

DS #:

4921

APN:

162-08-418-002

PROJECT:

Aren 15

SUBMITTAL:

1st

SCANNED BY/DATE:

CHECKED BY/DATE:



CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		October 17, 2017
TO: Land Development Services Department of Building & Safety		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	COPIES TO:
	Area 15	Kimley Horn and Associates, Inc.
Cross Streets:	SWC of Rancho drive & Sirius Avenue	Integral Partners Park Center Las Vegas, LLC
File Number:	F:\Depot\DSMemos\DS4921A.doc	Bart Anderson, P.E., DevCo
Parcel Number:	162-08-418-002	CCRFCFCD
Zoning Action:	SDR-70652	NDOT
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES	NO X

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1 st Submittal	9/27/2017 & 10/12/2017	10/17/2017	See Comments Below	\$400.00	490252: \$400
TOTAL FEES (LDDRS):				\$400.00	----

REMARKS:

The Drainage Study for the subject project has been reviewed and:

	is approved subject to conformance to all City standards and the following conditions:
X	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

1. Provide a copy of the zoning/planning conditions associated with this site (**SDR-70652**) with the next submittal to verify compliance with conditions. *Flood Control* will not issue conditional approval of the drainage study without the associated zoning/planning conditions (issued by the *City Council*). Any associated conditions of approval that revise the site drainage parameters will require that the drainage study be revised and resubmitted.
2. The site is adjacent to an existing or proposed *Clark County Regional Flood Control District* (CCRFCFCD) master planned facility. Therefore, CCRFCFCD concurrence is required prior to final approval of the drainage study.
3. The project proposes to construct facilities and/or increase flows within *Nevada Department of Transportation* (NDOT) right-of-way (the existing channel between *Rancho Road* and I-15). The engineer must contact NDOT for encroachment permit or concurrence for the proposed project.
4. **Existing Conditions Exhibit:** Basin 05, Basin 15 and Basin PS07A are developed areas. In Las Vegas valley, Q_{100} is generally at least 2cfs/acre. But all the basins in the **Exhibit** show as low as 1.5 cfs/acre which is unreasonable. Review and revise the hydrology and the Q_{10}/Q_{100} parameters table accordingly.

5. **Existing Conditions Exhibit:** In the "Existing Condition" Table, "CPPS07A" is shown to have $Q_{10}/Q_{100} = 480/1683$ cfs. However, in the map at the intersection of *Rancho Drive* and *Desert Inn Road* shows a huge discrepancy of $Q_{10}/Q_{100} = 210/1413$ cfs. Review and revise the **Exhibit** and all pertinent hydraulic sections and calculations accordingly in the next submittal.
6. The above comment applies to the **Onsite Proposed Conditions Exhibit** also.
7. The *Haestad Methods* hydraulic calculations presented in the last submittal for all cross sections at *Rancho Drive* did not include the adjacent channel as an integral part of the overall picture. Provide existing and proposed conditions at three locations, the north end, the middle and the south end of the building at *Rancho Drive* with complete cross section starting at the building wall, parking stalls, landscape area, *Rancho Drive*, the existing channel and the adjacent freeway. Justify that the adjacent freeway I-15 will not be negatively impacted.

Show and label the BFE at the three locations on the **Onsite Proposed Conditions Exhibit**.
8. The anticipated 100-year storm event will inundate into the proposed development beyond the right-of-way lines in all three perimeter streets. Delineate the 100-year flood inundation limit on the *Overall Grading Plan* and all the enlarged grading plan sheets.

Obtain a notarized letter of acceptance from the property owner acknowledging the potential inundation into the subject site for future repair and maintenance after each major storm event. The letter must be filed with **City Flood Control Section** prior to the final approval of the drainage study.
9. Provide *Warning Sign Post* for the parking lots within the inundation limit on the grading plans.
10. Per the **Existing Conditions Exhibit**, a $Q_{100} = 46$ cfs impacts at the southwest corner of the proposed building. It appears that the flow will split into north and east directions around the building. Provide section calculation to prove that the proposed FFE is adequate.
11. The 100-year flow depths and flow velocities in the perimeter streets (*Desert Inn Road*, *Rancho Drive* and *Sirius Avenue*) are above the top of curb and beyond the sidewalk and erosive to the proposed landscape zones. Provide adequate erosion protection measures such as riprap in the landscape areas. Provide riprap sizing calculations in the next submittal.
12. **Sheet C3.3:** A site visit by the City staff revealed that the open channel exists throughout the whole frontage of the project site along *Rancho Drive*. However, the contour lines as shown on the sheet and all other pertinent plans show that the channel is buried for some distance south of *Sirius Avenue*. Review and revise accordingly.
13. Provide the Recorded Document Number for the existing public drainage easements on the grading plans and include future MPU facilities.
14. For all onsite swales, flow depth calculations need to be provided to adequately analyze finished floor elevation requirements. The onsite hydraulic flow calculations are not provided in this study, only the adjacent street flows.
15. Along *Rancho Drive* the cross sections provide a flow of 1413 cfs at cross section H-H, it then increases to 1562 cfs at cross section B-B, and finally decreases to 1355 cfs at cross section C-C. Per **Existing Conditions Exhibit**, the flow should transition from 1413 cfs, collect the flow from CP15, and basin 25 and increase to 1462 at cross section B-B. Finally, it should collect from basins 20 and 30 to increase to 1482 at cross section C-C. Per the hydrology, please clarify the flow values provided at sections H-H, B-B, and C-C.
16. Please review the existing and proposed hydrology. If existing and proposed conditions are both paved surfaces, then the existing and proposed basins should have similar values. For example, basin 10 in the existing and proposed condition should have similar flow values.

17. In the report, Table 1 provides Q_{10} , Q_{25} , and Q_{100} flows. For basins 05 and 15 the amount of flow provided for Q_{25} is less than Q_{10} . Please check calculations to confirm that this is the case.
18. The T_c calculations for the Q_{25} values provided in table 1 are not provided in Appendix B, please provide the corresponding standard form 4 for Q_{25} .
19. The flowrates provided in Table 1 of the report do not match the flowrates provided in the **Existing Conditions Exhibit**. For example, in the table Basin 05 is shown to have a Q_{10} of 20 cfs in the report, but 18 cfs on the exhibit, please revise.
20. In the BMP design, per *Detail A/C5.0*, it is not clear whether a band of 6"-wide riprap is proposed around the A-curb or not. Clarify in the next submittal.

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the *Nevada Division of Environmental Protection* a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see <http://ndep.nv.gov/bwpc/storm01.htm> or call (775) 687-9429.

END OF REMARKS

T/R/S: T21S/R61E/S08
AREA R-08

Technical Drainage Study

Area 15

Prepared for:

Integral Partners Park
Center Las Vegas, LLC

299 Park Avenue
New York, NY 10171

Prepared by:

Kimley-Horn and Associates, Inc.

6671 Las Vegas Boulevard South
Suite 320
Las Vegas, NV 89119



Technical Drainage Study

Area 15

Prepared for:
Integral Partners
Park Center Las
Vegas, LLC
299 Park Avenue
New York, NY 10171

Prepared by:
Kimley-Horn and Associates, Inc.
6671 Las Vegas Boulevard South
Suite 320
Las Vegas, NV 89119

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September 2017
KHA Project #092965000

This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc. shall be without liability to Kimley-Horn and Associates, Inc.

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: _____ Date: _____

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

East/West: _____

b) Section: _____ Township: _____ Range: _____

c) APN : _____

Name of Owner: _____

Telephone No.: _____ Fax No.: _____ E-Mail Address: _____

Address: _____

Contact Person-Name: _____ Telephone No.: _____

* E-Mail Address: _____ Fax No.: _____

Firm: _____

Address: _____

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: _____ Being Developed/Disturbed: _____

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.): _____

5. Approximate upstream land area which drains to the subject site: _____

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: _____

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

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

Engineer's Seal

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL																										
DRAINAGE SUBMITTAL CHECKLIST																										
Project Name:	Map ID:																									
Firm Name:	Engineer:																									
Address:																										
City:	State:	Zip:																								
Phone Number:	Fax Number:																									
Property Owner:																										
Address:																										
City:	State:	Zip:																								
Reviewed By:	Date Received:	Date Accepted for Review:																								
The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study to submit to the local entity and Clark County Regional Flood Control District (if necessary). The listed items are the minimum information required prior to the entity performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (MANUAL). This document is intended as an aid in preparing Technical Drainage Studies. Each study submitted is reviewed for compliance with local and regional criteria. This form is not intended to be all inclusive and does not limit the extent of the information, calculations or exhibits which may be necessary to properly evaluate the intended land use. If items are not applicable for the subject site, provide N/A. I. GENERAL REQUIREMENT <table style="width: 100%;"> <tr> <td style="width: 10%; text-align: center;">Yes</td> <td style="width: 10%; text-align: center;">No</td> <td></td> </tr> <tr> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>Design Manual Standard Form 1 with the engineer's seal and signature.</td> </tr> <tr> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>Design Manual Standard Form 4.</td> </tr> <tr> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>2 copies of the 24" x 36" Drainage Plan.</td> </tr> <tr> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.</td> </tr> </table> II. MAPS AND EXHIBITS <table style="width: 100%;"> <tr> <td style="width: 10%; text-align: center;">Yes</td> <td style="width: 10%; text-align: center;">No</td> <td></td> </tr> <tr> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.</td> </tr> <tr> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.</td> </tr> </table>			Yes	No		_____	_____	Design Manual Standard Form 1 with the engineer's seal and signature.	_____	_____	Design Manual Standard Form 4 .	_____	_____	2 copies of the 24" x 36" Drainage Plan.	_____	_____	A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.	Yes	No		_____	_____	A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.	_____	_____	A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.
Yes	No																									
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REFERENCE:		STANDARD FORM 2																								

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

Yes No

- | | | |
|-------|-------|--|
| _____ | _____ | Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs. |
| _____ | _____ | On-site drainage basin maps for existing and proposed conditions showing the existing topography, basin boundaries, concentration points, and on-site and off-site flows in cfs. |
| _____ | _____ | Vicinity Map with local and major cross streets identified and a north arrow. |

III. DRAINAGE PLAN

Yes No

- | | | |
|-------|-------|---|
| _____ | _____ | Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada. |
| _____ | _____ | Minimum scale: 1" = 60'. |
| _____ | _____ | Project name. |
| _____ | _____ | Vicinity Map with local and major cross streets. |
| _____ | _____ | Revision box. |
| _____ | _____ | North arrow and bar scale. |
| _____ | _____ | Engineer's/consultant's address and phone number. |
| _____ | _____ | Elevation datum and benchmark. |
| _____ | _____ | Legend for symbols and abbreviations. |
| _____ | _____ | Cut/fill scarps, where applicable. |
| _____ | _____ | Street names, grades, widths. |
| _____ | _____ | Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street. |
| _____ | _____ | Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate. |
| _____ | _____ | Minimum finish floor elevations with top-of-curb elevations at upstream end of lot. |
| _____ | _____ | Proposed typical street sections. |

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes No

- | | | |
|--------------------------|--------------------------|---|
| ☐ | ☐ | Streets with off-set crowns. |
| ☐ | ☐ | Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes. |
| ☐ | ☐ | Property lines. |
| ☐ | ☐ | Right-of-way lines and widths, existing and proposed. |
| ☐ | ☐ | Existing improvements and their elevations. |
| ☐ | ☐ | Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points. |
| ☐ | ☐ | Concentration points and drainage flow direction with Q_{100} and V_{100} and D_{100} in streets. |
| ☐ | ☐ | Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows. |
| ☐ | ☐ | Location and cross-section of street capacity calculations. |
| ☐ | ☐ | Cross-sectional detail for channels, including cutoff wall locations. |
| ☐ | ☐ | Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations. |
| ☐ | ☐ | Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement. |
| ☐ | ☐ | Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs. |
| ☐ | ☐ | Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc. |
| ☐ | ☐ | Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit. |
| ☐ | ☐ | Building and/or lot numbers. |
| ☐ | ☐ | Alignment of all existing, proposed, or future Regional Facilities adjacent to the site. |
| ☐ | ☐ | Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information. |

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes No

- | | | |
|-------|-------|--|
| _____ | _____ | For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table. Finish floor elevations must be a minimum of 18 inches above BFE. |
| _____ | _____ | Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q_{100} flows. |
| _____ | _____ | Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent. |
| _____ | _____ | Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required). |

IV. HYDROLOGIC ANALYSIS

Yes No

- | | | |
|-------|-------|--|
| _____ | _____ | Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated. |
| _____ | _____ | Input and output information for existing conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models. |
| _____ | _____ | Input and output information for future conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models. |
| _____ | _____ | Use of correct precipitation values in and around the McCarran Airport rainfall area. |
| _____ | _____ | A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations. |
| _____ | _____ | A summary table of stormwater flows showing basin area, Q_{10} and Q_{100} for both individual basins and combined basin flows, where applicable. |
| _____ | _____ | Copies of supporting technical information referenced from a previously approved study and a statement accepting these results. |
| _____ | _____ | On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law. |
| _____ | _____ | Calculation for impervious area for parking lots and LIDs (if required). |

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes No

- | | | |
|-------|-------|---|
| _____ | _____ | Flow split calculations and supporting documentation or reference for the method of flow split calculations used. |
| _____ | _____ | Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q ₁₀₀ and Q ₁₀ flows representing the worst case for interior and all perimeter streets. Q ₁₀₀ d x v ≤ 8. Q ₁₀ d x v ≤ 6 and 12 foot dry lane for rights-of-way ≥ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan. |
| _____ | _____ | A summary table of interior and exterior street capacity calculations showing the street name, Q ₁₀₀ flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria. |
| _____ | _____ | Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.) |
| _____ | _____ | Appropriate hydraulic calculations at drainage easement entrance and discharge locations to set finish floor elevations. Hydraulic calculations must include submerged weir, superelevation and tee intersection losses, where appropriate. |
| _____ | _____ | Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the Q ₁₀₀ weir height or flow depth, whichever is greater. |
| _____ | _____ | A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. <ul style="list-style-type: none"> • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report. |
| _____ | _____ | Provide a 50 percent clogging factor in the capacity calculation for drop inlets. |
| _____ | _____ | Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public rights-of-way, including headwater pool inundation. |
| _____ | _____ | The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed. |
| _____ | _____ | Provide BMP type, size and supporting calculations for parking lots and LIDs (if required). |

REFERENCE:

STANDARD FORM 2



CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

The following checklist is intended as a supplemental guide for the engineer preparing a Technical Drainage Study submittal to the City of Las Vegas. This supplement focuses on requirements specific to the City of Las Vegas. The requirements presented are in addition to the Clark County Regional Flood Control District (CCRFCD) Manual Standard Form 2. The listed items are the minimum information required prior to the City performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the CCRFCD Hydrologic Criteria and Drainage Design Manual (Design Manual).

An appointment must be made to preview this checklist in conjunction with CCRFCD Standard Form 2 prior to the City accepting a new drainage study for review. The engineer must contact the Flood Control Section at (702) 229-6541 to schedule a submittal appointment.

If items are not applicable for the subject site, provide N/A.

I. GENERAL REQUIREMENT		
Yes	No	
	N/A	A notarized letter from the adjacent property owner(s) allowing off-site grading. (A copy of the letter must be received prior to final acceptance of the drainage study.)
	N/A	Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.
✓		An electronic copy of the complete submittal is required to be submitted with one original hard copy of the study. Electronic documents should be on a universal computer-readable digital output device replicating your submittal. An Indexed Portable Document Format (PDF) or Print Ready CAD file formats with a minimum of 300dpi are the desired formats. If figures are in color, they must be scanned in color and saved as a separate file. _____ by initial here, the engineer on record acknowledges that the electronic copy is an identical replicate of the original hard copy submitted to the City of Las Vegas.

II. GRADING PLAN INFORMATION		
Yes	No	
✓		(1) 24" X 36" copy of the Grading Plan, (including all Detail Sheets) sealed by the engineer.
✓		Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street. Note: Proposed top of curb elevations must be provided for both sides of roadways even if only half street construction is required.
✓		Label existing topography at a minimum 5 foot elevation interval including adjacent developments, finished floor elevations of existing buildings and top of existing curbs extending 100 feet around the perimeter of the site. (*Measured from the centerline of the adjacent roadway.)

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

II. GRADING PLAN INFORMATION		
Yes	No	
	N/A	Proposed on-site and off-site storm drains and other flood control facilities with plan and profile sheets for public storm drains showing the class of pipe, (Class III, IV, V, etc.), design hydraulic grade line, (HGL) and 100 year storm flow. A public drainage easement must be provided over on-site storm drains conveying off-site flows. An overflow path must be provided over all storm drains.
	N/A	All existing and "to be constructed" walls with cross-sections showing wall type, (e.g. block wall, retaining wall, flood wall, etc.), with limits clearly defined, adjacent ground elevations. Wall heights must meet current ordinances and in no case exceed 14 feet above the adjacent property.
✓		Street slopes for both interior and perimeter streets. Note: The minimum slope for a roadway is 0.4 percent, a minimum 18-inch storm drain must be provided where minimum slopes cannot be met.
✓		Back of lot elevations and lot drainage pattern for all lots including common lots.
	N/A	Sites with a grade difference two feet above or below existing ground are required to have approval from City of Las Vegas Current Planning. Current Planning approval is required prior to final approval of the drainage study.
✓		On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners. (The project must pass flows through the site every 600 feet where the project is blocking flow paths.)
	N/A	This project uses a solid grouted stem wall (or approved alternate) at the back of sidewalk to provide erosion protection for landscaped areas where the depth of flow in the roadway exceeds the back of walk elevation. A corresponding cross-section detail is included.
✓		Commercial and Common Lot Landscape areas are not allowed to drain over the sidewalk. The grading plans show flow lines with grades and sidewalk under drains for all landscape areas draining to the public ROW.

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
	N/A	Concrete valley gutters are required in parking lots with slopes less than 1 percent. Slopes through cul-de-sac must be at a 1 percent minimum where flow is drained through the cul-de-sac.
	N/A	Ten-foot wide public drainage easements to be privately maintained are allowed for flow less than 20 cfs. The depth of flow entering the easement must be checked using the submerged weir calculation.
✓		The limits of the flood zones and the base flood elevations (BFE) must be shown on all grading plans for all developments within a Special Flood Hazard Zone A, AO, AE, etc.
✓		Minimum finish floor elevation is 6 inches above highest adjacent top of curb. Finish floor calculations must include allowances for super elevations on curves and velocity head for tee intersections.
✓		Finished floor elevations for buildings adjacent to public drainage easements must be a minimum of 18 inches above the Q100 weir of submerged weir elevation, whichever is greater.

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
	N/A	Lots with "B and C Type Drainage" that drain from one lot to another through a drainage easement shall be required to install an underground nuisance drainage system or a 2-foot valley gutter. 16" x 24" minimum block wall openings are required for both options.
	N/A	Bubblers are required across 80 foot and greater ROW streets. When flows exceed 10 cfs, bubblers larger than 18 inches will be required up to a maximum of 36". Inlets must be sized to match the pipe size provided.

- Contact the Flood Control Section regarding the drainage study review fee. These fees are payable at the time of submittal.
- The Drainage Study must be conditionally approved prior to submitting improvement plans to the Civil and Planning Development of the Department of Building and Safety for review.

This document is intended as an **aid** in preparing Technical Drainage Studies for the City of Las Vegas. Each study submitted is reviewed for compliance with local and regional criteria. This form is not intended to be all-inclusive and does not limit the extent of the information, calculations or exhibits which may be necessary to properly evaluate the intended land use.

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APPENDICES

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Appendix D	Grading Plans (under separate cover)

1 GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

1.1 Location of Property

The proposed Area 15 site is located on the southwest corner of Rancho Drive and Sirius Avenue in Clark County, Nevada. See **Figure 1** for a project location map. The site is located within Section 8, Township 21 South, Range 61 East, M.D.M., Clark County. See **Appendix A** for a copy of the Assessor's Parcels Map with the site location.

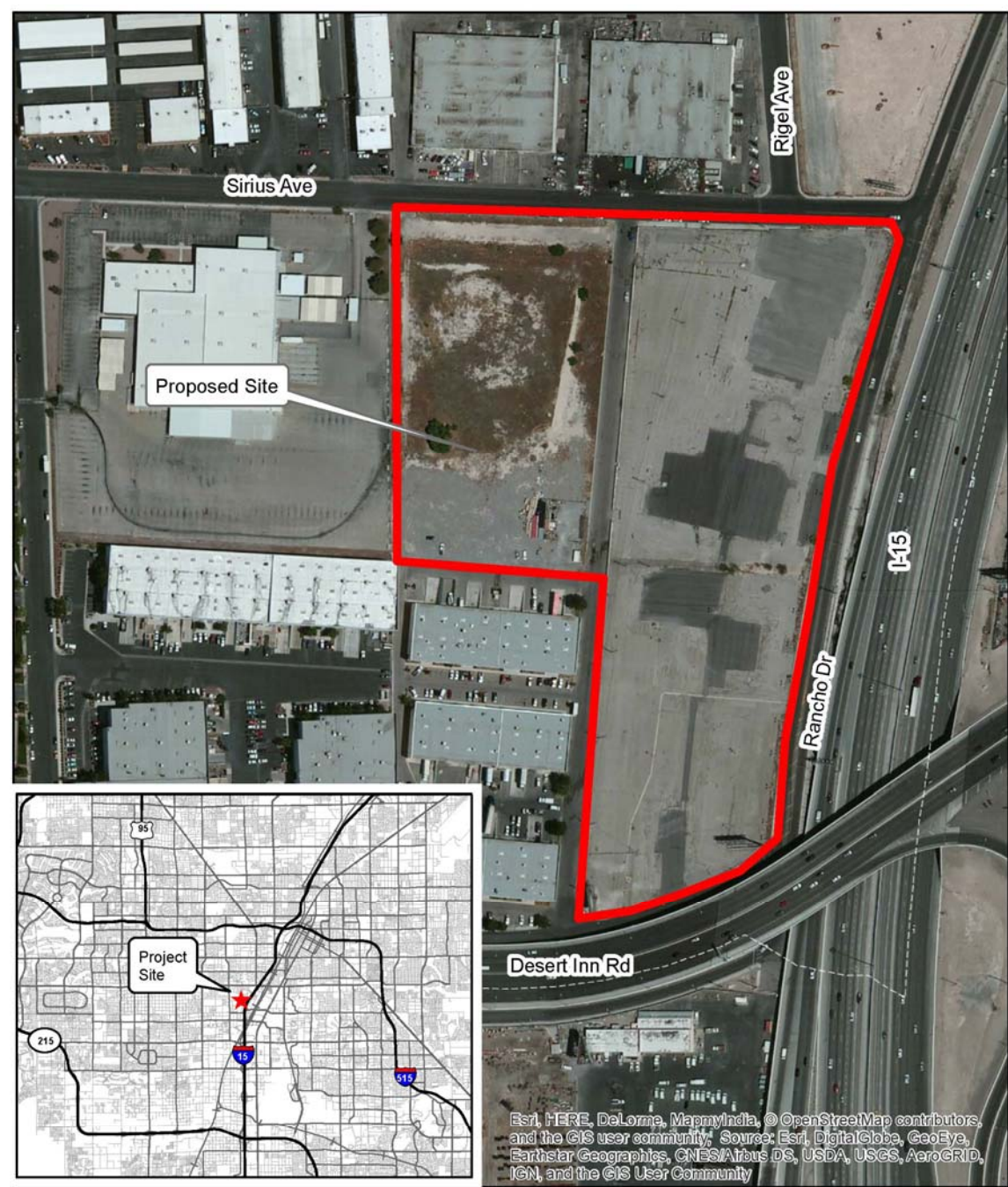
1.2 Description of Property

Site topography generally slopes from the southwest to the northeast. The Area 15 site is bounded by Sirius Avenue to the north, Rancho Drive to the east, Desert Inn Road and commercial developments to the south, and commercial properties that border Polaris Avenue to the west. Currently, the majority of the site is a paved abandoned parking lot, and an unpaved abandoned lot. The site is zoned for commercial, retail, casino and high rise condominiums.

1.2.1 General Project Description and Proposed Land Use

The proposed project is a mixed-use venue that will include retail, entertainment, small food venues, and surface parking wrapping around the south, east, and west sides of the site.

Figure 1. Location Map



	Area 15	City of Las Vegas Nevada
	Figure 1: Location Map	

2 DRAINAGE BASIN DESCRIPTION

2.1 Offsite Drainage Description

Historic patterns for offsite drainage are generally from west to east from Valley View Boulevard to Rancho Drive. Offsite flow reaching the northwest side of the site is intercepted by a concrete-lined rectangular channel with a width of 10 feet and a depth of two feet. The channel discharges flow onto Sirius Avenue where it is then conveyed in the street to the channel adjacent to Interstate 15. Minor offsite flow southwest of the site is conveyed north through the site in the unnamed road between Rancho Drive and Polaris Avenue. Runoff from major storm events will overtop the unnamed road and proceed east across the site, into Rancho Drive and ultimately into the channel adjacent to Interstate 15. Refer to the Existing Conditions Drainage Map provided in **Appendix A**.

Existing hydrology is based on the Central Neighborhood Flood Control Master Plan for the City of Las Vegas, dated March 2005 (Master Plan). Existing offsite and onsite flows were prorated from the Master Plan results. If a portion of the Master Plan drainage area drains to the site, the runoff amount was prorated. Flow splits were determined using roadway cross section calculations and regional facility data shown in the Master Plan. A summary of existing flow conditions is provided in **Table 1**. Relevant pages from the Master Plan and existing hydrology calculations are shown in **Appendix B**. Roadway street section calculations are shown in **Appendix C**.

Table 1. Prorated Peak Flow Rates

Basin / Concentration Point	Area [sq mi]	Q ₁₀ [cfs]	Q ₂₅ [cfs]	Q ₁₀₀ [cfs]
05	0.03	20	18	31
10	0.01	4	4	7
15	0.05	30	27	46
20	0.01	9	9	15
25	0.00	2	2	3
30	0.00	3	3	5
PS07A	0.03	21	23	37

2.2 Onsite Drainage Description

2.2.1 Historic On-site Drainage Patterns and Discharge Points

The site was previously developed as a car dealership and is currently a vacant paved parking lot zoned for commercial development, with driveways on Rancho Drive, Sirius Avenue, and Desert Inn Road. The Master Plan, Figure E-19, shows that historical flows approach the site primarily from the west. Runoff flows overland from the west through light industrial development towards the site. Small roads and alleyways disperse flows to Sirius Avenue and Desert Inn Road. During the 100-year storm event approximately

1,081 cfs and 617 cfs is conveyed in the roadway adjacent to the site on Sirius Avenue and Desert Inn Road, respectively. At the southeast corner of the site approximately 1,683 cfs is conveyed in Rancho Drive and the adjacent concrete channel. The majority of the flow that approaches the site ultimately outfalls to the existing concrete channel between Rancho Drive and Interstate 15. Downstream of the site, at the intersection of Rancho Drive and Sirius Avenue, there is approximately 2,538 cfs conveyed in the street and channel during the 100-year storm event. See **Appendix A** for the Existing Conditions Drainage Map. Copies of relevant pages from the referenced Master Plan are provided in **Appendix B**.

2.3 Master Planning Information

2.3.1 Currently Adopted Master Plan

The site is within the City of Las Vegas Central Neighborhood Flood Control Master Plan studied area. Figure E-19 shows the existing drainage conditions and offsite flows.

2.3.2 Proposed Master Plan Flood Control Facilities

Figure F-19 of the Master Plan lists two Regional Facilities adjacent to Sirius Avenue and Interstate 15. The facility along Interstate 15 is the proposed FW15 0301 channel adjacent to the interstate. The Master Plan indicates this facility will be a 12-foot-wide by four-foot-deep concrete channel with side slopes of 2:1 conveying 435 cfs in the 100-year event. The proposed facility in Sirius Avenue is FWPS 0000 and will be a 12-foot by 11-foot reinforced concrete box conveying 2,399 cfs in the 100-year event. Both figures E-19 and F-19 are provided in **Appendix A**.

The facilities map F-31 from the Clark County Regional Flood Control District 2015 Master Plan is provided in **Appendix A**. The map shows proposed Regional Facilities, FW15 0301 and FWPS 0000 as also shown in the City Master Plan.

2.4 Floodplain Information

The Federal Emergency Management Agency (FEMA) panel number 32003C2170F, effective November 16, 2011, indicates that the site is located within an unmapped area defined as "Other Areas." See **Appendix A** for a copy of the Flood Insurance Rate Map (FIRM) with the site location indicated.

2.5 Previous Drainage Reports

No previous design report was used in the preparation of this study. The CCRFCD Master Plan was used for existing hydrology.

3 PROPOSED DRAINAGE FACILITIES

3.1 General Description

The proposed project is a commercial development with surface parking wrapping around the south, east, and west sides of a proposed structure which will be located northeastern third of the site. Surface runoff will sheet-flow off the site into Sirius Avenue, Rancho Drive and Desert Inn Road. The runoff under proposed conditions will not vary from existing

conditions for the site because the east side of the site is paved in existing conditions. Historical drainage patterns will not be altered by the development. No proposed storm drain facilities are included in the design. A Proposed Conditions Drainage Map is provided in **Appendix A**.

3.2 Compliance with Regulations and Adopted Plans

3.2.1 Master Planned Flood Control Facilities

The proposed project is in compliance with the 2005 Central Neighborhood Flood Control Master Plan and the 2015 CCRFCD Master Plan Update.

3.2.2 FEMA Floodplain Regulations

The project site is located outside of the 100-year floodplain.

3.2.3 CCRFCD Manual

All calculations are based on generally accepted engineering practices in accordance with the CCRFCD Hydrologic Criteria and Drainage Design Manual and the requirements of the City of Las Vegas.

3.3 Hydrologic Analyses

The proposed conditions hydrology was calculated using the Modified Rational Method and McCarran Airport rainfall data. Runoff calculations for proposed conditions and an exhibit showing the site's location as within the McCarran Airport area are both in **Appendix B**. The methodology used in this study is based on generally accepted engineering practices in accordance with CCRFCD Drainage Design Manual.

3.3.1 Rainfall Calculations

The site is located within the McCarran Airport area. Rainfall intensities were determined from Figure 517 in the CCRFCD Manual. Times of concentration were determined using methodology for the Modified Rational Method. See **Appendix B** for calculations.

3.3.2 Peak Flow Rates

The Modified Rational Method was used to determine peak flow rates for proposed conditions. The site was delineated based on proposed grading and peak flows were calculated based on concentration points within the drainage areas. The peak flow rates for proposed conditions sub basins are shown in **Table 2**.

Table 2. Peak Flow Rates - Proposed Conditions

Subbasin ID	Basin Area [acres]	Q ₁₀ [cfs]	Q ₁₀₀ [cfs]
10	3.32	5.1	9.4
11	0.15	0.3	0.5
12	0.05	0.1	0.2
13	0.21	0.4	0.7
14	0.15	0.3	0.5
15	0.35	0.7	1.2
20	3.69	5.8	10.8
21	1.81	2.6	5.2
22	0.17	0.3	0.6
23	0.18	0.3	0.6
30	1.99	3.0	5.5
32	0.19	0.4	0.6
33	1.50	2.5	4.5
34	0.19	0.3	0.6
35	0.63	1.0	1.9
36	0.15	0.3	0.5

Please see the Existing and Proposed Conditions Drainage Maps provided in **Appendix A** for drainage patterns, sub basin delineations and street section locations.

3.4 Facility Design Calculations

3.4.1 Street Flow

The project site is located adjacent to Rancho Drive, Desert Inn Road, and Sirius Avenue. The 10-year and 100-year street flows were evaluated for future conditions adjacent to the project site. In existing conditions the site drains out existing driveways onto Sirius Avenue, Rancho Drive, and Desert Inn Road. The historic discharges points are maintained in proposed conditions. In both existing and proposed conditions, the discharges flow from the streets into the regional facility channel adjacent to Interstate 15. Proposed development of the site does not negatively impact existing conditions. No work is proposed within the rights-of-way on any of the perimeter streets. The right-of-way on Sirius and Rancho is 60 foot and 50 foot respectively, so the velocity times depth criteria does not apply.

The calculations for street flows are in **Appendix C** and the results are summarized in **Table 3**. The calculations are the same for existing and proposed conditions.

Street flow calculations were used to calculate the finished floor elevations for the proposed building. Street flow calculations were completed in FlowMaster V8i. Street sections along Rancho Drive, sections B-B, C-C and H-H, are each broken into two separate

calculations denoted as follows, B-Ba, C-Ca and H-Ha. These sections show the channel adjacent to Rancho Drive as a separate calculation from the street calculation in the same area. This was done to quantify the amount of flow that would be removed from the roadway by the channel. The west end of each section was modeled as a vertical wall to represent the elevated site. Two calculations for the finished floor elevations were checked. The first check was twice the difference between the water surface elevation and the gutter elevation plus the gutter elevation. The second check is the water surface elevation plus 1.5 feet. The lesser of the two checks was used for the finished floor elevations. A table detailing the calculations and results is provided in **Appendix C**.

Table 3. Street Cross Section Results

Street Name	Cross Section ID	Q ₁₀ [cfs]	d ₁₀ [ft]	V ₁₀ [ft/s]	Q ₁₀₀ [cfs]	d ₁₀₀ [ft]	V ₁₀₀ [ft/s]
Desert Inn Road	A-A	248	1.33	7.4	617	2.02	10.33
Rancho Drive	B-B	336	1.49	5.42	1562	3.22	8.79
Rancho Drive	C-C	123	0.88	4.61	1355	2.12	11.49
Driveway N/S	D-D	4	0.21	1.68	5	0.23	1.78
Sirius Ave	E-E	427	1.04	8.15	1081	1.70	11.72
Rancho Drive	F-F	873	3.96	9.67	2538	5.16	14.35
Sirius Ave	G-G	427	1.22	9.54	1081	1.78	13.74
Rancho Drive	H-H	210	0.86	6.4	1413	2.11	13.16

3.4.2 Best Management Practices

The total site size for this project is greater than 1 acre, and the parking area of this site is approximately 8 acres. Per Section 1500 of the HCDDM, sites larger than 1 acre and greater than 1 acre of parking lot area have a parking lot categorization of “Large”. As a result, the BMP requirement is to treat flows from at least 75% of parking lot areas and redirect them through BMPs such as rock swales. Swales have been provided and will serve as BMPs.

The site has been designed in accordance with section 1500 of the CCRFCD Manual for large parking lots. Each runoff area gets directed through curb cuts into rock-lined swales. The flow path is increased and there is an impervious area created prior to each drop inlet. BMP calculations have been provided in **Appendix C**.

4 CONCLUSIONS

4.1.1 Compliance with Drainage Laws

The proposed project is in compliance with regional and local laws and ordinances.

4.1.2 Compliance with Master Plans

The proposed project is in compliance with the 2005 City of Las Vegas Master Plan and the 2015 MPU.

4.1.3 Compliance with FEMA Requirements

The proposed project is located outside the 100-year floodplain.

4.1.4 Compliance with MANUAL

Hydrology and hydraulic calculations are based on generally accepted engineering practices and are in accordance with the CCRFCD Hydrologic Criteria and Drainage Design Manual and the City of Las Vegas criteria.

4.1.5 Impact of proposed development on off-site property and facilities

The ultimate historic drainage discharge points have been maintained with this design.

5 REFERENCES

City of Las Vegas. Central Neighborhood Flood Control Master Plan, March 2005.
Clark County Regional Flood Control District. Hydrologic Criteria and Drainage Manual.
Updated August 1999, revisions incorporated through September 2014.
Clark County Regional Flood Control District. 2008 Las Vegas Valley Flood Control Master Plan Update. 2008.
Clark County Regional Flood Control District. 2013 Las Vegas Valley Flood Control Master Plan Update. 2013.
Federal Emergency Management Agency website: www.fema.gov, accessed September 2017.

Appendix A Exhibits

- Assessor's Parcel Map
- FEMA FIRMs
- CCRFCD F-31 Facilities Map
- Existing Conditions Drainage Map
- Proposed Conditions Drainage Map

NOTES

This map is for assessment use only and does NOT represent a survey.

No liability is assumed for the accuracy of the data delineated herein. Information on roads and other non-assessed parcels may be obtained from the Road Document Listing in the Assessor's Office.

This map is compiled from official records, including surveys and deeds, but only contains the information required for assessment. See the recorded documents for more detailed legal information.

MAP LEGEND

PARCEL BOUNDARY

SUB BOUNDARY

PM/LD BOUNDARY

ROAD EASEMENT

MATCH / LEADER LINE

HISTORIC LOT LINE

HISTORIC SUB BOUNDARY

HISTORIC PM/LD BOUNDARY

SECTION LINE

CONDOMINIUM UNIT

AIR SPACE PCL

RIGHT OF WAY PCL

SUB-SURFACE PCL

001

ROAD PARCEL NUMBER

001

PARCEL NUMBER

1.00

ACREAGE

202

PARCEL SUB/SEQ NUMBER

PB 24-45

PLAT RECORDING NUMBER

5

BLOCK NUMBER

5

LOT NUMBER

GL5

GOV. LOT NUMBER

BOOK

T21S R61E

SEC.

8

MAP

S 2 SW 4

162-08-4

87138

139

140

64163

162

161

75176

177

178

Scale: 1" = 200'

Rev: 3/17/2016

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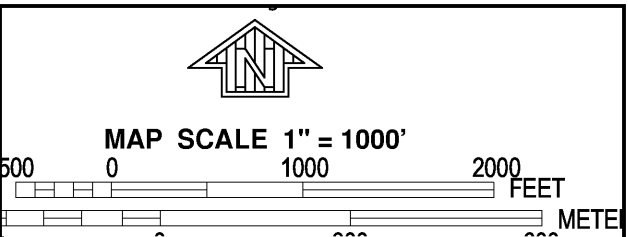
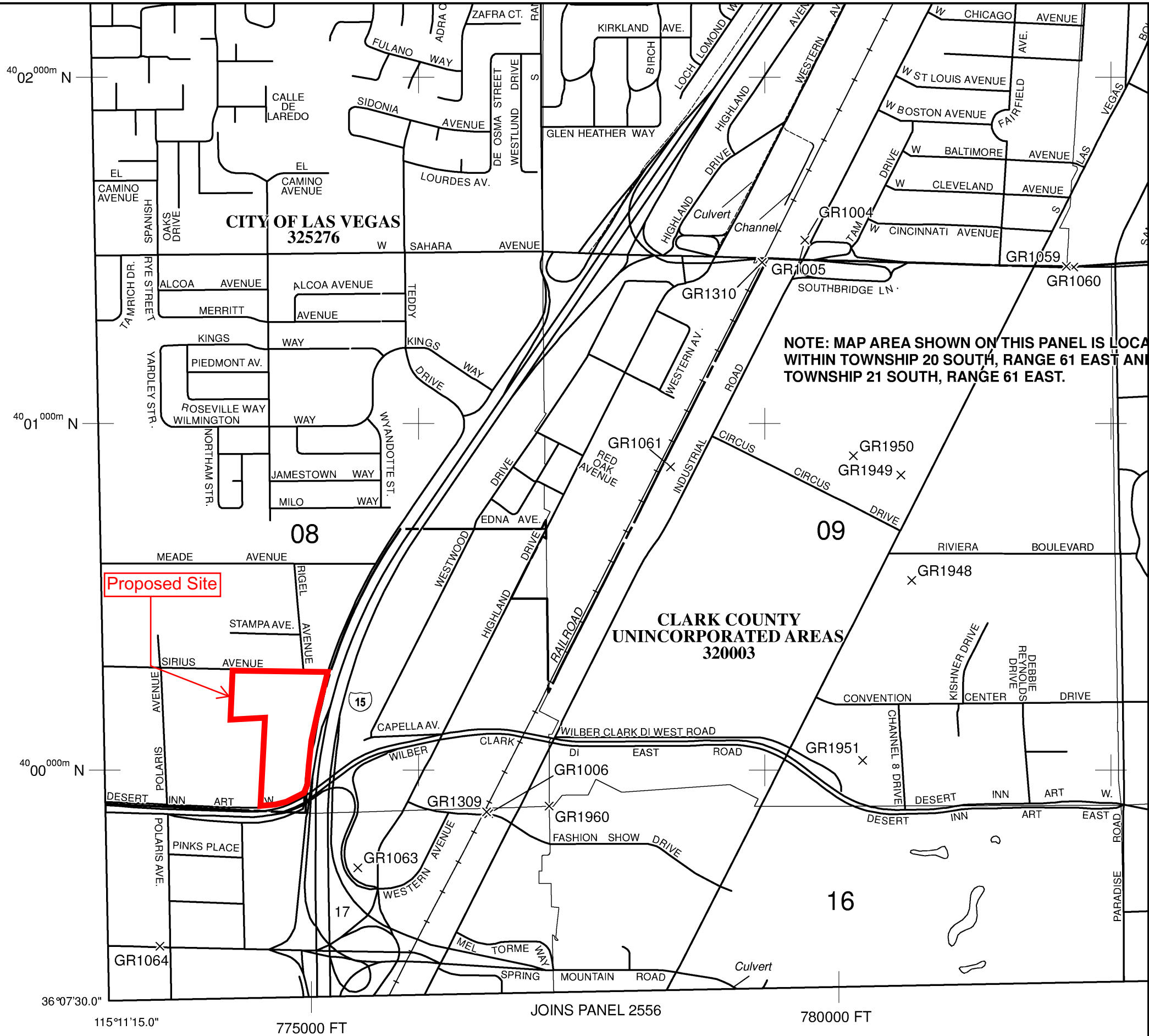
1

CLARK COUNTY

ASSESSOR

NEVADA

TAX DIST 212,200



PANEL 2170F

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY,
NEVADA
AND INCORPORATED AREAS

PANEL 2170 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2170	F
LAS VEGAS, CITY OF	325276	2170	F
NORTH LAS VEGAS, CITY OF	320007	2170	F

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

 **MAP NUMBER**
32003C2170F
MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



2008
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

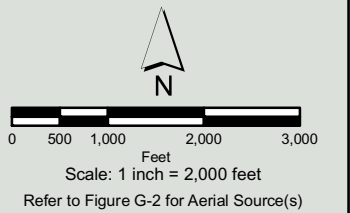
FIGURE F-31 FLOOD CONTROL FACILITIES

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed 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 |



US95		I-15		I-215	
2	3	8	9	10	11
4	5	12	13	14	15
16	17	18	19	20	21
22	23	24	25	26	27
28	29	30	31	32	33
34	35	36	37	38	39
40	41	42	43	44	45
46	47	48	49	50	51
52	53	54	55	56	57
58	59				



ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
BHSA		BOULDER HIGHWAY SAHARA AVENUE						
0175	P1	14' X 14' RCB	6000	3837	CSA13	SW3	7.93	0.67
0289	P1	14' X 12' RCB	2300	3566	CSA11	SW3	7.55	0.87
0331	P1	14' X 11' RCB	2000	3232	CSA10-1	SW3	7.15	1.00
CHRA		WEST CHARLESTON DRAINS - RANCHO						
0000	E	6' X 5' RCB	310	286	CAL95	SW3	0.62	1.92
0006	E	5' X 5' RCB	420	286	CAL95	SW3	0.62	1.00
0014	E	5' X 4' RCB	600	286	CAL95	SW3	0.62	1.50
FLBN		FLAMINGO - BOULDER HIGHWAY NORTH						
0281	P1	10' X 7' RCB	3100	1259	CCH56	SW3	1.64	1.33
0342	P1	7' X 4" RCB	4300	555	CCH52	SW3	0.55	4.20
FLFA		FLAMINGO - FASHION						
0000	E	12' X 5' RCB	2050	747	CFW17N	FLAM3A	0.72	0.28
0037	E	8' X 5' RCB	3060	526	FW14	FLAM3A	0.44	0.45
FW15		FREEWAY CHANNEL FROM DESERT INN TO EXPRESSWAY						
0000	E	3: 12' X 10' RCB	2170	3728	CAL93	SW4	10.63	0.17
0010	E	3: 12' X 10' RCB	677	3403	CAL96	SW4	10.10	0.17
0038	E	3: 12' X 10' RCB	1945	3344	CCCH22	SW4	9.92	0.17
0050	E	3: 12' X 10' RCB	870	2613	CCH50	SW4	8.54	0.17
0089	E	3: 12' X 10' RCB	980	2448	CCWAL2	SW4	8.28	0.17
0100	E	3: 12' X 9' RCB	1575	2295	COK11C	SW3	7.83	0.17
0125	E	2: 10' X 8' RCB	1350	1450	DCCSA08	SW3	6.67	0.80
0150	E	2: 10' X 8' RCB	1067	1450	DCCSA08	SW3	6.67	0.80
0175	E	2: 10' X 8' RCB	985	1450	DCCSA08	SW3	6.67	0.75
0214	P1	2: 12' X 10' RCB	1610	4104	CED10-C	SW3	6.25	0.73
0242	P1	2: 12' X 9' RCB	1500	3968	CCPS08	SW3	6.03	0.93
0271	P1	2: 12' X 10' RCB	1520	3674	CPS08	SW3	5.59	0.59
0301	P1	Conc Chnl 12'W 4'D 2:1 SS	1300	433	CCE3FD-C	SW3	0.54	0.42
FWCH		WEST CHARLESTON DRAINS						
0000	E	10' X 7' RCB	1710	1008	CCH22	SW3	1.38	0.74
0020	E	10' X 7' RCB	840	783	CCCH18-C	SW3	1.15	0.40
0036	E	9' X 7' RCB	425	783	CCCH18-C	SW3	1.15	0.40
0044	E	9' X 7' RCB	145	538	CCH18-C	SW3	0.53	0.40
0047	E	7' X 5' RCB	710	538	CCH18-C	SW3	0.53	2.05
0060	E	5' X 4' RCB	400	538	CCH18-C	SW3	0.53	0.40
FWOK		OAKLEY DRAIN						
0000	E	10' X 8' RCB	1350	928	1COK11C	SW3	1.16	0.62
0020	E	10' X 8' RCB	1025	928	1COK11C	SW3	1.16	0.60
0040	E	8' X 8' RCB	960	721	COK10	SW3	0.85	1.00
0060	E	5' X 5' RCB	970	453	COK09-C	SW3	0.55	1.50
0076	P1	6' X 6' RCB	1175	453	COK09-C	SW3	0.55	9.40
0100	P1	6' X 6' RCB	980	453	COK09-C	SW3	0.55	1.98
FWPS		PALMYRA / SIRIUS DRAIN						
0000	P1	12' X 11' RCB	3000	3240	CCPS06	SW3	4.88	1.50
0057	P1	10' X 10' RCB	5220	1941	CPS06	SW3	2.78	1.28
0157	P1	2: 66" RCP	5100	521	CPS03	SW3	0.60	1.15
FWR2		FREEWAY CHANNEL - RAILROAD CHANNEL						
0000	E	5' X 5' RCB	377					1.60
0020	E	Earth Chnl 10'W 4'D 2:1 SS	650					0.50
FWRR		FREEWAY CHANNEL BYPASS FACILITY RR BRANCH						
0000	E	48" RCP	70					1.22
0010	E	Conc Chnl 4'W 4'D 0:1 SS	220					1.22
FWSA		FREEWAY CHANNEL - SAHARA						
0000	P1	7' X 5' RCB	5700	486	CSA08	SW3	0.42	1.49
FWSH		SHADOW LANE DRAIN						
0000	E	7' X 4' RCB	950	253	CH22-C	SW3	0.23	0.20
FWUP		FREEWAY CHANNEL BYPASS FACILITY						
0000	E	10' X 9' RCB	350	242	CH50	SW3	0.26	0.37
0010	E	10' X 8' RCB	804	242	CH50	SW3	0.26	0.37
0059	E	10' X 6' RCB	2680	242	CH50	SW3	0.26	0.40
0100	E	8' X 4' RCB	1440	242	CH50	SW3	0.26	0.47
FWVV		VALLEY VIEW DRAIN						
0000	P1	12' X 11' RCB	1320	1475	CCE3FA	SW3	2.67	0.30
0025	P1	10' X 10' RCB	2665	1006	CR4C1	SW3	1.74	0.30
0050	P1	8' X 6' RCB	7785	712	DFW5	SW3	1.34	1.50
FWWL		FREEWAY CHANNEL-WALDMAN AVENUE						
0000	E	6' X 6' RCB	1000	418	CWAL2	SW3	0.45	0.20
LCCH		LAS VEGAS CREEK CHANNEL						
0000	E	2: 12' X 7' RCB	730	2894	CLC20-C	MEADOWS4	9.68	1.28
0013	E	2: 12' X 6' RCB	2035	2894	CLC20-C	MEADOWS4	9.68	0.82
0051	E	2:14' X 7' RCB	3113	2894	CLC20-C	MEADOWS4	9.68	0.60
0110	E	Transition Structure	220	2798	CCLC16-C	MEADOWS4	9.51	
0114	E	2: 14' X 7' RCB	670	2329	CRMEDET	MEADOWS4	8.25	0.80
0127	E	Transition Structure	110	2329	CRMEDET	MEADOWS4	8.25	
0129	E	2: 14' X 7' RCB	1130	2329	CRMEDET	MEADOWS4	8.25	0.50
0150	E	2: 13' X 7' RCB	200	2329	CRMEDET	MEADOWS4	8.25	0.95
0154	E	Transition Structure	190	2329	CRMEDET	MEADOWS4	8.25	
0157	E	2: 12' X 6' RCB	1650	1631	CCLC14-C	SW3	2.99	1.06
0230	E	12' X 6' RCB	2140	1381	CLC14-C	SW3	2.54	1.74
0270	E	12' X 6' RCB	1705	774	CCWA02-C	SW3	1.84	0.54
0302	E	8' X 6' RCB	3940	774	CCWA02-C	SW3	1.84	2.49
0377	E	10' X 7' RCB	1226	774	CCWA02-C	SW3	1.84	0.74
0400	E	Transition Structure	110	437	CWA02-C	SW3	1.47	0.49
0402	E	8' X 6' RCB @ Jones	535	437	CWA02-C	SW3	1.47	0.49
0412	E	60" RCP	1370	437	CWA02-C	SW3	1.47	1.08
0438	E	60" RCP	1090	162	CLC01-C	SW3	1.20	1.60
0458	E	60" RCP	1060	162	CLC01-C	SW3	1.20	1.60
0478	E	60" RCP	1110	162	CLC01-C	SW3	1.20	0.55
LCDE		LAS VEGAS CREEK - DECATUR						
0000	E	6' X 5' RCB	1800	404	LC11-C	SW3	0.38	1.26
0034	E	72" RCP	700	404	LC11-C	SW3	0.38	0.50
LCJO		LAS VEGAS CREEK - JONES						
0000	E	6' X 6' RCB	380	358	AL01B-C	SW3	0.37	0.50
0007	E	6' X 5' RCB	675	358	AL01B-C	SW3	0.37	0.62
LCME		LAS VEGAS CREEK - MEADOWS						
0000	E	14' X 8' RCB	895	1423	MEADOWDB	SW3SC	5.67	0.72
0016	E	Stilling Basin	140	1423	MEADOWDB	SW3SC	5.67	0.21
0017	E	3,300 cfs Spillway (Replace w/ LCME0018)		3300	MEADOWIN	SW3SC	5.67	
0018	P1	Modify Spillway, raise height by 1' (Replaces LCME0017)		3300	MEADOWIN	SW3SC	5.67	
0019	E	1: 11' X 5' RCB and 1: 11.5' X 5' RCB	110	1423	MEADOWDB	SW3SC	5.67	0.81
0020	E	213 ac-ft Meadows Detention Basin		4713	MEADOWIN	SW3SC	5.67	
0021	P1	Upgrade to 235 ac-ft Meadows Detention Basin		4713	MEADOWIN	SW3SC	5.67	
0025	E	Energy Dissipator (Replace w/ LCME0026)	110	4713	MEADOWIN	SW3SC	5.67	2.94
0026	P1	Energy Dissipator (Replaces LCME0025)	110	4713	MEADOWIN	SW3SC	5.67	2.94
0027	E	Conc Chnl 30'W 8.5'D 0:1 SS (Replace w/ LCME0028)	922	4713	MEADOWIN	SW3SC	5.67	0.40
0028	P3	Conc Chnl 42'W 9'D 0:1 SS (Replaces LCME0027)	922	4713	MEADOWIN	SW3SC	5.67	0.40
0039	E	Conc Chnl 18'W 6.5'D 1:1 SS (Replace w/ LCME0040)	525	4593	CAL90-C	SW3SC	5.44	0.92
0040	P3	Conc Chnl 40'W 10'D 0:1 SS (Replaces LCME0039)	525	4593	CAL90-C	SW3SC	5.44	0.40
0069	E	Conc Chnl 18'W 6.5'D 1:1 SS (Replace w/ LCME0070)	255	4593	CAL90-C	SW3SC	5.44	0.92
0070	P3	Conc Chnl 40'W 8.5'D 0:1 SS (Replaces LCME0069)	255	4593	CAL90-C	SW3SC	5.44	0.40
0076	E	Free Span Bridge 18'W 8'D @ Alta	100	4441	CCAL16	SW3SC	5.27	1.89
0077	E	Conc Chnl 18'W 8'D 1:1 SS	618	4441	CCAL16	SW3SC	5.27	1.89
0085	E	10' X 6' RCBC @ Valley View	275	1661	1CAL16	SW3	2.09	1.89
LCRA		LAS VEGAS CREEK - RANCHO						
0000	E	12' X 8' RCB	380	783	CLC16-C	SW3	1.71	0.60
0004	E	12' X 6' RCB	2367	783	CLC16-C	SW3	1.71	0.77
LVOE		OWENS AVENUE - EAST						
0345	P1	13' X 11' RCB	1685	2369	DLVOE	SW5	22.79	0.60
LVWH		WASHINGTON AVENUE CHANNEL						
0431	E	3: 14.33' X 10' RCB	665	2870	DCLC21	SW5	22.79	0.15
0446	E	Junction Structure	69	2870	DCLC21	SW5	22.79	0.15
0447	E	3: 14.33' X 10' RCB	1955	4978	CCAL93	SW5	22.19	0.15
ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
LVWH		WASHINGTON AVENUE CHANNEL						
0484	E	Confluence Structure	455	4978	CCAL93	SW5	22.19	0.15
MEAL		MEADOWS ALTA						
0000	E	Conc Chnl 8'W 11'D 1:1 SS	700	1207	CAL13-3	SW3	1.48	1.58
0012	E	12' X 6' RCBC @ Red Sky	160	1161	CAL10-C	SW3	1.42	3.03
0013	E	Conc Chnl 8'W 11'D 1:1 SS	320	1161	CAL10-C	SW3	1.42	3.03
0015	E	72" RCP	2500	1126	CAL11-C	SW3	1.38	1.94
0060	E	60" RCP	905	792	CBR3	SW3	1.08	1.00
0099	E	60" RCP (Replace w/ MEAL0100)	1160	792	CBR3	SW3	1.08	1.00
0100	P3	72" RCP (Replaces MEAL0099)	1160	792	CBR3	SW3	1.08	1.00
0120	E	60" RCP	3500	733	CAL05-C	SW3	1.01	1.00
0130	P3	6' X 4' RCB	1150	186	AL04-C	SW3	0.18	0.40
0150	E	60" RCP	285	499	CCUS	SW3	0.74	1.40
0160	E	36" RCP	2600	331	CJUS	SW3	0.56	1.25
0209	P3	48" RCP	2500	150	DCR2	SW3	0.41	1.70
MECH		EXTENSION OF MEADOWS / CHARLESTON						
0059	E	36" RCP	1310					0.25
0084	E	30" RCP	2960					1.26
0108	E	30" RCP	8550	32	OAKKEYOT	SW3	1.88	1.43
0310	E	24" RCP	1000	32	OAKKEYOT	SW3	1.88	1.43
0323	E	15" RCP Outlet	200	32	OAKKEYOT	SW3	1.88	
0324	E	201 ac-ft Oakley Detention Basin		1652	OAKKEYIN	SW3	1.88	
0334	E	11' X 6' RCB	200	573	C5-OAK-C	SW3	0.56	0.50
0337	E	9' X 6' RCB	520	573	C5-OAK-C	SW3	0.56	0.50
0338	E	10' X 8' RCB	2060	1131	C3A-OAKC	SW3	1.32	1.62
MECN		MEADOWS - CHARLESTON						
0000	P1	9' X 8' RCB	1570	1105	CCH10	SW3	1.00	1.09
0061	P1	8' X 7' RCB	3300	1105	CCH10	SW3	1.00	1.82
0123	P1	8' X 6' RCB	5200	821	CCH09-C	SW3	0.72	1.64
0223	P1	6' X 5' RCB	2700	422	CCH05-C	SW3	0.34	2.04
MEOK		OAKLEY MEADOWS STORMDRAIN						
0000	P3	19' X 7' RCB	900	2718	COK13	SW3SC	2.94	0.91
0017	P3	19' X 8' RCB	1550	2718	COK13	SW3SC	2.94	0.80
0048	P3	18' X 9' RCB	1700	2718	COK13	SW3SC	2.94	0.50

Plotted By: Weiren, Kelli Sheet Set: KHA Layout: Layout1 September 21, 2017 02:16:57pm K:\EAV\WaterResources\Shift\092965000_Area 15\Reports\TDS\CAD\Existing Conditions Drainage Map.dwg
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Existing Conditions				
Basin	Area [AC]	Q ₁₀ [CFS]	Q ₁₀₀ [CFS]	Subbasin Q ₁₀₀ /ac [CFS/AC]
05	19.8	18	31	1.6
CP05	19.8	18	31	1.6
10	4.4	4	7	1.6
CP10	4.4	4	5	1.1
15	30.0	27	46	1.5
CP15	30.0	27	46	1.5
20	9.4	9	15	1.6
25	1.9	2	3	1.6
CP25	1.9	2	3	1.6
30	3.0	3	5	1.7
CP30	3.0	3	5	1.7
PS07A	20.9	23	37	1.8
CPPS07A	N/A	480	1683	N/A
CP40	N/A	873	2538	N/A

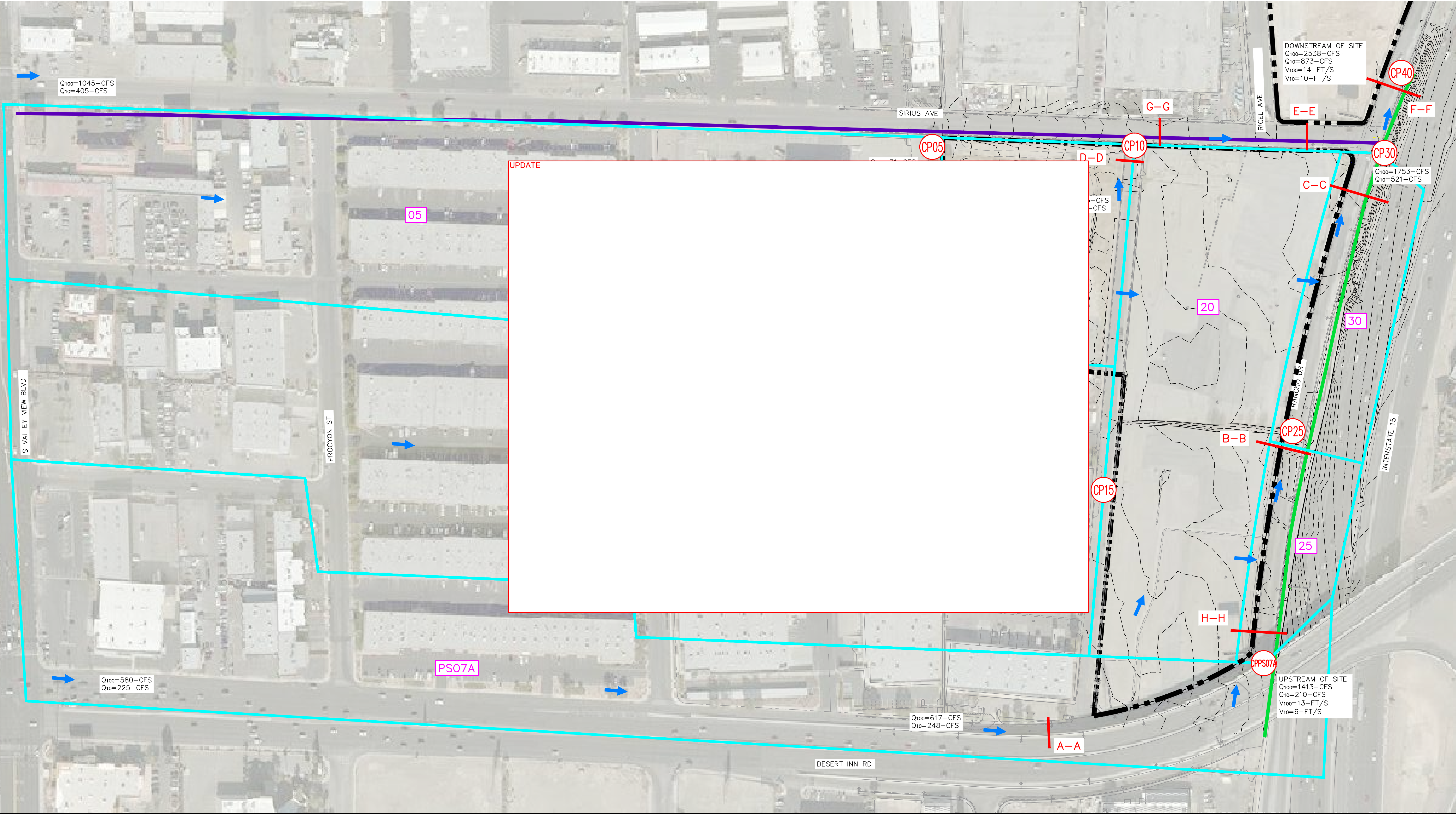
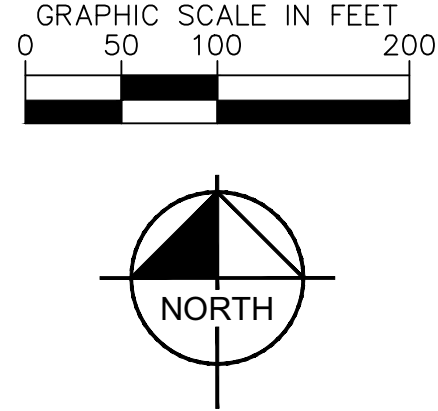
Street Hydraulics							
Street Name	Cross Section ID	Q ₁₀ [CFS]	V ₁₀ [FT/S]	D ₁₀ [FT]	Q ₁₀₀ [CFS]	V ₁₀₀ [FT/S]	D ₁₀₀ [FT]
Desert Inn Road	A-A	248	7.40	1.33	617	10.33	2.02
Rancho Drive	B-B	336	5.42	1.49	1562	8.79	3.22
Rancho Drive	C-C	123	4.61	0.88	1355	11.49	2.12
Driveway N/S	D-D	4	1.68	0.21	5	1.78	0.23
Sirius Ave	E-E	427	8.15	1.04	1081	11.72	1.70
Rancho Drive	F-F	873	9.67	3.96	2538	14.35	5.16
Sirius Ave	G-G	427	9.54	1.22	1081	13.74	1.78
Rancho Drive	H-H	210	6.40	0.86	1413	13.16	2.11

FLOOD ZONE NOTE

THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) INDICATES THAT THE SITE IS LOCATED IN ZONE "X" OF FLOOD INSURANCE RATE MAP (FIRM) No. 32003C2170F, AS SHOWN ON THE FIRM INDEX, EFFECTIVE 11/16/2011. ZONE "X" IS DEFINED BY FEMA AS "AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN."

LEGEND

- 2178----- EXISTING CONTOUR
- SUBBASIN BOUNDARY
- RCB CULVERT, 12' X 11'
- CONCRETE CHANNEL, 12'W X 4'D, 2:1 SS
- PROPERTY LINE
- 10 SUB-BASIN ID
- FLOW ARROW
- CONCENTRATION POINT
- MASTER STUDY FLOWS
- CROSS-SECTION ID



KHA PROJECT 092965000	DATE SEP 20, 2017	SCALE AS SHOWN	DESIGNED BY JRT	DRAWN BY KRW	CHECKED BY LSM	EXISTING CONDITIONS EXHIBIT	AREA 15 PREPARED FOR THE FISHER BROTHERS	CITY OF LAS VEGAS	NEVADA	SHEET NUMBER	No.	REVISIONS	DATE	BY

Kimley»Horn

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Plotted By: Weipen, Kelli Sheet: Sat.kha Layout: Layout1 September 21, 2017 02:48:55pm K:\EAV_WaterResources\Sheet\092965000_Area 15\Reports\TDS\CAD\Proposed Conditions Drainage Exhibit.dwg
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FLOOD ZONE NOTE

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LEGEND

- 2178

PROPOSED CONTOUR
- SUBBASIN BOUNDARY
- PROPERTY LINE
- TC FLOW PATH
- CONCRETE CHANNEL, 12'W X 4'D, 2:1 SS
- 20

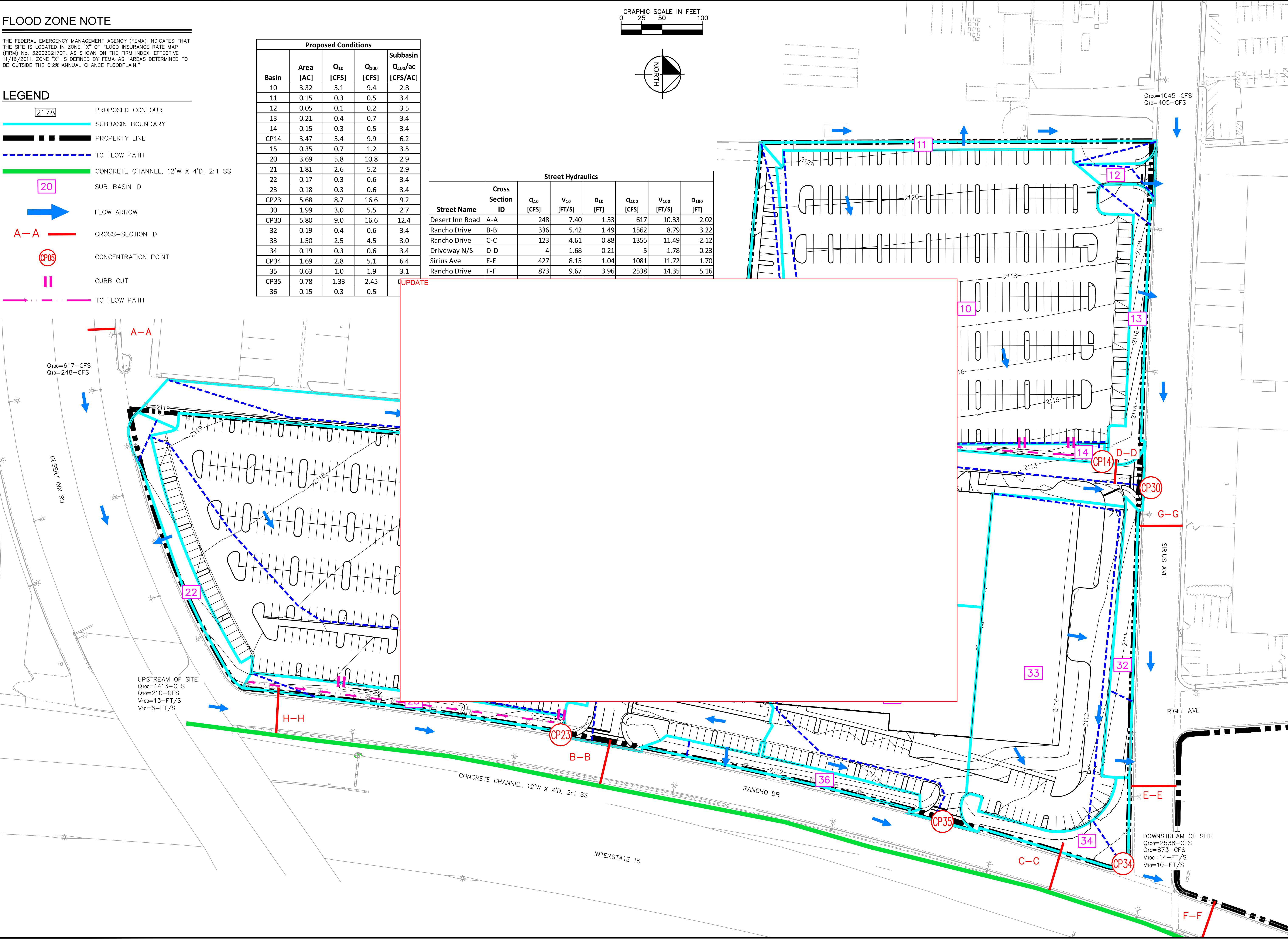
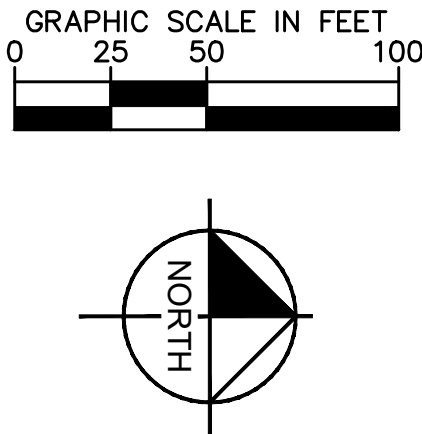
SUB-BASIN ID
- FLOW ARROW
- A-A

CROSS-SECTION ID
- CP05

CONCENTRATION POINT
- CURB CUT
- TC FLOW PATH

Proposed Conditions					
Basin	Area [AC]	Q ₁₀ [CFS]	Q ₁₀₀ [CFS]	Subbasin Q ₁₀₀ /ac [CFS/AC]	
10	3.32	5.1	9.4	2.8	
11	0.15	0.3	0.5	3.4	
12	0.05	0.1	0.2	3.5	
13	0.21	0.4	0.7	3.4	
14	0.15	0.3	0.5	3.4	
CP14	3.47	5.4	9.9	6.2	
15	0.35	0.7	1.2	3.5	
20	3.69	5.8	10.8	2.9	
21	1.81	2.6	5.2	2.9	
22	0.17	0.3	0.6	3.4	
23	0.18	0.3	0.6	3.4	
CP23	5.68	8.7	16.6	9.2	
30	1.99	3.0	5.5	2.7	
CP30	5.80	9.0	16.6	12.4	
32	0.19	0.4	0.6	3.4	
33	1.50	2.5	4.5	3.0	
34	0.19	0.3	0.6	3.4	
CP34	1.69	2.8	5.1	6.4	
35	0.63	1.0	1.9	3.1	
CP35	0.78	1.33	2.45	6UPDATE	
36	0.15	0.3	0.5		

Street Hydraulics							
Street Name	Cross Section ID	Q ₁₀ [CFS]	V ₁₀ [FT/S]	D ₁₀ [FT]	Q ₁₀₀ [CFS]	V ₁₀₀ [FT/S]	D ₁₀₀ [FT]
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Rancho Drive	C-C	123	4.61	0.88	1355	11.49	2.12
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KHA PROJECT
092965000

DATE
SEP 20, 2017

SCALE
AS SHOWN

DESIGNED BY
JRT

DRAWN BY
KRW

CHECKED BY
LSM

ONSITE PROPOSED
CONDITIONS
EXHIBIT

AREA 15
PREPARED FOR
THE FISHER BROTHERS

SHEET NUMBER

REVISIONS

DATE

BY

Appendix B Hydrology

- City of Las Vegas Master Plan Hydrology References
- Existing Conditions Hydrology
- Proposed Conditions Hydrology

VOLUME II

CENTRAL
NEIGHBORHOOD
FLOOD CONTROL
MASTER PLAN

MARCH 2005



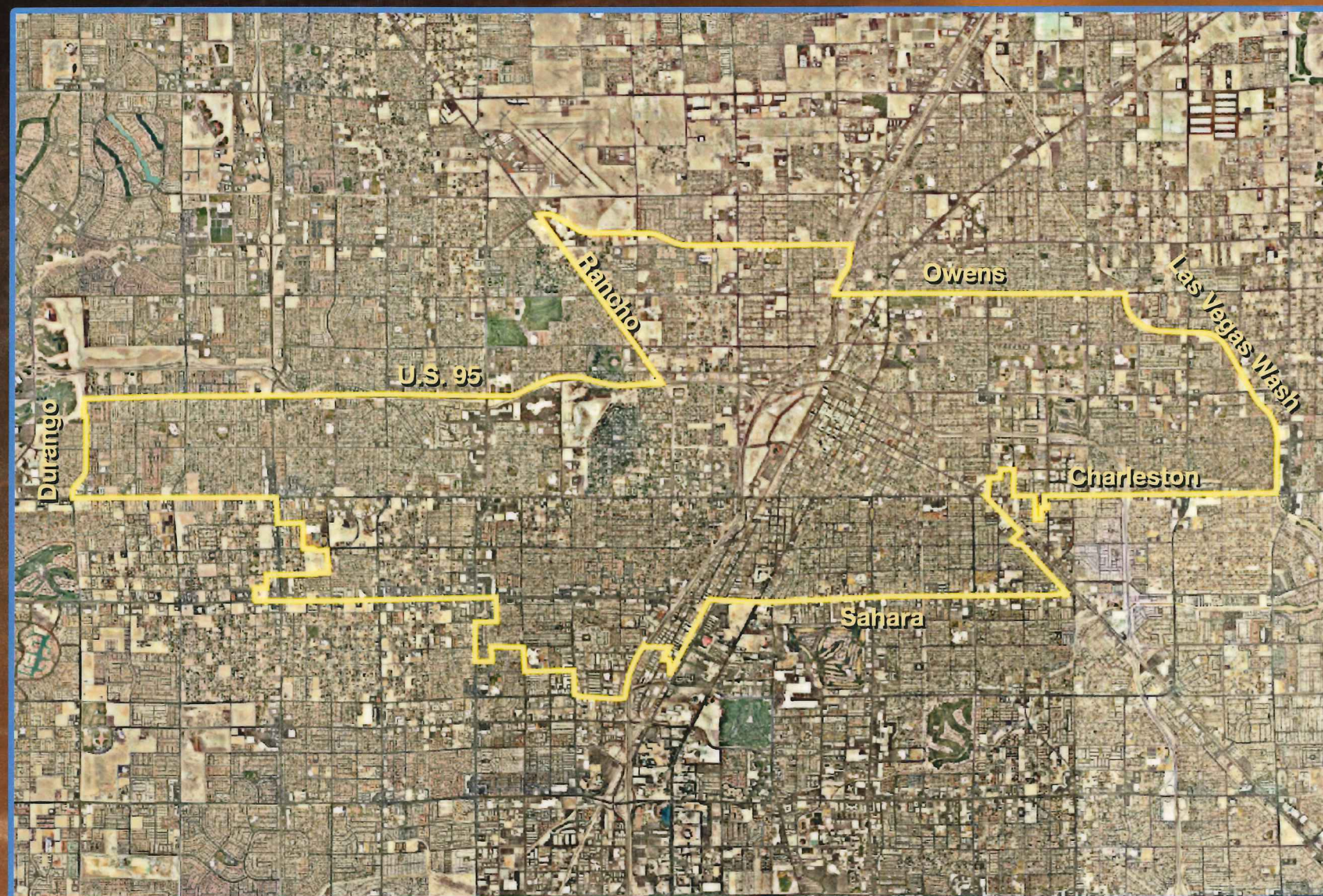
City of Las Vegas



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City of Las Vegas

CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN

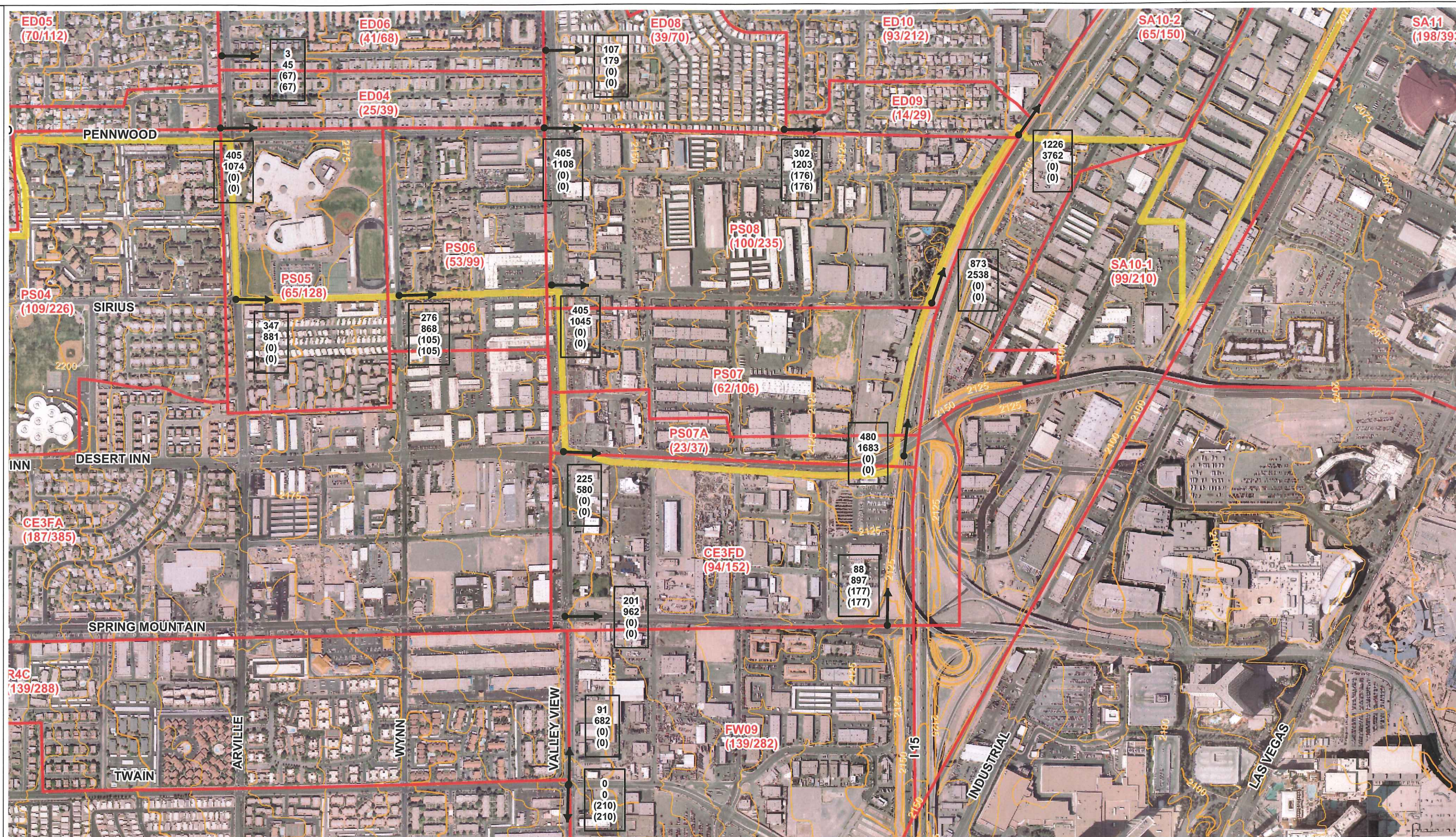
LEGEND

- Sub-basin Boundary
- LV12** Basin ID
- Contributing flow from the basin (cfs)
- 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)
- Study Area Limit

PHOTO DATE: SPRING 2004

FIGURE E- 19



EXISTING DRAINAGE CONDITIONS

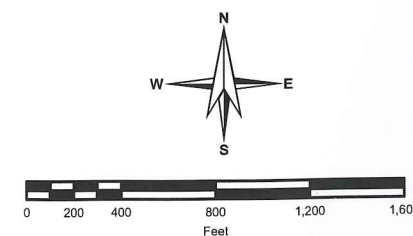


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	Durango	Rainbow	Decatur	Tonopah	5th	Pecos	Nellis
Lake Mead				1	2		
Washington				3	4	5	6
Charleston	7	8	9	10	11	12	
Sahara	13	14	15	16	17		
Desert Inn		18	19				

NOTE:
Existing conditions are based on future
Curve Number values with only existing local and
CCRFCD facilities in place.

100-Year flows at locations where a 100-Year
subbasin concentration point does not exist in the
hydrology model were based on an area-weighted
ratio of the 100-Year flows from concentration points
upstream and downstream of the location. See
Volume I for a more detailed explanation.



SCALE: 1 inch = 800 feet



2004 CITY OF LAS VEGAS
CENTRAL NEIGHBORHOOD
FLOOD CONTROL MASTER PLAN

LEGEND

REGIONAL STREAM NAME DESIGNATOR	AABB
REGIONAL MILE	0000
LOCAL STREAM NAME DESIGNATOR	AAB
LOCAL ID NUMBER	000
EXISTING FACILITY	E
PROPOSED OR MODIFIED FACILITY	P
CONTINGENCY LEVEL:	
CATEGORY B	P0
MASTER PLAN	P1
PRELIMINARY DESIGN	P2
DESIGN	P3
BOTTOM WIDTH	W
DEPTH	D
SIDE SLOPE, H:V	SS
LEFT SIDE SLOPE H:V	LSS
RIGHT SIDE SLOPE H:V	RSS
CORRUGATED METAL ARCH PIPE CULVERT	CMAP
CORRUGATED METAL PIPE CULVERT	CMP
DUCTILE IRON PIPE	DIP
HIGH DENSITY POLYETHYLENE PIPE	HDPE
HELICAL ELLIPTICAL REINFORCED CONCRETE PIPE	HERCP
PUBLIC DRAINAGE EASEMENT	PDE
POLYVINYL CHLORIDE PIPE	PVC
REINFORCED CONCRETE BOX	RCB
REINFORCED CONCRETE BOX CULVERT	RCBC
REINFORCED CONCRETE ELLIPTICAL PIPE	RCEP
REINFORCED CONCRETE PIPE	RCP
REINFORCED CONCRETE PIPE ARCH	RCPA
REINFORCED CONCRETE PIPE CULVERT	RCPC
STORM SEWER PIPE	SSP
VITRIFIED CLAY PIPE	VCP

NOTES:
FLOW = 100 YEAR HEC-1 FLOW (REGIONAL FACILITIES)
FLOW = FACILITY CAPACITY (LOCAL FACILITIES)

FLOOD CONTROL FACILITIES INVENTORY

SHEET I - 12



ID	MILE	Status	Plan No.	Facility Description	Facility Length L (ft)	Channel Slope S (%)	Flow (cfs)
F-18							
REGIONAL FACILITIES							
FLAMINGO WASH - DARBY STORM DRAIN							
FLDY	0000	E	2002 Master Plan Update	84" RCP	100	0.25	549
FLDY	0002	E	2002 Master Plan Update	10'X3' RCB	50	0.25	549
FLDY	0004	E	2002 Master Plan Update	60" RCP	680	2.80	549
FLAMINGO WASH - LATERAL DRAIN (FLAMINGO/RAINBOW)							
FLLA	0227	E	2002 Master Plan Update	93" RCP	1360	0.40	664
FLLA	0254	E	2002 Master Plan Update	90" RCP	2730	0.40	431
FLLA	0305	E	2002 Master Plan Update	1556 cfs Spillway			1556
FLLA	0306	E	2002 Master Plan Update	30" RCP WITH 18" Orifice Outlet	160	0.43	29
FLLA	0308	E	2002 Master Plan Update	62 ac-ft Desert Inn Detention Basin			734
FLLA	0322	E	2002 Master Plan Update	81" RCP	1370	0.50	
FLLA	0345	E	2002 Master Plan Update	81" RCP	1340	0.50	
FLLA	0369	E	2002 Master Plan Update	72" RCP	670	0.50	
FLAMINGO - VALLEY VIEW							
FLVV	0090	E	2002 Master Plan Update	48" RCP	4180	1.06	229
DECATUR DRAIN							
FWDE	0000	P1	2004 CNFCMP	12' X 8' RCB	1320	0.38	1039
FWDE	0025	P1	2004 CNFCMP	10' X 8' RCB	1325	0.25	632
PALMYRA / SIRIUS DRAIN							
FWPS	0057	P1	2004 CNFCMP	2:84" RCP	5280	1.28	1112
FWPS	0157	P1	2004 CNFCMP	2:66" RCP	5100	1.15	530
VALLEY VIEW DRAIN							
FWVV	0050	P1	2002 Master Plan Update	7' X 6' RCB	9000	1.50	716
LOCAL FACILITIES							
VVB	010	E	107-V604C	18" RCP	650		17
F-19							
REGIONAL FACILITIES							
FLAMINGO - FASHION							
FLFA	0037	E	2002 Master Plan Update	8' X 5' RCB	3060	0.45	527
FLAMINGO - VALLEY VIEW							
FLVV	0028	E	2002 Master Plan Update	48" RCP	3310	0.50	229
FLVV	0090	E	2002 Master Plan Update	48" RCP	4180	1.06	229
FREEWAY CHANNEL FROM DESERT INN TO EXPRESSWAY							
FW15	0242	P1	2002 Master Plan Update	2: 12' X 9' RCB	1500	0.93	4023
FW15	0271	P1	2004 CNFCMP	2: 12' X 10' RCB	1700	0.59	3655
FW15	0301	P1	2002 Master Plan Update	Conc Chnl 12'W 4'D 2:1 SS	1300	0.42	435
PALMYRA / SIRIUS DRAIN							
FWPS	0000	P1	2002 Master Plan Update	12' X 11' RCB	3000	1.50	2399
FWPS	0057	P1	2002 Master Plan Update	2:84" RCP	5280	1.28	1112
VALLEY VIEW DRAIN							
FWVV	0000	P1	2002 Master Plan Update	12' X 11' RCB	1320	0.30	1495
FWVV	0025	P1	2002 Master Plan Update	10' X 10' RCB	1320	0.30	1013
FWVV	0050	P1	2002 Master Plan Update	7' X 6' RCB	9000	1.50	716
LOCAL FACILITIES							
I15	001	E	HWY BK # I-2	36" RCP	150		60
I15	002	E	HWY BK # I-2	24" RCP	150		30
I15	003	E	HWY BK # I-2	24" CMP	150		30
I15	010	E	HWY BK # I-2	2: 36" RCP	152		120
I15	020	E	HWY BK # I-2	36" RCP	234		60
I15	030	E	HWY BK # I-2	2: 36" RCP	234		120
I15	031	E	327-V195	Unlined Chnl 20'W 1'D 1:1 SS	380		167
I15	032	E	327-V195	Unlined Chnl 20'W 2'D 1:1 SS	440		629
I15	035	E	HWY BK # I-2	24" CMP	150		30
I15	036	E	HWY BK # I-2	36" RCP	300		60
I15	037	E	HWY BK # I-2	24" CMP	150		30
I15	045	E	HWY BK # I-2	24" CMP	150		30
I15	050	E	327-V221	48" RCP	1275		47
I15	060	E	HWY BK # I-2	36" RCP	228		60
I15	061	E	HWY BK # I-2	2: 27" X 42" CMAP	220		220
I15	070	E	327-V221	2: 48" CMP	2910		144
I15	090	E	HWY BK # I-2	36" RCP	320		80
I15	091	E	HWY BK # I-2	24" RCP	150		30
VVB	000	E	107-V926	18" RCP	156		11
VVB	001	E	107-V926	19" X 30" RCP	118		23
VVB	002	E	107-V1306	24" RCP	220	0.00003	13

ID	MILE	Status	Plan No.	Facility Description	Facility Length L (ft)	Channel Slope S (%)	Flow (cfs)
F-19							
LOCAL FACILITIES (continued)							
VVB	003	E	107-V1306	24" RCP	199	0.0001	16
VVB	004	E	107-V604C	48" RCP	425		227
VVB	005	E	107-V926	42" RCP	330		45
VVB	006	E	107-V604C	36" RCP	1950		105
VVB	007	E	107-V604C	30" RCP	650		65
VVB	008	E	107-V604C	24" RCP	600		36
VVB	009	E	107-V604C	21" RCP	650		25
VVB	010	E	107-V604C	18" RCP	650		17
VVB	012	E	327-V228	18" RCP	1297		8
VVB	015	E	327-V228	18" RCP	325		11
VVB	020	E	327-V228	18" RCP	897		11
VVB	030	E	327-V224	24" RCP	1019		23
VVB	035	E	327-V224	30" RCP	790		37
VVB	040	E	327-V224	36" RCP	150		80
VVB	045	E	327Y-2153AT	54" RCP	325		176
VVB	050	E	327-V224	24" RCP	752		18
VVB	060	E	327-V224	18" RCP	786		11
VVB	070	E	107-V926	19" X 30" RCP	68		30
VVB	071	E	107V-604C	36" RCP	2660		67
VVB	072	E	107-V604C	24" RCP	514		18
VVB	073	E	107-V604C	30" RCP	659		29
VVB	130	E	107-V1306	24" RCP	200		16

Existing Conditions Hydrology

Sub Basin ID	Area [ac]	Percent of Total Area [%]	Total Q ₁₀₀ [cfs]	Total Q ₁₀ [cfs]
PS07 ^A	68.4	100%	106	62
5 ^B	19.8	29%	31	18
10 ^B	4.4	6%	7	4
15 ^B	30.0	44%	46	27
20 ^B	9.4	14%	15	9
25 ^B	1.9	3%	3	2
30 ^B	3.0	4%	5	3
PS07A ^A	20.9	100%	37	23

^A City of Las Vegas Master Study Data

^B Prorated Data

Proposed Conditions

Modified Rational Method

Area 15

KHA Project No. 092965000

Calculated by JRT
Checked by LSMDate 9/18/2017
Date 9/21/2017

10-Year Storm Event	Sub-Basin Data			Initial/Overland Time (t _i)			Travel Time (t _t)				t _c Check - Urbanized (Urbanized Basins)		Final t _e ^g [min]	10-Year Event		
	Name	K ^a	Area [ac]	Length [ft]	Slope [%]	t _i ^b [min]	Length [ft]	Slope [%]	Velocity ^c [fps]	t _t ^d [min]	Total Length [ft]	t _c =(L/180)+10 [min]		Intensity ^f [in/hr]	Runoff Coefficient, C ₁₀ ^g	Q ₁₀ ^h [cfs]
	10	0.90	3.32	343	1.7%	5.5	372	0.3%	1.3	4.8	715	14.0	10.3	3.40	0.90	5.1
	11	0.88	0.15	103	0.5%	5.1	0	0.0%	0.0	0	103	10.6	5.1	4.20	0.88	0.3
	12	0.90	0.05	109	2.3%	2.8	0	0.0%	0.0	0	109	10.6	5.0	4.20	0.90	0.1
	13	0.88	0.21	77	3.6%	2.3	0	0.0%	0.0	0	77	10.4	5.0	4.20	0.88	0.4
	14	0.88	0.15	23	4.3%	1.2	0	0.0%	0.0	0	23	10.1	5.0	4.20	0.88	0.3
	15	0.90	0.35	299	2.0%	4.9	59	2.1%	2.8	0.4	358	12.0	5.3	4.20	0.90	0.7
	20	0.90	3.69	313	1.0%	6.5	336	0.9%	2.0	2.8	649	13.6	9.3	3.50	0.90	5.8
	21	0.90	1.81	154	2.0%	3.5	759	0.9%	2.0	6.3	913	15.1	9.9	3.20	0.90	2.6
	22	0.88	0.17	55	2.0%	2.3	0	0.0%	0.0	0	55	10.3	5.0	4.20	0.88	0.3
	23	0.88	0.18	80	6.0%	1.9	0	0.0%	0.0	0	80	10.4	5.0	4.20	0.88	0.3
	30	0.90	1.99	171	0.5%	5.9	539	0.7%	1.6	5.6	710	13.9	11.5	3.30	0.90	3.0
	32	0.88	0.19	28	4.6%	1.3	0	0.0%	0.0	0	28	10.2	5.0	4.20	0.88	0.4
	33	0.89	1.50	156	1.9%	3.8	379	0.6%	1.5	4.2	535	13.0	8.0	3.70	0.89	2.5
	34	0.88	0.19	65	1.4%	2.9	0	0.0%	0.0	0	65	10.4	5.0	4.20	0.88	0.3
	35	0.90	0.63	146	0.3%	6.2	272	1.8%	2.7	1.7	418	12.3	7.9	3.70	0.90	1.0
	36	0.88	0.15	19	9.5%	0.8	0	0.0%	0.0	0	19	10.1	5.0	4.20	0.88	0.3

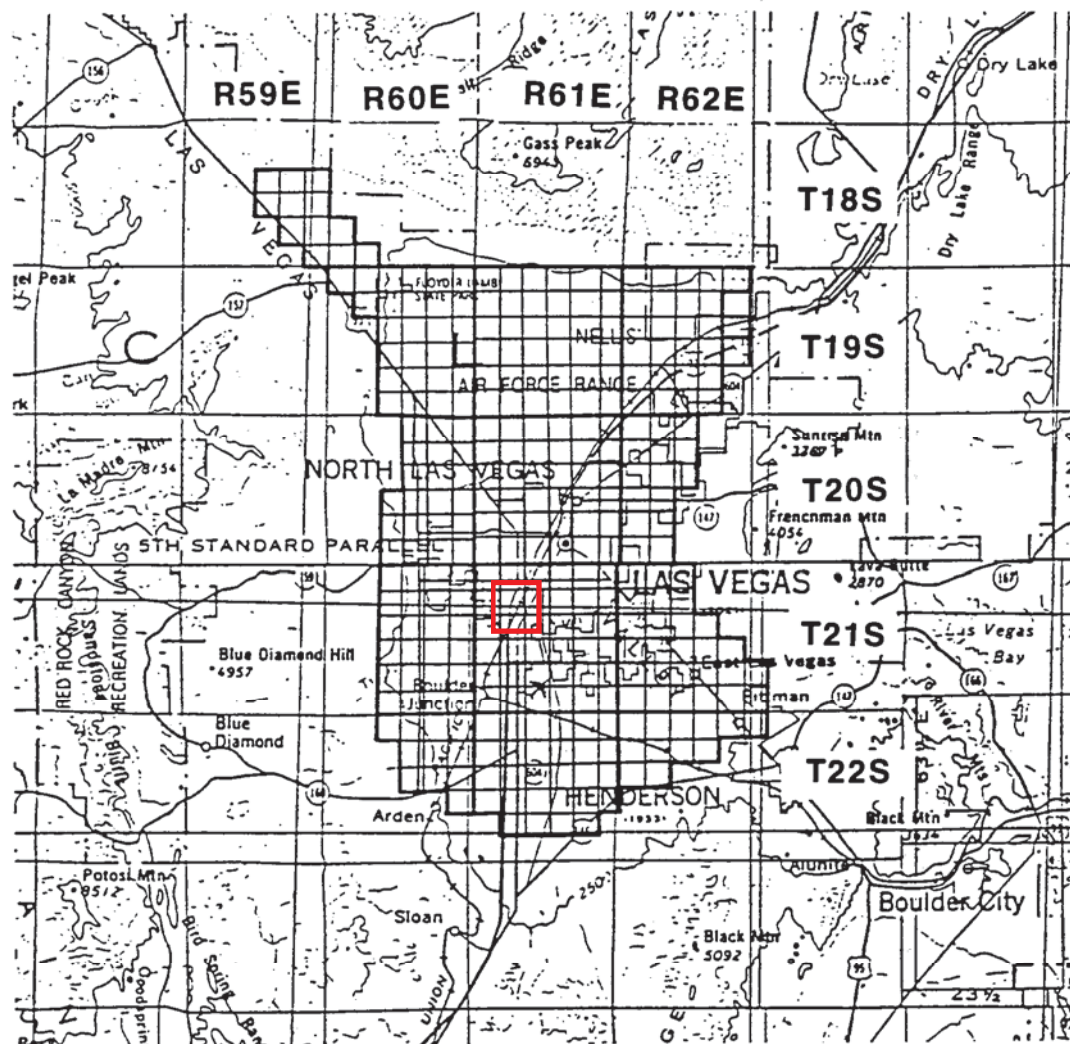
100-Year Storm Event	Sub-Basin Data			Initial/Overland Time (t _i)			Travel Time (t _t)				t _c Check - Urbanized (Urbanized Basins)		Final t _e ^g [min]	100-Year Event		
	Name	K ^a	Area [ac]	Length [ft]	Slope [%]	t _i ^b [min]	Length [ft]	Slope [%]	Velocity ^c [fps]	t _t ^d [min]	Total Length [ft]	t _c =(L/180)+10 [min]		Intensity ^f [in/hr]	Runoff Coefficient, C ₁₀₀ ^g	Q ₁₀₀ ^h [cfs]
	10	0.90	3.32	343	1.7%	5.5	372	0.3%	1.3	4.8	715	14.0	10.3	6.10	0.93	9.4
	11	0.88	0.15	103	0.5%	5.1	0	0.0%	0.0	0	103	10.6	5.1	7.60	0.89	0.5
	12	0.90	0.05	109	2.3%	2.8	0	0.0%	0.0	0	109	10.6	5.0	7.60	0.93	0.2
	13	0.88	0.21	77	3.6%	2.3	0	0.0%	0.0	0	77	10.4	5.0	7.60	0.89	0.7
	14	0.88	0.15	23	4.3%	1.2	0	0.0%	0.0	0	23	10.1	5.0	7.60	0.89	0.5
	15	0.90	0.35	299	2.0%	4.9	59	2.1%	2.8	0.4	358	12.0	5.3	7.50	0.93	1.2
	20	0.90	3.69	313	1.0%	6.5	336	0.9%	2.0	2.8	649	13.6	9.3	6.30	0.93	10.8
	21	0.90	1.81	154	2.0%	3.5	759	0.9%	2.0	6.3	913	15.1	9.9	6.20	0.93	5.2
	22	0.88	0.17	55	2.0%	2.3	0	0.0%	0.0	0	55	10.3	5.0	7.60	0.89	0.6
	23	0.88	0.18	80	6.0%	1.9	0	0.0%	0.0	0	80	10.4	5.0	7.60	0.89	0.6
	30	0.90	1.99	171	0.5%	5.9	539	0.7%	1.6	5.6	710	13.9	11.5	5.90	0.93	5.5
	32	0.88	0.19	28	4.6%	1.3	0	0.0%	0.0	0	28	10.2	5.0	7.60	0.89	0.6
	33	0.89	1.50	156	1.9%	3.8	379	0.6%	1.5	4.2	535	13.0	8.0	6.60	0.90	4.5
	34	0.88	0.19	65	1.4%	2.9	0	0.0%	0.0	0	65	10.4	5.0	7.60	0.89	0.6
	35	0.90	0.63	146	0.3%	6.2	272	1.8%	2.7	1.7	418	12.3	7.9	6.60	0.93	1.9
	36	0.88	0.15	19	9.5%	0.8	0	0.0%	0.0	0	19	10.1	5.0	7.60	0.89	0.5

Notes:

^a K = C₁₀, 10-year runoff coefficient, from Table 601^b t_i = 1.8(1.1-K)L^{1/2}/S^{1/3} equation 602, can also use Figure 601^c Determined from Figure 602^d t_t = L/60V where V is determined from Figure 602^e Final t_e is the minimum of t_i + t_t and t_c (Minimum t_c for urban area is 5 minutes) This applies to urbanized basins only.^f If in McCarran Airport Rainfall Data area, intensity is determined from Figure 517, if outside area, follow procedures in Section 507^g Determined from Table 601^h Q = kCIA where "k" is the local adjustment factor equal to 0.5 per Section 604.3 of the CCFCD Hydrologic Criteria and Drainage Design Manual

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:

Appendix C Hydraulics

- FlowMaster Street Cross Sections
- BMP Calculations
- Finished Floor Calculations

Worksheet for A-A Desert Inn Rd

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00480	ft/ft
Discharge	617.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
-0+08.00	2121.00
0+00.00	2119.94
0+05.00	2119.82
0+07.20	2119.44
0+13.50	2119.61
0+18.57	2119.72
0+25.00	2119.87
0+30.00	2119.96
0+30.30	2122.49
0+31.50	2122.51

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+08.00, 2121.00)	(0+31.50, 2122.51)	0.013

Options

Current Roughness weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.02	ft
Elevation Range	2119.44 to 2122.51 ft	
Flow Area	59.72	ft²

Worksheet for A-A Desert Inn Rd

Results

Wetted Perimeter	40.08	ft
Hydraulic Radius	1.49	ft
Top Width	38.18	ft
Normal Depth	2.02	ft
Critical Depth	2.47	ft
Critical Slope	0.00214	ft/ft
Velocity	10.33	ft/s
Velocity Head	1.66	ft
Specific Energy	3.68	ft
Froude Number	1.46	
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	2.02	ft
Critical Depth	2.47	ft
Channel Slope	0.00480	ft/ft
Critical Slope	0.00214	ft/ft

Cross Section for A-A Desert Inn Rd

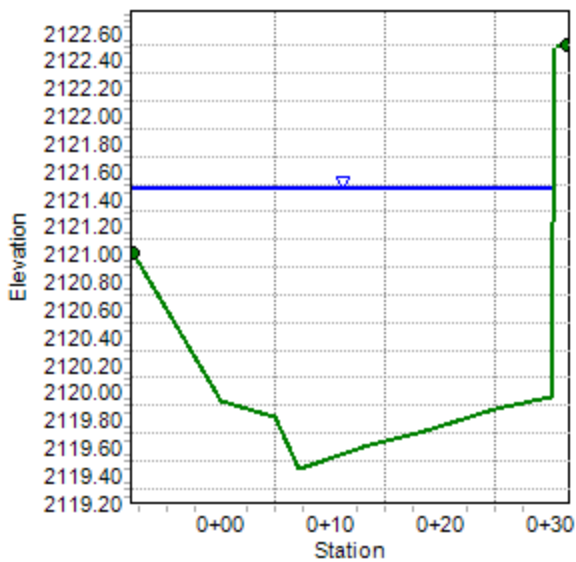
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00480	ft/ft
Normal Depth	2.02	ft
Discharge	617.00	ft ³ /s

Cross Section Image



Worksheet for B-B Rancho Dr South

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00290 ft/ft
Discharge 1562.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2120.00
0+00.00	2112.40
0+05.60	2112.20
0+05.60	2111.70
0+07.10	2111.81
0+08.70	2112.00
0+24.16	2111.00
0+39.60	2110.00
0+47.70	2109.75
0+73.93	2109.75
0+73.93	2120.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2120.00)	(0+07.10, 2111.81)	0.013
(0+07.10, 2111.81)	(0+73.93, 2120.00)	0.016

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 3.22 ft

Worksheet for B-B Rancho Dr South

Results

Elevation Range	2109.75 to 2120.00 ft	
Flow Area	177.64	ft ²
Wetted Perimeter	78.31	ft
Hydraulic Radius	2.27	ft
Top Width	73.93	ft
Normal Depth	3.22	ft
Critical Depth	3.22	ft
Critical Slope	0.00290	ft/ft
Velocity	8.79	ft/s
Velocity Head	1.20	ft
Specific Energy	4.42	ft
Froude Number	1.00	
Flow Type	Critical	

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	3.22	ft
Critical Depth	3.22	ft
Channel Slope	0.00290	ft/ft
Critical Slope	0.00290	ft/ft

Cross Section for B-B Rancho Dr South

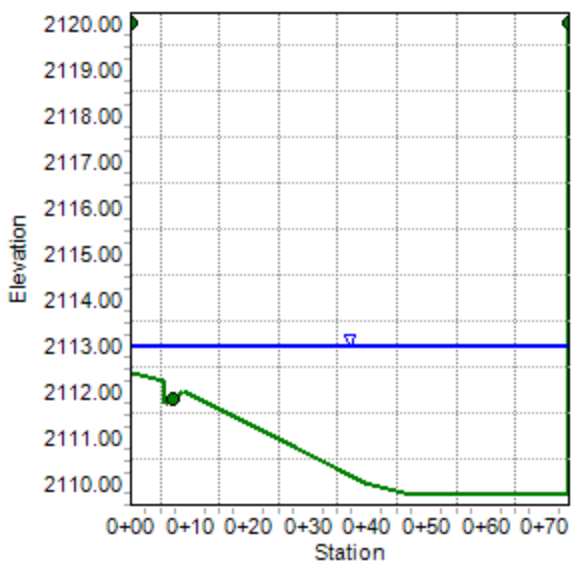
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00290	ft/ft
Normal Depth	3.22	ft
Discharge	1562.00	ft ³ /s

Cross Section Image



Worksheet for B-Ba Rancho Dr South

Project Description

Friction Method Manning Formula
Solve For Discharge

Input Data

Channel Slope 0.00110 ft/ft
Normal Depth 2.00 ft
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2120.00
0+00.00	2112.40
0+05.60	2112.20
0+05.60	2111.70
0+07.10	2111.81
0+08.70	2112.00
0+24.16	2111.00
0+39.60	2110.00
0+47.70	2109.75
0+52.85	2109.20
0+55.26	2109.00
0+56.86	2108.92
0+56.86	2106.92
0+73.64	2106.92
0+73.93	2109.75
0+73.93	2120.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2120.00)	(0+08.70, 2112.00)	0.013
(0+08.70, 2112.00)	(0+56.86, 2108.92)	0.016
(0+56.86, 2108.92)	(0+73.93, 2120.00)	0.013

Worksheet for B-Ba Rancho Dr South

Options

Current Roughness weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Discharge	176.85	ft ³ /s
Elevation Range	2106.92 to 2120.00 ft	
Flow Area	33.76	ft ²
Wetted Perimeter	20.79	ft
Hydraulic Radius	1.62	ft
Top Width	16.98	ft
Normal Depth	2.00	ft
Critical Depth	1.51	ft
Critical Slope	0.00265	ft/ft
Velocity	5.24	ft/s
Velocity Head	0.43	ft
Specific Energy	2.43	ft
Froude Number	0.65	
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	2.00	ft
Critical Depth	1.51	ft
Channel Slope	0.00110	ft/ft
Critical Slope	0.00265	ft/ft

Cross Section for B-Ba Rancho Dr South

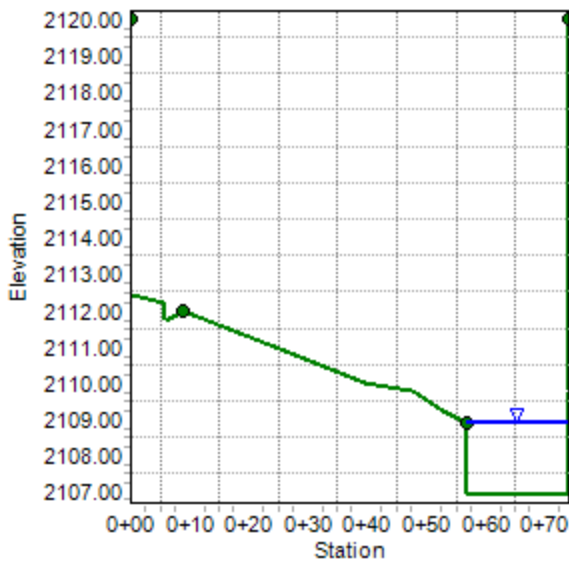
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00110	ft/ft
Normal Depth	2.00	ft
Discharge	176.85	ft ³ /s

Cross Section Image



Worksheet for C-C Rancho Dr Middle

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00750 ft/ft
Discharge 1354.72 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2120.00
0+00.00	2109.00
0+05.71	2108.95
0+05.71	2108.45
0+07.21	2108.56
0+46.89	2108.04
0+46.89	2108.54
0+50.45	2108.88
0+72.00	2108.88
0+80.70	2112.00
0+90.21	2114.00
0+97.52	2114.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2120.00)	(0+07.21, 2108.56)	0.013
(0+07.21, 2108.56)	(0+50.45, 2108.88)	0.016
(0+50.45, 2108.88)	(0+97.52, 2114.00)	0.013

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Worksheet for C-C Rancho Dr Middle

Results

Normal Depth	2.12	ft
Elevation Range	2108.04 to 2120.00 ft	
Flow Area	117.93	ft ²
Wetted Perimeter	77.97	ft
Hydraulic Radius	1.51	ft
Top Width	75.56	ft
Normal Depth	2.12	ft
Critical Depth	2.72	ft
Critical Slope	0.00260	ft/ft
Velocity	11.49	ft/s
Velocity Head	2.05	ft
Specific Energy	4.17	ft
Froude Number	1.62	
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	2.12	ft
Critical Depth	2.72	ft
Channel Slope	0.00750	ft/ft
Critical Slope	0.00260	ft/ft

Cross Section for C-C Rancho Dr Middle

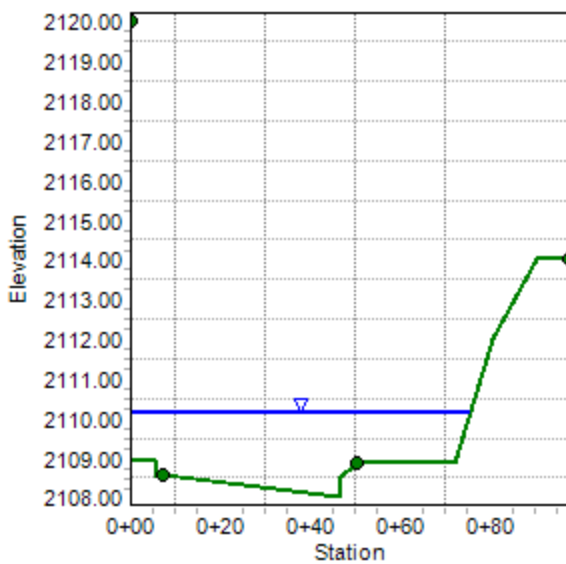
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00750	ft/ft
Normal Depth	2.12	ft
Discharge	1354.72	ft ³ /s

Cross Section Image



Worksheet for C-Ca Rancho Dr Middle

Project Description

Friction Method Manning Formula
Solve For Discharge

Input Data

Channel Slope 0.01000 ft/ft
Normal Depth 2.71 ft
Section Definitions

Station (ft)	Elevation (ft)
0+50.45	2108.88
0+55.18	2108.00
0+60.27	2107.00
0+65.54	2106.16
0+67.00	2107.00
0+80.70	2112.00
0+90.21	2114.00
0+97.52	2114.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+50.45, 2108.88)	(0+97.52, 2114.00)	0.013

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Discharge 398.28 ft³/s
Elevation Range 2106.16 to 2114.00 ft
Flow Area 29.21 ft²
Wetted Perimeter 22.42 ft
Hydraulic Radius 1.30 ft

Worksheet for C-Ca Rancho Dr Middle

Results

Top Width	21.62	ft
Normal Depth	2.71	ft
Critical Depth	3.58	ft
Critical Slope	0.00214	ft/ft
Velocity	13.64	ft/s
Velocity Head	2.89	ft
Specific Energy	5.60	ft
Froude Number	2.07	
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	2.71	ft
Critical Depth	3.58	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00214	ft/ft

Cross Section for C-Ca Rancho Dr Middle

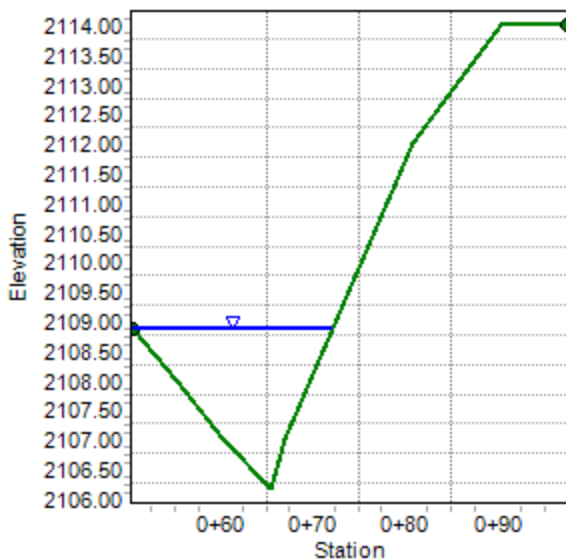
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	2.71	ft
Discharge	398.28	ft ³ /s

Cross Section Image



Worksheet for D-D Driveway N/S

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00448 ft/ft
Discharge 5.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2114.00
0+18.00	2114.77
0+20.00	2114.25
0+23.00	2114.00
0+39.00	2113.86
0+56.00	2113.67
0+58.00	2113.80
0+60.00	2113.81

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2114.00)	(0+60.00, 2113.81)	0.013

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 0.23 ft
Elevation Range 2113.67 to 2114.77 ft
Flow Area 2.82 ft²
Wetted Perimeter 25.25 ft
Hydraulic Radius 0.11 ft

Worksheet for D-D Driveway N/S

Results

Top Width	25.16	ft
Normal Depth	0.23	ft
Critical Depth	0.22	ft
Critical Slope	0.00518	ft/ft
Velocity	1.78	ft/s
Velocity Head	0.05	ft
Specific Energy	0.28	ft
Froude Number	0.94	
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	0.23	ft
Critical Depth	0.22	ft
Channel Slope	0.00448	ft/ft
Critical Slope	0.00518	ft/ft

Cross Section for D-D Driveway N/S

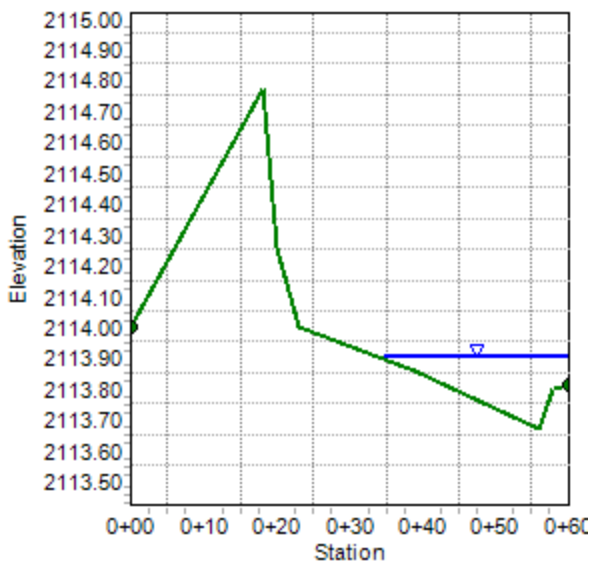
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00448	ft/ft
Normal Depth	0.23	ft
Discharge	5.00	ft ³ /s

Cross Section Image



Worksheet for E-E Sirius Avenue

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00620 ft/ft
Discharge 1081.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2109.49
0+01.00	2109.00
0+05.00	2109.21
0+07.00	2108.95
0+17.00	2109.00
0+46.00	2109.00
0+53.00	2108.89
0+55.00	2109.28
0+60.00	2109.85

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2109.49)	(0+60.00, 2109.85)	0.013

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 1.70 ft
Elevation Range 2108.89 to 2109.85 ft
Flow Area 92.22 ft²
Wetted Perimeter 62.05 ft

Worksheet for E-E Sirius Avenue

Results

Hydraulic Radius	1.49	ft
Top Width	60.00	ft
Normal Depth	1.70	ft
Critical Depth	2.32	ft
Critical Slope	0.00205	ft/ft
Velocity	11.72	ft/s
Velocity Head	2.14	ft
Specific Energy	3.84	ft
Froude Number	1.67	
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	1.70	ft
Critical Depth	2.32	ft
Channel Slope	0.00620	ft/ft
Critical Slope	0.00205	ft/ft

Cross Section for E-E Sirius Avenue

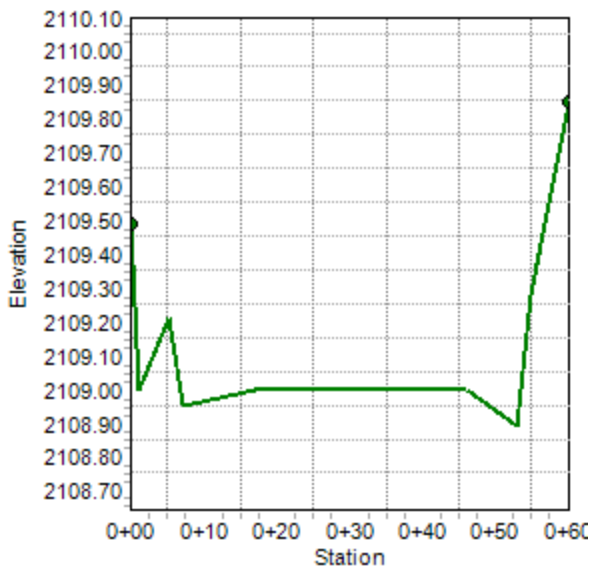
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00620	ft/ft
Normal Depth	1.70	ft
Discharge	1081.00	ft ³ /s

Cross Section Image



Worksheet for F-F Rancho Dr North

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00700 ft/ft
Discharge 2538.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+50.00	2112.00
0+50.00	2107.75
0+97.00	2107.00
1+05.00	2104.00
1+12.00	2104.00
1+20.00	2108.00
1+36.00	2112.00
1+58.00	2112.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+50.00, 2112.00)	(1+58.00, 2112.00)	0.015

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 5.16 ft
Elevation Range 2104.00 to 2112.00 ft
Flow Area 176.90 ft²
Wetted Perimeter 77.66 ft
Hydraulic Radius 2.28 ft

Worksheet for F-F Rancho Dr North

Results

Top Width	74.62	ft
Normal Depth	5.16	ft
Critical Depth	6.12	ft
Critical Slope	0.00238	ft/ft
Velocity	14.35	ft/s
Velocity Head	3.20	ft
Specific Energy	8.35	ft
Froude Number	1.64	
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	5.16	ft
Critical Depth	6.12	ft
Channel Slope	0.00700	ft/ft
Critical Slope	0.00238	ft/ft

Cross Section for F-F Rancho Dr North

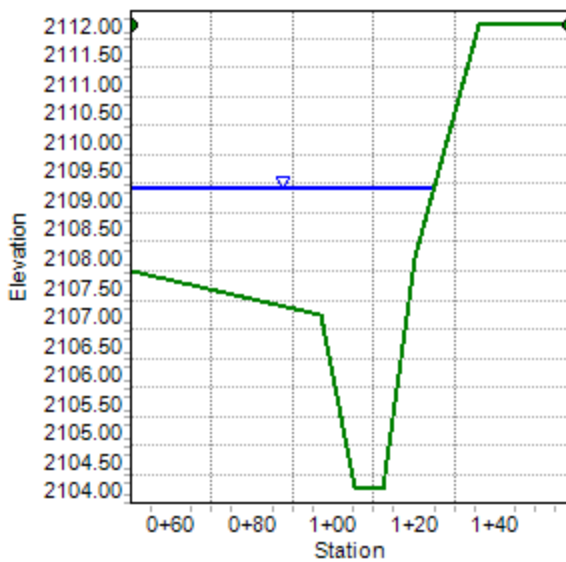
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00700	ft/ft
Normal Depth	5.16	ft
Discharge	2538.00	ft ³ /s

Cross Section Image



Worksheet for G-G Sirius Avenue

Project Description

Friction Method Manning Formula

Solve For	Normal Depth
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Input Data

Channel Slope	0.01500	ft/ft
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Discharge	1081.00	ft ³ /s
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Section Definitions

Station (ft)	Elevation (ft)
0+70.00	15.00
0+70.00	12.13
0+76.00	12.00
0+76.00	11.50
0+82.00	11.80
0+90.00	12.00
1+00.00	12.30
1+14.00	12.00
1+23.00	11.80
1+27.00	11.60
1+30.00	12.00
1+30.00	15.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+70.00, 15.00)	(0+76.00, 11.50)	0.013
(0+76.00, 11.50)	(1+23.00, 11.80)	0.016
(1+23.00, 11.80)	(1+30.00, 12.00)	0.013
(1+30.00, 12.00)	(1+30.00, 15.00)	0.016

Options

Current Roughness Weighted Method Pavlovskii's Method

Open Channel Weighting Method Pavlovskii's Method

Closed Channel Weighting Method Pavlovskii's Method

Worksheet for G-G Sirius Avenue

Results

Normal Depth		1.78	ft
Elevation Range	11.50 to 15.00 ft		
Flow Area		78.65	ft ²
Wetted Perimeter		62.99	ft
Hydraulic Radius		1.25	ft
Top Width		60.00	ft
Normal Depth		1.78	ft
Critical Depth		2.63	ft
Critical Slope		0.00294	ft/ft
Velocity		13.74	ft/s
Velocity Head		2.94	ft
Specific Energy		4.72	ft
Froude Number		2.12	
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	1.78	ft
Critical Depth	2.63	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.00294	ft/ft

Cross Section for G-G Sirius Avenue

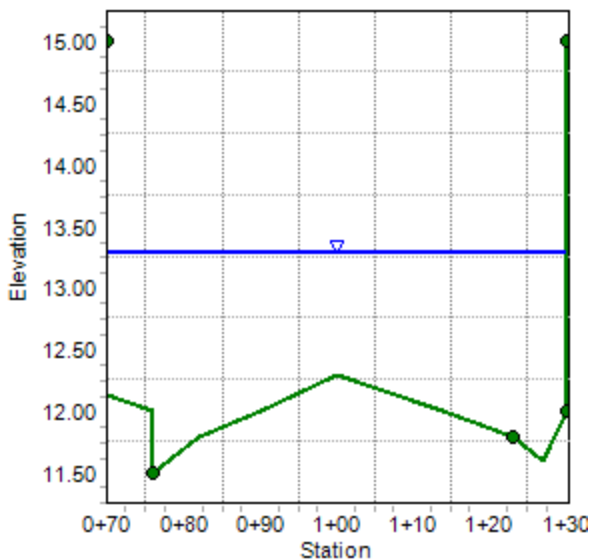
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01500	ft/ft
Normal Depth	1.78	ft
Discharge	1081.00	ft ³ /s

Cross Section Image



Worksheet for H-H Rancho Drive

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00900	ft/ft
Discharge	1413.00	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	2125.00
0+00.00	2115.12
0+05.58	2114.93
0+05.58	2114.43
0+07.08	2114.54
0+50.37	2114.02
0+52.59	2114.26
0+60.02	2114.26
0+60.82	2125.54

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2125.00)	(0+07.08, 2114.54)	0.013
(0+07.08, 2114.54)	(0+52.59, 2114.26)	0.016
(0+52.59, 2114.26)	(0+60.82, 2125.54)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.11	ft
Elevation Range	2114.02 to 2125.54 ft	

Worksheet for H-H Rancho Drive

Results

Flow Area	107.37	ft ²
Wetted Perimeter	63.44	ft
Hydraulic Radius	1.69	ft
Top Width	60.15	ft
Normal Depth	2.11	ft
Critical Depth	2.91	ft
Critical Slope	0.00273	ft/ft
Velocity	13.16	ft/s
Velocity Head	2.69	ft
Specific Energy	4.81	ft
Froude Number	1.74	
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	2.11	ft
Critical Depth	2.91	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00273	ft/ft

Cross Section for H-H Rancho Drive

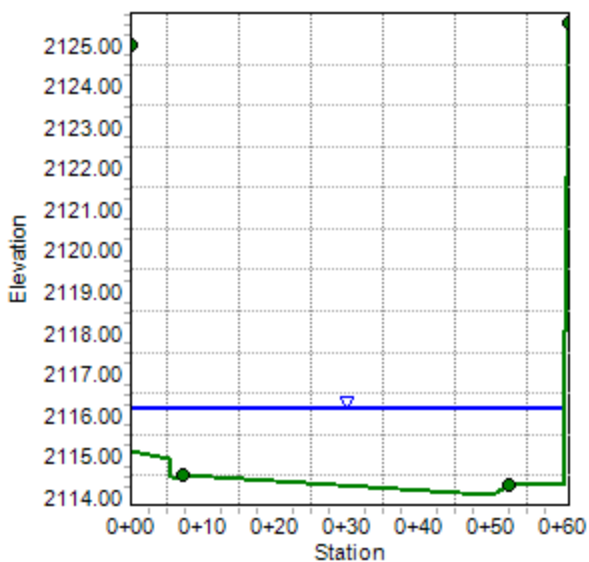
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00900	ft/ft
Normal Depth	2.11	ft
Discharge	1413.00	ft ³ /s

Cross Section Image



Worksheet for H-Ha Rancho Drive

Project Description

Friction Method Manning Formula
Solve For Discharge

Input Data

Channel Slope 0.00240 ft/ft
Normal Depth 4.35 ft
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2125.00
0+00.00	2115.12
0+05.58	2114.93
0+05.58	2114.43
0+07.08	2114.54
0+50.37	2114.02
0+52.59	2114.26
0+53.58	2109.65
0+60.02	2109.67
0+60.82	2125.54

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2125.00)	(0+07.08, 2114.54)	0.013
(0+07.08, 2114.54)	(0+52.59, 2114.26)	0.016
(0+52.59, 2114.26)	(0+60.82, 2125.54)	0.013

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Discharge 270.73 ft³/s

Worksheet for H-Ha Rancho Drive

Results

Elevation Range	2109.65 to 2125.54 ft	
Flow Area	30.45	ft ²
Wetted Perimeter	15.22	ft
Hydraulic Radius	2.00	ft
Top Width	7.59	ft
Normal Depth	4.35	ft
Critical Depth	3.71	ft
Critical Slope	0.00377	ft/ft
Velocity	8.89	ft/s
Velocity Head	1.23	ft
Specific Energy	5.58	ft
Froude Number	0.78	
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	4.35	ft
Critical Depth	3.71	ft
Channel Slope	0.00240	ft/ft
Critical Slope	0.00377	ft/ft

Cross Section for H-Ha Rancho Drive

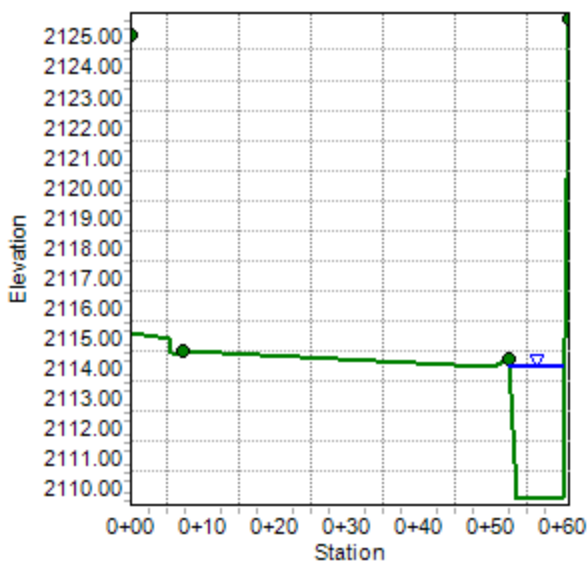
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00240	ft/ft
Normal Depth	4.35	ft
Discharge	270.73	ft ³ /s

Cross Section Image



Worksheet for A-A Desert Inn Rd 10-yr

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00480 ft/ft
Discharge 248.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
-0+08.00	2121.00
0+00.00	2119.94
0+05.00	2119.82
0+07.20	2119.44
0+13.50	2119.61
0+18.57	2119.72
0+25.00	2119.87
0+30.00	2119.96
0+30.30	2122.49
0+31.50	2122.51

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+08.00, 2121.00)	(0+31.50, 2122.51)	0.013

Options

Current Roughness weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 1.33 ft
Elevation Range 2119.44 to 2122.51 ft
Flow Area 33.54 ft²

Worksheet for A-A Desert Inn Rd 10-yr

Results

Wetted Perimeter	37.16	ft
Hydraulic Radius	0.90	ft
Top Width	36.35	ft
Normal Depth	1.33	ft
Critical Depth	1.55	ft
Critical Slope	0.00247	ft/ft
Velocity	7.40	ft/s
Velocity Head	0.85	ft
Specific Energy	2.18	ft
Froude Number	1.36	
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	1.33	ft
Critical Depth	1.55	ft
Channel Slope	0.00480	ft/ft
Critical Slope	0.00247	ft/ft

Cross Section for A-A Desert Inn Rd 10-yr

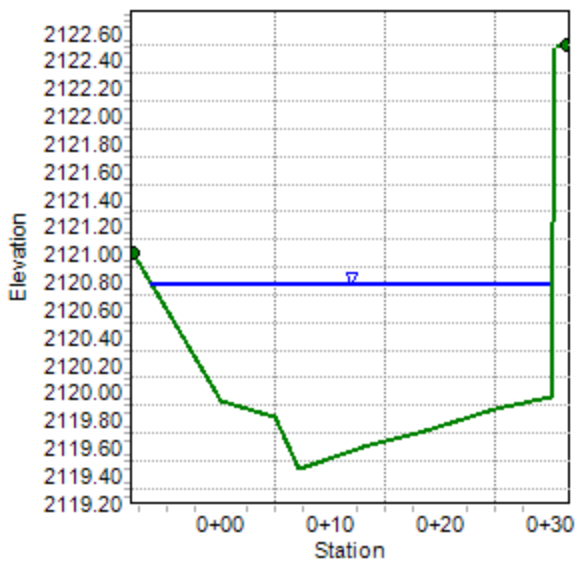
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00480	ft/ft
Normal Depth	1.33	ft
Discharge	248.00	ft ³ /s

Cross Section Image



Project Description

Input Data

0+00.00	2120.00
0+00.00	2112.40
0+05.60	2112.20
0+05.60	2111.70
0+07.10	2111.81
0+08.70	2112.00
0+24.16	2111.00
0+39.60	2110.00
0+47.70	2109.75
0+73.93	2109.75
0+73.93	2120.00

(0+00.00, 2120.00)	(0+07.10, 2111.81)	0.013
(0+07.10, 2111.81)	(0+73.93, 2120.00)	0.016

Current Roughness weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Normal Depth	1.49	ft
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Worksheet for B-B Rancho Dr South 10-yr

Results

Elevation Range	2109.75 to 2120.00 ft	
Flow Area	62.05	ft ²
Wetted Perimeter	55.03	ft
Hydraulic Radius	1.13	ft
Top Width	53.49	ft
Normal Depth	1.49	ft
Critical Depth	1.39	ft
Critical Slope	0.00376	ft/ft
Velocity	5.42	ft/s
Velocity Head	0.46	ft
Specific Energy	1.95	ft
Froude Number	0.89	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.49	ft
Critical Depth	1.39	ft
Channel Slope	0.00290	ft/ft
Critical Slope	0.00376	ft/ft

Cross Section for B-B Rancho Dr South 10-yr

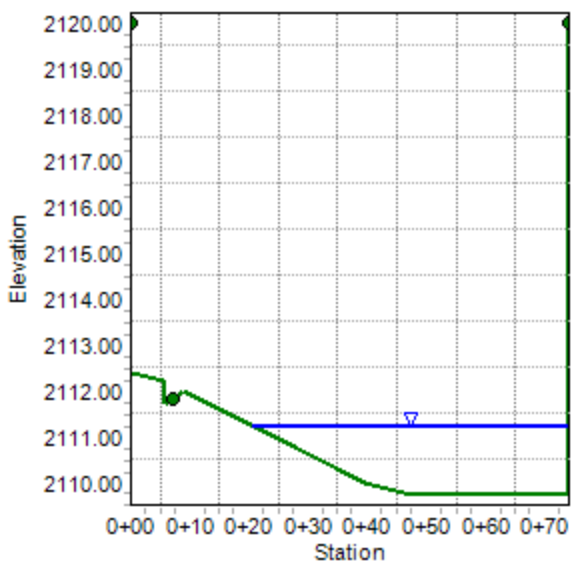
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00290	ft/ft
Normal Depth	1.49	ft
Discharge	336.15	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
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Roughness Segment Definitions

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Worksheet for B-Ba Rancho Dr South 10-yr

Options

Current Roughness weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Discharge	176.85	ft ³ /s
Elevation Range	2106.92 to 2120.00	ft
Flow Area	33.76	ft ²
Wetted Perimeter	20.79	ft
Hydraulic Radius	1.62	ft
Top Width	16.98	ft
Normal Depth	2.00	ft
Critical Depth	1.51	ft
Critical Slope	0.00265	ft/ft
Velocity	5.24	ft/s
Velocity Head	0.43	ft
Specific Energy	2.43	ft
Froude Number	0.65	
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	2.00	ft
Critical Depth	1.51	ft
Channel Slope	0.00110	ft/ft
Critical Slope	0.00265	ft/ft

Cross Section for B-Ba Rancho Dr South 10-yr

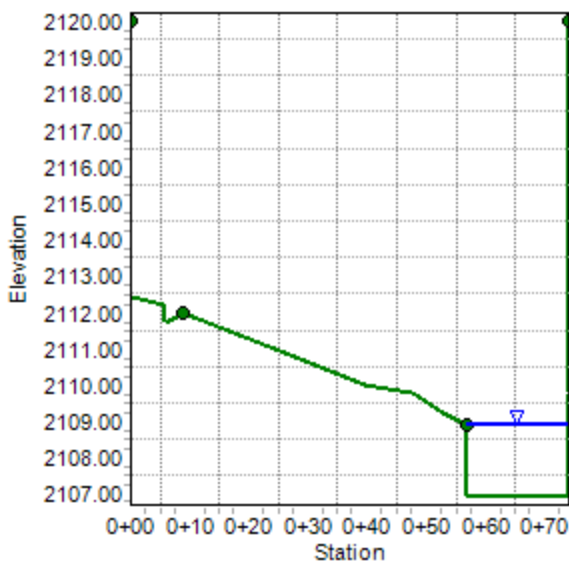
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00110	ft/ft
Normal Depth	2.00	ft
Discharge	176.85	ft ³ /s

Cross Section Image



Project Description

Input Data

0+00.00	2120.00
0+00.00	2109.00
0+05.71	2108.95
0+05.71	2108.45
0+07.21	2108.56
0+46.89	2108.04
0+46.89	2108.54
0+50.45	2108.88
0+72.00	2108.88
0+80.70	2112.00
0+90.21	2114.00
0+97.52	2114.00

(0+00.00, 2120.00)	(0+07.21, 2108.56)	0.013
(0+07.21, 2108.56)	(0+50.45, 2108.88)	0.016
(0+50.45, 2108.88)	(0+97.52, 2114.00)	0.013

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for C-C Rancho Dr Middle 10-yr

Results

Normal Depth		0.88	ft
Elevation Range	2108.04 to 2120.00 ft		
Flow Area		26.61	ft ²
Wetted Perimeter		67.39	ft
Hydraulic Radius		0.39	ft
Top Width		66.39	ft
Normal Depth		0.88	ft
Critical Depth		0.96	ft
Critical Slope		0.00438	ft/ft
Velocity		4.61	ft/s
Velocity Head		0.33	ft
Specific Energy		1.21	ft
Froude Number		1.28	
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	0.88	ft
Critical Depth	0.96	ft
Channel Slope	0.00750	ft/ft
Critical Slope	0.00438	ft/ft

Cross Section for C-C Rancho Dr Middle 10-yr

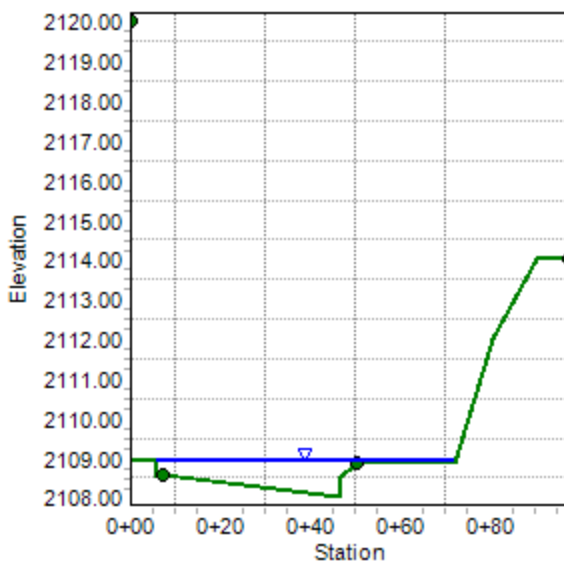
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00750	ft/ft
Normal Depth	0.88	ft
Discharge	122.72	ft ³ /s

Cross Section Image



Worksheet for C-Ca Rancho Dr Middle 10-yr

Project Description

Friction Method Manning Formula
Solve For Discharge

Input Data

Channel Slope 0.01000 ft/ft
Normal Depth 2.71 ft
Section Definitions

Station (ft)	Elevation (ft)
0+50.45	2108.88
0+55.18	2108.00
0+60.27	2107.00
0+65.54	2106.16
0+67.00	2107.00
0+80.70	2112.00
0+90.21	2114.00
0+97.52	2114.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+50.45, 2108.88)	(0+97.52, 2114.00)	0.013

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Discharge 398.28 ft³/s
Elevation Range 2106.16 to 2114.00 ft
Flow Area 29.21 ft²
Wetted Perimeter 22.42 ft
Hydraulic Radius 1.30 ft

Worksheet for C-Ca Rancho Dr Middle 10-yr

Results

Top Width	21.62	ft
Normal Depth	2.71	ft
Critical Depth	3.58	ft
Critical Slope	0.00214	ft/ft
Velocity	13.64	ft/s
Velocity Head	2.89	ft
Specific Energy	5.60	ft
Froude Number	2.07	
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	2.71	ft
Critical Depth	3.58	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00214	ft/ft

Cross Section for C-Ca Rancho Dr Middle 10-yr

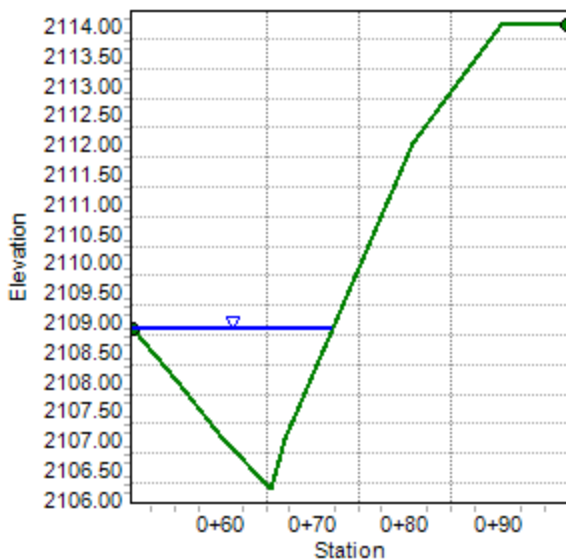
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	2.71	ft
Discharge	398.28	ft ³ /s

Cross Section Image



Worksheet for D-D Driveway N/S 10-yr

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00448 ft/ft
Discharge 4.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2114.00
0+18.00	2114.77
0+20.00	2114.25
0+23.00	2114.00
0+39.00	2113.86
0+56.00	2113.67
0+58.00	2113.80
0+60.00	2113.81

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2114.00)	(0+60.00, 2113.81)	0.013

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 0.21 ft
Elevation Range 2113.67 to 2114.77 ft
Flow Area 2.38 ft²
Wetted Perimeter 23.18 ft
Hydraulic Radius 0.10 ft

Worksheet for D-D Driveway N/S 10-yr

Results

Top Width	23.11	ft
Normal Depth	0.21	ft
Critical Depth	0.20	ft
Critical Slope	0.00533	ft/ft
Velocity	1.68	ft/s
Velocity Head	0.04	ft
Specific Energy	0.25	ft
Froude Number	0.92	
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	0.21	ft
Critical Depth	0.20	ft
Channel Slope	0.00448	ft/ft
Critical Slope	0.00533	ft/ft

Cross Section for D-D Driveway N/S 10-yr

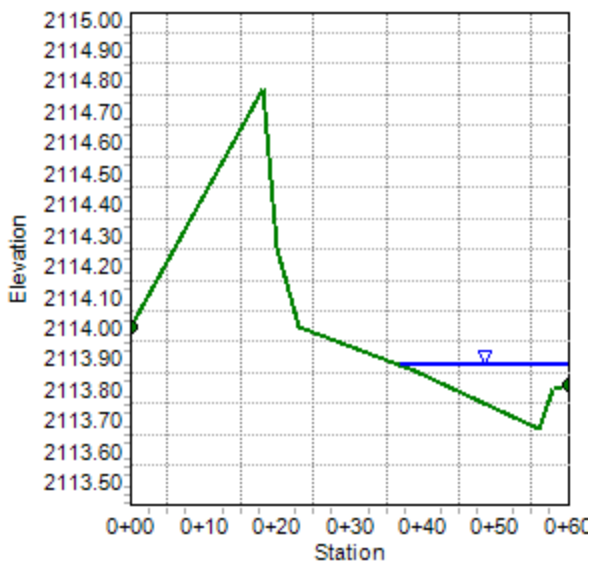
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00448	ft/ft
Normal Depth	0.21	ft
Discharge	4.00	ft ³ /s

Cross Section Image



Worksheet for E-E Sirius Avenue 10-yr

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00620 ft/ft
Discharge 427.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2109.49
0+01.00	2109.00
0+05.00	2109.21
0+07.00	2108.95
0+17.00	2109.00
0+46.00	2109.00
0+53.00	2108.89
0+55.00	2109.28
0+60.00	2109.85

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2109.49)	(0+60.00, 2109.85)	0.013

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 1.04 ft
Elevation Range 2108.89 to 2109.85 ft
Flow Area 52.37 ft²
Wetted Perimeter 60.72 ft

Worksheet for E-E Sirius Avenue 10-yr

Results

Hydraulic Radius	0.86	ft
Top Width	60.00	ft
Normal Depth	1.04	ft
Critical Depth	1.33	ft
Critical Slope	0.00241	ft/ft
Velocity	8.15	ft/s
Velocity Head	1.03	ft
Specific Energy	2.07	ft
Froude Number	1.54	
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	1.04	ft
Critical Depth	1.33	ft
Channel Slope	0.00620	ft/ft
Critical Slope	0.00241	ft/ft

Cross Section for E-E Sirius Avenue 10-yr

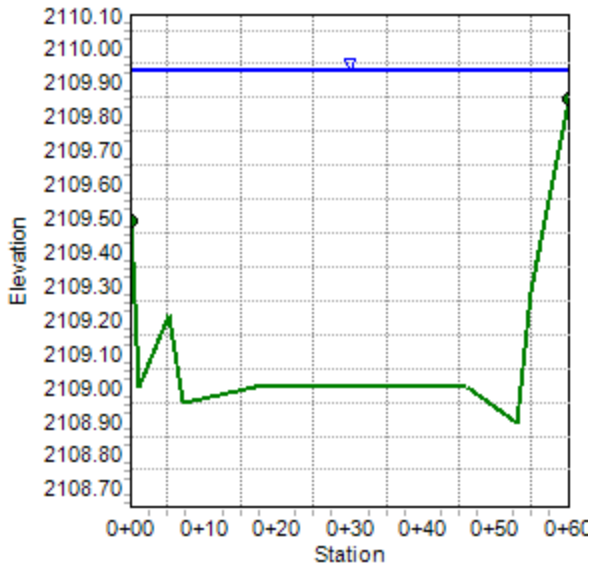
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00620	ft/ft
Normal Depth	1.04	ft
Discharge	427.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
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Roughness Segment Definitions

(0+50.00, 2112.00)	(1+58.00, 2112.00)	0.015
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Options

Results

Bentley Systems, Inc. Haestad Methods Soildyne Center Master V8i (SELECTseries 1) [08.11.01.03]

Worksheet for F-F Rancho Dr North 10-yr

Results

Top Width	69.91	ft
Normal Depth	3.96	ft
Critical Depth	4.37	ft
Critical Slope	0.00288	ft/ft
Velocity	9.67	ft/s
Velocity Head	1.45	ft
Specific Energy	5.41	ft
Froude Number	1.50	
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	3.96	ft
Critical Depth	4.37	ft
Channel Slope	0.00700	ft/ft
Critical Slope	0.00288	ft/ft

Cross Section for F-F Rancho Dr North 10-yr

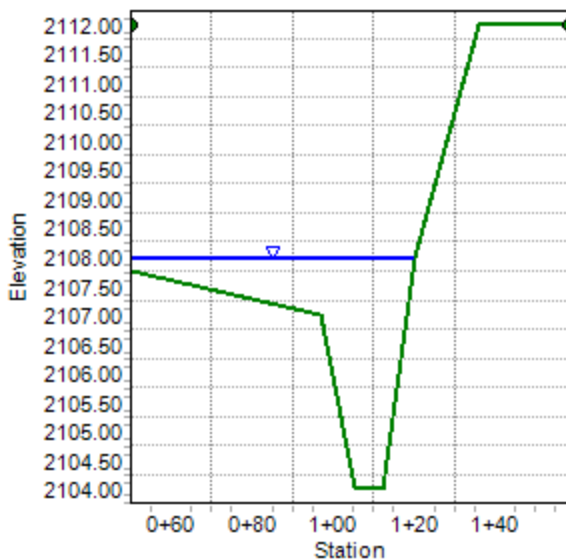
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00700	ft/ft
Normal Depth	3.96	ft
Discharge	873.00	ft ³ /s

Cross Section Image



Worksheet for G-G Sirius Avenue 10-yr

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.01500 ft/ft
Discharge 427.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+70.00	15.00
0+70.00	12.13
0+76.00	12.00
0+76.00	11.50
0+82.00	11.80
0+90.00	12.00
1+00.00	12.30
1+14.00	12.00
1+23.00	11.80
1+27.00	11.60
1+30.00	12.00
1+30.00	15.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+70.00, 15.00)	(0+76.00, 11.50)	0.013
(0+76.00, 11.50)	(1+23.00, 11.80)	0.016
(1+23.00, 11.80)	(1+30.00, 12.00)	0.013
(1+30.00, 12.00)	(1+30.00, 15.00)	0.016

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Worksheet for G-G Sirius Avenue 10-yr

Results

Normal Depth		1.22	ft
Elevation Range	11.50 to 15.00 ft		
Flow Area		44.75	ft ²
Wetted Perimeter		61.86	ft
Hydraulic Radius		0.72	ft
Top Width		60.00	ft
Normal Depth		1.22	ft
Critical Depth		1.64	ft
Critical Slope		0.00347	ft/ft
Velocity		9.54	ft/s
Velocity Head		1.41	ft
Specific Energy		2.63	ft
Froude Number		1.95	
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	1.22	ft
Critical Depth	1.64	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.00347	ft/ft

Cross Section for G-G Sirius Avenue 10-yr

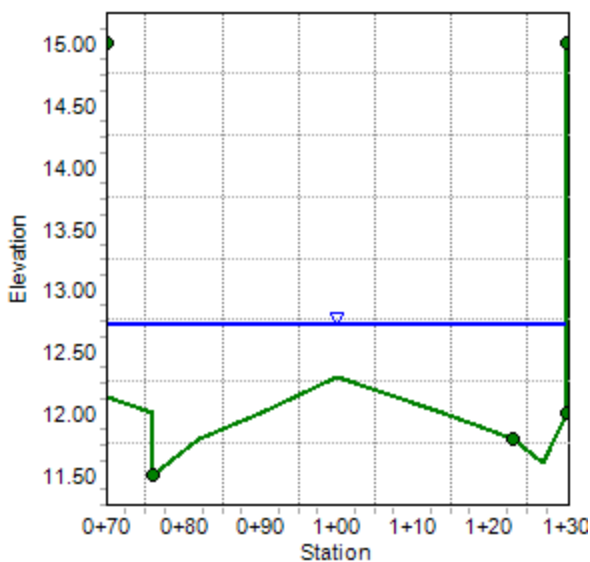
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01500	ft/ft
Normal Depth	1.22	ft
Discharge	427.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
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Roughness Segment Definitions

Options

Results

Bentley Systems, Inc. Haestad Methods Software Center Master V8i (SELECTseries 1) [08.11.01.03]

Worksheet for H-H Rancho Drive 10-yr

Results

Flow Area	32.80	ft ²
Wetted Perimeter	55.53	ft
Hydraulic Radius	0.59	ft
Top Width	54.48	ft
Normal Depth	0.86	ft
Critical Depth	1.04	ft
Critical Slope	0.00399	ft/ft
Velocity	6.40	ft/s
Velocity Head	0.64	ft
Specific Energy	1.50	ft
Froude Number	1.45	
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	0.86	ft
Critical Depth	1.04	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.00399	ft/ft

Cross Section for H-H Rancho Drive 10-yr

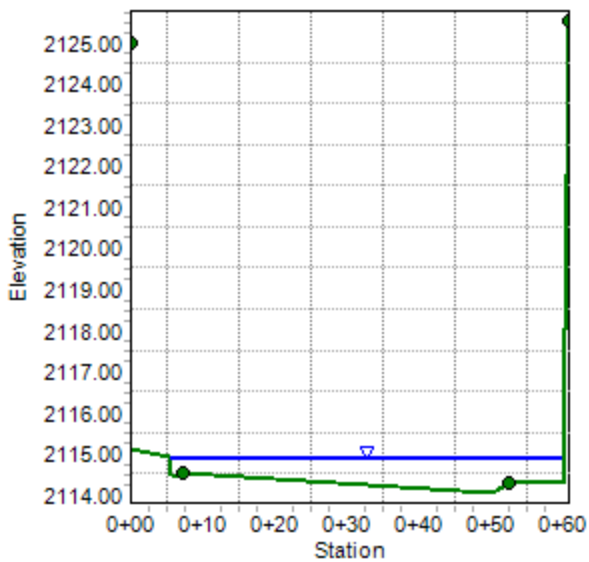
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00900	ft/ft
Normal Depth	0.86	ft
Discharge	210.00	ft ³ /s

Cross Section Image



Worksheet for H-Ha Rancho Drive 10-yr

Project Description

Friction Method Manning Formula
Solve For Discharge

Input Data

Channel Slope 0.00240 ft/ft
Normal Depth 4.35 ft
Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2125.00
0+00.00	2115.12
0+05.58	2114.93
0+05.58	2114.43
0+07.08	2114.54
0+50.37	2114.02
0+52.59	2114.26
0+53.58	2109.65
0+60.02	2109.67
0+60.82	2125.54

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 2125.00)	(0+07.08, 2114.54)	0.013
(0+07.08, 2114.54)	(0+52.59, 2114.26)	0.016
(0+52.59, 2114.26)	(0+60.82, 2125.54)	0.013

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Discharge 270.73 ft³/s

Worksheet for H-Ha Rancho Drive 10-yr

Results

Elevation Range	2109.65 to 2125.54 ft	
Flow Area	30.45	ft ²
Wetted Perimeter	15.22	ft
Hydraulic Radius	2.00	ft
Top Width	7.59	ft
Normal Depth	4.35	ft
Critical Depth	3.71	ft
Critical Slope	0.00377	ft/ft
Velocity	8.89	ft/s
Velocity Head	1.23	ft
Specific Energy	5.58	ft
Froude Number	0.78	
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	4.35	ft
Critical Depth	3.71	ft
Channel Slope	0.00240	ft/ft
Critical Slope	0.00377	ft/ft

Cross Section for H-Ha Rancho Drive 10-yr

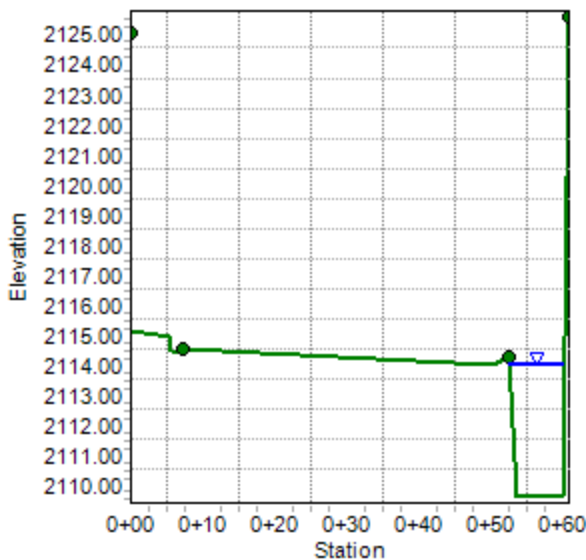
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00240	ft/ft
Normal Depth	4.35	ft
Discharge	270.73	ft³/s

Cross Section Image



BMP Calculations

From Procedure in Section 1502.3

$$\begin{aligned}\text{Site Area} &= 15 \text{ [acres]} \\ \text{D}_2 \text{ Site}^A &= 0.72 \text{ [in]} \\ \text{D}_2 \text{ Site} / \text{D}_2 \text{ McCarran} &= 1 \text{ } 1 \\ \text{Percent Impervious} &= 100\%\end{aligned}$$

1. Determine BMP Design Precipitation - 85th Percentile Rainfall Depth

$$\text{D}_{85} = 0.32 \text{ [in]}$$

2. Calculate BMP Design Discharge

$$\text{Q}_p/\text{A} (90\%) = 0.47 \text{ [cfs/ac]}$$

Find Adjustment Factor for % Impervious

$$\text{Q}_p/\text{A} = 0.50 \text{ [cfs/ac]}$$

$$\text{Q}_p = 7 \text{ [cfs]}$$

3. Calculate BMP Design Runoff Volume

$$\text{Vol}/\text{A} (90\%) = 0.03 \text{ [ft]}$$

$$\text{Vol}/\text{A} = 0.04 \text{ [ft]}$$

$$\text{Vol} = 0.5 \text{ [ac-ft]}$$

Note, BMPs provided on this project are Disconnected impervious areas. The parking lots drain through swales to perimeter roads.

^ASite is located in McCarran Airport Rainfall Area, 2-yr 6-hr storm event

Finished Floor Elevations

Cross Section I.D.	Gutter Elev	WSE [Elev]	(WSE - Gutter El) x 2 +Gutter El [Elev]	WSE+1.5' [Elev]	FF Elev
B-B	2111.70	2112.97	2114.24	2114.47	2114.24
C-C	2108.45	2110.16	2111.87	2111.66	2111.66
G-G	2111.30	2112.38	2113.46	2113.88	2113.46
H-H	2114.43	2116.13	2117.83	2117.63	2117.63

Appendix D Grading Plans
(under separate cover)