

DS #: 5399

APN: 163.01.510.001 & 163.01.510.004

PROJECT: Charleston & Westwind Retail Center

SUBMITTAL: 1st

SCANNED BY/DATE:

CHECKED BY/DATE:



CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM		DATE: January 13, 2021
TO: Land Development Services Department of Building & Safety		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	COPIES TO:
Charleston & Westwind Retail Center		McCay Engineering
Cross Streets:	SEC Charleston Blvd. & Westwind Road	LDR Partners
File Number:	F:\Depot\DSMemos\DS5399A.doc	Bart Anderson, P.E., DevCo
Parcel Number:	163-01-510-001 & 163-01-510-004	CCRFCD
Zoning Action:	20-0023-VAR1; SDR-78460; VAR-78455; VAR-78456 & ZON-78454	
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES	NO X

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1 st Submittal	12/23/2020	1/13/2021	See Comments Below	\$400.00	\$400
TOTAL FEES (LDDRS):				\$400.00	----

REMARKS:

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

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

1. The site is adjacent to or crosses an existing or proposed *Clark County Regional Flood Control District* (CCRFCD) master planned facility. Therefore, CCRFCD concurrence is required prior to final approval of the drainage study.

Please note that effective March 15, 2019, the CCRFCD adopted new requirements for drainage study concurrence submittal. Follow the link below for specific guidance.

<http://gustfront.ccrfcd.org/LandDev/LandDev.aspx>

Please note that effective April 6, 2020, only electronic submittals to the CCRFCD will be accepted for regional concurrence. Contact cwang@regionalflood.org for direction.

2. The subject development consists of two parcels. A reversionary map must be recorded prior to the final improvement plans approval. Provide proof of a reversionary map has been applied to the **City** in the next submittal.
3. There are existing buildings in the subject site. Provide a *Demolition Plan* to clearly identify what buildings are to be demolished and what buildings or features need to remain in the next submittal.

4. Provide street names on the grading plan and all drainage basin plans.
5. There is a discrepancy of what it's being proposed in "Chapter 1.1 Scope" and the *Description of Property*. The grading plan does not seem to have a *Gasoline Station*. Revise accordingly.
6. Provide a section at the *Future Pad* in *Charleston Boulevard*. Provide erosion protection measures behind the sidewalk in *Charleston Boulevard*.
7. Provide erosion protection measures behind the sidewalk in *Cross Section A*.
8. On the east side of the driveway entrance in *Charleston Boulevard*, explain why a local low point "68.34TC/LP" is created at the throat of the entrance which doesn't make sense. Address and revise accordingly.
9. Construction Note #18 on *Sheet C4.01* should provide "Install 3 course solid grouted flood wall."

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

END OF REMARKS
HDR/AYS

T/R/S: T21S/R60E/01
AREA Q-01

McCAY ENGINEERING

11700 W. CHARLESTON BLVD., SUITE 170-298
LAS VEGAS, NV 89135
702-860-3897

TECHNICAL DRAINAGE STUDY FOR Charleston & Westwind Retail Center

CLARK COUNTY, NV
December 23, 2020



**McCay
Engineering**

PREPARED FOR:

LDR PARTNERS
985 White Drive, Suite #100
LAS VEGAS, NV 89119
(702) 733-3622

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Charleston & Westwind Retail Center Date: December 23, 2020

Location of Development: a) Descriptive (Cross Streets) North/South: Westwind Rd.
 East/West: Charleston Blvd.

b) Section: 1 Township: 21 South Range: 60 East

c) APN : 163-01-510-001/004

Name of Owner: LDR Partners

Telephone No.: (702)733-3622 Fax No.: _____ E-Mail Address: N/A

Address: 985 White Drive, Suite #100 Las Vegas, NV 89119

Contact Person-Name: Jeremy McCay Telephone No.: (702) 860-3897

* E-Mail Address: jmcay@centurylink.net Fax No.: N/A

Firm: McCay ENGINEERING

Address: 11700 W. CHARLESTON BLVD., SUITE 170-298 LAS VEGAS NV 89135

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	

- Total Owned Land Area: At Site: 2.58 ACRES (+/-) Being Developed/Disturbed: 1.71 ACRES (+/-)
- Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ Yes** ☒ No
- Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☒ Yes** ☐ No
- Proposed type of development (Residential, Commercial, Etc.): Commercial buildings with parking addition
- Approximate upstream land area which drains to the subject site: 300 ACRES (+/-)
- Has the site drainage been evaluated in the past? ☐ YES ☒ NO If yes, please identify documentation: _____
- If known, please briefly identify the proposed discharge point(s) of runoff from the site: North to Charleston Boulevard
- 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



McCay ENGINEERING

11700 W. CHARLESTON BLVD.
SUITE #170-298
LAS VEGAS, NV 89135
JMCCAY@CENTURYLINK.NET
(702) 860-3897

Date: December 23, 2020

Albert Sung, P.E.
City of Las Vegas
Public Works Department – Flood Control
495 S. Main St.
Las Vegas, Nevada 89101

RE: TECHNICAL DRAINAGE STUDY FOR CHARLESTON & WESTWIND RETAIL CENTER
Job No. 20347

Dear Mr. Sung:

This letter is provided to certify that all items on the CD match 100% of the hard copy version provided.

If you have any questions or comments regarding this project, please do not hesitate to contact this office at (702) 860-3897.

Sincerely,
McCay Engineering

Jeremy S. McCay, P.E.
Principal

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: CHARLESTON + WESTWIND RETAIL CENTER	Map ID:	
Firm Name: McCay Engineering	Engineer: Jeremy McCay	
Address: 11700 W. CHARLESTON BLVD., Suite #170-298		
City: LAS VEGAS	State: NV	Zip: 89135
Phone Number: (702) 860-3897	Fax Number: N/A	
Property Owner: LDR PARTNERS		
Address: 985 WHITE DRIVE, STE. #100		
City: LAS VEGAS	State: NV	Zip: 89119
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. |
| No ☐ | Yes ☒ | 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	
☐	<u>N/A</u>	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.
☐	<u>N/A</u>	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.
☐	<u>N/A</u>	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
☐	<u>N/A</u>	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.
☐	<u>N/A</u>	Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
☐	<u>N/A</u>	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
☒	☐	Building and/or lot numbers.
☒	☐	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
☐	<u>N/A</u>	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 | |
|-------------------------------------|---|--|
| ☐ | ☒ N/A | 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	
	N/A	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.
	N/A	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.
	N/A	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.
	N/A	Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
	N/A	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 (CCRFCDD) 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 CCRFCDD Hydrologic Criteria and Drainage Design Manual (Design Manual).

An appointment must be made to preview this checklist in conjunction with CCRFCDD 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.)
✓		Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.
✓		An electronic copy of the complete submittal is required to be submitted with one original hard copy of the study. Electronic documents should be on a universal computer-readable digital output device replicating your submittal. An Indexed Portable Document Format (PDF) or Print Ready CAD file formats with a minimum of 300dpi are the desired formats. If figures are in color, they must be scanned in color and saved as a separate file. _____ by initial here, the engineer on record acknowledges that the electronic copy is an identical replicate of the original hard copy submitted to the City of Las Vegas.

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

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

II. GRADING PLAN INFORMATION		
Yes	No	
✓		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.
✓		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.

NOFA



**LAS VEGAS
CITY COUNCIL**

CAROLYN G. GOODMAN
Mayor

MICHELE FIORE
Mayor Pro Tem

STAVROS S. ANTHONY

CEDRIC CREAR

BRIAN KNUDSEN

VICTORIA SEAMAN

OLIVIA DÍAZ

SCOTT D. ADAMS
City Manager

DEPARTMENT OF PLANNING

ROBERT SUMMERFIELD

DIRECTOR

**DEVELOPMENT
SERVICES CENTER**

333 N. RANCHO DRIVE
3RD FLOOR
LAS VEGAS, NV 89106
702.229.6301 | VOICE
702.474.7463 | FAX
711 | TTY



cityoflasvegas
lasvegasnevada.gov

May 21, 2020

Ms. Macie Hertoghe
LDR Partners
3775 North Freeway, Suite #101
Sacramento, California 95834

**RE: ZON-78454 [PRJ-78379] - REZONING RELATED TO VAR-78455,
VAR-78456 AND SDR-78460
CITY COUNCIL MEETING OF MAY 20, 2020**

Dear Ms. Hertoghe:

The City Council at a regular meeting held on May 20, 2020 voted to **APPROVE** a request for a Rezoning FROM: U (UNDEVELOPED) [MXU (MIXED USE) GENERAL PLAN DESIGNATION] TO: C-1 (LIMITED COMMERCIAL) on 0.52 acres at the southeast corner of Charleston Boulevard and Westwind Drive (APN 163-01-103-001), Ward 1 (Knudsen) [PRJ-78379].

The Notice of Final Action was filed with the Las Vegas City Clerk on May 21, 2020.

Sincerely,

Robert Summerfield, AICP[®]
Director
Department of Planning

RTS:PL:clb

cc: Mr. John Curran
Dapper Development
985 White Drive, Suite #100
Las Vegas, Nevada 89119



**LAS VEGAS
CITY COUNCIL**

CAROLYN G. GOODMAN
Mayor

MICHELE FIORE
Mayor Pro Tem

STAVROS S. ANTHONY

CEDRIC CREAR

BRIAN KNUDSEN

VICTORIA SEAMAN

OLIVIA DÍAZ

SCOTT D. ADAMS
City Manager

DEPARTMENT OF PLANNING

ROBERT SUMMERFIELD
DIRECTOR

**DEVELOPMENT
SERVICES CENTER**

333 N. RANCHO DRIVE
3RD FLOOR
LAS VEGAS, NV 89106
702.229.6301 | VOICE
702.474.7463 | FAX
711 | TTY



cityoflasvegas
lasvegasnevada.gov

May 21, 2020

Ms. Macie Hertoghe
LDR Partners
3775 North Freeway, Suite #101
Sacramento, California 95834

**RE: VAR-78456 [PRJ-78379] - VARIANCE RELATED TO ZON-78454,
VAR-78455 AND SDR-78460
CITY COUNCIL MEETING OF MAY 20, 2020**

Dear Ms. Hertoghe:

The City Council at a regular meeting held on May 20, 2020 voted to **APPROVE** a request for a Variance TO ALLOW AN EIGHT-FOOT RESIDENTIAL ADJACENCY SETBACK FOR A TRASH RECEPTACLE WHERE 50 FEET IS REQUIRED AND A 21-FOOT RESIDENTIAL ADJACENCY SETBACK FOR A BUILDING WHERE 63 FEET IS REQUIRED on 0.52 acres at the southeast corner of Charleston Boulevard and Westwind Drive (APNs 163-01-103-001 and 004), U (Undeveloped) [MXU (Mixed Use) General Plan Designation)] [PROPOSED: C-1 (Limited Commercial)], Ward 1 (Knudsen) [PRJ-78379].

This approval is subject to the following conditions:

Planning

1. A Variance is hereby approved to allow an eight-foot residential adjacency setback for a trash receptacle where 50 feet is required.
2. A Variance is hereby approved to allow a 21-foot residential adjacency setback for a building where 63 feet is required.
3. Approval of Rezoning (ZON-78454); and approval of and conformance to the Conditions of Approval for Variance (VAR-78455) and Site Development Plan Review (SDR-78460) shall be required, if approved.
4. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.

Ms. Macie Hertoghe
LDR Partners
VAR-78456 [PRJ-78379] - Page Two
May 21, 2020

5. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
6. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.
7. All City Code requirements and design standards of all City departments must be satisfied, except as modified herein.

The Notice of Final Action was filed with the Las Vegas City Clerk on May 21, 2020.

Sincerely,



Robert Summerfield, AICP *RS*
Director
Department of Planning

RTS:PL:clb

cc: Mr. John Curran
Dapper Development
985 White Drive, Suite #100
Las Vegas, Nevada 89119



**LAS VEGAS
CITY COUNCIL**

CAROLYN G. GOODMAN
Mayor

MICHELE FIORE
Mayor Pro Tem

STAVROS S. ANTHONY

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City Manager

DEPARTMENT OF PLANNING

ROBERT SUMMERFIELD
DIRECTOR

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lasvegasnevada.gov

May 21, 2020

Ms. Macie Hertoghe
LDR Partners
3775 North Freeway, Suite #101
Sacramento, California 95834

**RE: VAR-78455 [PRJ-78379] - VARIANCE RELATED TO ZON-78454,
VAR-78456 AND SDR-78460
CITY COUNCIL MEETING OF MAY 20, 2020**

Dear Ms. Hertoghe:

The City Council at a regular meeting held on May 20, 2020 voted to **APPROVE** a request for a Variance TO ALLOW 74 PARKING SPACES WHERE 128 ARE REQUIRED on 0.52 acres at the southeast corner of Charleston Boulevard and Westwind Drive (APNs 163-01-103-001 and 004), U (Undeveloped) [MXU (Mixed Use) General Plan Designation)] [PROPOSED: C-1 (Limited Commercial)], Ward 1 (Knudsen) [PRJ-78379].

This approval is subject to the following conditions:

Planning

1. A Variance is hereby approved to allow 74 parking spaces where 128 are required.
2. Approval of Rezoning (ZON-78454); and approval of and conformance to the Conditions of Approval for Variance (VAR-78456) and Site Development Plan Review (SDR-78460) shall be required, if approved.
3. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.
4. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
5. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.

Ms. Macie Hertoghe
LDR Partners
VAR-78455 [PRJ-78379] - Page Two
May 21, 2020

6. All City Code requirements and design standards of all City departments must be satisfied, except as modified herein.

The Notice of Final Action was filed with the Las Vegas City Clerk on May 21, 2020.

Sincerely,



Robert Summerfield, AICPTM
Director
Department of Planning

RTS:PL:clb

cc: Mr. John Curran
Dapper Development
985 White Drive, Suite #100
Las Vegas, Nevada 89119



**LAS VEGAS
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May 21, 2020

Ms. Macie Hertoghe
LDR Partners
3775 North Freeway, Suite #101
Sacramento, California 95834

**RE: SDR-78460 [PRJ-78379] - SITE DEVELOPMENT PLAN REVIEW
RELATED TO ZON-78454, VAR-78455 AND VAR-78456
CITY COUNCIL MEETING OF MAY 20, 2020**

Dear Ms. Hertoghe:

The City Council at a regular meeting held on May 20, 2020 voted to **APPROVE** a request for a Site Development Plan Review FOR A PROPOSED 10,010 SQUARE-FOOT RETAIL DEVELOPMENT WITH WAIVERS OF THE PERIMETER LANDSCAPE BUFFER REQUIREMENTS AND TO ALLOW THE SOUTH FACADE TO NOT BE DESIGNED AND TREATED COHERENTLY WHERE ALL SIDES OF THE BUILDING ARE REQUIRED on 0.52 acres at the southeast corner of Charleston Boulevard and Westwind Drive (APNs 163-01-103-001 and 004), U (Undeveloped) [MXU (Mixed Use) General Plan Designation]] [PROPOSED: C-1 (Limited Commercial)], Ward 1 (Knudsen) [PRJ-78379].

This approval is subject to the following amended conditions:

Planning

1. Approval of Rezoning (ZON-78454); and approval of and conformance to the Conditions of Approval for Variance (VAR-78455) and Variance (VAR-78456) shall be required, if approved.
2. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.
3. All development shall be in conformance with the site plan and landscape plan date stamped 04/27/20, and building elevations, date stamped 02/24/20, except as amended by conditions herein.
4. Three handicap parking stalls shall be provided in accordance with Title 19.

5. The existing screen walls on the east and south property lines shall be demolished and constructed in accordance with Title 19.
6. The shipping container located at the rear of the tavern building at 5589 West Charleston Boulevard shall be removed 90 days after final approval.
7. A Waiver from Title 19.08 is hereby approved, to allow an eight-foot wide landscape buffer adjacent to the western property line where 15 feet is required.
8. A Waiver from Title 19.08 is hereby approved, to allow a nine-foot wide landscape buffer adjacent to the northern property line where 15 feet is required.
9. A Waiver from Title 19.08 is hereby approved, to allow the southern façade to not be designed and treated coherently.
10. An Exception from Title 19.08 is hereby approved, to allow 17 parking lot landscape islands where 20 is required.
11. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
12. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.
13. The applicant shall coordinate with the City Surveyor and other city staff to determine the most appropriate mapping action necessary to consolidate the existing lots. The mapping action shall be completed and recorded prior to the issuance of any building permits.
14. A technical landscape plan, signed and sealed by a Registered Architect, Landscape Architect, Residential Designer or Civil Engineer, must be submitted prior to or at the same time application is made for a building permit. A permanent underground sprinkler system is required, and shall be permanently maintained in a satisfactory manner; the landscape plan shall include irrigation specifications. Installed landscaping shall not impede visibility of any traffic control device. The technical landscape plan shall include the following changes from the conceptual landscape plan:
 - A minimum of three different shrub species shall be utilized within the landscape plan.
 - A minimum of two different shade tree species shall be utilized within the landscape plan.

- Seven, 24-inch box shade trees shall be planted in the perimeter landscape buffer adjacent to the north property line.
 - 16, 24-inch box shade trees shall be planted in the perimeter landscape buffer adjacent to the east property line.
 - All trees within the southern landscape buffer shall be a minimum of 36" box in size.
15. A fully operational fire protection system, including fire apparatus roads, fire hydrants and water supply, shall be installed and shall be functioning prior to construction of any combustible structures.
16. All City Code requirements and design standards of all City Departments must be satisfied, except as modified herein.

Public Works

17. Concurrent with development, dedicate a bus turnout and deceleration lane meeting the intent of Clark County Standard Drawing #234.4 for the existing bus stop on Charleston Boulevard unless otherwise allowed by the City Traffic Engineer.
18. The sidewalk along Charleston Boulevard and Westwind Drive adjacent to this site shall meet Public Right-of-Way Accessibility Guidelines (PROWAG) in accordance with code requirements of Title 13.56.040 to the satisfaction of the City Engineer concurrent with development of this site. Revise existing onsite parking so as to eliminate conflicts with public rights-of-way.
19. Landscape and maintain all unimproved right-of-way, if any, adjacent to this site. All landscaping and private improvements installed with this project shall be situated and maintained so as to not create sight visibility obstructions for vehicular traffic at all development access drives and abutting street intersections.
20. A Drainage Plan and Technical Drainage Study must be submitted to and approved by the Department of Public Works prior to the issuance of any building or grading permits or submittal of any construction drawings, whichever may occur first. Provide and improve all drainageways recommended in the approved drainage plan/study. The developer of this site shall be responsible to construct such neighborhood or local drainage facility improvements as are recommended by the City of Las Vegas Neighborhood Drainage Studies and approved Drainage Plan/Study concurrent with development of this site.

Ms. Macie Hertoghe
LDR Partners
SDR-78460 [PRJ-78379] - Page Four
May 21, 2020

The Notice of Final Action was filed with the Las Vegas City Clerk on May 21, 2020.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert Summerfield".

Robert Summerfield, AICP[®]
Director
Department of Planning

RTS:PL:clb

cc: Mr. John Curran
Dapper Development
985 White Drive, Suite #100
Las Vegas, Nevada 89119



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October 14, 2020

Ms. Macie Hertoghe
LDR Partners
3775 N. Freeway, Ste. 101
Sacramento, CA 65834

**RE: 20-0023-VAR1
PLANNING COMMISSION MEETING OF OCTOBER 13, 2020**

Dear Applicant:

The Planning Commission at a regular meeting held on *October 13, 2020* voted to **APPROVE** a request for a Variance TO ALLOW AN EXISTING 10-FOOT TALL PERIMETER WALL WHERE EIGHT FEET IS THE MAXIMUM ALLOWED on 2.06 acres at the southeast corner of Charleston Boulevard and Westwind Road (APN 163-01-103-004), C-1 (Limited Commercial) Zone, Ward 1 (Knudsen).

This approval is subject to the following conditions:

Planning

1. A Variance is hereby approved to allow a 10-foot perimeter wall adjacent to the southern and eastern property lines.
2. Conformance to the approved conditions for Rezoning (ZON-78454), Variance (VAR-78455), Variance (VAR-78456), and Site Development Plan Review (SDR78460), except as amended herein.
3. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.
4. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
5. Any existing visible steel rebar shall be removed.
6. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.

20-0023-VAR1 - Page Two
October 14, 2020

7. All City Code requirements and design standards of all City departments must be satisfied, except as modified herein.

This action by the Planning Commission on **October 13, 2020** is final unless a written appeal is filed with the City Clerk within ten days of the date of the Planning Commission's decision as allowed by code or there is a review action filed by the City Council within the same time period. For additional information on appeals or review requests submitted please access <https://www.lasvegasnevada.gov/Business/Permits-Licenses/Building-Permits/Permit-Application-Status>, or contact the Department of Planning and Development at 702.229.6301 after **October 26, 2020**. No building permits or business licenses related to these items shall be issued prior to the expiration of the required ten day waiting period, or until any filed appeal is resolved pursuant to LVMC Title 19.18.

Sincerely,



Eric McCammond
Senior Management Analyst
Case Planning Division

EM:nl

cc:

Mr. John Curran
Dapper Development
985 White Drive, Ste. 100
Las Vegas, Nevada 89119



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1 GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

1.1 Scope

The purpose of this technical report is to provide a hydrologic and hydraulic analysis in order to establish overall drainage patterns and constraints for the proposed Convenience Store and Gasoline Station. This report provides recommendations for any proposed drainage facilities, and addresses onsite and offsite drainage patterns and flow rates for both the existing and interim conditions. The study was analyzed and compiled in accordance to the criteria set forth by the Clark County Regional Flood Control District's (CCRFCD) *Hydrologic Criteria and Drainage Design Manual (HC&DDM)*.

1.2 Location

The project site is located in a portion of the Northern Half (N 1/2) of the Northwest Quarter (NW 1/4) of Section 1, Township 21 South, Range 60 East, unincorporated areas Clark County, Nevada. The site is recorded on the Clark County Assessor's maps as APN's 163-01-103-001/004. The site is bound by Westwind Rd. to the West, Charleston Blvd. to the north, an existing residential lot to the south and an existing commercial building lot and undeveloped parcel to the east. See Figure 1, *Vicinity Map*, and *Assessor's Parcel Map* in Appendix C.

1.3 Description of Property

The parcels total approximately 2.58 acres in area, with the northeast and southern areas (1.98 acres) of the entire site being developed at this time. The site will comprise of a Retail Store and a parking lot. The existing site is developed but the existing buildings along the south and southeast corner of the site will be demolished. The site generally slopes in a northeasterly direction at an average slope of approximately 1.00 percent.

2 GENERAL DRAINAGE DESCRIPTION

2.1 Master Planning Information

In the *2018 Las Vegas Valley Flood Control Master Plan Update – Volume I* (2018 MPU) (Reference 2), dated September 2018, as prepared by ATKINS. The valley was divided into ten watersheds and each watershed was further subdivided into sub-basins. The on-site basins fall within the Central Watershed. As shown in Figure W-5 of the 2018 MPU, the subject site is located within sub-basin CHO9-C.

Refer to the annotated Figure W-5 in Appendix A.

Existing and future CCRFCD flood control facilities are shown in the *2018 Las Vegas Valley Flood Control Master Plan Update – Volume II* (2018 MPU) (Reference 3), dated September 2018, as prepared by CCRFCD. The figures and inventory tables from Volume II of the 2018 MPU were updated by CCRFCD in 2018. Per Figure F-29, the subject parcel is adjacent to a Category 'A' Proposed MPU facility (Facility ID MECN 0123). The proposed facility is an 8ft x 6ft RCB (854cfs). Please note this facility will be connected with a future upstream facility (year 2023/2024) to eliminate all of the surface flow in Charleston Blvd.

Annotated Figure F-29 and its inventory table are provided in Appendix C.

2.2 Floodplain Information

The Special Flood Hazard Areas (SFHA) for Clark County and Incorporated Areas are outlined in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map, dated November 16, 2011. Upon reviewing the Community Panel No. 32003C2165D, the proposed site lies within a FEMA designated Zone "X". This area is described to be: areas outside of the 0.2% annual chance flood. Our site contains a panel that is not printed. This panel is entirely in Zone 'X'. See Figure 2, *FEMA Map* (Appendix C).

2.3 Previous Drainage Studies

The subject site is located within the City of Las Vegas jurisdiction. The overall area is covered within the CCRFCD "2018 Las Vegas Valley Flood Control Master Plan Update, Volume I and II" (Reference 2) and the W-5 Map for the Soil types. The site is also covered in the FIRM for the Clark County, Nevada and incorporated areas, Community Panel Number: 32003C2165D, Effective Date: November 16, 2011.

The most relevant study to the subject site include the City of Las Vegas Neighborhood Control MPU (Figures E-8 and F-8 – Reference 5). Reference 5 has been utilized to determine the flows along Charleston Blvd. at the Westwind Rd. intersection. Since the upstream regional facilities have not been constructed yet, Figure E-8 from the CLV Central Neighborhood MPU has been utilized for these flows.

Please note that all of the Regional drainage facilities upstream of Westwind Rd. along Charleston Blvd. have not been constructed and therefore; Figure E-8 flows (400/910cfs) have been accepted and utilized north of our Site. Please note that the MPU facilities upstream of our Site are planned to be completed by Year 2023/2024. These MPU flows currently represent the worse-case flows for our site development in all conditions (existing and interim/developed conditions) for our project site.

McCay Engineering generally concurs with all the pertinent referenced analyses and results utilized in these studies.

Excerpts of the MPU study can be found in Appendix 'C' of this Study.

2.4 Hydrologic and Hydraulic Procedures Used

HEC-1 version 4.1 was used to analyze storm runoff for the project site and surrounding area. Input/output files can be found in Appendix A. (See Appendix A for calculations).

Flow Master was used to analyze street and site flow depths and velocities for the subject site. (See Appendix B for calculations).

3 HYDROLOGY AND HYDRAULICS

3.1 Existing Condition

3.1.1 Hydrology

Off-site

As discussed earlier in the report Section 2.3 for the Charleston Blvd. flows, Reference 5 has been utilized for the flows at Charleston Blvd. and Westwind Rd. intersection. Referenced Figure E-8 from the CLV Central Neighborhood MPU has been utilized for these flows. Please note that all of the Regional drainage facilities upstream of Westwind Rd. along Charleston Blvd. have not been constructed currently. Figure F-8 shows surface flows of 0/0cfs and 713/1379cfs in facility flow for the 10 and 100yr storm events respectively. Since there are no facilities constructed yet upstream of Westwind Rd. along Charleston Blvd., we have utilized Figure E-8 flows for Charleston Blvd. flows north of our site.

Off-site flows impacting the project site originate in the adjacent perimeter streets of Charleston Blvd. and Westwind Rd. The flows from the west along Charleston Blvd. have been determined utilizing the City of Las Vegas Central Neighborhood Study (Figure E-8 – Existing Drainage Conditions). These referenced flows (400/910cfs) are the total flows at the intersection of Charleston Blvd. and Westwind Rd. until the upstream flood control facilities are constructed. The reason we accepted these flows is because upstream regional facilities along Charleston Blvd. have not been constructed yet. They are planned to be constructed starting in the year 2023. Therefore, we have adopted the Existing Drainage Conditions Exhibit E-8 flows.

For the flows west of our site within Westwind Rd., we have analyzed the existing commercial development west of the site and Westwind Rd. We have delineated an offsite basin FD1 (2.83 acres) that accounts for the existing commercial development and the street basin for the total flow west of our site. Basin FD1 discharges 5 and 9cfs in the 10yr and 100yr storm events south along Westwind Rd. beyond our Site.

The total flow in Charleston Blvd. north of our site is determined to be 400 and 910cfs in the 10 and 100yr storm events. This flow is the same for existing and developed conditions since all the upstream offsite area is developed and upstream drainage facilities are not constructed at this time.

Refer to Drainage Basin Map (Existing Condition) Sheet DR1 (back pocket) and Offsite Basin Exhibit OFF1 (Appendix C) included with this submittal.

On-site

The project site is analyzed as one (1) basin in the existing condition based on existing topography. NX1 (2.58 acres, 5/9cfs) comprises of existing buildings and paved areas (CN=98.0). Basin NX1 discharges 5/9cfs in a northeast direction and discharges ultimately north into Charleston Blvd. out the existing driveway at the northeast corner of the Site.

Refer to Drainage Basin Map (Existing Conditions) Sheet DR1 included with this submittal.

3.3.2 Interim (Proposed) Condition

Off-site

The offsite basins and flows remain the same as discussed in Existing conditions (Section 3.3.1). All of the offsite area is developed already.

Refer to Drainage Plan (Interim/Developed Condition) Sheet DR2 and Offsite Basin Map (Figure OF1) included with this submittal.

On-site

The project site has been delineated into three (2) basins based on proposed grading.

ND1 (1.64 acres, 3/5cfs) comprises the majority of the area in the southern portion of the site, consisting of parking, drive aisles, rooftop and landscaping. A majority of the flow discharges east to a landscape swale before discharging north along the east boundary. These flows continue north and ultimately discharge through a BMP swale within onsite basin ND2.

Basin ND2 (0.94 acres, 2/3cfs) is the northern half of the site which comprises of the undeveloped rough graded area in the northwest corner of the site and also drive aisles and an existing Tavern. Runoff from ND2 discharges 2 and 3cfs easterly in the 10yr and 100yr storm events respectively. The flow is conveyed through a BMP swale before discharging into the proposed driveway and combining with flow from onsite basin ND1 at combination point CPD1 (5/9cfs). This flow matches the existing condition flow from the site (Basin NX1); therefore our site development is not negatively affecting downstream properties.

Refer to the Drainage Plan (Proposed Condition) Sheet DR2 included with this submittal.

3.3.3 Ultimate (Future) Condition

Off-site

Off-site flows utilized in the interim condition analysis are from fully-developed basins. However, per Figure F-8 from the CLV Neighborhood Control MPU, it appears some decent sized RCP Storm drains will be constructed at some point which will reduce the amount of street flow immensely. We have ignored this option and utilized Existing and Interim condition offsite flows for our site design since it is worse-case. The reason we accepted these flows is because upstream regional facilities along Charleston Blvd. have not been constructed yet. They are planned to be constructed starting in the year 2023 and surface flow will be reduced to 0/0cfs in the future when the facilities have been completed.

On-site

The project site is considered fully-developed in the interim condition.

Please note that there is one driveway entrance for the site off of Westwind Rd. We have designed the driveway hump to be a minimum 6-inches above the 100yr water surface elevation in the street. The site is protected from any offsite flows.

There are two driveway entrances off of Charleston Blvd. Both of these driveways are used to convey the flow to Charleston Blvd; therefore, no driveway humps have been proposed. There will be some area of inundation onto the site at these driveways since the 100yr flow depth in Charleston Bld. is 1.46ft.

The proposed Retail building has a FF that is a minimum of twice the 100yr depth of flow in the perimeter streets and double the 100yr flow depth onsite. The onsite flowline high point adjacent to the proposed building is a minimum 6-inches below the proposed FF elevation.

There is an existing Tavern building near the NEC of the site and it will remain. However, we have provided a floodwall to the north of it for protection from the Charleston Blvd. street flow. The floodwall height is a minimum of double the 100yr flow depth ($1.46\text{ft} \times 2 = 2.92\text{ft}$) above the highest adjacent FL elevation in Charleston Blvd.

3.3.2 Hydraulics

No change in the ultimate street flow hydraulic analysis is expected from the interim condition, since worse case scenario offsite flows were utilized for our analysis. The assumption of developed offsite basins were used for our analysis.

4 RAINFALL METHODOLOGY AND SOILS INFORMATION

4.1 Hydrologic Methodology and Criteria

The U. S. Army Corps of Engineer's HEC-1 *Flood Hydrograph Package* was used to estimate the peak runoff values of the watershed for the 10-year and 100-year, 6-hour storm event. The HEC-1 model was designed for the simulation of flood events in watersheds and river basins. The HEC-1 computer model has the ability to simulate the surface runoff response of a drainage basin to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components. Each component models an aspect of the rainfall-runoff process within a portion of the whole basin. This basin portion is referred to as a sub-basin. The runoff hydrographs of each sub-basin are then combined and a final discharge hydrograph is obtained. Since the study watershed is ungaged, the analysis used to model the onsite runoff incorporated the Soil Conservation Service (SCS) unit hydrograph method to develop a hypothetical flood hydrograph.

Input parameters used for the HEC-1 hydrograph model were determined from the *HC&DDM*. Procedures and calculations related to these HEC-1 Parameters can be found in the following pages.

4.2 HEC-1 Parameters

Basin Area

The drainage basins were determined from the topographic maps at 1-foot and 5-foot contour intervals, aerial photographs, field investigation, and 30-scale onsite grading plans. The drainage basins are shown on the Drainage Plans located in the Appendix of this study.

Rainfall Criteria

The onsite/offsite areas analyzed in this report lie inside of the McCarran Airport Rainfall Area (see Figures in Appendix A). Depth-Duration-Frequency values from Table 505 (Appendix A) were used as rainfall depths for the 10-year and 100-year storm event. These storm water depth values are 1.58 inches (10yr) and 2.77 inches (100yr) respectively (see *Precipitation Calculations* in Appendix B).

Hydrologic Abstractions

Hydrologic abstractions include interception, infiltration, surface storage, evaporation, and evapo-transpiration. Infiltration is regarded as the primary rainfall loss component in hydrologic models.

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. The 2018 MPU's Figure W-5 indicates that the site is in an area consisting of hydrologic soil group D, defined as soils with "high runoff potential" (Reference 2). A portion of the offsite area consists of hydrologic soil group D, defined as soils with "high runoff potential." Refer to Appendix C for annotated Figure W-5. The CN values for the different land uses were determined from Table 602 (page 1) and Table 602A 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 off-site and on-site basins in the existing and proposed conditions are provided in Appendix A.

Lag Time

Lag time is a measure of the time elapsed between the occurrence of rainfall and the occurrence of runoff. It is a measure of the watershed's response time and is dependent upon basin length, slope and the basin's roughness characteristics.

Based on studies of many storm events for a range of watershed conditions, the following empirical relationship between lag time (T_{LAG}) and time of concentration (t_c) was derived:

$$T_{LAG} = 0.6t_c$$

Where t_c is the time of concentration. In order to calculate t_c the following equations are used:

$$t_c = t_i + t_t$$

Where t_i = Initial overland flow time in minutes:

$$t_i = 1.8 \frac{(1.1 - K)\sqrt{L_o}}{\sqrt[3]{S}}$$

Where:

K = Flow resistance factor, $K = 0.0132 * CN - 0.39$

CN = Curve Number.

L_o = Length of the overland flow element.

S = Average basin slope in percent.

And t_t = Travel time for flow within the channel or swale:

$$t_t = \frac{L}{V} (60)$$

Where:

L = Length of channel element in feet.

V = Flow velocity in feet per second.

Compliance with Section 1500 – Structural Best Management Practices

The proposed development area is approx. 1.71 acres, of which approx. 1.22 acres is impervious paved parking and building roof area that discharges over parking and drive-aisles. Per HCCDM Section 1500, the project site falls in to the "Large" Parking Lot Category. As such, 75% of the parking lot area ($1.22 \text{ acres} \times 75\% = \mathbf{0.92 \text{ acres}}$) must be treated using accepted BMPs. As shown in the grading plan, multiple BMP swales are being proposed near the NEC of the project site. The BMP swale is designed to settle out sediment and pollutant of the water quality design flows, prior to exiting the project site. As shown in the drainage exhibit (DR2), most of the onsite area is designed to drain towards the 2 water quality swales. The swales will handle a majority of the flows within the onsite basins. It is shown that a 40ft long swale can treat 1.00 acres of imperviousness. Therefore, for 1.22 acres of imperviousness, we need ($1.22 \text{ acres} \times 40\text{ft}$) we need 50ft of swale for treatment. Our swales total over 80ft long and meets the minimum required length for our Site.

As shown in the attached excerpts from Section 1500 of the HCDDM, since the parking lot area of the project site is more than 1 acre, the parking lot is categorized as 'Large' parking. For a Large parking lot, water quality BMPs are required for at least 75% of the proposed parking lot. The total area from basins ND1 and ND2 represent the whole site. Thus, the project is designed to provide water quality BMPs for approximately 75% of the site, which meets the minimum requirements.

Per the design guidelines of Section 1503.4.5, the proposed water quality riprap-lined swales throughout the site are set to a minimum 40ft long. The swales are designed with 1.00% slope, 4(horizontal):1(vertical) side slope, riprap lining with $D_{50}=4"$, and a minimum of 1ft depth. A capacity hydraulic calculation (Appendix B) has been provided to show the swales can convey at least the minimum 2yr flow (0.50cfs per acre).

5 CONCLUSIONS

The following conclusions have been made regarding safety, both public and private, for the proposed commercial development:

1. The interior development area will safely convey storm water towards the northeast corner of the project, and discharge north into Charleston Blvd.
2. The development of this site will comply with the Clark County Regional Flood Control District Flood Control Master Plan Update, the *HC&DDM*, and local flood plan ordinance.
3. The site and the proposed improvements are located entirely within areas designated as FEMA Zone "X," described by FEMA as "Areas of 0.2% annual chance flood."
4. The drainage facilities for this project have been designed to convey runoff from the 100-year storm safely past 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.

6 REFERENCES

1. Clark County Regional Flood Control District, "2018 Las Vegas Valley Flood Control Master Plan Update", 2013.
2. Clark County Regional Flood Control District, "Hydrologic Criteria and Drainage Design Manual", updated August 1999.
3. Flood Insurance Rate Map, Federal Emergency Management Agency Community Panel Number 32003C2165D, Clark County, Nevada and Incorporated Areas.
4. Flowmaster Version 8i, Haestad Methods, Inc., 2009
5. CLV Central Neighborhood MPU Plan (Figures E-8 and F-8)

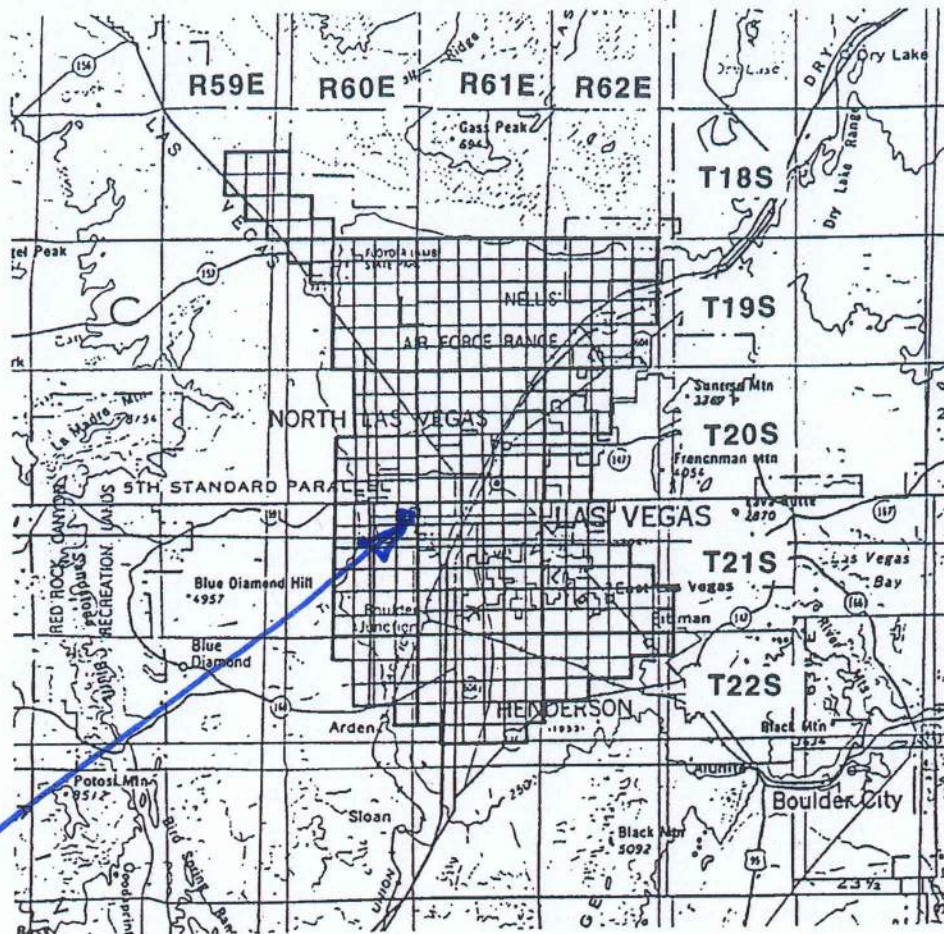
APPENDIX A

HYDROLOGIC ANALYSIS

HYDROLOGIC CHARTS

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

McCARRAN AIRPORT RAINFALL AREA



SITE

Section 1

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	<u>21 South</u>	<u>60 East</u>	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

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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

WMAF

Clark County Regional Flood Control District, 2018 *W-5 Map*

(Central Watershed)

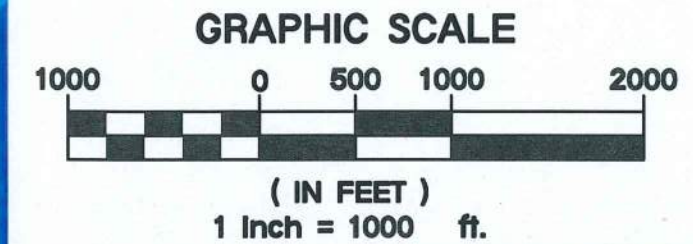
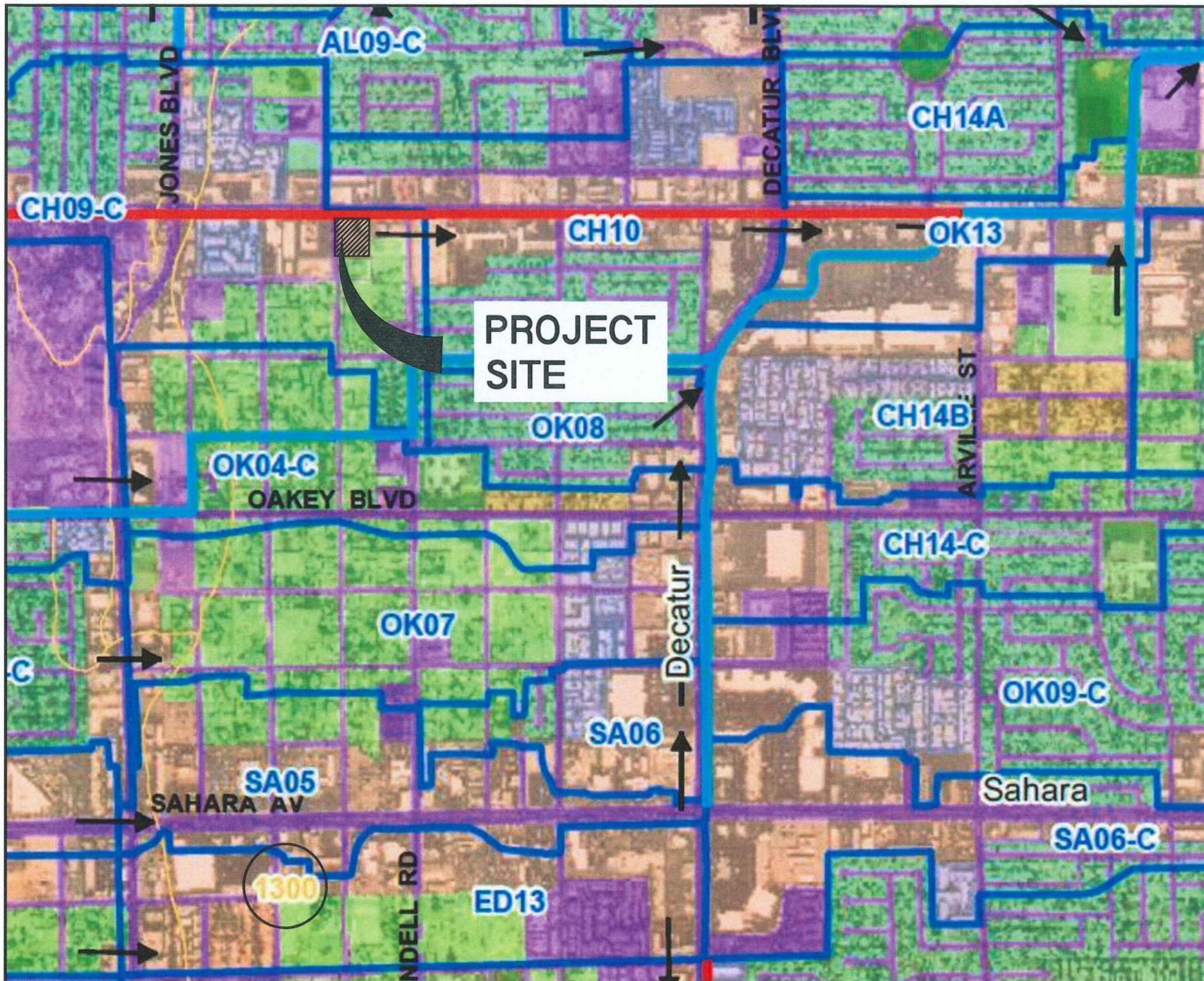


Figure W-5
Central Watershed

Legend

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

SUBBASIN:
CH09-C

1300:
100% D-SOIL

DRAWN BY: CB	SCALE: 1"=1000'	FILE NAME: WMAP
CHECKED BY: CB	DATE: 12/20/20	
MCCAY ENGINEERING		
LEGEND FOUND MONUMENTATION  CENTER LINE _____ ROW LINE _____ EASEMENT LINE _____ SECTION LINE _____ PROPERTY LINE _____ ADJACENT PROPERTY LINE		

**FIGURE W-5
CENTRAL WATERSHED**

CHARLESTON & WESTWIND RETAIL CENTER

PROJECT No.:
01234

SHEET No.

W-5

SHEET 1 OF 1

Curve Number Matrix

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												
1100	6	0	0	59	35	87.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1105	55	40	0	5	0	70.0	56.0	65.0	67.0	69.0	78.0	86.0	91.0	93.0	88.0	93.0	76.0	30.0
1107	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
1112	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
1113	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
1117	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
1120	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
1127	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
1129	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
1130	65	0	25	10	0	71.0	58.0	66.0	68.0	70.0	79.0	87.0	91.0	93.0	89.0	93.0	77.0	30.0
1132	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
1133	70	0	10	0	20	71.0	58.0	67.0	68.0	70.0	79.0	87.0	91.0	93.0	89.0	93.0	77.0	30.0
1134	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
1135	84	0	0	16	0	67.0	52.0	62.0	64.0	66.0	76.0	85.0	90.0	92.0	87.0	92.0	74.0	30.0
1140	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
1141	8	0	2	70	20	86.0	81.0	85.0	86.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1150	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
1151	41	0	0	59	0	78.0	68.0	74.0	76.0	77.0	84.0	90.0	93.0	94.0	91.0	94.0	82.0	30.0
1152	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
1155	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
1156	1	10	0	89	0	87.0	81.0	84.0	85.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1160	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
1160dn	46	1	0	53	0	76.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1165	32	40	15	13	0	75.0	64.0	71.0	73.0	74.0	82.0	88.0	92.0	94.0	90.0	94.0	80.0	30.0
1181	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
1182	95	0	5	0	0	64.0	48.0	58.0	61.0	63.0	74.0	84.0	90.0	92.0	86.0	92.0	72.0	30.0
1183	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
1184	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
1187	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
1190	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
1191	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
1192	55	35	0	10	0	70.0	57.0	66.0	68.0	70.0	79.0	87.0	91.0	93.0	88.0	93.0	76.0	30.0
1200	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
1206	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
1207	3	85	5	7	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
1222	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
1225	9	20	50	21	0	82.0	73.0	79.0	80.0	81.0	86.0	91.0	94.0	95.0	92.0	95.0	85.0	30.0
1230	54	0	0	46	0	75.0	63.0	70.0	72.0	74.0	81.0	88.0	92.0	94.0	90.0	94.0	80.0	30.0
1235	66	25	0	9	0	69.0	55.0	64.0	66.0	68.0	77.0	86.0	91.0	93.0	88.0	93.0	75.0	30.0
1236	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
1237	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
1240	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
1252	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
1255	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
1260	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
1262	75	0	0	25	0	69.0	56.0	64.0	67.0	69.0	78.0	86.0	91.0	93.0	88.0	93.0	76.0	30.0
1263	95	0	0	5	0	64.0	48.0	59.0	61.0	64.0	74.0	84.0	90.0	92.0	86.0	92.0	72.0	30.0
1264	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
1270	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
1278	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
1282	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
1300	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

100% D-SOIL

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

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

See Table 602A

Developing urban areas

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

1 Average runoff condition, and $I_p = 0.25$.

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

HYDROLOGY

DATE: December 21, 2020

TRIAL: Final Iteration

Curve Number Calculations

Charleston & Westwind Retail Center

Sub-Basin: 0.00

Total Area: 0.00 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.00	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.00	D	10%	88	8.8
Total:	0.00	-	100%	-	97.0

Curve Number Calculations

Charleston & Westwind Retail Center

Sub-Basin: FD1

Total Area: 2.83 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.55	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.28	D	10%	88	8.8
Total:	2.83	-	100%	-	97.0

Curve Number Calculations
Charleston & Westwind Retail Center

Sub-Basin: FD1
Total Area: 2.83 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.55	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.28	D	10%	88	8.8
Total:	2.83	-	100%	-	97.0

Curve Number Calculations
 Charleston & Westwind Retail Center

Sub-Basin: NX1
Total Area: 2.58 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)	2.58	D	100%	98	98.0
Total:	2.58	-	100%	-	98.0

Curve Number Calculations

Charleston & Westwind Retail Center

Sub-Basin: ND1

Total Area: 1.64 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.48	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.16	D	10%	88	8.8
Total:	1.64	-	100%	-	97.0

Curve Number Calculations

Charleston & Westwind Retail Center

Sub-Basin: ND2

Total Area: 0.94 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.85	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.09	D	10%	88	8.8
Total:	0.94	-	100%	-	97.0

[illegible]

	Output Variables									
Normal Depth, Y_n (ft):	0.15		0.14	0.11	0.08					
Area of Flow, A , (sf):	2.82		2.31	1.65	0.95					
Velocity, V (fps):	1.59		1.95	1.51	1.57					
Wetted Perimeter, p (ft):	33.75		30.54	25.90	19.77					
Hydraulic Radius, R_h (ft):	0.08		0.08	0.06	0.05					
Free Surface Top Width, T (ft):	33.75		30.54	25.90	19.77					
Centroid, Y^* , (ft):	0.06		0.05	0.04	0.03					

* NOTE : HALF OF THE 100-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)
FD1	2.83	5	9
NX1	2.58	5	9

```

1*****
*****
*
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*
* JUN 1998
*
* VERSION 4.1
*
*
* RUN DATE 21DEC20 TIME 16:26:37
*
*
*****
*****

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X

```

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

```

```

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

```

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

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

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

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION

KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

HEC-1 INPUT

PAGE 1

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1          ID      CHARLESTON AND WESTWIND RETAIL CENTER
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
8          ID
9          ID
10         ID      INPUT FILE NAME: X.DAT
11         ID
12         ID      DECEMBER 2020
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= 0.5704
22         ID
23         ID      *****
24         ID      *****
25         ID      *DIAGRAM
26         ID      IT      5      200
27         ID      IO      5
28         ID      IN      5
29         ID      JR      PREC .5704 1.0
30         ID
31         ID      KK      FD1
32         ID      KM      THE EXISTING SITE WEST OF OUR SITE AND ADJACENT STREET WESTWIND. DISCHARGES F
33         ID      PB      2.770
34         ID      PC      0.0      .02      .057      .07      .087      .108      .124      .13      .13      .13
35         ID      PC      .13      .13      .13      .133      .14      .142      .148      .158      .172      .181
36         ID      PC      .19      .197      .199      .2      .201      .204      .214      .229      .241      .249
37         ID      PC      .251      .256      .27      .278      .281      .283      .295      .322      .352      .409
38         ID      PC      .499      .59      .71      .744      .781      .812      .819      .835      .851      .856
39         ID      PC      .86      .868      .876      .888      .91      .926      .937      .95      .97      .976
40         ID      PC      .982      .985      .987      .989      .99      .993      .993      .994      .995      .998
41         ID      PC      .998      .999      1.0
42         ID      BA      .00442
43         ID      LS      0      97.0
44         ID      UD      .082
45         ID      *
46         ID
47         ID      KK      NX1
48         ID      KM      SOUTHERN ONSITE BASIN DRAINING NORTHEAST AND THEN NORTH TOWARD CHARLESTOMN BL
49         ID      BA      .00403
50         ID      LS      0      98.0
51         ID      UD      0.066
52         ID      *
53         ID      ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```

INPUT LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO.        (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW
29         FD1
          .
          .
          .
43         .      NX1

```


(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
 1*****

 *
 * FLOOD HYDROGRAPH PACKAGE (HEC-1) *
 * JUN 1998 *
 * VERSION 4.1 *
 *
 * RUN DATE 21DEC20 TIME 16:26:37 *
 *

X

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

CHARLESTON AND WESTWIND RETAIL CENTER
 ***** TECHNICAL DRAINAGE STUDY *****
 EXISTING CONDITION - ONSITE AND OFFSITE
 USING SCS METHODS AND KINEMATIC WAVE ROUTING
 MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION

INPUT FILE NAME: X.DAT
 DECEMBER 2020

 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= 0.5704

26 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 0200 STARTING TIME
 NQ 101 NUMBER OF HYDROGRAPH ORDINATES
 NDDATE 1 0 ENDING DATE
 NDTIME 1020 ENDING TIME
 ICENT 19 CENTURY MARK
 COMPUTATION INTERVAL .08 HOURS
 TOTAL TIME BASE 8.33 HOURS
 ENGLISH UNITS
 DRAINAGE AREA SQUARE MILES
 PRECIPITATION DEPTH INCHES
 LENGTH, ELEVATION FEET
 FLOW CUBIC FEET PER SECOND
 STORAGE VOLUME ACRE-Feet
 SURFACE AREA ACRES
 TEMPERATURE DEGREES FAHRENHEIT
 JP MULTI-PLAN OPTION
 NPLAN 1 NUMBER OF PLANS
 JR MULTI-RATIO OPTION
 RATIOS OF PRECIPITATION
 .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	.00	1 FLOW TIME	5. 3.50	9. 3.50
HYDROGRAPH AT					
+	NX1	.00	1 FLOW TIME	5. 3.50	9. 3.50

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

HEC-1 MODEL OUTPUT

(INTERIM / DEVELOPED CONDITIONS)

Peak Flow Summary
Developed Condition

HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
ND1	1.64	3	5
ND2	0.94	2	3
CPD1	-	5	9

(ND1+ND2)

D

```

*****
*****
*
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*
* JUN 1998
*
* VERSION 4.1
*
*
* RUN DATE 21DEC20 TIME 16:08:36
*
*
*****
*****

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

```

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X X XXXXXX XXXX X
X X X X X XX
X X X X X X
XXXXXX XXXX X XXXX X
X X X X X X
X X X X X
X X XXXXXX XXXX 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 CHARLESTON AND WESTWIND RETAIL CENTER
2 ID ***** TECHNICAL DRAINAGE STUDY *****
3 ID INTERIM / DEVELOPED 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
8 ID
9 ID
10 ID INPUT FILE NAME: D.DAT
11 ID
12 ID DECEMBER 2020
13 ID
14 ID *****
15 ID *****
16 ID MCCARRAN AIRPORT RAINFALL AREA
17 ID 10 & 100 YEAR - 6 HOUR STORM EVENT
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22 ID *****
23 ID *****
24 ID
25 ID *DIAGRAM
26 ID IT 5 200
27 ID IO 5
28 ID IN 5
29 ID JR PREC .5704 1.0
30 ID
31 ID KK FD1
32 ID KM THE EXISTING SITE WEST OF OUR SITE AND ADJACENT STREET WESTWIND. DISCHARGES F
33 ID PB 2.770
34 ID PC 0.0 .02 .057 .07 .087 .108 .124 .13 .13 .13
35 ID PC .13 .13 .13 .133 .14 .142 .148 .158 .172 .181
36 ID PC .19 .197 .199 .2 .201 .204 .214 .229 .241 .249
37 ID PC .251 .256 .27 .278 .281 .283 .295 .322 .352 .409
38 ID PC .499 .59 .71 .744 .781 .812 .819 .835 .851 .856
39 ID PC .86 .868 .876 .888 .91 .926 .937 .95 .97 .976
40 ID PC .982 .985 .987 .989 .99 .993 .993 .994 .995 .998
41 ID PC .998 .999 1.0
42 ID BA .00442
43 ID LS 0 97.0
44 ID UD .082
45 ID *
46 ID
47 ID KK ND1
48 ID KM SOUTHERN ONSITE BASIN DRAINING NORTHEAST AND THEN NORTH TOWARD CHARLESTOMN BL
49 ID BA .00256
50 ID LS 0 97.0
51 ID UD 0.073
52 ID *
53 ID KK CPD1

```

1

HEC-1 INPUT

PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
48 ID KK ND2
49 ID KM NORTHERN ONSITE BASIN DRAINING TO NORTHEAST DISCHARGING TO CHARLESTON BLVD.
50 ID BA .00147
51 ID LS 0 97.0
52 ID UD 0.057
53 ID *
54 ID KK CPD1

```


54 KM FLOWS COMBINED (ND1+ND2) AT NEC OF SITE DISCHARGING INTO CHARLESTON BLVD.
55 HC 2
56 ZZ

1 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

29 FD1
43 ND1
48 ND2
53 CPD1.....

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

FLOOD HYDROGRAPH PACKAGE (HEC-1)
JUN 1998
VERSION 4.1
RUN DATE 21DEC20 TIME 16:08:36

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

CHARLESTON AND WESTWIND RETAIL CENTER
***** TECHNICAL DRAINAGE STUDY *****
INTERIM / DEVELOPED CONDITION - ONSITE AND OFFSITE
USING SCS METHODS AND KINEMATIC WAVE ROUTING
MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION

INPUT FILE NAME: D.DAT

DECEMBER 2020

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= 0.5704

26 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 0200 STARTING TIME
NQ 101 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 1 0 ENDING DATE
NDTIME 1020 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 8.33 HOURS

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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.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 RATIO 2
Page 2

					.57	D 1.00
HYDROGRAPH AT						
+	FD1	.00	1	FLOW TIME	5. 3.50	9. 3.50
HYDROGRAPH AT						
+	ND1	.00	1	FLOW TIME	3. 3.50	5. 3.50
HYDROGRAPH AT						
+	ND2	.00	1	FLOW TIME	2. 3.50	3. 3.50
2 COMBINED AT						
+	CPD1	.00	1	FLOW TIME	5. 3.50	9. 3.50

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

APPENDIX B

HYDRAULIC ANALYSIS

NORMAL DEPTH STREET HYDRAULIC SECTIONS

(EXISTING & DEVELOPED CONDITIONS – 10yr / 100yr Storm)

Street Flow Summary
(Existing / 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)
Westwind Charleston	60 100	2 1	5 400	1.07 6.90	0.54 1.07	0.58 7.38	N/A 0.0

Street Flow Summary
(Existing / 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]
Westwind Charleston	60 100	2 1	9 910	1.18 9.49	0.62 1.46	0.73 13.86

**Charleston Blvd. (10yr Existing & Developed)
Worksheet for Irregular Channel**

Section 1

Project Description	
Worksheet	Charleston Blvd. (10yr Existing & Dev.)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.010300 ft/ft
Discharge	400.00 cfs

CLV MPU Flow (Figure E-8)

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.	69.84 ft
Elevation Range	68.77 to 70.06
Flow Area	58.0 ft ²
Wetted Perimeter	97.47 ft
Top Width	94.80 ft
Actual Depth	1.07 ft
Critical Elevation	70.06 ft
Critical Slope	0.003936 ft/ft
Velocity	6.90 ft/s
Velocity Head	0.74 ft
Specific Energy	70.58 ft
Froude Number	1.56
Flow Type	Supercritical

d_{10}

v_{10}

$$1.07 \times 6.90 = 7.38 > 6 \quad \underline{\text{Not OK}}$$

But this is an existing condition +
our site development does Not
make it worse

Calculation Messages:
Water elevation exceeds lowest end station by 0.46952931 ft.
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+51.70	0.016
0+51.70	0+56.90	0.013
0+56.90	0+92.80	0.016
0+92.80	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	69.37
0+05.00	69.27
0+05.50	69.27
0+05.50	68.77
0+07.00	68.90

Charleston Blvd. (10yr Existing & Developed)
Worksheet for Irregular Channel

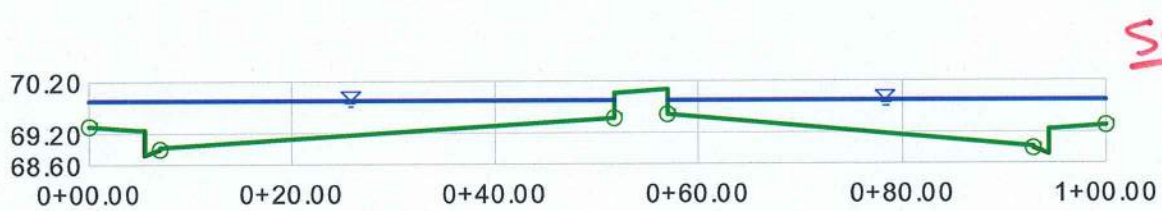
Natural Channel Points	
Station (ft)	Elevation (ft)
0+07.00	68.94
0+51.70	69.49
0+51.70	69.99
0+56.90	70.06
0+56.90	69.56
0+92.80	68.94
0+92.80	68.90
0+94.30	68.77
0+94.30	69.27
0+94.80	69.27
1+00.00	69.37

Charleston Blvd. (10yr Existing & Developed) **Cross Section for Irregular Channel**

Project Description	
Worksheet	Charleston Blvd. (10yr Existing & De
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.010300 ft/ft
Water Surface Elev.	69.84 ft
Elevation Range	68.77 to 70.06
Discharge	400.00 cfs

No Dry LANE



V:5.0
H:1
NTS

**Charleston Blvd. (100yr Existing & Developed)
Worksheet for Irregular Channel**

Section 1

Project Description	
Worksheet	Charleston Blvd. (100yr Existing & Dev.)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	010300 ft/ft
Discharge	910.00 cfs

CLV MPU Flow (Figure E-8)

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.	70.23 ft
Elevation Range	69.77 to 70.06
Flow Area	95.9 ft ²
Wetted Perimeter	103.82 ft
Top Width	100.00 ft
Actual Depth	1.46 ft
Critical Elevation	70.64 ft
Critical Slope	0.003163 ft/ft
Velocity	9.49 ft/s
Velocity Head	1.40 ft
Specific Energy	71.63 ft
Froude Number	1.71
Flow Type	Supercritical

d_{100}

V_{100}

$$1.46 \times 9.49 = 13.86 > 8 \quad \text{Not OK}$$

But this is an existing condition +
our site development does NOT
make it worse

Calculation Messages:
Water elevation exceeds lowest end station by 0.8582128 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+51.70	0.016
0+51.70	0+56.90	0.013
0+56.90	0+92.80	0.016
0+92.80	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	69.37
0+05.00	69.27
0+05.50	69.27
0+05.50	68.77
0+07.00	68.90
0+07.00	68.94

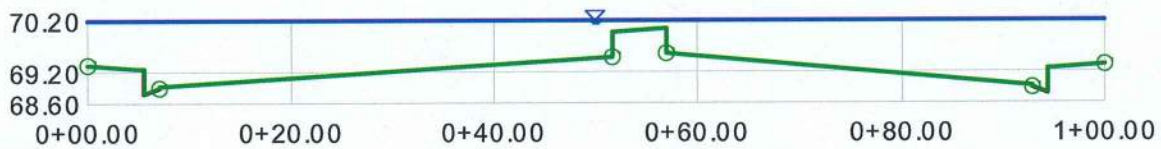
Charleston Blvd. (100yr Existing & Developed)
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+51.70	69.49
0+51.70	69.99
0+56.90	70.06
0+56.90	69.56
0+92.80	68.94
0+92.80	68.90
0+94.30	68.77
0+94.30	69.27
0+94.80	69.27
1+00.00	69.37

Charleston Blvd. (100yr Existing & Developed) **Cross Section for Irregular Channel**

Project Description	
Worksheet	Charleston Blvd. (100yr Existing & Developed)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.010300 ft/ft
Water Surface Elev.	70.23 ft
Elevation Range	68.77 to 70.06
Discharge	910.00 cfs



Site

V:5.0
H:1
NTS

**Westwind Rd. (10yr Existing & Developed)
Worksheet for Irregular Channel**

- Section 2

Project Description	
Worksheet	Westwind Rd. (10yr Existing & Dev.)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.001500 ft/ft
Discharge	5.00 cfs

FD1 Flow

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	70.25 ft
Elevation Range	69.71 to 70.55
Flow Area	4.7 ft²
Wetted Perimeter	32.10 ft
Top Width	31.21 ft
Actual Depth	0.54 ft
Critical Elevation	70.15 ft
Critical Slope	0.006636 ft/ft
Velocity	1.07 ft/s
Velocity Head	0.02 ft
Specific Energy	70.27 ft
Froude Number	0.49
Flow Type	Subcritical

d_{10}

V_{10}

$$.54 \times 1.07 = \underline{\underline{0.58}} < 6 \text{ OK} \checkmark$$

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+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	70.31
0+05.00	70.21
0+05.50	70.21
0+05.50	69.71
0+07.00	69.84
0+07.00	69.88
0+30.00	70.42
0+53.00	70.12

Westwind Rd. (10yr Existing & Developed)
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	70.08
0+54.50	69.95
0+54.50	70.45
0+55.00	70.45
0+60.00	70.55

Westwind Rd. (10yr Existing & Developed) Cross Section for Irregular Channel

Project Description	
Worksheet	Westwind Rd. (10yr Existing & De
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.001500 ft/ft
Water Surface Elev.	70.25 ft
Elevation Range	69.71 to 70.55
Discharge	5.00 cfs

Site



V:5.0
H:1
NTS

**Westwind Rd. (100yr Existing & Developed)
Worksheet for Irregular Channel**

- Section 2

Project Description	
Worksheet	Westwind Rd. (100yr Existing & Dev)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.001500 ft/ft
Discharge	9.00 cfs

FD1 Flow

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.	70.33 ft
Elevation Range	70.71 to 70.55
Flow Area	7.7 ft ²
Wetted Perimeter	44.58 ft
Top Width	43.58 ft
Actual Depth	0.62 ft
Critical Elevation	70.23 ft
Critical Slope	0.006561 ft/ft
Velocity	1.18 ft/s
Velocity Head	0.02 ft
Specific Energy	70.35 ft
Froude Number	0.50
Flow Type	Subcritical

d_{100}

V_{100}

$.62 \times 1.18 = 0.73 < 8 \text{ OK}$

Calculation Messages:

Water elevation exceeds lowest end station by 0.18446745e-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+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	70.31
0+05.00	70.21
0+05.50	70.21
0+05.50	69.71
0+07.00	69.84
0+07.00	69.88
0+30.00	70.42

Westwind Rd. (100yr Existing & Developed)
Worksheet for Irregular Channel

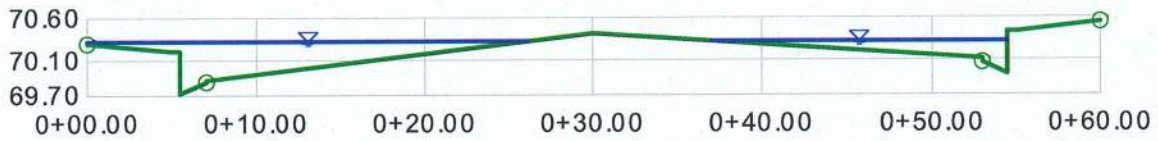
Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	70.12
0+53.00	70.08
0+54.50	69.95
0+54.50	70.45
0+55.00	70.45
0+60.00	70.55

Westwind Rd. (100yr Existing & Developed) Cross Section for Irregular Channel

Project Description	
Worksheet	Westwind Rd. (100yr Existing & D
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.001500 ft/ft
Water Surface Elev.	70.33 ft
Elevation Range	69.71 to 70.55
Discharge	9.00 cfs

Site



V:5.0
H:1
NTS

Onsite Normal Depth Hydraulic Sections

(Interim/Developed Conditions)

On-site Sections
(Interim / Developed Conditions)

Hydraulic Cross-Section Identifier	100-Year Flow [Q100] (cfs)	100-Year Velocity [v] (fps)	100-Year Flow Depth [d] (ft)	2x 100-Year 2 x [d]
3	5	1.66	0.24	0.48

Onsite (100yr Developed) - Section 3 Worksheet for Irregular Channel

Project Description	
Worksheet	Onsite (100yr Developed) - Sect. 3
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	5.00 cfs

ND1 Flow (conservative)

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	70.46 ft
Elevation Range	71.22 to 71.55
Flow Area	3.0 ft ²
Wetted Perimeter	27.32 ft
Top Width	27.32 ft
Actual Depth	0.24 ft
Critical Elevation	70.45 ft
Critical Slope	0.006581 ft/ft
Velocity	1.66 ft/s
Velocity Head	0.04 ft
Specific Energy	70.51 ft
Froude Number	0.88
Flow Type	Subcritical

d_{100}

V_{100}

$$.24 \times 1.66 = 0.40 < 6 \text{ OK}$$

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+00.50	0.013
0+00.50	0+18.50	0.016
0+18.50	0+20.50	0.013
0+20.50	0+67.50	0.016
0+67.50	0+78.00	0.013

$$\begin{aligned} \text{W.S.E.} &= 70.46' \\ + d_{100} &= .24' \\ \hline 70.70' &< 72.00' \text{ (FF)} \checkmark \text{ OK} \end{aligned}$$

FF MEETS CRITERIA

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	71.16
0+00.50	71.16
0+00.50	70.66
0+18.50	70.26
0+19.50	70.22
0+20.50	70.26
0+67.50	70.85
0+67.50	71.35
0+68.00	71.35

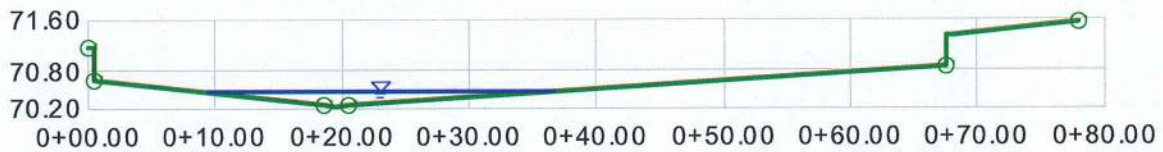
Onsite (100yr Developed) - Section 3
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+78.00	71.55

Onsite (100yr Developed) - Section 3 **Cross Section for Irregular Channel**

Project Description	
Worksheet	Onsite (100yr Developed) - Se
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.	70.46 ft
Elevation Range	70.22 to 71.55
Discharge	5.00 cfs



V:5.0
H:1
NTS

Section 1500 of the CCRFCD Drainage Design Manual

for the Best Management 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.

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.

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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.

Figure 1501, Conceptual Layout 1, represents a parking lot that can be designed so that the runoff can be directed towards the perimeter landscape buffer areas that incorporate a landscaped swale. These swales are designed as rock or xeriscaped swales to convey runoff to a low point, which discharges either directly to the MS4 or to a main drainage pipe and then into the MS4.

Figure 1502, Conceptual Layout 2, represents a parking lot that is not designed to direct all runoff towards swales installed in the perimeter landscape buffer areas. One example could be that the adjacent right-of-way at this area is higher in elevation than the onsite grade. In order to still use the landscape swale BMP, the Developer could use swales in depressed medians within the site, combined with perimeter swales where feasible.

Treatment control devices rather than BMP swales may be used, however, the amount of parking lot area required to be treated would need to be calculated.

Figure 1503, Conceptual Layout 3, shows a conceptual level layout for this scenario, which relies on a combination of modular pavers, sand/oil separators, and underground detention to provide treatment for at least 75 percent of the parking lot area. To size the treatment control BMPs, the approaches described in section 1502.3 should be used. Note that for treatment devices, hydraulic sizing may need to account for the contribution of runoff from building areas draining through the parking lot.

1502.3 Water Quality Design Storm

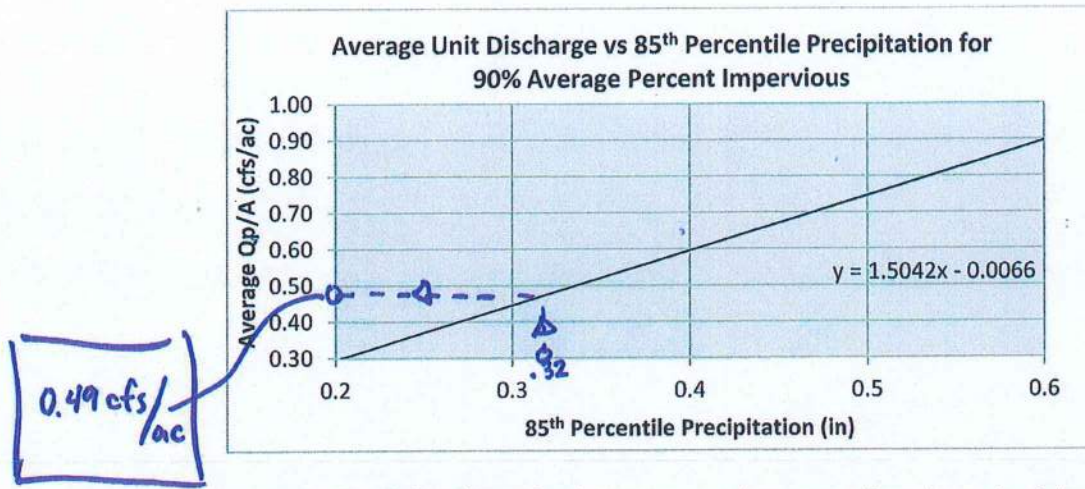
This section describes the steps to be followed to determine the design hydrology for sizing parking lot BMPs in the Las Vegas Valley.

- 1. Determine BMP Design Precipitation - 85th Percentile Rainfall Depth
 - a. Locate site on CCRFCD Design Rainfall Map for 2-year, 6-hour storm
 - b. Determine the adjusted 2-year rainfall depth (D_2) for site, per CCRFCD methods
 - c. Compute ratio of D_2 site to D_2 for the McCarran Airport Area
 - d. Compute 85th percentile rainfall depth (D_{85}) as $0.32 \times D_2$ ratio (0.32 is D_{85} for McCarran Area)
- 2. Calculate BMP Design Peak Discharge
 - a. Use the following chart or regression equation to calculate the unit discharge (Q_P/A) for the 90 percent average percent impervious area condition based on the D_{85} value.

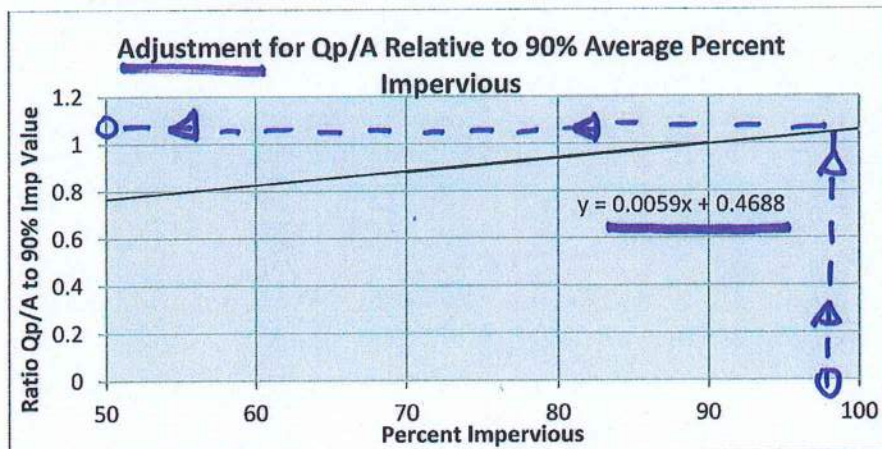
D_{85}

Q_P / area

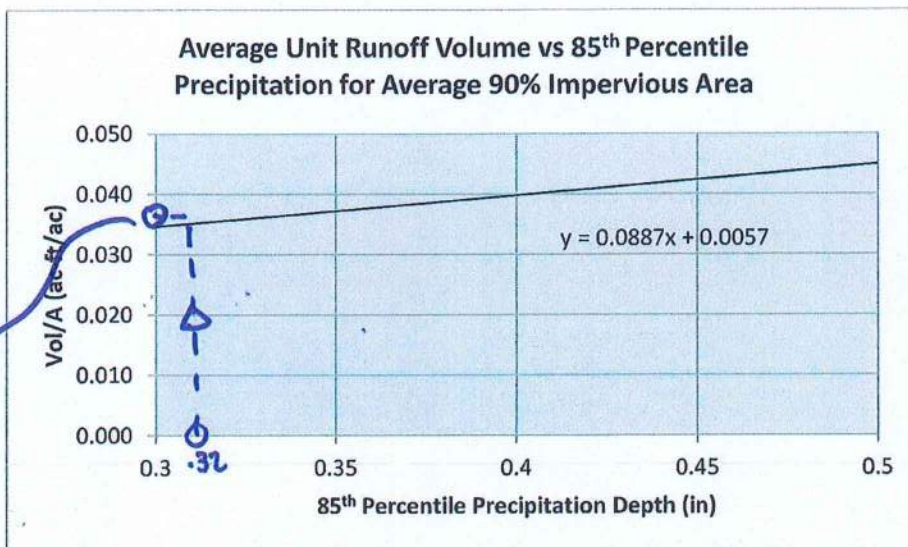
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- b. Use the following chart or regression equation to calculate the unit discharge for the site based on the actual percent impervious area of the parking lot and associated landscaped areas.



- c. Calculate the peak design discharge in cfs as $Q_P = Q_P/A \times A$ where Q_P/A is from step (2b) and A is in acres.
3. Calculate BMP Design Runoff Volume
- a. Use the following chart or regression equation to calculate the unit runoff volume (Vol/A) for the 90 percent impervious condition based on the D_{85} value.



- b. Use the chart or regression equation in step (2b) to calculate the unit runoff volume for the site based on the actual average percent impervious area of the parking lot and associated landscaped areas.
- c. Calculate the design runoff volume in acre-feet as $Vol = Vol/A \times A$ where Vol/A is from step (3b) and A is in acres

Sample Calculation

Given: New Commercial Center in Summerlin area

Site Area = 100 acres

D₂ site / D₂ McCarran Area = 1.25

percent impervious area = 85% (parking lot and associated landscaped area)

1. Determine BMP Design Precipitation - 85th Percentile Rainfall Depth (D_{85})

$$D_{85} = 1.25 \times 0.32 = 0.40 \text{ inches}$$

2. Calculate BMP Design Discharge

$$Q_P/A (90\%) = 1.5042 \times (0.40) + 0.0066 = 0.60$$

Find Adjustment factor for percent impervious

$$Q_P/A = 0.60 \times [(0.0059[85]) + 0.4688] = 0.58$$

$$Q_P = 0.58 \times 100 \text{ acres} = 58 \text{ cfs}$$

3. Calculate BMP Design Runoff Volume

$$\text{Vol/A (90\%)} = 0.0887 \times 0.40 + 0.0057 = 0.04$$

$$\text{Vol/A} = 0.04 \times (0.0059 \times [85] + 0.4688) = 0.04; \text{Vol} = 0.04 \times 100 \text{ acres} = 4.0 \text{ ac-ft.}$$

1503 LOW IMPACT DEVELOPMENT (LID) ←

1503.1 Description

LID measures can be used for managing runoff from areas of new development and significant redevelopment (NDSR). LIDs consist of a variety of site planning and site design measures or practices to minimize the impact of individual urban developments on stormwater quality and quantity. Developers proposing the use of measures that rely on infiltration to dispose of stormwater must perform studies to demonstrate that infiltration will be effective and will not adversely affect groundwater or downstream surface water quality. LID measures determined to be feasible for use in the Las Vegas Valley NDSR program can be found in **Table 1503**.

The BMPs presented in this section can be utilized for sites complying with the Parking Lot LID program or other site designs requiring BMPs. These BMPs are recommendations and the designer is not limited to the BMPs in this section. The designer is encouraged to contact the local entity when alternative BMPs are considered for use.

1503.2 Water Quality Benefits

Managing site runoff can significantly reduce the amount of pollutants conveyed to receiving waters. By incorporating the LID measures described below into site planning, runoff water quality can be improved by using simple technologies, employing basic practices, and educating those present on the site. Reducing pollutants in site runoff can reduce the need for downstream treatment to meet water quality goals.

1503.3 Disconnected Impervious Areas

1503.3.1 Description

This BMP consists of disconnecting impervious areas from downstream storm drainage infrastructure. Any surface in the landscape that cannot effectively absorb or infiltrate rainfall is an impervious area. This includes driveways, roads, parking lots, rooftops, and sidewalks. On natural landscapes, rainfall is absorbed into the soil and vegetation which naturally slows down, spreads out, and soaks up precipitation and runoff. A stable supply of groundwater is provided from water percolating into the soil, and the runoff is naturally filtered of impurities before it reaches creeks, streams, rivers, and bays.

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The amount of impervious cover increases as areas become more developed. Natural filter systems are no longer in place to intercept the runoff which has serious implications for water quality and flood control. Typical pollutants in runoff from impervious areas include oil, litter, sediment, bacteria and in some cases, herbicides and pesticides.

1503.3.2 Water Quality Benefits

Concentrations and loads of the following pollutants are typically reduced by the LID BMP described in this section:

- Trace metals
- Hydrocarbons
- Litter

1503.3.3 Applications

This BMP applies to all urban areas. A beneficial way of mitigating stormwater runoff from impervious areas is to direct the runoff from parking lots and roads to pervious and vegetated soils.

1503.3.4 Limitations

Limitations may occur in areas with poor soils, where infiltration would not occur or could exacerbate groundwater quality problems. Limitations may also occur in ultra-urban areas where the site has no pervious area, including but not limited to high density areas.

1503.3.5 Design Criteria

Ways to mitigate the stormwater runoff by disconnecting impervious areas include:

- Breaking up flow directions from paved surfaces – Impervious surfaces are designed to allow stormwater to run off in a dispersed manner in several directions. The drainage off impervious surfaces is directed onto adjacent vegetated soil and not onto other pavements or into storm sewers.
- Minimize directly connected impervious areas - The impact of impervious surfaces is reduced by minimizing directly connected impervious areas, directing runoff from the impervious areas to pervious areas and/or small depressions, and in the process disconnecting hydrologic flow paths.
- Locating impervious surfaces to drain to natural systems - Existing zones of vegetation, from forested zones to scrub vegetation, are used

for management of stormwater runoff, often with some sort of landforming to achieve volume control. The scale of this technique can vary from microcontrol by redirecting sidewalk and driveway runoff to adjacent vegetation to conveyance of runoff from larger impervious surfaces to natural areas on the development site.

1503.3.6 Maintenance

Sweep impervious areas regularly to collect loose particles and litter. Wipe up spills with rags and other absorbent material immediately, but do not hose down the area to a storm drain. Pervious areas receiving runoff should be cleared regularly of litter and accumulated sediment.

→ 1503.4 Landscape Swale ←

1503.4.1 Description of Facility

The purpose of the swale is to settle out sediment, which has the potential to have urban pollutants bound to the particulate matter. The required length of the swale to settle out particulate pollutants is dependent on multiple factors, including velocity, characteristics of the stormwater, characteristics of the swale, and length of the swale. For the Parking Lot LID program, sizing of swales will be based on minimizing the slope of the swale to minimize the swale length and flow velocities. Xeriscaped or rock swales can be sized using the standard sizing requirements, as shown in Section 1503.4.5.

Runoff from any impervious areas on a developed site can be directed to swales, including parking lots, roof tops, parking covers, etc. The swales can be installed either within the parking lot area or at the perimeter of the site.

1503.4.2 Water Quality Benefits

Concentrations and loads of the following pollutants are typically reduced by the LID BMP described in this section:

-
- Sediment
 - Total Phosphorus
 - Trace Metals
 - Hydrocarbons

Estimated pollutant removal efficiencies for vegetated landscape swales are given below. Pollutant removal efficiencies for rock lined or xeriscaped swales are expected to be lower.

Section 1500 – Structural Best Management Practices

<u>Pollutant</u>	<u>Removal Efficiency</u>
→ TSS	77%
Total Phosphorus	8%
Total Nitrogen	67%
Trace Metals	83-90%

Source: CASQA New Development and Redevelopment Handbook, 2003

1503.4.3 Applications

Landscape swales are typically located in parks, parkways, private landscaped areas, or in development buffers, and can also be used as pre-treatment devices for other structural treatment controls. They are primarily used as stormwater conveyance systems; however they are limited in their ability to mitigate large storms. Landscape swales are best utilized in low to moderate sloped areas as an alternative to ditches and curb and gutter drainage.

1503.4.4 Limitations

The effectiveness of landscape swales is decreased by compacted soils, frozen ground conditions, short grass heights, steep slopes, large storm events, high discharge rates, high velocities, and a short runoff contact time. Landscape swales also require a sufficient amount of available land area and they may not be appropriate for industrial sites or locations where spills may occur. In areas where burrowing animals are abundant, landscape swales may not perform effectively. Additionally, the infiltration rates of local soils can limit the application of landscape swales, unless underdrains are installed. Another possible issue is the formation of mosquito breeding habitat if water does not drain or infiltrate.

1503.4.5 Design Criteria

<u>Tributary Area (ac)</u>	<u>Swale Slope</u>	<u>Minimum Swale Length (ft)</u>	<u>Size of Swale</u>
→ ≤ 0.5	≤ 1%	30	9" deep maximum, 6 ft wide at top average, 4ft wide at top minimum, 4:1 side slope ←
0.5 - 1.0	≤ 1%	40	9" deep maximum, 6 ft wide at top average, 4ft wide at top minimum, 4:1 side slope

Minimum criteria for sizing landscaped swales for parking lot BMPs using xeriscaped surface treatments are provided below. Sizing was based on minimizing flow velocities and maximizing flow paths to encourage settlement of sediment.

BMP swales should be as long as practically feasible to provide as much treatment as possible. The minimum length is 30 ft for tributary areas up to 0.5 acres, and 40 ft for tributary areas of up to 1.0 acre. When incorporating swales into landscaping features, tributary areas to individual BMPs should be kept to less than 0.5 acre whenever possible, and should never exceed 1.0 acre unless hydrologic and hydraulic calculations are provided. BMP swales should have a minimum average top width of 6 ft, with a minimum top width at any point of 4 ft and a maximum flow depth of 9 inches for water quality flows (approximately 2-yr storm). When combined with a larger flood control facility these dimensions should apply to the portion of the swale carrying low flows. When lined with rock, landscaped swale BMPs should have a minimum rock size of 3-inch D₅₀. When combined with a larger flood control facility, rock lining should be sized based on the anticipated flood velocities in the facility.

The Developer may propose to use an alternative size swale, if supporting calculations are submitted.

1503.4.6 Maintenance

Remove any sediment or debris build-up when the depths exceed 3 inches. Inspect for pools of standing water. At regular intervals, re-grade to restore design grade and re-vegetate.

Use of heavy equipment for mowing and removing plants/debris should be avoided to minimize soil compaction. Disturbed areas should be stabilized with seed and mulch, or rock lining, as necessary.

If a spill occurs and hazardous materials contaminate soils in the swales, the affected areas should be removed immediately and disposed of in a manner that complies with federal and state regulations. The swale soils and materials should be replaced as soon as possible.

1503.5 Depressed Median

1503.5.1 Description of Facility

Medians come in the depressed or raised form, or are made flush with the surface of the carriageways. Only the depressed medians are discussed in this section.

[illegible]

Table 1501

PARKING LOT BMP DESIGN REQUIREMENTS BY PARKING LOT CATEGORY

[illegible]

FEASIBLE LID MEASURES IN THE LAS VEGAS VALLEY NDSR PROGRAM

[illegible]

BMP Swale Capacity

BMP SWALE CAPACITY

Worksheet for Triangular Channel

Project Description	
Worksheet	BMP SWALE CAPACITY
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Discharge

Input Data	
Mannings Coeffic	0.033
Slope	010000 ft/ft
Depth	1.00 ft
Left Side Slope	4.00 H : V
Right Side Slope	4.00 H : V

Results	
Discharge	11.12 cfs
Flow Area	4.0 ft ²
Wetted Perim	8.25 ft
Top Width	8.00 ft
Critical Depth	0.86 ft
Critical Slope	0.021861 ft/ft
Velocity	2.78 ft/s
Velocity Head	0.12 ft
Specific Energ	1.12 ft
Froude Numb	0.69
Flow Type	Subcritical

see MANNING'S CALC. (Appendix 'B') - 4" riprap

8' WIDE SWALE, 4:1 SS

SWALE CAN CONVEY ENTIRE 100YR FLOW ON SITE

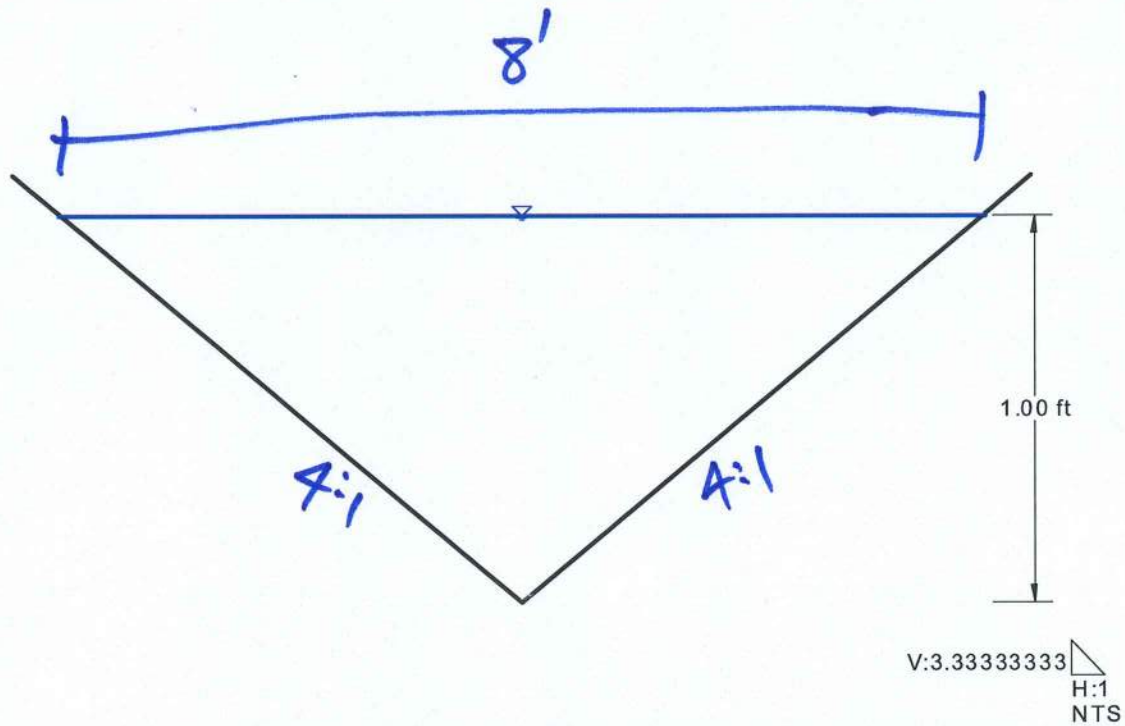
NON-EROSIVE

BMP SWALE CAPACITY

Cross Section for Triangular Channel

Project Description	
Worksheet	BMP SWALE C
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Discharge

Section Data	
Mannings Coeffic	0.033
Slope	010000 ft/ft
Depth	1.00 ft
Left Side Slope	4.00 H : V
Right Side Slope	4.00 H : V
Discharge	11.12 cfs



Manning's Calculations

Manning's Calculation

Charleston and Westwind Retail Center

Date: December, 2020

Calculated By: Chris Blake

From Section 705.4.4 of Hydrologic Criteria and Drainage Design Manual (HCDDM)
Equation 732:

$$n = 0.0395(D50)^{1/6}$$

n = Manning's coefficient

D50 = Mean stone size in ft, rock size for which 50% (by weight) of the riprap is smaller

Solve for n: D50= 4.0 inches

$$n = 0.0395(D50)^{1/6}$$

D50= 0.333 ft

n = **0.033** <<<< Manning's n-value for 4-inch Loose Riprap

APPENDIX C

FIGURES

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

163-01-1

1

126-125 124-12
137 138 139 14
164 163 162 16
175 176 177 17

Scale: 1" = 200'

Rev: 2/22/2019

T21S R60E

1

126-125 124-12
137 138 139 14
164 163 162 16
175 176 177 17

1

126-125 124-12
137 138 139 14
164 163 162 16
175 176 177 17

NOTES

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

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

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

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

MAP LEGEND

Parcel Boundary

Sub Boundary

PMAD Boundary

Road Easement

Match / Leader Line

Historic Sub Boundary

Historic PMAD Boundary

Section Line

PARCEL BOUNDARY

SUB BOUNDARY

PMAD BOUNDARY

ROAD EASEMENT

MATCH / LEADER LINE

HISTORIC SUB BOUNDARY

HISTORIC PMAD BOUNDARY

SECTION LINE

CONDOMINIUM UNIT

AIR SPACE PCL

RIGHT OF WAY PCL

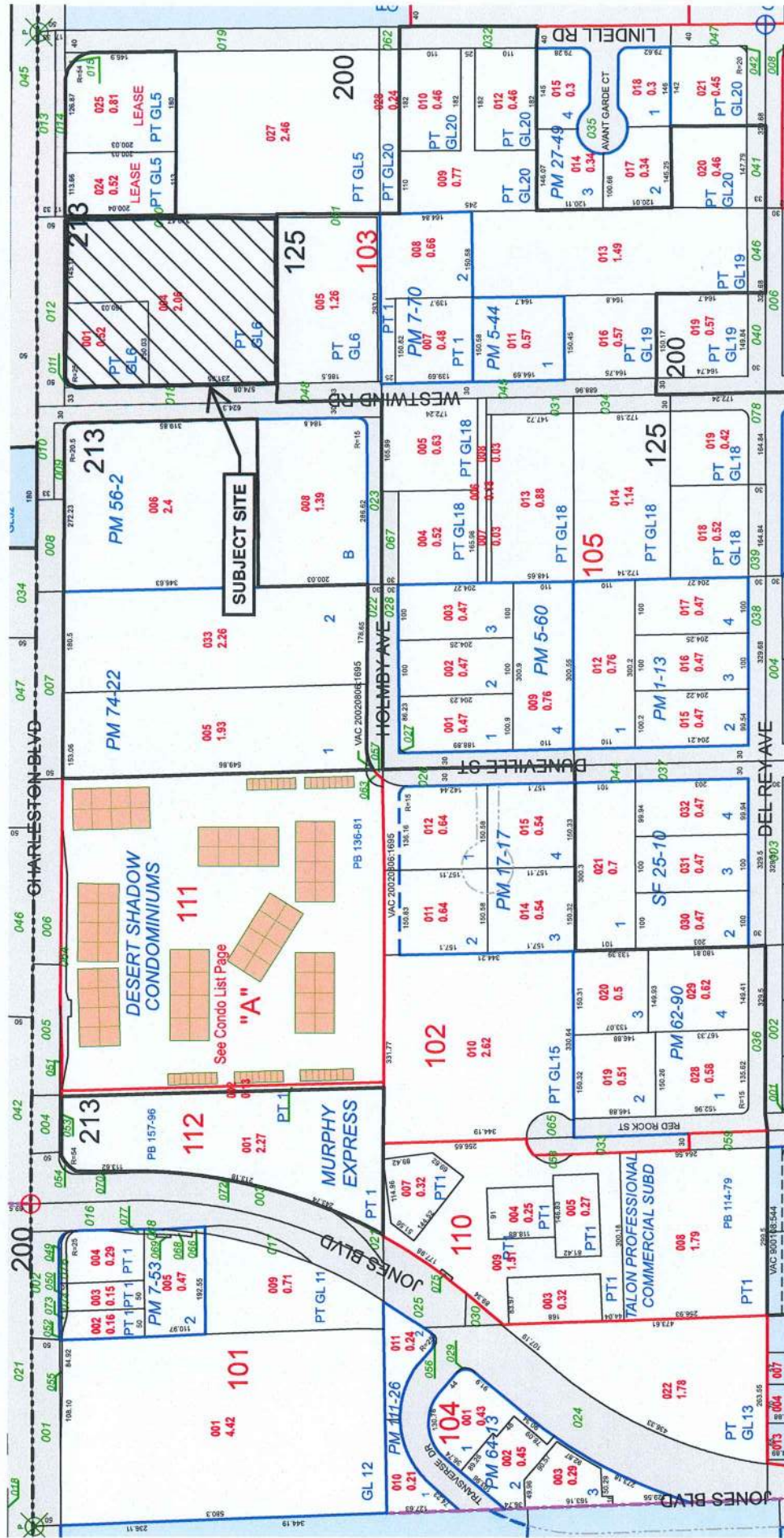
202 PARCEL SUBSEQ NUMBER

PB 24-48 PLAT RECORDING NUMBER

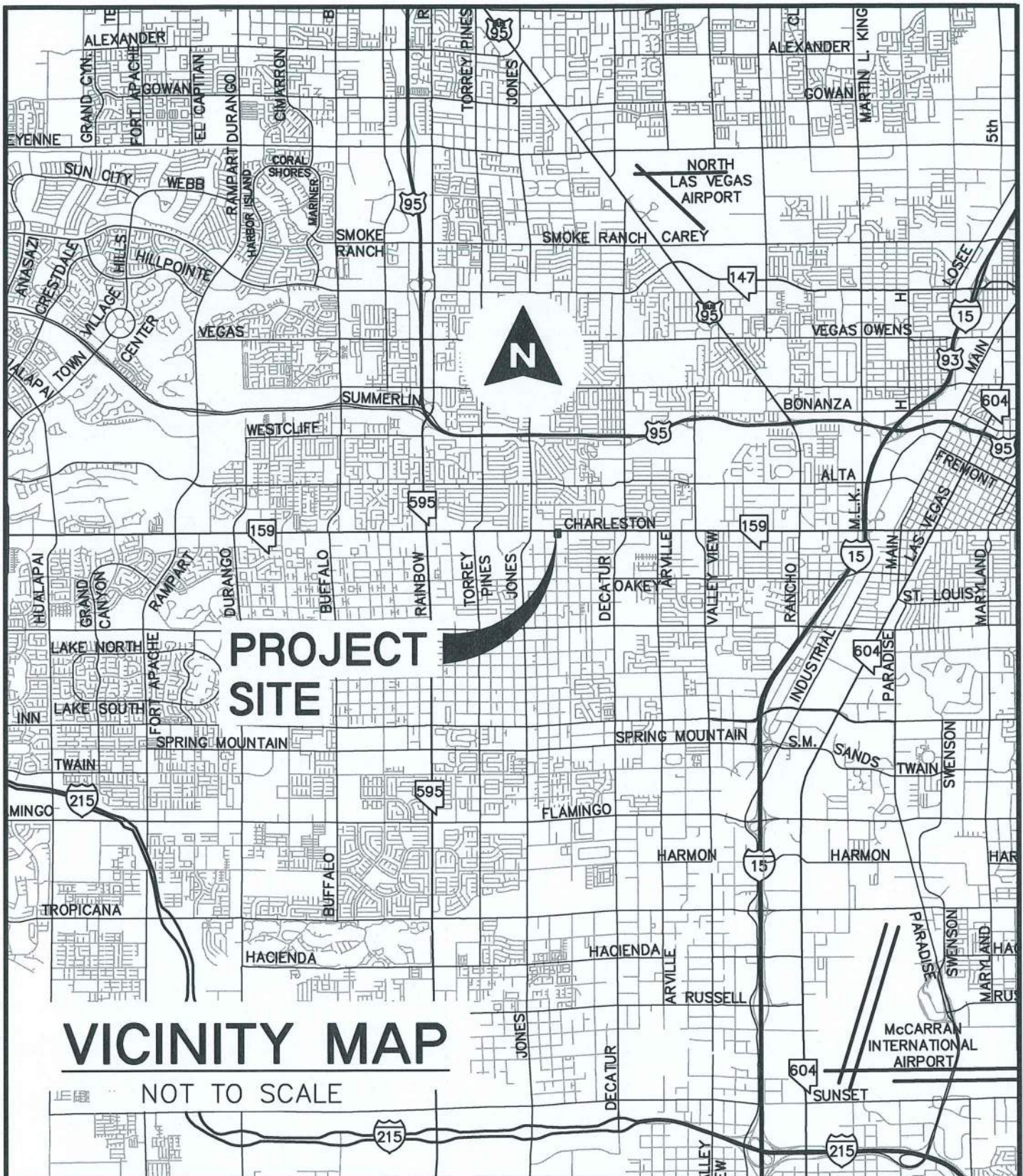
5 BLOCK NUMBER

5 LOT NUMBER

GLS GOV LOT NUMBER



TAX DIST 125.200



DRAWN BY: CB SCALE: N.T.S.

CHECKED BY: CB DATE: 12/20/20

**VICINITY
MAP
(FIGURE 1)**

PROJECT No.:

01234

SHEET No.

1

SHEET 1 OF 1

MCCAY ENGINEERING

**CHARLESTON & WESTWIND
RETAIL CENTER**

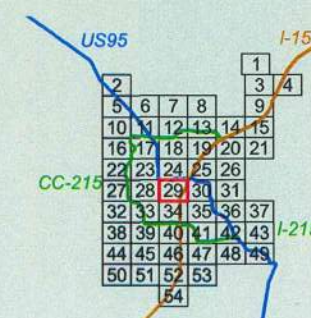


LEGEND

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



AerialSource:Esri World Imagery 2017

**ATKINS**

Member of the SNO-Lavalin Group



ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
BHSA 0175 0289 0331	P P P	BOULDER HIGHWAY SAHARA AVENUE 14' X 14' RCB 14' X 12' RCB 14' X 11' RCB	6000 2300 2000	3952 3669 3346	CSA13 CSA11 CSA10-1	SW3 SW3 SW3	7.93 7.55 7.15	0.67 0.87 1.00
CHRA 0000 0006 0014	E E E	WEST CHARLESTON DRAINS - RANCHO 8' X 9' RCB 8' X 9' RCB 8' X 4' RCB	310 420 600	302 302 302	CAL95 CAL95 CAL95	SW3 SW3 SW3	0.62 0.62 0.62	1.92 1.00 1.50
FLBN 0312 0342	P P	FLAMINGO - BOULDER HIGHWAY NORTH 7' X 4' RCB 7' X 4' RCB	2160 2425	621 621	CCH52 CCH52	SW3 SW3	0.62 0.62	4.20 4.20
FLDY 0000 0002 0004	E E E	FLAMINGO WASH - DARSY STORM DRAIN 84" RCP 10' X 9' RCB 80" RCP	100 50 680	611 611 611	CLF24 CLF24 CLF24	FLAM3A FLAM3A FLAM3A	0.78 0.78 0.78	0.25 0.25 2.80
FLFA 0000 0037	E E	FLAMINGO - FASHION 12' X 9' RCB 8' X 9' RCB	2050 3060	720 492	CFW17N FW14	FLAM3A FLAM3A	0.72 0.44	0.28 0.45
FLLA 0254 0304 0306 0308 0309 0322 0345 0369 0379	E PO E E PO E E E E	FLAMINGO WASH - LATERAL (FLAMINGO/RAINBOW) 90" RCP MODIFY SPILLWAY, RAISE HEIGHT BY 1' (REPLACES FLA0306) 1,555 CFS PMF SPILLWAY (REPLACE W/ FLA0304) 30" RCP WITH 18" ORIFICE OUTLET 62 AC-FT DESERT INN DETENTION BASIN UPGRADE TO 70 AC-FT DESERT INN DETENTION BASIN 81" RCP 81" RCP 72" RCP 86" RCP	2730 1556 1556 203 813 813 1370 1340 670 1320	572 CLF25 CLF25 DID8 CLF25 CLF25 LF25 LF25 LF25 LF25	FLAM3B FLAM3A FLAM3A FLAM3A FLAM3A FLAM3A FLAM3A FLAM3A FLAM3A FLAM3A	0.51 1.03 1.03 1.03 1.03 1.03 0.27 0.27 0.50 0.50	0.40 0.43 0.43 0.43 0.43 0.43 0.43 0.43 0.43 0.43	
FWIS 0000 0010 0036 0050 0089 0100 0125 0130 0150 0175 0214 0242 0271 0301	E E E E E E E E E E P P P P	FREEWAY CHANNEL FROM DESERT INN TO EXPRESSWAY 3' 12' X 10' RCB 3' 12' X 10' RCB 3' 12' X 10' RCB 3' 12' X 10' RCB 2' 18' X 10' RCB 2' 18' X 10' RCB 2' 10' X 8' RCB 2' 10' X 8' RCB 2' 10' X 8' RCB 2' 10' X 8' RCB 2' 12' X 10' RCB 2' 12' X 10' RCB 2' 12' X 10' RCB CONC CHNL 12W 4D 21 SS	2170 677 1945 870 1200 1510 287 1176 780 985 1610 1500 1520 1300	3685 3506 3369 2613 2485 2324 1450 1450 1450 1450 4289 4130 3842 353	CAL93 CAL96 CCH422 CCH59 CCWAL2 COK11C DCCSA08 DCCSA08 DCCSA08 DCCSA08 CED10-C CCPS08 CCPS08 CCE3PD-C	Boulder4 Boulder4 Boulder4 SW4 SW4 SW3 SW3 SW3 SW3 SW3 SW3 SW3 SW3 SW3	8.93 8.70 8.52 8.48 8.28 7.83 6.67 6.67 6.67 6.67 6.25 6.03 5.49 0.42	0.17 0.17 0.17 0.17 0.20 0.80 0.80 0.80 0.80 0.73 0.93 0.93 0.42
FWCH 0000 0020 0036 0044 0047 0060	E E E E E E	WEST CHARLESTON DRAIN 10' X 7' RCB 10' X 7' RCB 9' X 7' RCB 9' X 7' RCB 7' X 5' RCB 9' X 4' RCB	1710 840 425 145 710 400	1044 824 824 561 561 561	CCH22 CCH18-C CCH18-C CCH18-C CCH18-C CCH18-C	SW3 SW3 SW3 SW3 SW3 SW3	1.38 1.15 1.15 0.53 0.53 0.53	0.74 0.40 0.40 0.40 0.40 0.40
FWOK 0000 0020 0040 0060 0076 0100	E E E E E E	OAKEY DRAIN 10' X 8' RCB 10' X 8' RCB 8' X 8' RCB 9' X 9' RCB 9' X 8' RCB 9' X 9' RCB	1350 1025 960 970 1175 2020	960 960 749 749 749 465	10CK11C 10CK11C COK10 COK10 COK10 COK08-C	SW3 SW3 SW3 SW3 SW3 SW3	1.16 1.16 0.85 0.85 0.85 0.55	0.62 0.60 1.00 1.50 1.04 2.16
FWPS 0000 0057 0157	P P P	PALMYRA / SIRIUS DRAIN 12' X 12' RCB 10' X 10' RCB 2' 66" RCP	3000 5220 5100	3544 2101 547	CP508 CP506 CP503	SW3 SW3 SW3	5.07 2.78 0.59	1.50 1.28 1.15
FWR2 0000 0020	E E	FREEWAY CHANNEL - RAILROAD CHANNEL 9' X 4' RCB EARTH CHNL 10W 4D 21 SS	377 650					1.60 0.50
FWRR 0000 0010	E E	FREEWAY CHANNEL BYPASS FACILITY RR BRANCH 48" RCP CONC CHNL SW 5D 0.1 SS	70 220					1.22 1.22
FWSA 0000 0000	P P	FREEWAY CHANNEL - SAHARA 7' X 9' RCB 7' X 4' RCB	5700 496		CSA08	SW3	0.42	1.49
FWSH 0000 0000	E E	SHADOW LANE DRAIN 7' X 4' RCB 7' X 4' RCB	950 247		CH22-C	SW3	0.23	0.20
FWUP 0000 0010 0059 0100	E E E E	FREEWAY CHANNEL BYPASS FACILITY 10' X 8' RCB 10' X 8' RCB 10' X 8' RCB 8' X 4' RCB	350 804 2680 1440	181 181 181 181	CH50 CH50 CH50 CH50	SW3 SW3 SW3 SW3	0.20 0.20 0.20 0.20	0.37 0.37 0.40 0.47
FWVV 0000 0025 0050	P P P	VALLEY VIEW DRAIN 12' X 11' RCB 10' X 10' RCB 8' X 6' RCB	1320 2665 7785	1549 1059 750	CCE3FA CRAC1 DFW05	SW3 SW3 SW3	2.69 1.74 1.34	0.30 0.30 1.50
FWWL 0000 0000	E E	FREEWAY CHANNEL-WALDMAN AVENUE 8' X 6' RCB 8' X 6' RCB	820 431		CWAL2	SW3	0.45	0.20
LCCH 0000 0013 0051 0110 0114 0127 0129 0150 0154 0157 0230 0270 0302 0377 0400 0402 0412 0438 0458 0478 0499 0513	E E	LAS VEGAS CREEK CHANNEL 2' 12' X 7' RCB 2' 12' X 6' RCB 2' 14' X 7' RCB TRANSITION STRUCTURE 2' 14' X 7' RCB TRANSITION STRUCTURE 2' 14' X 7' RCB 2' 13' X 7' RCB TRANSITION STRUCTURE 2' 12' X 6' RCB 12' X 6' RCB 10' X 7' RCB TRANSITION STRUCTURE 8' X 6' RCB @ JONES 80" RCP 60" RCP 60" RCP 60" RCP 42" RCP OUTLET 102 AC-FT RAINBOW DETENTION BASIN	730 2035 3113 220 670 110 1130 200 190 1650 2140 1705 1226 110 535 1370 1090 1090 1110 660 1027	3212 3050 3050 3001 2385 2385 2385 2385 2385 1700 1450 814 814 458 458 458 171 171 171 87 1027	CAL93C CLC28-C CLC28-C CLC16-C CRMEDET CRMEDET CRMEDET CRMEDET CRMEDET CLC14-C CLC14-C CCWAQ2-C CCWAQ2-C CWAQ2-C CWAQ2-C CWAQ2-C CLC01-C CLC01-C CLC01-C RAINBOW RAINBOW	MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 SW3 SW3 SW3 SW3 SW3 SW3 SW3 SW3 SW3 SW3 SW3	9.90 9.60 9.60 9.50 8.19 8.19 8.19 8.19 8.19 2.93 2.53 1.84 1.84 1.47 1.47 1.47 1.20 1.20 1.20 1.11 1.11	1.28 0.82 0.60 0.50 0.80 0.50 0.95 0.50 1.06 1.74 0.54 0.74 0.49 0.49 1.08 1.60 1.60 0.55 1.88 1.11
LCDE 0000 0034	E E	LAS VEGAS CREEK - DECATUR 8' X 5' RCB 72" RCP	1800 700	430 430	LC11-C LC11-C	SW3 SW3	0.38 0.38	1.26 0.50
LCJO 0000 0007	E E	LAS VEGAS CREEK - JONES 8' X 6' RCB 8' X 5' RCB	380 575	381 381	AL01B-C AL01B-C	SW3 SW3	0.37 0.37	0.50 0.62
LCLO 0000 0008 0054	E E E	LAS VEGAS CREEK - LORENZI 7' X 6' RCB 7' X 6' RCB 7' X 5' RCB	445 2983 169	285 285 285	DAL00A DAL00A DAL00A	SW3 SW3 SW3	0.41 0.41 0.41	3.37 0.40 1.00
LCME 0000 0016 0017 0018 0019 0020 0021	E E E E E E P	LAS VEGAS CREEK - MEADOWS 14' X 8' RCB MEADOWS BASIN 3,300 CFS SPILLWAY (REPLACE W/ LCM0018) MODIFY SPILLWAY, RAISE HEIGHT BY 1' (REPLACES LCM0017) 1' 11' X 5' RCB AND 1' 11.5' X 5' RCB 213 AC-FT MEADOWS DETENTION BASIN UPGRADE TO 249 AC-FT MEADOWS DETENTION BASIN	895 140 3300 3300 110 4909 4909	1484 1484 3300 3300 1484 4909 4909	MEADOWS MEADOWS MEADOWS MEADOWS MEADOWS MEADOWS MEADOWS	SW3SC SW3SC SW3SC SW3SC SW3SC SW3SC SW3SC	5.57 5.57 5.57 5.57 5.57 7.55 7.55	0.72 0.21 0.81 0.81 0.81 0.81 0.81
LCME 0000 0002 0002 0004 0004 0007 0009 0010 0016 0019	E E E E E E E E E E E	LAS VEGAS CREEK - MEADOWS CONC CHNL 19W 9.5D 0.1 SS 19' X 7' RCB 19' X 8' RCB 18' X 8' RCB 7' X 8' RCB 18' X 8' RCB 18' X 8' RCB 12' X 8' RCB 12' X 8' RCB 12' X 8' RCB 12' X 7' RCB	112 800 1550 1700 1320 630 850 2304 642 1350 660	2871 2871 2871 2871 244 2524 2524 1568 1568 1568 895	COK13 COK13 COK13 COK13 CH14B COK12 COK12 CCOK08 COK08 COK08 COK07	SW3SC SW3SC SW3SC SW3SC SW3 SW3SC SW3SC SW3SC SW3 SW3 SW3	5.57 5.57 5.57 5.57 0.22 2.57 2.57 1.58 1.58 1.58 0.93	2.94 0.98 0.92 0.50 0.44 0.50 1.01 1.04 0.45 0.45 0.71
MEOK 0204 0217	E E	OAKEY MEADOWS STORMDRAIN 12' X 6' RCB 12' X 5' RCB	655 1276	995 570	COK07 CSA06	SW3 SW3	0.93 0.52	0.71 0.40
MEPA 0000 0022 0025	E E E	MEADOWS PARALLEL 10' X 6' RCB 8' X 9' RCB 78" RCP	1370 200 470	276 276 276	CCH14A CCH14A CCH14A	SW3 SW3 SW3	0.25 0.25 0.25	0.50 1.45 1.16
PSDE 0000 0025	P P	PALMYRA / SIRIUS DRAIN - DECATUR LATERAL 12' X 8' RCB 10' X 8' RCB	1330 1330	1127 662	CED02 CED13	SW3 SW3	1.21 0.65	0.38 0.25
WAGC 0014 0060	E E	WASHINGTON AVENUE CHANNEL - GRAND CENTRAL 1' 12' X 4' RCB AND 1' 11' X 4' RCB 12' X 4' RCB	2440 455	505 505	LC21 LC21	SW3 SW3	0.56 0.56	0.20 0.20

MECN 0123 : 8' X 6' RCB

MECN 0000 0061 0123 0223	P P P P	MEADOWS - CHARLESTON 8' X 8' RCB 8' X 7' RCB 8' X 6' RCB 8' X 9' RCB	1570 3300 5200 2700	1150 1150 854 438	CCH10 CCH10 CCH09-C CCH05-C	SW3 SW3 SW3 SW3	1.00 1.00 0.72 0.34	1.09 1.82 1.64 2.04
MEOK 0000 0002 0017 0048 0070 0079 0091 0110 0150 0166 0191	E E E E E E E E E E E	OAKEY MEADOWS STORMDRAIN CONC CHNL 19W 9.5D 0.1 SS 19' X 7' RCB 19' X 8' RCB 18' X 8' RCB 7' X 8' RCB 18' X 8' RCB 18' X 8' RCB 12' X 8' RCB 12' X 8' RCB 12' X 9' RCB 12' X 7' RCB	112 800 1550 1700 1320 630 850 2304 642 1350 660	2871 2871 2871 2871 244 2524 2524 1568 1568 1568 895	COK13 COK13 COK13 COK13 CH14B COK12 COK12 CCOK08 COK08 COK08 COK07	SW3SC SW3SC SW3SC SW3SC SW3 SW3SC SW3SC SW3SC SW3 SW3 SW3	5.57 5.57 5.57 5.57 0.22 2.57 2.57 1.58 1.58 1.58 0.93	2.94 0.98 0.92 0.50 0.44 0.50 1.01 1.04 0.45 0.45 0.71

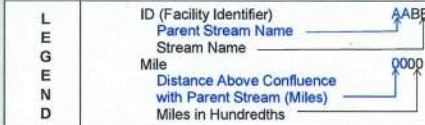
MECN 0123 : 8' X 6' RCB

*The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.
 **As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.
 ^ For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e. HEC-1 Node flow - existing facility normal depth capacity + proposed parallel facility flow).



2018 LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FACILITY INVENTORY
FIGURE F-29



Existing Facility..... E
 Proposed or Modified Facility..... P
 Contingency Level
 Category A..... P
 Category B..... P0

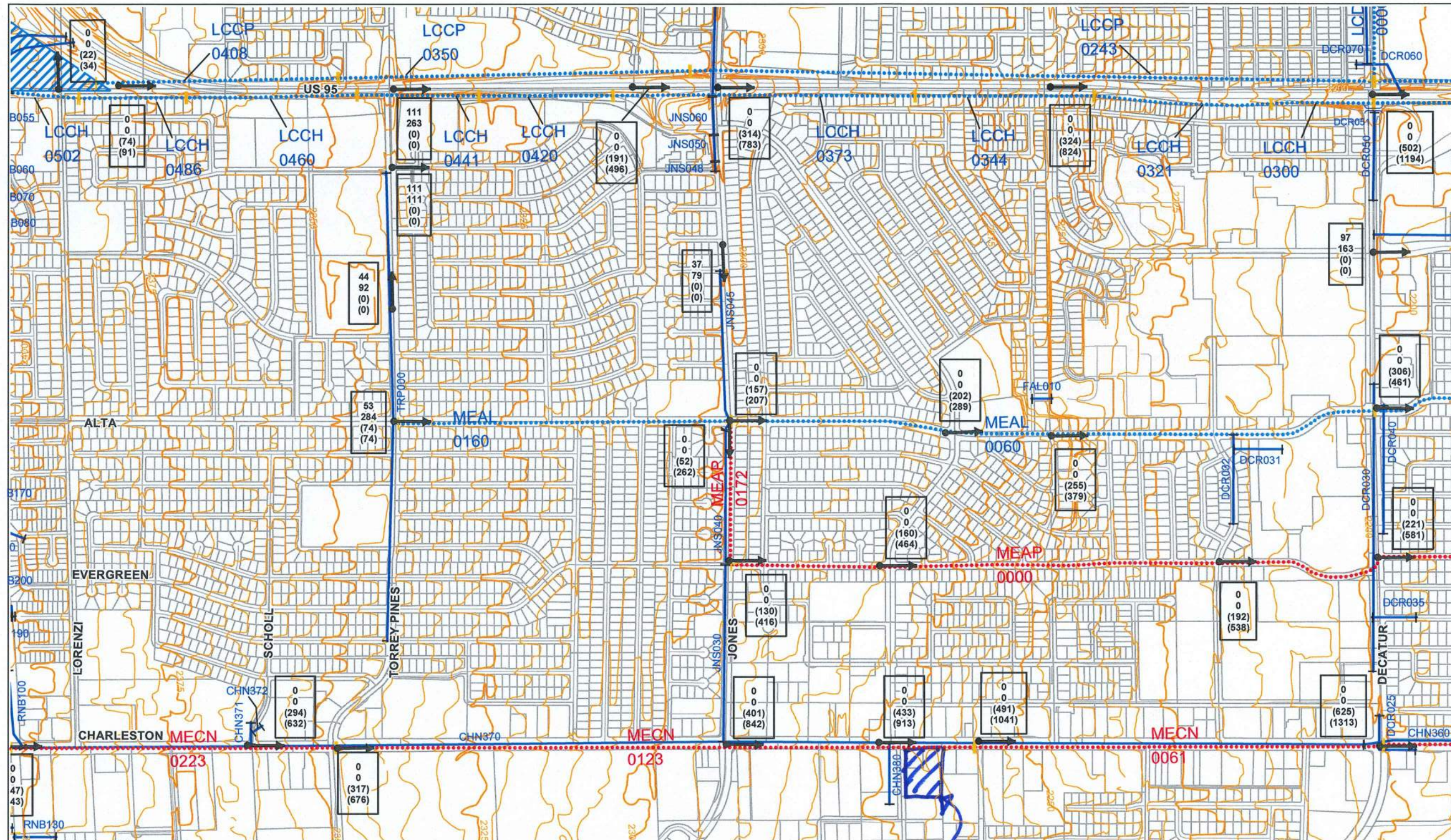
Bottom Width..... W
 Depth..... D
 Side Slope, H:V..... SS

Construction Features
 Cast in Place Concrete Pipe..... CIPCP
 Corrugated Metal Arch Pipe Culvert..... CMAP
 Corrugated Metal Pipe Culvert..... CMPC
 High Density Polyethylene..... HDPE
 Horizontal Elliptical Reinforced Concrete Pipe..... HERCP
 Reinforced Concrete Arch Pipe..... RCAP
 Reinforced Concrete Arch Culvert..... RCAC
 Reinforced Concrete Box..... RCB
 Reinforced Concrete Box Culvert..... RCB
 Reinforced Concrete Pipe..... RCP
 Reinforced Concrete Pipe Culvert..... RCP
 Storm Sewer Pipe..... SSP



CLV CENTRAL NEIGHBORHOOD MPU (Figures E-8 and F-8)

(EXISTING & FUTURE)



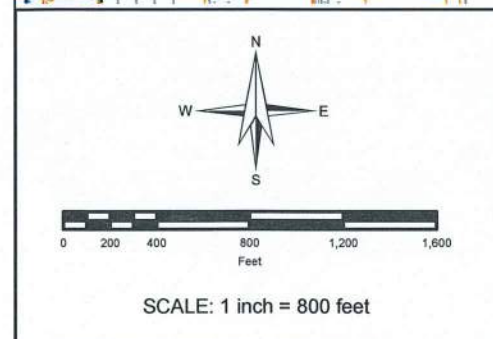
City of Las Vegas

CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN

LEGEND

- Existing Regional Facility
- Category A Proposed Regional Facility (2002 MPU)
- Category B Proposed Regional Facility (2002 MPU)
- Category A Proposed Regional Facility (2004 CNFCMP)
- Existing Local Facility
- Proposed Local Facility
- Regional Culvert
- Regional Bridge
- Regional Pipeline
- Regional Channel
- ~~~~~ Regional Levee
- ▨ Regional Detention Basin
- Local Storm Drain
- Local Culvert
- Proposed Local Storm Drain
- Regional ID-Mile Separator
- Local Facility Separator

FIGURE F-8

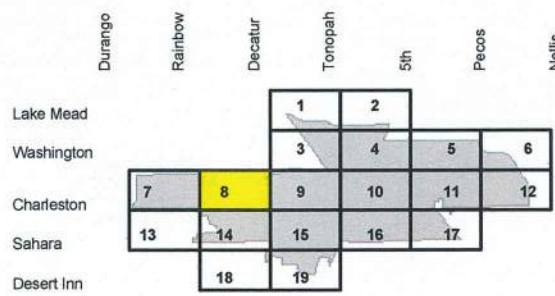


- Flow Arrow
- 250 10-Year Street Flow
500 100-Year Street Flow
(300) 10-Year Facility Flow
(800) 100-Year Facility Flow
- (Flows in CFS)

NOTE:
Ultimate drainage conditions are based on future Curve Number values with all flood control 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.

site



FUTURE DRAINAGE CONDITIONS



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



City of Las Vegas

CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN

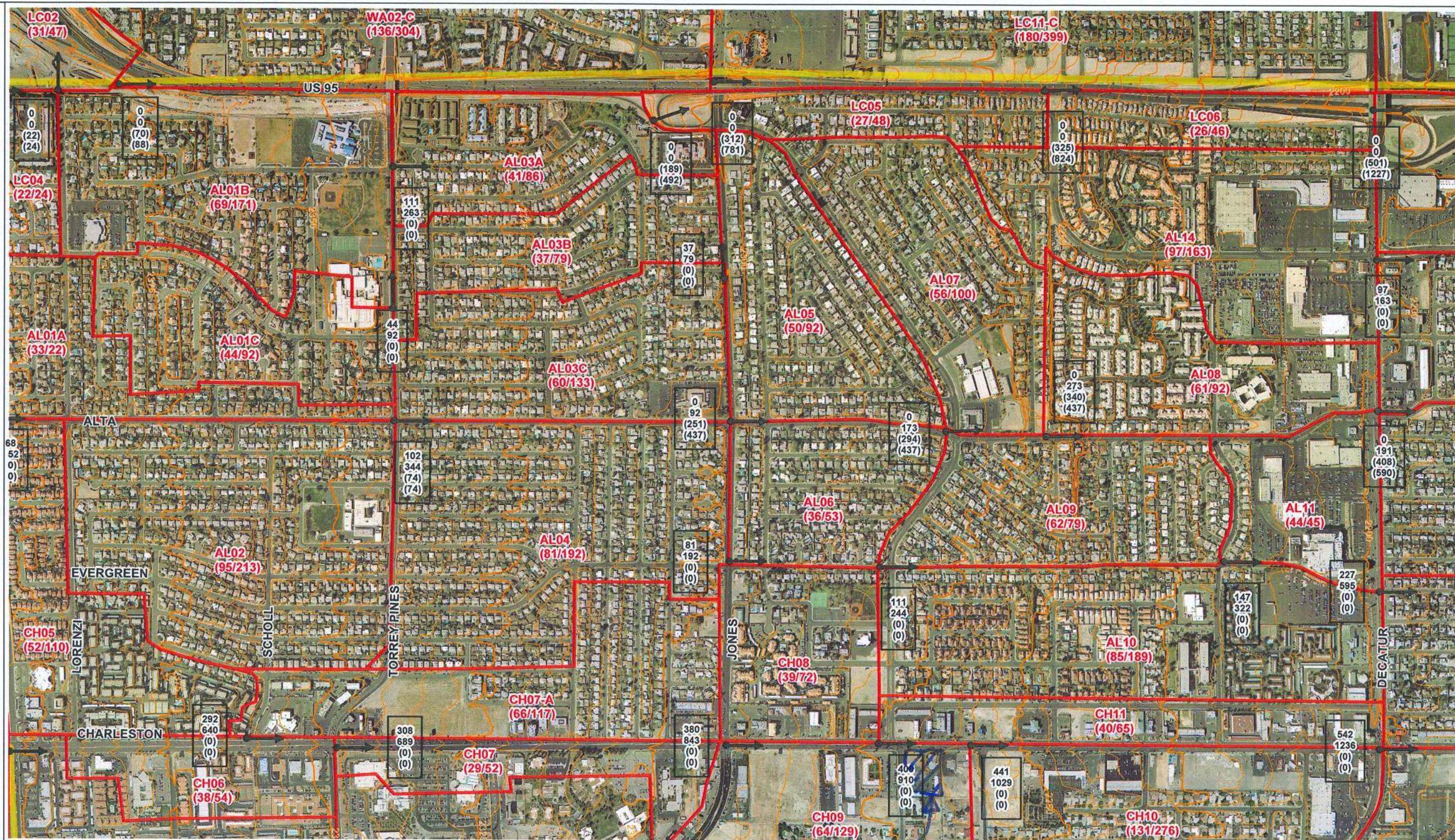
LEGEND

- Sub-basin Boundary
- LV12** Basin ID
- Contributing flow from the basin (cfs)
(10yr./100yr.)
- Flow Arrow
- | | |
|-------|------------------------|
| 250 | 10-Year Street Flow |
| 500 | 100-Year Street Flow |
| (300) | 10-Year Facility Flow |
| (800) | 100-Year Facility Flow |

(Flows in CFS)
- Study Area Limit

PHOTO DATE: SPRING 2004

FIGURE E-8



EXISTING DRAINAGE CONDITIONS

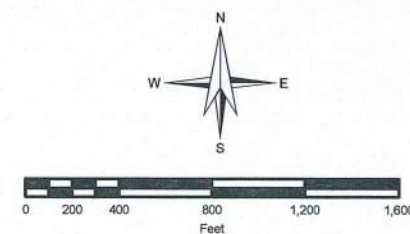


2270 Corporate Circle, Suite 100
Henderson, NV 89074
(702) 263-7275
Fax: (702) 263-7200

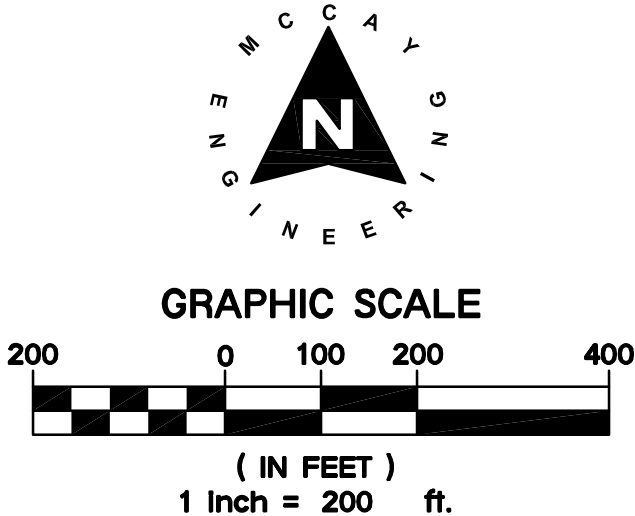
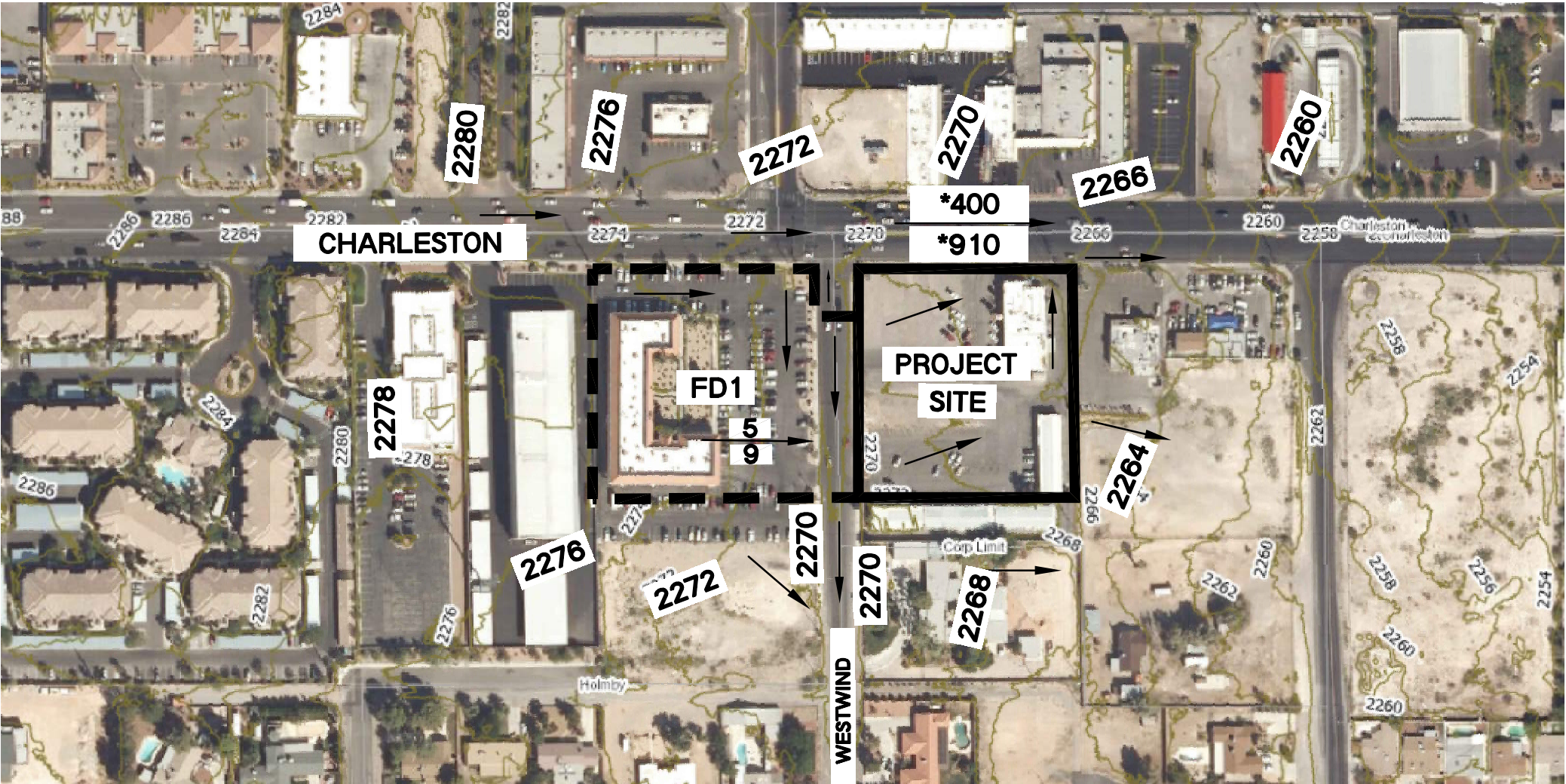
	Durango	Rainbow	Decatur	Toropah	5th	Pecos	Nellis
Lake Mead				1	2		
Washington				3	4	5	6
Charleston	7	8	9	10	11	12	
Sahara	13	14	15	16	17		
Desert Inn		18	19				

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

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



SCALE: 1 inch = 800 feet



DRAINAGE LEGEND	
ND1	DRAINAGE BASIN LABEL
●	CONCENTRATION POINT
CPD1	COMBINATION POINT
———	ONSITE BASIN BOUNDARY
- - - - -	OFFSITE BASIN BOUNDARY
$\frac{2}{3}$ →	Q10 FLOW IN CFS (INTERIM)
$\frac{X (X)(XX)}{X (X)(XX)}$ →	Q10 (V10)(D10)
→	Q100 FLOW IN CFS (INTERIM)
→	Q100 (V100)(D100)
→	BASIN FLOW DIRECTION
→	COMBINED FLOW DIRECTION

*CENTRAL NEIGHBORHOOD CLV MPU (FIGURE E-8)

Peak Flow Summary Existing Condition			
HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
NX1	2.58	5	9

Peak Flow Summary Developed Condition			
HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
ND1	1.64	3	5
ND2	0.94	2	3
CPD1	-	5	9
(ND1+ND2)			

DRAWN BY: CB

CHECKED BY: CB

McCAY ENGINEERING

SCALE: 1"=200'

DATE: 12/23/20

FILE NAME: OFFMAP

LEGEND

FOUND MONUMENTATION

CENTER LINE

ROW LINE

EASEMENT LINE

SECTION LINE

PROPERTY LINE

ADJACENT PROPERTY LINE

PROJECT No.: 01234

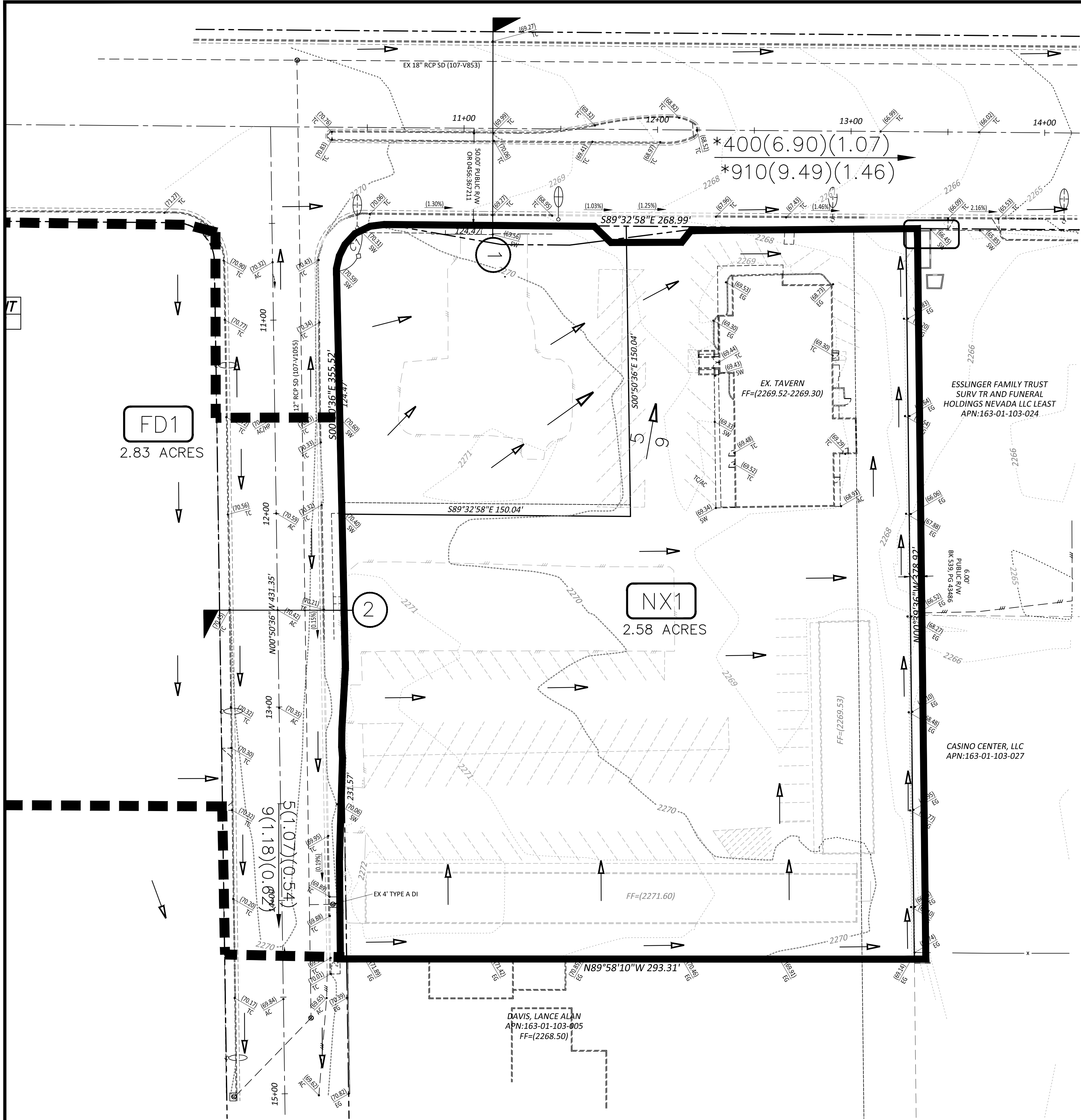
SHEET No.

OFF1

SHEET 1 OF 1

OFFSITE BASIN MAP

CHARLESTON & WESTWIND RETAIL CENTER



*CLV CENTRAL NEIGHBORHOOD MPU (Figure E-9)

ND1

CMD1

2

3

1 (1.0)(1.2)

1 (1.0)(1.2)

1

DRAINAGE BASIN LABEL

CONCENTRATION POINT

COMBINATION POINT

ONSITE BASIN BOUNDARY

Q10 FLOW IN CFS (10 YR.)

Q100 FLOW IN CFS (100 YR.)

Q10 (V10)(D10)

Q100 (V100)(D100)

BASIN FLOW DIRECTION

COMBINED FLOW DIRECTION

HYDRAULIC CROSS-SECTION

SITE

CHARLESTON

DEL RAY

UNDELL

WESTWIND

VICINITY MAP

SCALE: NTS

GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

1 INCH = 30 FT.

Peak Flow Summary			
Existing Condition			
HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
NX1	2.58	5	9

Street Flow Summary (Existing / 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)
Westwind	60	2	5	1.07	0.54	0.58	N/A
Charleston	100	1	400	6.90	1.07	7.38	0.0
Street Flow Summary (Existing / 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]	
Westwind	60	2	9	1.18	0.62	0.73	
Charleston	100	1	910	9.49	1.46	13.86	

REV

DATE

BY

REVISION

MCCAY ENGINEERING

CIVIL ENGINEERING

11700 W. CHARLESTON BLVD.
SUITE 100
LAS VEGAS, NV 89135
P 702-860-3897

985 WHITE DRIVE
LAS VEGAS, NV 89119
P 702-733-6622

EXISTING DRAINAGE PLAN

CHARLESTON & WESTWIND
RETAIL CENTER

DATE: 12/22/2020

DRAWN BY: JSM

PROJECT MGR: JSM

PROJECT NO: 20347

SCALE: 1"=30'

PROFESSIONAL ENGINEER'S SEAL OF THE STATE OF NEVADA

JEREMY S. MCCAY

Exp: 12/31/21

CIVIL

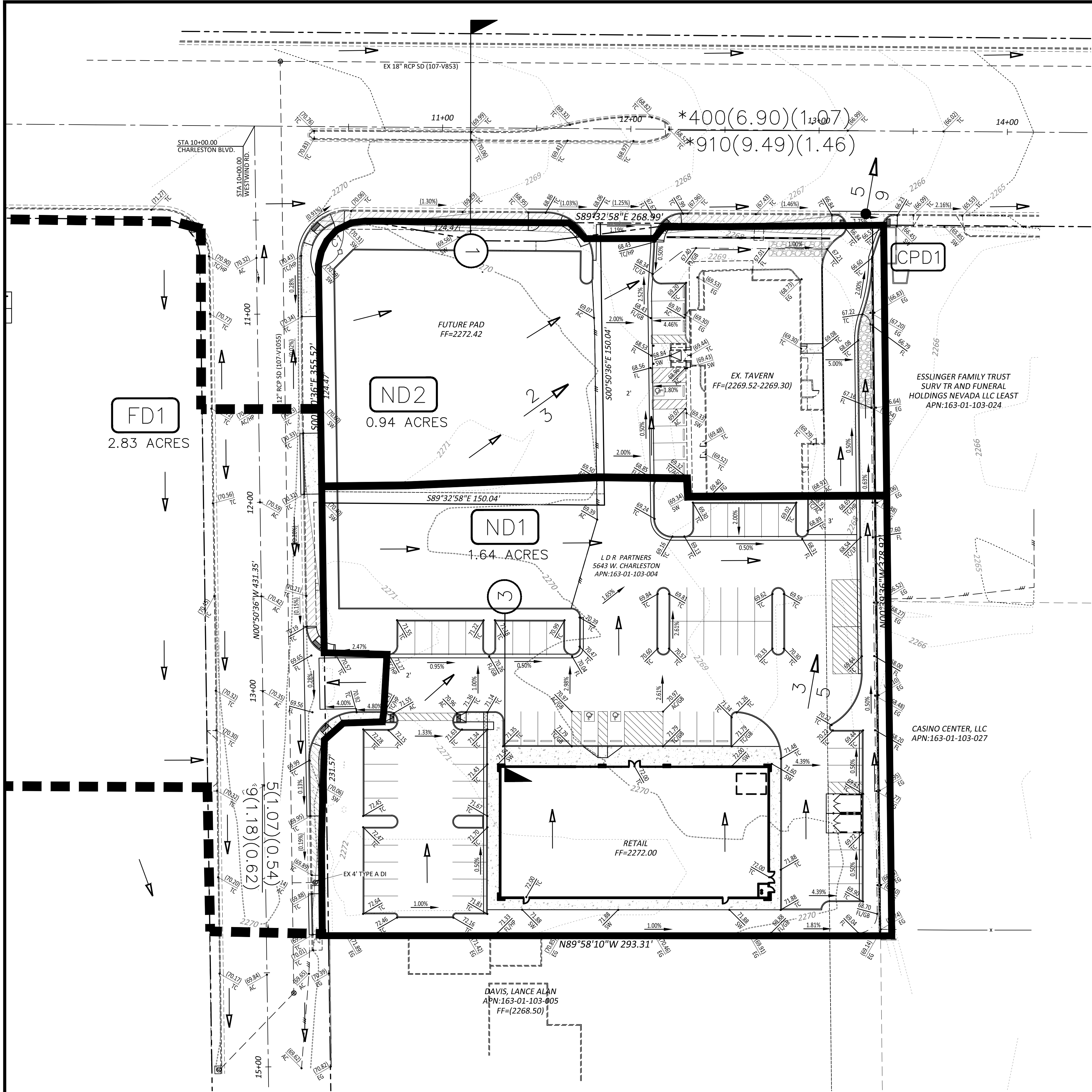
12/22/2020

SHEET

DR1

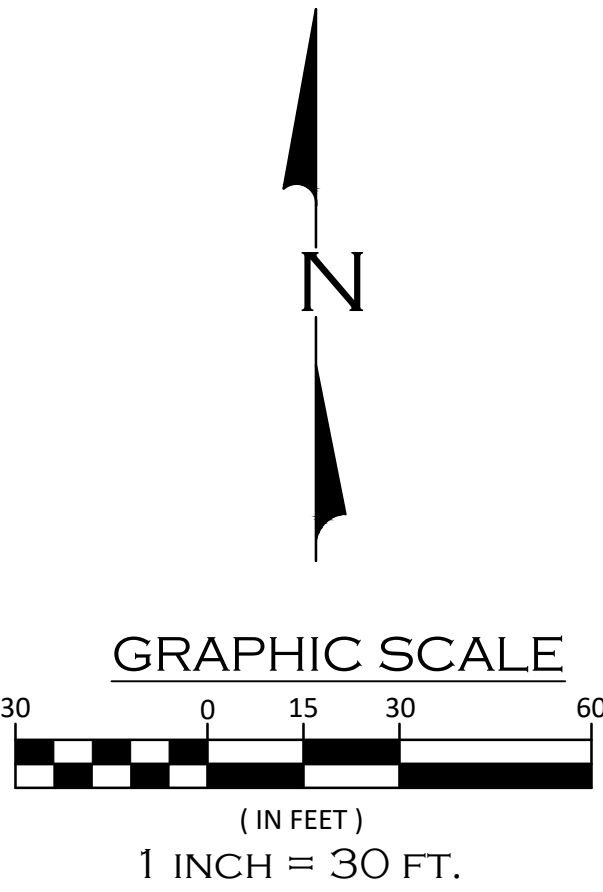
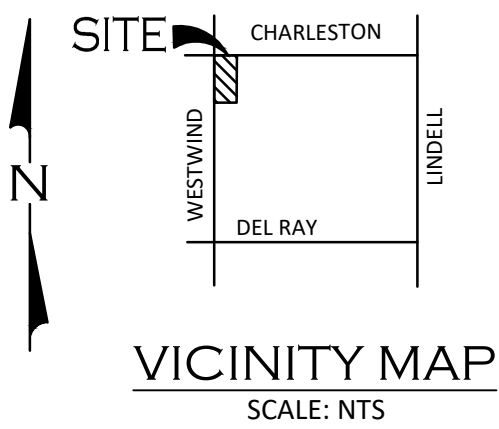
OF 5 SHEETS

DRAWING NO.



*CLV CENTRAL NEIGHBORHOOD MPU (Figure E-9)

DRAINAGE LEGEND	
ND1	DRAINAGE BASIN LABEL
●	CONCENTRATION POINT
CMD1	COMBINATION POINT
---	ONSITE BASIN BOUNDARY
$\frac{2}{3}$	Q10 FLOW IN CFS (10 YR.)
$\frac{1}{1}$	Q100 FLOW IN CFS (100 YR.)
$\frac{1}{1}$	Q10 (V10)(D10)
$\frac{1}{1}$	Q100 (V100)(D100)
→	BASIN FLOW DIRECTION
→	COMBINED FLOW DIRECTION
1	HYDRAULIC CROSS-SECTION



Peak Flow Summary			
Developed Condition			
HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
ND1	1.64	3	5
ND2	0.94	2	3
CPD1	-	5	9
(ND1+ND2)			

Street Flow Summary							
(Existing / 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)
Westwind Charleston	60 100	2 1	5 400	1.07 6.90	0.54 1.07	0.58 7.38	N/A 0.0
Street Flow Summary							
(Existing / 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]	
Westwind Charleston	60 100	2 1	9 910	1.18 9.49	0.62 1.46	0.73 13.86	

On-site Sections				
(Interim / Developed Conditions)				
Hydraulic Cross-Section Identifier	100-Year Flow [Q100] (cfs)	100-Year Velocity [v] (fps)	100-Year Flow Depth [d] (ft)	2x 100-Year 2 x [d]
3	5	1.66	0.24	0.48

REV

DATE

BY

REVISION

MCCAY

ENGINEERING

CIVIL ENGINEERING

11700 W. CHARLESTON BLVD.
SUITE 100
LAS VEGAS, NV 89135
P 702.860.3897

LDR PARTNERS

985 WHITE DRIVE
LAS VEGAS, NV 89119
P 702.733.6622

DEVELOPED DRAINAGE PLAN

CHARLESTON & WESTWIND
RETAIL CENTER

DATE: 12/22/2020
DRAWN BY: JSM
PROJECT MGR: JSM
PROJECT NO: 20347
SCALE: 1"=30'

PROFESSIONAL ENGINEER - STATE OF NEVADA

JEREMY S. MCCAY

Exp: 12/31/21

CIVIL

12/22/2020

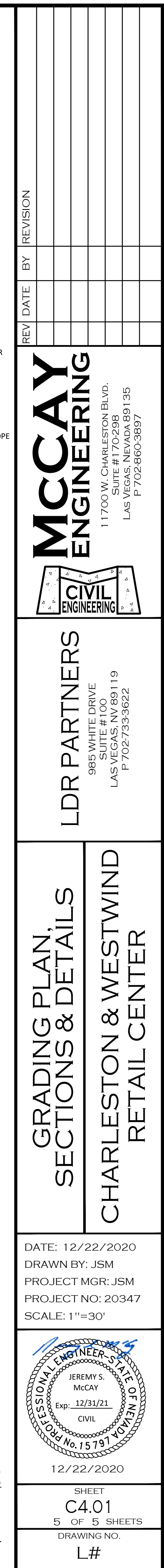
SHEET

DR2

OF 5 SHEETS

DRAWING NO.

L#



McCAY ENGINEERING

11700 W. CHARLESTON BLVD., SUITE 170-298
LAS VEGAS, NV 89135
702-860-3897

TECHNICAL DRAINAGE STUDY FOR Charleston & Westwind Retail Center

CLARK COUNTY, NV
December 23, 2020



**McCay
Engineering**

PREPARED FOR:

LDR PARTNERS
985 White Drive, Suite #100
LAS VEGAS, NV 89119
(702) 733-3622

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM ²³

Name of Development: Charleston & Westwind Retail Center Date: December 23, 2020

Location of Development: a) Descriptive (Cross Streets) North/South: Westwind Rd.

East/West: Charleston Blvd.

b) Section: 1 Township: 21 South Range: 60 East

c) APN : 163-01-510-001/004

Name of Owner: LDR Partners

Telephone No.: (702)733-3622 Fax No.: _____ E-Mail Address: N/A

Address: 985 White Drive, Suite #100 Las Vegas, NV 89119

Contact Person-Name: Jeremy McCay Telephone No.: (702) 860-3897

* E-Mail Address: jmcay@centurylink.net Fax No.: N/A

Firm: McCay ENGINEERING

Address: 11700 W. CHARLESTON BLVD., SUITE 170-298 LAS VEGAS NV 89135

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: 2.58 ACRES (+/-) Being Developed/Disturbed: 1.71 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.): Commercial buildings with parking addition

5. Approximate upstream land area which drains to the subject site: 300 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: North to Charleston Boulevard

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



McCay ENGINEERING

11700 W. CHARLESTON BLVD.
SUITE #170-298
LAS VEGAS, NV 89135
JMcCay@CENTURYLINK.NET
(702) 860-3897

Date: December 23, 2020

Albert Sung, P.E.
City of Las Vegas
Public Works Department – Flood Control
495 S. Main St.
Las Vegas, Nevada 89101

RE: TECHNICAL DRAINAGE STUDY FOR CHARLESTON & WESTWIND RETAIL CENTER
Job No. 20347

Dear Mr. Sung:

This letter is provided to certify that all items on the CD match 100% of the hard copy version provided.

If you have any questions or comments regarding this project, please do not hesitate to contact this office at (702) 860-3897.

Sincerely,
McCay Engineering

Jeremy S. McCay, P.E.
Principal

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: CHARLESTON + WESTWIND RETAIL CENTER	Map ID:	
Firm Name: McCay Engineering	Engineer: Jeremy McCay	
Address: 11700 W. CHARLESTON BLVD., Suite #170-298		
City: LAS VEGAS	State: NV	Zip: 89135
Phone Number: (702) 860-3897	Fax Number: N/A	
Property Owner: LDR PARTNERS		
Address: 985 WHITE DRIVE, STE. #100		
City: LAS VEGAS	State: NV	Zip: 89119
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. |
| No ☐ | Yes ☒ | 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	
☐	<u>N/A</u>	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.
☐	<u>N/A</u>	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.
☐	<u>N/A</u>	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
☐	<u>N/A</u>	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.
☐	<u>N/A</u>	Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
☐	<u>N/A</u>	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
☒	☐	Building and/or lot numbers.
☒	☐	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
☐	<u>N/A</u>	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 | |
|-------------------------------------|--|--|
| ☐ | ☒ N/A | 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	
	<u>N/A</u>	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.
	<u>N/A</u>	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.
	<u>N/A</u>	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.
	<u>N/A</u>	Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
	<u>N/A</u>	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 (CCRFCDD) 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 CCRFCDD Hydrologic Criteria and Drainage Design Manual (Design Manual).

An appointment must be made to preview this checklist in conjunction with CCRFCDD 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.)
✓		Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.
✓		An electronic copy of the complete submittal is required to be submitted with one original hard copy of the study. Electronic documents should be on a universal computer-readable digital output device replicating your submittal. An Indexed Portable Document Format (PDF) or Print Ready CAD file formats with a minimum of 300dpi are the desired formats. If figures are in color, they must be scanned in color and saved as a separate file. _____ by initial here, the engineer on record acknowledges that the electronic copy is an identical replicate of the original hard copy submitted to the City of Las Vegas.

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

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

II. GRADING PLAN INFORMATION		
Yes	No	
✓		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.
✓		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.

NOFA



**LAS VEGAS
CITY COUNCIL**

CAROLYN G. GOODMAN
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Mayor Pro Tem

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OLIVIA DÍAZ

SCOTT D. ADAMS
City Manager

DEPARTMENT OF PLANNING

ROBERT SUMMERFIELD

DIRECTOR

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cityoflasvegas
lasvegasnevada.gov

May 21, 2020

Ms. Macie Hertoghe
LDR Partners
3775 North Freeway, Suite #101
Sacramento, California 95834

**RE: ZON-78454 [PRJ-78379] - REZONING RELATED TO VAR-78455,
VAR-78456 AND SDR-78460
CITY COUNCIL MEETING OF MAY 20, 2020**

Dear Ms. Hertoghe:

The City Council at a regular meeting held on May 20, 2020 voted to **APPROVE** a request for a Rezoning FROM: U (UNDEVELOPED) [MXU (MIXED USE) GENERAL PLAN DESIGNATION] TO: C-1 (LIMITED COMMERCIAL) on 0.52 acres at the southeast corner of Charleston Boulevard and Westwind Drive (APN 163-01-103-001), Ward 1 (Knudsen) [PRJ-78379].

The Notice of Final Action was filed with the Las Vegas City Clerk on May 21, 2020.

Sincerely,

Robert Summerfield, AICP[®]
Director
Department of Planning

RTS:PL:clb

cc: Mr. John Curran
Dapper Development
985 White Drive, Suite #100
Las Vegas, Nevada 89119



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May 21, 2020

Ms. Macie Hertoghe
LDR Partners
3775 North Freeway, Suite #101
Sacramento, California 95834

**RE: VAR-78456 [PRJ-78379] - VARIANCE RELATED TO ZON-78454,
VAR-78455 AND SDR-78460
CITY COUNCIL MEETING OF MAY 20, 2020**

Dear Ms. Hertoghe:

The City Council at a regular meeting held on May 20, 2020 voted to **APPROVE** a request for a Variance TO ALLOW AN EIGHT-FOOT RESIDENTIAL ADJACENCY SETBACK FOR A TRASH RECEPTACLE WHERE 50 FEET IS REQUIRED AND A 21-FOOT RESIDENTIAL ADJACENCY SETBACK FOR A BUILDING WHERE 63 FEET IS REQUIRED on 0.52 acres at the southeast corner of Charleston Boulevard and Westwind Drive (APNs 163-01-103-001 and 004), U (Undeveloped) [MXU (Mixed Use) General Plan Designation)] [PROPOSED: C-1 (Limited Commercial)], Ward 1 (Knudsen) [PRJ-78379].

This approval is subject to the following conditions:

Planning

1. A Variance is hereby approved to allow an eight-foot residential adjacency setback for a trash receptacle where 50 feet is required.
2. A Variance is hereby approved to allow a 21-foot residential adjacency setback for a building where 63 feet is required.
3. Approval of Rezoning (ZON-78454); and approval of and conformance to the Conditions of Approval for Variance (VAR-78455) and Site Development Plan Review (SDR-78460) shall be required, if approved.
4. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.

Ms. Macie Hertoghe
LDR Partners
VAR-78456 [PRJ-78379] - Page Two
May 21, 2020

5. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
6. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.
7. All City Code requirements and design standards of all City departments must be satisfied, except as modified herein.

The Notice of Final Action was filed with the Las Vegas City Clerk on May 21, 2020.

Sincerely,



Robert Summerfield, AICP *RS*
Director
Department of Planning

RTS:PL:clb

cc: Mr. John Curran
Dapper Development
985 White Drive, Suite #100
Las Vegas, Nevada 89119



**LAS VEGAS
CITY COUNCIL**

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Mayor

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May 21, 2020

Ms. Macie Hertoghe
LDR Partners
3775 North Freeway, Suite #101
Sacramento, California 95834

**RE: VAR-78455 [PRJ-78379] - VARIANCE RELATED TO ZON-78454,
VAR-78456 AND SDR-78460
CITY COUNCIL MEETING OF MAY 20, 2020**

Dear Ms. Hertoghe:

The City Council at a regular meeting held on May 20, 2020 voted to **APPROVE** a request for a Variance TO ALLOW 74 PARKING SPACES WHERE 128 ARE REQUIRED on 0.52 acres at the southeast corner of Charleston Boulevard and Westwind Drive (APNs 163-01-103-001 and 004), U (Undeveloped) [MXU (Mixed Use) General Plan Designation)] [PROPOSED: C-1 (Limited Commercial)], Ward 1 (Knudsen) [PRJ-78379].

This approval is subject to the following conditions:

Planning

1. A Variance is hereby approved to allow 74 parking spaces where 128 are required.
2. Approval of Rezoning (ZON-78454); and approval of and conformance to the Conditions of Approval for Variance (VAR-78456) and Site Development Plan Review (SDR-78460) shall be required, if approved.
3. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.
4. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
5. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.

Ms. Macie Hertoghe
LDR Partners
VAR-78455 [PRJ-78379] - Page Two
May 21, 2020

6. All City Code requirements and design standards of all City departments must be satisfied, except as modified herein.

The Notice of Final Action was filed with the Las Vegas City Clerk on May 21, 2020.

Sincerely,



Robert Summerfield, AICPTM
Director
Department of Planning

RTS:PL:clb

cc: Mr. John Curran
Dapper Development
985 White Drive, Suite #100
Las Vegas, Nevada 89119



**LAS VEGAS
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May 21, 2020

Ms. Macie Hertoghe
LDR Partners
3775 North Freeway, Suite #101
Sacramento, California 95834

**RE: SDR-78460 [PRJ-78379] - SITE DEVELOPMENT PLAN REVIEW
RELATED TO ZON-78454, VAR-78455 AND VAR-78456
CITY COUNCIL MEETING OF MAY 20, 2020**

Dear Ms. Hertoghe:

The City Council at a regular meeting held on May 20, 2020 voted to **APPROVE** a request for a Site Development Plan Review FOR A PROPOSED 10,010 SQUARE-FOOT RETAIL DEVELOPMENT WITH WAIVERS OF THE PERIMETER LANDSCAPE BUFFER REQUIREMENTS AND TO ALLOW THE SOUTH FACADE TO NOT BE DESIGNED AND TREATED COHERENTLY WHERE ALL SIDES OF THE BUILDING ARE REQUIRED on 0.52 acres at the southeast corner of Charleston Boulevard and Westwind Drive (APNs 163-01-103-001 and 004), U (Undeveloped) [MXU (Mixed Use) General Plan Designation]] [PROPOSED: C-1 (Limited Commercial)], Ward 1 (Knudsen) [PRJ-78379].

This approval is subject to the following amended conditions:

Planning

1. Approval of Rezoning (ZON-78454); and approval of and conformance to the Conditions of Approval for Variance (VAR-78455) and Variance (VAR-78456) shall be required, if approved.
2. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.
3. All development shall be in conformance with the site plan and landscape plan date stamped 04/27/20, and building elevations, date stamped 02/24/20, except as amended by conditions herein.
4. Three handicap parking stalls shall be provided in accordance with Title 19.

5. The existing screen walls on the east and south property lines shall be demolished and constructed in accordance with Title 19.
6. The shipping container located at the rear of the tavern building at 5589 West Charleston Boulevard shall be removed 90 days after final approval.
7. A Waiver from Title 19.08 is hereby approved, to allow an eight-foot wide landscape buffer adjacent to the western property line where 15 feet is required.
8. A Waiver from Title 19.08 is hereby approved, to allow a nine-foot wide landscape buffer adjacent to the northern property line where 15 feet is required.
9. A Waiver from Title 19.08 is hereby approved, to allow the southern façade to not be designed and treated coherently.
10. An Exception from Title 19.08 is hereby approved, to allow 17 parking lot landscape islands where 20 is required.
11. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
12. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.
13. The applicant shall coordinate with the City Surveyor and other city staff to determine the most appropriate mapping action necessary to consolidate the existing lots. The mapping action shall be completed and recorded prior to the issuance of any building permits.
14. A technical landscape plan, signed and sealed by a Registered Architect, Landscape Architect, Residential Designer or Civil Engineer, must be submitted prior to or at the same time application is made for a building permit. A permanent underground sprinkler system is required, and shall be permanently maintained in a satisfactory manner; the landscape plan shall include irrigation specifications. Installed landscaping shall not impede visibility of any traffic control device. The technical landscape plan shall include the following changes from the conceptual landscape plan:
 - A minimum of three different shrub species shall be utilized within the landscape plan.
 - A minimum of two different shade tree species shall be utilized within the landscape plan.

- Seven, 24-inch box shade trees shall be planted in the perimeter landscape buffer adjacent to the north property line.
 - 16, 24-inch box shade trees shall be planted in the perimeter landscape buffer adjacent to the east property line.
 - All trees within the southern landscape buffer shall be a minimum of 36" box in size.
15. A fully operational fire protection system, including fire apparatus roads, fire hydrants and water supply, shall be installed and shall be functioning prior to construction of any combustible structures.
16. All City Code requirements and design standards of all City Departments must be satisfied, except as modified herein.

Public Works

17. Concurrent with development, dedicate a bus turnout and deceleration lane meeting the intent of Clark County Standard Drawing #234.4 for the existing bus stop on Charleston Boulevard unless otherwise allowed by the City Traffic Engineer.
18. The sidewalk along Charleston Boulevard and Westwind Drive adjacent to this site shall meet Public Right-of-Way Accessibility Guidelines (PROWAG) in accordance with code requirements of Title 13.56.040 to the satisfaction of the City Engineer concurrent with development of this site. Revise existing onsite parking so as to eliminate conflicts with public rights-of-way.
19. Landscape and maintain all unimproved right-of-way, if any, adjacent to this site. All landscaping and private improvements installed with this project shall be situated and maintained so as to not create sight visibility obstructions for vehicular traffic at all development access drives and abutting street intersections.
20. A Drainage Plan and Technical Drainage Study must be submitted to and approved by the Department of Public Works prior to the issuance of any building or grading permits or submittal of any construction drawings, whichever may occur first. Provide and improve all drainageways recommended in the approved drainage plan/study. The developer of this site shall be responsible to construct such neighborhood or local drainage facility improvements as are recommended by the City of Las Vegas Neighborhood Drainage Studies and approved Drainage Plan/Study concurrent with development of this site.

Ms. Macie Hertoghe
LDR Partners
SDR-78460 [PRJ-78379] - Page Four
May 21, 2020

The Notice of Final Action was filed with the Las Vegas City Clerk on May 21, 2020.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert Summerfield".

Robert Summerfield, AICP[®]
Director
Department of Planning

RTS:PL:clb

cc: Mr. John Curran
Dapper Development
985 White Drive, Suite #100
Las Vegas, Nevada 89119



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ROBERT SUMMERFIELD
DIRECTOR

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October 14, 2020

Ms. Macie Hertoghe
LDR Partners
3775 N. Freeway, Ste. 101
Sacramento, CA 65834

**RE: 20-0023-VAR1
PLANNING COMMISSION MEETING OF OCTOBER 13, 2020**

Dear Applicant:

The Planning Commission at a regular meeting held on *October 13, 2020* voted to **APPROVE** a request for a Variance TO ALLOW AN EXISTING 10-FOOT TALL PERIMETER WALL WHERE EIGHT FEET IS THE MAXIMUM ALLOWED on 2.06 acres at the southeast corner of Charleston Boulevard and Westwind Road (APN 163-01-103-004), C-1 (Limited Commercial) Zone, Ward 1 (Knudsen).

This approval is subject to the following conditions:

Planning

1. A Variance is hereby approved to allow a 10-foot perimeter wall adjacent to the southern and eastern property lines.
2. Conformance to the approved conditions for Rezoning (ZON-78454), Variance (VAR-78455), Variance (VAR-78456), and Site Development Plan Review (SDR78460), except as amended herein.
3. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.
4. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
5. Any existing visible steel rebar shall be removed.
6. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.

20-0023-VAR1 - Page Two
October 14, 2020

7. All City Code requirements and design standards of all City departments must be satisfied, except as modified herein.

This action by the Planning Commission on **October 13, 2020** is final unless a written appeal is filed with the City Clerk within ten days of the date of the Planning Commission's decision as allowed by code or there is a review action filed by the City Council within the same time period. For additional information on appeals or review requests submitted please access <https://www.lasvegasnevada.gov/Business/Permits-Licenses/Building-Permits/Permit-Application-Status>, or contact the Department of Planning and Development at 702.229.6301 after **October 26, 2020**. No building permits or business licenses related to these items shall be issued prior to the expiration of the required ten day waiting period, or until any filed appeal is resolved pursuant to LVMC Title 19.18.

Sincerely,



Eric McCammond
Senior Management Analyst
Case Planning Division

EM:nl

cc:

Mr. John Curran
Dapper Development
985 White Drive, Ste. 100
Las Vegas, Nevada 89119



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1 GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

1.1 Scope

The purpose of this technical report is to provide a hydrologic and hydraulic analysis in order to establish overall drainage patterns and constraints for the proposed Convenience Store and Gasoline Station. This report provides recommendations for any proposed drainage facilities, and addresses onsite and offsite drainage patterns and flow rates for both the existing and interim conditions. The study was analyzed and compiled in accordance to the criteria set forth by the Clark County Regional Flood Control District's (CCRFCD) *Hydrologic Criteria and Drainage Design Manual (HC&DDM)*.

1.2 Location

The project site is located in a portion of the Northern Half (N 1/2) of the Northwest Quarter (NW 1/4) of Section 1, Township 21 South, Range 60 East, unincorporated areas Clark County, Nevada. The site is recorded on the Clark County Assessor's maps as APN's 163-01-103-001/004. The site is bound by Westwind Rd. to the West, Charleston Blvd. to the north, an existing residential lot to the south and an existing commercial building lot and undeveloped parcel to the east. See Figure 1, *Vicinity Map*, and *Assessor's Parcel Map* in Appendix C.

1.3 Description of Property

The parcels total approximately 2.58 acres in area, with the northeast and southern areas (1.98 acres) of the entire site being developed at this time. The site will comprise of a Retail Store and a parking lot. The existing site is developed but the existing buildings along the south and southeast corner of the site will be demolished. The site generally slopes in a northeasterly direction at an average slope of approximately 1.00 percent.

2 GENERAL DRAINAGE DESCRIPTION

2.1 Master Planning Information

In the *2018 Las Vegas Valley Flood Control Master Plan Update – Volume I* (2018 MPU) (Reference 2), dated September 2018, as prepared by ATKINS. The valley was divided into ten watersheds and each watershed was further subdivided into sub-basins. The on-site basins fall within the Central Watershed. As shown in Figure W-5 of the 2018 MPU, the subject site is located within sub-basin CHO9-C.

Refer to the annotated Figure W-5 in Appendix A.

Existing and future CCRFCD flood control facilities are shown in the *2018 Las Vegas Valley Flood Control Master Plan Update – Volume II* (2018 MPU) (Reference 3), dated September 2018, as prepared by CCRFCD. The figures and inventory tables from Volume II of the 2018 MPU were updated by CCRFCD in 2018. Per Figure F-29, the subject parcel is adjacent to a Category 'A' Proposed MPU facility (Facility ID MECN 0123). The proposed facility is an 8ft x 6ft RCB (854cfs). Please note this facility will be connected with a future upstream facility (year 2023/2024) to eliminate all of the surface flow in Charleston Blvd.

Annotated Figure F-29 and its inventory table are provided in Appendix C.

2.2 Floodplain Information

The Special Flood Hazard Areas (SFHA) for Clark County and Incorporated Areas are outlined in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map, dated November 16, 2011. Upon reviewing the Community Panel No. 32003C2165D, the proposed site lies within a FEMA designated Zone "X". This area is described to be: areas outside of the 0.2% annual chance flood. Our site contains a panel that is not printed. This panel is entirely in Zone 'X'. See Figure 2, *FEMA Map* (Appendix C).

2.3 Previous Drainage Studies

The subject site is located within the City of Las Vegas jurisdiction. The overall area is covered within the CCRFCD "2018 Las Vegas Valley Flood Control Master Plan Update, Volume I and II" (Reference 2) and the W-5 Map for the Soil types. The site is also covered in the FIRM for the Clark County, Nevada and incorporated areas, Community Panel Number: 32003C2165D, Effective Date: November 16, 2011.

The most relevant study to the subject site include the City of Las Vegas Neighborhood Control MPU (Figures E-8 and F-8 – Reference 5). Reference 5 has been utilized to determine the flows along Charleston Blvd. at the Westwind Rd. intersection. Since the upstream regional facilities have not been constructed yet, Figure E-8 from the CLV Central Neighborhood MPU has been utilized for these flows.

Please note that all of the Regional drainage facilities upstream of Westwind Rd. along Charleston Blvd. have not been constructed and therefore; Figure E-8 flows (400/910cfs) have been accepted and utilized north of our Site. Please note that the MPU facilities upstream of our Site are planned to be completed by Year 2023/2024. These MPU flows currently represent the worse-case flows for our site development in all conditions (existing and interim/developed conditions) for our project site.

McCay Engineering generally concurs with all the pertinent referenced analyses and results utilized in these studies.

Excerpts of the MPU study can be found in Appendix 'C' of this Study.

2.4 Hydrologic and Hydraulic Procedures Used

HEC-1 version 4.1 was used to analyze storm runoff for the project site and surrounding area. Input/output files can be found in Appendix A. (See Appendix A for calculations).

Flow Master was used to analyze street and site flow depths and velocities for the subject site. (See Appendix B for calculations).

3 HYDROLOGY AND HYDRAULICS

3.1 Existing Condition

3.1.1 Hydrology

Off-site

As discussed earlier in the report Section 2.3 for the Charleston Blvd. flows, Reference 5 has been utilized for the flows at Charleston Blvd. and Westwind Rd. intersection. Referenced Figure E-8 from the CLV Central Neighborhood MPU has been utilized for these flows. Please note that all of the Regional drainage facilities upstream of Westwind Rd. along Charleston Blvd. have not been constructed currently. Figure F-8 shows surface flows of 0/0cfs and 713/1379cfs in facility flow for the 10 and 100yr storm events respectively. Since there are no facilities constructed yet upstream of Westwind Rd. along Charleston Blvd., we have utilized Figure E-8 flows for Charleston Blvd. flows north of our site.

Off-site flows impacting the project site originate in the adjacent perimeter streets of Charleston Blvd. and Westwind Rd. The flows from the west along Charleston Blvd. have been determined utilizing the City of Las Vegas Central Neighborhood Study (Figure E-8 – Existing Drainage Conditions). These referenced flows (400/910cfs) are the total flows at the intersection of Charleston Blvd. and Westwind Rd. until the upstream flood control facilities are constructed. The reason we accepted these flows is because upstream regional facilities along Charleston Blvd. have not been constructed yet. They are planned to be constructed starting in the year 2023. Therefore, we have adopted the Existing Drainage Conditions Exhibit E-8 flows.

For the flows west of our site within Westwind Rd., we have analyzed the existing commercial development west of the site and Westwind Rd. We have delineated an offsite basin FD1 (2.83 acres) that accounts for the existing commercial development and the street basin for the total flow west of our site. Basin FD1 discharges 5 and 9cfs in the 10yr and 100yr storm events south along Westwind Rd. beyond our Site.

The total flow in Charleston Blvd. north of our site is determined to be 400 and 910cfs in the 10 and 100yr storm events. This flow is the same for existing and developed conditions since all the upstream offsite area is developed and upstream drainage facilities are not constructed at this time.

Refer to Drainage Basin Map (Existing Condition) Sheet DR1 (back pocket) and Offsite Basin Exhibit OFF1 (Appendix C) included with this submittal.

On-site

The project site is analyzed as one (1) basin in the existing condition based on existing topography. NX1 (2.58 acres, 5/9cfs) comprises of existing buildings and paved areas (CN=98.0). Basin NX1 discharges 5/9cfs in a northeast direction and discharges ultimately north into Charleston Blvd. out the existing driveway at the northeast corner of the Site.

Refer to Drainage Basin Map (Existing Conditions) Sheet DR1 included with this submittal.

3.3.2 Interim (Proposed) Condition

Off-site

The offsite basins and flows remain the same as discussed in Existing conditions (Section 3.3.1). All of the offsite area is developed already.

Refer to Drainage Plan (Interim/Developed Condition) Sheet DR2 and Offsite Basin Map (Figure OF1) included with this submittal.

On-site

The project site has been delineated into three (2) basins based on proposed grading.

ND1 (1.64 acres, 3/5cfs) comprises the majority of the area in the southern portion of the site, consisting of parking, drive aisles, rooftop and landscaping. A majority of the flow discharges east to a landscape swale before discharging north along the east boundary. These flows continue north and ultimately discharge through a BMP swale within onsite basin ND2.

Basin ND2 (0.94 acres, 2/3cfs) is the northern half of the site which comprises of the undeveloped rough graded area in the northwest corner of the site and also drive aisles and an existing Tavern. Runoff from ND2 discharges 2 and 3cfs easterly in the 10yr and 100yr storm events respectively. The flow is conveyed through a BMP swale before discharging into the proposed driveway and combining with flow from onsite basin ND1 at combination point CPD1 (5/9cfs). This flow matches the existing condition flow from the site (Basin NX1); therefore our site development is not negatively affecting downstream properties.

Refer to the Drainage Plan (Proposed Condition) Sheet DR2 included with this submittal.

3.3.3 Ultimate (Future) Condition

Off-site

Off-site flows utilized in the interim condition analysis are from fully-developed basins. However, per Figure F-8 from the CLV Neighborhood Control MPU, it appears some decent sized RCP Storm drains will be constructed at some point which will reduce the amount of street flow immensely. We have ignored this option and utilized Existing and Interim condition offsite flows for our site design since it is worse-case. The reason we accepted these flows is because upstream regional facilities along Charleston Blvd. have not been constructed yet. They are planned to be constructed starting in the year 2023 and surface flow will be reduced to 0/0cfs in the future when the facilities have been completed.

On-site

The project site is considered fully-developed in the interim condition.

Please note that there is one driveway entrance for the site off of Westwind Rd. We have designed the driveway hump to be a minimum 6-inches above the 100yr water surface elevation in the street. The site is protected from any offsite flows.

There are two driveway entrances off of Charleston Blvd. Both of these driveways are used to convey the flow to Charleston Blvd; therefore, no driveway humps have been proposed. There will be some area of inundation onto the site at these driveways since the 100yr flow depth in Charleston Blvd. is 1.46ft.

The proposed Retail building has a FF that is a minimum of twice the 100yr depth of flow in the perimeter streets and double the 100yr flow depth onsite. The onsite flowline high point adjacent to the proposed building is a minimum 6-inches below the proposed FF elevation.

There is an existing Tavern building near the NEC of the site and it will remain. However, we have provided a floodwall to the north of it for protection from the Charleston Blvd. street flow. The floodwall height is a minimum of double the 100yr flow depth ($1.46\text{ft} \times 2 = 2.92\text{ft}$) above the highest adjacent FL elevation in Charleston Blvd.

3.3.2 Hydraulics

No change in the ultimate street flow hydraulic analysis is expected from the interim condition, since worse case scenario offsite flows were utilized for our analysis. The assumption of developed offsite basins were used for our analysis.

4 RAINFALL METHODOLOGY AND SOILS INFORMATION

4.1 Hydrologic Methodology and Criteria

The U. S. Army Corps of Engineer's HEC-1 *Flood Hydrograph Package* was used to estimate the peak runoff values of the watershed for the 10-year and 100-year, 6-hour storm event. The HEC-1 model was designed for the simulation of flood events in watersheds and river basins. The HEC-1 computer model has the ability to simulate the surface runoff response of a drainage basin to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components. Each component models an aspect of the rainfall-runoff process within a portion of the whole basin. This basin portion is referred to as a sub-basin. The runoff hydrographs of each sub-basin are then combined and a final discharge hydrograph is obtained. Since the study watershed is ungaged, the analysis used to model the onsite runoff incorporated the Soil Conservation Service (SCS) unit hydrograph method to develop a hypothetical flood hydrograph.

Input parameters used for the HEC-1 hydrograph model were determined from the *HC&DDM*. Procedures and calculations related to these HEC-1 Parameters can be found in the following pages.

4.2 HEC-1 Parameters

Basin Area

The drainage basins were determined from the topographic maps at 1-foot and 5-foot contour intervals, aerial photographs, field investigation, and 30-scale onsite grading plans. The drainage basins are shown on the Drainage Plans located in the Appendix of this study.

Rainfall Criteria

The onsite/offsite areas analyzed in this report lie inside of the McCarran Airport Rainfall Area (see Figures in Appendix A). Depth-Duration-Frequency values from Table 505 (Appendix A) were used as rainfall depths for the 10-year and 100-year storm event. These storm water depth values are 1.58 inches (10yr) and 2.77 inches (100yr) respectively (see *Precipitation Calculations* in Appendix B).

Hydrologic Abstractions

Hydrologic abstractions include interception, infiltration, surface storage, evaporation, and evapo-transpiration. Infiltration is regarded as the primary rainfall loss component in hydrologic models.

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. The 2018 MPU's Figure W-5 indicates that the site is in an area consisting of hydrologic soil group D, defined as soils with "high runoff potential" (Reference 2). A portion of the offsite area consists of hydrologic soil group D, defined as soils with "high runoff potential." Refer to Appendix C for annotated Figure W-5. The CN values for the different land uses were determined from Table 602 (page 1) and Table 602A 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 off-site and on-site basins in the existing and proposed conditions are provided in Appendix A.

Lag Time

Lag time is a measure of the time elapsed between the occurrence of rainfall and the occurrence of runoff. It is a measure of the watershed's response time and is dependent upon basin length, slope and the basin's roughness characteristics.

Based on studies of many storm events for a range of watershed conditions, the following empirical relationship between lag time (T_{LAG}) and time of concentration (t_c) was derived:

$$T_{LAG} = 0.6t_c$$

Where t_c is the time of concentration. In order to calculate t_c the following equations are used:

$$t_c = t_i + t_t$$

Where t_i = Initial overland flow time in minutes:

$$t_i = 1.8 \frac{(1.1 - K)\sqrt{L_o}}{\sqrt[3]{S}}$$

Where:

K = Flow resistance factor, $K = 0.0132 * CN - 0.39$

CN = Curve Number.

L_o = Length of the overland flow element.

S = Average basin slope in percent.

And t_t = Travel time for flow within the channel or swale:

$$t_t = \frac{L}{V} (60)$$

Where:

L = Length of channel element in feet.

V = Flow velocity in feet per second.

Compliance with Section 1500 – Structural Best Management Practices

The proposed development area is approx. 1.71 acres, of which approx. 1.22 acres is impervious paved parking and building roof area that discharges over parking and drive-aisles. Per HCCDM Section 1500, the project site falls in to the "Large" Parking Lot Category. As such, 75% of the parking lot area ($1.22 \text{ acres} \times 75\% = \mathbf{0.92 \text{ acres}}$) must be treated using accepted BMPs. As shown in the grading plan, multiple BMP swales are being proposed near the NEC of the project site. The BMP swale is designed to settle out sediment and pollutant of the water quality design flows, prior to exiting the project site. As shown in the drainage exhibit (DR2), most of the onsite area is designed to drain towards the 2 water quality swales. The swales will handle a majority of the flows within the onsite basins. It is shown that a 40ft long swale can treat 1.00 acres of imperviousness. Therefore, for 1.22 acres of imperviousness, we need ($1.22 \text{ acres} \times 40\text{ft}$) we need 50ft of swale for treatment. Our swales total over 80ft long and meets the minimum required length for our Site.

As shown in the attached excerpts from Section 1500 of the HCDDM, since the parking lot area of the project site is more than 1 acre, the parking lot is categorized as 'Large' parking. For a Large parking lot, water quality BMPs are required for at least 75% of the proposed parking lot. The total area from basins ND1 and ND2 represent the whole site. Thus, the project is designed to provide water quality BMPs for approximately 75% of the site, which meets the minimum requirements.

Per the design guidelines of Section 1503.4.5, the proposed water quality riprap-lined swales throughout the site are set to a minimum 40ft long. The swales are designed with 1.00% slope, 4(horizontal):1(vertical) side slope, riprap lining with $D_{50}=4"$, and a minimum of 1ft depth. A capacity hydraulic calculation (Appendix B) has been provided to show the swales can convey at least the minimum 2yr flow (0.50cfs per acre).

5 CONCLUSIONS

The following conclusions have been made regarding safety, both public and private, for the proposed commercial development:

1. The interior development area will safely convey storm water towards the northeast corner of the project, and discharge north into Charleston Blvd.
2. The development of this site will comply with the Clark County Regional Flood Control District Flood Control Master Plan Update, the *HC&DDM*, and local flood plan ordinance.
3. The site and the proposed improvements are located entirely within areas designated as FEMA Zone "X," described by FEMA as "Areas of 0.2% annual chance flood."
4. The drainage facilities for this project have been designed to convey runoff from the 100-year storm safely past 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.

6 REFERENCES

1. Clark County Regional Flood Control District, "2018 Las Vegas Valley Flood Control Master Plan Update", 2013.
2. Clark County Regional Flood Control District, "Hydrologic Criteria and Drainage Design Manual", updated August 1999.
3. Flood Insurance Rate Map, Federal Emergency Management Agency Community Panel Number 32003C2165D, Clark County, Nevada and Incorporated Areas.
4. Flowmaster Version 8i, Haestad Methods, Inc., 2009
5. CLV Central Neighborhood MPU Plan (Figures E-8 and F-8)

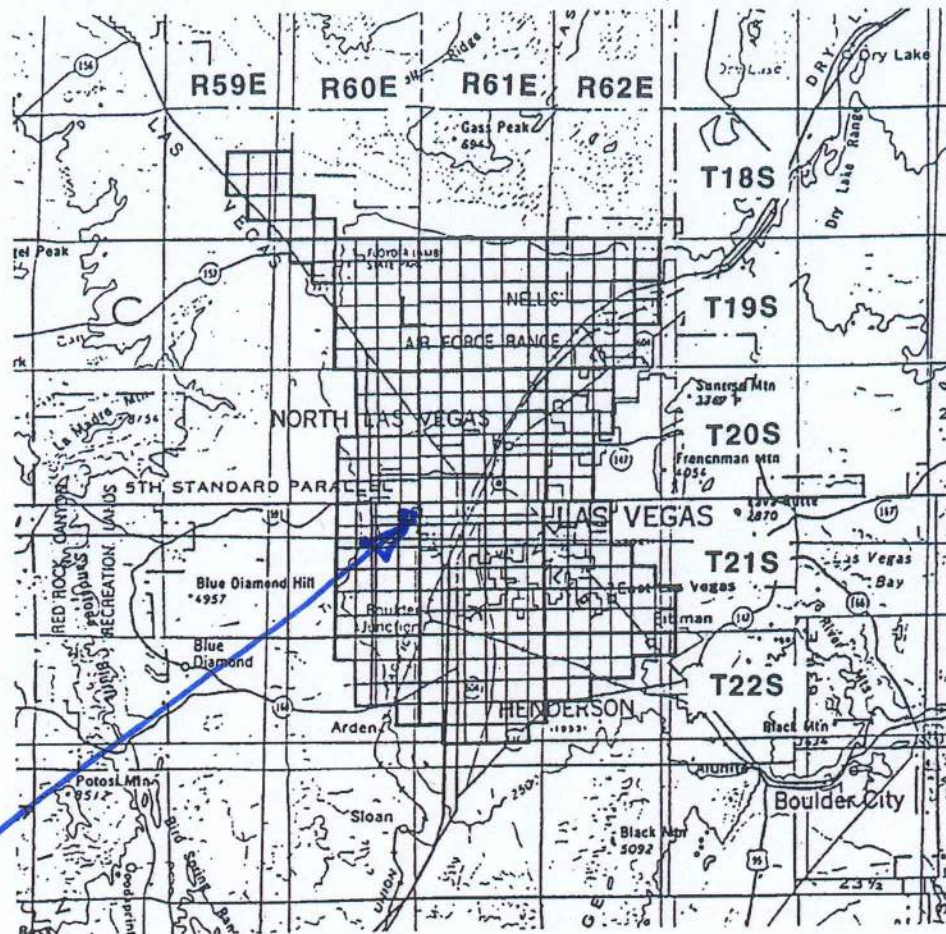
APPENDIX A

HYDROLOGIC ANALYSIS

HYDROLOGIC CHARTS

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

McCARRAN AIRPORT RAINFALL AREA



SITE

Section 1

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	<u>21 South</u>	<u>60 East</u>	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

WMAF

Clark County Regional Flood Control District, 2018 *W-5 Map*

(Central Watershed)

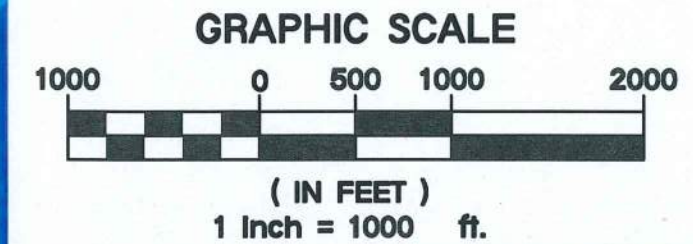
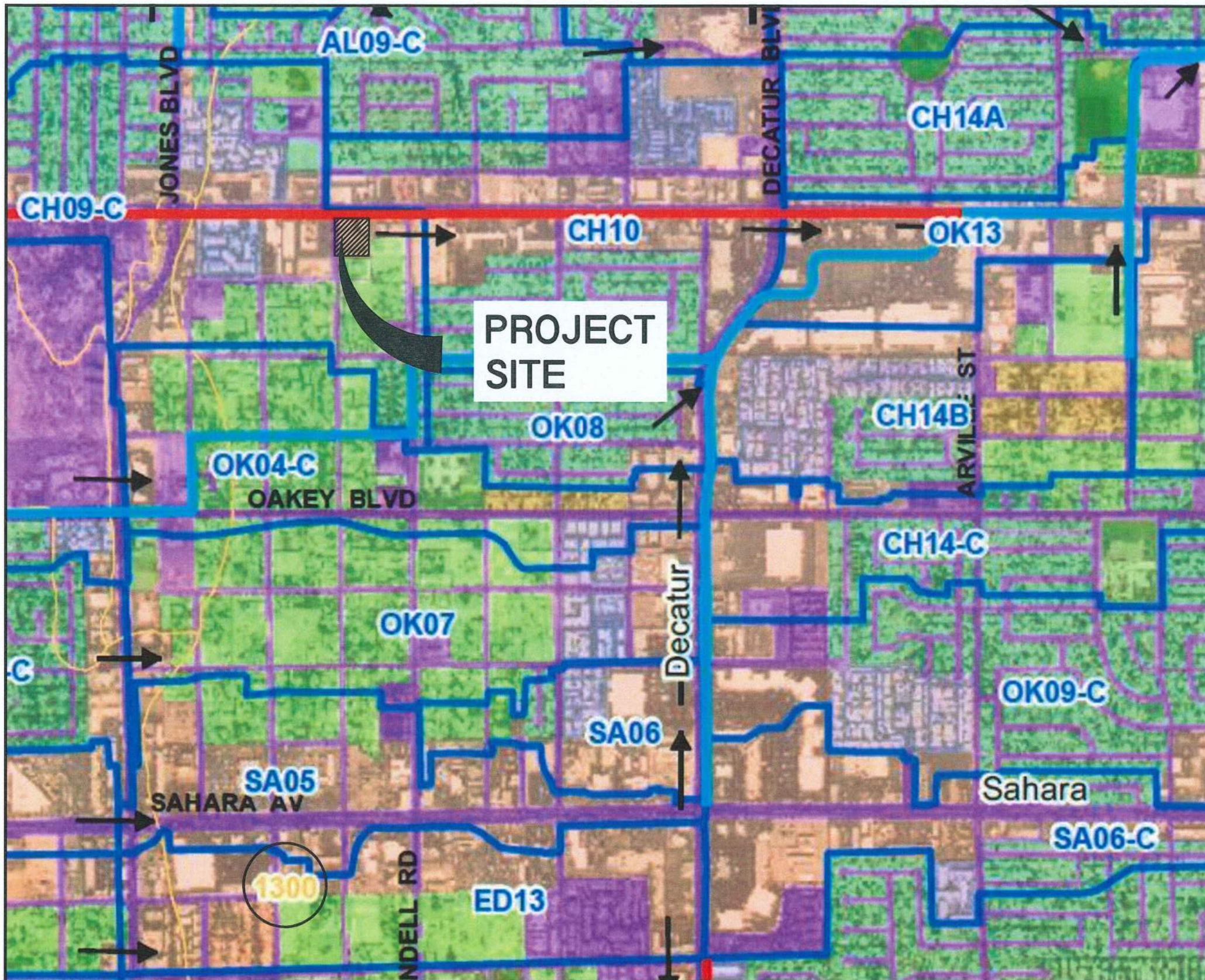


Figure W-5
Central Watershed

Legend

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

SUBBASIN:
CH09-C

1300:
100% D-SOIL

DRAWN BY: CB	SCALE: 1"=1000'	FILE NAME: WMAP
CHECKED BY: CB	DATE: 12/20/20	
MCCAY ENGINEERING		
LEGEND FOUND MONUMENTATION		
CENTER LINE — — — — —		
ROW LINE — — — — —		
EASEMENT LINE — — — — —		
SECTION LINE — — — — —		
PROPERTY LINE — — — — —		
ADJACENT PROPERTY LINE ·········		

**FIGURE W-5
CENTRAL WATERSHED**

CHARLESTON & WESTWIND RETAIL CENTER

PROJECT No.:
01234

SHEET No.

W-5

SHEET 1 OF 1

Curve Number Matrix

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												
1100	6	0	0	59	35	87.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1105	55	40	0	5	0	70.0	56.0	65.0	67.0	69.0	78.0	86.0	91.0	93.0	88.0	93.0	76.0	30.0
1107	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
1112	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
1113	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
1117	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
1120	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
1127	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
1129	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
1130	65	0	25	10	0	71.0	58.0	66.0	68.0	70.0	79.0	87.0	91.0	93.0	89.0	93.0	77.0	30.0
1132	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
1133	70	0	10	0	20	71.0	58.0	67.0	68.0	70.0	79.0	87.0	91.0	93.0	89.0	93.0	77.0	30.0
1134	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
1135	84	0	0	16	0	67.0	52.0	62.0	64.0	66.0	76.0	85.0	90.0	92.0	87.0	92.0	74.0	30.0
1140	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
1141	8	0	2	70	20	86.0	81.0	85.0	86.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1150	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
1151	41	0	0	59	0	78.0	68.0	74.0	76.0	77.0	84.0	90.0	93.0	94.0	91.0	94.0	82.0	30.0
1152	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
1155	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
1156	1	10	0	89	0	87.0	81.0	84.0	85.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1160	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
1160dn	46	1	0	53	0	76.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1165	32	40	15	13	0	75.0	64.0	71.0	73.0	74.0	82.0	88.0	92.0	94.0	90.0	94.0	80.0	30.0
1181	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
1182	95	0	5	0	0	64.0	48.0	58.0	61.0	63.0	74.0	84.0	90.0	92.0	86.0	92.0	72.0	30.0
1183	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
1184	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
1187	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
1190	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
1191	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
1192	55	35	0	10	0	70.0	57.0	66.0	68.0	70.0	79.0	87.0	91.0	93.0	88.0	93.0	76.0	30.0
1200	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
1206	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
1207	3	85	5	7	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
1222	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
1225	9	20	50	21	0	82.0	73.0	79.0	80.0	81.0	86.0	91.0	94.0	95.0	92.0	95.0	85.0	30.0
1230	54	0	0	46	0	75.0	63.0	70.0	72.0	74.0	81.0	88.0	92.0	94.0	90.0	94.0	80.0	30.0
1235	66	25	0	9	0	69.0	55.0	64.0	66.0	68.0	77.0	86.0	91.0	93.0	88.0	93.0	75.0	30.0
1236	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
1237	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
1240	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
1252	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
1255	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
1260	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
1262	75	0	0	25	0	69.0	56.0	64.0	67.0	69.0	78.0	86.0	91.0	93.0	88.0	93.0	76.0	30.0
1263	95	0	0	5	0	64.0	48.0	59.0	61.0	64.0	74.0	84.0	90.0	92.0	86.0	92.0	72.0	30.0
1264	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
1270	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
1278	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
1282	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
1300	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

100% D-SOIL

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

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

See Table 602A

Developing urban areas

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

1 Average runoff condition, and $I_p = 0.25$.

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

HYDROLOGY

DATE: December 21, 2020

TRIAL: Final Iteration

Curve Number Calculations

Charleston & Westwind Retail Center

Sub-Basin: 0.00

Total Area: 0.00 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.00	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.00	D	10%	88	8.8
Total:	0.00	-	100%	-	97.0

Curve Number Calculations

Charleston & Westwind Retail Center

Sub-Basin: FD1

Total Area: 2.83 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.55	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.28	D	10%	88	8.8
Total:	2.83	-	100%	-	97.0

Curve Number Calculations
Charleston & Westwind Retail Center

Sub-Basin: FD1
Total Area: 2.83 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.55	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.28	D	10%	88	8.8
Total:	2.83	-	100%	-	97.0

Curve Number Calculations
 Charleston & Westwind Retail Center

Sub-Basin: NX1
Total Area: 2.58 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Crue Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.58	D	100%	98	98.0
Total:	2.58	-	100%	-	98.0

Curve Number Calculations

Charleston & Westwind Retail Center

Sub-Basin: ND1

Total Area: 1.64 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.48	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.16	D	10%	88	8.8
Total:	1.64	-	100%	-	97.0

Curve Number Calculations

Charleston & Westwind Retail Center

Sub-Basin: ND2

Total Area: 0.94 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.85	D	90%	98	88.2
Natural desert landscaping (pervious areas only)	0.09	D	10%	88	8.8
Total:	0.94	-	100%	-	97.0

[illegible]

	Output Variables									
Normal Depth, Y_n (ft):	0.15		0.14	0.11	0.08					
Area of Flow, A , (sf):	2.82		2.31	1.65	0.95					
Velocity, V (fps):	1.59		1.95	1.51	1.57					
Wetted Perimeter, p (ft):	33.75		30.54	25.90	19.77					
Hydraulic Radius, R_h (ft):	0.08		0.08	0.06	0.05					
Free Surface Top Width, T (ft):	33.75		30.54	25.90	19.77					
Centroid, Y^* , (ft):	0.06		0.05	0.04	0.03					

* NOTE : HALF OF THE 100-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)
FD1	2.83	5	9
NX1	2.58	5	9


```

1*****
*****
*
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*
* JUN 1998
*
* VERSION 4.1
*
*
* RUN DATE 21DEC20 TIME 16:26:37
*
*
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*****

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X

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

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X   X XXXXXXX 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 XXXXXXX XXXXX   XXX

```

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

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

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

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION

KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

HEC-1 INPUT

PAGE 1

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1          ID      CHARLESTON AND WESTWIND RETAIL CENTER
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
8          ID
9          ID
10         ID      INPUT FILE NAME: X.DAT
11         ID
12         ID      DECEMBER 2020
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= 0.5704
22         ID
23         ID      *****
24         ID      *****
25         ID      *DIAGRAM
26         ID      IT      5      200
27         ID      IO      5
28         ID      IN      5
29         ID      JR      PREC .5704 1.0
30         ID
31         ID      KK      FD1
32         ID      KM      THE EXISTING SITE WEST OF OUR SITE AND ADJACENT STREET WESTWIND. DISCHARGES F
33         ID      PB      2.770
34         ID      PC      0.0      .02      .057      .07      .087      .108      .124      .13      .13      .13
35         ID      PC      .13      .13      .13      .133      .14      .142      .148      .158      .172      .181
36         ID      PC      .19      .197      .199      .2      .201      .204      .214      .229      .241      .249
37         ID      PC      .251      .256      .27      .278      .281      .283      .295      .322      .352      .409
38         ID      PC      .499      .59      .71      .744      .781      .812      .819      .835      .851      .856
39         ID      PC      .86      .868      .876      .888      .91      .926      .937      .95      .97      .976
40         ID      PC      .982      .985      .987      .989      .99      .993      .993      .994      .995      .998
41         ID      PC      .998      .999      1.0
42         ID      BA      .00442
43         ID      LS      0      97.0
44         ID      UD      .082
45         ID      *
46         ID
47         ID      KK      NX1
48         ID      KM      SOUTHERN ONSITE BASIN DRAINING NORTHEAST AND THEN NORTH TOWARD CHARLESTOMN BL
49         ID      BA      .00403
50         ID      LS      0      98.0
51         ID      UD      0.066
52         ID      *
53         ID      ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```

INPUT LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO.        (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW
29         FD1
          .
          .
          .
43         .      NX1

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

X

```
1*****
*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*
* JUN 1998 *
*
* VERSION 4.1 *
*
*
* RUN DATE 21DEC20 TIME 16:26:37 *
*
*
*****
*****
```

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

CHARLESTON AND WESTWIND RETAIL CENTER
***** TECHNICAL DRAINAGE STUDY *****
EXISTING CONDITION - ONSITE AND OFFSITE
USING SCS METHODS AND KINEMATIC WAVE ROUTING
MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION

INPUT FILE NAME: X.DAT
DECEMBER 2020

```
*****
*****
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= 0.5704
*****
*****
```

```
26 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 0200 STARTING TIME
      NQ 101 NUMBER OF HYDROGRAPH ORDINATES
      NDDATE 1 0 ENDING DATE
      NDTIME 1020 ENDING TIME
      ICENT 19 CENTURY MARK

      COMPUTATION INTERVAL .08 HOURS
      TOTAL TIME BASE 8.33 HOURS

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

JP MULTI-PLAN OPTION
      NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
      RATIOS OF PRECIPITATION
      .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	.00	1 FLOW TIME	5. 3.50	9. 3.50
HYDROGRAPH AT					
+	NX1	.00	1 FLOW TIME	5. 3.50	9. 3.50

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

HEC-1 MODEL OUTPUT

(INTERIM / DEVELOPED CONDITIONS)

Peak Flow Summary
Developed Condition

HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
ND1	1.64	3	5
ND2	0.94	2	3
CPD1	-	5	9

(ND1+ND2)

D

```

1*****
*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*
* JUN 1998
*
* VERSION 4.1
*
* RUN DATE 21DEC20 TIME 16:08:36
*
*****
*****

```

```

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

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X X XXXXXX XXXX X
X X X X X XX
X X X X X X
XXXXXX XXXX X XXXX X
X X X X X X
X X X X X
X X XXXXXX XXXX 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 CHARLESTON AND WESTWIND RETAIL CENTER
2 ID ***** TECHNICAL DRAINAGE STUDY *****
3 ID INTERIM / DEVELOPED 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
8 ID
9 ID
10 ID INPUT FILE NAME: D.DAT
11 ID
12 ID DECEMBER 2020
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= 0.5704
22 ID *****
23 ID *****
24 ID
25 ID *DIAGRAM
26 ID IT 5 200
27 ID IO 5
28 ID IN 5
29 ID JR PREC .5704 1.0
30 ID
31 ID KK FD1
32 ID KM THE EXISTING SITE WEST OF OUR SITE AND ADJACENT STREET WESTWIND. DISCHARGES F
33 ID PB 2.770
34 ID PC 0.0 .02 .057 .07 .087 .108 .124 .13 .13 .13
35 ID PC .13 .13 .13 .133 .14 .142 .148 .158 .172 .181
36 ID PC .19 .197 .199 .2 .201 .204 .214 .229 .241 .249
37 ID PC .251 .256 .27 .278 .281 .283 .295 .322 .352 .409
38 ID PC .499 .59 .71 .744 .781 .812 .819 .835 .851 .856
39 ID PC .86 .868 .876 .888 .91 .926 .937 .95 .97 .976
40 ID PC .982 .985 .987 .989 .99 .993 .993 .994 .995 .998
41 ID PC .998 .999 1.0
42 ID BA .00442
43 ID LS 0 97.0
44 ID UD .082
45 ID *
46 ID
47 ID KK ND1
48 ID KM SOUTHERN ONSITE BASIN DRAINING NORTHEAST AND THEN NORTH TOWARD CHARLESTOMN BL
49 ID BA .00256
50 ID LS 0 97.0
51 ID UD 0.073
52 ID *

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
48 ID KK ND2
49 ID KM NORTHERN ONSITE BASIN DRAINING TO NORTHEAST DISCHARGING TO CHARLESTON BLVD.
50 ID BA .00147
51 ID LS 0 97.0
52 ID UD 0.057
53 ID *
54 ID KK CPD1

```

54 KM FLOWS COMBINED (ND1+ND2) AT NEC OF SITE DISCHARGING INTO CHARLESTON BLVD.
55 HC 2
56 ZZ

1 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

29 FD1
43 ND1
48 ND2
53 CPD1.....

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 21DEC20 TIME 16:08:36 *

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

CHARLESTON AND WESTWIND RETAIL CENTER
***** TECHNICAL DRAINAGE STUDY *****
INTERIM / DEVELOPED CONDITION - ONSITE AND OFFSITE
USING SCS METHODS AND KINEMATIC WAVE ROUTING
MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION

INPUT FILE NAME: D.DAT

DECEMBER 2020

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= 0.5704

26 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 0200 STARTING TIME
NQ 101 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 1 0 ENDING DATE
NDTIME 1020 ENDING TIME
ICENT 19 CENTURY MARK
COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 8.33 HOURS

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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.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 RATIO 2
Page 2

					.57	D 1.00
HYDROGRAPH AT						
+	FD1	.00	1	FLOW TIME	5. 3.50	9. 3.50
HYDROGRAPH AT						
+	ND1	.00	1	FLOW TIME	3. 3.50	5. 3.50
HYDROGRAPH AT						
+	ND2	.00	1	FLOW TIME	2. 3.50	3. 3.50
2 COMBINED AT						
+	CPD1	.00	1	FLOW TIME	5. 3.50	9. 3.50

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

APPENDIX B

HYDRAULIC ANALYSIS

NORMAL DEPTH STREET HYDRAULIC SECTIONS

(EXISTING & DEVELOPED CONDITIONS – 10yr / 100yr Storm)

Street Flow Summary
(Existing / 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)
Westwind Charleston	60 100	2 1	5 400	1.07 6.90	0.54 1.07	0.58 7.38	N/A 0.0

Street Flow Summary
(Existing / 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]
Westwind Charleston	60 100	2 1	9 910	1.18 9.49	0.62 1.46	0.73 13.86

**Charleston Blvd. (10yr Existing & Developed)
Worksheet for Irregular Channel**

Section 1

Project Description	
Worksheet	Charleston Blvd. (10yr Existing & Dev.)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.010300 ft/ft
Discharge	400.00 cfs

CLV MPU Flow (Figure E-8)

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.	69.84 ft
Elevation Range	68.77 to 70.06
Flow Area	58.0 ft ²
Wetted Perimeter	97.47 ft
Top Width	94.80 ft
Actual Depth	1.07 ft
Critical Elevation	70.06 ft
Critical Slope	0.003936 ft/ft
Velocity	6.90 ft/s
Velocity Head	0.74 ft
Specific Energy	70.58 ft
Froude Number	1.56
Flow Type	Supercritical

d_{10}

v_{10}

$$1.07 \times 6.90 = 7.38 > 6 \quad \underline{\text{Not OK}}$$

But this is an existing condition +
our site development does Not
make it worse

Calculation Messages:
Water elevation exceeds lowest end station by 0.46952931 ft.
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+51.70	0.016
0+51.70	0+56.90	0.013
0+56.90	0+92.80	0.016
0+92.80	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	69.37
0+05.00	69.27
0+05.50	69.27
0+05.50	68.77
0+07.00	68.90

Charleston Blvd. (10yr Existing & Developed)
Worksheet for Irregular Channel

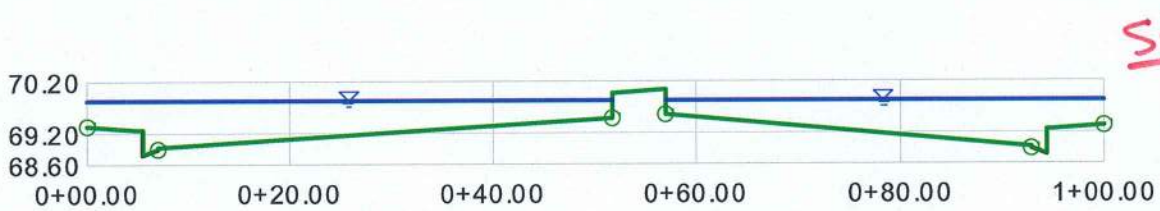
Natural Channel Points	
Station (ft)	Elevation (ft)
0+07.00	68.94
0+51.70	69.49
0+51.70	69.99
0+56.90	70.06
0+56.90	69.56
0+92.80	68.94
0+92.80	68.90
0+94.30	68.77
0+94.30	69.27
0+94.80	69.27
1+00.00	69.37

Charleston Blvd. (10yr Existing & Developed) **Cross Section for Irregular Channel**

Project Description	
Worksheet	Charleston Blvd. (10yr Existing & De
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.010300 ft/ft
Water Surface Elev.	69.84 ft
Elevation Range	68.77 to 70.06
Discharge	400.00 cfs

No Dry LANE



V:5.0
H:1
NTS

**Charleston Blvd. (100yr Existing & Developed)
Worksheet for Irregular Channel**

Section 1

Project Description	
Worksheet	Charleston Blvd. (100yr Existing & Dev.)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	010300 ft/ft
Discharge	910.00 cfs

CLV MPU Flow (Figure E-8)

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.	70.23 ft
Elevation Range	69.77 to 70.06
Flow Area	95.9 ft ²
Wetted Perimeter	103.82 ft
Top Width	100.00 ft
Actual Depth	1.46 ft
Critical Elevation	70.64 ft
Critical Slope	0.003163 ft/ft
Velocity	9.49 ft/s
Velocity Head	1.40 ft
Specific Energy	71.63 ft
Froude Number	1.71
Flow Type	Supercritical

d_{100}

V_{100}

$$1.46 \times 9.49 = 13.86 > 8 \quad \text{Not OK}$$

But this is an existing condition +
our site development does NOT
make it worse

Calculation Messages:
Water elevation exceeds lowest end station by 0.8582128 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+51.70	0.016
0+51.70	0+56.90	0.013
0+56.90	0+92.80	0.016
0+92.80	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	69.37
0+05.00	69.27
0+05.50	69.27
0+05.50	68.77
0+07.00	68.90
0+07.00	68.94

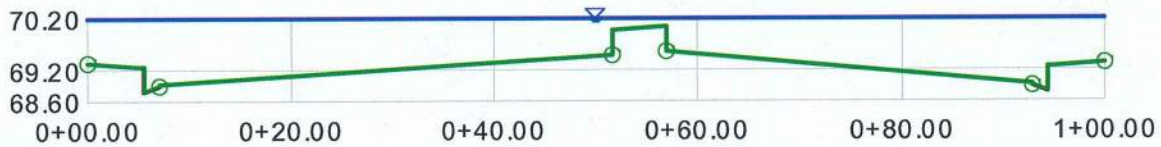
Charleston Blvd. (100yr Existing & Developed)
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+51.70	69.49
0+51.70	69.99
0+56.90	70.06
0+56.90	69.56
0+92.80	68.94
0+92.80	68.90
0+94.30	68.77
0+94.30	69.27
0+94.80	69.27
1+00.00	69.37

Charleston Blvd. (100yr Existing & Developed) **Cross Section for Irregular Channel**

Project Description	
Worksheet	Charleston Blvd. (100yr Existing & Developed)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.010300 ft/ft
Water Surface Elev.	70.23 ft
Elevation Range	68.77 to 70.06
Discharge	910.00 cfs



Site

V:5.0
H:1
NTS

Westwind Rd. (10yr Existing & Developed) Worksheet for Irregular Channel

Section 2

Project Description	
Worksheet	Westwind Rd. (10yr Existing & Dev.)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.001500 ft/ft
Discharge	5.00 cfs

FD1 Flow

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	70.25 ft
Elevation Range	69.71 to 70.55
Flow Area	4.7 ft ²
Wetted Perimeter	32.10 ft
Top Width	31.21 ft
Actual Depth	0.54 ft
Critical Elevation	70.15 ft
Critical Slope	0.006636 ft/ft
Velocity	1.07 ft/s
Velocity Head	0.02 ft
Specific Energy	70.27 ft
Froude Number	0.49
Flow Type	Subcritical

d₁₀

V₁₀

$$.54 \times 1.07 = 0.58 < 6 \text{ OK}$$

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+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	70.31
0+05.00	70.21
0+05.50	70.21
0+05.50	69.71
0+07.00	69.84
0+07.00	69.88
0+30.00	70.42
0+53.00	70.12

Westwind Rd. (10yr Existing & Developed)
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	70.08
0+54.50	69.95
0+54.50	70.45
0+55.00	70.45
0+60.00	70.55

Westwind Rd. (10yr Existing & Developed) Cross Section for Irregular Channel

Project Description	
Worksheet	Westwind Rd. (10yr Existing & De
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.001500 ft/ft
Water Surface Elev.	70.25 ft
Elevation Range	69.71 to 70.55
Discharge	5.00 cfs

Site



V:5.0
H:1
NTS

**Westwind Rd. (100yr Existing & Developed)
Worksheet for Irregular Channel**

- Section 2

Project Description	
Worksheet	Westwind Rd. (100yr Existing & Dev)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.001500 ft/ft
Discharge	9.00 cfs

FD1 Flow

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	70.33 ft
Elevation Range	70.17 to 70.55
Flow Area	7.7 ft ²
Wetted Perimeter	44.58 ft
Top Width	43.58 ft
Actual Depth	0.62 ft
Critical Elevation	70.23 ft
Critical Slope	0.006561 ft/ft
Velocity	1.18 ft/s
Velocity Head	0.02 ft
Specific Energy	70.35 ft
Froude Number	0.50
Flow Type	Subcritical

d_{100}

V_{100}

$$.62 \times 1.18 = 0.73 < 8 \text{ OK}$$

Calculation Messages:

Water elevation exceeds lowest end station by 0.18446745e-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+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	70.31
0+05.00	70.21
0+05.50	70.21
0+05.50	69.71
0+07.00	69.84
0+07.00	69.88
0+30.00	70.42

Westwind Rd. (100yr Existing & Developed)
Worksheet for Irregular Channel

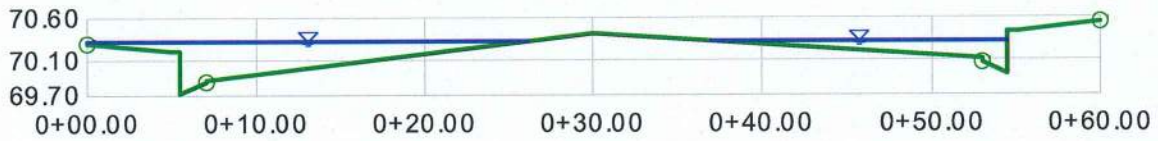
Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	70.12
0+53.00	70.08
0+54.50	69.95
0+54.50	70.45
0+55.00	70.45
0+60.00	70.55

Westwind Rd. (100yr Existing & Developed) Cross Section for Irregular Channel

Project Description	
Worksheet	Westwind Rd. (100yr Existing & D
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.001500 ft/ft
Water Surface Elev.	70.33 ft
Elevation Range	69.71 to 70.55
Discharge	9.00 cfs

Site



V:5.0
H:1
NTS

Onsite Normal Depth Hydraulic Sections

(Interim/Developed Conditions)

On-site Sections
(Interim / Developed Conditions)

Hydraulic Cross-Section Identifier	100-Year Flow [Q100] (cfs)	100-Year Velocity [v] (fps)	100-Year Flow Depth [d] (ft)	2x 100-Year 2 x [d]
3	5	1.66	0.24	0.48

Onsite (100yr Developed) - Section 3 Worksheet for Irregular Channel

Project Description	
Worksheet	Onsite (100yr Developed) - Sect. 3
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	5.00 cfs

ND1 Flow (conservative)

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

Results	
Mannings Coefficient	0.015
Water Surface Elev.	70.46 ft
Elevation Range	71.22 to 71.55
Flow Area	3.0 ft ²
Wetted Perimeter	27.32 ft
Top Width	27.32 ft
Actual Depth	0.24 ft
Critical Elevation	70.45 ft
Critical Slope	0.006581 ft/ft
Velocity	1.66 ft/s
Velocity Head	0.04 ft
Specific Energy	70.51 ft
Froude Number	0.88
Flow Type	Subcritical

d_{100}

V_{100}

$$.24 \times 1.66 = 0.40 < 6 \text{ OK}$$

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+00.50	0.013
0+00.50	0+18.50	0.016
0+18.50	0+20.50	0.013
0+20.50	0+67.50	0.016
0+67.50	0+78.00	0.013

$$W.S.E. = 70.46'$$

$$+ d_{100} = .24'$$

$$70.70' < 72.00' (FF) \checkmark \text{ OK}$$

FF MEETS CRITERIA

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	71.16
0+00.50	71.16
0+00.50	70.66
0+18.50	70.26
0+19.50	70.22
0+20.50	70.26
0+67.50	70.85
0+67.50	71.35
0+68.00	71.35

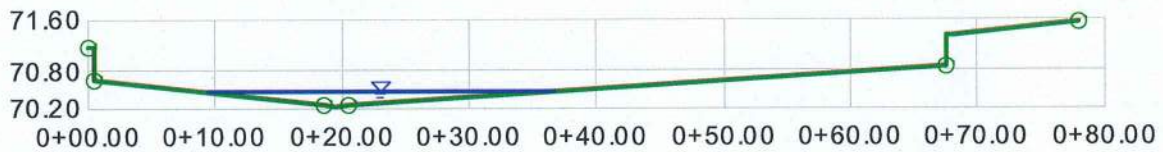
Onsite (100yr Developed) - Section 3
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+78.00	71.55

Onsite (100yr Developed) - Section 3 Cross Section for Irregular Channel

Project Description	
Worksheet	Onsite (100yr Developed) - Se
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.	70.46 ft
Elevation Range	70.22 to 71.55
Discharge	5.00 cfs



V:5.0
H:1
NTS

Section 1500 of the CCRFCD Drainage Design Manual

for the Best Management 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.

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.

Section 1500 – Structural Best Management Practices

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.

Figure 1501, Conceptual Layout 1, represents a parking lot that can be designed so that the runoff can be directed towards the perimeter landscape buffer areas that incorporate a landscaped swale. These swales are designed as rock or xeriscaped swales to convey runoff to a low point, which discharges either directly to the MS4 or to a main drainage pipe and then into the MS4.

Figure 1502, Conceptual Layout 2, represents a parking lot that is not designed to direct all runoff towards swales installed in the perimeter landscape buffer areas. One example could be that the adjacent right-of-way at this area is higher in elevation than the onsite grade. In order to still use the landscape swale BMP, the Developer could use swales in depressed medians within the site, combined with perimeter swales where feasible.

Treatment control devices rather than BMP swales may be used, however, the amount of parking lot area required to be treated would need to be calculated.

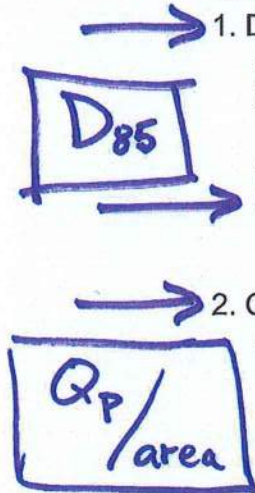
Figure 1503, Conceptual Layout 3, shows a conceptual level layout for this scenario, which relies on a combination of modular pavers, sand/oil separators, and underground detention to provide treatment for at least 75 percent of the parking lot area. To size the treatment control BMPs, the approaches described in section 1502.3 should be used. Note that for treatment devices, hydraulic sizing may need to account for the contribution of runoff from building areas draining through the parking lot.

1502.3 Water Quality Design Storm

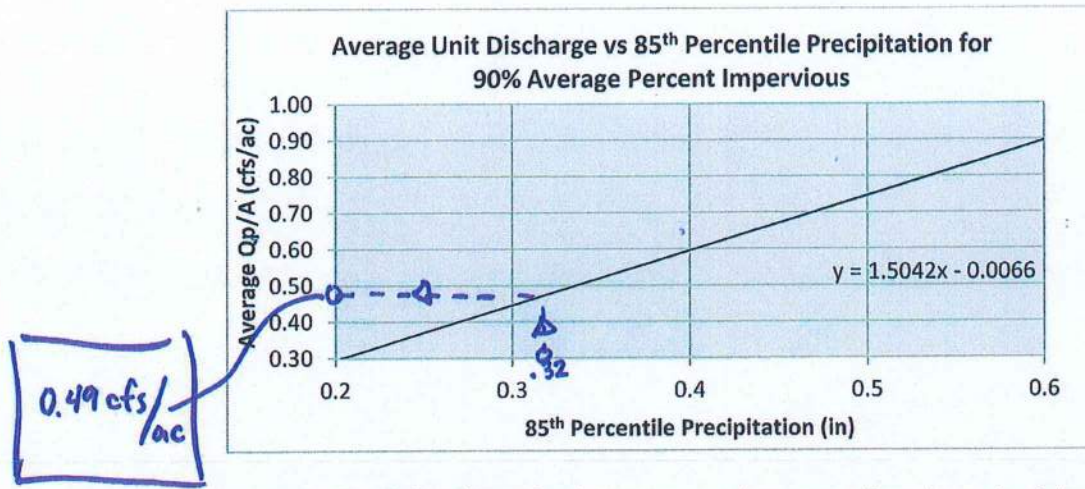
This section describes the steps to be followed to determine the design hydrology for sizing parking lot BMPs in the Las Vegas Valley.

- 1. Determine BMP Design Precipitation - 85th Percentile Rainfall Depth
 - a. Locate site on CCRFCD Design Rainfall Map for 2-year, 6-hour storm
 - b. Determine the adjusted 2-year rainfall depth (D_2) for site, per CCRFCD methods
 - c. Compute ratio of D_2 site to D_2 for the McCarran Airport Area
 - d. Compute 85th percentile rainfall depth (D_{85}) as $0.32 \times D_2$ ratio (0.32 is D_{85} for McCarran Area)

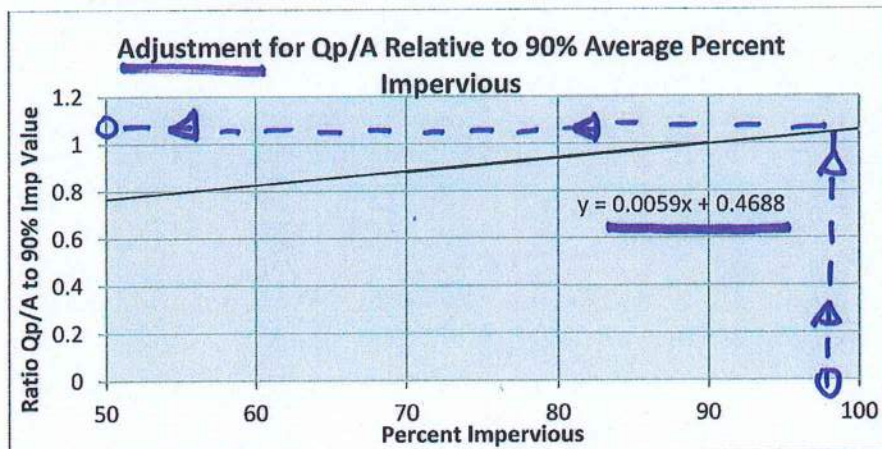
- 2. Calculate BMP Design Peak Discharge
 - a. Use the following chart or regression equation to calculate the unit discharge (Q_P/A) for the 90 percent average percent impervious area condition based on the D_{85} value.



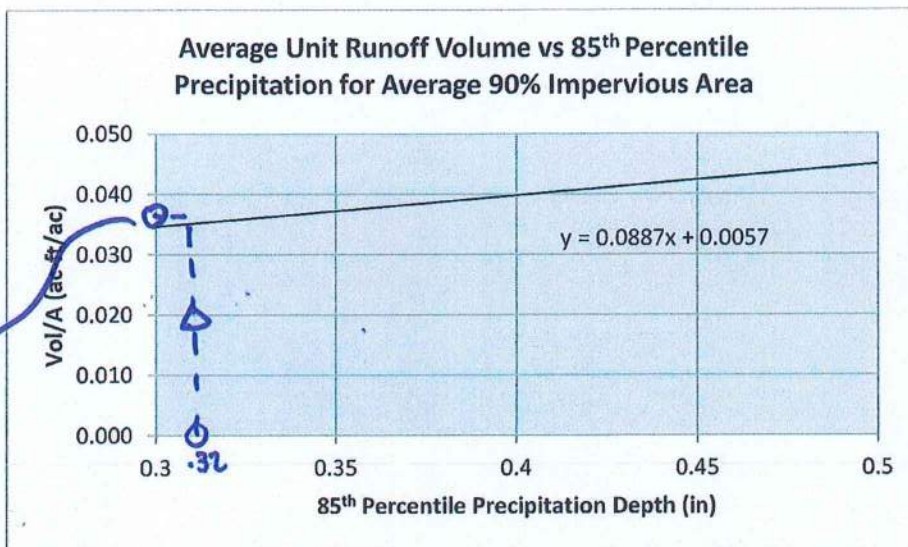
Section 1500 – Structural Best Management Practices



- b. Use the following chart or regression equation to calculate the unit discharge for the site based on the actual percent impervious area of the parking lot and associated landscaped areas.



- c. Calculate the peak design discharge in cfs as $Q_P = Q_P/A \times A$ where Q_P/A is from step (2b) and A is in acres.
3. Calculate BMP Design Runoff Volume
- a. Use the following chart or regression equation to calculate the unit runoff volume (Vol/A) for the 90 percent impervious condition based on the D_{85} value.



0.034

.034
*
1.047

- b. Use the chart or regression equation in step (2b) to calculate the unit runoff volume for the site based on the actual average percent impervious area of the parking lot and associated landscaped areas.
- c. Calculate the design runoff volume in acre-feet as $Vol = Vol/A \times A$ where Vol/A is from step (3b) and A is in acres

Sample Calculation

Given: New Commercial Center in Summerlin area

Site Area = 100 acres

D₂ site / D₂ McCarran Area = 1.25

percent impervious area = 85% (parking lot and associated landscaped area)

1. Determine BMP Design Precipitation - 85th Percentile Rainfall Depth (D_{85})

$$D_{85} = 1.25 \times 0.32 = 0.40 \text{ inches}$$

2. Calculate BMP Design Discharge

$$Q_P/A (90\%) = 1.5042 \times (0.40) + 0.0066 = 0.60$$

Find Adjustment factor for percent impervious

$$Q_P/A = 0.60 \times [(0.0059[85]) + 0.4688] = 0.58$$

$$Q_P = 0.58 \times 100 \text{ acres} = 58 \text{ cfs}$$

3. Calculate BMP Design Runoff Volume

$$\text{Vol/A (90\%)} = 0.0887 \times 0.40 + 0.0057 = 0.04$$

$$\text{Vol/A} = 0.04 \times (0.0059 \times [85] + 0.4688) = 0.04; \text{Vol} = 0.04 \times 100 \text{ acres} = 4.0 \text{ ac-ft.}$$

1503 LOW IMPACT DEVELOPMENT (LID) ←

1503.1 Description

LID measures can be used for managing runoff from areas of new development and significant redevelopment (NDSR). LIDs consist of a variety of site planning and site design measures or practices to minimize the impact of individual urban developments on stormwater quality and quantity. Developers proposing the use of measures that rely on infiltration to dispose of stormwater must perform studies to demonstrate that infiltration will be effective and will not adversely affect groundwater or downstream surface water quality. LID measures determined to be feasible for use in the Las Vegas Valley NDSR program can be found in **Table 1503**.

The BMPs presented in this section can be utilized for sites complying with the Parking Lot LID program or other site designs requiring BMPs. These BMPs are recommendations and the designer is not limited to the BMPs in this section. The designer is encouraged to contact the local entity when alternative BMPs are considered for use.

1503.2 Water Quality Benefits

Managing site runoff can significantly reduce the amount of pollutants conveyed to receiving waters. By incorporating the LID measures described below into site planning, runoff water quality can be improved by using simple technologies, employing basic practices, and educating those present on the site. Reducing pollutants in site runoff can reduce the need for downstream treatment to meet water quality goals.

1503.3 Disconnected Impervious Areas

1503.3.1 Description

This BMP consists of disconnecting impervious areas from downstream storm drainage infrastructure. Any surface in the landscape that cannot effectively absorb or infiltrate rainfall is an impervious area. This includes driveways, roads, parking lots, rooftops, and sidewalks. On natural landscapes, rainfall is absorbed into the soil and vegetation which naturally slows down, spreads out, and soaks up precipitation and runoff. A stable supply of groundwater is provided from water percolating into the soil, and the runoff is naturally filtered of impurities before it reaches creeks, streams, rivers, and bays.

Section 1500 – Structural Best Management Practices

The amount of impervious cover increases as areas become more developed. Natural filter systems are no longer in place to intercept the runoff which has serious implications for water quality and flood control. Typical pollutants in runoff from impervious areas include oil, litter, sediment, bacteria and in some cases, herbicides and pesticides.

1503.3.2 Water Quality Benefits

Concentrations and loads of the following pollutants are typically reduced by the LID BMP described in this section:

- Trace metals
- Hydrocarbons
- Litter

1503.3.3 Applications

This BMP applies to all urban areas. A beneficial way of mitigating stormwater runoff from impervious areas is to direct the runoff from parking lots and roads to pervious and vegetated soils.

1503.3.4 Limitations

Limitations may occur in areas with poor soils, where infiltration would not occur or could exacerbate groundwater quality problems. Limitations may also occur in ultra-urban areas where the site has no pervious area, including but not limited to high density areas.

1503.3.5 Design Criteria

Ways to mitigate the stormwater runoff by disconnecting impervious areas include:

- Breaking up flow directions from paved surfaces – Impervious surfaces are designed to allow stormwater to run off in a dispersed manner in several directions. The drainage off impervious surfaces is directed onto adjacent vegetated soil and not onto other pavements or into storm sewers.
- Minimize directly connected impervious areas - The impact of impervious surfaces is reduced by minimizing directly connected impervious areas, directing runoff from the impervious areas to pervious areas and/or small depressions, and in the process disconnecting hydrologic flow paths.
- Locating impervious surfaces to drain to natural systems - Existing zones of vegetation, from forested zones to scrub vegetation, are used

for management of stormwater runoff, often with some sort of landforming to achieve volume control. The scale of this technique can vary from microcontrol by redirecting sidewalk and driveway runoff to adjacent vegetation to conveyance of runoff from larger impervious surfaces to natural areas on the development site.

1503.3.6 Maintenance

Sweep impervious areas regularly to collect loose particles and litter. Wipe up spills with rags and other absorbent material immediately, but do not hose down the area to a storm drain. Pervious areas receiving runoff should be cleared regularly of litter and accumulated sediment.

→ 1503.4 Landscape Swale ←

1503.4.1 Description of Facility

The purpose of the swale is to settle out sediment, which has the potential to have urban pollutants bound to the particulate matter. The required length of the swale to settle out particulate pollutants is dependent on multiple factors, including velocity, characteristics of the stormwater, characteristics of the swale, and length of the swale. For the Parking Lot LID program, sizing of swales will be based on minimizing the slope of the swale to minimize the swale length and flow velocities. Xeriscaped or rock swales can be sized using the standard sizing requirements, as shown in Section 1503.4.5.

Runoff from any impervious areas on a developed site can be directed to swales, including parking lots, roof tops, parking covers, etc. The swales can be installed either within the parking lot area or at the perimeter of the site.

1503.4.2 Water Quality Benefits

Concentrations and loads of the following pollutants are typically reduced by the LID BMP described in this section:

-
- Sediment
 - Total Phosphorus
 - Trace Metals
 - Hydrocarbons

Estimated pollutant removal efficiencies for vegetated landscape swales are given below. Pollutant removal efficiencies for rock lined or xeriscaped swales are expected to be lower.

Section 1500 – Structural Best Management Practices

<u>Pollutant</u>	<u>Removal Efficiency</u>
→ TSS	77%
Total Phosphorus	8%
Total Nitrogen	67%
Trace Metals	83-90%

Source: CASQA New Development and Redevelopment Handbook, 2003

1503.4.3 Applications

Landscape swales are typically located in parks, parkways, private landscaped areas, or in development buffers, and can also be used as pre-treatment devices for other structural treatment controls. They are primarily used as stormwater conveyance systems; however they are limited in their ability to mitigate large storms. Landscape swales are best utilized in low to moderate sloped areas as an alternative to ditches and curb and gutter drainage.

1503.4.4 Limitations

The effectiveness of landscape swales is decreased by compacted soils, frozen ground conditions, short grass heights, steep slopes, large storm events, high discharge rates, high velocities, and a short runoff contact time. Landscape swales also require a sufficient amount of available land area and they may not be appropriate for industrial sites or locations where spills may occur. In areas where burrowing animals are abundant, landscape swales may not perform effectively. Additionally, the infiltration rates of local soils can limit the application of landscape swales, unless underdrains are installed. Another possible issue is the formation of mosquito breeding habitat if water does not drain or infiltrate.

1503.4.5 Design Criteria

<u>Tributary Area (ac)</u>	<u>Swale Slope</u>	<u>Minimum Swale Length (ft)</u>	<u>Size of Swale</u>
≤ 0.5	≤ 1%	30	9" deep maximum, 6 ft wide at top average, 4ft wide at top minimum, 4:1 side slope
0.5 - 1.0	≤ 1%	40	9" deep maximum, 6 ft wide at top average, 4ft wide at top minimum, 4:1 side slope

Minimum criteria for sizing landscaped swales for parking lot BMPs using xeriscaped surface treatments are provided below. Sizing was based on minimizing flow velocities and maximizing flow paths to encourage settlement of sediment.

BMP swales should be as long as practically feasible to provide as much treatment as possible. The minimum length is 30 ft for tributary areas up to 0.5 acres, and 40 ft for tributary areas of up to 1.0 acre. When incorporating swales into landscaping features, tributary areas to individual BMPs should be kept to less than 0.5 acre whenever possible, and should never exceed 1.0 acre unless hydrologic and hydraulic calculations are provided. BMP swales should have a minimum average top width of 6 ft, with a minimum top width at any point of 4 ft and a maximum flow depth of 9 inches for water quality flows (approximately 2-yr storm). When combined with a larger flood control facility these dimensions should apply to the portion of the swale carrying low flows. When lined with rock, landscaped swale BMPs should have a minimum rock size of 3-inch D₅₀. When combined with a larger flood control facility, rock lining should be sized based on the anticipated flood velocities in the facility.

The Developer may propose to use an alternative size swale, if supporting calculations are submitted.

1503.4.6 Maintenance

Remove any sediment or debris build-up when the depths exceed 3 inches. Inspect for pools of standing water. At regular intervals, re-grade to restore design grade and re-vegetate.

Use of heavy equipment for mowing and removing plants/debris should be avoided to minimize soil compaction. Disturbed areas should be stabilized with seed and mulch, or rock lining, as necessary.

If a spill occurs and hazardous materials contaminate soils in the swales, the affected areas should be removed immediately and disposed of in a manner that complies with federal and state regulations. The swale soils and materials should be replaced as soon as possible.

1503.5 Depressed Median

1503.5.1 Description of Facility

Medians come in the depressed or raised form, or are made flush with the surface of the carriageways. Only the depressed medians are discussed in this section.

[illegible]

PARKING LOT BMP DESIGN REQUIREMENTS BY PARKING LOT CATEGORY

[illegible]

FEASIBLE LID MEASURES IN THE LAS VEGAS VALLEY NDSR PROGRAM

[illegible]

BMP Swale Capacity

BMP SWALE CAPACITY

Worksheet for Triangular Channel

Project Description	
Worksheet	BMP SWALE CAPACITY
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Discharge

Input Data	
Mannings Coeffic	0.033
Slope	010000 ft/ft
Depth	1.00 ft
Left Side Slope	4.00 H : V
Right Side Slope	4.00 H : V

Results	
Discharge	11.12 cfs
Flow Area	4.0 ft ²
Wetted Perim	8.25 ft
Top Width	8.00 ft
Critical Depth	0.86 ft
Critical Slope	0.021861 ft/ft
Velocity	2.78 ft/s
Velocity Head	0.12 ft
Specific Energ	1.12 ft
Froude Numb	0.69
Flow Type	Subcritical

see MANNING'S CALC. (Appendix 'B') - 4" riprap

8' WIDE SWALE, 4:1 SS

SWALE CAN CONVEY ENTIRE 100YR FLOW ON SITE

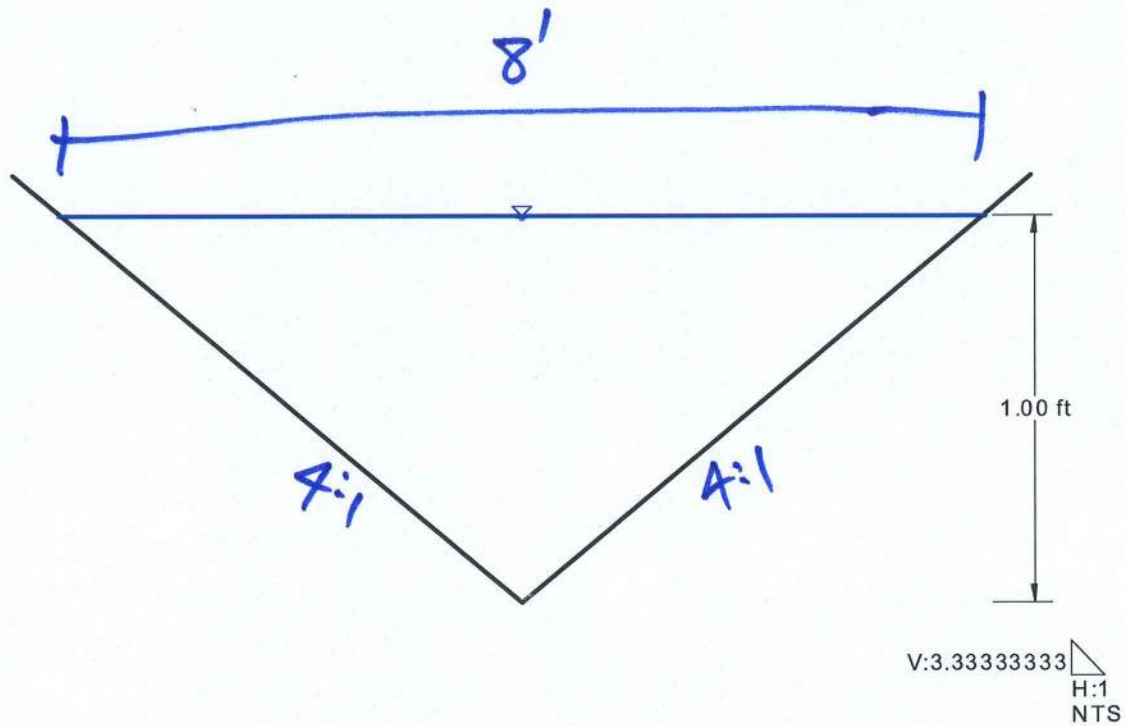
NON-EROSIVE

BMP SWALE CAPACITY

Cross Section for Triangular Channel

Project Description	
Worksheet	BMP SWALE C
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Discharge

Section Data	
Mannings Coeffic	0.033
Slope	010000 ft/ft
Depth	1.00 ft
Left Side Slope	4.00 H : V
Right Side Slope	4.00 H : V
Discharge	11.12 cfs



Manning's Calculations

Manning's Calculation

Charleston and Westwind Retail Center

Date: December, 2020

Calculated By: Chris Blake

From Section 705.4.4 of Hydrologic Criteria and Drainage Design Manual (HCDDM)
Equation 732:

$$n = 0.0395(D50)^{1/6}$$

n = Manning's coefficient

D50 = Mean stone size in ft, rock size for which 50% (by weight) of the riprap is smaller

Solve for n: D50= 4.0 inches

$$n = 0.0395(D50)^{1/6}$$

D50= 0.333 ft

n = **0.033** <<<< Manning's n-value for 4-inch Loose Riprap

APPENDIX C

FIGURES

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

163-01-1

1

126-125 - 124-12
137-138 139-14
164-163 162-16
175-176 177-17

Scale: 1" = 200'

Rev: 2/22/2019

CLARK COUNTY

1

126-125 - 124-12
137-138 139-14
164-163 162-16
175-176 177-17

Scale: 1" = 200'

Rev: 2/22/2019

MAP LEGEND

Parcel Boundary

Sub Boundary

PMAD Boundary

Road Easement

Match / Leader Line

Historic Sub Boundary

Historic PMAD Boundary

Section Line

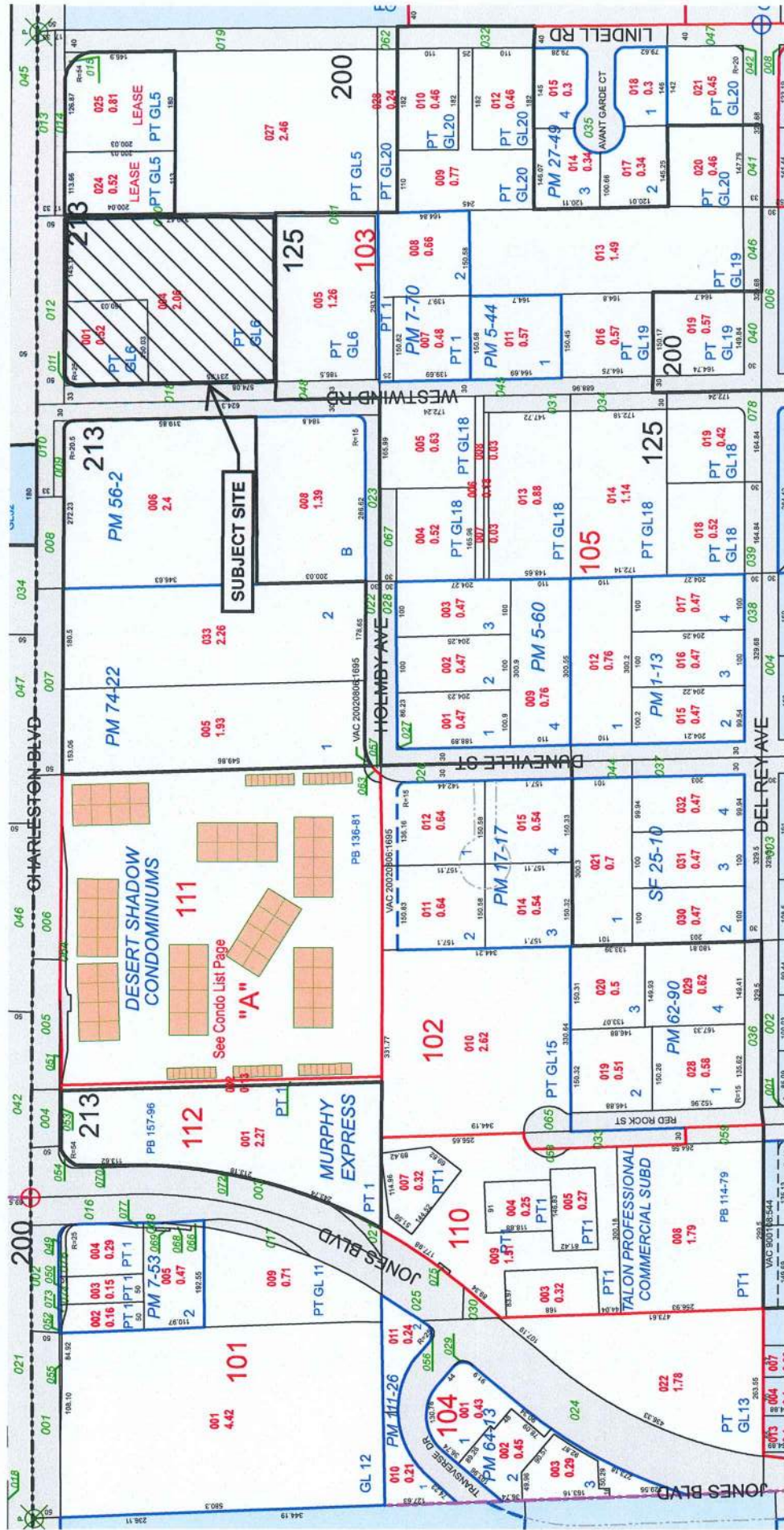
NOTES

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

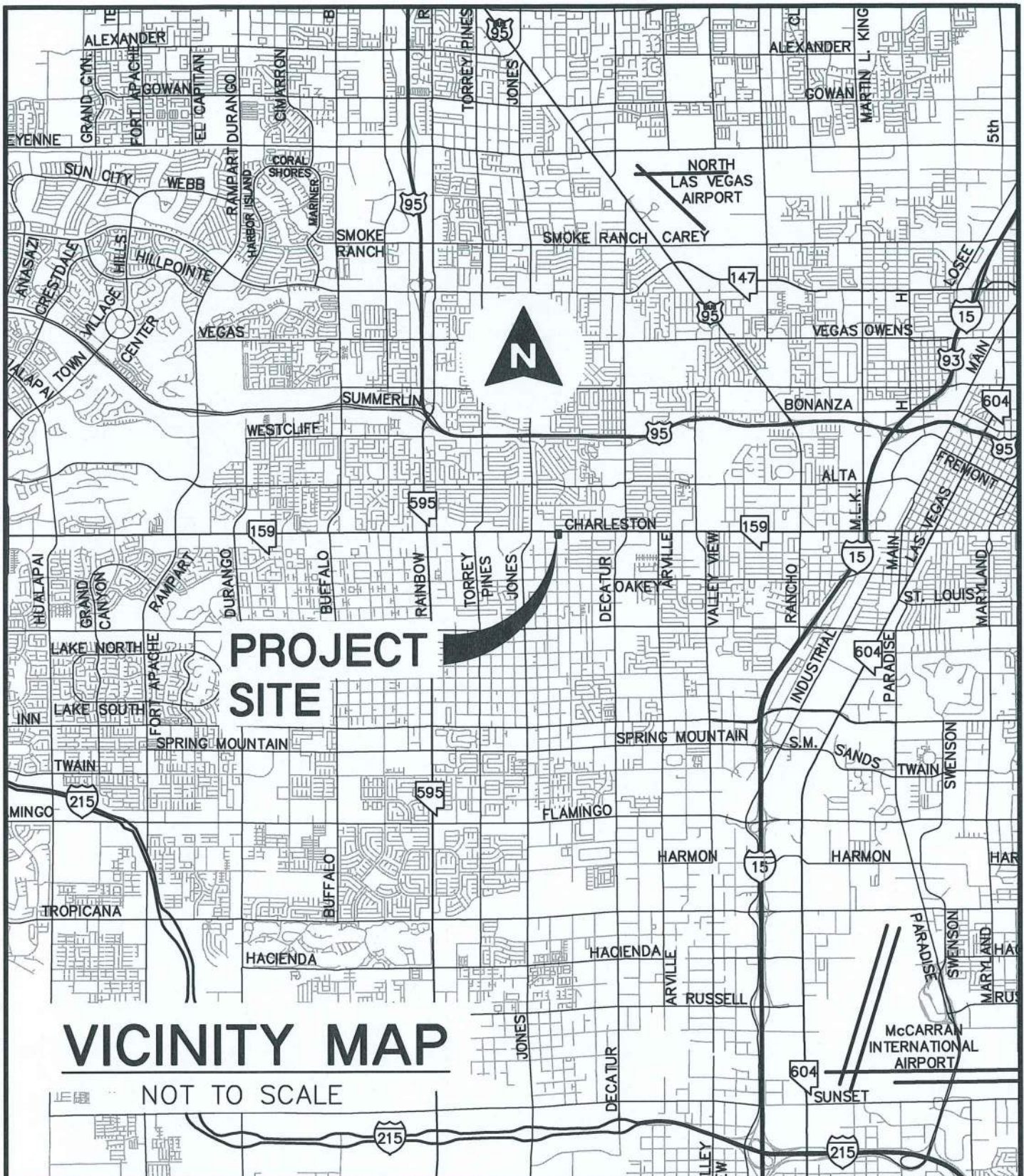
No liability is assumed for the accuracy of the data delineated herein. Information on roads and other non-assessed parcels may be obtained from the Road Document Listing in the Assessor's Office.

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

USE THIS SCALE (FEET) WHEN MAP REDUCED FROM 11x17 ORIGINAL



TAX DIST 125.200



DRAWN BY: CB SCALE: N.T.S.

CHECKED BY: CB DATE: 12/20/20

MCCAY ENGINEERING

**VICINITY
MAP
(FIGURE 1)**

**CHARLESTON & WESTWIND
RETAIL CENTER**

PROJECT No.:

01234

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

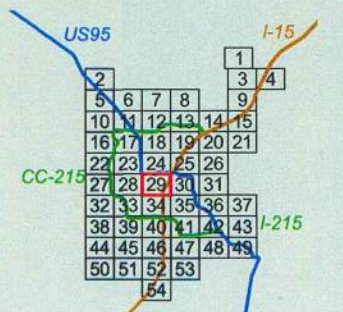
- | Category A | Category B |
|------------|------------|
| Channel | Channel |
| Stormdrain | Stormdrain |
| Crossing | Crossing |



0 500 1,000 2,000 3,000
Feet

Scale: 1 inch = 2,000 feet

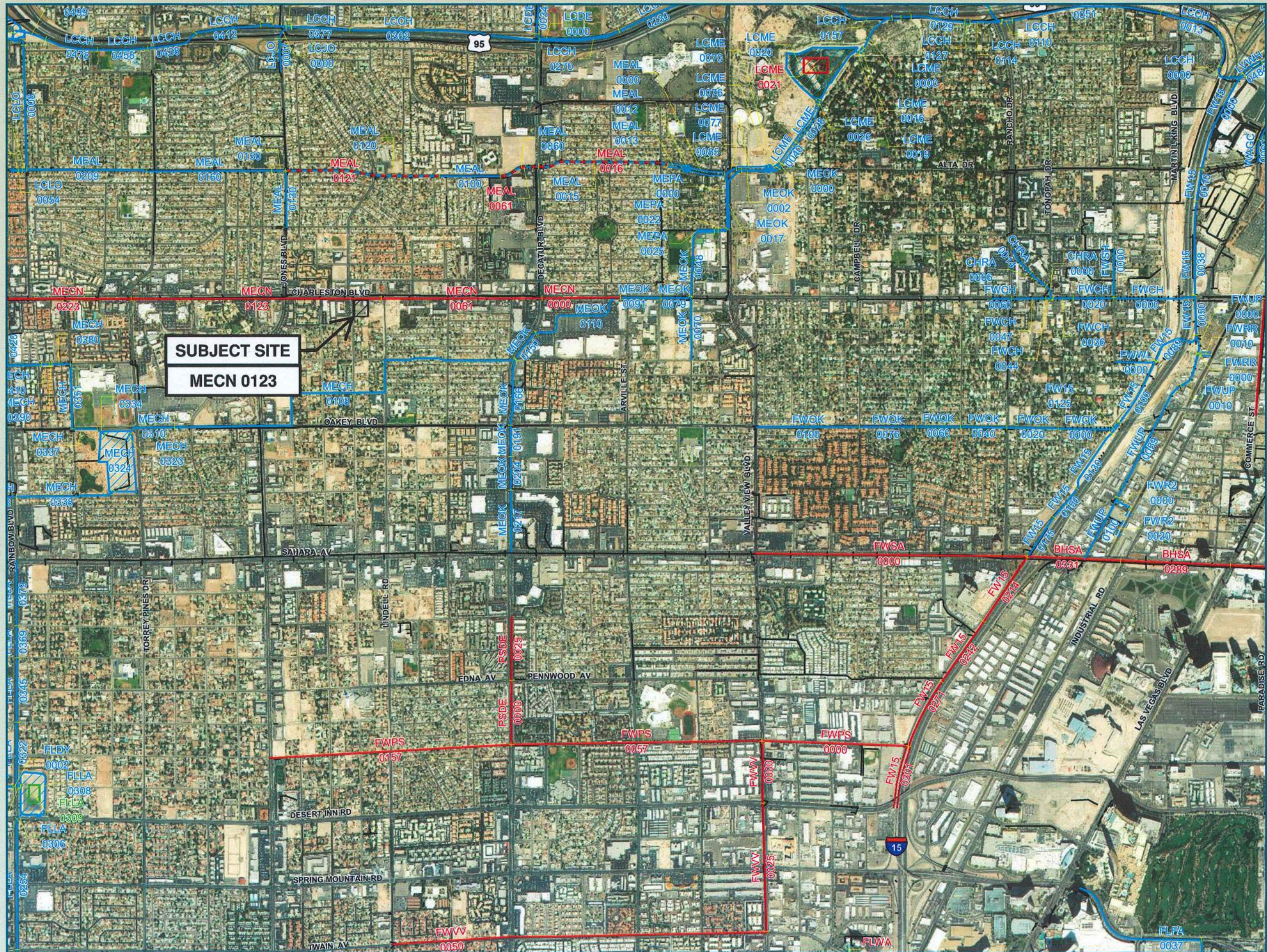
AerialSource:Esri World Imagery 2017



ATKINS

Member of the SNC-Lavalin Group

Louis Berger



ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
BHSA 0175 0289 0331	P P P	BOULDER HIGHWAY SAHARA AVENUE 14' X 14' RCB 14' X 12' RCB 14' X 11' RCB	6000 2300 2000	3952 3669 3346	CSA13 CSA11 CSA10-1	SW3 SW3 SW3	7.93 7.55 7.15	0.67 0.87 1.00
CHRA 0000 0006 0014	E E E	WEST CHARLESTON DRAINS - RANCHO 8' X 9' RCB 8' X 9' RCB 8' X 4' RCB	310 420 600	302 302 302	CAL95 CAL95 CAL95	SW3 SW3 SW3	0.62 0.62 0.62	1.92 1.00 1.50
FLBN 0312 0342	P P	FLAMINGO - BOULDER HIGHWAY NORTH 7' X 4' RCB 7' X 4' RCB	2160 2425	621 621	CCH52 CCH52	SW3 SW3	0.62 0.62	4.20 4.20
FLDY 0000 0002 0004	E E E	FLAMINGO WASH - DARSY STORM DRAIN 84" RCP 10' X 9' RCB 80" RCP	100 50 680	611 611 611	CLF24 CLF24 CLF24	FLAM3A FLAM3A FLAM3A	0.78 0.78 0.78	0.25 0.25 2.80
FLFA 0000 0037	E E	FLAMINGO - FASHION 12' X 9' RCB 8' X 9' RCB	2050 3060	720 482	CFW17N FW14	FLAM3A FLAM3A	0.72 0.44	0.28 0.45
FLLA 0254 0304 0306 0308 0309 0322 0345 0369 0379	E PO E E PO E E E E	FLAMINGO WASH - LATERAL (FLAMINGO/RAINBOW) 90" RCP MODIFY SPILLWAY, RAISE HEIGHT BY 1' (REPLACES FLA0306) 1,555 CFS PMF SPILLWAY (REPLACE W/ FLA0304) 30" RCP WITH 18" ORIFICE OUTLET 62 AC-FT DESERT INN DETENTION BASIN UPGRADE TO 70 AC-FT DESERT INN DETENTION BASIN 81" RCP 81" RCP 72" RCP 86" RCP	2730 1556 1556 203 813 813 1370 1340 670 1320	572 1556 1556 30 813 813 245 245 670 1320	CLF27 CLF25 CLF25 DID8 CLF25 CLF25 LF25 LF25	FLAM3B FLAM3A FLAM3A FLAM3A FLAM3A FLAM3A FLAM3A FLAM3A	0.51 1.03 1.03 1.03 1.03 0.27 0.27 0.50 0.50	0.40 0.43 0.43 0.43 0.43 0.50 0.50 0.50 0.50
FWIS 0000 0010 0038 0050 0089 0100 0125 0130 0150 0175 0214 0242 0271 0301	E E E E E E E E E E P P P P	FREEWAY CHANNEL FROM DESERT INN TO EXPRESSWAY 3' 12' X 10' RCB 3' 12' X 10' RCB 3' 12' X 10' RCB 3' 12' X 10' RCB 2' 18' X 10' RCB 2' 18' X 10' RCB 2' 10' X 8' RCB 2' 10' X 8' RCB 2' 10' X 8' RCB 2' 10' X 8' RCB 2' 12' X 10' RCB 2' 12' X 10' RCB 2' 12' X 10' RCB CONC CHNL 12W 4D 21 SS	2170 677 1945 870 1200 1510 287 1176 780 985 1610 1500 1520 1300	3685 3506 3369 2613 2485 2324 1450 1450 1450 1450 4289 4130 3842 353	CAL93 CAL96 CCH422 CCH59 CCWAL2 CCK11C DCCSA08 DCCSA08 DCCSA08 DCCSA08 CED10-C CCPS08 CCPS08 CCE3PD-C	Boulder4 Boulder4 Boulder4 SW4 SW4 SW3 SW3 SW3 SW3 SW3 SW3 SW3 SW3 SW3	8.93 8.70 8.52 8.48 8.28 7.83 6.67 6.67 6.67 6.67 6.25 6.03 5.49 0.42	0.17 0.17 0.17 0.17 0.20 0.80 0.80 0.80 0.80 0.73 0.93 0.93 0.42
FWCH 0000 0020 0038 0044 0047 0060	E E E E E E	WEST CHARLESTON DRAIN 10' X 7' RCB 10' X 7' RCB 9' X 7' RCB 9' X 7' RCB 7' X 5' RCB 9' X 4' RCB	1710 840 425 145 710 400	1044 824 824 561 561 561	CCH22 CCH18-C CCH18-C CCH18-C CCH18-C CCH18-C	SW3 SW3 SW3 SW3 SW3 SW3	1.38 1.15 1.15 0.53 0.53 0.53	0.74 0.40 0.40 0.40 2.05 0.40
FWOK 0000 0020 0040 0060 0076 0100	E E E E E E	OAKEY DRAIN 10' X 8' RCB 10' X 8' RCB 8' X 8' RCB 9' X 9' RCB 9' X 8' RCB 9' X 9' RCB	1350 1025 960 970 1175 2020	960 960 749 749 749 465	10CK11C 10CK11C CCK10 CCK10 CCK10 CCK08-C	SW3 SW3 SW3 SW3 SW3 SW3	1.16 1.16 0.85 0.85 0.85 0.55	0.62 0.60 1.00 1.50 1.04 2.18
FWPS 0000 0057 0157	P P P	PALMYRA / SIRIUS DRAIN 12' X 12' RCB 10' X 10' RCB 2' 86" RCP	3000 5220 5100	3544 2101 547	CP508 CP506 CP503	SW3 SW3 SW3	5.07 2.78 0.59	1.50 1.28 1.15
FWR2 0000 0020	E E	FREEWAY CHANNEL - RAILROAD CHANNEL 9' X 4' RCB CONC CHNL 10W 4D 21 SS	377 650					1.60 0.50
FWRR 0000 0010	E E	FREEWAY CHANNEL BYPASS FACILITY RR BRANCH 48" RCP CONC CHNL SW 5D 0.1 SS	70 220					1.22 1.22
FWSA 0000 0000	P P	FREEWAY CHANNEL - SAHARA 7' X 5' RCB 7' X 5' RCB	5700 496		CSA08	SW3	0.42	1.49
FWSH 0000 0000	E E	SHADOW LANE DRAIN 7' X 4' RCB 7' X 4' RCB	950 247		CH22-C	SW3	0.23	0.20
FWUP 0000 0010 0059 0100	E E E E	FREEWAY CHANNEL BYPASS FACILITY 10' X 8' RCB 10' X 8' RCB 10' X 8' RCB 8' X 4' RCB	350 804 2680 1440	181 181 181 181	CH50 CH50 CH50 CH50	SW3 SW3 SW3 SW3	0.20 0.20 0.20 0.20	0.37 0.37 0.40 0.47
FWVV 0000 0025 0050	P P P	VALLEY VIEW DRAIN 12' X 11' RCB 10' X 10' RCB 8' X 6' RCB	1320 2665 7785	1549 1059 750	CCE3FA CRAC1 DFW55	SW3 SW3 SW3	2.69 1.74 1.34	0.30 0.30 1.58
FWWL 0000 0000	E E	FREEWAY CHANNEL-WALDMAN AVENUE 8' X 6' RCB 8' X 6' RCB	820 431		CWAL2	SW3	0.45	0.29
LCCH 0000 0013 0051 0110 0114 0127 0129 0150 0154 0157	E E E E E E E E E	LAS VEGAS CREEK CHANNEL 2' 12' X 7' RCB 2' 12' X 6' RCB 2' 14' X 7' RCB TRANSITION STRUCTURE 2' 14' X 7' RCB TRANSITION STRUCTURE 2' 14' X 7' RCB 2' 13' X 7' RCB TRANSITION STRUCTURE 2' 12' X 6' RCB	730 2035 3113 220 670 110 1130 200 190	3212 3050 3050 3001 2385 2385 2385 2385 2385 1700	CAL93C CLC28-C CLC28-C CCLC16-C CRMEDET CRMEDET CRMEDET CRMEDET CRMEDET CCLC14-C	MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 MEADOWS4 SW3	9.90 9.60 9.60 9.50 8.19 8.19 8.19 8.19 8.19 2.93	1.28 0.82 0.60 0.50 0.80 0.50 0.50 0.50 0.50 1.06
LCDE 0000 0034	E E	LAS VEGAS CREEK - DECATUR 8' X 5' RCB 72" RCP	1800 700	430 430	LC11-C LC11-C	SW3 SW3	0.38 0.38	1.26 0.50
LCJO 0000 0007	E E	LAS VEGAS CREEK - JONES 8' X 6' RCB 8' X 5' RCB	380 575	381 381	AL018-C AL018-C	SW3 SW3	0.37 0.37	0.50 0.62
LCLO 0000 0008 0054	E E E	LAS VEGAS CREEK - LORENZI 7' X 6' RCB 7' X 6' RCB 7' X 5' RCB	445 2983 169	285 285 285	DAL00A DAL00A DAL00A	SW3 SW3 SW3	0.41 0.41 0.41	3.37 0.40 1.00
LCME 0000 0016 0017 0018 0019 0020 0021	E E E E E E P	LAS VEGAS CREEK - MEADOWS 14' X 8' RCB MEADOWS BASIN 3,300 CFS SPILLWAY (REPLACE W/ LOME0018) MODIFY SPILLWAY, RAISE HEIGHT BY 1' (REPLACES LOME0017) 1' 11' X 5' RCB AND 1' 11.5' X 5' RCB 213 AC-FT MEADOWS DETENTION BASIN UPGRADE TO 249 AC-FT MEADOWS DETENTION BASIN	895 140 3300 3300 110 4909 4909	1484 1484 3300 3300 1484 4909 4909	MEADOWS MEADOWS MEADOWS MEADOWS MEADOWS MEADOWS MEADOWS	SW3SC SW3SC SW3SC SW3SC SW3SC SW3SC SW3SC	5.57 5.57 5.57 5.57 7.55 7.55	0.72 0.21 0.81 0.81 0.81 0.81 0.81
LCME 0000 0002 0002 0004 0007 0007 0009 0010 0010 0016 0019	E E E E E E E E E E E E	LAS VEGAS CREEK - MEADOWS CONC CHNL 19W 9.5D 0.1 SS 19' X 7' RCB 19' X 8' RCB 18' X 8' RCB 7' X 8' RCB 18' X 8' RCB 18' X 8' RCB 12' X 8' RCB 12' X 8' RCB 12' X 8' RCB 12' X 8' RCB 12' X 7' RCB	112 800 1550 1700 1320 630 850 2304 642 1350 660	2871 2871 2871 2871 244 2524 2524 1568 1568 1568 995	CCK13 CCK13 CCK13 CCK13 CH14B CCK12 CCK12 CCCK08 CCK08 CCK08 CCK07	SW3SC SW3SC SW3SC SW3SC SW3 SW3SC SW3SC SW3SC SW3 SW3 SW3	5.57 5.57 5.57 5.57 0.22 2.57 2.57 1.58 1.58 1.58 0.93	2.94 2.94 2.94 2.94 0.44 0.50 1.01 1.04 0.45 0.45 0.71
LCME 0000 0002 0002 0004 0007 0007 0009 0010 0010 0016 0019	E E E E E E E E E E E E	LAS VEGAS CREEK - MEADOWS CONC CHNL 19W 9.5D 0.1 SS 19' X 7' RCB 19' X 8' RCB 18' X 8' RCB 7' X 8' RCB 18' X 8' RCB 18' X 8' RCB 12' X 8' RCB 12' X 8' RCB 12' X 8' RCB 12' X 8' RCB 12' X 7' RCB	112 800 1550 1700 1320 630 850 2304 642 1350 660	2871 2871 2871 2871 244 2524 2524 1568 1568 1568 995	CCK13 CCK13 CCK13 CCK13 CH14B CCK12 CCK12 CCCK08 CCK08 CCK08 CCK07	SW3SC SW3SC SW3SC SW3SC SW3 SW3SC SW3SC SW3SC SW3 SW3 SW3	5.57 5.57 5.57 5.57 0.22 2.57 2.57 1.58 1.58 1.58 0.93	2.94 2.94 2.94 2.94 0.44 0.50 1.01 1.04 0.45 0.45 0.71
MEOK 0204 0217	E E	OAKEY MEADOWS STORMDRAIN 12' X 6' RCB 12' X 5' RCB	655 1276	995 570	CCK07 CSA06	SW3 SW3	0.93 0.52	0.71 0.40
MEPA 0000 0022 0025	E E E	MEADOWS PARALLEL 10' X 6' RCB 8' X 9' RCB 78" RCP	1370 200 470	276 276 276	CCH14A CCH14A CCH14A	SW3 SW3 SW3	0.25 0.25 0.25	0.50 1.45 1.16
PSDE 0000 0025	P P	PALMYRA / SIRIUS DRAIN - DECATUR LATERAL 12' X 8' RCB 10' X 8' RCB	1330 1330	1127 662	CED02 CED13	SW3 SW3	1.21 0.65	0.38 0.25
WAGC 0014 0060	E E	WASHINGTON AVENUE CHANNEL - GRAND CENTRAL 1' 12' X 4' RCB AND 1' 11' X 4' RCB 12' X 4' RCB	2440 455	505 505	LC21 LC21	SW3 SW3	0.56 0.56	0.20 0.20

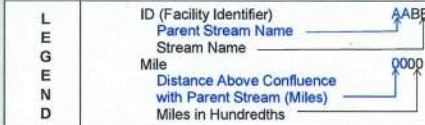
MECN 0123 : 8' X 6' RCB

*The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.
 **As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.
 ^ For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e. HEC-1 Node flow - existing facility normal depth capacity + proposed parallel facility flow).



2018 LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FACILITY INVENTORY
FIGURE F-29



Existing Facility..... E
 Proposed or Modified Facility..... P
 Contingency Level
 Category A..... P
 Category B..... P0

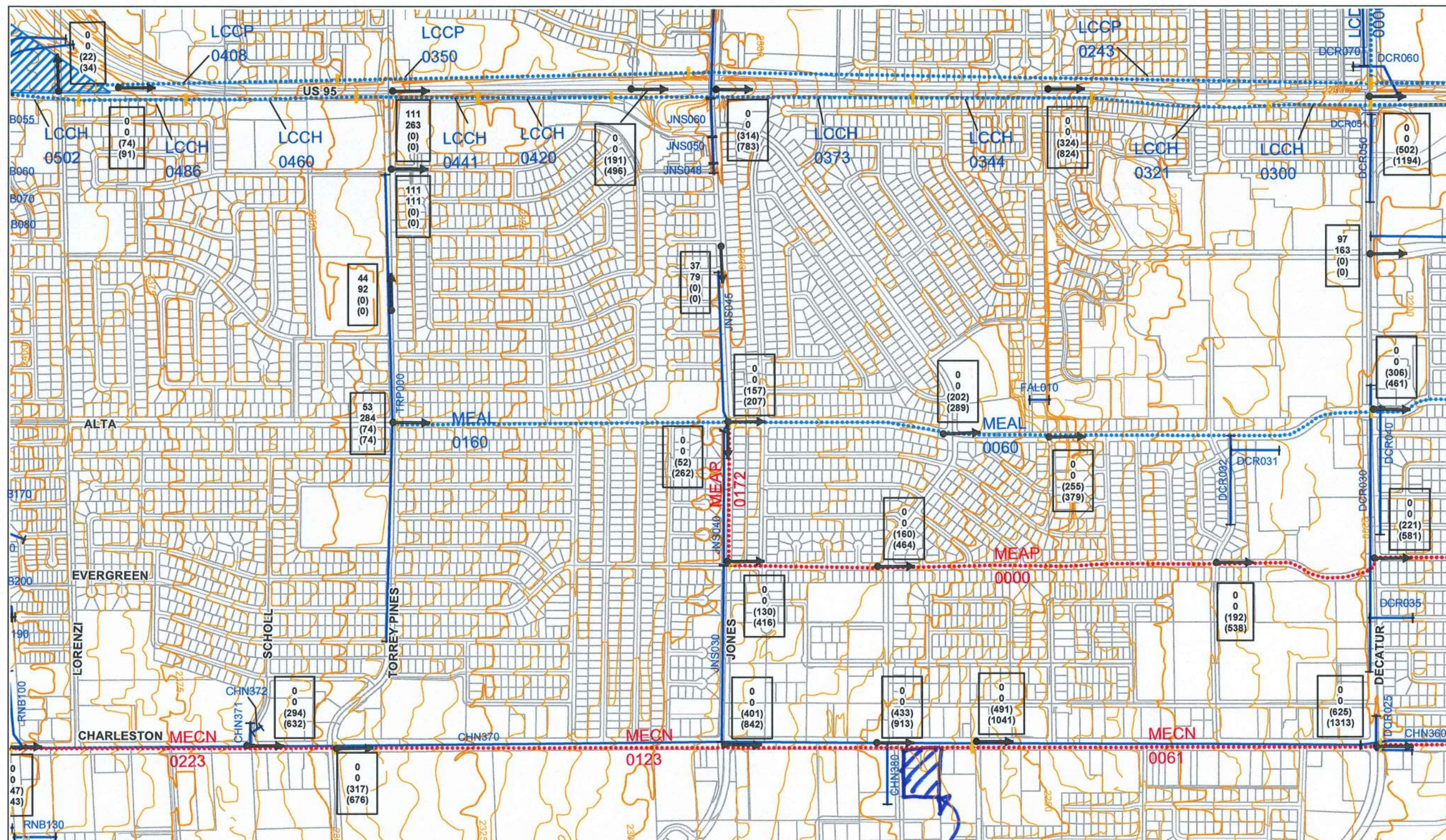
Bottom Width..... W
 Depth..... D
 Side Slope, H:V..... SS

Construction Features
 Cast in Place Concrete Pipe..... CIPCP
 Corrugated Metal Arch Pipe Culvert..... CMAP
 Corrugated Metal Pipe Culvert..... CMPC
 High Density Polyethylene..... HDPE
 Horizontal Elliptical Reinforced Concrete Pipe..... HERCP
 Reinforced Concrete Arch Pipe..... RCAP
 Reinforced Concrete Arch Culvert..... RCAC
 Reinforced Concrete Box..... RCB
 Reinforced Concrete Box Culvert..... RCB
 Reinforced Concrete Pipe..... RCP
 Reinforced Concrete Pipe Culvert..... RCP
 Storm Sewer Pipe..... SSP



CLV CENTRAL NEIGHBORHOOD MPU (Figures E-8 and F-8)

(EXISTING & FUTURE)



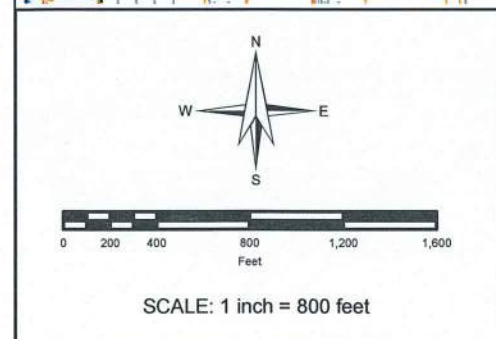
City of Las Vegas

CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN

LEGEND

- Existing Regional Facility
- Category A Proposed Regional Facility (2002 MPU)
- Category B Proposed Regional Facility (2002 MPU)
- Category A Proposed Regional Facility (2004 CNFCMP)
- Existing Local Facility
- Proposed Local Facility
- Regional Culvert
- Regional Bridge
- Regional Pipeline
- Regional Channel
- ~~~~~ Regional Levee
- ▨ Regional Detention Basin
- Local Storm Drain
- Local Culvert
- Proposed Local Storm Drain
- Regional ID-Mile Separator
- Local Facility Separator

FIGURE F-8

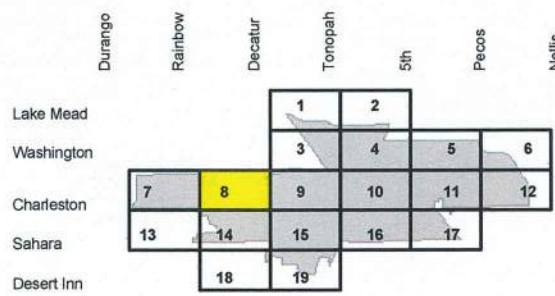


- Flow Arrow
- 250 10-Year Street Flow
500 100-Year Street Flow
(300) 10-Year Facility Flow
(800) 100-Year Facility Flow
- (Flows in CFS)

NOTE:
Ultimate drainage conditions are based on future Curve Number values with all flood control 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.

site



FUTURE DRAINAGE CONDITIONS



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



City of Las Vegas

CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN

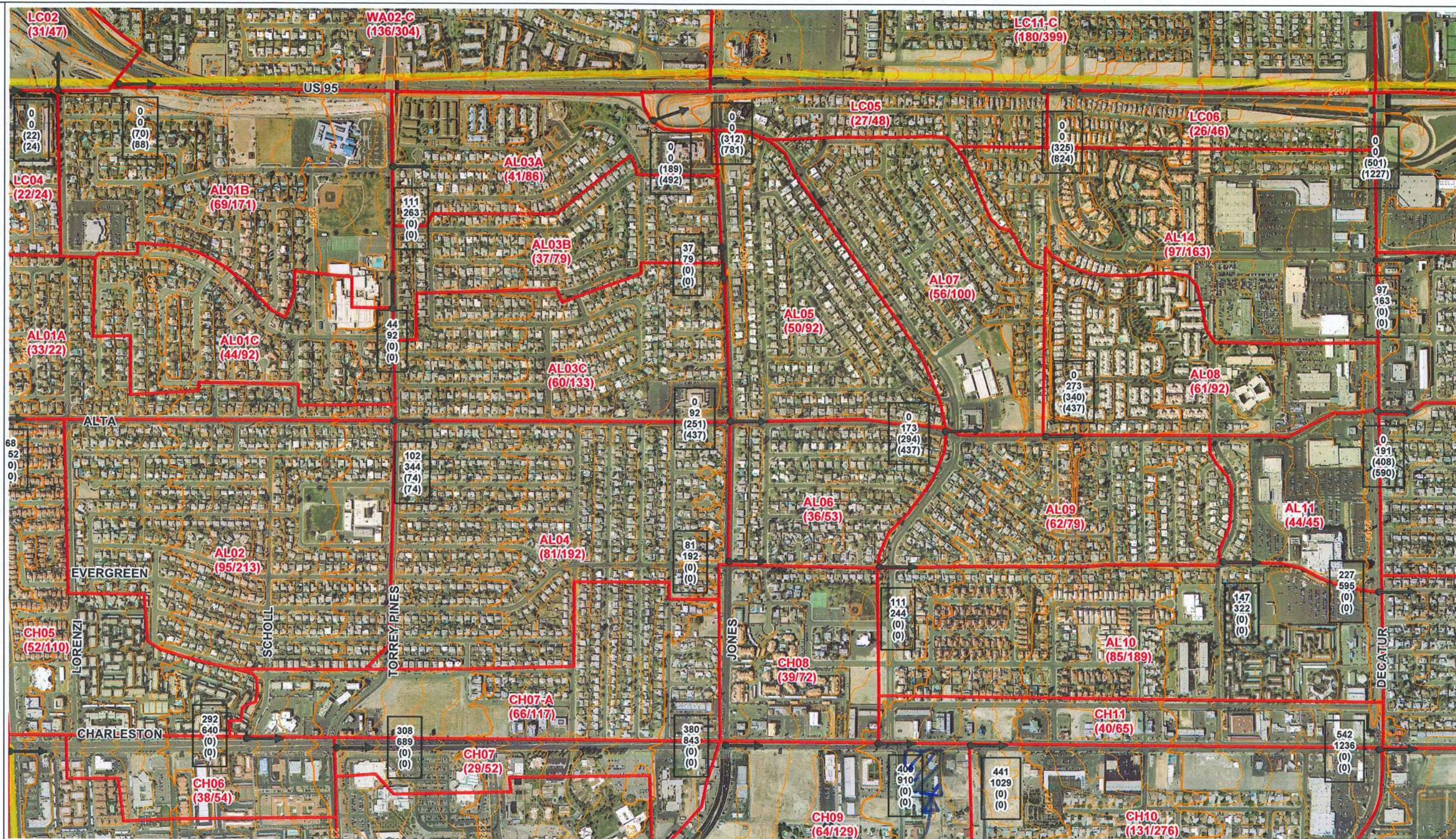
LEGEND

- Sub-basin Boundary
- LV12** Basin ID
- Contributing flow from the basin (cfs)
(10yr./100yr.)
- Flow Arrow
- | | |
|-------|------------------------|
| 250 | 10-Year Street Flow |
| 500 | 100-Year Street Flow |
| (300) | 10-Year Facility Flow |
| (800) | 100-Year Facility Flow |

(Flows in CFS)
- Study Area Limit

PHOTO DATE: SPRING 2004

FIGURE E-8



EXISTING DRAINAGE CONDITIONS



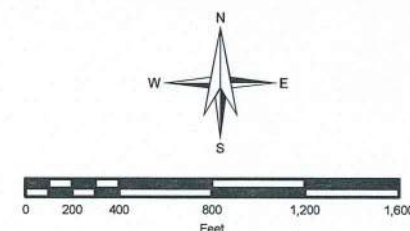
2270 Corporate Circle, Suite 100
Henderson, NV 89074
(702) 263-7275
Fax: (702) 263-7200

	Durango	Rainbow	Decatur	Toropah	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				

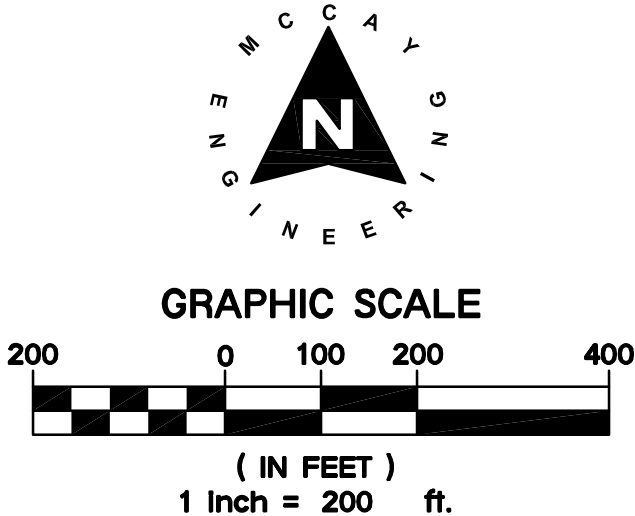
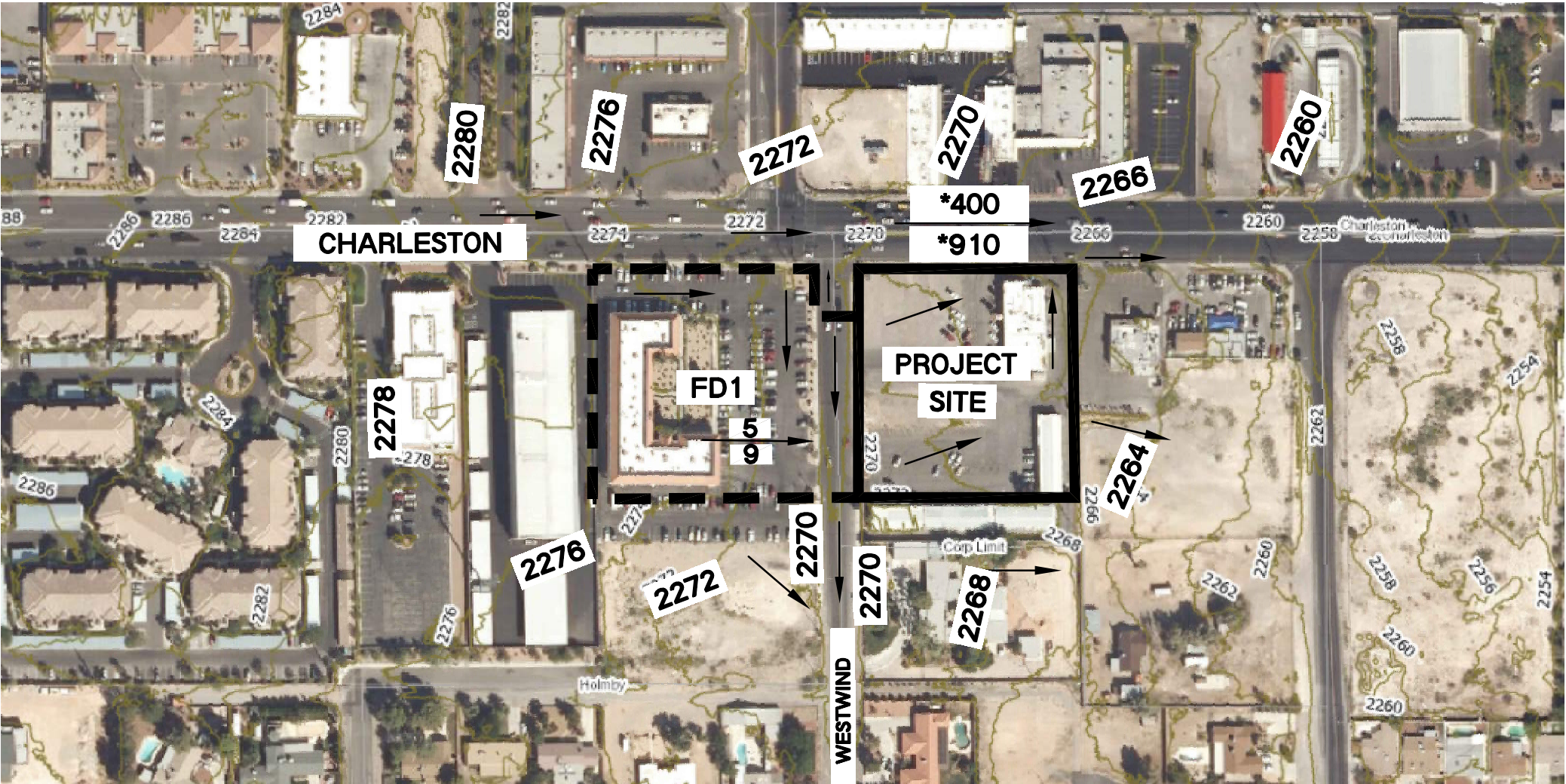
Site

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

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



SCALE: 1 inch = 800 feet



DRAINAGE LEGEND	
ND1	DRAINAGE BASIN LABEL
●	CONCENTRATION POINT
CPD1	COMBINATION POINT
—	ONSITE BASIN BOUNDARY
- - -	OFFSITE BASIN BOUNDARY
$\frac{2}{3}$ →	Q10 FLOW IN CFS (INTERIM)
$\frac{X}{X}$ (X)(XX) →	Q100 FLOW IN CFS (INTERIM)
→	Q10 (V10)(D10)
→	Q100 (V100)(D100)
→	BASIN FLOW DIRECTION
→	COMBINED FLOW DIRECTION

*CENTRAL NEIGHBORHOOD CLV MPU (FIGURE E-8)

Peak Flow Summary Existing Condition			
HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
NX1	2.58	5	9

Peak Flow Summary Developed Condition			
HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
ND1	1.64	3	5
ND2	0.94	2	3
CPD1	-	5	9
(ND1+ND2)			

DRAWN BY: CB

CHECKED BY: CB

McCAY ENGINEERING

SCALE: 1"=200'

DATE: 12/23/20

FILE NAME: OFFMAP

LEGEND

FOUND MONUMENTATION

CENTER LINE

ROW LINE

EASEMENT LINE

SECTION LINE

PROPERTY LINE

ADJACENT PROPERTY LINE

PROJECT No.: 01234

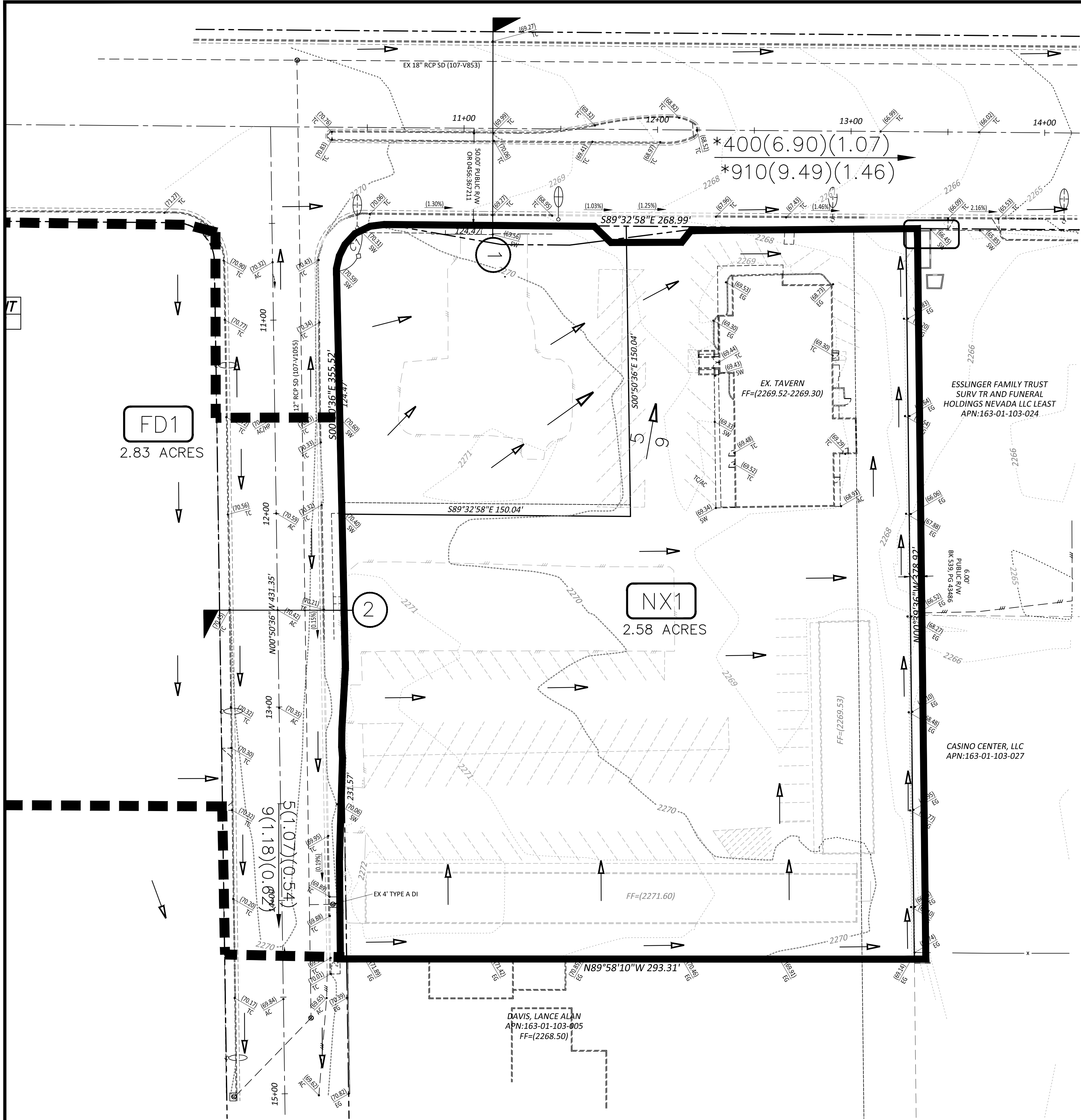
SHEET No.

OFF1

SHEET 1 OF 1

OFFSITE BASIN MAP

CHARLESTON & WESTWIND RETAIL CENTER



*CLV CENTRAL NEIGHBORHOOD MPU (Figure E-9)

ND1

CMD1

2

3

1

(1.0)(1.2)

1

(1.0)(1.2)

1

DRAINAGE BASIN LABEL

CONCENTRATION POINT

COMBINATION POINT

ONSITE BASIN BOUNDARY

Q10 FLOW IN CFS (10 YR.)

Q100 FLOW IN CFS (100 YR.)

Q10 (V10)(D10)

Q100 (V100)(D100)

BASIN FLOW DIRECTION

COMBINED FLOW DIRECTION

HYDRAULIC CROSS-SECTION

SITE

CHARLESTON

DEL RAY

UNDELL

VICINITY MAP

SCALE: NTS

GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

1 INCH = 30 FT.

Peak Flow Summary			
Existing Condition			
HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
NX1	2.58	5	9

Street Flow Summary (Existing / 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)
Westwind	60	2	5	1.07	0.54	0.58	N/A
Charleston	100	1	400	6.90	1.07	7.38	0.0
Street Flow Summary (Existing / 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]	
Westwind	60	2	9	1.18	0.62	0.73	
Charleston	100	1	910	9.49	1.46	13.86	

REV

DATE

BY

REVISION

MCCAY ENGINEERING

CIVIL ENGINEERING

11700 W. CHARLESTON BLVD.
SUITE 100
LAS VEGAS, NV 89135
P 702-860-3897

985 WHITE DRIVE
LAS VEGAS, NV 89119
P 702-733-6622

EXISTING DRAINAGE PLAN

CHARLESTON & WESTWIND
RETAIL CENTER

DATE: 12/22/2020

DRAWN BY: JSM

PROJECT MGR: JSM

PROJECT NO: 20347

SCALE: 1"=30'

PROFESSIONAL ENGINEER'S SEAL OF THE STATE OF NEVADA

JEREMY S. MCCAY

Exp: 12/31/21

CIVIL

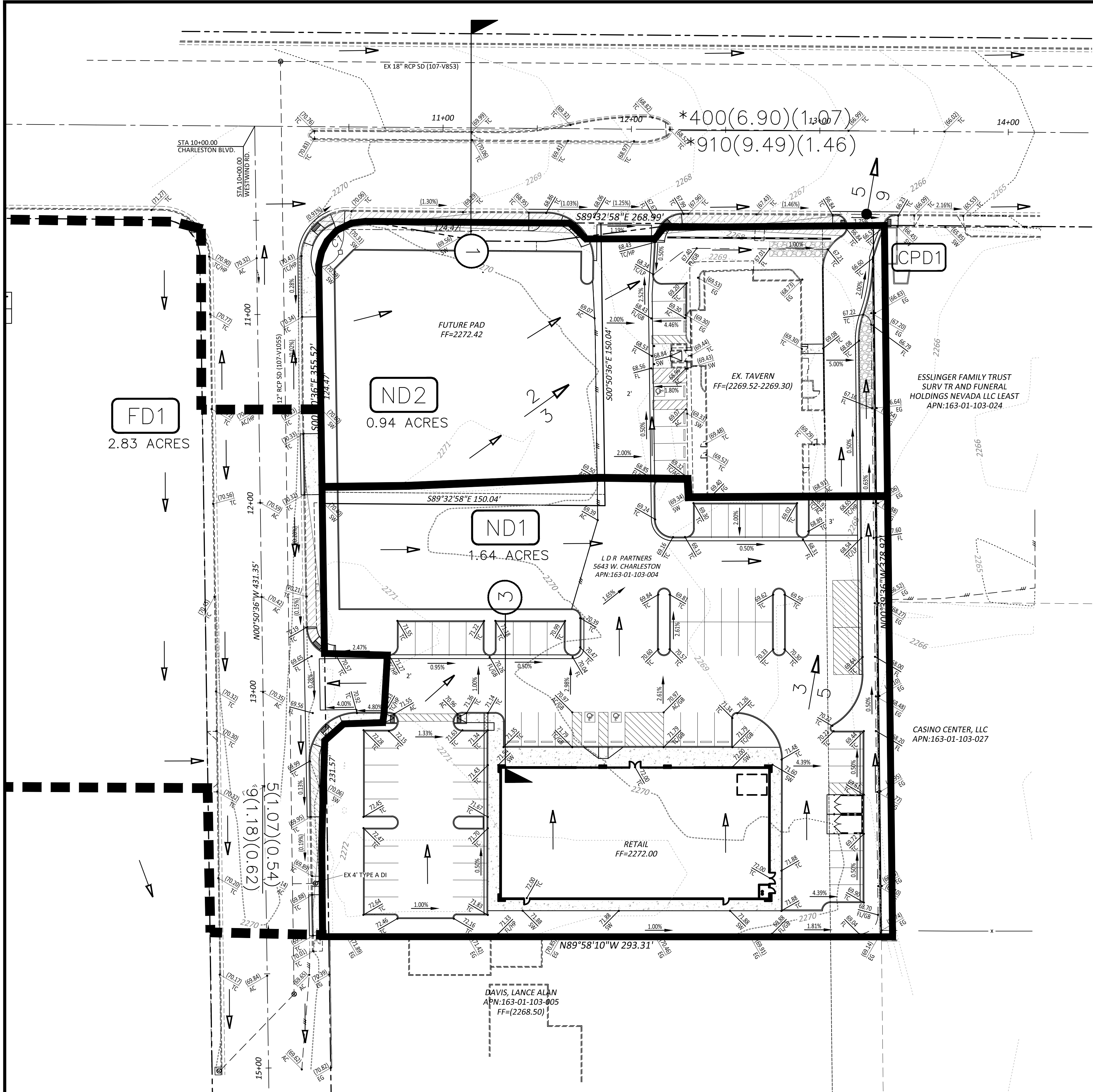
12/22/2020

SHEET

DR1

OF 5 SHEETS

DRAWING NO.



*CLV CENTRAL NEIGHBORHOOD MPU (Figure E-9)

ND1

CMD1

2

3

1 (1.0)(1.2)

1 (1.0)(1.2)

1

DRAINAGE BASIN LABEL

CONCENTRATION POINT

COMBINATION POINT

ONSITE BASIN BOUNDARY

Q10 FLOW IN CFS (10 YR.)

Q100 FLOW IN CFS (100 YR.)

Q10 (V10)(D10)

Q100 (V100)(D100)

BASIN FLOW DIRECTION

COMBINED FLOW DIRECTION

HYDRAULIC CROSS-SECTION

SITE

CHARLESTON

DEL RAY

UNDELL

WESTWIND

VICINITY MAP

SCALE: NTS

30

0

15

30

60

GRAPHIC SCALE

(IN FEET)

1 INCH = 30 FT.

Peak Flow Summary			
Developed Condition			
HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
FD1	2.83	5	9
ND1	1.64	3	5
ND2	0.94	2	3
CPD1	-	5	9
(ND1+ND2)			

Street Flow Summary							
(Existing / 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)
Westwind Charleston	60	2	5	1.07	0.54	0.58	N/A
	100	1	400	6.90	1.07	7.38	0.0
Street Flow Summary							
(Existing / 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]	
Westwind Charleston	60	2	9	1.18	0.62	0.73	
	100	1	910	9.49	1.46	13.86	

On-site Sections				
(Interim / Developed Conditions)				
Hydraulic Cross-Section Identifier	100-Year Flow [Q100] (cfs)	100-Year Velocity [v] (fps)	100-Year Flow Depth [d] (ft)	2x 100-Year 2 x [d]
3	5	1.66	0.24	0.48

REV

DATE

BY

REVISION

MCCAY

ENGINEERING

CIVIL

ENGINEERING

LDR PARTNERS

985 WHITE DRIVE

LAS VEGAS, NV 89119

P 702-733-6622

DEVELOPED DRAINAGE PLAN

CHARLESTON & WESTWIND

RETAIL CENTER

DATE: 12/22/2020

DRAWN BY: JSM

PROJECT MGR: JSM

PROJECT NO: 20347

SCALE: 1"=30'

PROFESSIONAL ENGINEER - STATE OF NEVADA

JEREMY S. MCCAY

Exp: 12/31/21

CIVIL

12/22/2020

SHEET

DR2

OF 5 SHEETS

DRAWING NO.

L#