

Technical Drainage Study for the Las Vegas Medical District (193 Unit Apartment Complex)

September 2022

Prepared for:

VEGAS MD ALTA PROPERTY OWNER LLC
1020 W. LAWRENCE AVE., Suite 300
Chicago, IL 60640

Prepared by:

Lochsa Engineering
6345 South Jones Boulevard, Suite 100
Las Vegas, Nevada 89118
(702) 365-9312

Lochsa Job No. 221050

September 21, 2022

Albert Sung, P.E.
City of Las Vegas Public Works Department
(Flood Control Division)
495 S. Main Street
Las Vegas, NV 89101

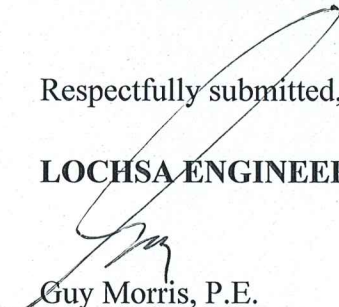
Subject: **Technical Drainage Study for Las Vegas Medical Office**
Lochsa Job No. 221050

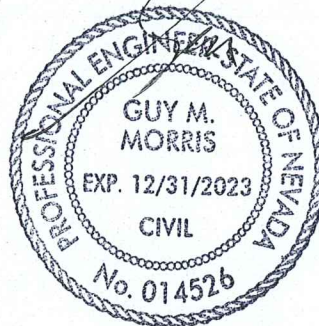
Mr. Sung:

This letter certifies that all items provided on the **Technical Drainage Study for Las Vegas Medical Office** electronic submittal matches the paper version bound into the study.

Respectfully submitted,

LOCHSA ENGINEERING


Guy Morris, P.E.



9-20-22

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Las Vegas Medical District Date: SEPTEMBER 20, 2022

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

East/West: ALTA DRIVE

b) Section: 33 Township: 20 SOUTH Range: 61 EAST

c) APN : 139-33-301-002/003/010/011/016

Name of Owner: VEGAS MD ALTA PROPERTY OWNER LLC

Telephone No.: N/A Fax No.: E-Mail Address: N/A

Address: 1020 W. LAWRENCE AVE., Suite 300 CHICAGO, IL 60640

Contact Person-Name: CHRIS BLAKE, EI Telephone No.: 702-365-9312

* E-Mail Address: CHRIS.BLAKE@LOCHSA.COM Fax No.: 702-365-9317

Firm: LOCHSA ENGINEERING

Address: 6345 S JONES BLVD STE 100 LAS VEGAS NV 89118

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: 1.12+/- ACRES Being Developed/Disturbed: 1.12+/- ACRES

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

3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☐ Yes** ☒ No

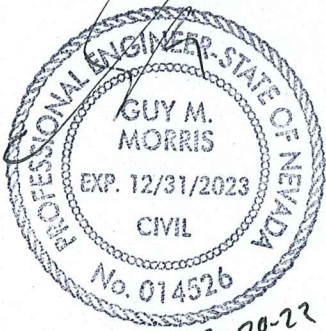
4. Proposed type of development (Residential, Commercial, Etc.): APARTMENT

5. Approximate upstream land area which drains to the subject site: 50+/- ACRES

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

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: NORTHEASTERLY TO ALTA DRIVE & SOUTHEASTERLY TO HAMILTON LANE

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



Engineer's Seal

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

***New Required Field**

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

	Revision	Date
Local Entity File No. _____		

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: LV Medical District	Map ID:
Firm Name: LOCHSA	Engineer: Guy Morris, PE
Address: 6345 S. JONES BLVD., STE. 100	
City: LAS VEGAS	State: NV Zip: 89118
Phone Number: (702) 365-9312	Fax Number: (702) 365-9317
Property Owner: VEGAS MD ALTA PROPERTY OWNER LLC	
Address: 1020 W. LAWRENCE AVE., STE. 300	
City: CHICAGO	State: IL Zip: 60640
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

- | | | |
|---|---|--|
| Yes ☒ | No ☐ | Design Manual Standard Form 1 with the engineer's seal and signature. |
| Yes ☒ | No ☐ | Design Manual Standard Form 4 . |
| Yes ☒ | No ☐ | 2 copies of the 24" x 36" Drainage Plan. |
| | N/A ☒ | A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge. |

II. MAPS AND EXHIBITS

- | | | |
|---|-----------------------------|---|
| Yes ☒ | No ☐ | A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated. |
| Yes ☒ | No ☐ | A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated. |

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	
☒	N/A	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.
☐	N/A	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.
☐	N/A	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
☐	N/A	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.
☐	N/A	Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
☐	N/A	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.
☐	N/A	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
☐	N/A	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. $Q_{100} d \times v \leq 8$. $Q_{10} d \times v \leq 6$ 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. • 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. <u>GM</u> 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.)
✓		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	
✓		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.
	N/A	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.
	N/A	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.

Technical Drainage Study For Las Vegas Medical Center (193 Unit Apartment Complex)

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APPENDICES

A	Hydrologic Analysis
B	Hydraulic Calculations
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1. GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

1.1 Purpose

Lochsa Engineering has been retained by Vegas MD Alta Property Owner LLC to provide a Technical Drainage Study for the proposed improvements at the LV Medical Center located at the SEC of Alta Drive and Tonopah Drive. The proposed improvements are limited to the proposed Medical building and minimal landscaping. The proposed improvements are located within an existing residential area, 2 vacant lots and a commercial lot. These existing areas will be demolished. The proposed improvements are located at the SEC of Alta Drive and Tonopah Drive intersection.

The purpose of this study is to provide a detailed hydrologic analysis of the site and watershed impacting it, and to substantiate the flood control design for the proposed improvements. The Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (HCDDM) and the 2018 Las Vegas Valley Flood Control Master Plan Update (2018 MPU) have been compiled and utilized to prepare this study. This report presents summary of the hydrologic and hydraulic analyses, methodology, and results of the study.

1.2 Location of Property

The property is located at the SEC of Alta Drive and Tonopah Drive intersection. The project site is bordered to the north by Alta Drive, south by Hamilton Lane, west by Tonopah Drive and east by an existing commercial building/parking lot. Currently, the existing site consists of two residential homes, two vacant lots semi rough graded and an abandoned commercial lot. The project site occupies parcels identified by the Assessor's Parcel Numbers (APN's) 139-33-301-002/003/010/016/011. The site occupies a portion of the north half (N ½), of the southwest quarter (SW ¼), of section 33, township 20 south, range 61 east, M.D.M., in City of Las Vegas, Clark County, Nevada. Please refer to the copy of the Assessor's Parcel Map provided in the appendix. Figure 1 in Appendix C also provides the location of the subject site in relation to the surrounding major streets.

1.3 Description of Property

The project site occupies approximately 1.12 acres. The project area is entirely 2 separate residential homes, 2 lots that are semi rough-graded and one abandoned commercial lot. The site generally slopes to the north at approximately 1.00% and south at 1.50%. A review of the 2018 CCRFCD W-5 Map indicates that the site is located within the hydrologic soil group 'C.' Soil group 'C' is defined as soils with "low infiltration rate, moderately high runoff potential."

2. DRAINAGE DESCRIPTION

In the CCRFCD's 2018 MPU (Reference 2), the valley was hydrologically divided into ten watersheds and each watershed was further subdivided into sub-basins. The onsite and offsite basins impacting the subject project area fall within the Central watershed. As shown in Figure W-5 of the 2018 MPU, the project site is all located within sub-basin AL96-C.

2.1 Existing Drainage Condition

The offsite drainage areas tributary to the site have been partially addressed from the CLV Central Neighborhood Flood Control MPU. As shown in Figure E-9 from the Neighborhood Study, the 10yr and 100yr runoff within Alta Drive (just east of Rancho Drive) were determined to be 20cfs and 127cfs (surface only) with 165cfs in the existing storm drain system (10yr and 100yr), respectively. These flows are utilized now and in the future for surface flows within Alta Drive.

All the offsite flows do not impact our site directly. These flows are conveyed along the north boundary, west boundary and south boundary to the Site and are already included in the referenced flows for Alta Drive.

We have performed our own offsite basin analysis for the flows impacting Alta Drive along the north boundary of our Site. An offsite basin exhibit (Figure OF1) has been created and included in Appendix C (Figures). It was determined that multiple offsite basins affect Alta Drive north of our Site.

Offsite Basin FD1 (3.54 acres) is west of the Site and is a portion of a commercial center. FD1 discharges 6 and 11 cfs north into Alta Drive. This flow combines with referenced surface flows (20/127 cfs) within Alta Drive and are manually added.

Offsite basin FD2 (1.90 acres) is north of Alta Drive and consists of residential homes and paved streets. The flow is conveyed south into Alta Drive. FD2 discharges 3 and 6 cfs in the 10yr and 100yr storm events. This flow combines with FD1 and the referenced flow (20/127 cfs).

Offsite street basin ALT (2.55 acres) is the Alta Street basin itself. ALT discharges 5 and 8 cfs easterly in the 10yr and 100yr storm events. Offsite basins ALT, FD1, FD2 and Referenced CLV MPU flow all combine at the NWC of our Site. Once our onsite basin NX1 (0.39 acres) discharges <1/1 cfs to Alta Drive, all of the flow combines at the NEC of our Site at combination point CPX1 (34/154 cfs).

Offsite basin FD3 (3.63 acres) consists of a commercial area, paved street and a couple residential homes. This basin is located west and southwest of our site. FD3 discharges 6 and 12cfs in the 10yr and 100yr storm events respectively. This flow concentrates to Hamilton Lane south of our site and continues east.

Onsite basin NX2 (0.73 acres) consists of rough graded areas and a vacant commercial lot. NX2 discharges 1 and 2cfs south to Hamilton Lane. This flow combines with FD3 flows at combination point CPX2 (7/14cfs) at the SEC of our Site. This flow continues east along Hamilton Lane.

Please refer to Figure DR1 (Existing Drainage Plan) for the delineation of each onsite basin in the map back pocket and Figure OF1 (offsite basin map in Appendix C) for our offsite basins.

The hydrologic analysis of the above mentioned offsite basins tributary to the site have been incorporated into the site specific analyses provided with the subject study. Additionally, the offsite basins are located within the McCarran Airport Rainfall Area, hence the point precipitation values for the 10-year and 100-year 6-hour storms are 1.58" and 2.77" respectively.

The HEC-1 Flood Hydrograph Package was utilized to determine the relevant onsite runoff flows. Utilizing the 1-ft topographic map for the project site, the site was delineated into onsite basins and offsite basins. The delineation of the onsite basins as well as offsite basins are depicted on Exhibit DR1, labeled as the 'Existing Drainage Plan'. Referenced flows are also labeled on the plan. Excerpts of the basin maps and hydrologic analysis from the referenced studies have been included in the appendix C along with the relevant CLV Neighborhood MPU Study Exhibits in Appendix C.

2.2 Interim Drainage Condition

For the interim condition, the analysis of the offsite basins will remain the same as in the existing condition, while the site will be developed to consist of the proposed Medical building on the entire project site. Therefore, the estimated flow rates from the offsite basins will remain the same as analyzed in the existing condition. See Figure DR2 (Interim/Developed Drainage Plan) for the flows and referenced flows in Alta Dr. for the site.

The developed site is analyzed as two (2) onsite drainage basins labeled ND1 and ND2.

Basin ND1 (1/2cfs) is 0.47ac. and consists of a rooftop of the proposed Medical building. ND1 discharges 1 and 2cfs to the north. As previously discussed, offsite basins ALT, FD1, FD2 and Referenced CLV MPU flow all combine at the NEC of our Site with ND1 flow at combination point CPD1 (35/155). This shows that there is a 1cfs increase in developed conditions from existing conditions for the 10yr and 100yr storm events, which is very minimal and can be considered negligible.

Basin ND2 (0.73ac. – 1/3cfs) is located at the south half of the Site and consists of the rooftop of the medical office building. Onsite basin ND2 discharges flows south to Hamilton Lane. This flow ultimately combines with offsite basin FD3 (6/12cfs) at Combination point CPD2 (7/14cfs) within Hamilton Lane. This matches CPX2 flows.

Please refer to Figure DR2 (Developed Drainage Plan) for the delineation of each onsite basin in the map back pocket and Figure OF1 (offsite basin map in Appendix C) for our offsite basins.

The HEC-1 Flood Hydrograph Package is utilized to determine the relevant onsite runoff flows. Utilizing the 1-ft topographic map for the project site, the site is delineated into onsite basins and offsite basins. The delineation of the onsite basins as well as offsite basins are depicted on Exhibit DR2, labeled as the 'Interim / Developed Drainage Plan'. Referenced flows are labeled on Figure DR2 for Alta Drive. Excerpts of the basin maps and hydrologic analysis from the referenced studies have been included in the appendix.

BMP's are not required for this site since the site is 100% rooftop and no parking area.

Normal depth calculations are being provided for Alta Drive, Tonopah Dr. and Hamilton Lane. As shown in the attached FlowMaster outputs, flows within all streets are well below the maximum allowable velocity x depth ($v \times d$) values of 6.0 and 8.0 during 10- and 100-year storm events, respectively.

Flows within Alta Drive are increasing in developed conditions by 1cfs since the onsite area is constructed as a building and not residences. Flows within Alta Drive are below the maximum allowable velocity x depth ($v \times d$) values of 6.0 and 8.0 during 10- and 100-year storm events, respectively. Our proposed building FF is a minimum of the 100yr double flow depth in Alta Drive.

As shown in the attached grading plan and exhibits, the finished floor (FF) elevation for the proposed building is more than double the 100yr flow depth in Alta Drive. From the south, the site is also protected by double 100yr flow depth. The FF is a minimum of double the 100yr flow depth onsite flow.

2.3 Future Drainage Condition

For the future condition, both the site and all the local offsite basins are assumed to be fully developed. There are no changes from interim/developed conditions. However, One of the changes from the interim/developed analysis is that the offsite referenced flow west of our site will decrease by 1cfs per the CLV Neighborhood Study MPU. The referenced flows reduced to 19 and 127cfs in the street per the CLV Neighborhood MPU (Figure F-9 in Appendix C). Our design is already based on worse case scenario.

The building has been flood protected to twice the depth of flow onsite. As shown in the attached grading plan and exhibits, the finished floor (FF) elevation for the proposed building is more than double the 100yr flow depth within Alta Drive.

2.4 Master Planning Information

The “*2018 Las Vegas Valley Flood Control Master Plan Update*” (2018 MPU, Reference 2), dated September 2018, as prepared by ATKINS, illustrates the existing and proposed regional master planned facilities. The CCRFCD facility exhibits and inventory tables were updated in 2018. Review of Figure F-29 of the 2018 MPU indicates that proposed improvements are not adjacent to an existing or a proposed Regional facility.

2.5 Floodplain Information

The project site is covered by Flood Insurance Rate Map (FIRM) for the Clark County, Nevada, and incorporated areas, Community Panel Number: 32003C2170F, Effective Date: November 16, 2011. The Site is entirely within FEMA Flood Zone “X” (un-shaded), defined as: “*Areas determined to be outside the 0.2% annual chance floodplain*”. Please refer to the attached Figure 2 for the location of the site on a portion of the FIRM Map Index.

2.6 Previous Drainage Studies

The overall area is covered within the CCRFCD “*2018 Las Vegas Valley Flood Control Master Plan Update, Volume I and II*” (Reference 2). The site is also covered in the FIRM for the Clark County, Nevada and incorporated areas, Community Panel Number: 32003C2170F, Effective Date: November 16, 2011.

No reference study was used for this Site.

The offsite drainage areas tributary to the site have been partially addressed from the CLV Central Neighborhood Flood Control MPU. As shown in Figure E-9 from the Neighborhood Study, the 10yr and 100yr runoff within Alta Drive were determined to be 20cfs and 127cfs, respectively. These flows are being utilized for reference flows upstream of our Site.

Lochsa Engineering generally concurs with all the pertinent referenced analyses from the CLV MPU and results utilized in their exhibits E-9 (20/127cfs) and F-9 (19/127cfs).

2.7 Compliance with CCRFCD Best Management Practices (BMP)

Since our site is entirely just a big building that overlays the entire 5 parcels, there are no parking stalls that are uncovered. It is basically one huge roof and rooftop flow is considered clean already. Per Section 1500, BMP swales are not applicable for our Site development.

3. PROPOSED DRAINAGE FACILITIES

3.1 General Description

The proposed improvements are limited to the proposed Medical building (1). The proposed improvements are located within an existing graded area already.

3.2 Compliance with Regulations and Adopted Plans

The hydrologic analysis and drainage design of this development is in compliance with local requirements, including the CCRFCD “*Hydrologic Criteria and Drainage Design Manual*” (HCDDM) (Reference 1), and the CCRFCD “*2018 Las Vegas Valley Flood Control Master Plan Update*” (Reference 2). The site design is also in compliance with FEMA’s FIRM with panel number 23003C2170F (Reference 4).

3.3 Hydrologic Criteria

The onsite basins of the subject project area all fall within the Central watershed. The hydrologic and hydraulic analyses presented in this report are carried out in accordance with the CCRFCD’s HCDDM (Reference 1). The rainfall values used for the hydrologic analysis of the site represent the 10-year and 100-year storm recurrence events, each with six-hour duration. The site is within the boundary for using the McCarran Airport Rainfall Data. Therefore, the rainfall values for the 6-hour, 10-year and 100-year storm events are determined from Table 505 as 1.58 and 2.77 inches, respectively.

The rainfall losses due to infiltration, interception, etc. are represented using the SCS curve number (CN) method recommended in the CCRFCD HCDDM (Reference 1). The SCS method divides the soils into four hydrologic groups as A, B, C and D. Review of the 2018 MPU's Figure W-5 indicates that the site is located mostly within the hydrologic soil type 1282 (soil group 'C'), defined as soils with "low infiltration rate, moderately high runoff potential." The CN values for the different land use were determined from Table 602 (page 1) of the CCRFCD HCDDM. The runoff hydrograph is determined from the design precipitation for each sub-basin using the Soil Conservation Service (SCS) unit hydrograph method. Calculations used in the hydrologic analysis for the onsite basins for existing and proposed conditions are attached in Appendix A.

3.4 Facility Design Calculations

All drainage facilities within this project have been designed in accordance with the CCRFCD "*Hydrologic Criteria and Drainage Design Manual*" (Reference 1). The onsite drainage plan has been developed to closely resemble existing drainage patterns, and to minimize any impact to the adjacent properties.

4. CONCLUSIONS AND RECOMMENDATIONS

1. This project is in compliance with the applicable drainage laws as recognized by the State of Nevada.
2. This project is in compliance with the CCRFCD “2018 Las Vegas Valley Flood Control Master Plan”, as well as the CCRFCD “*Hydrologic Criteria and Drainage Design Manual*”.
3. The site and the proposed improvements are located entirely within areas designated by FEMA as Zone “X” (unshaded), described by FEMA “*Areas determined to be outside the 0.2% annual chance floodplain.*”
4. The drainage facilities for this project have been designed to convey runoff from the 100-year storm safely through the site. In addition, they have been designed based on generally accepted engineering practices.
5. No adverse effects are expected either upstream or downstream of the subject site.

5. REFERENCES

1. Clark County Regional Flood Control District, "*Hydrologic Criteria and Drainage Design Manual*", August 1999.
2. ATKINS, "*2018 Las Vegas Valley Flood Control Master Plan Update, Volume 1 and II*", September 2018.
3. W-5 Map from 2018 CCRFCD MPU
4. Federal Emergency Management Agency, "*Flood Insurance Rate Maps; Community Panel Numbers 32003C2170F; Clark County, Nevada and Incorporated Areas*," Dated November 16, 2011.
5. CLV Central Neighborhood Study MPU, Figures E-9 and F-9

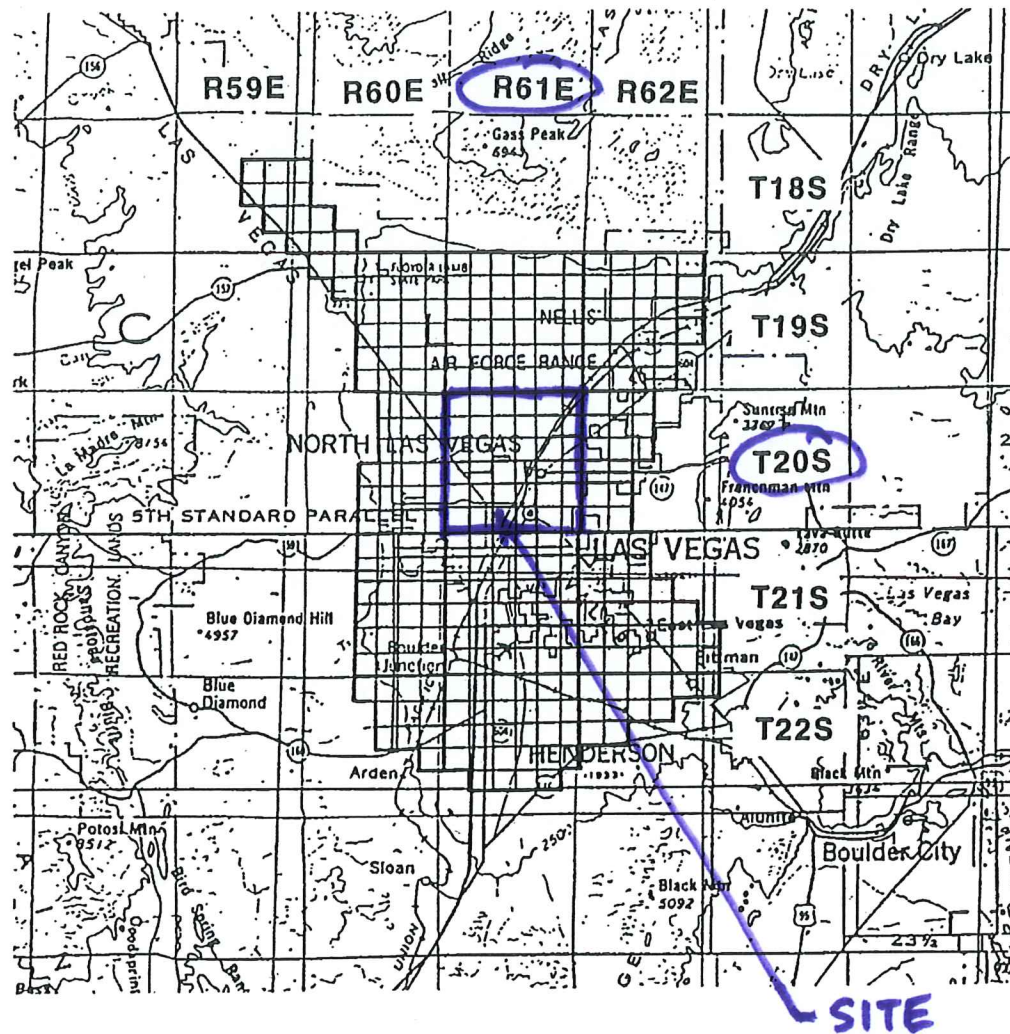
APPENDIX A

HYDROLOGY

HYDROLOGIC CHARTS

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP	RANGE	SECTIONS	TOWNSHIP	RANGE	SECTIONS
18 South	59 East	13-15,22-26,36	20 South	62 East	4-9,16-20,29-32
18 South	60 East	30-32	21 South	60 East	1-4,9-16,21-28,33-36
19 South	60 East	1-6,8-16,21-28,33-36	21 South	61 East	ALL SECTIONS
19 South	61 East	ALL SECTIONS	21 South	62 East	4-9,15-23, 25-36
19 South	62 East	2-11,14-23,27-34	22 South	60 East	1-4,10-15,24
20 South	60 East	1-3,10-15,21-28,33-36	22 South	61 East	1-24,26-29
20 South	61 East	ALL SECTIONS	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

WRC
ENGINEERING

REFERENCE:

USACE, Los Angeles District, 1988

FIGURE 513

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

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

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

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

Revision	Date

WRC
ENGINEERING

REFERENCE:

USACE, Los Angeles District, 1988

TABLE 505

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

SIX-HOUR STORM DISTRIBUTIONS

Percent of Total Storm Depth				Percent of Total Storm Depth			
Storm Time (In Minutes)	SDN3	SDN4	SDN5	Storm Time (In Minutes)	SDN3	SDN4	SDN5
0	0.0	0.0	0.0	185	32.2	37.6	43.0
5	2.0	2.0	2.0	190	35.2	41.5	47.7
10	5.7	5.8	5.9	195	40.9	46.2	51.4
15	7.0	7.5	8.0	200	49.9	53.0	56.1
20	8.7	9.9	11.0	205	59.0	61.0	63.0
25	10.8	12.6	14.4	210	71.0	71.0	71.0
30	12.4	13.7	15.0	215	74.4	73.2	72.0
35	13.0	14.5	16.0	220	78.1	75.6	73.1
40	13.0	14.9	16.8	225	81.2	78.2	75.2
45	13.0	15.1	17.1	230	81.9	79.9	77.9
50	13.0	15.5	18.0	235	83.5	81.3	79.0
55	13.0	15.6	18.2	240	85.1	82.3	79.5
60	13.0	15.9	18.7	245	85.6	83.0	80.4
65	13.3	16.2	19.0	250	86.0	83.5	81.0
70	14.0	16.9	19.7	255	86.8	84.4	82.0
75	14.2	17.2	20.2	260	87.6	85.1	82.6
80	14.8	17.9	21.0	265	88.8	86.4	84.0
85	15.8	18.9	22.0	270	91.0	88.5	85.9
90	17.2	20.1	23.0	275	92.6	90.8	88.9
95	18.1	21.1	24.1	280	93.7	92.4	91.0
100	19.0	22.0	25.0	285	95.0	94.4	93.8
105	19.7	22.8	25.9	290	97.0	96.8	96.6
110	19.9	23.2	26.5	295	97.6	97.3	97.0
115	20.0	24.0	28.0	300	98.2	97.8	97.4
120	20.1	24.6	29.0	305	98.5	98.2	97.9
125	20.4	25.2	30.0	310	98.7	98.4	98.1
130	21.4	26.0	30.5	315	98.9	98.6	98.3
135	22.9	26.9	30.9	320	99.0	98.8	98.5
140	24.1	27.6	31.0	325	99.3	99.1	98.9
145	24.9	28.3	31.7	330	99.3	99.2	99.0
150	25.1	28.6	32.1	335	99.4	99.3	99.2
155	25.6	29.2	32.7	340	99.5	99.4	99.3
160	27.0	30.2	33.3	345	99.8	99.7	99.6
165	27.8	31.2	34.6	350	99.8	99.8	99.7
170	28.1	32.1	36.1	355	99.9	99.9	99.9
175	28.3	33.2	38.1	360	100.0	100.0	100.0
180	29.5	35.2	40.8				

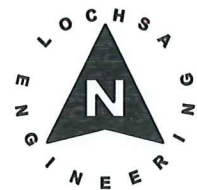
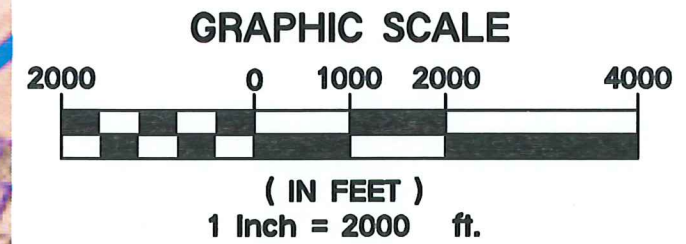
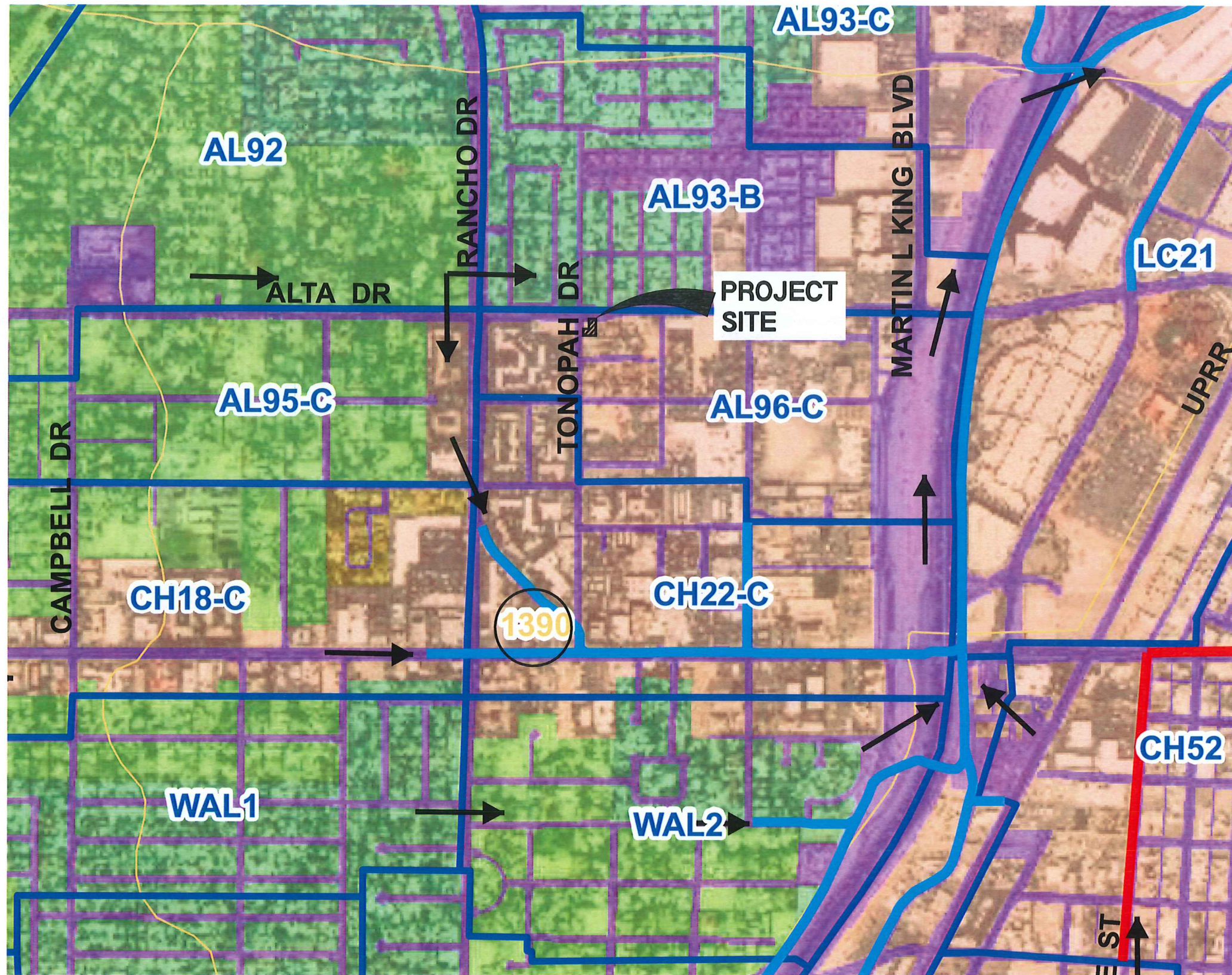
- Notes: 1. For drainage areas less than 8 square miles in size, use SDN 3.
 2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
 3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
 4. A graphical representation of these values is presented on **Figure 515**.

Revision	Date

REFERENCE:

TABLE 503

W-5 SOIL MAP & CURVE NUMBER MATRIX



2018 Las Vegas Valley
Master Plan Update

Figure W-5
Central Watershed

Legend

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

SUBBASIN:
AL96-C

1390:
100% C-SOIL

DRAWN BY: JD	SCALE: 1"=2000'	FILE NAME: C-221050-WMAP
CHECKED BY: CB	DATE: 5/25/22	LEGEND
FOUND MONUMENTATION		
CENTER LINE		
ROW LINE		
EASEMENT LINE		
SECTION LINE		
PROPERTY LINE		
ADJACENT PROPERTY LINE		

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**FIGURE W-5
CENTRAL WATERSHED**

LAS VEGAS MEDICAL DISTRICT

PROJECT No.:
221050

SHEET No.

W-5

SHEET 1 OF 1

Curve Number Matrix

100% C-SOIL

SOIL MAP UNIT	HYDROLOGIC SOIL GROUP					LAND USE CATEGORY INDEX NUMBER												
	A	B	C	D	ROCK OUTCROP	1	2	3	4	5	6	7	8	9	10	11	12	13
	CN --->					63	47	57	60	62	74	84	89	92	86	92	71	30
		CN --->				77	66	73	74	76	83	89	93	94	91	94	81	30
			CN --->			85	77	82	83	84	88	92	95	95	93	95	87	30
				CN --->		88	83	86	87	88	91	94	96	96	95	96	90	30
					CN --->	90	90	92	92	92	94	96	96	97	96	97	94	30
	%	%	%	%	%	SOIL TYPE COMPOSITE CN FOR LAND USE CATEGORY												
1301	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1302	35	20	0	45	0	77.0	67.0	73.0	75.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	82.0	30.0
1305	5	0	35	60	0	86.0	79.0	83.0	84.0	85.0	89.0	93.0	95.0	96.0	94.0	96.0	88.0	30.0
1307	10	0	30	60	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	96.0	93.0	96.0	87.0	30.0
1313	8	68	0	24	0	79.0	68.0	75.0	76.0	78.0	84.0	90.0	93.0	94.0	91.0	94.0	82.0	30.0
1314	80	5	0	15	0	67.0	53.0	62.0	65.0	67.0	77.0	86.0	91.0	92.0	88.0	92.0	74.0	30.0
1320	0	2	0	83	15	88.0	83.0	87.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1323	0	0	0	85	15	88.0	84.0	87.0	88.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	91.0	30.0
1325	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1326	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1340	9	0	0	71	20	86.0	81.0	85.0	85.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1341	0	100	0	0	0	77.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1342	0	7	0	78	15	88.0	83.0	86.0	87.0	87.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1360	15	0	0	35	50	85.0	81.0	84.0	85.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1380	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1390	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1400	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1415	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1417	5	0	55	10	30	86.0	80.0	84.0	85.0	86.0	89.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1419	35	0	55	10	0	78.0	67.0	74.0	75.0	77.0	83.0	89.0	93.0	94.0	91.0	94.0	82.0	30.0
1440	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1450	1	0	0	89	10	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1484	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1500	60	0	0	35	5	73.0	61.0	69.0	71.0	73.0	81.0	88.0	92.0	93.0	89.0	93.0	79.0	30.0
1501	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1502	60	0	0	40	0	73.0	61.0	69.0	71.0	72.0	80.0	88.0	92.0	93.0	89.0	93.0	79.0	30.0
1505	55	0	0	40	5	74.0	63.0	70.0	72.0	74.0	81.0	88.0	92.0	94.0	90.0	94.0	80.0	30.0
1506	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1508	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1510	10	0	0	55	35	86.0	82.0	85.0	86.0	87.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1540	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1541	4	0	0	76	20	87.0	83.0	86.0	87.0	87.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1542	60	0	30	10	0	72.0	59.0	67.0	69.0	71.0	80.0	87.0	92.0	93.0	89.0	93.0	78.0	30.0
1545	60	0	10	30	0	73.0	60.0	68.0	70.0	72.0	80.0	88.0	92.0	93.0	89.0	93.0	78.0	30.0
1600	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1605	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1610	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1615	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1630	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1635	7	0	5	63	25	87.0	82.0	85.0	86.0	87.0	90.0	94.0	95.0	96.0	94.0	96.0	89.0	30.0
1640	0	0	0	10	90	90.0	90.0	91.0	91.0	92.0	94.0	96.0	96.0	97.0	96.0	97.0	94.0	30.0
1645	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1674	27	26	0	45	2	78.0	69.0	75.0	76.0	78.0	84.0	90.0	93.0	94.0	91.0	94.0	83.0	30.0
1700	0	0	3	93	4	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1710	2	89	0	9	0	78.0	67.0	74.0	75.0	77.0	83.0	89.0	93.0	94.0	91.0	94.0	82.0	30.0
1731	10	2	0	88	0	85.0	79.0	83.0	84.0	85.0	89.0	93.0	95.0	96.0	94.0	96.0	88.0	30.0
1732	3	0	0	96	1	87.0	82.0	85.0	86.0	87.0	90.0	94.0	95.0	96.0	94.0	96.0	89.0	30.0
1753	0	8	0	90	2	87.0	81.0	85.0	86.0	87.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1850	0	0	0	94	6	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1853	0	0	0	85	15	88.0	84.0	87.0	88.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	91.0	30.0
1871	17	0	0	83	0	84.0	76.0	81.0	82.0	83.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1999	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

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

See Table 602A

Developing urban areas

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

1. Average runoff condition, and $I_p = 0.2S$.
2. The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.
3. CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4. Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5. Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

WRC
ENGINEERING

REFERENCE:
SCS TR-55, USDA, June 1986.

TABLE 602
1 of 4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS - RESIDENTIAL DISTRICTS

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

- 1 Lot size should represent the size of the average lot and not the gross acreage divided by the number of lots.
- 2 Actual percent impervious value should be compared to selected land use type.
- 3 In cases where average residential lots are smaller than 6,000 sq ft, commercial/business/industrial land use should be used.

Revision	Date

REFERENCE:

TABLE 602A

HYDROLOGY

Curve Number Calculations
LAS VEGAS MEDICAL CENTER

Sub-Basin: NX1
Total Area: 0.39 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Residential: 8,000 sf lots	0.39	C	100%	88	88.0
Total:	0.39	-	100%	-	88.0

Curve Number Calculations
LAS VEGAS MEDICAL CENTER

Sub-Basin: NX2
Total Area: 0.73 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Newly graded area (pervious area only, no vegetation)	0.42	C	58%	91	52.4
Commercial and buisness	0.31	C	42%	94	39.9
Total:	0.73	-	100%	-	92.3

Curve Number Calculations
LAS VEGAS MEDICAL CENTER

Sub-Basin: FD1
Total Area: 3.54 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Commercial and buisness	3.54	C	100%	94	94.0
Total:	3.54	-	100%	-	94.0

Curve Number Calculations
LAS VEGAS MEDICAL CENTER

Sub-Basin: ALT
Total Area: 2.55 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.55	C	100%	98	98.0
Total:	2.55	-	100%	-	98.0

Curve Number Calculations
LAS VEGAS MEDICAL CENTER

Sub-Basin: FD2
Total Area: 1.90 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.47	C	25%	98	24.2
Commercial and buisness	1.43	C	75%	94	70.7
Total:	1.90	-	100%	-	95.0

Curve Number Calculations
LAS VEGAS MEDICAL CENTER

Sub-Basin: FD3
Total Area: 3.63 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.15	C	32%	98	31.0
Commercial and buisness	2.17	C	60%	94	56.2
Residential: 10,000 sf lots	0.31	C	9%	83	7.1
Total:	3.63	-	100%	-	94.3

Curve Number Calculations
LAS VEGAS MEDICAL CENTER

Sub-Basin: ND1
Total Area: 0.47 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.47	C	100%	98	98.0
Total:	0.47	-	100%	-	98.0

Curve Number Calculations
LAS VEGAS MEDICAL CENTER

Sub-Basin: ND2
Total Area: 0.73 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.73	C	100%	98	98.0
Total:	0.73	-	100%	-	98.0

AVERAGE VELOCITY

Basin NX1	Basin NX2	Basin FD1	Basin ALT	Basin FD2	Basin FD3	Basin ND1	Basin ND2						
4.0	4.0	2.0	2.0	2.0	3.0	2.0	5.0						
100	100	50	0	50	100	0	200						
100	100	0	50	0	100	100	200						
0.020	0.020	0.015	0.015	0.015	0.016	0.016	0.016						
0.010	0.010	0.008	0.011	0.007	0.015	0.010	0.010						
0.5	1	5.5	4	3	6	1	1.5						

Output Variables

0.06	0.08	0.26	0.21	0.21	0.15	0.10	0.07						
0.60	1.00	2.24	1.56	1.49	2.77	0.71	1.36						
0.83	1.00	2.46	2.56	2.01	2.17	1.40	1.11						
15.99	20.39	15.35	12.88	12.60	33.40	12.21	33.33						
0.04	0.05	0.15	0.12	0.12	0.08	0.06	0.04						
15.99	20.38	15.08	12.67	12.39	33.39	12.10	33.33						
0.02	0.03	0.10	0.08	0.08	0.05	0.04	0.03						

■ 00-YEAR STORM RUNOFF FLOWS IS USED TO DETERMINE THE BASIN TRAVEL VELOCITY REQUIRED FOR THE LAG TIME CALCULATIONS

HEC-1 MODEL OUTPUT

(EXISTING CONDITIONS)

Peak Flow Summary

Existing Condition

HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)	
*REF. CLV MPU FLOW	-	*20	*127	
FD1	3.54	6	11	
ALT	2.55	5	8	
FD2	1.90	3	6	
NX1	0.39	<1	1	
CPX1	-	34	154	(*REF. CLV MPU FLOW + FD1 + ALT + FD2 + NX1)
FD3	3.63	6	12	
NX2	0.73	1	2	
CPX2	-	7	14	(FD3 + NX2)

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 01JUN22 TIME 06:31:50
*
*****

```

X

```

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

```

```

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

```

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

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,

DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION

KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

HEC-1 INPUT

PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1 ID LAS VEGAS MEDICAL DISTRICT
2 ID ***** TECHNICAL DRAINAGE STUDY *****
3 ID EXISTING CONDITION - ONSITE AND OFFSITE
4 ID USING SCS METHODS AND KINEMATIC WAVE ROUTING
5 ID MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION
6 ID
7 ID LOCHSA JOB # 221050
8 ID
9 ID
10 ID INPUT FILE NAME: X.DAT
11 ID
12 ID JUNE 2022
13 ID
14 ID *****
15 ID *****
16 ID MCCARRAN AIRPORT RAINFALL AREA
17 ID 10 & 100 YEAR - 6 HOUR STORM EVENT
18 ID PRECIPITATION:
19 ID 10-YEAR : 1.58 INCHES
20 ID 100-YEAR : 2.77 INCHES
21 ID 10-YEAR/100-YEAR : 1.58/2.77= 0.5700
22 ID *****
23 ID *****
24 ID *DIAGRAM
25 IT 5 200
26 IO 5 0
27 IN 5
28 JR PREC .5700 1.0
29
30 KK FD1
31 KM OFFSITE BASIN WEST OF THE PROJECT SITE, DISCHARGING NORTH TO ALTA DR.
32 PB 2.770
33 PC 0.0 .02 .057 .07 .087 .108 .124 .13 .13 .13
34 PC .13 .13 .13 .133 .14 .142 .148 .158 .172 .181
35 PC .19 .197 .199 .2 .201 .204 .214 .229 .241 .249
36 PC .251 .256 .27 .278 .281 .283 .295 .322 .352 .409
37 PC .499 .59 .71 .744 .781 .812 .819 .835 .851 .856
38 PC .86 .868 .876 .888 .91 .926 .937 .95 .97 .976
39 PC .982 .985 .987 .989 .99 .993 .993 .994 .995 .998
40 PC .998 .999 1.0
41 BA .00553
42 LS 0 94.0
43 UD .062
44 *
45
46 KK ALT
47 KM STREET BASIN NORTH OF SITE DISCHARGING EAST
48 BA .00398
49 LS 0 98.0
50 UD 0.078
51 *

```

1

HEC-1 INPUT

PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
47 KK FD2
48 KM DEVELOPED OFFSITE BASIN NOTH OF ALTA DISCHARGING SOUTH TO ALTA DR.
49 BA .00297
50 LS 0 95.0
51 UD 0.056
52 *
53 KK NX1
54 KM NORTH ONSITE BASIN DISCHARGING NORTH TO ALTA DR.
55 BA .00061
56 LS 0 88.0
57 UD 0.053
58 *
59 KK CPX1
60 KM COMBINE FD1, ALT, FD2, AND NX1 FOR TOTAL FLOWS DISCHARGING EAST ALONG ALTA DR
61 HC 4
62 *

```


X

```
60      KK      FD3
61      KM      SOUTHWEST AND SOUTH OFFSITE BASIN DISCHARGING EAST ALONG HAMILTON LN.
62      BA      .00567
63      LS      0      94.3
64      UD      0.065
        *

65      KK      NX2
66      KM      SOUTH ONSITE BASIN DISCHARGING SOUTH TO HAMILTON LN.
67      BA      .00114
68      LS      0      92.3
69      UD      0.050
        *

70      KK      CPX2
71      KM      COMBINE FD3 AND NX2 FOR TOTAL FLOWS DISCHARGING EAST ALONG HAMILTON LANE
72      HC      2
        *
73      ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

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

28      FD1
        .
42      .      ALT
        .
47      .      .      FD2
        .
52      .      .      .      NX1
        .
57      CPX1.....
        .
60      .      FD3
        .
65      .      .      NX2
        .
70      .      CPX2.....
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 01JUN22 TIME 06:31:50 *
*****
```

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

LAS VEGAS MEDICAL DISTRICT
***** TECHNICAL DRAINAGE STUDY *****
EXISTING CONDITION - ONSITE AND OFFSITE
USING SCS METHODS AND KINEMATIC WAVE ROUTING
MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION

LOCHSA JOB # 221050

INPUT FILE NAME: X.DAT

JUNE 2022

```
*****
*****
McCARRAN AIRPORT RAINFALL AREA
10 & 100 YEAR - 6 HOUR STORM EVENT
PRECIPITATION:
10-YEAR : 1.58 INCHES
100-YEAR : 2.77 INCHES
10-YEAR/100-YEAR : 1.58/2.77= 0.5700
*****
*****
```

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

IT      HYDROGRAPH TIME DATA
          NMIN      5      MINUTES IN COMPUTATION INTERVAL
          IDATE      1      0      STARTING DATE
          ITIME      0000      STARTING TIME
          NQ      200      NUMBER OF HYDROGRAPH ORDINATES
          NDDATE      1      0      ENDING DATE
          NDTIME      1635      ENDING TIME
          ICENT      19      CENTURY MARK

          COMPUTATION INTERVAL .08 HOURS
          TOTAL TIME BASE 16.58 HOURS
```

ENGLISH UNITS
DRAINAGE AREA SQUARE MILES
PRECIPITATION DEPTH INCHES
LENGTH, ELEVATION FEET
FLOW CUBIC FEET PER SECOND
STORAGE VOLUME ACRE-Feet

SURFACE AREA
 TEMPERATURE
 ACRES
 DEGREES FAHRENHEIT
 X
 JP MULTI-PLAN OPTION
 NPLAN 1 NUMBER OF PLANS
 JR MULTI-RATIO OPTION
 RATIOS OF PRECIPITATION
 .57 1.00

1

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION	
				RATIO 1 .57	RATIO 2 1.00
HYDROGRAPH AT +	FD1	.01	1 FLOW TIME	6. 3.50	11. 3.50
HYDROGRAPH AT +	ALT	.00	1 FLOW TIME	5. 3.50	8. 3.50
HYDROGRAPH AT +	FD2	.00	1 FLOW TIME	3. 3.50	6. 3.50
HYDROGRAPH AT +	NX1	.00	1 FLOW TIME	0. 3.50	1. 3.50
4 COMBINED AT +	CPX1	.01	1 FLOW TIME	14. 3.50	27. 3.50
HYDROGRAPH AT +	FD3	.01	1 FLOW TIME	6. 3.50	12. 3.50
HYDROGRAPH AT +	NX2	.00	1 FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT +	CPX2	.01	1 FLOW TIME	7. 3.50	14. 3.50

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

$Q_{10} \quad Q_{100}$
 + *Ref. CLV MPU Flowr (20/127) = 34 154

HEC-1 MODEL OUTPUT

(DEVELOPED CONDITIONS)

Peak Flow Summary
Developed Condition

HEC-1 ID	Area (acres)	10-year Flow	100-year Flow
*REF. CLV MPU FLOW	-	*20	*127
FD1	3.54	6	11
ALT	2.55	5	8
FD2	1.90	3	6
ND1	0.47	1	2
CPD1	-	35	155
FD3	3.63	6	12
ND2	0.73	1	3
CPD2	-	7	14

(*REF. CLV MPU FLOW + FD1 + ALT + FD2 + ND1)

(FD3 + ND2)

1*****
 * FLOOD HYDROGRAPH PACKAGE (HEC-1) *
 * JUN 1998 *
 * VERSION 4.1 *
 * RUN DATE 01JUN22 TIME 06:38:04 *

D

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

```

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

```

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

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

1

HEC-1 INPUT

PAGE 1

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1         ID      LAS VEGAS MEDICAL DISTRICT
2         ID      ***** TECHNICAL DRAINAGE STUDY *****
3         ID      DEVELOPED CONDITIONS - ONSITE AND OFFSITE
4         ID      USING SCS METHODS AND KINEMATIC WAVE ROUTING
5         ID      MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION
6         ID
7         ID      LOCHSA JOB # 221050
8         ID
9         ID
10        ID      INPUT FILE NAME: D.DAT
11        ID
12        ID      JUNE 2022
13        ID
14        ID      *****
15        ID      *****
16        ID      MCCARRAN AIRPORT RAINFALL AREA
17        ID      10 & 100 YEAR - 6 HOUR STORM EVENT
18        ID      PRECIPITATION:
19        ID          10-YEAR      : 1.58 INCHES
20        ID          100-YEAR     : 2.77 INCHES
21        ID          10-YEAR/100-YEAR : 1.58/2.77= 0.5700
22        ID      *****
23        ID      *****
24        ID      *DIAGRAM
25        IT      5          200
26        IO      5          0
27        IN      5
28        JR      PREC      .5700      1.0
29
30        KK      FD1
31        KM      OFFSITE BASIN WEST OF THE PROJECT SITE, DISCHARGING NORTH TO ALTA DR.
32        PB      2.770
33        PC      0.0      .02      .057      .07      .087      .108      .124      .13      .13      .13
34        PC      .13      .13      .13      .133      .14      .142      .148      .158      .172      .181
35        PC      .19      .197      .199      .2      .201      .204      .214      .229      .241      .249
36        PC      .251      .256      .27      .278      .281      .283      .295      .322      .352      .409
37        PC      .499      .59      .71      .744      .781      .812      .819      .835      .851      .856
38        PC      .86      .868      .876      .888      .91      .926      .937      .95      .97      .976
39        PC      .982      .985      .987      .989      .99      .993      .993      .994      .995      .998
40        PC      .998      .999      1.0
41        BA      .00553
42        LS      0          94.0
43        UD      .062
44        *
45
46        KK      ALT
47        KM      STREET BASIN NORTH OF SITE DISCHARGING EAST
48        BA      .00398
49        LS      0          98.0
50        UD      0.078
51        *

```

1

HEC-1 INPUT

PAGE 2

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
47        KK      FD2
48        KM      DEVELOPED OFFSITE BASIN NOTH OF ALTA DISCHARGING SOUTH TO ALTA DR.
49        BA      .00297
50        LS      0          95.0
51        UD      0.056
52        *
53
54        KK      ND1
55        KM      NORTH ONSITE BASIN DISCHARGING NORTH TO ALTA DR.
56        BA      .00073
57        LS      0          98.0
58        UD      0.050
59        *
60
61        KK      CPD1
62        KM      COMBINE FD1, ALT, FD2, AND ND1 FOR TOTAL FLOWS DISCHARGING EAST ALONG ALTA DR
63        HC      4
64        *

```

D

```

60      KK      FD3
61      KM      SOUTHWEST AND SOUTH OFFSITE BASIN DISCHARGING EAST ALONG HAMILTON LN.
62      BA      .00567
63      LS      0      94.3
64      UD      0.065
        *

65      KK      ND2
66      KM      SOUTH ONSITE BASIN DISCHARGING SOUTH TO HAMILTON LN.
67      BA      .00114
68      LS      0      98.0
69      UD      0.050
        *

70      KK      CPD2
71      KM      COMBINE FD3 AND ND2 FOR TOTAL FLOWS DISCHARGING EAST ALONG HAMILTON LANE
72      HC      2
        *
73      ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```

INPUT LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
          (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

28      FD1
        .
42      .      ALT
        .
47      .      .      FD2
        .
52      .      .      .      ND1
        .
57      CPD1.....
        .
60      .      FD3
        .
65      .      .      ND2
        .
70      .      CPD2.....

```

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 01JUN22 TIME 06:38:04
*
*****

```

```

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

```

LAS VEGAS MEDICAL DISTRICT
 ***** TECHNICAL DRAINAGE STUDY *****
 DEVELOPED CONDITIONS - ONSITE AND OFFSITE
 USING SCS METHODS AND KINEMATIC WAVE ROUTING
 MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION

LOCHSA JOB # 221050

INPUT FILE NAME: D.DAT

JUNE 2022

```

*****
*****
McCARRAN AIRPORT RAINFALL AREA
10 & 100 YEAR - 6 HOUR STORM EVENT
PRECIPITATION:
10-YEAR      : 1.58 INCHES
100-YEAR     : 2.77 INCHES
10-YEAR/100-YEAR : 1.58/2.77= 0.5700
*****
*****

```

```

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

IT      HYDROGRAPH TIME DATA
          NMIN      5      MINUTES IN COMPUTATION INTERVAL
          IDATE      1      0      STARTING DATE
          ITIME      0000      STARTING TIME
          NQ      200      NUMBER OF HYDROGRAPH ORDINATES
          NDDATE      1      0      ENDING DATE
          NDTIME      1635      ENDING TIME
          ICENT      19      CENTURY MARK

          COMPUTATION INTERVAL      .08 HOURS
          TOTAL TIME BASE      16.58 HOURS

```

```

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

```


D

SURFACE AREA
TEMPERATURE

ACRES
DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.57 1.00

1

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION	
					RATIO 1 .57	RATIO 2 1.00
HYDROGRAPH AT +	FD1	.01	1	FLOW TIME	6. 3.50	11. 3.50
HYDROGRAPH AT +	ALT	.00	1	FLOW TIME	5. 3.50	8. 3.50
HYDROGRAPH AT +	FD2	.00	1	FLOW TIME	3. 3.50	6. 3.50
HYDROGRAPH AT +	ND1	.00	1	FLOW TIME	1. 3.50	2. 3.50
4 COMBINED AT +	CPD1	.01	1	FLOW TIME	15. 3.50	28. 3.50
HYDROGRAPH AT +	FD3	.01	1	FLOW TIME	6. 3.50	12. 3.50
HYDROGRAPH AT +	ND2	.00	1	FLOW TIME	1. 3.50	3. 3.50
2 COMBINED AT +	CPD2	.01	1	FLOW TIME	7. 3.50	14. 3.50

+ Ref. CLV MP4 Flows (20/127) = $\frac{Q_{10}}{35}$ $\frac{Q_{100}}{155}$

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

APPENDIX B

HYDRAULICS

NORMAL DEPTH STREET HYDRAULIC CALCULATIONS

(10yr/100yr Existing Conditions)

Street Flow Summary
(Existing Condition)

10-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Cross-Section Identifier	10-Year Flow [Q10] (cfs)	10-Year Velocity [v] (fps)	10-Year Flow Depth [d] (ft)	10-Year Velocity x Depth [v x d]	Dry Lane Width (within 1/2 ROW) (ft)
ALTA DR.	100	A	34	3.94	0.68	2.68	15.0
TONOPAH	60	B	6	1.91	0.35	0.67	N/A
HAMILTON	45	C	7	2.42	0.43	1.04	N/A

Street Flow Summary
(Existing Condition)

100-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Cross-Section Identifier	100-Year Flow [Q100] (cfs)	100-Year Velocity [v] (fps)	100-Year Flow Depth [d] (ft)	100-Year Velocity x Depth [v x d]
ALTA DR.	100	A	154	5.25	0.99	5.20
TONOPAH	60	B	12	2.33	0.44	1.03
HAMILTON	45	C	14	2.64	0.53	1.40

Street Section A - Alta - Existing Condition - 10year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section A - Alta - Existing Condition - 10yr
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.012000 ft/ft
Discharge	34.00 cfs

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

Results	
Mannings Coefficient	0.014
Water Surface Elev.	63.62 ft
Elevation Range	63.94 to 64.48
Flow Area	8.6 ft ²
Wetted Perimeter	44.74 ft
Top Width	43.75 ft
Actual Depth	0.68 ft
Critical Elevation	63.70 ft
Critical Slope	0.004667 ft/ft
Velocity	3.94 ft/s
Velocity Head	0.24 ft
Specific Energy	63.86 ft
Froude Number	1.56
Flow Type	Supercritical

$0.68 \times 3.94 = 2.68 < 6 \text{ OK}$

Calculation Messages:
 Water elevation exceeds lowest end station by 0.80119864e-1 ft.
 Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+57.00	0.013
0+57.00	0+92.50	0.016
0+92.50	0+99.50	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	63.91
0+00.50	63.81
0+05.50	63.81
0+05.50	63.31
0+07.00	63.44

**Street Section A - Alta - Existing Condition - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+07.00	63.48
0+53.00	63.98
0+53.00	64.48
0+53.50	64.48
0+56.50	64.42
0+57.00	64.42
0+57.00	63.92
0+92.50	63.11
0+92.50	63.07
0+94.00	62.94
0+94.00	63.44
0+94.50	63.44
0+99.50	63.54

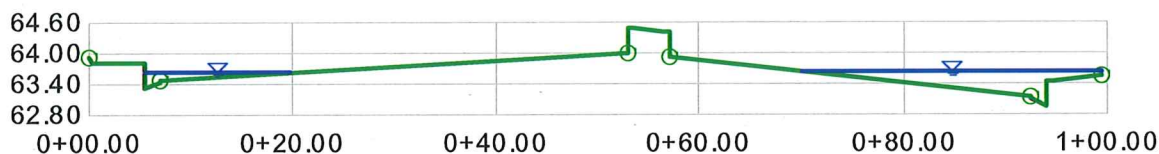
Street Section A - Alta - Existing Condition - 10year **Cross Section for Irregular Channel**

Project Description	
Worksheet	Street Section A - Alta - Existing Condition -
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.014
Slope	0.012000 ft/ft
Water Surface Elev.	63.62 ft
Elevation Range	62.94 to 64.48
Discharge	34.00 cfs

$$\text{dry lane} = \frac{63.92 - 63.62}{.02} = 15\text{ft} > 12\text{ft}$$

Meets ✓



V:5.0
H:1
NTS

Street Section A - Alta - Existing Condition - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section A - Alta - Existing Condition - 100yr
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.012000 ft/ft
Discharge	154.00 cfs

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

Results	
Mannings Coefficient	0.014
Water Surface Elev.	63.93 ft
Elevation Range	63.94 to 64.48
Flow Area	29.3 ft²
Wetted Perimeter	92.42 ft
Top Width	90.89 ft
Actual Depth	0.99 ft
Critical Elevation	64.06 ft
Critical Slope	0.004122 ft/ft
Velocity	5.25 ft/s
Velocity Head	0.43 ft
Specific Energy	64.36 ft
Froude Number	1.63
Flow Type	Supercritical

$.99 \times 5.25 = 5.20 < 8 \text{ OK}$

Calculation Messages:
Water elevation exceeds lowest end station by 0.38984251 ft.
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+57.00	0.013
0+57.00	0+92.50	0.016
0+92.50	0+99.50	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	63.91
0+00.50	63.81
0+05.50	63.81
0+05.50	63.31
0+07.00	63.44

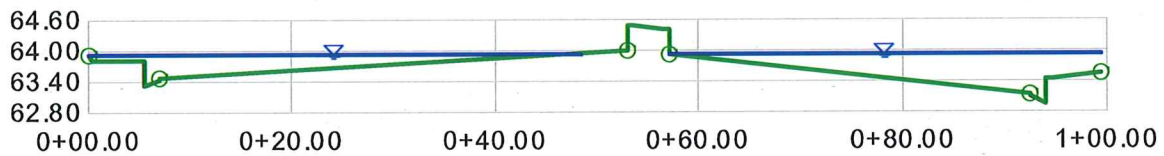
**Street Section A - Alta - Existing Condition - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+07.00	63.48
0+53.00	63.98
0+53.00	64.48
0+53.50	64.48
0+56.50	64.42
0+57.00	64.42
0+57.00	63.92
0+92.50	63.11
0+92.50	63.07
0+94.00	62.94
0+94.00	63.44
0+94.50	63.44
0+99.50	63.54

Street Section A - Alta - Existing Condition - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section A - Alta - Existing Condition -
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.014
Slope	0.012000 ft/ft
Water Surface Elev.	63.93 ft
Elevation Range	62.94 to 64.48
Discharge	154.00 cfs



V:5.0
H:1
NTS

Street Section B - Tonopah - Existing Condition - 10year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section B - Tonopah - Existing Condition (10yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	6.00 cfs

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	64.32 ft
Elevation Range	1.97 to 65.33
Flow Area	3.1 ft²
Wetted Perimeter	21.80 ft
Top Width	21.40 ft
Actual Depth	0.35 ft
Critical Elevation	64.31 ft
Critical Slope	0.006597 ft/ft
Velocity	1.91 ft/s
Velocity Head	0.06 ft
Specific Energy	64.38 ft
Froude Number	0.88
Flow Type	Subcritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	65.33
0+05.00	65.23
0+05.50	65.23
0+05.50	64.73
0+07.00	64.86
0+07.00	64.90
0+40.00	64.17
0+53.00	64.14
0+53.00	64.10
0+54.50	63.97
0+54.50	64.47

$.35 \times 1.91 = 0.32 < 6 \text{ OK}$

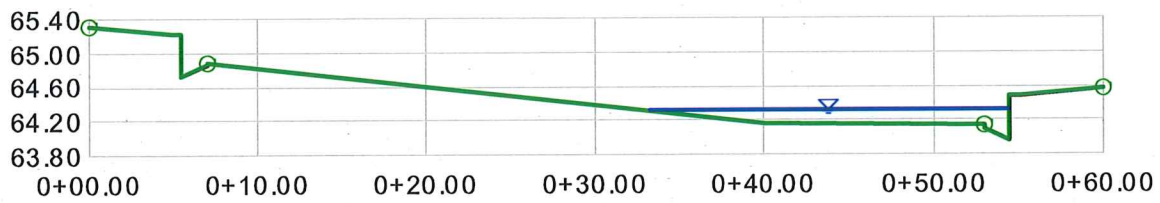
**Street Section B - Tonopah - Existing Condition - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+55.00	64.47
0+60.00	64.57

Street Section B - Tonopah - Existing Condition - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section B - Tonopah - Existing Conditio
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.005000 ft/ft
Water Surface Elev.	64.32 ft
Elevation Range	63.97 to 65.33
Discharge	6.00 cfs



V:5.0
H:1
NTS

Street Section B - Tonopah - Existing Condition - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section B - Tonopah - Existing Condition (100yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	12.00 cfs

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	64.41 ft
Elevation Range	63.97 to 65.33
Flow Area	5.1 ft ²
Wetted Perimeter	25.78 ft
Top Width	25.29 ft
Actual Depth	0.44 ft
Critical Elevation	64.39 ft
Critical Slope	0.006113 ft/ft
Velocity	2.33 ft/s
Velocity Head	0.08 ft
Specific Energy	64.49 ft
Froude Number	0.91
Flow Type	Subcritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	65.33
0+05.00	65.23
0+05.50	65.23
0+05.50	64.73
0+07.00	64.86
0+07.00	64.90
0+40.00	64.17
0+53.00	64.14
0+53.00	64.10
0+54.50	63.97
0+54.50	64.47

FD3

d₁₀₀

v₁₀₀

$.44 \times 2.33 = 1.03 < 8 \text{ OK}$

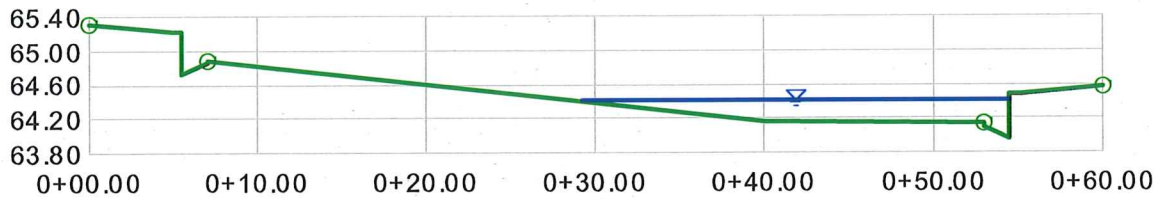
**Street Section B - Tonopah - Existing Condition - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+55.00	64.47
0+60.00	64.57

Street Section B - Tonopah - Existing Condition - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section B - Tonopah - Existing Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.005000 ft/ft
Water Surface Elev.	64.41 ft
Elevation Range	63.97 to 65.33
Discharge	12.00 cfs



V:5.0
H:1
NTS

Street Section C - Hamilton - Existing Condition - 10year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section C - Hamilton - Existing Condition (10yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.007000 ft/ft
Discharge	7.00 cfs

$$FD3 + NX2 = CPX2$$

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

Results	
Mannings Coefficient	0.014
Water Surface Elev.	62.78 ft
Elevation Range	62.35 to 63.44
Flow Area	2.9 ft²
Wetted Perimeter	19.48 ft
Top Width	19.00 ft
Actual Depth	0.43 ft
Critical Elevation	62.79 ft
Critical Slope	0.005806 ft/ft
Velocity	2.42 ft/s
Velocity Head	0.09 ft
Specific Energy	62.87 ft
Froude Number	1.09
Flow Type	Supercritical

$$d_{10}$$

$$v_{10}$$

$$.43 \times 2.42 = 1.04 < 6 \text{ OK}$$

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+38.00	0.016
0+38.00	0+45.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	63.44
0+05.00	63.34
0+05.50	63.34
0+05.50	62.84
0+07.00	62.97
0+07.00	63.01
0+25.00	62.70
0+38.00	62.52
0+38.00	62.48
0+39.50	62.35
0+39.50	62.85

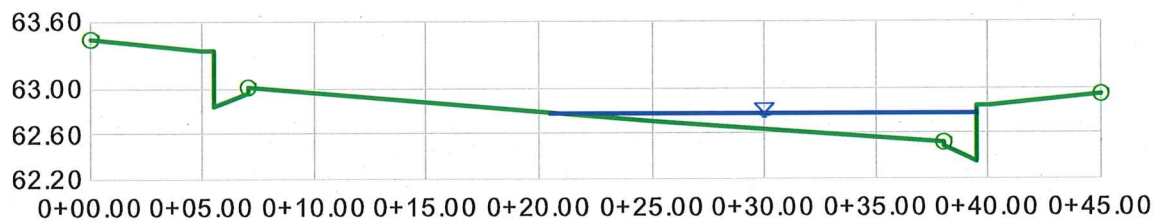
**Street Section C - Hamilton - Existing Condition - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+40.00	62.85
0+45.00	62.95

Street Section C - Hamilton - Existing Condition - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section C - Hamilton - Existing Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.014
Slope	0.007000 ft/ft
Water Surface Elev.	62.78 ft
Elevation Range	62.35 to 63.44
Discharge	7.00 cfs



V:5.0
H:1
NTS

Street Section C - Hamilton - Existing Condition - 100year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section C - Hamilton - Existing Condition (100yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.007000 ft/ft
Discharge	14.00 cfs

FD3 + NX2

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	62.88 ft
Elevation Range	62.35 to 63.44
Flow Area	5.3 ft²
Wetted Perimeter	28.47 ft
Top Width	27.88 ft
Actual Depth	0.53 ft
Critical Elevation	62.90 ft
Critical Slope	0.006115 ft/ft
Velocity	2.64 ft/s
Velocity Head	0.11 ft
Specific Energy	62.99 ft
Froude Number	1.07
Flow Type	Supercritical

d₁₀₀

V₁₀₀

$$0.53 \times 2.64 = 1.40 < 8 \text{ OK}$$

Calculation Messages:
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+38.00	0.016
0+38.00	0+45.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	63.44
0+05.00	63.34
0+05.50	63.34
0+05.50	62.84
0+07.00	62.97
0+07.00	63.01
0+25.00	62.70
0+38.00	62.52

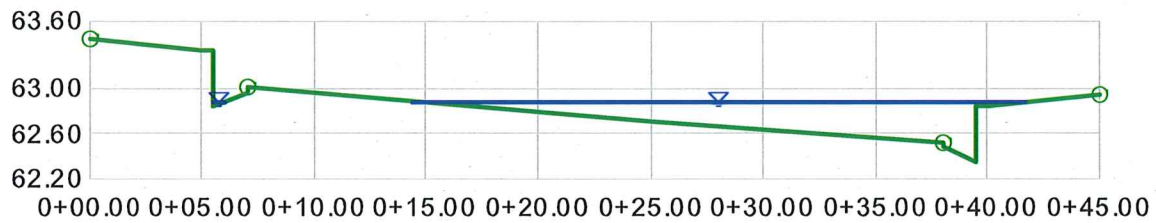
**Street Section C - Hamilton - Existing Condition - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+38.00	62.48
0+39.50	62.35
0+39.50	62.85
0+40.00	62.85
0+45.00	62.95

Street Section C - Hamilton - Existing Condition - 100year **Cross Section for Irregular Channel**

Project Description	
Worksheet	Street Section C - Hamilton - Existing Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.007000 ft/ft
Water Surface Elev.	62.88 ft
Elevation Range	62.35 to 63.44
Discharge	14.00 cfs



V:5.0
H:1
NTS

NORMAL DEPTH STREET HYDRAULIC CALCULATIONS

(10yr/100yr Developed Conditions)

Street Flow Summary
(Developed Condition)

10-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Cross-Section Identifier	10-Year Flow [Q10] (cfs)	10-Year Velocity [v] (fps)	10-Year Flow Depth [d] (ft)	10-Year Velocity x Depth [v x d]	Dry Lane Width (within 1/2 ROW) (ft)
ALTA DR.	100	A	35	3.96	0.68	2.69	15.0
TONOPAH	60	B	6	1.91	0.35	0.67	N/A
HAMILTON	45	C	7	2.42	0.43	1.04	N/A

Street Flow Summary
(Developed Condition)

100-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Cross-Section Identifier	100-Year Flow [Q100] (cfs)	100-Year Velocity [v] (fps)	100-Year Flow Depth [d] (ft)	100-Year Velocity x Depth [v x d]
ALTA DR.	100	A	155	5.26	0.99	5.21
TONOPAH	60	B	12	2.33	0.44	1.03
HAMILTON	45	C	14	2.64	0.53	1.40

Street Section A - Alta - Developed Condition - 10year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section A - Alta - Developed Condition (10yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.012000 ft/ft
Discharge	35.00 cfs

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

Results	
Mannings Coefficient	0.014
Water Surface Elev.	63.62 ft
Elevation Range	63.94 to 64.48
Flow Area	8.8 ft ²
Wetted Perimeter	45.37 ft
Top Width	44.38 ft
Actual Depth	0.68 ft
Critical Elevation	63.70 ft
Critical Slope	0.004655 ft/ft
Velocity	3.96 ft/s
Velocity Head	0.24 ft
Specific Energy	63.87 ft
Froude Number	1.56
Flow Type	Supercritical

$$.68 \times 3.96 = \underline{\underline{2.69}} < 6 \text{ OK}$$

Calculation Messages:

Water elevation exceeds lowest end station by 0.84746745e-1 ft.
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+57.00	0.013
0+57.00	0+92.50	0.016
0+92.50	0+99.50	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	63.91
0+00.50	63.81
0+05.50	63.81
0+05.50	63.31
0+07.00	63.44

**Street Section A - Alta - Developed Condition - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+07.00	63.48
0+53.00	63.98
0+53.00	64.48
0+53.50	64.48
0+56.50	64.42
0+57.00	64.42
0+57.00	63.92
0+92.50	63.11
0+92.50	63.07
0+94.00	62.94
0+94.00	63.44
0+94.50	63.44
0+99.50	63.54

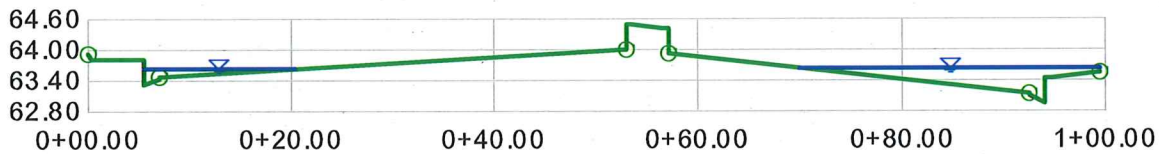
Street Section A - Alta - Developed Condition - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section A - Alta - Developed Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.014
Slope	0.012000 ft/ft
Water Surface Elev.	63.62 ft
Elevation Range	62.94 to 64.48
Discharge	35.00 cfs

$$\text{dry lane} = \frac{63.92 - 63.62}{.02} = \underline{\underline{15'}} > \underline{\underline{12'}} \text{ OK}$$

meets + matches existing



V:5.0
H:1
NTS

Street Section A - Alta - Developed Condition - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section A - Alta - Developed Condition (100yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.012000 ft/ft ← CPD1
Discharge	155.00 cfs

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

Results	
Mannings Coefficient	0.014
Water Surface Elev.	63.93 ft
Elevation Range	62.94 to 64.48
Flow Area	29.5 ft²
Wetted Perimeter	92.56 ft
Top Width	91.02 ft
Actual Depth	0.99 ft ← d ₁₀₀
Critical Elevation	64.06 ft
Critical Slope	0.004118 ft/ft
Velocity	5.26 ft/s ← V ₁₀₀
Velocity Head	0.43 ft
Specific Energy	64.36 ft
Froude Number	1.63
Flow Type	Supercritical

$$.99 \times 5.26 = \underline{\underline{5.21}} < 8 \text{ OK}$$

Calculation Messages:
Water elevation exceeds lowest end station by 0.39131753 ft.
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+57.00	0.013
0+57.00	0+92.50	0.016
0+92.50	0+99.50	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	63.91
0+00.50	63.81
0+05.50	63.81
0+05.50	63.31
0+07.00	63.44

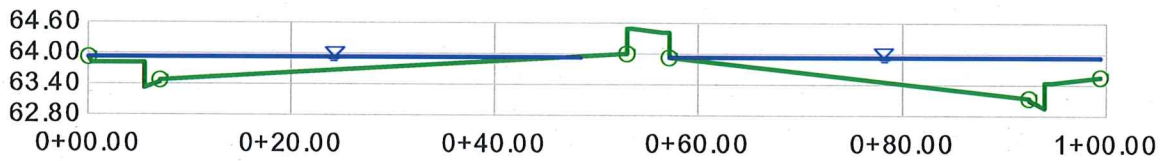
**Street Section A - Alta - Developed Condition - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+07.00	63.48
0+53.00	63.98
0+53.00	64.48
0+53.50	64.48
0+56.50	64.42
0+57.00	64.42
0+57.00	63.92
0+92.50	63.11
0+92.50	63.07
0+94.00	62.94
0+94.00	63.44
0+94.50	63.44
0+99.50	63.54

Street Section A - Alta - Developed Condition - 100year **Cross Section for Irregular Channel**

Project Description	
Worksheet	Street Section A - Alta - Developed Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.014
Slope	0.012000 ft/ft
Water Surface Elev.	63.93 ft
Elevation Range	62.94 to 64.48
Discharge	155.00 cfs



V:5.0
H:1
NTS

Street Section B - Tonopah - Developed Condition - 10year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section B - Tonopah - Developed Condition (10yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	6.00 cfs

← FD3 Flow (conservative)

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	64.32 ft
Elevation Range	63.97 to 65.33
Flow Area	3.1 ft ²
Wetted Perimeter	21.80 ft
Top Width	21.40 ft
Actual Depth	0.35 ft
Critical Elevation	64.31 ft
Critical Slope	0.006597 ft/ft
Velocity	1.91 ft/s
Velocity Head	0.06 ft
Specific Energy	64.38 ft
Froude Number	0.88
Flow Type	Subcritical

← d₁₀

← v₁₀

d x v < 6 OK

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	65.33
0+05.00	65.23
0+05.50	65.23
0+05.50	64.73
0+07.00	64.86
0+07.00	64.90
0+40.00	64.17
0+53.00	64.14
0+53.00	64.10
0+54.50	63.97
0+54.50	64.47

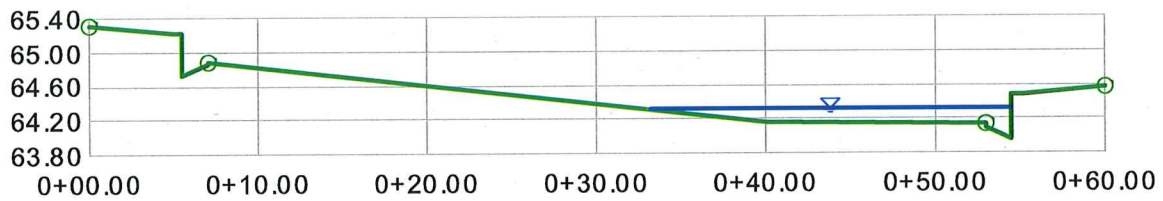
**Street Section B - Tonopah - Developed Condition - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+55.00	64.47
0+60.00	64.57

Street Section B - Tonopah - Developed Condition - 10year **Cross Section for Irregular Channel**

Project Description	
Worksheet	Street Section B - Tonopah - Developed Condi
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.005000 ft/ft
Water Surface Elev.	64.32 ft
Elevation Range	63.97 to 65.33
Discharge	6.00 cfs



V:5.0
H:1
NTS

Street Section B - Tonopah - Developed Condition - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section B - Tonopah - Developed Condition (100yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	12.00 cfs

← FD3 Flow

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	64.41 ft
Elevation Range	64.97 to 65.33
Flow Area	5.1 ft ²
Wetted Perimeter	25.78 ft
Top Width	25.29 ft
Actual Depth	0.44 ft
Critical Elevation	64.39 ft
Critical Slope	0.006113 ft/ft
Velocity	2.33 ft/s
Velocity Head	0.08 ft
Specific Energy	64.49 ft
Froude Number	0.91
Flow Type	Subcritical

← d₁₀₀

← V₁₀₀

$$\underline{d \times v < 8 \text{ OK}}$$

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	65.33
0+05.00	65.23
0+05.50	65.23
0+05.50	64.73
0+07.00	64.86
0+07.00	64.90
0+40.00	64.17
0+53.00	64.14
0+53.00	64.10
0+54.50	63.97
0+54.50	64.47

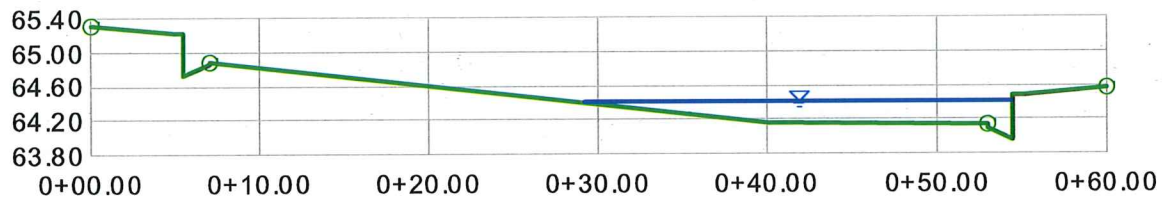
**Street Section B - Tonopah - Developed Condition - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+55.00	64.47
0+60.00	64.57

Street Section B - Tonopah - Developed Condition - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section B - Tonopah - Developed Condi
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.005000 ft/ft
Water Surface Elev.	64.41 ft
Elevation Range	1.97 to 65.33
Discharge	12.00 cfs



V:5.0
H:1
NTS

Street Section C - Hamilton - Developed Condition - 10year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section C - Hamilton - Developed Conditi. (10yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	007000 ft/ft
Discharge	7.00 cfs

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

Results	
Mannings Coefficient	0.014
Water Surface Elev.	62.78 ft
Elevation Range	61.35 to 63.44
Flow Area	2.9 ft ²
Wetted Perimeter	19.48 ft
Top Width	19.00 ft
Actual Depth	0.43 ft
Critical Elevation	62.79 ft
Critical Slope	0.005806 ft/ft
Velocity	2.42 ft/s
Velocity Head	0.09 ft
Specific Energy	62.87 ft
Froude Number	1.09
Flow Type	Supercritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+38.00	0.016
0+38.00	0+45.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	63.44
0+05.00	63.34
0+05.50	63.34
0+05.50	62.84
0+07.00	62.97
0+07.00	63.01
0+25.00	62.70
0+38.00	62.52
0+38.00	62.48
0+39.50	62.35
0+39.50	62.85

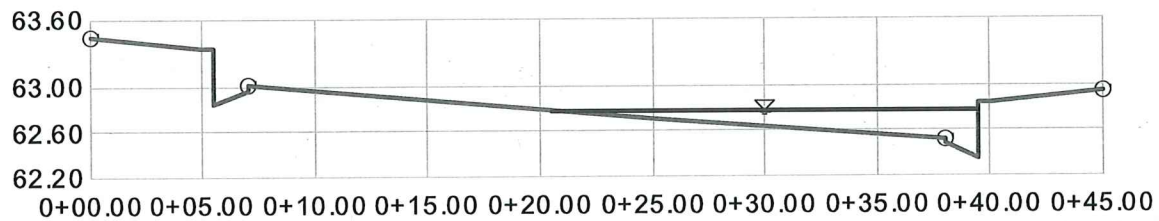
**Street Section C - Hamilton - Developed Condition - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+40.00	62.85
0+45.00	62.95

Street Section C - Hamilton - Developed Condition - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section C - Hamilton - Developed Condit
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.014
Slope	0.007000 ft/ft
Water Surface Elev.	62.78 ft
Elevation Range	62.35 to 63.44
Discharge	7.00 cfs



V:5.0
H:1
NTS

Street Section C - Hamilton - Developed Condition - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section C - Hamilton - Developed Condition (100yr)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.007000 ft/ft ← CPD2
Discharge	14.00 cfs

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	62.88 ft
Elevation Range	62.35 to 63.44
Flow Area	5.3 ft²
Wetted Perimeter	28.47 ft
Top Width	27.88 ft
Actual Depth	0.53 ft ← d ₁₀₀
Critical Elevation	62.90 ft
Critical Slope	0.006115 ft/ft
Velocity	2.64 ft/s ← v ₁₀₀
Velocity Head	0.11 ft
Specific Energy	62.99 ft
Froude Number	1.07
Flow Type	Supercritical

$$\underline{d \times v < 8 \text{ OK}}$$

Calculation Messages:
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+38.00	0.016
0+38.00	0+45.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	63.44
0+05.00	63.34
0+05.50	63.34
0+05.50	62.84
0+07.00	62.97
0+07.00	63.01
0+25.00	62.70
0+38.00	62.52

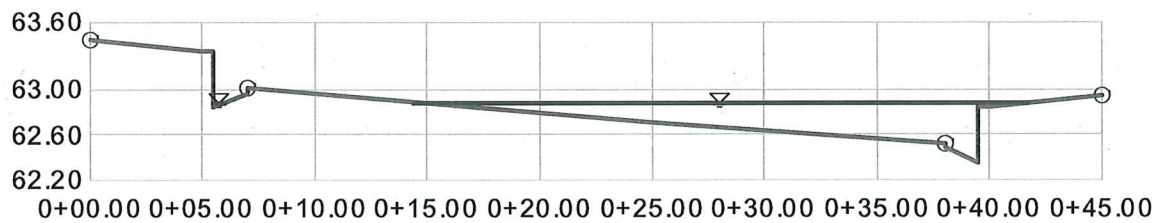
**Street Section C - Hamilton - Developed Condition - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+38.00	62.48
0+39.50	62.35
0+39.50	62.85
0+40.00	62.85
0+45.00	62.95

Street Section C - Hamilton - Developed Condition - 100year **Cross Section for Irregular Channel**

Project Description	
Worksheet	Street Section C - Hamilton - Developed Conditio
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.007000 ft/ft
Water Surface Elev.	62.88 ft
Elevation Range	62.35 to 63.44
Discharge	14.00 cfs



V:5.0
H:1
NTS

SECTION 1500 – BMP PRACTICES

Section 1500

Structural Best Management Practices

1501 INTRODUCTION

Presented in this section are design criteria for structural Best Management Practices (BMPs) for the control of surface water quality in Las Vegas Valley. These BMPs have been identified as having potential effectiveness in Las Vegas Valley based on the types of water quality conditions expected in this area, and on documented BMP performance in other areas. Criteria for the following BMPs are presented:

- Parking Lot Low Impact Development (LID)
- General Low Impact Development (LID)
 - Disconnected Impervious Areas
 - Landscape Swale
 - Depressed Medians
 - Depressed Landscaping
 - Buffer Strip
 - Pervious Overflow Parking
 - Sand / Media Filters
 - Oil / Water Separators
 - Oil / Grit Separators
 - On-Site Water Quality Basin
 - Infiltration Trench

There are currently no federal, state or local stormwater regulations which require the installation of specific water quality features in most new or existing developments in the Las Vegas Valley. The exception is new and redeveloped non-residential sites larger than 1.0 acre, for which low impact development (LID) measures are required by the Storm Water Management Plan. LID measures for sites smaller than 1 acre are encouraged for developers desiring to mitigate the impacts of urban development on surface water resources in the Las Vegas Valley.

There are three general categories of conditions for which urban stormwater quality management practices may be applied: (1) existing urban development; (2) new urban development and substantial redevelopment; and (3) construction activity. The BMPs in this section are primarily applicable to areas of new urban development, where land is available to devote to installations of this type and where design flexibility exists. In certain cases, these structural BMPs may be effective in retrofitting existing developed areas to control water quality problems. However, it is generally more cost-effective to rely on nonstructural BMPs (e.g., source controls, housekeeping practices, public education, and employee training) in these applications. BMPs related to construction activity are primarily directed toward erosion control. This issue

1502 Parking Lot LID Measures

1502.1 Description

Low impact development (LID) measures can be used for managing runoff from areas of new development and significant redevelopment (NDSR). LID measures must be applied to parking lots for all new non-residential sites of 1 acre and larger in the Las Vegas Valley. For the purpose of LID measures, a parking lot is defined as all of the impervious area outside the building footprint. Parking lot LID policies and design criteria are discussed in more detail in Proposed Parking Lot Low Impact Development Program for Las Vegas Valley, Las Vegas Valley Stormwater Quality Management Committee, February 2013.

1502.2 Design Criteria

Parking lot designs must be submitted to local entities with the technical drainage study required by Municipal code. A list of accepted parking lot BMPs that can be used in the Las Vegas Valley is provided in Table 1501.

BMP requirements shall adhere to this manual. A stepped approach to determine whether a parking lot is categorized as small, medium or large for the purpose of determining required BMPs is shown below. Any project site that is less than 1 acre in size is categorized as small; parking lot size is not a factor in determining required BMPs for small sites. For project sites that are greater than or equal to 1 acre, the parking lot size is used to determine if the category is medium or large. Sites having parking lots that are less than or equal to 1 acre are categorized as medium. Sites with parking lots greater than 1 acre are categorized as large.

Not
Applicable -
No
Parking
Lot

Total Site Size	Parking Lot Size	Parking Lot Category
< 1 acre	Not Applicable	Small
≥ 1 acre	≤ 1 acre	Medium
≥ 1 acre	> 1 acre	Large

Once the parking lot category is determined, the BMP requirements for the parking lot design can be determined as shown in Table 1502. BMP requirements are more stringent as the parking lot size increases.

The designer may choose how to meet the parking lot BMP design requirements depending on specific site characteristics. In order to maximize the water quality benefit of the parking lot BMPs, the designer is encouraged to locate BMPs to capture runoff from portions of the site with the highest potential to generate pollutants.

No
Parking
Lot

There are no specific BMP requirements for small parking lots; however, the designer is encouraged to install any of the BMPs that are listed for parking lots in the medium or large categories.

For the Medium parking lot category, the design requirements consist of disconnecting impervious areas for at least 75 percent of the parking lot area from the onsite drainage network. This may be accomplished by directing runoff to pervious areas such as landscaping, depressed medians, parking strips, or stormwater retention basins. The design criteria are based on meeting the accepted minimum standards for the BMPs selected. The designer may choose to install a treatment BMP listed in the Large parking lot category.

For the Large parking lot category, treatment BMPs are required to treat stormwater runoff from at least 75 percent of the parking lot. Because typical site drainage layouts must account for application of flood control criteria, treatment BMPs may need to be sized to accommodate runoff from the contributing building area as well. BMPs are to be sized for the 85th percentile storm, and hydrologic and hydraulic calculations are required to be submitted for the BMP design.

The requirement to treat 75 percent of the parking lot area, either through disconnecting impervious areas or installing treatment devices, recognizes that grading and other site conditions will prevent directing all site runoff to some type of BMP. However, designers are encouraged to exceed the minimum standard when this can be done cost effectively in order to maximize the potential water quality benefits of the BMP system.

LID measures that are incorporated in the parking lot design should be planned during the site design process. Certain LID measures, including depressed medians, islands, and rock-lined swales, help to disconnect impervious areas and remove suspended particles in the stormwater runoff, prior to connection to the MS4. Parking Lot BMPs can be integrated into perimeter landscaped areas (e.g., buffers) and interior landscaped areas (e.g., medians) required by local development standards whenever possible. When incorporated into landscaping features, tributary areas to individual BMPs should be kept to less than 0.5 acres whenever possible, and should never exceed 1.0 acre.

Figure 1501 through Figure 1503, provide ideas on how parking lots can be designed to comply with the water quality regulations. The designer is required to comply with the planning code for the municipality in which the site is located. The conceptual layouts incorporate general planning requirements, however, specific planning requirements such as those for landscape buffers are determined based in part on the adjacent property. The conceptual layouts are designed to represent a commercial property that is approximately 5 acres in size, with the total parking lot area of approximately 3.3 acres.

APPENDIX C

FIGURES

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.

USE THIS SCALE(FEET) WHEN MAP REDUCED FROM 11X17 ORIGINAL

MAP LEGEND

- PARCEL BOUNDARY
- SUB BOUNDARY
- PMD BOUNDARY
- ROAD EASEMENT
- MATCH / LEADER LINE
- HISTORIC LOT LINE
- HISTORIC SUB BOUNDARY
- SECTION LINE

- CONDOMINIUM UNIT
- AIR SPACE PCL
- RIGHT OF WAY PCL
- SUB-SURFACE PCL
- LOT NUMBER
- GLS GOV. LOT NUMBER

ASSESSOR'S PARCELS - CLARK COUNTY, NV.
Briana Johnson - Assessor

T20S R61E

33

N 2 SW 4

139-33-3

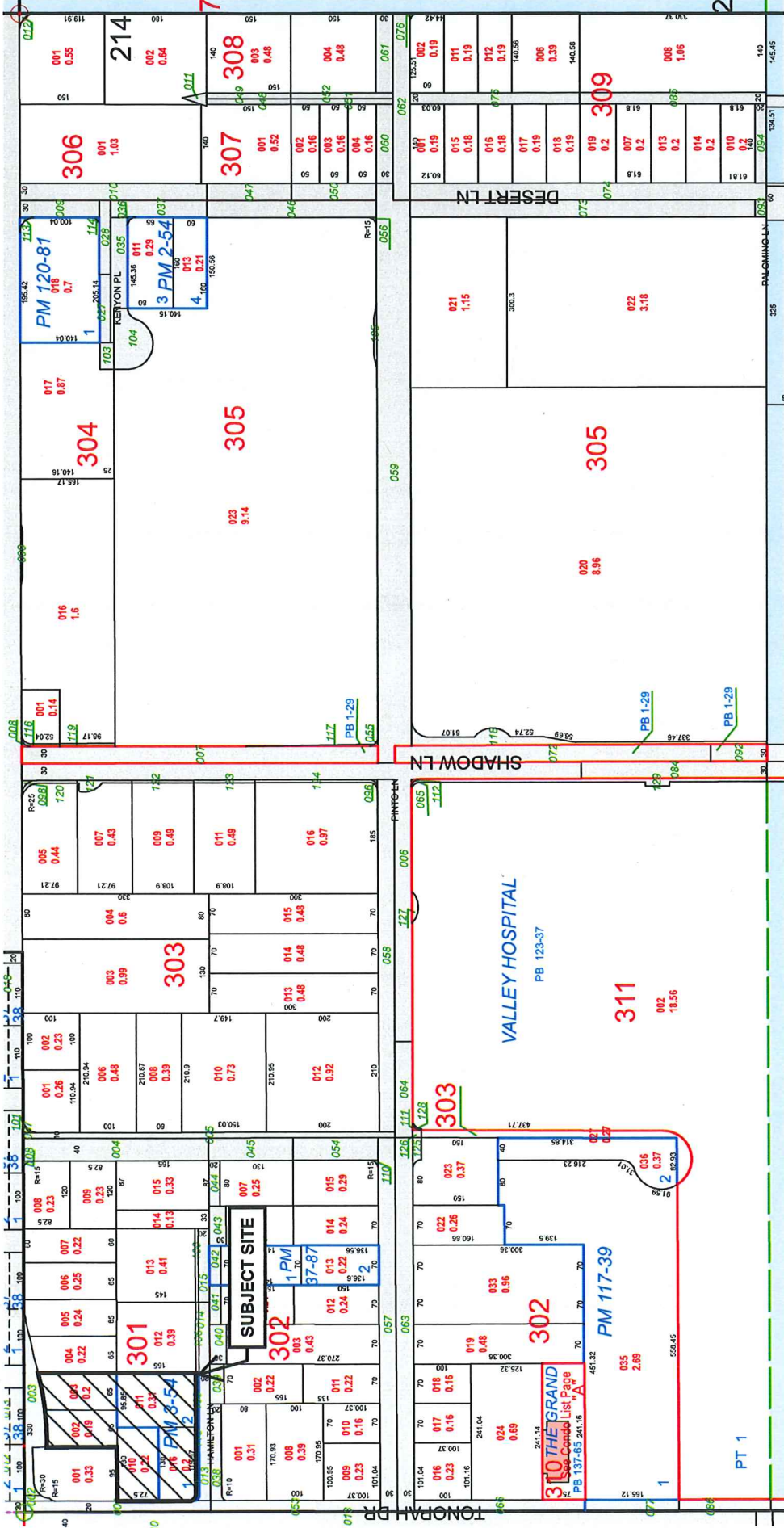


1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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125	124	123
138	139	140
163	162	161
176	177	178

Rev: 7/1/2021

Scale: 1" = 200'



NOT TO SCALE



DRAWN BY:	JD	SCALE:	N.T.S.
-----------	----	--------	--------

CHECKED BY: CB DATE: 5/25/22



6345 South Jones Blvd. Suite 100

Las Vegas, NV 89118

Phone (702) 365-9312 - Fax (702) 365-9317

VICINITY MAP (FIGURE 1)

LAS VEGAS MEDICAL DISTRICT

PROJECT No.:

221050

SHEET No.

1

SHEET 1 OF 1



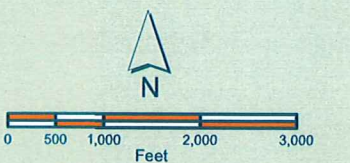
2018
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE
FIGURE F-29

FLOOD CONTROL FACILITIES

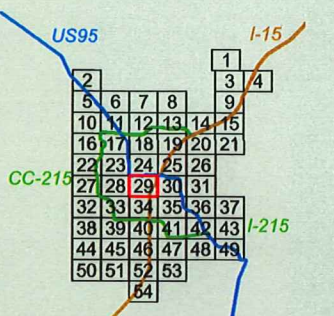
LEGEND

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

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



AerialSource:Esri World Imagery 2017

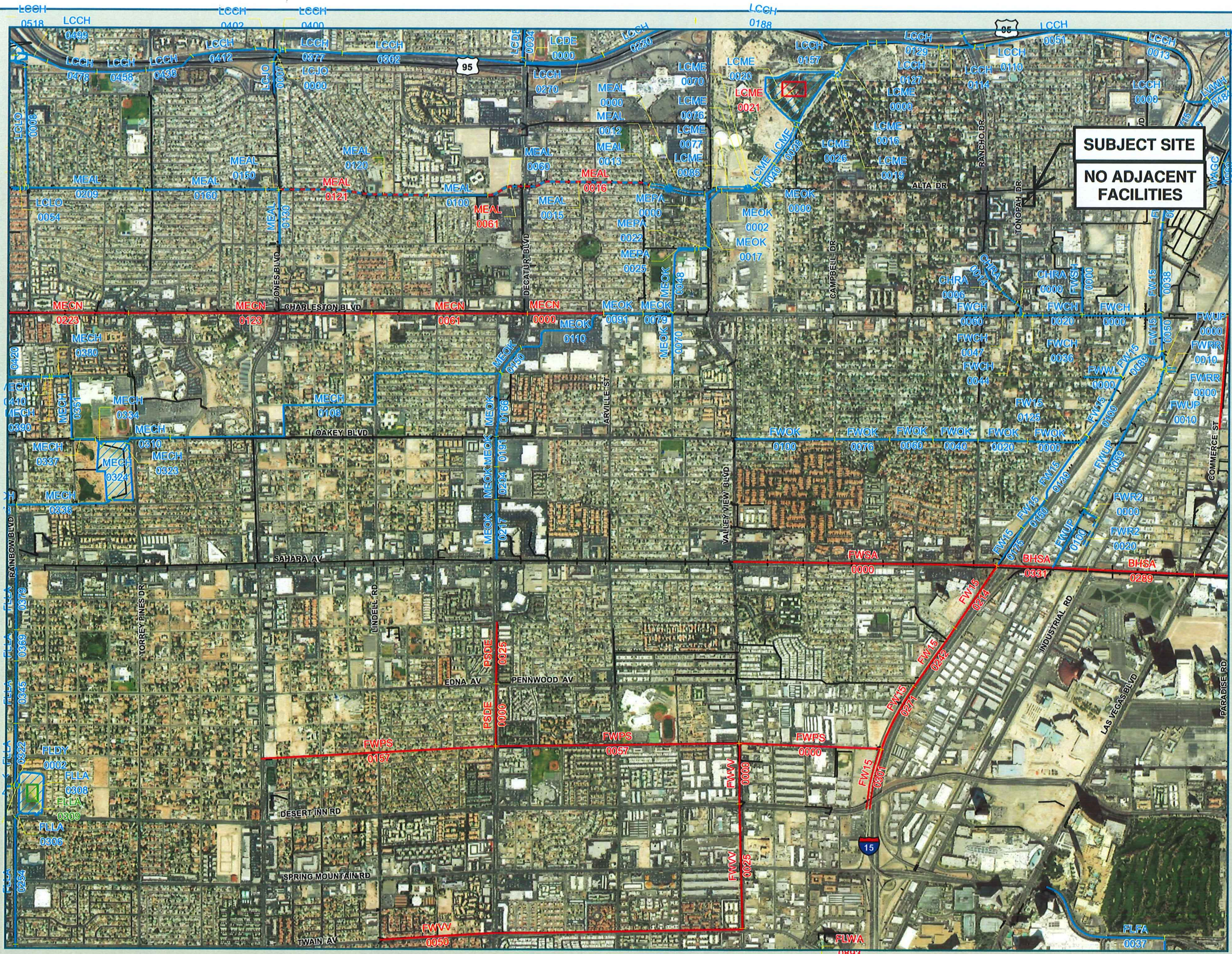


ATKINS

Member of the SNC-Lavalin Group

Louis Berger

SUBJECT SITE
NO ADJACENT
FACILITIES



ID / 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	P	14' X 14' RCB	6000	3552	CSA13	SW3	7.93	0.67
0289	P	14' X 12' RCB	2300	3669	CSA11	SW3	7.55	0.87
0331	P	14' X 11' RCB	2000	3345	CSA10-1	SW3	7.15	1.00
CHRA		WEST CHARLESTON DRAINS - RANCHO						
0000	E	6' X 5' RCB	310	302	CAL95	SW3	0.62	1.92
0006	E	5' X 5' RCB	420	302	CAL95	SW3	0.62	1.00
0014	E	5' X 4' RCB	600	302	CAL95	SW3	0.62	1.50
FLBN		FLAMINGO - BOULDER HIGHWAY NORTH						
0312	P	7' X 4' RCB	2160	621	CCH52	SW3	0.62	4.20
0342	P	7' X 4' RCB	2425	621	CCH52	SW3	0.62	4.20
FLDY		FLAMINGO WASH - DARBY STORM DRAIN						
0000	E	84" RCP	100	611	CLF24	FLAM3A	0.76	0.25
0002	E	10' X 3' RCB	50	611	CLF24	FLAM3A	0.76	0.25
0004	E	60" RCP	680	611	CLF24	FLAM3A	0.76	2.80
FLFA		FLAMINGO - FASHION						
0000	E	12' X 5' RCB	2050	720	CFW17N	FLAM3A	0.72	0.28
0037	E	8' X 5' RCB	3060	492	FW14	FLAM3A	0.44	0.45
FLLA		FLAMINGO WASH - LATERAL (FLAMINGORAINBOW)						
0254	E	90" RCP	2730	572	CLF27	FLAM3B	0.51	0.40
0304	P0	MODIFY SPILLWAY, RAISE HEIGHT BY 1" (REPLACES FLA0305)		1556	CLF25	FLAM3A	1.03	
0305	E	1,556 CFS PMF SPILLWAY (REPLACE W/ FLA0304)		1556	CLF25	FLAM3A	1.03	
0306	E	30" RCP WITH 18" ORIFICE OUTLET	203	30	DIDB	FLAM3A	1.03	0.43
0308	E	62 AC-FT DESERT INN DETENTION BASIN		813	CLF25	FLAM3A	1.03	
0309	P0	UPGRADE TO 70 AC-FT DESERT INN DETENTION BASIN		813	CLF25	FLAM3A	1.03	
0322	E	81" RCP	1370	245	LF25	FLAM3A	0.27	0.50
0345	E	81" RCP	1340	245	LF25	FLAM3A	0.27	0.50
0369	E	72" RCP	670					0.50
0379	E	66" RCP	1320					0.50
FWIS		FREEWAY CHANNEL FROM DESERT INN TO EXPRESSWAY						
0000	E	3: 12' X 10' RCB	2170	3685	CAL93	Boulder4	8.93	0.17
0010	E	3: 12' X 10' RCB	677	3506	CAL96	Boulder4	8.70	0.17
0038	E	3: 12' X 10' RCB	1945	3399	CCH22	Boulder4	8.52	0.17
0050	E	3: 12' X 10' RCB	870	2613	CCH50	SW4	8.48	0.17
0089	E	2: 18' X 10' RCB	1200	2485	CCWAL2	SW4	8.28	0.20
0100	E	2: 18' X 10' RCB	1510	2324	COK11C	SW3	7.83	0.60
0125	E	2: 10' X 8' RCB	267	1450	DCCSA08	SW3	6.67	0.80
0130	E	20' X 8' RCB	1176	1450	DCCSA08	SW3	6.67	0.57
0150	E	2: 10' X 8' RCB	760	1450	DCCSA08	SW3	6.67	0.80
0175	E	2: 10' X 8' RCB	985	1450	DCCSA08	SW3	6.67	0.75
0214	P	2: 12' X 10' RCB	1610	4269	CED10-C	SW3	6.25	0.73
0242	P	2: 12' X 9' RCB	1500	4130	CCCP908	SW3	6.03	0.93
0271	P	2: 12' X 10' RCB	1520	3842	CCP908	SW3	5.49	0.59
0301	P	CONC CHNL 12W 4D 2:1 SS	1300	353	CCE3FD-C	SW3	0.42	0.42
FWCH		WEST CHARLESTON DRAIN						
0000	E	10' X 7' RCB	1710	1044	CCH22	SW3	1.38	0.74
0020	E	10' X 7' RCB	840	824	CCH18-C	SW3	1.15	0.40
0036	E	9' X 7' RCB	425	824	CCH18-C	SW3	1.15	0.40
0044	E	9' X 7' RCB	145	561	CCH18-C	SW3	0.53	0.40
0047	E	7' X 5' RCB	710	561	CCH18-C	SW3	0.53	2.05
0060	E	5' X 4' RCB	400	561	CCH18-C	SW3	0.53	0.40
FWOK		OAKEY DRAIN						
0000	E	10' X 8' RCB	1350	960	1COK11C	SW3	1.16	0.62
0020	E	10' X 8' RCB	1025	960	1COK11C	SW3	1.16	0.60
0040	E	8' X 8' RCB	960	749	COK10	SW3	0.85	1.00
0060	E	5' X 5' RCB	970	749	COK10	SW3	0.85	1.50
0076	E	5' X 6' RCB	1175	749	COK10	SW3	0.85	1.04
0100	E	5' X 5' RCB	2020	465	COK09-C	SW3	0.55	2.16
FWPS		PALMYRA / SIRIUS DRAIN						
0000	P	12' X 12' RCB	3000	3544	CP908	SW3	5.07	1.50
0057	P	10' X 10' RCB	5220	2101	CP906	SW3	2.78	1.28
0157	P	2: 66" RCP	5100	547	CP903	SW3	0.59	1.15
FWR2		FREEWAY CHANNEL - RAILROAD CHANNEL						
0000	E	5' X 4' RCB	377					1.60
0020	E	EARTH CHNL 10W 4D 2:1 SS	650					0.50
FWRR		FREEWAY CHANNEL BYPASS FACILITY RR BRANCH						
0000	E	45" RCP	70					1.22
0010	E	CONC CHNL 5W 5D 0:1 SS	220					1.22
FWSA		FREEWAY CHANNEL - SAHARA						
0000	P	7' X 5' RCB	5700	496	CSA08	SW3	0.42	1.49
FWSH		SHADOW LAKE DRAIN						
0000	E	7' X 4' RCB	950	247	CH22-C	SW3	0.23	0.20
FWUP		FREEWAY CHANNEL BYPASS FACILITY						
0000	E	10' X 9' RCB	350	181	CH50	SW3	0.20	0.37
0010	E	10' X 8' RCB	804	181	CH50	SW3	0.20	0.37
0059	E	10' X 6' RCB	2650	181	CH50	SW3	0.20	0.40
0100	E	8' X 4' RCB	1440	181	CH50	SW3	0.20	0.47
FWVV		VALLEY VIEW DRAIN						
0000	P	12' X 11' RCB	1320	1549	CCE3FA	SW3	2.69	0.30
0025	P	10' X 10' RCB	2665	1059	CR4C1	SW3	1.74	0.30
0050	P	8' X 6' RCB	7785	750	DFW05	SW3	1.34	1.50
FWWL		FREEWAY CHANNEL-WALDMAN AVENUE						
0000	E	8' X 6' RCB	820	431	CWAL2	SW3	0.45	0.20
LCCH		LAS VEGAS CREEK CHANNEL						
0000	E	2: 12' X 7' RCB	730	3212	CAL93C	MEADOWS4	9.90	1.28
0013	E	2: 12' X 6' RCB	2035	3050	CLC20-C	MEADOWS4	9.60	0.82
0051	E	2: 14' X 7' RCB	3113	3050	CLC20-C	MEADOWS4	9.60	0.60
0110	E	TRANSITION STRUCTURE	220	3001	CCLC16-C	MEADOWS4	9.50	
0114	E	2: 14' X 7' RCB	670	2366	CRMEDET	MEADOWS4	8.19	0.60
0127	E	TRANSITION STRUCTURE	110	2366	CRMEDET	MEADOWS4	8.19	
0129	E	2: 14' X 7' RCB	1130	2366	CRMEDET	MEADOWS4	8.19	0.50
0150	E	2: 13' X 7' RCB	200	2366	CRMEDET	MEADOWS4	8.19	0.95
0154	E	TRANSITION STRUCTURE	190	2366	CRMEDET	MEADOWS4	8.19	
0157	E	2: 12' X 6' RCB	1650	1700	CCLC14-C	SW3	2.93	1.06
0230	E	12' X 6' RCB	2140	1450	CLC14-C	SW3	2.53	1.74
0270	E	12' X 6' RCB	1705	814	CCWA02-C	SW3	1.84	0.54
0302	E	8' X 6' RCB	3540	814	CCWA02-C	SW3	1.84	2.49
0377	E	10' X 7' RCB	1228	814	CCWA02-C	SW3	1.84	0.74
0400	E	TRANSITION STRUCTURE	110	458	CWA02-C	SW3	1.47	0.49
0402	E	8' X 6' RCB @ JONES	535	458	CWA02-C	SW3	1.47	0.49
0412	E	60" RCP	1370	458	CWA02-C	SW3	1.47	1.08
0438	E	60" RCP	1090	171	CLC01-C	SW3	1.20	1.60
0458	E	60" RCP	1060	171	CLC01-C	SW3	1.20	1.60
0478	E	60" RCP	1110	171	CLC01-C	SW3	1.20	0.55
0499	E	42" RCP OUTLET	660	87	RAINBWD8	SW3	1.11	1.88
0513	E	102 AC-FT RAINBOW DETENTION BASIN	1027		RAINBWN	SW3	1.11	
LCDE		LAS VEGAS CREEK - DECATUR						
0000	E	6' X 5' RCB	1600	430	LC11-C	SW3	0.38	1.28
0034	E	72" RCP	700	430	LC11-C	SW3	0.38	0.50
LCJO		LAS VEGAS CREEK - JONES						
0000	E	8' X 8' RCB	380	381	AL01B-C	SW3	0.37	0.50
0007	E	6' X 5' RCB	675	381	AL01B-C	SW3	0.37	0.62
LCLO		LAS VEGAS CREEK - LORENZI						
0000	E	7' X 6' RCB	445	285	DAL00A	SW3	0.41	3.37
0008	E	7' X 6' RCB	2983	285	DAL00A	SW3	0.41	0.40
0054	E	7' X 5' RCB	169	285	DAL00A	SW3	0.41	1.00
LCME		LAS VEGAS CREEK - MEADOWS						
0000	E	14' X 8' RCB	895	1484	MEADOWDB	SW3SC	5.67	0.72
0016	E	STILLING BASIN	140	1484	MEADOWDB	SW3SC	5.67	0.21
0017	E	3,300 CFS SPILLWAY (REPLACE W/ LCME0018)		3300	MEADOWDB	SW3SC	5.67	
0018	P	MODIFY SPILLWAY, RAISE HEIGHT BY 1" (REPLACES LCME0017)		3300	MEADOWDB	SW3SC	5.67	
0019	E	1: 11' X 5' RCB AND 1: 11.5' X 5' RCB	110	1484	MEADOWDB	SW3SC	5.67	0.81
0020	E	213 AC-FT MEADOWS DETENTION BASIN	4909		MEADOWIN	SW3SC	7.55	
0021	P	UPGRADE TO 249 AC-FT MEADOWS DETENTION BASIN	4909		MEADOWIN	SW3SC	7.55	
LCME		LAS VEGAS CREEK - MEADOWS						
0026	E	ENERGY DISSIPATOR	110	4909	MEADOWIN	SW3SC	5.67	2.94
0028	E	CONC CHNL 45W 8.5D 0:1 SS	922	4909	MEADOWIN	SW3SC	5.67	0.40
0040	E	CONC CHNL 40W 9.5D 0:1 SS	525	4819	CAL90-C	SW3SC	5.44	0.40
0070	E	CONC CHNL 18-30W 7-9.5D 0:1 SS	255	1956	CAL16	SW3	2.33	2.06
0076	E	FREE SPAN BRIDGE 18W 8D @ ALTA	100	1956	CAL16	SW3	2.33	1.89
0077	E	CONC CHNL 18W 8D 1:1 SS	618	1956	CAL16	SW3	2.33	1.89
0085	E	10' X 6' RCB @ VALLEY VIEW	275	1712	1CAL16	SW3	2.09	1.89
LCRA		LAS VEGAS CREEK - RANCHO						
0000	E	12' X 8' RCB	380	931	CLC16-C	SW3	1.71	0.60
0004	E	12' X 6' RCB	2367	931	CLC16-C	SW3	1.71	0.77
LVWH		WASHINGTON AVENUE CHANNEL						
0447	E	3: 14.33' X 10' RCB	1955	5193	CCAL93	SW5	22.05	0.15
0484	E	CONFLUENCE STRUCTURE	455	5193	CCAL93	SW5	22.05	0.15
MEAL		MEADOWS ALTA						
0000	E	CONC CHNL 8W 11D 1:1 SS	700	1277	CAL13-3	SW3	1.48	1.58
0012	E	12' X 6' RCB @ RED SKY	160	1227	CAL10-C	SW3	1.42	3.03
0013	E	CONC CHNL 8W 11D 1:1 SS	320	1227	CAL10-C	SW3	1.42	3.03
0015	E	72" RCP	2500	592	CAL11-C*	SW3	1.38	1.94
0016	P	ADD: 84" RCP	2500	592	CAL11-C*	SW4	1.38	1.94
0060	E	60" RCP	905	419	CBR3*	SW3	1.08	1.00
0061	P	ADD: 78" RCP	905	419	CBR3*	SW3	1.08	1.00
0100	E	72" RCP	1280	837	CBR3	SW3	1.08	1.40
0120	E	60" RCP	3500	355	CAL05-C*	SW3	1.01	1.00
0121	P	ADD: 78" RCP	3500	355	CAL05-C*	SW3	1.01	1.00
0130	E	6' X 4' RCB	1150	198	AL04-C	SW3	0.18	0.40
0150	E	60" RCP	285	518	CCUS	SW3	0.74	1.40
0160	E	36" RCP	2600	341	CUS	SW3	0.56	1.25
0209	E	48" RCP	2500	150	DCR2	SW3	0.41	1.70
0256	E	38" X 60" HERCP	81	150	DCR2	SW3	0.41	1.42
0258	E	48" RCP	275	150	DCR2	SW3	0.41	4.31
MECH		EXTENSION OF MEADOWS / CHARLESTON						
0108	E	30" RCP	8550	32	OAKEYD8	SW3	1.88	1.43
0310	E	24" RCP	1000	32	OAKEYD8	SW3	1.88	1.43
0323	E	15" RCP OUTLET</						



City of Las Vegas

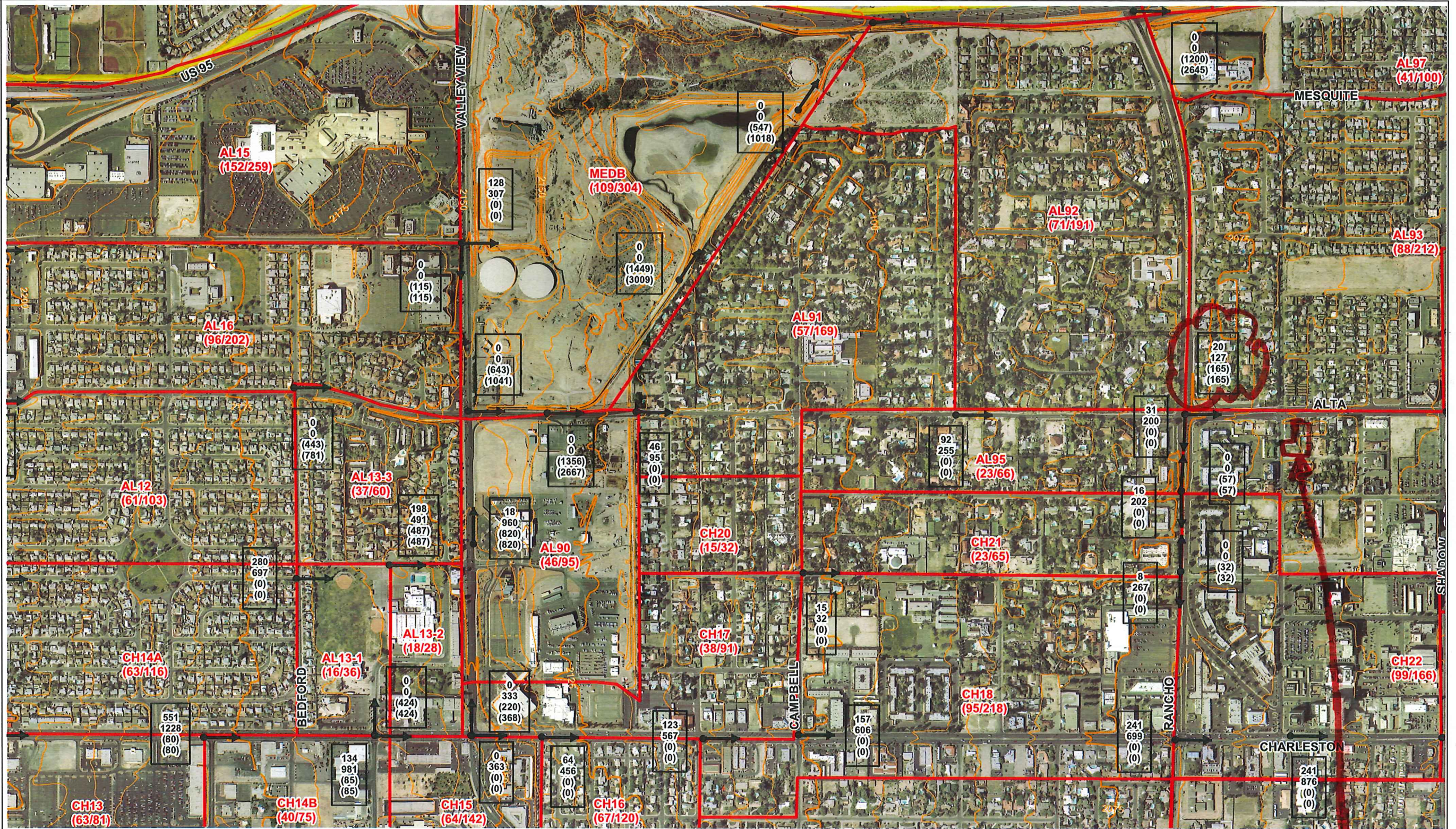
CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN

LEGEND

- Sub-basin Boundary
- Basin ID
- Contributing flow from the basin (cfs)
(10yr./100yr.)
- Flow Arrow
- 10-Year Street Flow
100-Year Street Flow
10-Year Facility Flow
100-Year Facility Flow
(Flows in CFS)
- Study Area Limit

PHOTO DATE: SPRING 2004

FIGURE E-9



EXISTING DRAINAGE CONDITIONS



2270 Corporate Circle, Suite 100
Henderson, NV 89074
(702) 263-7275
Fax: (702) 263-7200

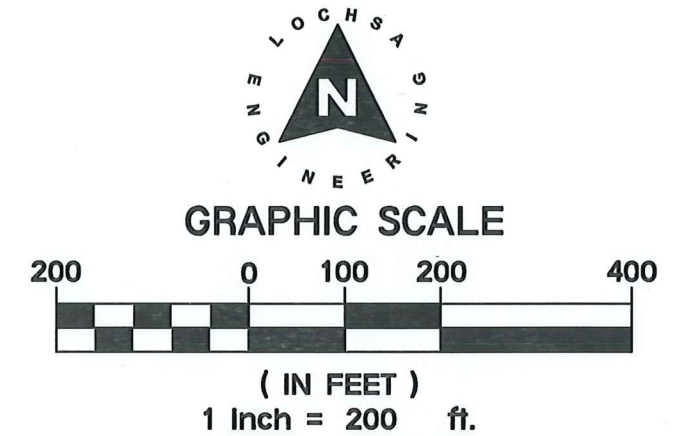
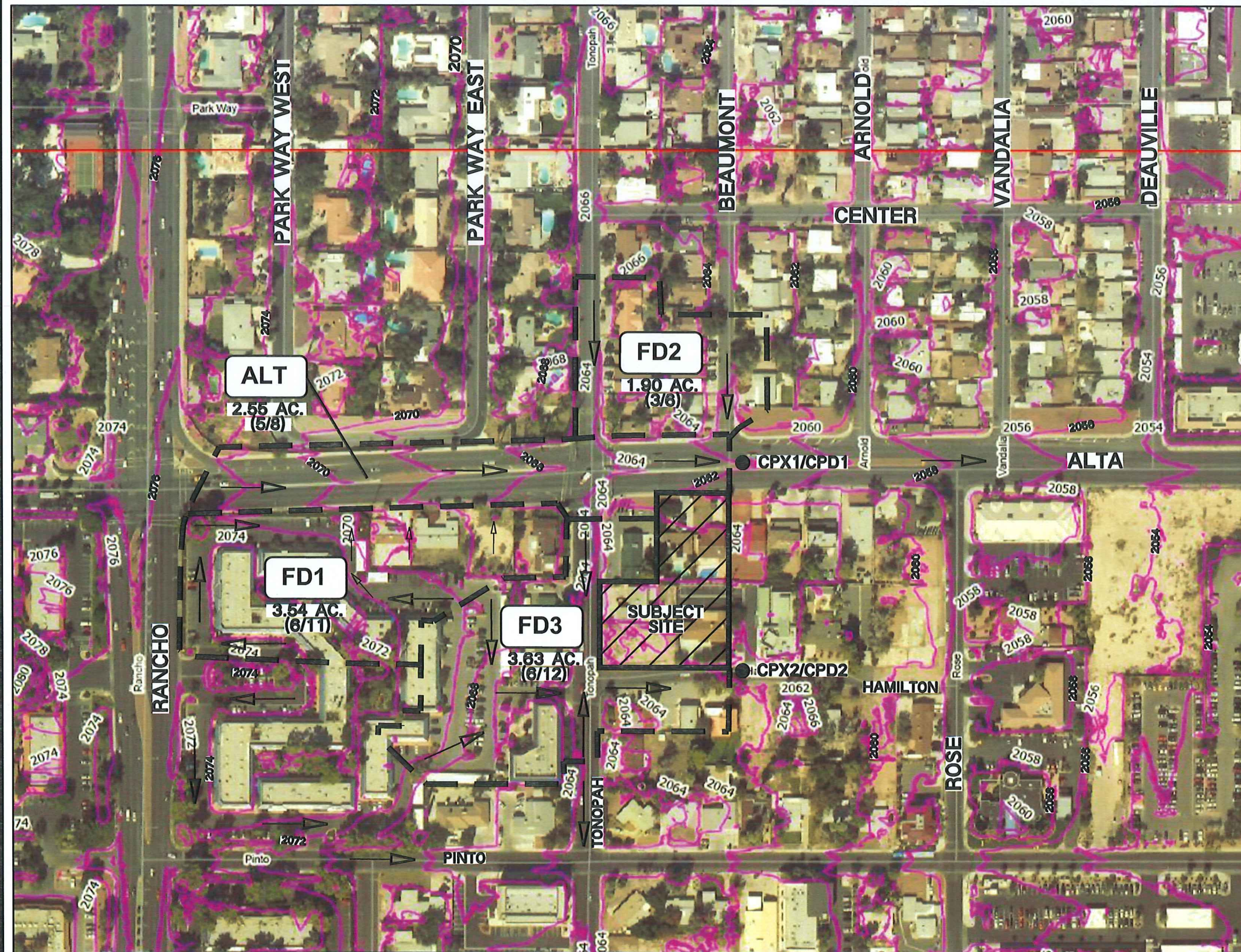
	Durango	Rainbow	Decatur	Tonopah	5th	Pecos	Nellis
Lake Mead				1	2		
Washington				3	4	5	6
Charleston	7	8	9	10	11		12
Sahara	13	14	15	16	17		
Desert Inn		18	19				

NOTE:
Existing conditions are based on future
Curve Number values with only existing local and
CCR/CFD 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



DRAINAGE LEGEND	
ND1	DRAINAGE BASIN LABEL
●	CONCENTRATION POINT
●	COMBINATION POINT
---	ONSITE BASIN BOUNDARY
---	OFFSITE BASIN BOUNDARY
$\frac{2}{3}$	Q10 FLOW IN CFS (10 YR.)
$\frac{1}{1}$	Q100 FLOW IN CFS (100 YR.)
$\frac{1 (1.0)(1.2)}{1 (1.0)(1.2)}$	Q10 (V10)(D10)
	Q100 (V100)(D100)
→	BASIN FLOW DIRECTION

Peak Flow Summary				
Existing Condition				
HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)	
*REF. CLV MPU FLOW	-	*20	*127	
FD1	3.54	6	11	
ALT	2.55	5	8	
FD2	1.90	3	6	
NX1	0.39	<1	1	
CPX1	-	34	154	*REF. CLV MPU FLOW + FD1 + ALT + FD2 + NX1
FD3	3.83	6	12	
NX2	0.73	1	2	
CPX2	-	7	14	(FD3 + NX2)

Peak Flow Summary				
Developed Condition				
HEC-1 ID	Area (acres)	10-year Flow	100-year Flow	
*REF. CLV MPU FLOW	-	*20	*127	
FD1	3.54	6	11	
ALT	2.55	5	8	
FD2	1.90	3	6	
ND1	0.47	1	2	
CPD1	-	35	155	*REF. CLV MPU FLOW + FD1 + ALT + FD2 + ND1
FD3	3.83	6	12	
ND2	0.73	1	3	
CPD2	-	7	14	(FD3 + ND2)

DRAWN BY: JD	SCALE: 1"=300'	FILE NAME: C-221050-OFFMAP.dwg
CHECKED BY: CB	DATE: 6/1/22	LEGEND
LOCHSA ENGINEERING 6345 SOUTH JONES BLVD., SUITE 100 LAS VEGAS, NV 89118 P: 702 365-9312, F: 702 365-9317		FOUND MONUMENTATION
		CENTER LINE
		ROW LINE
		EASEMENT LINE
		SECTION LINE
		PROPERTY LINE
		ADJACENT PROPERTY LINE

OFFSITE BASIN MAP

LAS VEGAS MEDICAL DISTRICT

PROJECT No.:
221050

SHEET No.

OFF

SHEET 1 OF 1