

TECHNICAL DRAINAGE STUDY FOR RANCHO MULTI FAMILY

Prepared for:

**Edward Homes
197 California Street
Las Vegas, NV 89104
Phone: (702)-665-6989
Fax: (702)-675-6319**

OCTOBER 2020

PROJECT 4555.007

**RCI Engineering
500 South Rancho Drive, Suite 17 * Las Vegas, NV 89106
Tel: 702.453.0800 * Fax: 702.453.0801
www.rcinevada.com**

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Rancho Multi-Family Date: October 2020

Location of Development: a) Descriptive (Cross Streets) North/South: Decatur Boulevard

East/West: Airport Drive

b) Section: 18 Township: 20 S Range: 61 E

c) APN : 139-18-410-012

Name of Owner: Edward Homes

Telephone No.: 702-665-6989 Fax No.: 702-675-6319 E-Mail Address: _____

Address: 197 California Street Las Vegas, Nevada 89104

Contact Person-Name: Rick Read, P.E. Telephone No.: 702-453-0800

* E-Mail Address: rread@rcinevada.com Fax No.: 702-453-0801

Firm: RCI Engineering

Address: 500 South Rancho Drive, Suite 17 Las Vegas, Nevada 89106

Type of Land Development/Land Disturbance Process:

☐	Rezoning	☐	Subdivision Map	☐	Clearing and Grading Only
☐	Parcel Map	☐	Planned Unit Development	☐	Other (Please specify below)
☐	Large Parcel Map	☒	Building Permit		

1. Total Owned Land Area: At Site: 10.6 Acres +/- Being Developed/Disturbed: 10.6 Acres +/-

2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ Yes** ☒ No

3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood

Control District Master Planned Facility? ☒ Yes** ☐ No

4. Proposed type of development (Residential, Commercial, Etc.): Residential Apartments

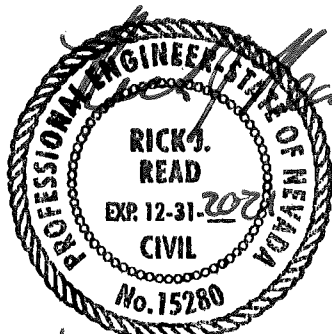
5. Approximate upstream land area which drains to the subject site: 230 Acres +/-

6. Has the site drainage been evaluated in the past? ☐ YES ☒ NO If yes, please identify documentation: _____

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: _____

Through storm drain into a 12-foot by 8-foot RCB in Rancho Drive (CCRFCD LVRA 0012)

8. Briefly describe your proposed schedule for the subject project: ASAP



Oct 22, 2020
Engineer's Seal

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

*New Required Field

**Review and concurrence of the Clark County Regional Flood Control District is required.

Local Entity File No.	Revision	Date

REFERENCE: STANDARD FORM 1

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I. INTRODUCTION

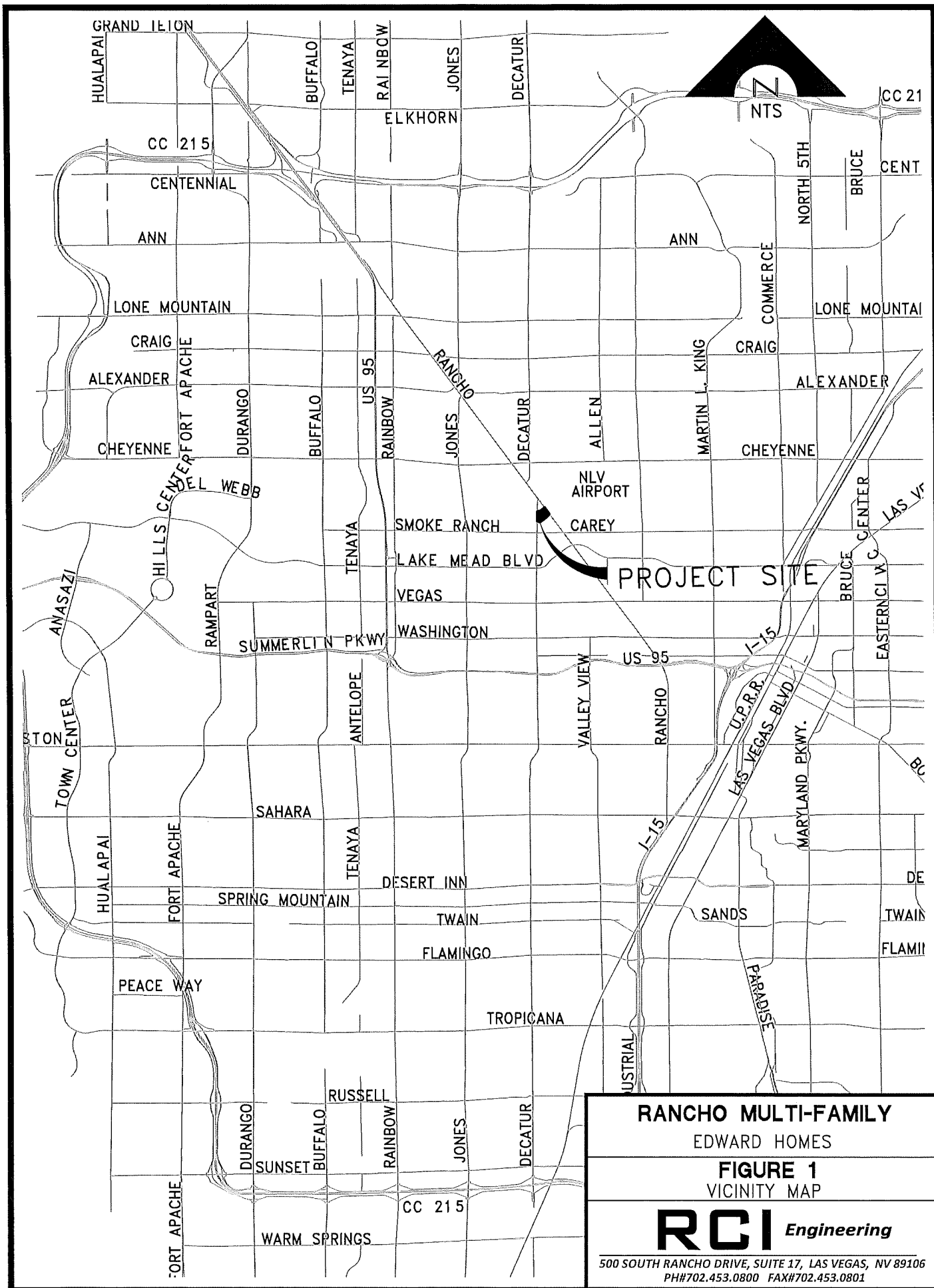
Edward Homes is proposing to develop the Rancho Multi Family Project, a 10.6 acre site as a Multi Family Project located within the City of Las Vegas. The Project will consist of 40-fourplexes, landscaping, a pool and park area and block walls. No perimeter roads will be constructed with this Projects, since they are already complete. The purpose of this report is to accompany the civil improvement plans, to provide detailed hydrological and hydraulic analyses for the site, and to determine adequate protection for the Project from offsite and onsite flows. The following tasks were performed in the preparation of this report:

- ♦ Identify previous drainage studies for the project site and surrounding areas.
- ♦ Identify the FEMA floodplain designation for the project site.
- ♦ Identify existing and proposed regional drainage facilities adjacent to the site.
- ♦ Estimate runoff generated for the peak offsite and onsite 10-year and 100-year return period storms for existing and developed conditions.
- ♦ Recommend drainage facilities to protect the project from storm runoff.

II. LOCATION AND DESCRIPTION

The Project is located in Section 18, Township 20 South, Range 61 East, M.D.M., in the City of Las Vegas, Nevada. The site is located on the southwest side of Rancho Drive and east side of Rancho Drive. Access to the site will be from Airport Road which is the Project's southern boundary. The proposed development will consist of four-plex apartments with Type "A" and Type "B" drainage. The interior streets will consist of 26-foot (back of curb to back of curb) roadways with a normal crown section with "R" Type curb and gutter. There will also be drive aisles on the Project that are 24 feet wide with an inverted crown and valley gutter.

Please refer to Figures 1 and 2 for the vicinity and location maps. The *2018 Master Planned Update* (Reference 1, hereinafter referred to as the 2018 MPU) along with the *City of Las Vegas Nevada Northwest Neighborhood Study* (Reference 2, hereinafter referred to as the Northwest Neighborhood Study) were reviewed to determine the 100-year storm flows that are tributary to Durango Drive and Airport Drive adjacent to the site. It was determined that the 2018 MPU are the worst case flows and those flows will be used for this study. The 100-year storm flows in Rancho





250' 0' 250' 500'



SCALE: 1" = 500'

PROJECT SITE

MADRE MESA

ROBERTA LANE

BEVVIE DRIVE

JEAN AVENUE

NORTH DECATUR BLVD

AIRPORT DRIVE

RANCHO DRIVE

SMOKE RANCH ROAD

RANCHO MULTI-FAMILY

EDWARD HOMES

FIGURE 2
LOCATION MAP

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500 S. RANCHO DRIVE SUITE 17, LAS VEGAS, NV 89106
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Drive were addressed in the *Technical Drainage Study for Avion (Formerly Rancho Park)* by CVL engineering (Reference 3, hereinafter referred to as the Avion Study). The Avion Study was approved August 29, 2007. Please see pertinent excerpts from these approved studies included in Appendix C.

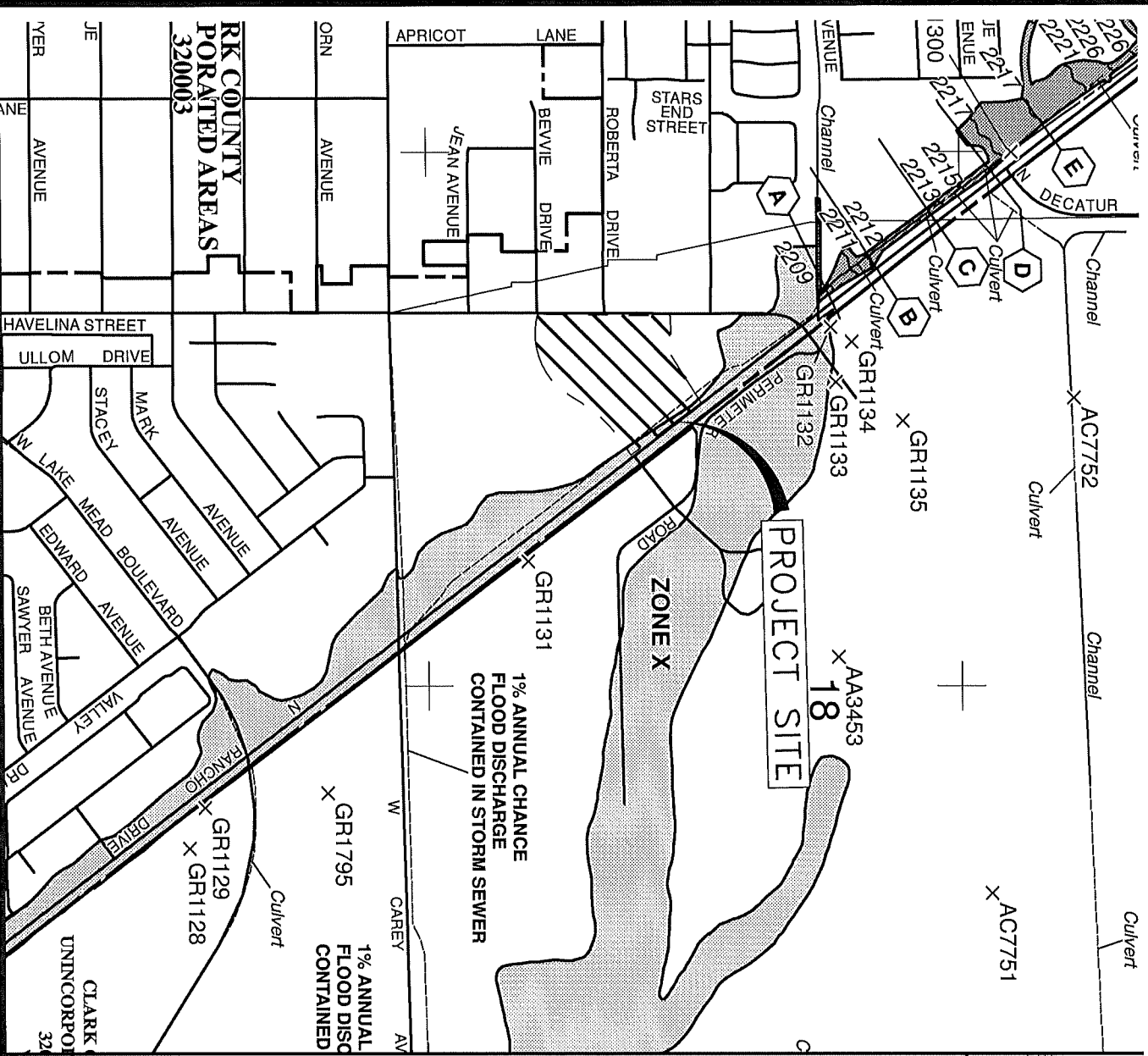
RCI Engineering has reviewed these studies and accepts the analysis presented in these approved studies.

III. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD HAZARD ANALYSIS

Figure 3 has been reproduced from the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) containing Community Panel Number 32003C2155F. Review of the Map shows that the Project Area is located within a Zone X and a shaded Zone X. Therefore, the project is not located within a FEMA-designated Special Flood Hazard Area (SFHA).

IV. CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT FACILITIES

Figure 4 has been reproduced from Figure F-24 of the 2018 *Clark County Regional Flood Control District (CCRFCD) Master Plan Update* (Reference 1, hereinafter referred to as the 2018 MPU). This figure depicts the project site in relation to existing and proposed CCRFCD facilities. As shown on the figure, the site is adjacent to existing CCRFCD Facility LVRA 0012. That facility is an existing 12' by 8' RCB and therefore, this drainage study will be submitted to CCRFCD upon receipt of a conditional letter of approval from Clark County.





NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2155F

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY,

NEVADA

AND INCORPORATED AREAS

PANEL 2155 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SHEET
CLARK COUNTY	2155	F	F
LAS VEGAS, CITY OF	2155	F	F
NORTH LAS VEGAS, CITY OF	2155	F	F

Map Number: 32003C2155F

Map Revised: NOVEMBER 16, 2011

Map Number: 32003C2155F

Map Revised: NOVEMBER 16, 2011

Federal Emergency Management Agency

Notes to Users: The Map Number shown below should be used when ordering map orders. The Community Number shown above should be used on insurance applications for the subject community.

MAP SCALE 1" = 1000'

0 1000 2000 FEET

RANCHO MULTI-FAMILY

EDWARD HOMES

FIGURE 3

F.I.R.M. MAP



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500 SOUTH RANCHO DRIVE, SUITE 17, LAS VEGAS, NV 89106
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2018
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

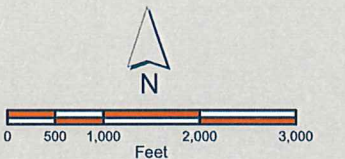
FIGURE F-24
FLOOD CONTROL FACILITIES

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Detention Basin
- Culvert or Bridge Crossing
- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

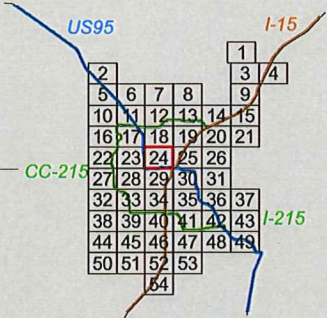
- Remove & Replace/Parallel Facilities
- | Category A | Category B |
|------------|------------|
| Channel | Channel |
| Stormdrain | Stormdrain |
| Crossing | Crossing |

FIGURE 4



Scale: 1 inch = 2,000 feet

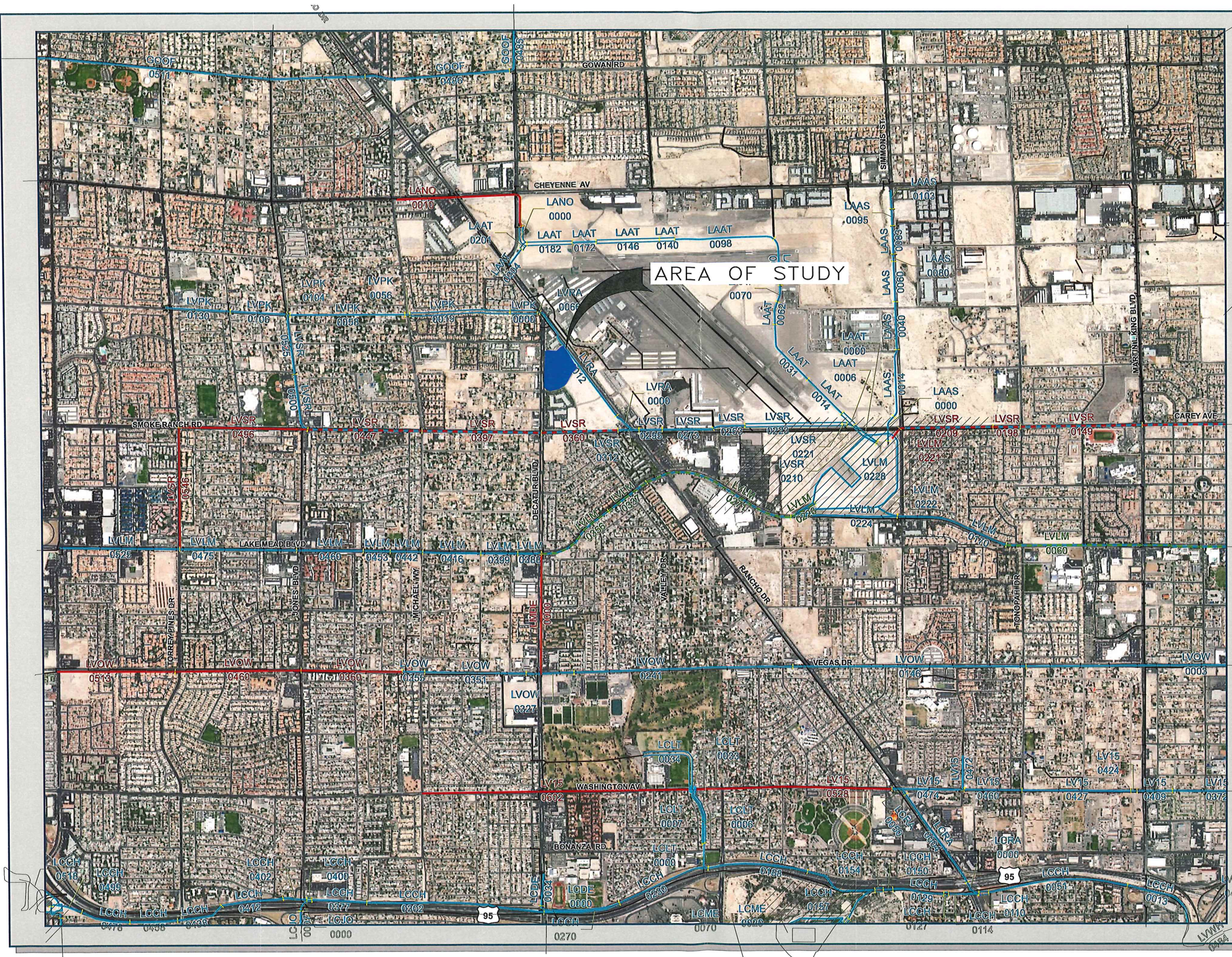
AerialSource: Esri World Imagery 2017



ATKINS
Member of the SNC-Lavalin Group

Louis Berger

AREA OF STUDY



V. HYDROLOGY

The methodology presented in this study is in compliance with the *CCRFCD Hydrologic Criteria and Drainage Design Manual* (Reference 4, hereinafter referred to as the Manual).

Model Description - The watersheds were modeled using the SCS Unit Hydrograph method within the U.S. Army Corps of Engineers *HEC-1 Flood Hydrograph Package* (Reference 5).

Precipitation - The project site and offsite subbasin lie within the McCarran Airport Rainfall Area. The rainfall depths have been referenced from Figures 505 and 513 from the Manual. The average 10-year and 100-year point precipitation values for the project site will be 1.58-inches and 2.77-inches during a 6-hour storm event, respectively. This equates to a 0.59 ratio between the 10-year and 100-year storm events (See Appendix A).

Since the drainage area for the project will be less than 8 square miles, an SDN 3 design storm distribution per Table 503 of the Manual was selected for use in the HEC-1 computer model.

Curve Numbers (CN) – The soils boundaries for the subject study area were obtained from the USGS soils website. The onsite and offsite subbasins have been delineated on the Soils Map exhibits included in Appendix A along with the USGS reference.

The USGS GIS soil coverage was based on the soil information provided in the NRCS soils data website. (Reference 6, hereinafter referred to as the USGS Study). References from the USGS Study have been included in Appendix A that delineates soil type 300 as 100 percent HSG “D”. The soils map for the site has been provided in Appendix A. For the given soils, CN values were determined from the appropriate columns of Table 602 of the Manual.

Drainage Areas and Flow Patterns – Under Ultimate conditions, electronic files of the grading plans for the Project were used to determine the onsite drainage patterns. Offsite subbasins and flow patterns were determined from field investigation, topographic contours, and the 2018 MPU.

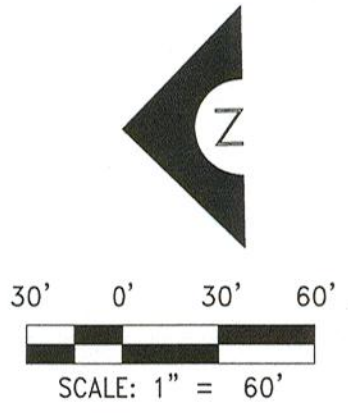
Lag Time - The lag time (TLAG) is described as the time between the center of mass of rainfall and the time of peak discharge from a basin. Lag time can be related to time of concentration (Tc) by the following relationship: $TLAG = 0.6 (Tc)$. The time of concentration (Tc) is defined as the time required for runoff to flow from the most remote part of the basin area to the outlet of the basin or a design point under consideration. The procedure for calculating Tc is outlined in Section 602 of the Manual. Lag time calculations for the drainage subbasins have been included in Appendix A on Standard Form 4.

VI. EXISTING CONDITIONS

Figure 5 depicts the existing conditions onsite subbasin and flow patterns. The existing condition HEC-1 model has been included in Appendix A. Table 1 summarizes the existing condition 100-year and 10-year flow rates for the identified subbasin. The surrounding area has been completely developed, and only the site itself has been modelled for existing conditions. Under existing conditions the site has been rough graded. Currently the site drains southeast as surface flow. Under existing conditions the site will produce a 100-year storm flow of 28 cfs and a 10-year storm flow of 15 cfs.

TABLE 1 EXISTING CONDITIONS HEC-1 MODEL SUMMARY			
*SUBBASIN OR CP	BASIN AREA (AC)	100 YR (cfs)	10 YR (cfs)
EX1	10.58	28	15

*See Figure 5



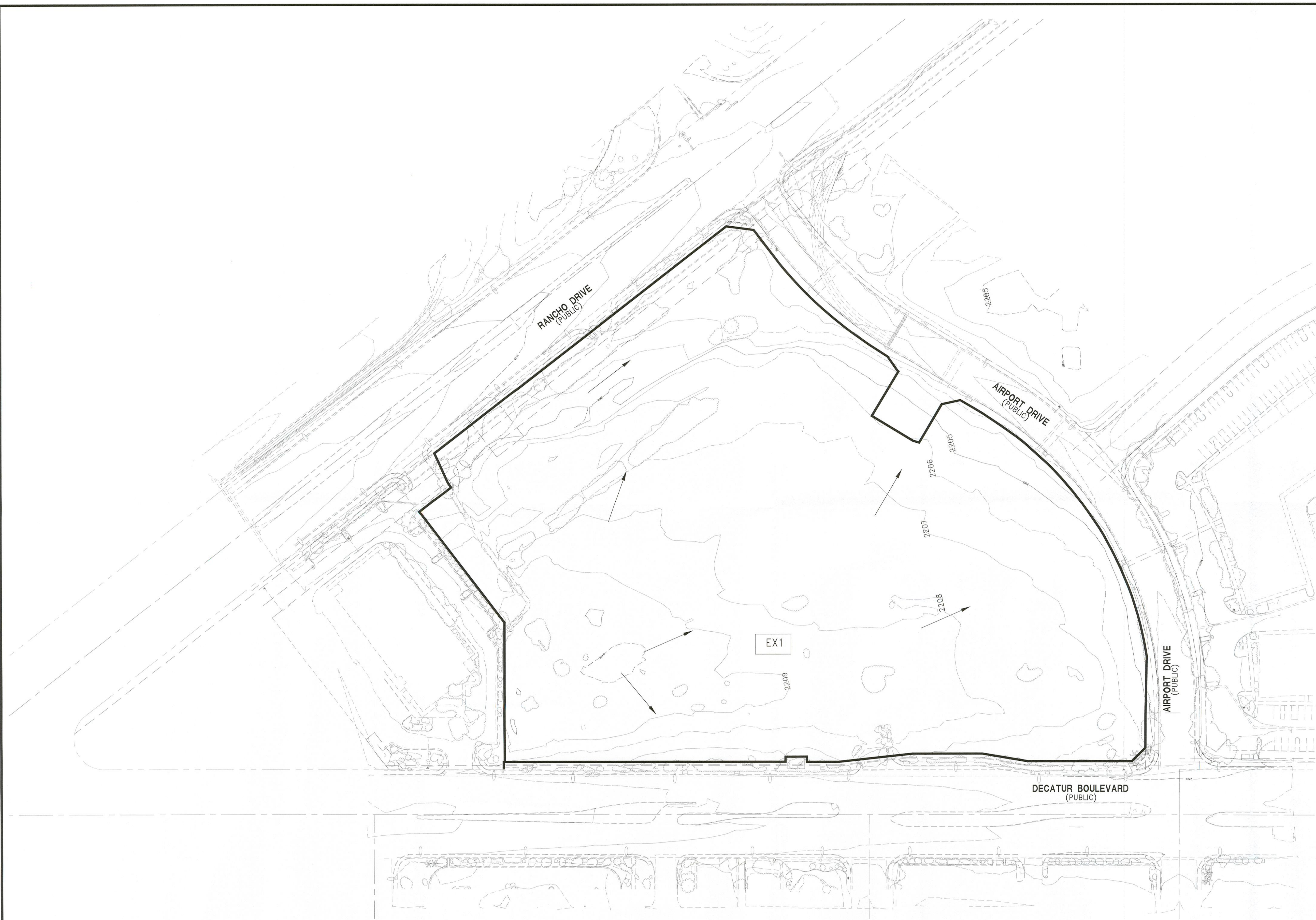
LEGEND

→ FLOW DIRECTION

— EXISTING SUBBASIN BOUNDARY

EX1 EXISTING DRAINAGE SUBBASIN

EXISTING CONDITIONS HEC-1 MODEL SUMMARY			
SUBBASIN OR CP	BASIN AREA (AC)	100 YR (cfs)	10 YR (CFS)
EX1	10.58	28	15



RANCHO MULTI FAMILY

EDWARD HOMES

FIGURE 5
EXISTING CONDITIONS MAP

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500 South Rancho Drive, suite 17 Las Vegas, NV 89106
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C:\4555_Edward Homes\0007_Rancho Multi-Family\DRAIN FIGURES\ORIGINAL\Figures5.dwg (reed 10/22/20 5:35am)

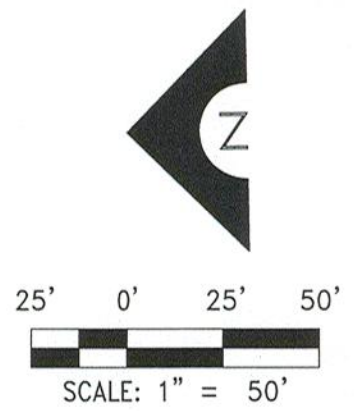
VII. ULTIMATE CONDITIONS

Figure 6 depicts the ultimate conditions subbasins and flow patterns. The ultimate conditions HEC-1 model has been included in Appendix A. Table 2 summarizes the ultimate condition 100-year and 10-year flow rates for each of the identified subbasins. Under ultimate conditions the offsite drainage patterns are the same as under the existing conditions. Under ultimate conditions the site will produce 100-year and a 10-year storm flows of 28 cfs and 14 cfs, respectively.

In the ultimate condition there will be 100-year and 10-year storm flows of 6 cfs and 3 cfs produced by Subbasin OFF1. The runoff from Subbasin OFF1 drains as surface flow to the northeast corner of the site where a proposed grate inlet and 18-inch storm drain will convey those flows to the existing 12-foot by 8-foot RCB CCRFCD facility in Rancho Drive. The site has been graded to convey the 100-year storm runoff to the southeast end of the Project and into a proposed grate inlet and 30 inch RCP and then ultimately to the 12-foot by 8-foot RCB CCRFCD facility. A high point has been graded in the entrance to site and in the ultimate condition the 100-year storm flows produced by Subbasin ON1 will be directed east to the grate inlet. The hump will provide 0.5 feet of freeboard to prevent flows from spilling into Airport Drive. The hydraulics and storm flows for the onsite and offsite runoff will be addressed in the Prorated Storm Flows and Hydraulics Section of this report.

TABLE 2 ULTIMATE CONDITIONS HEC-1 MODEL SUMMARY			
*SUBBASIN OR CP	BASIN AREA (AC)	100 YR (cfs)	10 YR (cfs)
ON1	10.58	28	14
OFF1	1.81	6	3

*See Figure 6



- LEGEND**
- STREET SLOPE
 - ULTIMATE SUBBASIN BOUNDARY
 - ON1
ULTIMATE DRAINAGE SUBBASIN
 - A
CROSS SECTION LOCATION
 - PROPOSED STORM DRAIN
 - EXISTING STORM DRAIN
 - PRORATED BASIN BOUNDARY
 - PR1
XX AC
PRORATED DRAINAGE BASIN
 - CPR2
PRORATED COMBINATION POINT

ULTIMATE CONDITIONS HEC-1 MODEL SUMMARY			
SUBBASIN OR CP	BASIN AREA (AC)	100 YR (cfs)	10 YR (cfs)
ON1	10.58	28	14
OFF1	1.81	6	3

100-YR PRORATED STORM FLOWS

PRORATED STORM FLOWS= 28 CFS/10.58 ACRES= 2.65 CFS/ACRE

PR1=2.65 ACRES X 2.65 CFS/ACRE=7 CFS

PR2=2.55 ACRES X 2.65 CFS/ACRE=7 CFS

PR3=1.85 ACRES X 2.65 CFS/ACRE=5 CFS

PR4=1.05 ACRES X 2.65 CFS/ACRE=3 CFS

PR5=1.05 ACRES X 2.50 CFS/ACRE=6 CFS

CPR1=14 CFS

CPR2=8 CFS

CPR3=ON1=28CFS

100-YEAR HYDRAULIC CROSS SECTION					
Location	Slope (%)	Q ₁₀₀ (cfs)	D ₁₀₀ (ft)	V ₁₀₀ (ft/sec)	D*V ₁₀₀
Sect 1	0.27	278	1.31	3.78	5.0
Sect 2	0.42	278	1.25	5.2	6.5
Sect A	0.40	3	0.25	1.79	N/A
Sect B	0.56	3	0.25	1.82	N/A
Sect C	0.67	14	0.47	2.37	N/A
Sect D	3.45	1	0.35	2.77	N/A
Sect E	0.59	8	0.49	2.46	N/A
Sect F	1.27	3	0.29	2.31	N/A
Sect G	0.57	4	0.35	1.62	N/A
Sect H	0.50	10	0.45	2.1	N/A
Sect J	1.00	28	1.45	3.35	N/A

RANCHO MULTI FAMILY

EDWARD HOMES

FIGURE 6
ULTIMATE CONDITIONS MAP

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VIII. PRORATED BASIN FLOWS AND HYDRAULICS

Prorated storm flows from this study were calculated to model the ultimate conditions onsite discharges to design points. Calculations for the prorated storm flows for each prorated basin are shown on Figure 6. Calculations are based on the overall 100-year storm flow from Subbasins ULT1 and then divided by the acreage to determine how much runoff per acre will be produced. The acreage of each Prorated Basin is then multiplied by the cfs/acre which equals the cfs (rounded to nearest whole number) per Prorated Basin. The Prorated Basins 100-year storm flows and the basin boundaries have been shown on Figure 6.

The cross section locations for the offsite streets adjacent to the site for the ultimate condition have been shown on Figure 6. There will be a worst case 100-year storm flow of 278 cfs from MPU Basin SRO5B-C in Decatur Boulevard adjacent to the site. Please refer to the W-Map and the Hec-1 model from the 2018 MPU in Appendix C. Decatur Boulevard slopes at 0.27 percent and storm flows will drain 1.31 feet deep during a 100-year storm event. The finish floor elevations of apartments adjacent to Decatur Boulevard are a minimum of 3 feet above the 100-year storm flows. There will also be a 100-year storm flow of 278 cfs in Airport Drive adjacent to the site. Airport Drive has a minimum slope of 0.42 percent and storm flows will drain 1.25 feet deep during a 100-year storm event. The finish floor elevations of apartments adjacent to Airport Drive are a minimum of 1.5 feet above the 100-year storm flows.

The only flow in Rancho Boulevard is what falls on the street itself. The storm flows in Rancho Boulevard were referenced from the Avion Study. Please see Figure 9 in Appendix C. The finish floor elevations for the apartments along Rancho Boulevard are a minimum of 4.5 feet above the street improvements. This area is prone to flooding and the finish floor elevations for the entire Project have been set to be a minimum of 1.5 feet above the 100-year storm flows in the adjacent streets.

The cross section locations for the onsite for the ultimate condition have also been shown on Figure 6. In the ultimate condition there will be a worst case 100-year storm flow of 3 cfs in the inverted crown drive aisles. The worst case depth of flow will be 0.25 feet deep in the drive aisles which occurs at Section A (1/2 100-year flow from PR3). All garage finish floor elevations have been set to twice the depth of flow for a minimum of 0.5 feet above the flow lines in the drive aisles at the top of driveway.

Cross sections have been cut at several locations in the normal crown streets to determine the garage finish floor elevations. The garage finish floor elevations for Buildings 8 through 13 and 16 through 19 have been set based on the 100-year storm flow depth at Cross Section G (4 cfs, 4/7 of the 100-year storm flows from Prorated Basin PR1). Those garage finish floor elevations are a minimum of 0.70 feet above the gutter flowline (0.32 feet above the high side top of curb). The garage finish floor elevations for Buildings 28 through 33 have been set based on the 100-year storm flow depth at Cross Section F (3 cfs, 1/2 of the 100-year storm flows from Prorated Basin PR5). Those garage finish floor elevations are a minimum of 0.58 feet above the gutter flowline (0.20 feet above the high side top of curb). The garage finish floor elevations for Buildings 34, 39 and 40 have been set based on the 100-year storm flow depth at Cross Section H (10 cfs, 100-year storm flows from CPR2 plus 1/3 of the 100-year storm flows from Prorated Basin PR5). Those garage finish floor elevations are a minimum of 0.90 feet above the gutter flowline (0.52 feet above the high side top of curb).

Per City of Las Vegas criteria in the Design Manual, the onsite finish floor elevations shall be set at a vertical distance of 6-inches above highest top of curb elevation or twice the depth of flow in the gutter flow line. The finish floor elevations are set at a minimum of twice the 100-year depth of flow elevation at the high side top of curb elevation. The garage finish floor elevations have been set at twice the 100-year storm depth of flow elevation at the high side of the driveway.

Based on the calculated street flow characteristics, the Design Manual criteria for depth (D) and velocity times depth ($V \cdot D$) to be less than 8 during the 100-year storm event will be met. Since in all cases the $D \cdot V$ was less than 6 during the 100-year storm event, 10-year cross section calculations were not warranted.

One 6-foot by 6-foot Jensen Precast area drain for the onsite storm flows is proposed for the Project. That inlet will intercept the 100-year storm flows of 28 cfs produced by the site at a ponding depth of 0.6 feet. The 100-year storm flows intercepted by the area drain will be conveyed to the existing 12 ft. by 8 ft. RCB in Rancho Drive (CCRFGD Facility LVRA 0012). The starting HGL for the onsite storm drain system will be 2196.5 and was referenced from the improvement plans for the City of Las Vegas Rancho Drive Drainage Improvements and Plans-Phase 2. Please refer to

Sheet C-3 in Appendix C. A Standard Form 6 model was prepared for the onsite storm drain and as shown in the model, the 100-year HGL will remain a minimum of 1 foot below finish grade per Manual Criteria. One 2.5-foot by 2.5-foot Jensen Precast area drain is proposed to intercept the 100-year storm flow of 6 cfs from Subbasin OFF1. That inlet will intercept the 100-year storm flows of 6 cfs at a ponding depth of 0.4 feet. The 100-year storm flows intercepted by the area drain will be conveyed to the existing 12 ft. by 8 ft. RCB in Rancho Drive (CCRFCD Facility LVRA 0012). The starting HGL for the onsite storm drain system will be 2199.40 and was referenced from the improvement plans for the City of Las Vegas Rancho Drive Drainage Improvements and Plans-Phase 2. Please refer to Sheet C-2 in Appendix C. A Standard Form 6 model was prepared for the onsite storm drain and as shown in the model, the 100-year HGL will remain a minimum of 1 foot below finish grade per Manual Criteria. The Standard Form 6 models and area drain calculations have been included in Appendix B.

The onsite storm drain conveys the 100-year storm flows from the site to the existing 12 ft. by 8 ft. RCB in Rancho Drive. The ultimate condition runoff from the site will be 28 cfs during a 100-year storm event and the runoff from the offsite will be 6 cfs during a 100-year storm event. There is a 100-year design flow in the existing 12-foot by 8-foot RCB in Rancho Drive of 1256 cfs and an increase of 6 cfs and 28 cfs into that storm drain is only an increase of 2.3 percent and will not have a negative impact to that existing facility since those flows drained into that storm drain downstream anyway. In the case that the 6-foot by 6-foot area drain becomes 100-percent clogged, the emergency overflow path is south into Airport Drive through the view fence on the east side of the entrance. In the case that the 2.5-foot by 2.5-foot area drain at the northeast corner of the Project becomes 100-percent clogged, the emergency overflow path is east into Rancho Drive.

There is an existing grate inlet in a sump condition across Airport Drive that has been designed to convey offsite flows to the 12-foot by 8-foot RCB in Rancho Drive. This Project has been designed to not increase flows to that facility. If that drain becomes clogged the runoff will spill and drain east into Rancho Drive and those flows will not have a negative impact on this Project.

The 48-foot long by 12-foot wide riprap lined ditch meets the minimum criteria per Section 1500 of the Manual.

IX. CONCLUSIONS AND RECOMMENDATIONS

1. Methodology used in this report is in compliance with the Clark County Regional Flood Control District (CCRFCD) criteria.
2. The proposed project lies within a FEMA Zone X. Therefore, the project is not currently located in a FEMA-designated Special Flood Hazard Area.
3. The proposed development has been designed to match established drainage patterns of adjacent developments in the area and follow the discharge patterns from the 2018 MPU.
4. Apartments to be constructed within this project will have adequate freeboard to be protected from flows conveyed in the adjacent streets.
5. All finish floor elevations are twice the depth of flow of a 100-year storm event at the high side of the lot.
6. All garage finish floor elevations are a minimum of twice the depth flow of a 100-year storm event at the high side of the driveway.

XI. REFERENCES

1. Atkins Engineering, Louis Berger, *Clark County Regional Flood Control District - The 2018 Las Vegas Valley Master Plan Update*, December 2018.
2. PBS&J, *City of Las Vegas Nevada Northwest Neighborhood Study*
3. CVL Engineering *Technical Drainage Study for Avion (Formerly Rancho Park)* by (Reference 3, hereinafter referred to as the Avion Study), August 2007.
4. Clark County Regional Flood Control District *Hydrologic Criteria and Drainage Design Manual*, updated August 1999.
5. U.S. Army Corps of Engineers, *HEC-1 Flood Hydrograph Package*, June 1998.
6. *USGS- NRCS Soils Survey Website*, August 2017

APPENDIX A

NOFA for SDR-73295 Site Development Plan Review

NOFA for ZON-73294 Rezoning

Precipitation Reference

Soils Maps for Project

Soils Reference – USDA

Curve Number References

Existing Conditions

- Curve Number Calculations

 - Standard Form 4

 - HEC-1 Model

Ultimate Conditions

- Curve Number Calculations

 - Standard Form 4

 - HEC-1 Model



**LAS VEGAS
CITY COUNCIL**

CAROLYN G. GOODMAN
Mayor

LOIS TARKANIAN
Mayor Pro Tem

STAVROS S. ANTHONY
BOB COFFIN
STEVEN G. SEROKA
MICHELE FIORE
CEDRIC CREAR

SCOTT D. ADAMS
City Manager

DEPARTMENT OF PLANNING

ROBERT SUMMERFIELD
DIRECTOR

**DEVELOPMENT
SERVICES CENTER**

DEPARTMENT OF PLANNING

333 N. RANCHO DRIVE
3RD FLOOR
LAS VEGAS, NV 89106

702.229.6301 | VOICE
702.474.7463 | FAX
711 | TTY



cityoflasvegas
lasvegasnevada.gov

August 16, 2018

Mr. Randy Blanchard
Rancho Village Partners
2222 Martin Street, Suite #160
Irvine, California 92612

**RE: SDR-73295 [PRJ-73073] - SITE DEVELOPMENT PLAN REVIEW
RELATED TO ZON-73294
CITY COUNCIL MEETING OF AUGUST 15, 2018**

Dear Mr. Blanchard,

The City Council at a regular meeting held on August 15, 2018 voted to **APPROVE** a request for a Site Development Plan Review FOR A PROPOSED 738-UNIT MULTI-FAMILY RESIDENTIAL DEVELOPMENT on 33.47 acres on the west side of Rancho Drive, 230 feet north of Smoke Ranch Road (APN 139-18-410-012), R-PD19 (Residential Planned Development - 19 Units per Acre) Zone [PROPOSED: R-3 (Medium Density Residential)], Ward 5 (Crear) [PRJ-73073].

This approval is subject to the following conditions:

Planning

1. The applicant shall construct a perimeter block wall consistent with LVMC 19 prior to certificate of occupancy for each phase of the development.
2. Approval of a Rezoning (ZON-73294) shall be required, if approved.
3. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.
4. All development shall be in conformance with the site plan and landscape plan, date stamped 05/10/18 and building elevations, date stamped 04/26/18 except as amended by conditions herein.
5. A Waiver from Title 19.06.110 is hereby approved, to allow a 10-foot wide perimeter landscape buffer along a portion of the south property line where 15 feet is required.
6. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
7. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.

- 8 A technical landscape plan, signed and sealed by a Registered Architect, Landscape Architect, Residential Designer or Civil Engineer, must be submitted prior to or at the same time application is made for a building permit. A permanent underground sprinkler system is required, and shall be permanently maintained in a satisfactory manner; the landscape plan shall include irrigation specifications. Installed landscaping shall not impede visibility of any traffic control device. The technical landscape plan shall include one 24-inch box tree at the ends of each parking row, plus four five-gallon shrubs for each required tree in planters.
- 9 A fully operational fire protection system, including fire apparatus roads, fire hydrants and water supply, shall be installed and shall be functioning prior to construction of any combustible structures.
10. Prior to or at the time of submittal for any building permit, the applicant shall provide written verification by the Federal Aviation Administration and/or the Clark County Department of Aviation of the following:
 - Applicant is required to file a valid FAA Form 7460-1, "Notice of Proposed Construction or Alteration" with the FAA, in accordance with 14 CFR Part 77, or submit to the Clark County Director of Aviation a "Property Owner's Shielding Determination Statement" and request written concurrence from the Clark County Department of Aviation,
 - No Building Permit or other construction permit shall be issued for any structure greater than 35 feet above the surface of land that, based upon the FAA's 7460 airspace determination (the outcome of filing the FAA Form 7460-1) would (a) constitute a hazard to air navigation, (b) would result in an increase to minimum flight altitudes during any phase of flight (unless approved by the Department of Aviation), or (c) would otherwise be determined to pose a significant adverse impact on airport or aircraft operations.
 - Applicant is advised that FAA's airspace determinations are dependent on petitions by any interested party and the height that will not present a hazard as determined by the FAA may change based on these comments.
 - Applicant is advised that the FAA's airspace determinations include expiration dates and that the separate airspace determinations will be needed for construction cranes or other temporary equipment.
11. Prior to the submittal of a building permit application, the applicant shall meet with Department of Planning staff to develop a comprehensive address plan for the subject site. A copy of the approved address plan shall be submitted with any future building permit applications related to the site.
- 12 All City Code requirements and design standards of all City Departments must be satisfied, except as modified herein.

Public Works

13. Correct all Americans with Disabilities Act (ADA) deficiencies, if any, on the sidewalk along Rancho Drive, Smoke Ranch Road, and Decatur Boulevard adjacent to this site in accordance with code requirements of Title 13.56.040 to the satisfaction of the City Engineer concurrent with development of this site. All existing paving damaged or removed by this development shall be restored at its original location and to its original width concurrent with development of this site
14. Landscape and maintain all unimproved rights-of-way, if any, adjacent to this site. All landscaping and private improvements installed with this project shall be situated and maintained so as to not create sight visibility obstructions for vehicular traffic at all development access drives and abutting street intersections.
15. Submit a License Agreement for landscaping and private improvements, if any, in the Smoke Ranch Road and Decatur Boulevard public rights of way adjacent to this site prior to this issuance of permits for these improvements. The applicant must carry an insurance policy for the term of the License Agreement and add the City of Las Vegas as an additionally insured entity on this insurance policy. If requested by the City, the applicant shall remove property encroaching in the public right-of-way at the applicant's expense pursuant to the terms of the City's License Agreement. The installation and maintenance of all private improvements in the public right of way shall be the responsibility of the adjacent property owner(s) and shall be transferred with the sale of the property for the entire term of the License Agreement. Coordinate all requirements for the License Agreement with the Land Development Section of the Department of Building and Safety (702-229-4836).
16. Obtain an Occupancy Permit from the Nevada Department of Transportation (NDOT) for all driveways or other private improvements, if any, in the Rancho Dive public right-of-way adjacent to this site prior to constructing any improvements within NDOT jurisdiction
17. No new permanent structures or landscaping taller than three feet shall be allowed in any existing public sewer easements
18. Contact the City Engineer's Office at 702-229-6272 to coordinate the development of this project with the Rancho Road – Mesquite to Decatur project and any other public improvement projects adjacent to this site. Comply with the recommendations of the City Engineer

Mr. Randy Blanchard
Rancho Village Partners
SDR-73295 [PRJ-73073] - Page Four
August 16, 2018

19. A Traffic Impact Analysis must be submitted to and approved by the Department of Public Works prior to the issuance of any building or grading permits, submittal of any construction drawings or the recordation of a Map subdividing this site, whichever may occur first. Comply with the recommendations of the approved Traffic Impact Analysis prior to occupancy of the site. The Traffic Impact Analysis shall also include a section addressing Standard Drawings #234.1 #234.2 and #234.3 to determine additional right-of-way requirements for bus turnouts adjacent to this site, if any, dedicate all areas recommended by the approved Traffic Impact Analysis. All additional rights of way required by Standard Drawing #201.1 for exclusive right turn lanes and dual left turn lanes shall be dedicated prior to or concurrent with the commencement of on site development activities unless specifically noted as not required in the approved Traffic Impact Analysis. Phased compliance will be allowed if recommended by the approved Traffic Impact Analysis. No recommendation of the approved Traffic Impact Analysis, nor compliance therewith, shall be deemed to modify or eliminate any condition of approval imposed by the Planning Commission or the City Council on the development of this site.
20. A Drainage Plan and Technical Drainage Study must be submitted to and approved by the Department of Public Works prior to the issuance of any building or grading permits or submittal of any construction drawings, whichever may occur first. Provide and improve all drainageways recommended in the approved drainage plan/study. The developer of this site shall be responsible to construct such neighborhood or local drainage facility improvements as are recommended by the City of Las Vegas Neighborhood Drainage Studies and approved Drainage Plan/Study concurrent with development of this site.

The Notice of Final Action was filed with the Las Vegas City Clerk on August 16, 2018

Sincerely,



Robert Summerfield, AICP
Director
Department of Planning

RTS:PL:clb

cc: Mr. Kevin Thistle
P.K Thistle Architect
7383 Atacama Avenue
Las Vegas, Nevada 89179



**LAS VEGAS
CITY COUNCIL**

CAROLYN G. GOODMAN
Mayor

LOIS TARKANIAN
Mayor Pro Tem

STAVROS S. ANTHONY
BOB COFFIN
STEVEN G. SEROKA
MICHELE FIORE
CEDRIC CREAR

SCOTT D. ADAMS
City Manager

DEPARTMENT OF PLANNING
ROBERT SUMMERFIELD
DIRECTOR

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August 16, 2018

Mr. Randy Blanchard
Rancho Village Partners
2222 Martin Street, Suite #160
Irvine, California 92612

**RE: ZON-73294 [PRJ-73073] - REZONING RELATED TO SDR-73295
CITY COUNCIL, MEETING OF AUGUST 15, 2018**

Dear Mr. Blanchard:

The City Council at a regular meeting held on August 15, 2018 voted to **APPROVE** a request for a Rezoning FROM: R-PD19 (RESIDENTIAL PLANNED DEVELOPMENT - 19 UNITS PER ACRE) TO: R-3 (MEDIUM DENSITY RESIDENTIAL) on 33.47 acres on the west side of Rancho Drive, 230 feet north of Smoke Ranch Road (APN 139-18-410-012), Ward 5 (Crear) [PRJ-73073]

The Notice of Final Action was filed with the Las Vegas City Clerk on August 16, 2018.

Sincerely,

Robert Summerfield, AICP
Director
Department of Planning

RTS.PL:plb

cc: Mr. Kevin Thistle
P.K. Thistle Architect
7383 Atacama Avenue
Las Vegas, Nevada 89179

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DEPTH-DURATION-FREQUENCY VALUES FOR McCARRAN AIRPORT RAINFALL AREA (IN INCHES)

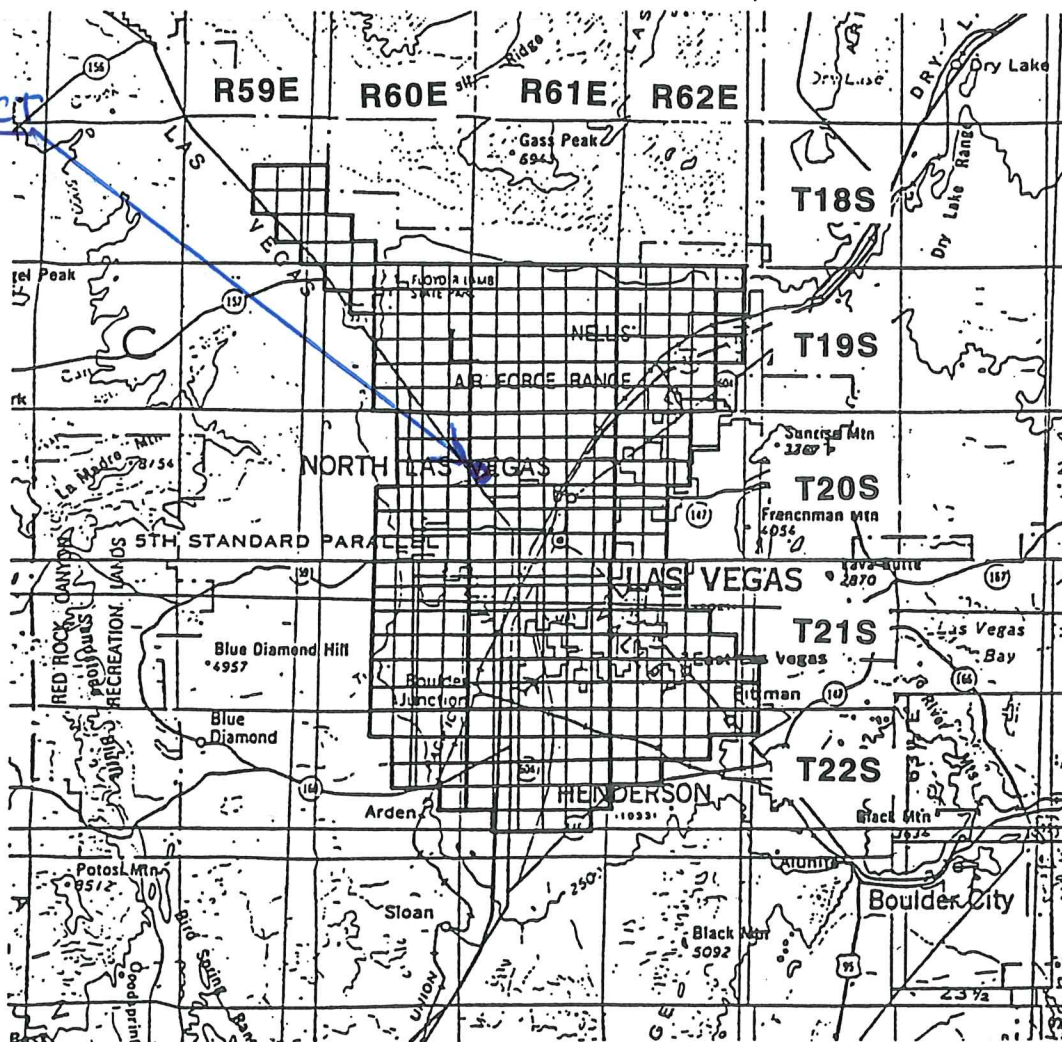
TIME	RECURRENCE INTERVAL					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5 min.	0.15	0.27	0.35	0.46	0.54	0.63
10 min.	0.25	0.44	0.57	0.74	0.89	1.02
15 min.	0.33	0.57	0.74	0.97	1.15	1.32
30 min.	0.44	0.78	1.01	1.31	1.55	1.79
1 hour	0.52	0.89	1.15	1.50	1.78	2.06
2 hour	0.59	1.01	1.30	1.70	2.01	2.30
3 hour	0.64	1.08	1.39	1.82	2.15	2.48
6 hour	0.72	1.22	1.58	2.05	2.41	2.77
24 hour (TR-55)	1.20	1.60	1.80	2.40	2.70	2.96

- NOTE: 1. Refer to Figure 513 for a description and drawing of the area included in the McCarran Airport Rainfall Area.
2. The 24 hour values presented above are for use with TR-55 only.
3. Table 501 adjustments not required.

Revision	Date

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP RANGE SECTIONS

18 South	59 East	13-15,22-26,36
18 South	60 East	30-32
19 South	60 East	1-6,8-16,21-28,33-36
19 South	61 East	ALL SECTIONS
19 South	62 East	2-11,14-23,27-34
20 South	60 East	1-3,10-15,21-28,33-36
20 South	61 East	ALL SECTIONS

TOWNSHIP RANGE SECTIONS

20 South	62 East	4-9,16-20,29-32
21 South	60 East	1-4,9-16,21-28,33-36
21 South	61 East	ALL SECTIONS
21 South	62 East	4-9,15-23, 25-36
22 South	60 East	1-4,10-15,24
22 South	61 East	1-24,26-29
22 South	62 East	1-10,17-18

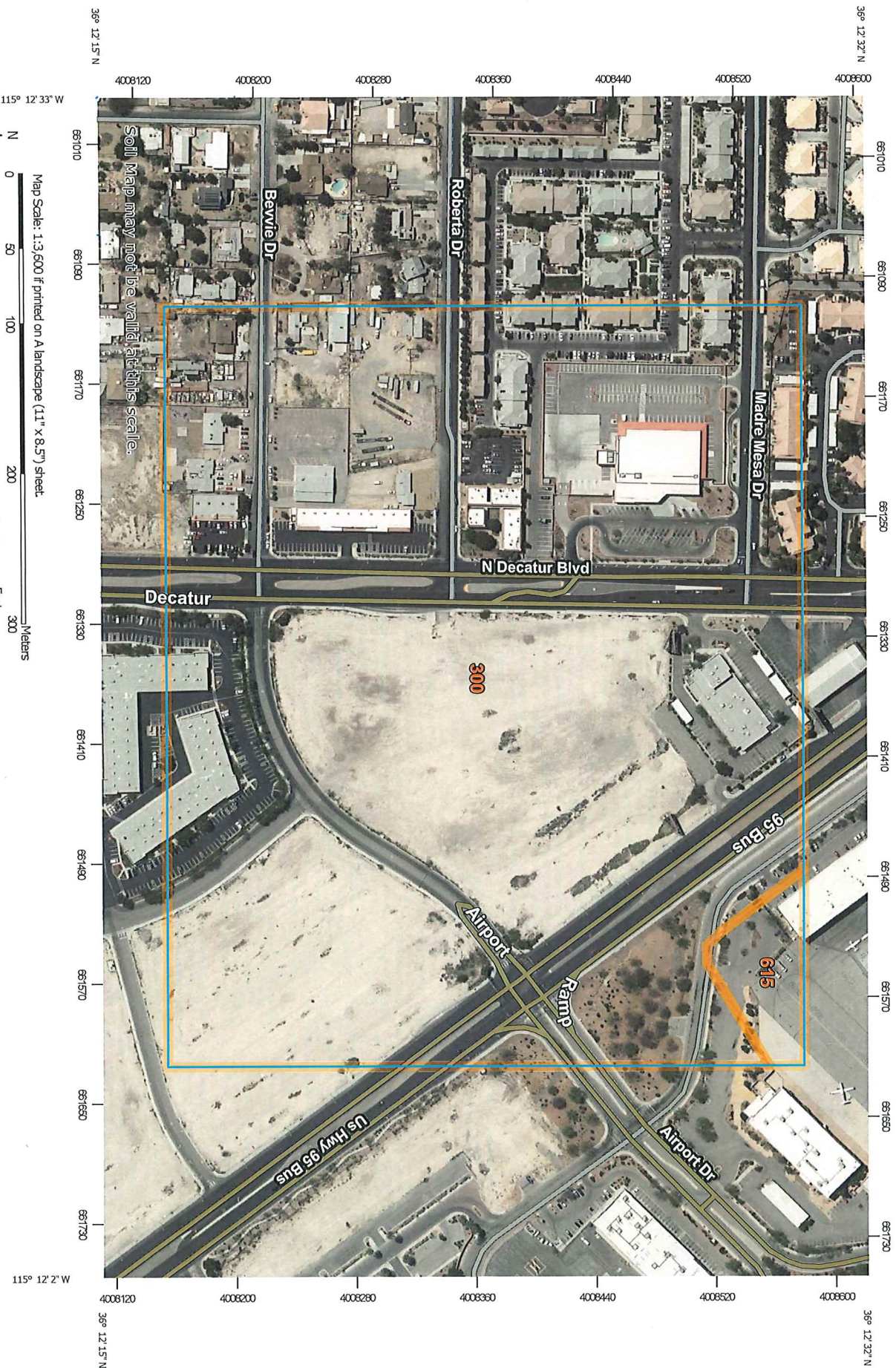
Notes:

1. Refer to Table 505 and Figure 516 Depth-Duration- Frequency values in the McCarran Airport Rainfall Area.
2. Refer to Table 506 and Figure 517 for Time-Intensity-Frequency values on the McCarran Airport Rainfall Area.

Revision	Date

REFERENCE:

Soil Map—Las Vegas Valley Area, Nevada, Part of Clark County
(RANCHO MULTI FAMILY)



MAP LEGEND

MAP INFORMATION

Area of Interest (AOI)	
	Area of Interest (AOI)
Soils	
	Soil Map Unit Polygons
	Soil Map Unit Lines
	Soil Map Unit Points
Special Point Features	
	Blowout
	Borrow Pit
	Clay Spot
	Closed Depression
	Gravel Pit
	Gravelly Spot
	Landfill
	Lava Flow
	Marsh or swamp
	Mine or Quarry
	Miscellaneous Water
	Perennial Water
	Rock Outcrop
	Saline Spot
	Sandy Spot
	Severely Eroded Spot
	Sinkhole
	Slide or Slip
	Sodic Spot

	Spoil Area
	Stony Spot
	Very Stony Spot
	Wet Spot
	Other
	Special Line Features
Water Features	
	Streams and Canals
Transportation	
	Rails
	Interstate Highways
	US Routes
	Major Roads
	Local Roads
Background	
	Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County
Survey Area Data: Version 15, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 3, 2019—May 14, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
300	Las Vegas gravelly fine sandy loam, 0 to 2 percent slopes	52.0	97.5%
615	Urban land	1.4	2.5%
Totals for Area of Interest		53.3	100.0%

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk "*" denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007 (<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties—Las Vegas Valley Area, Nevada, Part of Clark County														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
300—Las Vegas gravelly fine sandy loam, 0 to 2 percent slopes														
Las vegas	100	D	0-1	Gravelly fine sandy loam	SM	A-1, A-2	0-0-0	0-0-0	60-70-80	50-63-75	40-53-65	20-25-30	15-20-25	NP-3-5
			1-7	Fine sandy loam	SM	A-4	0-0-0	0-0-0	80-90-100	75-85-95	65-73-80	40-45-50	0-7-14	NP
			7-11	Gravelly sandy clay loam, gravelly loam	GC, SC	A-2, A-6	0-0-0	0-0-0	60-70-80	50-63-75	30-40-50	25-35-45	25-30-35	10-13-15
			11-15	Indurated	—	—	—	—	—	—	—	—	—	—

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area ²	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ³ :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ⁴ ...		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					

See Table 602A

Developing urban areas

* Newly graded areas (pervious areas only, no vegetation) ⁵	77	86	91	94 *
--	----	----	----	------

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS - RESIDENTIAL DISTRICTS

Average Lot Size or Usage ¹	Percent Impervious ²	Curve Number for Hydrologic Soil Groups			
		A	B	C	D
* Apartments/Condos *	72	81	88	91	93
Townhouses/6,000 sq ft lots or less ³	69	80	87	90	92
7,000 sq ft lots	63	76	84	89	91
8,000 sq ft lots	58	73	82	88	90
10,000 sq ft lots	38	61	75	83	87
14,000 sq ft lots	30	57	72	81	86
20,000 sq ft lots	25	54	70	80	85
40,000 sq ft lots	20	51	68	79	84
80,000 sq ft lots	12	46	65	77	82

1 Lot size should represent the size of the average lot and not the gross acreage divided by the number of lots.

2 Actual percent impervious value should be compared to selected land use type.

3 In cases where average residential lots are smaller than 6,000 sq ft, commercial/business/industrial land use should be used.

Revision	Date

REFERENCE:

TABLE 602A

CN CALCULATIONS - EXISTING CONDITIONS

NEWLY GRADED				WEIGHTED CN
Basin	% SOIL TYPE	HYDRO	%	
ON1		A	77	0.0
		B	86	0.0
		C	91	0.0
	100	D	100	94.0
				94.0

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

RCI
ENGINEERING

RANCHO MULTI-FAMILY
Existing Conditions

BY: rjr
DATE: 10/21/20

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)				TRAVEL TIME (Tt)					Tc	Tc Check	Tlag	REMARKS
DESIG:	DEV./EX. (D or E)	CN	K	AREA Ac	AREA Mi^2	INITIAL LENGTH Feet	SLOPE %	Ti Min	TRAVEL LENGTH Feet	SLOPE %	V1 VELOCITY FPS	V2 VELOCITY FPS	Tt Min	Tc Min	Tc Min	Tlag= 0.6Tc/60 Hours		
(1)			(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	(13)	(14)			
EX1	E	94.0	0.8508	10.58	0.0165	190	0.5	7.7	645	1.1	1.5	3.1	6.2	13.9	N/A	0.139		
Tc = Ti + Tt Tlag = 0.6 Tc Developed V1 = 20.2*(S/100)^1/2																		
Ti = 1.8 (1.1 - K) L^1/2 / S^1/3 For the travel time (Tt) calculations, Existing V1 = 14.8*(S/100)^1/2																		
K = 0.0132 (CN) - 0.39 V1 applies to the first 500 feet of travel distance; Existing V2 = 29.4*(S/100)^1/2																		
Tc Check (Developed) = L/180+10 V2 applies to the remaining travel distance. Existing V2 = 30.6*(S/100)^1/2																		
Minimum Tc (DEV) = 5 Min per Section 602.1																		
Minimum Tc (EX) = 10 Min per Section 602																		
REFERENCE :														STANDARD FORM 4				

$T_c = T_i + T_t$ $T_{lag} = 0.6 T_c$ For the travel time (T_t) calculations, Existing $V_1 = 14.8 * (S/100)^{1/2}$ Developed $V_1 = 20.2 * (S/100)^{1/2}$
 $T_i = 1.8 * (1.1 - K) * L^{1/2} / S^{1/3}$ V_1 applies to the first 500 feet of travel distance; Existing $V_2 = 29.4 * (S/100)^{1/2}$ Developed $V_2 = 30.6 * (S/100)^{1/2}$
 $K = 0.0132 (CN) - 0.39$ V_2 applies to the remaining travel distance. Minimum $T_c (EX) = 10$ Min per Section 602 Minimum $T_c (DEV) = 5$ Min per Section 602.1
 $T_c \text{ Check (Developed)} = L/180 + 10$

REFERENCE :

STANDARD FORM 4

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 21OCT20 TIME 05:13:17
*

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

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X  X  XXXXXX  XXXX  X
X  X  X      X  X  XX
X  X  X      X  X  X
XXXXXX XXXX  X      XXXX  X
X  X  X      X  X  X
X  X  X      X  X  X
X  X  XXXXXX  XXXX  XXX

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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 -AMSK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

HEC-1 INPUT

PAGE 1

```

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

          *DIAGRAM
1         ID      RANCHO MULTI-FAMILY
2         ID      EXISTING CONDITIONS ONSITE
3         ID      DESIGN STORM = 100-YEAR 6-HOUR STORM
4         ID      STORM DISTRIBUTION = SDN3
5         ID
6         ID      AREA (SQUARE MILES)  DARF
7         ID      10-YR STORM FLOW      0.59
8         ID
9         IT      5          0          0          300
10        IO      5          0          0
11        IN      5          0          0
12        JR      PREC      1.00      0.59
          *

13        KK      EX1
14        KM      EXIST ONSITE BASIN
15        BA      .0165
16        PB      2.77
17        PC      0.000  0.020  0.057  0.070  0.087  0.108  0.124  0.130  0.130  0.130
18        PC      0.130  0.130  0.130  0.133  0.140  0.142  0.148  0.158  0.172  0.181
19        PC      0.190  0.197  0.199  0.200  0.201  0.204  0.214  0.229  0.241  0.249
20        PC      0.251  0.256  0.270  0.278  0.281  0.283  0.295  0.322  0.352  0.409
21        PC      0.499  0.590  0.710  0.744  0.781  0.812  0.819  0.835  0.851  0.856
22        PC      0.860  0.868  0.876  0.888  0.910  0.926  0.937  0.950  0.970  0.976
23        PC      0.982  0.985  0.987  0.989  0.990  0.993  0.993  0.994  0.995  0.998
24        PC      0.998  0.999  1.000
25        LS      0          94
26        UD      0.139
          *
          *
27        ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```

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

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

13     EX1

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 21OCT20 TIME 05:13:17
*

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* (916) 756-1104
*

RANCHO MULTI-FAMILY
EXISTING CONDITIONS ONSITE
DESIGN STORM = 100-YEAR 6-HOUR STORM
STORM DISTRIBUTION = SDN3

AREA (SQUARE MILES) DARF
10-YR STORM FLOW 0.59

10 IO

OUTPUT CONTROL VARIABLES

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

IT HYDROGRAPH TIME DATA
 NMIN 5 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 0055 ENDING TIME
 ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
 TOTAL TIME BASE 24.92 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 .59

1

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	RATIO 2
				1.00	.59
HYDROGRAPH AT					
+	EX1	.02	1	FLOW	28.
				TIME	15.
					3.58
					3.58

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

CN CALCULATIONS - ULTIMATE CONDITIONS

			CN- APARTMENTS/ CONDOS		CN- STREETS		CN- COMMERCIAL		WEIGHTED CN
			% SOIL TYPE	HYDRO	%		%		
Basin ON1									0.0
		A		81		98		89	0.0
		B		88		98		92	0.0
		C		91		98		94	0.0
	100	D		90	10	98		95	93.5
93.5									
Basin OFF1									WEIGHTED CN
		HYDRO							0.0
		A		81		98		89	0.0
		B		88		98		92	0.0
		C		91		98		94	0.0
100	D		93		98	100	95	95.0	
95.0									

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

RCI
ENGINEERING

RANCHO MULTI-FAMILY
Ultimate Conditions

BY: rjr
DATE: 10/13/20

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)		TRAVEL TIME (Tt)					Tc	Tc Check	Ttag	REMARKS
DESIG:	DEV/JEX. (D or E)	CN	K	AREA Ac	AREA Mi^2	INITIAL LENGTH Feet	SLOPE %	Ti Min	TRAVEL LENGTH Feet	SLOPE %	V1 VELOCITY FPS	V2 VELOCITY FPS	Tt Min	Min	Min	
(1)			(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	(13)	(14)	Ttag= 0.6Tc/60 Hours
ON1	D	93.5	0.8442	10.58	0.0165	106	1.0	4.7	1225	0.9	1.9	2.9	8.5	13.3	17.4	0.133
OFF1	D	95.0	0.8640	1.81	0.0028	80	1.0	3.8	425	0.7	1.7	2.5	4.2	8.0	12.8	0.080

$$T_c = T_i + T_t \quad T_{lag} = 0.6 T_c$$

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

$$K = 0.0132 (CN) - 0.39$$

$$T_c \text{ Check (Developed)} = L / 180 + 10$$

For the travel time (Tt) calculations,

V1 applies to the first 500 feet of travel distance;

V2 applies to the remaining travel distance.

$$\text{Existing } V1 = 14.8 * (S/100)^{1/2}$$

$$\text{Existing } V2 = 29.4 * (S/100)^{1/2}$$

$$\text{Minimum } T_c (EX) = 10 \text{ Min per Section 602}$$

Developed

Developed

$$\text{Minimum } T_c (DEV) = 5 \text{ Min per Section 602.1}$$

$$V1 = 20.2 * (S/100)^{1/2}$$

$$V2 = 30.6 * (S/100)^{1/2}$$

REFERENCE :

STANDARD FORM 4


```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 13OCT20 TIME 05:48:13
*
*****

```

```

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

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

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

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

1

HEC-1 INPUT

PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*DIAGRAM
1 ID RANCHO MULTI-FAMILY
2 ID ULTIMATE CONDITIONS MODEL
3 ID DESIGN STORM = 100-YEAR 6-HOUR STORM
4 ID STORM DISTRIBUTION = SDN3
5 ID
6 ID AREA (SQUARE MILES) DARF
7 ID 10-YR STORM FLOW 0.59
8 ID
9 IT 5 0 0 300
10 IO 5 0 0
11 IN 5 0 0
12 JR PREC 1.00 0.59
*
13 KK ON1
14 KM ULTIMATE CONDITIONS SUBBASIN
15 BA .0165
16 PB 2.77
17 PC 0.000 0.020 0.057 0.070 0.087 0.108 0.124 0.130 0.130 0.130
18 PC 0.130 0.130 0.130 0.133 0.140 0.142 0.148 0.158 0.172 0.181
19 PC 0.190 0.197 0.199 0.200 0.201 0.204 0.214 0.229 0.241 0.249
20 PC 0.251 0.256 0.270 0.278 0.281 0.283 0.295 0.322 0.352 0.409
21 PC 0.499 0.590 0.710 0.744 0.781 0.812 0.819 0.835 0.851 0.856
22 PC 0.860 0.868 0.876 0.888 0.910 0.926 0.937 0.950 0.970 0.976
23 PC 0.982 0.985 0.987 0.989 0.990 0.993 0.993 0.994 0.995 0.998
24 PC 0.998 0.999 1.000
25 LS 0 93.5
26 UD 0.133
*
27 KK OFF1
28 KM ULTIMATE CONDITIONS SUBBASIN
29 BA .0028
30 LS 0 95
31 UD .080
*
32 ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```

INPUT
LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW
13 ON1
.
.
27 OFF1
.

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 13OCT20 TIME 05:48:13
*
*****

```

```

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

```

RANCHO MULTI-FAMILY

ULTIMATE CONDITIONS MODEL
DESIGN STORM = 100-YEAR 6-HOUR STORM
STORM DISTRIBUTION = SDN3

AREA (SQUARE MILES) DARE
10-YR STORM FLOW 0.59

10 IO OUTPUT CONTROL VARIABLES

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

IT

HYDROGRAPH TIME DATA

NMIN 5 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 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 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 .59

1

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	RATIO 2
				1.00	.59
HYDROGRAPH AT					
+	ON1	.02	1 FLOW	28.	14.
			TIME	3.58	3.58
HYDROGRAPH AT					
+	OFF1	.00	1 FLOW	6.	3.
			TIME	3.50	3.50

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

APPENDIX B – HYDRAULIC CALCS

100-Year Ultimate Flow Rate Hydraulic Calculations

Standard Form 6 Models

Grate Inlet Calculations

D-Load Calculations

Worksheet for 100-FOOT FULL STREET

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.27 %
Discharge	278.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
1+00.00	1.50
1+00.00	0.60
1+05.00	0.50
1+05.50	0.48
1+05.50	0.00
1+07.00	0.13
1+07.00	0.17
1+50.00	1.03
1+93.00	0.17
1+93.00	0.13
1+94.50	0.00
1+94.50	0.48
1+95.00	0.50
2+00.00	0.60
2+00.00	1.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00.00, 1.50)	(1+05.00, 0.50)	0.025
(1+05.00, 0.50)	(1+07.00, 0.17)	0.013
(1+07.00, 0.17)	(1+50.00, 1.03)	0.016
(1+50.00, 1.03)	(1+93.00, 0.17)	0.016
(1+93.00, 0.17)	(1+94.50, 0.48)	0.013
(1+94.50, 0.48)	(2+00.00, 1.50)	0.025

Options

Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results

Worksheet for 100-FOOT FULL STREET

Results

Normal Depth	1.31 ft
Elevation Range	0.00 to 1.50 ft
Flow Area	73.45 ft ²
Wetted Perimeter	102.49 ft
Hydraulic Radius	0.72 ft
Top Width	100.00 ft
Normal Depth	1.31 ft
Critical Depth	1.20 ft
Critical Slope	0.47 %
Velocity	3.78 ft/s
Velocity Head	0.22 ft
Specific Energy	1.53 ft
Froude Number	0.779
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.31 ft
Critical Depth	1.20 ft
Channel Slope	0.27 %
Critical Slope	0.47 %

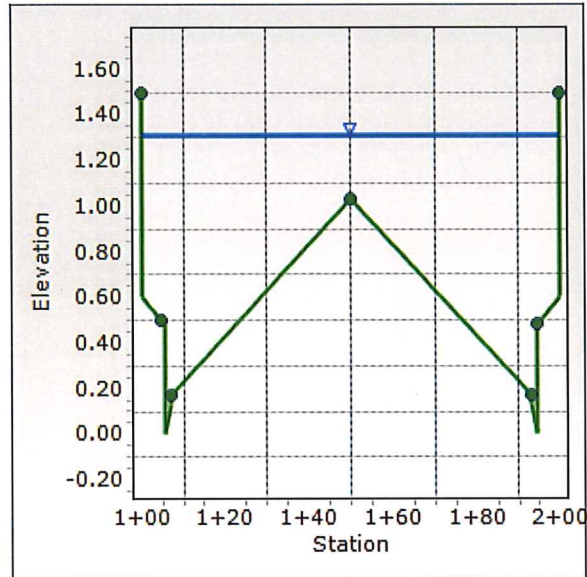
Cross Section for 100-FOOT FULL STREET

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.27 %
Normal Depth	1.31 ft
Discharge	278.00 cfs



Section 2 Airport Drive

Worksheet for 60-FOOT FULL STREET

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.42 %
Discharge	278.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
1+00.00	1.30
1+00.00	0.60
1+05.00	0.50
1+05.50	0.48
1+05.50	0.00
1+07.00	0.13
1+07.00	0.17
1+30.00	0.63
1+53.00	0.17
1+53.00	0.13
1+54.50	0.00
1+54.50	0.48
1+55.00	0.50
1+60.00	0.60
1+60.00	1.30

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00.00, 1.30)	(1+07.00, 0.17)	0.013
(1+07.00, 0.17)	(1+53.00, 0.17)	0.016
(1+53.00, 0.17)	(1+60.00, 1.30)	0.013

Options	
Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Normal Depth	1.25 ft
Elevation Range	0.00 to 1.30 ft
Flow Area	50.57 ft ²

Worksheet for 60-FOOT FULL STREET

Results

Wetted Perimeter	62.37 ft
Hydraulic Radius	0.81 ft
Top Width	60.00 ft
Normal Depth	1.25 ft
Critical Depth	1.28 ft
Critical Slope	0.37 %
Velocity	5.50 ft/s
Velocity Head	0.47 ft
Specific Energy	1.72 ft
Froude Number	1.056
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.25 ft
Critical Depth	1.28 ft
Channel Slope	0.42 %
Critical Slope	0.37 %

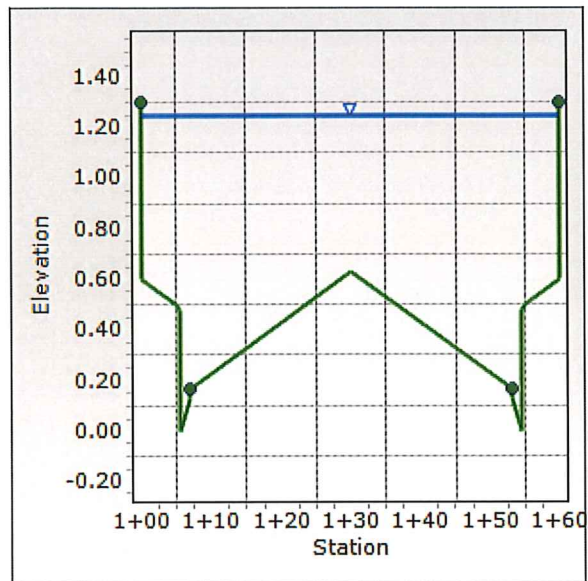
Cross Section for 60-FOOT FULL STREET

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.42 %
Normal Depth	1.25 ft
Discharge	278.00 cfs



WORST CASE

Worksheet for SECT A 24-FOOT DRIVE AISLE

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.40 %
Discharge	3.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
1+00.00	0.50
1+00.00	0.44
1+10.50	0.06
1+12.00	0.00
1+13.50	0.06
1+24.00	0.44
1+24.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00.00, 0.50)	(1+10.50, 0.06)	0.016
(1+10.50, 0.06)	(1+12.00, 0.00)	0.013
(1+12.00, 0.00)	(1+13.50, 0.06)	0.013
(1+13.50, 0.06)	(1+24.00, 0.50)	0.016

Options	
Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Normal Depth	0.25 ft
Elevation Range	0.00 to 0.50 ft
Flow Area	1.68 ft ²
Wetted Perimeter	13.58 ft
Hydraulic Radius	0.12 ft
Top Width	13.57 ft
Normal Depth	0.25 ft
Critical Depth	0.24 ft
Critical Slope	0.50 %
Velocity	1.79 ft/s

Worksheet for SECT A 24-FOOT DRIVE AISLE

Results

Velocity Head	0.05 ft
Specific Energy	0.30 ft
Froude Number	0.898
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.25 ft
Critical Depth	0.24 ft
Channel Slope	0.40 %
Critical Slope	0.50 %

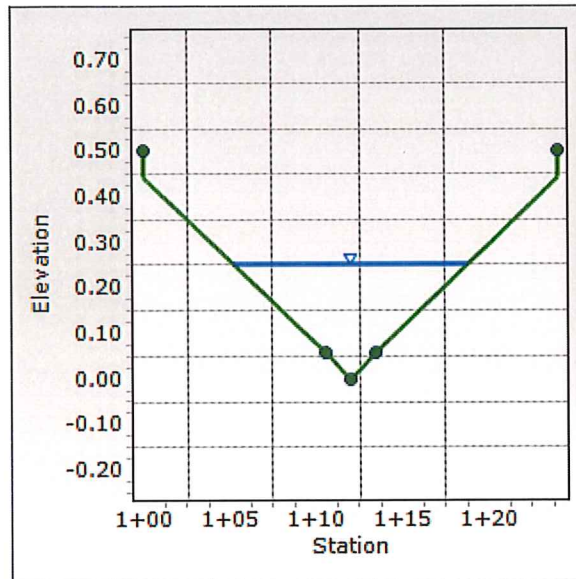
Cross Section for SECT A 24-FOOT DRIVE AISLE

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.40 %
Normal Depth	0.25 ft
Discharge	3.00 cfs



Worksheet for SECT B 24-FOOT DRIVE AISLE

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.56 %
Discharge	3.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
1+00.00	0.50
1+00.00	0.44
1+10.50	0.06
1+12.00	0.00
1+13.50	0.06
1+24.00	0.44
1+24.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00.00, 0.50)	(1+10.50, 0.06)	0.016
(1+10.50, 0.06)	(1+12.00, 0.00)	0.013
(1+12.00, 0.00)	(1+13.50, 0.06)	0.013
(1+13.50, 0.06)	(1+24.00, 0.50)	0.016

Options	
Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Normal Depth	0.25 ft
Elevation Range	0.00 to 0.50 ft
Flow Area	1.65 ft ²
Wetted Perimeter	13.46 ft
Hydraulic Radius	0.12 ft
Top Width	13.45 ft
Normal Depth	0.25 ft
Critical Depth	0.24 ft
Critical Slope	0.70 %
Velocity	1.82 ft/s

Worksheet for SECT B 24-FOOT DRIVE AISLE

Results

Velocity Head	0.05 ft
Specific Energy	0.30 ft
Froude Number	0.919
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.25 ft
Critical Depth	0.24 ft
Channel Slope	0.56 %
Critical Slope	0.70 %

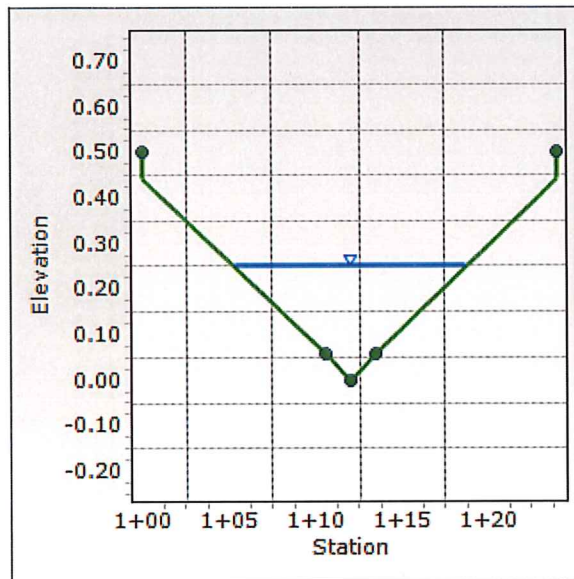
Cross Section for SECT B 24-FOOT DRIVE AISLE

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.56 %
Normal Depth	0.25 ft
Discharge	3.00 cfs



Worksheet for 100-YR SECTION C

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.67 %
Discharge	14 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+90.00	0.48
1+00.00	0.38
1+00.33	0.35
1+00.66	0.25
1+01.00	0.00
1+02.00	0.13
1+02.00	0.17
1+13.00	0.39
1+24.00	0.17
1+24.00	0.13
1+25.00	0.00
1+25.02	0.08
1+25.34	0.25
1+25.67	0.35
1+26.00	0.38
1+31.00	0.48

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+90.00, 0.48)	(1+02.00, 0.17)	0.013
(1+02.00, 0.17)	(1+13.00, 0.39)	0.016
(1+13.00, 0.39)	(1+24.00, 0.17)	0.016
(1+24.00, 0.17)	(1+31.00, 0.48)	0.013

Options	
Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Normal Depth	0.47 ft

Worksheet for 100-YR SECTION C

Results

Elevation Range	0.00 to 0.48 ft
Flow Area	5.9 ft ²
Wetted Perimeter	39.44 ft
Hydraulic Radius	0.15 ft
Top Width	39.12 ft
Normal Depth	0.47 ft
Critical Depth	0.48 ft
Critical Slope	0.58 %
Velocity	2.37 ft/s
Velocity Head	0.09 ft
Specific Energy	0.55 ft
Froude Number	1.073
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0.00

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.47 ft
Critical Depth	0.48 ft
Channel Slope	0.67 %
Critical Slope	0.58 %

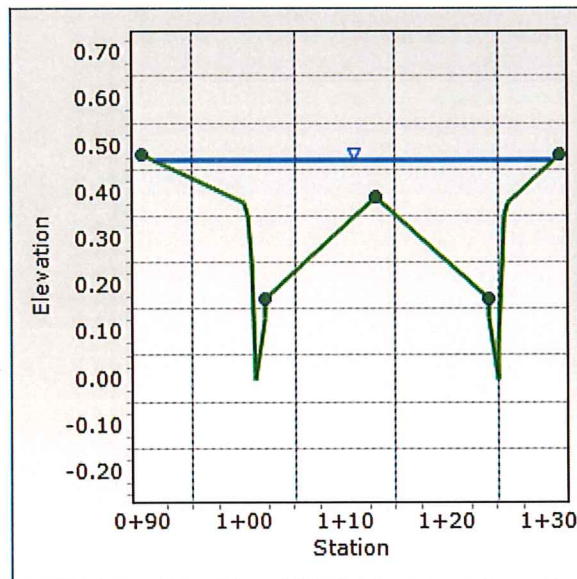
Cross Section for 100-YR SECTION C

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.67 %
Normal Depth	0.47 ft
Discharge	14 cfs



Worksheet for SECT D RIPRAP LINED SWALE

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	3.45 %
Discharge	1.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
1+00.00	0.50
1+01.50	0.00
1+03.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00.00, 0.50)	(1+03.00, 0.50)	0.030

Options	
Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Normal Depth	0.35 ft
Elevation Range	0.00 to 0.50 ft
Flow Area	0.36 ft ²
Wetted Perimeter	2.20 ft
Hydraulic Radius	0.16 ft
Top Width	2.08 ft
Normal Depth	0.35 ft
Critical Depth	0.37 ft
Critical Slope	2.47 %
Velocity	2.77 ft/s
Velocity Head	0.12 ft
Specific Energy	0.47 ft
Froude Number	1.171
Flow Type	Supercritical

GVF Input Data

Worksheet for SECT D RIPRAP LINED SWALE

GVF Input Data	
Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.35 ft
Critical Depth	0.37 ft
Channel Slope	3.45 %
Critical Slope	2.47 %

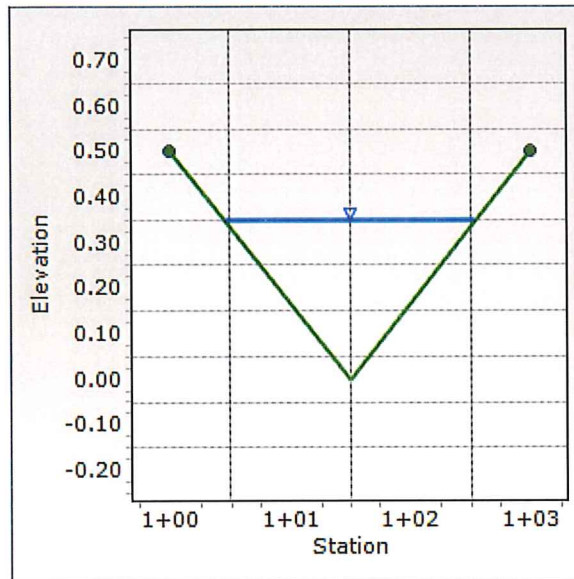
Cross Section for SECT D RIPRAP LINED SWALE

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	3.45 %
Normal Depth	0.35 ft
Discharge	1.00 cfs



Worksheet for 100-YR SECTION E

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.59 %
Discharge	8 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+95.25	0.75
1+24.00	0.17
1+24.00	0.13
1+25.00	0.00
1+25.02	0.08
1+25.34	0.25
1+25.67	0.35
1+26.00	0.38
1+26.00	0.60

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+95.25, 0.75)	(1+24.00, 0.17)	0.016
(1+24.00, 0.17)	(1+26.00, 0.60)	0.013

Options	
Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Normal Depth	0.49 ft
Elevation Range	0.00 to 0.75 ft
Flow Area	3.3 ft ²
Wetted Perimeter	18.37 ft
Hydraulic Radius	0.18 ft
Top Width	18.07 ft
Normal Depth	0.49 ft
Critical Depth	0.50 ft
Critical Slope	0.57 %
Velocity	2.46 ft/s

Worksheet for 100-YR SECTION E

Results	
Velocity Head	0.09 ft
Specific Energy	0.59 ft
Froude Number	1.020
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0.00
GVF Output Data	
Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.49 ft
Critical Depth	0.50 ft
Channel Slope	0.59 %
Critical Slope	0.57 %

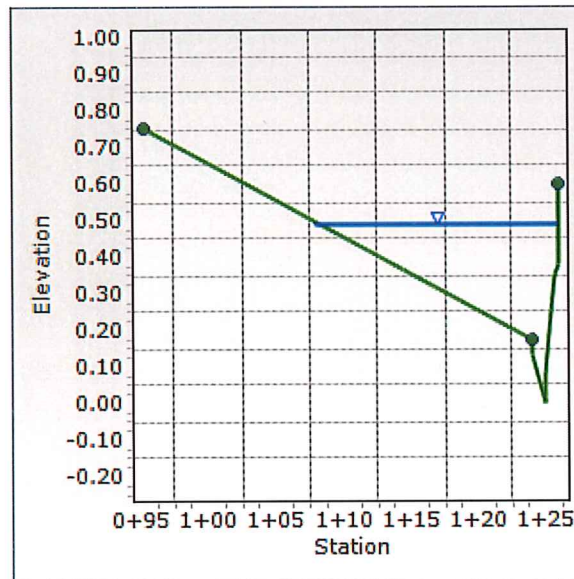
Cross Section for 100-YR SECTION E

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.59 %
Normal Depth	0.49 ft
Discharge	8 cfs



Worksheet for 100-YR SECTION F

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	1.27 %
Discharge	3 cfs

Section Definitions

Station (ft)	Elevation (ft)
1+00.00	0.38
1+00.33	0.35
1+00.66	0.25
1+01.00	0.00
1+02.00	0.13
1+02.00	0.17
1+13.00	0.39
1+24.00	0.17
1+24.00	0.13
1+25.00	0.00
1+25.02	0.08
1+25.34	0.25
1+25.67	0.35
1+26.00	0.38
1+31.00	0.48

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00.00, 0.38)	(1+13.00, 0.39)	0.016
(1+13.00, 0.39)	(1+24.00, 0.17)	0.016
(1+24.00, 0.17)	(1+31.00, 0.48)	0.013

Options	
Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Normal Depth	0.29 ft
Elevation Range	0.00 to 0.48 ft
Flow Area	1.3 ft ²

Worksheet for 100-YR SECTION F

Results

Wetted Perimeter	15.42 ft
Hydraulic Radius	0.08 ft
Top Width	15.12 ft
Normal Depth	0.29 ft
Critical Depth	0.32 ft
Critical Slope	0.63 %
Velocity	2.31 ft/s
Velocity Head	0.08 ft
Specific Energy	0.37 ft
Froude Number	1.387
Flow Type	Supercritical

GVF Input Data

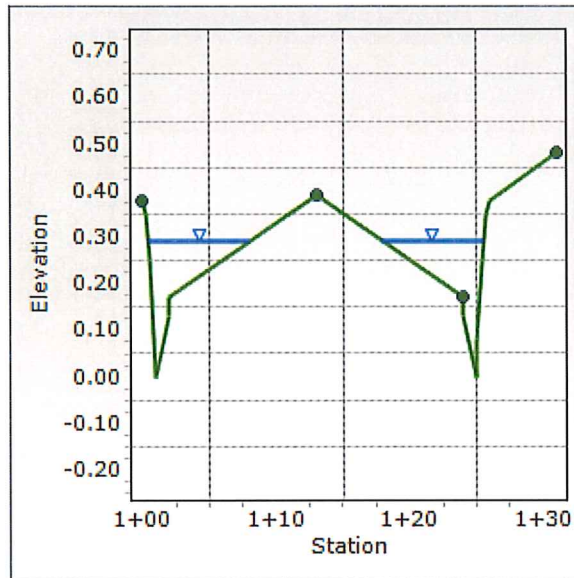
Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0.00

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.29 ft
Critical Depth	0.32 ft
Channel Slope	1.27 %
Critical Slope	0.63 %

Cross Section for 100-YR SECTION F

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	1.27 %
Normal Depth	0.29 ft
Discharge	3 cfs



Worksheet for 100-YR SECTION G

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.57 %
Discharge	4 cfs

Section Definitions

Station (ft)	Elevation (ft)
1+00.00	0.38
1+00.33	0.35
1+00.66	0.25
1+01.00	0.00
1+02.00	0.13
1+02.00	0.17
1+13.00	0.39
1+24.00	0.17
1+24.00	0.13
1+25.00	0.00
1+25.02	0.08
1+25.34	0.25
1+25.67	0.35
1+26.00	0.38

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00.00, 0.38)	(1+13.00, 0.39)	0.016
(1+13.00, 0.39)	(1+26.00, 0.38)	0.016

Options	
Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Normal Depth	0.35 ft
Elevation Range	0.00 to 0.39 ft
Flow Area	2.5 ft ²
Wetted Perimeter	22.26 ft
Hydraulic Radius	0.11 ft

Worksheet for 100-YR SECTION G

Results

Top Width	21.94 ft
Normal Depth	0.35 ft
Critical Depth	0.34 ft
Critical Slope	0.80 %
Velocity	1.62 ft/s
Velocity Head	0.04 ft
Specific Energy	0.40 ft
Froude Number	0.852
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0.00

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.35 ft
Critical Depth	0.34 ft
Channel Slope	0.57 %
Critical Slope	0.80 %

Messages

Messages	Flow is divided.
----------	------------------

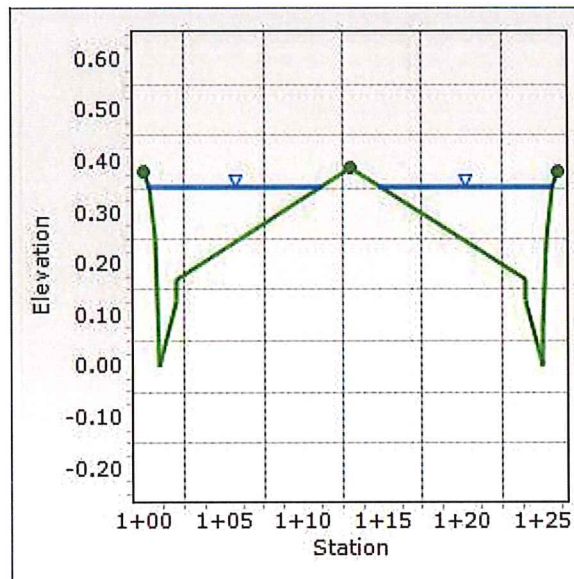
Cross Section for 100-YR SECTION G

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.57 %
Normal Depth	0.35 ft
Discharge	4 cfs



Worksheet for 100-YR SECTION H

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.50 %
Discharge	10 cfs

Section Definitions

Station (ft)	Elevation (ft)
1+00.00	0.38
1+00.33	0.35
1+00.66	0.25
1+01.00	0.00
1+02.00	0.13
1+02.00	0.17
1+13.00	0.39
1+24.00	0.17
1+24.00	0.13
1+25.00	0.00
1+25.02	0.08
1+25.34	0.25
1+25.67	0.35
1+26.00	0.38

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00.00, 0.38)	(1+13.00, 0.39)	0.016
(1+13.00, 0.39)	(1+26.00, 0.38)	0.016

Options	
Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Normal Depth	0.45 ft
Elevation Range	0.00 to 0.39 ft
Flow Area	4.8 ft ²
Wetted Perimeter	26.46 ft
Hydraulic Radius	0.18 ft

Worksheet for 100-YR SECTION H

Results

Top Width	26.00 ft
Normal Depth	0.45 ft
Critical Depth	0.43 ft
Critical Slope	0.69 %
Velocity	2.10 ft/s
Velocity Head	0.07 ft
Specific Energy	0.51 ft
Froude Number	0.863
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0.00

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.45 ft
Critical Depth	0.43 ft
Channel Slope	0.50 %
Critical Slope	0.69 %

Messages

Messages	Water Surface Elevation exceeds lowest end station by 0.070935454 8442542ft.
----------	---

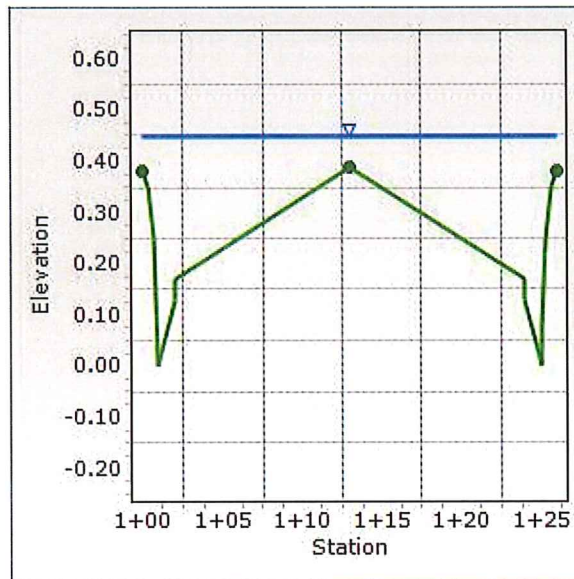
Cross Section for 100-YR SECTION H

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50 %
Normal Depth	0.45 ft
Discharge	10 cfs



Worksheet for SECT J-RIPRAP LINED SWALE

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.00 %
Discharge	28.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
1+00.00	1.50
1+06.00	0.00
1+12.00	1.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00.00, 1.50)	(1+12.00, 1.50)	0.035

Options

Current Roughness Weighted Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results

Normal Depth	1.45 ft
Elevation Range	0.00 to 1.50 ft
Flow Area	8.36 ft ²
Wetted Perimeter	11.92 ft
Hydraulic Radius	0.70 ft
Top Width	11.56 ft
Normal Depth	1.45 ft
Critical Depth	1.25 ft
Critical Slope	2.17 %
Velocity	3.35 ft/s
Velocity Head	0.17 ft
Specific Energy	1.62 ft
Froude Number	0.695
Flow Type	Subcritical

GVF Input Data

Worksheet for SECT J-RIPRAP LINED SWALE

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.45 ft
Critical Depth	1.25 ft
Channel Slope	1.00 %
Critical Slope	2.17 %

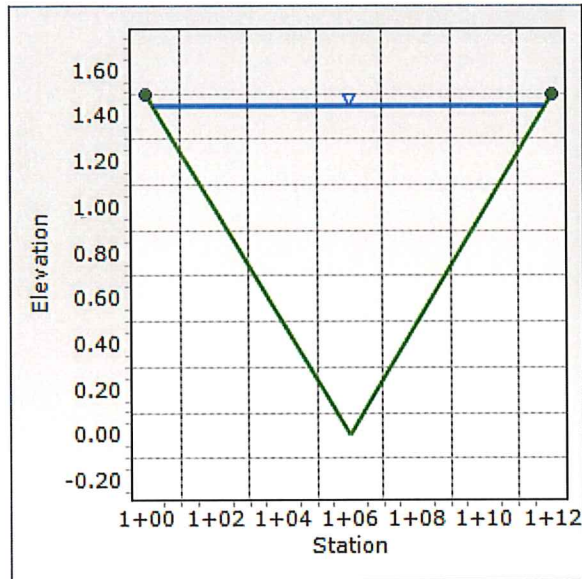
Cross Section for SECT J-RIPRAP LINED SWALE

Project Description

Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.00 %
Normal Depth	1.45 ft
Discharge	28.00 cfs



Storm Drain Hydraulics Calculations

18-INCH RCP

DATE: 10/19/20

[illegible]

Storm Drain Hydraulics Calculations

30-INCH RCP

DATE: 10/19/20

[illegible]

[illegible][illegible]

RANCHO MULTI-FAMILY AREA DRAIN CALCULATION

$Q = 28.0 \text{ cfs}$
 $A = (W)(D) = 36.00 \text{ ft}^2$
 $W = 72.0 \text{ in} \quad 6.0 \text{ ft}$
 $D = 72.0 \text{ in} \quad 6.0 \text{ ft}$
 $A' = A(1-0.33)(0.50)$
0.33 = 33% Reduction for steel
0.50 = 50% Clogging Factor
 $A' = 12.06 \text{ ft}^2$
 $L = 2W + 2D = 24.0 \text{ ft}$
 $* L' = W + 2D$
**Assume flow from 3 sides*
 $L' = 18.0 \text{ ft}$

<u>WEIR</u>	<u>ORIFICE</u>
$Q=CL'H^{1.5}$	$Q=CA'(2gH)^{0.5}$
C = 3	C = 0.65
H = 0.64	H = 0.20 ft

CONTROL = WEIR
 PONDING DEPTH = 0.6 ft

RANCHO MULTI-FAMILY AREA DRAIN CALCULATION

$Q =$	6.0 cfs	
$A = (W)(D)$	6.25 ft ²	
$W =$	30.0 in	2.5 ft
$D =$	30.0 in	2.5 ft
$A' = A(1-0.33)(0.50)$		
0.33 = 33% Reduction for steel		
0.50 = 50% Clogging Factor		
$A' =$	2.09 ft ²	
$L = 2W + 2D$	10.0 ft	
* $L' = W + 2D$		
*Assume flow from 3 sides		
$L' =$	7.5 ft	

<u>WEIR</u>	<u>ORIFICE</u>
$Q = CL'H^{1.5}$	$Q = CA'(2gH)^{0.5}$
$C =$ 3	$C =$ 0.65
$H =$ 0.41	$H =$ 0.30 ft

CONTROL = WEIR

PONDING DEPTH = 0.4 ft

DATE _____

CLIENT _____ JOB NO. _____ CALC. BY _____

DESCRIPTION _____ CHECKED BY _____

DLOADS

USE

Bedding Factor Other 1.9

Wall thickness B

Soil DENSITY 140

Live Load HS series 20

Soil Type 0.165 Sand & Gravel.

design data 7

american
Concrete
Pipe
association

CONCRETE PIPE SELECTION: Trench Installations

Trench conduits are usually installed in relatively narrow trenches excavated in undisturbed soil and backfilled to the original ground surface.

When a rigid conduit is installed in a narrow trench and backfilled, the backfill material will tend to settle. This downward movement generates frictional forces along the trench walls, which act upward to help support the weight of the backfill material. The magnitude of the frictional forces depends on the unit weight of the backfill material w , the value of Rankine's lateral pressure ratio K , and the coefficient of sliding friction μ' between the backfill material and the trench walls.

The backfill load on a conduit installed in a trench condition is equal to the weight of the mass of fill material within the trench less the summation of the frictional load transfers, and is expressed by the equation:

$$W_d = C_d w B_d z$$

where

W_d = backfill load, pounds per linear foot

C_d = load coefficient for trench condition

w = unit weight of backfill material, pounds per cubic foot

B_d = width of trench at the top of the conduit, feet

Figures 2 through 5, based on the above equation, enable a direct determination of backfill load for a given trench width and depth of cover. As the trench width increases for a given depth of cover and pipe diameter, a point is reached at which an embankment condition develops. The curves showing pipe size indicate the limiting trench width for each pipe diameter beyond which greater trench widths will not affect the load. When this condition occurs, the load on the conduit remains constant. This load should be determined by the intersection of the vertical line representing the depth of cover and the dashed line representing the particular pipe diameter under consideration. For intermediate pipe sizes not shown in Figures 2 through 5, interpolation should be used.

The field supporting strength of a concrete pipe line is dependent on the inherent strength of the pipe, the type of foundation on which the pipe is installed and the compaction of the sidefill material adjacent to the pipe. A common method used to determine the inherent strength of a pipe is the three-edge bearing test, in which the pipe is subjected to concentrated loads at the crown and invert. The load that a pipe will support under this condition of loading is called the *three-edge bearing strength* and is expressed in pounds per linear foot.

ASTM Specification C14 covers three strength classes for non-reinforced concrete pipe — Class 1, 2 and 3. These three classes are specified to meet ultimate loads, expressed in terms of minimum strength in three-edge-bearing as listed in Table I.

TABLE I: Strength Requirements Non-reinforced Concrete Pipe ASTM C14

Pipe Diameter, Inches	Minimum Three-Edge Bearing Strengths, Pounds per Linear Foot		
	Class 1	Class 2	Class 3
4	1500	2000	2400
6	1500	2000	2400
8	1500	2000	2400
10	1600	2000	2400
12	1800	2250	2600
15	2000	2600	2900
18	2200	3000	3300
21	2400	3300	3850
24	2600	3600	4400
27	2800	3950	4600
30	3000	4300	4750
33	3150	4400	4875
36	3300	4500	5000

Another means of expressing pipe strength is in terms of D-load. The D-load of a pipe is the supporting strength of a pipe loaded under three-edge-bearing test conditions expressed in pounds per linear foot per foot of inside diameter. Thus the bearing strength may be converted to D-load by dividing by the inside diameter in feet.

ASTM Specification C76 specifies five strength classes reinforced concrete pipe. These strength classes are expressed in terms of D-load at 0.01-inch crack and for ultimate load. The D-load to produce the 0.01-inch crack $D_{0.01}$ is the maximum load applied to the concrete pipe before a crack occurs having a width of 0.01-inch measured at close intervals, throughout a length of at least 1-foot. The D-load to produce ultimate load D_u is the maximum three-edge-bearing test load carried by a pipe, expressed as D-load. Table II lists 0.01-inch crack and ultimate D-loads for the strength classes covered by ASTM Specification C76.

TABLE II: Strength Requirements Reinforced Concrete Pipe ASTM C76

Strength Class	Minimum D-Load in Three-Edge Bearing Pounds per Linear Foot per Foot of Internal Diameter	
	0.01 Inch Crack- $D_{0.01}$	Ultimate- D_u
I	800	1200
II	1000	1500
III	1350	2000
IV	2000	3000
V	3000	3750

```

SSSSSSSSS  AAAAAAAAAA  MMM   MMM   MMM   MMM
SS          AA      AA   MM  M  M  MM   MM  M  M  MM
SSSSSSSSS  AAAAAAAAAA  MM   M   MM   MM   M   MM
          SS   AA      AA   MM      MM   MM      MM
SSSSSSSSS  AA        AA   MM      MM   MM      MM

```

P R O G R A M S A M M

AMERICAN CONCRETE PIPE ASSOCIATION
VERSION 2.0 - 1 SEPTEMBER 1990

Program SAMM computes earth loads on concrete pipe in accordance with the methods presented in the Concrete Pipe Design Manual (March 1990) and the Concrete Pipe Handbook (January 1988), published by the American Concrete Pipe Association. The user must select input values suitable to his specific installation. The information presented in the computer output is for review, interpretation, application and approval by a qualified engineer who must assume full responsibility for verifying that said output is appropriate and correct. There are no express or implied warranties. The use of this product does not constitute endorsement by ACPA or any other agents.

DATE: 10 / 22 / 2020

DESIGNER: R/R

PROGRAM SAMM
D-LOAD REQUIREMENTS FOR A 18 IN. DIAMETER CIRCULAR PIPE

P I P E D A T A

DIAMETER (in.)	18.00
WALL B, THICKNESS (in.)	2.500

I N S T A L L A T I O N C O N D I T I O N S

MINIMUM DEPTH OF FILL (ft.)	1.00
MAXIMUM DEPTH OF FILL (ft.)	20.00
SOIL DENSITY (lb/cu. ft.)	140.0
SPECIFIED BEDDING FACTOR	1.90
INSTALLATION TYPE	TRENCH
TRENCH WIDTH (ft.)	5.90
SOIL LATERAL PRESSURE/FRICTION TERM (KMU')	0.1650
PARAMETERS TO COMPUTE TRANSITION WIDTH	
POSITIVE PROJECTION RATIO	1.00
POSITIVE SETTLEMENT RATIO	0.50
SOIL LATERAL PRESSURE/FRICTION TERM (KMU)	0.1924
SOIL LATERAL PRESSURE COEFFICIENT	0.33

A D D I T I O N A L L O A D S

LIVE LOAD	AASHTO HS-20
NO SURCHARGE LOAD	

F A C T O R S O F S A F E T Y

FACTOR OF SAFETY ON 0.01 INCH CRACK D-LOAD (EARTH,LIVE)	1.00; 1.00
FACTOR OF SAFETY ON ULTIMATE LOAD (EARTH,LIVE) IN ACCORDANCE WITH ASTM C 76	
DL.01 LESS THAN 2000 LBS/FT/FT	1.5
DL.01 GREATER THAN 3000 LBS/FT/FT	1.25
DL.01 BETWEEN 2000 AND 3000 LBS/FT/FT	INTERPOLATED

R E S U L T S O F A N A L Y S I S

```

SSSSSSSSS  AAAAAAAAAA  MMM  MMM  MMM  MMM
SS          AA    AA    MM M M MM  MM M M MM
SSSSSSSSS  AAAAAAAAAA  MM  M  MM  MM  M  MM
          SS    AA    MM    MM  MM    MM
SSSSSSSSS  AA    AA    MM    MM  MM    MM

```

P R O G R A M S A M M

 AMERICAN CONCRETE PIPE ASSOCIATION
 VERSION 2.0 - 1 SEPTEMBER 1990

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PIPE DEPTH (ft.)	-----EARTH LOAD-----			LIVE	SURCH	TOTAL	BED	REQUIRED D-LOAD	
	ARCHING	>TRANS	LOAD	LOAD	LOAD	LOAD	FACT	0.01 in. ULT.	
	FACTOR		(lb/ft)	(lb/ft)	(lb/ft)	(lb/ft)		(lb/ft/ft)	
1.0	1.11	Y	297.	2603.	0.	2900.	1.90	1018.	1527.
1.5	1.17	Y	470.	1971.	0.	2440.	1.90	856.	1284.
2.0	1.23	Y	660.	1455.	0.	2115.	1.90	742.	1113.
2.5	1.30	Y	871.	1032.	0.	1903.	1.90	668.	1002.
3.0	1.37	Y	1104.	751.	0.	1855.	1.90	651.	976.
3.5	1.45	Y	1362.	616.	0.	1978.	1.90	694.	1041.
4.0	1.47	Y	1573.	516.	0.	2089.	1.90	733.	1100.
4.5	1.47	Y	1776.	439.	0.	2215.	1.90	777.	1166.
5.0	1.48	Y	1979.	378.	0.	2357.	1.90	827.	1241.
5.5	1.48	Y	2185.	329.	0.	2514.	1.90	882.	1323.
6.0	1.48	Y	2387.	290.	0.	2677.	1.90	939.	1409.
6.5	1.48	Y	2590.	257.	0.	2847.	1.90	999.	1498.
7.0	1.49	Y	2792.	229.	0.	3022.	1.90	1060.	1590.
7.5	1.49	Y	2995.	206.	0.	3201.	1.90	1123.	1685.
8.0	1.49	Y	3197.	186.	0.	3384.	1.90	1187.	1781.
8.5	1.49	Y	3400.	169.	0.	3569.	1.90	1252.	1879.
9.0	1.49	Y	3602.	155.	0.	3757.	1.90	1318.	1977.
9.5	1.49	Y	3805.	142.	0.	3947.	1.90	1385.	2077.
10.0	1.49	Y	4008.	130.	0.	4138.	1.90	1452.	2178.
10.5	1.49	Y	4210.	120.	0.	4330.	1.90	1519.	2279.
11.0	1.50	Y	4413.	111.	0.	4524.	1.90	1587.	2381.
11.5	1.50	Y	4616.	103.	0.	4719.	1.90	1656.	2484.
12.0	1.50	Y	4818.	96.	0.	4915.	1.90	1724.	2587.
12.5	1.49	Y	5014.	90.	0.	5103.	1.90	1791.	2686.
13.0	1.50	Y	5216.	84.	0.	5300.	1.90	1860.	2789.
13.5	1.50	Y	5418.	79.	0.	5497.	1.90	1929.	2893.

14.0	1.50	Y	5620.	74.	0.	5694.	1.90	1998.	2997.
14.5	1.50	Y	5823.	70.	0.	5892.	1.90	2067.	3066.
15.0	1.50	Y	6025.	66.	0.	6091.	1.90	2137.	3132.
15.5	1.50	Y	6227.	62.	0.	6289.	1.90	2207.	3196.
16.0	1.50	Y	6429.	59.	0.	6488.	1.90	2277.	3257.
16.5	1.50	Y	6632.	56.	0.	6687.	1.90	2346.	3316.
17.0	1.50	Y	6834.	53.	0.	6887.	1.90	2416.	3373.
17.5	1.50	Y	7036.	50.	0.	7087.	1.90	2487.	3427.
18.0	1.50	Y	7239.	48.	0.	7287.	1.90	2557.	3479.
18.5	1.50	Y	7441.	46.	0.	7487.	1.90	2627.	3529.
19.0	1.50	Y	7644.	43.	0.	7687.	1.90	2697.	3576.
19.5	1.50	Y	7846.	41.	0.	7887.	1.90	2768.	3620.
20.0	1.50	Y	8048.	40.	0.	8088.	1.90	2838.	3662.

PROGRAM SAMM

D-LOAD REQUIREMENTS FOR A 30 IN. DIAMETER CIRCULAR PIPE

 P I P E D A T A

DIAMETER (in.)	30.00
WALL B, THICKNESS (in.)	3.500

 I N S T A L L A T I O N C O N D I T I O N S

MINIMUM DEPTH OF FILL (ft.)	1.00
MAXIMUM DEPTH OF FILL (ft.)	20.00
SOIL DENSITY (lb/cu. ft.)	140.0
SPECIFIED BEDDING FACTOR	1.90
INSTALLATION TYPE	TRENCH
TRENCH WIDTH (ft.)	7.10
SOIL LATERAL PRESSURE/FRICTION TERM (KMU')	0.1650
PARAMETERS TO COMPUTE TRANSITION WIDTH	
POSITIVE PROJECTION RATIO	1.00
POSITIVE SETTLEMENT RATIO	0.50
SOIL LATERAL PRESSURE/FRICTION TERM (KMU)	0.1924
SOIL LATERAL PRESSURE COEFFICIENT	0.33

 A D D I T I O N A L L O A D S

LIVE LOAD	AASHTO HS-20
NO SURCHARGE LOAD	

 F A C T O R S O F S A F E T Y

FACTOR OF SAFETY ON 0.01 INCH CRACK D-LOAD (EARTH,LIVE)	1.00; 1.00
FACTOR OF SAFETY ON ULTIMATE LOAD (EARTH,LIVE) IN ACCORDANCE WITH ASTM C 76	
DL.01 LESS THAN 2000 LBS/FT/FT	1.5
DL.01 GREATER THAN 3000 LBS/FT/FT	1.25
DL.01 BETWEEN 2000 AND 3000 LBS/FT/FT	INTERPOLATED

RESULTS OF ANALYSIS

```

SSSSSSSSS  AAAAAAAAAA  MMM  MMM  MMM  MMM
SS          AA    AA    MM M M MM  MM M M MM
SSSSSSSSS  AAAAAAAAAA  MM  M  MM  MM  M  MM
          SS  AA    AA  MM    MM  MM    MM
SSSSSSSSS  AA    AA  MM    MM  MM    MM

```

PROGRAM SAMM

AMERICAN CONCRETE PIPE ASSOCIATION
VERSION 2.0 - 1 SEPTEMBER 1990

Program SAMM computes earth loads on concrete pipe in accordance with the methods presented in the Concrete Pipe Design Manual (March 1990) and the Concrete Pipe Handbook (January 1988), published by the American Concrete Pipe Association. The user must select input values suitable to his specific installation. The information presented in the computer output is for review, interpretation, application and approval by a qualified engineer who must assume full responsibility for verifying that said output is appropriate and correct. There are no express or implied warranties. The use of this product does not constitute endorsement by ACPA or any other agents.

PIPE DEPTH (ft.)	-----EARTH LOAD-----			LIVE LOAD (lb/ft)	SURCH LOAD (lb/ft)	TOTAL LOAD (lb/ft)	BED FACT	REQUIRED D-LOAD 0.01 in. ULT. (lb/ft/ft)	
	ARCHING FACTOR	>TRANS LOAD (lb/ft)	LOAD (lb/ft)						
1.0	1.07	Y	460.	2830.	0.	3290.	1.90	693.	1039.
1.5	1.10	Y	712.	2777.	0.	3489.	1.90	734.	1102.
2.0	1.14	Y	981.	2069.	0.	3050.	1.90	642.	963.
2.5	1.17	Y	1266.	1480.	0.	2746.	1.90	578.	867.
3.0	1.21	Y	1571.	1084.	0.	2655.	1.90	559.	838.
3.5	1.25	Y	1895.	896.	0.	2790.	1.90	587.	881.
4.0	1.30	Y	2239.	754.	0.	2993.	1.90	630.	945.
4.5	1.34	Y	2606.	644.	0.	3250.	1.90	684.	1026.
5.0	1.39	Y	2997.	558.	0.	3554.	1.90	748.	1122.
5.5	1.44	Y	3412.	488.	0.	3900.	1.90	821.	1232.
6.0	1.46	Y	3783.	431.	0.	4214.	1.90	887.	1331.
6.5	1.47	Y	4115.	383.	0.	4498.	1.90	947.	1420.
7.0	1.47	Y	4441.	343.	0.	4784.	1.90	1007.	1511.
7.5	1.47	Y	4767.	310.	0.	5077.	1.90	1069.	1603.
8.0	1.47	Y	5093.	281.	0.	5374.	1.90	1131.	1697.
8.5	1.48	Y	5427.	255.	0.	5682.	1.90	1196.	1794.
9.0	1.48	Y	5753.	234.	0.	5986.	1.90	1260.	1890.
9.5	1.48	Y	6079.	215.	0.	6293.	1.90	1325.	1987.
10.0	1.48	Y	6404.	198.	0.	6602.	1.90	1390.	2085.
10.5	1.48	Y	6730.	183.	0.	6913.	1.90	1455.	2183.
11.0	1.49	Y	7056.	170.	0.	7226.	1.90	1521.	2282.
11.5	1.49	Y	7382.	158.	0.	7540.	1.90	1587.	2381.
12.0	1.49	Y	7708.	147.	0.	7855.	1.90	1654.	2480.
12.5	1.49	Y	8034.	138.	0.	8171.	1.90	1720.	2580.
13.0	1.49	Y	8359.	129.	0.	8488.	1.90	1787.	2681.
13.5	1.49	Y	8685.	121.	0.	8806.	1.90	1854.	2781.

14.0	1.49	Y	7324.	94.	0.	7418.	1.90	1952.	2928.
14.5	1.50	Y	7588.	89.	0.	7677.	1.90	2020.	3020.
15.0	1.50	Y	7853.	84.	0.	7937.	1.90	2089.	3087.
15.5	1.50	Y	8117.	79.	0.	8196.	1.90	2157.	3151.
16.0	1.49	Y	8369.	75.	0.	8444.	1.90	2222.	3210.
16.5	1.49	Y	8633.	71.	0.	8704.	1.90	2291.	3269.
17.0	1.50	Y	8897.	68.	0.	8964.	1.90	2359.	3327.
17.5	1.50	Y	9160.	64.	0.	9225.	1.90	2428.	3382.
18.0	1.50	Y	9424.	61.	0.	9485.	1.90	2496.	3435.
18.5	1.50	Y	9688.	58.	0.	9746.	1.90	2565.	3485.
19.0	1.50	Y	9952.	56.	0.	10008.	1.90	2634.	3533.
19.5	1.50	Y	10216.	53.	0.	10269.	1.90	2702.	3579.
20.0	1.50	Y	10480.	51.	0.	10530.	1.90	2771.	3622.

APPENDIX C – REFERENCE MATERIALS

Atkins Engineering, Louis Berger, Clark County Regional Flood Control District -
The 2018 Las Vegas Valley Master Plan Update, December 2018.

PBS&J, City of Las Vegas Nevada Northwest Neighborhood Study

CVL Engineering Technical Drainage Study for Avion (Formerly Rancho Park) by
(Reference 3, hereinafter referred to as the Avion Study), August 2007.

City of Las Vegas Rancho Drive Drainage Improvements and Plans-Phase 2

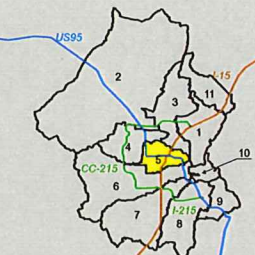


2018 Las Vegas Valley
Master Plan Update

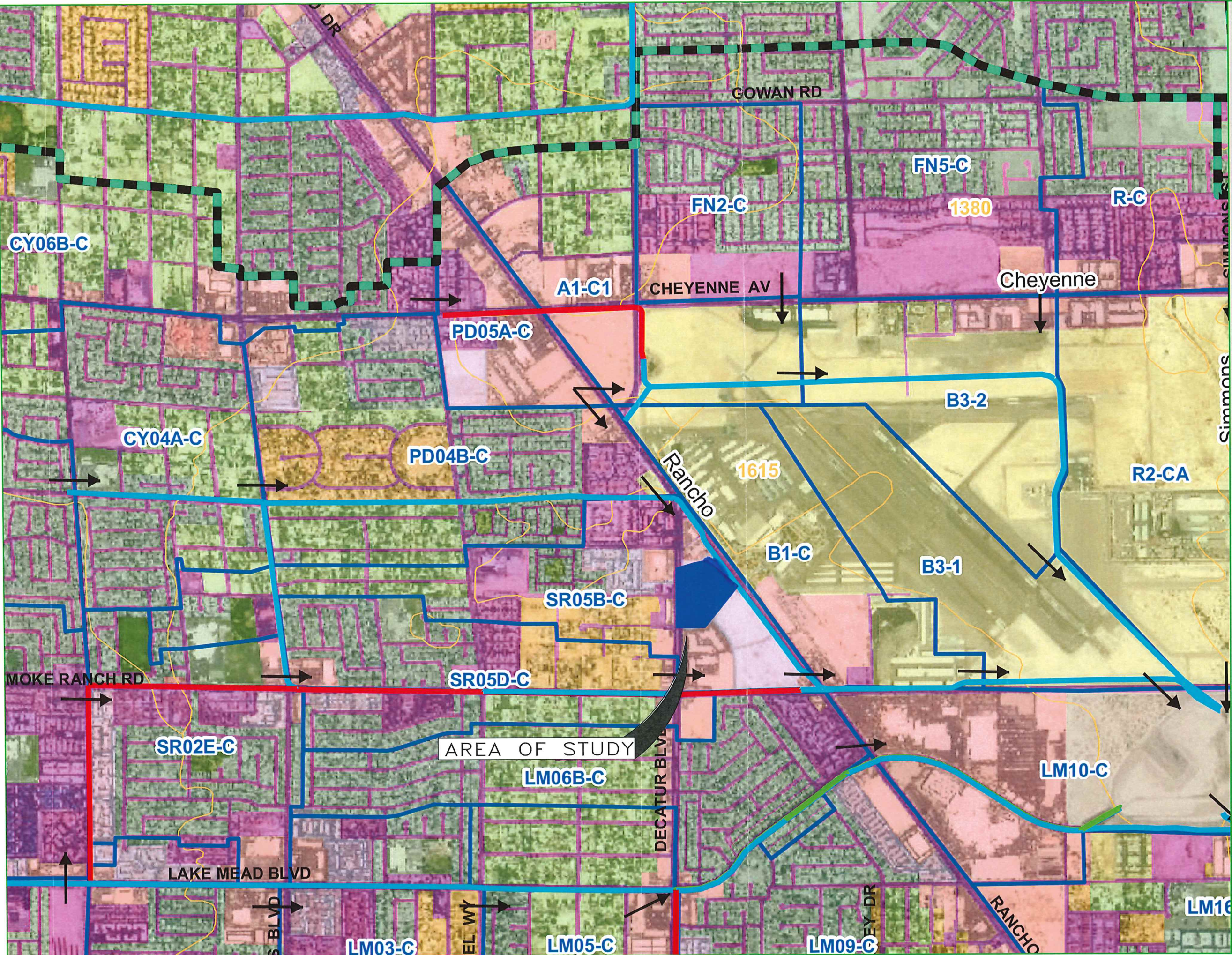
Figure W-5
Central Watershed

Legend

- Flow Arrows
- Concentration Points
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Ultimate Development Boundary
- Watershed
- Subbasins
- Soils
- 1: Undeveloped Land, Open desert
- 2: Parks, Golf Courses
- 3: Rural, 0.5-1 units per acre (uses 1 unit/acre)
- 4: Low-Density Residential, 1-2 units per acre (uses 2 units/acre)
- 5: Medium-Density Residential, 2-4 units per acre (uses 3 units/acre)
- 6: High-Density Residential, 4-8 units per acre (uses 6 units/acre)
- 7: Public Facility and Residential, 8-12 units/acre
- 8: Very High-Density Residential, 12 units/acre or more
- 9: Commercial, Retail, Casino, High Rise Condominiums
- 10: Light Industrial
- 11: Heavy Industrial
- 12: Schools
- 13: Lakes



- 1 Range
- 2 Upper Northern Las Vegas Wash
- 3 Lower Northern Las Vegas Wash
- 4 Gowan
- 5 Central
- 6 Flamingo/Tropicana
- 7 Duck Creek/Blue Diamond
- 8 Pittman
- 9 C-1
- 10 Lower Las Vegas Wash
- 11 Apex




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1*****
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* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 05SEP18 TIME 14:14:14
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*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
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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 -AMSK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

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

*** FREE ***

*DIAGRAM

```

1 ID CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT 2018 MASTER PLAN UPDATE
2 ID CENTRAL WATERSHED ( NORTHWESTERN PORTION)
3 ID RECOMMENDED DRAINAGE SYSTEM WITH ULTIMATE DEVELOPMENT
4 ID INPUT FILE = NW3.DAT
5 ID INPUT FILE DATE = SEP 2018
6 ID DESIGN STORM = 100-YEAR 6-HOUR STORM
7 ID STORM DISTRIBUTION = SDN3
8 ID MODELED BY ATKINS (MANOGYA KHANAL, P.E, CFM)
9 ID CHECKED BY ATKINS ( )
10 ID STORM CENTERING = ENTIRE WATERSHED
11 ID REFERENCED HYDROLOGIC MODELS:
12 ID CITY OF LAS VEGAS CITY WIDE HYDROLOGY ANALYSIS (PBS&J 1997)
13 ID RANCHO DRIVE DRAINAGE IMPROVEMENTS PEAK DRIVE TO LAKE MEAD BOULEVARD
14 ID (MONTGOMERY WATSON 2000)
15 ID US-95 WIDENING PROJECT, FINAL OVERALL PROJECT DRAINAGE DESIGN REPORT
16 ID (VTN NEVADA, MAY 2003)
17 ID VEGAS DRIVE IMPROVEMENTS PDR, SHADOW MOUNTAIN PLACE TO RANCHO DRIVE
18 ID (POGGEMEYER DESIGN GROUP, JULY 2007)
19 ID SIMMONS STREET IMPROVEMENT PROJECT, 70% DESIGN (VTN, FEB 2008)
20 ID WASHINGTON AVENUE STORM DRAIN, FINAL DESIGN REPORT (ATKINS 2013)
21 ID
22 ID AREA DARF
23 ID SQ.MI.
24 ID SDN 3 SDN 4 SDN 5
25 ID 0 - 0.5 0.99
26 ID 0.5 - 1 0.975
27 ID 1 - 2 0.95
28 ID 2 - 3 0.925
29 ID 3 - 4 0.915
30 ID 4 - 5 0.908
31 ID 5 - 6 0.903
32 ID 6 - 7 0.895
33 ID 7 - 8 0.885
34 ID 8 - 9 0.875
35 ID 9 - 10 0.865
36 ID 10 - 11 0.857
37 ID 11 - 12 0.85
38 ID 12 - 16 0.832
39 ID 16 - 20 0.804
40 ID 20 - 30 0.765
41 ID
42 IT 5 0 0 300
43 IO 5 0 0
44 IN 5 0 0
45 JR PREC 0.99 0.975 0.95 0.925 0.915 0.908 0.903 0.895 0.885
*
46 KK OG04-C
47 BA 0.288
48 PB 2.77
49 PC 0.000 0.020 0.057 0.070 0.087 0.108 0.124 0.130 0.130 0.130
50 PC 0.130 0.130 0.130 0.133 0.140 0.142 0.148 0.158 0.172 0.181
51 PC 0.190 0.197 0.199 0.200 0.201 0.204 0.214 0.229 0.241 0.249

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1

HEC-1 INPUT

PAGE 2

286	.	CPD04B-C.....	.
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290	CCPD04BC.....		
	V		
	V		
294	RCPD04B		
	.		
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	.	V	
	.	V	
305		ROG03-C	
	.		
309	.		OG02-C
	.		V
	.		V
314	.		ROG02-C
	.		
320	.		
	.		LM01-C
	.		.
325	.		CLM01-C.....
	.		V
	.		V
329	.		RCLM01-C
	.		
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	.	V	
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	.	V	
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	.	V	
	.	V	
378		RCSR05D	
	.		
384			SR05B-C
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	.		
393	CCSR05B.....		
	V		
	V		
397	RCCSR05B		
	.		
403		B1-C	
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408	CB1-C.....		
	V		
	V		
412	RCB1-C		
	.		
418		A1-C1	
	.		
425			<----- DA1-C
423			DA1-C
	.		V
	.		V
426			RDA1-C
	.		.
432		CA1-C.....	

2 COMBINED AT													
+	CCY04A-C	.83	1	FLOW TIME	762. 3.92	747. 3.92	723. 3.92	700. 3.92	690. 3.92	683. 3.92	678. 3.92	670. 3.92	661. 3.92
ROUTED TO													
+	RCCY04A	.83	1	FLOW TIME	753. 4.00	740. 4.00	716. 4.00	693. 4.00	684. 4.00	676. 4.00	672. 4.00	664. 4.00	654. 4.00
HYDROGRAPH AT													
+	PD04B-C	.47	1	FLOW TIME	385. 4.00	378. 4.00	365. 4.00	352. 4.00	347. 4.00	343. 4.00	340. 4.00	336. 4.00	331. 4.00
2 COMBINED AT													
+	CPD04B-C	1.30	1	FLOW TIME	1139. 4.00	1117. 4.00	1081. 4.00	1045. 4.00	1030. 4.00	1019. 4.00	1013. 4.00	1001. 4.00	985. 4.00
2 COMBINED AT													
+	CCPD04BC	3.87	1	FLOW TIME	1655. 4.08	1616. 4.08	1538. 4.08	1466. 4.08	1438. 4.08	1422. 4.08	1404. 4.08	1377. 4.08	1349. 4.08
ROUTED TO													
+	RCPD04B	3.87	1	FLOW TIME	1639. 4.08	1598. 4.08	1521. 4.08	1449. 4.08	1420. 4.08	1404. 4.08	1388. 4.08	1362. 4.08	1332. 4.08
HYDROGRAPH AT													
+	OG03-C	.32	1	FLOW TIME	254. 3.83	248. 3.83	237. 3.83	227. 3.83	223. 3.83	220. 3.83	218. 3.83	215. 3.83	211. 3.83
ROUTED TO													
+	ROG03-C	.32	1	FLOW TIME	253. 3.92	247. 3.92	236. 3.92	226. 3.92	222. 3.92	219. 4.00	217. 4.00	214. 4.00	210. 4.00
HYDROGRAPH AT													
+	OG02-C	.32	1	FLOW TIME	350. 3.75	343. 3.75	332. 3.75	321. 3.75	316. 3.75	313. 3.75	311. 3.75	307. 3.75	303. 3.75
ROUTED TO													
+	ROG02-C	.32	1	FLOW TIME	345. 3.83	340. 3.83	327. 3.83	318. 3.83	313. 3.83	309. 3.83	307. 3.83	303. 3.83	300. 3.83
HYDROGRAPH AT													
+	LM01-C	.33	1	FLOW TIME	231. 3.83	225. 3.83	216. 3.83	206. 3.83	202. 3.83	199. 3.83	197. 3.83	194. 3.83	190. 3.83
2 COMBINED AT													
+	CLM01-C	.64	1	FLOW TIME	577. 3.83	565. 3.83	543. 3.83	523. 3.83	515. 3.83	508. 3.83	504. 3.83	497. 3.83	490. 3.83
ROUTED TO													
+	RCLM01-C	.64	1	FLOW TIME	570. 3.83	558. 3.83	536. 3.83	516. 3.83	509. 3.83	502. 3.83	498. 3.83	491. 3.83	483. 3.83
HYDROGRAPH AT													
+	SR00A-C	.37	1	FLOW TIME	265. 3.92	259. 3.92	248. 3.92	237. 3.92	233. 3.92	230. 3.92	228. 3.92	225. 3.92	221. 3.92
2 COMBINED AT													
+	CSR00A	1.01	1	FLOW TIME	831. 3.83	813. 3.83	781. 3.83	750. 3.83	738. 3.83	728. 3.83	722. 3.83	712. 3.83	699. 3.83
2 COMBINED AT													
+	CCSR00A	1.34	1	FLOW TIME	1076. 3.92	1053. 3.92	1010. 3.92	971. 3.92	954. 3.92	942. 3.92	934. 3.92	922. 3.92	906. 3.92
ROUTED TO													
+	RCSR00A	1.34	1	FLOW TIME	1072. 3.92	1048. 3.92	1005. 3.92	966. 3.92	949. 3.92	938. 3.92	929. 3.92	916. 3.92	901. 3.92
HYDROGRAPH AT													
+	SR02E-C	.30	1	FLOW TIME	271. 3.83	265. 3.83	255. 3.83	245. 3.83	241. 3.83	238. 3.83	236. 3.83	233. 3.83	229. 3.83
2 COMBINED AT													
+	CSR02E	1.64	1	FLOW TIME	1326. 3.92	1297. 3.92	1245. 3.92	1196. 3.92	1175. 3.92	1162. 3.92	1151. 3.92	1135. 3.92	1116. 3.92
ROUTED TO													
+	RCSR02E	1.64	1	FLOW TIME	1324. 3.92	1293. 3.92	1238. 3.92	1194. 3.92	1170. 3.92	1156. 3.92	1143. 3.92	1132. 3.92	1109. 3.92
HYDROGRAPH AT													
+	SR05D-C	.30	1	FLOW TIME	260. 4.00	255. 4.00	247. 4.00	238. 4.00	235. 4.00	233. 4.00	231. 4.00	228. 4.00	225. 4.00
2 COMBINED AT													
+	CSR05D	1.94	1	FLOW TIME	1583. 3.92	1547. 3.92	1483. 3.92	1432. 3.92	1404. 3.92	1387. 3.92	1373. 3.92	1359. 3.92	1333. 3.92
ROUTED TO													
+	RCSR05D	1.94	1	FLOW TIME	1571. 3.92	1534. 3.92	1470. 3.92	1418. 3.92	1391. 3.92	1374. 3.92	1360. 3.92	1347. 3.92	1320. 3.92
HYDROGRAPH AT													
+	SR05B-C	.36	1	FLOW	278.	273.	264.	255.	251.	249.	247.	244.	241.

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1383E+04 EXCESS= .0000E+00 OUTFLOW= .1382E+04 BASIN STORAGE= .1562E+01 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCW1C2 MANE 1.74 5313.46 243.29 1.32 5.00 5305.77 245.00 1.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1367E+04 EXCESS= .0000E+00 OUTFLOW= .1367E+04 BASIN STORAGE= .1560E+01 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCW1C2 MANE 1.74 5275.56 242.18 1.31 5.00 5259.10 245.00 1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1356E+04 EXCESS= .0000E+00 OUTFLOW= .1355E+04 BASIN STORAGE= .1558E+01 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCW1C2 MANE 1.75 5210.92 243.24 1.29 5.00 5204.94 245.00 1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1338E+04 EXCESS= .0000E+00 OUTFLOW= .1337E+04 BASIN STORAGE= .1555E+01 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCW1C2 MANE 1.76 5135.18 242.67 1.27 5.00 5117.86 245.00 1.27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1315E+04 EXCESS= .0000E+00 OUTFLOW= .1315E+04 BASIN STORAGE= .1550E+01 PERCENT ERROR= -.1

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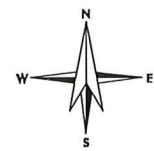
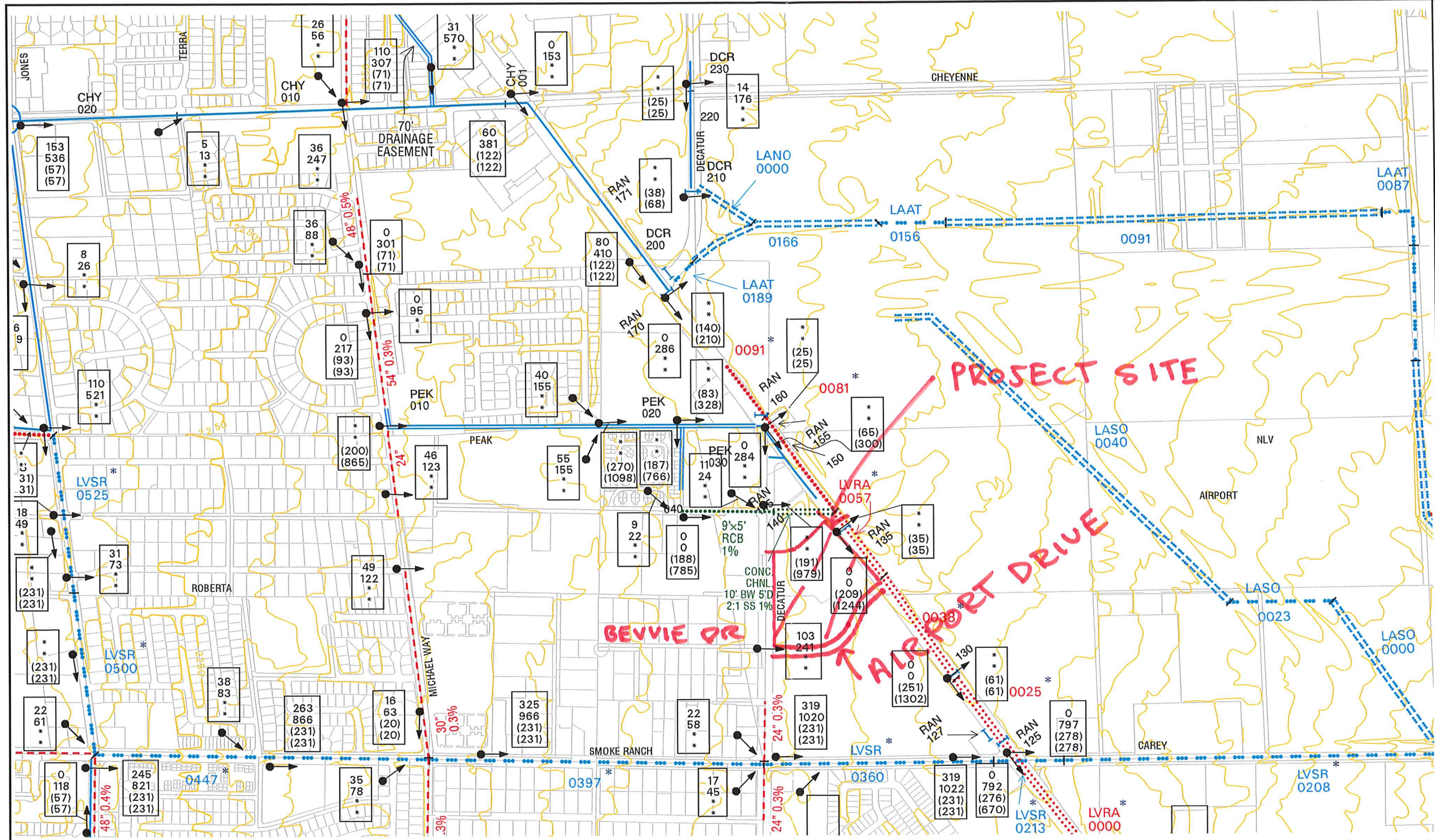


NORTHWEST NEIGHBORHOOD STUDY

LEGEND

- EXISTING REGIONAL DETENTION BASINS
- PROPOSED REGIONAL DETENTION BASINS
- EXISTING LOCAL DETENTION BASINS
- EXISTING REGIONAL BRIDGES
- PROPOSED REGIONAL BRIDGES
- EXISTING LOCAL BRIDGES
- EXISTING REGIONAL CULVERT
- PROPOSED REGIONAL CULVERT
- EXISTING LOCAL CULVERT
- EXISTING REGIONAL PIPELINE
- PROPOSED REGIONAL PIPELINE
- EXISTING LOCAL PIPELINE
- PROPOSED LOCAL PIPELINE
- EXISTING REGIONAL CHANNEL
- PROPOSED REGIONAL CHANNEL
- EXISTING LOCAL CHANNEL
- PROPOSED REGIONAL PIPELINE (Not Included In 1995 MPU)
- PROPOSED REGIONAL CHANNEL (Not Included In 1995 MPU)
- EXISTING REGIONAL DIKE/LEVEE
- PROPOSED REGIONAL DIKE/LEVEE
- EXISTING LOCAL DIKE/LEVEE
- EXISTING STORM WATER PUMPING STATION
- PROPOSED BELTWAY ALIGNMENT

FIGURE F-16



SCALE: 1 INCH = 800 FEET

FLOW ARROW

250	10-YEAR STREET FLOW
500	100-YEAR STREET FLOW
(300)	10-YEAR FACILITY FLOW
(800)	100-YEAR FACILITY FLOW

(FLOWS IN CFS)

NOTE:

Ultimate drainage conditions are based on future CN values with all flood control facilities in place

* See Chapter 7 of Volume I for additional proposed facilities in this area.

HUALPAIN	FT. APACHE	DURANGO	BUFFALO	RANBOW	JONES	DECATUR	ELKHORN
1	2	3					CENTENNIAL
4	5	6					ANN
7	8	9					LOVE MOUNTAIN
10	11	12					ALEXANDER
						13	14
						15	16
						17	18

FUTURE DRAINAGE CONDITIONS



POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING PLANNING SURVEYING GIS
901, N. Green Valley Pkwy, Ste 100, Henderson NV 89014
Phone: (702) 263-7275 Fax: (702) 263-7200

DS4038
400

M-18

7/10/06

CCRFCD

NDOT

CNLU

Zone A

**Technical Drainage Study
For
Avion
(Formerly Rancho Park)
CVL Project No. 05-9032-02**

Rec'd 10/15/07
DS 4038
M-18
\$100

**TECHNICAL DRAINAGE
STUDY UPDATE**

**FOR
Avenue One
(Formally Known As AVION)**

**CITY OF LAS VEGAS, NEVADA
DS4038**

PREPARED FOR:

**PAGEENTRY DEVELOPMENT COMPANY
2300 N. BUFFALO DRIVE, SUITE 220
LAS VEGAS, NEVADA 89128**

PREPARED BY:

**CVL Consultants, Inc.
6280 S. Valley View Blvd., Suite 200
Las Vegas, Nevada 89118**

**CVL Reference Number 09-12-0172802
October, 2007
CLV DS4038**

REGIONAL FLOOD CONTROL DISTRICT



SEP 4 2007

Gale Wm. Fraser, II, P.E.
General Manager/Chief
Engineer

BOARD OF DIRECTORS

Larry Brown
Chairman
City of Las Vegas

Chip Maxfield
Vice-Chairman
Clark County

David Bennett
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City of Las Vegas

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City of Henderson

Mayor Roger Tobler
City of Boulder City

Bruce L. Woodbury
Clark County

August 29, 2007

Mr. Randy Fultz, P.E.
City of Las Vegas Public Works
731 S. 4th Street
Las Vegas, NV 89101

DISTRICT COMMENTS:

AVENUE ONE (A.K.A. AVION-UNIT 1)
(DS4038) (RFCD No. 07-7329)

Dear Mr. Fultz:

Clark County Regional Flood Control District (District) reviewed Technical Drainage Study dated June 25, 2006, Addendum No. 1 dated April 5, 2007, Addendum No. 2 dated May 8, 2007 for above-mentioned project as submitted by CVL CONSULTANTS, INC. In addition, District is in receipt of the Conditional Letter of Acceptance from City of Las Vegas Public Works dated June 4, 2007.

District has the following comment:

- Sheet DT2, Section Y: Revise the detail to dowels connecting to the existing structure.

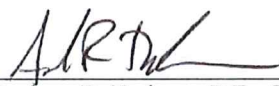
District's review of this project was limited to issues of Regional Flood Control Significance as defined in *Uniform Regulations for the Control of Drainage*.

The consultant must be advised to submit any revisions to the Technical Drainage Study and Improvement Plans to City of Las Vegas Public Works for review/re-approval. District review of any such revisions will commence upon City of Las Vegas Public Works' acceptance.

Please be aware that as additional information becomes available and/or restudies of Flood Insurance Studies are performed, information submitted by CVL CONSULTANTS, INC may be superseded. Compliance with regulatory elements and design standards specified in *Uniform Regulations for the Control of Drainage* does not imply a guarantee that properties will be free from flooding or flood damage. The District, its officials, or employees assume no liability for information, data, or conclusions presented by consulting engineers. We, therefore, make no warranties, either expressed or implied, in conducting this review.

GALE WM. FRASER, II, P.E.
General Manager/Chief Engineer

BY: 
Abigail Mayrena, P.E.
Associate Engineer


Andrew R. Trelease, P.E., CFM
Principal Civil Engineer

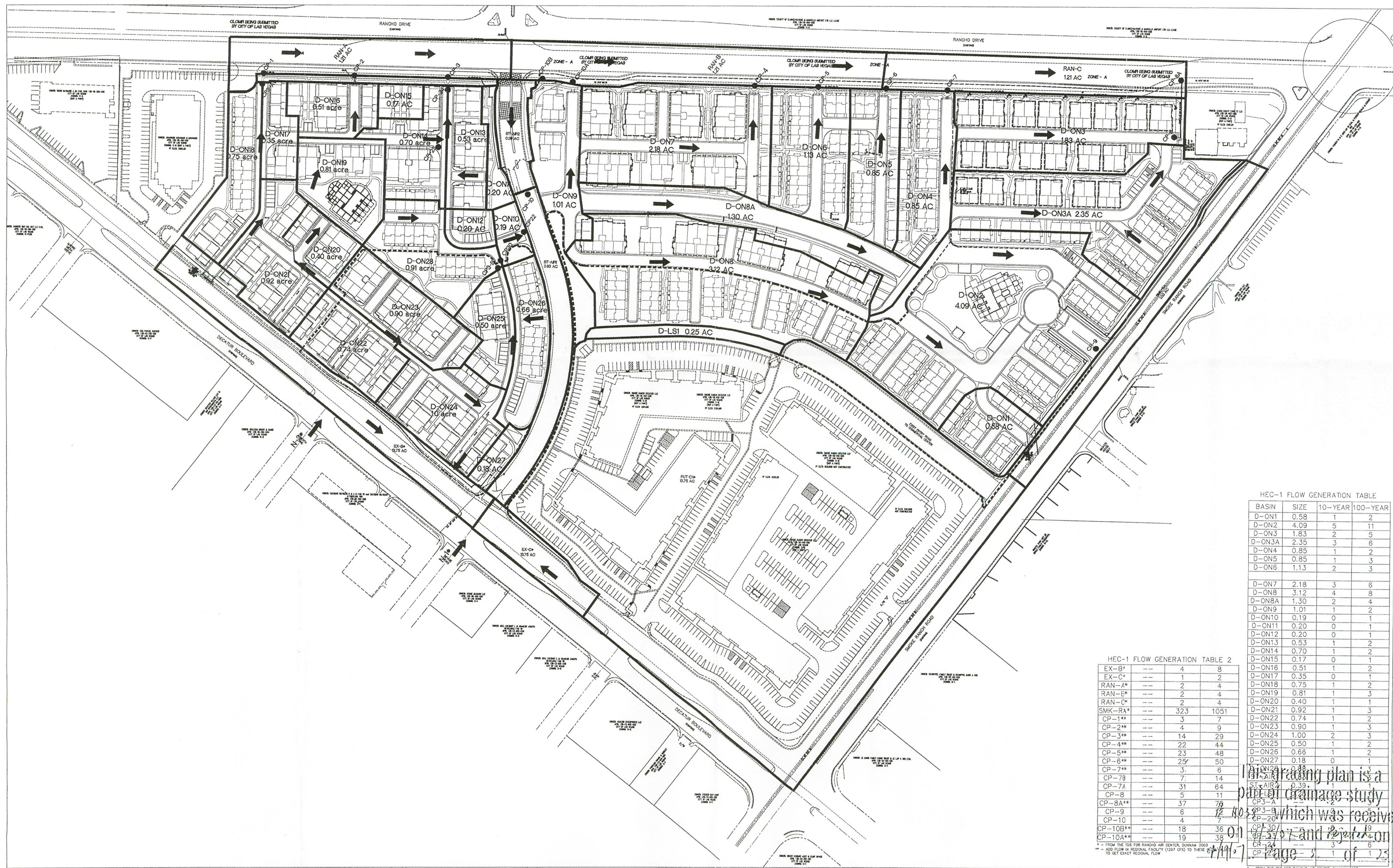
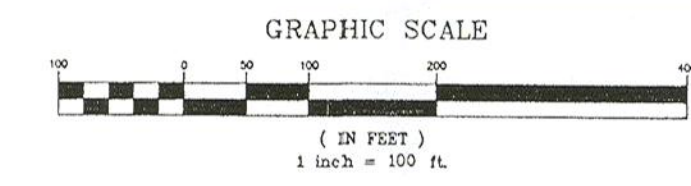
AM:ART:ph

c: Geoffrey G. Purse, P.E., CVL CONSULTANTS, INC.
P:\Letters and Memos\Local Drainage\Land Development & Drainage\Comment Letters\2007\Aug07\20-61-18.CLV.doc

Call before
you Dig
1-800-227-2600

Call before
you Overhead
1-702-227-2929

LOCATION	ROW (Ft)	FLOW Q10/Q100 (CFS)	DEPTH D10/D100 (Ft)	VELOCITY V10/V100 (Ft/S)	V x D Q10/Q100	10-Year Dry Lane Met
RANCHO RAN-A	125'	2/4	0.32/0.38	1.80/2.23	0.58/0.85	YES
RANCHO RAN-B	125'	4/8	0.38/0.47	2.23/2.68	0.85/1.26	YES
RANCHO RAN-C	125'	6/8	0.43/0.55	2.56/2.63	1.10/1.45	YES
SMK-RA RAN-B	105'	323/1051	1.20/1.86	5.17/8.21	6.2/15.3	NO
AIRPORT RD CP-10	60'	101/223	0.87/1.18	3.63/4.93	3.2/5.82	NA



BASIN	SIZE	10-YEAR	100-YEAR
D-ON1	0.58	1	2
D-ON2	4.09	5	11
D-ON3	1.83	2	5
D-ON3A	2.35	3	6
D-ON4	0.85	1	2
D-ON5	0.85	1	3
D-ON6	1.13	2	3

EX-B*	---	4	8
EX-C*	---	1	2
RAN-A*	---	2	4
RAN-D*	---	2	4
RAN-C*	---	2	4
SMK-RA*	---	323	1051
CP-1**	---	5	7
CP-2**	---	4	9
CP-3**	---	14	29
CP-4**	---	22	44
CP-5**	---	23	48
CP-6**	---	25	50
CP-7**	---	3	6
CP-78	---	7	14
CP-74	---	31	64
CP-8	---	5	11
CP-8A**	---	37	76
CP-9	---	6	12
CP-10	---	4	7
CP-10B**	---	18	36
CP-10A**	---	19	38

* - FROM THE TGS FOR RANDO AN CENTER, DUNSM 2003
 ** - ADD FLOW TO REGIONAL FACILITY (1297 QRS) TO BE 6.63 CFS REGIONAL FLOW

This training plan is a
part of drainage study
which was received
on 10/17/2017 and rejected on
10/17/2017. Page 2 of 25

AVION
DEVELOPED CONDITION
BASIN MAP
FIGURE 9

280 S. Valley View Blvd
Suite 200
Las Vegas, NV 89118
Tel: (702) 368-3008
Fax: (702) 368-0047



CFL
CONSULTANTS, INC.
ENGINEERING • PLANNING • LAND SURVEYING

SHEET

1 OF 1

AGENCY DWQ NO.

