS       0      87
 166          UD   0.102
              *
```

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

 167          KK     P4b
 168          KM   RUNOFF FROM PROPOSED BASIN P4b
 169          BA   0.010
 170          LS       0      87
 171          UD   0.087
              *

 172          KK    COMB
 173          KM   COMBINE PREV
 174          HC       4
              *

 175          KK      RT
 176          KM   ROUTE DOWNSTREAM IN PIPE
 177          RD     750   0.044   0.013              CIRC        6
              *

 178          KK      P1
 179          KM   RUNOFF FROM PROPOSED BASIN P1
 180          BA   0.056
 181          LS       0      87
 182          UD   0.178
              *

 183          KK      P3
 184          KM   RUNOFF FROM PROPOSED BASIN P3
 185          BA   0.016
 186          LS       0      87
 187          UD   0.108
              *

 188          KK      P9
 189          KM   RUNOFF FROM PROPOSED BASIN P9
 190          BA   0.008
 191          LS       0    91.1
 192          UD   0.091
              *

 193          KK     P10
 194          KM   RUNOFF FROM PROPOSED BASIN P10
 195          BA   0.065
 196          LS       0      75
 197          UD   0.215
              *

 198          KK     COM
 199          KM   COMBINE ROUTE W/P1,P3,P9&P10
 200          HC       5
              *
```

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


 201          KK      RT
 202          KM   ROUTE IN OPEN CHANNEL TO P2
 203          RD    1050   0.023   0.025            TRAP      10       3
              *

 204          KK      P2
 205          KM   RUNOFF FROM PROPOSED BASIN P2
 206          BA   0.038
 207          LS       0      75
 208          UD   0.084
              *

 209          KK     P11
 210          KM   RUNOFF FROM PROPOSED BASIN P11
 211          BA   0.033
 212          LS       0      75
 213          UD   0.092
              *

 214          KK COM-D13
 215          KM   COMBINE UPSTREAM, P2&P11
 216          HC       3
              *

 217          KK RT-D13E
 218          RD    5100  0.0314   0.025            TRAP       0       3
              *

 219          KK       E
 220          KM   RUNOFF FROM EXISTING BASIN E
 221          BA   0.575
 222          LS       0      75
 223          UD   0.648
              *

 224          KK  CM-ALL
 225          HC       4
              *

 226          KK      P8
 227          KM   RUNOFF FROM PROPOSED BASIN P8
 228          BA   0.002
 229          LS       0      87
 230          UD   0.088
              *
 231          ZZ
```

```
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

   30            A
                 V
                 V
   36        RT-AB
                 .
                 .
   39            .           B
                 .           .
                 .           .
   44       COM-AB............
                 V
                 V
   46        RT-BE
                 .
                 .
   48            .           C
                 .           V
                 .           V
   53            .       RT-CE
                 .           .
                 .           .
   55            .           .          D1
                 .           .           .
                 .           .           .
   60            .           .           .         D1b
                 .           .           .           .
                 .           .           .           .
   64            .           .           .           .          D2
                 .           .           .           .           .
                 .           .           .           .           .
   68            .           .      COM-PR........................
                 .           .           V
                 .           .           V
   71            .           .       RT-PR
                 .           .           .
                 .           .           .
   74            .           .           .          D4
                 .           .           .           V
                 .           .           .           V
   78            .           .           .       RT-D4
                 .           .           .           .
                 .           .           .           .
   81            .           .           .           .          D3
                 .           .           .           .           .
                 .           .           .           .           .
   85            .           .           .           .           .          D5
                 .           .           .           .           .           .
                 .           .           .           .           .           .
   89            .           .           .           .           .           .          D6
                 .           .           .           .           .           .           .
                 .           .           .           .           .           .           .
   93            .           .     COM-PR2................................................
                 .           .           .
```

```
                        .           .           .
 96                     .           .           .          D7
                        .           .           .           .
                        .           .           .           .
100                     .           .     COM-D7............
                        .           .           .
                        .           .           .
103                     .           .           .          D8
                        .           .           .           .
                        .           .           .           .
107                     .           .     COM-D8............
                        .           .           .
                        .           .           .
110                     .           .           .          D9
                        .           .           .           .
                        .           .           .           .
114                     .           .     COM-D9............
                        .           .           .
                        .           .           .
120                     .           .           .------->    DIV1
117                     .           .       DIV1
                        .           .           .
                        .           .           .
123                     .           .           .         D10
                        .           .           .           .
                        .           .           .           .
127                     .           .           .           .         D12
                        .           .           .           .           V
                        .           .           .           .           V
131                     .           .           .           .      RT-D12
                        .           .           .           .           .
                        .           .           .           .           .
134                     .           .           .           .           .         D11
                        .           .           .           .           .           .
                        .           .           .           .           .           .
138                     .           .    COM-D11....................................
                        .           .           .
                        .           .           .
141                     .           .           .          P6
                        .           .           .           .
                        .           .           .           .
146                     .           .           .           .          P7
                        .           .           .           .           .
                        .           .           .           .           .
151                     .           .        CCM........................
                        .           .           V
                        .           .           V
154                     .           .          RT
                        .           .           .
                        .           .           .
157                     .           .           .          P5
                        .           .           .           .
                        .           .           .           .
162                     .           .           .           .         P4a
                        .           .           .           .           .
                        .           .           .           .           .
167                     .           .           .           .           .         P4b
                        .           .           .           .           .           .
                        .           .           .           .           .           .
172                     .           .       COMB....................................
```

```
                             .            .            V
                             .            .            V
            175              .            .           RT
                             .            .            .
                             .            .            .
            178              .            .            .           P1
                             .            .            .            .
                             .            .            .            .
            183              .            .            .            .           P3
                             .            .            .            .            .
                             .            .            .            .            .
            188              .            .            .            .            .           P9
                             .            .            .            .            .            .
                             .            .            .            .            .            .
            193              .            .            .            .            .            .          P10
                             .            .            .            .            .            .            .
                             .            .            .            .            .            .            .
            198              .            .          COM....................................................
                             .            .            V
                             .            .            V
            201              .            .           RT
                             .            .            .
                             .            .            .
            204              .            .            .           P2
                             .            .            .            .
                             .            .            .            .
            209              .            .            .            .          P11
                             .            .            .            .            .
                             .            .            .            .            .
            214              .      COM-D13..........................
                             .            .            V
                             .            .            V
            217              .            .      RT-D13E
                             .            .            .
                             .            .            .
            219              .            .            .            E
                             .            .            .            .
                             .            .            .            .
            224         CM-ALL.......................................
                             .
                             .
            226              .           P8
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

HEC1 S/N: 1343001727   HMVersion: 6.33   Data File: ALLPR100.DAT

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE  12/16/1996  TIME  09:54:09 *
*                                      *
****************************************
```

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

BARKER HOMES, INC.
1955 BARING BLVD.
SPARKS, NV 89434

DESERT HIGHLANDS - OVERALL W/PROPOSED UNITS 2 AND 5
DECEMBER 1996
INPUT FILE NAME: ALLPR100.DAT
INPUT FILE NAME: ALLPR100.OUT

DEVELOPED CONDITION (UNITS 2&5)
Q100-24 HOUR STORM

RAINFALL FROM NOAA ATLAS 14-VOL 1-SEMI ARID SOUTHWEST U.S.
24-HOUR RAINFALL DERIVED FROM REGIONAL GROWTH FACTORS AS PER WASHOE
COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (WCDDM) TABLE 601

LAG TIMES COMPUTED USING STANDARED FORM 2 OF WCDDM
DEPTH-AREA-REDUCTION-FACTORS (DARF'S) COMPUTED USING
FIGURE 604 OF WCDDM-CURVE NUMBERS FROM SCS TABLES
MUSKINGUM-CUNGE ROUTING METHODOLOGY

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

    IT        HYDROGRAPH TIME DATA
                     NMIN          8  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      2   0  ENDING DATE
                   NDTIME       1552  ENDING TIME
                    ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL    0.13 HOURS
                   TOTAL TIME BASE   39.87 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

JP MULTI-PLAN OPTION

NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION

RATIOS OF PRECIPITATION

1.00 0.99

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 1.00	RATIO 2 0.99
HYDROGRAPH AT						
	A	0.85	1	FLOW	267.	262.
				TIME	12.53	12.67
ROUTED TO						
	RT-AB	0 85	1	FLOW	268.	264.
				TIME	12.67	12.67
HYDROGRAPH AT						
	B	0.92	1	FLOW	246.	241.
				TIME	12.80	12.80
2 COMBINED AT						
	COM-AB	1.76	1	FLOW	512.	503.
				TIME	12.67	12.67
ROUTED TO						
	RT-BE	1.76	1	FLOW	509.	501.
				TIME	12.80	12.80
HYDROGRAPH AT						
	C	0.69	1	FLOW	203.	199.
				TIME	12.67	12.67
ROUTED TO						
	RT-CE	0.69	1	FLOW	200.	196.
				TIME	12.80	12.80
HYDROGRAPH AT						
	D1	0.37	1	FLOW	141.	138.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D1b	0.00	1	FLOW	3.	3.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D2	0.02	1	FLOW	27.	26.
				TIME	12.13	12.13
3 COMBINED AT						
	COM-PR	0.39	1	FLOW	155.	152.
				TIME	12.40	12.40
ROUTED TO						
	RT-PR	0.39	1	FLOW	151.	148.
				TIME	12.40	12.40
HYDROGRAPH AT						

	D4	0.01	1	FLOW	12.	12.
				TIME	12.13	12.13
ROUTED TO						
	RT-D4	0.01	1	FLOW	11.	11.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D3	0.01	1	FLOW	7.	7.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D5	0.00	1	FLOW	3.	3.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D6	0.00	1	FLOW	2.	2.
				TIME	12.13	12.13
5 COMBINED AT						
	COM-PR2	0.42	1	FLOW	161.	159.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D7	0.00	1	FLOW	4.	4.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D7	0.42	1	FLOW	163.	161.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D8	0.01	1	FLOW	14.	14.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D8	0.43	1	FLOW	170.	167.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D9	0.01	1	FLOW	10.	9.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D9	0.44	1	FLOW	174.	171.
				TIME	12.40	12.40
DIVERSION TO						
	DIV1	0.44	1	FLOW	94.	93.
				TIME	12.40	12.40
HYDROGRAPH AT						
	DIV1	0.44	1	FLOW	80.	79.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D10	0.00	1	FLOW	2.	2.
				TIME	12.13	12.13
HYDROGRAPH AT						

.	D12	0.01	1	FLOW	6.	5.
				TIME	12.13	12.13
ROUTED TO						
	RT-D12	0.01	1	FLOW	5.	5.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D11	0.02	1	FLOW	29.	29.
				TIME	12.13	12.13
4 COMBINED AT						
	COM-D11	0.47	1	FLOW	103.	102.
				TIME	12.27	12.27
HYDROGRAPH AT						
	P6	0.00	1	FLOW	7.	7.
				TIME	12.13	12.13
HYDROGRAPH AT						
	P7	0.00	1	FLOW	4.	4.
				TIME	12.13	12.13
3 COMBINED AT						
	COM	0.47	1	FLOW	112.	110.
				TIME	12.27	12.27
ROUTED TO						
	RT	0.47	1	FLOW	111.	110.
				TIME	12.27	12.27
HYDROGRAPH AT						
	P5	0.00	1	FLOW	2.	2.
				TIME	12.13	12.13
HYDROGRAPH AT						
	P4a	0.01	1	FLOW	8.	8.
				TIME	12.13	12.13
HYDROGRAPH AT						
	P4b	0.01	1	FLOW	15.	15.
				TIME	12.13	12.13
4 COMBINED AT						
	COMB	0.49	1	FLOW	129.	127.
				TIME	12.27	12.27
ROUTED TO						
	RT	0.49	1	FLOW	129.	127.
				TIME	12.27	12.27
HYDROGRAPH AT						
	P1	0.06	1	FLOW	64	63
				TIME	12.27	12.27
HYDROGRAPH AT						
	P3	0.02	1	FLOW	21.	20.
				TIME	12.13	12.13
HYDROGRAPH AT						

	P9	0.01	1	FLOW	14.	14.
				TIME	12.13	12.13
HYDROGRAPH AT						
	P10	0.06	1	FLOW	31.	30.
				TIME	12.27	12.27
5 COMBINED AT						
	COM	0.64	1	FLOW	250.	247.
				TIME	12.27	12.27
ROUTED TO						
	RT	0.64	1	FLOW	244.	240.
				TIME	12.27	12.27
HYDROGRAPH AT						
	P2	0.04	1	FLOW	27.	27.
				TIME	12.13	12.13
HYDROGRAPH AT						
	P11	0.03	1	FLOW	22.	22.
				TIME	12.13	12.13
3 COMBINED AT						
	COM-D13	0.71	1	FLOW	281.	277.
				TIME	12.27	12.27
ROUTED TO						
	RT-D13E	0.71	1	FLOW	267.	251.
				TIME	12.40	12.40
HYDROGRAPH AT						
	E	0.57	1	FLOW	146.	144.
				TIME	12.80	12.80
4 COMBINED AT						
	CM-ALL	3.74	1	FLOW	970.	952.
				TIME	12.67	12.80
HYDROGRAPH AT						
	P8	0.00	1	FLOW	3.	3.
				TIME	12.13	12.13

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)

FOR PLAN = 1 RATIO= 0.00

RT-AB	MANE	2.80	269.16	761.60	0.74	8.00	268.08	760.00	0.74

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3364E+02 EXCESS=0.0000E+00 OUTFLOW=0.3365E+02 BASIN STORAGE=0.1362E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-AB	MANE	3.20	265.29	761.60	0.73	8.00	264.16	760.00	0.73

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3314E+02 EXCESS=0.0000E+00 OUTFLOW=0.3315E+02 BASIN STORAGE=0.1588E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-BE	MANE	3.60	509.19	766.80	0.74	8.00	508.88	768.00	0.74

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7005E+02 EXCESS=0.0000E+00 OUTFLOW=0.7007E+02 BASIN STORAGE=0.1377E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-BE	MANE	3.60	500.83	766.80	0.73	8.00	500.51	768.00	0.73

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6908E+02 EXCESS=0.0000E+00 OUTFLOW=0.6910E+02 BASIN STORAGE=0.1390E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-CE	MANE	3.20	199.73	768.00	0.74	8.00	199.73	768.00	0.75

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2743E+02 EXCESS=0.0000E+00 OUTFLOW=0.2744E+02 BASIN STORAGE=0.1281E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-CE	MANE	3.20	196.31	768.00	0.73	8.00	196.31	768.00	0.73

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2702E+02 EXCESS=0.0000E+00 OUTFLOW=0.2702E+02 BASIN STORAGE=0.1271E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

RT-PR	MANE	1.48	154.13	746.43	0.78	8.00	150.52	744.00	0.78

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1636E+02 EXCESS=0.0000E+00 OUTFLOW=0.1636E+02 BASIN STORAGE=0.4185E-03 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

```
      RT-PR  MANE        1.48    151.87    745.77      0.77      8.00    148.07    744.00        0.77

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1612E+02 EXCESS=0.0000E+00 OUTFLOW=0.1612E+02 BASIN STORAGE=0.4591E-03 PERCENT ERROR=   0.0

         FOR PLAN = 1  RATIO= 0.00
      RT-D4  MANE        1.48     12.09    729.91      1.45      8.00     10.91    728.00        1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6941E+00 EXCESS=0.0000E+00 OUTFLOW=0.6941E+00 BASIN STORAGE=0.2240E-03 PERCENT ERROR=   0.0

         FOR PLAN = 1  RATIO= 0.00
      RT-D4  MANE        1.49     11.89    729.33      1.43      8.00     10.84    728.00        1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6866E+00 EXCESS=0.0000E+00 OUTFLOW=0.6867E+00 BASIN STORAGE=0.2145E-03 PERCENT ERROR=   0.0

         FOR PLAN = 1  RATIO= 0.00
     RT-D12  MANE        1.60      5.65    731.20      0.75      8.00      4.59    736.00        0.75

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3183E+00 EXCESS=0.0000E+00 OUTFLOW=0.3184E+00 BASIN STORAGE=0.5345E-03 PERCENT ERROR=  -0.2

         FOR PLAN = 1  RATIO= 0.00
     RT-D12  MANE        1.60      5.55    731.20      0.73      8.00      4.52    736.00        0.74

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3134E+00 EXCESS=0.0000E+00 OUTFLOW=0.3136E+00 BASIN STORAGE=0.5309E-03 PERCENT ERROR=  -0.2

         FOR PLAN = 1  RATIO= 0.00
         RT  MANE        0.27    111.64    736.41      0.46      8.00    111.37    736.00        0.46

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1166E+02 EXCESS=0.0000E+00 OUTFLOW=0.1166E+02 BASIN STORAGE=0.2667E-04 PERCENT ERROR=   0.0

         FOR PLAN = 1  RATIO= 0.00
         RT  MANE        0.27    109.98    736.25      0.45      8.00    109.68    736.00        0.45

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1151E+02 EXCESS=0.0000E+00 OUTFLOW=0.1151E+02 BASIN STORAGE=0.2680E-04 PERCENT ERROR=   0.0

         FOR PLAN = 1  RATIO= 0.00
         RT  MANE        0.44    128.92    736.17      0.49      8.00    128.78    736.00        0.49

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1302E+02 EXCESS=0.0000E+00 OUTFLOW=0.1302E+02 BASIN STORAGE=0.4448E-04 PERCENT ERROR=   0.0

         FOR PLAN = 1  RATIO= 0.00
         RT  MANE        0.44    127.02    736.14      0.49      8.00    126.91    736.00        0.49

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1285E+02 EXCESS=0.0000E+00 OUTFLOW=0.1285E+02 BASIN STORAGE=0.4512E-04 PERCENT ERROR=   0.0
```

```
FOR PLAN = 1  RATIO= 0.00
     RT  MANE         1.56    247.89    737.77      0.64      8.00    243.75    736.00       0.64


CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2192E+02 EXCESS=0.0000E+00 OUTFLOW=0.2192E+02 BASIN STORAGE=0.5274E-03 PERCENT ERROR=   0.0


FOR PLAN = 1  RATIO= 0.00
     RT  MANE         1.56    245.33    737.61      0.64      8.00    240.49    736.00       0.64


CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2165E+02 EXCESS=0.0000E+00 OUTFLOW=0.2165E+02 BASIN STORAGE=0.5249E-03 PERCENT ERROR=   0.0


FOR PLAN = 1  RATIO= 0.00
 RT-D13E  MANE        6.04    276.16    742.32      0.66      8.00    266.79    744.00       0.66


CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2480E+02 EXCESS=0.0000E+00 OUTFLOW=0.2482E+02 BASIN STORAGE=0.1482E-02 PERCENT ERROR=  -0.1


FOR PLAN = 1  RATIO= 0.00
 RT-D13E  MANE        6.06    281.69    738.83      0.65      8.00    251.33    744.00       0.64


CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2443E+02 EXCESS=0.0000E+00 OUTFLOW=0.2445E+02 BASIN STORAGE=0.1590E-02 PERCENT ERROR=  -0.1


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

HEC1 S/N: 1343001727   HMVersion: 6.33   Data File: ALLPR5.DAT

```
****************************************                              ****************************************
*                                      *                              *                                      *
*   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  12/16/1996  TIME  10:00:34 *                             *           (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
   2          ID
   3          ID   BARKER HOMES, INC.
   4          ID   1955 BARING BLVD.
   5          ID   SPARKS, NV 89434
   6          ID
   7          ID   DESERT HIGHLANDS - OVERALL W/PROPOSED UNITS 2 AND 5
   8          ID   DECEMBER 1996
   9          ID   INPUT FILE NAME:  ALLPR5.DAT
  10          ID   INPUT FILE NAME:  ALLPR5.OUT
  11          ID
  12          ID   DEVELOPED CONDITION (UNITS 2&5)
  13          ID   Q5-24 HOUR STORM
  14          ID
  15          ID   RAINFALL FROM NOAA ATLAS 14-VOL 1-SEMI ARID SOUTHWEST U.S.
  16          ID   24-HOUR RAINFALL DERIVED FROM REGIONAL GROWTH FACTORS AS PER WASHOE
  17          ID   COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (WCDDM) TABLE 601
  18          ID
  19          ID
  20          ID   LAG TIMES COMPUTED USING STANDARED FORM 2 OF WCDDM
  21          ID   DEPTH-AREA-REDUCTION-FACTORS (DARF'S) COMPUTED USING
  22          ID   FIGURE 604 OF WCDDM-CURVE NUMBERS FROM SCS TABLES
  23          ID   MUSKINGUM-CUNGE ROUTING METHODOLOGY
  24          ID
  25          ID
              *DIAGRAM
*** FREE ***
  26          IT       8       0       0     300
  27          IN      15
  28          IO       5
  29          JR    PREC    1.00   0.993
              *

  30          KK       A
  31          KM   RUNOFF FROM EXISTING BASIN A
  32          BA   0.848
  33          LS       0      75
  34          PH                    0.18    0.33    0.54    0.65    0.74    0.91    1.22    1.54
  35          UD   0.456
              *

  36          KK   RT-AB
  37          KM   ROUTE BASIN A THROUGH BASIN B
  38          RD    5880  0.0442   0.025            TRAP       0       3
              *

  39          KK       B
  40          KM   RUNOFF FROM EXISTING BASIN B
  41          BA   0.917
  42          LS       0      75
  43          UD   0.589
              *
```

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

          KK  COM-AB
          HC       2
          *

          KK   RT-BE
          KM   ROUTE A AND B THROUGH E
          RD    5500  0.0291   0.025             TRAP       0       3
          *

          KK       C
          KM   RUNOFF FROM EXISTING BASIN C
          BA   0.691
          LS       0      75
          UD   0.527
          *

          KK   RT-CE
          RD    5200  0.0308   0.025             TRAP       0       3
          *

          KK      D1
          KM   RUNOFF FROM EXISTING BASIN D
          BA   0.367
          LS       0      75
          UD   0.329
          *

          KK     D1b
          BA   0.004
          LS       0      75
          UD   0.083
          *

          KK      D2
          BA   0.021
          LS       0      87
          UD   0.110
          *

          KK  COM-PR
          KM   COMBINE D1,D1b & D2
          HC       3
          *

          KK   RT-PR
          KM   ROUTE COMB TO D3
          RD    1050   0.040   0.025             TRAP      10       3
          *
```

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


 75           KK      D4
 76           BA   0.009
 77           LS       0      87
 78           UD   0.101
              *

 79           KK   RT-D4
 80           KM   ROUTE D4 TO D3
 81           RD     500   0.040   0.025            TRAP       10        3
              *

 82           KK      D3
 83           BA   0.011
 84           LS       0      75
 85           UD   0.097
              *

 86           KK      D5
 87           BA   0.002
 88           LS       0      87
 89           UD   0.072
              *

 90           KK      D6
 91           BA   0.001
 92           LS       0      87
 93           UD   0.035
              *

 94           KK COM-PR2
 95           KM   COMBINE RT-PR,RT-D4,D3,D5,D6
 96           HC       5
              *
              * NULL ROUTE
              * ROUTE IS SHORT-LEFT OUT
              * KK RT-ALL
              * KM ROUTE TO D7 THROUGH 48"PIPE
              * RD 190,0.064,0.013,,CIRC,4
              *

 97           KK      D7
 98           BA   0.003
 99           LS       0      87
100           UD   0.119
              *

101           KK  COM-D7
102           KM   COMBINE ALL WITH D7
103           HC       2
              *
              * NULL ROUTE
              * KK RT-D7
              * ROUTE IS SHORT-LEFT OUT
              * KM ROUTE TO A8 THROUGH 48" PIPE
              * RD 110,0.064,0.013,,CIRC,4
```

```
* RD 140,0.0142,0.013,,CIRC,4
*
```

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

 104          KK      D8
 105          BA   0.011
 106          LS       0      87
 107          UD   0.110
              *

 108          KK  COM-D8
 109          KM   COMBINE D8 WITH ALL
 110          HC       2
              *
              * NULL ROUTE
              * ROUTE IS SHORT-LEFT OUT
              * KK RT-D8
              * KM ROUTE TO D9 THROUGH 54" PIPE
              * RD 160,0.005,0.013,,CIRC,4.5
              *

 111          KK      D9
 112          BA   0.007
 113          LS       0      87
 114          UD   0.100
              *

 115          KK  COM-D9
 116          KM   COMBINE D9 WITH ALL
 117          HC       2
              *

 118          KK    DIV1
 119          KM   DIVERT SOME FLOW NORTH
 120          DT    DIV1
 121          DI       0      50     100     150     174
 122          DQ       0      27      54      81      94
              *

 123          KK     D10
 124          BA  0.0009
 125          LS       0      98
 126          UD   0.057
              *

 127          KK     D12
 128          BA   0.008
 129          LS       0      75
 130          UD   0.087
              *

 131          KK  RT-D12
 132          KM   ROUTE D12 THROUGH D11
 133          RD     720   0.044   0.015            TRAP      50       5
              *
```

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

134           KK      D11
135           BA    0.022
136           LS        0      87
137           UD    0.103
              *

138           KK COM-D11
139           KM    COMBINE D12 AND D11
140           HC        4
              *

141           KK       P6
142           KM    RUNOFF FROM PROPOSED BASIN P6
143           BA    0.005
144           LS        0      87
145           UD    0.093
              *

146           KK       P7
147           KM    RUNOFF FROM PROPOSED BASIN P7
148           BA    0.003
149           LS        0      87
150           UD    0.105
              *

151           KK      COM
152           KM    COMBINE PREVICUS W/P6&P7
153           HC        3
              *

154           KK       RT
155           KM    ROUTE ALL THROUGH P9
156           RD      450   0.044   0.013             CIRC       6
              *

157           KK       P5
158           KM    RUNOFF FROM PROPOSED BASIN P5
159           BA    0.003
160           LS        0      75
161           UD    0.080
              *

162           KK      P4a
163           KM    RUNOFF FROM PROPOSED BASIN P4a
164           BA    0.006
165           LS        0      87
166           UD    0.102
              *
```

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


 167          KK     P4b
 168          KM   RUNOFF FROM PROPOSED BASIN P4b
 169          BA   0.010
 170          LS       0      87
 171          UD   0.087
              *

 172          KK    COMB
 173          KM   COMBINE PREV
 174          HC       4
              *

 175          KK      RT
 176          KM   ROUTE DOWNSTREAM IN PIPE
 177          RD     750   0.044   0.013                CIRC        6
              *

 178          KK      P1
 179          KM   RUNOFF FROM PROPOSED BASIN P1
 180          BA   0.056
 181          LS       0      87
 182          UD   0.178
              *

 183          KK      P3
 184          KM   RUNOFF FROM PROPOSED BASIN P3
 185          BA   0.016
 186          LS       0      87
 187          UD   0.115
              *

 188          KK      P9
 189          KM   RUNOFF FROM PROPOSED BASIN P9
 190          BA   0.008
 191          LS       0    91.1
 192          UD   0.091
              *

 193          KK     P10
 194          KM   RUNOFF FROM PROPOSED BASIN P10
 195          BA   0.065
 196          LS       0      75
 197          UD   0.215
              *

 198          KK     COM
 199          KM   COMBINE ROUTE W/P1,P3,P9&P10
 200          HC       5
              *
```

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


 201            KK      RT
 202            KM   ROUTE IN OPEN CHANNEL TO P2
 203            RD    1050   0.023   0.025            TRAP      10       3
                *

 204            KK      P2
 205            KM   RUNOFF FROM PROPOSED BASIN P2
 206            BA   0.038
 207            LS       0      75
 208            UD   0.084
                *

 209            KK     P11
 210            KM   RUNOFF FROM PROPOSED BASIN P11
 211            BA   0.033
 212            LS       0      75
 213            UD   0.092
                *

 214            KK COM-D13
 215            KM   COMBINE UPSTREAM, P2&P11
 216            HC       3
                *

 217            KK RT-D13E
 218            KM   ROUTE D13 THROUGH E
 219            RD    5100  0.0314   0.025            TRAP       0       3
                *

 220            KK       E
 221            KM   RUNOFF FROM EXISTING BASIN E
 222            BA   0.575
 223            LS       0      75
 224            UD   0.648
                *

 225            KK  CM-ALL
 226            HC       4
                *

 227            KK      P8
 228            KM   RUNOFF FROM PROPOSED BASIN P8
 229            BA   0.002
 230            LS       0      87
 231            UD   0.088
                *
 232            ZZ
```

```
                SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

  30            A
                V
                V
  36        RT-AB
                .
                .
  39            .           B
                .           .
                .           .
  44       COM-AB............
                V
                V
  46        RT-BE
                .
                .
  49            .           C
                .           V
                .           V
  54            .       RT-CE
                .           .
                .           .
  56            .           .          D1
                .           .           .
                .           .           .
  61            .           .           .         D1b
                .           .           .           .
                .           .           .           .
  65            .           .           .           .          D2
                .           .           .           .           .
                .           .           .           .           .
  69            .           .      COM-PR........................
                .           .           V
                .           .           V
  72            .           .       RT-PR
                .           .           .
                .           .           .
  75            .           .           .          D4
                .           .           .           V
                .           .           .           V
  79            .           .           .       RT-D4
                .           .           .           .
                .           .           .           .
  82            .           .           .           .          D3
                .           .           .           .           .
                .           .           .           .           .
  86            .           .           .           .           .          D5
                .           .           .           .           .           .
                .           .           .           .           .           .
  90            .           .           .           .           .           .          D6
                .           .           .           .           .           .           .
                .           .           .           .           .           .           .
  94            .           .     COM-PR2............................... ................
                .           .           .
```

```
              .         .         .
  97          .         .         .        D7
              .         .         .         .
              .         .         .         .
 101          .         .    COM-D7............
              .         .         .
              .         .         .
 104          .         .         .        D8
              .         .         .         .
              .         .         .         .
 108          .         .    COM-D8............
              .         .         .
              .         .         .
 111          .         .         .        D9
              .         .         .         .
              .         .         .         .
 115          .         .    COM-D9............
              .         .         .
              .         .         .
 120          .         .         .------->    DIV1
 118          .         .      DIV1
              .         .         .
              .         .         .
 123          .         .         .       D10
              .         .         .         .
              .         .         .         .
 127          .         .         .         .        D12
              .         .         .         .          V
              .         .         .         .          V
 131          .         .         .         .     RT-D12
              .         .         .         .          .
              .         .         .         .          .
 134          .         .         .         .          .        D11
              .         .         .         .          .          .
              .         .         .         .          .          .
 138          .         .   COM-D11.................................
              .         .         .
              .         .         .
 141          .         .         .        P6
              .         .         .         .
              .         .         .         .
 146          .         .         .         .         P7
              .         .         .         .          .
              .         .         .         .          .
 151          .         .       COM.......................
              .         .         V
              .         .         V
 154          .         .        RT
              .         .         .
              .         .         .
 157          .         .         .        P5
              .         .         .         .
              .         .         .         .
 162          .         .         .         .        P4a
              .         .         .         .          .
              .         .         .         .          .
 167          .         .         .         .          .        P4b
              .         .         .         .          .          .
              .         .         .         .          .          .
 172          .         .      COMB.................................
```

```
                 .          .          V
                 .          .          V
 175             .          .          RT
                 .          .          .
                 .          .          .
 178             .          .          .          P1
                 .          .          .          .
                 .          .          .          .
 183             .          .          .          .          P3
                 .          .          .          .          .
                 .          .          .          .          .
 188             .          .          .          .          .          P9
                 .          .          .          .          .          .
                 .          .          .          .          .          .
 193             .          .          .          .          .          .          P10
                 .          .          .          .          .          .          .
                 .          .          .          .          .          .          .
 198             .          .         COM.............................................. .
                 .          .          V
                 .          .          V
 201             .          .          RT
                 .          .          .
                 .          .          .
 204             .          .          .          P2
                 .          .          .          .
                 .          .          .          .
 209             .          .          .          .         P11
                 .          .          .          .          .
                 .          .          .          .          .
 214             .          .      COM-D13......................
                 .          .          V
                 .          .          V
 217             .          .      RT-D13E
                 .          .          .
                 .          .          .
 220             .          .          .          E
                 .          .          .          .
                 .          .          .          .
 225        CM-ALL...................................
                 .
                 .
 227             .         P8
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

HEC1 S/N: 1343001727   HMVersion: 6.33   Data File: ALLPR5.DAT

```
****************************************          ****************************************
*                                      *          *                                      *
*   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  12/16/1996  TIME  10:00:34 *          *        (916) 756-1104                *
*                                      *          *                                      *
****************************************          ****************************************
```

```
                    BARKER HOMES, INC.
                    1955 BARING BLVD.
                    SPARKS, NV 89434

                    DESERT HIGHLANDS - OVERALL W/PROPOSED UNITS 2 AND 5
                    DECEMBER 1996
                    INPUT FILE NAME:  ALLPR5.DAT
                    INPUT FILE NAME.  ALLPR5.OUT

                    DEVELOPED CONDITION (UNITS 2&5)
                    Q5-24 HOUR STORM

                    RAINFALL FROM NOAA ATLAS 14-VOL 1-SEMI ARID SOUTHWEST U.S.
                    24-HOUR RAINFALL DERIVED FROM REGIONAL GROWTH FACTORS AS PER WASHOE
                    COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (WCDDM) TABLE 601


                    LAG TIMES COMPUTED USING STANDARED FORM 2 OF WCDDM
                    DEPTH-AREA-REDUCTION-FACTORS (DARF'S) COMPUTED USING
                    FIGURE 604 OF WCDDM-CURVE NUMBERS FROM SCS TABLES
                    MUSKINGUM-CUNGE ROUTING METHODOLOGY


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

    IT        HYDROGRAPH TIME DATA
                    NMIN          8  MINUTES IN COMPUTATION INTERVAL
                   IDATE     1    0  STARTING DATE
                   ITIME       0000  STARTING TIME
                      NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE     2    0  ENDING DATE
                  NDTIME       1552  ENDING TIME
                  ICENT          19  CENTURY MARK

              COMPUTATION INTERVAL    0.13 HOURS
                   TOTAL TIME BASE   39.87 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

JP MULTI-PLAN OPTION

NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION

RATIOS OF PRECIPITATION

1.00 0.99

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 1.00	RATIO 2 0.99
HYDROGRAPH AT						
	A	0.85	1	FLOW	26.	25.
				TIME	12.67	12.67
ROUTED TO						
	RT-AB	0.85	1	FLOW	25.	24.
				TIME	12.80	12.80
HYDROGRAPH AT						
	B	0.92	1	FLOW	24.	23.
				TIME	12.93	12.93
2 COMBINED AT						
	COM-AB	1.76	1	FLOW	49.	47.
				TIME	12.80	12.80
ROUTED TO						
	RT-BE	1.76	1	FLOW	49.	47.
				TIME	13.07	13.07
HYDROGRAPH AT						
	C	0.69	1	FLOW	20.	19.
				TIME	12.80	12.80
ROUTED TO						
	RT-CE	0.69	1	FLOW	19.	19.
				TIME	12.93	12.93
HYDROGRAPH AT						
	D1	0.37	1	FLOW	13.	13.
				TIME	12.53	12.53
HYDROGRAPH AT						
	D1b	0.00	1	FLOW	0.	0.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D2	0.02	1	FLOW	7.	7.
				TIME	12.13	12.13
3 COMBINED AT						
	COM-PR	0.39	1	FLOW	15.	15.
				TIME	12.53	12.53
ROUTED TO						
	RT-PR	0.39	1	FLOW	15.	15.
				TIME	12.53	12.53
HYDROGRAPH AT						

	D4	0.01	1	FLOW	3.	3.
				TIME	12.13	12.13
ROUTED TO						
	RT-D4	0.01	1	FLOW	3.	3.
				TIME	12.27	12.13
HYDROGRAPH AT						
	D3	0.01	1	FLOW	1.	1.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D5	0.00	1	FLOW	1.	1.
				TIME	12.13	12.13
HYDROGRAPH AT						
	D6	0.00	1	FLOW	0.	0.
				TIME	12.13	12.13
5 COMBINED AT						
	COM-PR2	0.42	1	FLOW	17.	17.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D7	0.00	1	FLOW	1.	1.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D7	0.42	1	FLOW	18.	17.
				TIME	12.40	12.40
HYDROGRAPH AT						
	D8	0.01	1	FLOW	3.	3.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D8	0.43	1	FLOW	20.	19.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D9	0.01	1	FLOW	2.	2.
				TIME	12.13	12.13
2 COMBINED AT						
	COM-D9	0.44	1	FLOW	22.	21.
				TIME	12.27	12.27
DIVERSION TO						
	DIV1	0.44	1	FLOW	12.	11.
				TIME	12.27	12.27
HYDROGRAPH AT						
	DIV1	0.44	1	FLOW	10.	10.
				TIME	12.27	12.27
HYDROGRAPH AT						
	D10	0.00	1	FLOW	1.	1.
				TIME	12.13	12.13
HYDROGRAPH AT						

```
                     D12      0.01     1   FLOW          0.       0.
                                           TIME      12.13    12.13

ROUTED TO
                  RT-D12      0.01     1   FLOW          0.       0.
                                           TIME      12.27    12.27

HYDROGRAPH AT
                     D11      0.02     1   FLOW          7.       7.
                                           TIME      12.13    12.13

 4 COMBINED AT
                 COM-D11      0.47     1   FLOW         17.      16.
                                           TIME      12.27    12.27

HYDROGRAPH AT
                      P6      0.00     1   FLOW          2.       2.
                                           TIME      12.13    12.13

HYDROGRAPH AT
                      P7      0.00     1   FLOW          1.       1.
                                           TIME      12.13    12.13

 3 COMBINED AT
                     COM      0.47     1   FLOW         19.      19.
                                           TIME      12.13    12.13

ROUTED TO
                      RT      0.47     1   FLOW         19.      18.
                                           TIME      12.27    12.27

HYDROGRAPH AT
                      P5      0.00     1   FLOW          0.       0.
                                           TIME      12.13    12.13

HYDROGRAPH AT
                     P4a      0.01     1   FLOW          2.       2.
                                           TIME      12.13    12.13

HYDROGRAPH AT
                     P4b      0.01     1   FLOW          4.       4.
                                           TIME      12.13    12.13

 4 COMBINED AT
                    COMB      0.49     1   FLOW         24.      24.
                                           TIME      12.13    12.13

ROUTED TO
                      RT      0.49     1   FLOW         23.      23.
                                           TIME      12.13    12.13

HYDROGRAPH AT
                      P1      0.06     1   FLOW         16.      16.
                                           TIME      12.27    12.27

HYDROGRAPH AT
                      P3      0.02     1   FLOW          5.       5.
                                           TIME      12.13    12.13

HYDROGRAPH AT
```

	P9	0.01	1	FLOW	4.	4.
				TIME	12.13	12.13
HYDROGRAPH AT						
	P10	0.06	1	FLOW	3.	3.
				TIME	12.40	12.40
5 COMBINED AT						
	CCM	0.64	1	FLOW	49.	48.
				TIME	12.27	12.27
ROUTED TO						
	RT	0.64	1	FLOW	47.	46.
				TIME	12.27	12.27
HYDROGRAPH AT						
	P2	0.04	1	FLOW	2.	2.
				TIME	12.13	12.13
HYDROGRAPH AT						
	P11	0.03	1	FLOW	2.	2.
				TIME	12.13	12.13
3 COMBINED AT						
	COM-D13	0.71	1	FLOW	51.	49.
				TIME	12.27	12.27
ROUTED TO						
	RT-D13E	0.71	1	FLOW	55.	54.
				TIME	12.40	12.40
HYDROGRAPH AT						
	E	0.57	1	FLOW	15.	14.
				TIME	12.93	12.93
4 COMBINED AT						
	CM-ALL	3.74	1	FLOW	101.	98.
				TIME	12.93	12.93
HYDROGRAPH AT						
	P8	0.00	1	FLOW	1.	1.
				TIME	12.13	12.13

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)

FOR PLAN = 1 RATIO= 0.00

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
RT-AB	MANE	2.40	25.64	772.80	0.18	8.00	25.18	768.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.8171E+01 EXCESS=0.0000E+00 OUTFLOW=0.8173E+01 BASIN STORAGE=0.1461E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
RT-AB	MANE	2.40	24.74	772.80	0.18	8.00	24.24	768.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7991E+01 EXCESS=0.0000E+00 OUTFLOW=0.7993E+01 BASIN STORAGE=0.1445E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
RT-BE	MANE	3.20	49.42	780.80	0.18	8.00	48.88	784.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1699E+02 EXCESS=0.0000E+00 OUTFLOW=0.1699E+02 BASIN STORAGE=0.1415E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
RT-BE	MANE	3.20	47.69	780.80	0.18	8.00	47.25	784.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1661E+02 EXCESS=0.0000E+00 OUTFLOW=0.1662E+02 BASIN STORAGE=0.1400E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
RT-CE	MANE	2.80	19.35	778.40	0.18	8.00	19.32	776.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6662E+01 EXCESS=0.0000E+00 OUTFLOW=0.6664E+01 BASIN STORAGE=0.1390E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
RT-CE	MANE	2.80	18.67	778.40	0.18	8.00	18.63	776.00	0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6515E+01 EXCESS=0.0000E+00 OUTFLOW=0.6517E+01 BASIN STORAGE=0.1369E-02 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
RT-PR	MANE	2.91	15.50	747.81	0.20	8.00	15.37	752.00	0.20

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4213E+01 EXCESS=0.0000E+00 OUTFLOW=0.4213E+01 BASIN STORAGE=0.4496E-03 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 0.00

```
        RT-PR  MANE       2.94     14.95    749.49      0.20      8.00     14.84    752.00       0.20

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4125E+01 EXCESS=0.0000E+00 OUTFLOW=0.4125E+01 BASIN STORAGE=0.4213E-03 PERCENT ERROR=   0.0

     FOR PLAN = 1  RATIO= 0.00
        RT-D4  MANE       2.24      2.96    731.77      0.56      8.00      2.55    736.00       0.56

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2703E+00 EXCESS=0.0000E+00 OUTFLOW=0.2703E+00 BASIN STORAGE=0.2273E-03 PERCENT ERROR=  -0.1

     FOR PLAN = 1  RATIO= 0.00
        RT-D4  MANE       2.25      2.95    730.45      0.56      8.00      2.50    728.00       0.56

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2668E+00 EXCESS=0.0000E+00 OUTFLOW=0.2668E+00 BASIN STORAGE=0.2363E-03 PERCENT ERROR=  -0.1

     FOR PLAN = 1  RATIO= 0.00
       RT-D12  MANE       0.80      0.57    735.20      0.18      8.00      0.39    736.00       0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7736E-01 EXCESS=0.0000E+00 OUTFLOW=0.7749E-01 BASIN STORAGE=0.4816E-03 PERCENT ERROR=  -0.8

     FOR PLAN = 1  RATIO= 0.00
       RT-D12  MANE       0.80      0.53    735.20      0.18      8.00      0.41    736.00       0.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7565E-01 EXCESS=0.0000E+00 OUTFLOW=0.7578E-01 BASIN STORAGE=0.4765E-03 PERCENT ERROR=  -0.8

     FOR PLAN = 1  RATIO= 0.00
           RT  MANE       0.39     18.88    728.75      0.14      8.00     18.67    736.00       0.14

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3484E+01 EXCESS=0.0000E+00 OUTFLOW=0.3484E+01 BASIN STORAGE=0.2656E-04 PERCENT ERROR=   0.0

     FOR PLAN = 1  RATIO= 0.00
           RT  MANE       0.39     18.56    728.64      0.14      8.00     18.34    736.00       0.14

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3423E-01 EXCESS=0.0000E+00 OUTFLOW=0.3423E+01 BASIN STORAGE=0.2693E-04 PERCENT ERROR=   0.0

     FOR PLAN = 1  RATIO= 0.00
           RT  MANE       0.62     24.19    729.28      0.15      8.00     23.01    728.00       0.15

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3995E+01 EXCESS=0.0000E+00 OUTFLOW=0.3995E+01 BASIN STORAGE=0.4514E-04 PERCENT ERROR=   0.0

     FOR PLAN = 1  RATIO= 0.00
           RT  MANE       0.62     23.81    729.15      0.15      8.00     22.62    728.00       0.15

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3927E+01 EXCESS=0.0000E+00 OUTFLOW=0.3927E+01 BASIN STORAGE=0.4476E-04 PERCENT ERROR=   0.0
```

APPENDIX IV

EXCERPTS FROM PREVIOUS DRAINAGE STUDIES

EXCERPTS FROM WRC ENGINEERING *DRAINAGE EVALUATION FOR EASTLAND HILLS CHANNEL*

INTRODUCTION

The purpose of this Drainage Evaluation (Evaluation) is to address the outfall system capacities for storm runoff originating in the Pah Rah Canyon and to provide drainage improvement alternatives to accommodate storm runoff from the Pah Rah Drainage Basin (see Figure 1).

The existing outfall system consists of a channel (Eastland Hills Channel) that is located within the Eastland Hills subdivision, road cross-culverts, and a storm sewer system that ultimately discharges into the North Truckee Drain. The ability of this system to adequately convey storm runoff is suspect, and it has been reported that flooding commonly occurs where an existing natural channel passes the Jerry Whitehead Elementary School.

GENERAL LOCATION

The Eastland Hills Channel is located in the City of Sparks, Washoe County, Nevada in the northwest quarter of Section 35, Township 20 North, Range 20 East of the Mount Diablo Meridian. The reach extends from Vista Boulevard to Lida Lane (see Figure 2). The channel is located more or less parallel to the southern boundary of the Pah Rah Mountain Park near the Jerry Whitehead Elementary School and meanders through and along the Eastland Hills Subdivision Unit Nº's. 1-A, 1-B and 2. Flows in the channel cross under Vista Boulevard, Shadow Lane and Round Mountain Road via culverts and the channel terminates at the intersection of Lida Lane and Springland Drive.

HYDROLOGIC ANALYSIS

The 100-year design flows are based on a previous memorandum for the Conceptual Cost Estimates for Drainage Improvements (Memorandum), prepared by WRC Engineering, Inc. and dated April 2, 1996. In the Memorandum a preliminary hydrologic analysis was obtained for the Pah Rah Drainage Basin. The total undetained historic flow and developed flow at Vista Boulevard (Design Point A4 of Figure 1) was determined to be 1,367 cubic feet per second (cfs) and 1,431 cfs, respectively. Two detention ponds (Design Points A1 and A2 of Figure 1) were proposed that reduced historic flow and developed flow at Vista Boulevard to 617 cfs and 710 cfs, respectively. The preliminary design of the two detention ponds did not take into account the capacities of associated culvert, storm sewer and streets downstream of the Eastland Hills Channel. In this evaluation, the developed flow of 710 cfs was used to evaluate existing drainage facilities, potential drainage problems and alternative drainage improvements. If the detention ponds are not constructed, the alternatives discussed herein would have to be sized for approximately twice the flow used in this Evaluation, resulting in substantial increases in construction costs.

**DRAINAGE EVALUATION
FOR
EASTLAND HILLS CHANNEL**

TABLE OF CONTENTS

DRAINAGE EVALUATION
FOR
EASTLAND HILLS CHANNEL

DRAFT

Prepared For:

THE CITY OF SPARKS
431 PRATER WAY
WASHOE COUNTY
SPARKS, NEVADA 89432-0857

Prepared By:

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET, SUITE 404
DENVER, COLORADO 80222
TELEPHONE (303)757-8513
FAX (303)758-3208

WRC FILE: 1942/4
JUNE, 1996

EXCERPTS FROM WRC ENGINEERING ***MEMORANDUM: CONCEPTUAL COST ESTIMATES FOR DRAINAGE IMPROVEMENTS***

WRC ENGINEERING, INC.

MEMORANDUM

TO: Scott Barnes

FROM: Bruce J. Buttner
B.J. Urbiztondo

SUBJECT: Conceptual Cost Estimates for Drainage Improvements

DATE: April 2, 1996

WRC FILE: 1942/3

Per our telephone conversation today, we have developed conceptual cost estimates for potential drainage improvements in the Vistas and Pah Rah areas. These estimates are very preliminary and based on potential configurations of the subject facilities. At the present time we have only begun to develop the hydrologic and alternative improvements analyses for the subject areas, and facility requirements could change dramatically from those discussed herein as the master plans become better defined. Nevertheless, these figures should provide some guidance for developing estimated budgets for capital improvements to be implemented in the upcoming years.

1. Pah Rah Detention Basins

Based on the detention storage requirements obtained through our preliminary hydrologic analysis for the Pah Rah area, we have determined that two separate detention basins could be constructed to substantially reduce flows at ~~Sparks~~ Vista Boulevard. These detention basins would have storage capacities of approximately 25 and 67 acre-feet, and would result in 100-year flows at ~~Sparks~~ Vista Boulevard of approximately 700 cubic feet per second (cfs). This compares to a historic flow of 1,400 cfs at this location. We have estimated the cost of design and construction of these detention facilities to range from $15,000 to $20,000 per acre-foot.

The detention cost estimates were estimated through review of two projects designed by our office. One of these projects was a water storage reservoir that included 23 acre-feet of storage, an approximate 30-foot high earth dam with concrete baffle chute spillway, and an outlet structure. Total construction cost of this facility was approximately $15,600 per acre-foot, not including engineering costs. The second project reviewed for comparative purposes was a 30 acre-foot detention basin, in the Denver metro area, currently being designed by

CONSULTING ENGINEERS
950 SOUTH CHERRY STREET • SUITE 404 • DENVER, COLORADO 80222 • (303) 757-8513 • FAX (303) 758-3208

our office. The basin consists of a 10-foot high embankment (to be used for a road) and emergency overflow into a box culvert beneath the road. The engineering estimate for this project is approximately $16,700 per acre-foot of storage.

2. Eastland Hills Channel Improvements

The cost of improving the Pah Rah basin outfall channel from Vista Boulevard to Lida Lane was estimated based on a design flow of 1,500 cfs. This design flow does not include flow reductions obtained through implementation of the Pah Rah detention basins described above. The improvements evaluated include constructing box culverts at Vista Boulevard, Shadow Lane and Round Mountain Road; improving the existing swale through the park and schoolyard just downstream of Vista Boulevard; and constructing three drop structures along the improved channel. Total cost of these improvements, including engineering, was estimated to be $750,000. These improvements were defined based on the assumption that existing facilities from Lida Lane and downstream to the North Truckee Drain have adequate capacity to convey the assumed design flow.

3. Vistas Area Drainage Improvements

At the present time several options for stormwater management in this area are being considered. The final recommended facilities could either be local systems with relatively small detention basins, or a larger regional system incorporating a large detention facility. We currently consider that budgeting from $750,000 to $1,000,000 of capital improvement resources for drainage improvements in this area would provide adequate funding for initial local system improvements or the first development phase of a larger-scale regional stormwater management system. This cost figure is based on the estimated cost of an outfall system from near the proposed Detention Pond #2 (Summit Engineering, January 1993) to the North Truckee Drain to fully convey undetained runoff, or the potential construction of a regional detention facility north and east of the Disc Drive/Sparks Boulevard area.

Please understand that the cost estimates presented above are preliminary and conceptual, and are only intended to provide an order-of-magnitude estimate for drainage improvements in the subject areas. Final system configurations and costs could vary markedly from those presented above as the hydrologic models and alternatives evaluations for the drainage systems are further developed.

If you have any questions or comments regarding this subject, please do not hesitate to call.

BJB/RJU/jlb

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*                                        *                    *                                     *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)     *                    *  U.S. ARMY CORPS OF ENGINEERS       *
*           SEPTEMBER 1990               *                    *  HYDROLOGIC ENGINEERING CENTER      *
*            VERSION 4.0                 *                    *      609 SECOND STREET              *
*                                        *                    *    DAVIS, CALIFORNIA 95616          *
* RUN DATE  03/25/1996  TIME  12:35:57   *                    *       (916) 756-1104                *
*                                        *                    *                                     *
******************************************                    ***************************************
```

PAH-FA3.OUT

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

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

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


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

            *DIAGRAM
   1        ID     PAH RAH DETENTION BASINS RUNOFF ANALYSIS
   2        ID     WRC ENGINEERING, INC.    MARCH 1996
   3        ID
   4        ID     100-YEAR STORM
   5        ID     HISTORIC LAND USE CONDITIONS
   6        ID
```

```
  7        IT     15      0      0    300
  8        IN     15
  9        IO      3

 10        KK  BAS-A1  BASIN A1 RUNOFF
 11        BA   1.77
 12        PH                 0.41   0.75   1.25   1.38   1.48   1.68   2.05   2.40
 13        LS      0     86
 14        UD    .80
           *

 15        KK   DET-1  ROUTE SUB-BASIN A1 FLOWS THROUGH DETENTION POND 1
 16        KO      1
 17        RS      1   STOR      0      0
 18        SV      0      1      2      3      4     20    100
 19        SQ      0     10     50     50     50     50     50
           *

 20        KK  BAS-A2  BASIN A2 RUNOFF
 21        BA    .69
 22        LS      0     86
 23        UD    .59
           *

 24        KK   DET-2  ROUTE SUB-BASIN A2 FLOWS THROUGH DETENTION POND 2
 25        KO      1
 26        RS      1   STOR      0      0
 27        SV      0      1      2      3      4     20    100
 28        SQ      0     10     25     25     25     25     25
           *

 29        KK  BAS-A3  BASIN A3 RUNOFF
 30        BA     .7
 31        LS      0     86
 32        UD    .69
           *

 33        KK  COMB-1  COMBINE BASINS A1,A2 AND A3
 34        HC      3
           *

 35        KK    RT-1  ROUTE 3 BASINS TO STUDY AREA BOUNDARY
 36        RK   5000   .035   .025          TRAP    30.      5
           *
1                                    HEC-1 INPUT                                     PAGE  2

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


 37        KK  BAS-A4  BASIN A4 RUNOFF
 38        BA    .72
 39        LS      0   89.3
 40        UD    .38
           *

 41        KK  COMB-2  COMBINE 2 BASINS
 42        HC      2
 43        ZZ
1

      SCHEMATIC DIAGRAM OF STREAM NETWORK
```

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   10      BAS-A1
               V
               V
   15       DET-1
               .
               .
   20          .     BAS-A2
               .          V
               .          V
   24          .      DET-2
               .          .
               .          .
   29          .          .     BAS-A3
               .          .          .
               .          .          .
   33      COMB-1.......................
               V
               V
   35        RT-1
               .
               .
   37          .     BAS-A4
               .          .
               .          .
   41      COMB-2............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                                        ****************************************
*                                       *                                        *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                        *   U.S. ARMY CORPS OF ENGINEERS       *
*            SEPTEMBER 1990             *                                        *   HYDROLOGIC ENGINEERING CENTER      *
*              VERSION 4.0              *                                        *         609 SECOND STREET            *
*                                       *                                        *      DAVIS, CALIFORNIA 95616         *
*  RUN DATE  03/25/1996  TIME  12:35:57 *                                        *           (916) 756-1104             *
*                                       *                                        *                                      *
*****************************************                                        ****************************************



                              PAH RAH DETENTION BASINS RUNOFF ANALYSIS
                              WRC ENGINEERING, INC.   MARCH 1996

                              100-YEAR STORM
                              HISTORIC LAND USE CONDITIONS


   9 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN         15  MINUTES IN COMPUTATION INTERVAL
```

```
          IDATE      1    0  STARTING DATE
          ITIME        0000  STARTING TIME
             NQ         300  NUMBER OF HYDROGRAPH ORDINATES
         NDDATE      4    0  ENDING DATE
         NDTIME        0245  ENDING TIME
          ICENT          19  CENTURY MARK

      COMPUTATION INTERVAL     .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
```

*** ***

```
           **************
           *            *
10 KK      *   BAS-A1   *       BASIN A1 RUNOFF
           *            *
           **************

              SUBBASIN RUNOFF DATA

11 BA           SUBBASIN CHARACTERISTICS
                      TAREA        1.77  SUBBASIN AREA

                PRECIPITATION DATA

12 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
```

..... HYDRO-35			.... TP-40					.... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
.41	.75	1.25	1.38	1.48	1.68	2.05	2.40	.00	.00	.00	.00

```
                                        STORM AREA =     1.77

13 LS           SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

14 UD           SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .60  LAG

                                             ***

                                         UNIT HYDROGRAPH
                                   18 END-OF-PERIOD ORDINATES
```

151.	506.	866.	917.	757.	498.	310.	204.	130.	85.
54.	35.	23.	14.	10.	7.	4.	1.		

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

HYDROGRAPH AT STATION BAS-A1

TOTAL RAINFALL = 2.39, TOTAL LOSS = 1.24, TOTAL EXCESS = 1.16

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	74.75-HR
+ (CFS)	(HR)					
		(CFS)				
+ 606.	13.00		181.	55.	18.	18.
		(INCHES)	.949	1.158	1.158	1.158
		(AC-FT)	90.	109.	109.	109.

CUMULATIVE AREA = 1.77 SQ MI

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           *            *
  15 KK    *    DET-1   *      ROUTE SUB-BASIN A1 FLOWS THROUGH DETENTION POND 1
           *            *
           **************
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16 KO OUTPUT CONTROL VARIABLES

IPRNT	1	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

17 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	STOR	TYPE OF INITIAL CONDITION
RSVRIC	.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

18 SV	STORAGE	.0	1.0	2.0	3.0	4.0	20.0	100.0
19 SQ	DISCHARGE	0.	10.	50.	50.	50.	50.	50.

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HYDROGRAPH AT STATION DET-1

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE
1		0000	1	0.	.00	*	2		0100	101	50.	54.53	*	3		0200	201	0.	.00
1		0015	2	0.	.00	*	2		0115	102	50.	53.67	*	3		0215	202	0.	.00
1		0030	3	0.	.00	*	2		0130	103	50.	52.74	*	3		0230	203	0.	.00
1		0045	4	0.	.00	*	2		0145	104	50.	51.78	*	3		0245	204	0.	.00
1		0100	5	0.	.00	*	2		0200	105	50.	50.79	*	3		0300	205	0.	.00
1		0115	6	0.	.00	*	2		0215	106	50.	49.79	*	3		0315	206	0.	.00

1	0130	7	0.	.00	*	2	0230	107	50.	48.78	*	3	0330	207	0.	.00
1	0145	8	0.	.00	*	2	0245	108	50.	47.75	*	3	0345	208	0.	.00
1	0200	9	0.	.00	*	2	0300	109	50.	46.73	*	3	0400	209	0.	.00
1	0215	10	0.	.00	*	2	0315	110	50.	45.70	*	3	0415	210	0.	.00
1	0230	11	0.	.00	*	2	0330	111	50.	44.67	*	3	0430	211	0.	.00
1	0245	12	0.	.00	*	2	0345	112	50.	43.64	*	3	0445	212	0.	.00
1	0300	13	0.	.00	*	2	0400	113	50.	42.61	*	3	0500	213	0.	.00
1	0315	14	0.	.00	*	2	0415	114	50.	41.57	*	3	0515	214	0.	.00
1	0330	15	0.	.00	*	2	0430	115	50.	40.54	*	3	0530	215	0.	.00
1	0345	16	0.	.00	*	2	0445	116	50.	39.51	*	3	0545	216	0.	.00
1	0400	17	0.	.00	*	2	0500	117	50.	38.47	*	3	0600	217	0.	.00
1	0415	18	0.	.00	*	2	0515	118	50.	37.44	*	3	0615	218	0.	.00
1	0430	19	0.	.00	*	2	0530	119	50.	36.41	*	3	0630	219	0.	.00
1	0445	20	0.	.00	*	2	0545	120	50.	35.38	*	3	0645	220	0.	.00
1	0500	21	0.	.00	*	2	0600	121	50.	34.34	*	3	0700	221	0.	.00
1	0515	22	0.	.00	*	2	0615	122	50.	33.31	*	3	0715	222	0.	.00
1	0530	23	0.	.00	*	2	0630	123	50.	32.28	*	3	0730	223	0.	.00
1	0545	24	0.	.00	*	2	0645	124	50.	31.24	*	3	0745	224	0.	.00
1	0600	25	0.	.00	*	2	0700	125	50.	30.21	*	3	0800	225	0.	.00
1	0615	26	0.	.00	*	2	0715	126	50.	29.18	*	3	0815	226	0.	.00
1	0630	27	0.	.00	*	2	0730	127	50.	28.14	*	3	0830	227	0.	.00
1	0645	28	0.	.00	*	2	0745	128	50.	27.11	*	3	0845	228	0.	.00
1	0700	29	0.	.00	*	2	0800	129	50.	26.08	*	3	0900	229	0.	.00
1	0715	30	0.	.00	*	2	0815	130	50.	25.05	*	3	0915	230	0.	.00
1	0730	31	0.	.00	*	2	0830	131	50.	24.01	*	3	0930	231	0.	.00
1	0745	32	0.	.00	*	2	0845	132	50.	22.98	*	3	0945	232	0.	.00
1	0800	33	0.	.00	*	2	0900	133	50.	21.95	*	3	1000	233	0.	.00
1	0815	34	0.	.00	*	2	0915	134	50.	20.91	*	3	1015	234	0.	.00
1	0830	35	0.	.00	*	2	0930	135	50.	19.88	*	3	1030	235	0.	.00
1	0845	36	0.	.00	*	2	0945	136	50.	18.85	*	3	1045	236	0.	.00
1	0900	37	0.	.00	*	2	1000	137	50.	17.81	*	3	1100	237	0.	.00
1	0915	38	0.	.01	*	2	1015	138	50.	16.78	*	3	1115	238	0.	.00
1	0930	39	0.	.02	*	2	1030	139	50.	15.75	*	3	1130	239	0.	.00
1	0945	40	0.	.04	*	2	1045	140	50.	14.71	*	3	1145	240	0.	.00
1	1000	41	1.	.07	*	2	1100	141	50.	13.68	*	3	1200	241	0.	.00
1	1015	42	1.	.12	*	2	1115	142	50.	12.65	*	3	1215	242	0.	.00
1	1030	43	2.	.18	*	2	1130	143	50.	11.62	*	3	1230	243	0.	.00
1	1045	44	3.	.26	*	2	1145	144	50.	10.58	*	3	1245	244	0.	.00
1	1100	45	4.	.35	*	2	1200	145	50.	9.55	*	3	1300	245	0.	.00
1	1115	46	5.	.48	*	2	1215	146	50.	8.52	*	3	1315	246	0.	.00
1	1130	47	6.	.64	*	2	1230	147	50.	7.48	*	3	1330	247	0.	.00
1	1145	48	9.	.87	*	2	1245	148	50.	6.45	*	3	1345	248	0.	.00
1	1200	49	22.	1.30	*	2	1300	149	50.	5.42	*	3	1400	249	0.	.00
1	1215	50	50.	2.71	*	2	1315	150	50.	4.38	*	3	1415	250	0.	.00
1	1230	51	50.	7.07	*	2	1330	151	50.	3.35	*	3	1430	251	0.	.00
1	1245	52	50.	15.57	*	2	1345	152	50.	2.32	*	3	1445	252	0.	.00
1	1300	53	50.	26.58	*	2	1400	153	30.	1.49	*	3	1500	253	0.	.00
1	1315	54	50.	37.27	*	2	1415	154	12.	1.06	*	3	1515	254	0.	.00
1	1330	55	50.	45.80	*	2	1430	155	8.	.84	*	3	1530	255	0.	.00
1	1345	56	50.	51.80	*	2	1445	156	7.	.69	*	3	1545	256	0.	.00
1	1400	57	50.	55.93	*	2	1500	157	6.	.56	*	3	1600	257	0.	.00
1	1415	58	50.	58.82	*	2	1515	158	5.	.45	*	3	1615	258	0.	.00
1	1430	59	50.	60.83	*	2	1530	159	4.	.37	*	3	1630	259	0.	.00
1	1445	60	50.	62.23	*	2	1545	160	3.	.30	*	3	1645	260	0.	.00
1	1500	61	50.	63.20	*	2	1600	161	2.	.24	*	3	1700	261	0.	.00
1	1515	62	50.	63.85	*	2	1615	162	2.	.20	*	3	1715	262	0.	.00
1	1530	63	50.	64.31	*	2	1630	163	2.	.16	*	3	1730	263	0.	.00
1	1545	64	50.	64.67	*	2	1645	164	1.	.13	*	3	1745	264	0.	.00
1	1600	65	50.	64.99	*	2	1700	165	1.	.11	*	3	1800	265	0.	.00
1	1615	66	50.	65.29	*	2	1715	166	1.	.09	*	3	1815	266	0.	.00

1	1630	67	50.	65.56	*	2	1730	167	1.	.07	*	3	1830	267	0.	.00
1	1645	68	50.	65.78	*	2	1745	168	1.	.06	*	3	1845	268	0.	.00
1	1700	69	50.	65.97	*	2	1800	169	0.	.05	*	3	1900	269	0.	.00
1	1715	70	50.	66.12	*	2	1815	170	0.	.04	*	3	1915	270	0.	.00
1	1730	71	50.	66.23	*	2	1830	171	0.	.03	*	3	1930	271	0.	.00
1	1745	72	50.	66.31	*	2	1845	172	0.	.02	*	3	1945	272	0.	.00
1	1800	73	50.	66.34	*	2	1900	173	0.	.02	*	3	2000	273	0.	.00
1	1815	74	50.	66.35	*	2	1915	174	0.	.02	*	3	2015	274	0.	.00
1	1830	75	50.	66.30	*	2	1930	175	0.	.01	*	3	2030	275	0.	.00
1	1845	76	50.	66.20	*	2	1945	176	0.	.01	*	3	2045	276	0.	.00
1	1900	77	50.	66.03	*	2	2000	177	0.	.01	*	3	2100	277	0.	.00
1	1915	78	50.	65.80	*	2	2015	178	0.	.01	*	3	2115	278	0.	.00
1	1930	79	50.	65.53	*	2	2030	179	0.	.01	*	3	2130	279	0.	.00
1	1945	80	50.	65.21	*	2	2045	180	0.	.00	*	3	2145	280	0.	.00
1	2000	81	50.	64.87	*	2	2100	181	0.	.00	*	3	2200	281	0.	.00
1	2015	82	50.	64.50	*	2	2115	182	0.	.00	*	3	2215	282	0.	.00
1	2030	83	50.	64.10	*	2	2130	183	0.	.00	*	3	2230	283	0.	.00
1	2045	84	50.	63.69	*	2	2145	184	0.	.00	*	3	2245	284	0.	.00
1	2100	85	50.	63.27	*	2	2200	185	0.	.00	*	3	2300	285	0.	.00
1	2115	86	50.	62.82	*	2	2215	186	0.	.00	*	3	2315	286	0.	.00
1	2130	87	50.	62.37	*	2	2230	187	0.	.00	*	3	2330	287	0.	.00
1	2145	88	50.	61.89	*	2	2245	188	0.	.00	*	3	2345	288	0.	.00
1	2200	89	50.	61.41	*	2	2300	189	0.	.00	*	4	0000	289	0.	.00
1	2215	90	50.	60.92	*	2	2315	190	0.	.00	*	4	0015	290	0.	.00
1	2230	91	50.	60.41	*	2	2330	191	0.	.00	*	4	0030	291	0.	.00
1	2245	92	50.	59.90	*	2	2345	192	0.	.00	*	4	0045	292	0.	.00
1	2300	93	50.	59.37	*	3	0000	193	0.	.00	*	4	0100	293	0.	.00
1	2315	94	50.	58.84	*	3	0015	194	0.	.00	*	4	0115	294	0.	.00
1	2330	95	50.	58.29	*	3	0030	195	0.	.00	*	4	0130	295	0.	.00
1	2345	96	50.	57.74	*	3	0045	196	0.	.00	*	4	0145	296	0.	.00
2	0000	97	50.	57.18	*	3	0100	197	0.	.00	*	4	0200	297	0.	.00
2	0015	98	50.	56.60	*	3	0115	198	0.	.00	*	4	0215	298	0.	.00
2	0030	99	50.	55.99	*	3	0130	199	0.	.00	*	4	0230	299	0.	.00
2	0045	100	50.	55.30	*	3	0145	200	0.	.00	*	4	0245	300	0.	.00
					*						*					

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	PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
				6-HR	24-HR	72-HR	74.75-HR
+	(CFS)	(HR)					
			(CFS)				
+	50.	12.25		50.	50.	18.	18.
			(INCHES)	.263	1.051	1.158	1.158
			(AC-FT)	25.	99.	109.	109.

	PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	74.75-HR
+	(AC-FT)	(HR)				
	66.	18.25	65.	46.	15.	15.

CUMULATIVE AREA = 1.77 SQ MI

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 20 KK     *   BAS-A2  *       BASIN A2 RUNOFF
           *           *
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               SUBBASIN RUNOFF DATA

 21 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .69  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                    DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .41     .75    1.25    1.38    1.48    1.68    2.05    2.40     .00     .00     .00     .00

                                                    STORM AREA =      .69

 22 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 23 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .59  LAG

                                                                           ***

                                                              UNIT HYDROGRAPH
                                                         14 END-OF-PERIOD ORDINATES
              116.       381.       463.       363.       198.       114.        64.        36.        20.        12.
                7.         4.         2.         0.

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

                         HYDROGRAPH AT STATION   BAS-A2

   TOTAL RAINFALL =     2.40, TOTAL LOSS =     1.24, TOTAL EXCESS =     1.16

  PEAK FLOW      TIME                      MAXIMUM AVERAGE FLOW
                                      6-HR         24-HR        72-HR     74.75-HR
+   (CFS)        (HR)
                           (CFS)
+     292.      12.75                  71.          22.           7.           7.
                        (INCHES)      .957        1.161        1.161        1.161
                         (AC-FT)       35.          43.          43.          43.

                        CUMULATIVE AREA =      .69 SQ MI

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           *           *
 24 KK     *   DET-2   *       ROUTE SUB-BASIN A2 FLOWS THROUGH DETENTION POND 2
           *           *
           *************
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25 KO          OUTPUT CONTROL VARIABLES
                    IPRNT          1  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

             HYDROGRAPH ROUTING DATA

26 RS          STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       STOR  TYPE OF INITIAL CONDITION
                   RSVRIC        .00  INITIAL CONDITION
                        X        .00 WORKING R AND D COEFFICIENT

27 SV            STORAGE         .0      1.0      2.0      3.0      4.0     20.0    100.0

28 SQ          DISCHARGE         0.      10.      25.      25.      25.      25.      25.
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HYDROGRAPH AT STATION DET-2

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE
1		0000	1	0.	.00	*	2		0100	101	25.	15.60	*	3		0200	201	0.	.00
1		0015	2	0.	.00	*	2		0115	102	25.	15.11	*	3		0215	202	0.	.00
1		0030	3	0.	.00	*	2		0130	103	25.	14.62	*	3		0230	203	0.	.00
1		0045	4	0.	.00	*	2		0145	104	25.	14.11	*	3		0245	204	0.	.00
1		0100	5	0.	.00	*	2		0200	105	25.	13.60	*	3		0300	205	0.	.00
1		0115	6	0.	.00	*	2		0215	106	25.	13.09	*	3		0315	206	0.	.00
1		0130	7	0.	.00	*	2		0230	107	25.	12.57	*	3		0330	207	0.	.00
1		0145	8	0.	.00	*	2		0245	108	25.	12.06	*	3		0345	208	0.	.00
1		0200	9	0.	.00	*	2		0300	109	25.	11.54	*	3		0400	209	0.	.00
1		0215	10	0.	.00	*	2		0315	110	25.	11.03	*	3		0415	210	0.	.00
1		0230	11	0.	.00	*	2		0330	111	25.	10.51	*	3		0430	211	0.	.00
1		0245	12	0.	.00	*	2		0345	112	25.	9.99	*	3		0445	212	0.	.00
1		0300	13	0.	.00	*	2		0400	113	25.	9.48	*	3		0500	213	0.	.00
1		0315	14	0.	.00	*	2		0415	114	25.	8.96	*	3		0515	214	0.	.00
1		0330	15	0.	.00	*	2		0430	115	25.	8.44	*	3		0530	215	0.	.00
1		0345	16	0.	.00	*	2		0445	116	25.	7.93	*	3		0545	216	0.	.00
1		0400	17	0.	.00	*	2		0500	117	25.	7.41	*	3		0600	217	0.	.00
1		0415	18	0.	.00	*	2		0515	118	25.	6.89	*	3		0615	218	0.	.00
1		0430	19	0.	.00	*	2		0530	119	25.	6.38	*	3		0630	219	0.	.00
1		0445	20	0.	.00	*	2		0545	120	25.	5.86	*	3		0645	220	0.	.00
1		0500	21	0.	.00	*	2		0600	121	25.	5.34	*	3		0700	221	0.	.00
1		0515	22	0.	.00	*	2		0615	122	25.	4.83	*	3		0715	222	0.	.00
1		0530	23	0.	.00	*	2		0630	123	25.	4.31	*	3		0730	223	0.	.00
1		0545	24	0.	.00	*	2		0645	124	25.	3.80	*	3		0745	224	0.	.00
1		0600	25	0.	.00	*	2		0700	125	25.	3.28	*	3		0800	225	0.	.00
1		0615	26	0.	.00	*	2		0715	126	25.	2.76	*	3		0815	226	0.	.00
1		0630	27	0.	.00	*	2		0730	127	25.	2.25	*	3		0830	227	0.	.00
1		0645	28	0.	.00	*	2		0745	128	21.	1.77	*	3		0845	228	0.	.00
1		0700	29	0.	.00	*	2		0800	129	16.	1.38	*	3		0900	229	0.	.00
1		0715	30	0.	.00	*	2		0815	130	11.	1.10	*	3		0915	230	0.	.00
1		0730	31	0.	.00	*	2		0830	131	9.	.89	*	3		0930	231	0.	.00
1		0745	32	0.	.00	*	2		0845	132	7.	.72	*	3		0945	232	0.	.00

1	0800	33	0.	.00	*	2	0900	133	6.	.59	*	3	1000	233	0.	.00
1	0815	34	0.	.00	*	2	0915	134	5.	.48	*	3	1015	234	0.	.00
1	0830	35	0.	.00	*	2	0930	135	4.	.39	*	3	1030	235	0.	.00
1	0845	36	0.	.00	*	2	0945	136	3.	.32	*	3	1045	236	0.	.00
1	0900	37	0.	.00	*	2	1000	137	3.	.26	*	3	1100	237	0.	.00
1	0915	38	0.	.00	*	2	1015	138	2.	.21	*	3	1115	238	0.	.00
1	0930	39	0.	.01	*	2	1030	139	2.	.17	*	3	1130	239	0.	.00
1	0945	40	0.	.02	*	2	1045	140	1.	.14	*	3	1145	240	0.	.00
1	1000	41	0.	.04	*	2	1100	141	1.	.11	*	3	1200	241	0.	.00
1	1015	42	1.	.06	*	2	1115	142	1.	.09	*	3	1215	242	0.	.00
1	1030	43	1.	.09	*	2	1130	143	1.	.07	*	3	1230	243	0.	.00
1	1045	44	1.	.13	*	2	1145	144	1.	.06	*	3	1245	244	0.	.00
1	1100	45	2.	.18	*	2	1200	145	0.	.05	*	3	1300	245	0.	.00
1	1115	46	2.	.24	*	2	1215	146	0.	.04	*	3	1315	246	0.	.00
1	1130	47	3.	.31	*	2	1230	147	0.	.03	*	3	1330	247	0.	.00
1	1145	48	4.	.43	*	2	1245	148	0.	.03	*	3	1345	248	0.	.00
1	1200	49	7.	.75	*	2	1300	149	0.	.02	*	3	1400	249	0.	.00
1	1215	50	23.	1.87	*	2	1315	150	0.	.02	*	3	1415	250	0.	.00
1	1230	51	25.	4.98	*	2	1330	151	0.	.01	*	3	1430	251	0.	.00
1	1245	52	25.	9.97	*	2	1345	152	0.	.01	*	3	1445	252	0.	.00
1	1300	53	25.	15.02	*	2	1400	153	0.	.01	*	3	1500	253	0.	.00
1	1315	54	25.	18.75	*	2	1415	154	0.	.01	*	3	1515	254	0.	.00
1	1330	55	25.	21.05	*	2	1430	155	0.	.01	*	3	1530	255	0.	.00
1	1345	56	25.	22.46	*	2	1445	156	0.	.00	*	3	1545	256	0.	.00
1	1400	57	25.	23.32	*	2	1500	157	0.	.00	*	3	1600	257	0.	.00
1	1415	58	25.	23.84	*	2	1515	158	0.	.00	*	3	1615	258	0.	.00
1	1430	59	25.	24.14	*	2	1530	159	0.	.00	*	3	1630	259	0.	.00
1	1445	60	25.	24.30	*	2	1545	160	0.	.00	*	3	1645	260	0.	.00
1	1500	61	25.	24.36	*	2	1600	161	0.	.00	*	3	1700	261	0.	.00
1	1515	62	25.	24.35	*	2	1615	162	0.	.00	*	3	1715	262	0.	.00
1	1530	63	25.	24.31	*	2	1630	163	0.	.00	*	3	1730	263	0.	.00
1	1545	64	25.	24.28	*	2	1645	164	0.	.00	*	3	1745	264	0.	.00
1	1600	65	25.	24.25	*	2	1700	165	0.	.00	*	3	1800	265	0.	.00
1	1615	66	25.	24.24	*	2	1715	166	0.	.00	*	3	1815	266	0.	.00
1	1630	67	25.	24.21	*	2	1730	167	0.	.00	*	3	1830	267	0.	.00
1	1645	68	25.	24.17	*	2	1745	168	0.	.00	*	3	1845	268	0.	.00
1	1700	69	25.	24.11	*	2	1800	169	0.	.00	*	3	1900	269	0.	.00
1	1715	70	25.	24.04	*	2	1815	170	0.	.00	*	3	1915	270	0.	.00
1	1730	71	25.	23.96	*	2	1830	171	0.	.00	*	3	1930	271	0.	.00
1	1745	72	25.	23.86	*	2	1845	172	0.	.00	*	3	1945	272	0.	.00
1	1800	73	25.	23.74	*	2	1900	173	0.	.00	*	3	2000	273	0.	.00
1	1815	74	25.	23.62	*	2	1915	174	0.	.00	*	3	2015	274	0.	.00
1	1830	75	25.	23.46	*	2	1930	175	0.	.00	*	3	2030	275	0.	.00
1	1845	76	25.	23.29	*	2	1945	176	0.	.00	*	3	2045	276	0.	.00
1	1900	77	25.	23.08	*	2	2000	177	0.	.00	*	3	2100	277	0.	.00
1	1915	78	25.	22.85	*	2	2015	178	0.	.00	*	3	2115	278	0.	.00
1	1930	79	25.	22.61	*	2	2030	179	0.	.00	*	3	2130	279	0.	.00
1	1945	80	25.	22.36	*	2	2045	180	0.	.00	*	3	2145	280	0.	.00
1	2000	81	25.	22.09	*	2	2100	181	0.	.00	*	3	2200	281	0.	.00
1	2015	82	25.	21.83	*	2	2115	182	0.	.00	*	3	2215	282	0.	.00
1	2030	83	25.	21.55	*	2	2130	183	0.	.00	*	3	2230	283	0.	.00
1	2045	84	25.	21.27	*	2	2145	184	0.	.00	*	3	2245	284	0.	.00
1	2100	85	25.	20.98	*	2	2200	185	0.	.00	*	3	2300	285	0.	.00
1	2115	86	25.	20.68	*	2	2215	186	0.	.00	*	3	2315	286	0.	.00
1	2130	87	25.	20.39	*	2	2230	187	0.	.00	*	3	2330	287	0.	.00
1	2145	88	25.	20.08	*	2	2245	188	0.	.00	*	3	2345	288	0.	.00
1	2200	89	25.	19.78	*	2	2300	189	0.	.00	*	4	0000	289	0.	.00
1	2215	90	25.	19.46	*	2	2315	190	0.	.00	*	4	0015	290	0.	.00
1	2230	91	25.	19.15	*	2	2330	191	0.	.00	*	4	0030	291	0.	.00
1	2245	92	25.	18.83	*	2	2345	192	0.	.00	*	4	0045	292	0.	.00

1	2300	93	25.	18.51	*	3	0000	193	0.	.00	*	4	0100	293	0.	.00
1	2315	94	25.	18.18	*	3	0015	194	0.	.00	*	4	0115	294	0.	.00
1	2330	95	25.	17.85	*	3	0030	195	0.	.00	*	4	0130	295	0.	.00
1	2345	96	25.	17.52	*	3	0045	196	0.	.00	*	4	0145	296	0.	.00
2	0000	97	25.	17.18	*	3	0100	197	0.	.00	*	4	0200	297	0.	.00
2	0015	98	25.	16.83	*	3	0115	198	0.	.00	*	4	0215	298	0.	.00
2	0030	99	25.	16.46	*	3	0130	199	0.	.00	*	4	0230	299	0.	.00
2	0045	100	25.	16.05	*	3	0145	200	0.	.00	*	4	0245	300	0.	.00
					*						*					

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	74.75-HR
+ (CFS)	(HR)					
		(CFS)				
+ 25.	12.50		25.	21.	7.	7.
		(INCHES)	.337	1.155	1.161	1.161
		(AC-FT)	12.	43.	43.	43.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	74.75-HR
+ (AC-FT)	(HR)					
24.	15.00		24.	14.	5.	4.

CUMULATIVE AREA = .69 SQ MI

*** ***

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          **************
          *            *
 29 KK    *   BAS-A3   *      BASIN A3 RUNOFF
          *            *
          **************
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SUBBASIN RUNOFF DATA

30 BA SUBBASIN CHARACTERISTICS

TAREA .70 SUBBASIN AREA

PRECIPITATION DATA

12 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

..... HYDRO-35			.... TP-40					.... TP-49			
5-MIN	15-MIN	60-MIN	2-HR	3-HR	6-HR	12-HR	24-HR	2-DAY	4-DAY	7-DAY	10-DAY
.41	.75	1.25	1.38	1.48	1.68	2.05	2.40	.00	.00	.00	.00

STORM AREA = .70

31 LS SCS LOSS RATE

STRTL .33 INITIAL ABSTRACTION

CRVNBR 86.00 CURVE NUMBER

RTIMP .00 PERCENT IMPERVIOUS AREA

32 UD SCS DIMENSIONLESS UNITGRAPH

TLAG .69 LAG

***

UNIT HYDROGRAPH
16 END-OF-PERIOD ORDINATES

82.	283.	412.	378.	265.	152.	94.	56.	34.	21.
13.	8.	5.	3.	2.	0.				

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

HYDROGRAPH AT STATION BAS-A3

TOTAL RAINFALL = 2.40, TOTAL LOSS = 1.24, TOTAL EXCESS = 1.16

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	74.75-HR
+ (CFS)	(HR)					
		(CFS)				
+ 262.	12.75		72.	22.	7.	7.
		(INCHES)	.954	1.160	1.160	1.160
		(AC-FT)	36.	43.	43.	43.

CUMULATIVE AREA = .70 SQ MI

*** ***

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              **************
              *            *
   33 KK      *   COMB-1   *       COMBINE BASINS A1,A2 AND A3
              *            *
              **************

   34 HC           HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE
```

***

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

HYDROGRAPH AT STATION COMB-1

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	74.75-HR
+ (CFS)	(HR)					
		(CFS)				
+ 337.	12.75		146.	93.	33.	32.
		(INCHES)	.429	1.089	1.159	1.159
		(AC-FT)	72.	183.	195.	195.

CUMULATIVE AREA = 3.16 SQ MI

*** ***

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              **************
              *            *
   35 KK      *    RT-1    *       ROUTE 3 BASINS TO STUDY AREA BOUNDARY
              *            *
              **************

                HYDROGRAPH ROUTING DATA

   36 RK          KINEMATIC WAVE STREAM ROUTING
                          L        5000.  CHANNEL LENGTH
                          S        .0350  SLOPE
                          N         .025  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .00  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD        30.00  BOTTOM WIDTH OR DIAMETER
                          Z         5.00  SIDE SLOPE
                     NDXMIN            2  MINIMUM NUMBER OF DX INTERVALS

                                                      ***
                                  COMPUTED KINEMATIC PARAMETERS
                                       VARIABLE TIME STEP
                                      (DT SHOWN IS A MINIMUM)

                   ELEMENT    ALPHA      M        DT       DX      PEAK    TIME TO   VOLUME   MAXIMUM
                                                                            PEAK              CELERITY
                                                 (MIN)    (FT)     (CFS)   (MIN)      (IN)     (FPS)

                  MAIN         1.80     1.47      1.99  1666.67   336.06   770.69     1.16     14.09


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1953E+03  EXCESS= .0000E+00 OUTFLOW= .1953E+03 BASIN STORAGE= .1854E-04 PERCENT ERROR=     .0


                                   INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                  MAIN         1.80     1.47     15.00             330.14   780.00     1.16

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

                       HYDROGRAPH AT STATION      RT-1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR      74.75-HR
+   (CFS)       (HR)
                          (CFS)
+     330.     13.00               146.          92.         33.          32.
                        (INCHES)   .428        1.088       1.159        1.159
                         (AC-FT)    72.         183.        195.         195.

                        CUMULATIVE AREA =    3.16 SQ MI



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


              **************
              *            *
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 37 KK      *   BAS-A4  *       BASIN A4 RUNOFF
            *           *
            *************

               SUBBASIN RUNOFF DATA

 38 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .72  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .41     .75    1.25    1.38    1.48    1.68    2.05    2.40     .00     .00     .00     .00

                                                   STORM AREA =      .72

 39 LS          SCS LOSS RATE
                      STRTL          .24  INITIAL ABSTRACTION
                     CRVNBR        89.30  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

 40 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG          .38  LAG

                                                                           ***

                                                        UNIT HYDROGRAPH
                                                   10 END-OF-PERIOD ORDINATES
            320.      693.      482.      201.       91.       40.       18.        8.        4.        0.

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

                     HYDROGRAPH AT STATION    BAS-A4

   TOTAL RAINFALL =    2.40, TOTAL LOSS =    1.01, TOTAL EXCESS =    1.39

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     74.75-HR
+   (CFS)       (HR)
                          (CFS)
+     477.     12.50                 88.          27.           9.           9.
                      (INCHES)     1.140        1.388        1.388        1.388
                       (AC-FT)       44.          53.          53.          53.

                      CUMULATIVE AREA =     .72 SQ MI

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

            *************
            *           *
 41 KK      *   COMB-2  *       COMBINE 2 BASINS
            *           *
            *************
```

42 HC HYDROGRAPH COMBINATION

ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

***

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

HYDROGRAPH AT STATION COMB-2

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	74.75-HR
+ (CFS)	(HR)					
		(CFS)				
+ 710.	12.50		232.	118.	42.	40.
		(INCHES)	.555	1.130	1.202	1.202
		(AC-FT)	115.	234.	249.	249.

CUMULATIVE AREA = 3.88 SQ MI

1

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	BAS-A1	606.	13.00	181.	55.	18.	1.77		
+	ROUTED TO	DET-1	50.	12.25	50.	50.	18.	1.77		
+	HYDROGRAPH AT	BAS-A2	292.	12.75	71.	22.	7.	.69		
+	ROUTED TO	DET-2	25.	12.50	25.	21.	7.	.69		
+	HYDROGRAPH AT	BAS-A3	262.	12.75	72.	22.	7.	.70		
+	3 COMBINED AT	COMB-1	337.	12.75	146.	93.	33.	3.16		
+	ROUTED TO	RT-1	330.	13.00	146.	92.	33.	3.16		
+	HYDROGRAPH AT	BAS-A4	477.	12.50	88.	27.	9.	.72		
+	2 COMBINED AT	COMB-2	710.	12.50	232.	118.	42.	3.88		

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO	VOLUME

				PEAK				PEAK	
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
RT-1	MANE	1.99	336.06	770.69	1.16	15.00	330.14	780.00	1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1953E+03 EXCESS= .0000E+00 OUTFLOW= .1953E+03 BASIN STORAGE= .1854E-04 PERCENT ERROR= .0

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

MANIPULATED HEC-1 OUTPUT

```
HEC1 S/N: 1343001727        HMVersion: 6.33    Data File: WRC.DAT

****************************************                                           ****************************************
*                                      *                                           *                                      *
*   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  11/27/1996  TIME  15:59:47 *                                           *         (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
   2          ID
   3          ID
   4          ID
   5          ID   WRC RUN W/O DET BASINS
   6          ID   WRC BASINS AND PARAMETERS
   7          ID
   8          ID
              *DIAGRAM
*** FREE ***
   9          IT      15       0       0     300
  10          IN      15
  11          IO       5
              *

  12          KK  BAS-A1
  13          BA    1.77
  14          LS       0      86
  15          PH                      0.41    0.75    1.25    1.38    1.48    1.68    2.05    2.40
  16          UD    0.80
              *

  17          KK  BAS-A2
  18          BA    0.69
  19          LS       0      86
  20          UD    0.59
              *

  21          KK  BAS-A3
  22          BA    0.70
  23          LS       0      86
  24          UD    0.59
              *

  25          KK  CCMB-1
  26          HC       3
              *

  27          KK    RT-1
  28          RK    5000   0.035   0.025            TRAP      30       5
              *

  29          KK  BAS-A4
  30          BA    0.72
  31          LS       0    89.3
  32          UD    0.38
              *

  33          KK  CCMB-2
  34          HC       2
  35          ZZ
```

```
                  SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  12      BAS-A1
              .
              .
  17          .     BAS-A2
              .          .
              .          .
  21          .          .     BAS-A3
              .          .          .
              .          .          .
  25      COMB-1.......................
              V
              V
  27        RT-1
              .
              .
  29          .     BAS-A4
              .          .
              .          .
  33      COMB-2...........

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
HEC1 S/N: 1343001727        HMVersion: 6.33    Data File: WRC.DAT


****************************************                                                    ****************************************
*                                      *                                                    *                                      *
*   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  11/27/1996  TIME  15:59:47 *                                                    *         (916) 756-1104               *
*                                      *                                                    *                                      *
****************************************                                                    ****************************************



                                    WRC RUN W/O DET BASINS
                                    WRC BASINS AND PARAMETERS


  11 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      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      4    0  ENDING DATE
                      NDTIME        0245  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
```

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			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	BAS-A1	606.	13.00	181.	55.	18.	1.77		
HYDROGRAPH AT	BAS-A2	292.	12.75	71.	22.	7.	0.69		
HYDROGRAPH AT	BAS-A3	296.	12.75	72.	22.	7.	0.70		
3 COMBINED AT	COMB-1	1147.	12.75	323.	98.	33.	3.16		
ROUTED TO	RT-1	1111.	13.00	324.	99.	33.	3.16		
HYDROGRAPH AT	BAS-A4	477.	12.50	88.	27.	9.	0.72		
2 COMBINED AT	COMB-2	1470.	12.75	411.	126.	42.	3.88		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
RT-1	MANE	1.44	1146.36	768.05	1.16	15.00	1111.22	780.00	1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1953E+03 EXCESS=0.0000E+00 OUTFLOW=0.1954E+03 BASIN STORAGE=0.5531E-05 PERCENT ERROR= 0.0

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

```
HEC1 S/N: 1343001727        HMVersion: 6.33    Data File: WRC1.DAT

****************************************                          **************************************
*                                      *                          *                                    *
*   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  11/27/1996  TIME  16:22:39 *                         *         (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
   2          ID
   3          ID
   4          ID
   5          ID   WRC RUN W/O DET BASINS
   6          ID   ASSUME CN=75 W/O CHANGING LAGS
   7          ID   WRC BASINS AND PARAMETERS
   8          ID
              *DIAGRAM
*** FREE ***
   9          IT      15       0       0     300
  10          IN      15
  11          IO       5
              *

  12          KK  BAS-A1
  13          BA    1.77
  14          LS       0      75
  15          PH                    0.41    0.75    1.25    1.38    1.48    1.68    2.05    2.40
  16          UD    0.80
              *

  17          KK  BAS-A2
  18          BA    0.69
  19          LS       0      75
  20          UD    0.59
              *

  21          KK  BAS-A3
  22          BA    0.70
  23          LS       0      75
  24          UD    0.59
              *

  25          KK  COMB-1
  26          HC       3
              *

  27          KK    RT-1
  28          RK    5000   0.035   0.025            TRAP      30       5
              *

  29          KK  BAS-A4
  30          BA    0.72
  31          LS       0      75
  32          UD    0.38
              *

  33          KK  COMB-2
  34          HC       2
  35          ZZ
```

```
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   12      BAS-A1
               .
               .
   17          .      BAS-A2
               .          .
               .          .
   21          .          .      BAS-A3
               .          .          .
               .          .          .
   25      COMB-1......................
               V
               V
   27       RT-1
               .
               .
   29          .      BAS-A4
               .          .
               .          .
   33      COMB-2...........

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
HEC1 S/N: 1343001727        HMVersion: 6.33    Data File: WRC1.DAT

****************************************                    ****************************************
*                                      *                    *                                      *
*   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  11/27/1996  TIME  16:22:39 *                   *          (916) 756-1104              *
*                                      *                    *                                      *
****************************************                    ****************************************


                              WRC RUN W/O DET BASINS
                              ASSUME CN=75 W/O CHANGING LAGS
                              WRC BASINS AND PARAMETERS


  11 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     1     0  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE     4     0  ENDING DATE
                       NDTIME        0245  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
```

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	BAS-A1	271.	13.00	88.	28.	9.	1.77		
HYDROGRAPH AT	BAS-A2	130.	12.75	35.	11.	4.	0.69		
HYDROGRAPH AT	BAS-A3	132.	12.75	35.	11.	4.	0.70		
3 COMBINED AT	COMB-1	508.	13.00	158.	50.	17.	3.16		
ROUTED TO	RT-1	505.	13.00	159.	50.	17.	3.16		
HYDROGRAPH AT	BAS-A4	176.	12.50	37.	11.	4.	0.72		
2 COMBINED AT	COMB-2	609.	12.75	194.	62.	21.	3.88		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
RT-1	MANE	1.81	506.72	783.60	0.59	15.00	504.75	780.00	0.59

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.9954E+02 EXCESS=0.0000E+00 OUTFLOW=0.9952E+02 BASIN STORAGE=0.5171E-05 PERCENT ERROR= 0.0

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

```
HEC1 S/N: 1343001727        HMVersion: 6.33     Data File: WRC2.DAT


****************************************                                                    ***************************************
*                                      *                                                    *                                     *
*   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  12/03/1996  TIME  14:55:22 *                                                   *          (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
  2      ID
  3      ID
  4      ID
  5      ID   WRC RUN W/O DET BASINS
  6      ID   ASSUME WRC PARAMETERS
  7      ID   CHANGE PH CARD VALUES
  8      ID   2.66 IN VS. 2.40 IN
  9      ID
         *DIAGRAM
*** FREE ***
 10      IT      15       0       0     300
 11      IN      15
 12      IO       5
         *

 13      KK  BAS-A1
 14      BA    1.77
 15      LS       0      86
 16      PH                    0.48    0.87    1.45    1.49    1.52    1.58    2.12    2.66
 17      UD    0.80
         *

 18      KK  BAS-A2
 19      BA    0.69
 20      LS       0      86
 21      UD    0.59
         *

 22      KK  BAS-A3
 23      BA    0.70
 24      LS       0      86
 25      UD    0.59
         *

 26      KK  COMB-1
 27      HC       3
         *

 28      KK    RT-1
 29      RK    5000   0.035   0.025            TRAP      30       5
         *

 30      KK  BAS-A4
 31      BA    0.72
 32      LS       0    89.3
 33      UD    0.38
         *

 34      KK  COMB-2
 35      HC       2
 36      ZZ
```

```
                SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   13      BAS-A1
              .
              .
   18         .      BAS-A2
              .            .
              .            .
   22         .            .      BAS-A3
              .            .           .
              .            .           .
   26      COMB-1.......................
              V
              V
   28       RT-1
              .
              .
   30         .      BAS-A4
              .            .
              .            .
   34      COMB-2............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION.
```

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE  12/03/1996  TIME  14:55:22 *
*                                      *
****************************************
```

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

```
                    WRC RUN W/O DET BASINS
                    ASSUME WRC PARAMETERS
                    CHANGE PH CARD VALUES
                    2.56 IN VS. 2.40 IN

 12 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     1    0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     4    0  ENDING DATE
                   NDTIME       0245  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
```

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			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	BAS-A1	733.	13.00	198.	65.	22.	1.77		
HYDROGRAPH AT	BAS-A2	359.	12.75	78.	25.	8.	0.69		
HYDROGRAPH AT	BAS-A3	364.	12.75	79.	26.	9.	0.70		
3 COMBINED AT	COMB-1	1410.	12.75	355.	117.	39.	3.16		
ROUTED TO	RT-1	1349.	12.75	355.	117.	39.	3.16		
HYDROGRAPH AT	BAS-A4	580.	12.50	96.	31.	10.	0.72		
2 COMBINED AT	COMB-2	1796.	12.75	450.	148.	49.	3.88		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
RT-1	MANE	1.32	1409.28	767.64	1.37	15.00	1349.24	765.00	1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2311E+03 EXCESS=0.0000E+00 OUTFLOW=0.2312E+03 BASIN STORAGE=0.5870E-05 PERCENT ERROR= 0.0

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

```
HEC1 S/N: 1343001727        HMVersion: 6.33    Data File: WRC3.DAT

****************************************                                       **************************************
*                                      *                                       *                                    *
*   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  12/03/1996  TIME  14:58:44 *                                      *         (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
   2          ID
   3          ID
   4          ID
   5          ID   WRC RUN W/O DET BASINS
   6          ID   ASSUME CN=75 W/O CHANGING LAGS
   7          ID   CHANGE PH CARD VALUES
   8          ID
              *DIAGRAM
*** FREE ***
   9          IT      15       0       0     300
  10          IN      15
  11          IO       5
              *

  12          KK  BAS-A1
  13          BA    1.77
  14          LS       0      75
  15          PH                    0.48    0.87    1.45    1.49    1.52    1.58    2.12    2.66
  16          UD    0.80
              *

  17          KK  BAS-A2
  18          BA    0.69
  19          LS       0      75
  20          UD    0.59
              *

  21          KK  BAS-A3
  22          BA    0.70
  23          LS       0      75
  24          UD    0.59
              *

  25          KK  COMB-1
  26          HC       3
              *

  27          KK    RT-1
  28          RK    5000   0.035   0.025            TRAP      30       5
              *

  29          KK  BAS-A4
  30          BA    0.72
  31          LS       0      75
  32          UD    0.38
              *

  33          KK  COMB-2
  34          HC       2
  35          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   12      BAS-A1
                .
                .
   17           .      BAS-A2
                .           .
                .           .
   21           .           .      BAS-A3
                .           .           .
                .           .           .
   25      COMB-1.......................
                V
                V
   27       RT-1
                .
                .
   29           .      BAS-A4
                .           .
                .           .
   33      COMB-2............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

HEC1 S/N: 1343001727   HMVersion: 6.33   Data File: WRC3.DAT

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             MAY   1991               *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE  12/03/1996  TIME  14:58:44 *
*                                      *
****************************************
```

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

```
                    WRC RUN W/O DET BASINS
                    ASSUME CN=75 W/O CHANGING LAGS
                    CHANGE PH CARD VALUES


 11 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     1    0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     4    0  ENDING DATE
                     NDTIME       0245  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
```

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	BAS-A1	361.	13.00	102.	35.	12.	1.77		
HYDROGRAPH AT	BAS-A2	177.	12.75	41.	14.	5.	0.69		
HYDROGRAPH AT	BAS-A3	180.	12.75	41.	14.	5.	0.70		
3 COMBINED AT	COMB-1	677.	12.75	184.	63.	21.	3.16		
ROUTED TO	RT-1	669.	13.00	184.	63.	21.	3.16		
HYDROGRAPH AT	BAS-A4	242.	12.50	43.	14.	5.	0.72		
2 COMBINED AT	COMB-2	834.	12.75	226.	78.	26.	3.88		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
RT-1	MANE	1.64	676.50	769.28	0.74	15.00	669.23	780.00	0.74

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1252E+03 EXCESS=0.0000E+00 OUTFLOW=0.1252E+03 BASIN STORAGE=0.5376E-05 PERCENT ERROR= 0.0

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

EXCERPTS FROM SUMMIT ENGINEERING *HYDROLOGY REPORT FOR VISTA RIDGE UNIT 1 AND VISTA TERRACE LANE*

TRAFFIC IMPACT STUDY

FOR

MIRAMONTE
TOWNHOME DEVELOPMENT

August 9, 2016

PREPARED BY:

TRAFFIC WORKS LLC

PROFESSIONAL ENGINEER STATE OF NEVADA
LOREN EDWARD CHILSON
Exp: 12·31·16
CIVIL
No. 15619
8·9·16

TRAFFIC WORKS, LLC
5482 Longley Lane, Suite B, Reno, NV 89511
775.322.4300
www.Traffic-Works.com

YOUR QUESTIONS ANSWERED QUICKLY

Why did you perform this study?

This Traffic Impact Study evaluates the potential traffic impacts associated with construction of the proposed Miramonte Townhome Development.

What does the project consist of?

The proposed project consists of up to 448 residential ownership townhome units.

How much traffic will the project generate?

The proposed project is anticipated to generate a total of 2,371 daily trips, 171 AM peak hour trips, and 206 PM peak hour trips. The ITE trip generation manual does not provide any guidance regarding off-peak trip generation. Hence, as a conservative estimate, the AM off-peak trip generation was assumed to be the same as trip generation during the AM peak hour.

Are there any traffic impacts?

All the study intersections are anticipated to operate at acceptable level of service conditions under the "Plus Project" scenario. However, excessive queuing is anticipated to occur at the Los Altos Parkway/Vista Boulevard (south) intersection. With the addition of the project traffic and existing lane configurations, the average westbound queue length is anticipated to be approximately 725 feet during the AM peak hour, which exceeds a reasonable queue length at this location.

Are any traffic related improvements proposed?

The following two improvements are recommend to mitigate anticipated queuing issues at the Los Altos Parkway/Vista Boulevard (south) intersection:

- Extend the westbound left-turn pocket (on Los Altos Parkway) to 400 feet of striped storage length.
- Optimize the green times allocated to the side street movements (eastbound and westbound).

No other mitigations are proposed at any other study intersections since the analysis showed that the anticipated project traffic does not cause any other significant impacts requiring mitigation. Los Altos Parkway south of Belmar Drive (existing two-lane facility) is anticipated to operate at LOS "C" in 2015 and in 2035 with the addition of the project traffic. A two-lane facility is shown to provide sufficient capacity (LOS "C") through the year 2035. The project's contribution of Regional Road Impact Fees will mitigate the minor project effects on the overall roadway network.

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

This report presents the findings of a Traffic Impact Study completed to assess the potential traffic impacts on local intersections and roadway segments associated with construction of the Miramonte Townhome Development. This traffic impact study has been prepared to document existing traffic conditions, quantify traffic volumes generated by the proposed project, identify potential impacts, document findings, and make recommendations to mitigate impacts, if any are found.

Study Area and Evaluated Scenarios

The project site is located east of Los Altos Parkway, on the east side of Belmar Drive, in Sparks, NV. The study intersections were identified based on scoping conversations with City of Sparks staff. The project site location and the study intersections are shown in **Figure 1**. The following intersections are included in this study:

- Vista Blvd / Los Altos Pkwy (south)
- Los Altos Pkwy / Belmar Drive
- Belmar Drive / Project Access Road
- Los Altos Pkwy / Vista Heights Drive
- Vista Blvd / Los Altos Pkwy (north)

The following roadway segments were also analyzed:

- Los Altos Pkwy (south of Belmar Drive)
- Los Altos Pkwy (north of Belmar Drive) – Year 2035 only

This study includes analysis of the both the weekday AM and PM peak hours as these are the periods of time in which peak traffic is anticipated to occur. The study also includes analysis of the AM off-peak hour, between 9:30 AM and 10:30 AM which occurs after the school peak time period. The evaluated development scenarios are:

- Existing Conditions (no project)
- Baseline Conditions (existing plus traffic generated by approved but unbuilt lots)
- Baseline Plus Project Conditions

Analysis Methodology

Level of service (LOS) is a term commonly used by transportation practitioners to measure and describe the operational characteristics of intersections, roadway segments, and other facilities. This term equates seconds of delay per vehicle at intersections to letter grades "A" through "F" with "A" representing optimum conditions and "F" representing breakdown or over capacity flows. The complete methodology is established in the Highway Capacity Manual (HCM), 2010, published by the Transportation Research Board.

Signalized and Un-signalized Intersections

Table 1 presents the delay thresholds for each level of service grade at un-signalized and signalized intersections.

Table 1: Level of Service Definition for Intersections

Level of Service	Brief Description	Un-signalized Intersections (average delay/vehicle in seconds)	Signalized Intersections (average delay/vehicle in seconds)
A	Free flow conditions.	< 10	< 10
B	Stable conditions with some affect from other vehicles.	10 to 15	10 to 20
C	Stable conditions with significant affect from other vehicles.	15 to 25	20 to 35
D	High density traffic conditions still with stable flow.	25 to 35	35 to 55
E	At or near capacity flows.	35 to 50	55 to 80
F	Over capacity conditions.	> 50	> 80

Source: Highway Capacity Manual (2010), Chapters 16 and 17

Level of service calculations were performed for the study intersections using the Synchro 9 software suite, with analysis and results reported in accordance with HCM methodology.

Roadway Segments

Table 2 shows the level of service thresholds for roadway segments as established in the Washoe County *2035 Regional Transportation Plan* (2035 RTP). The daily traffic volumes were compared to the daily volume thresholds shown in **Table 2** to determine roadway segment level of service.

Level of Service Policy

The 2035 Regional Transportation Plan (2035 RTP) establishes level of service criteria for regional roadway facilities within Washoe County, the City of Reno, and the City of Sparks. The current Level of Service policy is:

- "All regional roadway facilities projected to carry less than 27,000 ADT at the latest RTP horizon – LOS D or better."
- "All regional roadway facilities projected to carry 27,000 ADT or more at the latest RTP horizon – LOS E or better."
- "All intersections shall be designed to provide a level of service consistent with maintaining the policy level of service of the intersecting roadways".

According to the Nevada Department of Transportation's 2014 AADT data, the average daily volumes on the study roadways are less than 27,000 ADT. Hence, the level of service threshold specific to the study roadways and intersections is LOS "D".

Table 2: Average Daily Traffic LOS Thresholds by Facility Type for Roadway Planning

Facility Type	Maximum Service Flow Rate (daily for given service level)				
Number of Lanes	LOS A	LOS B	LOS C	LOS D	LOS E
Freeway					
4	≤ 28,600	42,700	63,500	80,000	90,200
6	≤ 38,300	61,200	91,100	114,000	135,300
8	51,100	81,500	121,400	153,200	180,400
10	63,800	101,900	151,800	191,500	225,500
Arterial-High Access Control					
2	n/a	9,400	17,300	19,200	20,300
4	n/a	20,400	36,100	38,400	40,600
6	n/a	31,600	54,700	57,600	60,900
8	n/a	42,500	73,200	76,800	81,300
Arterial-Moderate Access Control					
2	n/a	5,500	14,800	17,500	18,600
4	n/a	12,000	32,200	35,200	36,900
6	n/a	18,800	49,600	52,900	55,400
8	n/a	25,600	66,800	70,600	73,900
Arterial/Collector-Low Access Control					
2	n/a	n/a	6,900	13,400	15,100
4	n/a	n/a	15,700	28,400	30,200
6	n/a	n/a	24,800	43,100	45,400
8	n/a	n/a	34,000	57,600	60,600
Arterial/Collector-Ultra-Low Access Control					
2	n/a	n/a	6,500	13,300	14,200
4	n/a	n/a	15,300	27,300	28,600
6	n/a	n/a	24,100	41,200	43,000
8	n/a	n/a	33,300	55,200	57,400
Source: Washoe County 2035 RTP Table 3-4.					

EXISTING TRANSPORTATION FACILITIES

Roadway Facilities

A brief description of the key roadways in the study area is provided below.

Vista Boulevard within the study area is a four-lane north-south roadway with two lanes in each direction. It is classified as a “Medium Access Control Arterial” in the 2035 RTP. The posted speed limit is 40 mph in the study area.

Los Altos Parkway is a two-lane roadway with one lane in each direction. It is classified as a “Medium Access Control Arterial” in the 2035 RTP. The posted speed limit is 35 mph.

Belmar Drive is a two-lane roadway that serves as one of the main access roadways to the project. It is classified as a “Low Access Control Collector” in the 2035 RTP.

Vista Heights Drive is a two-lane roadway east of Los Altos Parkway. The posted speed limit is 25 mph.

Alternate Travel Modes

There are currently sidewalks along the east side of Los Altos Parkway south of Goodwin Road, the west side of Los Altos Parkway north of Goodwin Road, both sides of Belmar Drive, both sides of Vista Heights Drive, and both sides of Vista Boulevard. Dedicated bike lanes exist in both directions on Los Altos Parkway and Vista Boulevard. The project site is adequately served with bicycle and pedestrian facilities.

EXISTING CONDITIONS

Traffic Volumes

Existing traffic volumes were determined by conducting new video counts at the study intersections. The counts were conducted during an average mid-week day on February 2nd, 2016 with schools in session. The existing intersection traffic volumes and lane configurations are shown on **Figure 2,** attached.

Intersection Level of Service

Level of service calculations were performed using the existing traffic volumes, lane configurations, and traffic controls. The results are presented in **Table 3** and the calculation sheets are provided in **Appendix A**, attached.

As shown in **Table 3**, all the study intersections operate at acceptable level of service conditions during both the AM and PM peak hours, and also during the AM off-peak hour.

Table 3: Existing Conditions Intersection Level of Service Summary

Intersection	AM Peak		AM Off-Peak		PM Peak	
	LOS	Delay	LOS	Delay	LOS	Delay
Los Altos Pkwy/Vista Blvd (south)	C	32.8	C	24.5	C	26.3
Los Altos Pkwy/Belmar Dr	A	6.8	A	5.7	A	7.0
Los Altos Pkwy/Vista Heights Dr	A	6.4	A	4.2	A	6.1
Los Altos Pkwy/Vista Blvd (north)	C	23.6	B	18.5	C	31.3

Roadway Level of Service

Table 4 summarizes the existing daily volumes on Los Altos Parkway south of Belmar Drive and the corresponding level of service.

Table 4: Existing Conditions Road Segment Level of Service Summary

Class	Segment	# Lanes	Daily Volume	LOS
MAC	Los Altos Parkway south of Belmar Drive	2	10,400	C

As shown in **Table 4**, Los Altos Parkway south of Belmar Drive currently operates at LOS "C".

BASELINE CONDITIONS

Baseline Traffic Volumes

A previously approved development is located north of the proposed project on Belmar Drive. The MTA Development has approximately 138 unbuilt lots that are approved for single family housing units. The baseline traffic volumes were obtained by adding the trips generated by these 138 approved but unbuilt single family homes to the existing traffic volumes. The baseline traffic volumes are shown on **Figure 4**, attached.

Intersection Level of Service

Level of service calculations were performed using the baseline traffic volumes, existing lane configurations, and existing traffic controls. The results are presented in **Table 5** and the calculation sheets are provided in **Appendix B**, attached.

As shown in **Table 5**, all the study intersections are anticipated to operate at acceptable LOS conditions.

Table 5: Baseline Conditions Intersection Level of Service Summary

Intersection	AM Peak		AM Off-Peak		PM Peak	
	LOS	Delay	LOS	Delay	LOS	Delay
Los Altos Pkwy/Vista Blvd (south)	C	33.6	C	26.4	C	27.7
Los Altos Pkwy/Belmar Dr	A	7.2	A	6.1	A	8.0
Los Altos Pkwy/Vista Heights Dr	A	6.7	A	4.5	A	6.4
Los Altos Pkwy/Vista Blvd (north)	C	24.8	B	19.4	C	33.2

Roadway Level of Service

Table 6 summarizes the baseline conditions daily volumes on Los Altos Parkway south of Belmar Drive and the corresponding level of service.

Table 6: Baseline Conditions Road Segment Level of Service Summary

Class	Segment	# Lanes	Baseline	
			Daily Volume	LOS
MAC	Los Altos Parkway south of Belmar Drive	2	11,193	C

Los Altos Parkway south of Belmar Drive is anticipated to continue to operate at LOS "C" with the baseline traffic volumes.

Queue Length Analysis

A micro-simulation analysis was performed using SimTraffic to evaluate westbound queue lengths at the Los Altos Parkway/Vista Boulevard (south) intersection. Multiple simulation runs were performed to account for the variations that inherently occur between different days. All the simulations were then averaged to obtain a representation of a typical day. **Table 7** shows the 95th percentile and average queue lengths. The 95th percentile queue is the maximum back of queue with 95th percentile traffic volumes. In other words, the 95th-percentile queue is the queue length that has only a 5-percent probability of being exceeded during the analysis time period.

Table 7: Baseline Queue Length Summary - Los Altos Parkway/Vista Boulevard (south)

Intersection	Approach	AM Peak		AM Off-Peak		PM Peak	
		Avg	95%tile	Avg	95%tile	Avg	95%tile
Los Altos Pkwy/Vista Blvd (south)	Westbound	525	853	160	264	250	402

With the baseline traffic volumes, existing lane configurations and signal timings, the worst queuing on the westbound approach would occur during the AM peak hour. The average westbound queue is estimated to be approximately 525 feet during the AM peak hour and 250 feet during the PM peak hour.

PROJECT GENERATED TRAFFIC

Project Description

The project site is located east of Belmar Drive between Platinum Way and Burlington Drive. The location of the project site is shown in **Figure 1**. The proposed project consists of 448 ownership townhome units.

Trip Generation

Trip generation rates for the proposed project were obtained from the Trip Generation Manual, 9th Edition, published by the Institute of Transportation Engineers. **Table 8** provides the Daily, AM peak hour and PM peak hour trip generation calculation details for the proposed project. As shown in **Table 8**, the proposed project is anticipated to generate a total of 2,371 daily trips, 171 AM peak hour trips, and 206 PM peak hour trips. The ITE trip generation manual does not provide any guidance regarding off-peak trip generation. Hence, as a conservative estimate, the AM off-peak trip generation was assumed to be same as the AM peak hour trip generation. Realistically, the AM off-peak trip generation should be considerably lower than the AM peak hour trip generation.

Table 8: Trip Generation Estimates

ITE Land Use (#)	Size (units)	Daily	AM Peak Hour			PM Peak Hour		
			Total	In	Out	Total	In	Out
230 - Residential Condominium/Townhouse	448	2,371	171	29	142	206	138	68

Project Access

Access to the project site will be provided via a new Project Access Road that will connect to Belmar Drive. The Project Access Road/Belmar Drive intersection will be full-access, allowing for all possible movements, with STOP control on the Project Access Road approach.

Trip Distribution and Assignment

Traffic generated by the project was distributed to the road network based on the location of the project site, major activity centers, the access connection points to arterial roadways, and discussions with City of Sparks staff.

The following trip distribution percentages were used for distributing the project traffic:

- 60% to/from the south via Vista Boulevard
- 10% to/from the north via Vista Boulevard
- 30% to/from the west via Los Altos Parkway

Project generated trips were assigned to the adjacent roadway system based on the distributions outlined above. The project trip assignment is shown on **Figure 5**, attached.

EXISTING PLUS PROJECT CONDITIONS

Traffic Volumes

Plus project traffic volumes were developed by adding the project generated trips (**Figure 5**) to the baseline traffic volumes (**Figure 4**) and are shown on **Figure 6**, attached. The "Plus Project" condition Peak Hour Factors (PHF) and travel patterns were assumed to remain the same as were observed under existing conditions.

Intersection Level of Service Analysis

Table 9 presents the level of service analysis summary for the "Plus Project" scenario assuming the existing intersection configurations. Detailed calculation sheets are provided in **Appendix C**, attached.

Table 9: Plus Project Intersection Level of Service Summary

Intersection	AM Peak		AM Off-Peak		PM Peak	
	LOS	Delay	LOS	Delay	LOS	Delay
Los Altos Pkwy/Vista Blvd (south)	D	35.5	C	29.5	C	29.4
Los Altos Pkwy/Belmar Dr	A	8.6	A	7.2	B	10.4
Belmar Dr/Project Dwy	B	10.8	B	10.9	B	11.2
Los Altos Pkwy/Vista Heights Dr	A	7.1	A	4.9	A	6.9
Los Altos Pkwy/Vista Blvd (north)	C	26.9	C	21.4	D	36.9

All the study intersections are anticipated to operate at acceptable LOS conditions even with the addition of the project traffic. During the AM peak hour and off-peak AM, the increase in average delay does not exceed 3 seconds per vehicle at any intersection. During the PM peak hour, the average delay is not anticipated to increase by more than 4 seconds per vehicle at any intersection. LOS at the Los Altos Parkway/Vista Boulevard (north & south) intersections declines from LOS "C" to LOS "D" with the project.

Roadway Level of Service

Table 10 summarizes the "Plus Project" conditions roadway level of service.

Table 10: Plus Project Conditions Road Segment Level of Service Summary

Class	Segment	# Lanes	Plus Project	
			Daily Volume	LOS
MAC	Los Altos Parkway south of Belmar Drive	2	12,616	C

As shown in **Table 10**, Los Altos Parkway south of Belmar Drive will operate at acceptable LOS conditions during the "Plus Project" scenario. The roadway LOS remains unchanged (LOS "C") after addition of the project traffic.

Queue Length Analysis

A micro-simulation analysis was performed to estimate the "Plus Project" conditions queue lengths. **Table 11** summarizes the average and 95th percentile queue lengths.

Table 11: Plus Project Queue Length Summary - Los Altos Parkway/Vista Boulevard (south)

Intersection	Approach	Scenario	AM Peak		AM Off-Peak		PM Peak	
			Avg	95%tile	Avg	95%tile	Avg	95%tile
Los Altos Pkwy/Vista Blvd (south)	Westbound	Baseline	525	853	160	264	250	402
Los Altos Pkwy/Vista Blvd (south)	Westbound	Plus Project	716	1302	238	422	320	543

With the addition of the project traffic, during the AM peak hour, the average queue length on the westbound approach at the Los Altos Parkway/Vista Boulevard (south) intersection is anticipated to increase by approximately 449 feet compared to the baseline conditions. The average westbound queue length during the AM peak hour, with the existing lane configuration, is anticipated to be approximately 725 feet. The average queue lengths during the AM off-peak and PM peak hours are anticipated to increase by approximately 70 to 80 feet compared to the baseline conditions.

2035 ROADWAY ANALYSIS

Traffic volumes in the broader study area are anticipated to increase in the future as more development occurs in east Sparks. However, potential future traffic generated by all of the approved but unbuilt housing units in the immediate project vicinity have been included in the Baseline Conditions. Very little additional traffic volume growth is anticipated to occur on Belmar Drive or Los Altos Parkway. Hence, no additional growth rates were applied for 2035 roadway segment analysis as discussed and agreed with City of Sparks staff.

Table 12 summarizes the 2035 roadway segment level of service analysis.

Table 12: 2035 Road Segment Level of Service Summary

Class	Segment	# Lanes	2035	
			Daily Volume	LOS
MAC	Los Altos Parkway south of Belmar Drive	2	12,616	C
MAC	Los Altos Parkway north of Belmar Drive	2	8,212	C

As shown in **Table 12**, Los Altos Parkway south of Belmar Drive and Los Altos Parkway north of Belmar Drive are anticipated to operate at acceptable LOS conditions in the year 2035. The roadway LOS remains unchanged after the addition of the project traffic.

MITIGATION MEASURES

Although the Los Altos Parkway/Vista Boulevard (south) intersection is anticipated to operate at acceptable level of service conditions during the “Plus Project” conditions, the queue length analysis shows that the proposed project will contribute to excessive westbound queuing during the AM peak hour. During the highest AM peak hour, the average queue length is estimated to extend up to 725 feet, with existing lane configuration.

In order to keep the westbound queue within reasonable limits, without affecting the coordinated through movement on Vista Boulevard, we recommend the following improvements:

- Extend the westbound left-turn pocket to have approximately 400 feet of storage (an increase from 120 feet of existing left-turn pocket) as shown in **Exhibit 1**.

Exhibit 1

- Increase the green time for the westbound approach keeping the same cycle length and offset as exists today. This can be achieved by reducing the green time for the eastbound approach by 11 seconds and allocating it to the westbound movement. The suggested change in the splits is shown in **Exhibit 2**.

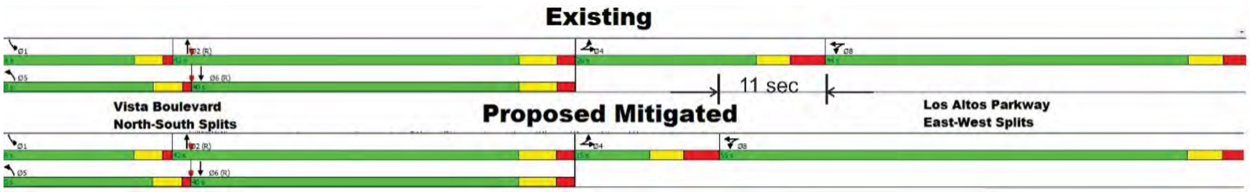

Exhibit 2

With the above two improvements, the resulting westbound queue length is considerably reduced. **Table 12** shows the queue length comparisons**.**

Table 12: Queue Length Comparison - Los Altos Parkway/Vista Boulevard (south)

Intersection	Approach	Scenario	AM Peak		AM Off-Peak		PM Peak	
			Avg	95%tile	Avg	95%tile	Avg	95%tile
Los Altos Pkwy/Vista Blvd (south)	Westbound	Baseline	525	853	160	264	250	402
Los Altos Pkwy/Vista Blvd (south)	Westbound	Plus Project	716	1302	238	422	320	543
Los Altos Pkwy/Vista Blvd (south)	Westbound	Plus Project - Mitigated	300	421	234	242	266	291

As shown in **Table 12**, the queue length on the westbound approach is significantly reduced by extending the westbound left-turn pocket and optimizing east-west green times. The average queues are anticipated to be under 300 feet with extended left-turn storage, during both the peak and non-peak hours.

CONCLUSIONS & RECOMMENDATIONS

The following is a list of our key findings and recommendations to best manage the traffic generated by the proposed project:

Project Trips: The proposed project is anticipated to generate a total of 2,371 daily trips, 171 AM peak hour trips, and 206 PM peak hour trips. The ITE trip generation manual does not provide any guidance regarding off-peak trip generation. Hence, as a conservative estimate, the AM off-peak trip generation was assumed to be the same as the trip generation during the AM peak hour.

Project Access: Access to the project site will be provided via a new Project Access Road that connects to Belmar Drive. The Project Access Road/Belmar Drive intersection will be full-access, allowing for all possible movements, with STOP control on the Project Access Road approach. A single lane approach is sufficient.

Existing/Baseline Level of Service: All the study intersections operate at acceptable levels of service during both the AM and PM peak hours. During the baseline AM peak hour conditions the westbound average queue at the Los Altos Parkway/Vista Boulevard (south) intersection is anticipated to exceed 500 feet.

Plus Project Level of Service: With the addition of the project traffic, all the study intersections continue to operate at acceptable Level of Service (LOS) conditions during the AM and PM peak hours, and AM off-peak hour. However, excessive queuing is anticipated to occur at the at the Los Altos Parkway/Vista Boulevard (south) intersection. With the addition of the project traffic, the average westbound queue length is anticipated be approximately 725 feet during the AM peak hour, with the existing lane configuration.

Mitigation Measures: The following two improvements are recommend to mitigate the westbound queuing issues at the Los Altos Parkway/Vista Boulevard (south) intersection:

- Extend the westbound left-turn pocket (on Los Altos Parkway) to approximately 400 feet of striped storage length.
- Optimize the green times allocated to the side street movements (eastbound and westbound).

No other mitigations are proposed at any other study intersections since the analysis shows that the anticipated project traffic does not cause any other significant impacts requiring mitigation.

2035 Roadway Level of Service: The Los Altos Parkway south of Belmar Drive road segment and Los Altos Parkway north of Belmar Drive road segment are anticipated to operate at LOS "C" under 2035 conditions. The roadway segment LOS is anticipated to be the same with or without project. A two-lane facility is shown to provide sufficient capacity (LOS "C") on Los Altos Parkway through the year 2035.

Regional Road Impact Fees: The project's contribution of standard Regional Road Impact Fees will mitigate the minor project effects on the overall roadway network.

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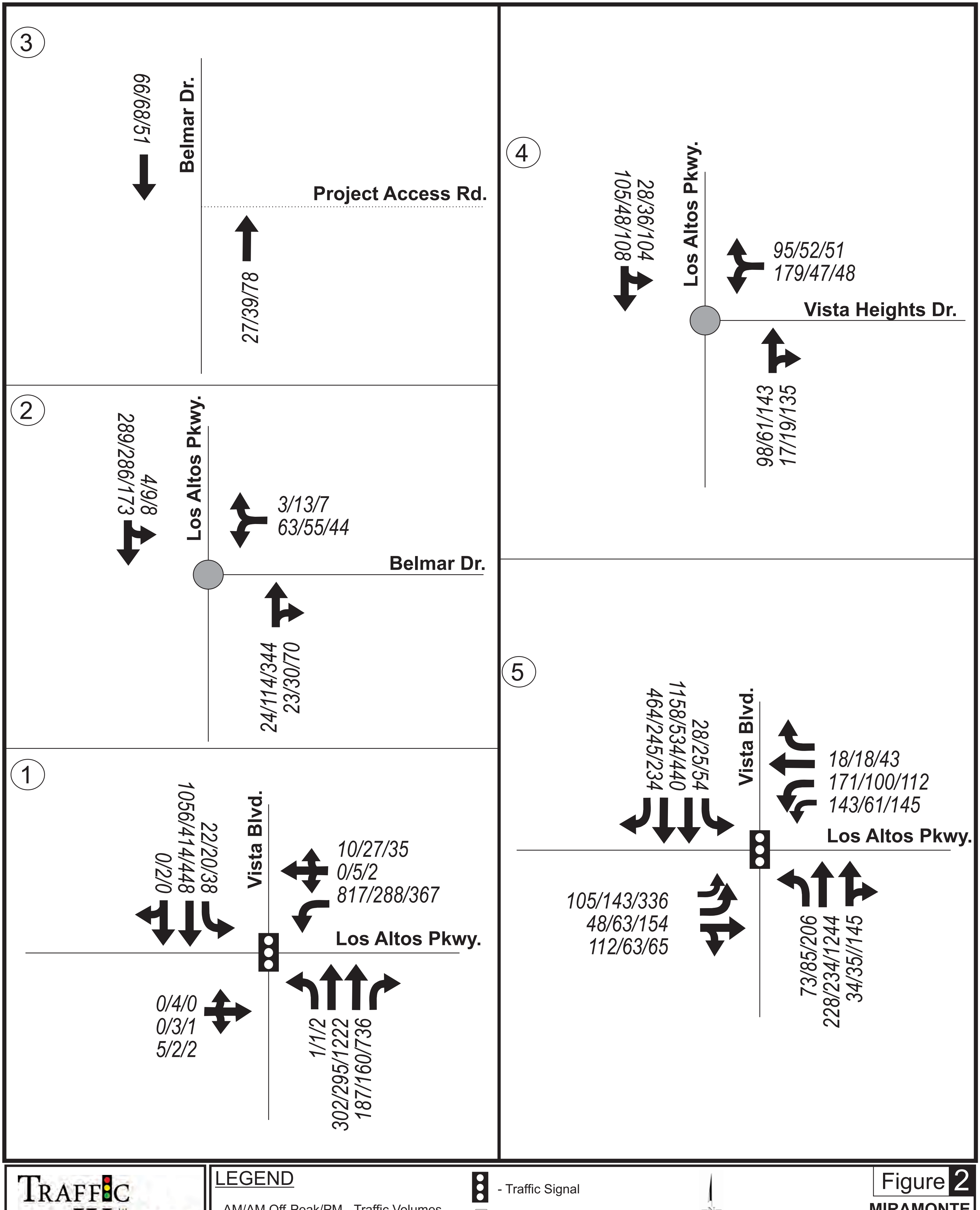
Figure 1

MIRAMONTE TRAFFIC IMPACT STUDY

Study Area



TRAFFIC WORKS LLC

LEGEND

AM/AM Off-Peak/PM - Traffic Volumes

- Lane Configuration

- Traffic Signal

STOP - Stop Sign

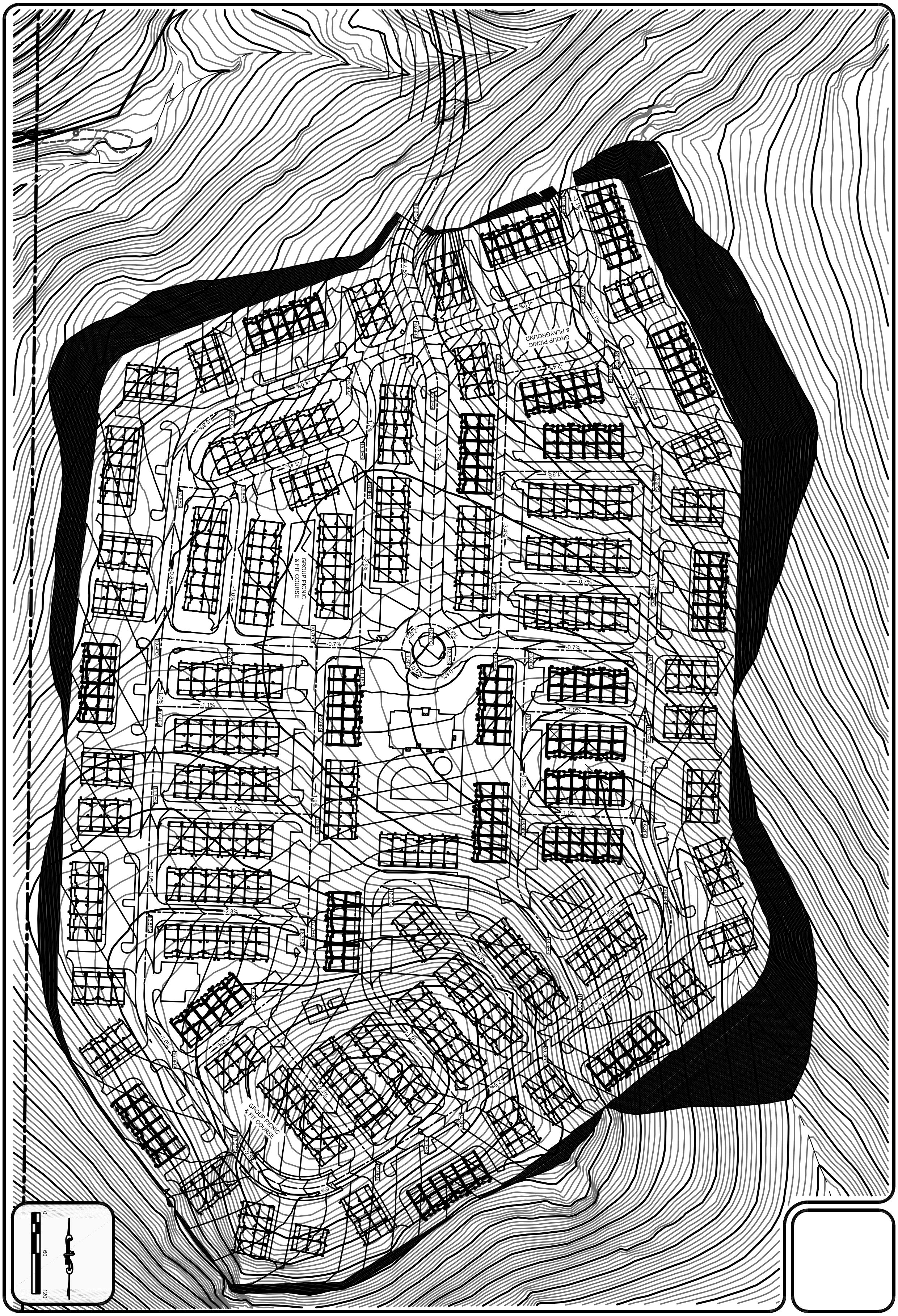
- Roundabout

N

NO SCALE

Figure 2

MIRAMONTE
TRAFFIC IMPACT STUDY
Existing Traffic Volumes



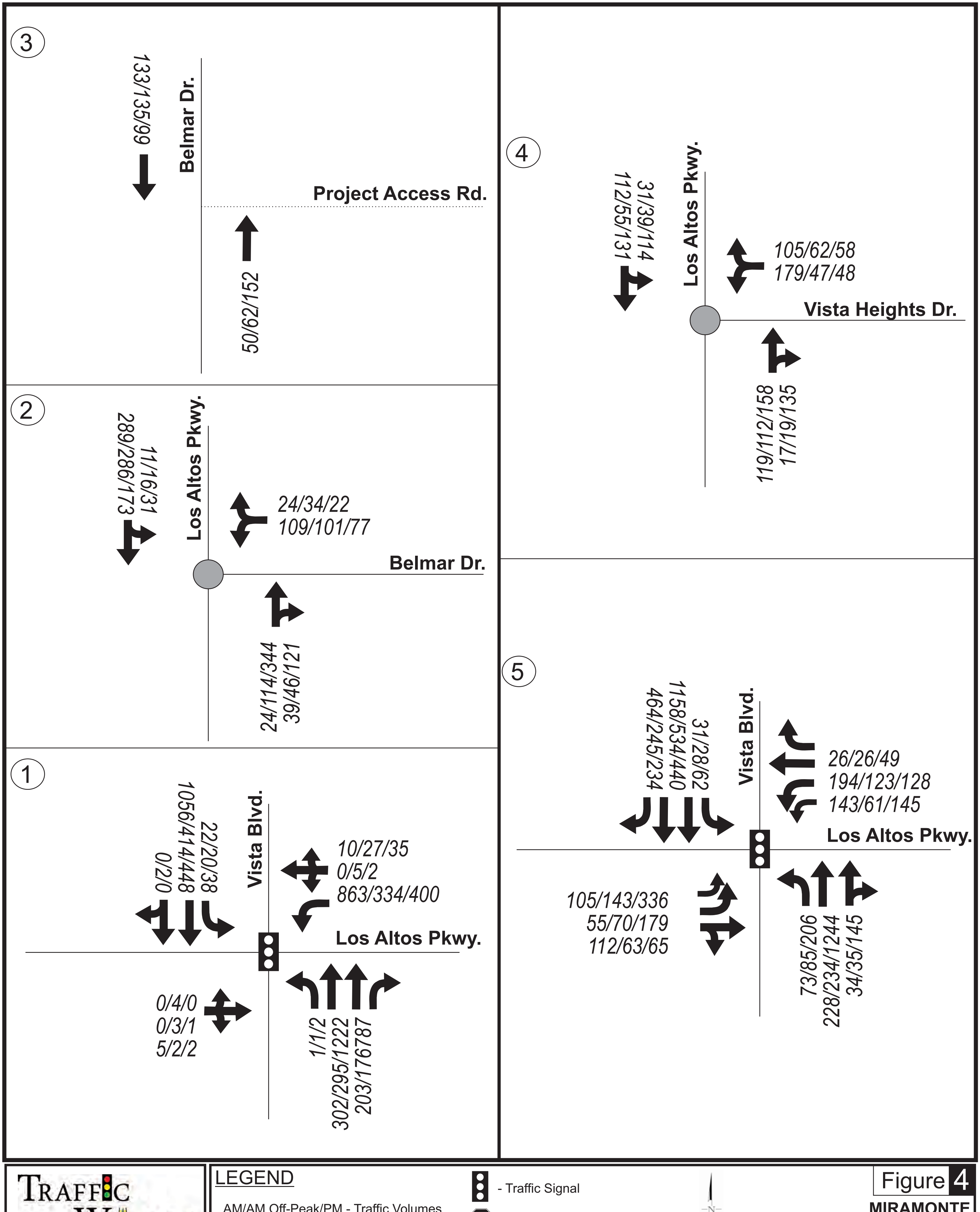
BASEMAP
MIRAMONTE TOWNHOME
GRADING CONCEPT
SPARKS | A PORTION OF SEC 25 T20N R20E, MDM | NEVADA

PLACES Consulting Services, Inc.
PLANNING LANDSCAPE ARCHITECTURE CIVIL ENGINEERING SERVICES
6250 Fieldstone Place, Reno, Nevada 89523
Ph. (775) 355-7721 Fax. (775) 355-7795

project no.:
sheet 1 of 1
date: 06/06/16
designed by: SRC
checked by: ?

TRAFFIC WORKS LLC

Figure 3
MIRAMONTE
TRAFFIC IMPACT STUDY
Site Plan



TRAFFIC WORKS LLC

LEGEND

AM/AM Off-Peak/PM - Traffic Volumes

- Lane Configuration

- Traffic Signal

STOP - Stop Sign

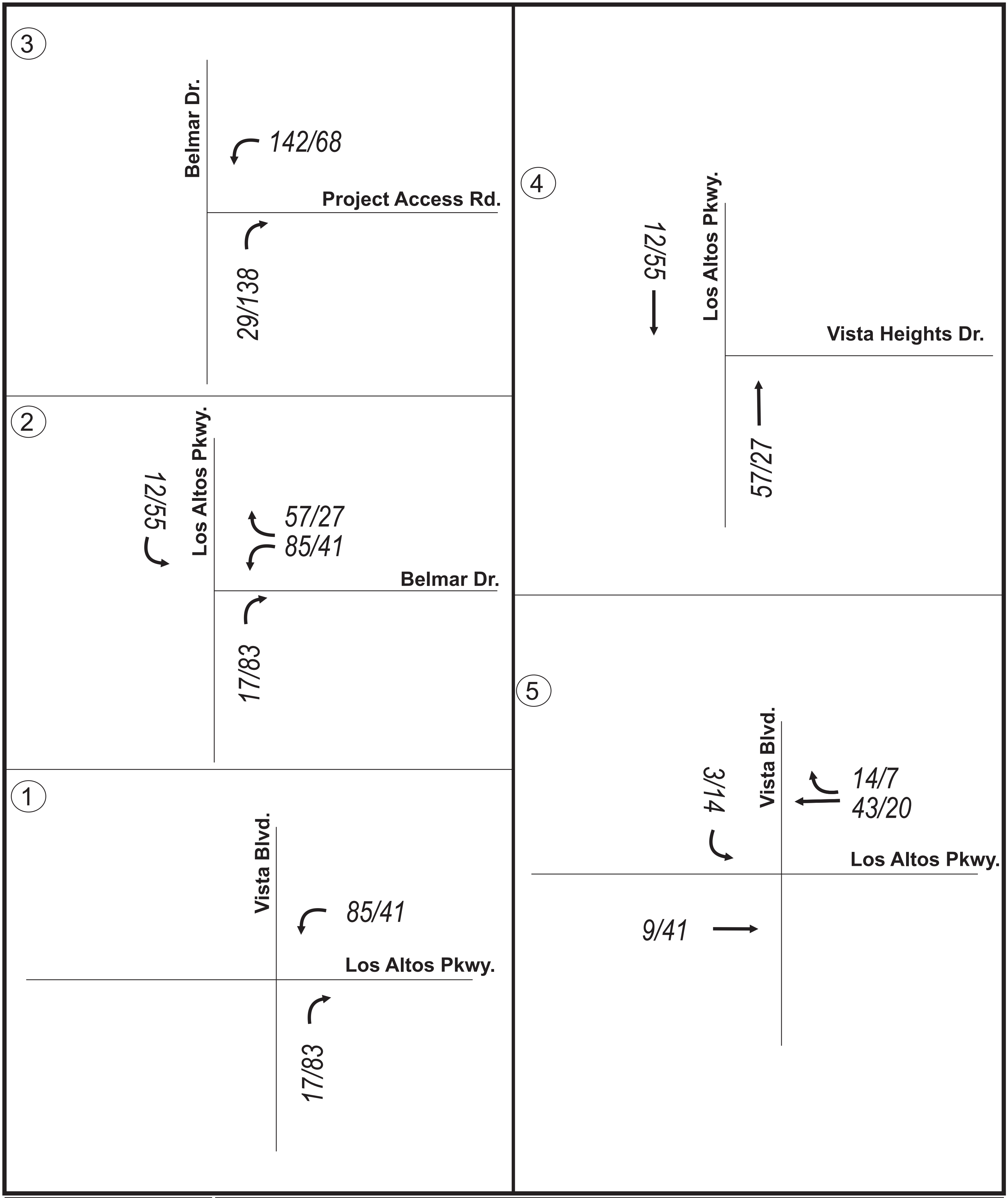
- Roundabout

N

NO SCALE

Figure 4

MIRAMONTE
TRAFFIC IMPACT STUDY
Baseline Traffic Volumes



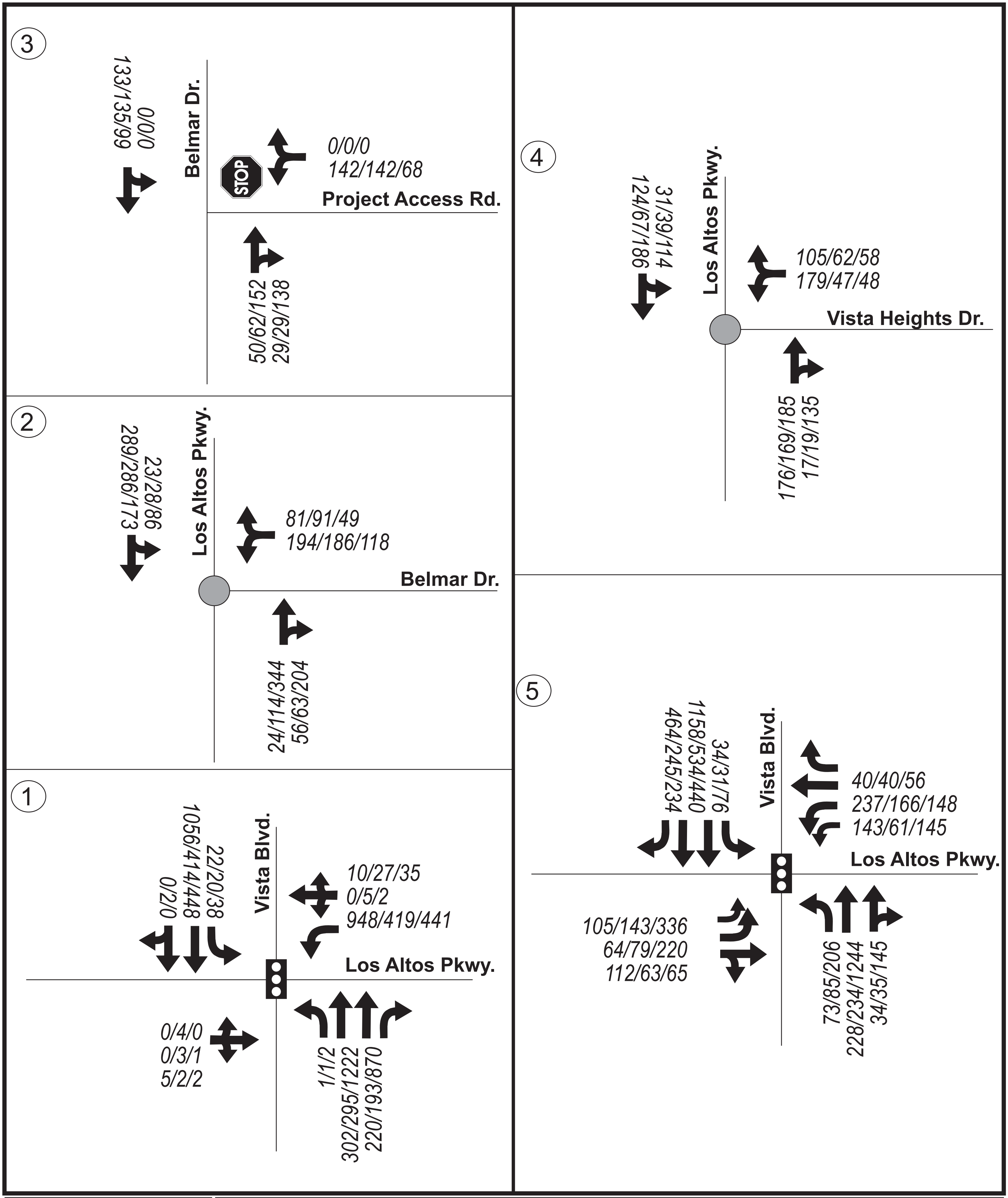
LEGEND

AM/PM - Trip Assignment

NO SCALE

Figure 5

MIRAMONTE
TRAFFIC IMPACT STUDY
Project Trips



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LEGEND

AM/AM Off-Peak/PM - Traffic Volumes

- Lane Configuration

- Traffic Signal

- Stop Sign

- Roundabout

NO SCALE

Figure 6

MIRAMONTE TRAFFIC IMPACT STUDY

Plus Project Traffic Volumes

Appendix A

Existing Conditions LOS Calculations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	5	817	0	10	1	302	187	22	1056	0
Future Volume (vph)	0	0	5	817	0	10	1	302	187	22	1056	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Lane Util. Factor		1.00		0.95	0.95		1.00	0.95	1.00	1.00	0.95	
Frt		0.86		1.00	1.00		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	0.95		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1627		1698	1698		1787	3574	1599	1787	3574	
Flt Permitted		1.00		0.95	0.95		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1627		1698	1698		1787	3574	1599	1787	3574	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	5	888	0	11	1	328	203	24	1148	0
RTOR Reduction (vph)	0	5	0	0	80	0	0	0	110	0	0	0
Lane Group Flow (vph)	0	0	0	453	366	0	1	328	93	24	1148	0
Turn Type		NA		Split	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)		0.9		42.0	42.0		1.0	59.4	59.4	4.4	62.8	
Effective Green, g (s)		0.9		42.0	42.0		1.0	59.4	59.4	4.4	62.8	
Actuated g/C Ratio		0.01		0.32	0.32		0.01	0.46	0.46	0.03	0.48	
Clearance Time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Vehicle Extension (s)		2.0		2.0	2.0		2.0	4.0	4.0	2.0	4.0	
Lane Grp Cap (vph)		11		548	548		13	1633	730	60	1726	
v/s Ratio Prot		c0.00		c0.27	0.22		0.00	0.09		c0.01	c0.32	
v/s Ratio Perm									0.06			
v/c Ratio		0.00		0.83	0.67		0.08	0.20	0.13	0.40	0.67	
Uniform Delay, d1		64.1		40.6	38.0		64.0	21.1	20.4	61.5	25.6	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.0		9.4	2.4		0.9	0.3	0.4	1.6	2.0	
Delay (s)		64.1		50.1	40.4		65.0	21.4	20.7	63.1	27.6	
Level of Service		E		D	D		E	C	C	E	C	
Approach Delay (s)		64.1			45.3			21.2			28.4	
Approach LOS		E			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	32.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	23.3
Intersection Capacity Utilization	68.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	6.8
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	93	66	413
Demand Flow Rate, veh/h	94	66	417
Vehicles Circulating, veh/h	34	6	90
Vehicles Exiting, veh/h	38	501	38
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	4.1	3.7	7.9
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	94	66	417
Cap Entry Lane, veh/h	1092	1123	1033
Entry HV Adj Factor	0.989	0.995	0.990
Flow Entry, veh/h	93	66	413
Cap Entry, veh/h	1081	1117	1023
V/C Ratio	0.086	0.059	0.404
Control Delay, s/veh	4.1	3.7	7.9
LOS	A	A	A
95th %tile Queue, veh	0	0	2

Intersection	
Intersection Delay, s/veh	6.4
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	347	146	168
Demand Flow Rate, veh/h	350	147	169
Vehicles Circulating, veh/h	125	35	229
Vehicles Exiting, veh/h	57	363	246
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.4	4.5	5.9
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	350	147	169
Cap Entry Lane, veh/h	997	1091	899
Entry HV Adj Factor	0.991	0.992	0.992
Flow Entry, veh/h	347	146	168
Cap Entry, veh/h	989	1082	892
V/C Ratio	0.351	0.135	0.188
Control Delay, s/veh	7.4	4.5	5.9
LOS	A	A	A
95th %tile Queue, veh	2	0	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	48	112	143	171	18	73	228	34	28	1158	464
Future Volume (vph)	105	48	112	143	171	18	73	228	34	28	1158	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.89		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3467	1684		3467	1881	1599	1787	3504		1787	3574	1599
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3467	1684		3467	1881	1599	1787	3504		1787	3574	1599
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	117	53	124	159	190	20	81	253	38	31	1287	516
RTOR Reduction (vph)	0	84	0	0	0	17	0	8	0	0	0	236
Lane Group Flow (vph)	117	93	0	159	190	3	81	283	0	31	1287	280
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	6.9	12.8		9.2	15.1	15.1	7.3	57.3		3.6	53.6	53.6
Effective Green, g (s)	6.9	12.8		9.2	15.1	15.1	7.3	57.3		3.6	53.6	53.6
Actuated g/C Ratio	0.07	0.13		0.09	0.15	0.15	0.07	0.58		0.04	0.54	0.54
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	241	217		322	287	244	131	2030		65	1936	866
v/s Ratio Prot	0.03	0.06		c0.05	c0.10		c0.05	c0.08		0.02	c0.36	
v/s Ratio Perm						0.00						0.17
v/c Ratio	0.49	0.43		0.49	0.66	0.01	0.62	0.14		0.48	0.66	0.32
Uniform Delay, d1	44.3	39.7		42.6	39.5	35.6	44.4	9.5		46.7	16.2	12.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.5	1.4		1.2	5.6	0.0	8.4	0.1		5.4	1.8	1.0
Delay (s)	45.8	41.1		43.8	45.1	35.6	52.9	9.7		52.2	18.0	13.6
Level of Service	D	D		D	D	D	D	A		D	B	B
Approach Delay (s)		43.0			44.1			19.1			17.4	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	23.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	98.9	Sum of lost time (s)	16.0
Intersection Capacity Utilization	63.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	4	3	2	288	5	27	1	295	160	20	414	2
Future Volume (vph)	4	3	2	288	5	27	1	295	160	20	414	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Lane Util. Factor		1.00		0.95	0.95		1.00	0.95	1.00	1.00	0.95	
Frt		0.97		1.00	0.97		1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.98		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1785		1698	1675		1072	2859	1583	1787	3572	
Flt Permitted		0.98		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1785		1698	1675		1072	2859	1583	1787	3572	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	4	3	2	313	5	29	1	321	174	22	450	2
RTOR Reduction (vph)	0	2	0	0	7	0	0	0	63	0	0	0
Lane Group Flow (vph)	0	7	0	175	165	0	1	321	111	22	452	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	100	100	0	0	0	0
Turn Type	Split	NA		Split	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)		1.3		18.1	18.1		1.1	83.0	83.0	4.3	86.2	
Effective Green, g (s)		1.3		18.1	18.1		1.1	83.0	83.0	4.3	86.2	
Actuated g/C Ratio		0.01		0.14	0.14		0.01	0.64	0.64	0.03	0.66	
Clearance Time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Vehicle Extension (s)		2.0		2.0	2.0		2.0	4.0	4.0	2.0	4.0	
Lane Grp Cap (vph)		17		236	233		9	1825	1010	59	2368	
v/s Ratio Prot		c0.00		c0.10	0.10		0.00	0.11		c0.01	c0.13	
v/s Ratio Perm									0.07			
v/c Ratio		0.41		0.74	0.71		0.11	0.18	0.11	0.37	0.19	
Uniform Delay, d1		64.0		53.7	53.4		64.0	9.6	9.1	61.5	8.4	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		5.8		10.4	7.8		2.0	0.2	0.2	1.4	0.2	
Delay (s)		69.8		64.1	61.2		66.0	9.8	9.4	63.0	8.6	
Level of Service		E		E	E		E	A	A	E	A	
Approach Delay (s)		69.8			62.7			9.7			11.1	
Approach LOS		E			E			A			B	

Intersection Summary			
HCM 2000 Control Delay	24.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	23.3
Intersection Capacity Utilization	42.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	5.7
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	78	164	335
Demand Flow Rate, veh/h	79	165	338
Vehicles Circulating, veh/h	131	10	64
Vehicles Exiting, veh/h	44	392	146
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	4	0	0
Ped Cap Adj	0.999	1.000	1.000
Approach Delay, s/veh	4.4	4.5	6.6
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	79	165	338
Cap Entry Lane, veh/h	991	1119	1060
Entry HV Adj Factor	0.987	0.992	0.990
Flow Entry, veh/h	78	164	335
Cap Entry, veh/h	978	1110	1050
V/C Ratio	0.080	0.147	0.319
Control Delay, s/veh	4.4	4.5	6.6
LOS	A	A	A
95th %tile Queue, veh	0	1	1

Intersection	
Intersection Delay, s/veh	4.2
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	110	89	93
Demand Flow Rate, veh/h	112	90	94
Vehicles Circulating, veh/h	69	40	53
Vehicles Exiting, veh/h	61	107	128
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	4.4	4.1	4.1
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	112	90	94
Cap Entry Lane, veh/h	1055	1086	1072
Entry HV Adj Factor	0.982	0.992	0.994
Flow Entry, veh/h	110	89	93
Cap Entry, veh/h	1036	1077	1066
V/C Ratio	0.106	0.083	0.088
Control Delay, s/veh	4.4	4.1	4.1
LOS	A	A	A
95th %tile Queue, veh	0	0	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	143	63	63	61	100	18	85	234	35	25	534	245
Future Volume (vph)	143	63	63	61	100	18	85	234	35	25	534	245
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.93		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3467	1740		3467	1881	1599	1787	3504		1787	3574	1599
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3467	1740		3467	1881	1599	1787	3504		1787	3574	1599
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	154	68	68	66	108	19	91	252	38	27	574	263
RTOR Reduction (vph)	0	49	0	0	0	17	0	8	0	0	0	139
Lane Group Flow (vph)	154	87	0	66	108	2	91	282	0	27	574	124
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	7.7	11.1		4.3	7.7	7.7	6.8	38.6		2.3	34.1	34.1
Effective Green, g (s)	7.7	11.1		4.3	7.7	7.7	6.8	38.6		2.3	34.1	34.1
Actuated g/C Ratio	0.11	0.15		0.06	0.11	0.11	0.09	0.53		0.03	0.47	0.47
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	369	267		206	200	170	168	1870		56	1685	754
v/s Ratio Prot	c0.04	c0.05		0.02	c0.06		c0.05	0.08		0.02	c0.16	
v/s Ratio Perm						0.00						0.08
v/c Ratio	0.42	0.33		0.32	0.54	0.01	0.54	0.15		0.48	0.34	0.16
Uniform Delay, d1	30.2	27.3		32.6	30.6	28.9	31.3	8.5		34.4	12.0	10.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.8	0.7		0.9	3.0	0.0	3.5	0.2		6.4	0.6	0.5
Delay (s)	31.0	28.0		33.5	33.6	28.9	34.8	8.7		40.8	12.6	11.4
Level of Service	C	C		C	C	C	C	A		D	B	B
Approach Delay (s)		29.6			33.1			14.9			13.1	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	18.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	72.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	44.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1	2	367	2	35	2	1222	736	38	448	0
Future Volume (vph)	0	1	2	367	2	35	2	1222	736	38	448	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Lane Util. Factor		1.00		0.95	0.95		1.00	0.95	1.00	1.00	0.95	
Frt		0.91		1.00	0.97		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1712		1698	1672		1072	2859	1583	1787	3574	
Flt Permitted		1.00		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1712		1698	1672		1072	2859	1583	1787	3574	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1	2	386	2	37	2	1286	775	40	472	0
RTOR Reduction (vph)	0	2	0	0	5	0	0	0	282	0	0	0
Lane Group Flow (vph)	0	1	0	216	204	0	2	1286	493	40	472	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	100	100	0	0	0	0
Turn Type		NA		Split	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)		1.1		23.3	23.3		1.2	95.4	95.4	6.9	101.1	
Effective Green, g (s)		1.1		23.3	23.3		1.2	95.4	95.4	6.9	101.1	
Actuated g/C Ratio		0.01		0.16	0.16		0.01	0.64	0.64	0.05	0.67	
Clearance Time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Vehicle Extension (s)		2.0		2.0	2.0		2.0	4.0	4.0	2.0	4.0	
Lane Grp Cap (vph)		12		263	259		8	1818	1006	82	2408	
v/s Ratio Prot		c0.00		c0.13	0.12		0.00	c0.45		c0.02	0.13	
v/s Ratio Perm									0.31			
v/c Ratio		0.08		0.82	0.79		0.25	0.71	0.49	0.49	0.20	
Uniform Delay, d1		73.9		61.3	61.0		74.0	18.1	14.4	69.8	9.2	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.1		17.5	13.5		5.9	2.4	1.7	1.7	0.2	
Delay (s)		75.1		78.8	74.5		79.8	20.4	16.1	71.5	9.4	
Level of Service		E		E	E		E	C	B	E	A	
Approach Delay (s)		75.1			76.7			18.9			14.2	
Approach LOS		E			E			B			B	

Intersection Summary			
HCM 2000 Control Delay	26.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	23.3
Intersection Capacity Utilization	66.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	7.0
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	60	487	213
Demand Flow Rate, veh/h	61	492	215
Vehicles Circulating, veh/h	409	9	53
Vehicles Exiting, veh/h	92	259	417
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	4	0	0
Ped Cap Adj	0.999	1.000	1.000
Approach Delay, s/veh	5.7	8.0	5.2
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	61	492	215
Cap Entry Lane, veh/h	751	1120	1072
Entry HV Adj Factor	0.984	0.990	0.991
Flow Entry, veh/h	60	487	213
Cap Entry, veh/h	738	1108	1061
V/C Ratio	0.081	0.439	0.201
Control Delay, s/veh	5.7	8.0	5.2
LOS	A	A	A
95th %tile Queue, veh	0	2	1

Intersection	
Intersection Delay, s/veh	6.1
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	114	319	244
Demand Flow Rate, veh/h	116	323	246
Vehicles Circulating, veh/h	166	121	56
Vehicles Exiting, veh/h	278	181	226
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.0	7.0	5.6
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	116	323	246
Cap Entry Lane, veh/h	957	1001	1068
Entry HV Adj Factor	0.983	0.989	0.991
Flow Entry, veh/h	114	319	244
Cap Entry, veh/h	941	990	1059
V/C Ratio	0.121	0.323	0.230
Control Delay, s/veh	5.0	7.0	5.6
LOS	A	A	A
95th %tile Queue, veh	0	1	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	336	154	65	145	112	43	206	1244	145	54	440	234
Future Volume (vph)	336	154	65	145	112	43	206	1244	145	54	440	234
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3467	1797		3467	1881	1599	1787	3518		1787	3574	1599
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3467	1797		3467	1881	1599	1787	3518		1787	3574	1599
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	361	166	70	156	120	46	222	1338	156	58	473	252
RTOR Reduction (vph)	0	16	0	0	0	40	0	6	0	0	0	153
Lane Group Flow (vph)	361	220	0	156	120	6	222	1488	0	58	473	99
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	13.1	17.7		9.0	13.6	13.6	16.8	51.4		3.9	38.5	38.5
Effective Green, g (s)	13.1	17.7		9.0	13.6	13.6	16.8	51.4		3.9	38.5	38.5
Actuated g/C Ratio	0.13	0.18		0.09	0.14	0.14	0.17	0.52		0.04	0.39	0.39
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	463	324		318	261	221	306	1845		71	1404	628
v/s Ratio Prot	c0.10	c0.12		0.04	0.06		c0.12	c0.42		0.03	0.13	
v/s Ratio Perm						0.00						0.06
v/c Ratio	0.78	0.68		0.49	0.46	0.03	0.73	0.81		0.82	0.34	0.16
Uniform Delay, d1	41.1	37.5		42.3	38.8	36.5	38.4	19.2		46.7	20.8	19.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	8.1	5.8		1.2	1.3	0.1	8.3	3.9		49.3	0.6	0.5
Delay (s)	49.2	43.3		43.5	40.1	36.5	46.7	23.1		96.0	21.5	19.8
Level of Service	D	D		D	D	D	D	C		F	C	B
Approach Delay (s)		46.8			41.2			26.1			26.4	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	31.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	98.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Appendix B

Baseline Conditions LOS Calculations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	5	863	0	10	1	302	203	22	1056	0
Future Volume (vph)	0	0	5	863	0	10	1	302	203	22	1056	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Lane Util. Factor		1.00		0.95	0.95		1.00	0.95	1.00	1.00	0.95	
Frt		0.86		1.00	1.00		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	0.95		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1627		1698	1698		1787	3574	1599	1787	3574	
Flt Permitted		1.00		0.95	0.95		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1627		1698	1698		1787	3574	1599	1787	3574	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	5	938	0	11	1	328	221	24	1148	0
RTOR Reduction (vph)	0	5	0	0	77	0	0	0	125	0	0	0
Lane Group Flow (vph)	0	0	0	478	394	0	1	328	96	24	1148	0
Turn Type		NA		Split	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)		0.9		44.8	44.8		1.0	56.6	56.6	4.4	60.0	
Effective Green, g (s)		0.9		44.8	44.8		1.0	56.6	56.6	4.4	60.0	
Actuated g/C Ratio		0.01		0.34	0.34		0.01	0.44	0.44	0.03	0.46	
Clearance Time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Vehicle Extension (s)		2.0		2.0	2.0		2.0	4.0	4.0	2.0	4.0	
Lane Grp Cap (vph)		11		585	585		13	1556	696	60	1649	
v/s Ratio Prot		c0.00		c0.28	0.23		0.00	0.09		c0.01	c0.32	
v/s Ratio Perm									0.06			
v/c Ratio		0.00		0.82	0.67		0.08	0.21	0.14	0.40	0.70	
Uniform Delay, d1		64.1		38.9	36.3		64.0	22.8	22.0	61.5	27.8	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.0		8.2	2.4		0.9	0.3	0.4	1.6	2.5	
Delay (s)		64.1		47.1	38.8		65.0	23.1	22.5	63.1	30.2	
Level of Service		E		D	D		E	C	C	E	C	
Approach Delay (s)		64.1			42.9			22.9			30.9	
Approach LOS		E			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	33.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	23.3
Intersection Capacity Utilization	70.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	7.2
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	188	89	422
Demand Flow Rate, veh/h	190	90	426
Vehicles Circulating, veh/h	34	15	156
Vehicles Exiting, veh/h	71	567	68
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	4.9	4.0	8.9
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	190	90	426
Cap Entry Lane, veh/h	1092	1113	967
Entry HV Adj Factor	0.989	0.985	0.990
Flow Entry, veh/h	188	89	422
Cap Entry, veh/h	1081	1097	957
V/C Ratio	0.174	0.081	0.441
Control Delay, s/veh	4.9	4.0	8.9
LOS	A	A	A
95th %tile Queue, veh	1	0	2

Intersection	
Intersection Delay, s/veh	6.7
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	360	173	181
Demand Flow Rate, veh/h	363	175	182
Vehicles Circulating, veh/h	153	39	229
Vehicles Exiting, veh/h	61	372	287
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.8	4.8	6.1
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	363	175	182
Cap Entry Lane, veh/h	970	1087	899
Entry HV Adj Factor	0.992	0.991	0.992
Flow Entry, veh/h	360	173	181
Cap Entry, veh/h	962	1077	892
V/C Ratio	0.374	0.161	0.203
Control Delay, s/veh	7.8	4.8	6.1
LOS	A	A	A
95th %tile Queue, veh	2	1	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	55	112	143	194	26	73	228	34	31	1158	464
Future Volume (vph)	105	55	112	143	194	26	73	228	34	31	1158	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.90		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3467	1692		3467	1881	1599	1787	3504		1787	3574	1599
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3467	1692		3467	1881	1599	1787	3504		1787	3574	1599
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	117	61	124	159	216	29	81	253	38	34	1287	516
RTOR Reduction (vph)	0	71	0	0	0	24	0	8	0	0	0	238
Lane Group Flow (vph)	117	114	0	159	216	5	81	283	0	34	1287	278
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	6.9	14.2		9.2	16.5	16.5	7.4	57.4		3.6	53.6	53.6
Effective Green, g (s)	6.9	14.2		9.2	16.5	16.5	7.4	57.4		3.6	53.6	53.6
Actuated g/C Ratio	0.07	0.14		0.09	0.16	0.16	0.07	0.57		0.04	0.53	0.53
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	238	239		317	309	262	131	2003		64	1908	853
v/s Ratio Prot	0.03	0.07		c0.05	c0.11		c0.05	c0.08		0.02	c0.36	
v/s Ratio Perm						0.00						0.17
v/c Ratio	0.49	0.48		0.50	0.70	0.02	0.62	0.14		0.53	0.67	0.33
Uniform Delay, d1	45.1	39.7		43.4	39.6	35.2	45.1	10.0		47.6	17.0	13.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.6	1.5		1.3	6.8	0.0	8.4	0.1		8.2	1.9	1.0
Delay (s)	46.7	41.2		44.7	46.4	35.2	53.5	10.2		55.8	19.0	14.2
Level of Service	D	D		D	D	D	D	B		E	B	B
Approach Delay (s)		43.3			44.9			19.6			18.3	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	24.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	100.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	63.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	4	3	2	334	5	27	1	295	176	20	414	2
Future Volume (vph)	4	3	2	334	5	27	1	295	176	20	414	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Lane Util. Factor		1.00		0.95	0.95		1.00	0.95	1.00	1.00	0.95	
Frt		0.97		1.00	0.98		1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.98		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1785		1698	1678		1072	2859	1583	1787	3572	
Flt Permitted		0.98		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1785		1698	1678		1072	2859	1583	1787	3572	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	4	3	2	363	5	29	1	321	191	22	450	2
RTOR Reduction (vph)	0	2	0	0	6	0	0	0	72	0	0	0
Lane Group Flow (vph)	0	7	0	200	191	0	1	321	119	22	452	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	100	100	0	0	0	0
Turn Type	Split	NA		Split	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)		1.3		20.0	20.0		1.1	81.1	81.1	4.3	84.3	
Effective Green, g (s)		1.3		20.0	20.0		1.1	81.1	81.1	4.3	84.3	
Actuated g/C Ratio		0.01		0.15	0.15		0.01	0.62	0.62	0.03	0.65	
Clearance Time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Vehicle Extension (s)		2.0		2.0	2.0		2.0	4.0	4.0	2.0	4.0	
Lane Grp Cap (vph)		17		261	258		9	1783	987	59	2316	
v/s Ratio Prot		c0.00		c0.12	0.11		0.00	0.11		c0.01	c0.13	
v/s Ratio Perm									0.08			
v/c Ratio		0.41		0.77	0.74		0.11	0.18	0.12	0.37	0.20	
Uniform Delay, d1		64.0		52.8	52.5		64.0	10.4	9.9	61.5	9.2	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		5.8		11.4	9.6		2.0	0.2	0.3	1.4	0.2	
Delay (s)		69.8		64.2	62.1		66.0	10.6	10.2	63.0	9.4	
Level of Service		E		E	E		E	B	B	E	A	
Approach Delay (s)		69.8			63.1			10.5			11.9	
Approach LOS		E			E			B			B	

Intersection Summary			
HCM 2000 Control Delay	26.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.31		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	23.3
Intersection Capacity Utilization	43.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	6.1
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	154	182	343
Demand Flow Rate, veh/h	155	184	346
Vehicles Circulating, veh/h	131	18	116
Vehicles Exiting, veh/h	71	444	170
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	4	0	0
Ped Cap Adj	0.999	1.000	1.000
Approach Delay, s/veh	5.1	4.8	7.2
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	155	184	346
Cap Entry Lane, veh/h	991	1110	1006
Entry HV Adj Factor	0.994	0.988	0.991
Flow Entry, veh/h	154	182	343
Cap Entry, veh/h	984	1096	997
V/C Ratio	0.156	0.166	0.344
Control Delay, s/veh	5.1	4.8	7.2
LOS	A	A	A
95th %tile Queue, veh	1	1	2

Intersection	
Intersection Delay, s/veh	4.5
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	121	145	104
Demand Flow Rate, veh/h	123	146	105
Vehicles Circulating, veh/h	125	43	53
Vehicles Exiting, veh/h	64	115	195
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	4.8	4.6	4.2
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	123	146	105
Cap Entry Lane, veh/h	997	1082	1072
Entry HV Adj Factor	0.984	0.992	0.994
Flow Entry, veh/h	121	145	104
Cap Entry, veh/h	981	1073	1065
V/C Ratio	0.123	0.135	0.098
Control Delay, s/veh	4.8	4.6	4.2
LOS	A	A	A
95th %tile Queue, veh	0	0	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	143	70	63	61	123	26	85	234	35	38	534	245
Future Volume (vph)	143	70	63	61	123	26	85	234	35	38	534	245
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.93		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3467	1747		3467	1881	1599	1787	3504		1787	3574	1599
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3467	1747		3467	1881	1599	1787	3504		1787	3574	1599
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	154	75	68	66	132	28	91	252	38	41	574	263
RTOR Reduction (vph)	0	43	0	0	0	25	0	9	0	0	0	141
Lane Group Flow (vph)	154	100	0	66	132	3	91	281	0	41	574	122
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	7.7	12.0		4.2	8.5	8.5	6.8	36.9		3.4	33.5	33.5
Effective Green, g (s)	7.7	12.0		4.2	8.5	8.5	6.8	36.9		3.4	33.5	33.5
Actuated g/C Ratio	0.11	0.17		0.06	0.12	0.12	0.09	0.51		0.05	0.46	0.46
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	368	289		200	220	187	167	1783		83	1651	738
v/s Ratio Prot	c0.04	c0.06		0.02	c0.07		c0.05	c0.08		0.02	c0.16	
v/s Ratio Perm						0.00						0.08
v/c Ratio	0.42	0.34		0.33	0.60	0.02	0.54	0.16		0.49	0.35	0.16
Uniform Delay, d1	30.3	26.8		32.8	30.4	28.3	31.4	9.5		33.7	12.5	11.4
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.8	0.7		1.0	4.4	0.0	3.6	0.2		4.6	0.6	0.5
Delay (s)	31.1	27.5		33.8	34.7	28.3	35.0	9.7		38.3	13.1	11.8
Level of Service	C	C		C	C	C	C	A		D	B	B
Approach Delay (s)		29.4			33.7			15.7			13.9	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	19.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	72.5	Sum of lost time (s)	16.0
Intersection Capacity Utilization	44.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1	2	400	2	35	2	1222	787	38	448	0
Future Volume (vph)	0	1	2	400	2	35	2	1222	787	38	448	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Lane Util. Factor		1.00		0.95	0.95		1.00	0.95	1.00	1.00	0.95	
Frt		0.91		1.00	0.98		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1712		1698	1674		1072	2859	1583	1787	3574	
Flt Permitted		1.00		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1712		1698	1674		1072	2859	1583	1787	3574	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1	2	421	2	37	2	1286	828	40	472	0
RTOR Reduction (vph)	0	2	0	0	5	0	0	0	309	0	0	0
Lane Group Flow (vph)	0	1	0	232	223	0	2	1286	519	40	472	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	100	100	0	0	0	0
Turn Type		NA		Split	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)		1.1		24.6	24.6		1.2	94.1	94.1	6.9	99.8	
Effective Green, g (s)		1.1		24.6	24.6		1.2	94.1	94.1	6.9	99.8	
Actuated g/C Ratio		0.01		0.16	0.16		0.01	0.63	0.63	0.05	0.67	
Clearance Time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Vehicle Extension (s)		2.0		2.0	2.0		2.0	4.0	4.0	2.0	4.0	
Lane Grp Cap (vph)		12		278	274		8	1793	993	82	2377	
v/s Ratio Prot		c0.00		c0.14	0.13		0.00	c0.45		c0.02	0.13	
v/s Ratio Perm									0.33			
v/c Ratio		0.08		0.83	0.81		0.25	0.72	0.52	0.49	0.20	
Uniform Delay, d1		73.9		60.7	60.5		74.0	18.9	15.5	69.8	9.7	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.1		18.2	15.9		5.9	2.5	2.0	1.7	0.2	
Delay (s)		75.1		78.9	76.4		79.8	21.4	17.5	71.5	9.9	
Level of Service		E		E	E		E	C	B	E	A	
Approach Delay (s)		75.1			77.7			19.9			14.7	
Approach LOS		E			E			B			B	

Intersection Summary			
HCM 2000 Control Delay	27.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	23.3
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	8.0
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	117	547	240
Demand Flow Rate, veh/h	118	552	242
Vehicles Circulating, veh/h	409	36	92
Vehicles Exiting, veh/h	179	298	435
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	4	0	0
Ped Cap Adj	0.999	1.000	1.000
Approach Delay, s/veh	6.5	9.2	5.8
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	118	552	242
Cap Entry Lane, veh/h	751	1090	1031
Entry HV Adj Factor	0.992	0.991	0.992
Flow Entry, veh/h	117	547	240
Cap Entry, veh/h	744	1080	1022
V/C Ratio	0.157	0.506	0.235
Control Delay, s/veh	6.5	9.2	5.8
LOS	A	A	A
95th %tile Queue, veh	1	3	1

Intersection	
Intersection Delay, s/veh	6.4
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	122	337	282
Demand Flow Rate, veh/h	124	341	285
Vehicles Circulating, veh/h	184	132	56
Vehicles Exiting, veh/h	289	209	252
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.1	7.3	6.0
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	124	341	285
Cap Entry Lane, veh/h	940	990	1068
Entry HV Adj Factor	0.984	0.989	0.991
Flow Entry, veh/h	122	337	282
Cap Entry, veh/h	925	979	1059
V/C Ratio	0.132	0.344	0.267
Control Delay, s/veh	5.1	7.3	6.0
LOS	A	A	A
95th %tile Queue, veh	0	2	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	336	179	65	145	128	49	206	1244	145	62	440	234
Future Volume (vph)	336	179	65	145	128	49	206	1244	145	62	440	234
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3467	1806		3467	1881	1599	1787	3518		1787	3574	1599
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3467	1806		3467	1881	1599	1787	3518		1787	3574	1599
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	361	192	70	156	138	53	222	1338	156	67	473	252
RTOR Reduction (vph)	0	13	0	0	0	45	0	6	0	0	0	154
Lane Group Flow (vph)	361	249	0	156	138	8	222	1488	0	67	473	98
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	13.0	19.3		9.1	15.4	15.4	17.1	51.2		5.0	39.1	39.1
Effective Green, g (s)	13.0	19.3		9.1	15.4	15.4	17.1	51.2		5.0	39.1	39.1
Actuated g/C Ratio	0.13	0.19		0.09	0.15	0.15	0.17	0.51		0.05	0.39	0.39
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	448	346		313	287	244	303	1790		88	1389	621
v/s Ratio Prot	c0.10	c0.14		0.04	0.07		c0.12	c0.42		0.04	0.13	
v/s Ratio Perm						0.01						0.06
v/c Ratio	0.81	0.72		0.50	0.48	0.03	0.73	0.83		0.76	0.34	0.16
Uniform Delay, d1	42.6	38.1		43.6	38.9	36.3	39.6	21.0		47.2	21.7	20.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	10.2	7.0		1.3	1.3	0.1	8.8	4.7		31.5	0.7	0.5
Delay (s)	52.7	45.1		44.8	40.2	36.3	48.4	25.7		78.7	22.3	20.6
Level of Service	D	D		D	D	D	D	C		E	C	C
Approach Delay (s)		49.5			41.7			28.6			26.5	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	33.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	100.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Appendix C

Plus Project Conditions LOS Calculations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	5	948	0	10	1	302	220	22	1056	0
Future Volume (vph)	0	0	5	948	0	10	1	302	220	22	1056	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Lane Util. Factor		1.00		0.95	0.95		1.00	0.95	1.00	1.00	0.95	
Frt		0.86		1.00	1.00		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	0.95		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1627		1698	1698		1787	3574	1599	1787	3574	
Flt Permitted		1.00		0.95	0.95		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1627		1698	1698		1787	3574	1599	1787	3574	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	5	1030	0	11	1	328	239	24	1148	0
RTOR Reduction (vph)	0	5	0	0	71	0	0	0	147	0	0	0
Lane Group Flow (vph)	0	0	0	525	445	0	1	328	92	24	1148	0
Turn Type		NA		Split	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)		0.9		51.4	51.4		1.0	50.0	50.0	4.4	53.4	
Effective Green, g (s)		0.9		51.4	51.4		1.0	50.0	50.0	4.4	53.4	
Actuated g/C Ratio		0.01		0.40	0.40		0.01	0.38	0.38	0.03	0.41	
Clearance Time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Vehicle Extension (s)		2.0		2.0	2.0		2.0	4.0	4.0	2.0	4.0	
Lane Grp Cap (vph)		11		671	671		13	1374	615	60	1468	
v/s Ratio Prot		c0.00		c0.31	0.26		0.00	0.09		c0.01	c0.32	
v/s Ratio Perm									0.06			
v/c Ratio		0.00		0.78	0.66		0.08	0.24	0.15	0.40	0.78	
Uniform Delay, d1		64.1		34.4	32.2		64.0	27.1	26.1	61.5	33.2	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.0		5.5	1.9		0.9	0.4	0.5	1.6	4.2	
Delay (s)		64.1		39.9	34.1		65.0	27.5	26.6	63.1	37.5	
Level of Service		E		D	C		E	C	C	E	D	
Approach Delay (s)		64.1			37.0			27.2			38.0	
Approach LOS		E			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	35.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	23.3
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	8.6
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	387	113	439
Demand Flow Rate, veh/h	391	114	443
Vehicles Circulating, veh/h	34	32	276
Vehicles Exiting, veh/h	112	687	149
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.0	4.2	11.3
Approach LOS	A	A	B

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	391	114	443
Cap Entry Lane, veh/h	1092	1094	857
Entry HV Adj Factor	0.990	0.988	0.991
Flow Entry, veh/h	387	113	439
Cap Entry, veh/h	1081	1082	850
V/C Ratio	0.358	0.104	0.517
Control Delay, s/veh	7.0	4.2	11.3
LOS	A	A	B
95th %tile Queue, veh	2	0	3

Intersection	
Int Delay, s/veh	4.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	142	0	50	29	0	133
Future Vol, veh/h	142	0	50	29	0	133
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	1	1	1	1	1	1
Mvmt Flow	154	0	54	32	0	145

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	215	70	0	0	86	0
Stage 1	70	-	-	-	-	-
Stage 2	145	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.11	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.209	-
Pot Cap-1 Maneuver	775	996	-	-	1517	-
Stage 1	955	-	-	-	-	-
Stage 2	885	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	775	996	-	-	1517	-
Mov Cap-2 Maneuver	775	-	-	-	-	-
Stage 1	955	-	-	-	-	-
Stage 2	885	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.8	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	775	-	1517	-
HCM Lane V/C Ratio	-	-	0.199	-	-	-
HCM Control Delay (s)	-	-	10.8	0	0	-
HCM Lane LOS	-	-	B	A	A	-
HCM 95th %tile Q(veh)	-	-	0.7	-	0	-

Intersection	
Intersection Delay, s/veh	7.1
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	360	245	204
Demand Flow Rate, veh/h	363	247	206
Vehicles Circulating, veh/h	225	39	229
Vehicles Exiting, veh/h	61	396	359
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.7	5.5	6.4
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	363	247	206
Cap Entry Lane, veh/h	902	1087	899
Entry HV Adj Factor	0.992	0.991	0.992
Flow Entry, veh/h	360	245	204
Cap Entry, veh/h	895	1077	891
V/C Ratio	0.402	0.227	0.229
Control Delay, s/veh	8.7	5.5	6.4
LOS	A	A	A
95th %tile Queue, veh	2	1	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	64	112	143	237	40	73	228	34	34	1158	464
Future Volume (vph)	105	64	112	143	237	40	73	228	34	34	1158	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.90		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3467	1702		3467	1881	1599	1787	3504		1787	3574	1599
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3467	1702		3467	1881	1599	1787	3504		1787	3574	1599
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	117	71	124	159	263	44	81	253	38	38	1287	516
RTOR Reduction (vph)	0	60	0	0	0	36	0	8	0	0	0	218
Lane Group Flow (vph)	117	135	0	159	263	8	81	283	0	38	1287	298
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	6.9	17.0		9.3	19.4	19.4	7.4	57.4		3.6	53.6	53.6
Effective Green, g (s)	6.9	17.0		9.3	19.4	19.4	7.4	57.4		3.6	53.6	53.6
Actuated g/C Ratio	0.07	0.16		0.09	0.19	0.19	0.07	0.56		0.03	0.52	0.52
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	231	280		312	353	300	128	1947		62	1854	829
v/s Ratio Prot	0.03	0.08		c0.05	c0.14		c0.05	c0.08		0.02	c0.36	
v/s Ratio Perm						0.01						0.19
v/c Ratio	0.51	0.48		0.51	0.75	0.03	0.63	0.15		0.61	0.69	0.36
Uniform Delay, d1	46.6	39.2		44.8	39.6	34.2	46.6	11.1		49.2	18.7	14.7
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.7	1.3		1.3	8.3	0.0	9.8	0.2		16.6	2.2	1.2
Delay (s)	48.3	40.5		46.1	47.9	34.3	56.4	11.3		65.8	20.9	15.9
Level of Service	D	D		D	D	C	E	B		E	C	B
Approach Delay (s)		43.4			46.0			21.1			20.4	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	103.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Intersection: 1: Vista Blvd & Los Altos Pkwy

Movement	EB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	LTR	L	LTR	L	T	T	L	T	TR
Maximum Queue (ft)	37	145	1546	5	116	133	299	422	405
Average Queue (ft)	7	141	716	0	50	47	33	255	233
95th Queue (ft)	27	158	1302	3	104	113	132	378	357
Link Distance (ft)	299		3511		2073	2073		1041	1041
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)		120		125			275		
Storage Blk Time (%)		23	44		0			6	
Queuing Penalty (veh)		110	210		0			1	

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1	2	441	2	35	2	1222	870	38	448	0
Future Volume (vph)	0	1	2	441	2	35	2	1222	870	38	448	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Lane Util. Factor		1.00		0.95	0.95		1.00	0.95	1.00	1.00	0.95	
Frt		0.91		1.00	0.98		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1712		1698	1676		1072	2859	1583	1787	3574	
Flt Permitted		1.00		0.95	0.96		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1712		1698	1676		1072	2859	1583	1787	3574	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1	2	464	2	37	2	1286	916	40	472	0
RTOR Reduction (vph)	0	2	0	0	4	0	0	0	354	0	0	0
Lane Group Flow (vph)	0	1	0	255	244	0	2	1286	562	40	472	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	100	100	0	0	0	0
Turn Type		NA		Split	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)		1.1		26.7	26.7		1.2	92.0	92.0	6.9	97.7	
Effective Green, g (s)		1.1		26.7	26.7		1.2	92.0	92.0	6.9	97.7	
Actuated g/C Ratio		0.01		0.18	0.18		0.01	0.61	0.61	0.05	0.65	
Clearance Time (s)		7.2		6.2	6.2		4.0	5.9	5.9	4.0	5.9	
Vehicle Extension (s)		2.0		2.0	2.0		2.0	4.0	4.0	2.0	4.0	
Lane Grp Cap (vph)		12		302	298		8	1753	970	82	2327	
v/s Ratio Prot		c0.00		c0.15	0.15		0.00	c0.45		c0.02	0.13	
v/s Ratio Perm									0.35			
v/c Ratio		0.08		0.84	0.82		0.25	0.73	0.58	0.49	0.20	
Uniform Delay, d1		73.9		59.6	59.3		74.0	20.4	17.4	69.8	10.5	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.1		18.3	15.1		5.9	2.8	2.5	1.7	0.2	
Delay (s)		75.1		77.9	74.4		79.8	23.1	19.9	71.5	10.7	
Level of Service		E		E	E		E	C	B	E	B	
Approach Delay (s)		75.1			76.2			21.9			15.5	
Approach LOS		E			E			C			B	

Intersection Summary			
HCM 2000 Control Delay	29.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	23.3
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Intersection Delay, s/veh	10.4
Intersection LOS	B

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	197	645	305
Demand Flow Rate, veh/h	199	651	308
Vehicles Circulating, veh/h	409	102	140
Vehicles Exiting, veh/h	344	346	468
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	4	0	0
Ped Cap Adj	0.999	1.000	1.000
Approach Delay, s/veh	7.9	12.8	7.0
Approach LOS	A	B	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	199	651	308
Cap Entry Lane, veh/h	751	1020	982
Entry HV Adj Factor	0.990	0.991	0.990
Flow Entry, veh/h	197	645	305
Cap Entry, veh/h	743	1011	973
V/C Ratio	0.265	0.638	0.314
Control Delay, s/veh	7.9	12.8	7.0
LOS	A	B	A
95th %tile Queue, veh	1	5	1

Intersection	
Int Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	68	0	152	138	0	99
Future Vol, veh/h	68	0	152	138	0	99
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	1	1	1	1	1	1
Mvmt Flow	74	0	165	150	0	108

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	348	240	0	0	315	0
Stage 1	240	-	-	-	-	-
Stage 2	108	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.11	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.209	-
Pot Cap-1 Maneuver	651	801	-	-	1251	-
Stage 1	802	-	-	-	-	-
Stage 2	919	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	651	801	-	-	1251	-
Mov Cap-2 Maneuver	651	-	-	-	-	-
Stage 1	802	-	-	-	-	-
Stage 2	919	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.2	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	651	-	1251	-
HCM Lane V/C Ratio	-	-	0.114	-	-	-
HCM Control Delay (s)	-	-	11.2	0	0	-
HCM Lane LOS	-	-	B	A	A	-
HCM 95th %tile Q(veh)	-	-	0.4	-	0	-

Intersection	
Intersection Delay, s/veh	6.9
Intersection LOS	A

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	122	368	345
Demand Flow Rate, veh/h	124	372	348
Vehicles Circulating, veh/h	215	132	56
Vehicles Exiting, veh/h	289	272	283
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.3	7.7	6.7
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	124	372	348
Cap Entry Lane, veh/h	911	990	1068
Entry HV Adj Factor	0.984	0.989	0.991
Flow Entry, veh/h	122	368	345
Cap Entry, veh/h	897	979	1059
V/C Ratio	0.136	0.376	0.326
Control Delay, s/veh	5.3	7.7	6.7
LOS	A	A	A
95th %tile Queue, veh	0	2	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	336	220	65	145	148	56	206	1244	145	76	440	234
Future Volume (vph)	336	220	65	145	148	56	206	1244	145	76	440	234
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3467	1817		3467	1881	1599	1787	3518		1787	3574	1599
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3467	1817		3467	1881	1599	1787	3518		1787	3574	1599
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	361	237	70	156	159	60	222	1338	156	82	473	252
RTOR Reduction (vph)	0	10	0	0	0	49	0	7	0	0	0	157
Lane Group Flow (vph)	361	297	0	156	159	11	222	1487	0	82	473	95
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8						6
Actuated Green, G (s)	13.1	22.0		9.2	18.1	18.1	17.3	51.2		5.0	38.9	38.9
Effective Green, g (s)	13.1	22.0		9.2	18.1	18.1	17.3	51.2		5.0	38.9	38.9
Actuated g/C Ratio	0.13	0.21		0.09	0.18	0.18	0.17	0.50		0.05	0.38	0.38
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	439	386		308	329	279	298	1741		86	1344	601
v/s Ratio Prot	c0.10	c0.16		0.04	0.08		c0.12	c0.42		0.05	0.13	
v/s Ratio Perm						0.01						0.06
v/c Ratio	0.82	0.77		0.51	0.48	0.04	0.74	0.85		0.95	0.35	0.16
Uniform Delay, d1	44.0	38.3		44.9	38.4	35.4	41.0	22.8		49.1	23.2	21.4
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	11.8	8.9		1.3	1.1	0.1	9.7	5.6		81.0	0.7	0.6
Delay (s)	55.8	47.2		46.2	39.6	35.5	50.6	28.4		130.1	23.9	21.9
Level of Service	E	D		D	D	D	D	C		F	C	C
Approach Delay (s)		51.9			41.7			31.3			34.1	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	36.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	103.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Intersection: 1: Vista Blvd & Los Altos Pkwy

Movement	EB	WB	WB	NB	NB	NB	NB	SB	SB	SB
Directions Served	LTR	L	LTR	L	T	T	R	L	T	TR
Maximum Queue (ft)	30	145	612	16	414	451	405	88	180	159
Average Queue (ft)	4	131	320	1	153	165	39	36	65	39
95th Queue (ft)	21	164	543	7	318	330	182	76	125	92
Link Distance (ft)	299		3511		2073	2073			1041	1041
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)		120		125			380	275		
Storage Blk Time (%)		20	53		10	0	0			
Queuing Penalty (veh)		52	116		0	2	0			